

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



MOSFET PRODUCT SUMMARY			
V_{DS} (V)	$r_{DS(on)}$ (Ω)	I_D (A) ^a	Q_g (Typ)
20	0.039 @ $V_{GS} = 4.5$ V	6	6 nC
	0.045 @ $V_{GS} = 2.5$ V	6	
	0.055 @ $V_{GS} = 1.8$ V	6	

SCHOTTKY PRODUCT SUMMARY		
V_{KA} (V)	V_f (V) Diode Forward Voltage	I_F (A) ^a
20	0.375 @ 1 A	1

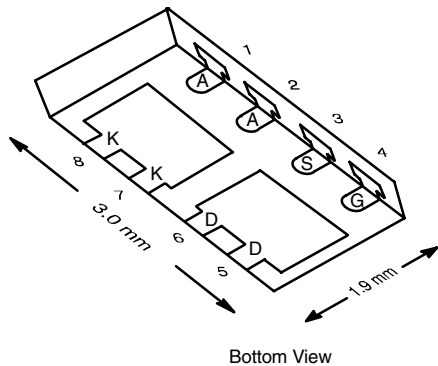
FEATURES

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

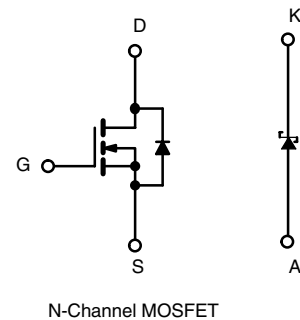
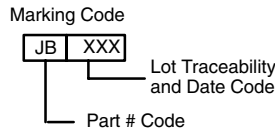
APPLICATIONS

- Load Switch for Portable Applications
 - Ideal for Boost Circuits

PowerPAK® ChipFET® Dual



Bottom View



N-Channel MOSFET

Ordering Information: Si5858DU-T1-E3 (Lead (Pb) Free)

ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$ 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}	± 8		
Continuous Drain Current ($T_J = 150^\circ\text{C}$) (MOSFET)	I_D	$T_C = 25^\circ\text{C}$	6 ^a	A
		$T_C = 70^\circ\text{C}$	6 ^a	
		$T_A = 25^\circ\text{C}$	7.2 ^{b, c}	
		$T_A = 70^\circ\text{C}$	5.8 ^{b, c}	
Pulsed Drain Current (MOSFET)	I_{DM}	20	A	
Continuous Source Current (MOSFET Diode Conduction)	I_S	$T_C = 25^\circ\text{C}$		6.9
		$T_A = 25^\circ\text{C}$		1.9 ^{b, c}
Average Forward Current (Schottky)	I_F	1 ^b	A	
Pulsed Forward Current (Schottky)	I_{FM}	7		
Maximum Power Dissipation (MOSFET)	P_D	$T_C = 25^\circ\text{C}$	8.3	W
		$T_C = 70^\circ\text{C}$	5.3	
		$T_A = 25^\circ\text{C}$	2.3 ^{b, c}	
		$T_A = 70^\circ\text{C}$	1.5 ^{b, c}	
Maximum Power Dissipation (Schottky)	P_D	$T_C = 25^\circ\text{C}$	7.8	W
		$T_C = 70^\circ\text{C}$	5	
		$T_A = 25^\circ\text{C}$	2.1	
		$T_A = 70^\circ\text{C}$	1.3	
Operating Junction and Storage Temperature Range	T_J, T_{stg}	-55 to 150	$^\circ\text{C}$	
Soldering Recommendation (Peak Temperature) ^{d, e}		260	$^\circ\text{C}$	

THERMAL RESISTANCE RATINGS				
Parameter	Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient (MOSFET) ^{b, f}	R_{thJA}	45	55	°C/W
Maximum Junction-to-Case (Drain) (MOSFET)	R_{thJC}	12	15	
Maximum Junction-to-Ambient (Schottky)	R_{thJA}	49	61	°C/W
Maximum Junction-to-Case (Drain) (Schottky)	R_{thJC}	13	16	

Notes

- Package limited.
- Surface Mounted on FR4 Board.
- $t \leq 5$ sec.
- 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.
- Rework Conditions: manual soldering with a soldering iron is not recommended for leadless components.
- Maximum under Steady State conditions for MOSFETS is 105 °C/W.
- Maximum under Steady state conditions for Schottky is 110 °C/W.

SPECIFICATIONS ($T_J = 25^\circ\text{C}$ UNLESS OTHERWISE NOTED)						
Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Static						
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	20			V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = 250\ \mu\text{A}$		17.4		mV/°C
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$			-2.6		
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	0.4		1.0	V
Gate-Source Leakage	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = \pm 8\text{ V}$			± 100	ns
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$			-1	μA
		$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}, T_J = 55^\circ\text{C}$			-10	
On-State Drain Current ^a	$I_{D(on)}$	$V_{DS} \leq 5\text{ V}, V_{GS} = 4.5\text{ V}$	-20			A
Drain-Source On-State Resistance ^a	$r_{DS(on)}$	$V_{GS} = 4.5\text{ V}, I_D = 4.4\text{ A}$		0.032	0.039	Ω
		$V_{GS} = 2.5\text{ V}, I_D = 4.1\text{ A}$		0.037	0.045	
		$V_{GS} = 1.8\text{ V}, I_D = 1.8\text{ A}$		0.0455	0.055	
Forward Transconductance ^a	g_{fs}	$V_{DS} = 10\text{ V}, I_D = 4.4\text{ A}$		22		S
Dynamic^b						
Input Capacitance	C_{iss}	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		520		pF
Output Capacitance	C_{oss}			100		
Reverse Transfer Capacitance	C_{rss}			60		
Total Gate Charge	Q_g	$V_{DS} = 10\text{ V}, V_{GS} = 8\text{ V}, I_D = 4.4\text{ A}$		10.5	16	nC
				6	9	
Gate-Source Charge	Q_{gs}	$V_{DS} = 10\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 4.4\text{ A}$		0.91		
Gate-Drain Charge	Q_{gd}			0.7		
Gate Resistance	R_g	$f = 1\text{ MHz}$		1.9		Ω
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 10\text{ V}, R_L = 2.8\ \Omega$ $I_D \cong 3.6\text{ A}, V_{GEN} = 4.5\text{ V}, R_g = 1\ \Omega$		20	30	ns
Rise Time	t_r			65	100	
Turn-Off Delay Time	$t_{d(off)}$			40	60	
Fall Time				10	15	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 10\text{ V}, R_L = 2.8\ \Omega$ $I_D \cong 3.6\text{ A}, V_{GEN} = 8\text{ V}, R_g = 1\ \Omega$		5	10	
Rise Time	t_r			12	20	
Turn-Off Delay Time	$t_{d(off)}$			26	40	
Fall Time	t_f			8	15	



SPECIFICATIONS ($T_J = 25^\circ\text{C}$ UNLESS OTHERWISE NOTED)						
Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I_S	$T_C = 25^\circ\text{C}$			14.8	A
Pulse Diode Forward Current	I_{SM}				20	
Body Diode Voltage	V_{SD}	$I_S = 1.2\text{ A}, V_{GS} = 0\text{ V}$		0.8	1.2	V
Body Diode Reverse Recovery Time	t_{rr}	$I_F = -2\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, T_J = 25^\circ\text{C}$		45	70	ns
Body Diode Reverse Recovery Charge	Q_{rr}			21	32	nC
Reverse Recovery Fall Time	t_a			29		ns
Reverse Recovery Rise Time	t_b			16		

Notes

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

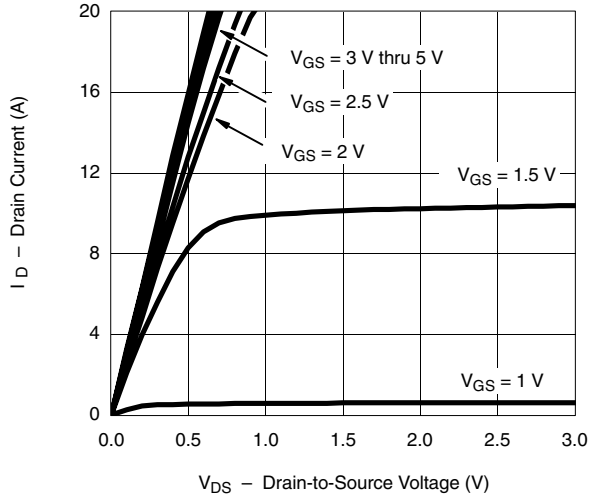
SCHOTTKY SPECIFICATIONS ($T_J = 25^\circ\text{C}$ UNLESS OTHERWISE NOTED)						
Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Forward Voltage Drop	V_F	$I_F = 1\text{ A}$		0.34	0.375	V
		$I_F = 1\text{ A}, T_J = 125^\circ\text{C}$		0.255	0.290	
Maximum Reverse Leakage Current	I_{rm}	$V_r = 20\text{ V}$		0.05	0.500	mA
		$V_r = 20\text{ V}, T_J = 85^\circ\text{C}$		2	20	
		$V_r = 20\text{ V}, T_J = 125^\circ\text{C}$		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.

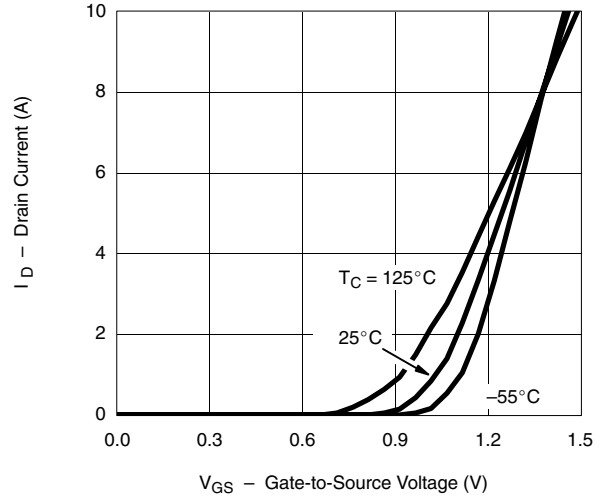
TYPICAL CHARACTERISTICS (25 °C UNLESS NOTED)

MOSFET

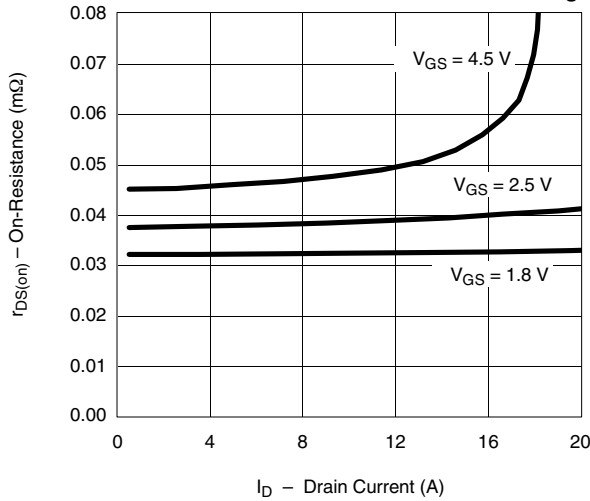
Output Characteristics



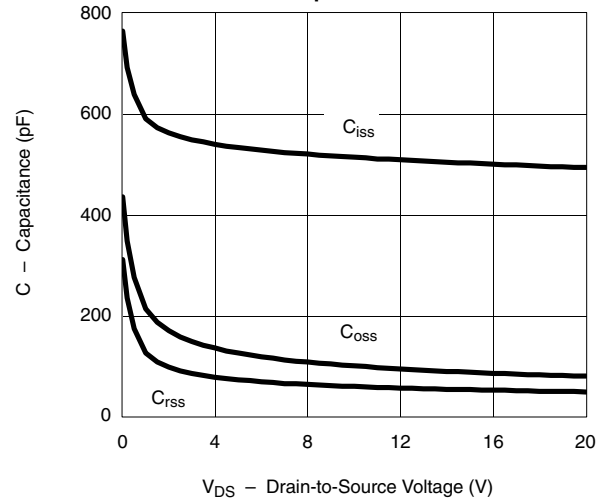
Transfer Characteristics



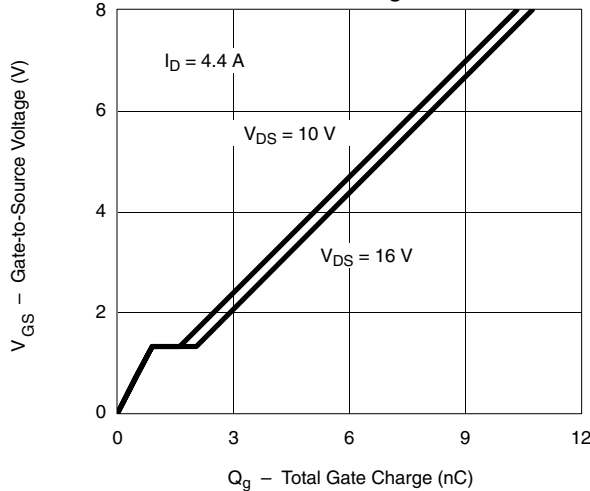
On-Resistance vs. Drain Current and Gate Voltage



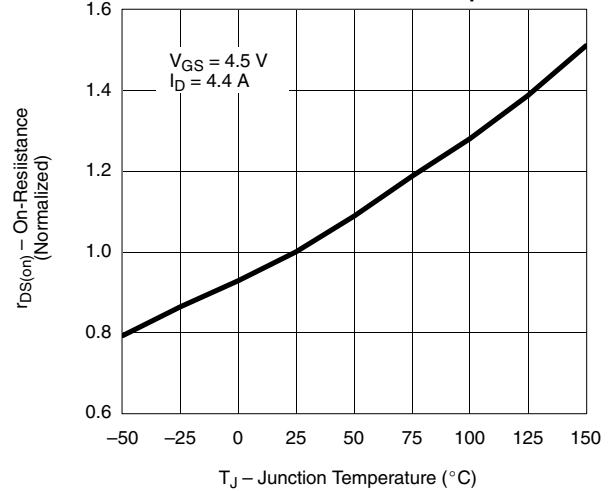
Capacitance



Gate Charge



On-Resistance vs. Junction Temperature

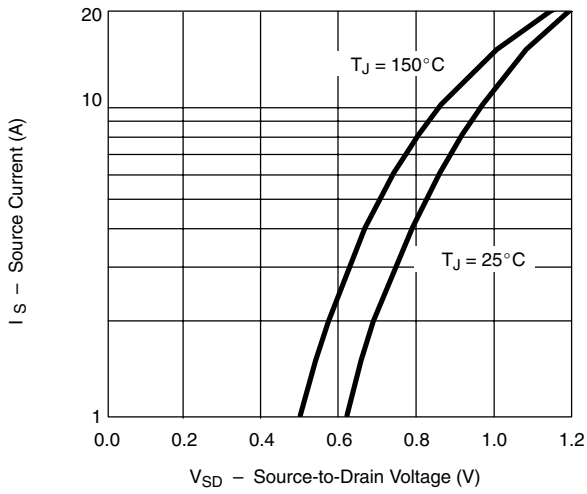




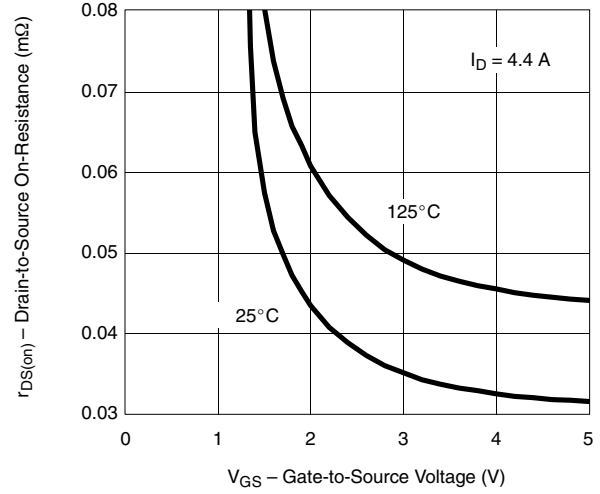
TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

MOSFET

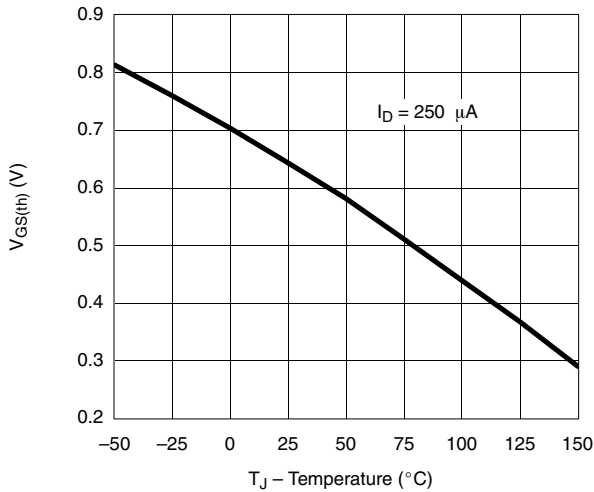
Source-Drain Diode Forward Voltage



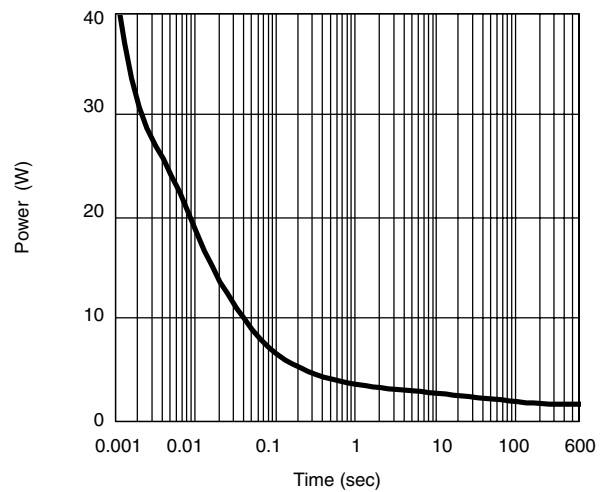
On-Resistance vs. Gate-to-Source Voltage



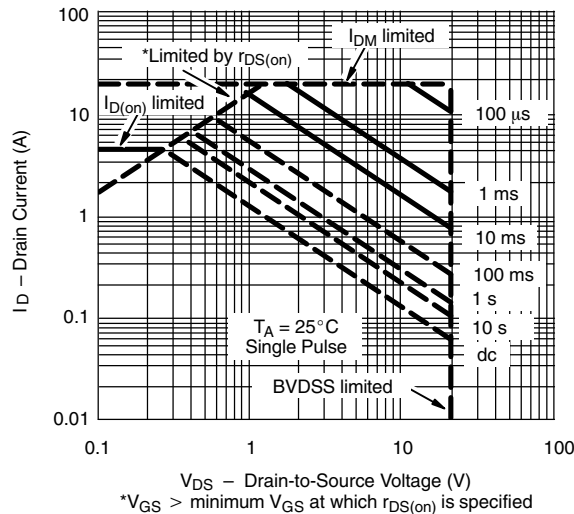
Threshold Voltage



Single Pulse Power, Junction-to-Ambient

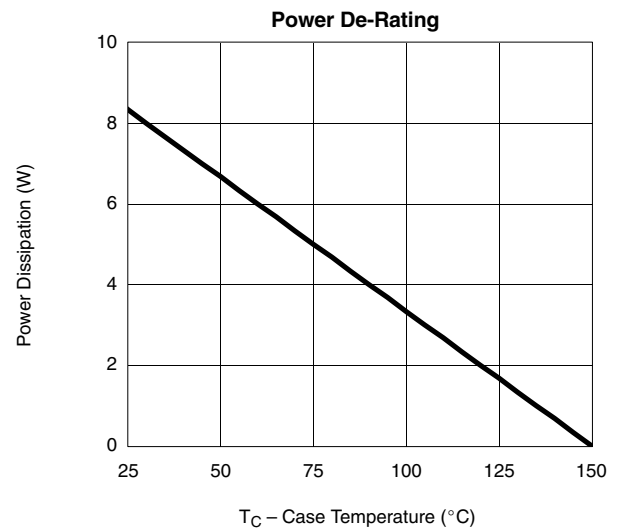
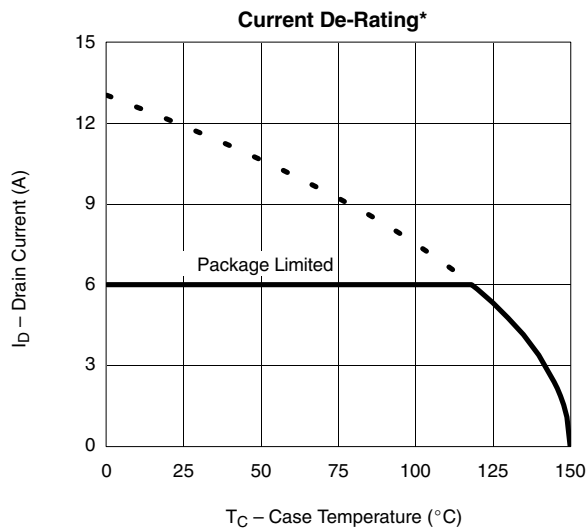


Safe Operating Area, Junction-to-Ambient



TYPICAL CHARACTERISTICS (25 °C UNLESS NOTED)

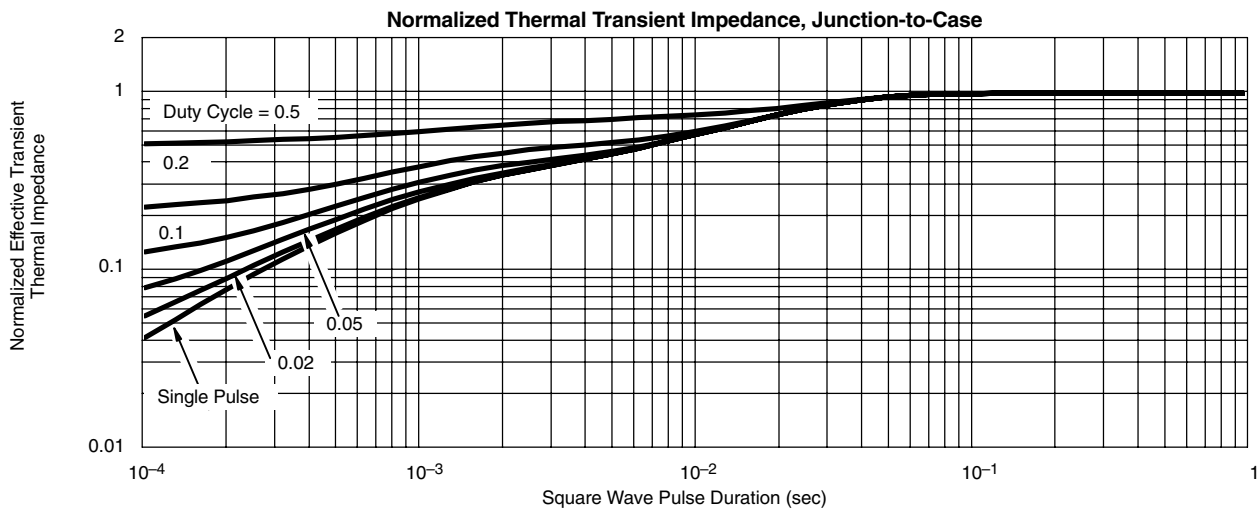
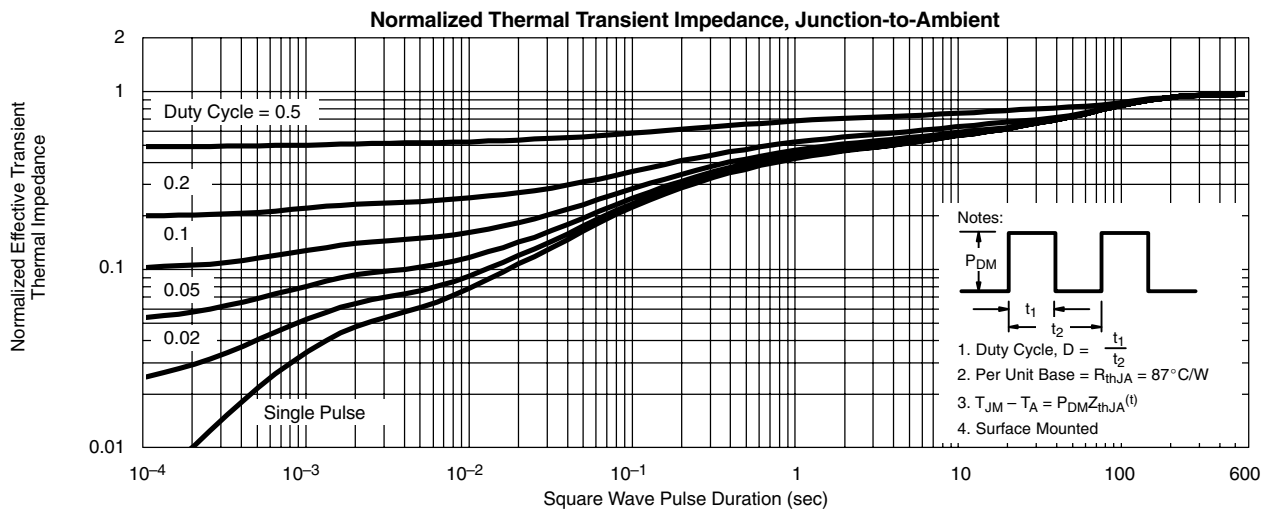
MOSFET



*The power dissipation P_D is based on $T_{J(max)} = 150^\circ\text{C}$, 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.

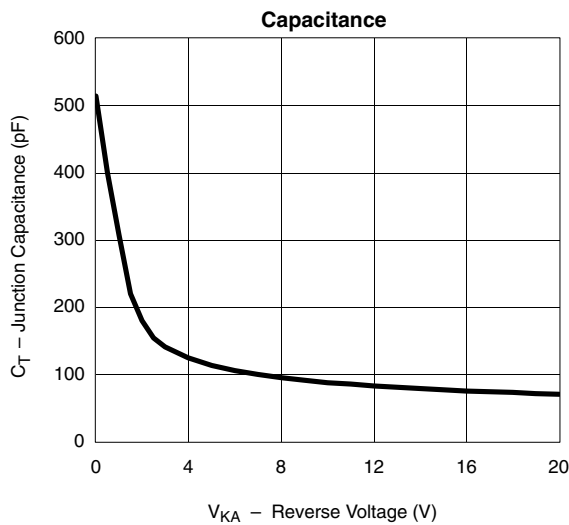
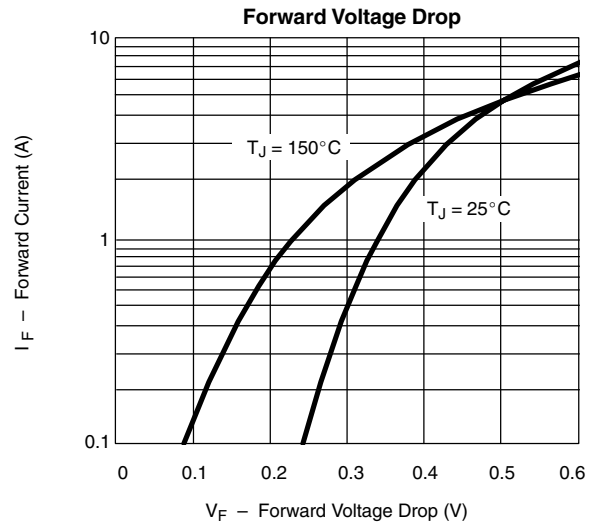
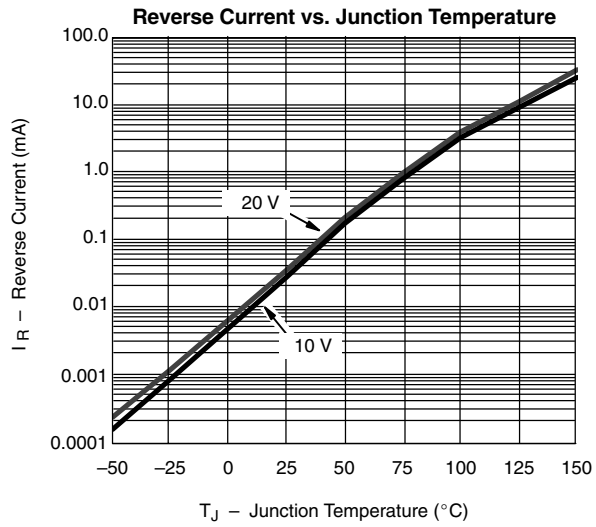
TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

MOSFET



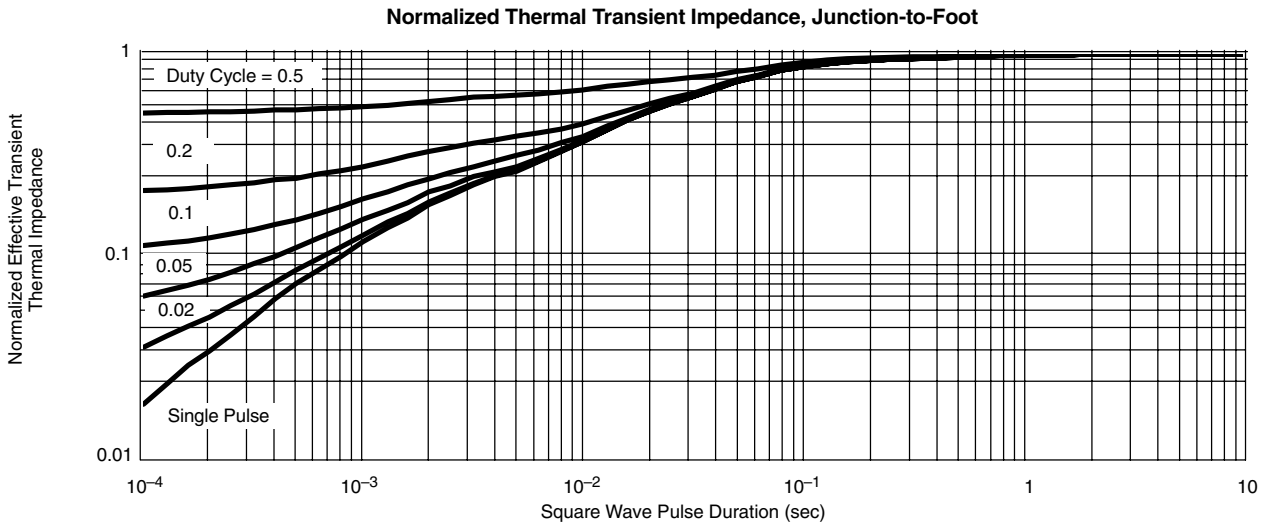
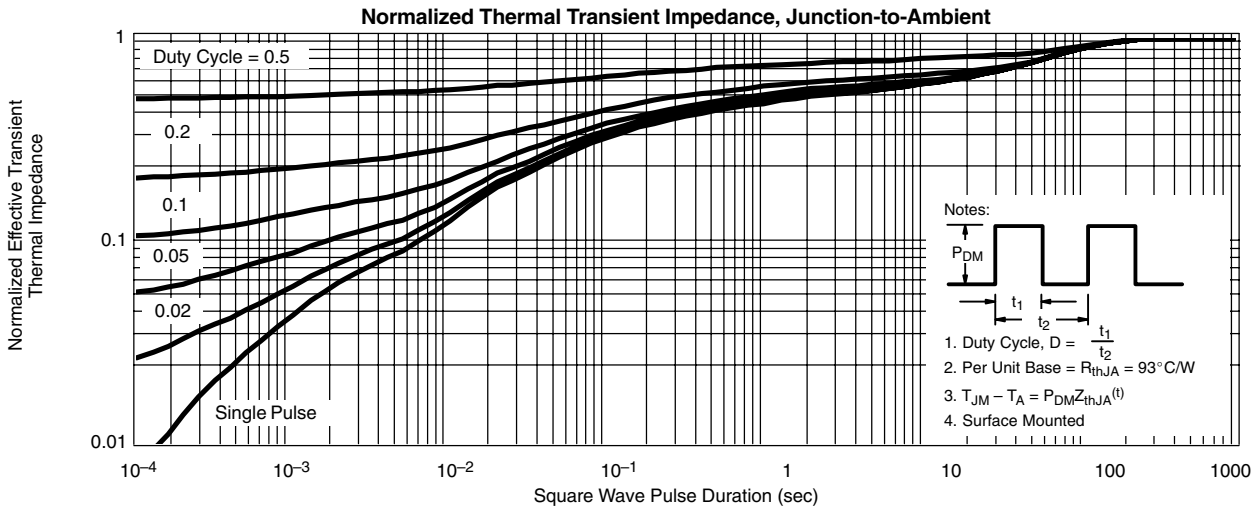
TYPICAL CHARACTERISTICS (25 °C UNLESS NOTED)

SCHOTTKY



TYPICAL CHARACTERISTICS (25 °C UNLESS NOTED)

SCHOTTKY



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