# MAGX-000035-045000

## GaN on SiC HEMT Pulsed Power Transistor
## 45 W Peak, DC-3500 MHz, 1 ms Pulse, 10% Duty

Rev. V2

### Features

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

### Application

- Civilian and Military Pulsed Radar

### Description

The MAGX-000035-045000 is a gold metalized unmatched Gallium Nitride (GaN) on Silicon Carbide (SiC) RF power transistor optimized for civilian and military radar pulsed applications between DC - 3500 MHz. 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. The MAGX-000035-045000 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.

**MAGX-000035-045000**

### Ordering Information

| Part Number | Description |
|---|---|
| MAGX-000035-045000 | Bulk Packaging |
| MAGX-S10035-045000 | Sample Board (2.7 - 3.5 GHz) |

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

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## Electrical Specifications[1]: Freq. = 2700-3500 MHz, $T_A$ = 25°C

| Parameter | Test Conditions | Symbol | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| **RF Functional Tests: $V_{DD}$ = 50 V, $I_{DQ}$ = 100 mA, 1 ms Pulse, 10% Duty** | | | | | | |
| Output Power | $P_{IN}$= 4 W | $P_{OUT}$ | 45 | 54 | - | W |
| Power Gain | $P_{IN}$= 4 W | $G_P$ | 10.5 | 11.3 | - | dB |
| Drain Efficiency | $P_{IN}$= 4 W | $\eta_D$ | 48 | 55 | - | % |
| Input Return Loss | $P_{IN}$= 4 W | IRL | - | -8 | - | dB |
| Load Mismatch Stability | $P_{IN}$= 4 W | VSWR-S | - | 5:1 | - | - |
| Load Mismatch Tolerance | $P_{IN}$= 4 W | VSWR-T | - | 10:1 | - | - |

## Electrical Specifications[1]: Freq. = 1030-1090 MHz, $T_A$ = 25°C

| Parameter | Test Conditions | Symbol | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| **RF Functional Tests: $V_{DD}$ = 50 V, $I_{DQ}$ = 100 mA, 1 ms Pulse, 10% Duty** | | | | | | |
| Output Power | $P_{IN}$= 0.9 W | $P_{OUT}$ | - | 60 | - | W |
| Power Gain | $P_{IN}$= 0.9 W | $G_P$ | - | 18 | - | dB |
| Drain Efficiency | $P_{IN}$= 0.9 W | $\eta_D$ | - | 64 | - | % |
| Input Return Loss | $P_{IN}$= 0.9 W | IRL | - | -8 | - | dB |
| Load Mismatch Stability | $P_{IN}$= 0.9 W | VSWR-S | - | 5:1 | - | - |
| Load Mismatch Tolerance | $P_{IN}$= 0.9 W | 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 | $I_{DS}$ | - | - | 3.0 | mA |
| Gate Threshold Voltage | $V_{DS}$ = 5 V, $I_D$ = 6 mA | $V_{GS\ (TH)}$ | -5 | -3 | -2 | V |
| Forward Transconductance | $V_{DS}$ = 5 V, $I_D$ = 1500 mA | $G_M$ | 1.1 | - | - | S |
| **Dynamic Characteristics** | | | | | | |
| Input Capacitance | $V_{DS}$ = 0 V, $V_{GS}$ = -8 V, F = 1 MHz | $C_{ISS}$ | - | 13.2 | - | pF |
| Output Capacitance | $V_{DS}$ = 50 V, $V_{GS}$ = -8 V, F = 1 MHz | $C_{OSS}$ | - | 5.6 | - | pF |
| Reverse Transfer Capacitance | $V_{DS}$ = 50 V, $V_{GS}$ = -8 V, F = 1 MHz | $C_{RSS}$ | - | 0.5 | - | pF |



1. Electrical Specifications measured in MACOM RF evaluation board.

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

| Parameter | Limit |
|---|---|
| Supply Voltage ($V_{DD}$) (Pulsed) | +65 V |
| Supply Voltage ($V_{Gg}$) | -8 to 0 V |
| Supply Current ($I_{DMAX}$) for pulsed operation at $V_{DD}$ = 50 V | 3 A |
| Input Power ($P_{IN}$) for pulsed operation at $V_{DD}$ = 50 V | $P_{IN}$ (nominal) + 3 dB |
| Absolute Max. Junction/Channel Temperature | 200ºC |
| Power Dissipation at 85 ºC for pulsed operation at $V_{DD}$ = 50 V | 48 W |
| MTTF ($T_J$<200°C) | 600 years |
| Thermal Resistance, ($T_J$= 200 ºC)<br>$V_{DD}$ = 50 V, $I_{DQ}$ = 100 mA, Pulsed 1 ms, 10% Duty Cycle | 2.3 ºC/W |
| Operating Temperature | -40 to +95ºC |
| Storage Temperature | -65 to +150ºC |
| Mounting Temperature | See solder reflow profile |
| ESD Min. - Charged Device Model (CDM) | 200 V |
| ESD Min. - Human Body Model (HBM) | 550 V |

2. Operation of this device above any one of these parameters may cause permanent damage.
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 is recommended that the sum of (3*$V_{DD}$ + abs($V_{GG}$)) <175 V.



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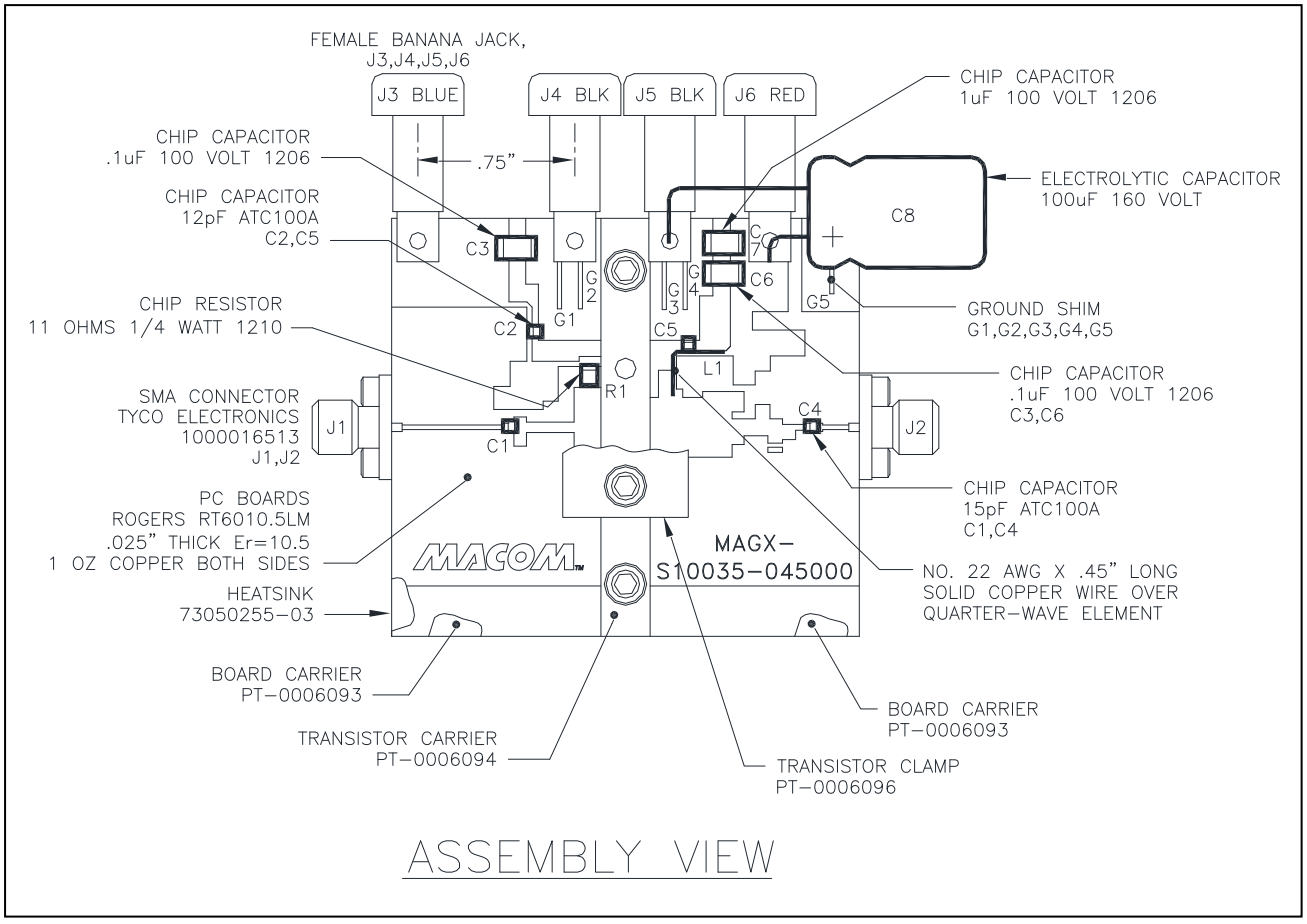
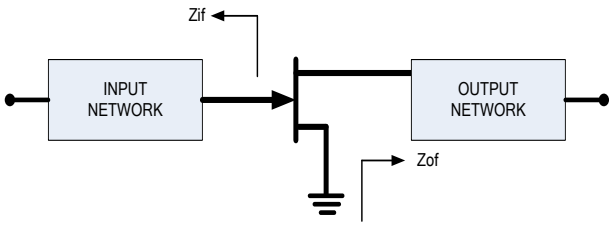
### Test Fixture Assembly (2700-3500 MHz)




### Test Fixture Impedances

| F (MHz) | $Z_{IF}$ (Ω) | $Z_{OF}$ (Ω) |
|---|---|---|
| 2700 | 7.7 - j3.9 | 7.5 + j3.0 |
| 2900 | 8.0 - j5.2 | 7.9 + j1.8 |
| 3100 | 7.2 - j6.8 | 7.5 + j8.3 |
| 3300 | 5.2 - j7.7 | 6.8 + j3.9 |
| 3500 | 3.1 - j7.1 | 6.0 + j7.1 |




### 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 (+50V).
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 $V_{GS}$.

Contact factory for Gerber file or additional circuit information.



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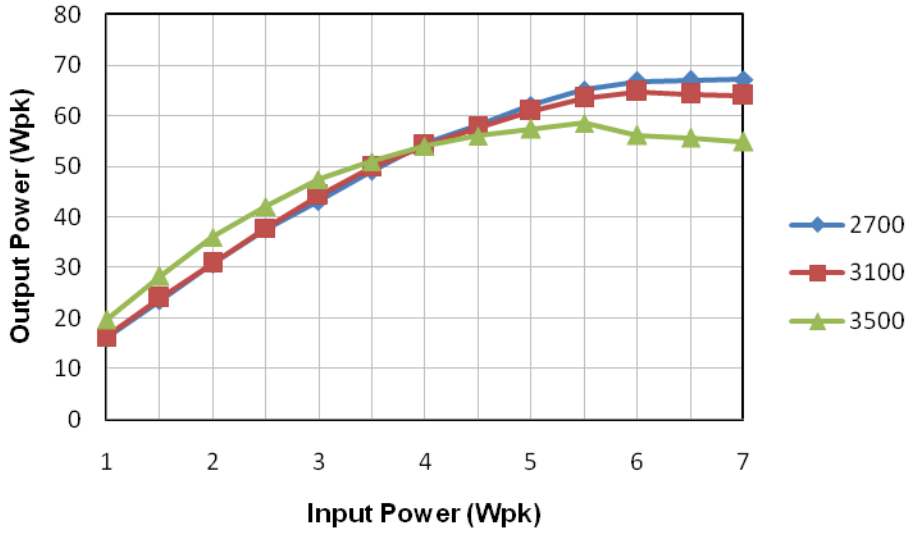
## Application Section

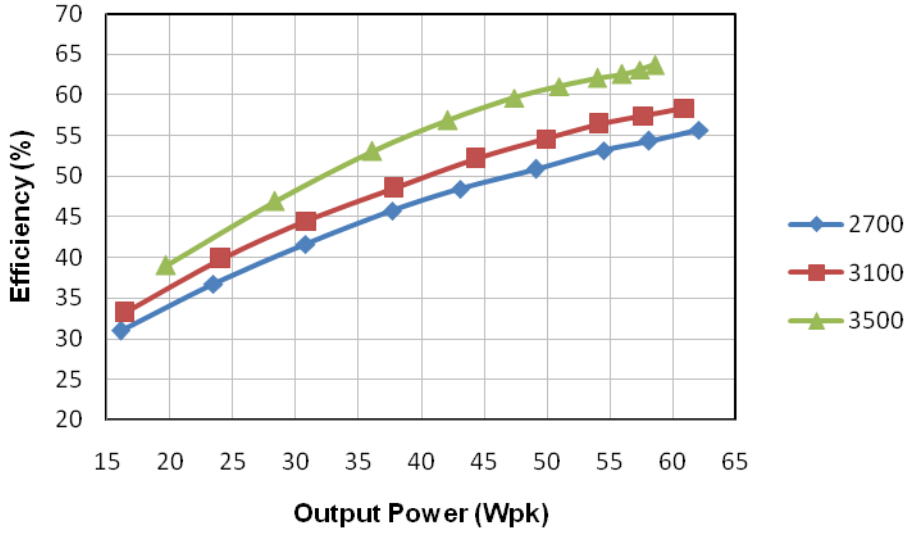
### Typical Performance Curves

**2700 - 3500 MHz, 1 ms Pulse, 10% Duty, $V_{DD}$ = 50 V, Idq = 100 mA, $T_A$ = 25°C**

***Output Power Vs. Input Power***




***Drain Efficiency Vs. Output Power***



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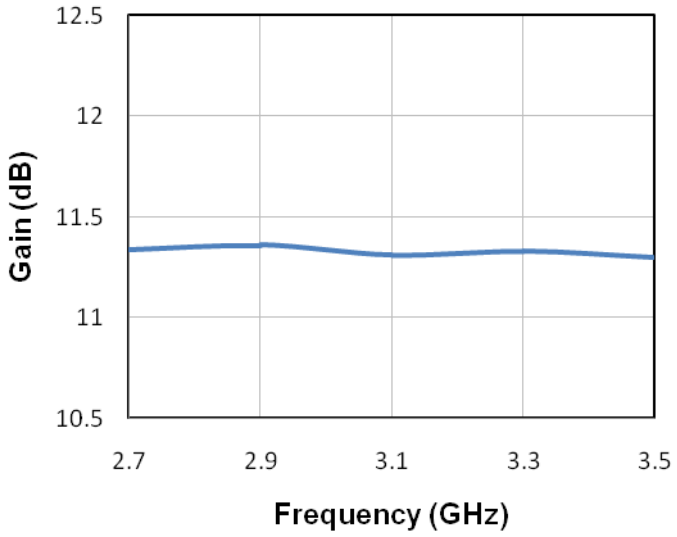
## Application Section

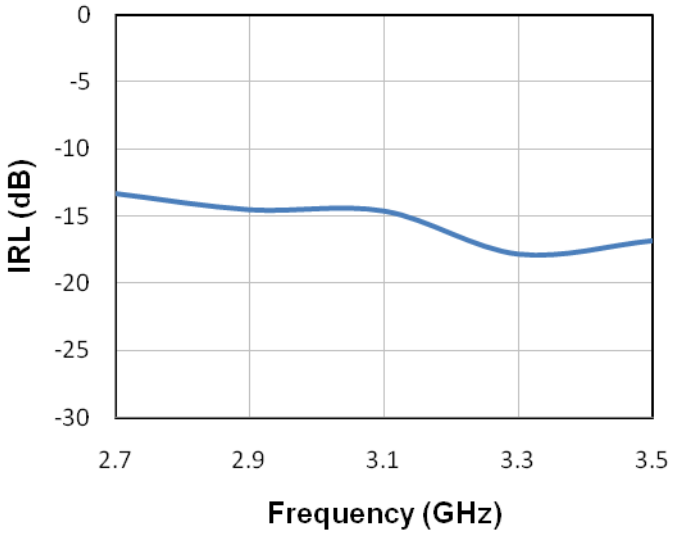
### Typical Performance Curves

**2700 - 3500 MHz, 1 ms Pulse, 10% Duty, $V_{DD}$ = 50 V, Idq = 100 mA, $T_A$ = 25°C**

***Gain vs. Frequency***




***Input Return Loss vs. Frequency***



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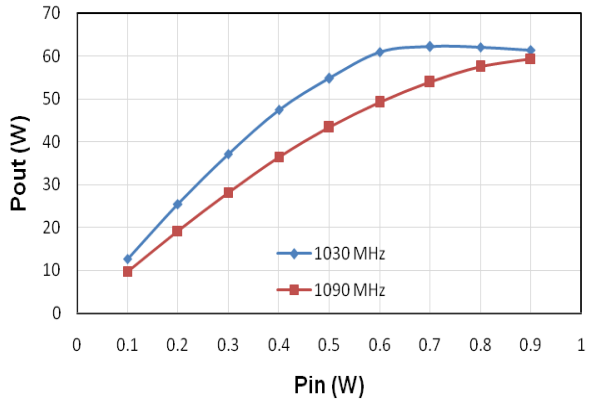
## Application Section

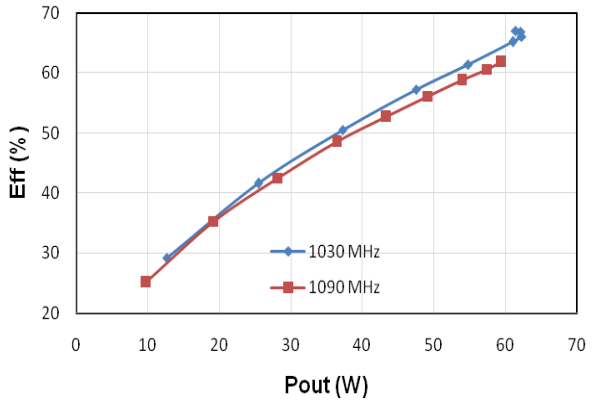
### Typical Performance Curves

**1030 - 1090 MHz, 1 ms Pulse, 10% Duty, $V_{DD}$ = 50 V, Idq = 100 mA, $T_A$ = 25°C**

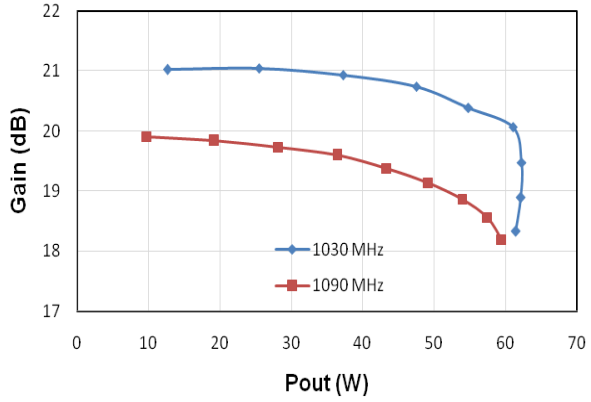
***Output Power vs. Input Power***



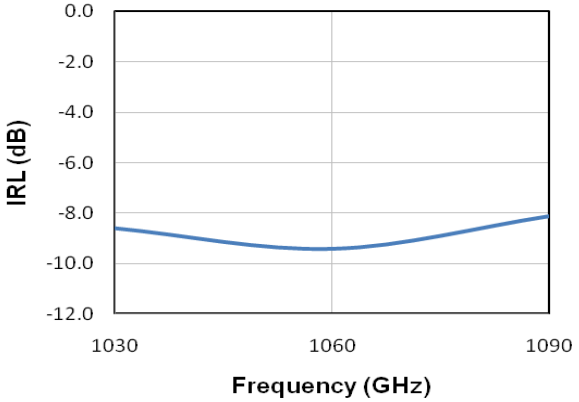

***Drain Efficiency Vs. Output Power***




***Gain vs. Output Power***




***Input Return Loss vs. Frequency***







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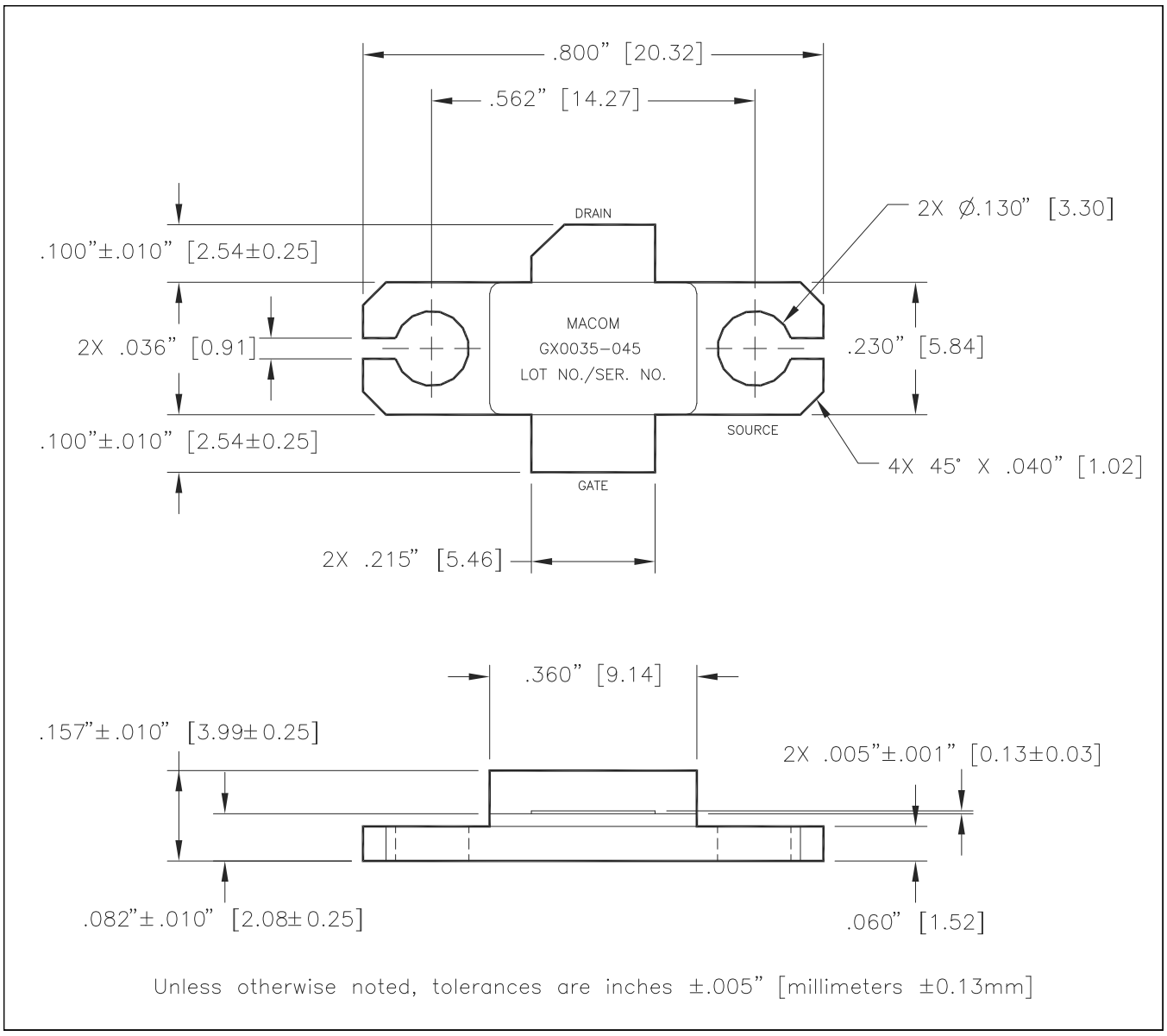
## Outline Drawing MAGX-000035-045000



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