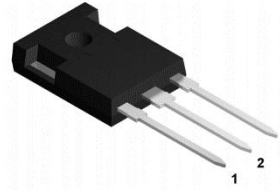


$V_{DS} = 1200\text{ V}$

$I_D(T_C=25^\circ\text{C}) = 59\text{ A}$

$R_{DS(on),typ} = 40\text{ m}\Omega @ V_{GS}=20\text{ V}$



TO-247-3

Features

- Wide bandgap SiC MOSFET technology
- Low On-Resistance with High Blocking Voltage
- Low Capacitances with High-Speed switching
- Low reverse recovery(Qrr)
- Halogen free, RoHs compliant

Benefits

- Reduce switching losses
- Increased system Switching Frequency
- Increased power density
- Reduction of heat sink requirements

Applications

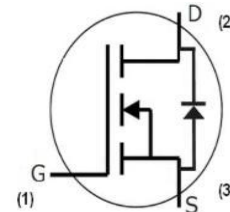
- Switch mode power supplies
- Renewable energy
- Motor drives
- High voltage DC/DC converters

Package Pin Definitions

- Pin1- Drain
- Pin2- Power Source
- Pin3- Kelvin Source
- Pin4- Gate

Package Parameters

Part Number	Marking	Package
SMC40N120T3BS	SMC40N120T3BS	TO-247-3



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

Symbol	Parameter	Test conditions	Value	Unit	Note
V_{DSmax}	Drain-Source Voltage	$V_{GS} = 0V, I_D = 100\mu A$	1200	V	
V_{GSmax}	Gate-Source voltage	AC ($f > 1\text{ Hz}$)	-10/+25	V	
V_{GSop}	Recommend Gate-Source Voltage	Static	-5/+20	V	
I_D	Continuous Drain current	$V_{GS} = 20V, T_C = 25^\circ\text{C}$	59	A	Fig. 14
		$V_{GS} = 20V, T_C = 100^\circ\text{C}$	42		
$I_{D,pulse}$	Pulsed Drain Current	Pulse with t_p limited by T_{jmax}	160	A	Fig. 18
P_D	Power Dissipation	$T_C = 25^\circ\text{C}, T_j = 175^\circ\text{C}$	300	W	Fig. 16
T_j	Operating junction temperature		-55~150	$^\circ\text{C}$	
T_{stg}	Storage temperature		-55~150	$^\circ\text{C}$	
	TO-247 mounting torque	M3 Screw	0.7	Nm	

Electrical Characteristics $T_j=25^\circ\text{C}$ unless otherwise specified

Static Characteristics

Symbol	Parameter	Test conditions	Value			Unit	Note
			Min.	Typ.	Max.		
$V_{(BR)DSS}$	Drain-Source Breakdown voltage	$V_{GS} = 0V, I_D = 100\mu A$	1200			V	
$V_{GS(th)}$	Gate Threshold voltage	$V_{GS} = V_{DS}, I_D = 9.5\text{mA}$		2.6		V	Fig. 9
		$V_{GS} = V_{DS}, I_D = 9.5\text{mA}, T_j = 175^\circ\text{C}$		1.5			
I_{GSS}	Gate-Source Leakage current	$V_{GS} = 20V, V_{DS} = 0V$			250	nA	
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 1200V, V_{GS} = 0V, T_j = 25^\circ\text{C}$		1	100	μA	
$R_{DS(on)}$	Drain-Source On-state Resistance	$V_{GS} = 20V, I_D = 40A$		42	65	m Ω	Fig. 3, 4, 5
		$V_{GS} = 20V, I_D = 40A, T_j = 175^\circ\text{C}$		90			
g_{fs}	Transconductance	$V_{GS} = 20V, I_D = 40A$		15		S	Fig. 6
		$V_{GS} = 20V, I_D = 40A, T_j = 175^\circ\text{C}$		11			

Thermal Characteristics

Symbol	Parameter	Value			Unit	Note
		Min.	Typ.	Max.	Max.	
$R_{th(jc)}$	Thermal resistance from Junction to Case		0.5		K/W	Fig. 15
$R_{th(ja)}$	Thermal resistance from Junction to Ambient		40		K/W	

Gate Charge Characteristics

Symbol	Parameter	Test conditions	Value			Unit	Note
			Min.	Typ.	Max.		
Q_{GS}	Gate to Source Charge	$V_{DS} = 800V$ $I_D = 40A$ $V_{GS} = -5V/20V$		24		nC	Fig. 10
Q_{GD}	Gate to Drain Charge			51			
Q_G	Total Gate Charge			97			

AC Characteristics ($T_j=25^\circ C$ unless otherwise specified)

Symbol	Parameter	Test conditions	Value			Unit	Note
			Min.	Typ.	Max.		
C_{iss}	Input Capacitance	$V_{GS} = 0V, V_{DS} = 1000V$ $f = 1 MHz$ $V_{AC} = 25 mV$		2229		pF	Fig. 13
C_{oss}	Output Capacitance			110		pF	
C_{rss}	Reverse Transfer Capacitance			3.6		pF	
$R_{G(int)}$	Internal Gate Resistance	$f=1 MHz, V_{AC} = 25mV$		1.4		Ω	

Switching Characteristics

Symbol	Parameter	Test conditions	Value			Unit	Note	
			Min.	Typ.	Max.			
$t_{d(on)}$	Turn-On Delay Time	$V_{DS} = 800V, V_{GS} = -5V/20V$ $I_D = 40A, R_{G(int)} = 2.2 \Omega$ $L = 100 \mu H$ Inductive load		32		nS	Fig. 22	
t_r	Rise Time			124.5		nS		
$t_{d(off)}$	Turn-Off Delay Time			50		nS		
t_f	Fall Time			32		nS		
E_{on}	Turn-On Energy				3.8		mJ	Fig. 21
E_{off}	Turn-Off Energy				3.1		mJ	

Reverse Diode Characteristics ($T_j=25^\circ C$ unless otherwise specified)

Symbol	Parameter	Test conditions	Value			Unit	Note	
			Min.	Typ.	Max.			
V_{SD}	Diode Forward Voltage	$V_{GS} = -4V, I_{SD} = 20A$		4.0		V	Fig. 7, 8	
		$V_{GS} = -4V, I_{SD} = 20A, T_j = 175^\circ C$		3.5				
I_s	Continuous Diode Forward Current	$T_C = 25^\circ C$		65		A		
$I_{s, pulse}$	Diode Pulse Current	$V_{GS} = -4V$ Pulse width t_p limited by T_{jmax}		160		A		
t_{rr}	Reverse Recovery Time	$V_{GS} = -4V, I_{SD} = 40A, T_j = 25^\circ C$ $VR = 800V$ $Dif/dt = 1000 A/us$		90		nS		
Q_{rr}	Reverse Recovery Charge				432		nC	
I_{rrm}	Peak Reverse Recovery Current				30		A	

Typical Performance

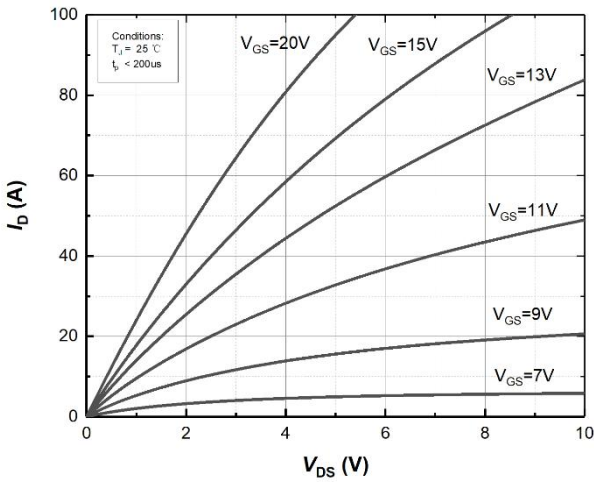


Figure 1. Output characteristics at $T_j=25^\circ\text{C}$

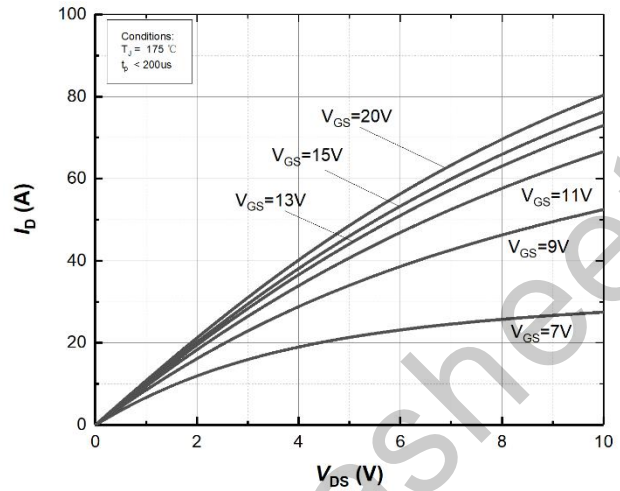


Figure 2. Output characteristics at $T_j=175^\circ\text{C}$

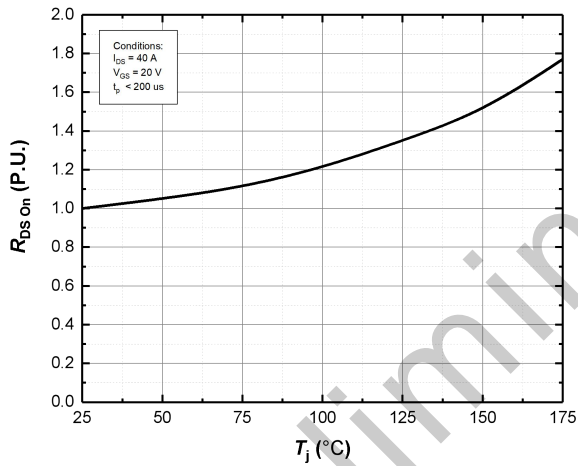


Figure 3. Normalized On-Resistance vs. Temperature

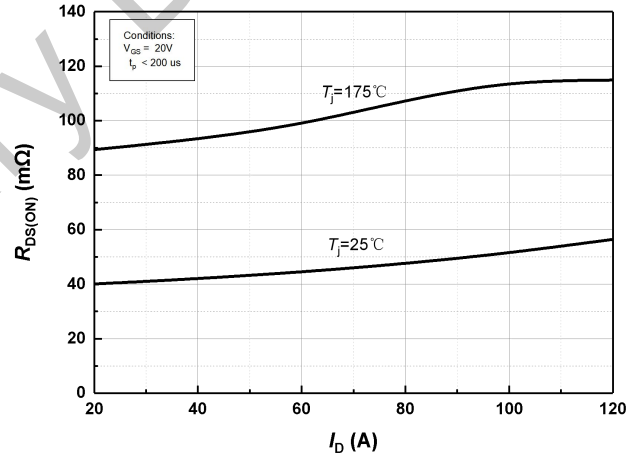


Figure 4. On-Resistance vs. Drain current for Various Temperature

Typical Performance

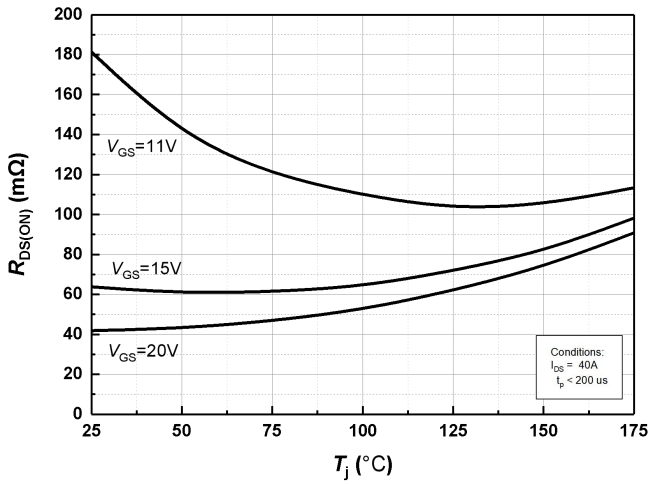


Figure 5. On-Resistance vs. Temperature for Various Gate Voltage

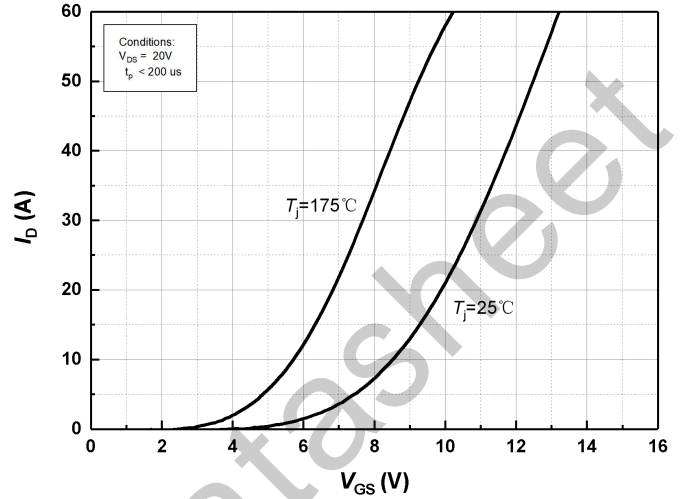


Figure 6. Transfer Characteristics for Various Junction Temperatures

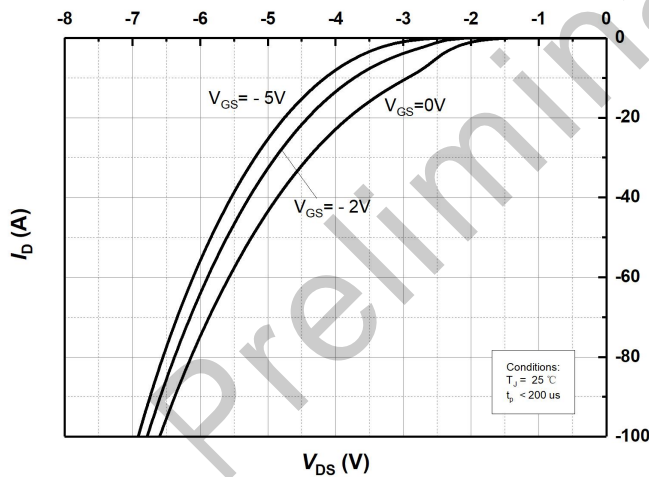


Figure 7. Body Diode Characteristics at Tj=25°C

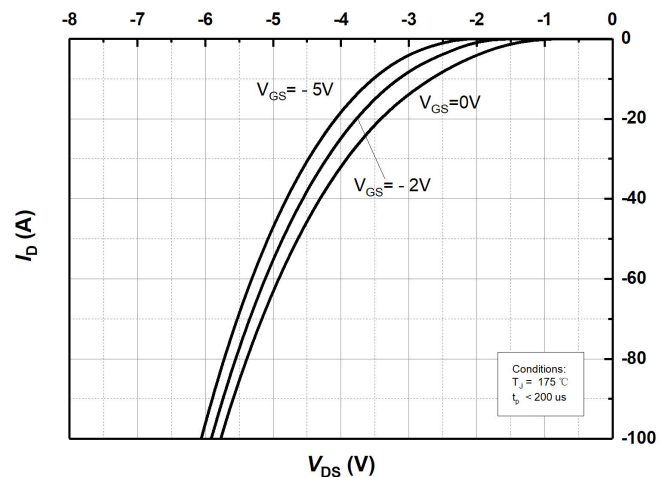


Figure 8. Body Diode Characteristics at Tj=175°C

Typical Performance

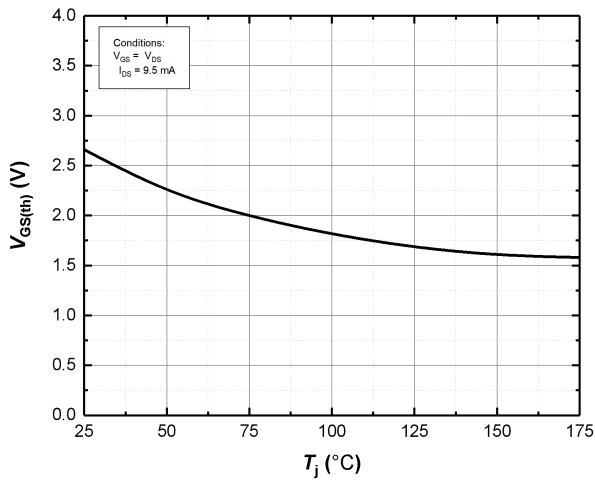


Figure 9. Threshold Voltage vs. Temperature

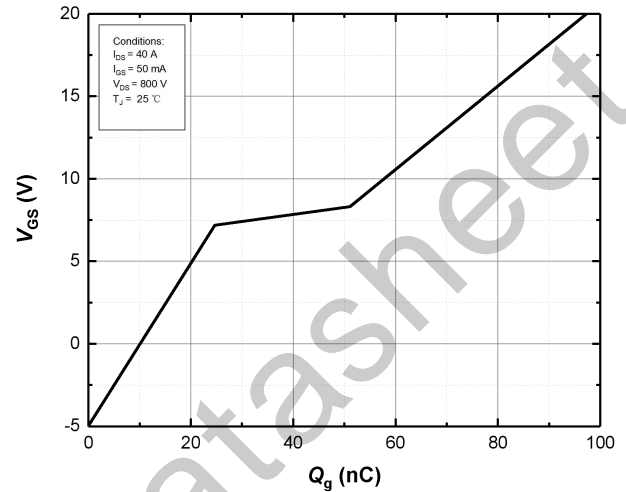


Figure 10 Gate Charge Characteristics

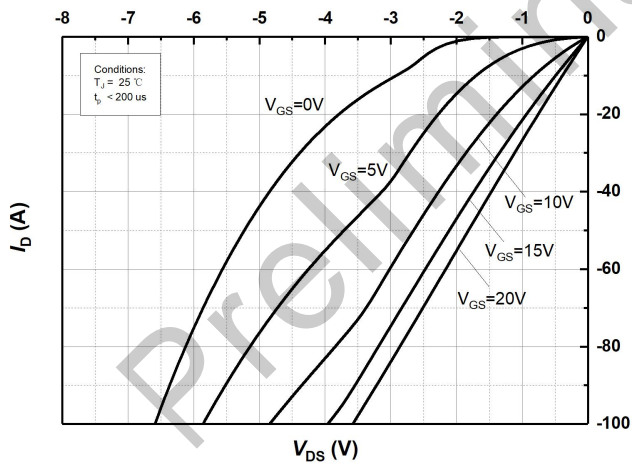


Figure 11. 3rd Quadrant Characteristic at T_j=25°C

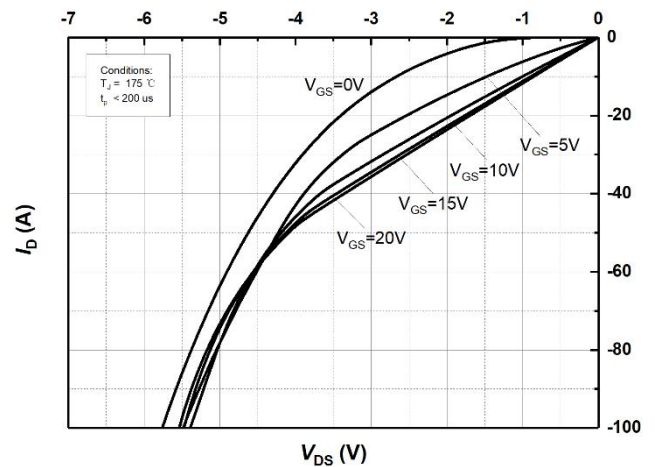


Figure 12. 3rd Quadrant Characteristic at T_j=175°C

Typical Performance

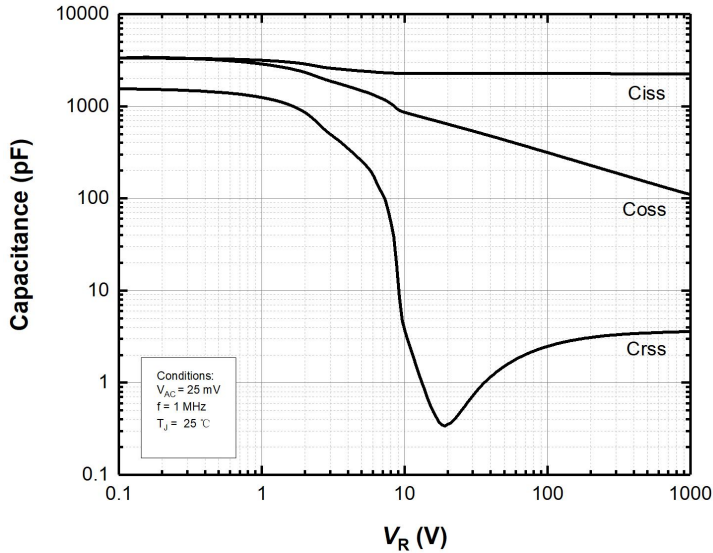


Figure 13. Capacitances vs. Drain-Source Voltage (0 – 1000V)

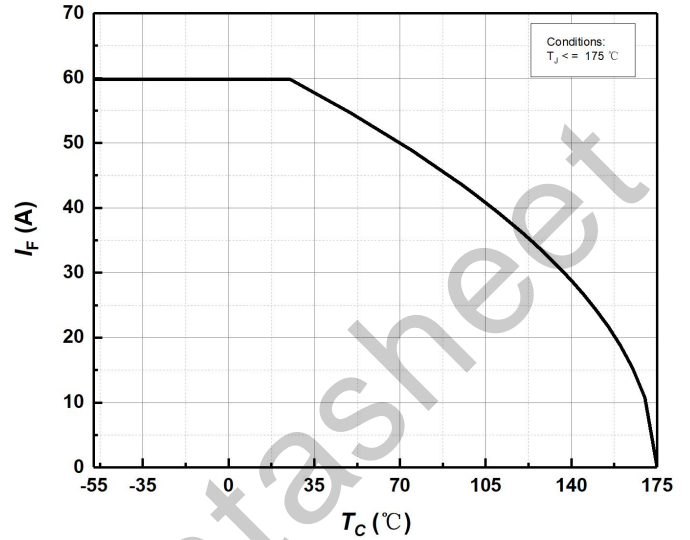


Figure 14. Continuous Drain Current Derating vs Case Temperature

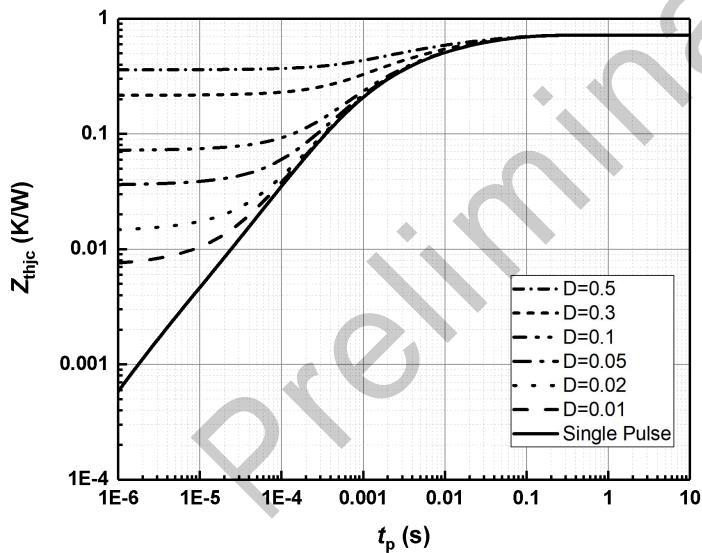


Figure 15. Transient Thermal Impedance (Junction – Case)

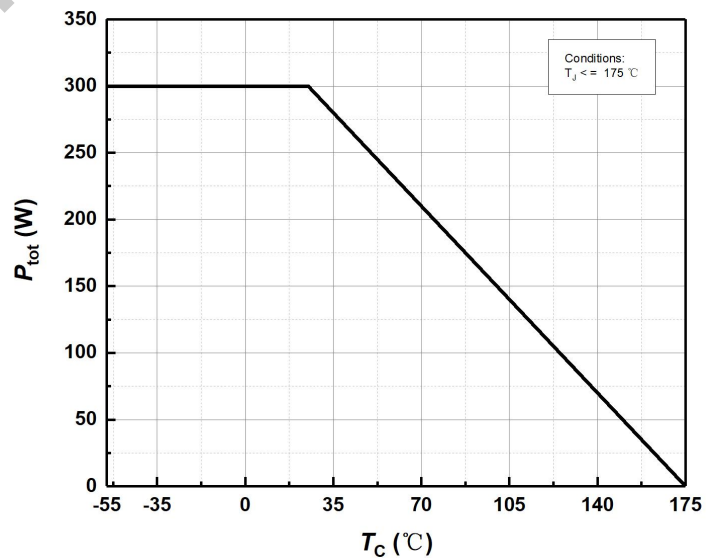


Figure 16. Maximum Power Dissipation Derating vs. Case Temperature

Typical Performance

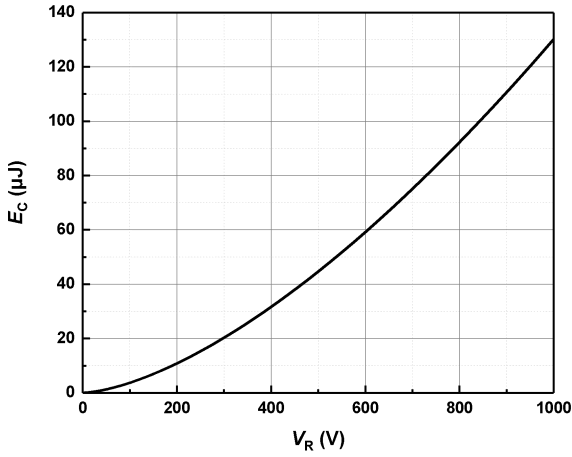


Figure 17. Output Capacitor Stored Energy

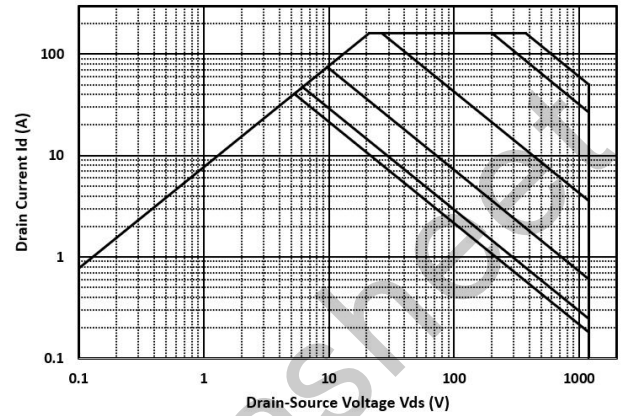


Figure 18. Safe Operating Area

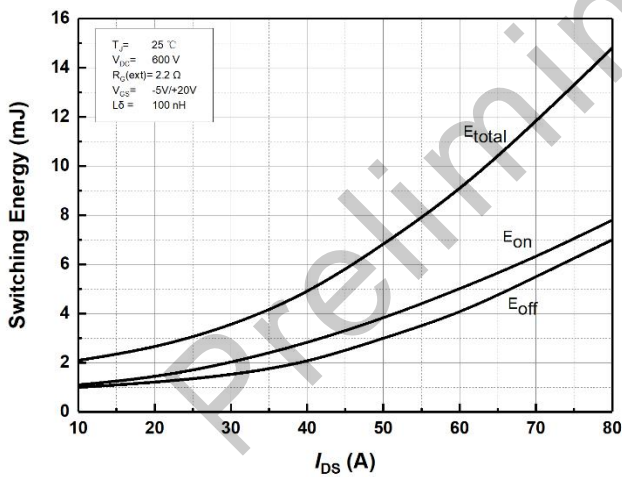


Figure 19. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 600V$)

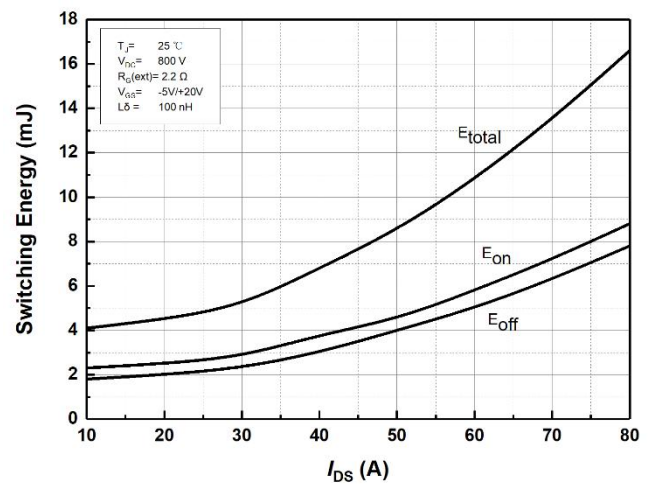


Figure 20. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 800V$)

Typical Performance

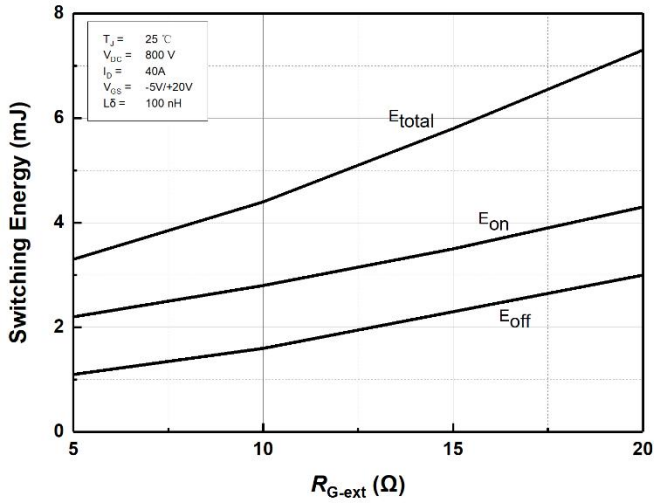


Figure 21. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

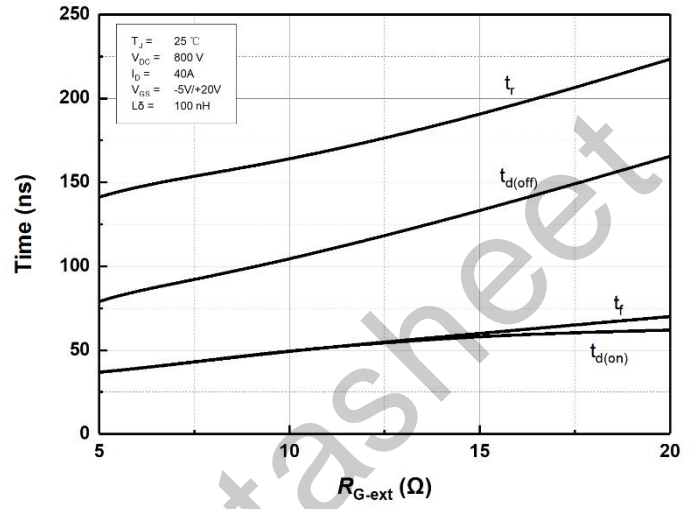
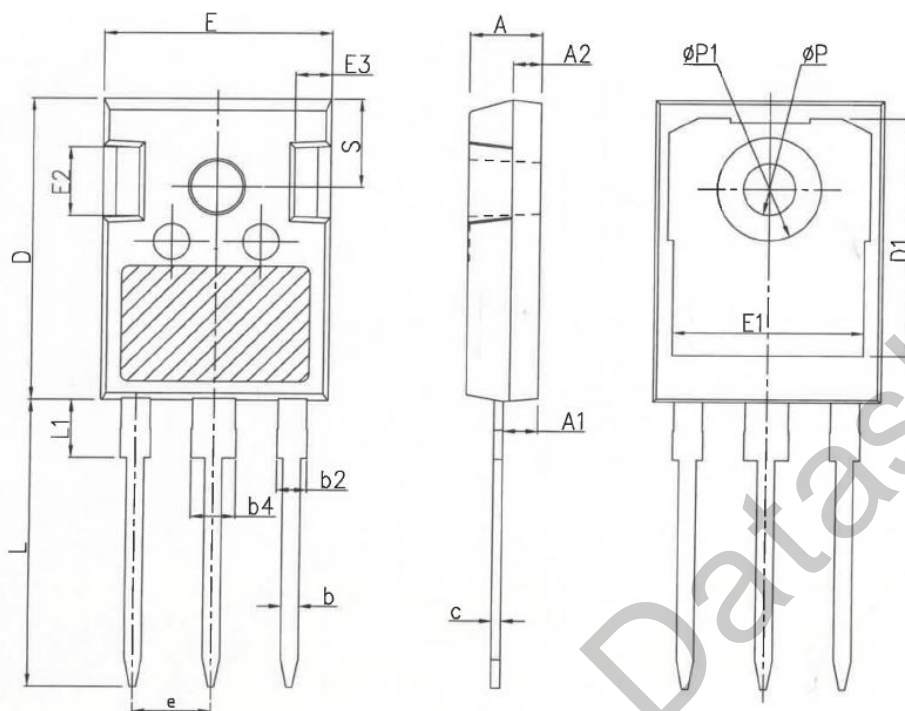


Figure 22. Switching Times vs. $R_{G(ext)}$

Preliminary Datasheet

Package Dimensions



SYMBOL	MM		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.59
A2	1.85	2.00	2.15
b	1.11	1.21	1.36
b2	1.91	2.01	2.21
b4	2.91	3.01	3.21
c	0.51	0.61	0.75
D	20.70	21.00	21.30
D1	16.25	16.55	16.85
E	15.50	15.80	16.10
E1	13.00	13.30	13.60
E2	4.80	5.00	5.20
E3	2.30	2.50	2.70
e	5.44BSC		
L	19.62	19.92	20.22
L1	NA	NA	4.30
ϕP	3.40	3.60	3.80
$\phi P1$	NA	NA	7.30
S	6.15BSC		

Revision History

Document Version	Date of Release	Description of Changes
Rev 0.0	2022-11-03	Target of the datasheet.

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