

S1P14R120SSE-A(Preliminary)

1200V / 14mΩ SiC Power MOSFET Module

Features

- High speed switching
- Very low switching losses
- High blocking voltage with low on-resistance
- Temperature independent turn-off switching losses
- Ultra-low thermal resistance
- Isolated back-side

Applications

- Solar power optimizer
- UPS system
- Motor drives
- High power converters
- Photovoltaics, wind power generation
- Induction heating equipment
- Smart grid transmission and distribution

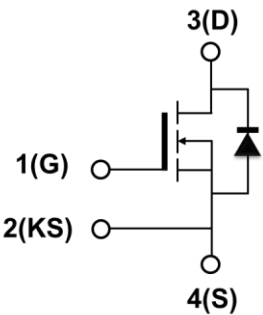


Table 1 Key performance and package parameters

Type	V _{DS}	I _{DS} (T _C = 25°C, R _{th(j-c,max)})	R _{DS(ON)} , typ (V _{GS} = 18V, I _D = 100A, T _J = 25°C)	T _{j,max}	Marking	Package
S1P14R120SSE-A	1200 V	125A	14 mΩ	175°C	S1P14R120SSE-A	SOT227

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1、Maximum ratings

Table 2 Maximum rating ($T_c = 25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
$V_{DS,max}$	Drain source voltage	1200	V	$V_{GS} = 0V, I_D = 100 \mu A$	
$V_{GS,max}$	Gate source voltage	-8 /+22	V	Absolute maximum values	
V_{GSop}	Gate source voltage	-4 /+18	V	Recommended operational values	
I_D	Continuous drain current	125	A	$V_{GS} = 18V, T_C = 25^{\circ}\text{C}$	Fig.19
		88		$V_{GS} = 18V, T_C = 100^{\circ}\text{C}$	
$I_{D(pulse)}$	Pulsed drain current	240	A	Pulse width t_p limited by $T_{j,max}$	Fig.22
P_D	Power dissipation	375	W	$T_C = 25^{\circ}\text{C}, T_J = 175^{\circ}\text{C}$	Fig.20
T_J, T_{stg}	Operating Junction and storage temperature	-55 to +175	$^{\circ}\text{C}$		

2、 Thermal / Packaging Characteristics

Table 3 Package Characteristics

Symbol	Description	Min.	Typ.	Max.	Unit	Note
R_{th-JC}	Thermal Resistance, Junction to Case	-	0.4	-	°C/W	
V_{ISO}	Isolation Test Voltage RMS, f=50Hz, t=1min	2.5	-	-	kV	
Creepage	Terminal to Heatsink Creepage Distance	-	8.5	-	mm	
	Terminal to Terminal Creepage Distance	-	10.5	-	mm	
Clearance	Terminal to Heatsink Clearance	-	6.8	-	mm	
	Terminal to Terminal Clearance	-	4.4	-	mm	
T_{jmax}	Maximum Junction Temperature	-	175	-	°C	
T_{jop}	Operation Junction Temperature	-	-55 to +175	-	°C	
T_{STG}	Storage Temperature Range	-	-55 to +175	-	°C	
W	Weight	-	28.5	-	g	
T_M	Screws to Heatsink Mounting Torque	-	-	1.5	N·m	
T_C	Terminal Connection Torque (M4 *8mm)	-	-	1.3	N·m	

¹ Not subject to production test. Parameter verified by design/characterization.

3、Electrical characteristics

3.1 Static characteristics

Table 4 Static characteristics (Tc = 25°C unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$V_{(BR)DSS}$	Drain-source breakdown voltage	1200	-	-	V	$V_{GS} = 0V, I_D = 100\mu A$	
$V_{GS(th)}$	Gate threshold voltage	2.3	2.8	4	V	$V_{DS} = V_{GS}, I_D = 28mA$	Fig.11
		-	2.0	-	V	$V_{DS} = V_{GS}, I_D = 28mA, T_J = 175^\circ C$	
I_{DSS}	Zero gate voltage drain current	-	1	10	μA	$V_{DS} = 1200V, V_{GS} = 0V$	
I_{GSS}	Gate source leakage current	-	-	100	nA	$V_{GS} = 18V, V_{DS} = 0V$	
$R_{DS(on)}$	Current drain-source on-state resistance	-	17	21	m Ω	$V_{GS} = 15V, I_D = 100A$	Fig.4,5,6
		-	28	-		$V_{GS} = 15V, I_D = 100A, T_J = 175^\circ C$	
		-	14	18		$V_{GS} = 18V, I_D = 100A$	
		-	24	-		$V_{GS} = 18V, I_D = 100A, T_J = 175^\circ C$	
g_{fs}	Transconductance	-	72	-	S	$V_{DS} = 20V, I_D = 100A$	Fig.7
		-	57	-		$V_{DS} = 20V, I_D = 100A, T_J = 175^\circ C$	
$R_{g,int}$	Internal gate resistance	-	0.9	-	Ω	$V_{AC} = 25mV, f = 1MHz, \text{open drain}$	

3.2 Dynamic characteristics

Table 5 Dynamic characteristics (Tc = 25°C unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
C_{iss}	Input capacitance	-	5521	-	pF	$V_{DS} = 1000V, V_{GS} = 0V$ $T_J = 25^\circ C, V_{AC} = 25mV$ $f = 100KHz$	Fig.17, 18
C_{oss}	Output capacitance	-	247	-			
C_{rss}	Reverse capacitance	-	22	-			
E_{oss}	Coss stored energy	-	154	-	μJ		Fig.16

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Q_{gs}	Gate source charge	-	54	-	nC	$V_{DS} = 800V, V_{GS} = -4/+18V$ $I_D = 100A$	Fig.12
Q_{gd}	Gate drain charge	-	45	-			
Q_g	Gate charge	-	230	-			

3.3 Switching characteristics

Table 6 Dynamic characteristics($T_c = 25^\circ C$ unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
E _{on}	Turn on switching energy	-	812	-	μJ	V _{DS} = 800V, V _{GS} = -4/+18V I _D = 100A, R _g = 2.5Ω, L = 16.7μH	
E _{off}	Turn off switching energy	-	383	-			
t _{d (on)}	Turn on delay time	-	19	-	ns		
t _r	Rise time	-	29	-			
t _{d (off)}	Turn off delay time	-	42	-			
t _f	Fall time	-	9.3	-			

Table 7 Body diode characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
V_{SD}	Diode forward voltage	-	3.8	-	V	$V_{GS} = -4V, I_{SD} = 50A$	Fig.8,9,10
		-	3.6	-	V	$V_{GS} = -4V, I_{SD} = 50A$ $T_J = 175^\circ C$	
I_S	Continuous diode forward current	-	90	-	A	$V_{GS} = -4V, T_c = 25^\circ C$	
t_{rr}	Reverse recovery time	-	66	-	ns	$V_R = 800V, V_{GS} = -4V$ $I_D = 100A$ $T_J = 175^\circ C$	
Q_{rr}	Reverse recovery charge	-	1830	-	nC		
I_{rrm}	Peak reverse recovery current	-	52	-	A		

Note : When using SiC Body Diode the maximum recommended $V_{GS} = -4V$

4、Electrical characteristic diagrams

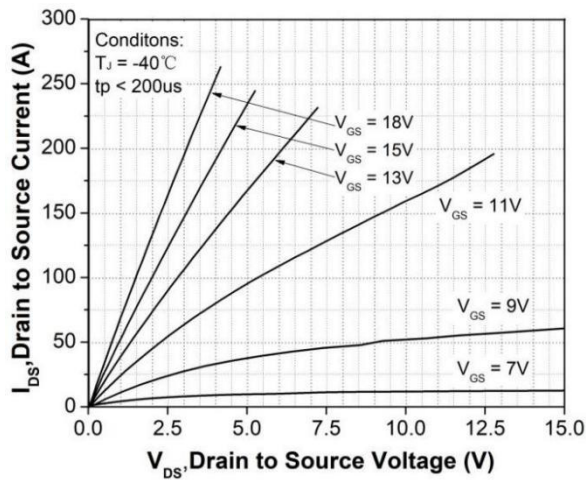


Figure 1. Output characteristics $T_J = -40\text{ }^{\circ}\text{C}$

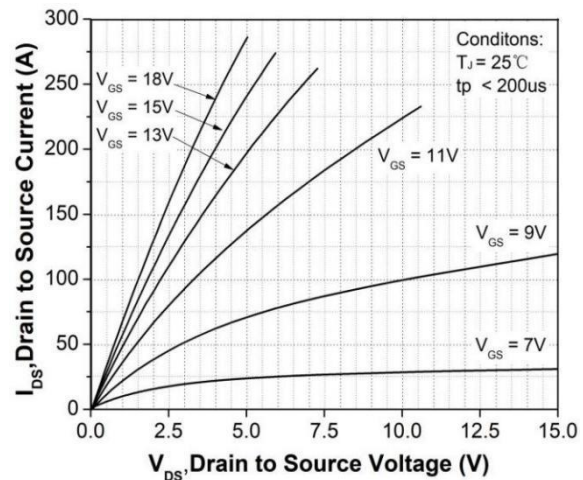


Figure 2. Output characteristics $T_J = 25\text{ }^{\circ}\text{C}$

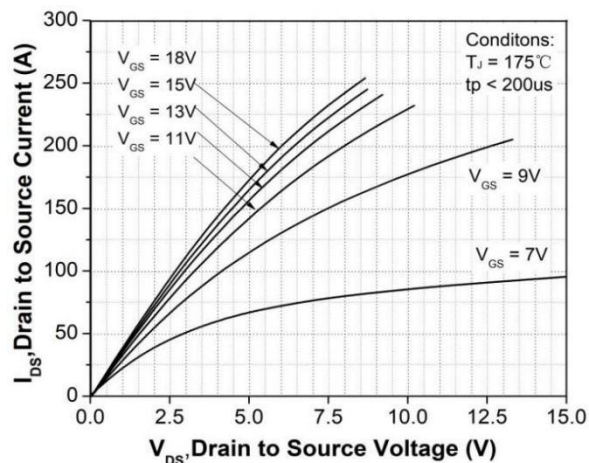


Figure 3. Output characteristics $T_J = 175\text{ }^{\circ}\text{C}$

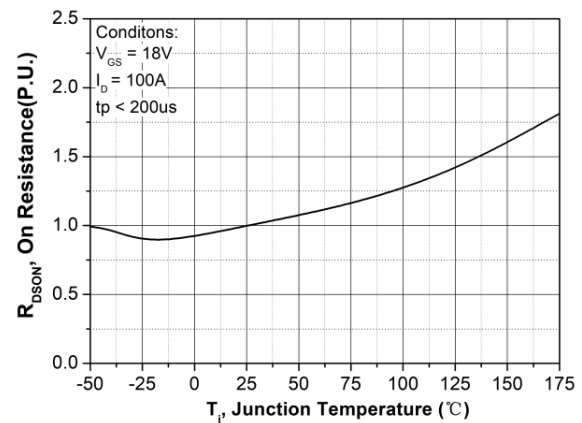


Figure 4. Normalized on-resistance vs. temperature

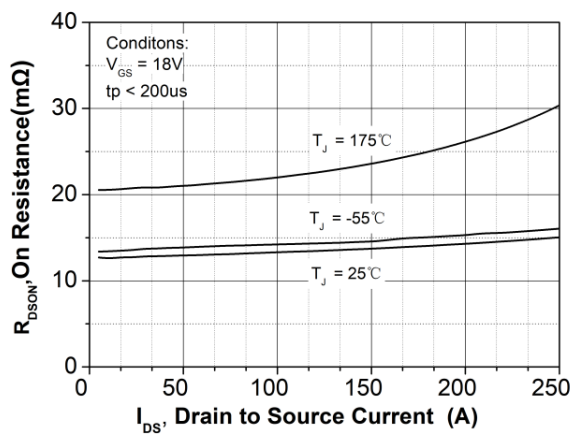


Figure 5. On-resistance vs. drain current

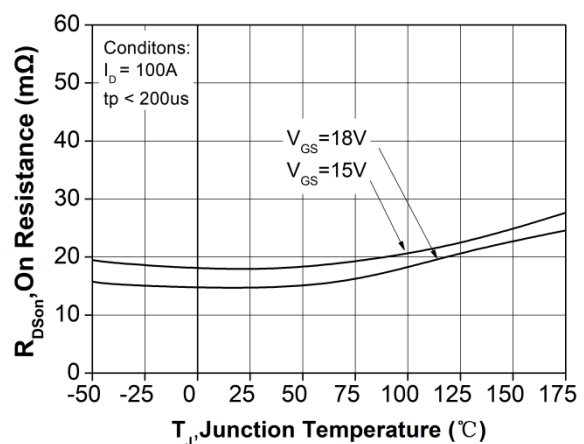


Figure 6. On-resistance vs. temperature

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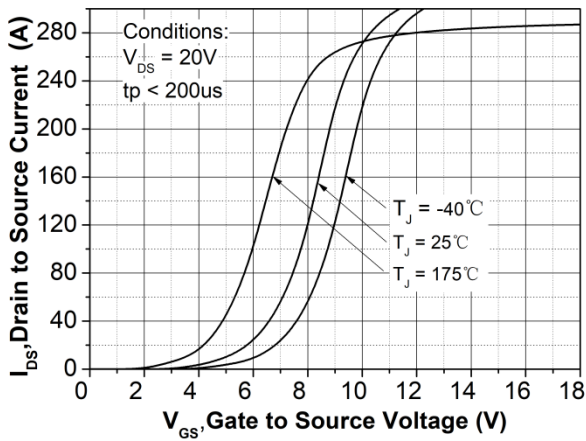


Figure 7. Transfer characteristic for various junction temperatures

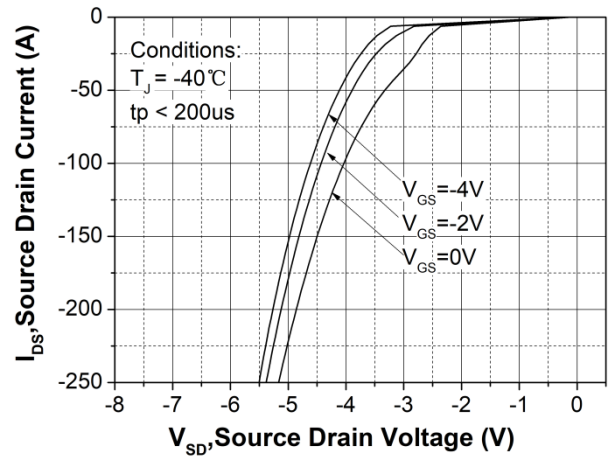


Figure 8. Body diode characteristic at $T_J = -40\text{ }^{\circ}\text{C}$

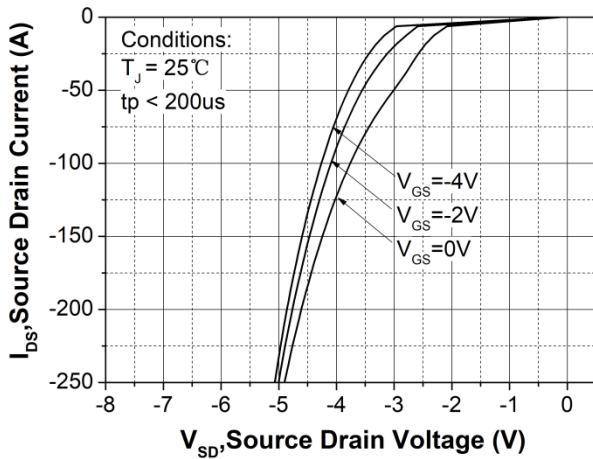


Figure 9. Body diode characteristic at $T_J = 25\text{ }^{\circ}\text{C}$

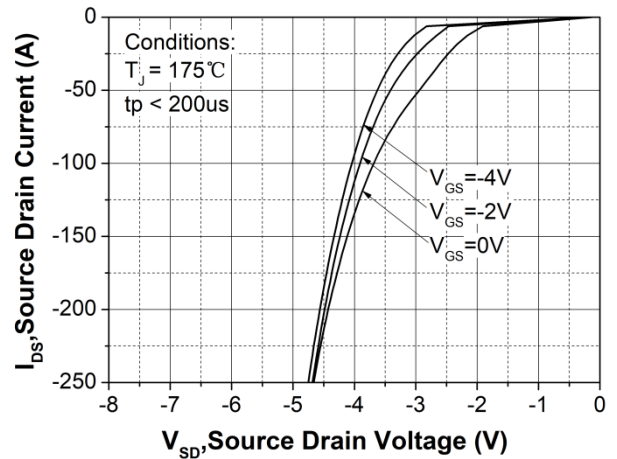


Figure 10. Body diode characteristic at $T_J = 175\text{ }^{\circ}\text{C}$

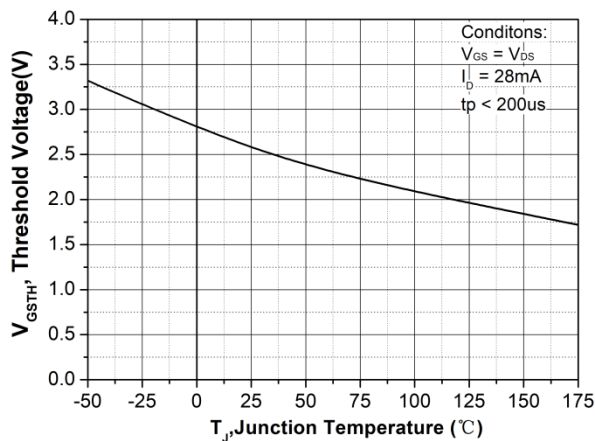


Figure 11. Threshold voltage vs. temperature

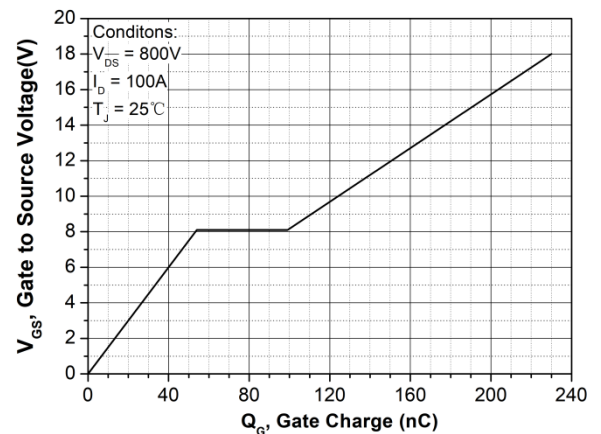


Figure 12. Gate charge characteristic

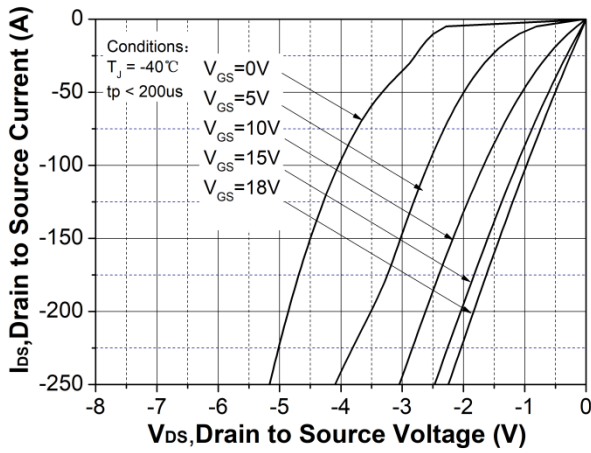


Figure 13. 3rd quadrant characteristic at $T_J = -40\text{ }^{\circ}\text{C}$

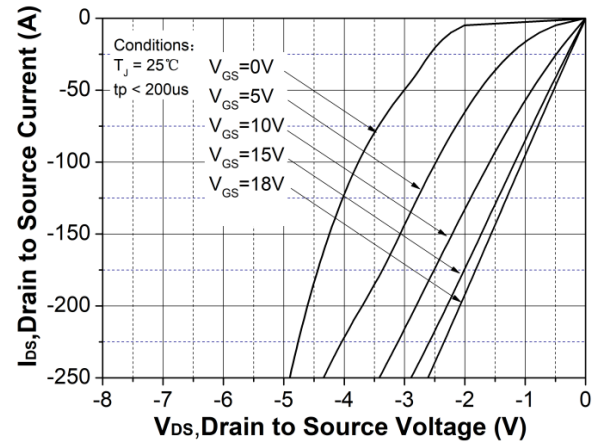


Figure 14. 3rd quadrant characteristic at $T_J = 25\text{ }^{\circ}\text{C}$

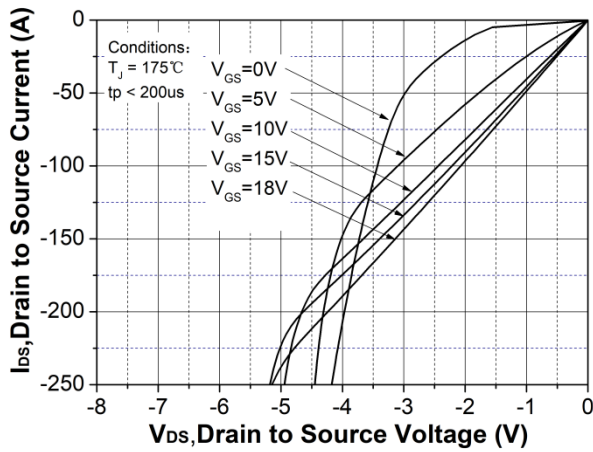


Figure 15. 3rd quadrant characteristic at $T_J = 175\text{ }^{\circ}\text{C}$

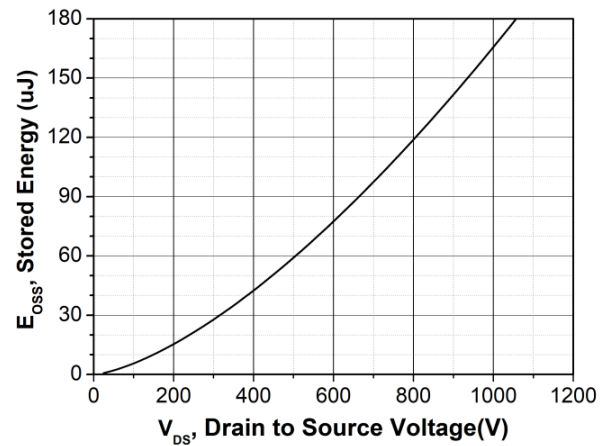


Figure 16. Output capacitor stored energy

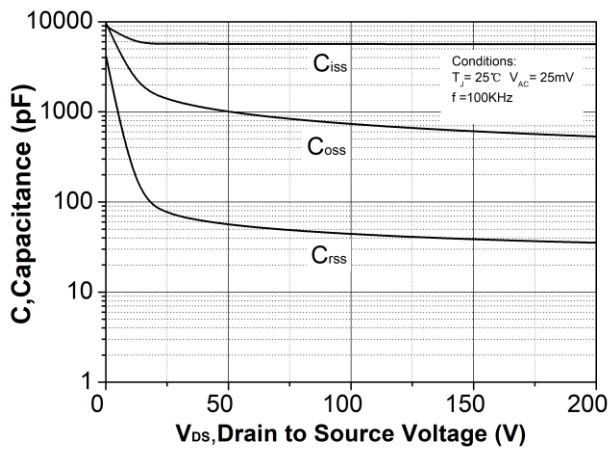


Figure 17. Capacitances vs. drain-source voltage (0 - 200V)

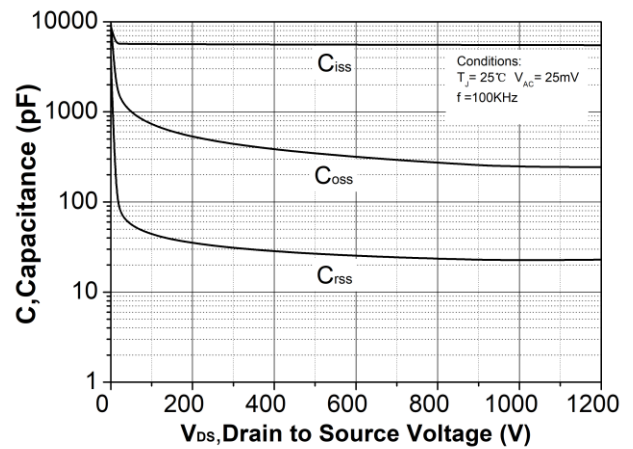


Figure 18. Capacitances vs. drain-source voltage (0 - 1200V)

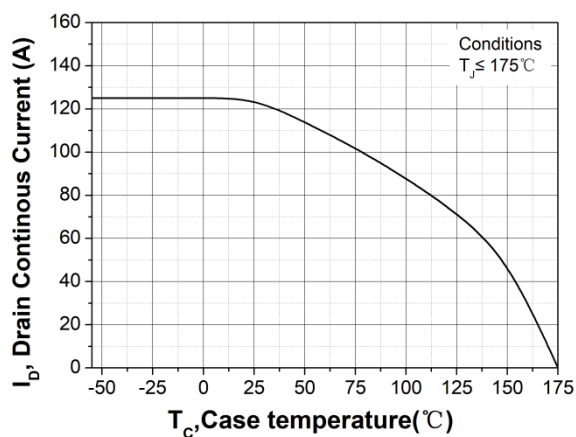


Figure 19. Continuous drain current derating vs. case temperature

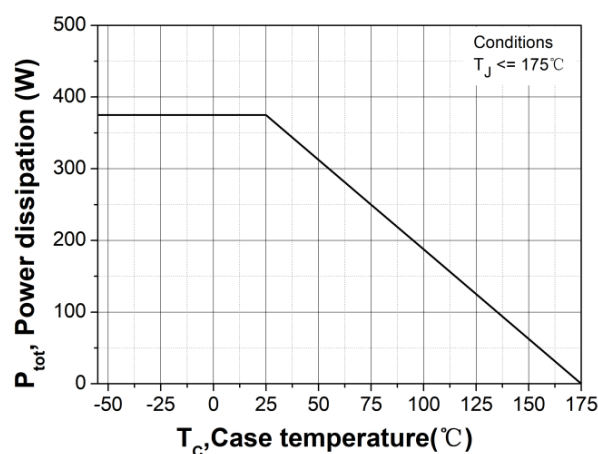


Figure 20. Maximum power dissipation derating vs. case temperature

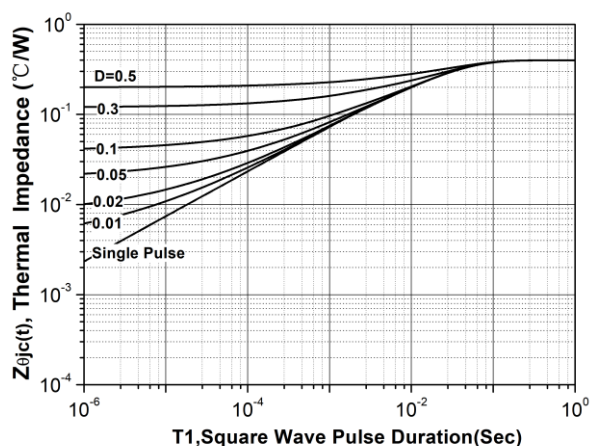


Figure 21. Transient thermal impedance (junction - case)

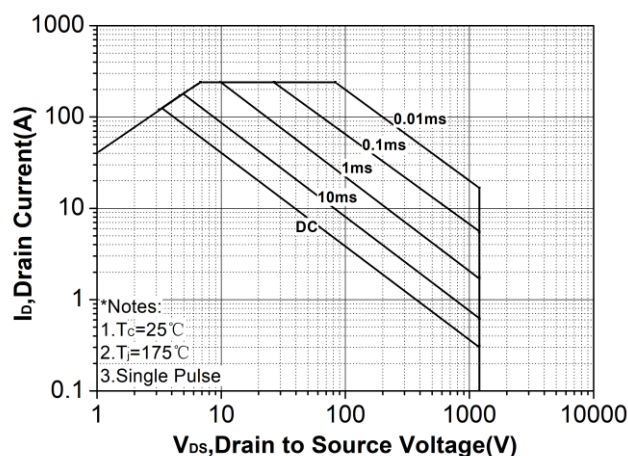


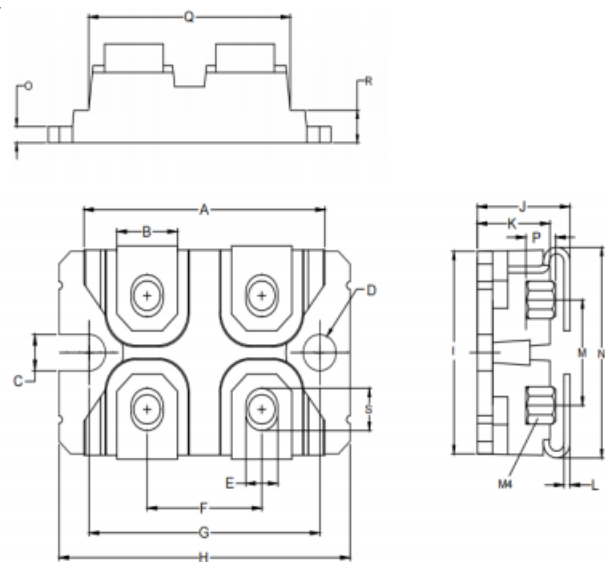
Figure 22. Safe operating area

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5、 Package drawing



DiM	Millimeter	
	Min	Max
A	31.40	31.60
B	7.70	8.10
C	4.20	4.40
D	4.20	4.40
E	4.10	4.30
F	14.90	15.10
G	30.10	30.20
H	38.00	38.40
I	23.80	24.20
J	11.80	12.20
K	9.40	9.60
L	0.75	0.85
M	12.40	12.80
N	24.50	25.40
O	1.90	2.10
P	3.10	3.95
Q	26.60	27.00
R	3.80	4.20
S	5.10	5.40

6、 Test conditions

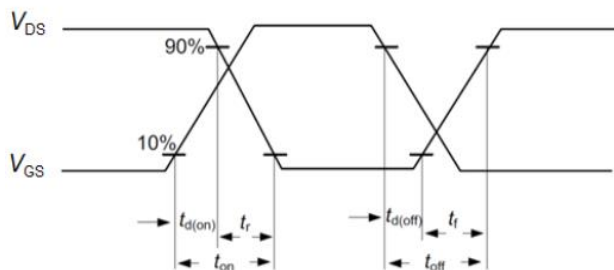


Figure A. Definition of switching times

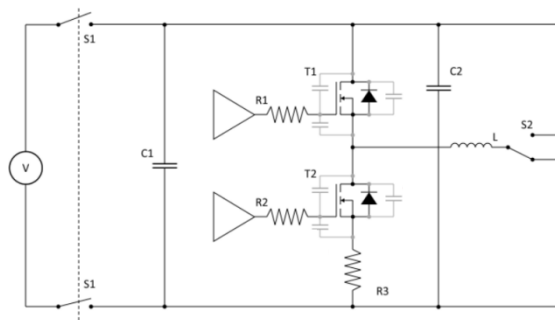


Figure B. Dynamic test circuit

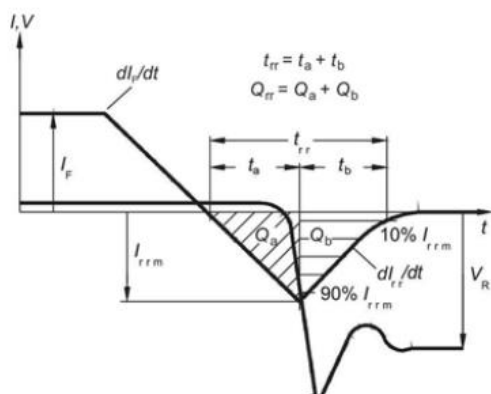


Figure C. Definition of diode switching characteristics

Figure C. Definition of body diode switching characteristics

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Revision history

Document version	Date of release	Description of changes
V01_00	2023-11-29	——
V01_01	2024-02-21	——

Attention

1. **Rohs compliance**

The levels of RoHS restricted materials in this product are below the maximum concentration values (also referred to as the threshold limits) permitted for such substances, or are used in an exempted application, in accordance with EU Directive 2011/65/ EC (RoHS2), as implemented January 2, 2013.

2. **REACH compliance**

REACH substances of high concern (SVHCs) information is available for this product. Since the European Chemical Agency (ECHA) has published notice of their intent to frequently revise the SVHC listing for the foreseeable future, please contact a Sichain representative to insure you get the most up-to-date REACH SVHC Declaration. REACH banned substance information (REACH Article 67) is also available upon request.

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6. Due to technical requirements products may contain dangerous substances. For information on the types in question please contact Sichain office.

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7. Except as otherwise explicitly approved by Sichain in a written document signed by authorized representatives of Sichain, Sichain' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.

8. For use of our products in applications requiring a high degree of reliability (as exemplified below), please contact and consult with a Sichain representatives, for example but not limited to: transportation equipment, primary communication equipment, traffic lights, fire/crime prevention, safety equipment, medical systems, and power transmission systems.