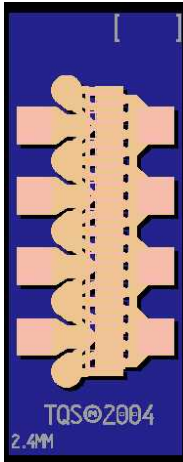


DC - 20 GHz Discrete power pHEMT

TGF2022-24



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.

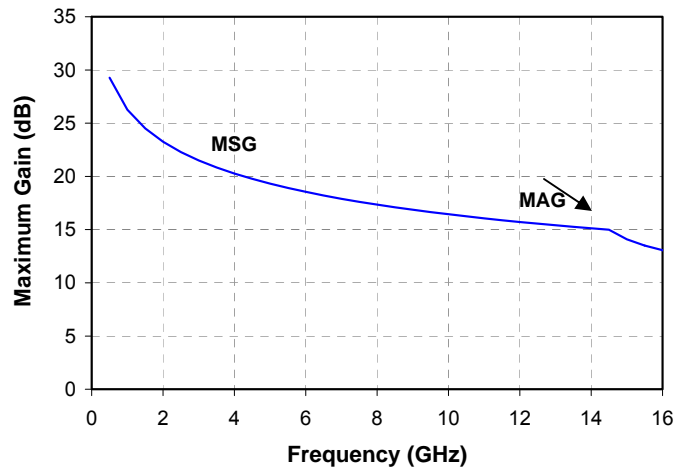
Lead-free and RoHS compliant

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 0.35um 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



**TABLE I
 MAXIMUM RATINGS**
TGF2022-24

| Symbol | Parameter <u>1/</u> | Value | Notes |
|------------------|-----------------------------------|---------------|--------------|
| V ⁺ | Positive Supply Voltage | 12.5 V | <u>2/</u> |
| V ⁻ | Negative Supply Voltage Range | -5V to 0V | |
| I ⁺ | Positive Supply Current | 1120 mA | <u>2/</u> |
| I _G | Gate Supply Current | 28 mA | |
| P _{IN} | Input Continuous Wave Power | 29 dBm | <u>2/</u> |
| P _D | Power Dissipation | See note 3 | <u>2/ 3/</u> |
| T _{CH} | Operating Channel Temperature | 150 °C | <u>4/</u> |
| 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:
 $P_{D(max)} = (150\text{ °C} - T_{BASE}\text{ °C}) / 34.5\text{ (°C/W)}$

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 |
|------------------|-------------------------------|---------|---------|---------|------|
| I _{DSS} | Saturated Drain Current | - | 720 | - | mA |
| G _m | 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

www.BDTIC.com/TriQuint/

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

| SYMBOL | PARAMETER | f = 10 GHz | | f = 18 GHz | | UNITS |
|--------------------------|-----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------|
| | | Vd = 10V Idq = 180 mA | Vd = 12V Idq = 180 mA | Vd = 10V Idq = 180 mA | Vd = 12V Idq = 180 mA | |
| Power Tuned: | | | | | | |
| 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 \angle 167.6 | 0.737 \angle 163.4 | 0.831 \angle 167.8 | 0.842 \angle 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 \angle 159.3 | 0.741 \angle 158.8 | 0.867 \angle 166.6 | 0.885 \angle 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

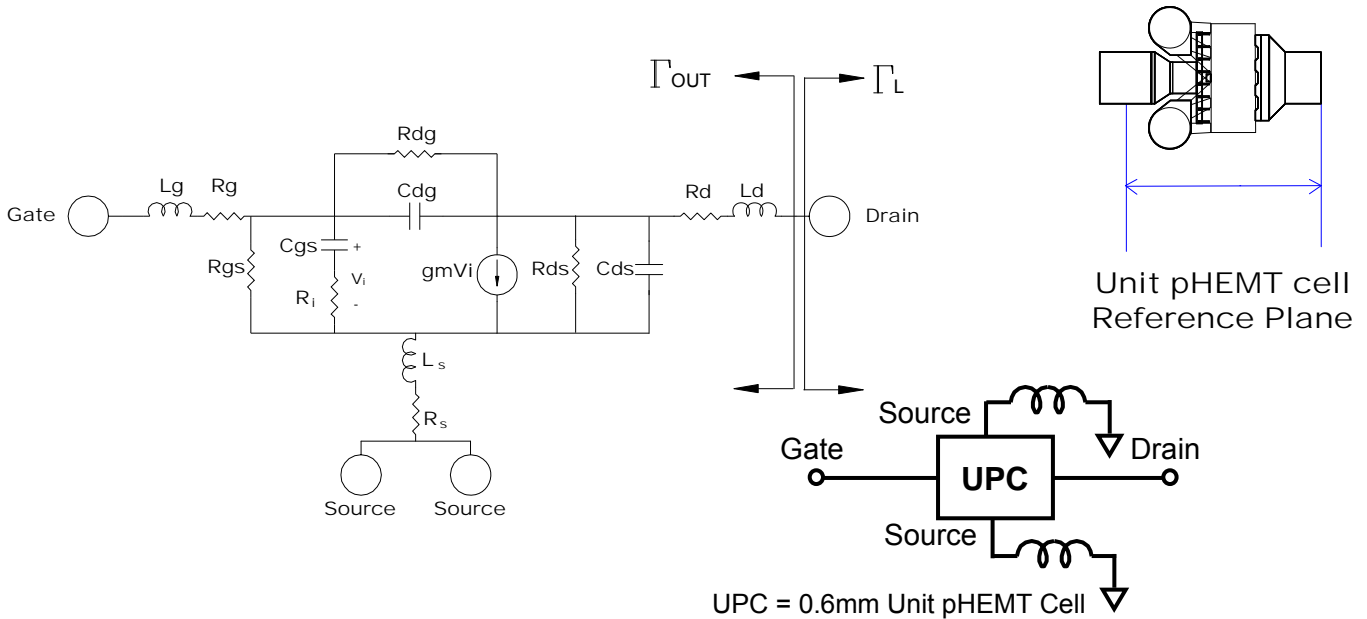
2/ Optimum load impedance for maximum power or maximum PAE at 10 and 18 GHz

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 P _{diss} = 2.16 W | 145 | 34.5 | 1.6 E+6 |

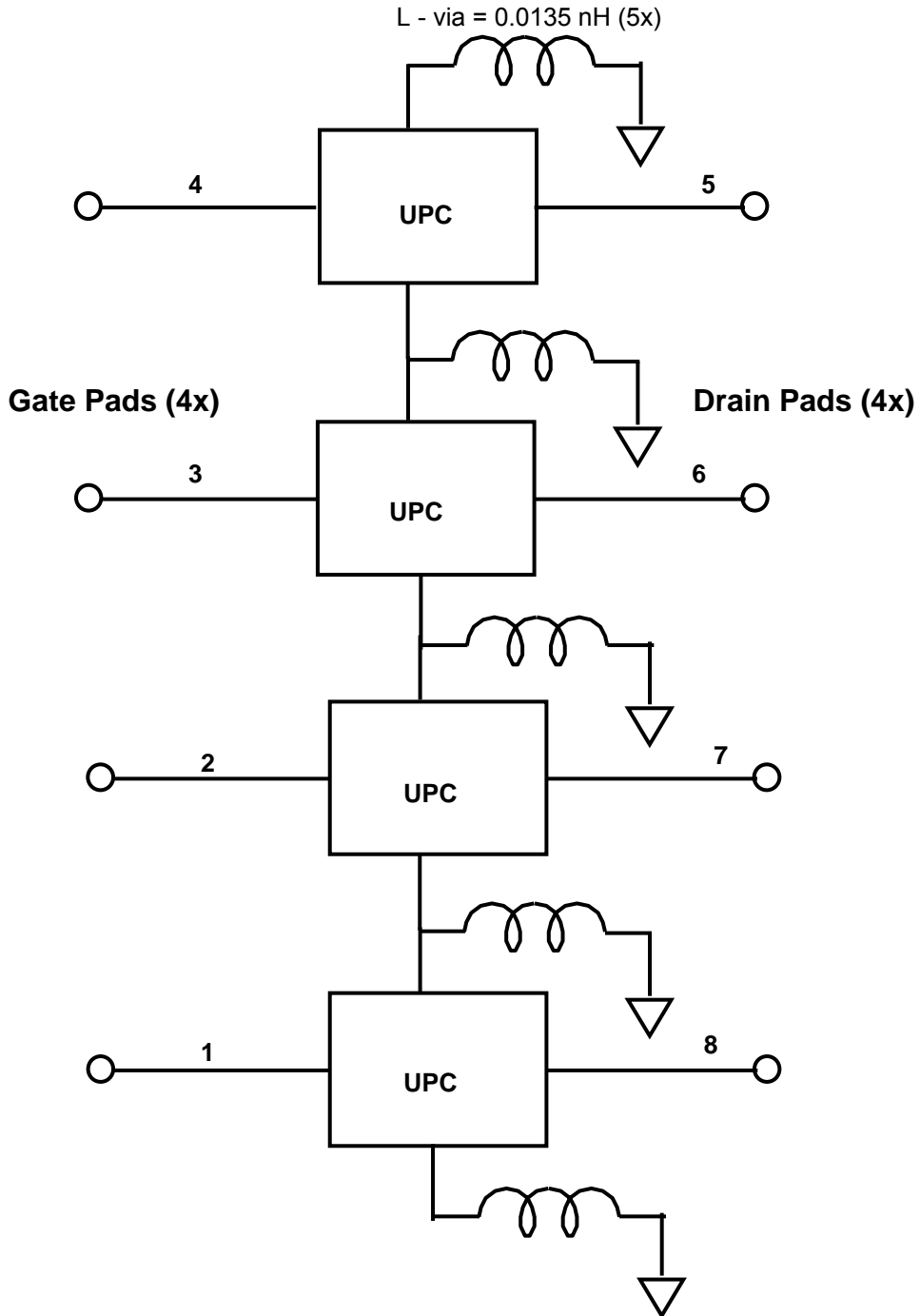
Note: Assumes eutectic attach using 1.5 mil 80/20 AuSn mounted to a 20 mil CuMo Carrier at 70°C base plate temperature.

Linear Model for 0.6 mm 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



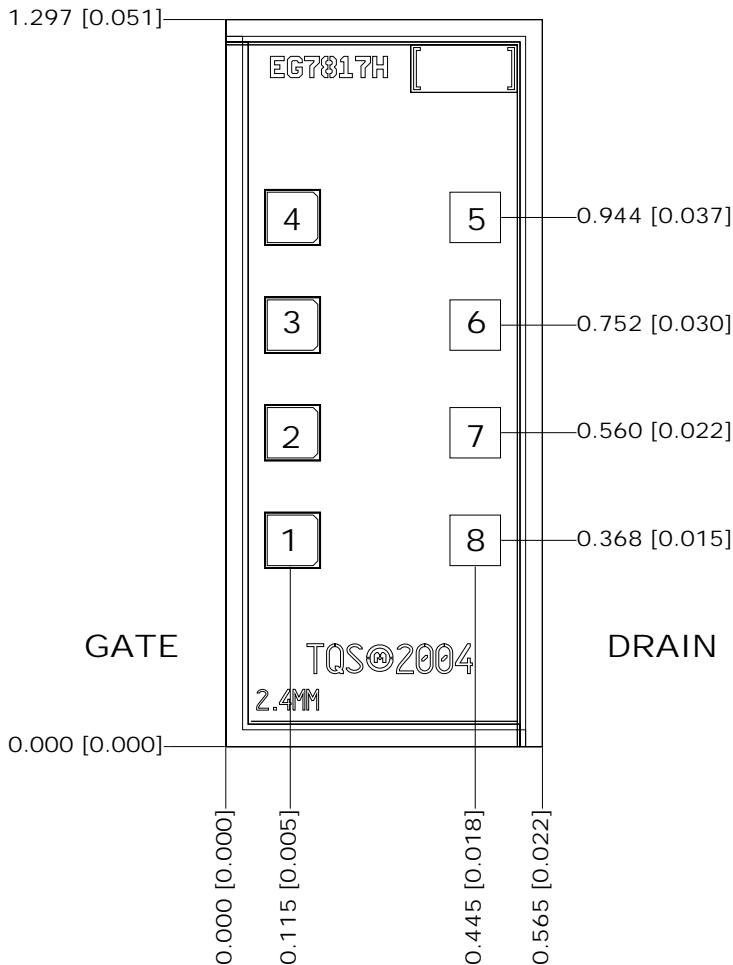
Unmatched S-parameters for 2.4 mm pHEMT

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

| Frequency (GHz) | s11 dB | s11 ang deg | s21 dB | s21 ang deg | s12 dB | s12 ang deg | s22 dB | s22 ang 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 handling, 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.