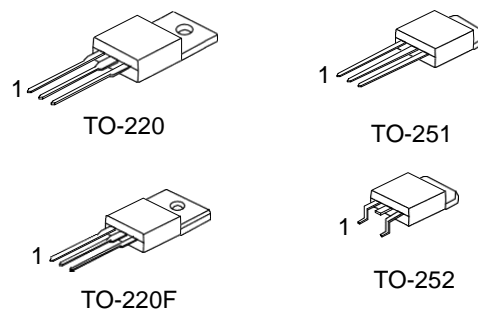


## 4.0A 600V N-CHANNEL POWER MOSFET

### Description:

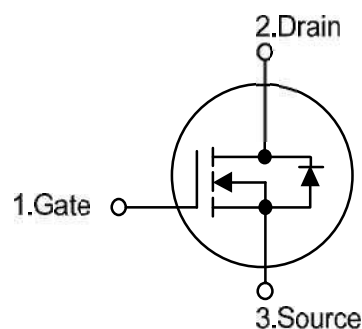
The KW4N60 is a high voltage MOSFET and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristics. This power MOSFET is usually used at high speed switching applications in power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.



### Features:

- \*  $V_{DS} = 600V$
- \*  $I_D = 4.0A$
- \*  $R_{DS(ON)} = 2.5\Omega @ V_{GS} = 10V$ .
- \* Ultra Low gate charge (typical 15nC)
- \* Low reverse transfer capacitance ( $C_{RSS} =$  typical 8.0pF)
- \* Fast switching capability
- \* Avalanche energy specified
- \* Improved dv/dt capability, high ruggedness

### SYMBOL



### ORDERING INFORMATION

Ordering Number	Package	Pin Assignment			Packing
		1	2	3	
KW4N60-LI	TO-220	G	D	S	Tape Box
KW4N60-BL	TO-220	G	D	S	Bulk
KW4N60F-LI	TO-220F	G	D	S	Tube
KW4N60A-LI	TO-251	G	D	S	Tube
KW4N60D-TR	TO-252	G	D	S	Tape Ree
KW4N60D-LI	TO-252	G	D	S	Tube

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

**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)	$E_{AS}$	200	mJ
	Repetitive (Note 2)			
Peak Diode Recovery $dv/dt$ (Note 4)		$dv/dt$	4.5	V/ns
Power Dissipation	TO-220	$P_D$	106	W
	TO-220F		36	
	TO-251		50	
	TO-252		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.  $L = 30\text{mH}$ ,  $I_{AS} = 4\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\ \Omega$ , 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**

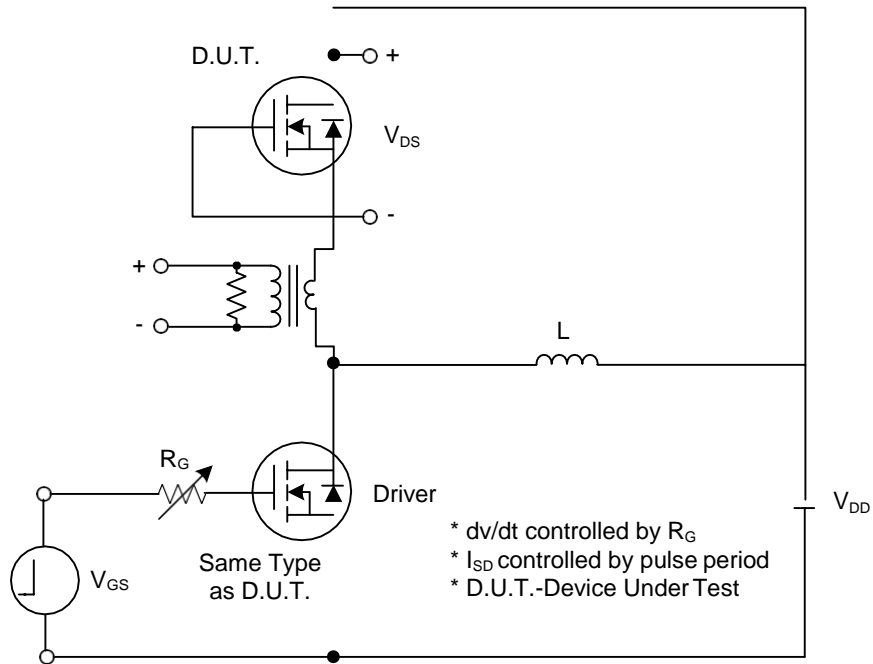
PARAMETER	PACKAGE	SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220	$\theta_{JA}$	62.5	$^\circ\text{C}/\text{W}$
	TO-220F		62.5	
	TO-251		110	
	TO-252		110	
Junction to Case	TO-220	$\theta_{JC}$	1.18	$^\circ\text{C}/\text{W}$
	TO-220F		3.47	
	TO-251		2.5	
	TO-252		2.5	

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

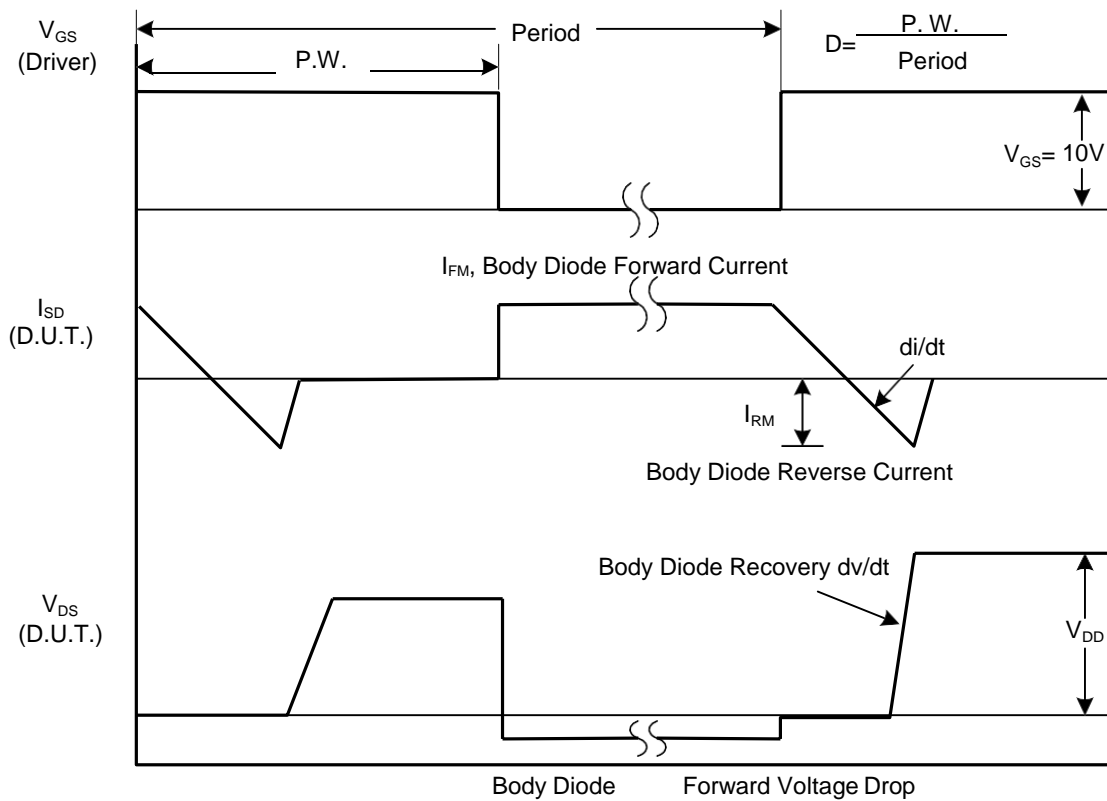
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
<b>OFF CHARACTERISTICS</b>							
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	600			V	
Drain-Source Leakage Current	$I_{DSS}$	$V_{DS} = 600V, V_{GS} = 0V$			10	$\mu A$	
Gate-Source Leakage Current	Forward	$V_{GS} = 30V, V_{DS} = 0V$			100	nA	
	Reverse		$V_{GS} = -30V, V_{DS} = 0V$			-100	nA
Breakdown Voltage Temperature Coefficient	$\Delta BV_{DSS}/\Delta T_J$	$I_D = 250\mu A$ , Referenced to $25^\circ C$		0.6		$V/^\circ C$	
<b>ON CHARACTERISTICS</b>							
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	2.0		4.0	V	
Static Drain-Source On-State Resistance	KW4N60	$V_{GS} = 10V, I_D = 2.2A$		2.2	2.5	$\Omega$	
	KW4N60-E			2.2	2.5	$\Omega$	
	KW4N60-N			2.2	2.5	$\Omega$	
	KW4N60-Q			2.2	2.5	$\Omega$	
	KW4N60-S			2.2	2.5	$\Omega$	
<b>DYNAMIC CHARACTERISTICS</b>							
Input Capacitance	$C_{ISS}$	$V_{DS} = 25V, V_{GS} = 0V,$ $f = 1MHz$		520	670	pF	
Output Capacitance	$C_{OSS}$			70	90	pF	
Reverse Transfer Capacitance	$C_{RSS}$			8	11	pF	
<b>SWITCHING CHARACTERISTICS</b>							
Turn-On Delay Time	$t_{D(ON)}$	$V_{DD} = 300V, I_D = 4.0A,$ $R_G = 25\Omega$ (Note 1, 2)		13	35	ns	
Turn-On Rise Time	KW4N60		$t_R$		70	100	ns
	KW4N60-E				60	100	ns
	KW4N60-N				100	130	ns
	KW4N60-Q				45	100	ns
	KW4N60-S				40	100	ns
Turn-Off Delay Time	$t_{D(OFF)}$			25	60	ns	
Turn-Off Fall Time	KW4N60		$t_F$		100	120	ns
	KW4N60-E				70	120	ns
	KW4N60-N				180	220	ns
	KW4N60-Q			35	120	ns	
	KW4N60-S			70	120	ns	
Total Gate Charge	$Q_G$		15	20	nC		
Gate-Source Charge	$Q_{GS}$	$V_{DS} = 480V, I_D = 4.0A,$		3.4		nC	
Gate-Drain Charge	$Q_{GD}$	$V_{GS} = 10V$ (Note 1, 2)		7.1		nC	
<b>SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS</b>							
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	
Reverse Recovery Time	$t_{rr}$	$V_{GS} = 0V, I_S = 4.4A,$		250		ns	
Reverse Recovery Charge	$Q_{RR}$	$di_F/dt = 100 A/\mu s$ (Note 1)		1.5		$\mu C$	

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

**TEST CIRCUITS AND WAVEFORMS**

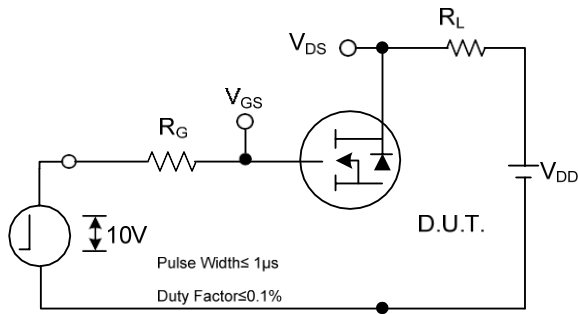


**Peak Diode Recovery  $dv/dt$  Test Circuit**

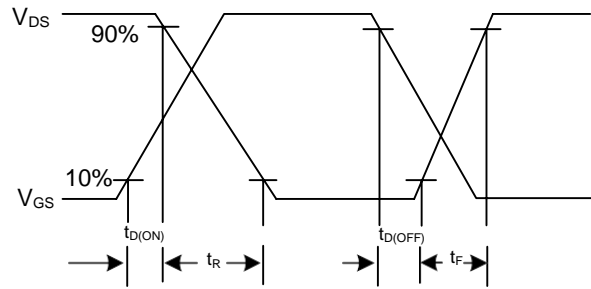


**Peak Diode Recovery  $dv/dt$  Waveforms**

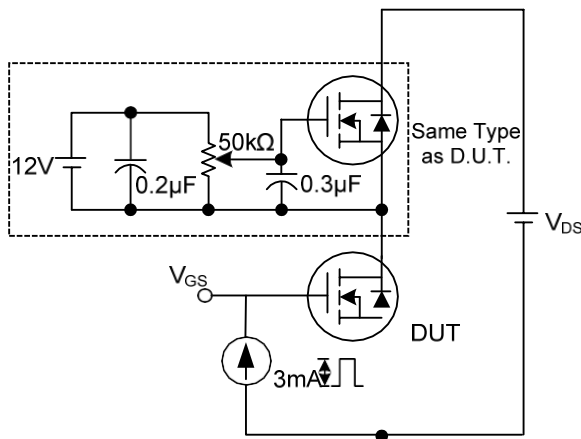
**TEST CIRCUITS AND WAVEFORMS(Cont.)**



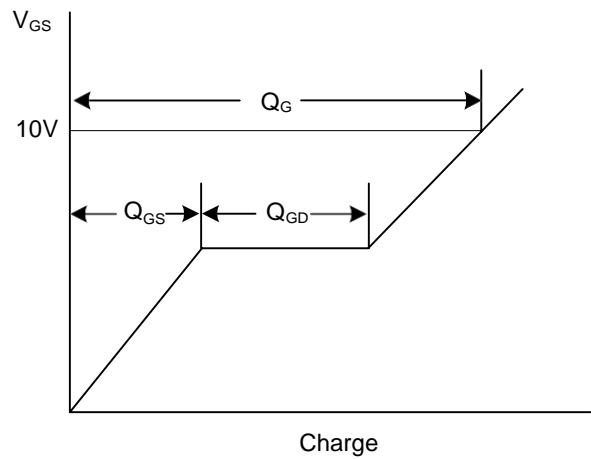
**Switching Test Circuit**



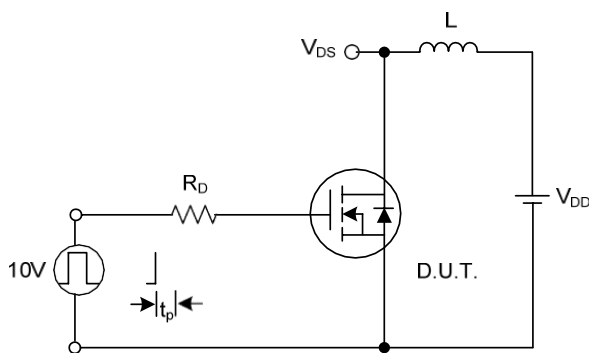
**Switching Waveforms**



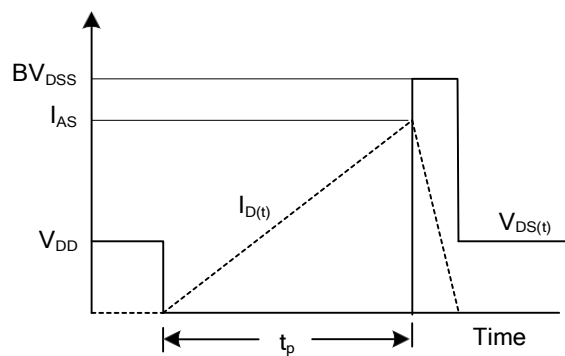
**Gate Charge Test Circuit**



**Gate Charge Waveform**

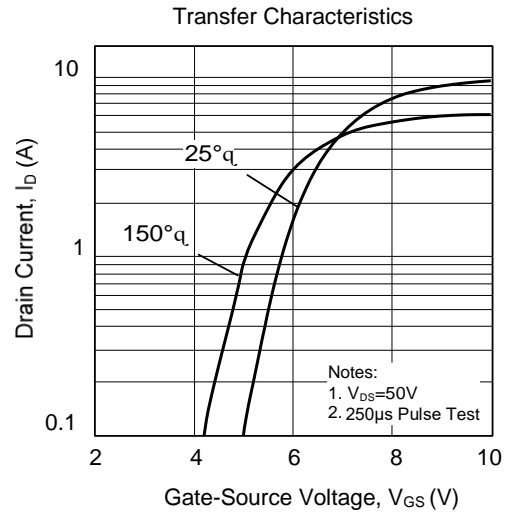
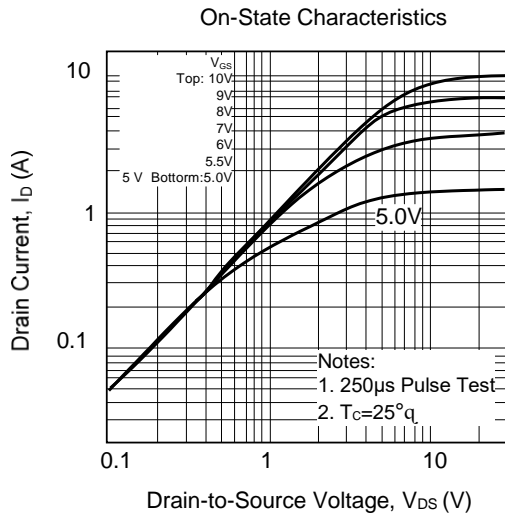
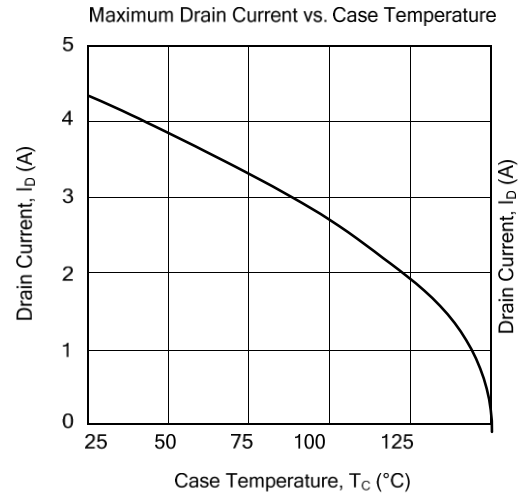
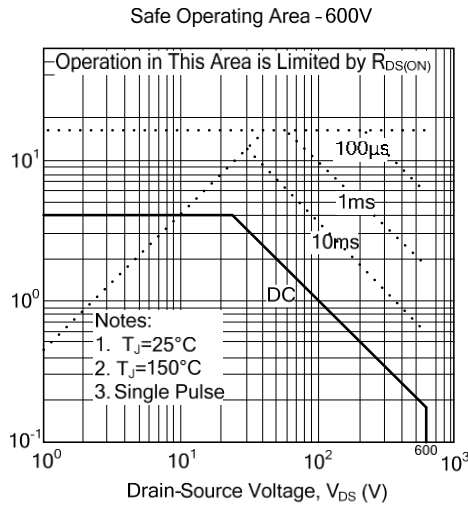
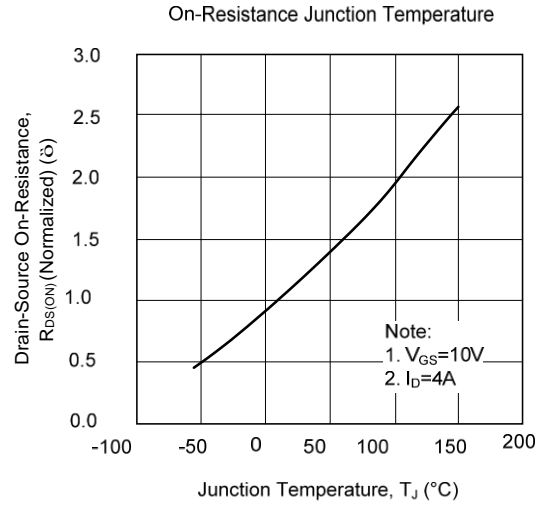
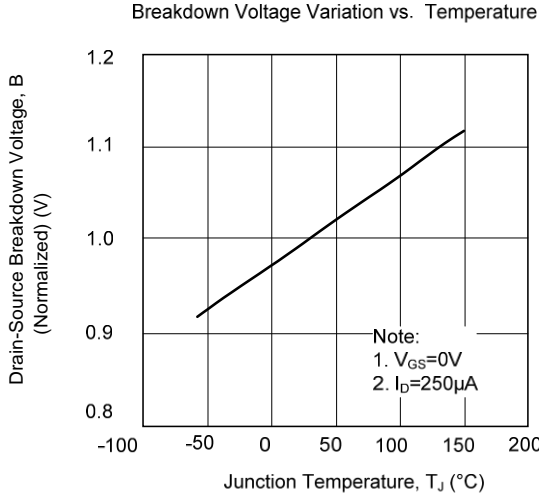


**Unclamped Inductive Switching Test Circuit**



**Unclamped Inductive Switching Waveforms**

**TYPICAL CHARACTERISTICS**



**TYPICAL CHARACTERISTICS(Cont.)**

