

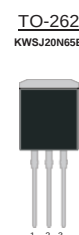
650V 20A Power MOSFET

Features:

- $R_{DS(ON)} < 0.19\Omega @ V_{GS} = 10V$
- 100% avalanche tested
- RoHS compliant

Mechanical Data:

- Case: TO-220, ITO-220, TO-3P, TO-247, TO-262, TO-263 package



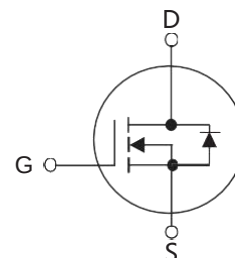
Ordering Information

Part No.	Package Type	Package	Quality(box)
KWSJ20N65	TO-220	Tube	1000
KWSJ20N65F	ITO-220	Tube	1000
KWSJ20N65E	TO-262	Tube	1000
KWSJ20N65D	TO-263	Tape & Reel	800
KWSJ20N65K	TO-3P	Tube	600
KWSJ20N65P	TO-247	Tube	600

Pin Definition:

1. Gate
2. Drain
3. Source

Block Diagram



PRODUCT SUMMARY

$V_{DS}(V)$	$R_{DS(on)}(\Omega)$ Typ	$I_D(A)$
650	0.17@ $V_{GS}=10V$	20

ABSOLUTE MAXIMUM RATINGS

($T_c=25^\circ C$, unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNIT
Drain-Source Voltage	V_{DS}	650	V
Gate-Source Voltage	V_{GS}	± 30	V
Continuous Drain Current	I_D	20	A
Pulsed Drain Current (Note 1)	I_{DM}	45	A
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
Power Dissipation	TO-220/TO-263/TO-262 TO-251/TO-252	151	W
	ITO-220	35	
Junction Temperature	T_J	+150	$^\circ C$
Storage Temperature	T_{STG}	-55 ~ +150	$^\circ C$

THERMAL DATA

PARAMETER	SYMBOL	RATING	UNIT
Junction to Ambient	R _{θJA}	62	°C/W
		82	
		1.2	
Junction to Case	R _{θJC}	4.1	°C/W

ELECTRICAL CHARACTERISTICS

(T_c=25°C, unless otherwise specified)

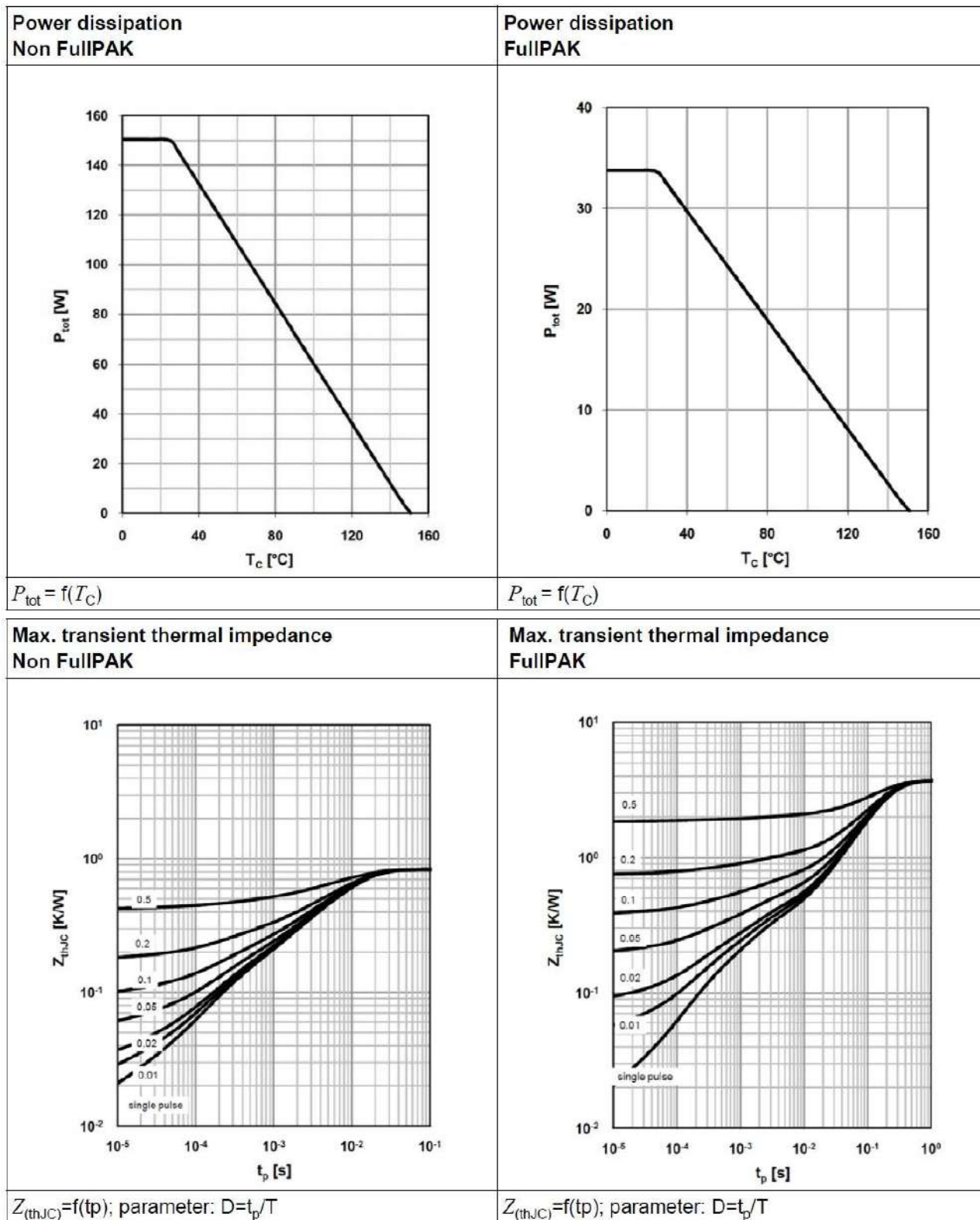
PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		BV _{DSS}	V _{GS} =0V,I _D =250μA	650			V
Drain-Source Leakage Current		I _{DSS}	V _{DS} =650V,V _{GS} =0V			1	μA
Gate- Source Leakage Current	Forward	I _{GSS}	V _{GS} =30V,V _{DS} =0V			100	nA
	Reverse		V _{GS} =-30V,V _{DS} =0V			-100	nA
ON CHARACTERISTICS(Note 3)							
Gate Threshold Voltage		V _{GS (TH)}	V _{DS} =V _{GS} ,I _D =250μA	2		4	V
DRAIN-SOURCE ON-RESISTANCE		R _{DS(ON)}	V _{GS} =10V,I _D =10A		0.17	0.19	Ω
DYNAMIC CHARACTERISTICS							
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							
Turn-On Delay Time		t _{D(ON)}	V _{DD} =520V,I _D =10A, 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 =10A, V _{GS} =10V		90	120	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 =10A		0.9	1.5	V
Maximum Continuous Drain-Source Diode Forward Current		I _S				20	A
Reverse Recovery Time		trr	V _{GS} =0V, I _S =10A dI _F /dt=100A/μs (Note 1)		475		ns
Reverse Recovery Charge		Q _{RR}			5.8		μC

Note:1. Repetitive Rating : Pulse width limited by maximum junction temperature

2. L=60mH, I_{AS}=3A, V_{DD}=150V, Starting T_J=25 C

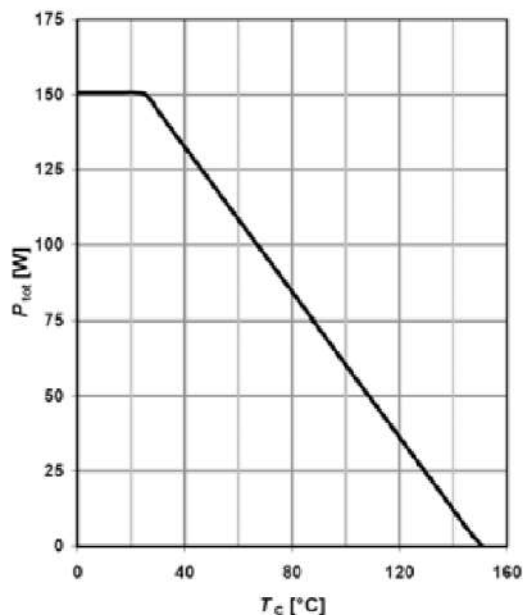
3. Pulse Test: Pulse width ≤300μs, Duty cycle≤1%.

Typical characteristics Diagrams



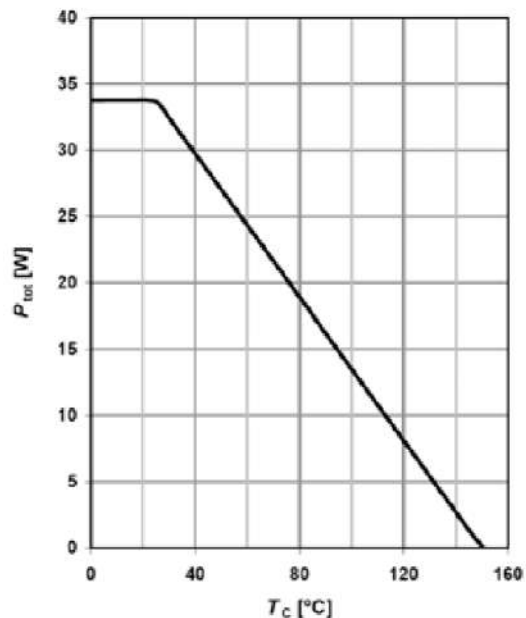
Typical characteristics Diagrams

Power dissipation



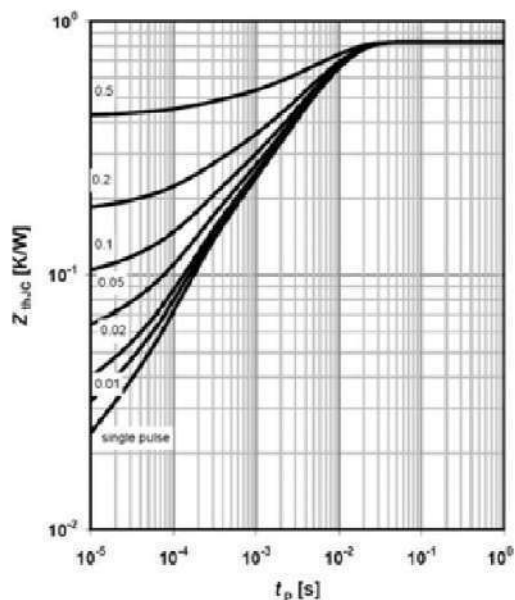
$$P_{tot} = f(T_c)$$

Power dissipation
TO-220 FullPAK



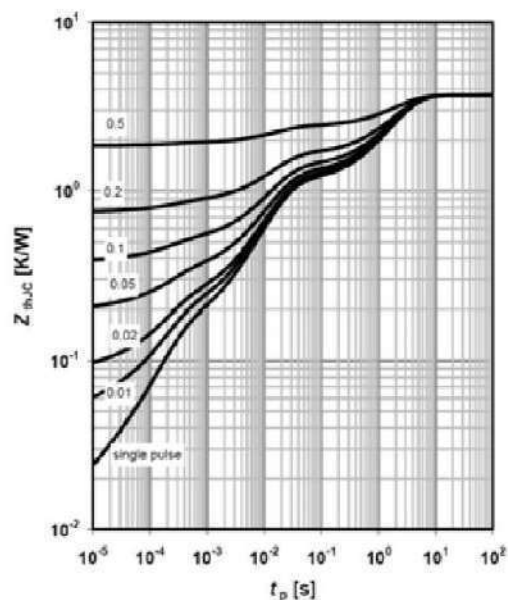
$$P_{tot} = f(T_c)$$

Max. transient thermal impedance



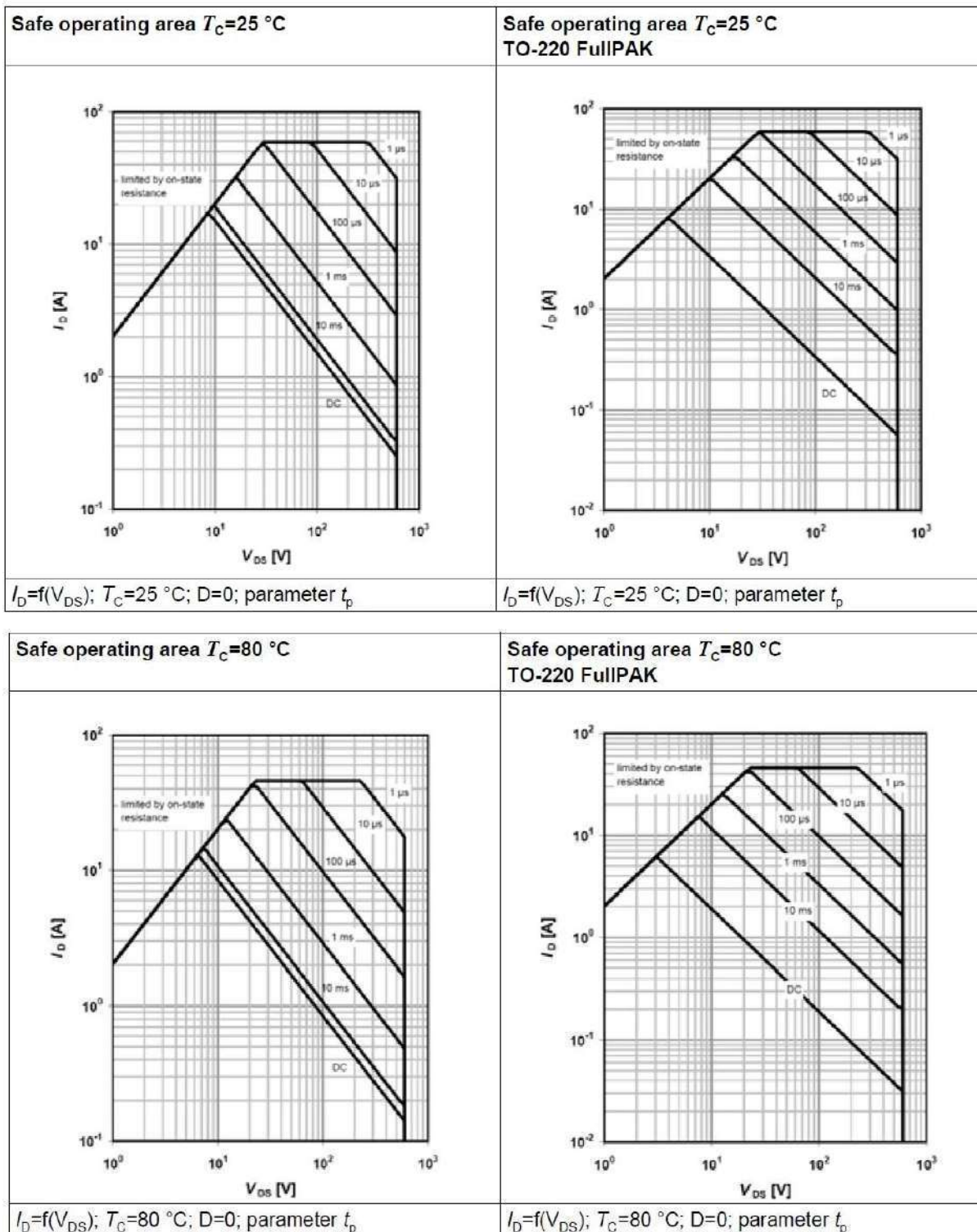
$$Z_{(thJC)} = f(t_p); \text{ parameter: } D = t_p/T$$

Max. transient thermal impedance
TO-220 FullPAK

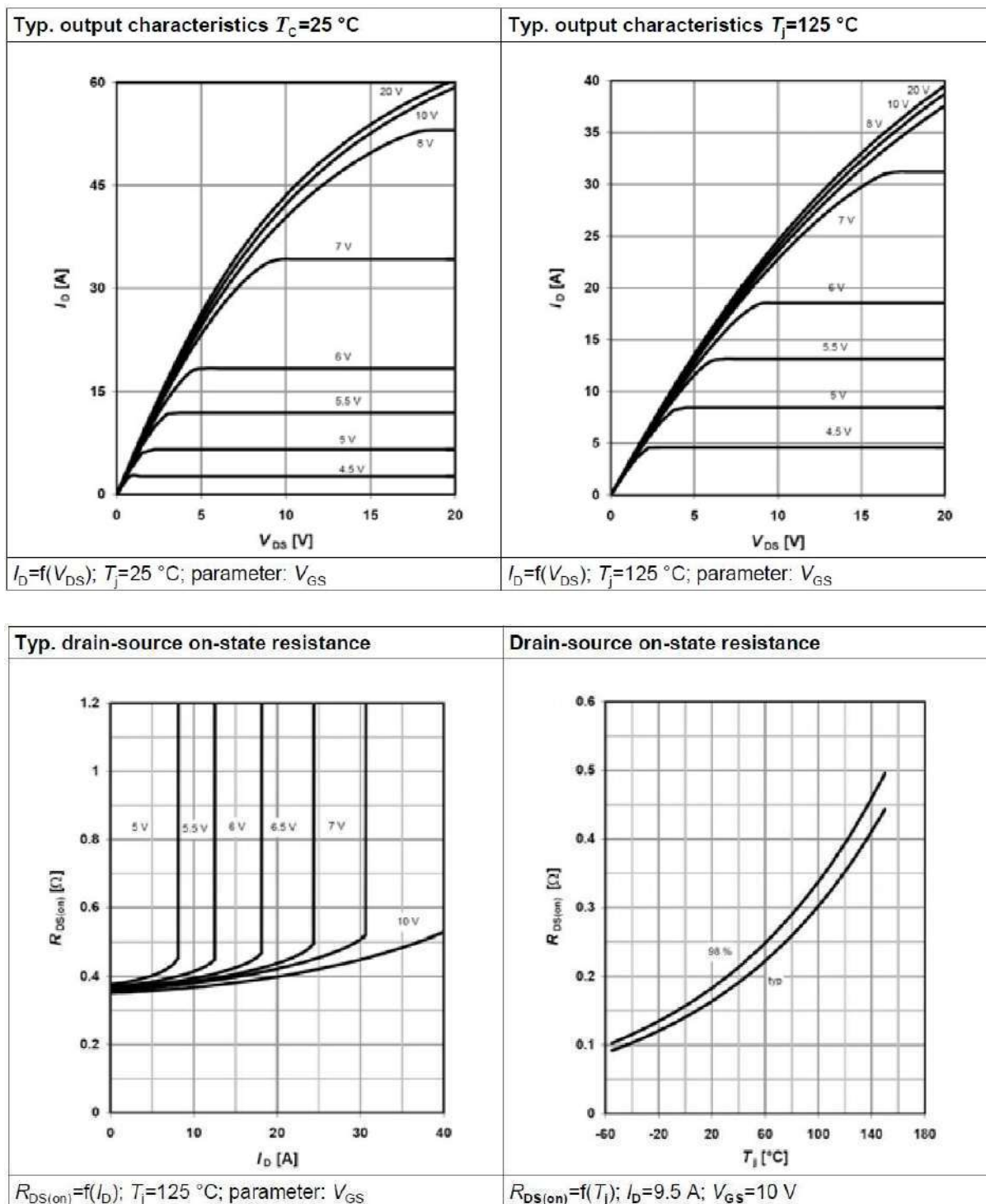


$$Z_{(thJC)} = f(t_p); \text{ parameter: } D = t_p/T$$

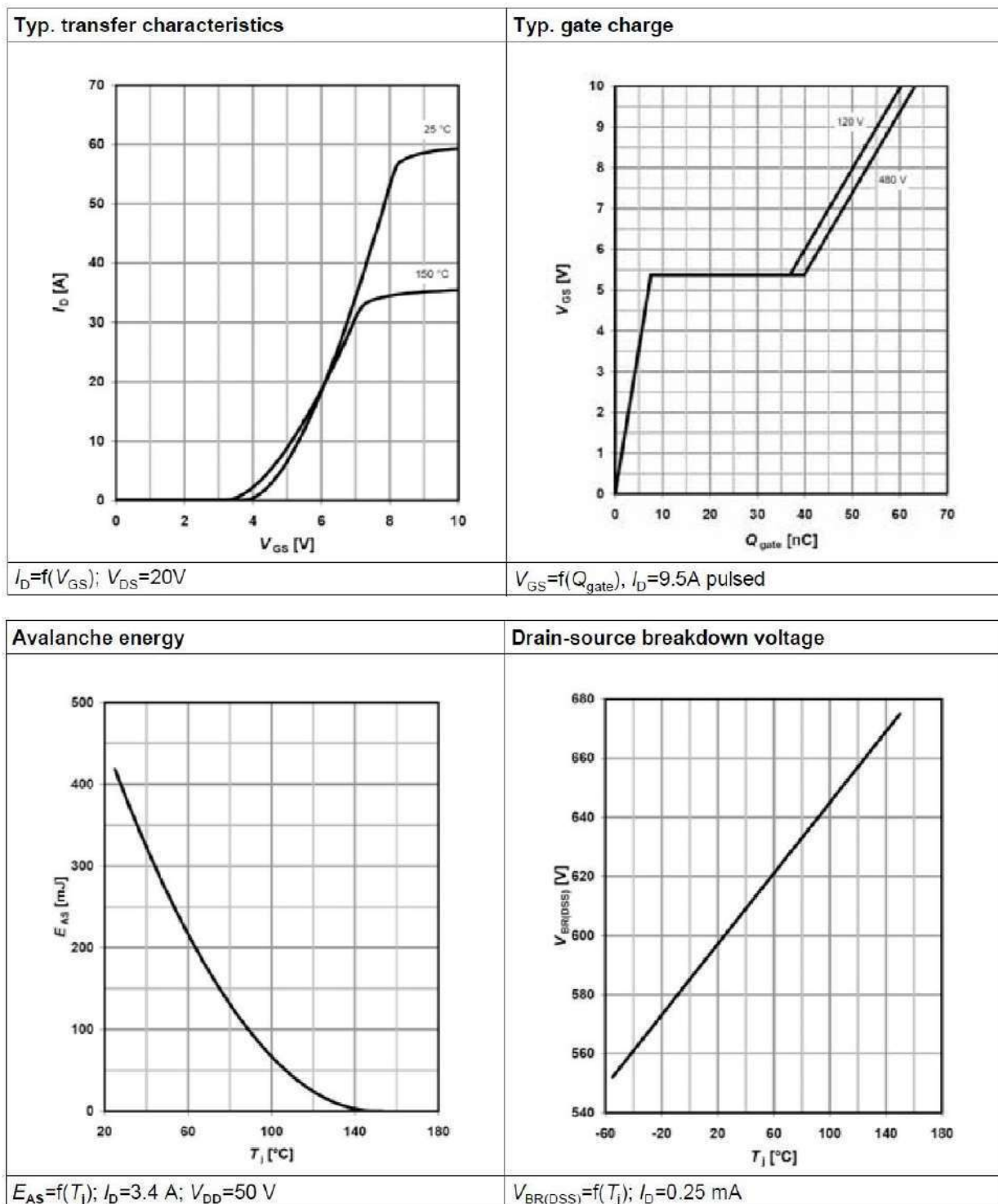
Typical characteristics Diagrams



Typical characteristics Diagrams



Typical characteristics Diagrams



TYPICAL TEST CIRCUIT

Table 20 Switching times test circuit and waveform for inductive load

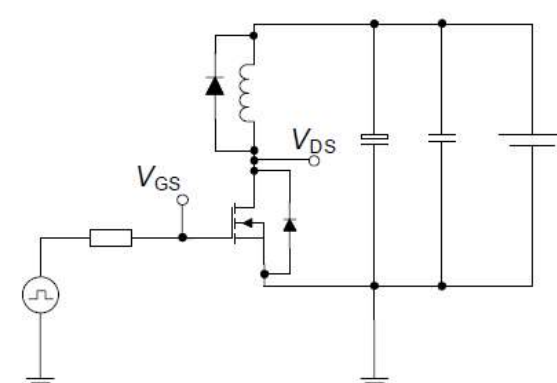
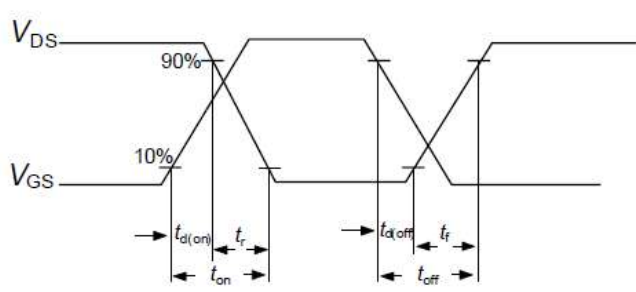
Switching times test circuit for inductive load	Switching time waveform
	

Table 21 Unclamped inductive load test circuit and waveform

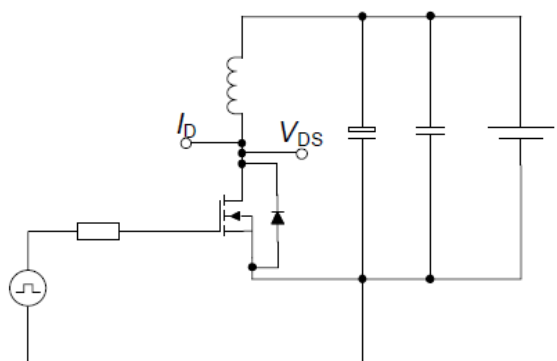
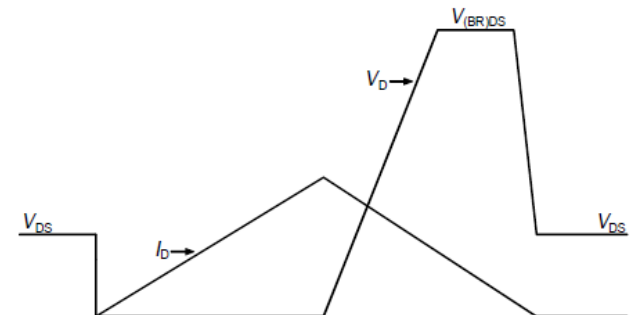
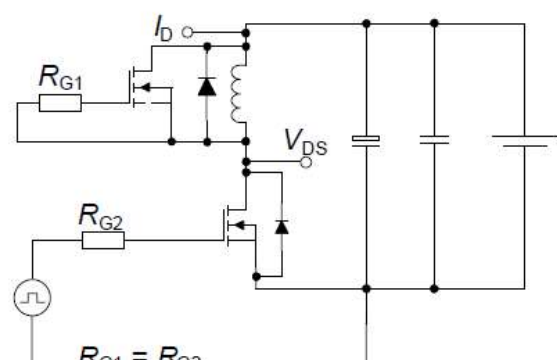
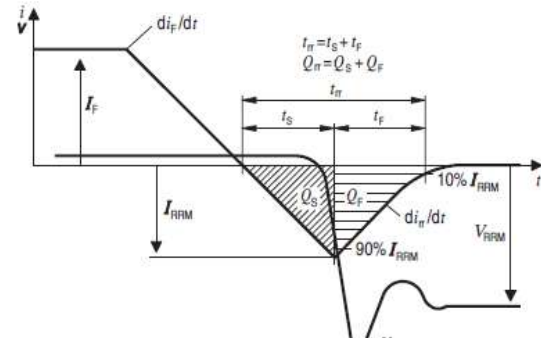
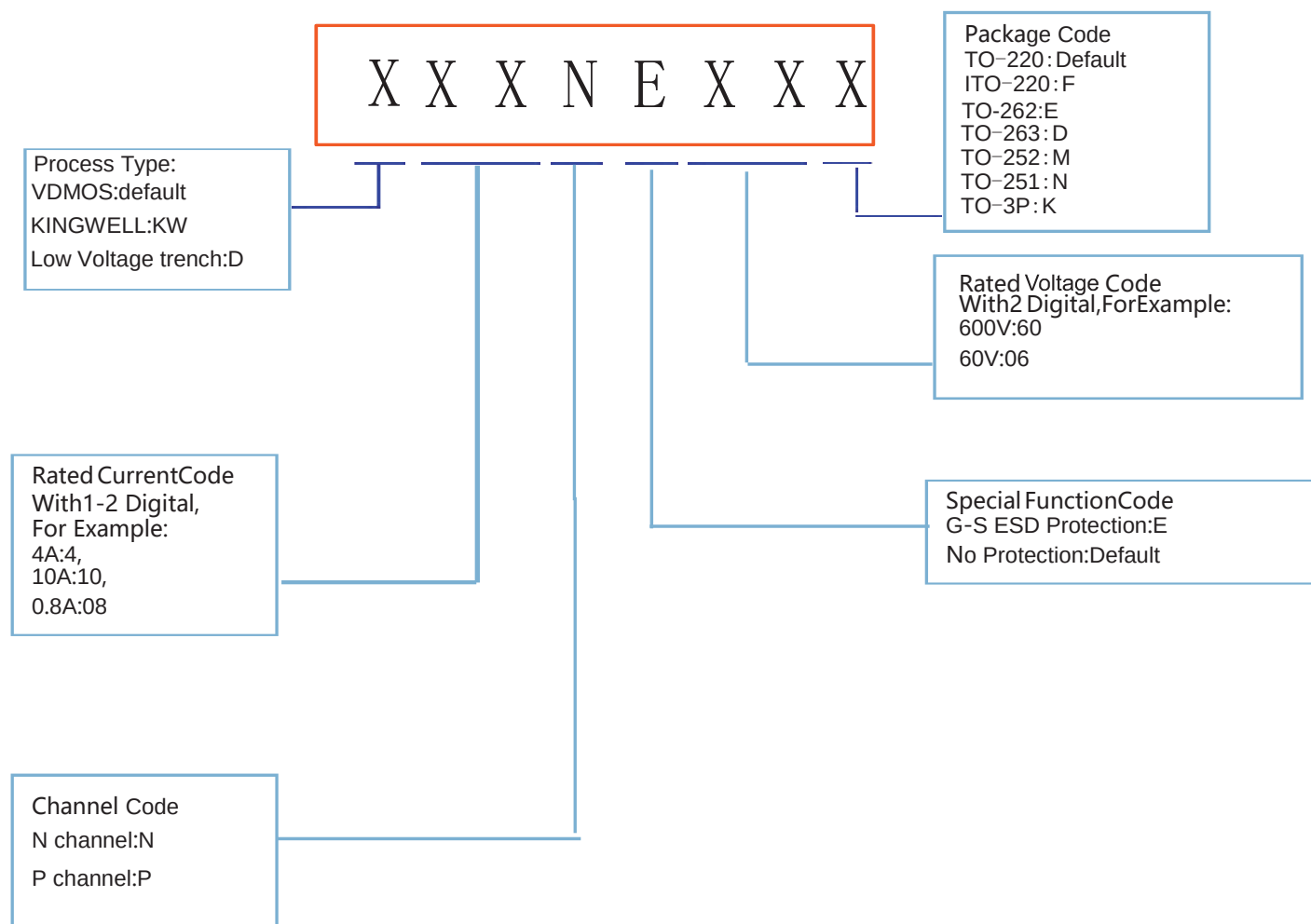
Unclamped inductive load test circuit	Unclamped inductive waveform
	

Table 22 Test circuit and waveform for diode characteristics

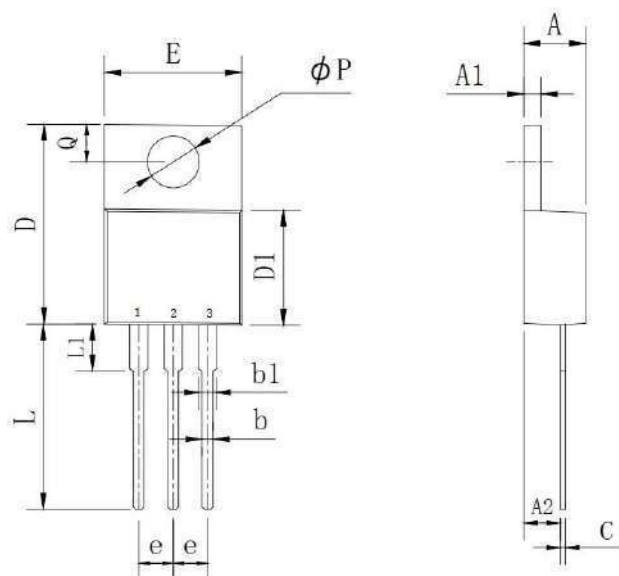
Test circuit for diode characteristics	Diode recovery waveform
 $R_{G1} = R_{G2}$	 SL00088

Product Names Rules



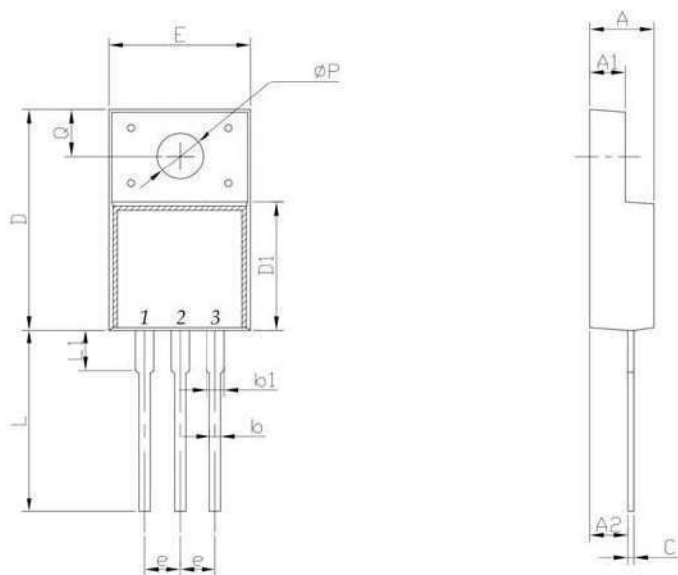
Dimensions

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

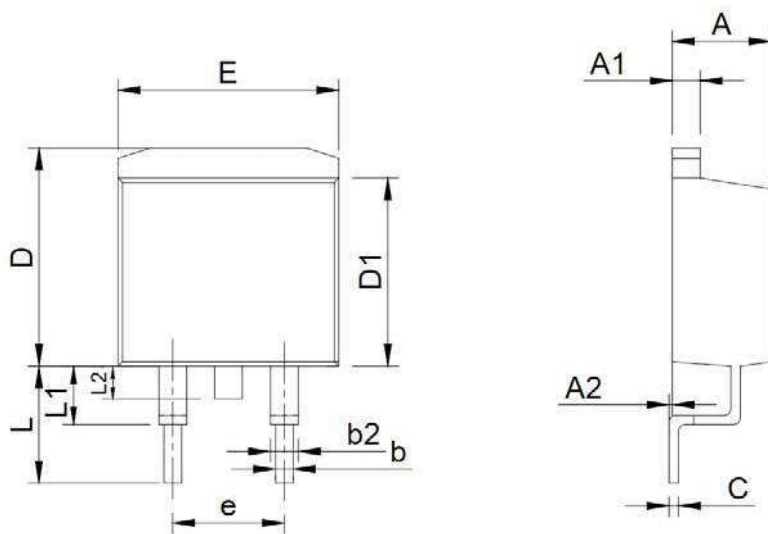
ITO-220 PACKAGE OUTLINE DIMENSIONS



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

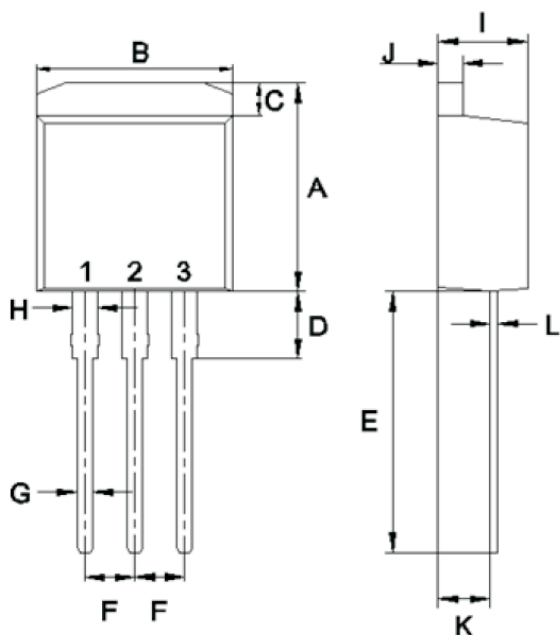
Dimensions

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

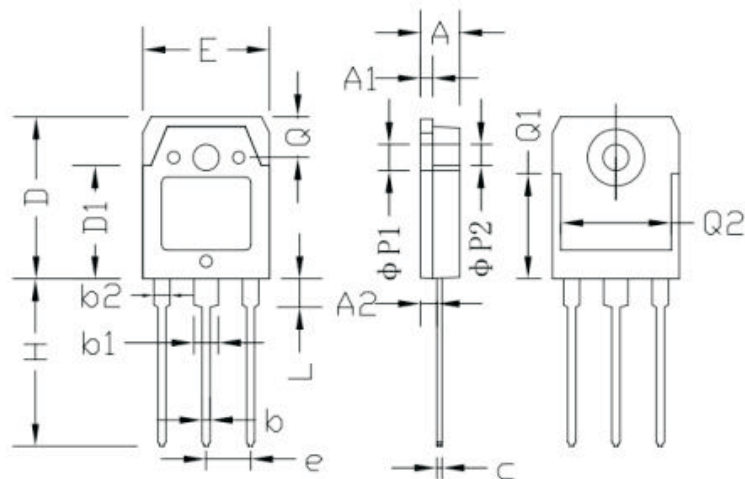
TO-262 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	10.14	11.14	0.399	0.439
B	9.57	10.57	0.377	0.416
C	1.15	1.84	0.045	0.072
D	2.95	3.95	0.116	0.156
E	12.25	13.75	0.482	0.541
F	2.34	2.74	0.092	0.108
G	0.51	1.11	0.020	0.044
H	0.97	1.57	0.038	0.062
I	4.25	4.87	0.167	0.192
J	1.07	1.47	0.042	0.058
K	2.03	2.92	0.080	0.115
L	0.3	0.6	0.012	0.024

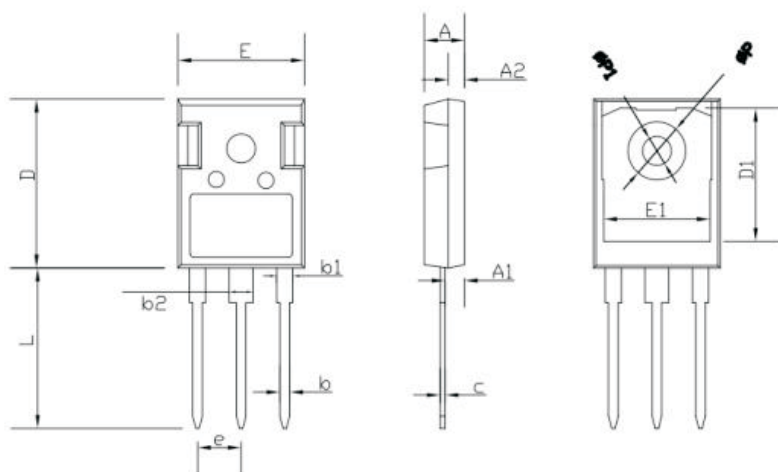
Dimensions

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	-

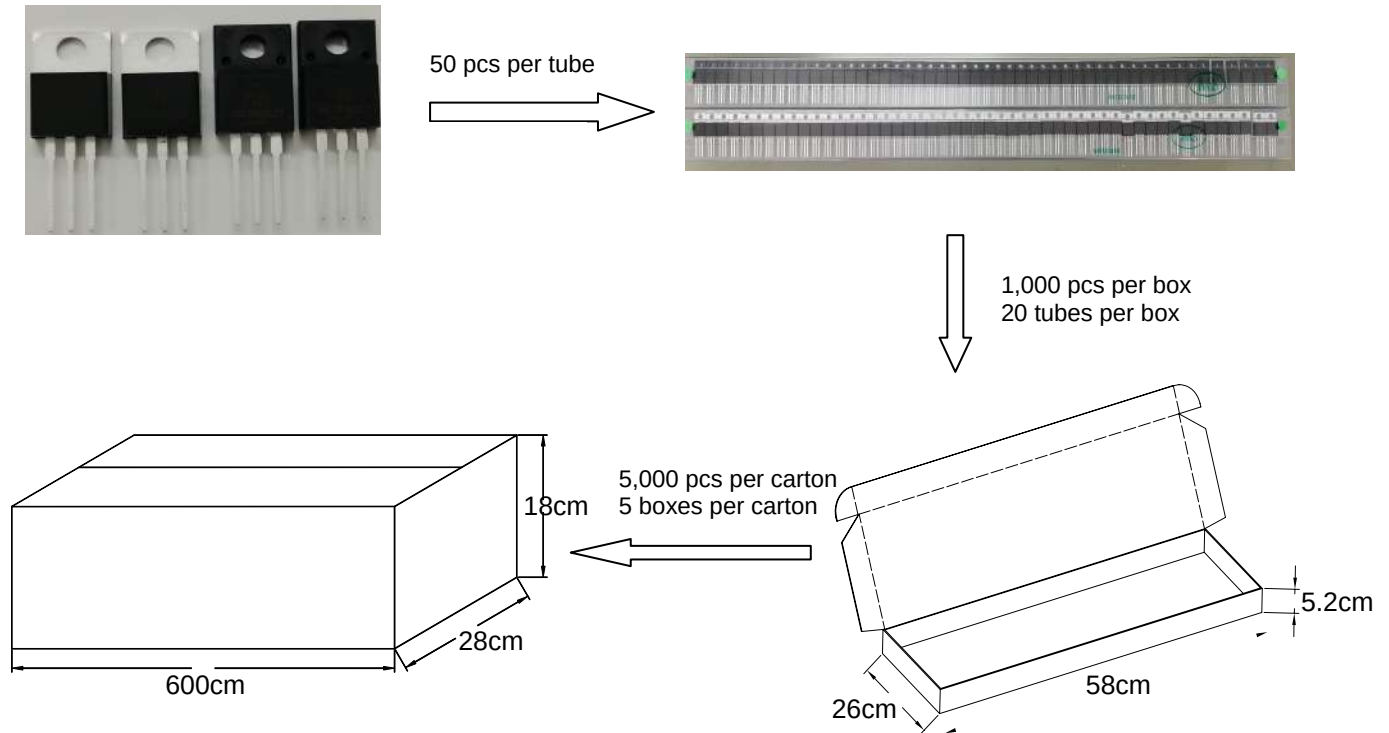
TO-247 PACKAGE OUTLINE DIMENSIONS



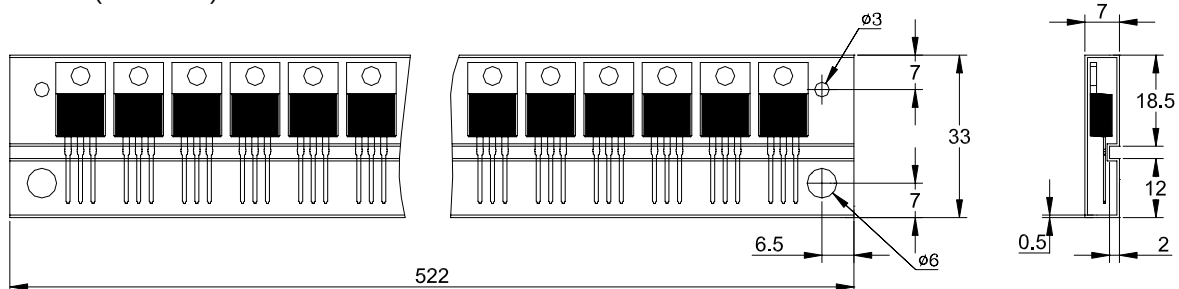
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
A	4.90	5.10	0.193	0.201
A1	2.31	2.51	0.091	0.099
A2	1.90	2.10	0.075	0.083
b	1.16	1.26	0.046	0.050
b1	1.96	2.06	0.0772	0.0812
b2	2.96	3.06	0.117	0.121
c	0.59	0.66	0.0232	0.0260
D	20.90	21.10	0.8235	0.8313
D1	16.25	16.85	0.6403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

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°C~35°C (32°F~95°F)

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