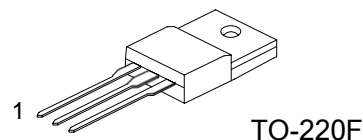
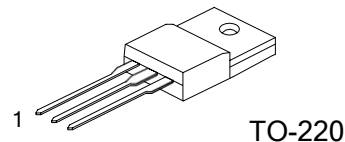


# 10A 600V N-CHANNEL POWER MOSFET

## Description:

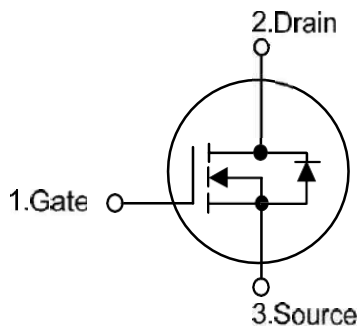
The KWNJ10N60 is a high voltage and high current power MOSFET, designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristics. This power MOSFET is usually used at high speed switching applications in power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.



## Features:

- \*  $V_{DS} = 600V$
- \*  $I_D = 10A$
- \*  $R_{DS(ON)} = 0.75\Omega @ V_{GS} = 10V$ .
- \* Low gate charge ( typical 44nC)
- \* Low CRSS ( typical 18 pF)
- \* Fast switching capability
- \* Avalanche energy specified
- \* Improved dv/dt capability

### ■ SYMBOL



## ORDERING INFORMATION

Ordering Number	Package	Pin Assignment			Packing
		1	2	3	
KWNJ10N60	TO-220	G	D	S	Tape Box
KWNJ10N60-BL	TO-220	G	D	S	Bulk
KWNJ10N60F	TO-220F	G	D	S	Tube

Note: Pin Assignment: G: Gate D: Drain S: Source

**ABSOLUTE MAXIMUM RATINGS** ( $T_C=25^{\circ}\text{C}$  unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNIT
Drain-Source Voltage	$V_{DSS}$	600	V
Gate-Source Voltage	$V_{GSS}$	$\pm 30$	V
Avalanche Current (Note 2)	$I_{AR}$	10	A
Drain Current	Continuous	$I_D$	10
	Pulsed (Note 2)	$I_{DM}$	38
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	700
	Repetitive (Note 2)	$E_{AR}$	15.6
Peak Diode Recovery dv/dt (Note 4)	dv/dt	4.5	V/ns
Power Dissipation	TO-220	$P_D$	156
	TO-220F		50
Junction Temperature	$T_J$	+150	$^{\circ}\text{C}$
Operating Temperature	$T_{OPR}$	-55 ~ +150	$^{\circ}\text{C}$
Storage Temperature	$T_{STG}$	-55 ~ +150	$^{\circ}\text{C}$

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. Repetitive Rating: Pulse width limited by maximum junction temperature

3.  $L = 14.2\text{mH}$ ,  $I_{AS} = 10\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\ \Omega$  Starting  $T_J = 25^{\circ}\text{C}$

4.  $I_{SD} = 9.5\text{A}$ ,  $di/dt = 200\text{A}/3\text{s}$ ,  $V_{DD} = BV_{DSS}$ , Starting  $T_J = 25^{\circ}\text{C}$

**THERMAL DATA**

PARAMETER	SYMBOL	RATING	UNIT
Junction to Ambient	$\theta_{JA}$	62.5	$^{\circ}\text{C}/\text{W}$
Junction to Case	TO-220	0.8	$^{\circ}\text{C}/\text{W}$
	TO-220F	2.5	
	$\theta_{JC}$		

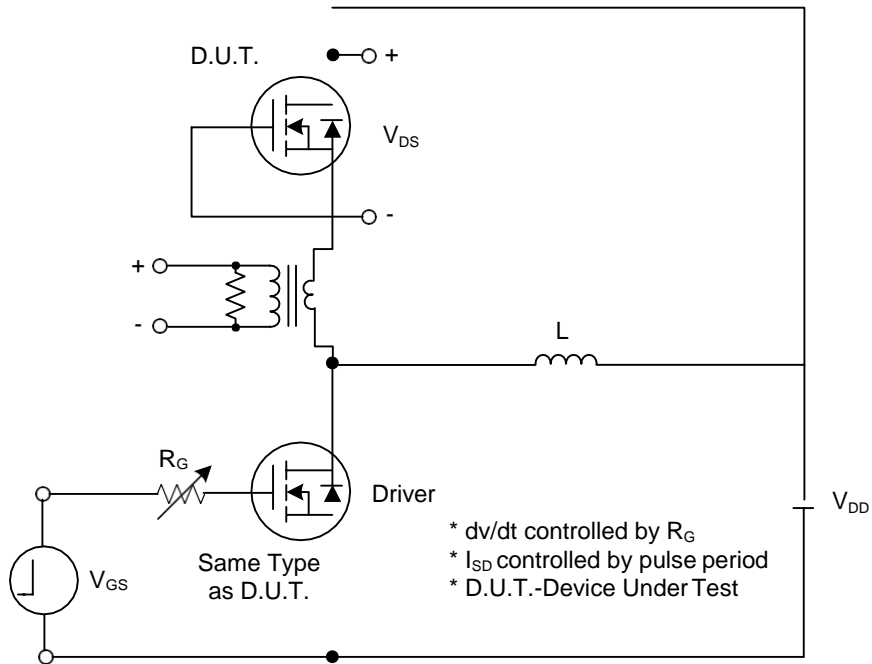
**ELECTRICAL CHARACTERISTICS** (T<sub>C</sub>=25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V, I <sub>D</sub> =250 $\mu$ A	600			V
Drain-Source Leakage Current	I <sub>DSS</sub>	V <sub>DS</sub> =600V, V <sub>GS</sub> =0V			1	$\mu$ A
Gate-Source Leakage Current	Forward	V <sub>GS</sub> =30 V, V <sub>DS</sub> =0V			100	nA
	Reverse		V <sub>GS</sub> =-30 V, V <sub>DS</sub> =0V			-100
Breakdown Voltage Temperature Coefficient	$\frac{\Delta BV_{DSS}}{\Delta T_J}$	I <sub>D</sub> =250 $\mu$ A, Referenced to 25°C		0.7		V/°C
<b>ON CHARACTERISTICS</b>						
Gate Threshold Voltage	V <sub>GS(TH)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250 $\mu$ A	2.0		4.0	V
Static Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =5A		0.68	0.75	$\Omega$
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> =25V, V <sub>GS</sub> =0V, f=1.0 MHz		1570	2040	pF
Output Capacitance	C <sub>OSS</sub>		166	215	pF	
Reverse Transfer Capacitance	C <sub>RSS</sub>		18	24	pF	
Gate Resistance	R <sub>G</sub>	V <sub>DS</sub> =0V, V <sub>GS</sub> =0V, f=1MHz	0.25		1.4	$\Omega$
<b>SWITCHING CHARACTERISTICS</b>						
Turn-On Delay Time	t <sub>D(ON)</sub>	V <sub>DD</sub> =300V, I <sub>D</sub> =10A, R <sub>G</sub> =25 $\Omega$ (Note1, 2)		23	55	ns
Turn-On Rise Time	t <sub>r</sub>		69	150	ns	
Turn-Off Delay Time	t <sub>D(OFF)</sub>		144	300	ns	
Turn-Off Fall Time	t <sub>f</sub>		77	165	ns	
Total Gate Charge	Q <sub>G</sub>	V <sub>DS</sub> =480V, I <sub>D</sub> =10A, V <sub>GS</sub> =10 V (Note1, 2)		44	57	nC
Gate-Source Charge	Q <sub>GS</sub>		6.7		nC	
Gate-Drain Charge	Q <sub>GD</sub>		18.5		nC	
<b>DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS</b>						
Drain-Source Diode Forward Voltage	V <sub>SD</sub>	V <sub>GS</sub> =0 V, I <sub>S</sub> =10A			1.4	V
Maximum Continuous Drain-Source Diode Forward Current	I <sub>S</sub>				10	A
Maximum Pulsed Drain-Source Diode Forward Current	I <sub>SM</sub>				38	A
Reverse Recovery Time	t <sub>rr</sub>	V <sub>GS</sub> =0 V, I <sub>S</sub> =10A,		420		ns
Reverse Recovery Charge	Q <sub>RR</sub>	dI <sub>F</sub> /dt=100A/ $\mu$ s (Note 1)		4.2		$\mu$ C

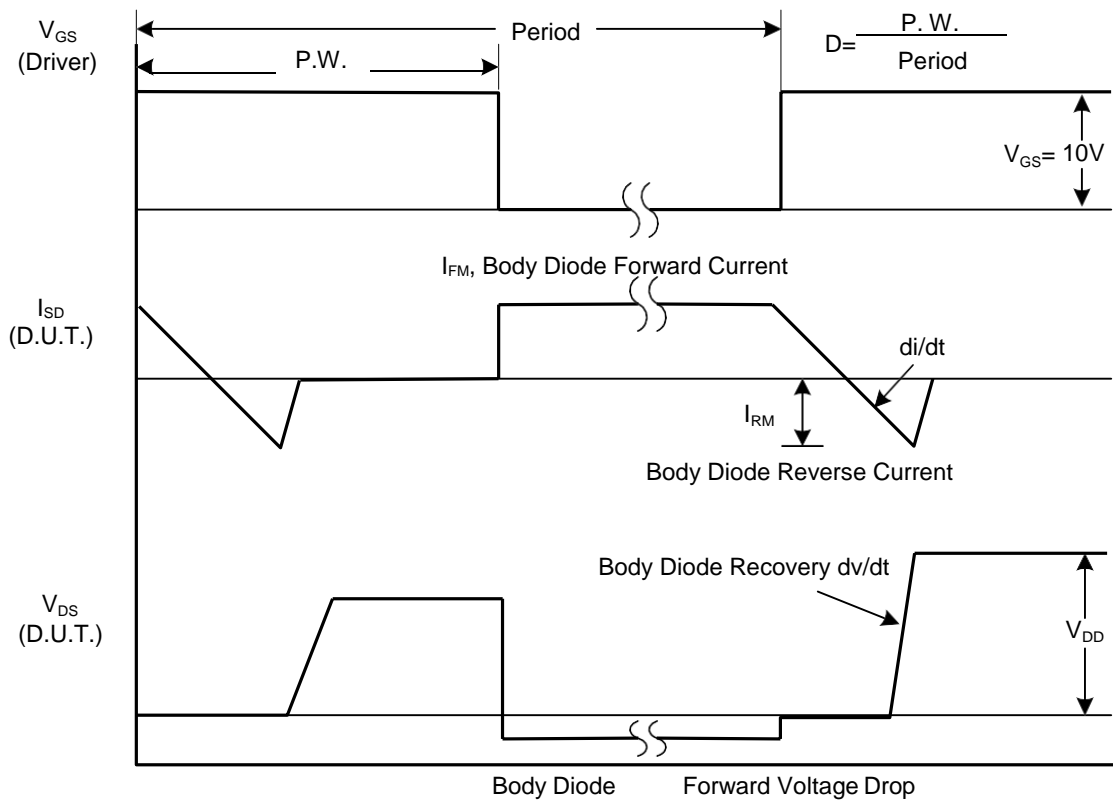
Notes: 1. Pulse Test : Pulse width  $\gg$  300 $\mu$ s, Duty cycle  $\gg$  2%

2. Essentially independent of operating temperature

**TEST CIRCUITS AND WAVEFORMS**

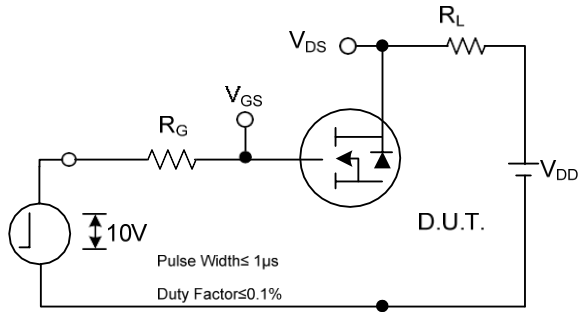


**Peak Diode Recovery  $dv/dt$  Test Circuit**

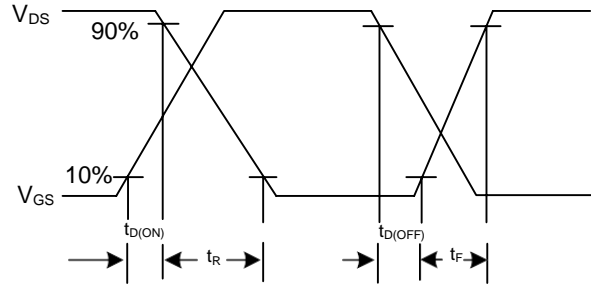


**Peak Diode Recovery  $dv/dt$  Waveforms**

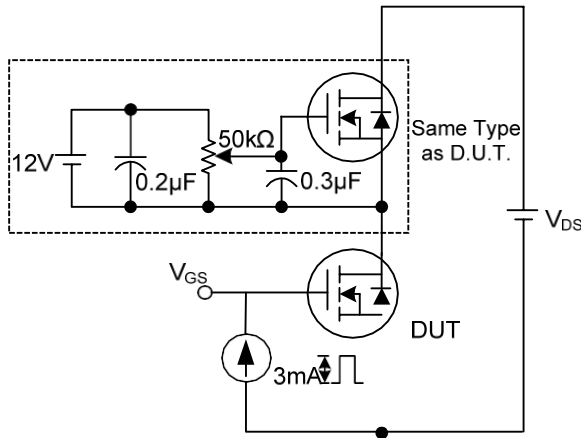
**TEST CIRCUITS AND WAVEFORMS(Cont.)**



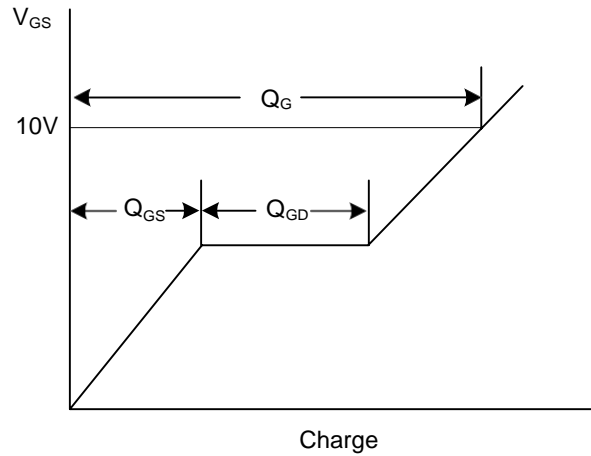
**Switching Test Circuit**



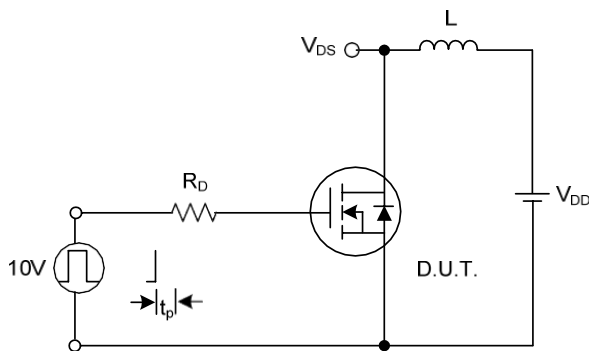
**Switching Waveforms**



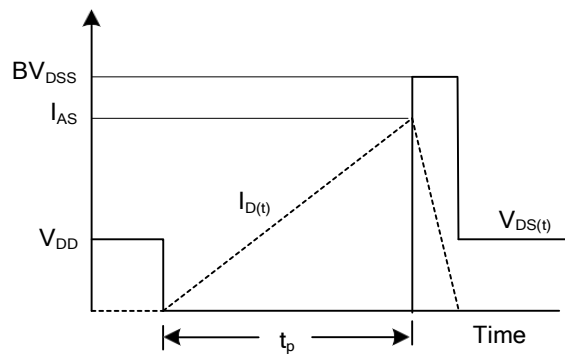
**Gate Charge Test Circuit**



**Gate Charge Waveform**



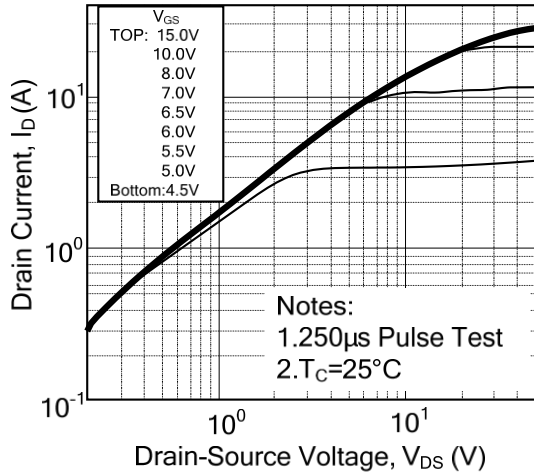
**Unclamped Inductive Switching Test Circuit**



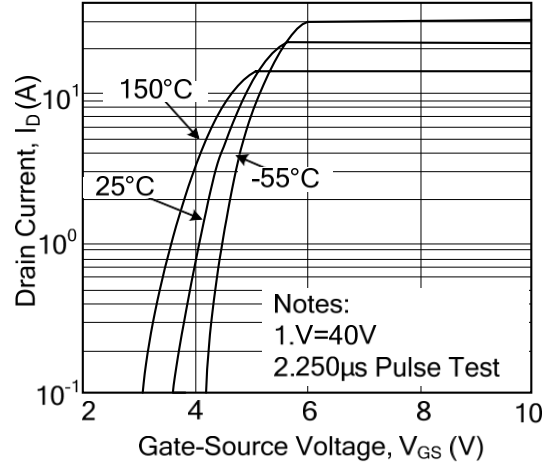
**Unclamped Inductive Switching Waveforms**

**TYPICAL CHARACTERISTICS**

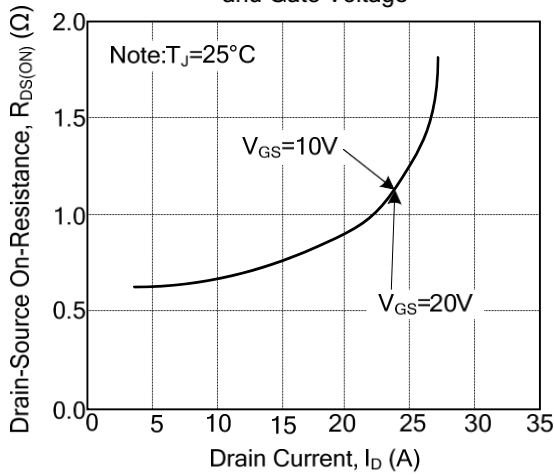
On-Region Characteristics



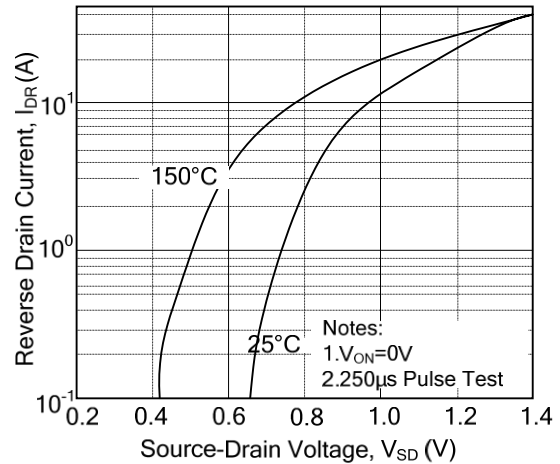
Transfer Characteristics



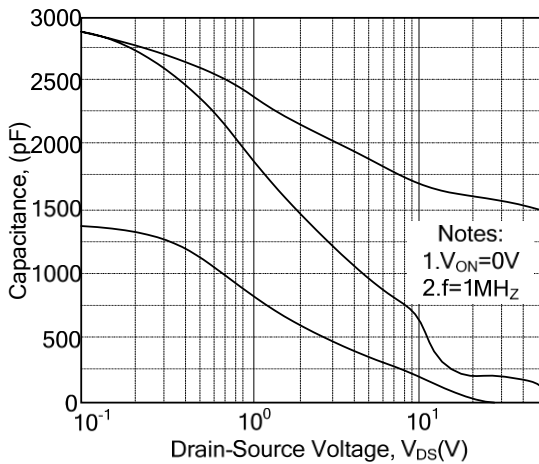
On-Resistance Variation vs. Drain Current and Gate Voltage



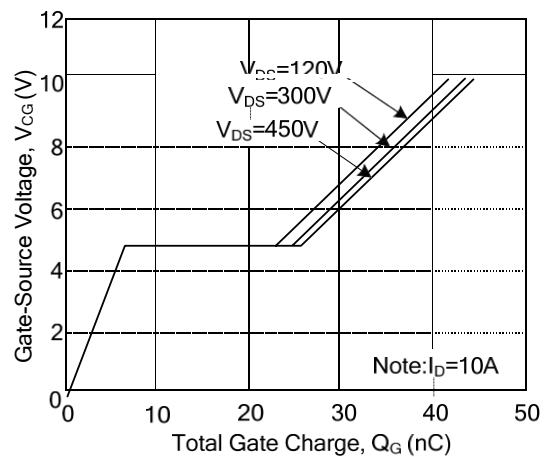
Body Diode Forward Voltage Variation with Source Current and Temperature



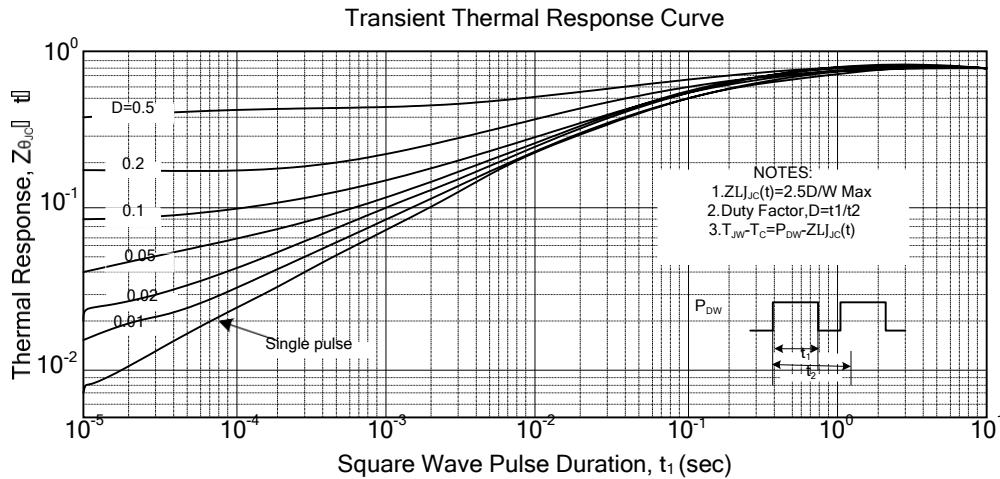
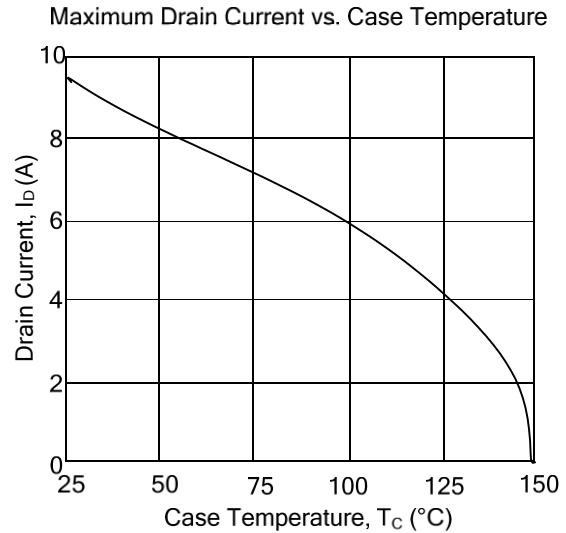
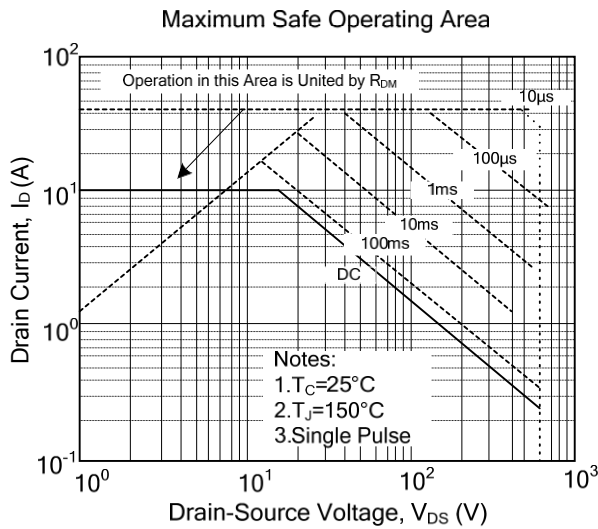
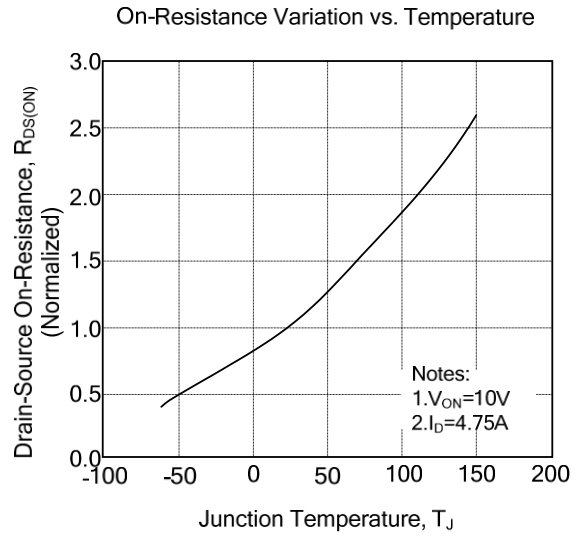
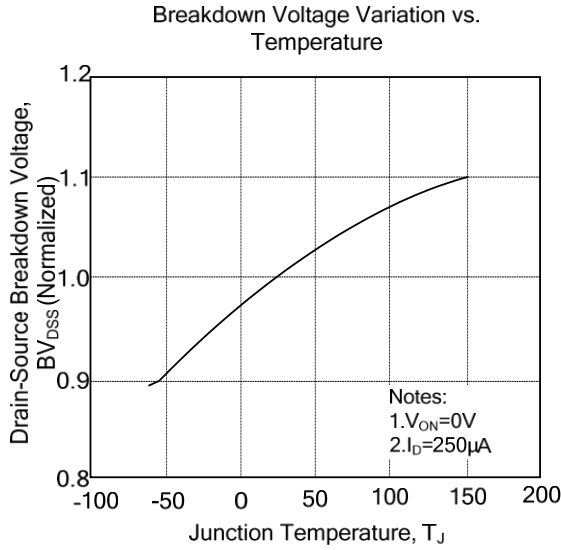
Capacitance Characteristics



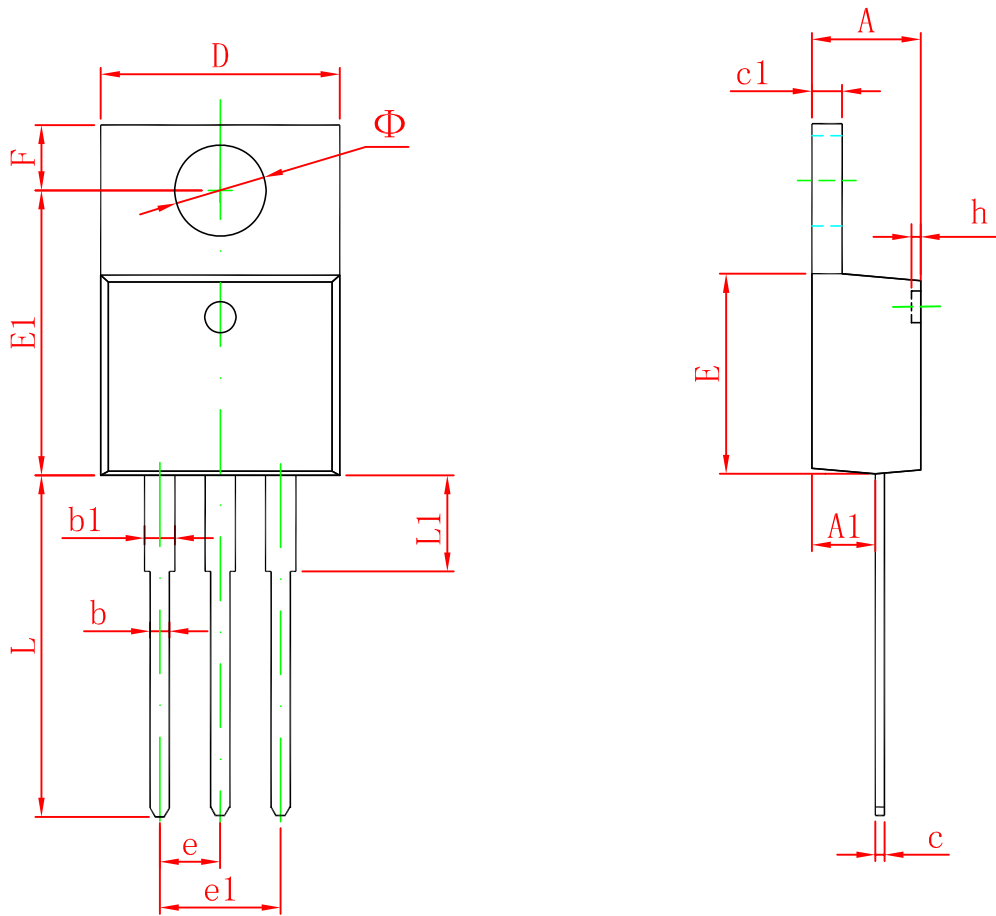
Gate Charge Characteristics



**TYPICAL CHARACTERISTICS(Cont.)**



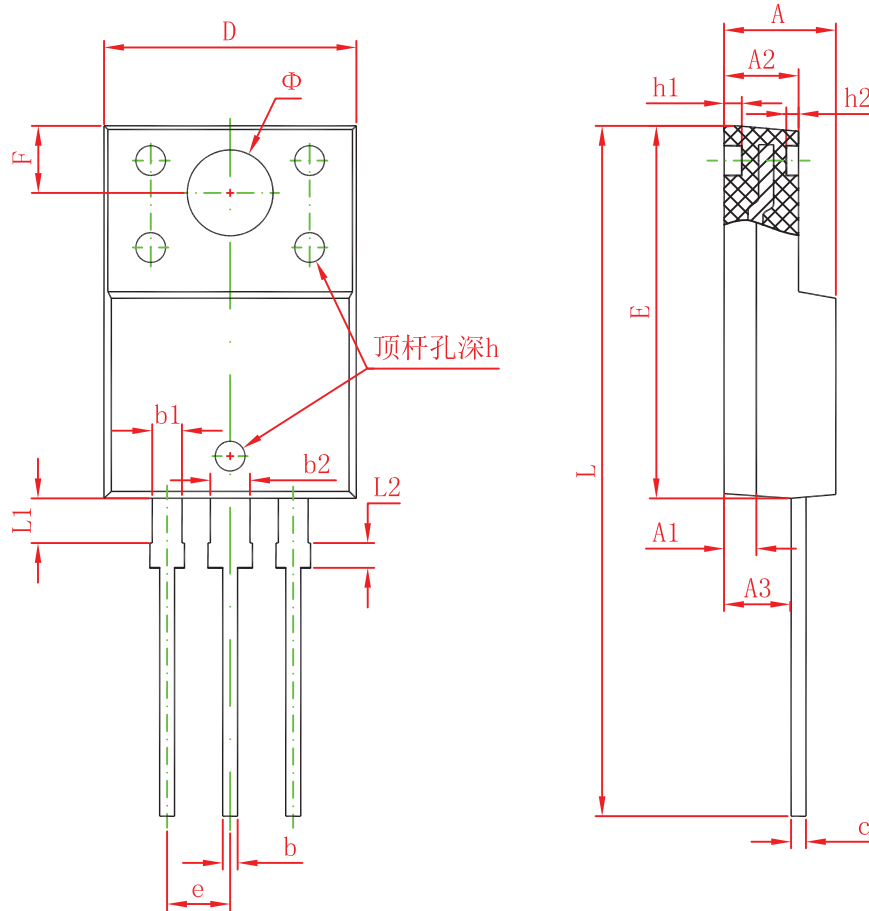
**TO-220-3L Package Outline Dimensions**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	4.470	4.670	0.176	0.184
A1	2.520	2.820	0.099	0.111
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.310	0.530	0.012	0.021
c1	1.170	1.370	0.046	0.054
D	10.010	10.310	0.394	0.406
E	8.500	8.900	0.335	0.350
E1	12.060	12.460	0.475	0.491
e	2.540 TYP		0.100 TYP	
e1	4.980	5.180	0.196	0.204
F	2.590	2.890	0.102	0.114
h	0.000	0.300	0.000	0.012
L	13.400	13.800	0.528	0.543
L1	3.560	3.960	0.140	0.156
$\Phi$	3.735	3.935	0.147	0.155



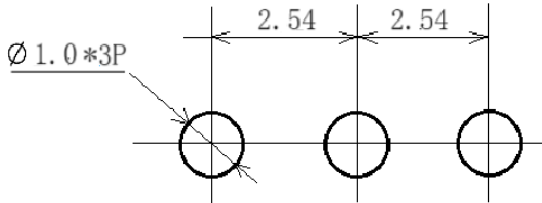
**TO-220F Package Outline Dimensions**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.300	4.700	0.169	0.185
A1	1.300 REF.		0.051 REF.	
A2	2.800	3.200	0.110	0.126
A3	2.500	2.900	0.098	0.114
b	0.500	0.750	0.020	0.030
b1	1.100	1.350	0.043	0.053
b2	1.500	1.750	0.059	0.069
c	0.500	0.750	0.020	0.030
D	9.960	10.360	0.392	0.408
E	14.800	15.200	0.583	0.598
e	2.540 TYP.		0.100 TYP.	
F	2.700 REF.		0.106 REF.	
$\Phi$	3.500 REF.		0.138 REF.	
h	0.000	0.300	0.000	0.012
h1	0.800 REF.		0.031 REF.	
h2	0.500 REF.		0.020 REF.	
L	28.000	28.400	1.102	1.118
L1	1.700	1.900	0.067	0.075
L2	0.900	1.100	0.035	0.043

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

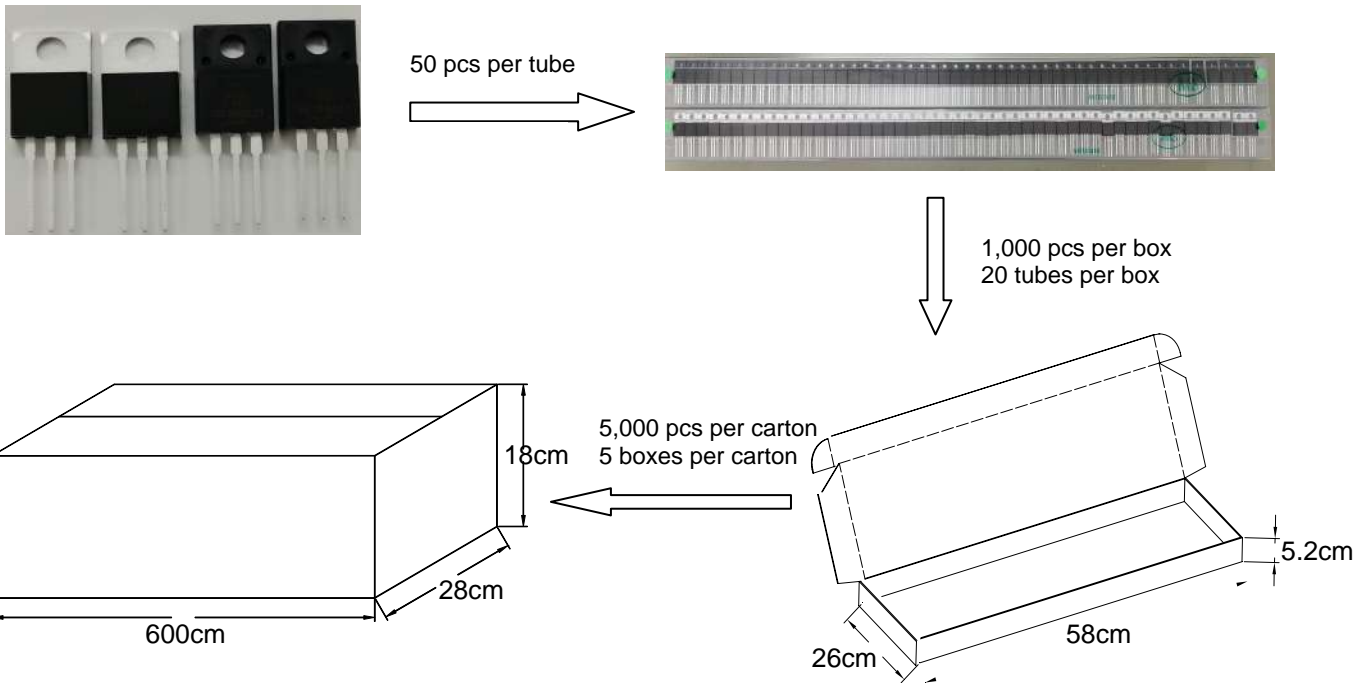
### TO-220AB&ITO-220AB Suggested Pad Layout



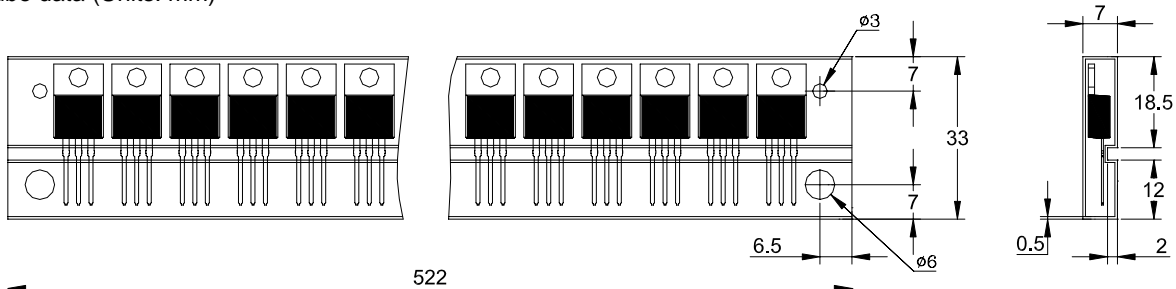
**Note:**

1. Controlling dimension: in millimeters.
2. General tolerance:  $\pm 0.05\text{mm}$ .
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.