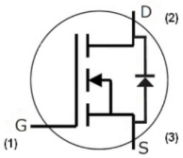
1200V Silicon Carbide Power MOSFET 1200V G1 （ N Channel Enhancement ）

Features

- High speed switching
- Very low switching losses
- IGBT-compatible driving voltage (18V for turn-on)
- Fully controllable dv/dt
- High blocking voltage with low on-resistance
- Fast intrinsic diode with low reverse recovery(Qrr)
- Temperature independent turn-off switching losses
- Halogen free, RoHS compliant



TO-247-4L

Benefits

- Cooling effort reduction
- Efficiency improvement
- Reduced cooling requirements
- Increased power density
- Increased system switching frequency

Applications

- On-board charger/PFC
- EV battery chargers
- Booster/DC-DC converter
- Switch mode power supplies

Table 1 Key performance and package parameters

Type	V_{DS}	I_{DS} (T_C=25℃, $R_{th\ (j\text{-}c,max)}$)	$R_{DS(ON),\ typ}$ (V_{GS} = 18 V, I_D = 20 A, T_J=25℃)	$T_{j,max}$	Marking	Package
KN3M80120D	1200 V	38 A	8 0 mΩ	175℃	KN3M80120D	TO247-4L

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1、Maximum ratings

Table 2 Maximum rating (Tc = 25°C unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
$V_{DS,max}$	Drain source voltage	1200	V	V_{GS} = 0 V, I_D = 100 μA	
$V_{GS,max}$	Gate source voltage	-8 /+22	V	Absolute maximum values	Note1
V_{GSop}	Gate source voltage	-4 /+18	V	Recommended operational values	
I_D	Continuous drain current	38	A	V_{GS} = 18 V, T_C = 25˚C	Fig.19
		27		V_{GS} = 18 V, T_C = 100˚C	
$I_{D(pluse)}$	Pulsed drain current	80	A	Pulse width t_P limited by $T_{j,max}$	Fig.22
P_D	Power dissipation	214	W	T_C =25˚C,T_J =175˚C	Fig.20
T_J ,T_{stg}	Operating Junction and storage temperature	-55 to +175	˚C		
T_L	Soldering temperature	260	˚C	1.6mm (0.063”) from case for 10s	
T_M	Mounting torque	1 8.8	Nm lbf-in	M3 or 6-32 screw	

Note 1：when using MOSFET Body Diode $V_{GS,max}$ = -4 / +22V

2、Thermal characteristics

Table 3 Thermal characteristics[1]

Symbol	Parameter	Value	Unit	Test Conditions	Note
$R_{th(j-c)}$	Thermal resistance from junction to case	0.7	°C/W		Fig.21
$R_{th(j-a)}$	Thermal resistance from junction to ambient	35			

[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 = 100μA	
$V_{GS(th)}$	Gate threshold voltage	2.3	2.8	3.6	V	V_{DS} = V_{GS}, I_D = 5mA	Fig.11
		-	2.1	-	V	V_{DS} = V_{GS}, I_D = 5mA, T_J=175°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	-	70	85	mΩ	V_{GS} = 18V, I_D = 20A	Fig.4,5,6
		-	125	-		V_{GS} = 18V, I_D = 20A, T_J=175°C	
g_{fs}	Transconductance	-	10	-	S	V_{DS} = 20V, I_D = 20A	Fig.7
		-	9.2	-		V_{DS} = 20V, I_D = 20A, T_J=175°C	
$R_{g,int}$	Internal gate resistance	-	1.5	-	Ω	V_{AC} = 25mV, f=1MHz	
V_{SD}	Diode forward voltage	-	4.3	-	V	V_{GS} = -4V, I_{SD} = 10A	Fig.8,9,10
		-	3.8	-		V_{GS} = -4V, I_{SD} = 10A T_J = 175°C	

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	-	920	-	pF	V_{DS} = 1000V, V_{GS} = 0V T_J = 25°C, V_{AC} = 25mV f=1MHz	Fig.17,18
C_{oss}	Output capacitance	-	57	-			
C_{rss}	Reverse capacitance	-	3.9	-			
E_{oss}	Coss stored energy	-	35	-	μJ		Fig.16
Q_{gs}	Gate source charge	-	7	-	nC	V_{DS} = 800V, V_{GS} = -4/18V I_D = 20A	Fig.12
Q_{gd}	Gate drain charge	-	19	-			
Q_g	Gate charge	-	40	-			

3.3 Switching characteristics

Table 6 Dynamic characteristics(Tc = 25°C unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
E_{on}	Turn on switching energy	-	320	-	μJ	V_{DD} = 800V, V_{GS} = -4/+15V I_D = 20A, Rg = 0Ω L = 120uH	Fig.25
E_{off}	Turn off switching energy	-	49	-			
$t_{d(on)}$	Turn on delay time	-	19	-	ns		Fig.27
t_r	Rise time	-	21	-			
$t_{d(off)}$	Turn off delay time	-	15	-			
t_f	Fall time	-	17	-			

Table 7 Body diode characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
V_{SD}	Diode forward voltage	-	4.3	-	V	V_{GS} = -4V, I_{SD} = 10A	Fig.8,9,10
		-	3.8	-	V	V_{GS} = -4V, I_{SD} = 10A T_J = 175°C	
I_S	Continuous diode forward current	-	38	-	A	Tc = 25°C	Note1
t_{rr}	Reverse recovery time	-	41	-	nS	V_R = 800V, V_{GS} = -4V I_D = 20A di/dt = 700A/μS T_J = 150°C	
Q_{rr}	Reverse recovery charge	-	405	-	nC		
I_{rrm}	Peak reverse recovery current	-	20	-	A		

Note 1: When using SiC Body Diode the maximum recommended VGS = -4 V

4、Electrical characteristic diagrams

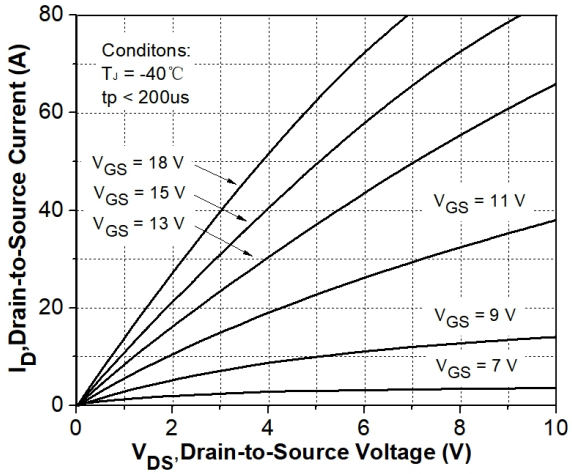


Figure 1. Output characteristics T_J = -40 ºC

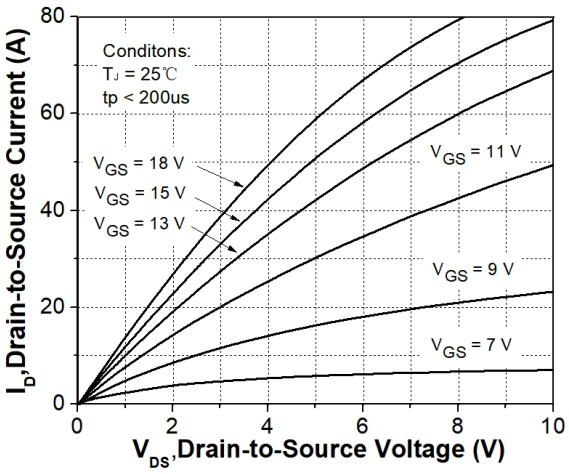


Figure 2. Output characteristics T_J = 25 ºC

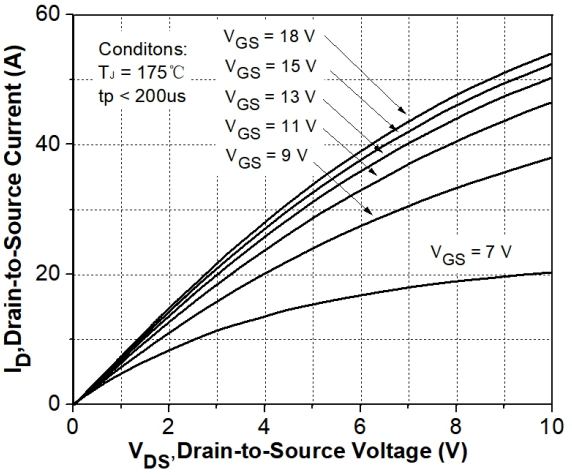


Figure 3. Output characteristics T_J = 175 ºC

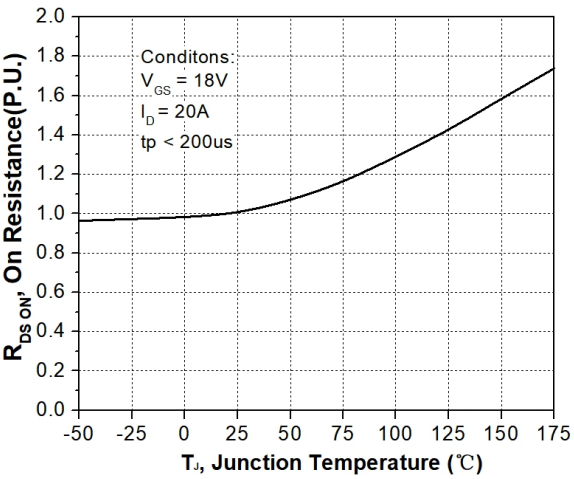


Figure 4. Normalized on-resistance vs. temperature

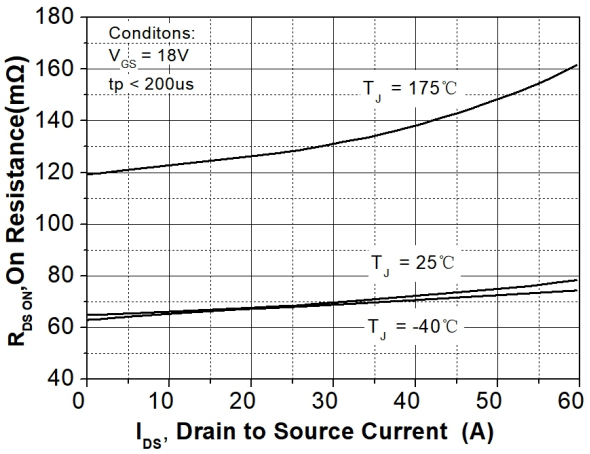


Figure 5. On-resistance vs. drain current

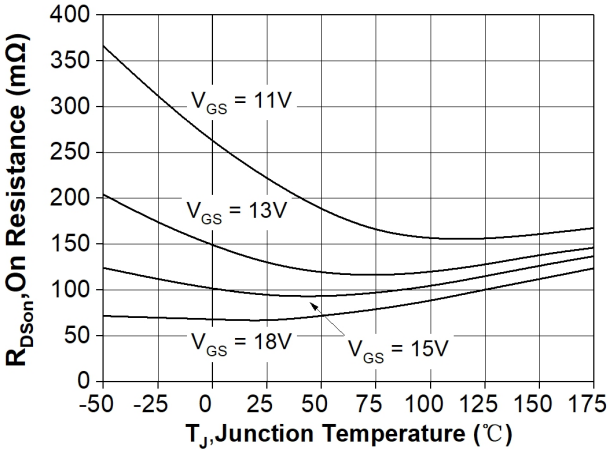


Figure 6. On-resistance vs. temperature for various gate voltage

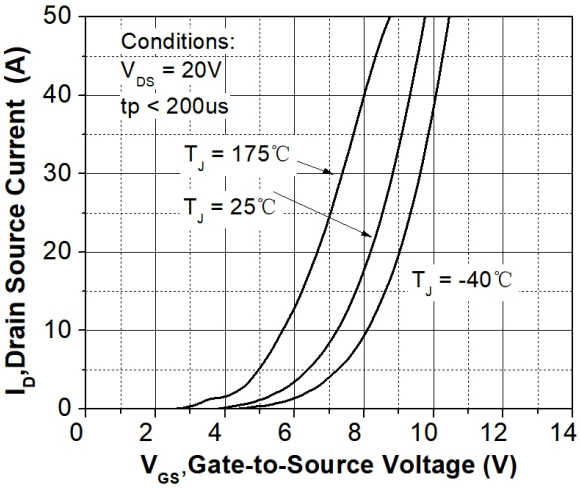


Figure 7. Transfer characteristic for various junction temperatures

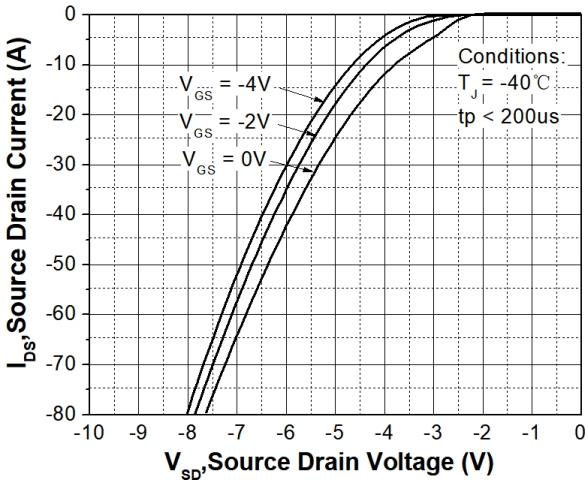


Figure 8. Body diode characteristic at T_J = -40 ºC

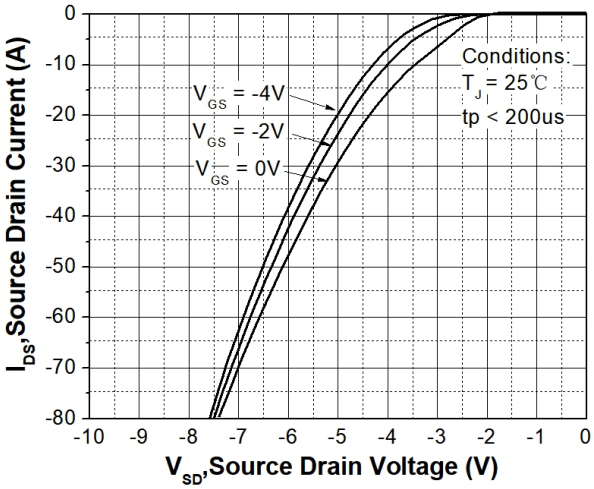


Figure 9. Body diode characteristic at T_J = 25 ºC

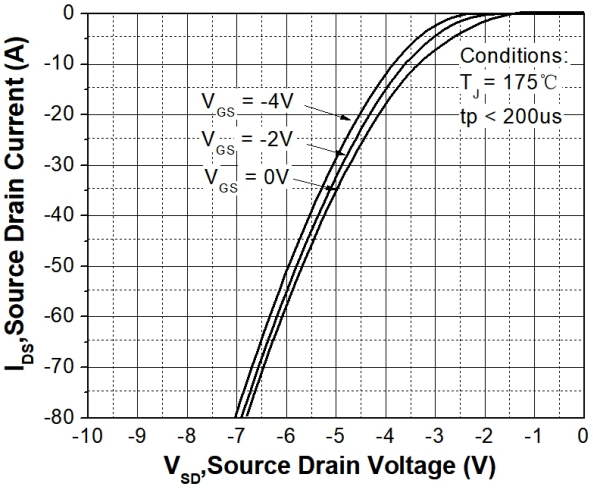


Figure 10. Body diode characteristic at T_J = 175ºC

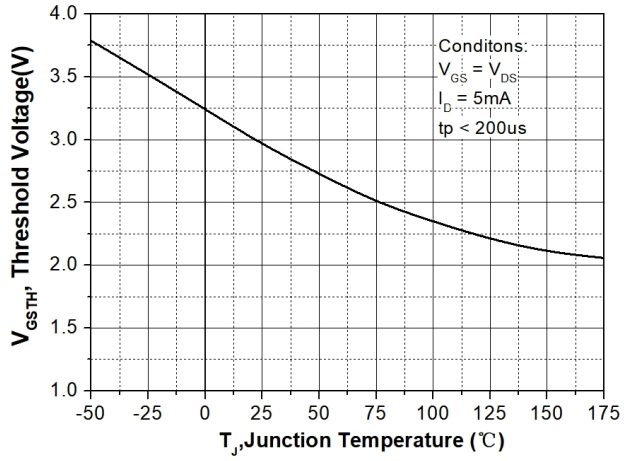


Figure 11. Threshold voltage vs. temperature

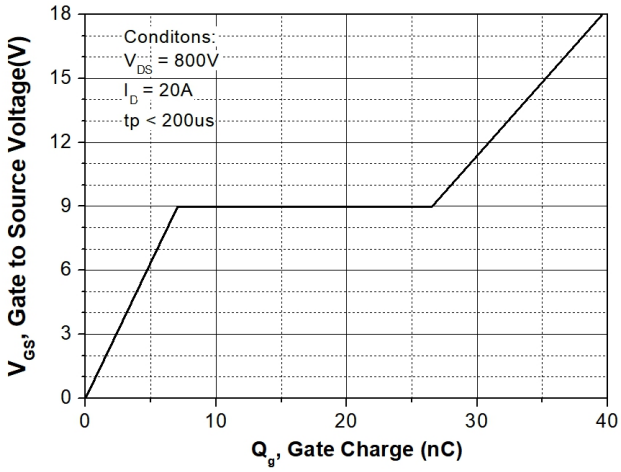


Figure 12. Gate charge characteristic

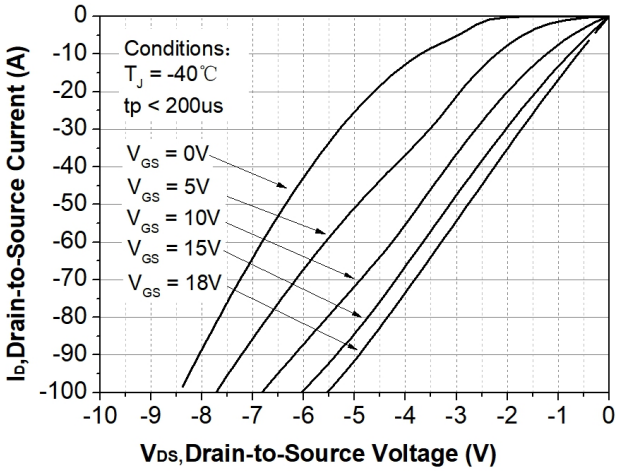


Figure 13. 3rd quadrant characteristic at T_J = -40 ºC

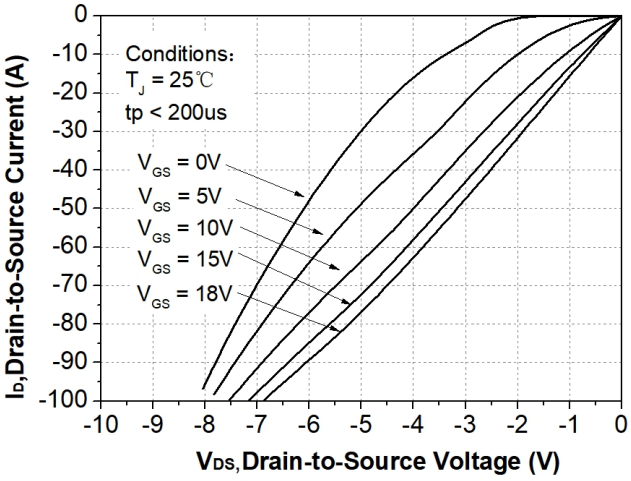


Figure 14. 3rd quadrant characteristic at T_J = 25 ºC

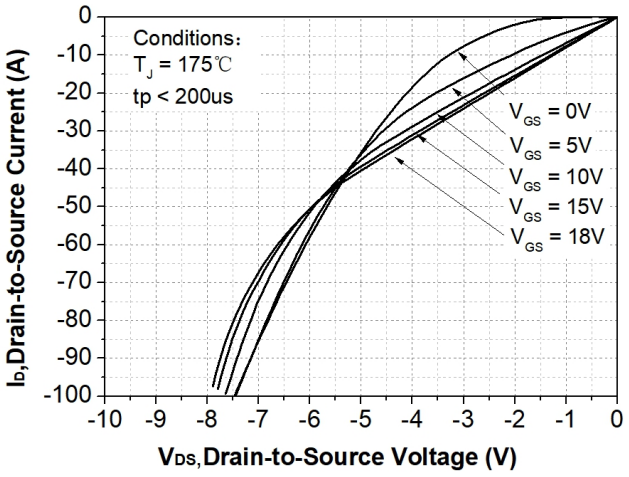


Figure 15. 3rd quadrant characteristic at T_J = 175 ºC

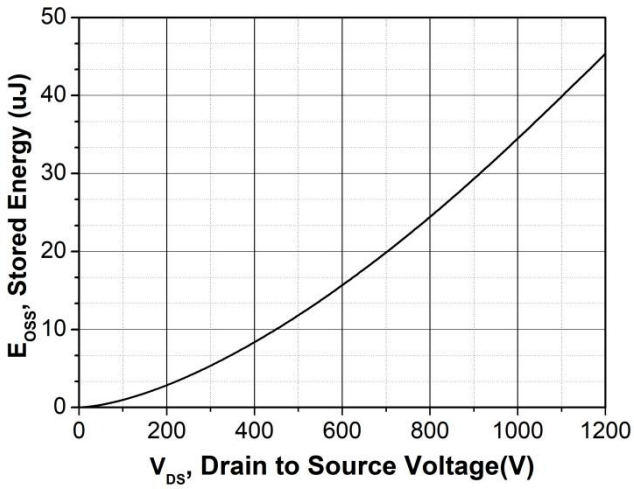


Figure 16. Output capacitor stored energy

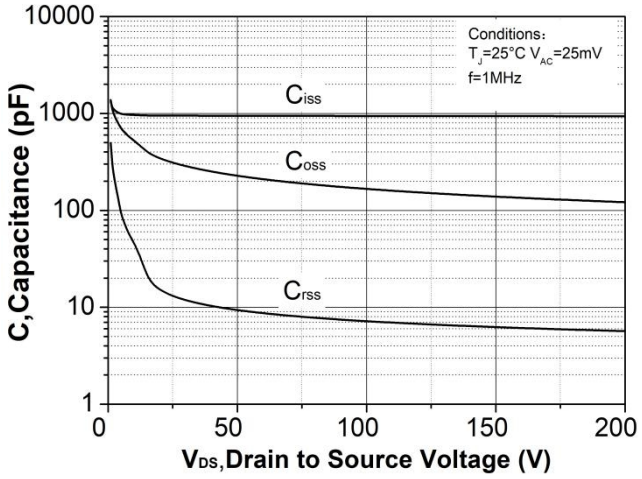


Figure 17. Capacitances vs. drain-source voltage (0 - 200V)

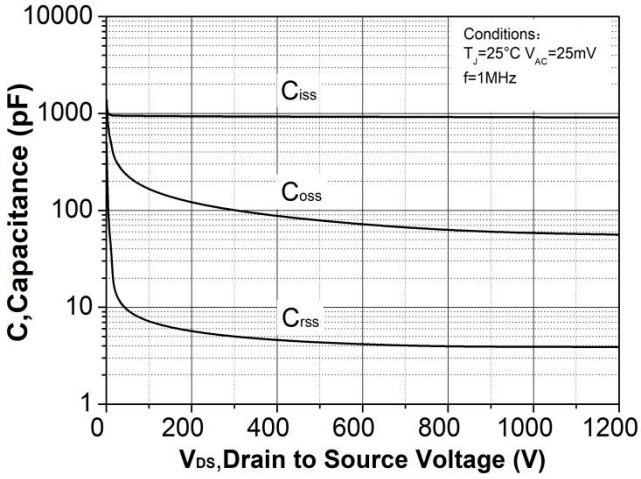


Figure 18. Capacitances vs. drain-source voltage (0 - 1200V)

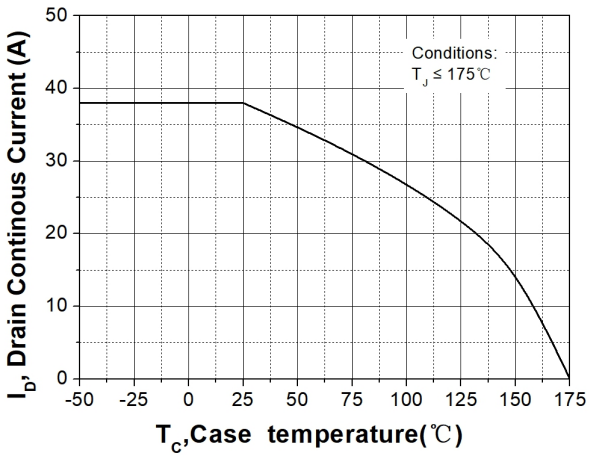


Figure 19. Continuous drain current derating vs. case temperature

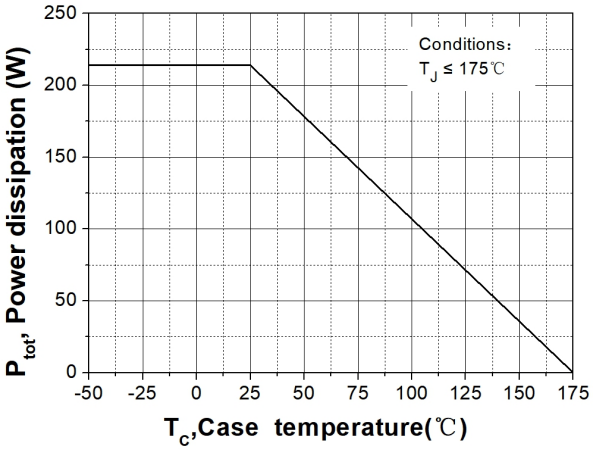


Figure 20. Maximum power dissipation derating vs. case temperature

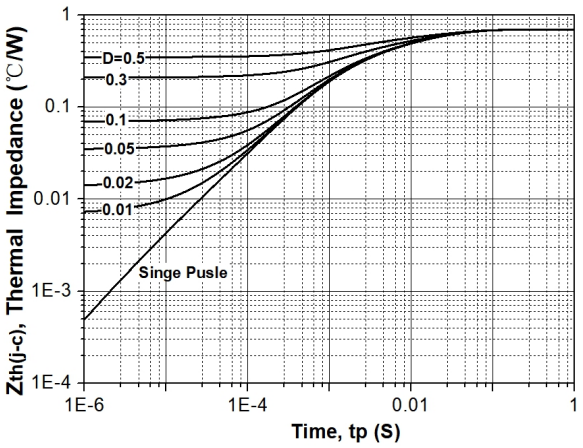


Figure 21. Transient thermal impedance (junction - case)

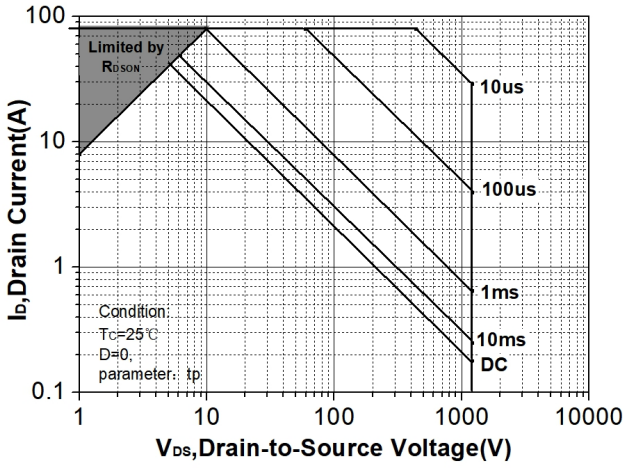


Figure 22. Safe operating area

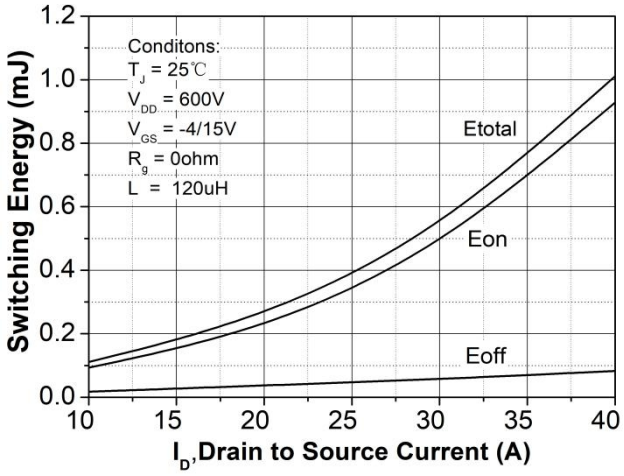


Figure 23. Clamped Inductive switching energy vs. drain current (V_{DD} = 600V)

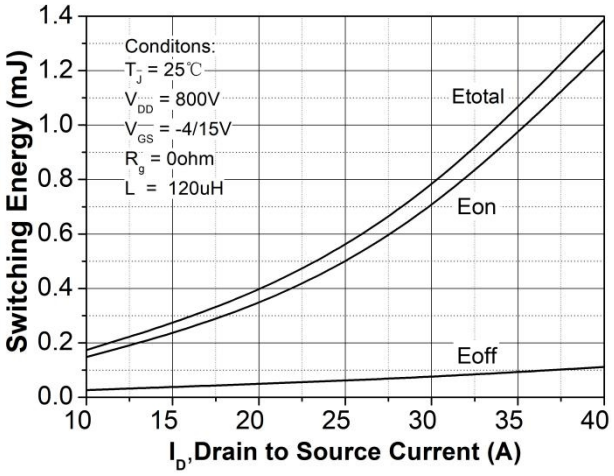


Figure 24. Clamped inductive switching energy vs. drain current (V_{DD} = 800V)

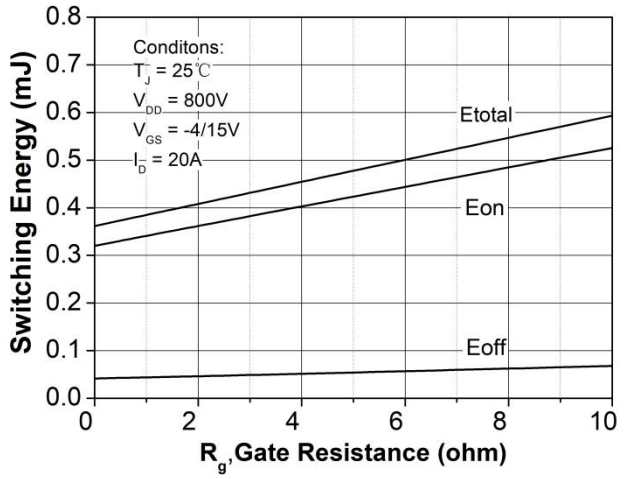


Figure 25. Clamped inductive switching energy vs. R_G(ext)

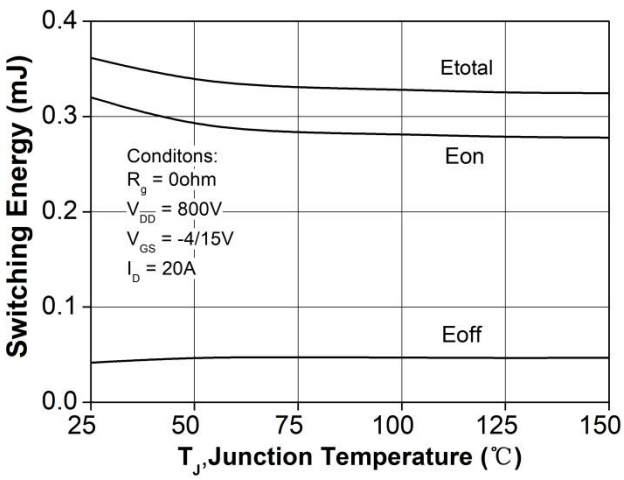


Figure 26. Clamped inductive switching energy vs. temperature

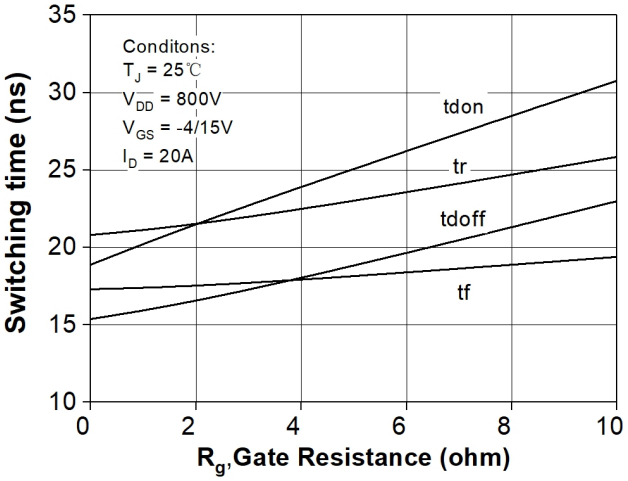


Figure 27. Switching times vs. R_G(ext)

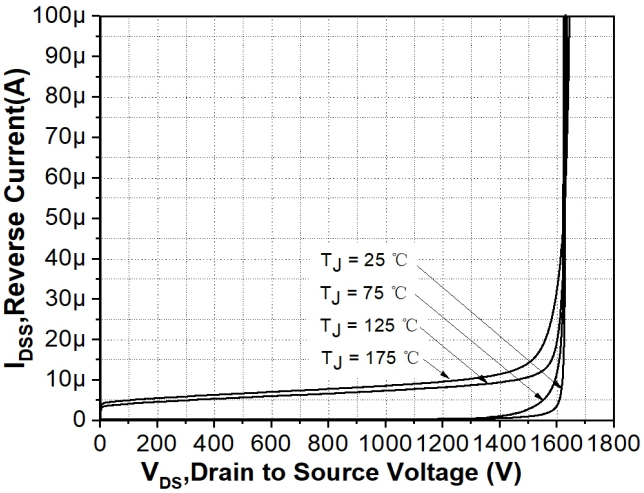
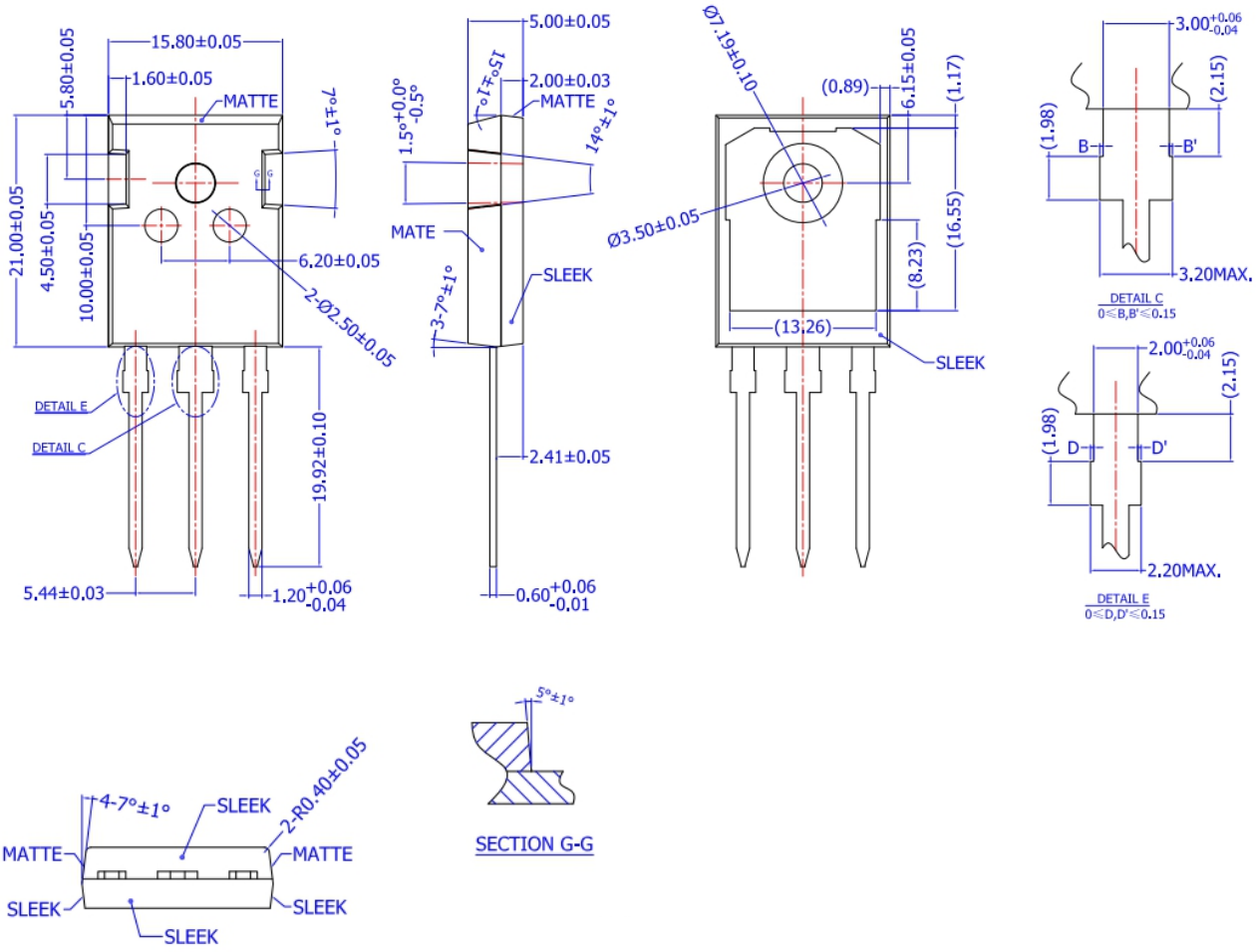


Figure 28. Reverse characteristics vs.T_J

5、Package drawing (TO-247-3L)



6、Test conditions

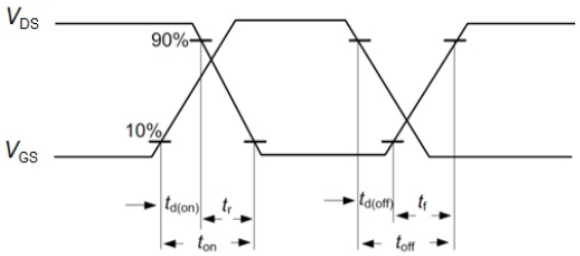


Figure A. Definition of switching times

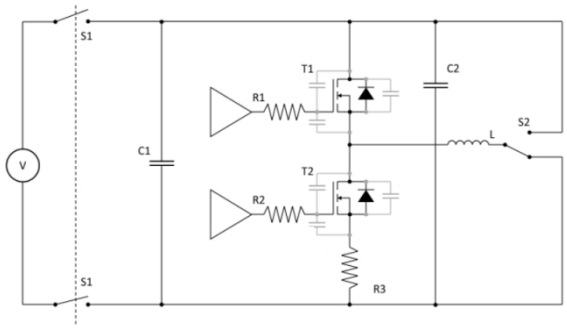


Figure B. Dynamic test circuit

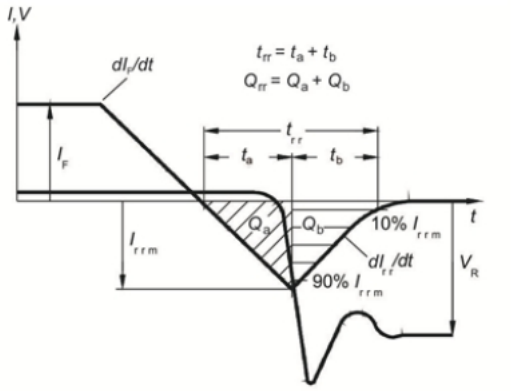


Figure C. **Definition of diode switching characteristics**

Figure C. Definition of body diode switching characteristics

Revision history

Document version	Date of release	Description of changes
V01_00	2022-03-03	——
V01_01	2022-03-13	——
V01_02	2022-07-18	——

Attention

- **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.
- **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.
- Specifications of any and all products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.
- We assume no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all products described or contained herein.
- Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc.

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