

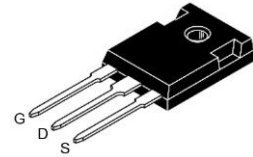
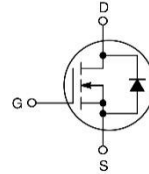
40mΩ, 1200V, Silicon Carbide N-Channel Power MOSFET

Description

The LXP SEMI LX1C040N120BW silicon carbide Power MOSFET device has been developed using LXP’s advanced and innovative 1st 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. $R_{DS(on)} = 40m\Omega @ V_{GS} = 18V$
- High speed switching performances
- Low Switching Losses
- 100% Avalanche Tested
- EMI Improved Design
- Very fast and robust intrinsic body diode



TO-247-3

Applications

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



Key performance

Parameter	Value	Unit
$V_{DS}(T_J=25^\circ C)$	1200	V
$R_{DS(on)}$, typ($T_J=25^\circ C$, $I_D=24A$, $V_{GS}=18V$)	40	mΩ
$I_D(T_J=25^\circ C)$	59	A
$T_{j, max}$	175	°C

Package Feature

Order code	Marking	Package	Packing
LX1C040N120BW	LX1C040N120B	TO-247-3PIN	Tube



1. Maximum Ratings ($T_J=25^{\circ}\text{C}$ 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 ($t_p < 1\mu\text{s}$, $t \leq 10$ hours)	V_{GSS}	-11/+25	V
Continuous Drain Current	I_D	$T_C = 25^{\circ}\text{C}$	59
		$T_C = 100^{\circ}\text{C}$	42
Pulsed Drain Current (Note 2)	I_{DM}	195	A
Avalanche Energy, Single Pulse (Note 3)	E_{AS}	312	mJ
Avalanche Current, Repetitive (Note 2)	I_{AR}	25	A
Continuous Diode Forward Current	I_S	59	A
Power Dissipation	P_{tot}	357	W
Operating Temperature/ Storage Temperature	T_J	-55~175	$^{\circ}\text{C}$

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. $L = 1\text{mH}$, $I_{AS} = 25\text{A}$, $V_{DD} = 120\text{V}$, $V_{GS} = 18\text{V}$, $R_g = 25\Omega$, Starting $T_J = 25^{\circ}\text{C}$

2. Thermal characteristics

Parameter	Symbol	Value	Unit
Thermal resistance, junction-to-case	R_{thJC}	0.42	$^{\circ}\text{C/W}$
Thermal resistance, junction-to-ambient	R_{thJA}	45	$^{\circ}\text{C/W}$



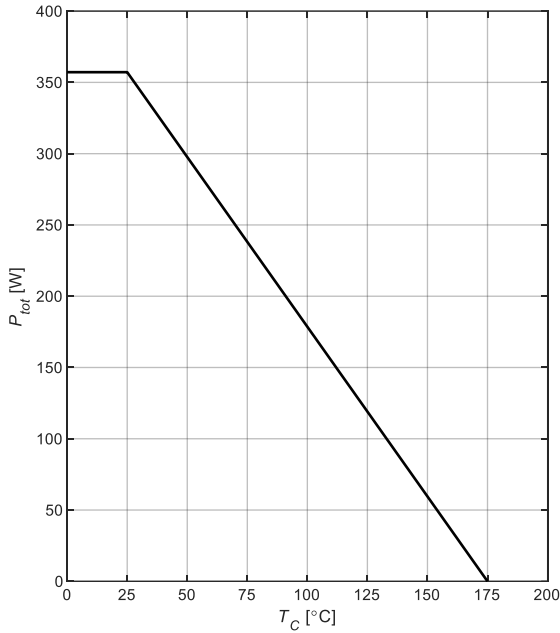
3.Electrical Characteristics ($T_j=25^{\circ}\text{C}$ unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit	
Statistic Characteristics							
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS} = 0\text{ V}, I_D = 100\ \mu\text{A}$	1200	1500		V	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$		1	10	μA	
Gate-Source Leakage Current	I_{GSSF}	$V_{GS} = 22\text{ V}, V_{DS} = 0\text{ V}$			100	nA	
	I_{GSSR}	$V_{GS} = -10\text{ V}, V_{DS} = 0\text{ V}$			-100	nA	
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 10\text{ mA}$	2.1	2.8	3.5	V	
Static Drain-Source On-Resistance	$R_{DS(on)}$	$V_{GS} = 18\text{ V}, I_D = 24\text{ A}$		40	50	m Ω	
		$V_{GS} = 18\text{ V}, I_D = 24\text{ A}, T_j = 150^{\circ}\text{C}$		55			
		$V_{GS} = 18\text{ V}, I_D = 24\text{ A}, T_j = 175^{\circ}\text{C}$		60			
		$V_{GS} = 15\text{ V}, I_D = 24\text{ A}$		55	70		
		$V_{GS} = 15\text{ V}, I_D = 24\text{ A}, T_j = 150^{\circ}\text{C}$		65			
		$V_{GS} = 15\text{ V}, I_D = 24\text{ A}, T_j = 175^{\circ}\text{C}$		70			
Gate Resistance	R_G	$f = 1\text{ MHz}, \text{ open drain}$		3		Ω	
Dynamic Characteristics							
Input Capacitance	C_{ISS}	$V_{GS} = 0\text{ V}$		3250		pF	
Output Capacitance	C_{OSS}	$V_{DS} = 800\text{ V}$		120			
Reverse Transfer Capacitance	C_{RSS}	$f = 1\text{ MHz}$		9			
Gate to Source Charge	Q_{gs}	$V_{DS} = 800\text{ V}$		53		nC	
Gate to Drain Charge	Q_{gd}	$V_{GS} = -5\text{ to }18\text{ V}$		27			
Gate Charge Total	Q_g	$I_D = 24\text{ A}$		128			
Switching Characteristics							
Turn-on delay time	$T_{d(on)}$	$V_{DD} = 800\text{ V}, I_D = 24\text{ A},$ $R_G = 2.4\ \Omega, V_{GS} = -5/+18\text{ V}$		20		ns	
Rise time	T_r			25			
Turn-off delay time	$T_{d(off)}$			30			
Fall time	T_f			12			
Turn-on switching energy	E_{on}				275		μJ
Turn-off switching energy	E_{off}				60		
Reverse Diode Characteristics							
Diode Forward Voltage	V_{SD}	$V_{GS} = -5\text{ V}, I_{SD} = 24\text{ A}$		3.6		V	
		$V_{GS} = -5\text{ V}, I_{SD} = 24\text{ A}, T_j = 175^{\circ}\text{C}$		3.3			
Reverse Recovery Time	t_{rr}	$V_R = 800\text{ V}, I_F = 24\text{ A},$ $di/dt = 1000\text{ A}/\mu\text{s}$		23		ns	
Reverse Recovery Charge	Q_{rr}			130		nC	
Peak Reverse Recovery Current	I_{rrm}			12		A	



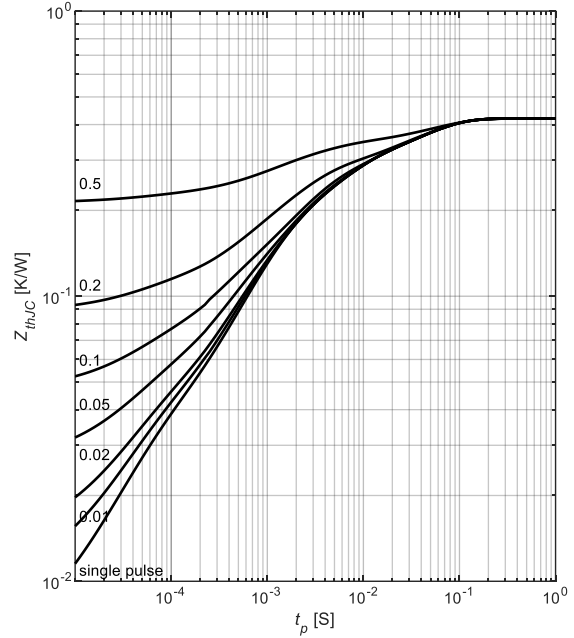
4. Electrical characteristic curves

Figure 1: Power dissipation



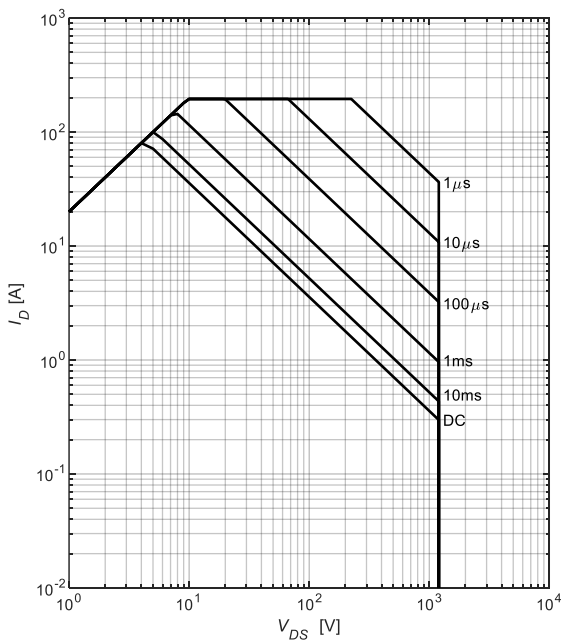
$P_{tot}=f(T_c)$

Figure 2: Transient thermal impedance



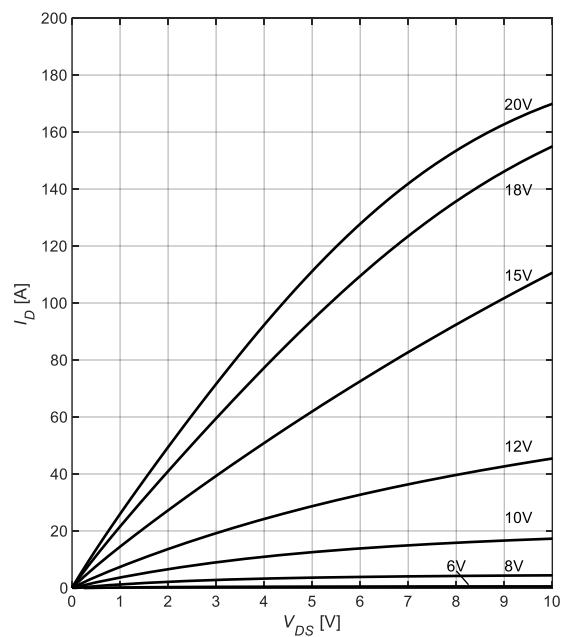
$Z_{(th)JC}=f(t_p)$; parameter: $D=t_p/T$

Figure 3: Safe operating area



$I_D=f(V_{DS})$; $T_c=25^\circ\text{C}$; $V_{GS}>7.5\text{V}$; parameter t_p

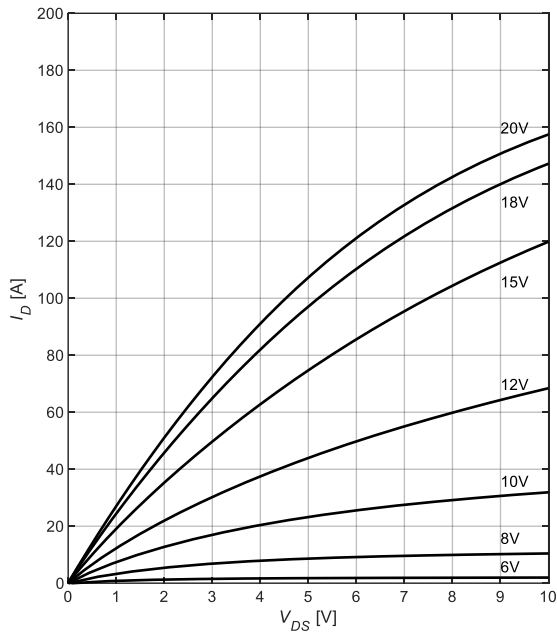
Figure 4: Typ. output characteristics



$I_D=f(V_{DS})$; $T_j=-55^\circ\text{C}$; parameter: V_{GS}

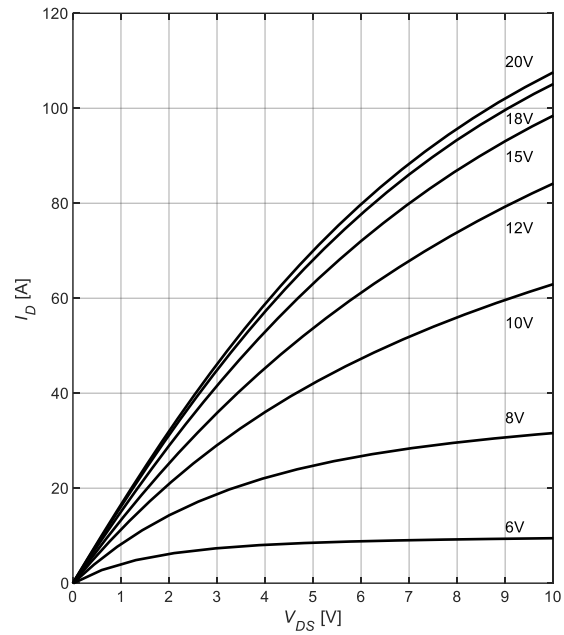


Figure 5: Typ. output characteristics



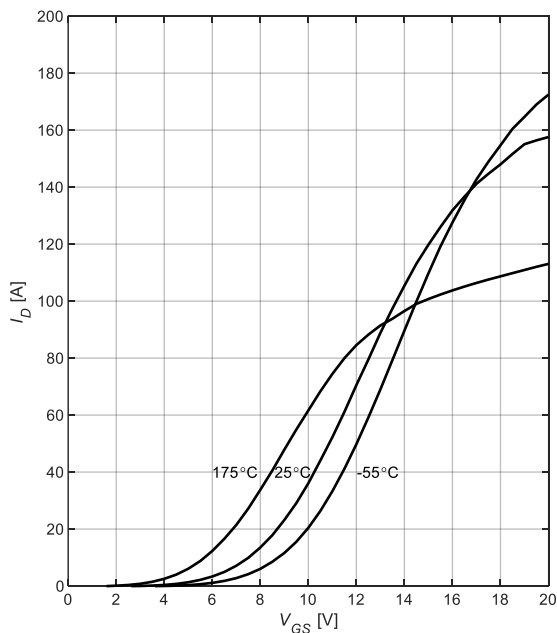
$I_D=f(V_{DS}); T_j=25^{\circ}\text{C};$ parameter: V_{GS}

Figure 6: Typ. output characteristics



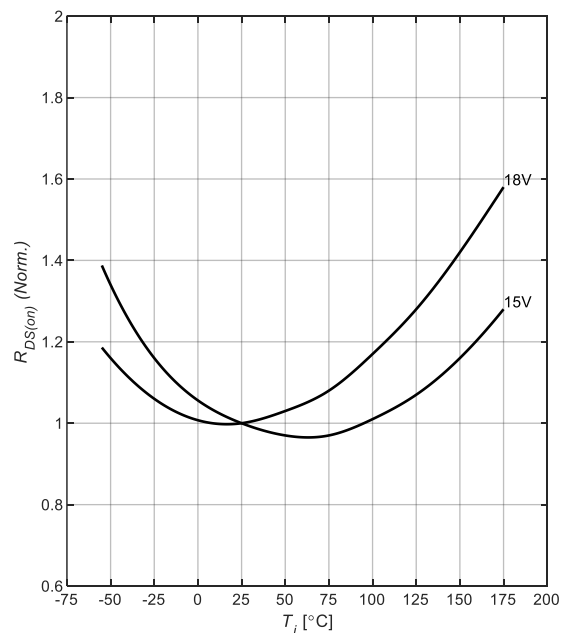
$I_D=f(V_{DS}); T_j=175^{\circ}\text{C};$ parameter: V_{GS}

Figure 7: Typ. transfer characteristics



$I_D=f(V_{GS}); V_{DS}=10\text{V};$ parameter: T_j

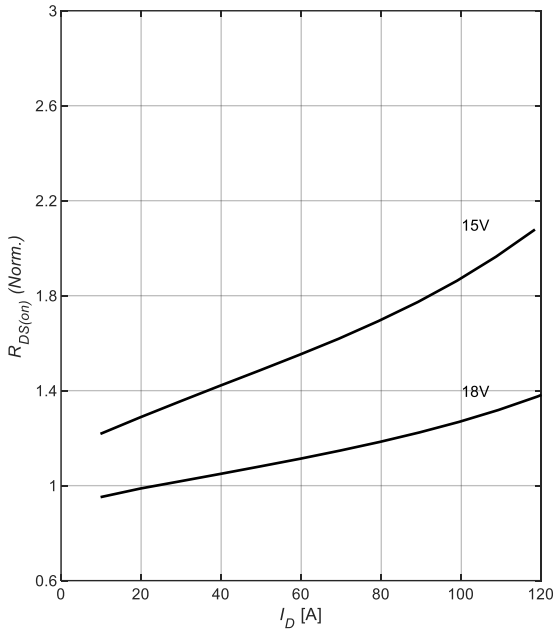
Figure 8: Norm. Drain-Source On-State Resistance



$R_{DS(on)}=f(T_j); I_D=24\text{A};$ parameter: V_{GS}

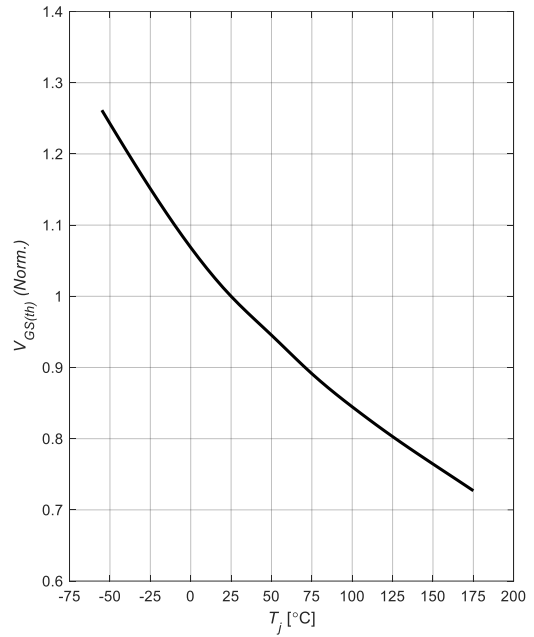


Figure 9: Norm. Drain-Source On-State Resistance



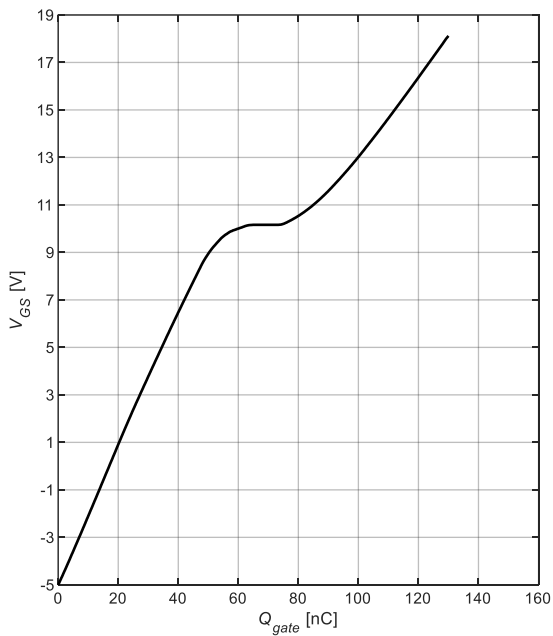
$R_{DS(on)}=f(I_D)$; $T_j=25^\circ\text{C}$; parameter: V_{GS}

Figure 10: Norm. gate threshold voltage



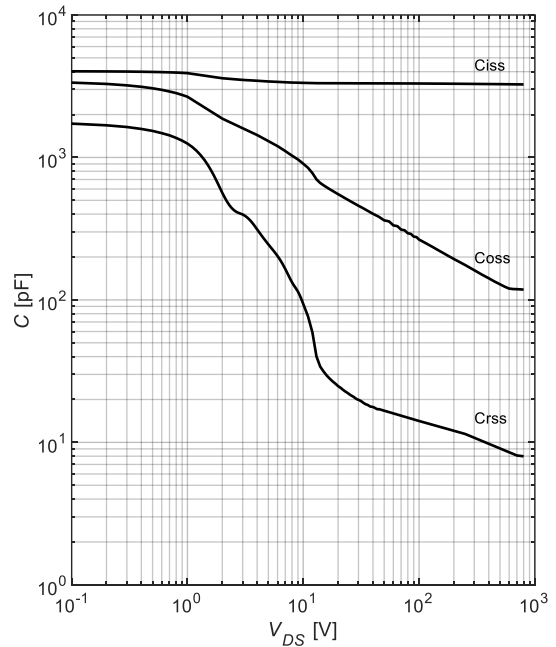
$V_{GS(th)}=f(T_j)$; $V_{DS}=V_{GS}$, $I_D=10\text{mA}$

Figure 11: Typ. gate charge



$V_{GS}=f(Q_{gate})$, $V_{DS}=800\text{V}$, $I_D=24\text{A}$ pulsed

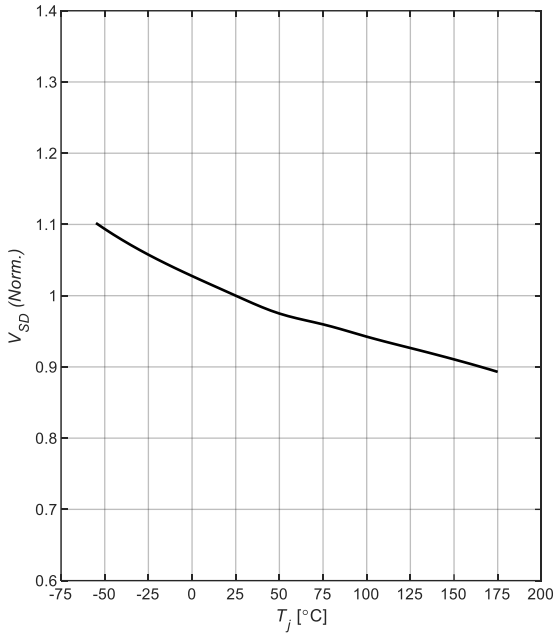
Figure 12: Typ. capacitances



$C=f(V_{DS})$; $V_{GS}=0$; $f=1\text{MHz}$

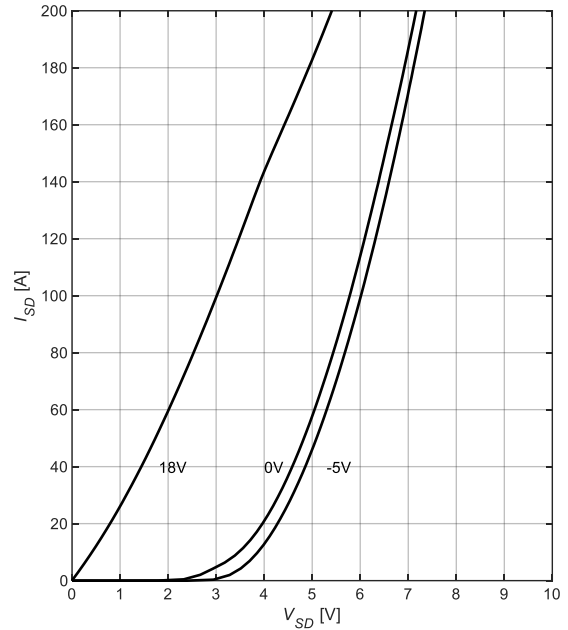


Figure 13: Norm. reverse diode forward voltage



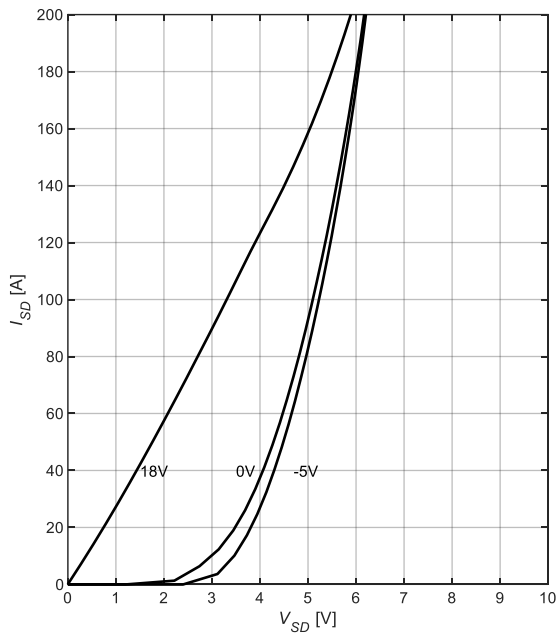
$V_{SD}=f(T_j)$; $I_{SD}=24A$; $V_{GS}=-5V$

Figure 14: Typ. reverse conduction characteristics



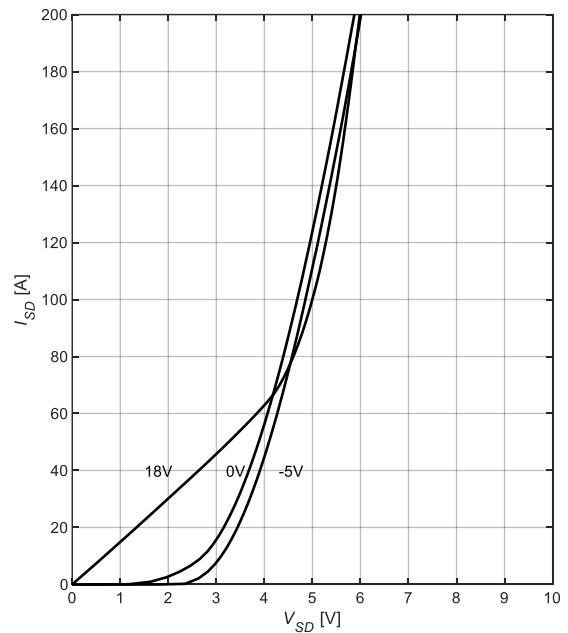
$I_{SD}=f(V_{SD})$; $T_j=-55^{\circ}C$; parameter: V_{GS}

Figure 15: Typ. reverse conduction characteristics



$I_{SD}=f(V_{SD})$; $T_j=25^{\circ}C$; parameter: V_{GS}

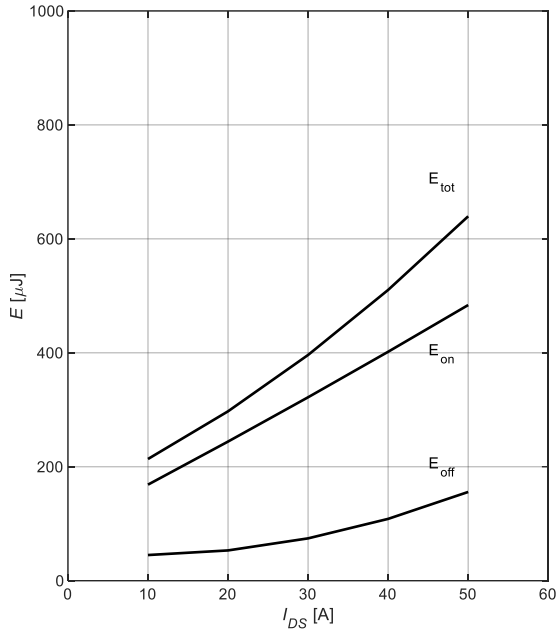
Figure 16: Typ. reverse conduction characteristics



$I_{SD}=f(V_{SD})$; $T_j=175^{\circ}C$; parameter: V_{GS}

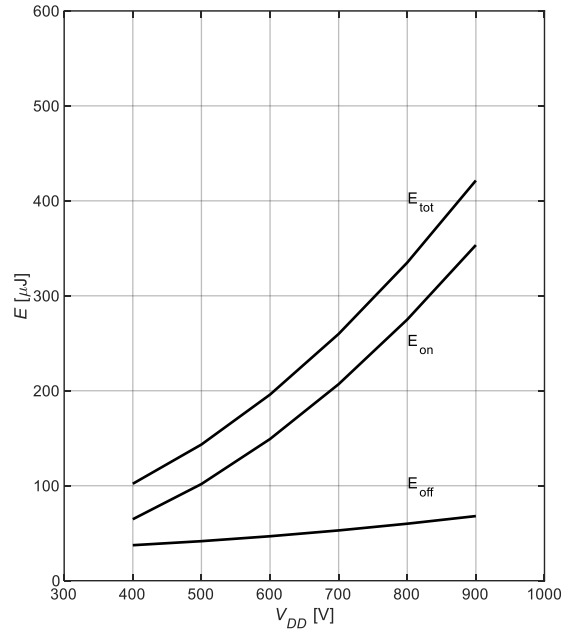


Figure 17: Typ. switching energy losses



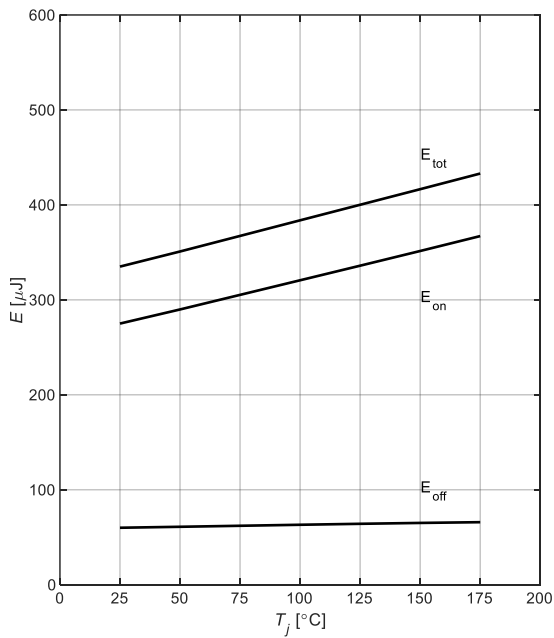
$E=f(I_{DS}); V_{DD}=800V; V_{GS}=-5/+18V; R_G=2.4\Omega; T_j=25^\circ C$

Figure 18: Typ. switching energy losses



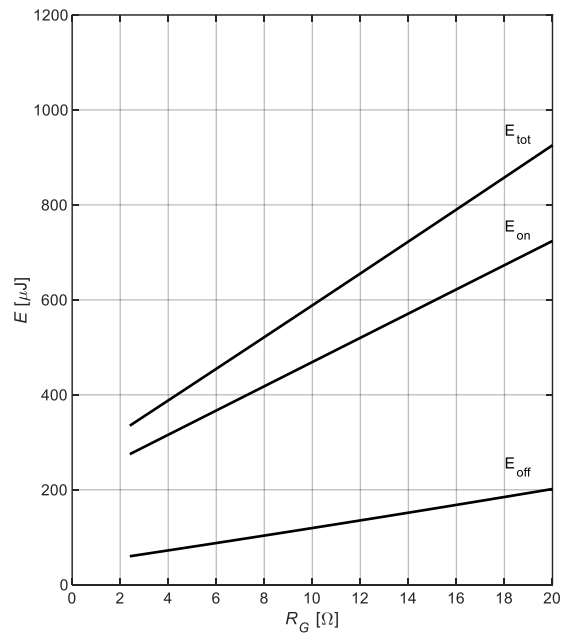
$E=f(V_{DD}); V_{GS}=-5/+18V; R_G=2.4\Omega; I_D=24A$

Figure 19: Typ. switching energy losses



$E=f(T_j); V_{DD}=800V; V_{GS}=-5/+18V; R_G=2.4\Omega; I_D=24A$

Figure 20: Typ. switching energy losses

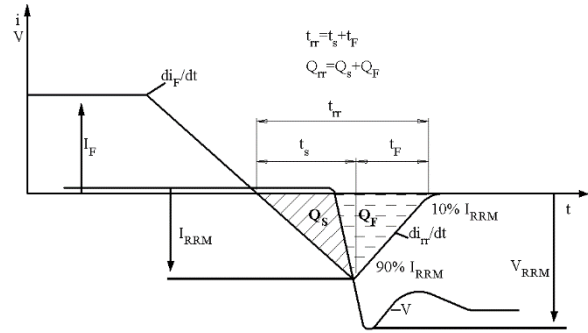
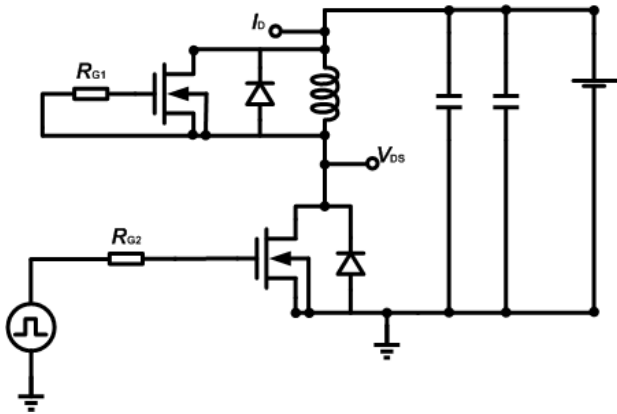


$E=f(R_G); V_{DD}=800V; V_{GS}=-5/+18V; I_D=24A$

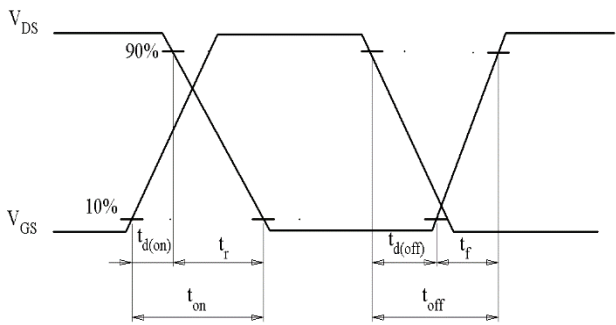
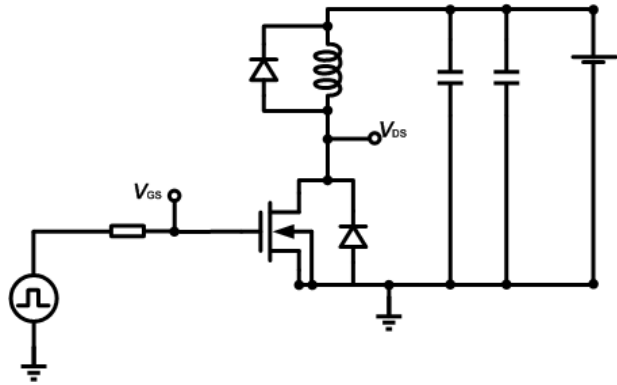


5. Test Circuits

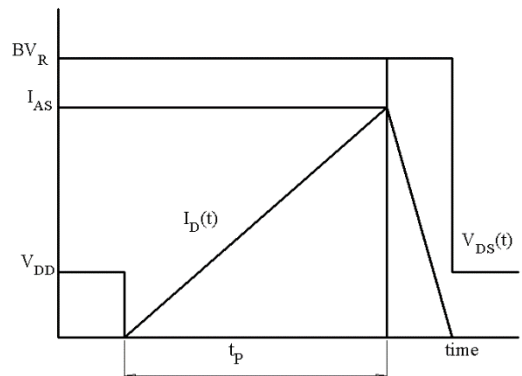
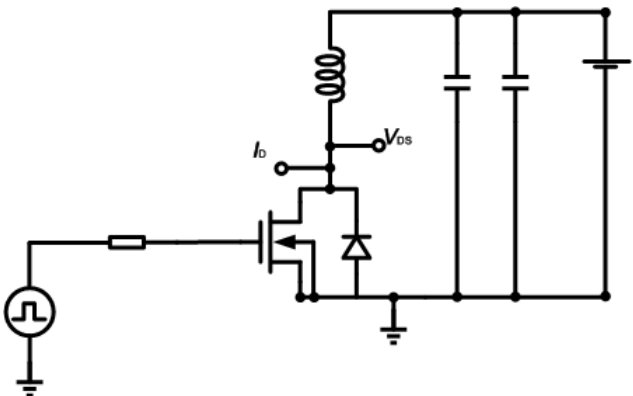
1) Test circuit and waveform for diode characteristics



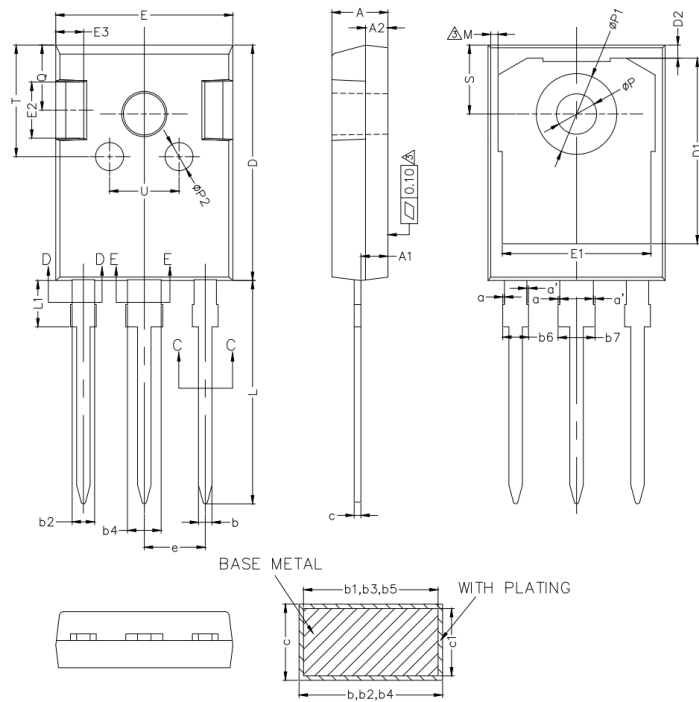
2) Switch time test circuit



3) Unclaimed inductive switching test circuit & waveforms



6.Package outline dimensions



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
a	0	—	0.15
a'	0	—	0.15
b	1.16	—	1.26
b1	1.15	1.2	1.22
b2	1.96	—	2.06
b3	1.95	2.00	2.02
b4	2.96	—	3.06
b5	2.95	3.00	3.02
b6	—	—	2.25
b7	—	—	3.25
c	0.59	—	0.66
c1	0.58	0.60	0.62
D	20.90	21.00	21.10
D1	16.25	16.55	16.85
D2	1.05	1.20	1.35
E	15.70	15.80	15.90
E1	13.10	13.30	13.50
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	5.34	5.44	5.54
L	19.80	19.92	20.10
L1	3.95	4.13	4.30
M	0.35	—	0.95
P	3.50	3.60	3.70
P1	7.00	—	7.40
P2	2.40	2.50	2.60
Q	5.60	—	6.00
S	6.05	6.15	6.25
T	9.80	—	10.20
U	6.00	—	6.40



7.Revision History

Revision	Description	Date
1.0	Initial version	2023/12/06

IMPORTANT NOTICE

LXP SEMI reserves the right to make changes without further notice to any products or specifications herein. You are solely responsible for your use of LXP SEMI's products and applications, and for the safety thereof. You shall comply with all laws, regulations and requirements related to LXP SEMI's products and applications, although information or support related to any application may still be provided by LXP SEMI.

The resources are intended only for skilled developers designing with LXP SEMI's products. LXP SEMI reserves the rights to make corrections, modifications, enhancements, improvements or other changes to the products and services provided. LXP SEMI authorizes you to use these resources exclusively for the development of relevant applications designed to integrate LXP SEMI's products. Using these resources for any other purpose, or any unauthorized reproduction or display of these resources is strictly prohibited. LXP SEMI shall not be liable for any claims, damages, costs, losses or liabilities arising out of the use of these resources.

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

Shanghai Lanxin Power Semiconductor Co., Ltd
Room 302, Building 1, No.515 HuanKe Road, Pudong New Area, Shanghai
Tel1: 13341860056
Tel2: 19921018496