

600V N-Channel Super Junction Power MOSFET

Description:

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

Features:

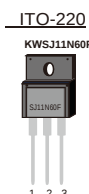
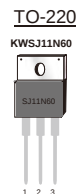
- Low on-resistance
- Ultra low gate charge and input capacitance
- 100% avalanche tested
- Rohs compliant

Mechanical Data:

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

Application:

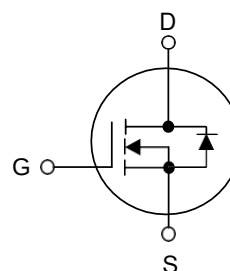
- Switching applications



Block Diagram

Pin Definition:

1. Gate
2. Drain
3. Source



Product Summary

V_{DS}	$R_{DS(on)}$ (Ω) Typ	I_D (A)	Q_g (Typ)
600V	0.38 @ 10V	5.5	32nc

Ordering Information

Part No.	Package Type	Package	Quantity(box)
KWSJ11N60	TO-220	Tube	1000
KWSJ11N60F	ITO-220	Tube	1000
KWSJ11N60D	TO-263	Tape & Reel	800

Table1 Absolute Maximum Ratings ($T_C=25^\circ\text{C}$, unless otherwise specified)

Parameter		Symbol	KWSJ11N60	KWSJ11N60D	KWSJ11N60F	Unit
Drain-Source Voltage		V _{DS}	600			V
Gate-Source Voltage		V _{GS}	±30			V
Continuous Drain Current	T _C =25°C	I _D	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	KWSJ11N60 KWSJ11N60D	KWSJ11N60F	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	600			V
Drain-Source Leakage Current		I _{DSS}	V _{DS} =600V, 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		trr	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

$L=60\text{mH}, I_{AS}=3A, V_{DD}=150V, \text{Starting } T_J=25^{\circ}\text{C}$

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

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
TO-220, TO-263

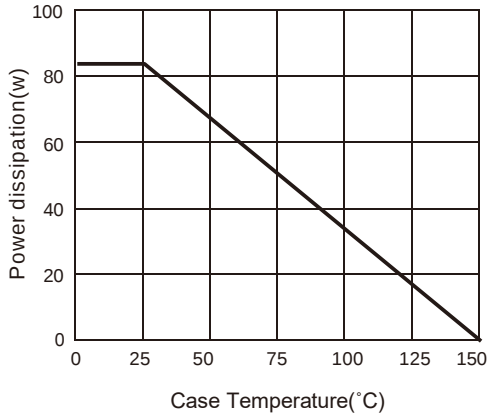


Fig2. Power Dissipation
ITO-220

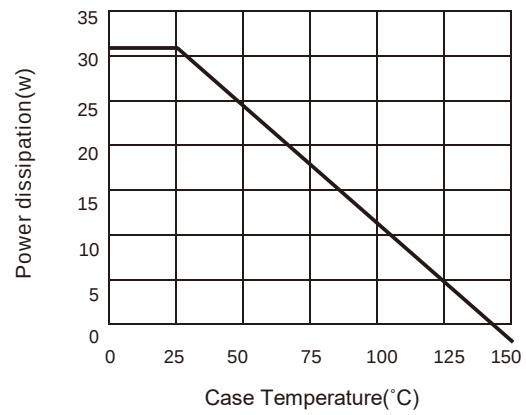


Fig3. Maximum Effective Thermal Impedance

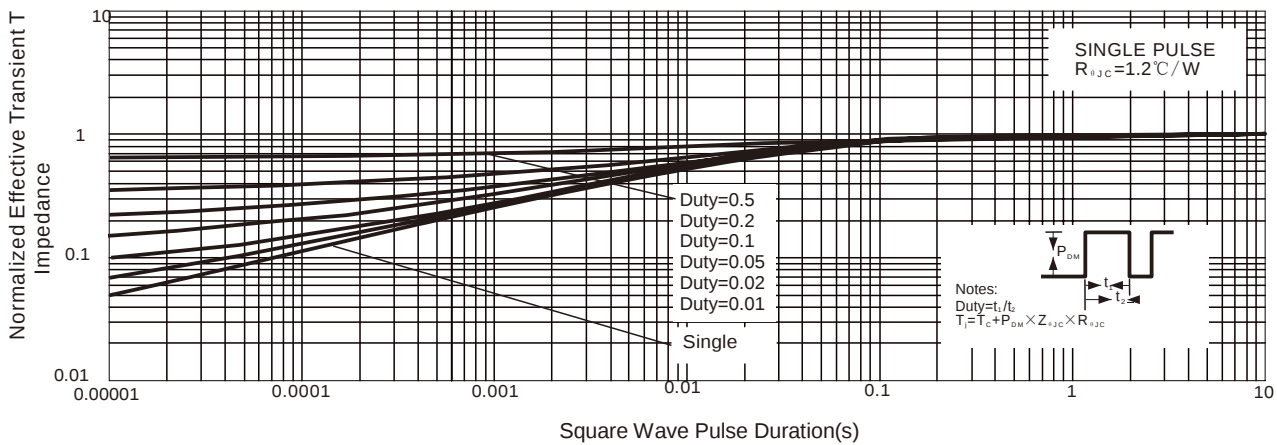


Fig4. Safe Operation Area
TO-220, TO-263

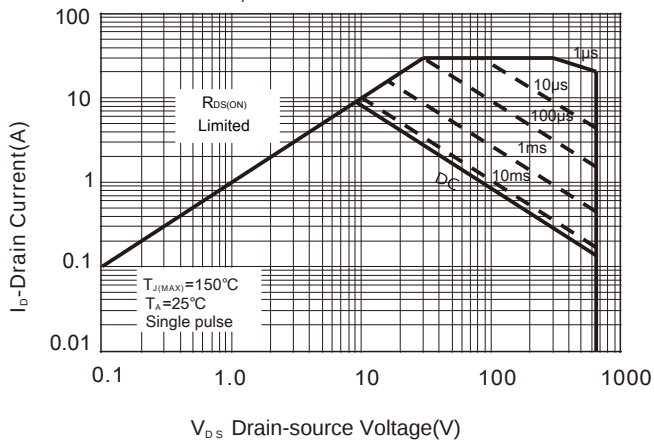
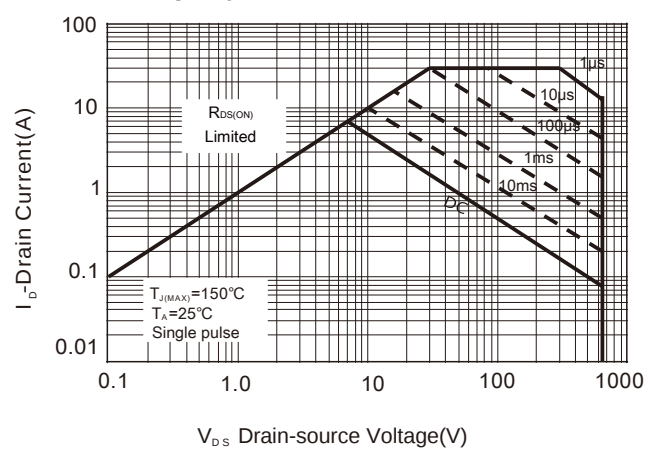


Fig5. Safe Operation Area
ITO-220



Typical Characteristics Diagrams

Fig6. Output Characteristics

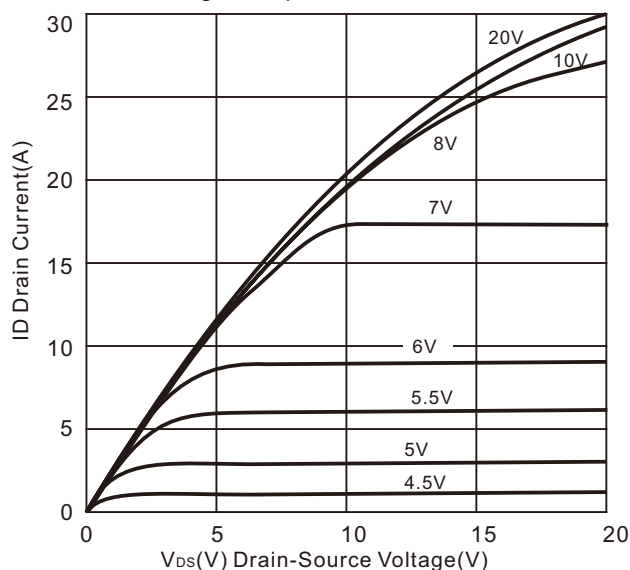


Fig7. Drain-Source on Resistance

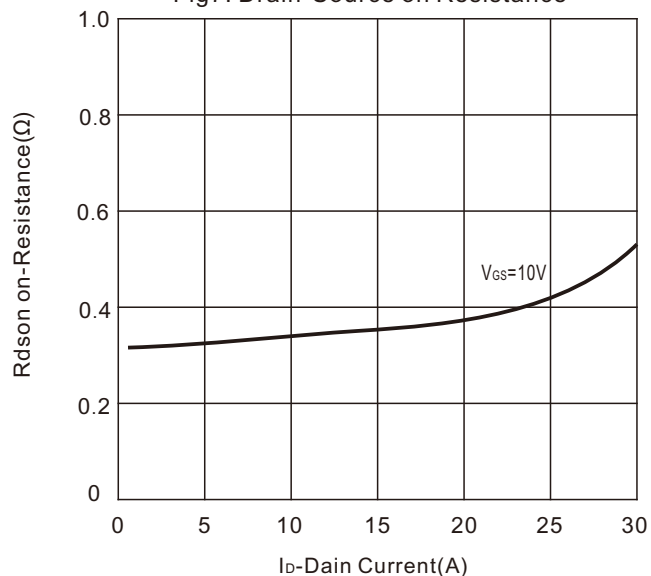


Fig8. Drain-Source on Resistance

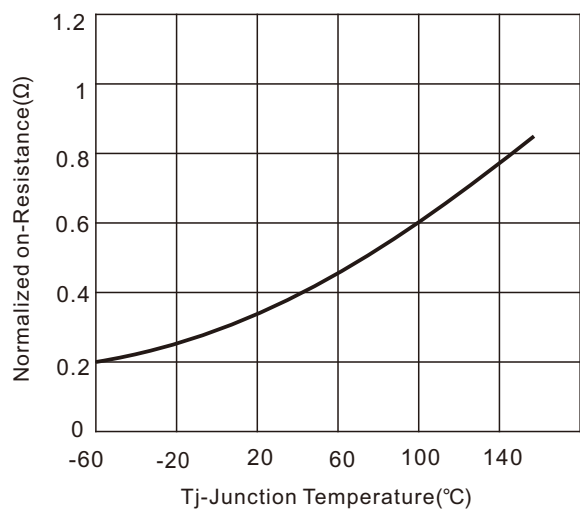


Fig9. Transfer Characteristics

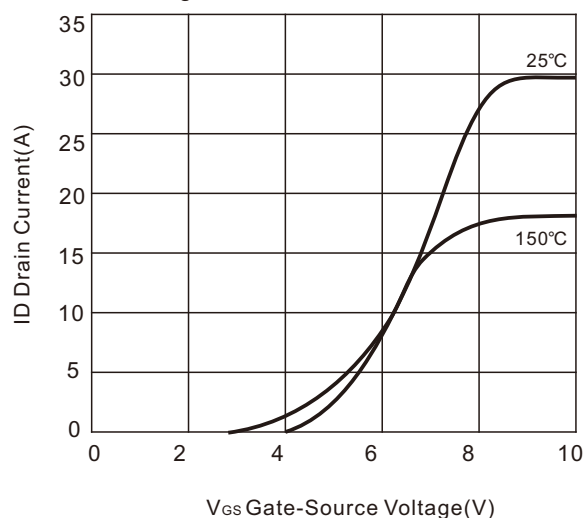


Fig10. Coss stored energy

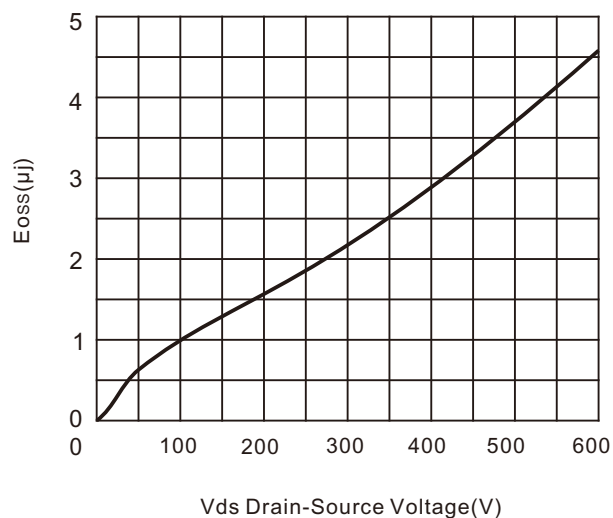
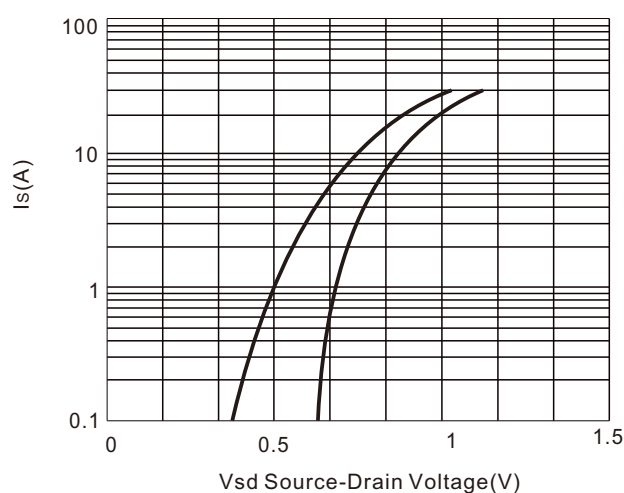


Fig11. Forward Characteristics of Reverse diode



Typical Characteristics Diagrams

Fig12. Capacitance Characteristics

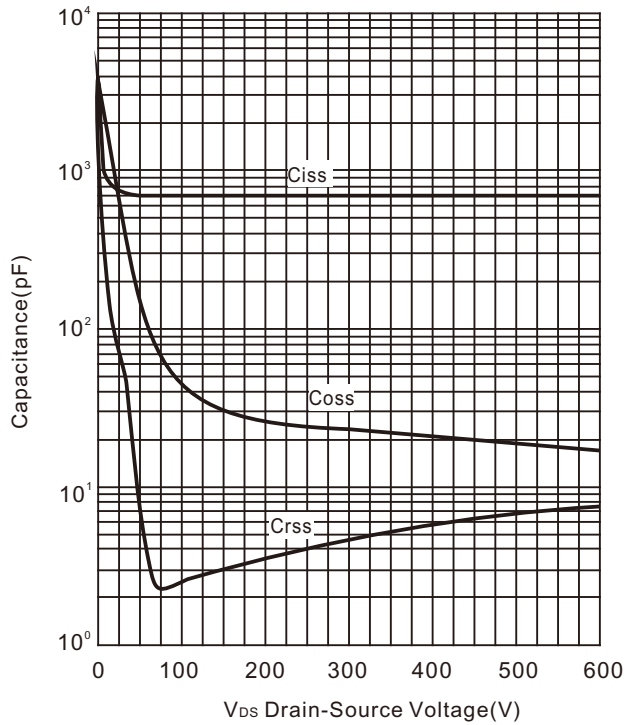


Fig13. Gate Charge

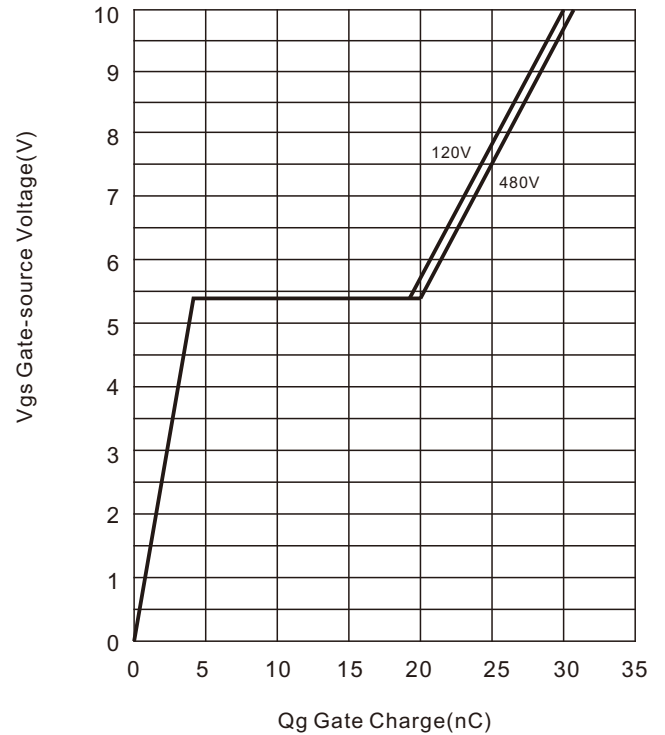


Fig14. Avalanche energy

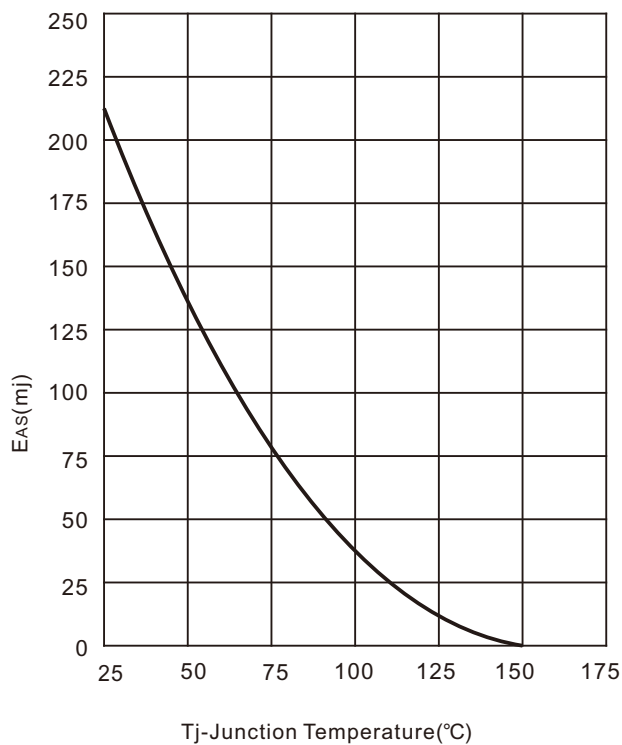
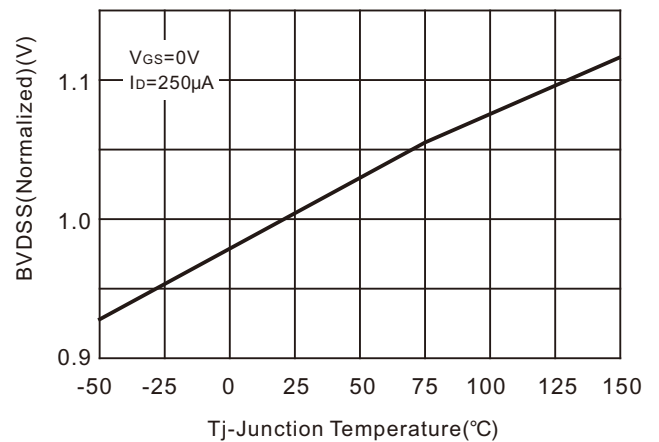


Fig15. Drain-source breakdown voltage



Typical Test Circuit

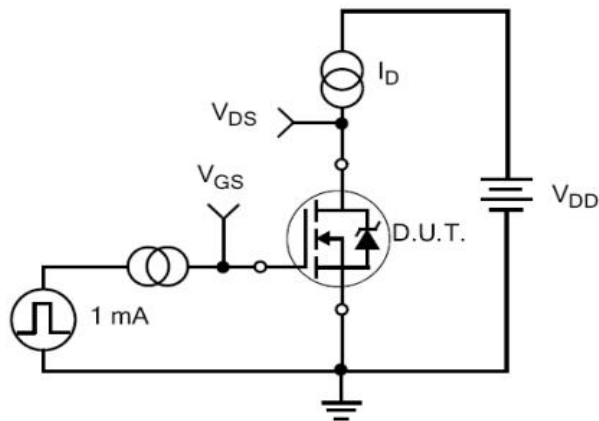


Figure 17. Gate Charge Test Circuit

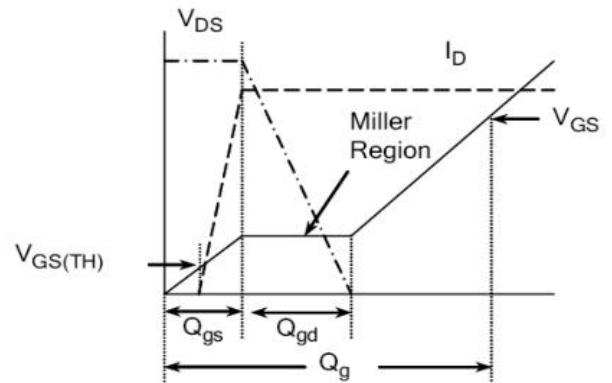


Figure 18. Gate Charge Waveform

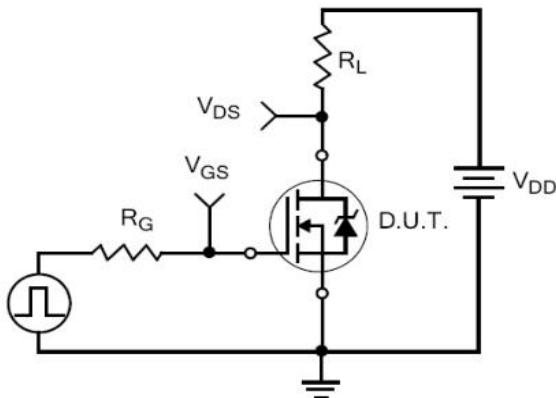


Figure 19. Resistive Switching Test Circuit

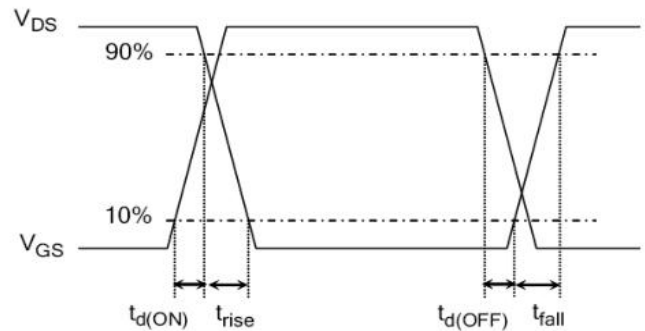


Figure 20. Resistive Switching Waveforms

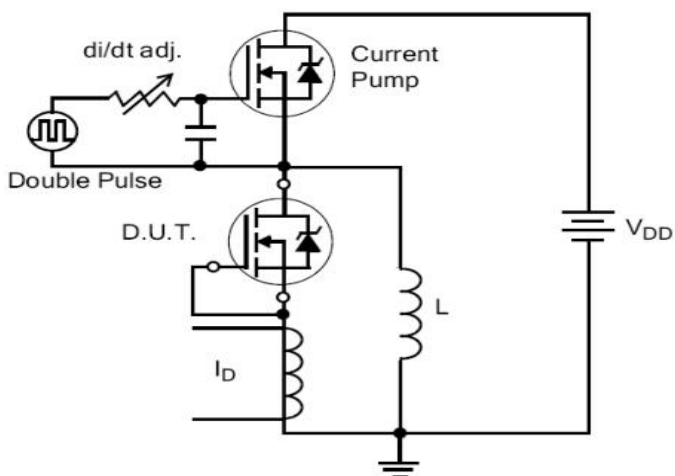


Figure 21. Diode Reverse Recovery Test Circuit

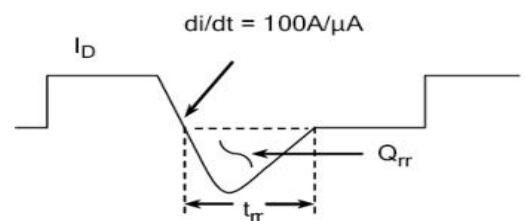


Figure 22. Diode Reverse Recovery Waveform

Typical Test Circuit And Waveform(continues)

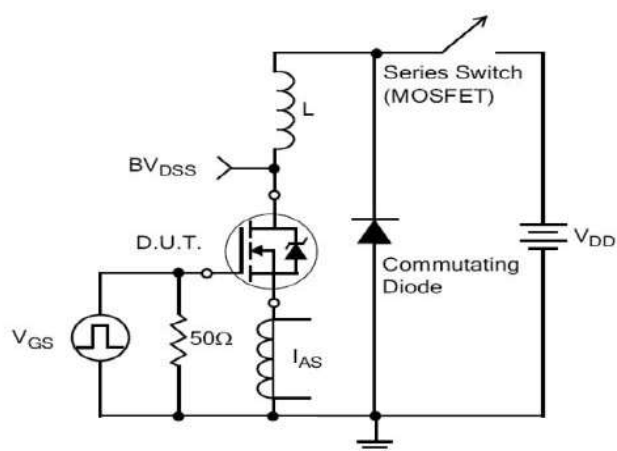


Figure 23. Unclamped Inductive Switching Test Circuit

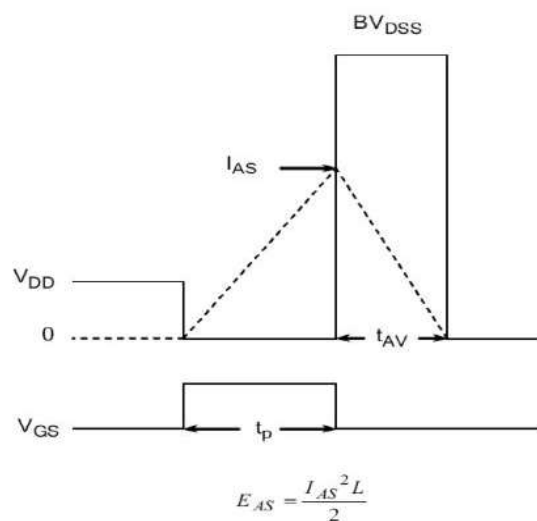


Figure 24. Unclamped Inductive Switching Waveforms

Product Names Rules

X X X N E X X X

Process Type:
 VDMOS:default
 Super junction:SJ
 Low Voltage trench:D

Package Code
 TO-220: Default
 ITO-220: F
 TO-262: E
 TO-263: D
 TO-252: M
 TO-251: N
 TO-3P: K

Rated Voltage Code
 With 2 Digital, For Example:
 600V: 60
 60V: 06

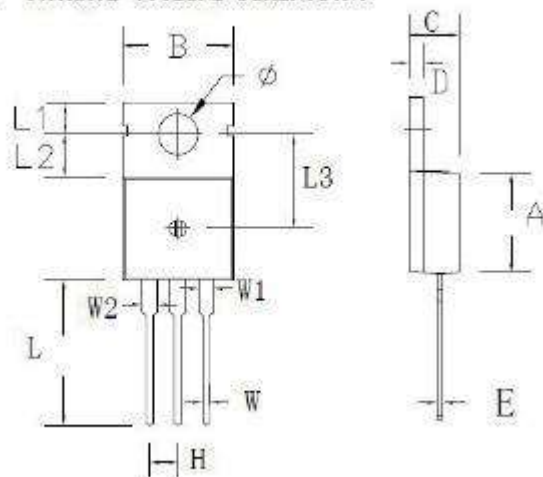
Rated Current Code
 With 1-2 Digital,
 For Example:
 4A: 4,
 10A: 10,
 0.8A: 08

Special Function Code
 G-S ESD Protection: E
 No Protection: Default

Channel Code
 N channel: N
 P channel: P

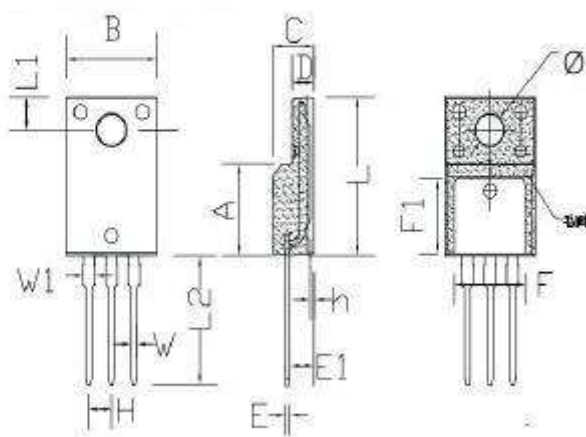
Dimensions

TO-220 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
A	8.80	9.30	0.346	0.366
B	9.70	10.30	0.382	0.406
C	4.25	4.75	0.167	0.187
D	1.20	1.45	0.047	0.057
E	0.40	0.60	0.016	0.024
H	2.54 TYP		0.100 TYP	
W	0.60	0.95	0.024	0.037
W1	1.05	1.45	0.041	0.057
W2	1.20	1.60	0.047	0.063
L	12.60	13.40	0.496	0.528
L1	2.45	2.95	0.096	0.116
L2	3.45	3.95	0.136	0.156
L3	8.15	8.65	0.321	0.341
Φ	3.50	3.90	0.138	0.154

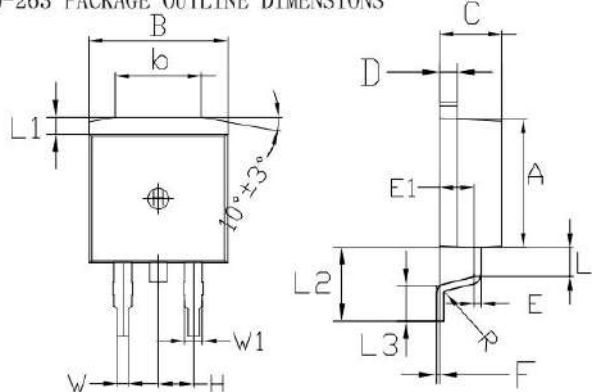
ITO-220 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
A	8.80	9.30	0.346	0.366
B	10.00	10.50	0.394	0.413
C	4.30	4.90	0.169	0.193
D	2.30	2.70	0.091	0.106
L	15.55	16.15	0.612	0.636
h	0.40	0.60	0.016	0.024
L1	3.15	3.55	0.124	0.140
L2	12.65	13.35	0.498	0.526
W	0.70	0.90	0.028	0.035
W1	1.15	1.55	0.045	0.061
H	2.54 TYP		0.100 TYP	
E	0.48	0.53	0.019	0.021
Φ	2.90	3.40	0.114	0.134
E1	2.40	2.90	0.094	0.114
F	7.75	8.25	0.305	0.325
F1	7.35	7.85	0.289	0.309

Dimensions

TO-263 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
A	8.80	9.30	0.346	0.366
B	9.70	10.30	0.382	0.406
C	4.25	4.75	0.167	0.187
D	1.20	1.45	0.047	0.057
E	0.40	0.60	0.016	0.024
L	1.90	2.30	0.075	0.091
L1	1.15	1.45	0.045	0.057
R	0.24	0.26	0.0095	0.0102
W	0.80	0.82	0.0315	0.0323
W1	1.20	1.30	0.047	0.051
H	2.54 TYP		0.200 TYP	
b	5.50	6.50	0.216	0.256
E1	2.4	2.6	0.0946	0.1024
L2	5.20	5.80	0.205	0.228
L3	2.20	3.20	0.087	0.126
F	0.03	0.23	0.0012	0.0091