



## 40V N-Channel MOSFET

Lead Free Package and Finish

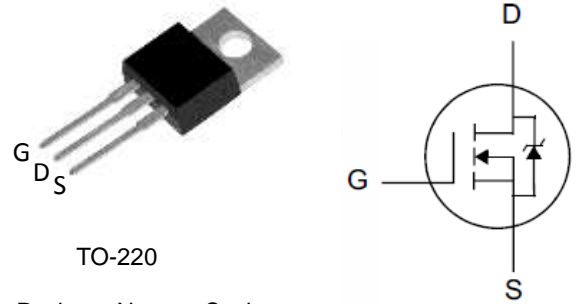
### General Features

- Proprietary New Trench Technology
- $R_{DS(ON),typ.}=1.65\text{ m}\Omega@V_{GS}=10\text{V}$
- Low Gate Charge Minimize Switching Loss
- Fast Recovery Body Diode

$BV_{DSS}$	$R_{DS(ON),typ.}$	$I_D$
40V	1.65m $\Omega$	245A

### Applications

- High efficiency DC/DC Converters
- Synchronous Rectification
- UPS Inverter



### Ordering Information

Part Number	Package	Brand
PTP02N04NB	TO-220	

### Absolute Maximum Ratings $T_C=25^\circ\text{C}$ unless otherwise specified

Symbol	Parameter	PTP02N04NB	Unit
$V_{DSS}$	Drain-to-Source Voltage <sup>[1]</sup>	40	V
$V_{GSS}$	Gate-to-Source Voltage	$\pm 20$	V
$I_D$	Continuous Drain Current <sup>[2]</sup>	245	A
	Continuous Drain Current <sup>[3]</sup>	120	
	Continuous Drain Current @ $T_C=100^\circ\text{C}$ <sup>[2]</sup>	165	
$I_{DM}$	Pulsed Drain Current at $V_{GS}=10\text{V}$	735	
$E_{AS}$	Single Pulse Avalanche Energy, $L=1\text{mH}$	1200	mJ
$dv/dt$	Peak Diode Recovery $dv/dt$ <sup>[3]</sup>	5.0	V/ns
$P_D$	Power Dissipation	300	W
	Derating Factor above $25^\circ\text{C}$	2.0	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 175	

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

### Thermal Characteristics

Symbol	Parameter	PTP02N04NB	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.5	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	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	40	--	--	V	$V_{GS}=0V, I_D=250\mu A$
$I_{DSS}$	Drain-to-Source Leakage Current	--	--	1	$\mu A$	$V_{DS}=40V, V_{GS}=0V$
		--	--	5		$V_{DS}=32V, V_{GS}=0V, T_J=125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Leakage Current	--	--	+100	$nA$	$V_{GS}=+20V, V_{DS}=0V$
		--	--	-100		$V_{GS}=-20V, V_{DS}=0V$

### 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	--	1.65	2.1	$m\Omega$	$V_{GS}=10V, I_D=24A$
$V_{GS(TH)}$	Gate Threshold Voltage	2.0	--	4.0	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	--	5.1	--	$nF$	$V_{GS}=0V, V_{DS}=25V, f=1.0MHz$
$C_{rSS}$	Reverse Transfer Capacitance	--	0.37	--		
$C_{oss}$	Output Capacitance	--	0.91	--		
$R_G$	Gate Series Resistance	--	1.4	--	$\Omega$	$f=1.0MHz$
$Q_g$	Total Gate Charge	--	125	--	$nC$	$V_{DD}=20V, I_D=80A, V_{GS}=0 \text{ to } 10V$
$Q_{gs}$	Gate-to-Source Charge	--	9.0	--		
$Q_{gd}$	Gate-to-Drain (Miller) Charge	--	37	--		

### Resistive Switching Characteristics

Essentially independent of operating temperature

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$t_{d(ON)}$	Turn-on Delay Time	--	10	--	$nS$	$V_{DD}=20V, I_D=24A, V_{GS}=10V, R_G=2.5\Omega$
$t_{rise}$	Rise Time	--	24	--		
$t_{d(OFF)}$	Turn-Off Delay Time	--	77	--		
$t_{fall}$	Fall Time	--	23	--		



## 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	--	--	245	A	Integral PN-diode in MOSFET
$I_{SM}$	Pulsed Source Current	--	--	735		
$V_{SD}$	Diode Forward Voltage	--	--	1.2	V	$I_S=24\text{A}$ , $V_{GS}=0\text{V}$
$t_{rr}$	Reverse recovery time	--	55	--	ns	$V_{GS}=0\text{V}$ , $I_F=24\text{A}$ , $di_F/dt=100\text{A}/\mu\text{s}$
$Q_{rr}$	Reverse recovery charge	--	35	--	nC	

### Note:

- [1]  $T_J=+25^{\circ}\text{C}$  to  $+175^{\circ}\text{C}$  .
- [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 Effective Thermal Impedance, Junction-to-Case

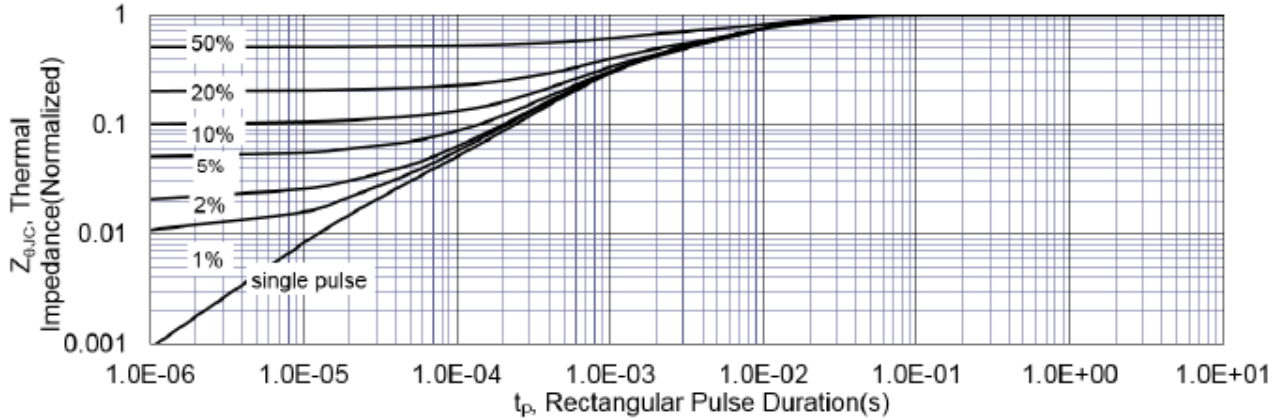


Figure 2. Max. Power Dissipation vs Case Temperature

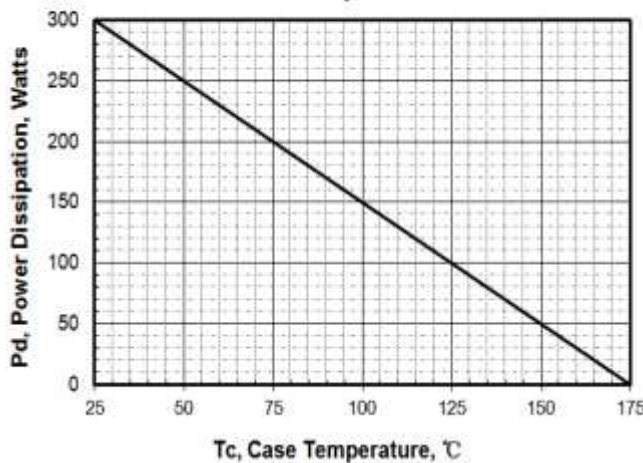


Figure 3. Maximum Continuous Drain Current vs  $T_c$

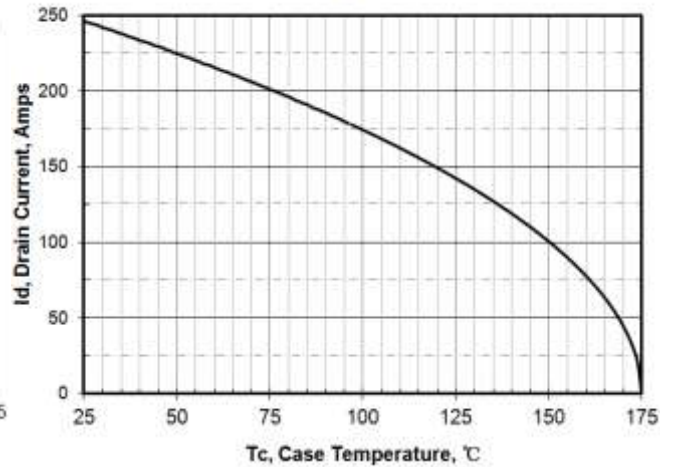


Figure 4. Typical Output Characteristics

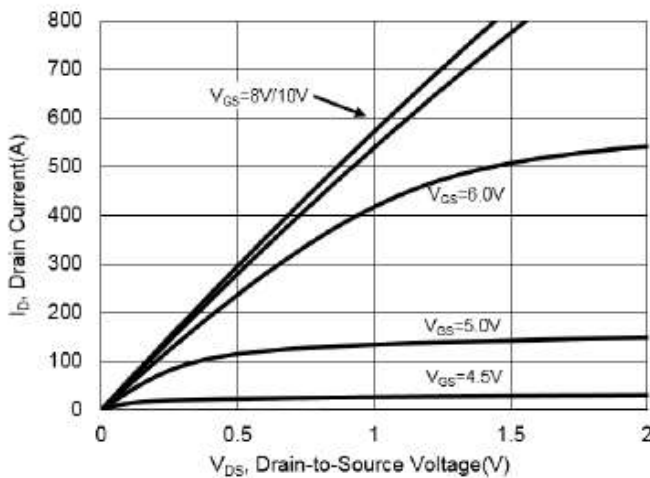
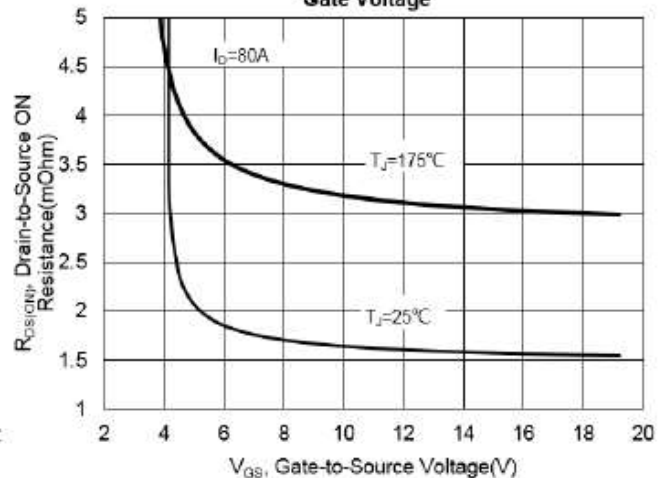


Figure 5. Typical Drain-to-Source ON Resistance vs. Gate Voltage





### Typical Characteristics(Cont.)

Figure 6. Maximum Peak Current Capability

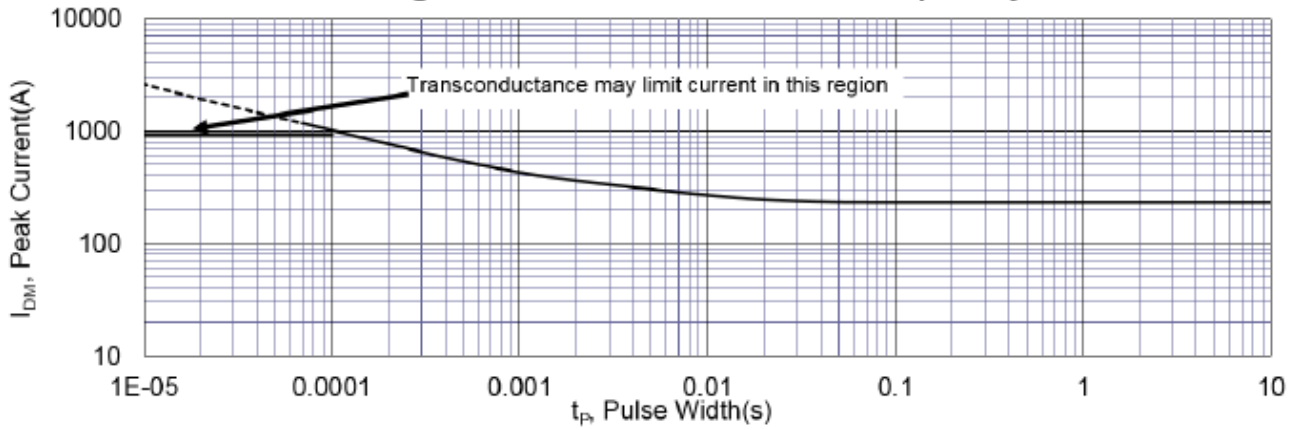


Figure 7. Typical Transfer Characteristics

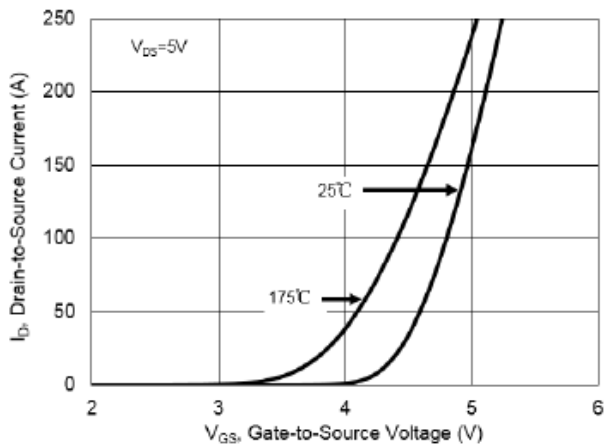


Figure 8. Unclamped Inductive Switching Capability

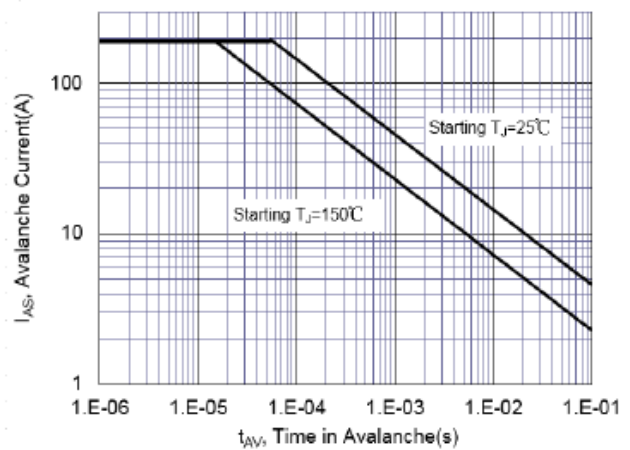


Figure 9. Typical Drain-to-Source ON Resistance

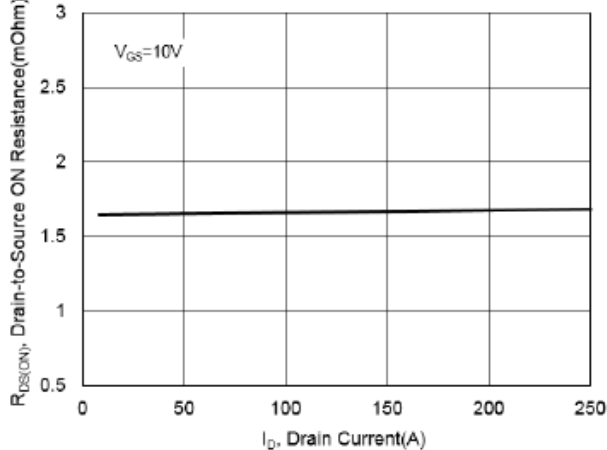
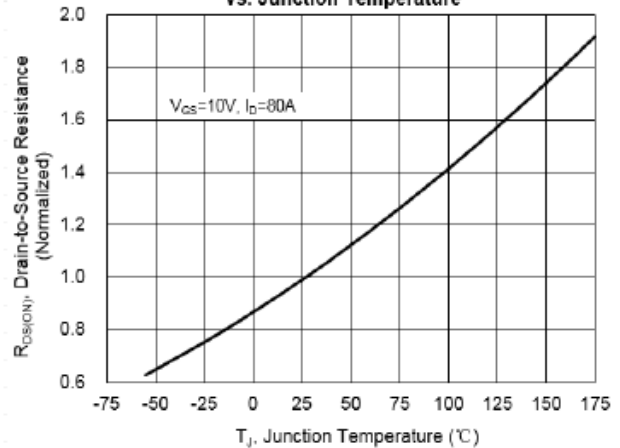


Figure 10. Typical Drain-to-Source On Resistance vs. Junction Temperature





### Typical Characteristics(Cont.)

Figure 11. Typical Breakdown Voltage vs. Junction Temperature

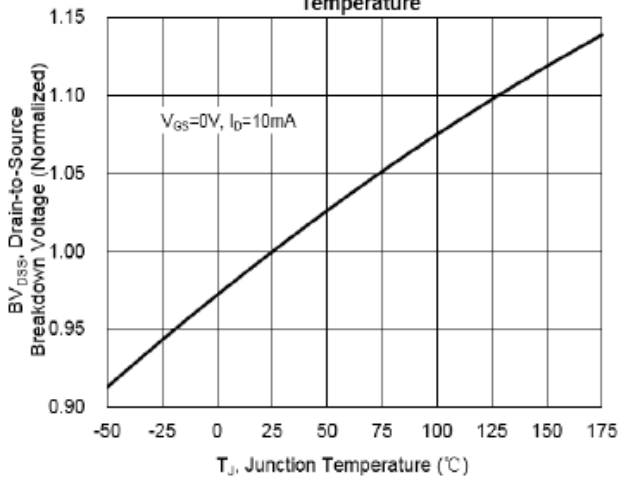


Figure 12. Typical Threshold Voltage vs. Junction Temperature

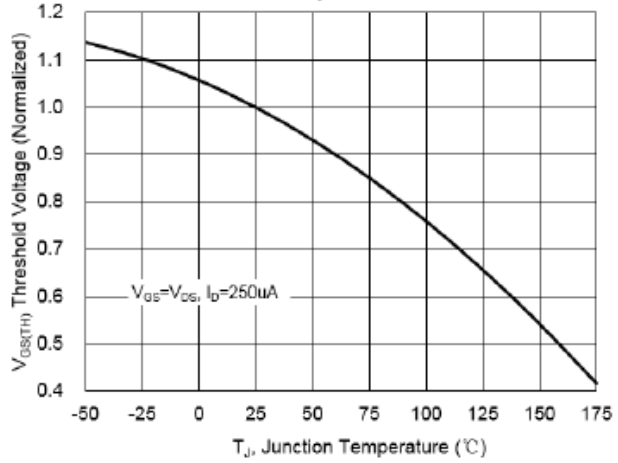


Figure 13. Maximum Safe Operating Area

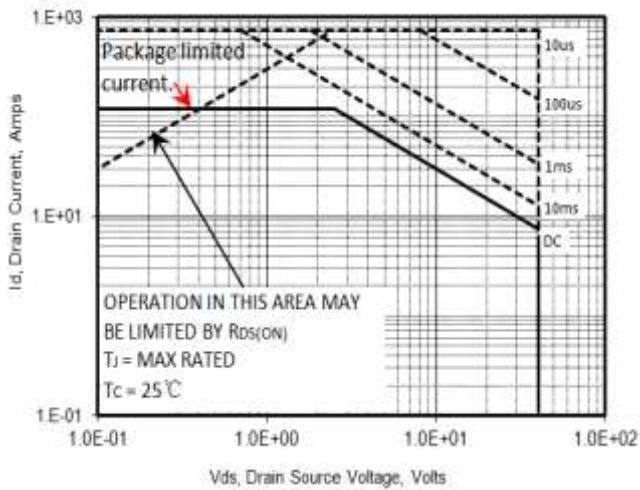


Figure 14. Typical Capacitance vs. Drain-to-Source Voltage

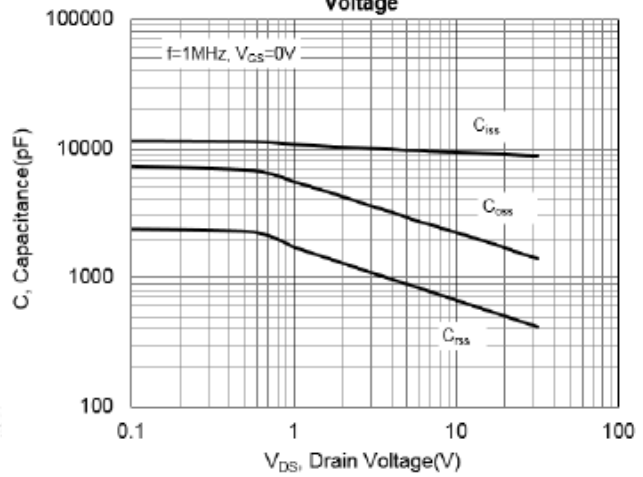


Figure 15. Typical Body Diode Transfer Characteristics

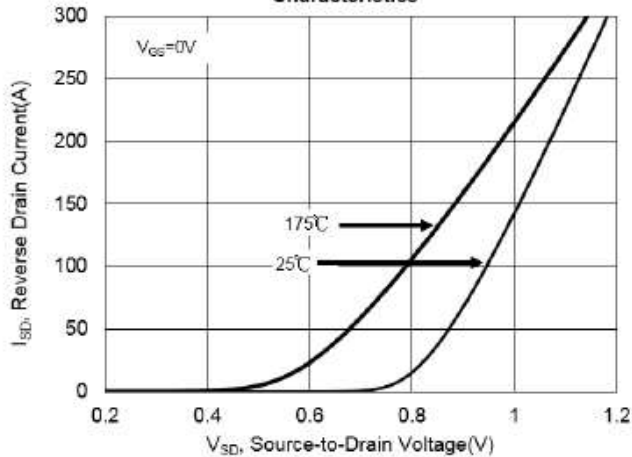
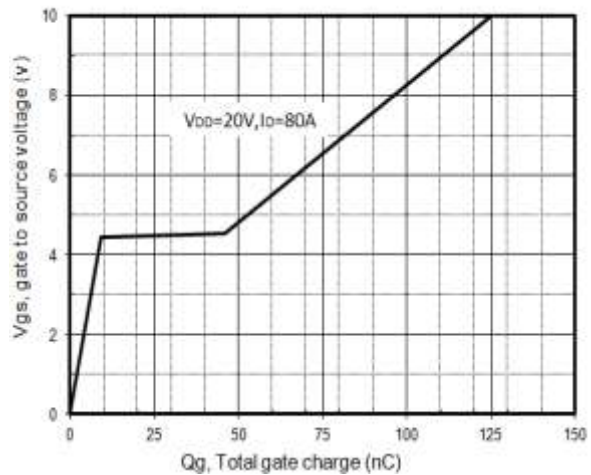


Figure 16. Typical Gate Charge



Test Circuits and Waveforms

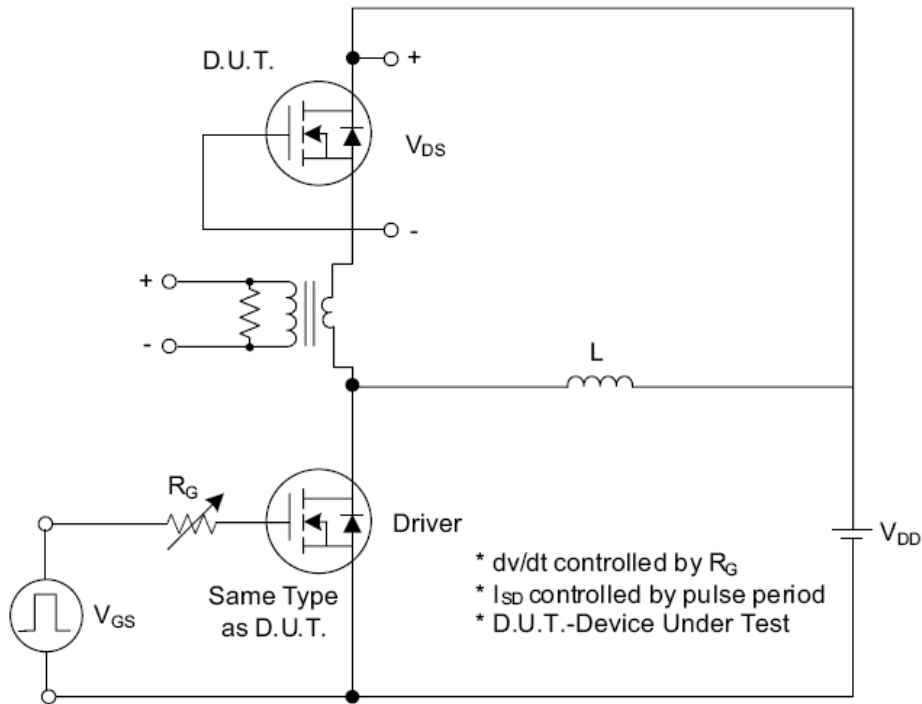


Fig. 1.1 Peak Diode Recovery  $dv/dt$  Test Circuit

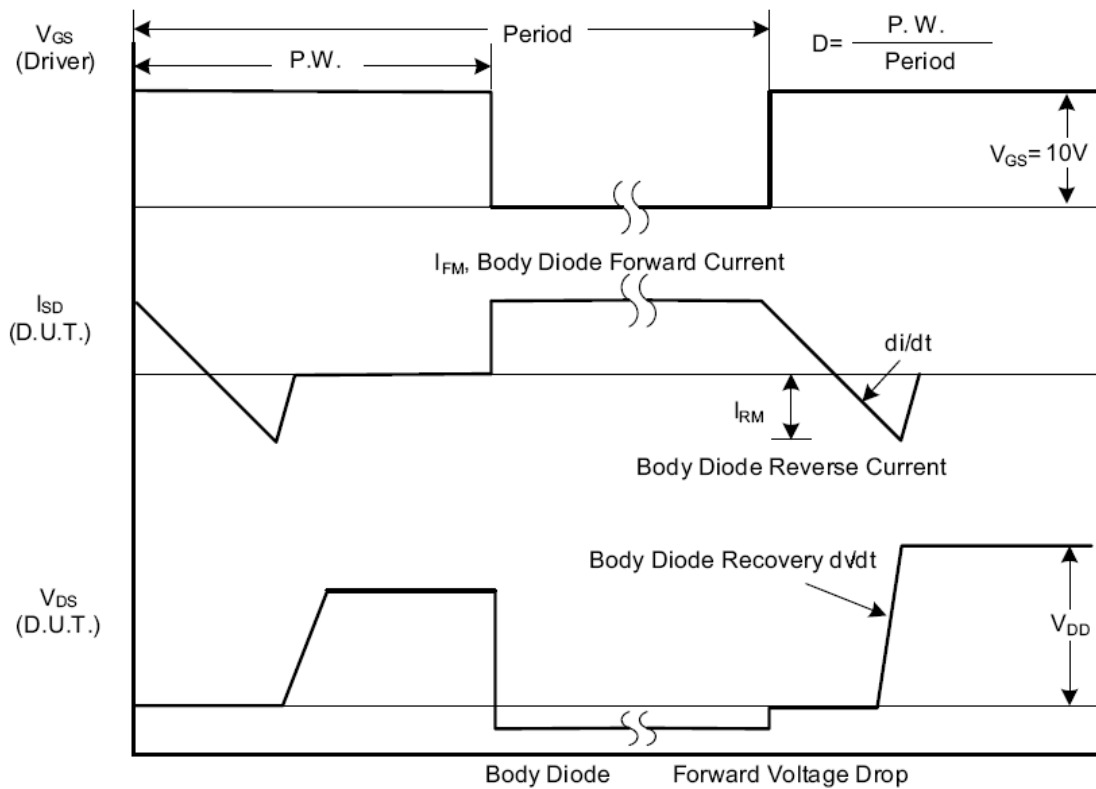


Fig. 1.2 Peak Diode Recovery  $dv/dt$  Waveforms

## Test Circuits and Waveforms (Cont.)

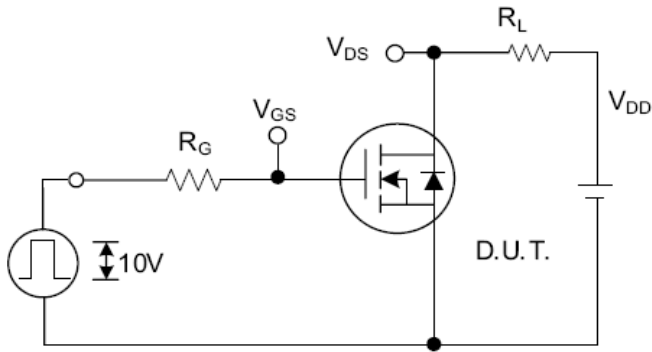


Fig. 2.1 Switching Test Circuit

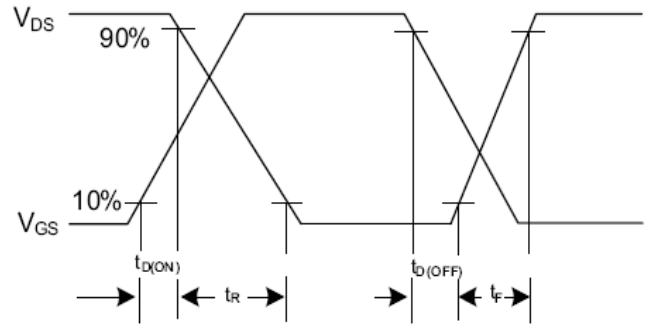


Fig. 2.2 Switching Waveforms

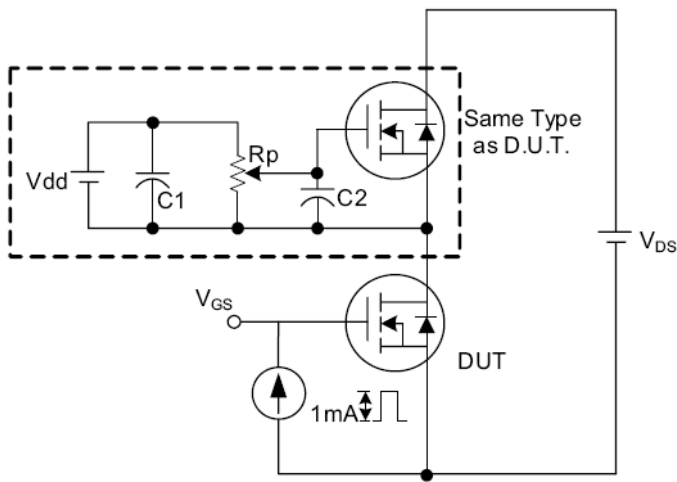


Fig. 3.1 Gate Charge Test Circuit

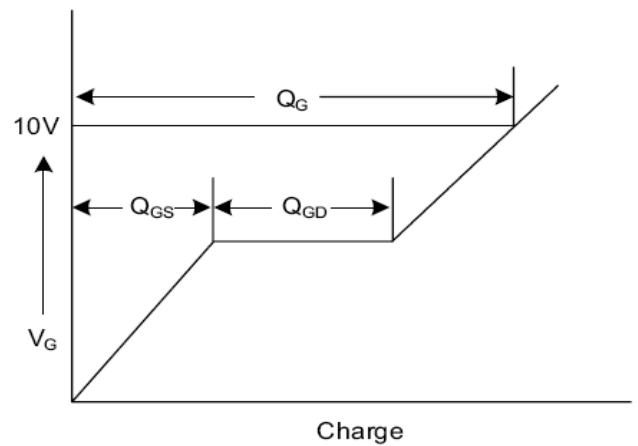


Fig. 3.2 Gate Charge Waveform

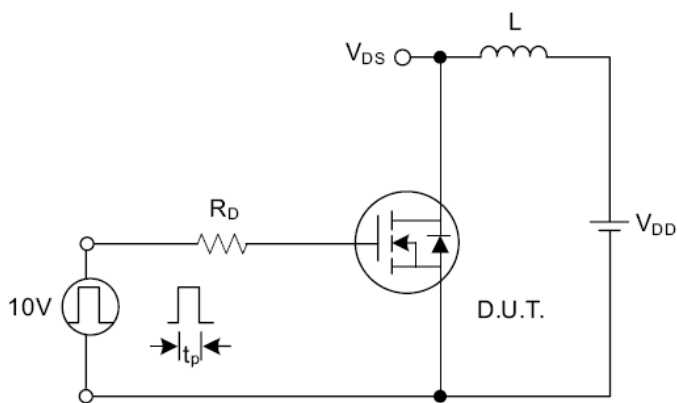


Fig. 4.1 Unclamped Inductive Switching Test Circuit

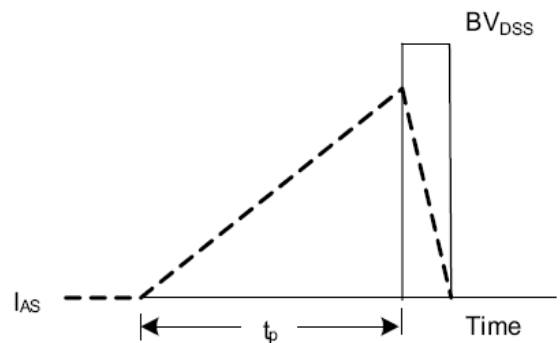


Fig. 4.2 Unclamped Inductive Switching Waveforms





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