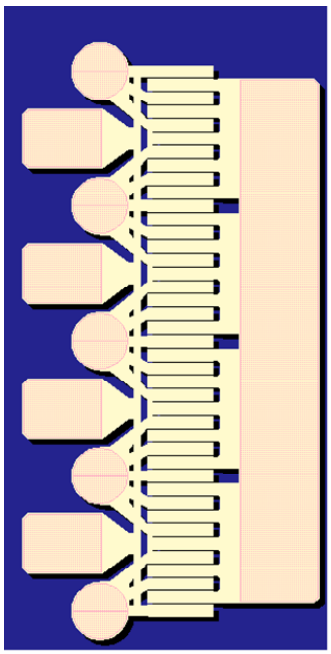
TGF2023-2-05

25 Watt Discrete Power GaN on SiC HEMT

Applications

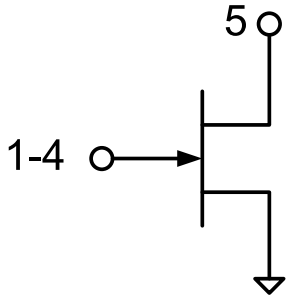
- Defense & Aerospace
- Broadband Wireless



Product Features

- Frequency Range: DC - 18 GHz
- 43.9 dBm Nominal P_{SAT} at 3 GHz
- 62% Maximum PAE
- 17.8 dB Nominal Power Gain at 3 GHz
- Bias: V_D = 28 - 32 V, I_{DQ} = 0.5 A
- Technology: TQGaN25 on SiC
- Chip Dimensions: 0.82 x 1.44 x 0.10 mm

Functional Block Diagram



General Description

The TriQuint TGF2023-2-05 is a discrete 5 mm GaN on SiC HEMT which operates from DC-18 GHz. The TGF2023-2-05 is designed using TriQuint's proven TQGaN25 production process. This process features advanced field plate techniques to optimize microwave power and efficiency at high drain bias operating conditions.

The TGF2023-2-05 typically provides 43.9 dBm of saturated output power with power gain of 17.8 dB at 3GHz. The maximum power added efficiency is 62% which makes the TGF2023-2-05 appropriate for high efficiency applications.

Lead-free and RoHS compliant

Pad Configuration

Pad No.	Symbol
1-4	V_G / RF IN
5	V_D / RF OUT
Backside	Source / Ground

Ordering Information

Part	ECCN	Description
TGF2023-2-05	3A001b.3.b	25 Watt GaN HEMT

Absolute Maximum Ratings

Parameter	Value
Drain to Gate Voltage (V_{DG})	100 V
Drain Voltage (V_D)	40 V
Gate Voltage Range (V_G)	-50 to 0 V
Drain Current (I_D)	5 A
Gate Current (I_G)	-5 to 14 mA
Power Dissipation (P_D)	Refer to graph on pg.3.
CW Input Power (P_{IN})	+37 dBm
Channel Temperature (T_{CH})	275 °C
Mounting Temperature (30 Seconds)	320 °C
Storage Temperature	-65 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	Value
Drain Voltage Range (V_D)	28 – 32 V
Drain Quiescent Current (I_{DQ})	500 mA
Drain Current Under RF Drive (I_D)	1.5 A (Typ.)
Gate Voltage (V_G)	-3.0 V (Typ.)
Channel Temperature (T_{CH})	225 °C (Max.)

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

RF Characterization – Optimum Power Tune

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 0.5 A

Parameter	Typical Value					Units
Frequency (F)	3	6	8.45	10	14	GHz
Saturated Output Power (P_{SAT})	43.9	43.2	TBD	43	41.6	dBm
Power Added Efficiency (PAE)	56	56	TBD	49	39	%
Power Gain (Gain)	17.8	11.9	TBD	9.4	6.1	dB
Parallel Resistance [1] (R_P)	59.5	72.1	57.7	59.8	57.9	Ω·mm
Parallel Capacitance [1] (C_P)	0.416	0.294	0.329	0.334	0.328	pF/mm
Load Reflection Coefficient (Γ_L)	0.675∠169	0.706∠163	0.797∠167	0.832∠167	0.886∠168	--

Notes:
1. Large signal equivalent output network (normalized) (see figure, pg 6).

RF Characterization – Optimum Efficiency Tune

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 0.5 A

Parameter	Typical Value					Units
Frequency (F)	3	6	8.45	10	14	GHz
Saturated Output Power (P_{SAT})	42.6	41.5	TBD	42.7	41.6	dBm
Power Added Efficiency (PAE)	62	62	TBD	51	40	%
Power Gain (Gain)	17.1	12.5	TBD	9.7	6.0	dB
Parallel Resistance [1] (R_P)	147.6	120.1	98.3	91.2	67.5	Ω·mm
Parallel Capacitance [1] (C_P)	0.110	0.347	0.393	0.386	0.369	pF/mm
Load Reflection Coefficient (Γ_L)	0.316∠154	0.767∠155	0.863∠162	0.885∠164	0.912∠168	--

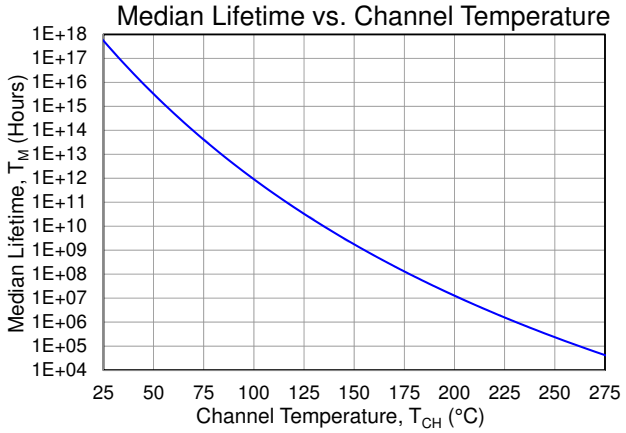
Notes:
1. Large signal equivalent output network (normalized) (see figure, pg 6).

Thermal and Reliability Information (1)

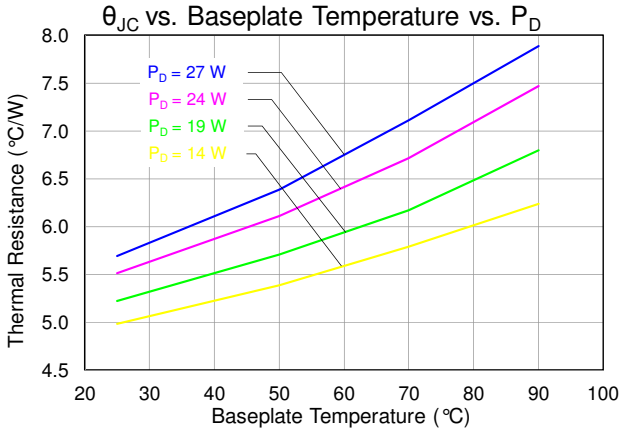
Parameter	Test Conditions	Value	Units
Thermal Resistance, θ_{JC} (No RF Drive)	V_D = 28 V, I_D = 0.5 A , P_D = 14 W, Tbaseplate = 70°C	5.79	ºC/W
Channel Temperature, T_{CH} (No RF Drive)		151	°C
Median Lifetime, T_M (No RF Drive)		1.57 x 10^9	Hrs
Thermal Resistance, θ_{JC} (Under RF Drive)	V_D = 28 V, I_D = 1.54 mA, P_{OUT} = 43.9 dBm, P_D = 18 W, Tbaseplate = 70°C	6.09	°C/W
Channel Temperature, T_{CH} (Under RF Drive)		180	°C
Median Lifetime, T_M (Under RF Drive)		7.99 x 10^7	Hrs

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

Median Lifetime

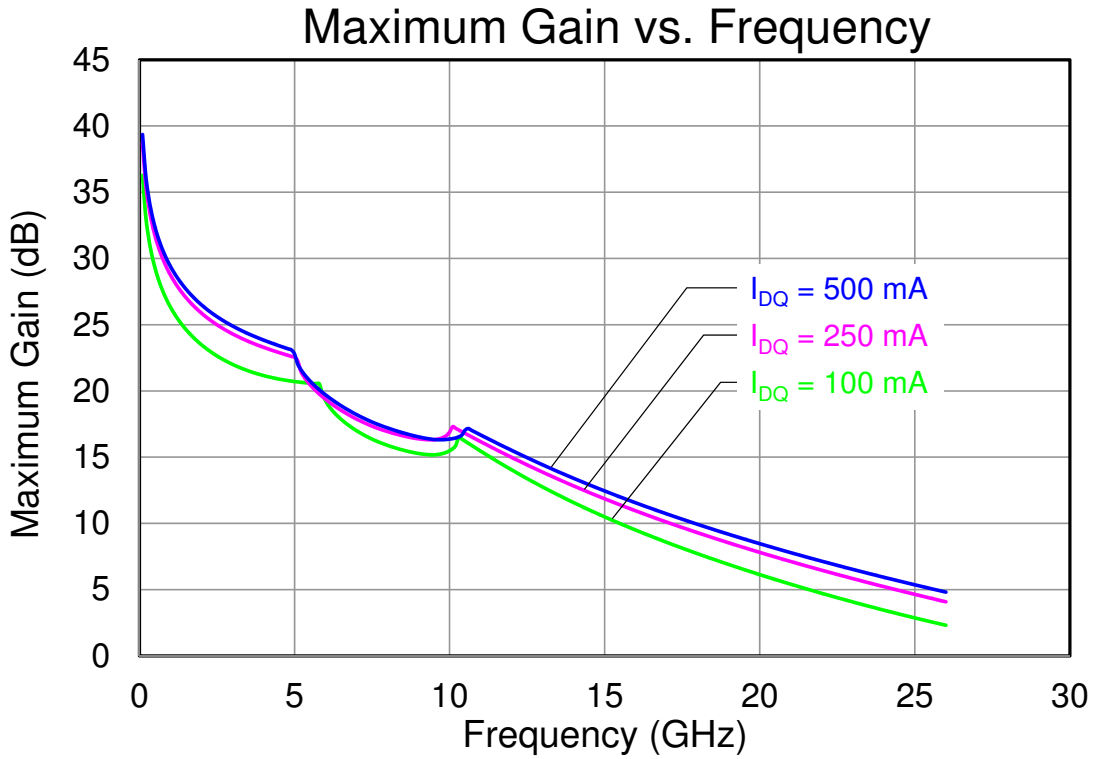


Thermal Resistance

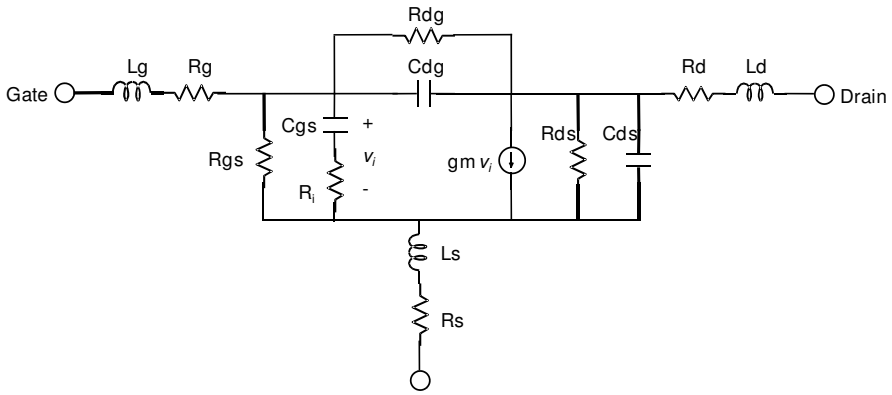


Simulated Performance

Bias conditions: V_D = 28 V



Linear Model for 1.25 mm Unit GaN Cell (UGC)

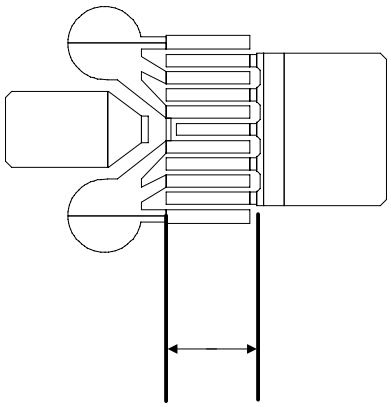


UGC Linear Model Parameters

Test Conditions: V_D=28 V

Parameter	Value			Units
I_{DQ}	25	62.5	125	mA
Rg	0.57	0.58	0.64	Ω
Rs	0.03	0.03	0.04	Ω
Rd	1.460	1.510	1.05	Ω
gm	0.152	0.249	0.289	S
Cgs	1.619	1.831	1.903	pF
Ri	0.07	0.07	0.12	Ω
Cds	0.282	0.273	0.303	pF
Rds	242.55	166.45	133.88	Ω
Cgd	0.056	0.052	0.052	pF
Tau	3.380	3.320	3.010	pS
Ls	0.014	0.014	0.009	nH
Lg	0.034	0.034	0.060	nH
Ld	-0.004	-0.008	0.0004	nH
Rgs	336000	307000	154000	Ω
Rgd	1380000	1360000	421000	Ω

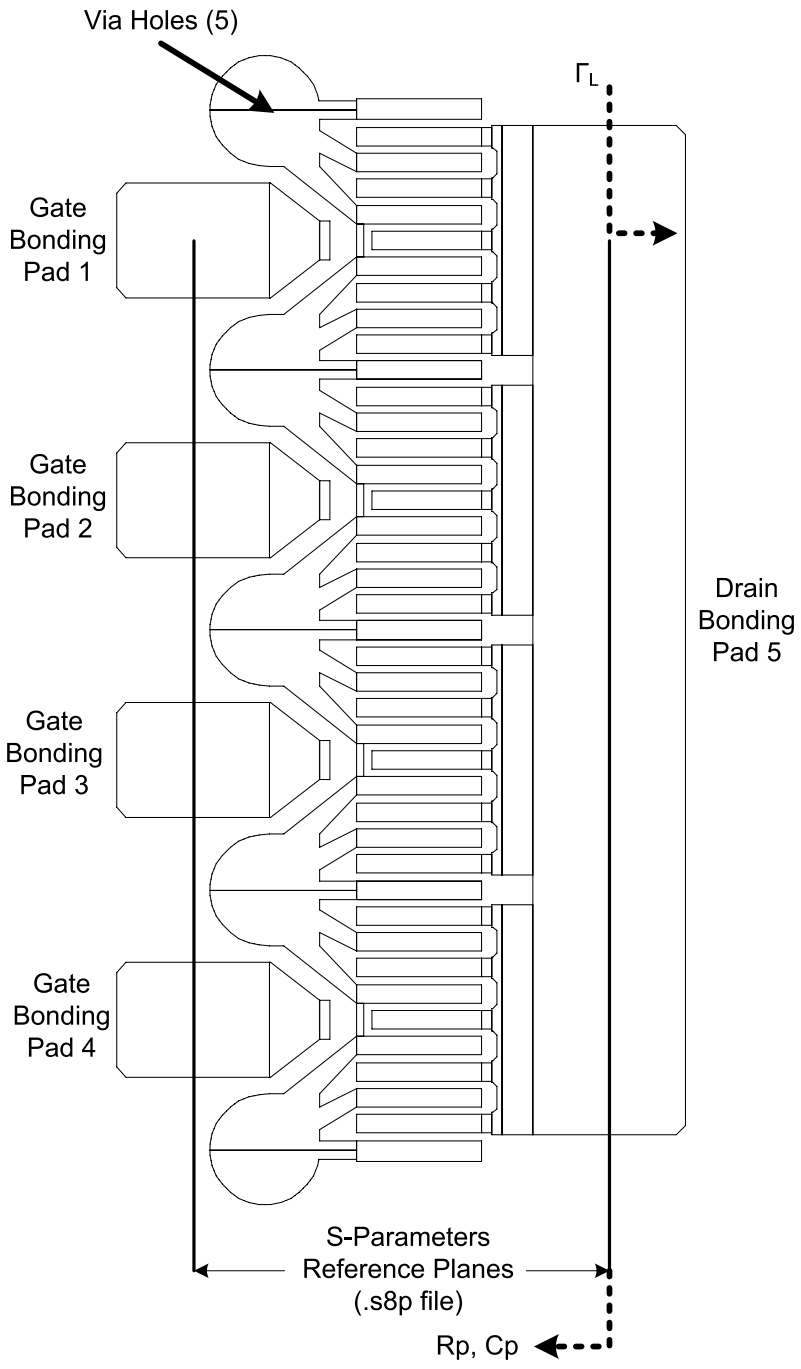
UGC Linear Model Ref. Planes



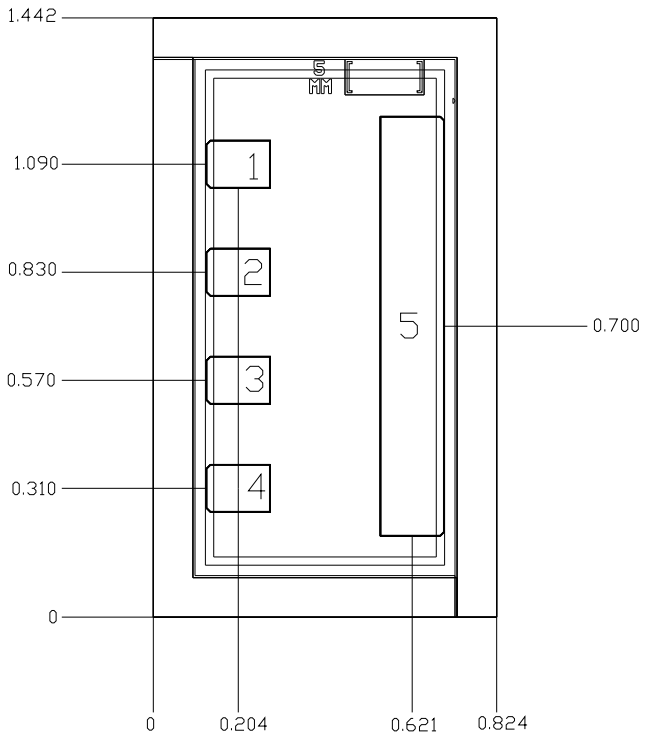
Unit GaN Cell (UGC) Linear Model
Reference Planes

Complete 5 mm GaN Model

Includes 4 UGC, 5 vias, and 5 bonding pads



Mechanical Drawing



Bond Pads

Pad No.	Description	Dimensions
1-4	Gate	0.154 x 0.115
5	Drain	0.154 x 1.01
Die Backside	Source / Ground	0.824 x 1.442

Notes:

1. Units: millimeters
2. Thickness: 0.100 mm
3. Die x,y size tolerance: +/- 0.050 mm

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) not recommended.

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.

Disclaimer

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

Bias-up Procedure

1. V_G set to -5.0V.
2. V_D set to 28 V.
3. Adjust V_G more positive until quiescent I_D is 500 mA.
4. Apply RF signal.

Bias-down Procedure

1. Turn off RF signal.
2. Turn off V_D and wait 1 second to allow drain capacitor dissipation.
3. Turn off V_G.

Product Compliance Information

ESD Sensitivity Ratings

Caution! ESD-Sensitive Device

ESD Rating: TBD
Value: TBD
Test: TBD
Standard: TBD

Solderability

Compatible with gold/tin (320°C maximum reflow temperature) soldering processes.

RoHs Compliance

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 ($C_{15}H_{12}Br_40_2$) Free
- PFOS Free
- SVHC Free

Contact Information

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