

650V 22A Power MOSFET

Features :

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

Mechanical Data :

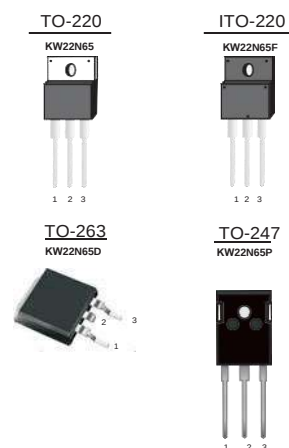
- Case: TO-220, ITO-220, TO-263, TO-247 package

Ordering Information

Part No.	Package Type	Package	Quality(box)
KW22N65	TO-220	Tube	1000
KW22N65F	ITO-220	Tube	1000
KW22N65D	TO-263	Tape & Reel	800
KW22N65P	TO-247	Tube	600

PRODUCT SUMMARY

$V_{DS}(V)$	$R_{DS(on)}(\Omega)_{Typ}$	$I_D(A)$
650	0.15@ $V_{GS}=10V$	22



Pin Definition:

1. Gate
2. Drain
3. Source

Block Diagram

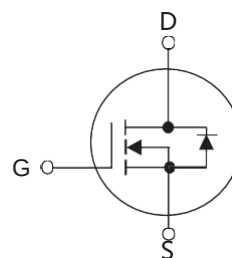


Table1 Absolute Maximum Ratings ($T_C=25^\circ C$, unless otherwise specified)

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	I_D	22		A
	$T_C=100^\circ C$	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 ($V_{DS}=480V$)	dV_{DS}/dt	50		V/ns
Power Dissipation $T_C=25^\circ C$	P_D	151	35	W
Operating Junction and Storage Temperature	T_J/T_{STG}	$-55 \sim +150$		$^\circ C$
Maximum Temperature for soldering	T_L	300		$^\circ C$

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	$^{\circ}\text{C/W}$
Thermal resistance Junction to Case	$R_{\theta JC}$	0.82	3.57	$^{\circ}\text{C/W}$

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	--	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		t _d (on)	V _{DD} =520V,I _D =11A, R _G =20Ω	--	25	--	ns
Turn-On Rise Time		t _R		--	17	--	ns
Turn-Off Delay Time		t _d (off)		--	130	--	ns
Turn-Off Fall Time		t _f		--	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	--	475	--	ns
Reverse Recovery Charge		Q _{RR}	dI _F /dt=100A/μs (Note 1)	--	5800	--	nC

Notes : 1 Repetitive Rating:Pulse width limited by maximum junction temperature 2

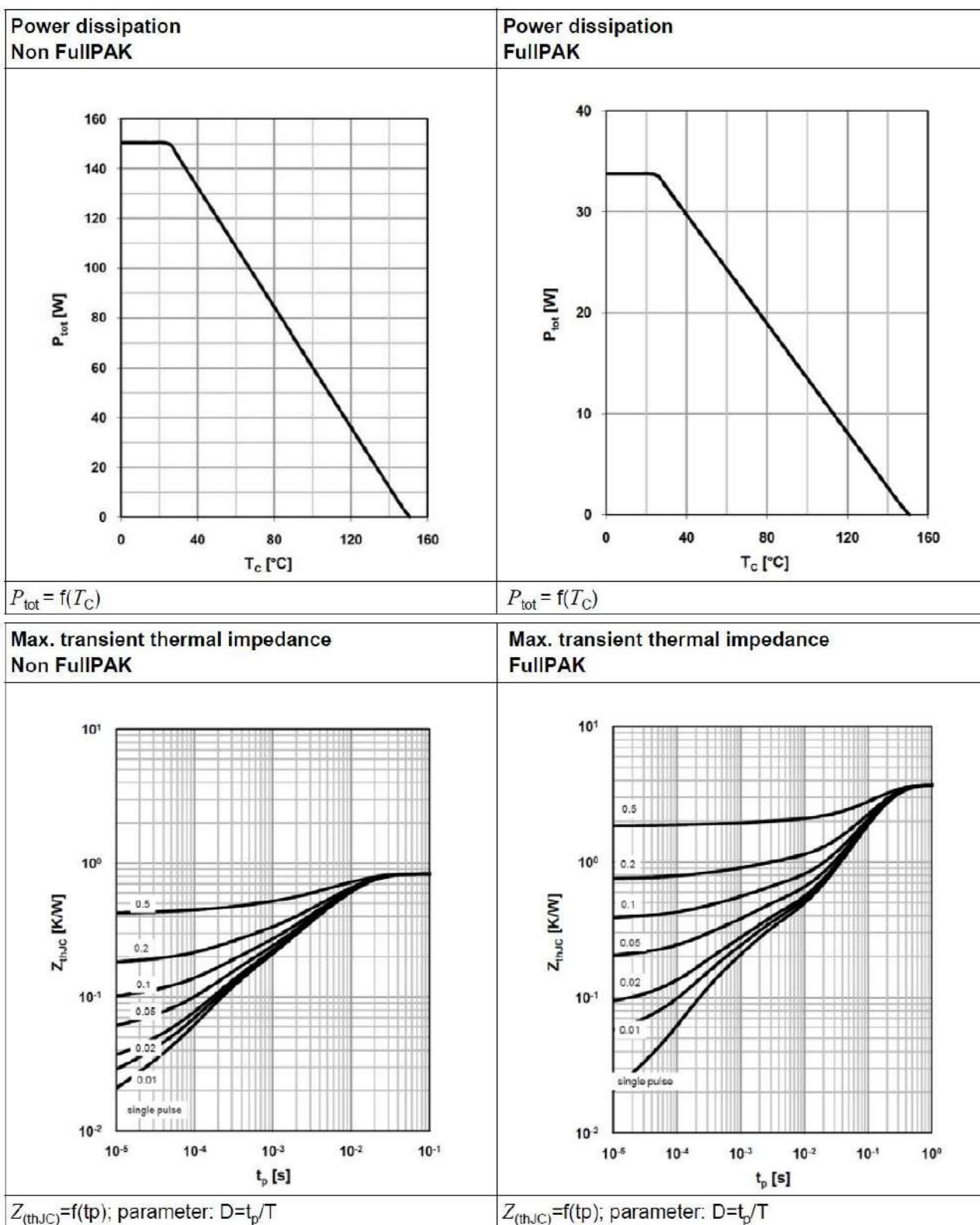
L=60mH, $I_{AS}=3A, V_{DD}=150V$, Starting $T_J=25^{\circ}\text{C}$

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 $\leq 2\%$

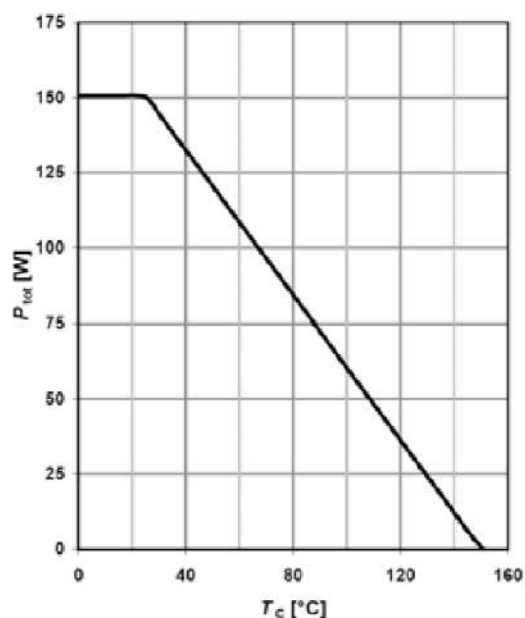
5 Guaranteed by design, not subject to production

Typical characteristics Diagrams



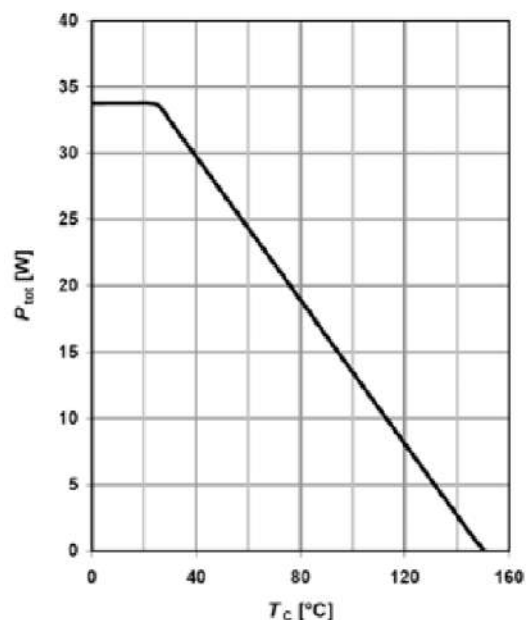
Typical characteristics Diagrams

Power dissipation
TO-220, TO-247, TO-262, TO-263



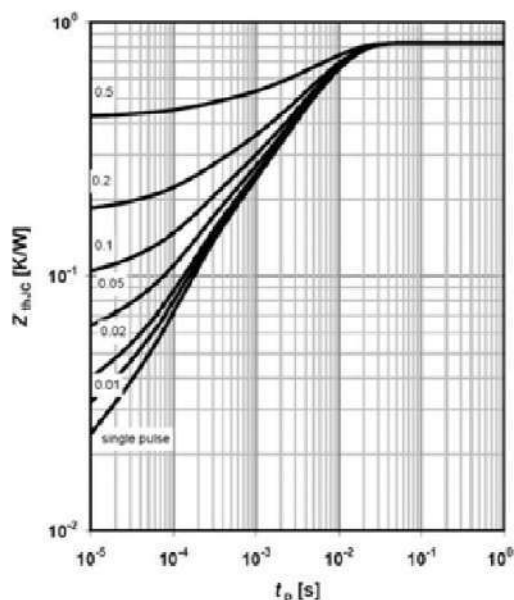
$$P_{tot} = f(T_c)$$

Power dissipation
TO-220 FullPAK



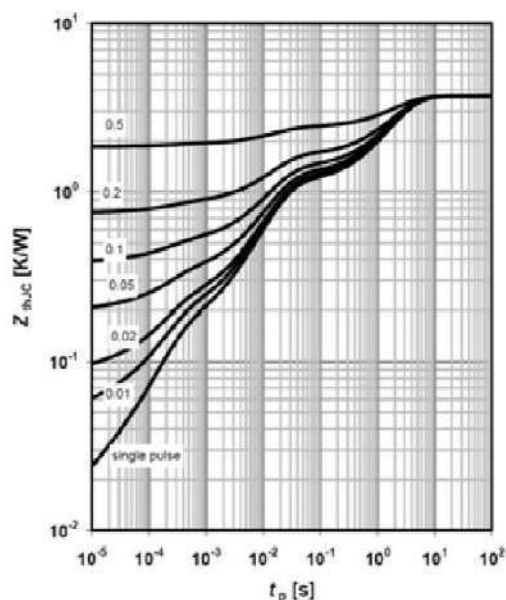
$$P_{tot} = f(T_c)$$

Max. transient thermal impedance
TO-220, TO-247, TO-262, TO-263



$$Z_{(thJC)} = f(t_p); \text{ parameter: } D = t_p / T$$

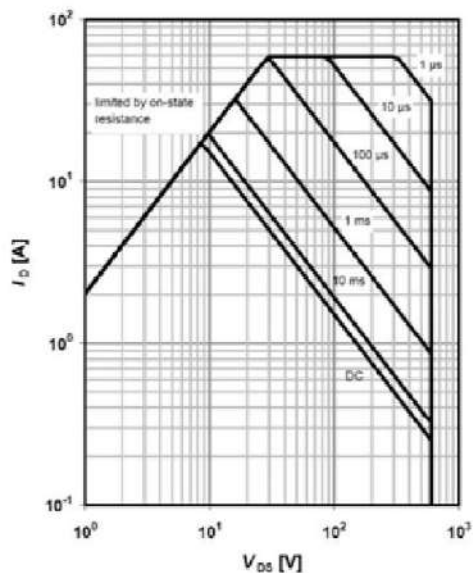
Max. transient thermal impedance
TO-220 FullPAK



$$Z_{(thJC)} = f(t_p); \text{ parameter: } D = t_p / T$$

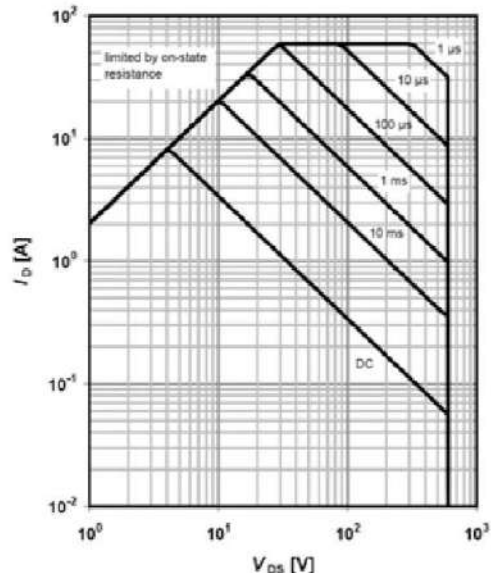
Typical characteristics Diagrams

Safe operating area $T_C=25\text{ }^{\circ}\text{C}$
 TO-220, TO-247, TO-262, TO-263



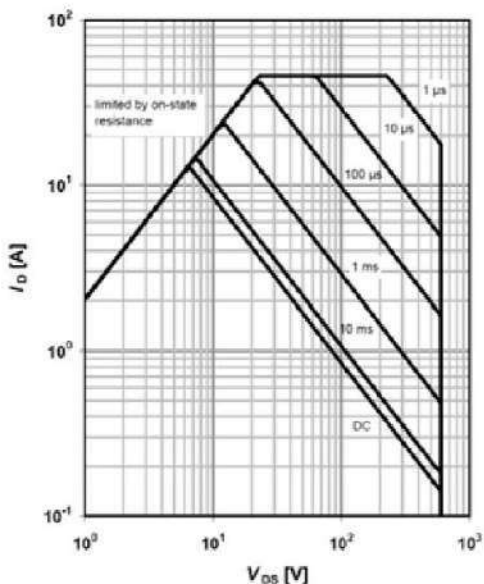
$$I_D = f(V_{DS}); T_C = 25\text{ }^{\circ}\text{C}; D = 0; \text{parameter } t_p$$

Safe operating area $T_C=25\text{ }^{\circ}\text{C}$
 TO-220 FullPAK



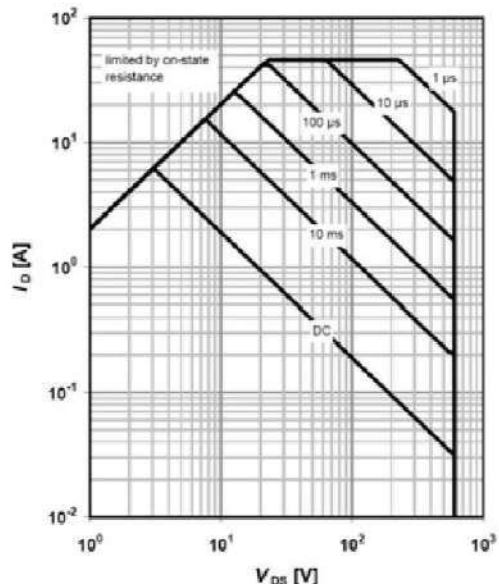
$$I_D = f(V_{DS}); T_C = 25\text{ }^{\circ}\text{C}; D = 0; \text{parameter } t_p$$

Safe operating area $T_C=80\text{ }^{\circ}\text{C}$
 TO-220, TO-247, TO-262, TO-263



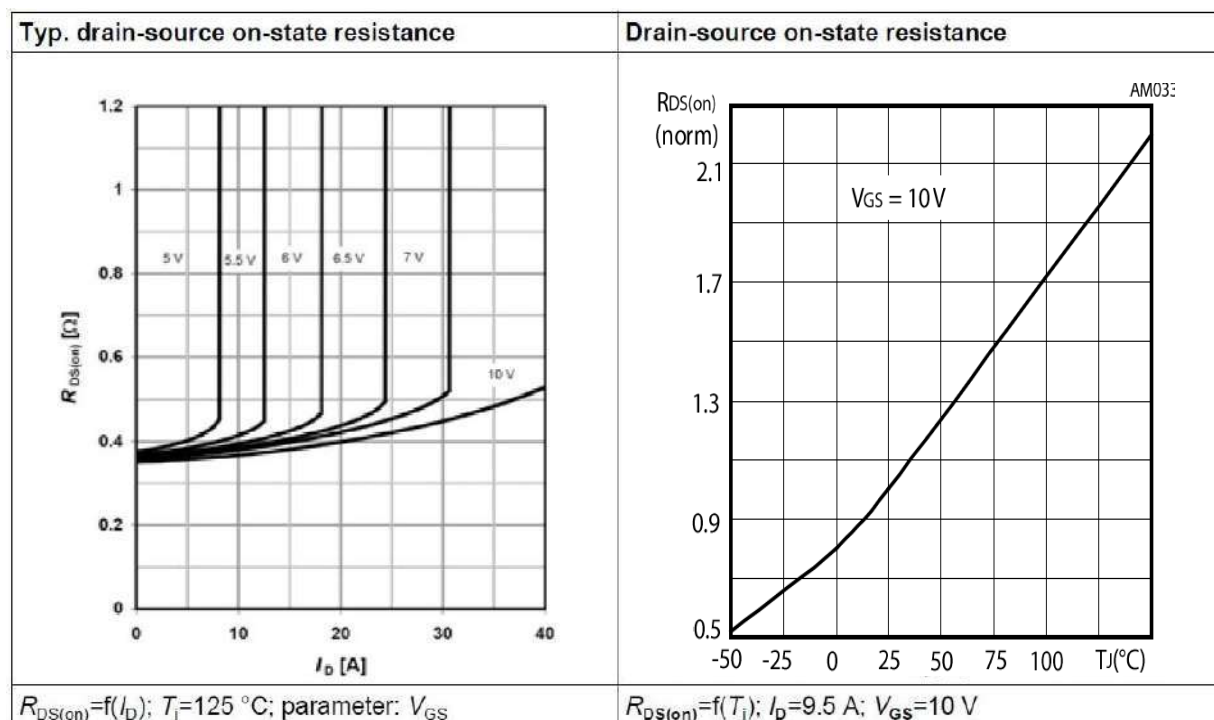
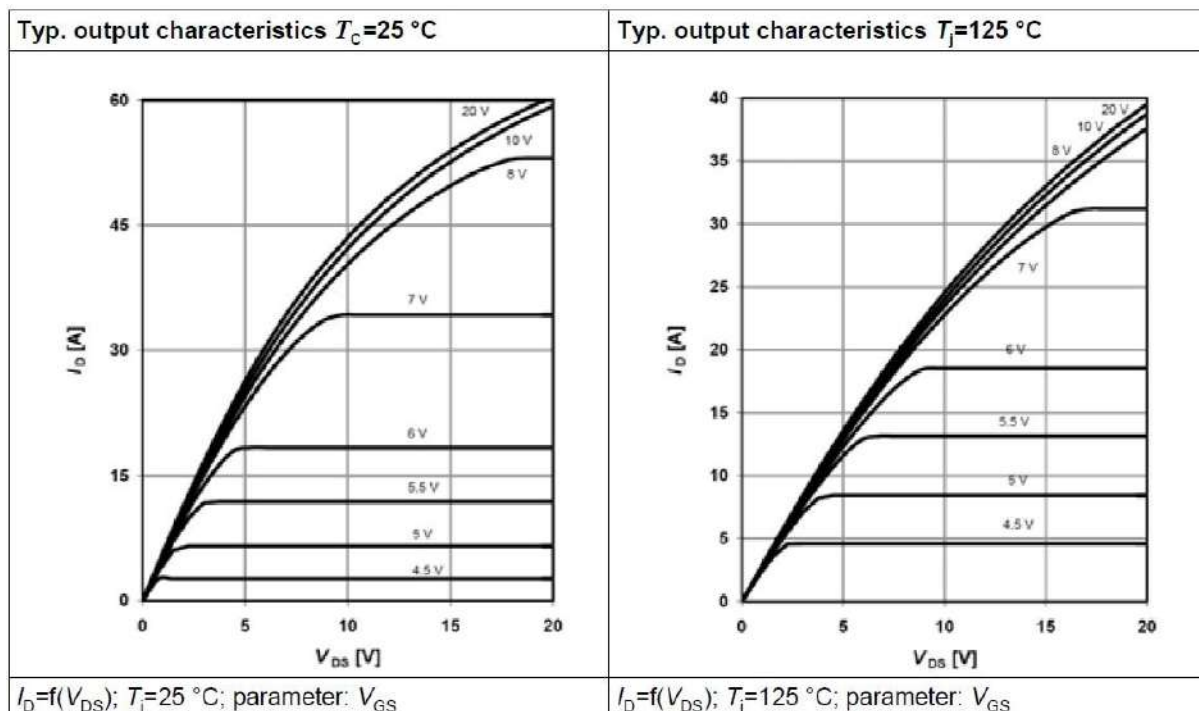
$$I_D = f(V_{DS}); T_C = 80\text{ }^{\circ}\text{C}; D = 0; \text{parameter } t_p$$

Safe operating area $T_C=80\text{ }^{\circ}\text{C}$
 TO-220 FullPAK

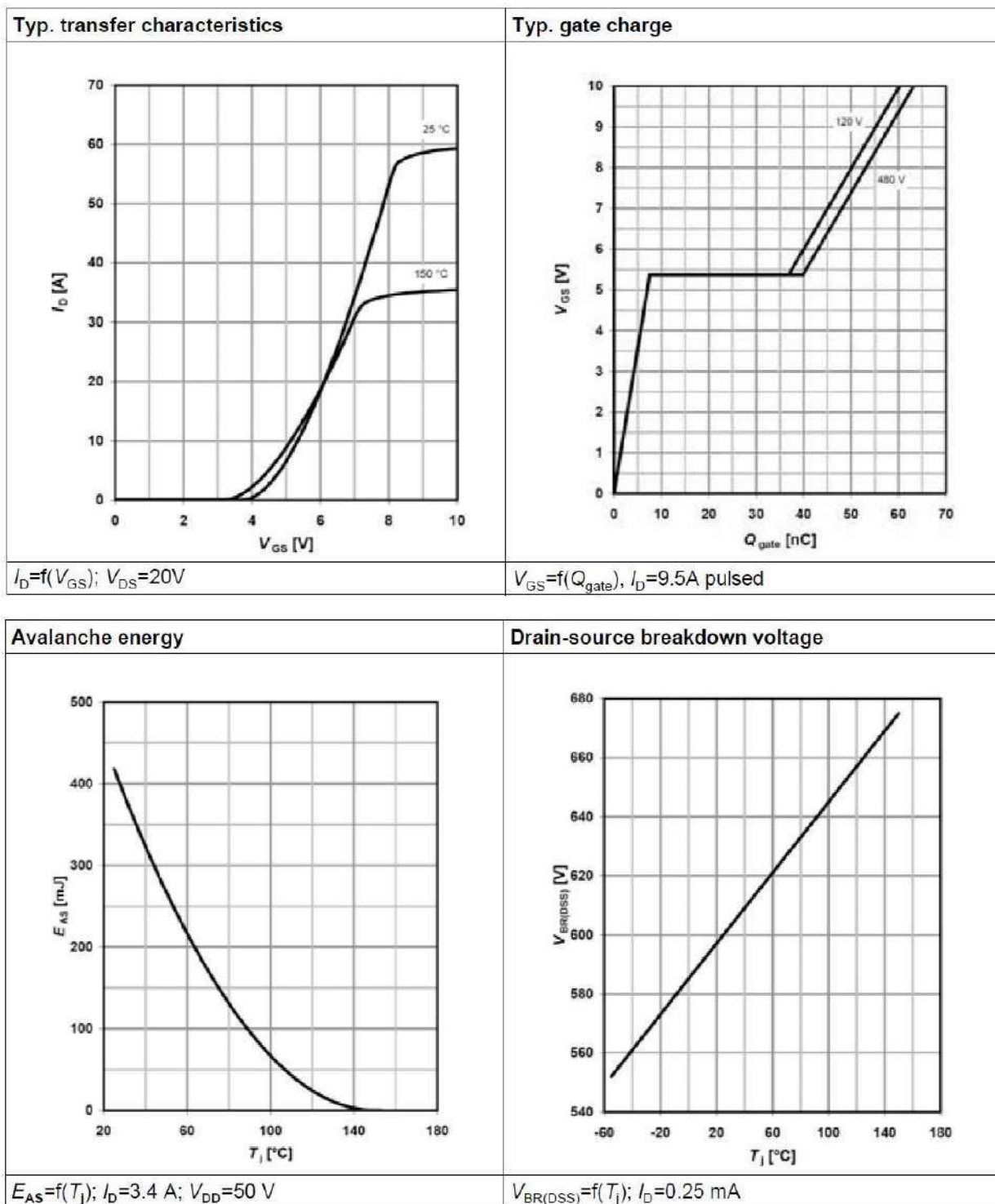


$$I_D = f(V_{DS}); T_C = 80\text{ }^{\circ}\text{C}; D = 0; \text{parameter } t_p$$

Typical characteristics Diagrams



Typical characteristics Diagrams



TYPICAL TEST CIRCUIT

Table 20 Switching times test circuit and waveform for inductive load

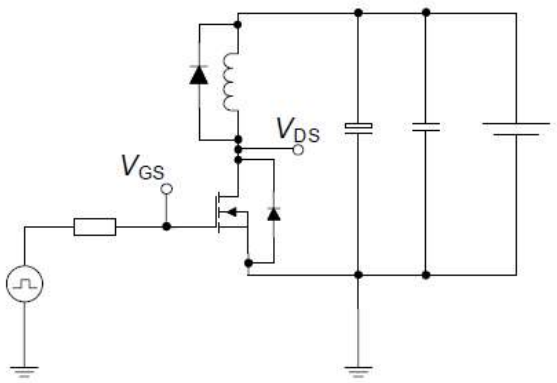
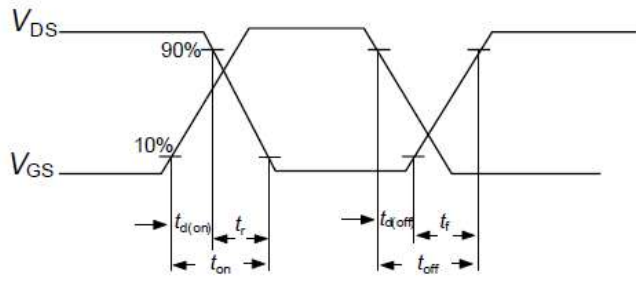
Switching times test circuit for inductive load	Switching time waveform
	

Table 21 Unclamped inductive load test circuit and waveform

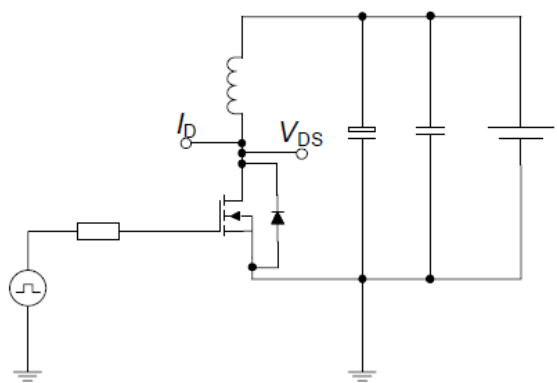
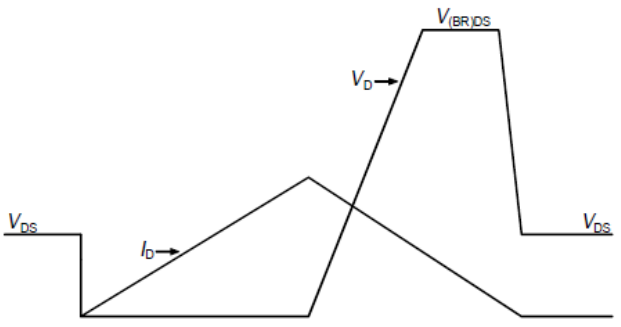
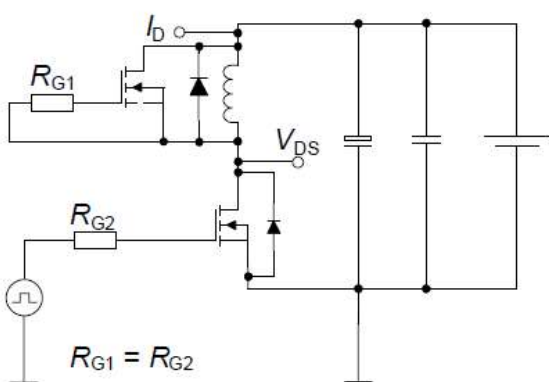
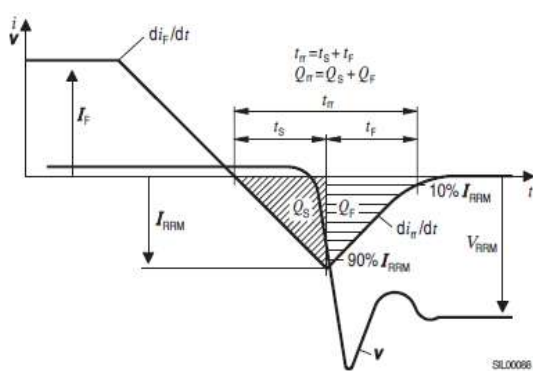
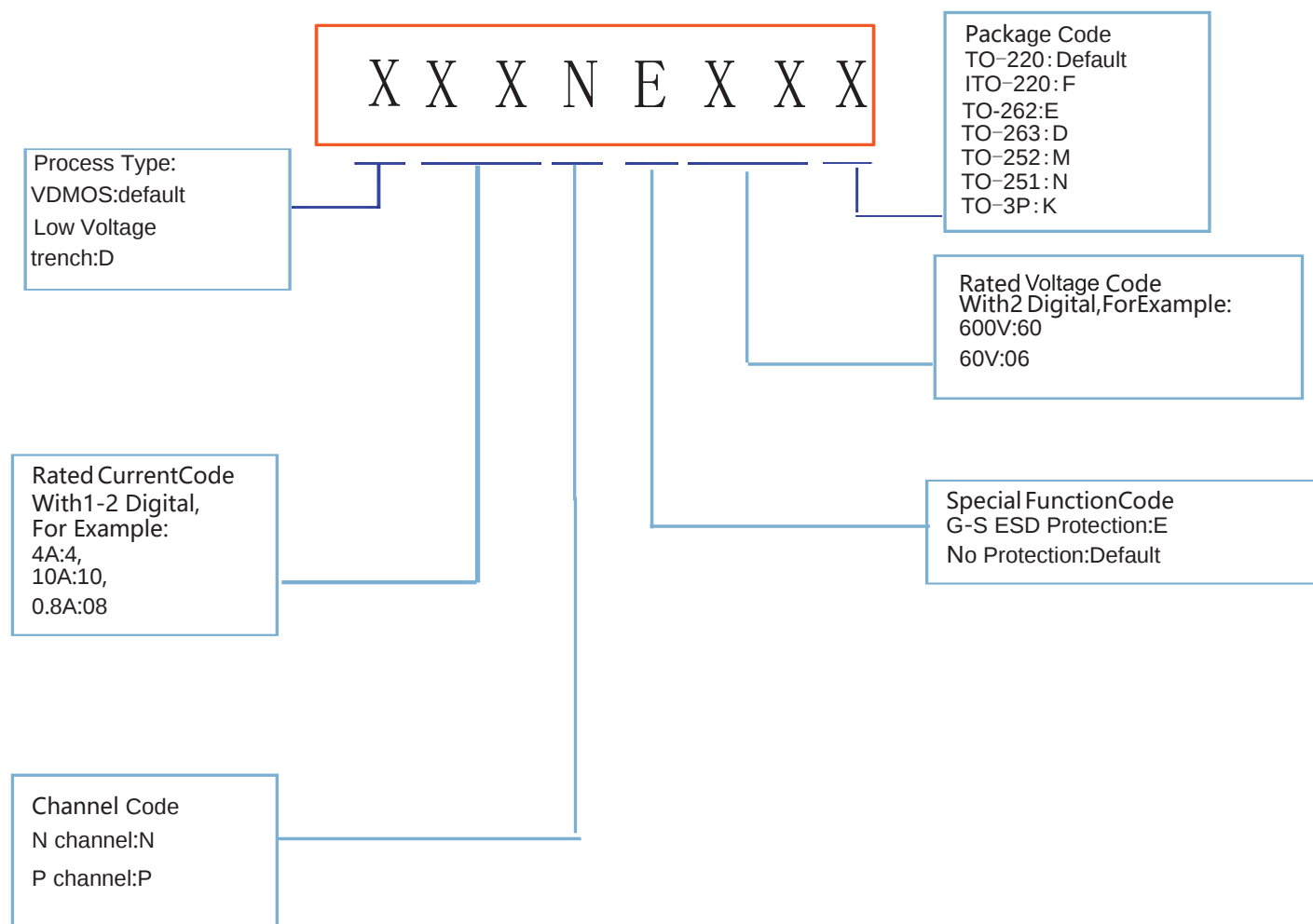
Unclamped inductive load test circuit	Unclamped inductive waveform
	

Table 22 Test circuit and waveform for diode characteristics

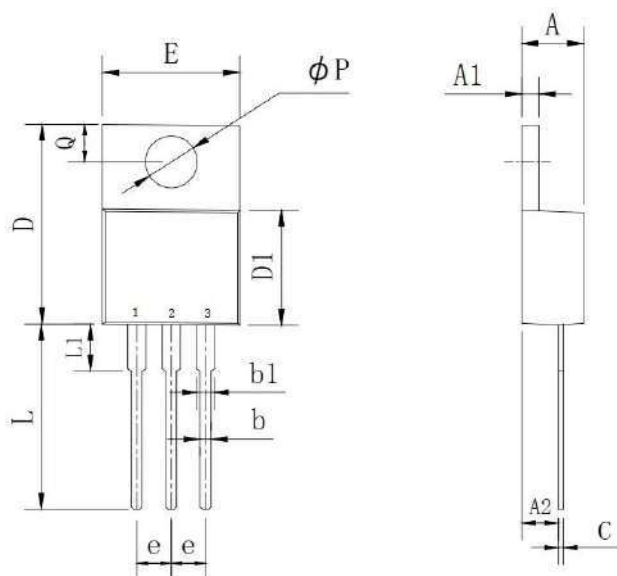
Test circuit for diode characteristics	Diode recovery waveform
	

Product Names Rules



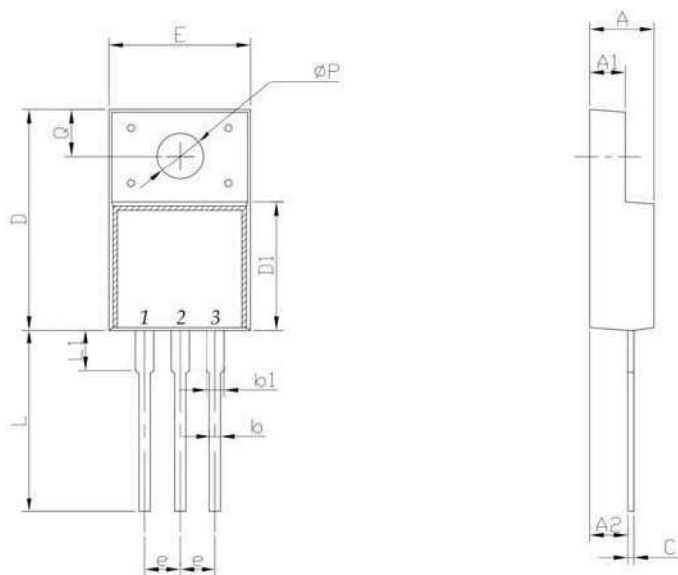
Dimensions

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

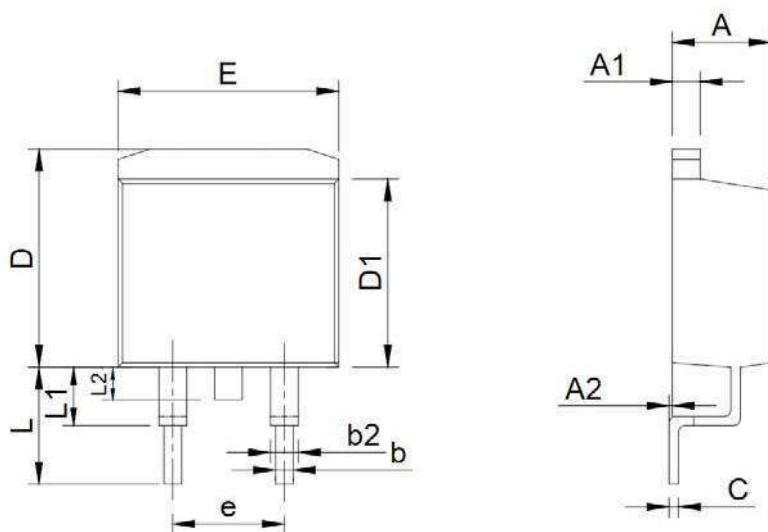
ITO-220 PACKAGE OUTLINE DIMENSIONS



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

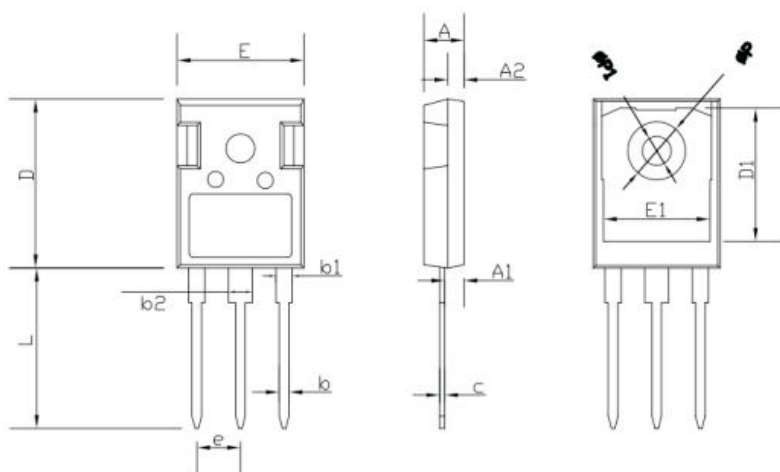
Dimensions

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

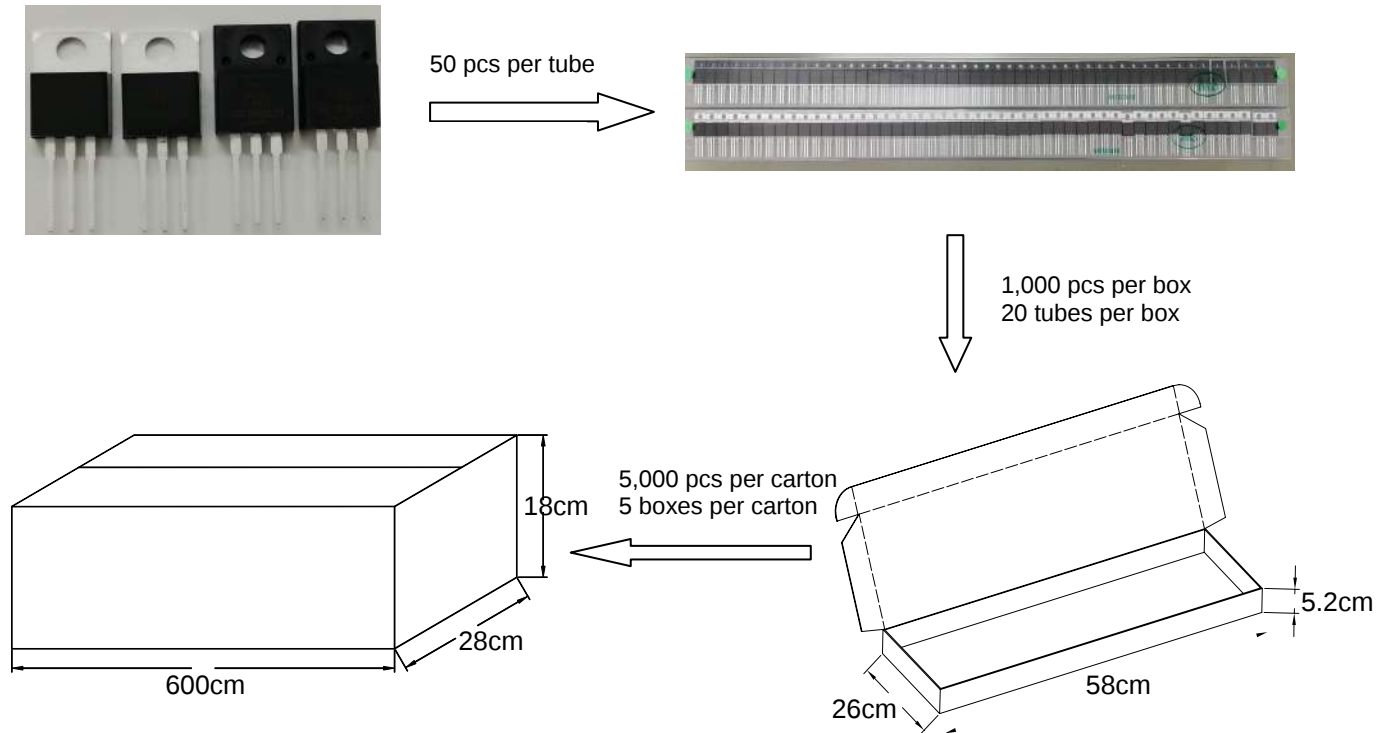
TO-247 PACKAGE OUTLINE DIMENSIONS



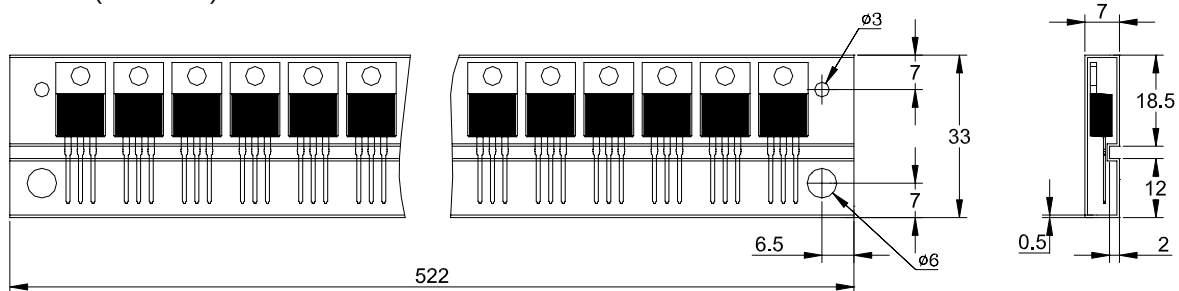
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
A	4.90	5.10	0.193	0.201
A1	2.31	2.51	0.091	0.099
A2	1.90	2.10	0.075	0.083
b	1.16	1.26	0.046	0.050
b1	1.96	2.06	0.0772	0.0812
b2	2.96	3.06	0.117	0.121
c	0.59	0.66	0.0232	0.0260
D	20.90	21.10	0.8235	0.8313
D1	16.25	16.85	0.6403	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

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 : $0^{\circ}\text{C} \sim 35^{\circ}\text{C}$ ($32^{\circ}\text{F} \sim 95^{\circ}\text{F}$)

2 Shelf life : 12 month at $< 0^{\circ}\text{C} \sim 35^{\circ}\text{C}$ ($32^{\circ}\text{F} \sim 95^{\circ}\text{F}$) and $< 75\%$ R.H.