Technical Data
Data Sheet N2705, REV.A

RoHS

S2M0016120K-1
1200V SIC POWER MOSFET

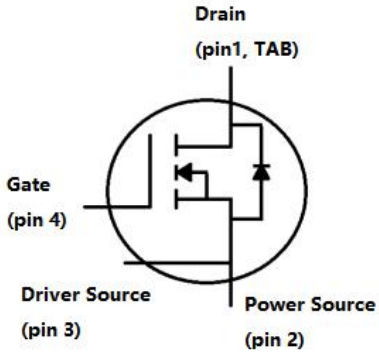
1 2 3 4

V_{DS} = 1200 V
I_{DS} = 140 A
R_{DS}(on) = 17 mΩ

Description

S2M0016120K-1 is single SiC Power MOSFET packaged in TO-247-4 case. The device is a high voltage n-channel enhancement mode MOSFET that has very low total conduction losses and very stable switching characteristics over temperature extremes. The S2M0016120K-1 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) = 17mΩ .
- Fast switching speed and low switching losses.
- Very fast and robust intrinsic body diode.
- Process of non-bright Tin electroplatin

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)

Maximum Ratings(T=25℃ unless otherwise specified)

Characteristics	Symbol	Condition	Max.	Units
Drain Source Voltage	V_{DSS}	V_{GS} = 0V, I_{DS} = 100uA, T_C = 25°C	1200	V
Gate Source Voltage	V_{GSS}	T_C = 25°C, Absolute maximum values, AC (f>1Hz)	-10 to +25	V
Gate Source Voltage	V_{GSOP}	T_C = 25°C Recommended Operational Values	-5 to +20	V
Continuous Drain Current	I_D	V_{GS} = 20V, T_C = 25°C	140	A
	I_D	V_{GS} = 20V, T_C = 100°C	99	A
Pulsed Drain Current	$I_{D,pulse}$	T_C=25˚C	250	A
Power Dissipation	P_D	T_C=25˚C	517	W

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Electrical Characteristics(T=25℃ unless otherwise specified)

Characteristics	Symbol	Condition	Min.	Typ.	Max.	Units
Drain Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS} = 0V, I_D = 100uA	1200			V
Gate Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 23mA	1.8	2.55	3.6	V
		V_{DS} = V_{GS}, I_D = 23mA, T_J = 175 °C		1.85		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 1200V, V_{GS} = 0V		1	10	uA
Gate Source Leakage Current	I_{GSS}	V_{GS} = 20V, V_{DS} = 0V		10	250	nA
Drain Source On-State Resistance	$R_{DS(on)}$	V_{GS} = 20V, I_D = 75A	11.2	17	23	mΩ
		V_{GS} = 18V, I_D = 75A		19		mΩ
		V_{GS} = 20V, I_D = 75A, T_J = 175 °C		28		mΩ
		V_{GS} = 18V, I_D = 75A, T_J = 175 °C		29		mΩ
Transconductance	gfs	V_{DS}= 20 V, I_D= 75 A		24		S
		V_{DS}= 20 V, I_D= 75 A, T_J = 175 °C		18		S
Input Capacitance	C_{ISS}	V_{GS} = 0V,		4540		pF
Output Capacitance	C_{OSS}	V_{DS} = 1000V		210		
Reverse Transfer Capacitance	C_{RSS}	V_{AC} = 25mV		29.3		
C_{OSS} Stored Energy	E_{OSS}	f =100kHz		122		uJ
Turn-On Switching Energy	E_{ON}	V_{DS} = 800V, V_{GS} = -5/+20V ID =75A, RG(ext)=2.5Ω L=65.7uH, TJ = 25 °C		0.44		mJ
Turn-Off Switching Energy	E_{OFF}			0.44		
Turn-On Delay Time	$t_{d(on)}$	V_{DS} = 800V, V_{GS} = -5/20V		13.76		ns
Rise Time	t_r	I_D = 75A, $R_{G(ext)}$= 2.5Ω, L=67.5uH		21.12		
Turn-Off Delay Time	$t_{d(off)}$	Inductive Load Timing relative to VDS Per IEC60747-8-4 pg 83		33.92		
Fall Time	t_f			8.96		
Internal Gate Resistance	$R_{G(int)}$	f = 1MHz, VAC = 25 mV, D-S short		1.5		Ω
Gate to Source Charge	Q_{gs}	V_{DS} = 800V, V_{GS} = -5/20V		290		nC
Gate to Drain Charge	Q_{gd}	I_D = 75A		37.2		
Total Gate Charge	Q_g			285		

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Reverse Diode Characteristics:

Characteristics	Symbol	Condition	Typ.	Max.	Units
Diode Forward Voltage	V_{SD}	V_{GS}= -5V, I_{SD}= 37.5A	4.0		V
	V_{SD}	V_{GS}= -5V, I_{SD}= 37.5A, T_J= 175°C	3.5		V
Continuous Diode Forward Current	I_S	V_{GS}= -5V, T_C= 25℃		112	A
Reverse Recovery Time	t_{rr}	V_{GS}= -5V, I_{SD}= 75A, T_J= 175°C	15		ns
Reverse Recovery Charge	Q_{rr}	V_R= 800V	201		nC
Peak Reverse Recovery Current	I_{mm}	dif/dt= 2664A/μs	21		A

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	0.29	°C/W
Typical Thermal Resistance Junction to Ambient	$R_{\theta JA}$		38.85	°C/W

Ordering Information:

Device	Package	Shipping
S2M0016120K-1	TO-247-4	30pcs/tube

Marking Diagram

Where XXXXX is YYWWL

S2M = Device Type
0016 = R_{DS}(on)
120 = Reverse Voltage (1200V)
K = Package
SSG = SSG
YY = Year
WW = Week
L = Lot Number

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

Ratings and Characteristics Curves

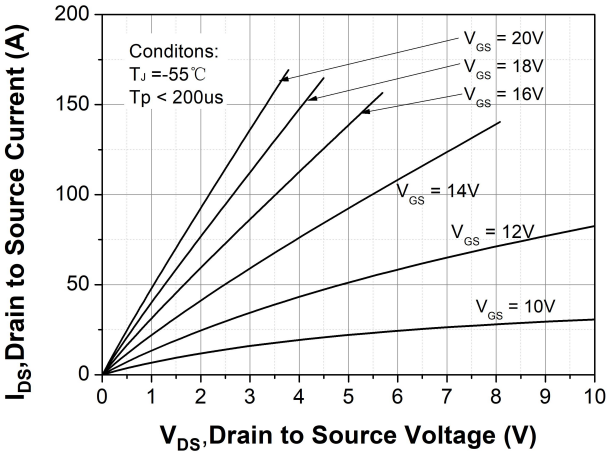

Figure 1. Output Characteristics T_J = -55 °C

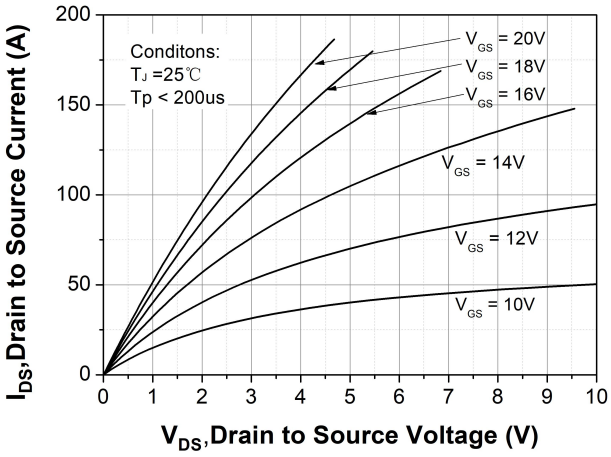

Figure 2. Output Characteristics T_J = 25 °C

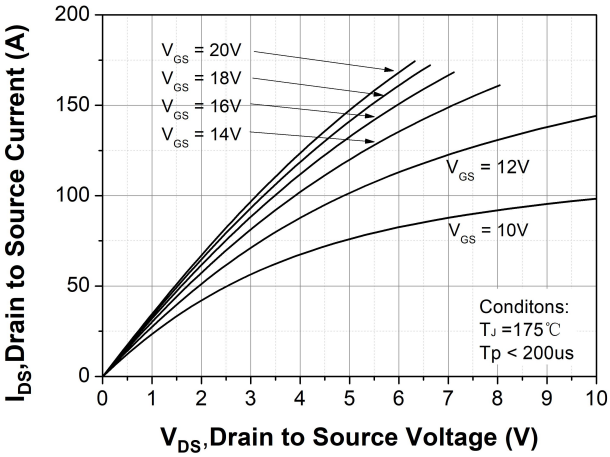

Figure 3. Output Characteristics T_J = 175°C

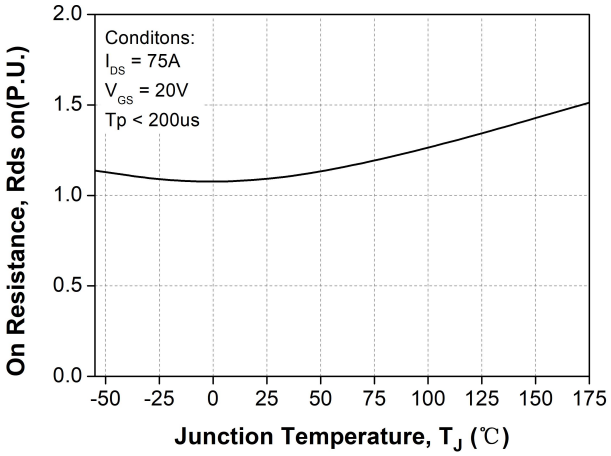

Figure 4. Normalized On-Resistance vs. Temperature

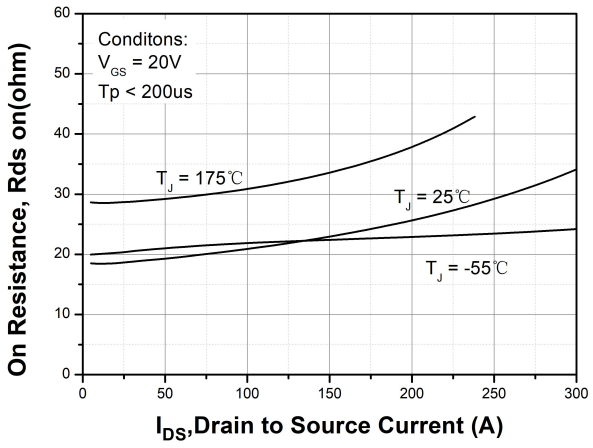

Figure 5. On-Resistance vs. Drain Current
For Various Temperatures

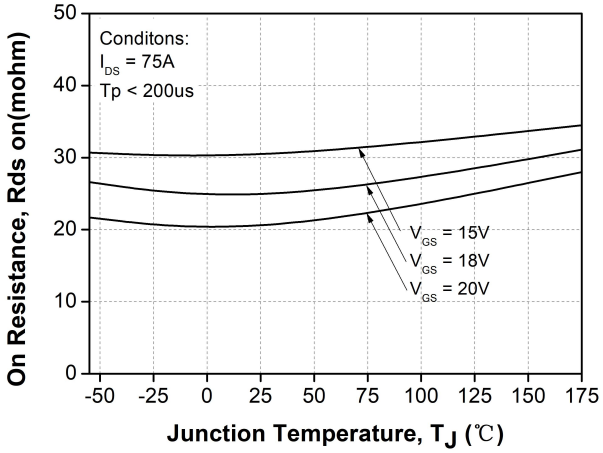

Figure 6. On-Resistance vs. Temperature
For Various Gate Voltage

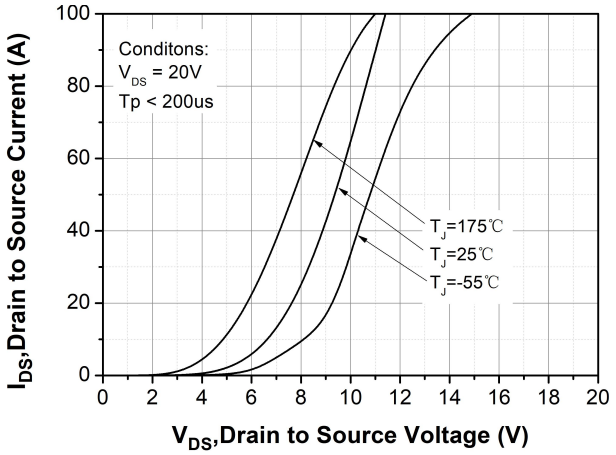

Figure 7. Transfer Characteristic for Various Junction Temperatures

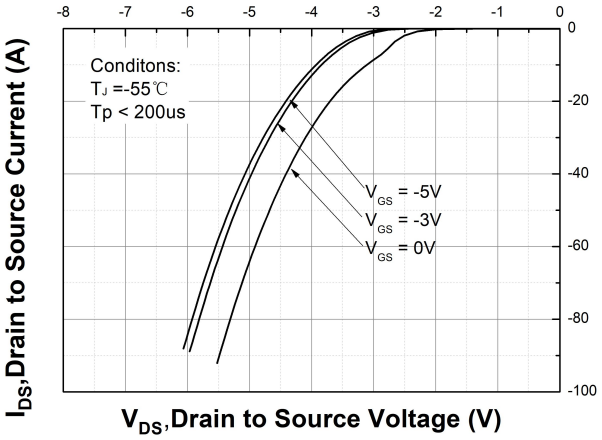

Figure 8. Body Diode Characteristic at T_J = -55 °C

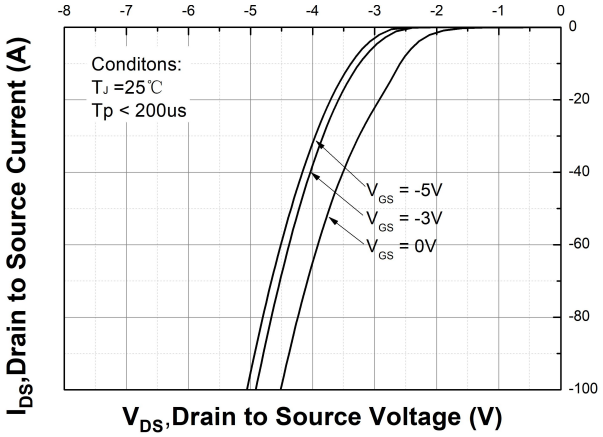

Figure 9. Body Diode Characteristic at T_J = 25 °C

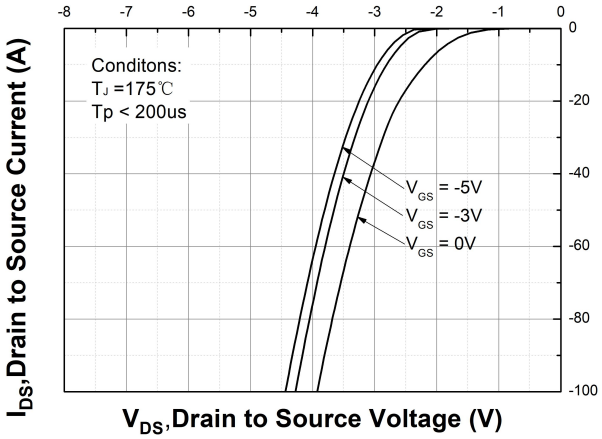

Figure 10. Body Diode Characteristic at T_J = 175 °C

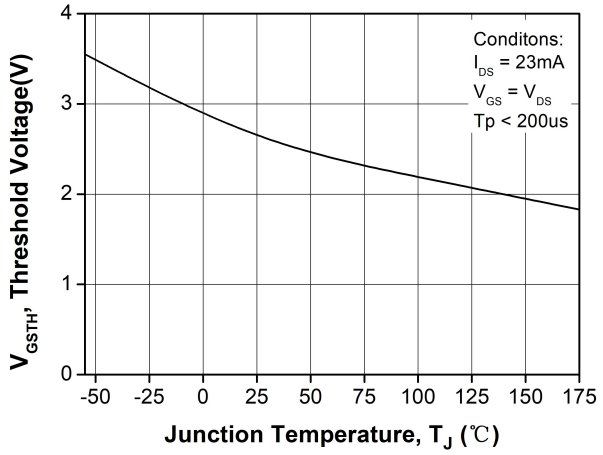

Figure 11. Threshold Voltage vs. Temperature

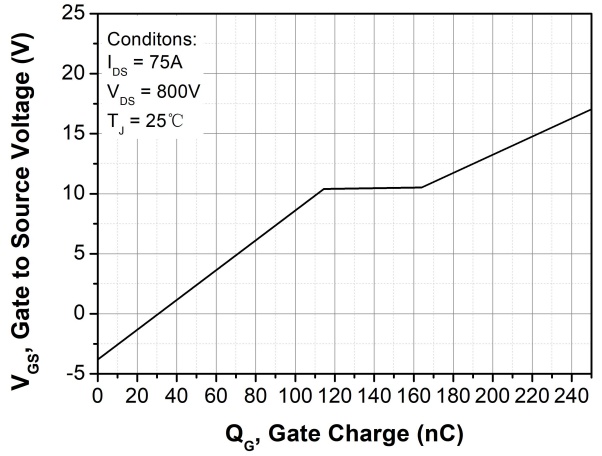

Figure 12. Gate Charge Characteristic

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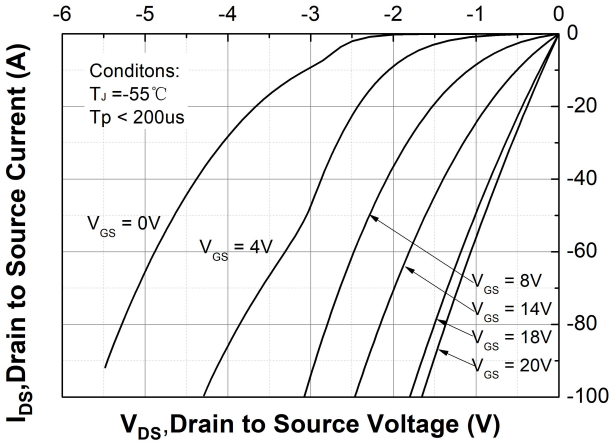

Figure 13. 3rd Quadrant Characteristic at T_J = -55 °C

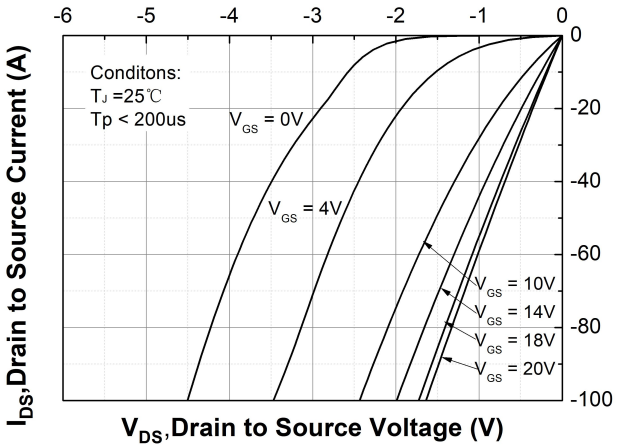

Figure 14. 3rd Quadrant Characteristic at T_J = 25 °C

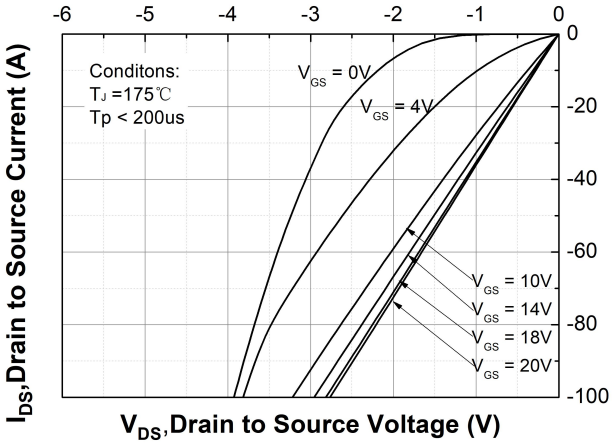

Figure 15. 3rd Quadrant Characteristic at T_J = 175°C

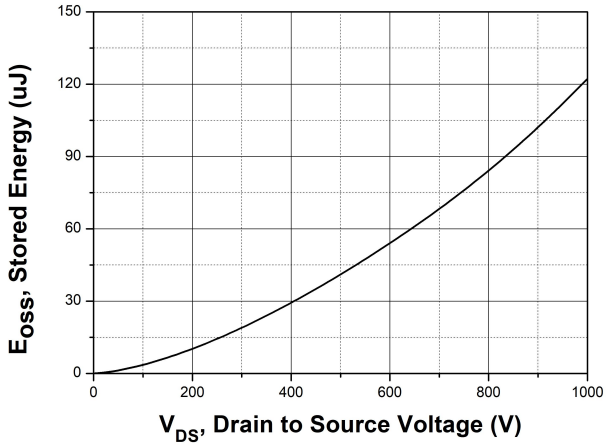

Figure 16. Output Capacitor Stored Energy

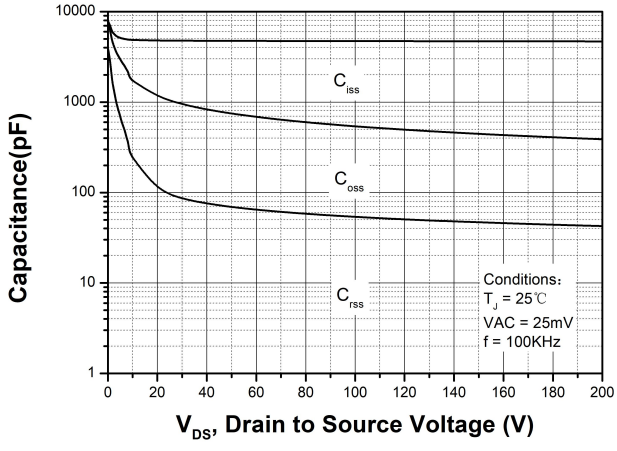

Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

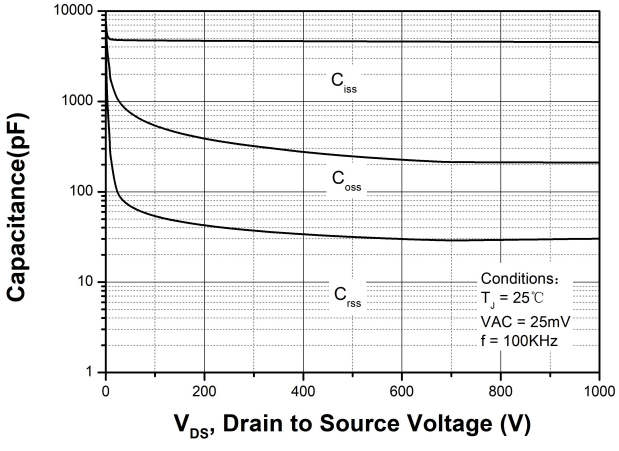

Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1000V)

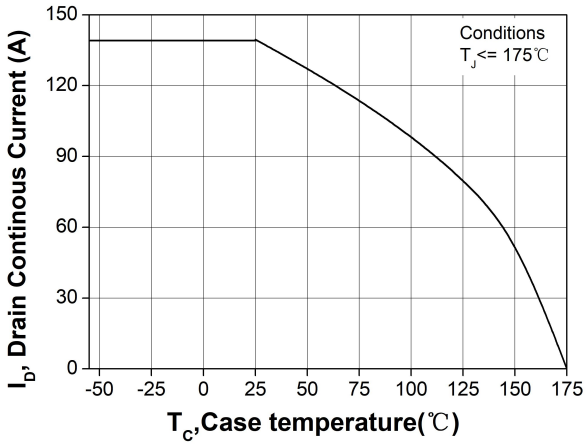

Figure 19. Continuous Drain Current Derating vs. Case Temperature

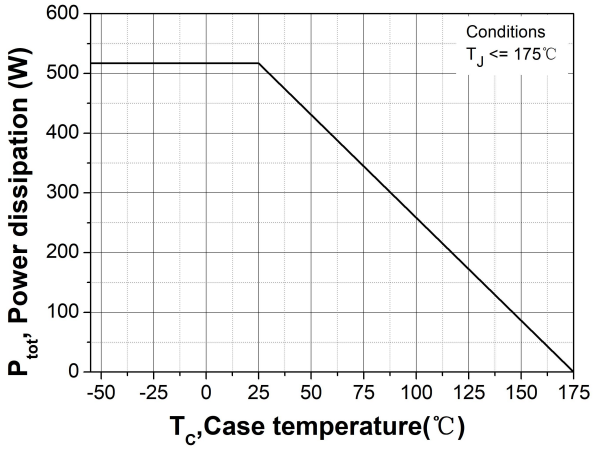

Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

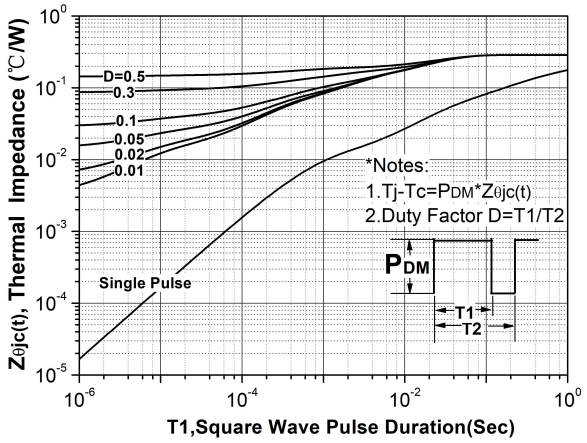

Figure 21. Transient Thermal Impedance (Junction - Case)

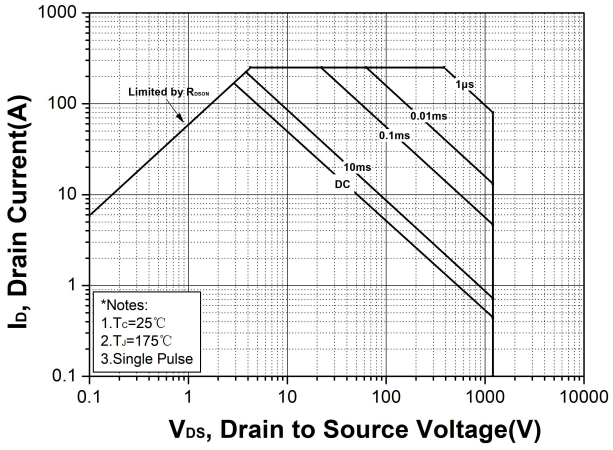

Figure 22. Safe Operating Area

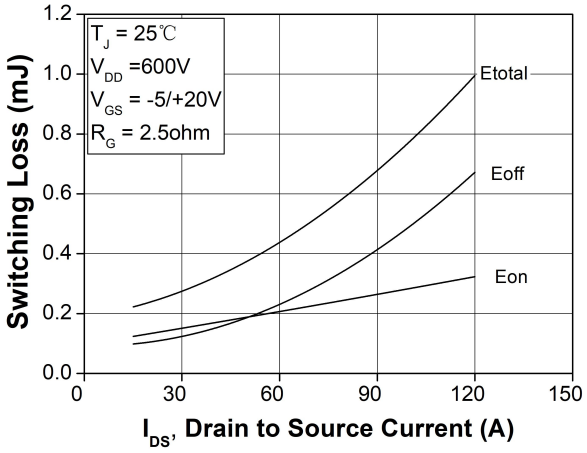

Figure 23. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 600V)

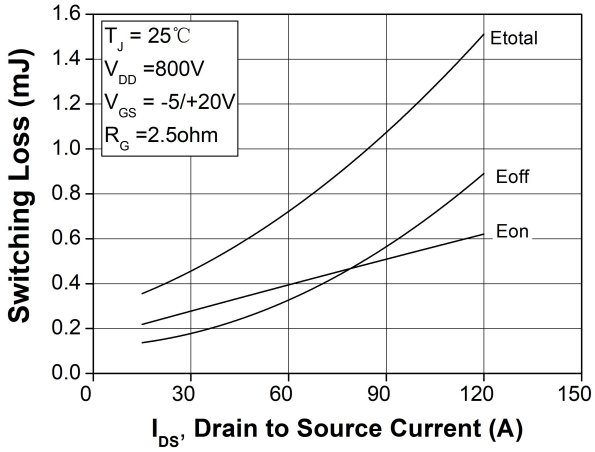

Figure 24. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 800V)

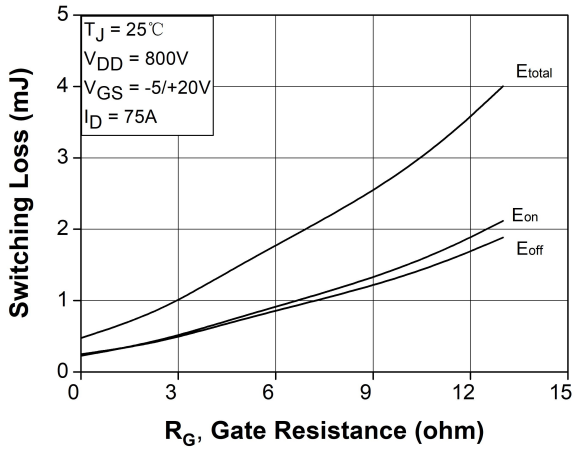

Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

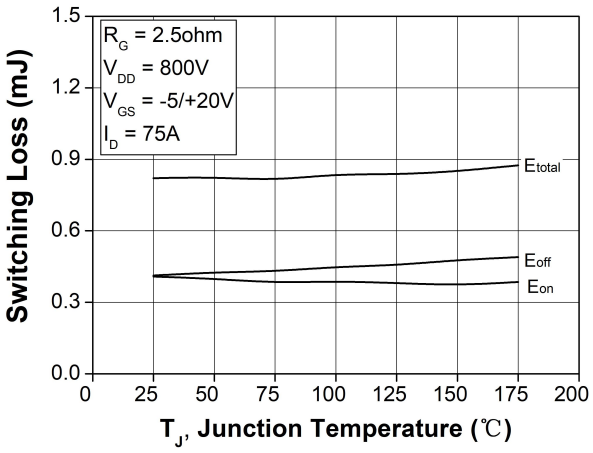

Figure 26. Clamped Inductive Switching Energy vs. Temperature

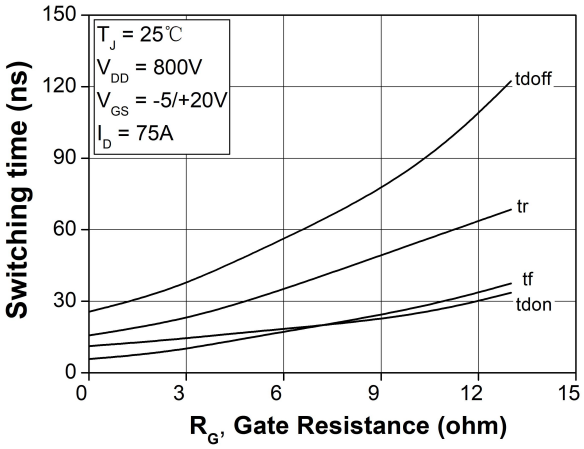

Figure 27. Switching Times vs. $R_{G(ext)}$

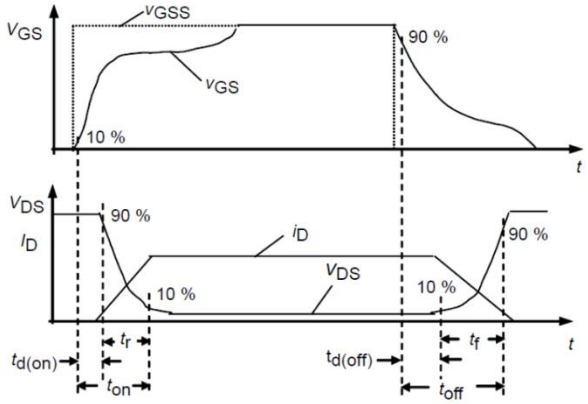

Figure 28. Switching Times Definition

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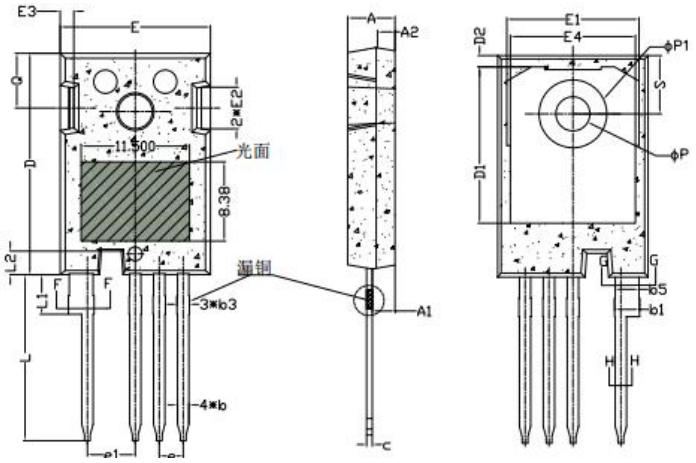
Mechanical Dimensions TO-247-4



Symbol	In mm		
	Min	Nom	Max
A	4.83	5.00	5.21
A1	2.29	2.41	2.54
A2	1.91	2.00	2.16
b’	1.07	1.20	1.28
b	1.07	1.20	1.33
b1	2.39	2.67	2.94
b2	2.39	2.67	2.84
b3	1.07	1.30	1.60
b4	1.07	1.30	1.50
b5	2.39	2.53	2.69
b6	2.39	2.53	2.64
c	0.55	0.60	0.68
c1	0.55	0.60	0.65
D	23.30	23.45	23.60
D1	16.25	16.55	17.65
D2	0.95	1.19	1.25
E	15.75	15.94	16.13
E1	13.10	14.02	14.15
E2	3.68	4.40	5.10
E3	1.00	1.45	1.90
E4	12.38	13.26	13.43
e	2.54 BSC		
e1	5.08 BSC		
L	17.31	17.57	17.82
L1	3.97	4.19	4.37
L2	2.35	2.50	2.65
ΦP	3.51	3.61	3.65
ΦP1	7.19 REF		
Q	5.49	5.79	6.00
S	6.04	6.17	6.30

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