

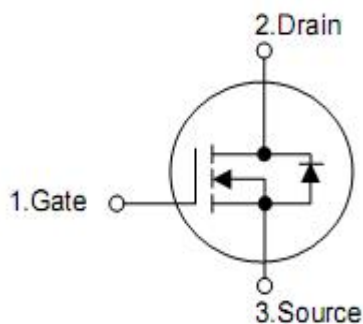
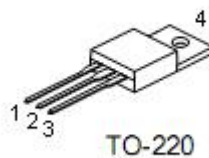
## 1. General Features

- $R_{DS(ON),typ.}=4m\Omega(typ.)@V_{GS}=10V$
- Proprietary New Trench Technology
- Low Gate Charge Minimize Switching Loss
- Fast Recovery Body Diode

## 2. Applications

- DC-DC converters
- DC-DC Inverters
- Power Supply

## 3. Pin configuration



Pin	Function
1	Gate
2	Drain
3	Source
4	Drain

## 4. Ordering Information

Part Number	Package	Brand
KNP2404N	TO-220	KIA

## 5. Absolute maximum ratings

(T<sub>c</sub> = 25 °C , unless otherwise specified)

Symbol	Parameter	Ratings	Unit
V <sub>DSS</sub>	Drain-to-Source Voltage <sup>[1]</sup>	40	V
V <sub>GSS</sub>	Gate-to-Source Voltage	±20	
I <sub>D</sub>	Continuous Drain Current <sup>[2]</sup>	190	A
	Continuous Drain Current <sup>[3]</sup>	80	
I <sub>DM</sub>	Pulsed Drain Current at V <sub>GS</sub> =10V <sup>[2,4]</sup>	480	
E <sub>AS</sub>	Single Pulse Avalanche Energy	1200	mJ
dv /dt	Peak Diode Recovery dv/dt <sup>[3]</sup>	5.0	V/ns
P <sub>D</sub>	Power Dissipation	333	W
	Derating Factor above 25 °C	2	W/ °C
T <sub>L</sub> T <sub>PAK</sub>	Maximum Temperature for Soldering Leads at 0.063in (1.6mm) from Case for 10 seconds, Package Body for 10 seconds	300 260	°C
T <sub>J</sub> &T <sub>STG</sub>	Operating and Storage Temperature Range	-55 to 175	

*Caution: Stresses greater than those listed in the “Absolute Maximum Ratings” may cause permanent damage to the device.*

\* Drain current limited by maximum junction temperature.

## 6. Thermal characteristics

Symbol	Parameter	Ratings	Unit
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case	0.45	°C /W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient	62	

## 6. Electrical characteristics

OFF Characteristics		(T <sub>J</sub> =25°C, unless otherwise specified)				
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
B <sub>V</sub> DSS	Drain-to-Source Breakdown Voltage	V <sub>GS</sub> =0V, I <sub>D</sub> =250uA	40	--	--	V
I <sub>DSS</sub>	Drain-to-Source Leakage Current	V <sub>DS</sub> =40V, V <sub>GS</sub> =0V	--	--	1	uA
		V <sub>DS</sub> =32V, V <sub>GS</sub> =0V, T <sub>J</sub> =125°C	--	--	100	
I <sub>GSS</sub>	Gate-to-Source Leakage Current	V <sub>GS</sub> =+20V, V <sub>DS</sub> =0V	--	--	+100	nA
		V <sub>GS</sub> =-20V, V <sub>DS</sub> =0V	--	--	-100	
ON Characteristics		(T <sub>J</sub> =25°C, unless otherwise specified)				
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
R <sub>DS(ON)</sub>	Static Drain-to-Source On-Resistance <sup>[4]</sup>	V <sub>GS</sub> =10V, I <sub>D</sub> =80A <sup>[5]</sup>	--	4.0	5.0	mΩ
V <sub>GS(TH)</sub>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250uA	2.0	--	4.0	V
Dynamic Characteristics		Essentially independent of operating temperature				
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> =0V, V <sub>DS</sub> =25V, f=1.0MHZ	--	3850	--	pF
C <sub>oss</sub>	Output Capacitance		--	1750	--	
C <sub>rss</sub>	Reverse Transfer Capacitance		--	420	--	
R <sub>g</sub>	Gate Series Resistance	f=1.0MHZ	--	1.5	--	Ω
Q <sub>g</sub>	Total Gate Charge	V <sub>DD</sub> =20V, I <sub>D</sub> =80A, V <sub>GS</sub> =0 to 10V	--	97	--	nC
Q <sub>gs</sub>	Gate-to-Source Charge		--	18	--	
Q <sub>gd</sub>	Gate-to-Drain (Miller) Charge		--	37	--	
Resistive Switching Characteristics		Essentially independent of operating temperature				
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t <sub>d(ON)</sub>	Turn-on Delay Time	V <sub>DD</sub> =20V, I <sub>D</sub> =50A, V <sub>GS</sub> = 10V R <sub>G</sub> =10Ω	--	32	--	nS
t <sub>rise</sub>	Rise Time		--	90	--	
t <sub>d(OFF)</sub>	Turn-Off Delay Time		--	100	--	
t <sub>fall</sub>	Fall Time		--	72	--	
Source-Drain Body Diode Characteristics		(T <sub>J</sub> =25°C, unless otherwise specified)				
Symbol	Parameter	Test Conditions	Min	Typ.	Max.	Unit
I <sub>SD</sub>	Continuous Source Current <sup>[4]</sup>	Integral PN-diode in MOSFET	--	--	190	A
I <sub>SM</sub>	Pulsed Source Current <sup>[4]</sup>		--	--	480	
V <sub>SD</sub>	Diode Forward Voltage	I <sub>S</sub> =80A, V <sub>GS</sub> =0V	--	--	1.3	V
t <sub>rr</sub>	Reverse recovery time	V <sub>GS</sub> =0V, I <sub>F</sub> =80A, diF/dt=100A/μs	--	76	--	ns
Q <sub>rr</sub>	Reverse recovery charge		--	35	--	nC

Note:

[1] T<sub>J</sub> = +25 °C to +175 °C.

[2] [2] Silicon limited current only.

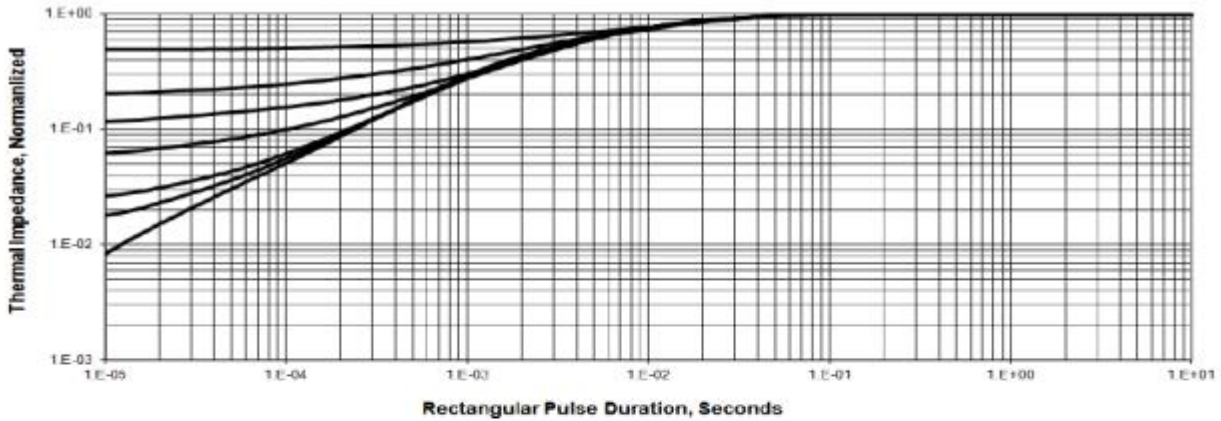
[3] [3] Package limited current.

[4] Repetitive rating; pulse width limited by maximum junction temperature.

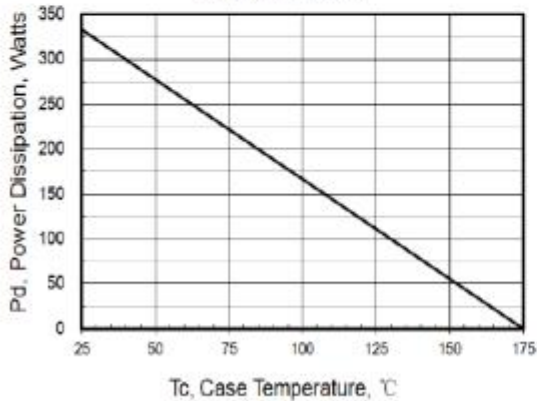
[5] Pulse width ≤ 380μs; duty cycle ≤ 2%.

**7. Test circuits and waveforms**

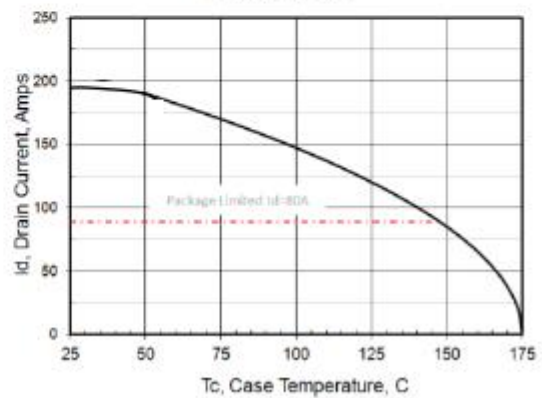
**Figure 1. Maximum Transient Thermal Impedance**



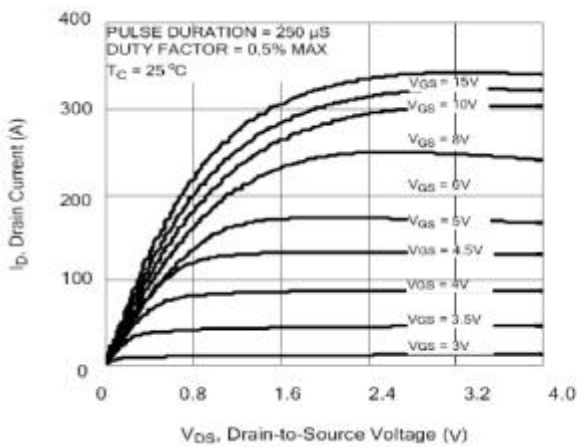
**Figure 2 . Max. Power Dissipation vs Case Temperature**



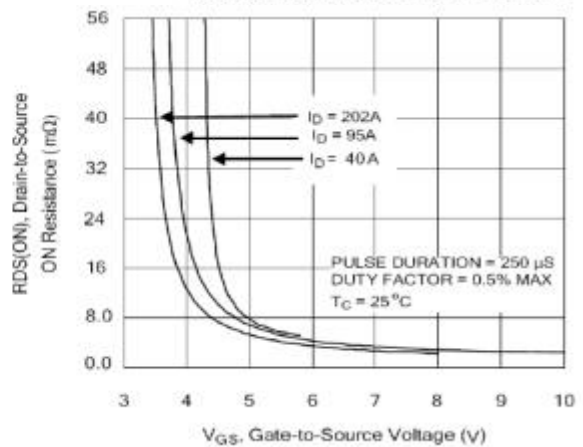
**Figure 3 .Maximum Continuous Drain Current vs Tc**



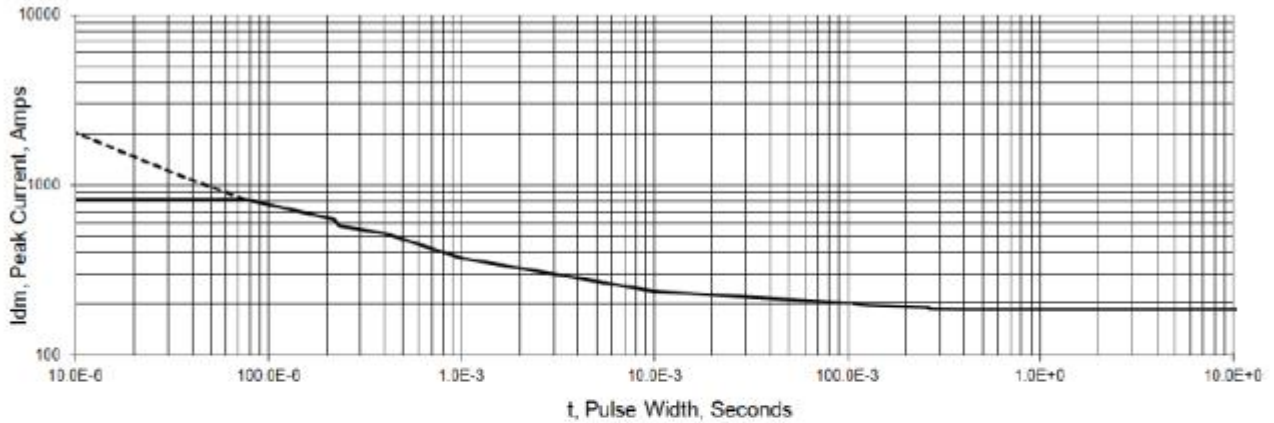
**Figure 4. Typical Output Characteristics**



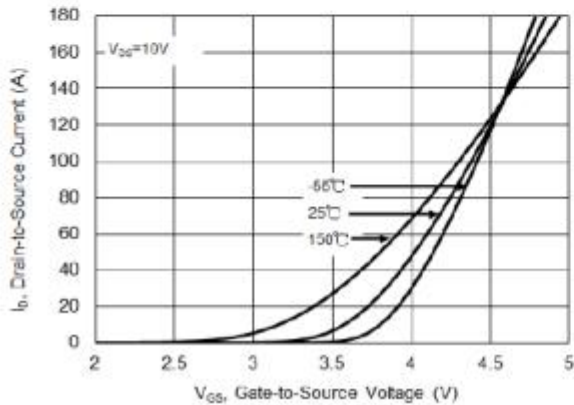
**Figure5. Typical Drain-to-Source ON Resistance vs Gate Voltage and Drain Current**



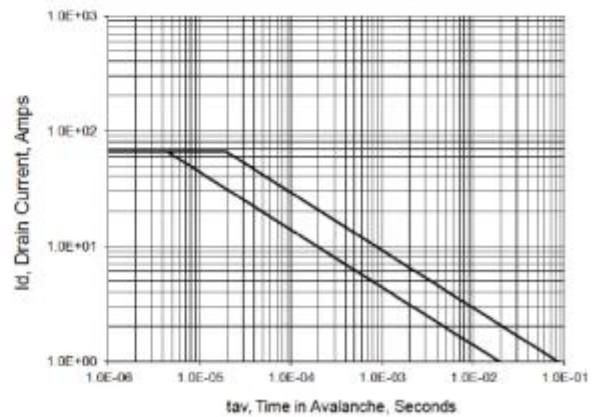
**Figure 6. Peak Current Capability**



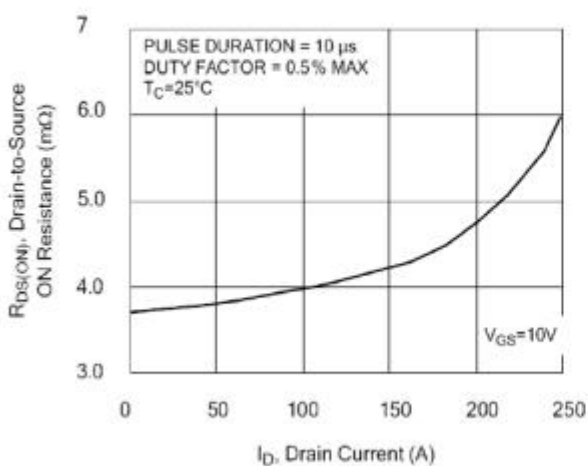
**Figure 7. Typical Transfer Characteristics**



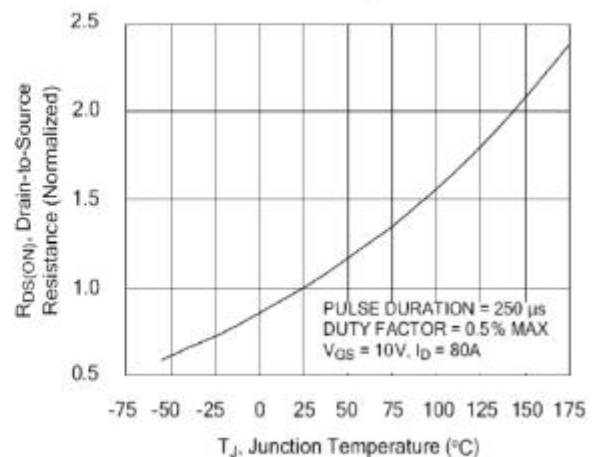
**Figure 8. Unclamped Inductive Switching Capability**



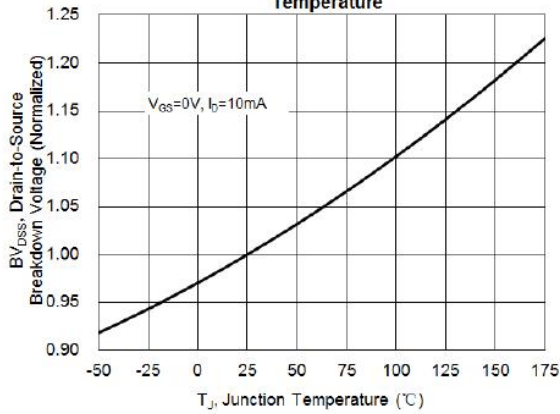
**Figure 9. Typical Drain-to-Source ON Resistance vs Drain Current**



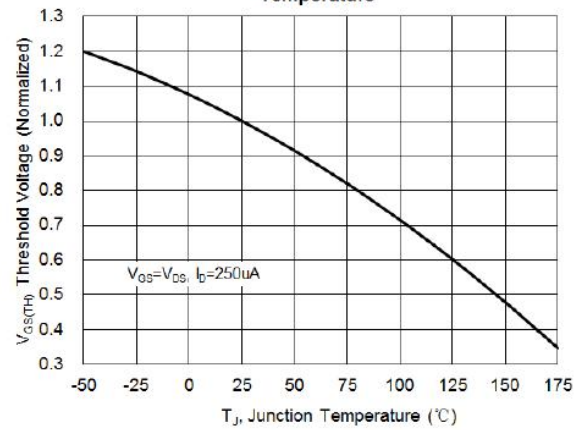
**Figure 10. Typical Drain-to-Source ON Resistance vs Junction Temperature**



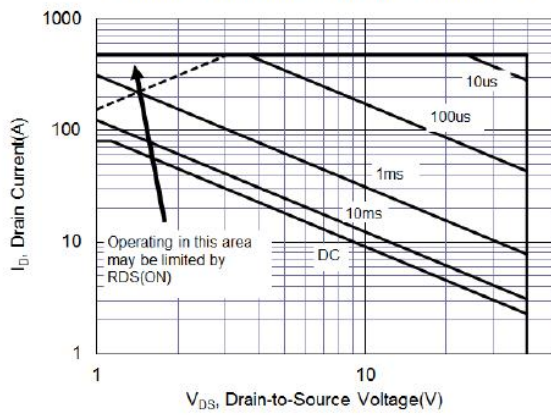
**Figure 11. Typical Breakdown Voltage vs. Junction Temperature**



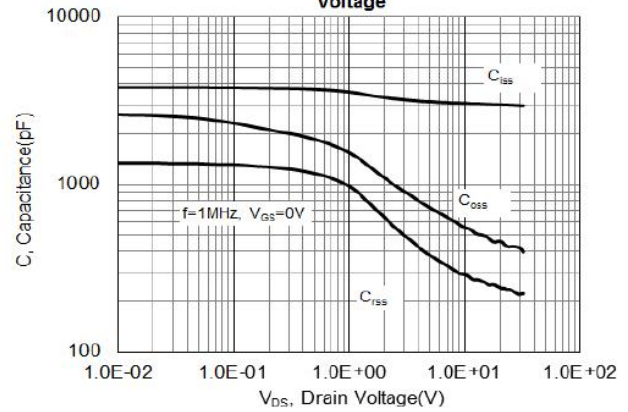
**Figure 12. Typical Threshold Voltage vs. Junction Temperature**



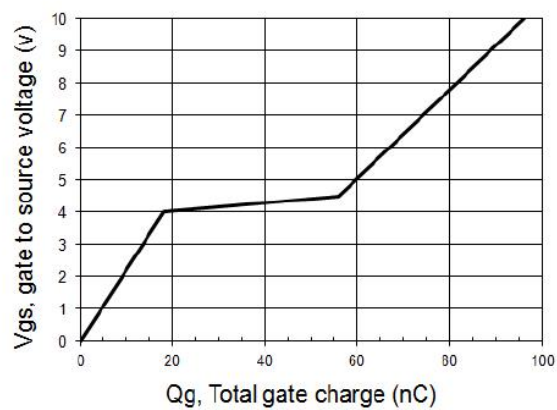
**Figure 13. Maximum Forward Safe Operation Area**



**Figure 14. Typical Capacitance vs. Drain-to-Source Voltage**



**Figure 15. Typical Gate Charge**



**Figure 16. Body Diode Transfer Characteristics**

