

650V N-Channel Super Junction Power MOSFET

General Description:

This series of power MOSFET use Nchannel 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- 251, TO-252 Package

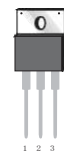
Application :

- Switching applications

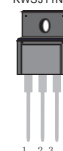
Ordering Information

Part No.	Package Type	Package	Quality(box)
KWSJ11N65	TO-220	Tube	1000
KWSJ11N65F	ITO-220	Tube	1000
KWSJ11N65D	TO-263	Tape & Reel	800
KWSJ11N65N	TO-251	Tube	1000
KWSJ11N65M	TO-252	Tape & Reel	2500

TO-220
KWSJ11N65



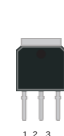
ITO-220
KWSJ11N65F



TO-263
KWSJ11N65D



TO-251
KWSJ11N65N



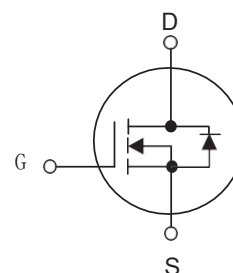
TO-252
KWSJ11N65M



Block Diagram

Pin Definition:

- 1.Gate
- 2.Drain
- 3.Source



VDS	RDS(on)(Ω)Typ	Io(A)	Qg(Typ)
650V	0.38 @ 10V	5.5	32nc

Table1 Absolute Maximum Ratings (Tc=25°C , unless otherwise specified)

Parameter	Symbol	TO-220/TO-263/TO-251/TO-252	ITO-220	Unit
Drain-Source Voltage	V _{DS}	650		V
Gate-Source Voltage	V _{GS}	30		V
Continuous Drain Current	I _D	T _C =25 °C	11	A
		T _C =100 °C	7	
Pulsed Drain Current (Note 1)	I _{DM}	42		A
Single Pulse Avalanche Energy(Note 2)	E _{AS}	260		mJ
Avalanche Current(Note 1)	I _{AR}	2		A
Repetitive Avalanche Energy(Note 1)	E _{AR}	1		mJ
Reverse Diode Recovery dv/dt(Note 3)	dv/dt	15		V/ns
Drain Source Voltage Slope (V _{DS} =480V)	dv/dt	50		V/ns
Power Dissipation T _C =25°C	P _D	151	35	W
Operating Junction and Storage Temperature	T _J /T _{STG}	-55 ~ +150		°C

Table 2. Thermal Characteristics

Parameter	Symbol	TO-220/TO-263 TO-251/TO-252	ITO-220	Unit
Thermal resistance Junction to Ambient	$R_{\theta JA}$	62	80	$^{\circ}\text{C/W}$
Thermal resistance Junction to Case	$R_{\theta JC}$	1.2	4.1	$^{\circ}\text{C/W}$

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 _{DSS}	V _{GS} =0V, I _D =250μA	650			V
Drain-Source Leakage Current		I _{DSS}	V _{DS} =650V, V _{GS} =0V			1	μA
Gate- Source Leakage Current	Forward	I _{GSS}	V _{GS} =30V, V _{DS} =0V			100	nA
	Reverse		V _{GS} =-30V, V _{DS} =0V			-100	nA
On Characteristics(Note 4)							
Gate Threshold Voltage		V _{GS(TH)}	V _{DS} =V _{GS} , I _D =250μA	2.5		4.5	V
Static Drain-Source On-State Resistance		R _{DS(ON)}	V _{GS} =10V, I _D =5.5A		0.38	0.42	Ω
Dynamic Characteristics(Note 5)							
Input Capacitance		C _{ISS}	V _{DS} =25V, V _{GS} =0V, f=1MHz		720		pF
Output Capacitance		C _{OSS}			20		pF
Reverse Transfer Capacitance		C _{RSS}			1.5		pF
Switching Characteristics (Note 5)							
Turn-On Delay Time		t _{d(on)}	V _{DD} =400V, I _D =5.5A, R _G =20Ω		15		ns
Turn-On Rise Time		t _r			10		ns
Turn-Off Delay Time		t _{d(off)}			110		ns
Turn-Off Fall Time		t _f			9		ns
Total Gate Charge		Q _G	V _{DS} =400V, I _D =5.5A, V _{GS} =10V		32		nC
Gate-Source Charge		Q _{GS}			4		nC
Gate-Drain Charge		Q _{GD}			16		nC
Drain-Source Diode Characteristics and Maximum Ratings							
Drain-Source Diode Forward Voltage		V _{SD}	V _{GS} =0V, I _S =5. 5A		0.9	1.5	V
Maximum Continuous Drain-Source Diode Forward Current		I _S				9.2	A
Maximum Pulsed Drain-Source Diode Forward Current		I _{SM}				30	A
Reverse Recovery Time		t _{rr}	V _{GS} =0V, I _S =5. 5A		280		ns
Reverse Recovery Charge		Q _{RR}	dI _F /dt=100A/μs (Note 1)		3300		nC

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

2 $L=60\text{ mH}, I_{AS}=3A, V_{DD}=150V$, 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

Fig1. Power Dissipation

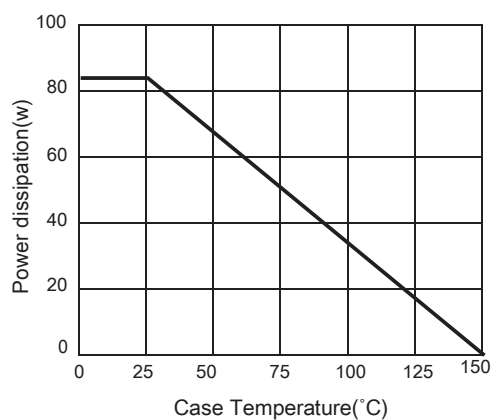


Fig2. Power Dissipation
ITO-220

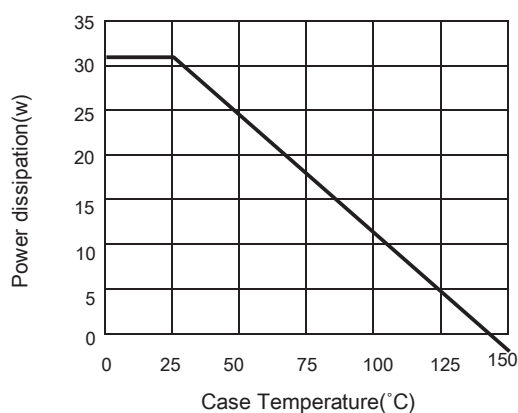


Fig3. Maximum Effective Thermal Impedance

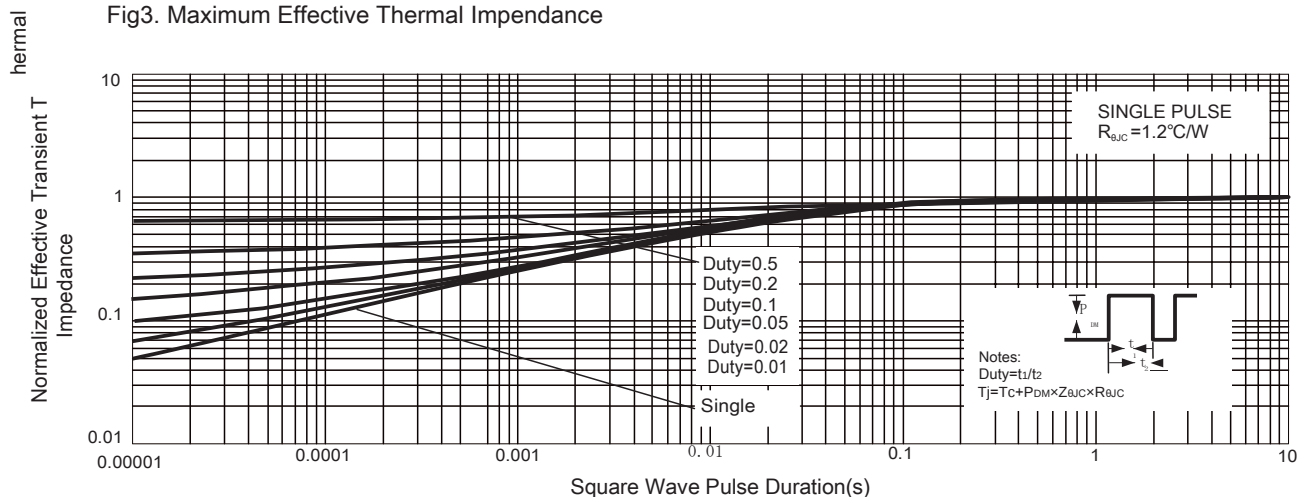


Fig4. Safe Operation Area

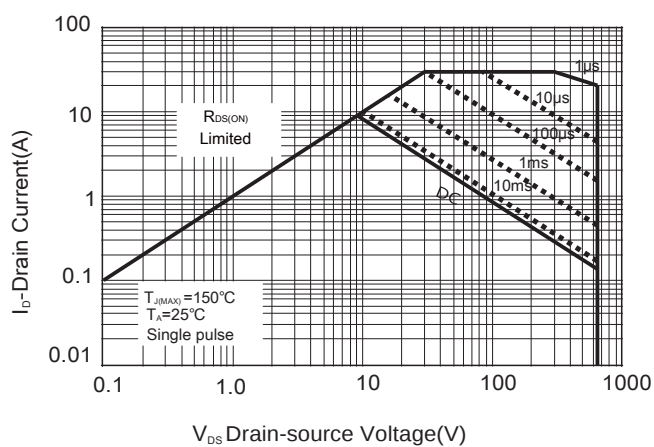
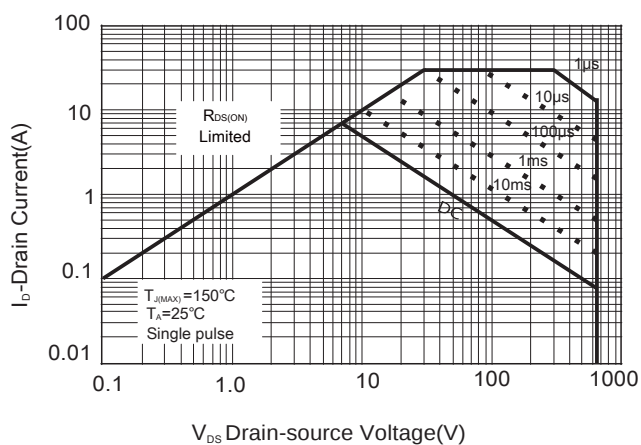


Fig5. Safe Operation Area
ITO-220



Typical Characteristics Diagrams

Fig6. Output Characteristics

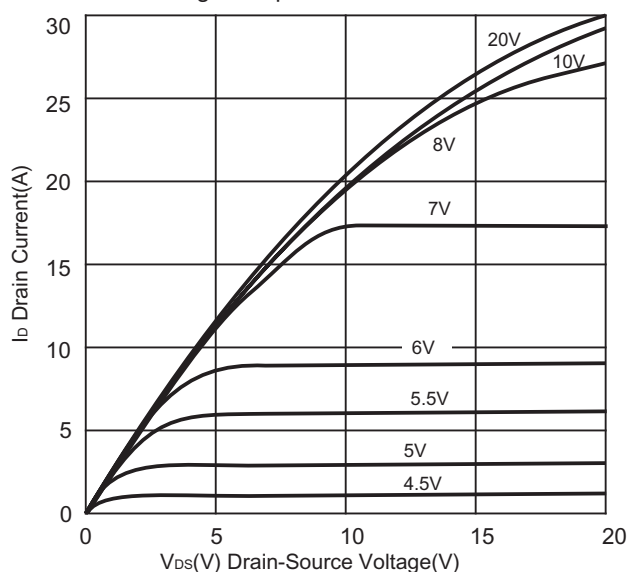


Fig7. Drain-Source on Resistance

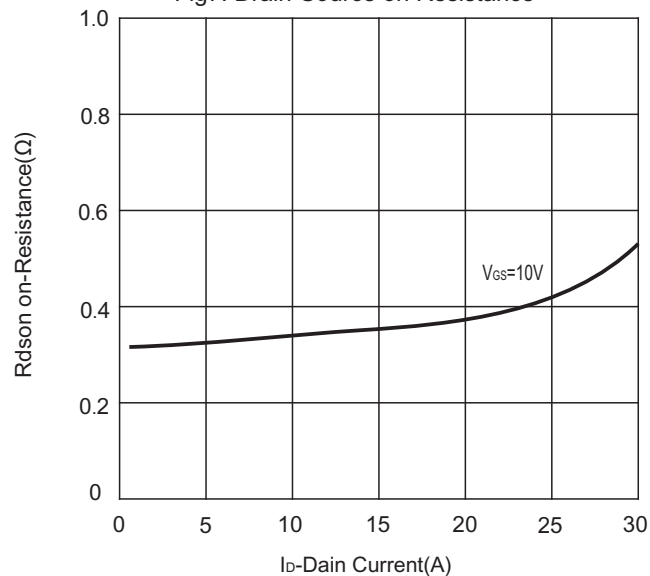


Fig8. Drain-Source on Resistance

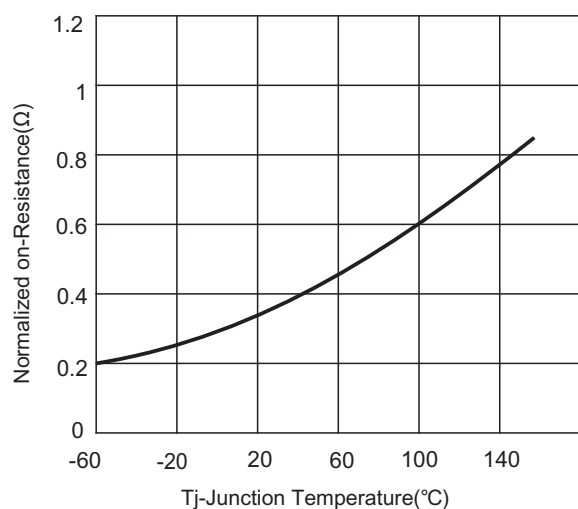


Fig9. Transfer Characteristics

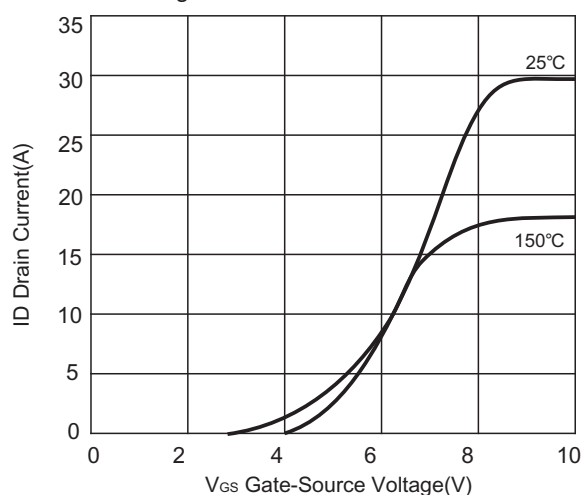


Fig10. Coss stored energy

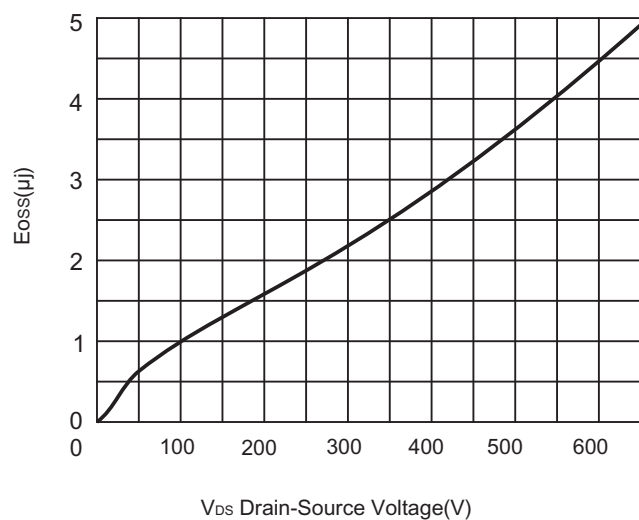
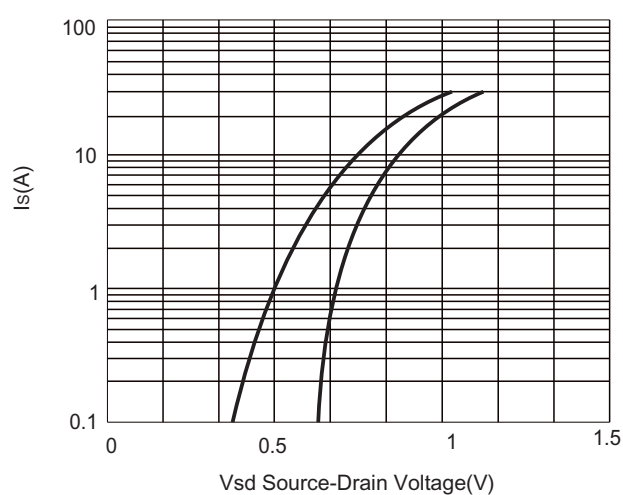


Fig11. Forward Characteristics of Reverse diode



Typical Characteristics Diagrams

Fig12. Capacitance Characteristics

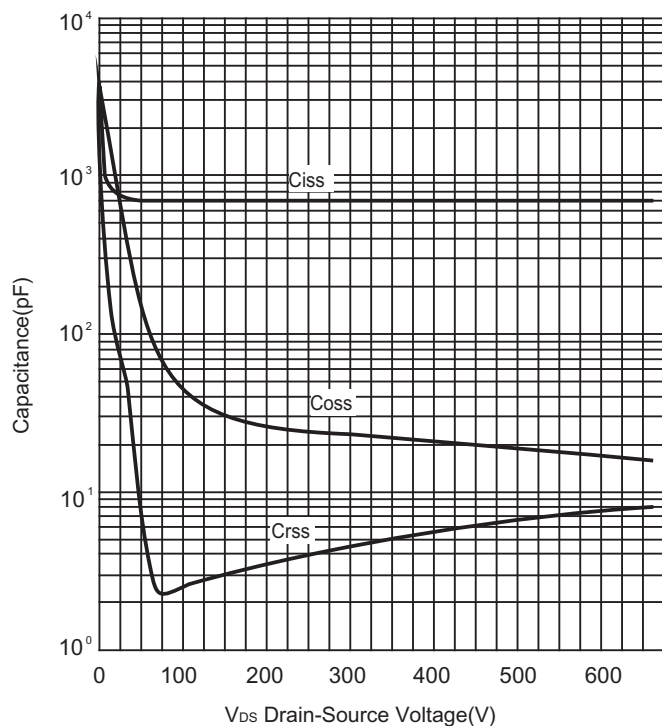


Fig13. Gate Charge

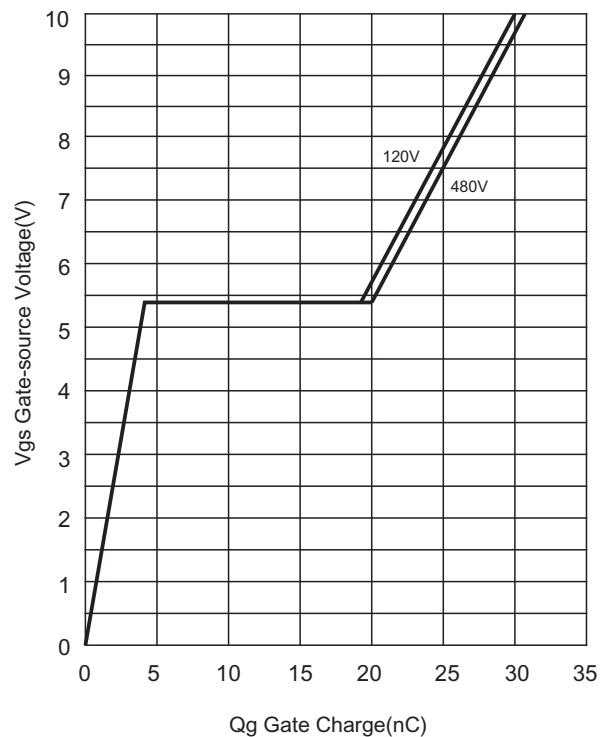


Fig14. Avalanche energy

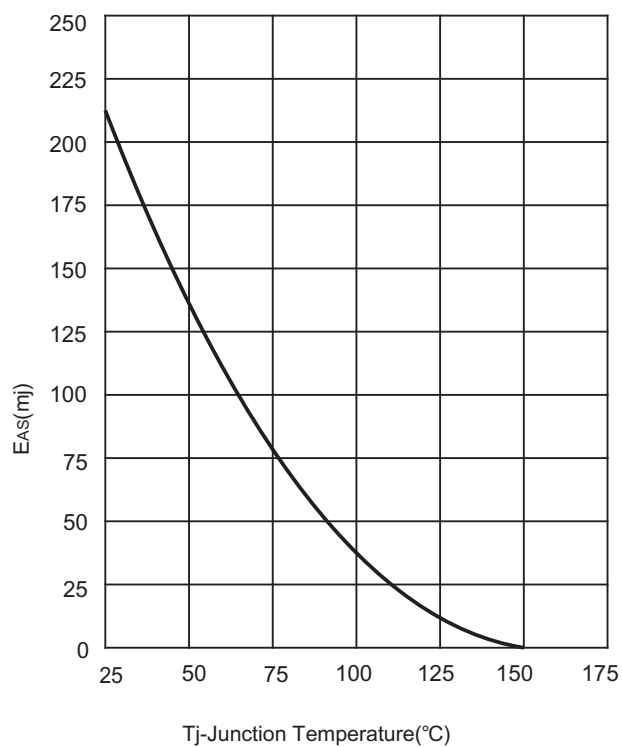
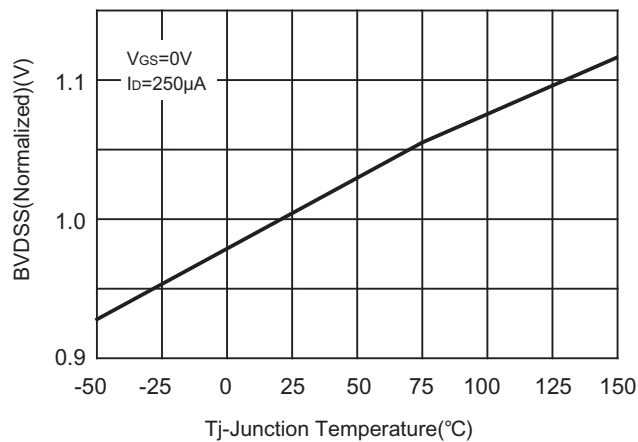


Fig15. Drain-source breakdown voltage



Typical Test Circuit

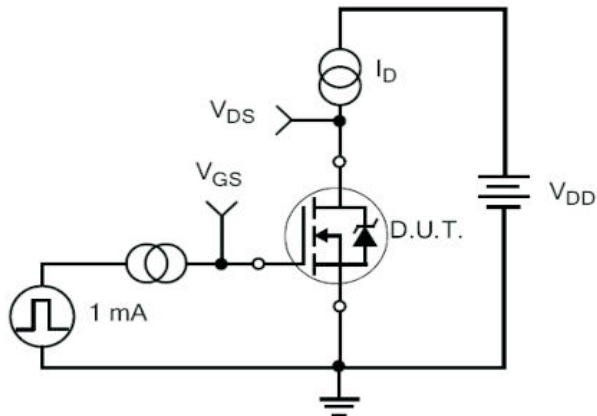


Figure 17. Gate Charge Test Circuit

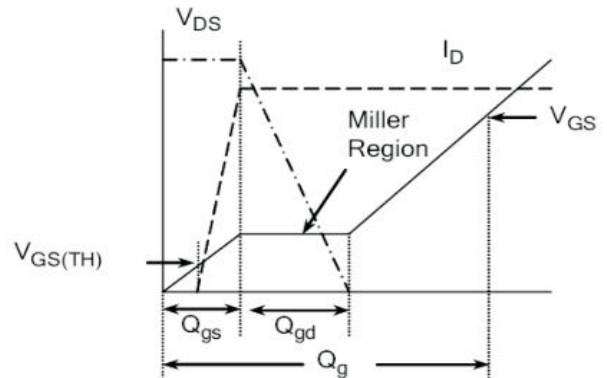


Figure 18. Gate Charge Waveform

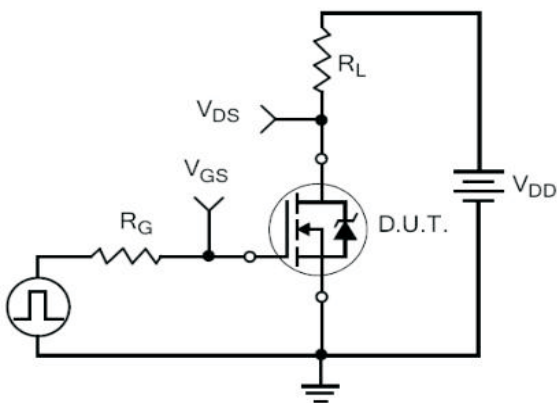


Figure 19. Resistive Switching Test Circuit

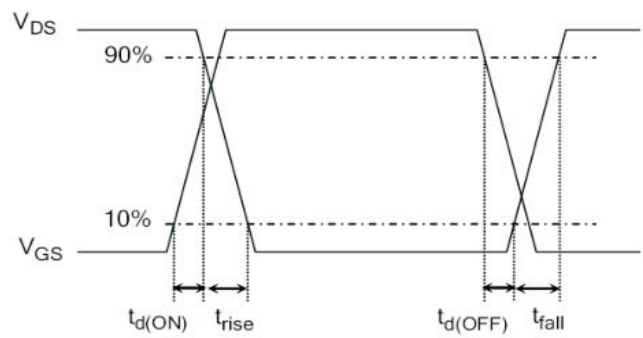


Figure 20. Resistive Switching Waveforms

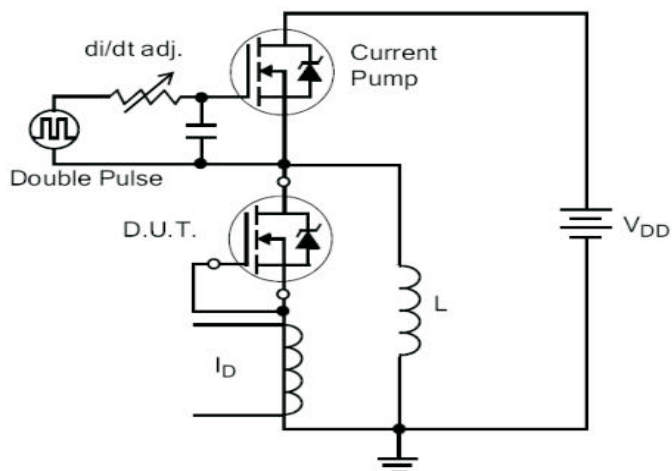


Figure 21. Diode Reverse Recovery Test Circuit

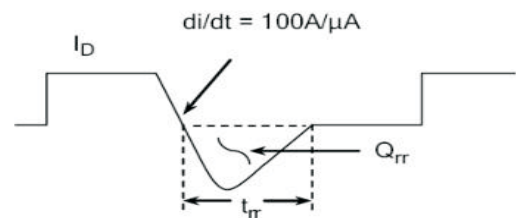


Figure 22. Diode Reverse Recovery Waveform

Typical Test Circuit And Waveform(continues)

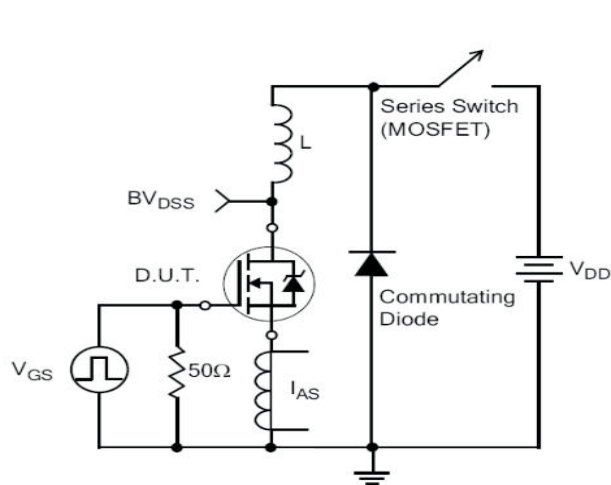


Figure 23. Unclamped Inductive Switching Test Circuit

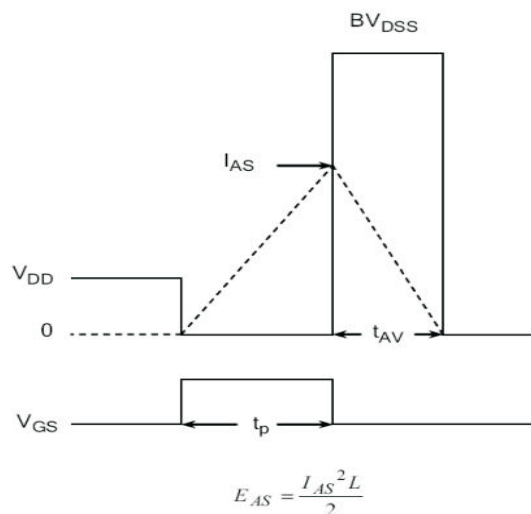
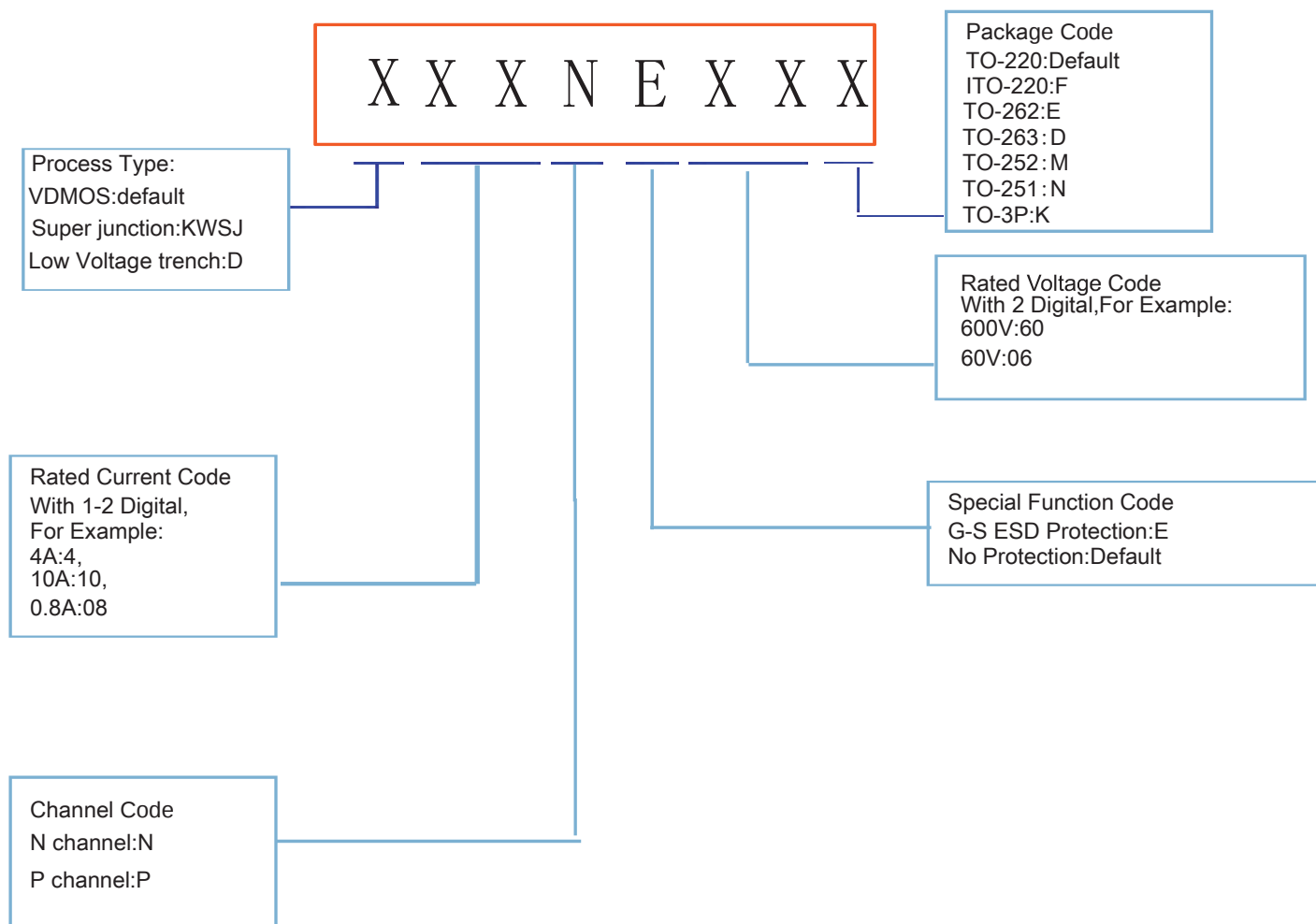


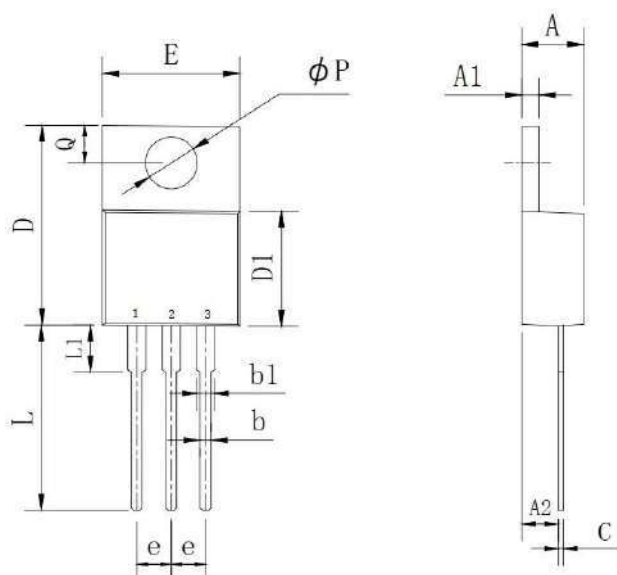
Figure 24. Unclamped Inductive Switching Waveforms

Product Names Rules



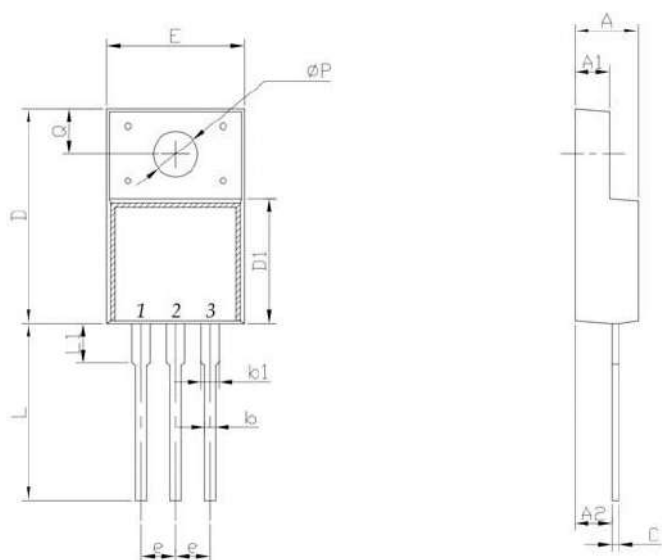
Dimensions

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

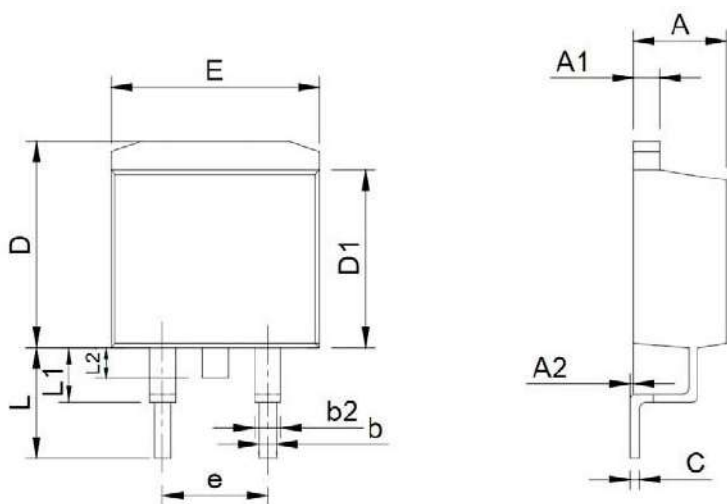
ITO-220 PACKAGE OUTLINE DIMENSIONS



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

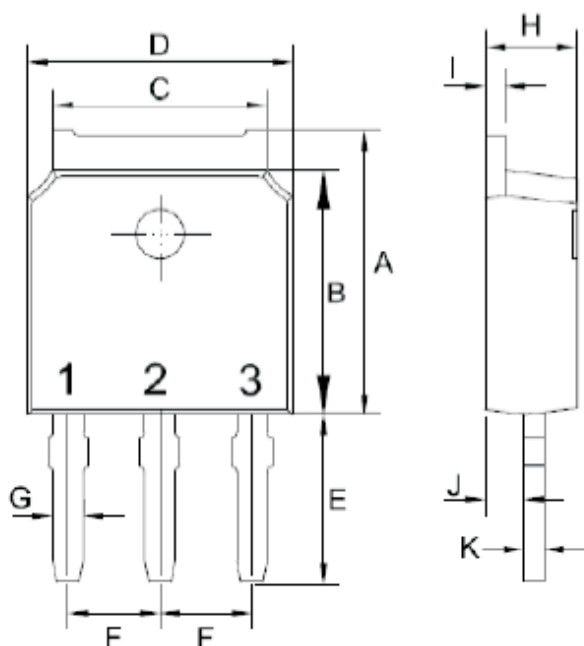
TO-263 PACKAGE OUTLINE DIMENSIONS



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

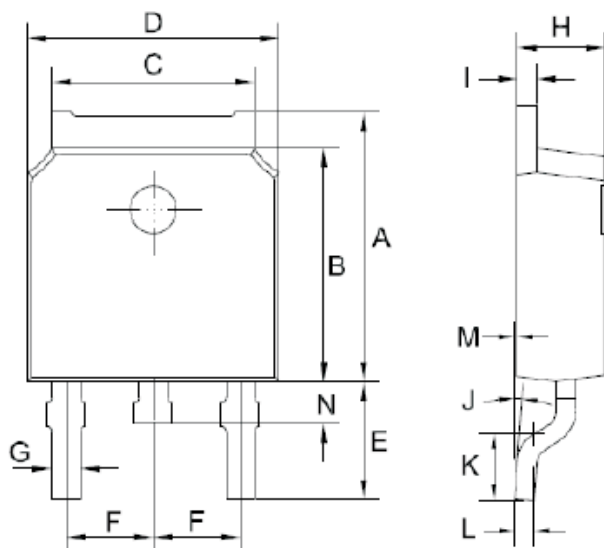
Dimensions

TO-251 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	6.85	7.25	0.270	0.285
B	5.8	6.3	0.228	0.248
C	5	5.53	0.197	0.218
D	6.3	6.8	0.248	0.268
E	3.5	4.35	0.138	0.171
F	2.19	2.39	0.086	0.094
G	0.45	0.85	0.018	0.033
H	2.2	2.4	0.087	0.094
I	0.41	0.61	0.016	0.024
J	0.71	1.31	0.028	0.052
K	0.41	0.61	0.016	0.024

TO-252 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	6.85	7.25	0.270	0.285
B	5.8	6.3	0.228	0.248
C	5	5.53	0.197	0.218
D	6.3	6.8	0.248	0.268
E	2.6	3.3	0.102	0.130
F	2.19	2.39	0.086	0.094
G	0.45	0.85	0.018	0.033
H	2.2	2.4	0.087	0.094
I	0.41	0.61	0.016	0.024
J	0	8	0	8
K	1.45	1.85	0.057	0.073
L	0.41	0.61	0.016	0.024
M	0	0.12	0.000	0.005
N	0.6	1	0.024	0.039