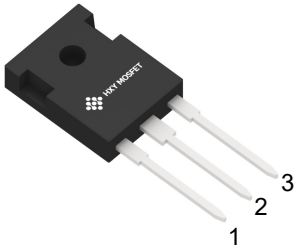
IPW60R024P7XKSA1

SiC Power MOSFET N-Channel Enhancement Mode

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



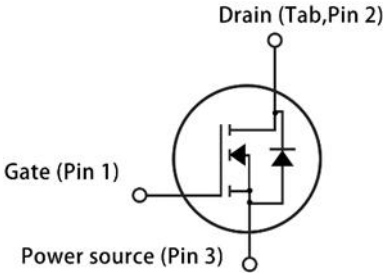
TO-247

Benefits

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

Applications

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



Ordering Part Number	Package	Brand
IPW60R024P7XKSA1	TO-247	HXY MOSFET

Maximum Ratings (T_C = 25 ˚C unless otherwise specified)

Symbol	Parameter	Test conditions	Value	Unit	Note
V_{DSmax}	Drain-Source Voltage	V_{GS} = 0V, I_D = 100μA	650	V	
V_{GSmax}	Gate-Source voltage	AC (f > 1 Hz)	-10/+25	V	
V_{GSop}	Recommend Gate-Source Voltage	Static	-4/+15 -4/+18	V	
I_D	Continuous Drain current	V_{GS} = 18V, T_C = 25°C	108	A	Fig. 14
		V_{GS} = 18V, T_C = 100°C	76		
$I_{D,pulse}$	Pulsed Drain Current	Pulse with t_p limited by T_{jmax}	193	A	
P_D	Power Dissipation	T_C = 25°C, Tj = 175°C	341	W	Fig.16
T_j	Operating junction temperature		-55~175	°C	
T_{stg}	Storage temperature		-55~175	°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		0.44		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 = 100μA	650			V	
$V_{GS(th)}$	Gate Threshold voltage	V_{GS} = $V_{DS,}$ I_D =20mA		2.6		V	Fig. 9
		V_{GS} = $V_{DS,}$ I_D =20mA, T_j=175°C		1.8			
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°C		1	50	μA	
$R_{DS(on)}$	Drain-Source On-state Resistance	V_{GS} = 15V, I_D =40A		24		mΩ	Fig. 3, 4 , 5
		V_{GS} = 18V, I_D =40A		20	30		
		V_{GS} = 15V, I_D =40A, T_j = 175°C		30			
		V_{GS} = 18V, I_D =40A, T_j = 175°C		28			
g_{fs}	Transconductance	V_{DS} = 15V, I_D =40A		25		S	Fig. 6
		V_{DS} = 15V, I_D =40A, T_j = 175°C		25			

Gate Charge Characteristics

Symbol	Parameter	Test conditions	Value			Unit	Note
			Min.	Typ.	Max.		
Q_{GS}	Gate to Source Charge	V_{DS} = 400V I_D =40A V_{GS} =-4V/18V		35		nC	Fig. 10
Q_{GD}	Gate to Drain Charge			17			
Q_G	Total Gate Charge			142			

AC Characteristics

Symbol	Parameter	Test conditions	Value			Unit	Note
			Min.	Typ.	Max.		
C_{iss}	Input Capacitance	V_{GS} = 0V, V_{DS} = 600V f =1 MHz V_{AC} = 25mV		2935		pF	Fig. 13
C_{oss}	Output Capacitance			221		pF	
C_{rss}	Reverse Transfer Capacitance			16.6		pF	
$R_{G(int)}$	Internal Gate Resistance	f=1 MHz, V_{AC} = 25mV		1.2		Ω	

Reverse Diode Characteristics

Symbol	Parameter	Test conditions	Value			Unit	Note
			Min.	Typ.	Max.		
V_{SD}	Diode Forward Voltage	V_{GS} = -4V, I_{SD} = 20A		3.7		V	Fig. 7,8
		V_{GS} = -4V, I_{SD} = 20A, T_j = 175°C		3.2			
I_S	Continuous Diode Forward Current	V_{GS} = -4V, T_C = 25°C		81		A	
$I_{S,\ pulse}$	Diode pulse Current	V_{GS} = -4V, pulse width t_p limited by T_{jmax}		193		A	
t_{rr}	Reverse Recovery Time	V_{GS} = -4V, I_{SD} = 40 A, V_R = 400V dif/dt = 2200A/us		19		nS	
Q_{rr}	Reverse Recovery Charge			238		nC	
I_{rrm}	Peak Reverse Recovery Current			17		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= 40 A, $R_{G(iext)}$ = 5Ω L = 200μH		3		nS	Fig.21
t_r	Rise Time			29		nS	
$t_{d(off)}$	Turn-Off Delay Time			32		nS	
t_f	Fall Time			9		nS	
E_{on}	Turn-On Energy			181		μJ	Fig.19
E_{off}	Turn-Off Energy			151		μJ	
E_{tot}	Total switching energy			332		μJ	

Typical Performance

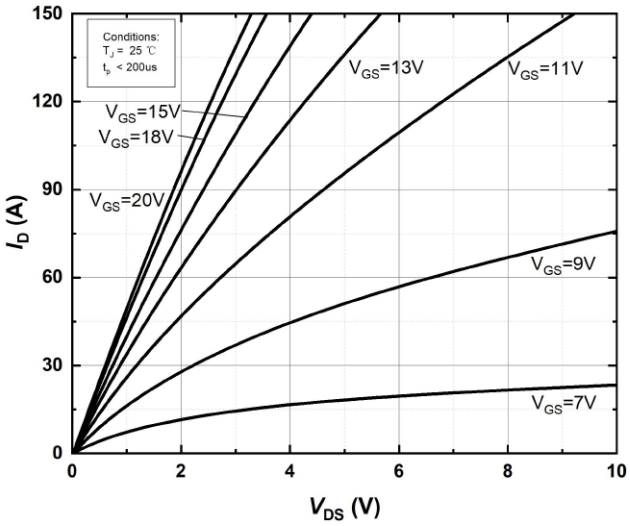


Figure 1. Output characteristics at Tj=25°C

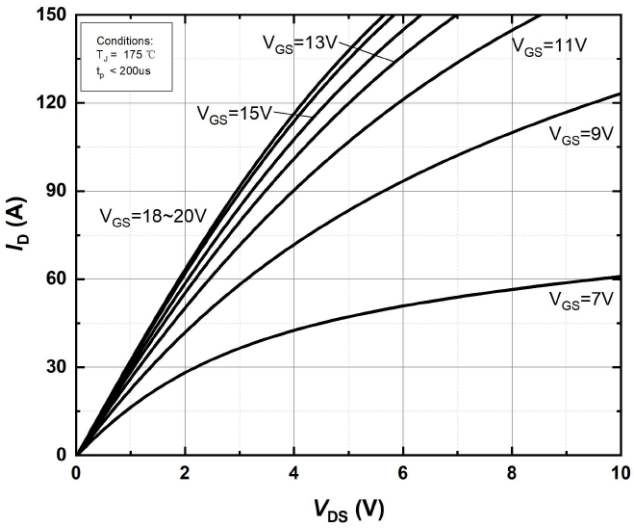


Figure 2. Output characteristics at Tj=175°C

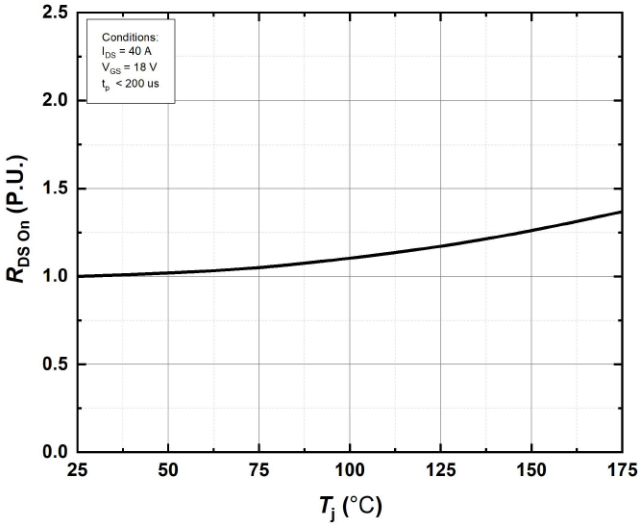


Figure 3. Normalized On-Resistance vs. Temperature

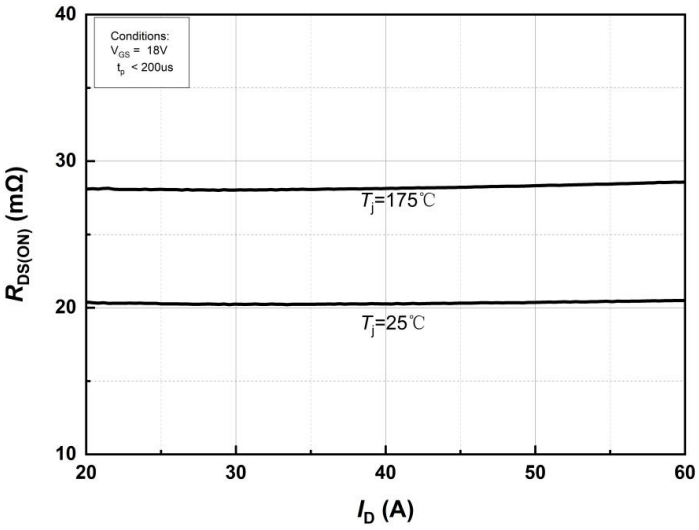


Figure 4. On-Resistance vs. Drain current for Various Temperature

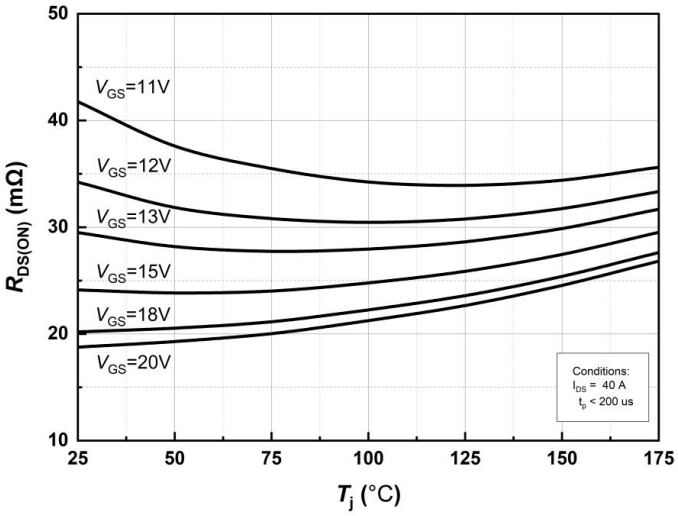


Figure 5. On-Resistance vs. Temperature for Various Gate Voltage

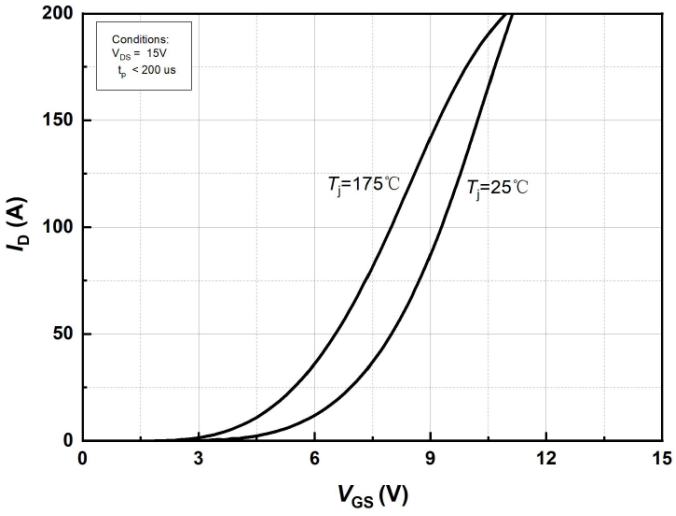


Figure 6. Transfer Characteristics for Various Junction Temperatures

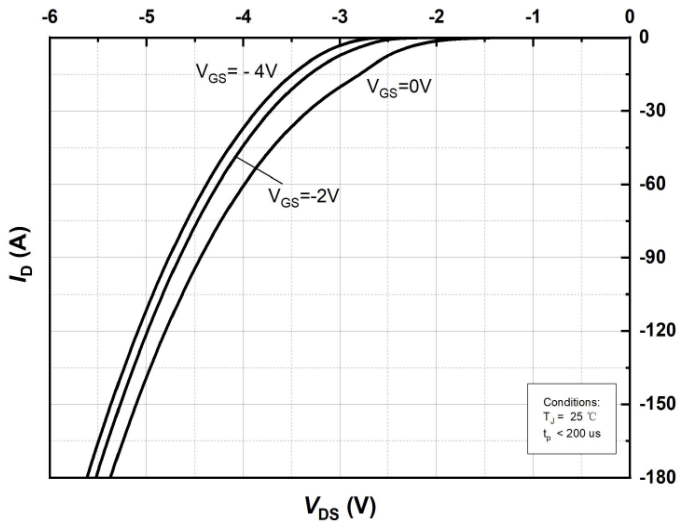


Figure 7. Body Diode Characteristics at Tj=25°C

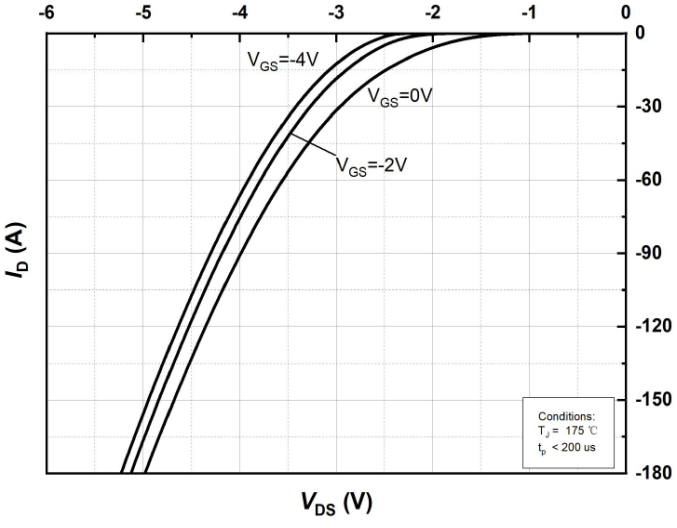


Figure 8. Body Diode Characteristics at Tj=175°C

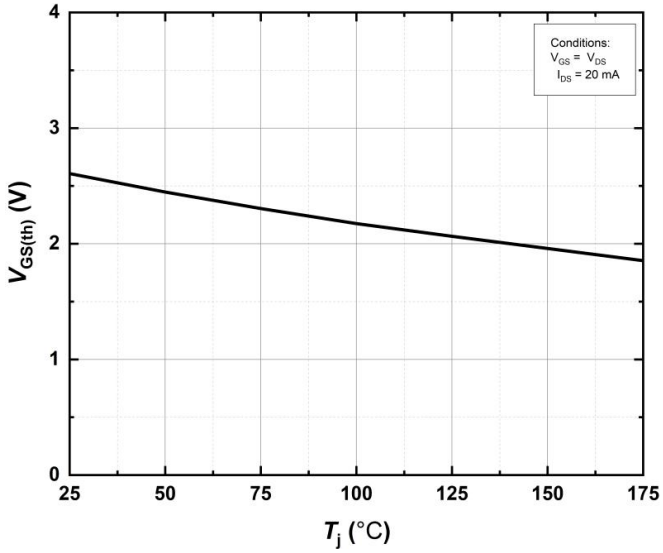


Figure 9. Threshold Voltage vs. Temperature

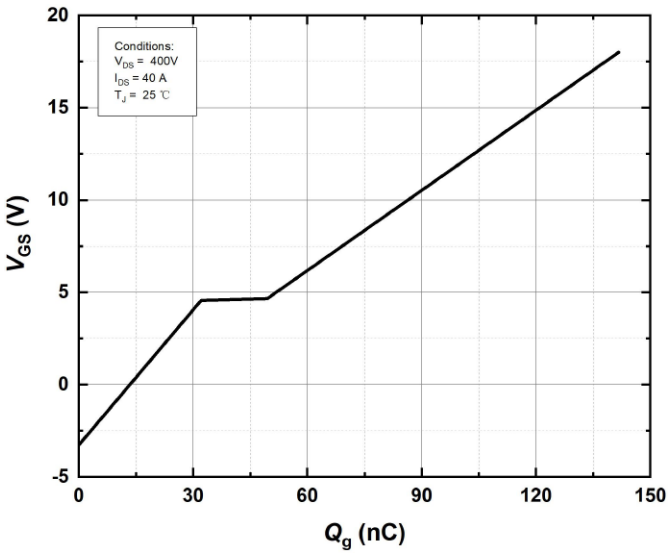


Figure 10 Gate Charge Characteristics

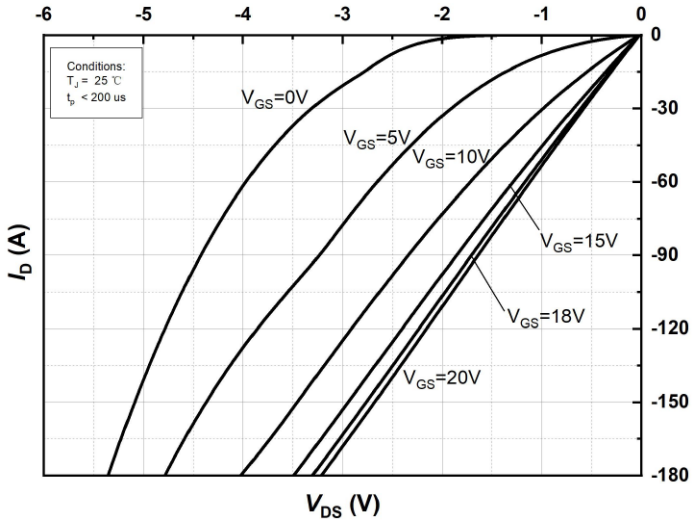


Figure 11. 3rd Quadrant Characteristic at Tj=25°C

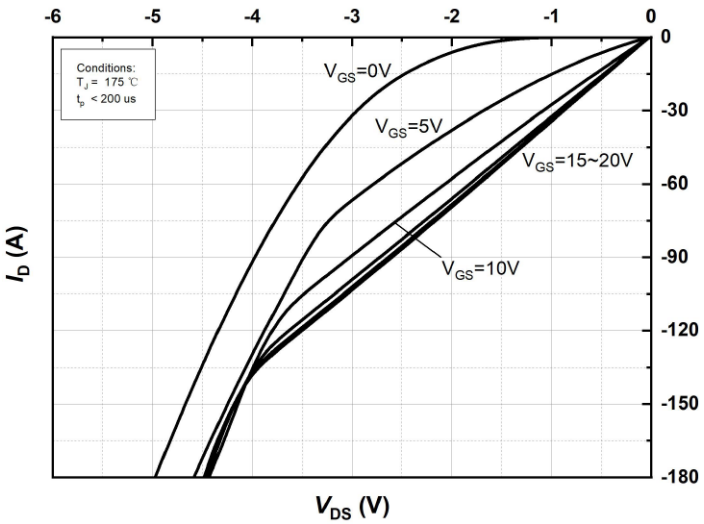


Figure 12. 3rd Quadrant Characteristic at Tj=175°C

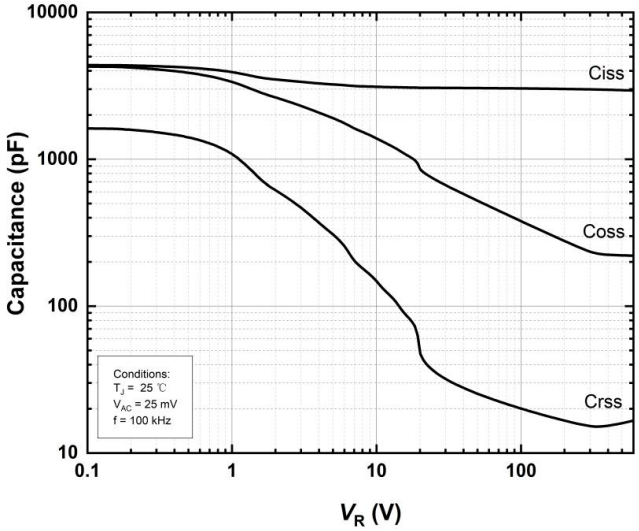


Figure 13. Capacitances vs. Drain-Source Voltage (0 – 600V)

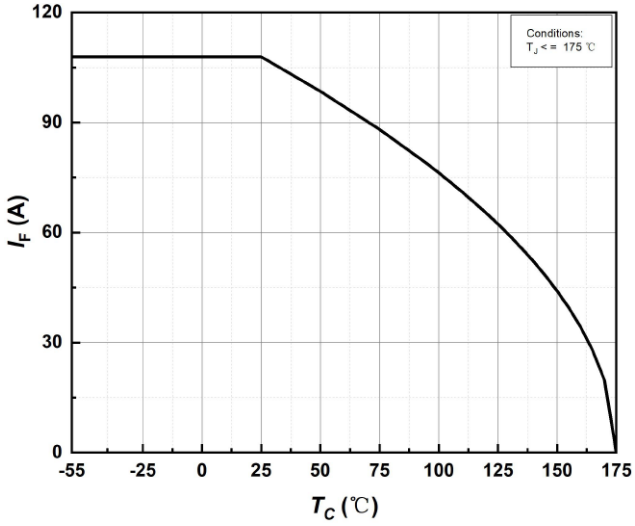


Figure 14. Continuous Drain Current Derating vs Case Temperature

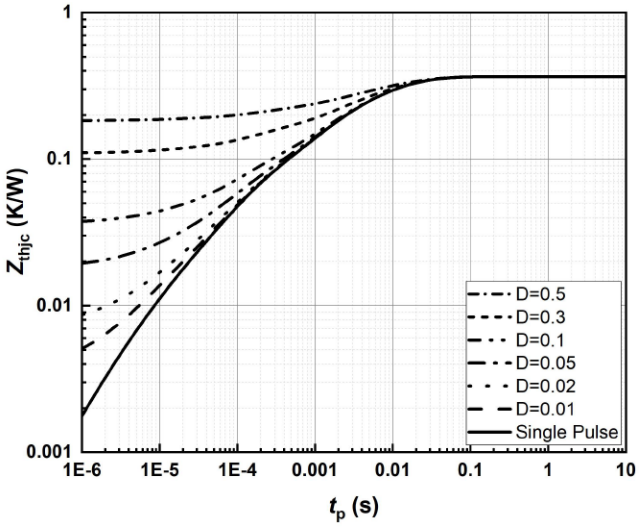


Figure 15.Transient Thermal Impedance (Junction – Case)

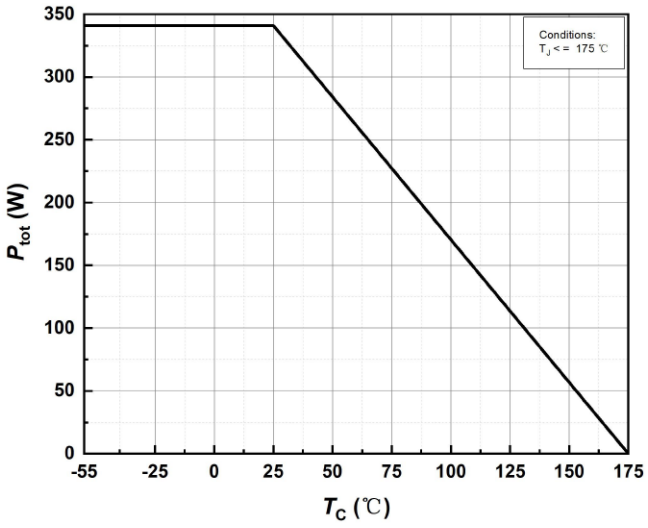


Figure 16. Maximum Power Dissipation Derating vs. Case Temperature

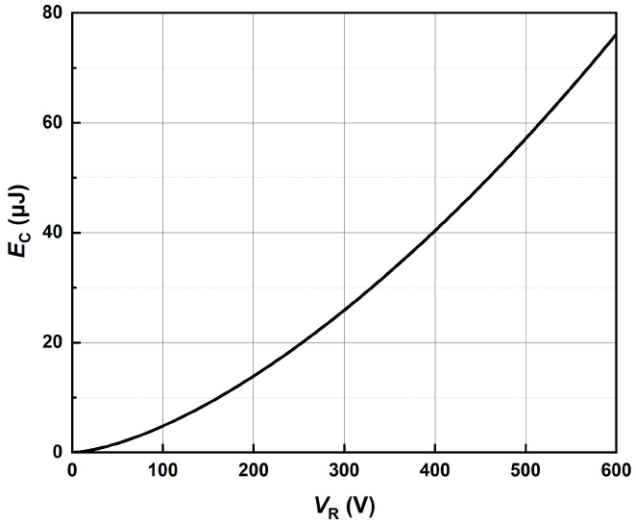


Figure 17. Output Capacitor Stored Energy

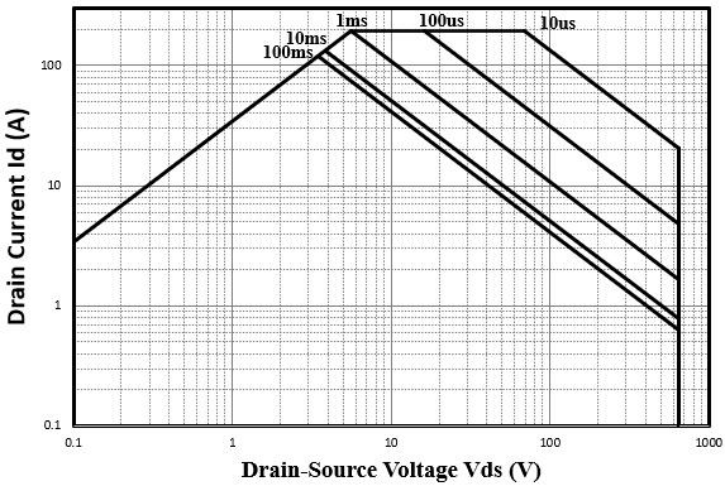


Figure 18. Safe Operating Area

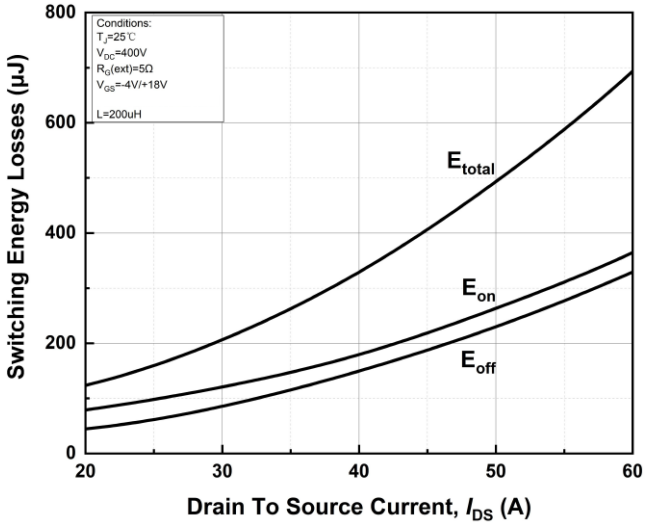


Figure 19. Clamped Inductive Switching Energy vs. Drain Current(V_{DD} = 400V)

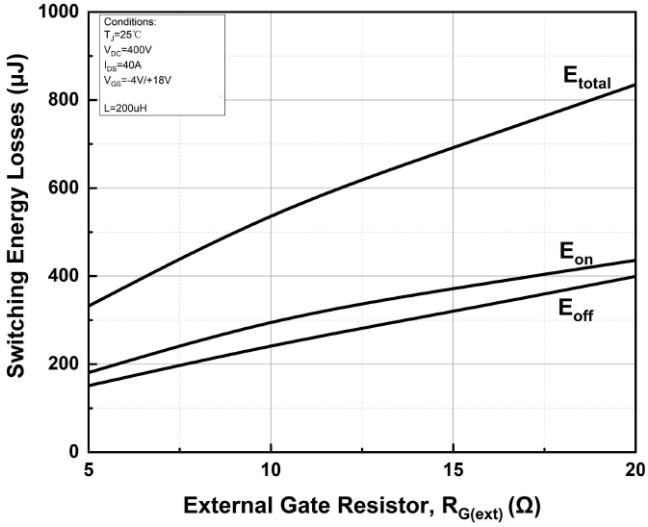


Figure 20. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

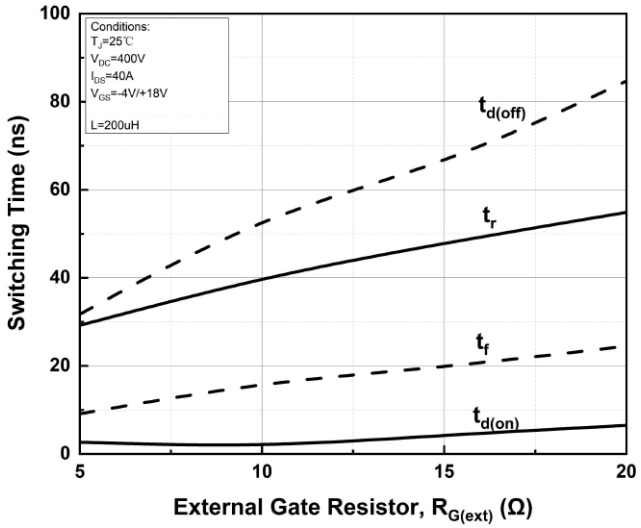
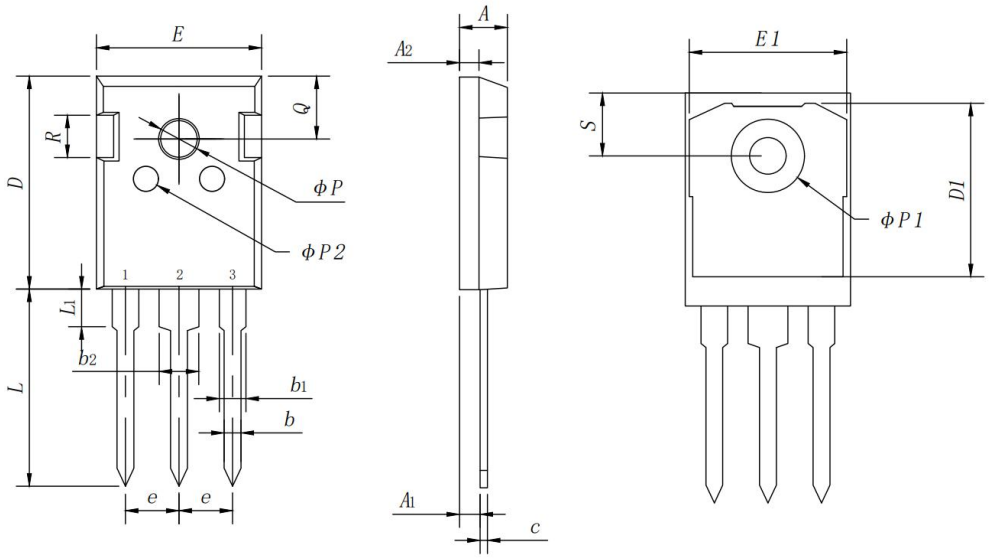


Figure 21. Switching Times vs. $R_{G(ext)}$

Package Dimensions

Package TO-247



SYMBOLS	DIMENSION IN MM		
	MIN	NOM	MAX
A	4.70	5.00	5.30
A_1	2.24	2.41	2.58
A_2	1.80	2.00	2.20
b	1.00	1.20	1.40
b_1	1.60	2.10	2.60
b_2	2.60	3.10	3.60
c	0.40	0.60	0.80
D	20.0	21.00	22.0
D1	15.24	16.24	17.24
E	15.50	15.75	16.01
E1	13.77	14.02	14.27
e	5.20	5.44	5.72
L	19.70	19.95	20.20
L_1	3.85	4.15	4.45
ΦP	3.55	3.60	3.65
Φp1	7.14	7.19	7.24
Φp2	2.35	2.40	2.45
Q	5.89	6.15	6.40
R	4.30	4.60	4.90
S	6.04	6.17	6.30

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