

TO-220/ TO-220F Plastic-Encapsulate MOSFETS

7.4 A 600V N-CHANNEL POWER MOSFET

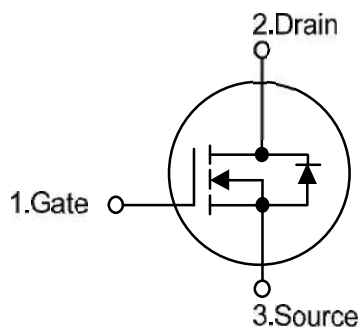
■ DESCRIPTION

The KWNJ7N60 is a high voltage power MOSFET and is 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 switching power supplies and adaptors.

■ FEATURES

- * $V_{DS} = 600V$ $I_D = 7.4A$
- * $R_{DS(ON)} = 1.2 \text{ ohm@}V_{GS} = 10V$ (7N60)
- * $R_{DS(ON)} = 1.2 \text{ ohm@}V_{GS} = 10V$ (7N60F)
- * Ultra Low Gate Charge (Typical 29 nC)
- * Low Reverse Transfer Capacitance ($CR_{SS} = \text{typical } 16pF$)
- * Fast switching capability
- * Avalanche energy specified
- * Improved dv/dt Capability, High Ruggedness

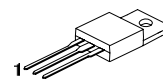
■ SYMBOL



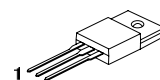
■ ORDERING INFORMATION

Ordering Number	Package	Pin Assignment			Packing
		1	2	3	
KWNJ7N60-LI	TO-220	G	D	S	Tape Box
KWNJ7N60-BL	TO-220	G	D	S	Bulk
KWNJ7N60F-LI	TO-220F	G	D	S	Tube

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



TO-220



TO-220F

MOSFET ELECTRICAL CHARACTERISTICS

■ 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}	± 30	V
Avalanche Current (Note 2)		I_{AR}	7.4	A
Drain Current	Continuous	I_D	7.4	A
	Pulsed (Note 2)	I_{DM}	29.6	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	530	mJ
	Repetitive (Note 2)	E_{AR}	14.2	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns
Power Dissipation	TO-220	P_D	142	W
	TO-220F		48	
Junction Temperature		T_J	+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. $L = 19.5\text{mH}$, $I_{AS} = 7.4\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\ \Omega$, Starting $T_J = 25^\circ\text{C}$

4. $I_{SD} \leq 7.4\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$

■ THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient		θ_{JA}	62.5	$^\circ\text{C}/\text{W}$
Junction to Case	TO-220	θ_{JC}	0.88	$^\circ\text{C}/\text{W}$
	TO-220F		2.6	

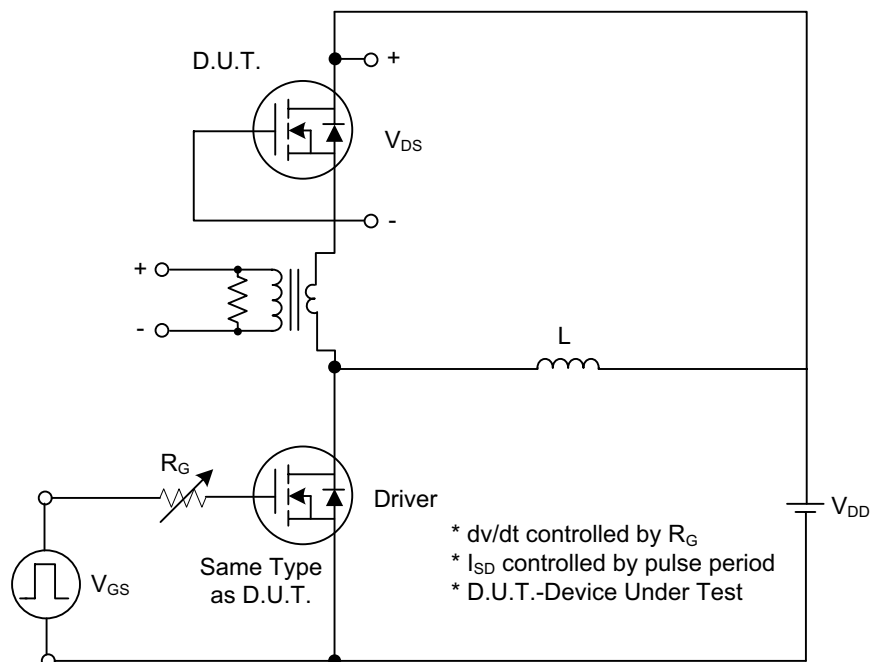
MOSFET ELECTRICAL CHARACTERISTICS

■ ELECTRICAL CHARACTERISTICS (T_C = 25°C, unless otherwise specified)

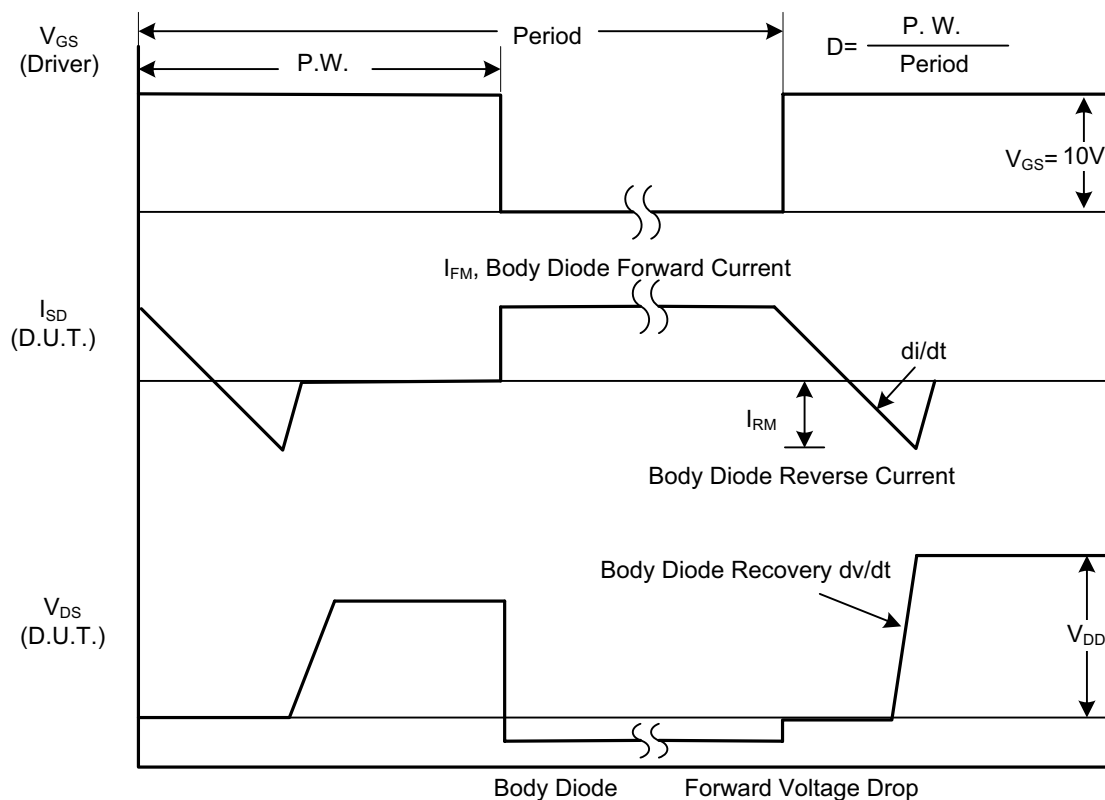
PARAMETER		SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS								
Drain-Source Breakdown Voltage		BV _{DSS}	V _{GS} = 0V, I _D = 250μA		600			V
Drain-Source Leakage Current		I _{DSS}	V _{DS} = 600V, V _{GS} = 0V				1	μA
Gate- Source Leakage Current	Forward	I _{GSS}	V _{GS} = 30V, V _{DS} = 0V				100	nA
	Reverse		V _{GS} = -30V, V _{DS} = 0V				-100	nA
Breakdown Voltage Temperature Coefficient		ΔBV _{DSS} /ΔT _J		I _D =250μA,Referenced to 25°C		0.67		V/°C
ON CHARACTERISTICS								
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 = 3.7A	7N60		0.83	1.2	Ω
				7N60F		0.83	1.2	Ω
DYNAMIC CHARACTERISTICS								
Input Capacitance		C _{ISS}	V _{DS} =25V, V _{GS} =0V, f=1.0 MHz				1400	pF
Output Capacitance		C _{OSS}					180	pF
Reverse Transfer Capacitance		C _{RSS}				16	21	pF
SWITCHING CHARACTERISTICS								
Turn-On Delay Time		t _{D(ON)}	V _{DD} =300V, I _D =7.4A, R _G =25Ω (Note 1, 2)				70	ns
Turn-On Rise Time		t _r					170	ns
Turn-Off Delay Time		t _{D(OFF)}					140	ns
Turn-Off Fall Time		t _f					130	ns
SWITCHING CHARACTERISTICS								
Total Gate Charge		Q _G	V _{DS} =480V, I _D =7.4A, V _{GS} =10V (Note 1, 2)			29	38	nC
Gate-Source Charge		Q _{GS}				7		nC
Gate-Drain Charge		Q _{GD}				14.5		nC
DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS								
Drain-Source Diode Forward Voltage		V _{SD}	V _{GS} = 0V, I _S = 7.4 A				1.4	V
Maximum Continuous Drain-Source Diode Forward Current		I _S					7.4	A
Maximum Pulsed Drain-Source Diode Forward Current		I _{SM}					29.6	A
Reverse Recovery Time		t _{rr}	V _{GS} = 0V, I _S = 7.4 A,			320		ns
Reverse Recovery Charge		Q _{RR}	dI _F / dt = 100A/μs (Note 1)			2.4		μC

Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%
2. Essentially independent of operating temperature

TEST CIRCUITS AND WAVEFORMS

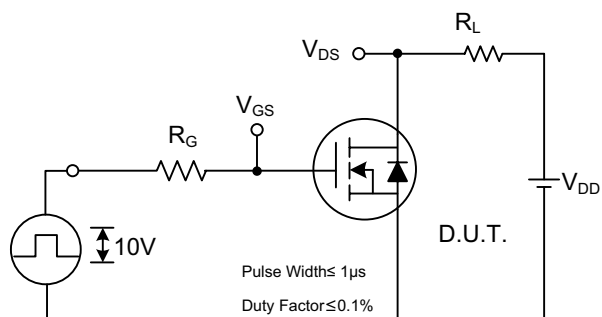


Peak Diode Recovery dv/dt Test Circuit

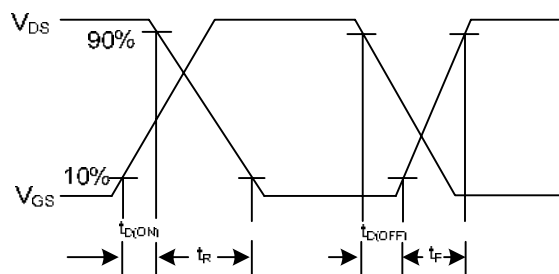


Peak Diode Recovery dv/dt Waveforms

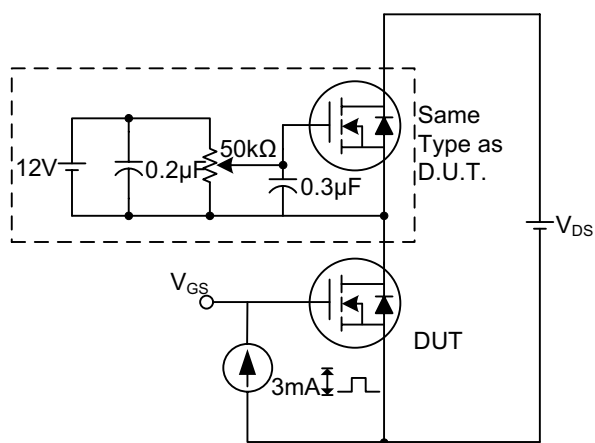
■ TEST CIRCUITS AND WAVEFORMS (Cont.)



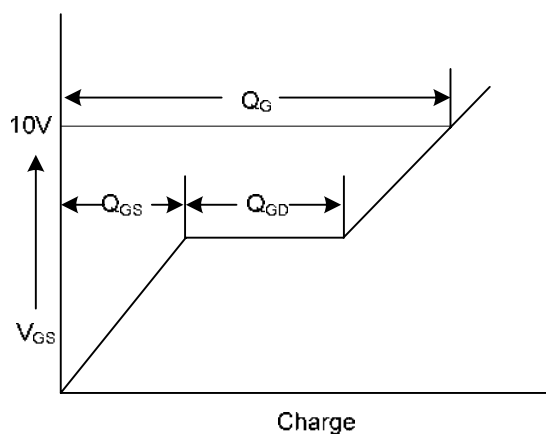
Switching Test Circuit



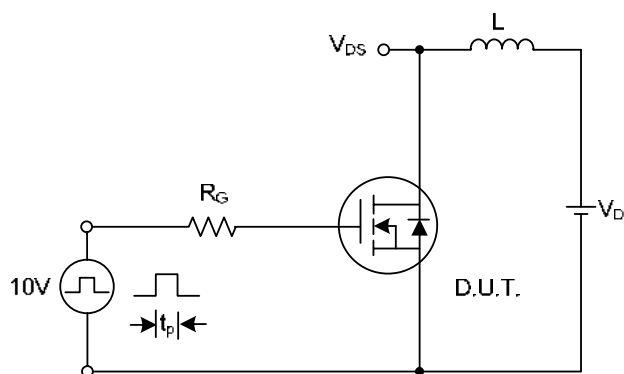
Switching Waveforms



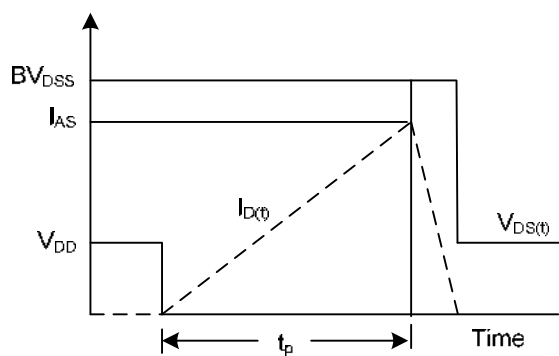
Gate Charge Test Circuit



Gate Charge Waveform



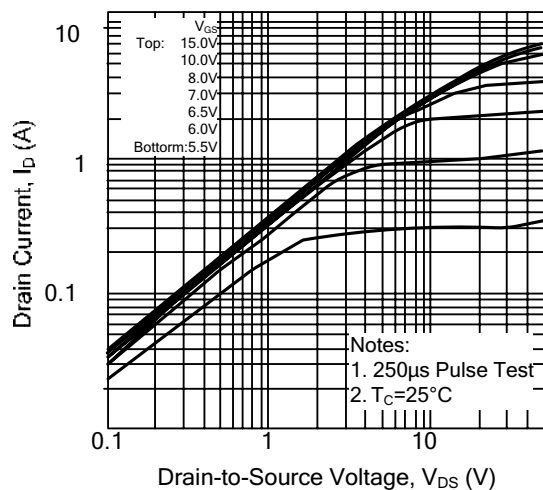
Unclamped Inductive Switching Test Circuit



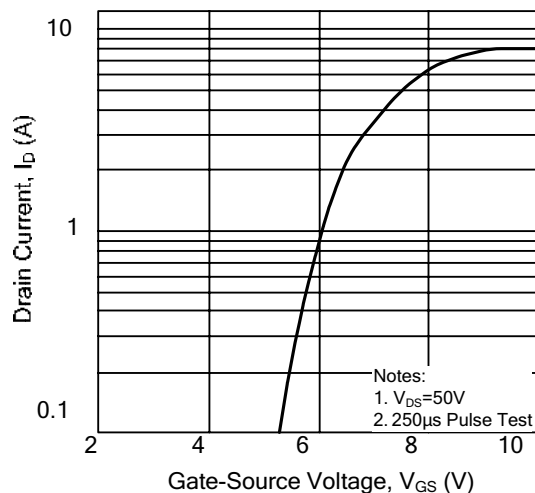
Unclamped Inductive Switching Waveforms

TYPICAL CHARACTERISTICS

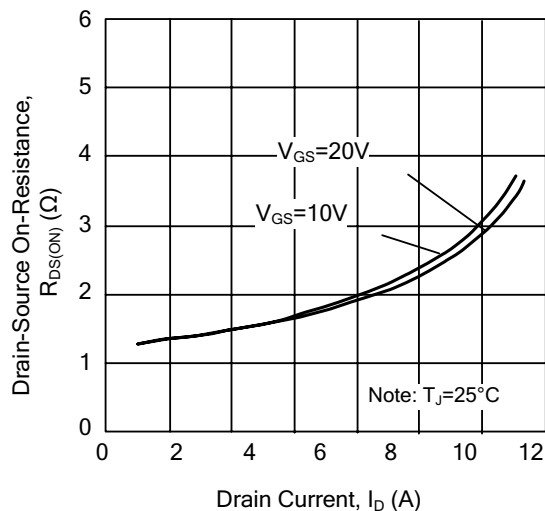
On-State Characteristics



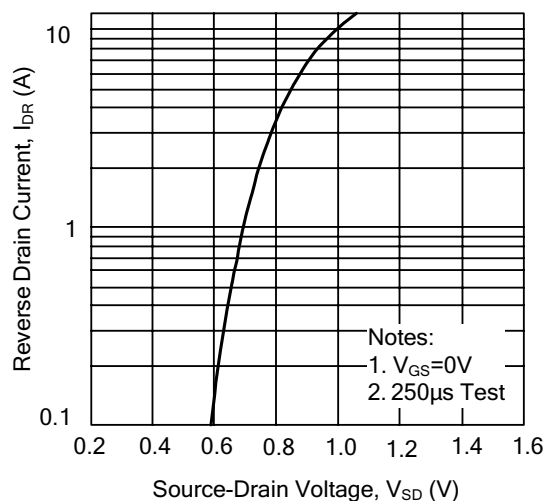
Transfer Characteristics



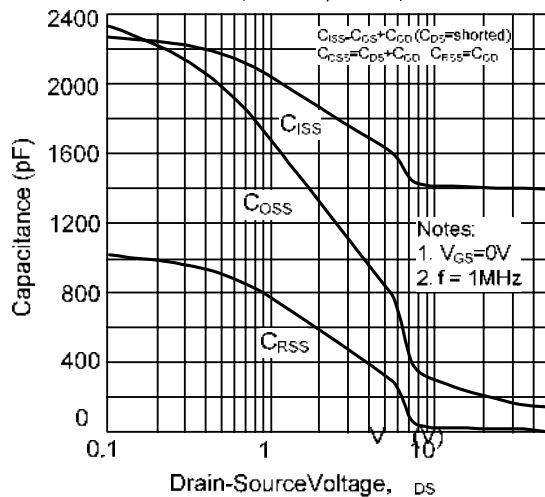
On-Resistance Variation vs. Drain Current and Gate Voltage



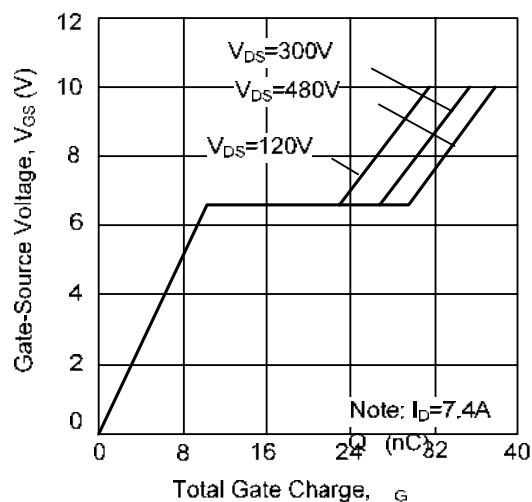
On State Current vs. Allowable Case Temperature



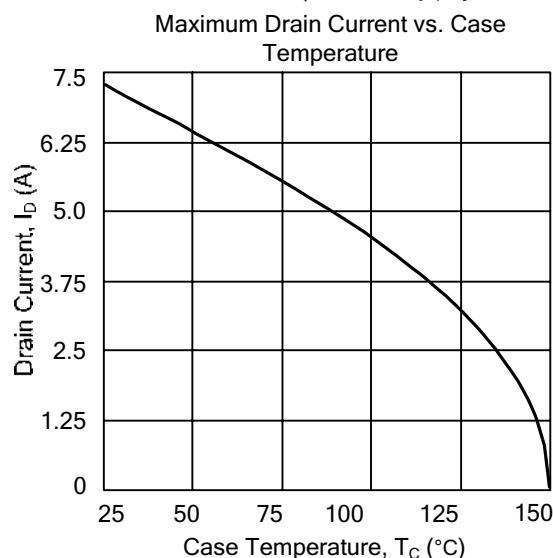
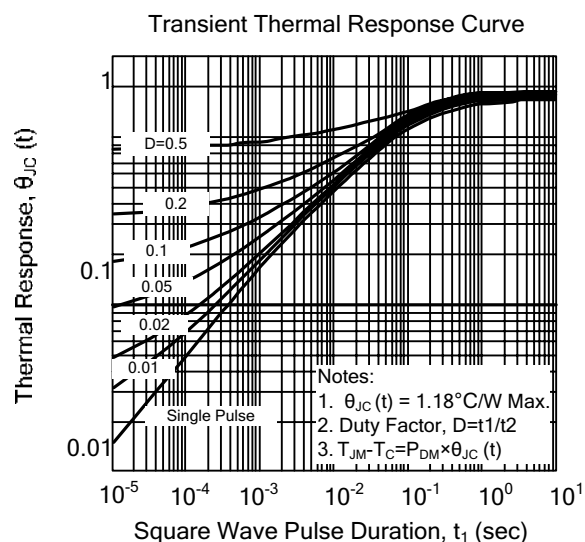
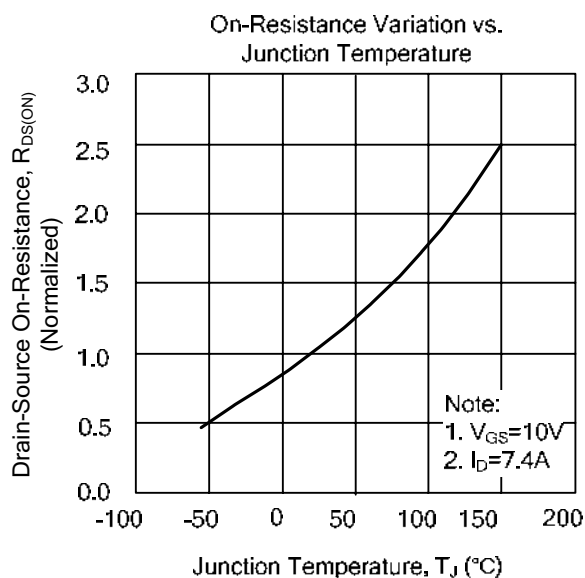
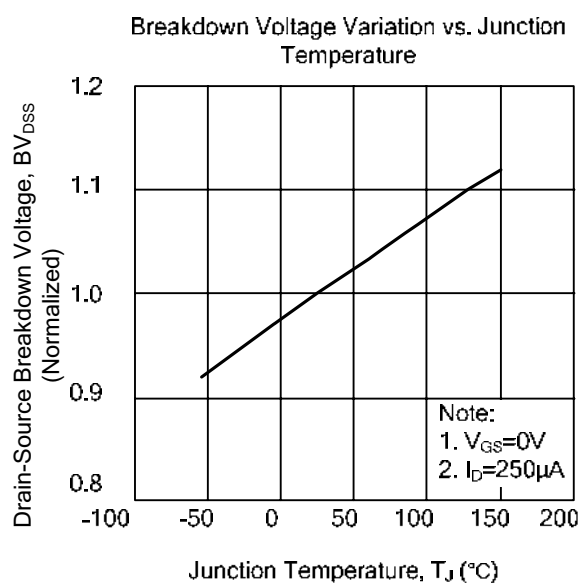
Capacitance Characteristics (Non-Repetitive)



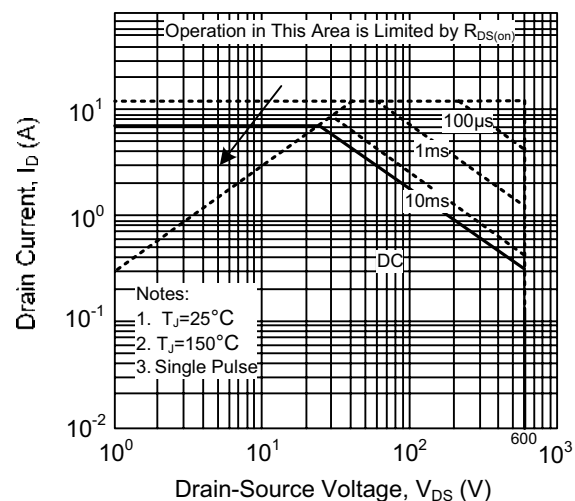
Gate Charge Characteristics



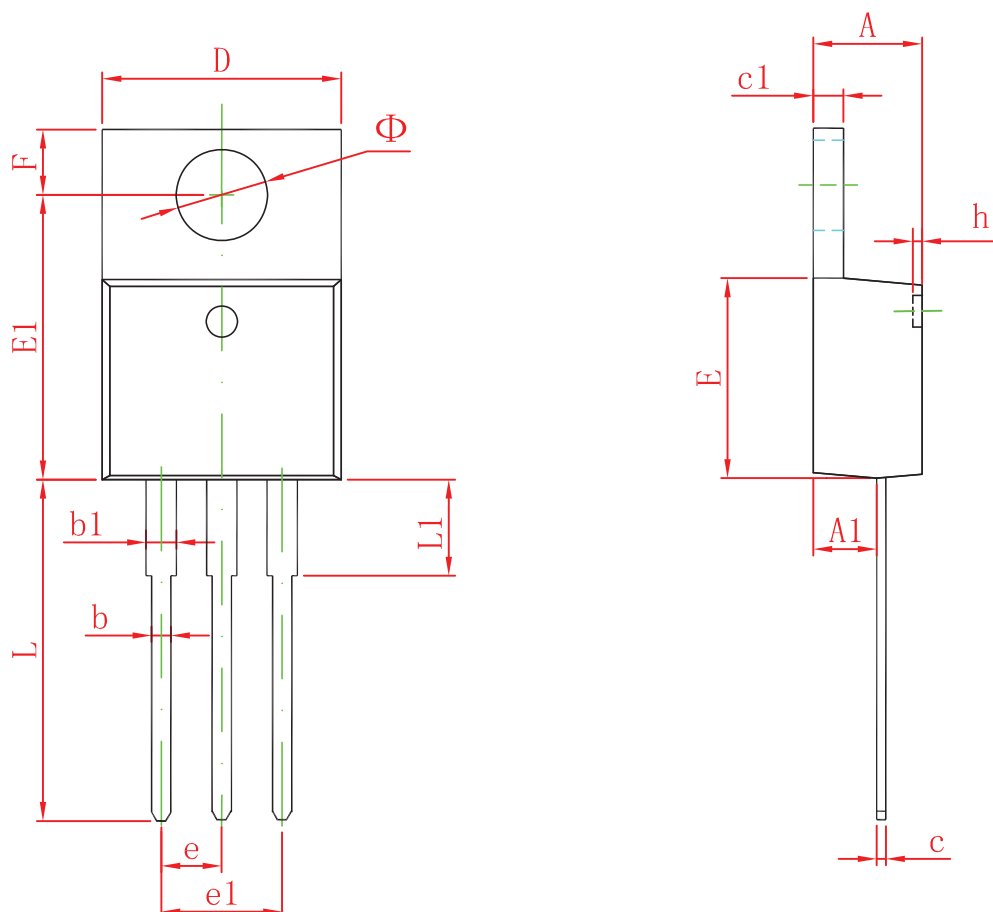
■ TYPICAL CHARACTERISTICS(Cont.)



Safe Operating Area - 600V

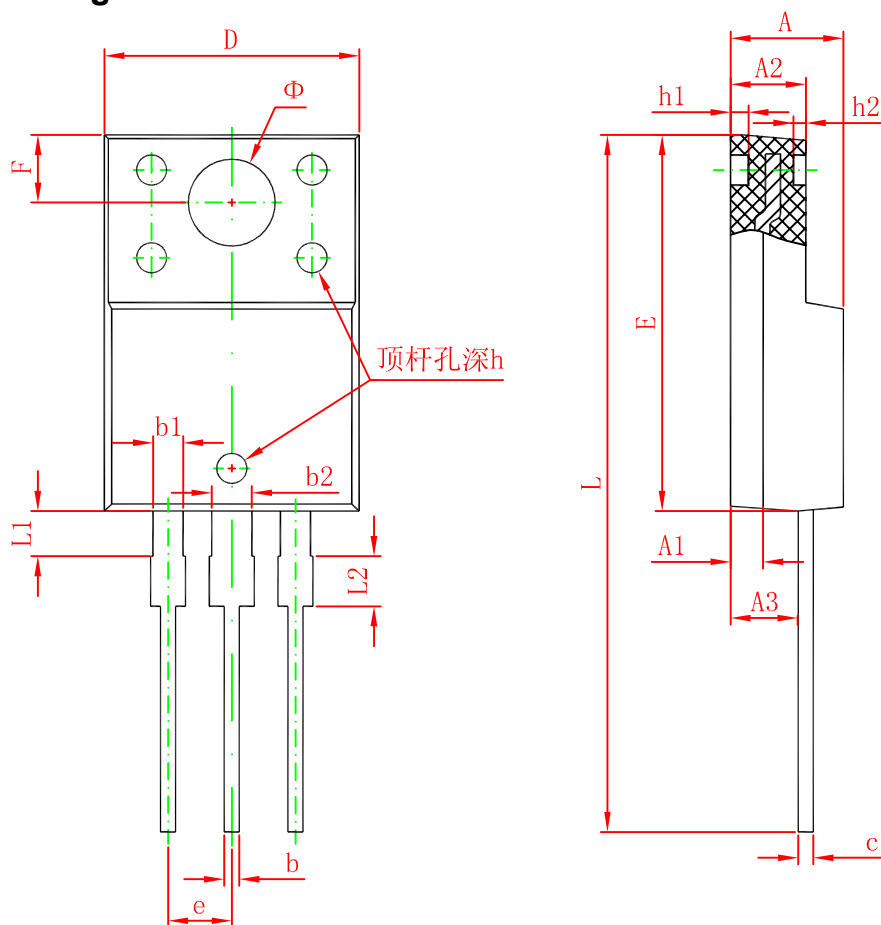


TO-220 Package Outline Dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	4.450	4.750	0.175	0.187
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	0.300	0.500	0.012	0.020
c1	1.170	1.370	0.046	0.054
D	9.830	10.330	0.387	0.407
E	8.500	8.900	0.335	0.350
E1	12.050	12.650	0.474	0.498
e	2.540 TYP		0.100 TYP	
e1	4.900	5.200	0.192	0.205
F	2.540	2.940	0.100	0.116
h	0.100 TYP		0.004 TYP	
L	13.300	13.800	0.523	0.543
L1	3.540	3.940	0.139	0.155
Φ	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.	
Φ	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	1.900	2.100	0.075	0.083