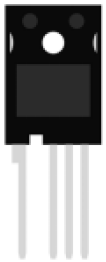
Technical Data
Data Sheet N2911, REV.-

RoHS

S1M0060065K
650V Silicon Carbide Power MOSFET

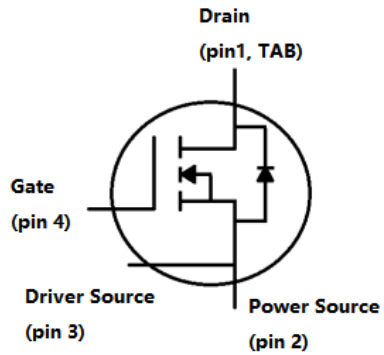


V_{DS} = 650 V
I_{DS}@ 25 °C = 55 A
R_{DS}(on) = 60 mΩ

Description

S1M0060065K is a single SiC Power MOSFET packaged in a TO-247-4 case. The device is a high voltage n-channel enhancement mode MOSFET which has very low total conduction losses and very stable switching characteristics over temperature extremes. The S1M0060065K is ideal for energy sensitive, high frequency applications in challenging environments.

Circuit Diagram



Features

- Positive temperature characteristics, easy to parallel.
- Low on-resistance typ. RDS(on) = 60 mΩ.
- Fast switching speed and low switching losses.
- Very fast and robust intrinsic body diode.
- Process of non-bright tin electroplating.
- "-A" is an AEC-Q101 qualified device.

Applications

- EV Fast Charging Modules
- EV On-Board Chargers
- Solar Inverters
- Online UPS/Industrial UPS
- SMPS (Switch Mode Power Supplies)
- DC-DC Converters
- ESS (Energy Storage Systems)

Technical Data
Data Sheet N2911, REV.-

RoHS

Maximum Ratings (T_A = 25 °C, unless otherwise specified)

Characteristics	Symbol	Conditions	Min.	Typ.	Max.	Units	Note
Drain - Source Voltage	V_{DSmax}	V_{GS} = 0 V, I_D = 100 µA			650	V	
Gate - Source Voltage (dynamic)	V_{GSmax}	AC (f > 1 Hz)	-10		+25	V	
Gate - Source Voltage (static)	V_{GSop}	Static		-4 / +18		V	[1]
Continuous Drain Current	I_D	V_{GS} = 18 V, T_C = 25 °C V_{GS} = 18 V, T_C = 100 °C		55 39		A	
Pulsed Drain Current	$I_{D(pulse)}$	Pulse width t_P limited by T_{jmax}		99		A	
Power Dissipation	P_D	T_C = 25 °C		307		W	

[1] Recommended turn off gate voltage is -4 V. Recommended turn on gate voltage is 18 V. Do not use with V_{GSON} < 15 V.

Electrical Characteristics (T_A = 25 °C, unless otherwise specified)

Characteristics	Symbol	Conditions	Min.	Typ.	Max.	Units
Drain Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS} = 0 V, I_D = 100 µA	650			V
Gate Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 5 mA	2	2.8	4	V
		V_{DS} = V_{GS}, I_D = 5 mA, T_J = 175 °C		2.1		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 650 V, V_{GS} = 0 V		1	100	µA
Gate Source Leakage Current	I_{GSS}	V_{GS} = 18 V, V_{DS} = 0 V		10	250	nA
Drain Source On-State Resistance	$R_{DS(on)}$	V_{GS} = 18 V, I_D = 15 A	42	60	79	Ω
		V_{GS} = 18 V, I_D = 15 A, T_J = 175 °C		65		Ω
Transconductance	gfs	V_{DS} = 18 V, I_{DS} = 15 A		8		S
		V_{DS} = 18 V, I_{DS} = 15 A, T_J = 175 °C		6		S
Input Capacitance	C_{ISS}	V_{GS} = 0 V		1660		pF
Output Capacitance	C_{OSS}	V_{DS} = 650 V		139		
Reverse Transfer Capacitance	C_{RSS}	V_{AC} = 25 mV		9		
C_{OSS} Stored Energy	E_{OSS}	f = 1 MHz		13		µJ
Turn-On Switching Energy	E_{ON}	V_{DS} = 400 V, V_{GS} = -4 / 18 V		94		µJ
Turn-Off Switching Energy	E_{OFF}	I_D = 15 A, $R_{G(ext)}$ = 2.5 Ω, L = 99 uH		21		
Turn-On Delay Time	$t_{d(on)}$	V_{DS} = 400 V, V_{GS} = -4 / 18 V		28		ns
Rise Time	t_r	I_D = 15 A, $R_{G(ext)}$ = 2.5 Ω		16		

Turn-Off Delay Time	$t_{d(off)}$	Inductive Load Timing relative to		28		
Fall Time	t_f	VDS Per IEC60747-8-4 pg 83		10		
Internal Gate Resistance	$R_{G(int)}$	f = 1 MHz, AC = 25 mV		2		Ω
Gate to Source Charge	Q_{gs}	V_{DS} = 400 V, V_{GS} = -4 / 18 V		21.9		nC
Gate to Drain Charge	Q_{gd}	I_D = 15 A		20.3		
Total Gate Charge	Q_g	Per IEC60747-8-4 pg 21		62.5		

Reverse Diode Characteristics (T_A = 25 °C, unless otherwise specified)

Characteristics	Symbol	Conditions	Typ.	Max.	Units
Diode Forward Voltage	V_{SD}	V_{GS} = -4 V, I_{SD} = 7.5 A	4.5		V
	V_{SD}	V_{GS} = -4 V, I_{SD} = 7.5 A, T_J = 175 °C	4.0		V
Continuous Diode Forward Current	I_S	V_{GS}= -4 V, T_C= 25 °C	26		A
Reverse Recovery Time	t_{rr}	V_{GS} = -4 V, I_{SD} = 15 A, T_J = 25 °C	15		ns
Reverse Recovery Charge	Q_{rr}	V_R = 400 V	107		nC
Peak Reverse Recovery Current	I_{mm}	dif / dt = A / µs	12		A

Technical Data
Data Sheet N2911, REV.-

RoHS

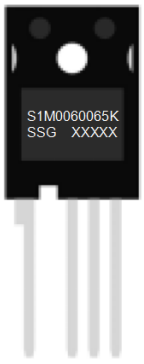
Thermal-Mechanical Specifications

Characteristics	Symbol	Condition	Specification	Units
Junction Temperature	T_J	-	-55 to +175	°C
Storage Temperature	T_{stg}	-	-55 to +175	°C
Typical Thermal Resistance Junction to Case	$R_{\theta JC}$	DC operation	0.49	°C / W

Ordering Information

Device	Package	Shipping
S1M0060065K	TO-247-4	30pcs / tube

Marking Diagram



Where XXXXX is YYWWL

S1M = Device Type
0060 = R_{DS}(on)
065 = Reverse Voltage (650V)
K = Package
SSG = SSG
YY = Year
WW = Week
L = Lot Number

Cautions: Molding resin
Epoxy resin UL:94V-0

Ratings and Characteristics Curves

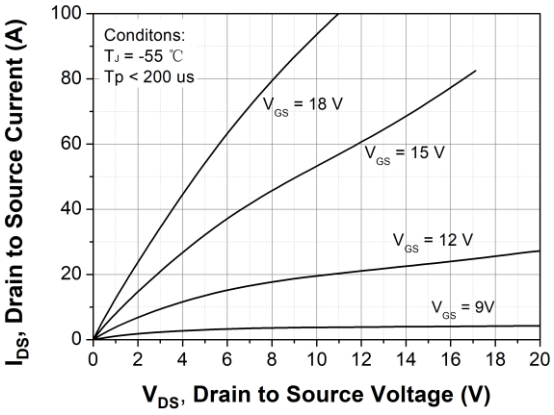


Figure 1. Output Characteristics T_J = -55 ºC

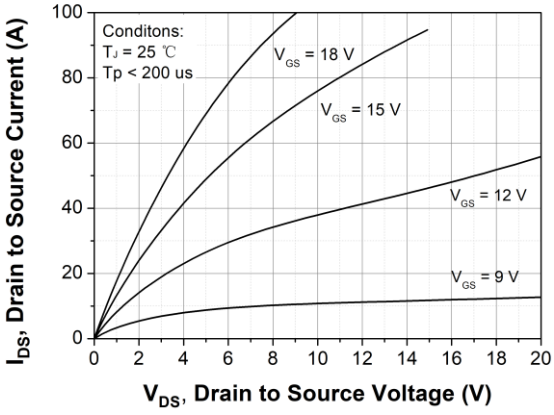


Figure 2. Output Characteristics T_J = 25 ºC

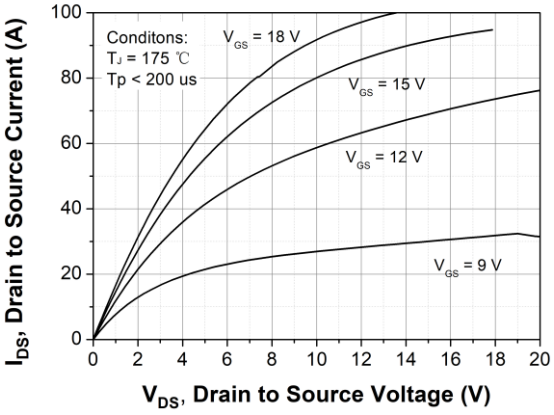


Figure 3. Output Characteristics T_J = 175 ºC

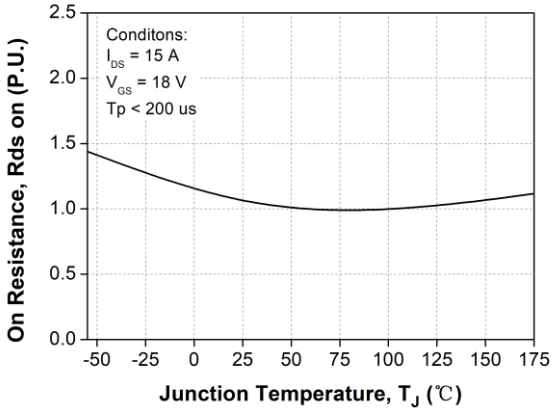


Figure 4. Normalized On-Resistance vs. Temperature

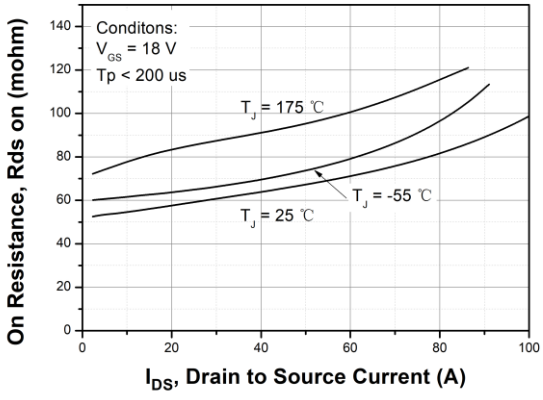


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

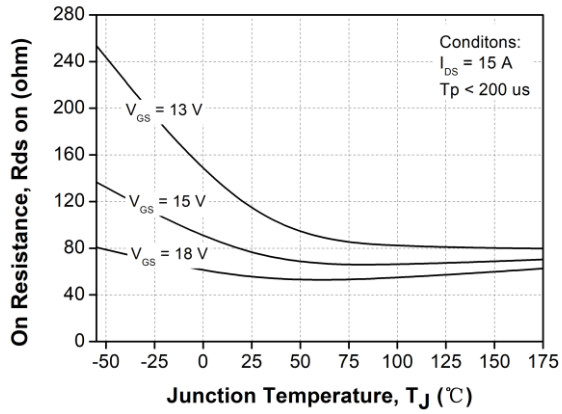


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

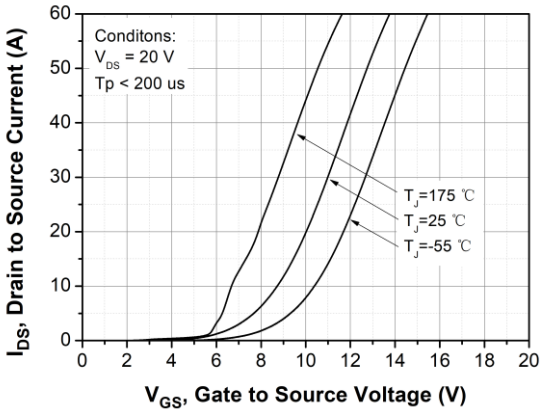


Figure 7. Transfer Characteristic for Various Junction Temperatures

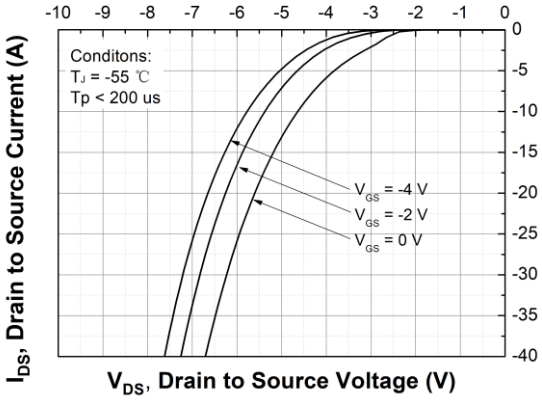


Figure 8. Body Diode Characteristic at T_J = -55 ºC

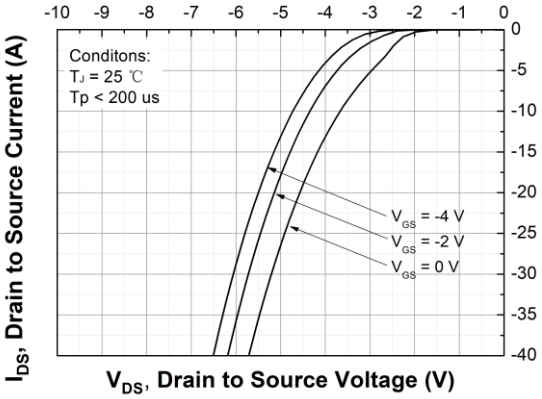


Figure 9. Body Diode Characteristic at T_J = 25 ºC

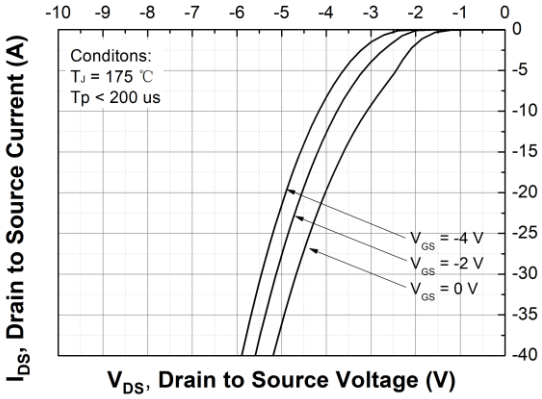


Figure 10. Body Diode Characteristic at T_J = 175 ºC

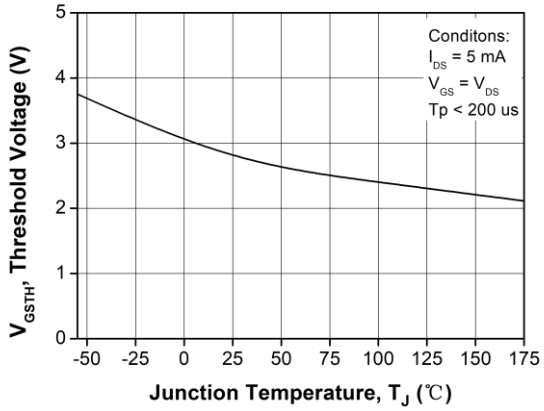


Figure 11. Threshold Voltage vs. Temperature

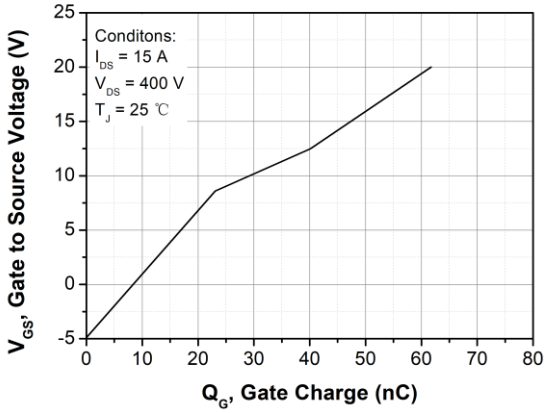


Figure 12. Gate Charge Characteristic

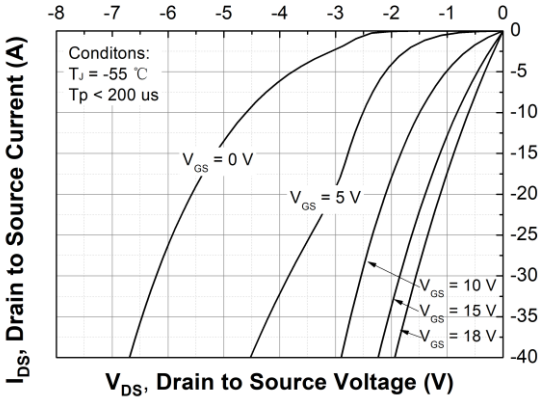


Figure 13. 3rd Quadrant Characteristic at T_J = -55 ºC

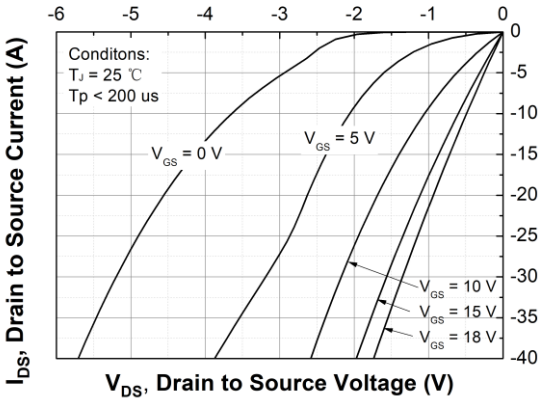


Figure 14. 3rd Quadrant Characteristic at T_J = 25 ºC

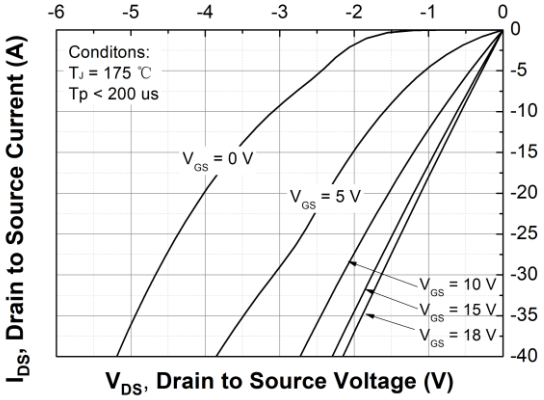


Figure 15. 3rd Quadrant Characteristic at T_J = 175 ºC

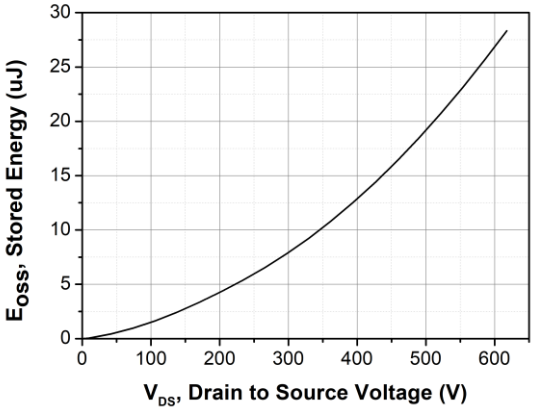


Figure 16. Output Capacitor Stored Energy

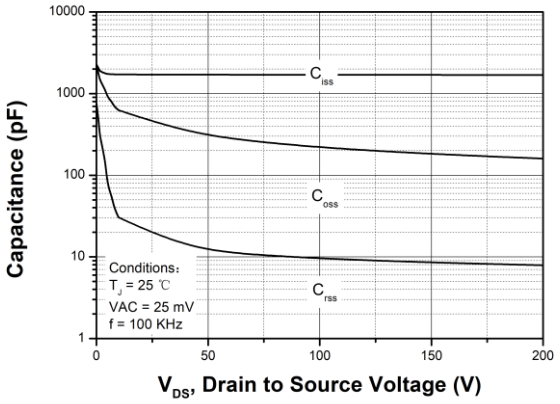


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200 V)

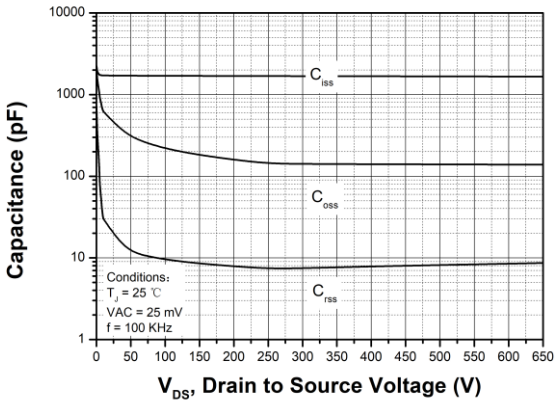


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 650 V)

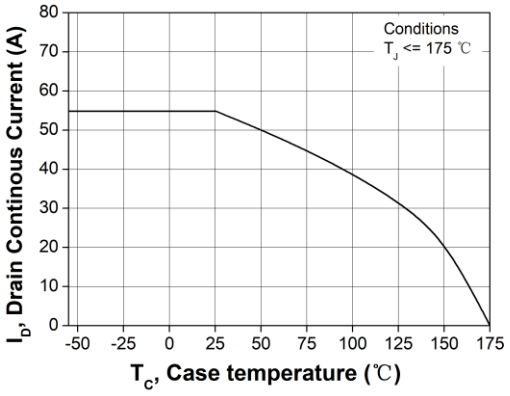


Figure 19. Continuous Drain Current Derating vs. Case Temperature

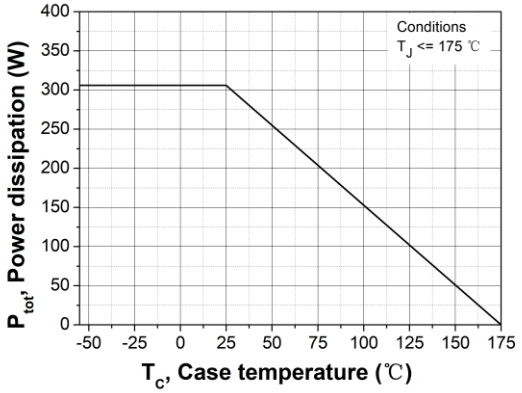


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

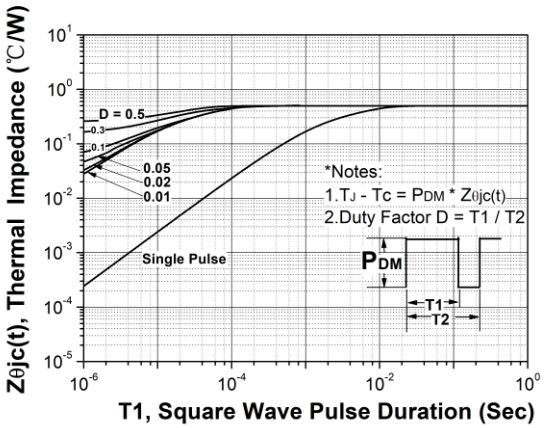


Figure 21. Transient Thermal Impedance (Junction - Case)

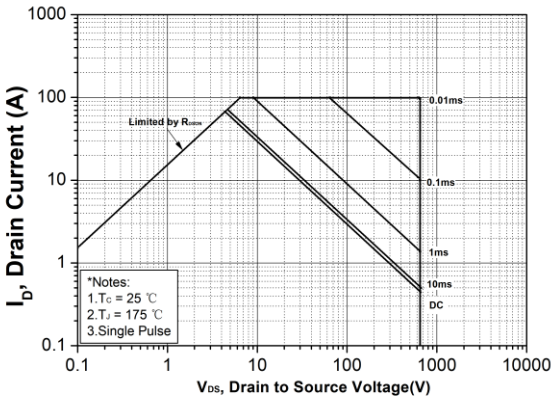


Figure 22. Safe Operating Area

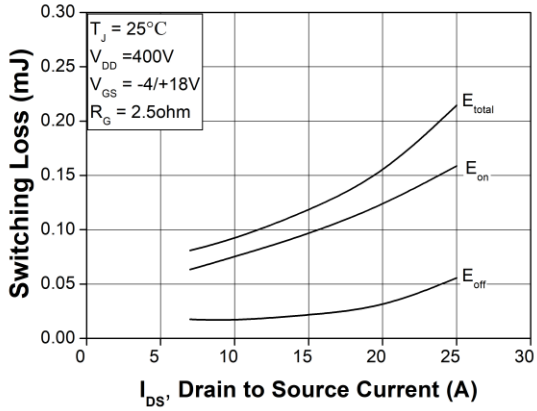


Figure 23. Clamped Inductive Switching Energy vs. Drain Current (VDD = 400V)

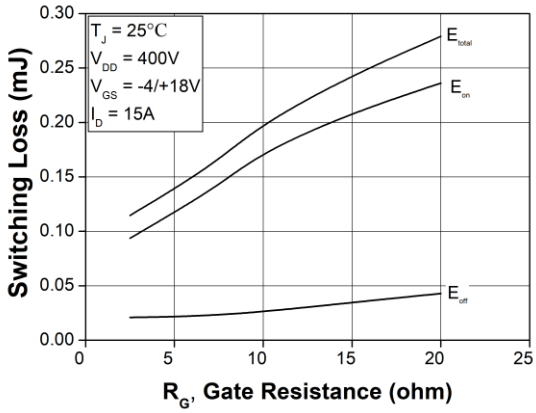


Figure 24. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

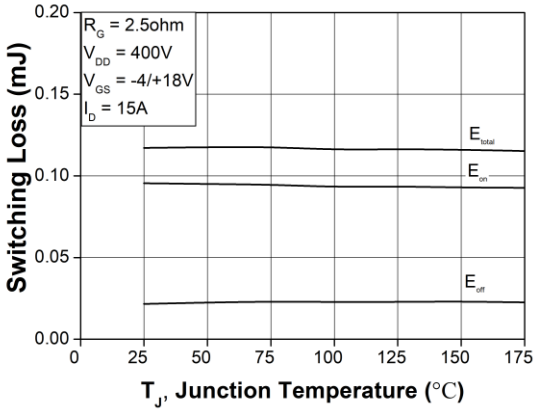


Figure 25. Clamped Inductive Switching Energy vs. Temperature

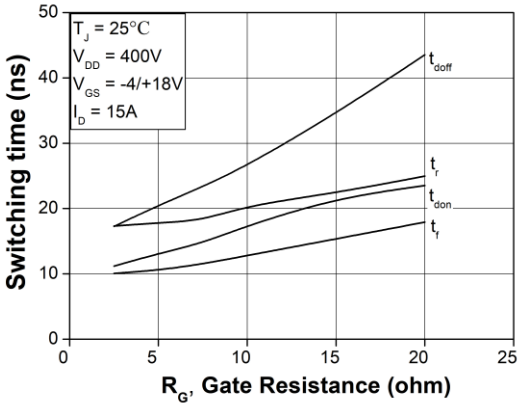
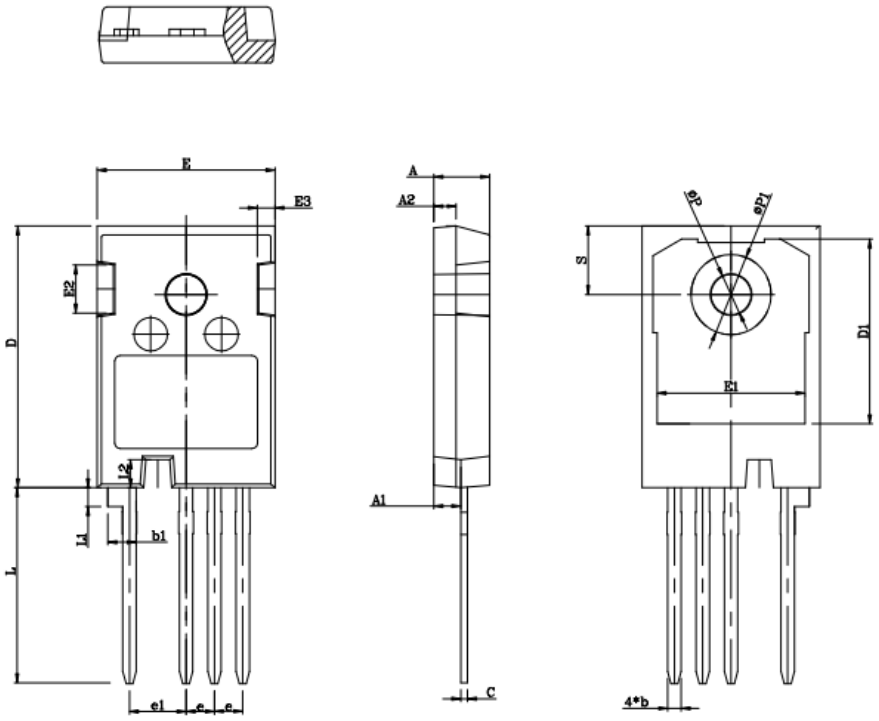


Figure 26. Switching Times vs. $R_{G(ext)}$

Technical Data
Data Sheet N2911, REV.-

RoHS

Mechanical Dimensions TO-247-4



SYMBOL	mm		
	Min	Nom	Max
A	4.80	5.00	5.20
A1	2.23	2.41	2.59
A2	1.85	2.00	2.15
b	1.11	1.21	1.36
b1	2.35	2.55	2.75
c	0.51	0.61	0.75
D	23.30	23.45	23.60
D1	16.25	16.55	16.85
E	15.75	15.94	16.10
E1	13.00	13.26	13.43
E2	4.00	4.30	4.60
E3	1.15	1.45	1.75
e		2.54BSC	
e1		5.08BSC	
L	17.31	17.47	17.82
L1	1.50	1.70	1.90
ØP	3.51	3.60	3.65
ØP1	7.08	7.19	7.30
S		6.15BSC	

S1M0060065K

Technical Data
Data Sheet N2911, REV.-

RoHS

DISCLAIMER:
1- The information given herein, including the specifications and dimensions, is subject to change without prior notice to improve product characteristics. Before ordering, purchasers are advised to contact the SMC Diode Solutions sales department for the latest version of the datasheet(s).
2- In cases where extremely high reliability is required (such as use in nuclear power control, aerospace and aviation, traffic equipment, medical equipment , and safety equipment) , safety should be ensured by using semiconductor devices that feature assured safety or by means of users' fail-safe precautions or other arrangement .
3- In no event shall SMC Diode Solutions be liable for any damages that may result from an accident or any other cause during operation of the user's units according to the datasheet(s). SMC Diode Solution assumes no responsibility for any intellectual property claims or any other problems that may result from applications of information, products or circuits described in the datasheets.
4- In no event shall SMC Diode Solutions be liable for any failure in a semiconductor device or any secondary damage resulting from use at a value exceeding the absolute maximum rating.
5- No license is granted by the datasheet(s) under any patents or other rights of any third party or SMC Diode Solutions.
6- The datasheet(s) may not be reproduced or duplicated, in any form, in whole or part, without the expressed written permission of SMC Diode Solutions.
7- The products (technologies) described in the datasheet(s) are not to be provided to any party whose purpose in their application will hinder maintenance of international peace and safety nor are they to be applied to that purpose by their direct purchasers or any third party. When exporting these products (technologies), the necessary procedures are to be taken in accordance with related laws and regulations..