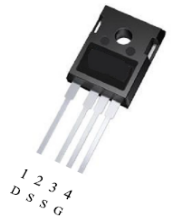
650V N-Channel Silicon Carbide Power MOSFET

Features

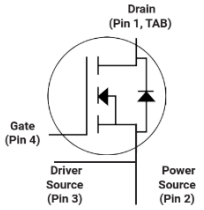
- High blocking voltage with low on-resistance
- High-speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery (Qrr)
- Easy to parallel
- RoHS compliant

Pin Description

TO-247-4



Symbol



Applications

- Switch Mode Power Supplies
- DC/DC converters
- Solar Inverters
- Battery Chargers
- Motor Drives

V_{DS}	650	V
$R_{DS(ON)-Typ}$	60	mΩ
I_D	56	A

Absolute Maximum Ratings (T_C=25℃, Unless Otherwise Noted)

Symbol	Parameter	Value	Unit
V_{DS}	Drain-Source Voltage	650	V
I_D	Continuous Drain Current	56	A
$I_{D,\ pulse}$	Pulse Drain Current Tested	112	A
V_{GSmax}	Maximum Gate Source Voltage	-10/+25	V
$V_{GS,op}$	Recommend Gate Source Voltage	-5/+20	V
P_D	Maximum Power Dissipation	259	W
T_J	Maximum Junction Temperature	-55 to 175	℃
T_{STG}	Storage Temperature Range	-55 to 175	℃

Thermal Characteristics

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance-Junction to Case	0.59	℃/W

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Electrical Characteristics (T_J=25℃, Unless Otherwise Noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Static Electrical Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS}=0V, I_D=100uA	650	---	---	V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=650V, V_{GS}=0V	---	10	100	uA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS} , I_D=5mA	2	3	4	V
I_{GSS}	Gate Leakage Current	V_{GS}=20V, V_{DS}=0V	---	---	250	uA
$R_{DS(ON)}$	Drain-Source On-state Resistance	V_{GS}=20V, I_D=13.2A	---	60	80	mΩ
		V_{GS}=18V, I_D=13.2A		80		mΩ
		V_{GS}=15V, I_D=13.2A		89		mΩ
Dynamic Characteristics⑤						
$R_{G(int)}$	Internal Gate Resistance	f=1MHz, V_{AC}=25 mV	---	2.8	---	Ω
C_{iss}	Input Capacitance	V_{DS}=600V, V_{GS}=0V, f=1MHz	---	1129	---	pF
C_{oss}	Output Capacitance		---	114	---	
C_{rss}	Reverse Transfer Capacitance		---	6.5	---	
E_{OSS}	C_{OSS} Stored Energy		---	25	---	μJ
$T_{d(on)}$	Turn-on Delay Time	V_{DS}=400V,V_{GS}=-5/+20V, I_D=13.2A,$R_{G(ext)}$=2.5Ω	---	21	---	nS
T_r	Turn-on Rise Time		---	14	---	
$T_{d(off)}$	Turn-off Delay Time		---	132	---	
T_f	Turn-off Fall Time		---	42	---	
Q_g	Total Gate Charge	V_{DS}=400V,V_{GS}=-5/+20V, I_D=13.2A	---	62	---	nC
Q_{gs}	Gate-Source Charge		---	18	---	
Q_{gd}	Gate-Drain Charge		---	33	---	
Source-Drain Characteristics						
I_S	Continuous Diode Froward Current	V_{GS} = 0V	---	56	---	A
V_{SD}	Diode Forward Voltage	I_S=6.6A, V_{GS}=0V	---	3	---	V
t_{rr}	Reverse Recovery Time	V_{DS}=400V,I_S=3.2A, V_{GS} = -5V dif/dt = 2100 A/μs	---	23	---	nS
Q_{rr}	Reverse Recovery Charge		---	132	---	nC
I_{rrm}	Peak reverse recovery current		---	13	---	A

Typical Performance Characteristics

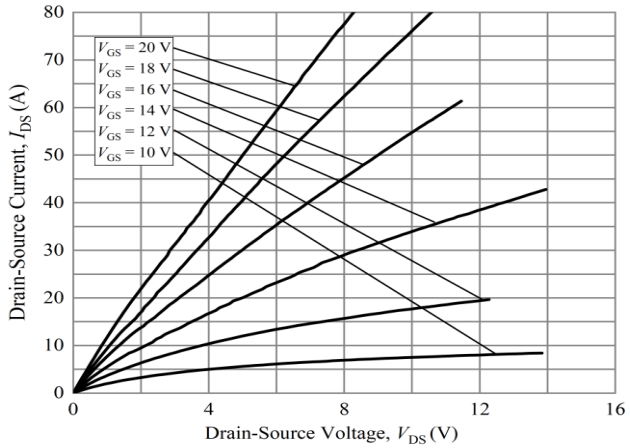


Figure 1: Typical Output Characteristics at T_J = -55 °C

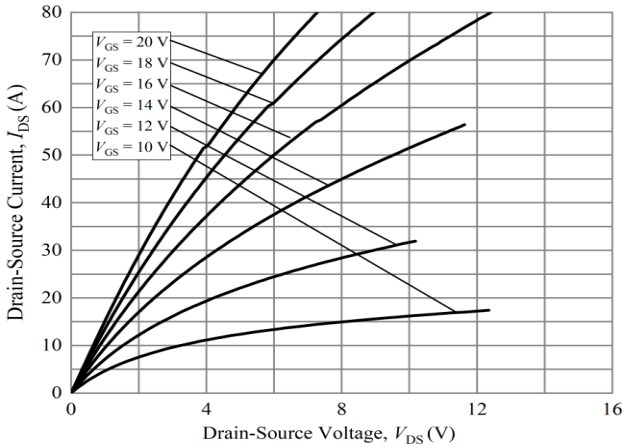


Figure 2: Typical Output Characteristics at T_J = 25 °C

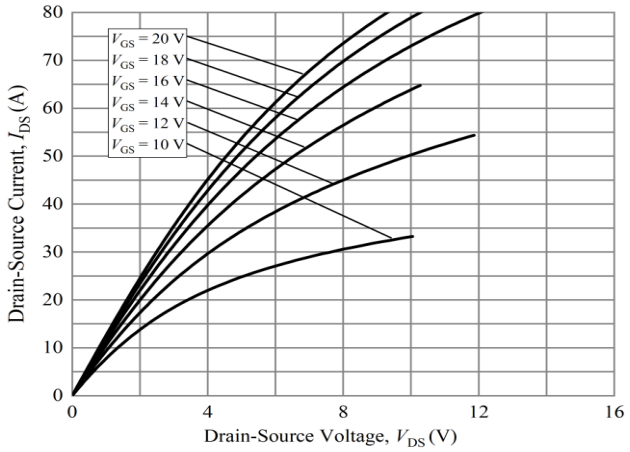


Figure 3: Typical Output Characteristics at T_J = 175 °C

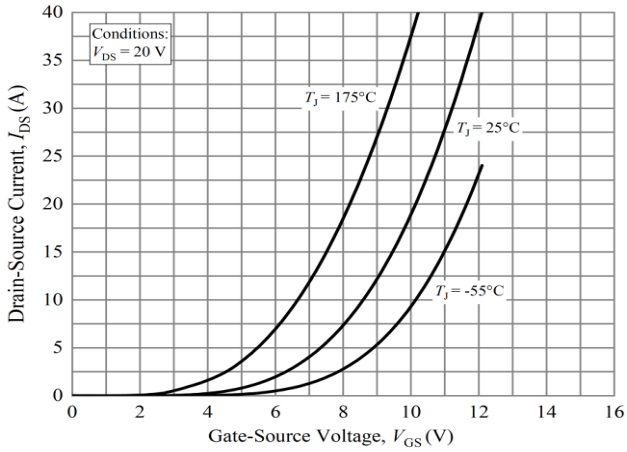


Figure 4: Typical Transfer Characteristics for Various Temperature

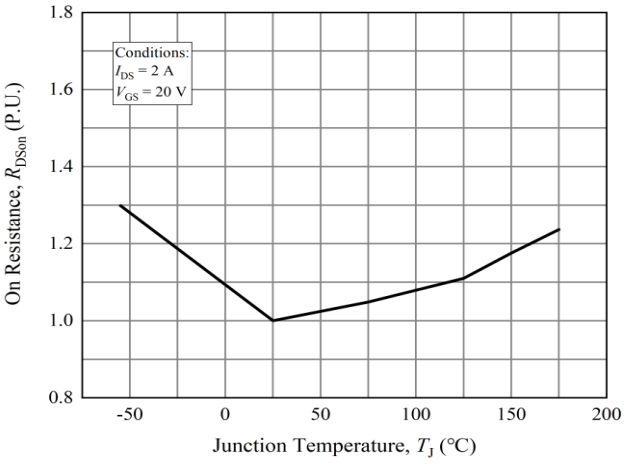


Figure 5: Normalized On-Resistance vs. Temperature

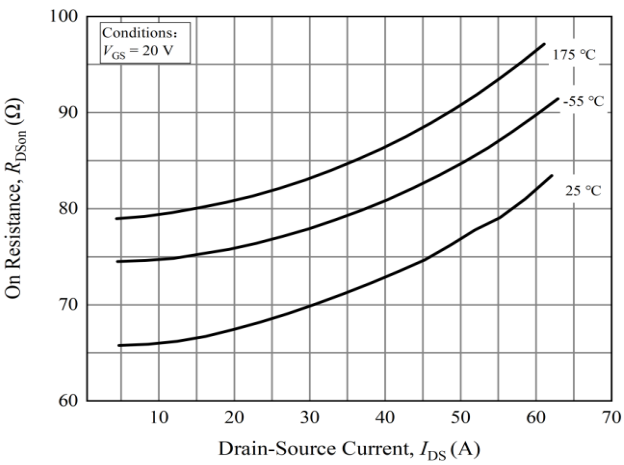


Figure 6: On-Resistance vs. Drain Current for Gate Various Temperatures

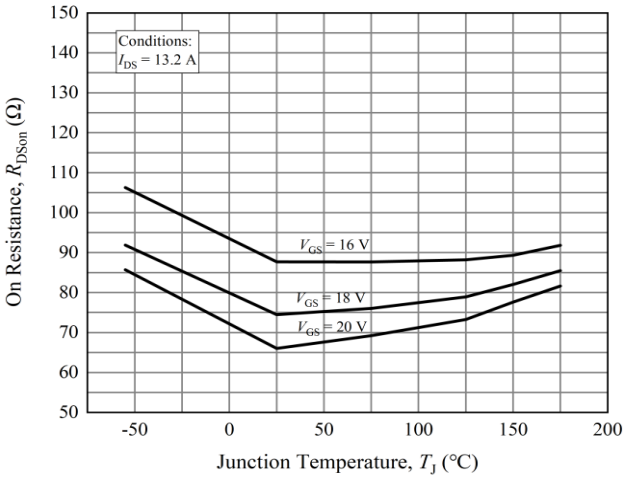


Figure 7: On-Resistance vs. Temperature for Gate Various Voltage

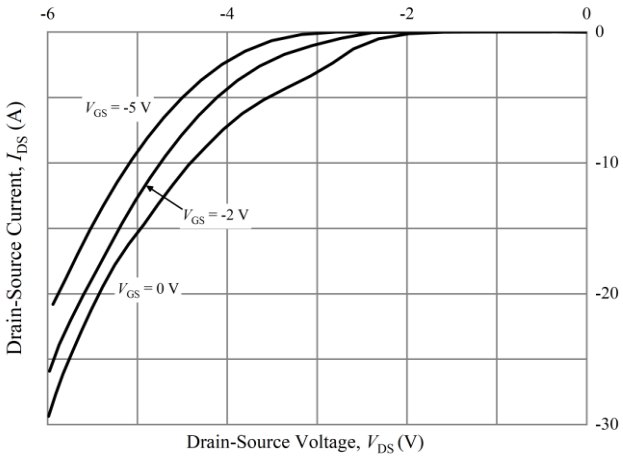


Figure 8: Typical Body Diode Characteristics at T_J = -55 °C

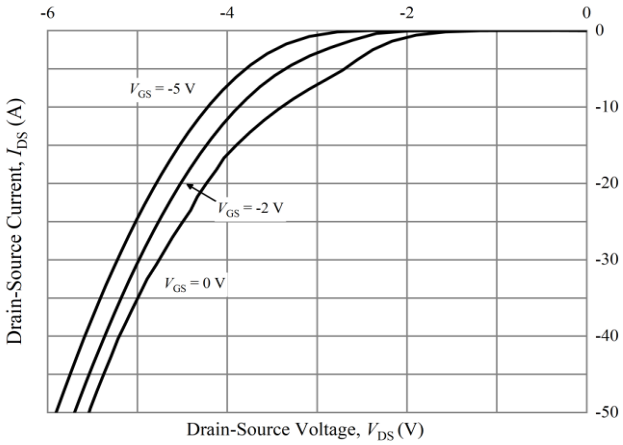


Figure 9: Typical Body Diode Characteristics at T_J = 25 °C

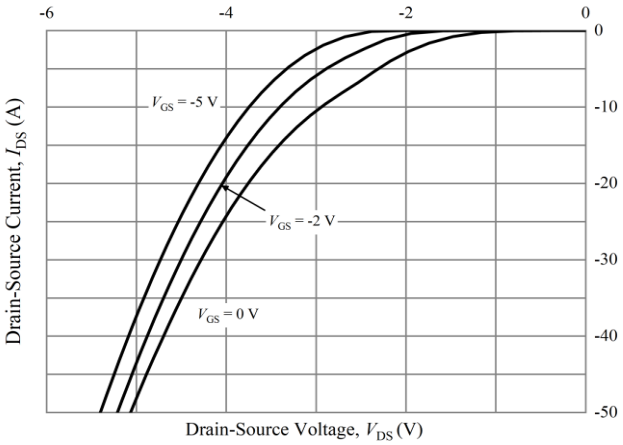


Figure 10: Typical Body Diode Characteristics at T_J = 175 ℃

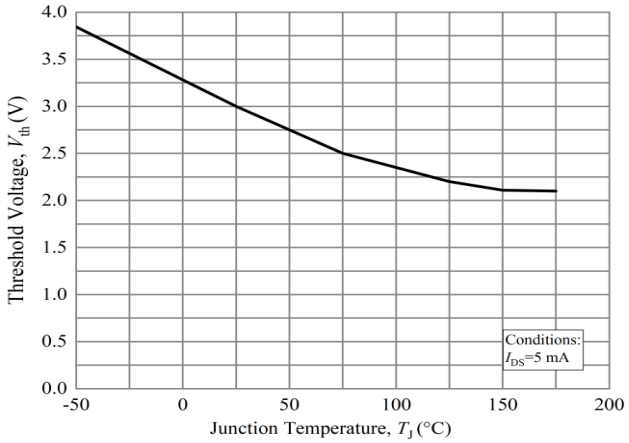


Figure 11: Typical Threshold Voltage vs. Temperature

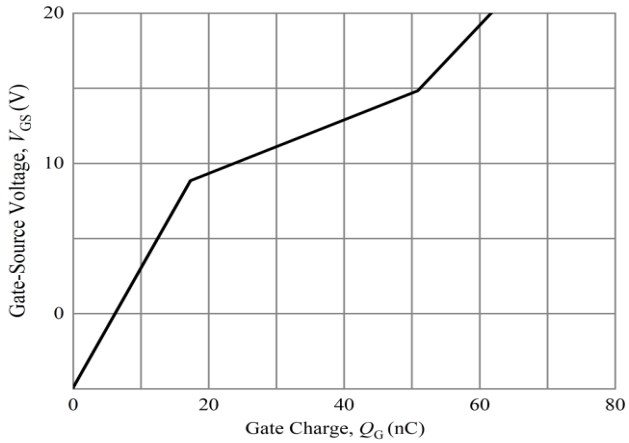


Figure 12: Typical Gate Charge Characteristics at T_J = 25 °C

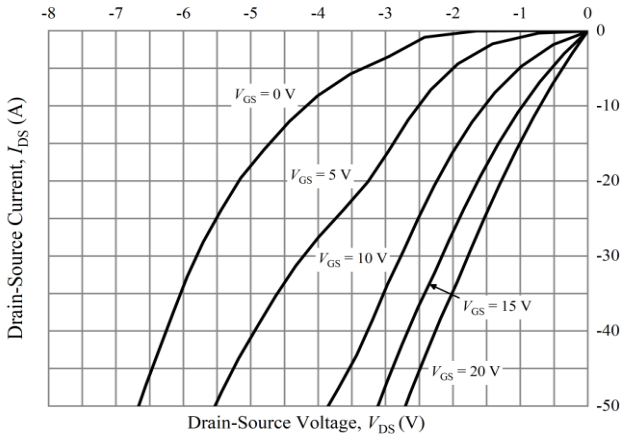


Figure 13: Typical 3rd Quadrant Characteristics T_J = -55 °C

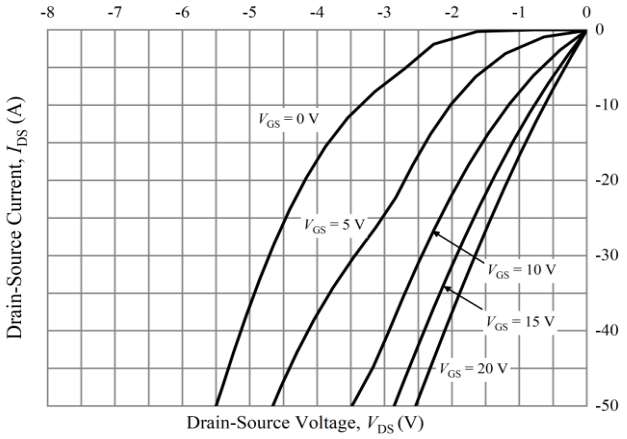


Figure 14: Typical 3rd Quadrant Characteristics at T_J = 25 °C

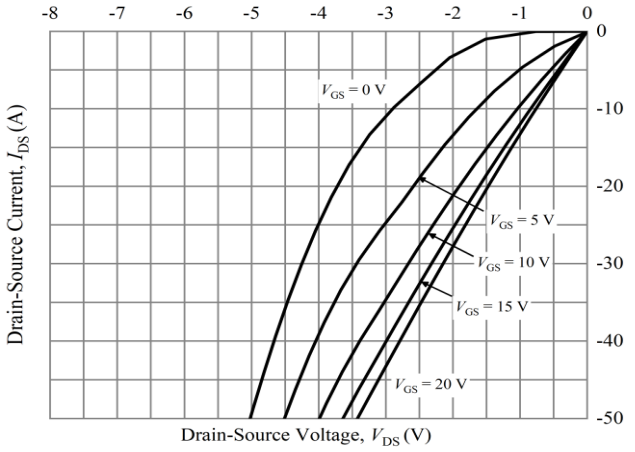


Figure 15: Typical 3rd Quadrant Characteristics at T_J = 175 °C

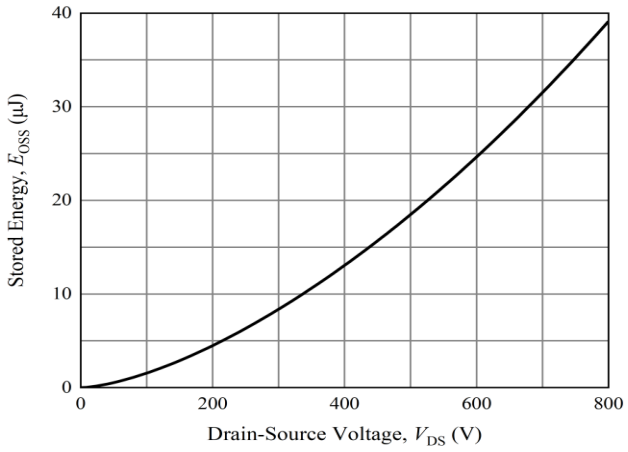


Figure 16: Typical Output Capacitor Stored Energy

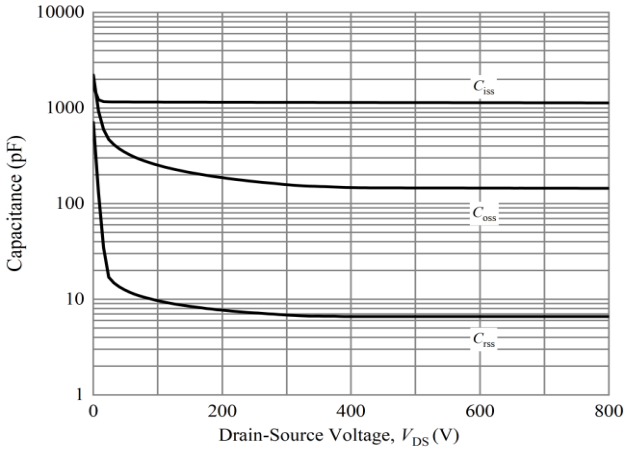


Figure 17: Typical Capacitances vs. Drain-Source Voltage

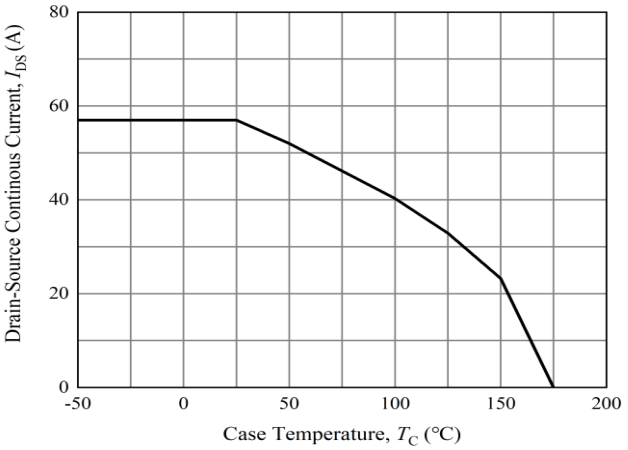


Figure 18: Continuous I_{DS} Current Derating Curve

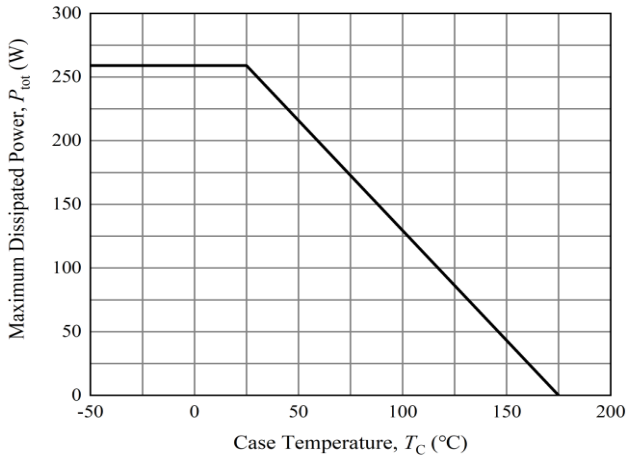


Figure 19: Power Dissipation Derating Curve

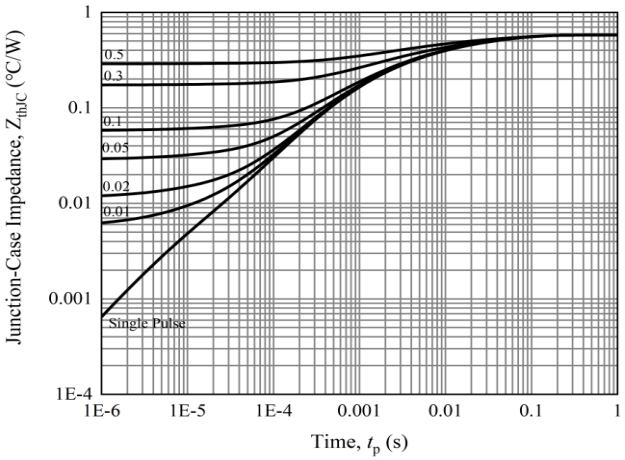


Figure 20: Typical Transient Thermal Impedance (Junction – Case) with Duty Cycle

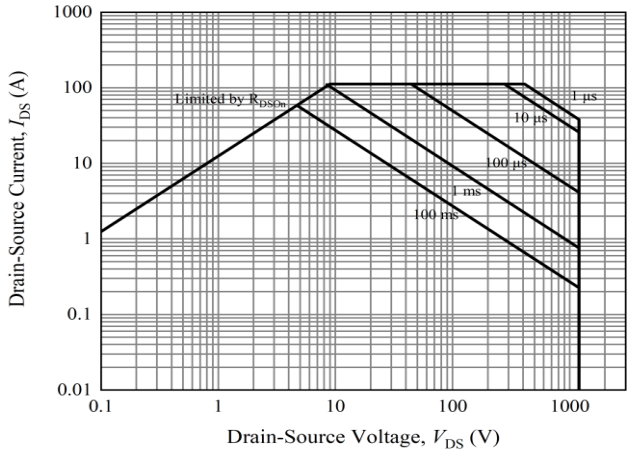


Figure 21: Safe Operate Area

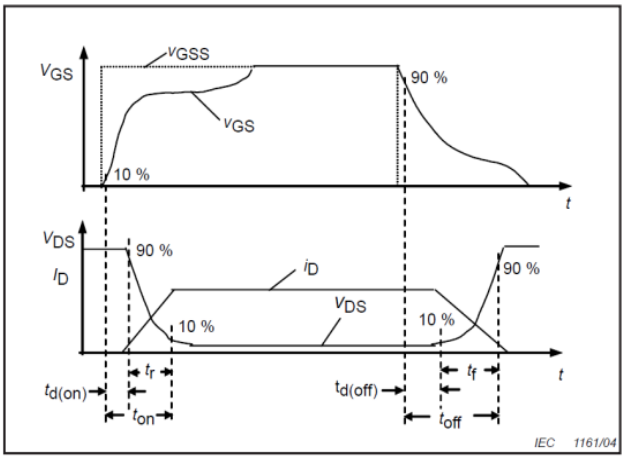
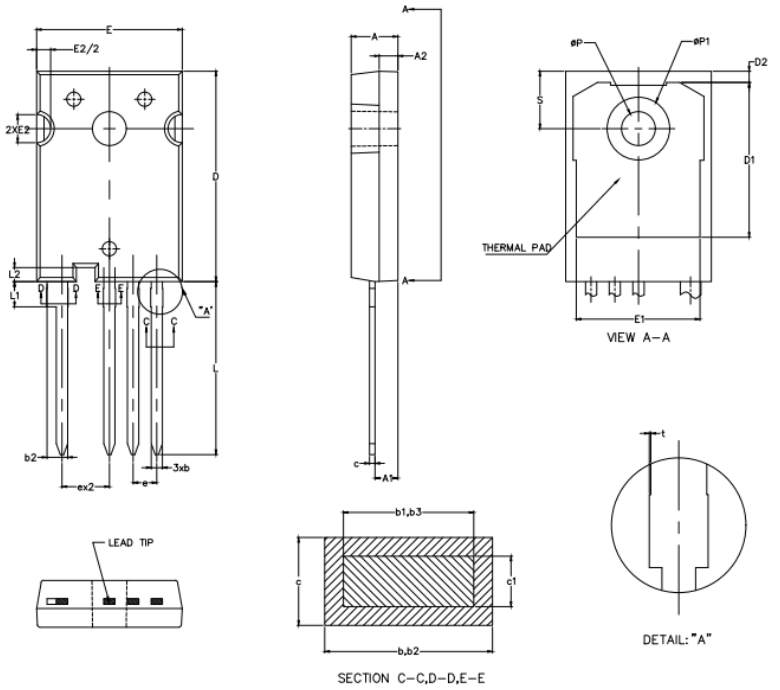


Figure 22: Resistive Switching Time Description

650V N-Channel Silicon Carbide Power MOSFET

Package：TO-247-4



SYMBOLS	DIMENSIONS			
	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A	4.90	5.10	0.193	0.201
A1	2.31	2.51	0.091	0.099
A2	1.90	2.10	0.075	0.083
b	1.16	1.26	0.046	0.050
b1	1.15	1.22	0.045	0.048
b2	2.16	2.26	0.085	0.089
b3	2.15	2.22	0.085	0.087
c	0.59	0.66	0.023	0.026
c1	0.58	0.62	0.023	0.024
D	22.40	22.60	0.882	0.890
D1	16.25	16.85	0.640	0.663
D2	1.05	1.35	0.041	0.053
E	15.75	15.90	0.620	0.626
E1	13.26	——	0.552	——
E2	2.90	3.10	0.114	0.122
e	2.54BSC		0.1BSC	
L	18.30	18.60	0.720	0.732
L1	——	2.80	——	0.110
L2	——	1.50	——	0.059
øP	3.50	3.70	0.138	0.146
øP1	——	7.40	——	0.291
S	6.05	6.25	0.238	0.246
t	0.00	0.15	0.000	0.006