

## N- and P- Channel 40 V (D-S) MOSFET

PRODUCT SUMMARY				
	V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω)	I <sub>D</sub> (A) <sup>a</sup>	Q <sub>g</sub> (Typ.)
N-Channel	40	0.016 at V <sub>GS</sub> = 10 V	18	5.2
		0.024 at V <sub>GS</sub> = 4.5 V	13	
P-Channel	- 40	0.032 at V <sub>GS</sub> = - 10 V	-14	11.4
		0.052 at V <sub>GS</sub> = - 4.5 V	- 7	

### FEATURES

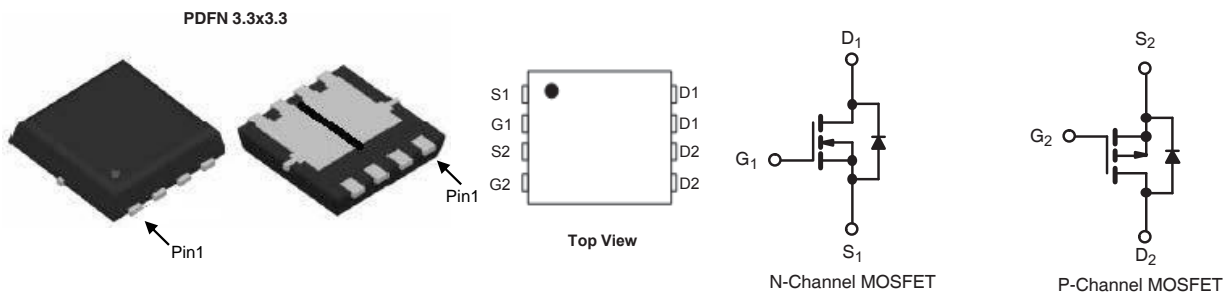
- DT-Trench Power MOSFET
- 100 % R<sub>g</sub> Tested
- 100 % UIS Tested

### APPLICATIONS

- Backlight Inverter for LCD Display
- Full Bridge Converter



**RoHS**  
COMPLIANT



ABSOLUTE MAXIMUM RATINGS T <sub>A</sub> = 25 °C, unless otherwise noted					
Parameter	Symbol	N-Channel	P-Channel	Unit	
Drain-Source Voltage	V <sub>DS</sub>	40	- 40	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	18	-14	
		T <sub>C</sub> = 70 °C	14	-10	
		T <sub>A</sub> = 25 °C	8 <sup>b, c</sup>	-4.7 <sup>b, c</sup>	
		T <sub>A</sub> = 70 °C	4 <sup>b, c</sup>	-2 <sup>b, c</sup>	
Pulsed Drain Current	I <sub>DM</sub>	54	-42	A	
Source-Drain Current Diode Current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	18		- 14
		T <sub>A</sub> = 25 °C	8.6 <sup>b, c</sup>		- 6 <sup>b, c</sup>
Pulsed Diode Source-Drain Current	I <sub>SM</sub>	54	- 42		
Single Pulse Avalanche Current	I <sub>AS</sub>	17	-12.7	mJ	
Single Pulse Avalanche Energy	E <sub>AS</sub>	21	15		
Maximum Power Dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C	12	8	
		T <sub>C</sub> = 70 °C	10.3	5.5	
		T <sub>A</sub> = 25 °C	2.7 <sup>b, c</sup>	2.0 <sup>b, c</sup>	
		T <sub>A</sub> = 70 °C	1.65 <sup>b, c</sup>	1.25 <sup>b, c</sup>	
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	- 55 to 150		°C	

THERMAL RESISTANCE RATINGS							
Parameter	Symbol	N-Channel		P-Channel		Unit	
		Typ.	Max.	Typ.	Max.		
Maximum Junction-to-Ambient <sup>b, d</sup>	R <sub>thJA</sub>	54	64	49	62.5	°C/W	
Maximum Junction-to-Foot (Drain)	R <sub>thJF</sub>	33	42	30	40		

Notes:

- Based on T<sub>C</sub> = 25 °C.
- Surface Mounted on 1" x 1" FR4 board.
- t = 10 s.
- Maximum under Steady State conditions is 120 °C/W.

<b>SPECIFICATIONS</b> $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted							
Parameter	Symbol	Test Conditions	Min.	Typ. <sup>a</sup>	Max.	Unit	
<b>Static</b>							
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	N-Ch	40			V
		$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$	P-Ch	-40			
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = 250\text{ }\mu\text{A}$	N-Ch		44		mV/ $^\circ\text{C}$
		$I_D = -250\text{ }\mu\text{A}$	P-Ch		-42		
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$	$I_D = 250\text{ }\mu\text{A}$	N-Ch		-5.5		
		$I_D = -250\text{ }\mu\text{A}$	P-Ch		4.6		
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	N-Ch	1.0		3.0	V
		$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	P-Ch	-1.2		-3.0	
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$	N-Ch			100	nA
			P-Ch			-100	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}$	N-Ch			1	$\mu\text{A}$
		$V_{DS} = -30\text{ V}, V_{GS} = 0\text{ V}$	P-Ch			-1	
		$V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$	N-Ch			10	
		$V_{DS} = -30\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$	P-Ch			-10	
On-State Drain Current <sup>b</sup>	$I_{D(on)}$	$V_{DS} = 5\text{ V}, V_{GS} = 10\text{ V}$	N-Ch	10			A
		$V_{DS} = -5\text{ V}, V_{GS} = -10\text{ V}$	P-Ch	-10			
Drain-Source On-State Resistance <sup>b</sup>	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 3\text{ A}$	N-Ch		0.016	0.019	$\Omega$
		$V_{GS} = -10\text{ V}, I_D = -3\text{ A}$	P-Ch		0.032	0.039	
		$V_{GS} = 4.5\text{ V}, I_D = 2\text{ A}$	N-Ch		0.024	0.028	
		$V_{GS} = -4.5\text{ V}, I_D = -2\text{ A}$	P-Ch		0.052	0.058	
Forward Transconductance <sup>b</sup>	$g_{fs}$	$V_{DS} = 15\text{ V}, I_D = 5\text{ A}$	N-Ch		22		S
		$V_{DS} = -15\text{ V}, I_D = -5\text{ A}$	P-Ch		14		
<b>Dynamic<sup>a</sup></b>							
Input Capacitance	$C_{iss}$	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$  N-Channel  P-Channel  $V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	N-Ch		1540		$\mu\text{F}$
			P-Ch		1170		
Output Capacitance	$C_{oss}$		N-Ch		370		
			P-Ch		420		
Reverse Transfer Capacitance	$C_{rss}$		N-Ch		41		
			P-Ch		95		
Total Gate Charge	$Q_g$	$V_{DS} = 20\text{ V}, V_{GS} = 10\text{ V}, I_D = 5\text{ A}$	N-Ch		11.7	20	nC
		$V_{DS} = -20\text{ V}, V_{GS} = -10\text{ V}, I_D = -5\text{ A}$	P-Ch		25	38	
		N-Channel $V_{DS} = 20\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 5\text{ A}$	N-Ch		5.3	9	
			P-Ch		11.8	18	
Gate-Source Charge	$Q_{gs}$	P-Channel $V_{DS} = -20\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -5\text{ A}$	N-Ch		1.9		
			P-Ch		3.0		
Gate-Drain Charge	$Q_{gd}$		N-Ch		1.7		
			P-Ch		5.2		
Gate Resistance	$R_g$	$f = 1\text{ MHz}$	N-Ch	0.5	2.2	4.5	$\Omega$
			P-Ch	1.0	5.5	11	

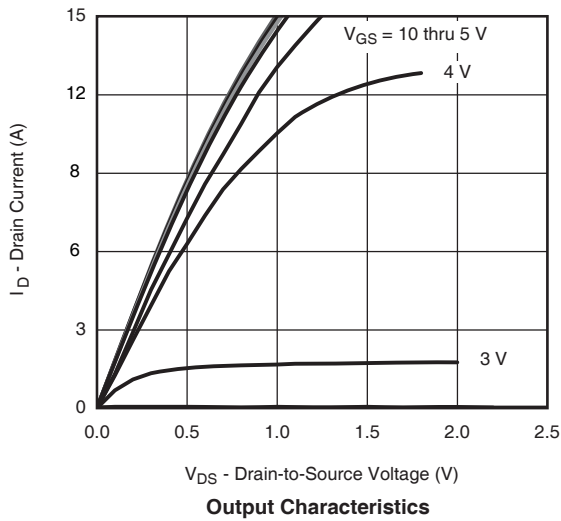
SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted							
Parameter	Symbol	Test Conditions	Min.	Typ. <sup>a</sup>	Max.	Unit	
<b>Dynamic<sup>a</sup></b>							
Turn-On Delay Time	$t_{d(on)}$	N-Channel $V_{DD} = 20\text{ V}$ , $R_L = 4\ \Omega$ $I_D \cong 5\text{ A}$ , $V_{GEN} = 10\text{ V}$ , $R_g = 1\ \Omega$	N-Ch		7	14	ns
			P-Ch		7	14	
Rise Time	$t_r$		N-Ch		10	20	
			P-Ch		12	24	
Turn-Off Delay Time	$t_{d(off)}$	P-Channel $V_{DD} = -20\text{ V}$ , $R_L = 4\ \Omega$ $I_D \cong -5\text{ A}$ , $V_{GEN} = -10\text{ V}$ , $R_g = 1\ \Omega$	N-Ch		15	30	
			P-Ch		30	60	
Fall Time	$t_f$		N-Ch		9	18	
			P-Ch		9	18	
Turn-On Delay Time	$t_{d(on)}$	N-Channel $V_{DD} = 20\text{ V}$ , $R_L = 4\ \Omega$ $I_D \cong 5\text{ A}$ , $V_{GEN} = 4.5\text{ V}$ , $R_g = 1\ \Omega$	N-Ch		16	30	
			P-Ch		44	80	
Rise Time	$t_r$		N-Ch		17	30	
			P-Ch		33	50	
Turn-Off Delay Time	$t_{d(off)}$	P-Channel $V_{DD} = -20\text{ V}$ , $R_L = 4\ \Omega$ $I_D \cong -5\text{ A}$ , $V_{GEN} = -4.5\text{ V}$ , $R_g = 1\ \Omega$	N-Ch		16	30	
			P-Ch		28	60	
Fall Time	$t_f$		N-Ch		10	20	
			P-Ch		13	25	
<b>Drain-Source Body Diode Characteristics</b>							
Body Diode Voltage	$V_{SD}$	$I_S = 1.6\text{ A}$	N-Ch		0.78	1.2	V
		$I_S = -1.6\text{ A}$	P-Ch		-0.76	-1.2	
Body Diode Reverse Recovery Time	$t_{rr}$	N-Channel $I_F = 2\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $T_J = 25\text{ }^\circ\text{C}$	N-Ch		19	30	ns
			P-Ch		26	50	
Body Diode Reverse Recovery Charge	$Q_{rr}$	P-Channel $I_F = -2\text{ A}$ , $di/dt = -100\text{ A}/\mu\text{s}$ , $T_J = 25\text{ }^\circ\text{C}$	N-Ch		14	25	nC
			P-Ch		18.5	35	
Reverse Recovery Fall Time	$t_a$		N-Ch		13		ns
			P-Ch		12.5		
Reverse Recovery Rise Time	$t_b$		N-Ch		6		
			P-Ch		13.5		

Notes:

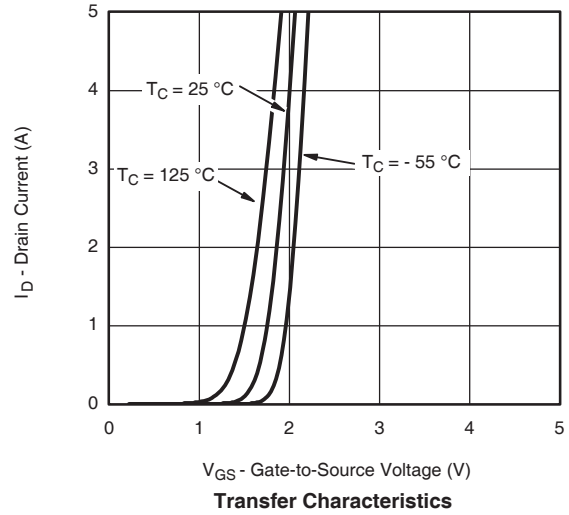
- Guaranteed by design, not subject to production testing.
- Pulse test; pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .

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.

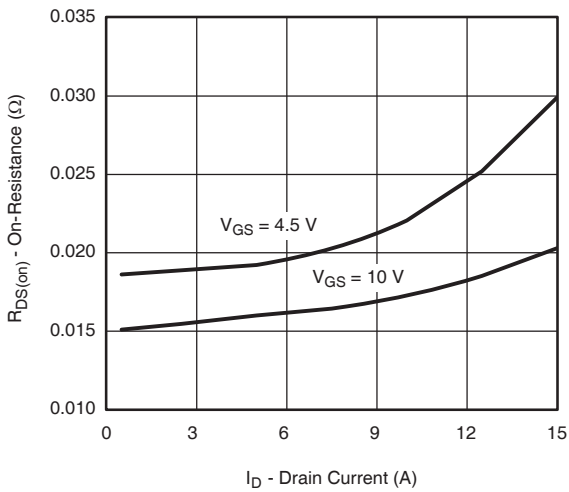
**N-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



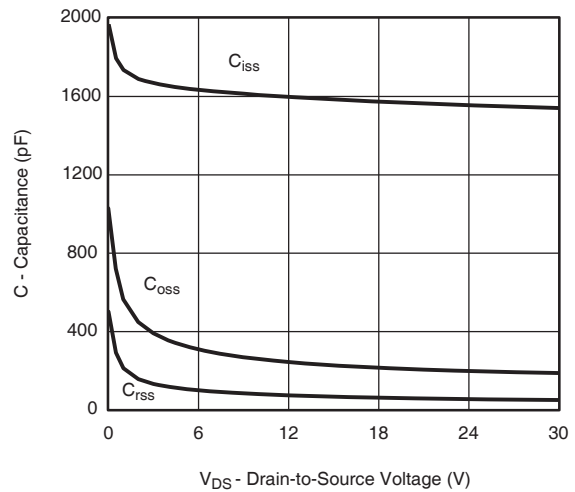
**Output Characteristics**



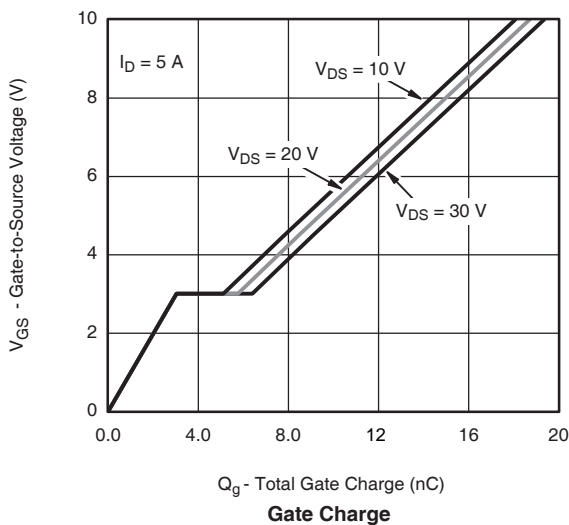
**Transfer Characteristics**



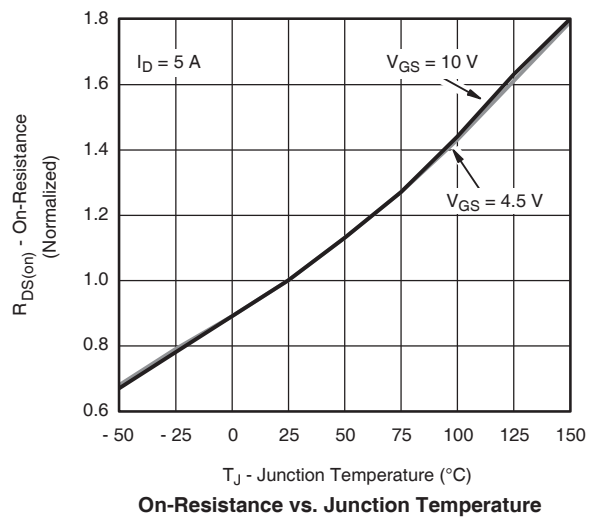
**On-Resistance vs. Drain Current**



**Capacitance**

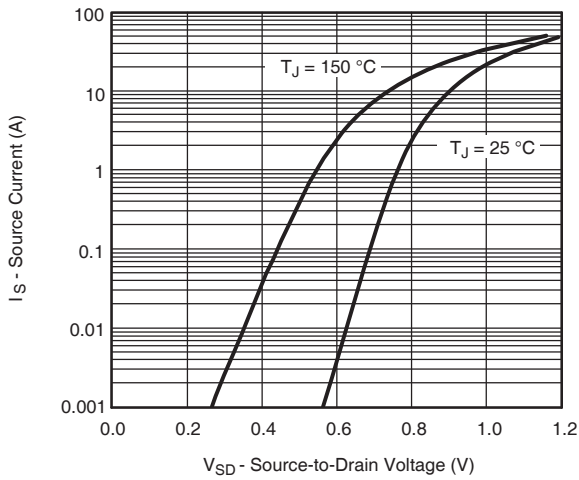


**Gate Charge**

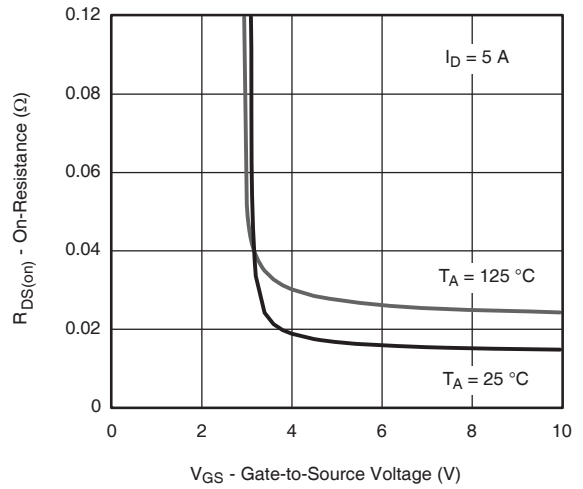


**On-Resistance vs. Junction Temperature**

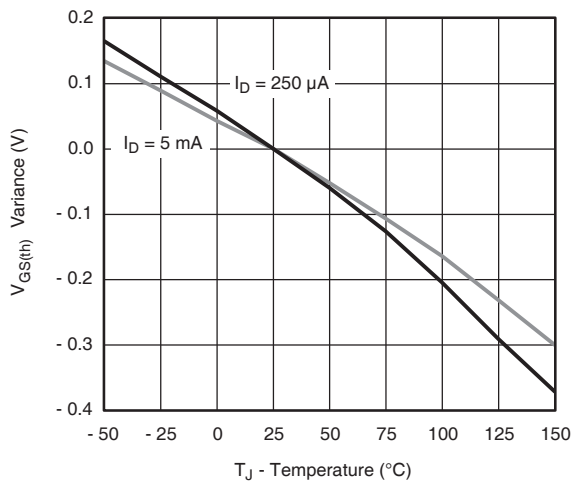
**N-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



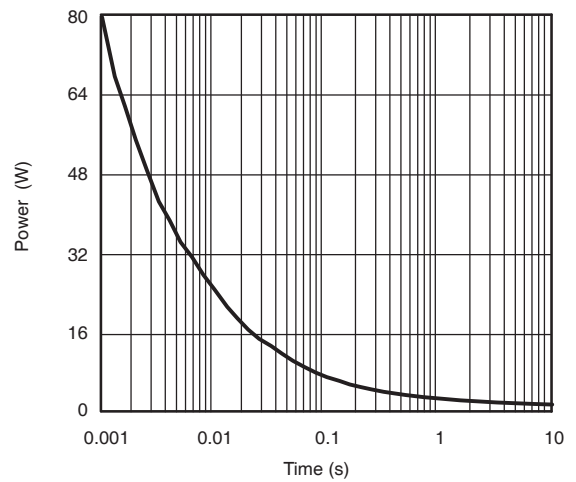
**Source-Drain Diode Forward Voltage**



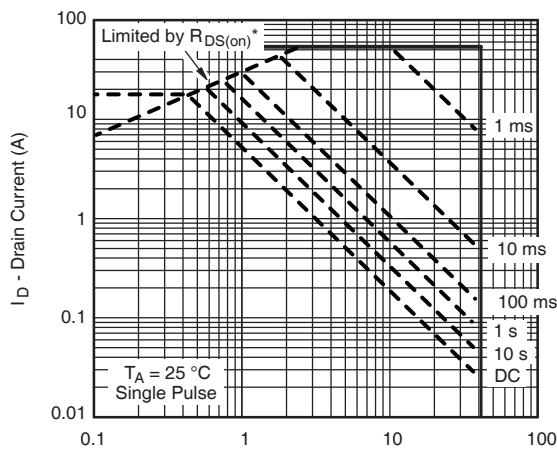
**On-Resistance vs. Gate-to-Source Voltage**



**Threshold Voltage**

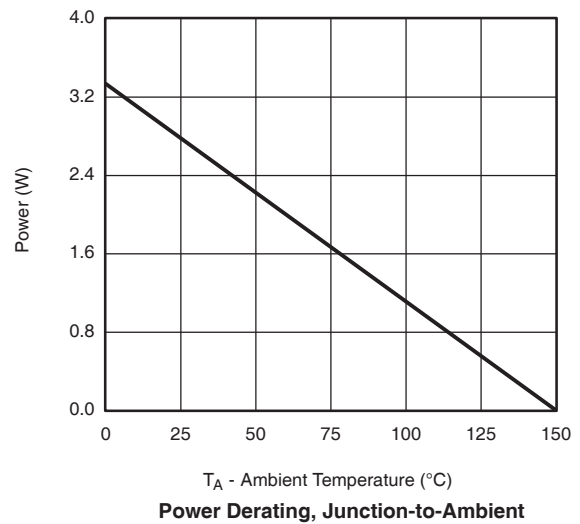
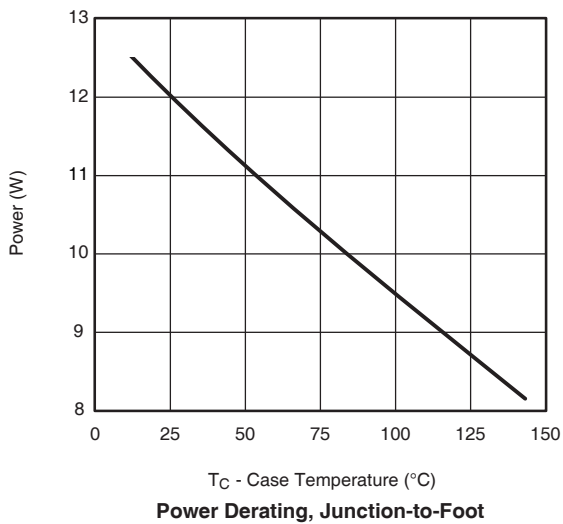
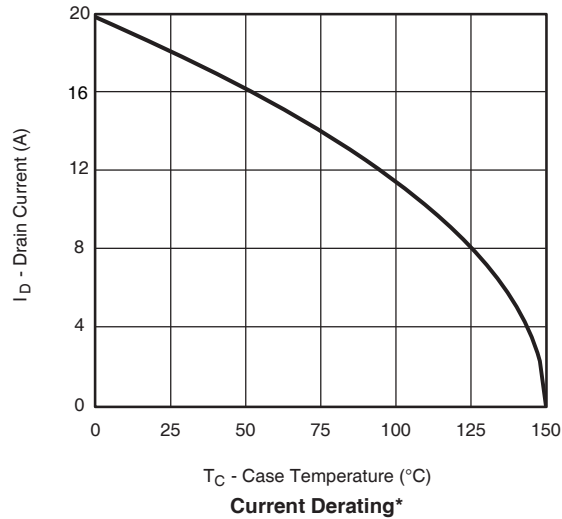


**Single Pulse Power, Junction-to-Ambient**



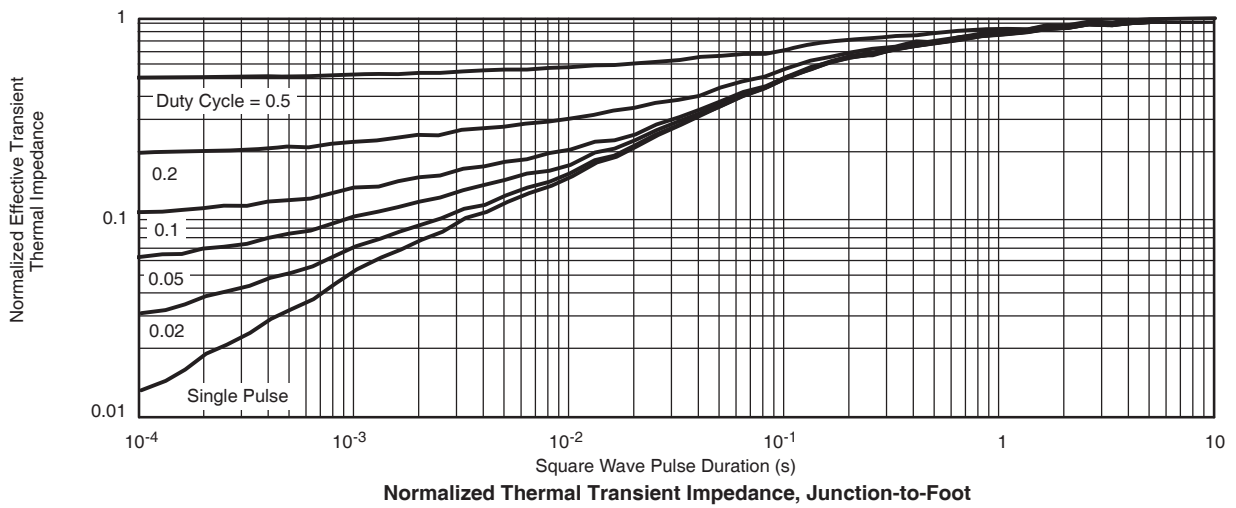
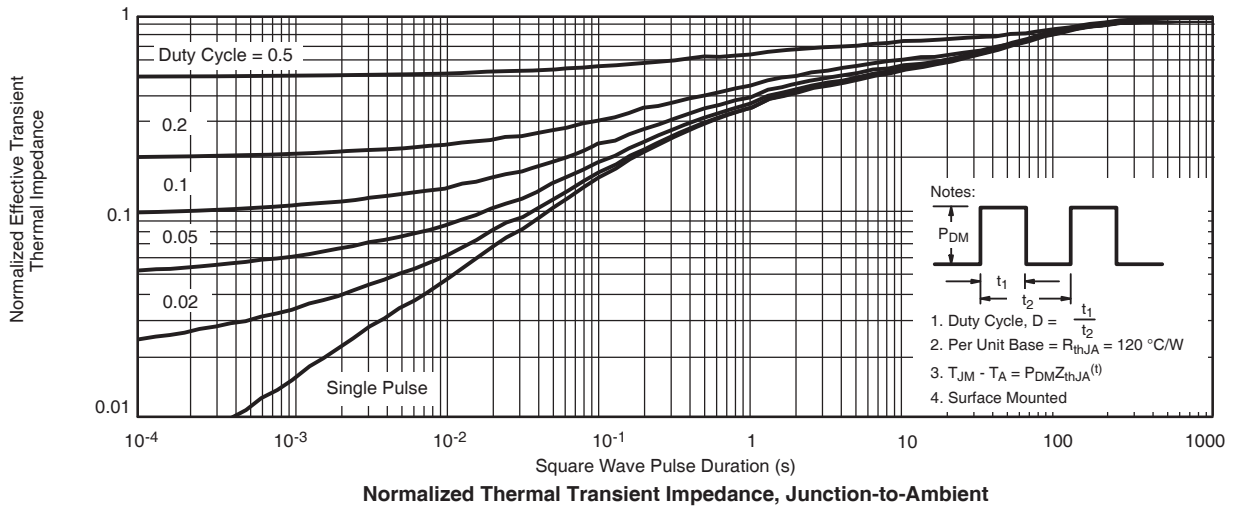
**Safe Operating Area, Junction-to-Ambient**  
\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $r_{DS(on)}$  is specified

**N-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted

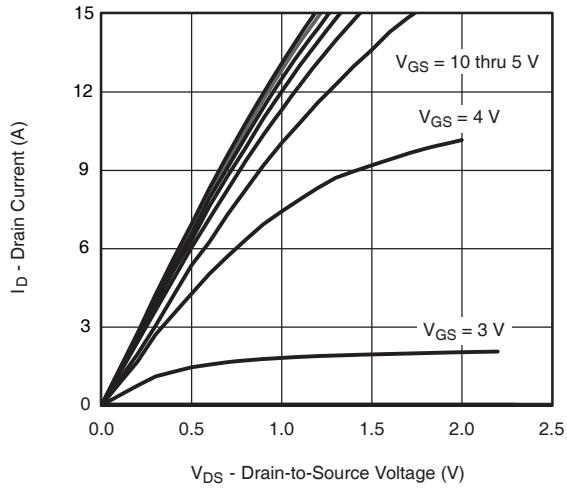


\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 150$  °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package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

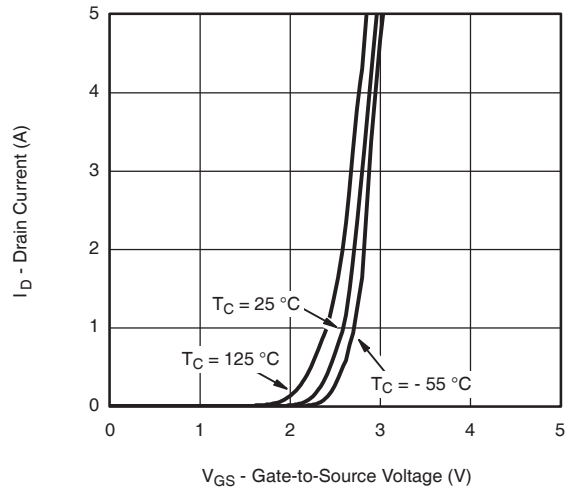
**N-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



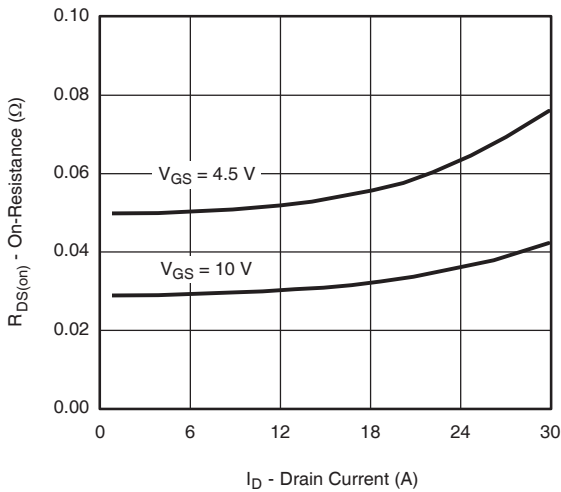
**P-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



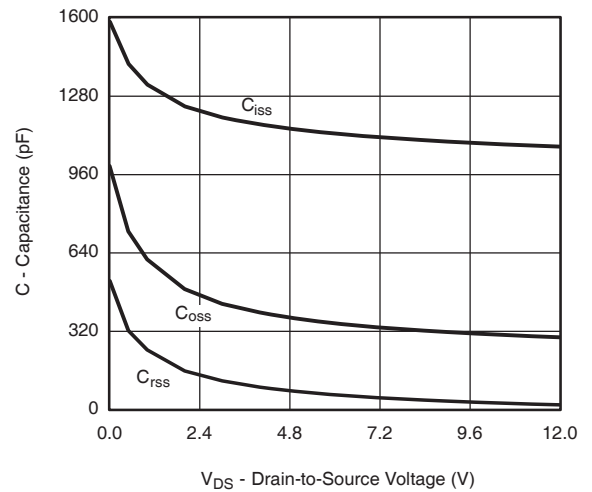
**Output Characteristics**



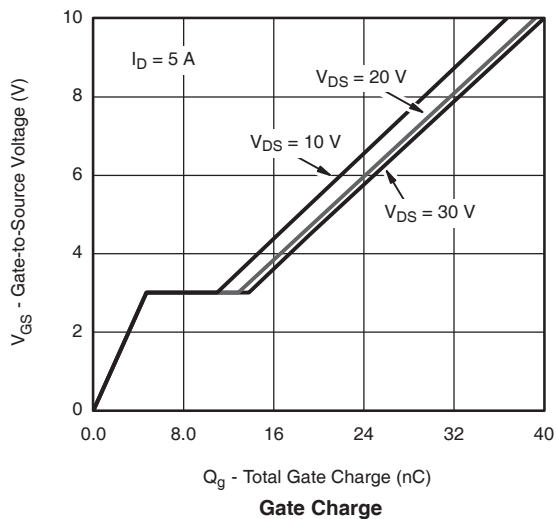
**Transfer Characteristics**



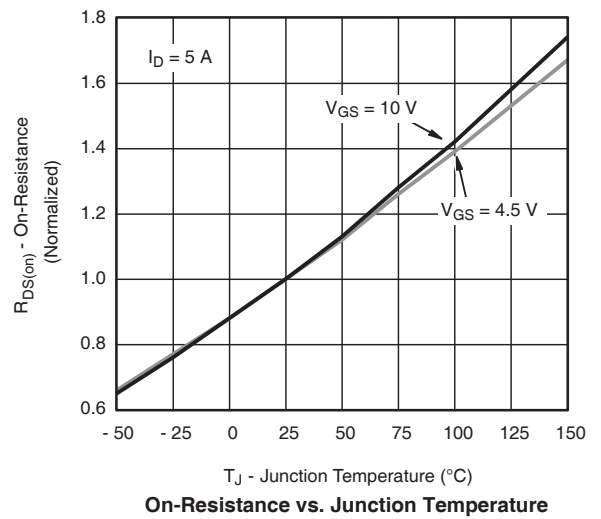
**On-Resistance vs. Drain Current**



**Capacitance**



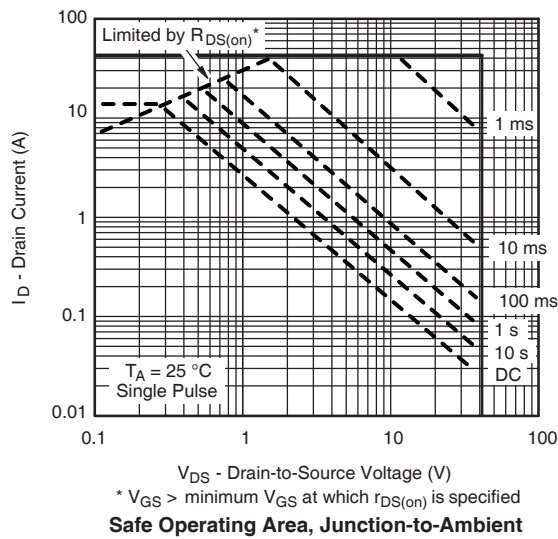
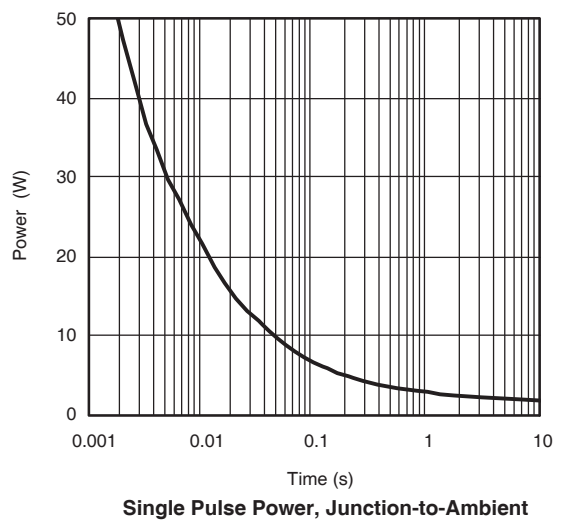
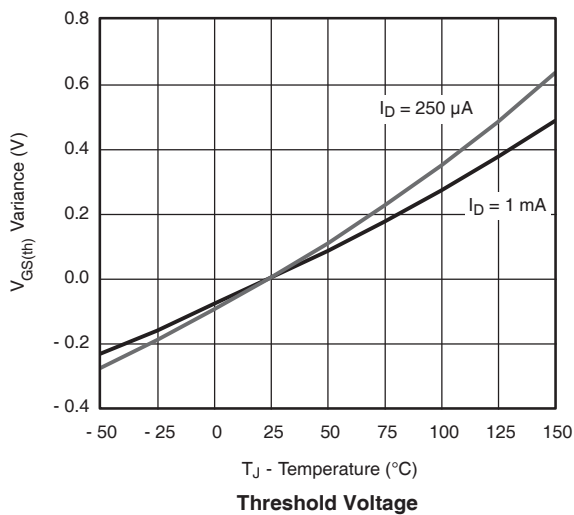
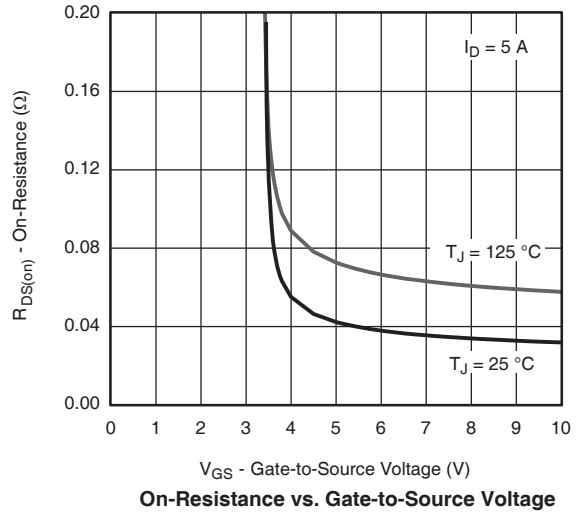
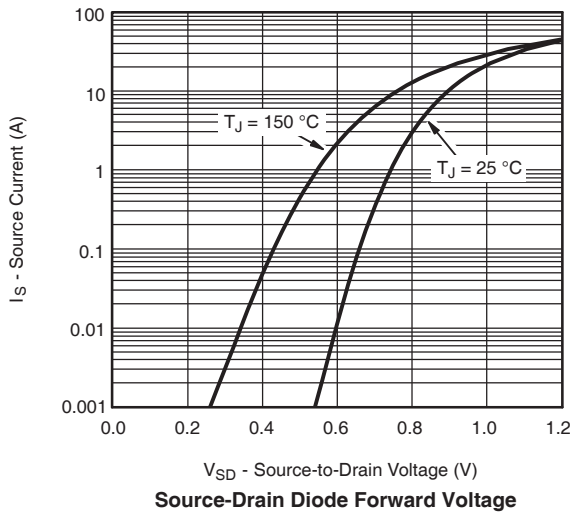
**Gate Charge**



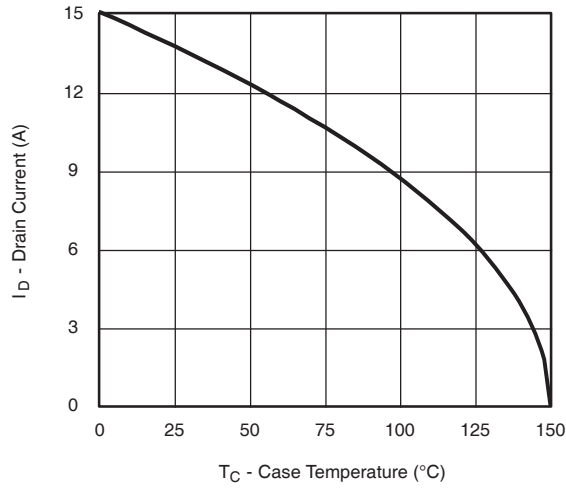
**On-Resistance vs. Junction Temperature**



**P-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted

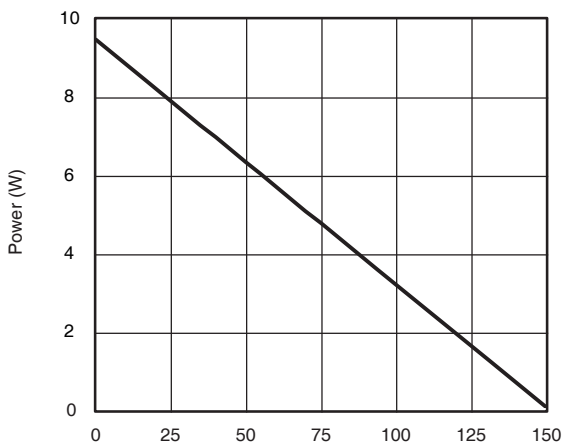


**P-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



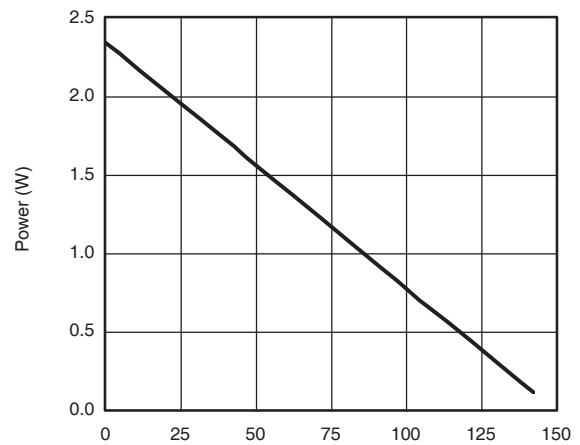
$T_C$  - Case Temperature (°C)

**Current Derating\***



$T_C$  - Case Temperature (°C)

**Power Derating, Junction-to-Foot**

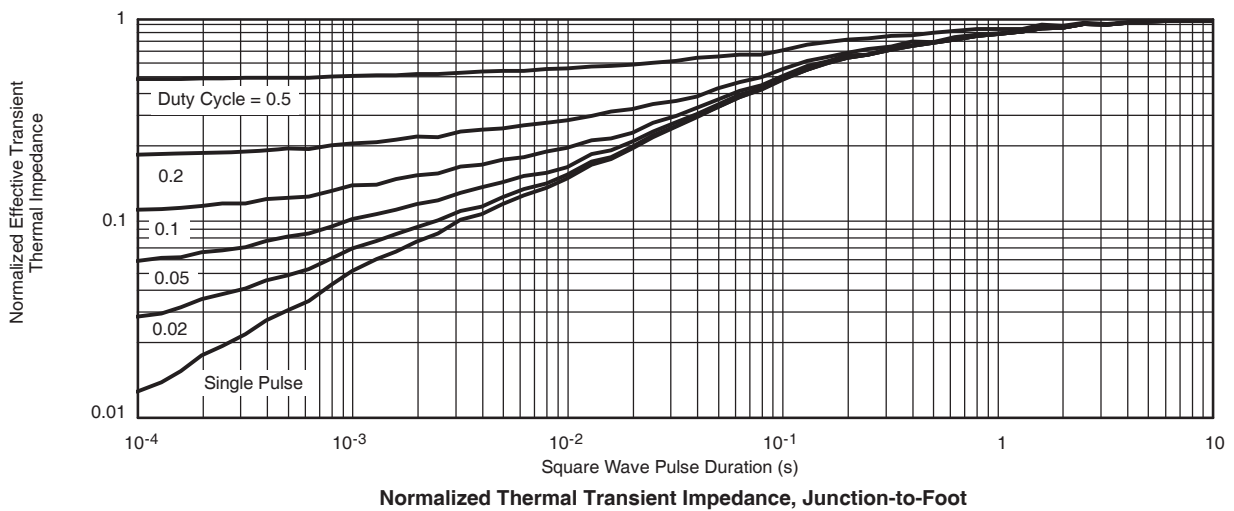
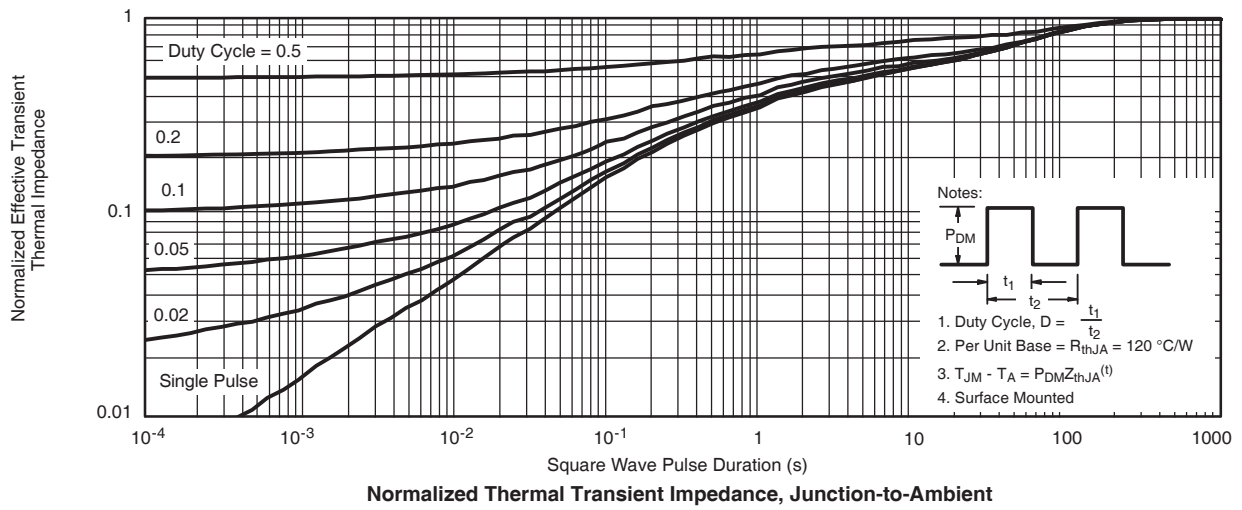


$T_A$  - Ambient Temperature (°C)

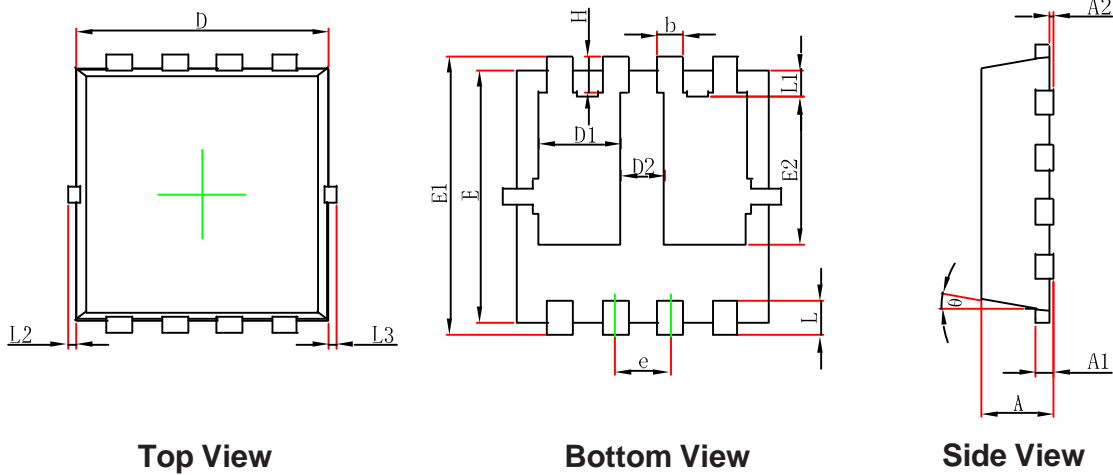
**Power Derating, Junction-to-Ambient**

\* 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.

**P-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



## PDFN3.3X3.3-8L Package Outline Dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.650	0.850	0.026	0.033
A1	0.152 REF.		0.006 REF.	
A2	0~0.05		0~0.002	
D	2.900	3.100	0.114	0.122
D1	0.935	1.135	0.037	0.045
D2	0.280	0.480	0.011	0.019
E	2.900	3.100	0.114	0.122
E1	3.150	3.450	0.124	0.136
E2	1.535	1.935	0.060	0.076
b	0.200	0.400	0.008	0.016
e	0.550	0.750	0.022	0.030
L	0.300	0.500	0.012	0.020
L1	0.180	0.480	0.007	0.019
L2	0~0.100		0~0.004	
L3	0~0.100		0~0.004	
H	0.315	0.515	0.012	0.020
θ	9°	13°	9°	13°

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## Material Category Policy

**Din-Tek Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Din-Tek documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

**Din-Tek Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Din-Tek documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**