

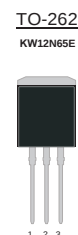
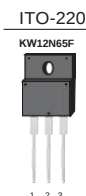
650V N-Channel Power MOSFET

Features:

- $R_{DS(ON)} < 0.8\Omega @ V_{GS}=10V$
- Fast switching capability
- Low Gate Charge
- Lead free in compliance with EU RoHS directive.

Mechanical Data:

- Case: TO-220, ITO-220, TO-262, TO-263 Package



Ordering Information

Part No.	Package Type	Package	Quality(box)
KW12N65	TO-220	Tube	1000
KW12N65F	ITO-220	Tube	1000
KW12N65E	TO-262	Tube	1000
KW12N65D	TO-263	Tape & Reel	800

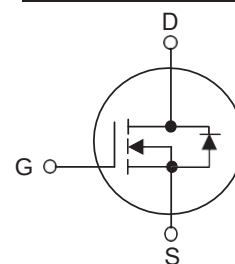
PRODUCT SUMMARY

$V_{DS}(V)$	$R_{DS(ON)} (TYP)(\Omega)$	$I_D(A)$
650	0.66 @ $V_{GS}=10V$	12

Pin Definition:

1. Gate
2. Drain
3. Source

Block Diagram



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	12	A
Pulsed Drain Current (Note 1)		I_{DM}	48	A
Avalanche Energy(Note 5)		E_{AS}	550	mJ
Power Dissipation	TO-220/TO-263/TO-262	P_D	150	W
	ITO-220		42	
Junction Temperature		T_J	+150	C
Storage Temperature		T_{STG}	-55 ~ +150	C

THERMAL DATA

PARAMETER		SYMBOL	RATING	UNIT
Junction to Ambient	TO-220/TO-251/TO-252	θ_{JA}	62.5	C/W
	TO-262/TO-263			
	ITO-220			
Junction to Case	TO-220/TO-263/TO-262	θ_{JC}	0.83	C/W
	ITO-220		2.98	

ELECTRICAL CHARACTERISTICS ($T_C=25^{\circ}\text{C}$, 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 3)							
Gate Threshold Voltage		V _{GS(TH)}	V _{DS} =V _{GS} ,I _D =250μA	2.0		4.0	V
Static Drain-Source On-State Resistance		R _{DS(ON)}	V _{GS} =10V,I _D =6A		0.66	0.8	Ω
DYNAMIC CHARACTERISTICS(Note 4)							
Input Capacitance		C _{ISS}	V _{DS} =25V,V _{GS} =0V,f=1MHz		1993		pF
Output Capacitance		C _{OSS}			160		pF
Reverse Transfer Capacitance		C _{RSS}			9.5		pF
SWITCHING CHARACTERISTICS (Note 4)							
Turn-On Delay Time		t _{D(ON)}	V _{DD} =325V,I _D =12A, R _G =10Ω		28		ns
Turn-On Rise Time		t _R			26		ns
Turn-Off Delay Time		t _{D(OFF)}			64		ns
Turn-Off Fall Time		t _F			45		ns
Total Gate Charge		Q _G	V _{DS} =520V,I _D =12A, V _{GS} =10V		40		nC
Gate-Source Charge		Q _{GS}			10		nC
Gate-Drain Charge		Q _{GD}			14		nC
DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS							
Drain-Source Diode Forward Voltage		V _{SD}	V _{GS} =0V, I _S =12A			1.5	V
Maximum Continuous Drain-Source Diode Forward Current (Note 2)		I _S				12	A
Reverse Recovery Current		I _{RRM}			13.2		A
Reverse Recovery Time		t _{rr}	V _{GS} =0V, I _S =12A		651		ns
Reverse Recovery Charge		Q _{RR}	diI/dt=100A/μs (Note 1)		4297		nC

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

2. Surface mounted on FR4 Board, $t \leq 10\text{sec}$
3. Pulse Test: Pulse width $\leq 300\mu s$, Duty cycles $\leq 2\%$.
4. Guaranteed by design, not subject to production.
5. $L=10\text{mH}, I_D=10.5A, V_{DD}=50V, R_G=25\Omega$, Starting $T_J=25^{\circ}\text{C}$

Typical characteristics Diagrams

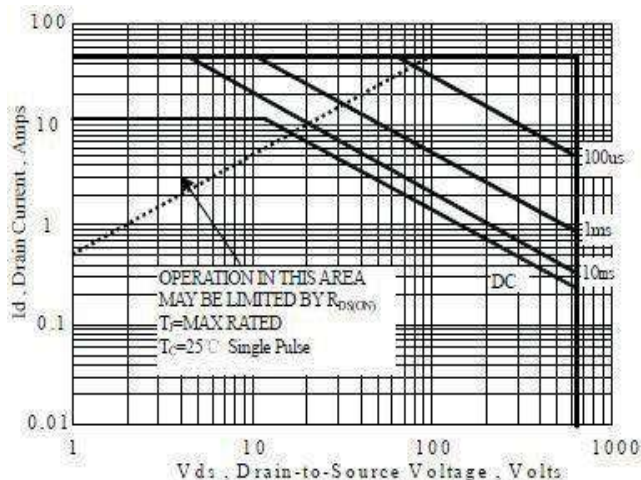


Figure 1 Maximum Forward Bias Safe Operating Area

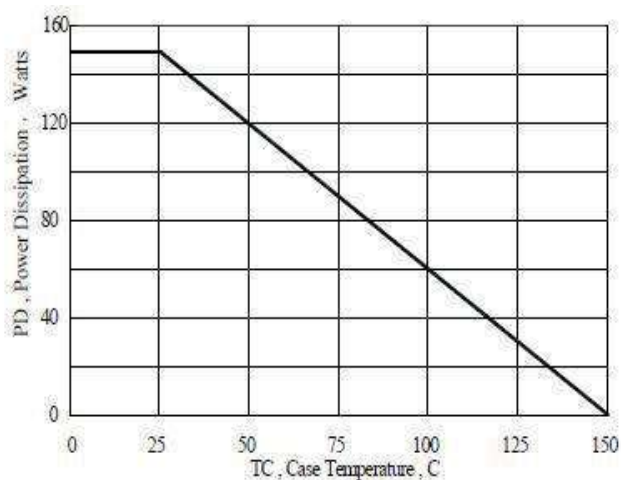


Figure 2 Maximum Power Dissipation vs Case Temperature

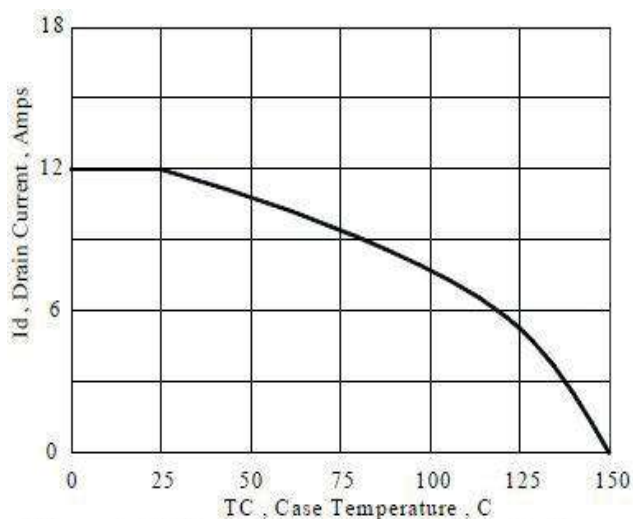


Figure 3 Maximum Continuous Drain Current vs Case Temperature

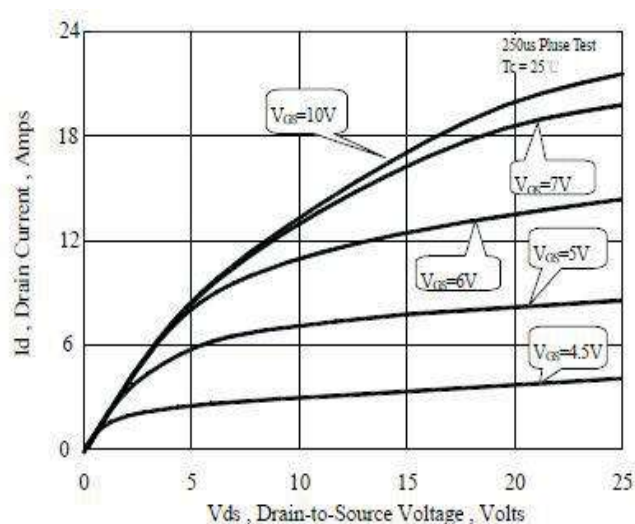


Figure 4 Typical Output Characteristics

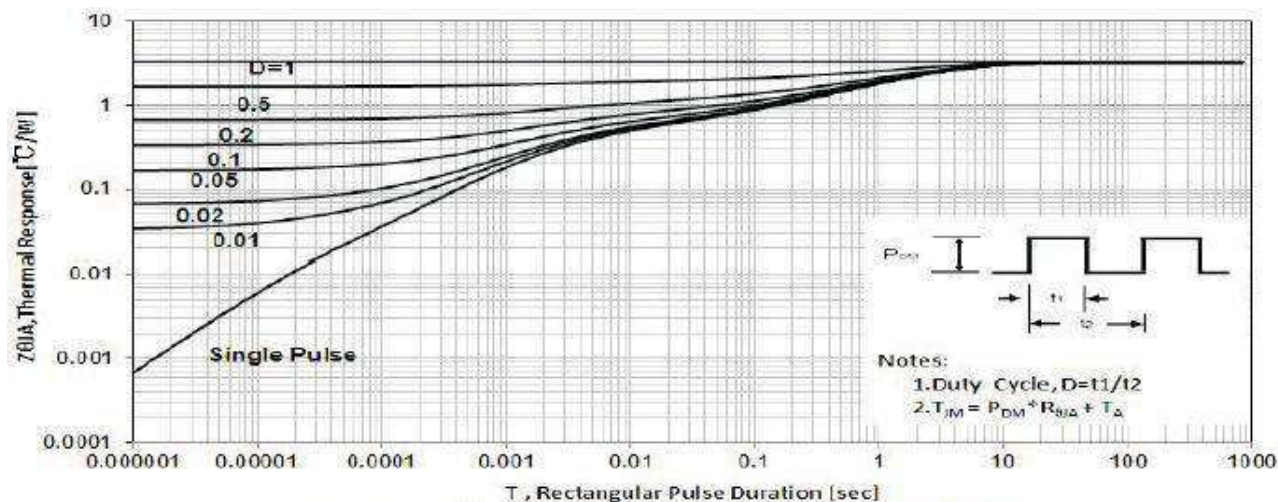


Figure 5 Maximum Effective Thermal Impedance. Junction to Case

Typical characteristics Diagrams

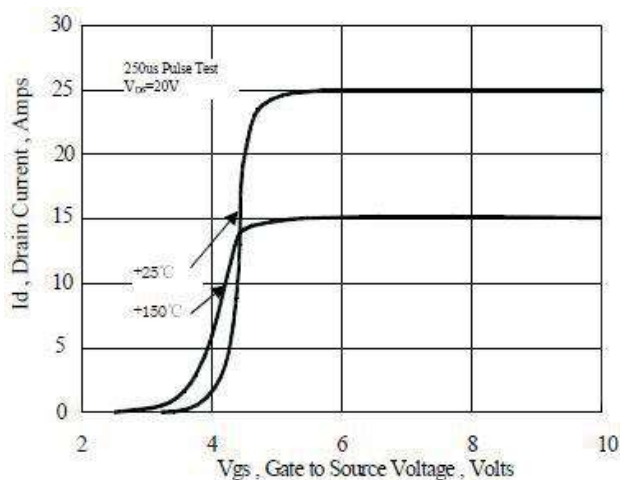


Figure 6 Typical Transfer Characteristics

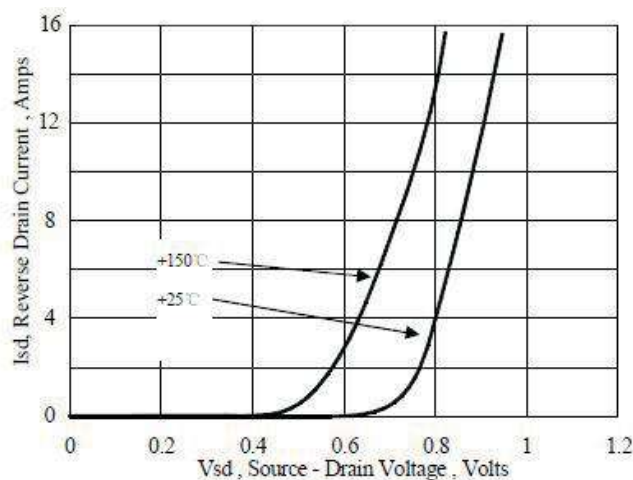


Figure 7 Typical Body Diode Transfer Characteristics

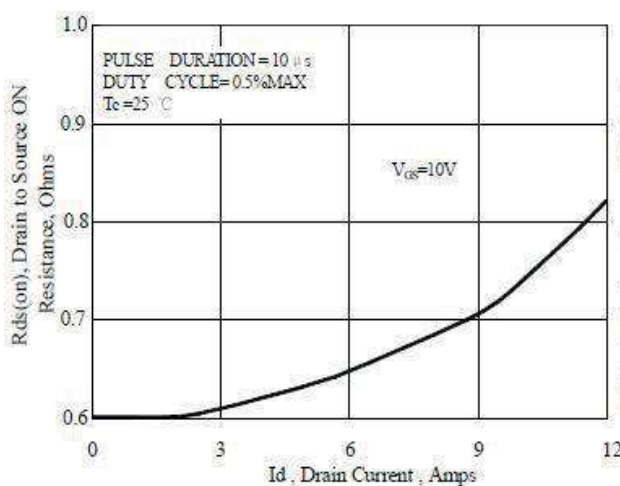


Figure 8 Typical Drain to Source ON Resistance vs Drain Current

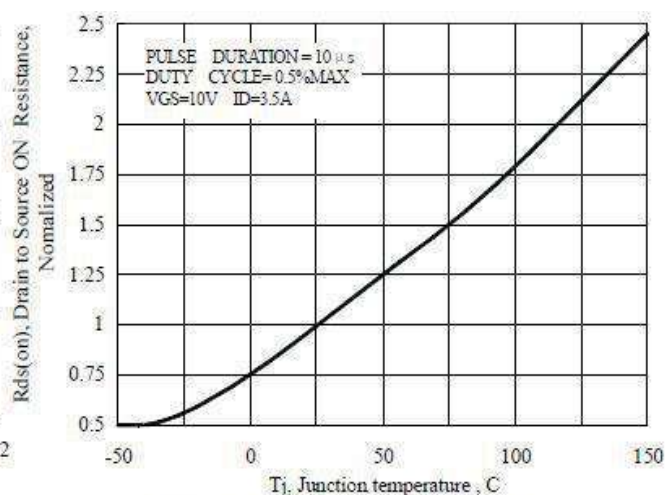


Figure 9 Typical Drain to Source on Resistance vs Junction Temperature

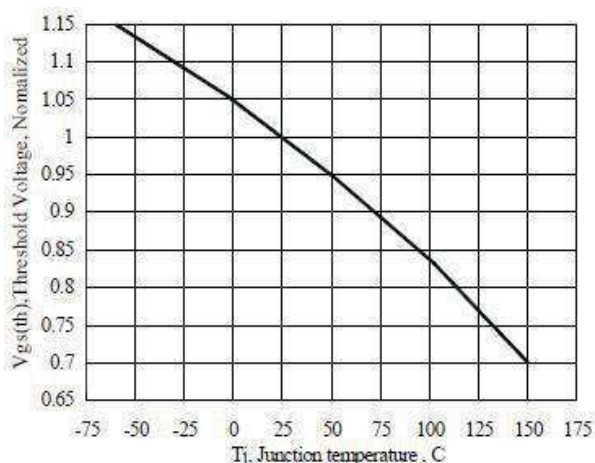


Figure 10 Typical Threshold Voltage vs Junction Temperature

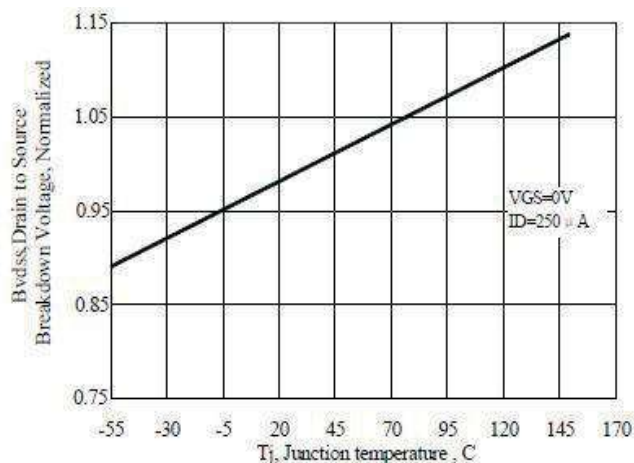


Figure 11 Typical Breakdown Voltage vs Junction Temperature

Typical characteristics Diagrams

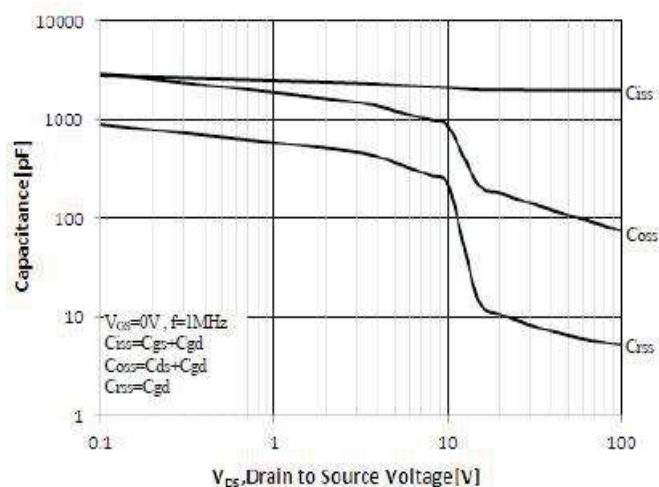


Figure 12 Typical Capacitance vs Drain to Source Voltage

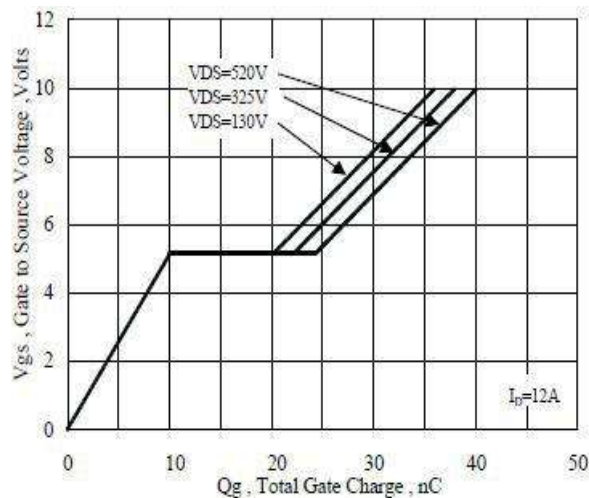


Figure 13 Typical Gate Charge vs Gate to Source Voltage

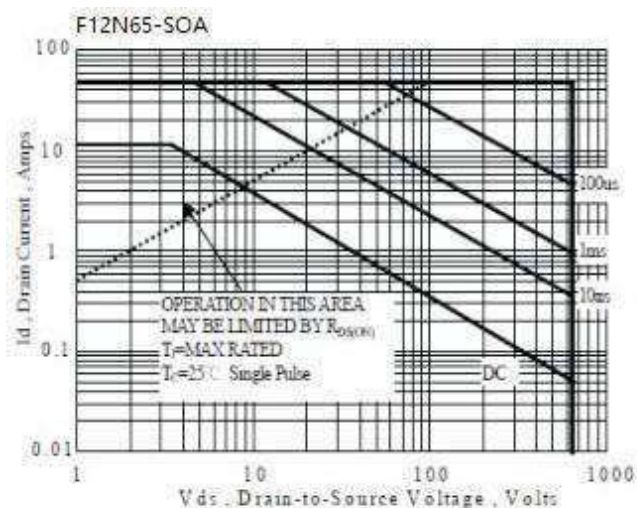


Figure 14 Maximum Forward Bias Safe Operating Area

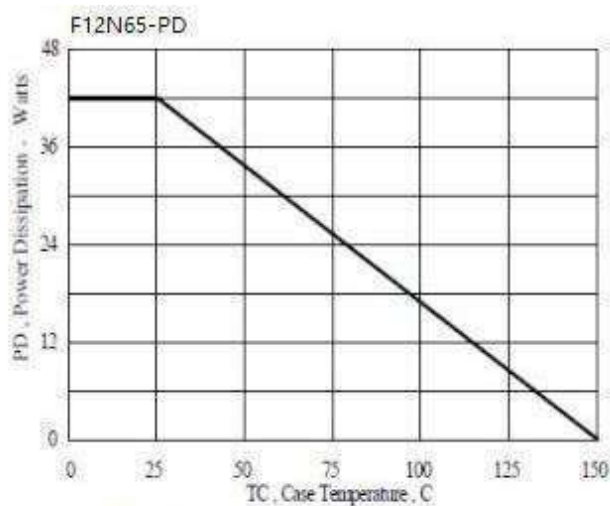


Figure 15 Maximum Power Dissipation vs Case Temperature

TYPICAL TEST CIRCUIT

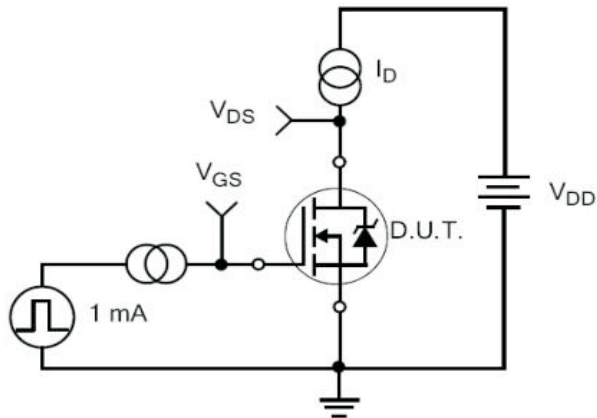


Figure 17. Gate Charge Test Circuit

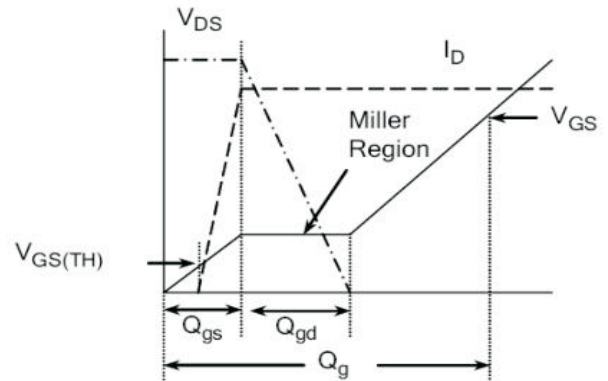


Figure 18. Gate Charge Waveform

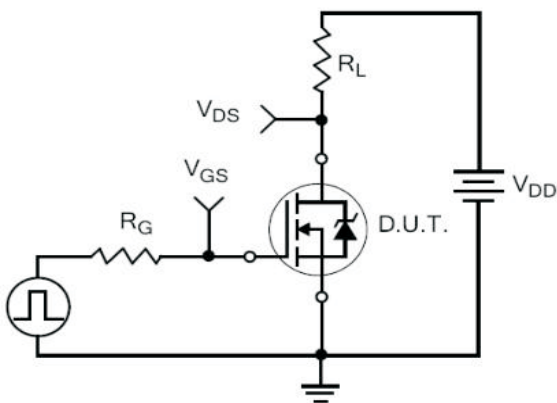


Figure 19. Resistive Switching Test Circuit

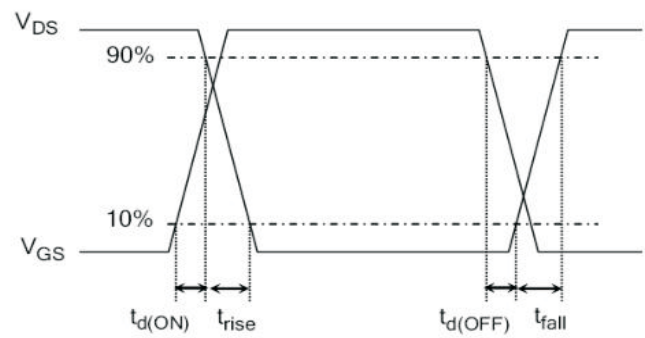


Figure 20. Resistive Switching Waveforms

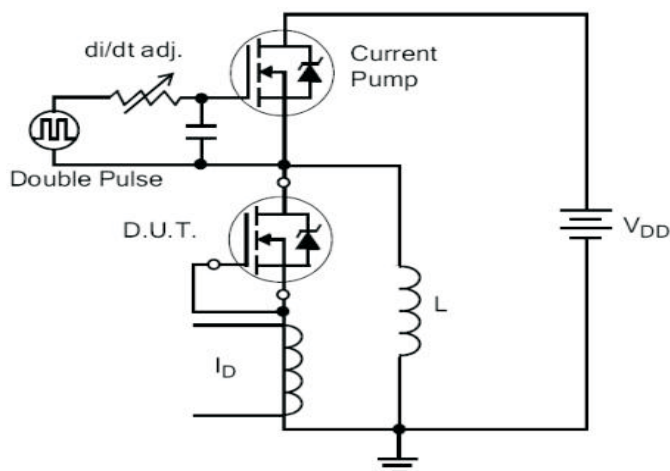


Figure 21. Diode Reverse Recovery Test Circuit

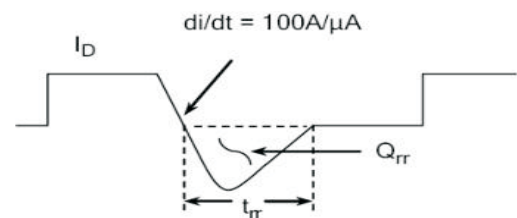


Figure 22. Diode Reverse Recovery Waveform

TYPICAL TEST CIRCUIT AND WAVEFORM(CONTINUES)

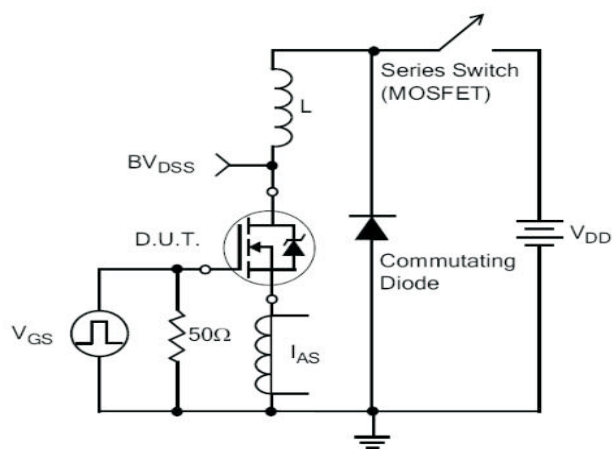


Figure 23. Unclamped Inductive Switching Test Circuit

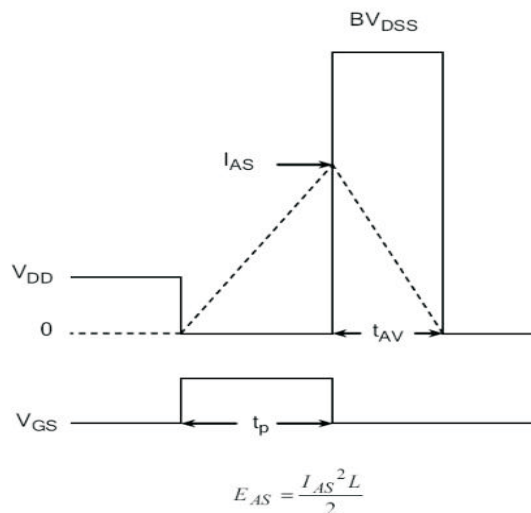


Figure 24. Unclamped Inductive Switching Waveforms

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

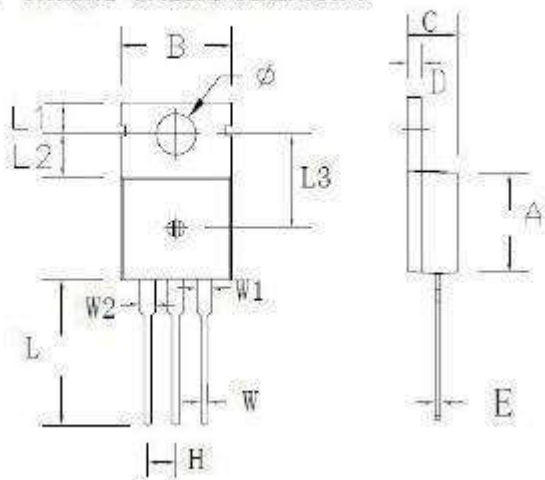
Rated Current Code
With 1-2 Digital,
For Example:
4A:4,
10A:10,
0.8A:08

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

Channel Code
N channel:N
P channel:P

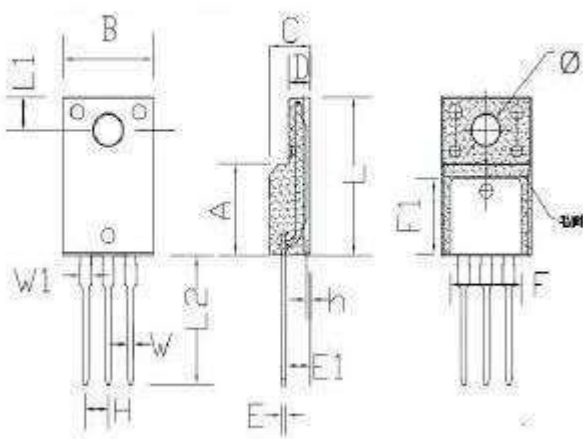
Dimensions

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

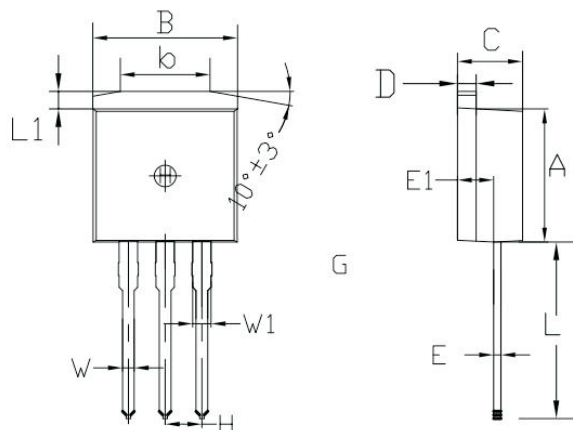
ITO-220 PACKAGE OUTLINE DIMENSIONS



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

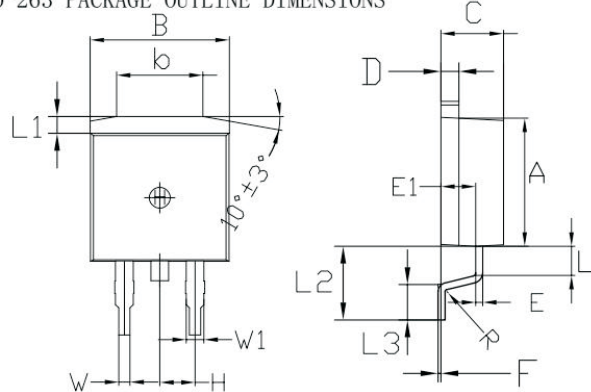
Dimensions

TO-262 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	12.25	13.75	0.482	0.541
L1	1.15	1.45	0.045	0.057
E1	2.4	2.6	0.0945	0.1024
W	0.80	0.82	0.0315	0.034
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

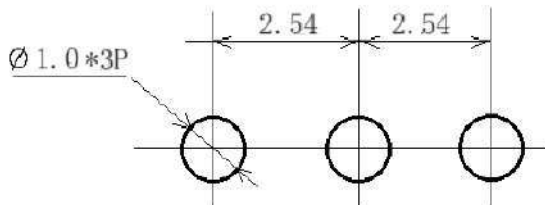
TO-263 PACKAGE OUTLINE DIMENSIONS



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

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

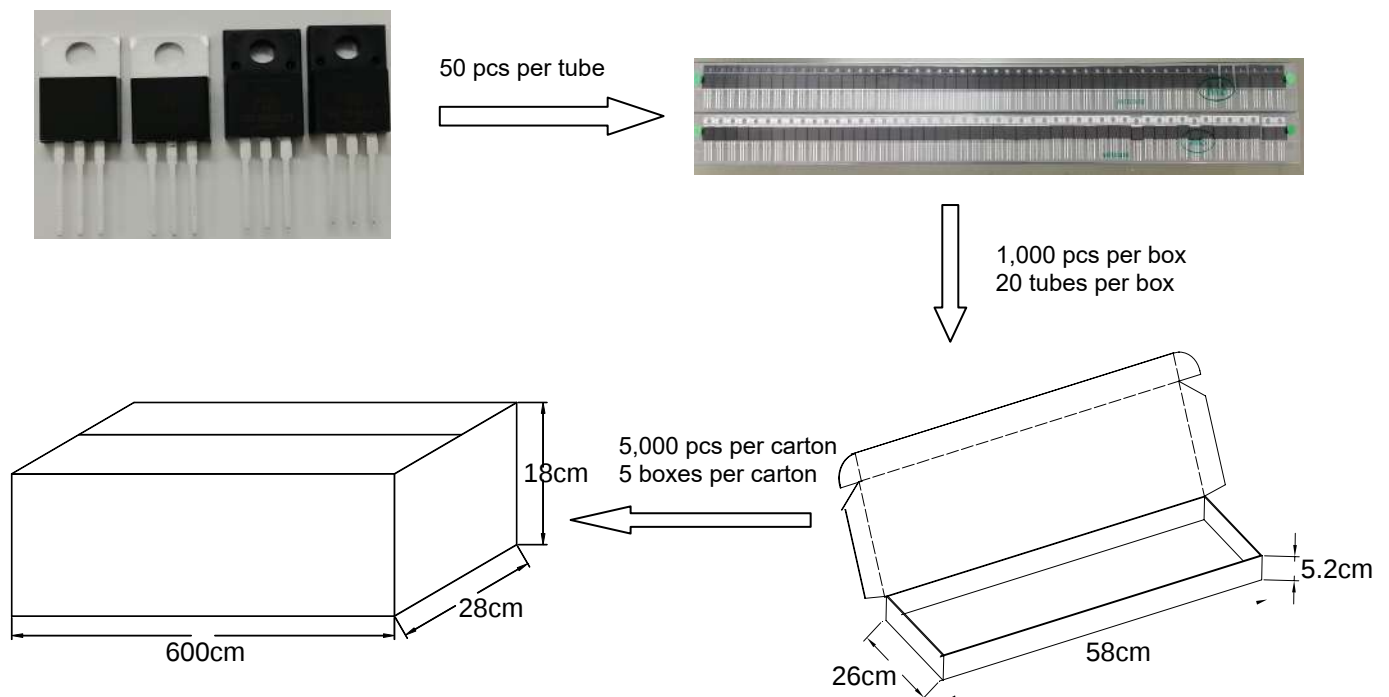
TO-220AB&ITO-220AB Suggested Pad Layout



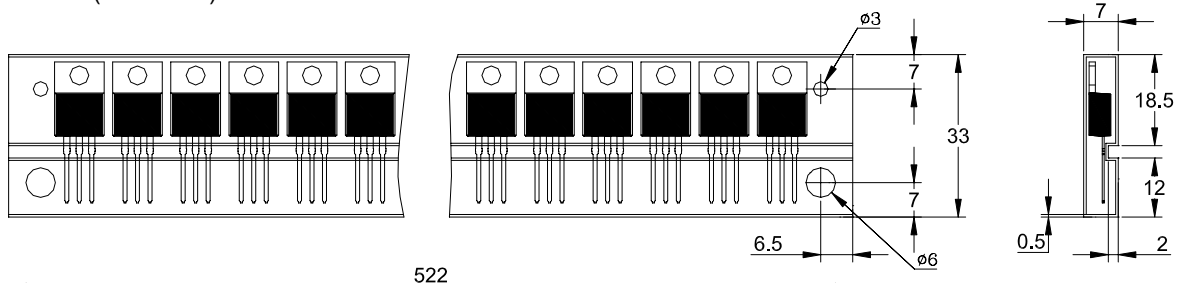
Note:

1. Controlling dimension: in millimeters.
2. General tolerance: ± 0.05 mm.
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 : $0^{\circ}\text{C} \sim 35^{\circ}\text{C}$ ($32^{\circ}\text{F} \sim 95^{\circ}\text{F}$)

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.