# MAGX-000912-125L00

## GaN on SiC HEMT Pulsed Power Transistor
## 125 W Peak, 960-1215 MHz, 128 µs Pulse, 10% Duty

Rev. V3

### Features

- GaN on SiC Depletion-Mode Transistor Technology
- Internally Matched
- Common-Source Configuration
- Broadband Class AB Operation
- RoHS* Compliant and 260 °C Reflow Compatible
- +50 V Typical Operation
- MTTF = 600 years ($T_J$ < 200 °C)


### Applications

- Civilian Air Traffic Control (ATC), L-Band Secondary Radar for IFF and Mode-S Avionics.
- Military radar for IFF and Data Links.

### Description

The MAGX-000912-500L00 is a gold metalized matched Gallium Nitride (GaN) on Silicon Carbide RF power transistor optimized for civilian and military pulsed avionics amplifier applications for the 960 MHz to 1215 MHz range such as Mode-S, TCAS, JTIDS, DME and TACAN. Using state of the art wafer fabrication processes, these high performance transistors provide high gain, efficiency, bandwidth, ruggedness over a wide bandwidth for today's demanding application needs. High breakdown voltages allow for reliable and stable operation in extreme mismatched load conditions unparalleled with older semiconductor technologies.

### Ordering Information

| Part Number | Description |
|---|---|
| MAGX-000912-125L00 | 125W GaN Power Transistor |
| MAGX-000912-SB0PPR | Evaluation Test Fixture |

### Typical RF Performance under Standard Operating Conditions, $P_{OUT}$ = 125 W (Peak)

| Freq (MHz) | $P_{IN}$ (W) | Gain (dB) | $I_D$ (A) | Eff. (%) | RL (dB) | Droop (dB) | VSWR-S (5:1) | VSWR-T (10:1) |
|---|---|---|---|---|---|---|---|---|
| 960 | 1.4 | 19.7 | 3.9 | 64.4 | -6.1 | 0.3 | S | P |
| 1030 | 1.3 | 19.8 | 4.0 | 61.6 | -11.9 | 0.3 | S | P |
| 1090 | 1.6 | 18.9 | 4.1 | 60.4 | -9.6 | 0.3 | S | P |
| 1150 | 1.7 | 18.6 | 4.1 | 61.4 | -9.3 | 0.3 | S | P |
| 1215 | 1.6 | 18.9 | 4.0 | 61.9 | -12.0 | 0.3 | S | P |

* Restrictions on Hazardous Substances, European Union Directive 2002/95/EC.

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### Electrical Specifications: Freq. = 960 - 1215 MHz, $T_A$ = 25°C

| Parameter | Test Conditions | Symbol | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| **RF Functional Tests** | | | | | | |
| Peak Input Power | $V_{DD}$ = 50 V, $I_{DQ}$ = 100 mA, Pulse Width = 128 µs, Duty Cycle = 10%, $P_{OUT}$ = 125 W Peak (12.5 W avg.) | $P_{IN}$ | - | 1.2 | 2.2 | W |
| Power Gain | | $G_P$ | 17.5 | 19.2 | - | dB |
| Drain Efficiency | | $\eta_D$ | 57 | 62 | - | % |
| 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 | $I_{DS}$ | - | 0.2 | 6 | mA |
| Gate Threshold Voltage | $V_{DS}$ = 5 V, $I_D$ = 15 mA | $V_{GS\ (TH)}$ | -5 | -3.8 | -2 | V |
| Forward Transconductance | $V_{DS}$ = 5 V, $I_D$ = 3.5 mA | $G_M$ | 2.5 | 3.6 | - | 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, Freq. = 1 MHz | $C_{OSS}$ | - | 11 | - | pF |
| Reverse Transfer Capacitance | | $C_{RSS}$ | - | 1.1 | - | pF |

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

| Parameter | Limit |
|---|---|
| Drain Voltage ($V_{DD}$) | +65 V |
| Gate Voltage ($V_{GG}$) | -8 to -2 V |
| Drain Current ($I_{DD}$) | 9.5 A |
| Input Power[4] ($P_{IN}$) | $P_{IN}$ (nominal) + 3 dB |
| Operating Junction Temperature[5] | 250 ºC |
| Peak Pulsed Power Dissipation at 85 ºC | 350 W |
| Operating Temperature Range | -40 to +95 ºC |
| Storage Temperature Range | -65 to +150 ºC |
| ESD Maximum - Machine Model (MM) | 50 V |
| ESD Maximum - Human Body Model (HBM) | 250 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 it is recommended that the sum of ( 3 * $V_{DD}$ + | $V_{GG}$ | ) < 175 V.
4. Input Power Limit is +3 dB over nominal drive required to achieve $P_{OUT}$ = 125 W.
5. Operating junction temperature is measured with infrared (IR) microscope. Junction temperature directly affects a device's MTTF and should be kept as low as possible to maximize lifetime.
   - MTTF = 5.3 x $10^6$ hours ($T_J$ < 200 °C)
   - MTTF = 6.8 x $10^4$ hours ($T_J$ < 250 °C)

### Thermal Characteristics

| Parameter | Test Conditions | Symbol | Typical | Units |
|---|---|---|---|---|
| Thermal Resistance | $T_C$ = 70 ºC, $V_{DD}$ = 50 V, $I_{DQ}$ = 100 mA, $P_{OUT}$ = 125 W, Pulse Width = 128 µs, Duty Cycle = 10% | $\Theta_{JC}$ | 0.5 | °C/W |

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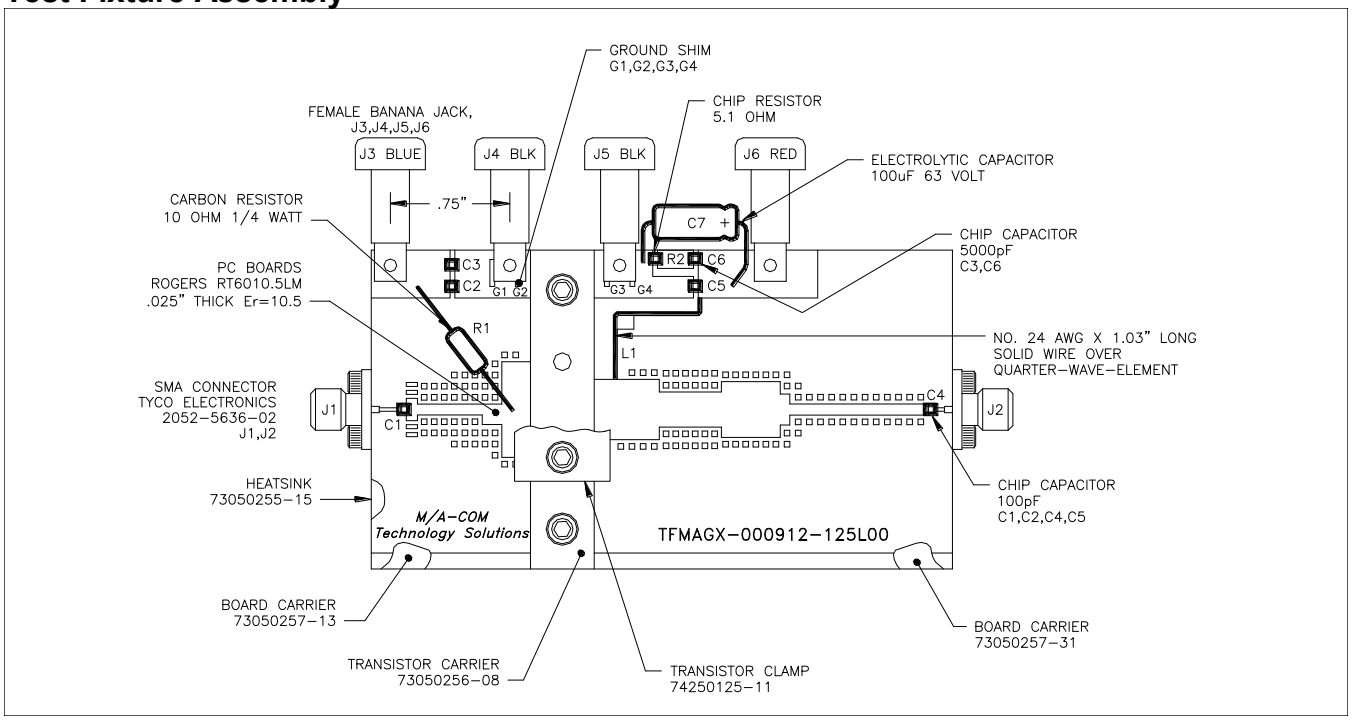
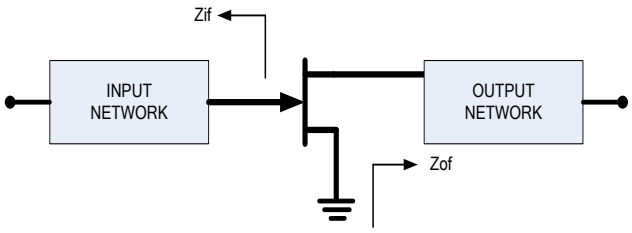
### Test Fixture Assembly




Contact MACOM for additional circuit information.

### Test Fixture Impedances

| Freq. (MHz) | $Z_{IF}$ (Ω) | $Z_{OF}$ (Ω) |
|---|---|---|
| 960 | 3.9 - j7.5 | 7.6 + j2.6 |
| 1030 | 3.7 - j6.6 | 8.3 + j1.5 |
| 1090 | 3.6 - j5.6 | 8.2 + j0.8 |
| 1150 | 4.7 - j6.0 | 8.0 + j0.6 |
| 1215 | 4.1 - j5.5 | 8.2 + j0.9 |




### Correct Device Sequencing

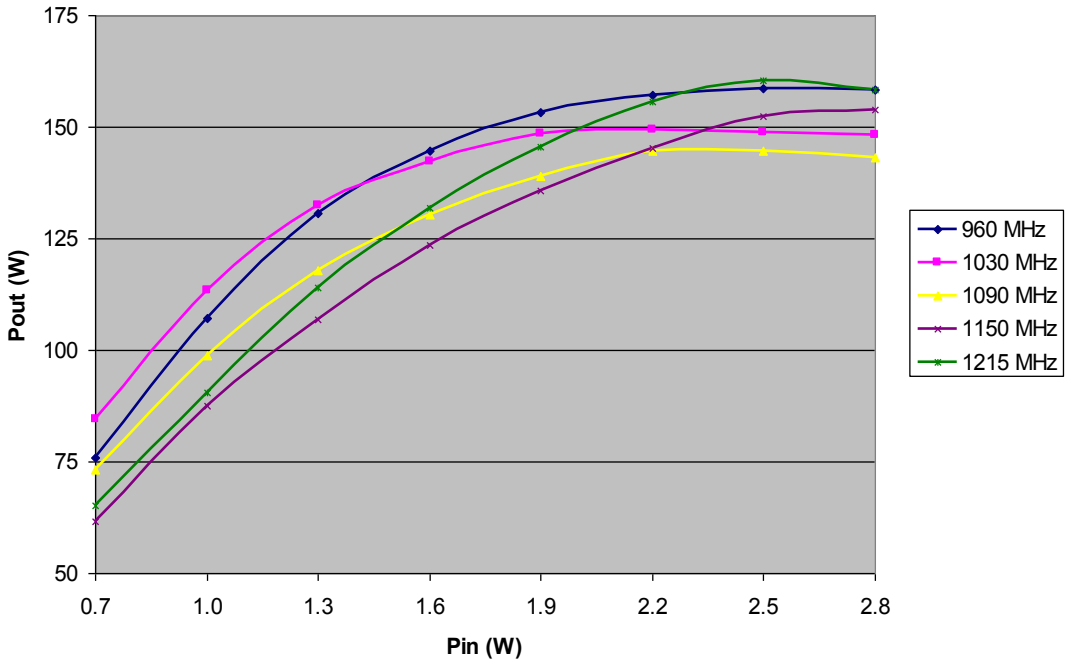
#### Turning the device ON

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.

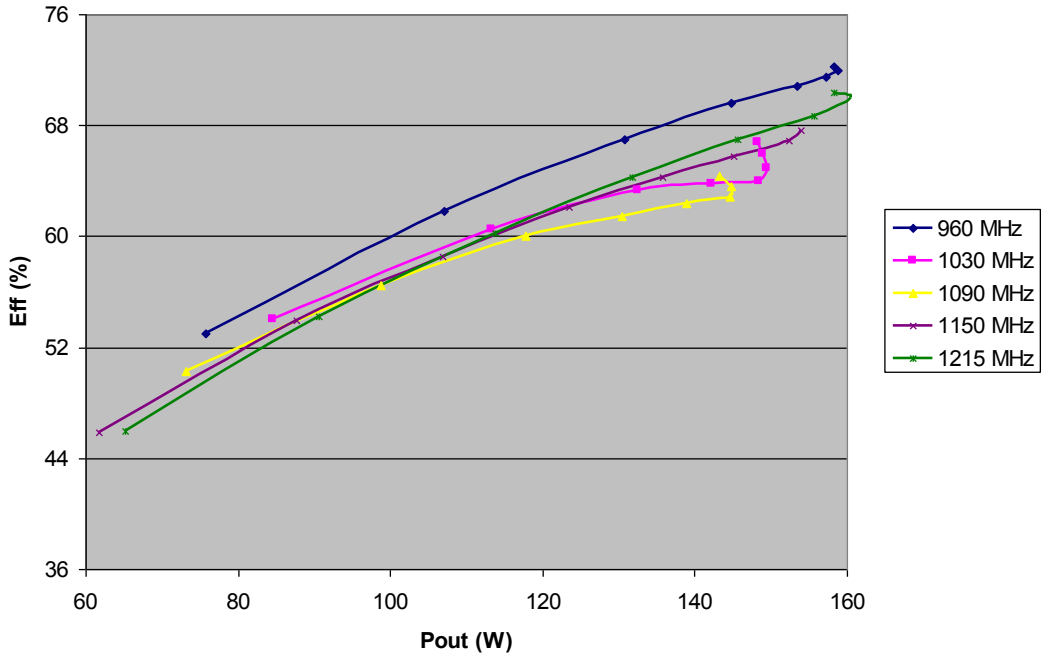
#### Turning the device OFF

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 $V_{GS}$

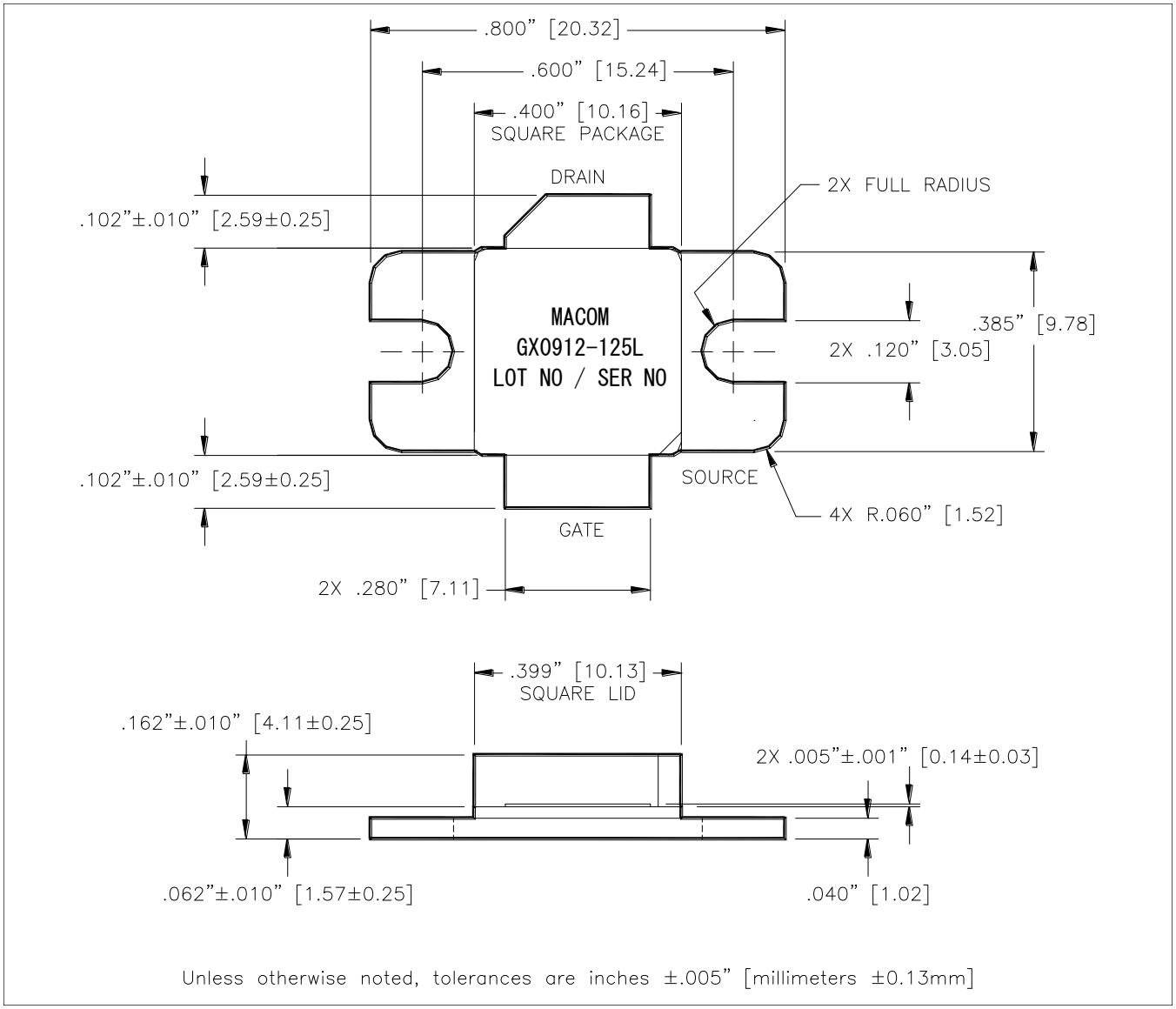
## RF Power Transfer Curve (Output Power Vs. Input Power)




## RF Power Transfer Curve (Drain Efficiency Vs. Output Power)



## Outline Drawing†




† Reference Application Note AN3025 for mounting/soldering recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is Ni/Au.