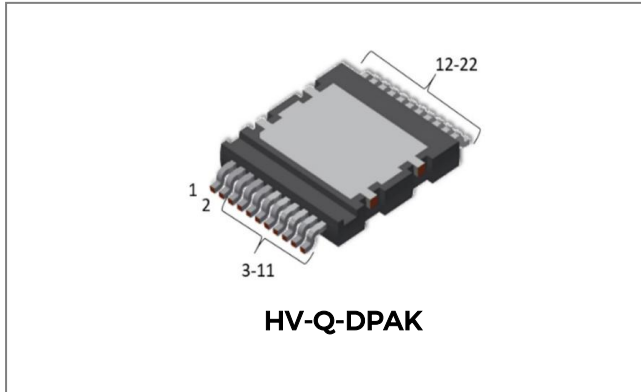


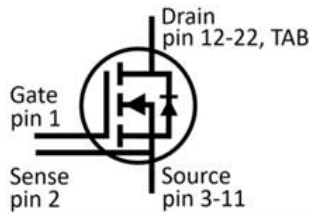
S4M0040120Q Silicon Carbide Power MOSFET



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	$V_{GS} = 18 \text{ V}$, $T_c = 25^\circ\text{C}$ $V_{GS} = 18 \text{ V}$, $T_c = 100^\circ\text{C}$			46 32	A	
Pulsed Drain Current	$I_{D(pulse)}$	Pulse width t_p limited by T_{jmax}			147	A	
Power Dissipation	P_D	$T_c = 25^\circ\text{C}$			251	W	

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

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	$IDSS$	$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$			100	μA
Gate Source Leakage Current	$IGSS$	$V_{GS} = 18\text{ V}, V_{DS} = 0\text{ V}$			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}	$f = 1\text{ MHz}$		62		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 ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise specified)

Characteristics	Symbol	Conditions	Typ.	Max.	Units
Diode Forward Voltage	V_{SD}	$V_{GS} = -4\text{ V}$, $I_{SD} = 14.3\text{ A}$	3.9		V
	V_{SD}	$V_{GS} = -4\text{ V}$, $I_{SD} = 14.3\text{ A}$, $T_J = 175\text{ }^{\circ}\text{C}$	3.4		V
Reverse Recovery Time	t_{rr}	$V_{GS} = -4\text{ V}$, $I_{SD} = 28.6\text{ A}$, $T_J = 25\text{ }^{\circ}\text{C}$	14		ns
Reverse Recovery Charge	Q_{rr}	$V_R = 800\text{ V}$	207		nC
Peak Reverse Recovery Current	I_{mm}	$di/dt = 2000\text{ A}/\mu\text{s}$	17		A

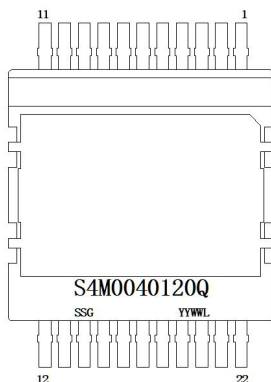
Thermal-Mechanical Specifications

Characteristics	Symbol	Condition	Specification	Units
Junction Temperature	T_J	-	-55 to +175	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-	-55 to +175	$^{\circ}\text{C}$
Typical Thermal Resistance Junction to Case	$R_{\theta JC}$		0.6	$^{\circ}\text{C}/\text{W}$

Ordering Information

Device	Package	Shipping
S4M0040120Q	HV-Q-DPAK	1000 pcs/reel

Marking Diagram



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

Cautions: Molding resin
 Epoxy resin UL94V-0

Ratings and Characteristics Curves

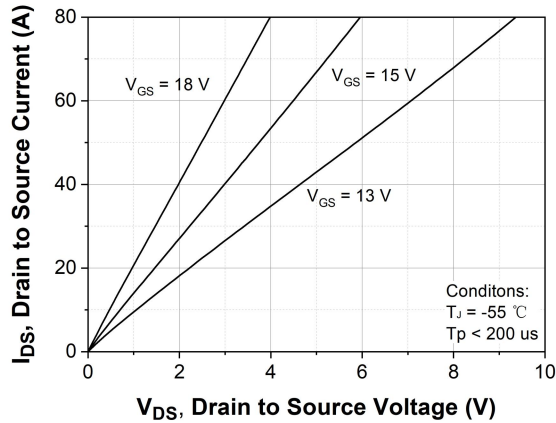


Figure 1. Output Characteristics $T_J = -55^\circ\text{C}$

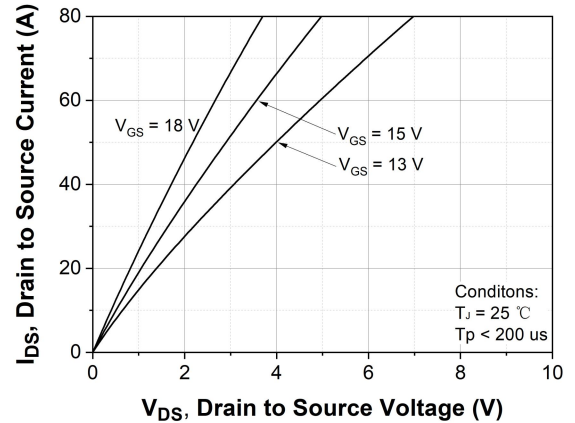


Figure 2. Output Characteristics $T_J = 25^\circ\text{C}$

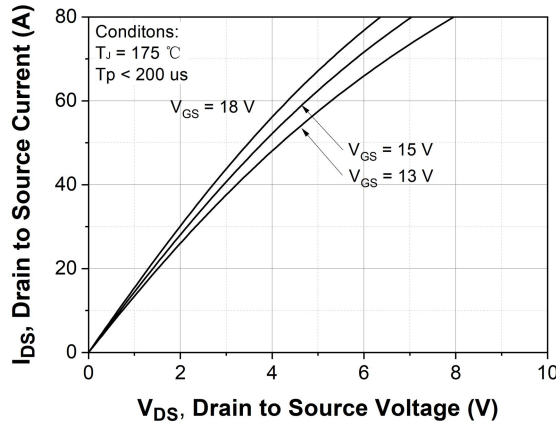


Figure 3. Output Characteristics $T_J = 175^\circ\text{C}$

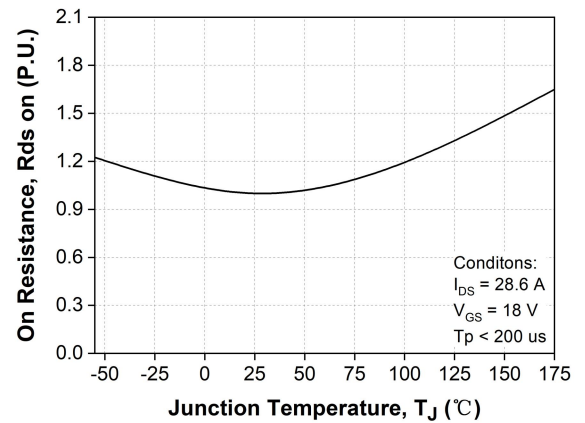


Figure 4. Normalized On-Resistance vs. Temperature

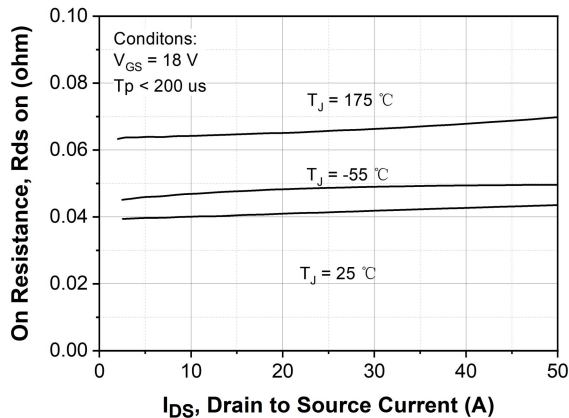


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

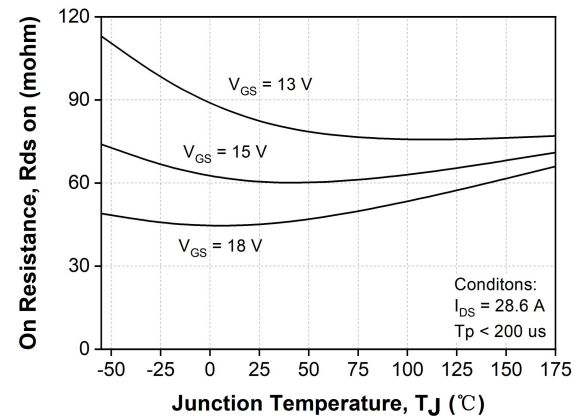


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

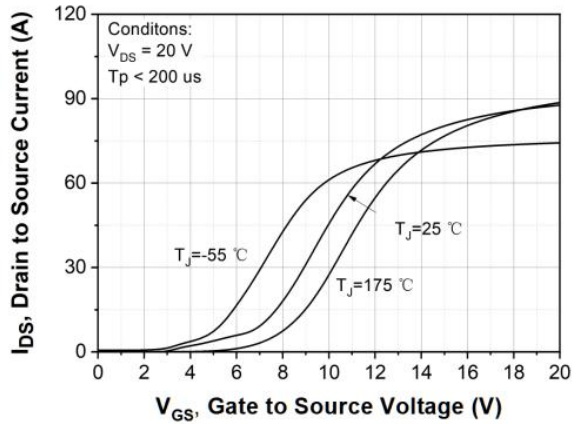


Figure 7. Transfer Characteristic for Various Junction Temperatures

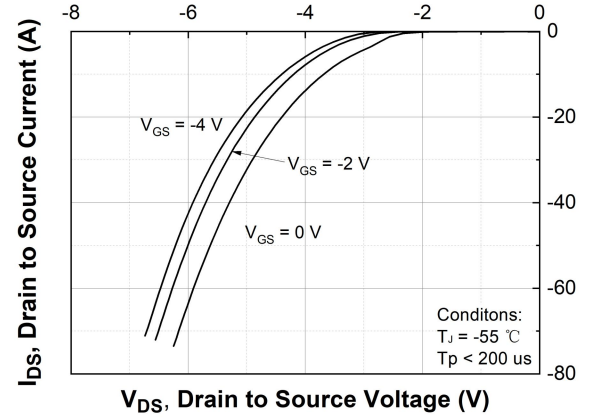


Figure 8. Body Diode Characteristic at $T_J = -55\text{ °C}$

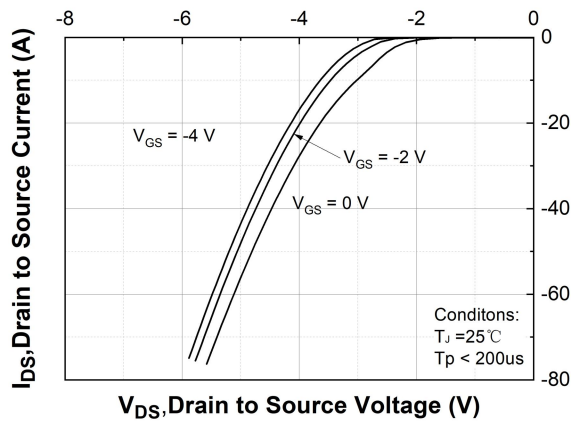


Figure 9. Body Diode Characteristic at $T_J = 25\text{ °C}$

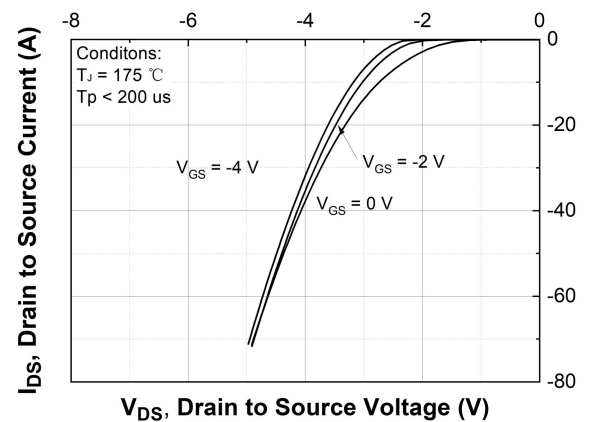


Figure 10. Body Diode Characteristic at $T_J = 175\text{ °C}$

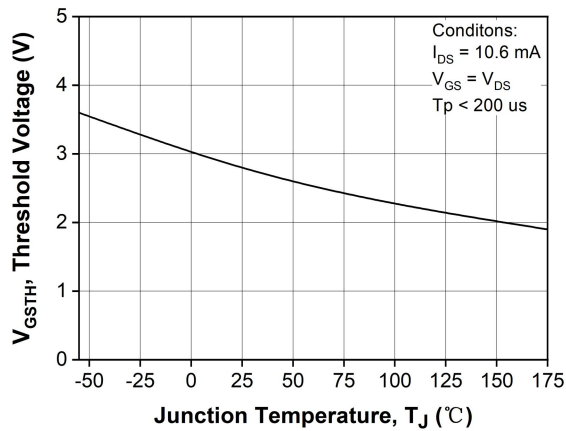


Figure 11. Threshold Voltage vs. Temperature

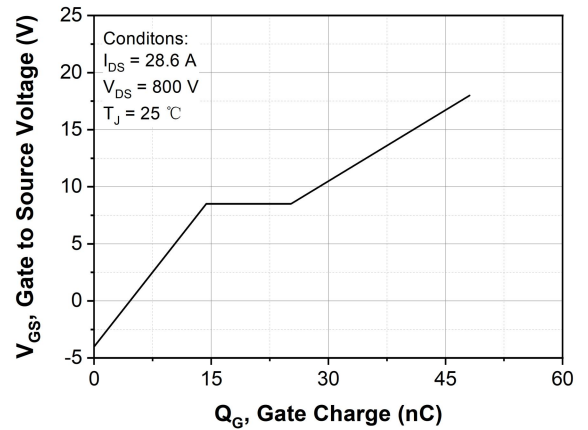


Figure 12. Gate Charge Characteristic

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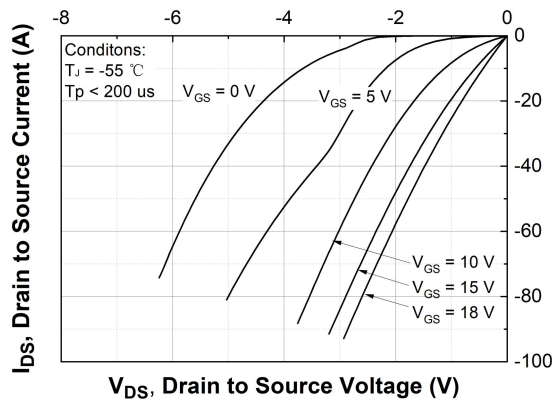


Figure 13. 3rd Quadrant Characteristic at $T_J = -55\text{ }^{\circ}\text{C}$

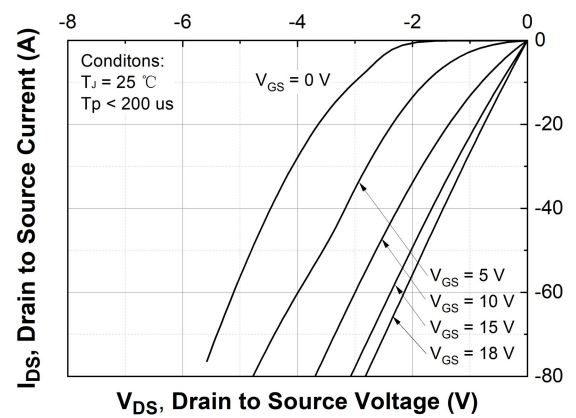


Figure 14. 3rd Quadrant Characteristic at $T_J = 25\text{ }^{\circ}\text{C}$

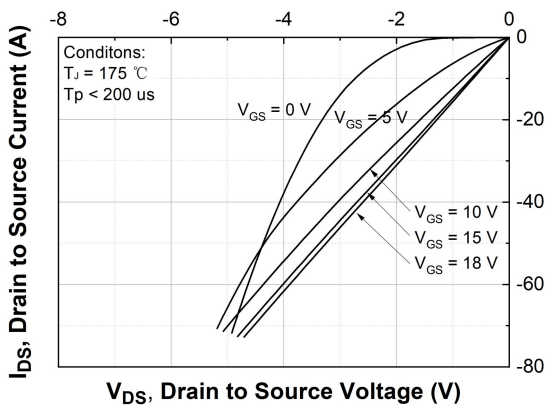


Figure 15. 3rd Quadrant Characteristic at $T_J = 175\text{ }^{\circ}\text{C}$

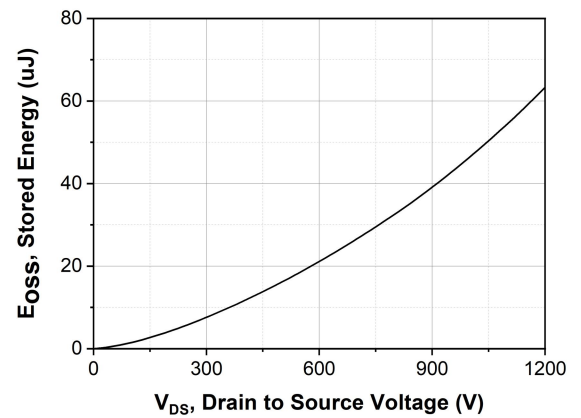


Figure 16. Output Capacitor Stored Energy

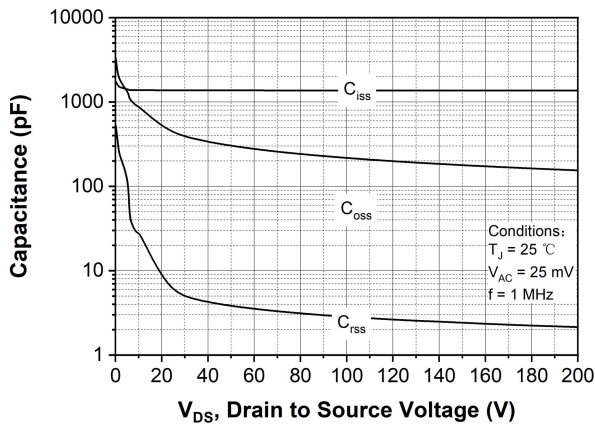


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200 V)

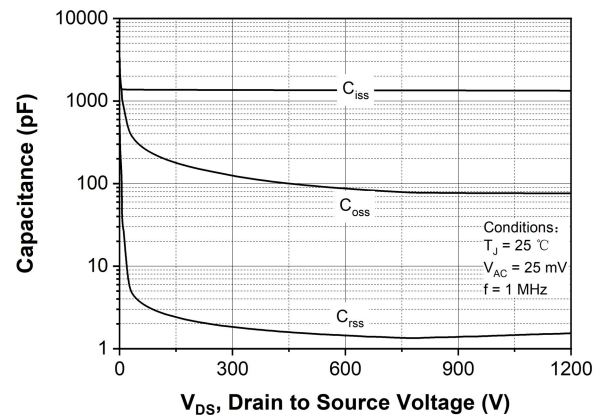


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1200V)

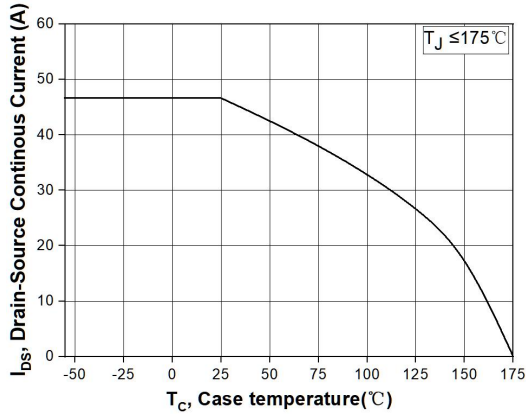


Figure 19. Continuous Drain Current Derating vs. Case Temperature

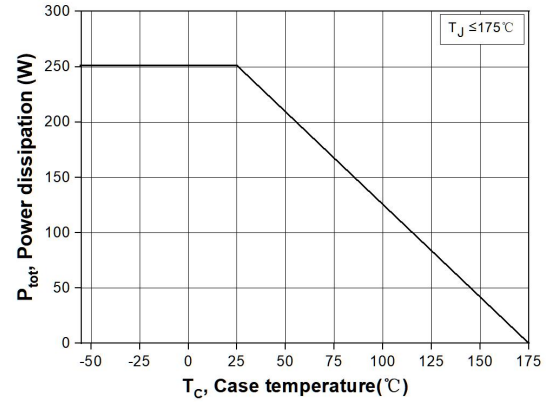


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

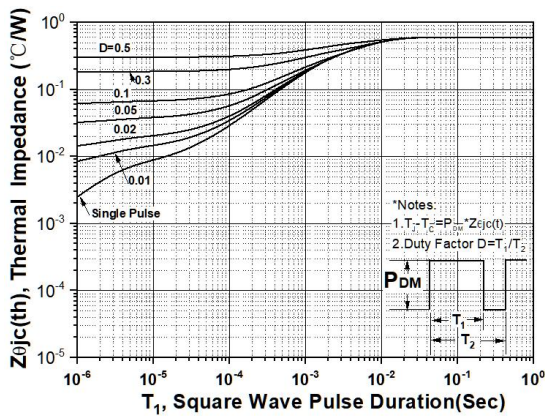


Figure 21. Transient Thermal Impedance (Junction - Case)

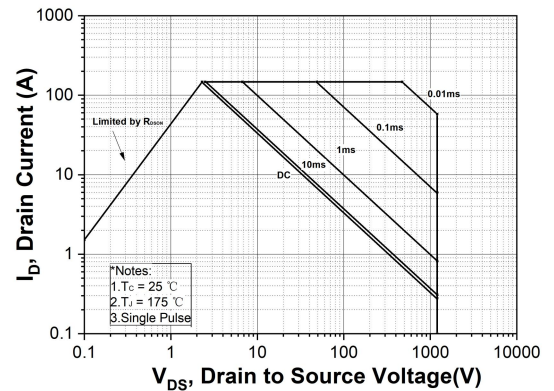


Figure 22. Safe Operating Area

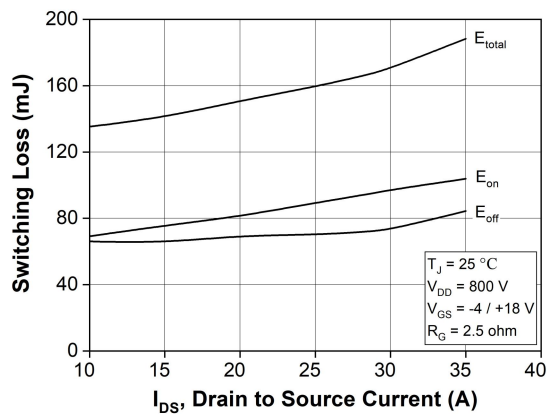


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 800V$)

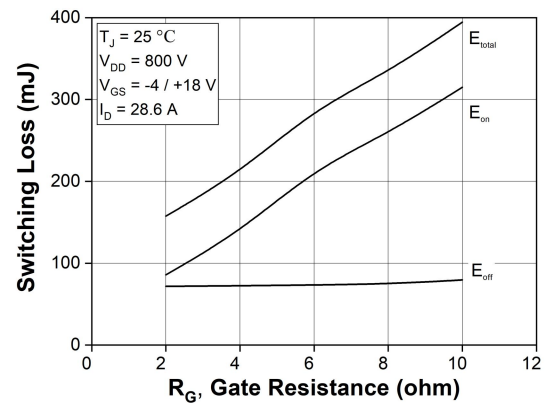


Figure 24. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

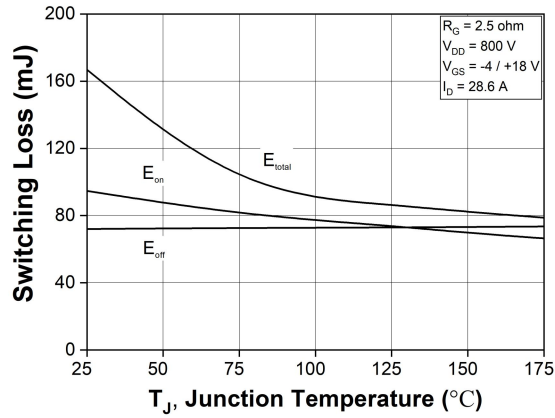


Figure 25. Clamped Inductive Switching Energy vs. Temperature

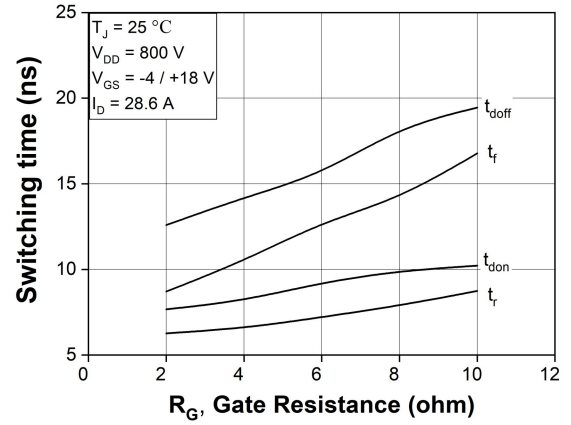
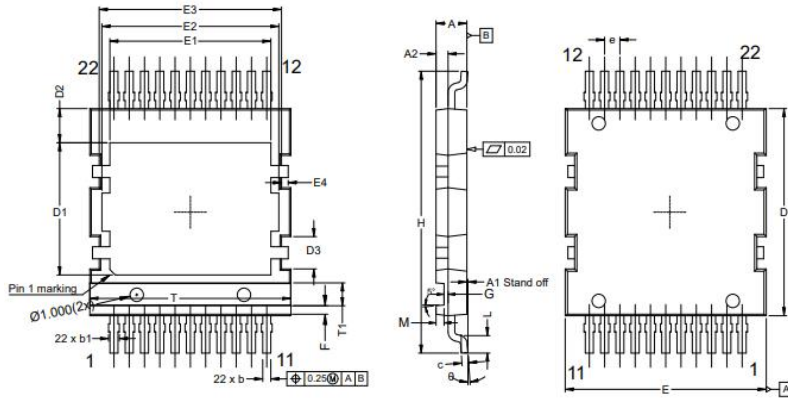


Figure 26. Switching Times vs. $R_{G(ext)}$

Mechanical Dimensions HV-Q-DPAK



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

COMMON DIMENSIONS		
SYMBOL	mm	
	Min	Max
A	2.20	2.35
A1	0.00	0.15
A2	0.80	1.00
b	0.50	0.70
b1	0.50	0.90
c	0.46	0.58
e	1.14	
D	15.30	15.50
D1	9.74	9.94
D2	2.54	
D3	2.40	
E	14.90	15.10
E1	11.91	12.11
E2	13.20	
E3	13.60	
E4	0.50	
H	20.81	21.11
L	1.20	1.40
T	14.90	15.10
T1	1.65	1.75
M	0.60	
F	0.631	
C	0.30	

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