



## 3N60

Power MOSFET

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

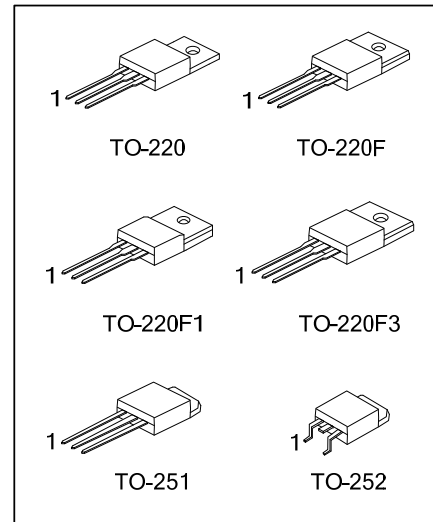
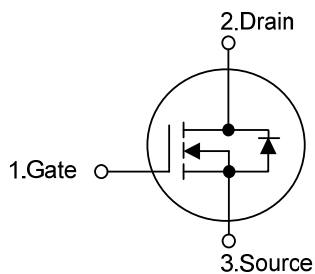
#### DESCRIPTION

The UTC **3N60** 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

- \*  $V_{DS} = 600V$ ,  $I_D = 3A$
- \*  $R_{DS(ON)} < 3.6\Omega$  @  $V_{GS} = 10V$
- \* Ultra low gate charge ( typical 18 nC )
- \* Low reverse transfer capacitance (  $C_{RSS} =$  typical 5.5 pF )
- \* 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	
3N60L-TA3-T	3N60G-TA3-T	TO-220	G	D	S	Tube
3N60L-TF1-T	3N60G-TF1-T	TO-220F1	G	D	S	Tube
3N60L-TF3-T	3N60G-TF3-T	TO-220F	G	D	S	Tube
3N60L-TF3T-T	3N60G-TF3T-T	TO-220F3	G	D	S	Tube
3N60L-TM3-T	3N60G-TM3-T	TO-251	G	D	S	Tube
3N60L-TN3-R	3N60G-TN3-R	TO-252	G	D	S	Tape Reel

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

<p>3N60L-TA3-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) TA3: TO-220, TF1: TO-220F1, TF3: TO-220F, TF3T: TO-220F3, TM3: TO-251, TN3: TO-252</p> <p>(3) L: Lead Free, G: Halogen Free</p>
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### MARKING INFORMATION

PACKAGE	MARKING
TO-220 TO-220F TO-220F1 TO-220F3 TO-251 TO-252	<p>UTC</p> <p>3N60</p> <p>Lot Code →</p> <p>→ Data Code</p> <p>1</p> <p>L: Lead Free G: Halogen Free</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)	$E_{AS}$	200	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-220	$P_D$	75	W
	TO-220F/TO-220F1		34	
	TO-220F3		50	
	TO-251/TO-252			
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.  $L=44.4\text{mH}$ ,  $I_{AS}=3\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $R_G=25\ \Omega$ , 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

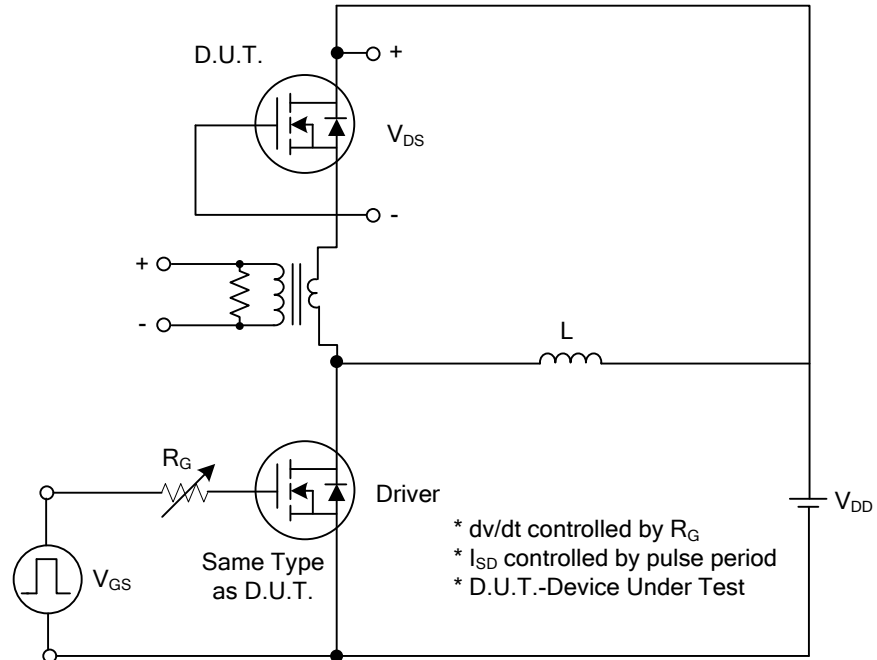
PARAMETER		SYMBOL	RATING	UNIT
Junction to Ambient	TO-220	$\theta_{JA}$	62.5	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1		62.5	
	TO-220F3		110	
	TO-251/TO-252			
Junction to Case	TO-220	$\theta_{JC}$	1.67	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1		3.68	
	TO-220F3			
	TO-251/TO-252		2.5	

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

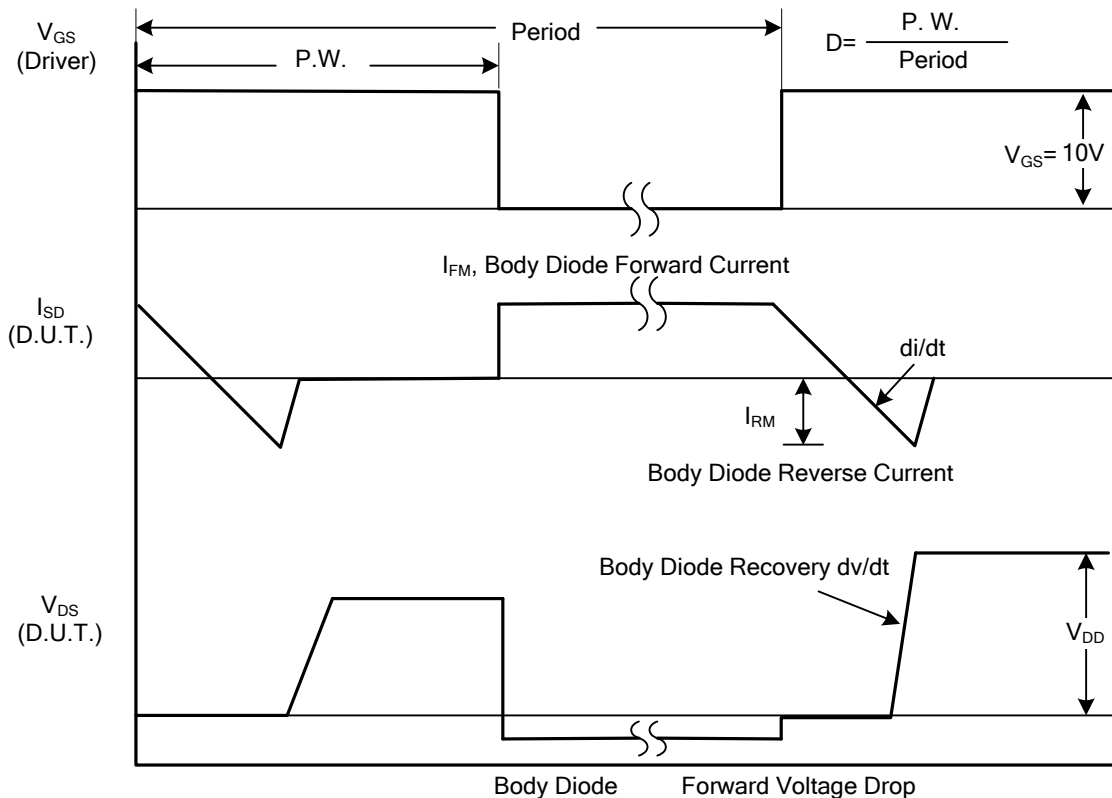
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0 V, I <sub>D</sub> =250 μA	600			V
Drain-Source Leakage Current	I <sub>DSS</sub>	V <sub>DS</sub> =600 V, V <sub>GS</sub> =0 V			10	μA
Gate-Source Leakage Current	Forward	I <sub>GSS</sub>			100	nA
	Reverse					
		V <sub>GS</sub> =-30 V, V <sub>DS</sub> =0 V			-100	nA
Breakdown Voltage Temperature Coefficient	ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	I <sub>D</sub> =250μA, 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> =250μA	2.0		4.0	V
Static Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10 V, I <sub>D</sub> =1.5A		2.8	3.6	Ω
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> =25V, V <sub>GS</sub> =0V, 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> =0.5A, R <sub>G</sub> =25Ω (Note 1, 2)		35	50	ns
Turn-On Rise Time	t <sub>R</sub>			60	70	ns
Turn-Off Delay Time	t <sub>D(OFF)</sub>			100	150	ns
Turn-Off Fall Time	t <sub>F</sub>			65	75	ns
Total Gate Charge	Q <sub>G</sub>	V <sub>DS</sub> =50V, I <sub>D</sub> =1.3A, I <sub>G</sub> =100μA V <sub>GS</sub> =10V (Note 1, 2)		18.5	23	nC
Gate-Source Charge	Q <sub>GS</sub>			5.2		nC
Gate-Drain Charge	Q <sub>GD</sub>			4.9		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> =3.0A			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> =0V, I <sub>S</sub> =3.0A,		210		ns
Reverse Recovery Charge	Q <sub>RR</sub>	di/dt = 100 A/μs (Note 1)		1.2		μC

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

#### TEST CIRCUITS AND WAVEFORMS

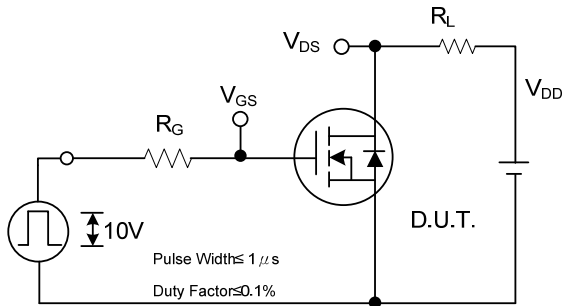


Peak Diode Recovery  $dv/dt$  Test Circuit

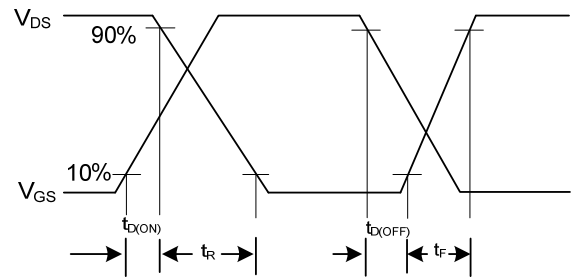


Peak Diode Recovery dv/dt Waveforms

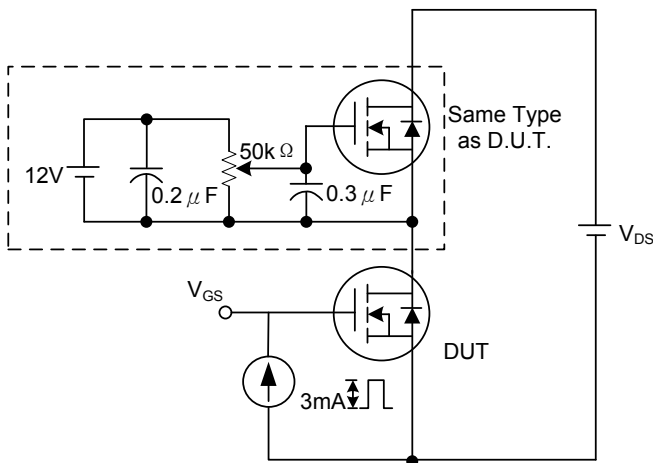
■ TEST CIRCUITS AND WAVEFORMS (Cont.)



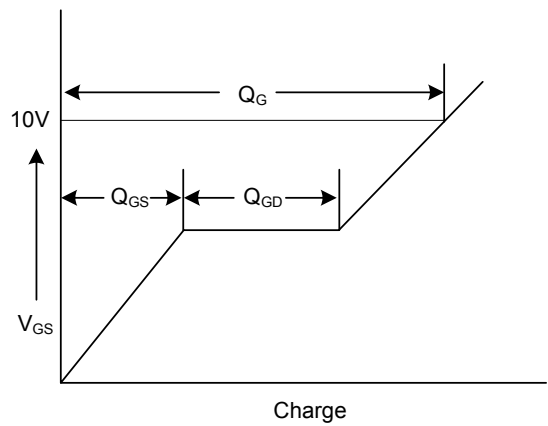
Switching Test Circuit



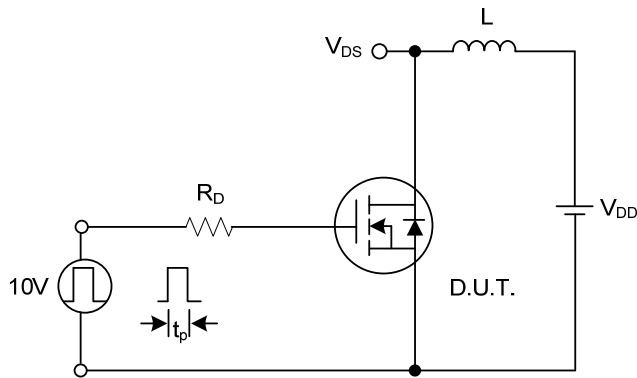
Switching Waveforms



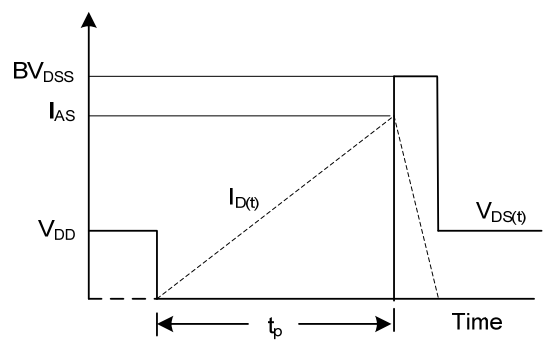
Gate Charge Test Circuit



Gate Charge Waveform



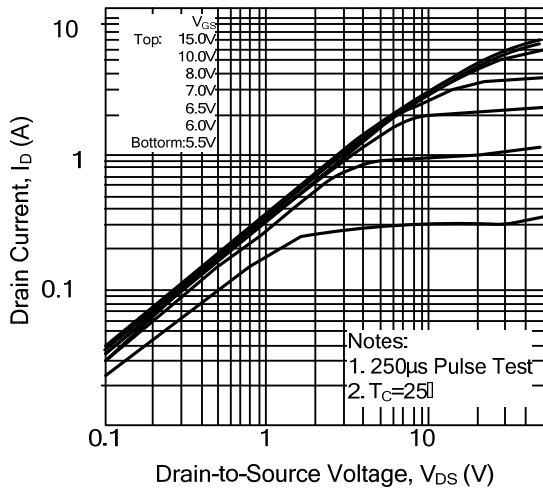
Unclamped Inductive Switching Test Circuit



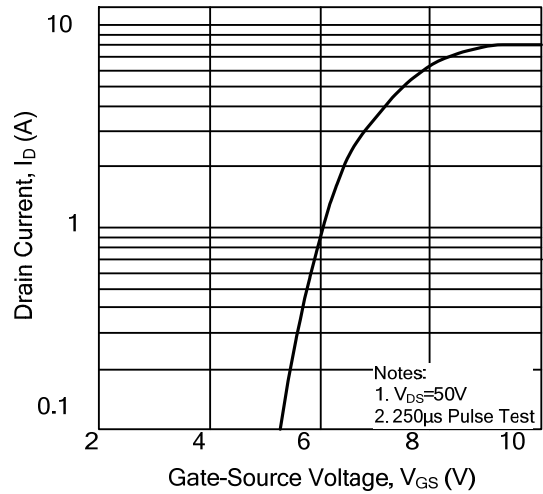
Unclamped Inductive Switching Waveforms

## TYPICAL CHARACTERISTICS

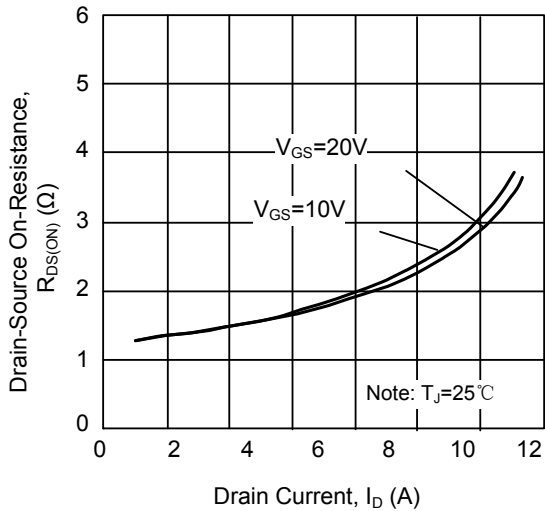
### On-State Characteristics



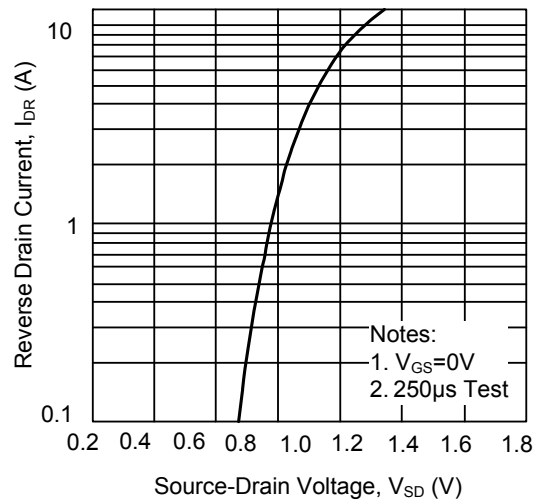
### Transfer Characteristics



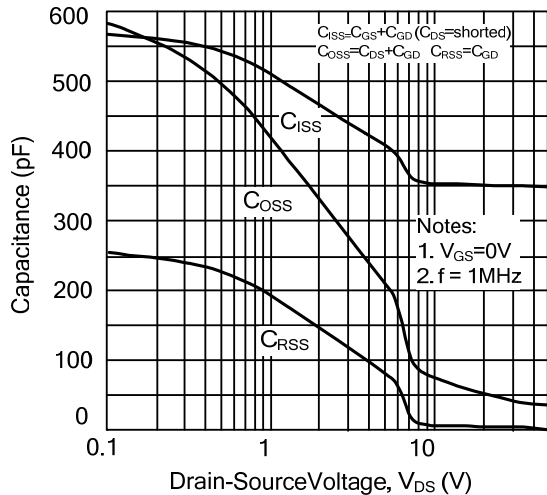
### On-Resistance Variation vs. Drain Current and Gate Voltage



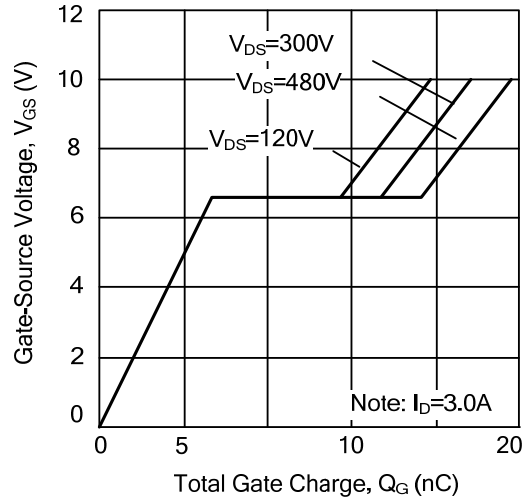
### On State Current vs. Allowable Case Temperature



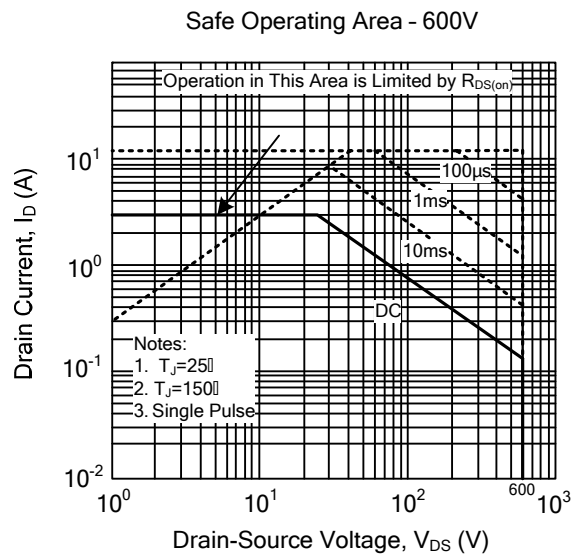
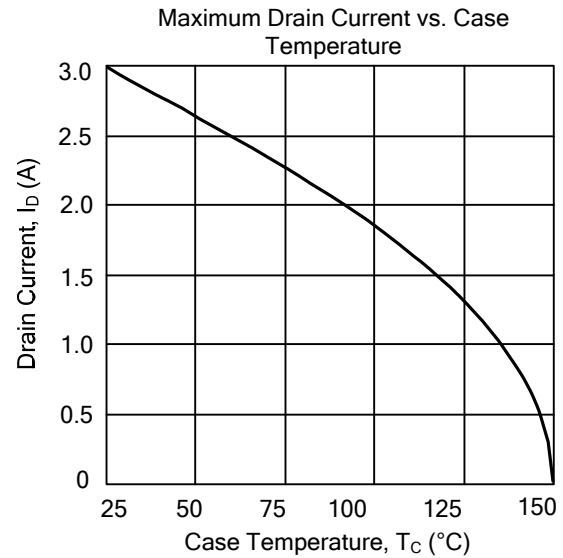
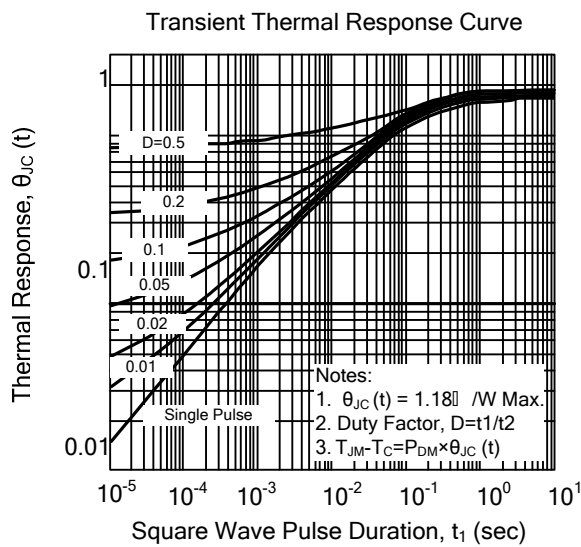
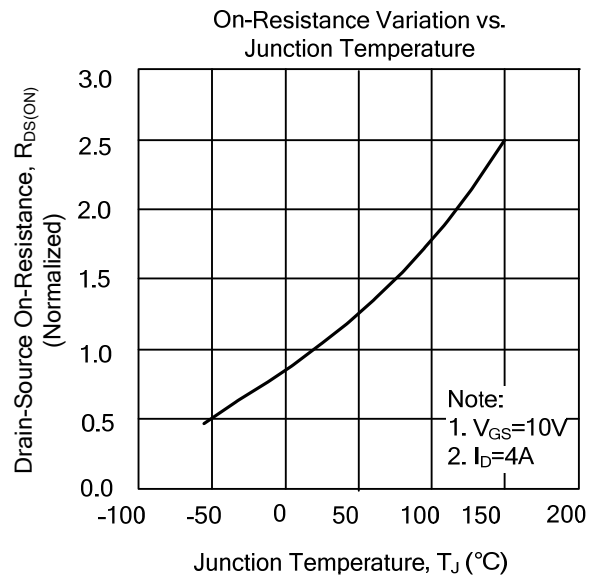
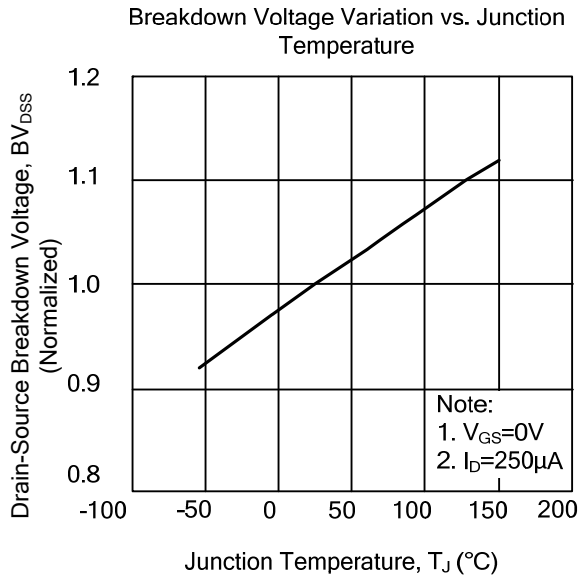
### Capacitance Characteristics (Non-Repetitive)



### Gate Charge Characteristics



## TYPICAL CHARACTERISTICS(Cont.)





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