

N1M120021PK3

Silicon Carbide Power MOSFET

N-Channel Enhancement Mode

V_{DS}	1200V
$I_D @ 25^\circ C$	100A
$R_{DS(ON)}$	21mΩ

Features

- Low On-Resistance
- Low Capacitances
- Low Switching Losses
- Easy to Parallel and Simple to Drive

Benefits

- Improved System Efficiency
- Reduced Cooling Requirements
- Increased Power Density
- Increased System Switching Frequency

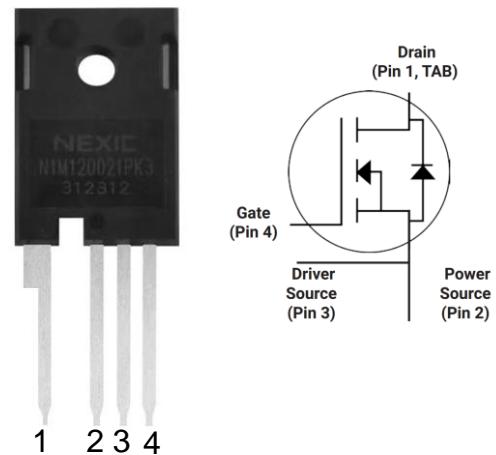
Applications

- Solar inverter
- EV charging station
- UPS
- Industrial power supply

Maximum Ratings ($T_C = 25^\circ C$ unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
V_{DSmax}	Drain - Source Voltage	1200	V	$V_{GS} = 0$ V, $I_D = 100$ μA	
V_{GSmax}	Gate - Source Voltage	-10/+22	V	Absolute maximum values, DC	
V_{GSop}	Gate - Source Voltage	-5/+18	V	Recommended operational values	
I_D	Continuous Drain Current	100	A	$T_C = 25^\circ C$	Fig.13
		68	A	$T_C = 100^\circ C$	
$I_{D(pulse)}$	Pulsed Drain Current	250	A	Pulse width t_P limited by T_{jmax}	Fig.20
P_D	Power Dissipation	469	W	$T_C=25^\circ C$	Fig.14
T_J, T_{stg}	Operating Junction and Storage Temperature	-55 to + 175	°C		
T_L	Maximum Lead Temperature for Soldering, 1/8" from Case for 10 Seconds	260	°C		

Package



Part Number	Package
N1M120021PK3	TO-247-4

Electrical Characteristics (T_C= 25°C unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note		
V _{(BR)DSS}	Drain-Source Breakdown Voltage	1200			V	V _{GS} =0V, I _D =1mA			
V _{GS(th)}	Gate Threshold Voltage	2.0	3.0	4.5	V	V _{DS} =V _{GS} , I _D =17mA	Fig.9		
I _{DSS}	Zero Gate Voltage Drain Current		1	100	uA	V _{DS} =1200V, V _{GS} =0V			
			10			V _{DS} =1200V, V _{GS} =0V, T _J =175°C			
I _{GSS}	Gate-Source Leakage Current			+100	nA	V _{GS} =+22V, V _{DS} =0V			
				-100		V _{GS} =-10V, V _{DS} =0V			
R _{DS(on)}	Drain-Source On-State Resistance		21	29.4	mΩ	V _{GS} =18V, I _D =50A	Fig.4		
			28			V _{GS} =18V, I _D =50A, T _J =175°C			
g _{fs}	Transconductance		24.4		S	V _{DS} =20V, I _{DS} =50A	Fig.5		
C _{iss}	Input Capacitance		3798		pF	V _{GS} =0V, V _{DS} =800V, f=1MHz	Fig.12		
C _{oss}	Output Capacitance		225						
C _{rss}	Reverse Transfer Capacitance		14						
E _{OSS}	Stored Energy in Output Capacitance		93		μJ	V _{GS} =0V, V _{DS} =0V to 800V			
C _{o(er)}	Energy Related Output Capacitance		291		pF				
C _{o(tr)}	Time Related Output Capacitance		456						
E _{ON}	Turn-On Switching Energy		477		μJ				
E _{OFF}	Turn Off Switching Energy		342						
t _{d(on)}	Turn-On Delay Time		29		ns	V _{DS} =800V, V _{GS} = -5/18V, I _D =50A, R _{G(ext)} =2Ω	Fig.15, 16		
t _r	Rise Time		29						
t _{d(off)}	Turn-Off Delay Time		62						
t _f	Fall Time		12						
R _{G(int)}	Internal Gate Resistance		3.0		Ω	f = 1 MHz, V _{AC} = 30 mV			
Q _{gs}	Gate to Source Charge		48		nC	V _{DS} =800V, V _{GS} =-5/18V, I _D =50A	Fig.10		
Q _{gd}	Gate to Drain Charge		65						
Q _g	Total Gate Charge		198						

Reverse Diode Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test conditions	Note
V _{SD}	Diode Forward Voltage	4.2		V	V _{GS} =-5V, I _{SD} =50A	Fig.7
I _S	Continuous Diode Forward Current		100	A		
I _{SM}	Pulsed Diode Forward Current		250	A		
t _{rr}	Reverse Recovery Time	22		ns	I _{SD} =50A, V _R =800V, dif/dt=3000A/us	
Q _{rr}	Reverse Recovery Charge	482		nC		

Thermal Characteristics

Symbol	Parameter	Typ.	Unit	Test conditions	Note
R _{θJC}	Thermal Resistance from Junction to Case	0.32	°C/W		Fig.19
R _{θJA}	Thermal Resistance from Junction to Ambient	40			

Typical Performance

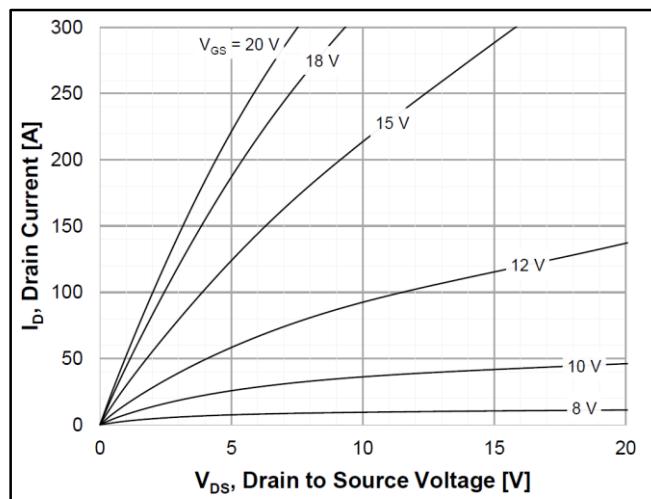


Figure 1. Output Characteristics $T_J = -40\text{ }^{\circ}\text{C}$

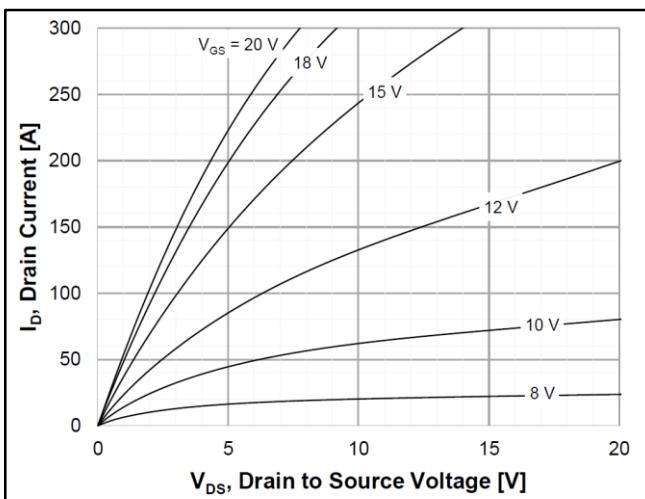


Figure 2. Output Characteristics $T_J = 25\text{ }^{\circ}\text{C}$

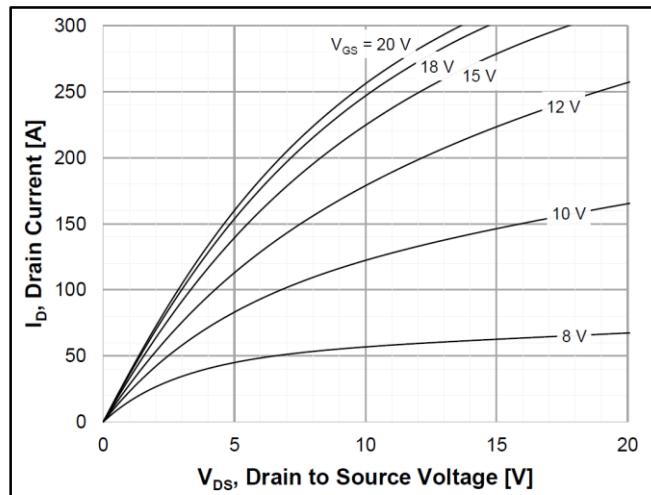


Figure 3. Output Characteristics $T_J = 175\text{ }^{\circ}\text{C}$

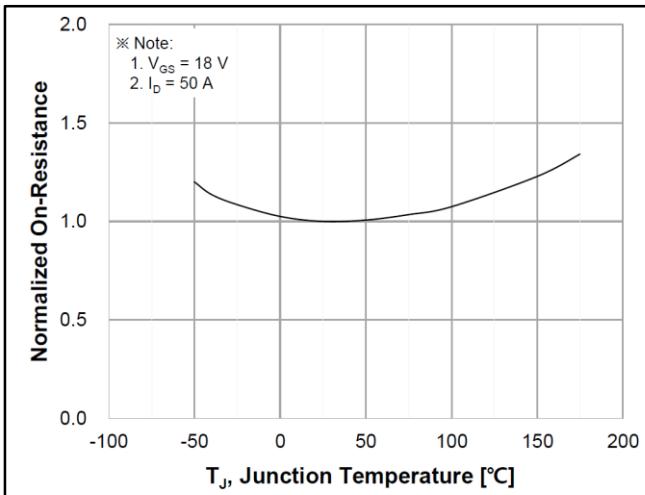


Figure 4. Normalized On-Resistance vs. Temperature

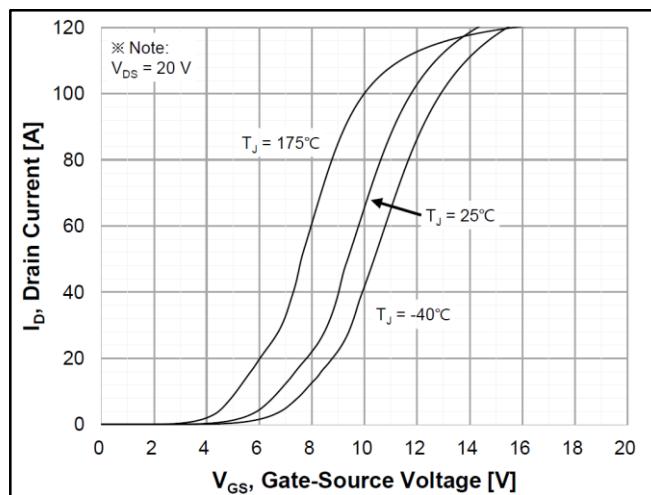


Figure 5. Transfer Characteristics for Various Junction Temperatures

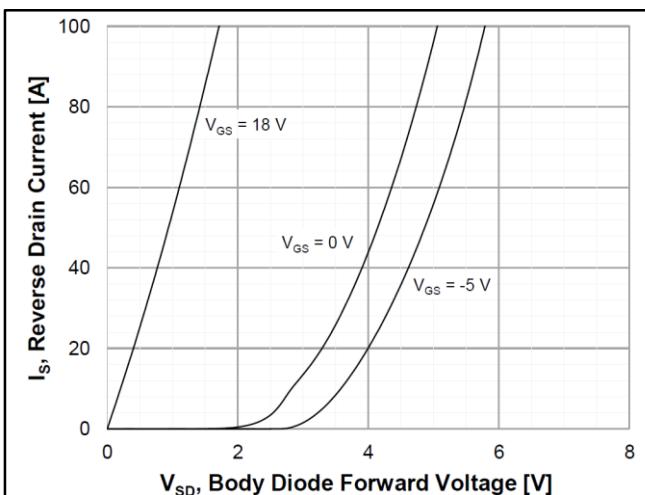
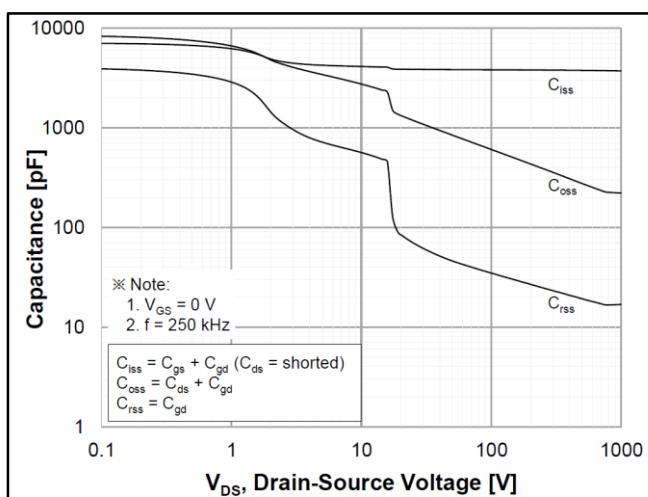
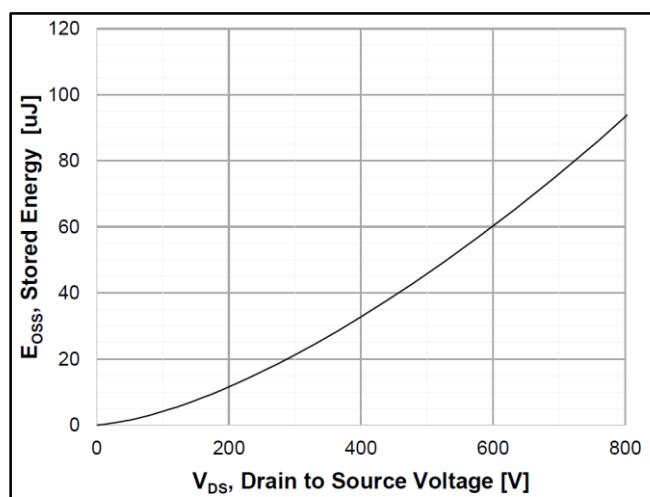
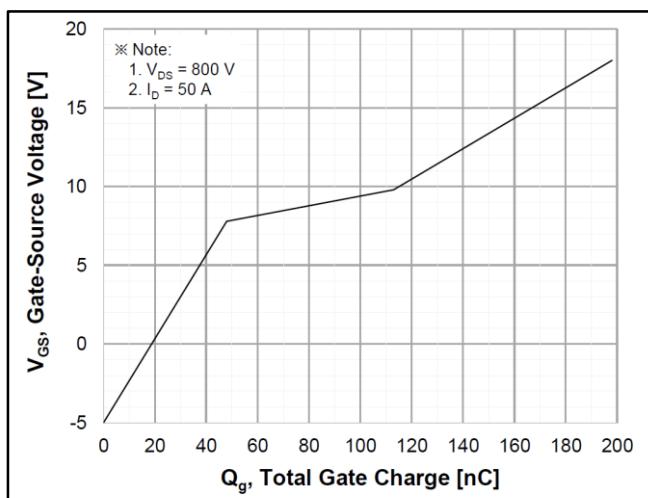
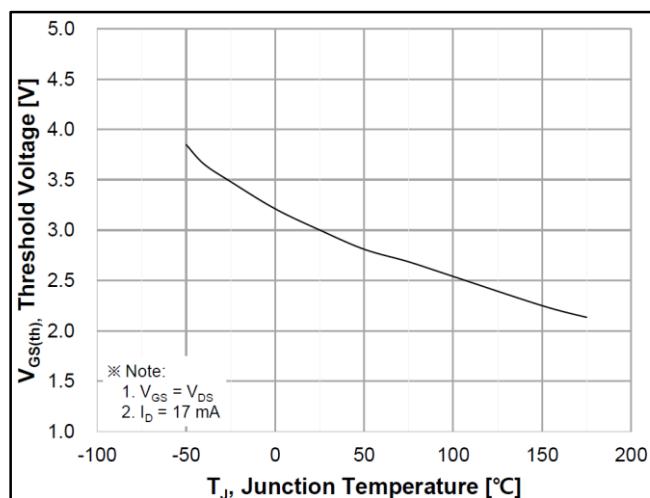
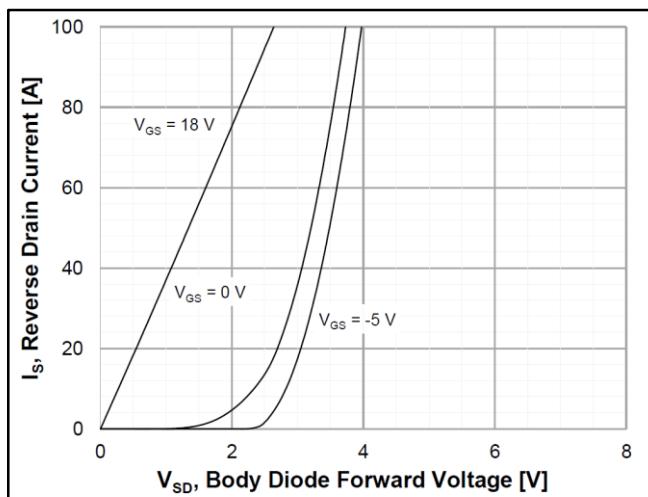
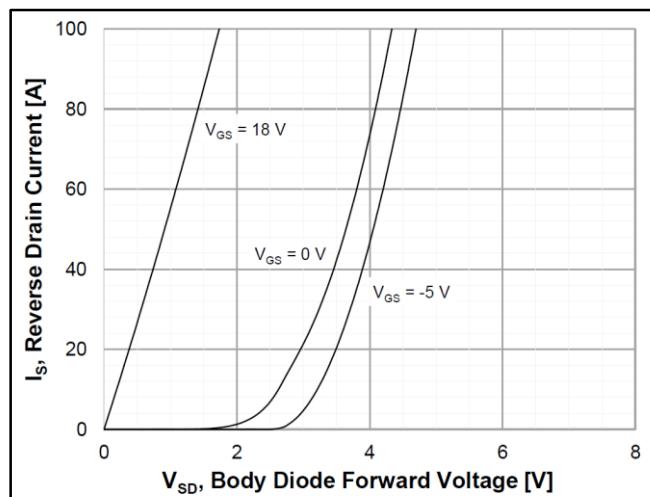


Figure 6. Body Diode Characteristics at $-40\text{ }^{\circ}\text{C}$

Typical Performance



Typical Performance

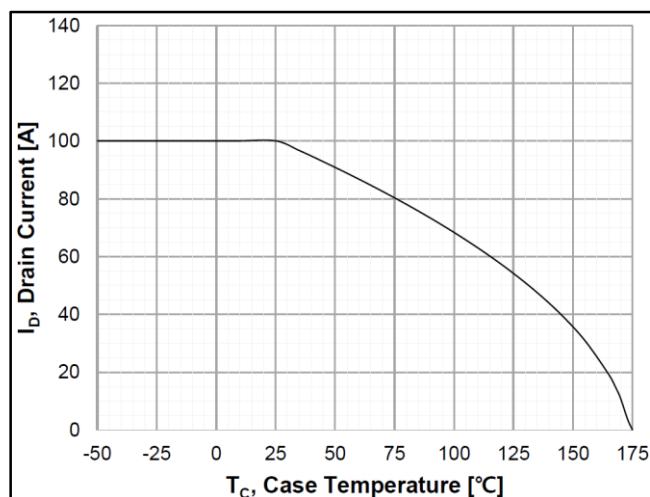


Figure 13. Continuous Drain Current Derating vs. Case Temperature

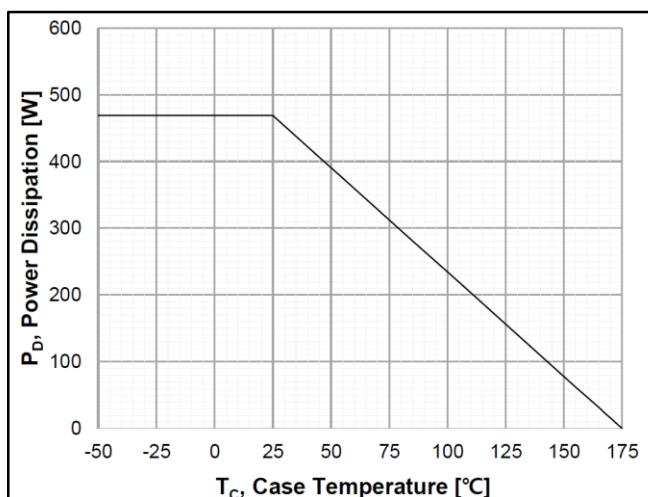


Figure 14. Maximum Power Dissipation Derating vs. Case Temperature

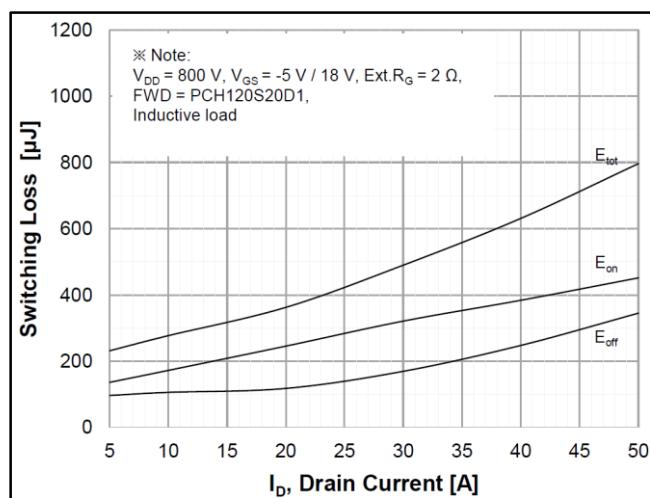


Figure 15. Switching Losses vs. Drain Current

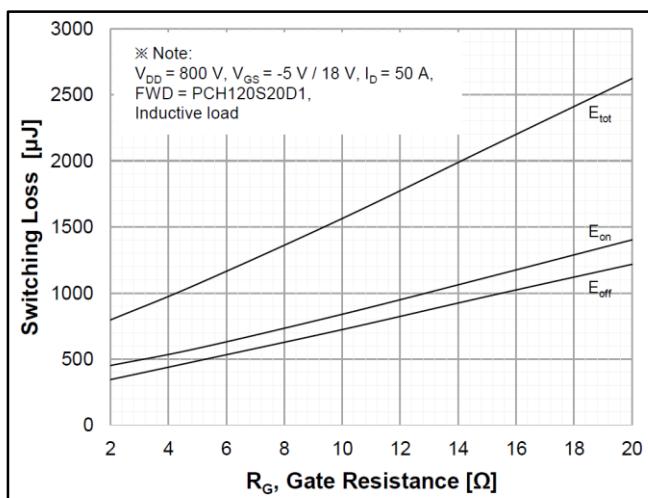


Figure 16. Switching Losses vs. Gate Resistance

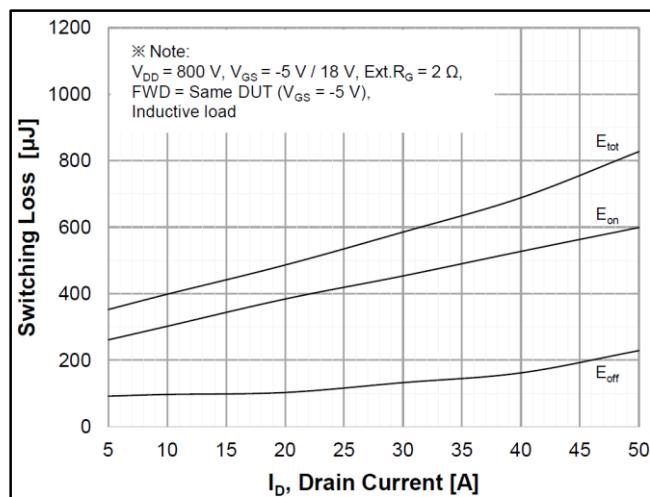


Figure 17. Switching Losses vs. Drain Current

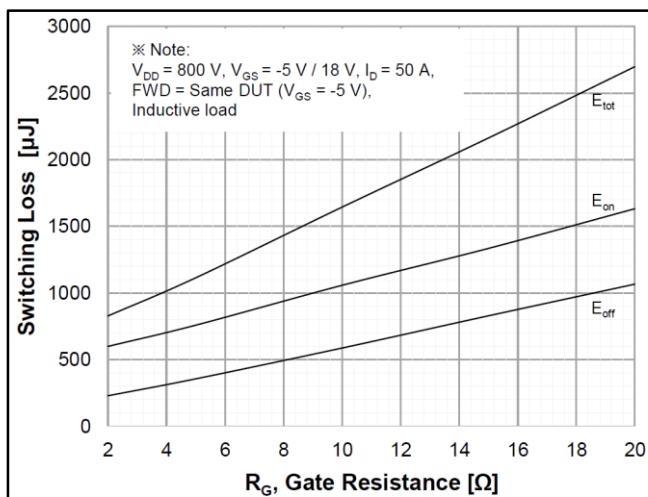
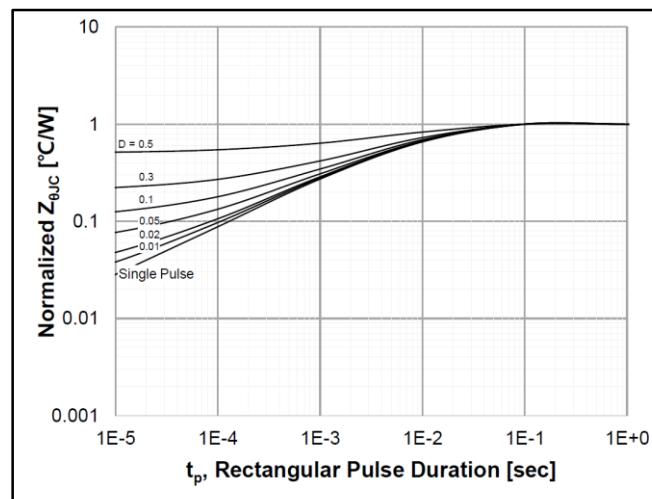


Figure 18. Switching Losses vs. Gate Resistance

Typical Performance



**Figure 19. Transient Thermal Impedance
(Junction - Case)**

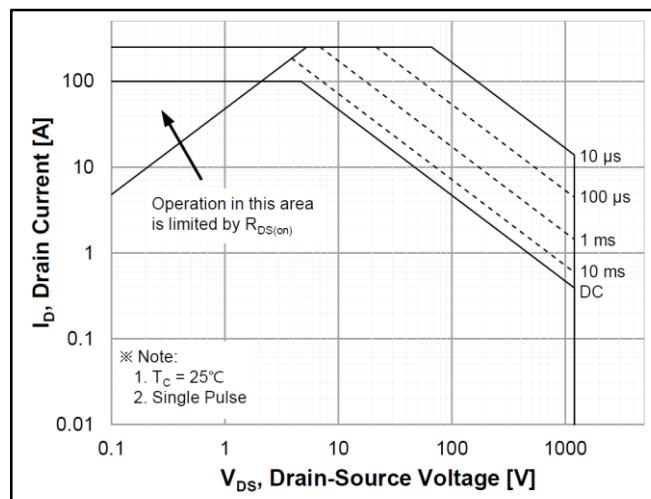
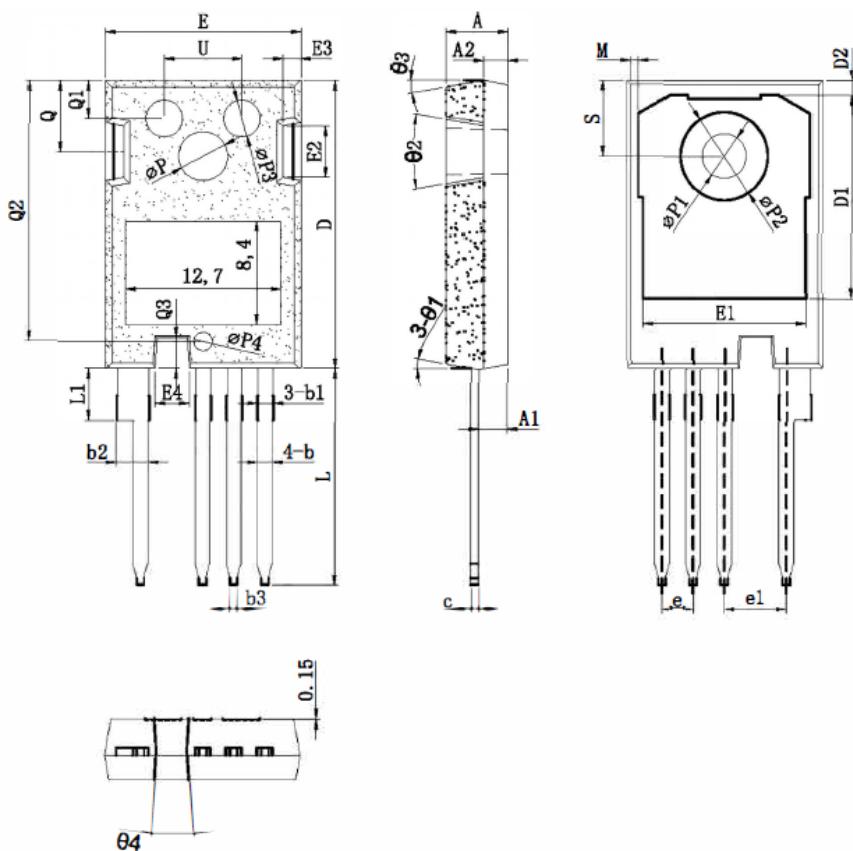


Figure 20. Safe Operating Area

Package Dimensions

Package TO-247-4



SYMBOL	mm		
	MIN	NOM	MAX
A	4.83	5.02	5.21
A1	2.29	2.42	2.54
A2	1.91	2.00	2.16
b	1.07	1.20	1.33
b1	1.15	1.30	1.45
b2	2.39	2.67	2.94
b3	0.45	0.60	0.75
c	0.55	0.60	0.68
D	23.30	23.45	23.60
D1	16.35	16.65	16.95
D2	0.95	1.19	1.25
E	15.75	15.94	16.13
E1	13.10	13.25	13.40
E2	4.00	4.40	4.80
E3	1.00	1.45	1.90
E4	2.40	2.80	3.20
e	2.50	2.54	2.58
e1	5.03	5.08	5.13
L	17.31	17.57	17.82
L1	—	—	4.37
M	0.40	0.60	0.80
φP	3.90	4.00	4.10
φP1	3.51	3.61	3.71
φP2	7.03	7.18	7.33
φP3	2.80	3.00	3.20
φP4	1.30	1.50	1.70
Q	5.49	5.79	6.00
Q1	2.80	3.10	3.40
Q2	19.95	21.25	21.55
Q3	2.35	2.50	2.65
S	6.04	6.17	6.30
U	6.05	6.35	6.55
θ1	6°	10°	13°
θ2	16°	20°	24°
θ3	6°	10°	13°
θ4	5°	8°	11°