650V 22A Super Junction Power MOSFET

Features :

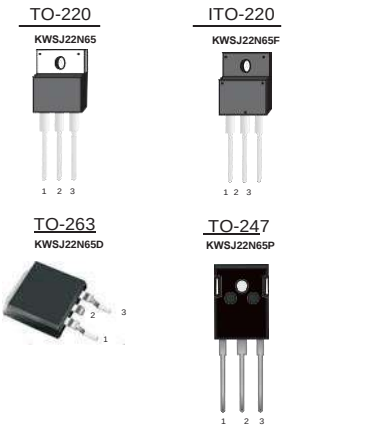
- $R_{DS(ON)}$<0.17Ω@V_{GS}=10V
- 100% avalanche tested
- RoHS compliant

Mechanical Data :

- Case:TO-220,ITO-220,TO-263,TO-247 package

PRODUCT SUMMARY

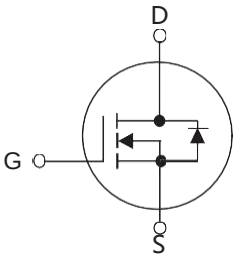
V_{DS}(V)	RDS(on) (Ω)Typ	I_D(A)
650	0.15@ VGS=10V	22



Ordering Information

Part No.	Package Type	Package	Quality(box)	Marking
KWSJ22N65	TO-220	Tube	1000	JF SJ22N65 / SJ22N65
KWSJ22N65F	ITO-220	Tube	1000	JF SJ22N65F / SJ22N65F
KWSJ22N65D	TO-263	Tape & Reel	800	JF SJ22N65D / SJ22N65D
KWSJ22N65P	TO-247	Tube	600	JF SJ22N65P / SJ22N65P

Block Diagram



Pin Definition:

1. Gate
2. Drain
3. Source

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

Parameter		Symbol	TO-220/TO-263/TO-247	ITO-220	Unit
Drain-Source Voltage		V_{DS}	650		V
Gate-Source Voltage		V_{GS}	±30		V
Continuous Drain Current	T_C=25°C	I_D	22		A
	T_C=100°C		13		
Pulsed Drain Current (Note 1)		I_{DM}	48		A
Single Pulse Avalanche Energy(Note 2)		E_{AS}	485		mJ
Avalanche Current(Note 1)		I_{AR}	3.5		A
Repetitive Avalanche Energy(Note 1)		E_{AR}	1		mJ
Peak Diode Recovery dv/dt(Note 3)		dv/dt	15		V/ns
Drain Source voltage slope(Vds=480V)		dVds/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
Maximum Temperature for soldering		T_L	300		°C

Table 2.Thermal Characteristics

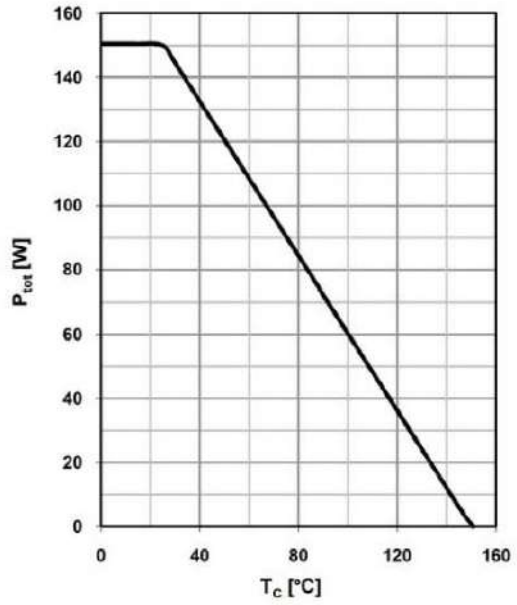
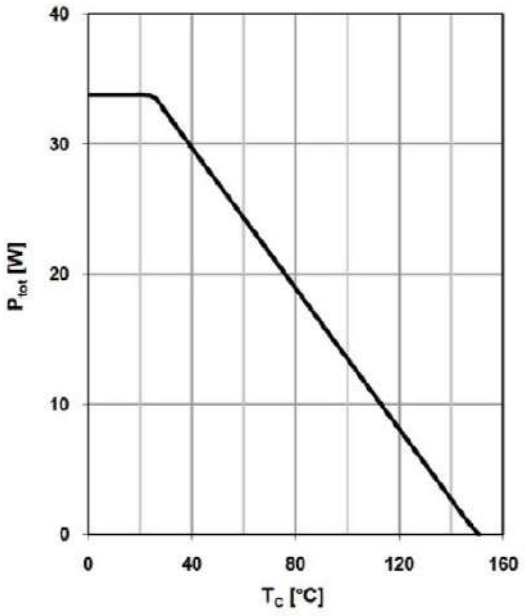
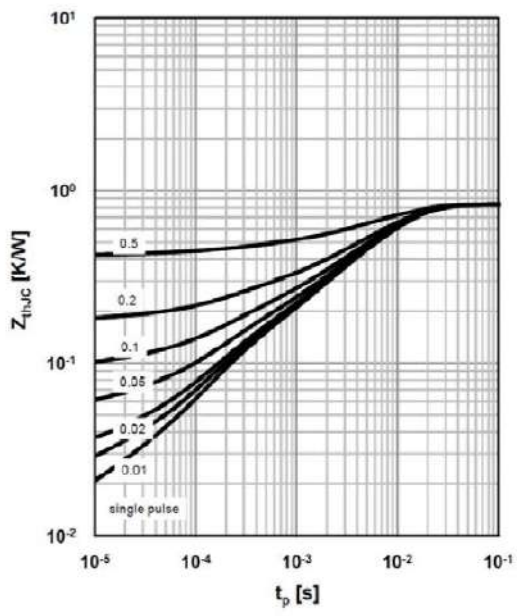
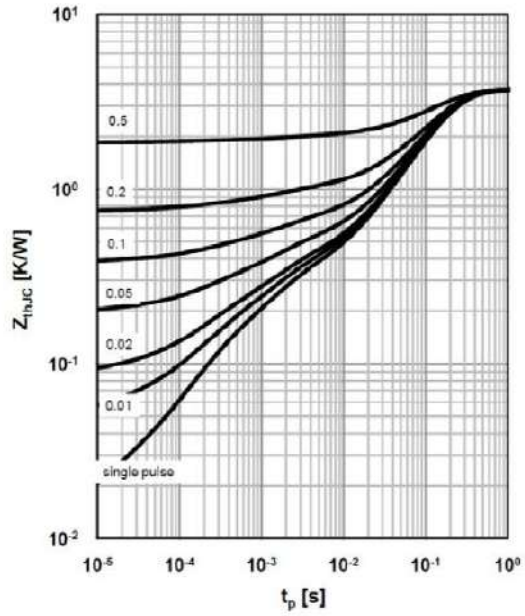
Parameter	Symbol	TO-220/TO-263/TO-247	ITO-220	Unit
Thermal resistance Junction to Ambient	$R_{\theta JA}$	62	62	°C/W
Thermal resistance Junction to Case	$R_{\theta JC}$	0. 82	3. 57	°C/W

Table 3. Electrical Characteristics (T_J=25°C, unless otherwise specified)

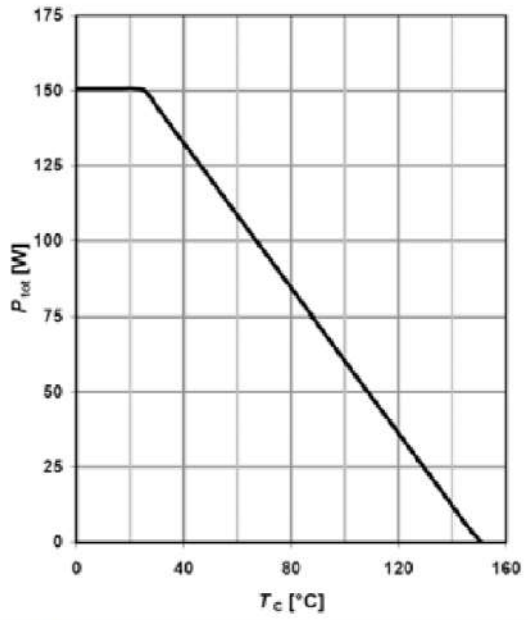
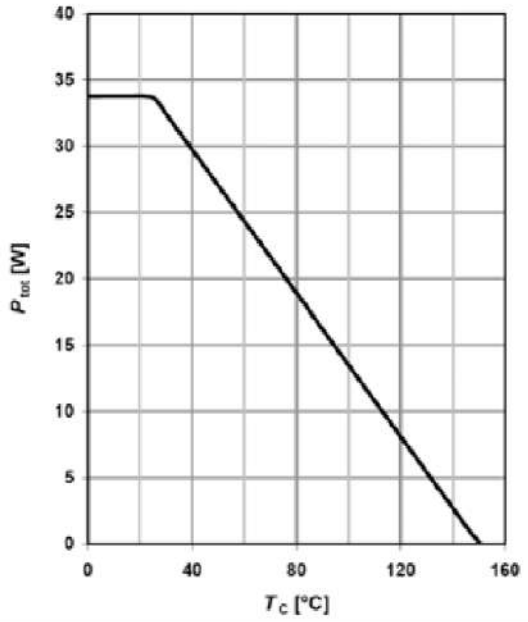
Parameter		Symbol	Test Conditions	Min	Typ	Max	Unit
Off Characteristics							
Drain-Source Breakdown Voltage		BV_{DSS}	V_{GS}=0V,I_D=250μA	650	--	--	V
Drain-Source Leakage Current		I_{DSS}	V_{DS}=650V,V_{GS}=0V	--	--	1	μA
Gate- Source Leakage Current	Forward	I_{GSS}	V_{GS}=30V,V_{DS}=0V	--	--	100	nA
	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	--	4	V
Static Drain-Source On-State Resistance		$R_{DS(ON)}$	V_{GS}=10V,I_D=11A	--	0.15	0.17	Ω
Dynamic Characteristics(Note 5)							
Input Capacitance		C_{ISS}	V_{DS}=25V,V_{GS}=0V,f=1MHz	--	1510	--	pF
Output Capacitance		C_{OSS}		--	75	--	pF
Reverse Transfer Capacitance		C_{RSS}		--	6	--	pF
Switching Characteristics (Note 5)							
Turn-On Delay Time		td(on)	V_{DD}=520V,I_D=11A, R_G=20Ω	--	25	--	ns
Turn-On Rise Time		t_R		--	17	--	ns
Turn-Off Delay Time		td(off)		--	130	--	ns
Turn-Off Fall Time		tf		--	11	--	ns
Total Gate Charge		Q_G	V_{DS}=520V,I_D=11A, V_{GS}=10V	--	90	--	nC
Gate-Source Charge		Q_{GS}		--	8.5	--	nC
Gate-Drain Charge		Q_{GD}		--	13	--	nC
Drain-Source Diode Characteristics and Maximum Ratings							
Drain-Source Diode Forward Voltage		V_{SD}	V_{GS}=0V, I_S=11A	--	0.9	1.5	V
Maximum Continuous Drain-Source Diode Forward Current		I_S		--	--	22	A
Reverse Recovery Time		trr	V_{GS}=0V, I_F=11A dIF/dt=100A/μs (Note 1)	--	475	--	ns
Reverse Recovery Charge		Q_{RR}		--	5800	--	nC

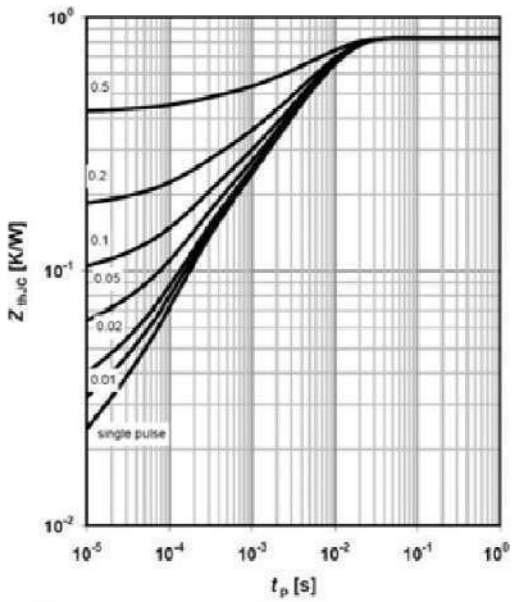
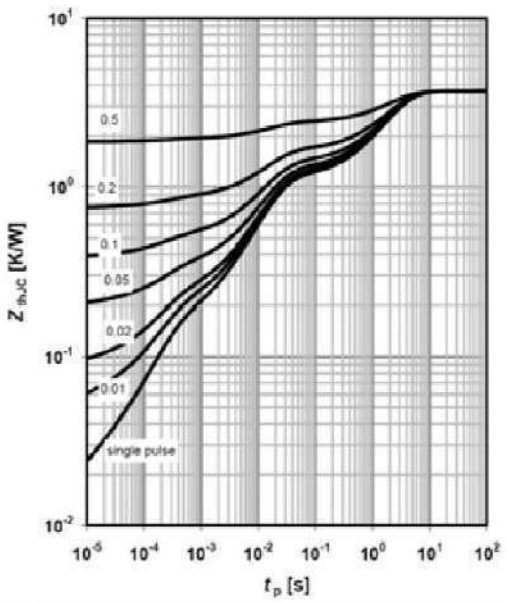
Notes：1 Repetitive Rating:Pulse width limited by maximum junction temperature 2
L=60mH, I_{AS}=3A,V_{DD}=150V,Starting T_J=25°C
3 I_{SD}≤4.5A,di/dt≤200A/μs,V_{DD}≤BVDSS,Starting TJ=25°C
4 Pulse Test: Pulse width ≤300μS, Duty cycle≤2%
5 Guaranteed by design,not subject to production

Typical characteristics Diagrams

Power dissipation Non FullPAK	Power dissipation FullPAK
	
$P_{tot} = f(T_C)$	$P_{tot} = f(T_C)$
Max. transient thermal impedance Non FullPAK	**Max. transient thermal impedance FullPAK**
	
$Z_{(thJC)}$=f(tp); parameter: D=t_p/T	$Z_{(thJC)}$=f(tp); parameter: D=t_p/T

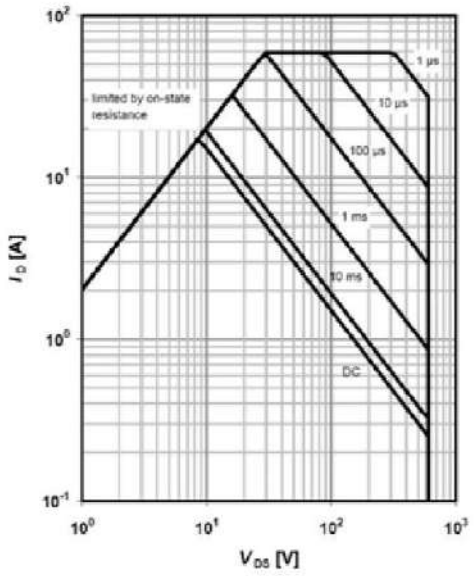
Typical characteristics Diagrams

Power dissipation TO-220, TO-247, TO-262, TO-263	Power dissipation TO-220 FullPAK
	
$P_{tot} = f(T_C)$	$P_{tot} = f(T_C)$

Max. transient thermal impedance TO-220, TO-247, TO-262, TO-263	Max. transient thermal impedance TO-220 FullPAK
	
$Z_{(thJC)}$=f(tp); parameter: D=t_p/T	$Z_{(thJC)}$=f(tp); parameter: D=t_p/T

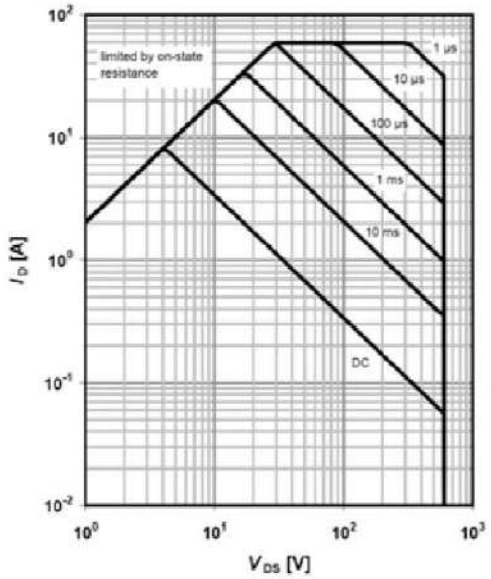
Typical characteristics Diagrams

Safe operating area T_C=25 °C
TO-220, TO-247, TO-262, TO-263



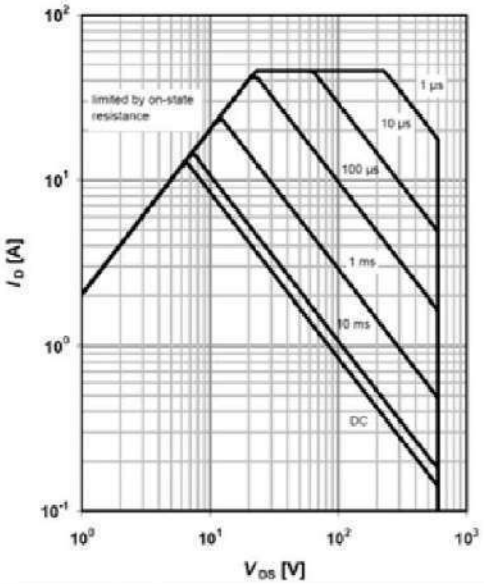
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter t_p

Safe operating area T_C=25 °C
TO-220 FullPAK



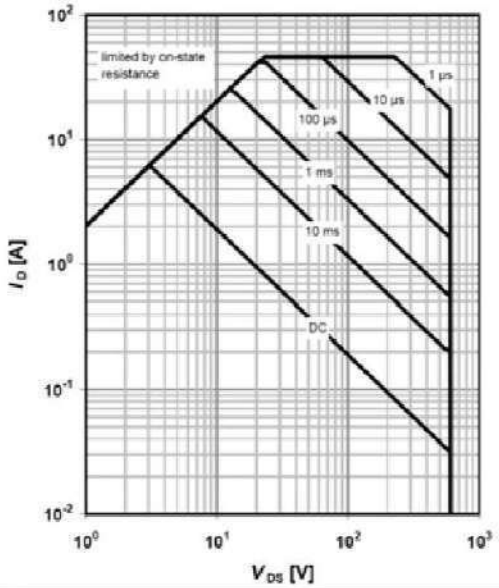
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter t_p

Safe operating area T_C=80 °C
TO-220, TO-247, TO-262, TO-263



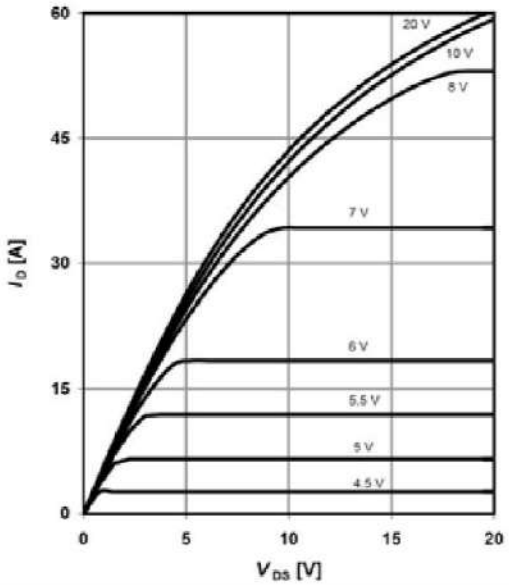
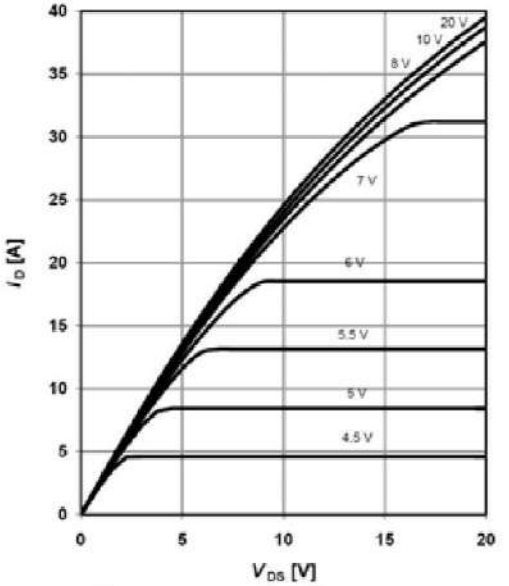
I_D=f(V_{DS}); T_C=80 °C; D=0; parameter t_p

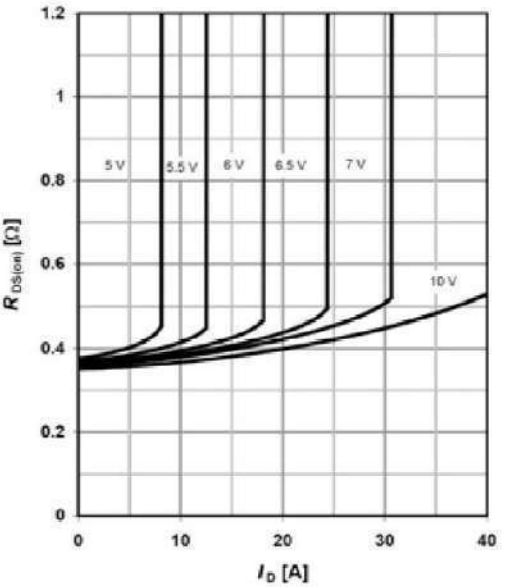
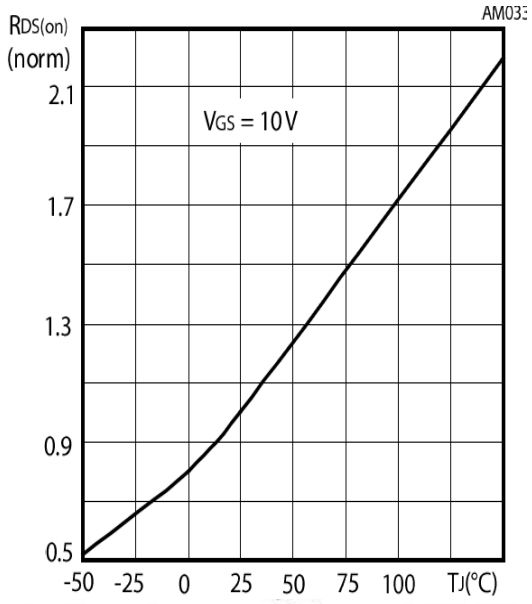
Safe operating area T_C=80 °C
TO-220 FullPAK



I_D=f(V_{DS}); T_C=80 °C; D=0; parameter t_p

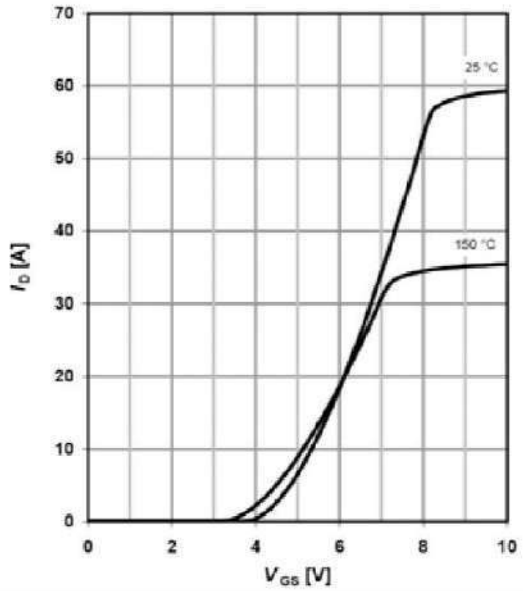
Typical characteristics Diagrams

Typ. output characteristics T_C=25 °C	Typ. output characteristics T_j=125 °C
	
I_D=f(V_{DS}); T_j=25 °C; parameter: V_{GS}	I_D=f(V_{DS}); T_j=125 °C; parameter: V_{GS}

Typ. drain-source on-state resistance	Drain-source on-state resistance
	
$R_{DS(on)}$=f(I_D); T_j=125 °C; parameter: V_{GS}	$R_{DS(on)}$=f(T_j); I_D=9.5 A; V_{GS}=10 V

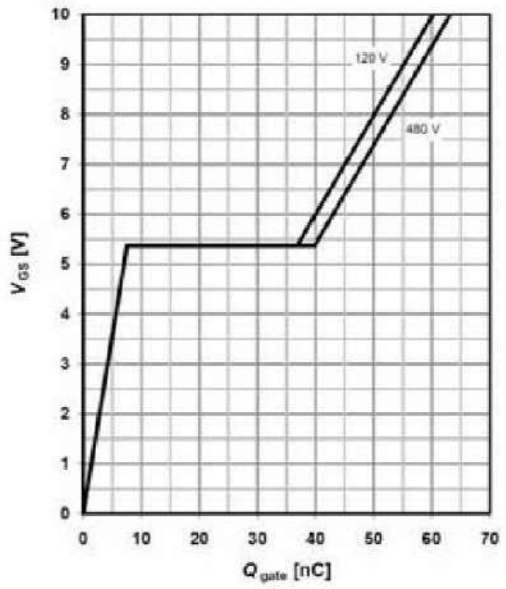
Typical characteristics Diagrams

Typ. transfer characteristics



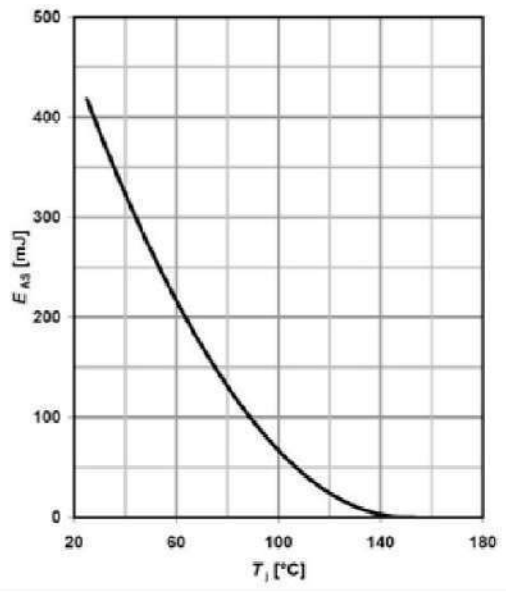
I_D=f(V_{GS}); V_{DS}=20V

Typ. gate charge



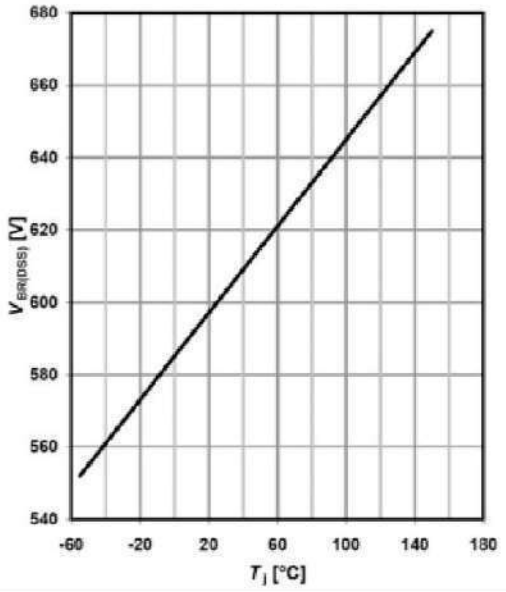
V_{GS}=f(Q_{gate}), I_D=9.5A pulsed

Avalanche energy



E_{AS}=f(T_j); I_D=3.4 A; V_{DD}=50 V

Drain-source breakdown voltage



$V_{BR(DSS)}$=f(T_j); I_D=0.25 mA

TYPICAL TEST CIRCUIT

Table 20 Switching times test circuit and waveform for inductive load

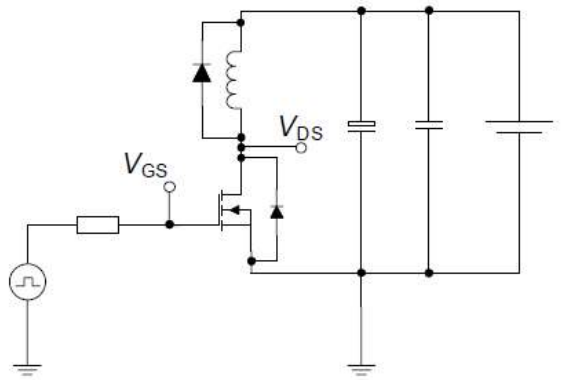
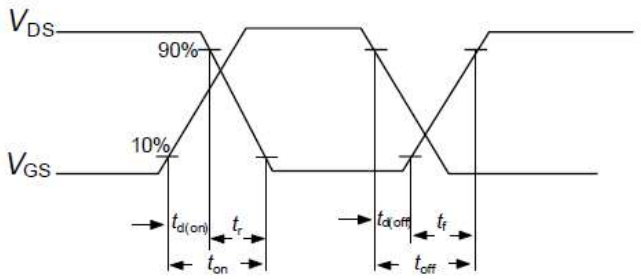
Switching times test circuit for inductive load	Switching time waveform
	

Table 21 Unclamped inductive load test circuit and waveform

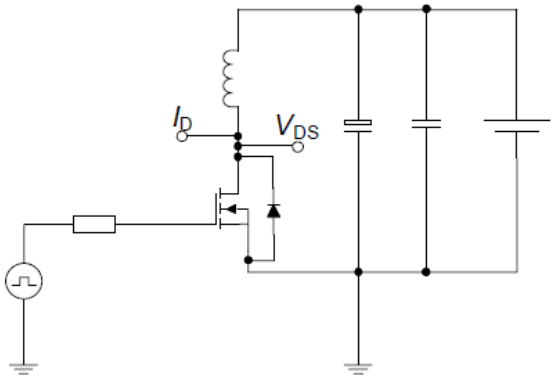
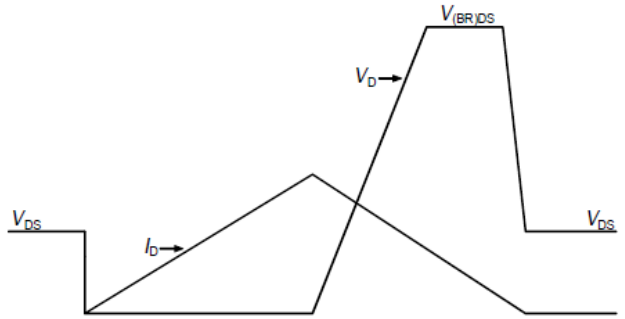
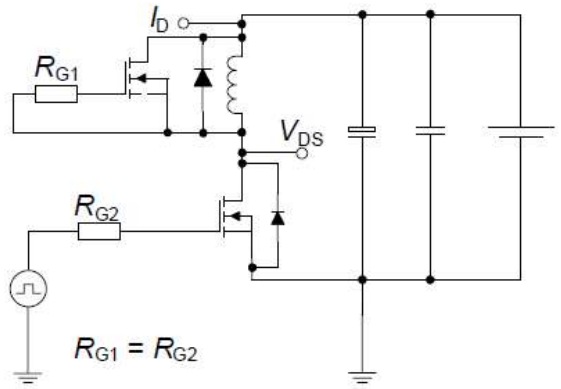
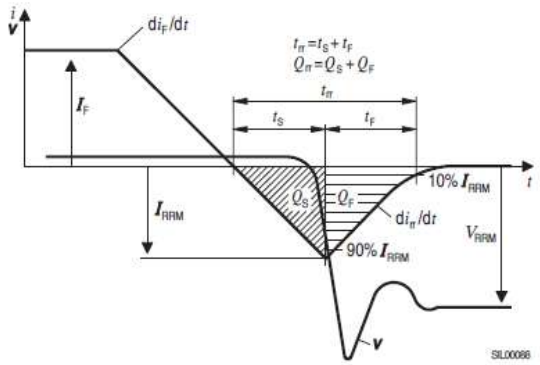
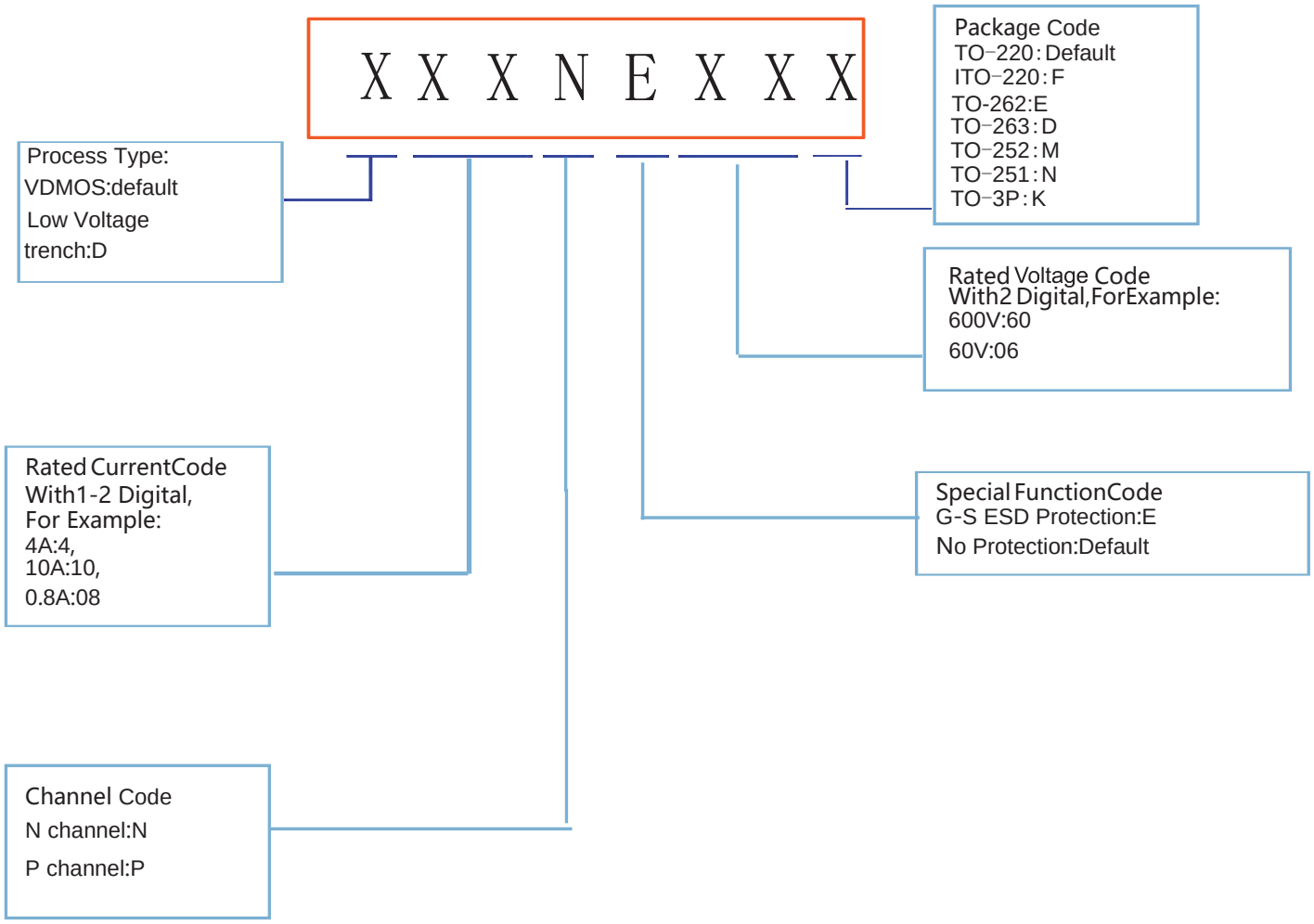
Unclamped inductive load test circuit	Unclamped inductive waveform
	

Table 22 Test circuit and waveform for diode characteristics

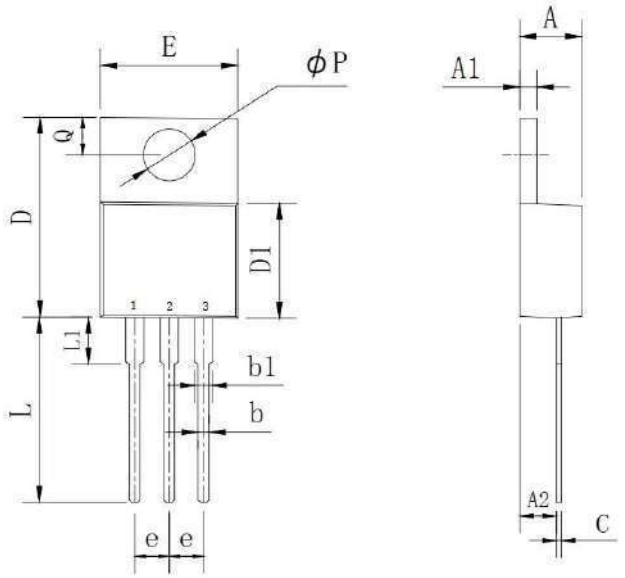
Test circuit for diode characteristics	Diode recovery waveform
	

Product Names Rules



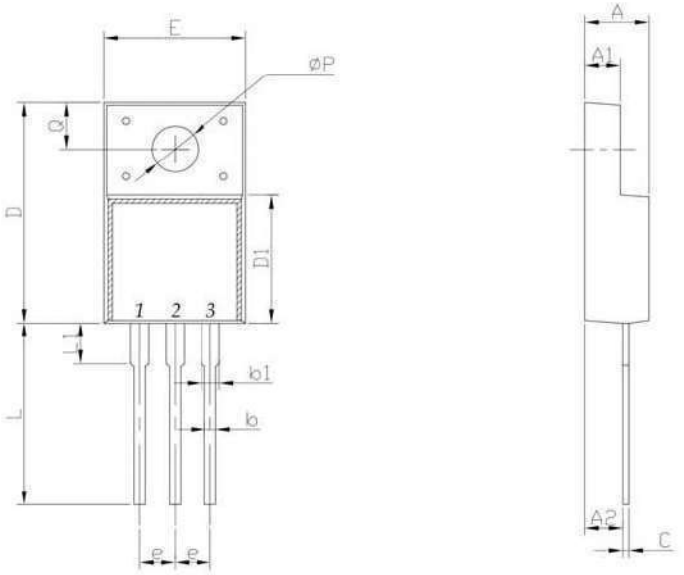
Dimensions

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

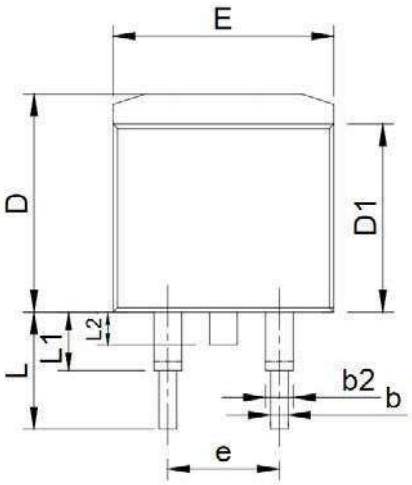
ITO-220 PACKAGE OUTLINE DIMENSIONS

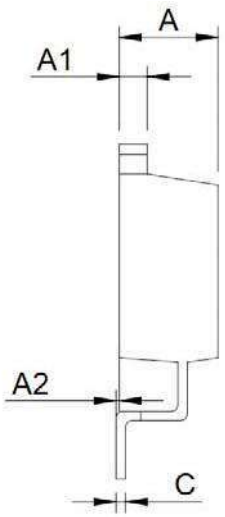


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	4.24	4.9	0.167	0.193
A1	2.3	2.92	0.091	0.115
A2	2.61	2.81	0.103	0.111
b	0.3	1	0.012	0.039
b1	0.9	1.55	0.035	0.061
C	0.3	0.7	0.012	0.028
D	14.5	16.36	0.571	0.644
D1	8.8	9.41	0.346	0.370
E	9.5	10.5	0.374	0.413
e	2.3	2.75	0.091	0.108
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

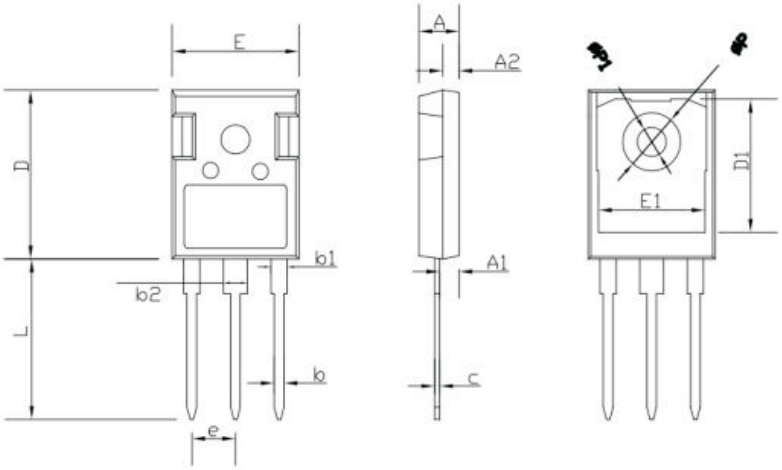
TO-263 PACKAGE OUTLINE DIMENSIONS





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

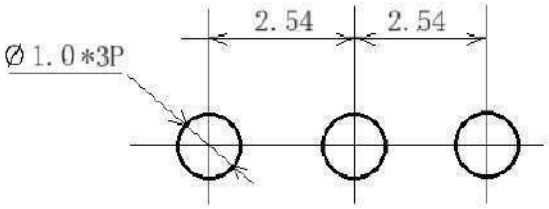
TO-247 PACKAGE OUTLINE DIMENSIONS



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

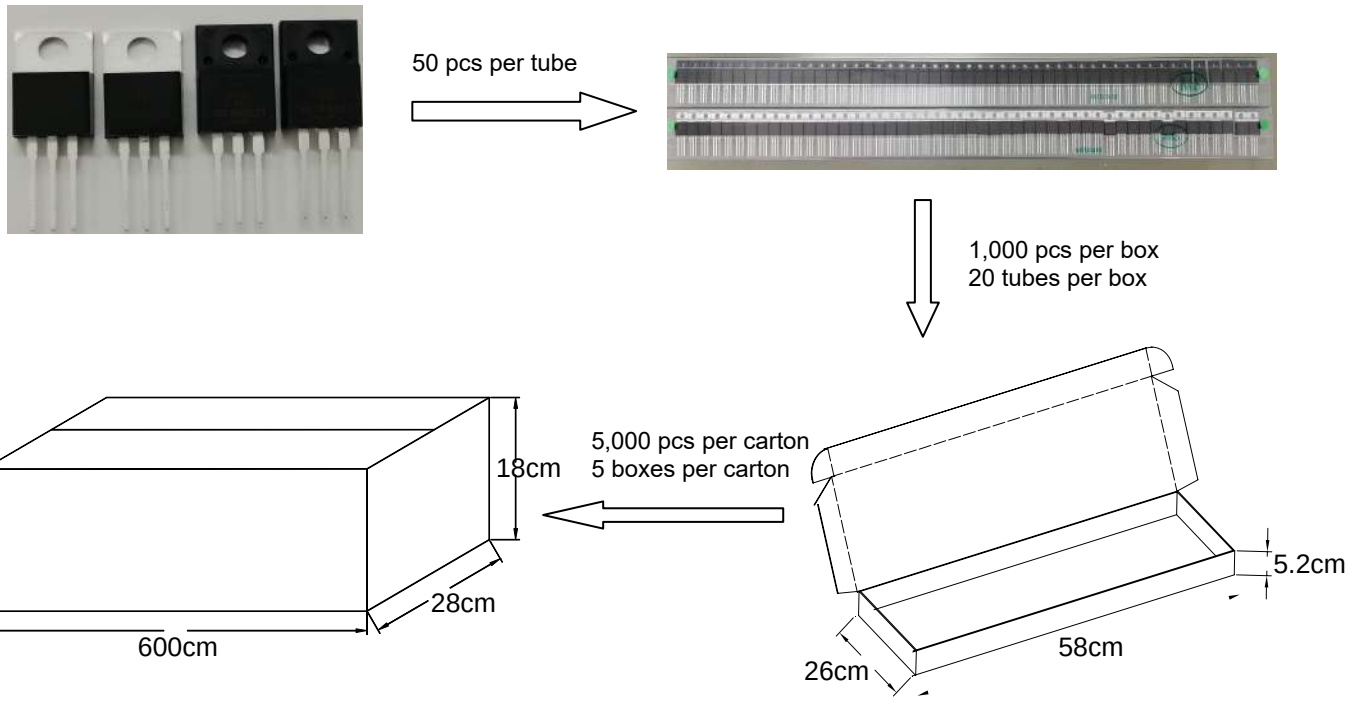
Packaging Specifications of Tube Pack for TO-220AB and ITO-220AB

TO-220AB&ITO-220AB Suggested Pad Layout

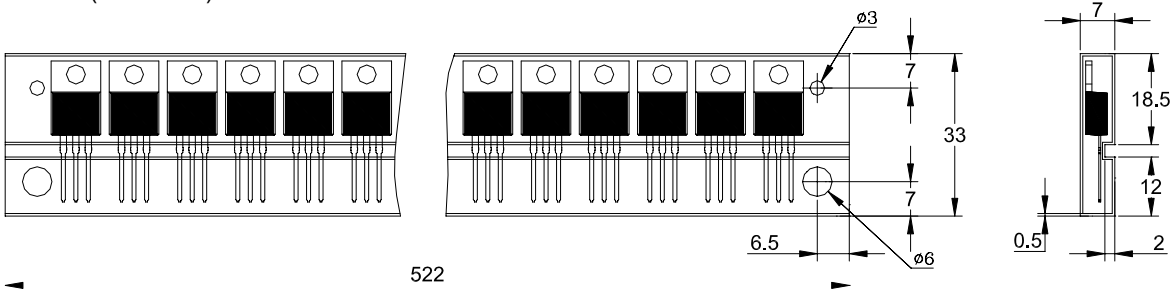


Note:
1.Controlling dimension:in millimeters.
2.General tolerance:±0.05mm.
3.The pad layout is for reference purposes only.

1. The method of packaging and dimension are shown as below figure. (Dimension in mm)



2. Tube data (Units: mm)



Storage

1 It is recommended to store the products in the following conditions:

Humidity: 75% R.H. Max.

Temperature : 0℃~35℃(32℉~95℉)

2 Shelf life : 12 month at ＜0℃~35℃(32℉~95℉) and ＜75% R.H.