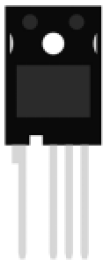
Technical Data
Data Sheet N2877, REV.-

RoHS

S3M0012120K
1200V SIC POWER MOSFET

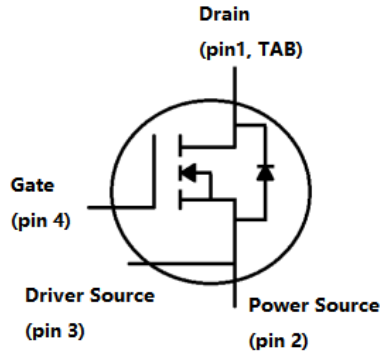


V_{DS} = 1200 V
I_{DS}@ 25℃ = 155 A
R_{DS}(on) = 12 mΩ

Description

S3M0012120K is a 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 S3M0012120K 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) = 12 mΩ.
- 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
- SMPS (Switch Mode Power Supplies)
- DC-DC Converters
- ESS (Energy Storage Systems)

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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			1200	V	
Gate - Source Voltage (dynamic)	V_{GSmax}	AC (f > 1 Hz)	-8		+22	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			155 110	A	
Pulsed Drain Current	$I_{D(pulse)}$	Pulse width t_P limited by T_{jmax}			330	A	
Power Dissipation	P_D	T_C = 25 ˚C			937	W	

[1] Recommended turn off gate voltage is -4 V. Recommended turn on gate voltage is 18 V. Do not use with V_{GSON} < 12 V.

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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	1200			V
Gate Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 40 mA	2	2.8	4	V
		V_{DS} = V_{GS}, I_D = 40 mA, T_J = 175 °C		1.8		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 1200 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 = 100 A		12	16	mΩ
		V_{GS} = 18 V, I_D = 100 A, T_J = 175 °C		19		mΩ
Transconductance	gfs	V_{DS} = 20 V, I_{DS} = 100 A		19		S
		V_{DS} = 20 V, I_{DS} = 100 A, T_J = 175 °C		21		S
Input Capacitance	C_{ISS}	V_{GS} = 0 V		6358		pF
Output Capacitance	C_{OSS}	V_{DS} = 1000 V		283		
Reverse Transfer Capacitance	C_{RSS}	V_{AC} = 25 mV		37		
C_{OSS} Stored Energy	E_{OSS}	f = 100 KHz		115		µJ
Turn-On Switching Energy	E_{ON}	V_{DS} = 800 V, V_{GS} = -4 / 18 V		1312		µJ
Turn-Off Switching Energy	E_{OFF}	I_D = 100 A, $R_{G(ext)}$ = 2.5 Ω, L = 99 uH		800		
Turn-On Delay Time	$t_{d(on)}$	V_{DS} = 800 V, V_{GS} = -4 / 18 V		21		ns
Rise Time	t_r	I_D = 100 A, $R_{G(ext)}$ = 2.5 Ω		31		

Turn-Off Delay Time	$t_{d(off)}$	Inductive Load Timing relative to		66		
Fall Time	t_f	VDS Per IEC60747-8-4 pg 83		14		
Internal Gate Resistance	$R_{G(int)}$	f = 1 MHz, AC = 25 mV		1.6		Ω
Gate to Source Charge	Q_{gs}	V_{DS} = 800 V, V_{GS} = -4 / 18 V		122		nC
Gate to Drain Charge	Q_{gd}	I_D = 85 A		183		
Total Gate Charge	Q_g	Per IEC60747-8-4 pg 21		347		

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} = 50 A	4.0		V
	V_{SD}	V_{GS} = -4 V, I_{SD} = 50 A, T_J = 175°C	3.5		V
Continuous Diode Forward Current	I_S	V_{GS}= -4 V, T_C= 25 ℃	98		A
Reverse Recovery Time	t_{rr}	V_{GS} = -4 V, I_{SD} = 100 A, T_J = 25 °C	25		ns
Reverse Recovery Charge	Q_{rr}	V_R = 800V	533		nC
Peak Reverse Recovery Current	I_{mm}	dif / dt = 2500 A / µs	36		A

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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	0.16	°C/W

Ordering Information

Device	Package	Shipping
S3M0012120K	TO-247-4	30pcs/tube

Marking Diagram

Where XXXXX is YYWWL

S3M = Device Type
0012 = 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

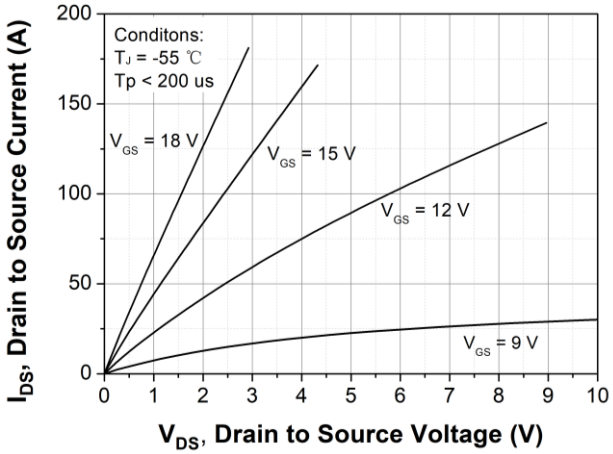

Figure 1. Output Characteristics T_J = -55 °C

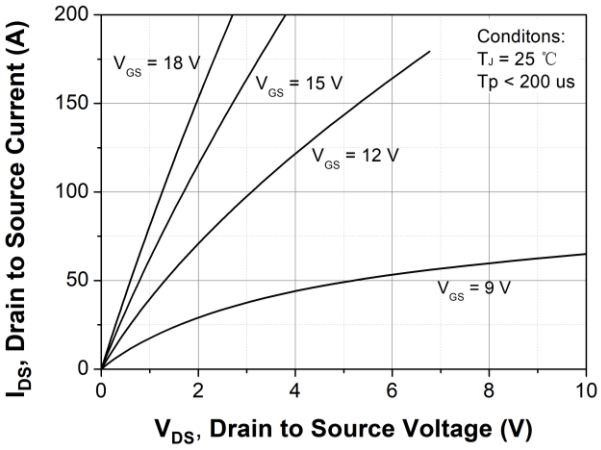

Figure 2. Output Characteristics T_J = 25 °C

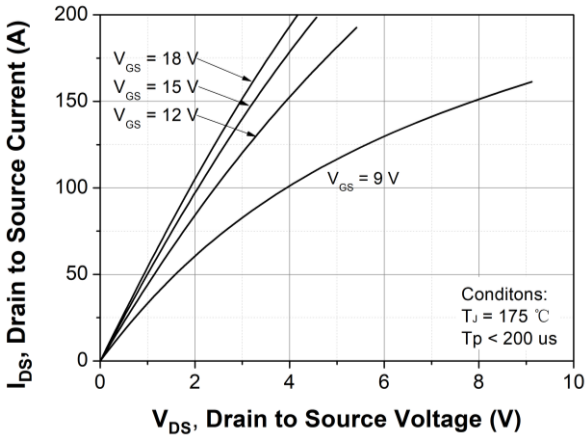

Figure 3. Output Characteristics T_J = 175 °C

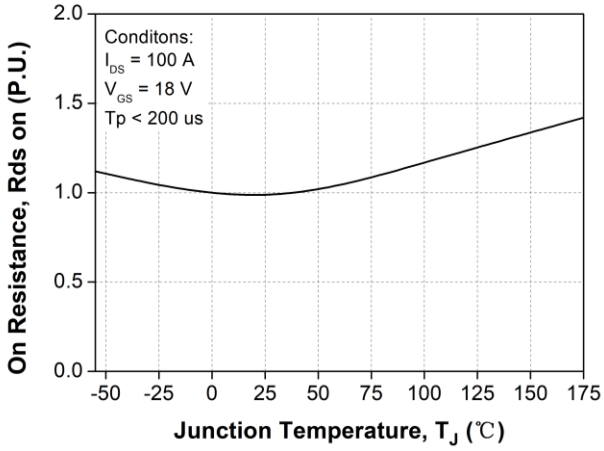

Figure 4. Normalized On-Resistance vs. Temperature

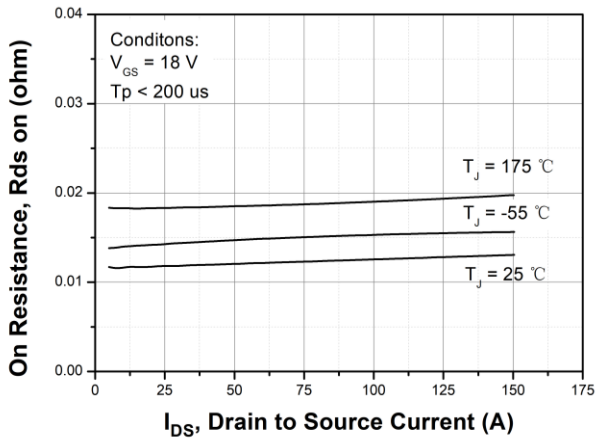

Figure 5. On-Resistance vs. Drain Current For Various Temperatures

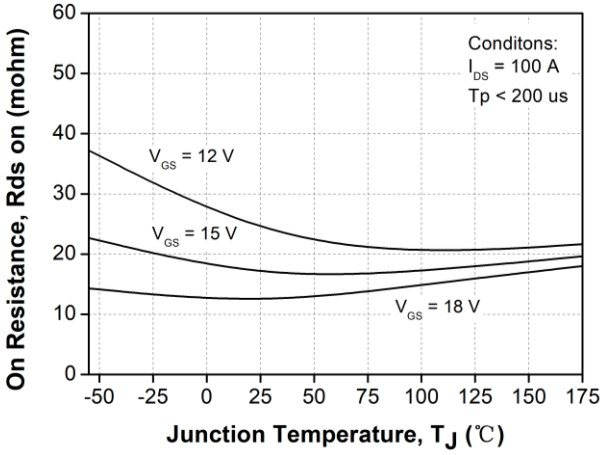

Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

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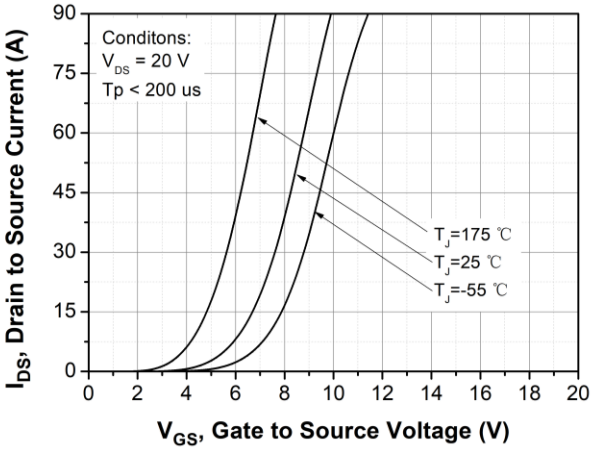

Figure 7. Transfer Characteristic for Various Junction Temperatures

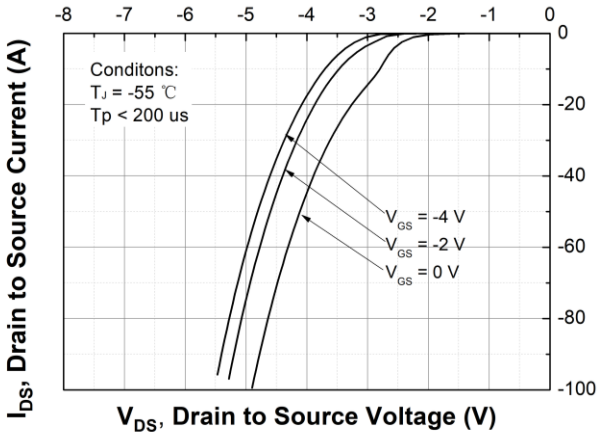

Figure 8. Body Diode Characteristic at T_J = -55 °C

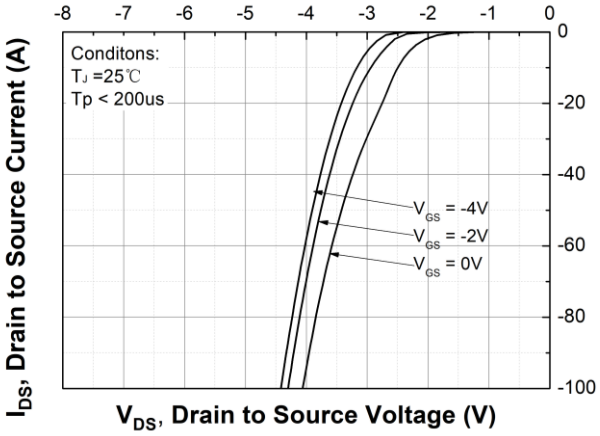

Figure 9. Body Diode Characteristic at T_J = 25 °C

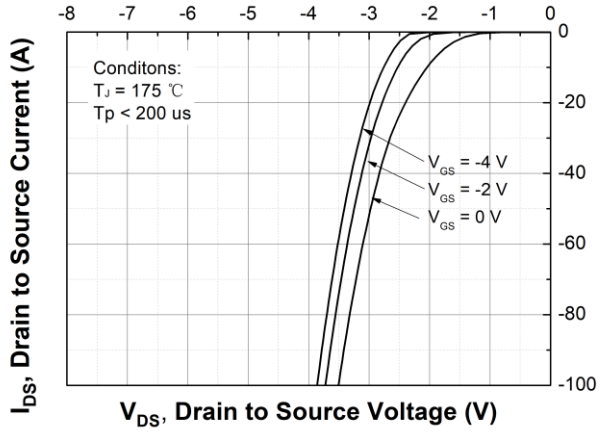

Figure 10. Body Diode Characteristic at T_J = 175 °C

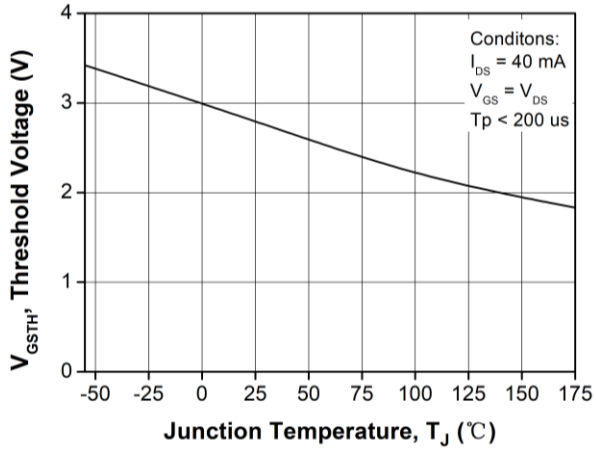

Figure 11. Threshold Voltage vs. Temperature

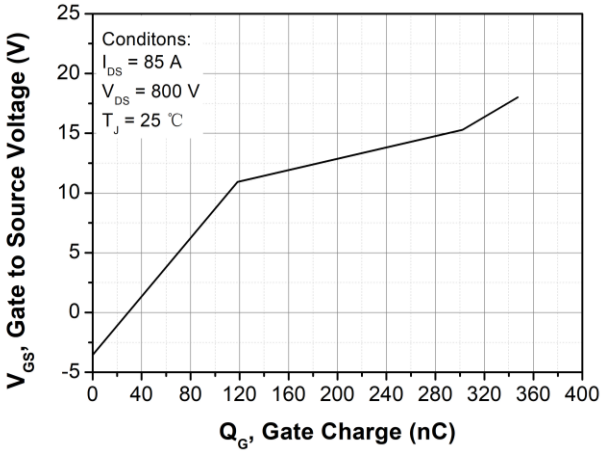

Figure 12. Gate Charge Characteristic

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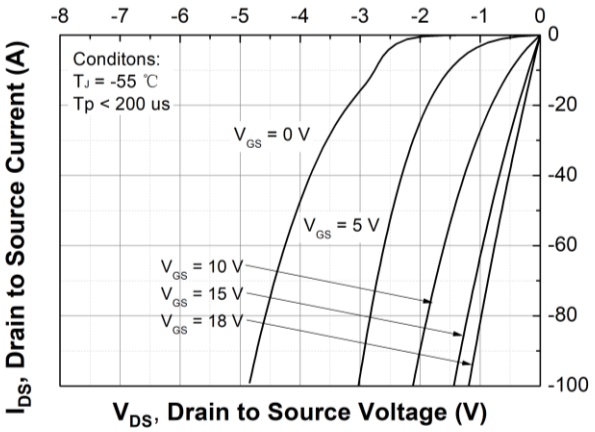

Figure 13. 3rd Quadrant Characteristic at T_J = -55 °C

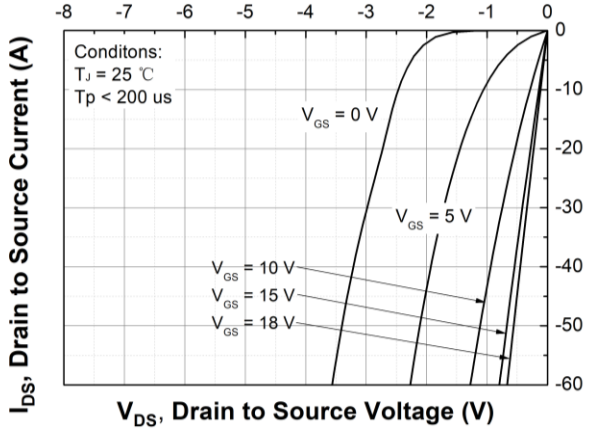

Figure 14. 3rd Quadrant Characteristic at T_J = 25 °C

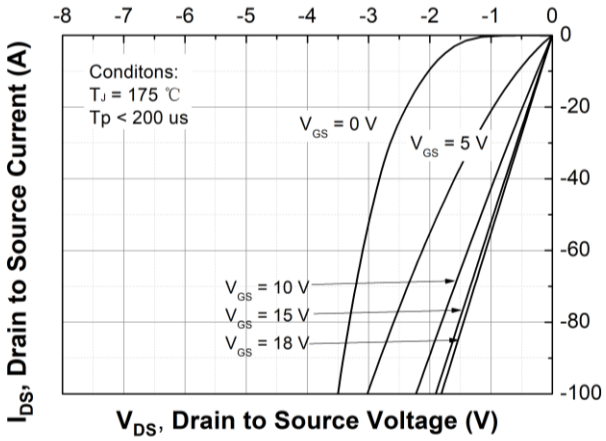

Figure 15. 3rd Quadrant Characteristic at T_J = 175 °C

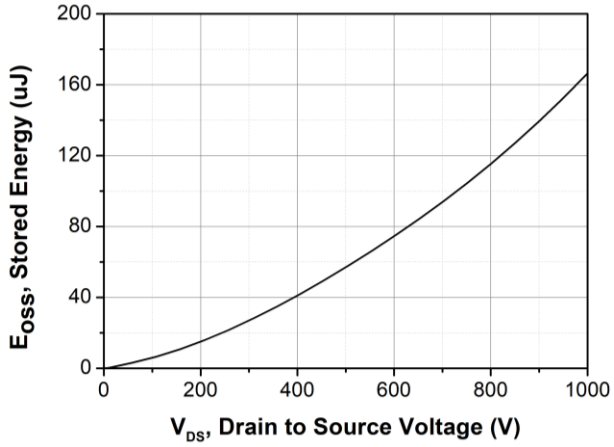

Figure 16. Output Capacitor Stored Energy

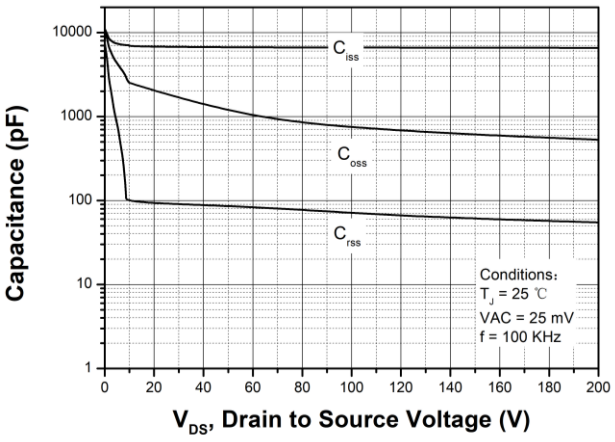

Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200 V)

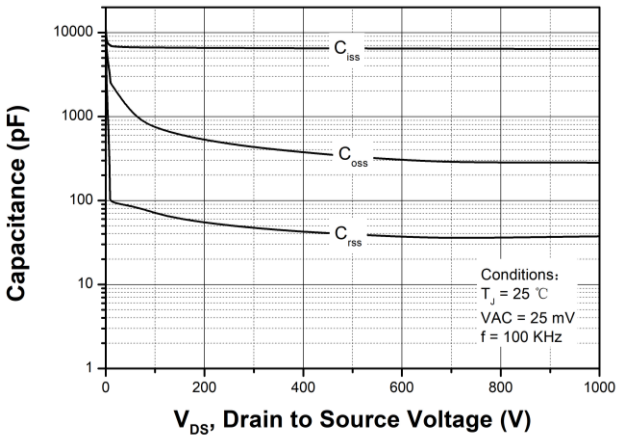

Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1000 V)

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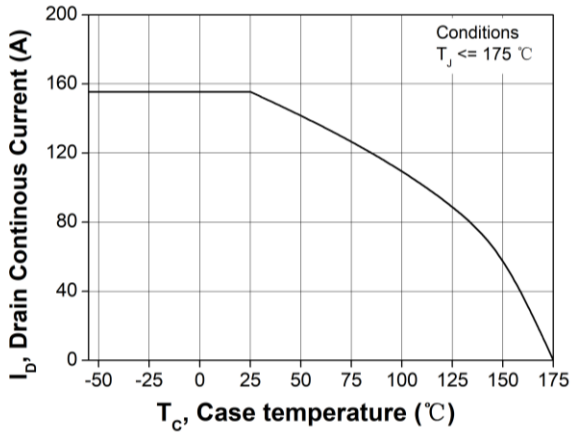

Figure 19. Continuous Drain Current Derating vs. Case Temperature

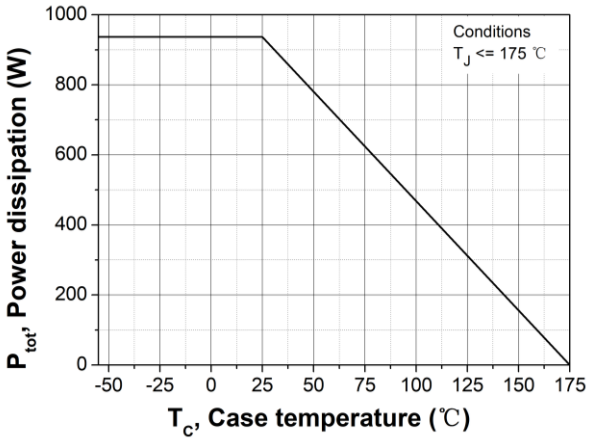

Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

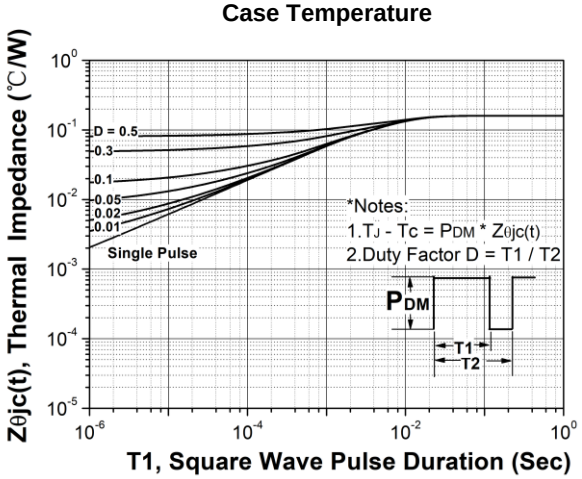

Figure 21. Transient Thermal Impedance (Junction - Case)

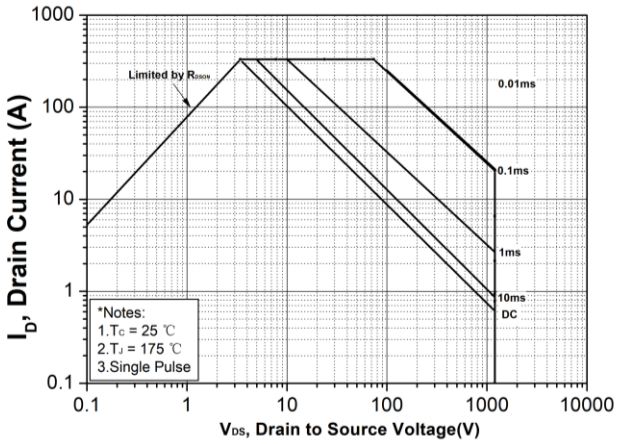

Figure 22. Safe Operating Area

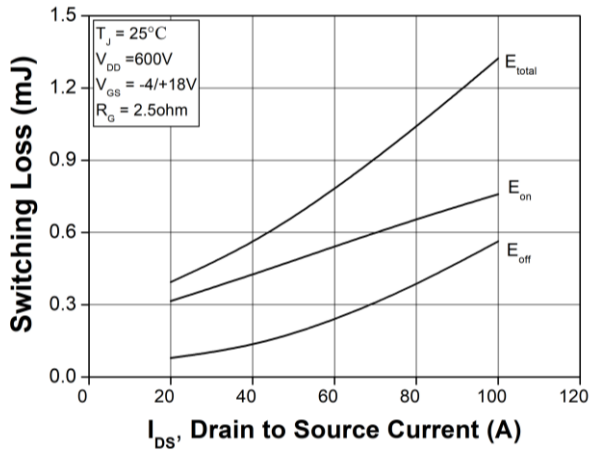

Figure 23. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 600V)

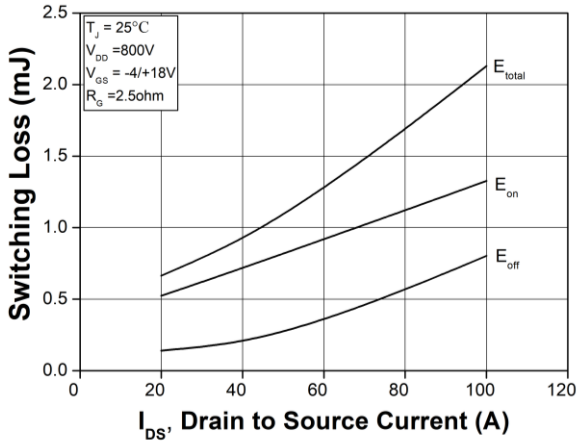

Figure 24. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 800V)

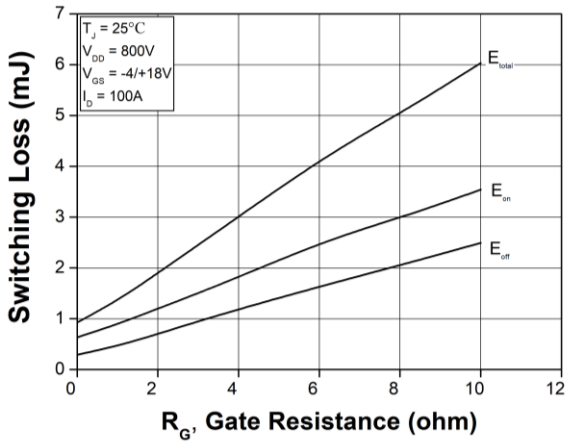

Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

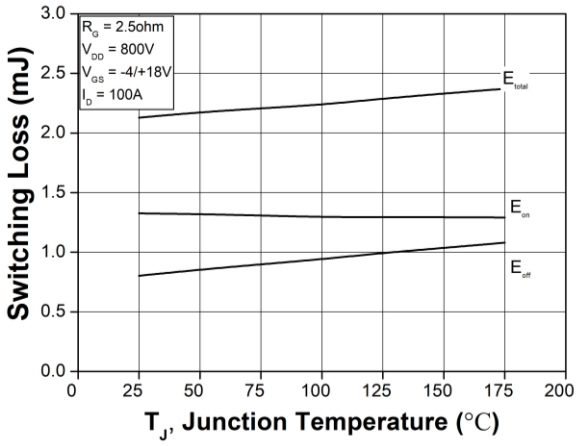

Figure 26. Clamped Inductive Switching Energy vs. Temperature

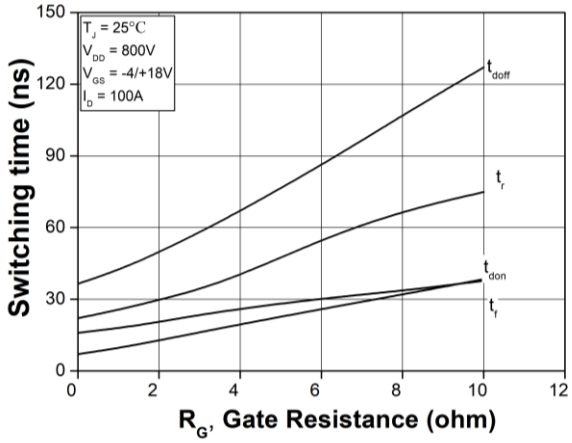

Figure 27. Switching Times vs. $R_{G(ext)}$

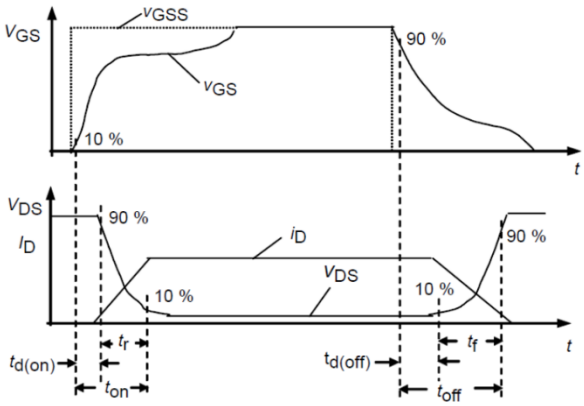

Figure 28. Switching Times Definition

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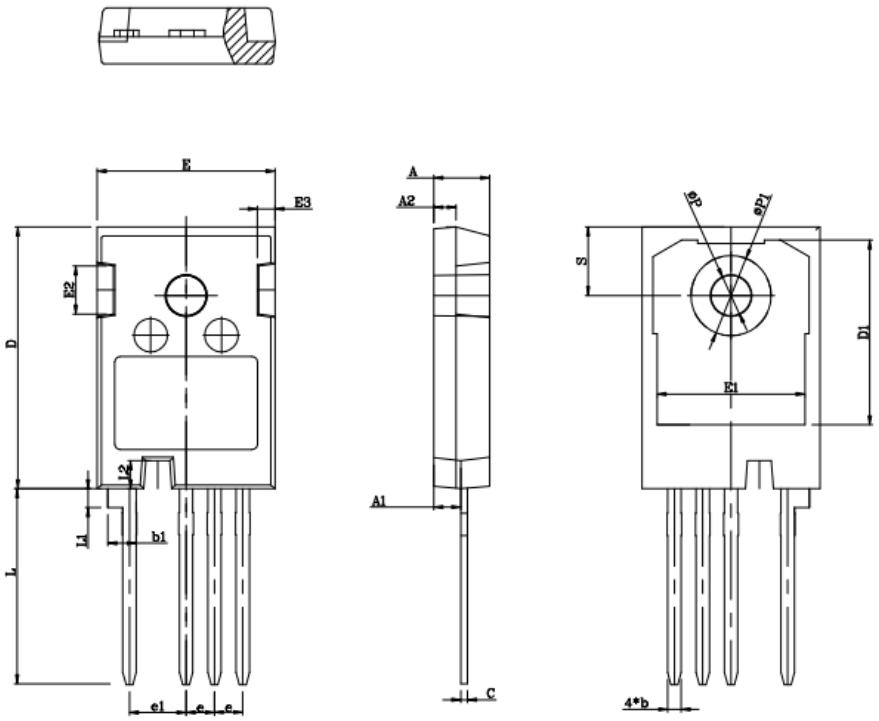
Mechanical Dimensions TO-247-4



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	

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