

GaN on SiC HEMT Pulsed Power Transistor 650 W Peak, 1200-1400 MHz, 300 µs 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)

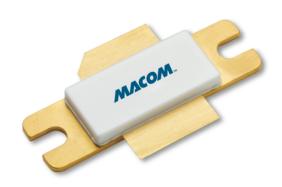
Applications

• L-Band pulsed radar.

Description

The MAGX-001214-650L0x is a gold-metalized matched Gallium Nitride (GaN) on Silicon Carbide (SiC) 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, 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-001214-650L00



Ordering Information

Part Number	Description
MAGX-001214-650L00	GaN Transistor
MAGX-L21214-650L00	1200-1400 MHz Evaluation Board

Typical RF Performance Under Standard Operating Conditions, Pout = 650 W (Peak)

Freq. (MHz)	P _{IN} (W)	Gain (dB)	I _D (A)	Eff. (%)	RL (dB)	Droop (dB)	+1dB OD (W)	VSWR-S (3:1)
1200	8.7	18.8	21.3	61.0	-13.9	0.2	717	S
1250	8.5	18.9	22.0	58.9	-13.8	0.3	726	S
1300	8.0	19.1	22.4	57.8	-13.5	0.3	724	S
1350	7.0	19.7	21.8	59.7	-15.8	0.3	723	S
1400	7.0	19.7	21.1	61.4	-15.0	0.2	697	S

^{*} Restrictions on Hazardous Substances, European Union Directive 2002/95/EC.



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Electrical Specifications: Freq. = 1200 - 1400 MHz, T_A = 25°C

Parameter	Test Conditions	Symbol	Min.	Тур.	Max.	Units
RF Functional Tests	RF Functional Tests					
Peak Input Power		P _{IN}	-	7.5	10.3	W
Power Gain	V _{DD} = 50 V, I _{DQ} = 500 mA Pulse Width = 300 μs, Duty Cycle = 10% P _{OUT} = 650 W Peak (65 W avg.)	G_P	18	19.5	-	dB
Drain Efficiency		η_{D}	55	60	-	%
Pulse Droop		Droop	-	0.3	0.6	dB
Load Mismatch Stability		VSWR-S	-	2:1	-	-
Load Mismatch Tolerance		VSWR-T	-	3:1	-	-

Electrical Characteristics: $T_A = 25$ °C

Parameter	Test Conditions	Symbol	Min.	Тур.	Max.	Units
DC Characteristics						
Drain-Source Leakage Current	V _{GS} = -8 V, V _{DS} = 175 V	I _{DS}	-	1.7	33	mA
Gate Threshold Voltage	$V_{DS} = 5 \text{ V}, I_{D} = 90 \text{ mA}$	V _{GS (TH)}	-5	-2.9	-2	V
Forward Transconductance	$V_{DS} = 5 \text{ V}, I_{D} = 21 \text{ mA}$	G _M	16.2	21.7	-	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,	Coss	-	55	-	pF
Reverse Transfer Capacitance	Freq. = 1 MHz	C _{RSS}	-	5.5	-	pF



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Absolute Maximum Ratings^{1,2,3}

Parameter	Limit
Drain Voltage (V _{DD})	+65 V
Gate Voltage (V _{GG})	-8 to 0 V
Drain Current (I _{DD})	27 A
Input Power ⁴ (P _{IN})	P _{IN} (nominal) + 3 dB
Operating Junction Temperature ⁵	250°C
Peak Pulsed Power Dissipation at 85°C	700 W
Operating Temperature Range	-40 to +85°C
Storage Temperature Range	-65 to +150°C
ESD Min Charged Device Model (CDM)	1300 V
ESD Min Human Body Model (HBM)	4000 V

^{1.} Exceeding any one or combination of these limits may cause permanent damage to this device.

Thermal Characteristics

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance	T_C = 70°C, V_{DD} = 50 V, I_{DQ} = 500 mA, P_{OUT} = 650 W Pulse Width = 300 μ s, Duty Cycle = 10%	Θ _{JC}	0.25	°C/W

^{2.} MACOM does not recommend sustained operation near these survivability limits.

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

^{4.} Input Power Limit is +3 dB over nominal drive required to achieve P_{OUT} = 650 W.

^{5.} 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.

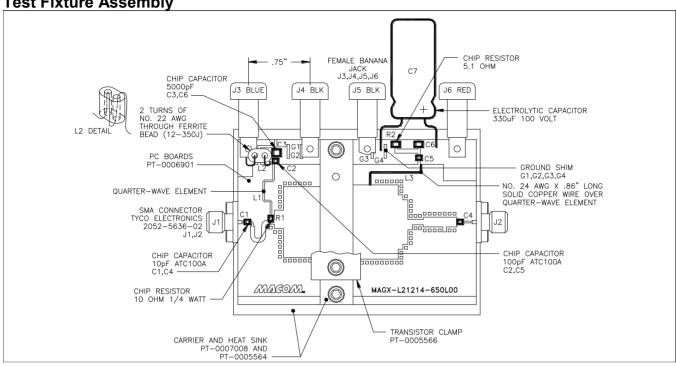
MTTF = 5.3 x 10⁶ hours (T_J < 200°C)
MTTF = 6.8 x 10⁴ hours (T_J < 250°C)



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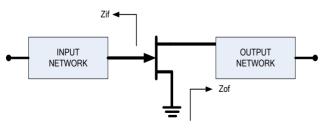
Test Fixture Assembly



Contact factory for gerber file or additional circuit information.

Test Fixture Impedances

F (MHz)	Z _{IF} (Ω)	$Z_{OF}\left(\Omega\right)$
1200	0.8 - j0.9	1.4 + j0.2
1250	0.8 - j0.7	1.4 + j0.2
1300	0.7 - j0.6	1.4 + j0.1
1350	0.7 - j0.4	1.2 + j0.1
1400	0.7 - j0.2	1.1 + j0.2



Contact factory for gerber file or additional circuit information.

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

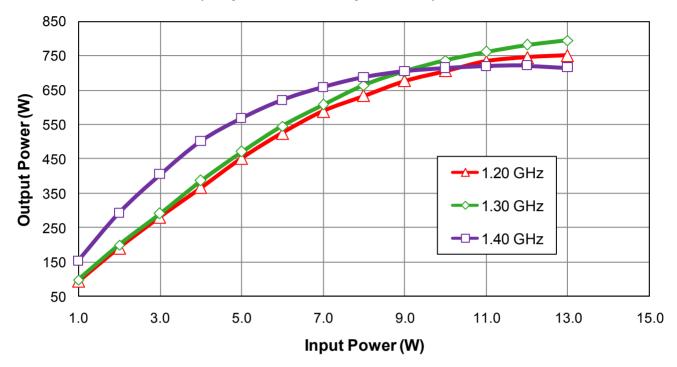
- 1. Turn the RF power off.
- 2. Decrease V_{GS} down to V_P.
- 3. Decrease V_{DS} down to 0 V.
- 4. Turn off V_{GS}



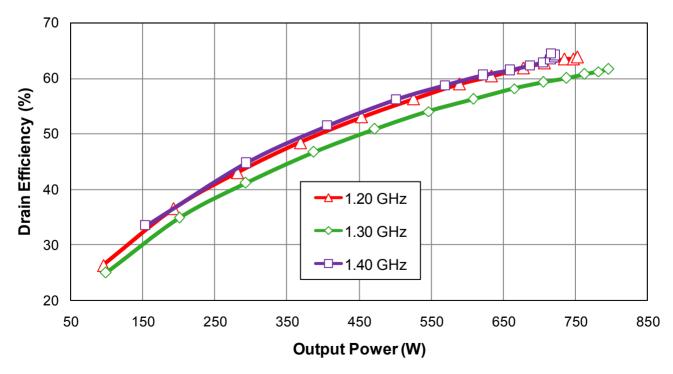
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RF Power Transfer Curve (Output Power vs. Input Power)



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

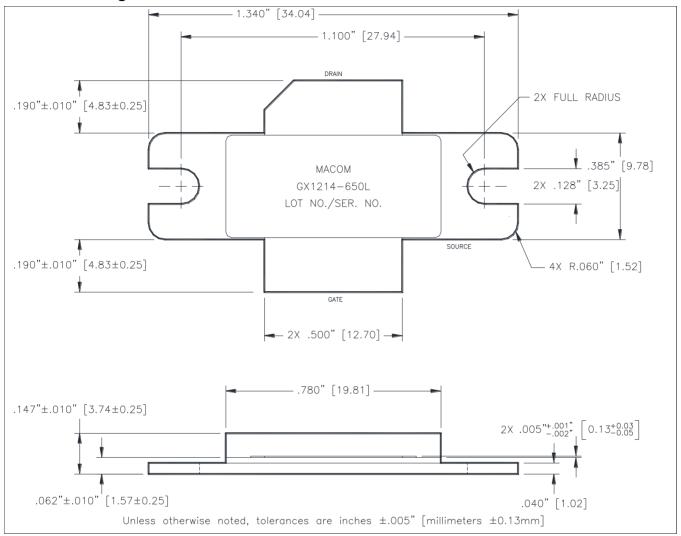




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Outline Drawing MAGX-001214-650L00





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