



650V N-ch Super-Junction MOSFET

Pb Lead Free Package and Finish

General Features

- Proprietary New Super-Junction Technology
- $R_{DS(ON),typ.}=0.16\ \Omega@V_{GS}=10V$
- Low Gate Charge Minimize Switching Loss
- Fast Recovery Body Diode

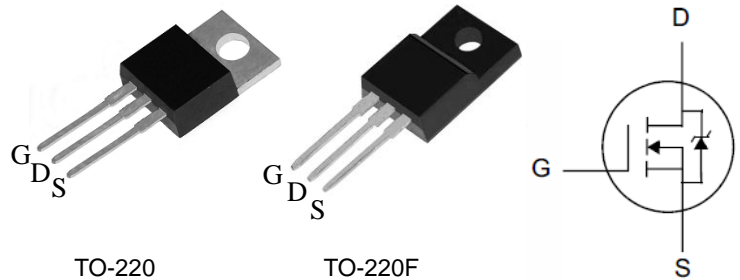
$BV_{DSS}@T_J=150^\circ C$	$R_{DS(ON),typ.}$	I_D
700V	0.16Ω	20A

Applications

- Adaptor
- Charger
- SMPS Standby Power

Ordering Information

Part Number	Package	Brand
SPTP65R160	TO-220	
SPTA65R160	TO-220F	



Package Not to Scale

Absolute Maximum Ratings

$T_C=25^\circ C$ unless otherwise specified

Symbol	Parameter	Value		Unit
		SPTP65R160	SPTA65R160	
V_{DSS}	Drain-to-Source Voltage	650		V
V_{GSS}	Gate-to-Source Voltage	±30		
I_D	Continuous Drain Current	20		A
I_{DM}	Pulsed Drain Current at $V_{GS}=10V^{[1]}$	60		
E_{AS}	Single Pulse Avalanche Energy ^[2]	800		mJ
P_D	Power Dissipation	176	34	W
T_L	Soldering Temperature Distance of 1.6mm from case for 10 seconds	300		°C
$T_J \& T_{STG}$	Operating and Storage Temperature Range	-55 to 150		

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

Thermal Characteristics

Symbol	Parameter	Max. Value		Unit
		SPTP65R160	SPTA65R160	
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.71	3.67	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62	100	



Electrical Characteristics

OFF Characteristics

$T_J = 25^\circ\text{C}$ unless otherwise specified

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	650	--	--	V	$V_{GS}=0V, I_D=250\mu A$
I_{DSS}	Drain-to-Source Leakage Current	--	--	1	μA	$V_{DS}=650V, V_{GS}=0V$
		--	--	100		$V_{DS}=520V, V_{GS}=0V, T_J=125^\circ\text{C}$
I_{GSS}	Gate-to-Source Leakage Current	--	--	+100	nA	$V_{GS}=+30V, V_{DS}=0V$
		--	--	-100		$V_{GS}=-30V, V_{DS}=0V$

ON Characteristics

$T_J = 25^\circ\text{C}$ unless otherwise specified

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$R_{DS(ON)}$	Static Drain-to-Source On-Resistance ^[3]	--	0.16	0.18	Ω	$V_{GS}=10V, I_D=10A$
$V_{GS(TH)}$	Gate Threshold Voltage	2.0	--	4.0	V	$V_{DS}=V_{GS}, I_D=250\mu A$
gfs	Forward Transconductance ^[3]	--	19	--	S	$V_{DS}=10V, I_D=20A$

Dynamic Characteristics

Essentially independent of operating temperature

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
C_{iss}	Input Capacitance	--	1600	--	pF	$V_{GS}=0V, V_{DS}=50V, f=1.0MHz$
C_{rss}	Reverse Transfer Capacitance	--	15	--		
C_{oss}	Output Capacitance	--	220	--		
Q_g	Total Gate Charge	--	40	--	nC	$V_{DD}=520V, I_D=20A, V_{GS}=0 \text{ to } 10V$
Q_{gs}	Gate-to-Source Charge	--	7.5	--		
Q_{gd}	Gate-to-Drain (Miller) Charge	--	15	--		

Resistive Switching Characteristics

Essentially independent of operating temperature

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$t_{d(ON)}$	Turn-on Delay Time	--	15	--	nS	$V_{DD}=400V, I_D=20A, V_{GS}=10V, R_g=25\Omega$
t_{rise}	Rise Time	--	15	--		
$t_{d(OFF)}$	Turn-Off Delay Time	--	95	--		
t_{fall}	Fall Time	--	10	--		



Source-Drain Body Diode Characteristics

T_J=25°C unless otherwise specified

Symbol	Parameter	Min	Typ.	Max.	Unit	Test Conditions
I _{SD}	Continuous Source Current ^[2]	--	--	20	A	Maximum Ratings
I _{SM}	Pulsed Source Current ^[2]	--	--	60		
V _{SD}	Diode Forward Voltage	--	0.95	1.2	V	I _S =20A, V _{GS} =0V
t _{rr}	Reverse Recovery Time	--	450	--	ns	V _R =480V, V _{GS} =0V I _F = I _S , di/dt =100A/μs
Q _{rr}	Reverse Recovery Charge	--	8.0	--	uC	

Note:

- [1] Repetitive Rating: Pulse width limited by maximum junction temperature
[2] L = 10mH, VDD= 50V, Starting T_J= 25°C
[3] Pulse Test: Pulse width ≤ 380us, Duty Cycle ≤ 2%



Typical Characteristics

Figure 1. Output Characteristics

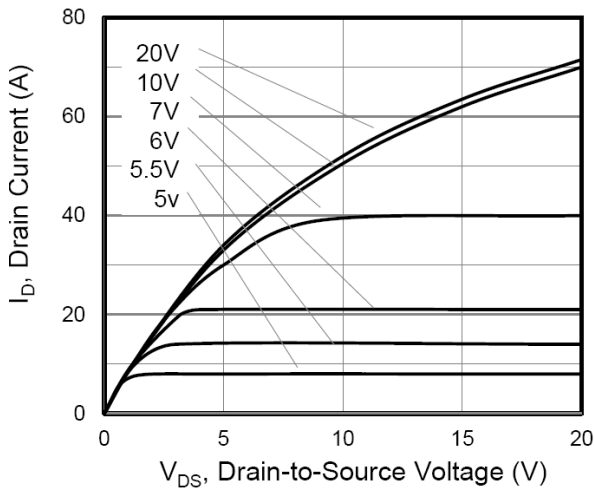


Figure 2. Transfer Characteristics

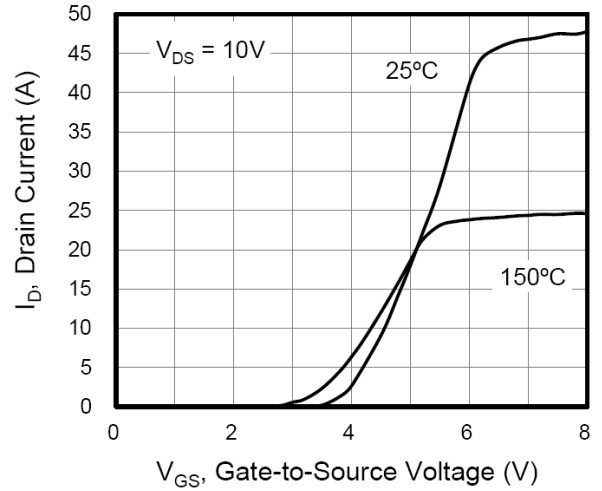


Figure 3. On-Resistance vs. Drain Current

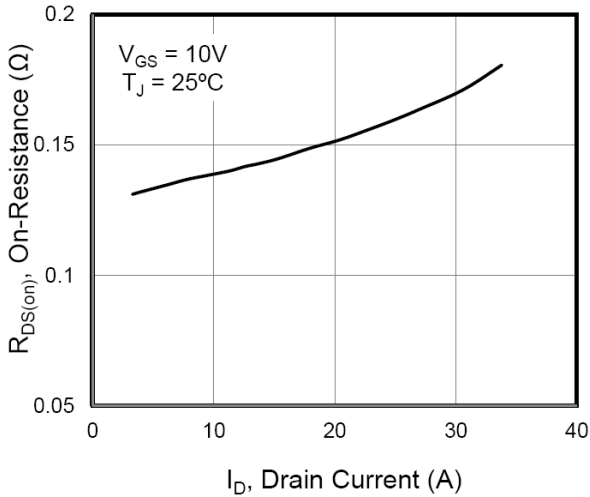


Figure 4. Capacitance

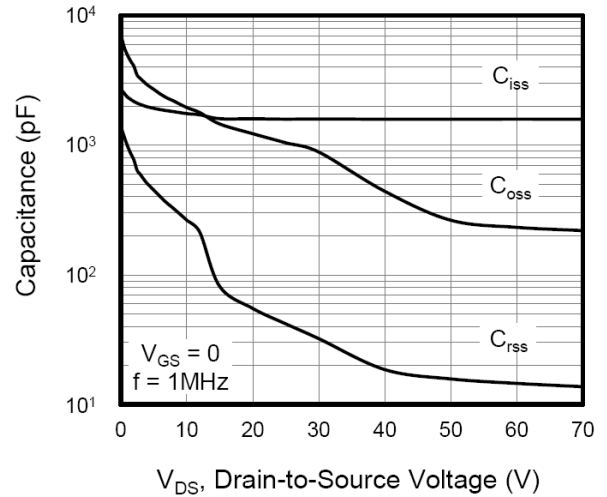


Figure 5. Gate Charge

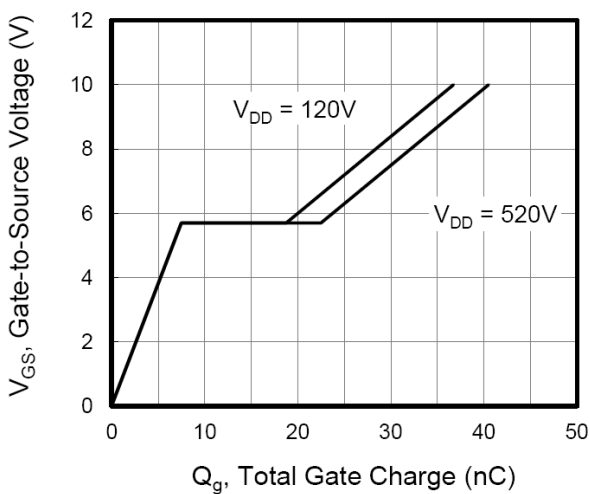
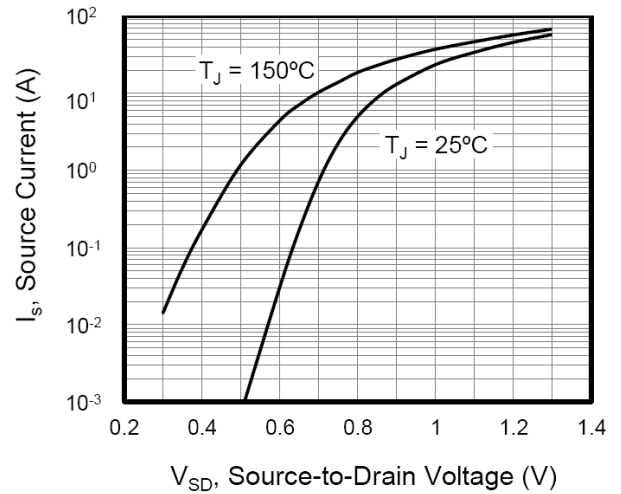


Figure 6. Body Diode Forward Voltage





Typical Characteristics(Cont.)

Figure 7. On-Resistance vs. Junction Temperature

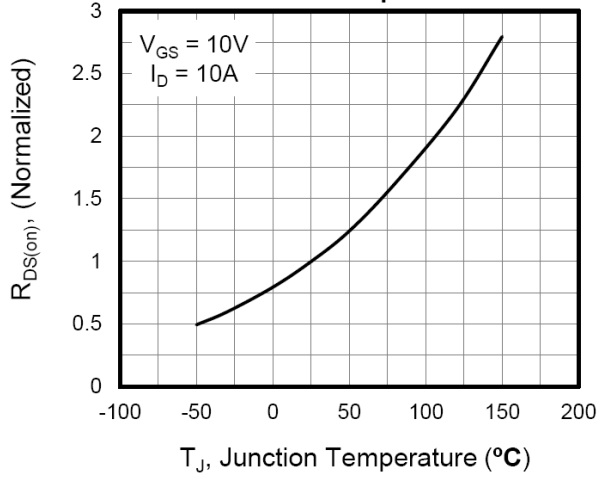


Figure 8. Threshold Voltage vs. Junction Temperature

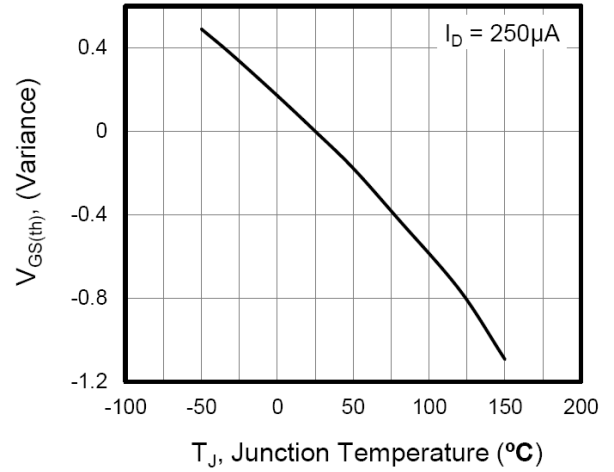


Figure 9. Transient Thermal Impedance TO-220

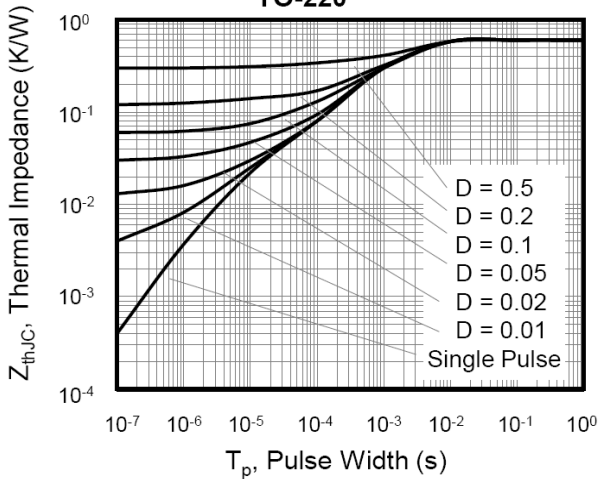
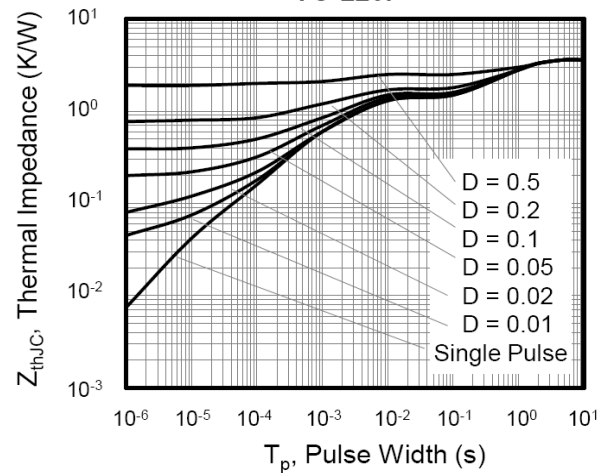


Figure 10. Transient Thermal Impedance TO-220F





Test Circuits and Waveforms

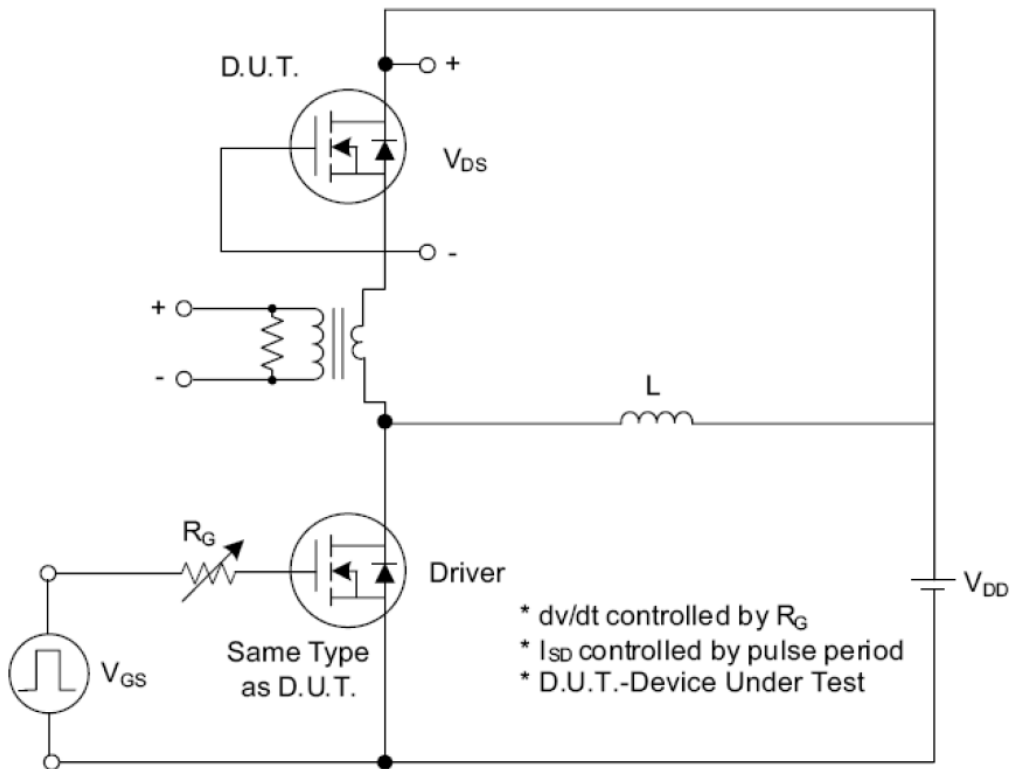


Fig. 1.1 Peak Diode Recovery dv/dt Test Circuit

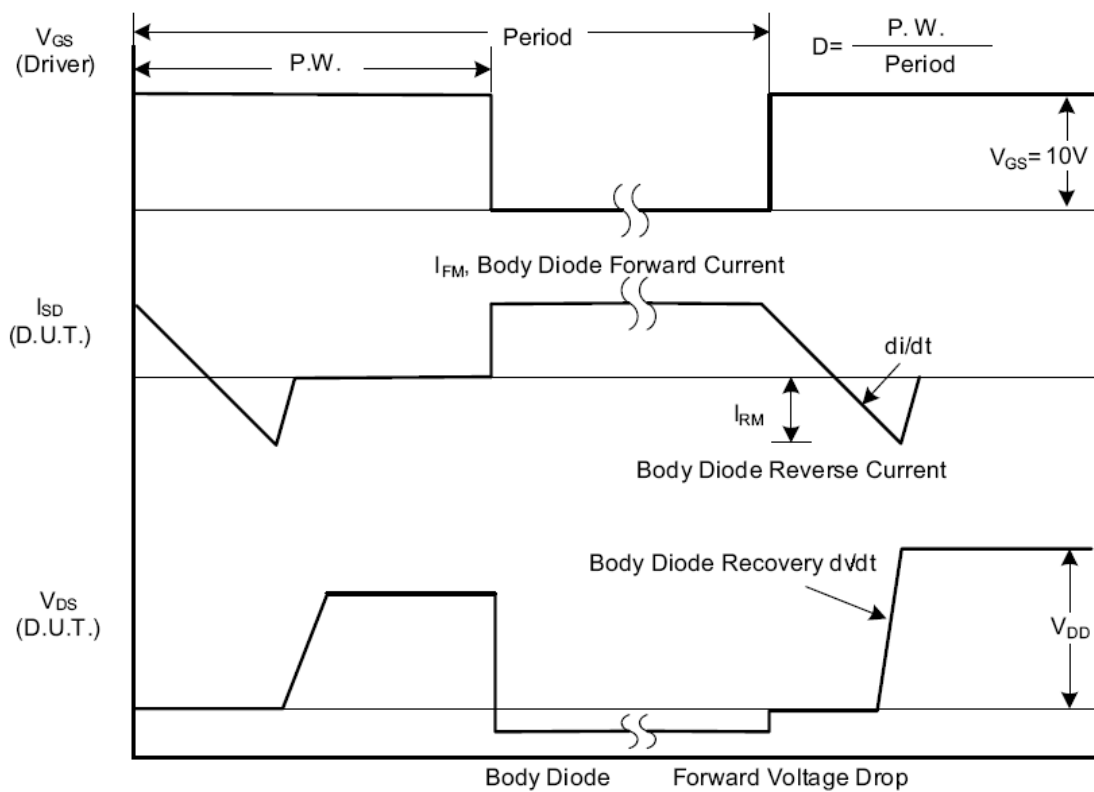


Fig. 1.2 Peak Diode Recovery dv/dt Waveforms

Test Circuits and Waveforms (Cont.)

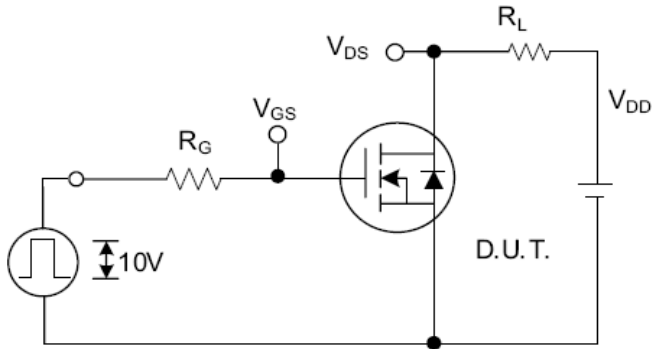


Fig. 2.1 Switching Test Circuit

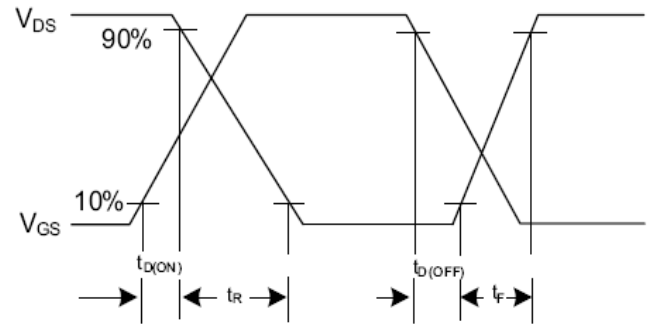


Fig. 2.2 Switching Waveforms

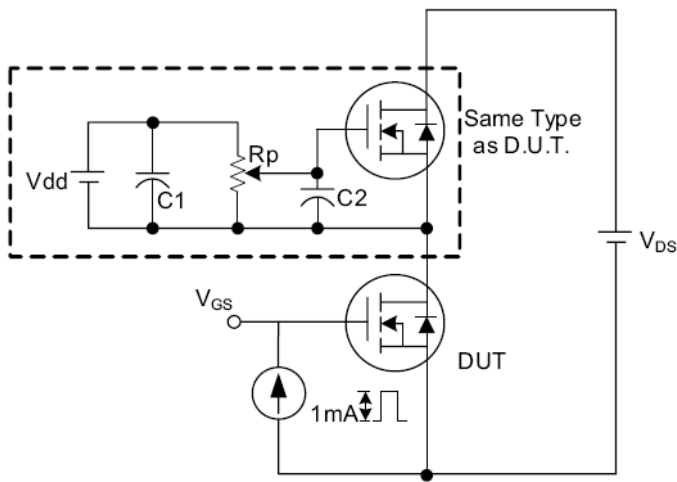


Fig. 3.1 Gate Charge Test Circuit

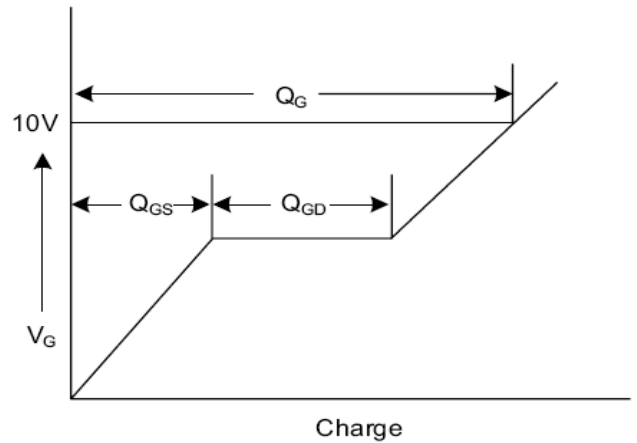


Fig. 3.2 Gate Charge Waveform

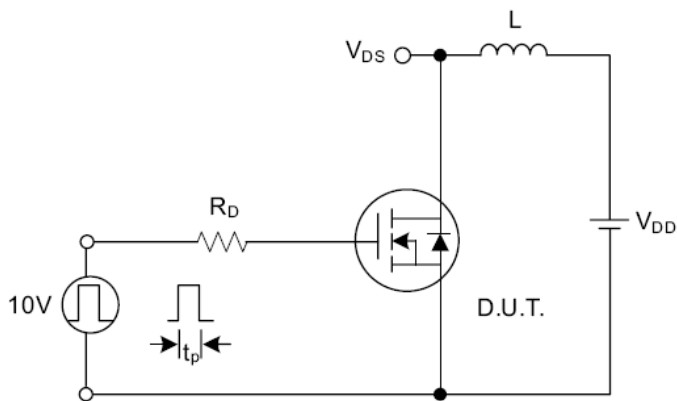


Fig. 4.1 Unclamped Inductive Switching Test Circuit

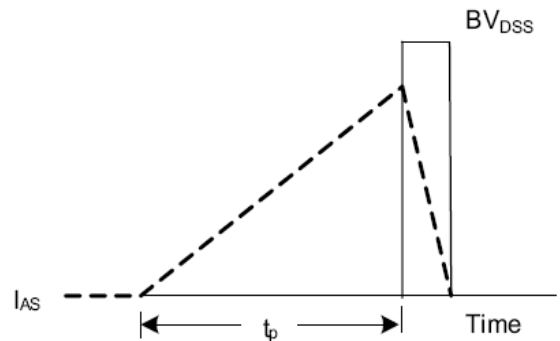


Fig. 4.2 Unclamped Inductive Switching Waveforms



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