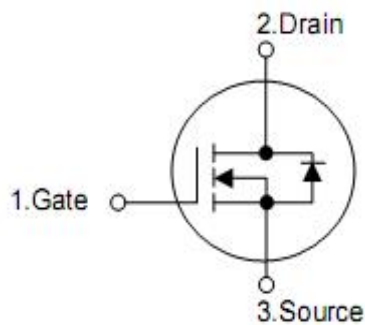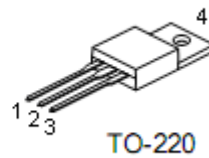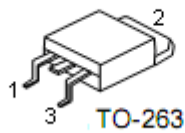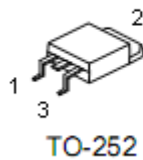## 1. General Features

- n Proprietary New Trench Technology
- n $R_{DS(ON),typ.}=3.0m\Omega(typ.)@V_{GS}=10V$
- n Low Gate Charge Minimize Switching Loss
- n Fast Recovery Body Diode

2. Applications

- n High efficiency DC/DC converters
- n Synchronous Rectification
- n UPS Inverter

3. Pin configuration

TO-252   TO-263   TO-220

Pin	Function
1	Gate
2	Drain
3	Source
4	Drain

4. Ordering Information

Part Number	Package	Brand
KNP2804A	TO-220	KIA
KNB2804A	TO-263	KIA
KND2804A	TO-252	KIA

5. Absolute maximum ratings

(Tc= 25 ºC , unless otherwise specified)

Symbol	Parameter	Rating		Unit
		To-252	To-220/263	
V_{DSS}	Drain-to-Source Voltage[1]	40		V
V_{GSS}	Gate-to-Source Voltage	±20		
I_D	Continuous Drain Current[2]	150*	150	A
	Continuous Drain Current[3]	80*	80	
I_{DM}	Pulsed Drain Current at V_{GS}=10V[2,4]	600*	600	
E_{AS}	Single Pulse Avalanche Energy	240	240	mJ
dv /dt	Peak Diode Recovery dv/dt[3]	5.0		V/ns
P_D	Power Dissipation	164	300	W
	Derating Factor above 25 ºC	1.09	2.0	W/ ºC
T_L T_{PAK}	Maximum Temperature for Soldering Leads at 0.063in (1.6mm) from Case for 10 seconds, Package Body for 10 seconds	300 260		ºC
T_J&T_{STG}	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	Rating		Unit
		To-252	To-220/263	
$R_{θJC}$	Thermal Resistance, Junction-to-Case	0.91	0.5	ºC /W
$R_{θJA}$	Thermal Resistance, Junction-to-Ambient	113	62	

6. Electrical characteristics

OFF Characteristics		(TJ=25°C,unless otherwise specified)				
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
BV_{DSS}	Drain-to-Source Breakdown Voltage	V_{GS}=0V, I_D=250uA	40	--	--	V
I_{DSS}	Drain-to-Source Leakage Current	V_{DS}=40V, V_{GS}=0V	--	--	10	uA
		V_{DS}=32V,V_{GS}=0V, T_J=125°C	--	--	100	
I_{GSS}	Gate-to-Source Leakage Current	V_{GS}=+20V,V_{DS}=0V	--	--	+100	nA
		V_{GS}=-20V, V_{DS}=0V	--	--	-100	

ON Characteristics		(TJ=25°C,unless otherwise specified)				
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$R_{DS(ON)}$	Static Drain-to-Source On-Resistance	V_{GS}=10V, I_D=24A[5]	--	3.0	3.5	mΩ
$V_{GS(TH)}$	Gate Threshold Voltage	V_{DS}=V_{GS},I_D=250uA	2.0	--	4.0	V
gfs	Forward Transconductance	V_{DS}=10V, I_D=80A[5]	--	220	--	S

Dynamic Characteristics		Essentially independent of operating temperature				
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=25V, f=1.0MHZ	--	5000	--	pF
C_{oss}	Output Capacitance		--	790	--	
C_{rss}	Reverse Transfer Capacitance		--	295	--	
R_g	Gate Series Resistance	f=1.0MHZ	--	1.9	--	Ω
Q_g	Total Gate Charge	V_{DD}=20V, I_D=80A, V_{GS}=0 to 10V	--	75	--	nC
Q_{gs}	Gate-to-Source Charge		--	24	--	
Q_{gd}	Gate-to-Drain (Miller) Charge		--	25	--	

Resistive Switching Characteristics		Essentially independent of operating temperature				
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(ON)}$	Turn-on Delay Time	V_{DD}=20V, I_D=80A, V_{GS}= 10V R_G=2.5Ω	--	20	--	nS
t_{rise}	Rise Time		--	66	--	
$t_{d(OFF)}$	Turn-Off Delay Time		--	50	--	
t_{fall}	Fall Time		--	30	--	

Source-Drain Body Diode Characteristics		(TJ=25°C,unless otherwise specified)				
Symbol	Parameter	Test Conditions	Min	Typ.	Max.	Unit
I_{SD}	Continuous Source Current[2]	Integral PN-diode in MOSFET	--	--	150	A
I_{SM}	Pulsed Source Current[2]		--	--	600	
V_{SD}	Diode Forward Voltage	I_S=80A, V_{GS}=0V	--	0.9	1.3	V
t_{rr}	Reverse recovery time	V_{GS}=0V ,I_F=80A, diF/dt=100A/μs	--	77	--	ns
Q_{rr}	Reverse recovery charge		--	53	--	uC

Note:
[1] T_J=+25 °C to +175 °C.
[2] Silicon limited current only.
[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

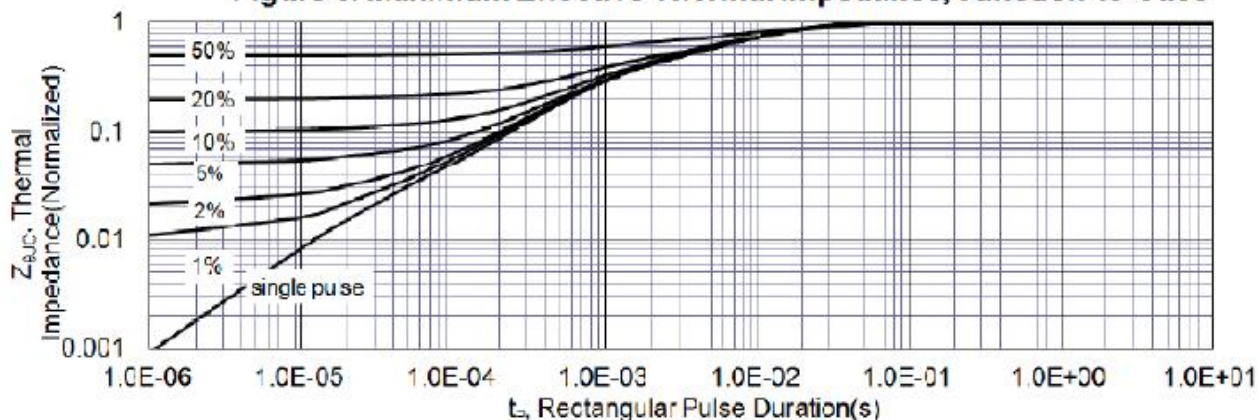## Figure 1. Maximum Effective Thermal Impedance, Junction-to-Case

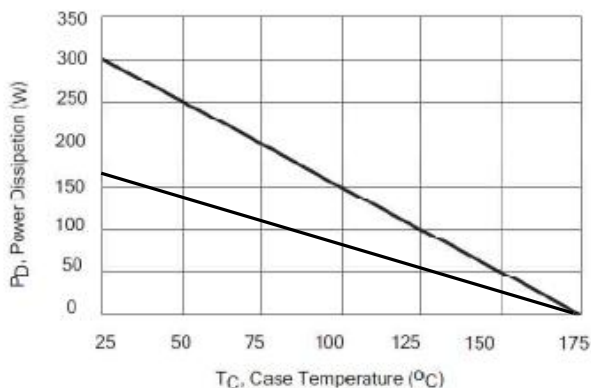Figure 2. Maximum Power Dissipation vs Case Temperature
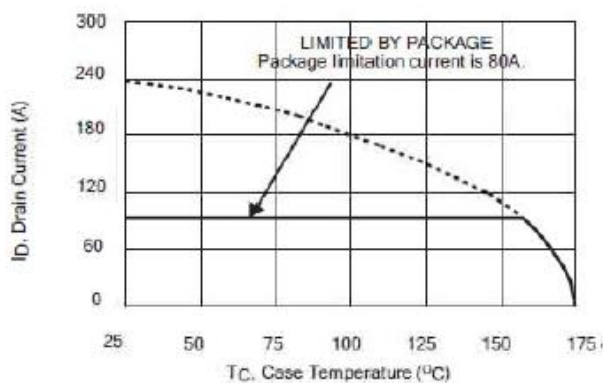

Figure3. Maximum Continuous Drain Current vs Case Temperature
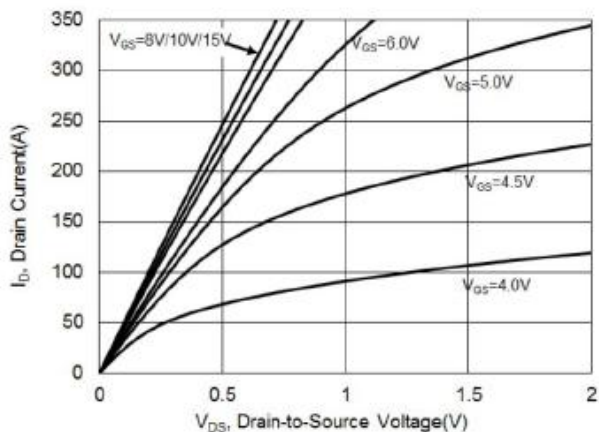

Figure 4. Typical Output Characteristics

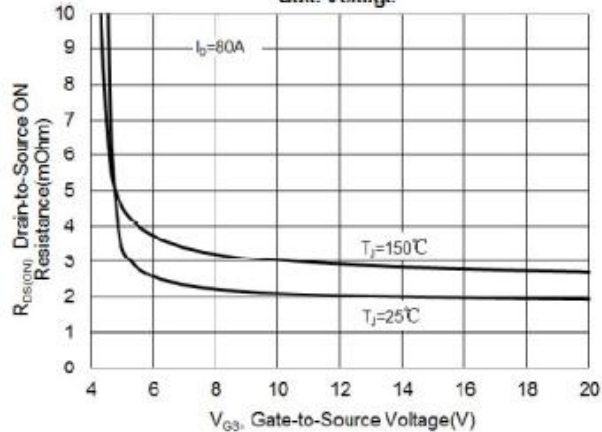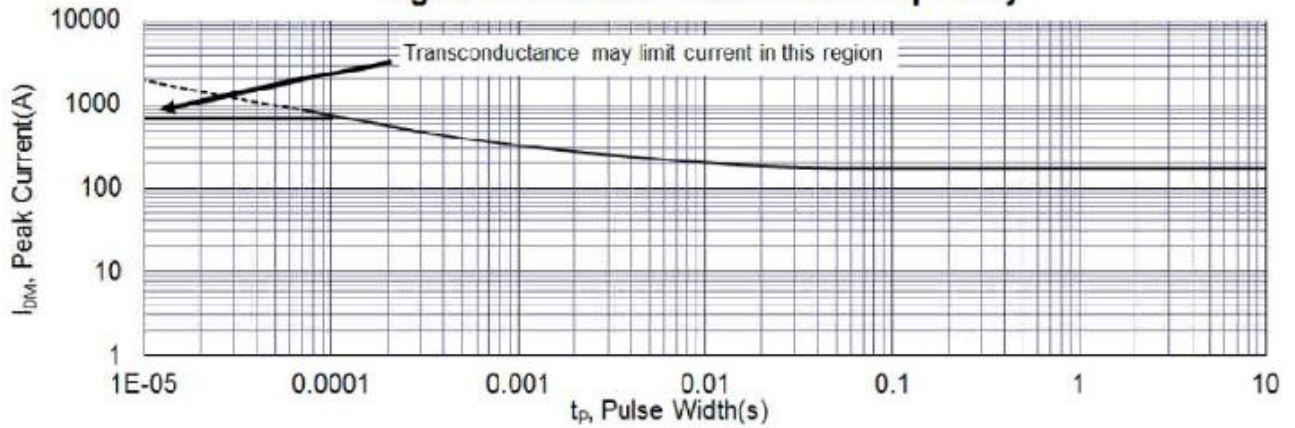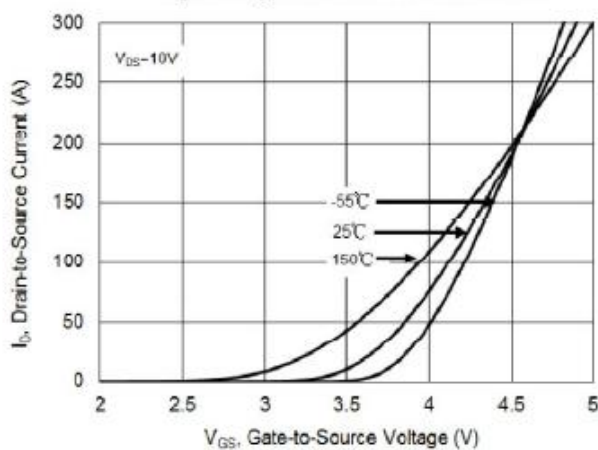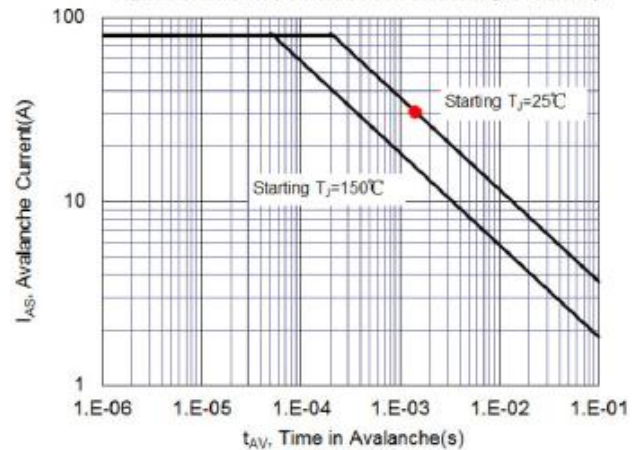Figure 5. Typical Drain-to-Source ON Resistance vs. Gate Voltage

Figure 6. Maximum Peak Current Capability
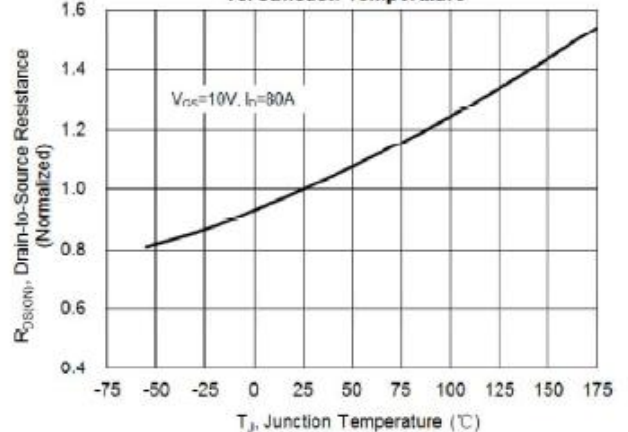

Figure 7. Typical Transfer Characteristics
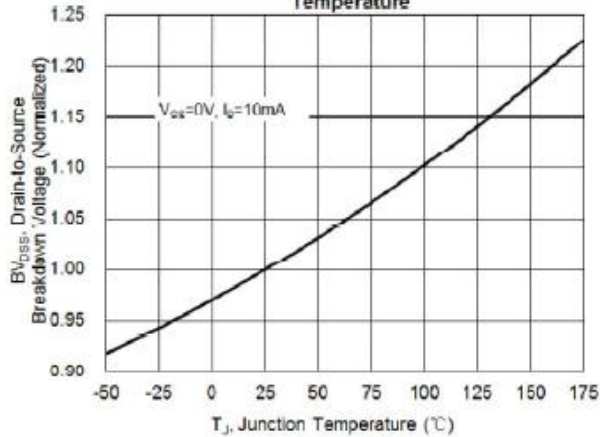

Figure 8. Unclamped Inductive Switching Capability

Figure 9. Typical Drain-to-Source ON Resistance
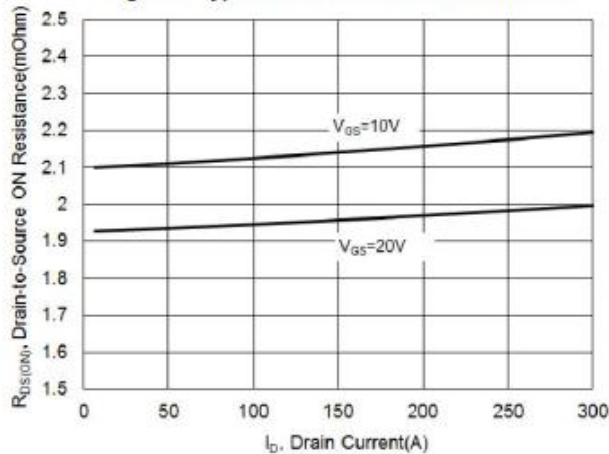
Figure 10. Typical Drain-to-Source On Resistance vs. Junction Temperature
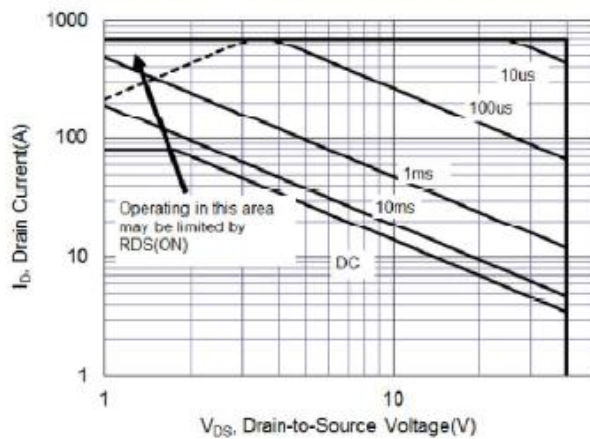
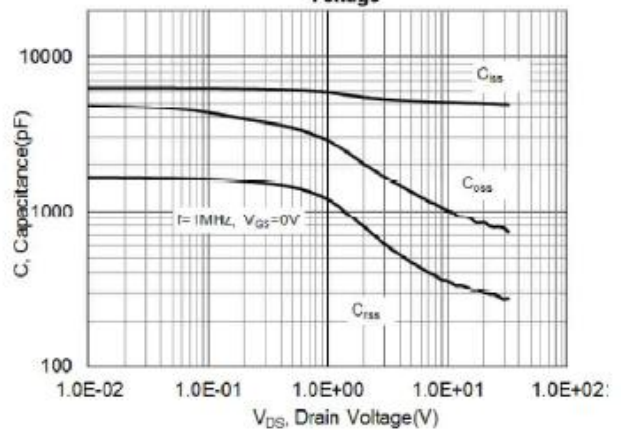Figure 11. Typical Breakdown Voltage vs. Junction Temperature

$V_{GS}=0V, I_D=10mA$

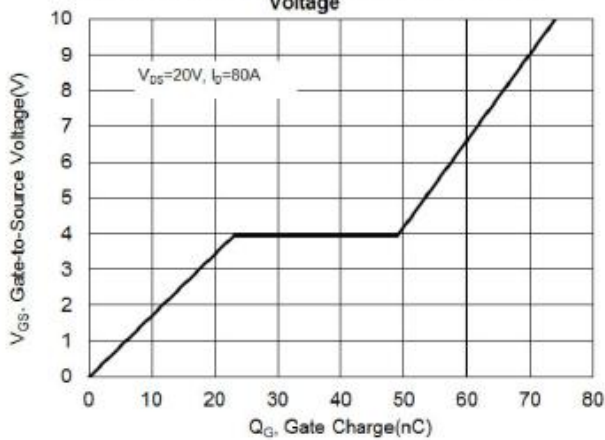Figure 12. Typical Threshold Voltage vs. Junction Temperature

$V_{GS}=V_{DS}, I_D=250uA$
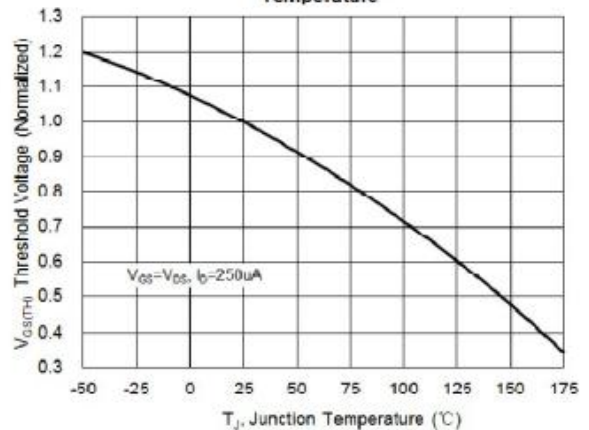
Figure 13. Maximum Forward Safe Operation Area

10us
100us
1ms
10ms
DC

Operating in this area may be limited by RDS(ON)

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

C_{iss}
C_{oss}
C_{rss}
f=1MHz, $V_{GS}=0V$

Figure 15. Typical Gate Charge vs. Gate-to-Source Voltage

$V_{DS}=20V, I_D=80A$

Figure 16. Typical Body Diode Transfer Characteristics

150℃
25℃
-55℃
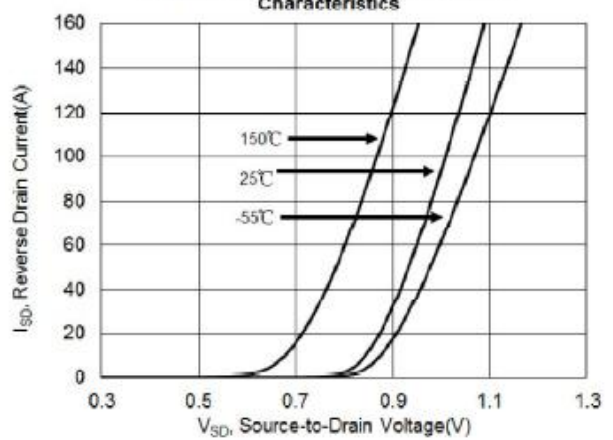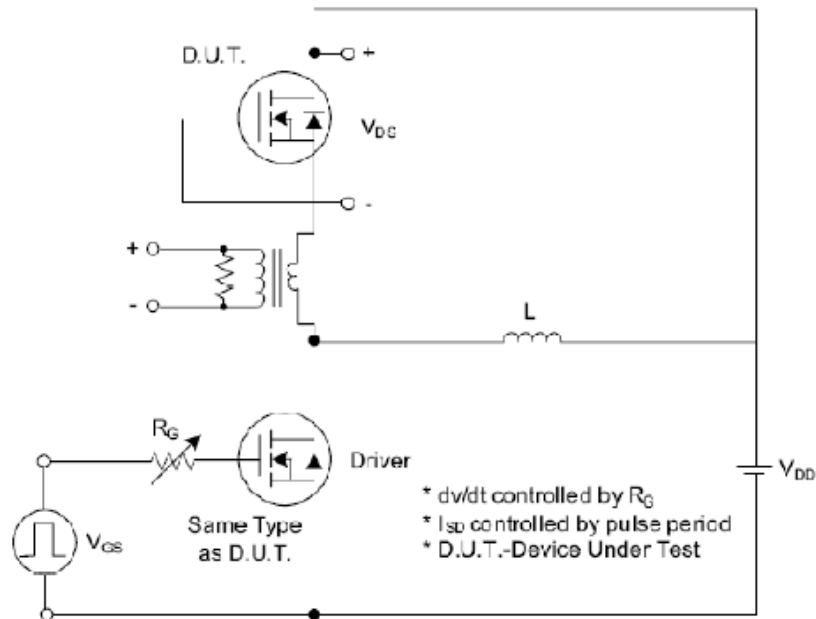
Fig. 1.1 Peak Diode Recovery dv/dt Test Circuit

* dv/dt controlled by R_G
* I_{SD} controlled by pulse period
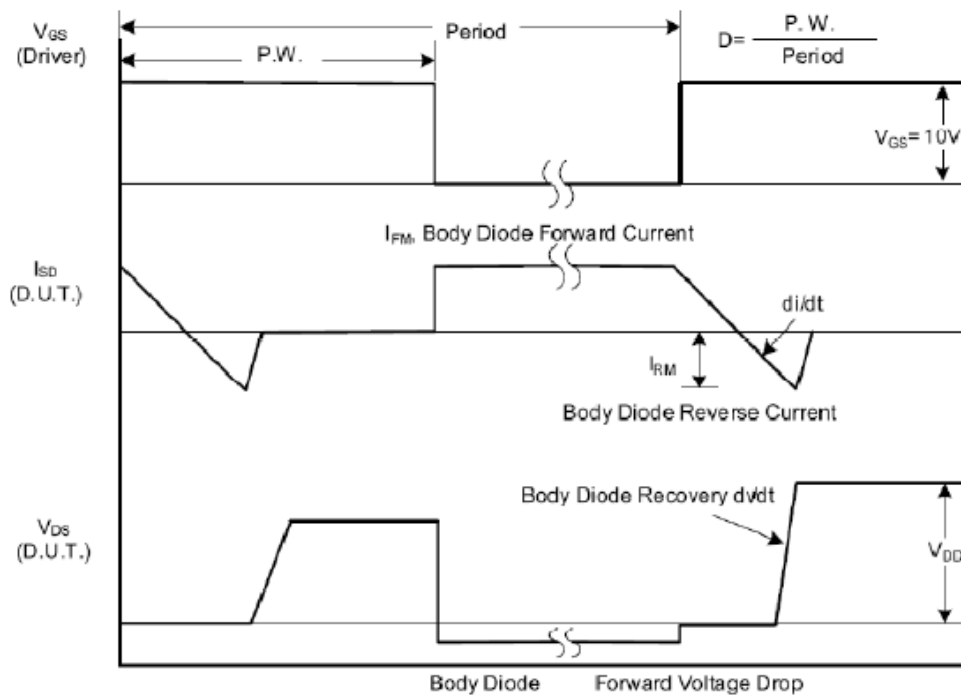* D.U.T.-Device Under Test

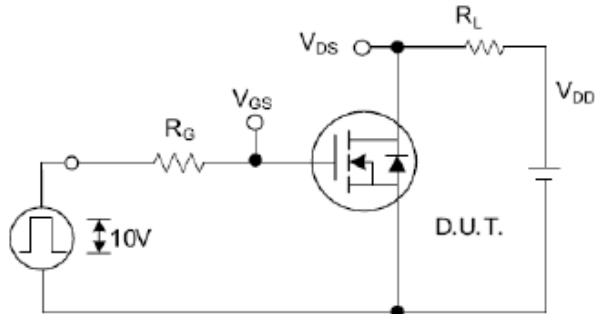Fig. 1.2 Peak Diode Recovery dv/dt Waveforms
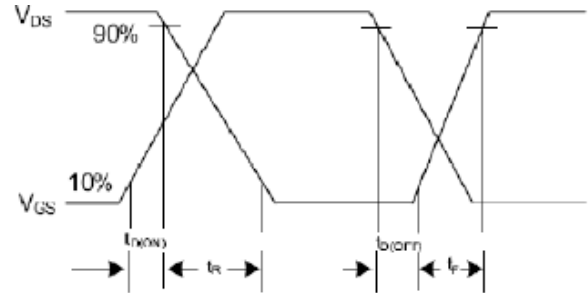
Fig. 2.1 Switching Test Circuit
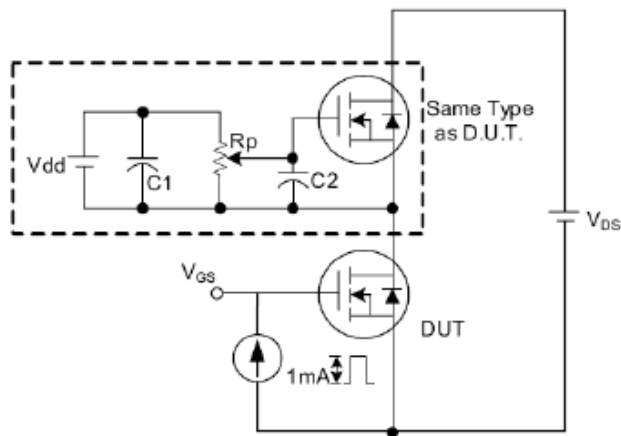

Fig. 2.2 Switching Waveforms

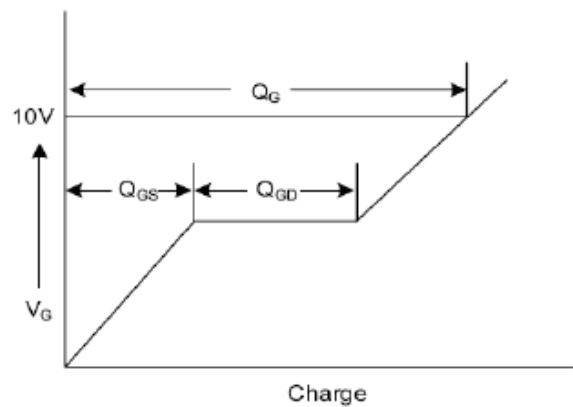Fig. 3 . 1 Gate Charge Test Circuit

Fig. 3 . 2 Gate Charge Waveform

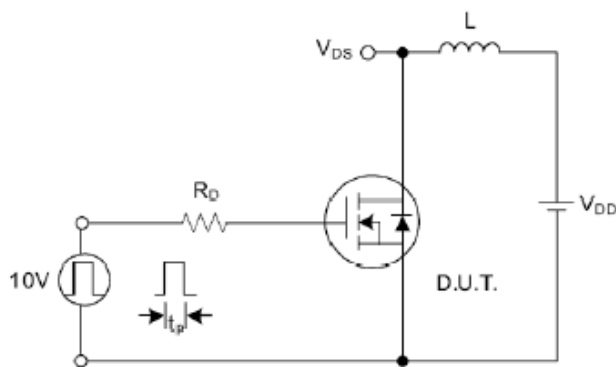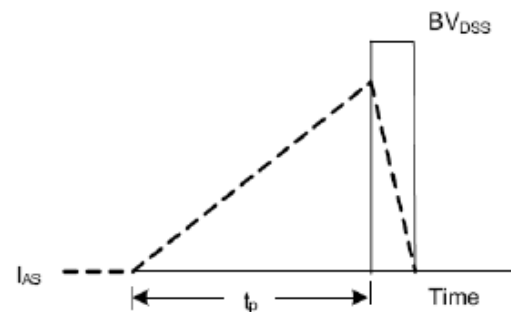Fig. 4.1 Unclamped Inductive Switching Test Circuit

Fig. 4.2 Unclamped Inductive Switching Waveforms

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