

# MAGX-001214-125L00



## GaN on SiC HEMT Pulsed Power Transistor 125W Peak, 1200-1400 MHz, 300μs 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 ( $T_J < 200\text{ °C}$ )



### Applications

- L-Band pulsed radar

### Description

The MAGX-001214-125L00 is a gold metalized matched Gallium Nitride (GaN) on Silicon Carbide RF power transistor optimized for pulsed L-Band radar applications. 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-001214-125L00 | 125W GaN Power Transistor |
| MAGX-001214-SB0PPR | Evaluation Test Fixture   |

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

| Freq (MHz) | $P_{IN}$ (W) | Gain (dB) | $I_D$ (A) | Eff. (%) | RL (dB) | Droop (dB) | VSWR-S (5:1) | VSWR-T (10:1) |
|------------|--------------|-----------|-----------|----------|---------|------------|--------------|---------------|
| 1200       | 1.8          | 18.3      | 4.0       | 62.5     | -9.0    | 0.4        | S            | P             |
| 1250       | 1.9          | 18.1      | 4.2       | 59.0     | -11.6   | 0.6        | S            | P             |
| 1300       | 2.0          | 18.0      | 4.4       | 56.5     | -16.0   | 0.6        | S            | P             |
| 1350       | 1.9          | 18.1      | 4.3       | 57.7     | -19.0   | 0.5        | S            | P             |
| 1400       | 1.8          | 18.4      | 3.9       | 62.9     | -14.5   | 0.3        | S            | P             |

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

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**Electrical Specifications: Freq. = 1200 - 1400 MHz, T<sub>A</sub> = 25°C**

| Parameter                  | Test Conditions   | Symbol          | Min. | Typ. | Max. | Units |
|----------------------------|---|-----------------|------|------|------|-------|
| <b>RF Functional Tests</b> |   |                 |      |      |      |       |
| Peak Input Power           | V <sub>DD</sub> = 50 V, I <sub>DQ</sub> = 100 mA,<br>Pulse Width = 300 µs, Duty Cycle = 10%,<br>P <sub>OUT</sub> = 125 W Peak (12.5 W avg.) | P <sub>IN</sub> | -    | 1.9  | 2.4  | W     |
| Power Gain                 |   | G <sub>P</sub>  | 17.2 | 18.1 | -    | dB    |
| Drain Efficiency           |   | η <sub>D</sub>  | 54   | 59.8 | -    | %     |
| Load Mismatch Stability    |   | VSWR-S          | 5:1  | -    | -    | -     |
| Load Mismatch Tolerance    |   | VSWR-T          | 10:1 | -    | -    | -     |

**Electrical Characteristics: T<sub>A</sub> = 25°C**

| Parameter                      | Test Conditions  | Symbol               | Min. | Typ. | Max. | Units |
|--------------------------------|--|----------------------|------|------|------|-------|
| <b>DC Characteristics</b>      |  |                      |      |      |      |       |
| Drain-Source Leakage Current   | V <sub>GS</sub> = -8 V, V <sub>DS</sub> = 175 V                  | I <sub>DS</sub>      | -    | 0.2  | 6    | mA    |
| Gate Threshold Voltage         | V <sub>DS</sub> = 5 V, I <sub>D</sub> = 15 mA                    | V <sub>GS (TH)</sub> | -5   | -3.8 | -2   | V     |
| Forward Transconductance       | V <sub>DS</sub> = 5 V, I <sub>D</sub> = 3.5 mA                   | G <sub>M</sub>       | 2.5  | 3.6  | -    | S     |
| <b>Dynamic Characteristics</b> |  |                      |      |      |      |       |
| Input Capacitance              | Not applicable - Input matched                                   | C <sub>ISS</sub>     | N/A  | N/A  | N/A  | pF    |
| Output Capacitance             | V <sub>DS</sub> = 50 V, V <sub>GS</sub> = -8 V,<br>Freq. = 1 MHz | C <sub>OSS</sub>     | -    | 11   | -    | pF    |
| Reverse Transfer Capacitance   |  | C <sub>RSS</sub>     | -    | 1.1  | -    | pF    |

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**Absolute Maximum Ratings<sup>1,2,3</sup>**

| Parameter                                   | Limit                     |
|---|---------------------------|
| Drain Voltage ( $V_{DD}$ )                  | +65 V                     |
| Gate Voltage ( $V_{GG}$ )                   | -8 to -2 V                |
| Drain Current ( $I_{DD}$ )                  | 6.0 A                     |
| Input Power <sup>4</sup> ( $P_{IN}$ )       | $P_{IN}$ (nominal) + 3 dB |
| Operating Junction Temperature <sup>5</sup> | 250 °C                    |
| Peak Pulsed Power Dissipation at 85 °C      | 175 W                     |
| Operating Temperature Range                 | -40 to +95 °C             |
| Storage Temperature Range                   | -65 to +150 °C            |
| ESD Maximum - Machine Model (MM)            | 50 V                      |
| ESD Maximum - Human Body Model (HBM)        | 250 V                     |

- Exceeding any one or combination of these limits may cause permanent damage to this device.
- MACOM does not recommend sustained operation near these survivability limits.
- For saturated performance it is recommended that the sum of  $(3 * V_{DD} + |V_{GG}|) < 175$  V.
- Input Power Limit is +3 dB over nominal drive required to achieve  $P_{OUT} = 125$  W.
- 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 =  $5.3 \times 10^6$  hours ( $T_J < 200$  °C)
  - MTTF =  $6.8 \times 10^4$  hours ( $T_J < 250$  °C)

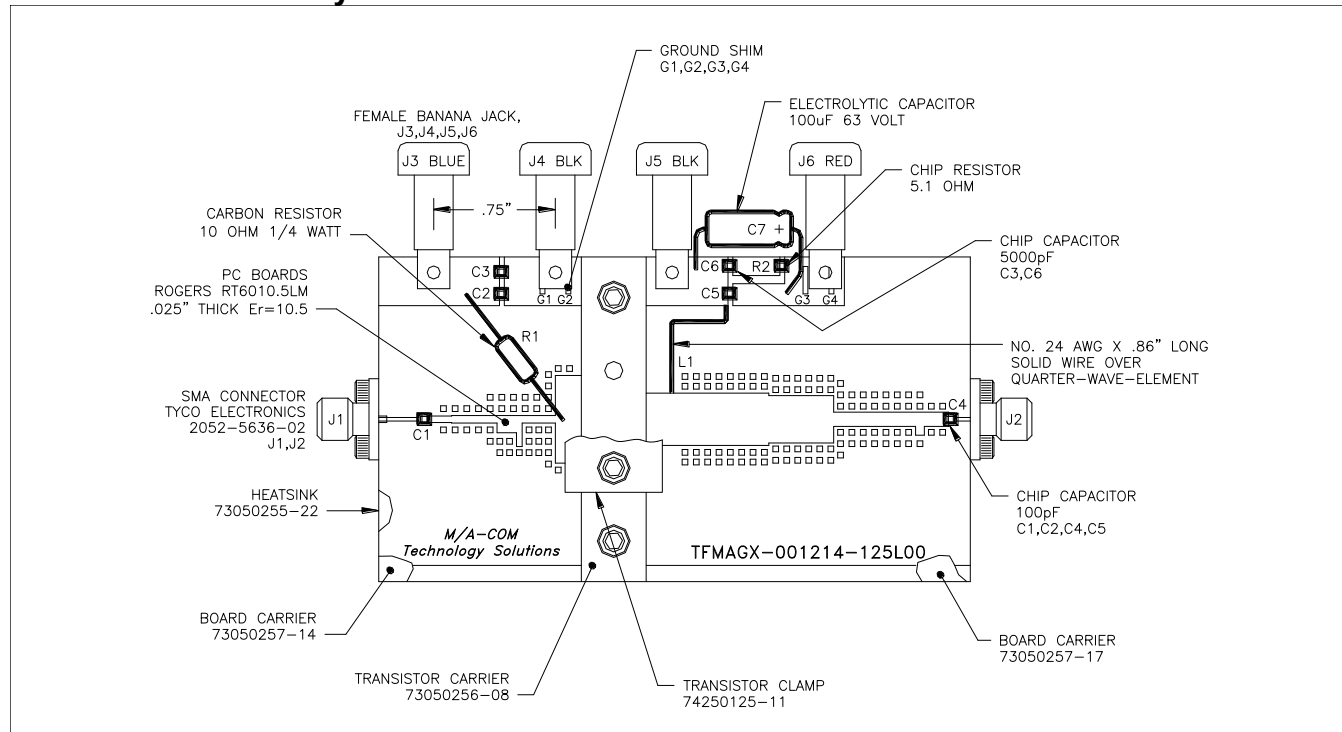
**Thermal Characteristics**

| Parameter          | Test Conditions   | Symbol        | Typical | Units |
|--------------------|---|---------------|---------|-------|
| Thermal Resistance | $T_C = 70$ °C, $V_{DD} = 50$ V, $I_{DQ} = 100$ mA, $P_{OUT} = 125$ W,<br>Pulse Width = 300 µs, Duty Cycle = 10% | $\Theta_{JC}$ | 1.0     | °C/W  |

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### Test Fixture Assembly



Contact MACOM for additional circuit information.

### Test Fixture Impedances

| Freq. (MHz) | $Z_{IF}$ ( $\Omega$ ) | $Z_{OF}$ ( $\Omega$ ) |
|-------------|-----------------------|-----------------------|
| 1200        | 6.6 - j7.1            | 8.0 + j1.9            |
| 1250        | 6.6 - j6.9            | 7.4 + j1.3            |
| 1300        | 6.6 - j6.7            | 6.6 + j1.3            |
| 1350        | 6.7 - j6.7            | 6.1 + j1.6            |
| 1400        | 6.7 - j6.7            | 5.7 + j2.2            |

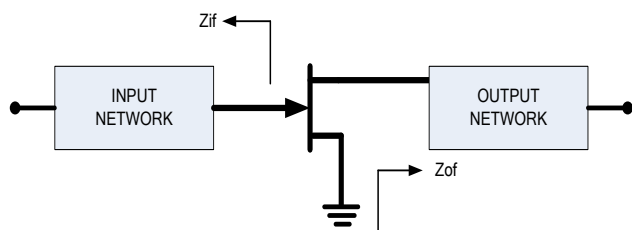
### Correct Device Sequencing

#### 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

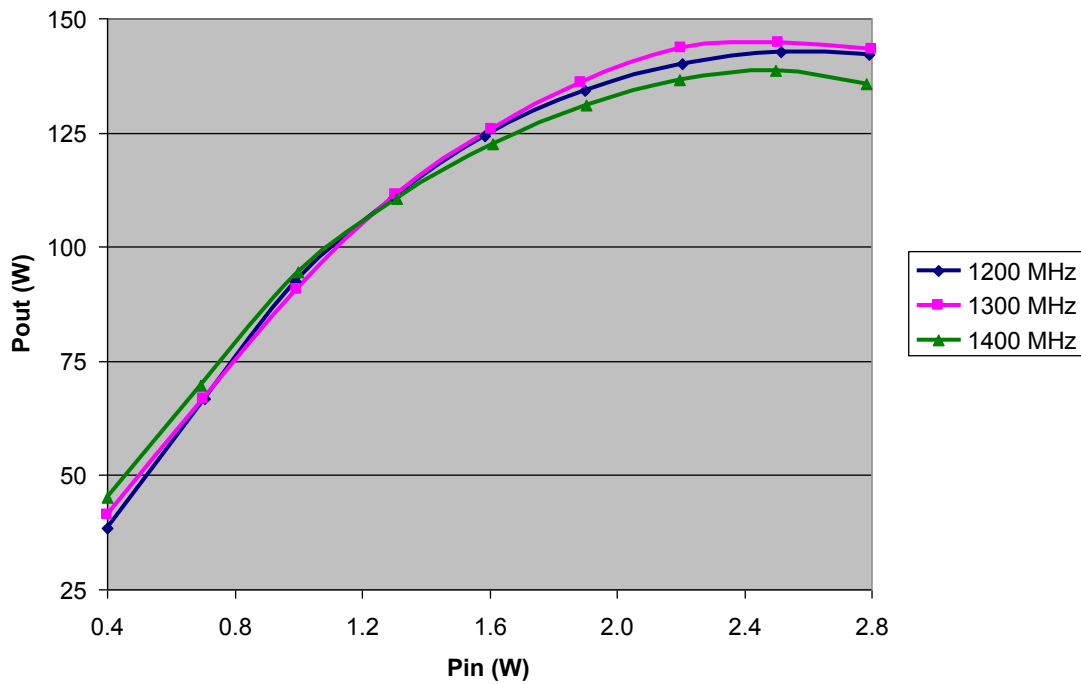
1. Turn the RF power off.
2. Decrease  $V_{GS}$  down to  $V_P$ .
3. Decrease  $V_{DS}$  down to 0 V.
4. Turn off  $V_{GS}$



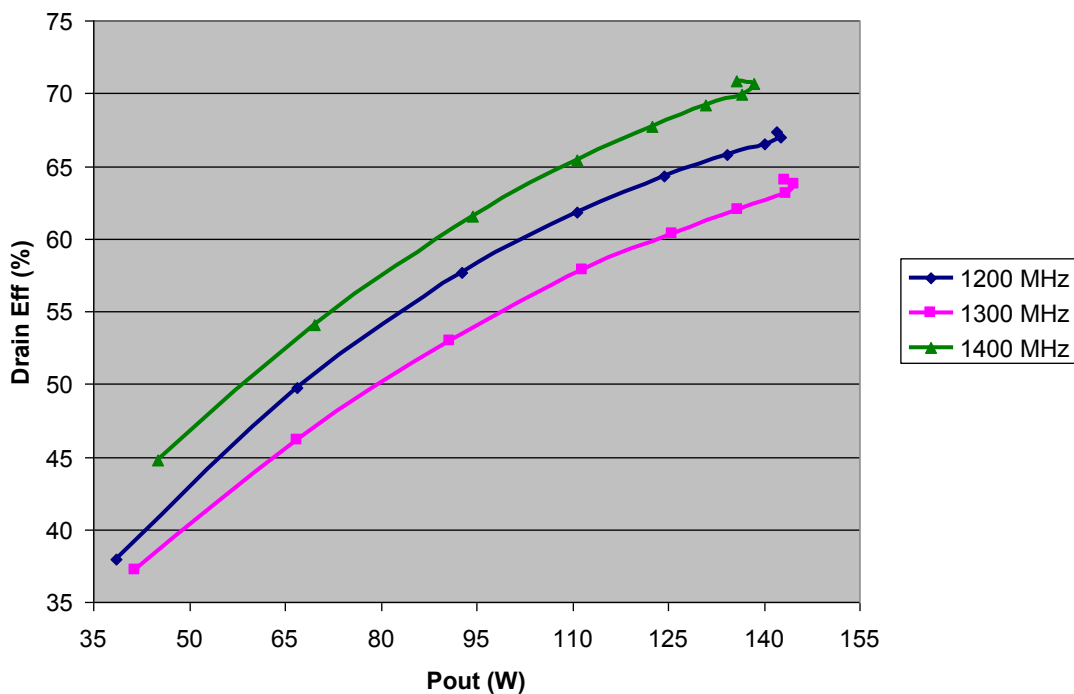
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**RF Power Transfer Curve (Output Power Vs. Input Power)**



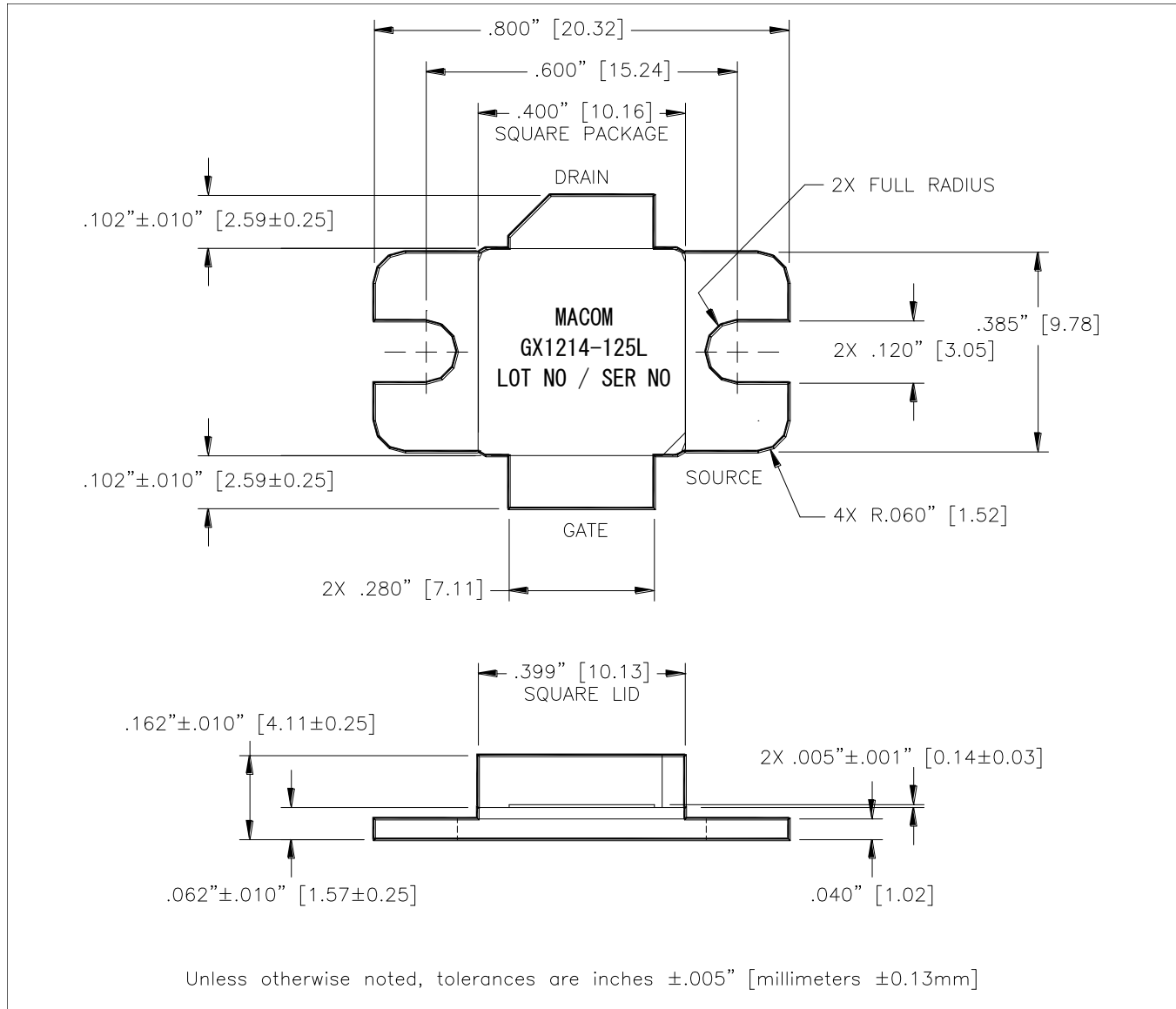
**RF Power Transfer Curve (Drain Efficiency Vs. Output Power)**



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**Outline Drawing†**



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

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