



3N60

Power MOSFET

3 Amps, 600/650 Volts N-CHANNEL POWER MOSFET

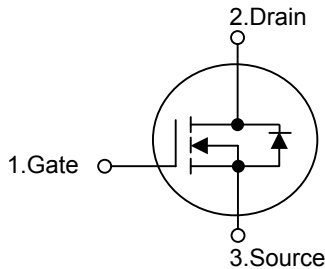
DESCRIPTION

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

- * $R_{DS(ON)} = 3.6\Omega @ V_{GS} = 10V$
- * Ultra low gate charge (typical 10 nC)
- * Low reverse transfer capacitance ($C_{RSS} =$ typical 5.5 pF)
- * Fast switching capability
- * Avalanche energy specified
- * Improved dv/dt capability, high ruggedness

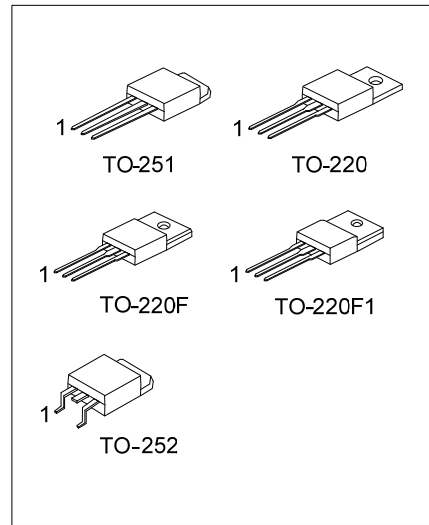
SYMBOL



ORDERING INFORMATION

Ordering Number			Package	Pin Assignment			Packing
Normal	Lead Free	Halogen Free		1	2	3	
3N60-x-TA3-T	3N60L-x-TA3-T	3N60G-x-TA3-T	TO-220	G	D	S	Tube
3N60-x-TF1-T	3N60L-x-TF1-T	3N60G-x-TF1-T	TO-220F1	G	D	S	Tube
3N60-x-TF3-T	3N60L-x-TF3-T	3N60G-x-TF3-T	TO-220F	G	D	S	Tube
3N60-x-TM3-R	3N60L-x-TM3-R	3N60G-x-TM3-R	TO-251	G	D	S	Tube
3N60-x-TN3-R	3N60L-x-TN3-R	3N60G-x-TN3-R	TO-252	G	D	S	Tape Reel

<p>3N60L-x-TA3-T</p>	<p>(1) R: Tape Reel, T: Tube (2) TA3: TO-220, TF1: TO-220F1, TF3: TO-22F, TM3: TO-251, TN3: TO-252 (3) A: 600V, B: 650V (4) G: Halogen Free, L: Lead Free, Blank: Pb/Sn</p>
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Lead-free: 3N60L
Halogen-free: 3N60G

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

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage	3N60-A	V_{DSS}	600	V
	3N60-B		650	V
Gate-Source Voltage		V_{GSS}	± 30	V
Avalanche Current (Note 1)		I_{AR}	3.0	A
Continuous Drain Current		I_D	3.0	A
Pulsed Drain Current (Note 1)		I_{DM}	12	A
Avalanche Energy	Single Pulsed (Note 2)	E_{AS}	200	mJ
	Repetitive (Note 1)	E_{AR}	7.5	mJ
Peak Diode Recovery dv/dt (Note 3)		dv/dt	4.5	V/ns
Power Dissipation	TO-220	P_D	75	W
	TO-220F/TO-220F1		34	
	TO-251/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	$^\circ\text{C}$

Note: 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.

■ THERMAL DATA

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

■ 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	3N60-A	BV_{DSS}	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	600			V
	3N60-B			650			V
Drain-Source Leakage Current		I_{DSS}	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$			10	μA
Gate-Source Leakage Current	Forward	I_{GSS}	$V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$			100	nA
	Reverse		$V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$			-100	nA
Breakdown Voltage Temperature Coefficient		$\Delta BV_{DSS}/\Delta T_J$	$I_D = 250\ \mu\text{A}$, Referenced to 25°C		0.6		$^\circ\text{C}$
ON CHARACTERISTICS							
Gate Threshold Voltage		$V_{GS(TH)}$	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	2.0		4.0	V
Static Drain-Source On-State Resistance		$R_{DS(ON)}$	$V_{GS} = 10\text{ V}, I_D = 1.5\text{ A}$		2.8	3.6	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance	C_{ISS}	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$			350	450	pF
Output Capacitance	C_{OSS}				50	65	pF
Reverse Transfer Capacitance	C_{RSS}				5.5	7.5	pF

■ ELECTRICAL CHARACTERISTICS(Cont.)

SWITCHING CHARACTERISTICS						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Turn-On Delay Time	$t_{D(ON)}$	$V_{DD} = 300V, I_D = 3.0 A, R_G = 25\Omega$ (Note 4, 5)		10	30	ns
Turn-On Rise Time	t_R			30	70	ns
Turn-Off Delay Time	$t_{D(OFF)}$			20	50	ns
Turn-Off Fall Time	t_F			30	70	ns
Total Gate Charge	Q_G	$V_{DS} = 480V, I_D = 3.0A, V_{GS} = 10 V$ (Note 4, 5)		10	13	nC
Gate-Source Charge	Q_{GS}			2.7		nC
Gate-Drain Charge	Q_{DD}			4.9		nC
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS						
Drain-Source Diode Forward Voltage	V_{SD}	$V_{GS} = 0 V, I_S = 3.0 A$			1.4	V
Maximum Continuous Drain-Source Diode Forward Current	I_S				3.0	A
Maximum Pulsed Drain-Source Diode Forward Current	I_{SM}				12	A
Reverse Recovery Time	t_{RR}	$V_{GS} = 0 V, I_S = 3.0 A,$ $di_F/dt = 100 A/\mu s$ (Note 4)		210		ns
Reverse Recovery Charge	Q_{RR}			1.2		μC

- Notes:
1. Repetitive Rating: Pulse width limited by maximum junction temperature
 2. $L = 64mH, I_{AS} = 2.4A, V_{DD} = 50V, R_G = 25 \Omega$, Starting $T_J = 25^\circ C$
 3. $I_{SD} \leq 3.0A, di/dt \leq 200A/\mu s, V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ C$
 4. Pulse Test: Pulse width $\leq 300\mu s$, Duty cycle $\leq 2\%$
 5. Essentially independent of operating temperature

■ TEST CIRCUITS AND WAVEFORMS

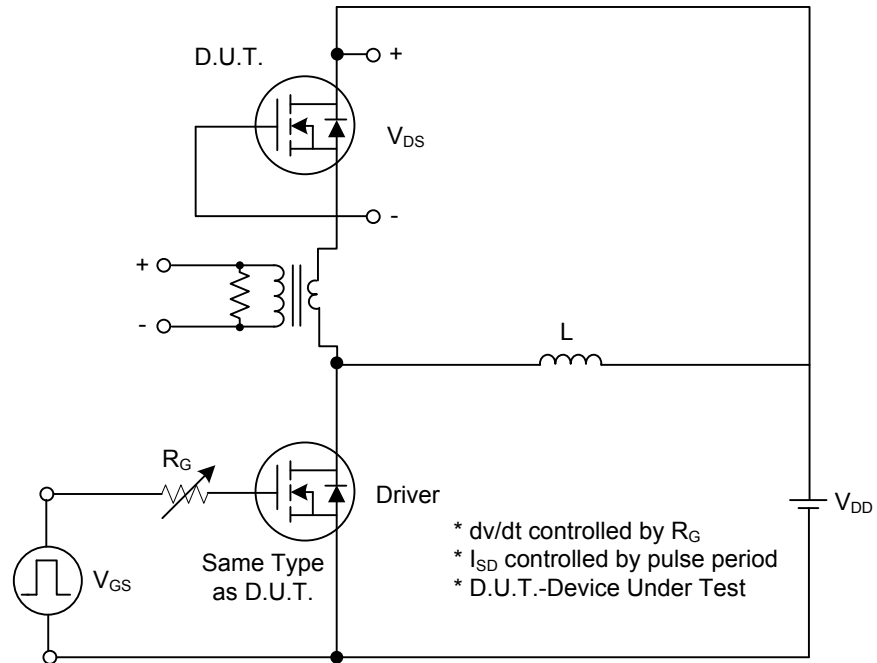


Fig. 1A Peak Diode Recovery dv/dt Test Circuit

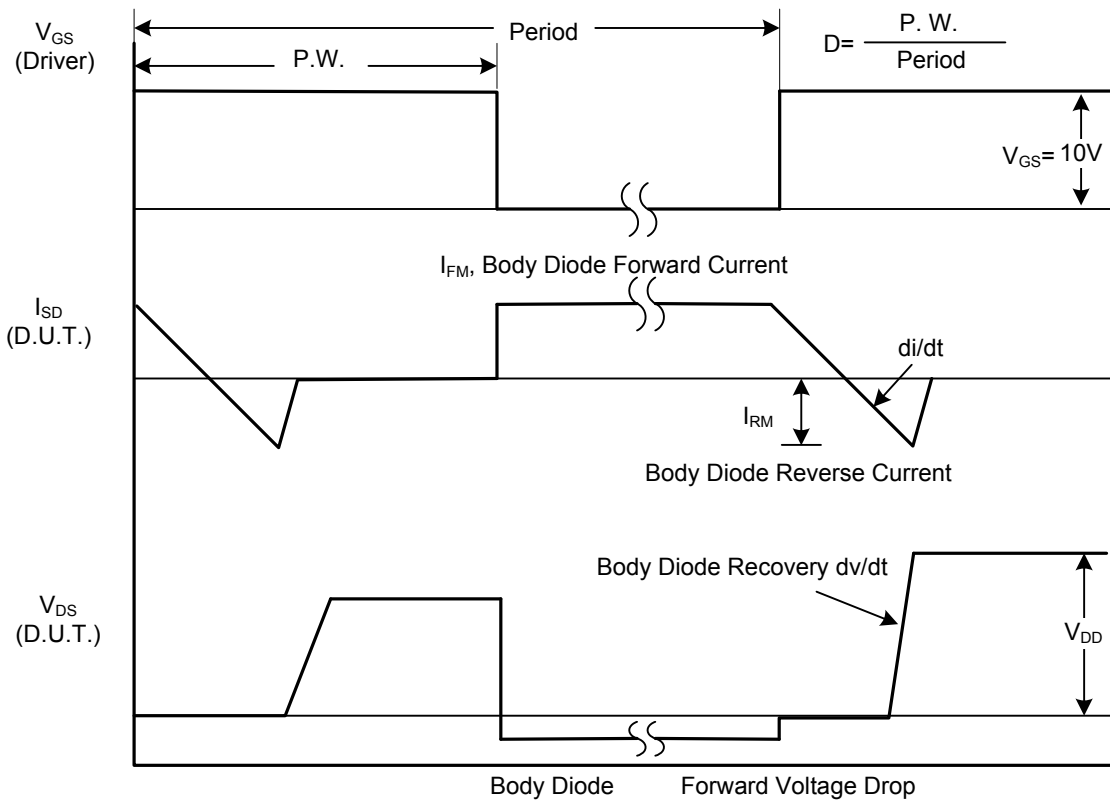


Fig. 1B Peak Diode Recovery dv/dt Waveforms

■ TEST CIRCUITS AND WAVEFORMS (Cont.)

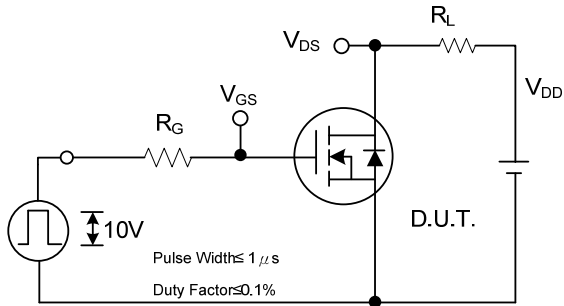


Fig. 2A Switching Test Circuit

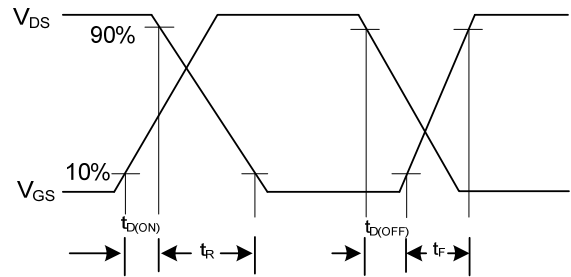


Fig. 2B Switching Waveforms

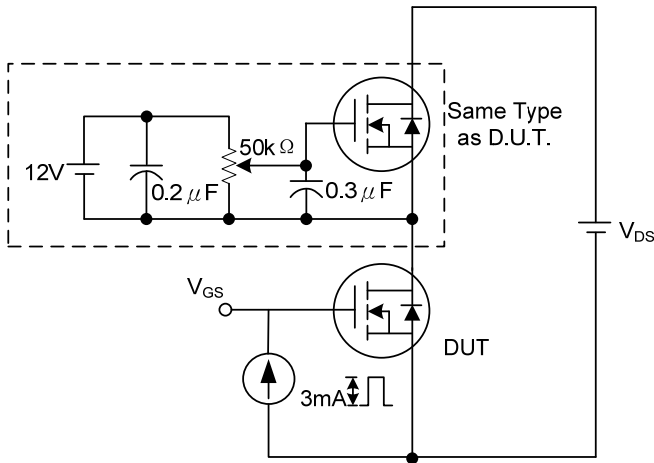


Fig. 3A Gate Charge Test Circuit

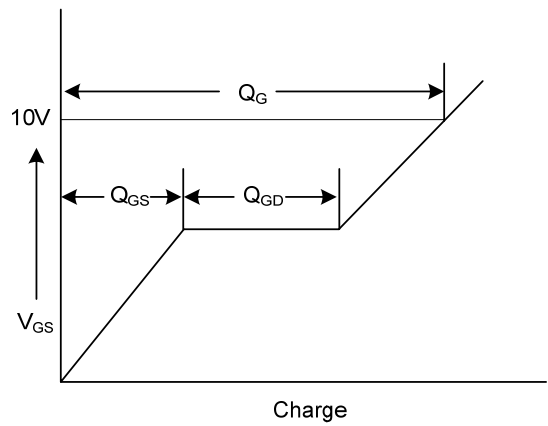


Fig. 3B Gate Charge Waveform

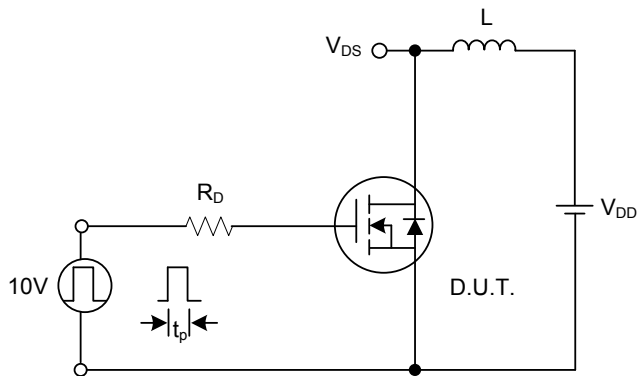


Fig. 4A Unclamped Inductive Switching Test Circuit

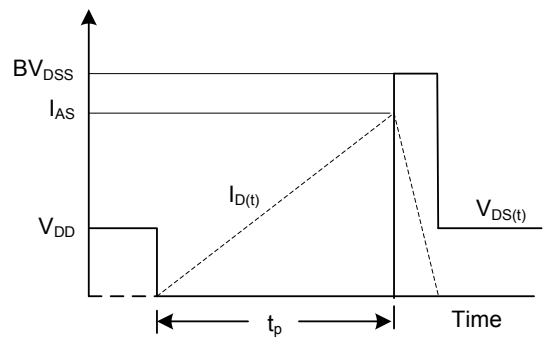
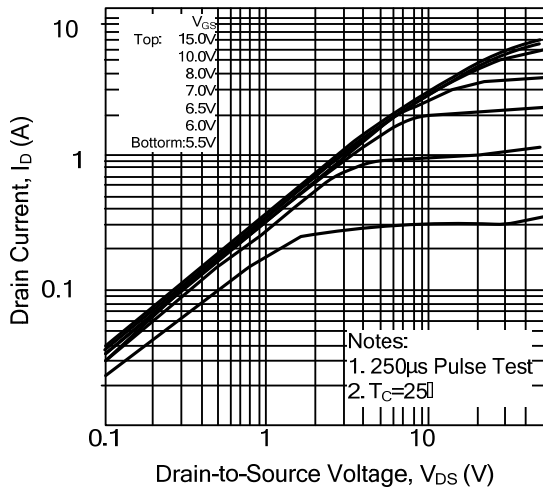


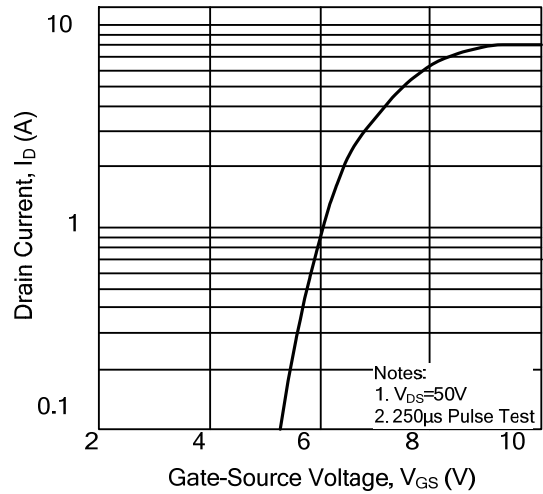
Fig. 4B Unclamped Inductive Switching Waveforms

TYPICAL CHARACTERISTICS

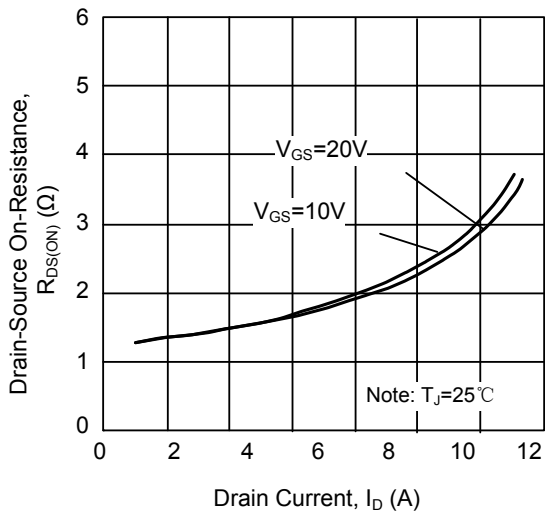
On-State Characteristics



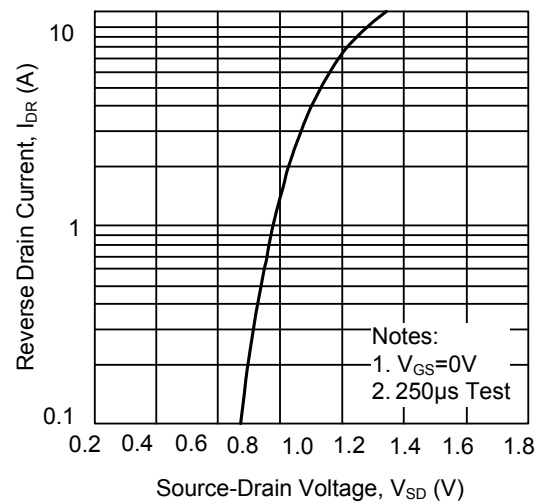
Transfer Characteristics



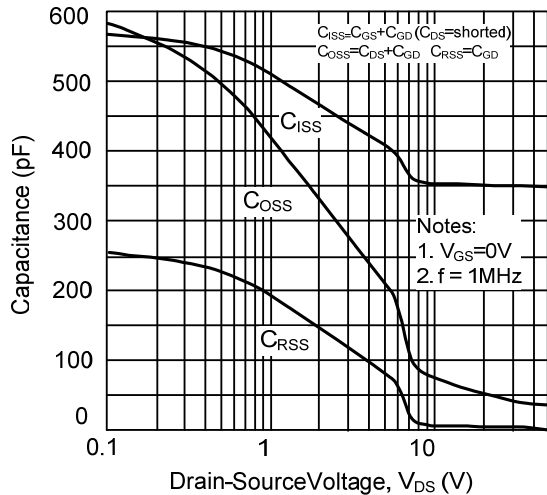
On-Resistance Variation vs. Drain Current and Gate Voltage



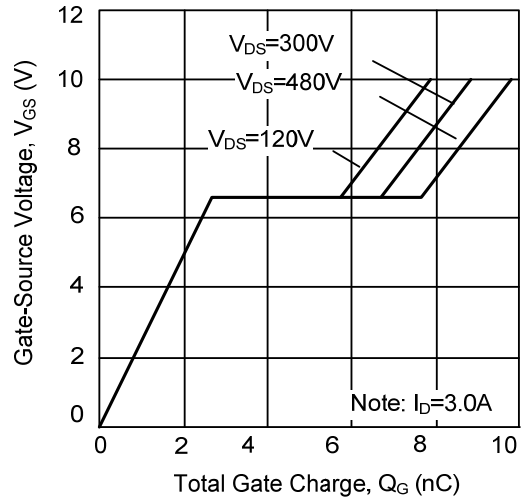
On State Current vs. Allowable Case Temperature



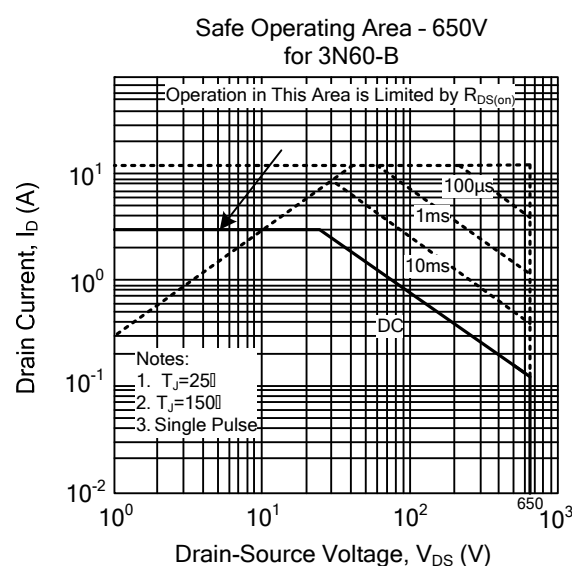
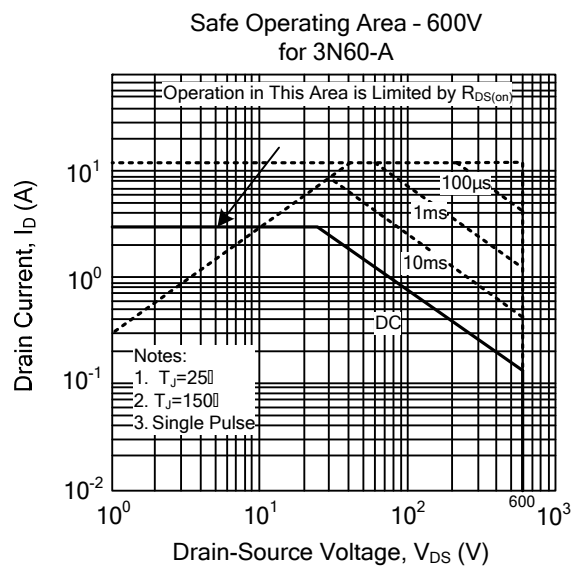
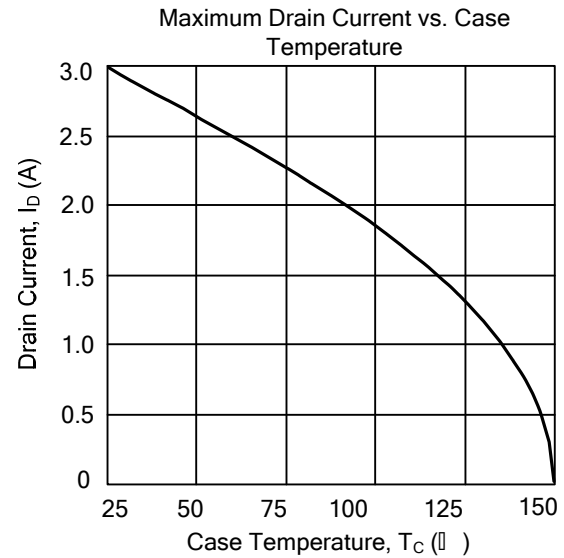
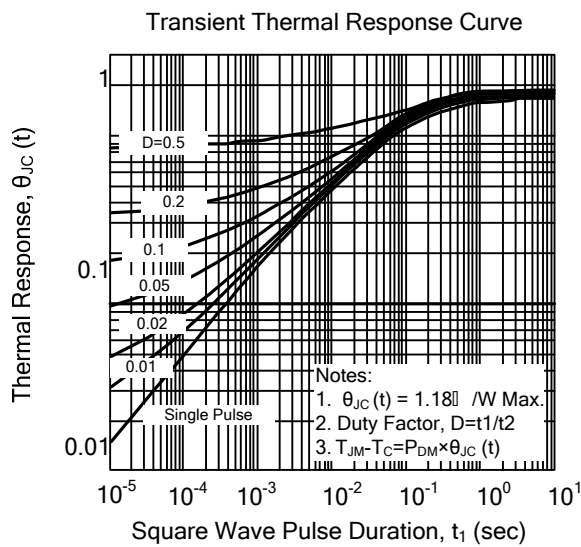
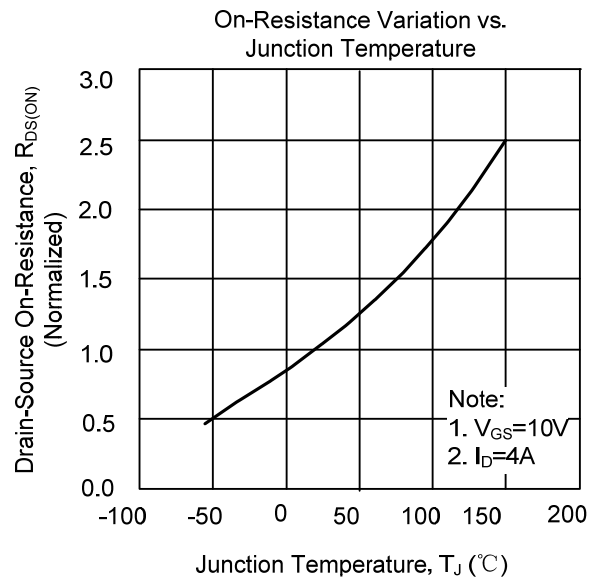
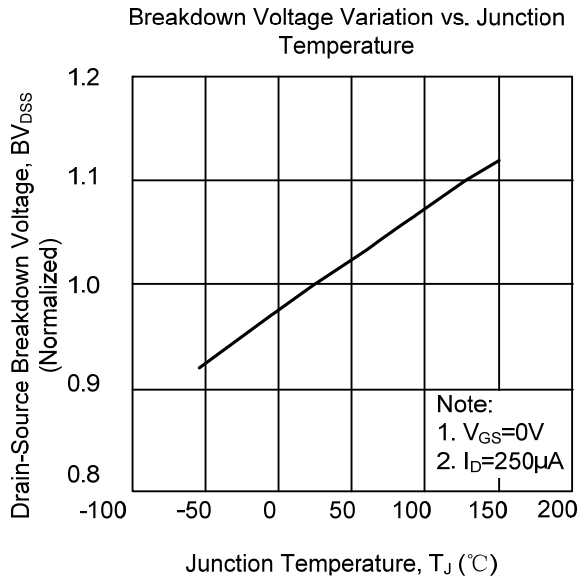
Capacitance Characteristics (Non-Repetitive)



Gate Charge Characteristics



TYPICAL CHARACTERISTICS(Cont.)



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