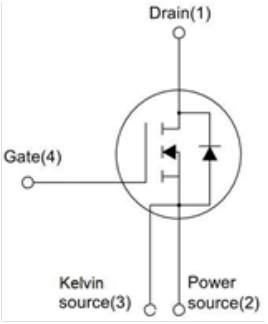
V_{DS} = **1200 V**

I_D (T_C=25℃) = **41A**

$R_{DS(on).typ}$ = **80 mΩ@ V_{GS}=20V**

TO-247-4



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
- Motor drives
- High voltage DC/DC converters

Package Parameters

Part Number	Marking	Package
ES80N120T4AA	ES80N120T4AA	TO-247-4

Package Pin Definitions

- Pin1- Drain
- Pin2- Power Source
- Pin3- Kelvin Source
- Pin4- Gate

Maximum Ratings (T_C=25℃ unless otherwise specified)

Symbol	Parameter	Test conditions	Value	Unit	Note
V_{DSmax}	Drain-Source Voltage	V_{GS} = 0V, I_D = 100μA	1200	V	
V_{GSmax}	Gate-Source voltage	AC (f > 1 Hz)	-10/+25	V	
V_{GSop}	Recommend Gate-Source Voltage	Static	-5/+20	V	
I_D	Continuous Drain current	V_{GS} = 20V, T_C = 25°C	41	A	Fig. 14
		V_{GS} = 20V, T_C = 100°C	28		
$I_{D,pulse}$	Pulsed Drain Current	Pulse with t_p limited by T_{jmax}	80	A	Fig. 18
P_D	Power Dissipation	T_C = 25°C, Tj = 175°C	208	W	Fig. 16
T_j	Operating junction temperature		-55~150	°C	
T_{stg}	Storage temperature		-55~150	°C	
	TO-247 mounting 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		0.72		K/W	Fig. 15
$R_{th(ja)}$	Thermal resistance from Junction to Ambient		40		K/W	

Electrical Characteristics T_j=25°C unless otherwise 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	1200			V	
$V_{GS(th)}$	Gate Threshold voltage	V_{GS} = V_{DS}, I_D = 5mA		3.0		V	Fig. 9
		V_{GS}= V_{DS}, I_D = 5mA, T_j=175°C		2.3			
I_{GSS}	Gate-Source Leakage current	V_{GS} = 20V, V_{DS} = 0V			250	nA	
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 1200V, V_{GS} = 0V, T_j = 25°C		1	50	μA	
$R_{DS(on)}$	Drain-Source On-state Resistance	V_{GS} = 20V, I_D = 20A V_{GS} = 18V, I_D = 20A		80	98	mΩ	Fig. 3, 4, 5
		V_{GS} = 20V, I_D = 20A, T_j = 175°C V_{GS} = 18V, I_D = 20A, T_j = 175°C		130			
g_{fs}	Transconductance	V_{GS} = 20V, I_D = 20A		9		S	Fig. 6
		V_{GS} = 20V, I_D = 20A, T_j = 175°C		7			

Gate Charge Characteristics

Symbol	Parameter	Test conditions	Value			Unit	Note
			Min.	Typ.	Max.		
Q_{GS}	Gate to Source Charge	V_{DS} = 800V I_D = 20A V_{GS} = -5V/20V		15		nC	Fig. 10
Q_{GD}	Gate to Drain Charge			30			
Q_G	Total Gate Charge			66			

AC Characteristics (T_j=25°C unless otherwise specified)

Symbol	Parameter	Test conditions	Value			Unit	Note
			Min.	Typ.	Max.		
C_{iss}	Input Capacitance	V_{GS} = 0V, V_{DS} = 1000V f =1 MHz V_{AC} = 25mV		1374		pF	Fig. 13
C_{oss}	Output Capacitance			63		pF	
C_{rss}	Reverse Transfer Capacitance			3.5		pF	
$R_{G(int)}$	Internal Gate Resistance	f=1 MHz, V_{AC} = 25mV		2		Ω	

Reverse Diode Characteristics (T_j=25°C unless otherwise specified)

Symbol	Parameter	Test conditions	Value			Unit	Note
			Min.	Typ.	Max.		
V_{SD}	Diode Forward Voltage	V_{GS} = -4V, I_{SD} = 10A		3.7		V	Fig. 7,8
		V_{GS} = -4V, I_{SD} = 10A, T_j = 175°C		3.1			
I_S	Continuous Diode Forward Current	V_{GS} = -4V, T_C = 25°C		35		A	
$I_{S,\ pulse}$	Diode pulse Current	V_{GS} = -4V, pulse width t_p limited by T_{jmax}		80		A	
t_{rr}	Reverse Recovery Time	V_{GS} = -4V, I_{SD} = 20A, V_R = 800V dif/dt = 2800A/us		29.3		nS	
Q_{rr}	Reverse Recovery Charge			156.5		nC	
I_{rrm}	Peak Reverse Recovery Current			9.5		A	

Switching Characteristics

Symbol	Parameter	Test conditions	Value			Unit	Note
			Min.	Typ.	Max.		
$t_{d(on)}$	Turn-On Delay Time	V_{DS} = 800V, V_{GS} = -4/+20V I_D= 20A, $R_{G(int)}$ = 5Ω L = 276nH		8.2		nS	Fig.22
t_r	Rise Time			10.8		nS	
$t_{d(off)}$	Turn-Off Delay Time			16.7		nS	
t_f	Fall Time			10.5		nS	
E_{on}	Turn-On Energy			73		uJ	Fig.19
E_{off}	Turn-Off Energy			145		uJ	
E_{tot}	Total switching energy			218		uJ	

Typical Performance

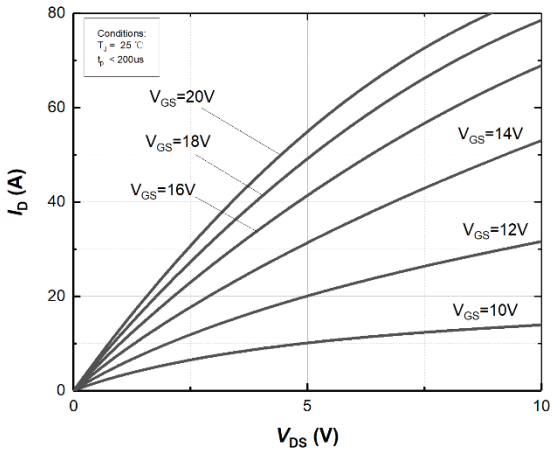


Figure 1. Output characteristics at Tj=25°C

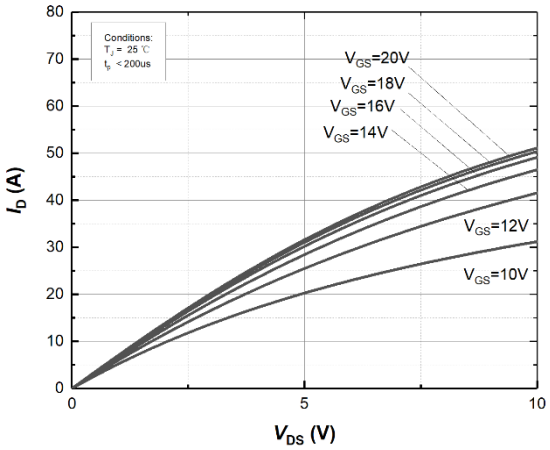


Figure 2. Output characteristics at Tj=175°C

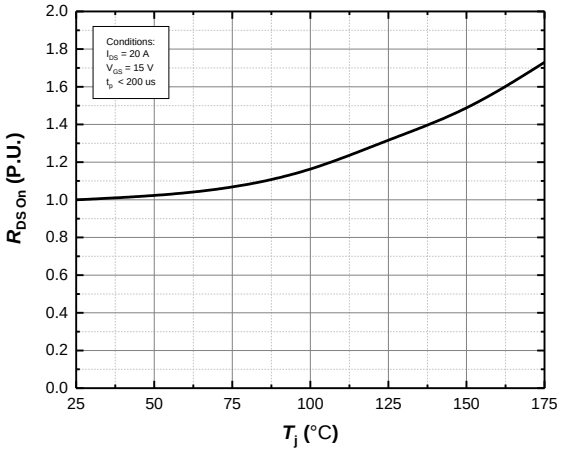


Figure 3. Normalized On-Resistance vs. Temperature

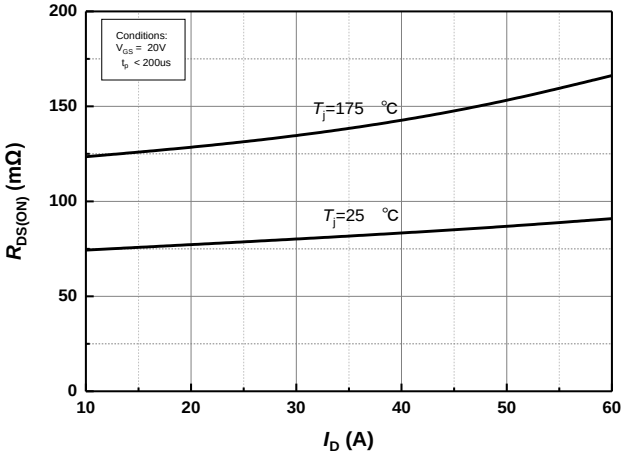


Figure 4. On-Resistance vs. Drain current for Various Temperature

Typical Performance

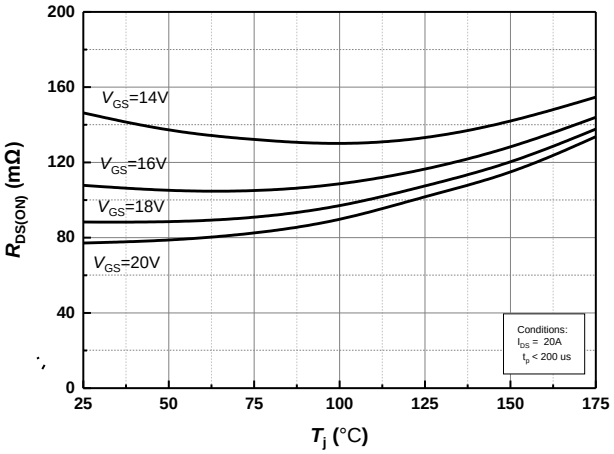


Figure 5. On-Resistance vs. Temperature for Various Gate Voltage

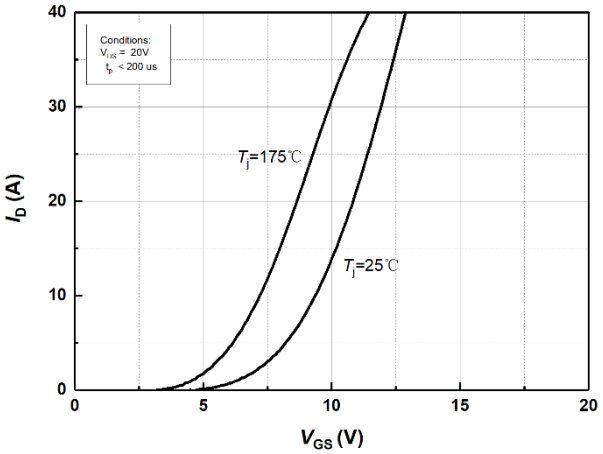


Figure 6. Transfer Characteristics for Various Junction Temperatures

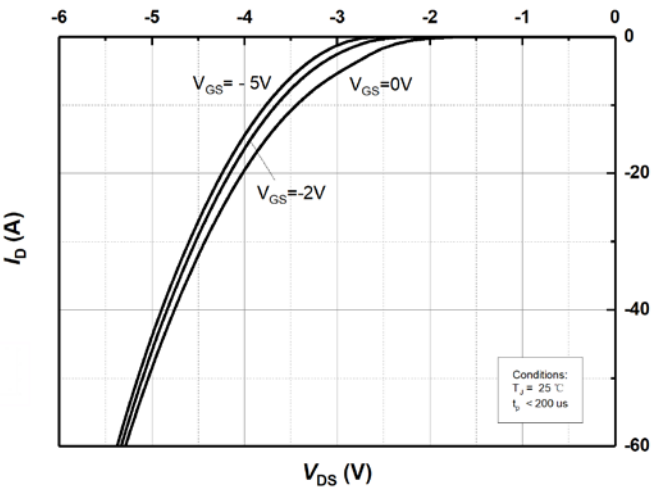


Figure 7. Body Diode Characteristics at Tj=25°C

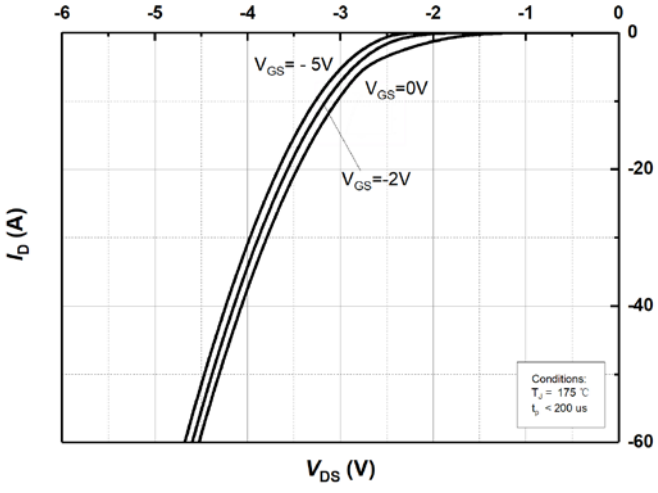


Figure 8. Body Diode Characteristics at Tj=175°C

Typical Performance

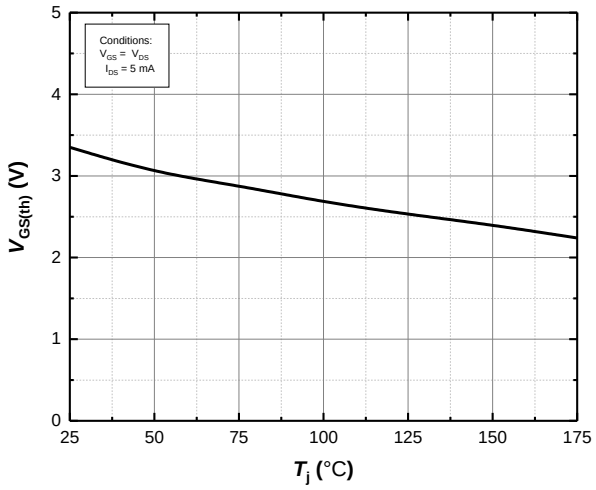


Figure 9. Threshold Voltage vs. Temperature

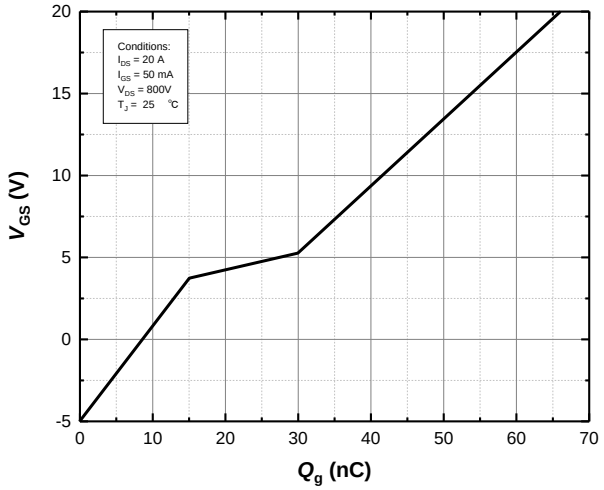


Figure 10 Gate Charge Characteristics

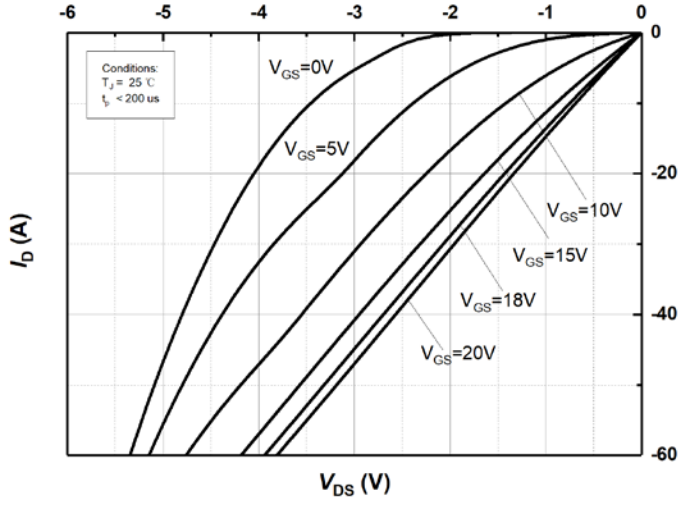


Figure 11. 3rd Quadrant Characteristic at Tj=25°C

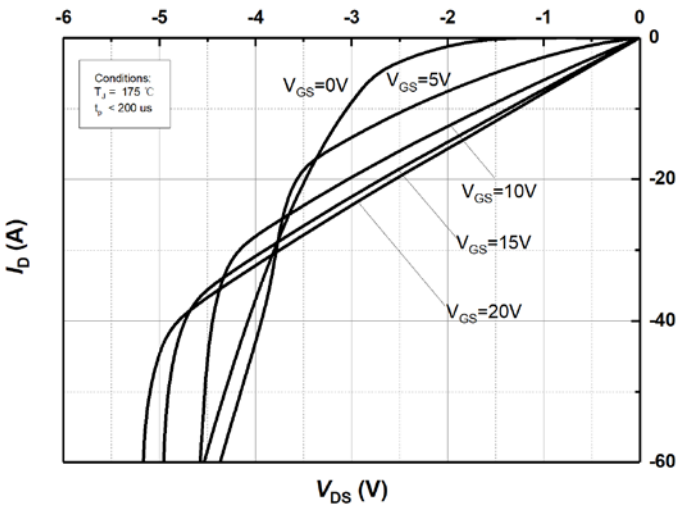


Figure 12. 3rd Quadrant Characteristic at Tj=175°C

Typical Performance

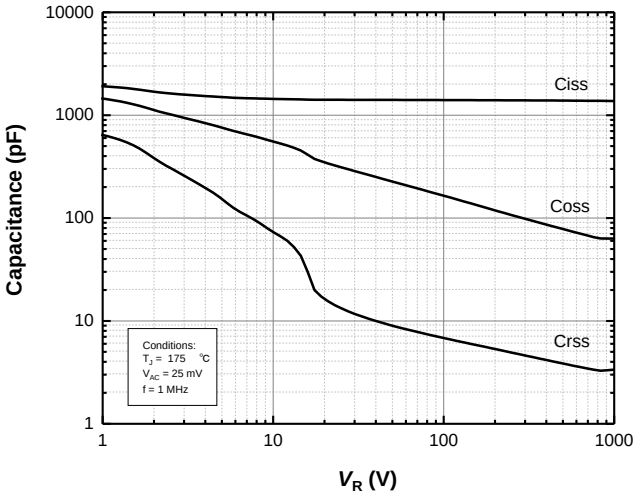


Figure 13. Capacitances vs. Drain-Source Voltage (0 – 1000V)

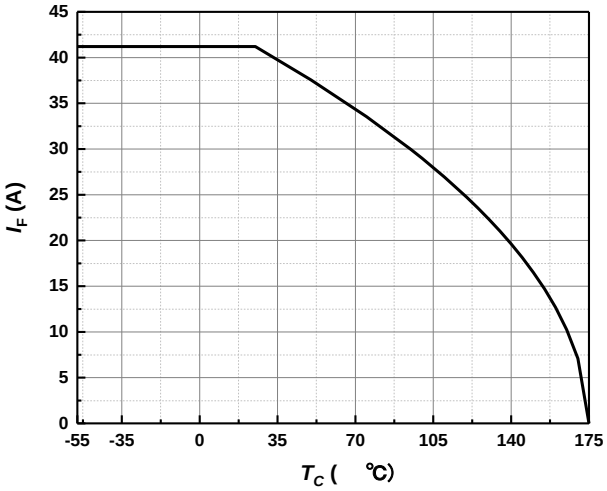


Figure 14. Continuous Drain Current Derating vs Case Temperature

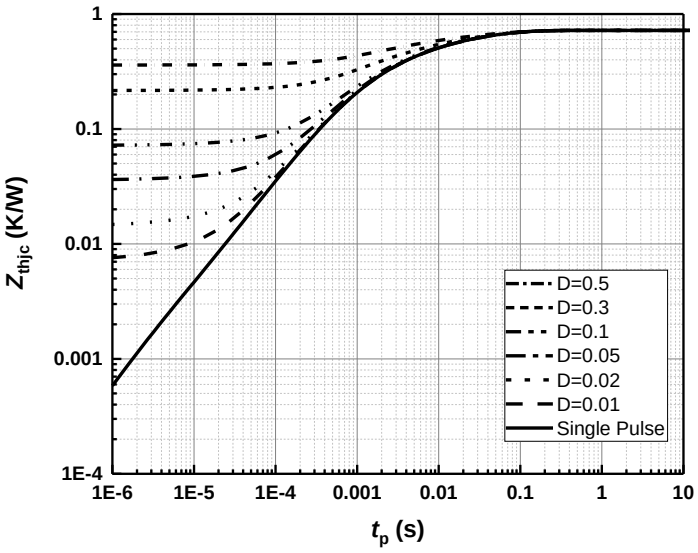


Figure 15.Transient Thermal Impedance (Junction – Case)

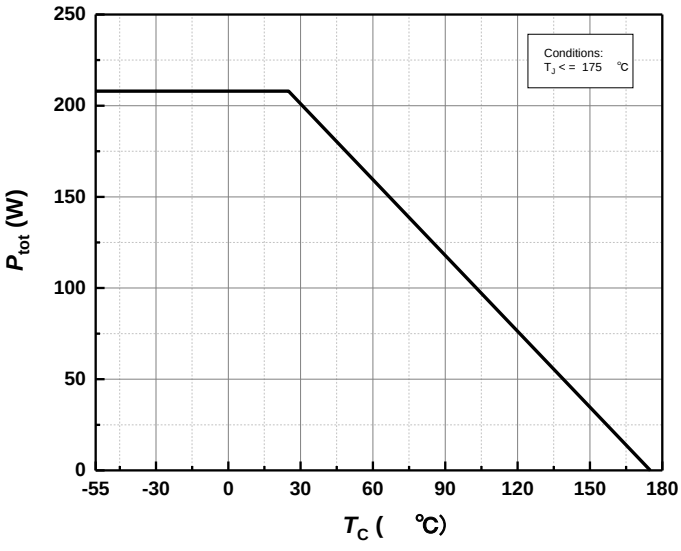


Figure 16. Maximum Power Dissipation Derating vs. Case Temperature

Typical Performance

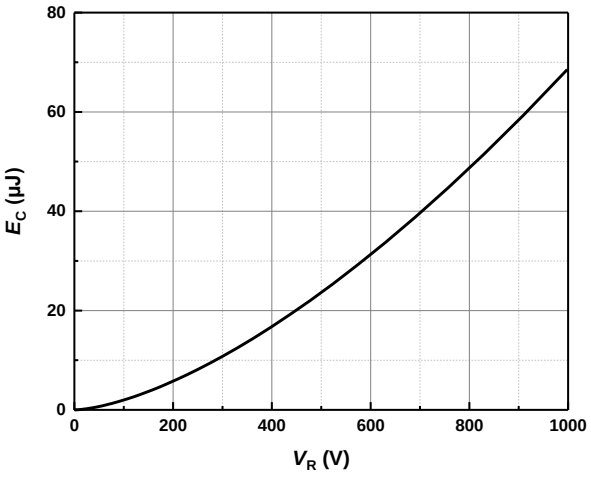


Figure 17. Output Capacitor Stored Energy

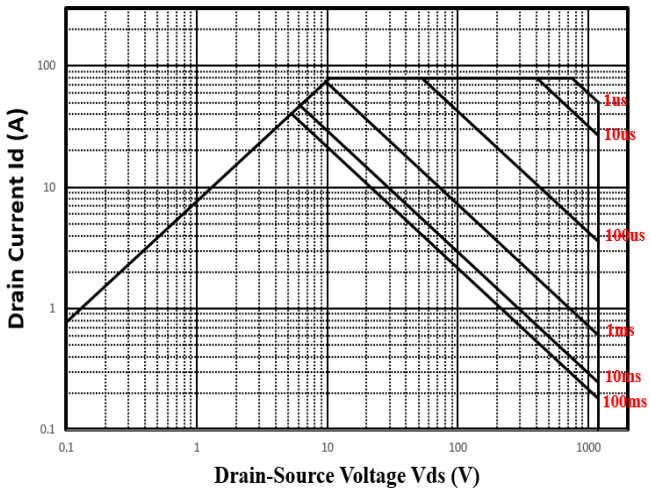


Figure 18. Safe Operating Area

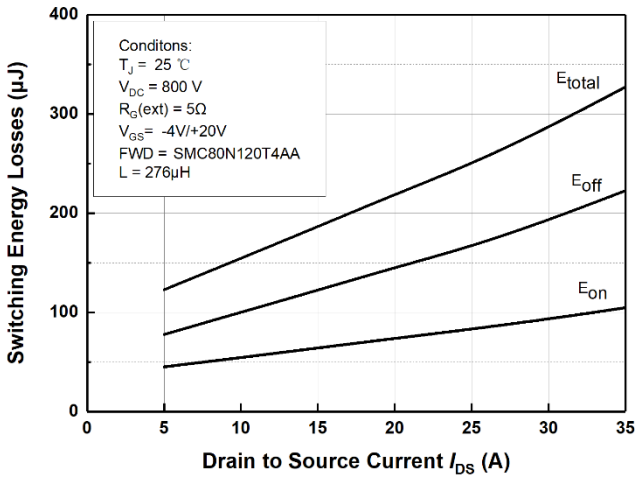


Figure 19. Clamped Inductive Switching Energy vs. Drain Current(V_{DD} = 800V)

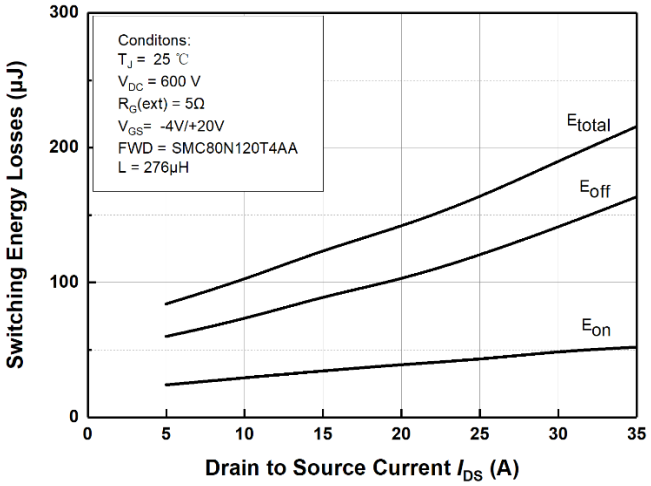


Figure 20. Clamped Inductive Switching Energy vs. Drain Current(V_{DD} = 600V)

Typical Performance

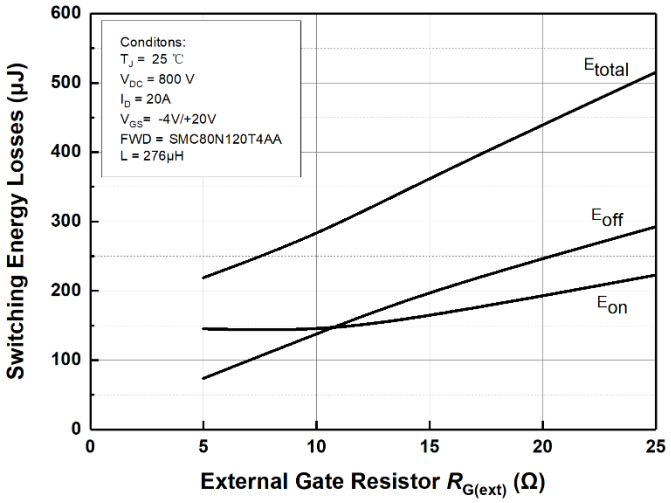


Figure 21. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

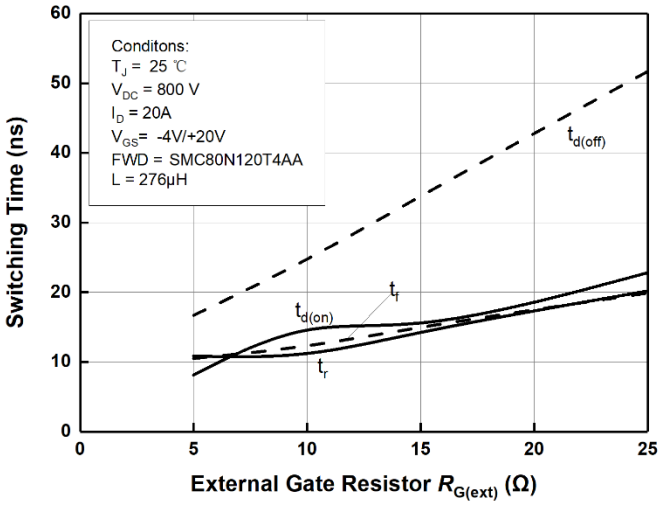
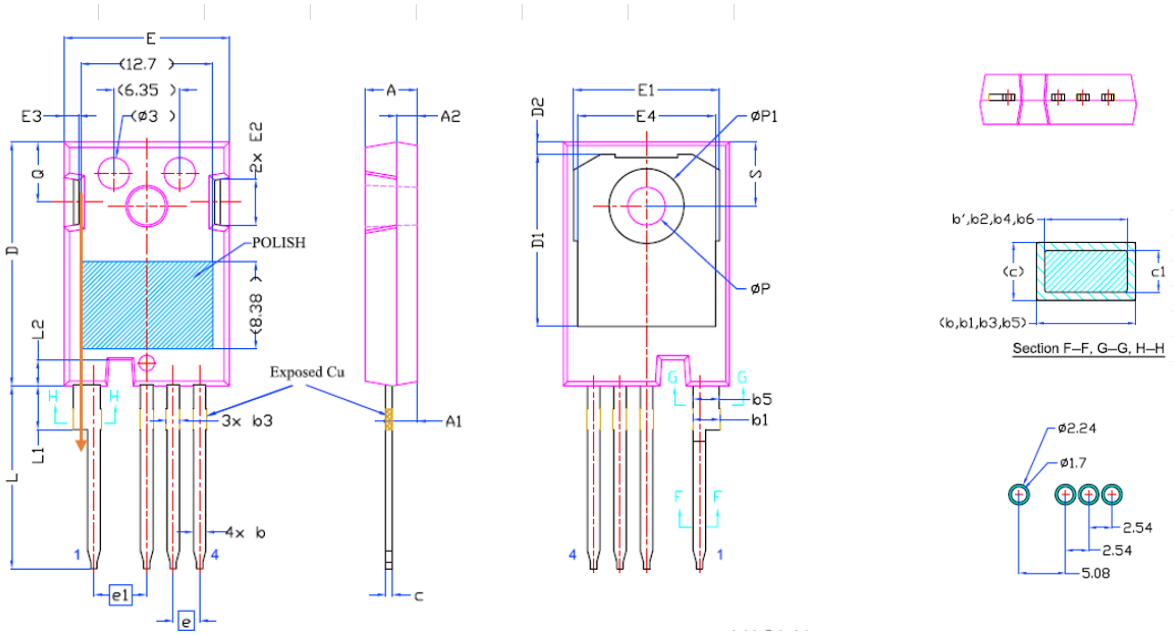


Figure 22. Switching Times vs. $R_{G(ext)}$

Package Dimensions



SYMBOL	MM		
	MIN	NOM	MAX
A	4.80	5.02	5.21
A1	2.29	2.41	2.54
A2	1.91	2.00	2.16
b'	1.07	1.20	1.28
b	1.07	1.20	1.33
b1	2.39	2.67	2.94
b2	2.39	2.67	2.84
b3	1.07	1.30	1.60
b4	1.07	1.30	1.50
b5	2.39	2.53	2.69
b6	2.39	2.53	2.64
c	0.55	0.60	0.68
c1	0.55	0.60	0.65
D	23.30	23.45	23.60
D1	16.25	16.55	17.65
D2	0.95	1.19	1.25
E	15.75	15.94	16.13
E1	13.10	14.02	14.15
E2	3.68	4.40	5.10
E3	1.00	1.45	1.90
E4	12.38	13.26	13.43
e		2.54BSC	
e1		5.08BSC	
L	17.31	17.57	17.82
L1	3.97	4.19	4.37
L2	2.35	2.50	2.65
ΦP	3.51	3.61	3.51
ΦP1		7.19REF.	
Q	5.49	5.79	6.00
S	6.04	6.17	6.30

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