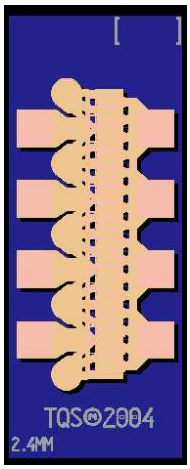
DC - 20 GHz Discrete power pHEMT TGF2022-24



Key Features and Performance

- Frequency Range: DC - 20 GHz
- > 34 dBm Nominal Psat
- 58% Maximum PAE
- 42 dBm Nominal OIP3
- 13 dB Nominal Power Gain
- Suitable for high reliability applications
- 2.4mm x 0.35µm Power pHEMT
- Nominal Bias Vd = 8-12V, Idq = 180-300mA
  (Under RF Drive, Id rises from 180mA to 600mA)
- Chip Dimensions: 0.57 x 1.30 x 0.10 mm
  (0.022 x 0.051 x 0.004 in)

Primary Applications

- Point-to-point Radio
- High-reliability space
- Military
- Base Stations
- Broadband Wireless Applications

Product Description

The TriQuint TGF2022-24 is a discrete 2.4 mm pHEMT which operates from DC-20 GHz. The TGF2022-24 is designed using TriQuint's proven standard 0.35um power pHEMT production process.

The TGF2022-24 typically provides > 34 dBm of saturated output power with power gain of 13 dB. The maximum power added efficiency is 58% which makes the TGF2022-24 appropriate for high efficiency applications.

The TGF2022-24 is also ideally suited for Point-to-point Radio, High-reliability space, and Military applications.

The TGF2022-24 has a protective surface passivation layer providing environmental robustness.

Lead-free and RoHS compliant

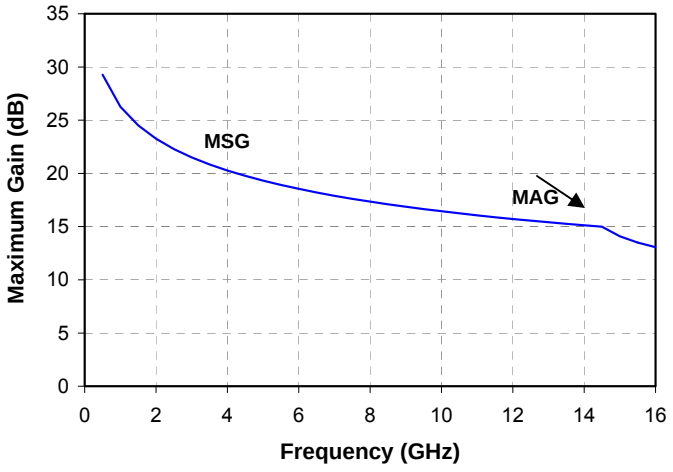


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TABLE I
MAXIMUM RATINGS

Symbol	Parameter 1/	Value	Notes
V^+	Positive Supply Voltage	12.5 V	2/
V^-	Negative Supply Voltage Range	-5V to 0V	
I^+	Positive Supply Current	1120 mA	2/
$\| I_G \|$	Gate Supply Current	28 mA	
P_{IN}	Input Continuous Wave Power	29 dBm	2/
P_D	Power Dissipation	See note 3	2/ 3/
T_{CH}	Operating Channel Temperature	150 °C	4/
T_M	Mounting Temperature (30 Seconds)	320 °C	
T_{STG}	Storage Temperature	-65 to 150 °C	

1/ These ratings represent the maximum operable values for this device.

2/ Combinations of supply voltage, supply current, input power, and output power shall not exceed P_D.

3/ For a median life time of 1E+6 hrs, Power dissipation is limited to:
$P_D(max) = (150\ °C – TBASE\ °C) / 34.5\ (°C/W)$

4/ Junction operating temperature will directly affect the device median time to failure (T_M). For maximum life, it is recommended that junction temperatures be maintained at the lowest possible levels.

TABLE II
DC PROBE CHARACTERISTICS
(T_A = 25 °C, Nominal)

Symbol	Parameter	Minimum	Typical	Maximum	Unit
Idss	Saturated Drain Current	-	720	-	mA
Gm	Transconductance	-	900	-	mS
V_P	Pinch-off Voltage	-1.5	-1	-05	V
V_{BGS}	Breakdown Voltage Gate-Source	-30	-	-8	V
V_{BGD}	Breakdown Voltage Gate-Drain	-30	-	-14	V

Note: For TriQuint's 0.35um power pHEMT devices, RF breakdown >> DC breakdown

TABLE III
RF CHARACTERIZATION TABLE 1/
(T_A = 25 °C, Nominal)

SYMBOL	PARAMETER	f = 10 GHz		f = 18 GHz		UNITS
Power Tuned:		**Vd = 10V Idq = 180 mA**	**Vd = 12V Idq = 180 mA**	**Vd = 10V Idq = 180 mA**	**Vd = 12V Idq = 180 mA**	
Psat	Saturated Output Power	34.9	35.6	34.1	34.7	dBm
PAE	Power Added Efficiency	52.4	51.9	41.5	37.0	%
Gain	Power Gain	12.9	12.9	8.3	8.0	dB
Γ_L 2/	Load Reflection coefficient	0.757 ∠ 167.6	0.737 ∠163.4	0.831 ∠167.8	0.842 ∠166.7	-
Efficiency Tuned:						
Psat	Saturated Output Power	35.3	35.3	33.5	34.1	dBm
PAE	Power Added Efficiency	58.3	56.0	46.0	42.5	%
Gain	Power Gain	13	13	8.5	8.3	dB
Γ_L 2/	Load Reflection coefficient	0.738 ∠159.3	0.741 ∠158.8	0.867 ∠166.6	0.885 ∠165.6	-
OIP3	Output TOI	43	42	43	42	dBm

1/ Values in this table are from measurements taken from a 0.6mm unit pHEMT cell at 10 and 18 GHz

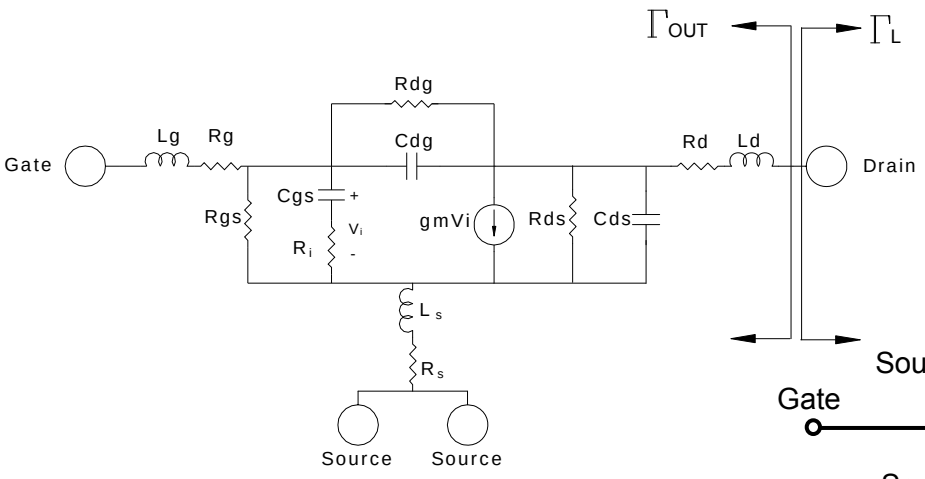
2/ Optimum load impedance for maximum power or maximum PAE at 10 and 18 GHz

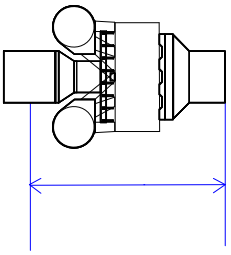
TABLE IV
THERMAL INFORMATION

Parameter	Test Conditions	T_{CH} (°C)	θ_{JC} (°C/W)	T_M (HRS)
θ_{JC} Thermal Resistance (channel to backside of carrier)	Vd = 12 V Idq = 180 mA Pdiss = 2.16 W	145	34.5	1.6 E+6

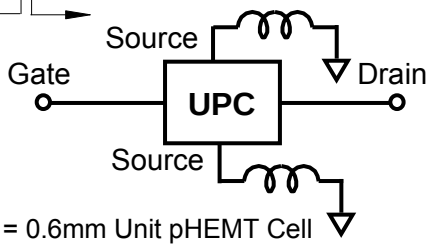
Note: Assumes eutectic attach using 1.5 mil 80/20 AuSn mounted to a 20 mil CuMo Carrier at 70°C baseplate temperature.

Linear Model for 0.6 mm Unit pHEMT cell





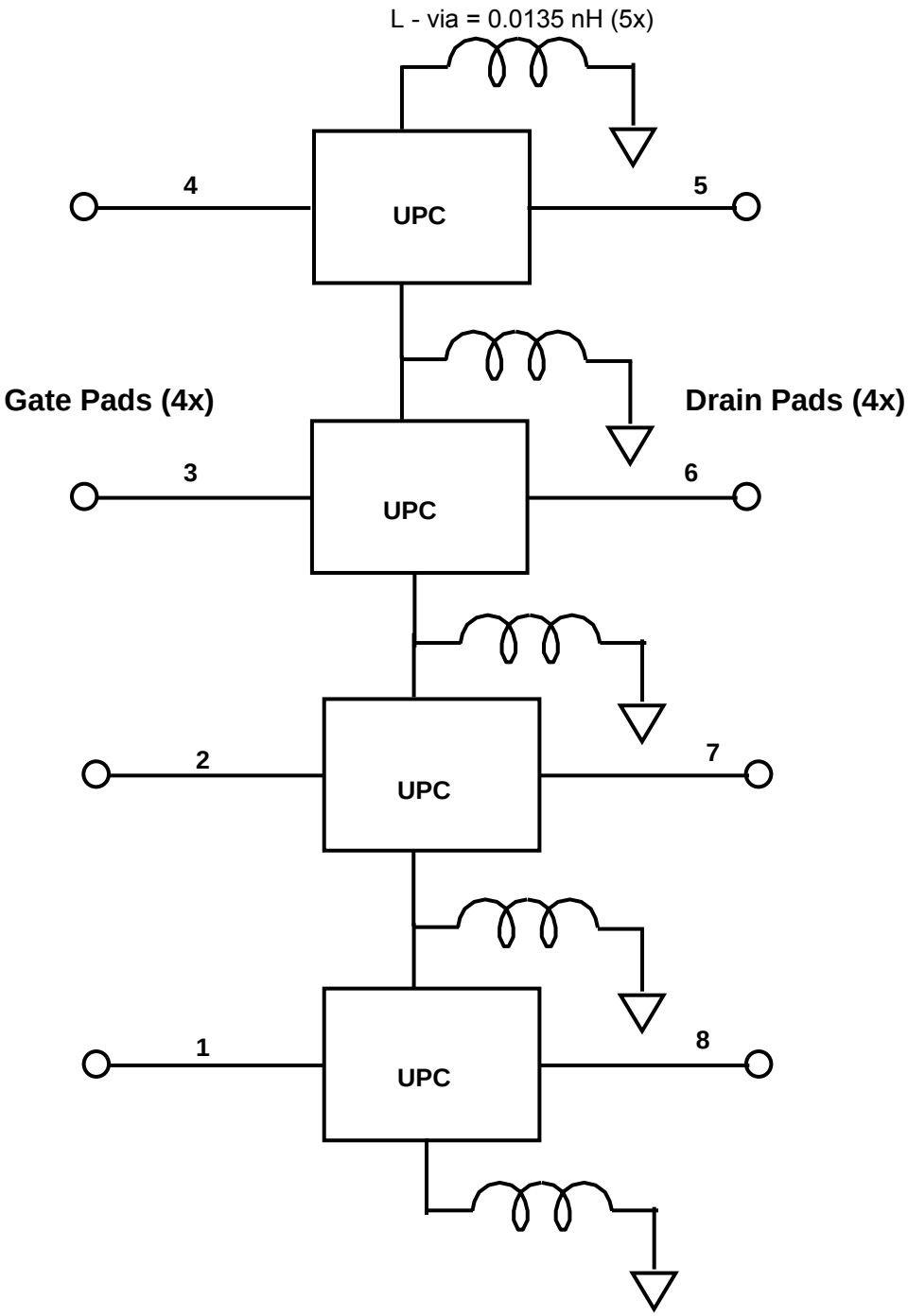
Unit pHEMT cell
Reference Plane



UPC = 0.6mm Unit pHEMT Cell

MODEL PARAMETER	Vd = 8V Idq = 45mA	Vd = 8V Idq = 60mA	Vd = 8V Idq = 75mA	Vd = 10V Idq = 45mA	Vd = 10V Idq = 60mA	Vd = 12V Idq = 45mA	UNITS
Rg	0.22	0.23	0.24	0.23	0.24	0.24	Ω
Rs	0.40	0.41	0.41	0.46	0.45	0.50	Ω
Rd	0.51	0.52	0.52	0.50	0.50	0.48	Ω
gm	0.195	0.202	0.202	0.188	0.195	0.183	S
Cgs	1.50	1.63	1.70	1.64	1.73	1.71	pF
Ri	1.65	1.59	1.58	1.72	1.64	1.73	Ω
Cds	0.115	0.115	0.116	0.114	0.115	0.114	pF
Rds	243.14	247.08	255.12	278.72	279.31	302.49	Ω
Cgd	0.072	0.066	0.063	0.064	0.061	0.060	pF
Tau	5.94	6.23	6.51	6.85	6.95	7.36	pS
Ls	0.001	0.001	0.001	0.001	0.001	0.001	nH
Lg	0.108	0.108	0.108	0.108	0.108	0.108	nH
Ld	0.121	0.120	0.118	0.118	0.118	0.117	nH
Rgs	5110	5140	8310	5110	5420	5120	Ω
Rgd	57700	64800	74400	79400	82900	82300	Ω

Linear Model for 2.4mm pHEMT



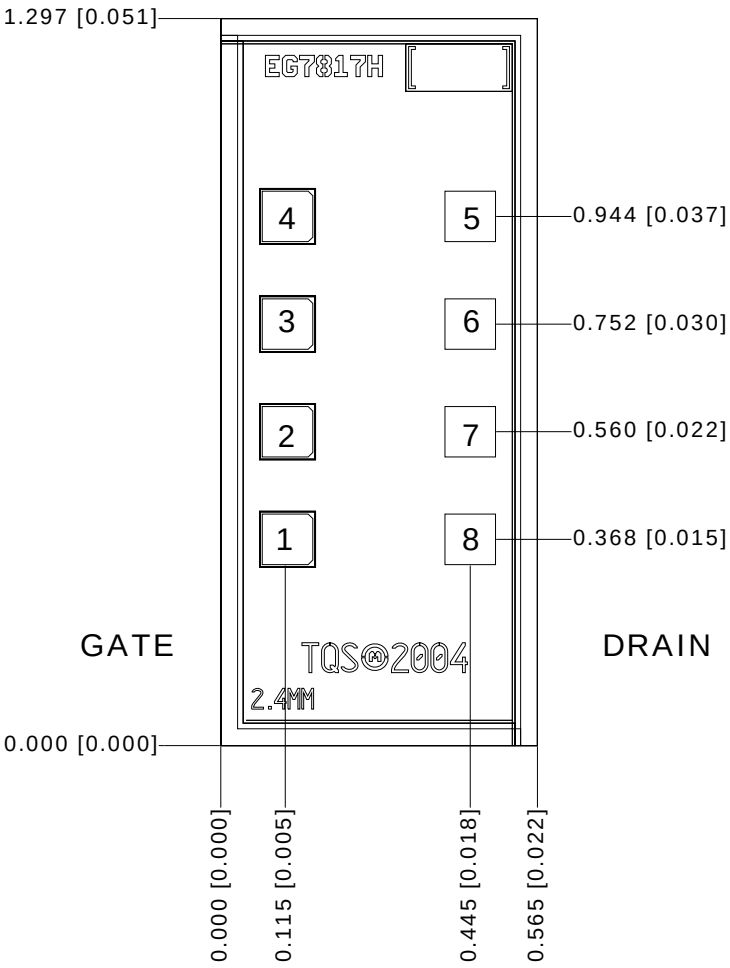
Unmatched S-parameters for 2.4 mm pHEMT

Bias Conditions: Vd = 12V, Idq = 180mA

Frequency	s11	s11 ang	s21	s21 ang	s12	s12 ang	s22	s22 ang
(GHz)	dB	deg	dB	deg	dB	deg	dB	deg
0.5	-0.489	-123.26	25.697	115.91	-32.842	27.72	-9.738	-127.01
1	-0.456	-149.89	20.491	99.75	-32.030	13.51	-9.284	-147.73
1.5	-0.448	-159.80	17.125	92.03	-31.879	7.69	-9.068	-153.52
2	-0.444	-164.92	14.667	86.72	-31.845	4.30	-8.858	-155.29
2.5	-0.441	-168.06	12.731	82.43	-31.853	1.91	-8.627	-155.54
3	-0.438	-170.19	11.130	78.67	-31.881	0.06	-8.372	-155.16
3.5	-0.436	-171.74	9.762	75.22	-31.922	-1.49	-8.097	-154.53
4	-0.433	-172.93	8.565	71.97	-31.974	-2.83	-7.809	-153.84
4.5	-0.429	-173.88	7.498	68.87	-32.035	-4.02	-7.512	-153.19
5	-0.426	-174.66	6.533	65.88	-32.104	-5.10	-7.212	-152.62
5.5	-0.423	-175.31	5.650	62.97	-32.179	-6.08	-6.913	-152.15
6	-0.419	-175.87	4.834	60.15	-32.261	-6.99	-6.617	-151.80
6.5	-0.415	-176.36	4.074	57.39	-32.349	-7.82	-6.328	-151.57
7	-0.411	-176.80	3.362	54.69	-32.443	-8.60	-6.046	-151.44
7.5	-0.407	-177.20	2.691	52.04	-32.541	-9.31	-5.775	-151.41
8	-0.403	-177.56	2.055	49.45	-32.644	-9.97	-5.513	-151.48
8.5	-0.398	-177.89	1.451	46.90	-32.751	-10.57	-5.262	-151.63
9	-0.394	-178.20	0.874	44.40	-32.862	-11.12	-5.023	-151.84
9.5	-0.390	-178.48	0.322	41.95	-32.976	-11.62	-4.794	-152.12
10	-0.385	-178.75	-0.208	39.54	-33.094	-12.07	-4.576	-152.46
10.5	-0.381	-179.01	-0.717	37.17	-33.213	-12.47	-4.369	-152.84
11	-0.377	-179.26	-1.209	34.85	-33.335	-12.83	-4.172	-153.26
11.5	-0.373	-179.49	-1.684	32.56	-33.459	-13.13	-3.986	-153.72
12	-0.368	-179.72	-2.143	30.31	-33.585	-13.39	-3.809	-154.20
12.5	-0.364	-179.94	-2.588	28.11	-33.712	-13.61	-3.641	-154.71
13	-0.360	179.85	-3.019	25.93	-33.840	-13.78	-3.482	-155.24
13.5	-0.356	179.64	-3.438	23.80	-33.968	-13.91	-3.331	-155.78
14	-0.352	179.44	-3.846	21.70	-34.097	-13.99	-3.188	-156.34
14.5	-0.349	179.24	-4.242	19.63	-34.226	-14.04	-3.052	-156.91
15	-0.345	179.05	-4.628	17.60	-34.355	-14.04	-2.924	-157.48
15.5	-0.341	178.86	-5.004	15.59	-34.483	-14.00	-2.802	-158.06
16	-0.338	178.68	-5.371	13.62	-34.611	-13.92	-2.686	-158.65
16.5	-0.334	178.49	-5.729	11.68	-34.737	-13.80	-2.577	-159.23
17	-0.331	178.31	-6.079	9.77	-34.863	-13.65	-2.472	-159.82
17.5	-0.328	178.14	-6.421	7.88	-34.987	-13.45	-2.373	-160.41
18	-0.324	177.96	-6.755	6.03	-35.110	-13.23	-2.279	-160.99
18.5	-0.321	177.79	-7.082	4.20	-35.231	-12.96	-2.190	-161.57
19	-0.318	177.62	-7.401	2.39	-35.350	-12.67	-2.105	-162.15
19.5	-0.316	177.45	-7.715	0.61	-35.467	-12.34	-2.024	-162.73
20	-0.313	177.28	-8.022	-1.15	-35.582	-11.98	-1.947	-163.30
20.5	-0.310	177.12	-8.322	-2.89	-35.694	-11.59	-1.874	-163.87
21	-0.307	176.95	-8.617	-4.60	-35.804	-11.16	-1.804	-164.44
21.5	-0.305	176.79	-8.907	-6.30	-35.911	-10.71	-1.737	-164.99
22	-0.302	176.63	-9.191	-7.97	-36.015	-10.24	-1.673	-165.55
22.5	-0.300	176.47	-9.470	-9.63	-36.116	-9.73	-1.612	-166.10
23	-0.298	176.31	-9.744	-11.26	-36.214	-9.21	-1.554	-166.64
23.5	-0.295	176.15	-10.013	-12.88	-36.308	-8.65	-1.498	-167.18
24	-0.293	176.00	-10.278	-14.49	-36.399	-8.08	-1.445	-167.71
24.5	-0.291	175.84	-10.538	-16.07	-36.487	-7.48	-1.394	-168.23
25	-0.289	175.69	-10.794	-17.64	-36.571	-6.86	-1.345	-168.76
25.5	-0.287	175.53	-11.047	-19.20	-36.652	-6.23	-1.299	-169.27
26	-0.285	175.38	-11.295	-20.74	-36.729	-5.58	-1.254	-169.78

Note: The s-parameters are calculated by connecting nodes 1-4 together, and nodes 5-8 together to form a 2-port network.

Mechanical Drawing



Units: millimeters (inches)
Thickness: 0.100 (0.004)
Chip edge to bond pad dimensions are shown to center of bond pad
Chip size tolerance: +/- 0.051 (0.002)

GND IS BACKSIDE OF MMIC

Bond pads #1-4: (Gate) 0.090 x 0.090 (0.004 x 0.004)
Bond pads # 5-8: (Drain) 0.090 x 0.090 (0.004 x 0.004)

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

Assembly Process Notes

Reflow process assembly notes:

- Use AuSn (80/20) solder with limited exposure to temperatures at or above 300 °C for 30 sec
- An alloy station or conveyor furnace with reducing atmosphere should be used.
- No fluxes should be utilized.
- Coefficient of thermal expansion matching is critical for long-term reliability.
- Devices must be stored in a dry nitrogen atmosphere.

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 can be used in low-power applications.
- Curing should be done in a convection oven; proper exhaust is a safety concern.
- Microwave or radiant curing should not be used because of differential heating.
- Coefficient of thermal expansion matching is critical.

Interconnect process assembly notes:

- Thermosonic ball bonding is the preferred interconnect technique.
- Force, time, and ultrasonics are critical parameters.
- Aluminum wire should not be used.
- Devices with small pad sizes should be bonded with 0.0007-inch wire.
- Maximum stage temperature is 200 °C.