



## 2N60

Power MOSFET

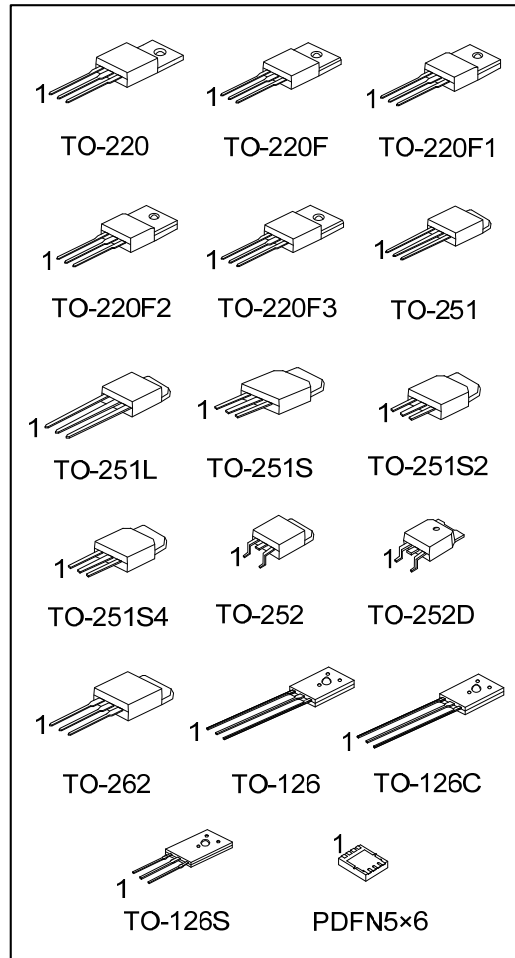
### 2.0A, 600V N-CHANNEL POWER MOSFET

#### DESCRIPTION

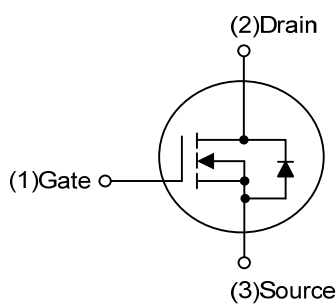
The UTC **2N60** is a high voltage power MOSFET and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristics. This power MOSFET is usually used at high speed switching applications in power supplies, PWM motor controls, high efficient AC to DC converters and bridge circuits.

#### FEATURES

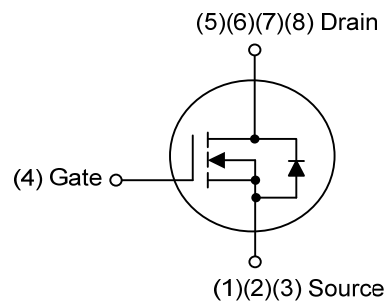
- \*  $R_{DS(ON)} \leq 5.0 \Omega @ V_{GS} = 10V, I_D = 1.0A$
- \* Fast switching capability
- \* Avalanche energy specified
- \* Improved dv/dt capability, high ruggedness



#### SYMBOL



TO-220/TO-220F/TO-220F1/TO-220F2  
 TO-220F3/TO-251/TO-251L/TO-251S  
 TO-251S2/TO-251S4/TO-252/TO-252D  
 TO-262/TO-126/TO-126C/TO-126S



PDFN5x6

## ORDERING INFORMATION

Ordering Number		Package	Pin Assignment								Packing
Lead Free	Halogen Free		1	2	3	4	5	6	7	8	
2N60L-TA3-T	2N60G-TA3-T	TO-220	G	D	S	-	-	-	-	-	Tube
2N60L-TF1-T	2N60G-TF1-T	TO-220F1	G	D	S	-	-	-	-	-	Tube
2N60L-TF2-T	2N60G-TF2-T	TO-220F2	G	D	S	-	-	-	-	-	Tube
2N60L-TF3-T	2N60G-TF3-T	TO-220F	G	D	S	-	-	-	-	-	Tube
2N60L-TF3T-T	2N60G-TF3T-T	TO-220F3	G	D	S	-	-	-	-	-	Tube
2N60L-TM3-T	2N60G-TM3-T	TO-251	G	D	S	-	-	-	-	-	Tube
2N60L-TMA-T	2N60G-TMA-T	TO-251L	G	D	S	-	-	-	-	-	Tube
2N60L-TMS-T	2N60G-TMS-T	TO-251S	G	D	S	-	-	-	-	-	Tube
2N60L-TMS2-T	2N60G-TMS2-T	TO-251S2	G	D	S	-	-	-	-	-	Tube
2N60L-TMS4-T	2N60G-TMS4-T	TO-251S4	G	D	S	-	-	-	-	-	Tube
2N60L-TN3-R	2N60G-TN3-R	TO-252	G	D	S	-	-	-	-	-	Tape Reel
2N60L-TND-R	2N60G-TND-R	TO-252D	G	D	S	-	-	-	-	-	Tape Reel
2N60L-T2Q-T	2N60G-T2Q-T	TO-262	G	D	S	-	-	-	-	-	Tube
2N60L-T60-K	2N60G-T60-K	TO-126	G	D	S	-	-	-	-	-	Bulk
2N60L-T6C-K	2N60G-T6C-K	TO-126C	G	D	S	-	-	-	-	-	Bulk
2N60L-T6S-K	2N60G-T6S-K	TO-126S	G	D	S	-	-	-	-	-	Tube
2N60L-P5060-R	2N60G-P5060-R	PDFN5×6	S	S	S	G	D	D	D	D	Tape Reel

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

<p>2N60G-TA3-T</p> <p>(1)Packing Type (2)Package Type (3)Green Package</p>	<p>(1) T: Tube, R: Tape Reel, K: Bulk (2) TA3: TO-220, TF1: TO-220F1, TF2: TO-220F2, TF3: TO-220F, TF3T: TO-220F3, TM3: TO-251, TMA: TO-251L, TMS: TO-251S, TMS2: TO-251S2, TMS4: TO-251S4, TN3: TO-252, TND: TO-252D, T2Q: TO-262, T60: TO-126, T6C: TO-126C, T6S: TO-126S, P5060: PDFN5×6 (3) G: Halogen Free and Lead Free, L: Lead Free</p>
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## MARKING

PACKAGE	MARKING
TO-220 TO-220F TO-220F1 TO-220F2 TO-220F3 TO-251 TO-251L  TO-251S TO-251S2 TO-251S4 TO-252 TO-252D TO-262	<p>Lot Code ← UTC 2N60 → Date Code</p> <p>1</p> <p>L: Lead Free G: Halogen Free</p>
TO-126 TO-126C TO-26S	<p>UTC 2N60 → Date Code</p> <p>1</p> <p>L: Lead Free G: Halogen Free</p>
PDFN5×6	<p>UTC 2N60</p> <p>Lot Code ← → Date 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)	$I_{AR}$	2.0	A
Drain Current	Continuous	$I_D$	2.0
	Pulsed (Note 2)	$I_{DM}$	8.0
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	140
	Repetitive (Note 2)	$E_{AR}$	4.5
Peak Diode Recovery dv/dt (Note 4)	dv/dt	4.5	V/ns
Power Dissipation ( $T_C = 25^\circ\text{C}$ )	TO-220/ TO-262	$P_D$	54
	TO-220F/TO-220F1 TO-220F3		23
	TO-220F2		24
	TO-251/TO-251L TO-251S/TO-251S2 TO-251S4/TO-252 TO-252D		44
	TO-126/TO-126C TO-126S		40
	PDFN5x6		22
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.  $L=64\text{mH}$ ,  $I_{AS}=2.0\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $R_G=25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$   
 4.  $I_{SD} \leq 2.4\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

PARAMETER	PACKAGE	SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220/TO-220F TO-220F1/TO-220F2 TO-220F3/TO-262	$\theta_{JA}$	62.5	$^\circ\text{C}/\text{W}$
	TO-251/TO-251L TO-251S/TO-251S2 TO-251S4/TO-252 TO-252D		100	$^\circ\text{C}/\text{W}$
	TO-126/TO-126C TO-126S		89	$^\circ\text{C}/\text{W}$
	PDFN5x6		75 (Note)	$^\circ\text{C}/\text{W}$
Junction to Case	TO-220/TO-262	$\theta_{JC}$	2.32	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1 TO-220F3		5.5	$^\circ\text{C}/\text{W}$
	TO-220F2		5.43	$^\circ\text{C}/\text{W}$
	TO-251/TO-251L TO-251S/TO-251S2 TO-251S4/TO-252 TO-252D		2.87	$^\circ\text{C}/\text{W}$
	TO-126/TO-126C TO-126S		3.12	$^\circ\text{C}/\text{W}$
	PDFN5x6		5.6 (Note)	$^\circ\text{C}/\text{W}$

Note: Device mounted on FR-4 substrate PC board, 2oz copper, with 1inch square copper plate.

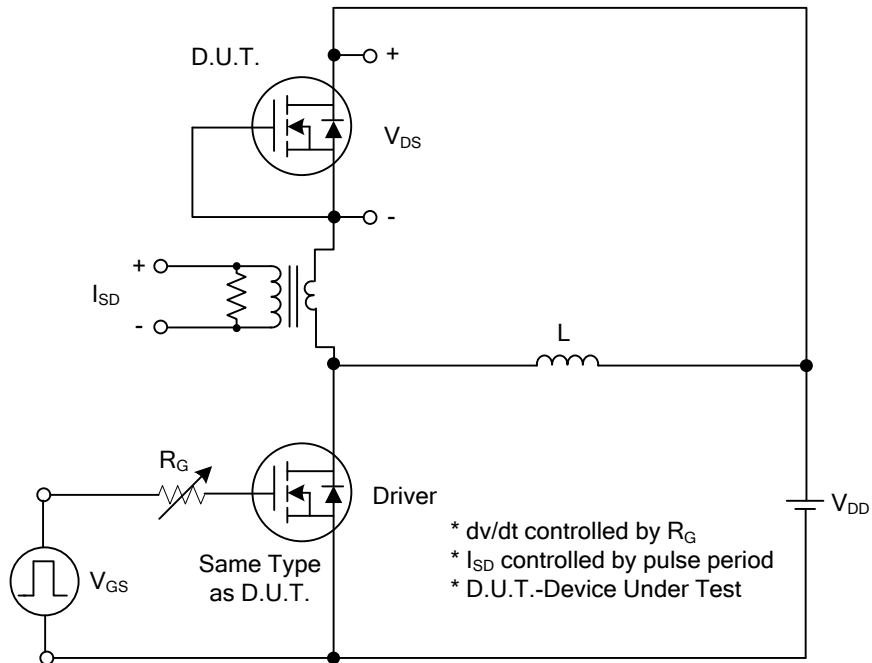
■ ELECTRICAL CHARACTERISTICS ( $T_J=25^\circ\text{C}$ , unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	600			V
Drain-Source Leakage Current	$I_{DSS}$	$V_{DS} = 600V, V_{GS} = 0V$			10	$\mu A$
		$V_{DS} = 480V, T_C = 125^\circ\text{C}$			100	$\mu A$
Gate-Source Leakage Current	Forward	$I_{GSS}$				
	Reverse					
		$V_{GS} = -30V, V_{DS} = 0V$			-100	nA
Breakdown Voltage Temperature Coefficient	$\Delta BV_{DSS}/\Delta T_J$	$I_D=250\mu A$ , Referenced to $25^\circ\text{C}$		0.4		$V/^\circ\text{C}$
<b>ON CHARACTERISTICS</b>						
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	2.0		4.0	V
Static Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS} = 10V, I_D = 1.0A$		3.6	5	$\Omega$
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	$C_{ISS}$	$V_{DS} = 25V, V_{GS} = 0V,$ $f = 1\text{MHz}$		300	350	pF
Output Capacitance	$C_{OSS}$			45	50	pF
Reverse Transfer Capacitance	$C_{RSS}$			10	13	pF
<b>SWITCHING CHARACTERISTICS</b>						
Total Gate Charge	$Q_G$	$V_{DS}=480V, V_{GS}=10V,$ $I_D=2.4A$ (Note 1, 2)		40	50	nC
Gate-Source Charge	$Q_{GS}$			4.2		nC
Gate-Drain Charge	$Q_{GD}$			8.4		nC
Turn-On Delay Time	$t_{D(ON)}$	$V_{DD}=300V, I_D=2.4A,$ $R_G=25\Omega$ (Note 1, 2)		40	60	ns
Turn-On Rise Time	$t_R$			35	55	ns
Turn-Off Delay Time	$t_{D(OFF)}$			90	120	ns
Turn-Off Fall Time	$t_F$			50	60	ns
<b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>						
Continuous Drain-Source Current	$I_S$				2.0	A
Pulsed Drain-Source Current	$I_{SM}$				8.0	A
Drain-Source Diode Forward Voltage	$V_{SD}$	$V_{GS} = 0V, I_{SD} = 2.0A$			1.4	V
Reverse Recovery Time	$t_{rr}$	$V_{GS} = 0V, I_{SD} = 2.4A,$ $di/dt = 100 A/\mu s$ (Note 1)		180		ns
Reverse Recovery Charge	$Q_{rr}$			0.72		$\mu C$

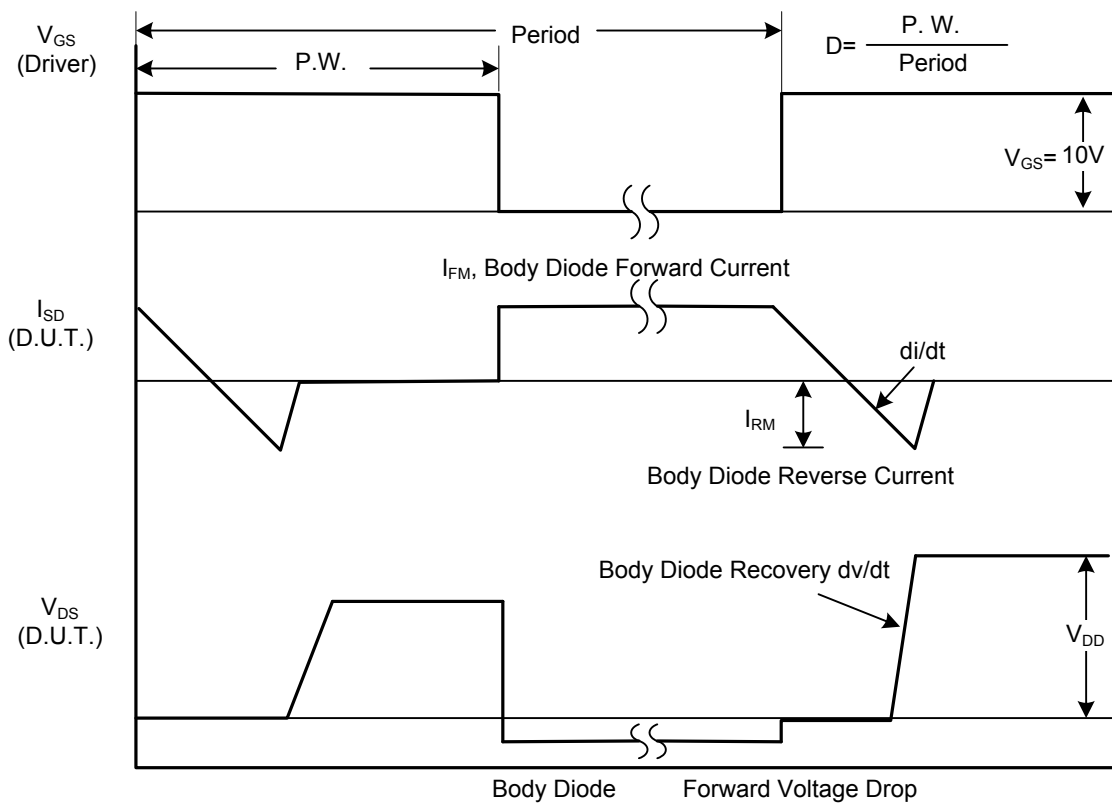
Notes: 1. Pulse Test: Pulse width  $\leq 300\mu s$ , Duty cycle  $\leq 2\%$ .

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

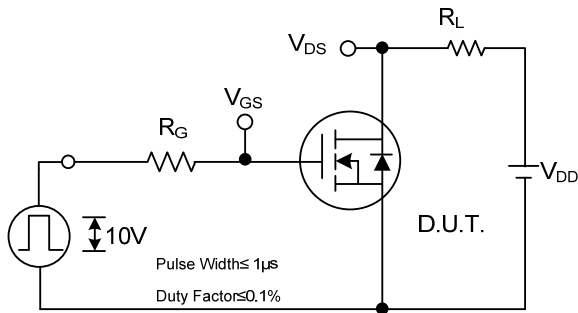


Peak Diode Recovery dv/dt Test Circuit

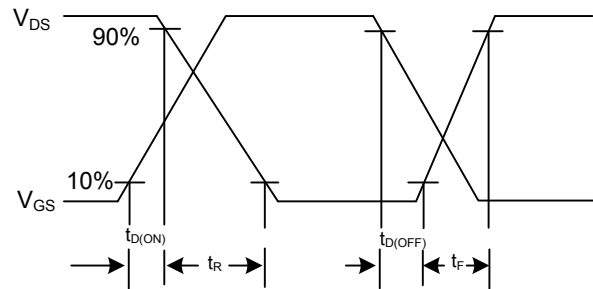


Peak Diode Recovery dv/dt Waveforms

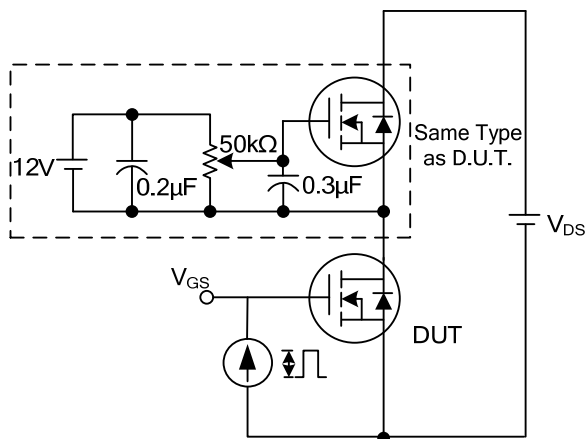
## TEST CIRCUITS AND WAVEFORMS



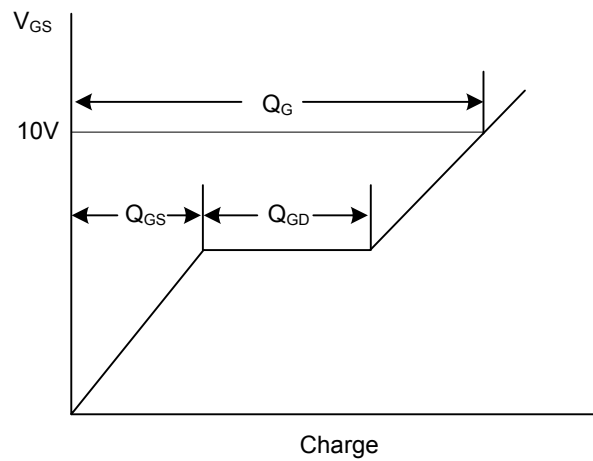
**Switching Test Circuit**



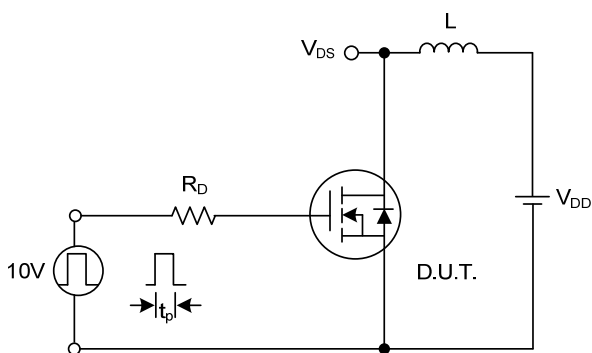
**Switching Waveforms**



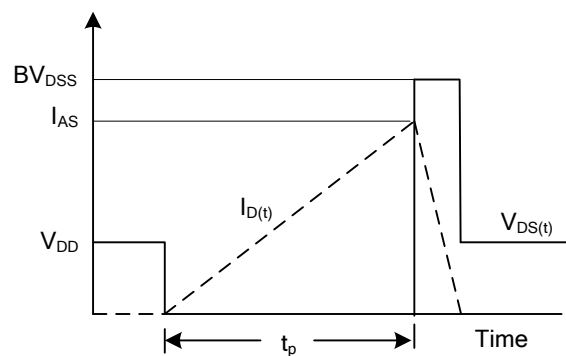
**Gate Charge Test Circuit**



**Gate Charge Waveform**

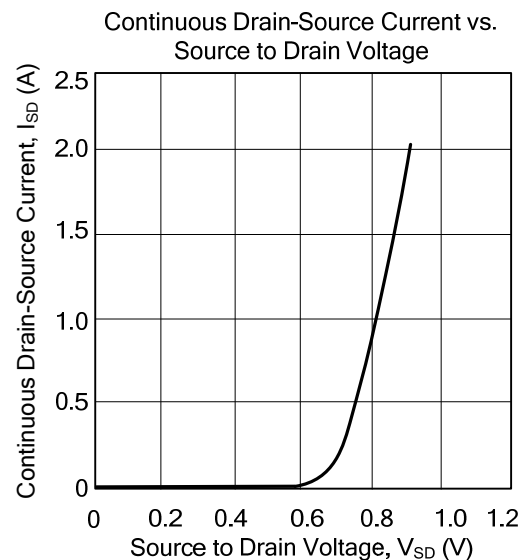
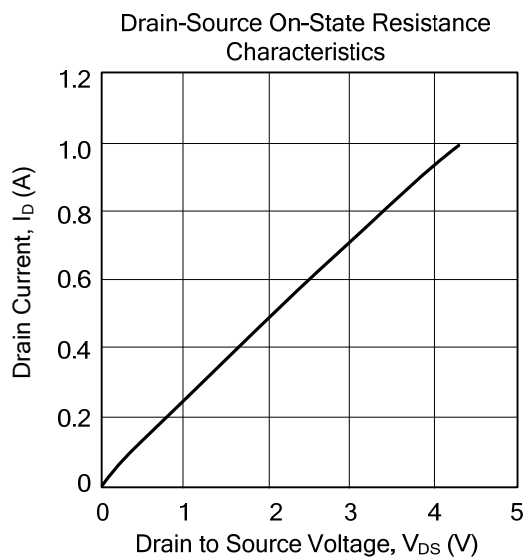
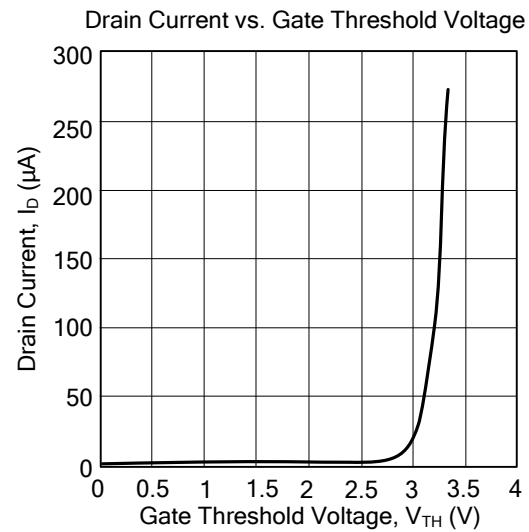
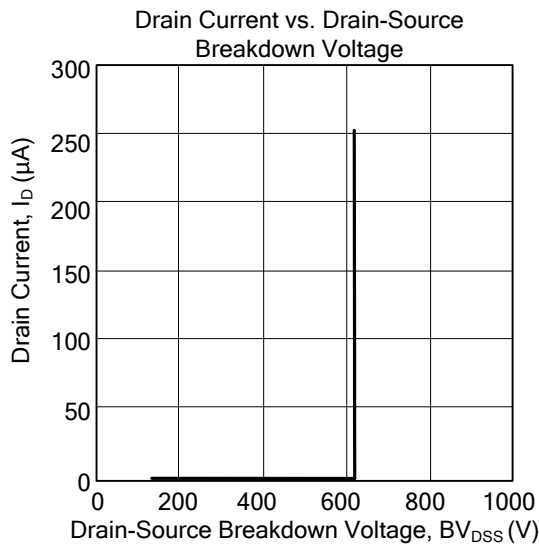


**Unclamped Inductive Switching Test Circuit**



**Unclamped Inductive Switching Waveforms**

## ■ TYPICAL CHARACTERISTICS



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