

### General Description

This series of power MOSFET use N channel Trench Super-Junction technology and design to provide better characteristics, such as fast switchingtime, low Ciss and Crss, low on resistance and excellent avalanche characteristics,making it especially suitable for applications which require superior power density and outstanding efficiency.

### Features

- Low on-resistance
- Ultra low gate charge and input capacitance
- 100% avalanche tested
- Rohs compliant

### Mechanical Data

- Case:TO-220,ITO-220,TO-263,TO-262, Package

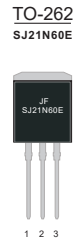
### Application

- Switching applications

### Ordering Information

Part No.	Package Type	Package	Quality(box)
SJ21N60	TO-220	Tube	1000
SJ21N60F	ITO-220	Tube	1000
SJ21N60D	TO-263	Tape & Reel	800
SJ21N60E	TO-262	Tube	1000

Product Summary			
V <sub>DS</sub>	R <sub>DS(on)</sub> (Ω) Typ	I <sub>D</sub> (A)	Q <sub>g</sub> (Typ)
600V	0.13 @ 10V	10.5	46nc



### Block Diagram

Pin Definition:

1. Gate
2. Drain
3. Source

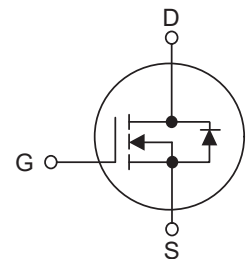


Table1 Absolute Maximum Ratings (T<sub>C</sub>=25°C, unless otherwise specified)

Parameter	Symbol	SJ21N60 SJ21N60D SJ21N60E	SJ21N60F	Unit
Drain-Source Voltage	V <sub>DS</sub>	600		V
Gate-Source Voltage	V <sub>GS</sub>	±30		V
Continuous Drain Current	I <sub>D</sub>	T <sub>C</sub> =25°C	21	A
		T <sub>C</sub> =100°C	13.2	
Pulsed Drain Current (Note 1)	I <sub>DM</sub>	63		A
Single Pulse Avalanche Energy(Note 2)	E <sub>AS</sub>	480		mJ
Avalanche Current(Note 1)	I <sub>AR</sub>	4		A
Repetitive Avalanche Energy(Note 1)	E <sub>AR</sub>	0.75		mJ
Power Dissipation T <sub>C</sub> =25°C	P <sub>D</sub>	151	34	W
Operating Junction and Storage Temperature	T <sub>J</sub> /T <sub>STG</sub>	-55 ~ +150		°C

\* limited by maximum junction temperature

Table 2. Thermal Characteristics

Parameter	Symbol	SJ21N60 SJ21N60D SJ21N60E	SJ21N60F	Unit
Thermal resistance Junction to Ambient	$R_{\theta JA}$	62.5	62.5	C/W
Thermal resistance Junction to Case	$R_{\theta JC}$	0.83	3.68	C/W

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

Parameter		Symbol	Test Conditions	Min	Typ	Max	Unit
Off Characteristics							
Drain-Source Breakdown Voltage		BV <sub>DSS</sub>	V <sub>GS</sub> =0V,I <sub>D</sub> =250μA	600			V
Drain-Source Leakage Current		I <sub>DSS</sub>	V <sub>DS</sub> =600V,V <sub>GS</sub> =0V			1	μA
Gate- Source Leakage Current	Forward	I <sub>GSS</sub>	V <sub>GS</sub> =30V,V <sub>DS</sub> =0V			100	nA
	Reverse		V <sub>GS</sub> =-30V,V <sub>DS</sub> =0V			-100	nA
On Characteristics(Note 4)							
Gate Threshold Voltage		V <sub>GS(TH)</sub>	V <sub>DS</sub> =V <sub>GS</sub> ,I <sub>D</sub> =250μA	2.5		4	V
Static Drain-Source On-State Resistance		R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V,I <sub>D</sub> =10.5A		130	150	m Ω
Dynamic Characteristics(Note 5)							
Input Capacitance		C <sub>ISS</sub>	V <sub>DS</sub> =50V,V <sub>GS</sub> =0V,f=1MHz		2328		pF
Output Capacitance		C <sub>OSS</sub>			116		pF
Reverse Transfer Capacitance		C <sub>RSS</sub>			7		pF
Switching Characteristics (Note 5)							
Turn-On Delay Time		t <sub>d (on)</sub>	V <sub>DD</sub> =400V,I <sub>D</sub> =21A, V <sub>GS</sub> =10V,R <sub>G</sub> =25Ω		43		ns
Turn-On Rise Time		t <sub>R</sub>			14		ns
Turn-Off Delay Time		t <sub>d (off)</sub>			150		ns
Turn-Off Fall Time		t <sub>f</sub>			7		ns
Total Gate Charge		Q <sub>G</sub>	V <sub>DS</sub> =480V,I <sub>D</sub> =21A, V <sub>GS</sub> =10V		46		nC
Gate-Source Charge		Q <sub>GS</sub>			11		nC
Gate-Drain Charge		Q <sub>GD</sub>			13		nC
Drain-Source Diode Characteristics and Maximum Ratings							
Drain-Source Diode Forward Voltage		V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =21A			1.2	V
Maximum Continuous Drain-Source Diode Forward Current		I <sub>S</sub>				21	A
Reverse Recovery Time		trr	V <sub>GS</sub> =0V, I <sub>S</sub> =5. 5A		280		ns
Reverse Recovery Charge		Q <sub>RR</sub>	dI <sub>F</sub> /dt=100A/μs (Note 1)		3300		nC

Notes : 1 Repetitive Rating: Pulse width limited by maximum junction temperature

2  $L=10mH, I_D=9.8A, V_{DD}=50V$ , Starting  $T_J=25^\circ\text{C}$

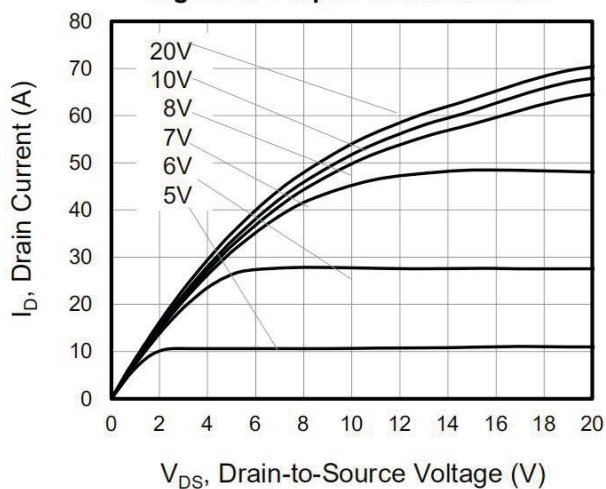
3  $I_{SD}\leq 4.5A, di/dt\leq 200A/\mu s, V_{DD}\leq BV_{DSS}$ , starting  $T_J=25^\circ\text{C}$

4 Pulse Test: Pulse width  $\leq 300\mu s$ , Duty cycle  $\leq 2\%$

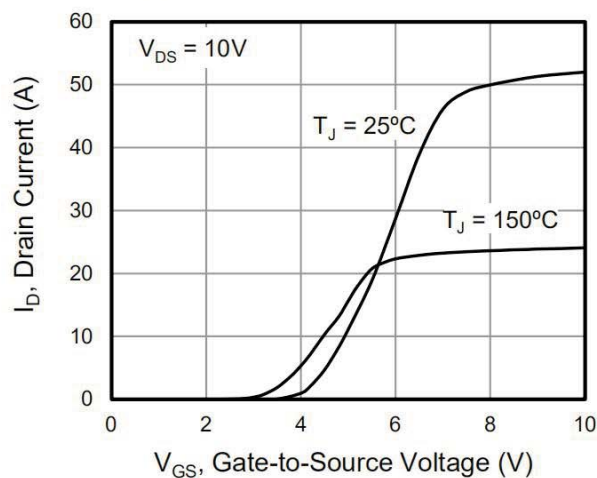
5 Guaranteed by design, not subject to production

## Typical Characteristics Diagrams

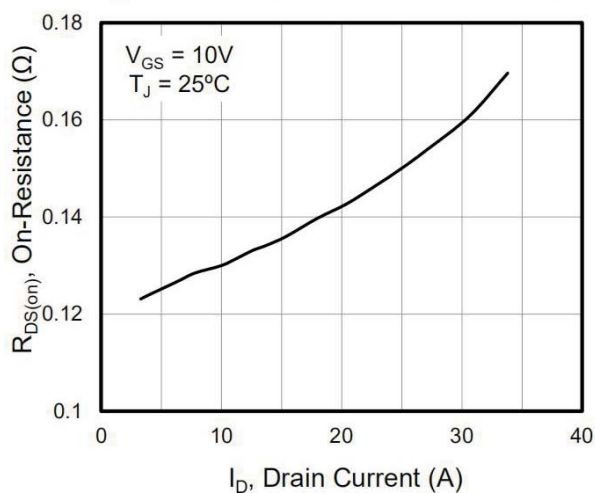
**Figure 1. Output Characteristics**



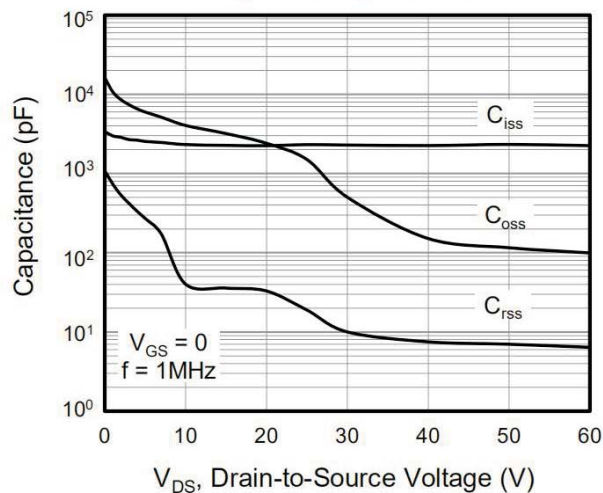
**Figure 2. Transfer Characteristics**



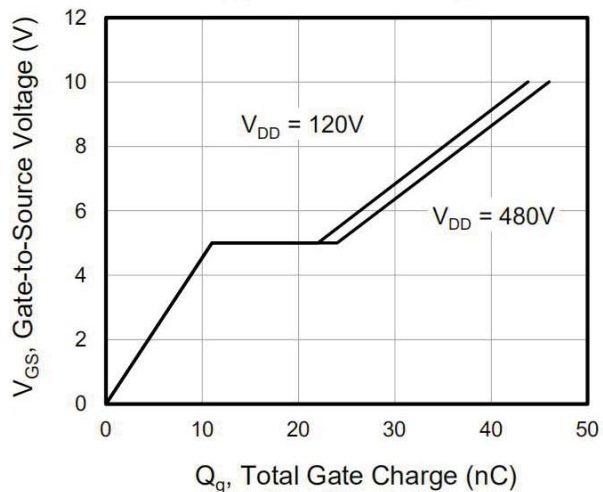
**Figure 3. On-Resistance vs. Drain Current**



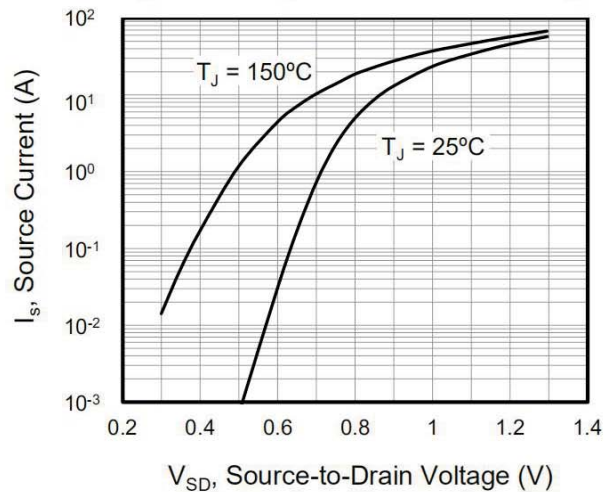
**Figure 4. Capacitance**



**Figure 5. Gate Charge**

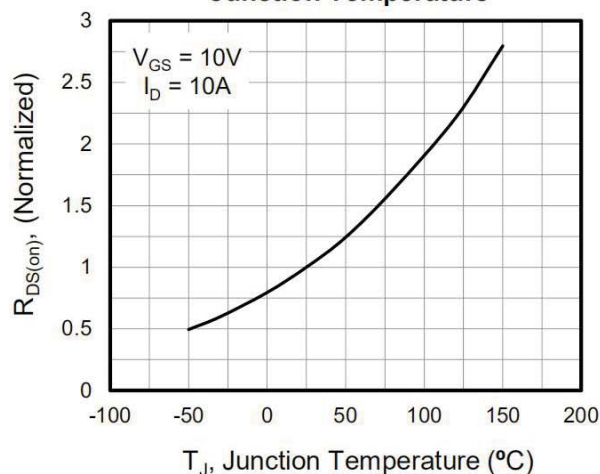


**Figure 6. Body Diode Forward Voltage**

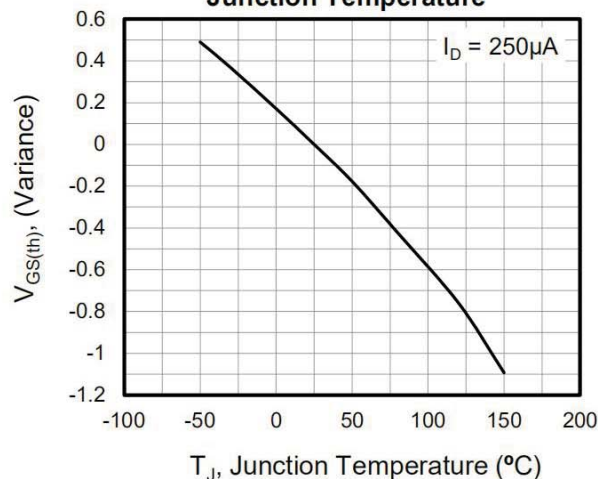


## Typical Characteristics Diagrams

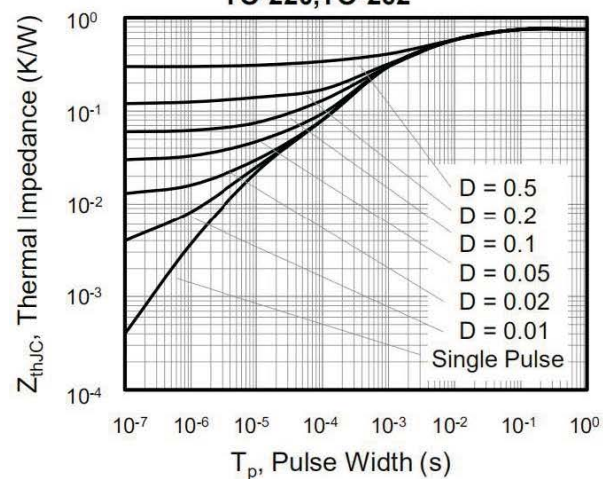
**Figure 7. On-Resistance vs. Junction Temperature**



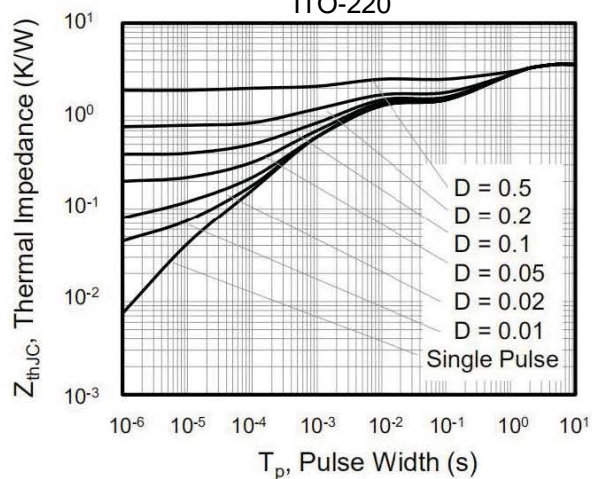
**Figure 8. Threshold Voltage vs. Junction Temperature**



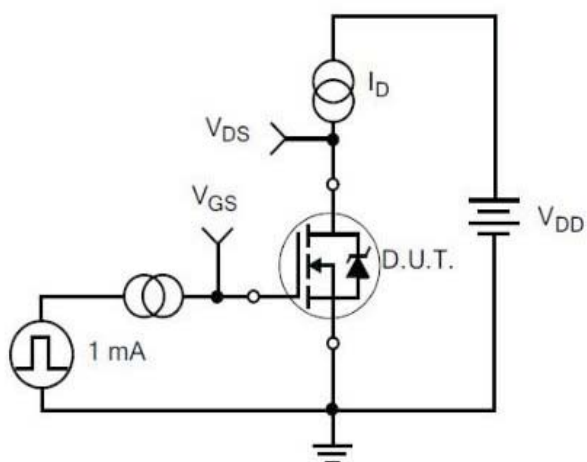
**Figure 9. Transient Thermal Impedance TO-220, TO-262**



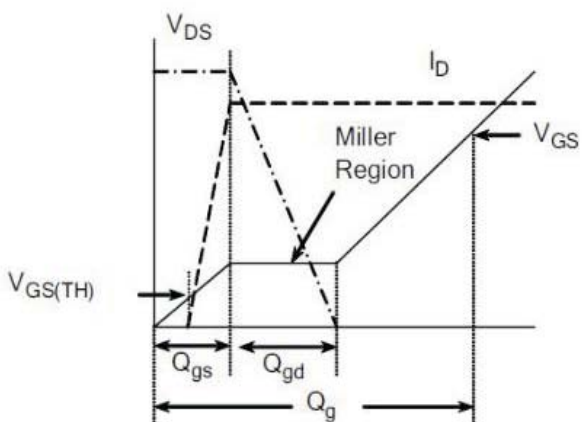
**Figure 10. Transient Thermal Impedance ITO-220**



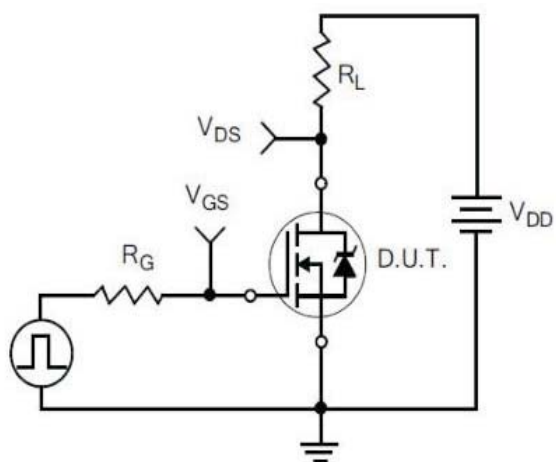
## Typical Test Circuit



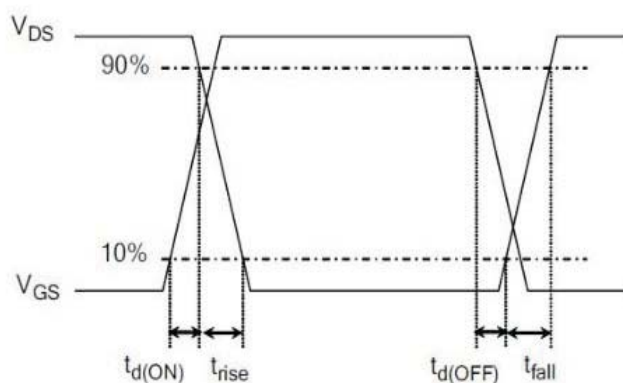
1) Gate Charge Test Circuit



2) Gate Charge Waveform

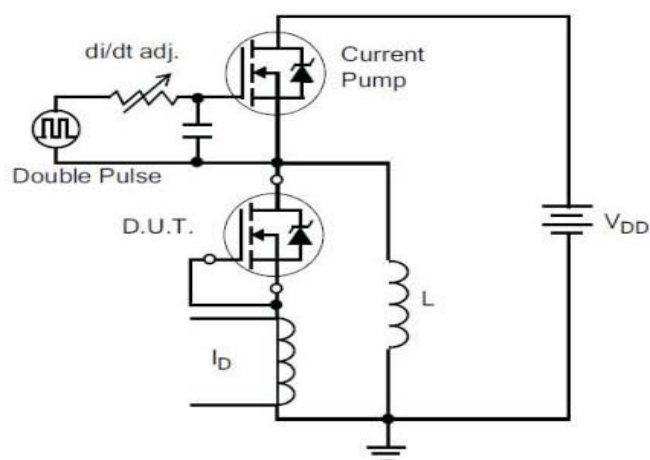


3) Resistive Switching Test Circuit

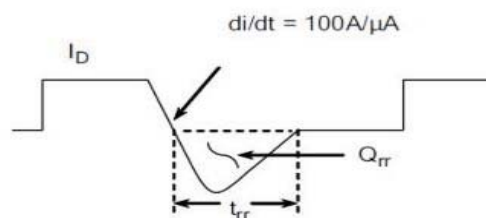


4) Resistive Switching Waveforms

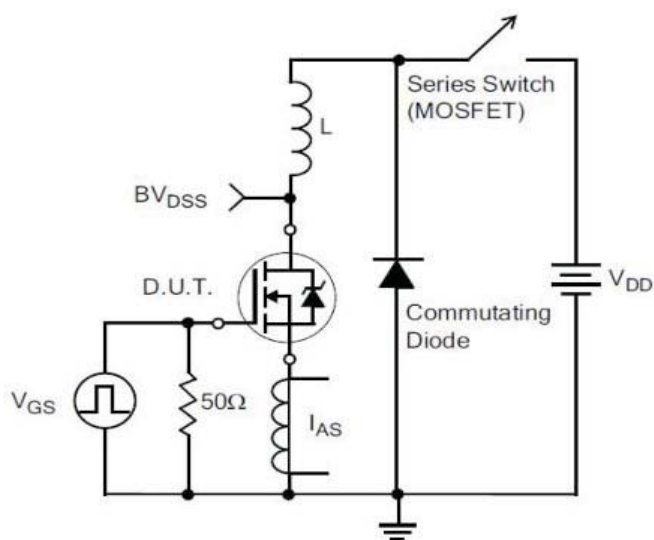
## Typical Test Circuit



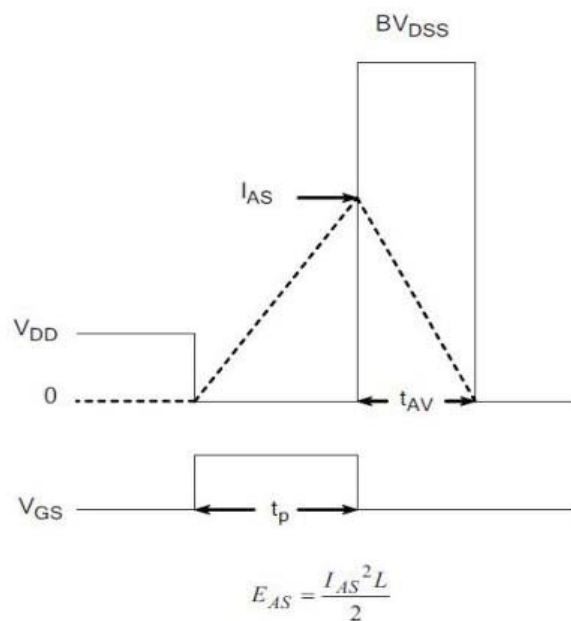
5) Diode Reverse Recovery Test Circuit



6) Diode Reverse Recovery Waveform

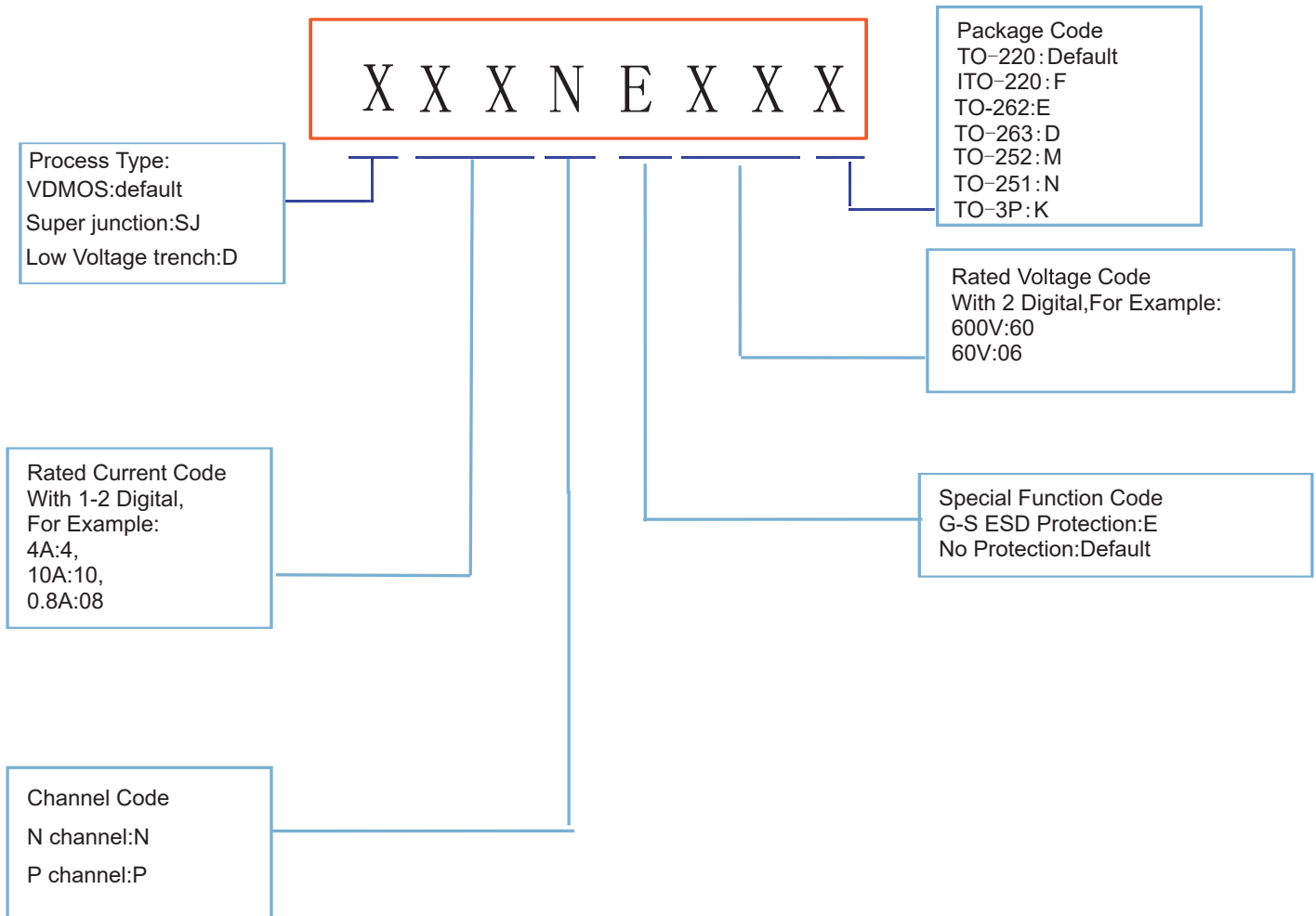


7) . Unclamped Inductive Switching Test Circuit



8) Unclamped Inductive Switching Waveforms

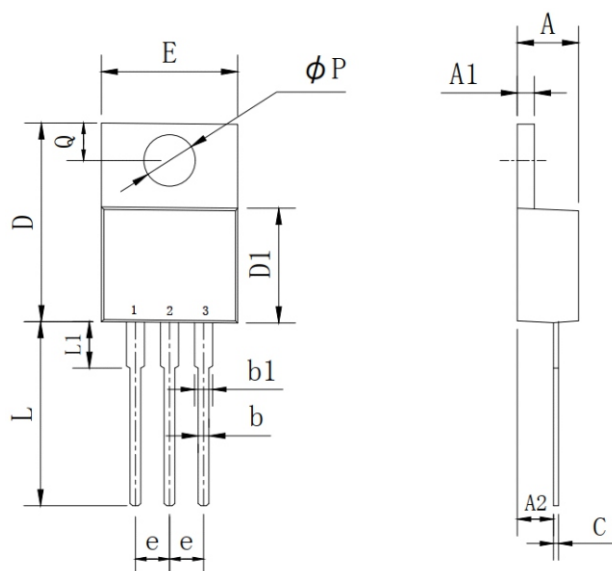
## Product Names Rules





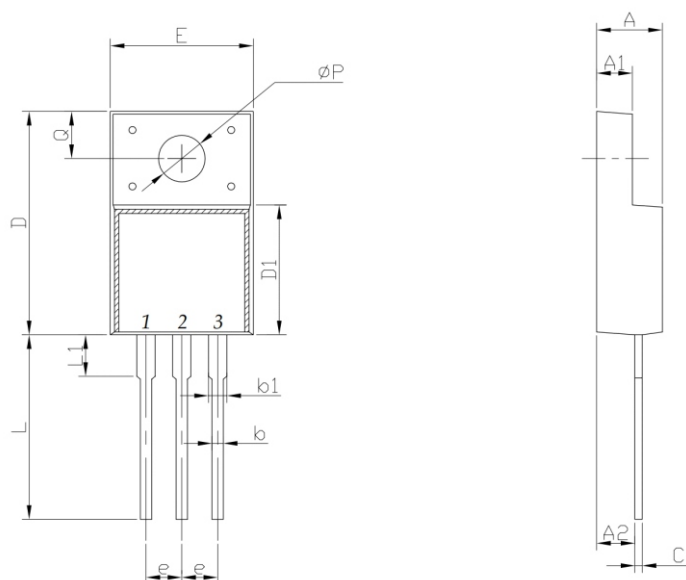
## Dimensions

### TO-220 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	4.25	4.87	0.167	0.192
A1	1.07	1.47	0.042	0.058
A2	2.03	2.92	0.080	0.115
b	0.51	1.11	0.020	0.044
b1	0.97	1.6	0.038	0.063
C	0.3	0.7	0.012	0.028
D	14.6	15.9	0.575	0.626
D1	8.04	9.3	0.317	0.366
E	9.57	10.57	0.377	0.416
e	2.34	2.74	0.092	0.108
L	12.58	14.3	0.495	0.563
L1	2.8	4.2	0.110	0.165
P	3.4	4.14	0.134	0.163
Q	2.45	3	0.096	0.118

### ITO-220 PACKAGE OUTLINE DIMENSIONS

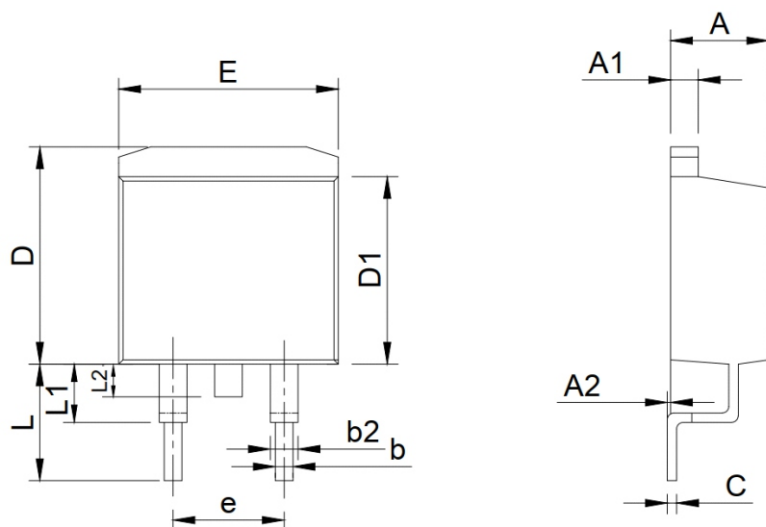


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	4.24	4.9	0.167	0.193
A1	2.3	2.92	0.091	0.115
A2	2.61	2.81	0.103	0.111
b	0.3	1	0.012	0.039
b1	0.9	1.55	0.035	0.061
C	0.3	0.7	0.012	0.028
D	14.5	16.36	0.571	0.644
D1	8.8	9.41	0.346	0.370
E	9.5	10.5	0.374	0.413
e	2.3	2.75	0.091	0.108
L	12.6	14	0.496	0.551
L1	2.45	4.3	0.096	0.169
P	2.9	3.8	0.114	0.150
Q	2.5	3.55	0.098	0.140



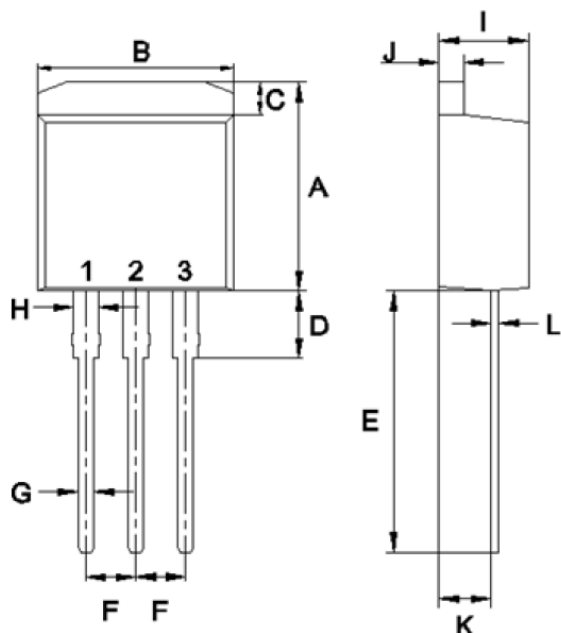
## Dimensions

### TO-263 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	4.25	4.87	0.167	0.192
A1	1.07	1.47	0.042	0.058
A2	0	0.25	0.000	0.010
b	0.61	1.01	0.024	0.040
b1	1.2	1.34	0.047	0.053
C	0.3	0.6	0.012	0.024
D	9.48	10.84	0.373	0.427
D1	8.49	9.3	0.334	0.366
E	9.7	10.31	0.382	0.406
e	4.88	5.28	0.192	0.208
L	4.46	5.85	0.176	0.230
L1	1.33	2.33	0.052	0.092
L2	0	2.2	0.000	0.087

### TO-262 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	10.14	11.14	0.399	0.439
B	9.57	10.57	0.377	0.416
C	1.15	1.84	0.045	0.072
D	2.95	3.95	0.116	0.156
E	12.25	13.75	0.482	0.541
F	2.34	2.74	0.092	0.108
G	0.51	1.11	0.020	0.044
H	0.97	1.57	0.038	0.062
I	4.25	4.87	0.167	0.192
J	1.07	1.47	0.042	0.058
K	2.03	2.92	0.080	0.115
L	0.3	0.6	0.012	0.024

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