



## 650V N-ch Super-Junction MOSFET

Lead Free Package and Finish

### General Features

- Proprietary New Super-Junction Technology
- $R_{DS(ON),typ.}=0.62\Omega@V_{GS}=10V$
- Very low FOM  $R_{DS(on)}\times Q_g$

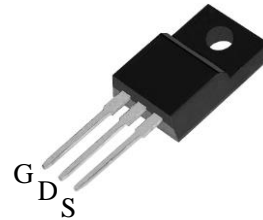
### Applications

- Power factor correction (PFC)
- Uninterruptible Power Supply (UPS)
- Switched mode power supplies(SMPS)

$BV_{DSS}$	$R_{DS(ON),typ.}$	$I_D$
650V	0.62Ω	6A

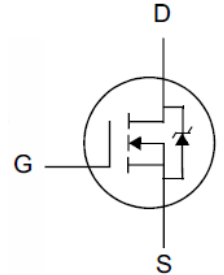
### Ordering Information

Part Number	Package	Brand
SPTA65R650	TO-220F	



TO-220F

Package Not to Scale



### Absolute Maximum Ratings

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

Symbol	Parameter	Value	Unit
		SPTA65R650	
$V_{DSS}$	Drain-to-Source Voltage	650	V
$V_{GSS}$	Gate-to-Source Voltage	±30	
$I_D$	Continuous Drain Current @ $T_C = 25^\circ C$	6	A
	Continuous Drain Current @ $T_C = 100^\circ C$	4.2	
$I_{DM}$	Pulsed Drain Current at $V_{GS}=10V^{[1]}$	20	
$E_{AS}$	Single Pulse Avalanche Energy <sup>[2]</sup>	140	mJ
$P_D$	Power Dissipation	30	W
	Derating Factor above 25°C	0.24	W/°C
dv/dt	Drain Source voltage slope, $V_{DS}\leq 480V$	50	V/ns
dv/dt	Reverse diode dv/dt, $V_{DS}\leq 480V, I_{SD}<I_D$	50	V/ns
$T_J$ & $T_{STG}$	Operating and Storage Temperature Range	-55 to 150	°C

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
		SPTA65R650	
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	4.2	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62	



## 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	$\mu A$	$V_{DS}=650V, V_{GS}=0V$
		--	--	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 <sup>[3]</sup>	--	0.62	0.68	$\Omega$	$V_{GS}=10V, I_D=1.5A$
$V_{GS(TH)}$	Gate Threshold Voltage	2.5	--	4.5	V	$V_{DS}=V_{GS}, I_D=250\mu A$

### Dynamic Characteristics

Essentially independent of operating temperature

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$C_{iss}$	Input Capacitance	--	398	--	$\mu F$	$V_{GS}=0V, V_{DS}=50V, f=1.0MHz$
$C_{rSS}$	Reverse Transfer Capacitance	--	1.3	--		
$C_{oss}$	Output Capacitance	--	43	--		
$R_G$	Gate Series Resistance	--	14	--	$\Omega$	$f=1.0MHz$
$Q_g$	Total Gate Charge	--	9.4	--	$nC$	$V_{DD}=325V, I_D=2.5A, V_{GS}=0 \text{ to } 10V$
$Q_{gs}$	Gate-to-Source Charge	--	2	--		
$Q_{gd}$	Gate-to-Drain (Miller) Charge	--	4	--		

### Resistive Switching Characteristics

Essentially independent of operating temperature

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$t_{d(ON)}$	Turn-on Delay Time	--	17	--	$ns$	$V_{DD}=325V, I_D=2.5A, V_{GS}=10V, R_g=2.35\Omega$
$t_{rise}$	Rise Time	--	4.5	--		
$t_{d(OFF)}$	Turn-Off Delay Time	--	31	--		
$t_{fall}$	Fall Time	--	11	--		

**Source-Drain Body Diode Characteristics**T<sub>J</sub>=25°C unless otherwise specified

Symbol	Parameter	Min	Typ.	Max.	Unit	Test Conditions
I <sub>SD</sub>	Continuous Source Current <sup>[2]</sup>	--	--	6	A	Maximum Ratings
I <sub>SM</sub>	Pulsed Source Current <sup>[2]</sup>	--	--	20		
V <sub>SD</sub>	Diode Forward Voltage	--	--	1.2	V	I <sub>S</sub> =3A, V <sub>GS</sub> =0V
t <sub>rr</sub>	Reverse Recovery Time	--	219	--	ns	I <sub>F</sub> = 2.5A, di/dt =100A/μs
Q <sub>rr</sub>	Reverse Recovery Charge	--	1080	--	nC	

**Note:**

[1] Repetitive Rating: Pulse width limited by maximum junction temperature

[2] VDD= 50V, VG=10V, RG=25Ω, Starting T<sub>J</sub>= 25°C L=10mH

[3] Pulse Test: Pulse width ≤ 380us, Duty Cycle ≤ 2%



## Typical Characteristics

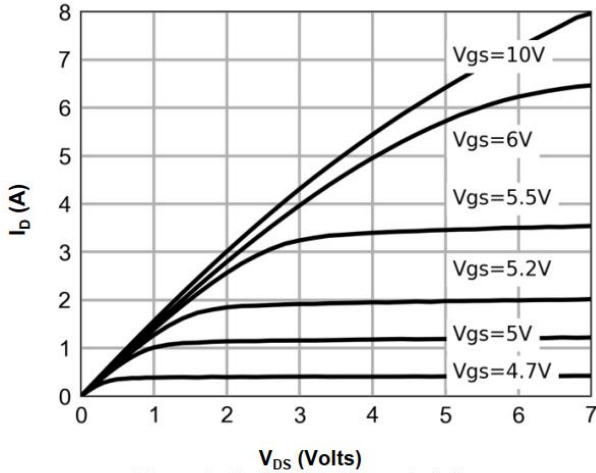


Figure 1: On-Region Characteristics

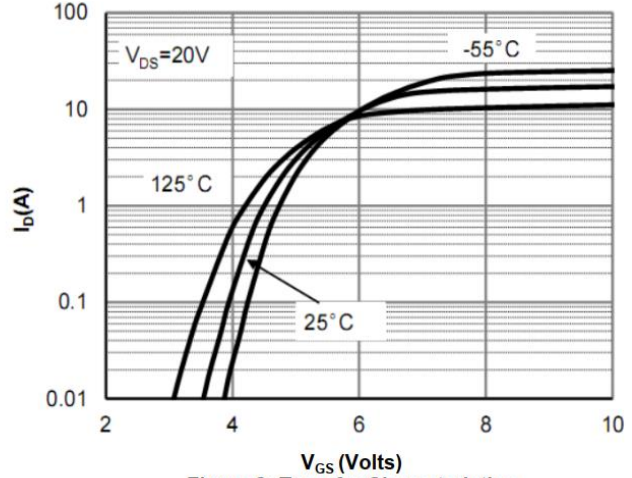


Figure 2: Transfer Characteristics

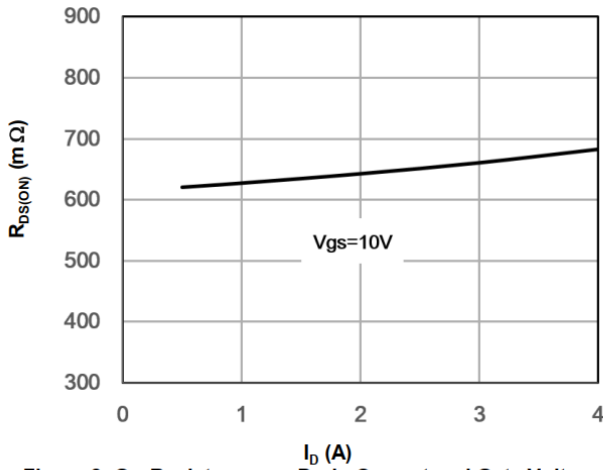


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

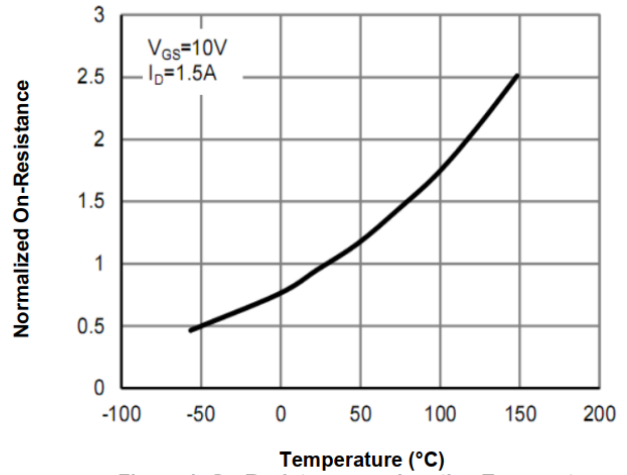


Figure 4: On-Resistance vs. Junction Temperature

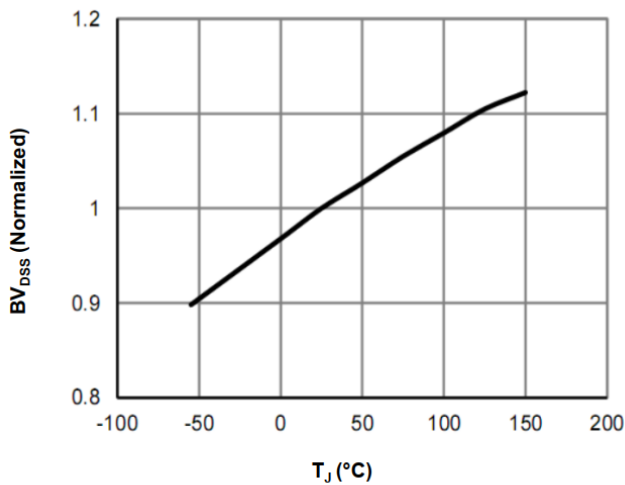


Figure 5: Break Down vs. Junction Temperature

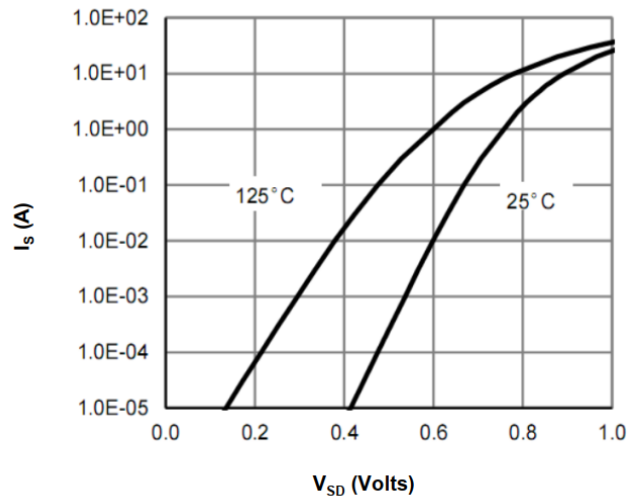


Figure 6: Body-Diode Characteristics

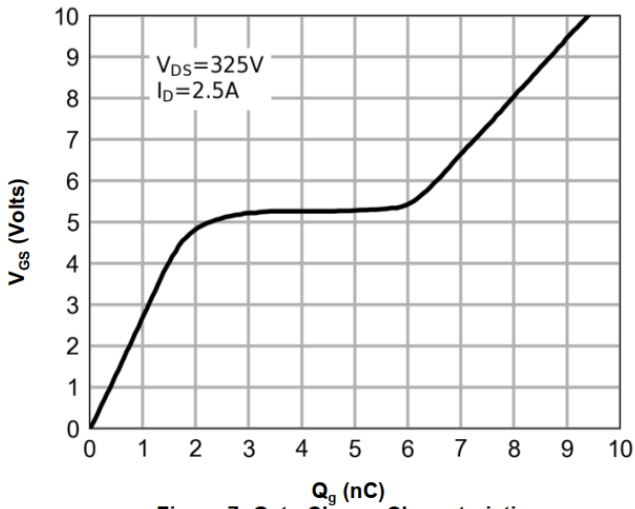


Figure 7: Gate-Charge Characteristics

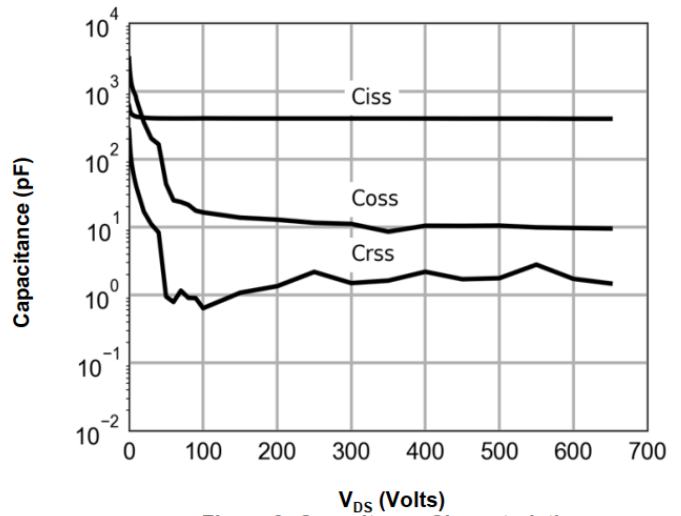


Figure 8: Capacitance Characteristics

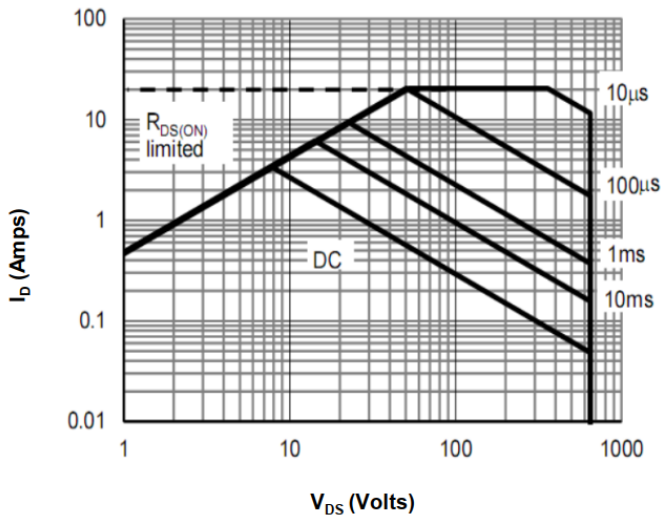


Figure 9: Maximum Forward Biased Safe Operating Area

Test Circuits and Waveforms

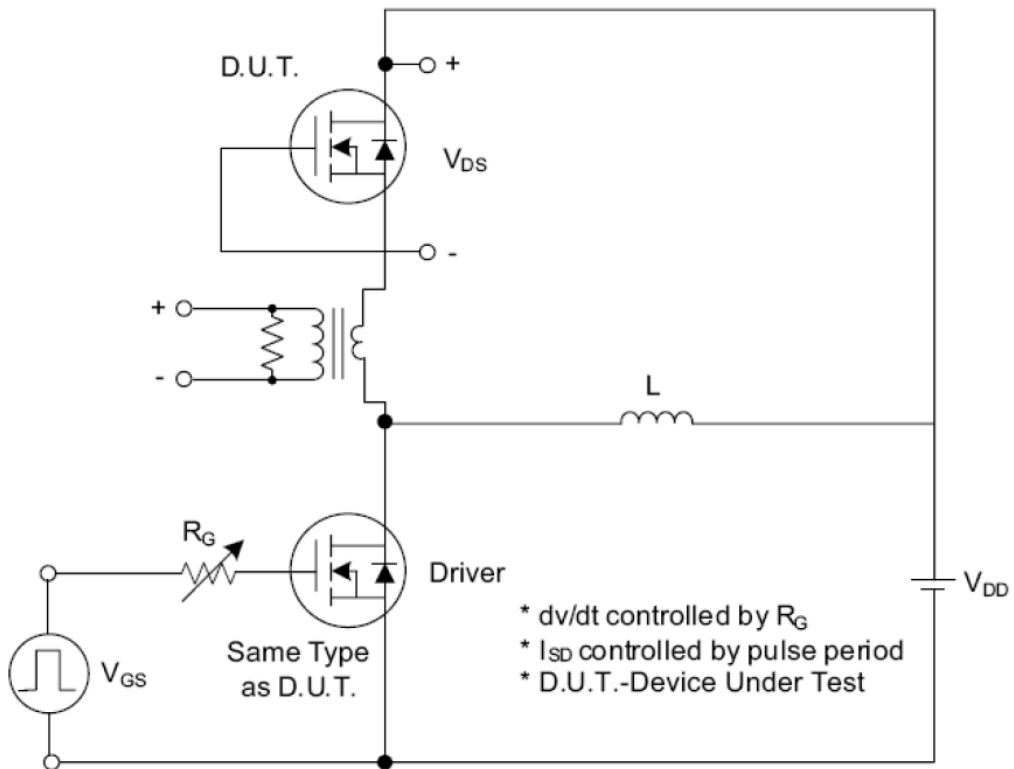


Fig. 1.1 Peak Diode Recovery  $dv/dt$  Test Circuit

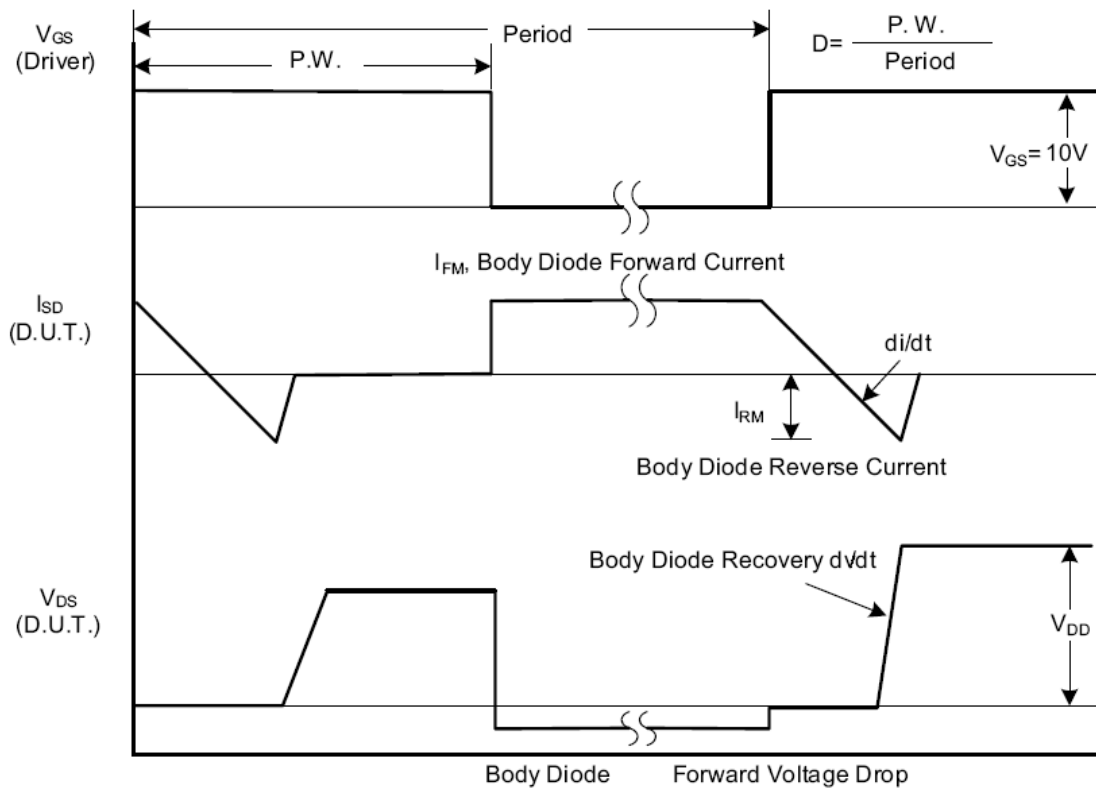


Fig. 1.2 Peak Diode Recovery  $dv/dt$  Waveforms

Test Circuits and Waveforms (Cont.)

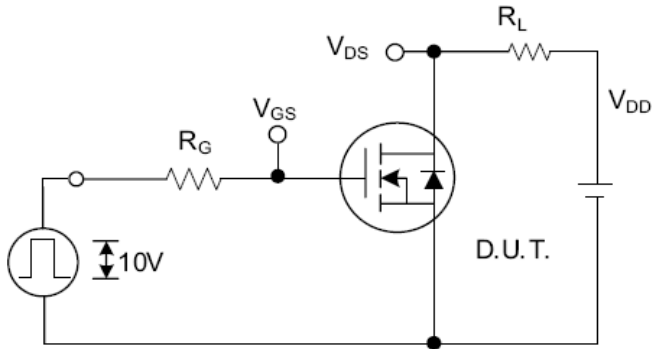


Fig. 2.1 Switching Test Circuit

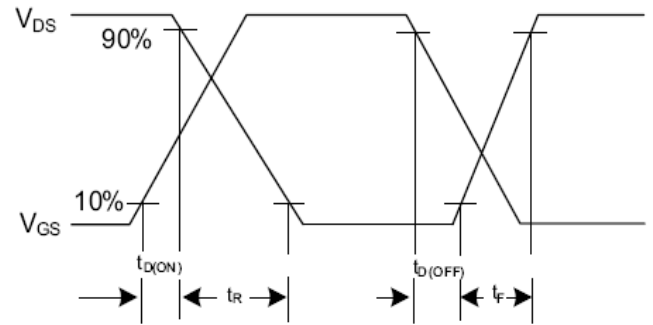


Fig. 2.2 Switching Waveforms

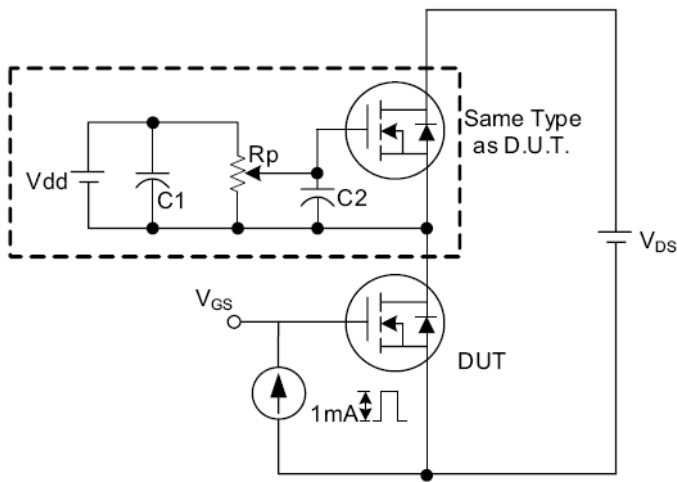


Fig. 3.1 Gate Charge Test Circuit

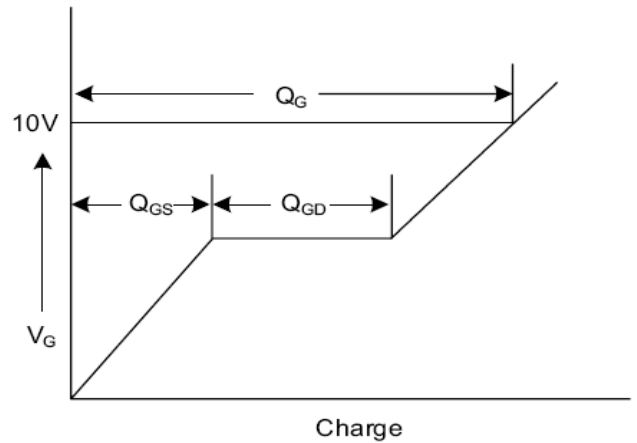


Fig. 3.2 Gate Charge Waveform

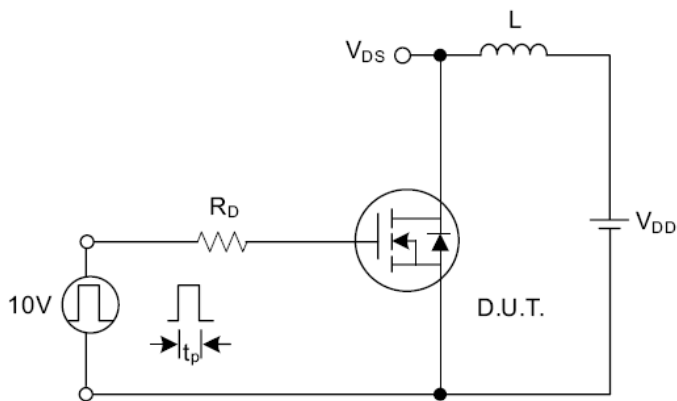


Fig. 4.1 Unclamped Inductive Switching Test Circuit

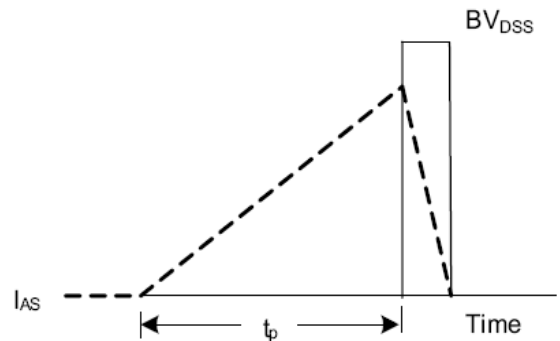


Fig. 4.2 Unclamped Inductive Switching Waveforms



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