

# 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



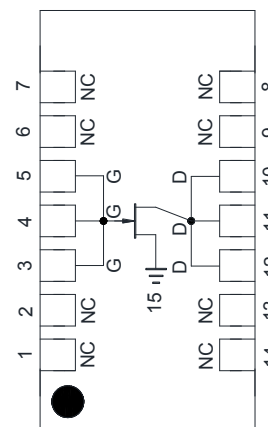
### Description

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

$V_{DS} = 50\text{ V}$ ,  $T_C = 25^\circ\text{C}$ ,  $I_{DQ} = 45\text{ mA}$

Freq (MHz)	Pout (dBm)	Gain (dB)	Drain Eff (%)	Test Conditions
2450 <sup>1</sup>	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<sup>2,3</sup>

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<sup>4,5</sup>

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 <sup>6</sup>

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.
<b>DC Characteristics: <math>T_C = 25^\circ\text{C}</math></b>						
Drain-Source Leakage Current	$I_{DLK}$	$V_{GS} = -8\text{ V}, V_{DS} = 50\text{ V}$	$\mu\text{A}$	—	84	—
Gate-Source Leakage Current	$I_{GLK}$	$V_{GS} = 0\text{ V}, V_{DS} = 7\text{ V}$	$\mu\text{A}$	—	-6	—
Breakdown Voltage	$V_{DSBR}$	$V_{GS} = -8\text{ V}, I_D = 160\ \mu\text{A}$	V	130	—	—
Gate Threshold Voltage	$V_T$	$V_{DS} = 50\text{ V}, I_D = 5\text{ mA}$	V	—	-2.17	—
Gate Quiescent Voltage	$V_{GSQ}$	$V_{DS} = 50\text{ V}, I_D = 45\text{ mA}$	V	—	-1.93	—
On Resistance	$R_{ON}$	$V_{GS} = 2\text{ V}, I_D = 20\text{ mA}$	$\Omega$	—	1.48	—
<b>RF Specifications: Freq. = 2450 MHz, CW, <math>V_{DS} = 50\text{ V}</math>, <math>I_{DQ} = 45\text{ mA}</math>, <math>T_C = 25^\circ\text{C}</math><sup>6</sup></b>						
Saturated Output Power	$P_{SAT}$	@ 2 dB Gain compression	dBm	—	42.6	—
Power Gain	$G_P$	@ $P_{-2dB}$	dBm	—	15.5	—
Drain Efficiency	$\eta_D$	@ $P_{-2dB}$	%	—	68	—
Input Return Loss	IRL	@ $P_{IN} = 26.8\text{ dBm}$	dB	—	13	—
Load Mismatch Stability	VSWR-S	All power levels	—	—	10:1	—
Load Mismatch Tolerance	VSWR-T	CW, P1dB Gain Compression 2 dB Overdrive, $V_{DS} = 50\text{ V}$ , No damage at all phase angles	—	—	10:1	—

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

Preliminary Information

## Absolute Maximum Ratings<sup>8,9</sup>

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 <sup>10</sup>	$T_{CH}$	+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  $T_{CH} \leq +210^\circ\text{C}$  will ensure MTTF >  $1 \times 10^6$  hours.

## Thermal Characteristics<sup>11,12</sup>

Parameter	Symbol	Test Conditions	Units	Typ.
Thermal Resistance using Infrared Measurement of the Die Surface Temperature	$R_{TH,S-C}$ (IR)	$V_{DS} = 50 \text{ V}, P_D = 9.4 \text{ W}, T_C = 85^\circ\text{C}$	°C/W	6.1
Thermal Resistance using Finite Element Analysis	$R_{TH,CH-C}$ (FEA) <sup>13,14</sup>	$V_{DS} = 50 \text{ V}, P_D = 15 \text{ W}, T_C = 85^\circ\text{C}$	°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  $T_C = 85^\circ\text{C}$ ,  $R_{TH,CH-C} = 7.7^\circ\text{C/W}$ ,  $V_{DS} = 50 \text{ V}$ ,  $I_{DS} = 465 \text{ mA}$ ,  $P_{OUT} = 15 \text{ W}$ ,  $P_{IN} = 0.41 \text{ W}$ , the channel temperature is:

$$T_{CH} = 85 + 7.7 * ((50 * 0.465) - (15 - 0.41)) = 151.7^\circ\text{C}$$

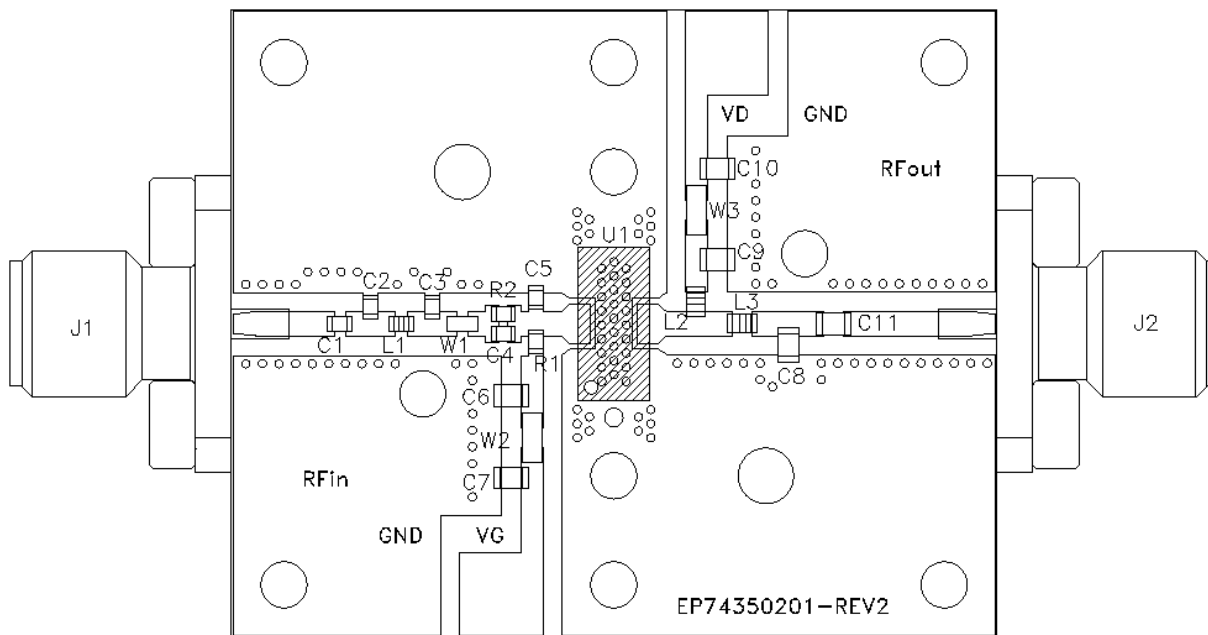
# MAGX-100027-015S0P



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

Preliminary - Rev. V2P

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

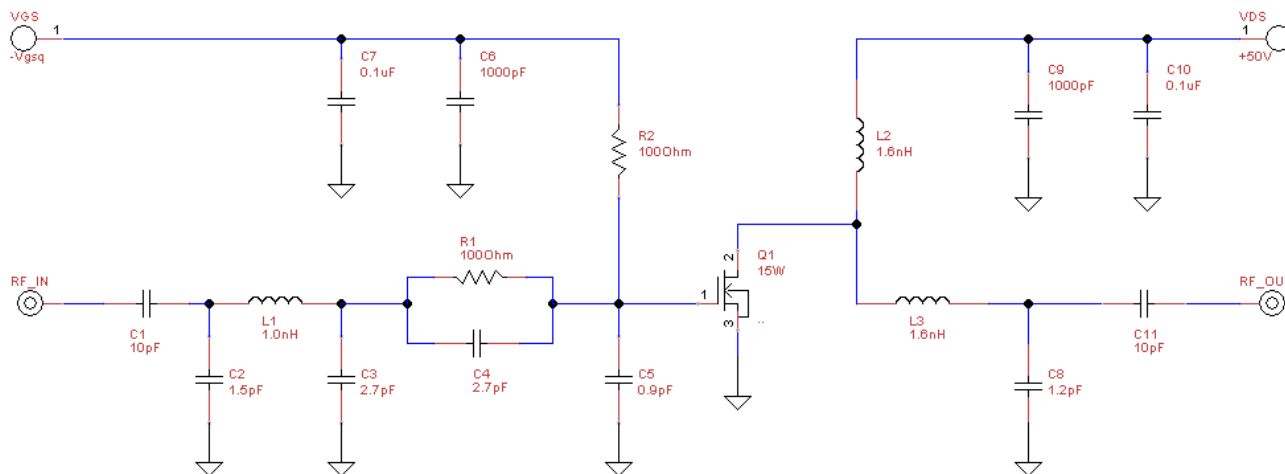


### Parts List

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

Preliminary Information

## 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

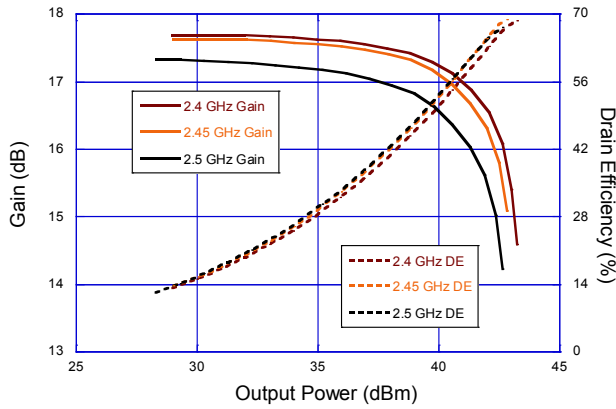
Gallium nitride circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these CDM class C2A devices.

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

Preliminary - Rev. V2P

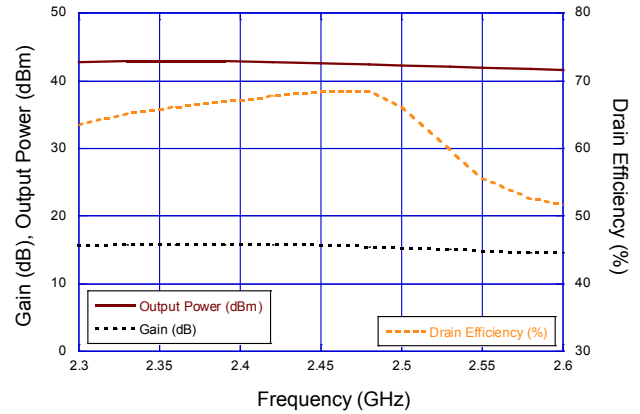
### Typical Performance Curves<sup>15</sup>

Gain and Efficiency versus Output Power



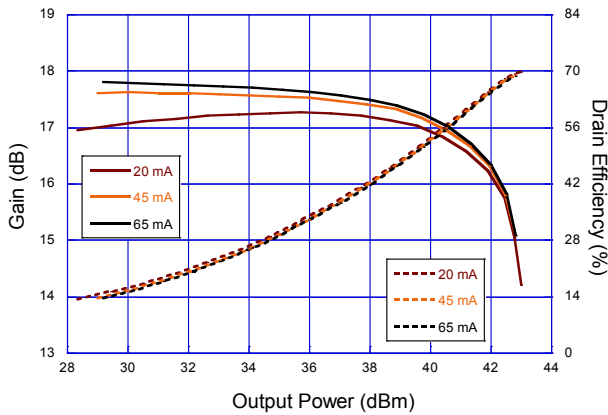
Performance versus Frequency at Fixed Input Power

Fixed Input Power = 27.1 dBm



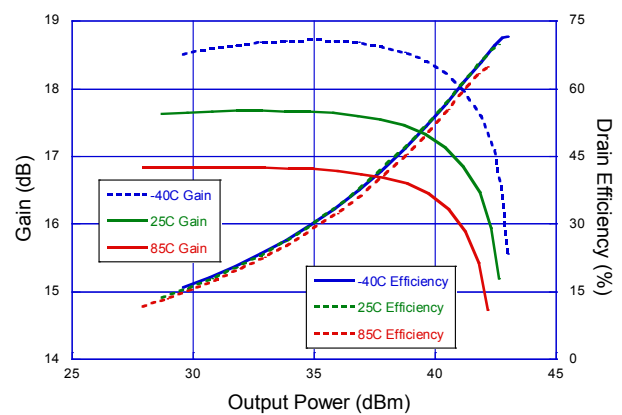
RF Performance versus  $I_{DQ}$

2.45 GHz, CW,  $V_{DS}=50V$



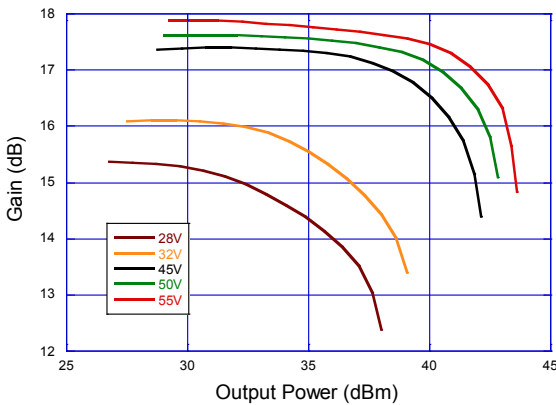
Gain and Efficiency versus Output Power versus  $T_C$

2.45 GHz, CW,  $V_{DS}=50V$ ,  $I_{DQ}=45mA$



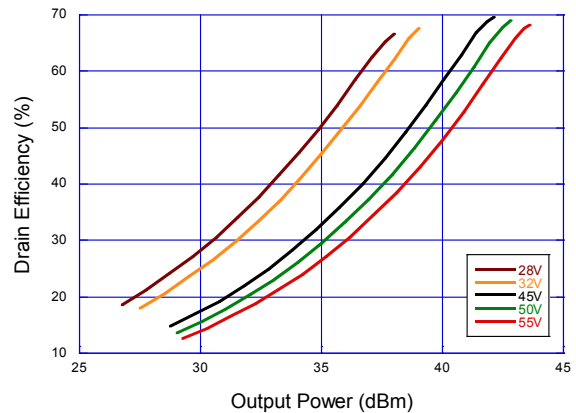
Gain versus Output Power and  $V_{DS}$

2.45 GHz, CW,  $I_{DQ}=45mA$



Efficiency versus Output Power and  $V_{DS}$

2.45 GHz, CW,  $I_{DQ}=45mA$



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

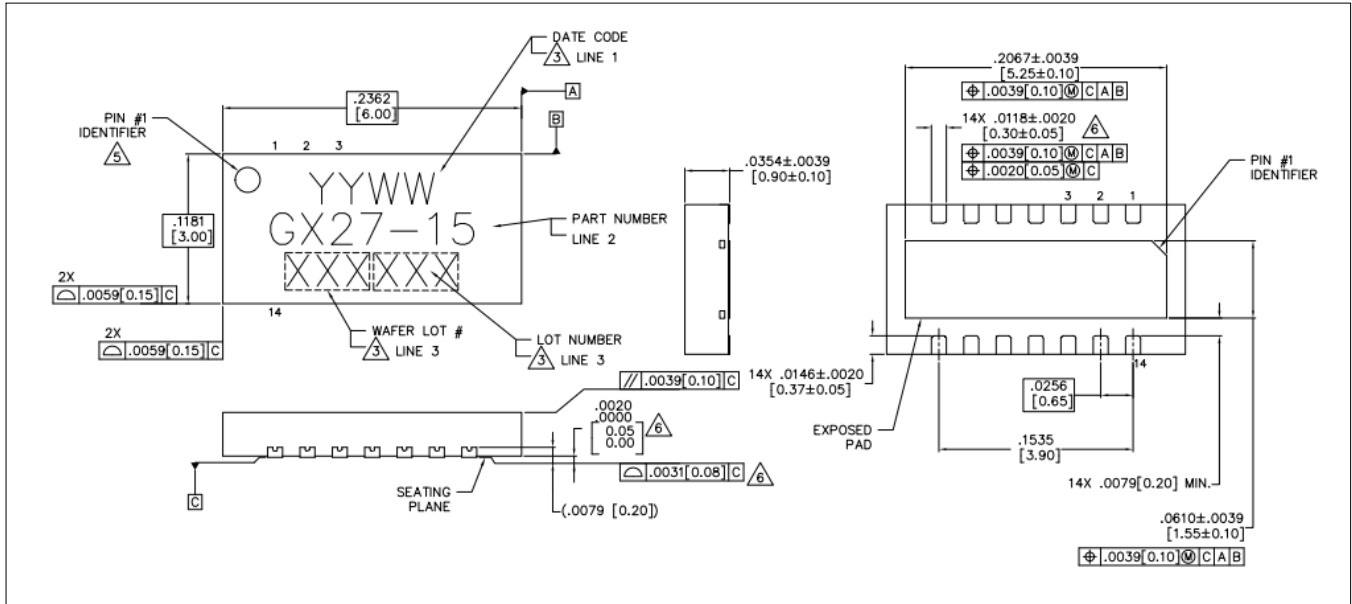
# MAGX-100027-015S0P



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

Preliminary - Rev. V2P

Lead-Free 3 x 6 mm 14-Lead DFN<sup>†</sup>



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

Preliminary Information

MACOM Technology Solutions Inc. All rights reserved.

Information in this document is provided in connection with MACOM 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.