



## 1N60A

Power MOSFET

### 0.5A, 600V N-CHANNEL POWER MOSFET

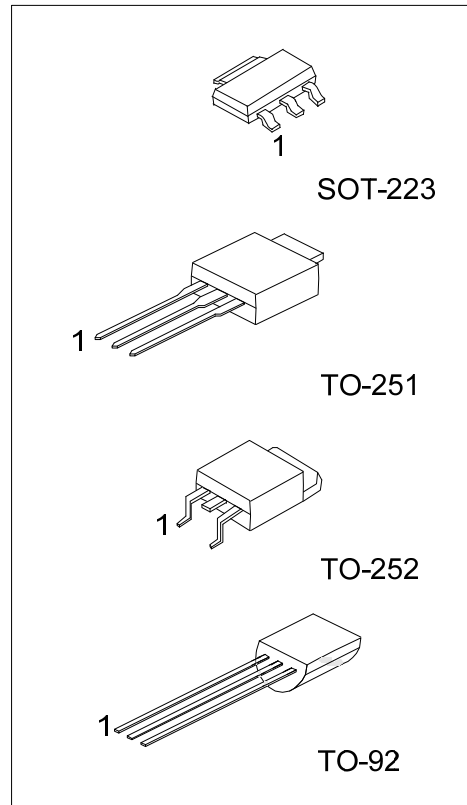
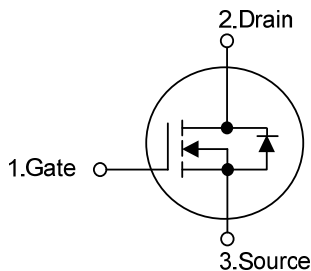
#### DESCRIPTION

The UTC **1N60A** 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 DC to DC converters and bridge circuits.

#### FEATURES

- \*  $R_{DS(ON)} < 15\Omega @ V_{GS} = 10V$ .
- \* Ultra Low gate charge (typical 8.0nC)
- \* Low reverse transfer capacitance ( $C_{RSS} = 3.0\text{ pF(max)}$ )
- \* Fast switching capability
- \* Avalanche energy specified
- \* Improved dv/dt capability, high ruggedness

#### SYMBOL



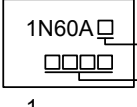
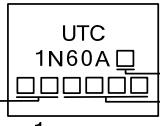
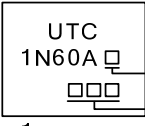
#### ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
1N60AL-AA3-R	1N60AG-AA3-R	SOT-223	G	D	S	Tape Reel
1N60AL-TM3-T	1N60AG-TM3-T	TO-251	G	D	S	Tube
1N60AL-TN3-R	1N60AG-TN3-R	TO-252	G	D	S	Tape Reel
1N60AL-T92-B	1N60AG-T92-B	TO-92	G	D	S	Tape Box
1N60AL-T92-K	1N60AG-T92-K	TO-92	G	D	S	Bulk

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

<p>1N60AL-AA3-R</p> <p>(1)Packing Type (2)Package Type (3)Lead Free</p>	<p>(1) B: Tape Box, K: Bulk, R: Tape Reel, T: Tube (2) AA3: SOT-223, TM3: TO-251, TN3: TO-252 T92: TO-92 (3) L: Lead Free, G: Halogen Free</p>
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■ MARKING INFORMATION

PACKAGE	MARKING
SOT-223	 <p>1N60A □ □□□□ 1</p> <p>L: Lead Free G: Halogen Free Data Code</p>
TO-251 TO-252	 <p>UTC 1N60A □ □□□□□□ 1</p> <p>Lot Code ← Data Code</p> <p>L: Lead Free G: Halogen Free Data Code</p>
TO-92	 <p>UTC 1N60A □ □□□ 1</p> <p>L: Lead Free P: 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
Continuous Drain Current		$I_D$	0.5	A
Pulsed Drain Current (Note 2)		$I_{DM}$	2	A
Avalanche Energy	Single Pulse(Note 3)	$E_{AS}$	50	mJ
	Repetitive(Note 2)	$E_{AR}$	3.6	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns
Power Dissipation ( $T_C=25^\circ\text{C}$ )	SOT-223	$P_D$	6.25	W
	TO-251/TO-252		34	
	TO-92		3	
Derate above $25^\circ\text{C}$	SOT-223		0.05	$\text{W}/^\circ\text{C}$
	TO-251/TO-252		0.27	
	TO-92		0.025	
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 maximum junction temperature  
 3.  $L=92\text{mH}$ ,  $I_{AS}=0.8\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $R_G=0\Omega$ , Starting  $T_J=25^\circ\text{C}$   
 4.  $I_{SD}\leq 1.0\text{A}$ ,  $di/dt\leq 100\text{A}/\mu\text{s}$ ,  $V_{DD}\leq BV_{DSS}$ , Starting  $T_J=25^\circ\text{C}$

■ THERMAL DATA

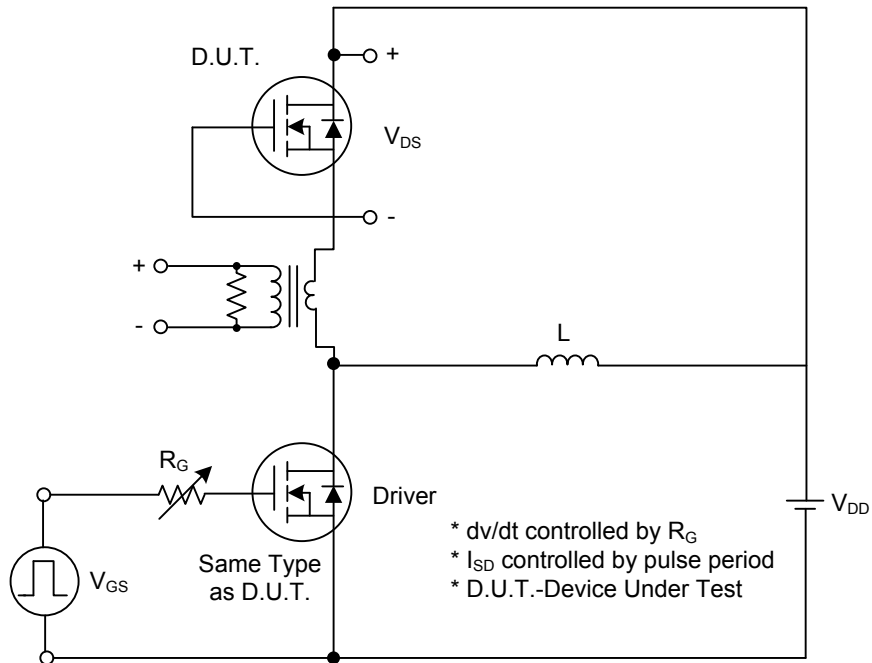
PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	SOT-223	$\theta_{JA}$	150	$^\circ\text{C}/\text{W}$
	TO-251/TO-252		110	
	TO-92		160	
Junction to Case	SOT-223	$\theta_{JC}$	20	$^\circ\text{C}/\text{W}$
	TO-251/TO-252		5	
	TO-92		80	

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

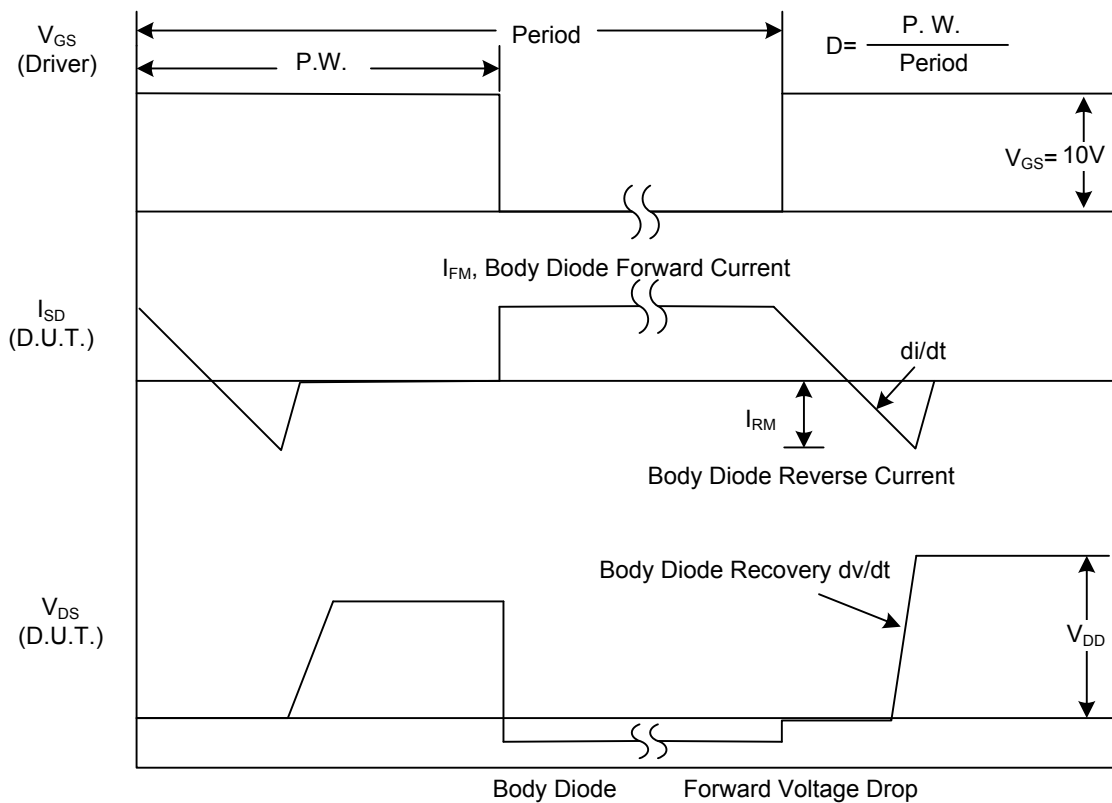
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	600			V
Drain-Source Leakage Current ( $T_J=25^\circ\text{C}$ )	$I_{DSS}$	$V_{DS} = 600V, V_{GS} = 0V$			10	$\mu A$
Drain-Source Leakage Current ( $T_J=125^\circ\text{C}$ )					10	
Gate-Source Leakage Current	Forward	$V_{GS} = 30V, V_{DS} = 0V$			100	nA
	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		4.5	V
Static Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS} = 10V, I_D = 0.5A$		11	15	$\Omega$
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	$C_{ISS}$	$V_{DS}=25V, V_{GS}=0V, f=1\text{MHz}$			100	pF
Output Capacitance	$C_{OSS}$				20	pF
Reverse Transfer Capacitance	$C_{RSS}$				3	pF
<b>SWITCHING CHARACTERISTICS</b>						
Turn-On Delay Time	$t_{D(ON)}$	$V_{DD}=300V, I_D=0.5A, R_G=5\Omega$ (Note 1,2)		12	34	ns
Turn-On Rise Time	$t_R$			11	32	ns
Turn-Off Delay Time	$t_{D(OFF)}$			40	90	ns
Turn-Off Fall Time	$t_F$			18	46	ns
Total Gate Charge	$Q_G$	$V_{DS}=480V, V_{GS}=10V, I_D=0.8A$ (Note 1,2)		8	10	nC
Gate-Source Charge	$Q_{GS}$			1.8		nC
Gate-Drain Charge	$Q_{GD}$			4.0		nC
<b>SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS</b>						
Drain-Source Diode Forward Voltage	$V_{SD}$	$V_{GS}=0V, I_{SD} = 1.2A$			1.6	V
Maximum Continuous Drain-Source Diode Forward Current	$I_S$				1.2	A
Maximum Pulsed Drain-Source Diode Forward Current	$I_{SM}$				4.8	A
Reverse Recovery Time	$t_{RR}$	$V_{GS}=0V, I_{SD} = 1.2A$		136		ns
Reverse Recovery Charge	$Q_{RR}$	$di/dt = 100A/\mu s$		0.3		$\mu C$

Notes: 1. Pulse Test: Pulse Width $\leq 300\mu s$ , Duty Cycle $\leq 2\%$   
2. Essentially independent of operating temperature.

## TEST CIRCUITS AND WAVEFORMS

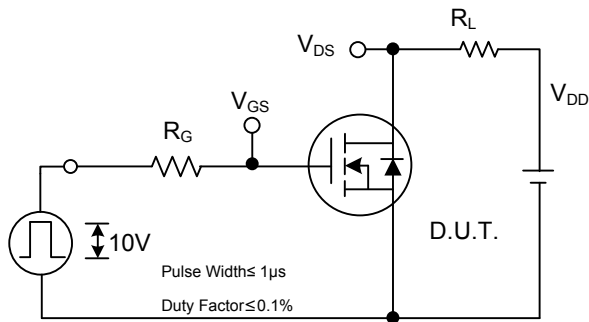


**Peak Diode Recovery  $dv/dt$  Test Circuit**

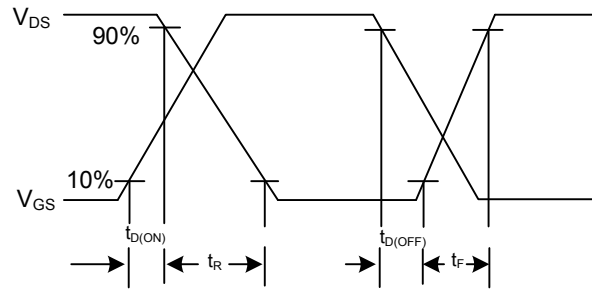


**Peak Diode Recovery  $dv/dt$  Waveforms**

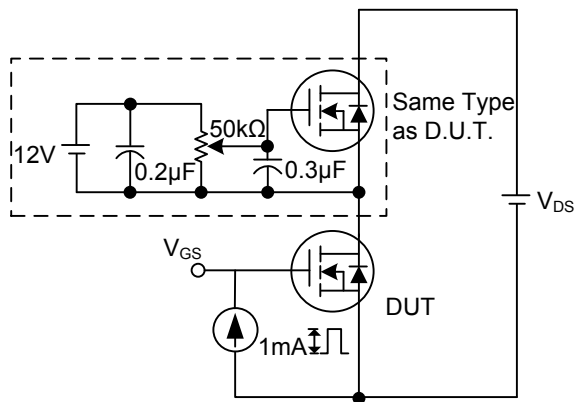
## ■ TEST CIRCUITS AND WAVEFORMS (Cont.)



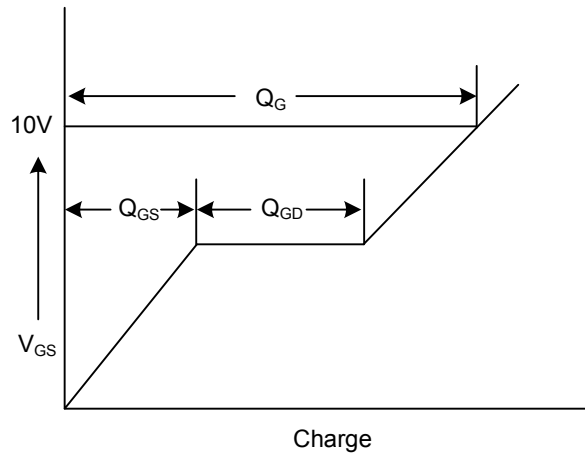
**Switching Test Circuit**



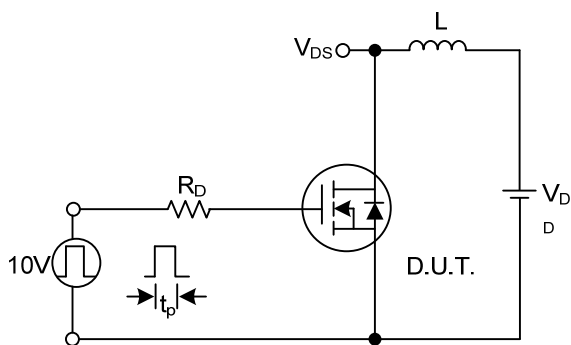
**Switching Waveforms**



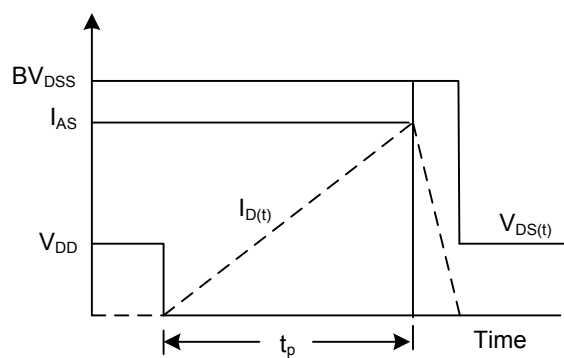
**Gate Charge Test Circuit**



**Gate Charge Waveform**

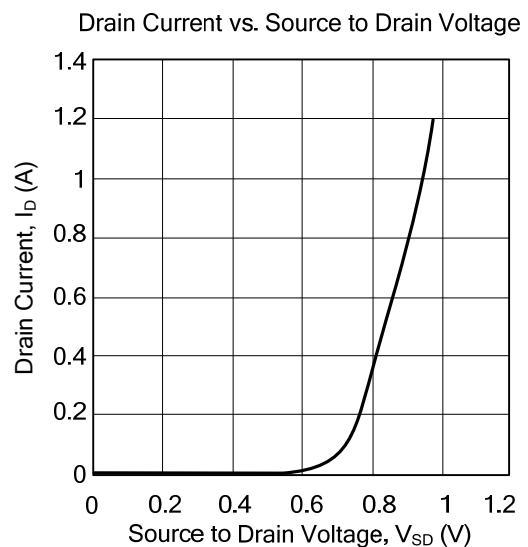
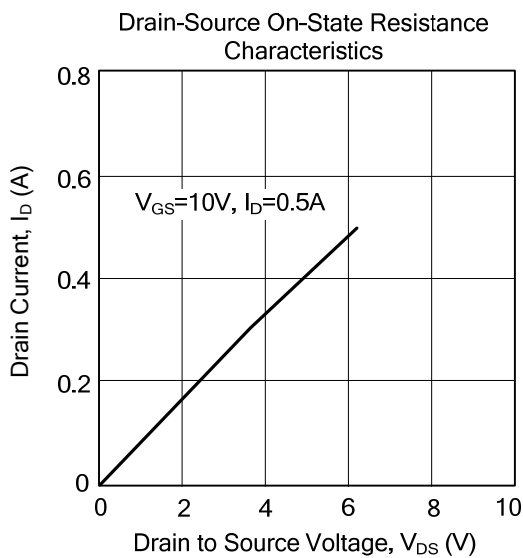
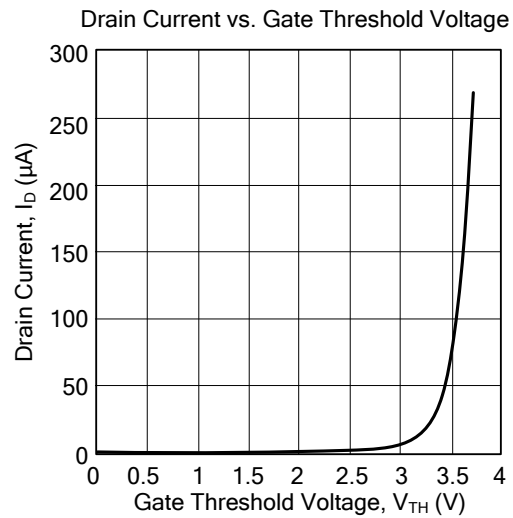
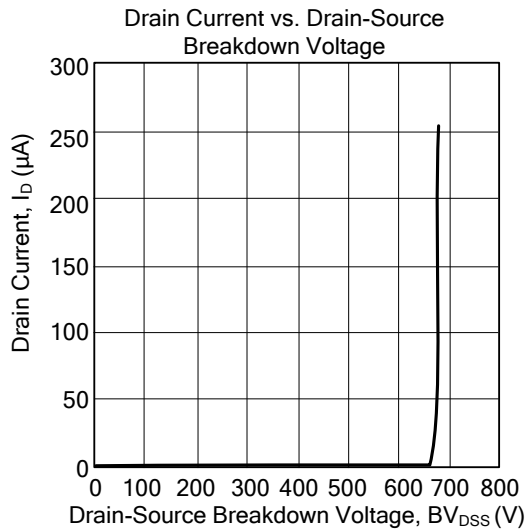


**Unclamped Inductive Switching Test Circuit**



**Unclamped Inductive Switching Waveforms**

### TYPICAL CHARACTERISTICS



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