

1.2mΩ, 40V, N-Channel Power MOSFET
SRT04N012L

General Description

The Sanrise SRT04N012L is a low voltage power MOSFET, fabricated using advanced split gate trench 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 synchronous rectification.

The SRT04N012L break down voltage is 40V and it has a high rugged avalanche characteristics. The SRT04N012L is available in PDFN5*6 package.

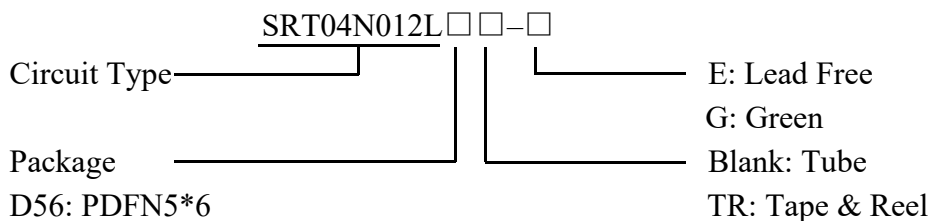
Features

- Ultra Low $R_{DS(ON_TYP)} = 1.05m\Omega @V_{GS} = 10V$.
- Ultra Low Gate Charge, $Q_g=105nC$ typ.
- Fast switching capability
- Robust design with better EAS performance
- EMI Improved
- Non-automotive Qualified

Application

- Server/Telecom
- DC/DC Converter
- High Power Supply
- E-Tools
- BMS

Ordering Information



Symbol

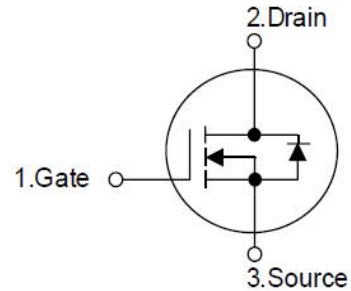


Figure 1 Symbol of SRT04N012L

Package Type

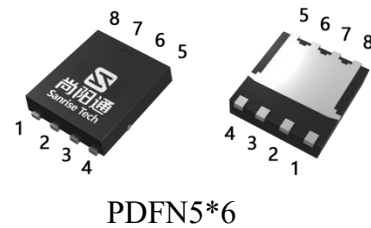


Figure 2 Package Type of SRT04N012L

Package	Part Number	Marking ID	Packing Type
PDFN5*6	SRT04N012LD56TR-G	SRT04N012LD56G	Tape & Reel

Absolute Maximum Ratings

Parameter		Symbol	Rating	Unit
Drain-Source Voltage		V_{DSS}	40	V
Gate-Source Voltage		V_{GSS}	±20	V
Continuous Drain Current, Silicon	$T_C=25^{\circ}C$	I_D	228	A
	$T_C=100^{\circ}C$		144	
Pulsed Drain Current (Note 3)		I_{DM}	912	A
Power Dissipation ($T_C = 25^{\circ}C$)		P_D	131	W
Avalanche Destructive Energy, Single Pulse (Note 5)		E_{AS_Limit}	625	mJ
Avalanche Energy, Single Pulse (Note 4)		E_{AS}	121	mJ
Avalanche Energy, Repetitive (Note 3)		E_{AR}	0.3	mJ
Avalanche Current, Repetitive (Note 3)		I_{AR}	50.0	A
Continuous Diode Forward Current		I_S	228	A
Diode Pulse Current		$I_{S,PULSE}$	912	A
Operating Junction Temperature		T_J	150	°C
Storage Temperature		T_{STG}	-55 to 150	°C
Lead Temperature (Soldering, 10 sec)		T_{LEAD}	260	°C

Note:

- 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.
- Current Limited by Package.
- Repetitive Rating: Pulse width limited by maximum junction temperature
- $I_{AS}= 22A$, $V_{DD}= 20V$, $R_G= 25\Omega$, Starting $T_J= 25^{\circ}C$
- $I_{AS_Limit}= 50.0A$, $V_{DD}= 20V$, $R_G= 25\Omega$, Starting $T_J= 25^{\circ}C$

Thermal Resistance

Parameter		Symbol	Min	Typ	Max	Unit
Thermal Resistance, Junction-to-Case	PDFN5*6	R_{thJC}			0.95	°C/W
Thermal Resistance, Junction-to-Ambient	PDFN5*6	R_{thJA}			50	

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}	$V_{GS}=0V, I_D=250\mu A$	40			V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS}=40V, V_{GS}=0V$			1	μA
Gate-Body Leakage Current	Forward	$I_{GSSF}, V_{GS}=20V, V_{DS}=0V$			200	nA
	Reverse	$I_{GSSR}, V_{GS}=-20V, V_{DS}=0V$			-200	
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS}=V_{GS}, I_D=0.25mA$	1.2	1.8	2.4	V
Static Drain-Source On-Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=60A$		1.05	1.2	mΩ
		$V_{GS}=4.5V, I_D=20A$		1.6	2.3	
Gate Resistance	R_G	$f=1MHz, \text{Open Drain}$		1.1		Ω
Dynamic Characteristics						
Input Capacitance	C_{ISS}	$V_{DS}=20V, V_{GS}=0V, f=1MHz$		7.4		nF
Output Capacitance	C_{OSS}			2.0		nF
Reverse Transfer Capacitance	C_{RSS}			125		pF
Effective output capacitance, energy related ^{NOTE5}	$C_{O(er)}$	$V_{GS}=0V, V_{DS}=0\dots 32V$		3.1		nF
Effective output capacitance, time related ^{NOTE6}	$C_{O(tr)}$			3.8		
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=20V, I_D=60A, R_G=1.6\Omega, V_{GS}=10V$		19		ns
Rise Time	t_r			57		
Turn-off Delay Time	$t_{d(off)}$			62		
Fall Time	t_f			13		
Gate Charge Characteristics						
Gate to Source Charge	Q_{gs}	$V_{DD}=20V, I_D=60A, V_{GS}=0 \text{ to } 10V$		16		nC
Gate to Drain Charge	Q_{gd}			12		
Gate Charge Total	Q_g			105		
Gate Plateau Voltage	$V_{plateau}$			2.4		V
Gate Charge Total, sync FET	Q_g	$V_{DD}=0.1V, V_{GS}=0 \text{ to } 10V$		99		nC
Reverse Diode Characteristics						
Drain-Source Diode Forward Voltage	V_{SD}	$V_{GS}=0V, I_{SD}=60A$		0.84	1.0	V
Reverse Recovery Time	t_{rr}	$V_R=20V, I_F=60A, dI_F/dt=100A/\mu s$		62		ns
Reverse Recovery Charge	Q_{rr}			130		nC
Peak Reverse Recovery Current	I_{rrm}			4.3		A

Note:

- $C_{O(er)}$ is a fixed capacitance that gives the same stored energy as C_{OSS} while V_{DS} is rising from 0 to 32V
- $C_{O(tr)}$ is a fixed capacitance that gives the same charging time as C_{OSS} while V_{DS} is rising from 0 to 32V

Typical Performance Characteristics

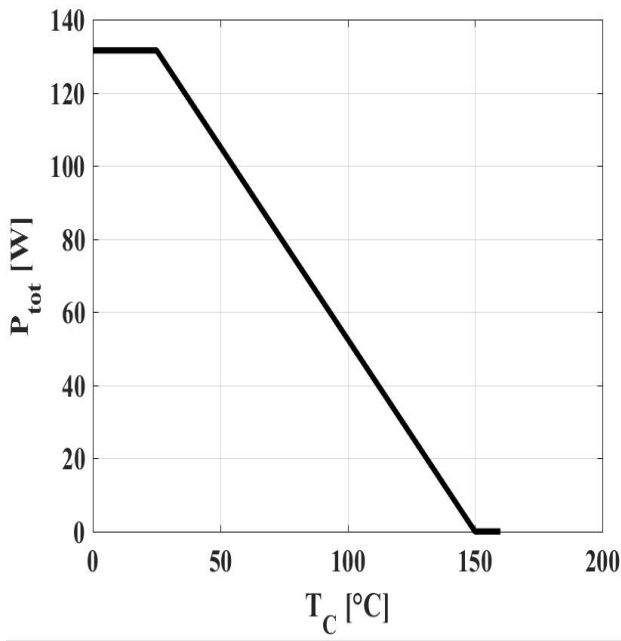
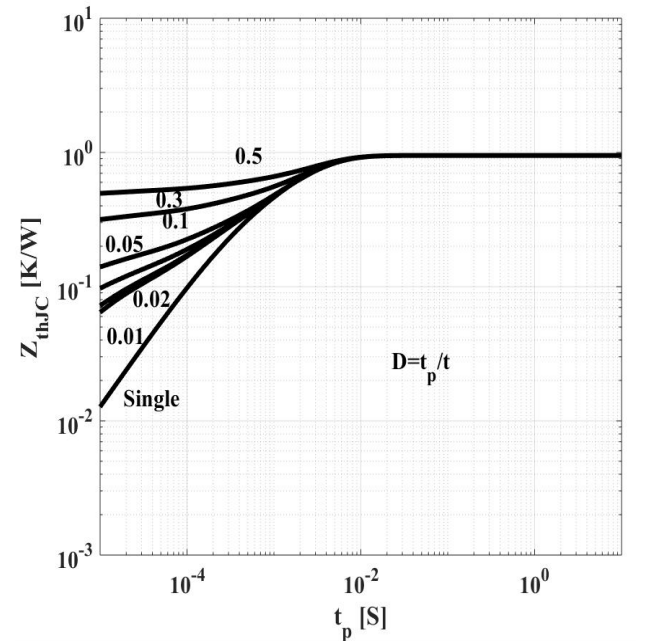
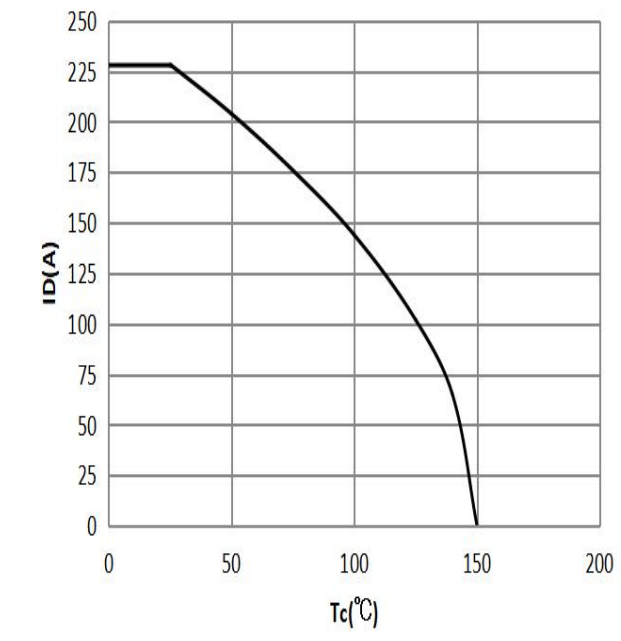
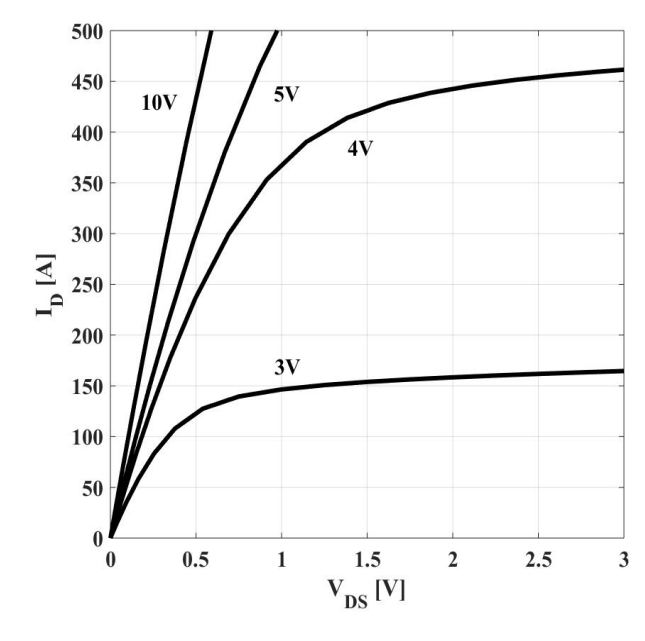
<p>Figure 3: Power Dissipation</p>  <p>$P_{tot}=f(T_C)$</p>	<p>Figure 4: Max. Transient Thermal Impedance</p>  <p>$Z_{(th)C}=f(t_p)$; parameter: $D=t_p/T$</p>
<p>Figure5: Drain Current</p>  <p>$I_D=f(T_C); V_{GS} \geq 10V$</p>	<p>Figure6: Typ. Output Characteristics</p>  <p>$I_D=f(V_{DS}); T_j=25^\circ C$; parameter: V_{GS}</p>

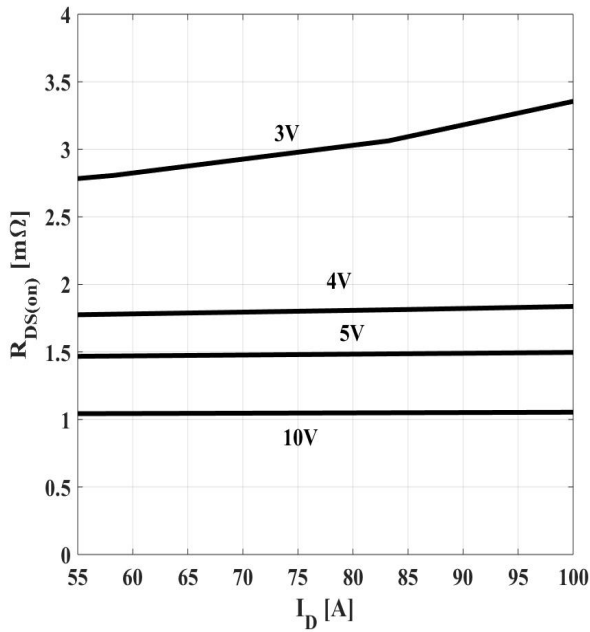
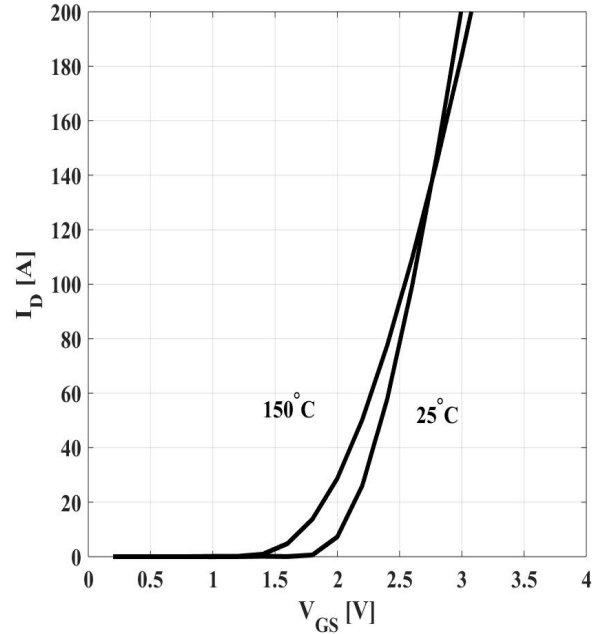
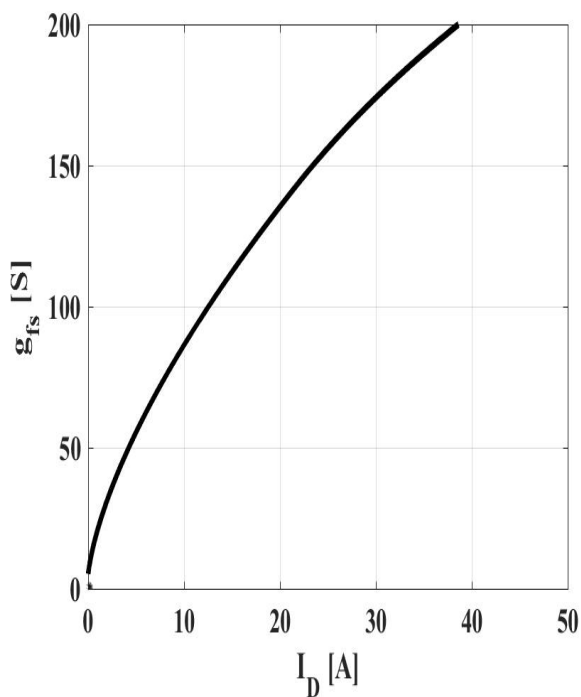
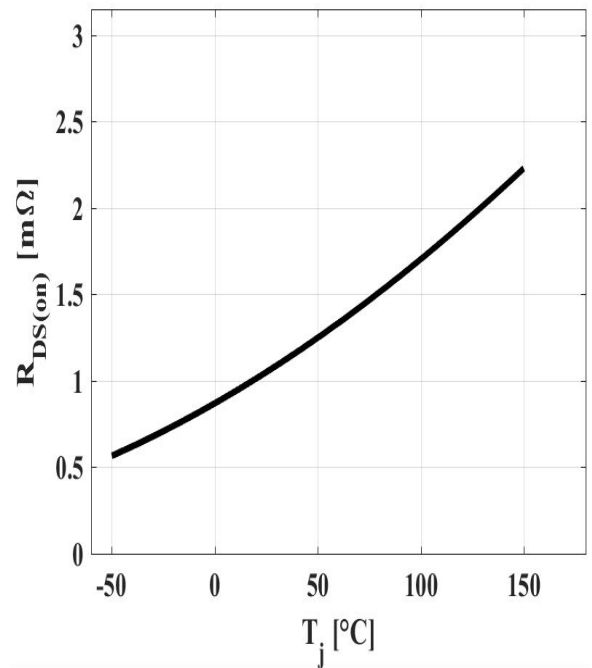
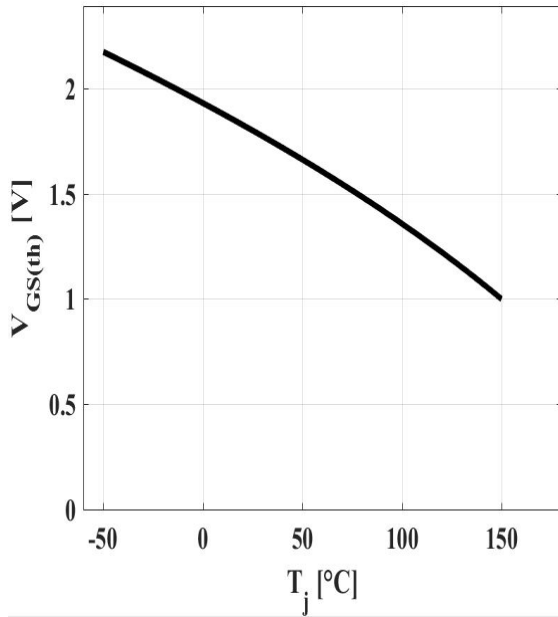
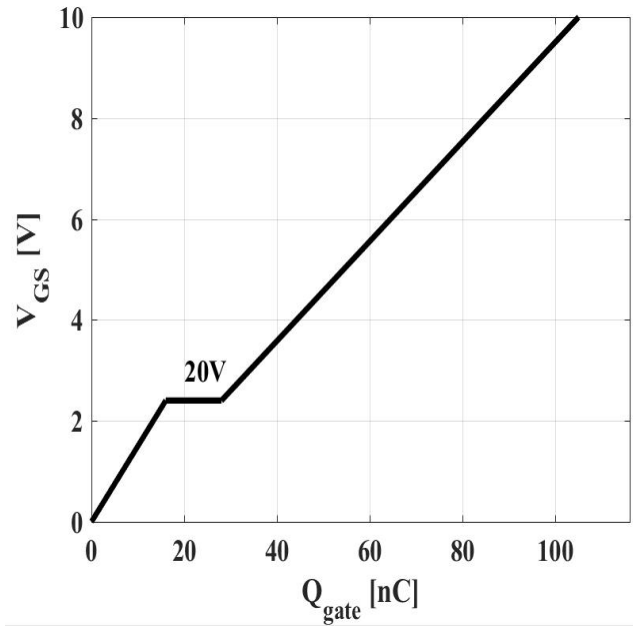
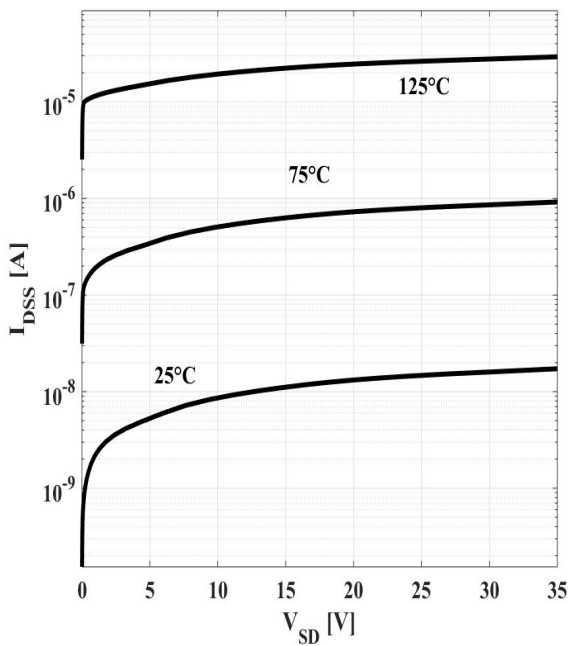
Figure7: Typ. Drain-Source On-State Resistance

 $R_{DS(ON)}=f(I_D); T_j=25^\circ C; \text{parameter: } V_{GS}$
Figure8: Typ. Transfer Characteristics

 $I_D=f(V_{GS}); |V_{DS}|>2|I_D|R_{DS(on)max}; \text{parameter: } T_j$
Figure9: Typ. Forward Transconductance

 $g_{fs}=f(I_D); T_j=25^\circ C$
Figure10: Typ. Drain-Source On-State Resistance

 $R_{DS(ON)}=f(T_j); I_D=60A; V_{GS}=10V$

Figure 11: Typ. Gate Threshold Voltage


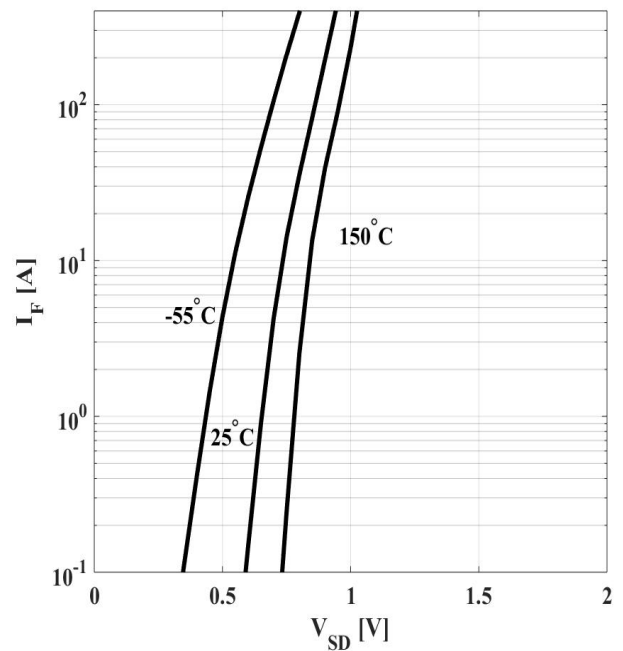
$$V_{GS(th)}=f(T_j); V_{GS}=V_{DS}; I_{DS}=250\mu A$$

Figure 12: Typ. Gate Charge


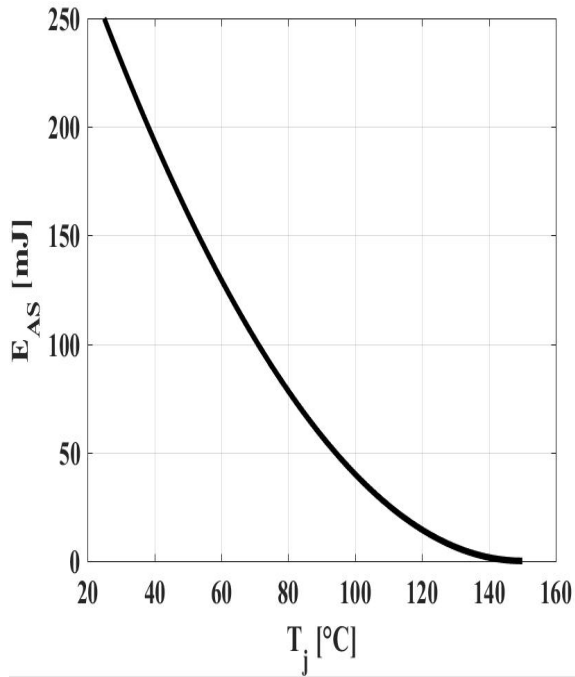
$$V_{GS}=f(Q_{gate}), I_D=60A \text{ pulsed}$$

Figure 13: Drain-Source Leakage Current


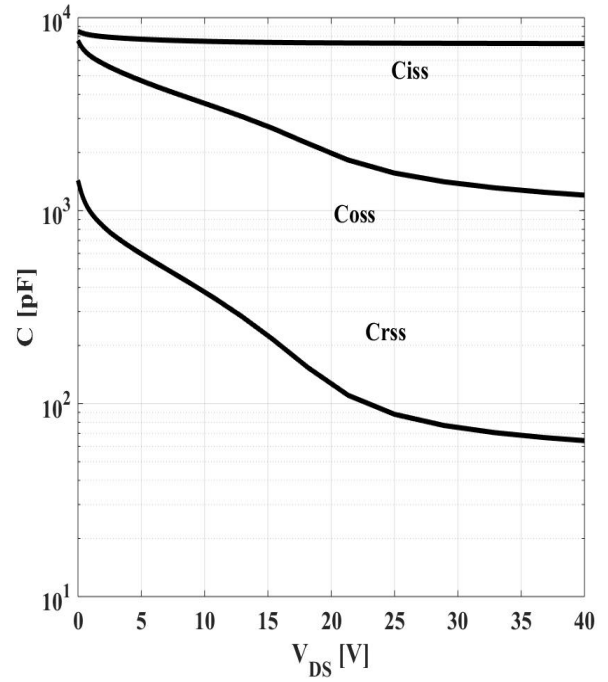
$$I_{DSS}=f(V_{DS}); V_{GS}=0V; \text{parameter: } T_j$$

Figure 14: Forward Characteristics of Reverse Diode


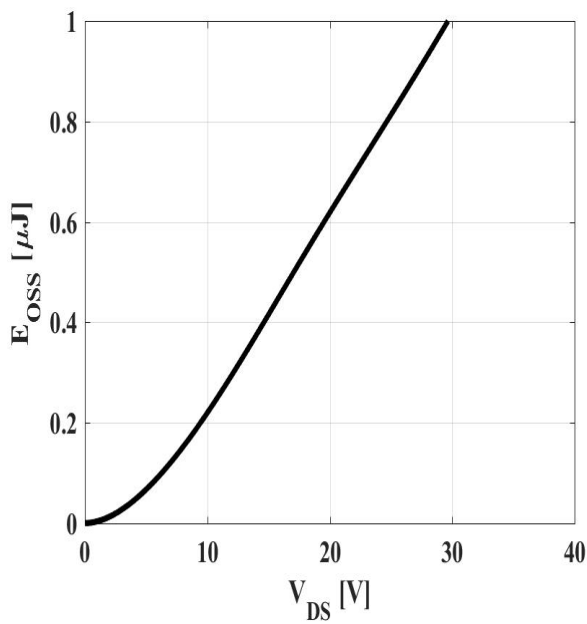
$$I_F=f(V_{SD}); \text{parameter: } T_j$$

Figure 15: Avalanche Energy


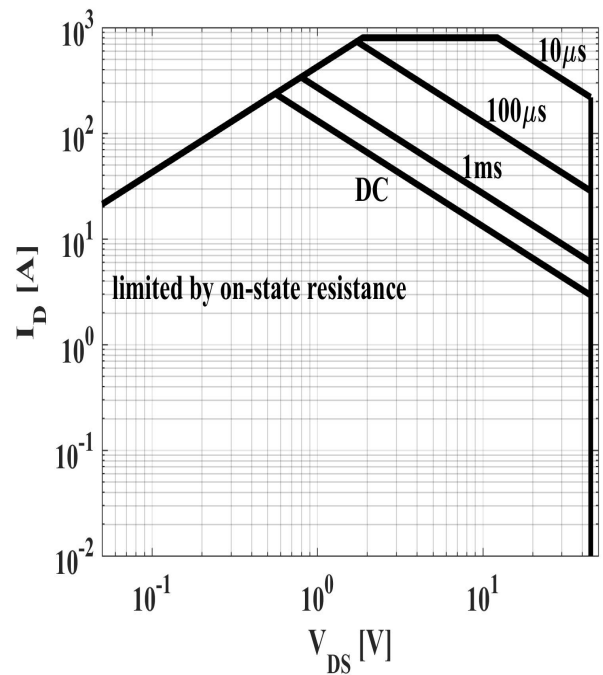
$$E_{AS}=f(T_j); I_D=50.0A; V_{DD}=20V$$

Figure 16: Typ. Capacitances


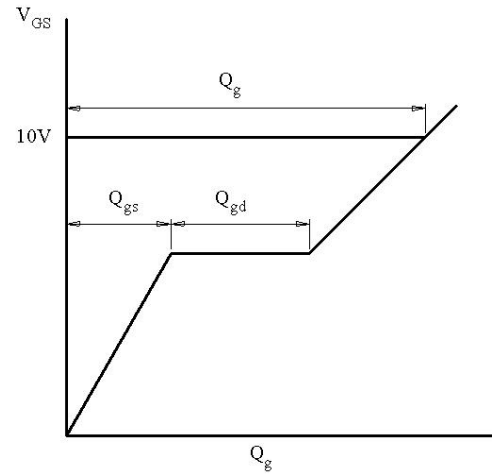
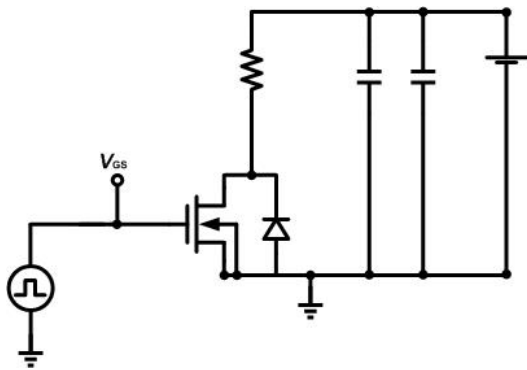
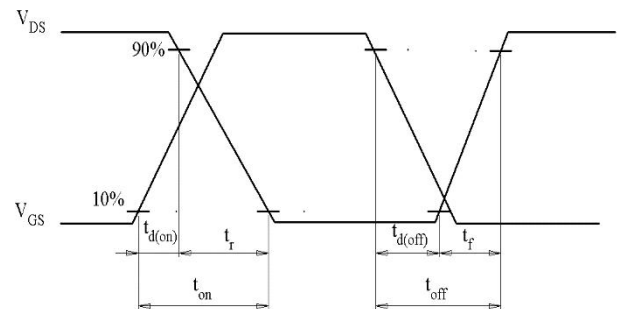
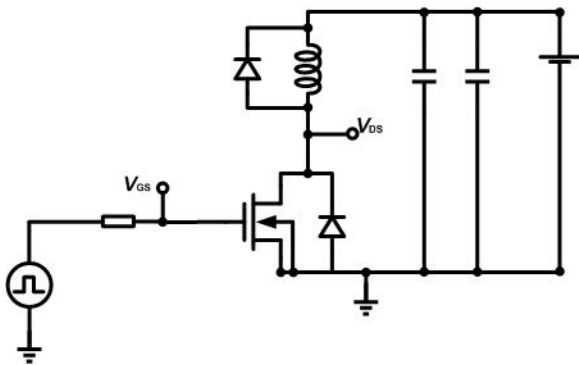
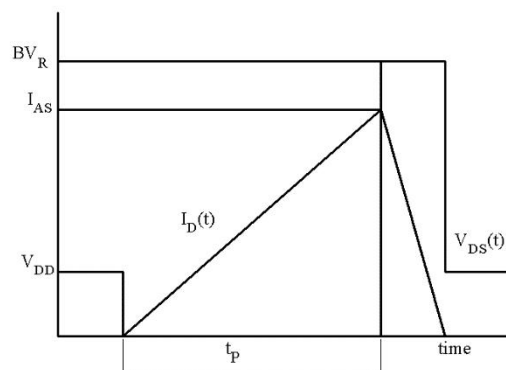
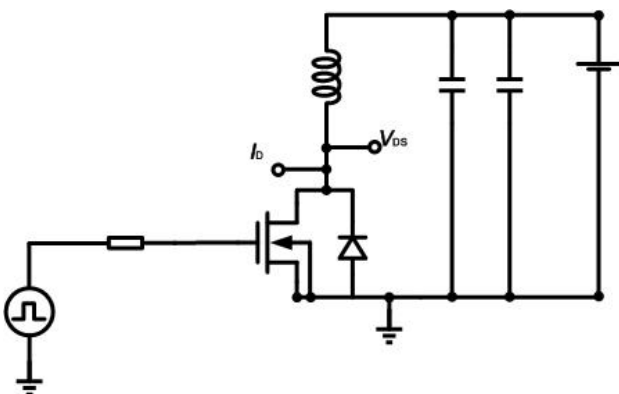
$$C=f(V_{DS}); V_{GS}=0; f=1MHz$$

Figure 17: Coss Stored Energy


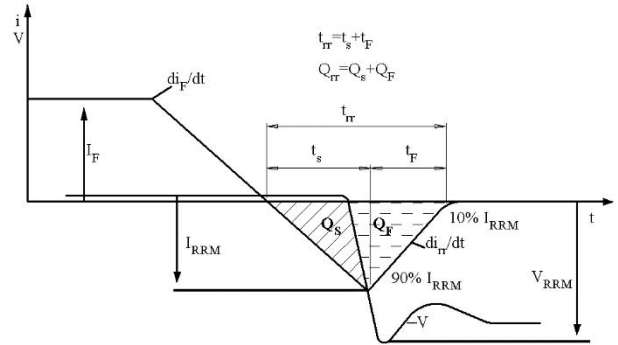
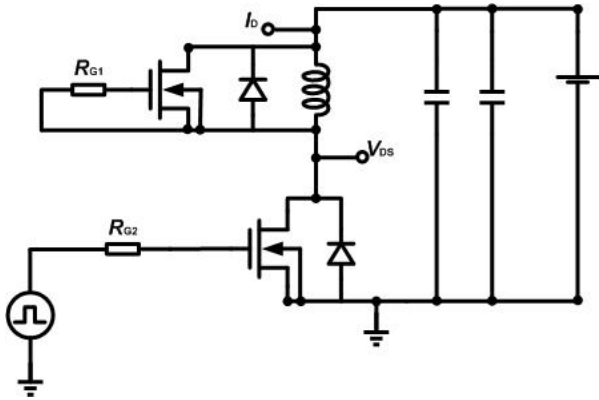
$$E_{OSS}=f(V_{DS})$$

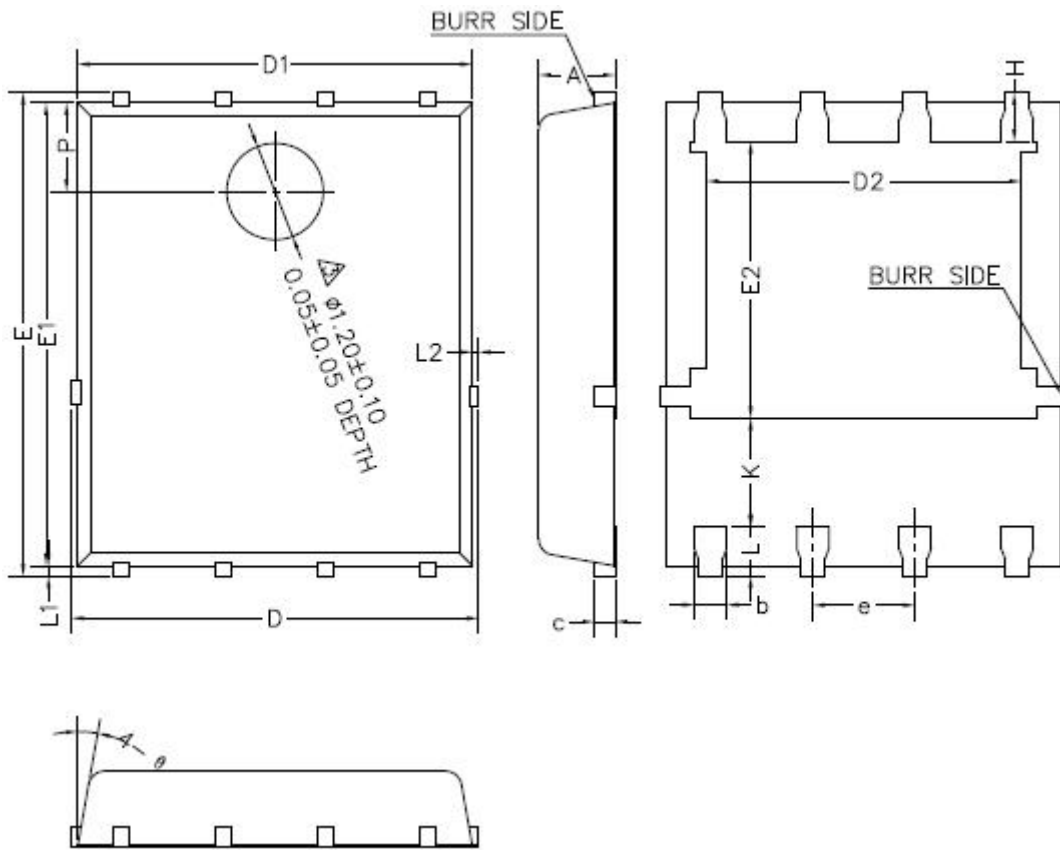
Figure 18: Safe Operating Area


$$I_D = f(V_{DS}); T_c = 25^\circ C; V_{GS} > 7V; \text{parameter } t_p$$

Test Circuits
1. Gate Charge Test Circuit & Waveform

2. Switch Time Test Circuit

3. Unclamped Inductive Switching Test Circuit & Waveforms


4. Test Circuit and Waveform for Diode Characteristics



Mechanical Dimension
PDFN5*6-8 Unit: mm


Symbol	Dimensions(mm)		
	Min.	Typ.	Max.
A	0.90	1.10	1.20
b	0.35	0.40	0.45
c	0.21	0.25	0.34
D			5.10
D1	4.80	4.90	5.00
D2	3.91	4.01	4.11
e	1.17	1.27	1.37
E	5.90	6.00	6.10
E1	5.70	5.75	5.80
E2	3.34	3.44	3.54
H	0.51	0.61	0.71
K	1.10		
L	0.51	0.61	0.71
L1	0.06	0.13	0.20
L2			0.10
P	1.00	1.10	1.20
θ	8°	10°	12°



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