



## 2N60

## Power MOSFET

### 2 Amps, 600/650 Volts N-CHANNEL POWER MOSFET

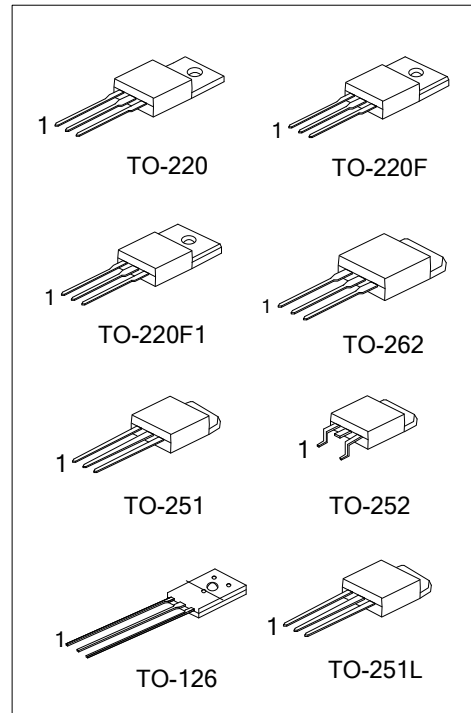
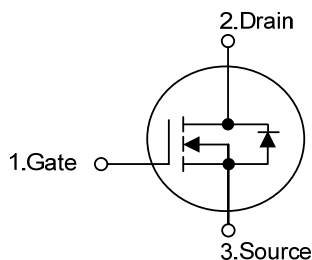
#### DESCRIPTION

The UTC **2N60** 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

- \*  $R_{DS(ON)} = 5\Omega @ V_{GS} = 10V$
- \* Ultra Low gate charge (typical 9.0nC)
- \* Low reverse transfer capacitance ( $C_{RSS} =$  typical 5.0 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	
2N60L-x-TA3-T	2N60G-x-TA3-T	TO-220	G	D	S	Tube
2N60L-x-TF1-T	2N60G-x-TF1-T	TO-220F1	G	D	S	Tube
2N60L-x-TF3-T	2N60G-x-TF3-T	TO-220F	G	D	S	Tube
2N60L-x-TM3-T	2N60G-x-TM3-T	TO-251	G	D	S	Tube
2N60L-x-TMA-T	2N60G-x-TMA-T	TO-251L	G	D	S	Tube
2N60L-x-TN3-R	2N60G-x-TN3-R	TO-252	G	D	S	Tape Reel
2N60L-x-T2Q-T	2N60G-x-T2Q-T	TO-262	G	D	S	Tube
2N60L-x-T60-K	2N60G-x-T60-K	TO-126	G	D	S	Bulk

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

<p>2N60L-x-TA3-T</p>	<p>(1) T: Tube, R: Tape Reel, K: Bulk  (2) TA3: TO-220, TF1: TO-220F1, TF3: TO-220F  TM3: TO-251, TMA: TO-251L, TN3: TO-252,  T2Q: TO-262, T60: TO-126  (3) A: 600V, B: 650V  (4) 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	2N60-A	$V_{DSS}$	600	V
	2N60-B		650	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	A
	Pulsed (Note 2)	$I_{DM}$	8.0	A
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	140	mJ
	Repetitive (Note 2)	$E_{AR}$	4.5	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns
Power Dissipation	TO-220	$P_D$ ( $T_C = 25^\circ\text{C}$ )	54	W
	TO-220F/TO-220F1		23	W
	TO-251/TO-251L/TO-252		44	W
	TO-262		54	W
	TO-126		40	W
Junction Temperature		$T_J$	+150	$^\circ\text{C}$
Ambient 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	$\theta_{JA}$	62.5	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1		62.5	$^\circ\text{C}/\text{W}$
	TO-251/TO-251L/TO-252		100	$^\circ\text{C}/\text{W}$
	TO-262		62.5	$^\circ\text{C}/\text{W}$
	TO-126		89	$^\circ\text{C}/\text{W}$
Junction to Case	TO-220	$\theta_{Jc}$	2.32	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1		5.5	$^\circ\text{C}/\text{W}$
	TO-251/TO-251L/TO-252		2.87	$^\circ\text{C}/\text{W}$
	TO-262		2.32	$^\circ\text{C}/\text{W}$
	TO-126		3.12	$^\circ\text{C}/\text{W}$

■ 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	2N60-A	$V_{GS} = 0\text{V}, I_D = 250\mu\text{A}$	600			V
	2N60-B		650			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	Forward	$V_{GS} = 30\text{V}, V_{DS} = 0\text{V}$ $V_{GS} = -30\text{V}, V_{DS} = 0\text{V}$			100	nA
	Reverse				-100	nA
Breakdown Voltage Temperature Coefficient	$\Delta BV_{DSS}/\Delta T_J$	$I_D = 250\mu\text{A}$ , Referenced to $25^\circ\text{C}$		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	$R_{DS(ON)}$	$V_{GS} = 10\text{V}, I_D = 1\text{A}$		3.8	5	$\Omega$
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	$C_{ISS}$	$V_{DS} = 25\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		270	350	pF
Output Capacitance	$C_{OSS}$			40	50	pF
Reverse Transfer Capacitance	$C_{RSS}$			5	7	pF
<b>SWITCHING CHARACTERISTICS</b>						
Turn-On Delay Time	$t_{D(ON)}$	$V_{DD} = 300\text{V}, I_D = 2.4\text{A},$ $R_G = 25\Omega$ (Note 1, 2)		10	30	ns
Turn-On Rise Time	$t_R$			25	60	ns
Turn-Off Delay Time	$t_{D(OFF)}$			20	50	ns
Turn-Off Fall Time	$t_F$			25	60	ns
Total Gate Charge	$Q_G$	$V_{DS} = 480\text{V}, V_{GS} = 10\text{V},$ $I_D = 2.4\text{A}$ (Note 1, 2)		9.0	11	nC
Gate-Source Charge	$Q_{GS}$			1.6		nC
Gate-Drain Charge	$Q_{GD}$			4.3		nC
<b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>						
Drain-Source Diode Forward Voltage	$V_{SD}$	$V_{GS} = 0\text{V}, I_{SD} = 2.0\text{A}$			1.4	V
Continuous Drain-Source Current	$I_{SD}$				2.0	A
Pulsed Drain-Source Current	$I_{SM}$				8.0	A
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{V}, I_{SD} = 2.4\text{A},$ $di/dt = 100\text{A}/\mu\text{s}$ (Note1)		180		ns
Reverse Recovery Charge	$Q_{RR}$			0.72		$\mu\text{C}$

Notes: 1. Pulse Test: Pulse width  $\leq 300\mu\text{s}$ , Duty cycle  $\leq 2\%$   
2. Essentially independent of operating temperature

■ TEST CIRCUITS AND WAVEFORMS

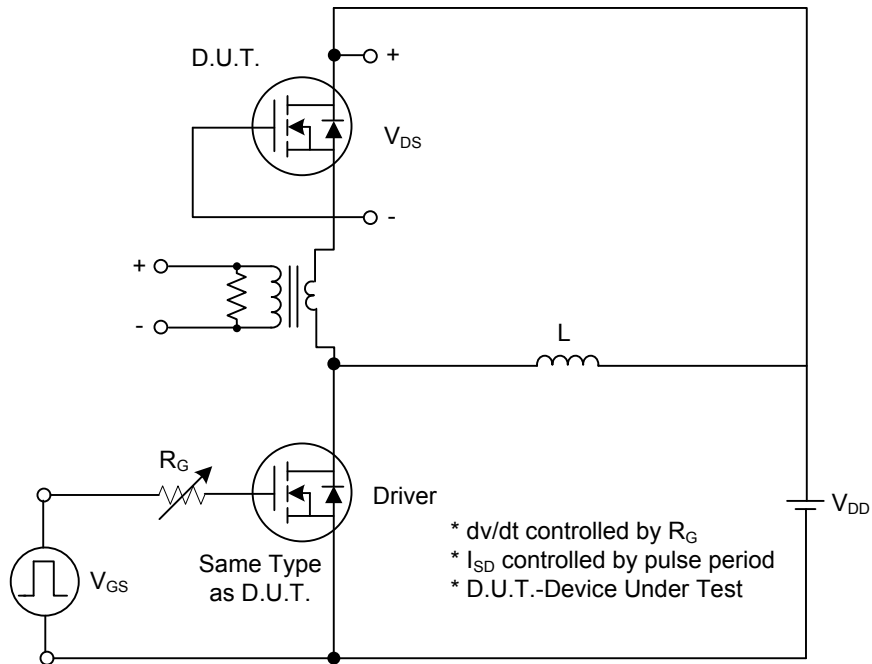


Fig. 1A Peak Diode Recovery dv/dt Test Circuit

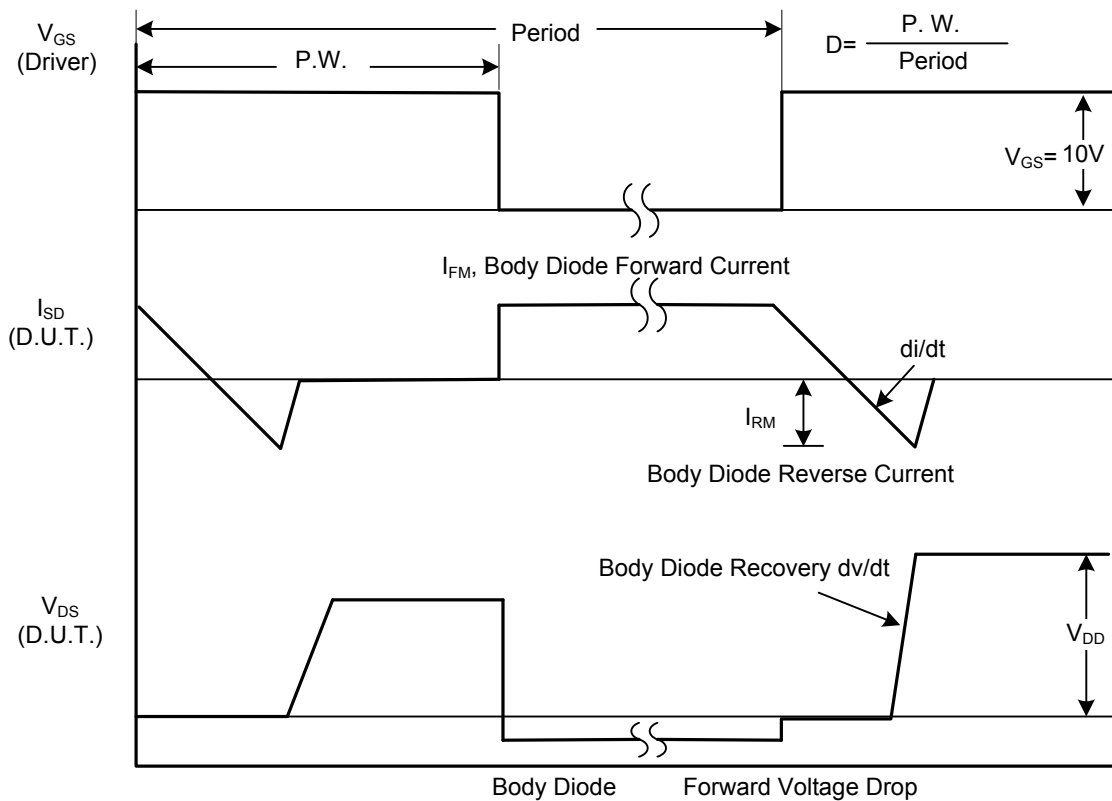


Fig. 1B Peak Diode Recovery dv/dt Waveforms

■ TEST CIRCUITS AND WAVEFORMS (Cont.)

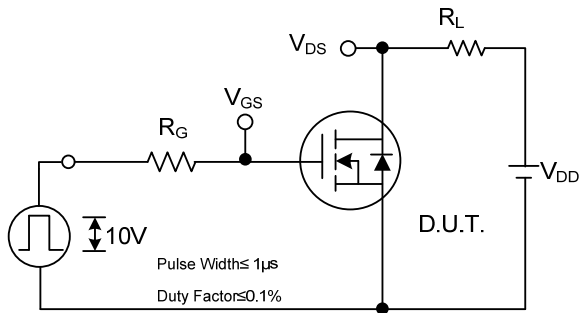


Fig. 2A Switching Test Circuit

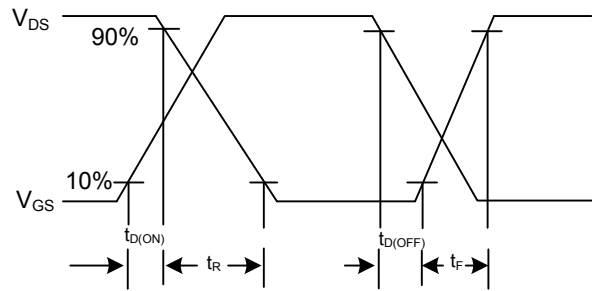


Fig. 2B Switching Waveforms

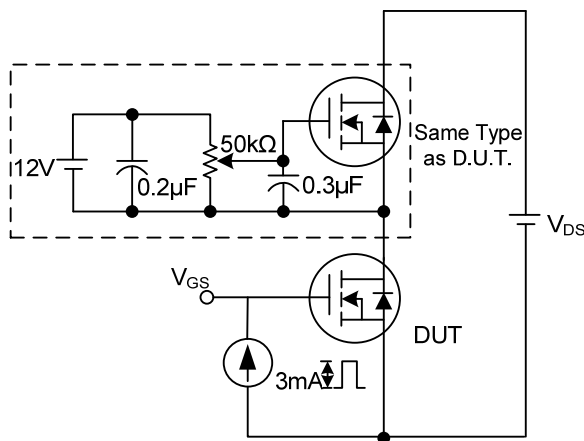


Fig. 3A Gate Charge Test Circuit

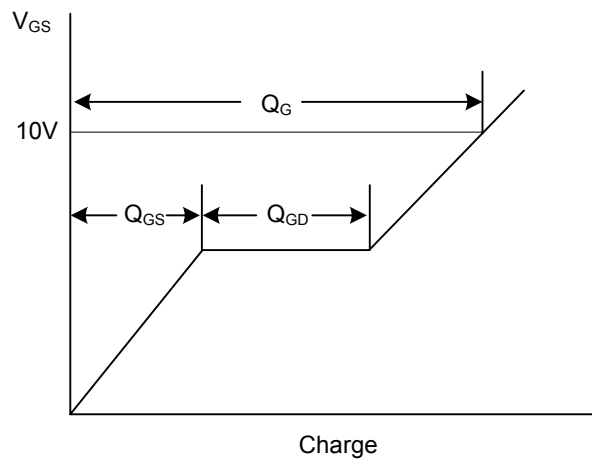


Fig. 3B Gate Charge Waveform

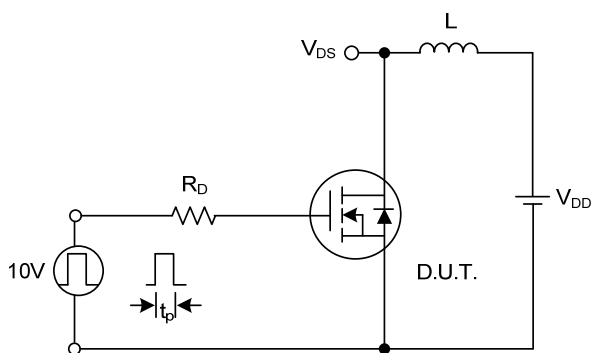


Fig. 4A Unclamped Inductive Switching Test Circuit

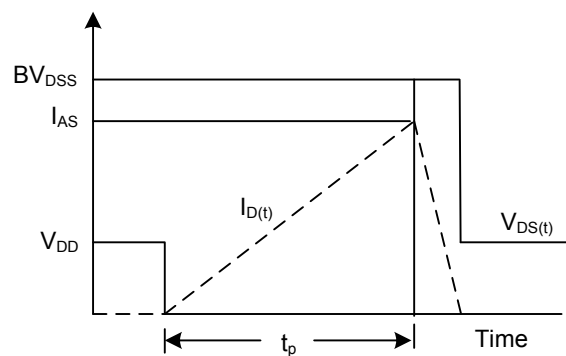


Fig. 4B Unclamped Inductive Switching Waveforms

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