

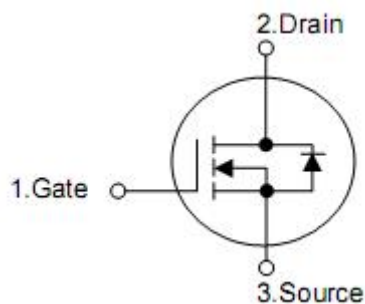
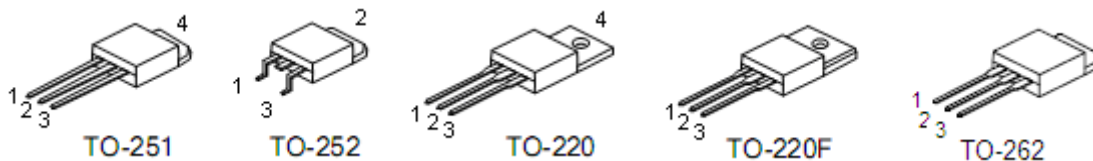
## 1. Description

The KIA4N60H N-Channel enhancement mode silicon gate power MOSFET is designed for high voltage, high speed power switching applications such as switching regulators, switching converters, solenoid, motor drivers, relay drivers.

## 2. Features

- n  $R_{DS(ON)}=2.3\Omega @ V_{GS}=10V$
- n Low gate charge (typical 13.5nC)
- n High ruggedness
- n Fast switching capability
- n Avalanche energy specified
- n Improved dv/dt capability

## 3. Pin configuration



Pin	Function
1	Gate
2	Drain
3	Source
4	Drain

## 4. Absolute maximum ratings

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

Parameter	Symbol	Rating				Units
		TO220 TO262	TO220F	TO251	TO252	
Drain-source voltage	$V_{DSS}$	600				V
Gate-source voltage	$V_{GSS}$	$\pm 30$				V
Drain current continuous	$I_D$	$T_C=25^\circ\text{C}$	4.0	4.0*	2.8	A
		$T_C=100^\circ\text{C}$	2.4	2.4*	1.8	A
Drain current pulsed (note1)	$I_{DM}$	16	16*	12	A	
Avalanche energy	Repetitive (note1)	9.3		5.5		mJ
	Single pulse (note2)	180				mJ
Peak diode recovery dv/dt (note3)	dv/dt	4.5				V/ns
Total power dissipation	$P_D$	$T_C=25^\circ\text{C}$	93	31	55	W
		Derate above $25^\circ\text{C}$	0.74	0.24	0.44	W/ $^\circ\text{C}$
Junction temperature	$T_J$	+150				$^\circ\text{C}$
Storage temperature	$T_{STG}$	-55~+150				$^\circ\text{C}$

\*Drain current limited by maximum junction temperature.

## 5. Thermal characteristics

Parameter	Symbol	Rating				Unit
		TO220 TO262	TO220F	TO251	TO252	
Thermal resistance, junction-ambient	$R_{thJA}$	62.5		110		$^\circ\text{C/W}$
Thermal resistance, case-to-sink typ	$R_{thJS}$	0.5	--	50		
Thermal resistance junction-case	$R_{thJC}$	1.35	4.05	2.25		

## 6. Electrical characteristics

(T<sub>J</sub>=25°C, unless otherwise notes)

Parameter	Symbol	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
Zero gate voltage drain current	I <sub>DSS</sub>	V <sub>DS</sub> =600V, V <sub>GS</sub> =0V	-	-	1	μA
		V <sub>DS</sub> =480V, T <sub>C</sub> =125 °C	-	-	10	μA
Gate-body leakage current	Forward	I <sub>GSS</sub>	-	-	100	nA
	Reverse				-100	nA
Breakdown voltage temperature coefficient	ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	I <sub>D</sub> =250μA	-	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-resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =2.0A(TO220, TO262, TO220F) I <sub>D</sub> =1.4A(TO251, TO252)	-	2.3	2.7	Ω
<b>Dynamic characteristics</b>						
Input capacitance	C <sub>ISS</sub>	V <sub>DS</sub> =25V, V <sub>GS</sub> =0V, f=1MHz	-	500	-	pF
Output capacitance	C <sub>OSS</sub>		-	45	-	pF
Reverse transfer capacitance	C <sub>RSS</sub>		-	4.5	-	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(TO220, TO262, TO220F) I <sub>D</sub> =2.8A(TO251, TO252) R <sub>G</sub> =25Ω (note4,5)	-	10	-	ns
Rise time	t <sub>R</sub>		-	32	-	ns
Turn-off delay time	t <sub>D(OFF)</sub>		-	32	-	ns
Fall time	t <sub>F</sub>		-	40	-	ns
Total gate charge	Q <sub>G</sub>	V <sub>DS</sub> =480V, I <sub>D</sub> =4.0A(TO220, TO262, TO220F) I <sub>D</sub> =2.8A(TO251, TO252) V <sub>GS</sub> =10V (note4,5)	-	13.5	-	nC
Gate-source charge	Q <sub>GS</sub>		-	2.2	-	nC
Gate-drain charge	Q <sub>GD</sub>		-	5.4	-	nC
<b>Drain-source diode characteristics</b>						
Drain-source diode forward voltage	V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>SD</sub> =4.0A(TO220, TO262, TO220F) I <sub>SD</sub> =2.8A(TO251, TO252)	-	-	1.4	V
Continuous drain-source current	I <sub>SD</sub>	TO220, TO262, TO220F	-	-	4.0	A
		TO251, TO252	-	-	2.8	
Pulsed drain-source current	I <sub>SM</sub>	TO220, TO262, TO220F	-	-	16.0	A
		TO251, TO252	-	-	12	
Reverse recovery time	t <sub>RR</sub>	I <sub>SD</sub> =4.0A(TO220, TO262, TO220F)	-	250	-	ns
Reverse recovery charge	Q <sub>RR</sub>	I <sub>SD</sub> =2.8A(TO251, TO252) di <sub>SD</sub> /dt=100A/μs (note 4)	-	1.8	-	μC

Notes: 1. Repetitive rating : pulse width limited by maximum junction temperature

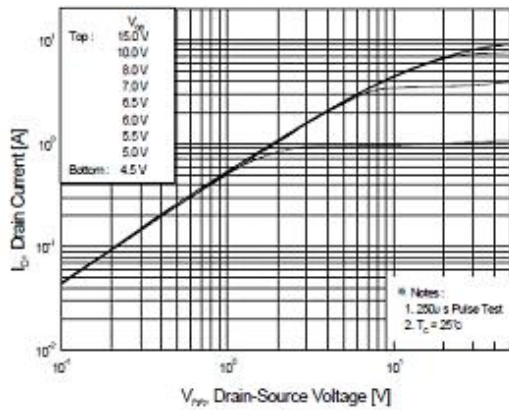
2. L=20mH, I<sub>AS</sub>=4.0A, V<sub>DD</sub>=50V, R<sub>G</sub>=25Ω, starting T<sub>J</sub>=25°C

3. I<sub>SD</sub>≤4.0A, di/dt≤200A/μs, V<sub>DD</sub>≤BV<sub>DSS</sub>, starting T<sub>J</sub>=25 °C

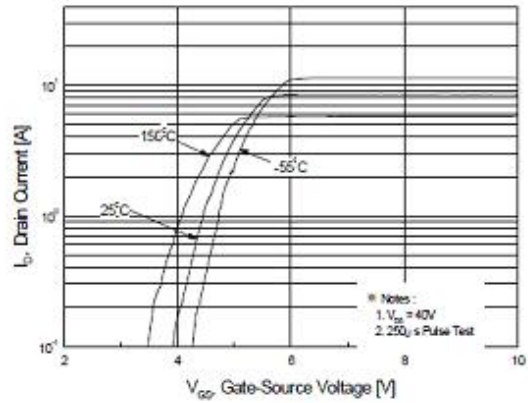
4. Pulse test : pulse width≤300μs, duty cycle≤2%

5. Essentially independent of operating temperature

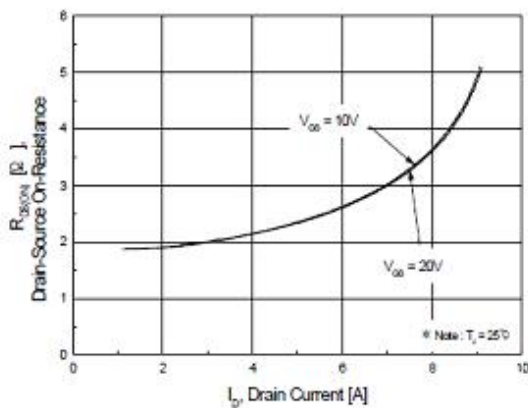
**7. Test circuits and waveforms**



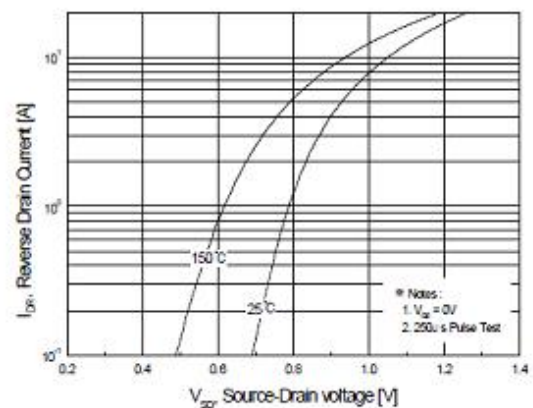
**Figure 1. On-Region Characteristics**



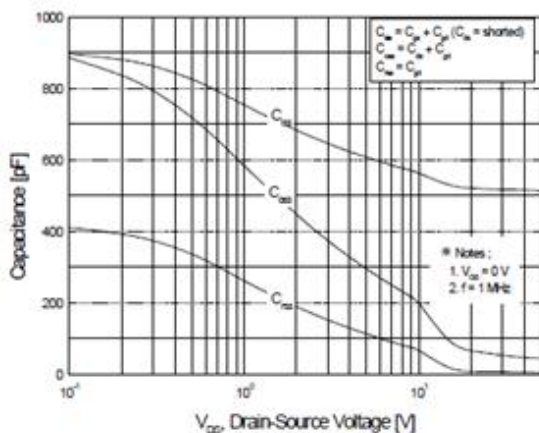
**Figure 2. Transfer Characteristics**



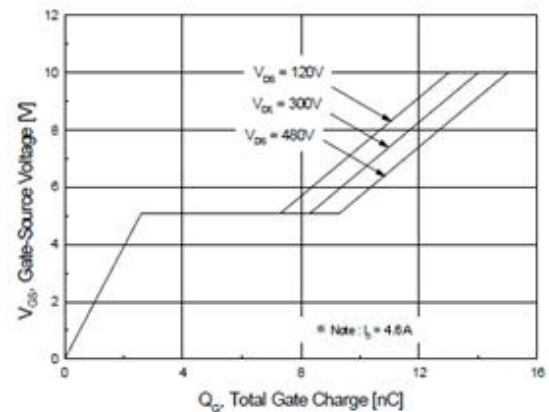
**Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage**



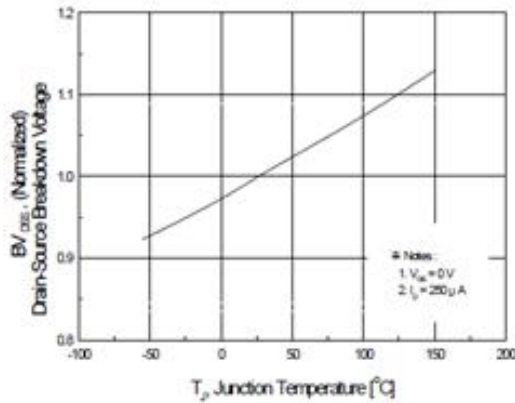
**Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature**



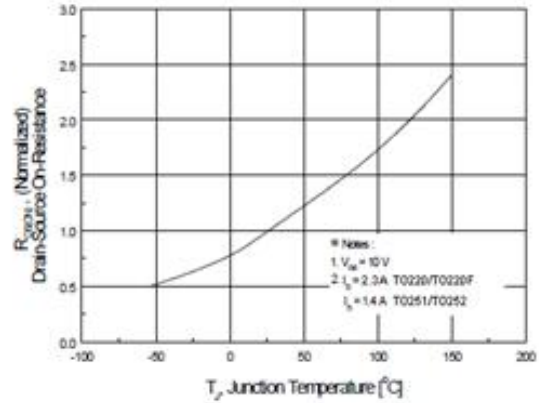
**Figure 5. Capacitance Characteristics**



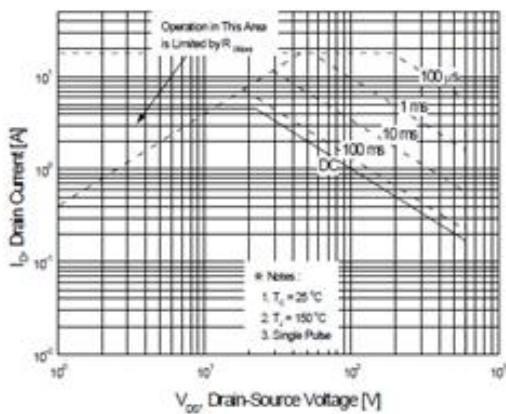
**Figure 6. Gate Charge Characteristics**



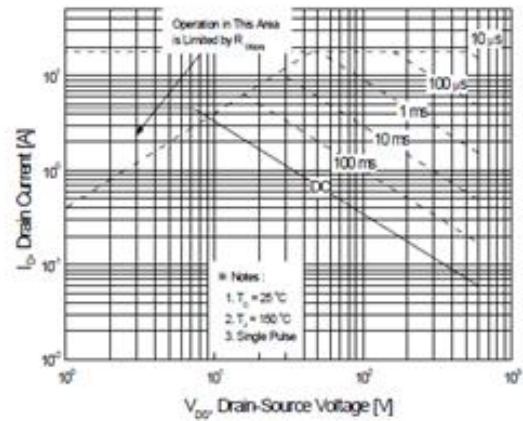
**Figure 7. Breakdown Voltage Variation vs Temperature**



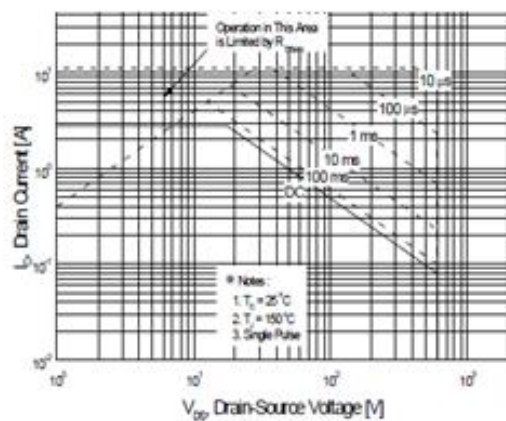
**Figure 8. On-Resistance Variation vs Temperature**



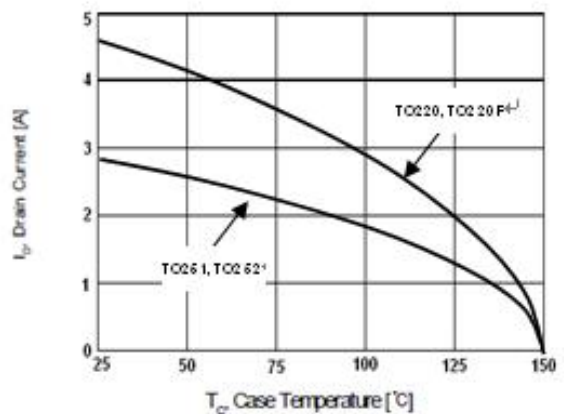
**Figure 9-1. Maximum Safe Operating Area for TO220**



**Figure 9-2. Maximum Safe Operating Area for TO220F**

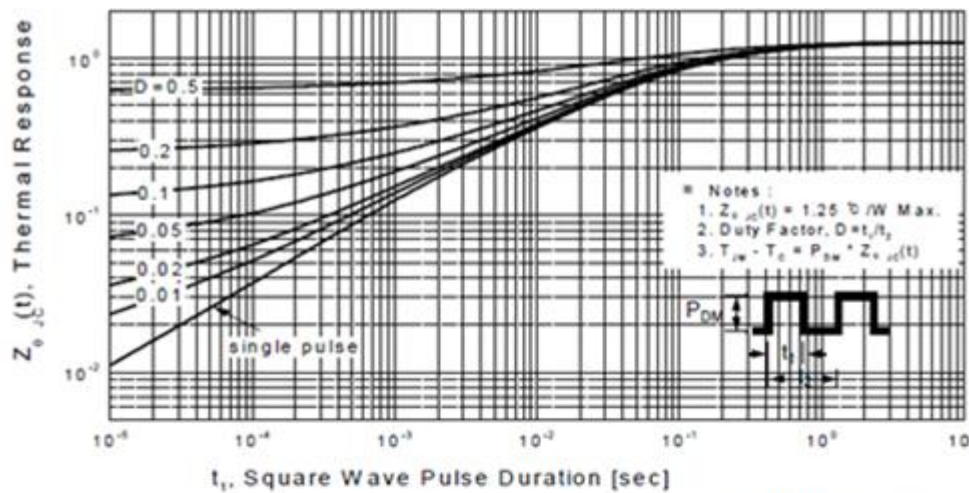


**Figure 9-3. Maximum Safe Operating Area for TO251, TO252**

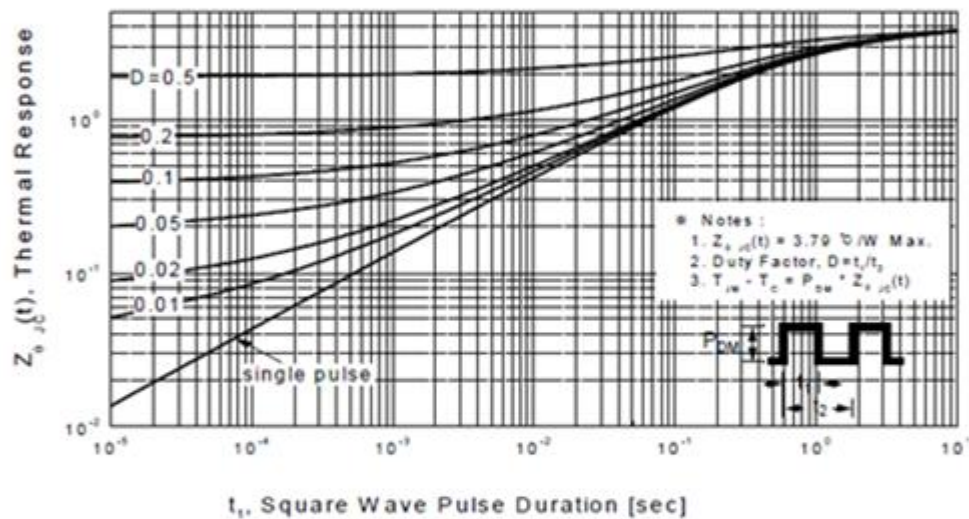


**Figure 10. Maximum Drain Current vs Case Temperature**

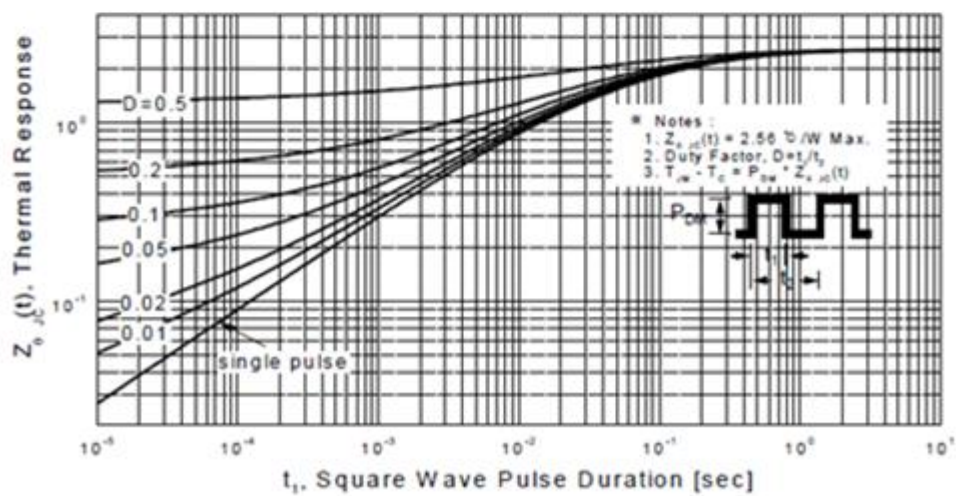




**Figure 11-1. Transient Thermal Response Curve for TO220/TO262**



**Figure 11-2. Transient Thermal Response Curve for TO220F**



**Figure 11-3. Transient Thermal Response Curve for TO251/T0252**