MAGX-001214-650L0x

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, P_{OUT} = 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.	Typ.	Max.	Units
RF Functional Tests						
Peak Input Power	V_{DD} = 50 V, I_{DQ} = 500 mA Pulse Width = 300 µs, Duty Cycle = 10% P_{OUT} = 650 W Peak (65 W avg.)	P_{IN}	-	7.5	10.3	W
Power Gain		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.	Typ.	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 V, I_D = 90 mA	$V_{GS\ (TH)}$	-5	-2.9	-2	V
Forward Transconductance	V_{DS} = 5 V, I_D = 21 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, Freq. = 1 MHz	C_{OSS}	-	55	-	pF
Reverse Transfer Capacitance		C_{RSS}	-	5.5	-	pF

Absolute Maximum Ratings[1,2,3]

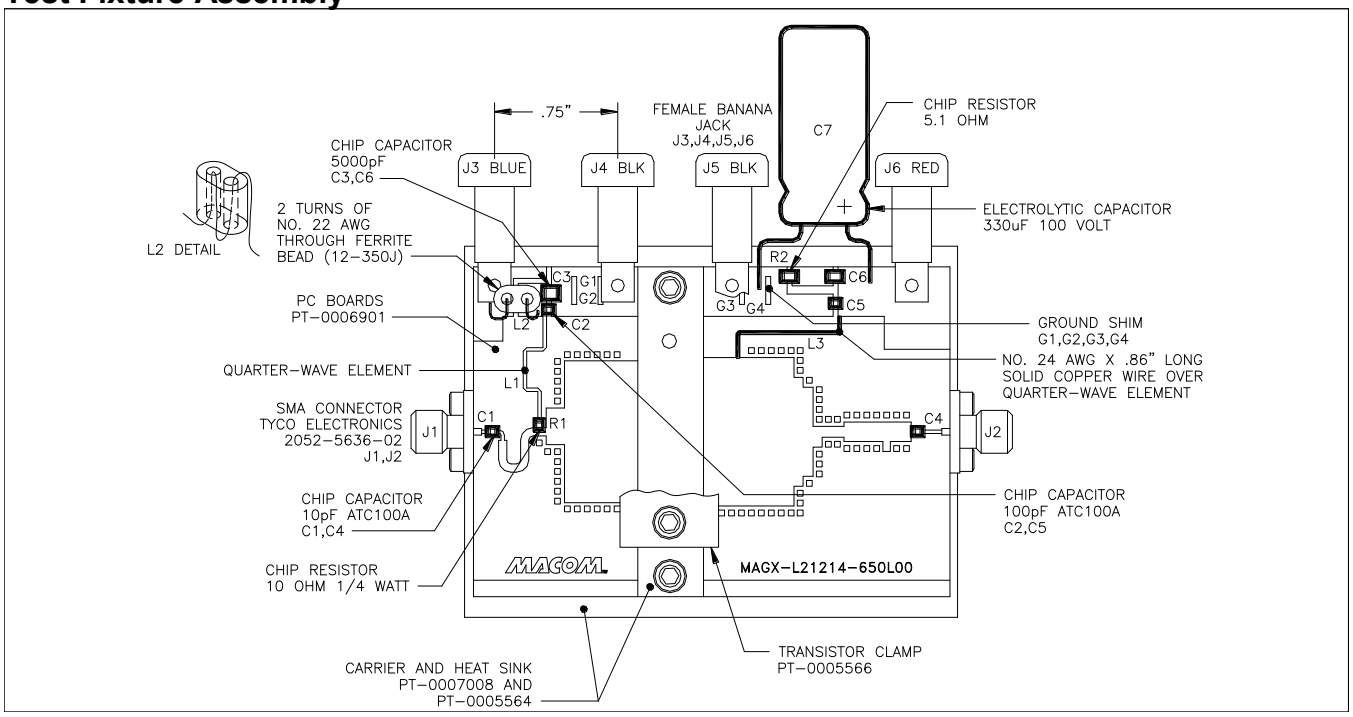
Parameter	Limit
Drain Voltage (V_{DD})	+65 V
Gate Voltage (V_{GG})	-8 to 0 V
Drain Current (I_{DD})	27 A
Input Power[4] (P_{IN})	P_{IN} (nominal) + 3 dB
Operating Junction Temperature[5]	250ºC
Peak Pulsed Power Dissipation at 85ºC	700 W
Operating Temperature Range	-40 to +85ºC
Storage Temperature Range	-65 to +150ºC
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.
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 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 = 70ºC, V_{DD} = 50 V, I_{DQ} = 500 mA, P_{OUT} = 650 W Pulse Width = 300 µs, Duty Cycle = 10%	Θ_{JC}	0.25	°C/W

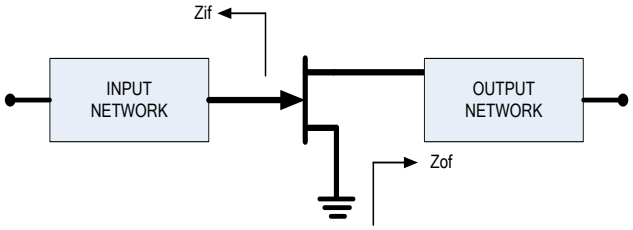
Test Fixture Assembly



Contact factory for gerber file or additional circuit information.

Test Fixture Impedances

F (MHz)	Z_{IF} (Ω)	Z_{OF} (Ω)
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



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Correct Device Sequencing

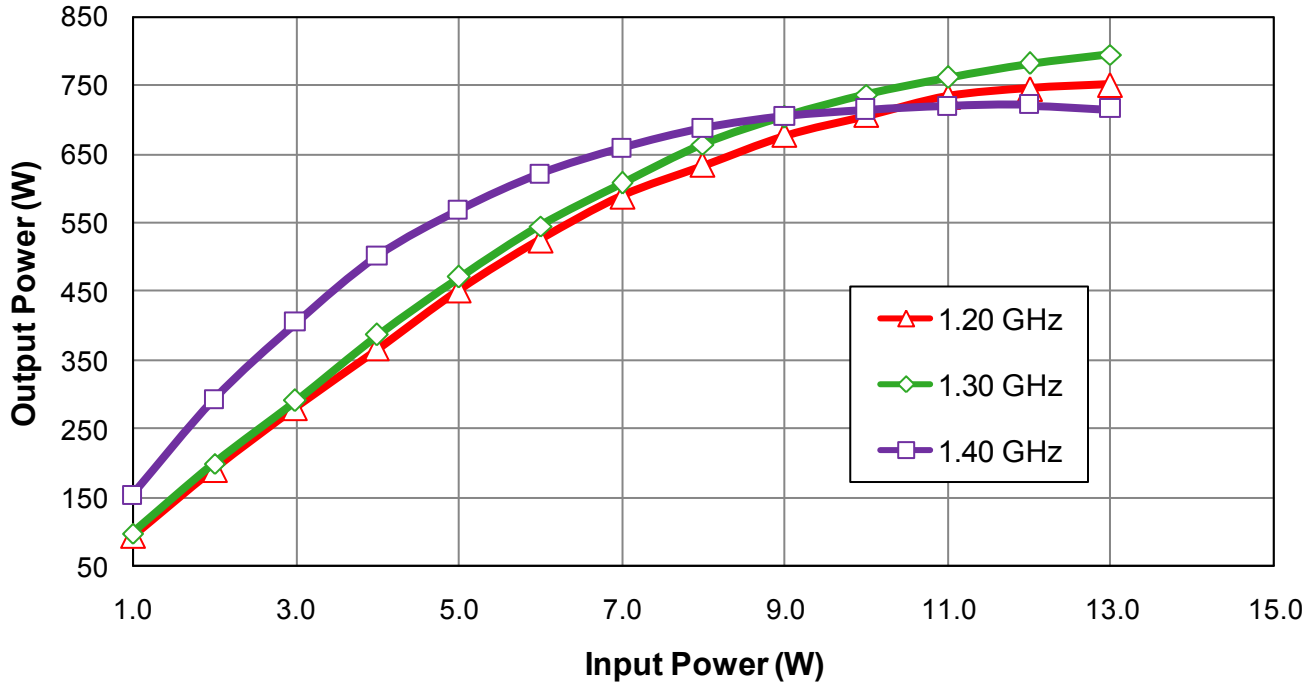
Turning the device ON

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.

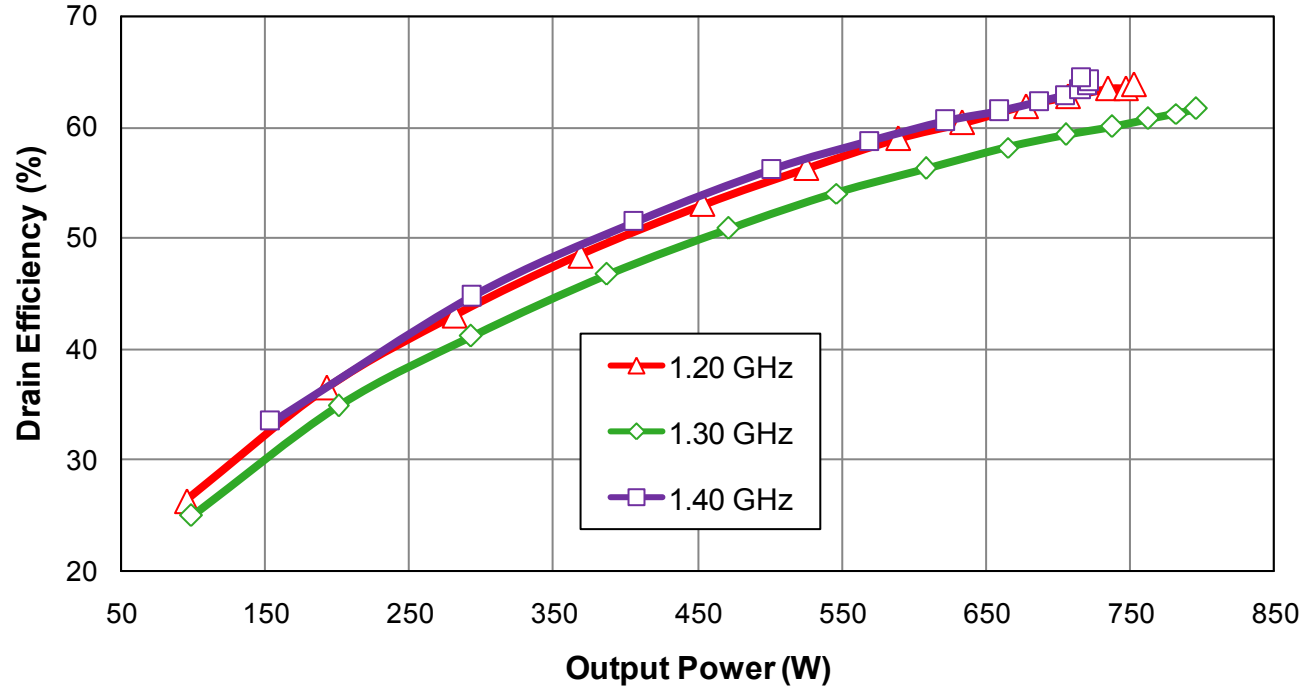
Turning the device OFF

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)



Outline Drawing MAGX-001214-650L00