

## Features

- GaN on SiC Depletion-Mode HEMT Transistor
- Common-Source Configuration
- Broadband Class AB Operation
- Thermally Enhanced Cu/Mo/Cu Package
- RoHS\* Compliant
- +50 V Typical Operation
- MTTF = 600 Years ( $T_J < 200^\circ\text{C}$ )
- 3A001.b.3.a.3 Export Classification
- MSL-1



## Description

The MAGX-003135-120L00 is a gold metalized matched Gallium Nitride (GaN) on Silicon Carbide RF power transistor optimized for civilian and military radar pulsed applications between 3.1 - 3.5 GHz. 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-003135-120L00 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.

## Ordering Information

Part Number	Description
MAGX-003135-120L00	120 W GaN Power Transistor
MAGX-003135-SB4PPR	3.1-3.5 GHz Evaluation Board

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

**GaN on SiC HEMT Pulsed Power Transistor**  
**120 W Peak, 3.1 to 3.5 GHz, 300  $\mu$ s Pulse, 10% Duty**

Rev. V4

**Electrical Specifications: Freq. = 3.1 - 3.5 GHz,  $T_A = 25^\circ\text{C}$**

Parameter	Symbol	Min.	Typ.	Max.	Units
<b>RF Functional Tests: <math>P_{IN} = 10\text{ W}</math>, <math>V_{DD} = 50\text{ V}</math>, <math>I_{DQ} = 300\text{ mA}</math>, Pulse Width = 300 <math>\mu</math>s, Duty = 10%</b>					
Peak Output Power	$P_{OUT}$	120	135	-	W
Power Gain	$G_P$	10.8	11.8	-	dB
Drain Efficiency	$\eta_D$	45	52	-	%
Load Mismatch Stability	VSWR-S	-	5:1	-	-
Load Mismatch Tolerance	VSWR-T	-	10:1	-	-

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

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
<b>DC Characteristics</b>						
Drain-Source Leakage Current	$V_{GS} = -8\text{ V}$ , $V_{DS} = 175\text{ V}$	$I_{DS}$	-	0.5	9	mA
Gate Threshold Voltage	$V_{DS} = 5\text{ V}$ , $I_D = 23\text{ mA}$	$V_{GS(TH)}$	-5	-3	-2	V
Forward Transconductance	$V_{DS} = 5\text{ V}$ , $I_D = 9\text{ A}$	$G_M$	3.3	-	-	S
<b>Dynamic Characteristics</b>						
Input Capacitance	Not Applicable (Input Matched)	$C_{ISS}$	N/A	N/A	N/A	pF
Output Capacitance	$V_{DS} = 50\text{ V}$ , $V_{GS} = -8\text{ V}$ , $F = 1\text{ MHz}$	$C_{OSS}$	-	13.4	16	pF
Reverse Transfer Capacitance	$V_{DS} = 50\text{ V}$ , $V_{GS} = -8\text{ V}$ , $F = 1\text{ MHz}$	$C_{RSS}$	-	1.4	2.2	pF

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### Absolute Maximum Ratings<sup>1,2,3,4,5</sup>

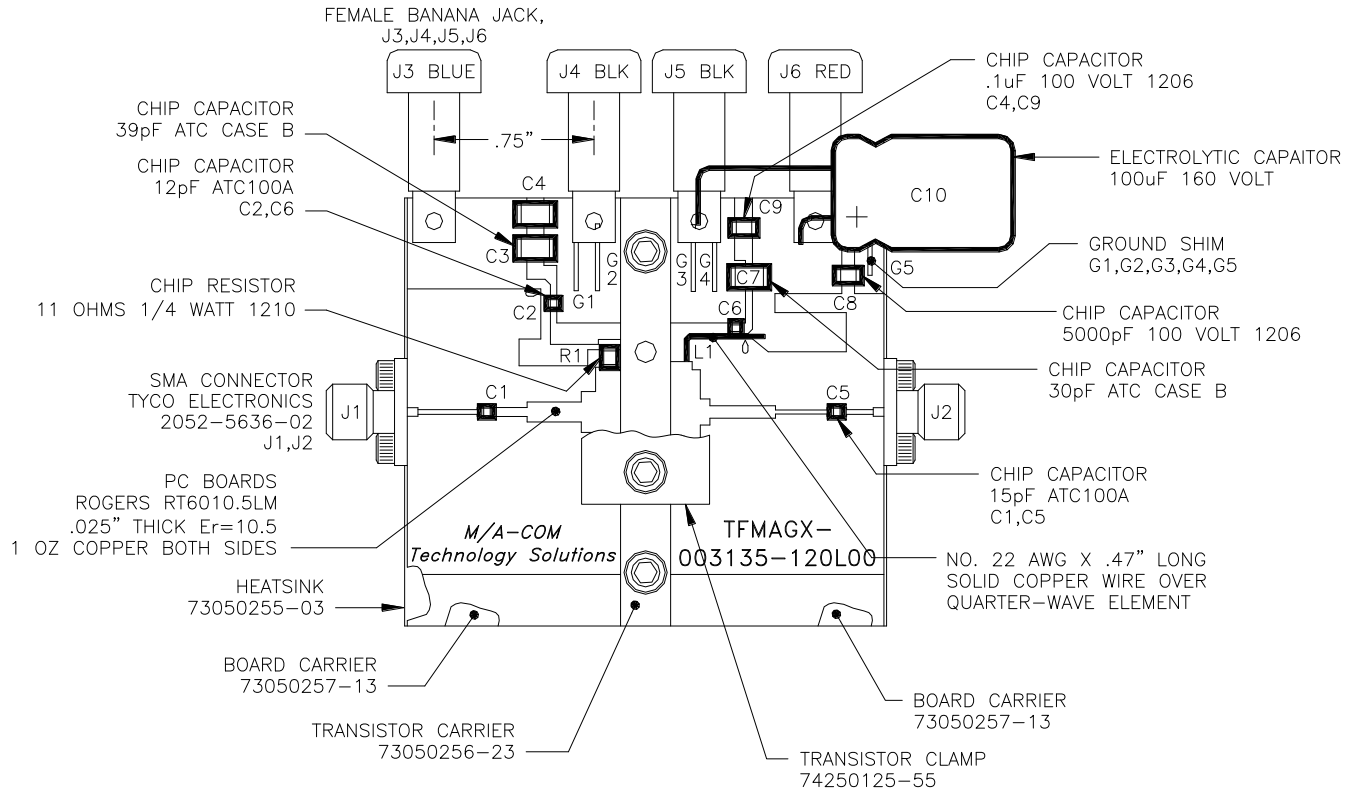
Parameter	Limit
Input Power ( $P_{IN}$ )	42 dBm
Drain Supply Voltage ( $V_{DD}$ )	+65 V
Gate Supply Voltage ( $V_{GG}$ )	-8 to 0 V
Supply Current ( $I_{DD}$ )	6.7 A
Absolute Maximum Junction/Channel Temperature	200°C
Pulsed Power Dissipation at 85°C	170 W (Pulse Width = 100 $\mu$ s) 144 W (Pulse Width = 300 $\mu$ s)
Operating Temperature	-40 to +95°C
Storage Temperature	-65 to +150°C
ESD Min. - Charged Device Model (CDM)	300 V
ESD Min. - Human Body Model (HBM)	700 V

- Exceeding any one or combination of these limits may cause permanent damage to this device.
- MACOM does not recommend sustained operation near these survivability limits.
- For saturated performance, the following is recommended:  $(3 * V_{DD} + \text{abs}(V_{GG})) < 175 \text{ V}$ .
- Operating at nominal conditions with  $T_J \leq +200^\circ\text{C}$  will ensure MTTF  $> 1 \times 10^6$  hours. Junction temperature directly affects device MTTF and should be kept as low as possible to maximize lifetime.
- Junction Temperature ( $T_J$ ) =  $T_C + \Theta_{JC} * ((V * I) - (P_{OUT} - P_{IN}))$ .

Typical Transient Thermal Resistances ( $I_{DQ} = 300 \text{ mA}$ , 300  $\mu$ s pulse, 10% duty cycle):

- Freq. = 3.1 GHz,  $\Theta_{JC} = 0.63^\circ\text{C/W}$   
 $T_J = 178^\circ\text{C}$  ( $T_C = 85^\circ\text{C}$ , 50 V, 5.15 A,  $P_{OUT} = 120 \text{ W}$ ,  $P_{IN} = 9.5 \text{ W}$ )
- Freq. = 3.3 GHz,  $\Theta_{JC} = 0.69^\circ\text{C/W}$   
 $T_J = 188^\circ\text{C}$  ( $T_C = 85^\circ\text{C}$ , 50 V, 5.24 A,  $P_{OUT} = 120 \text{ W}$ ,  $P_{IN} = 7.0 \text{ W}$ )
- Freq. = 3.5 GHz,  $\Theta_{JC} = 0.67^\circ\text{C/W}$   
 $T_J = 180^\circ\text{C}$  ( $T_C = 85^\circ\text{C}$ , 50 V, 5.12 A,  $P_{OUT} = 120 \text{ W}$ ,  $P_{IN} = 6.8 \text{ W}$ )

## Evaluation Board Assembly (3.1 - 3.5 GHz)



## Evaluation Board Impedances

Freq. (MHz)	$Z_{IF}$ ( $\Omega$ )	$Z_{OF}$ ( $\Omega$ )
3100	5.9 - j4.2	4.1 - j2.4
3300	5.2 - j4.8	4.0 - j2.8
3500	3.9 - j5.0	2.6 - j2.6

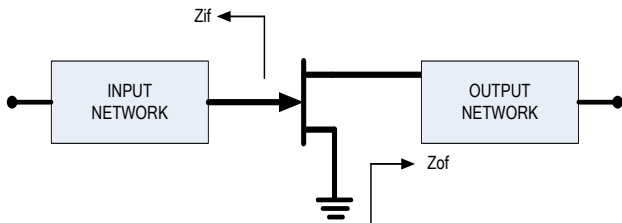
## Correct Device Sequencing

### 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  $V_{GS}$

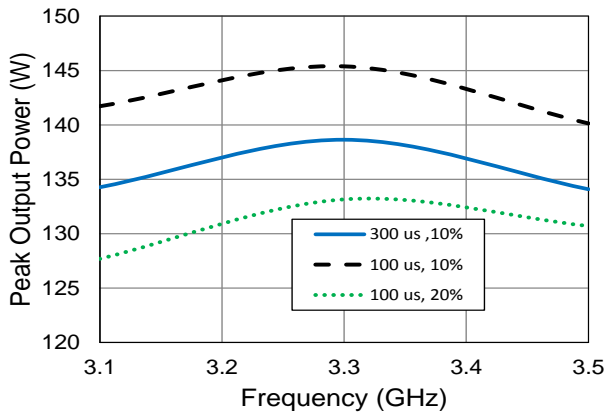


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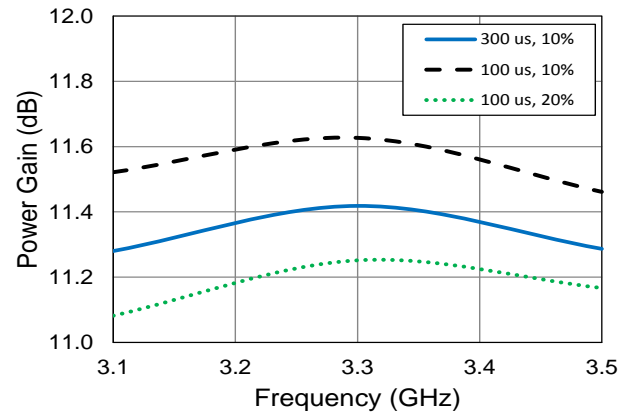
Rev. V4

Typical Performance Curves:  $P_{IN} = 10$  W,  $V_{DD} = 50$  V,  $I_{DQ} = 300$  mA

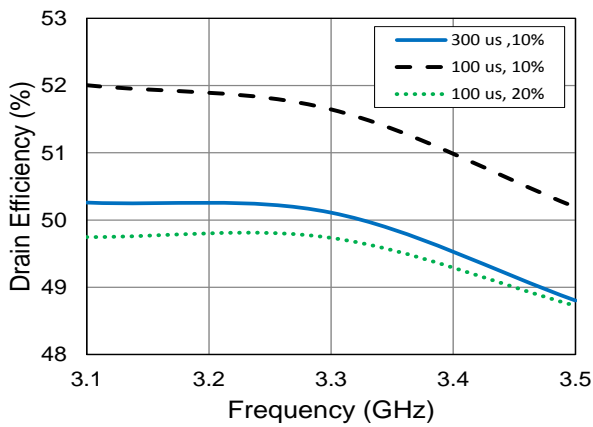
**Peak Output Power vs. Frequency**



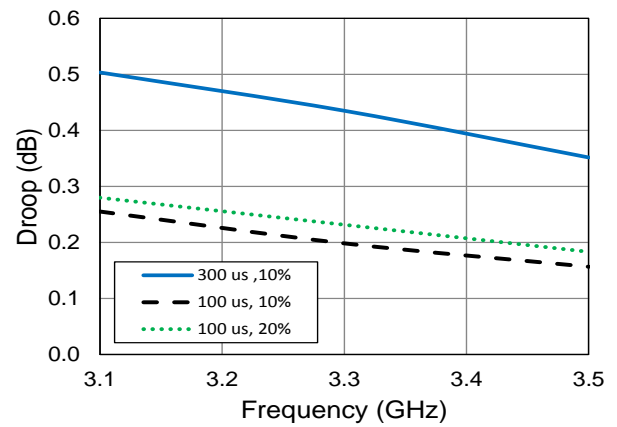
**Power Gain vs. Frequency**



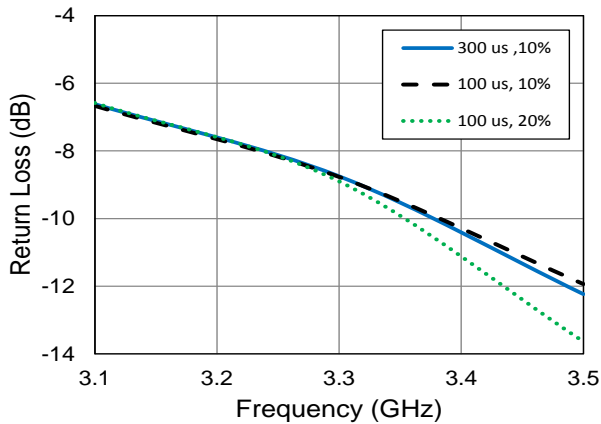
**Drain Efficiency vs. Frequency**



**Return Loss vs. Frequency**



**Droop vs. Frequency**

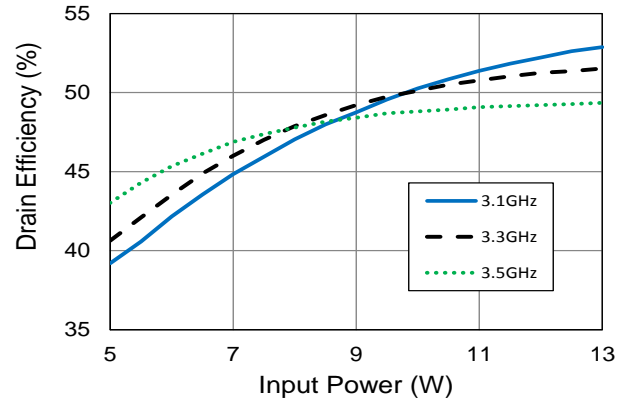
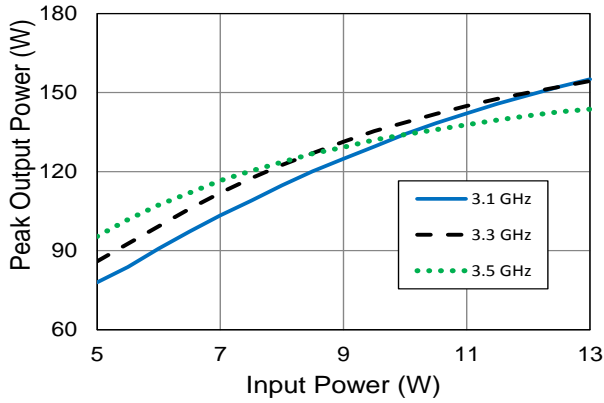


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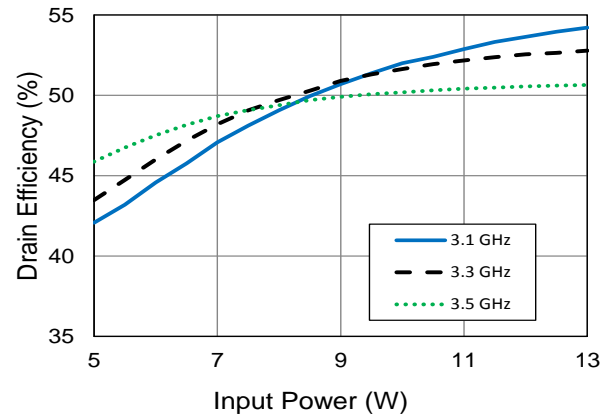
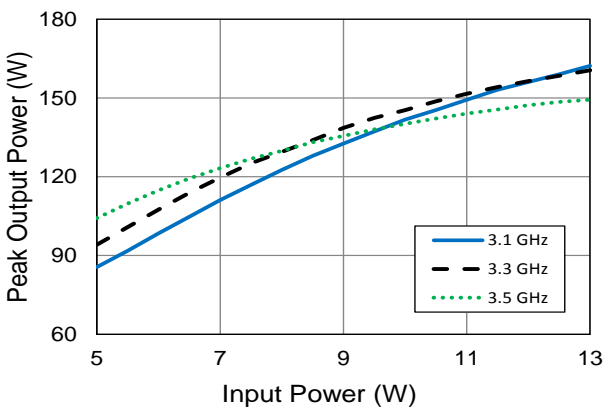
Rev. V4

**Typical Performance Curves:  $V_{DD} = 50$  V,  $I_{DQ} = 300$  mA**

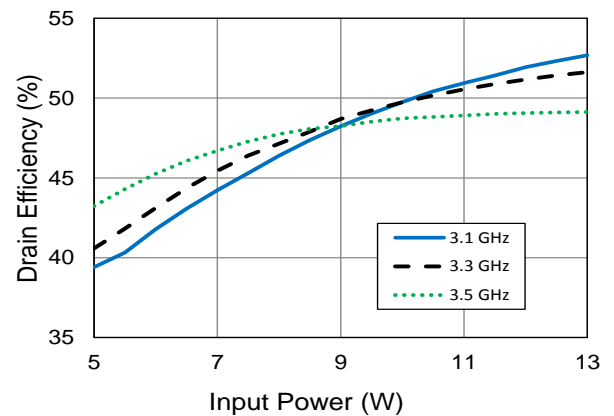
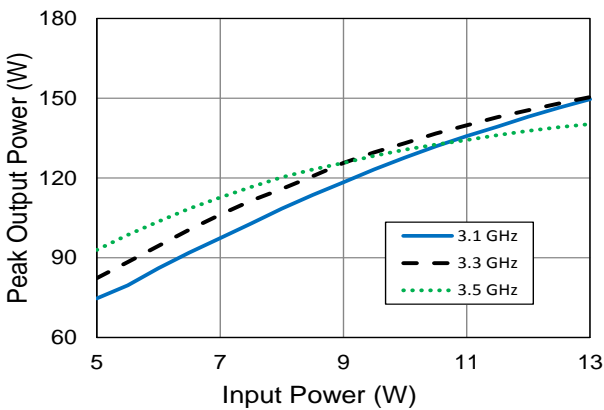
**Output Power / Drain Efficiency vs. Input Power (Pulse Width = 300  $\mu$ s, Duty = 10%)**



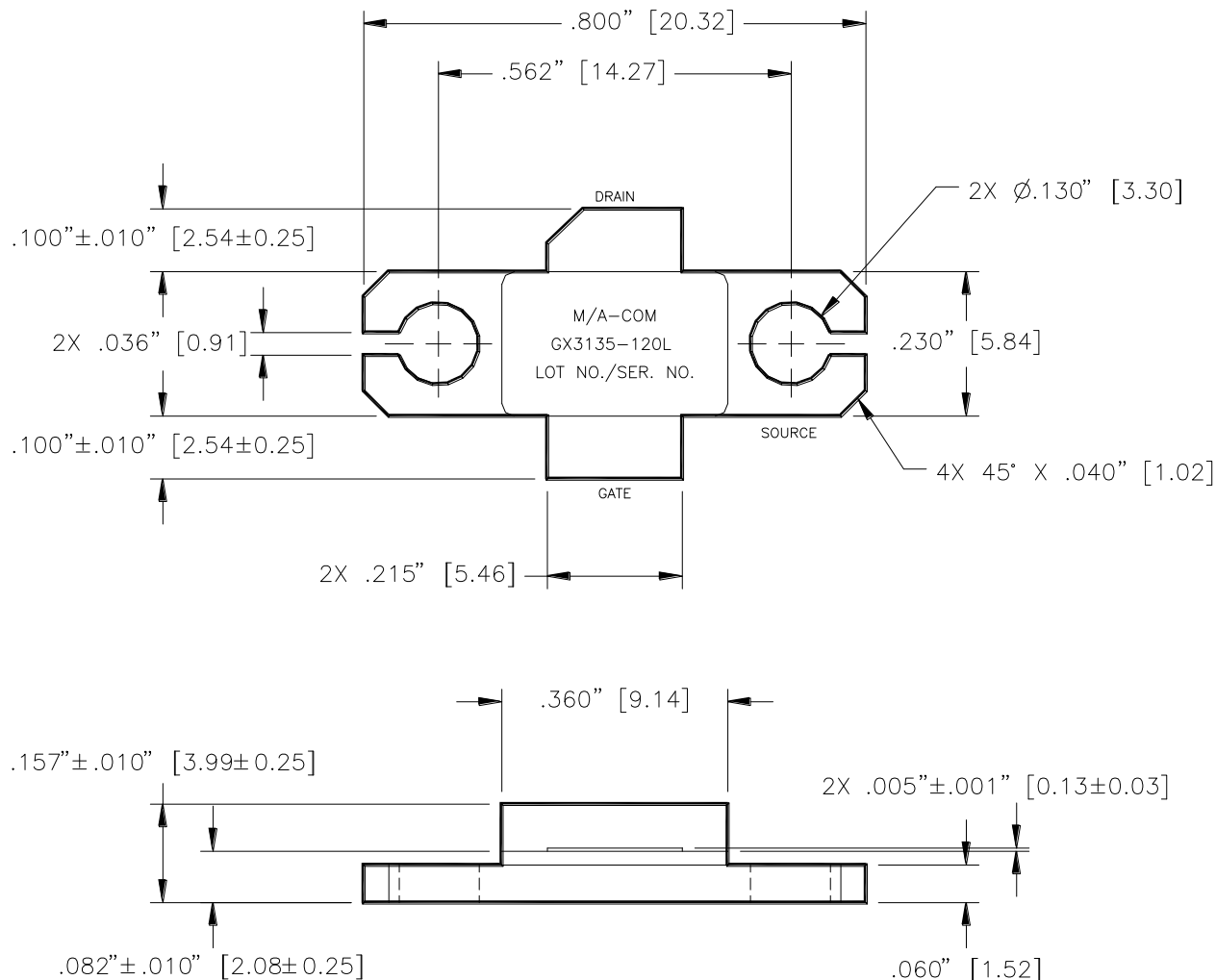
**Output Power / Drain Efficiency vs. Input Power (Pulse Width = 100  $\mu$ s, Duty = 10%)**



**Output Power / Drain Efficiency vs. Input Power (Pulse Width = 100  $\mu$ s, Duty = 20%)**



## Package Outline



Unless otherwise noted, tolerances are inches  $\pm$ .005" [millimeters  $\pm$ 0.13mm]

## Handling Procedures

Please observe the following precautions to avoid damage:

## Static Sensitivity

Gallium Nitride devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

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