



4N60K-MT

Preliminary

Power MOSFET

4A, 600V N-CHANNEL
POWER MOSFET

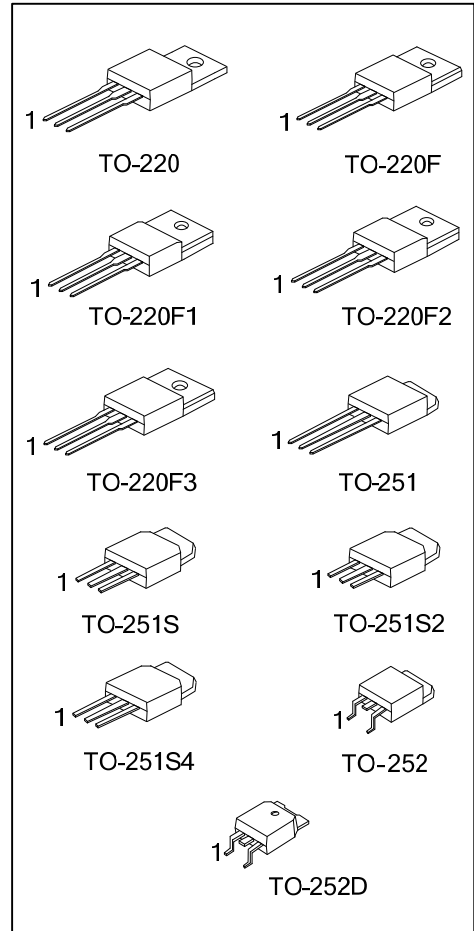
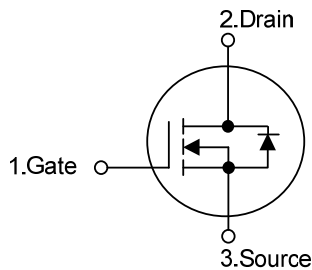
DESCRIPTION

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



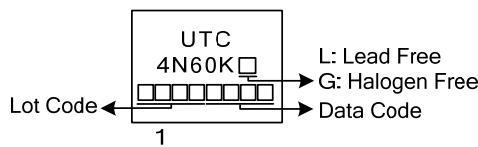
ORDERING INFORMATION

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

<p>4N60KL-TA3-T</p> <p>(1) Packing Type (2) Package Type (3) Green Package</p>	<p>(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</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
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 TO-220F2/TO-220F3		36	
	TO-251/TO-251S TO-251S2/TO-251S4 TO-252/TO-252D		50	
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. $L = 26.25\text{mH}$, $I_{AS} = 4\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\ \Omega$, 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

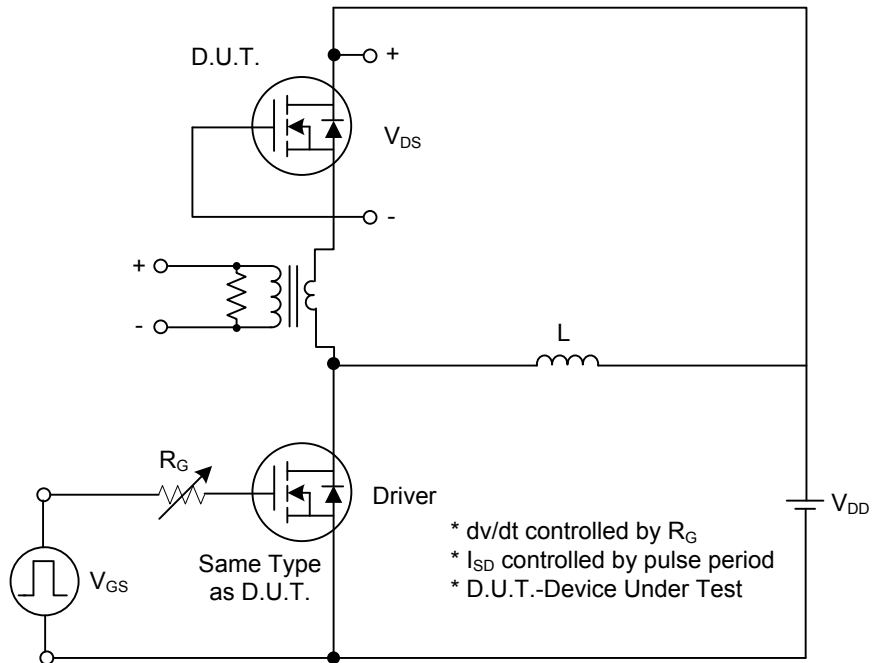
PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220/TO-220F TO-220F1/TO-220F2 TO-220F3	θ_{JA}	62.5	$^\circ\text{C}/\text{W}$
	TO-251/TO-251S TO-251S2/TO-251S4 TO-252/TO-252D		110	$^\circ\text{C}/\text{W}$
Junction to Case	TO-220	θ_{JC}	1.18	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1 TO-220F3	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

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

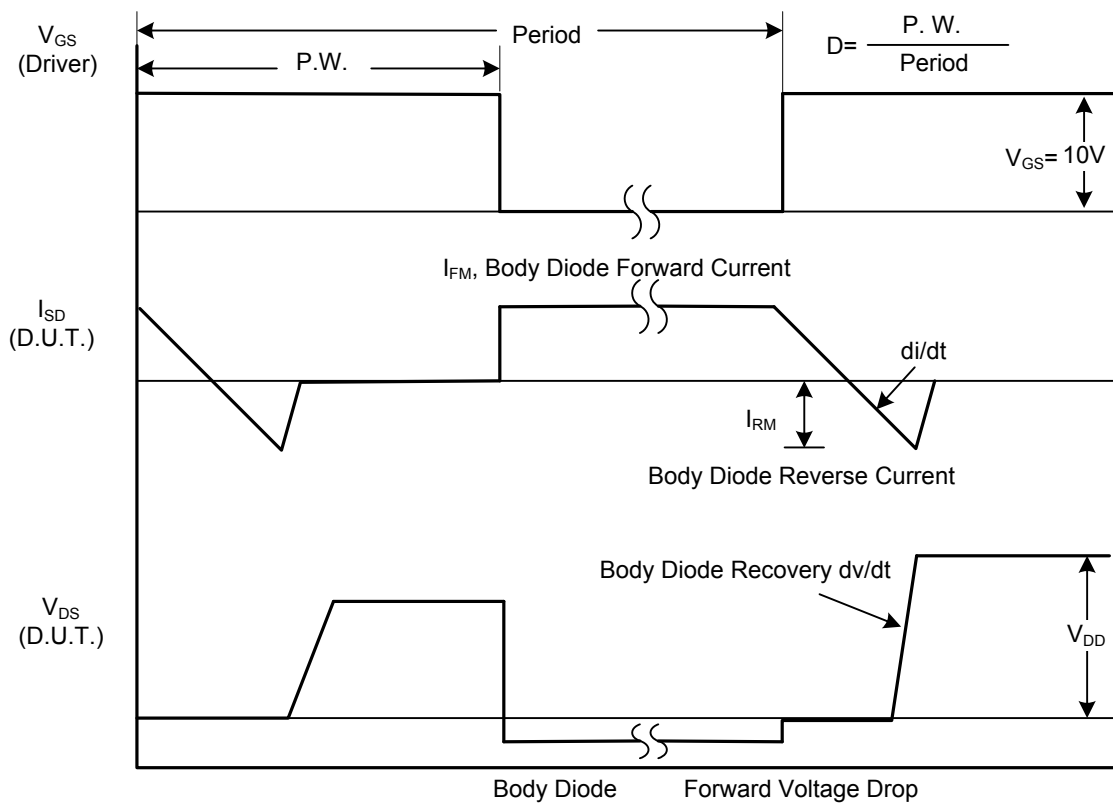
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS}=0V, I_D=250\mu A$	600			V
Drain-Source Leakage Current	I_{DSS}	$V_{DS}=600V, V_{GS}=0V$			10	μA
		$V_{DS}=600V, V_{GS}=0V, T_C=125^\circ\text{C}$			10	μA
Gate-Source Leakage Current	Forward	I_{GSS}			100	nA
	Reverse					
					-100	nA
Breakdown Voltage Temperature Coefficient	$\Delta BV_{DSS}/\Delta T_J$	$I_D=250\mu A$, Referenced to 25°C		0.6		$V/^\circ\text{C}$
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	3.0		5.0	V
Static Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=2.2A$		1.79	2.5	Ω
DYNAMIC CHARACTERISTICS						
Input Capacitance	C_{ISS}	$V_{DS} = 25V, V_{GS} = 0V,$ $f = 1\text{MHz}$		425	575	pF
Output Capacitance	C_{OSS}			55	75	pF
Reverse Transfer Capacitance	C_{RSS}			6	11	pF
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	$t_{D(ON)}$	$V_{DD} = 30V, I_D = 0.5A,$ $R_G = 25\Omega$ (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

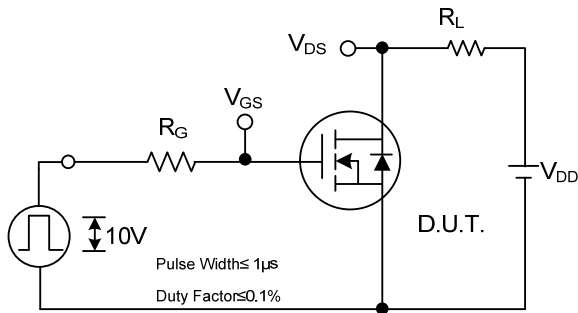


Peak Diode Recovery dv/dt Test Circuit

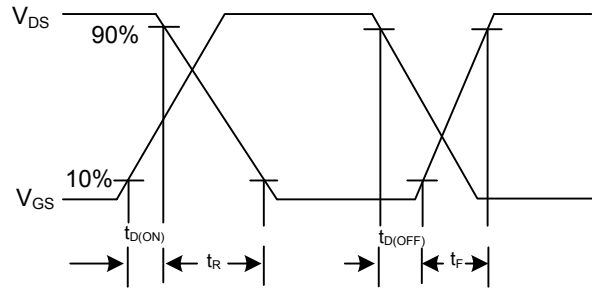


Peak Diode Recovery dv/dt Waveforms

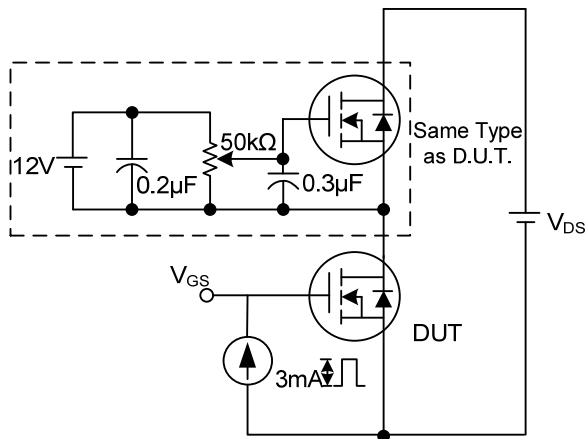
■ TEST CIRCUITS AND WAVEFORMS (Cont.)



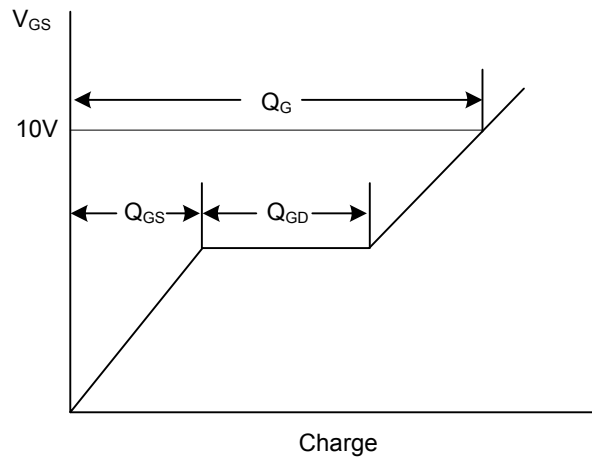
Switching Test Circuit



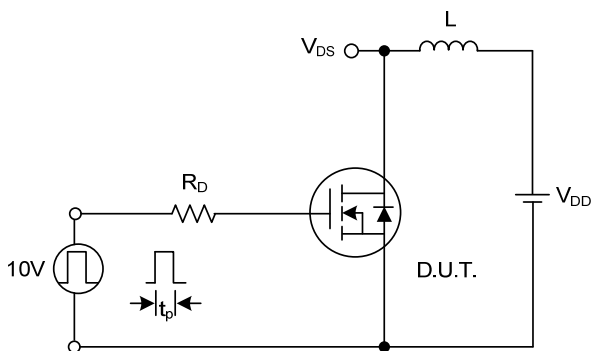
Switching Waveforms



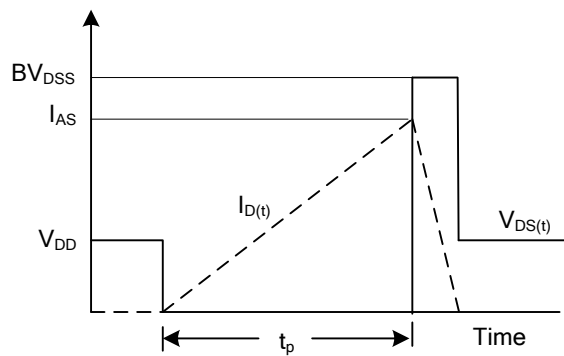
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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