



# 1N60Z

*Power MOSFET*

## 1.2A, 600V N-CHANNEL POWER MOSFET

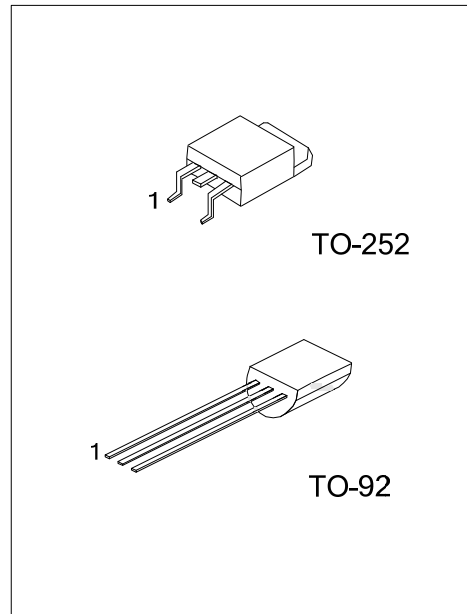
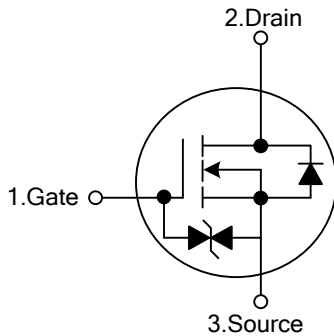
### DESCRIPTION

The UTC **1N60Z** 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 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

- \*  $R_{DS(ON)} = 11.5\Omega @ V_{GS} = 10V$ .
- \* Ultra Low gate charge (typical 5.0nC)
- \* Low reverse transfer capacitance ( $C_{RSS} = \text{typical } 3.0 \text{ pF}$ )
- \* 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	
1N60ZL-T92-B	1N60ZG-T92-B	TO-92	G	D	S	Tape Box
1N60ZL-T92-K	1N60ZG-T92-K	TO-92	G	D	S	Bulk
1N60ZL-T92-R	1N60ZG-T92-R	TO-92	G	D	S	Tape Reel
1N60ZL-TN3-R	1N60ZG-TN3-R	TO-252	G	D	S	Tape Reel
1N60ZL-TN3-T	1N60ZG-TN3-T	TO-252	G	D	S	Tube

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

<p>1N60ZL-T92-B</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) T92: TO-92, TN3: TO-252 (3) G: Halogen Free, L: Lead Free</p>
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■ 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	$V_{GSS}$	$\pm 20$	V
Avalanche Current (Note 2)	$I_{AR}$	1.2	A
Continuous Drain Current	$I_D$	1.2	A
Pulsed Drain Current (Note 2)	$I_{DM}$	4.8	A
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	50
	Repetitive (Note 2)	$E_{AR}$	4.0
Peak Diode Recovery dv/dt (Note 4)	dv/dt	4.5	V/ns
Power Dissipation ( $T_A=25^\circ\text{C}$ )	TO-92	$P_D$	1
	TO-252		1.5
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.  $L = 60\text{mH}$ ,  $I_{AS} = 1\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$

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

■ THERMAL DATA

PARAMETER	SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-92	$\theta_{JA}$	140
	TO-252		100

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

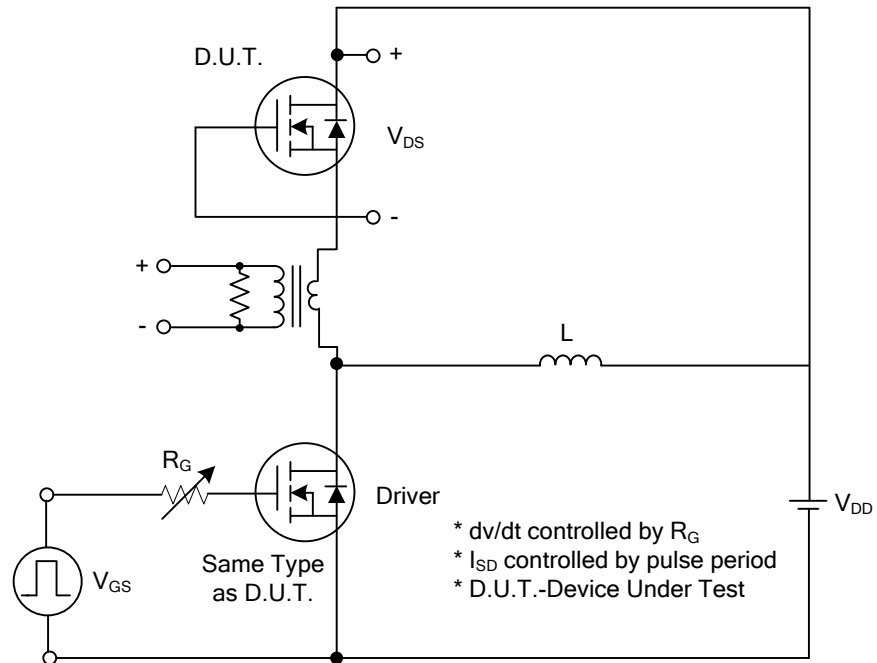
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0\text{V}$ , $I_D=250\mu\text{A}$	600			V
Drain-Source Leakage Current	$I_{DSS}$	$V_{DS}=600\text{V}$ , $V_{GS}=0\text{V}$			10	$\mu\text{A}$
Gate-Source Leakage Current	$I_{GSS}$	Forward			+5	$\mu\text{A}$
		Reverse			-5	$\mu\text{A}$
Breakdown Voltage Temperature Coefficient	$\Delta BV_{DSS}/\Delta T_J$	$I_D=250\mu\text{A}$		0.4		$\text{V}/^\circ\text{C}$
<b>ON CHARACTERISTICS</b>						
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	$R_{DS(ON)}$	$V_{GS}=10\text{V}$ , $I_D=0.6\text{A}$		9.3	11.5	$\Omega$
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	$C_{ISS}$	$V_{DS}=25\text{V}$ , $V_{GS}=0\text{V}$ , $f=1\text{MHz}$		120	150	pF
Output Capacitance	$C_{OSS}$			20	25	pF
Reverse Transfer Capacitance	$C_{RSS}$			3.0	4.0	pF
<b>SWITCHING CHARACTERISTICS</b>						
Turn-On Delay Time	$t_{D(ON)}$	$V_{DD}=300\text{V}$ , $I_D=1.2\text{A}$ , $R_G=50\Omega$ (Note 2,3)		5	20	ns
Turn-On Rise Time	$t_R$			25	60	ns
Turn-Off Delay Time	$t_{D(OFF)}$			7	25	ns
Turn-Off Fall Time	$t_F$			25	60	ns
Total Gate Charge	$Q_G$	$V_{DS}=480\text{V}$ , $V_{GS}=10\text{V}$ , $I_D=1.2\text{A}$ (Note 2,3)		5.0	6.0	nC
Gate-Source Charge	$Q_{GS}$			1.0		nC
Gate-Drain Charge	$Q_{GD}$			2.6		nC

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

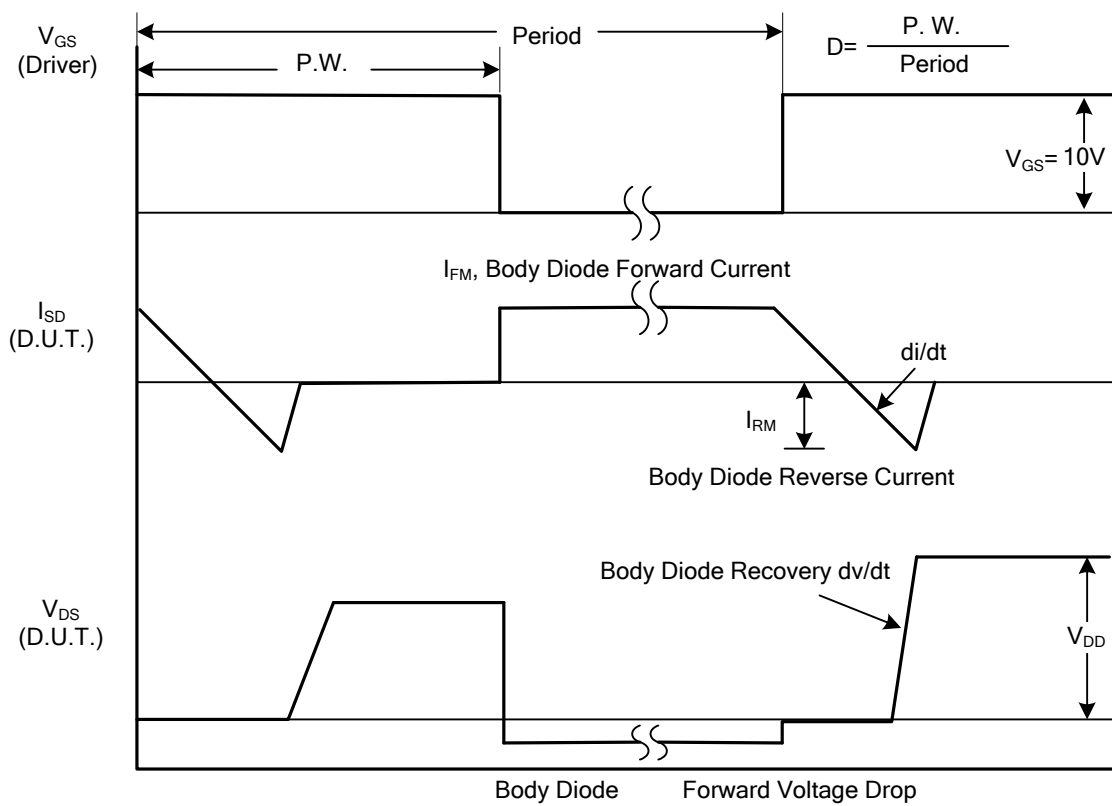
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS</b>						
Drain-Source Diode Forward Voltage	$V_{SD}$	$V_{GS}=0V, I_S=1.2A$			1.4	V
Maximum Continuous Drain-Source Diode Forward Current	$I_S$				1.2	A
Maximum Pulsed Drain-Source Diode Forward Current	$I_{SM}$				4.8	A
Reverse Recovery Time	$t_{rr}$	$V_{GS}=0V, I_S=1.2A$		160		ns
Reverse Recovery Charge	$Q_{RR}$	$dI_F/dt=100A/\mu s$ (Note 1)		0.3		$\mu C$

- Note:
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

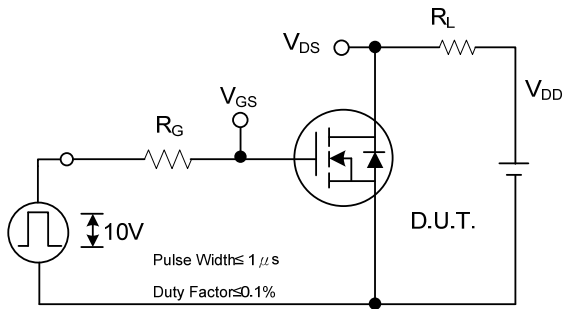


Peak Diode Recovery dv/dt Test Circuit

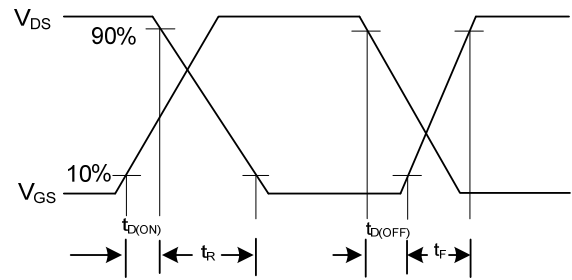


Peak Diode Recovery dv/dt Waveforms

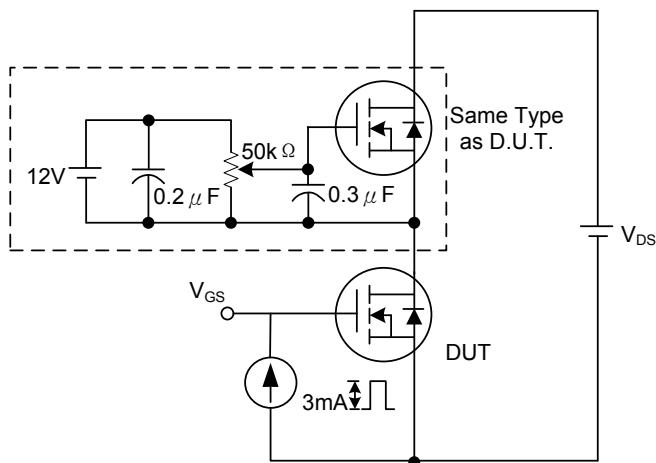
### TEST CIRCUITS AND WAVEFORMS (Cont.)



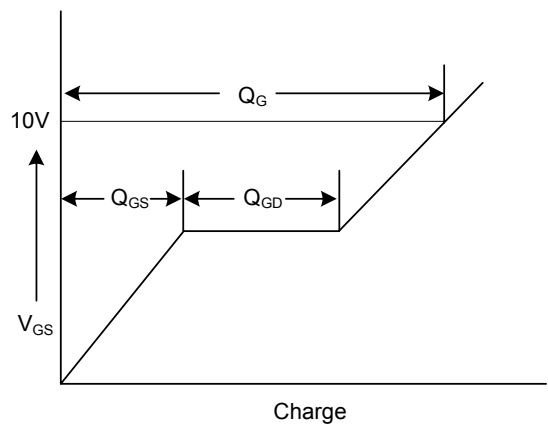
Switching Test Circuit



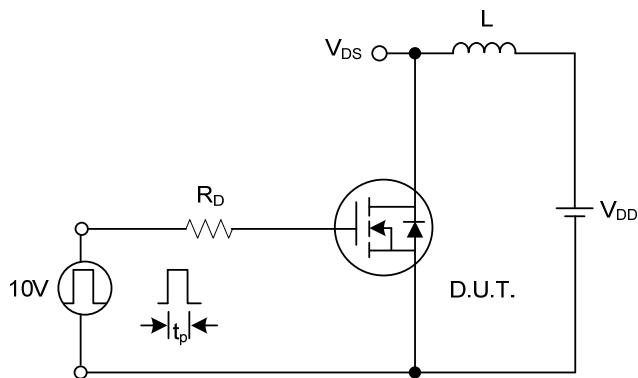
Switching Waveforms



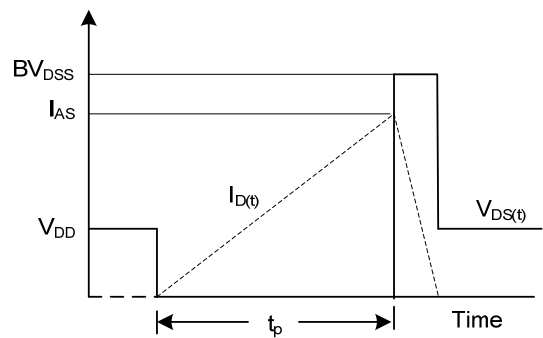
Gate Charge Test Circuit



Gate Charge Waveform

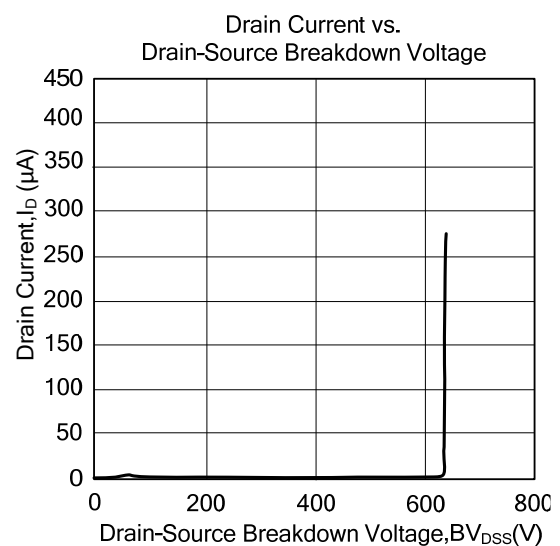
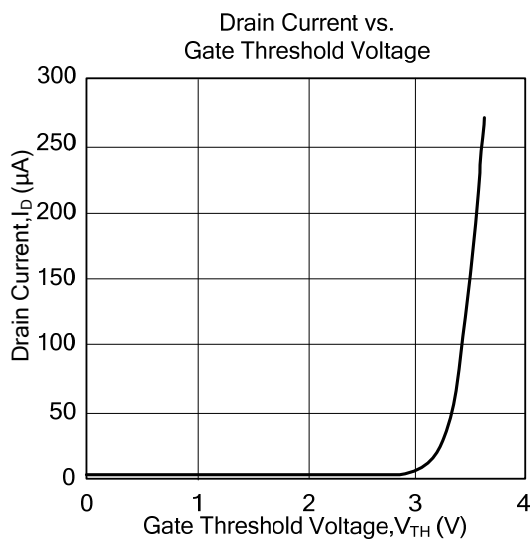
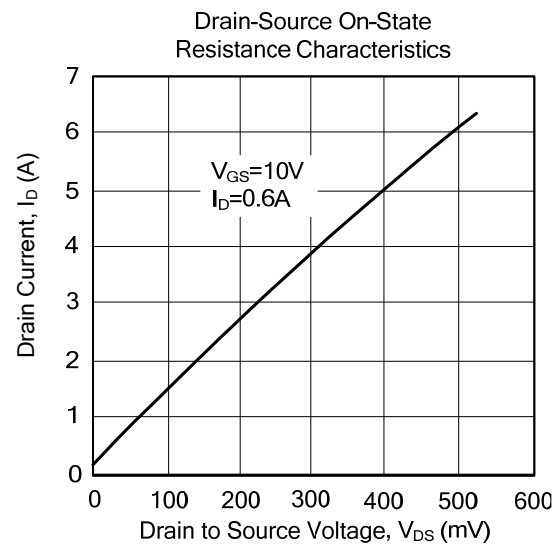
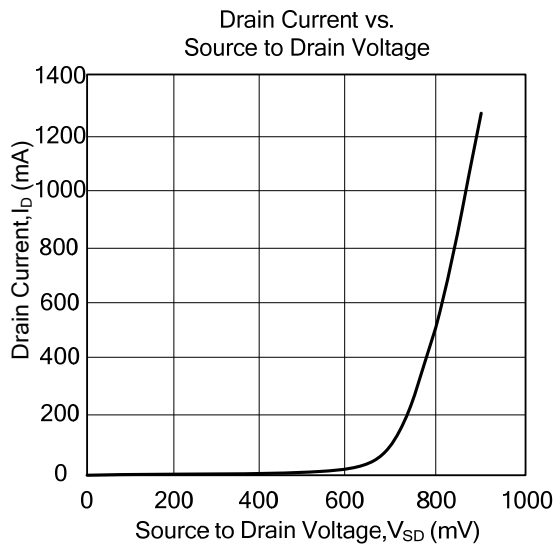


Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

### TYPICAL CHARACTERISTICS



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