

N1M120080PK-A

Automotive Grade SiC Power MOSFET

N-Channel Enhancement Mode

V_{DS}	1200V
$I_D @ 25^\circ\text{C}$	36A
$R_{DS(ON)}$	80m Ω

Features

- Low On-Resistance
- Low Capacitances
- Low Switching Losses
- Easy to Parallel and Simple to Drive
- Automotive Qualified (AEC-Q101)

Benefits

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

Applications

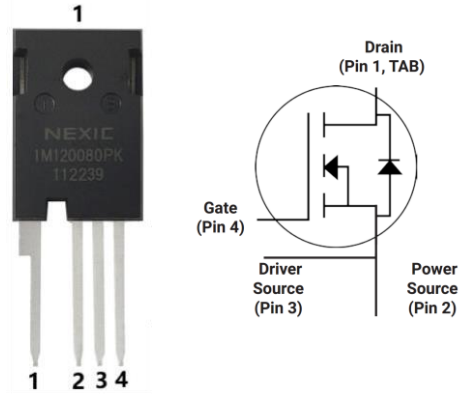
- On-Board Charger/PFC
- Solar Inverters
- Booster/DC-DC Converters
- Motor Drives
- Switch Mode Power Supplies

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

Symbol	Parameter	Value	Unit	Test Conditions	Note
V_{DSmax}	Drain - Source Voltage	1200	V	$V_{GS} = 0\text{ V}, I_D = 100\ \mu\text{A}$	
V_{GSmax}	Gate - Source Voltage	-10/+25	V	Absolute maximum values, AC ($f > 1\text{ Hz}$)	
V_{GSop}	Gate - Source Voltage	-5/+20	V	Recommended operational values	
I_D	Continuous Drain Current	36	A	$V_{GS} = 20\text{ V}, T_C = 25^\circ\text{C}$	Note 1
		24	A	$V_{GS} = 20\text{ V}, T_C = 100^\circ\text{C}$	
$I_{D(pulse)}$	Pulsed Drain Current	80	A	Pulse width t_p limited by T_{jmax}	
P_D	Power Dissipation	181	W	$T_C = 25^\circ\text{C}, T_J = 150^\circ\text{C}$	
T_J, T_{stg}	Operating Junction and Storage Temperature	-55 to + 150	$^\circ\text{C}$		
T_{Proc}	Maximum Processing Temperature	325	$^\circ\text{C}$	10 min. maximum	

Note (1): Assumes a $R_{\theta JC} < 0.69\text{ K/W}$

Package



Part Number	Package
N1M120080PK-A	TO-247-4

Electrical Characteristics ($T_C=25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	1200			V	$V_{GS}=0V, I_D=100\mu A$	
$V_{GS(th)}$	Gate Threshold Voltage	2	2.7	4	V	$V_{DS}=V_{GS}, I_D=5mA$	Fig. 11
			2.0		V	$V_{DS}=V_{GS}, I_D=5mA, T_J=150^{\circ}\text{C}$	
I_{DSS}	Zero Gate Voltage Drain Current		0.01	100	μA	$V_{DS}=1200V, V_{GS}=0V$	
I_{GSS}	Gate-Source Leakage Current			250	nA	$V_{GS}=20V, V_{DS}=0V$	
$R_{DS(on)}$	Drain-Source On-State Resistance		80	98	m Ω	$V_{GS}=20V, I_D=20A$	Fig. 4, 5, 6
			131			$V_{GS}=20V, I_D=20A, T_J=150^{\circ}\text{C}$	
g_{fs}	Transconductance		7.4		S	$V_{DS}=20V, I_{DS}=20A$	Fig. 7
			8.4			$V_{DS}=20V, I_{DS}=20A, T_J=150^{\circ}\text{C}$	
C_{iss}	Input Capacitance		1365		pF	$V_{GS}=0V, V_{DS}=1000V, f=1MHz, V_{AC}=25mV$	Fig. 17, 18
C_{oss}	Output Capacitance		75				
C_{riss}	Reverse Transfer Capacitance		6				
E_{oss}	C_{oss} Stored Energy		22		μJ		Fig. 16
E_{AS}	Avalanche Energy, Single Pluse		780		mJ	$I_D=20A, V_{DD}=50V$	
E_{ON}	Turn-On Switching Energy		142		μJ	$V_{DS}=800V, V_{GS}=-5/20V, I_D=20A, R_{G(ext)}=2.5\Omega, L=142\mu H$	Fig. 21
E_{OFF}	Turn Off Switching Energy		24				
$t_{d(on)}$	Turn-On Delay Time		9		ns	$V_{DD}=800V, V_{GS}=-5/20V, I_D=20A, R_{G(ext)}=2.5\Omega, R_L=40\Omega$	Fig. 22
t_r	Rise Time		6				
$t_{d(off)}$	Turn-Off Delay Time		19				
t_f	Fall Time		5				
$R_{G(int)}$	Internal Gate Resistance		3.1		Ω	$f=1MHz, V_{AC}=25mV$	
Q_{gs}	Gate to Source Charge		15		nC	$V_{DS}=800V, V_{GS}=-5/20V, I_D=20A$	Fig. 12
Q_{gd}	Gate to Drain Charge		10				
Q_g	Total Gate Charge		48				

Reverse Diode Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test conditions	Note
V_{SD}	Diode Forward Voltage	4.0		V	$V_{GS}=-5V, I_{SD}=10A$	Fig. 8, 9, 10
		3.5		V	$V_{GS}=-5V, I_{SD}=10A, T_J=150^{\circ}\text{C}$	
I_S	Continuous Diode Forward Current		36	A	$T_C=25^{\circ}\text{C}$	Note 2
t_{rr}	Reverse Recovery time	26		ns	$V_{GS}=-5V, I_{SD}=20A, V_R=800V, dif/dt=1950A/\mu s$	Note 2
Q_{rr}	Reverse Recovery Charge	110		nC		
I_{rrm}	Peak Reverse Recovery Current	9.6		A		

Note (2): When using SiC Body Diode the maximum recommended $V_{GS} = -5V$

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	0.69		$^{\circ}\text{C/W}$		
$R_{\theta JA}$	Thermal Resistance from Junction to Ambient	33				

Typical Performance

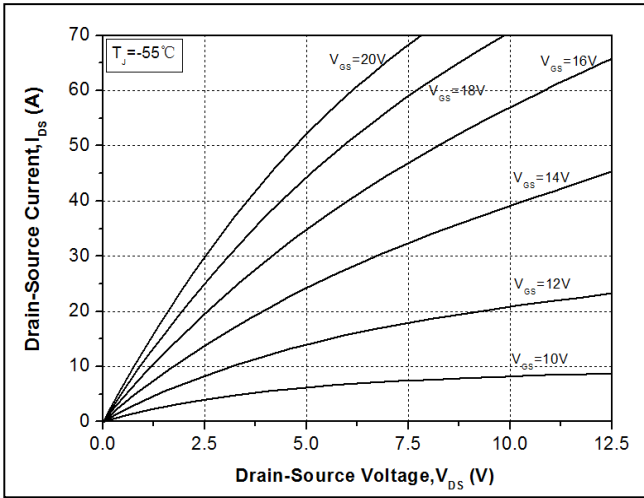


Figure 1. Output Characteristics $T_J = -55\text{ }^{\circ}\text{C}$

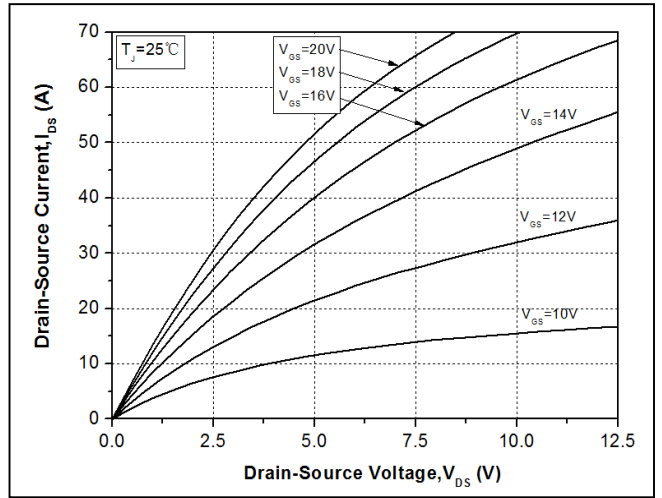


Figure 2. Output Characteristics $T_J = 25\text{ }^{\circ}\text{C}$

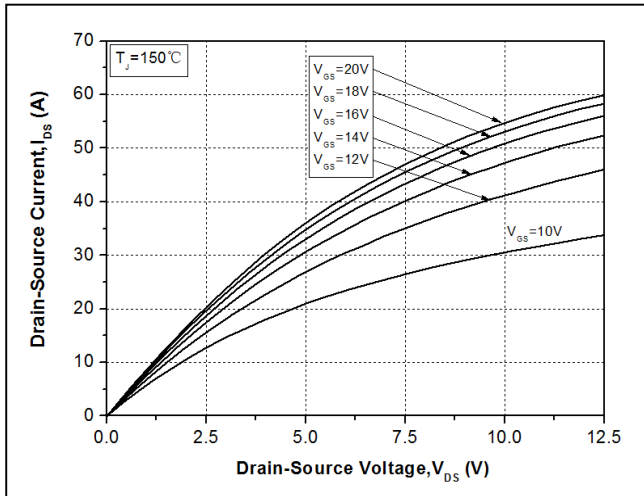


Figure 3. Output Characteristics $T_J = 150\text{ }^{\circ}\text{C}$

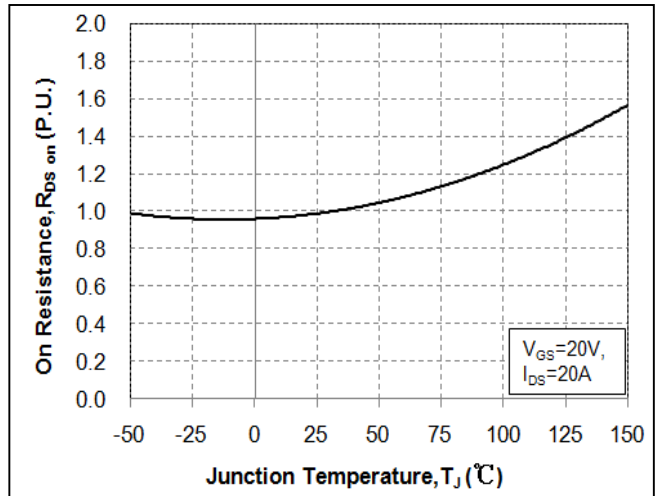


Figure 4. Normalized On-Resistance vs. Temperature

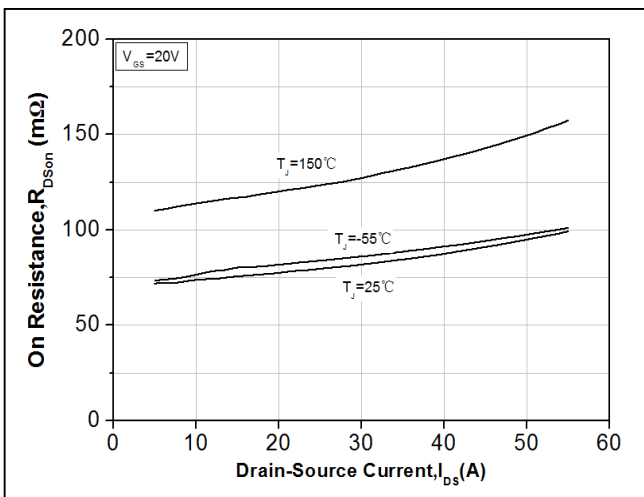


Figure 5. On-Resistance vs. Drain Current for Various Temperatures

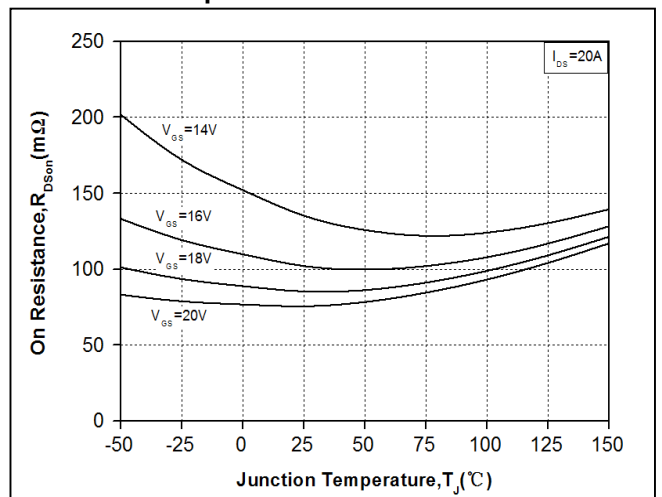


Figure 6. On-Resistance vs. Temperature for Various Gate Voltages

Typical Performance

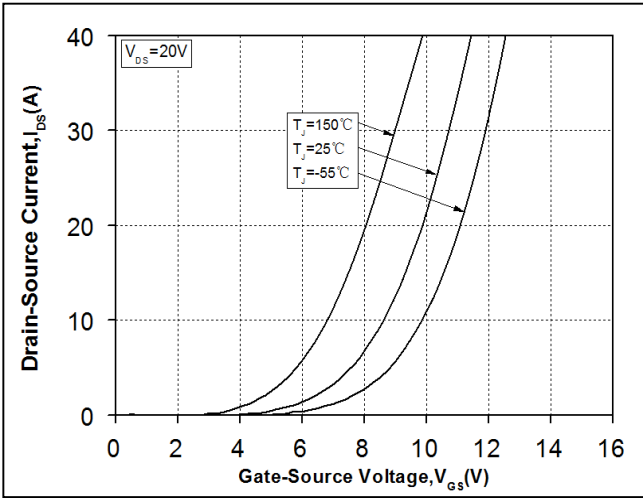


Figure 7. Transfer Characteristics for Various Junction Temperatures

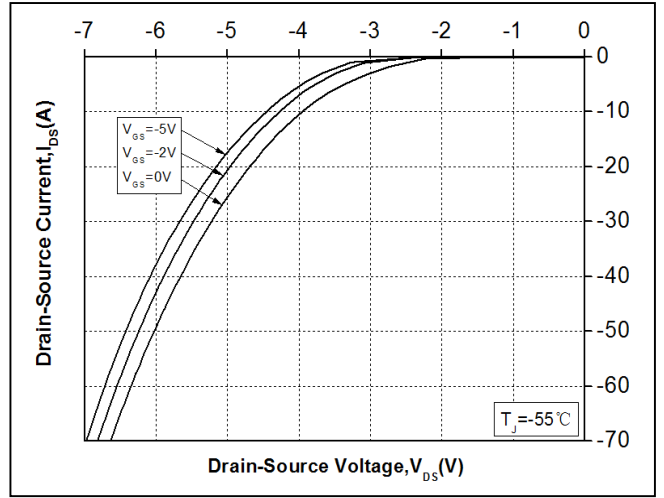


Figure 8. Body Diode Characteristics at -55 °C

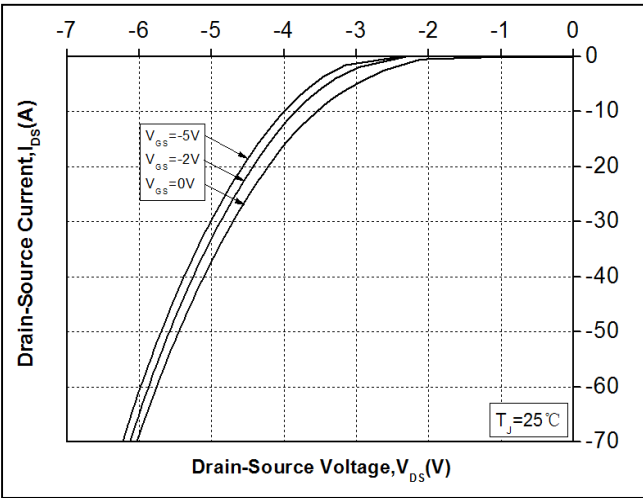


Figure 9. Body Diode Characteristics at 25 °C

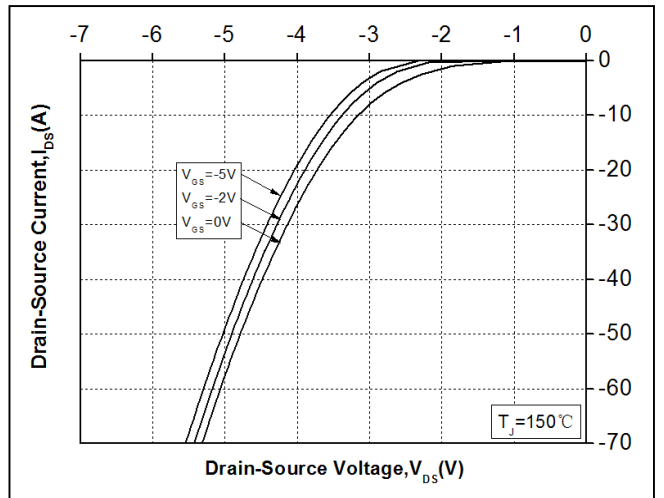


Figure 10. Body Diode Characteristics at 150 °C

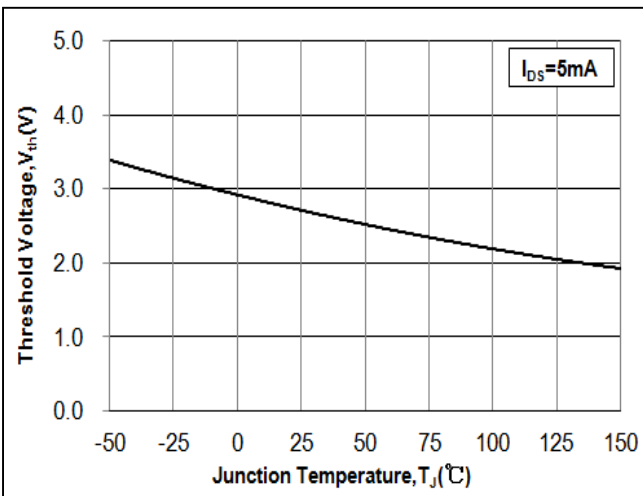


Figure 11. Threshold Voltage vs. Temperature

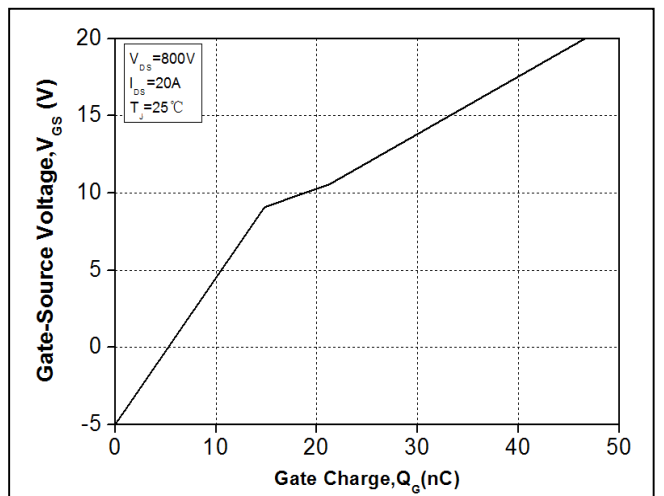


Figure 12. Gate Charge Characteristics

Typical Performance

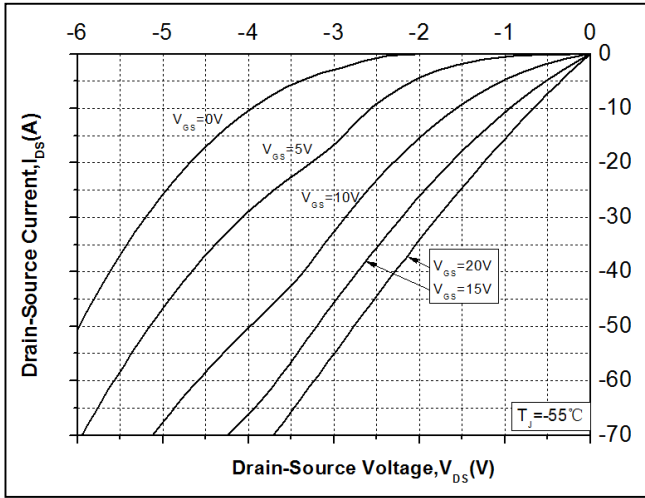


Figure 13. 3rd Quadrant Characteristics at -55 °C

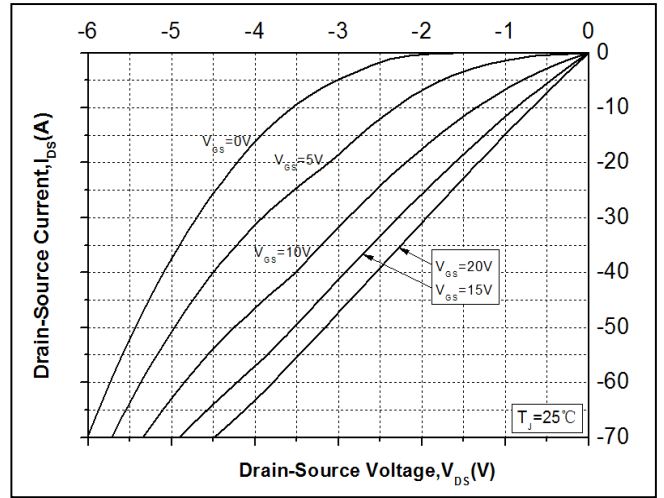


Figure 14. 3rd Quadrant Characteristics at 25 °C

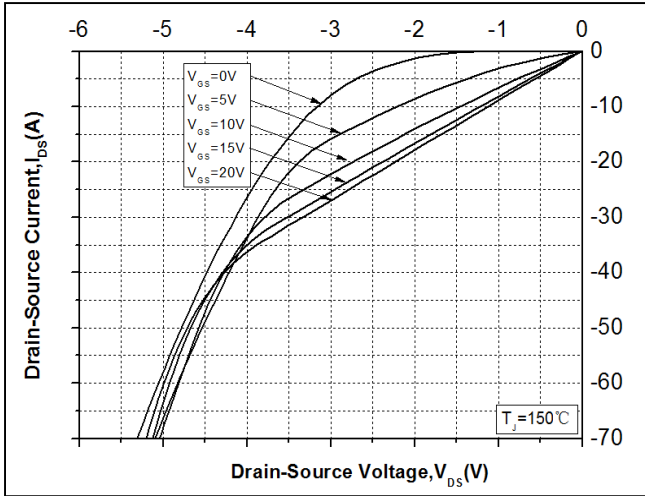


Figure 15. 3rd Quadrant Characteristics at 150 °C

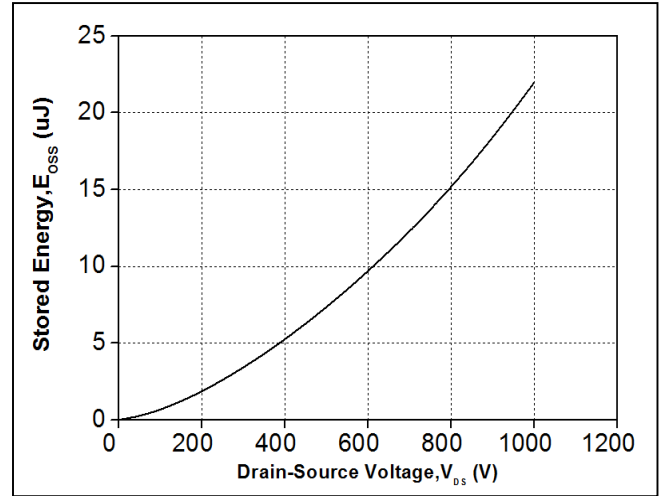


Figure 16. Output Capacitor Stored Energy

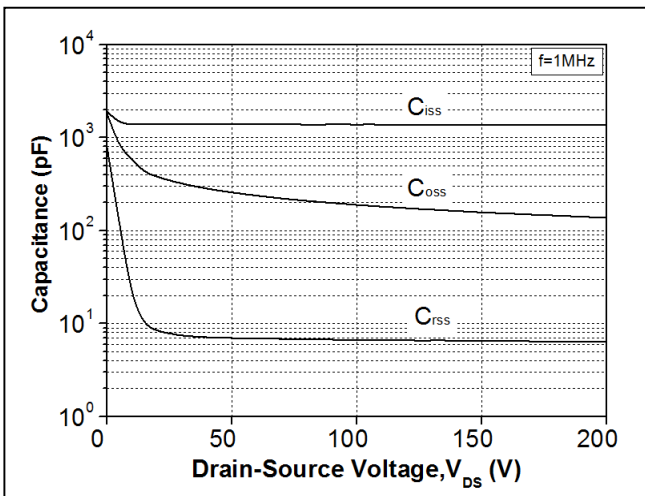


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

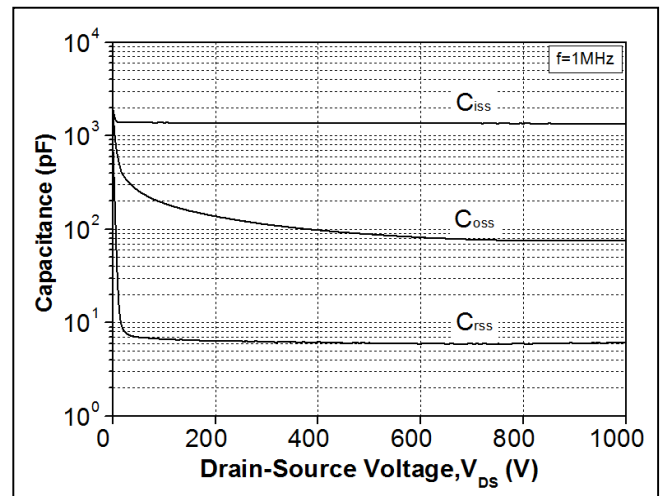


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1000V)

Typical Performance

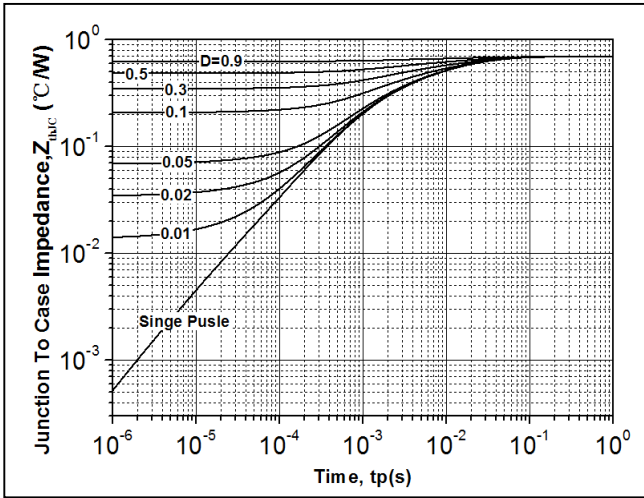


Figure 19. Transient Thermal Impedance (Junction - Case)

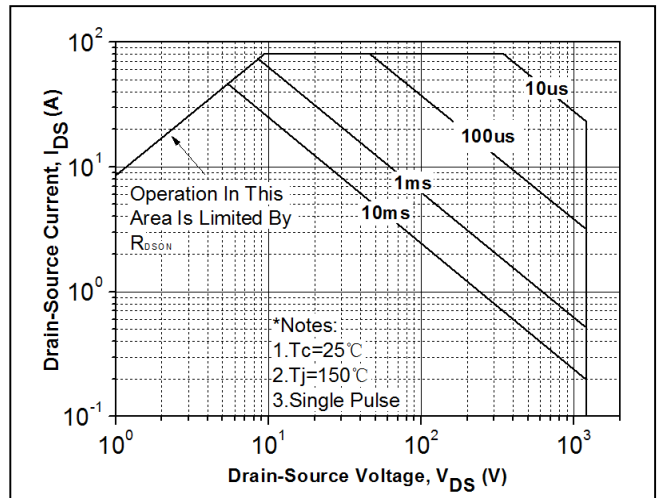


Figure 20. Safe Operating Area

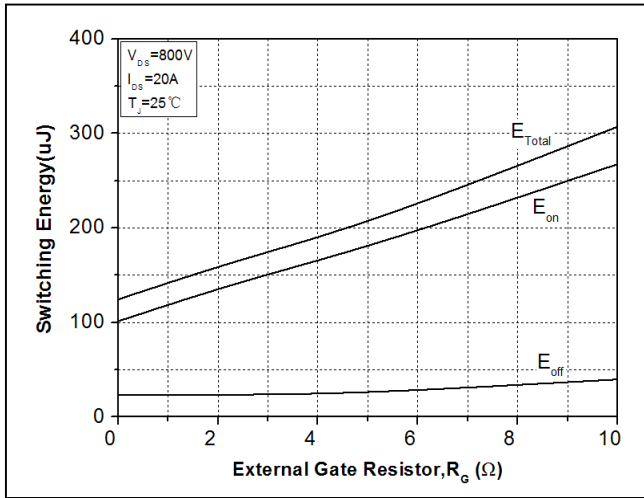


Figure 21. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

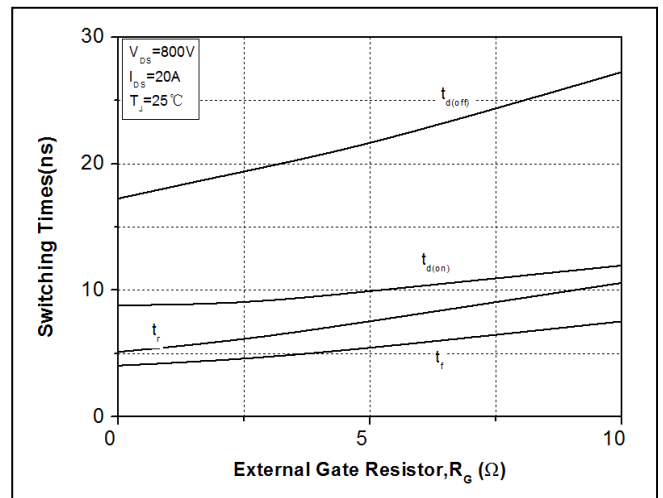
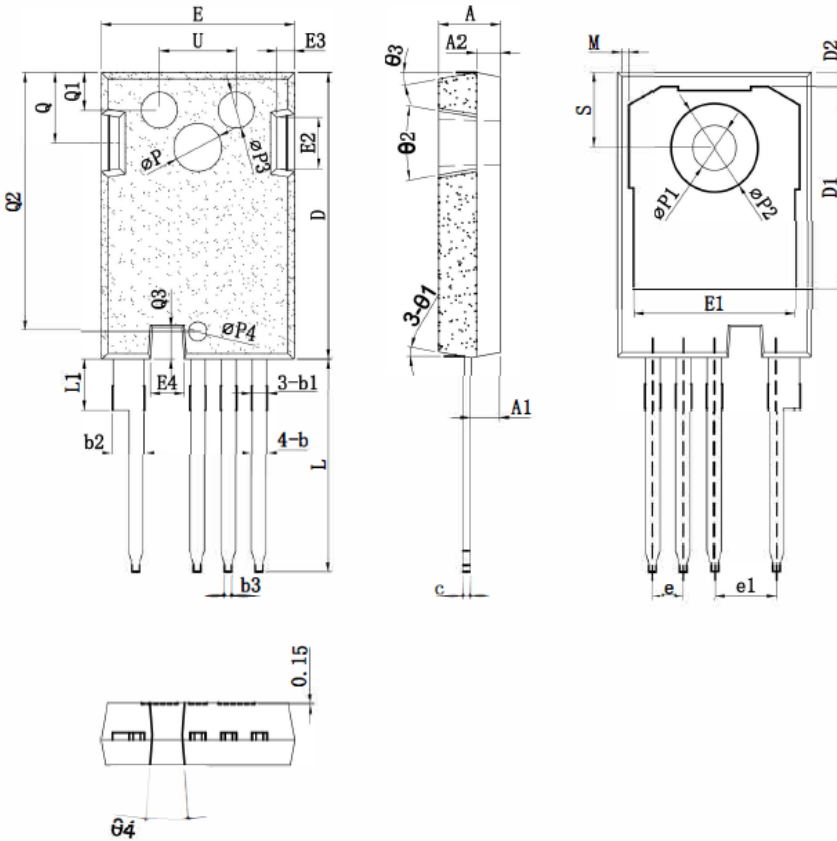


Figure 22. Switching Times vs. $R_{G(ext)}$

Package Dimensions

Package TO-247-4



SYMBOL	mm		
	MIN	NOM	MAX
A	4.23	4.52	4.81
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	22.60	23.25	23.90
D1	15.85	16.25	16.65
D2	0.95	1.19	1.25
E	15.25	15.64	16.23
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	17.01	17.27	17.62
L1	—	—	4.37
M	0.40	0.60	0.80
ϕP	3.90	4.00	4.10
$\phi P1$	3.51	3.61	3.71
$\phi P2$	7.03	7.18	7.33
$\phi P3$	2.80	3.00	3.20
$\phi P4$	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
$\theta1$	6°	10°	13°
$\theta2$	16°	20°	24°
$\theta3$	6°	10°	13°
$\theta4$	5°	8°	11°