



## 4N60-HC

Power MOSFET

### 4A, 600V N-CHANNEL POWER MOSFET

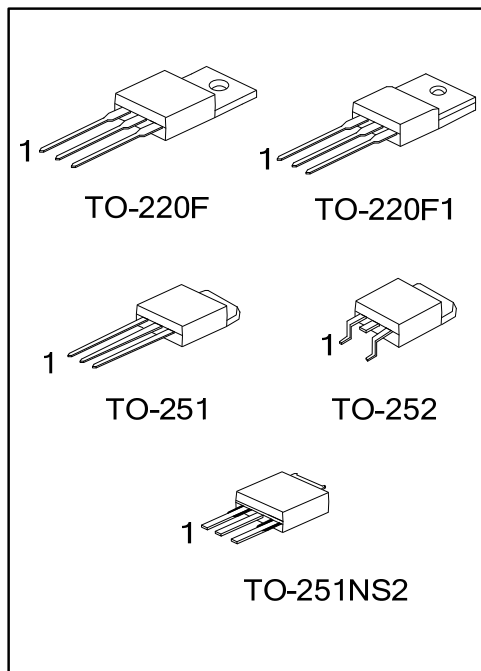
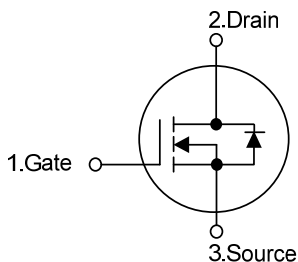
#### DESCRIPTION

The UTC **4N60-HC** is a high voltage power MOSFET 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 in high speed switching applications of switching power supplies and adaptors.

#### FEATURES

- \*  $R_{DS(ON)} < 2.2 \Omega @ V_{GS} = 10V, I_D = 2.0A$
- \* Fast switching capability
- \* Avalanche energy tested
- \* Improved dv/dt capability, high ruggedness

#### SYMBOL



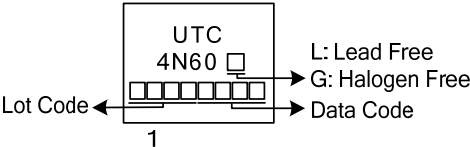
#### ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
4N60L-TF1-T	4N60G-TF1-T	TO-220F1	G	D	S	Tube
4N60L-TF3-T	4N60G-TF3-T	TO-220F	G	D	S	Tube
4N60L-TM3-T	4N60G-TM3-T	TO-251	G	D	S	Tube
4N60L-TN3-R	4N60G-TN3-R	TO-252	G	D	S	Tape Reel
4N60L-TMN2-T	4N60G-TMN2-T	TO-251NS2	G	D	S	Tube

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

<p>4N60G-TF1-T</p>	<p>(1) T: Tube, R: Tape Reel</p> <p>(2) TF1: TO-220F1, TF3: TO-220F, TM3: TO-251 TN3: TO-252, TMS2: TO-251NS2</p> <p>(3) G: Halogen Free and Lead Free, L: Lead Free</p>
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MARKING



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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		$V_{GSS}$	$\pm 30$	V
Continuous Drain Current		$I_D$	4	A
Pulsed Drain Current (Note 2)		$I_{DM}$	16	A
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	132	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	3.4	V/ns
Power Dissipation	TO-220F/TO-220F1	$P_D$	34	W
	TO-251/TO-252		50	W
	TO-251NS2			
Junction Temperature		$T_J$	+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.  $L = 30\text{mH}$ ,  $I_{AS} = 2.97\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD} \leq 4.0\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

PARAMETER		SYMBOL	RATING	UNIT
Junction to Ambient	TO-220F/TO-220F1	$\theta_{JA}$	62.5	$^\circ\text{C}/\text{W}$
	TO-251/TO-252		110	$^\circ\text{C}/\text{W}$
	TO-251NS2			
Junction to Case	TO-220F/TO-220F1	$\theta_{JC}$	3.68	$^\circ\text{C}/\text{W}$
	TO-251/TO-252		2.5	$^\circ\text{C}/\text{W}$
	TO-251NS2			

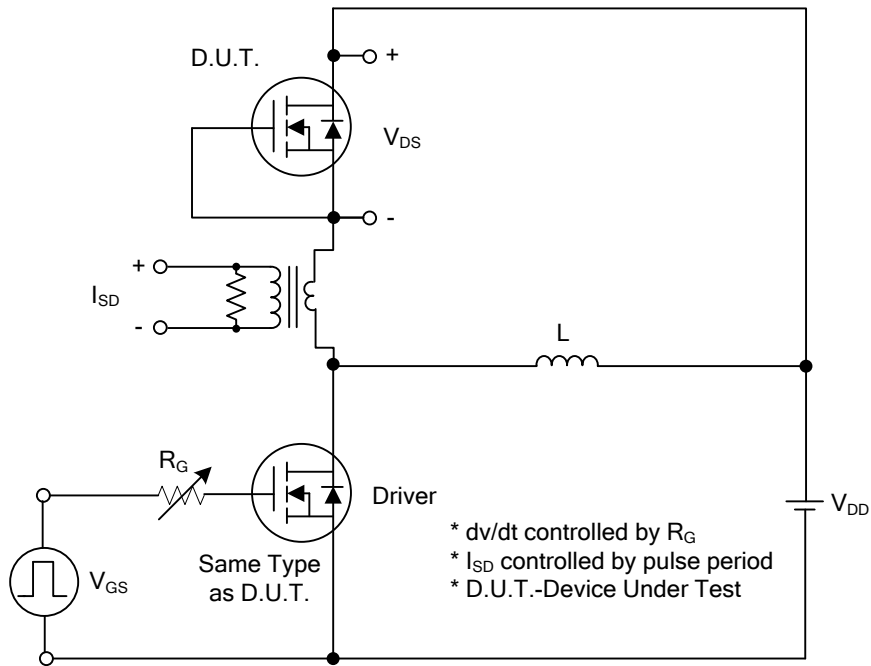
■ ELECTRICAL CHARACTERISTICS (T<sub>J</sub>=25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA	600			V
Drain-Source Leakage Current	I <sub>DSS</sub>	V <sub>DS</sub> = 600V, V <sub>GS</sub> = 0V			10	μA
Gate- Source Leakage Current	Forward	I <sub>GSS</sub>			100	nA
	Reverse					
		V <sub>GS</sub> = -30V, V <sub>DS</sub> = 0V			-100	nA
<b>ON CHARACTERISTICS</b>						
Gate Threshold Voltage	V <sub>GS(TH)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA	2.0		4.0	V
Static Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> = 10V, I <sub>D</sub> = 2.0A			2.2	Ω
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> =25V, V <sub>GS</sub> =0V, f=1.0 MHz		551		pF
Output Capacitance	C <sub>OSS</sub>			186		pF
Reverse Transfer Capacitance	C <sub>RSS</sub>			66		pF
<b>SWITCHING CHARACTERISTICS</b>						
Total Gate Charge (Note 1)	Q <sub>G</sub>	V <sub>DS</sub> =150V, V <sub>GS</sub> =10V, I <sub>D</sub> =5.0A, I <sub>D</sub> =100μA (Note 1, 2)		18.3		nC
Gate-Source Charge	Q <sub>GS</sub>			6.4		nC
Gate-Drain Charge	Q <sub>GD</sub>			5.6		nC
Turn-On Delay Time (Note 1)	t <sub>D(ON)</sub>	V <sub>DD</sub> =30V, V <sub>GS</sub> =10V, I <sub>D</sub> =5.0A, R <sub>G</sub> =25Ω (Note 1, 2)		11		ns
Turn-On Rise Time	t <sub>R</sub>			15		ns
Turn-Off Delay Time	t <sub>D(OFF)</sub>			60		ns
Turn-Off Fall Time	t <sub>F</sub>			26		ns
<b>DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS</b>						
Maximum Continuous Drain-Source Diode Forward Current	I <sub>S</sub>				4	A
Maximum Pulsed Drain-Source Diode Forward Current	I <sub>SM</sub>				16	A
Drain-Source Diode Forward Voltage	V <sub>SD</sub>	I <sub>S</sub> =4.0A, V <sub>GS</sub> =0V			1.4	V
Body Diode Reverse Recovery Time	t <sub>rr</sub>	I <sub>S</sub> =4.0A, V <sub>GS</sub> =0V di/dt=100A/μs		285		ns
Body Diode Reverse Recovery Charge	Q <sub>rr</sub>			1.54		μC

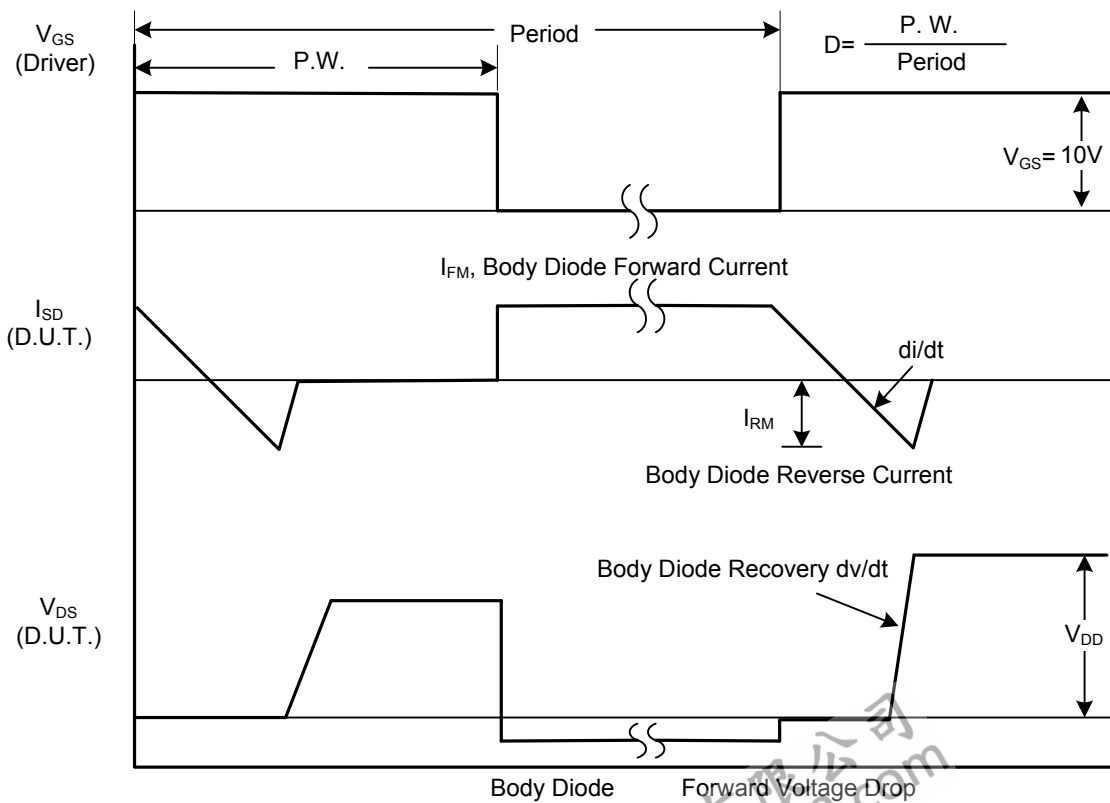
Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%.

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

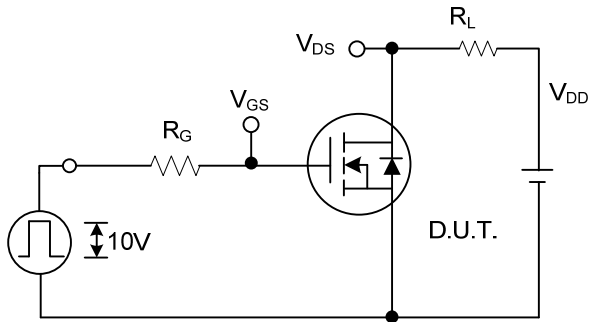


Peak Diode Recovery  $dv/dt$  Test Circuit

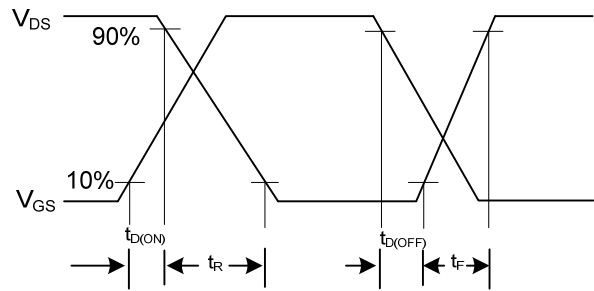


Peak Diode Recovery  $dv/dt$  Waveforms

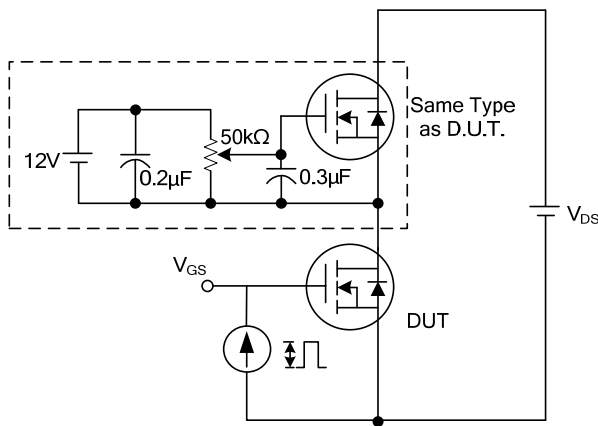
## TEST CIRCUITS AND WAVEFORMS (Cont.)



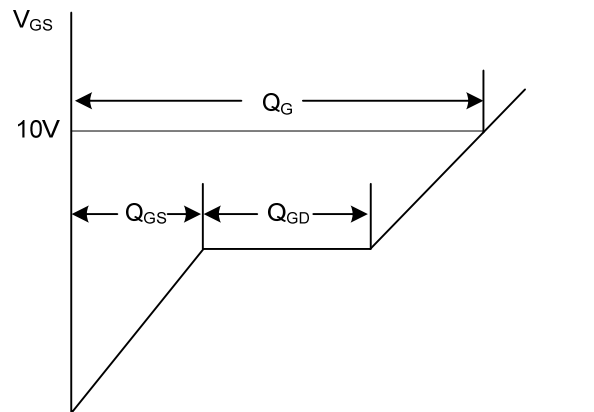
Switching Test Circuit



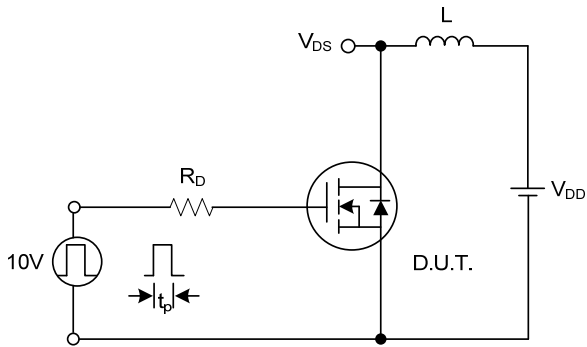
Switching Waveforms



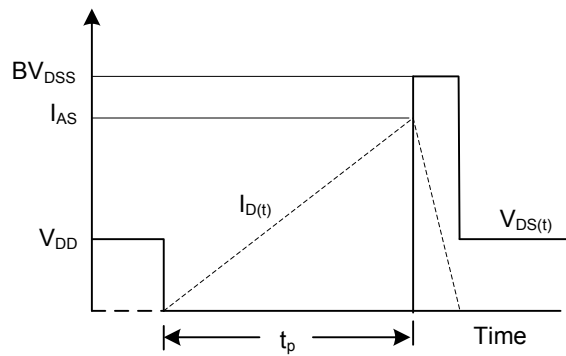
Gate Charge Test Circuit



Charge  
Gate Charge Waveform

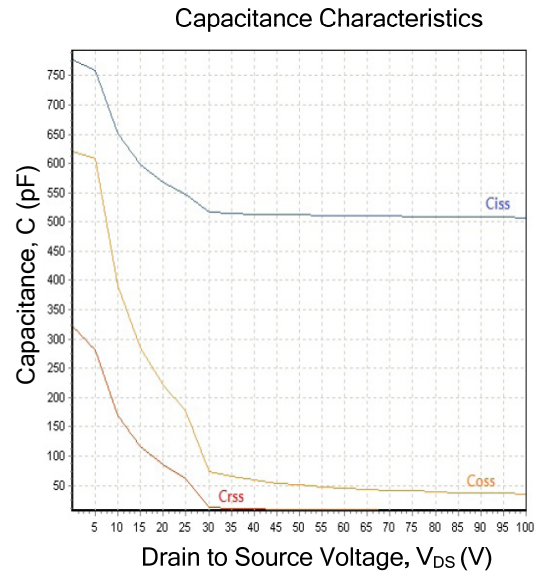
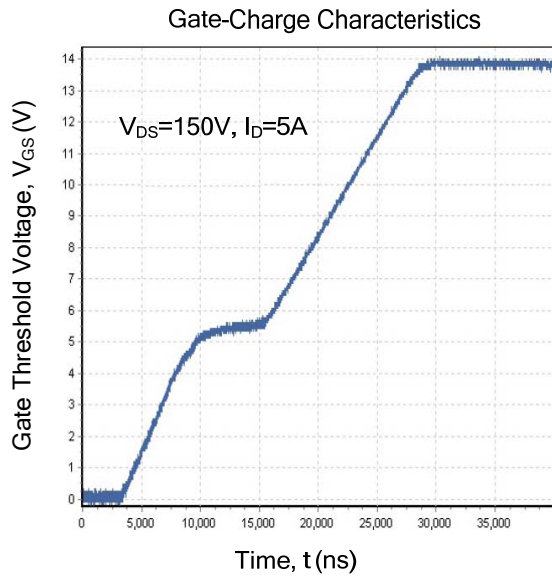


Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

### TYPICAL CHARACTERISTICS



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