

# MAGX-001214-250L00



**GaN on SiC HEMT Pulsed Power Transistor**  
**250 W Peak, 1200-1400 MHz, 300  $\mu$ s Pulse, 10% Duty**

Rev. V3

## 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

- L-Band pulsed radar

## Description

The MAGX-001214-250L00 is a gold metalized matched Gallium Nitride (GaN) on Silicon Carbide 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, ruggedness over a wide bandwidth for today's demanding application needs. 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-001214-250L00	250W GaN Power Transistor
MAGX-001214-SB1PPR	Evaluation Test Fixture

## Typical RF Performance under Standard Operating Conditions, $P_{OUT} = 250$ W (Peak)

Freq (MHz)	$P_{IN}$ (W)	Gain (dB)	$I_D$ (A)	Eff. (%)	RL (dB)	Droop (dB)	VSWR-S (5:1)	VSWR-T (10:1)
1200	4.4	17.6	8.0	62.2	-13.3	0.4	S	P
1250	4.0	18.0	8.2	60.4	-19.2	0.5	S	P
1300	4.1	17.8	8.7	57.1	-22.6	0.6	S	P
1350	4.4	17.5	9.1	54.6	-19.2	0.7	S	P
1400	4.4	17.6	9.0	55.0	-19.8	0.6	S	P

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

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

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
<b>RF Functional Tests</b>						
Peak Input Power	$V_{DD} = 50\text{ V}$ , $I_{DQ} = 250\text{ mA}$ , Pulse Width = 300 $\mu$ s, Duty Cycle = 10%, $P_{OUT} = 250\text{ W Peak (25 W avg.)}$	$P_{IN}$	-	4.2	5.6	W
Power Gain		$G_P$	16.5	17.7	-	dB
Drain Efficiency		$\eta_D$	50	57.9	-	%
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	$V_{GS} = -8\text{ V}$ , $V_{DS} = 175\text{ V}$	$I_{DS}$	-	0.4	12	mA
Gate Threshold Voltage	$V_{DS} = 5\text{ V}$ , $I_D = 30\text{ mA}$	$V_{GS(TH)}$	-5	-3.1	-2	V
Forward Transconductance	$V_{DS} = 5\text{ V}$ , $I_D = 7\text{ mA}$	$G_M$	5.0	7.7	-	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	$C_{OSS}$	-	22	-	pF
Reverse Transfer Capacitance		$C_{RSS}$	-	2.2	-	pF

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

Parameter	Limit
Drain Voltage ( $V_{DD}$ )	+65 V
Gate Voltage ( $V_{GG}$ )	-8 to -2 V
Drain Current ( $I_{DD}$ )	10.7 A
Input Power <sup>4</sup> ( $P_{IN}$ )	$P_{IN}$ (nominal) + 3 dB
Operating Junction Temperature <sup>5</sup>	250 °C
Peak Pulsed Power Dissipation at 85 °C	292 W
Operating Temperature Range	-40 to +95 °C
Storage Temperature Range	-65 to +150 °C
ESD Maximum - Machine Model (MM)	50V
ESD Maximum - Human Body Model (HBM)	250V

- 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 it is recommended that the sum of  $(3 * V_{DD} + |V_{GG}|) < 175$  V.
- Input Power Limit is +3 dB over nominal drive required to achieve  $P_{OUT} = 250$  W.
- 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)

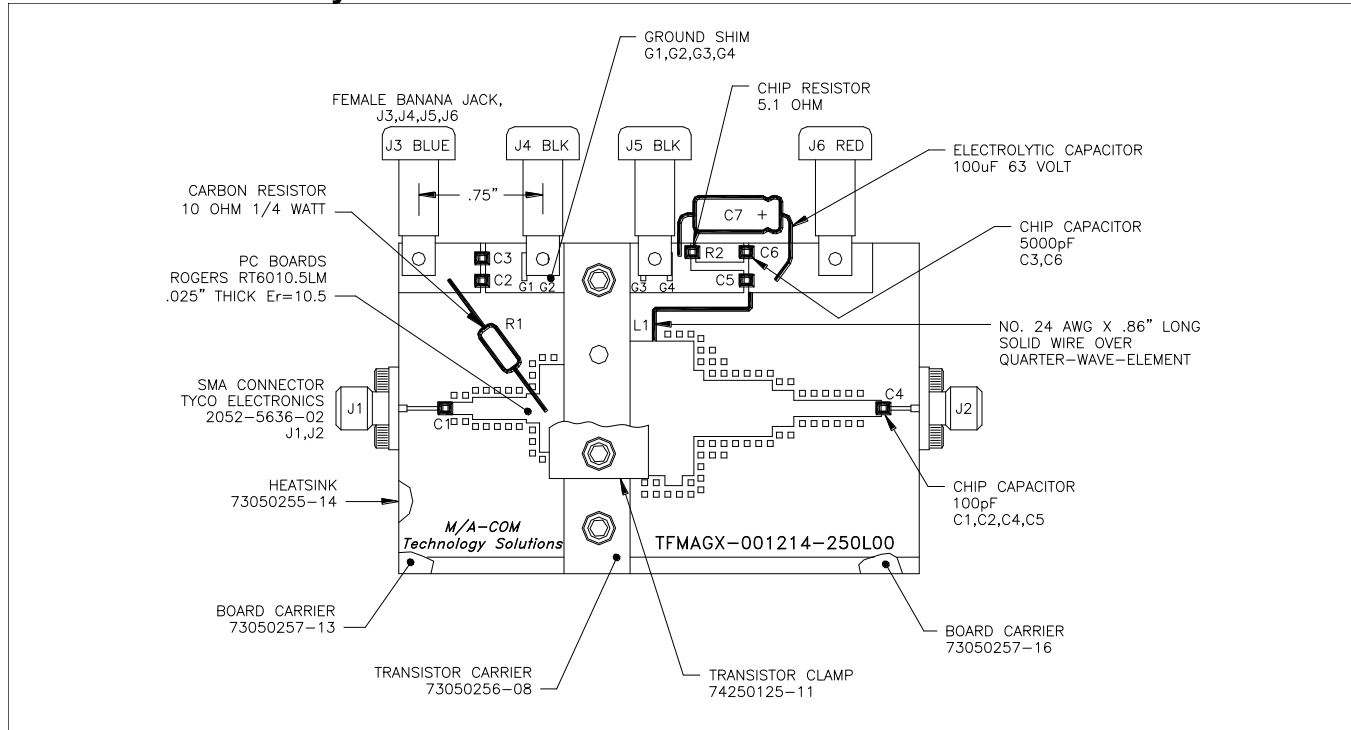
### Thermal Characteristics

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance	$T_C = 70$ °C, $V_{DD} = 50$ V, $I_{DQ} = 250$ mA, $P_{OUT} = 250$ W, Pulse Width = 300 $\mu$ s, Duty Cycle = 10%	$\Theta_{JC}$	0.6	°C/W

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### Test Fixture Assembly



Contact MACOM for additional circuit information.

### Test Fixture Impedances

F (MHz)	Z <sub>IF</sub> ( $\Omega$ )	Z <sub>OF</sub> ( $\Omega$ )
1200	3.6 - j5.3	3.5 + j0.7
1250	3.3 - j4.9	3.7 + j0.2
1300	3.2 - j4.4	3.5 - j0.3
1350	3.2 - j4.0	3.2 - j0.6
1400	3.2 - j3.6	2.7 - j0.7

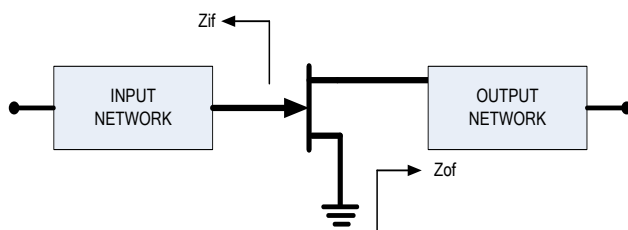
### Correct Device Sequencing

#### 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

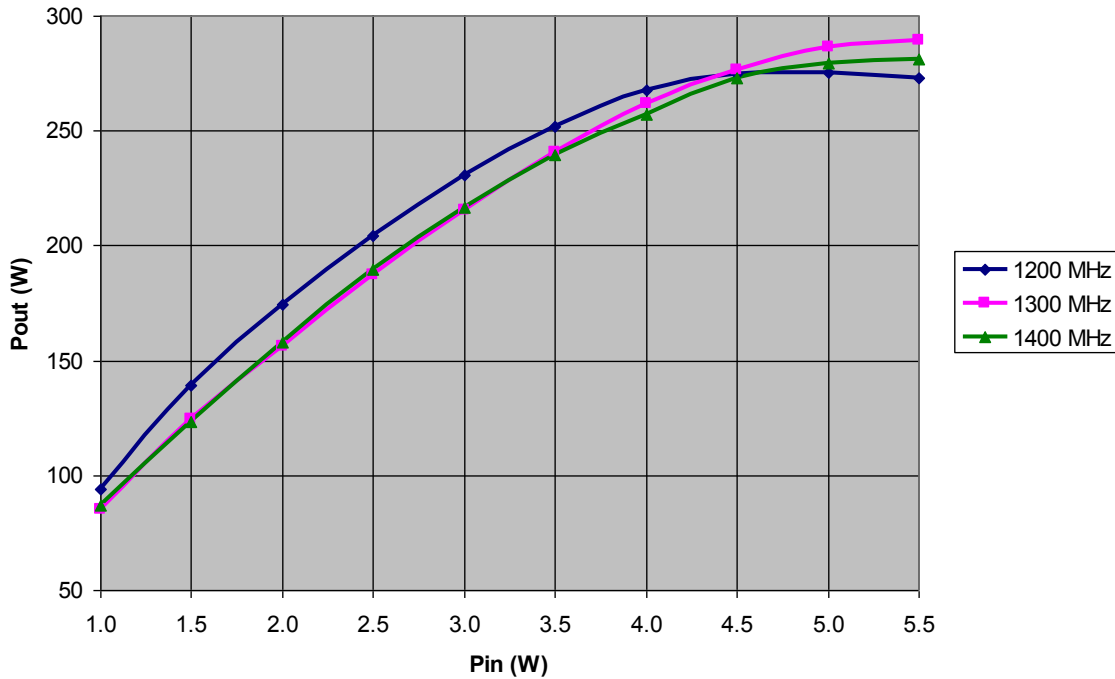
1. Turn the RF power off.
2. Decrease  $V_{GS}$  down to  $V_P$ .
3. Decrease  $V_{DS}$  down to 0 V.
4. Turn off  $V_{GS}$



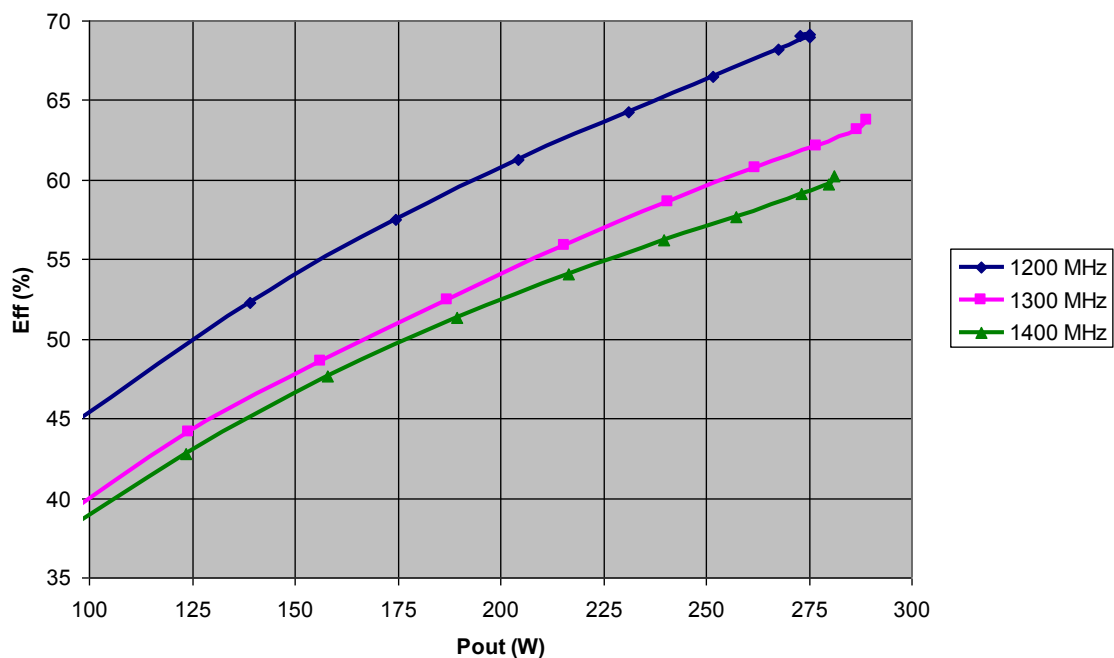
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## RF Power Transfer Curve (Output Power Vs. Input Power)



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



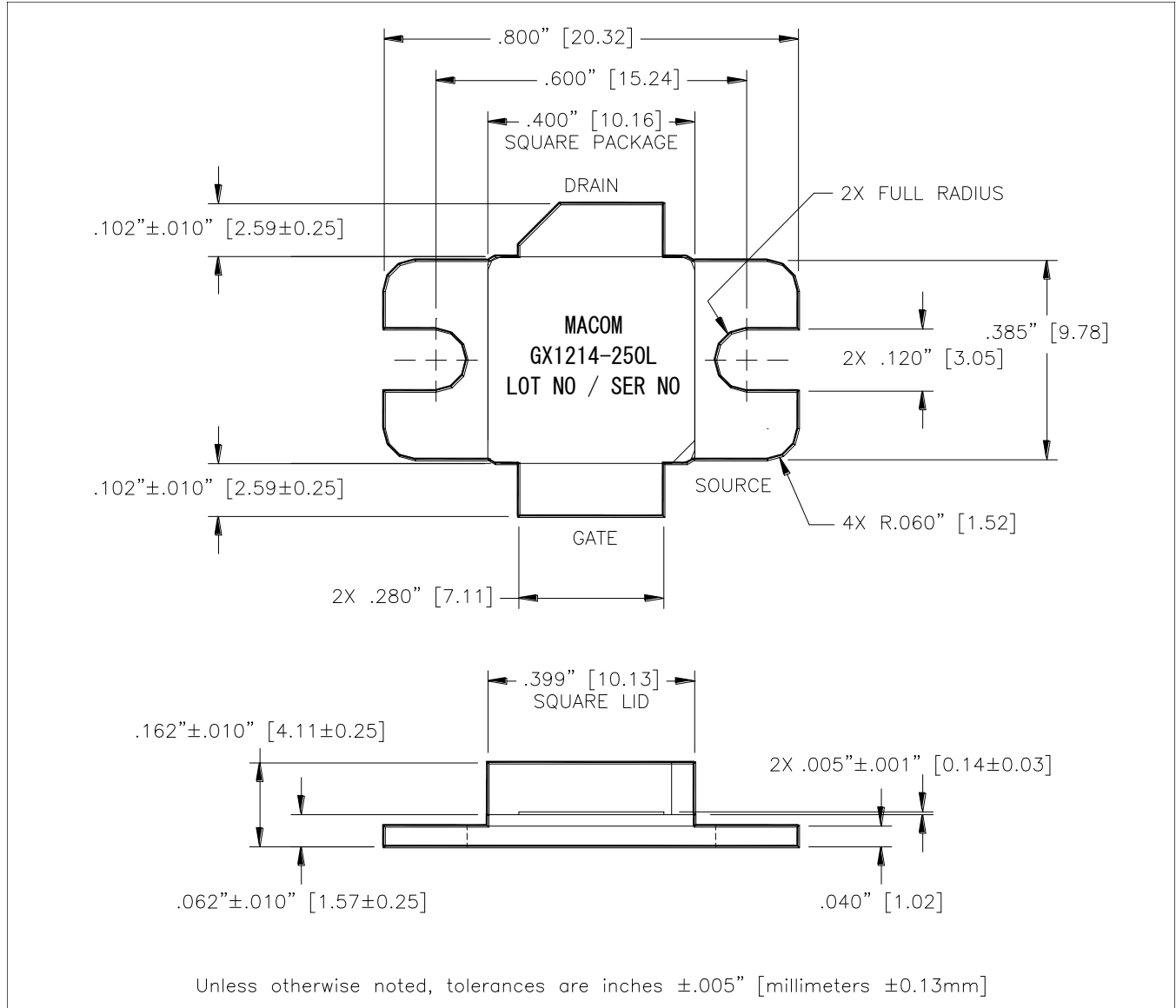
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## Outline Drawing†



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

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