



## 650V N-Channel MOSFET

Lead Free Package and Finish

### General Features

- Advanced Planar Process
- $R_{DS(ON),typ.} = 350\text{ m}\Omega @ V_{GS}=10\text{V}$
- Low Gate Charge Minimize Switching Loss
- Rugged Poly silicon Gate Structure

$BV_{DSS}$	$R_{DS(ON),typ.}$	$I_D$
650V	350m $\Omega$	22A

### Applications

- BLDC Motor Driver
- Electric Welder
- High Efficiency SMPS

### Ordering Information

Part Number	Package	Brand
PTA22N65	TO-220F	



TO-220F Package

### Absolute Maximum Ratings

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

Symbol	Parameter	PTA22N65	Unit
$V_{DSS}$	Drain-to-Source Voltage	650	V
$V_{GSS}$	Gate-to-Source Voltage	$\pm 30$	
$I_D$	Continuous Drain Current	22	A
	Continuous Drain Current @ $T_c=100^\circ\text{C}$	14	
$I_{DM}$	Pulsed Drain Current at $V_{GS}=10\text{V}^{[2,4]}$	88	
$E_{AS}$	Single Pulse Avalanche Energy	800	mJ
$dv/dt$	Peak Diode Recovery $dv/dt^{[3]}$	5.0	V/ns
$P_D$	Power Dissipation	75	W
	Derating Factor above $25^\circ\text{C}$	0.598	W/ $^\circ\text{C}$
$T_L$ $T_{PAK}$	Maximum Temperature for Soldering Leads at 0.063in (1.6mm) from Case for 10 seconds, Package Body for 10 seconds	300 260	$^\circ\text{C}$
$T_J$ & $T_{STG}$	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	PTA22N65	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	1.67	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	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	$\mu A$	$V_{DS}=650V, V_{GS}=0V$
		--	--	125		$V_{DS}=520V, V_{GS}=0V, T_J=125^\circ\text{C}$
$I_{GSS}$	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	--	350	450	$m\Omega$	$V_{GS}=10V, I_D=11A$
$V_{GS(TH)}$	Gate Threshold Voltage	2.0	--	4.0	V	$V_{DS}=V_{GS}, I_D=250\mu A$
$g_{FS}$	Forward Transconductance	--	33	--	S	$V_{DS}=25V, I_D=11A$

### Dynamic Characteristics

Essentially independent of operating temperature

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$C_{iss}$	Input Capacitance	--	3500	--	$pF$	$V_{GS}=0V, V_{DS}=25V, f=1.0MHz$
$C_{rss}$	Reverse Transfer Capacitance	--	240	--		
$C_{oss}$	Output Capacitance	--	255	--		
$Q_g$	Total Gate Charge	--	65	--	$nC$	$V_{DD}=325V, I_D=22A, V_{GS}=0 \text{ to } 10V$
$Q_{gs}$	Gate-to-Source Charge	--	19	--		
$Q_{gd}$	Gate-to-Drain (Miller) Charge	--	17	--		

### Resistive Switching Characteristics

Essentially independent of operating temperature

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$t_{d(ON)}$	Turn-on Delay Time	--	46	--	$ns$	$V_{DD}=325V, I_D=11A, V_{GS}=10V, R_G=25\Omega$
$t_{rise}$	Rise Time	--	115	--		
$t_{d(OFF)}$	Turn-Off Delay Time	--	92	--		
$t_{fall}$	Fall Time	--	105	--		

**Source-Drain Body Diode Characteristics** $T_J=25^{\circ}\text{C}$  unless otherwise specified

Symbol	Parameter	Min	Typ.	Max.	Unit	Test Conditions
$I_{SD}$	Continuous Source Current <sup>[2]</sup>	--	--	22	A	Integral PN-diode in MOSFET
$I_{SM}$	Pulsed Source Current <sup>[2]</sup>	--	--	88		
$V_{SD}$	Diode Forward Voltage	--	--	1.5	V	$I_S=22\text{A}$ , $V_{GS}=0\text{V}$
$t_{rr}$	Reverse recovery time	--	625	--	ns	$V_{GS}=0\text{V}$ , $I_F=22\text{A}$ , $di_F/dt=100\text{A}/\mu\text{s}$
$Q_{rr}$	Reverse recovery charge	--	5.0	--	$\mu\text{C}$	

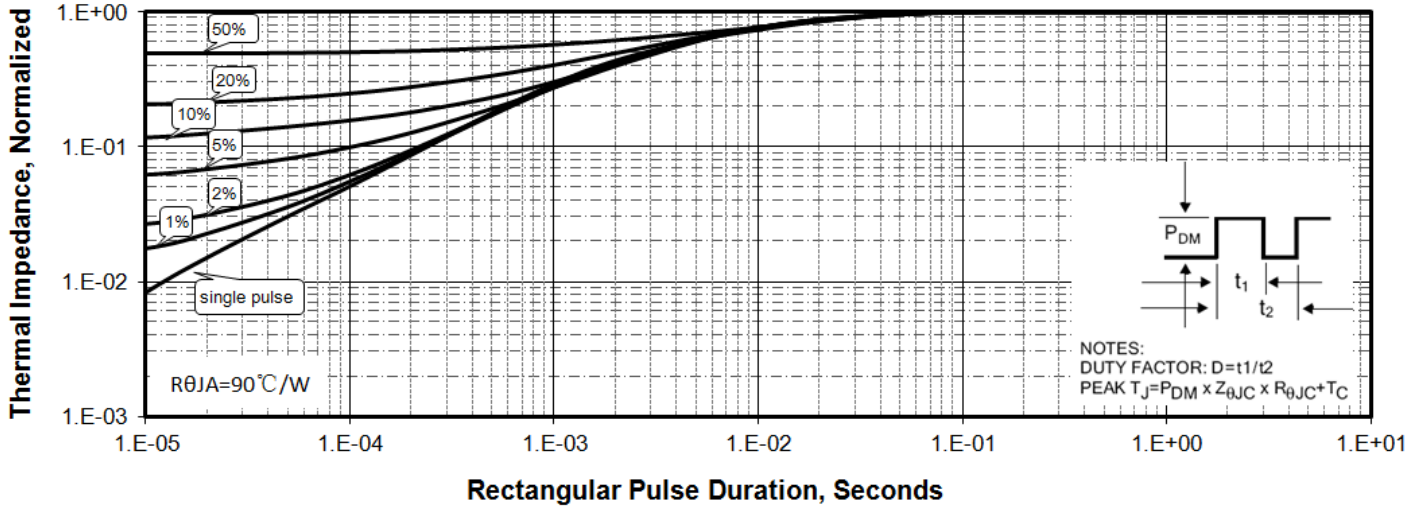
**Note:**

- [1]  $T_J=+25^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$  .  
[2] Silicon limited current only.  
[3] Package limited current.  
[4] Repetitive rating; pulse width limited by maximum junction temperature.  
[5] Pulse width $\leq 380\mu\text{s}$ ; duty cycle $\leq 2\%$ .

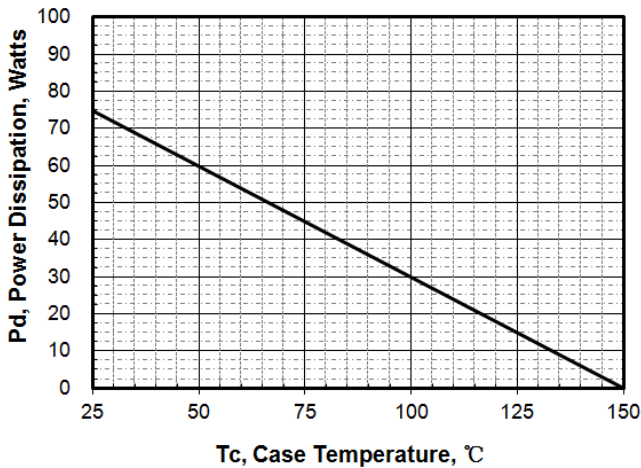


## Typical Characteristics

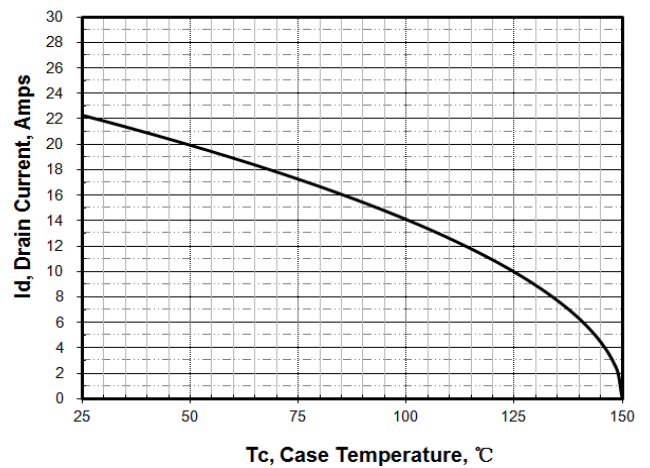
### Figure 1. Maximum Transient Thermal Impedance



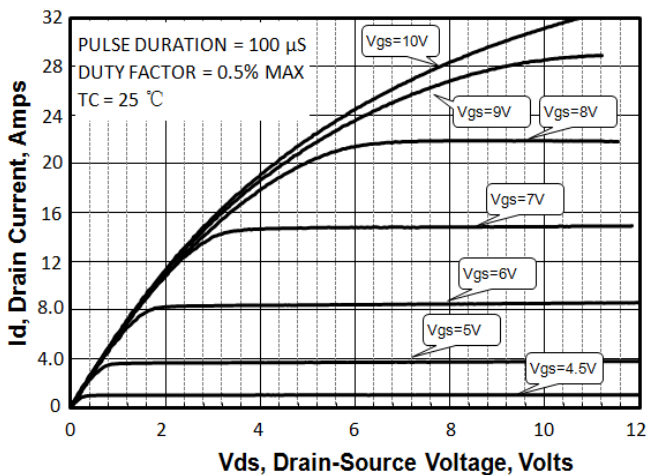
### Figure 2 . Max. Power Dissipation vs Case Temperature



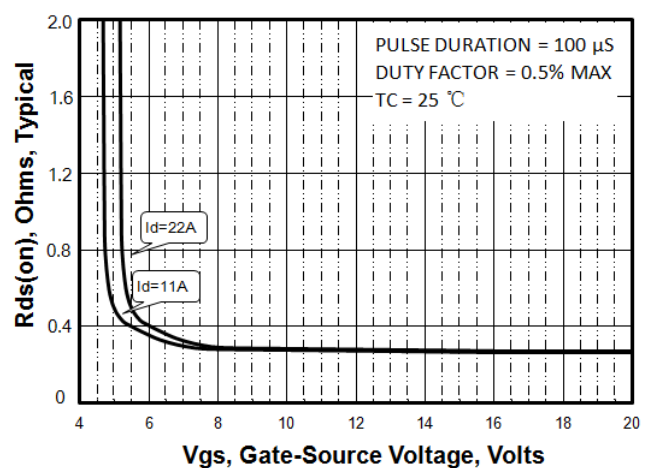
### Figure 3 .Maximum Continuous Drain Current vs $T_c$



### Figure 4. Output Characteristics



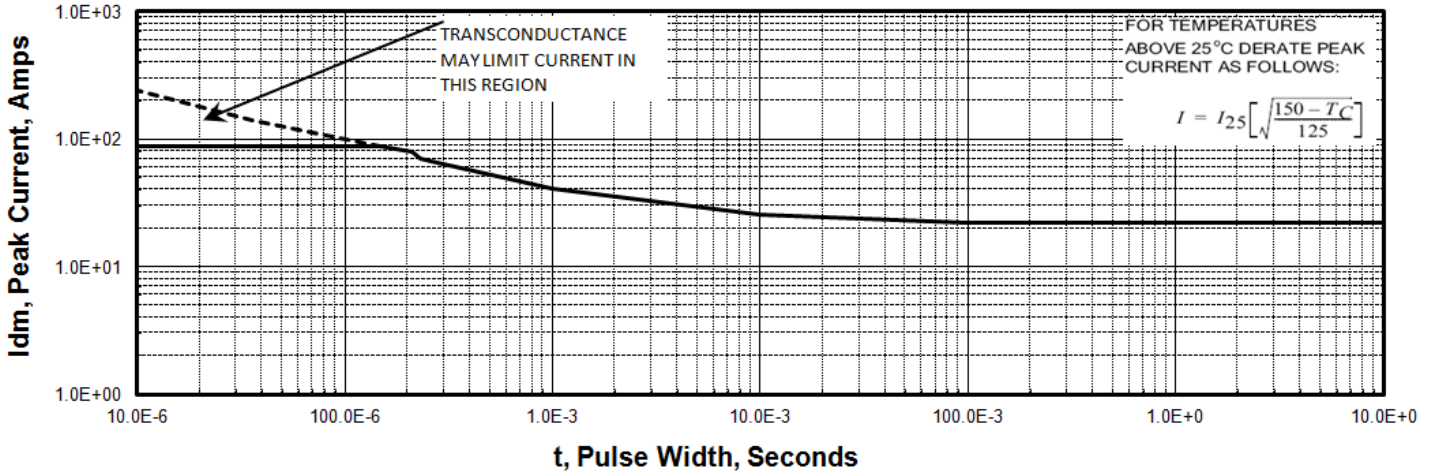
### Figure 5. $R_{ds(on)}$ vs Gate Voltage



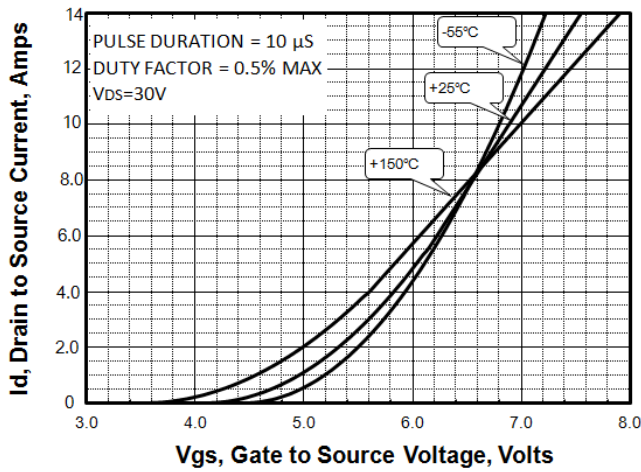


### Typical Characteristics(Cont.)

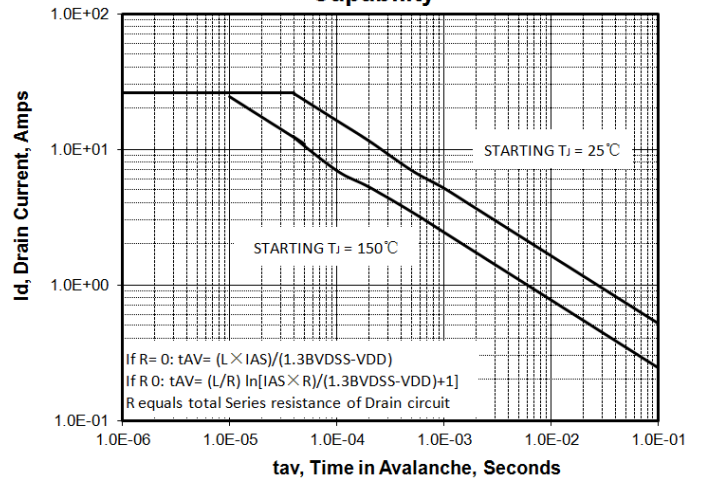
#### Figure 6. Peak Current Capability



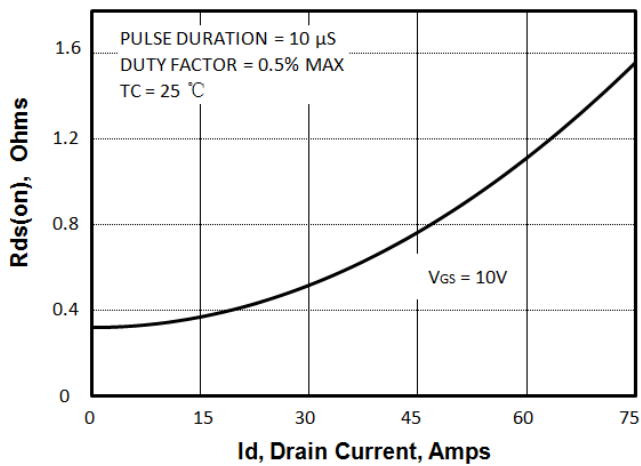
#### Figure 7. Transfer Characteristics



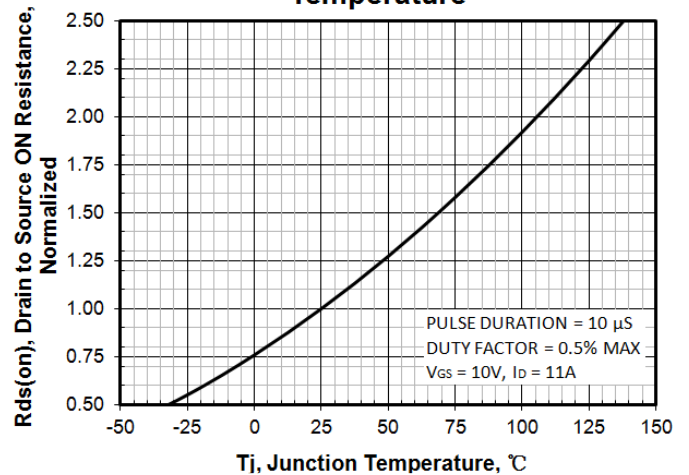
#### Figure 8. Unclamped Inductive Switching Capability



#### Figure 9. Drain to Source ON Resistance vs Drain Current



#### Figure 10. Rds(on) vs Junction Temperature







### Typical Characteristics(Cont.)

Figure 11. Breakdown Voltage vs Temperature

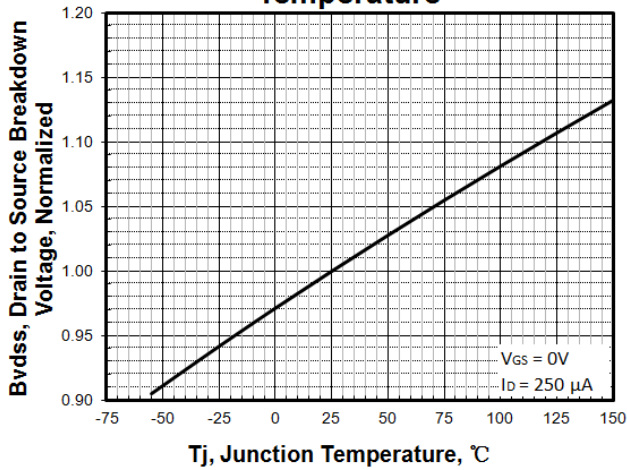


Figure 12. Threshold Voltage vs Temperature

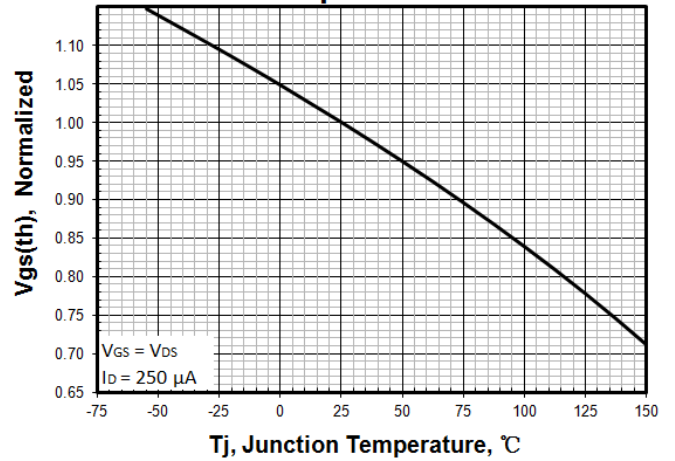


Figure 13. Maximum Safe Operating Area

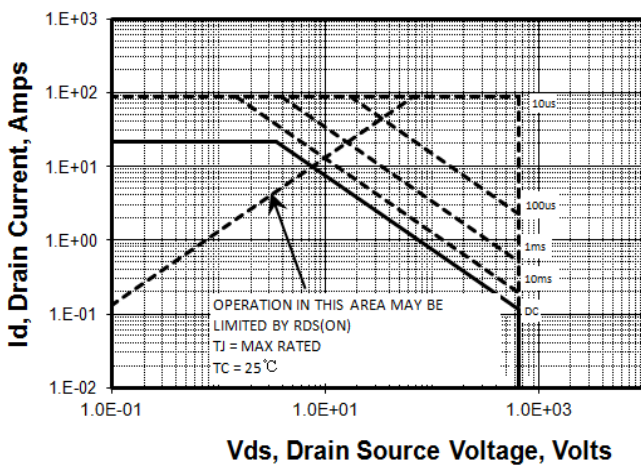


Figure 14. Capacitance vs Vds

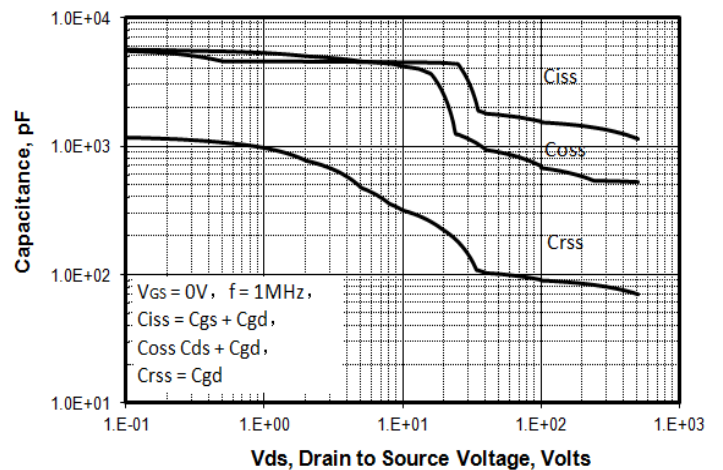


Figure 15. Typical Gate Charge

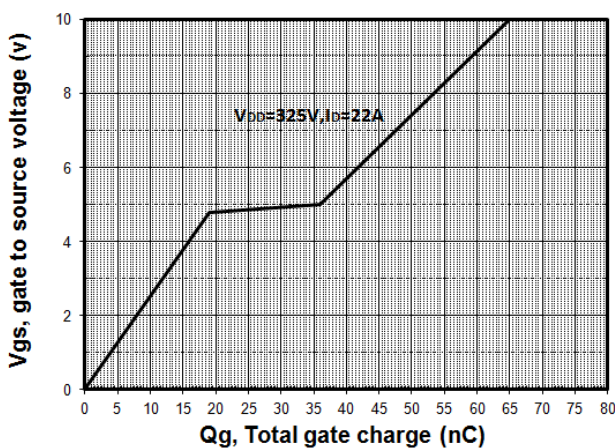
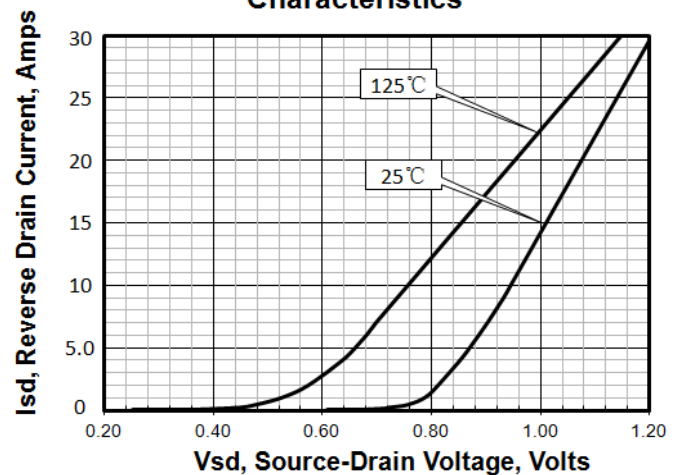


Figure 16. Body Diode Transfer Characteristics



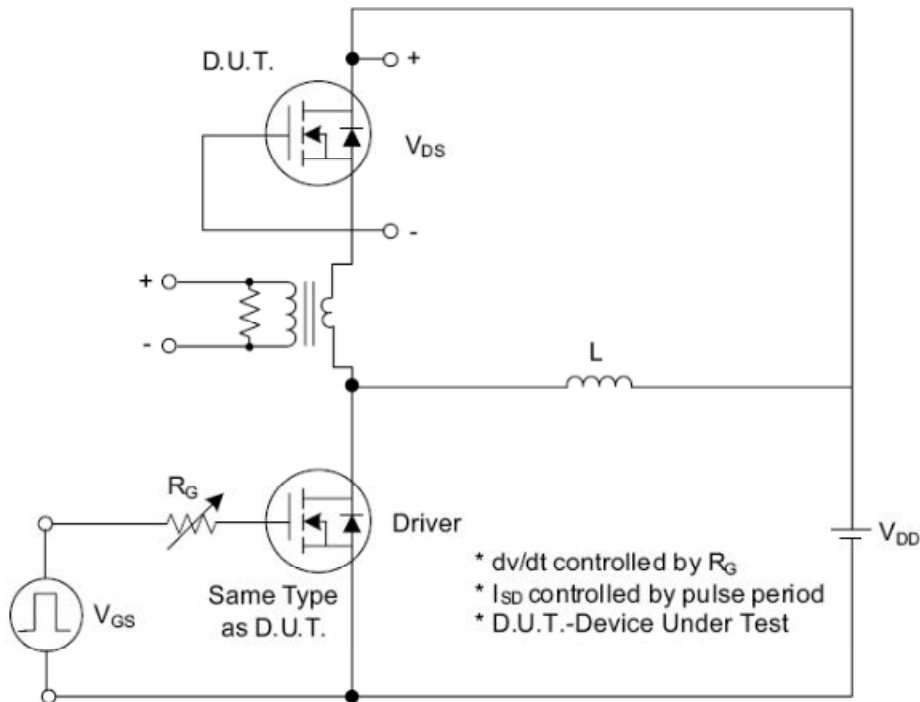
**Test Circuits and Waveforms**


Fig. 1.1 Peak Diode Recovery dv/dt Test Circuit

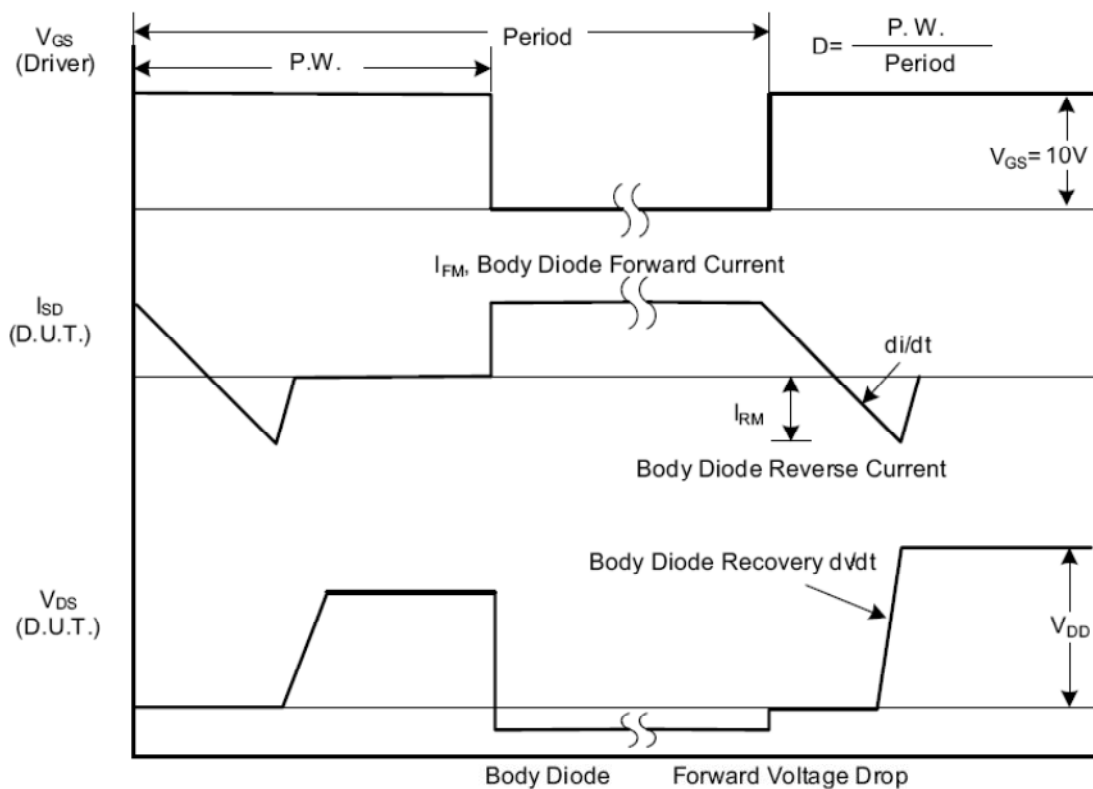


Fig. 1.2 Peak Diode Recovery dv/dt Waveforms

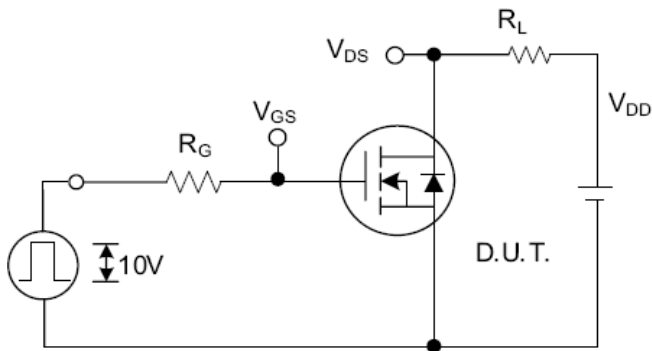
**Test Circuits and Waveforms (Cont.)**


Fig. 2.1 Switching Test Circuit

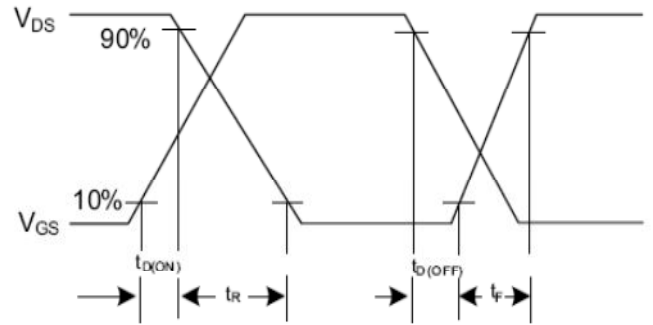


Fig. 2.2 Switching Waveforms

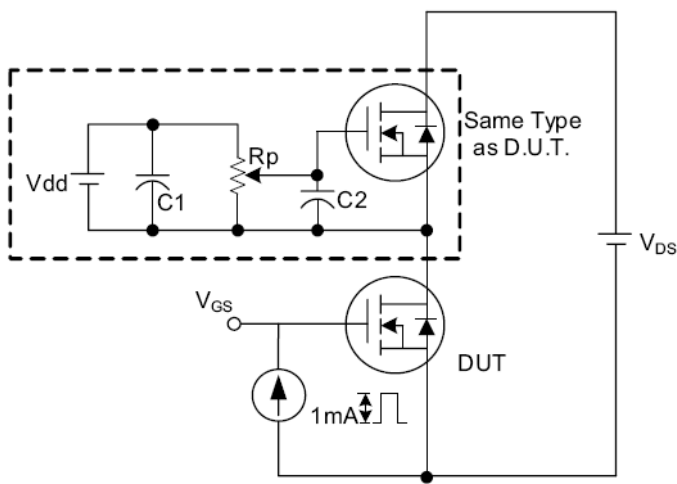


Fig. 3.1 Gate Charge Test Circuit

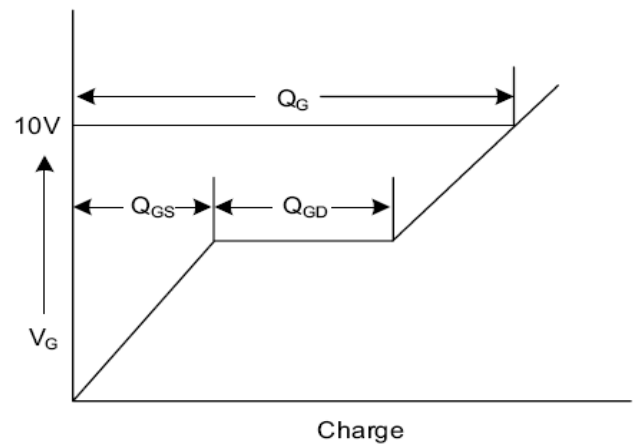


Fig. 3.2 Gate Charge Waveform

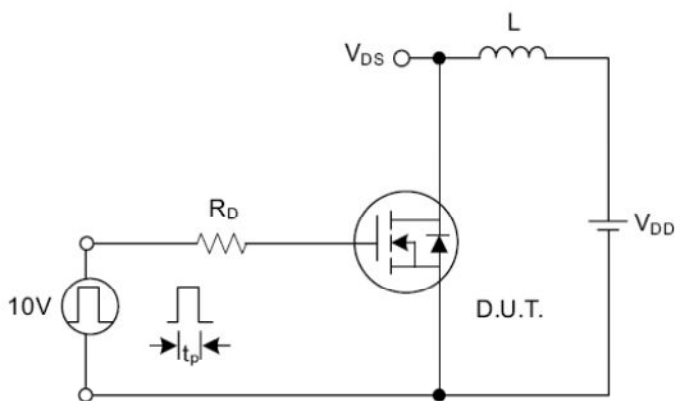


Fig. 4.1 Unclamped Inductive Switching Test Circuit

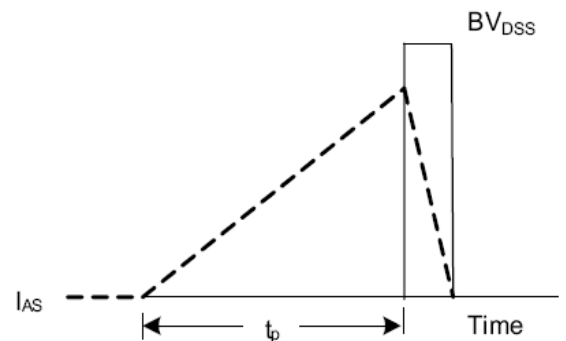


Fig. 4.2 Unclamped Inductive Switching Waveforms





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