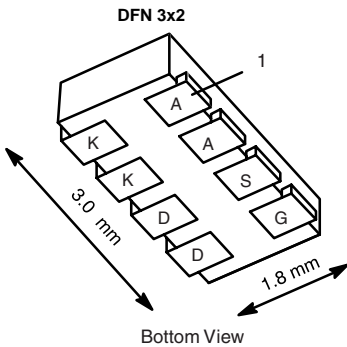


## P-Channel 20 V (D-S) MOSFET with Schottky Diode

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.)
- 20	0.009 at V <sub>GS</sub> = - 4.5 V	- 4.0	4.1 nC
	0.125 at V <sub>GS</sub> = - 2.5 V	- 3.3	
	0.155 at V <sub>GS</sub> = - 1.8 V	- 3.0	

SCHOTTKY PRODUCT SUMMARY		
V <sub>KA</sub> (V)	V <sub>f</sub> (V) Diode Forward Voltage	I <sub>F</sub> (A) <sup>a</sup>
20	0.375 at 1 A	1



### FEATURES

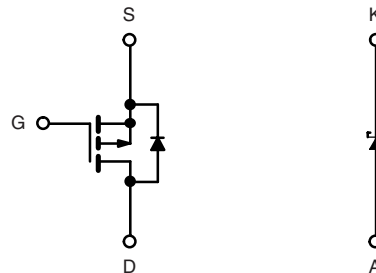
- Halogen-free According to IEC 61249-2-21 Definition
- LITTLE FOOT<sup>®</sup> Plus Power MOSFET
- Ultra Low V<sub>F</sub> Schottky
- Compliant to RoHS Directive 2002/95/EC



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
Available

### APPLICATIONS

- Charging Switch for Portable Devices  
- With Integrated Low V<sub>F</sub> Trench Schottky Diode



P-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS T <sub>A</sub> = 25 °C, unless otherwise noted				
Parameter		Symbol	Limit	Unit
Drain-Source Voltage (MOSFET)		V <sub>DS</sub>	- 20	V
Reverse Voltage (Schottky)		V <sub>KA</sub>	20	
Gate-Source Voltage (MOSFET)		V <sub>GS</sub>	± 8	
Continuous Drain Current (T <sub>J</sub> = 150 °C) (MOSFET)	T <sub>C</sub> = 25 °C	I <sub>D</sub>	- 4.0 <sup>a</sup>	A
	T <sub>C</sub> = 70 °C		- 3.0	
	T <sub>A</sub> = 25 °C		- 2.5 <sup>b, c</sup>	
	T <sub>A</sub> = 70 °C		- 2.0 <sup>b, c</sup>	
Pulsed Drain Current (MOSFET)		I <sub>DM</sub>	- 12	
Continuous Source Current (MOSFET Diode Conduction)	T <sub>C</sub> = 25 °C	I <sub>S</sub>	- 2.3 <sup>a</sup>	
	T <sub>A</sub> = 25 °C		- 1.1 <sup>b, c</sup>	
Average Forward Current (Schottky)		I <sub>F</sub>	1	
Pulsed Forward Current (Schottky)		I <sub>FM</sub>	7	
Maximum Power Dissipation (MOSFET)	T <sub>C</sub> = 25 °C	P <sub>D</sub>	2.8	W
	T <sub>C</sub> = 70 °C		1.8	
	T <sub>A</sub> = 25 °C		1.3 <sup>b, c</sup>	
	T <sub>A</sub> = 70 °C		0.8 <sup>b, c</sup>	
Maximum Power Dissipation (Schottky)	T <sub>C</sub> = 25 °C	P <sub>D</sub>	3.1	W
	T <sub>C</sub> = 70 °C		2.0	
	T <sub>A</sub> = 25 °C		1.9	
	T <sub>A</sub> = 70 °C		1.2	
Operating Junction and Storage Temperature Range		T <sub>J</sub> , T <sub>stg</sub>	- 55 to 150	°C
Soldering Recommendation (Peak Temperature) <sup>d, e</sup>			260	

THERMAL RESISTANCE RATINGS				
Parameter	Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient (MOSFET) <sup>b, c, f</sup>	$R_{thJA}$	82	99	°C/W
Maximum Junction-to-Foot (Drain) (MOSFET)	$R_{thJF}$	35	45	
Maximum Junction-to-Ambient (Schottky) <sup>b, c, g</sup>	$R_{thJA}$	54	65	
Maximum Junction-to-Foot (Drain) (Schottky)	$R_{thJF}$	30	40	

Notes:

a. Based on  $T_C = 25\text{ °C}$ .

b. Surface mounted on FR4 board.

c.  $t \leq 5\text{ s}$ .

d. See Reliability Manual for profile. The DFN3X2 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.

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

f. Maximum under steady state conditions for MOSFETs is 130 °C/W.

g. Maximum under steady state conditions for Schottky is 115 °C/W.

SPECIFICATIONS $T_J = 25\text{ °C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$	-20			V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = -250\text{ }\mu\text{A}$		-19		mV/°C
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$		2			
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	-0.45		-1	V
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 8\text{ V}$			$\pm 100$	ns
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}$			-1	$\mu\text{A}$
		$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ °C}$			-10	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} \leq -5\text{ V}, V_{GS} = -4.5\text{ V}$	-10			A
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = -4.5\text{ V}, I_D = -2.5\text{ A}$		0.090		$\Omega$
		$V_{GS} = -2.5\text{ V}, I_D = -2.2\text{ A}$		0.125		
		$V_{GS} = -1.8\text{ V}, I_D = -2.0\text{ A}$		0.155		
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = -10\text{ V}, I_D = -2.5\text{ A}$		18		S
<b>Dynamic<sup>b</sup></b>						
Input Capacitance	$C_{iss}$	$V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		276		$\mu\text{F}$
Output Capacitance	$C_{oss}$		60			
Reverse Transfer Capacitance	$C_{rss}$		43			
Total Gate Charge	$Q_g$	$V_{DS} = -10\text{ V}, V_{GS} = -5\text{ V}, I_D = -2.5\text{ A}$		4.5	6.8	nC
				4.1	6.2	
Gate-Source Charge	$Q_{gs}$	$V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -2.5\text{ A}$		0.6		
Gate-Drain Charge	$Q_{gd}$			1.0		
Gate Resistance	$R_g$	$f = 1\text{ MHz}$	1.1	5.5	11	$\Omega$
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -10\text{ V}, R_L = 5\text{ }\Omega$ $I_D \cong -2\text{ A}, V_{GEN} = -4.5\text{ V}, R_g = 1\text{ }\Omega$		11	17	ns
Rise Time	$t_r$			34	51	
Turn-Off Delay Time	$t_{d(off)}$			22	33	
Fall Time	$t_f$			8	16	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -10\text{ V}, R_L = 5\text{ }\Omega$ $I_D \cong -2\text{ A}, V_{GEN} = -5\text{ V}, R_g = 1\text{ }\Omega$		5	10	
Rise Time	$t_r$			14	21	
Turn-Off Delay Time	$t_{d(off)}$			17	26	
Fall Time	$t_f$			8	16	

SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25\text{ }^\circ\text{C}$			- 2.3	A
Pulse Diode Forward Current	$I_{SM}$				- 10	
Body Diode Voltage	$V_{SD}$	$I_S = - 2\text{ A}, V_{GS} = 0\text{ V}$		- 0.8	- 1.2	V
Body Diode Reverse Recovery Time	$t_{rr}$	$I_F = - 2\text{ A } dI/dt = 100\text{ A}/\mu\text{s } T_J = 25\text{ }^\circ\text{C}$		23	35	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$			13	20	
Reverse Recovery Fall Time	$t_a$			10		ns
Reverse Recovery Rise Time	$t_b$			13		

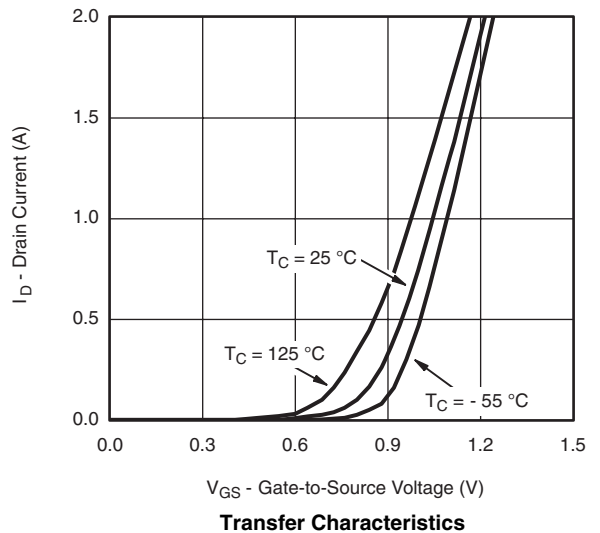
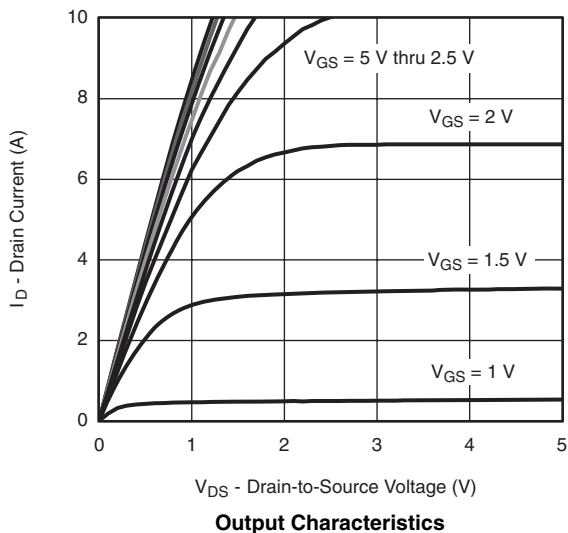
Notes:

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

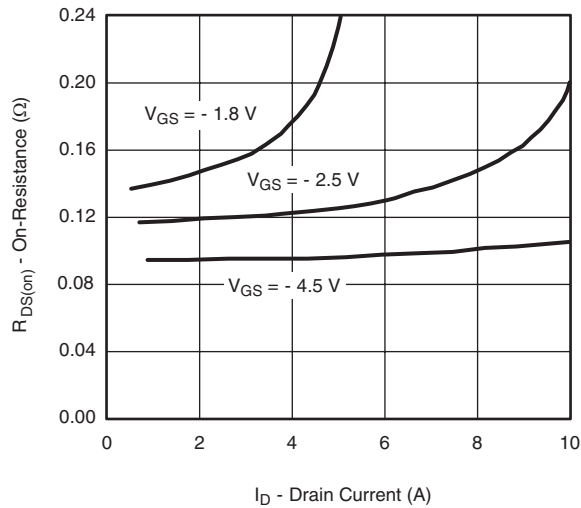
SCHOTTKY SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Forward Voltage Drop	$V_F$	$I_F = 1\text{ A}$		0.34	0.375	V
		$I_F = 1\text{ A}, T_J = 125\text{ }^\circ\text{C}$		0.255	0.290	
Maximum Reverse Leakage Current	$I_{rm}$	$V_r = 20\text{ V}$		0.05	0.500	mA
		$V_r = 20\text{ V}, T_J = 85\text{ }^\circ\text{C}$		2	20	
		$V_r = 20\text{ V}, T_J = 125\text{ }^\circ\text{C}$		10	100	
Junction Capacitance	$C_T$	$V_r = 10\text{ V}$		90		pF

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.

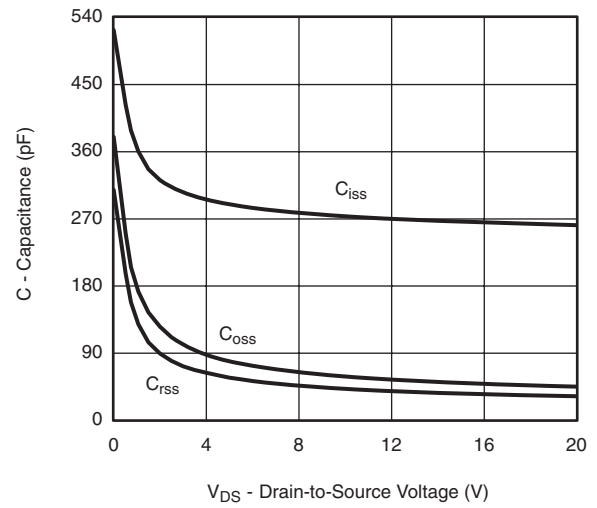
**TYPICAL CHARACTERISTICS**  $25\text{ }^\circ\text{C}$ , unless otherwise noted



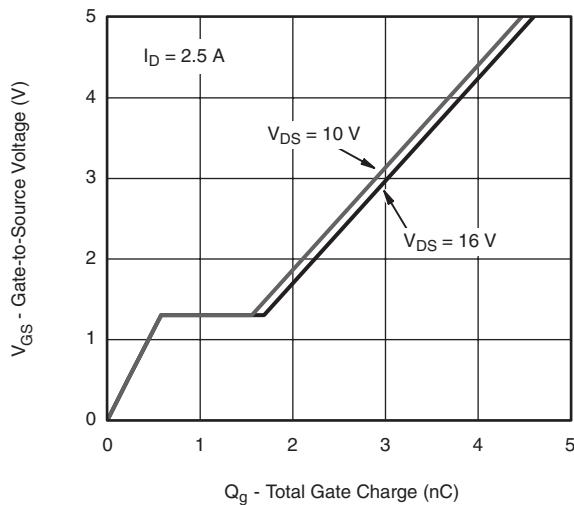
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



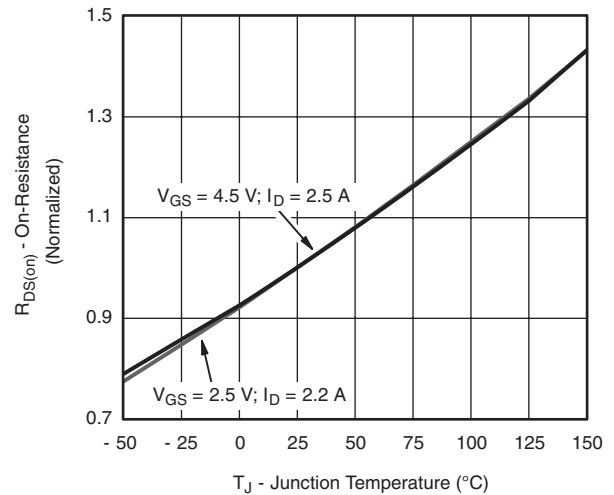
**On Resistance vs. Drain Current**



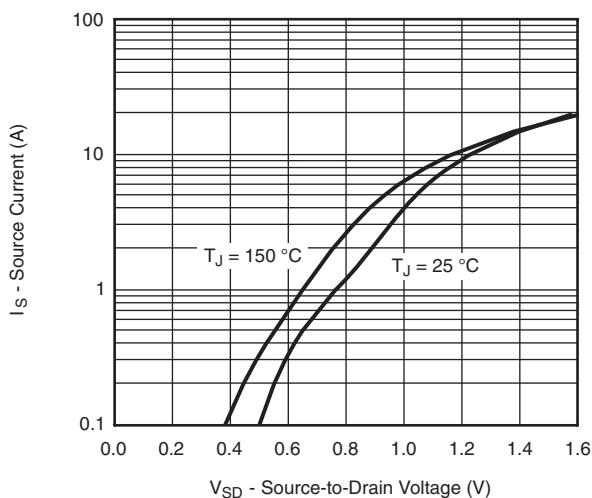
**Capacitance**



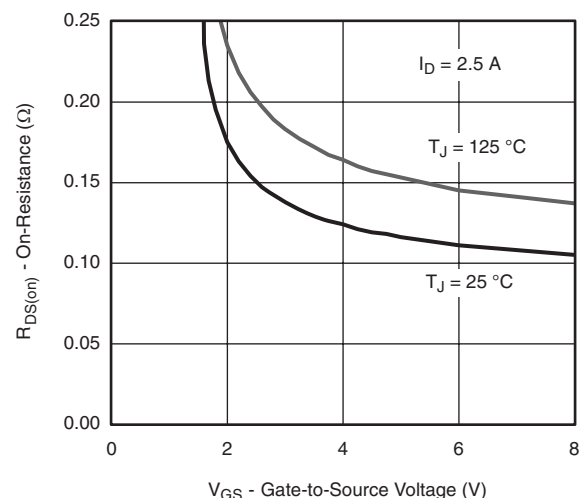
**Gate Charge**



**On-Resistance vs. Junction Temperature**

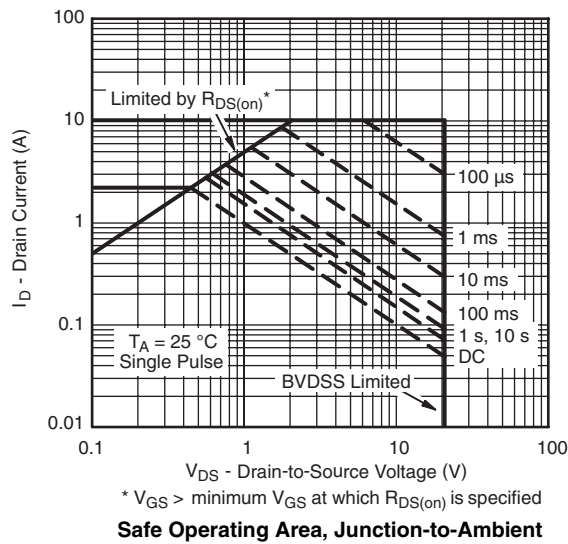
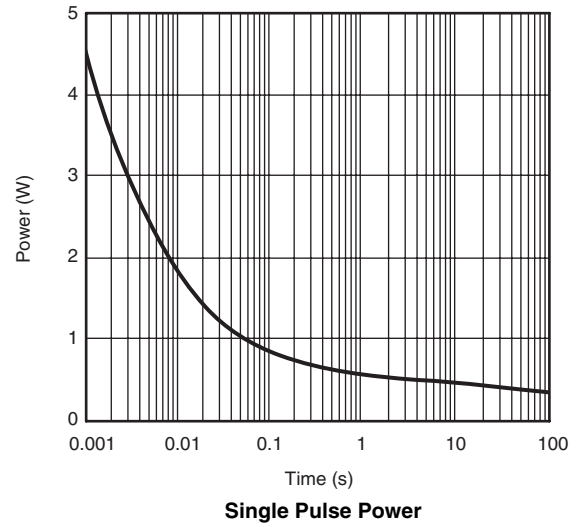
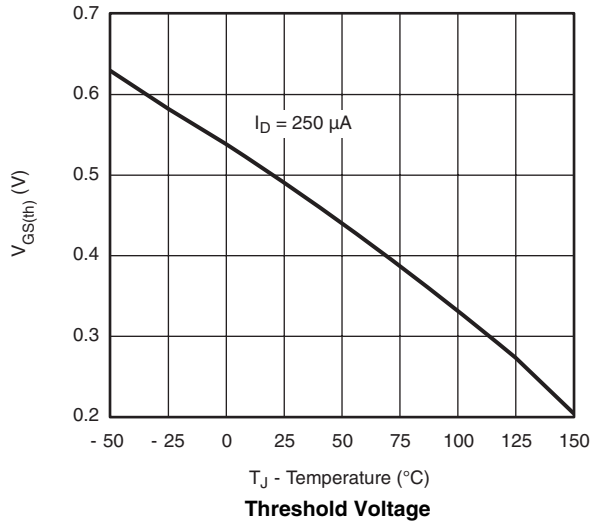


**Forward Diode Voltage vs. Temp.**

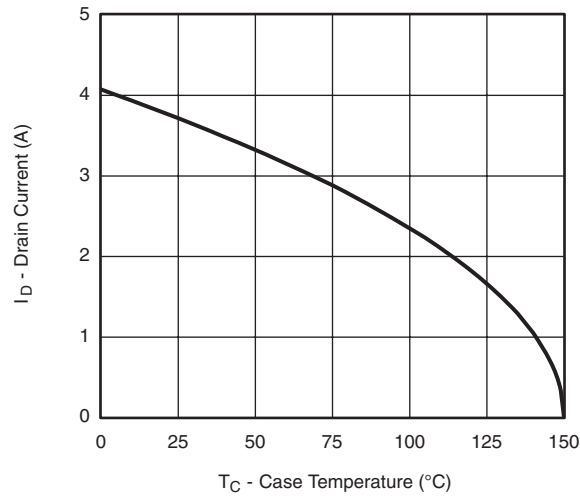


**On-Resistance vs. Gate-to-Source Voltage**

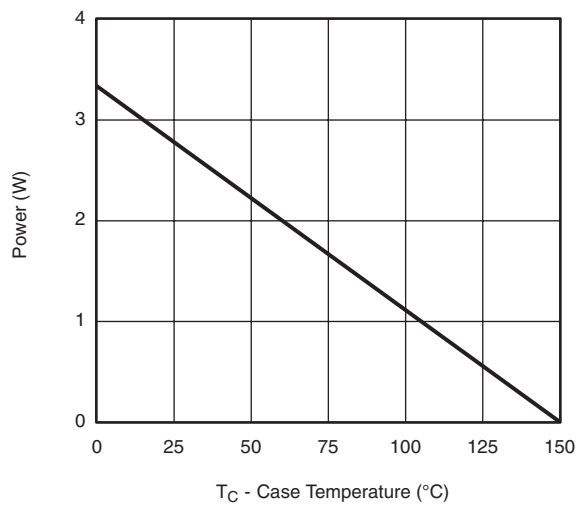
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



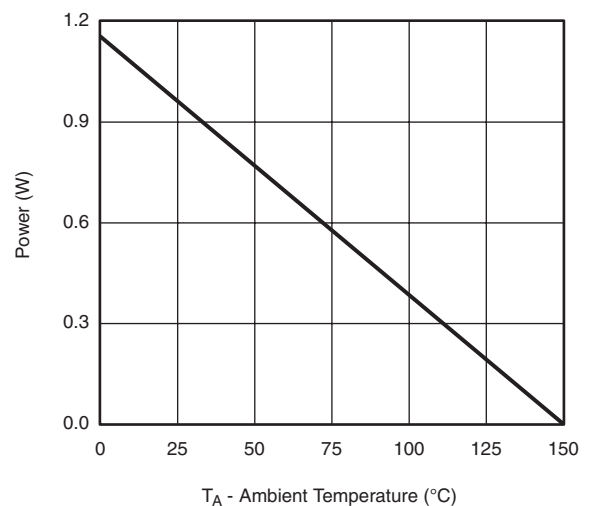
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



**Current Derating\***



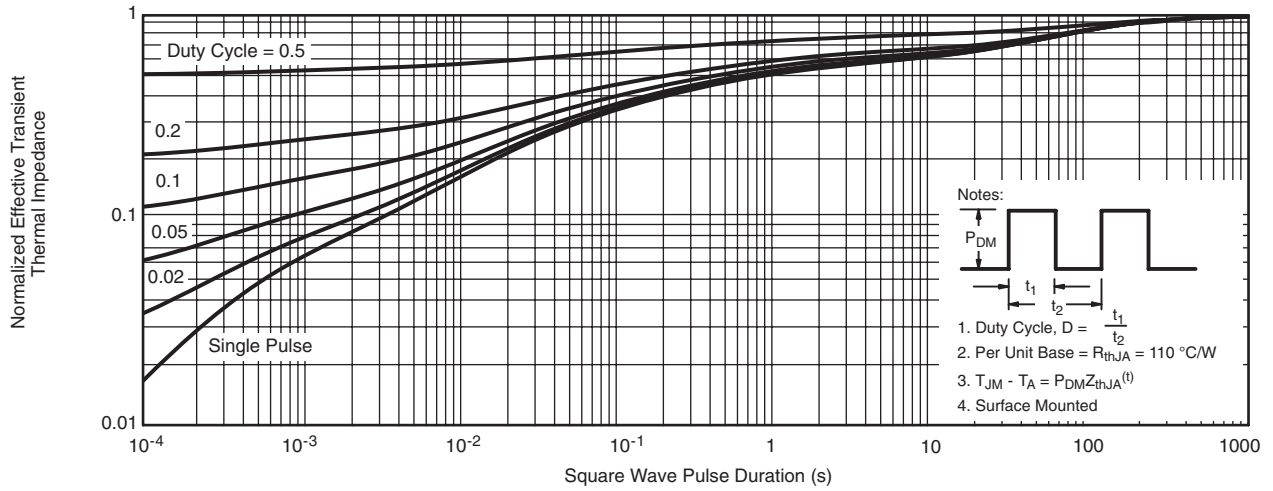
**Power, Junction-to-Foot**



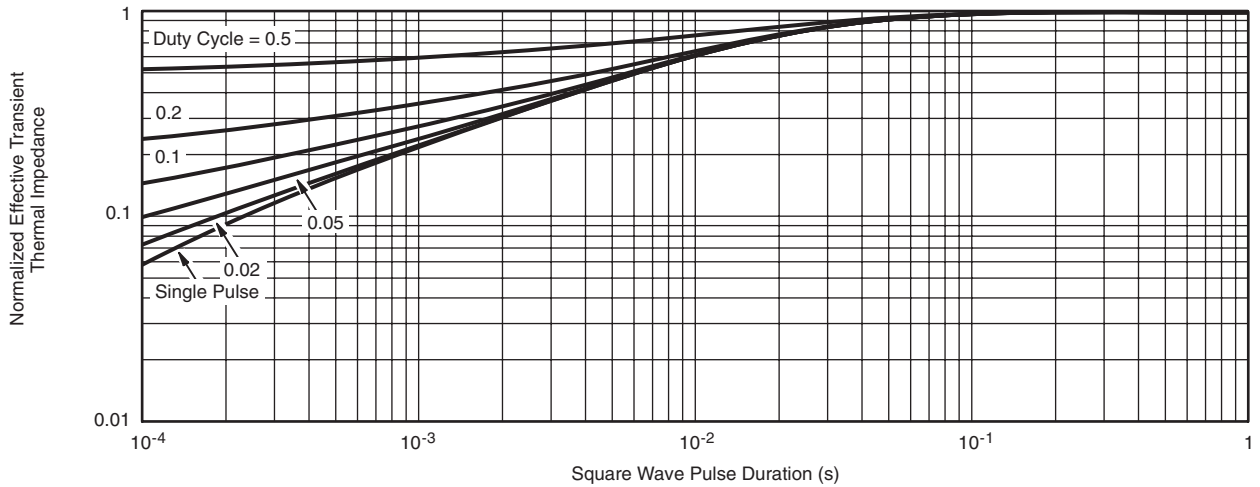
**Power, Junction-to-Ambient**

\* 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

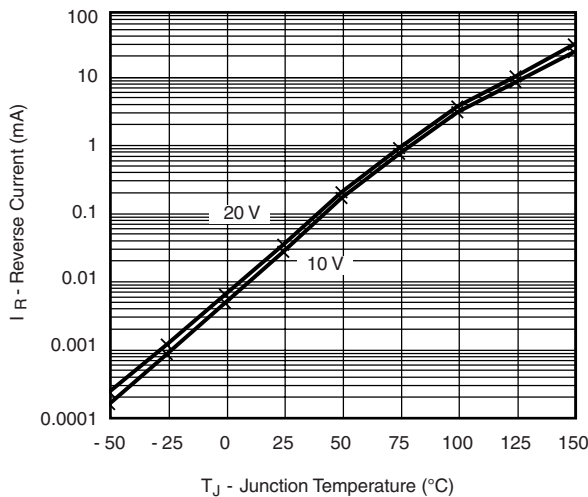


**Normalized Thermal Transient Impedance, Junction-to-Ambient**

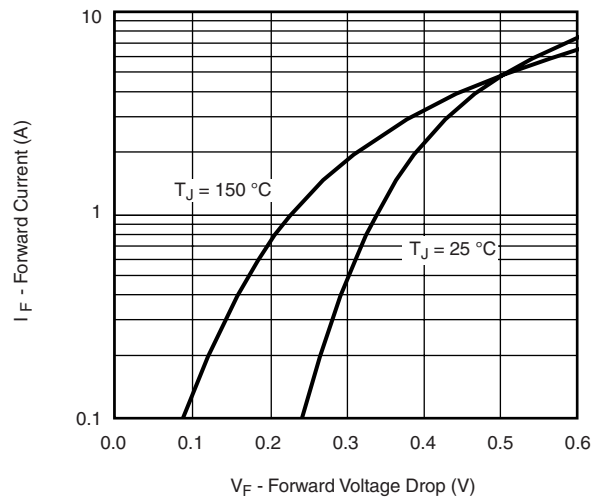


**Normalized Thermal Transient Impedance, Junction-to-Foot**

**SCHOTTKY TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted

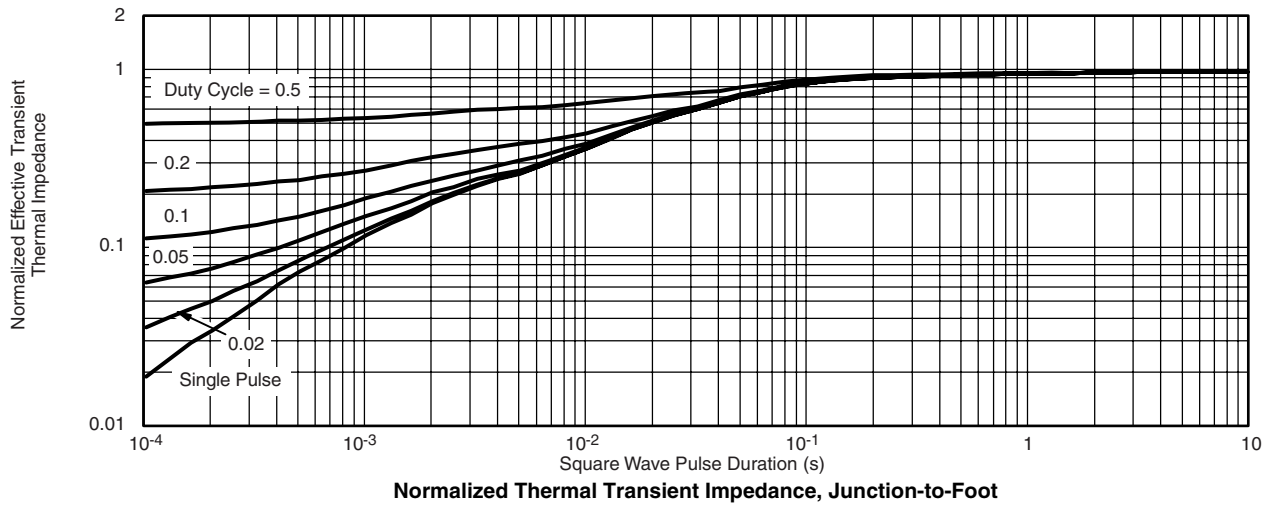
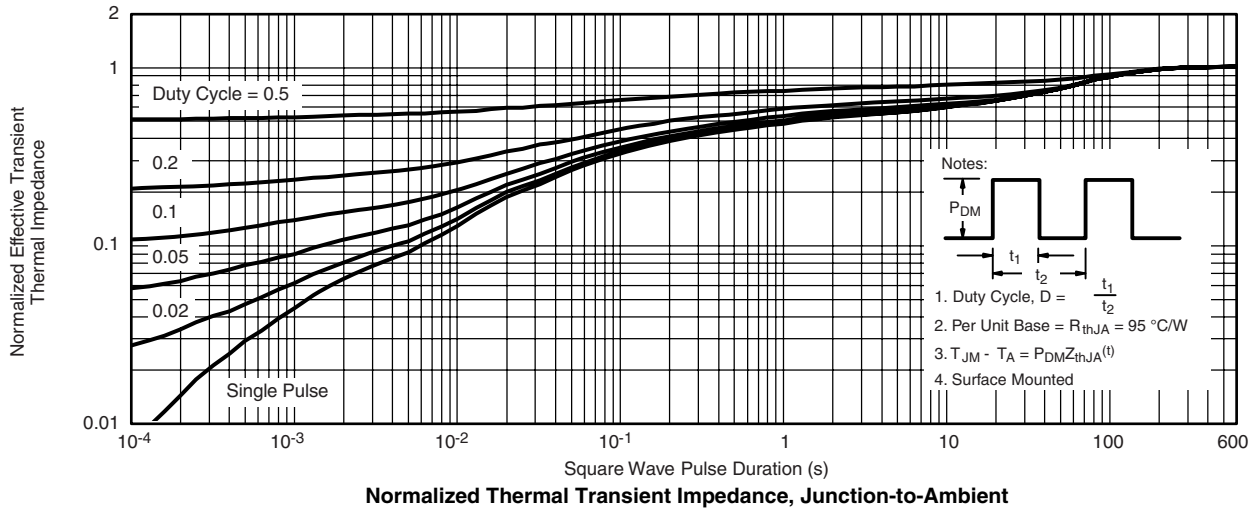
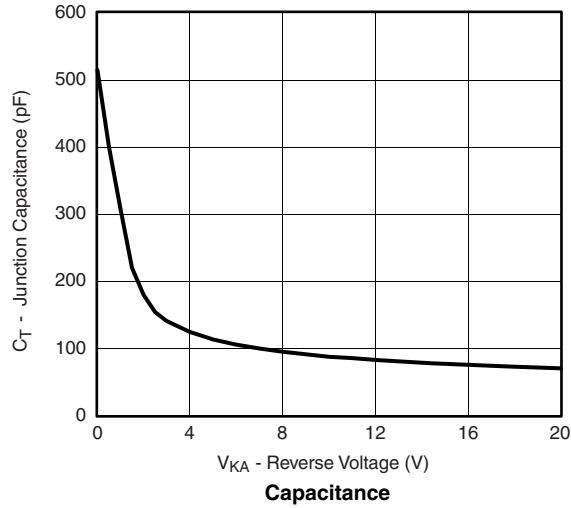


**Reverse Current vs. Junction Temperature**



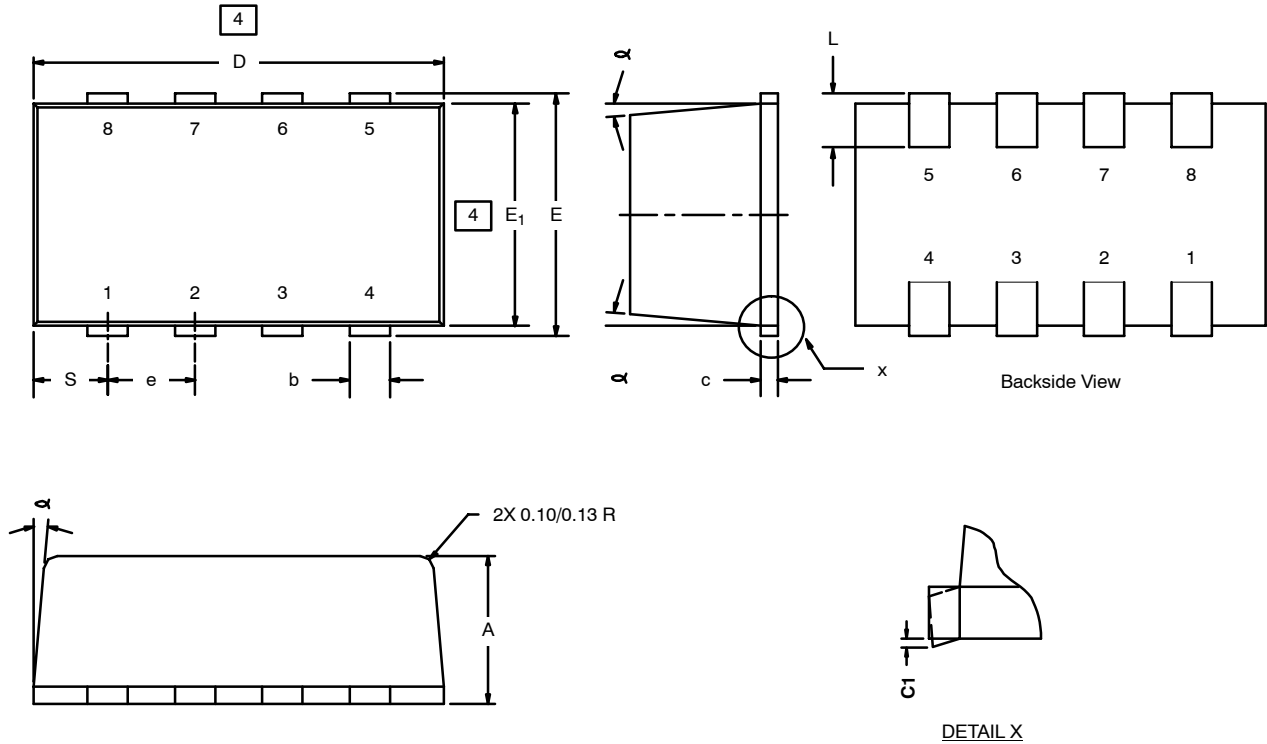
**Forward Voltage Drop**

**SCHOTTKY TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted





DFN 3x2

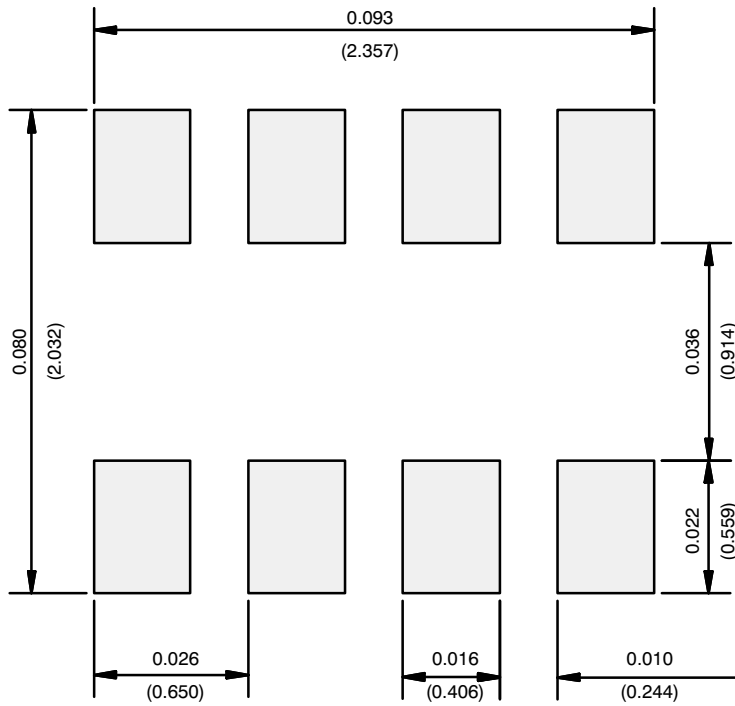


NOTES:

1. All dimensions are in millimeters.
2. Mold gate burrs shall not exceed 0.13 mm per side.
3. Leadframe to molded body offset is horizontal and vertical shall not exceed 0.08 mm.
4. Dimensions exclusive of mold gate burrs.
5. No mold flash allowed on the top and bottom lead surface.

Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
<b>A</b>	1.00	-	1.10	0.039	-	0.043
<b>b</b>	0.25	0.30	0.35	0.010	0.012	0.014
<b>c</b>	0.1	0.15	0.20	0.004	0.006	0.008
<b>c1</b>	0	-	0.038	0	-	0.0015
<b>D</b>	2.95	3.05	3.10	0.116	0.120	0.122
<b>E</b>	1.825	1.90	1.975	0.072	0.075	0.078
<b>E<sub>1</sub></b>	1.55	1.65	1.70	0.061	0.065	0.067
<b>e</b>	0.65 BSC			0.0256 BSC		
<b>L</b>	0.28	-	0.42	0.011	-	0.017
<b>S</b>	0.55 BSC			0.022 BSC		
<b>α</b>	5°Nom			5°Nom		
ECN: C-03528—Rev. F, 19-Jan-04 DWG: 5547						

RECOMMENDED MINIMUM PADS FOR DFN 3x2



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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