MS12BS200S

Single-Bridge Module with parallel SiC MOSFETs

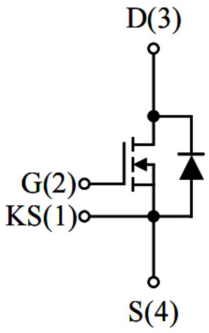
V_{DS}	1200V
I_D(T_C=100˚C)	160A
$R_{DS(on)}$	6.50mΩ

Technical Features:

- Ultra-Low Loss
- Zero Reverse Recovery
- Low Thermal Resistance
- Standard SOT227 Package
- High Frequency Operation
- High Performance AMB Ceramic

Applications:

- Solar
- UPS System
- Renewable Energy
- Converters/Inverters



Package 38mm × 25mm × 12mm

Part Number	Package	Marking
MS12BS200S	**Single Bridge OM1 Module**	**MS12BS200S**

Maximum Ratings (T_C=25˚C unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Notes
V_{DSmax}	Drain-Source Voltage	1.2	kV		
V_{GSmax}	Gate-Source Voltage	-10/+22	V	Absolute Maximum Values	Fig.28
V_{GSop}	Gate-Source Voltage	-4/+18	V	Recommended Operational Values	
I_D	Continuous Drain Current	230	A	V_{GS}=18V, T_C=25˚C, T_J≤175℃	
		140		V_{GS}=18V, T_C=100˚C, T_J≤150℃	
		160		V_{GS}=18V, T_C=100˚C, T_J≤175℃	
$I_{SD(BD)}$	DC Source-Drain Current (Body Diode)	108	A	V_{GS}=-4V, T_C=100˚C, T_J≤175℃	
$I_{D(pulse)}$	Pulsed Drain Current	320	A	Pulse Width t_p Limited by T_{Jmax}	
P_D	Power Dissipation	710	W	T_C=25˚C, T_J≤175℃	
T_{Jmax}	Maximum Junction Temperature	175	˚C		
$T_{J,opt}$	Recommended operating junction temperature	-40 to +150	˚C		
T_C, T_{STG}	Case & Storage Temperature Range	-40 to +125	˚C		
V_{isol}	Case Isolation Voltage	4.0	kV	AC, 50 Hz, 1min	

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

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Notes
V_{DSS}	Drain Source Blocking Voltage	1.2			kV	V_{GS}=0V, I_D=200uA	
$V_{GS(th)}$	Gate Threshold Voltage	1.8	2.9	3.8	V	V_{DS}=V_{GS}, I_D=54mA	
I_{DSS}	Zero Gate Voltage Drain Current		2	100	μA	V_{DS}=1.2kV, V_{GS}=0V	
I_{GSS}	Gate-Source Leakage Current		2	400	nA	V_{GS}=18V/-4V, V_{DS}=0V	
$R_{DS(on)}$	On State Resistance		6.50	8.50	mΩ	V_{GS}=18V, I_{DS}=160A, T_J=25˚C	Fig.5 Fig.6,7
			10.50			V_{GS}=18V, I_{DS}=160A, T_J=125˚C	
			12.00			V_{GS}=18V, I_{DS}=160A, T_J=150˚C	
			13.50			V_{GS}=18V, I_{DS}=160A, T_J=175˚C	
g_{fs}	Transconductance		150		S	V_{DS}=20V, I_{DS}=300A	Fig.8
			160			V_{DS}=20V, I_{DS}=300A, T_J=150˚C	
Q_{GS}	Gate-Source Charge		120		nC	V_{DD}=800V, V_{GS}=-4V/+18V, I_D=200A, Per JEDEC 24 pg 27	
Q_{GD}	Gate-Drain Charge		256				
Q_G	Total Gate Charge		492				
C_{iss}	Input Capacitance		10.4n		F	V_{GS}=0V, V_{DS}=1000V, f=100kHz, V_{AC}=25mV	Fig.14
C_{oss}	Output Capacitance		450p				
C_{rss}	Reverse Transfer Capacitance		38p				
$R_{G(int)}$	Internal Gate Resistance		3.6		Ω	V_{GS}=0V, f=100kHz, V_{AC}=25mV	
E_{on}	Turn-On Energy T_J=25℃ T_J=125℃ T_J=150℃ T_J=175℃		 3.72 3.77 3.88 3.98		mJ	V_{DD}=600V, V_{GS}=-4V/+18V I_D=200A, $R_{G(off)}$=1Ω, $R_{G(on)}$=4.7Ω Load=30μH	Fig.16 - Fig.20
E_{off}	Turn-Off Energy T_J=25℃ T_J=125℃ T_J=150℃ T_J=175℃		 1.95 1.95 1.96 1.97		mJ		
$t_{d(on)}$	Turn-on delay time T_J=25℃ T_J=125℃ T_J=150℃ T_J=175℃		 56 49 48 48		ns		
t_r	Rise Time T_J=25℃ T_J=125℃ T_J=150℃ T_J=175℃		 30 27 27 26				
$t_{d(off)}$	Turn-off delay time T_J=25℃ T_J=125℃ T_J=150℃ T_J=175℃		 84 86 89 90				

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

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Notes
t_f	Fall Time				ns	V_{DD}=600V, V_{GS}=-4V/+18V I_D=200A, $R_{G(0ff)}$=1Ω, $R_{G(on)}$=4.7Ω Load=30μH	
	T_J=25℃		26				
	T_J=125℃		26				
	T_J=150℃		26				
	T_J=175℃		27				

Thermal Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Notes
$R_{thJC\ MOS}$	Juction-to-Case Thermal Resistance for MOSFET	-		0.21	K/W	Per SiC MOSFET	Fig.23
$R_{thJC\ BD}$	Juction-to-Case Thermal Resistance for Body Diode	-		0.22	K/W	Per Body Diode	

Diode Characteristics (T_J = 25˚C unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Notes
V_{SD}	Diode Forward Voltage		4.61		V	I_F=160A, T_J=25˚C, V_{GS}=-4V	Fig.11
			4.20			I_F=160A, T_J=125˚C, V_{GS}=-4V	
			4.13			I_F=160A, T_J=150˚C, V_{GS}=-4V	
			4.07			I_F=160A, T_J=175˚C, V_{GS}=-4V	
t_{rr}	Reverse Recovery Time				ns	V_{DD}=600V, V_{GS}=-4V/+18V I_D=200A, $R_{G(0ff)}$=1Ω, $R_{G(on)}$=4.7Ω Load=30μH	
	T_J=25℃		25				
	T_J=125℃		34				
	T_J=150℃		35				
	T_J=175℃		36				
Q_{RR}	Reverse Recovery Charge				μC		
	T_J=25℃		1.04				
	T_J=125℃		2.76				
	T_J=150℃		3.27				
	T_J=175℃		3.69				
I_{RRM}	Peak Reverse Recovery Current				A		
	T_J=25℃		67				
	T_J=125℃		133				
	T_J=150℃		148				
	T_J=175℃		162				
E_{RR}	Reverse Recovery Energy				mJ	V_{DD}=600V, V_{GS}=-4V/+18V I_D=200A, $R_{G(0ff)}$=1Ω, $R_{G(on)}$=4.7Ω Load=30μH	Fig.21 Fig.22
	T_J=25℃		0.34				
	T_J=125℃		0.73				
	T_J=150℃		0.83				
	T_J=175℃		0.91				

Module Physical Characteristics

Symbol	Parameter	Typ.	Unit	Test Conditions	Notes
	Material of Module Baseplate	Cu			
V_{isol}	Isolation Test Voltage	2.5	kV	RMS, f=50Hz, t=1min	
T_{stg}	Storage Temperature	-55 to 150	˚C		
da	Clearance	4.4	mm	Terminal to Terminal	
		6.8	mm	Terminal to Heatsink	
ds	Creepage	10.5	mm	Terminal to Terminal	
		8.5	mm	Terminal to Heatsink	
M_S	Mounting Torque of Screws	0.9~1.5	N · m	Baseplate To Heatsink, Screw M6	
M_T	Mounting Torque of Screws	0.9~1.3	N · m	To Terminals, Screw (M4*9mm)	
G	Weight	29	g		
CTI	Comparative Tracking Index	>200			

Typical Performance

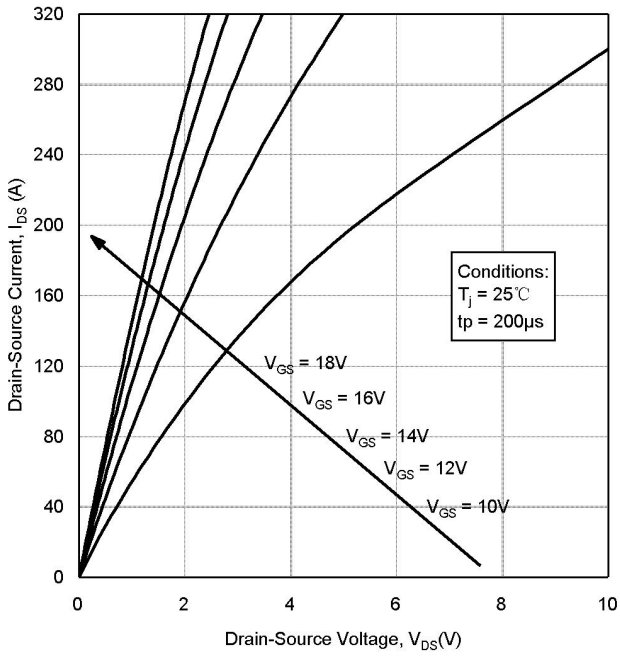


Figure 1. Output Characteristics T_J=25℃

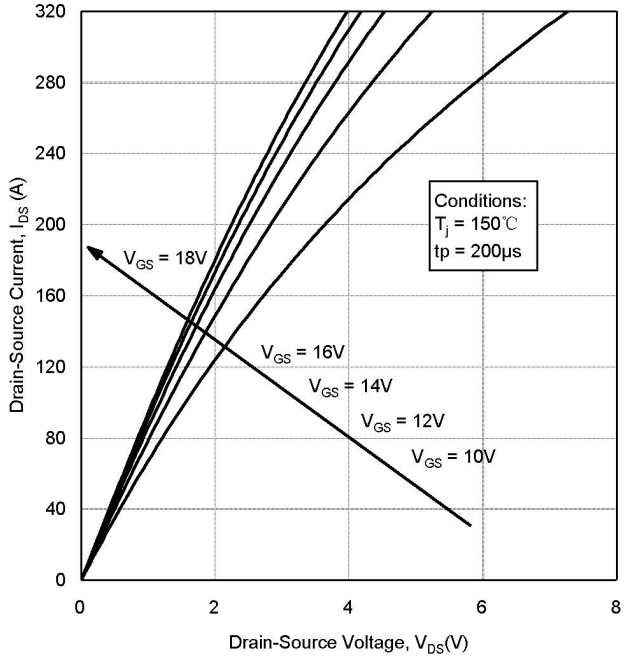


Figure 2. Output Characteristics T_J=150℃

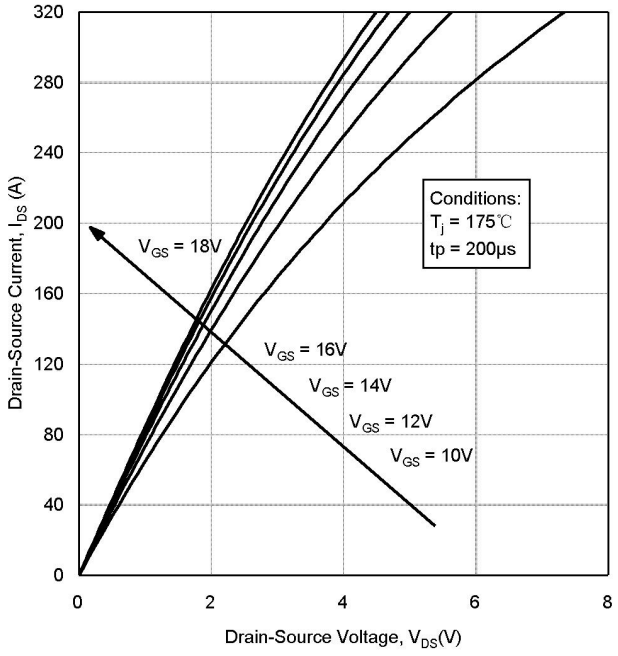


Figure 3. Output Characteristics T_J=175℃

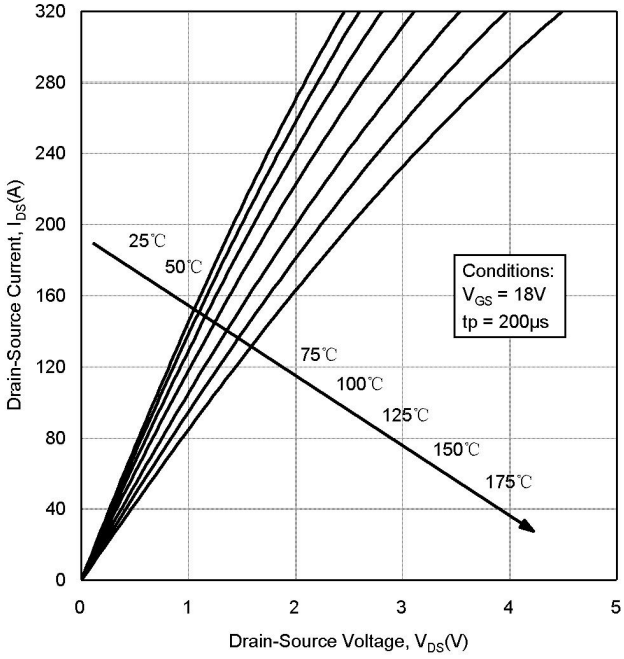


Figure 4. Output Characteristics vs. Temperature

Typical Performance

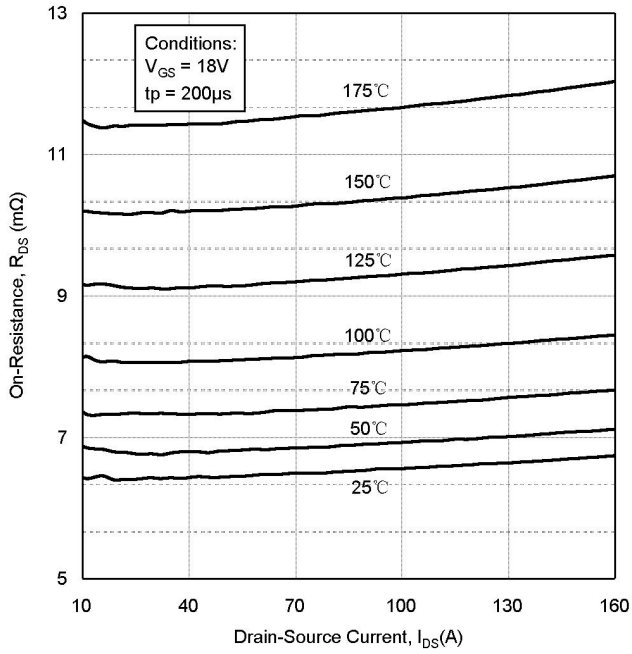


Figure 5. On-Resistance vs. Drain Current

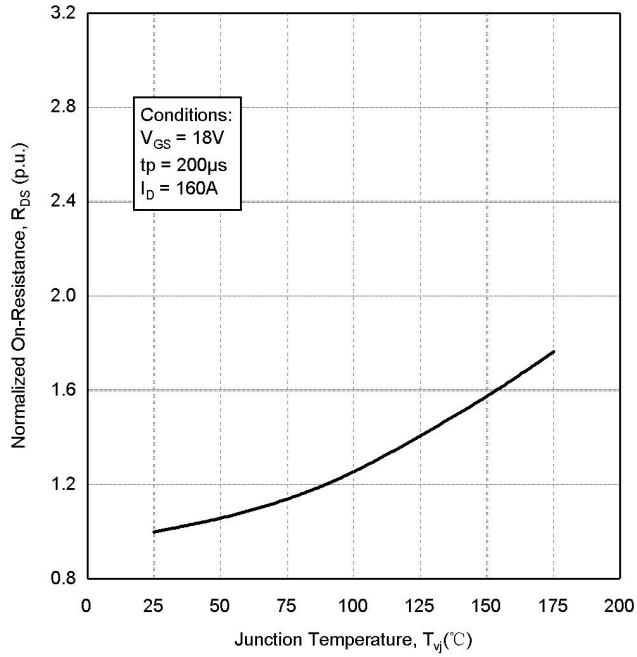


Figure 6. Normalized On-Resistance vs. Junction Temperature

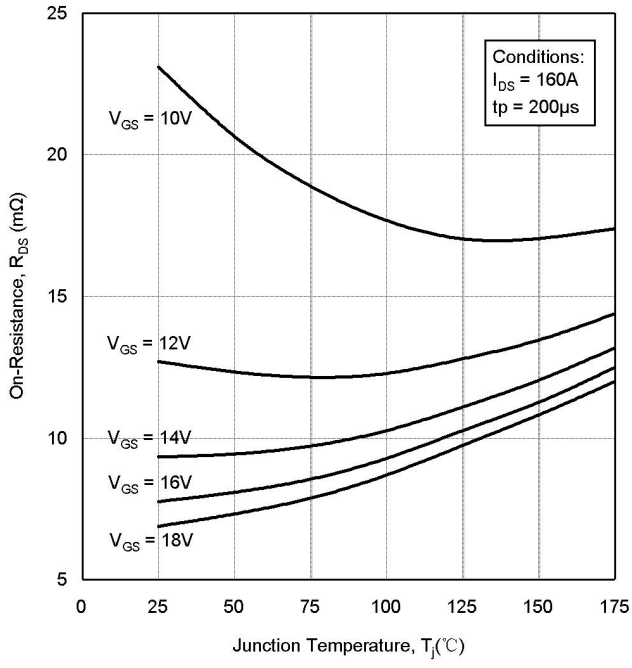


Figure 7. On-State Resistance vs. Junction Temperature

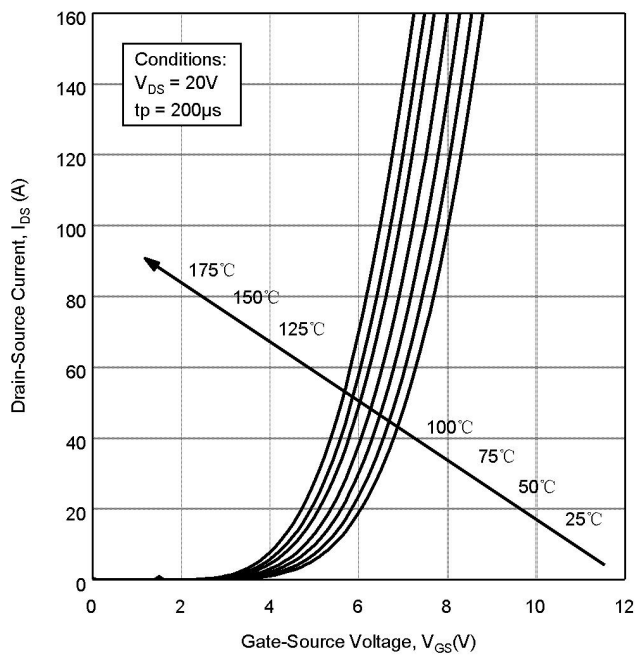


Figure 8. Transfer Characteristics

Typical Performance

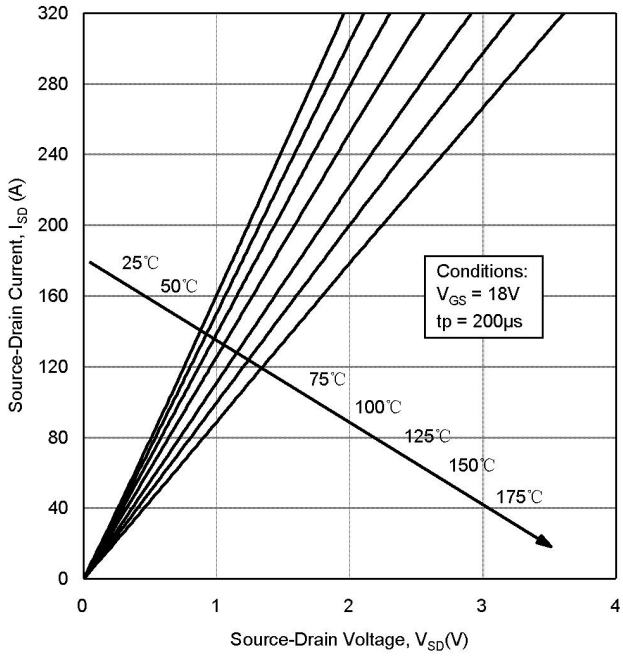


Figure 9. Diode Characteristics

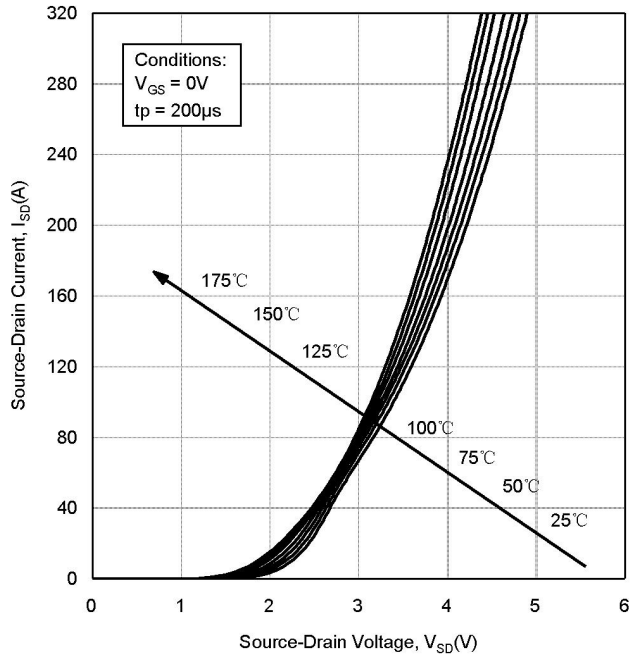


Figure 10. 3rd Quadrant Characteristic.vs.Junction (Body Diode)Temperature at V_{GS}=0V

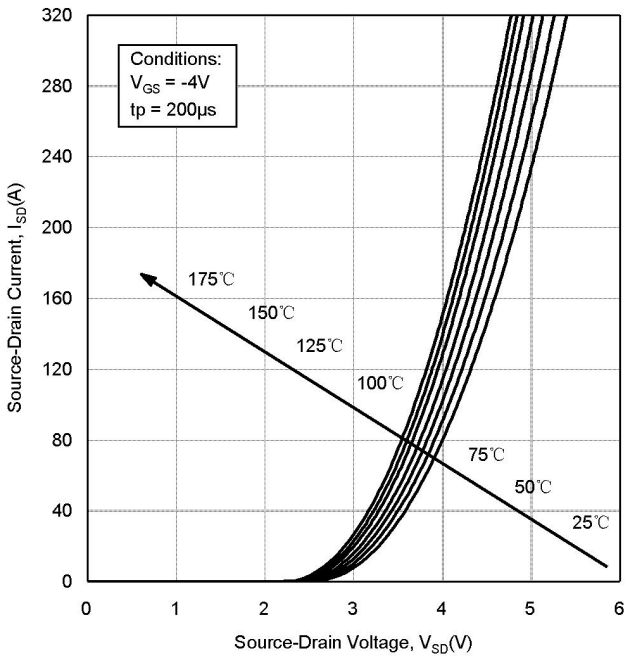


Figure 11. 3rd Quadrant Characteristic vs. Junction Temperature at V_{GS}=-4V (Body Diode)

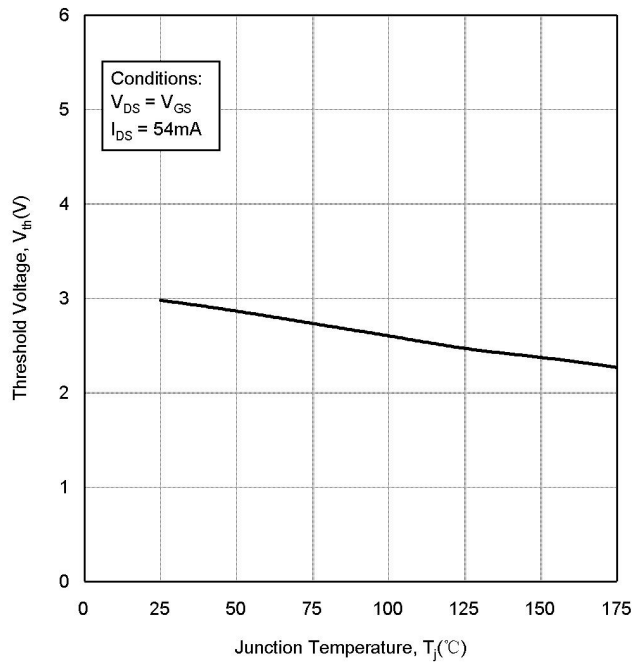


Figure 12. Threshold Voltage vs. Junction Temperature

Typical Performance

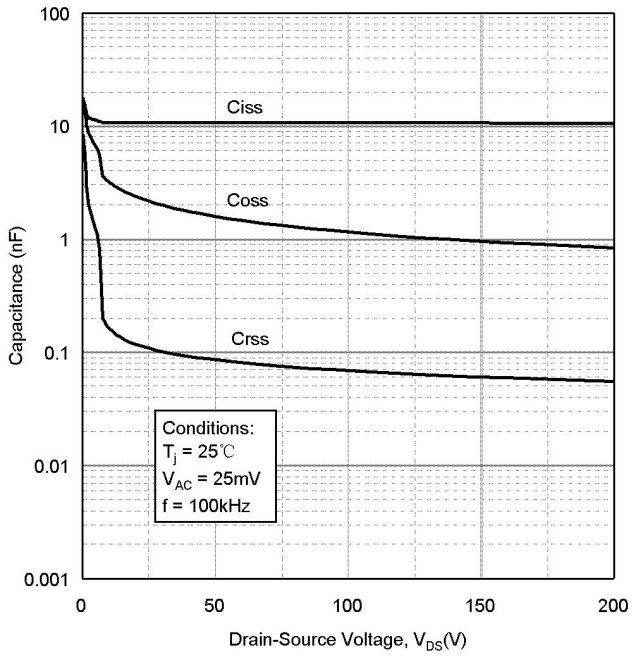


Figure 13. Capacitances vs. Drain-Source (0-200V)

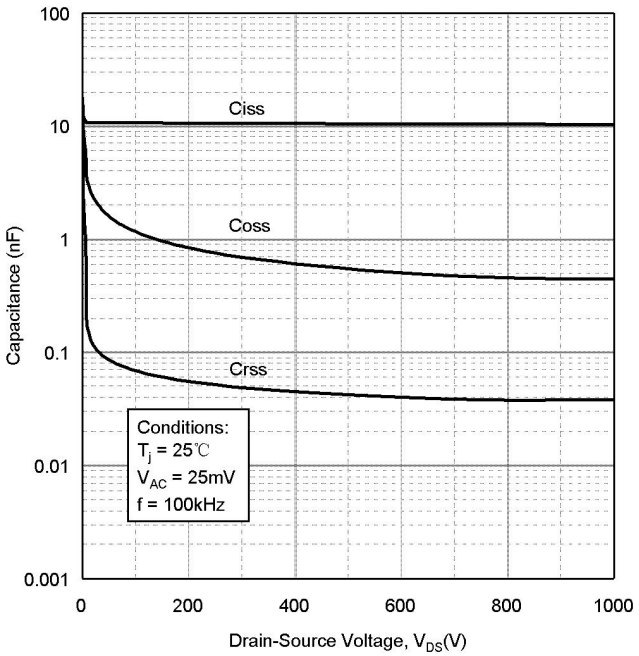


Figure 14. Capacitances vs. Drain-Source (0-1000V)

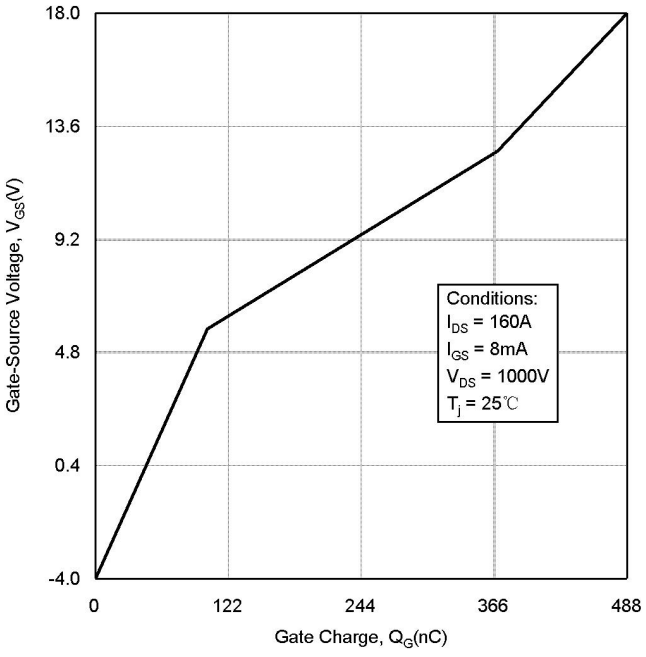


Figure 15. Gate Charge Characteristics

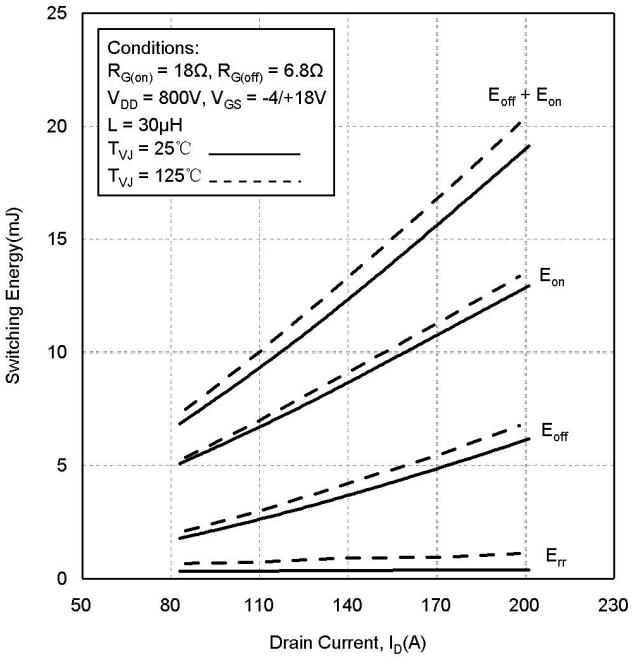


Figure 16. Inductive Switching Energy vs. Drain Current (T_J=25℃, T_J=125℃)

Typical Performance

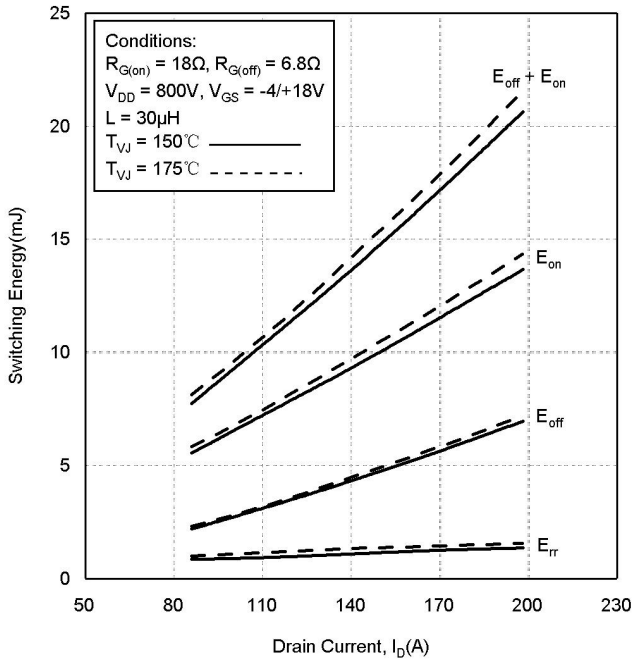


Figure 17. Inductive Switching Energy vs. Drain Current (T_J=150℃, T_J=175℃)

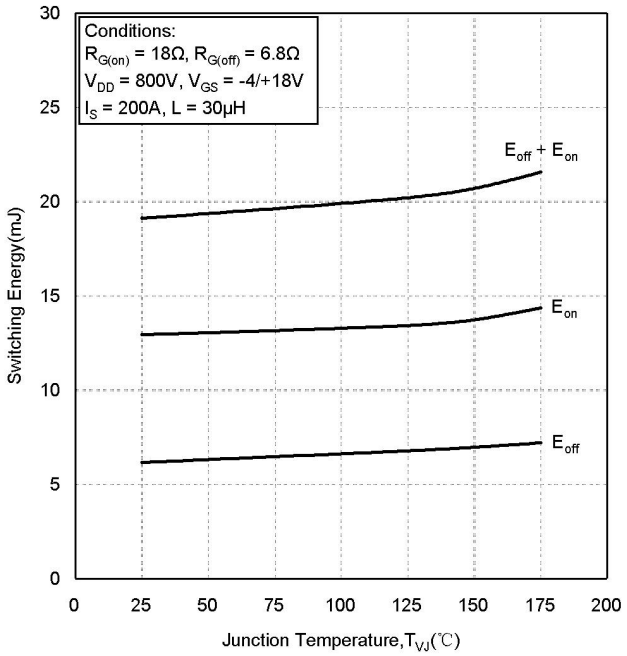


Figure 18. MOSFET Switching Energy vs. Junction Temperature

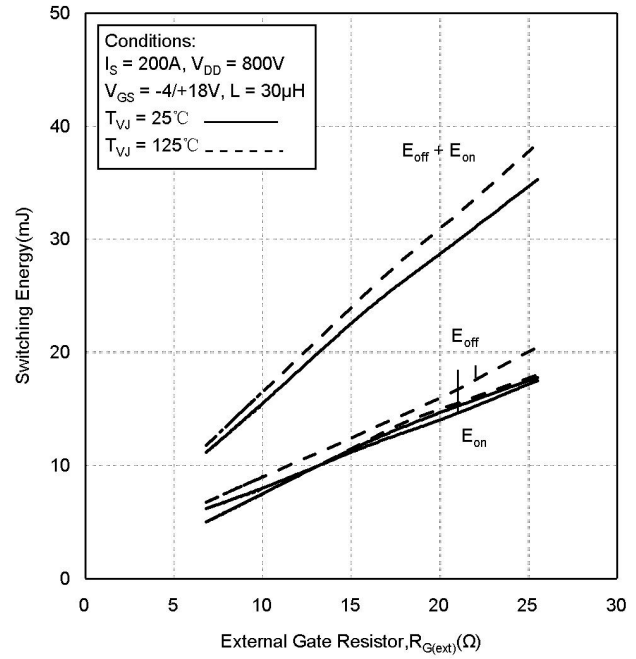


Figure 19. Inductive Switching Energy vs. $R_{G(ext)}$ (T_J=25℃, T_J=125℃)

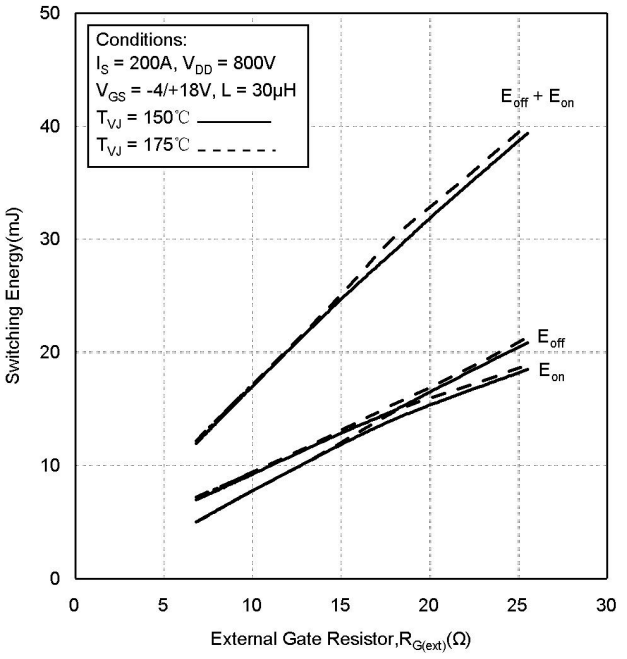


Figure 20. Inductive Switching Energy vs. $R_{G(ext)}$ (T_J=150℃, T_J=175℃)

Typical Performance

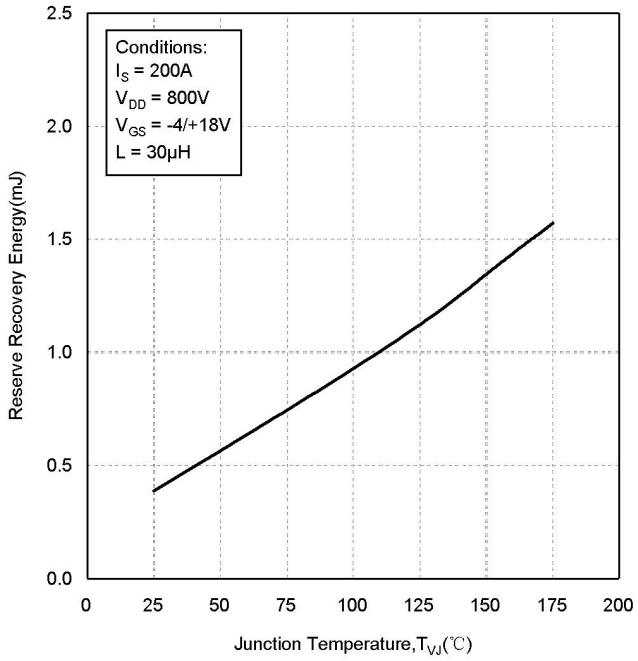


Figure 21. Reverse Recovery Energy vs. Junction Temperature

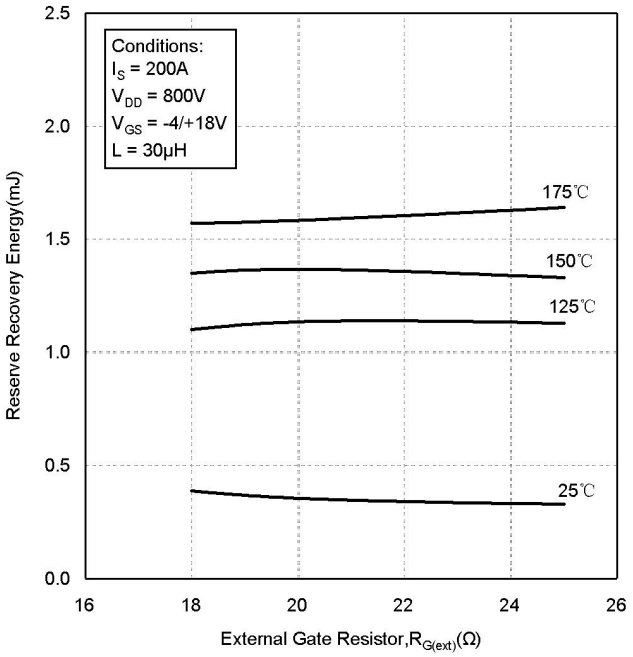
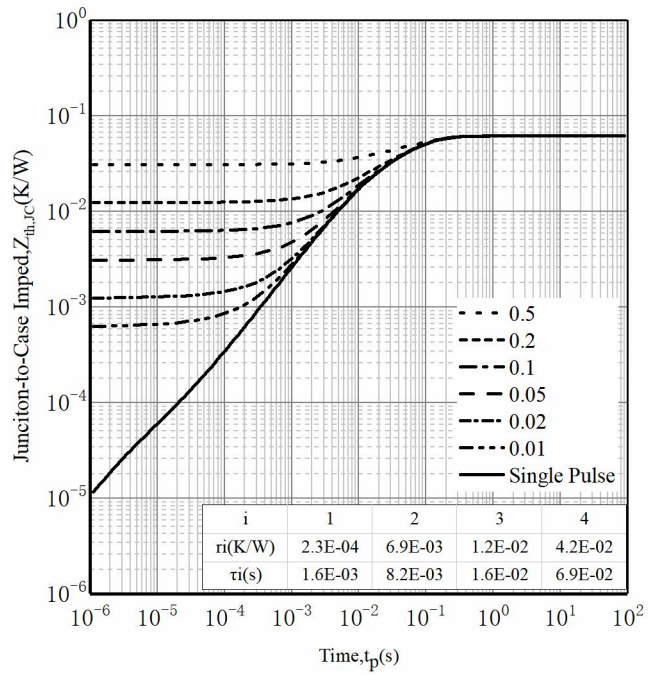


Figure 22. Reverse Recovery Energy vs. External Gate Resistance



i	1	2	3	4
ri(K/W)	2.3E-04	6.9E-03	1.2E-02	4.2E-02
τi(s)	1.6E-03	8.2E-03	1.6E-02	6.9E-02

Figure 23. MOSFET Junction to Case Transient Thermal Impedance, $Z_{th,JC}$ (K/W)

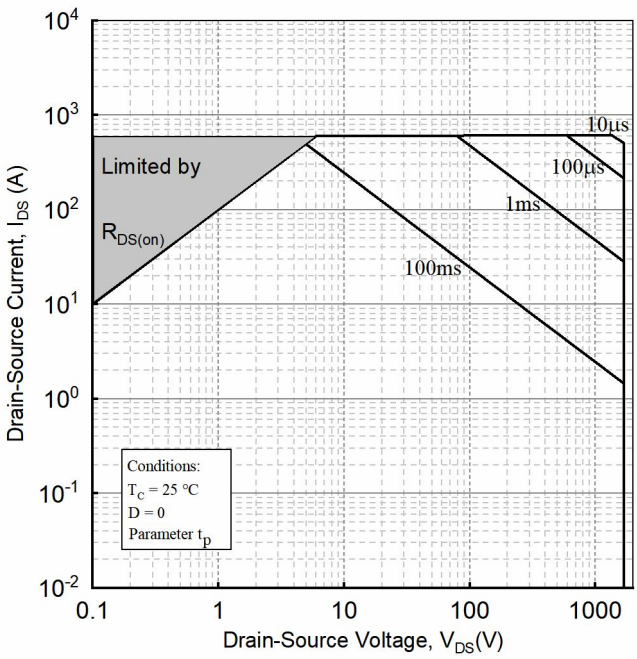


Figure 24. Forward Bias Safe Operating Area (FBSOA)

Typical Performance

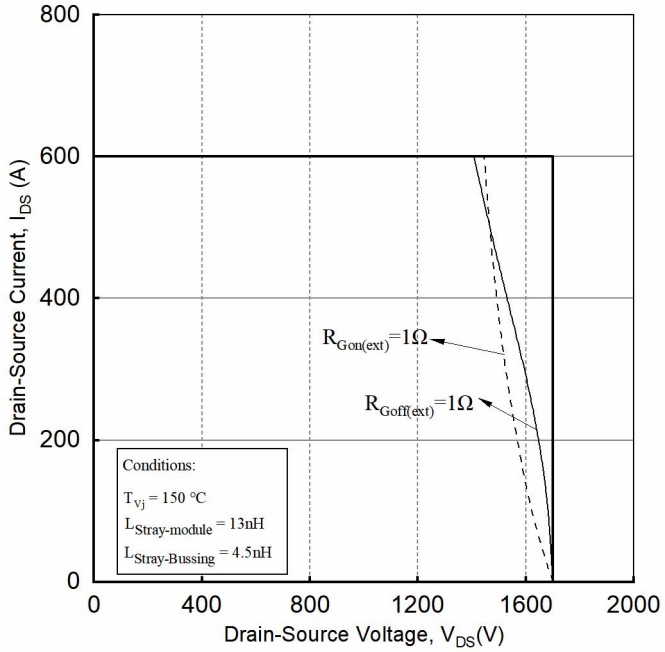


Figure 25. Reverse Bias Safe Operating Area (RBSOA)

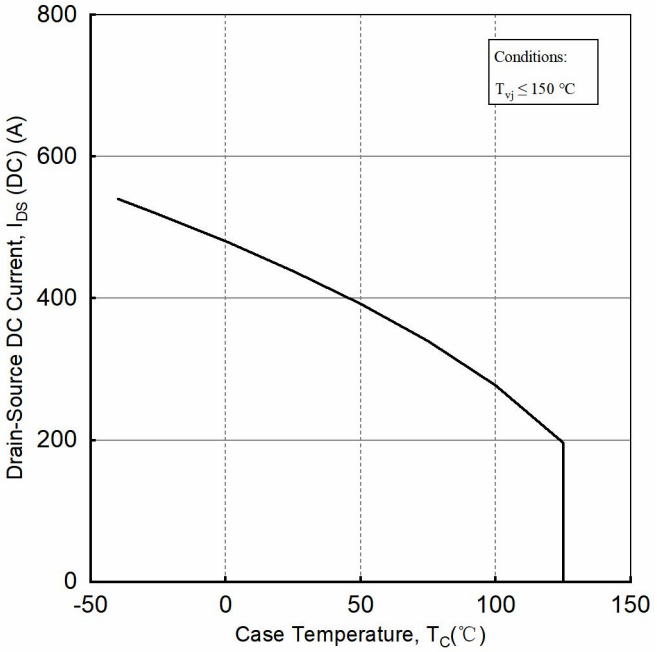


Figure 26. Continuous Drain Current Derating vs. Case Temperature

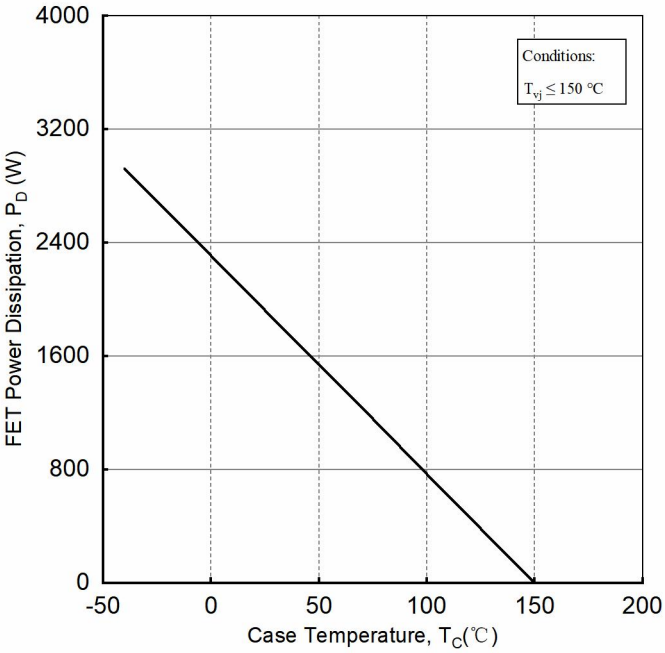


Figure 27. Maximum Power Dissipation Derating vs. Case Temperature

Definitions

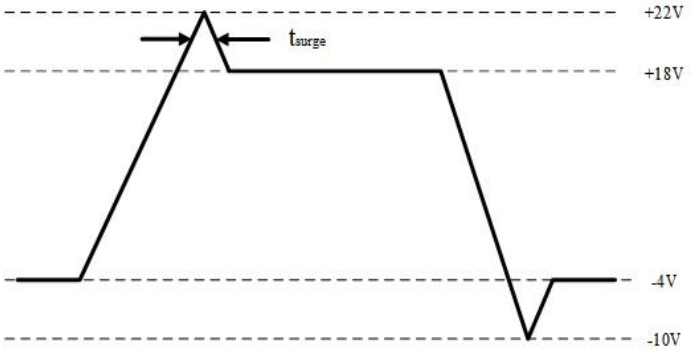


Figure 28. Example of acceptable V_{GS} waveform

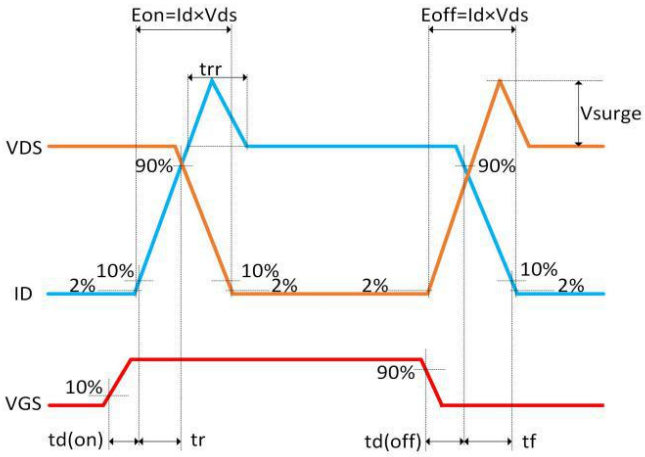


Figure 29. Wavelength for Switching Test

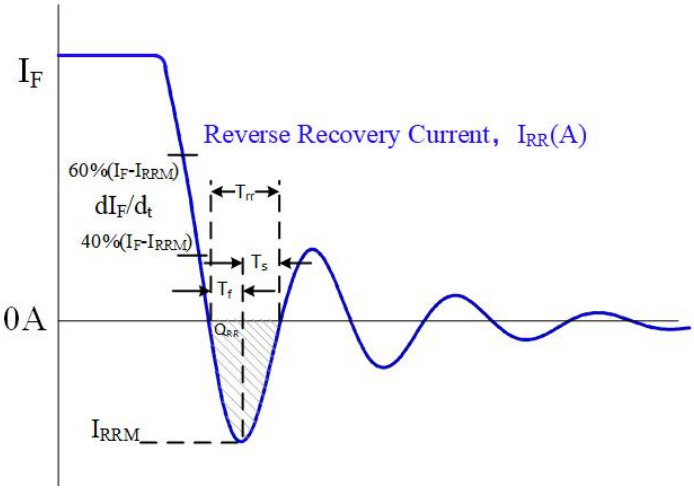
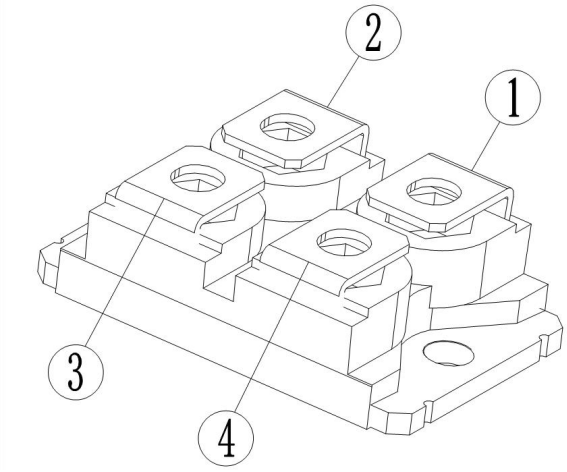
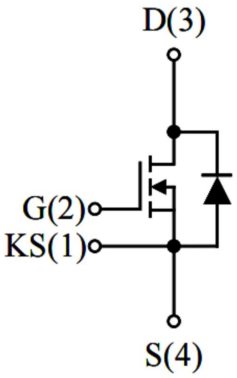


Figure 30. Reverse Recovery Definitions

Schematic





Package Dimensions (The dimension unit is millimeter)