

MAGX-000912-125L00



GaN on SiC HEMT Pulsed Power Transistor 125 W Peak, 960-1215 MHz, 128 μ 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

- 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-000912-500L00 is a gold metalized matched Gallium Nitride (GaN) on Silicon Carbide RF power transistor optimized for civilian and military pulsed avionics amplifier applications for the 960 MHz to 1215 MHz range such as Mode-S, TCAS, JTIDS, DME and TACAN. 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-000912-125L00	125W GaN Power Transistor
MAGX-000912-SB0PPR	Evaluation Test Fixture

Typical RF Performance under Standard Operating Conditions, $P_{OUT} = 125$ 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)
960	1.4	19.7	3.9	64.4	-6.1	0.3	S	P
1030	1.3	19.8	4.0	61.6	-11.9	0.3	S	P
1090	1.6	18.9	4.1	60.4	-9.6	0.3	S	P
1150	1.7	18.6	4.1	61.4	-9.3	0.3	S	P
1215	1.6	18.9	4.0	61.9	-12.0	0.3	S	P

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

GaN on SiC HEMT Pulsed Power Transistor
125 W Peak, 960-1215 MHz, 128 μ s Pulse, 10% Duty

Rev. V3

Electrical Specifications: Freq. = 960 - 1215 MHz, $T_A = 25^\circ\text{C}$

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
RF Functional Tests						
Peak Input Power	$V_{DD} = 50\text{ V}$, $I_{DQ} = 100\text{ mA}$, Pulse Width = 128 μ s, Duty Cycle = 10%, $P_{OUT} = 125\text{ W Peak (12.5 W avg.)}$	P_{IN}	-	1.2	2.2	W
Power Gain		G_P	17.5	19.2	-	dB
Drain Efficiency		η_D	57	62	-	%
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
DC Characteristics						
Drain-Source Leakage Current	$V_{GS} = -8\text{ V}$, $V_{DS} = 175\text{ V}$	I_{DS}	-	0.2	6	mA
Gate Threshold Voltage	$V_{DS} = 5\text{ V}$, $I_D = 15\text{ mA}$	$V_{GS(TH)}$	-5	-3.8	-2	V
Forward Transconductance	$V_{DS} = 5\text{ V}$, $I_D = 3.5\text{ mA}$	G_M	2.5	3.6	-	S
Dynamic Characteristics						
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}	-	11	-	pF
Reverse Transfer Capacitance		C_{RSS}	-	1.1	-	pF

GaN on SiC HEMT Pulsed Power Transistor 125 W Peak, 960-1215 MHz, 128 μ s Pulse, 10% Duty

Rev. V3

Absolute Maximum Ratings^{1,2,3}

Parameter	Limit
Drain Voltage (V_{DD})	+65 V
Gate Voltage (V_{GG})	-8 to -2 V
Drain Current (I_{DD})	9.5 A
Input Power ⁴ (P_{IN})	P_{IN} (nominal) + 3 dB
Operating Junction Temperature ⁵	250 °C
Peak Pulsed Power Dissipation at 85 °C	350 W
Operating Temperature Range	-40 to +95 °C
Storage Temperature Range	-65 to +150 °C
ESD Maximum - Machine Model (MM)	50 V
ESD Maximum - Human Body Model (HBM)	250 V

- 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 $P_{OUT} = 125$ 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 = 5.3×10^6 hours ($T_J < 200$ °C)
 - MTTF = 6.8×10^4 hours ($T_J < 250$ °C)

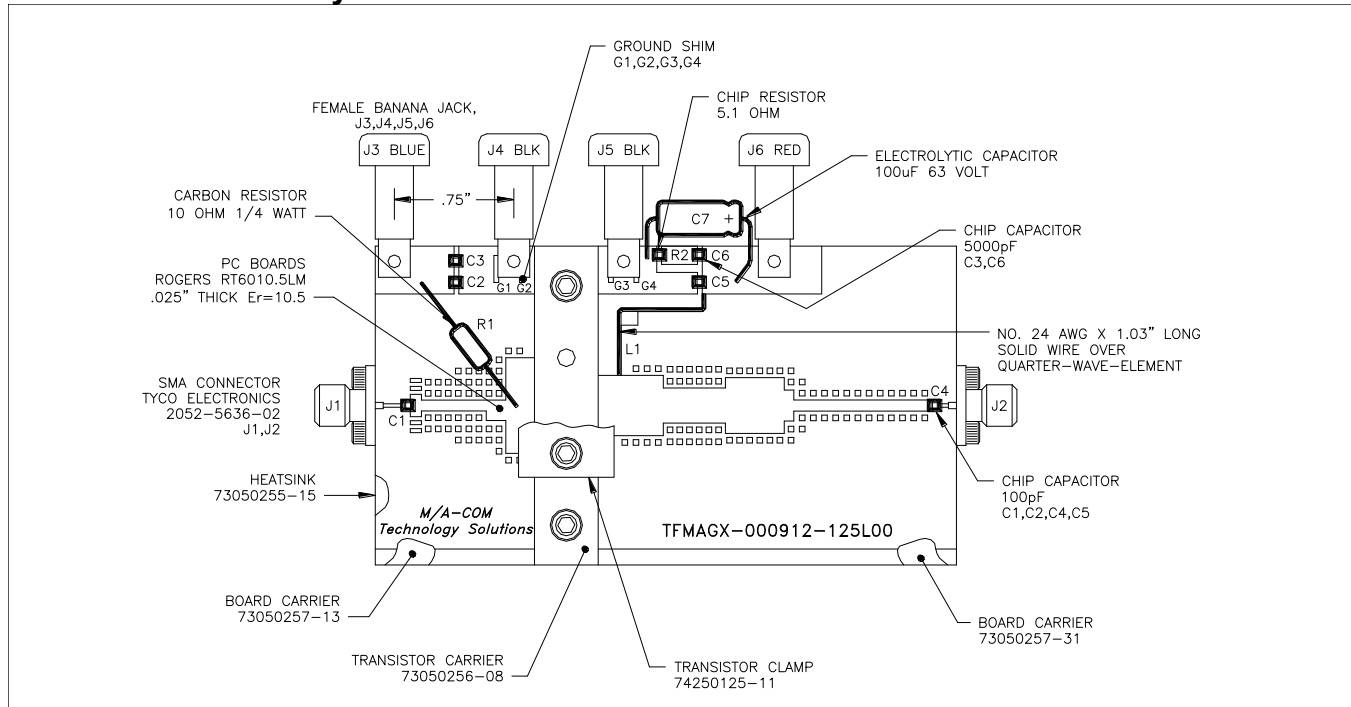
Thermal Characteristics

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance	$T_C = 70$ °C, $V_{DD} = 50$ V, $I_{DQ} = 100$ mA, $P_{OUT} = 125$ W, Pulse Width = 128 μ s, Duty Cycle = 10%	Θ_{JC}	0.5	°C/W

GaN on SiC HEMT Pulsed Power Transistor 125 W Peak, 960-1215 MHz, 128 μ s Pulse, 10% Duty

Rev. V3

Test Fixture Assembly



Contact MACOM for additional circuit information.

Test Fixture Impedances

Freq. (MHz)	Z_{IF} (Ω)	Z_{OF} (Ω)
960	3.9 - j7.5	7.6 + j2.6
1030	3.7 - j6.6	8.3 + j1.5
1090	3.6 - j5.6	8.2 + j0.8
1150	4.7 - j6.0	8.0 + j0.6
1215	4.1 - j5.5	8.2 + j0.9

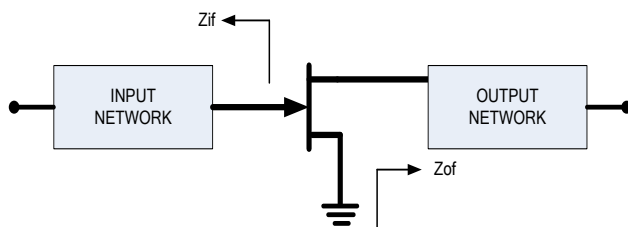
Correct Device Sequencing

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

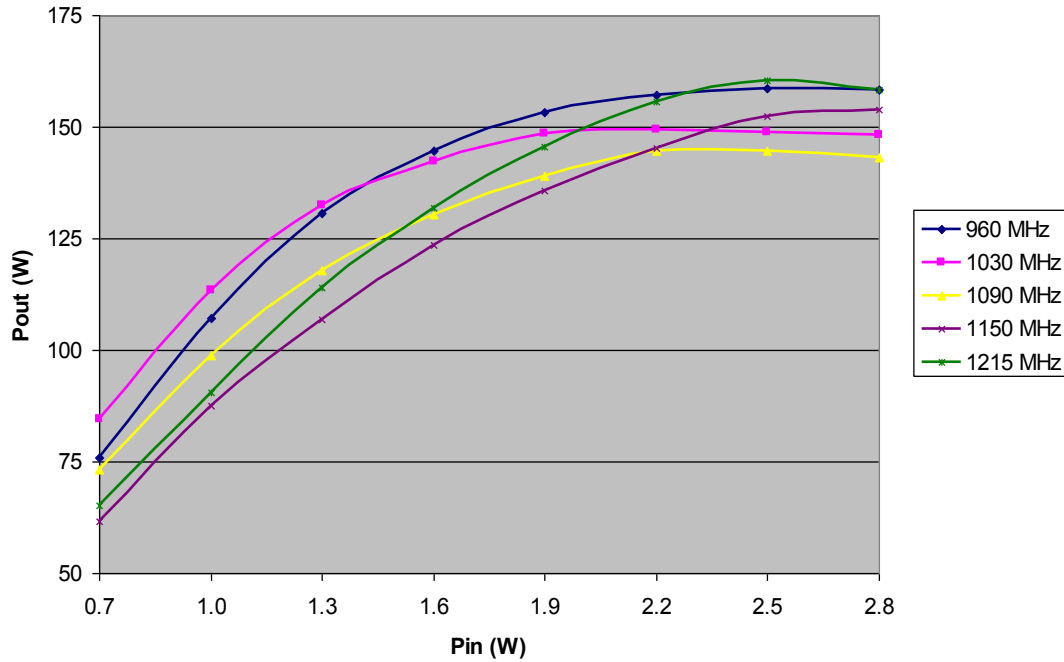
1. Turn the RF power off.
2. Decrease V_{GS} down to V_P .
3. Decrease V_{DS} down to 0 V.
4. Turn off V_{GS} .



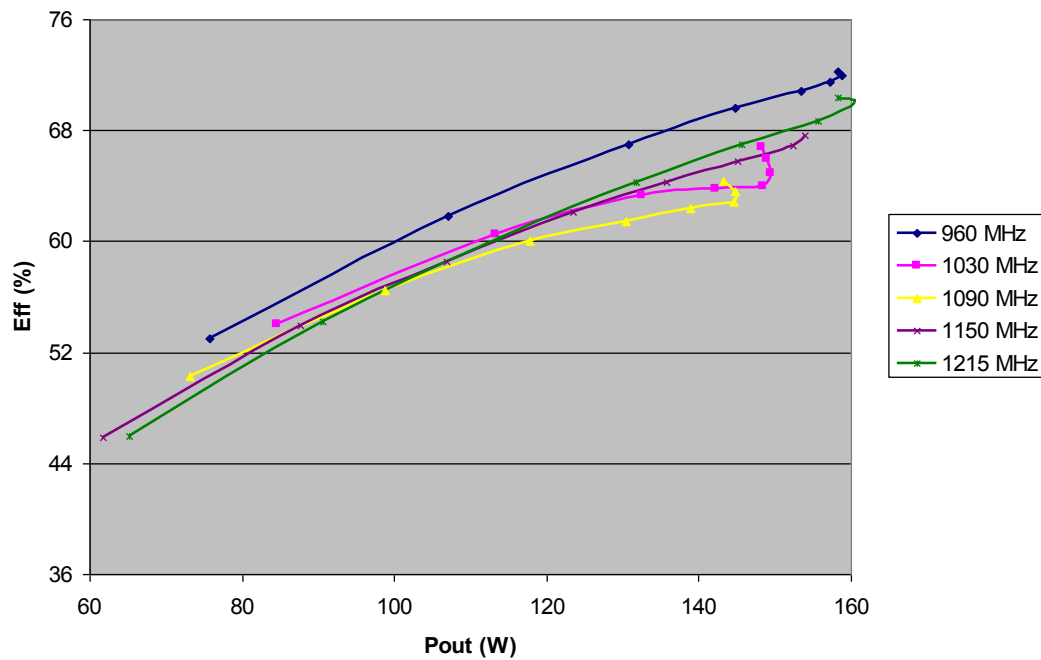
GaN on SiC HEMT Pulsed Power Transistor
 125 W Peak, 960-1215 MHz, 128 μ s Pulse, 10% Duty

Rev. V3

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



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



M/A-COM Technology Solutions Inc. All rights reserved.

Information in this document is provided in connection with M/A-COM Technology Solutions Inc ("MACOM") products. These materials are provided by MACOM as a service to its customers and may be used for informational purposes only. Except as provided in MACOM's Terms and Conditions of Sale for such products or in any separate agreement related to this document, MACOM assumes no liability whatsoever. MACOM assumes no responsibility for errors or omissions in these materials. MACOM may make changes to specifications and product descriptions at any time, without notice. MACOM makes no commitment to update the information and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to its specifications and product descriptions. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document.

THESE MATERIALS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, CONSEQUENTIAL OR INCIDENTAL DAMAGES, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT. MACOM FURTHER DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. MACOM SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS, WHICH MAY RESULT FROM THE USE OF THESE MATERIALS.

MACOM products are not intended for use in medical, lifesaving or life sustaining applications. MACOM customers using or selling MACOM products for use in such applications do so at their own risk and agree to fully indemnify MACOM for any damages resulting from such improper use or sale.