



VMDSEMI

**VSXX060R22BNA**

**Datasheet**

## General Description

The VSXX060R22BNA 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. The VSXX060R22BNA break down voltage is 600V and it has a high rugged avalanche characteristics. The VSXX060R22BNA is available in TO-251, TO-252 and TO-220F packages.

## Symbol

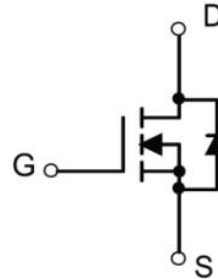


Figure 1 Symbol of VSXX060R22BNA

## Features

- Low  $R_{DS(ON)_{max}} = 2.2\Omega @ V_{GS} = 10V$
- Ultra Low Gate Charge,  $Q_g = 1.5nC$  typ.
- Ultra Fast switching capability
- Robust design with better EAS performance

## Package Type

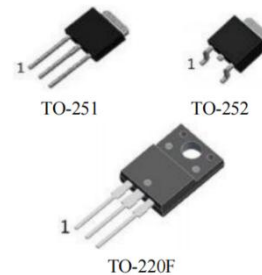
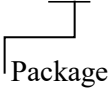


Figure 2 Package Type of VSXX060R22BNA

## Application

- LED Lighting Power
- General Used Charger / Adapter

## Ordering Information

		VSXX060R22BNA
TO-251:	TJ	 Package
TO-252:	TL	
TO-220F:	TD	

Product Name	Package
VSTJ060R22BNA	TO-251
VSTL060R22BNA	TO-252
VSTD060R22BNA	TO-220F

**Absolute Maximum Ratings**<sup>Note1</sup>

Parameter	Symbol	Rating	Unit
Drain-Source Voltage	$V_{DS}$	600	V
Gate-Source Voltage	$V_{GS}$	±30	V
Continuous Drain Current	$I_D$	$T_C=25^{\circ}C$	1.9
		$T_C=125^{\circ}C$	0.8
Pulsed Drain Current <sup>Note 2</sup>	$I_{DM}$	5.5	A
Avalanche Energy, Single Pulse <sup>Note 3</sup>	$E_{AS}$	11	mJ
Avalanche Energy, Repetitive <sup>Note 2</sup>	$E_{AR}$	0.05	mJ
Avalanche Current, Repetitive <sup>Note 2</sup>	$I_{AR}$	0.57	A
Continuous Diode Forward Current	$I_S$	1.9	A
Diode Pulse Current	$I_{S,PULSE}$	5.5	A
Operating Junction Temperature	$T_J$	150	°C

Note:

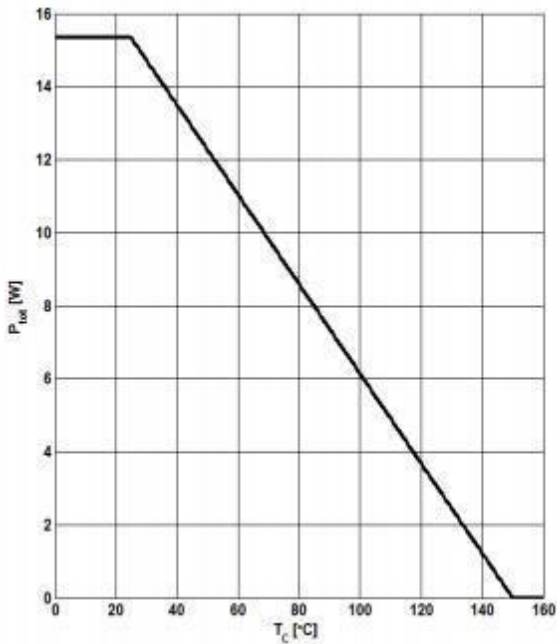
- Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.
- Repetitive Rating: Pulse width limited by maximum junction temperature
- $I_{AS} = 0.57A$ ,  $V_{DD} = 60V$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^{\circ}C$

**Electrical Characteristics** ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>Statistic Characteristics</b>						
Drain-Source Breakdown Voltage	$B_{V_{DS}}$	$V_{GS}=0V, I_D=250\mu A$	600			V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=600V, V_{GS}=0V$			1	$\mu A$
Gate-Body Leakage Current	Forward	$V_{GS}=30V, V_{DS}=0V$			100	nA
	Reverse	$V_{GS}=-30V, V_{DS}=0V$			- 100	
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2.6	3.5	4.4	V
Static Drain-Source On-Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=0.5A$		1.82	2.2	$\Omega$
Gate Resistance	$R_G$	$f=1MHz, \text{Open Drain}$		6.7		$\Omega$
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{ISS}$	$V_{DS}=25V$		50		pF
Output Capacitance	$C_{OSS}$	$V_{GS}=0V$		72		
Reverse Transfer Capacitance	$C_{RSS}$	$f=1MHz$		1.6		
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=400V$		20		ns
Rise Time	$t_r$	$I_D=1.0A$		7		
Turn-off Delay Time	$t_{d(off)}$	$R_G=10\Omega$		40		
Fall Time	$t_f$	$V_{GS}=10V$		7		
<b>Gate Charge Characteristics</b>						
Gate to Source Charge	$Q_{gs}$	$V_{DD}=480V$ $I_D=1.0A$		0.48		nC
Gate to Drain Charge	$Q_{gd}$			0.55		
Gate Charge Total	$Q_g$			1.5		
Gate Plateau Voltage	$V_{plateau}$	$V_{GS}=0 \text{ to } 10V$		5.7		V
<b>Reverse Diode Characteristics</b>						
Drain-Source Diode Forward Voltage	$V_{SD}$	$V_{GS}=0V, I_{SD}=1A$		0.84	1.1	V
Reverse Recovery Time	$t_{rr}$	$V_R=100V,$		110		ns
Reverse Recovery Charge	$Q_{rr}$	$I_F=1.0A$		0.44		$\mu C$
Peak Reverse Recovery Current	$I_{rrm}$	$dI_F/dt=100A/\mu s$		7.0		A

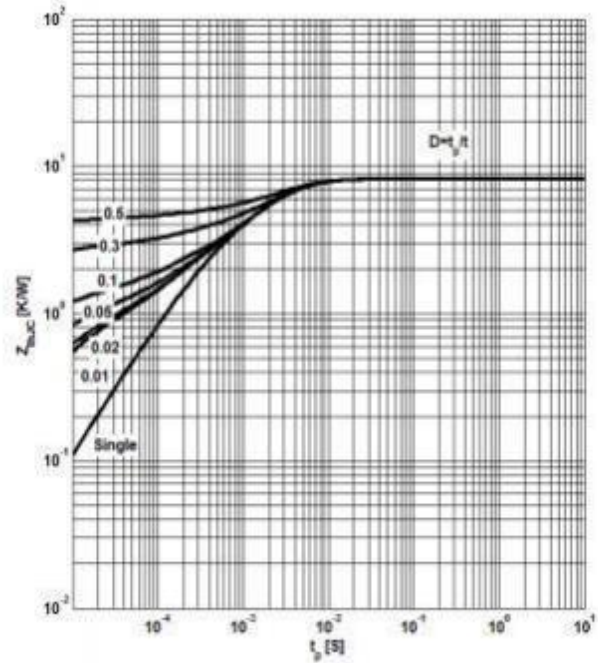
**Typical Performance Characteristics**

Figure 3: Power Dissipation



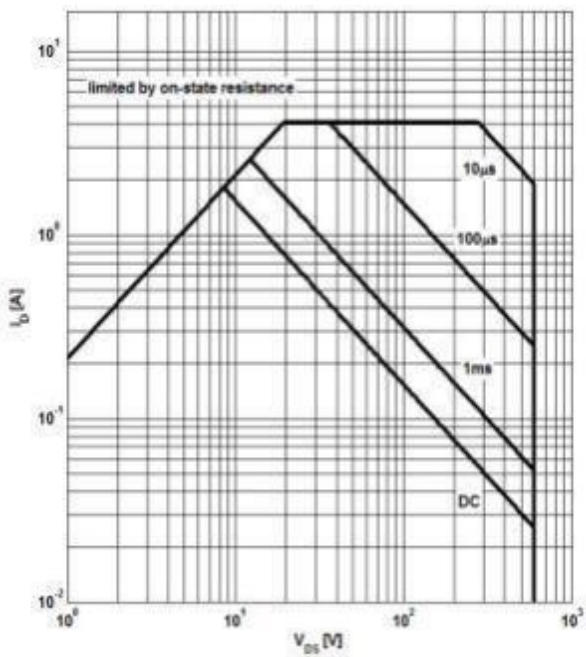
$$P_{tot} = f(T_c)$$

Figure 4: Max. Transient Thermal Impedance



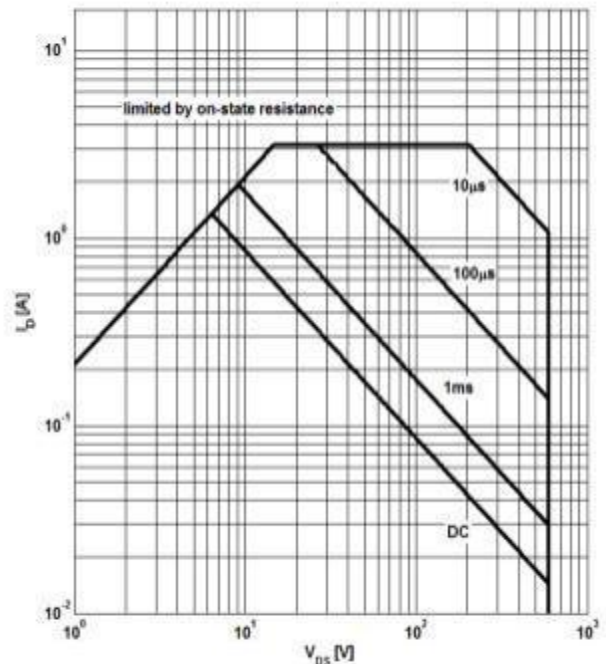
$$Z(thJC) = f(t_p); \text{ parameter: } D = t_p/T$$

Figure 5: Safe Operating Area



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

Figure 6: Safe Operating Area



$$I_D = f(V_{DS}); T_c = 80^\circ\text{C}; V_{GS} > 7\text{V}; \text{ parameter } t_p$$

Figure 7: Typ. Output Characteristics

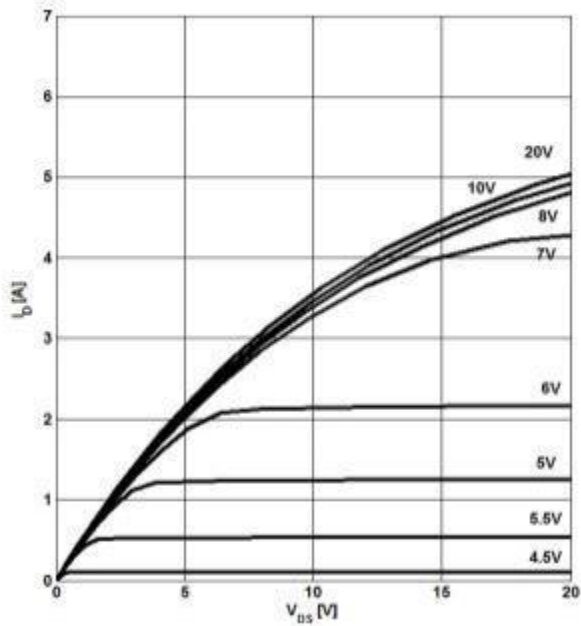

 $I_D = f(V_{DS}); T_j = 25^\circ\text{C};$  parameter:  $V_{GS}$ 

Figure 8: Typ. Output Characteristics

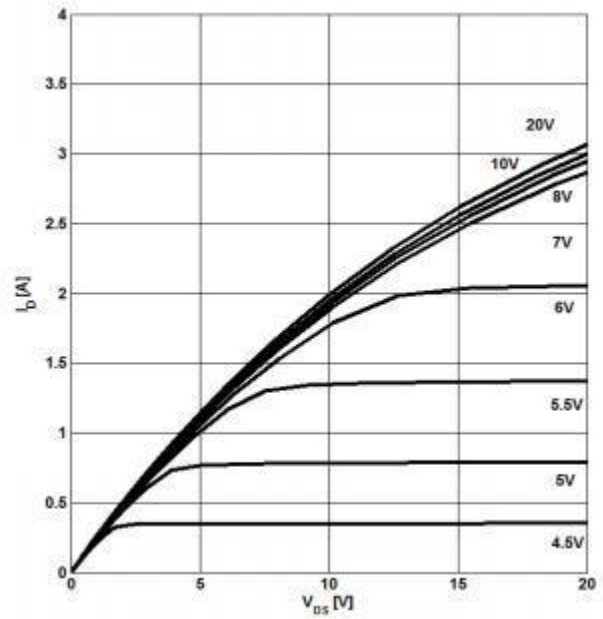

 $I_D = f(V_{DS}); T_j = 125^\circ\text{C};$  parameter:  $V_{GS}$ 

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

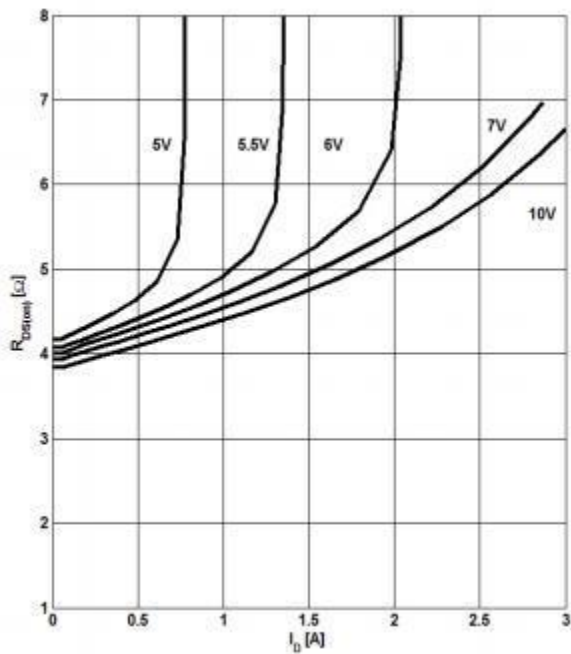

 $R_{DS(ON)} = f(I_D); T_j = 125^\circ\text{C};$  parameter:  $V_{GS}$ 

Figure 10: Typ. Drain-Source On-State Resistance

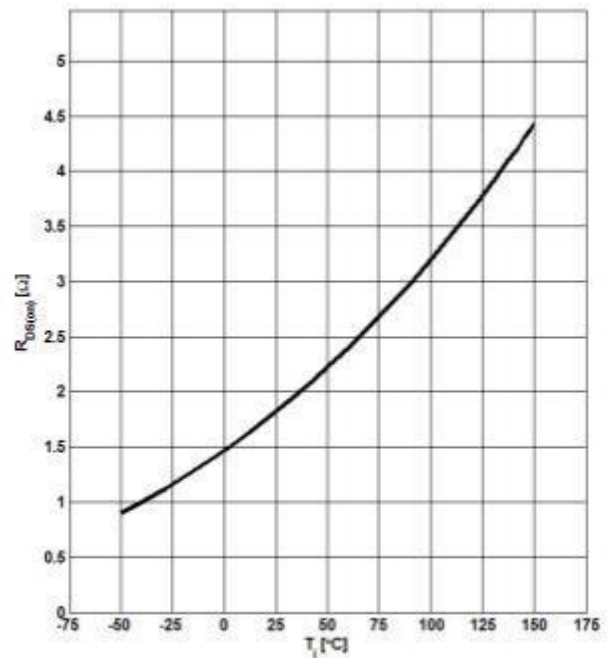
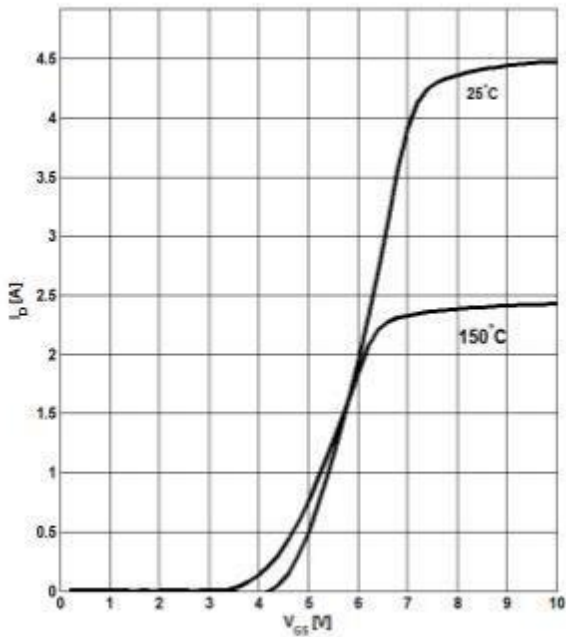
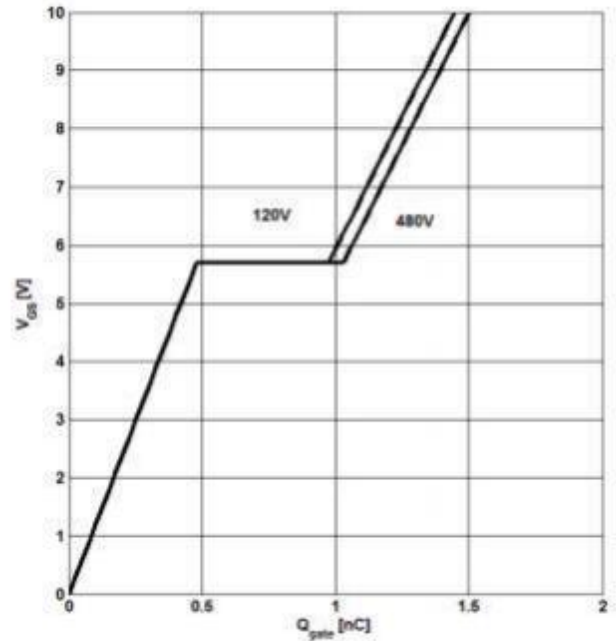

 $R_{DS(ON)} = f(T_j); I_D = 0.5\text{A}; V_{GS} = 10\text{V}$

Figure 11: Typ. Transfer Characteristics



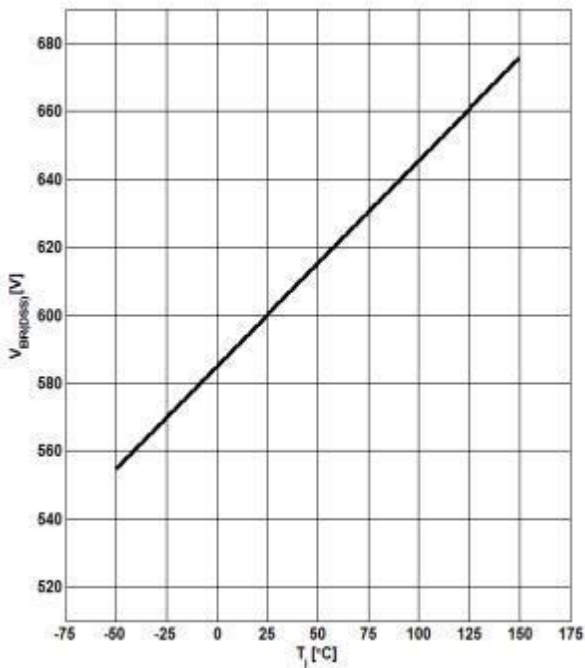
$$I_D = f(V_{GS}); V_{DS} = 20V$$

Figure 12: Typ. Gate Charge



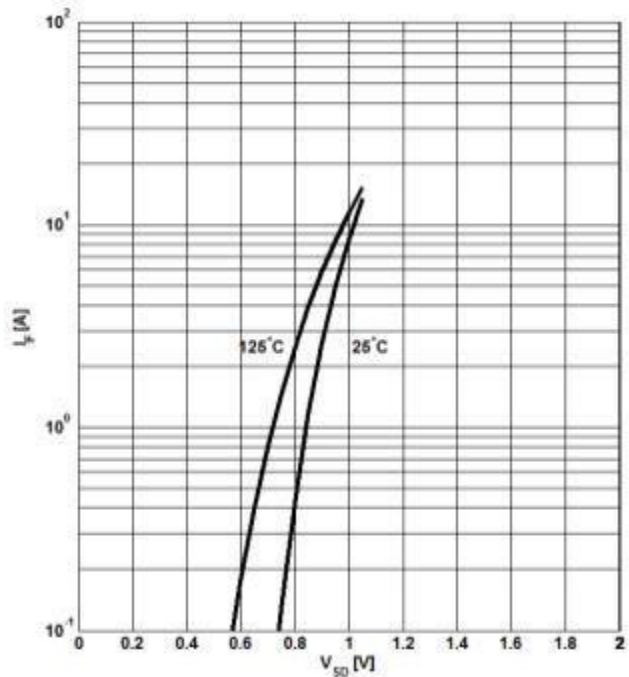
$$V_{GS} = f(Q_{gate}), I_D = 1.0A \text{ pulsed}$$

Figure 13: Drain-Source Breakdown Voltage

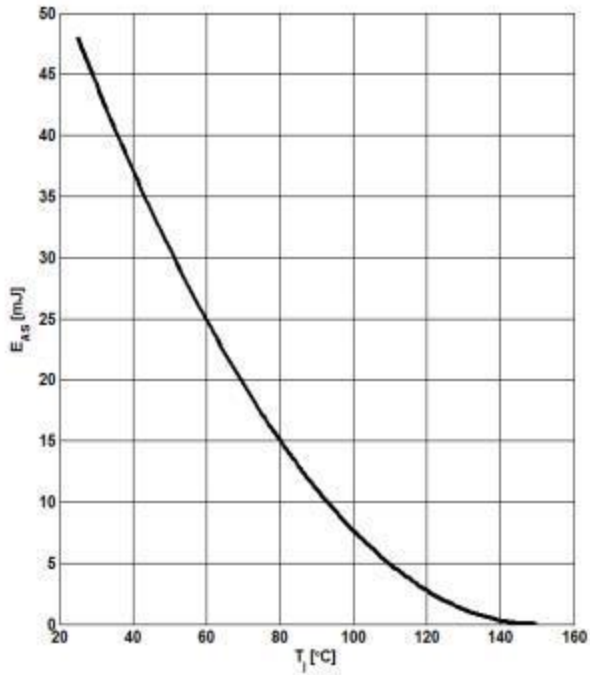


$$V_{BR(DSS)} = f(T_j); I_D = 1mA$$

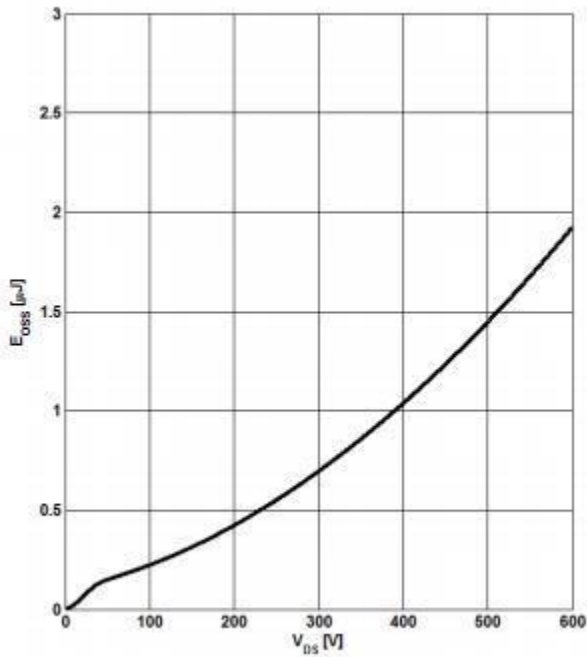
Figure 14: Forward Characteristics of Reverse Diode



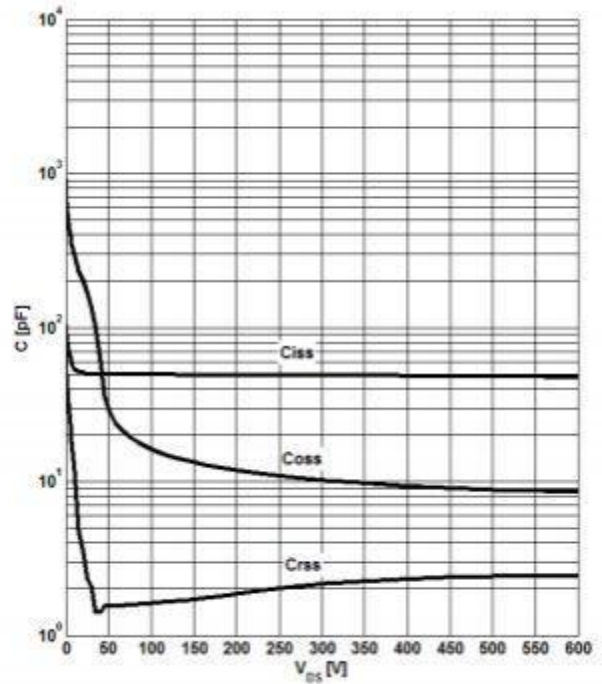
$$I_R = f(V_{SD}); \text{parameter: } T_j$$

**Figure 15: Avalanche Energy**


$$E_{AS}=f(T_j); I_D=0.9A; V_{DD}=60V$$

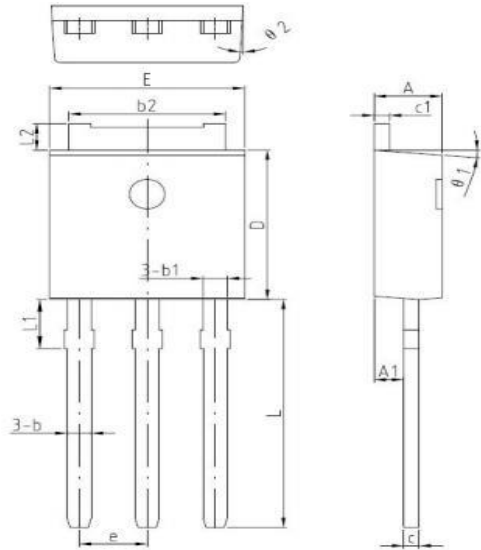
**Figure 17:  $C_{OSS}$  Stored Energy**


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

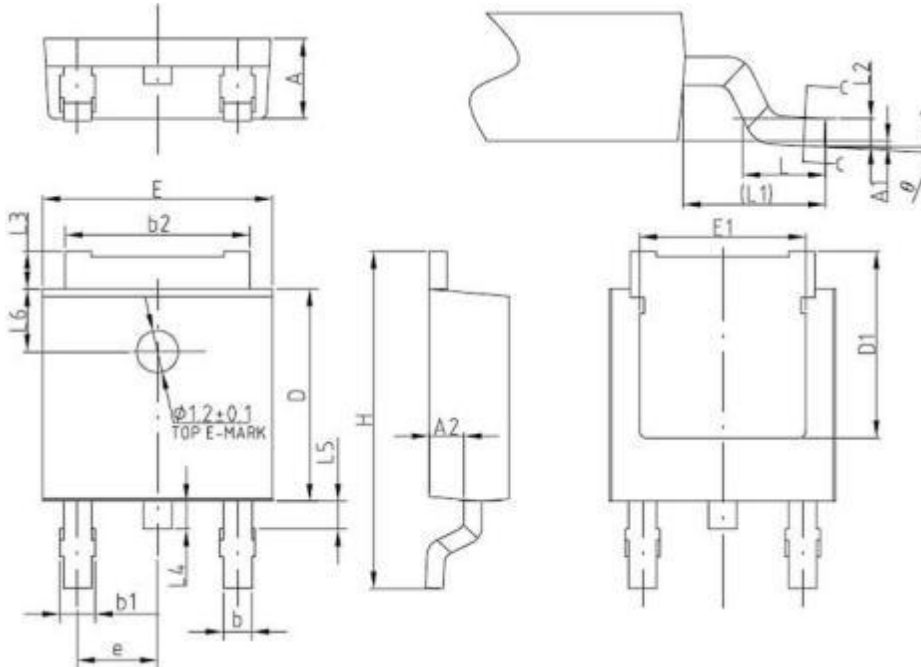
**Figure 16: Typ. Capacitances**


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

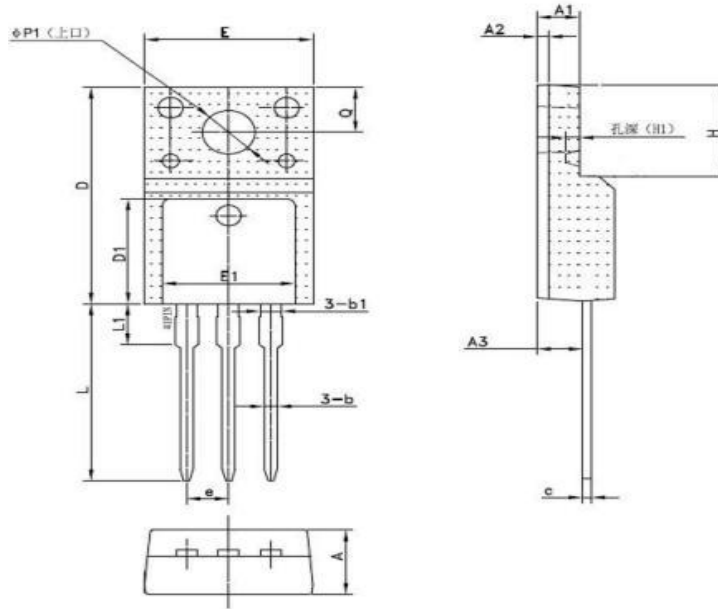


**Mechanical Dimensions:**
**TO-251 Package Information**

**Unit: mm**

Symbol	Dimensions(mm)		
	Min	Typ	Max
A	2.20	2.30	2.40
A1	0.90	1.01	1.17
b	0.50	-	0.91
b1	-	0.81	-
b2	5.13	5.33	5.46
c	0.46	0.50	0.60
c1	0.46	0.50	0.60
D	5.95	6.10	6.25
E	6.45	6.60	6.75
e	2.286(BSC)		
L	9.00	9.30	9.60
L1	-	2.00	-
L2	0.90	-	1.25
$\theta1$	-	5°	-
$\theta2$	-	3°	-

**Mechanical Dimensions:**
**TO-252 Package Information**

**Unit: mm**

Symbol	Dimensions(mm)		
	Min	Typ	Max
A	2.20	2.30	2.40
A1	0	-	0.10
A2	0.90	1.00	1.17
b	0.70	0.76	0.90
b1	0.77	-	1.10
b2	5.13	5.33	5.46
c	0.45	-	0.60
D	5.95	6.10	6.25
D1	-	5.30	-
E	6.45	6.60	6.75
E1	-	4.80	-
e	2.286(BSC)		
H	9.70	10.10	10.40
L	1.25	1.50	1.75
L1	-	2.90	-
L2	-	0.51	-
L3	0.90	-	1.25
L4	-	0.80	-
L5	-	1.00	-
L6	-	1.80	-
θ	0°	-	8°

**Mechanical Dimensions:**
**TO-220F Package Information**

**Unit: mm**

Symbol	Dimensions (mm)		
	Min	Typ	Max
A	4.30	4.70	4.90
A1	2.34	2.54	2.90
A2	-	0.70	-
A3	2.56	2.76	2.96
b	0.55	-	0.95
b1	-	1.28	-
c	0.42	0.50	0.70
D	14.70	-	16.07
D1	-	7.70	-
E	9.96	10.16	10.36
E1	-	8.00	-
e	2.54(BSC)		
H	-	6.70	-
(H1)	-	(0.81)	-
L	12.48	12.98	13.50
L1	-	2.93	-
ΦP1	-	3.18	-
Q	2.90	3.30	3.50

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