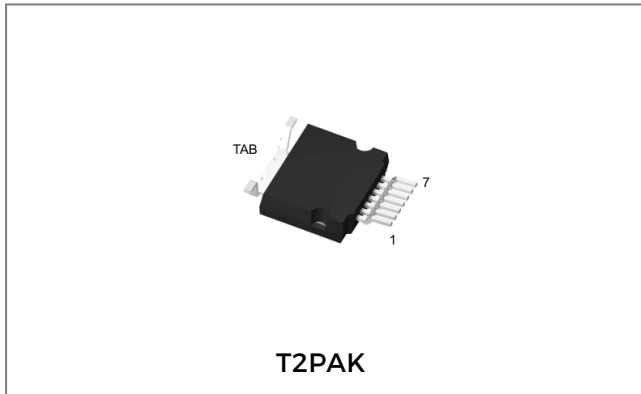


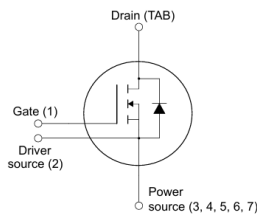
S4M0040120B Silicon Carbide Power MOSFET



Features

- Positive temperature characteristics, easy to parallel.
- Low on-resistance typ. $R_{DS(on)} = 40 \text{ m}\Omega$.
- 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.

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($T_c = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Conditions	Min.	Typ.	Max.	Units	Note
Drain - Source Voltage	V_{DSmax}	$V_{GS} = 0 \text{ V}$, $I_D = 100 \mu\text{A}$			1200	V	
Gate - Source Voltage (dynamic)	V_{GSmax}	AC ($f > 1 \text{ Hz}$)	-8		+22	V	
Gate - Source Voltage (static)	V_{GSop}	Static		-4 / +18		V	[1]
Continuous Drain Current	I_D	$V_{GS} = 18 \text{ V}$, $T_c = 25^\circ\text{C}$			50	A	
		$V_{GS} = 18 \text{ V}$, $T_c = 100^\circ\text{C}$			35	A	
Pulsed Drain Current	$I_{D(pulse)}$	Pulse width t_p limited by T_{jmax}			147	A	
Power Dissipation	P_D	$T_c = 25^\circ\text{C}$			258	W	

[1] Recommended turn off gate voltage is -4 V. Recommended turn on gate voltage is 18 V. Do not use with $V_{GS(on)} < 12 \text{ V}$.

Electrical Characteristics:

Characteristics	Symbol	Conditions	Min.	Typ.	Max.	Units
Drain Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 100\text{ }\mu\text{A}$	1200			V
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 10.6\text{ mA}$	2	2.8	4	V
		$V_{DS} = V_{GS}, I_D = 10.6\text{ mA}, T_J = 175\text{ }^\circ\text{C}$		1.9		V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$			100	μA
Gate Source Leakage Current	I_{GSS}	$V_{GS} = 18\text{ V}, V_{DS} = 0\text{ V}$			250	nA
Drain Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 18\text{ V}, I_D = 28.6\text{ A}$		40	52	m Ω
		$V_{GS} = 18\text{ V}, I_D = 28.6\text{ A}, T_J = 175\text{ }^\circ\text{C}$		66		m Ω
Transconductance	g_{fs}	$V_{DS} = 20\text{ V}, I_{DS} = 28.6\text{ A}$		14		S
		$V_{DS} = 20\text{ V}, I_{DS} = 28.6\text{ A}, T_J = 175\text{ }^\circ\text{C}$		13		S
Input Capacitance	C_{ISS}	$V_{GS} = 0\text{ V}$		1337		pF
Output Capacitance	C_{OSS}	$V_{DS} = 1200\text{ V}$		76		
Reverse Transfer Capacitance	C_{RSS}	$V_{AC} = 25\text{ mV}$		1.5		
COSS Stored Energy	E_{OSS}	$f = 1\text{ MHz}$		63		μJ
Turn-On Switching Energy	E_{ON}	$V_{DS} = 800\text{ V}, V_{GS} = -4 / 18\text{ V}$		92		μJ
Turn-Off Switching Energy	E_{OFF}	$I_D = 28.6\text{ A}, R_{G(ext)} = 2.5\text{ }\Omega, L = 99\text{ }\mu\text{H}$		70		
Turn-On Delay Time	$t_{d(on)}$	$V_{DS} = 800\text{ V}, V_{GS} = -4 / 18\text{ V}$		7.6		ns
Rise Time	t_r	$I_D = 28.6\text{ A}, R_{G(ext)} = 2.5\text{ }\Omega$		9.0		
Turn-Off Delay Time	$t_{d(off)}$	Inductive Load Timing relative to		12.9		
Fall Time	t_f	V_{DS} Per IEC60747-8-4 pg 83		6.4		
Internal Gate Resistance	$R_{G(int)}$	$f = 1\text{ MHz}, AC = 25\text{ mV}$		1.5		Ω
Gate to Source Charge	Q_{gs}	$V_{DS} = 800\text{ V}, V_{GS} = -4 / 18\text{ V}$		14		nC
Gate to Drain Charge	Q_{gd}	$I_D = 28.6\text{ A}$		10		
Total Gate Charge	Q_g	Per IEC60747-8-4 pg 21		48		

Reverse Diode Characteristics (TA = 25 °C, unless otherwise specified)

Characteristics	Symbol	Conditions	Typ.	Max.	Units
Diode Forward Voltage	V _{SD}	V _{GS} = -4 V, I _{SD} = 14.3 A	3.9		V
	V _{SD}	V _{GS} = -4 V, I _{SD} = 14.3 A, T _J = 175 °C	3.4		V
Reverse Recovery Time	t _{rr}	V _{GS} = -4 V, I _{SD} = 28.6 A, T _J = 25 °C	14		ns
Reverse Recovery Charge	Q _{rr}	V _R = 800 V	207		nC
Peak Reverse Recovery Current	I _{rm}	dif / dt = 2000 A / μs	17		A

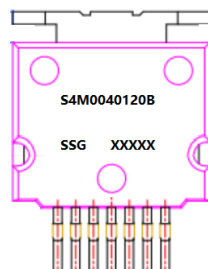
Thermal-Mechanical Specifications

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 _{θJC}		0.58	°C /W

Ordering Information

Device	Package	Shipping
S4M0040120BTA	T2PAK	35 pcs/tube
S4M0040120BTR	T2PAK	700 pcs/reel

Marking Diagram



Where XXXXX is YYWWL

S4M = Device Type
 0040 = RDS(on)
 120 = Reverse Voltage (1200V)
 B = Package
 SSG = SSG
 YY = Year
 WW = Week
 L = Lot Number

Cautions: Molding resin
 Epoxy resin UL94V-0

Ratings and Characteristics Curves

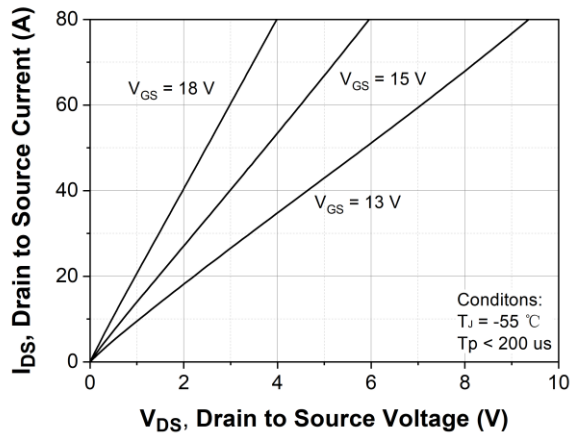


Figure 1. Output Characteristics $T_J = -55^\circ\text{C}$

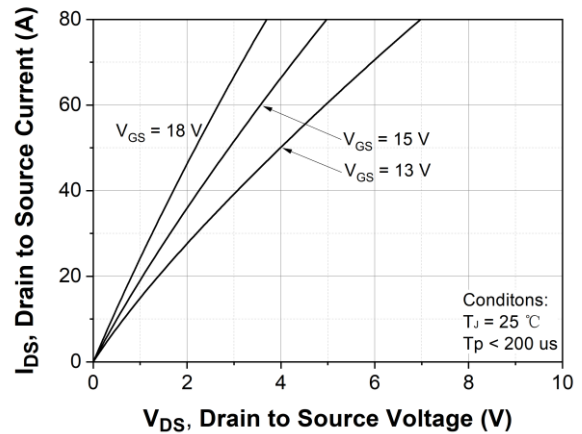


Figure 2. Output Characteristics $T_J = 25^\circ\text{C}$

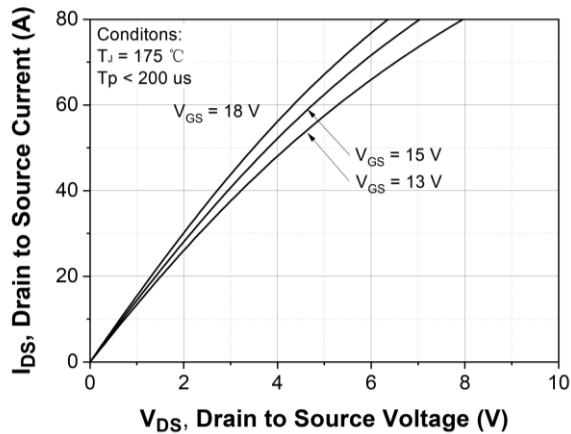


Figure 3. Output Characteristics $T_J = 175^\circ\text{C}$

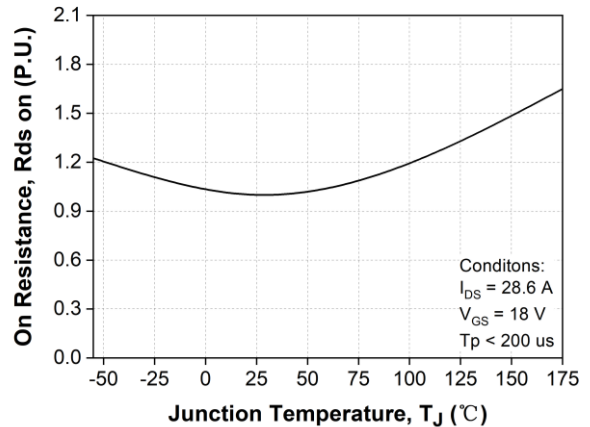


Figure 4. Normalized On-Resistance vs. Temperature

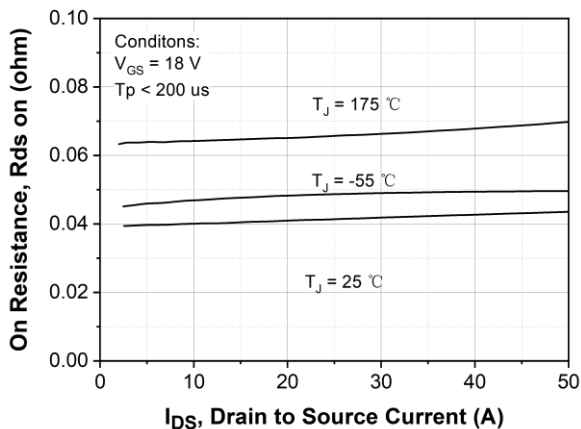


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

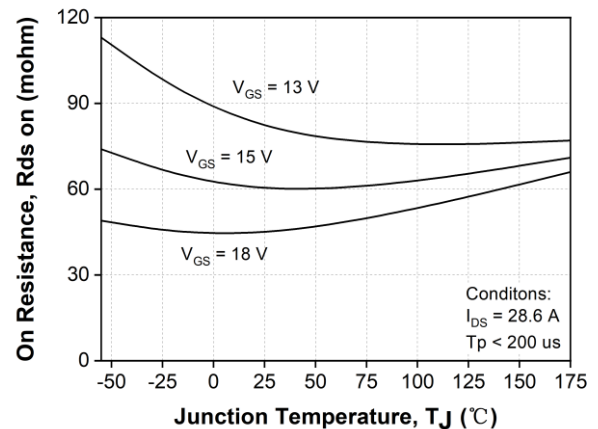


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

Technical Data
Data Sheet N3263, Rev.-

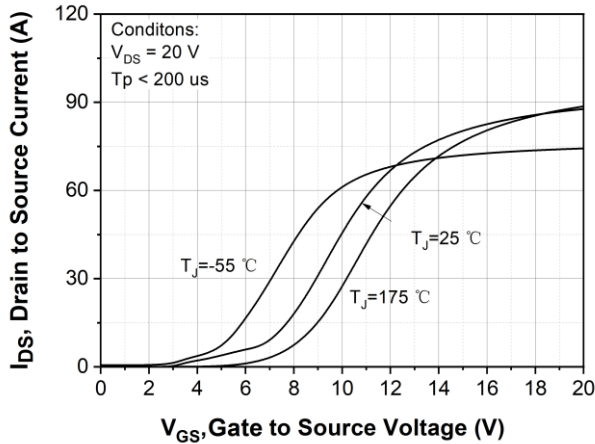


Figure 7. Transfer Characteristic for Various Junction Temperatures

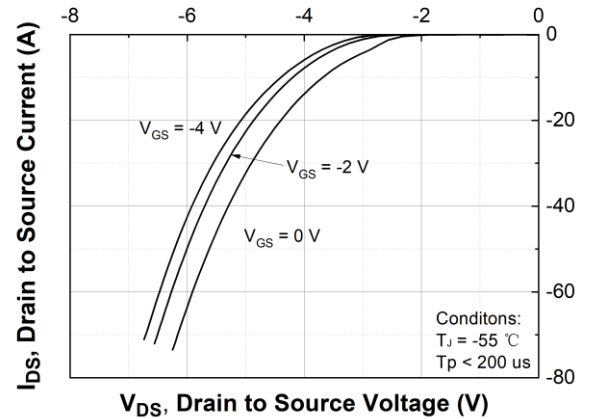


Figure 8. Body Diode Characteristic at $T_J = -55\text{ }^{\circ}\text{C}$

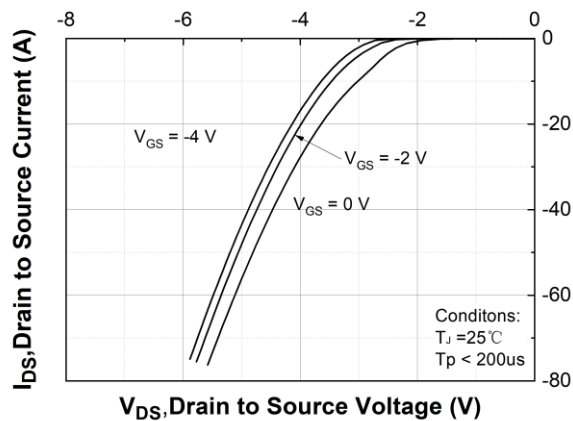


Figure 9. Body Diode Characteristic at $T_J = 25\text{ }^{\circ}\text{C}$

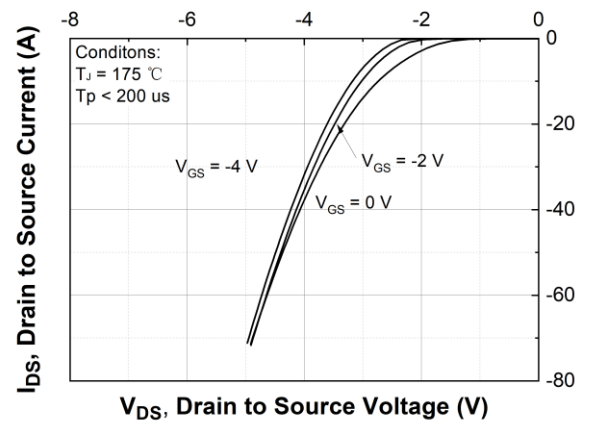


Figure 10. Body Diode Characteristic at $T_J = 175\text{ }^{\circ}\text{C}$

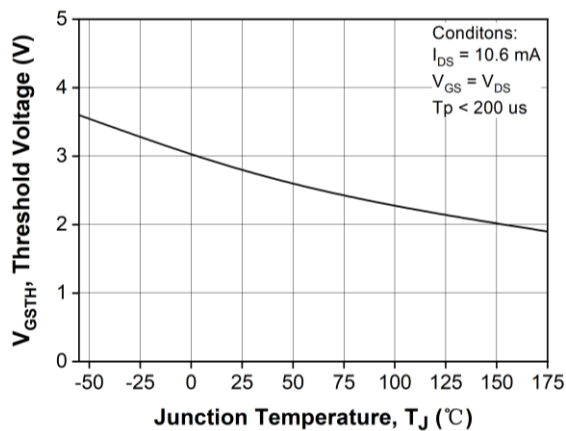


Figure 11. Threshold Voltage vs. Temperature

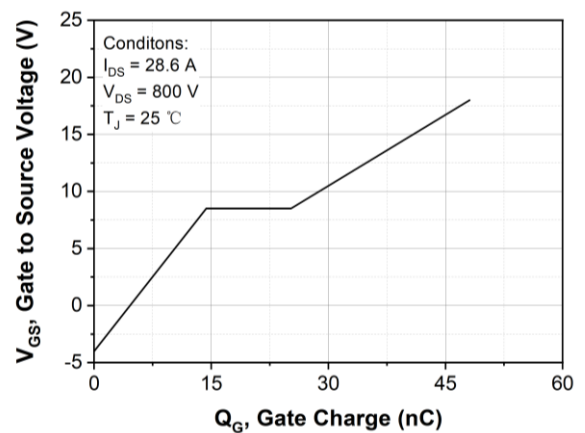


Figure 12. Gate Charge Characteristic

Technical Data
Data Sheet N3263, Rev.-

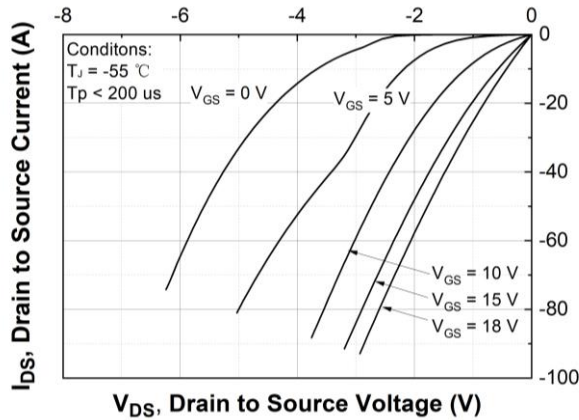


Figure 13. 3rd Quadrant Characteristic at $T_J = -55\text{ }^{\circ}\text{C}$

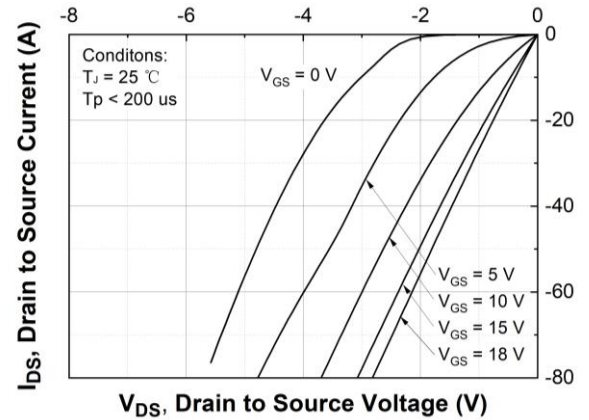


Figure 14. 3rd Quadrant Characteristic at $T_J = 25\text{ }^{\circ}\text{C}$

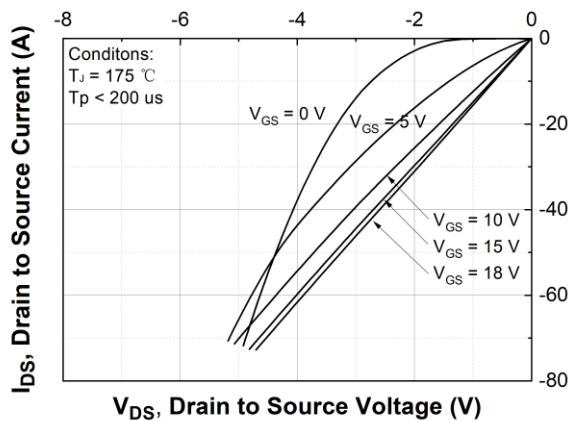


Figure 15. 3rd Quadrant Characteristic at $T_J = 175\text{ }^{\circ}\text{C}$

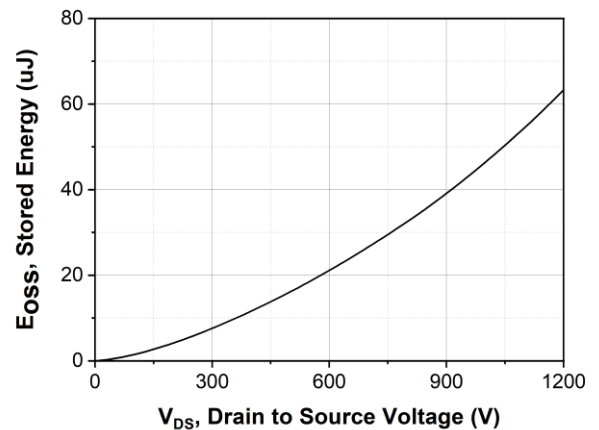


Figure 16. Output Capacitor Stored Energy

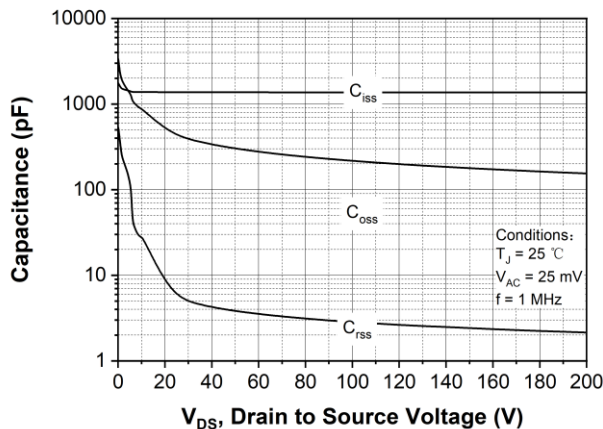


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200 V)

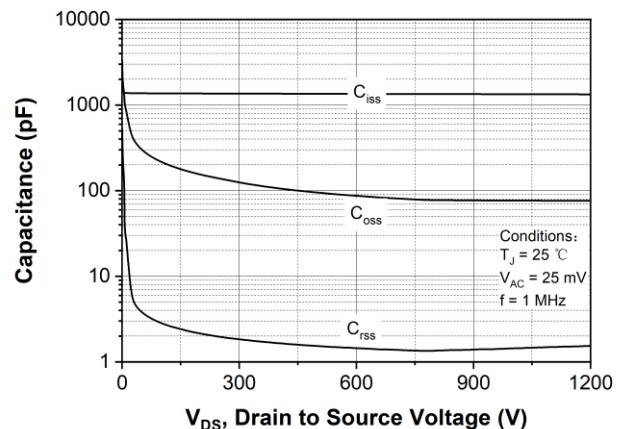


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1200V)

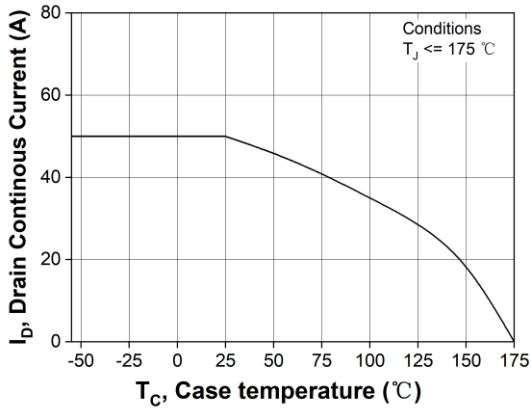


Figure 19. Continuous Drain Current Derating vs. Case Temperature

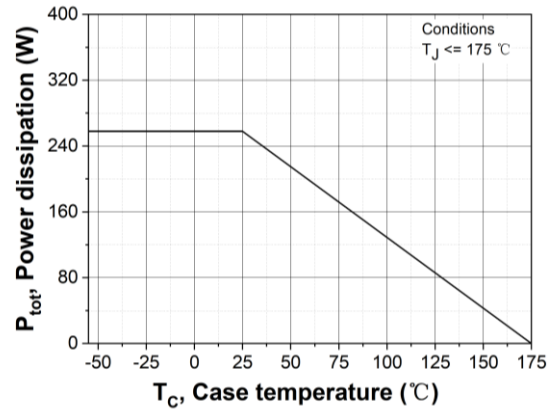


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

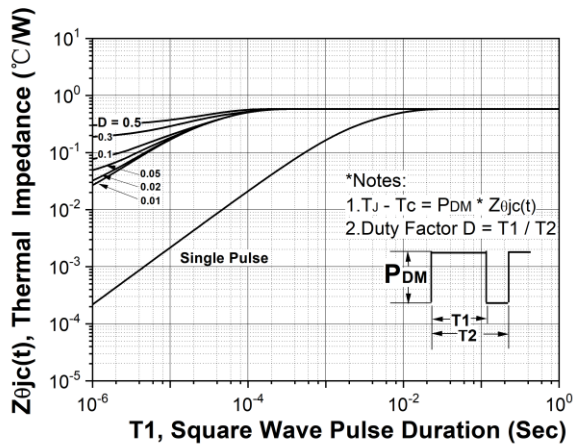


Figure 21. Transient Thermal Impedance (Junction - Case)

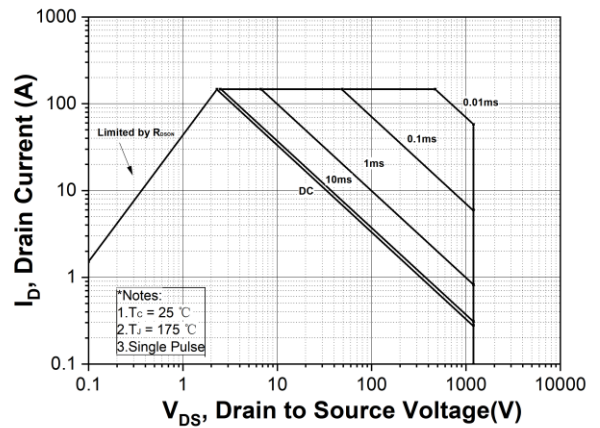


Figure 22. Safe Operating Area

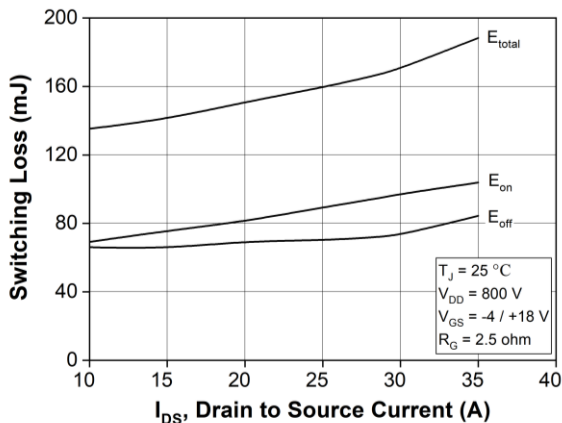


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 800V$)

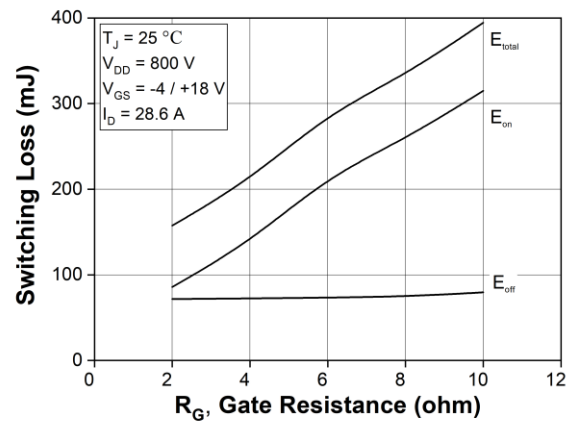


Figure 24. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

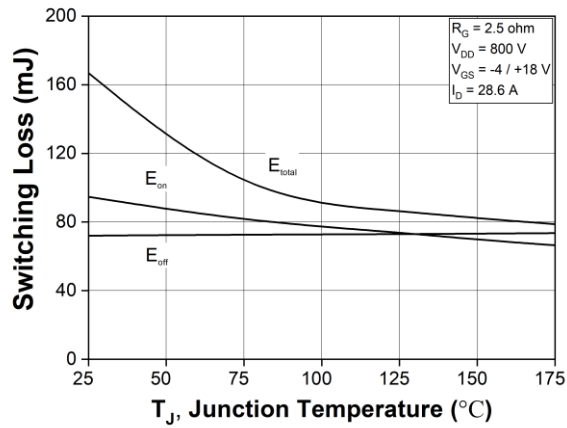


Figure 25. Clamped Inductive Switching Energy vs. Temperature

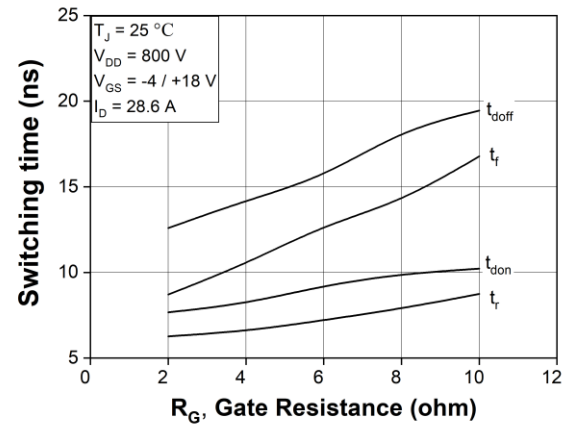
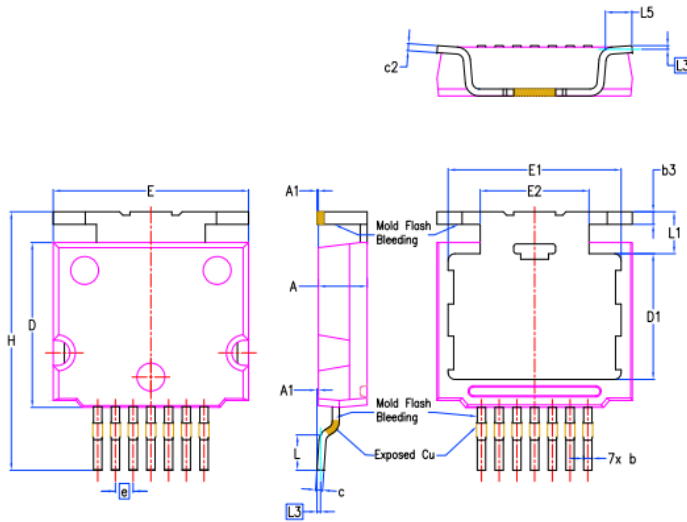


Figure 26. Switching Times vs. R_{G(ext)}

Mechanical Dimensions T2PAK



The outline from different package houses may have slight differences. So the outline above is just schematic. The dimensions are controlled per specifications.

SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	3.40	3.50	3.60
A1	0.00	0.10	0.25
b	0.50	0.60	0.70
b3	0.80	0.90	1.00
c	0.40	0.50	0.60
c2	0.40	0.50	0.60
D	11.70	11.80	11.90
D1	8.80	9.00	9.10
E	13.90	14.00	14.10
E1	12.30	12.40	12.50
E2	7.75	7.80	7.85
e	1.27 BSC		
H	18.00	18.50	19.00
L	2.30	2.50	2.75
L1	—	3.05	—
L3	—	0.26	—
L5	1.70	1.90	2.15

Technical Data
Data Sheet N3263, Rev.-



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