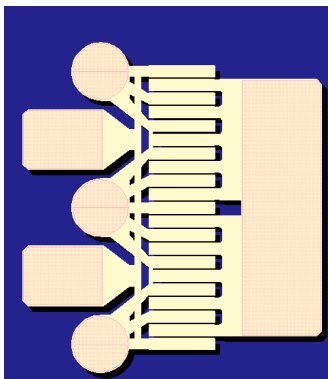
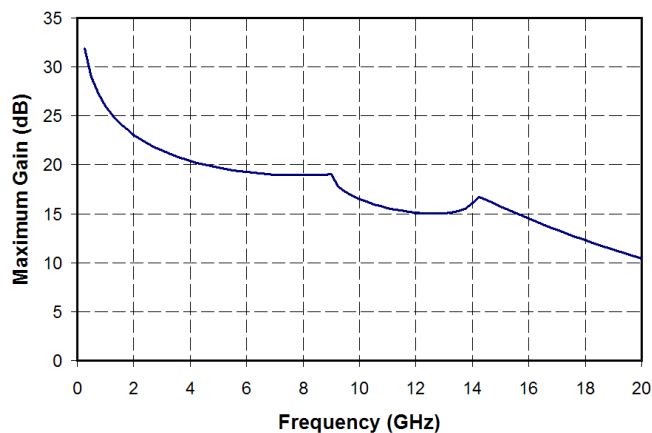


## 12 Watt Discrete Power GaN on SiC HEMT



### Measured Performance

Bias conditions:  $V_d = 28 - 40$  V,  $I_{dq} = 250$  mA,  $V_g = -3$  V Typical



### Key Features

- Frequency Range: DC - 18 GHz
- > 41 dBm Nominal  $P_{sat}$
- 55% Maximum PAE
- 15 dB Nominal Power Gain
- Bias:  $V_d = 28 - 40$  V,  $I_{dq} = 250$  mA,  $V_g = -3$  V
- Typical
- Technology: 0.25  $\mu$ m 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 0.25 $\mu$ m 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 1/**

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

- 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 - 40 V
Idq	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
<b>Power Tuned:</b>				
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	$\Omega$ ·mm
Cp <u>2/</u>	Parallel Capacitance	0.444	0.461	pF/mm
$\Gamma_L$ <u>3/</u>	Load Reflection Coefficient	0.474 $\angle$ 138.6	0.488 $\angle$ 147.2	-
<b>Efficiency Tuned:</b>				
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	$\Omega$ ·mm
Cp <u>2/</u>	Parallel Capacitance	0.263	0.314	pF/mm
$\Gamma_L$ <u>3/</u>	Load Reflection Coefficient	0.466 $\angle$ 87.8	0.447 $\angle$ 102.1	-

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

2/ Large signal equivalent GaN on SiC output network

3/ 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/ 3/</u>
Thermal Resistance, $\theta_{jc}$	Vd = 40 V Id = 250 mA Pd = 10 W Tbaseplate = 70 °C	$\theta_{jc} = 8.0$ (°C/W) Tchannel = 150 °C Tm = 2.0E+6 Hrs	
Thermal Resistance, $\theta_{jc}$ Under RF Drive	Vd = 40 V Id = 750 mA Pout = 41.5 dBm Pd = 15.9 W Tbaseplate = 23 °C	$\theta_{jc} = 8.0$ (°C/W) Tchannel = 150 °C Tm = 2E+6 Hrs	<u>4/</u>
Mounting Temperature	30 Seconds	320 °C	
Storage Temperature		-65 to 150 °C	

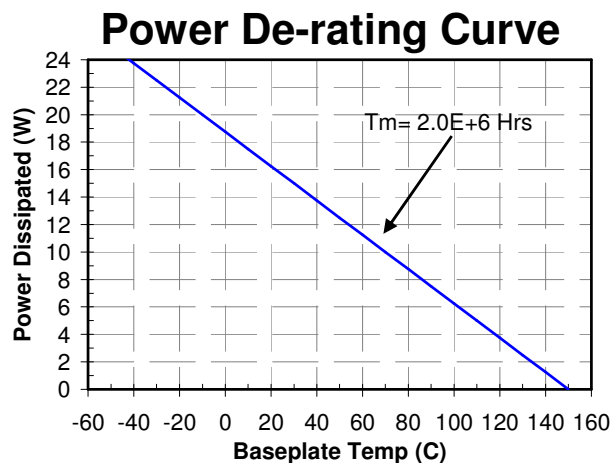
1/ Assumes eutectic attach using 1mil thick 80/20 AuSn mounted to a 10mil CuMo Carrier Plate

2/ For a median life of 2E+6 hours, Power Dissipation is limited to

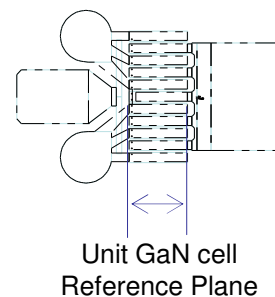
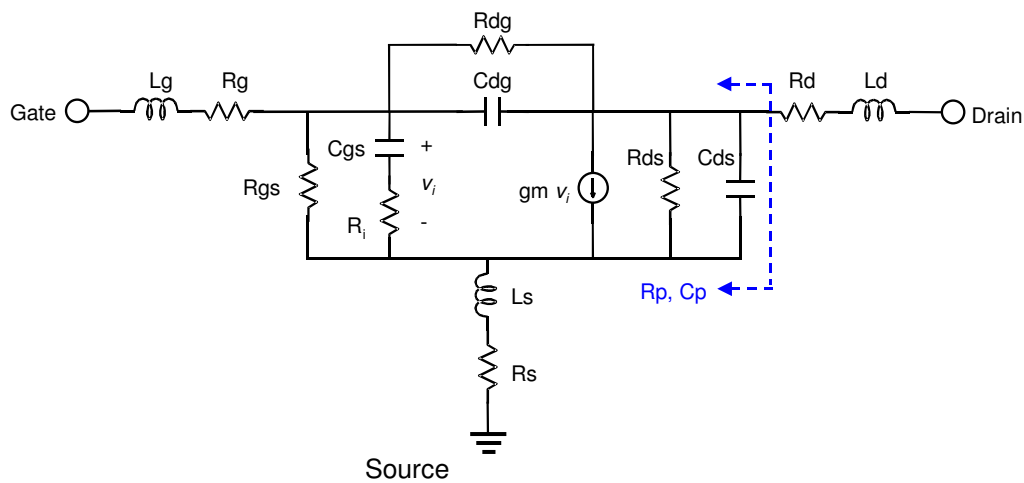
$$Pd(max) = (150\text{ °C} - Tbase\text{ °C})/\theta_{jc}.$$

3/ 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.

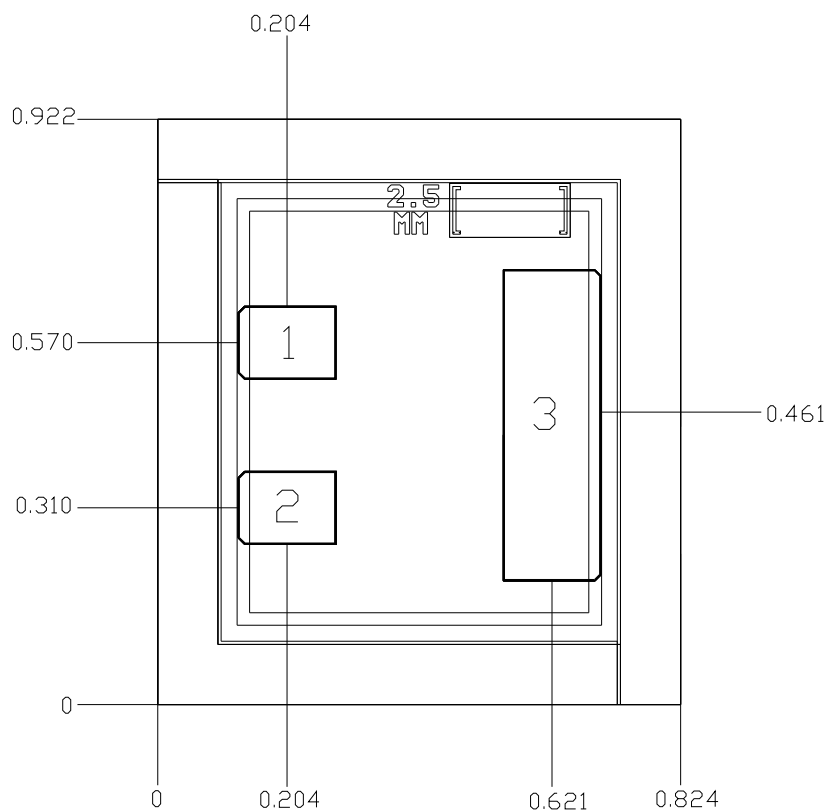


## Linear Model for 1.25 mm Unit GaN Cell



MODEL PARAMETER	Vd = 40V Idq = 19mA	Vd = 32V Idq = 19mA	UNITS
Rg	0.56	0.56	$\Omega$
Rs	0.08	0.07	$\Omega$
Rd	0.31	0.33	$\Omega$
gm	0.134	0.138	S
Cgs	1.52	1.50	pF
Ri	0.24	0.23	$\Omega$
Cds	0.239	0.263	pF
Rds	373.7	319.2	$\Omega$
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	$\Omega$
Rgd	70500	47800	$\Omega$

## 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.***

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