



## 1N60-KW

Power MOSFET

### 1A, 600V N-CHANNEL POWER MOSFET

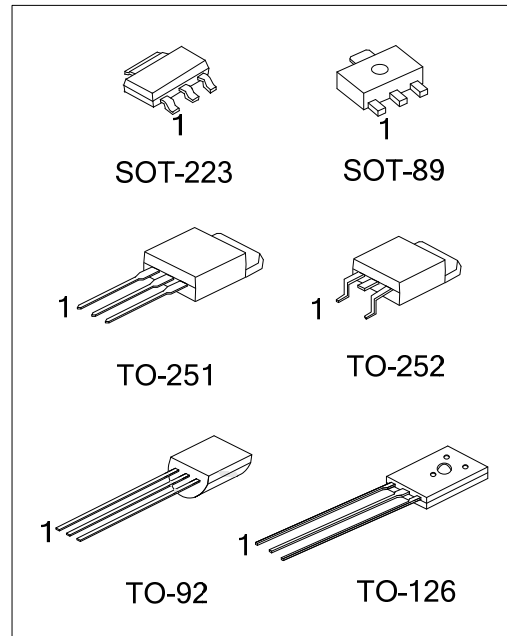
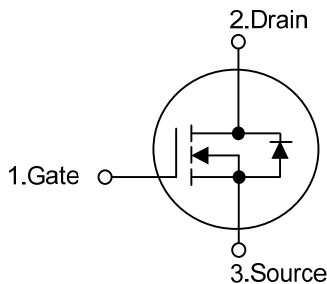
#### DESCRIPTION

The UTC 1N60-KW is a high voltage 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

- \*  $R_{DS(ON)} \leq 15\Omega @ V_{GS}=10V, I_D=0.5A$
- \* Fast switching capability
- \* Avalanche energy specified
- \* Improved dv/dt capability, high ruggedness

#### SYMBOL



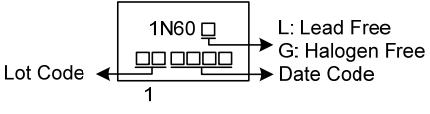
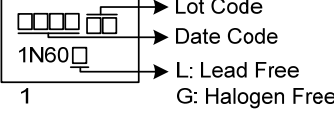
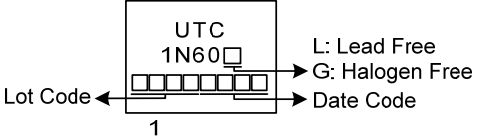
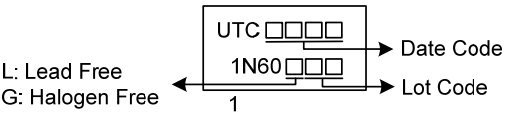
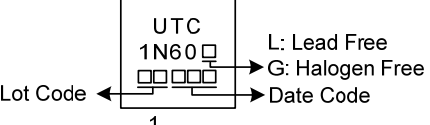
#### ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
1N60L-AA3-R	1N60G-AA3-R	SOT-223	G	D	S	Tape Reel
1N60L-AB3-R	1N60G-AB3-R	SOT-89	G	D	S	Tape Reel
1N60L-TM3-T	1N60G-TM3-T	TO-251	G	D	S	Tube
1N60L-TN3-R	1N60G-TN3-R	TO-252	G	D	S	Tape Reel
1N60L-T60-K	1N60G-T60-K	TO-126	G	D	S	Bulk
1N60L-T92-B	1N60G-T92-B	TO-92	G	D	S	Tape Box
1N60L-T92-K	1N60G-T92-K	TO-92	G	D	S	Bulk

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

<p>1N60G-AA3-R</p>	<p>(1) T: Tube, R: Tape Reel, B: Tape Box, K: Bulk  (2) AA3: SOT-223, AB3: SOT-89, TM3: TO-251  TN3: TO-252, T60: TO-126, T92: TO-92  (3) G: Halogen Free and Lead Free, L: Lead Free</p>
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## MARKING

PACKAGE	MARKING
SOT-223	 <p>1N60 □            Lot Code ← □ □ □ □ □ → Date Code            1            L: Lead Free            G: Halogen Free</p>
SOT-89	 <p>□ □ □ □ □ → Lot Code            □ □ □ □ □ → Date Code            1N60 □            1            L: Lead Free            G: Halogen Free</p>
TO-251 / TO-252	 <p>UTC            1N60 □            Lot Code ← □ □ □ □ □ → Date Code            1            L: Lead Free            G: Halogen Free</p>
TO-126	 <p>UTC □ □ □ □ □ → Date Code            L: Lead Free ← □ □ □ □ □ → Lot Code            G: Halogen Free            1N60 □ □ □ □ □            1</p>
TO-92	 <p>UTC            1N60 □            Lot Code ← □ □ □ □ □ → Date Code            1            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
Continuous Drain Current		$I_D$	1	A
Avalanche Energy	Single Pulsed (Note 2)	$E_{AS}$	7.2	mJ
Peak Diode Recovery dv/dt (Note 3)		dv/dt	4.5	V/ns
Power Dissipation ( $T_A=25^\circ\text{C}$ )	SOT-89	$P_D$	8	W
	SOT-223		8	W
	TO-251/TO-252		27	W
	TO-126/TO-92		12.5	W
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.  $L = 10\text{mH}$ ,  $I_{AS} = 1.2\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$

3.  $I_{SD} \leq 1.2\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ **THERMAL DATA**

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	SOT-89/SOT-223	$\theta_{JA}$	150	$^\circ\text{C}/\text{W}$
	TO-251/TO-252		100	$^\circ\text{C}/\text{W}$
	TO-126/TO-92		132	$^\circ\text{C}/\text{W}$
Junction to Case	SOT-89/SOT-223	$\theta_{JC}$	15.6	$^\circ\text{C}/\text{W}$
	TO-251/TO-252		4.6	$^\circ\text{C}/\text{W}$
	TO-126/TO-92		10	$^\circ\text{C}/\text{W}$

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

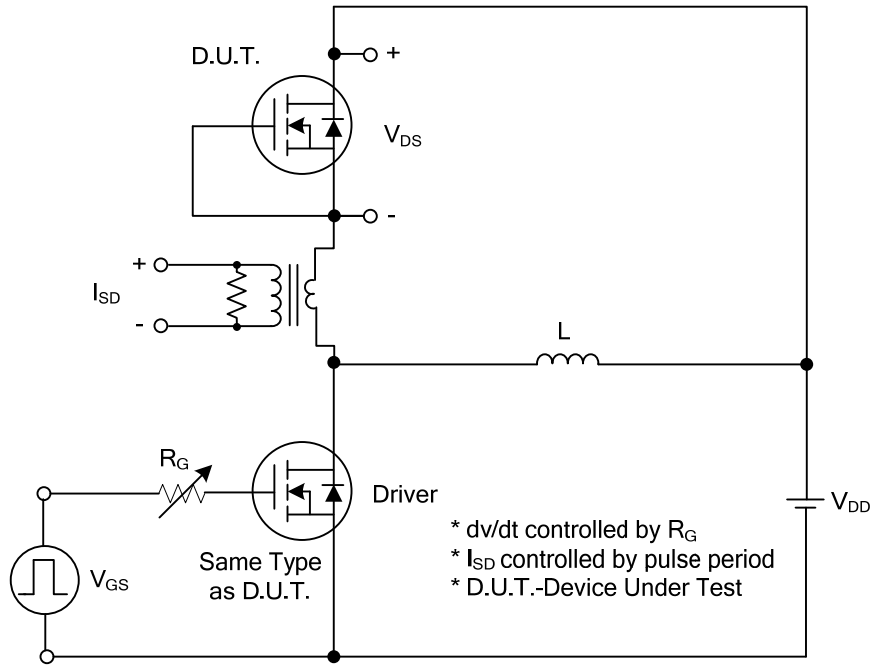
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	600			V
Drain-Source Leakage Current	$I_{DSS}$	$V_{DS}=600V, V_{GS}=0V$			10	$\mu A$
Gate-Source Leakage Current	Forward	$I_{GSS}$			100	nA
	Reverse					
<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	$R_{DS(ON)}$	$V_{GS}=10V, I_D=0.5A$		12	15	$\Omega$
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	$C_{ISS}$	$V_{DS}=25V, V_{GS}=0V, f=1\text{MHz}$		115		pF
Output Capacitance	$C_{OSS}$			17.5		pF
Reverse Transfer Capacitance	$C_{RSS}$			2		pF
<b>SWITCHING CHARACTERISTICS</b>						
Total Gate Charge	$Q_G$	$V_{DS}=480V, V_{GS}=10V, I_D=1A$ (Note 2,3)		7.5		nC
Gate-Source Charge	$Q_{GS}$			3.2		nC
Gate-Drain Charge	$Q_{GD}$			0.6		nC
Turn-On Delay Time	$t_{D(ON)}$	$V_{DD}=100V, V_{GS}=10V, I_D=1A,$ $R_G=25\Omega, \text{(Note 2,3)}$		2.4		ns
Turn-On Rise Time	$t_R$			15		ns
Turn-Off Delay Time	$t_{D(OFF)}$			9.6		ns
Turn-Off Fall Time	$t_F$			35		ns
<b>SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS</b>						
Maximum Continuous Drain-Source Diode Forward Current	$I_S$				1	A
Maximum Pulsed Drain-Source Diode Forward Current	$I_{SM}$				2	A
Drain-Source Diode Forward Voltage	$V_{SD}$	$I_S=1A, V_{GS}=0V$			1.4	V
Reverse Recovery Time	$t_{rr}$	$I_S=1A, V_{GS}=0V$ $dI_F/dt=100A/\mu s \text{ (Note 1)}$		280		ns
Reverse Recovery Charge	$Q_{rr}$			400		nC

Notes: 1. Repetitive Rating: Pulse width limited by maximum junction temperature.

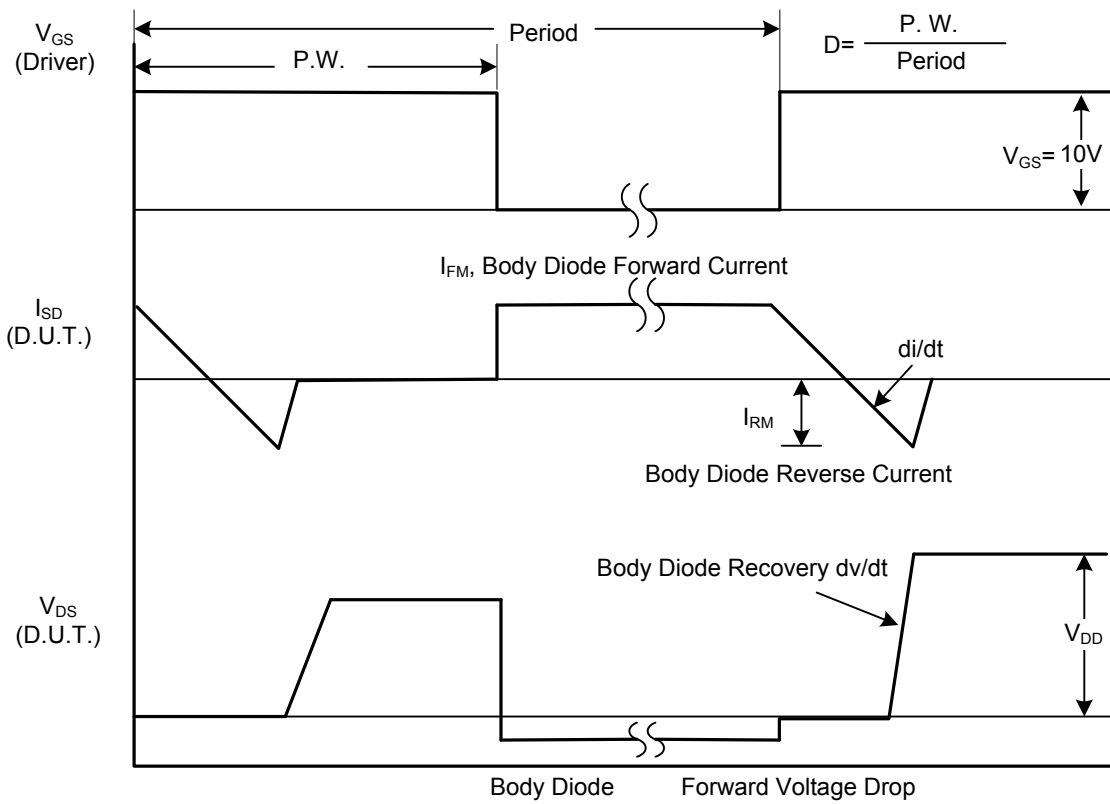
2. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .

3. Essentially Independent of Operating Temperature.

■ TEST CIRCUITS AND WAVEFORMS

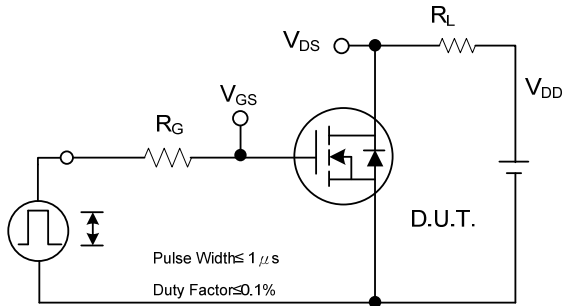


Peak Diode Recovery dv/dt Test Circuit

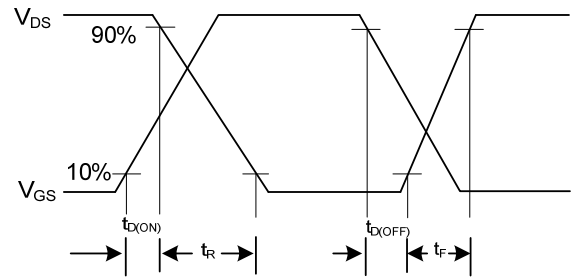


Peak Diode Recovery dv/dt Waveforms

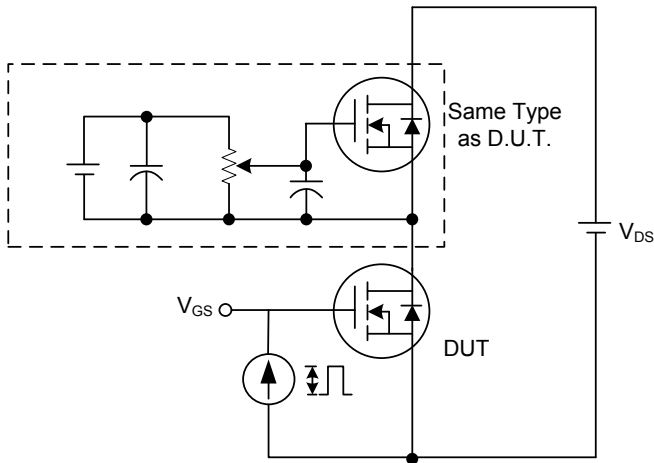
## ■ TEST CIRCUITS AND WAVEFORMS



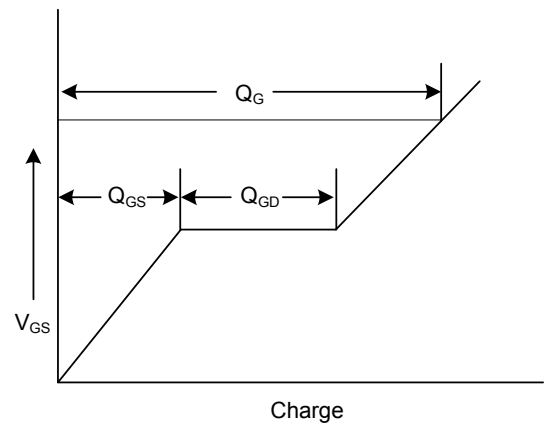
Switching Test Circuit



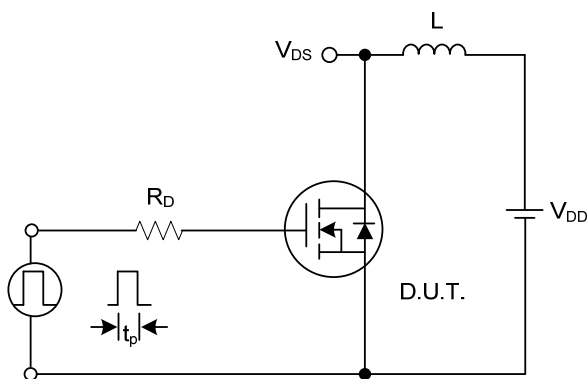
Switching Waveforms



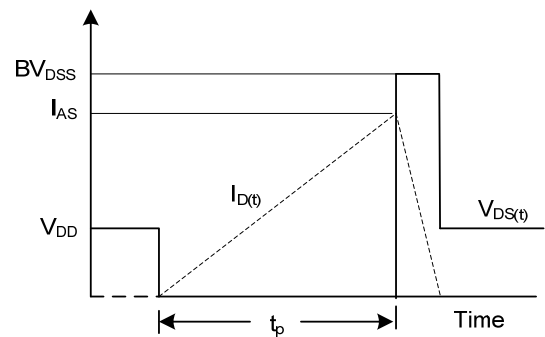
Gate Charge Test Circuit



Gate Charge Waveform

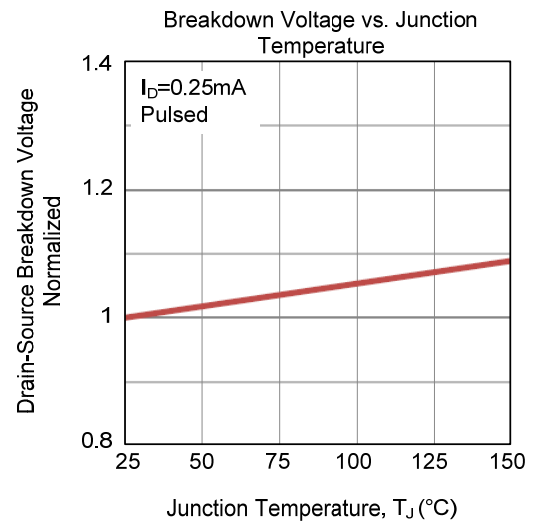
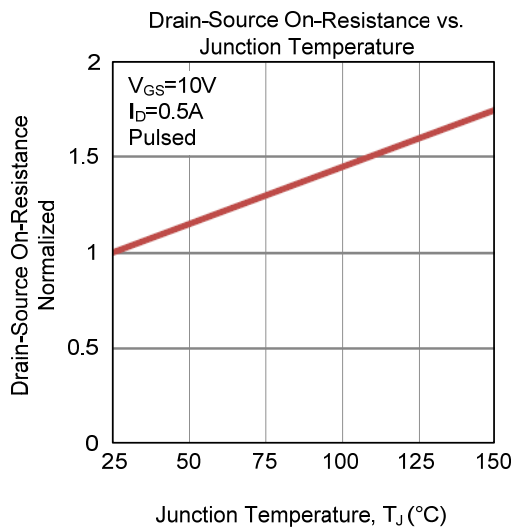
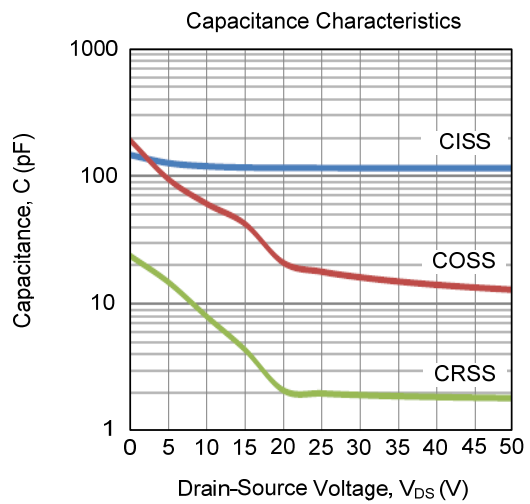
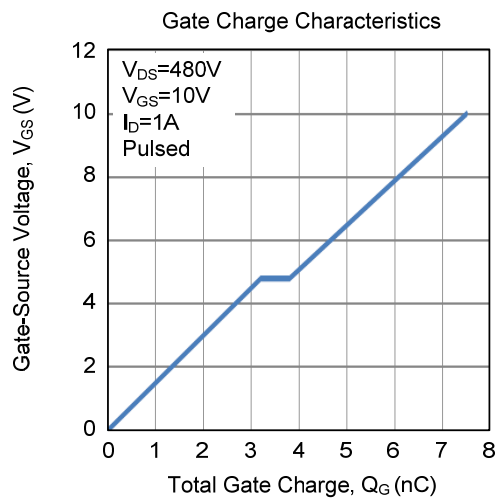
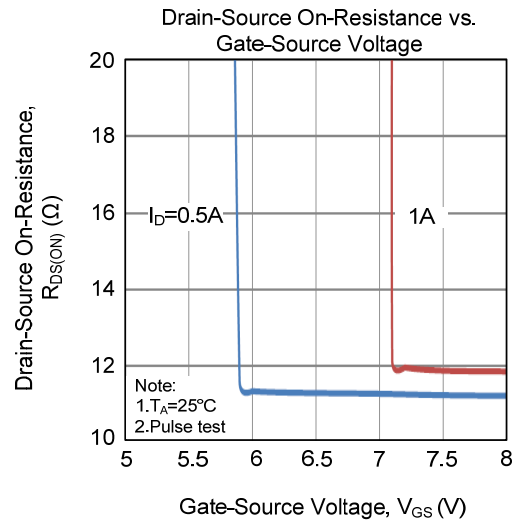
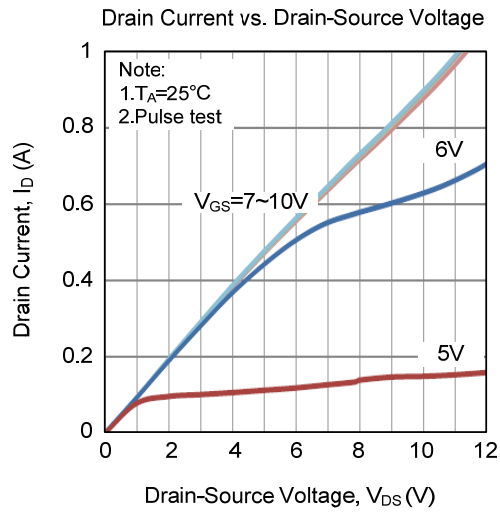


Unclamped Inductive Switching Test Circuit

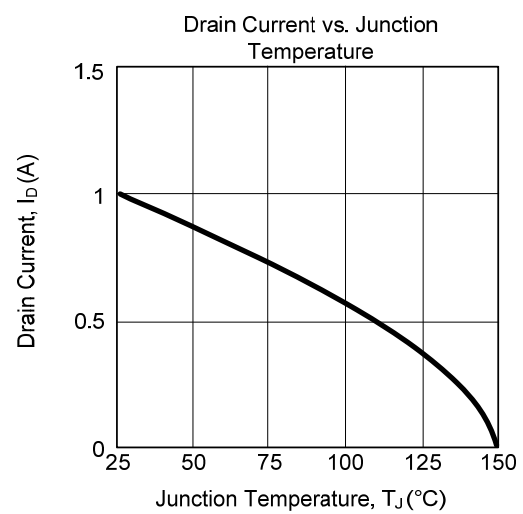
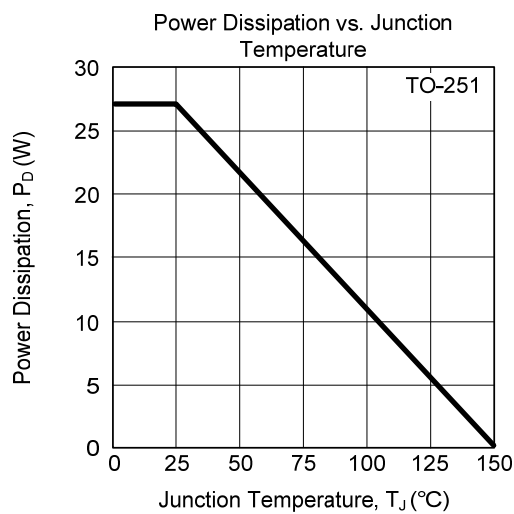
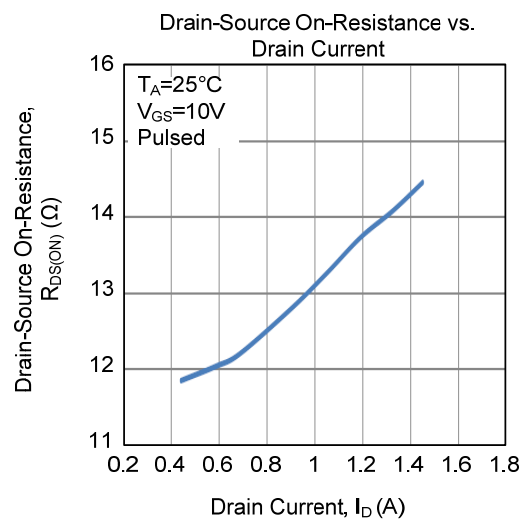
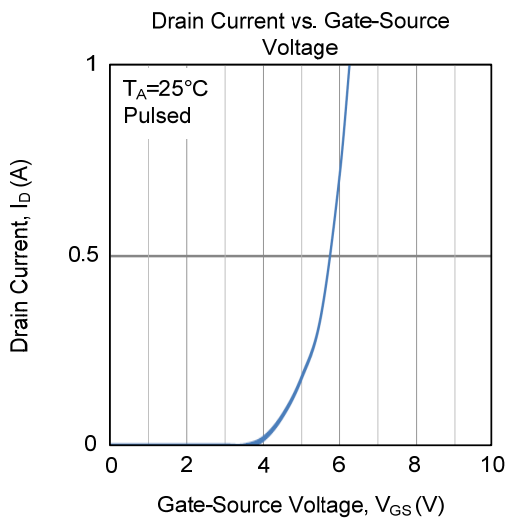
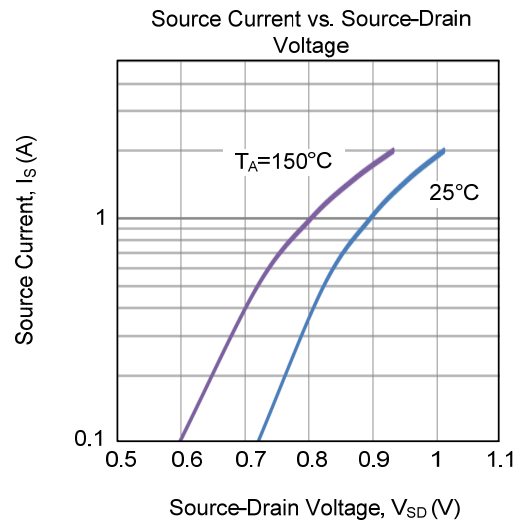
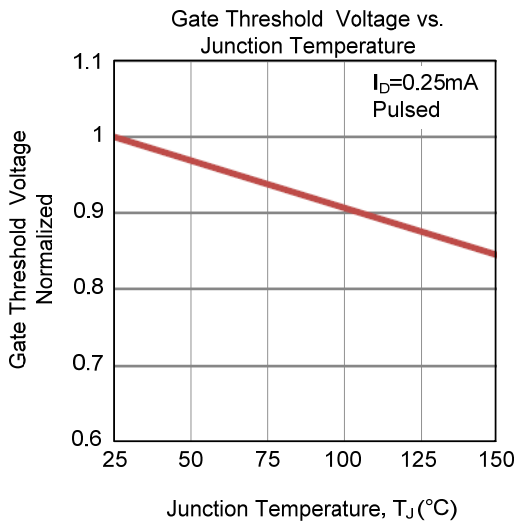


Unclamped Inductive Switching Waveforms

## TYPICAL CHARACTERISTICS

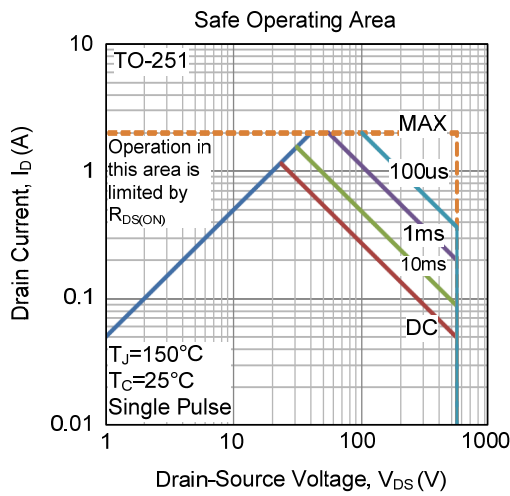


## ■ TYPICAL CHARACTERISTICS (Cont.)





■ **TYPICAL CHARACTERISTICS (Cont.)**



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