MAGX-100027-015S0P

15 W GaN-Si Transistor in Surface Mount Plastic Package
DC - 2.7 GHz

Preliminary **- Rev. V2P**

Features

- GaN on Si Depletion Mode Transistor Technology
- Unmatched, Common-Source Configuration
- Ideal for CW and Pulsed Applications
- Operation up to 50 V, Class AB
- Lead-Free 3 x 6 mm 14-lead DFN Package
- Halogen-Free "Green" Mold Compound
- RoHS* Compliant
- MSL-3

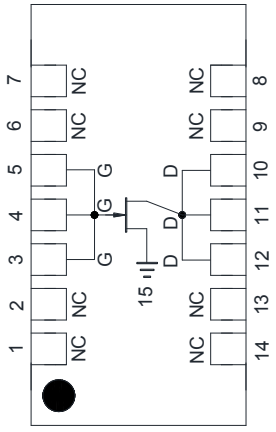
Description

The MAGX-100027-015S0P is a multi-purpose GaN on Si unmatched power transistor in a compact 3 x 6 mm, 14 lead plastic DFN surface mount package.

A thermally enhanced FET layout allows reliable operation at channel temperatures up to 210°C in CW mode.

The small package size and excellent RF performance make it an ideal replacement for costly flanged components in any application, CW or pulsed.

Functional Schematic



Typical RF Performance

V_{DS} = 50 V, T_C = 25°C, I_{DQ} = 45 mA

Freq (MHz)	Pout (dBm)	Gain (dB)	Drain Eff (%)	Test Conditions
2450[1]	42.6	15.5	68	CW

1. Data measured at 2 dB compression point in MAGX-1D0027-015S0P 2400 - 2500 MHz sample board.

Ordering Information[2,3]

Part Number	Package
MAGX-100027-015S0P	Bulk
MAGX-1A0027-015PPR	Sample Board
MAGX-100027-015PPR	Sample Device

2. Reference Application Note M513 for reel size information.
3. PPR is a pre-production sample part.

Pin Configuration[4,5]

Pin #	Function
1,2	NC
3 - 5	V_{GS}/RF_{IN}
6 - 9	NC
10 - 12	V_{DS}/RF_{OUT}
13,14	NC
15	Paddle[6]

4. MACOM recommends connecting unused package pins to ground.
5. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

Preliminary Information

Electrical Specifications:

Parameter	Symbol	Test Conditions	Units	Min.	Typ.	Max.
DC Characteristics: T_C = 25°C						
Drain-Source Leakage Current	I_{DLK}	V_{GS} = -8 V, V_{DS} = 50 V	µA	—	84	—
Gate-Source Leakage Current	I_{GLK}	V_{GS} = 0 V, V_{DS} = 7 V	µA	—	-6	—
Breakdown Voltage	V_{DSBR}	V_{GS} = -8 V, I_D = 160 µA	V	130	—	—
Gate Threshold Voltage	V_T	V_{DS} = 50 V, I_D = 5 mA	V	—	-2.17	—
Gate Quiescent Voltage	V_{GSQ}	V_{DS} = 50 V, I_D = 45 mA	V	—	-1.93	—
On Resistance	R_{ON}	V_{GS} = 2 V, I_D = 20 mA	Ω	—	1.48	—
RF Specifications: Freq. = 2450 MHz, CW, V_{DS} = 50 V, I_{DQ} = 45 mA, T_C = 25°C[6]						
Saturated Output Power	P_{SAT}	@ 2 dB Gain compression	dBm	—	42.6	—
Power Gain	G_P	@ P_{-2dB}	dBm	—	15.5	—
Drain Efficiency	η_D	@ P_{-2dB}	%	—	68	—
Input Return Loss	IRL	@ P_{IN} = 26.8 dBm	dB	—	13	—
Load Mismatch Stability	VSWR-S	All power levels	—	—	10:1	—
Load Mismatch Tolerance	VSWR-T	CW, P1dB Gain Compression 2 dB Overdrive, V_{DS} = 50 V, No damage at all phase angles	—	—	10:1	—

6. Data measured in MAGX-1D0027-015S0P 2400-2500 MHz sample board.

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Absolute Maximum Ratings[8,9]

Parameter	Symbol	Absolute Maximum
Drain-Source Voltage	V_{DS}	130 V
Operating Voltage	V_{DS}	55 V
Gate Source Voltage	V_{GS}	-10 to + 3 V
Gate Current	I_G	3 mA
Channel Temperature [10]	T_{CH}	+225°C
Operating Temperature	T_{OP}	-40°C to +85°C
Storage Temperature	T_{STG}	-65°C to +150°C

8. Exceeding any one or combination of these limits may cause permanent damage to this device.
9. MACOM does not recommend sustained operation near these survivability limits.
10. Operating at nominal conditions with $T_{CH} \leq +210°C$ will ensure MTTF > 1 x 10^6 hours.

Thermal Characteristics[11,12]

Parameter	Symbol	Test Conditions	Units	Typ.
Thermal Resistance using Infrared Measurement of the Die Surface Temperature	$R_{TH,S-C}$ (IR)	V_{DS} = 50 V, P_D = 9.4 W, T_C = 85°C	°C/W	6.1
Thermal Resistance using Finite Element Analysis	$R_{TH,CH-C}$ (FEA)[13,14]	V_{DS} = 50 V, P_D = 15 W, T_C = 85°C	°C/W	7.7

11. Case temperature measured using thermocouple embedded in heat sink. Contact local applications support for more details on this measurement.
12. Channel Temperature (T_{CH}) = T_C + $R_{TH,CH-C}$ * ((V_{DS} * I_{DS}) - (P_{OUT} - P_{IN}))
    Typical thermal resistance ($R_{TH,CH-C}$) = 7.7°C/W.
13. In this case, the thermal resistance is defined from channel to case (bottom side of transistor). The channel temperature (T_{CH}) is determined using Raman and simulation techniques. T_{CH} determined with such methods is higher than the surface temperature measured with IR scan techniques (surface temperature T_S). Contact local application support team for more details on this measurement.
14. Channel temperature calculation example:
    T_{CH} = T_C + $R_{TH,CH-C}$ * ((V_{DS} * I_{DS}) - (P_{OUT} - P_{IN}))
    For T_C = 85°C, $R_{TH,CH-C}$ = 7.7°C/W, V_{DS} = 50 V, I_{DS} = 465 mA, P_{OUT} = 15 W, P_{IN} = 0.41 W, the channel temperature is:
    T_{CH} = 85 + 7.7 * ((50 * 0.465) - (15 - 0.41) = 151.7°C

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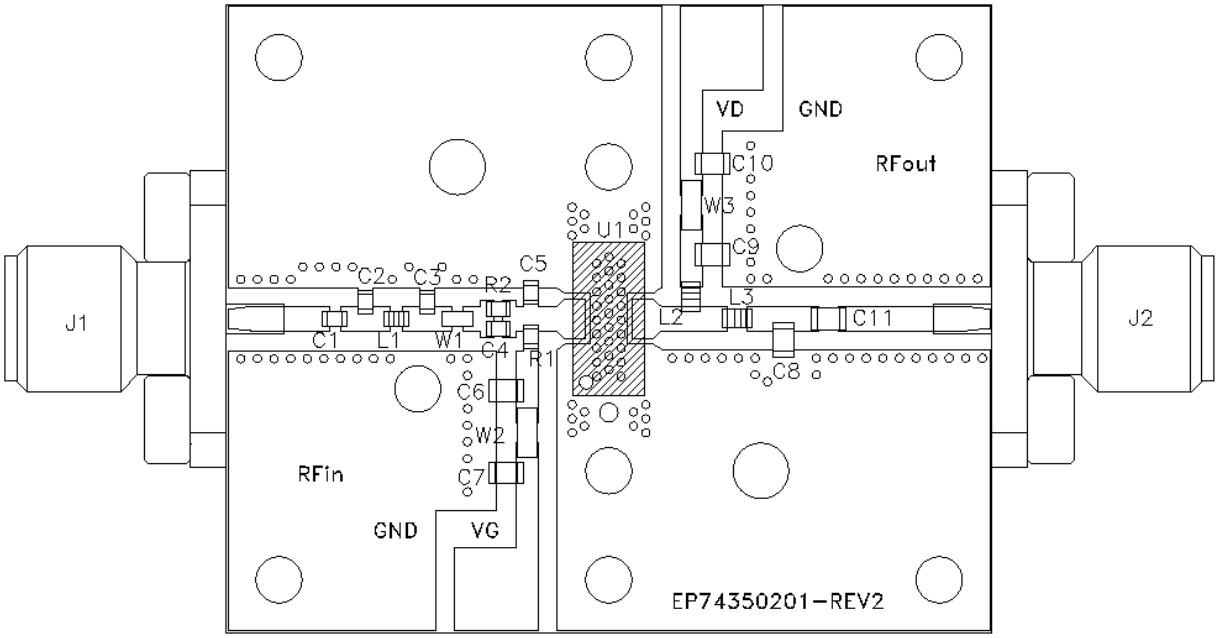
MAGX-1D0027-015S0P Sample Board Assembly (2400 - 2500 MHz)



Parts List

Reference	Description	Value	Manufacturer	Part Number
Q1	15W GaNSi Transistor in DFN3x6mm 14 lead packaging	-	MACOM	MAGX-100027-015S0P
C1	Capacitor, 0402N, 200V, 5%	10 pF	Passive Plus	0402N100JW201
C2	Capacitor, 0402N, 200V, ±0.05pF	1.5 pF	Passive Plus	0402N1R5AW201
C3, C4	Capacitor, 0402N, 200V, ±0.05pF	2.7 pF	Passive Plus	0402N2R7AW201
C5	Capacitor, 0402N, 200V, ±0.05pF	0.9 pF	Passive Plus	0402N0R9AW201
C6	Capacitor, 0603, X7R, 100V, 10%	0.1 µF	Murata	GRM188R72A104KA35D
C7	Capacitor, 0805, X5R, 35V, 10%	10 µF	Murata	GRM21BR6YA106KE43L
C8	Capacitor, 0402N, 200V, ±0.05pF	1.2 pF	Passive Plus	0402N1R2AW201
C9	Capacitor, 0603, 250V, 5%	1000 pF	Kemet	C0603C102JAGAC
C10	Capacitor, 0805, 200V, 10%	0.1 µF	TDK	CGJ4J3X7T2D104K125AA
C11	Capacitor, 0603N, 200V, 5%	10 pF	Passive Plus	0603N100JW201
R1,R2	Resistor, 0402, 1/10W, 5%	100 Ω	Panasonic	ERJ-2GEJ101X
L1	Inductor, 0402HP, 5%	1.0 nH	Coilcraft	0402HP-1N0XJL
L2, L3	Inductor, 0603HC, 5%	1.6 nH	Coilcraft	0603HC-1N6XJL
W1,W2,W3	Copper shim	-	-	-
J1, J2	SMA Connectors	-	Huber & Suhner	23_SMA-50-0-52/199_NE
PCB	Rogers RO 4350B 0.020 in. thk	-	Avanti	EP74350201-REV2

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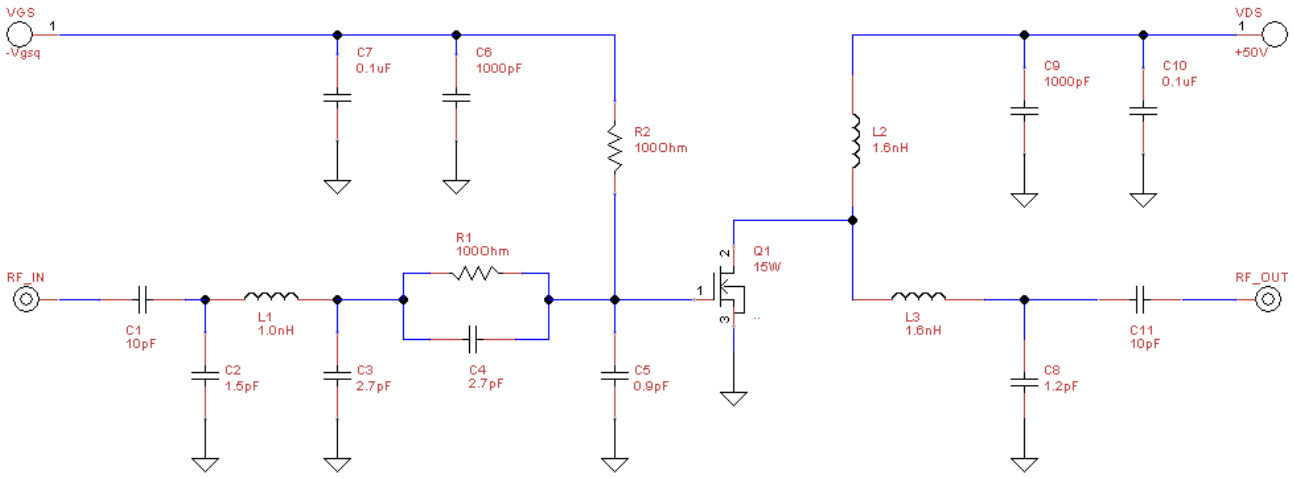
MAGX-1D0027-015S0P 2400 - 2500 MHz Sample Board Schematic



Correct Device Sequencing

Turning the device ON:

1. Set V_{GS} to pinch-off (V_P), typically -5 V.
2. Turn on V_{DS} to nominal voltage (50 V).
3. Increase V_{GS} until the quiescent drain current I_{DQ} is reached, typically 45 mA.
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.

Handling Procedures

Please observe the following precautions to avoid damage:

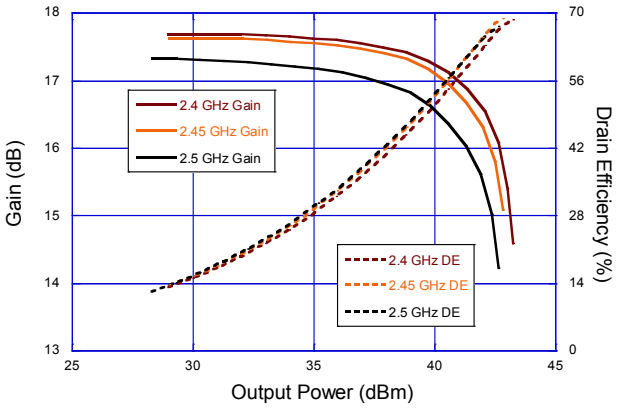
Static Sensitivity

Gallium nitride circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these CDM class C2A devices.

Preliminary Information

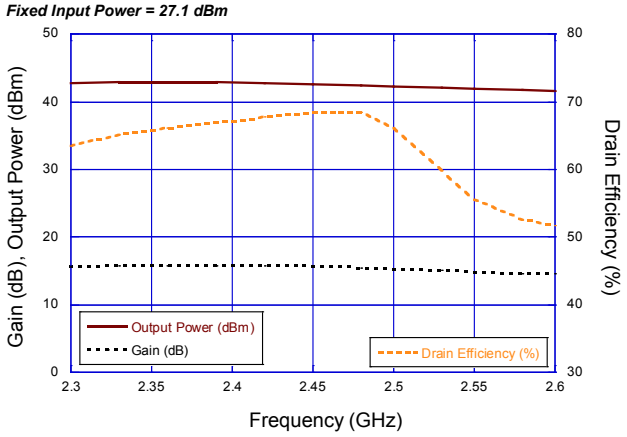
Typical Performance Curves[15]

Gain and Efficiency versus Output Power



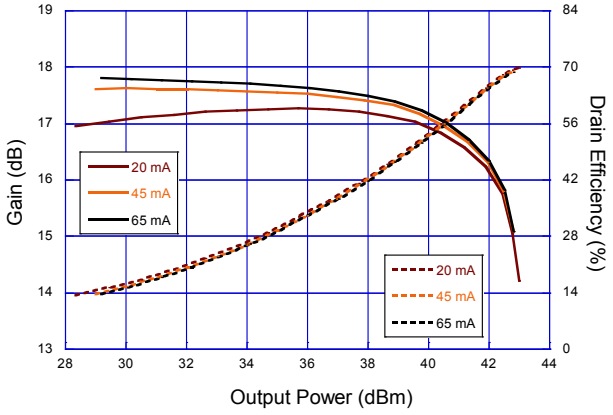
Performance versus Frequency at Fixed Input Power

Fixed Input Power = 27.1 dBm



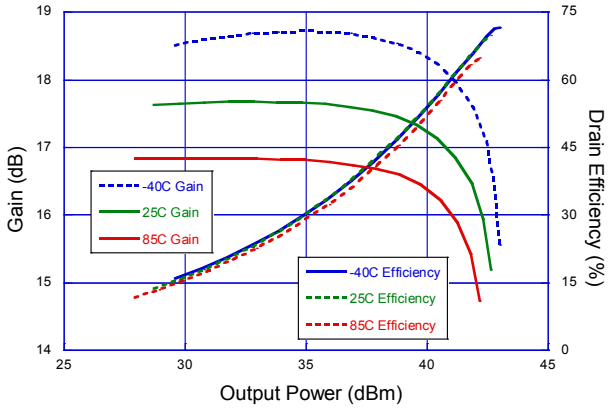
RF Performance versus I_{DQ}

2.45 GHz, CW, VDS=50V



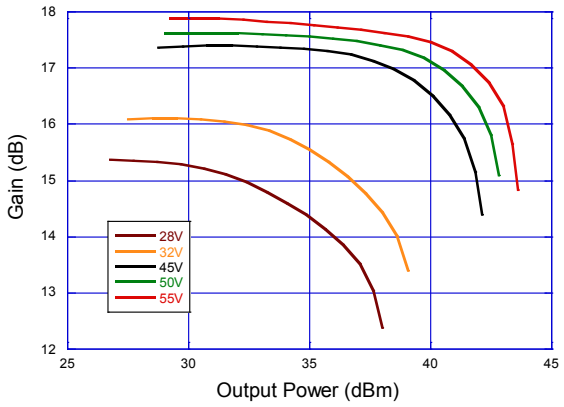
Gain and Efficiency versus Output Power versus T_C

2.45 GHz, CW, VDS=50V, IDQ=45mA



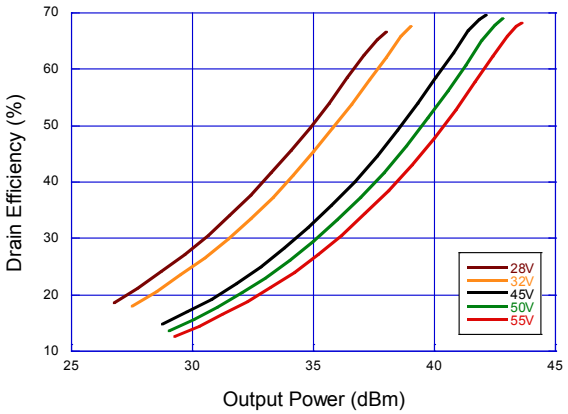
Gain versus Output Power and V_{DS}

2.45 GHz, CW, IDQ=45mA



Efficiency versus Output Power and V_{DS}

2.45 GHz, CW, IDQ=45mA



15. As measured in MAGX-1D0027-015S0P 2400 - 2500 MHz Sample

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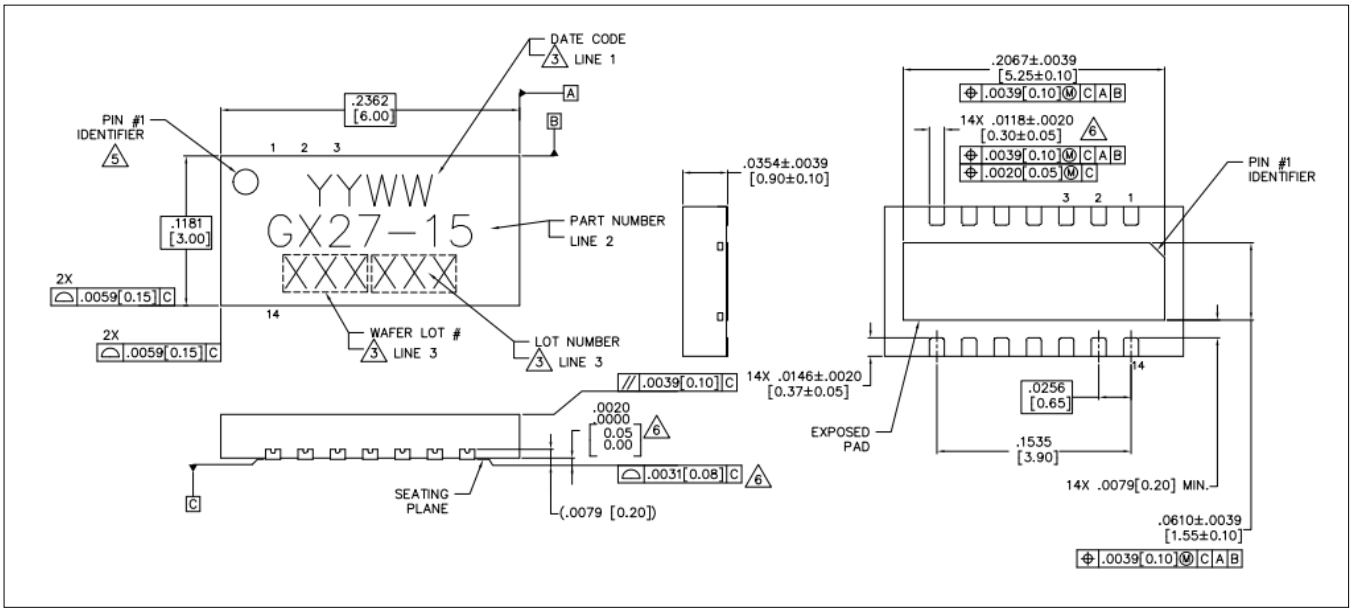
Lead-Free 3 x 6 mm 14-Lead DFN†



† Reference Application Note M538 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.

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