

## 4N60-C

Power MOSFET

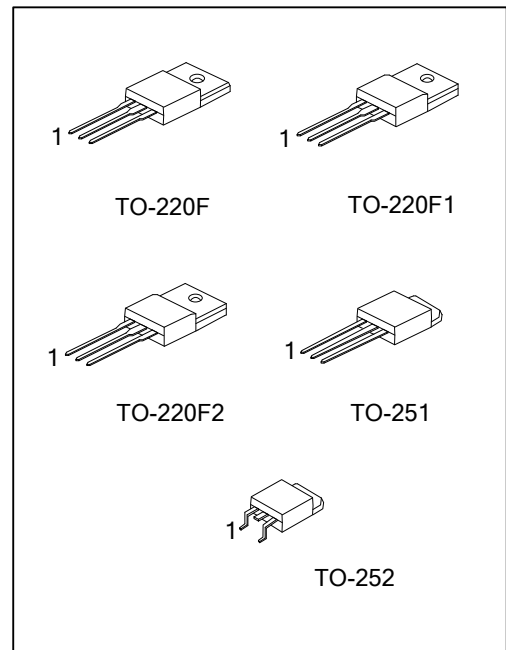
### 4A, 600V N-CHANNEL POWER MOSFET

#### DESCRIPTION

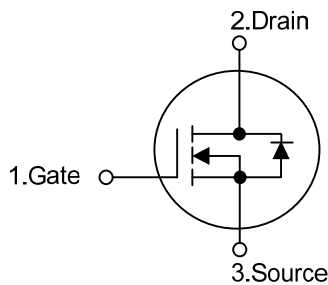
The UTC **4N60-C** is a high voltage power MOSFET and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristics. This power MOSFET is usually used at high speed switching applications in power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.

#### FEATURES

- \*  $R_{DS(ON)} < 2.5\Omega @ V_{GS} = 10V$
- \* Fast Switching Capability
- \* Avalanche Energy Specified
- \* Improved dv/dt Capability, high Ruggedness



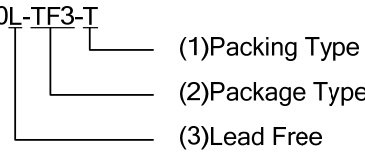
#### SYMBOL



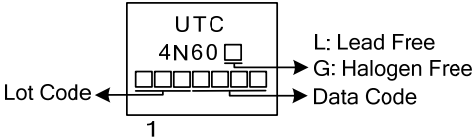
#### ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
4N60L-TF3-T	4N60G-TF3-T	TO-220F	G	D	S	Tube
4N60L-TF1-T	4N60G-TF1-T	TO-220F1	G	D	S	Tube
4N60L-TF2-T	4N60G-TF2-T	TO-220F2	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

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

<p>4N60L-TF3-T</p>  <p>(1) Packing Type (2) Package Type (3) Lead Free</p>	<p>(1) T: Tube (2) TF3: TO-220F, TF1: TO-220F1, TF2: TO-220F2 TM3: TO-251, TN3: TO-252 (3) L: Lead Free, G: Halogen 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		$V_{GSS}$	$\pm 30$	V
Avalanche Current (Note 2)		$I_{AR}$	4.4	A
Drain Current	Continuous	$I_D$	4.0	A
	Pulsed (Note 2)	$I_{DM}$	16	A
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	240	mJ
	Repetitive (Note 2)	$E_{AR}$	10.6	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns
Power Dissipation	TO-220F/TO-220F1	$P_D$	36	W
	TO-220F2			
	TO-251/TO-252		50	W
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.  $L = 30\text{mH}$ ,  $I_{AS} = 4\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD} \leq 4.4\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

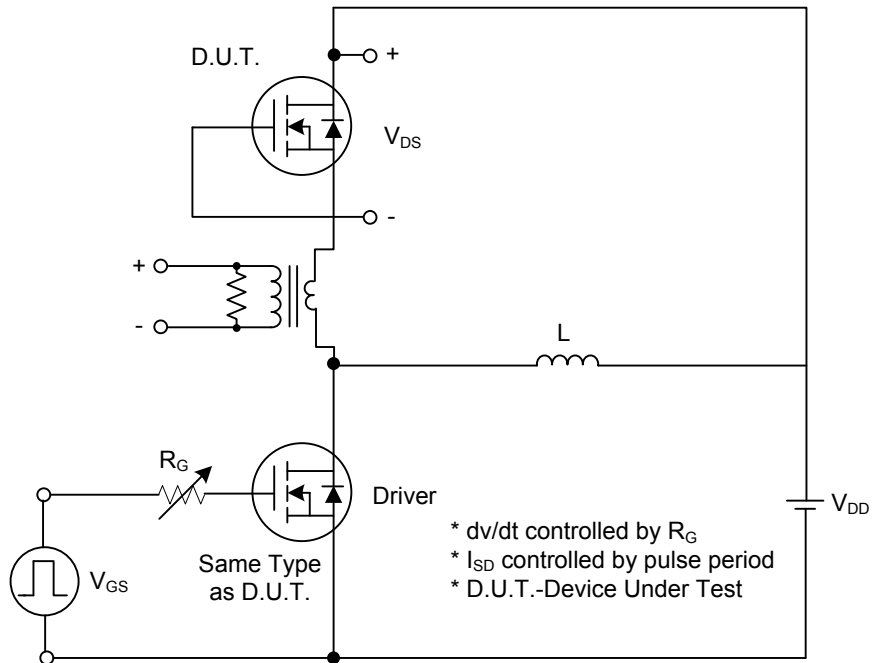
PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220F/TO-220F1	$\theta_{JA}$	62.5	$^\circ\text{C}/\text{W}$
	TO-220F2			
	TO-251/TO-252		110	$^\circ\text{C}/\text{W}$
Junction to Case	TO-220F/TO-220F1	$\theta_{JC}$	3.47	$^\circ\text{C}/\text{W}$
	TO-220F2		3.28	$^\circ\text{C}/\text{W}$
	TO-251/TO-252		2.5	$^\circ\text{C}/\text{W}$

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

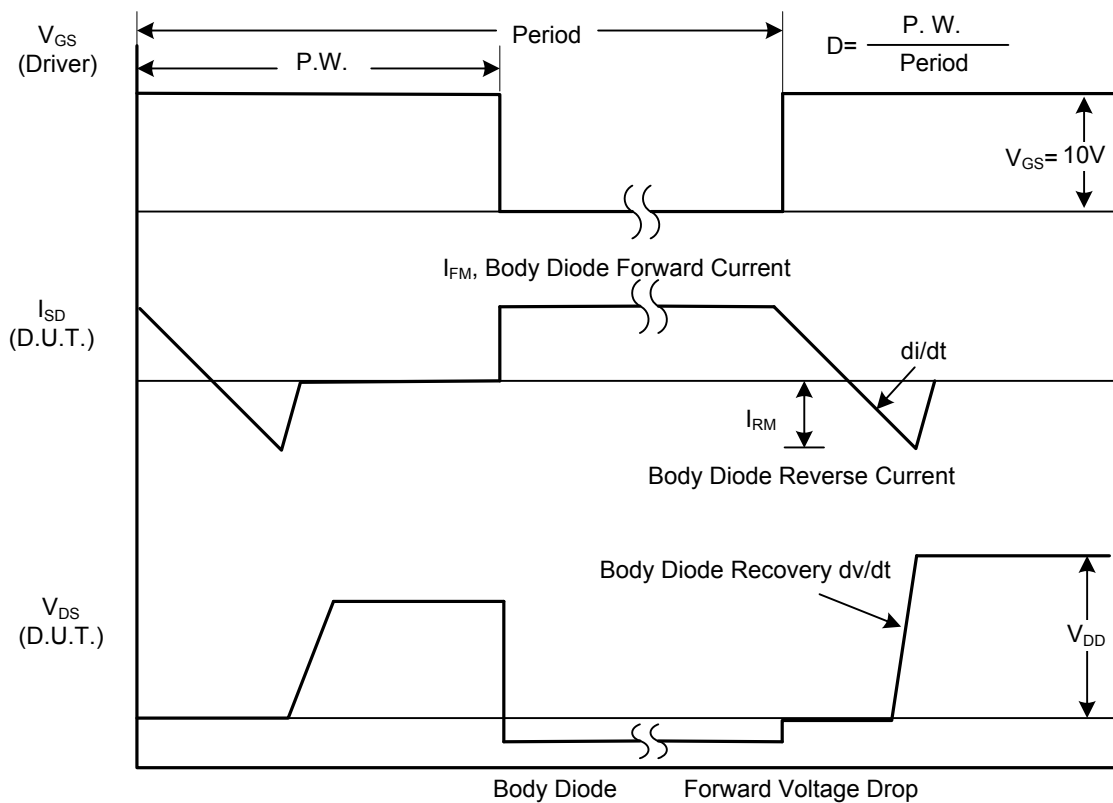
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA	600			V
Drain-Source Leakage Current	I <sub>DSS</sub>	V <sub>DS</sub> = 600V, V <sub>GS</sub> = 0V			10	μA
		V <sub>DS</sub> = 480V, V <sub>GS</sub> = 0V, T <sub>C</sub> = 125°C			100	μA
Gate-Source Leakage Current	Forward	I <sub>GSS</sub>				nA
	Reverse					
					-100	nA
Breakdown Voltage Temperature Coefficient	ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	I <sub>D</sub> =250μA, Referenced to 25°C		0.6		V/°C
<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> = 10 V, I <sub>D</sub> = 2.2A		1.9	2.5	Ω
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V, f = 1MHz		600	700	pF
Output Capacitance	C <sub>OSS</sub>			60	80	pF
Reverse Transfer Capacitance	C <sub>RSS</sub>			6	15	pF
<b>SWITCHING CHARACTERISTICS</b>						
Turn-On Delay Time	t <sub>D(ON)</sub>	V <sub>DD</sub> = 300V, I <sub>D</sub> = 4.0A, R <sub>G</sub> = 25Ω (Note 1, 2)		35	55	ns
Turn-On Rise Time	t <sub>R</sub>			55	80	ns
Turn-Off Delay Time	t <sub>D(OFF)</sub>			100	130	ns
Turn-Off Fall Time	t <sub>F</sub>			40	60	ns
Total Gate Charge	Q <sub>G</sub>	V <sub>DS</sub> = 480V, I <sub>D</sub> = 4.0A, V <sub>GS</sub> = 10V (Note 1, 2)		20	50	nC
Gate-Source Charge	Q <sub>GS</sub>			5		nC
Gate-Drain Charge	Q <sub>GD</sub>			3		nC
<b>SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS</b>						
Drain-Source Diode Forward Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0V, I <sub>S</sub> = 4.4A			1.4	V
Maximum Continuous Drain-Source Diode Forward Current	I <sub>SD</sub>				4.4	A
Maximum Pulsed Drain-Source Diode Forward Current	I <sub>SM</sub>				17.6	A
Reverse Recovery Time	t <sub>rr</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 4.4A,		250		ns
Reverse Recovery Charge	Q <sub>RR</sub>	dI <sub>F</sub> /dt = 100 A/μs (Note 1)		1.5		μC

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

## TEST CIRCUITS AND WAVEFORMS

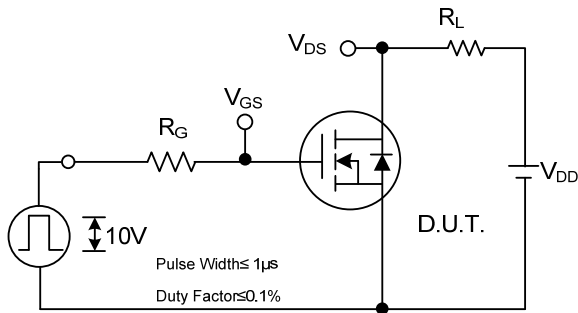


**Peak Diode Recovery dv/dt Test Circuit**

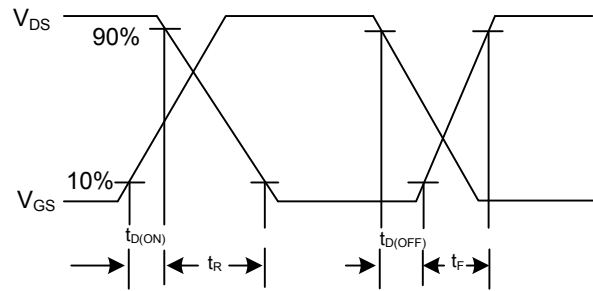


**Peak Diode Recovery dv/dt Waveforms**

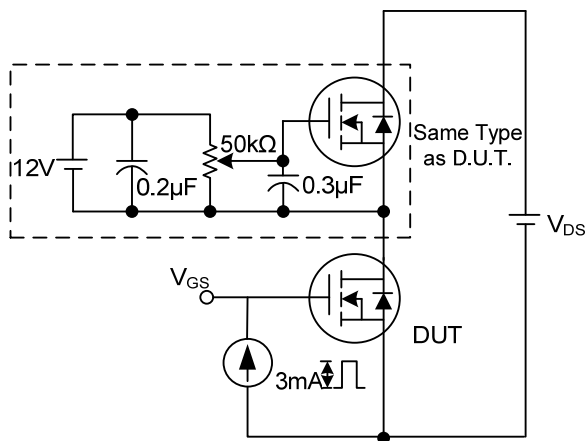
## TEST CIRCUITS AND WAVEFORMS (Cont.)



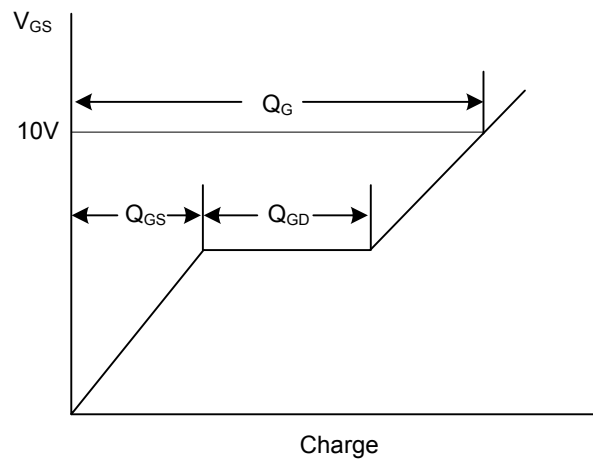
**Switching Test Circuit**



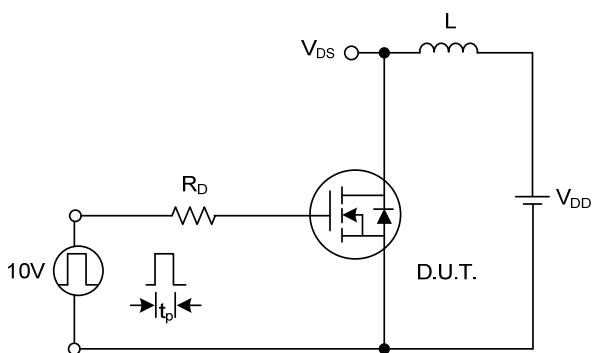
**Switching Waveforms**



**Gate Charge Test Circuit**



**Gate Charge Waveform**

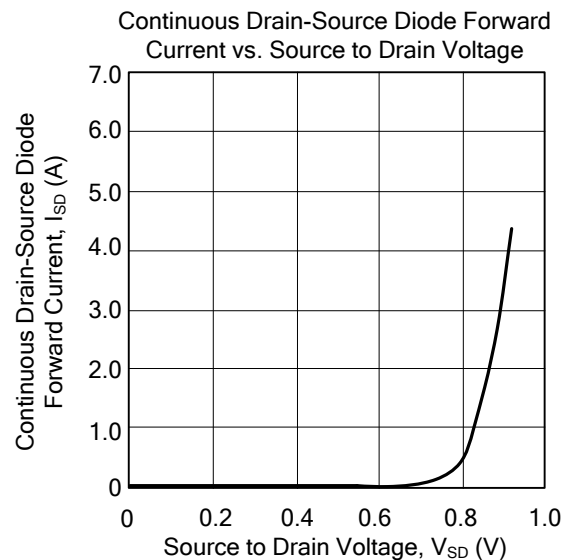
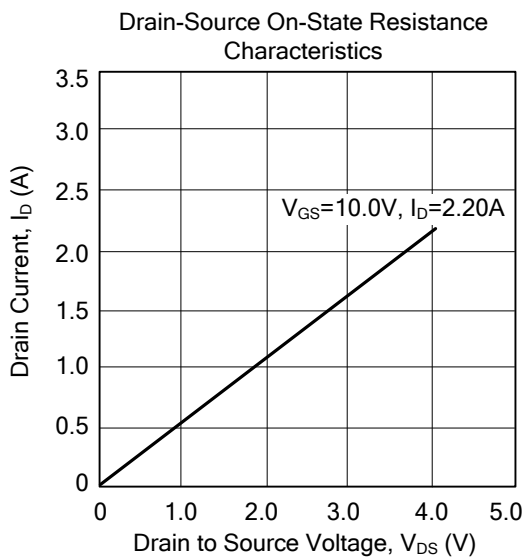
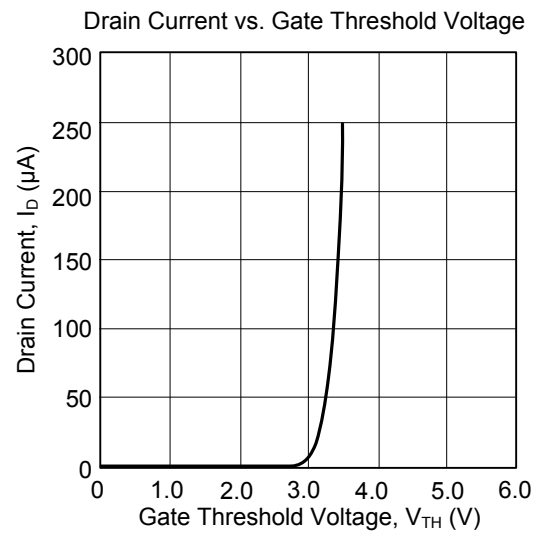
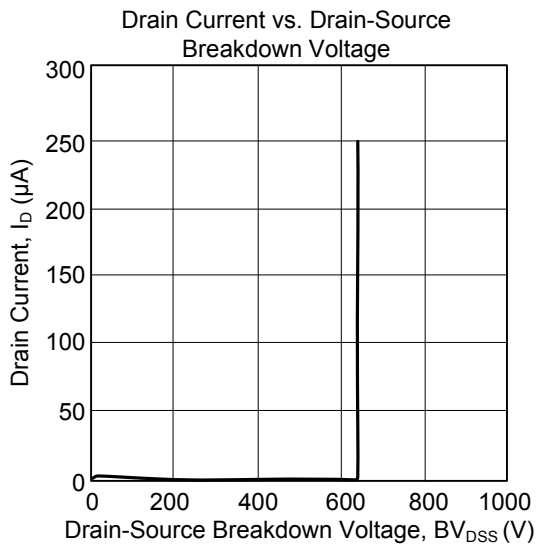


**Unclamped Inductive Switching Test Circuit**



**Unclamped Inductive Switching Waveforms**

## TYPICAL CHARACTERISTICS



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