



## 5N60

## Power MOSFET

### 5A, 600V N-CHANNEL POWER MOSFET

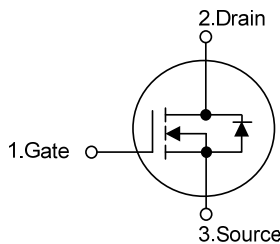
#### DESCRIPTION

The UTC **5N60** 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

- \*  $R_{DS(ON)} < 2.2\Omega$  @  $V_{GS} = 10V$
- \* Ultra Low Gate Charge ( Typical 15 nC )
- \* Low Reverse Transfer Capacitance (  $C_{RSS}$  = Typical 6.5 pF )
- \* Fast Switching Capability
- \* Avalanche Energy Specified
- \* Improved dv/dt Capability, High Ruggedness

#### SYMBOL



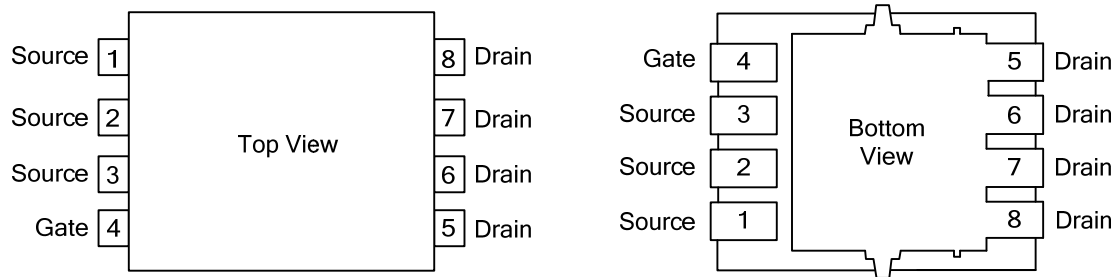
#### ORDERING INFORMATION

Ordering Number		Package	Pin Assignment								Packing
Lead Free	Halogen Free		1	2	3	4	5	6	7	8	
5N60L-TA3-T	5N60G-TA3-T	TO-220	G	D	S	-	-	-	-	-	Tube
5N60L-TF1-T	5N60G-TF1-T	TO-220F1	G	D	S	-	-	-	-	-	Tube
5N60L-TF2-T	5N60G-TF2-T	TO-220F2	G	D	S	-	-	-	-	-	Tube
5N60L-TF3-T	5N60G-TF3-T	TO-220F	G	D	S	-	-	-	-	-	Tube
5N60L-TF3T-T	5N60G-TF3T-T	TO-220F3	G	D	S	-	-	-	-	-	Tube
5N60L-TM3-T	5N60G-TM3-T	TO-251	G	D	S	-	-	-	-	-	Tube
5N60L-TN3-T	5N60G-TN3-T	TO-252	G	D	S	-	-	-	-	-	Tube
5N60L-TN3-R	5N60G-TN3-R	TO-252	G	D	S	-	-	-	-	-	Tape Reel
5N60L-K08-5060-R	5N60G-K08-5060-R	DFN-8(5x6)	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
	(2) TA3: TO-220, TF3: TO-220F, TF1: TO-220F1, TF2: TO-220F2, TM3: TO-251, TN3: TO-252, K08-5060: DFN-8(5x6)
	(3) L: Lead Free, G: Halogen Free

## ■ PIN CONFIGURATION



DFN-8(5×6)

■ ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^\circ\text{C}$ , unless otherwise specified)

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage		V <sub>DSS</sub>	600	V
Gate-Source Voltage		V <sub>GSS</sub>	±30	V
Avalanche Current (Note 2)		I <sub>AR</sub>	5	A
Continuous Drain Current		I <sub>D</sub>	5	A
Pulsed Drain Current (Note 2)		I <sub>DM</sub>	20	A
Avalanche Energy	Single Pulsed (Note 3)	E <sub>AS</sub>	210	mJ
	Repetitive (Note 2)	E <sub>AR</sub>	10	
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns
Power Dissipation	TO-220	P <sub>D</sub>	100	W
	TO-220F/TO-220F1		36	
	TO-220F3			
	TO-220F2		38	
	TO-251 / TO-252		54	
	DFN-8(5×6)		28	
Junction Temperature		T <sub>J</sub>	+150	°C
Operation Temperature		T <sub>OPR</sub>	-55 ~ +150	°C
Storage Temperature		T <sub>STG</sub>	-55 ~ +150	°C

Note: 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. Pulse width limited by  $T_{J(MAX)}$

3.  $L = 16.8\text{mH}$ ,  $I_{AS} = 5\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD} \leq 5\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220/TO-220F TO-220F1/ TO-220F2 TO-220F3	$\theta_{JA}$	62.5	$^{\circ}\text{C/W}$
	TO-251 / TO-252		160	
	DFN-8(5×6)		75	
Junction to Case	TO-220	$\theta_{JC}$	1.25	$^{\circ}\text{C/W}$
	TO-220F/TO-220F1 TO-220F3		3.47	
	TO-220F2		3.28	
	TO-251 / TO-252		2.3	
	DFN-8(5×6)		4.46	

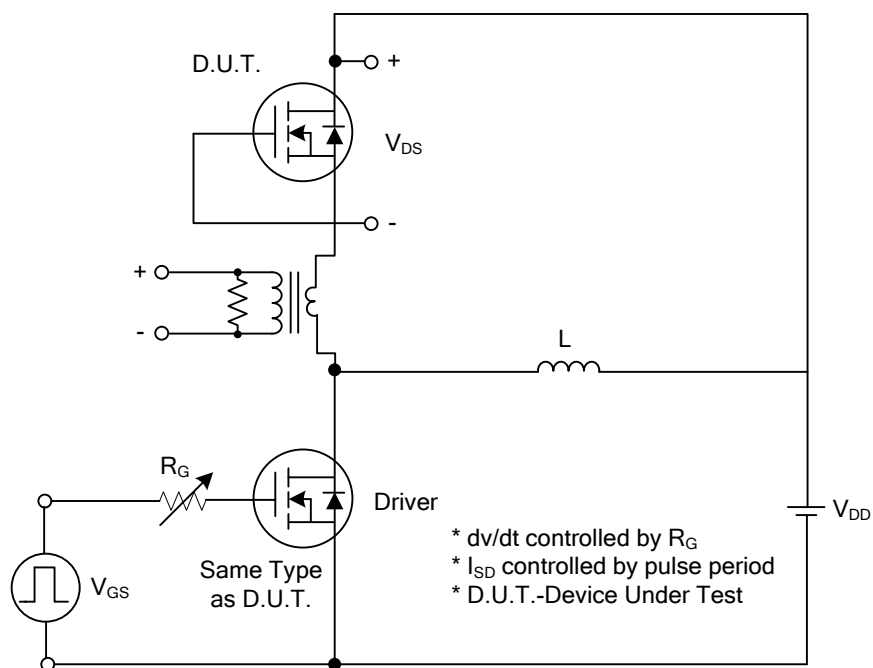
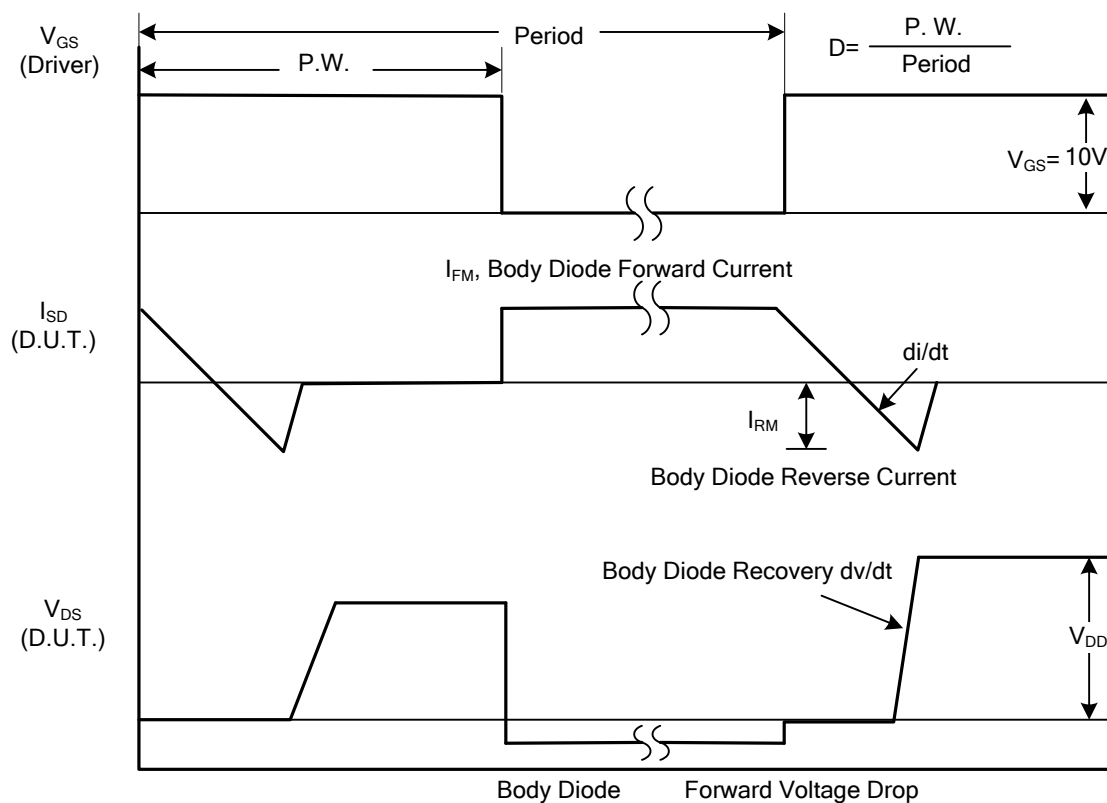
■ ELECTRICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ , unless otherwise specified)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
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			1	μA
Gate-Source Leakage Current	Forward	I <sub>GSS</sub>	V <sub>GS</sub> =30V, V <sub>DS</sub> = 0V			100	nA
	Reverse		V <sub>GS</sub> =-30V, V <sub>DS</sub> = 0V			-100	
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
ON CHARACTERISTICS							
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> = 2.5A		1.8	2.2	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C <sub>ISS</sub>	V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V, f = 1.0MHz		515	670	pF
Output Capacitance		C <sub>OSS</sub>			55	72	pF
Reverse Transfer Capacitance		C <sub>RSS</sub>			6.5	8.5	pF
SWITCHING CHARACTERISTICS							
Turn-On Delay Time		t <sub>D(ON)</sub>	V <sub>DD</sub> = 300V, I <sub>D</sub> =5A, R <sub>G</sub> = 25Ω (Note 1, 2)		10	30	ns
Turn-On Rise Time		t <sub>R</sub>			42	90	ns
Turn-Off Delay Time		t <sub>D(OFF)</sub>			38	85	ns
Turn-Off Fall Time		t <sub>F</sub>			46	100	ns
Total Gate Charge		Q <sub>G</sub>	V <sub>DS</sub> = 480 V, I <sub>D</sub> = 5A, V <sub>GS</sub> = 10 V (Note 1, 2)		15	19	nC
Gate-Source Charge		Q <sub>GS</sub>			2.5		nC
Gate-Drain Charge		Q <sub>GD</sub>			6.6		nC
DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS							
Drain-Source Diode Forward Voltage		V <sub>SD</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 5A			1.4	V
Maximum Continuous Drain-Source Diode Forward Current		I <sub>S</sub>				5	A
Maximum Pulsed Drain-Source Diode Forward Current		I <sub>SM</sub>				20	A
Reverse Recovery Time		t <sub>rr</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 5A,		300		ns
Reverse Recovery Charge		Q <sub>RR</sub>	dI <sub>F</sub> / dt = 100 A/μs (Note 1)		2.2		μC

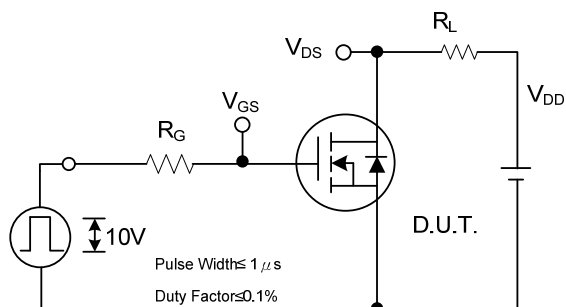
Note: 1. Pulse Test: Pulse width  $\leq 300\mu s$ , Duty cycle  $\leq 2\%$

2. Essentially independent of operating temperature

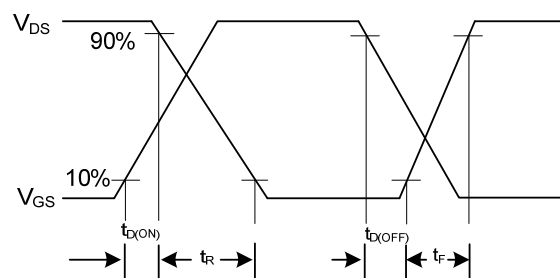
# ■ TEST CIRCUITS AND WAVEFORMS

Peak Diode Recovery  $dv/dt$  Test CircuitPeak Diode Recovery  $dv/dt$  Waveforms

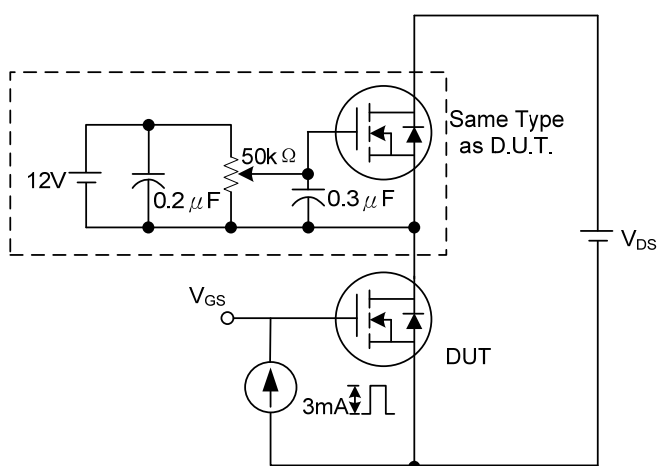
### ■ TEST CIRCUITS AND WAVEFORMS (Cont.)



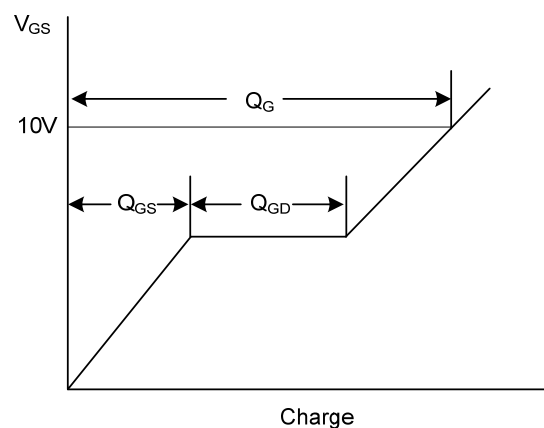
**Switching Test Circuit**



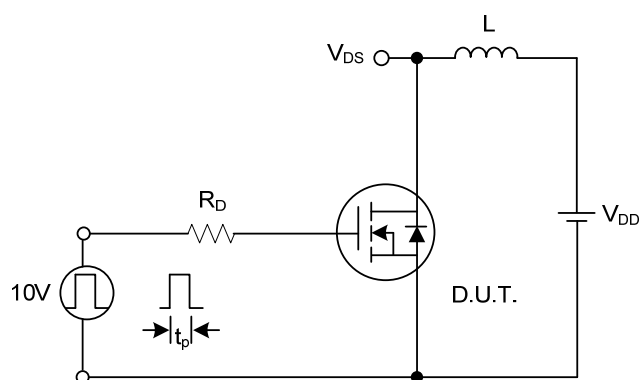
**Switching Waveforms**



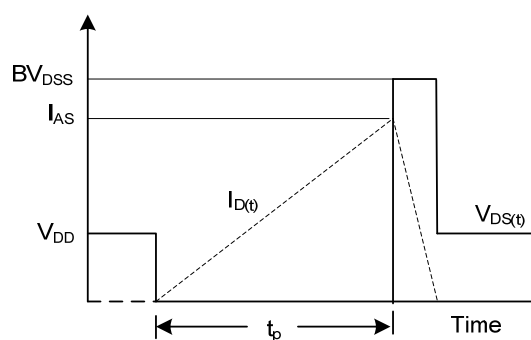
**Gate Charge Test Circuit**



**Gate Charge Waveform**

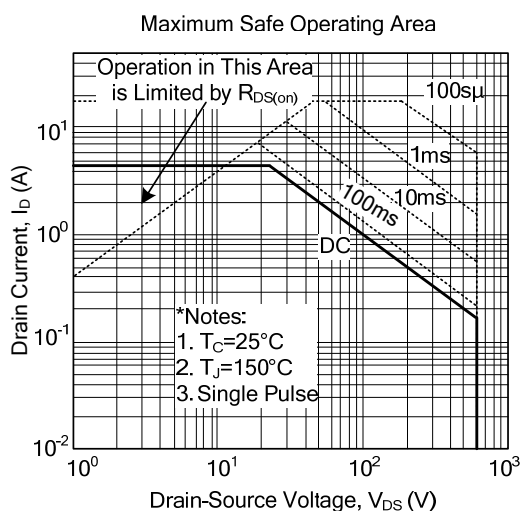
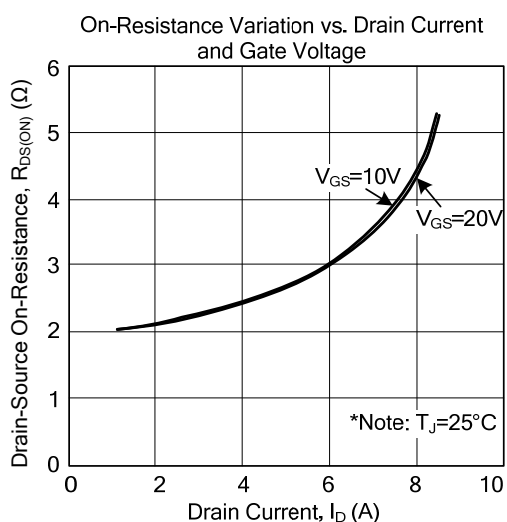
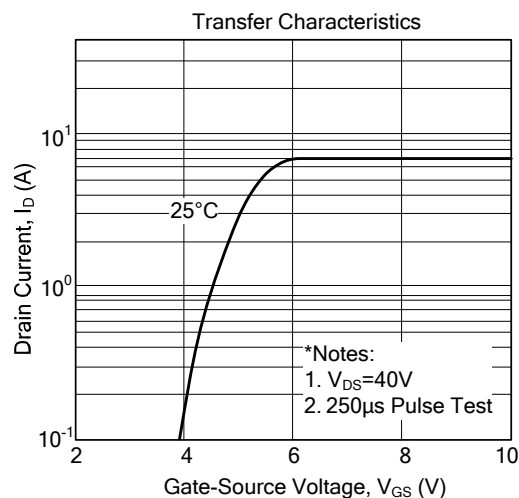
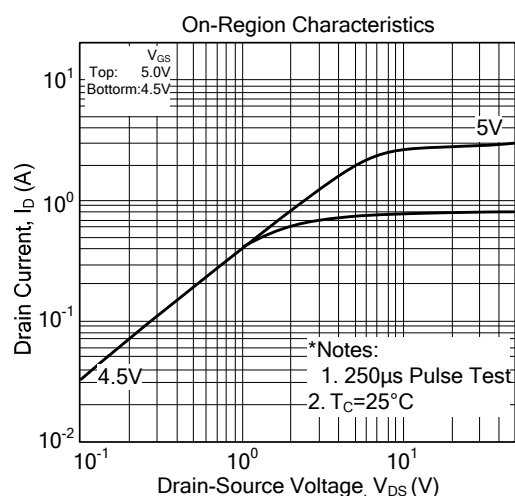


**Unclamped Inductive Switching Test Circuit**



**Unclamped Inductive Switching Waveforms**

## ■ TYPICAL CHARACTERISTICS



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