# MAGX-001220-100L00

**GaN on SiC HEMT Pulsed Power Transistor**
**100 W Peak, 1.2 to 2.0 GHz, 300 µs Pulse, 10% Duty** Rev. V2

## Features

- GaN on SiC Depletion-Mode HEMT Transistor
- Common-Source Configuration
- Broadband Class AB Operation
- Thermally Enhanced Cu/Mo/Cu Package
- RoHS* Compliant
- +50 V Typical Operation
- MTTF = 600 Years ($T_J$ < 200°C)
- EAR99 Export Classification
- MSL-1


## Applications

- General Purpose for Pulsed or CW Applications
- Commercial Wireless Infrastructure (WCDMA, LTE, WIMAX)
- Civilian and Military Radar
- Military and Commercial Communications
- Public Radio
- Industrial, Scientific, and Medical
- SATCOM
- Instrumentation
- DTV

## Ordering Information

| Part Number | Description |
|---|---|
| MAGX-001220-100L00 | 100 W GaN Power Transistor |
| MAGX-001220-SB1PPR | 1.2-2.0 GHz Evaluation Board |

## Description

The MAGX-001220-100L00 is a gold metalized Gallium Nitride (GaN) on Silicon Carbide RF power transistor suitable for a variety of RF power amplifier applications. Using state of the art wafer fabrication processes, these high performance transistors provide high gain, efficiency, bandwidth, and ruggedness over multiple octave bandwidths for today's demanding application needs. The MAGX-001220-100L00 is constructed using a thermally enhanced Cu/Mo/Cu flanged ceramic package which provides excellent thermal performance. High breakdown voltages allow for reliable and stable operation in extreme mismatched load conditions unparalleled with older semiconductor technologies.

* Restrictions on Hazardous Substances, European Union Directive 2011/65/EU.

## Electrical Specifications: Freq. = 1.2 - 2.0 GHz, $T_A$ = +25°C

| Parameter | Symbol | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| **RF Functional Tests: $P_{IN}$ = 4 W, $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA, Pulse Width = 300 μs, Duty = 10%** | | | | | |
| Peak Output Power | $P_{OUT}$ | 100 | 110 | - | W |
| Power Gain | $G_P$ | 14.0 | 14.8 | - | dB |
| Drain Efficiency | $\eta_D$ | 50 | 55 | - | % |
| Load Mismatch Stability | VSWR-S | - | 5:1 | - | - |
| Load Mismatch Tolerance | VSWR-T | - | 10:1 | - | - |

## Electrical Characteristics: $T_A$ = +25°C

| Parameter | Test Conditions | Symbol | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| **DC Characteristics** | | | | | | |
| Drain-Source Leakage Current | $V_{GS}$ = -8 V, $V_{DS}$ = 175 V | $I_{DS}$ | - | - | 6 | mA |
| Gate Threshold Voltage | $V_{DS}$ = 5 V, $I_D$ = 15 mA | $V_{GS\ (TH)}$ | -5 | -3 | -2 | V |
| Forward Transconductance | $V_{DS}$ = 5 V, $I_D$ = 3.5 A | $G_M$ | 2.5 | - | - | S |
| **Dynamic Characteristics** | | | | | | |
| Input Capacitance | Not Applicable (Input Matched) | $C_{ISS}$ | N/A | N/A | N/A | pF |
| Output Capacitance | $V_{DS}$ = 50 V, $V_{GS}$ = -8 V, F = 1 MHz | $C_{OSS}$ | - | 30.3 | 35 | pF |
| Reverse Transfer Capacitance | $V_{DS}$ = 50 V, $V_{GS}$ = -8 V, F = 1 MHz | $C_{RSS}$ | - | 2.8 | 5.4 | pF |

## Absolute Maximum Ratings[1,2,3,4,5]

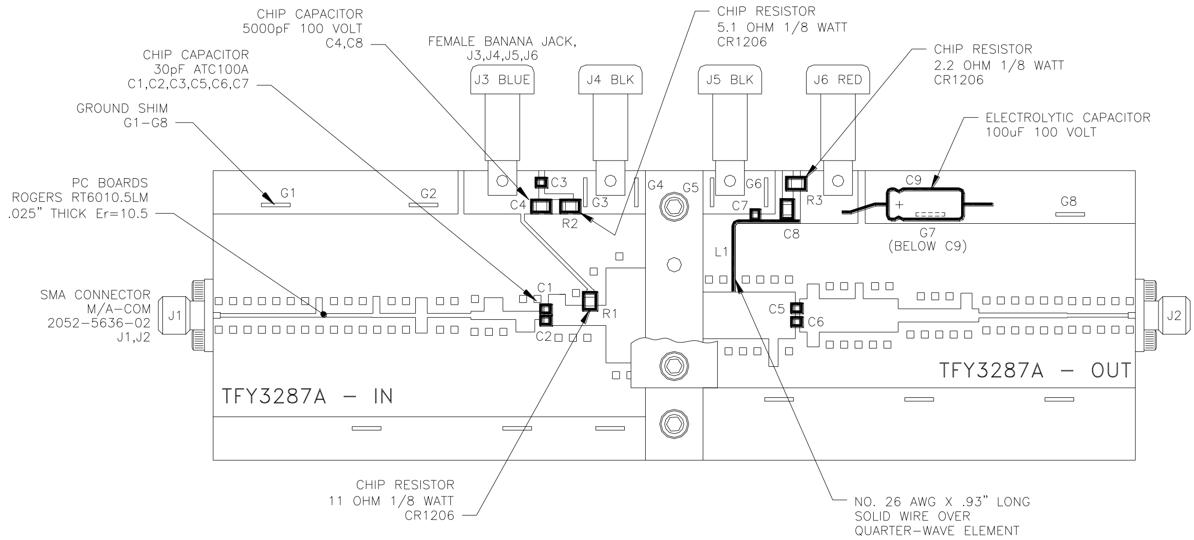
| Parameter | Limit |
|---|---|
| Input Power ($P_{IN}$) | $P_{IN}$ (nominal) + 3 dB |
| Drain Supply Voltage ($V_{DD}$) | +65 V |
| Gate Supply Voltage ($V_{GG}$) | -8 to 0 V |
| Peak Supply Current ($I_{DD}$) | 9 A |
| Junction/Channel Temperature | +200ºC |
| Average Pulsed Power Dissipation at 85ºC | 105 W |
| Operating Temperature | -40 to +95ºC |
| Storage Temperature | -65 to +150ºC |
| ESD Min. - Charged Device Model (CDM) | 300 V |
| ESD Min. - Human Body Model (HBM) | 600 V |

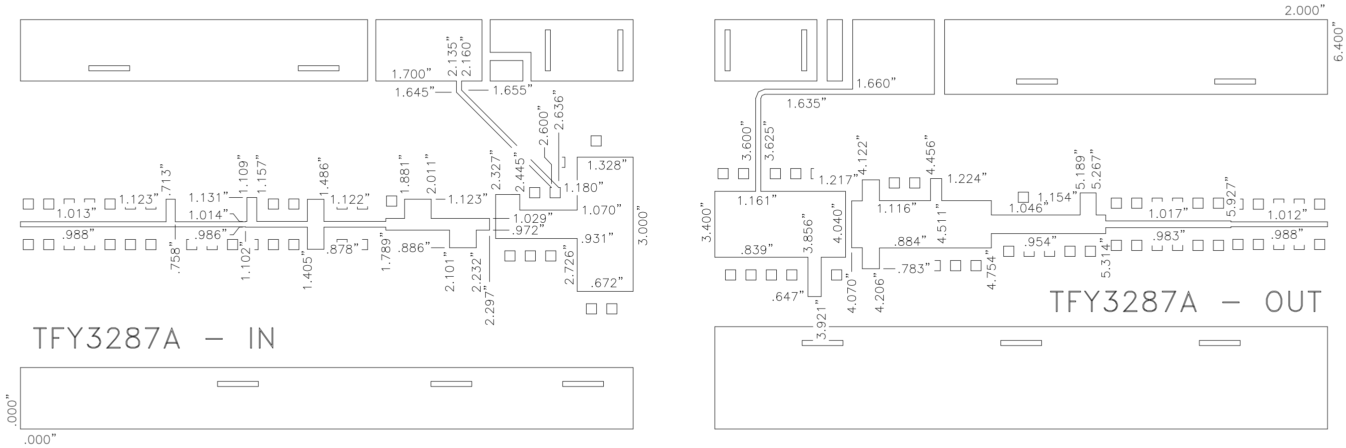
1. Exceeding any one or combination of these limits may cause permanent damage to this device.
2. MACOM does not recommend sustained operation near these survivability limits.
3. For saturated performance, the following is recommended: ($3*V_{DD}$ + abs($V_{GG}$)) <175 V.
4. Operating at nominal conditions with $T_J \leq +200°C$ will ensure MTTF > $1 \times 10^6$ hours. Junction temperature directly affects device MTTF and should be kept as low as possible to maximize lifetime.
5. Junction Temperature ($T_J$) = $T_C + \Theta_{JC} * ((V * I) - (P_{OUT} - P_{IN}))$.

   Typical Transient Thermal Resistances (Freq. = 2.0 GHz, $I_{DQ}$ = 500 mA):

   - $\Theta_{JC}$ = 0.68°C/W, Pulse Width = 300 μs, 10% duty cycle
     $T_J$ = 135°C ($T_C$ = 80°C, 50 V, 3.71 A, $P_{OUT}$ = 108 W, $P_{IN}$ = 4 W)
   - $\Theta_{JC}$ = 0.97°C/W, Pulse Width = 1000 μs, 10% duty cycle
     $T_J$ = 160°C ($T_C$ = 80°C, 50 V, 3.64 A, $P_{OUT}$ = 103 W, $P_{IN}$ = 4 W)

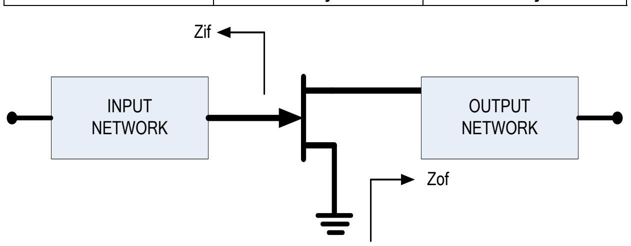
## Evaluation Board Assembly & Circuit Dimensions (1.2 - 2.0 GHz)




## Evaluation Board Impedances

| Freq. (MHz) | $Z_{IF}$ (Ω) | $Z_{OF}$ (Ω) |
|---|---|---|
| 1200 | 3.9 - j2.9 | 8.6 + j1.1 |
| 1400 | 4.2 - j1.8 | 6.9 + j0.2 |
| 1600 | 4.7 - j2.2 | 6.8 + j0.7 |
| 1800 | 3.5 - j2.8 | 6.1 - j0.6 |
| 2000 | 2.2 - j1.9 | 3.2 + j0.4 |




## Correct Device Sequencing

### Turning the device ON

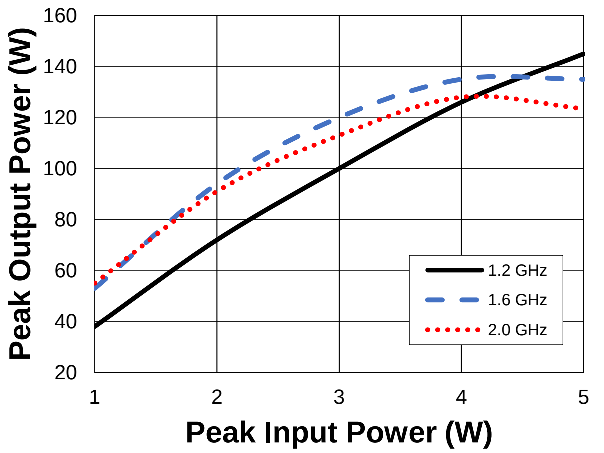
1. Set $V_{GS}$ to the pinch-off ($V_P$), typically -5 V.
2. Turn on $V_{DS}$ to nominal voltage (50 V).
3. Increase $V_{GS}$ until the $I_{DS}$ current is reached.
4. Apply RF power to desired level.

### Turning the device OFF

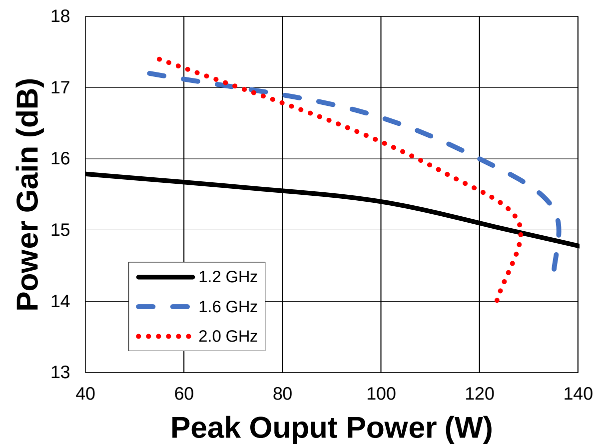
1. Turn the RF power off.
2. Decrease $V_{GS}$ down to $V_P$.
3. Decrease $V_{DS}$ down to 0 V.
4. Turn off $V_{GS}$.

## Typical Performance Curves

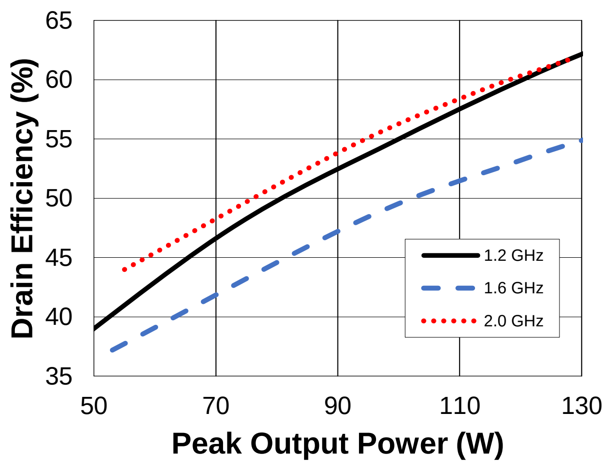
*Peak Output Power vs. Peak Input Power*



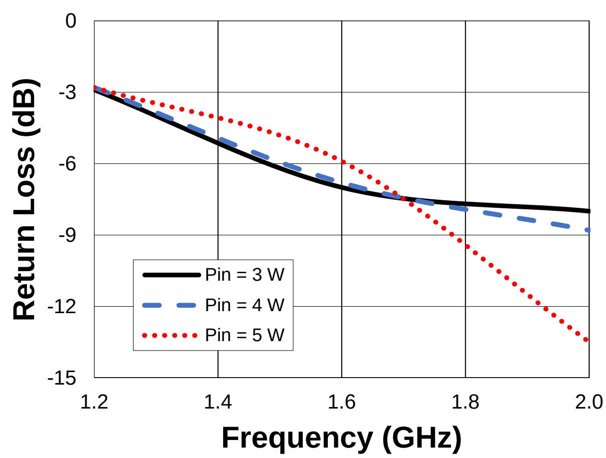

*Power Gain vs. Peak Output Power*



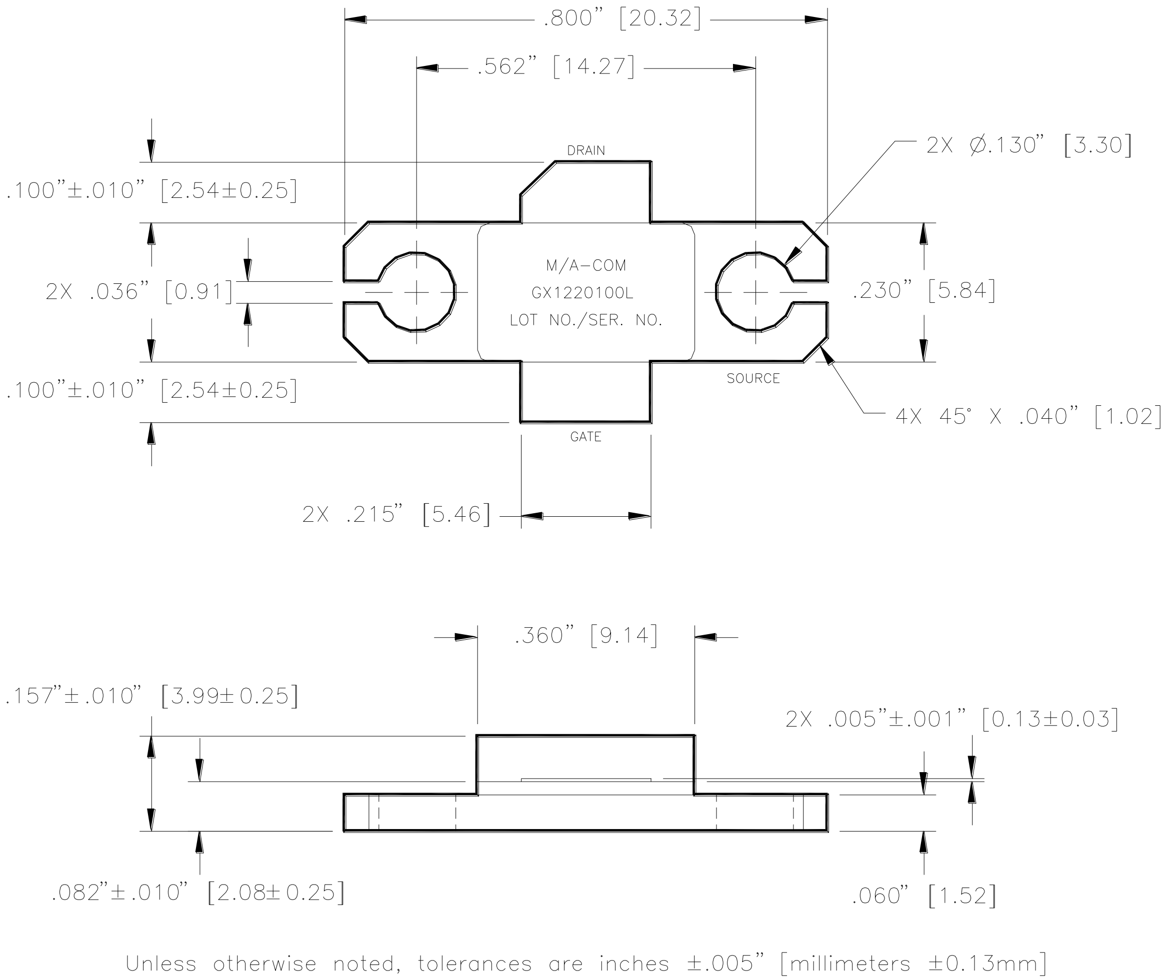

*Drain Efficiency vs. Peak Output Power*




*Return Loss vs. Frequency*



## Package Outline




## Handling Procedures

Please observe the following precautions to avoid damage:

## Static Sensitivity

Gallium Nitride devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.