MAGX-001090-600L0x

GaN on SiC HEMT Pulsed Power Transistor
600 W Peak, 1030 to 1090 MHz, 32 µs 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[1]

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.

Electrical Specifications: Freq. = 1030 - 1090 MHz, T_A = 25 °C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
RF Functional Tests						
Peak Input Power	V_{DD} = 50 V, I_{DQ} = 600 mA, Pulse Width = 32 µs, Duty Cycle = 2%, P_{OUT} = 600 W Peak (12 W avg.)	P_{IN}	-	4.3	6.7	W
Power Gain		G_P	19.5	21.4	-	dB
Drain Efficiency		η_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	-	-
Mode-S ELM Pulse Width Conditions[2]						
Peak Input Power	V_{DD} = 50 V, I_{DQ} = 400 mA, 48 pulses of 32 µs on and 18 µs off, repeat every 24 ms, Overall Duty Factor = 6.4%, P_{OUT} = 550 W Peak (35.2 W avg.)	P_{IN}	-	4.6	-	W
Power Gain		G_P	-	20.7	-	dB
Drain Efficiency		η_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 ms);
Droop measurements are defined as the drop in power from the 5th pulse (t = 216us) and 43rd pulse (t = 2.116ms) in the burst.

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}	-	1.0	30	mA
Gate Threshold Voltage	V_{DS} = 5 V, I_D = 75 mA	$V_{GS\ (TH)}$	-5	-3.1	-2	V
Forward Transconductance	V_{DS} = 5 V, I_D = 17.5 mA	G_M	12.5	19.2	-	S
Dynamic Characteristics						
Input Capacitance	Not applicable - Input matched	C_{ISS}	N/A	N/A	N/A	pF
Output Capacitance	V_{DS} = 50 V, V_{GS} = -8 V, Freq. = 1 MHz	C_{OSS}	-	55	-	pF
Reverse Transfer Capacitance		C_{RSS}	-	5.5	-	pF

Absolute Maximum Ratings[3,4,5]

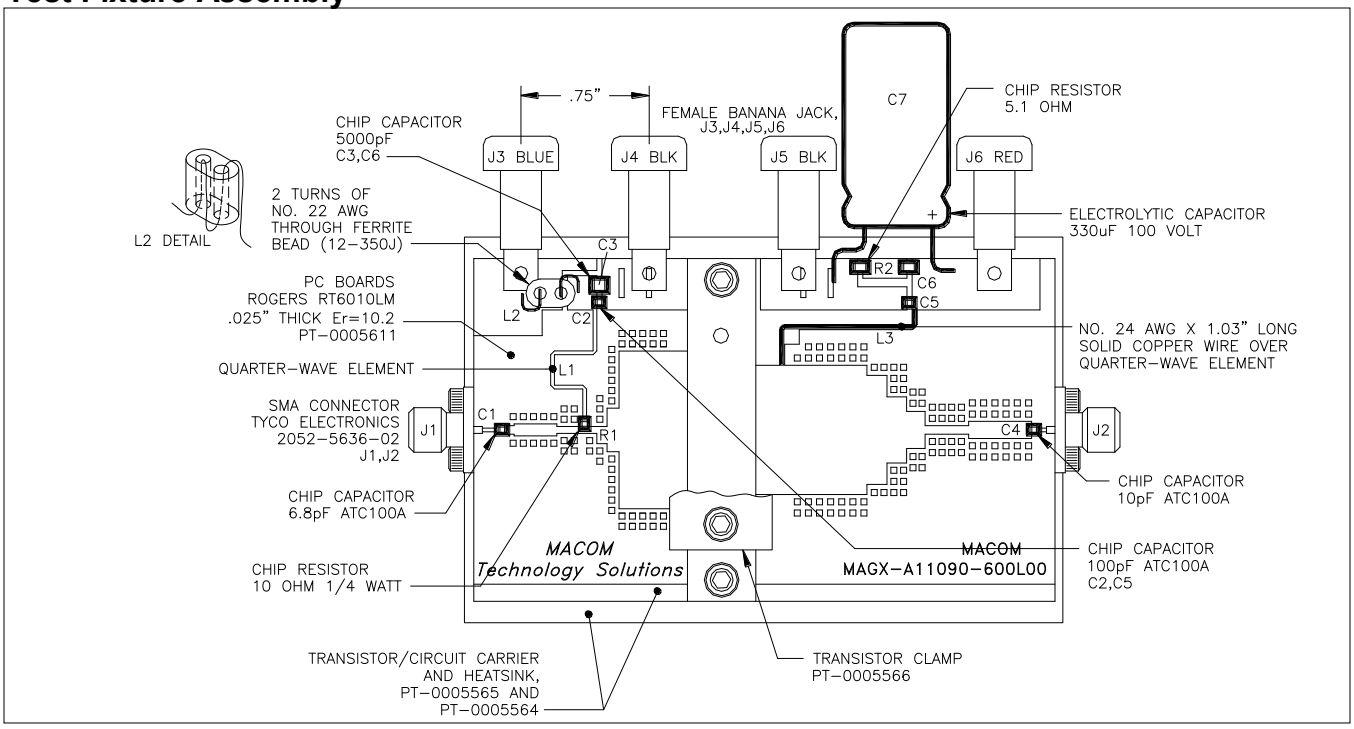
Parameter	Limit
Drain Voltage (V_{DD})	+65 V
Gate Voltage (V_{GG})	-8 to -2 V
Drain Current (I_{DD})	80 A
Input Power[6] (P_{IN})	P_{IN} (nominal) + 3 dB
Operating Junction Temperature[7]	250 ºC
Peak Pulsed Power Dissipation at 85 ºC	3.5 kW
Operating Temperature Range	-40 to +95 ºC
Storage Temperature Range	-65 to +150 ºC
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 x 10^6 hours (T_J < 200 °C)
   - MTTF = 6.8 x 10^4 hours (T_J < 250 °C)

Thermal Characteristics

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance	T_C = 70 ºC, V_{DD} = 50 V, I_{DQ} = 600 mA, P_{OUT} = 600 W, Pulse Width = 32 µs, Duty Cycle = 2%	Θ_{JC}	0.05	°C/W

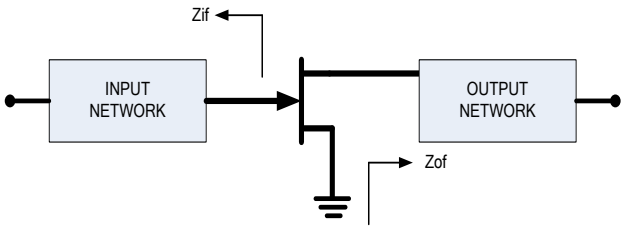
Test Fixture Assembly



Contact MACOM for additional circuit information.

Test Fixture Impedances

Freq. (MHz)	Z_{IF} (Ω)	Z_{OF} (Ω)
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

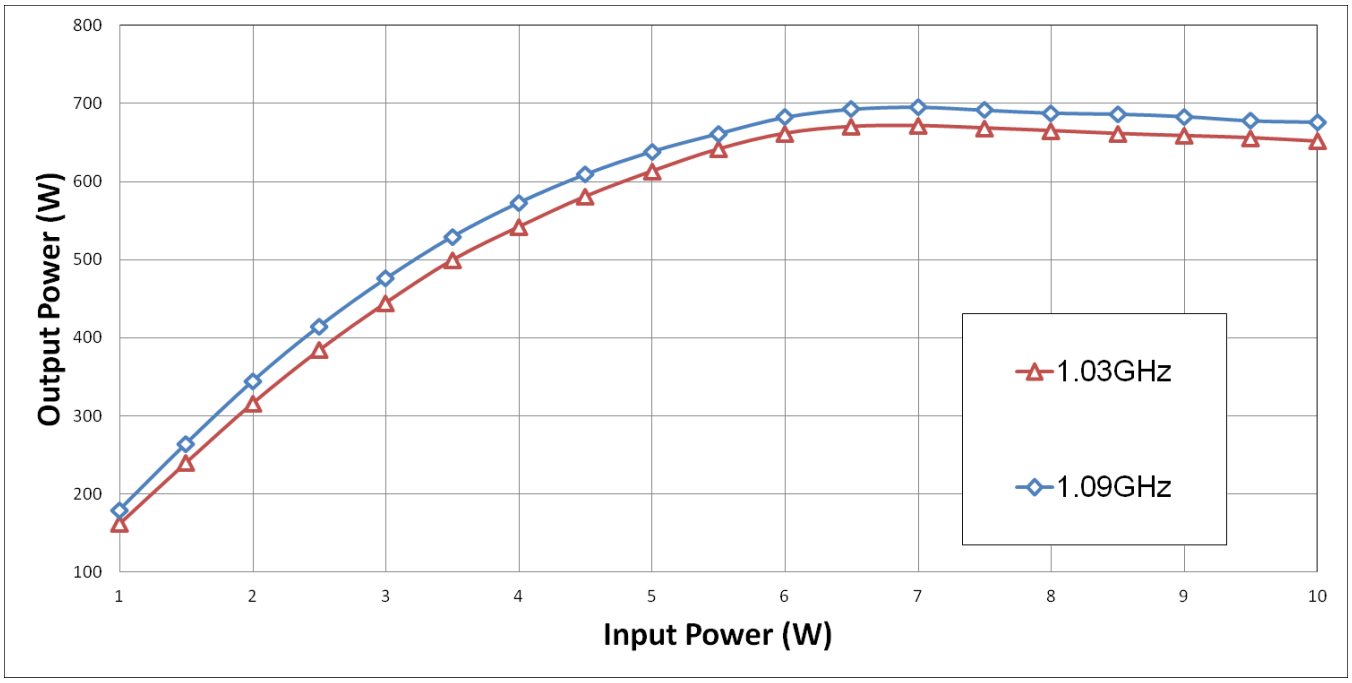
Turning the device ON

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.

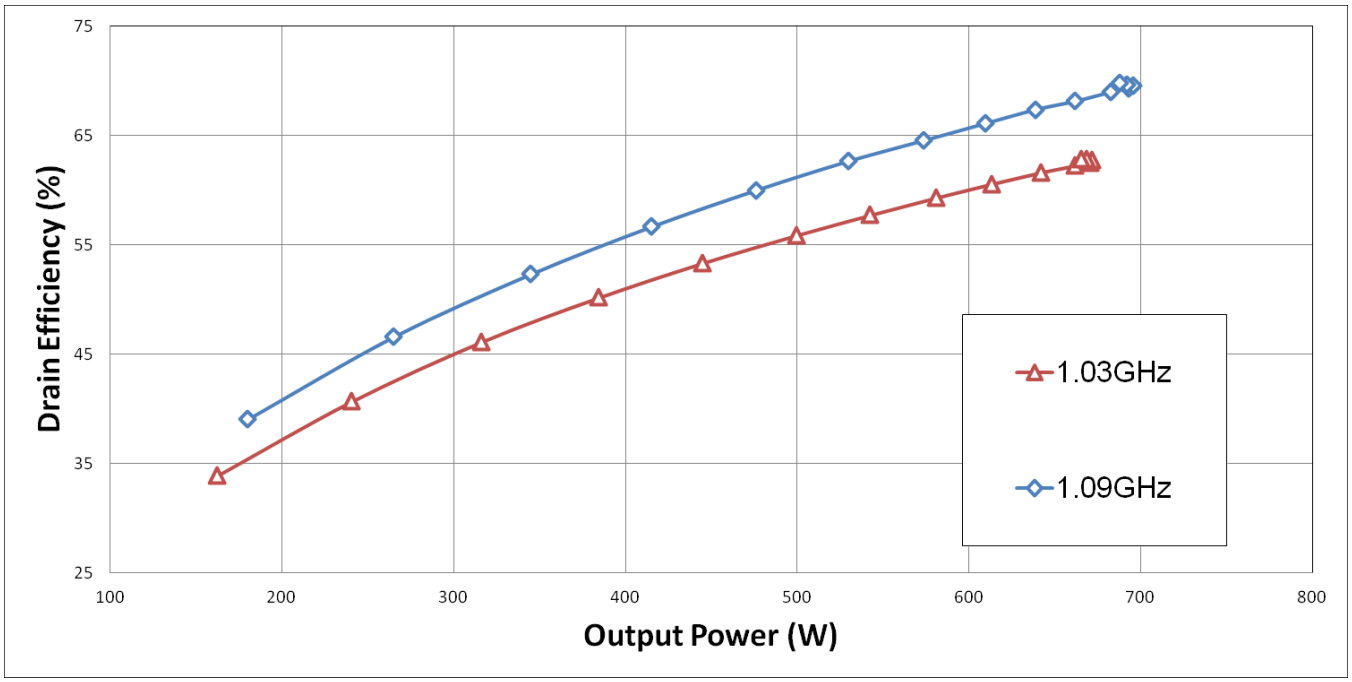
Turning the device OFF

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)



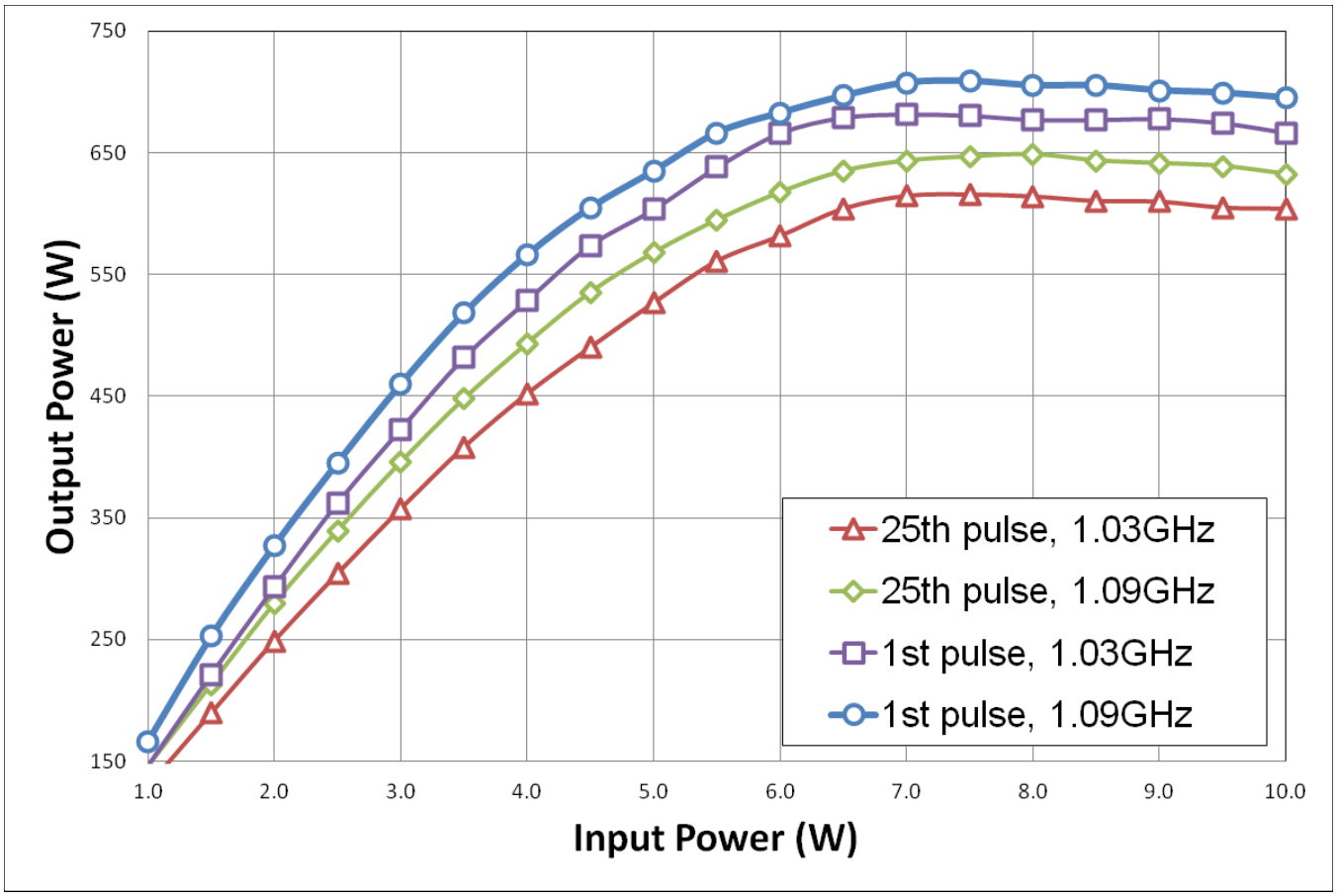
RF Power Transfer Curve (Drain Efficiency Vs. Output Power)



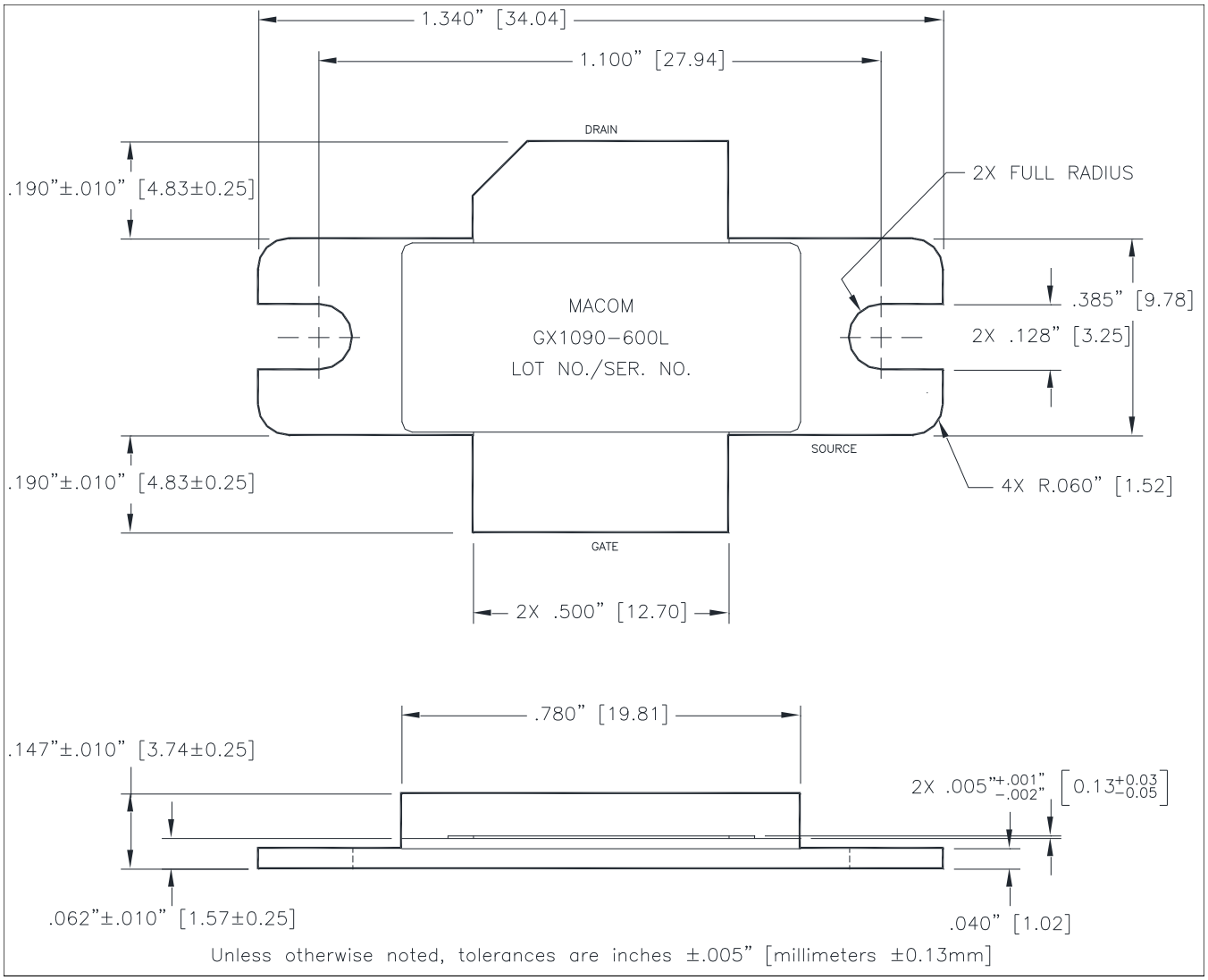
Typical RF Data with Mode-S ELM 'pulse' conditions:

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

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

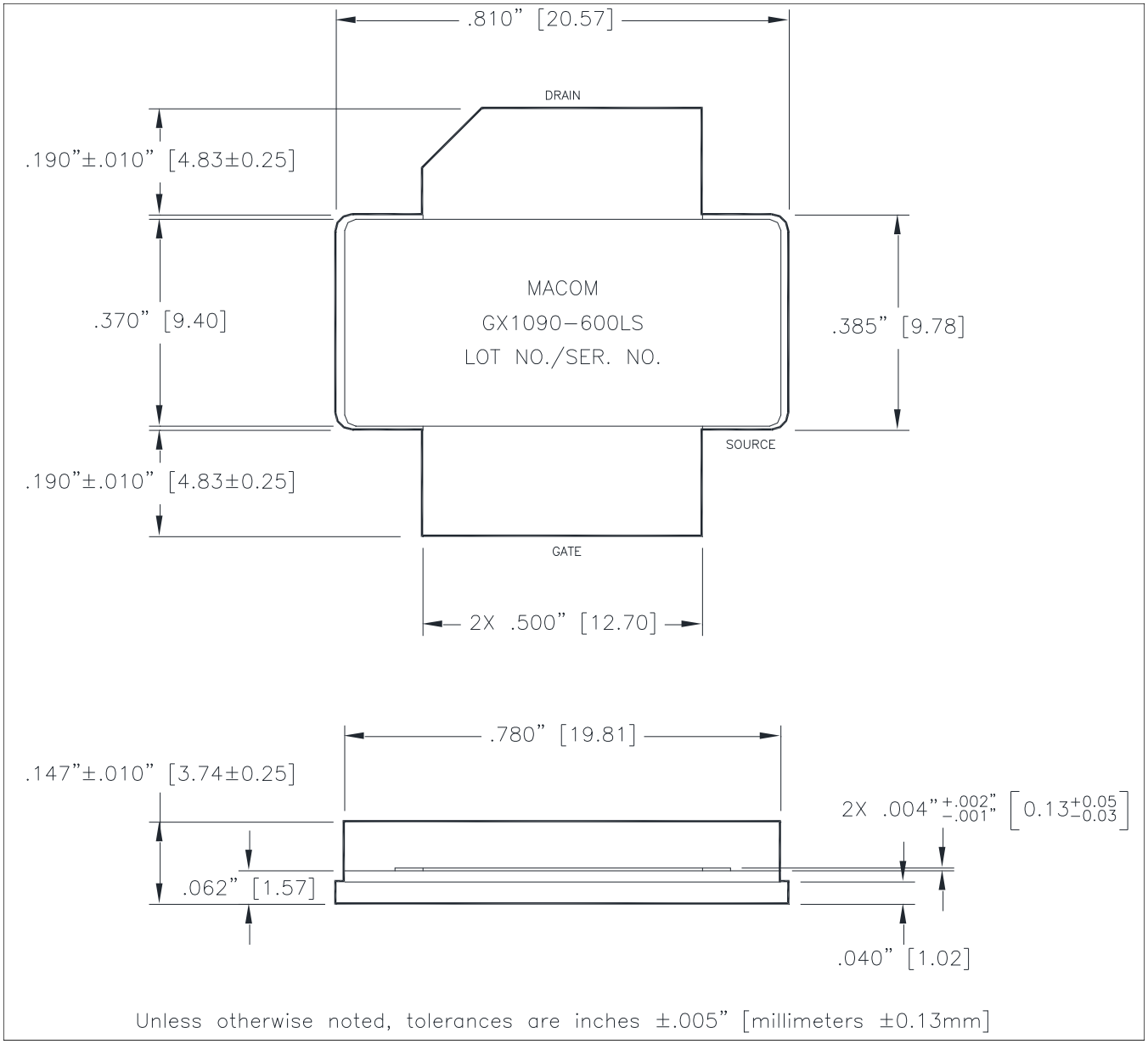


Outline Drawing MAGX-001090-600L00†



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

Outline Drawing MAGX-001090-600L0S†



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Meets JEDEC moisture sensitivity level 1 requirements.
Plating is Ni/Au.