



Features

- Wide bandgap SiC MOSFET technology
- Low On-Resistance with High Blocking Voltage
- Low Capacitances with High-Speed switching
- Low reverse recovery(Qrr)
- Halogen free, RoHs compliant

Benefits

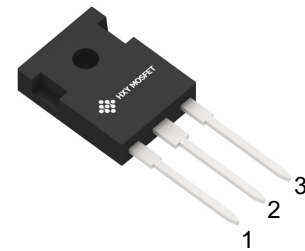
- Reduce switching losses
- Increased system Switching Frequency
- Increased power density
- Reduction of heat sink requirements

Applications

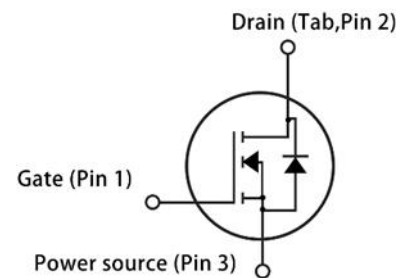
- Switch mode power supplies
- Renewable energy
- On Board Charger
- High Voltage DC/DC Converters



Ordering Part Number	Package	Brand
IPW60R045CPFKSA1	TO-247	HXY MOSFET



TO-247



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

Symbol	Parameter	Test conditions	Value	Unit	Note
V_{DSmax}	Drain-Source Voltage	$V_{GS} = 0V, I_D = 100\mu A$	650	V	
V_{GSmax}	Gate-Source voltage (transient)	$t_p \leq 500ns, \text{duty cycle} \leq 1\%$	-8/+20	V	
V_{GSop}	Recommend Gate-Source Voltage	Static	-4/+18	V	
I_D	Continuous Drain current	$V_{GS} = 18V, T_c = 25^\circ\text{C}$	70	A	Fig. 14
		$V_{GS} = 18V, T_c = 100^\circ\text{C}$	49		
$I_{D,pulse}$	Pulsed Drain Current	Pulse width t_p limited by T_{jmax}	121	A	Fig.18
P_D	Power Dissipation	$T_c = 25^\circ\text{C}, T_j = 175^\circ\text{C}$	214	W	Fig.16
T_j	Operating junction temperature		-55~175	$^\circ\text{C}$	
T_{stg}	Storage temperature		-55~175	$^\circ\text{C}$	
	TO-247 miunting torque	M3 Screw	0.7	Nm	



Thermal Characteristics

Symbol	Parameter	Value			Unit	Note
		Min.	Typ.	Max.		
$R_{th(jc)}$	Thermal resistance from Junction to Case		0.7		K/W	Fig. 15
$R_{th(ja)}$	Thermal resistance from Junction to Ambient		40		K/W	

Electrical Characteristics (T_C = 25°C unless other wise specified)

Static Characteristics

Symbol	Parameter	Test conditions	Value			Unit	Note
			Min.	Typ.	Max.		
$V_{(BR)DSS}$	Drain-Source Breakdown voltage	$V_{GS} = 0V, I_D = 100\mu A$	650			V	
$V_{GS(th)}$	Gate Threshold voltage	$V_{GS} = V_{DS}, I_D = 12mA$		2.7		V	Fig. 9
		$V_{GS} = V_{DS}, I_D = 12mA, T_j = 175^\circ C$		1.9			
I_{GSS}	Gate-Source Leakage current	$V_{GS} = 18V, V_{DS} = 0V$			250	nA	
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 650V, V_{GS} = 0V, T_j = 25^\circ C$		1	50	μA	
$R_{DS(on)}$	Drain-Source On-state Resistance	$V_{GS} = 15V, I_D = 20A$		44	56	m Ω	Fig. 3, 4, 5
		$V_{GS} = 18V, I_D = 20A$		36			
		$V_{GS} = 15V, I_D = 20A, T_j = 175^\circ C$ $V_{GS} = 18V, I_D = 20A, T_j = 175^\circ C$		52 47			
g_{fs}	Transconductance	$V_{DS} = 18V, I_D = 20A$		15		S	Fig. 6
		$V_{DS} = 18V, I_D = 20A, T_j = 175^\circ C$		14			



Gate Charge Characteristics

Symbol	Parameter	Test conditions	Value			Unit	Note
			Min.	Typ.	Max.		
Q_{GS}	Gate to Source Charge	$V_{DS} = 400V$ $I_D = 20A$ $V_{GS} = -4V/18V$		19		nC	Fig. 10
Q_{GD}	Gate to Drain Charge			21			
Q_G	Total Gate Charge			80			

AC Characteristics

Symbol	Parameter	Test conditions	Value			Unit	Note
			Min.	Typ.	Max.		
C_{iss}	Input Capacitance	$V_{GS} = 0V, V_{DS} = 600V$ $f = 1\text{ MHz}$ $V_{AC} = 25mV$		1525		pF	Fig. 13
C_{oss}	Output Capacitance			115		pF	
C_{rss}	Reverse Transfer Capacitance			3.3		pF	
$R_{G(int)}$	Internal Gate Resistance	$f = 1\text{ MHz}, V_{AC} = 25mV$		1.4		Ω	



Reverse Diode Characteristics

Symbol	Parameter	Test conditions	Value			Unit	Note
			Min.	Typ.	Max.		
V_{SD}	Diode Forward Voltage	$V_{GS} = -4V, I_{SD} = 10A$		4.0		V	Fig. 7,8
		$V_{GS} = -4V, I_{SD} = 10A, T_J = 175^{\circ}C$		3.5			
I_S	Continuous Diode Forward Current	$V_{GS} = -4V, T_C = 25^{\circ}C$		44		A	
$I_{S, pulse}$	Diode pulse Current	$V_{GS} = -4V$, pulse width t_p limited by T_{jmax}		121		A	
t_{rr}	Reverse Recovery Time	$V_{GS} = -4V, I_{SD} = 20A, V_R = 400V$ $diff/dt = 2400A/us$		18		nS	
Q_{rr}	Reverse Recovery Charge			95		nC	
I_{rrm}	Peak Reverse Recovery Current			10		A	

Switching Characteristics

Symbol	Parameter	Test conditions	Value			Unit	Note
			Min.	Typ.	Max.		
$t_{d(on)}$	Turn-On Delay Time	$V_{DS} = 400V, V_{GS} = -4/+18V$ $I_D = 20A, R_{G(ext)} = 5\Omega$ $L = 200\mu H$		3		nS	Fig.21
t_r	Rise Time			22		nS	
$t_{d(off)}$	Turn-Off Delay Time			19		nS	
t_f	Fall Time			5		nS	
E_{on}	Turn-On Energy			108		μJ	Fig.19
E_{off}	Turn-Off Energy			22		μJ	
E_{tot}	Total switching energy			130		μJ	



Typical Performance

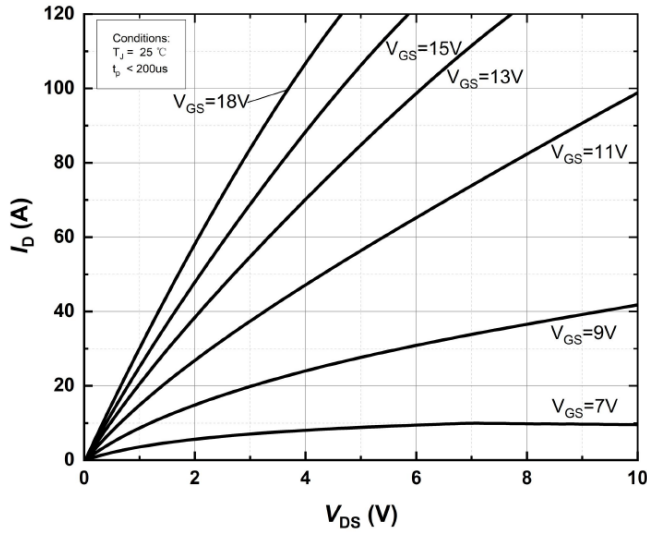


Figure 1. Output characteristics at $T_j = 25^\circ\text{C}$

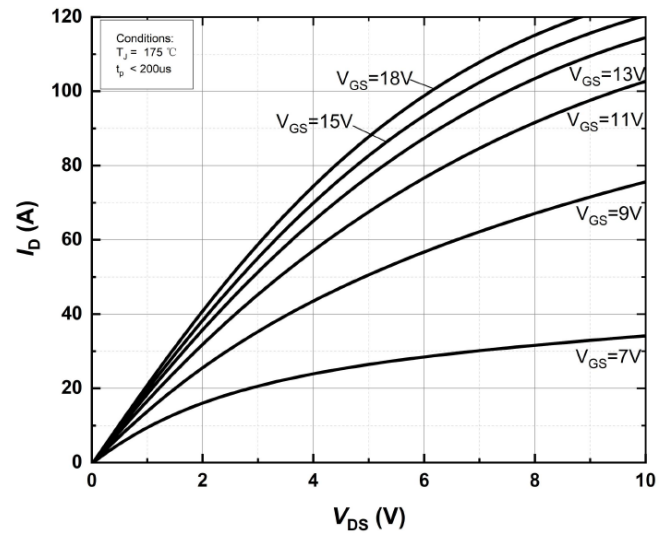


Figure 2. Output characteristics at $T_j = 175^\circ\text{C}$

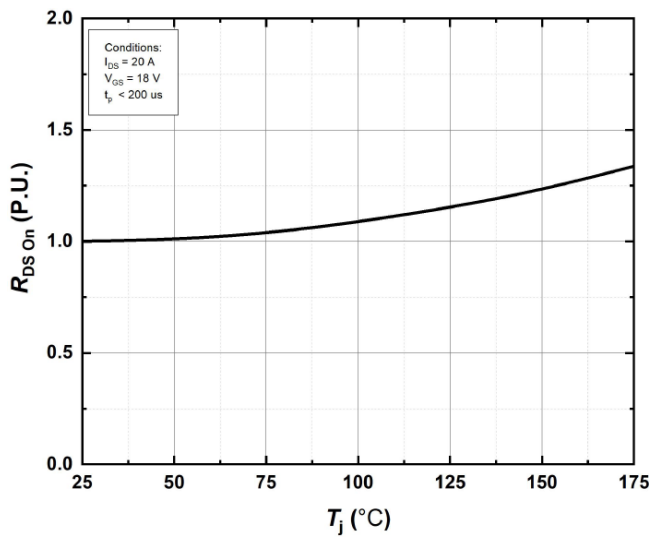


Figure 3. Normalized On-Resistance vs. Temperature

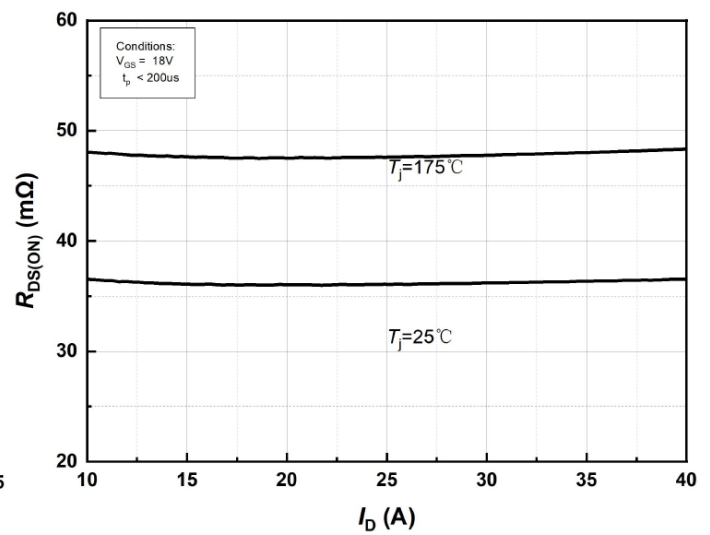


Figure 4. On-Resistance vs. Drain current for Various Temperature

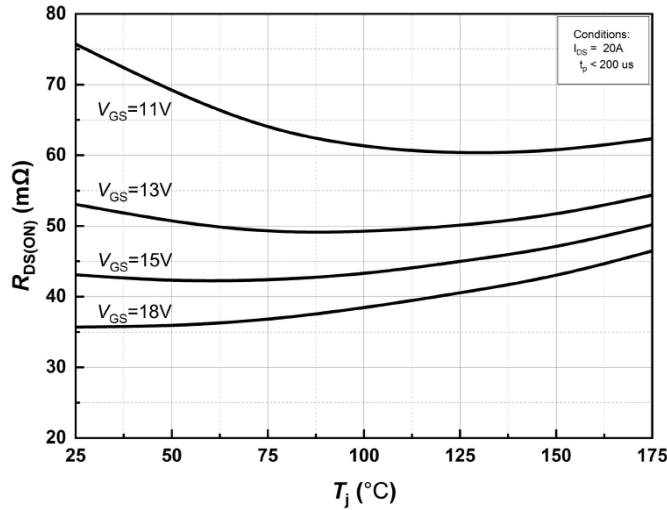


Figure 5. On-Resistance vs. Temperature for Various Gate Voltage

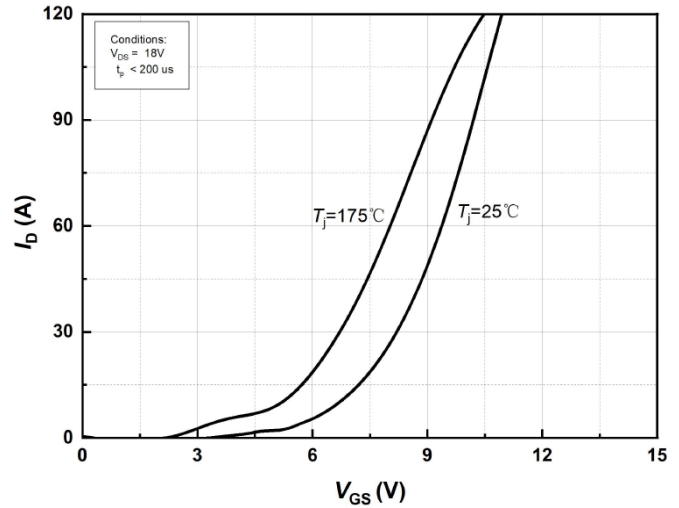


Figure 6. Transfer Characteristics for Various Junction Temperatures

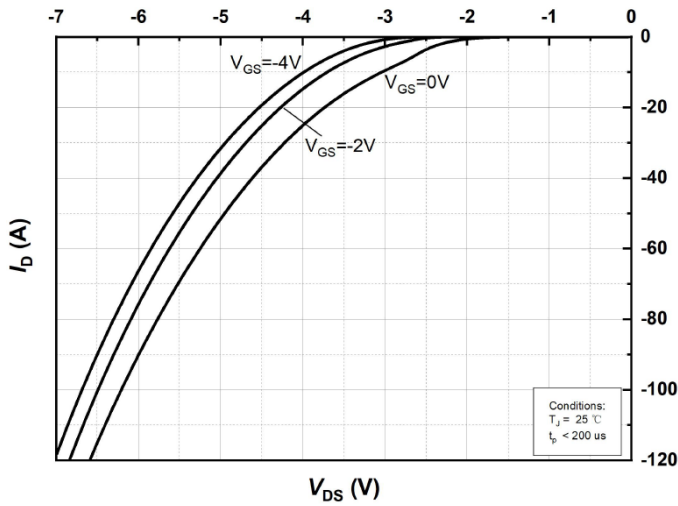


Figure 7. Body Diode Characteristics at $T_j=25^{\circ}C$

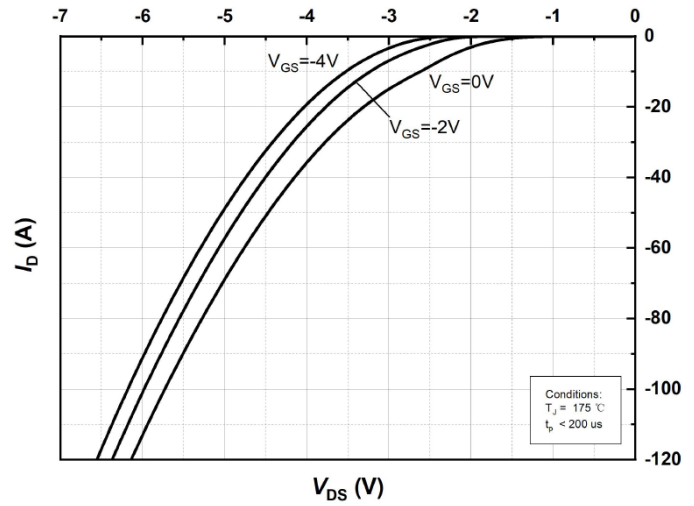


Figure 8. Body Diode Characteristics at $T_j=175^{\circ}C$

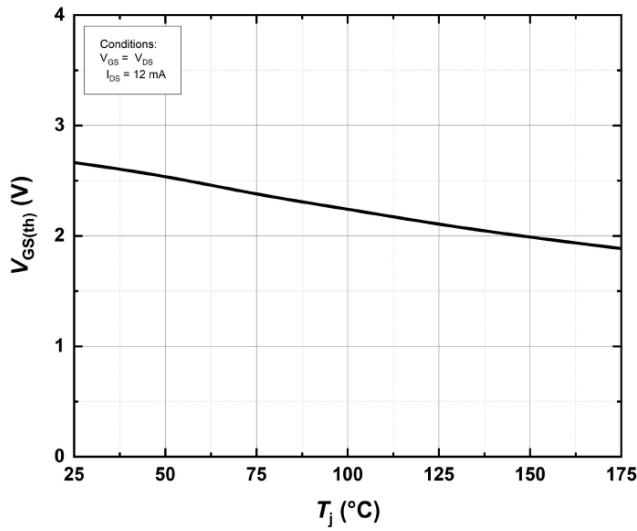


Figure 9. Threshold Voltage vs. Temperature

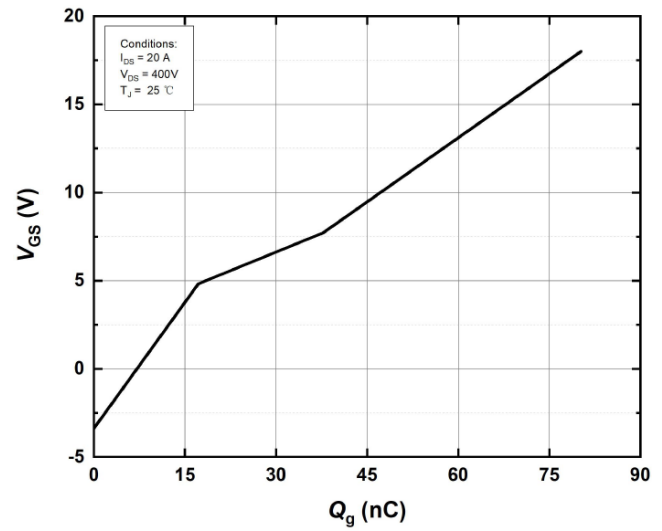


Figure 10 Gate Charge Characteristics

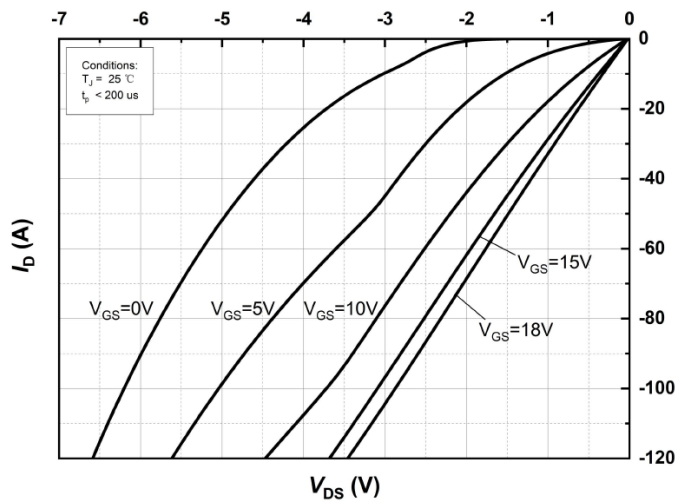


Figure 11. 3rd Quadrant Characteristic at $T_j=25\text{°C}$

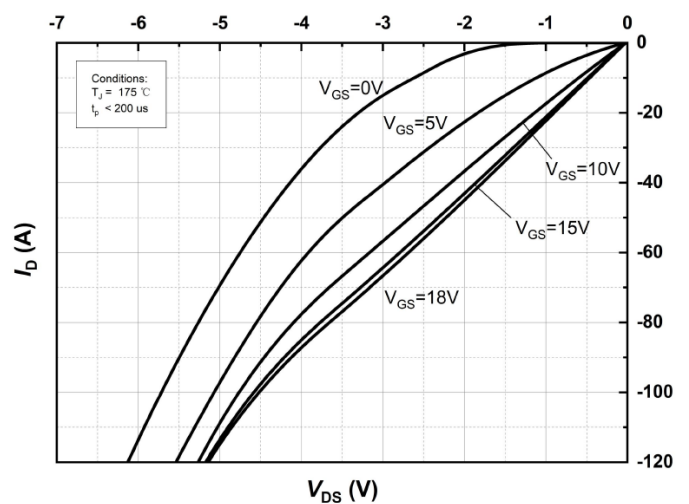


Figure 12. 3rd Quadrant Characteristic at $T_j=175\text{°C}$

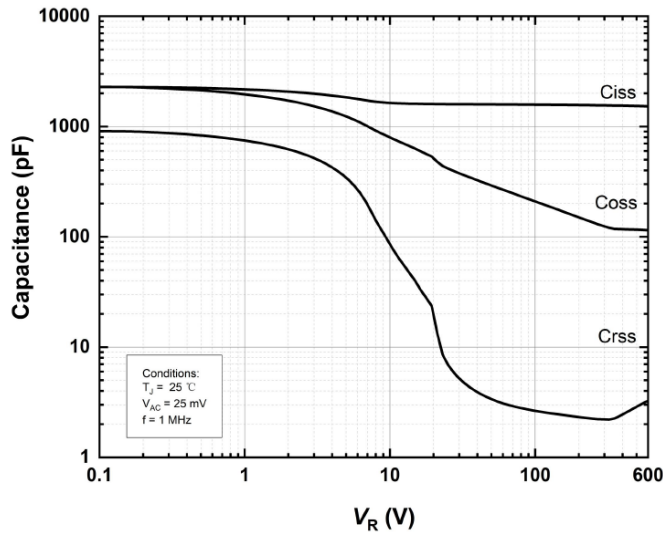


Figure 13. Capacitances vs. Drain-Source Voltage (0 – 600V)

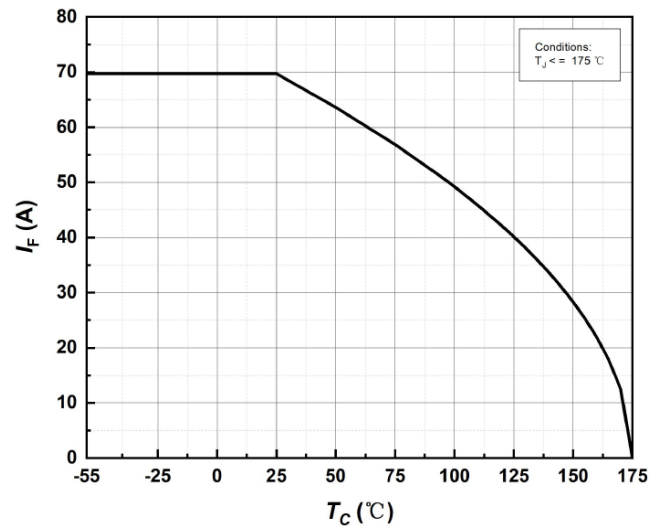


Figure 14. Continuous Drain Current Derating vs Case Temperature

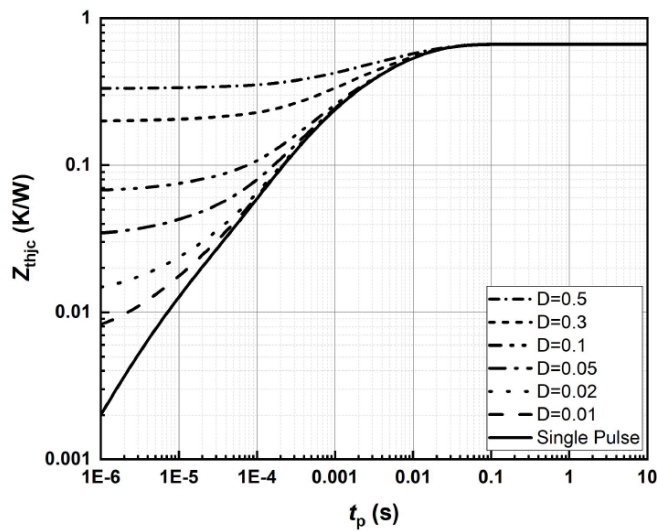


Figure 15. Transient Thermal Impedance (Junction – Case)

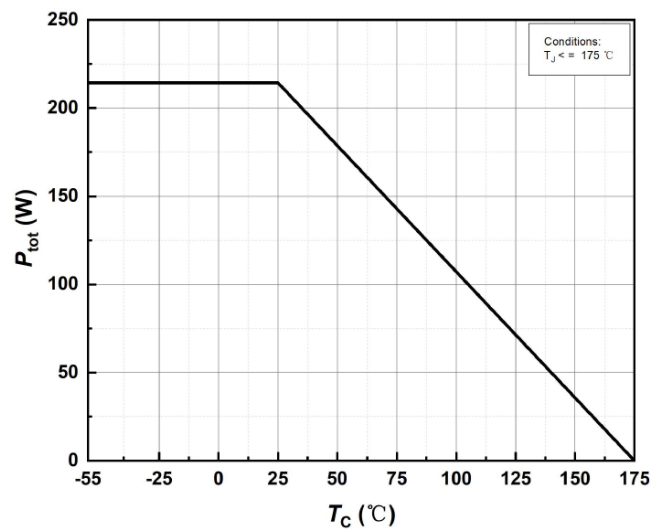


Figure 16. Maximum Power Dissipation Derating vs. Case Temperature

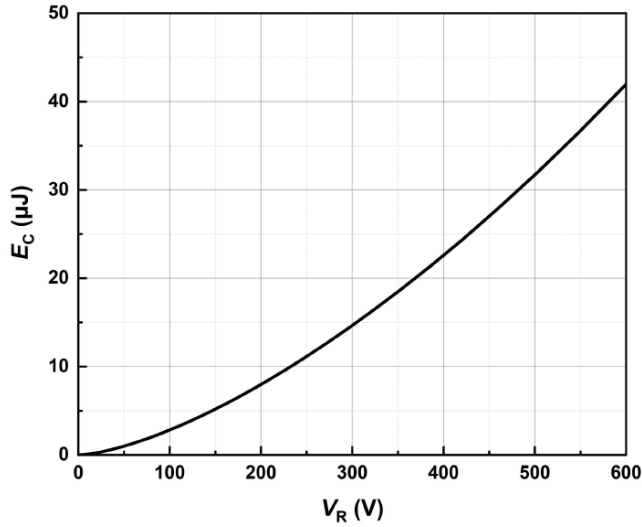


Figure 17. Output Capacitor Stored Energy

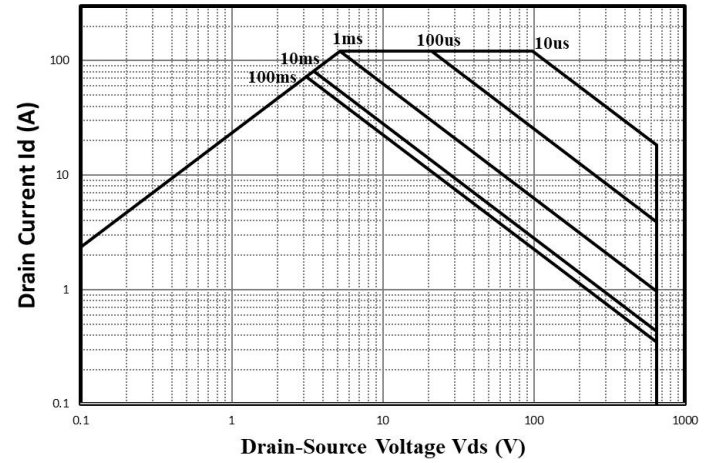


Figure 18. Safe Operating Area

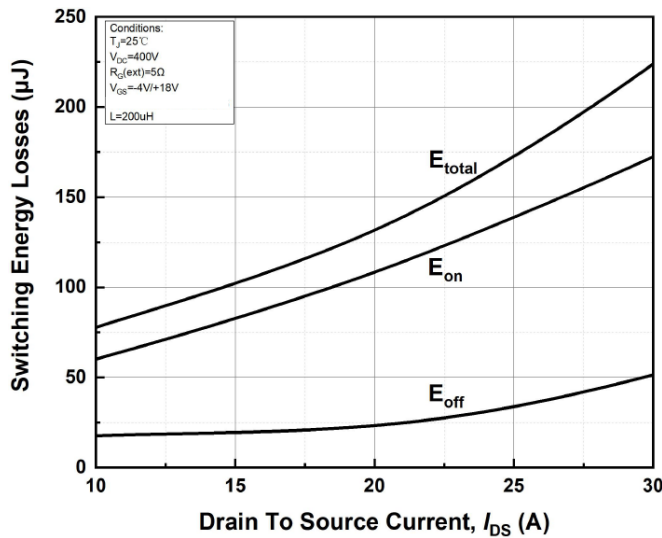


Figure 19. Clamped Inductive Switching Energy vs. Drain Current($V_{DD} = 400V$)

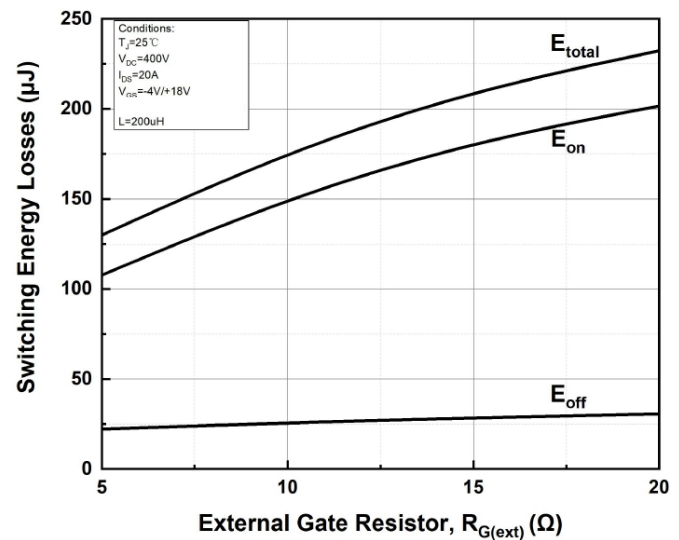


Figure 20. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

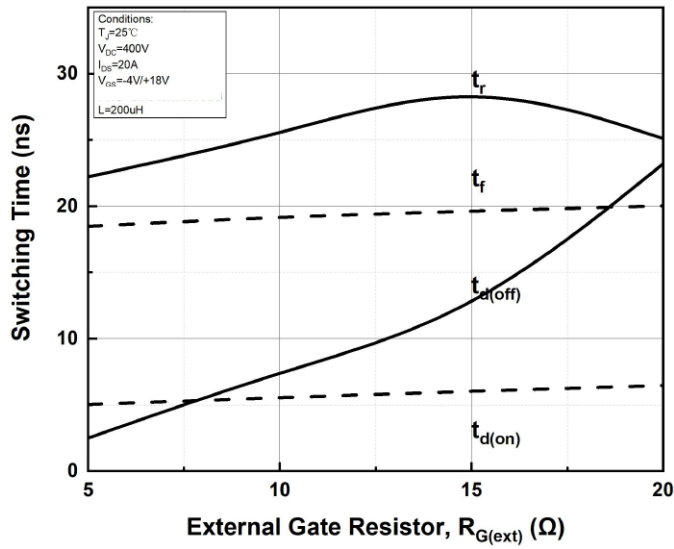
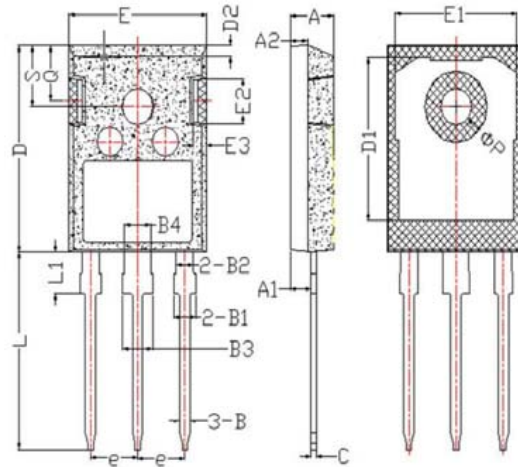


Figure 21. Switching Times vs. $R_{G(\text{ext})}$



Package Dimensions

Package TO-247



Items	Values(mm)	
	MIN	MAX
A	4.6	5.2
A1	2.2	2.6
B	0.9	1.4
B1	1.75	2.35
B2	1.75	2.15
B3	2.8	3.35
B4	2.8	3.15
C	0.5	0.7
D	20.6	21.3
D1	16	18
E	15.5	16.1
E1	13	14.7
E2	3.8	5.3
E3	0.8	2.6
e	5.2	5.2
L	19	20.5
L1	3.9	4.6
Φp	3.3	3.7
Q	5.2	6
S	5.8	6.6



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