

## P-Channel 60 V (D-S) MOSFET



RoHS  
COMPLIANT

### PRODUCT SUMMARY

V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω) Max.	I <sub>D</sub> (A)	Q <sub>g</sub> (Typ.)
- 60	0.024 at V <sub>GS</sub> = - 10 V	- 32 <sup>d</sup>	29 nC
	0.029 at V <sub>GS</sub> = - 4.5 V	- 29 <sup>d</sup>	

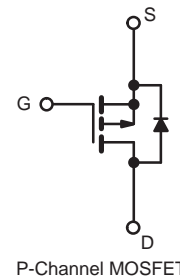
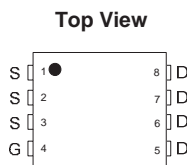
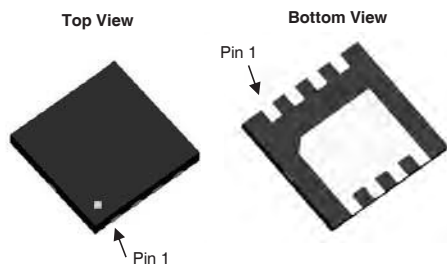
### FEATURES

- DT-Trench Power MOSFET
- 100 % R<sub>g</sub> and UIS Tested

### APPLICATIONS

- Battery, Load and Adaptor Switches
  - Notebook Computers
  - Notebook Battery Packs

DFN 3x3 EP



### ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25 °C, unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	V <sub>DS</sub>	- 60	V
Gate-Source Voltage	V <sub>GS</sub>	± 20	
Continuous Drain Current (T <sub>J</sub> = 150 °C)	I <sub>D</sub>	T <sub>C</sub> = 25 °C	- 32 <sup>d</sup>
		T <sub>C</sub> = 70 °C	- 26 <sup>d</sup>
		T <sub>A</sub> = 25 °C	- 7.9 <sup>a, b</sup>
		T <sub>A</sub> = 70 °C	- 4.5 <sup>a, b</sup>
Pulsed Drain Current (t = 100 μs)	I <sub>DM</sub>	- 125	A
Continuous Source-Drain Diode Current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	
		T <sub>A</sub> = 25 °C	- 1.5 <sup>a, b</sup>
Avalanche Current	I <sub>AS</sub>	- 30	mJ
Single-Pulse Avalanche Energy	E <sub>AS</sub>	35	
Maximum Power Dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C	26.3
		T <sub>C</sub> = 70 °C	16.8
		T <sub>A</sub> = 25 °C	4.4 <sup>a, b</sup>
		T <sub>A</sub> = 70 °C	2.8 <sup>a, b</sup>
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	- 55 to 150	°C

### THERMAL RESISTANCE RATINGS

Parameter	Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient <sup>a, c</sup>	R <sub>thJA</sub>	23	30	°C/W
Maximum Junction-to-Case	R <sub>thJC</sub>	5.1	8.5	

Notes:

a. Surface mounted on 1" x 1" FR4 board.

b. t = 10 s.

c. Maximum under steady state conditions is 70 °C/W.

d. Package limited.

e. The DFN3X3 is a leadless package. The end of the lead terminal is exposed copper (not plated) as a result of the singulation process in manufacturing. A solder fillet at the exposed copper tip cannot be guaranteed and is not required to ensure adequate bottom side solder interconnection.

f. Rework conditions: manual soldering with a soldering iron is not recommended for leadless components.

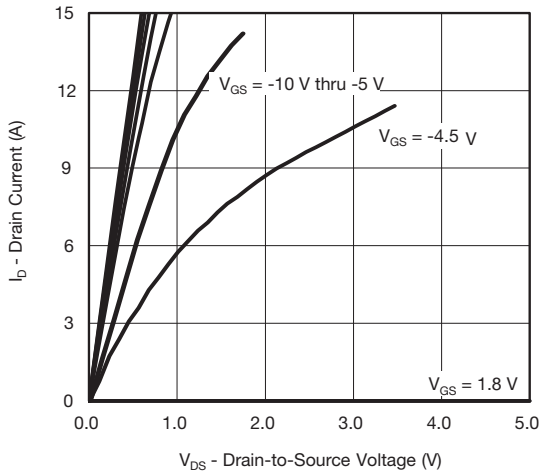
<b>SPECIFICATIONS</b> ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0, I_D = -250\text{ }\mu\text{A}$	-60			V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = -250\text{ }\mu\text{A}$		-20		mV/ $^\circ\text{C}$
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$			3.6		
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	-1		-3	V
Gate-Source Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -48\text{ V}, V_{GS} = 0\text{ V}$			-1	$\mu\text{A}$
		$V_{DS} = -48\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$			-5	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} \geq -10\text{ V}, V_{GS} = -10\text{ V}$	-32			A
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = -10\text{ V}, I_D = -5\text{ A}$		0.024	0.033	$\Omega$
		$V_{GS} = -4.5\text{ V}, I_D = -5\text{ A}$		0.029	0.040	
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = -10\text{ V}, I_D = -5\text{ A}$		25		S
<b>Dynamic<sup>b</sup></b>						
Input Capacitance	$C_{iss}$	$V_{DS} = -30\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		5550		pF
Output Capacitance	$C_{oss}$			1390		
Reverse Transfer Capacitance	$C_{rss}$			436		
Total Gate Charge	$Q_g$	$V_{DS} = -30\text{ V}, V_{GS} = -10\text{ V}, I_D = -5\text{ A}$		29		nC
				18.3		
Gate-Source Charge	$Q_{gs}$	$V_{DS} = -30\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -5\text{ A}$		10.1		
Gate-Drain Charge	$Q_{gd}$			33.2		
Gate Resistance	$R_g$	$f = 1\text{ MHz}$		1.5		$\Omega$
Turn-On Delay Time	$t_{d(on)}$	$V_{DS} = -30\text{ V}, R_L = 3.5\text{ }\Omega$ $I_D \cong -5\text{ A}, V_{GEN} = -10\text{ V}, R_g = 1\text{ }\Omega$		25		ns
Rise Time	$t_r$			13		
Turn-Off Delay Time	$t_{d(off)}$			29		
Fall Time	$t_f$			11		
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -30\text{ V}, R_L = 3.5\text{ }\Omega$ $I_D \cong -5\text{ A}, V_{GEN} = -4.5\text{ V}, R_g = 1\text{ }\Omega$		28		
Rise Time	$t_r$			30		
Turn-Off Delay Time	$t_{d(off)}$			22		
Fall Time	$t_f$			19		
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25\text{ }^\circ\text{C}$			-32	A
Pulse Diode Forward Current (100 $\mu\text{s}$ )	$I_{SM}$				-125	
Body Diode Voltage	$V_{SD}$	$I_S = -3\text{ A}, V_{GS} = 0$		-0.7	-1.2	V
Body Diode Reverse Recovery Time	$t_{rr}$	$I_F = -5\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$		29		ns
Body Diode Reverse Recovery Charge	$Q_{rr}$			53		nC
Reverse Recovery Fall Time	$t_a$			11		ns
Reverse Recovery Rise Time	$t_b$			15		

Notes:

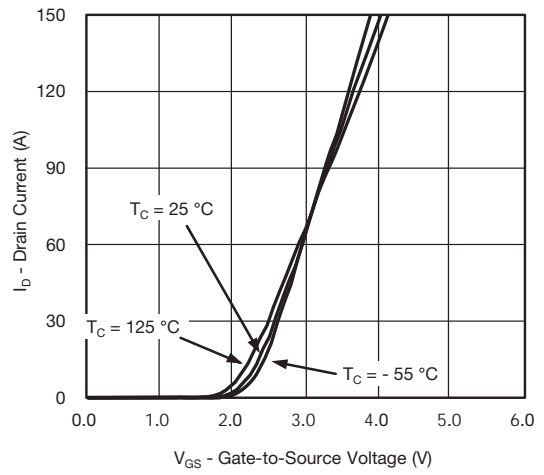
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
 b. Guaranteed by design, not subject to production testing.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

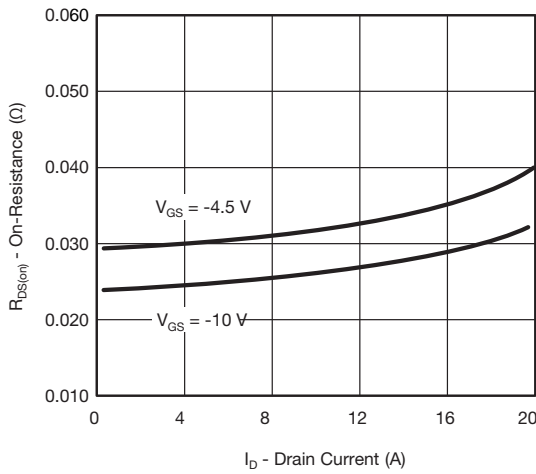
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



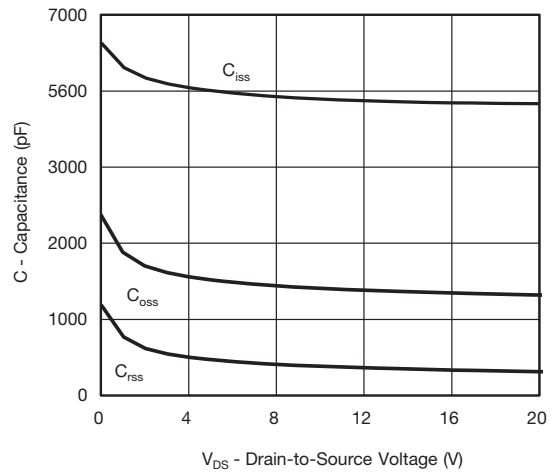
**Output Characteristics**



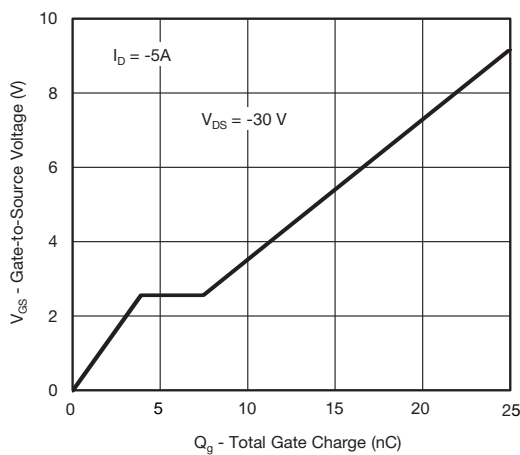
**Transfer Characteristics**



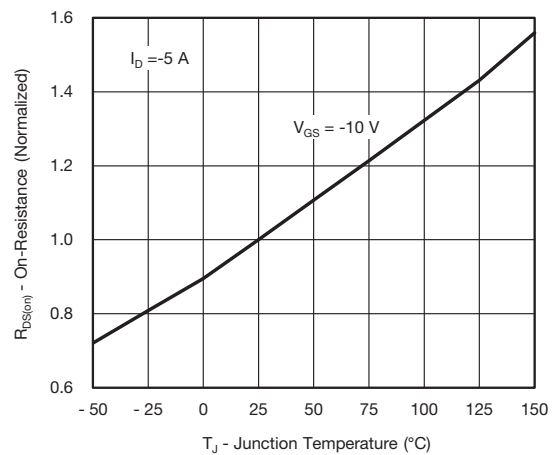
**On-Resistance vs. Drain Current**



**Capacitance**

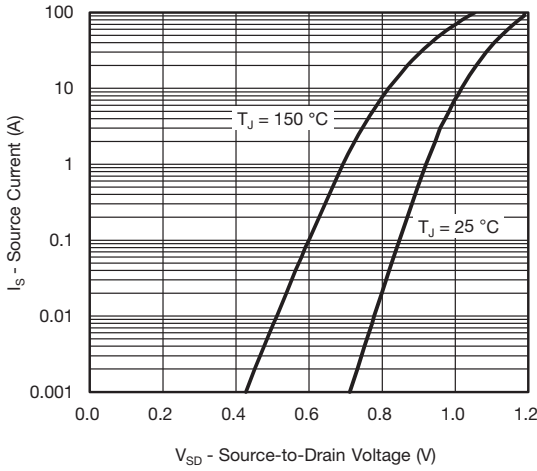


**Gate Charge**

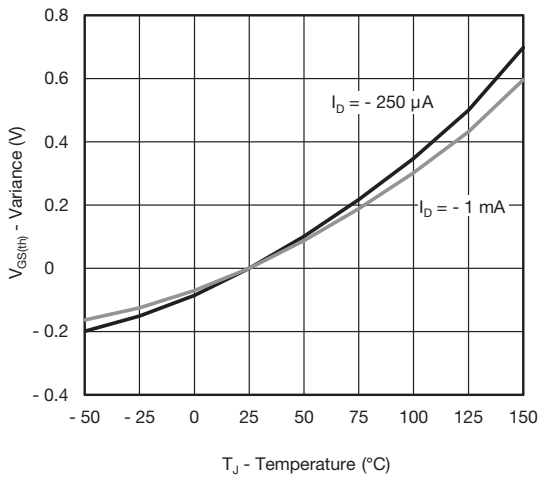


**On-Resistance vs. Junction Temperature**

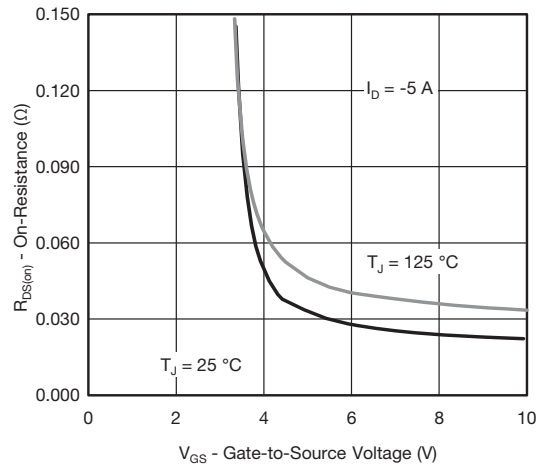
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



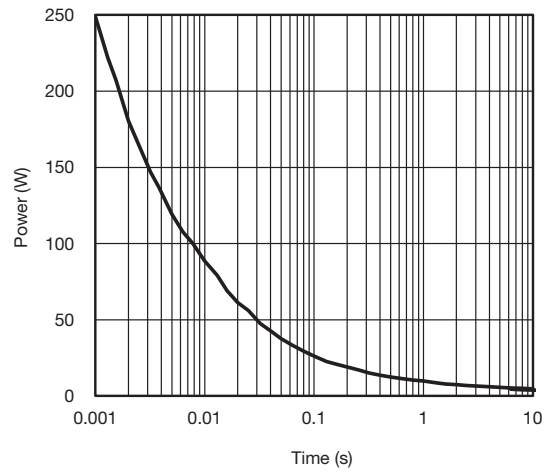
**Source-Drain Diode Forward Voltage**



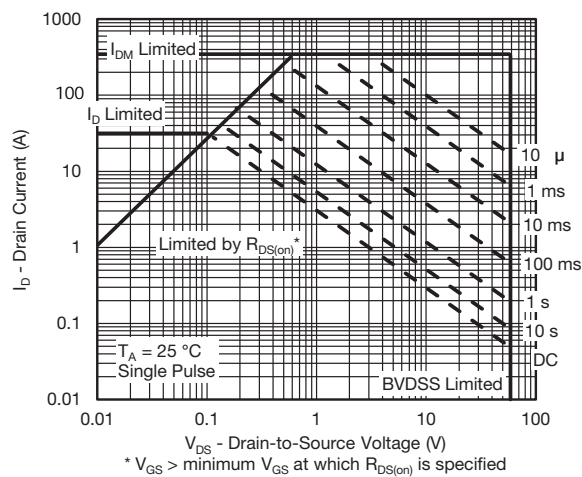
**Threshold Voltage**



**On-Resistance vs. Gate-to-Source Voltage**

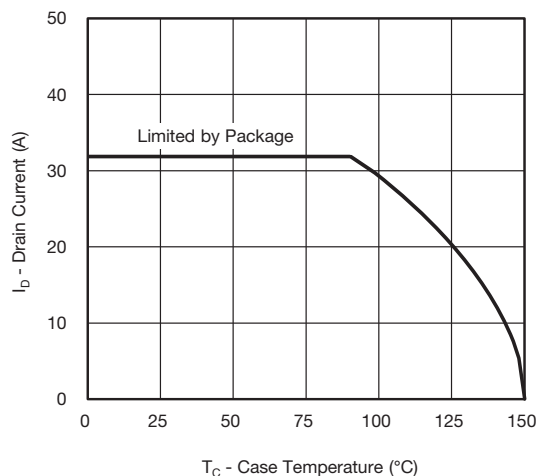


**Single Pulse Power, Junction-to-Ambient**

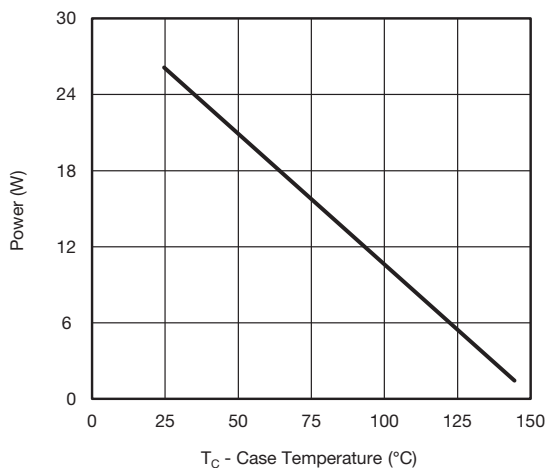


**Safe Operating Area**

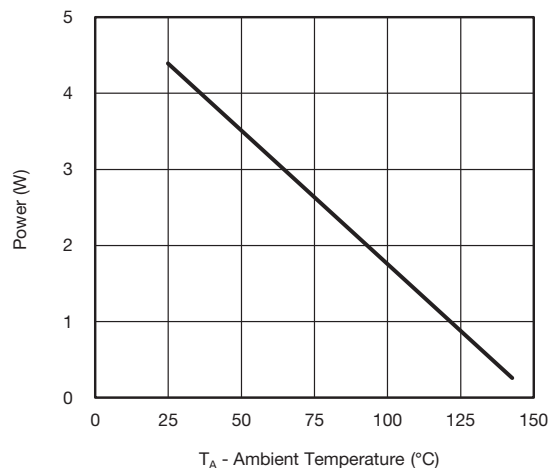
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



**Current Derating\***



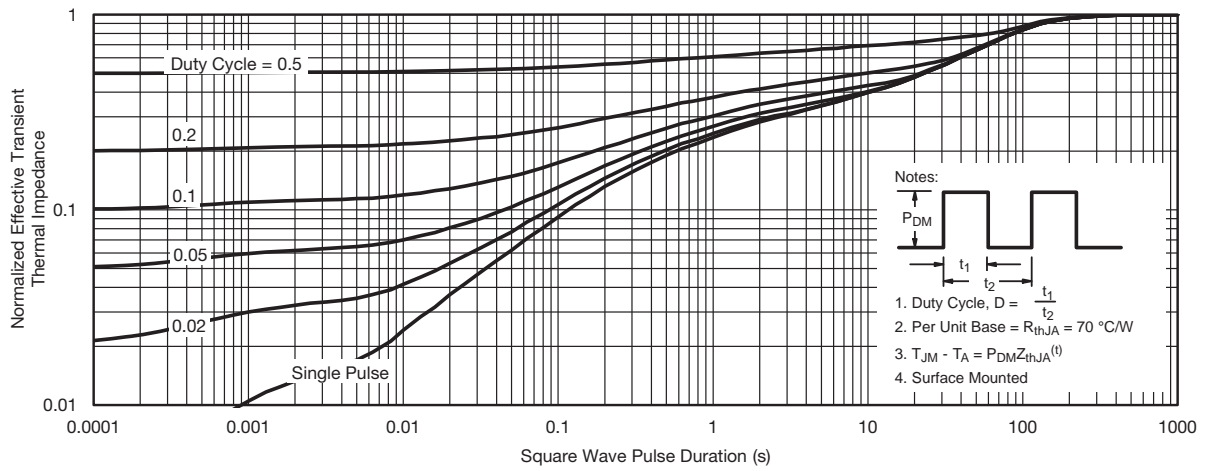
**Power, Junction-to-Case**



**Power Derating, Junction-to-Ambient**

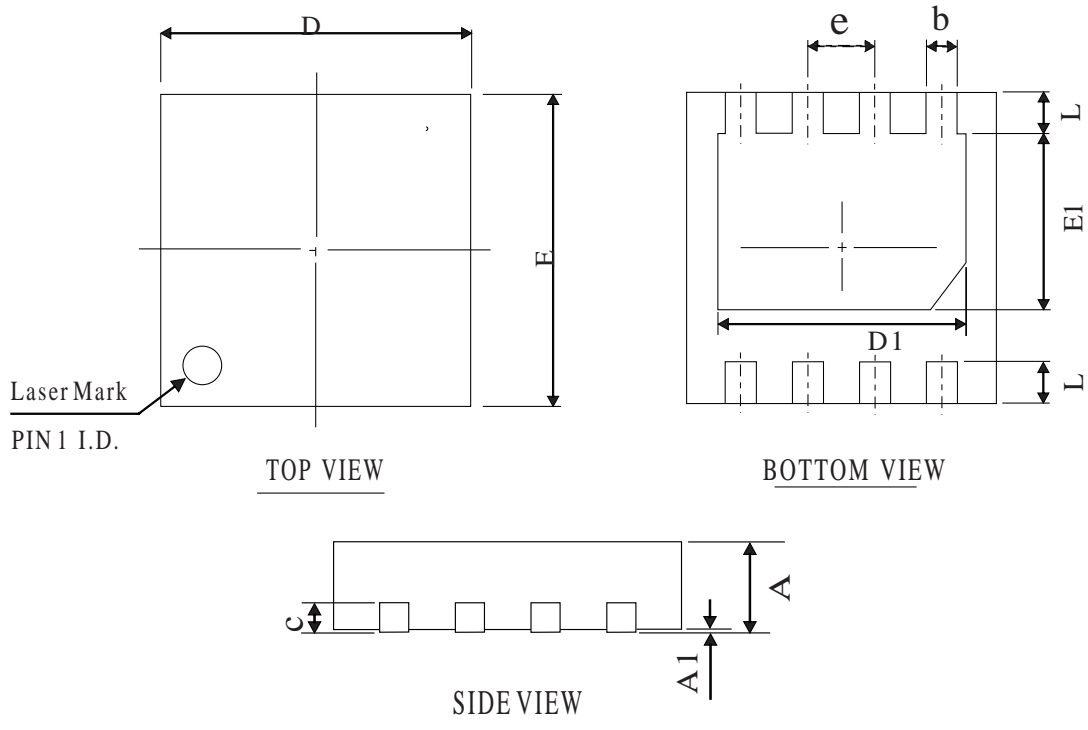
\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 150$  °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



**Normalized Thermal Transient Impedance, Junction-to-Ambient**

## DFN3\*3-8L PACKAGE OUTLINE



### COMMON DIMENSIONS (UNITS OF MEASURE=mm)

SYMBOL	MIN	NOM	MAX
<b>A</b>	0.60	0.75	0.90
<b>A1</b>	0.00	0.02	0.08
<b>b</b>	0.20	0.30	0.45
<b>D</b>	2.85	3.00	3.15
<b>E</b>	2.85	3.00	3.15
<b>D1</b>	2.10	2.40	2.70
<b>E1</b>	1.50	1.70	2.00
<b>L</b>	0.20	0.40	0.60
<b>C</b>	0.203 REF		
<b>e</b>	0.65 BSC		

### OTHER DIMENSIONS

<b>A</b>	0.50	0.55	0.60
<b>A</b>	0.40	0.45	0.50

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