

Features

- GaN on SiC D-Mode Transistor Technology
- Internally Matched
- Common-Source Configuration
- Broadband Class AB Operation
- RoHS* Compliant
- +50 V Typical Operation
- MTTF = 600 years ($T_J < 200^\circ\text{C}$)

Applications

- L-Band pulsed radar

Description

The MAGX-001214-500L00 is a gold-metalized matched Gallium Nitride (GaN) on Silicon Carbide (SiC) 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, and ruggedness over a wide bandwidth for today's demanding application needs. High breakdown voltages allow for reliable and stable operation under more extreme mismatch load conditions compared with older semiconductor technologies.

MAGX-001214-500L00



MAGX-001214-500L0S



Ordering Information

| Part Number | Description |
|--------------------|--------------------------------|
| MAGX-001214-500L00 | Flanged |
| MAGX-001214-500L0S | Flangeless |
| MAGX-001214-SB3PPR | 1.2 - 1.4 GHz Evaluation Board |

Typical RF Performance under standard operating conditions, $P_{OUT} = 500$ W (Peak)

| Freq. (MHz) | P_{IN} (W) | Gain (dB) | I_D (A) | Eff. (%) | RL (dB) | Droop (dB) | +1 dB OD (W) |
|-------------|--------------|-----------|-----------|----------|---------|------------|--------------|
| 1200 | 5.15 | 19.86 | 17.7 | 56.2 | -12.7 | 0.29 | 568 |
| 1250 | 5.35 | 19.69 | 16.7 | 59.5 | -10.3 | 0.30 | 561 |
| 1300 | 5.69 | 19.43 | 17.2 | 57.9 | -10.9 | 0.33 | 554 |
| 1350 | 5.86 | 19.31 | 17.9 | 55.7 | -15.3 | 0.36 | 547 |
| 1400 | 5.85 | 19.22 | 18.1 | 54.8 | -17.5 | 0.38 | 549 |

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

GaN on SiC HEMT Pulsed Power Transistor
500 W Peak, 1200-1400 MHz, 300 μ s Pulse, 10% Duty

Rev. V3

Electrical Specifications: Freq. = 1200 - 1400 MHz, $T_A = 25^\circ\text{C}$

| Parameter | Test Conditions | Symbol | Min. | Typ. | Max. | Units |
|---------------------------------|--|-----------------|------|------|------|-------|
| RF Functional Tests | | | | | | |
| Peak Input Power | V _{DD} = 50 V, I _{DQ} = 400 mA Pulse Width = 300 μs, Duty Cycle = 10% P _{OUT} = 500 W Peak (50 W avg.) | P _{IN} | - | 6 | 8.9 | W |
| Power Gain | | G _P | 17.5 | 19.2 | - | dB |
| Drain Efficiency | | η _D | 50 | 56 | - | % |
| Pulse Droop | | Droop | - | 0.4 | 0.7 | dB |
| Load Mismatch Stability | | VSWR-S | - | 3:1 | - | - |
| Load Mismatch Tolerance | | VSWR-T | - | 5:1 | - | - |
| Extended Pulse Width Conditions | | | | | | |
| Peak Input Power | V _{DD} = 42 V, I _{DQ} = 400 mA Pulse Width = 1 ms, Duty Cycle = 10% P _{OUT} = 375 W Peak (37.5 W avg.) | P _{IN} | - | 5.3 | - | W |
| Power Gain | | G _P | - | 18.5 | - | dB |
| Drain Efficiency | | η _D | - | 55 | - | % |

Electrical Characteristics: $T_A = 25^\circ\text{C}$

| Parameter | Test Conditions | Symbol | Min. | Typ. | Max. | Units |
|--------------------------------|--|--------------|------|------|------|-------|
| DC Characteristics | | | | | | |
| Drain-Source Leakage Current | $V_{GS} = -8\text{ V}$, $V_{DS} = 175\text{ V}$ | I_{DS} | - | 1.0 | 30 | mA |
| Gate Threshold Voltage | $V_{DS} = 5\text{ V}$, $I_D = 75\text{ mA}$ | $V_{GS(TH)}$ | -5 | -3.1 | -2 | V |
| Forward Transconductance | $V_{DS} = 5\text{ V}$, $I_D = 17.5\text{ mA}$ | G_M | 12.5 | 19.2 | - | S |
| Dynamic Characteristics | | | | | | |
| Input Capacitance | Not applicable - Input matched | C_{ISS} | N/A | N/A | N/A | pF |
| Output Capacitance | $V_{DS} = 50\text{ V}$, $V_{GS} = -8\text{ V}$, Freq. = 1 MHz | C_{OSS} | - | 55 | - | pF |
| Reverse Transfer Capacitance | | C_{RSS} | - | 5.5 | - | pF |

GaN on SiC HEMT Pulsed Power Transistor
500 W Peak, 1200-1400 MHz, 300 μ s Pulse, 10% Duty

Rev. V3

Absolute Maximum Ratings^{1,2,3}

| Parameter | Limit |
|---|---------------------------|
| Drain Voltage (V_{DD}) | +65 V |
| Gate Voltage (V_{GG}) | -8 to 0 V |
| Drain Current (I_{DD}) | 21.5 A |
| Input Power ⁴ (P_{IN}) | P_{IN} (nominal) + 3 dB |
| Operating Junction Temperature ⁵ | +250°C |
| Peak Pulsed Power Dissipation at +85°C | 583 W |
| Operating Temperature Range | -40 to +85°C |
| Storage Temperature Range | -65 to +150°C |
| ESD Min. - Charged Device Model (CDM) | 1300 V |
| ESD Min. - Human Body Model (HBM) | 4000 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 $P_{OUT} = 500$ 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 = 5.3×10^6 hours ($T_J < 200$ °C)
- MTTF = 6.8×10^4 hours ($T_J < 250$ °C)

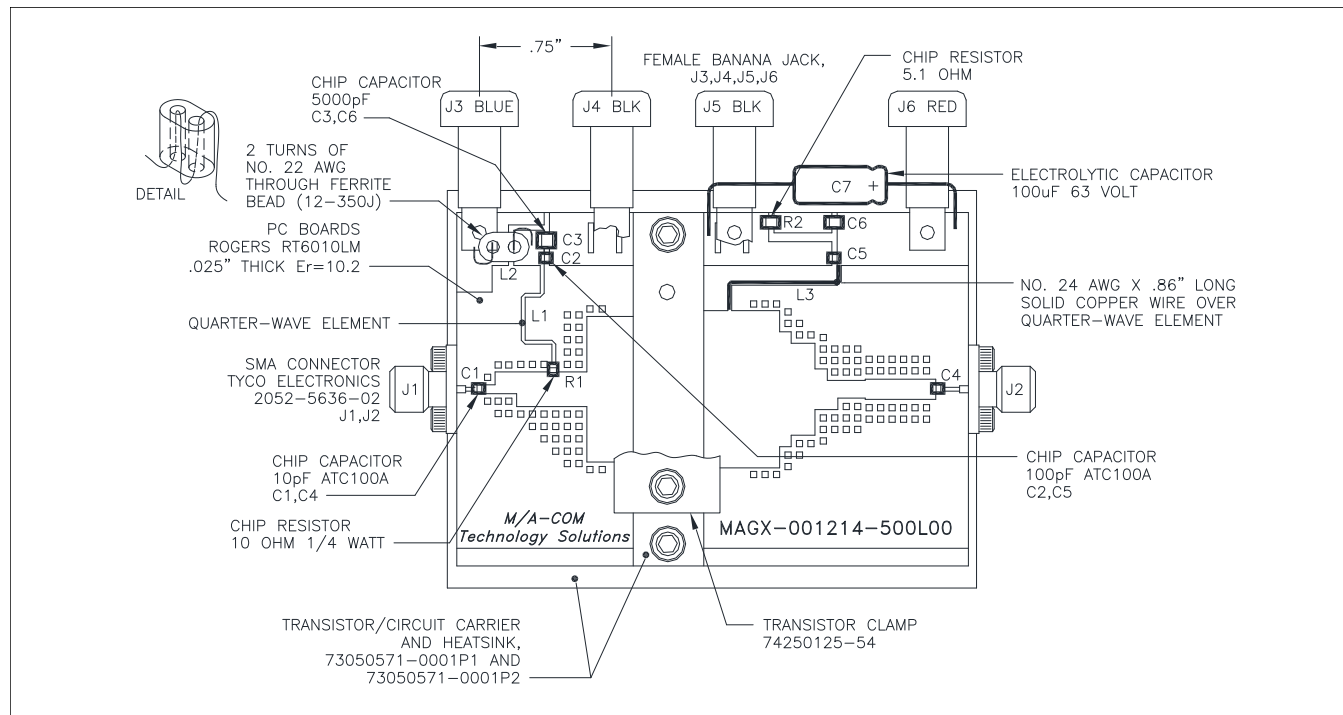
Thermal Characteristics

| Parameter | Test Conditions | Symbol | Typical | Units |
|--------------------|--|---------------|---------|-------|
| Thermal Resistance | $T_C = +70^\circ\text{C}$, $V_{DD} = 50$ V, $I_{DQ} = 400$ mA, $P_{OUT} = 500$ W Pulse Width = 300 μ s, Duty Cycle = 10% | Θ_{JC} | 0.3 | °C/W |

GaN on SiC HEMT Pulsed Power Transistor 500 W Peak, 1200-1400 MHz, 300 μ s Pulse, 10% Duty

Rev. V3

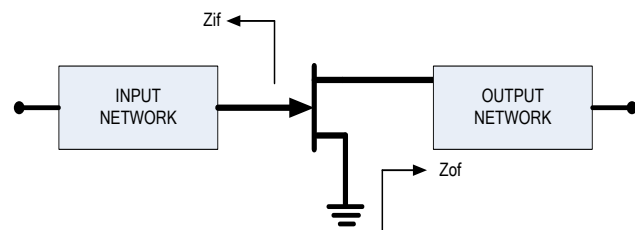
Test Fixture Assembly



Contact factory for gerber file or additional circuit information.

Test Fixture Impedances

| F (MHz) | Z_{IF} (Ω) | Z_{OF} (Ω) |
|---------|-----------------------|-----------------------|
| 1200 | $1.2 - j1.2$ | $1.8 + j0.5$ |
| 1250 | $1.2 - j0.9$ | $1.9 + j0.4$ |
| 1300 | $1.3 - j0.6$ | $2.0 + j0.3$ |
| 1350 | $1.4 - j0.3$ | $1.9 + j0.2$ |
| 1400 | $1.6 + j0.0$ | $1.7 + j0.1$ |



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.

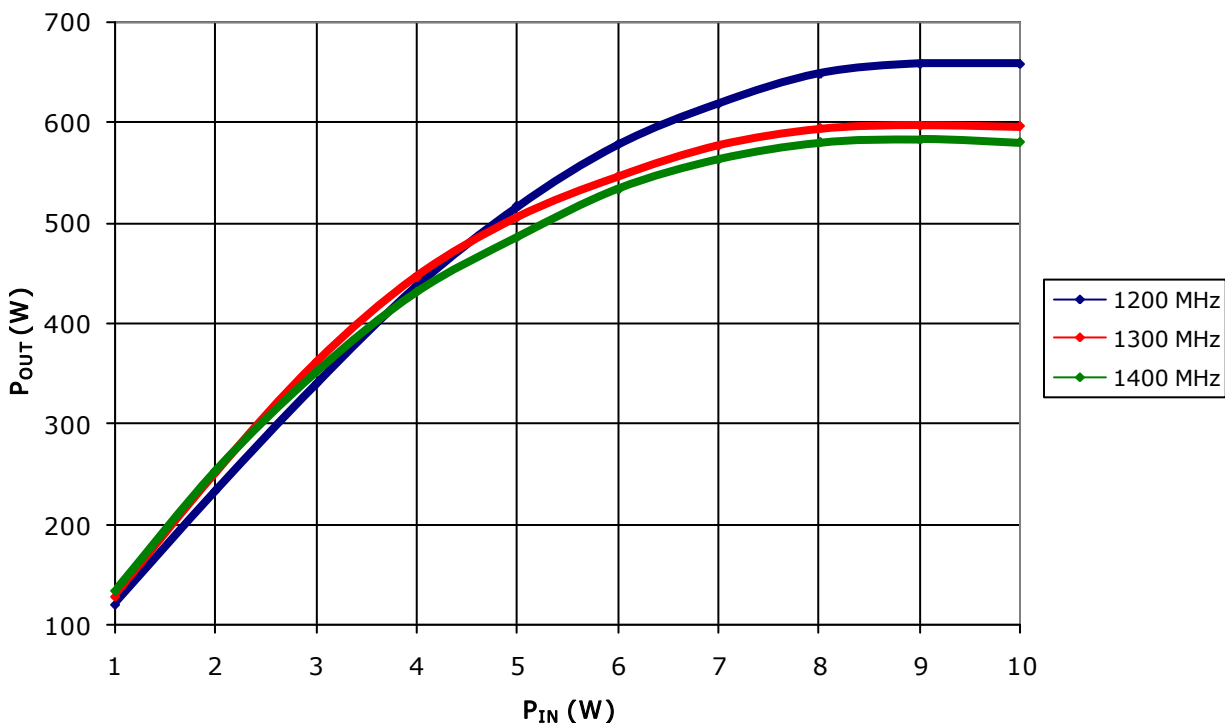
Turning the device OFF

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}

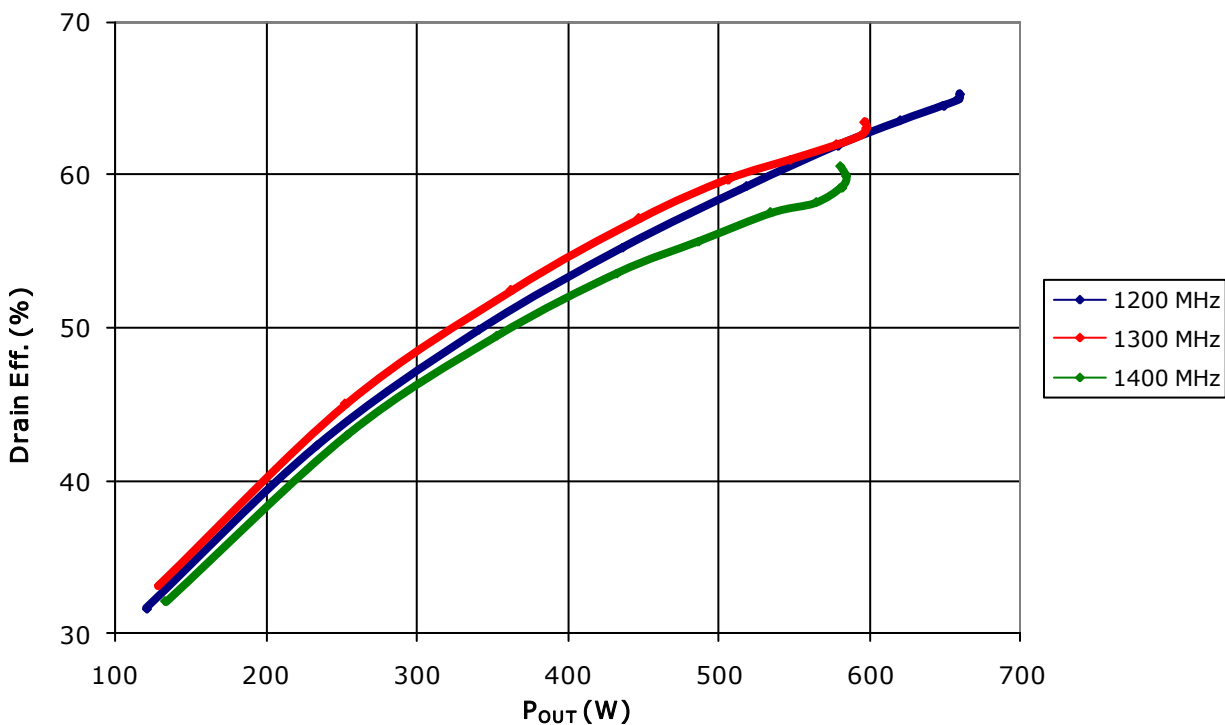
GaN on SiC HEMT Pulsed Power Transistor
500 W Peak, 1200-1400 MHz, 300 μ s Pulse, 10% Duty

Rev. V3

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



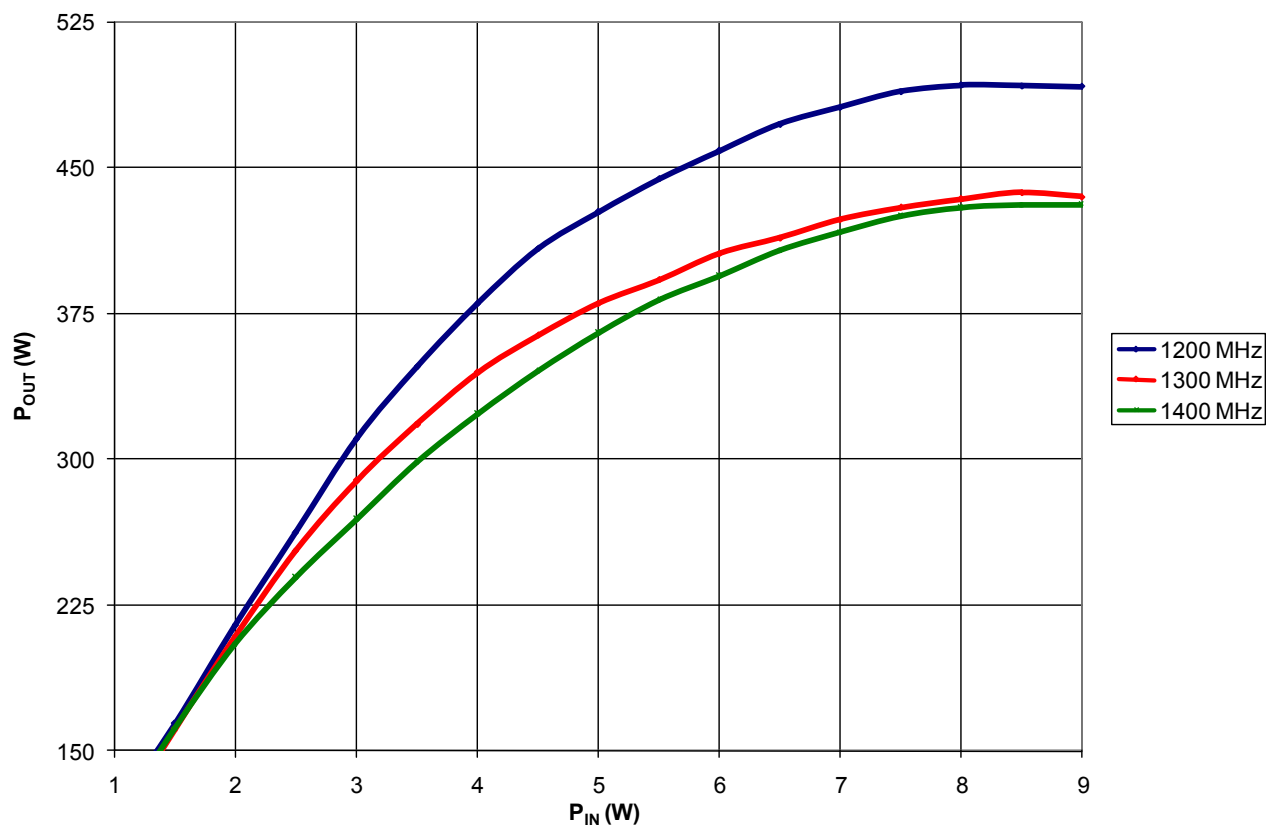
RF Power Transfer Curve (Drain Efficiency Vs. Output Power)



GaN on SiC HEMT Pulsed Power Transistor
500 W Peak, 1200-1400 MHz, 300 μ s Pulse, 10% Duty

Rev. V3

Typical RF Data with 'extended pulse' conditions⁶:
1.0 ms Pulse, 10% Duty, $V_{DD} = 42$ V, $I_{DQ} = 400$ mA

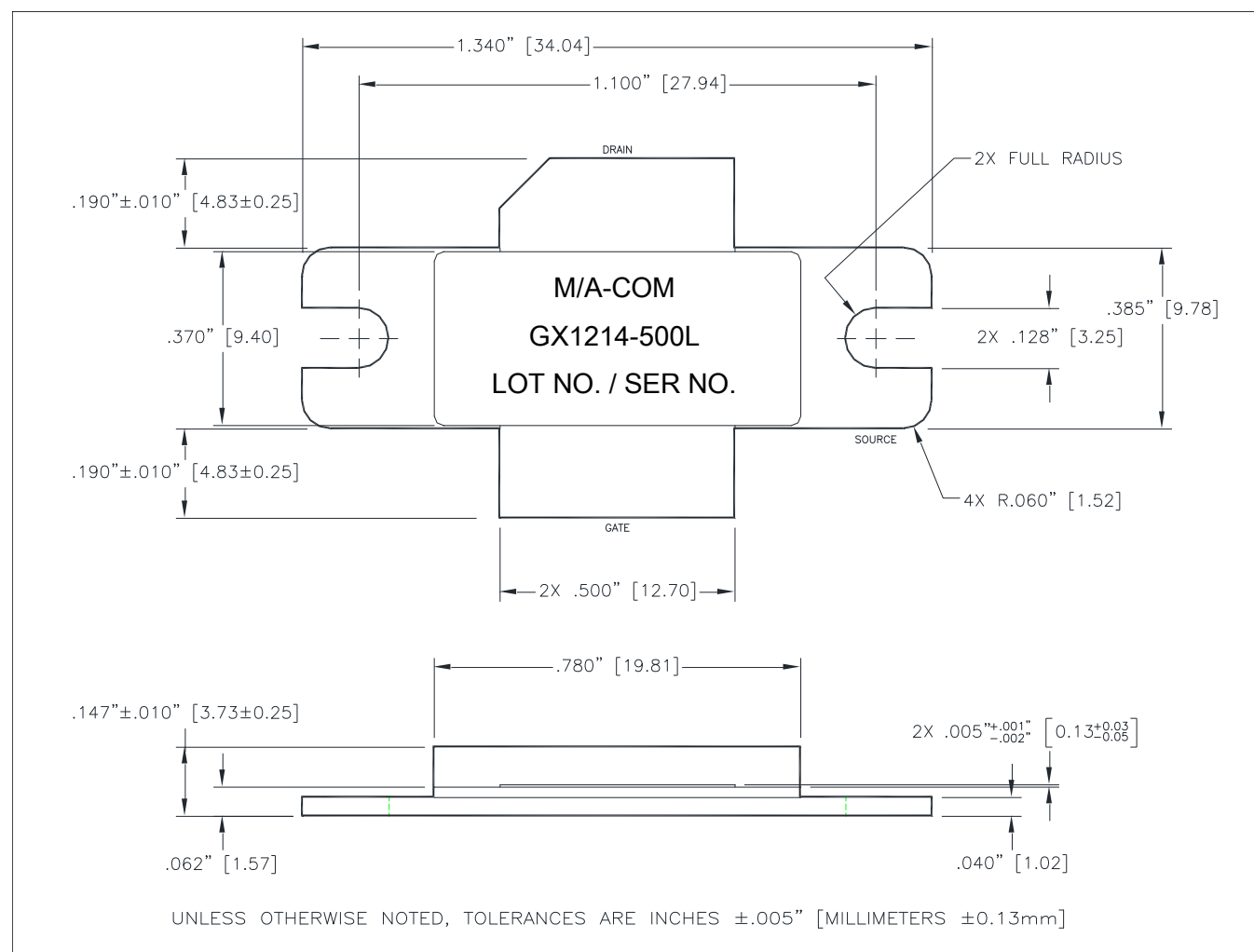


6. Drain Voltage and RF output power is de-rated to keep junction temperature within acceptable levels.

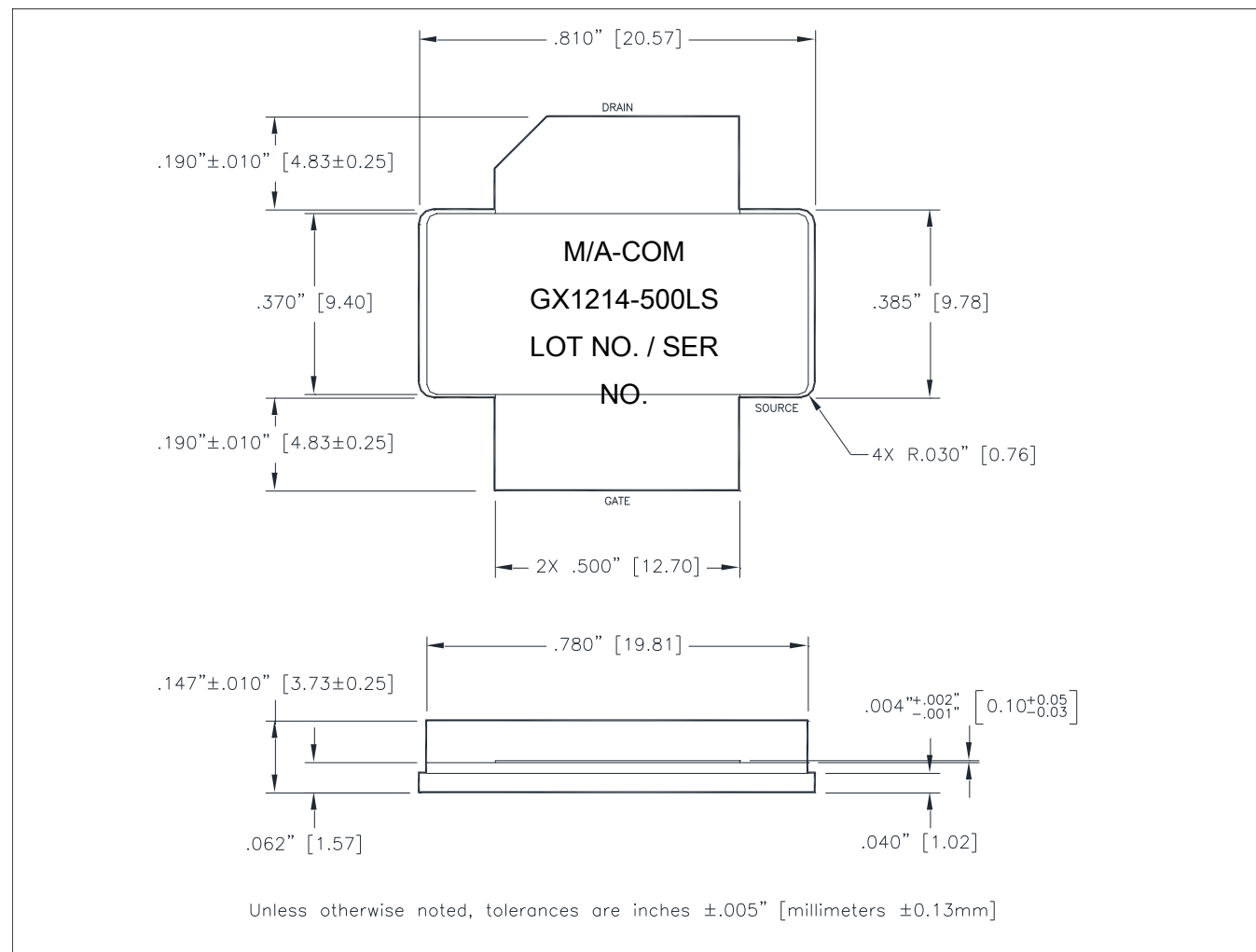
GaN on SiC HEMT Pulsed Power Transistor
500 W Peak, 1200-1400 MHz, 300 μ s Pulse, 10% Duty

Rev. V3

Outline Drawing MAGX-001214-500L00



Outline Drawing MAGX-001214-500L0S



M/A-COM Technology Solutions Inc. All rights reserved.

Information in this document is provided in connection with M/A-COM Technology Solutions Inc ("MACOM") products. These materials are provided by MACOM as a service to its customers and may be used for informational purposes only. Except as provided in MACOM's Terms and Conditions of Sale for such products or in any separate agreement related to this document, MACOM assumes no liability whatsoever. MACOM assumes no responsibility for errors or omissions in these materials. MACOM may make changes to specifications and product descriptions at any time, without notice. MACOM makes no commitment to update the information and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to its specifications and product descriptions. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document.

THESE MATERIALS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, CONSEQUENTIAL OR INCIDENTAL DAMAGES, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT. MACOM FURTHER DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. MACOM SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS, WHICH MAY RESULT FROM THE USE OF THESE MATERIALS.

MACOM products are not intended for use in medical, lifesaving or life sustaining applications. MACOM customers using or selling MACOM products for use in such applications do so at their own risk and agree to fully indemnify MACOM for any damages resulting from such improper use or sale.

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

MACOM:

[MAGX-001214-500L0S](#) [MAGX-001214-500L00](#)