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# MAGX-001090-600L0x



**GaN on SiC HEMT Pulsed Power Transistor**  
**600 W Peak, 1030 to 1090 MHz, 32  $\mu$ s Pulse, 2% Duty**

Rev. V6

## 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-001090-600L00 and MAGX-001090-600L0S are gold metalized matched Gallium Nitride (GaN) on Silicon Carbide (SiC) RF power transistor optimized for pulsed avionics and 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-001090-600L00



## MAGX-001090-600L0S



## Ordering Information<sup>1</sup>

Part Number	Description
MAGX-001090-600L00	Flanged
MAGX-001090-600L0S	Flangeless
MAGX-A11090-600L00	1030 - 1090 MHz Evaluation Board

1. When ordering the evaluation board, please indicate on sales order notes if it will be used for:  
A. Standard Flange devices  
B. Earless Flange devices

## Typical RF Performance under Standard Operating Conditions, $P_{OUT} = 600$ W (Peak)

Freq (MHz)	$P_{IN}$ (W)	Gain (dB)	$I_D$ (A)	Eff. (%)	RL (dB)	Droop (dB)	+1dB OD (W)	VSWR-S (3:1)	VSWR-T (5:1)
1030	4.95	20.8	20.4	58.6	-16.8	0.24	649	S	P
1090	4.50	21.3	18.6	64.4	-11.0	0.23	661	S	P

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

1

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**Electrical Specifications: Freq. = 1030 - 1090 MHz,  $T_A = 25\text{ }^\circ\text{C}$**

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
<b>RF Functional Tests</b>						
Peak Input Power	$V_{DD} = 50\text{ V}$ , $I_{DQ} = 600\text{ mA}$ , Pulse Width = 32 $\mu$ s, Duty Cycle = 2%, $P_{OUT} = 600\text{ W Peak (12 W avg.)}$	$P_{IN}$	-	4.3	6.7	W
Power Gain		$G_P$	19.5	21.4	-	dB
Drain Efficiency		$\eta_D$	55	63	-	%
Pulse Droop		Droop	-	0.2	0.3	dB
Load Mismatch Stability		VSWR-S	-	3:1	-	-
Load Mismatch Tolerance		VSWR-T	-	5:1	-	-
<b>Mode-S ELM Pulse Width Conditions<sup>2</sup></b>						
Peak Input Power	$V_{DD} = 50\text{ V}$ , $I_{DQ} = 400\text{ mA}$ , 48 pulses of 32 $\mu$ s on and 18 $\mu$ s off, repeat every 24 ms, Overall Duty Factor = 6.4%, $P_{OUT} = 550\text{ W Peak (35.2 W avg.)}$	$P_{IN}$	-	4.6	-	W
Power Gain		$G_P$	-	20.7	-	dB
Drain Efficiency		$\eta_D$	-	61	-	%

2. For Mode-S ELM pulse conditions power measurements are obtained as follows:  
 RF input / output power is measured at the middle of the 25th pulse in the burst ( $t = 1.216\text{ ms}$ );  
 Droop measurements are defined as the drop in power from the 5th pulse ( $t = 216\mu\text{s}$ ) and 43rd pulse ( $t = 2.116\text{ms}$ ) in the burst.

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

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
<b>DC Characteristics</b>						
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
<b>Dynamic Characteristics</b>						
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

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## Absolute Maximum Ratings<sup>3,4,5</sup>

Parameter	Limit
Drain Voltage ( $V_{DD}$ )	+65 V
Gate Voltage ( $V_{GG}$ )	-8 to -2 V
Drain Current ( $I_{DD}$ )	80 A
Input Power <sup>6</sup> ( $P_{IN}$ )	$P_{IN}$ (nominal) + 3 dB
Operating Junction Temperature <sup>7</sup>	250 °C
Peak Pulsed Power Dissipation at 85 °C	3.5 kW
Operating Temperature Range	-40 to +95 °C
Storage Temperature Range	-65 to +150 °C
ESD Maximum - Charged Device Model (CDM)	1300 V
ESD Maximum - Human Body Model (HBM)	4000 V

3. Exceeding any one or combination of these limits may cause permanent damage to this device.

4. MACOM does not recommend sustained operation near these survivability limits.

5. For saturated performance it is recommended that the sum of  $(3 * V_{DD} + |V_{GG}|) < 175$  V.

6. Input Power Limit is +3 dB over nominal drive required to achieve  $P_{OUT} = 600$  W.

7. 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, $I_{DQ} = 600$ mA, $P_{OUT} = 600$ W, Pulse Width = 32 $\mu$ s, Duty Cycle = 2%	$\Theta_{JC}$	0.05	°C/W

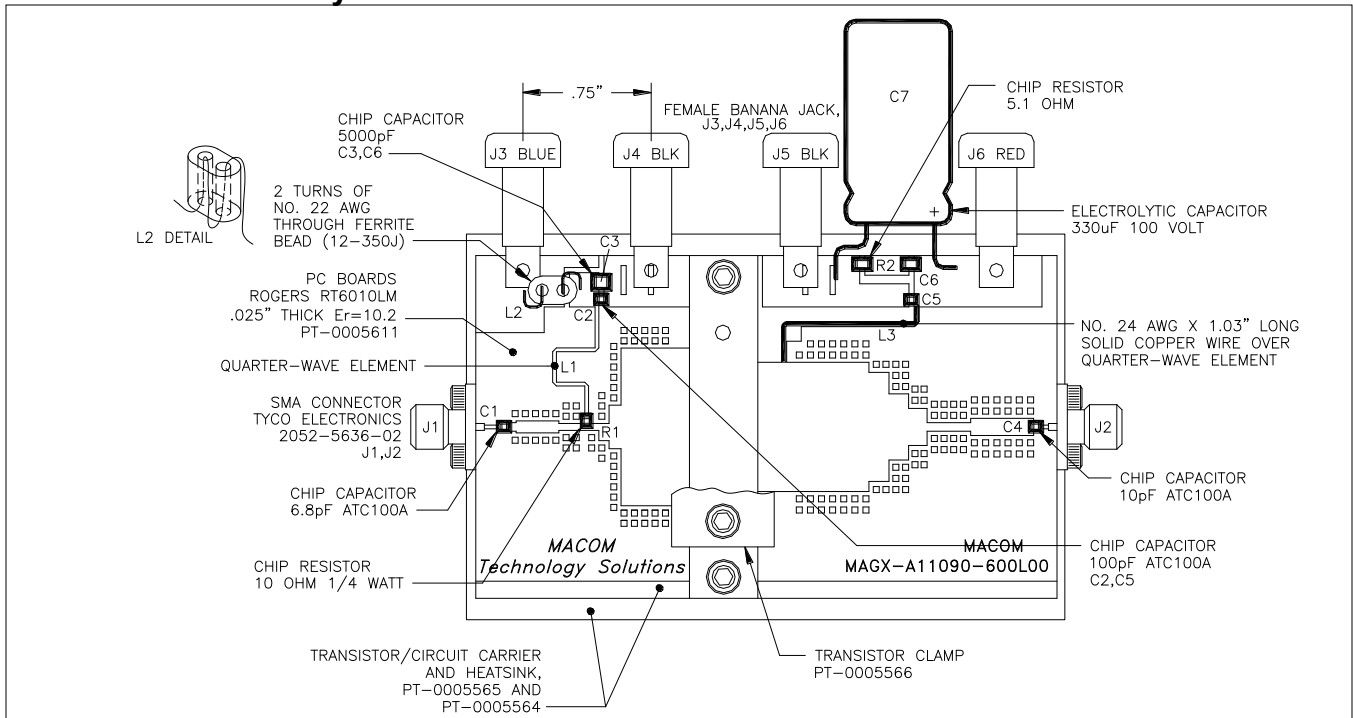
# MAGX-001090-600L0x



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## Test Fixture Assembly



Contact MACOM for additional circuit information.

## Test Fixture Impedances

Freq. (MHz)	$Z_{IF}$ ( $\Omega$ )	$Z_{OF}$ ( $\Omega$ )
1030	1.1 - j1.5	1.5 + j0.5
1060	1.1 - j1.4	1.5 + j0.6
1090	1.1 - j1.3	1.5 + j0.6

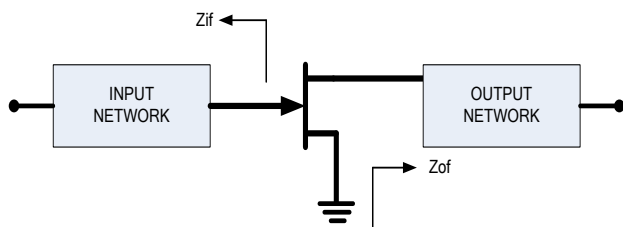
## Correct Device Sequencing

### Turning the device ON

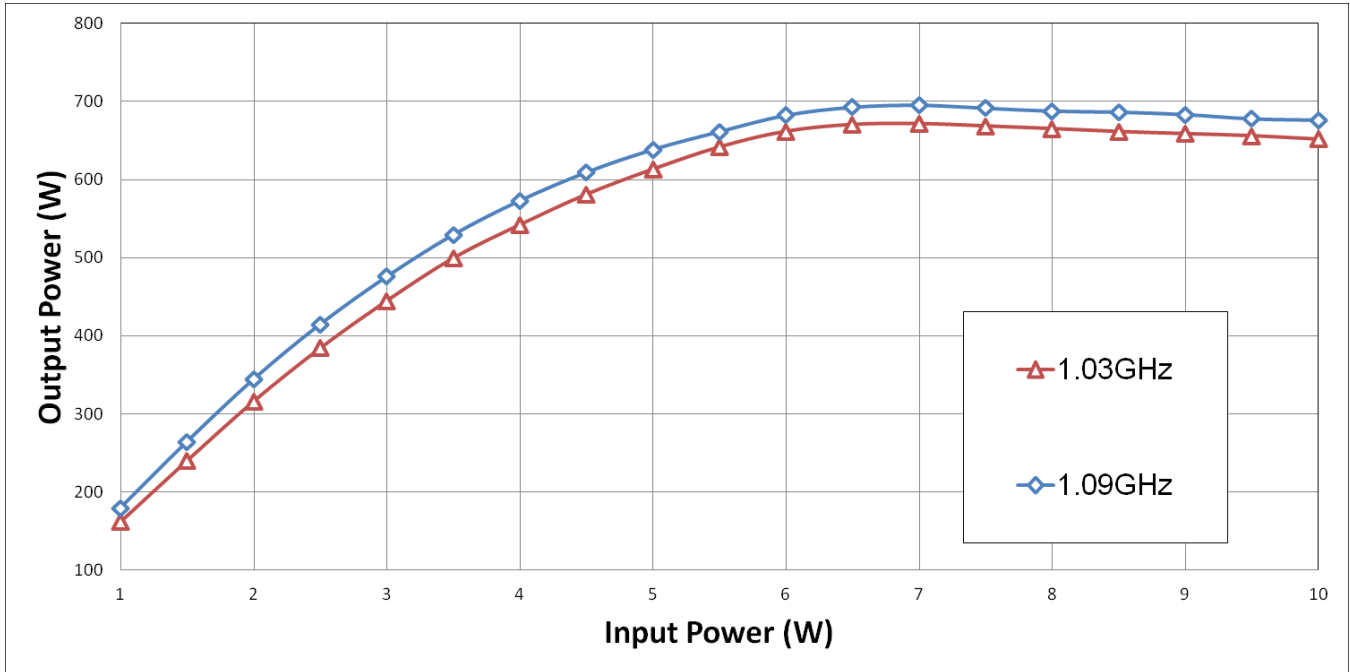
1. Set  $V_{GS}$  to the pinch-off ( $V_P$ ), typically -5 V.
2. Turn on  $V_{DS}$  to nominal voltage (50 V).
3. Increase  $V_{GS}$  until the  $I_{DS}$  current is reached.
4. Apply RF power to desired level.

### Turning the device OFF

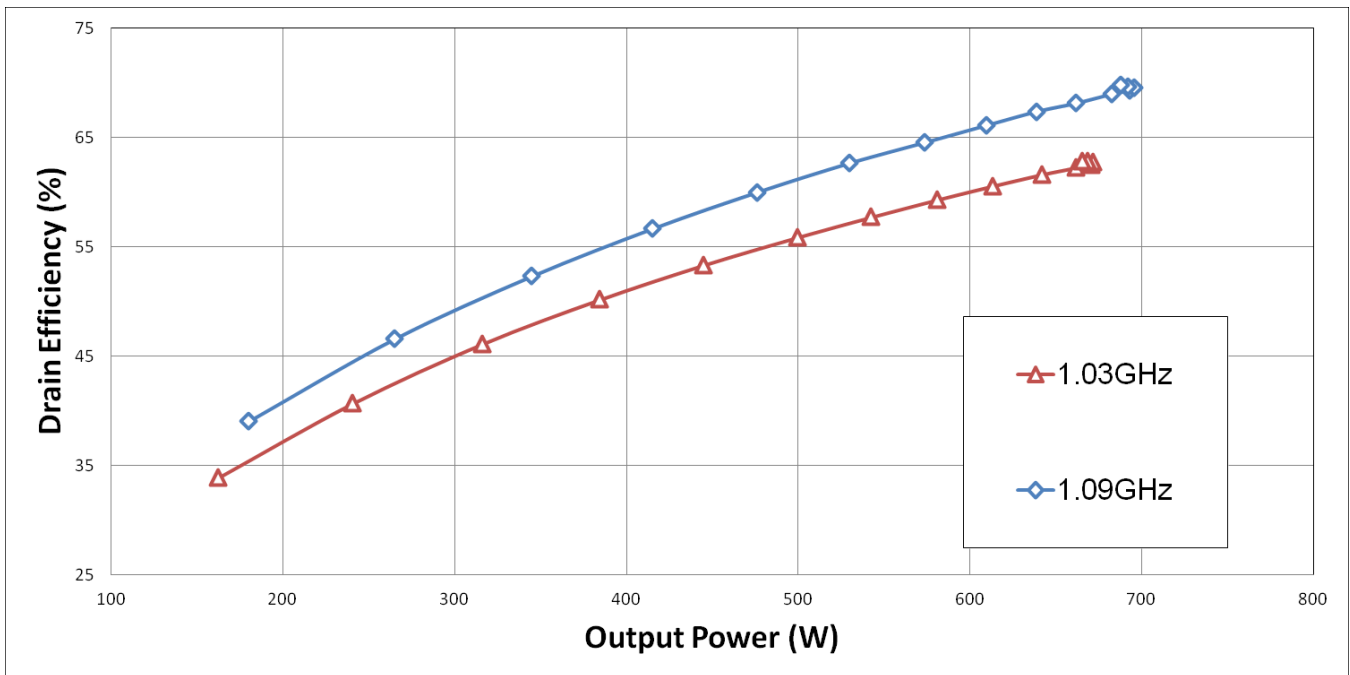
1. Turn the RF power off.
2. Decrease  $V_{GS}$  down to  $V_P$ .
3. Decrease  $V_{DS}$  down to 0 V.
4. Turn off  $V_{GS}$



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



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



# MAGX-001090-600L0x



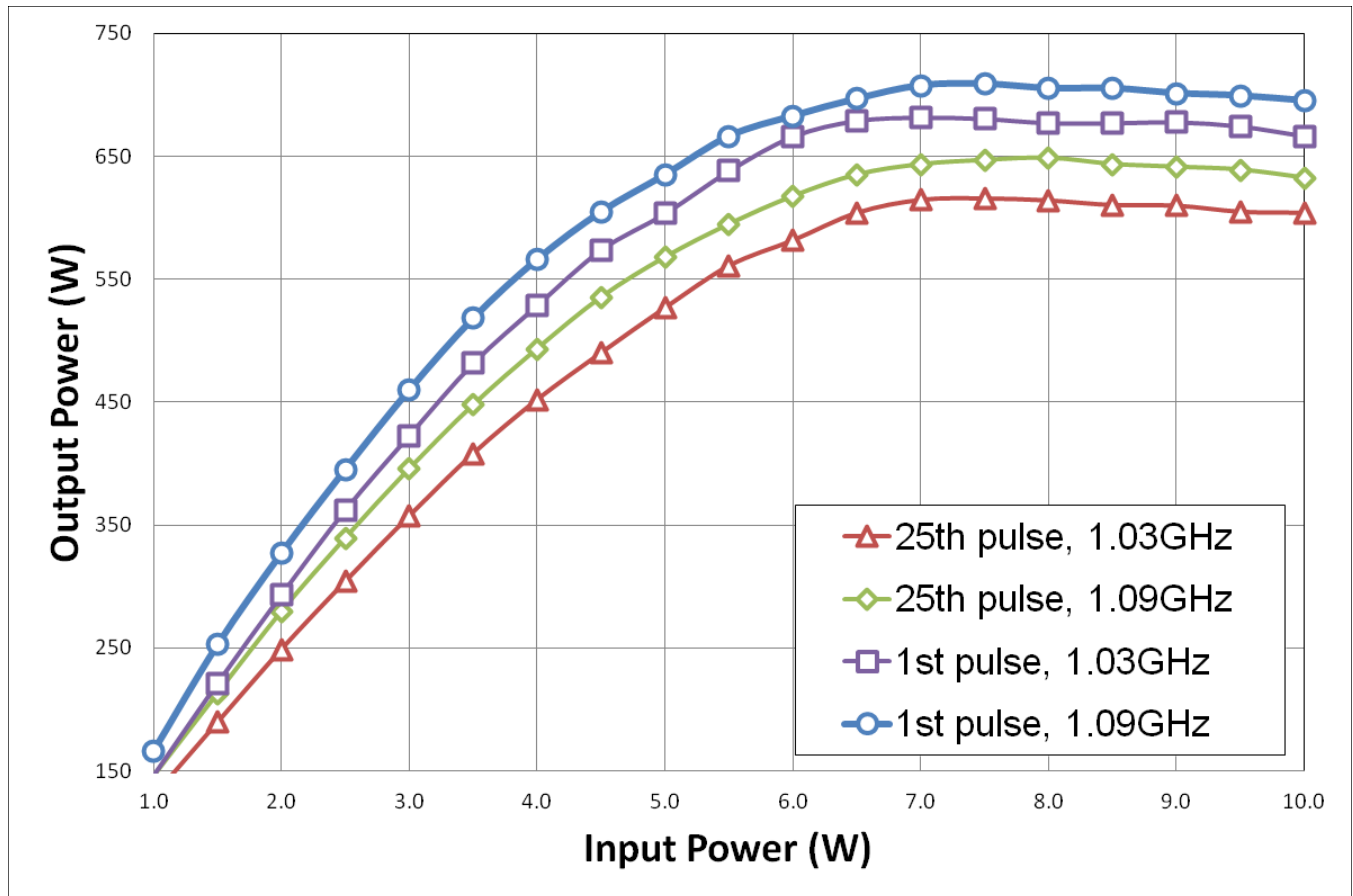
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Rev. V6

Typical RF Data with Mode-S ELM 'pulse' conditions:

48 pulses of 32  $\mu$ s on and 18  $\mu$ s off, repeat every 24ms; Overall Duty Factor = 6.4%

$V_{DD} = 50$  V;  $I_{DQ} = 400$  mA



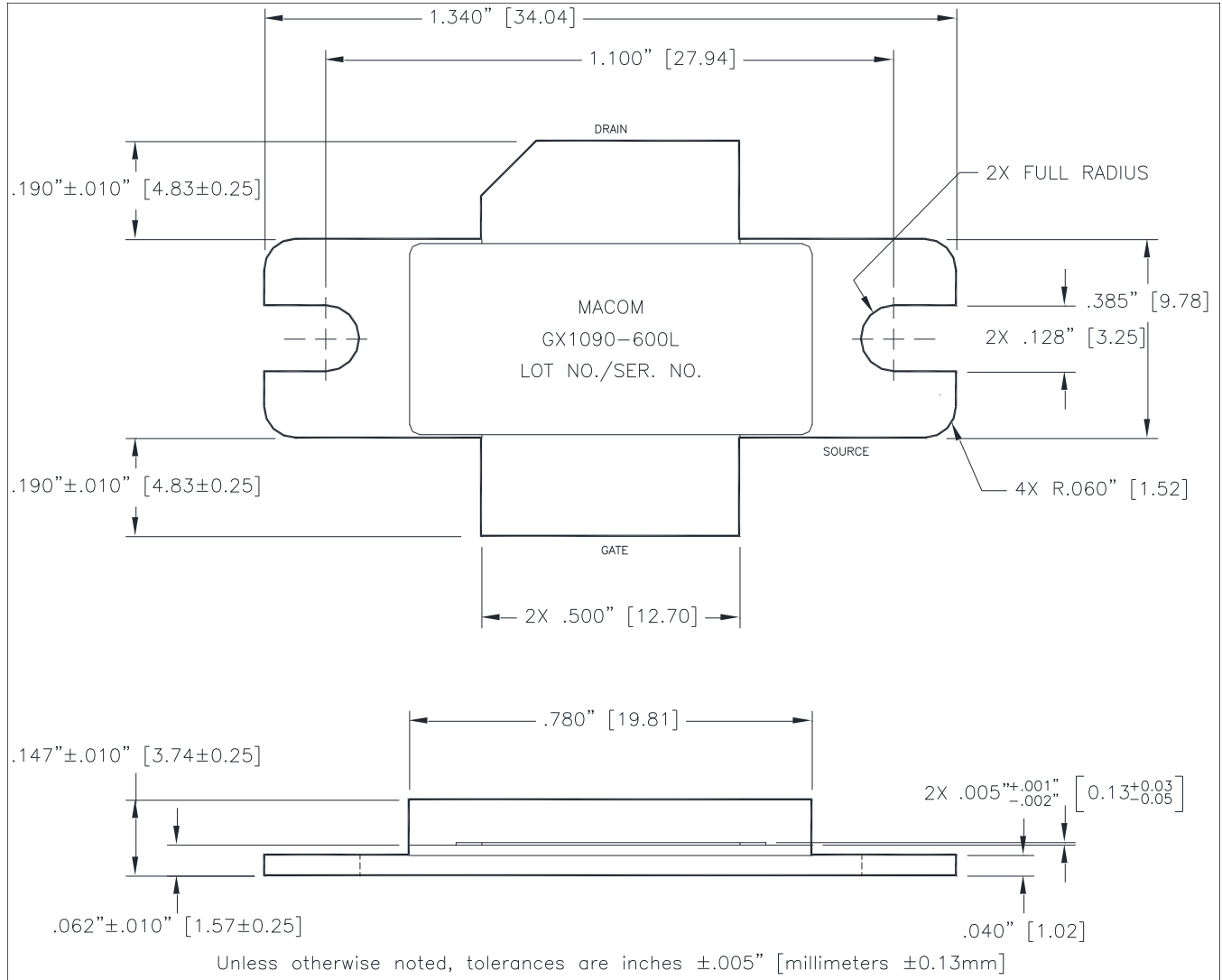
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Rev. V6

## Outline Drawing MAGX-001090-600L00<sup>†</sup>



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



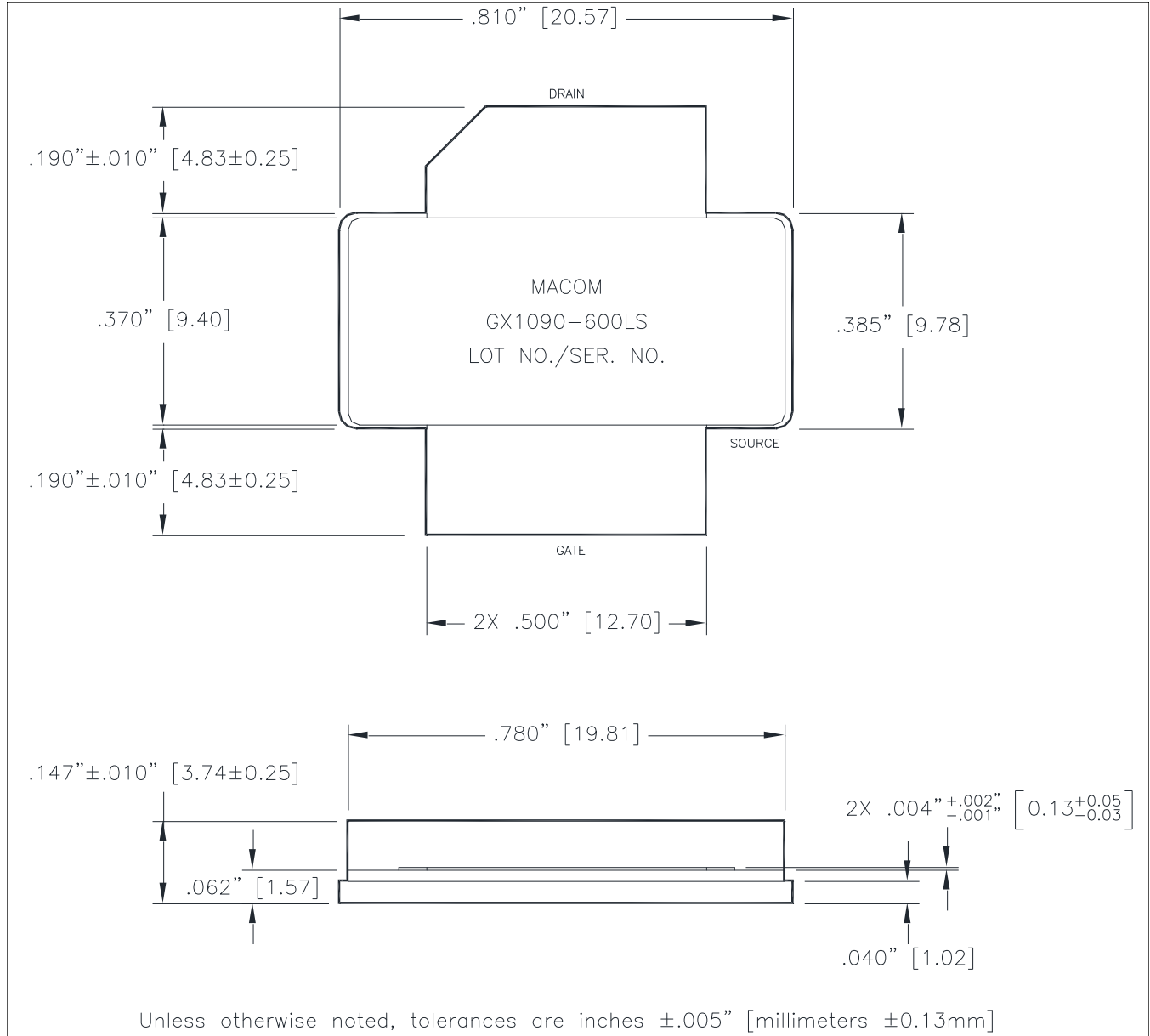
# MAGX-001090-600L0x



GaN on SiC HEMT Pulsed Power Transistor  
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## Outline Drawing MAGX-001090-600L0S†



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

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