MAGX-003135-120L00

GaN on SiC HEMT Pulsed Power Transistor
120 W Peak, 3.1 to 3.5 GHz, 300 μs Pulse, 10% Duty

Rev. V4

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°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.

Electrical Specifications: Freq. = 3.1 - 3.5 GHz, T_A = 25°C

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

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}	-	0.5	9	mA
Gate Threshold Voltage	V_{DS} = 5 V, I_D = 23 mA	$V_{GS\ (TH)}$	-5	-3	-2	V
Forward Transconductance	V_{DS} = 5 V, I_D = 9 A	G_M	3.3	-	-	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, F = 1 MHz	C_{OSS}	-	13.4	16	pF
Reverse Transfer Capacitance	V_{DS} = 50 V, V_{GS} = -8 V, F = 1 MHz	C_{RSS}	-	1.4	2.2	pF

Absolute Maximum Ratings[1,2,3,4,5]

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	200ºC
Pulsed Power Dissipation at 85ºC	170 W (Pulse Width = 100 μs) 144 W (Pulse Width = 300 μs)
Operating Temperature	-40 to +95ºC
Storage Temperature	-65 to +150ºC
ESD Min. - Charged Device Model (CDM)	300 V
ESD Min. - Human Body Model (HBM)	700 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, the following is recommended: (3*V_{DD} + abs(V_{GG})) <175 V.
4. Operating at nominal conditions with $T_J \leq +200°C$ will ensure MTTF > 1 x 10^6 hours. Junction temperature directly affects device MTTF and should be kept as low as possible to maximize lifetime.
5. Junction Temperature (T_J) = T_C + Θ_{JC} * ((V * I) - (P_{OUT} - P_{IN})).

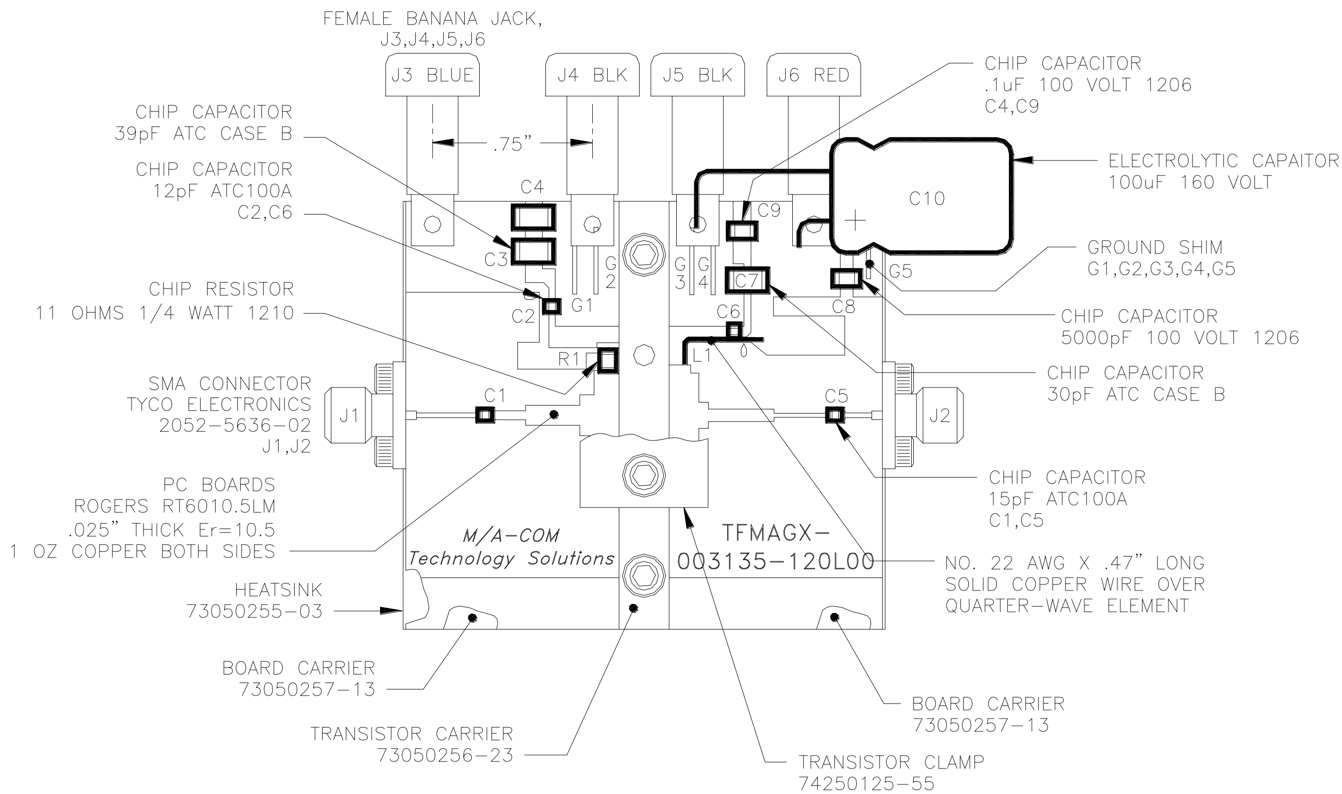
   Typical Transient Thermal Resistances (I_{DQ} = 300 mA, 300 μs pulse, 10% duty cycle):

   a) Freq. = 3.1 GHz, Θ_{JC} = 0.63°C/W
   T_J = 178°C (T_C = 85°C, 50 V, 5.15 A, P_{OUT} = 120 W, P_{IN} = 9.5 W)

   b) Freq. = 3.3 GHz, Θ_{JC} = 0.69°C/W
   T_J = 188°C (T_C = 85°C, 50 V, 5.24 A, P_{OUT} = 120 W, P_{IN} = 7.0 W)

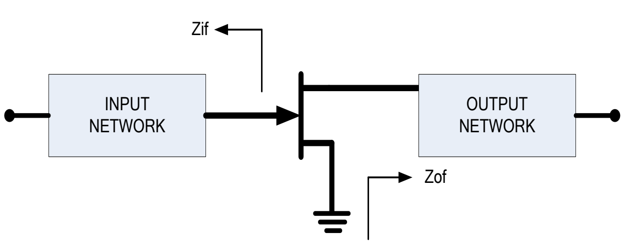
   c) Freq. = 3.5 GHz, Θ_{JC} = 0.67°C/W
   T_J = 180°C (T_C = 85°C, 50 V, 5.12 A, P_{OUT} = 120 W, P_{IN} = 6.8 W)

Evaluation Board Assembly (3.1 - 3.5 GHz)



Evaluation Board Impedances

Freq. (MHz)	Z_{IF} (Ω)	Z_{OF} (Ω)
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

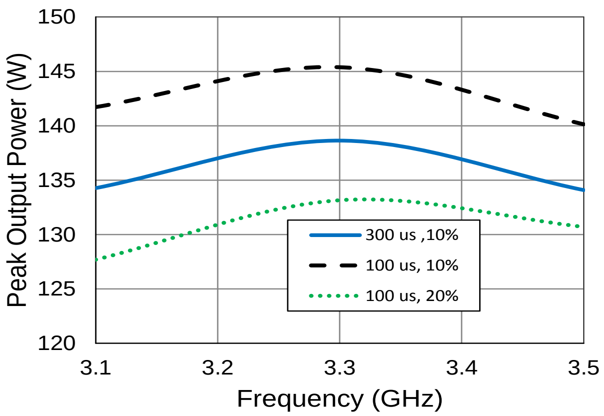
1. Set V_{GS} to the pinch-off (V_P), typically -5 V.
2. Turn on V_{DS} to nominal voltage (50 V).
3. Increase V_{GS} until the I_{DS} current is reached.
4. Apply RF power to desired level.

Turning the device OFF

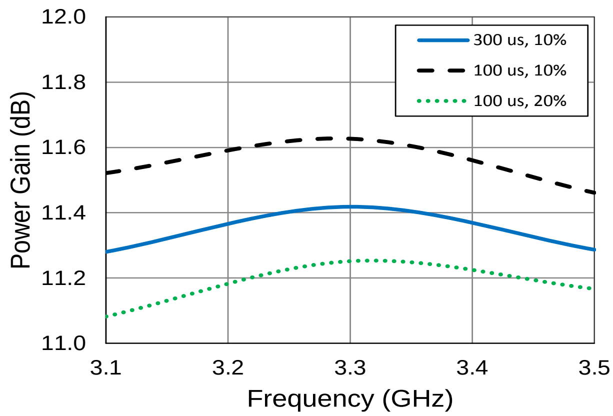
1. Turn the RF power off.
2. Decrease V_{GS} down to $V_{P.}$
3. Decrease V_{DS} down to 0 V.
4. Turn off V_{GS}

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

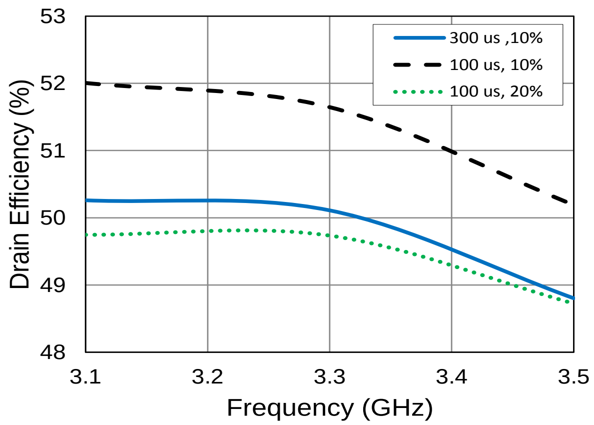
Peak Output Power vs. Frequency



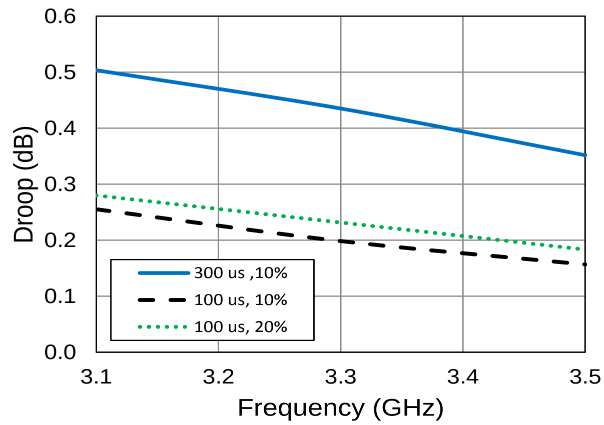
Power Gain vs. Frequency



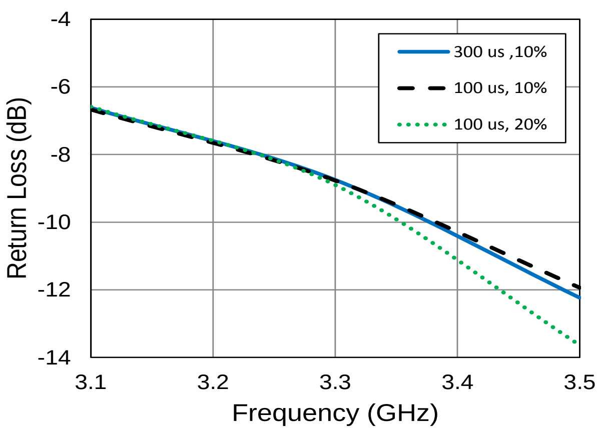
Drain Efficiency vs. Frequency



Return Loss vs. Frequency

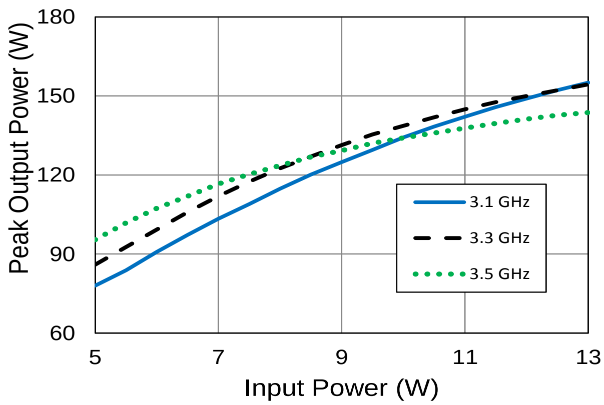


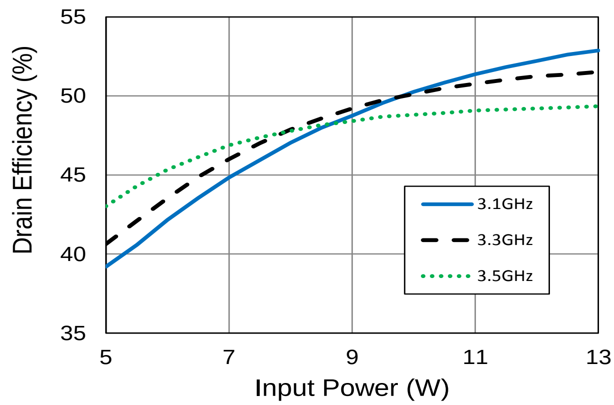
Droop vs. Frequency



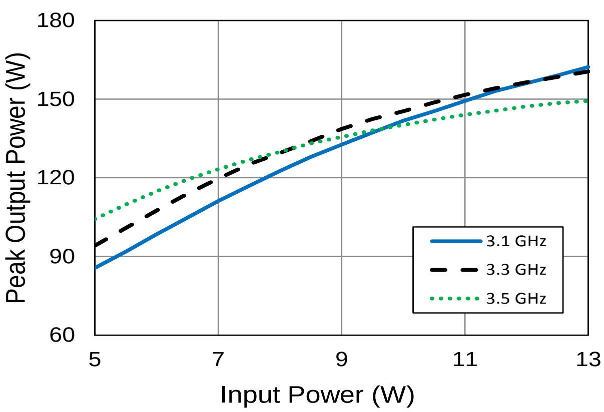
Typical Performance Curves: V_{DD} = 50 V, I_{DQ} = 300 mA

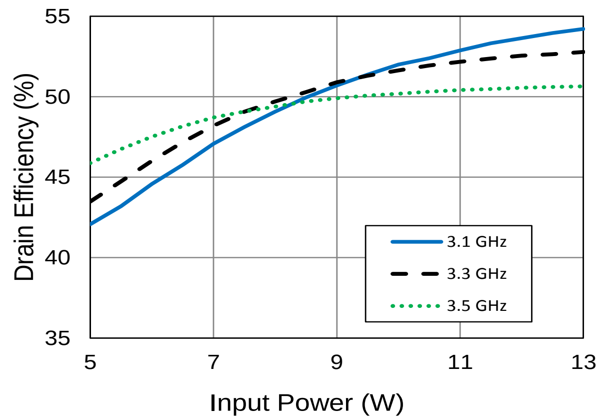
Output Power / Drain Efficiency vs. Input Power (Pulse Width = 300 µs, Duty = 10%)



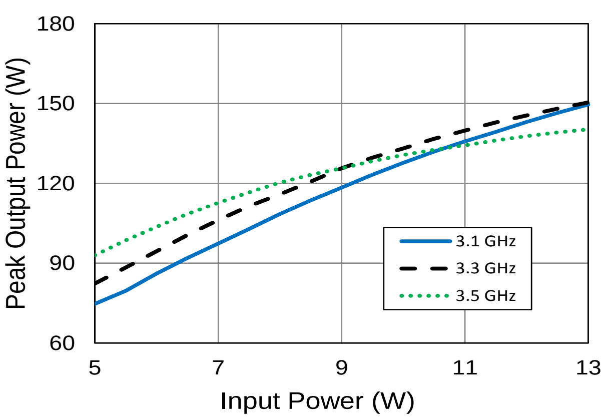


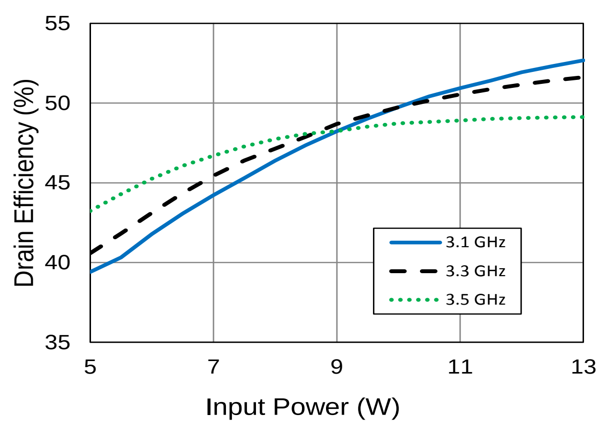
Output Power / Drain Efficiency vs. Input Power (Pulse Width = 100 µs, Duty = 10%)



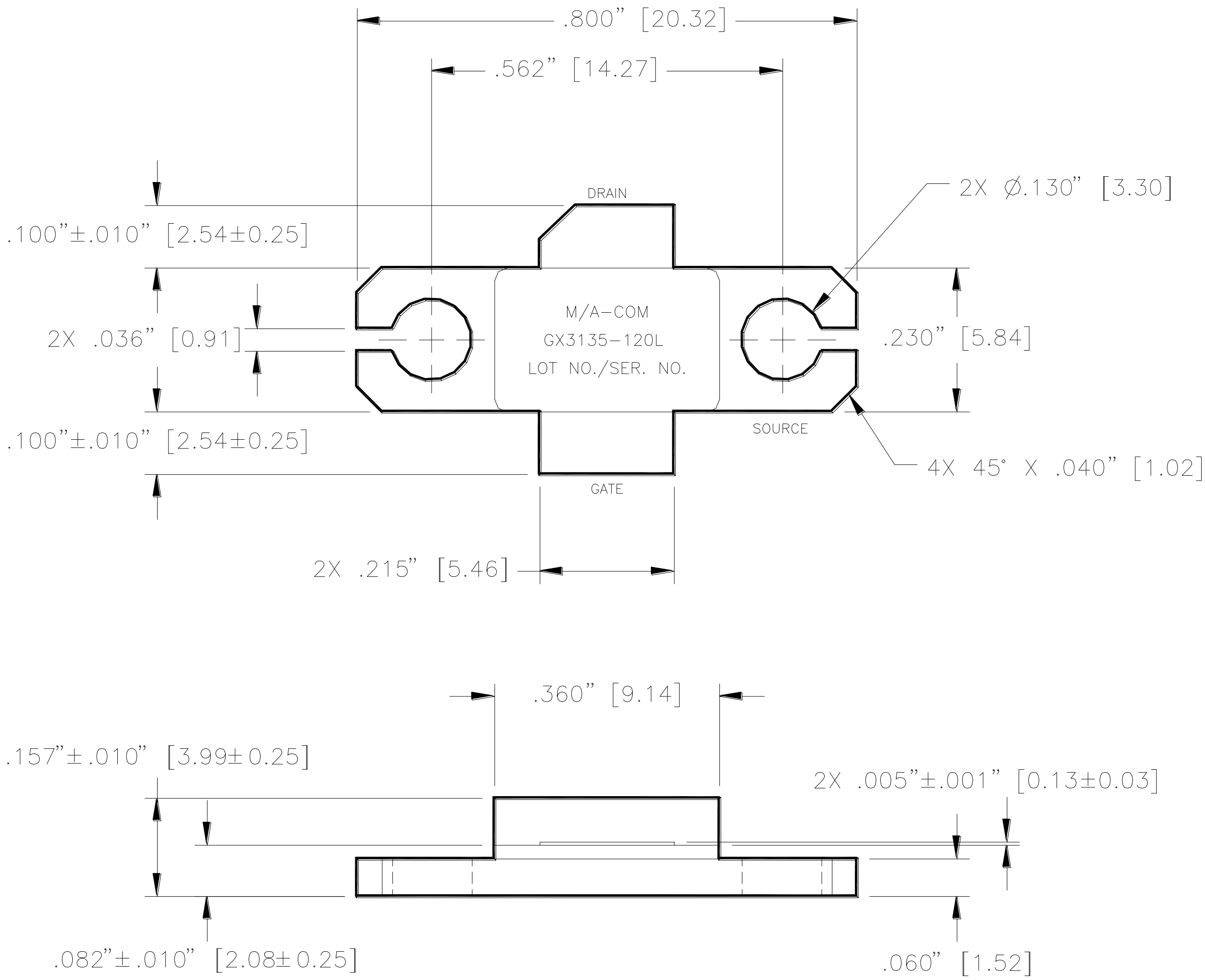


Output Power / Drain Efficiency vs. Input Power (Pulse Width = 100 µs, Duty = 20%)





Package Outline



Unless otherwise noted, tolerances are inches ±.005” [millimeters ±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.