Technical Data
Data Sheet N2678, REV.A

RoHS

S2M0040120D-1
1200V SIC POWER MOSFET

V_{DS} = 1200 V
I_{DS}@ 25℃ = 55 A
R_{DS}(on) = 45 mΩ

Description

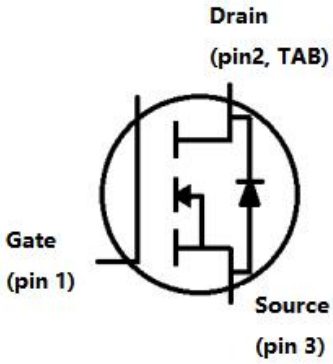
S2M0040120D-1 is single SiC Power MOSFET packaged in TO-247AD(TO-247-3) case. The device is a high voltage n-channel Enhancement mode MOSFET that has very low total conduction losses and very stable switching characteristics over temperature extremes. The S2M0040120D-1 is ideal for energy sensitive, high frequency applications in challenging environments.

Features

- Positive temperature characteristics, easy to parallel.
- Low on-resistance Typ. RDS(on) = 45mΩ .
- Fast switching speed and low switching losses.
- Very fast and robust intrinsic body diode.
- Process of non-bright Tin electroplatin

"-A" is an AEC-Q101 qualified device

Circuit Diagram



Applications

- EV Fast Charging Modules
- EV On Board Chargers
- Solar Inverters
- Online UPS/Industrial UPS

Maximum Ratings(T=25℃ unless otherwise specified)

Characteristics	Symbol	Condition	Max.	Units
Drain Source Voltage	V_{DSS}	V_{GS} = 0V, I_{DS} = 100uA, T_j = 25°C	1200	V
Gate Source Voltage	V_{GSS}	T_j = 25°C, Absolute maximum values, AC (f>1Hz)	-10 to 25	V
Gate Source Voltage	V_{GSOP}	T_j = 25°C Recommended Operational Values	-5 to 20	V
Continuous Drain Current	I_D	V_{GS} = 20V, T_j = 25°C	55	A
	I_D	V_{GS} = 20V, T_j = 100°C	32	A
Pulsed Drain Current	$I_{D,pulse}$	Pulse width tP limited by Tjmax	160	A
Power Dissipation	PD	TC=25˚C, Tj = 175 ˚C	348	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	2.0	2.8	4.0	V
		V_{DS} = V_{GS}, I_D = 10mA T_J = 175 °C		1.8		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		45	52	mΩ
		V_{GS} = 20V, I_D = 40A, T_J = 175 °C		73		mΩ
Transconductance	gfs	V_{DS}= 20 V, I_{DS}= 40 A		10		S
		V_{DS}= 20 V, I_{DS}= 40 A, T_J = 175 °C		12		S
Input Capacitance	C_{ISS}	V_{GS} = 0V, V_{DS} = 1000V V_{AC} = 25mV f = 1MHz		1904		pF
Output Capacitance	C_{OSS}			108		
Reverse Transfer Capacitance	C_{RSS}			6		
C_{OSS} Stored Energy	E_{OSS}			72.9		uJ
Turn-On Switching Energy	E_{ON}	V_{DS} = 800V, V_{GS} = -5/20V I_D =40A, $R_{G(ext)}$=2.5Ω, L=99uH		0.25		mJ
Turn-Off Switching Energy	E_{OFF}			0.05		
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		12		ns
Rise Time	t_r			14		
Turn-Off Delay Time	$t_{d(off)}$			22		
Fall Time	t_f			4		
Internal Gate Resistance	$R_{G(int)}$	f = 1MHz, VAC = 25 mV		2.6		Ω
Gate to Source Charge	Q_{gs}	V_{DS} = 800V, V_{GS} = -5/20V, I_D = 40A Per IEC60747-8-4 pg 21		34.3		nC
Gate to Drain Charge	Q_{gd}			32.1		
Total Gate Charge	Q_g			92.1		

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Reverse Diode Characteristics:

Characteristics	Symbol	Condition	Typ.	Max.	Units
Diode Forward Voltage	V_{SD}	V_{GS}= -5V, I_{SD}= 20A	3.6		V
		V_{GS}= -5V, I_{SD}= 20A, T_J=175℃	3.2		V
Continuous Diode Forward Current	Is	T_C=25℃	44		A
Reverse Recovery Time	t_{rr}	V_{GS}=-5V, I_{SD}=40A, T_J=25°C V_R=800V dif/dt=1047A/μs	43.4		ns
Reverse Recovery Charge	Q_{rr}		162		nC
Peak Reverse Recovery Current	I_{mm}		8.1		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	0.43	°C/W
Maximun Thermal Resistance Junction to Ambient	$R_{\theta JA}$		32.6	°C/W

Ordering Information:

Device	Package	Shipping
S2M0040120D-1	TO-247AD(TO-247-3)	30pcs/tube

Ratings and Characteristics Curves

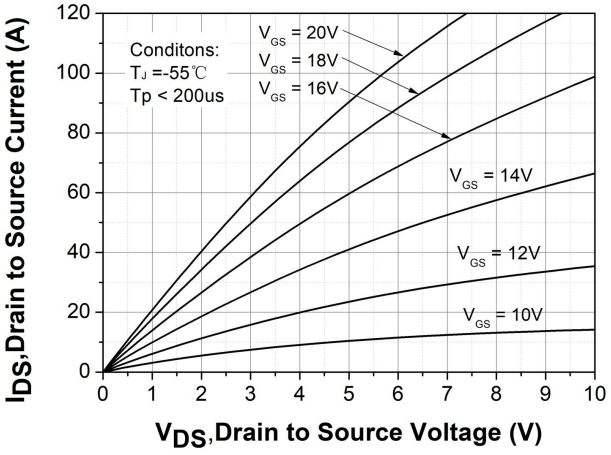

Figure 1. Output Characteristics T_J = -55 °C

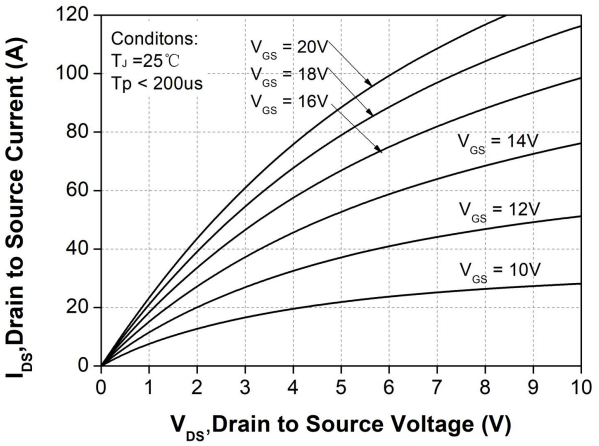

Figure 2. Output Characteristics T_J = 25 °C

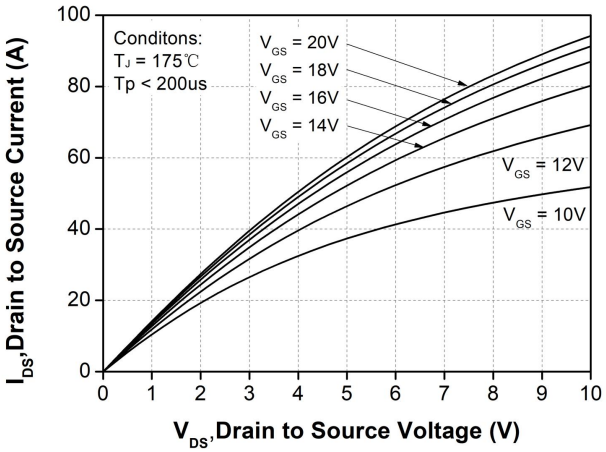

Figure 3. Output Characteristics T_J = 175°C

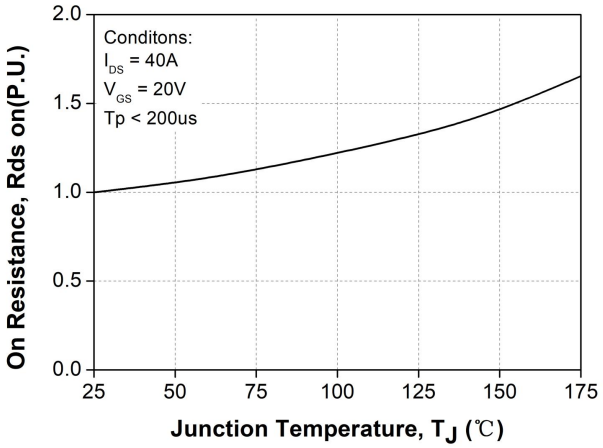

Figure 4. Normalized On-Resistance vs. Temperature

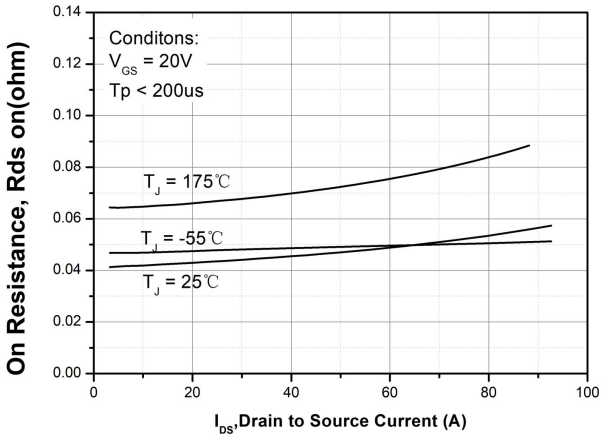

Figure 5. On-Resistance vs. Drain Current
For Various Temperatures

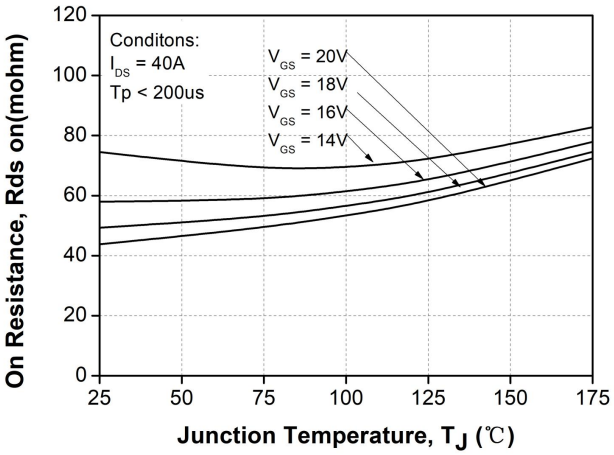

Figure 6. On-Resistance vs. Temperature
For Various Gate Voltage

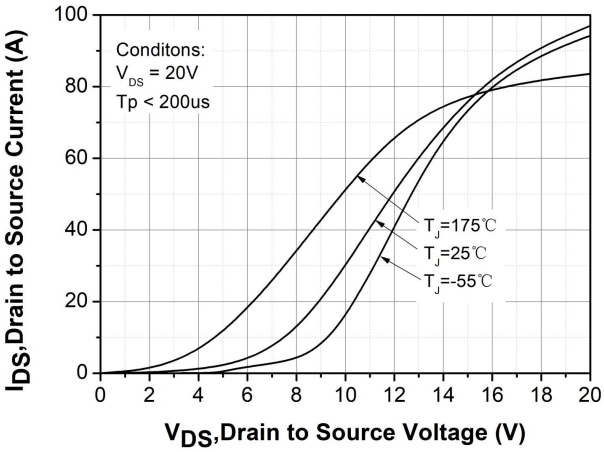

Figure 7. Transfer Characteristic for Various Junction Temperatures

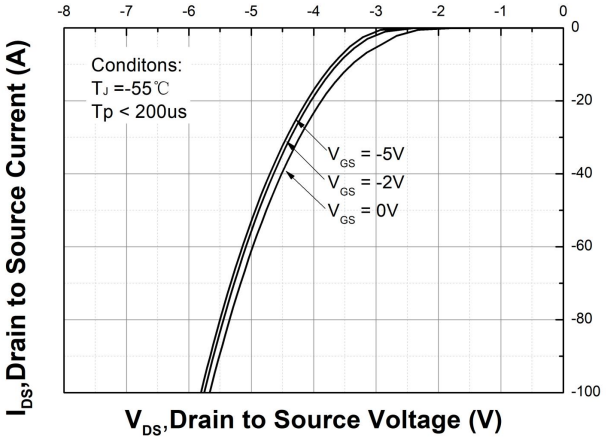

Figure 8. Body Diode Characteristic at T_J = -55 °C

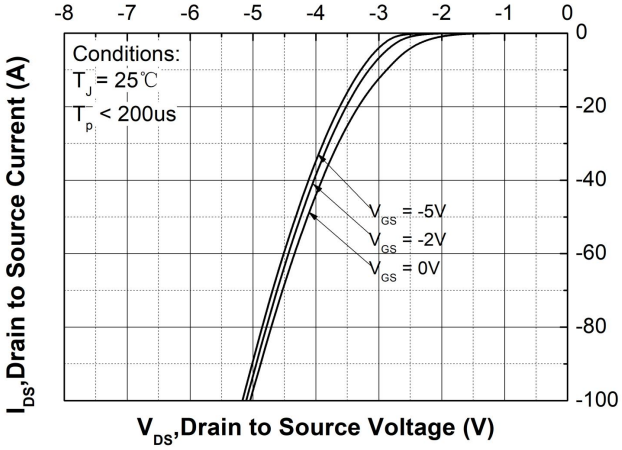

Figure 9. Body Diode Characteristic at T_J = 25 °C

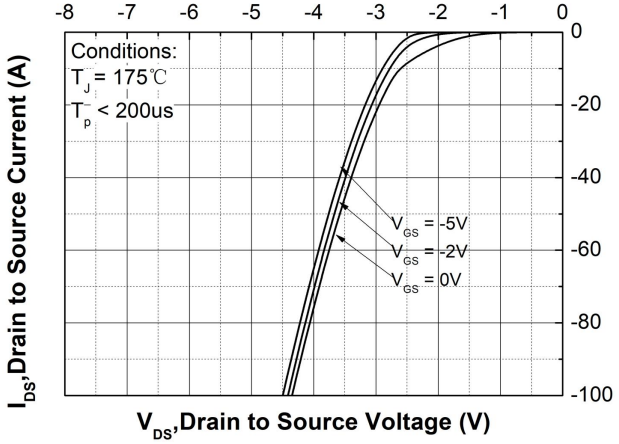

Figure 10. Body Diode Characteristic at T_J = 175 °C

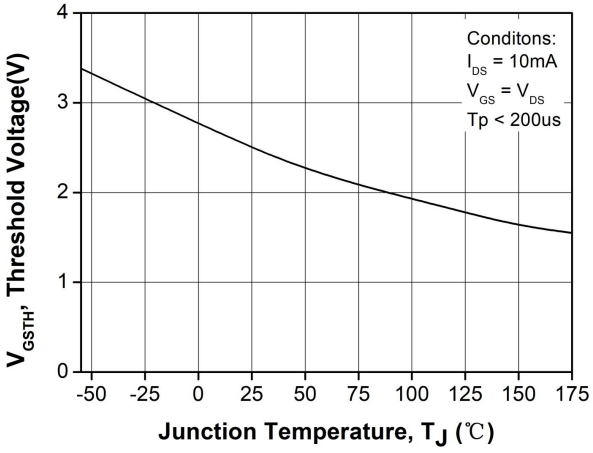

Figure 11. Threshold Voltage vs. Temperature

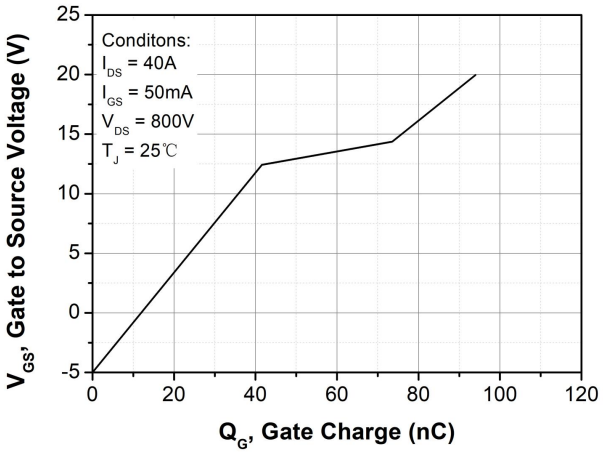

Figure 12. Gate Charge Characteristic

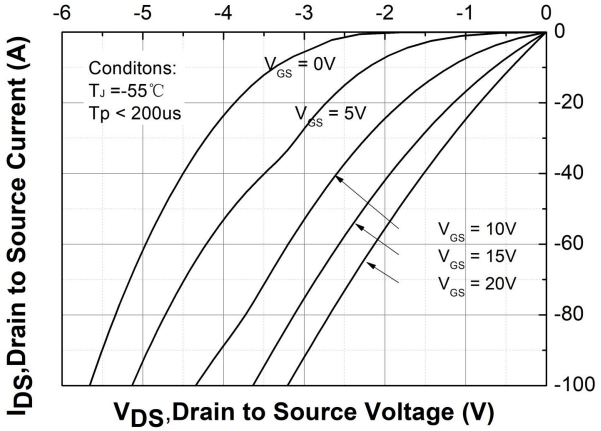

Figure 13. 3rd Quadrant Characteristic at T_J = -55 °C

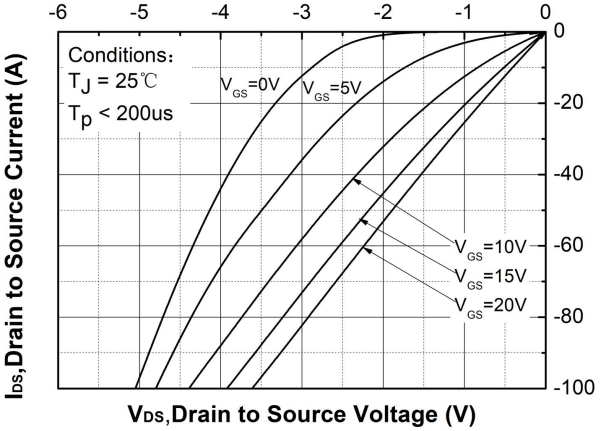

Figure 14. 3rd Quadrant Characteristic at T_J = 25 °C

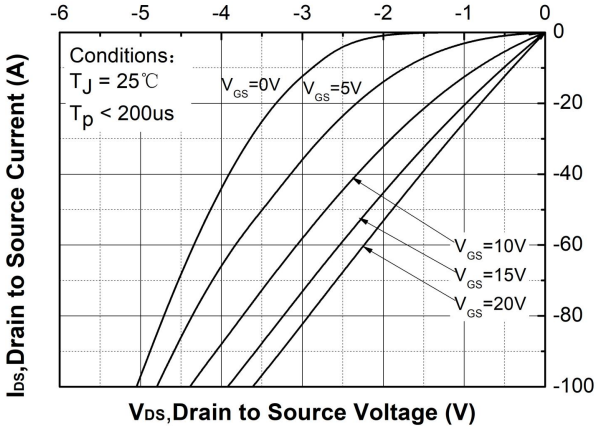

Figure 15. 3rd Quadrant Characteristic at T_J = 175°C

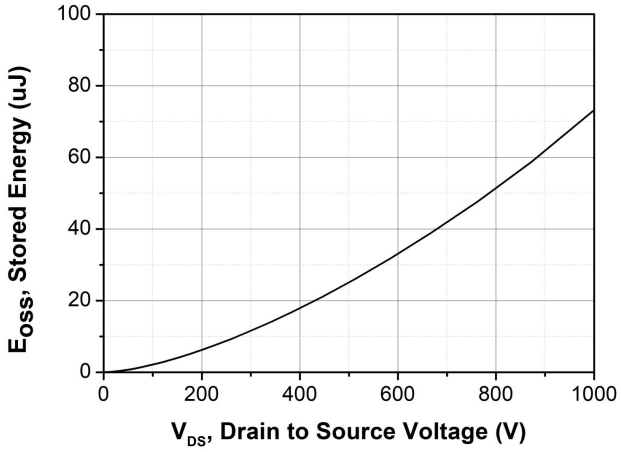

Figure 16. Output Capacitor Stored Energy

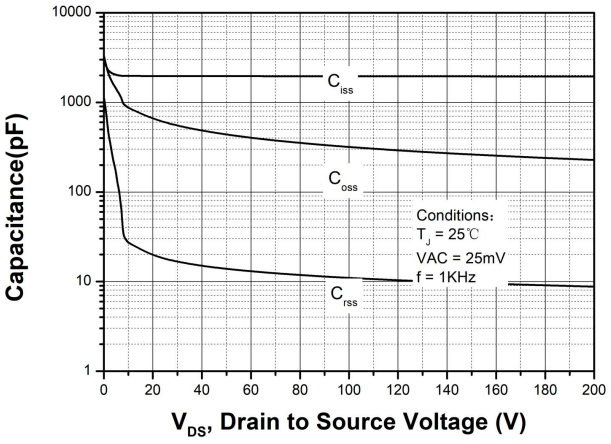

Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

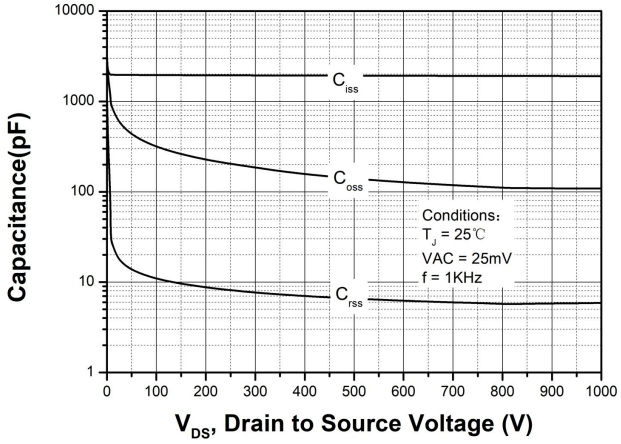

Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1000V)

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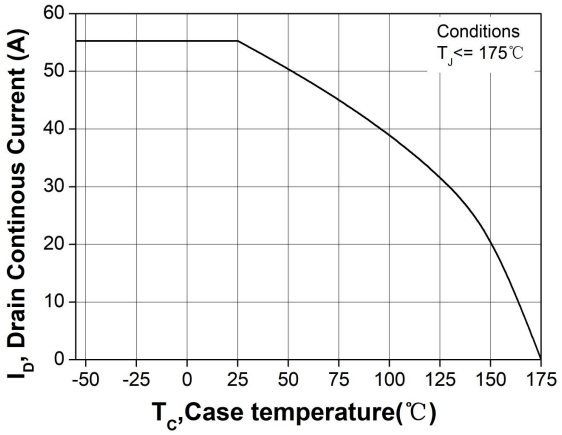

Figure 19. Continuous Drain Current Derating vs. Case Temperature

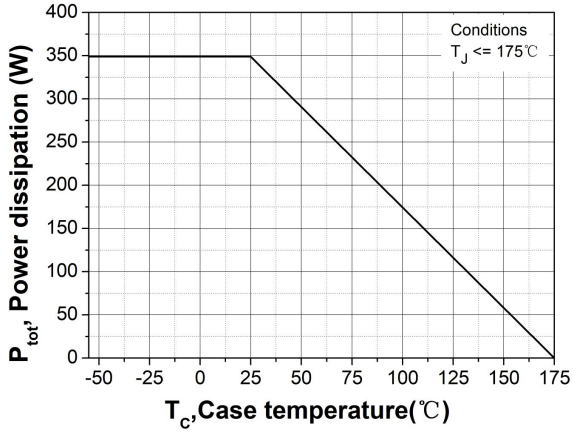

Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

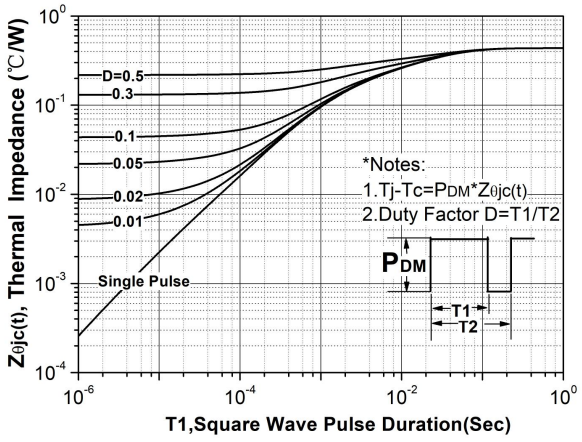

Figure 21. Transient Thermal Impedance (Junction - Case)

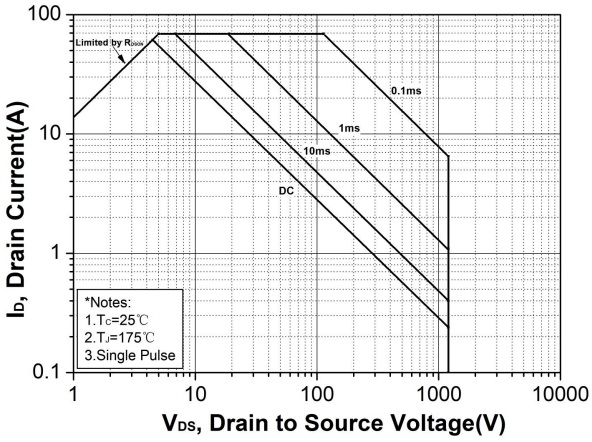

Figure 22. Safe Operating Area

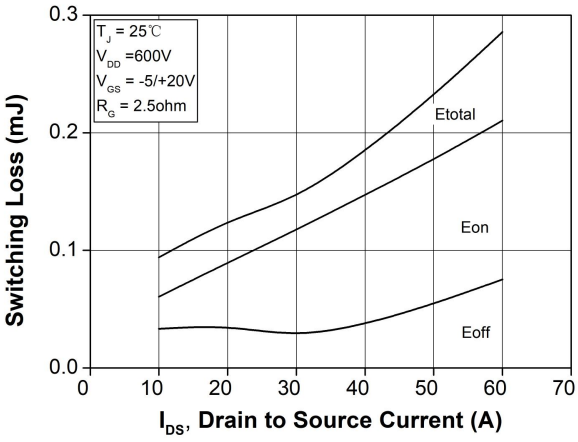

Figure 23. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 600V)

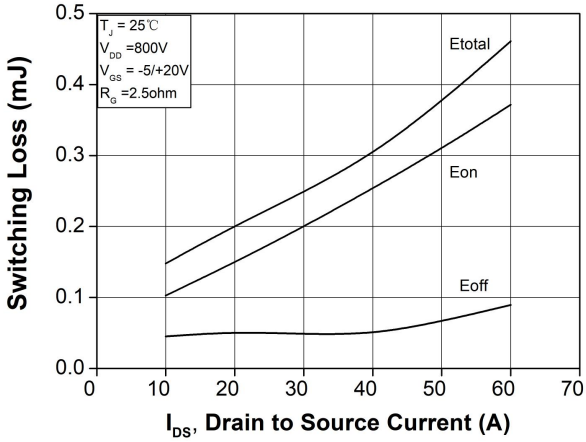

Figure 24. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 800V)

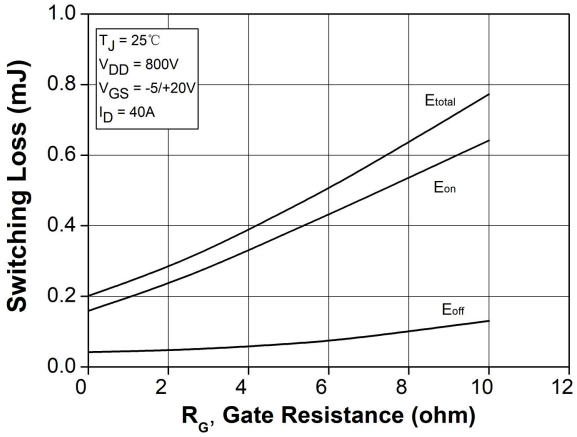

Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

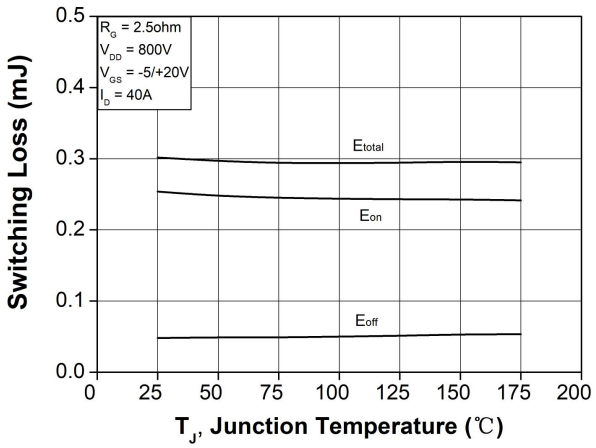

Figure 26. Clamped Inductive Switching Energy vs. Temperature

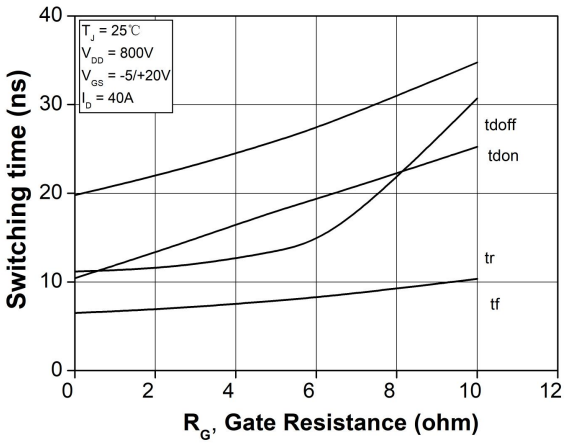

Figure 27. Switching Times vs. $R_{G(ext)}$

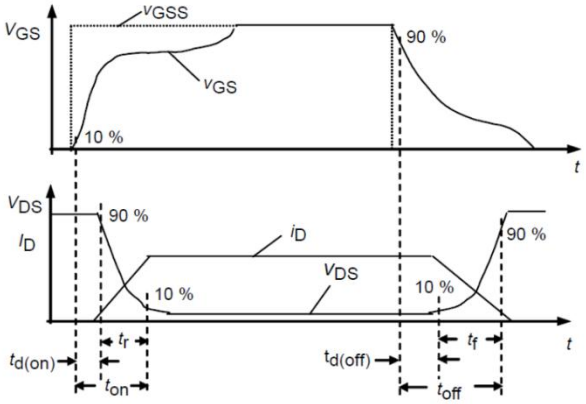

Figure 28. Switching Times Definition

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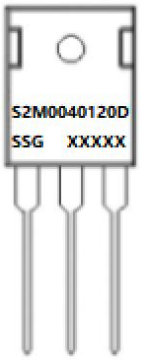
Marking Diagram

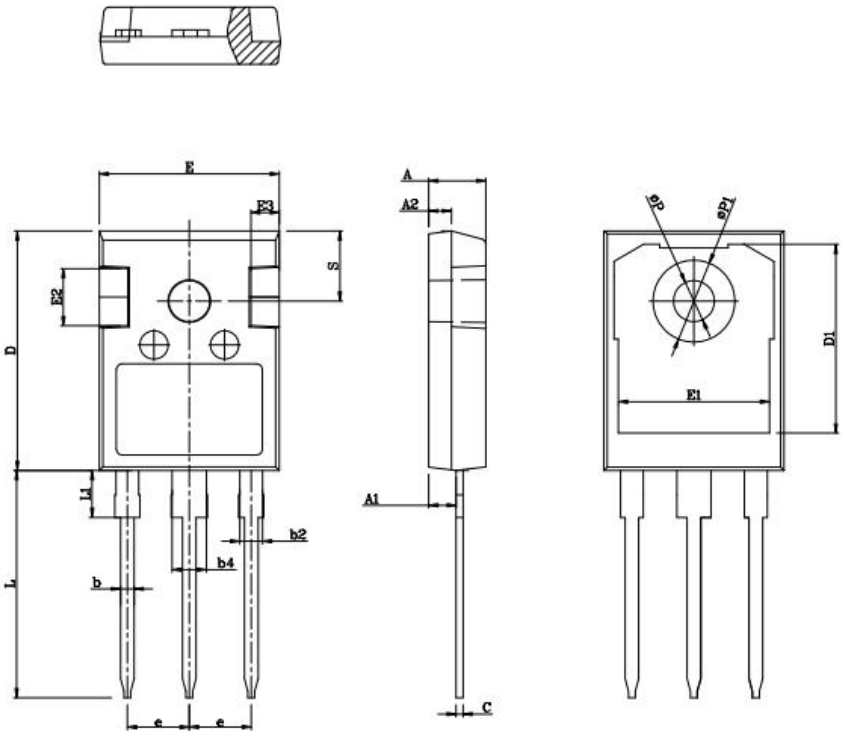


Where XXXXX is YYWWL

S2M = Device Type
0040 = R_{DS}(on)
120 = Reverse Voltage (1200V)
D = Package
SSG = SSG
YY = Year
WW = Week
L = Lot Number

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

Mechanical Dimensions TO-247AD(TO-247-3)



COMMON DIMENSIONS

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
b2	1.91	2.01	2.21
b4	2.91	3.01	3.21
c	0.51	0.61	0.75
D	20.80	21.00	21.30
D1	16.25	16.55	16.85
E	15.50	15.80	16.10
E1	13.00	13.26	13.56
E2	4.80	5.00	5.20
E3	2.30	2.50	2.70
e	5.44BSC		
L	19.82	19.92	20.22
L1	3.94	4.12	4.30
ØP	3.40	3.60	3.80
ØP1	7.08	7.19	7.30
S	6.15BSC		

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