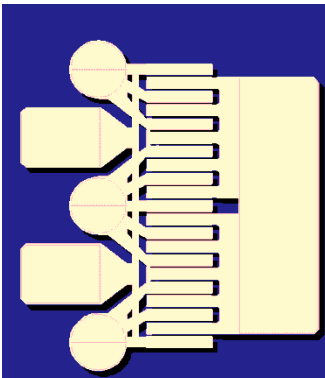


## 12 Watt Discrete Power GaN on SiC HEMT



### Key Features

- Frequency Range: DC - 18 GHz
- 41 dBm Nominal Psat at 3 GHz
- 58% Maximum PAE
- 18 dB Nominal Power Gain
- Bias:  $V_d = 28 - 32$  V,  $I_{dq} = 250$  mA,  $V_g = -3.6$  V Typical
- Technology: 0.25  $\mu$ m Power GaN on SiC
- Chip Dimensions: 0.82 x 0.92 x 0.10 mm

### Primary Applications

- Defense & Aerospace
- Broadband Wireless

### Product Description

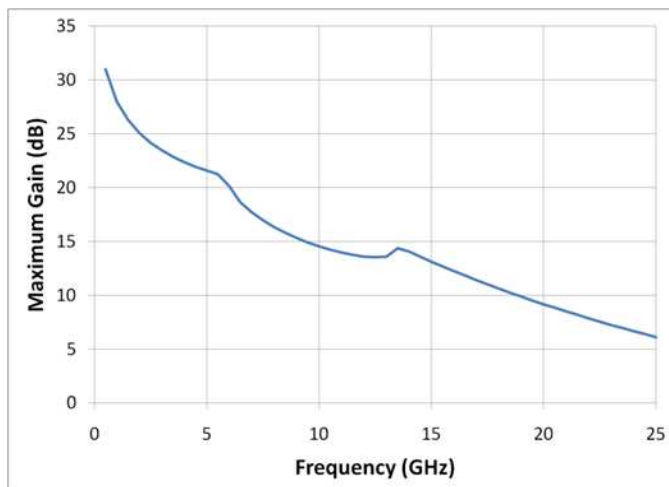
The TriQuint TGF2023-02 is a discrete 2.5 mm GaN on SiC HEMT which operates from DC-18 GHz. The TGF2023-02 is designed using TriQuint's proven 0.25 $\mu$ m GaN production process. This process features advanced field plate techniques to optimize microwave power and efficiency at high drain bias operating conditions.

The TGF2023-02 typically provides 41 dBm of saturated output power with power gain of 18dB at 3 GHz. The maximum power added efficiency is 58% which makes the TGF2023-02 appropriate for high efficiency applications.

Lead-free and RoHS compliant

*Datasheet subject to change without notice.*

Bias conditions:  $V_d = 28$  V,  $I_{dq} = 250$  mA,  $V_g = -3.6$  V Typical



**Table I**  
**Absolute Maximum Ratings 1/**

<b>Symbol</b>	<b>Parameter</b>	<b>Value</b>	<b>Notes</b>
Vd	Drain Voltage	40 V	<u>2/</u>
Vg	Gate Voltage Range	-50 to 0 V	
Vdg	Drain-Gate Voltage	80 V	
Id	Drain Current	2.5 A	<u>2/</u>
Ig	Gate Current	14 mA	
Pin	Input Continuous Wave Power	34 dBm	<u>2/</u>
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**

<b>Symbol</b>	<b>Parameter</b>	<b>Value</b>
Vd	Drain Voltage	28 - 32 V
Idq	Drain Current	250 mA
Id_Drive	Drain Current under RF Drive	750 mA
Vg	Gate Voltage	-3.6 V

**Table III**  
**RF Characterization Table 1/**

**Bias: Vd = 28 V, Idq = 250 mA, Vg = -3.6V Typical**

SYMBOL	PARAMETER	3 GHz	6 GHz	10 GHz	14 GHz	UNITS
<b>Power Tuned:</b>						
Psat	Saturated Output Power	41	40.3	40.2	38.8	dBm
PAE	Power Added Efficiency	58	56	50	41	%
Gain	Power Gain	18.1	12.3	9.9	6.6	dB
<b>Efficiency Tuned:</b>						
Psat	Saturated Output Power	39.7	38.6	39.9	38.8	dBm
PAE	Power Added Efficiency	64	64	52	42	%
Gain	Power Gain	17.4	12.9	10.2	6.5	dB

SYMBOL	PARAMETER	3 GHz	6 GHz	10 GHz	14 GHz	UNITS
<b>Power Tuned:</b>						
Rp <u>2/</u>	Parallel Resistance	79.3	81.9	61.5	49.9	$\Omega$ -mm
Cp <u>2/</u>	Parallel Capacitance	0.524	0.348	0.426	0.432	pF/mm
<b>Efficiency Tuned:</b>						
Rp <u>2/</u>	Parallel Resistance	153	171	72.1	53.1	$\Omega$ -mm
Cp <u>2/</u>	Parallel Capacitance	0.426	0.372	0.414	0.472	pF/mm

1/ Values in this table are engineering estimates scaled from measurements on the 1.25 mm GaN/SiC unit cell (see TGF2023-01 datasheet)

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

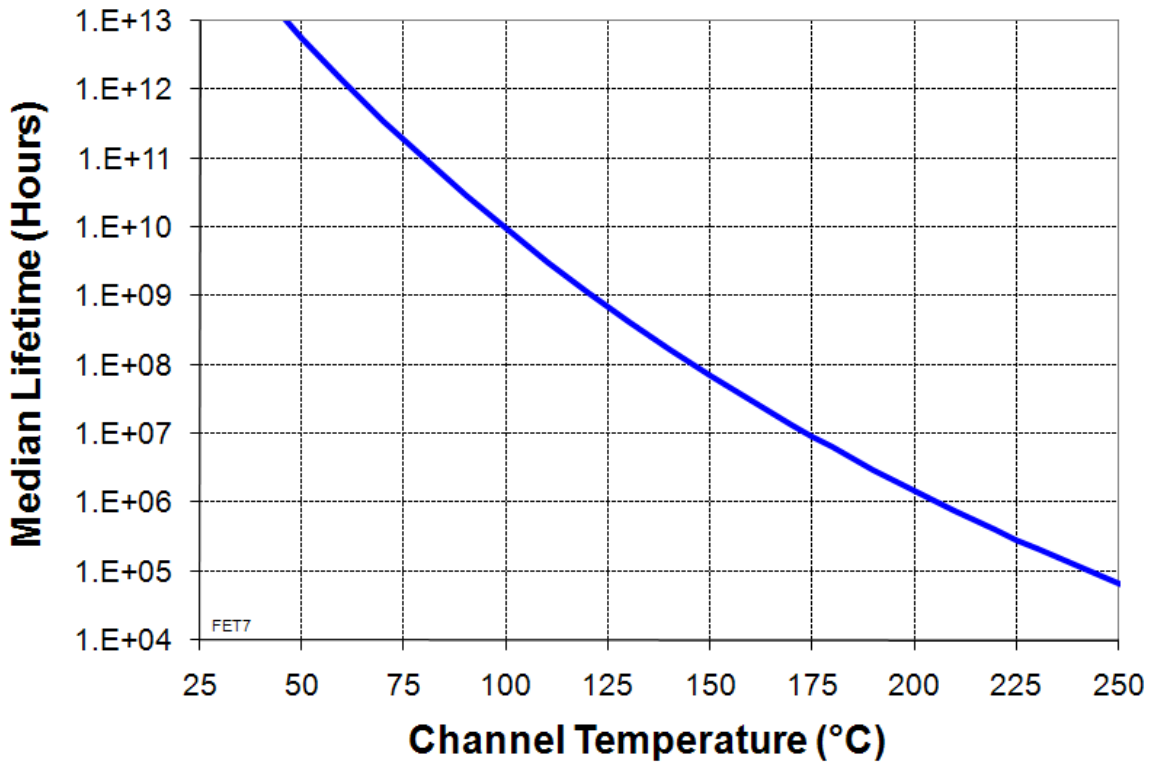
**Table IV**  
**Power Dissipation and Thermal Properties 1/**

Parameter	Test Conditions	Value	Notes
Maximum Power Dissipation	Tbaseplate = 70 °C	Pd = 16.2 W Tchannel = 200 °C Tm = 1.5E+6 Hrs	<u>2/</u>
Thermal Resistance, $\theta_{jc}$	Vd = 28 V Id = 250 mA Pd = 7 W Tbaseplate = 70 °C	$\theta_{jc}$ = 8.0 (°C/W) Tchannel = 126 °C Tm = 6.4E+8 Hrs	
Thermal Resistance, $\theta_{jc}$ Under RF Drive	Vd = 28 V Id = 763 mA Pout = 41 dBm Pd = 9.0 W Tbaseplate = 70 °C	$\theta_{jc}$ = 8.0 (°C/W) Tchannel = 142 °C Tm = 1.5E+8 Hrs	
Mounting Temperature	30 Seconds	320 °C	
Storage Temperature		-65 to 150 °C	

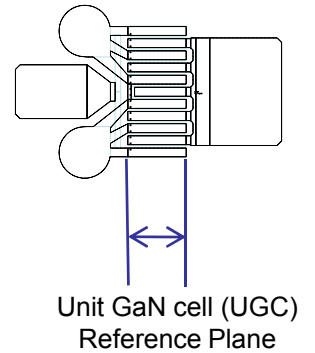
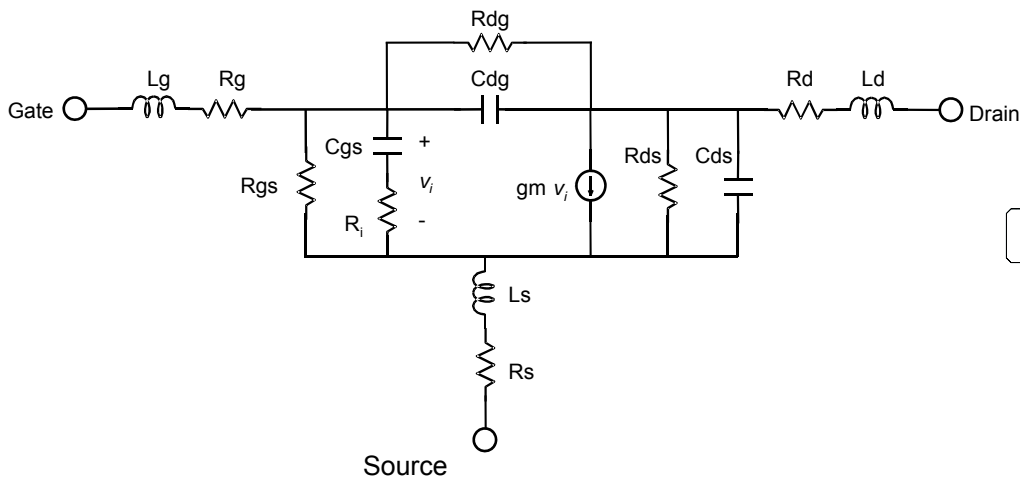
1/ Assumes eutectic attach using 1mil thick 80/20 AuSn mounted to a 10mil CuMo Carrier Plate

2/ 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**



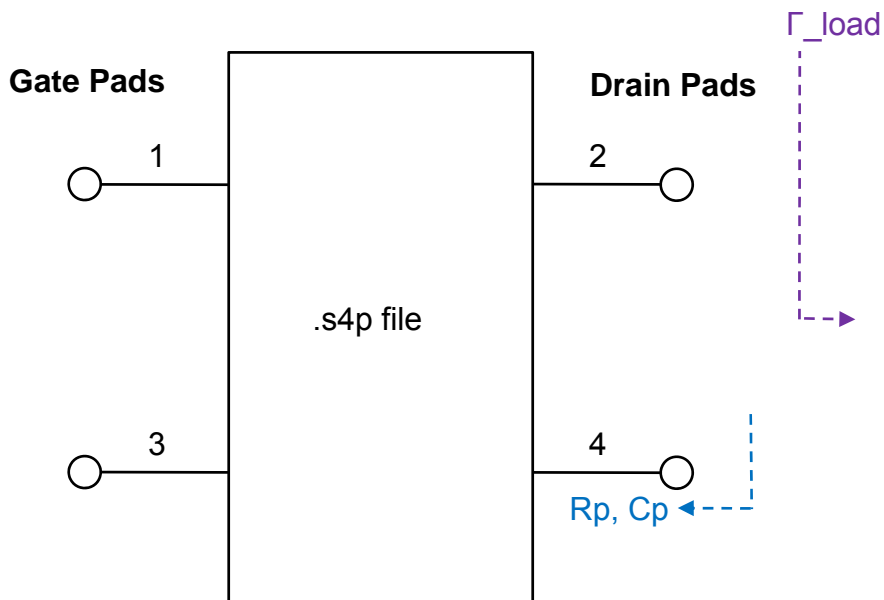
**Linear Model for 1.25 mm Unit GaN Cell (UGC)**



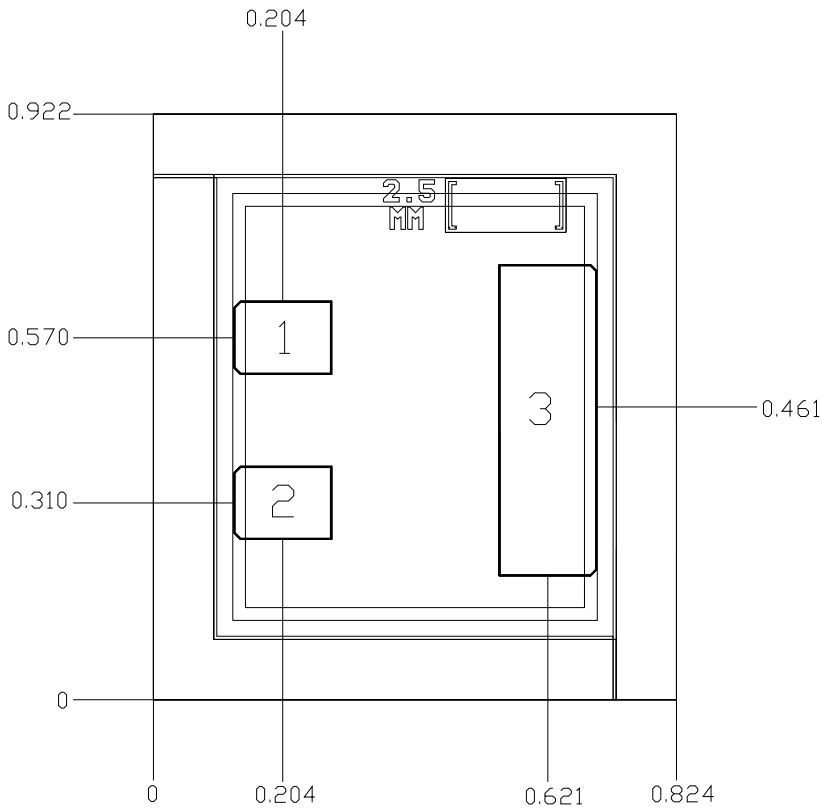
MODEL PARAMETER	Vd=28V Idq=125mA	UNITS
Rg	0.78	$\Omega$
Rs	0.13	$\Omega$
Rd	1.28	$\Omega$
gm	0.270	S
Cgs	1.79	pF
Ri	0.26	$\Omega$
Cds	0.308	pF
Rds	123.6	$\Omega$
Cgd	0.064	pF
Tau	2.78	pS
Ls	0.0058	nH
Lg	-0.013	nH
Ld	0.018	nH
Rgs	8900	$\Omega$
Rgd	1730000	$\Omega$

## Complete 2.5mm GaN HEMT Linear Model

Includes 2 UGC, 3 vias, and 4 bonding pads



**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	ECCN	Package Style
TGF2023-02	EAR99	GaN on SiC Die

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