

### General Description

These N-channel enhanced mode power mosfets Used advanced trench technology design, provided excellent Rdson and low gate charge. Which accords with the RoHS standard.

Product Summary			
V <sub>DS</sub>	R <sub>DS(on)</sub> (mΩ) Typ	I <sub>D</sub> (A)	Q <sub>g</sub> (Typ)
40V	1.9@ 10V	40	155nc

### Features

- Fast switching
- Low on-resistance
- Low gate charge and low reverse transfer capacitances
- 100% avalanche tested

### Mechanical Data

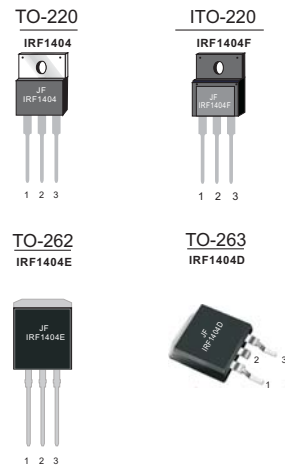
- Case:TO-220,ITO-220,TO-263,TO-262 Package

### Application

- Switching applications

### Ordering Information

Part No.	Package Type	Package	Quality(box)
IRF1404	TO-220	Tube	1000
IRF1404F	ITO-220	Tube	1000
IRF1404D	TO-263	Tape & Reel	800
IRF1404E	TO-262	Tube	1000



### Block Diagram

Pin Definition:

1. Gate
2. Drain
3. Source

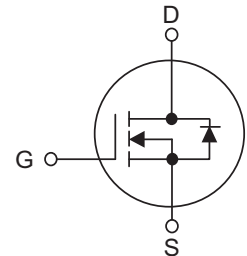


Table1 Absolute Maximum Ratings (T<sub>c</sub>=25 C , unless otherwise specified)

Parameter	Symbol	TO-220/TO-262/TO-263	ITO-220	Unit
Drain-Source Voltage	V <sub>DS</sub>	40		V
Gate-Source Voltage	V <sub>GS</sub>	±20		V
Continuous Drain Current	I <sub>D</sub>	T <sub>C</sub> =25°C	200	A
		T <sub>C</sub> =100°C	135	
Pulsed Drain Current (Note 1)	I <sub>DM</sub>	750		A
Single Pulse Avalanche Energy(Note 2)	E <sub>AS</sub>	121		mJ
Avalanche Current(Note 1)	I <sub>AS</sub>	90		A
Power Dissipation T <sub>C</sub> =25°C	P <sub>D</sub>	215	85	W
Operating Junction and Storage Temperature	T <sub>J</sub> /T <sub>STG</sub>	-55 ~ +175		C

Table 2. Thermal Characteristics

Parameter	Symbol	TO-220/TO-262/TO-263	ITO-220	Unit
Thermal resistance Junction to Ambient	$R_{\theta JA}$	75	75	C/W
Thermal resistance Junction to Case	$R_{\theta JC}$	0.7	1.76	C/W

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	40	50		V
Drain-Source Leakage Current	$I_{DSS}$	$V_{DS}=40V, V_{GS}=0V$			10	$\mu A$
Gate- Source Leakage Current	Forward	$V_{GS}=20V, V_{DS}=0V$			100	nA
	Reverse	$V_{GS}=-20V, V_{DS}=0V$			-100	nA
On Characteristics(Note 4)						
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2.0		4.0	V
Static Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=40A$		1.9	4	m $\Omega$
Dynamic Characteristics(Note 5)						
Input Capacitance	$C_{ISS}$	$V_{DS}=25V, V_{GS}=0V, f=1MHz$		5700		pF
Output Capacitance	$C_{OSS}$			1450		pF
Reverse Transfer Capacitance	$C_{RSS}$			590		pF
Switching Characteristics (Note 5)						
Turn-On Delay Time	$t_d(on)$	$V_{DD}=30V, I_D=60A,$ $V_{GS}=10V, R_G=6\Omega$		35		ns
Turn-On Rise Time	$t_R$			20		ns
Turn-Off Delay Time	$t_d(off)$			45		ns
Turn-Off Fall Time	$t_f$			62		ns
Total Gate Charge	$Q_G$	$V_{DD}=32V, I_D=60A,$ $V_{GS}=10V$		155		nC
Gate-Source Charge	$Q_{GS}$			30		nC
Gate-Drain Charge	$Q_{GD}$			60		nC
Drain-Source Diode Characteristics and Maximum Ratings						
Drain-Source Diode Forward Voltage	$V_{SD}$	$V_{GS}=0V, I_S=60A$			1.3	V
Maximum Continuous Drain-Source Diode Forward Current	$I_S$				200	A
Reverse Recovery Time	$t_{rr}$	$V_{GS}=0V, I_F=60A$		36		ns
Reverse Recovery Charge	$Q_{RR}$	$di/dt=100A/\mu s$ (Note 1)		60		nC

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

2  $L=0.5mH, I_D=90A, V_{DD}=50V, V_{GATE}=40V, Starting T_J=25\text{ }^\circ\text{C}$

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

5 Guaranteed by design, not subject to production



Typical Characteristics Diagrams

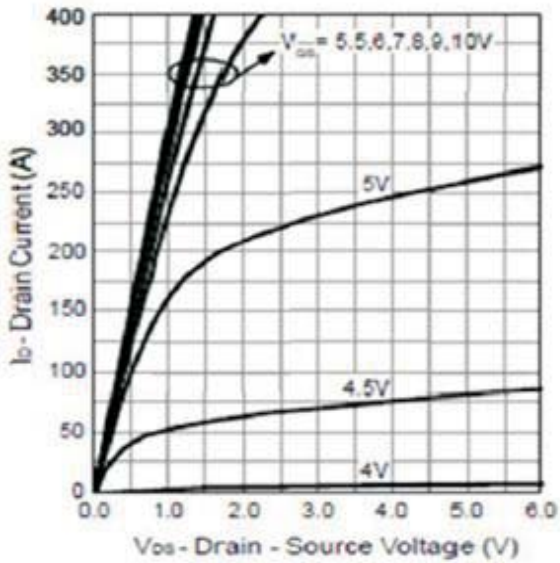


Figure 1 Output Characteristics

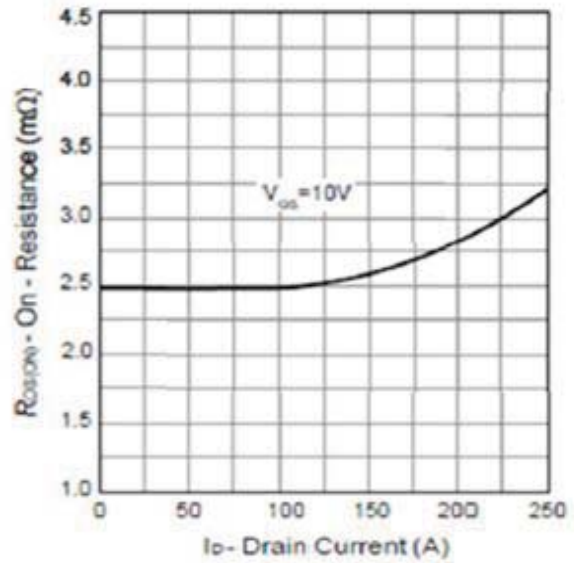


Figure 2 Drain-Source On Resistance

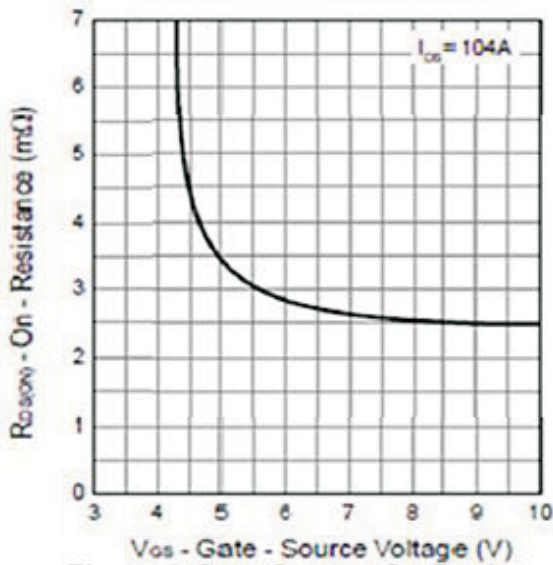


Figure 3 Gate-Source On Resistance

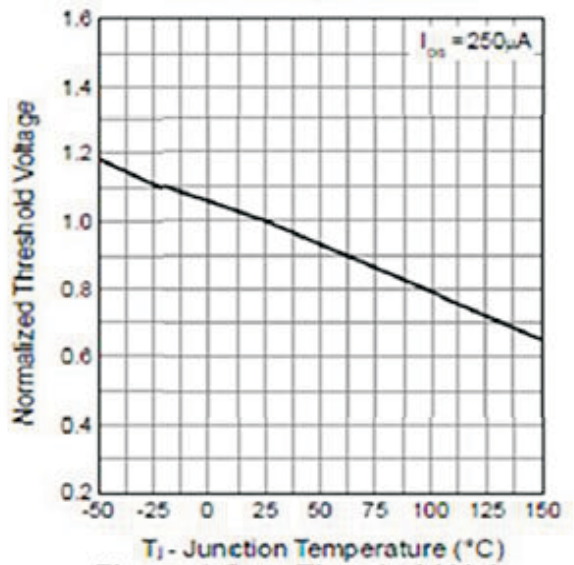


Figure 4 Gate Threshold Voltage



Typical Characteristics Diagrams

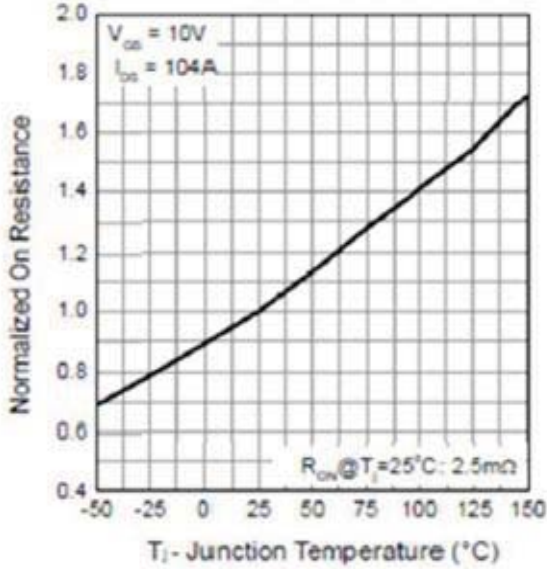


Figure 5 Drain-Source On Resistance

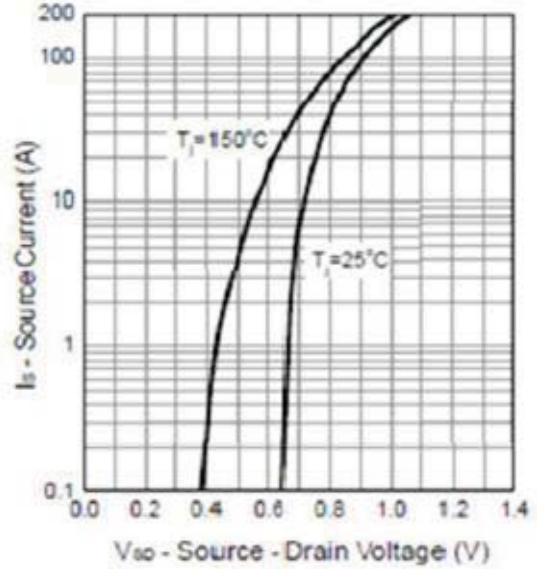


Figure 6 Source-Drain Diode Forward

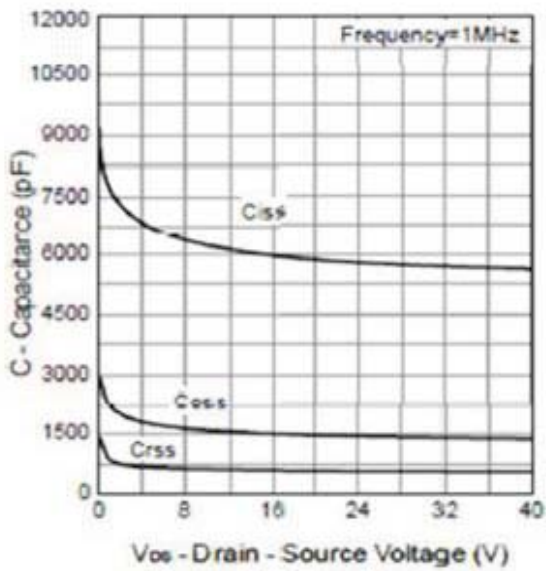


Figure 7 Capacitance

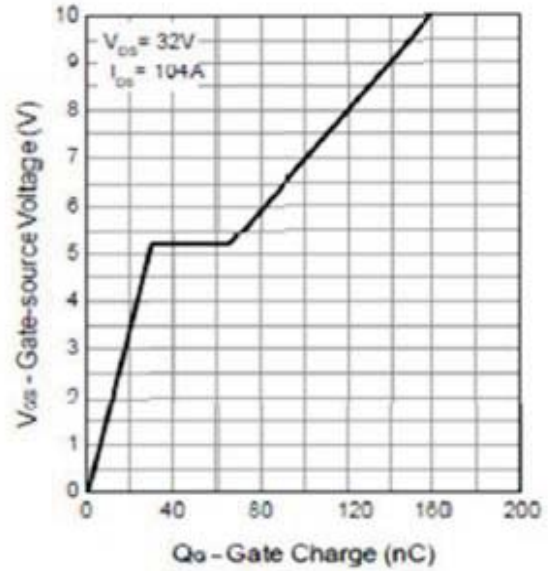
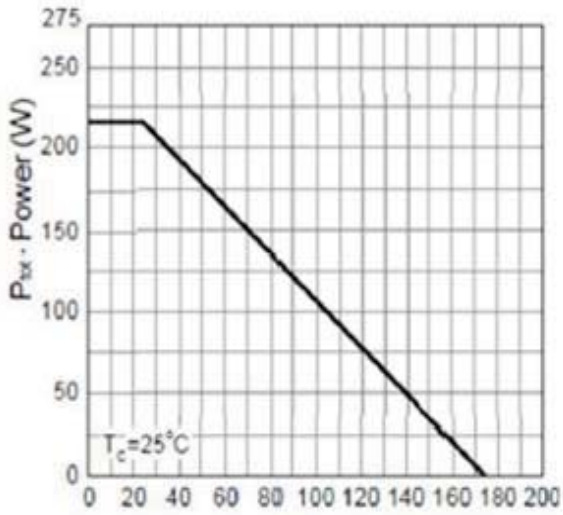


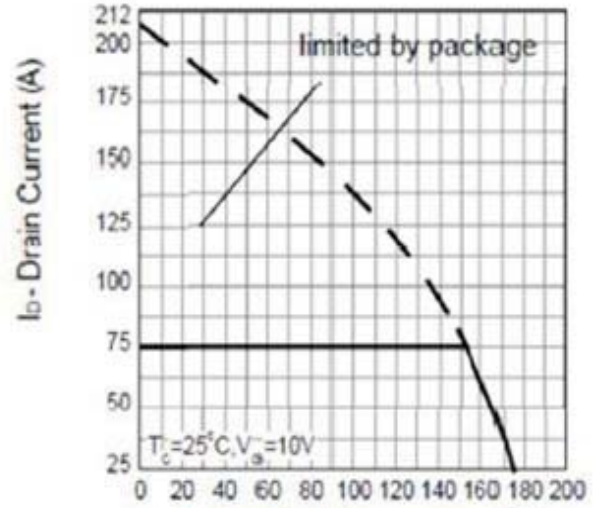
Figure 8 Gate Charge



Typical Characteristics Diagrams



T<sub>J</sub>- Junction Temperature (°C)  
Figure 9 Power Dissipation



T<sub>J</sub>- Junction Temperature (°C)  
Figure 10 Drain Current

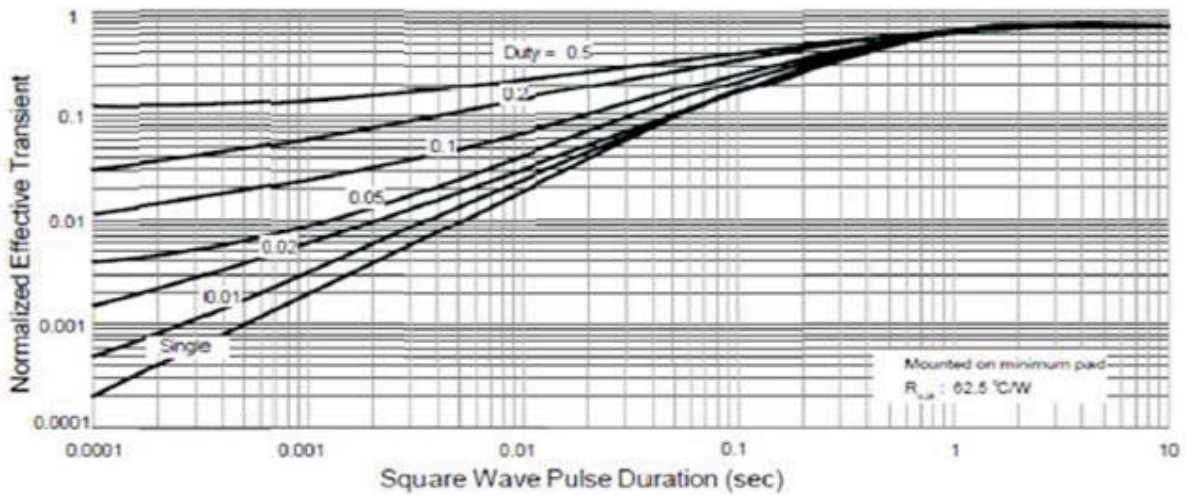
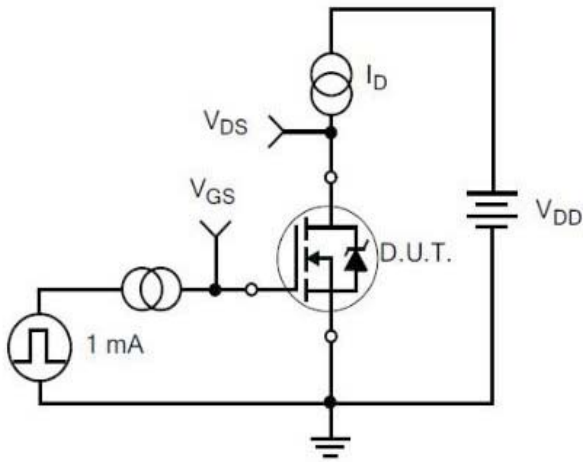


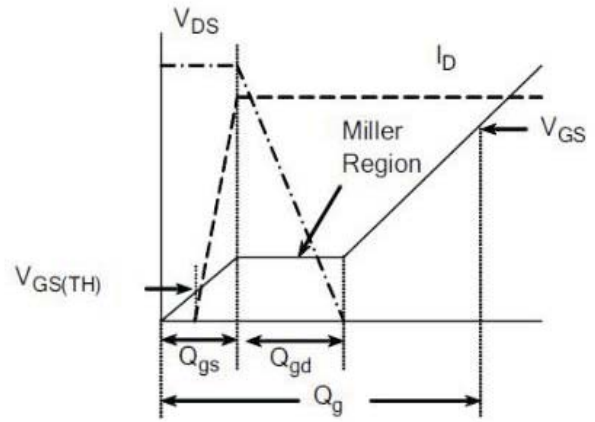
Figure 11 Thermal Transient Impedance



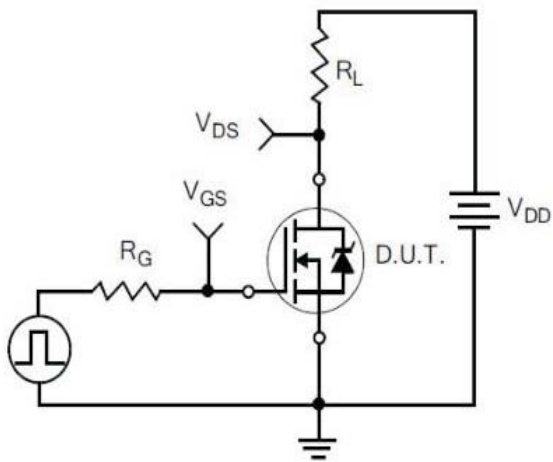
Typical Test Circuit



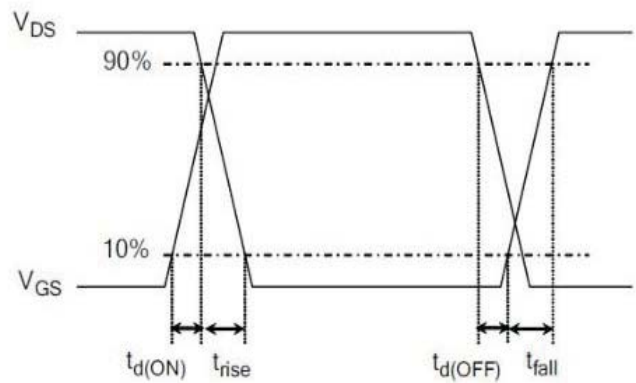
1) Gate Charge Test Circuit



2) Gate Charge Waveform

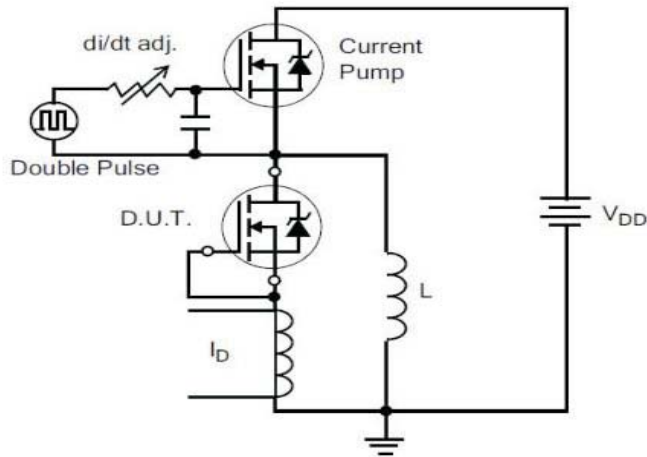


3) Resistive Switching Test Circuit

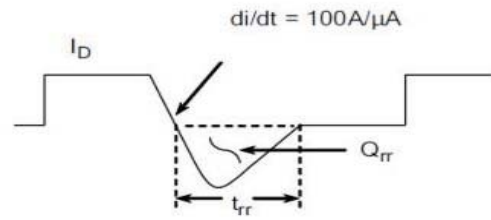


4) Resistive Switching Waveforms

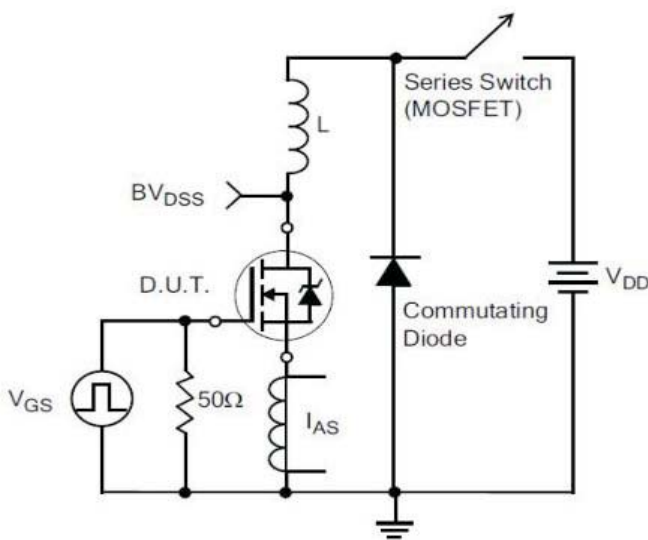
Typical Test Circuit



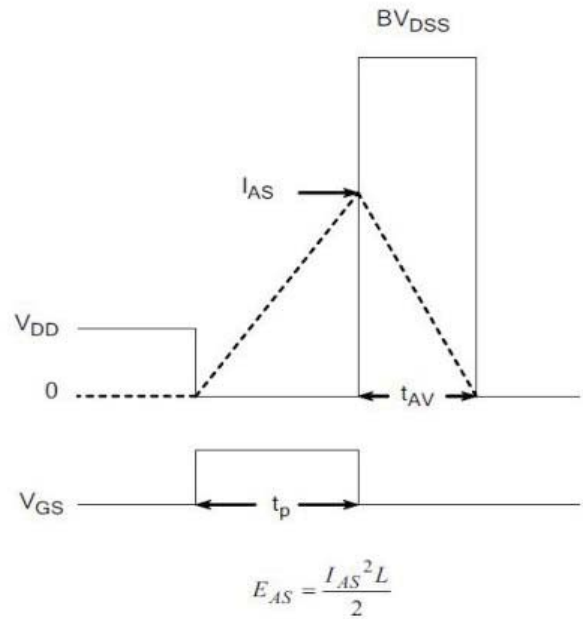
5) Diode Reverse Recovery Test Circuit



6) Diode Reverse Recovery Waveform

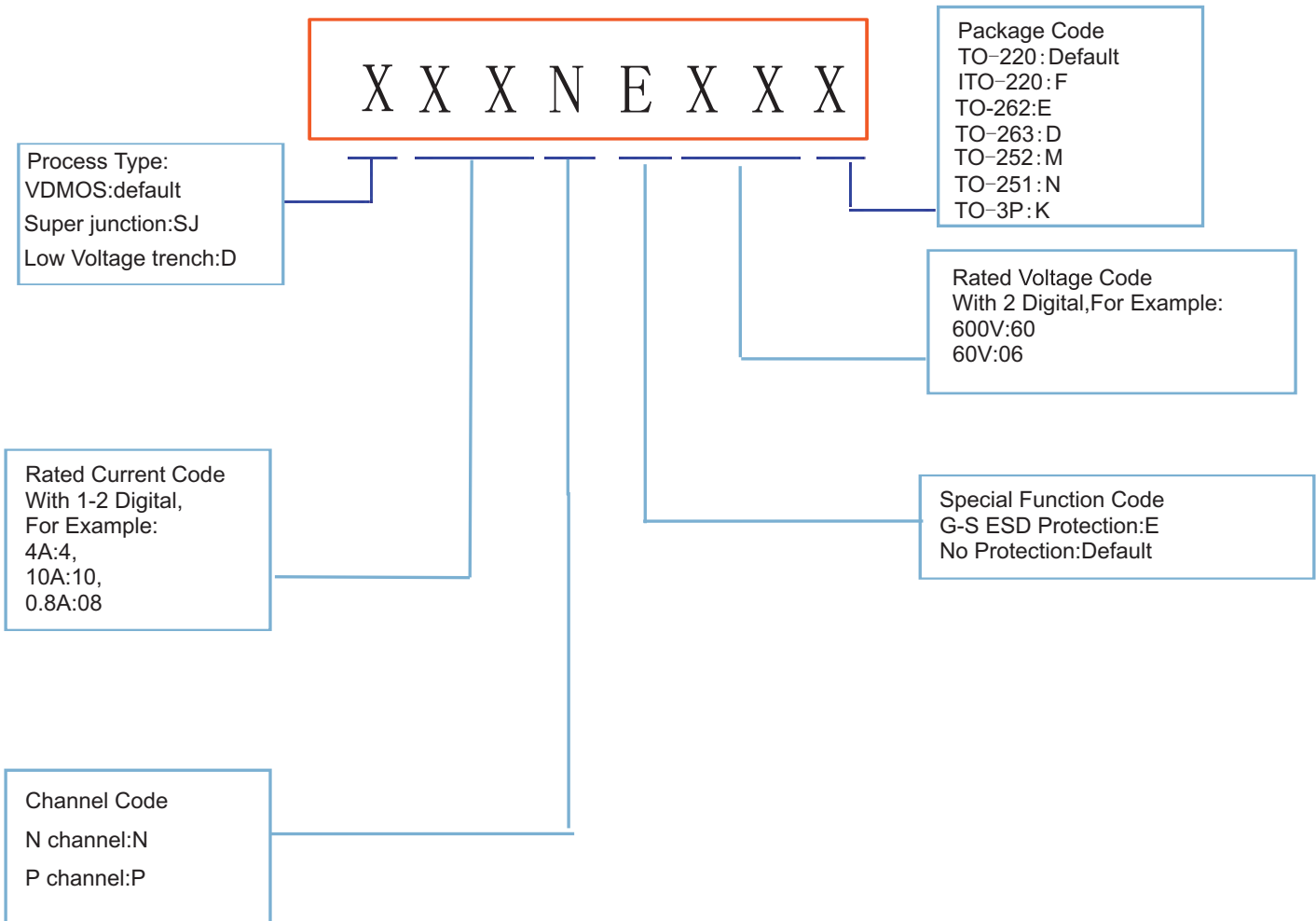


7) . Unclamped Inductive Switching Test Circuit



8) Unclamped Inductive Switching Waveforms

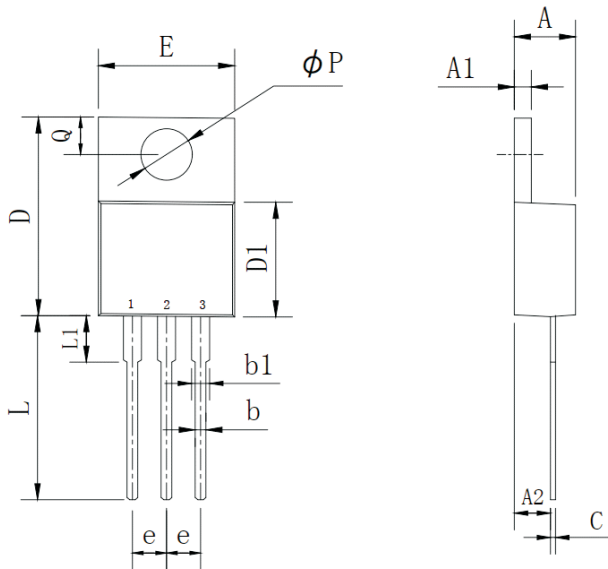
Product Names Rules





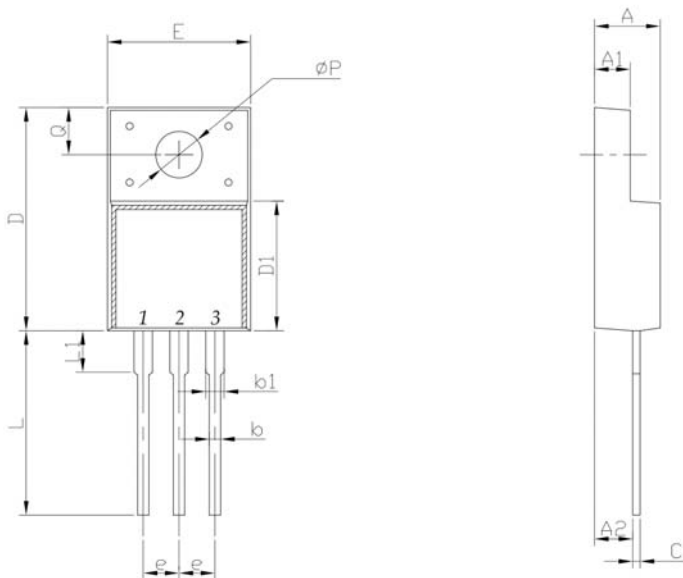
Dimensions

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

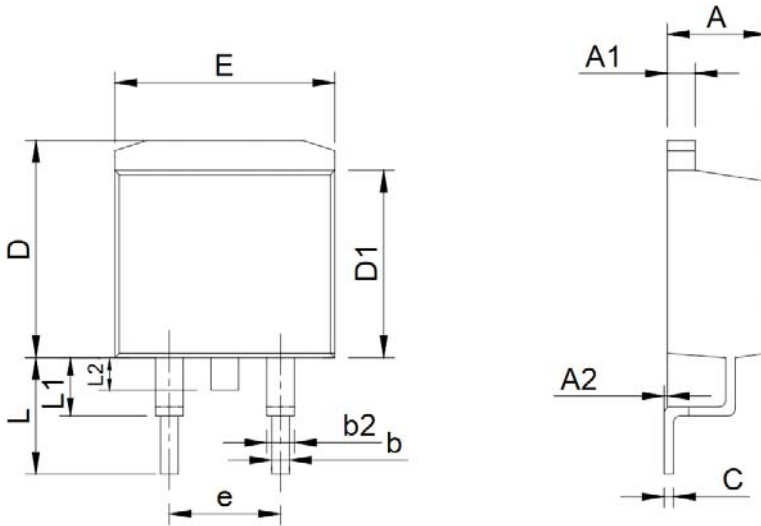
ITO-220 PACKAGE OUTLINE DIMENSIONS



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

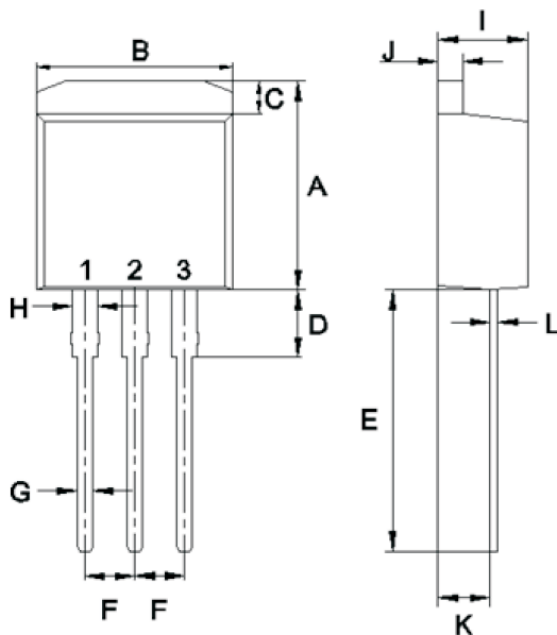
Dimensions

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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