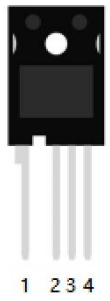
Technical Data
Data Sheet N2511, REV.A

RoHS

S2M0040120K
1200V SIC POWER MOSFET



V_{DS} = 1200 V
I_{DS}@ 25℃ = 55 A
R_{DS}(on) = 40 mΩ

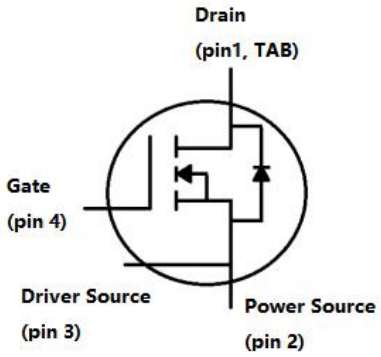
Description

S2M0040120K 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 S2M0040120K is ideal for energy sensitive, high frequency applications in challenging environments.

Features

- Positive temperature characteristics, easy to parallel.
- Low on-resistance Typ. RDS(on) = 40mΩ .
- Fast switching speed and low switching losses.
- Very fast and robust intrinsic body diode.
- Process of non-bright Tin electroplatin

Circuit Diagram



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	55	A
	I_D	V_{GS} = 20V, T_C = 100°C	44	A
Pulsed Drain Current	$I_{D,pulse}$	Pulse width tP limited by T_J max	160	A
Power Dissipation	PD	T_C=25˚C, T_J = 175 ˚C	320.5	W
Solder Temperature	TL	1.6mm (0.063”) from case for 10s	260	°C

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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 = 10mA	1.8	2.0	4	V
		V_{DS} = V_{GS}, I_D = 10mA, T_J = 175 °C		1.4		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 1200V, V_{GS} = 0V		1	100	uA
Gate Source Leakage Current	I_{GSS}	V_{GS} = 20V, V_{DS} = 0V			250	nA
Drain Source On-State Resistance	$R_{DS(on)}$	V_{GS} = 20V, I_D = 40A		44	52	mΩ
		V_{GS} = 20V, I_D = 40A, T_J = 175 °C		82		mΩ
Transconductance	gfs	V_{DS} = 20 V, I_{DS} = 40 A		14		S
		V_{DS} = 20 V, I_{DS} = 40 A, T_J = 175 °C		11		S
Input Capacitance	C_{ISS}	V_{GS} = 0V, V_{DS} = 1000V, V_{AC} = 25mV, f = 1MHz		2748		pF
Output Capacitance	C_{OSS}			169		
Reverse Transfer Capacitance	C_{RSS}			5		
C_{OSS} Stored Energy	E_{OSS}			84		uJ
Turn-On Switching Energy	E_{ON}	V_{DS} = 800V, V_{GS} = -5/20V, I_D = 40A, $R_{G(ext)}$ = 2.5Ω, L= 99uH		1.2		mJ
Turn-Off Switching Energy	E_{OFF}			0.4		
Turn-On Delay Time	$t_{d(on)}$	V_{DS} = 800V, V_{GS} = -5/20V, I_D = 40A, $R_{G(ext)}$ = 2.5Ω, Inductive Load Timing relative to VDS Per IEC60747-8-4 pg 83		43		ns
Rise Time	t_r			14		
Turn-Off Delay Time	$t_{d(off)}$			30		
Fall Time	t_f			18		
Internal Gate Resistance	$R_{G(int)}$	f = 1MHz, VAC = 25 mV		4.5		Ω
Gate to Source Charge	Q_{gs}	V_{DS} = 800V, V_{GS} = -5/20V, I_D = 40A, Per IEC60747-8-4 pg 21		34		nC
Gate to Drain Charge	Q_{gd}			42		
Total Gate Charge	Q_g			118		

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Reverse Diode Characteristics:

Characteristics	Symbol	Condition	Typ.	Max.	Units
Diode Forward Voltage	V_{SD}	V_{GS} = -5V, I_{SD} = 20A	4.1		V
		V_{GS} = -5V, I_{SD} = 20A, T_J =175℃	3.6		V
Continuous Diode Forward Current	Is	T_C = 25℃		63	A
Reverse Recovery Time	t_{rr}	V_{GS} = -5V, I_{SD} = 40A, T_J = 25°C V_R = 800V dif/dt = 1047A/μs	63		ns
Reverse Recovery Charge	Q_{rr}		301		nC
Peak Reverse Recovery Current	I_{mm}		9.3		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	0.39	°C/W
Maximun Thermal Resistance Junction to Ambient	$R_{\theta JA}$		40	°C/W

Ordering Information:

Device	Package	Shipping
S2M0040120K	TO-247-4	30pcs/tube

Ratings and Characteristics Curves

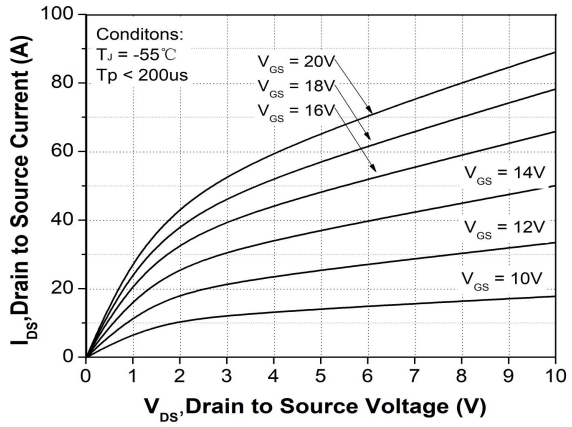

Figure 1. Output Characteristics T_J = -55 °C

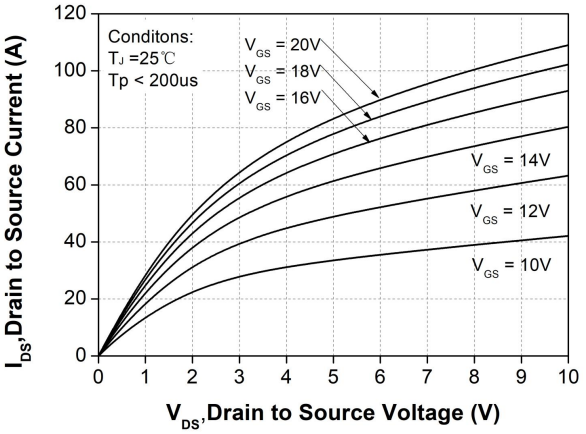

Figure 2. Output Characteristics T_J = 25 °C

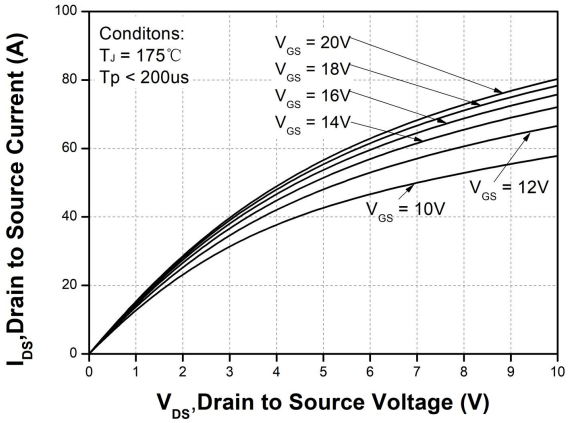

Figure 3. Output Characteristics T_J = 175°C

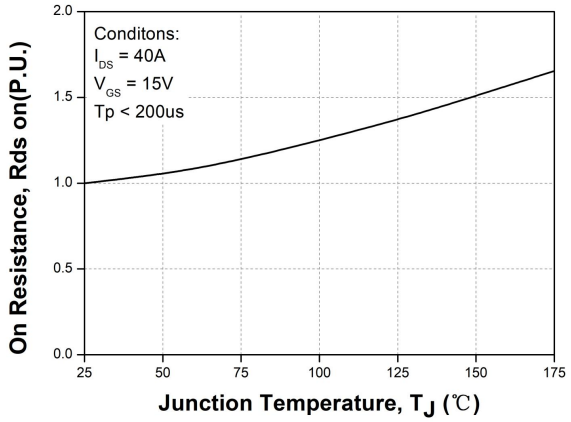

Figure 4. Normalized On-Resistance vs. Temperature

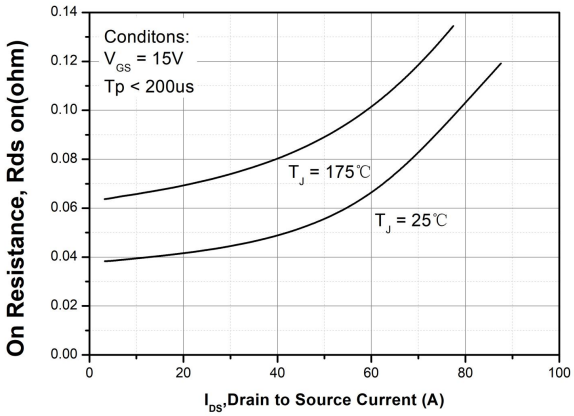

Figure 5. On-Resistance vs. Drain Current
For Various Temperatures

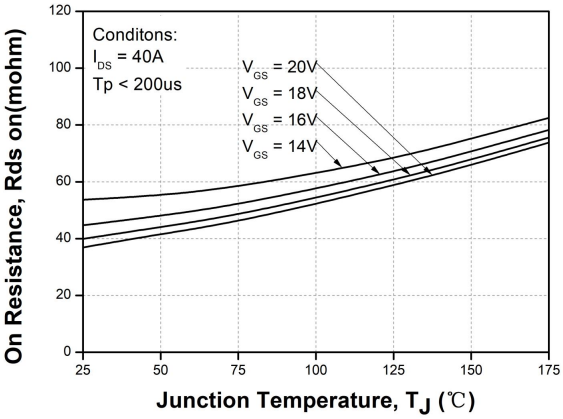

Figure 6. On-Resistance vs. Temperature
For Various Gate Voltage

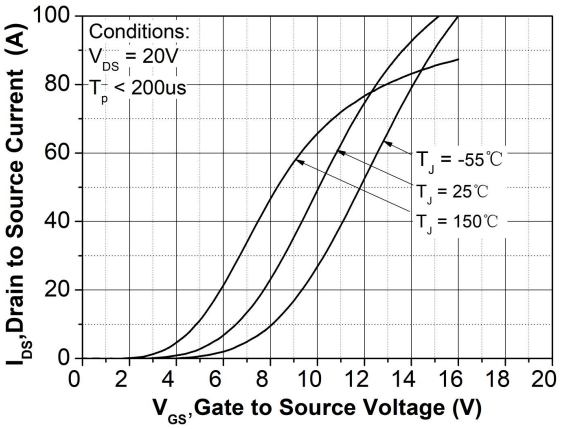

Figure 7. Transfer Characteristic for Various Junction Temperatures

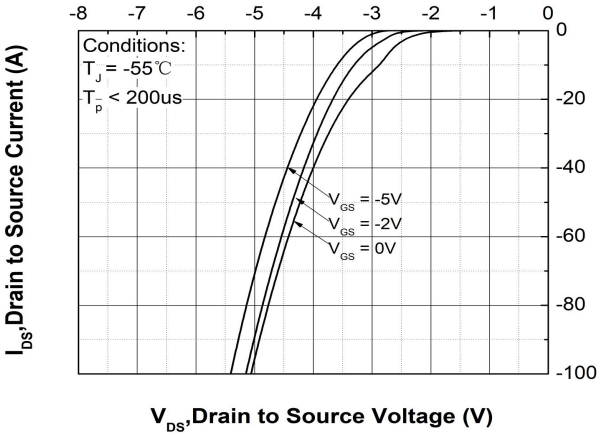

Figure 8. Body Diode Characteristic at T_J = -55 °C

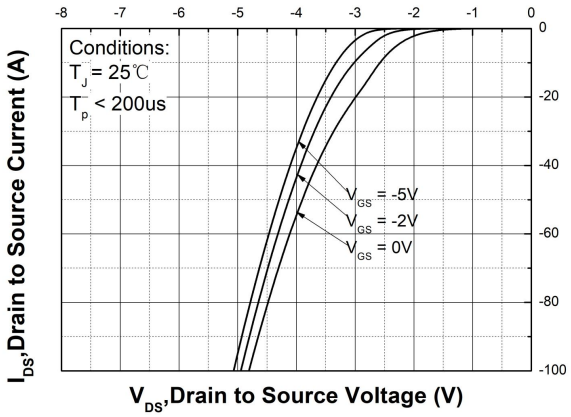

Figure 9. Body Diode Characteristic at T_J = 25 °C

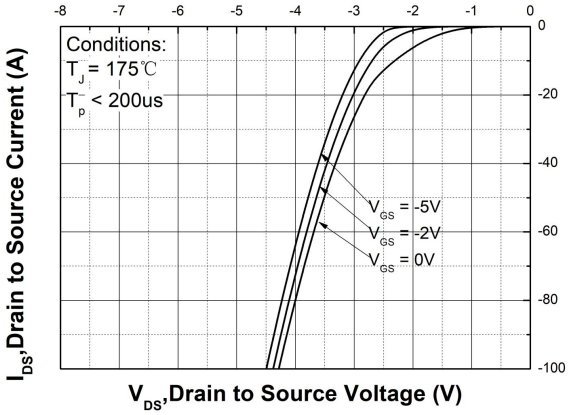

Figure 10. Body Diode Characteristic at T_J = 175 °C

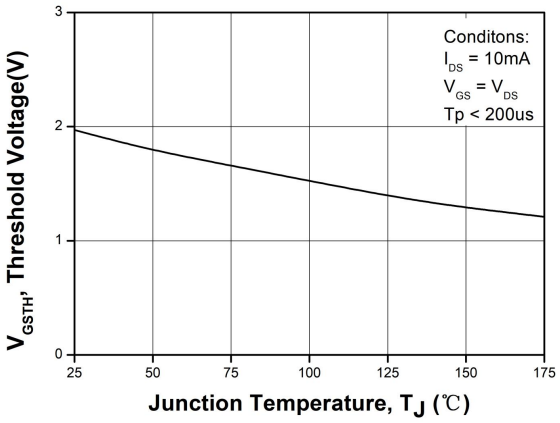

Figure 11. Threshold Voltage vs. Temperature

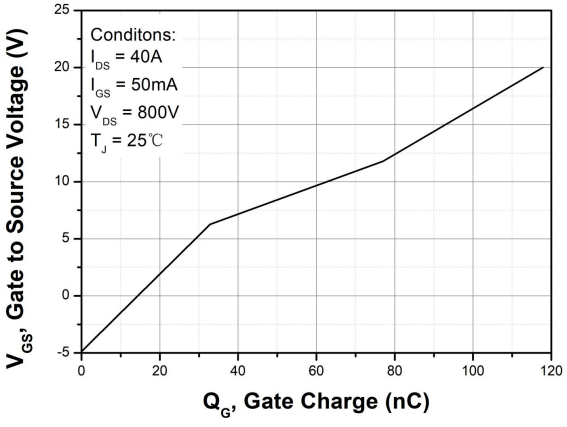

Figure 12. Gate Charge Characteristic

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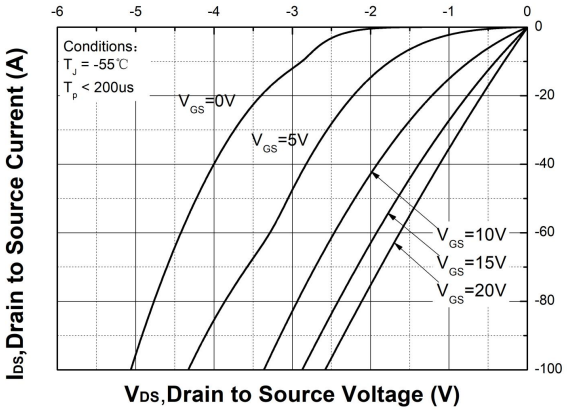

Figure 13. 3rd Quadrant Characteristic at T_J = -55 °C

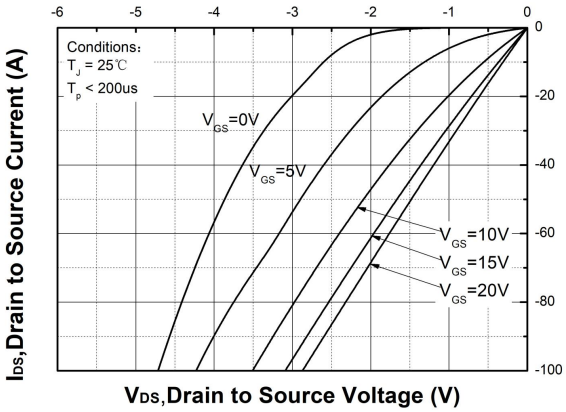

Figure 14. 3rd Quadrant Characteristic at T_J = 25 °C

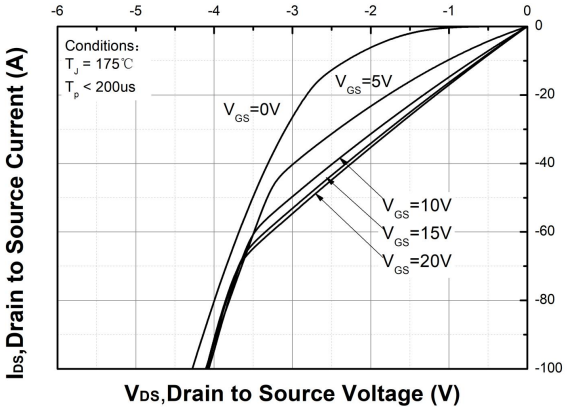

Figure 15. 3rd Quadrant Characteristic at T_J = 175°C

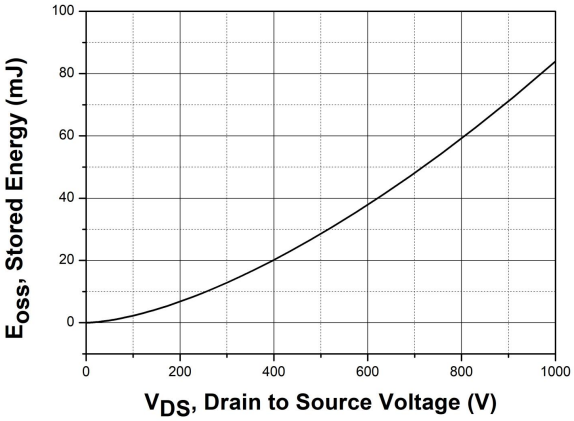

Figure 16. Output Capacitor Stored Energy

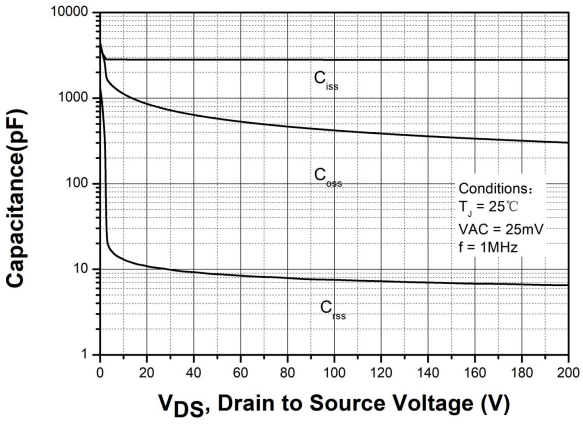

Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

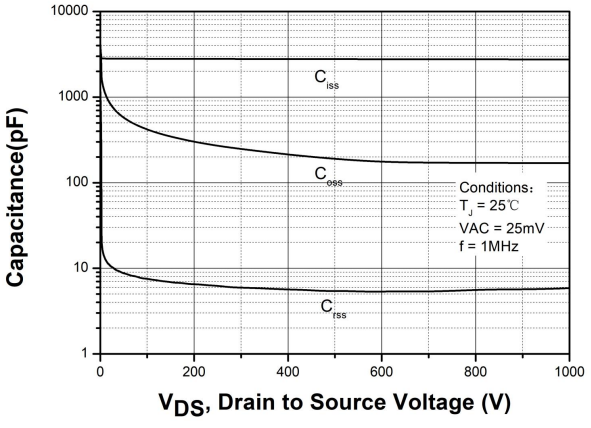

Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1000V)

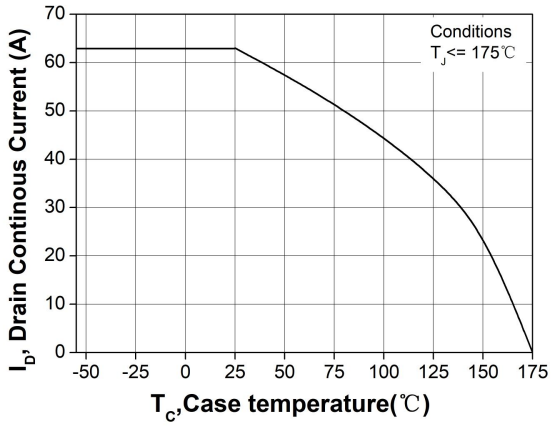

Figure 19. Continuous Drain Current Derating vs. Case Temperature

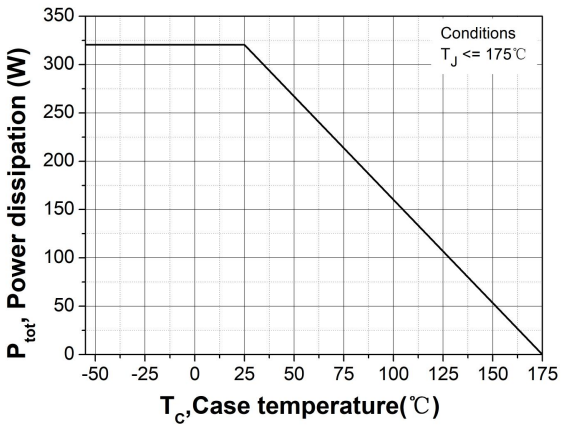

Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

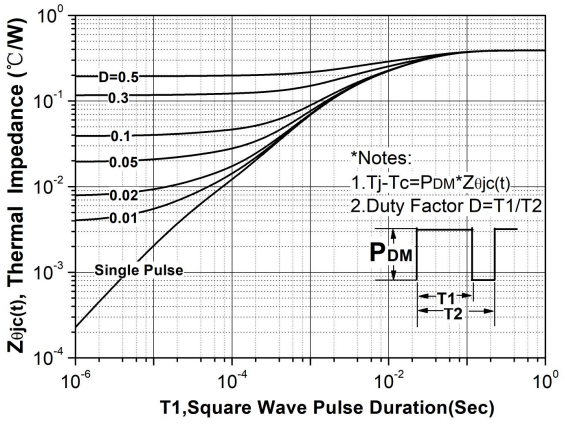

Figure 21. Transient Thermal Impedance (Junction - Case)

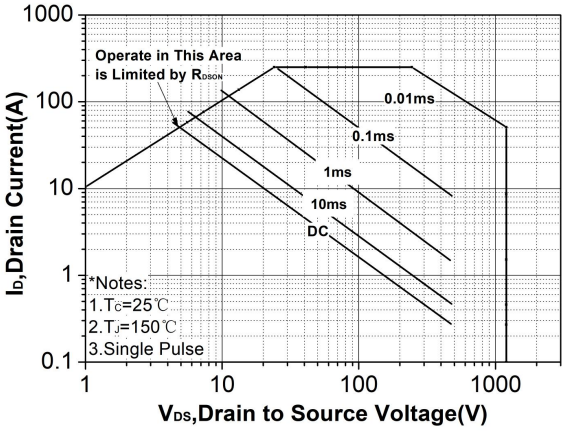

Figure 22. Safe Operating Area

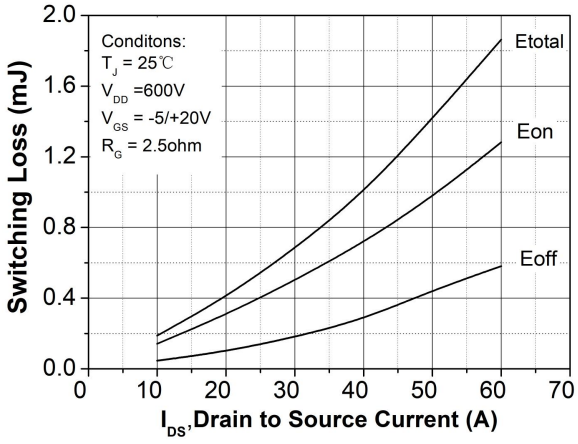

Figure 23. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 600V)

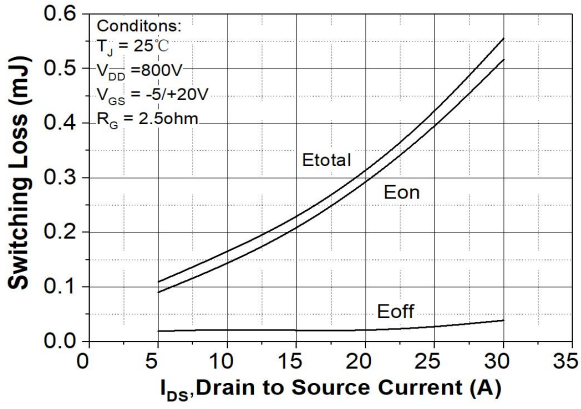

Figure 24. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 800V)

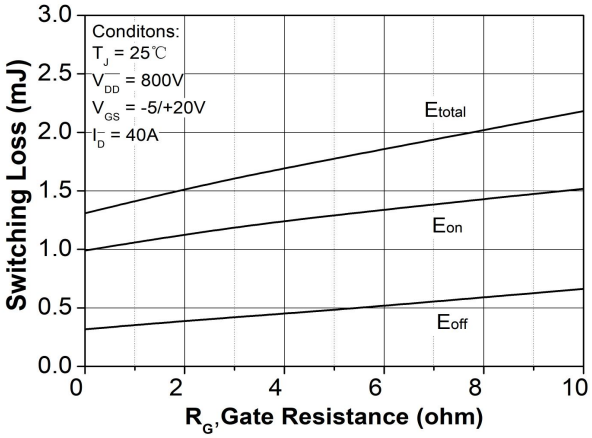

Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

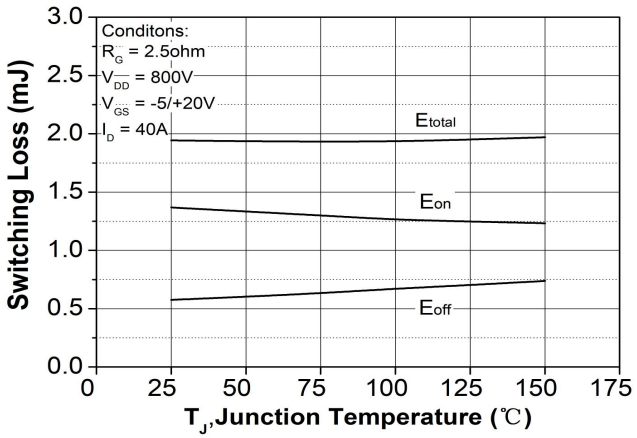

Figure 26. Clamped Inductive Switching Energy vs. Temperature

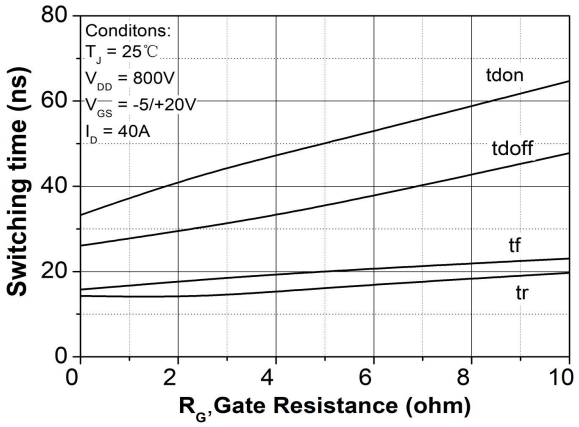

Figure 27. Switching Times vs. $R_{G(ext)}$

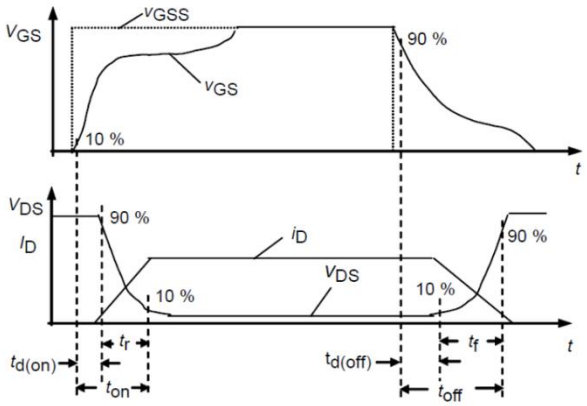

Figure 28. Switching Times Definition

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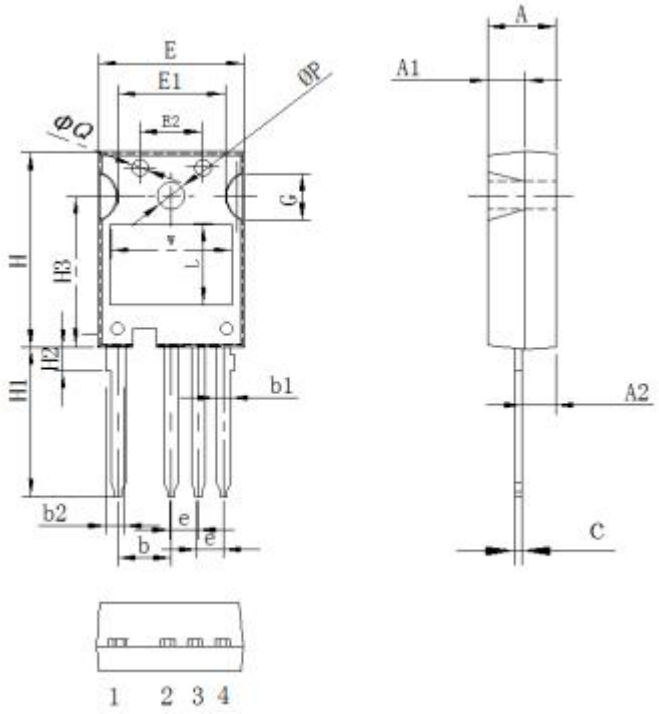
Marking Diagram

Where XXXXX is YYWWL

S2M = Device Type
0040 = 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

Mechanical Dimensions TO-247-4



Symbol	In mm		
	Min	Nom	Max
A	4.80	5.00	5.21
A1	2.29	3.00	3.20
A2	1.91	2.40	2.60
b	4.80	5.05	5.25
b1	1.05	1.25	1.60
b2	1.07	2.30	2.65
c	0.50	0.60	0.70
e	2.35	2.55	2.88
E	15.50	15.70	16.13
E1	10.50	10.70	10.90
E2	6.35	7.60	7.80
G	4.80	5.00	5.20
H	22.40	22.60	23.60
H1	17.31	18.50	18.70
H2	2.50	3.00	4.37
H3	16.00	16.50	17.35
ΦP	3.00	3.60	3.80
ΦQ	2.20	2.50	3.00

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