

MAGX-001214-500L00

MAGX-001214-500L0S

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

Rev. V2

Features

- GaN on SiC D-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 ($T_J < 200^\circ\text{C}$)

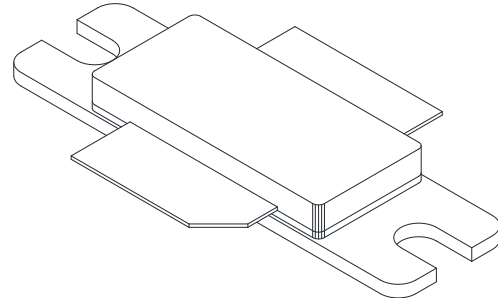
Applications

- L-Band pulsed radar

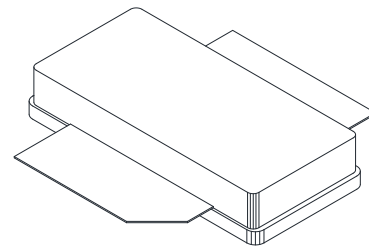
Description

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 |

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

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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) | +1dB 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 |

Electrical Specifications: Freq. = 1200 - 1400 MHz, $I_{DQ} = 400$ mA, $T_A = 25^\circ\text{C}$

| Parameter | Test Conditions | Symbol | Min. | Typ. | Max. | Units |
|---|--------------------------------------|----------|------|------|------|-------|
| RF Functional Tests: $V_{DD} = 50$ V; 300 μs / 10% | | | | | | |
| Input Power | $P_{OUT} = 500$ W Peak (50 W avg.) | P_{IN} | - | 6 | 8.9 | Wpk |
| Power Gain | $P_{OUT} = 500$ W Peak (50 W avg.) | G_P | 17.5 | 19.2 | - | dB |
| Drain Efficiency | $P_{OUT} = 500$ W Peak (50 W avg.) | η_D | 50 | 56 | - | % |
| Pulse Droop | $P_{OUT} = 500$ W Peak (50 W avg.) | Droop | - | 0.4 | 0.7 | dB |
| Load Mismatch Stability | $P_{OUT} = 500$ W Peak (50 W avg.) | VSWR-S | - | 3:1 | - | - |
| Load Mismatch Tolerance | $P_{OUT} = 500$ W Peak (50 W avg.) | VSWR-T | - | 5:1 | - | - |
| Extended Pulse Width Conditions: $V_{DD} = 42$ V; 1.0 ms / 10%; (typical RF data) | | | | | | |
| Input Power | $P_{OUT} = 375$ W Peak (37.5 W avg.) | P_{IN} | - | 5.3 | - | Wpk |
| Power Gain | $P_{OUT} = 375$ W Peak (37.5 W avg.) | G_P | - | 18.5 | - | dB |
| Drain Efficiency | $P_{OUT} = 375$ W Peak (37.5 W avg.) | 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 | $V_{GS} = -8$ V, $V_{DS} = 175$ V | I_{DS} | - | 1.0 | 30 | mA |
| Gate Threshold Voltage | $V_{DS} = 5$ V, $I_D = 75$ mA | $V_{GS(TH)}$ | -5 | -3.1 | -2 | V |
| Forward Transconductance | $V_{DS} = 5$ V, $I_D = 17.5$ 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 | $V_{DS} = 50$ V, $V_{GS} = -8$ V, $F = 1$ MHz | C_{OSS} | - | 55 | - | pF |
| Reverse Transfer Capacitance | $V_{DS} = 50$ V, $V_{GS} = -8$ V, $F = 1$ MHz | C_{RSS} | - | 5.5 | - | pF |

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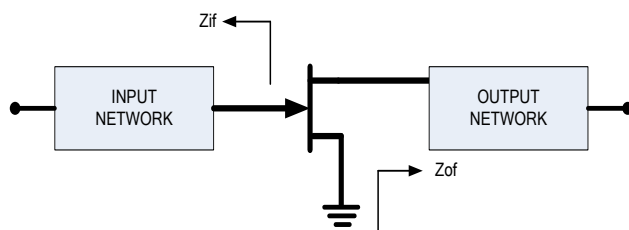
Absolute Maximum Ratings^{1,2,3,4}

| Parameter | Limit |
|---|---------------------------|
| Supply Voltage (V_{DD}) | +65 V |
| Supply Voltage (V_{GS}) | -8 to -2 V |
| Supply Current ($I_{D_{MAX}}$) | 21.5 A |
| Input Power (P_{IN}) | P_{IN} (nominal) + 3 dB |
| Absolute Max. Junction/Channel Temp | 200°C |
| Pulsed Power Dissipation at 85 °C | 583 W |
| Thermal Resistance, ($T_J = 70$ °C) $V_{DD} = 50$ V, $I_{DQ} = 400$ mA, $P_{out} = 500$ W, 300 μ s Pulse / 10% Duty | 0.30 °C/W |
| Operating Temp | -40 to +95°C |
| Storage Temp | -65 to +150°C |
| Mounting Temperature | See solder reflow profile |
| ESD Min. - Charged Device Model (CDM) | 1300 V |
| ESD Min. - Human Body Model (HBM) | 4000 V |

1. Operation of this device above any one of these parameters may cause permanent damage.
2. Input Power Limit is +3 dB over nominal drive required to achieve $P_{OUT} = 500$ W.
3. Channel temperature directly affects a device's MTTF. Channel temperature should be kept as low as possible to maximize lifetime.
4. For saturated performance it recommended that the sum of $(3 \cdot V_{DD} + \text{abs}(V_{GS})) < 175$ V.

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

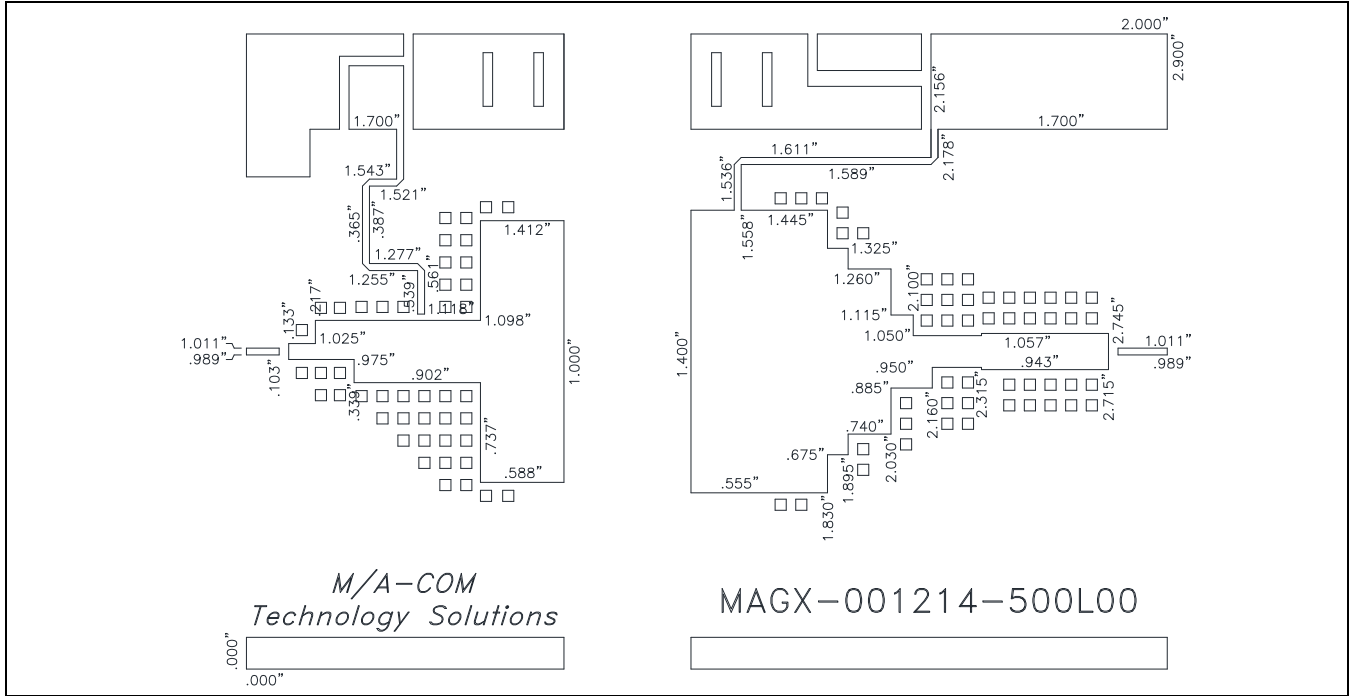
1. Turn the RF power off.
2. Decrease V_{GS} down to V_P .
3. Decrease V_{DS} down to 0 V.
4. Turn off V_{GS}

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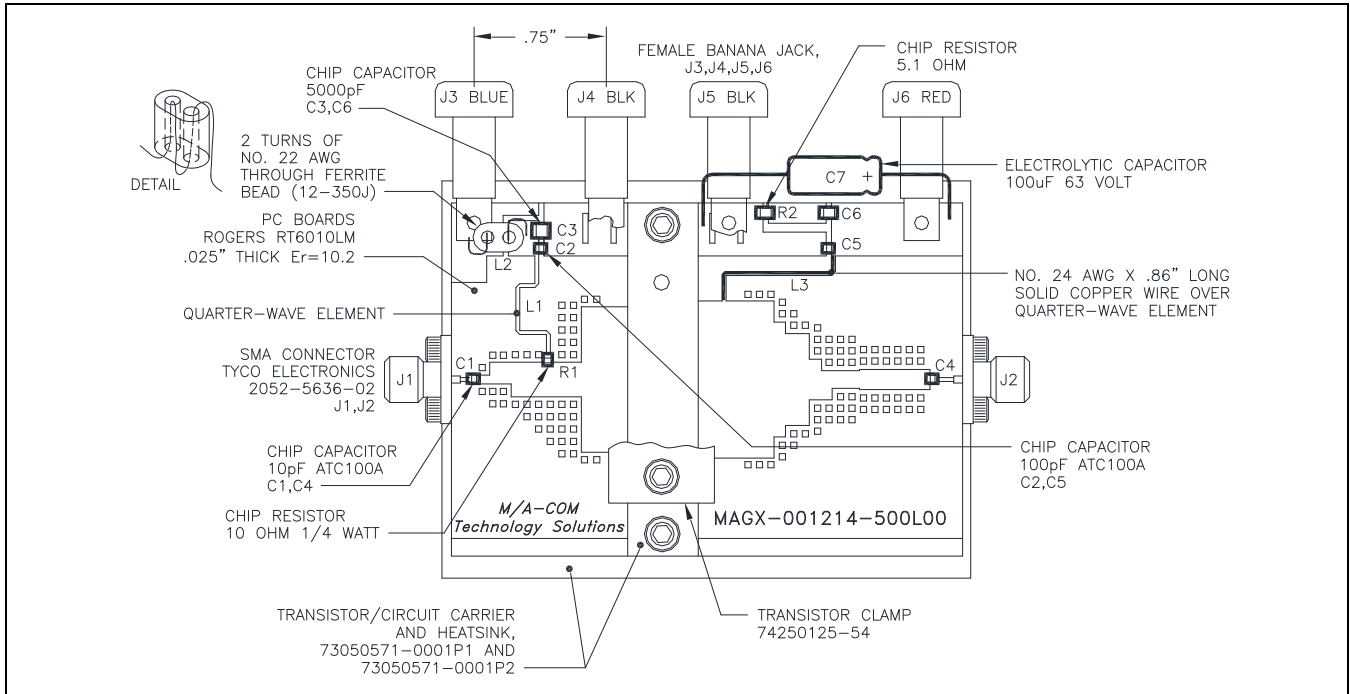
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Test Fixture Circuit Dimensions



Test Fixture Assembly



Contact factory for gerber file or additional circuit information.

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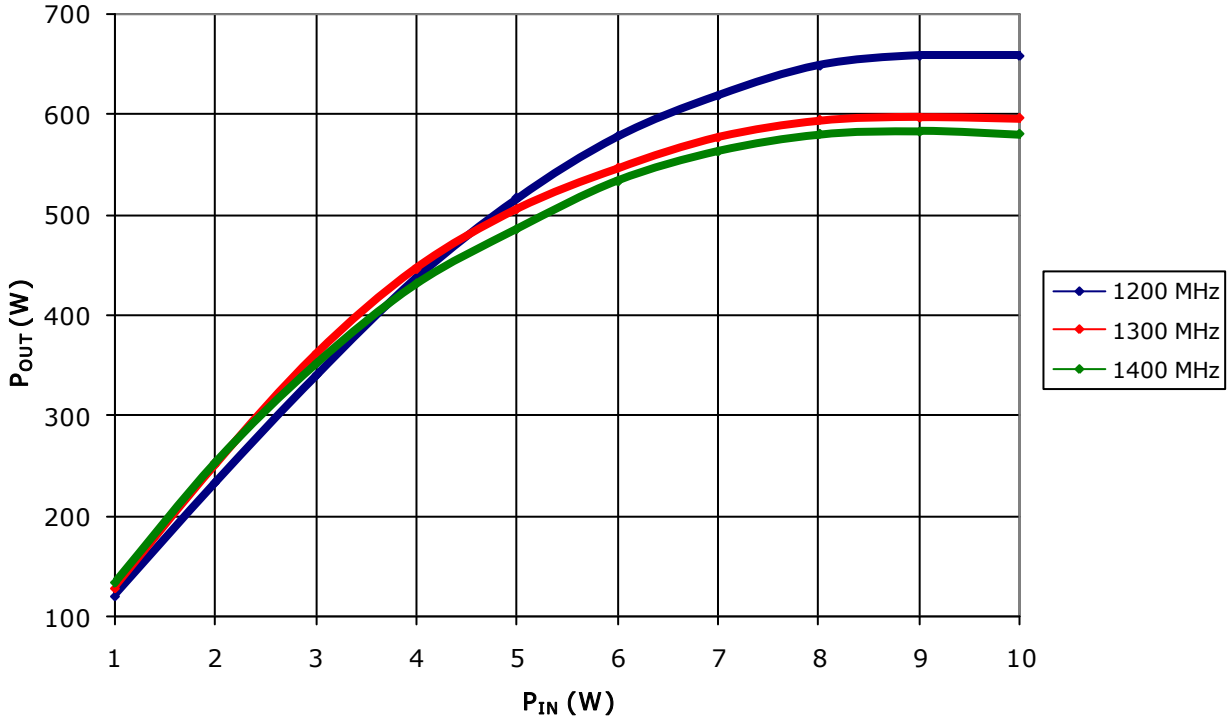
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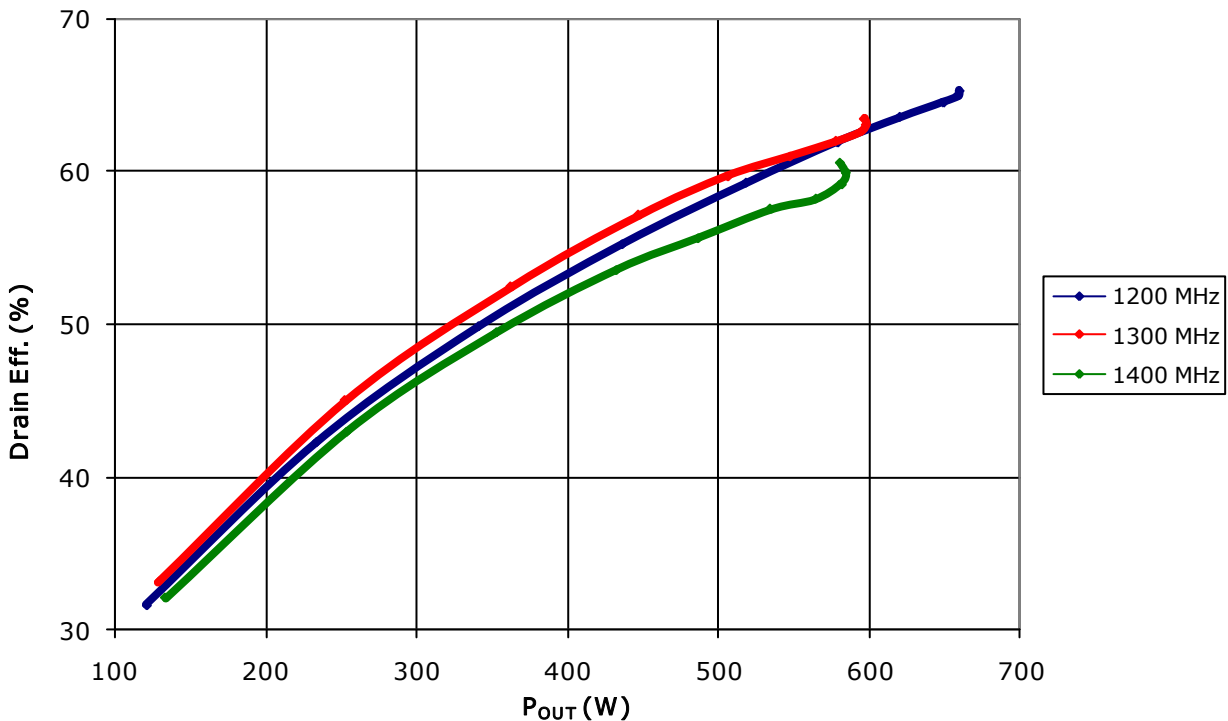
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RF Power Transfer Curve (Output Power Vs. Input Power)



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



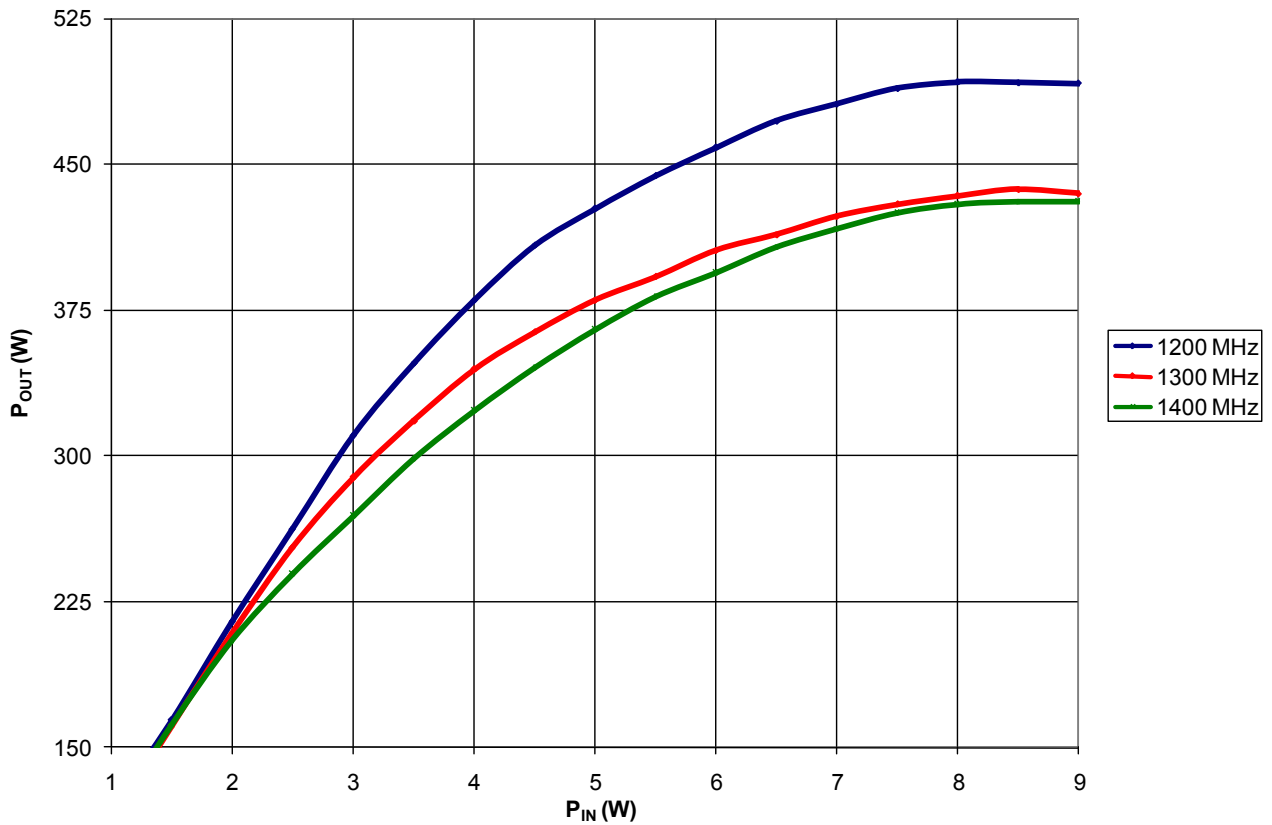
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Typical RF Data with 'extended pulse' conditions⁵:
1.0 ms Pulse, 10% Duty, $V_{DD} = 42$ V, $I_{DQ} = 400$ mA



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

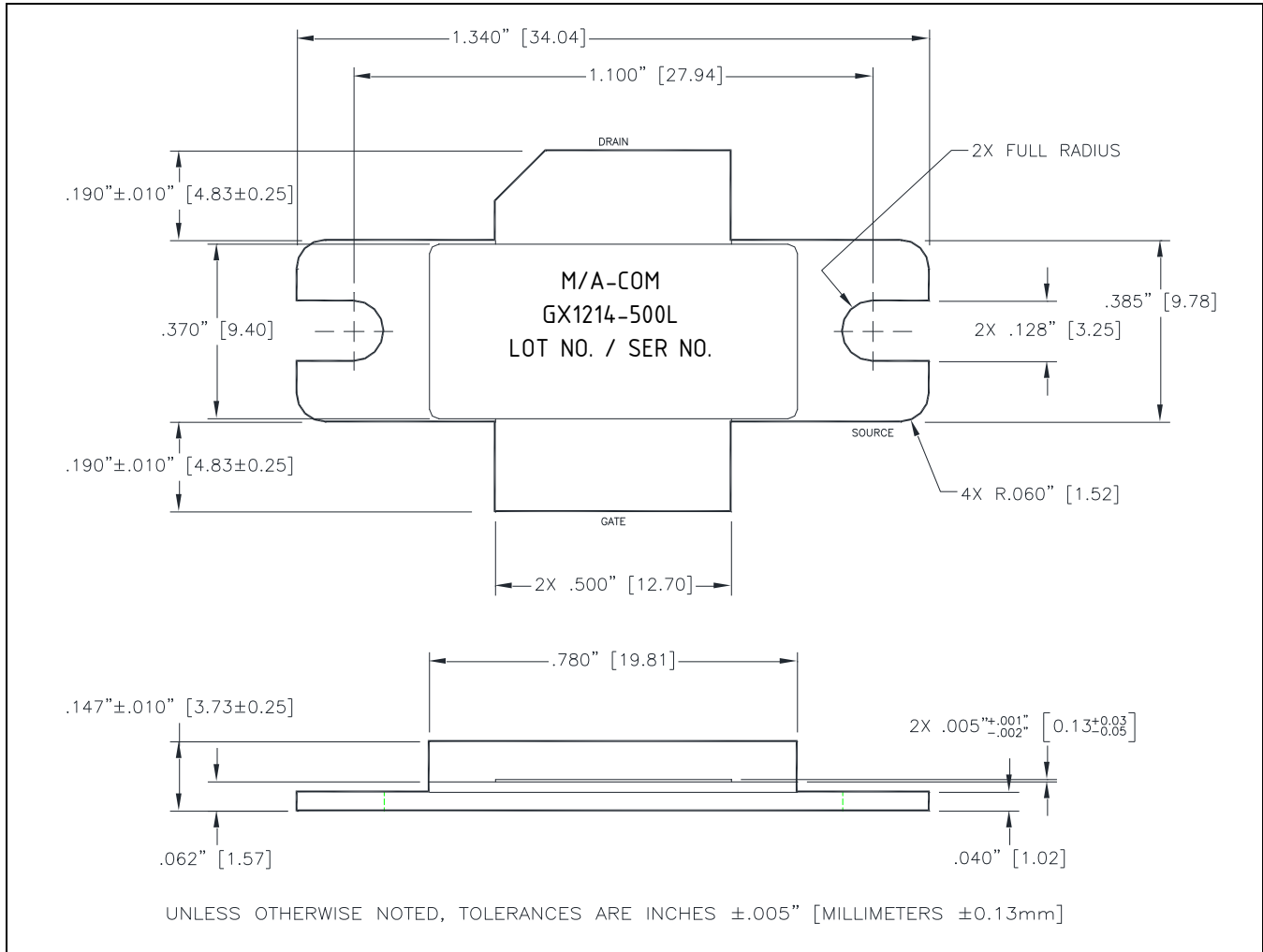
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Outline Drawing MAGX-002114-500L00



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