

S2M0040120D-1

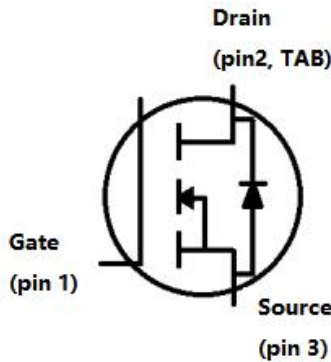
1200V SiC POWER MOSFET



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.

Circuit Diagram



Features

- Positive temperature characteristics, easy to parallel.
- Low on-resistance Typ. $R_{DS(on)} = 45\text{m}\Omega$.
- 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

Applications

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

Maximum Ratings(T=25°C unless otherwise specified)

Characteristics	Symbol	Condition	Max.	Units
Drain Source Voltage	V_{DSS}	$V_{GS} = 0\text{V}, I_{DS} = 100\mu\text{A}, T_j = 25^{\circ}\text{C}$	1200	V
Gate Source Voltage	V_{GSS}	$T_j = 25^{\circ}\text{C}$, Absolute maximum values, AC ($f > 1\text{Hz}$)	-10 to 25	V
Gate Source Voltage	V_{GSOP}	$T_j = 25^{\circ}\text{C}$ Recommended Operational Values	-5 to 20	V
Continuous Drain Current	I_D	$V_{GS} = 20\text{V}, T_j = 25^{\circ}\text{C}$	55	A
	I_D	$V_{GS} = 20\text{V}, T_j = 100^{\circ}\text{C}$	32	A
Pulsed Drain Current	$I_{D,pulse}$	Pulse width t_P limited by T_{jmax}	160	A
Power Dissipation	PD	$TC=25^{\circ}\text{C}, T_j = 175^{\circ}\text{C}$	348	W
Solder Temperature	TL	1.6mm (0.063") from case for 10s	260	°C

Electrical Characteristics(T=25°C unless otherwise specified)

Characteristics	Symbol	Condition	Min.	Typ.	Max.	Units
Drain Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 100\mu A$	1200			V
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 10mA$	1.8	2.4	4	V
		$V_{DS} = V_{GS}, I_D = 10mA, T_J = 175^\circ C$		1.55		V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 1200V, V_{GS} = 0V$		1	100	μA
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	m Ω
		$V_{GS} = 20V, I_D = 40A, T_J = 175^\circ C$		73		m Ω
Transconductance	gfs	$V_{DS} = 20V, I_{DS} = 40A$		10		S
		$V_{DS} = 20V, I_{DS} = 40A, T_J = 175^\circ C$		12		S
Input Capacitance	C_{ISS}	$V_{GS} = 0V,$		1904		pF
Output Capacitance	C_{OSS}	$V_{DS} = 1000V$		108		
Reverse Transfer Capacitance	C_{RSS}	$V_{AC} = 25mV$ $f = 1MHz$		6		
Coss Stored Energy	E_{OSS}			72.9		μJ
Turn-On Switching Energy	E_{ON}	$V_{DS} = 800V, V_{GS} = -5/20V$		0.25		mJ
Turn-Off Switching Energy	E_{OFF}	$I_D = 40A, R_{G(ext)} = 2.5\Omega, L = 99\mu H$		0.05		
Turn-On Delay Time	$t_{d(on)}$	$V_{DS} = 800V, V_{GS} = -5/20V$		12		ns
Rise Time	t_r	$I_D = 40A, R_{G(ext)} = 2.5\Omega$		14		
Turn-Off Delay Time	$t_{d(off)}$	Inductive Load Timing relative to VDS Per IEC60747-8-4 pg 83		22		
Fall Time	t_f			4		
Internal Gate Resistance	$R_{G(int)}$	$f = 1MHz, V_{AC} = 25mV$		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		

Reverse Diode Characteristics:

Characteristics	Symbol	Condition	Typ.	Max.	Units
Diode Forward Voltage	V_{SD}	$V_{GS} = -5V, I_{SD} = 20A$	3.6		V
		$V_{GS} = -5V, I_{SD} = 20A, T_J = 175^\circ C$	3.2		V
Continuous Diode Forward Current	I_S	$T_C = 25^\circ C$	44		A
Reverse Recovery Time	t_{rr}	$V_{GS} = -5V, I_{SD} = 40A, T_J = 25^\circ C$	43.4		ns
Reverse Recovery Charge	Q_{rr}	$V_R = 800V$	162		nC
Peak Reverse Recovery Current	I_{mm}	$di/dt = 1047A/\mu s$	8.1		A

Thermal-Mechanical Specifications:

Characteristics	Symbol	Condition	Specification	Units
Junction Temperature	T_J	-	-55 to +175	$^\circ C$
Storage Temperature	T_{stg}	-	-55 to +175	$^\circ C$
Typical Thermal Resistance Junction to Case	$R_{\theta JC}$	DC operation	0.43	$^\circ C/W$
Maximun Thermal Resistance Junction to Ambient	$R_{\theta JA}$		32.6	$^\circ C/W$

Ordering Information:

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

Ratings and Characteristics Curves

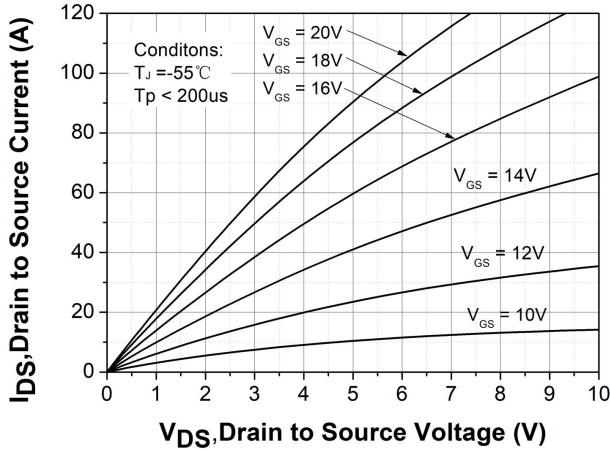


Figure 1. Output Characteristics $T_J = -55^\circ\text{C}$

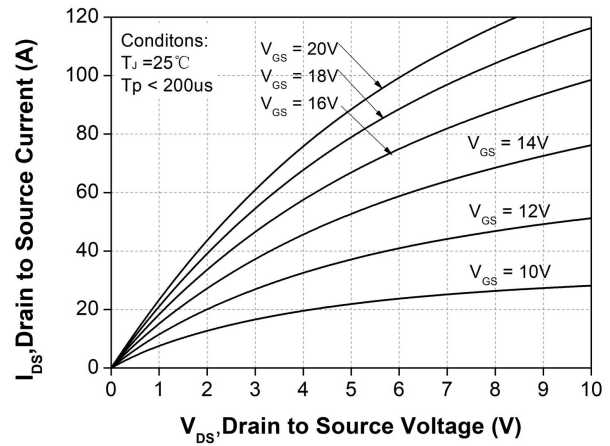


Figure 2. Output Characteristics $T_J = 25^\circ\text{C}$

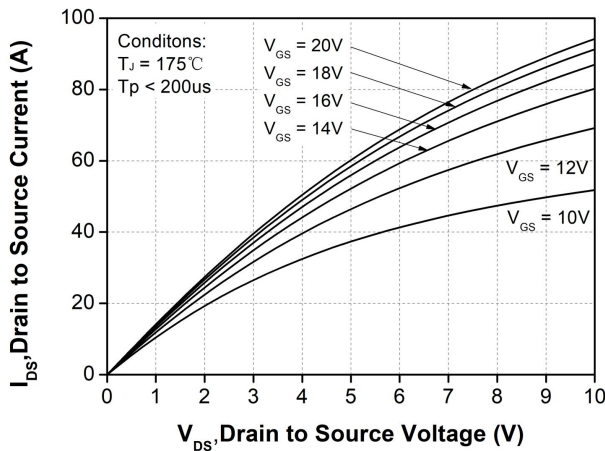


Figure 3. Output Characteristics $T_J = 175^\circ\text{C}$

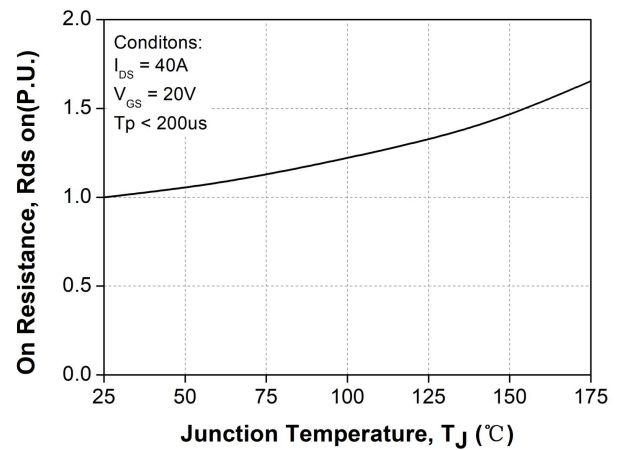


Figure 4. Normalized On-Resistance vs. Temperature

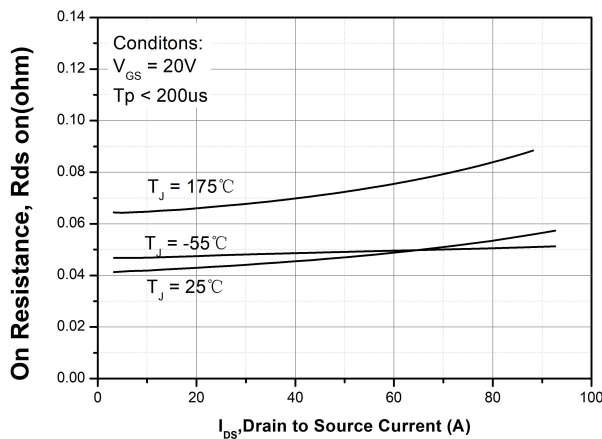


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

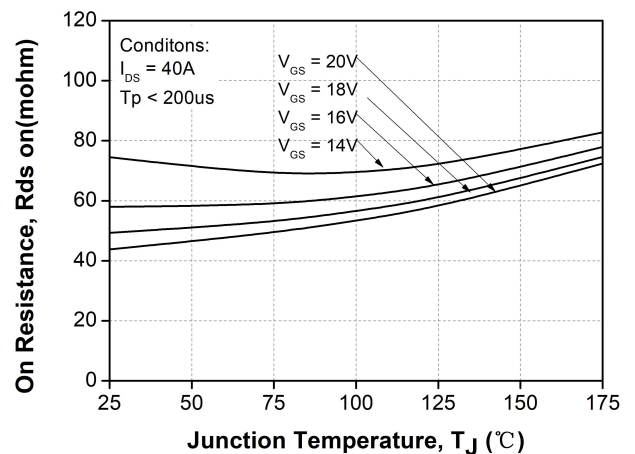


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

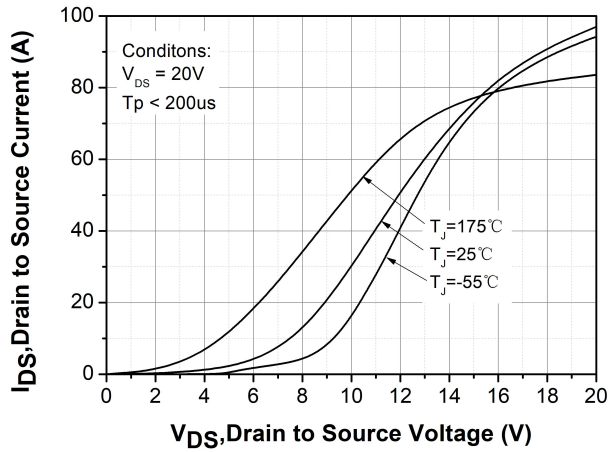


Figure 7. Transfer Characteristic for Various Junction Temperatures

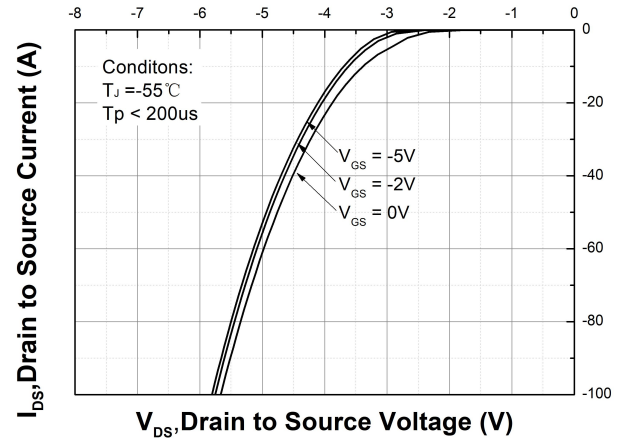


Figure 8. Body Diode Characteristic at $T_J = -55^\circ\text{C}$

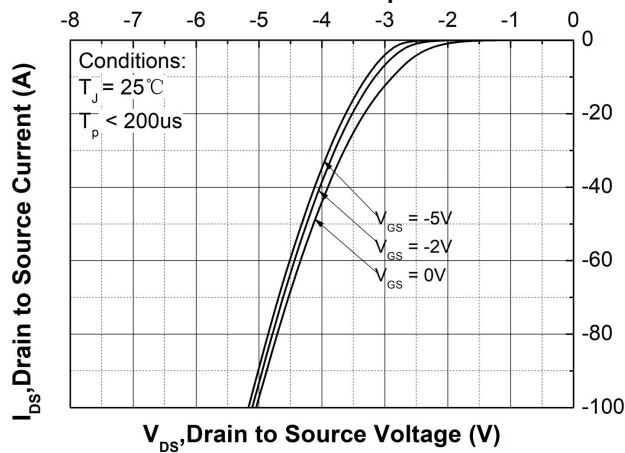


Figure 9. Body Diode Characteristic at $T_J = 25^\circ\text{C}$

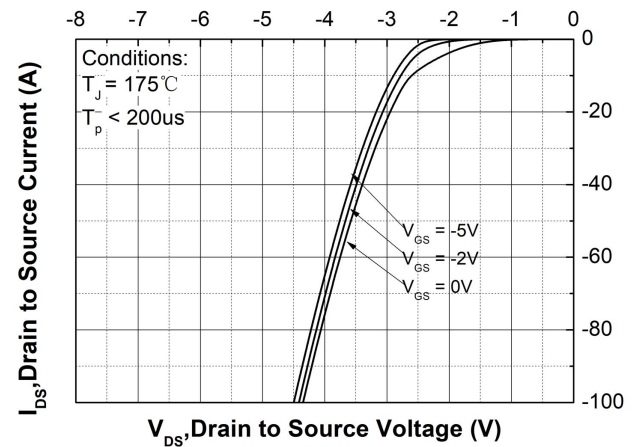


Figure 10. Body Diode Characteristic at $T_J = 175^\circ\text{C}$

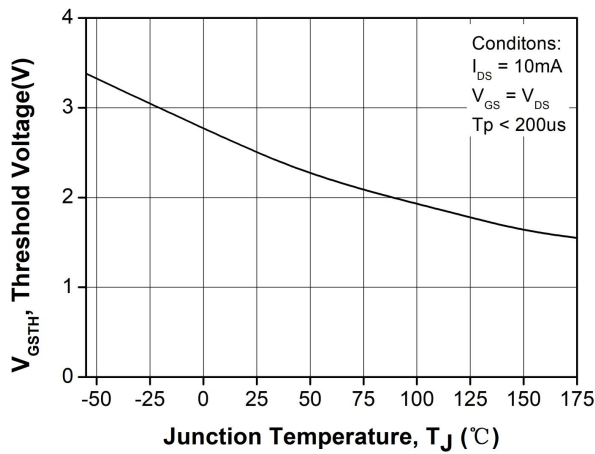


Figure 11. Threshold Voltage vs. Temperature

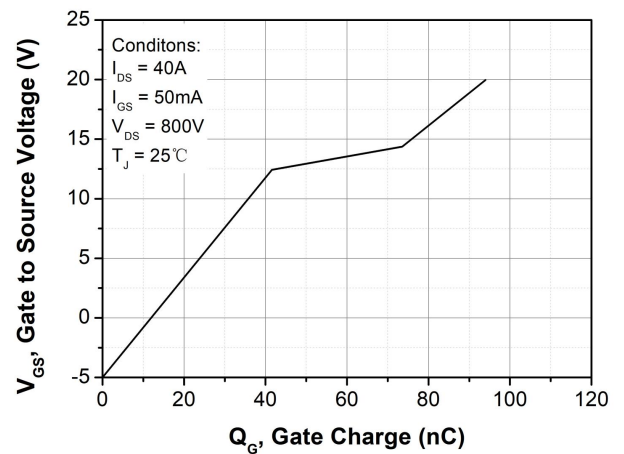


Figure 12. Gate Charge Characteristic

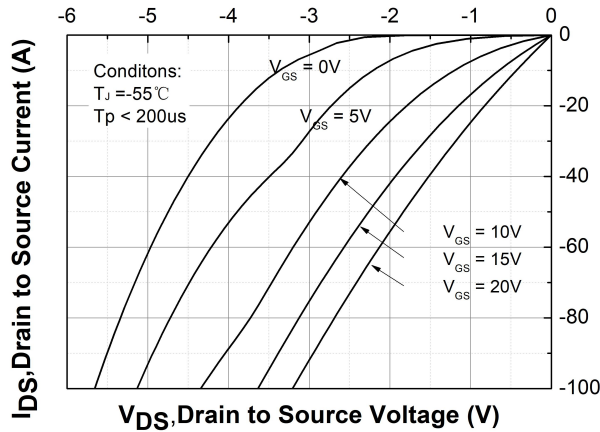


Figure 13. 3rd Quadrant Characteristic at $T_J = -55^\circ\text{C}$

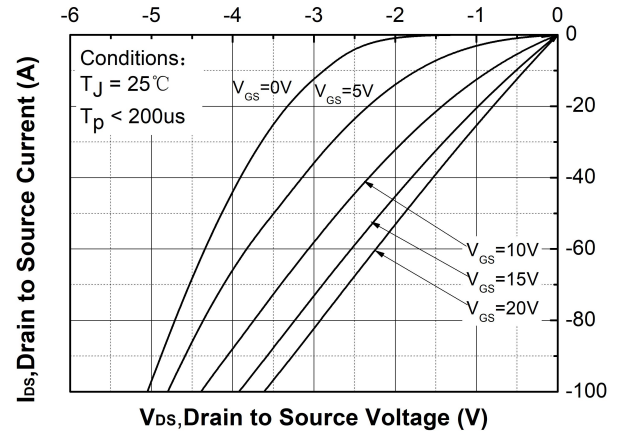


Figure 14. 3rd Quadrant Characteristic at $T_J = 25^\circ\text{C}$

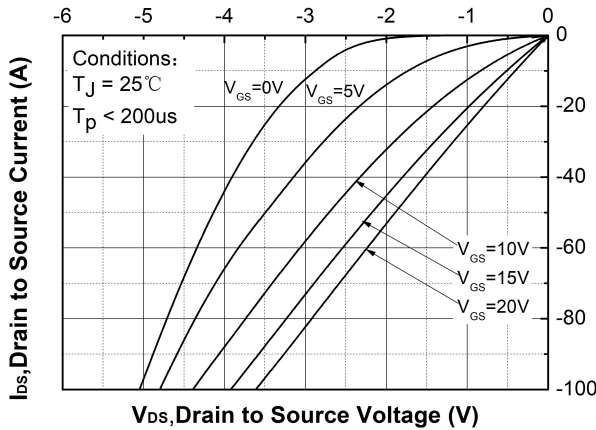


Figure 15. 3rd Quadrant Characteristic at $T_J = 175^\circ\text{C}$

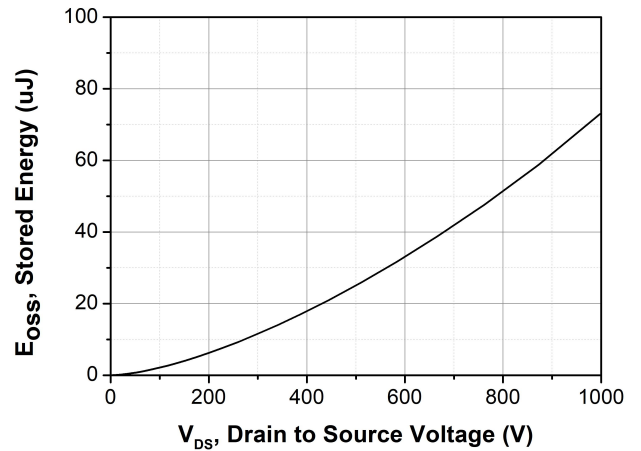


Figure 16. Output Capacitor Stored Energy

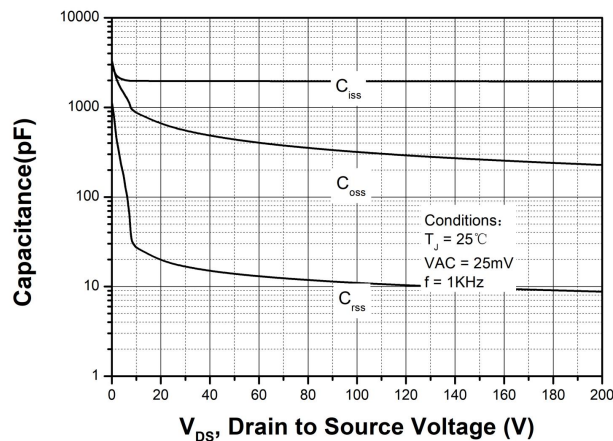


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

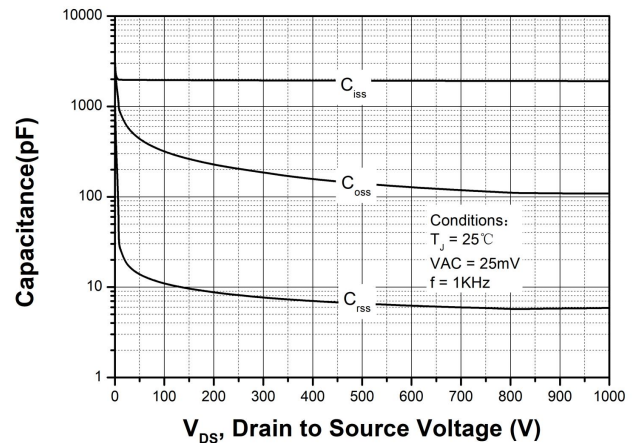


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1000V)

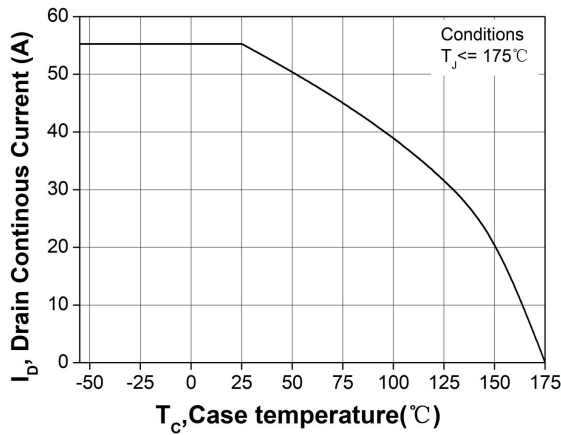


Figure 19. Continuous Drain Current Derating vs. Case Temperature

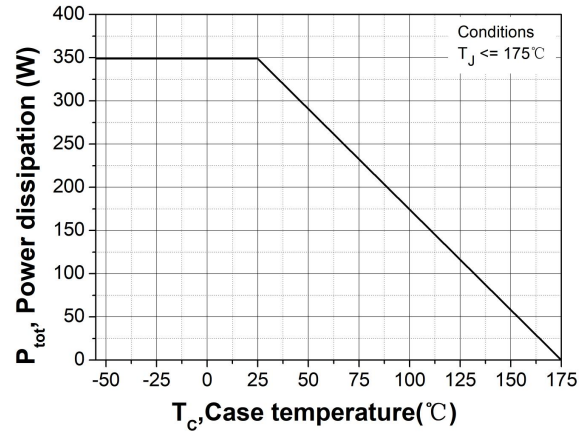


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

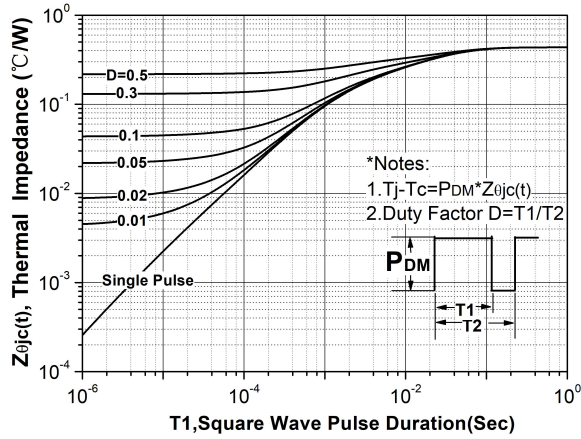


Figure 21. Transient Thermal Impedance (Junction - Case)

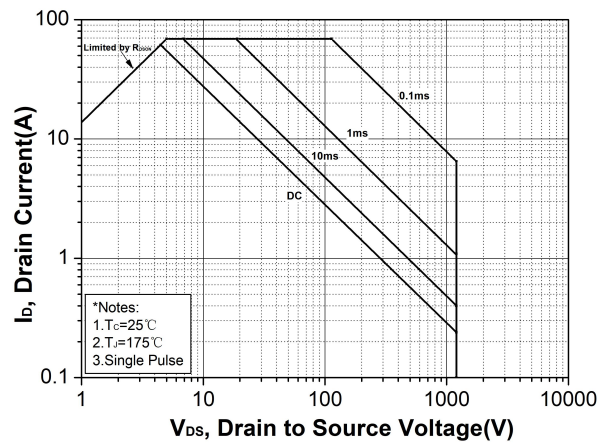


Figure 22. Safe Operating Area

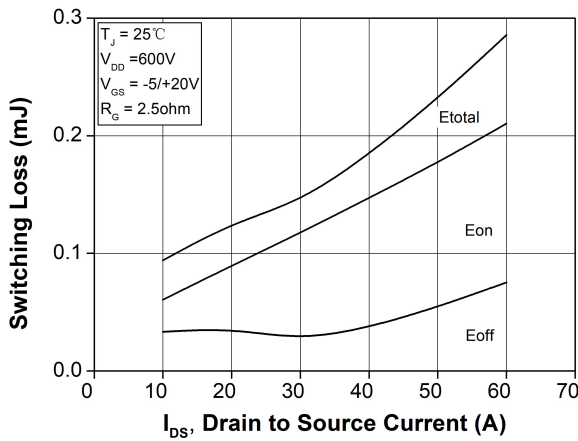


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 600V$)

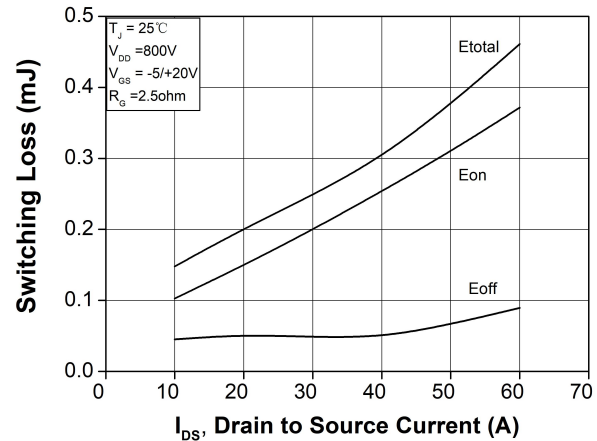


Figure 24. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 800V$)

Technical Data
Data Sheet N2678, REV.-

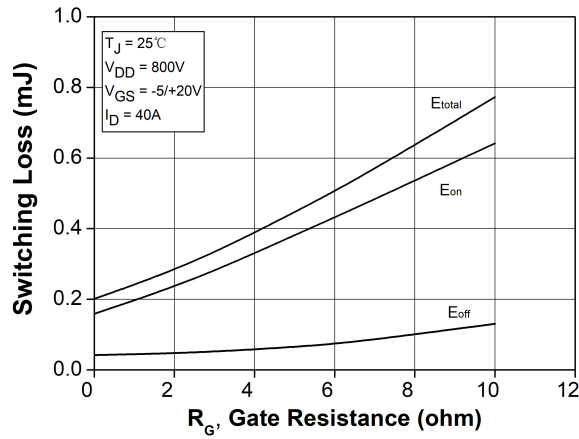


Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

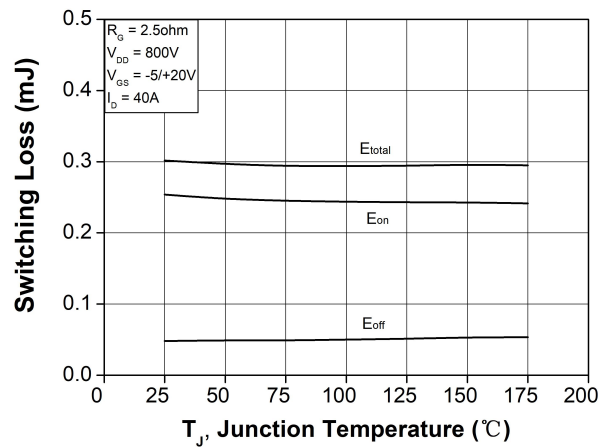


Figure 26. Clamped Inductive Switching Energy vs. Temperature

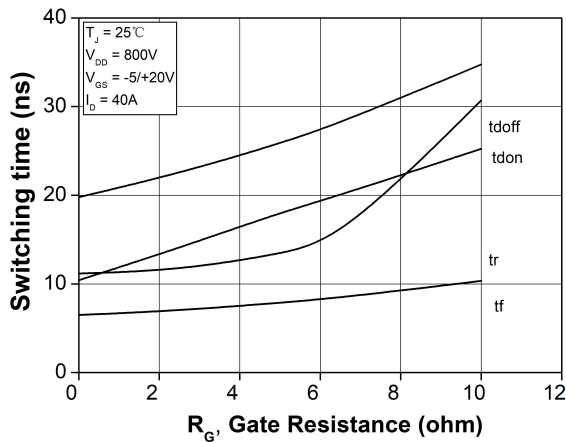


Figure 27. Switching Times vs. $R_{G(ext)}$

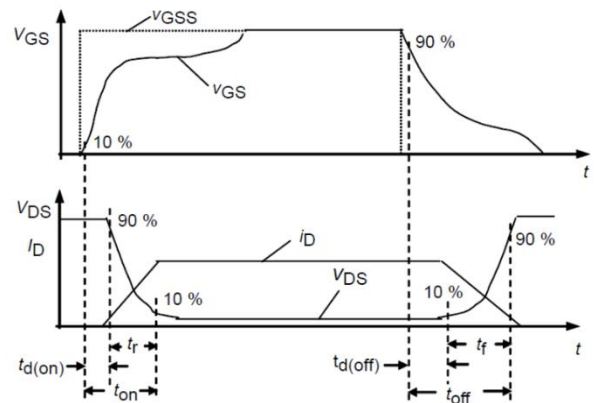
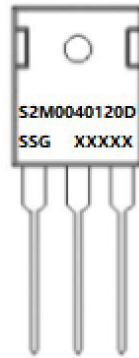


Figure 28. Switching Times Definition

Marking Diagram

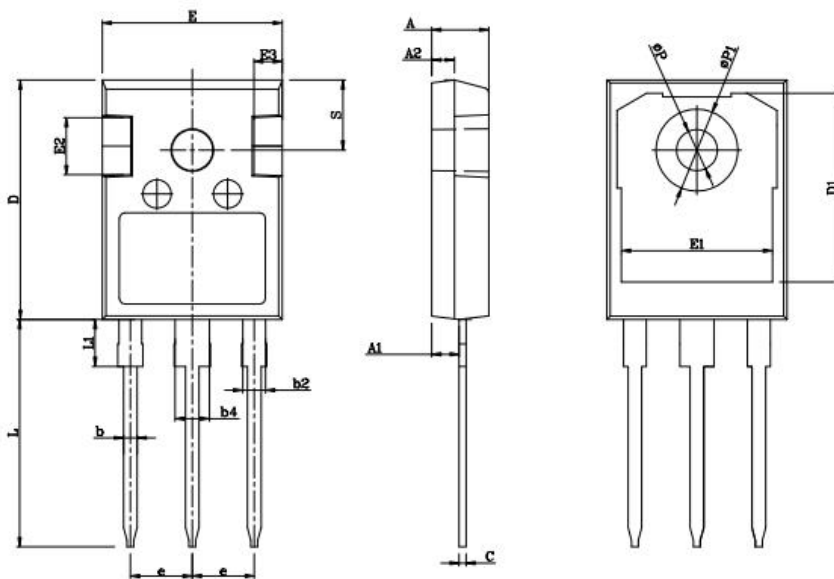
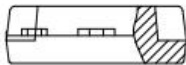


Where XXXXX is YYWWL

- S2M = Device Type
- 0040 = $R_{bs(on)}$
- 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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