



# 3N60K

**Power MOSFET**

## 3A, 600V N-CHANNEL POWER MOSFET

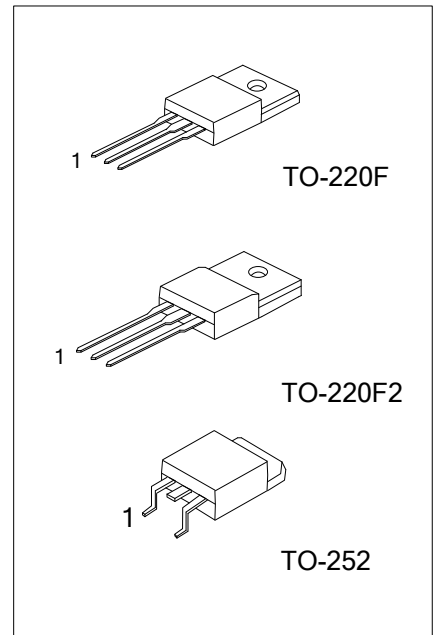
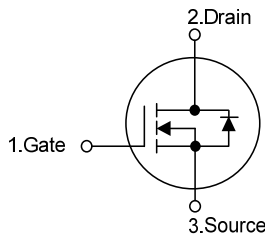
■ DESCRIPTION

The UTC **3N60K** 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

- \*  $V_{DS} = 600V, I_D = 3A$
- \*  $R_{DS(ON)} < 3.6\Omega @ V_{GS} = 10V$
- \* Fast switching capability
- \* Avalanche energy specified
- \* Improved dv/dt capability, high ruggedness

■ SYMBOL



■ ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
3N60KL-TF2-T	3N60KG-TF2-T	TO-220F2	G	D	S	Tube
3N60KL-TF3-T	3N60KG-TF3-T	TO-220F	G	D	S	Tube
3N60KL-TN3-R	3N60KG-TN3-R	TO-252	G	D	S	Tape Reel

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

<p>3N60KL-TF2-T</p> <p>(1)Packing Type</p> <p>(2)Package Type</p> <p>(3)Lead Free</p>	<p>(1) T: Tube, R: Tape Reel</p> <p>(2) TF2: TO-220F2, TF3: TO-220F, TN3: TO-252</p> <p>(3) L: Lead Free, G: Halogen Free</p>
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■ MARKING INFORMATION

PACKAGE	MARKING
TO-220F2 TO-220F TO-252	<p>UTC 3N60K</p> <p>Lot Code</p> <p>L: Lead Free G: Halogen Free Data Code</p>

■ 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)		$I_{AR}$	3.0	A
Continuous Drain Current		$I_D$	3.0	A
Pulsed Drain Current (Note 2)		$I_{DM}$	12	A
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	150	mJ
	Repetitive (Note 2)	$E_{AR}$	7.5	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns
Power Dissipation	TO-220F	$P_D$	34	W
	TO-220F2		35	
	TO-252		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  $T_J$ .

3.  $L=33\text{mH}$ ,  $I_{AS}=3\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $R_G=25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD}\leq 3.0\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD}\leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

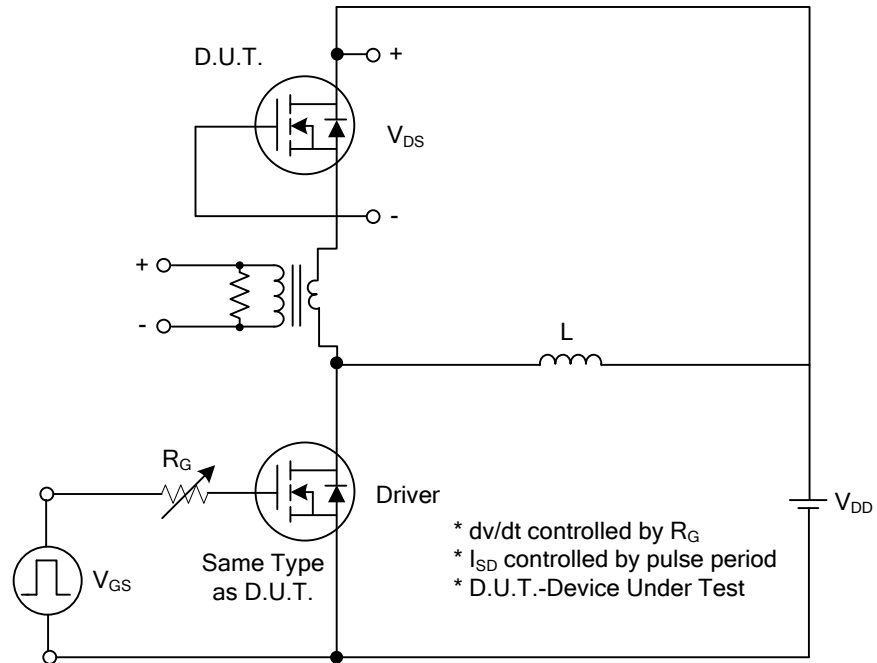
PARAMETER		SYMBOL	RATING	UNIT
Junction to Ambient	TO-220F/TO-220F2	$\theta_{JA}$	62.5	$^\circ\text{C}/\text{W}$
	TO-252		110	
Junction to Case	TO-220F	$\theta_{JC}$	3.68	$^\circ\text{C}/\text{W}$
	TO-220F2		3.58	
	TO-252		2.5	

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

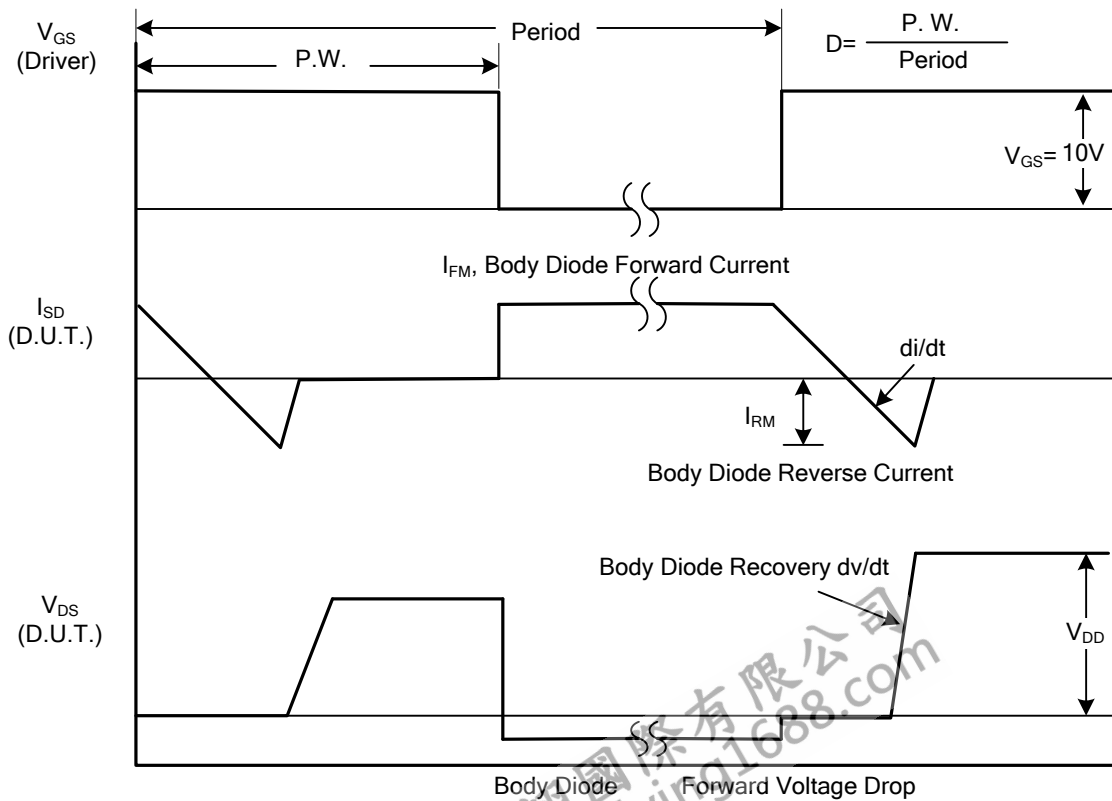
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
<b>OFF CHARACTERISTICS</b>							
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	600			V	
Drain-Source Leakage Current	I <sub>DSS</sub>	V <sub>DS</sub> = 600 V, V <sub>GS</sub> = 0 V			10	μA	
Gate-Source Leakage Current	Forward	I <sub>GSS</sub>			100	nA	
	Reverse						V <sub>GS</sub> = 30 V, V <sub>DS</sub> = 0 V
		V <sub>GS</sub> = -30 V, V <sub>DS</sub> = 0 V			-100	nA	
Breakdown Voltage Temperature Coefficient	ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	I <sub>D</sub> = 250 μA, Referenced to 25°C		0.6		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 μA	3.0		5.0	V	
Static Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 1.5A		3.3	3.6	Ω	
<b>DYNAMIC CHARACTERISTICS</b>							
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1MHz		350	450	pF	
Output Capacitance	C <sub>OSS</sub>				50	65	pF
Reverse Transfer Capacitance	C <sub>RSS</sub>				5.5	7.5	pF
<b>SWITCHING CHARACTERISTICS</b>							
Turn-On Delay Time	t <sub>D(ON)</sub>	V <sub>DD</sub> = 30V, I <sub>D</sub> = 0.5 A, R <sub>G</sub> = 25Ω (Note 1, 2)		40	60	ns	
Turn-On Rise Time	t <sub>R</sub>				28	50	ns
Turn-Off Delay Time	t <sub>D(OFF)</sub>				65	70	ns
Turn-Off Fall Time	t <sub>F</sub>				40	70	ns
Total Gate Charge	Q <sub>G</sub>	V <sub>DS</sub> = 50V, I <sub>D</sub> = 1.3A, V <sub>GS</sub> = 10 V (Note 1, 2)		13	16	nC	
Gate-Source Charge	Q <sub>GS</sub>				4.9		nC
Gate-Drain Charge	Q <sub>GD</sub>				2.5		nC
<b>SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS</b>							
Drain-Source Diode Forward Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 3.0 A			1.4	V	
Maximum Continuous Drain-Source Diode Forward Current	I <sub>S</sub>				3.0	A	
Maximum Pulsed Drain-Source Diode Forward Current	I <sub>SM</sub>				12	A	
Reverse Recovery Time	t <sub>RR</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 3.0 A, di/dt = 100 A/μs (Note 1)		210		ns	
Reverse Recovery Charge	Q <sub>RR</sub>				1.2		μC

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

## TEST CIRCUITS AND WAVEFORMS

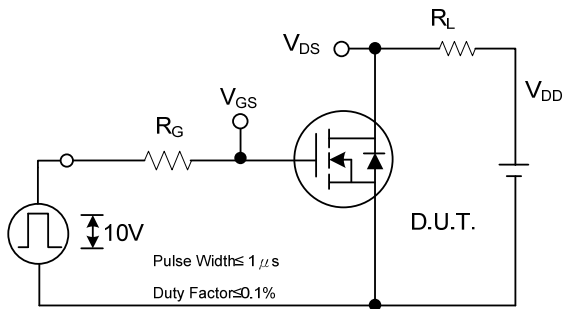


Peak Diode Recovery  $dv/dt$  Test Circuit

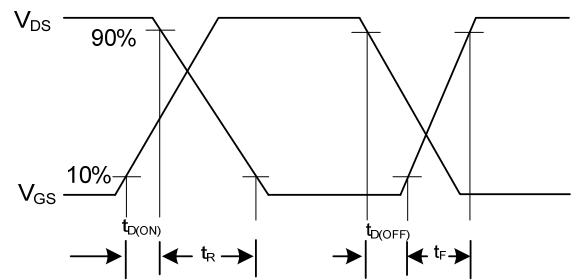


Peak Diode Recovery  $dv/dt$  Waveforms

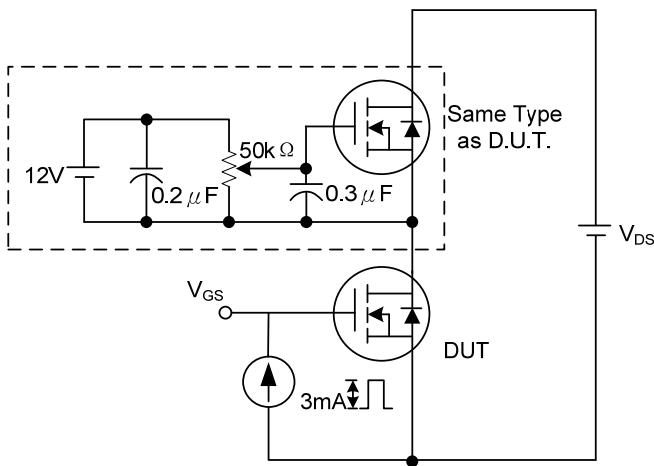
## TEST CIRCUITS AND WAVEFORMS (Cont.)



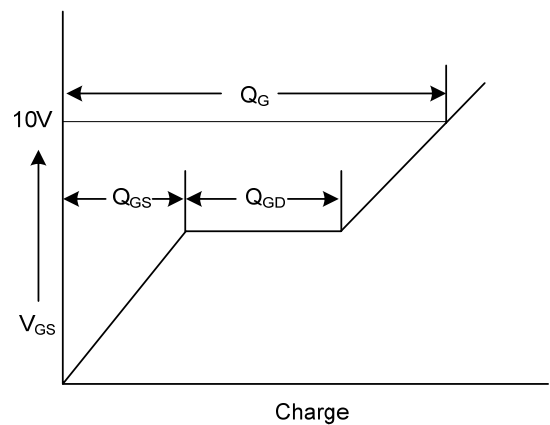
Switching Test Circuit



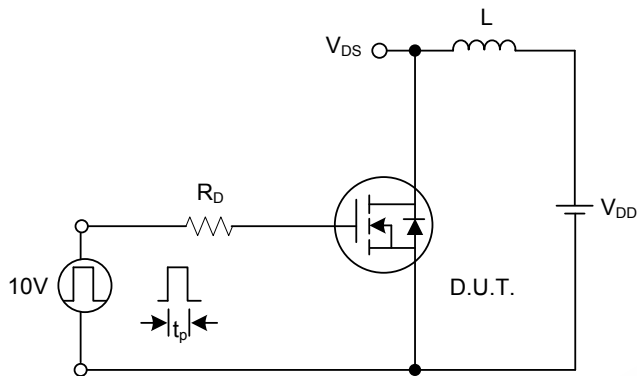
Switching Waveforms



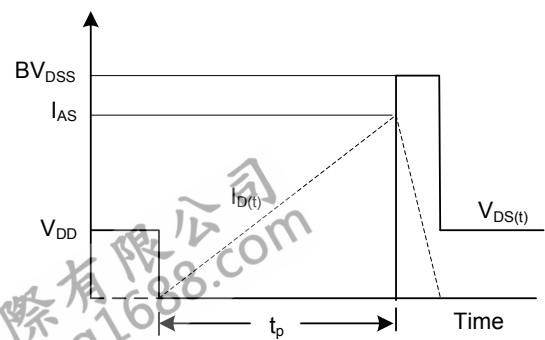
Gate Charge Test Circuit



Gate Charge Waveform



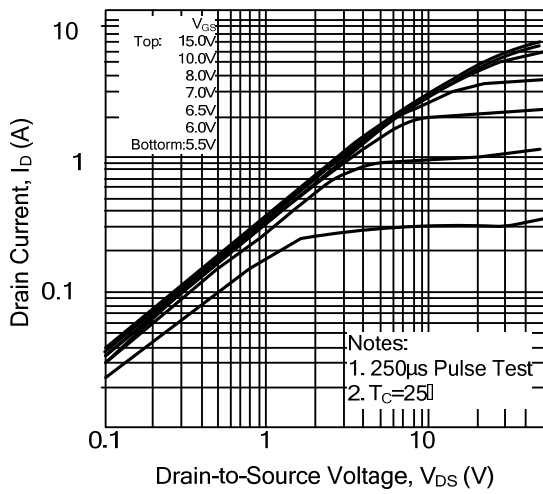
Unclamped Inductive Switching Test Circuit



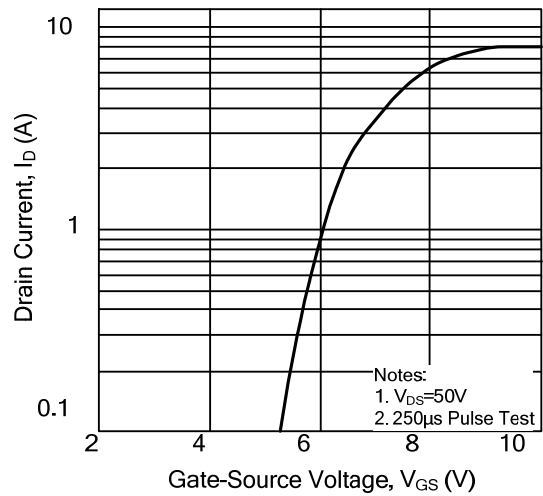
Unclamped Inductive Switching Waveforms

## TYPICAL CHARACTERISTICS

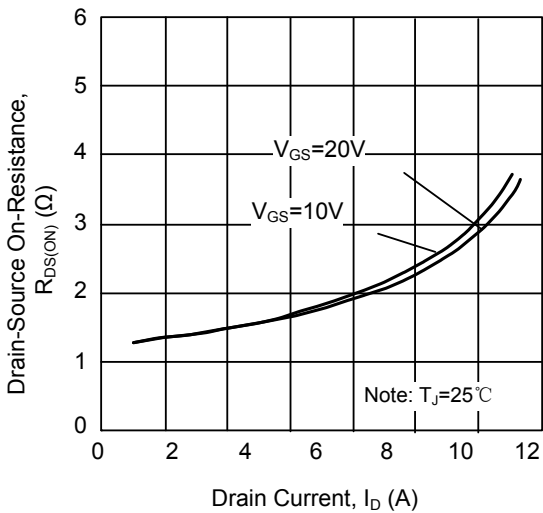
### On-State Characteristics



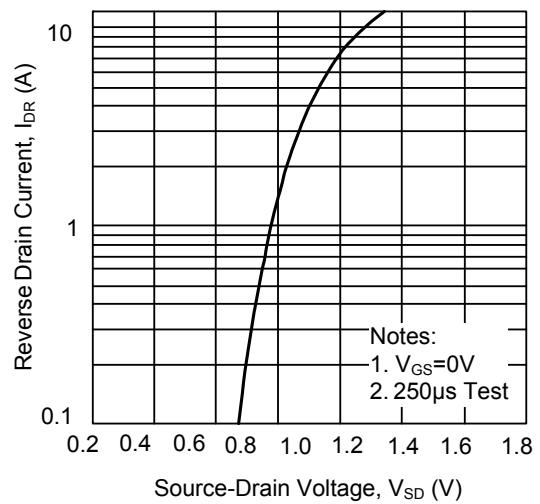
### Transfer Characteristics



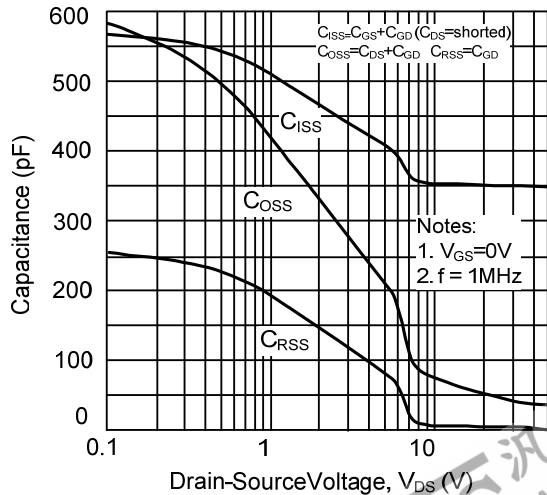
### On-Resistance Variation vs. Drain Current and Gate Voltage



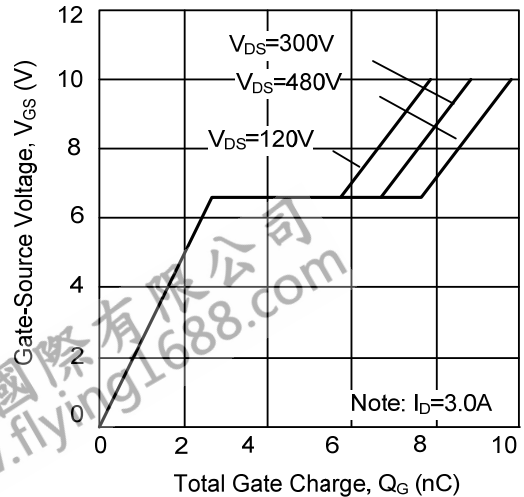
### On State Current vs. Allowable Case Temperature



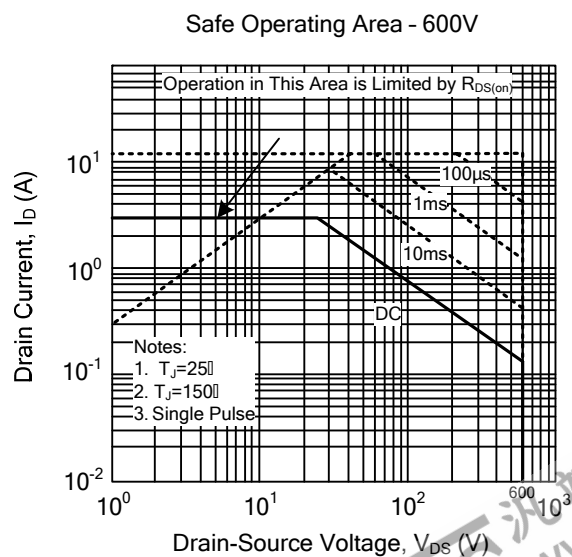
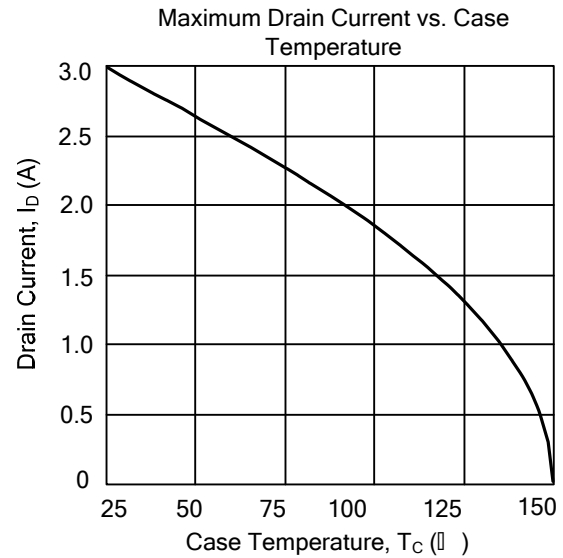
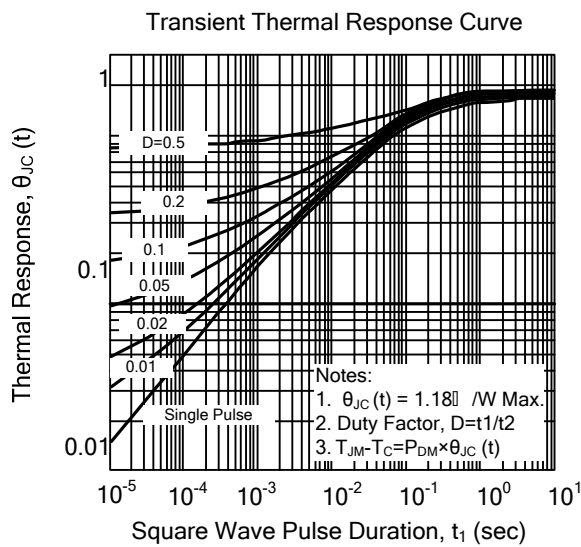
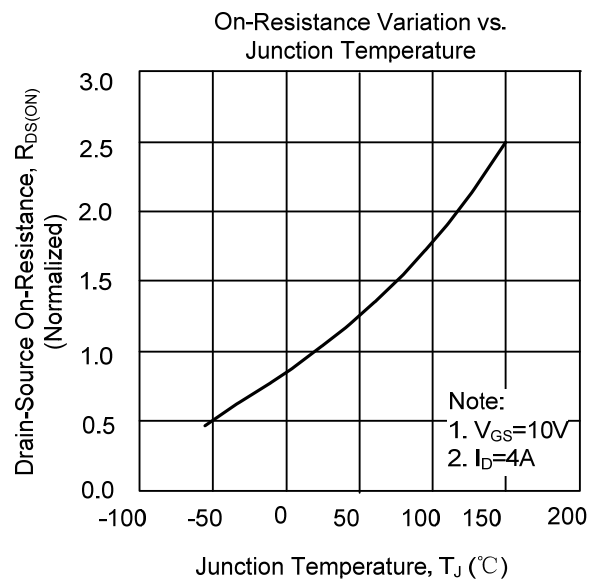
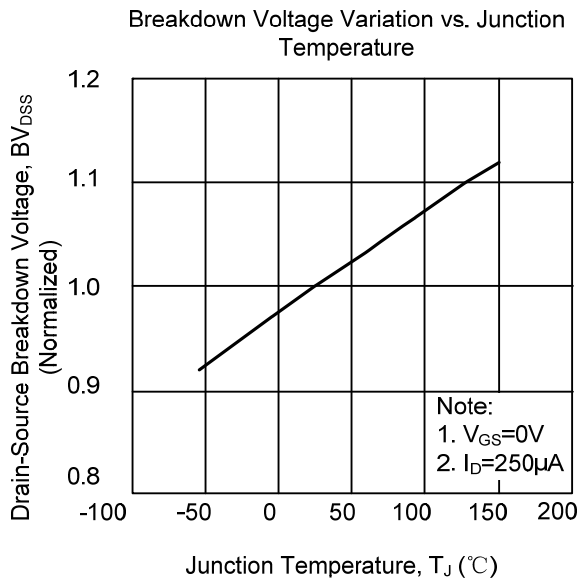
### Capacitance Characteristics (Non-Repetitive)



### Gate Charge Characteristics



## TYPICAL CHARACTERISTICS(Cont.)



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