

650V N-Channel Super Junction Power MOSFET

Description:

This series of power MOSFET use N channel Multi-EPI Super-Junction technology and design to provide better characteristics, such as fast switching time, 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-247, TO-3P, TO-263-7L Package

Application:

- Switching applications

Ordering Information

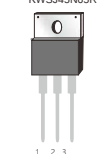
Part No.	Package Type	Package	Quantity(box)
KWSJ45N65R	TO-220	Tube	1000
KWSJ45N65FR	ITO-220	Tube	1000
KWSJ45N65DR	TO-263	Tape & Reel	800
KWSJ45N65PR	TO-247	Tube	600
KWSJ45N65KR	TO-3P	Tube	600
KWSJ45N65D7R	TO-263-7	Tape & Reel	800

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

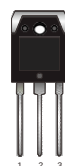
Parameters	Symbol	KWSJ45N65R KWSJ45N65DR KWSJ45N65D7R	KWSJ45N65PR KWSJ45N65KR	KWSJ45N65FR	Unit
Drain-Source Voltage	V_{DS}	650			V
Gate-Source Voltage	V_{GS}	±30			V
Continuous Drain Current	$T_C=25^{\circ}\text{C}$	I_D	45	45 [※]	A
	$T_C=100^{\circ}\text{C}$		24	24 [※]	
Pulsed Drain Current (Note 1)	I_{DM}	130			A
Single Pulse Avalanche Energy (Note 2)	E_{AS}	1050			mJ
Avalanche Current (Note 1)	I_{AR}	9.5			A
Repetitive Avalanche Energy (Note 1)	E_{AR}	1.6			mJ
Reverse Diode Recovery dv/dt (Note 3)	dv/dt	15			V/ns
Drain Source Voltage Slope ($V_{DS}=480\text{V}$)	dv/dt	50			V/ns
Power Dissipation $T_C=25^{\circ}\text{C}$	P_D	391		50	W
Operating Junction and Storage Temperature	T_J/T_{STG}	-55 ~ +150			°C

※ limited by maximum junction temperature

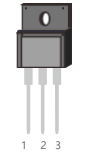
TO-220
KWSJ45N65R



TO-3P
KWSJ45N65KR



ITO-220
KWSJ45N65FR



TO-247
KWSJ45N65PR



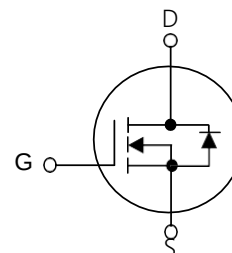
TO-263
KWSJ45N65DR



TO-263-7L
KWSJ45N65D7R



Block Diagram



Pin Definition:

1. Gate
2. Drain

3/4/5/6/7. Source

Table 2. Thermal Characteristics

Parameters	Symbol	KWSJ45N65R KWSJ45N65DR KWSJ45N65D7R	KWSJ45N65PR KWSJ45N65KR	KWSJ45N65FR	Unit
Thermal resistance Junction to Ambient	$R_{\theta JA}$	62		82	$^{\circ}\text{C/W}$
Thermal resistance Junction to Case	$R_{\theta JC}$	0.32		2.5	$^{\circ}\text{C/W}$

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

Parameters		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 =23A		75	85	mΩ
Dynamic Characteristics(Note 5)							
Input Capacitance		C _{ISS}	V _{DS} =25V,V _{GS} =0V,f=1MHz		2800		pF
Output Capacitance		C _{OSS}			138		pF
Reverse Transfer Capacitance		C _{RSS}			5		pF
Switching Characteristics (Note 5)							
Turn-On Delay Time		td(on)	V _{DD} =480V,I _D =23A, V _{GS} =10V,R _G =20Ω		19		ns
Turn-On Rise Time		tr			10		ns
Turn-Off Delay Time		td(off)			87		ns
Turn-Off Fall Time		tf			5		ns
Total Gate Charge		Q _G	V _{DS} =480V,I _D =23A, V _{GS} =10V		190		nC
Gate-Source Charge		Q _{GS}			30		nC
Gate-Drain Charge		Q _{GD}			95		nC
Drain-Source Diode Characteristics and Maximum Ratings							
Drain-Source Diode Forward Voltage		V _{SD}	V _{GS} =0V,I _S =23A		0.9	1.5	V
Maximum Continuous Drain-Source Diode Forward Current(Note 4)		I _S				45	A
Reverse Recovery Time		trr	V _{GS} =0V,I _S =23A		180		ns
Reverse Recovery Charge		Q _{RR}	dI _F /dt=100A/μs(Note 4)		17		μC

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

2 Pulse width t_p limited by $T_{J,max}$

3 $V_{DD} \leq BV_{DSS}$, 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

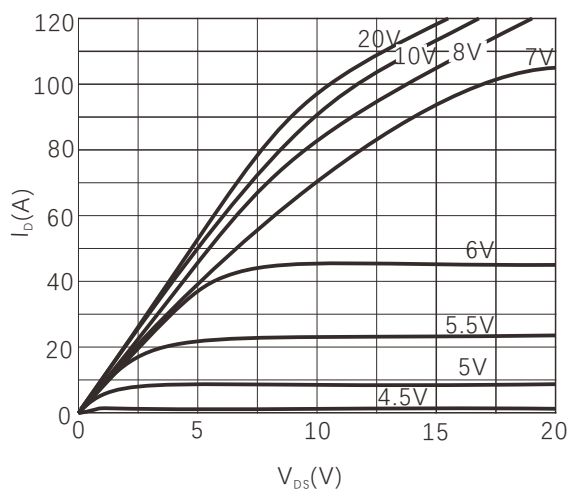


Figure 2. Transfer Characteristics

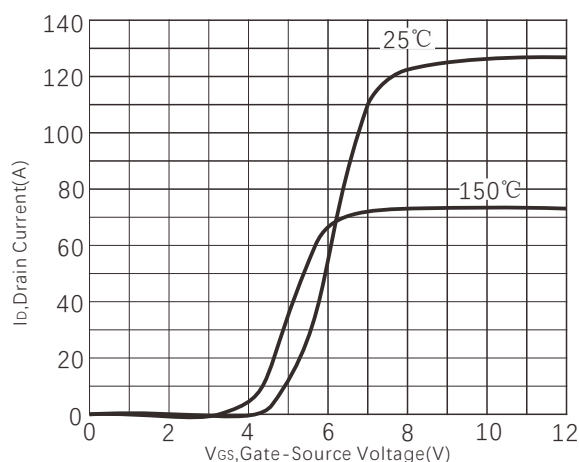


Figure 3. On-Resistance vs. Drain Current

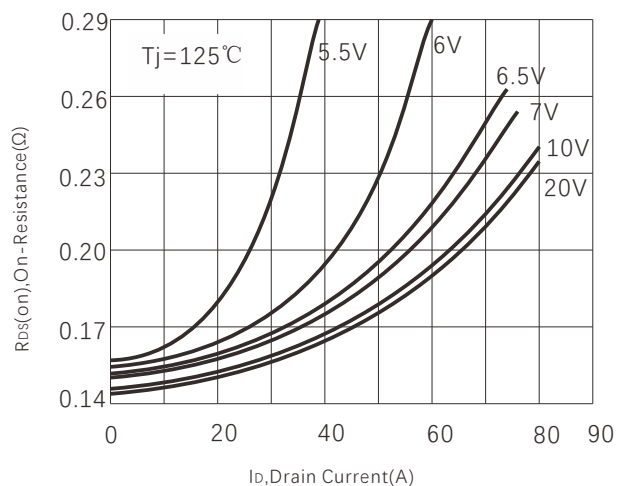


Figure 4. Capacitance

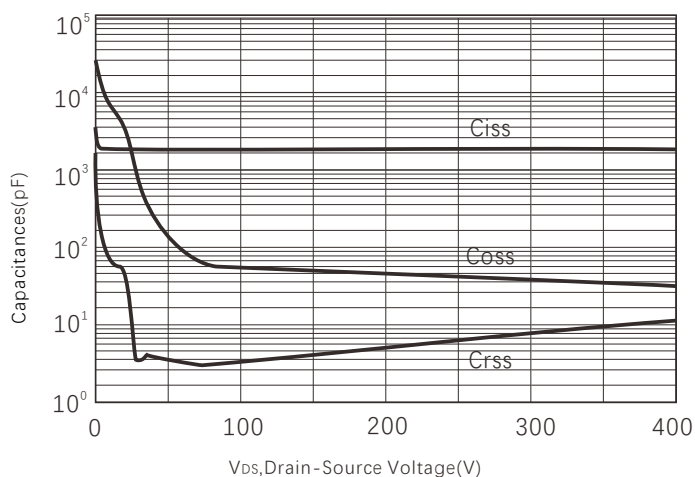


Figure 5. Gate charge

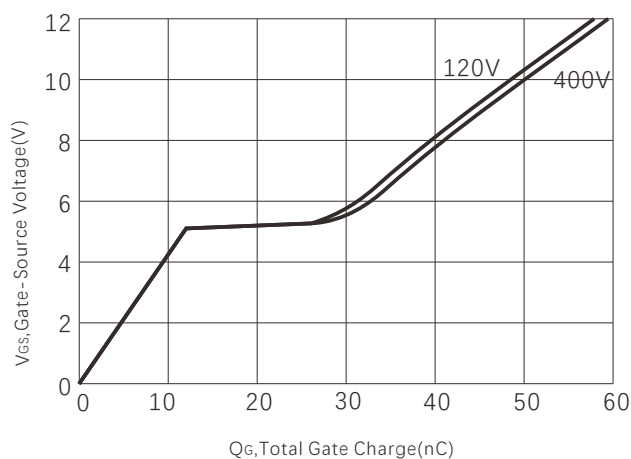


Figure 6. Source-Drain Diode Forward Voltage

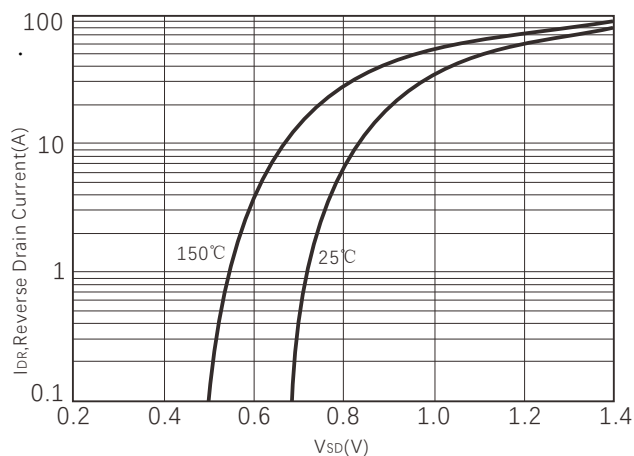


Figure 7. Normalized $R_{DS(ON)}$ vs Junction Temperature

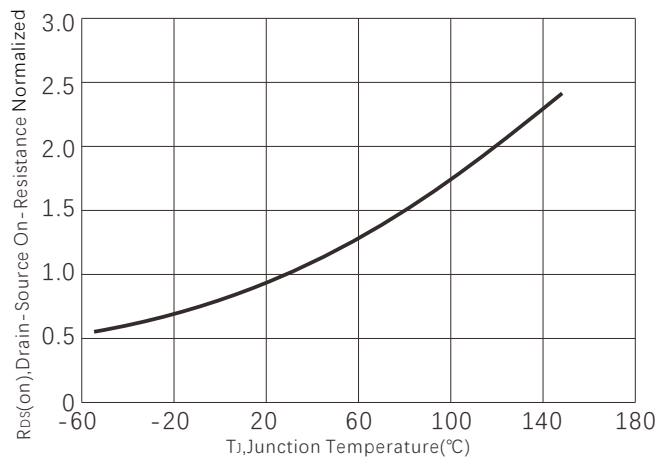


Figure 8. BV_{DSS} vs Junction Temperature

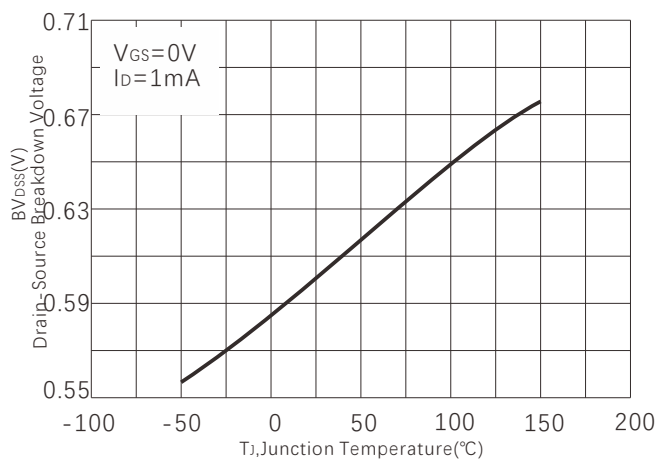


Figure 9. Safe operating area

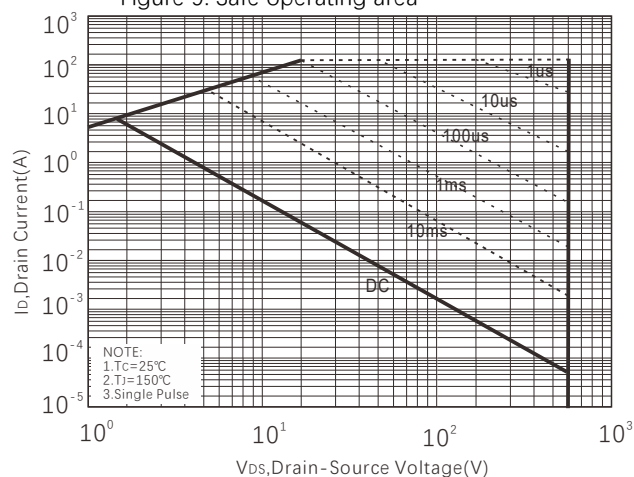


Figure 10. Power dissipation

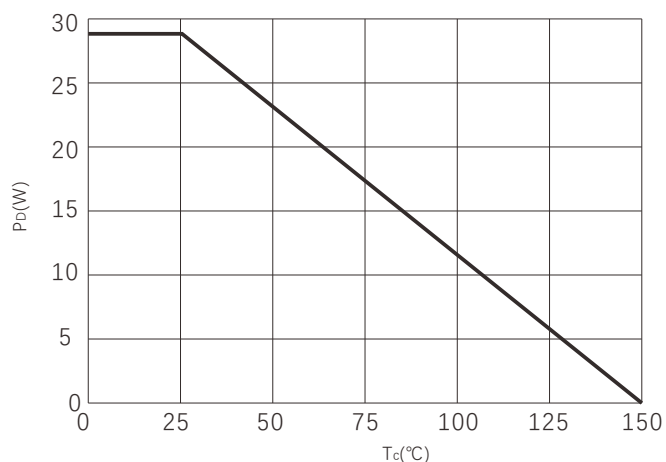
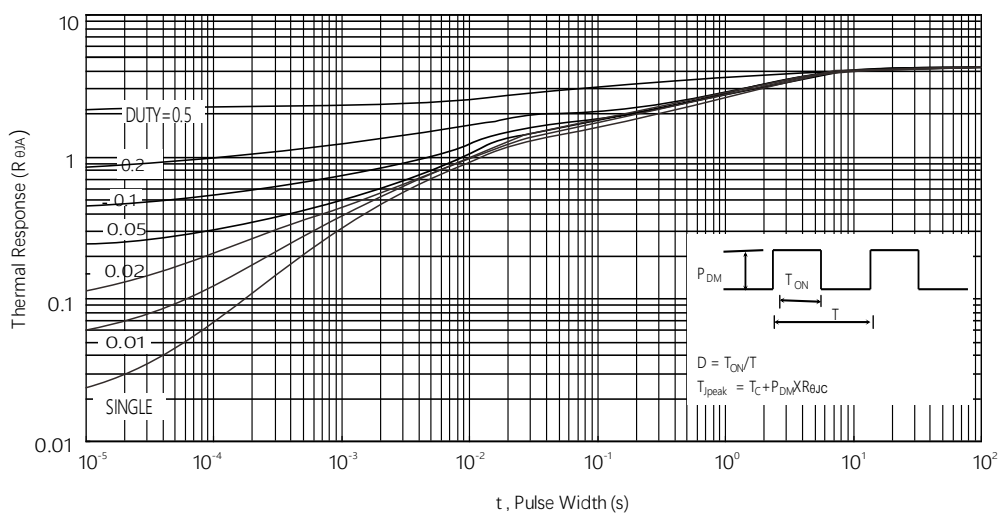
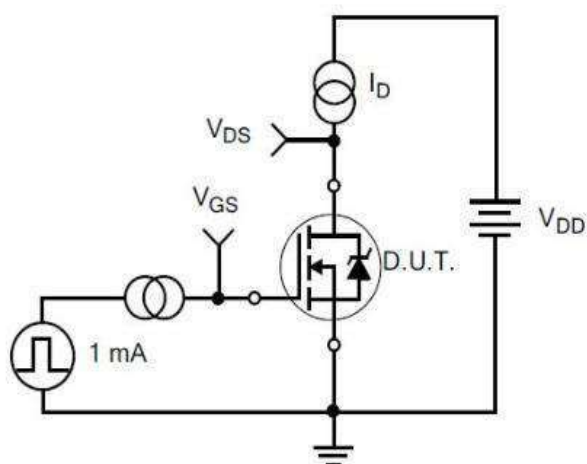


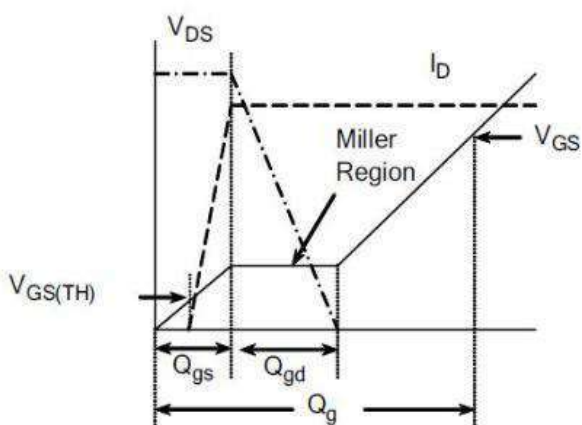
Figure 11. Maximum Transient Thermal Impedance



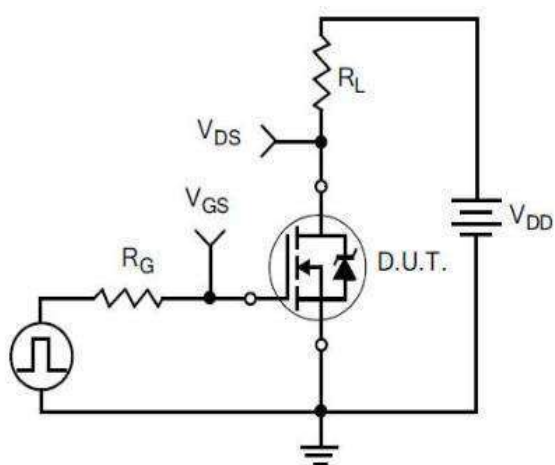
Typical Test Circuit



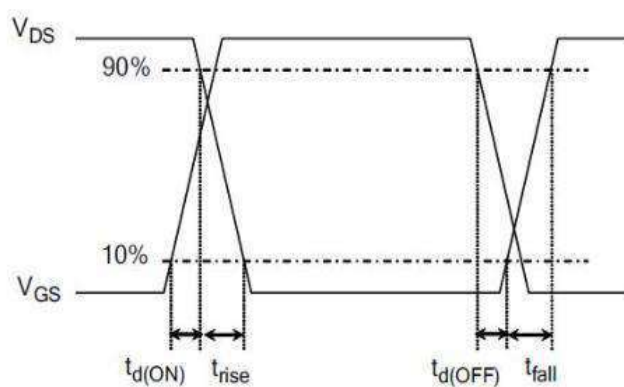
1) Gate Charge Test Circuit



2) Gate Charge Waveform

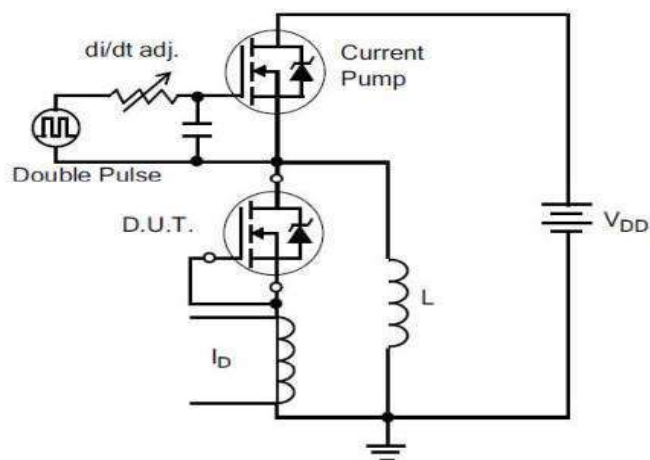


3) Resistive Switching Test Circuit

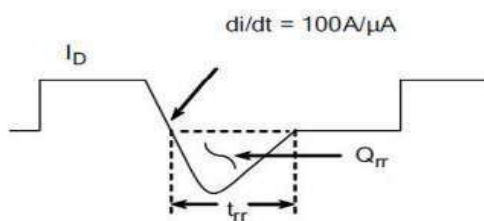


4) Resistive Switching Waveforms

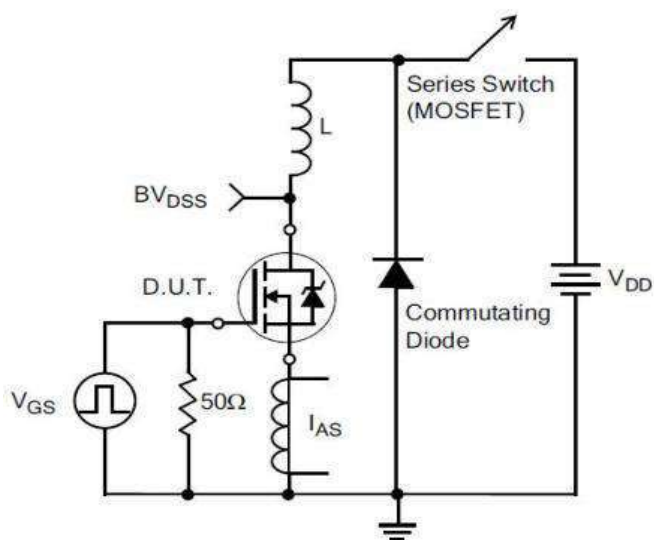
Typical Test Circuit



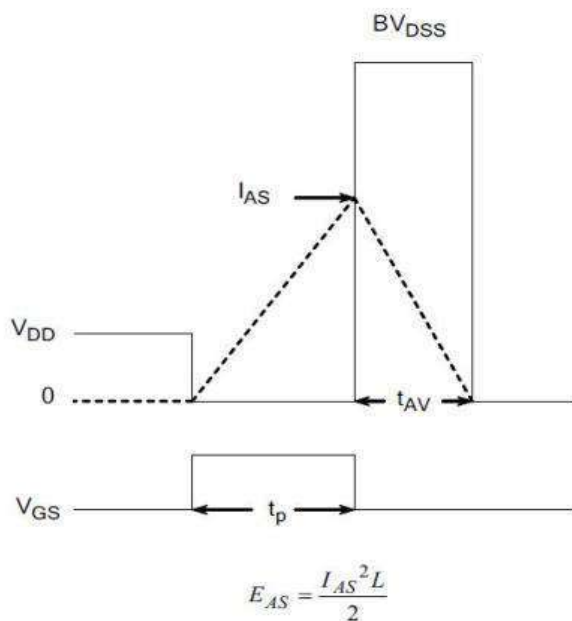
5) Diode Reverse Recovery Test Circuit



6) Diode Reverse Recovery Waveform

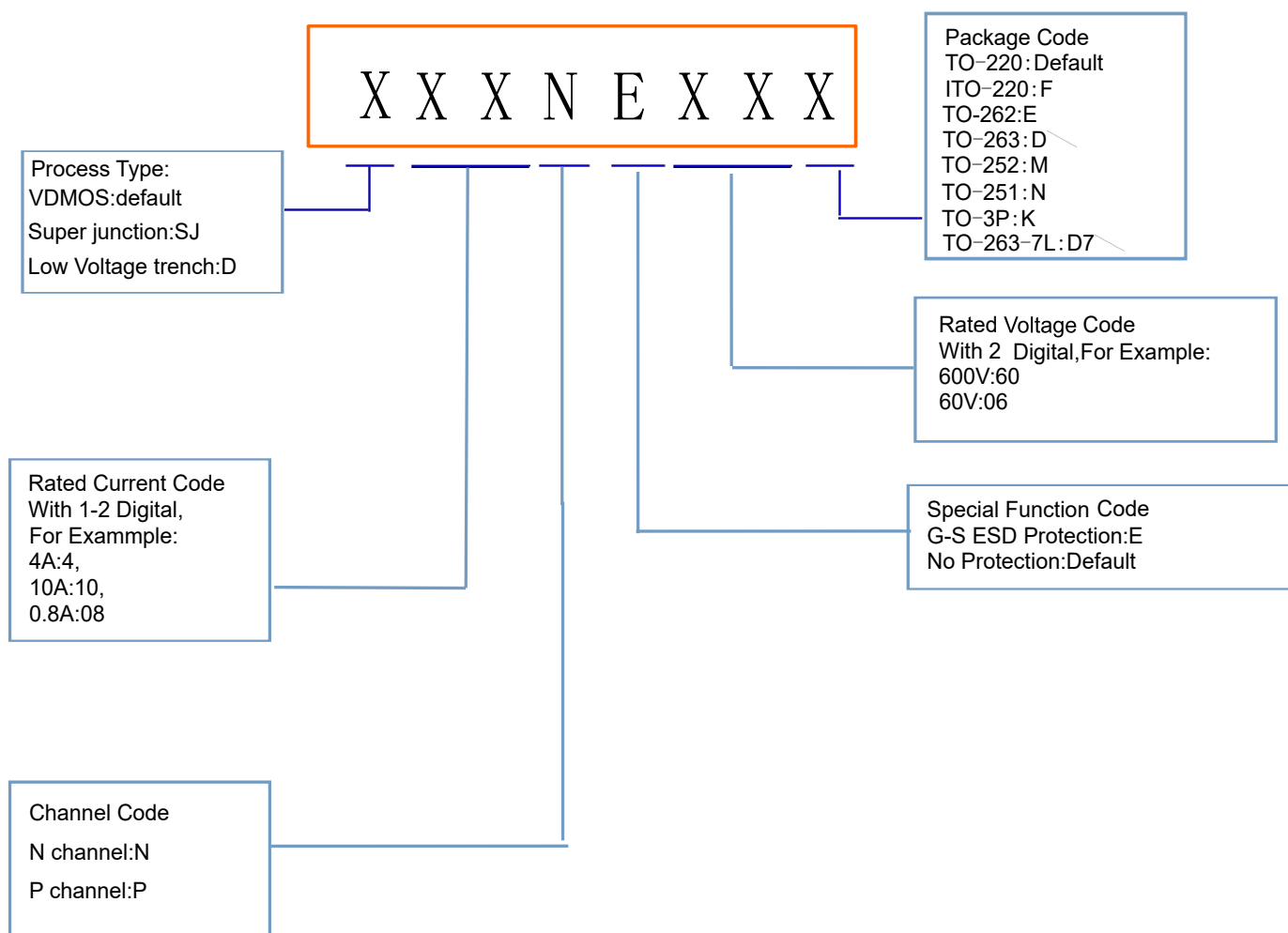


7) . Unclamped Inductive Switching Test Circuit



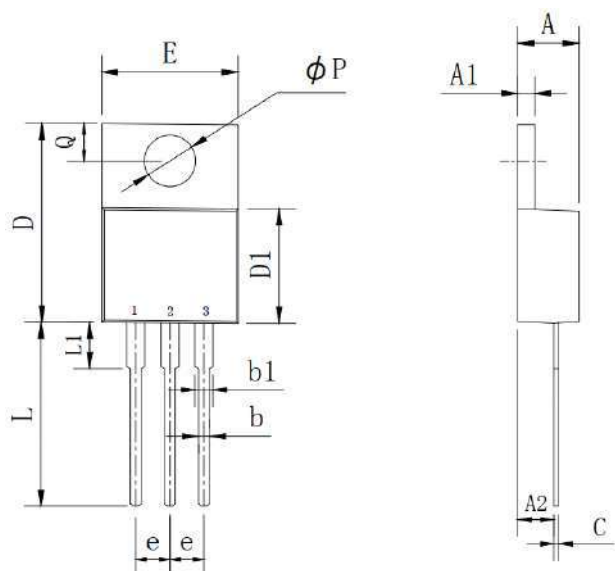
8) Unclamped Inductive Switching Waveforms

Product Names Rules



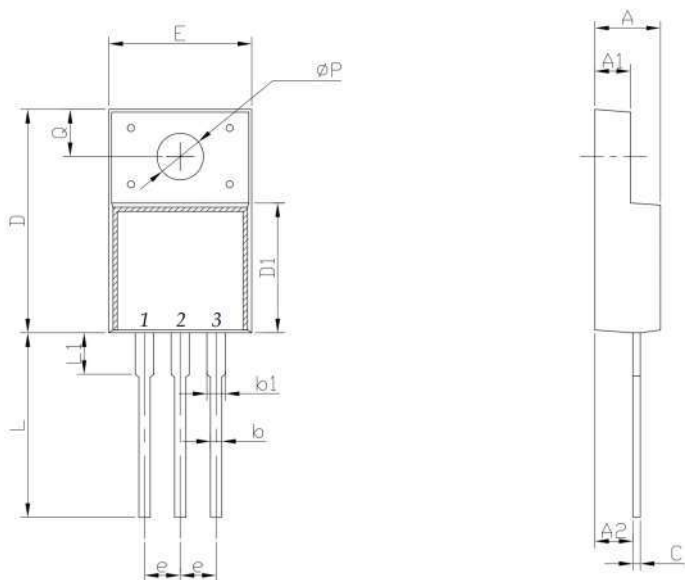
Dimensions

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

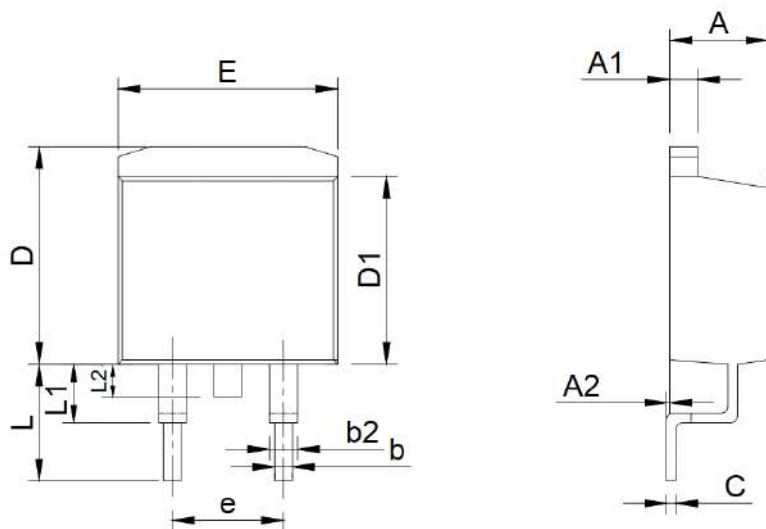
ITO-220 PACKAGE OUTLINE DIMENSIONS



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

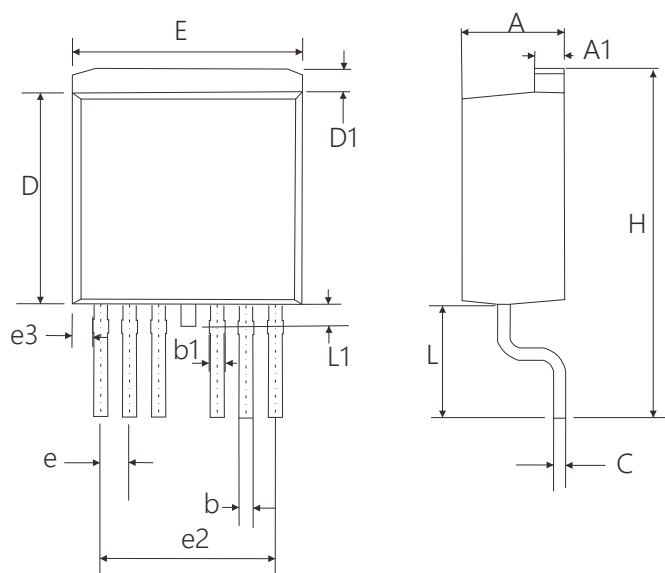
Dimensions

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

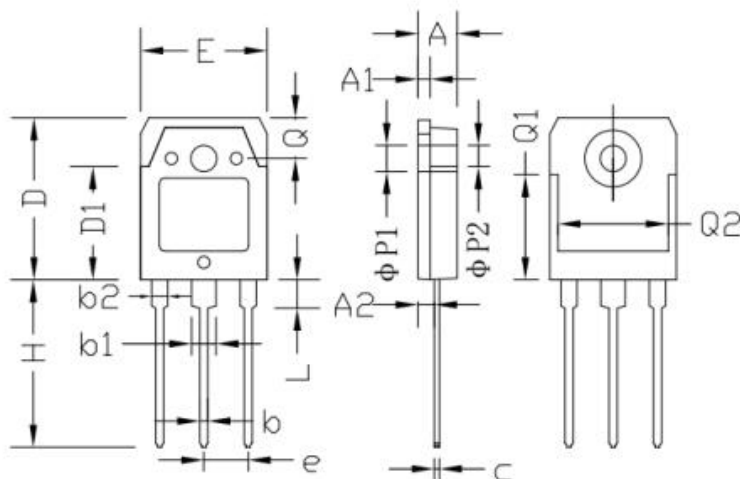
TO-263-7L PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	4.25	4.75	0.167	0.187
A1	1.2	1.4	0.047	0.055
b	0.5	0.7	0.020	0.028
b1	0.5	0.9	0.020	0.035
C	0.4	0.6	0.016	0.024
D	9.05	9.45	0.356	0.372
D1	0.7	1.3	0.028	0.051
E	9.8	10.2	0.386	0.402
e	1.07	1.47	0.042	0.058
e2	7.32	7.92	0.288	0.312
e3	0.64	1.04	0.025	0.041
H	14.65	15.65	0.577	0.616
L	4.47	5.47	0.176	0.215
L1	0.90	1.50	0.035	0.059

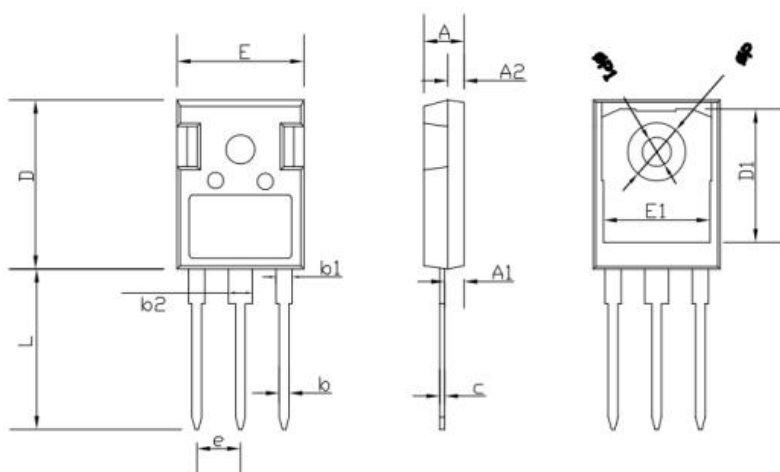
Dimensions

TO-3P PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
A	4.60	5.00	0.181	0.197
A1	1.45	1.65	0.057	0.065
A2	2.20	2.60	0.087	0.102
b	0.80	1.20	0.032	0.047
b1	2.80	3.20	0.110	0.126
b2	1.80	2.20	0.071	0.087
C	0.55	0.75	0.022	0.030
D	19.20	19.70	0.756	0.776
D1	13.10	14.70	0.516	0.578
E	15.40	15.80	0.607	0.623
e	5.45 TYP		0.215 TYP	
H	19.80	20.20	0.780	0.826
L	3.30	3.70	0.130	0.146
ΦP1	3.20 TYP		0.126 TYP	
ΦP2	3.50 TYP		0.138 TYP	
Q	5.00 TYP		0.197 TYP	
Q1	12.40 TYP		0.488 TYP	
Q2	12.6	-	0.496	-

TO-247 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
A	4.90	5.10	0.193	0.201
A1	2.31	2.51	0.091	0.099
A2	1.90	2.10	0.075	0.083
b	1.16	1.26	0.046	0.050
b1	1.96	2.06	0.0772	0.0812
b2	2.96	3.06	0.117	0.121
c	0.59	0.66	0.0232	0.0260
D	20.90	21.10	0.8235	0.8313
D1	16.25	16.85	0.6403	0.6639
E	15.70	15.90	0.6186	0.6265
E1	13.10	13.50	0.5161	0.5319
e	5.44		0.2143	
L	19.80	20.10	0.7801	0.7919
ΦP	3.50	3.70	0.1379	0.1458
ΦP1	0	7.30	0	0.2876