

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

MOSFET PRODUCT SUMMARY			
$V_{DS}$ (V)	$r_{DS(on)}$ ( $\Omega$ )	$I_D$ (A) <sup>a</sup>	$Q_g$ (Typ)
- 20	0.058 at $V_{GS} = -4.5$ V	6	5.5 nC
	0.100 at $V_{GS} = -2.5$ V	6	

SCHOTTKY PRODUCT SUMMARY		
$V_{KA}$ (V)	$V_f$ (V) Diode Forward Voltage	$I_F$ (A) <sup>a</sup>
20	0.375 at 1 A	2

## FEATURES

- LITTLE FOOT<sup>®</sup> Plus Power MOSFET
- New Thermally Enhanced PowerPAK<sup>®</sup> ChipFET<sup>®</sup> Package
  - Small Footprint Area
  - Low On-Resistance
  - Thin 0.8 mm Profile

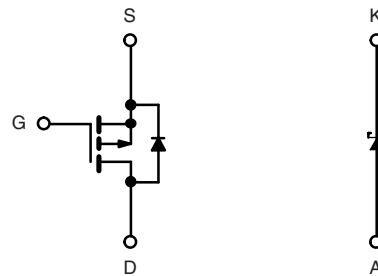
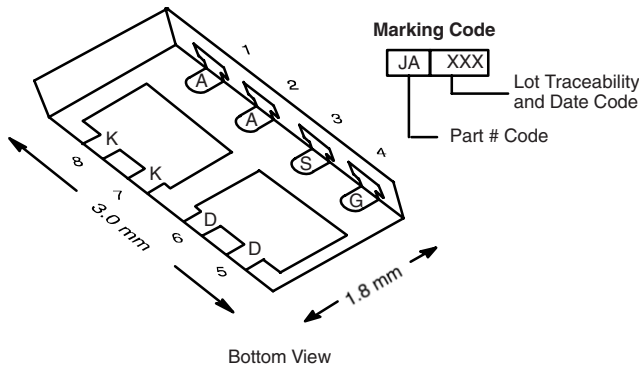


RoHS  
COMPLIANT

## APPLICATIONS

- Charging Switch for Portable Devices
  - With Integrated Low  $V_f$  Trench Schottky Diode

PowerPAK<sup>®</sup> ChipFET<sup>®</sup> Dual



P-Channel MOSFET

Ordering Information: Si5857DU-T1-E3 (Lead (Pb)-free)

ABSOLUTE MAXIMUM RATINGS $T_A = 25$ °C, unless otherwise noted						
Parameter	Symbol	Limit	Unit			
Drain-Source Voltage (MOSFET)	$V_{DS}$	- 20	V			
Reverse Voltage (Schottky)	$V_{KA}$	20				
Gate-Source Voltage (MOSFET)	$V_{GS}$	$\pm 12$				
Continuous Drain Current ( $T_J = 150$ °C) (MOSFET)	$I_D$	$T_C = 25$ °C	6 <sup>a</sup>			
		$T_C = 70$ °C	6 <sup>a</sup>			
		$T_A = 25$ °C	- 5 <sup>b, c</sup>			
		$T_A = 70$ °C	- 4 <sup>b, c</sup>			
Pulsed Drain Current (MOSFET)	$I_{DM}$	- 20	A			
Continuous Source Current (MOSFET Diode Conduction)	$I_S$	$T_C = 25$ °C			- 6 <sup>a</sup>	
		$T_A = 25$ °C			1.9 <sup>b, c</sup>	
Average Forward Current (Schottky)	$I_F$	2	A			
Pulsed Forward Current (Schottky)	$I_{FM}$	7				
Maximum Power Dissipation (MOSFET)	$P_D$	$T_C = 25$ °C	10.4			
		$T_C = 70$ °C	6.7			
		$T_A = 25$ °C	2.3 <sup>b, c</sup>			
		$T_A = 70$ °C	1.5 <sup>b, c</sup>			
Maximum Power Dissipation (Schottky)	$P_D$	$T_C = 25$ °C	7.8			
		$T_C = 70$ °C	5			
		$T_A = 25$ °C	2.1			
		$T_A = 70$ °C	1.3			
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 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, f</sup>	$R_{thJA}$	43	55	°C/W
Maximum Junction-to-Case (Drain) (MOSFET)	$R_{thJC}$	9.5	12	
Maximum Junction-to-Ambient (Schottky) <sup>b, g</sup>	$R_{thJA}$	49	61	
Maximum Junction-to-Case (Drain) (Schottky)	$R_{thJC}$	13	16	

## Notes:

a. Package limited.

b. Surface Mounted on FR4 Board.

c.  $t \leq 5$  sec.d. See Solder Profile (<http://www.vishay.com/doc?73257>). The PowerPAK ChipFET 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. Rework Conditions: manual soldering with a soldering iron is not recommended for leadless components.

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

f. Maximum under Steady State conditions for MOSFETS is 105 °C/W.

g. Maximum under Steady State conditions for Schottky is 110 °C/W.

**SPECIFICATIONS**  $T_J = 25$  °C, unless otherwise noted

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0$ V, $I_D = -250$ $\mu$ A	-20			V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS/TJ}$	$I_D = -250$ $\mu$ A		-19		mV/°C
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)/TJ}$		2.6			
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$ , $I_D = -250$ $\mu$ A	-0.6		-1.5	V
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0$ V, $V_{GS} = \pm 12$ V			$\pm 100$	ns
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -20$ V, $V_{GS} = 0$ V			-1	$\mu$ A
		$V_{DS} = -20$ V, $V_{GS} = 0$ V, $T_J = 55$ °C			-10	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} \leq -5$ V, $V_{GS} = -4.5$ V	-20			A
Drain-Source On-State Resistance <sup>a</sup>	$r_{DS(on)}$	$V_{GS} = -4.5$ V, $I_D = -3.6$ A		0.048	0.058	$\Omega$
		$V_{GS} = -2.5$ V, $I_D = -1$ A		0.081	0.100	
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = -10$ V, $I_D = -3.6$ A		10		S
<b>Dynamic<sup>b</sup></b>						
Input Capacitance	$C_{iss}$	$V_{DS} = -10$ V, $V_{GS} = 0$ V, $f = 1$ MHz		480		pF
Output Capacitance	$C_{oss}$		125			
Reverse Transfer Capacitance	$C_{rss}$		90			
Total Gate Charge	$Q_g$	$V_{DS} = -10$ V, $V_{GS} = -10$ V, $I_D = -5$ A		11	17	nC
				5.5	8.5	
Gate-Source Charge	$Q_{gs}$	$V_{DS} = -10$ V, $V_{GS} = -4.5$ V, $I_D = -5$ A		1.2		
Gate-Drain Charge	$Q_{gd}$			1.8		
Gate Resistance	$R_g$	$f = 1$ MHz		9		$\Omega$
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -10$ V, $R_L = 2.5$ $\Omega$ $I_D \cong -4$ A, $V_{GEN} = -4.5$ V, $R_g = 1$ $\Omega$		11	20	ns
Rise Time	$t_r$			42	65	
Turn-Off Delay Time	$t_{d(off)}$			33	50	
Fall Time	$t_f$			50	75	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -10$ V, $R_L = 2.5$ $\Omega$ $I_D \cong -4$ A, $V_{GEN} = -10$ V, $R_g = 1$ $\Omega$		5	10	
Rise Time	$t_r$			15	25	
Turn-Off Delay Time	$t_{d(off)}$			25	40	
Fall Time	$t_f$			10	20	

<b>SPECIFICATIONS</b> $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25\text{ }^\circ\text{C}$			- 6	A
Pulse Diode Forward Current	$I_{SM}$				- 20	
Body Diode Voltage	$V_{SD}$	$I_S = - 4\text{ A}, V_{GS} = 0\text{ V}$		- 0.9	- 1.2	V
Body Diode Reverse Recovery Time	$t_{rr}$	$I_F = - 4\text{ A di/dt} = 100\text{ A}/\mu\text{s } T_J = 25\text{ }^\circ\text{C}$		25	50	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$			10	20	nC
Reverse Recovery Fall Time	$t_a$			9		ns
Reverse Recovery Rise Time	$t_b$			16		

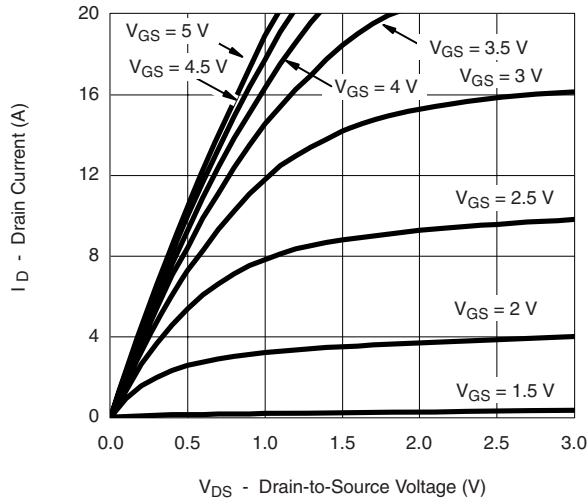
Notes:

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

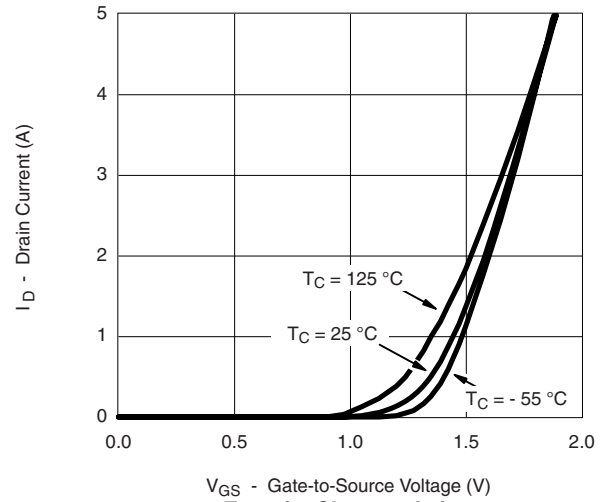
<b>SCHOTTKY SPECIFICATIONS</b> $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Forward Voltage Drop	$V_F$	$I_F = 1\text{ A}$		0.34	0.375	V
		$I_F = 1\text{ A}, T_J = 125\text{ }^\circ\text{C}$		0.255	0.290	
Maximum Reverse Leakage Current	$I_{rm}$	$V_r = 20\text{ V}$		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.*

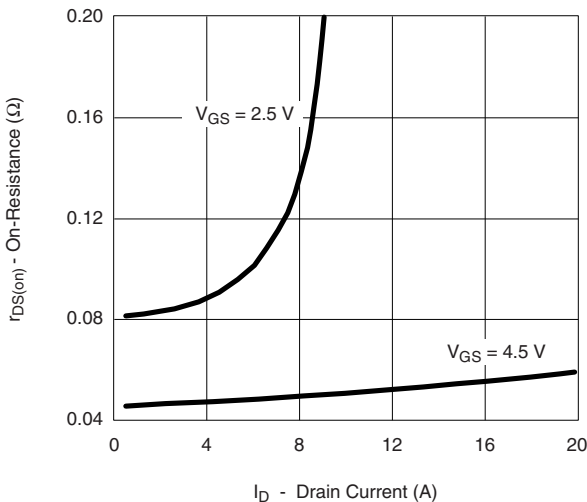
**MOSFET TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



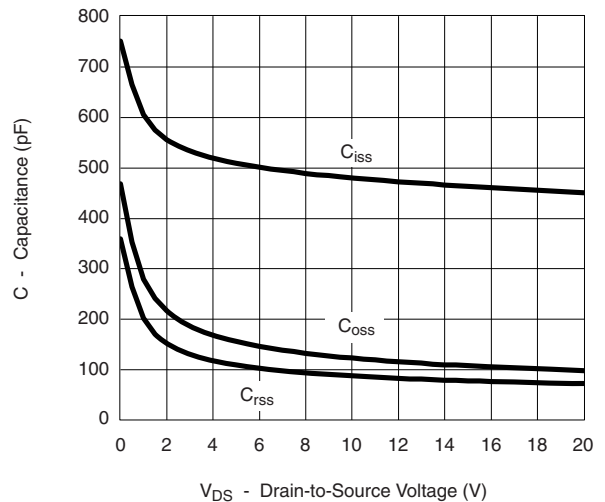
**Output Characteristics**



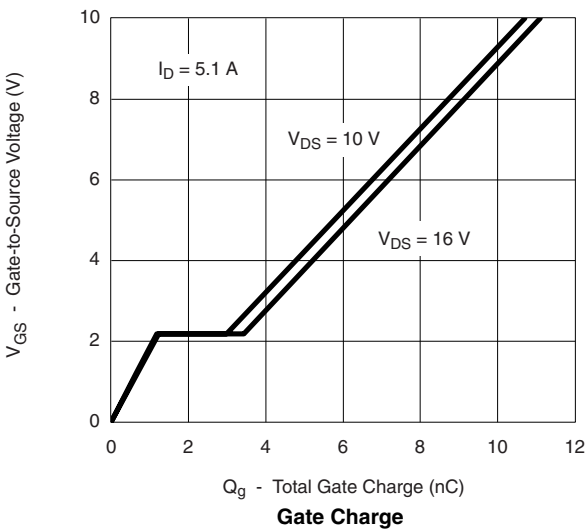
**Transfer Characteristics**



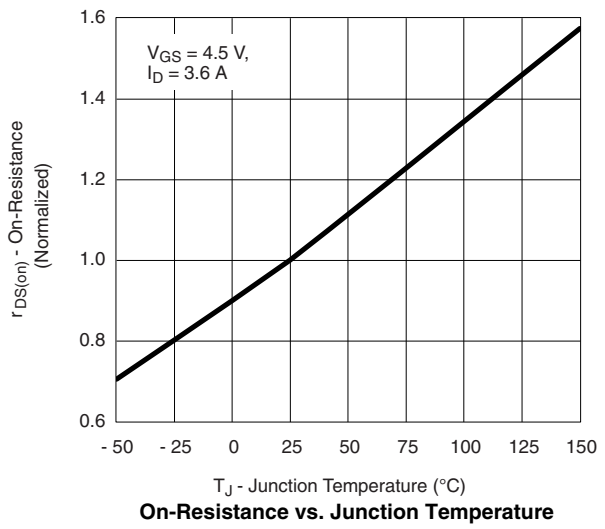
**On-Resistance vs. Drain Current and Gate Voltage**



**Capacitance**

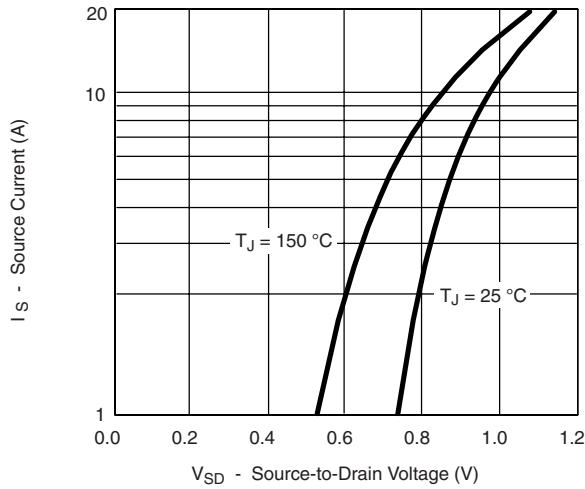


**Gate Charge**

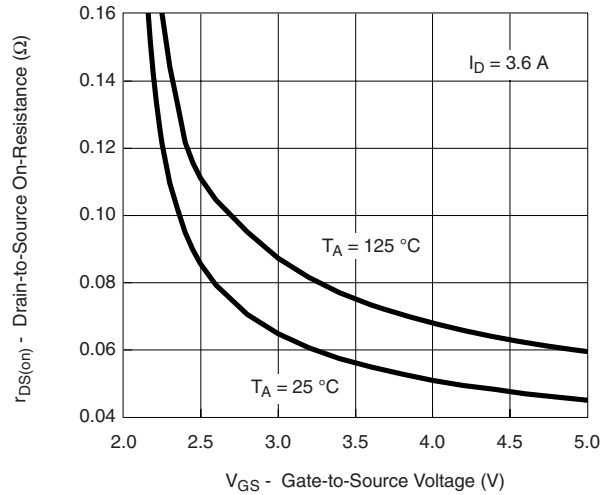


**On-Resistance vs. Junction Temperature**

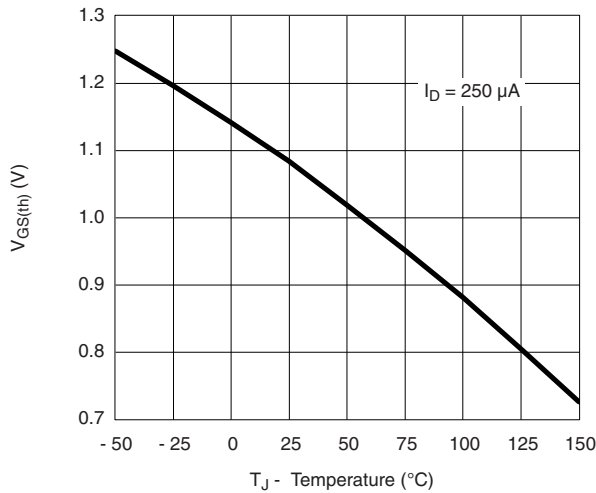
**MOSFET TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



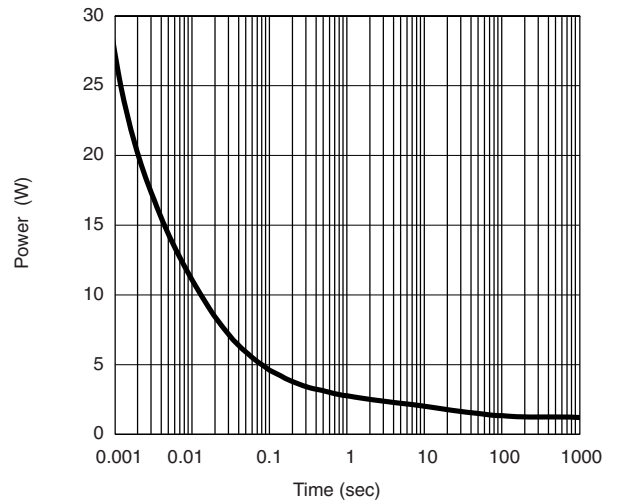
**Source-Drain Diode Forward Voltage**



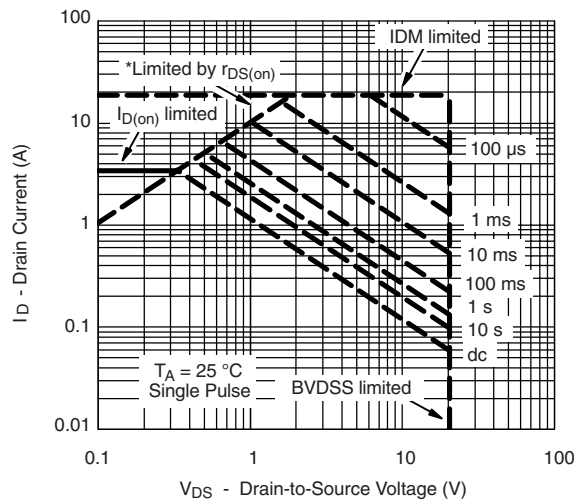
**On-Resistance vs. Gate-to-Source Voltage**



**Threshold Voltage**

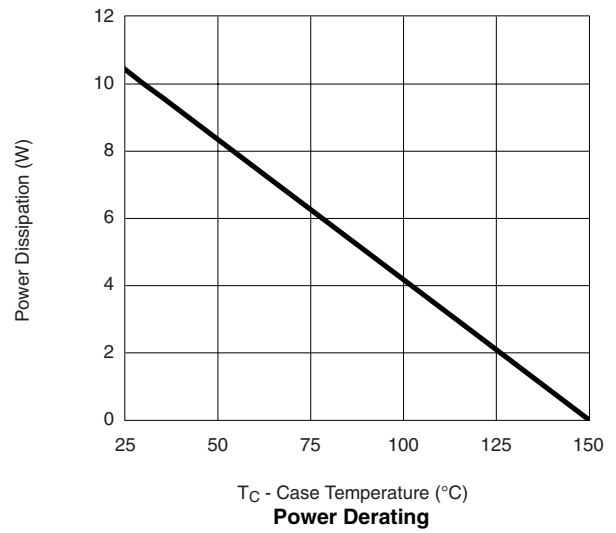
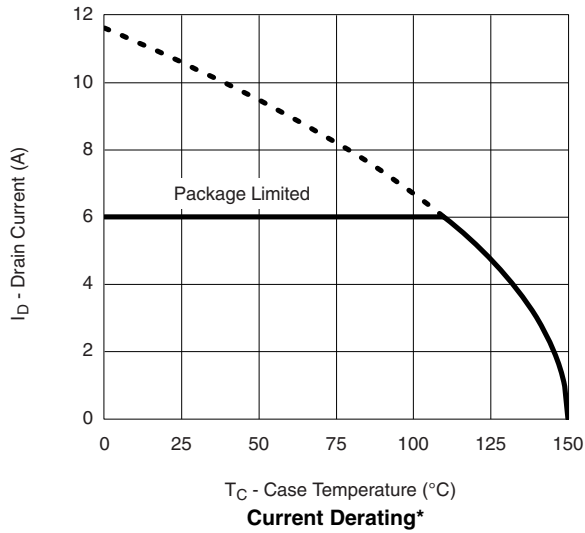


**Single Pulse Power, Junction-to-Ambient**



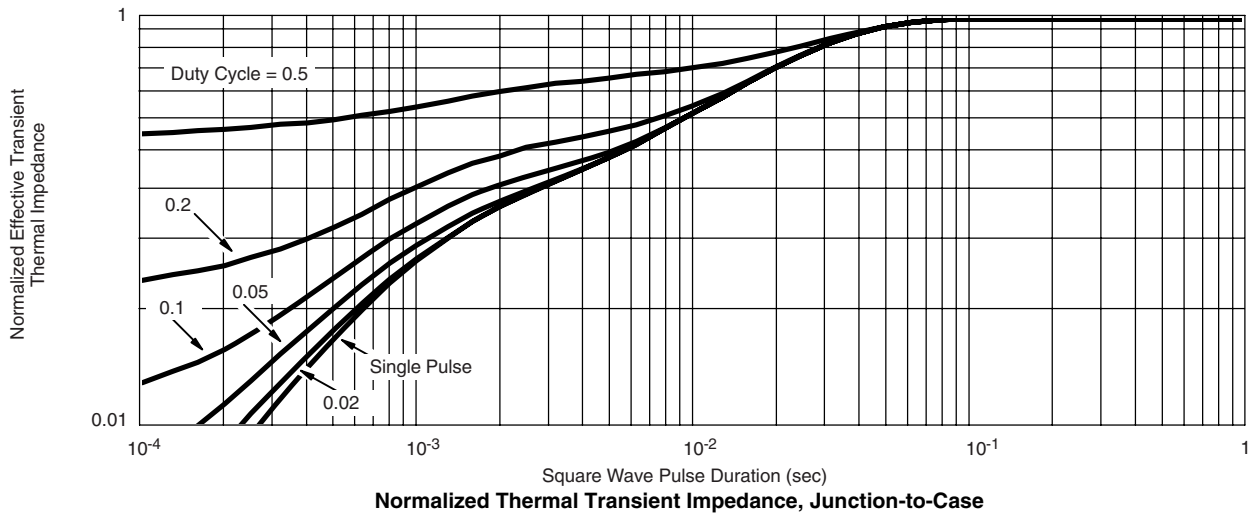
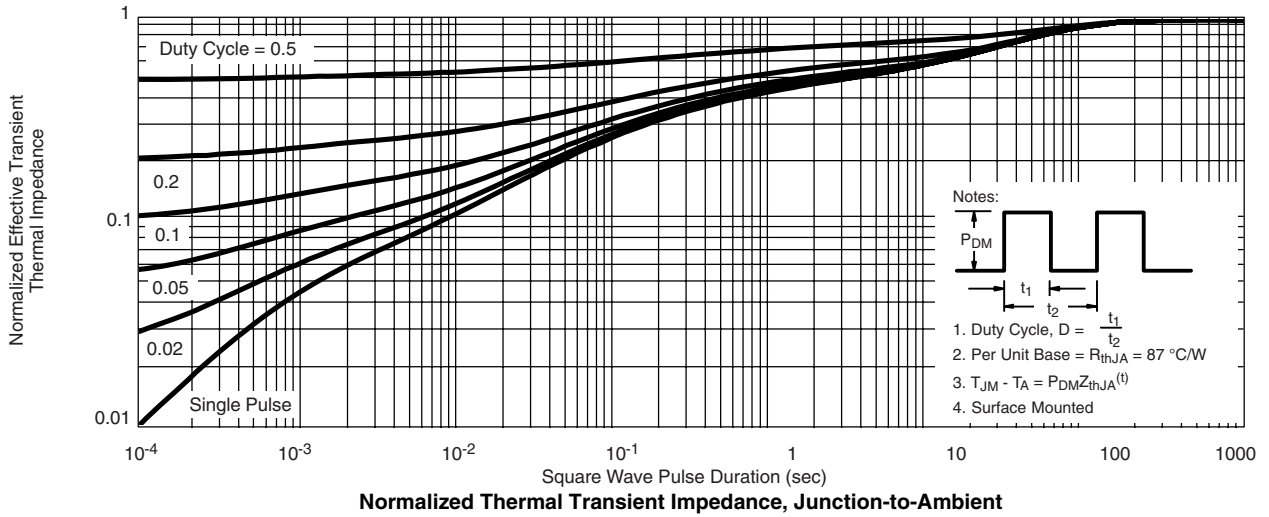
**Safe Operating Area, Junction-to-Case**

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

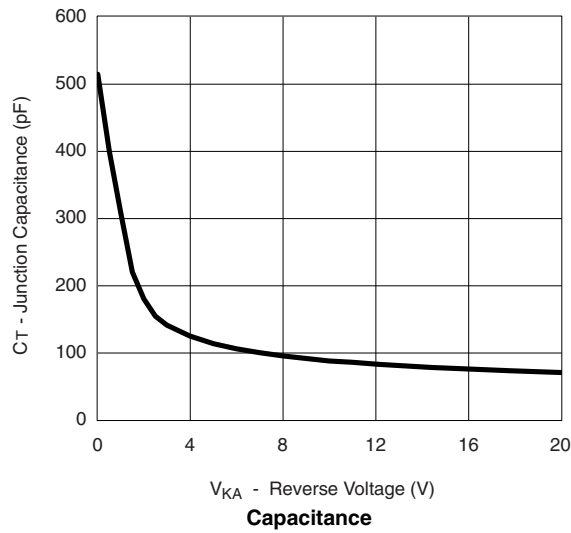
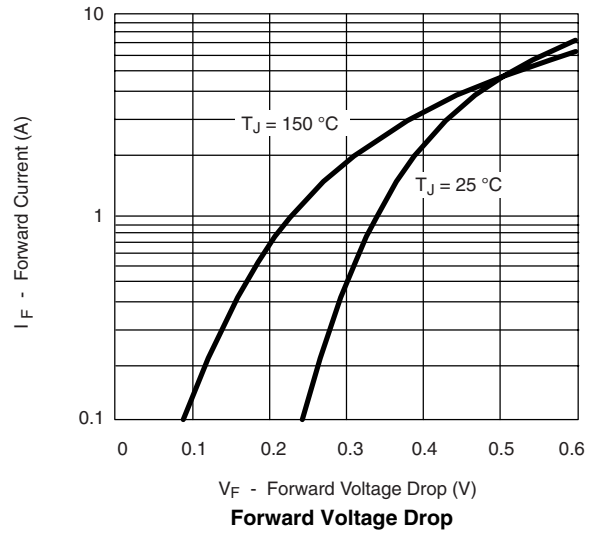
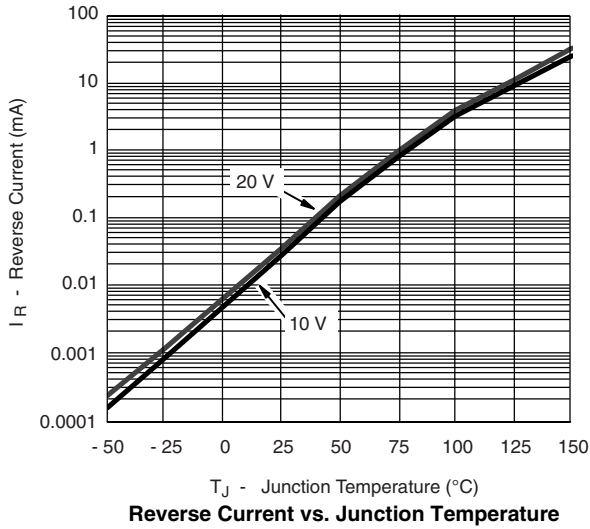


\*The power dissipation  $P_D$  is based on  $T_{J(max)} = 150$  °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package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

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

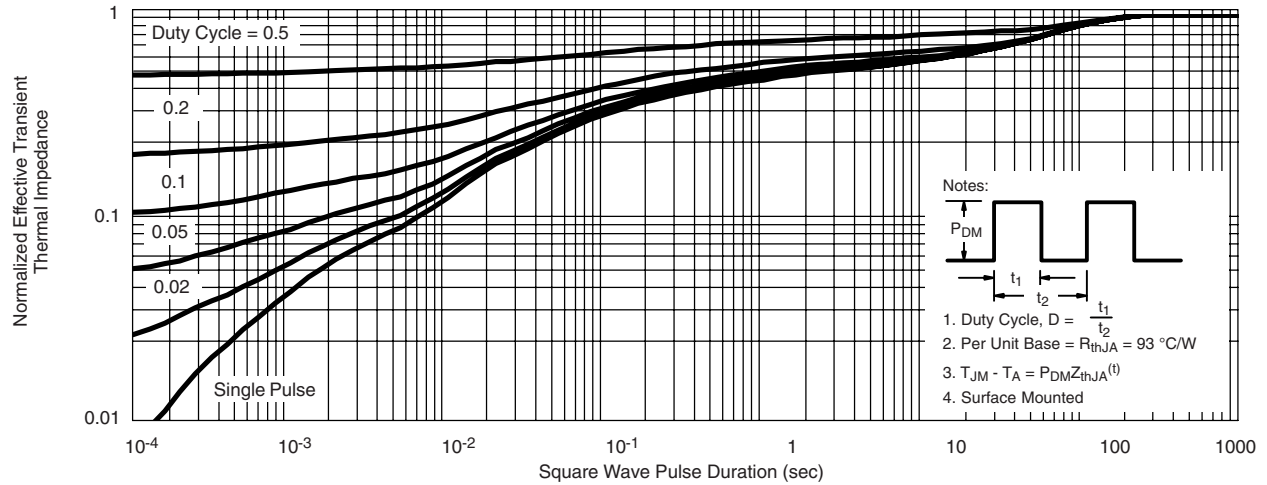


## SCHOTTKY TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

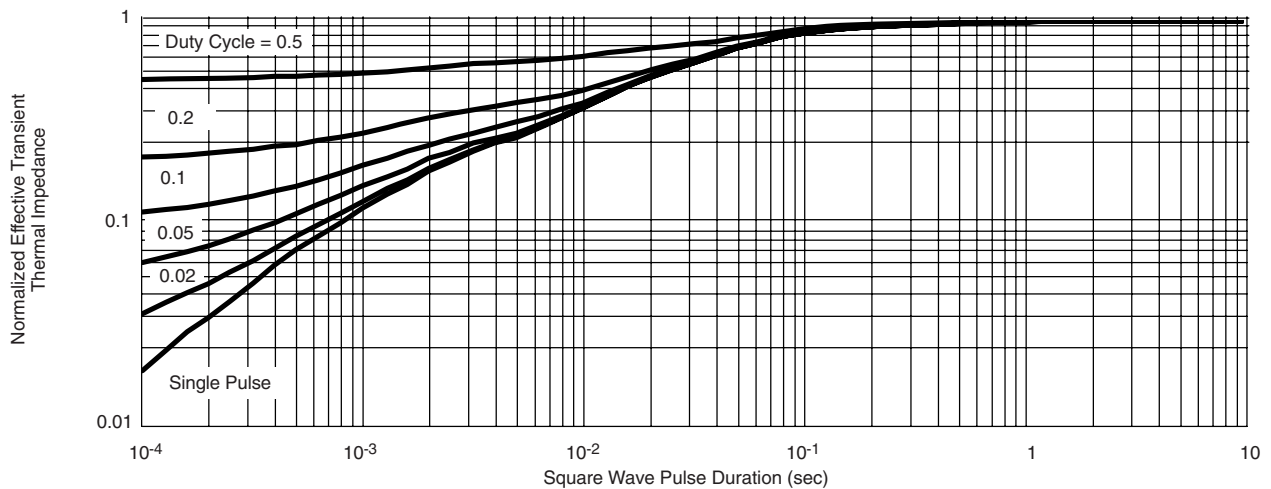




**SCHOTTKY TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



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



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

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see <http://www.vishay.com/ppg?73696>.



## Notice

Specifications of the products displayed herein are subject to change without notice. Vishay Intertechnology, Inc., or anyone on its behalf, assumes no responsibility or liability for any errors or inaccuracies.

Information contained herein is intended to provide a product description only. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document. Except as provided in Vishay's terms and conditions of sale for such products, Vishay assumes no liability whatsoever, and disclaims any express or implied warranty, relating to sale and/or use of Vishay products including liability or warranties relating to fitness for a particular purpose, merchantability, or infringement of any patent, copyright, or other intellectual property right.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Vishay for any damages resulting from such improper use or sale.