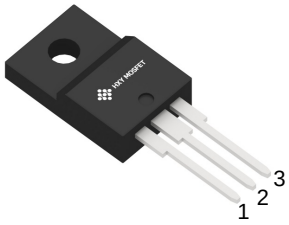
SPA15N60CFDXKSA1

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



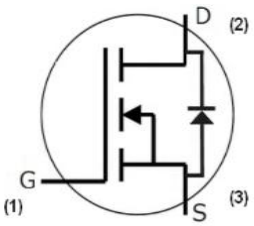
TO-220F

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
SPA15N60CFDXKSA1	TO-220F	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_{GS}	Gate-Source voltage (transient)	t_p≤500ns, duty cycle ≤1%	-8/+20	V	
V_{GSop}	Recommend Gate-Source Voltage	Static	-4/+18	V	
EAS	Single pulse avalanche energy	V_{DS}=650V, V_{DD}=50V, V_{GS}=10V, L=10mH, T_C=25°C	106	mJ	
I_D	Continuous Drain current	V_{GS} = 18V, T_C = 25°C	9	A	Fig. 14
		V_{GS} = 18V, T_C = 100°C	6.4		
$I_{D,pulse}$	Pulsed Drain Current	Pulse with t_p limited by T_{jmax}	17	A	
P_D	Power Dissipation	T_C = 25°C, Tj = 175°C	32	W	Fig. 16
T_j	Operating junction temperature		-55~175	°C	
T_{stg}	Storage temperature		-55~175	°C	

Thermal Characteristics

Symbol	Parameter	Value			Unit	Note
		Min.	Typ.	Max.		
$R_{th(jc)}$	Thermal resistance from Junction to Case		4.76		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 =1.33mA		2.7		V	Fig. 9
		V_{GS} = V_{DS}, I_D =1.33mA, 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 =4.5A V_{GS} = 18V, I_D =4.5A		390 320	390	mΩ	Fig. 3, 4 , 5
		V_{GS} = 15V, I_D =4.5A, T_j = 175°C V_{GS} = 18V, I_D =4.5A, T_j = 175°C		480 420			
g_{fs}	Transconductance	V_{DS} = 18V, I_D =4.5A		4		S	Fig. 6
		V_{DS} = 18V, I_D =4.5A, T_j = 175°C		3			

Gate Charge Characteristics

Symbol	Parameter	Test conditions	Value			Unit	Note
			Min.	Typ.	Max.		
Q_{GS}	Gate to Source Charge	V_{DS} = 400V I_D =4.5A V_{GS} = -4V/18V		2.5		nC	Fig. 10
Q_{GD}	Gate to Drain Charge			6			
Q_G	Total Gate Charge			11.6			

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		184		pF	Fig. 13
C_{oss}	Output Capacitance			22		pF	
C_{rss}	Reverse Transfer Capacitance			3.2		pF	
$R_{G(int)}$	Internal Gate Resistance	f=1 MHz, V_{AC} = 25mV		13		Ω	

Reverse Diode Characteristics

Symbol	Parameter	Test conditions	Value			Unit	Note
			Min.	Typ.	Max.		
V_{SD}	Diode Forward Voltage	V_{GS} = -4V, I_{SD} = 2.5A		4.2		V	Fig. 7,8
		V_{GS} = -4V, I_{SD} = 2.5A , T_j = 175°C		3.9			
I_S	Continuous Diode Forward Current	V_{GS} = -4V, T_C = 25°C		6		A	
$I_{S,\ pulse}$	Diode pulse Current	V_{GS} = -4V, pulse width t_p limited by T_{jmax}		17		A	
t_{rr}	Reverse Recovery Time	V_{GS} = -4V, I_{SD} = 4.5A , V_R = 400V dif/dt = 1000A/us		23		nS	
Q_{rr}	Reverse Recovery Charge			34		nC	
I_{rrm}	Peak Reverse Recovery Current			3.2		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= 4.5A , $R_{G(iext)}$ = 20Ω L = 500μH		1		nS	Fig.21
t_r	Rise Time			10		nS	
$t_{d(off)}$	Turn-Off Delay Time			7		nS	
t_f	Fall Time			11		nS	
E_{on}	Turn-On Energy			12		μJ	Fig.19
E_{off}	Turn-Off Energy			5		μJ	
E_{tot}	Total switching energy			17		μJ	

Typical Performance

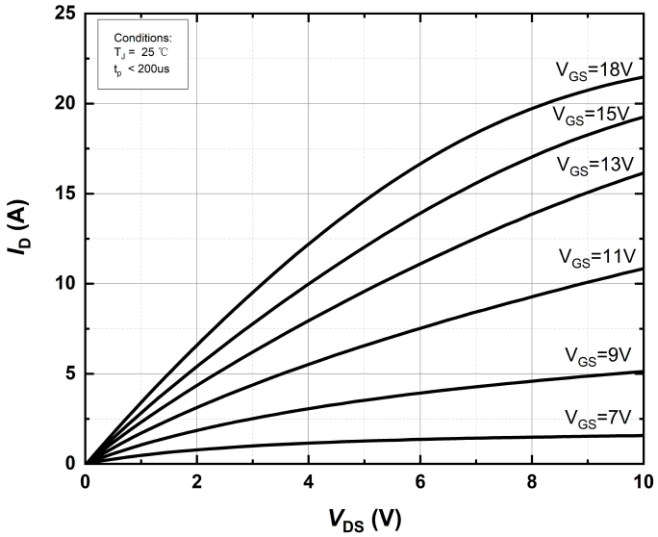


Figure 1. Output characteristics at Tj=25°C

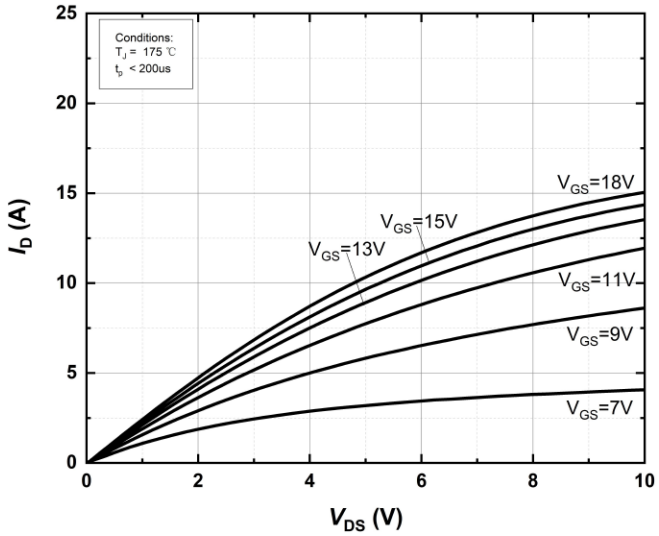


Figure 2. Output characteristics at Tj=175°C

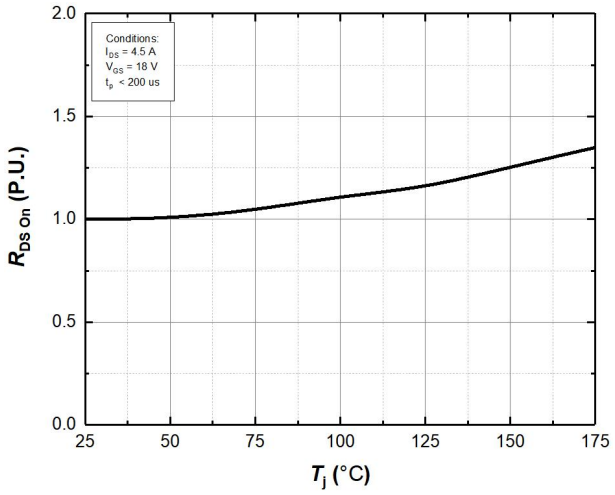


Figure 3. Normalized On-Resistance vs. Temperature

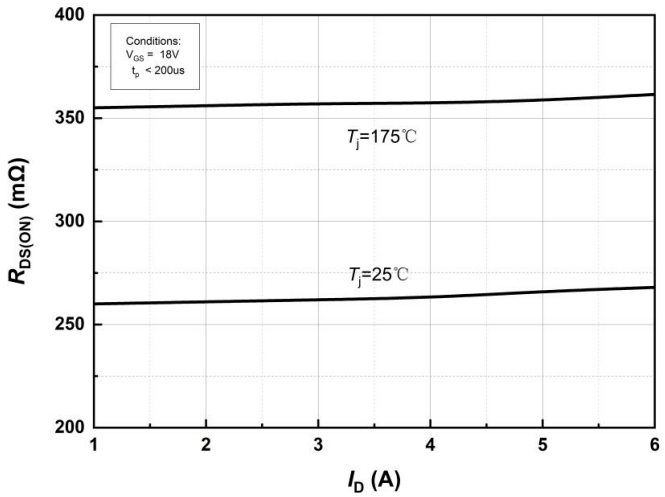


Figure 4. On-Resistance vs. Drain current for Various Temperature

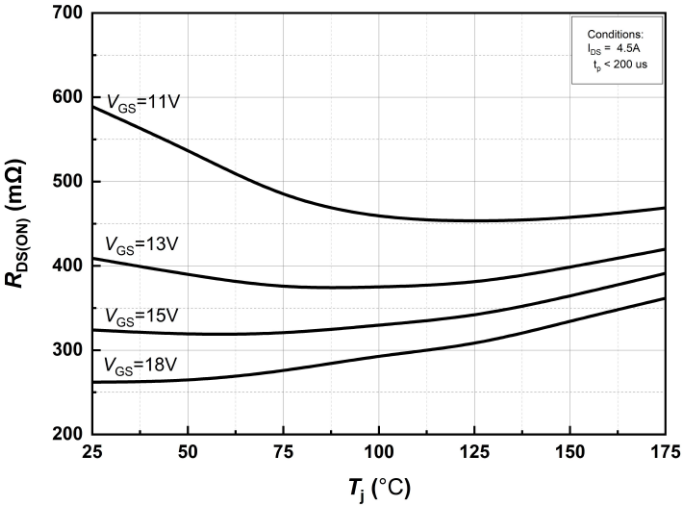


Figure 5. On-Resistance vs. Temperature for Various Gate Voltage

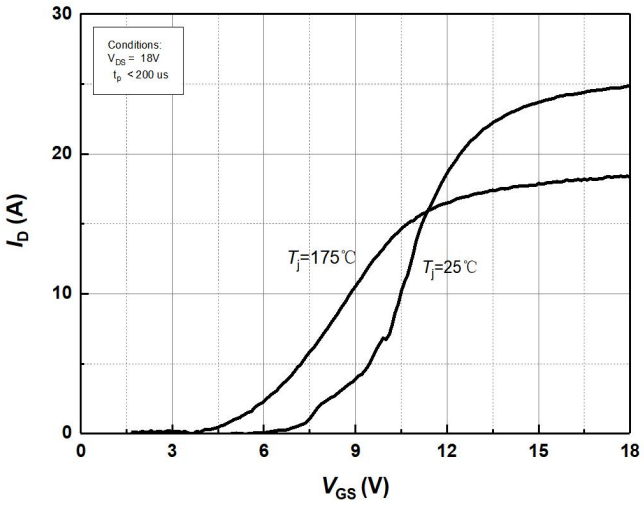


Figure 6. Transfer Characteristics for Various Junction Temperatures

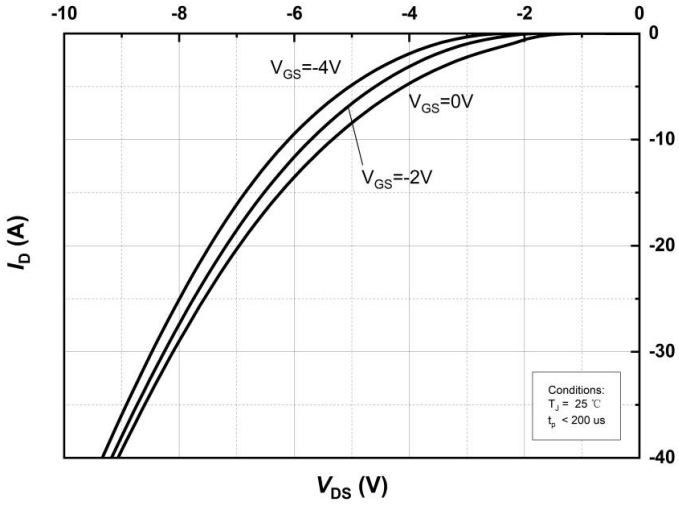


Figure 7. Body Diode Characteristics at Tj=25°C

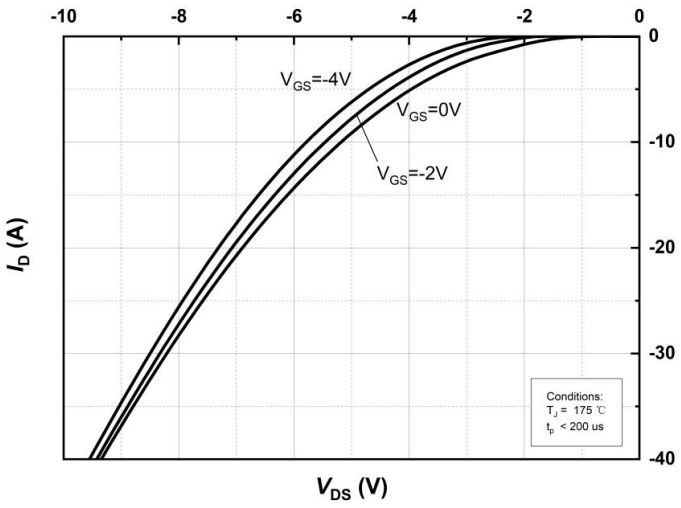


Figure 8. Body Diode Characteristics at Tj=175°C

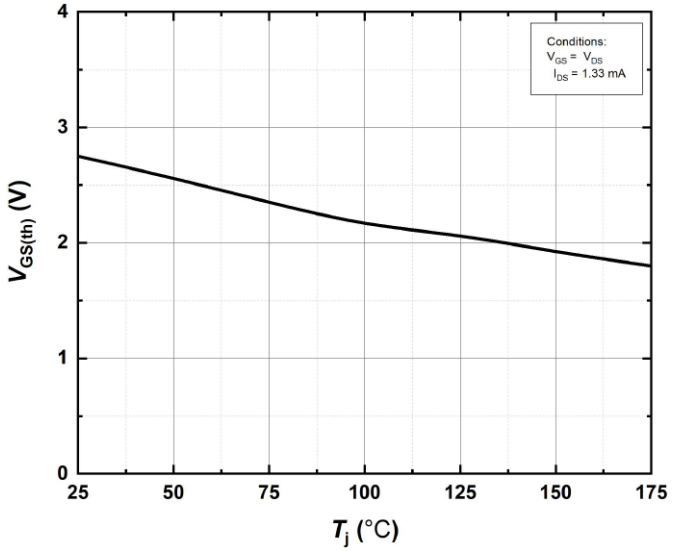


Figure 9. Threshold Voltage vs. Temperature

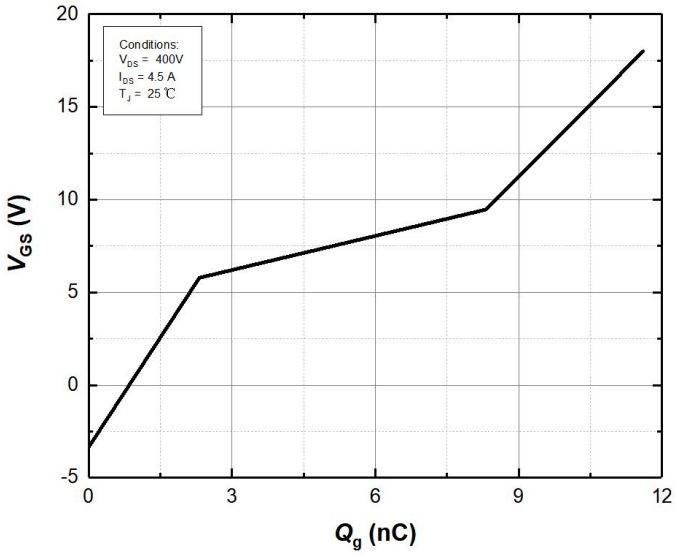


Figure 10 Gate Charge Characteristics

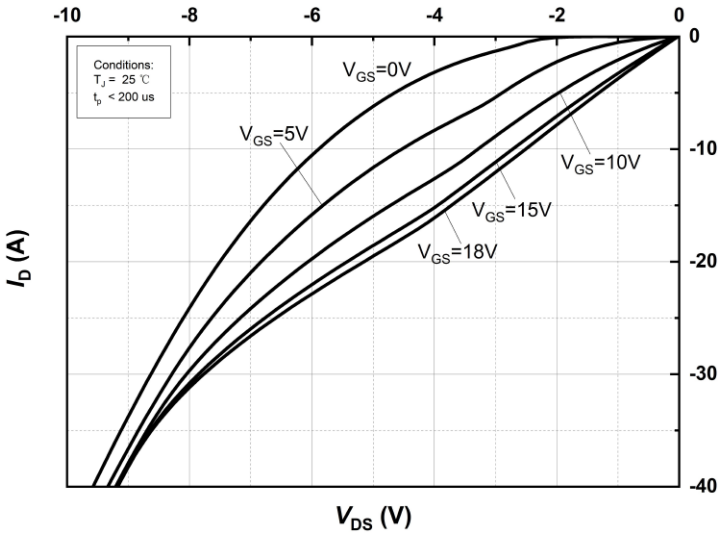


Figure 11. 3rd Quadrant Characteristic at Tj=25°C

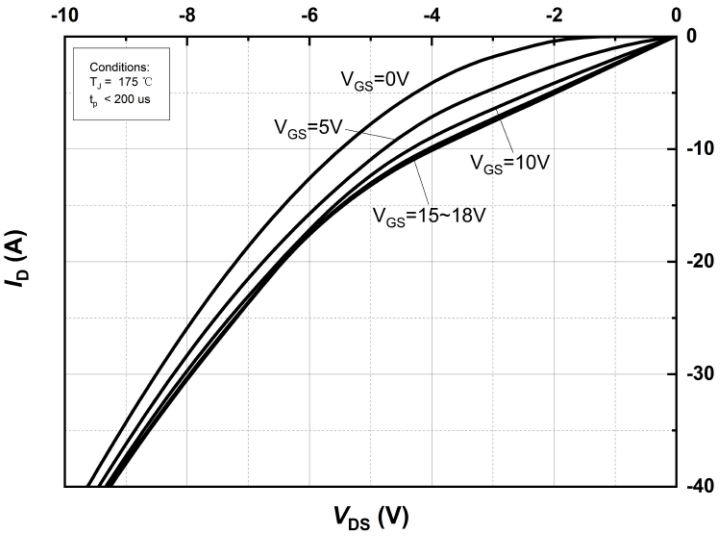


Figure 12. 3rd Quadrant Characteristic at Tj=175°C

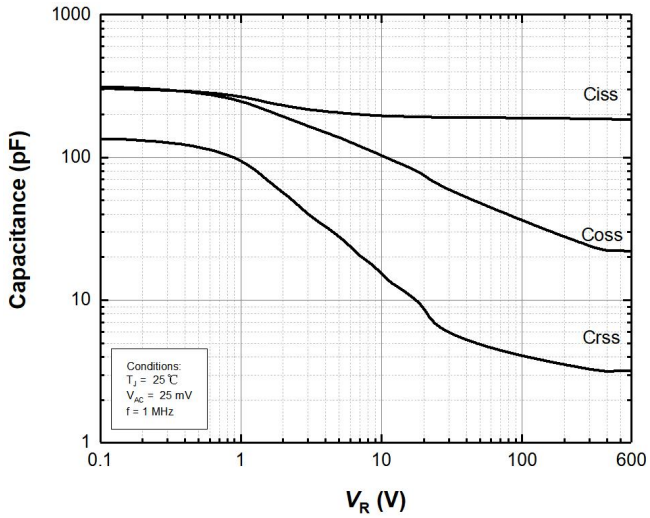


Figure 13. Capacitances vs. Drain-Source Voltage (0 – 600V)

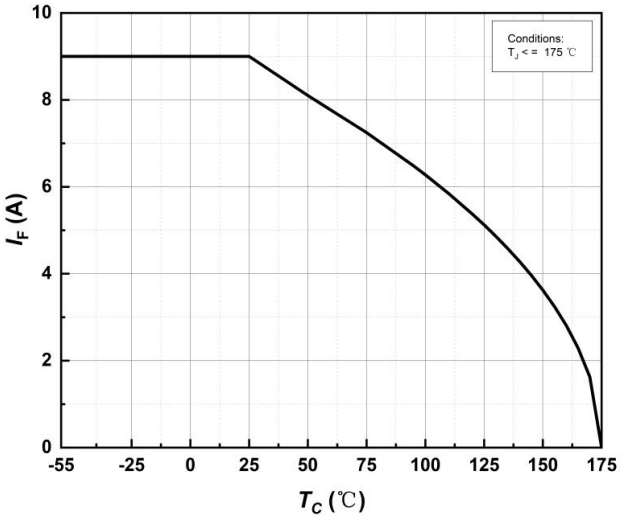


Figure 14. Continuous Drain Current Derating vs Case Temperature

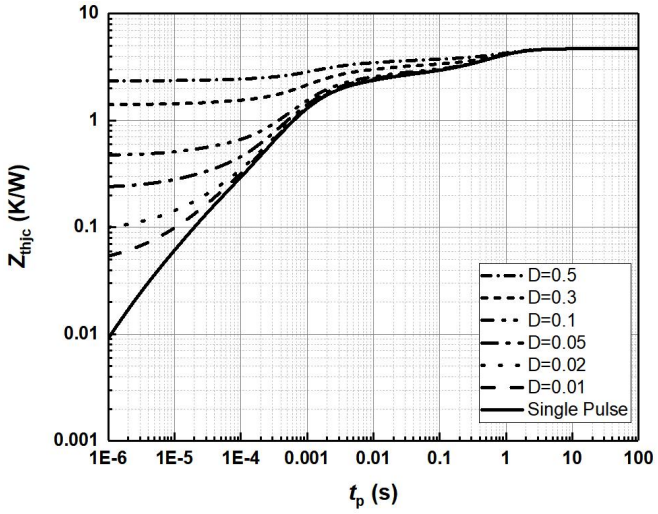


Figure 15.Transient Thermal Impedance (Junction – Case)

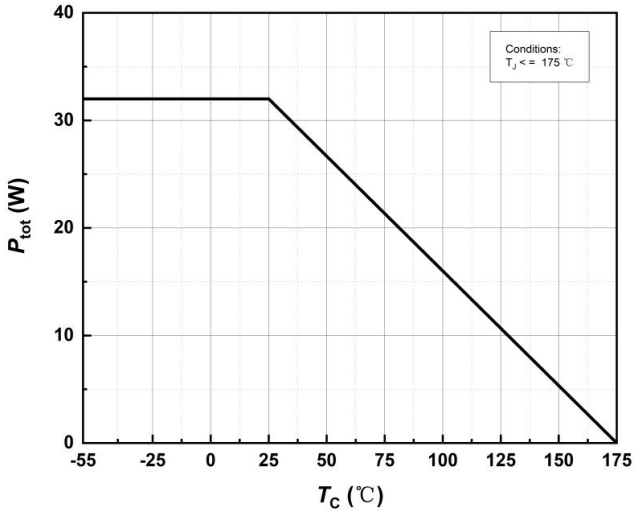


Figure 16. Maximum Power Dissipation Derating vs. Case Temperature

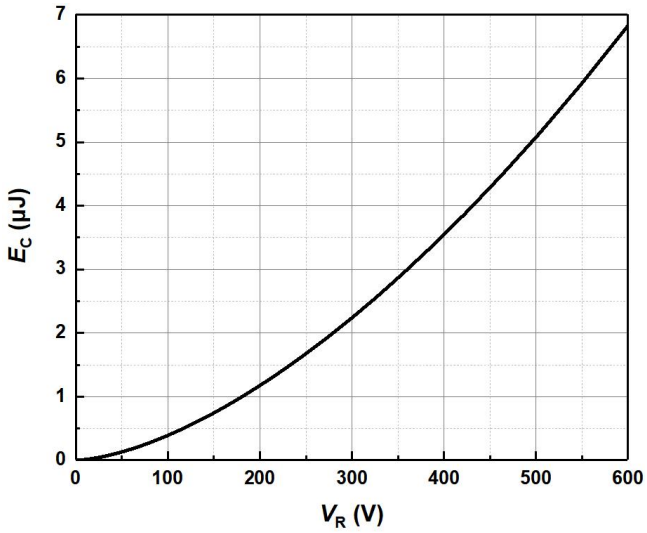


Figure 17. Output Capacitor Stored Energy

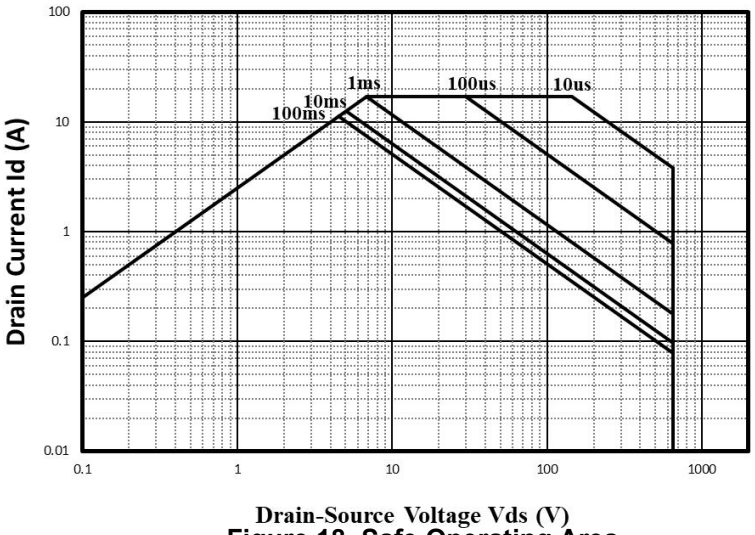


Figure 18. Safe Operating Area

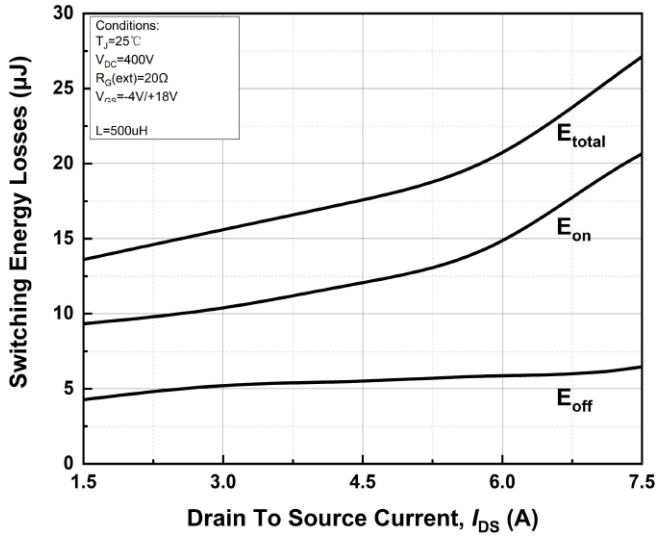


Figure 19. Clamped Inductive Switching Energy vs. Drain Current(V_{DD} = 400V)

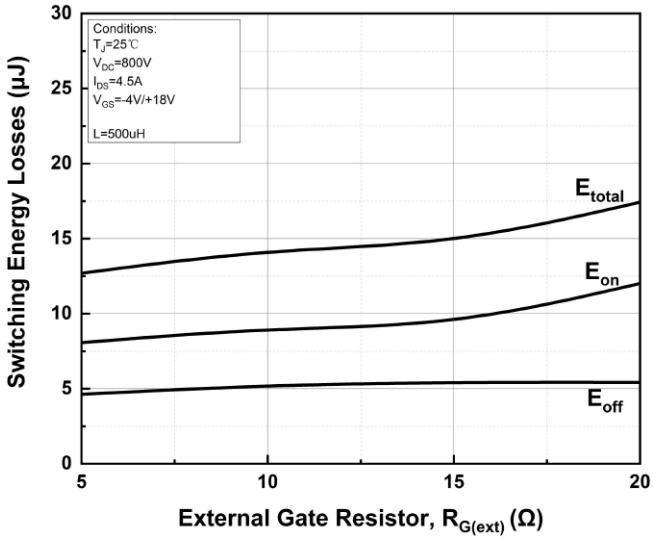


Figure 20. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

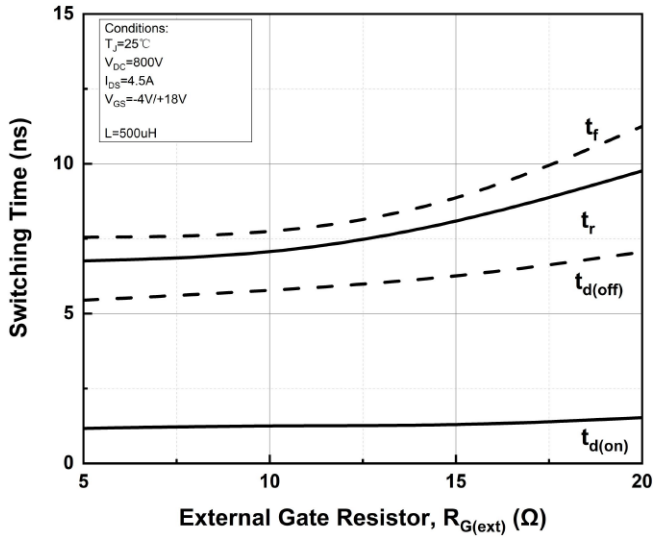
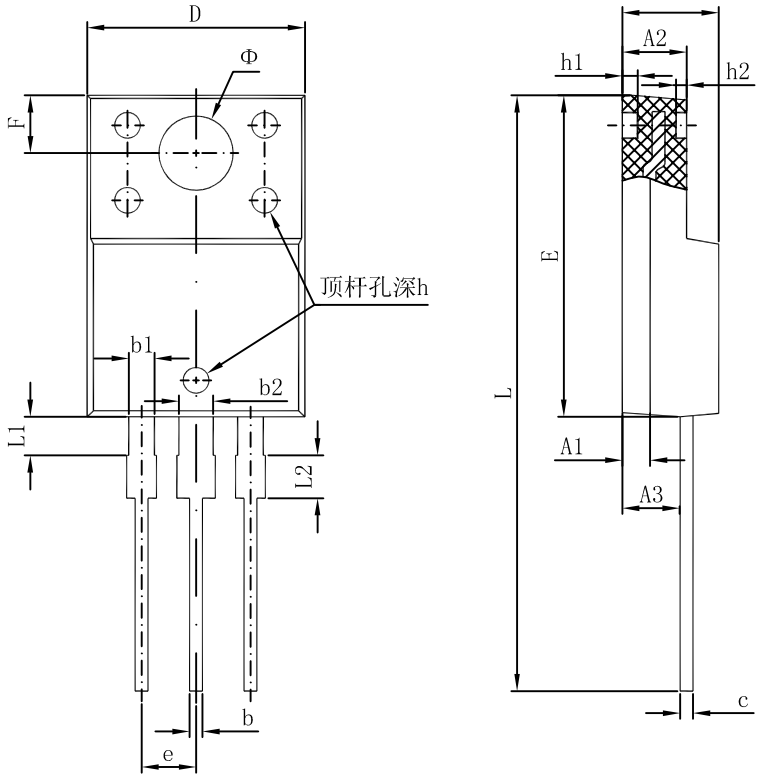


Figure 21. Switching Times vs. $R_{G(ext)}$

Package Dimensions

Package TO-220F



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.300	4.700	0.169	0.185
A1	1.300 REF.		0.051 REF.	
A2	2.800	3.200	0.110	0.126
A3	2.500	2.900	0.098	0.114
b	0.500	0.750	0.020	0.030
b1	1.100	1.350	0.043	0.053
b2	1.500	1.750	0.059	0.069
c	0.500	0.750	0.020	0.030
D	9.960	10.360	0.392	0.408
E	14.800	15.200	0.583	0.598
e	2.540 TYP.		0.100 TYP.	
F	2.700 REF.		0.106 REF.	
Φ	3.500 REF.		0.138 REF.	
h	0.000	0.300	0.000	0.012
h1	0.800 REF.		0.031 REF.	
h2	0.500 REF.		0.020 REF.	
L	28.000	28.400	1.102	1.118
L1	1.700	1.900	0.067	0.075
L2	1.900	2.100	0.075	0.083

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