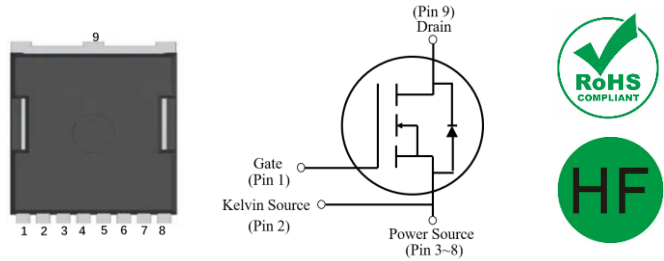


## IV2Q06040L1 – 650V 40mΩ Gen2 SiC MOSFET

### Features

- High blocking voltage with low on-resistance
- High speed switching with low capacitance
- High operating junction temperature capability
- Very fast and robust intrinsic body diode
- Kelvin source pin easing driver circuit design

### Outline:

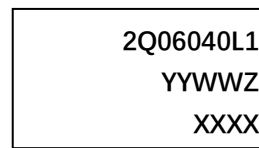


TOLL

### Applications

- Solar inverters
- UPS
- Motor drivers
- High voltage DC/DC converters
- Switch mode power supplies

### Marking Diagram:



2Q06040L1 = Specific Device Code  
 YY = Year  
 WW = Work Week  
 Z = Assembly Location  
 XXXX = Lot Traceability

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

Symbol	Parameter	Value	Unit	Test Conditions	Note
$V_{DS}$	Drain-Source voltage	650	V	$V_{GS}=0V, I_D=100\mu A$	
$V_{GSmax}(DC)$	Maximum DC voltage	-5 to 20	V	Static (DC)	
$V_{GSmax}(Spike)$	Maximum spike voltage	-10 to 23	V	Duty cycle<1%, and pulse width<200ns	
$V_{GSon}$	Recommended turn-on voltage	$18\pm 0.5$	V		
$V_{GSoff}$	Recommended turn-off voltage	-3.5 to -2	V		
$I_D$	Drain current (continuous)	60	A	$V_{GS}=18V, T_c=25^\circ\text{C}$	Fig. 21
		43	A	$V_{GS}=18V, T_c=100^\circ\text{C}$	
$I_{DM}$	Drain current (pulsed)	150	A	Pulse width limited by SOA	Fig. 24
$P_{TOT}$	Total power dissipation	249	W	$T_c=25^\circ\text{C}$	Fig. 22
$T_{stg}$	Storage temperature range	-55 to 175	$^\circ\text{C}$		
$T_J$	Operating junction temperature	-55 to 175	$^\circ\text{C}$		
$T_L$	Solder Temperature	260	$^\circ\text{C}$	wave soldering only allowed at leads, 1.6mm from case for 10 s	

### Thermal Data

Symbol	Parameter	Value	Unit	Note
$R_{\theta(J-C)}$	Thermal Resistance from Junction to Case	0.6	$^\circ\text{C}/\text{W}$	Fig. 23

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

Symbol	Parameter	Value			Unit	Test Conditions	Note
		Min.	Typ.	Max.			
$I_{DSS}$	Zero gate voltage drain current		3	100	$\mu\text{A}$	$V_{DS}=650\text{V}, V_{GS}=0\text{V}$	
$I_{GSS}$	Gate leakage current			$\pm 100$	$\text{nA}$	$V_{DS}=0\text{V}, V_{GS}=-5\sim 20\text{V}$	
$V_{TH}$	Gate threshold voltage	1.8	2.8	4.5	$\text{V}$	$V_{GS}=V_{DS}, I_D=7.5\text{mA}$	Fig. 8, 9
			2.1			$V_{GS}=V_{DS}, I_D=7.5\text{mA}$ @ $T_J=175^\circ\text{C}$	
$R_{ON}$	Static drain-source on-resistance		40	53	$\text{m}\Omega$	$V_{GS}=18\text{V}, I_D=20\text{A}$ @ $T_J=25^\circ\text{C}$	Fig. 4, 5, 6, 7
			60		$\text{m}\Omega$	$V_{GS}=18\text{V}, I_D=20\text{A}$ @ $T_J=175^\circ\text{C}$	
$C_{iss}$	Input capacitance		2000		$\text{pF}$	$V_{DS}=600\text{V}, V_{GS}=0\text{V},$ $f=1\text{MHz}, V_{AC}=25\text{mV}$	Fig. 16
$C_{oss}$	Output capacitance		158		$\text{pF}$		
$C_{rss}$	Reverse transfer capacitance		11.4		$\text{pF}$		
$E_{oss}$	$C_{oss}$ stored energy		31		$\mu\text{J}$		Fig. 17
$Q_g$	Total gate charge		94.7		$\text{nC}$	$V_{DS}=400\text{V}, I_D=20\text{A},$ $V_{GS}=-3\text{ to }18\text{V}$	Fig. 18
$Q_{gs}$	Gate-source charge		24.5		$\text{nC}$		
$Q_{gd}$	Gate-drain charge		47.3		$\text{nC}$		
$R_g$	Gate input resistance		2.9		$\Omega$	$f=1\text{MHz}$	
$E_{ON}$	Turn-on switching energy		133.4		$\mu\text{J}$	$V_{DS}=400\text{V}, I_D=30\text{A},$ $V_{GS}=-3.5\text{ to }18\text{V},$ $R_{G(ext)}=3.3\Omega,$ $L=200\mu\text{H}$ $T_J=25^\circ\text{C}$	Fig. 19, 20
$E_{OFF}$	Turn-off switching energy		37.6		$\mu\text{J}$		
$t_{d(on)}$	Turn-on delay time		7.0		$\text{ns}$		
$t_r$	Rise time		14.1				
$t_{d(off)}$	Turn-off delay time		17.0				
$t_f$	Fall time		8.0				

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

Symbol	Parameter	Value			Unit	Test Conditions	Note
		Min.	Typ.	Max.			
$V_{SD}$	Diode forward voltage		4.1		$\text{V}$	$I_{SD}=20\text{A}, V_{GS}=0\text{V}$	Fig. 10, 11, 12
			3.8		$\text{V}$	$I_{SD}=20\text{A}, V_{GS}=0\text{V},$ $T_J=175^\circ\text{C}$	
$t_{rr}$	Reverse recovery time		33.3		$\text{ns}$	$V_{GS}=-3.5\text{V}/+18\text{V},$	
$Q_{rr}$	Reverse recovery charge		192.1		$\text{nC}$	$I_{SD}=30\text{A}, V_R=400\text{V},$	
$I_{RRM}$	Peak reverse recovery current		17.5		$\text{A}$	$R_{G(ext)}=15\Omega L=200\mu\text{H}$ $di/dt=3000\text{A}/\mu\text{s}$	

## Typical Performance (curves)

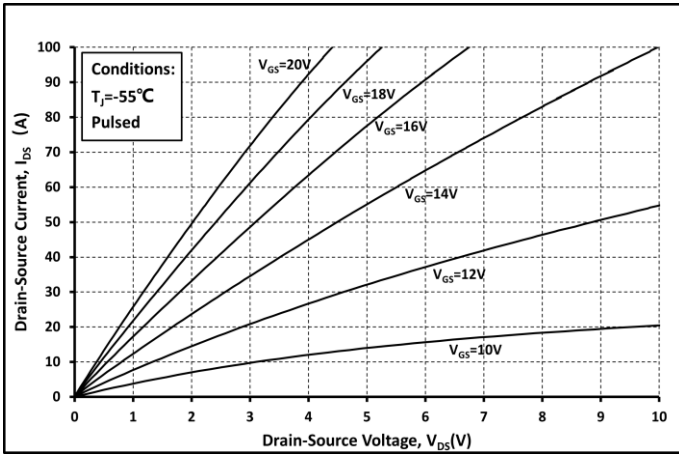


Fig. 1 Output Curve @  $T_j = -55^\circ\text{C}$

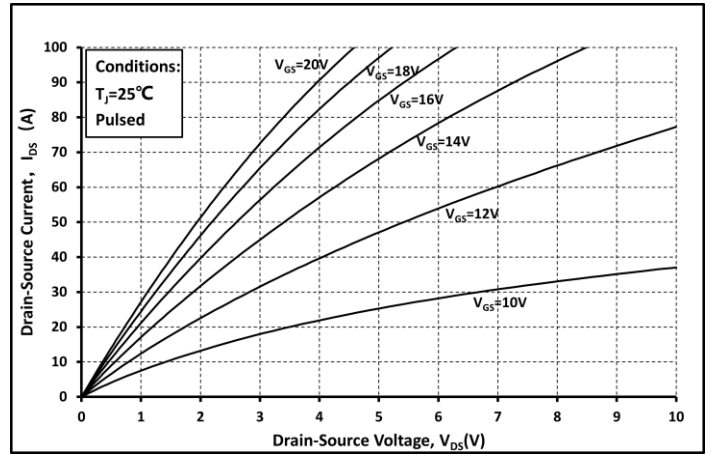


Fig. 2 Output Curve @  $T_j = 25^\circ\text{C}$

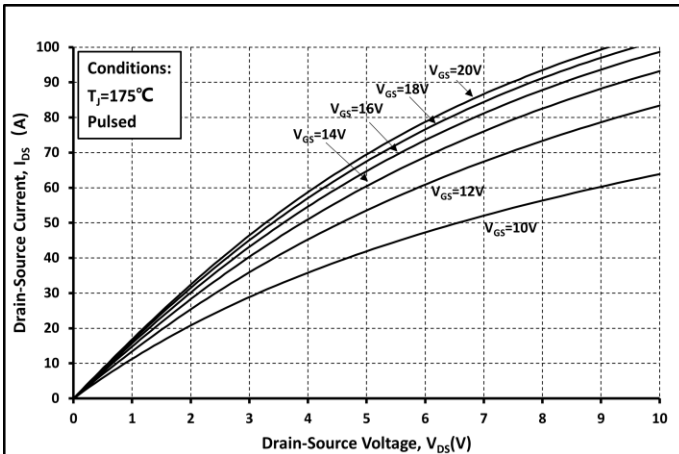


Fig. 3 Output Curve @  $T_j = 175^\circ\text{C}$

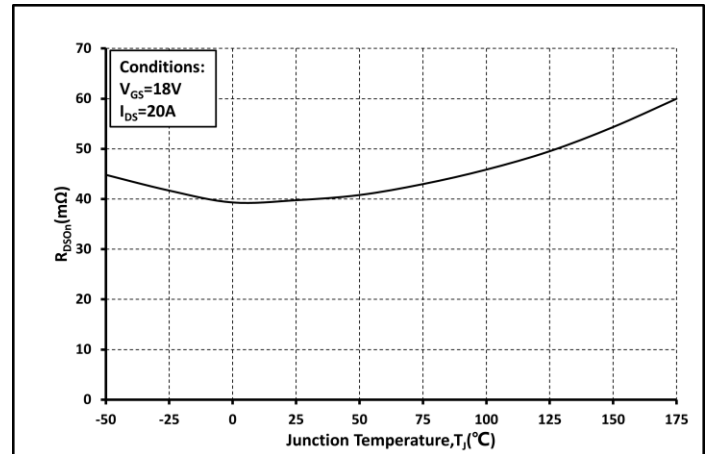


Fig. 4  $R_{DS(on)}$  vs. Temperature

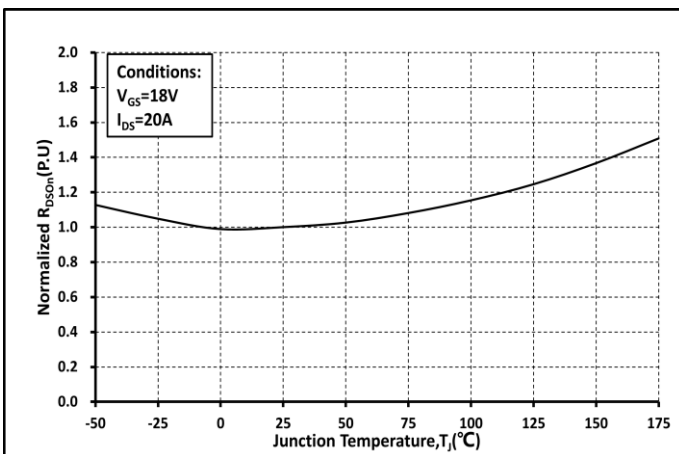


Fig. 5 Normalized  $R_{DS(on)}$  vs. Temperature

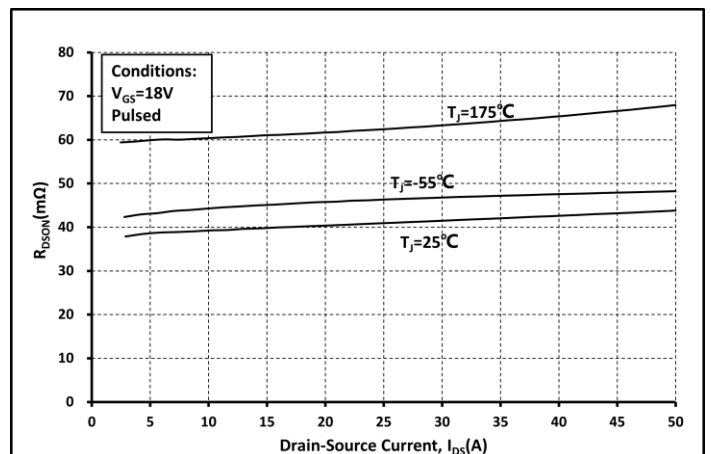


Fig. 6  $R_{DS(on)}$  vs.  $I_{DS}$  @ Various Temperature

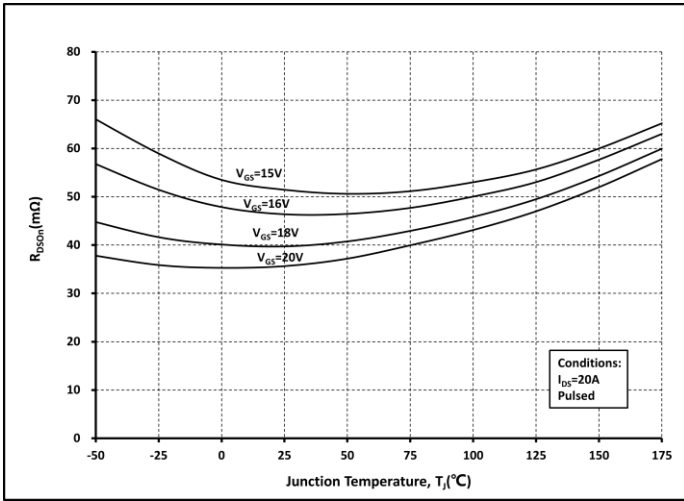


Fig. 7 Ron vs. Temperature @ Various  $V_{GS}$

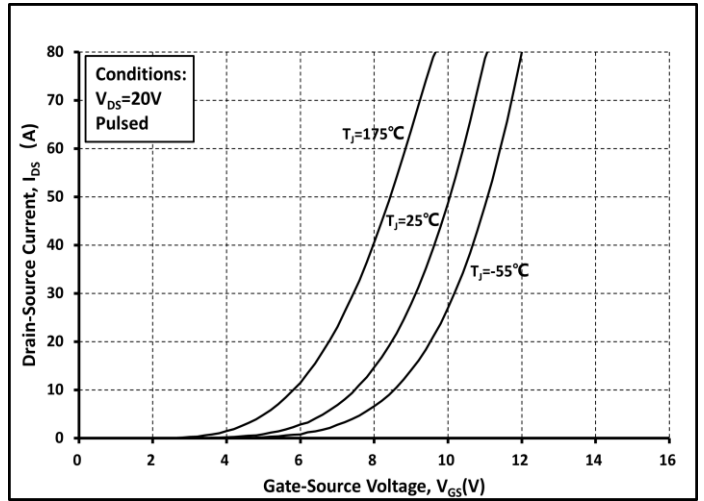


Fig. 8 Transfer Curves @ Various Temperature

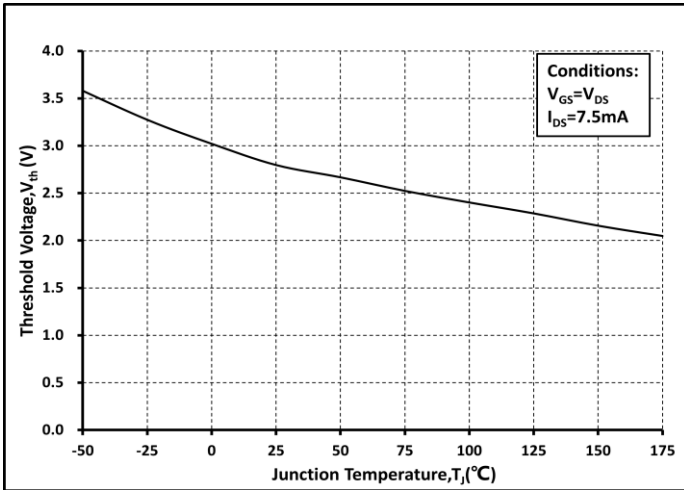


Fig. 9 Threshold Voltage vs. Temperature

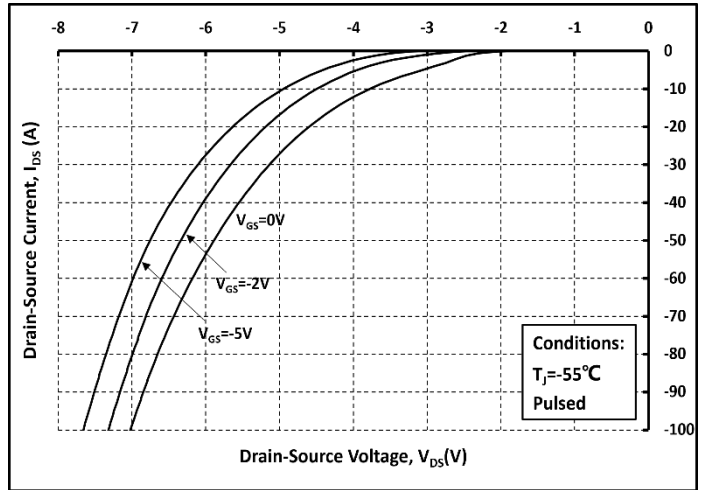


Fig. 10 Body Diode curves @  $T_J = -55^\circ\text{C}$

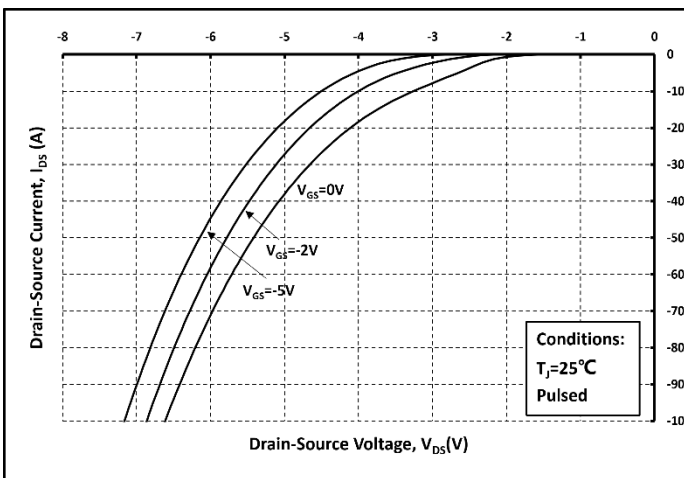


Fig. 11 Body Diode curves @  $T_J = 25^\circ\text{C}$

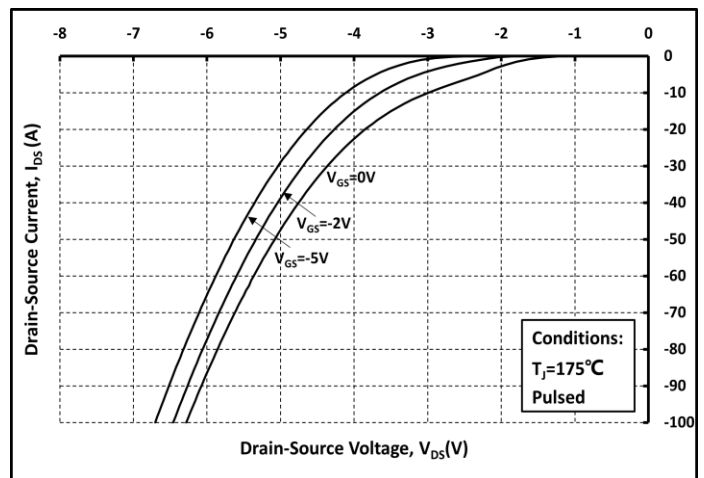


Fig. 12 Body Diode curves @  $T_J = 175^\circ\text{C}$

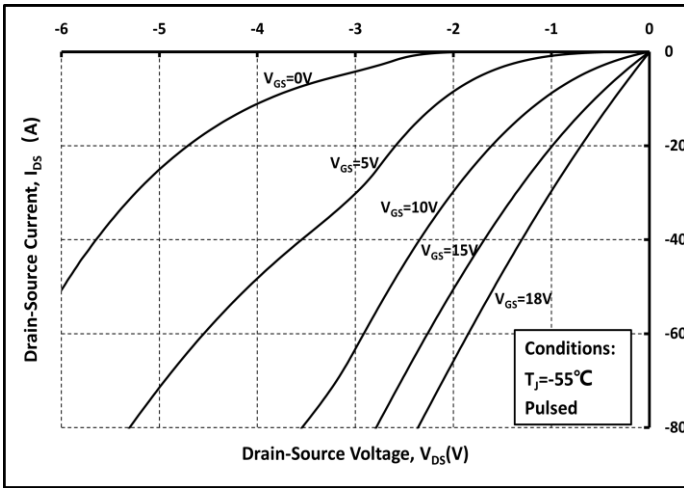


Fig. 13 3<sup>rd</sup> Quadrant curves @  $T_j = -55^\circ\text{C}$

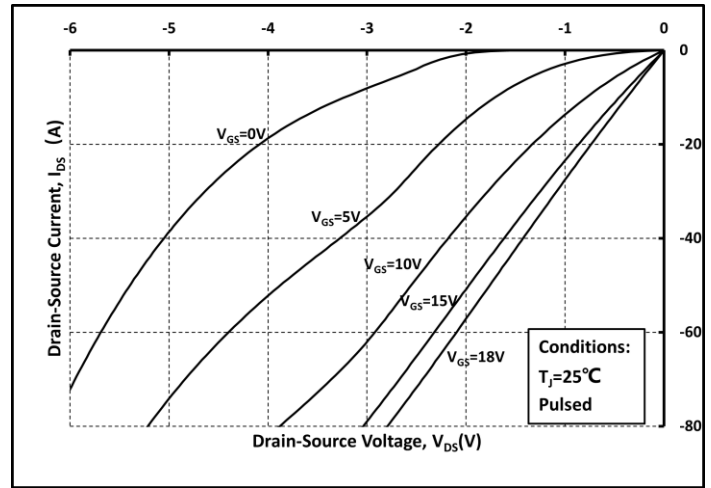


Fig. 14 3<sup>rd</sup> Quadrant curves @  $T_j = 25^\circ\text{C}$

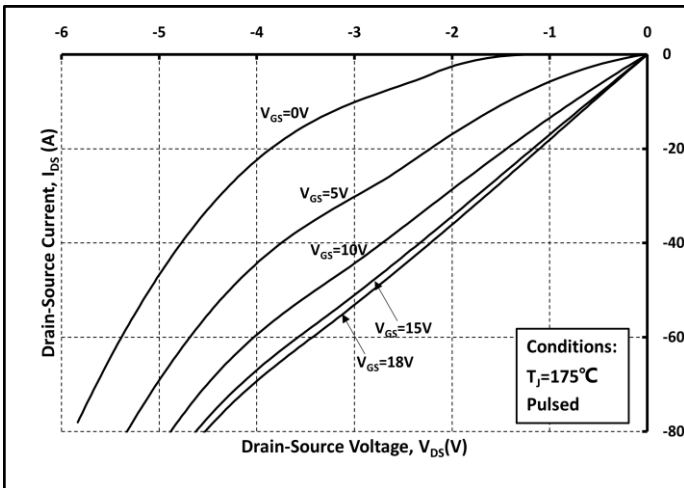


Fig. 15 3<sup>rd</sup> Quadrant curves @  $T_j = 175^\circ\text{C}$

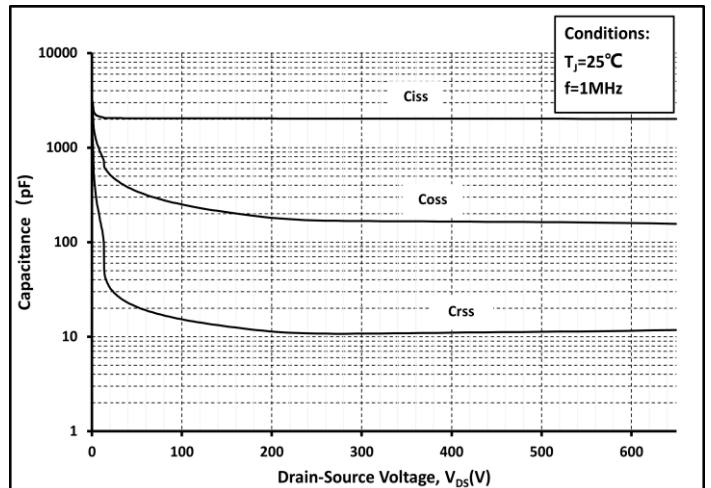


Fig. 16 Capacitance vs.  $V_{DS}$

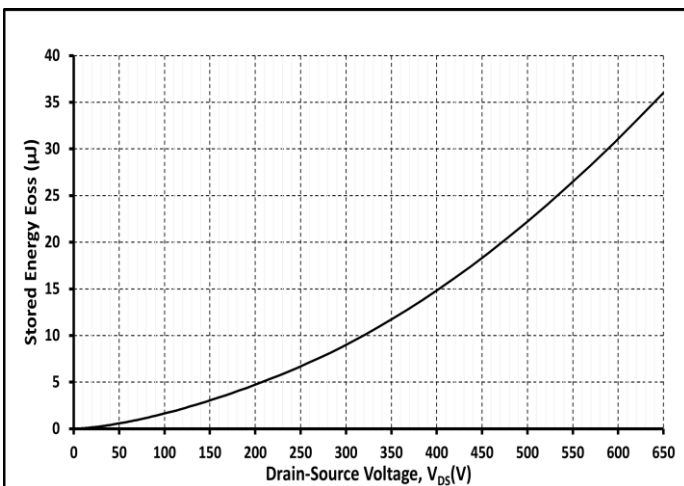


Fig. 17 Output Capacitor Stored Energy

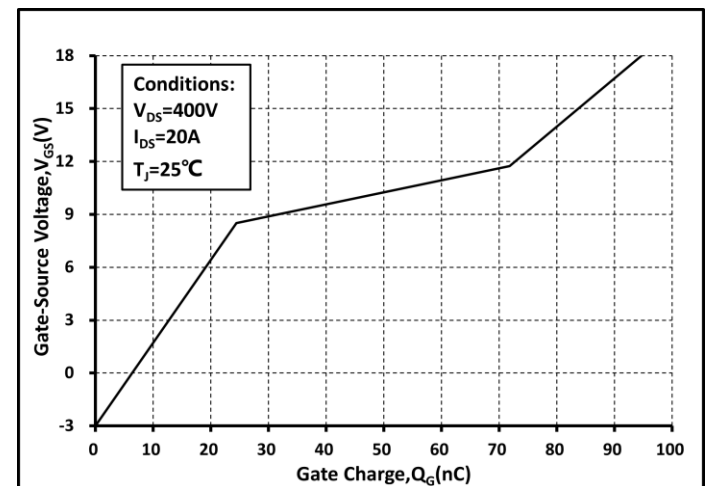


Fig. 18 Gate Charge Characteristics

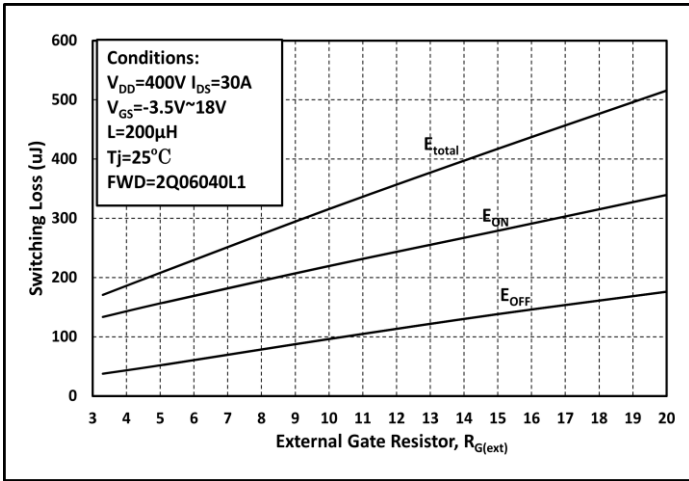


Fig. 19 Switching Energy vs.  $R_{G(ext)}$

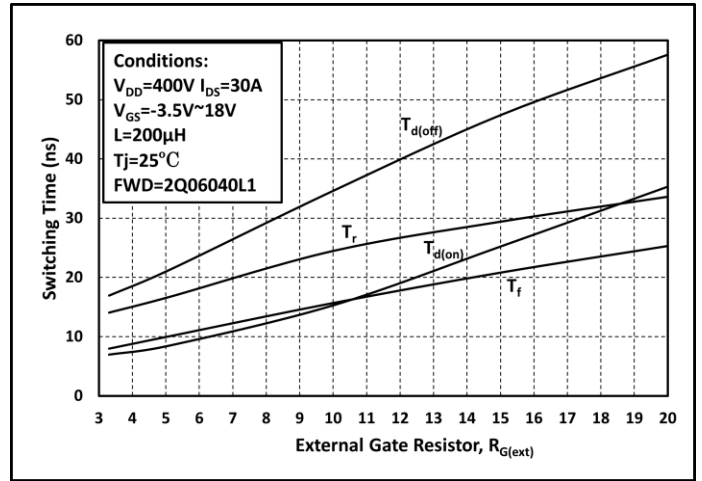


Fig. 20 Switching Times vs.  $R_{G(ext)}$

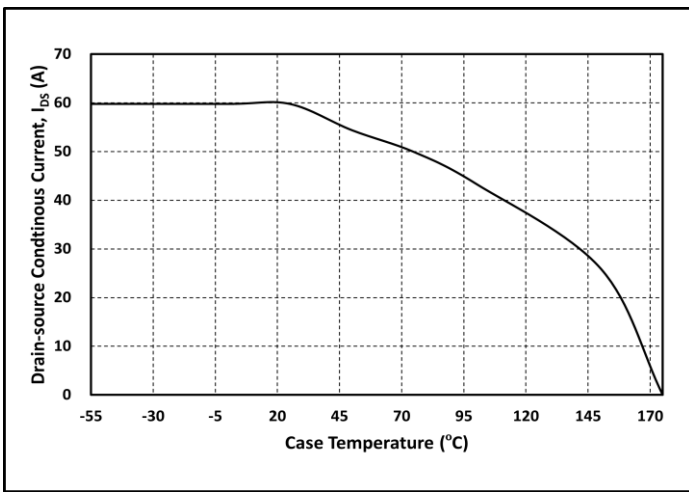


Fig. 21 Continuous Drain Current vs. Case Temperature

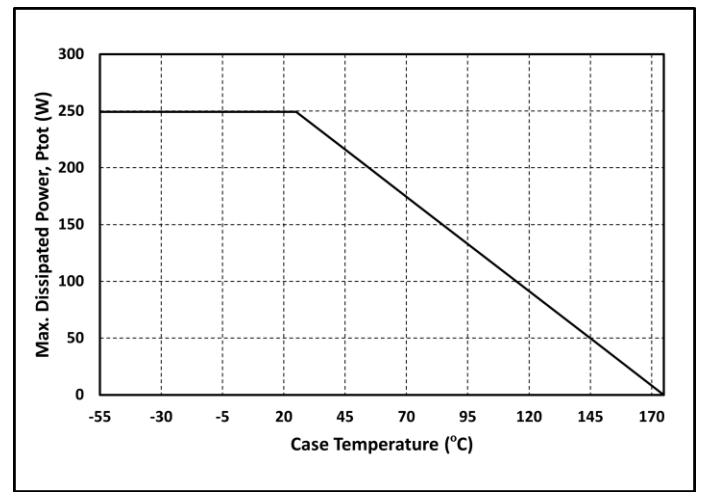


Fig. 22 Max. Power Dissipation Derating vs. Case Temperature

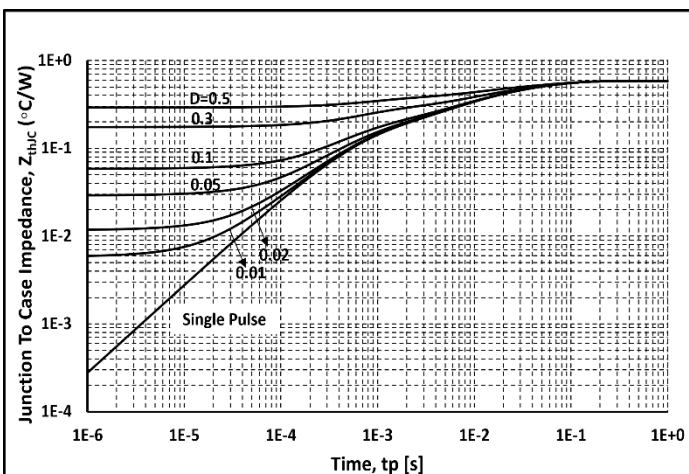


Fig. 23 Thermal impedance

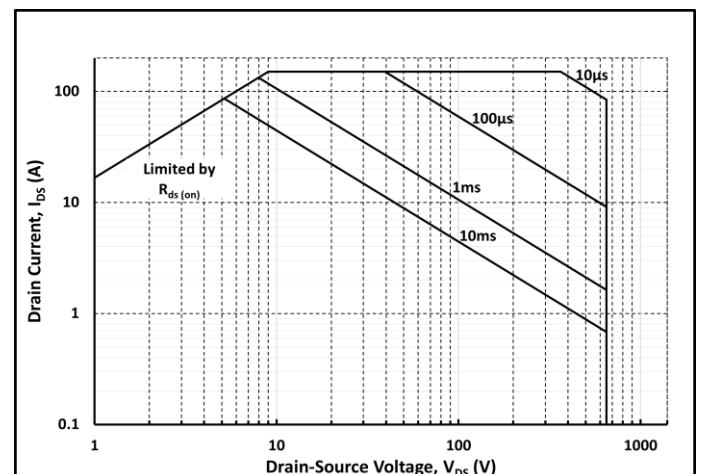
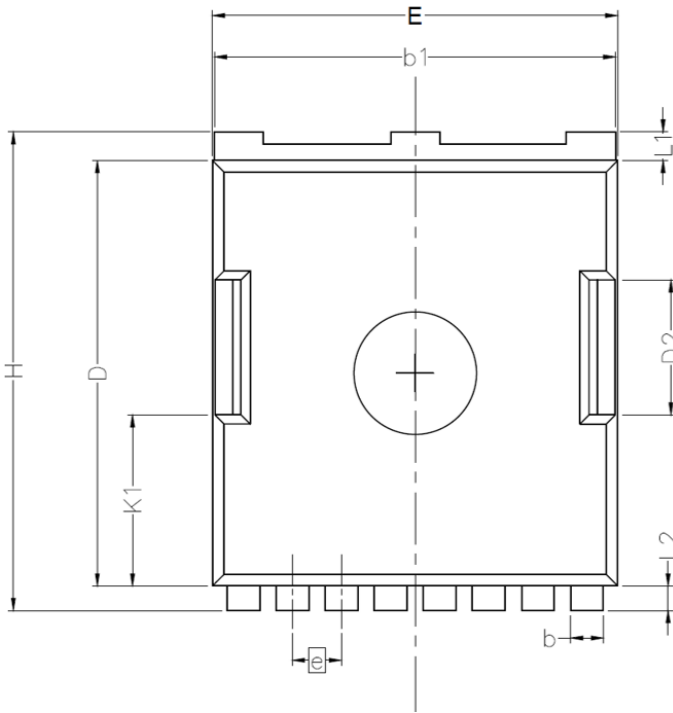
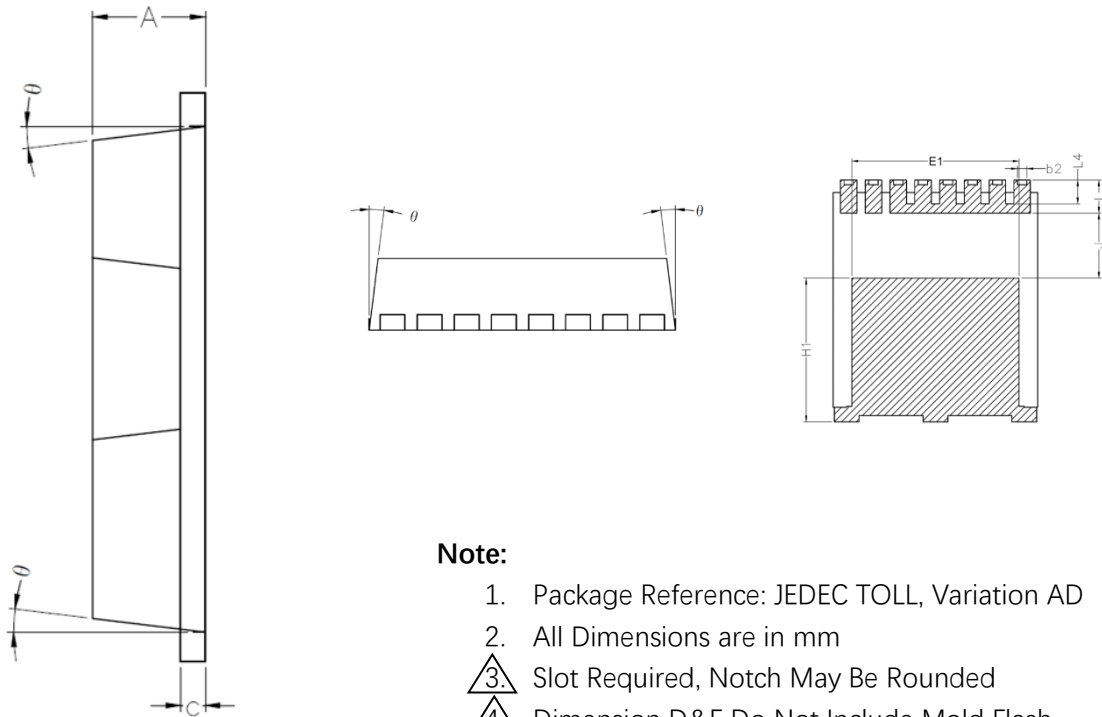


Fig. 24 Safe Operating Area

## Package Dimensions



Dimensions In Millimeters <sup>↵</sup>		
SYMBOL <sup>↵</sup>	MIN. <sup>↵</sup>	MAX. <sup>↵</sup>
A <sup>↵</sup>	2.20 <sup>↵</sup>	2.40 <sup>↵</sup>
b <sup>↵</sup>	0.70 <sup>↵</sup>	0.90 <sup>↵</sup>
b1 <sup>↵</sup>	9.70 <sup>↵</sup>	9.90 <sup>↵</sup>
b2 <sup>↵</sup>	0.42 <sup>↵</sup>	0.50 <sup>↵</sup>
c <sup>↵</sup>	0.40 <sup>↵</sup>	0.60 <sup>↵</sup>
D <sup>↵</sup>	10.28 <sup>↵</sup>	10.58 <sup>↵</sup>
D2 <sup>↵</sup>	3.10 <sup>↵</sup>	3.50 <sup>↵</sup>
E <sup>↵</sup>	9.7 <sup>↵</sup>	10.10 <sup>↵</sup>
E1 <sup>↵</sup>	7.90 <sup>↵</sup>	8.30 <sup>↵</sup>
e <sup>↵</sup>	1.20 BSC <sup>↵</sup>	
H <sup>↵</sup>	11.48 <sup>↵</sup>	11.88 <sup>↵</sup>
H1 <sup>↵</sup>	6.75 <sup>↵</sup>	7.15 <sup>↵</sup>
N <sup>↵</sup>	8 <sup>↵</sup>	
J <sup>↵</sup>	3.00 <sup>↵</sup>	3.30 <sup>↵</sup>
K1 <sup>↵</sup>	3.98 <sup>↵</sup>	4.38 <sup>↵</sup>
L <sup>↵</sup>	1.40 <sup>↵</sup>	1.80 <sup>↵</sup>
L1 <sup>↵</sup>	0.60 <sup>↵</sup>	0.80 <sup>↵</sup>
L2 <sup>↵</sup>	0.50 <sup>↵</sup>	0.70 <sup>↵</sup>
L4 <sup>↵</sup>	1.00 <sup>↵</sup>	1.30 <sup>↵</sup>
θ <sup>↵</sup>	4° <sup>↵</sup>	10° <sup>↵</sup>



**Note:**

1. Package Reference: JEDEC TOLL, Variation AD
2. All Dimensions are in mm
3. Slot Required, Notch May Be Rounded
4. Dimension D&E Do Not Include Mold Flash
5. Subject to Change Without Notice

## Notes

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