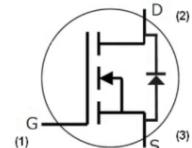


## 1200V Silicon Carbide Power MOSFET 1200V G1 ( N Channel Enhancement )

### 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



### Benefits

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

TO-247-4L



### 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 <sub>DS</sub>	I <sub>DS</sub> (T <sub>C</sub> =25°C, R <sub>th(j-c,max)</sub> )	R <sub>DS(ON), typ</sub> (V <sub>GS</sub> = 18 V, I <sub>D</sub> = 20 A, T <sub>J</sub> =25°C)	T <sub>j,max</sub>	Marking	Package
KN3M80120D	1200 V	38 A	8 0 mΩ	175°C	KN3M80120D	TO247-4L

**1200V SiC Power MOSFET**

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**Table of contents**

<b>Table of contents</b>	
Features.....	1
Benefits.....	1
Applications.....	1
Table of contents.....	2
1、 Maximum ratings.....	3
2、 Thermal characteristics.....	3
3、 Electrical characteristics.....	4
3.1 Static characteristics.....	4
3.2 Dynamic characteristics.....	4
3.3 Switching characteristics.....	5
4、 Electrical characteristic diagrams.....	6
5、 Package drawing.....	11
6、 Test conditions.....	12
Revision history.....	13
Attention.....	13

1200V SiC Power MOSFET

## 1、Maximum ratings

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

<b>Symbol</b>	<b>Parameter</b>	<b>Value</b>	<b>Unit</b>	<b>Test Conditions</b>	<b>Note</b>
$V_{DS,\text{max}}$	Drain source voltage	1200	V	$V_{GS} = 0 \text{ V}, I_D = 100 \mu\text{A}$	
$V_{GS,\text{max}}$	Gate source voltage	-8 /+22	V	Absolute maximum values	Note1
$V_{GS,\text{op}}$	Gate source voltage	-4 /+18	V	Recommended operational values	
$I_D$	Continuous drain current	38	A	$V_{GS} = 18 \text{ V}, T_c = 25^\circ\text{C}$	Fig.19
		27		$V_{GS} = 18 \text{ V}, T_c = 100^\circ\text{C}$	
$I_{D(\text{pulse})}$	Pulsed drain current	80	A	Pulse width $t_p$ limited by $T_{j,\text{max}}$	Fig.22
$P_D$	Power dissipation	214	W	$T_c = 25^\circ\text{C}, T_j = 175^\circ\text{C}$	Fig.20
$T_J, T_{\text{stg}}$	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  $V_{GS,\text{max}} = -4 / +22\text{V}$ 

## 2、Thermal characteristics

**Table 3 Thermal characteristics<sup>1</sup>**

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

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

1200V SiC Power MOSFET

### 3、Electrical characteristics

#### 3.1 Static characteristics

**Table 4 Static characteristics (T<sub>c</sub> = 25°C unless otherwise specified)**

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
V <sub>(BR)DSS</sub>	Drain-source breakdown voltage	1200	-	-	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 100μA	
V <sub>GS(th)</sub>	Gate threshold voltage	2.3	2.8	3.6	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 5mA	Fig.11
		-	2.1	-	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 5mA, T <sub>J</sub> =175°C	
I <sub>DSS</sub>	Zero gate voltage drain current	-	1	10	μA	V <sub>DS</sub> = 1200V, V <sub>GS</sub> = 0V	
I <sub>GSS</sub>	Gate source leakage current	-	-	100	nA	V <sub>GS</sub> = 18V, V <sub>DS</sub> = 0V	
R <sub>DS(on)</sub>	Current drain-source on-state resistance	-	70	85	mΩ	V <sub>GS</sub> = 18V, I <sub>D</sub> = 20A	Fig.4,5 ,6
		-	125	-		V <sub>GS</sub> = 18V, I <sub>D</sub> = 20A, T <sub>J</sub> =175°C	
g <sub>fs</sub>	Transconductance	-	10	-	S	V <sub>DS</sub> = 20V, I <sub>D</sub> = 20A	Fig.7
		-	9.2	-		V <sub>DS</sub> = 20V, I <sub>D</sub> = 20A, T <sub>J</sub> =175°C	
R <sub>g,int</sub>	Internal gate resistance	-	1.5	-	Ω	V <sub>AC</sub> = 25mV, f=1MHz	
V <sub>SD</sub>	Diode forward voltage	-	4.3	-	V	V <sub>GS</sub> = -4V, I <sub>SD</sub> = 10A	Fig.8,9, 10
		-	3.8	-		V <sub>GS</sub> = -4V, I <sub>SD</sub> = 10A T <sub>J</sub> = 175°C	

#### 3.2 Dynamic characteristics

**Table 5 Dynamic characteristics (T<sub>c</sub> = 25°C unless otherwise specified)**

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
C <sub>iss</sub>	Input capacitance	-	920	-	pF	V <sub>DS</sub> = 1000V, V <sub>GS</sub> = 0V T <sub>J</sub> = 25°C, V <sub>AC</sub> = 25mV f=1MHz	Fig.17,18
C <sub>oss</sub>	Output capacitance	-	57	-			
C <sub>rss</sub>	Reverse capacitance	-	3.9	-			
E <sub>oss</sub>	Coss stored energy	-	35	-	μJ		
Q <sub>gs</sub>	Gate source charge	-	7	-	nC	V <sub>DS</sub> = 800V, V <sub>GS</sub> = -4/18V I <sub>D</sub> = 20A	Fig.12
Q <sub>gd</sub>	Gate drain charge	-	19	-			
Q <sub>g</sub>	Gate charge	-	40	-			

1200V SiC Power MOSFET**3.3 Switching characteristics****Table 6 Dynamic characteristics**( $T_c = 25^\circ\text{C}$  unless otherwise specified)

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

**Table 7 Body diode characteristics**

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

Note 1: When using SiC Body Diode the maximum recommended  $V_{GS} = -4\text{ V}$

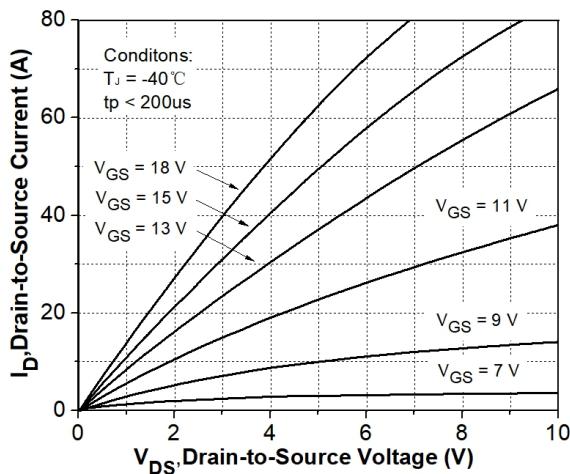
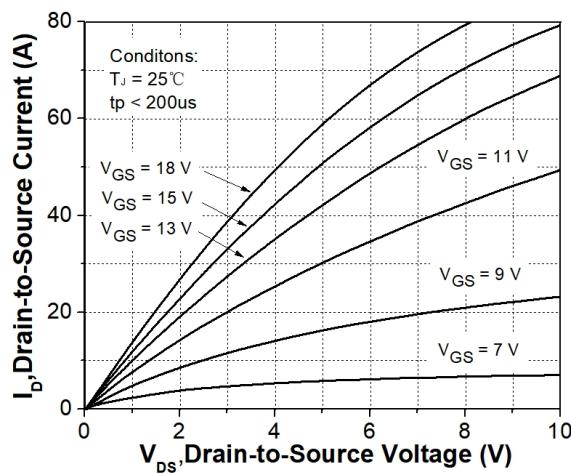
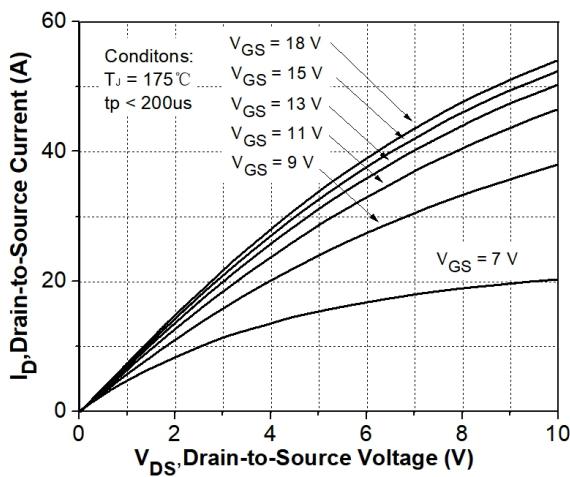
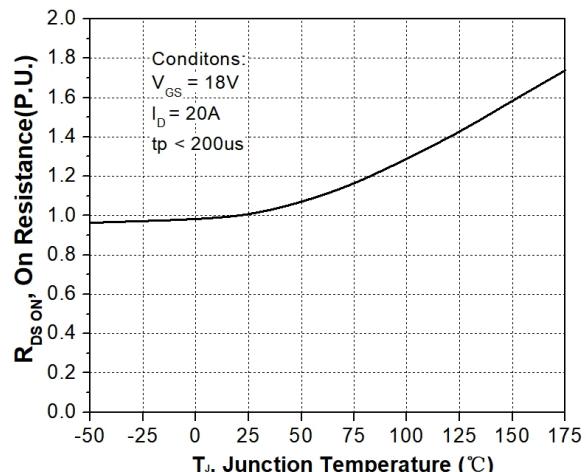
1200V SiC Power MOSFET**4、Electrical characteristic diagrams**Figure 1. Output characteristics  $T_J = -40^\circ\text{C}$ Figure 2. Output characteristics  $T_J = 25^\circ\text{C}$ Figure 3. Output characteristics  $T_J = 175^\circ\text{C}$ 

Figure 4. Normalized on-resistance vs. temperature

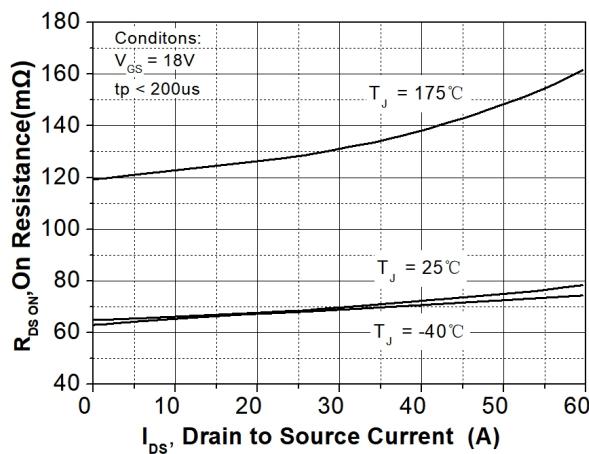
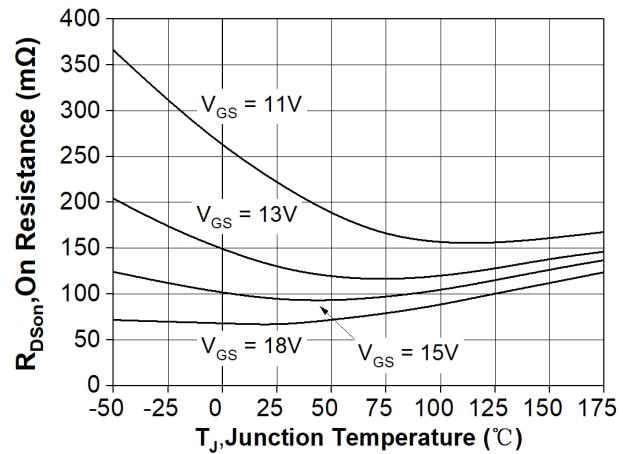
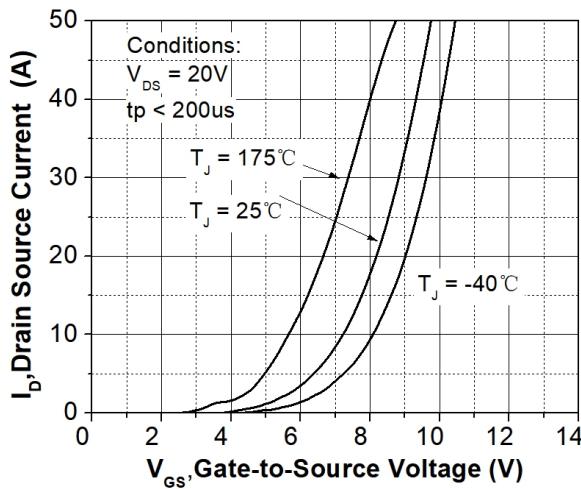
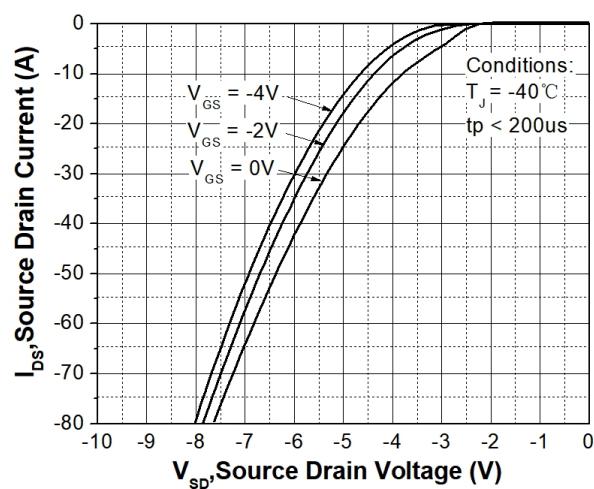
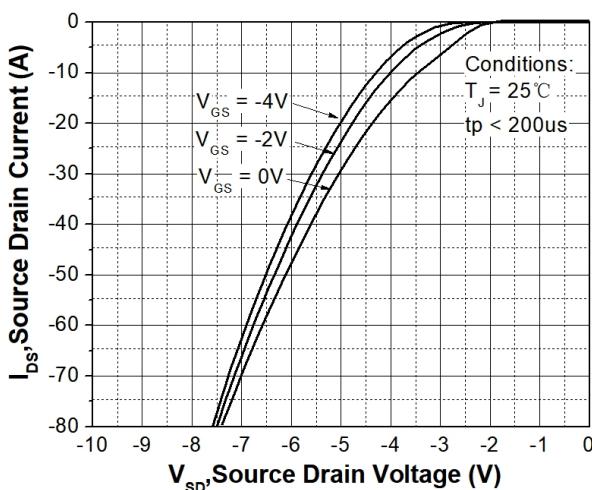
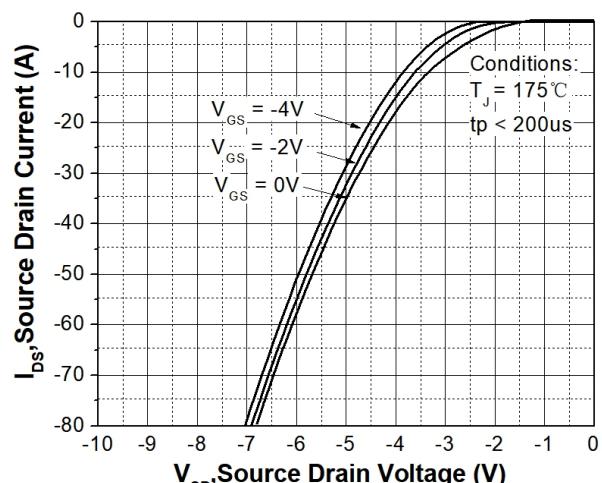


Figure 5. On-resistance vs. drain current

Figure 6. On-resistance vs. temperature  
for various gate voltageFigure 7. Transfer characteristic for  
various junction temperaturesFigure 8. Body diode characteristic at  $T_J = -40^\circ C$ Figure 9. Body diode characteristic at  $T_J = 25^\circ C$ Figure 10. Body diode characteristic at  $T_J = 175^\circ C$

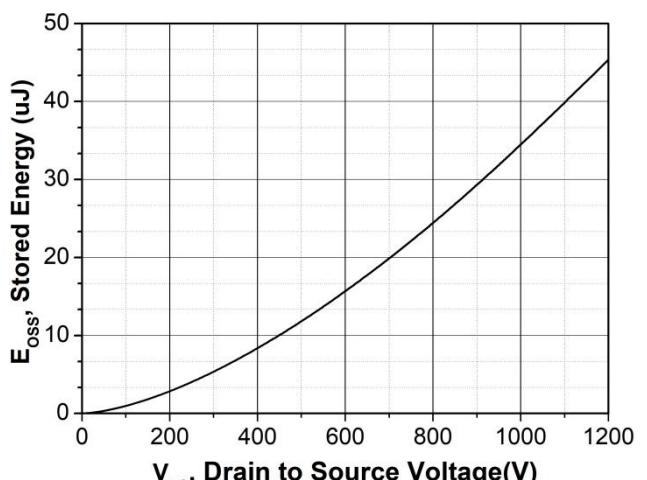
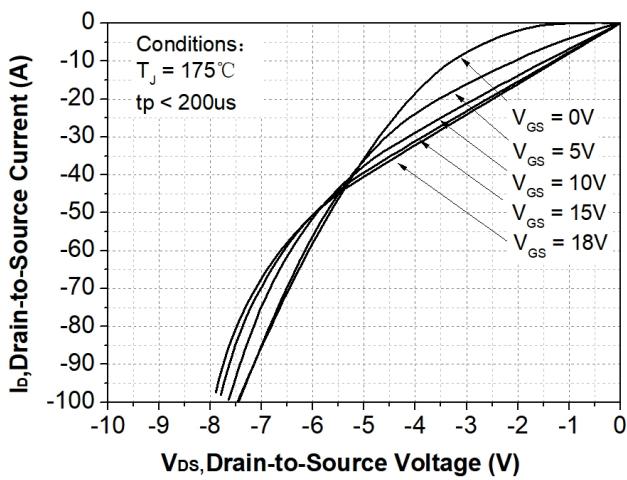
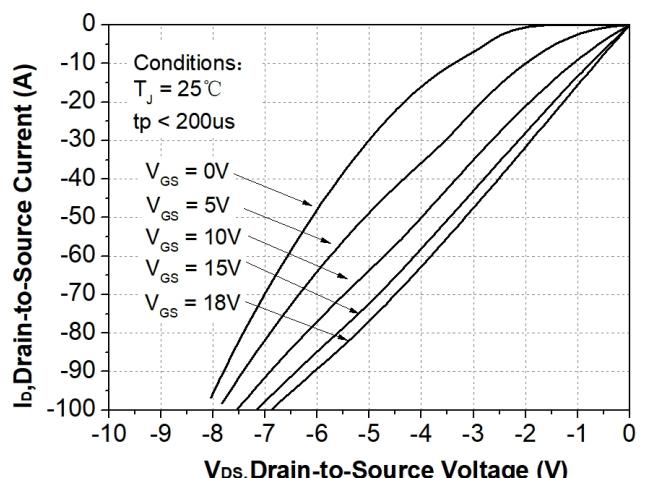
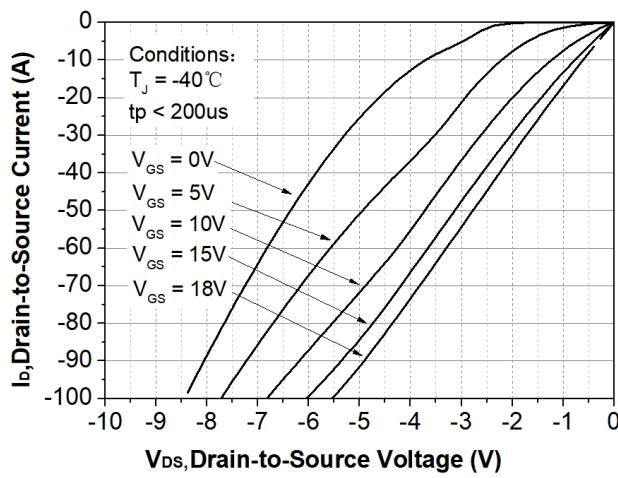
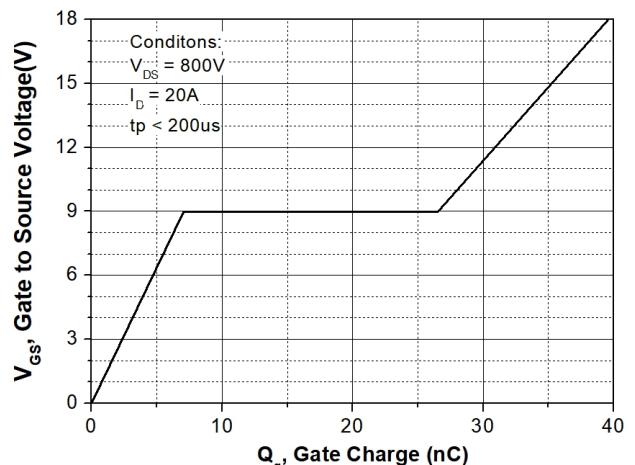
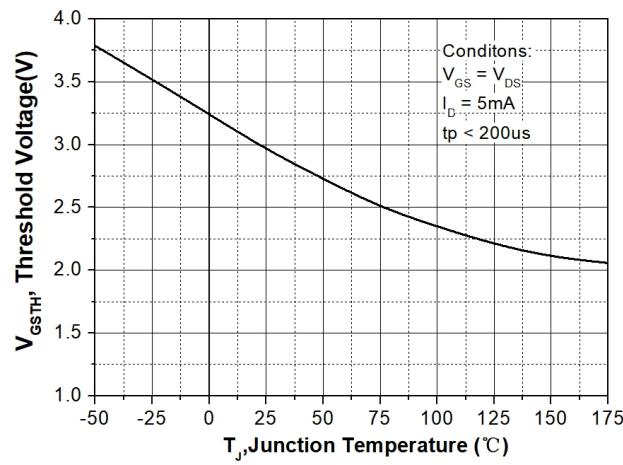
Figure 15. 3rd quadrant characteristic at  $T_J = 175 \text{ } ^\circ\text{C}$ 

Figure 16. Output capacitor stored energy

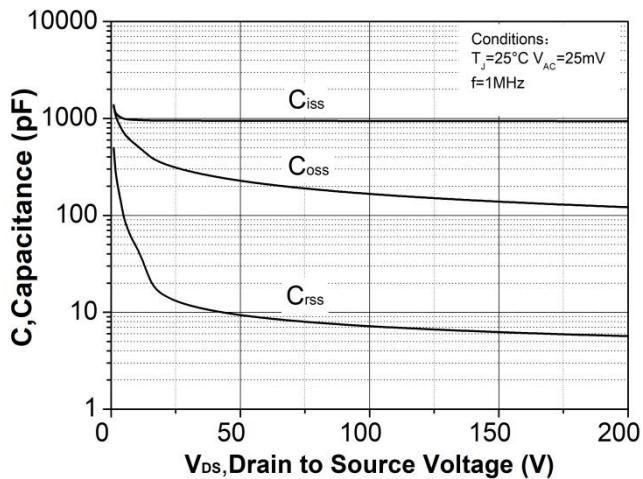


Figure 17. Capacitances vs. drain-source voltage (0 - 200V)

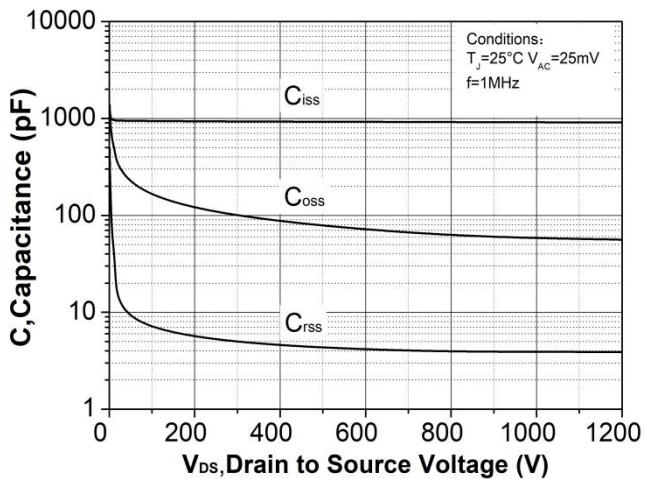


Figure 18. Capacitances vs. drain-source voltage (0 - 1200V)

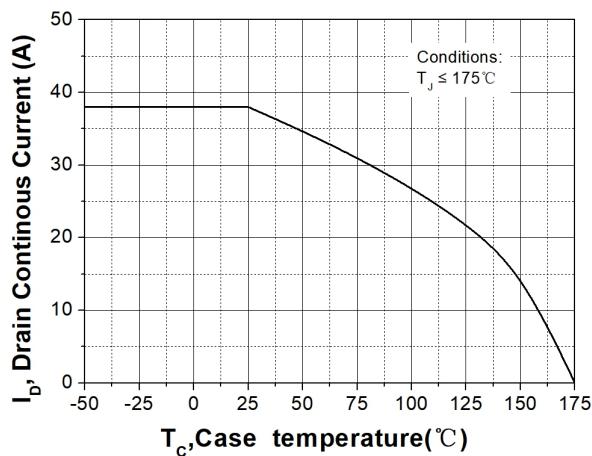


Figure 19. Continuous drain current derating vs. case temperature

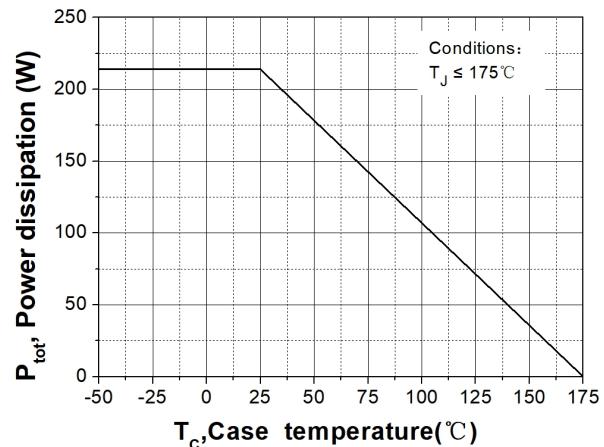


Figure 20. Maximum power dissipation derating vs. case temperature

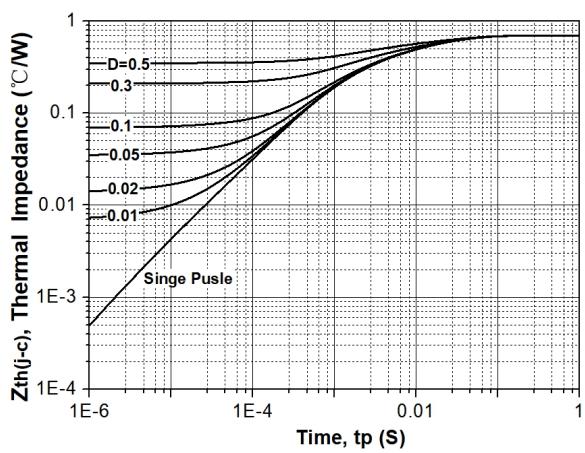


Figure 21. Transient thermal impedance  
(junction - case)

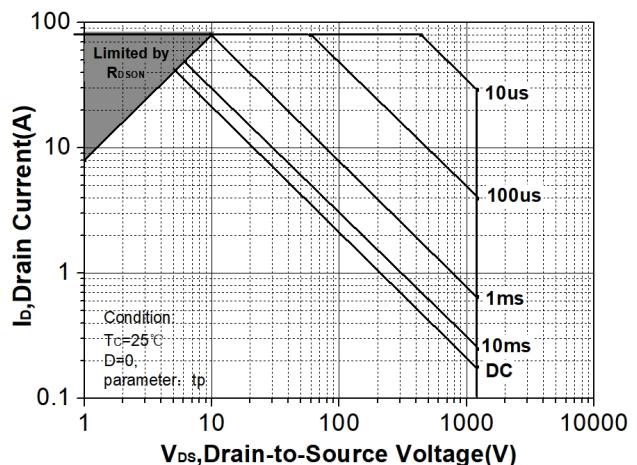


Figure 22. Safe operating area

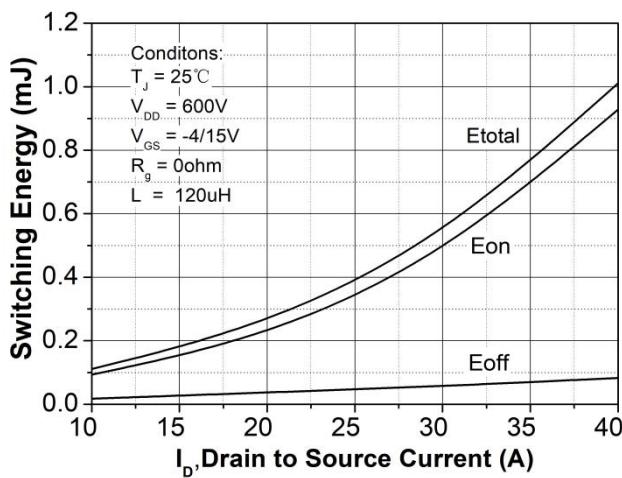


Figure 23. Clamped Inductive switching energy vs. drain current ( $V_{DD} = 600V$ )

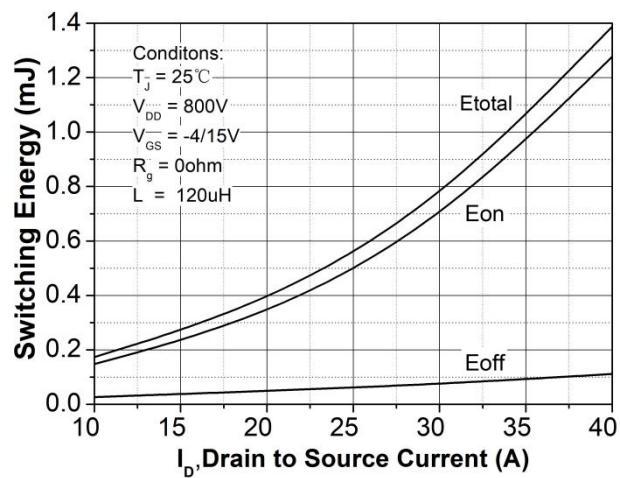


Figure 24. Clamped inductive switching energy vs. drain current ( $V_{DD} = 800V$ )

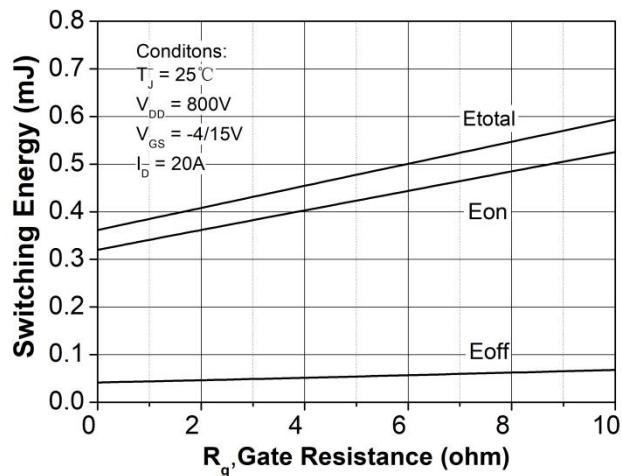


Figure 25. Clamped inductive switching energy vs.  $R_g$ (ext)

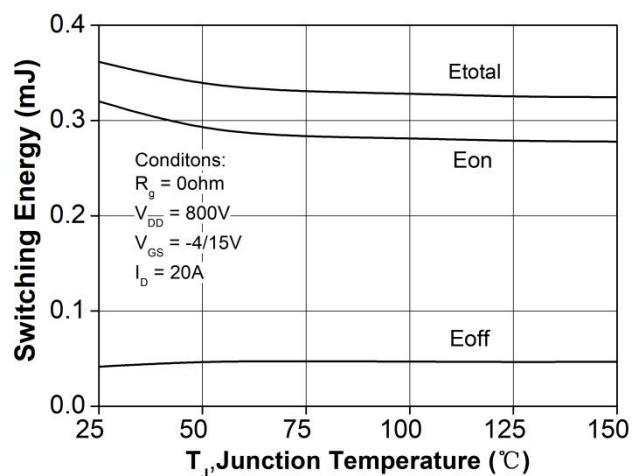


Figure 26. Clamped inductive switching energy vs. temperature

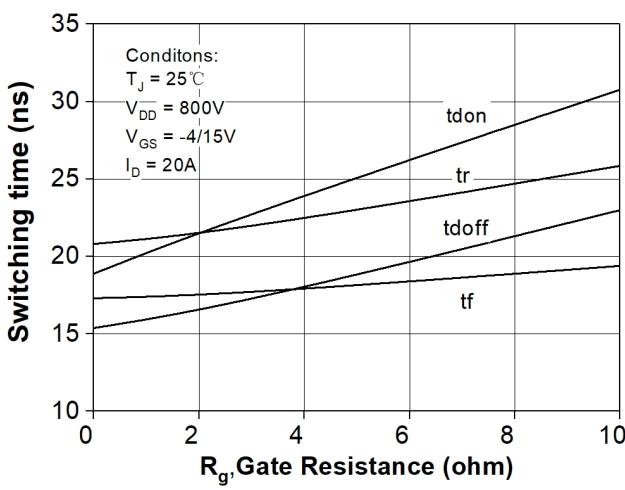


Figure 27. Switching times vs.  $R_g$ (ext)

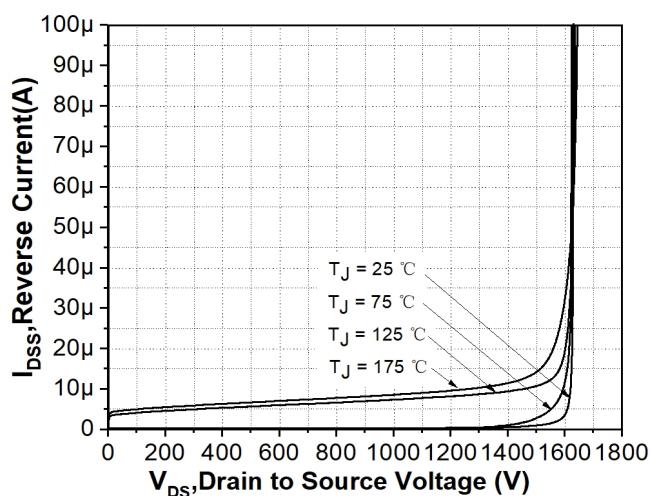
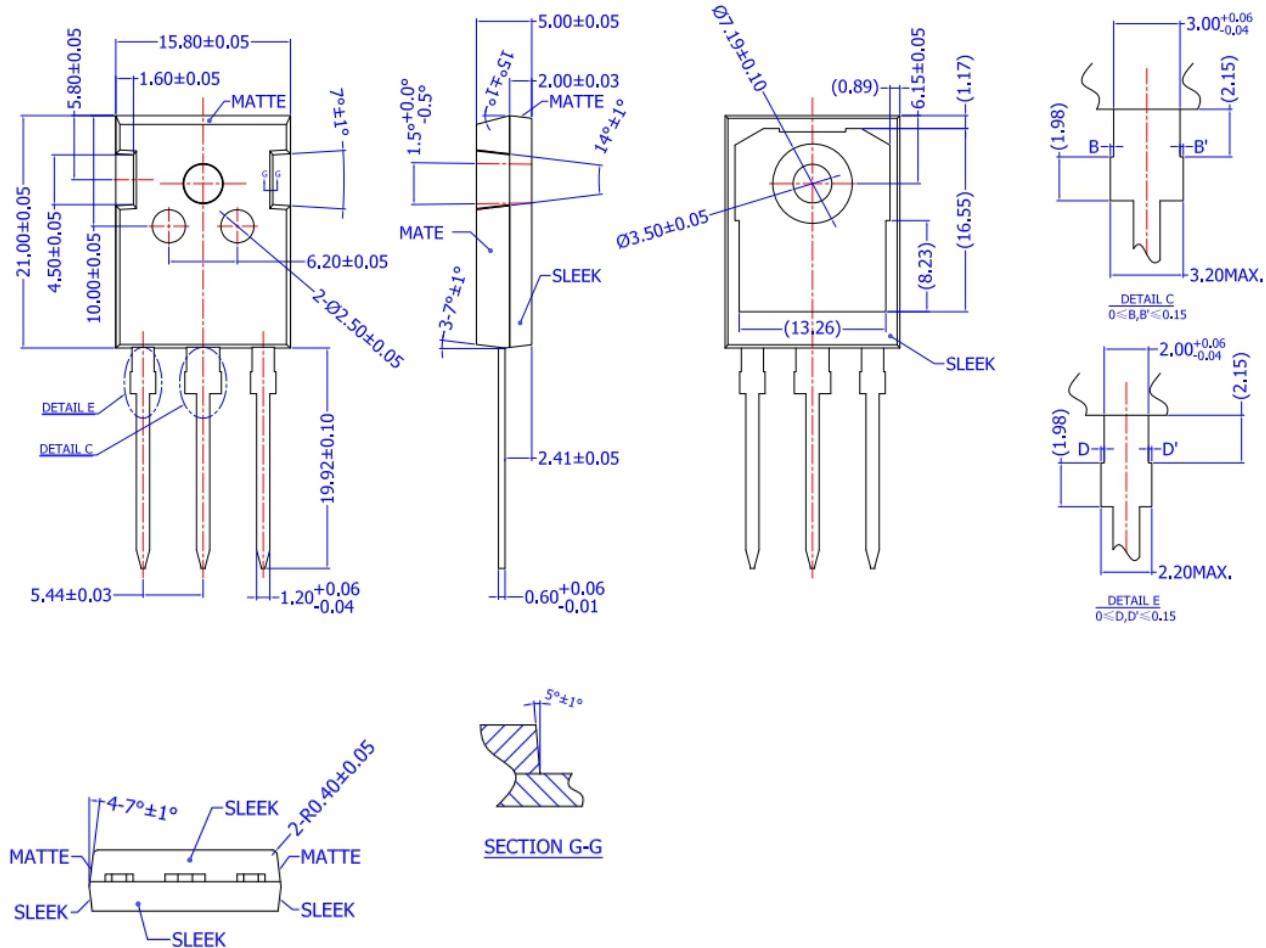


Figure 28. Reverse characteristics vs.  $T_J$

1200V SiC Power MOSFET**5、 Package drawing ( TO-247-3L )**

## 1200V SiC Power MOSFET

### 6、Test conditions

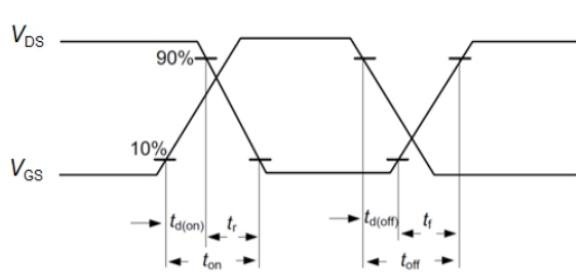


Figure A. Definition of switching times

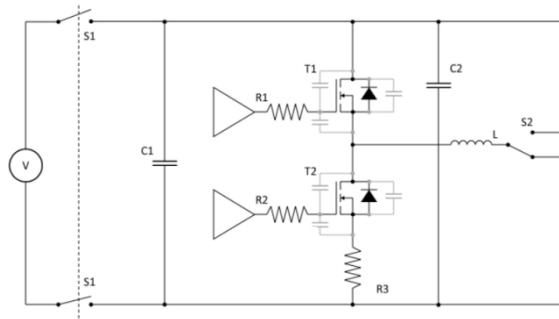


Figure B. Dynamic test circuit

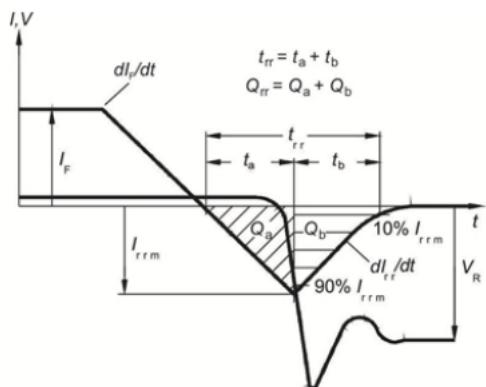


Figure C. Definition of diode switching characteristics

Figure C. Definition of body diode

switching characteristics

1200V SiC Power MOSFET

## 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.