



4N60-HC

Power MOSFET

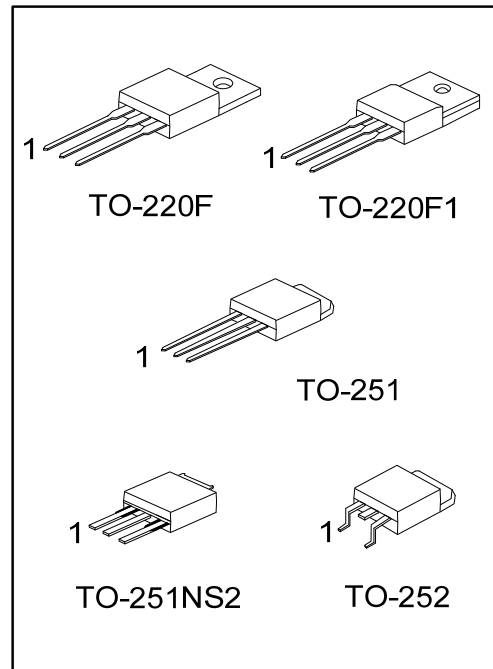
4.0A, 600V N-CHANNEL POWER MOSFET

■ DESCRIPTION

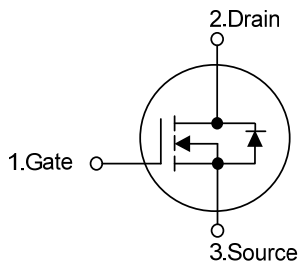
The UTC **4N60-HC** is a high voltage power MOSFET designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and high rugged avalanche characteristics. This power MOSFET is usually used in high speed switching applications of switching power supplies and adaptors.

■ FEATURES

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



■ SYMBOL



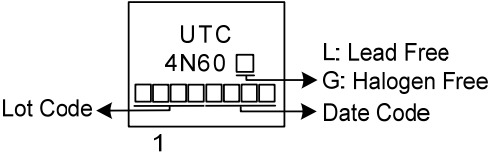
■ ORDERING INFORMATION

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



■ 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}	± 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	θ_{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	θ_{JC}	3.68	$^\circ\text{C}/\text{W}$
	TO-251/TO-252		2.5	$^\circ\text{C}/\text{W}$
	TO-251NS2			

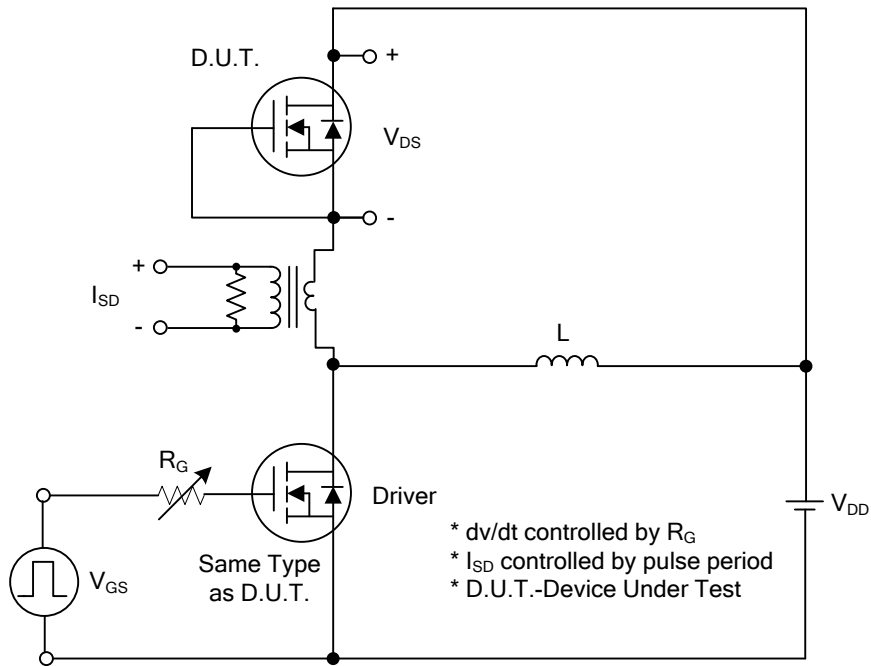
■ ELECTRICAL CHARACTERISTICS (T_J=25°C, unless otherwise specified)

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
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 = 2.0A			2.2	Ω
DYNAMIC CHARACTERISTICS						
Input Capacitance	C _{ISS}	V _{DS} =25V, V _{GS} =0V, f=1.0 MHz		551		pF
Output Capacitance	C _{OSS}			186		pF
Reverse Transfer Capacitance	C _{RSS}			66		pF
SWITCHING CHARACTERISTICS						
Total Gate Charge (Note 1)	Q _G	V _{DS} =150V, V _{GS} =10V, I _D =5.0A, I _D =100μA (Note 1, 2)		18.3		nC
Gate-Source Charge	Q _{GS}			6.4		nC
Gate-Drain Charge	Q _{GD}			5.6		nC
Turn-On Delay Time (Note 1)	t _{D(ON)}	V _{DD} =30V, V _{GS} =10V, I _D =5.0A, R _G =25Ω (Note 1, 2)		11		ns
Turn-On Rise Time	t _R			15		ns
Turn-Off Delay Time	t _{D(OFF)}			60		ns
Turn-Off Fall Time	t _F			26		ns
DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS						
Maximum Continuous Drain-Source Diode Forward Current	I _S				4	A
Maximum Pulsed Drain-Source Diode Forward Current	I _{SM}				16	A
Drain-Source Diode Forward Voltage	V _{SD}	I _S =4.0A , V _{GS} =0V			1.4	V
Body Diode Reverse Recovery Time	t _{rr}	I _S =4.0A , V _{GS} =0V di/dt=100A/μs		285		ns
Body Diode Reverse Recovery Charge	Q _{rr}			1.54		μC

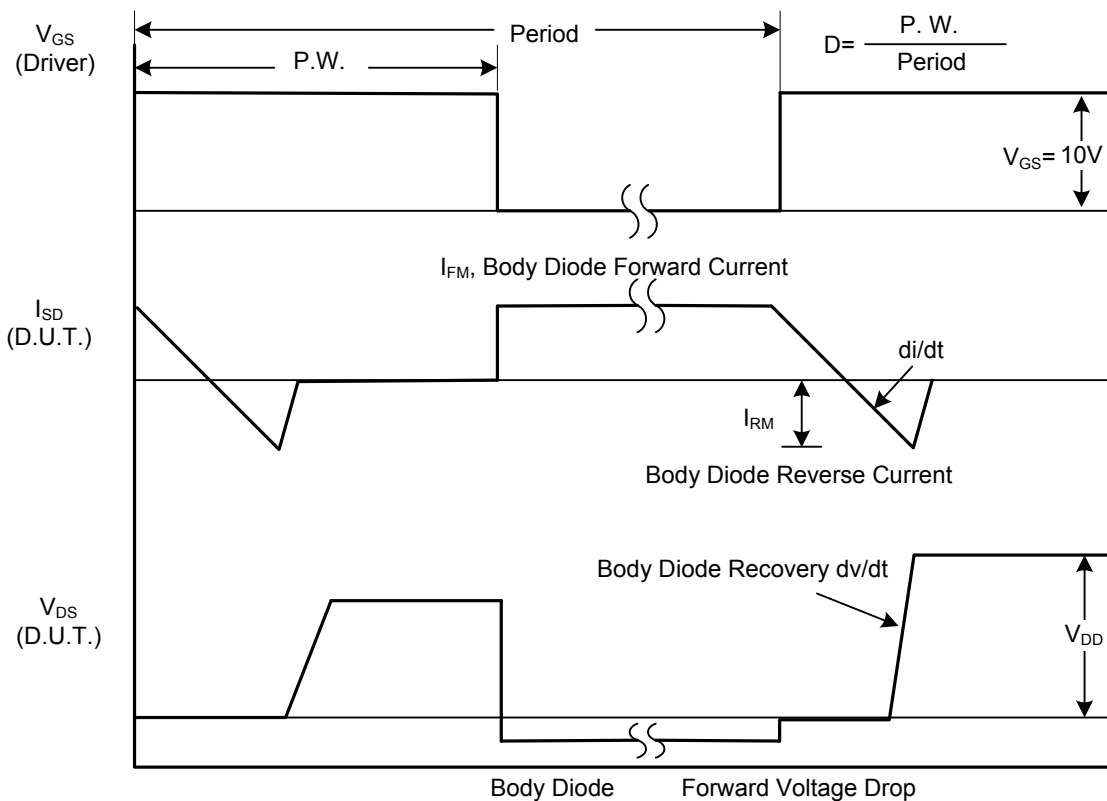
Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%.

2. Essentially independent of operating temperature.

TEST CIRCUITS AND WAVEFORMS

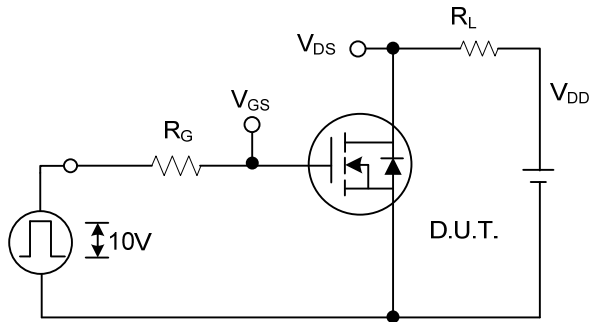


Peak Diode Recovery dv/dt Test Circuit

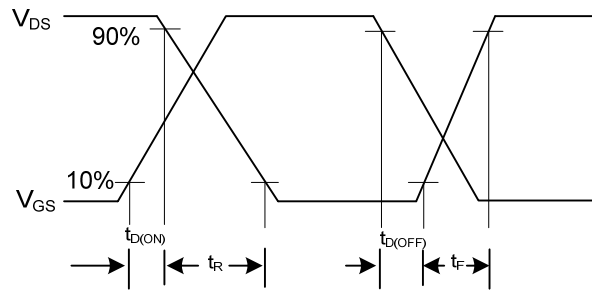


Peak Diode Recovery dv/dt Waveforms

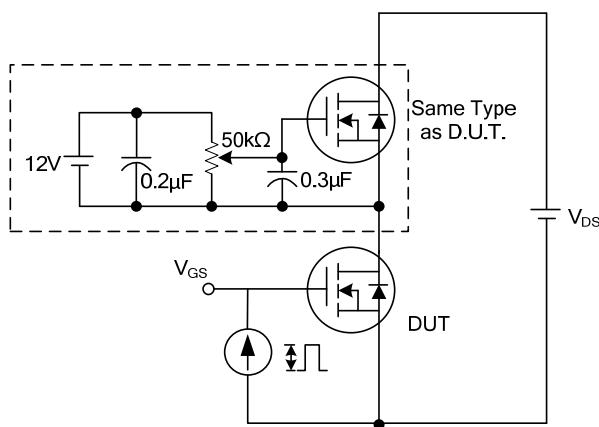
TEST CIRCUITS AND WAVEFORMS



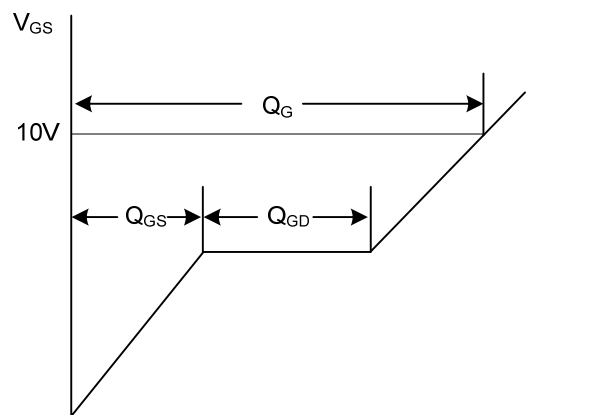
Switching Test Circuit



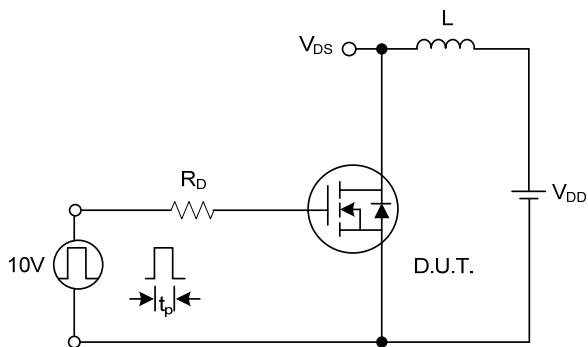
Switching Waveforms



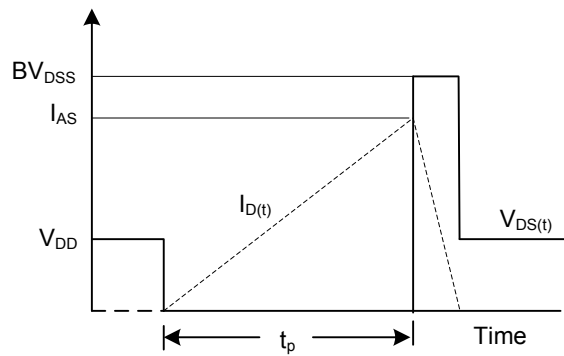
Gate Charge Test Circuit



Gate Charge Waveform

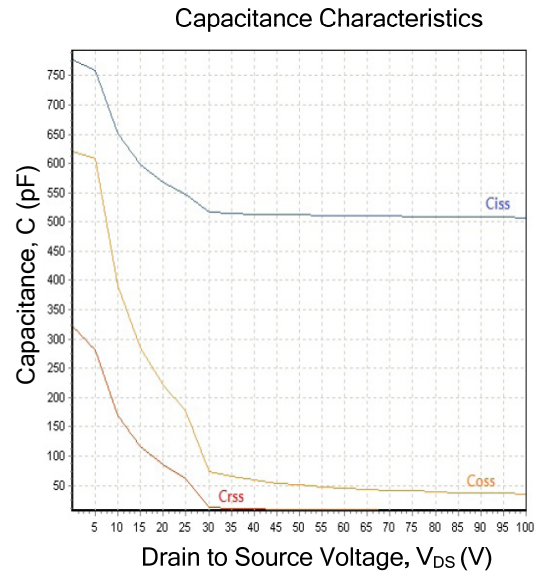
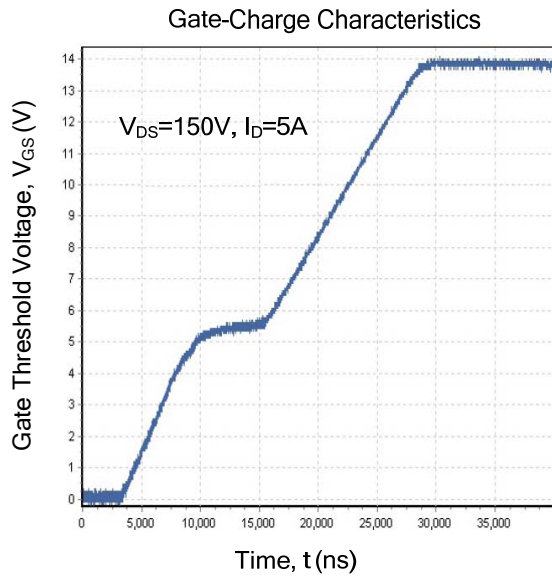


Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

TYPICAL CHARACTERISTICS



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