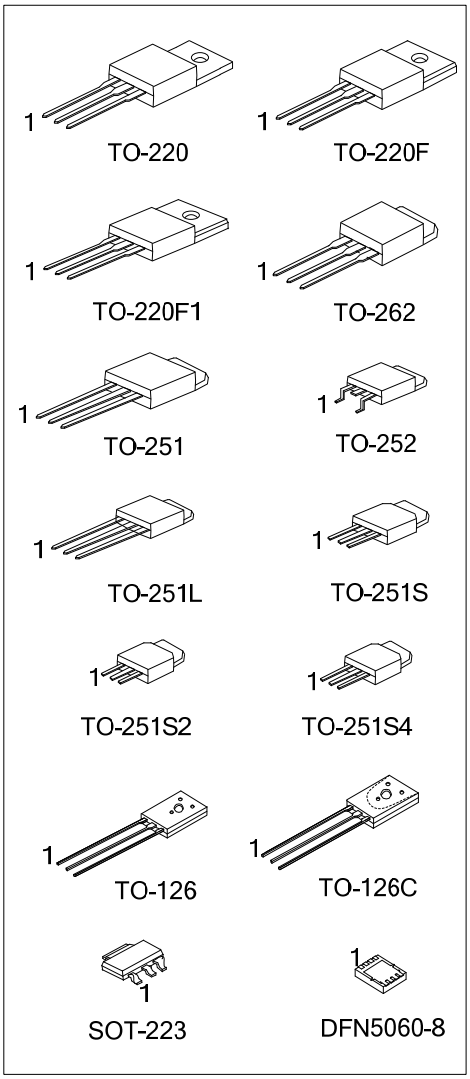
2N60-E

Power MOSFET

2A, 600V N-CHANNEL POWER MOSFET



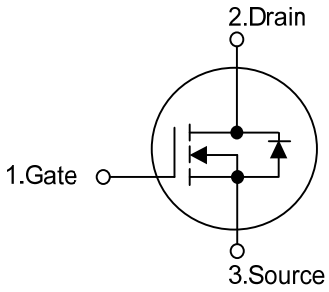
■ DESCRIPTION

The UTC **2N60-E** 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 DC to DC converters and bridge circuits.

■ FEATURES

* $R_{DS(ON)}$ < 5.0Ω @ V_{GS} = 10V, I_D =1A
* Fast switching capability
* Avalanche energy specified
* Improved dv/dt capability, high ruggedness

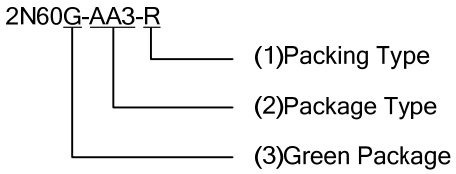
■ SYMBOL



■ ORDERING INFORMATION

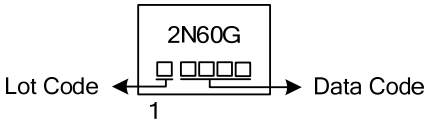
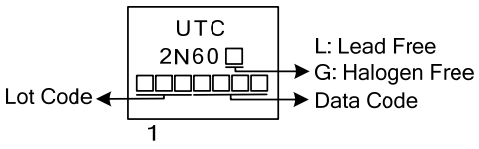
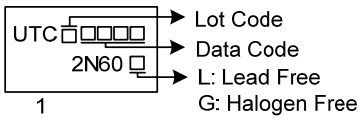
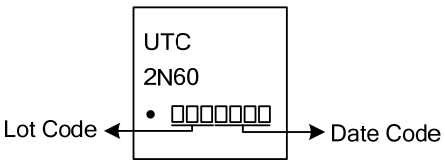
Ordering Number		Package	Pin Assignment								Packing
Lead Free	Halogen Free		1	2	3	4	5	6	7	8	
2N60L-AA3-T	2N60G-AA3-T	SOT-223	G	D	S	-	-	-	-	-	Tube
2N60L-TA3-T	2N60G-TA3-T	TO-220	G	D	S	-	-	-	-	-	Tube
2N60L-TF1-T	2N60G-TF1-T	TO-220F1	G	D	S	-	-	-	-	-	Tube
2N60L-TF3-T	2N60G-TF3-T	TO-220F	G	D	S	-	-	-	-	-	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-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-K08-5060-R	2N60G-K08-5060-R	DFN5060-8	S	S	S	G	D	D	D	D	Tape Reel

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



(1) T: Tube, R: Tape Reel, K:Bulk
(2) AA3: SOT-223, TA3: TO-220, TF1: TO-220F1, TF3: TO-220F, TM3: TO-251, TMA: TO-251L, TMS: TO-251S, TMS: TO-251S2, TMS: TO-251S4, TN3: TO-252, T2Q: TO-262, T60: TO-126, T6C:TO-126C, K08-5060: DFN5060-8
(3) G: Halogen Free and Lead Free, L: Lead Free

■ MARKING

PACKAGE		MARKING
SOT-223		
TO-220 TO-220F TO-220F1 TO-251 TO-251L	TO-251S TO-251S2 TO-251S4 TO-252 TO-262	
TO-126 TO-126C		
DFN5060-8		

■ ABSOLUTE MAXIMUM RATINGS (T_C = 25°C, unless otherwise specified)

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage		V_{DSS}	600	V
Gate-Source Voltage		V_{GSS}	±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}	100	mJ
Power Dissipation (T_C = 25°C)	SOT-223	P_D	1	W
	TO-220/ TO-262		54	W
	TO-220F/TO-220F1		23	W
	TO-251/TO-251L TO-252/TO-251S TO-251S2/TO-251S4		44	W
	TO-126/TO-126C		40	W
	DFN5060-8		22	W
Junction Temperature		T_J	+150	°C
Operating Temperature		T_{OPR}	-55 ~ +150	°C
Storage Temperature		T_{STG}	-55 ~ +150	°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=50mH, I_{AS}=2A, V_{DD}=50V, R_G=25 Ω, Starting T_J = 25°C
4. I_{SD}≤2.4A, di/dt≤200A/μs, V_{DD} ≤ BV_{DSS}, Starting T_J = 25°C

■ THERMAL DATA

PARAMETER	PACKAGE	SYMBOL	RATINGS	UNIT
Junction to Ambient	SOT-223	θ_{JA}	150	°C/W
	TO-220/ TO-262 TO-220F/TO-220F1		62.5	°C/W
	TO-251/TO-251L TO-252/TO-251S TO-251S2/TO-251S4		100	°C/W
	TO-126/TO-126C		89	°C/W
	DFN5060-8		75 (Note)	°C/W
Junction to Case	SOT-223	θ_{JC}	14	°C/W
	TO-220/ TO-262		2.32	°C/W
	TO-220F/TO-220F1		5.5	°C/W
	TO-251/TO-251L TO-252/TO-251S TO-251S2/TO-251S4		2.87	°C/W
	TO-126/TO-126C		3.12	°C/W
	DFN5060-8		5.6 (Note)	°C/W

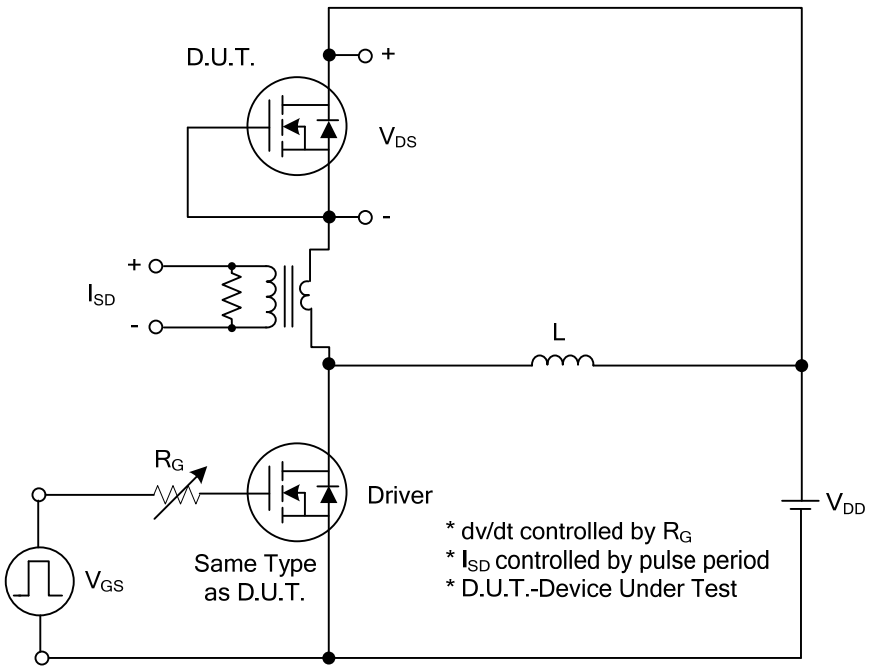
Note: Note: The data tested by surface mounted on a 1 inch^2 FR-4 board with 2OZ copper.

■ ELECTRICAL CHARACTERISTICS (T_J=25°C, unless otherwise specified)

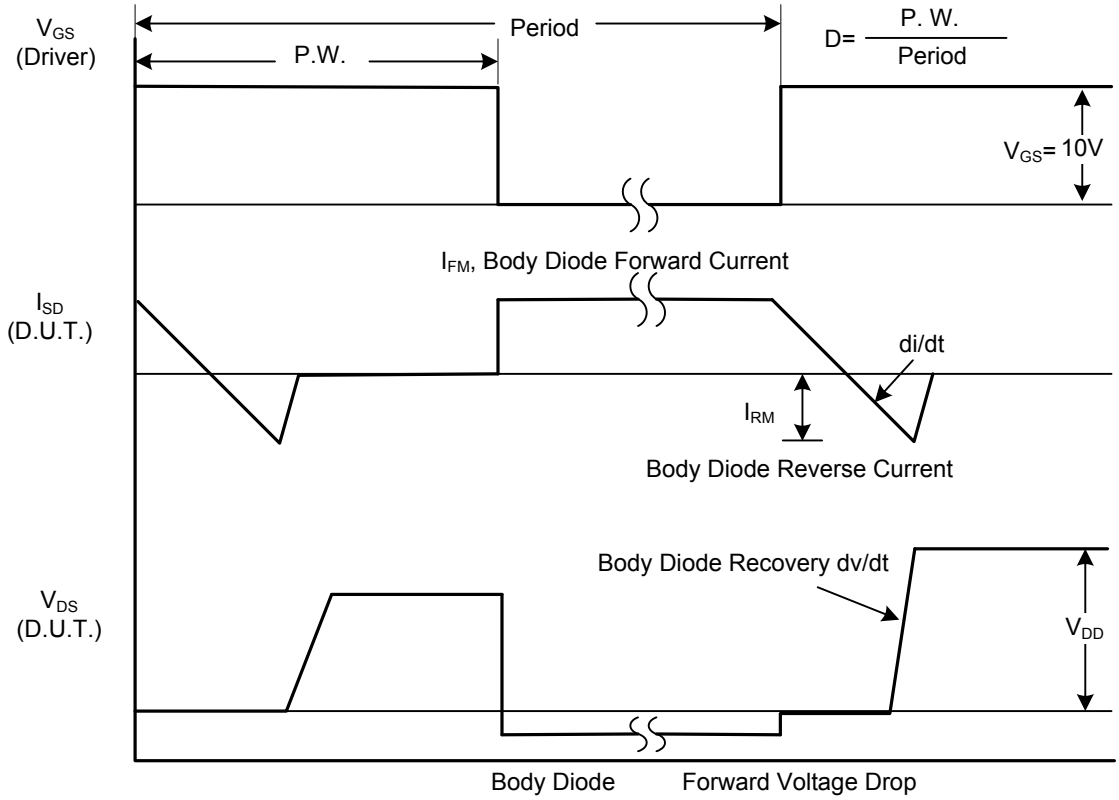
PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		BV_{DSS}	V_{GS} = 0V, I_D = 250μA	600			V
Drain-Source Leakage Current		I_{DSS}	V_{DS} = 600V, V_{GS} = 0V			10	μA
Gate-Source Leakage Current	Forward	I_{GSS}	V_{GS} = 30V, V_{DS} = 0V			100	nA
	Reverse		V_{GS} = -30V, V_{DS} = 0V			-100	nA
Breakdown Voltage Temperature Coefficient		$\triangle BV_{DSS}/\triangle T_J$	I_D=250μA, Referenced to 25°C		0.4		V/°C
ON CHARACTERISTICS							
Gate Threshold Voltage		$V_{GS(TH)}$	V_{DS} = V_{GS}, I_D = 250μA	2.0		4.0	V
Static Drain-Source On-State Resistance		$R_{DS(ON)}$	V_{GS} = 10V, I_D =1A		4.36	5.0	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C_{ISS}	V_{DS} =25V, V_{GS} =0V, f =1MHz		260	300	pF
Output Capacitance		C_{OSS}			35	40	pF
Reverse Transfer Capacitance		C_{RSS}			9	13	pF
SWITCHING CHARACTERISTICS							
Total Gate Charge		Q_G	V_{DS}=100V, V_{GS}=10V, I_D=2.4A (Note 1, 2)		35	50	nC
Gate-Source Charge		Q_{GS}			3.5		nC
Gate-Drain Charge		Q_{GD}			8		nC
Turn-On Delay Time		$t_{D\ (ON)}$	V_{DD} =30V, I_D =1A, R_G=25Ω (Note 1, 2)		40	60	ns
Turn-On Rise Time		t_R			35	55	ns
Turn-Off Delay Time		$t_{D(OFF)}$			70	90	ns
Turn-Off Fall Time		t_F			40	55	ns
DRAIN-SOURCE DIODE CHARACTERISTICS							
Drain-Source Diode Forward Voltage		V_{SD}	V_{GS} = 0 V, I_{SD} = 2.0 A			1.4	V
Continuous Drain-Source Current		I_{SD}				2.0	A
Pulsed Drain-Source Current		I_{SM}				8.0	A

Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle≤2%.
2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

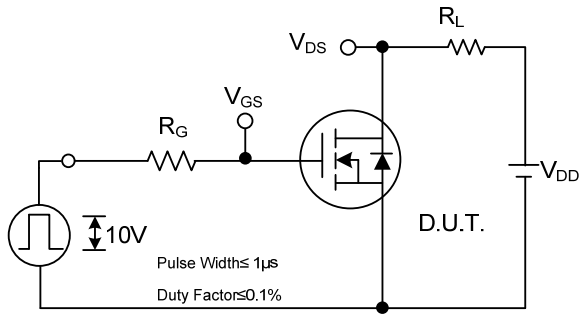


Peak Diode Recovery dv/dt Test Circuit

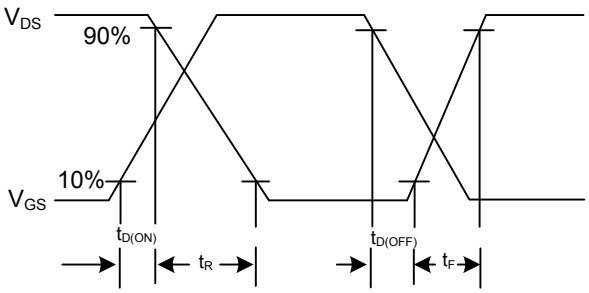


Peak Diode Recovery dv/dt Waveforms

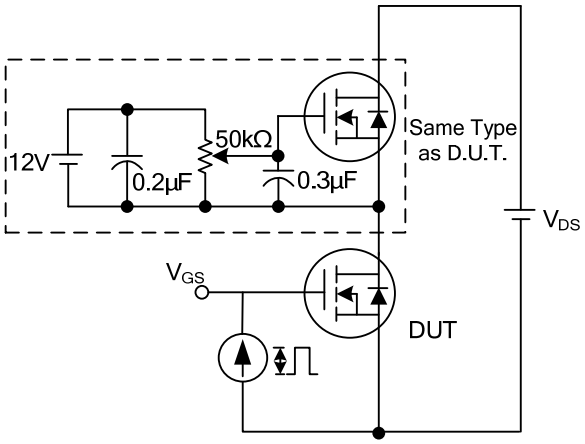
■ TEST CIRCUITS AND WAVEFORMS (Cont.)



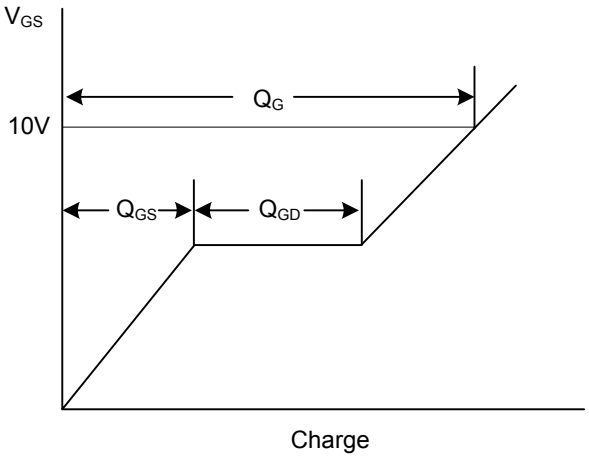
Switching Test Circuit



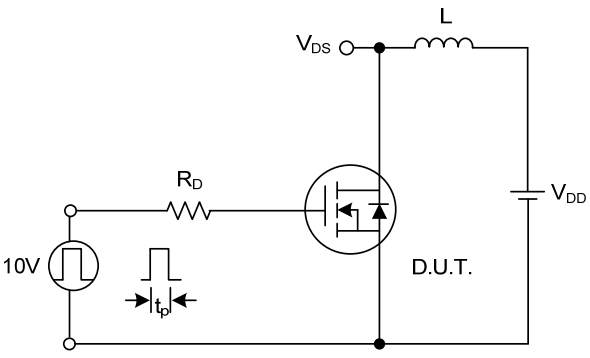
Switching Waveforms



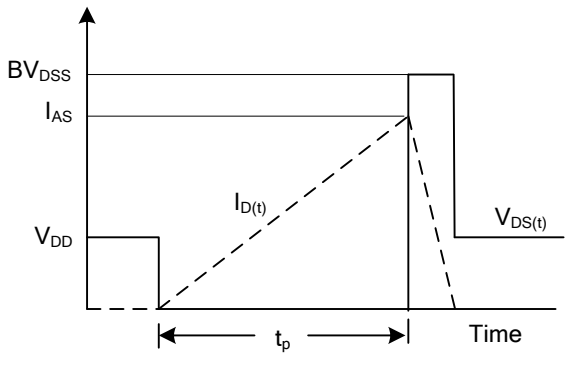
Gate Charge Test Circuit



Gate Charge Waveform



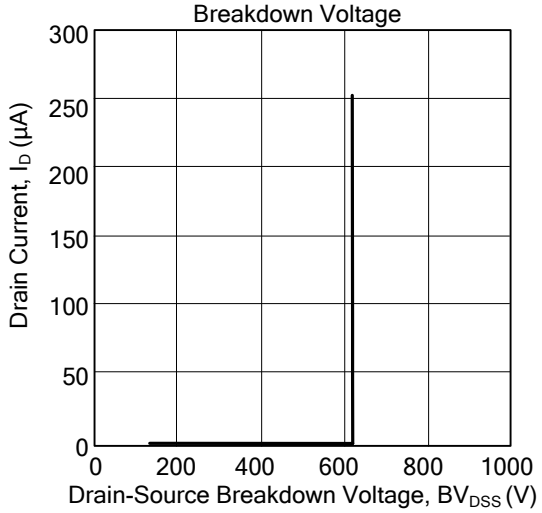
Unclamped Inductive Switching Test Circuit



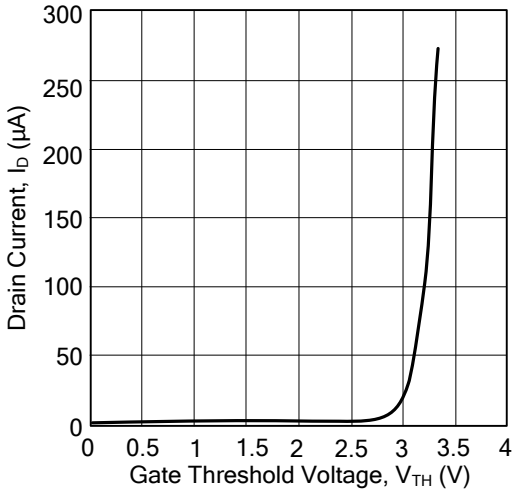
Unclamped Inductive Switching Waveforms

■ TYPICAL CHARACTERISTICS

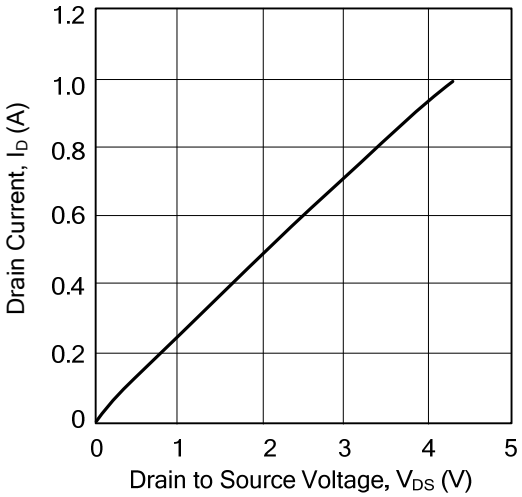
Drain Current vs. Drain-Source Breakdown Voltage



Drain Current vs. Gate Threshold Voltage



Drain-Source On-State Resistance Characteristics



Continuous Drain-Source Current vs. Source to Drain Voltage