

## GaN on SiC HEMT Pulsed Power Transistor 180 W Peak, 2700 to 3100 MHz, 300 $\mu$ s Pulse, 10% Duty

Rev. V6

### Features

- GaN Depletion Mode HEMT Microwave Transistor
- Common Source Configuration
- Broadband Class AB Operation
- Thermally Enhanced Cu/Mo/Cu Package
- RoHS Compliant
- +50 V Typical Operation
- MTTF of 600 Years ( $T_J < 200^\circ\text{C}$ )
- EAR99 Export Classification

### Applications

- Civilian and Military Pulsed Radar

### Description

The MAGX-002731-180L00 and MAGX-002731-180L0S are gold metalized matched Gallium Nitride (GaN) on Silicon Carbide RF power transistors optimized for civilian and military radar pulsed applications between 2700 - 3100 MHz.

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.

The MAGX-002731-180L00 and MAGX-002731-180L0S are constructed using thermally enhanced Cu/Mo/Cu flanged ceramic packages which provide excellent thermal performance. High breakdown voltages allow for reliable and stable operation in extreme mismatched load conditions unparalleled with older semiconductor technologies.

### MAGX-002731-180L00



### MAGX-002731-180L0S



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

Part Number	Package
MAGX-002731-180L00	Standard Flange
MAGX-002731-180L0S	Earless Flange
MAGX-S32731-180L00	2700 – 3100 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

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**Electrical Specifications<sup>2</sup>: 2700 - 3100 MHz,  $T_A = 25^\circ\text{C}$** 

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
<b>RF Functional Tests: <math>V_{DD} = 50\text{ V}</math>, <math>I_{DQ} = 500\text{ mA}</math>, 300 <math>\mu</math>s Pulse, 10% Duty Cycle</b>						
Output Power	$P_{IN} = 14\text{ Wpk}$	$P_{OUT}$	180	215	-	Wpk
Gain	$P_{IN} = 14\text{ Wpk}$	$G_P$	11.1	11.8	-	dB
Drain Efficiency	$P_{IN} = 14\text{ Wpk}$	$\eta_D$	43	51	-	%
Load Mismatch Stability	$P_{IN} = 14\text{ Wpk}$	VSWR-S	-	5:1	-	-
Load Mismatch Tolerance	$P_{IN} = 14\text{ Wpk}$	VSWR-T	-	10:1	-	-

2. Typical RF performance measured in an RF evaluation board.

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

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
<b>DC Characteristics</b>						
Drain-Source Leakage Current	$V_{GS} = -8\text{ V}$ , $V_{DS} = 175\text{ V}$	$I_{DS}$	-	-	12	mA
Gate Threshold Voltage	$V_{DS} = 5\text{ V}$ , $I_D = 30\text{ mA}$	$V_{GS(TH)}$	-5	-3	-2	V
Forward Transconductance	$V_{DS} = 5\text{ V}$ , $I_D = 3.5\text{ mA}$	$G_M$	5	-	-	S
<b>Dynamic Characteristics</b>						
Input Capacitance	N/A - Input Internally Matched	$C_{ISS}$	N/A	N/A	N/A	pF
Output Capacitance	$V_{DS} = 50\text{ V}$ , $V_{GS} = -8\text{ V}$ , $F = 1\text{ MHz}$	$C_{OSS}$	-	26.1	30.3	pF
Reverse Transfer Capacitance	$V_{DS} = 50\text{ V}$ , $V_{GS} = -8\text{ V}$ , $F = 1\text{ MHz}$	$C_{RSS}$	-	2.3	4.7	pF

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

Parameter	Absolute Maximum
Drain Supply Voltage ( $V_{DD}$ )	+65 V
Gate Supply Voltage ( $V_{GG}$ )	-8 V to 0 V
Drain Supply Current ( $I_D$ )	10 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 @ 85°C	192 W
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C
ESD Min. - Charged Device Model (CDM)	350 V
ESD Min. - Human Body Model (HBM)	550 V
Maximum Solder Temperature	260°C

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  $P_{OUT} = 180$  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 ( $T_J < 200^\circ\text{C}$ )
- MTTF =  $6.8 \times 10^4$  hours ( $T_J < 250^\circ\text{C}$ )

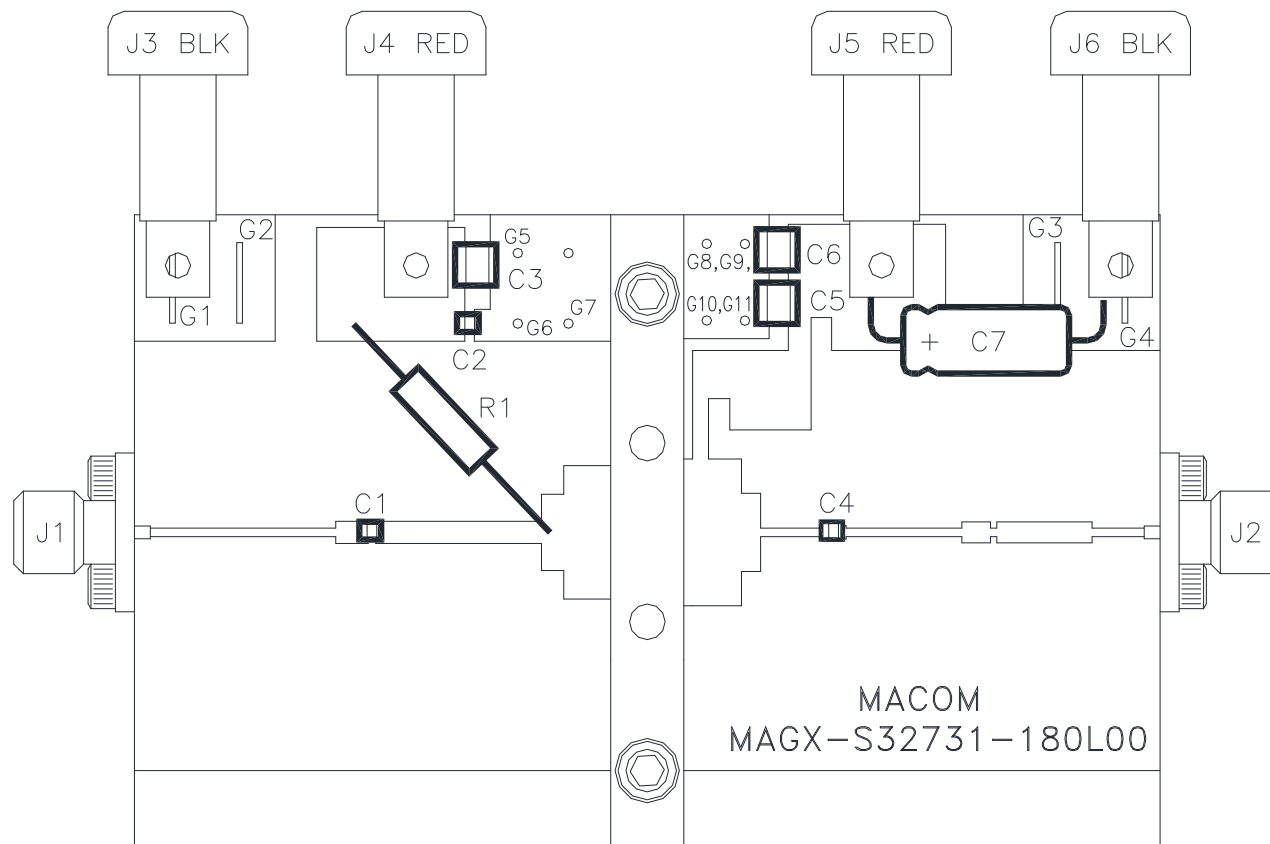
### Thermal Characteristics

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance	$T_C = 85^\circ\text{C}$ , $V_{DD} = 50$ V, $I_{DQ} = 500$ mA Pulse Width = 500 $\mu$ s, Duty Cycle = 10%	$\Theta_{JC}$	0.6	$^\circ\text{C/W}$

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Rev. V6

## Test Fixture Assembly



## Parts List

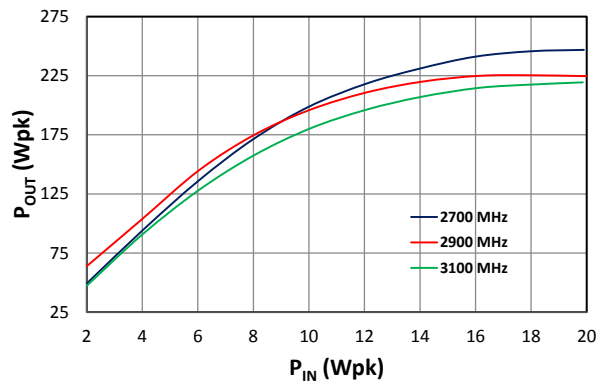
Part	Description
C1, C2, C4	Capacitor, 12 pF, 250 V, 5%, ATC800A
C3, C5	Capacitor, 0.1 $\mu$ F, 100 V, 10%, X7R, 0805, TDK
C6	Capacitor, 1.0 $\mu$ F, 100 V, 5%, 1206, Murata
C7	Capacitor, 22 $\mu$ F, 100 V, 20%, Panasonic
R1	Resistor, 12 ohm, 1/4 W, 1%, Axial, Vishay Dale
J1, J2	SMA Connector
J3, J6	Female Banana Jack, Black
J4, J5	Female Banana Jack, Red
PCB	MACOM (Rogers RT6010.5LM, 0.25" thick, Er = 10.5)

## Applications Section

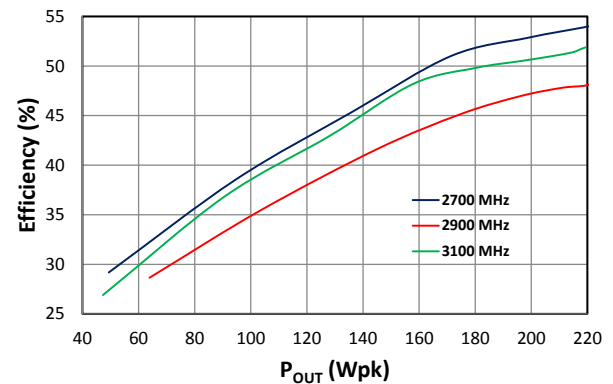
### Typical Large-Signal Performance Curves

2700 - 3100 MHz, 300  $\mu$ s Pulse, 10% Duty Cycle,  $V_{DD} = 50$  V,  $I_{DQ} = 500$  mA,  $P_{IN} = 14$  Wpk,  $T_A = 25^\circ\text{C}$

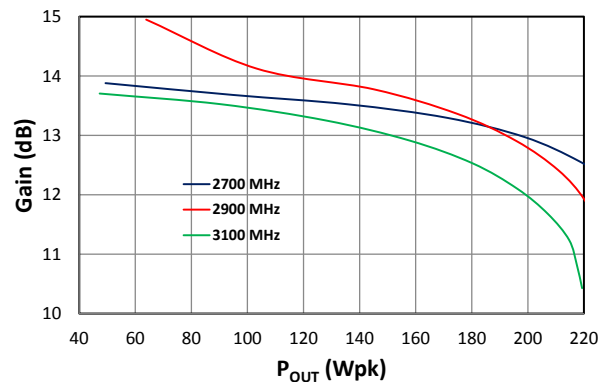
**Output Power vs. Input Power**



**Drain Efficiency vs. Output Power**



**Gain vs. Output Power**

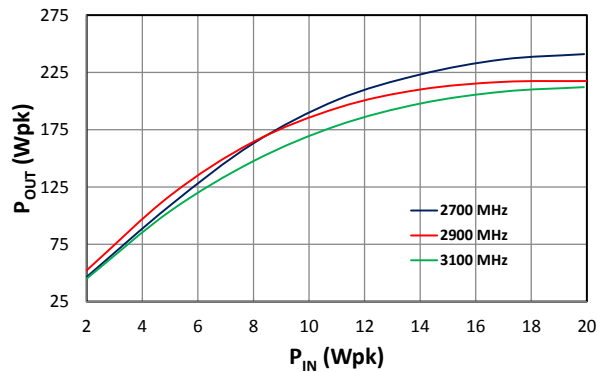


## Applications Section

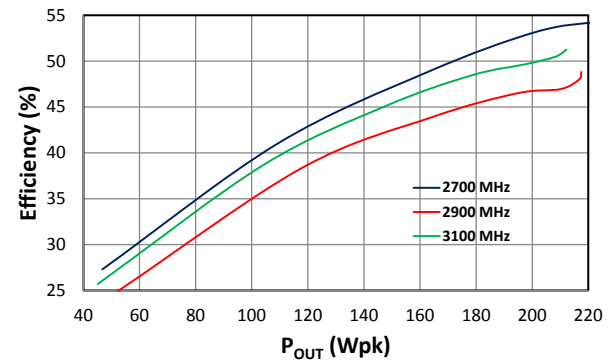
### Typical Large-Signal Performance Curves

2700 - 3100 MHz, 500  $\mu$ s Pulse, 10% Duty Cycle,  $V_{DD} = 50$  V,  $I_{DQ} = 500$  mA,  $P_{IN} = 14$  Wpk,  $T_A = 25^\circ\text{C}$

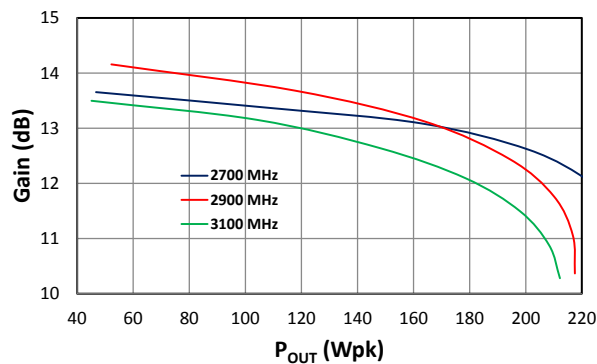
**Output Power vs. Input Power**



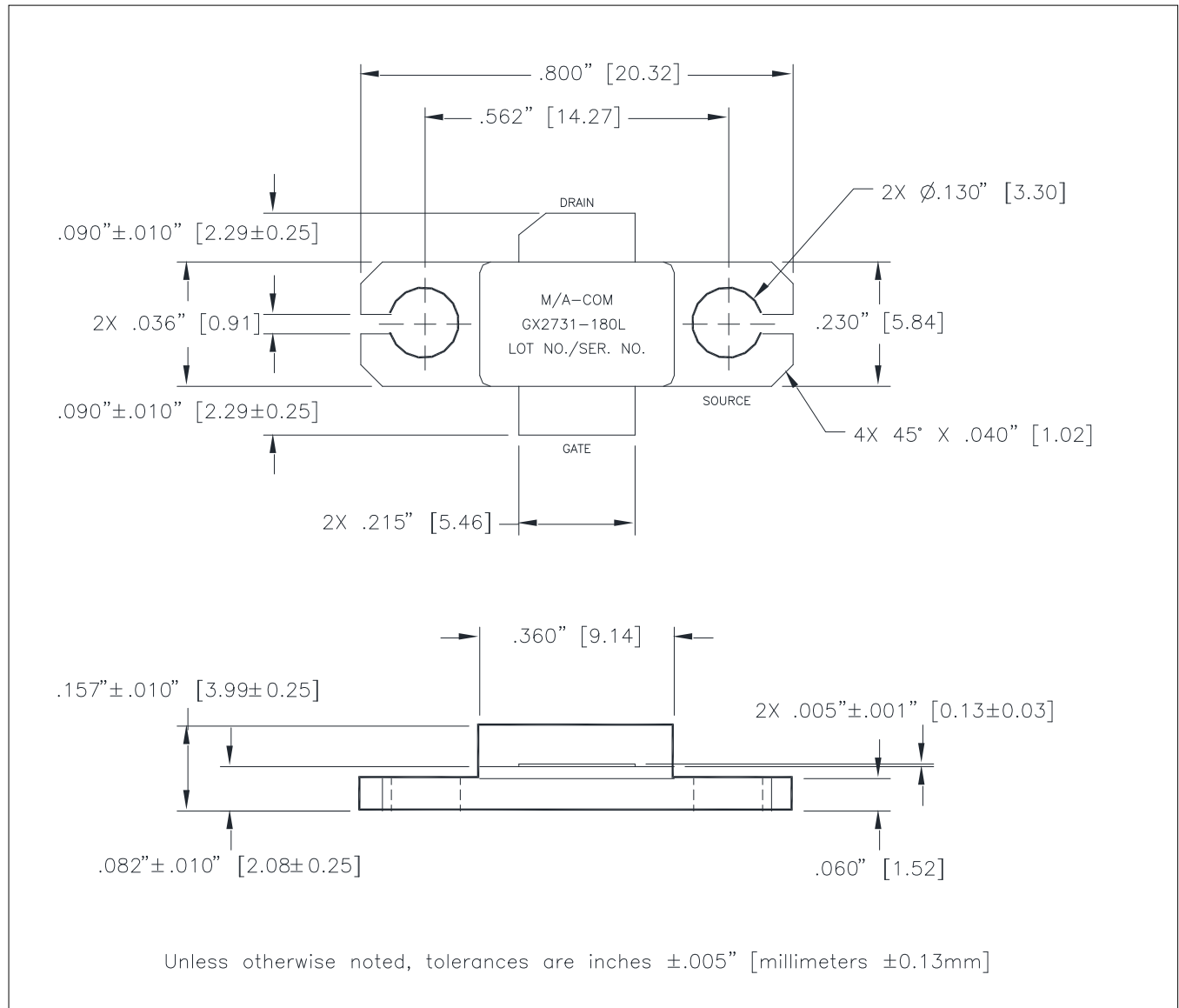
**Drain Efficiency vs. Output Power**



**Gain vs. Output Power**



## Outline Drawing (Flanged)



## Bias 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.

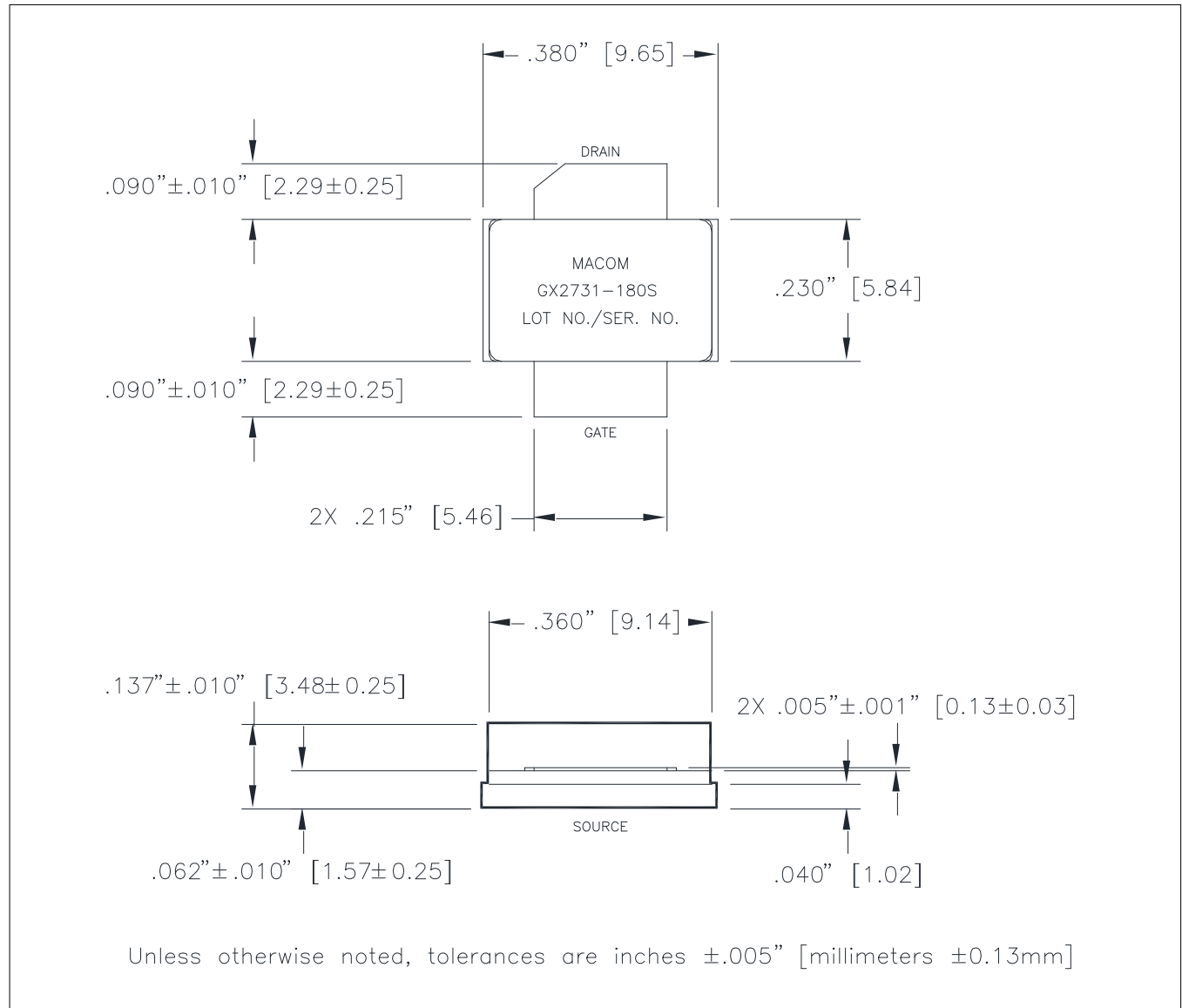
### TURNING THE DEVICE OFF

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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**Outline Drawing (Flangeless)**





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