



4N60K-MT

Preliminary

Power MOSFET

4A, 600V N-CHANNEL POWER MOSFET

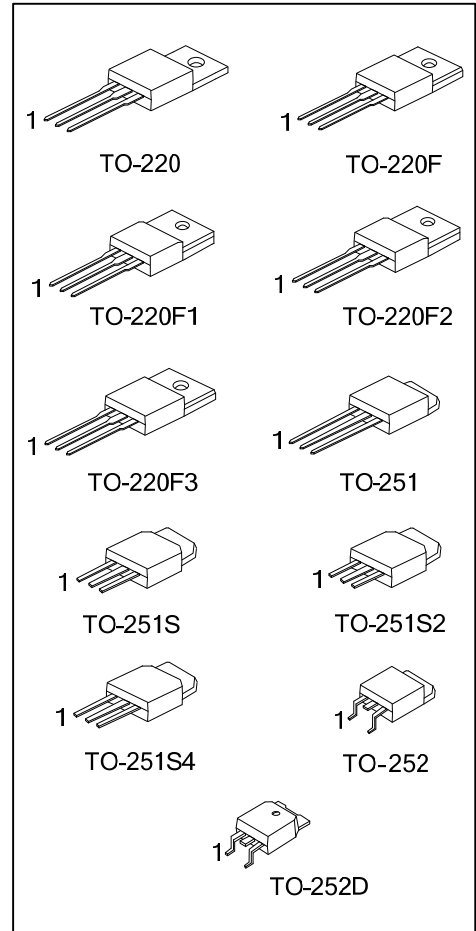
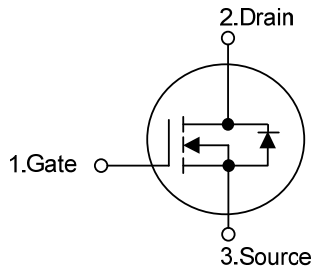
■ DESCRIPTION

The UTC 4N60K-MT 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

- * $R_{DS(ON)} < 2.5\Omega$ @ $V_{GS} = 10V$, $I_D = 2.2A$
- * Fast Switching Capability
- * Avalanche Energy Specified
- * Improved dv/dt Capability, high Ruggedness

■ SYMBOL



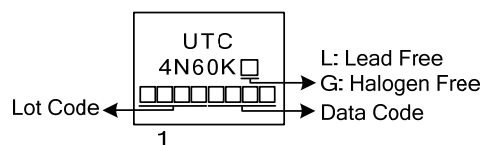
ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
4N60KL-TA3-T	4N60KG-TA3-T	TO-220	G	D	S	Tube
4N60KL-TF3-T	4N60KG-TF3-T	TO-220F	G	D	S	Tube
4N60KL-TF1-T	4N60KG-TF1-T	TO-220F1	G	D	S	Tube
4N60KL-TF2-T	4N60KG-TF2-T	TO-220F2	G	D	S	Tube
4N60KL-TF3-T	4N60KG-TF3-T	TO-220F3	G	D	S	Tube
4N60KL-TM3-T	4N60KG-TM3-T	TO-251	G	D	S	Tube
4N60KL-TMS-T	4N60KG-TMS-T	TO-251S	G	D	S	Tube
4N60KL-TMS2-T	4N60KG-TMS2-T	TO-251S2	G	D	S	Tube
4N60KL-TMS4-T	4N60KG-TMS4-T	TO-251S4	G	D	S	Tube
4N60KL-TN3-R	4N60KG-TN3-R	TO-252	G	D	S	Tape Reel
4N60KL-TND-R	4N60KG-TND-R	TO-252D	G	D	S	Tape Reel

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

4N60KL-TA3-T (1) Packing Type (2) Package Type (3) Green Package	(1) T: Tube, R: Tape Reel (2) TA3: TO-220, TF3: TO-220F, TF1: TO-220F1, TF2: TO-220F2, TF3: TO-220F3, TM3: TO-251, TMS: TO-251S, TMS2: TO-251S2, TMS4: TO-251S4, TN3: TO-252, TND: TO-252D (3) L: Lead Free, G: Halogen Free and Lead Free
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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
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}	210	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns
Power Dissipation	TO-220	P _D	106	W
	TO-220F/TO-220F1		36	
	TO-220F2/TO-220F3			
	TO-251/TO-251S		50	
	TO-251S2/TO-251S4			
TO-252/TO-252D				
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 maximum junction temperature

3. $L = 26.25\text{mH}$, $I_{AS} = 4\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\ \Omega$, 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**

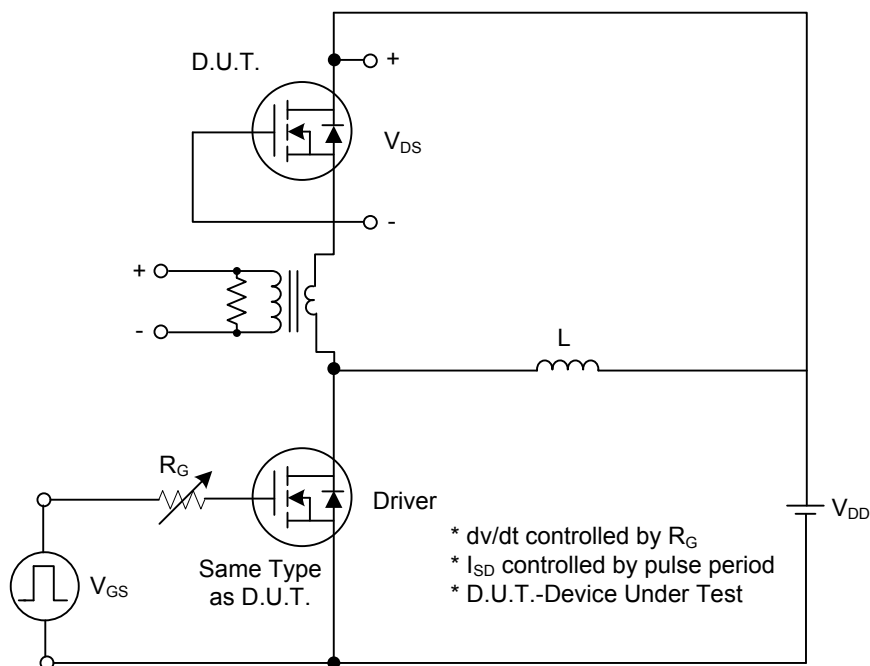
PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220/TO-220F	θ_{JA}	62.5	$^\circ\text{C}/\text{W}$
	TO-220F1/TO-220F2			
	TO-220F3			
	TO-251/TO-251S		110	$^\circ\text{C}/\text{W}$
	TO-251S2/TO-251S4			
	TO-252/TO-252D			
Junction to Case	TO-220	θ_{JC}	1.18	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1		3.47	$^\circ\text{C}/\text{W}$
	TO-220F3			
	TO-220F2		3.4	$^\circ\text{C}/\text{W}$
	TO-251/TO-251S		2.50	$^\circ\text{C}/\text{W}$
	TO-251S2/TO-251S4			
	TO-252/TO-252D			

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

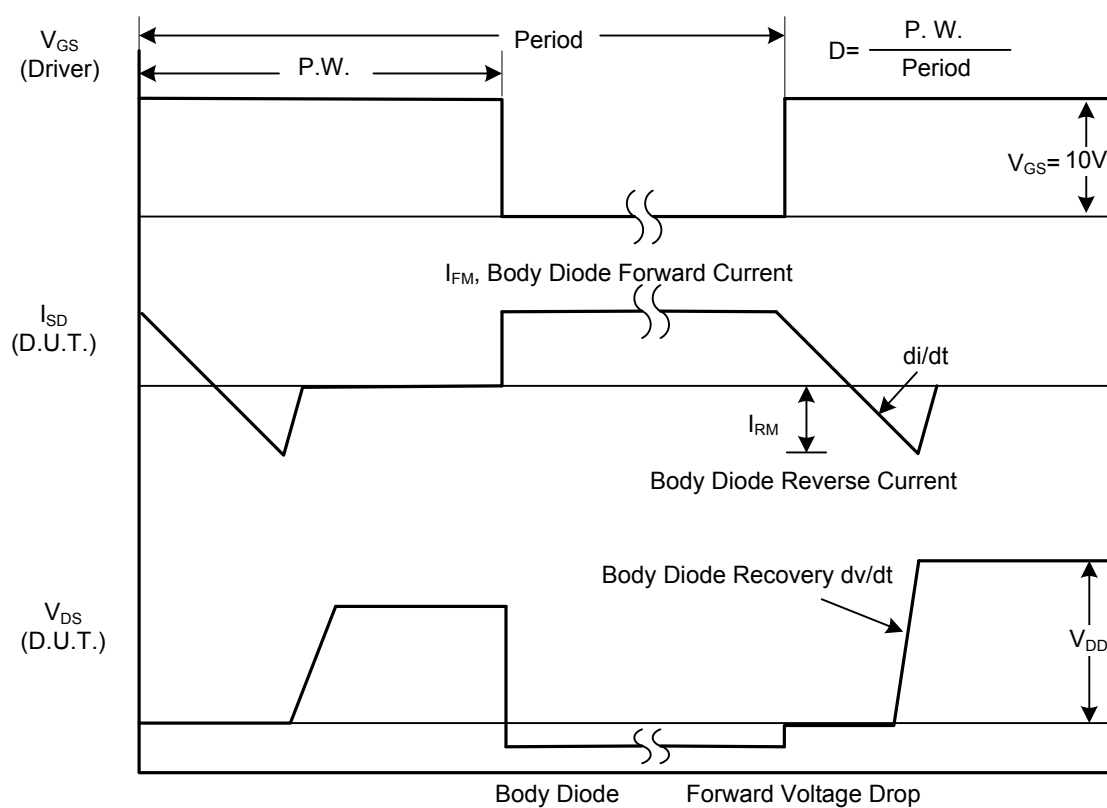
PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		BV _{DSS}	V _{GS} =0V, I _D =250μA	600			V
Drain-Source Leakage Current		I _{DSS}	V _{DS} =600V, V _{GS} =0V			10	μA
			V _{DS} =600V, V _{GS} =0V, T _C =125°C			10	μA
Gate-Source Leakage Current	Forward	I _{GSS}	V _{GS} =30V, V _{DS} =0V			100	nA
	Reverse		V _{GS} = -30V, V _{DS} =0V			-100	nA
Breakdown Voltage Temperature Coefficient		ΔBV _{DSS} /ΔT _J	I _D =250μA,Referenced to 25°C		0.6		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} =10 V, I _D =2.2A		1.79	2.5	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C _{ISS}	V _{DS} = 25V, V _{GS} = 0V, f = 1MHz		425	575	pF
Output Capacitance		C _{OSS}			55	75	pF
Reverse Transfer Capacitance		C _{RSS}			6	11	pF
SWITCHING CHARACTERISTICS							
Turn-On Delay Time		t _{D(ON)}	V _{DD} = 30V, I _D = 0.5A, R _G = 25Ω (Note 1, 2)		45		ns
Turn-On Rise Time		t _R			49		ns
Turn-Off Delay Time		t _{D(OFF)}			80		ns
Turn-Off Fall Time		t _F			43		ns
Total Gate Charge		Q _G	V _{DS} = 50V,I _D = 1.3A, V _{GS} = 10V (Note 1, 2)		20		nC
Gate-Source Charge		Q _{GS}			5.6		nC
Gate-Drain Charge		Q _{GD}			4.0		nC
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS							
Drain-Source Diode Forward Voltage		V _{SD}	V _{GS} = 0V, I _S = 4.4A			1.4	V
Maximum Continuous Drain-Source Diode Forward Current		I _S				4.4	A
Maximum Pulsed Drain-Source Diode Forward Current		I _{SM}				17.6	A

Notes: 1. Pulse Test: Pulse width $\leq 300\mu s$, Duty cycle $\leq 2\%$
 2. Essentially independent of operating temperature

■ TEST CIRCUITS AND WAVEFORMS

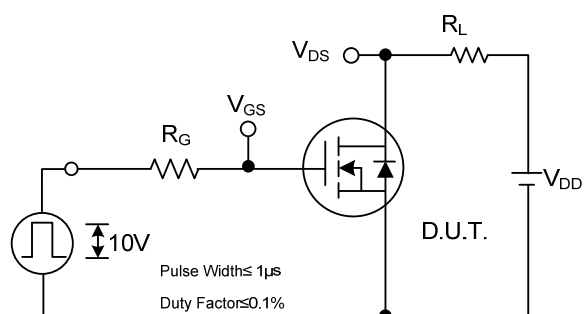


Peak Diode Recovery dv/dt Test Circuit

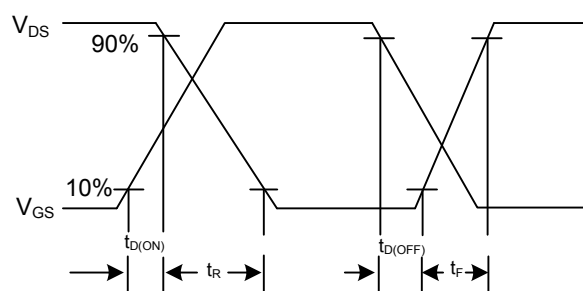


Peak Diode Recovery dv/dt Waveforms

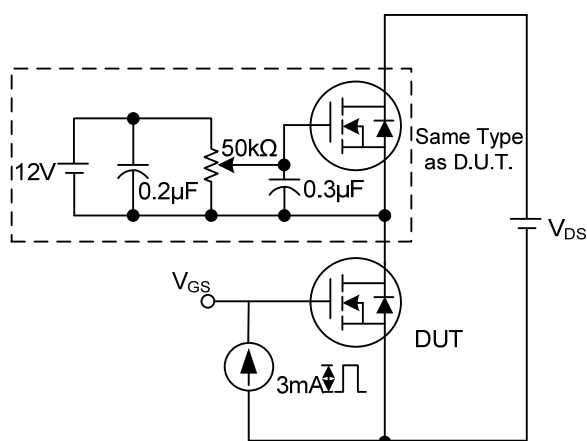
■ TEST CIRCUITS AND WAVEFORMS (Cont.)



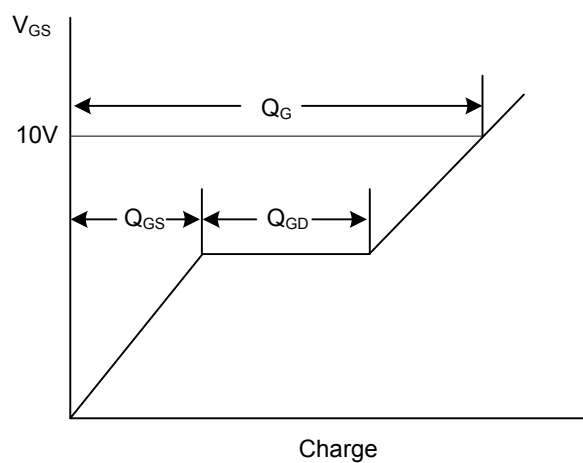
Switching Test Circuit



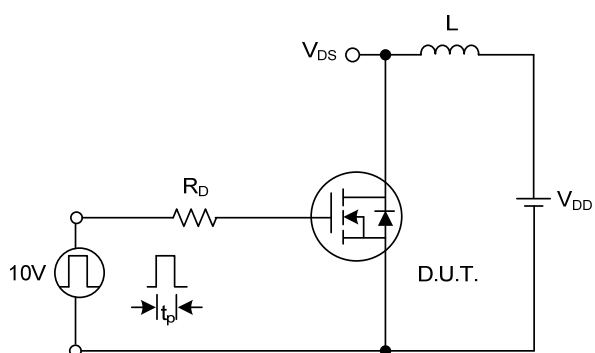
Switching Waveforms



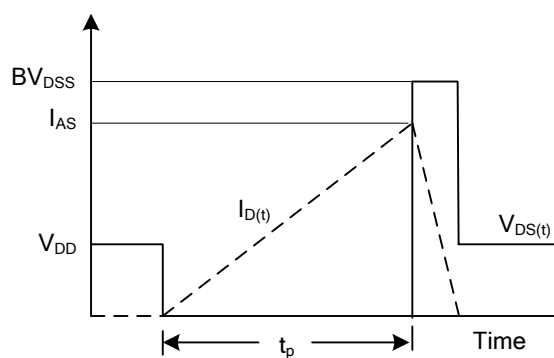
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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