

## Power MOSFET

PRODUCT SUMMARY		
$V_{DS}$ (V)	100	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10\text{ V}$	0.077
$Q_g$ (Max.) (nC)	72	
$Q_{gs}$ (nC)	11	
$Q_{gd}$ (nC)	32	
Configuration	Single	

### FEATURES

- Surface Mount
- Available in Tape and Reel
- Dynamic  $dV/dt$  Rating
- Repetitive Avalanche Rated
- 175 °C Operating Temperature
- Fast Switching
- Ease of Paralleling
- Lead (Pb)-free Available



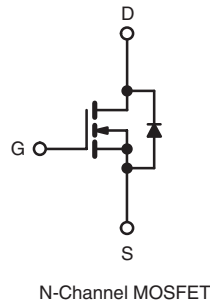
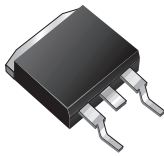
Available  
**RoHS\***  
 COMPLIANT

### DESCRIPTION

Third generation Power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The SMD-220 is a surface mount power package capable of accommodating die size up to HEX-4. It provides the highest power capability and the lowest possible on-resistance in any existing surface mount package. The SMD-220 is suitable for high current applications because of its low internal connection resistance and can dissipate up to 2.0 W in a typical surface mount application.

SMD-220



ORDERING INFORMATION			
Package	SMD-220	SMD-220	SMD-220
Lead (Pb)-free	IRF540SPbF	IRF540STRLPbF <sup>a</sup>	IRF540STRRPbF <sup>a</sup>
	SiHF540S-E3	SiHF540STL-E3 <sup>a</sup>	SiHF540STR-E3 <sup>a</sup>
SnPb	IRF540S	IRF540STRL <sup>a</sup>	IRF540STRR <sup>a</sup>
	SiHF540S	SiHF540STL <sup>a</sup>	SiHF540STR <sup>a</sup>

#### Note

a. See device orientation.

ABSOLUTE MAXIMUM RATINGS $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted				
PARAMETER	SYMBOL		LIMIT	UNIT
Drain-Source Voltage	$V_{DS}$		100	V
Gate-Source Voltage	$V_{GS}$		$\pm 20$	
Continuous Drain Current	$V_{GS}$ at 10 V	$T_C = 25\text{ }^\circ\text{C}$	28	A
		$T_C = 100\text{ }^\circ\text{C}$	20	
Pulsed Drain Current <sup>a</sup>	$I_{DM}$		110	W/ $^\circ\text{C}$
Linear Derating Factor			1.0	
Linear Derating Factor (PCB Mount) <sup>e</sup>			0.025	
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$		230	mJ
Avalanche Current <sup>a</sup>	$I_{AR}$		28	A
Repetitive Avalanche Energy <sup>a</sup>	$E_{AR}$		15	mJ
Maximum Power Dissipation	$T_C = 25\text{ }^\circ\text{C}$		150	W
	$T_A = 25\text{ }^\circ\text{C}$		3.7	
Peak Diode Recovery $dV/dt^c$	$dV/dt$		5.5	V/ns

\* Pb containing terminations are not RoHS compliant, exemptions may apply

<b>ABSOLUTE MAXIMUM RATINGS</b> $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted			
PARAMETER	SYMBOL	LIMIT	UNIT
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to + 175	°C
Soldering Recommendations (Peak Temperature)	for 10 s	300 <sup>d</sup>	

**Notes**

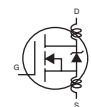
- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- b.  $V_{DD} = 25\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 440\text{ }\mu\text{H}$ ,  $R_G = 25\text{ }\Omega$ ,  $I_{AS} = 28\text{ A}$  (see fig. 12).
- c.  $I_{SD} \leq 28\text{ A}$ ,  $di/dt \leq 170\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 175\text{ }^\circ\text{C}$ .
- d. 1.6 mm from case.
- e. When mounted on 1" square PCB (FR-4 or G-10 material).


<b>THERMAL RESISTANCE RATINGS</b>				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	62	°C/W
Maximum Junction-to-Ambient (PCB Mount) <sup>a</sup>	$R_{thJA}$	-	40	
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	1.0	

**Note**

- a. When mounted on 1" square PCB (FR-4 or G-10 material).

<b>SPECIFICATIONS</b> $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$	100	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$	-	0.13	-	V/°C
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	2.0	-	4.0	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}$	-	-	$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 100\text{ V}$ , $V_{GS} = 0\text{ V}$	-	-	25	$\mu\text{A}$
		$V_{DS} = 80\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$	-	-	250	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$ , $I_D = 17\text{ A}^b$	-	-	0.077	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 50\text{ V}$ , $I_D = 17\text{ A}^b$	8.7	-	-	S
<b>Dynamic</b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1.0\text{ MHz}$ , see fig. 5	-	1700	-	pF
Output Capacitance	$C_{oss}$		-	560	-	
Reverse Transfer Capacitance	$C_{rss}$		-	120	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}$ , $I_D = 17\text{ A}$ , $V_{DS} = 80\text{ V}$ , see fig. 6 and 13 <sup>b</sup>	-	-	72	nC
Gate-Source Charge	$Q_{gs}$		-	-	11	
Gate-Drain Charge	$Q_{gd}$		-	-	32	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 50\text{ V}$ , $I_D = 17\text{ A}$ , $R_G = 9.1\text{ }\Omega$ , $R_D = 2.9\text{ }\Omega$ , see fig. 10 <sup>b</sup>	-	11	-	ns
Rise Time	$t_r$		-	44	-	
Turn-Off Delay Time	$t_{d(off)}$		-	53	-	
Fall Time	$t_f$		-	43	-	
Internal Drain Inductance	$L_D$	Between lead, 6 mm (0.25") from package and center of die contact	-	4.5	-	nH
Internal Source Inductance	$L_S$		-	7.5	-	



<b>SPECIFICATIONS</b> $T_J = 25^\circ\text{C}$ , unless otherwise noted						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	28	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$		-	-	110	
Body Diode Voltage	$V_{SD}$	$T_J = 25^\circ\text{C}$ , $I_S = 28\text{ A}$ , $V_{GS} = 0\text{ V}^b$	-	-	2.5	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25^\circ\text{C}$ , $I_F = 17\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$	-	180	360	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$		-	1.3	2.8	$\mu\text{C}$
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )				

**Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- b. Pulse width  $\leq 300\ \mu\text{s}$ ; duty cycle  $\leq 2\%$ .

**TYPICAL CHARACTERISTICS**  $25^\circ\text{C}$ , unless otherwise noted

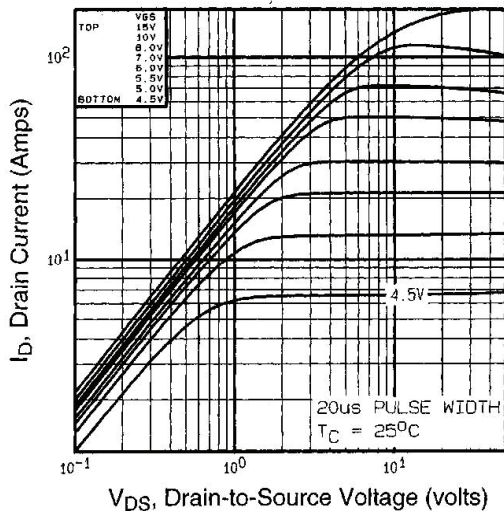


Fig. 1 - Typical Output Characteristics,  $T_C = 25^\circ\text{C}$

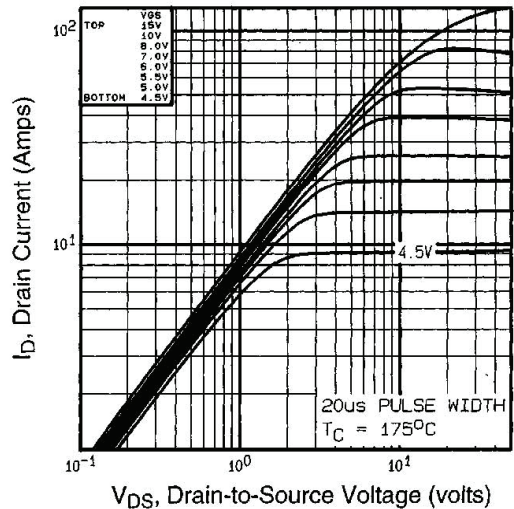


Fig. 2 - Typical Output Characteristics,  $T_C = 175^\circ\text{C}$

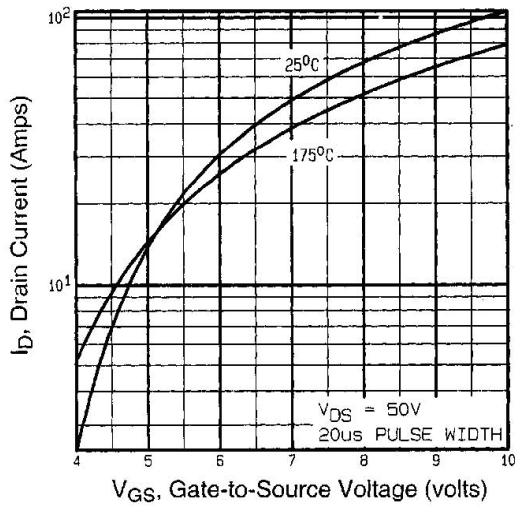


Fig. 3 - Typical Transfer Characteristics

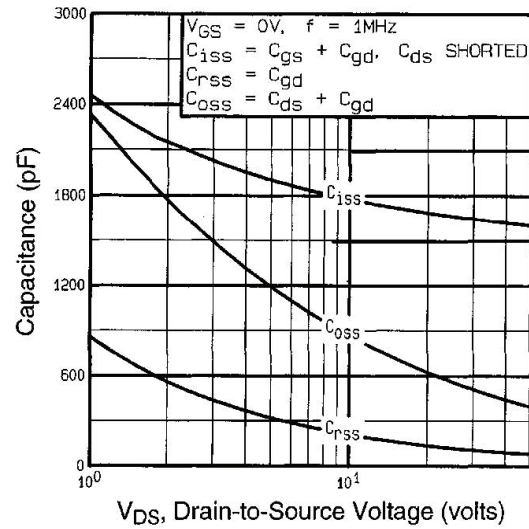


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

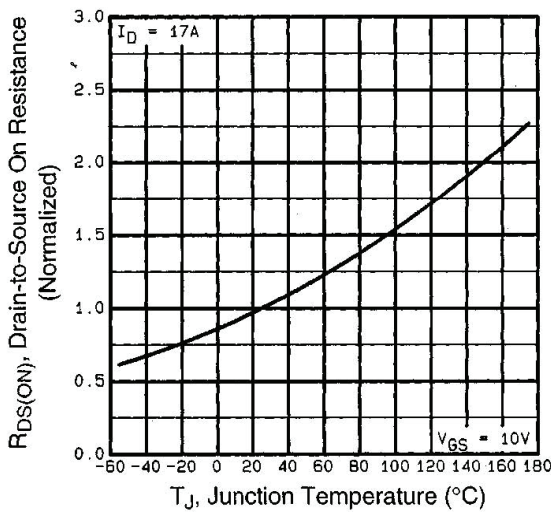


Fig. 4 - Normalized On-Resistance vs. Temperature

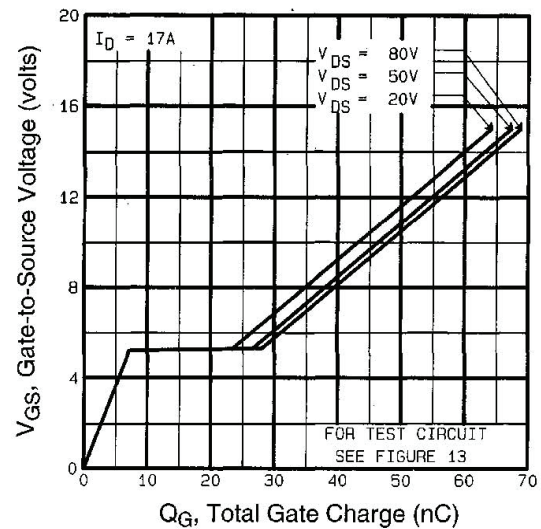


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

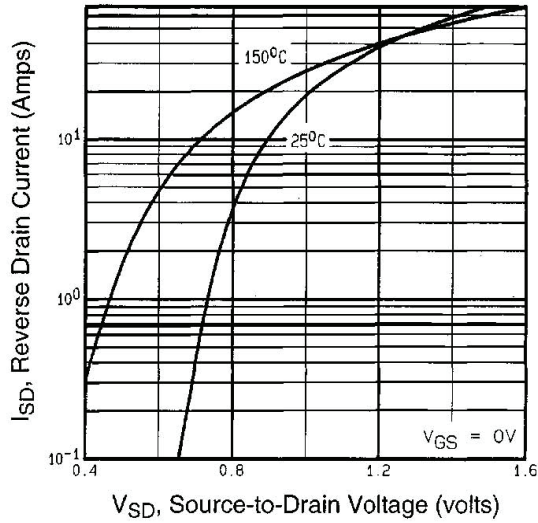


Fig. 7 - Typical Source-Drain Diode Forward Voltage

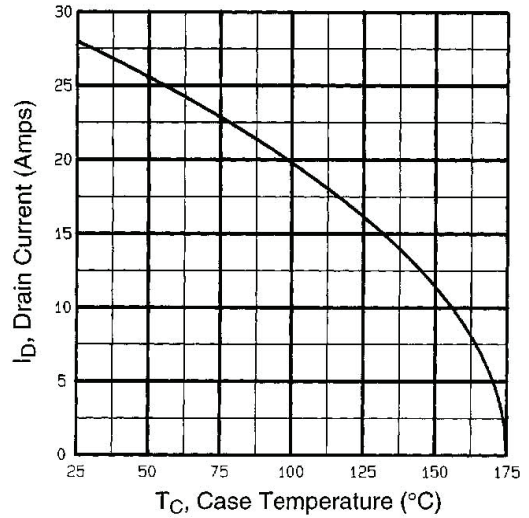


Fig. 9 - Maximum Drain Current vs. Case Temperature

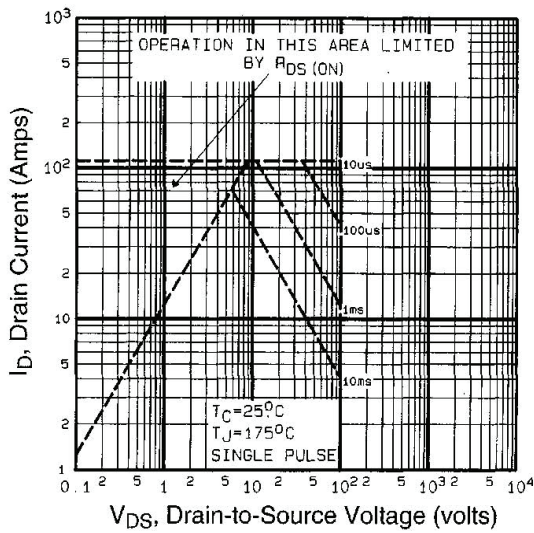


Fig. 8 - Maximum Safe Operating Area

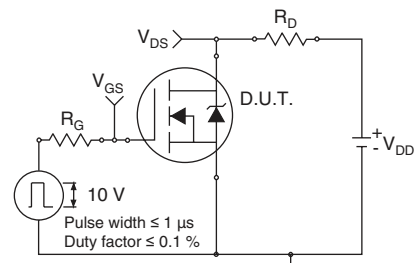


Fig. 10a - Switching Time Test Circuit

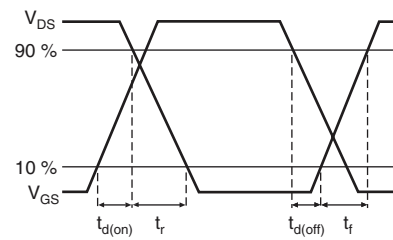


Fig. 10b - Switching Time Waveforms

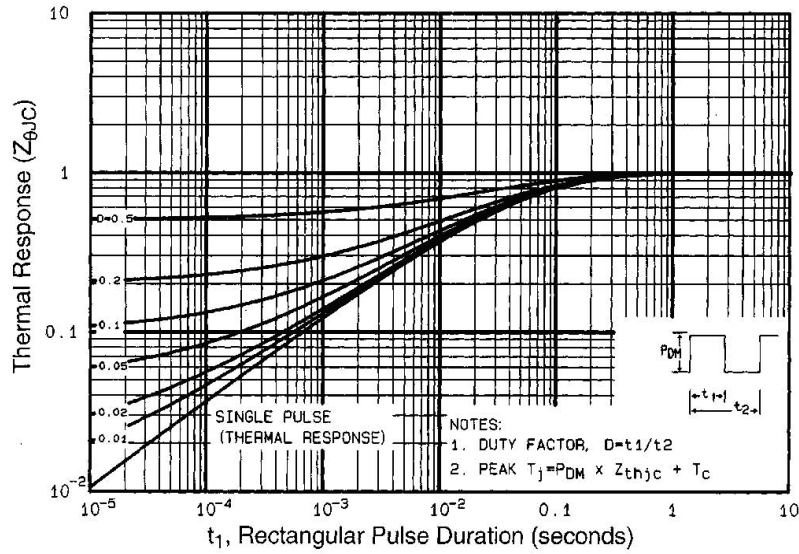


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

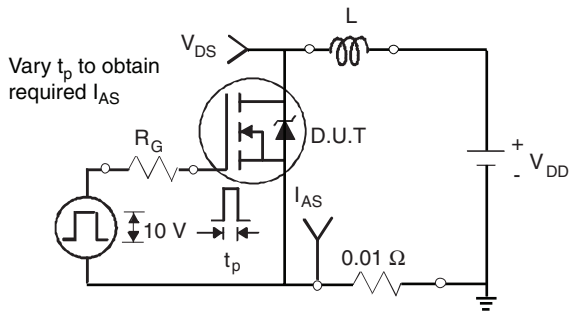


Fig. 12a - Unclamped Inductive Test Circuit

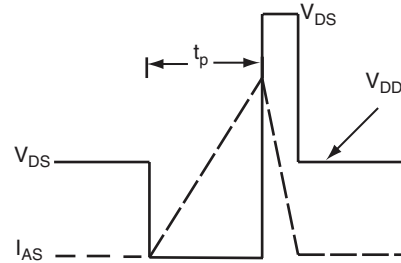


Fig. 12b - Unclamped Inductive Waveforms

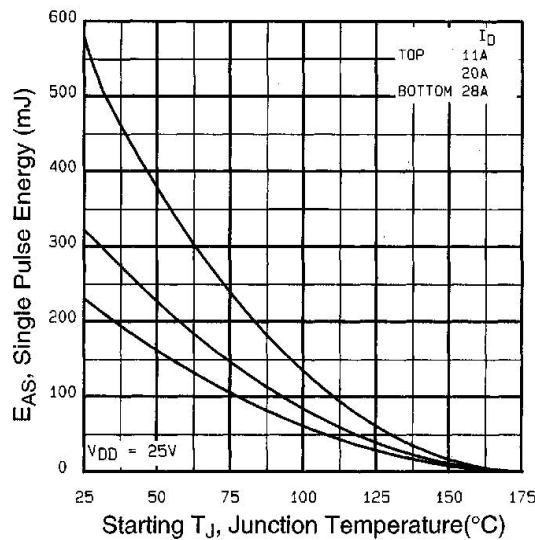


Fig. 12c - Maximum Avalanche Energy vs. Drain Current



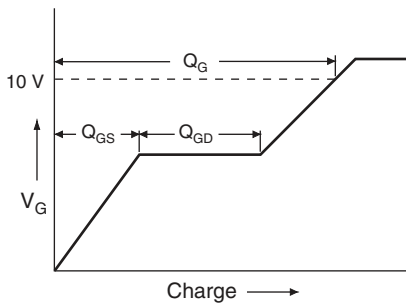


Fig. 13a - Basic Gate Charge Waveform

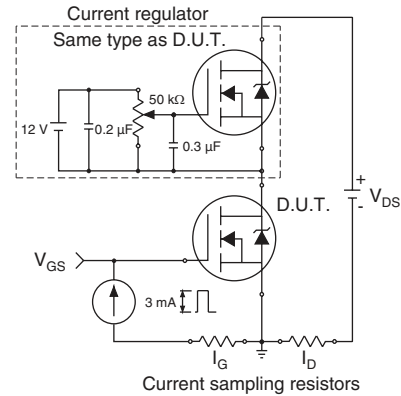
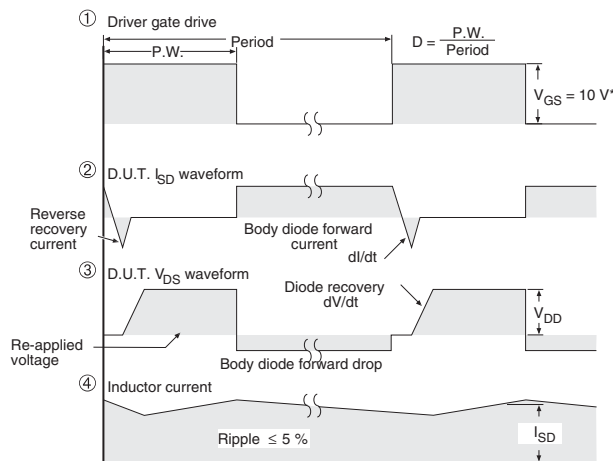
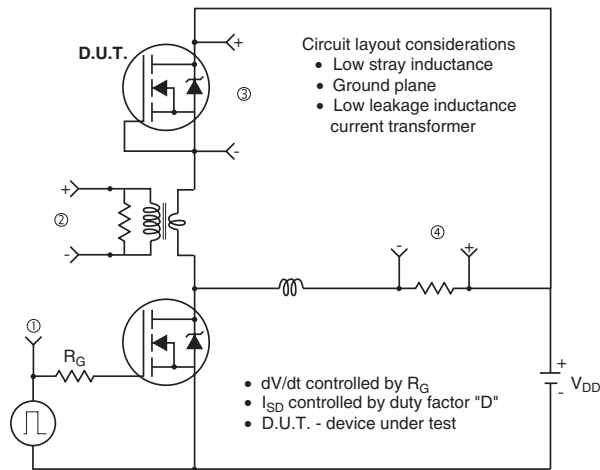


Fig. 13b - Gate Charge Test Circuit

### Peak Diode Recovery dV/dt Test Circuit



\*  $V_{GS} = 5V$  for logic level and  $3V$  drive devices

Fig. 14 - For N-Channel

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