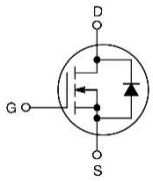
40mΩ, 650V, Super Junction N-Channel Power MOSFET

Description

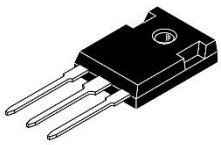
The LXP SEMI LX1S040N065NB is a high voltage power MOSFET, fabricated using advanced super junction technology. The resulting device has extremely low on resistance, low gate charge and fast switching time, making it especially suitable for applications which require superior power density and outstanding efficiency.

The LX1S040N065NB break down voltage is 650V and it has a high rugged avalanche characteristic. The LX1S040N065NB is available in TO-247-3 package.

Key Features



- Ultra Low $R_{DS(on)}$ =33mΩ @ V_{GS} = 10V.
- Low Gate Charge, Q_g=170nC typ.
- Fast switching capability
- Robust design with better EAS performance
- EMI Improved
- Fast-Recovery Body Diode



TO-247-3

Applications

- Telecom Power
- EV Charger
- LED Lighting

Key performance

Parameter	Value	Unit
$V_{DS(Tj=25°C)}$	650	V
$R_{DS(on),\ max(Tj=25°C)}$	40	mΩ
$R_{DS(on),\ typic(Tj=25°C,\ ID=35\ A)}$	33	mΩ
$I_{D(Tj=25°C)}$	70	A
$Q_{g,\ typic}$	170	nC
$Q_{rr,\ typic}$	3.3	μC
$t_{rr,\ typic}$	200	ns
$T_{j,\ max}$	150	°C

Package Feature

Order code	Marking	Package	Packing
LX1S040N065NB	**LX1S040N065NB-W**	**TO-247-3PIN**	**Tube**

1.Maximum Ratings (Tj=25°C unless otherwise specified)

Parameter		Symbol	Rating	Unit
Drain-Source Voltage		V_{DSS}	650	V
Gate-Source Voltage		V_{GSS}	±30	V
Continuous Drain Current	T_C=25ºC	I_D	70	A
	T_C=100ºC		45	
Pulsed Drain Current (Note 2)		I_{DM}	210	A
Avalanche Energy, Single Pulse (Note 3)		E_{AS}	2170	mJ
Avalanche Energy, Repetitive (Note 2)		E_{AR}	3.3	mJ
Avalanche Current, Repetitive (Note 2)		I_{AR}	13.8	A
Continuous Diode Forward Current		I_S	70	A
Diode Pulse Current		$I_{S.pulse}$	210	A
MOSFET dv/dt Ruggedness, V_{DS}≤400V		dv/dt	80	V/ns
Reverse diode dv/dt Ruggedness, V_{DS}≤400V		dv/dt	50	V/ns
Power Dissipation (TO247 Package)		P_{tot}	500	W
Operating Temperature/ Storage Temperature		T_J	-55~150	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. I_{AS} = 13.8A, V_{DD} = 50V, R_g = 25Ω, Starting T_J = 25°C

2.Thermal characteristics (TO247 Package)

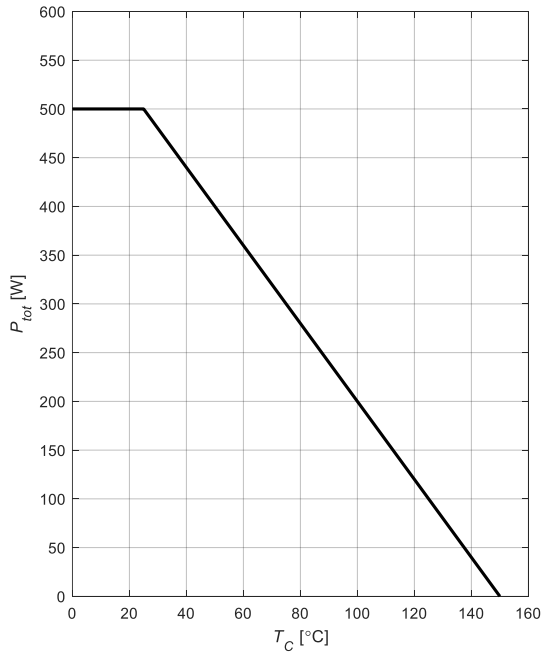
Parameter	Symbol	Max. Value	Unit
Thermal resistance, junction-to-case	R_{thJC}	0.25	°C/W
Thermal resistance, junction-to-ambient	R_{thJA}	62	°C/W

3.Electrical Characteristics (T_{vj}=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 = 250 μA	650			V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 650 V, V_{GS} = 0 V			10	μA
Gate-Source Leakage Current	I_{GSSF}	V_{GS} = 20 V, V_{DS} = 0 V			100	nA
	I_{GSSR}	V_{GS} = -20 V, V_{DS} = 0 V			-100	nA
Gate Threshold Voltage	$V_{GS(TH)}$	V_{DS} = V_{GS}, I_D = 3 mA	3.8	4.3	4.8	V
Static Drain-Source On-Resistance	$R_{DS(on)}$	V_{GS} = 10 V, I_D = 35 A		33	40	mΩ
		V_{GS} = 10 V, I_D = 35 A T_j =125 ºC		71		
Gate Resistance	R_G	f = 1 MHz，open drain		3.0		Ω
Dynamic Characteristics						
Input Capacitance	C_{ISS}	V_{GS} = 0 V V_{DS} = 100 V f = 1 MHz		8400		pF
Output Capacitance	C_{OSS}			280		
Reverse Transfer Capacitance	C_{RSS}			2		
Gate to Source Charge	Q_{gs}	V_{DS} = 520V V_{GS} = 0 to 10 V I_D = 35A		50		nC
Gate to Drain Charge	Q_{gd}			60		
Gate Charge Total	Q_g			170		
Switching Characteristics						
Turn-on delay time	$T_{d(on)}$	V_{DD} = 400 V, I_D = 35 A, R_G =10Ω, V_{GS} = 0/10 V		304		ns
Rise time	T_r			37		
Turn-off delay time	$T_{d(off)}$			364		
Fall time	T_f			13		
Turn-on switching energy	E_{on}			2.2		mJ
Turn-off switching energy	E_{off}			1.0		
Reverse Diode Characteristics						
Drain-Source Diode Forward Voltage	V_{SD}	V_{GS} = 0 V, I_{SD} = 35 A		0.9		V
		V_{GS} = 0 V, I_{SD} = 35 A T_j=125 ºC		0.8		
Reverse Recovery Time	t_{rr}	V_R = 400 V, I_F = 35 A, di/dt =150A/μs		200		ns
Reverse Recovery Charge	Q_{rr}			3.3		μC
Peak Reverse Recovery Current	I_{rrm}			28		A

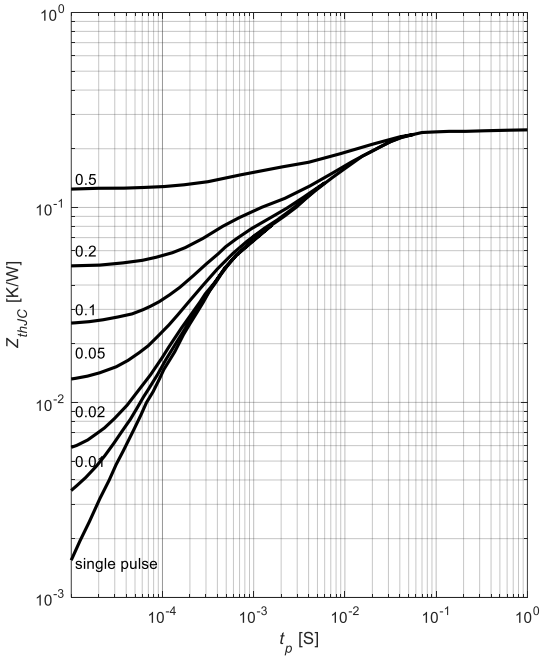
4.Electrical characteristic curves

Figure 1: Power dissipation (TO247 Package)



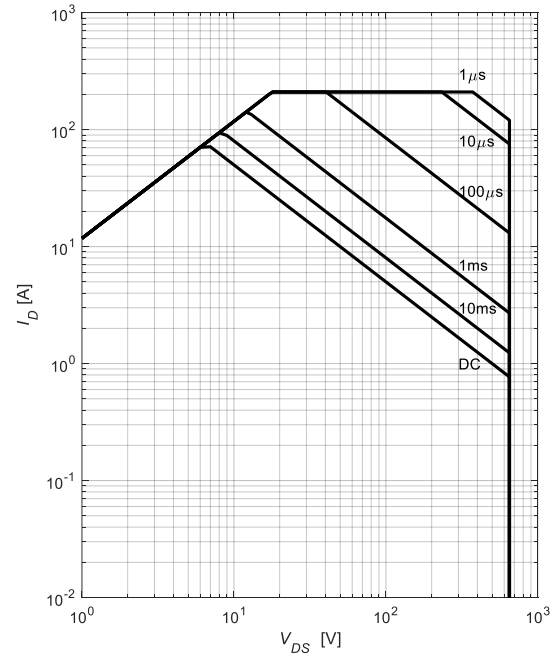
$P_{tot}=f(T_c)$

Figure 2: Max: transient thermal impedance



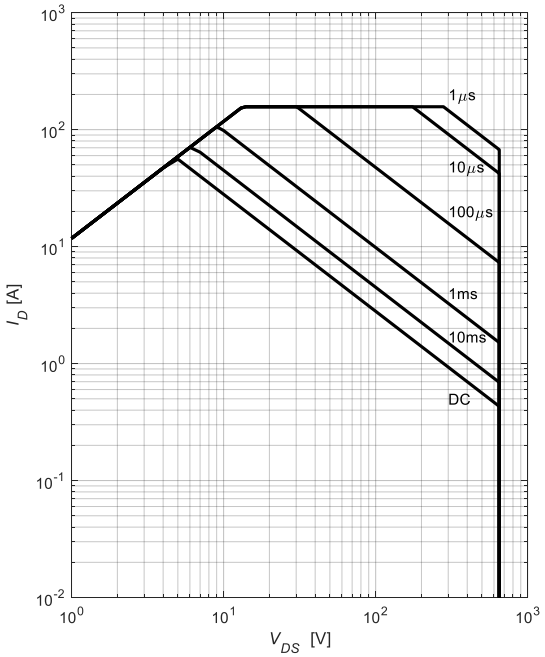
$Z(_{thJC})=f(t_p)$; parameter: $D=t_p/T$

Figure 3: Safe operating area



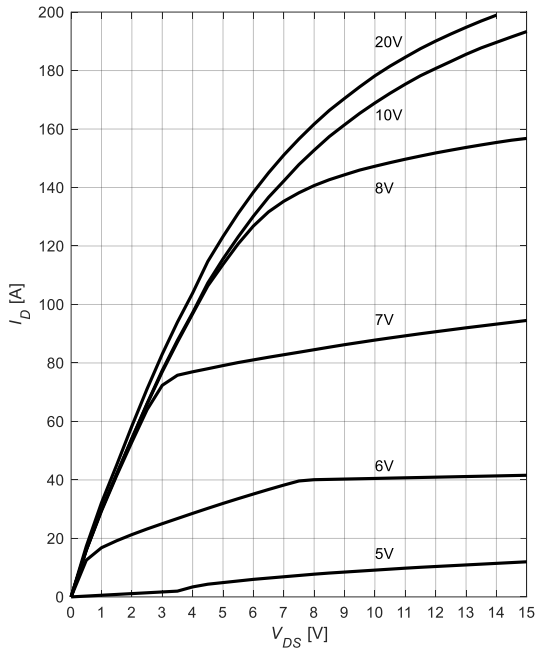
$I_D=f(V_{DS})$; $T_c=25℃$; $V_{GS}>7.5V$; parameter t_p

Figure 4: Safe operating area



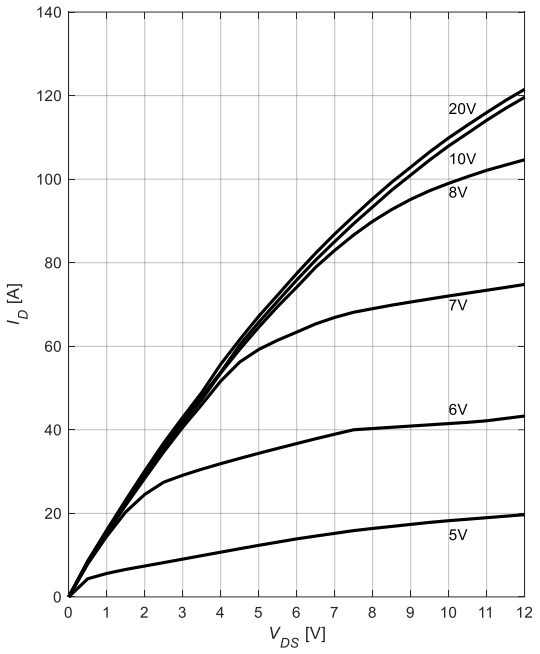
$I_D=f(V_{DS})$; $T_c=80℃$; $V_{GS}>7.5V$; parameter t_p

Figure 5: Typ. output characteristics



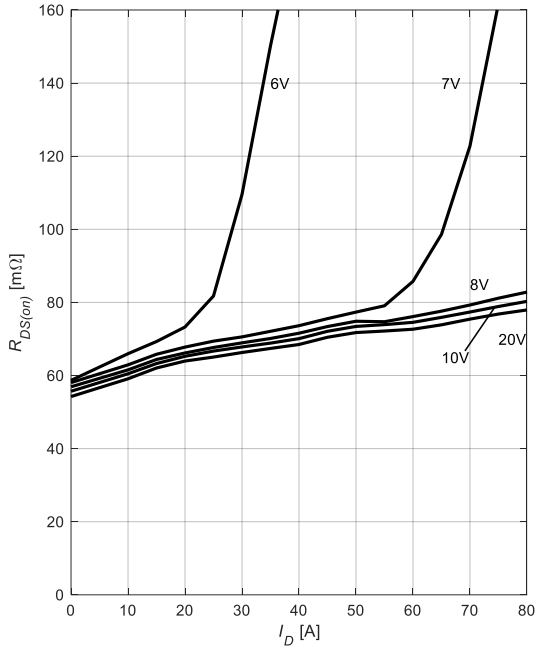
$I_D=f(V_{DS})$; $T_j=25℃$; parameter: V_{GS}

Figure 6: Typ. output characteristics



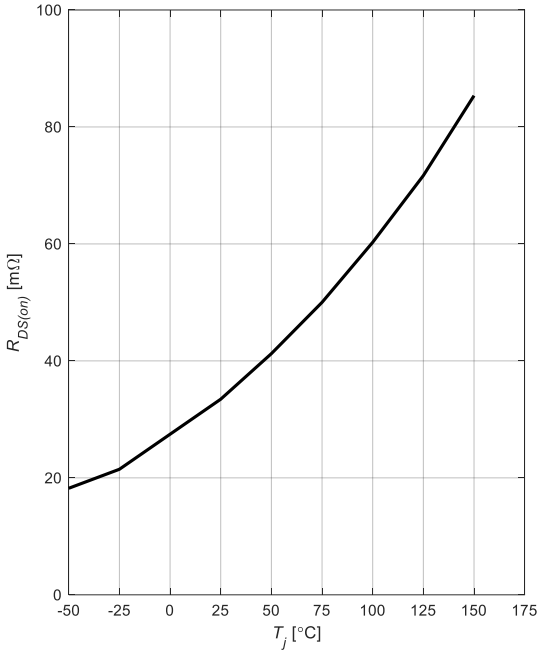
$I_D=f(V_{DS})$; $T_j=125℃$; parameter: V_{GS}

Figure 7: Typ. Drain-Source On-State Resistance



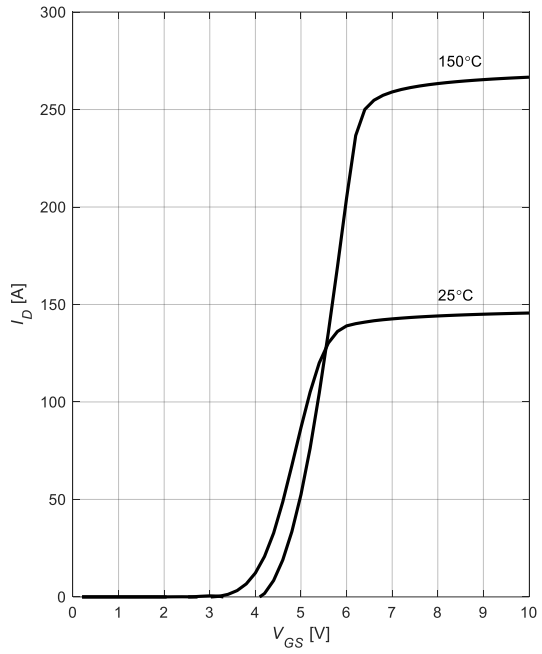
$R_{DS(on)}=f(I_D)$; $T_j=125℃$; parameter: V_{GS}

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



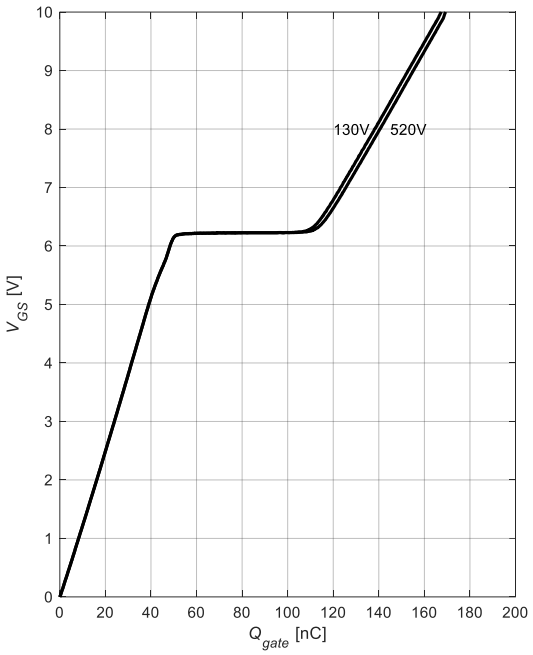
$R_{DS(on)}=f(T_j)$; $I_D=35A$; $V_{GS}=10V$

Figure 9: Typ. transfer characteristics



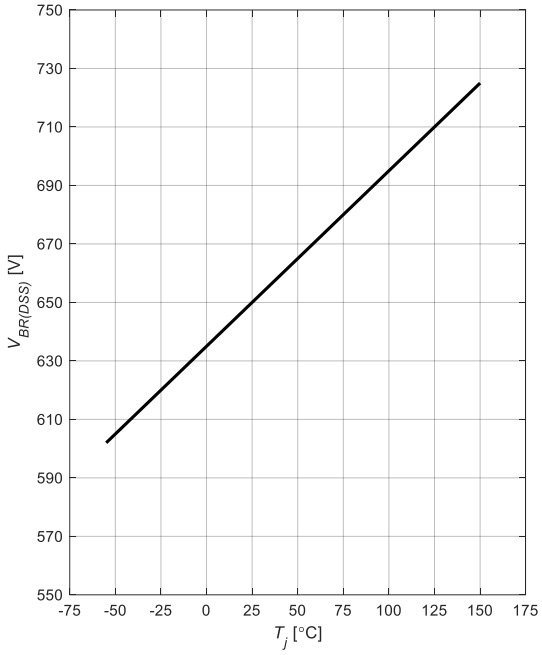
$I_D=f(V_{GS})$; $V_{DS}=20V$

Figure 10: Typ. gate charge



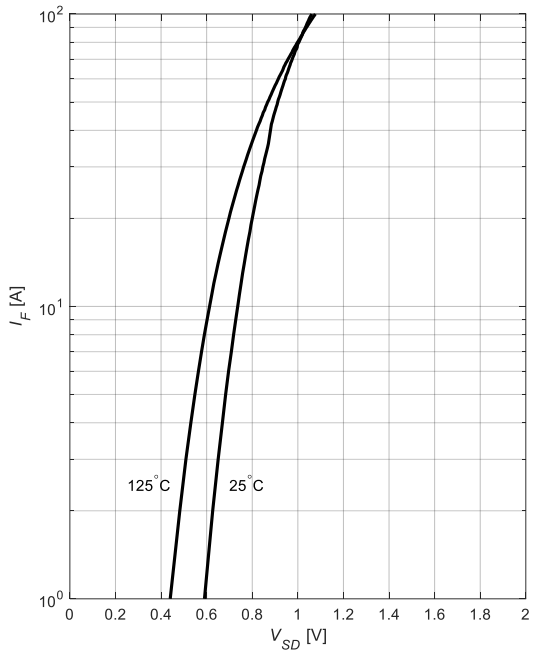
$V_{GS}=f(Q_{gate})$, $I_D=35A$ pulsed

Figure 11: Drain-source breakdown voltage



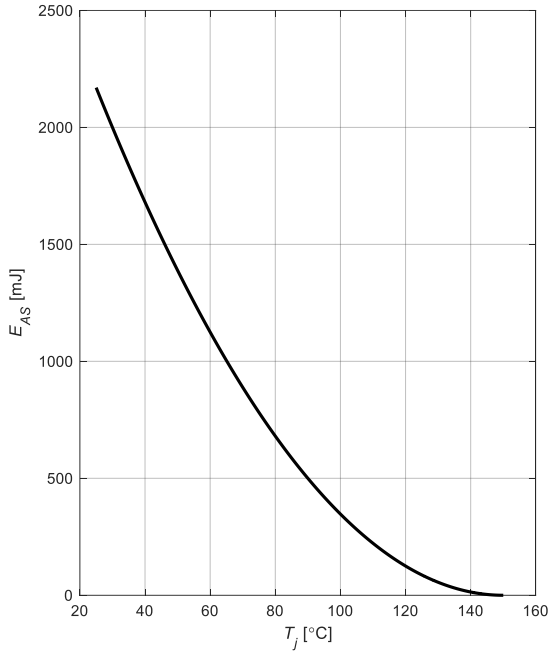
$V_{BR(DSS)}=f(T_j)$; $I_D=1mA$

Figure 12: Forward characteristics of reverse diode



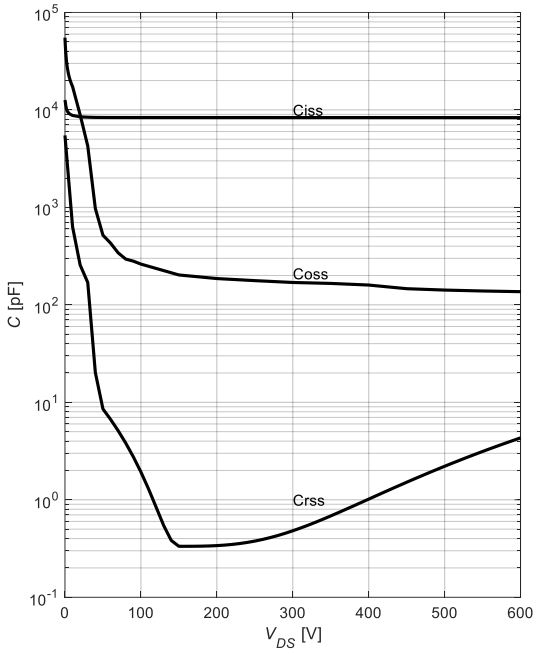
$I_F=f(V_{SD})$; parameter: T_j

Figure 13: Avalanche energy



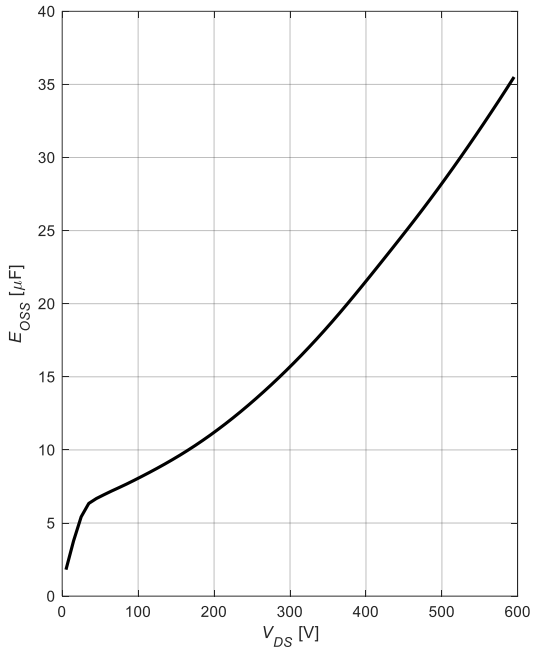
$E_{AS}=f(T_j)$; I_D=13.8A; V_{DD}=50V

Figure 14: Typ. capacitances



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

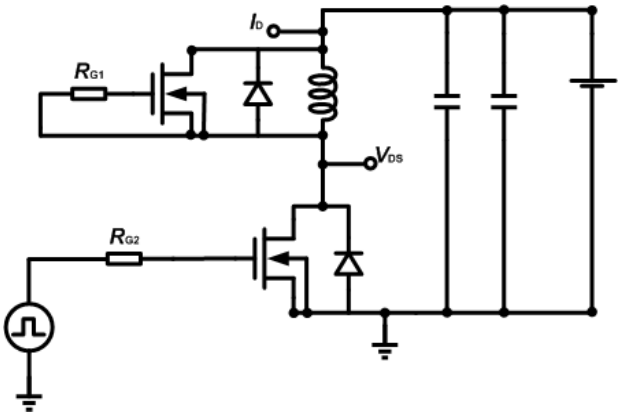
Figure 15: C_{OSS} stored energy

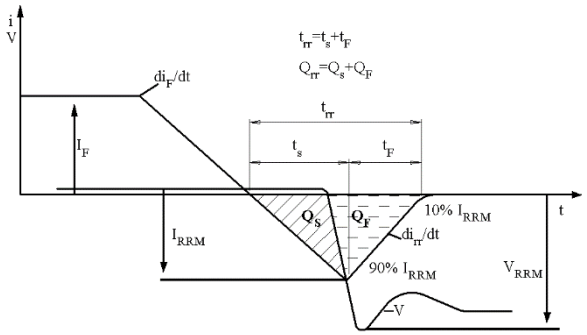


$E_{OSS}=f(V_{DS})$

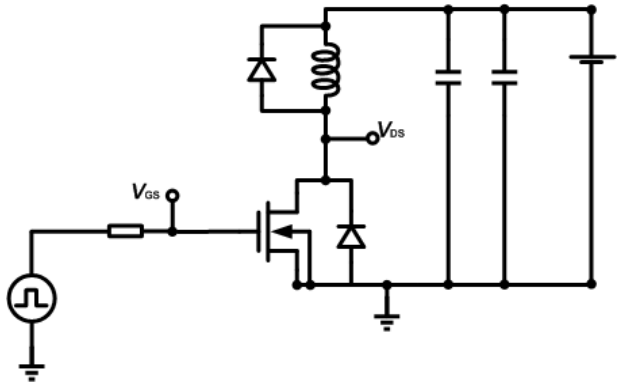
5.Test Circuits

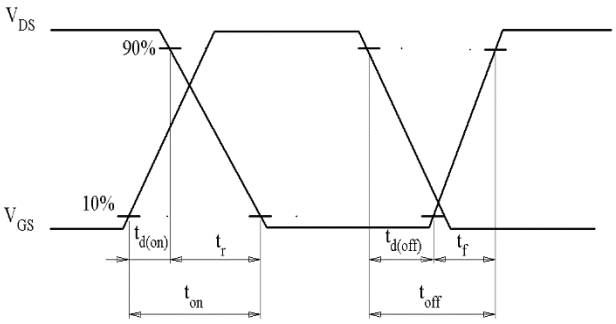
1) Test circuit and waveform for diode characteristics



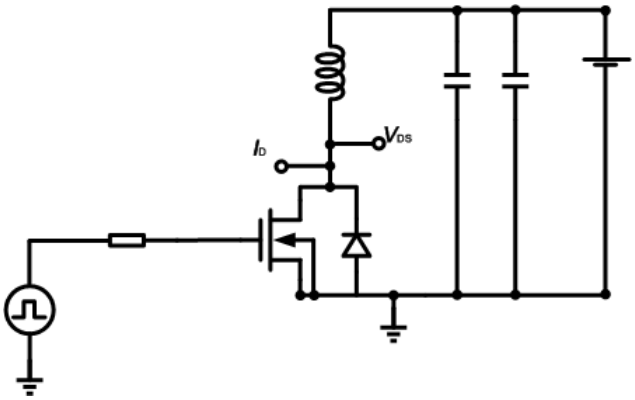


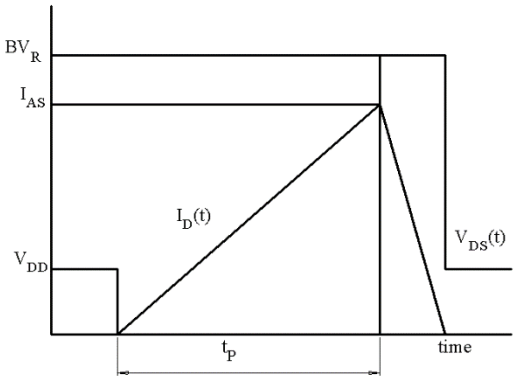
2) Switch time test circuit





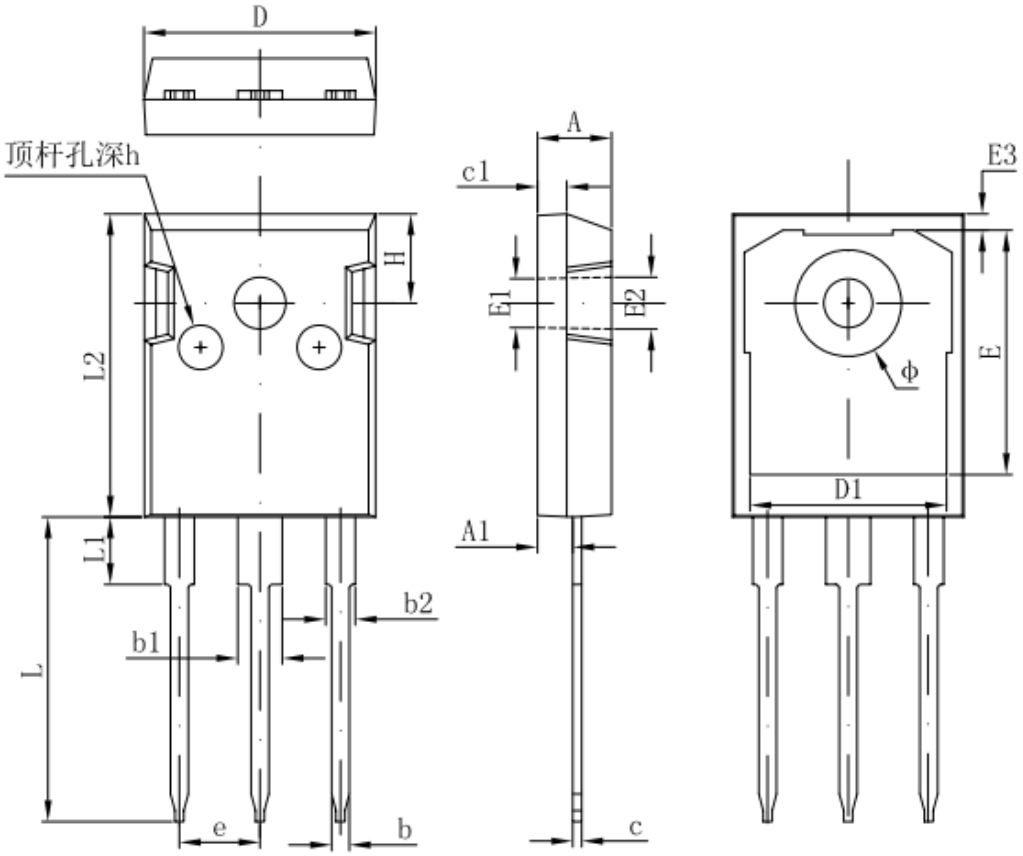
3) Unclaimed inductive switching test circuit & waveforms





6.Package outline dimensions

TO-247A PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	4.850	5.150	0.191	0.200
A1	2.200	2.600	0.087	0.102
b	1.000	1.400	0.039	0.055
b1	2.800	3.200	0.110	0.126
b2	1.800	2.200	0.071	0.087
c	0.500	0.700	0.020	0.028
c1	1.900	2.100	0.075	0.083
D	15.450	15.750	0.608	0.620
D1	13.110	13.410	0.516	0.528
E	16.400	16.700	0.646	0.657
E1	3.500 REF.		0.138 REF.	
E2	3.600 REF.		0.142 REF.	
E3	0.900	1.250	0.035	0.049
L	20.320	20.720	0.800	0.816
L1	4.300	4.700	0.169	0.185
L2	20.300	20.600	0.799	0.811
Φ	7.100	7.300	0.280	0.287
e	5.450 TYP.		0.215 TYP.	
H	5.980 REF.		0.235 REF.	
h	0.000	0.300	0.000	0.012

7.Revision History

Revision	Description	Date
1.0	Initial version	2023/07/14

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