12mΩ, 1200V, Silicon Carbide N-Channel Power MOSFET

Description

The LXP SEMI LX2C012N120AY silicon carbide Power MOSFET device has been developed using LXP's advanced and innovative 2nd generation SiC MOSFET technology. The device features a very low $R_{DS(on)}$ over the entire temperature range combined with low capacitances and good switching performance, which improve application performance in frequency, energy efficiency, system size and weight reduction.

Key Features

- Typ. $R_{DS(on)}$ = 12mΩ @ V_{GS} = 18V
- High speed switching performances
- Low Switching Losses
- 100% Avalanche Tested
- EMI Improved Design
- Very fast and robust intrinsic body diode

Applications

- DC/DC converter for EV/HEV
- On board charger (OBC)
- Solar Inverters
- Energy Storage Systems
- SMPS (Switch Mode Power Supplies)

TO-247-4

Key performance

Parameter	Value	Unit
$V_{DS(T_j=25°C)}$	1200	V
$R_{DS(on),\ typ(T_j=25°C,\ I_D=70A,\ V_{GS}=18V)}$	12	mΩ
$I_{D(T_j=25°C)}$	168	A
$T_{j,\ max}$	175	°C

Package Feature

Order code	Marking	Package	Packing
LX2C012N120AY	LX2C012N120A	TO-247-4PIN	Tube

1.Maximum Ratings (T$_j$=25°C unless otherwise specified)

Parameter		Symbol	Rating	Unit
Drain-Source Voltage		V$_{DSS}$	1200	V
Gate-Source Voltage		V$_{GSS}$	-10/+22	V
Gate-Source Voltage Recommended Operation Values		V$_{GSS}$	-5/+18	V
Gate-Source Transient Voltage (t$_p$ < 1μs, t ≤ 10 hours)		V$_{GSS}$	-11/+25	V
Continuous Drain Current	T$_C$ = 25ºC	I$_D$	168	A
	T$_C$ = 100ºC		119	
Pulsed Drain Current (Note 2)		I$_{DM}$	376	A
Avalanche Energy, Single Pulse (Note 3)		E$_{AS}$	800	mJ
Avalanche Current, Repetitive (Note 2)		I$_{AR}$	40	A
Continuous Diode Forward Current		I$_S$	168	A
Power Dissipation		P$_{tot}$	1000	W
Operating Temperature/ Storage Temperature		T$_J$	-55~175	ºC

Note:

1. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. Repetitive Rating: Pulse width limited by maximum junction temperature

3. L = 1mH, I$_{AS}$ = 40A, V$_{DD}$ = 120V, V$_{GS}$ = 18V, R$_g$ = 25Ω, Starting T$_J$ = 25°C

2.Thermal characteristics

Parameter	Symbol	Value	Unit
Thermal resistance, junction-to-case	R$_{thJC}$	0.15	°C/W
Thermal resistance, junction-to-ambient	R$_{thJA}$	41	°C/W

3.Electrical Characteristics (T$_j$=25°C unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Statistic Characteristics						
Drain-Source Breakdown Voltage	BV$_{DSS}$	V$_{GS}$ = 0 V, I$_D$ = 100 μA	1200	1500		V
Zero Gate Voltage Drain Current	I$_{DSS}$	V$_{DS}$ = 1200 V, V$_{GS}$ = 0 V		1	10	μA
Gate-Source Leakage Current	I$_{GSSF}$	V$_{GS}$ = 22 V, V$_{DS}$ = 0 V			100	nA
	I$_{GSSR}$	V$_{GS}$ = -10 V, V$_{DS}$ = 0 V			-100	nA
Gate Threshold Voltage	V$_{GS(th)}$	V$_{DS}$ = V$_{GS}$, I$_D$ = 30 mA	2.1	2.8	3.5	V
Static Drain-Source On-Resistance	R$_{DS(on)}$	V$_{GS}$ = 18 V, I$_D$ = 70 A		12	16	mΩ
		V$_{GS}$ = 18 V, I$_D$ = 70 A, T$_j$ =150 ºC		18		
		V$_{GS}$ = 18 V, I$_D$ = 70 A, T$_j$ =175 ºC		20		
		V$_{GS}$ = 15 V, I$_D$ = 70 A		15	20	
		V$_{GS}$ = 15 V, I$_D$ = 70 A, T$_j$ =150 ºC		20		
		V$_{GS}$ = 15 V, I$_D$ = 70 A, T$_j$ =175 ºC		21		
Gate Resistance	R$_G$	f = 1 MHz，open drain		2		Ω
Dynamic Characteristics						
Input Capacitance	C$_{ISS}$	V$_{GS}$ = 0 V		4770		pF
Output Capacitance	C$_{OSS}$	V$_{DS}$ = 800 V		280		
Reverse Transfer Capacitance	C$_{RSS}$	f = 1 MHz		17		
Gate to Source Charge	Q$_{gs}$	V$_{DS}$ = 800 V		80		nC
Gate to Drain Charge	Q$_{gd}$	V$_{GS}$ = -5 to 18 V		67		
Gate Charge Total	Q$_g$	I$_D$ = 70 A		253		
Switching Characteristics						
Turn-on delay time	T$_{d(on)}$	V$_{DD}$ = 800 V, I$_D$ = 70 A, R$_G$ = 2.4 Ω, V$_{GS}$ = -5/+18 V		18		ns
Rise time	T$_r$			28		
Turn-off delay time	T$_{d(off)}$			55		
Fall time	T$_f$			12		
Turn-on switching energy	E$_{on}$			600		μJ
Turn-off switching energy	E$_{off}$			230		
Reverse Diode Characteristics						
Diode Forward Voltage	V$_{SD}$	V$_{GS}$ = -5 V, I$_{SD}$ = 70 A		4.6		V
		V$_{GS}$ = -5 V, I$_{SD}$ = 70 A, Tj=175 ºC		4.1		
Reverse Recovery Time	t$_{rr}$	V$_R$ = 800 V, I$_F$ = 70 A, di/dt =1000 A/μs		30		ns
Reverse Recovery Charge	Q$_{rr}$			260		nC
Peak Reverse Recovery Current	I$_{rrm}$			19		A

4.Electrical characteristic curves

| Figure 1: Power dissipation	Figure 2: Transient thermal impedance
$P_{tot}=f(T_c)$	$Z_{(thJC)}=f(t_p)$; parameter: $D=t_p/T$
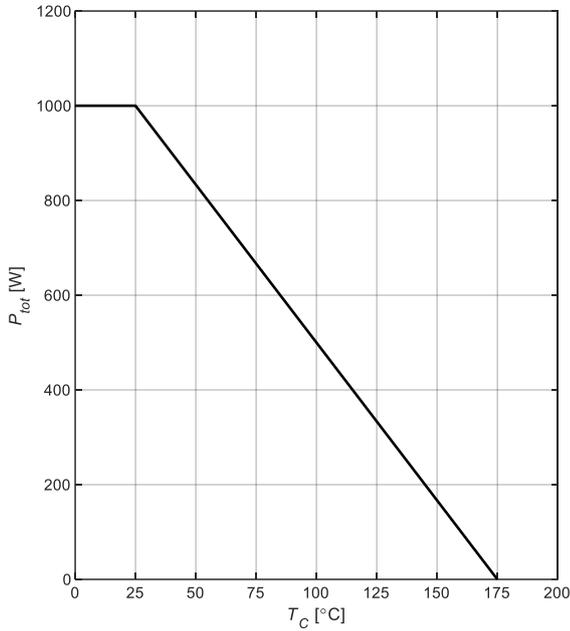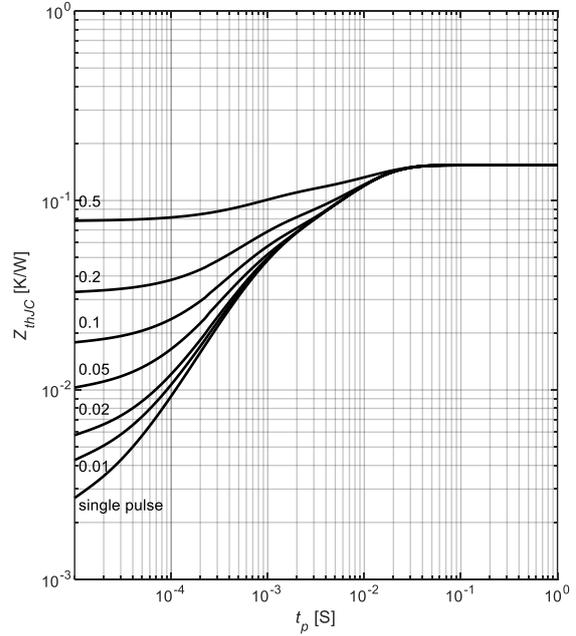
Figure 3: Safe operating area	Figure 4: Typ. output characteristics
$I_D=f(V_{DS})$; $T_c=25°C$; $V_{GS}>7.5V$; parameter t_p	$I_D=f(V_{DS})$; $T_j=-55°C$; parameter: V_{GS}
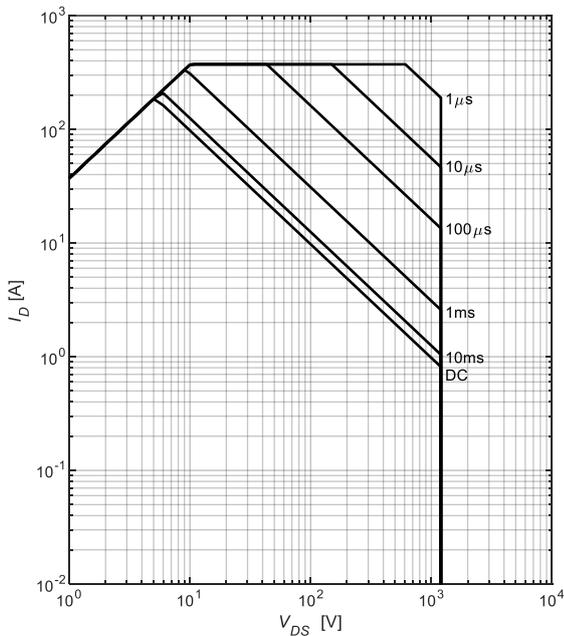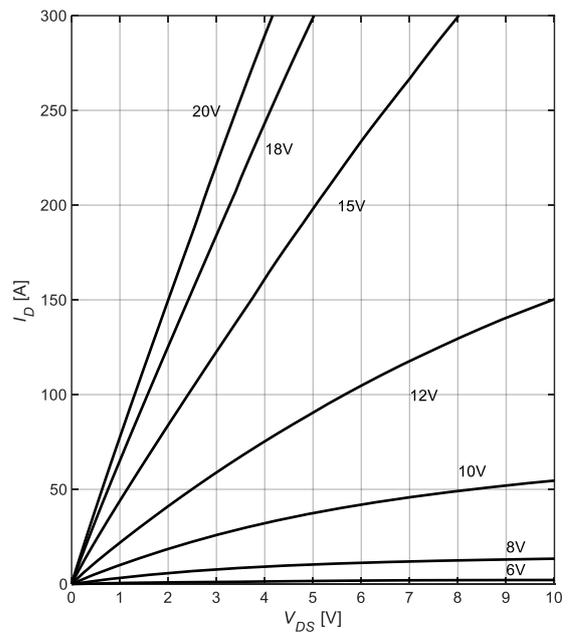
Figure 5: Typ. output characteristics	Figure 6: Typ. output characteristics
I_D=f(V_{DS}); T_j=25℃; parameter: V_{GS}	I_D=f(V_{DS}); T_j=175℃; parameter: V_{GS}
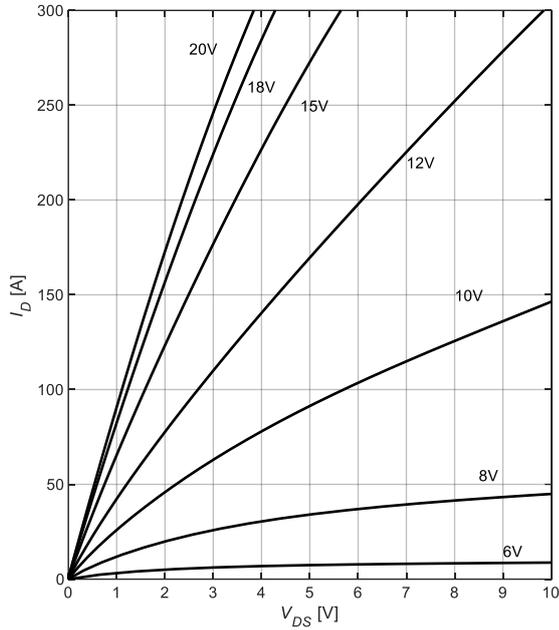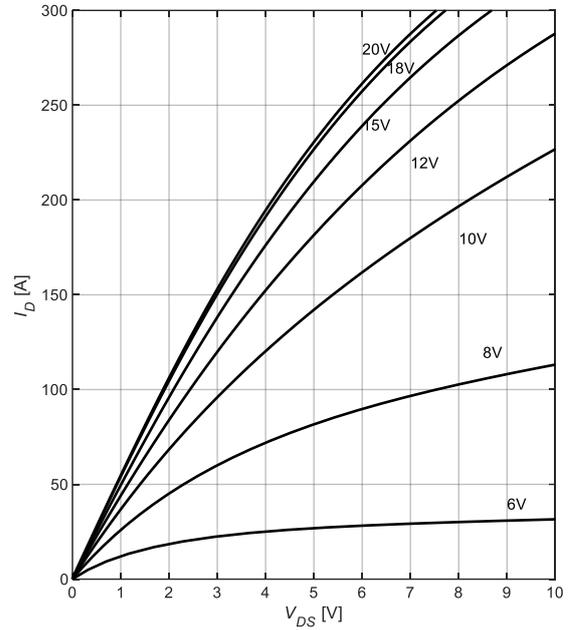
Figure 7: Typ. transfer characteristics	Figure 8: Norm. Drain-Source On-State Resistance
I_D=f(V_{GS}); V_{DS}=10V; parameter: T_j	$R_{DS(on)}$=f(T_j); I_D=70A; parameter: V_{GS}
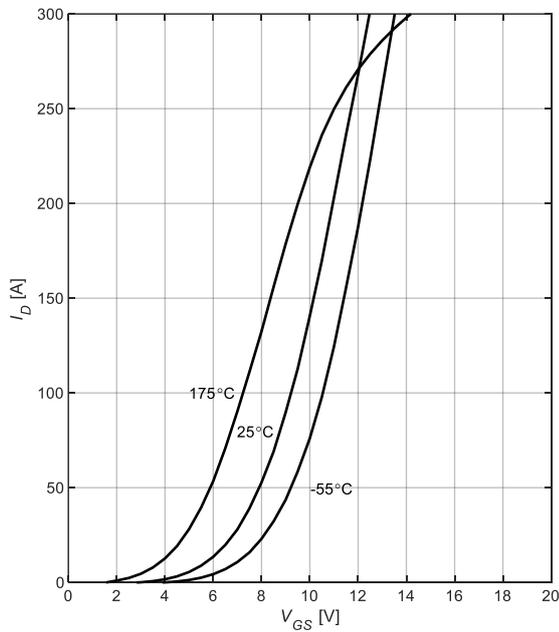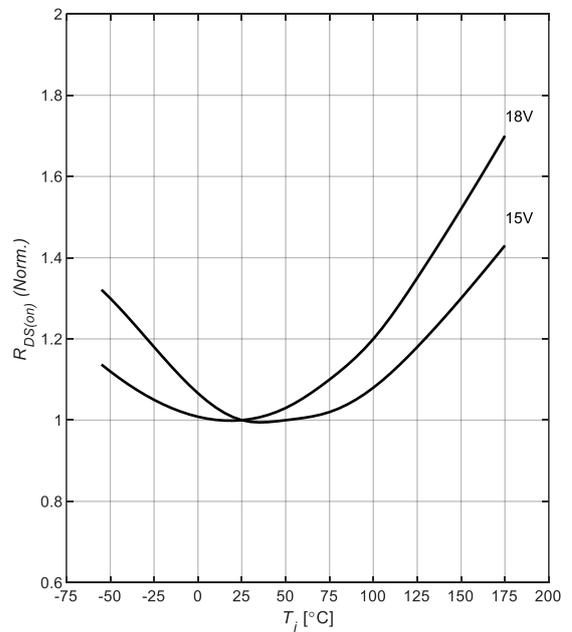
Figure 9: Norm. Drain-Source On-State Resistance	Figure 10: Norm. gate threshold voltage
$R_{DS(on)}=f(I_D)$; $T_j=25℃$; parameter: V_{GS}	$V_{GS(th)}=f(T_j)$; $V_{DS}=V_{GS}$, $I_D=30mA$
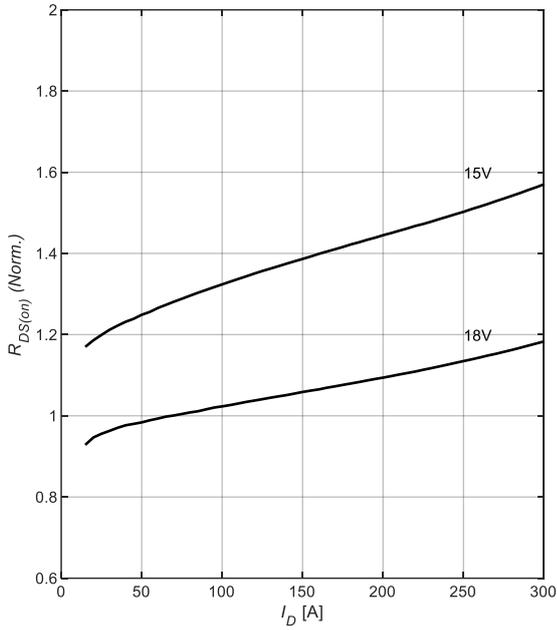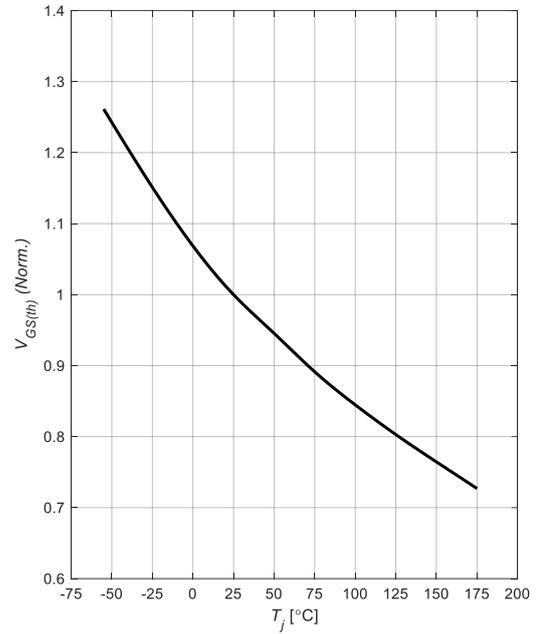
Figure 11: Typ. gate charge	Figure 12: Typ. capacitances
$V_{GS}=f(Q_{gate})$, $V_{DS}=800V$, $I_D=70A$ pulsed	$C=f(V_{DS})$; $V_{GS}=0$; $f=1MHz$
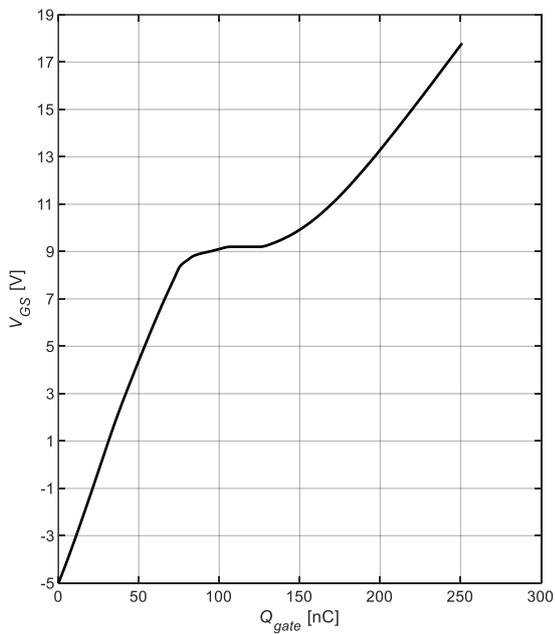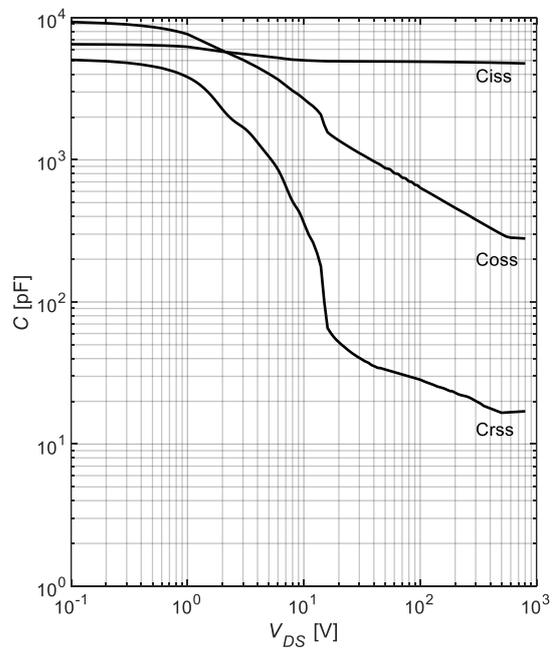
Figure 13: Norm. reverse diode forward voltage	Figure 14: Typ. reverse conduction characteristics
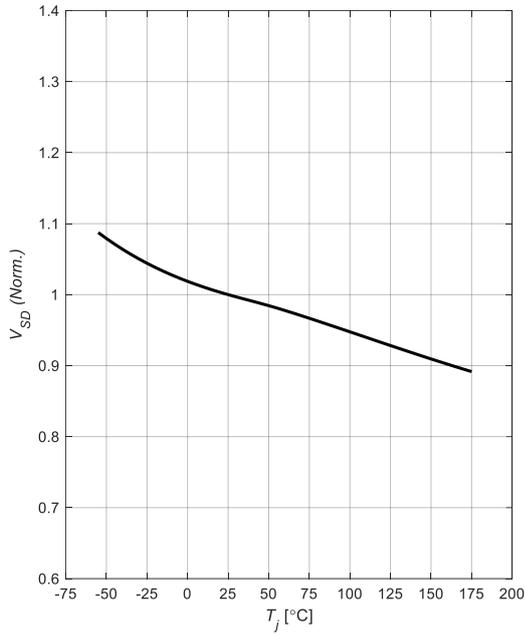
V_{SD}=f(T_j); I_{SD}=70A; V_{GS}=-5V
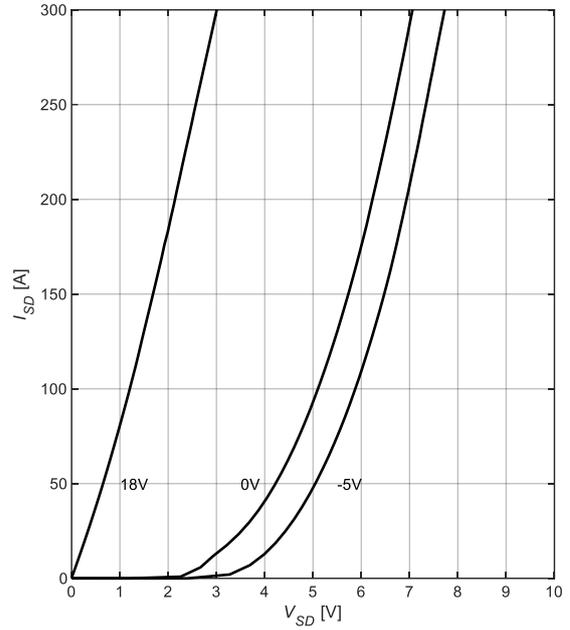
I_{SD}=f(V_{SD}); T_j=-55℃; parameter: V_{GS}

Figure 15: Typ. reverse conduction characteristics	Figure 16: Typ. reverse conduction characteristics
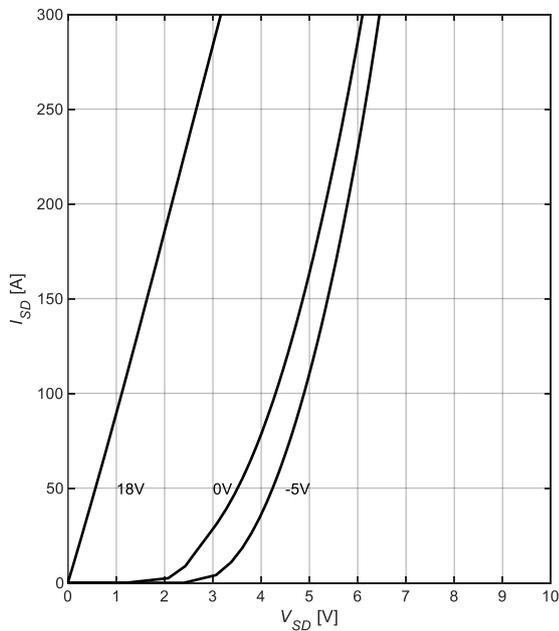
I_{SD}=f(V_{SD}); T_j=25℃; parameter: V_{GS}
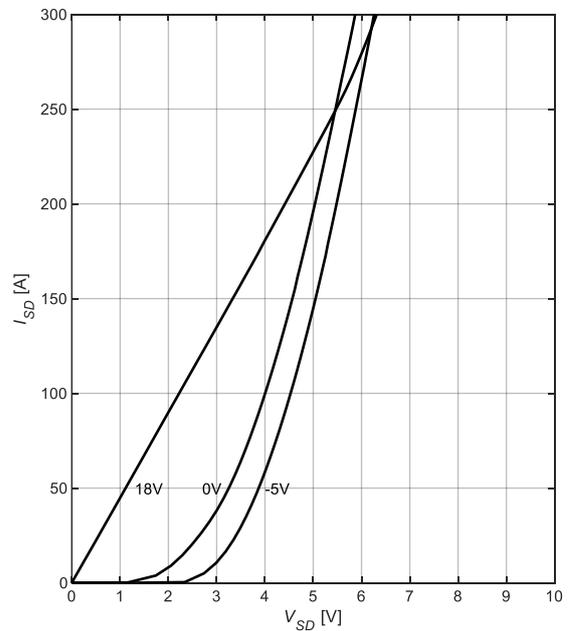
I_{SD}=f(V_{SD}); T_j=175℃; parameter: V_{GS}

Figure 17: Typ. switching energy losses
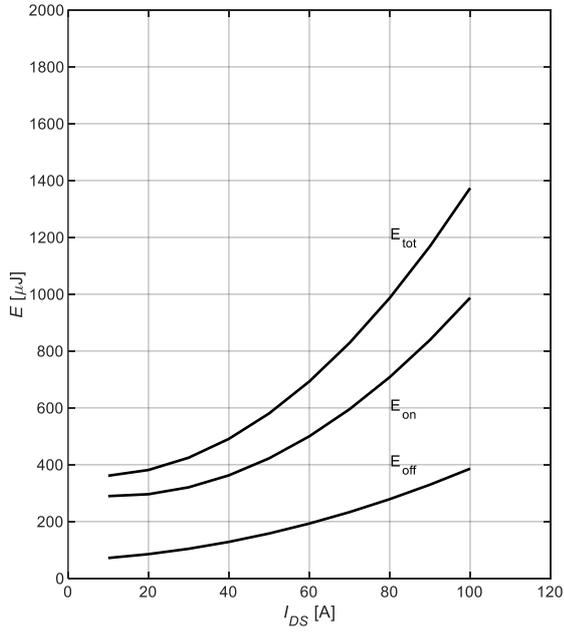
E=f(I_{DS}); V_{DD}=800V; V_{GS}=-5/+18V; R_G =2.4Ω; T_j= 25°C

Figure 18: Typ. switching energy losses
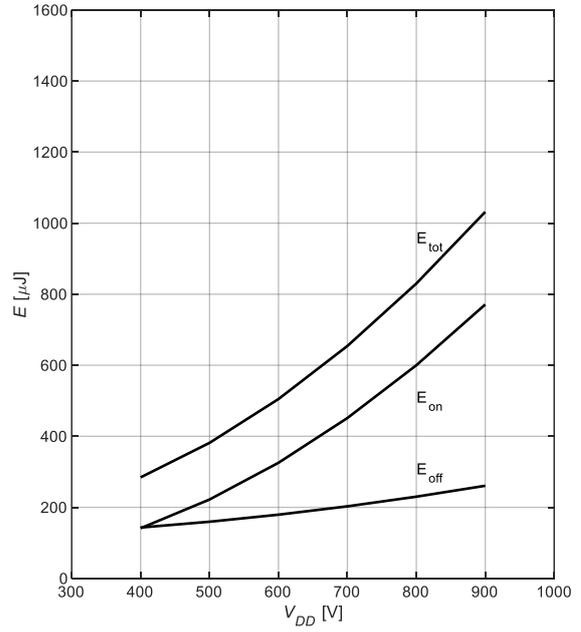
E=f(V_{DD}); V_{GS}=-5/+18V; R_G =2.4Ω; I_D=70A

Figure 19: Typ. switching energy losses
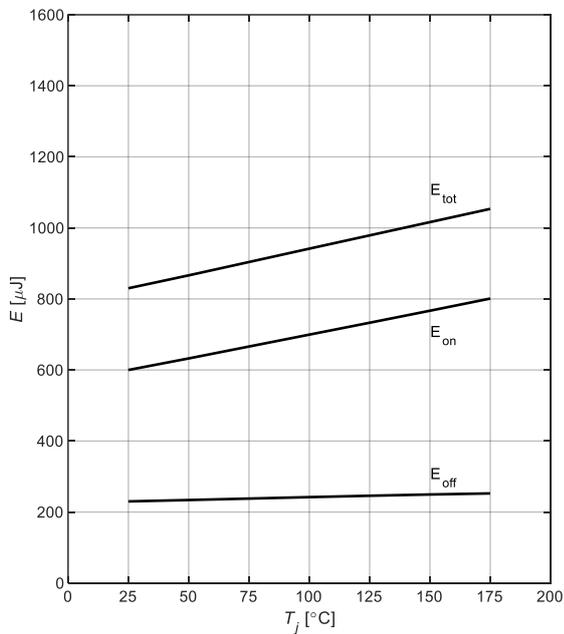
E=f(T_j); V_{DD}=800V; V_{GS}=-5/+18V; R_G =2.4Ω; I_D=70A

Figure 20: Typ. switching energy losses
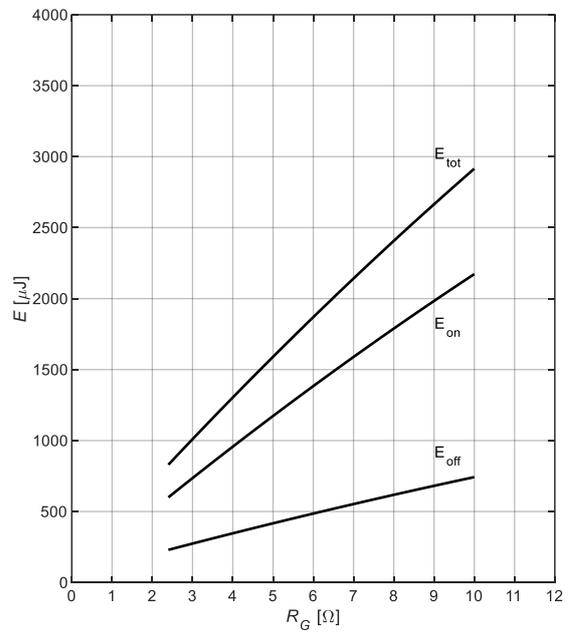

E=f(R_G); V_{DD}=800V; V_{GS}=-5/+18V; I_D=70A

5.Test Circuits

1) Test circuit and waveform for diode characteristics
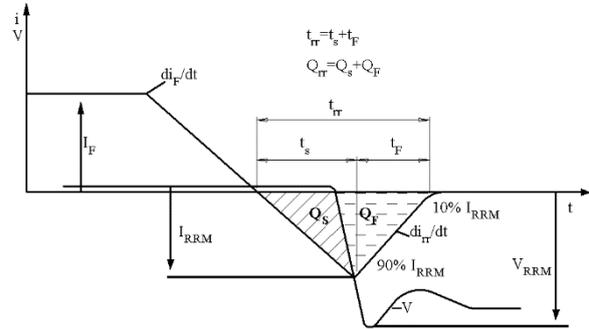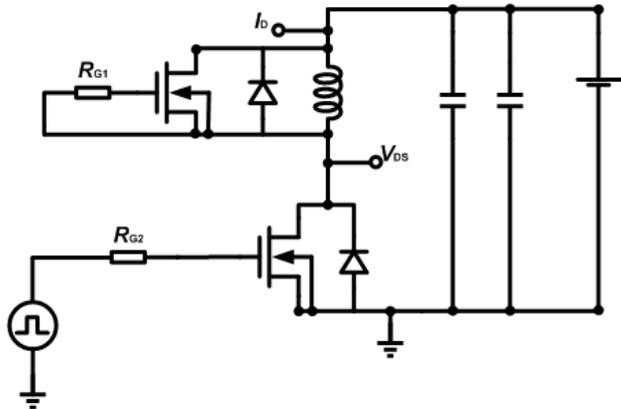
2) Switch time test circuit
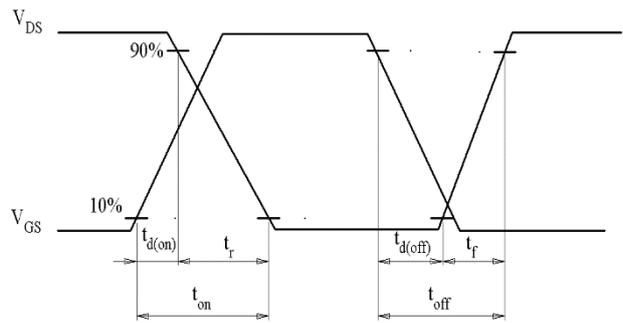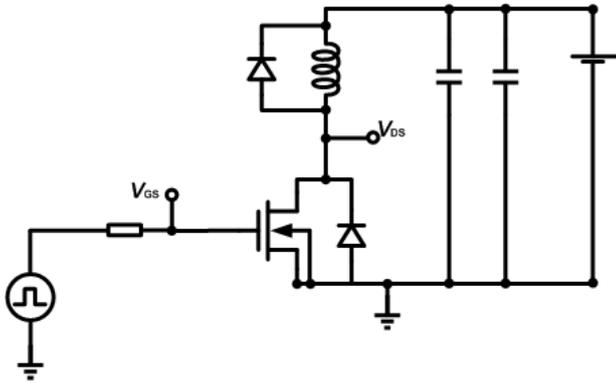
3) Unclaimed inductive switching test circuit & waveforms
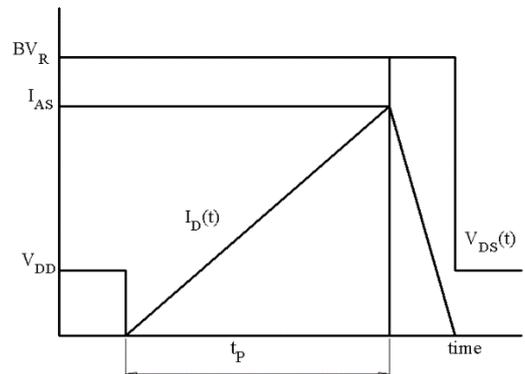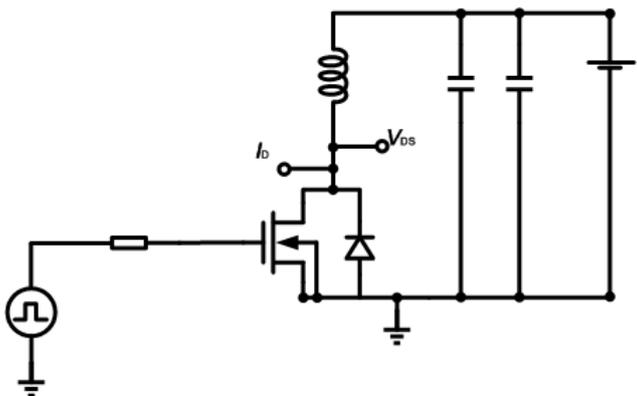
6.Package outline dimensions
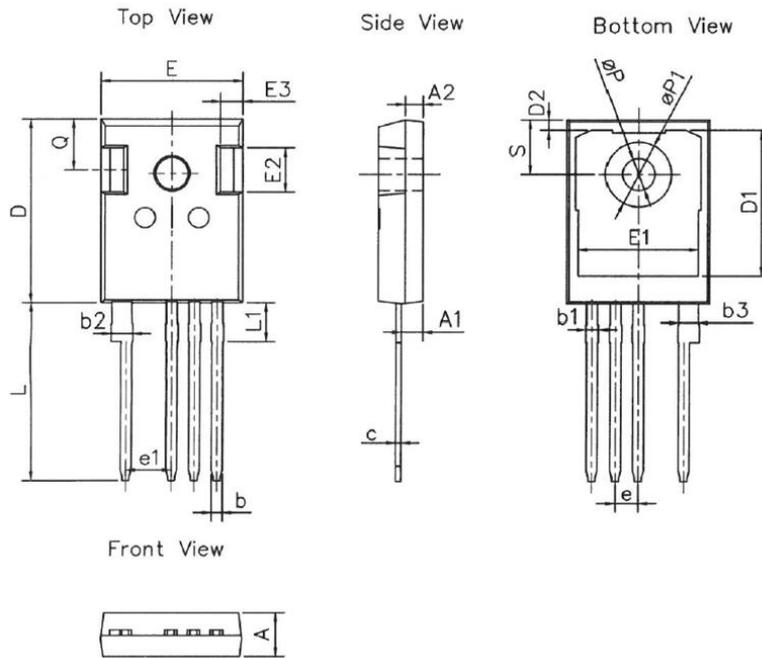
Dimension unit:[mm]			
SYMBOL	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.61
A2	1.85	2.00	2.15
b	1.11	1.21	1.36
b1	1.11	1.37	1.57
b2	2.24	2.40	2.60
b3	2.11	2.21	2.36
c	0.51	0.60	0.75
D	20.70	20.90	21.30
D1	15.92	16.22	16.52
D2	1.00	1.20	1.35
E	15.50	15.80	16.10
E1	13.00	13.30	13.60
E2	4.80	5.00	5.20
E3	2.30	2.50	2.70
e	2.54 BSC		
e1	5.08 BSC		
L	19.62	19.92	20.22
L1	–	–	4.30
øP	3.40	3.60	3.80
øP1	–	–	7.30
Q	5.40	5.80	6.20
S	6.20 BSC		

7.Revision History

Revision	Description	Date
1.0	Initial version	2023/12/15

IMPORTANT NOTICE

For further information on applications, products and technologies, please contact LXP SEMI office.