

GaN on SiC HEMT Pulsed Power Transistor 45 W Peak, DC-3500 MHz, 1 ms Pulse, 10% Duty

Rev. V1

Features

- GaN on SiC Depletion Mode Transistor
- Common-Source Configuration
- Broadband Class AB Operation
- Thermally Enhanced Cu/Mo/Cu Package
- RoHS* Compliant
- +50V Typical Operation
- MTTF = 600 years ($T_J < 200^\circ\text{C}$)

Application

- Civilian and Military Pulsed Radar

Description

The MAGX-000035-045000 is a gold metalized unmatched Gallium Nitride (GaN) on Silicon Carbide (SiC) RF power transistor optimized for civilian and military radar pulsed applications between DC - 3500 MHz. 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. The MAGX-000035-045000 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.

MAGX-000035-045000



Ordering Information

Part Number	Description
MAGX-000035-045000	Bulk Packaging
MAGX-S10035-045000	Sample Board (2.7 - 3.5 GHz)

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Electrical Specifications¹: Freq. = 2700-3500 MHz, T_A = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
RF Functional Tests: V_{DD} = 50 V, I_{DQ} = 100 mA, 1 ms Pulse, 10% Duty						
Output Power	P _{IN} = 4 W	P _{OUT}	45	54	-	W
Power Gain	P _{IN} = 4 W	G _P	10.5	11.3	-	dB
Drain Efficiency	P _{IN} = 4 W	η _D	48	55	-	%
Input Return Loss	P _{IN} = 4 W	IRL	-	-13	-8	dB
Load Mismatch Stability	P _{IN} = 4 W	VSWR-S	-	5:1	-	-
Load Mismatch Tolerance	P _{IN} = 4 W	VSWR-T	-	10:1	-	-

Electrical Specifications¹: Freq. = 1030-1090 MHz, T_A = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
RF Functional Tests: V_{DD} = 50 V, I_{DQ} = 100 mA, 1 ms Pulse, 10% Duty						
Output Power	P _{IN} = 0.9 W	P _{OUT}	-	60	-	W
Power Gain	P _{IN} = 0.9 W	G _P	-	18	-	dB
Drain Efficiency	P _{IN} = 0.9 W	η _D	-	64	-	%
Input Return Loss	P _{IN} = 0.9 W	IRL	-	-8	-	dB
Load Mismatch Stability	P _{IN} = 0.9 W	VSWR-S	-	5:1	-	-
Load Mismatch Tolerance	P _{IN} = 0.9 W	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}	-	-	3.0	mA
Gate Threshold Voltage	V _{DS} = 5 V, I _D = 6 mA	V _{GS(TH)}	-5	-3	-2	V
Forward Transconductance	V _{DS} = 5 V, I _D = 1500 mA	G _M	1.1	-	-	S
Dynamic Characteristics						
Input Capacitance	V _{DS} = 0 V, V _{GS} = -8 V, F = 1 MHz	C _{ISS}	-	13.2	-	pF
Output Capacitance	V _{DS} = 50 V, V _{GS} = -8 V, F = 1 MHz	C _{OSS}	-	5.6	-	pF
Reverse Transfer Capacitance	V _{DS} = 50 V, V _{GS} = -8 V, F = 1 MHz	C _{RSS}	-	0.5	-	pF

1. Electrical Specifications measured in MACOM RF evaluation board.

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Absolute Maximum Ratings^{2,3,4}

Parameter	Limit
Supply Voltage (V_{DD}) (Pulsed)	+65 V
Supply Voltage (V_{GG})	-8 to 0 V
Supply Current ($I_{D(MAX)}$) for pulsed operation at $V_{DD} = 50$ V	3 A
Input Power (P_{IN}) for pulsed operation at $V_{DD} = 50$ V	P_{IN} (nominal) + 3 dB
Absolute Max. Junction/Channel Temperature	200°C
Power Dissipation at 85 °C for pulsed operation at $V_{DD} = 50$ V	48 W
MTTF ($T_J < 200^\circ\text{C}$)	600 years
Thermal Resistance, ($T_J = 200^\circ\text{C}$) $V_{DD} = 50$ V, $I_{DQ} = 100$ mA, Pulsed 1 ms, 10% Duty Cycle	2.3 °C/W
Operating Temperature	-40 to +95°C
Storage Temperature	-65 to +150°C
Mounting Temperature	See solder reflow profile
ESD Min. - Charged Device Model (CDM)	200 V
ESD Min. - Human Body Model (HBM)	550 V

2. Operation of this device above any one of these parameters may cause permanent damage.

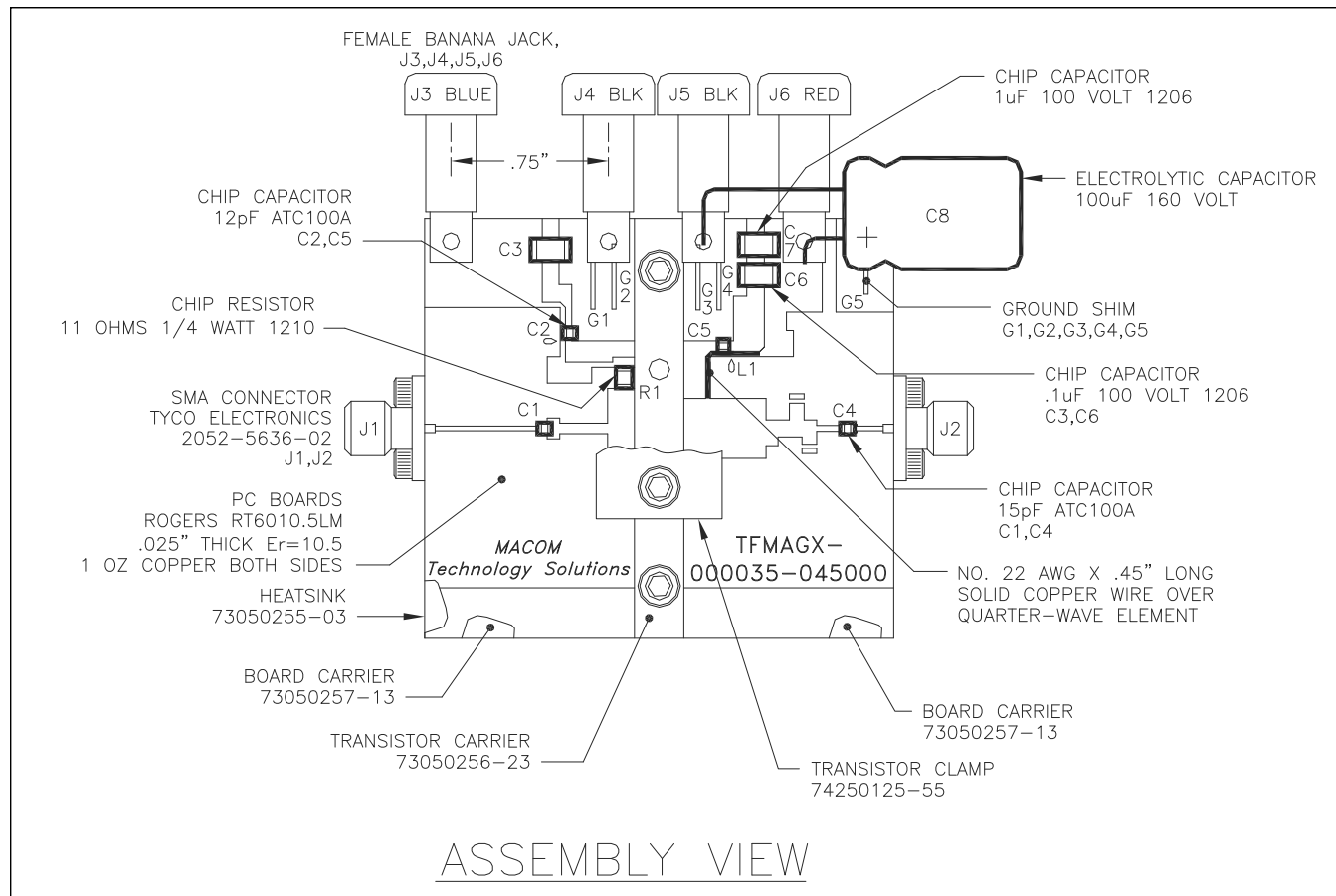
3. Channel temperature directly affects a device's MTTF. Channel temperature should be kept as low as possible to maximize lifetime.

4. For saturated performance it is recommended that the sum of $(3 \cdot V_{DD} + \text{abs}(V_{GG})) < 175$ V.

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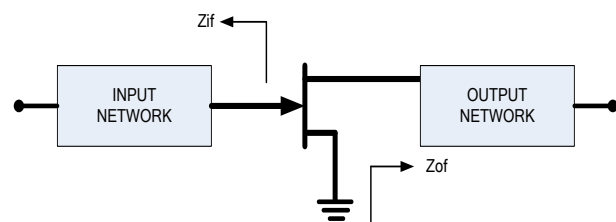
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Test Fixture Assembly (2700-3500 MHz)



Test Fixture Impedances

F (MHz)	Z_{IF} (Ω)	Z_{OF} (Ω)
2700	$9.0 + j1.2$	$7.0 + j1.6$
2900	$9.1 + j1.2$	$7.7 + j1.6$
3100	$8.9 + j1.2$	$7.8 + j1.6$
3300	$7.8 + j1.2$	$8.0 + j1.7$
3500	$6.3 + j1.2$	$8.8 + j1.7$



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 (+50V).
3. Increase V_{GS} until the I_{DS} current is reached.
4. Apply RF power to desired level.

Turning the device OFF

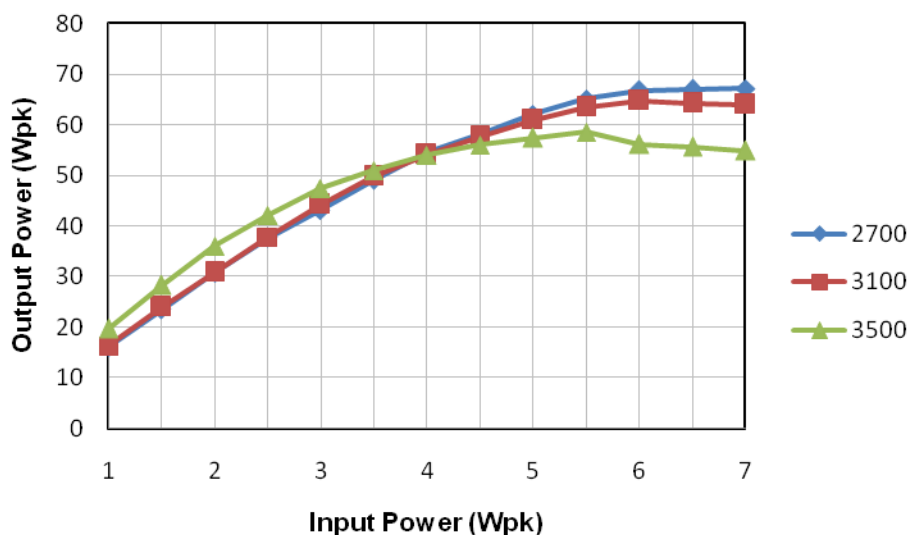
1. Turn the RF power off.
2. Decrease V_{GS} down to V_P .
3. Decrease V_{DS} down to 0 V.
4. Turn off V_{GS} .

Application Section

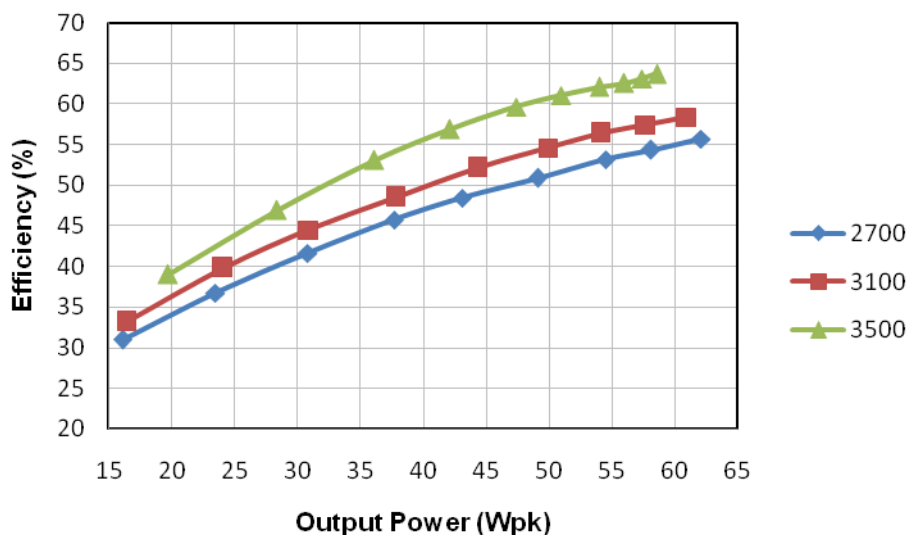
Typical Performance Curves

2700 - 3500 MHz, 1 ms Pulse, 10% Duty, $V_{DD} = 50$ V, $I_{dQ} = 100$ mA, $T_A = 25^\circ\text{C}$

Output Power Vs. Input Power



Drain Efficiency Vs. Output Power

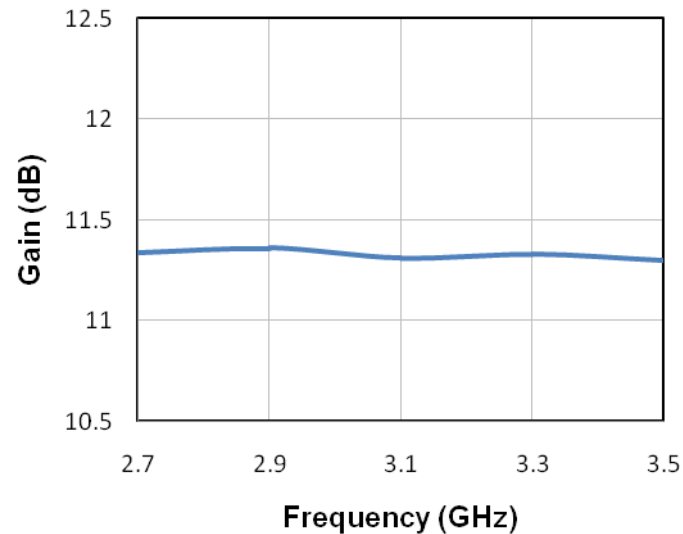


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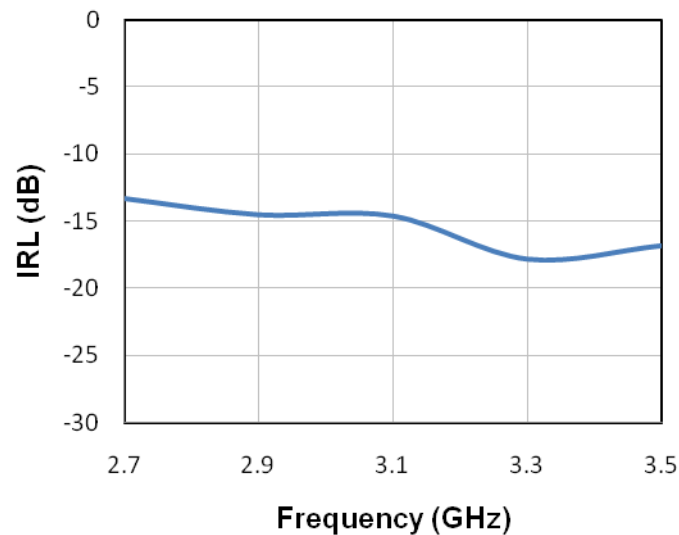
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Gain vs. Frequency



Input Return Loss vs. Frequency

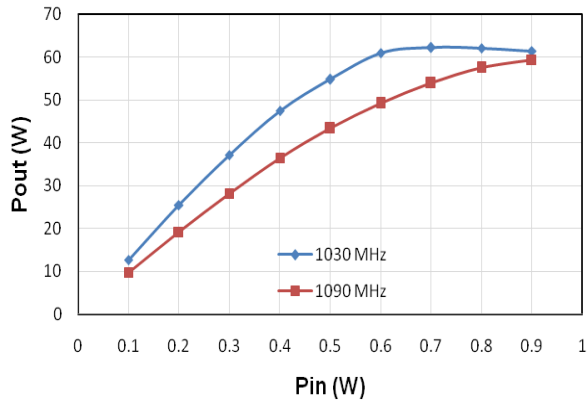


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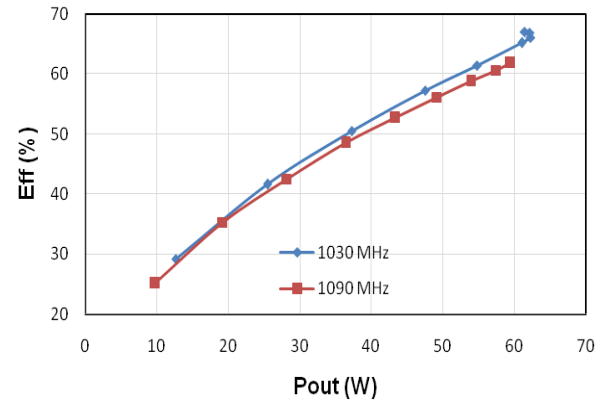
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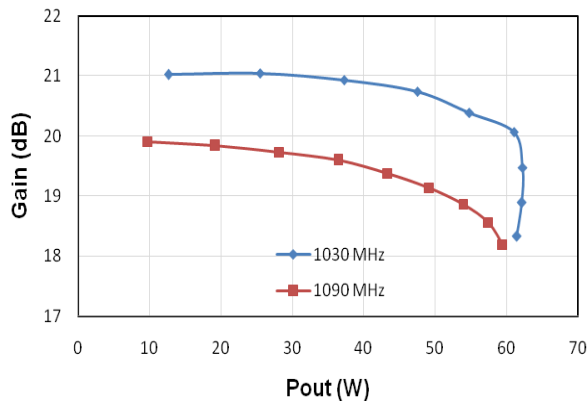
Output Power vs. Input Power



Drain Efficiency Vs. Output Power



Gain vs. Output Power



Input Return Loss vs. Frequency

