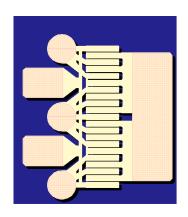
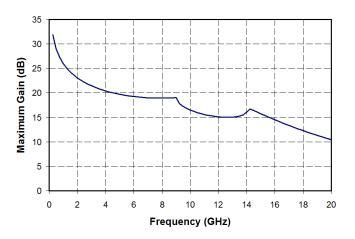


### 12 Watt Discrete Power GaN on SiC HEMT



### **Measured Performance**

Bias conditions: Vd = 28 - 40 V, Idq = 250 mA, Vg = -3 V Typical



### **Key Features**

- Frequency Range: DC 18 GHz
- > 41 dBm Nominal Psat
- 55% Maximum PAE
- 15 dB Nominal Power Gain
- Bias: Vd = 28 40 V, Idq = 250 mA, Vg = -3 V
   Typical
- Technology: 0.25 um Power GaN on SiC
   Chip Dimensions: 0.82 x 0.92 x 0.10 mm

### **Primary Applications**

- Space
- Military
- Broadband Wireless

### **Product Description**

The TriQuint TGF2023-02 is a discrete 2.5 mm GaN on SiC HEMT which operates from DC-18 GHz. The TGF2023-02 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 TGF2023-02 typically provides > 41 dBm of saturated output power with power gain of 15 dB. The maximum power added efficiency is 55% which makes the TGF2023-02 appropriate for high efficiency applications.

Lead-free and RoHS compliant

.

Datasheet subject to change without notice.



# Table I Absolute Maximum Ratings <u>1</u>/

Symbol	Parameter	Value	Notes
Vd	Drain Voltage	40 V	<u>2</u> /
Vg	Gate Voltage Range	-10 to 0 V	
ld	Drain Current	2.5 A	<u>2</u> /
lg	Gate Current	14 mA	
Pin	Input Continuous Wave Power	29 dBm	<u>2</u> /

- 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 - 40 V
ldq	Drain Current	250 mA
Id_Drive	Drain Current under RF Drive	750 mA
Vg	Gate Voltage -3 V	



## Table III RF Characterization Table 1/

Bias: Vd = 32 V & 40 V, Idq = 250 mA, Vg = -3 V Typical

SYMBOL	PARAMETER	Vd = 40 V	Vd = 32 V	UNITS
Power Tuned:				
Psat	Saturated Output Power	41.5	40.5	dBm
PAE	Power Added Efficiency	46	47	%
Gain	Power Gain	15	15	dB
Rp <u>2</u> /	Parallel Resistance	87.79	68.58	Ω·mm
Cp <u>2</u> /	Parallel Capacitance	0.444	0.461	pF/mm
Γ <sub>L</sub> <u>3</u> /	Load Reflection Coefficient	0.474 ∠138.6	0.488	-
Efficiency Tuned:				
Psat	Saturated Output Power	39	38.5	dBm
PAE	Power Added Efficiency	55	57	%
Gain	Power Gain	19.5	19.5	dB
Rp <u>2</u> /	Parallel Resistance	190.2	158.1	Ω·mm
Cp <u>2</u> /	Parallel Capacitance	0.263	0.314	pF/mm
Γ <sub>L</sub> <u>3</u> /	Load Reflection Coefficient	0.466 <u></u> 87.8	0.447 <u></u> 102.1	-

<sup>1/</sup> Values in this table are scaled from a 1.25 mm unit GaN on SiC cell at 3.5 GHz

<sup>2/</sup> Large signal equivalent GaN on SiC output network

Optimum load impedance for maximum power or maximum PAE at 3.5 GHz. The series resistance and inductance (Rd and Ld) shown in the Figure on page 5 is excluded



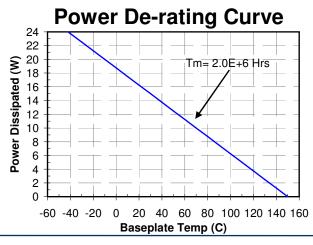
### Table IV Power Dissipation and Thermal Properties 1/

Parameter	Test Conditions	Value	Notes
Maximum Power Dissipation	Tbaseplate = 70 °C	Pd = 10 W Tchannel = 150 °C Tm = 2.0E+6 Hrs	<u>2</u> / <u>3</u> /
Thermal Resistance, θjc	Vd = 40 V Id = 250 mA Pd = 10 W Tbaseplate = 70 °C	θjc = 8.0 (°C/W) Tchannel = 150 °C Tm = 2.0E+6 Hrs	
Thermal Resistance, θjc Under RF Drive	Vd = 40 V Id = 750 mA Pout = 41.5 dBm Pd = 15.9 W Tbaseplate = 23 °C	θjc = 8.0 ( <sup>o</sup> C/W) Tchannel = 150 <sup>o</sup> C Tm = 2E+6 Hrs	<u>4</u> /
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/ For a median life of 2E+6 hours, Power Dissipation is limited to

$$Pd(max) = (150 \, {}^{\circ}C - Tbase \, {}^{\circ}C)/\theta jc.$$

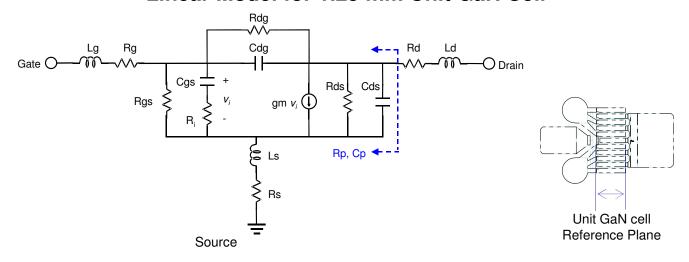
- Solution
  Channel operating temperature will directly affect the device median time to failure (MTTF). For maximum life, it is recommended that channel temperatures be maintained at the lowest possible levels.
- 4/ Channel temperatures at high drain voltages can be excessive, leading to reduced MTTF. Operation at reduced baseplate temperatures and/or pulsed RF modulation is recommended.







#### Linear Model for 1.25 mm Unit GaN Cell

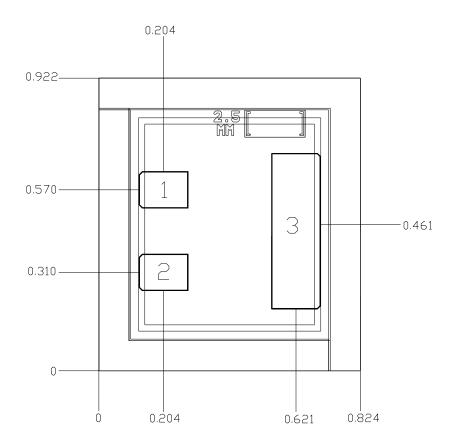


MODEL PARAMETER	Vd = 40V Idq = 19mA	Vd = 32V Idq = 19mA	UNITS
Rg	0.56	0.56	Ω
Rs	0.08	0.07	Ω
Rd	0.31	0.33	Ω
gm	0.134	0.138	S
Cgs	1.52	1.50	pF
Ri	0.24	0.23	Ω
Cds	0.239	0.263	pF
Rds	373.7	319.2	Ω
Cgd	0.053	0.0646	pF
Tau	4.11	3.57	pS
Ls	0.0148	0.0147	nH
Lg	-0.0135	-0.013	nH
Ld	0.048	0.0485	nH
Rgs	1550	1950	Ω
Rgd	70500	47800	Ω





### **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, #2	Vg	0.154 x 0.115
Bond Pad #3	Vd	0.154 x 0.490

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	Package Style	
TGF2023-02	GaN on SiC Die	

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