KHB011N40P1/F1/F2

N CHANNEL MOS FIELD EFFECT TRANSISTOR

General Description

This planar stripe MOSFET has better characteristics, such as fast switching time, low on resistance, low gate charge and excellent avalanche characteristics. It is mainly suitable for electronic ballast and switching mode power supplies.

FEATURES

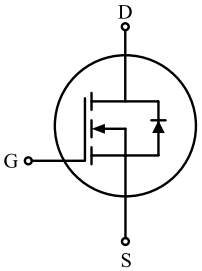
- $V_{DSS(Min.)}$= 400V, I_D= 10.5A
- Drain-Source ON Resistance :
  $R_{DS(ON)}$=0.53Ω @V_{GS} =10V
- Qg(typ.) =32.5nC

MAXIMUM RATING (Tc=25℃)

CHARACTERISTIC		SYMBOL	RATING		UNIT
			KHB011N40P1	KHB011N40F1 KHB011N40F2	
Drain-Source Voltage		V_{DSS}	400		V
Gate-Source Voltage		V_{GSS}	±30		V
Drain Current	@T_C=25℃	I_D	10.5	10.5*	A
	@T_C=100℃		6.6	6.6*	
	Pulsed (Note1)	I_{DP}	42	42*	
Single Pulsed Avalanche Energy (Note 2)		E_{AS}	360		mJ
Repetitive Avalanche Energy (Note 1)		E_{AR}	13.5		mJ
Peak Diode Recovery dv/dt (Note 3)		dv/dt	4.5		V/ns
Drain Power Dissipation	Tc=25℃	P_D	135	44	W
	Derate above25℃		1.07	0.35	W/℃
Maximum Junction Temperature		T_j	150		℃
Storage Temperature Range		T_{stg}	-55 150		℃
Thermal Characteristics					
Thermal Resistance, Junction-to-Case		R_{thJC}	0.93	2.86	℃/W
Thermal Resistance, Case-to-Sink		R_{thCS}	0.5	-	℃/W
Thermal Resistance, Junction-to-Ambient		R_{thJA}	62.5	62.5	℃/W

* : Drain current limited by maximum junction temperature.

PIN CONNECTION



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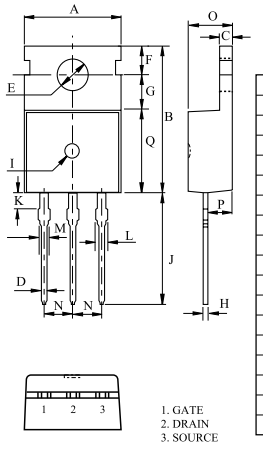

DIM	MILLIMETERS
A	9.9±0.2
B	15.95 MAX
C	1.3+0.1/-0.05
D	0.8±0.1
E	ø3.6±0.2
F	2.8±0.1
G	3.7
H	0.5+0.1/-0.05
I	ø1.5
J	13.08±0.3
K	1.46
L	1.4±0.1
M	1.27±0.1
N	2.54±0.2
O	4.5±0.2
P	2.4±0.2
Q	9.2±0.2

TO-220AB

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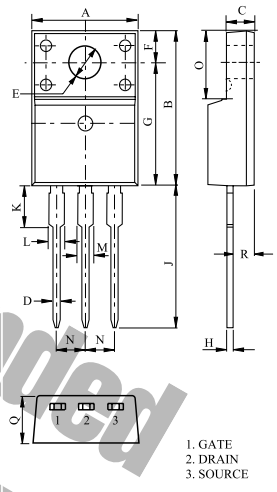
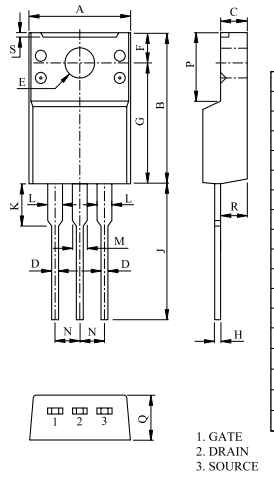


DIM	MILLIMETERS
A	10.16±0.2
B	15.87±0.2
C	2.54±0.2
D	0.8±0.1
E	ø3.18±0.1
F	3.3±0.1
G	12.57±0.2
H	0.5±0.1
J	13.0 MAX
K	3.23±0.1
L	1.47 MAX
M	1.47 MAX
N	2.54±0.2
O	6.68±0.2
Q	4.7±0.2
R	2.76±0.2

TO-220IS (1)

KHB011N40F2



DIM	MILLIMETERS
A	10.0±0.3
B	15.0±0.3
C	2.70±0.3
D	0.76+0.09/-0.05
E	Φ3.2±0.2
F	3.0±0.3
G	12.0±0.3
H	0.5+0.1/-0.05
J	13.6±0.5
K	3.7±0.2
L	1.2+0.25/-0.1
M	1.5+0.25/-0.1
N	2.54±0.1
P	6.8±0.1
Q	4.5±0.2
R	2.6±0.2
S	0.5 Typ

TO-220IS

ELECTRICAL CHARACTERISTICS (Tc=25℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Static						
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=250 μA, V_{GS}=0V	400	-	-	V
Breakdown Voltage Temperature Coefficient	$\Delta BV_{DSS}/\Delta T_j$	I_D=250 μA, Referenced to 25℃	-	0.54	-	V/℃
Drain Cut-off Current	I_{DSS}	V_{DS}=400V, V_{GS}=0V,	-	-	10	μA
Gate Threshold Voltage	V_{th}	V_{DS}=V_{GS}, I_D=250 μA	2.0	-	4.0	V
Gate Leakage Current	I_{GSS}	V_{GS}=±30V, V_{DS}=0V	-	-	±100	nA
Drain-Source ON Resistance	$R_{DS(ON)}$	V_{GS}=10V, I_D=5.25A	-	0.5	0.53	Ω
Dynamic						
Total Gate Charge	Q_g	V_{DS}=320V, I_D=10.5A V_{GS}=10V (Note4,5)	-	32.5	37.5	nC
Gate-Source Charge	Q_{gs}		-	6.4	-	
Gate-Drain Charge	Q_{gd}		-	13	-	
Turn-on Delay time	$t_{d(on)}$	V_{DD}=200V R_L=20Ω R_G=25Ω (Note4,5)	-	23	45	ns
Turn-on Rise time	t_r		-	65	140	
Turn-off Delay time	$t_{d(off)}$		-	138	235	
Turn-off Fall time	t_f		-	81	170	
Input Capacitance	C_{iss}	V_{DS}=25V, V_{GS}=0V, f=1.0MHz	-	1472	1913	pF
Reverse Transfer Capacitance	C_{rss}		-	18.9	24.5	
Output Capacitance	C_{oss}		-	168	218	
Source-Drain Diode Ratings						
Continuous Source Current	I_S	V_{GS}<V_{th}	-	-	10.5	A
Pulsed Source Current	I_{SP}		-	-	42	
Diode Forward Voltage	V_{SD}	I_S=10.5A, V_{GS}=0V	-	-	1.5	V
Reverse Recovery Time	t_{rr}	I_S=10.5A, V_{GS}=0V, dIs/dt=100A/μs	-	355	-	ns
Reverse Recovery Charge	Q_{rr}		-	4.0	-	μC

Note 1) Repetivity rating : Pulse width limited by junction temperature.

Note 2) L = 5.7mH, I_S=10.5A, V_{DD}=50V, R_G = 25Ω, Starting T_j = 25℃.

Note 3) I_S ≤10.5A, dI/dt≤200A/μs, V_{DD}≤BV_{DSS}, Starting T_j = 25℃.

Note 4) Pulse Test : Pulse width ≤ 300μs, Duty Cycle ≤ 2%.

Note 5) Essentially independent of operating temperature.

Fig1. I_D - V_{DS}

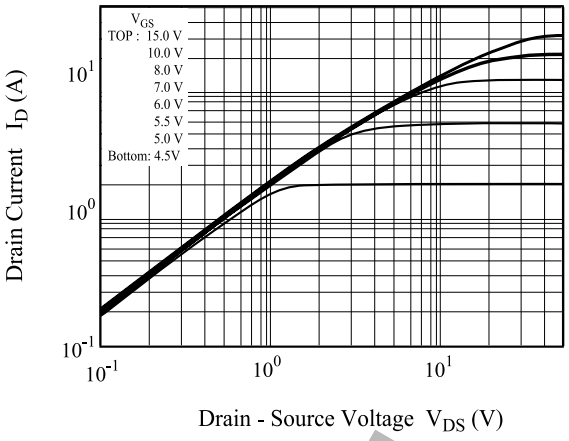


Fig2. I_D - V_{GS}

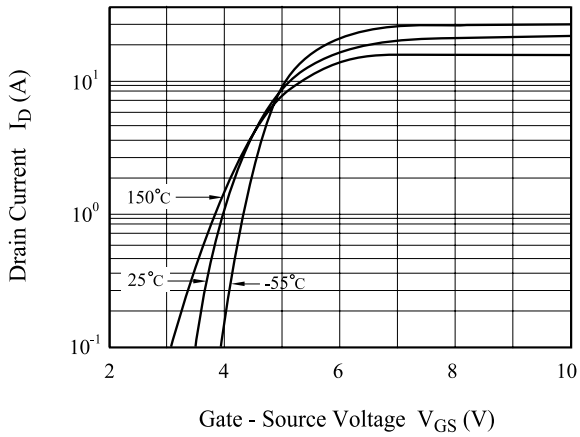


Fig3. BV_{DSS} - T_j

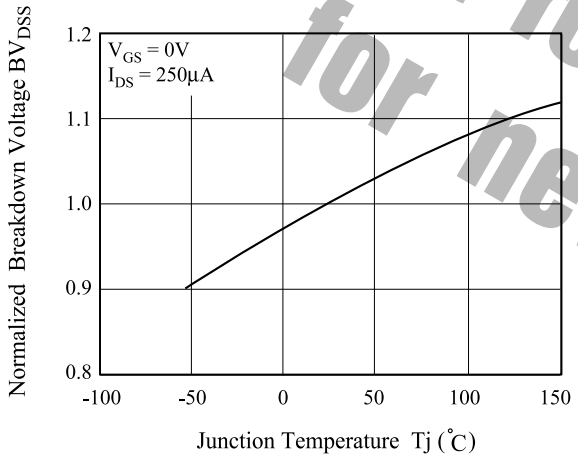


Fig4. $R_{DS(ON)}$ - I_D

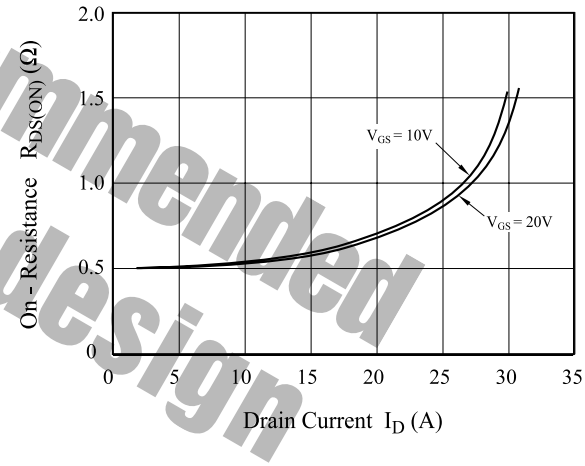


Fig5. I_S - V_{SD}

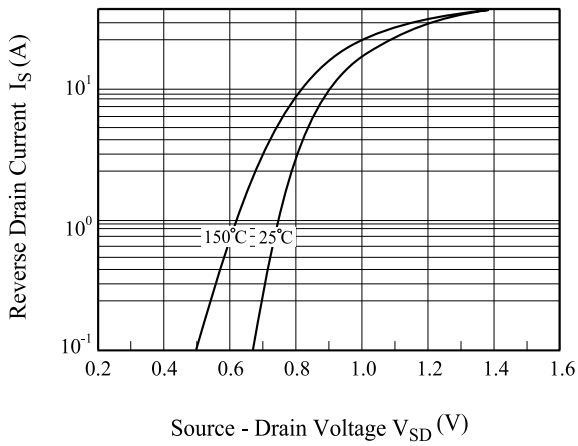


Fig6. $R_{DS(ON)}$ - T_j

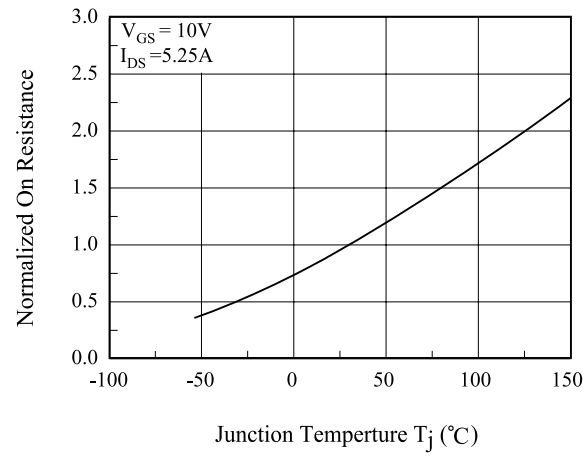


Fig7. C - V_{DS}

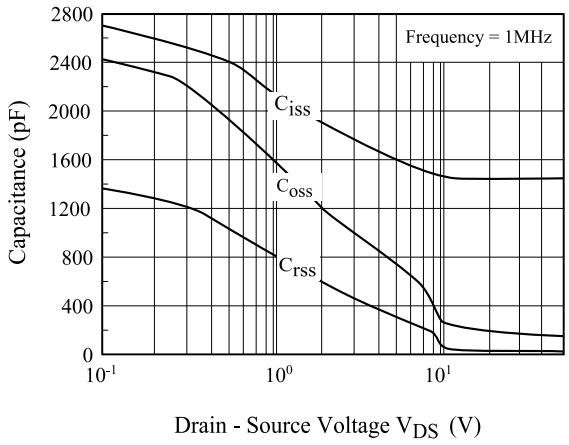


Fig8. Q_g- V_{GS}

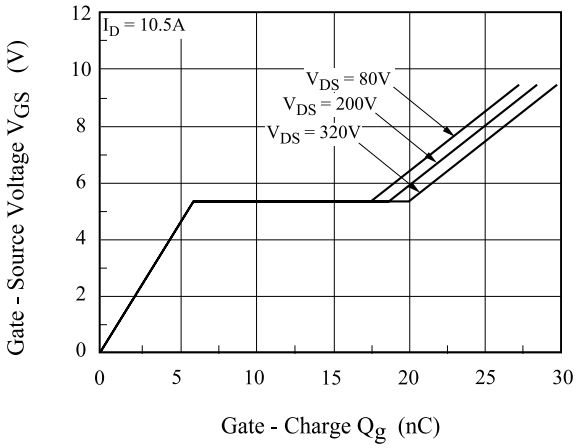


Fig9. Safe Operation Area

(KHB011N40P1)

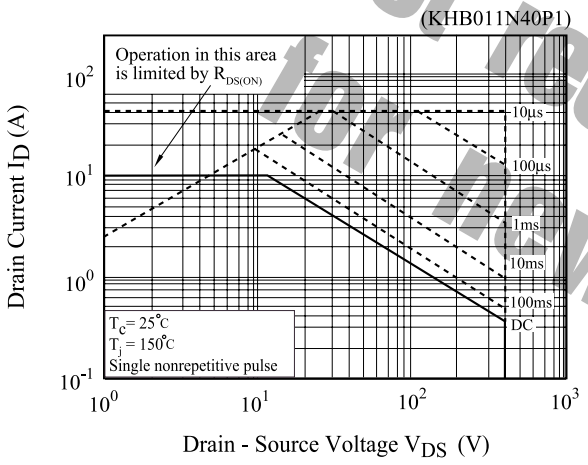


Fig10. Safe Operation Area

(KHB011N40F1, KHB011N40F2)

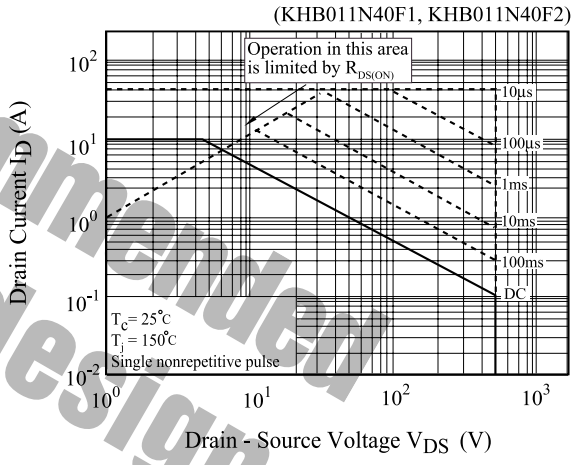


Fig11. I_D - T_j

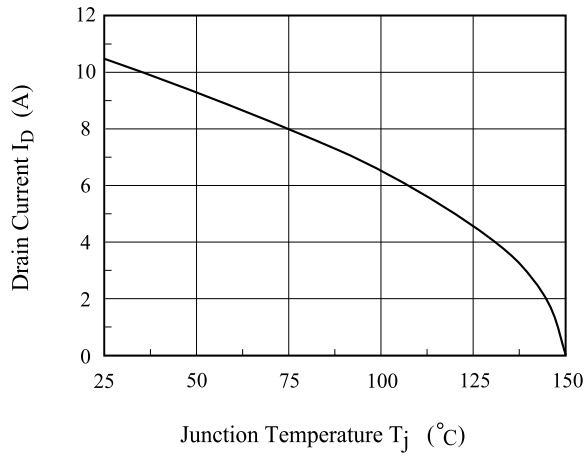


Fig12. Transient Thermal Response Curve

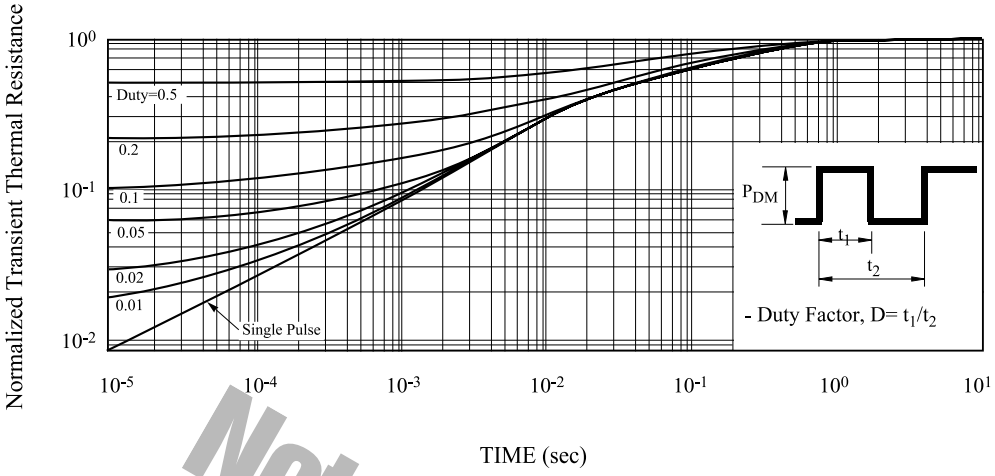


Fig13. Transient Thermal Response Curve

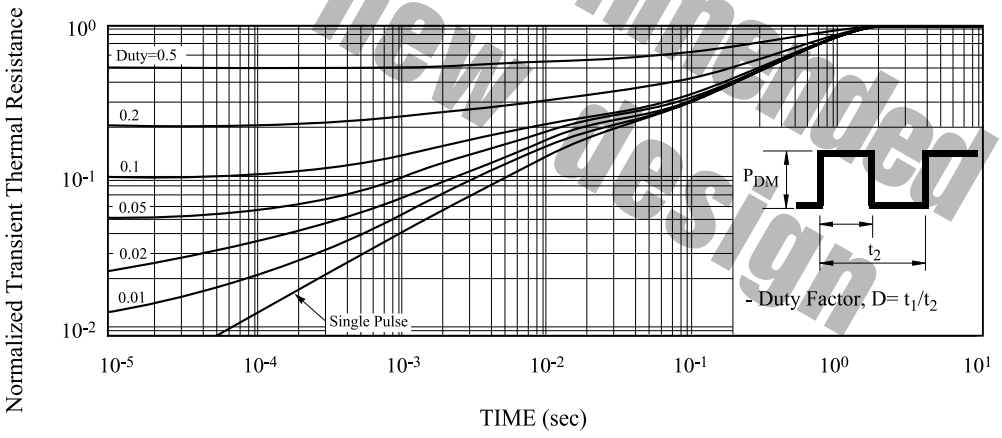
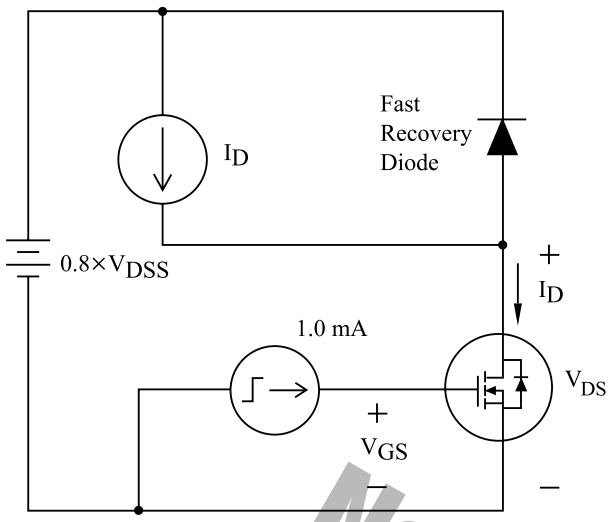


Fig14. Gate Charge



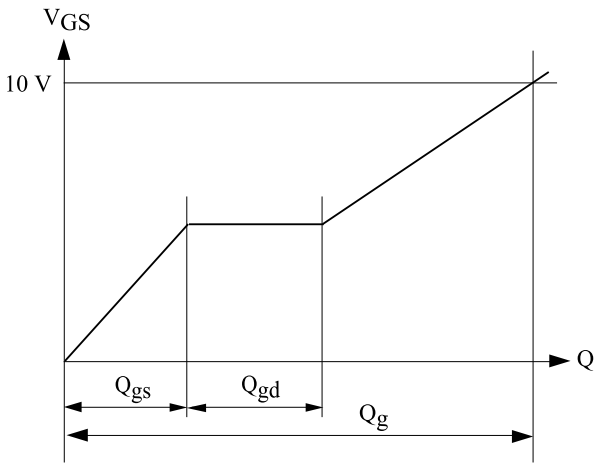
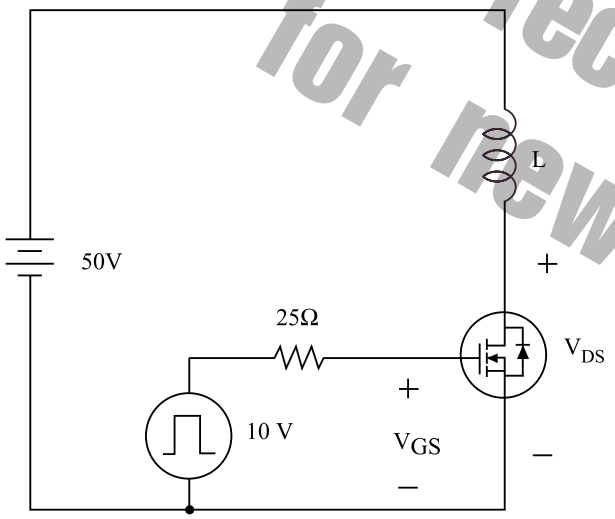


Fig15. Single Pulsed Avalanche Energy



$$E_{AS}=\frac{1}{2}\,LI_{AS}^2\,\frac{BV_{DSS}}{BV_{DSS}-V_{DD}}$$

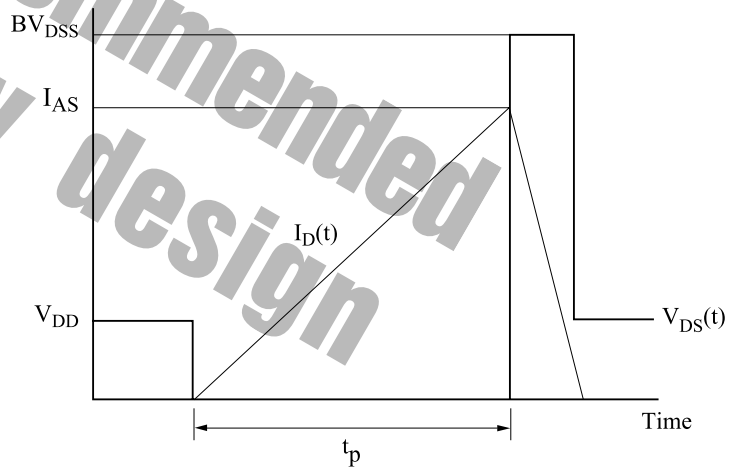
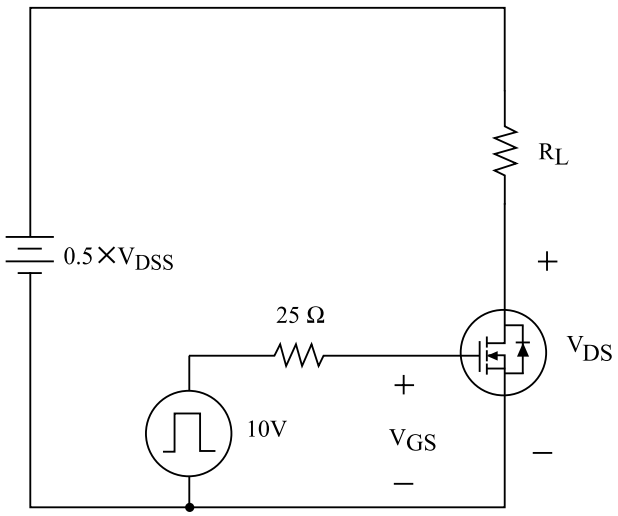


Fig16. Resistive Load Switching



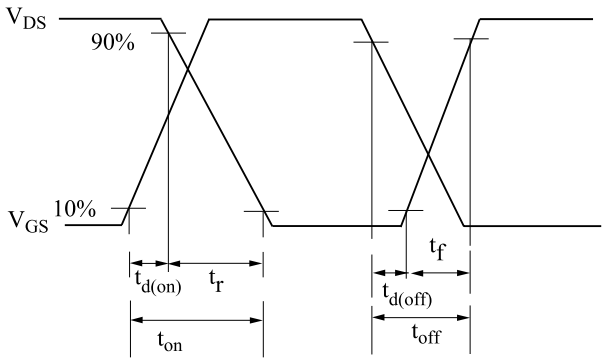


Fig17. Source - Drain Diode Reverse Recovery and dv /dt