

## Power MOSFET

PRODUCT SUMMARY		
$V_{DS}$ (V)	60	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10\text{ V}$	0.018
$Q_g$ (Max.) (nC)	110	
$Q_{gs}$ (nC)	29	
$Q_{gd}$ (nC)	36	
Configuration	Single	

### FEATURES

- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- Ultra Low On-Resistance
- Very Low Thermal Resistance
- 175 °C Operating Temperature
- Fast Switching
- Ease of Paralleling
- Compliant to RoHS Directive 2002/95/EC

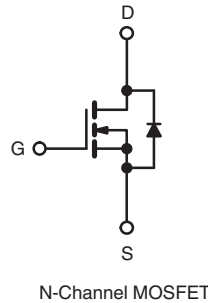
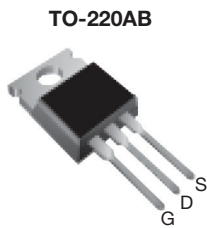


**RoHS\***  
COMPLIANT

### 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 TO-220AB package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 W. The low thermal resistance and low package cost of the TO-220AB contribute to its wide acceptance throughout the industry.



ORDERING INFORMATION	
Package	TO-220AB
Lead (Pb)-free	IRFZ48PbF SiHFZ48-E3
SnPb	IRFZ48 SiHFZ48

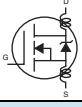

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted)					
PARAMETER		SYMBOL	LIMIT	UNIT	
Drain-Source Voltage		$V_{DS}$	60	V	
Gate-Source Voltage		$V_{GS}$	$\pm 20$		
Continuous Drain Current <sup>e</sup>	$V_{GS}$ at 10 V	$I_D$	$T_C = 25\text{ }^\circ\text{C}$	50	A
			$T_C = 100\text{ }^\circ\text{C}$	50	
Pulsed Drain Current <sup>a</sup>		$I_{DM}$	290		
Linear Derating Factor			1.3	W/°C	
Single Pulse Avalanche Energy <sup>b</sup>		$E_{AS}$	100	mJ	
Avalanche Current <sup>a</sup>		$I_{AR}$	50	A	
Repetitive Avalanche Energy <sup>a</sup>		$E_{AR}$	19	mJ	
Maximum Power Dissipation	$T_C = 25\text{ }^\circ\text{C}$	$P_D$	190	W	
Peak Diode Recovery dV/dt <sup>c</sup>		dV/dt	4.5	V/ns	
Operating Junction and Storage Temperature Range		$T_J, T_{stg}$	- 55 to + 175	°C	
Soldering Recommendations (Peak Temperature) <sup>d</sup>	for 10 s		300		
Mounting Torque	6-32 or M3 screw		10	lbf · in	
			1.1	N · m	

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 25\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 22\text{ }\mu\text{H}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 72\text{ A}$  (see fig. 12).
- $I_{SD} \leq 72\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 175\text{ }^\circ\text{C}$ .
- 1.6 mm from case
- Current limited by the package, (die current = 72 A).

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

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	62	°C/W
Case-to-Sink, Flat, Greased Surface	$R_{thCS}$	0.50	-	
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	0.80	

SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
<b>Static</b>							
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		60	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$		-	0.060	-	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	$I_{GSS}$	$V_{GS} = \pm 20$		-	-	$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$		-	-	25	$\mu\text{A}$
		$V_{DS} = 48\text{ V}, V_{GS} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$		-	-	250	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 43\text{ A}^b$	-	-	0.018	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 25\text{ V}, I_D = 43\text{ A}^b$		27	-	-	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		-	2400	-	pF
Output Capacitance	$C_{oss}$			-	1300	-	
Reverse Transfer Capacitance	$C_{rss}$			-	190	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}$	$I_D = 72\text{ A}, V_{DS} = 48\text{ V}$ , see fig. 6 and 13 <sup>b</sup>	-	-	110	nC
Gate-Source Charge	$Q_{gs}$			-	-	29	
Gate-Drain Charge	$Q_{gd}$			-	-	36	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 30\text{ V}, I_D = 72\text{ A}, R_g = 9.1\text{ }\Omega, R_D = 0.34\text{ }\Omega$ , see fig. 10 <sup>b</sup>		-	8.1	-	ns
Rise Time	$t_r$			-	250	-	
Turn-Off Delay Time	$t_{d(off)}$			-	210	-	
Fall Time	$t_f$			-	250	-	
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>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	50 <sup>c</sup>	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$			-	-	290	
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = 72\text{ A}, V_{GS} = 0\text{ V}^b$		-	-	2.0	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = 72\text{ A}, di/dt = 100\text{ A}/\mu\text{s}^b$		-	120	180	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$			-	0.50	0.80	$\mu\text{C}$
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )					

### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- Current limited by the package, (die current = 72 A).

## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

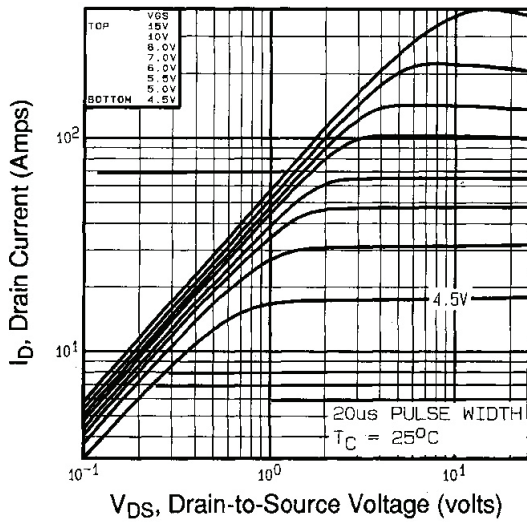


Fig. 1 - Typical Output Characteristics,  $T_C = 25^\circ\text{C}$

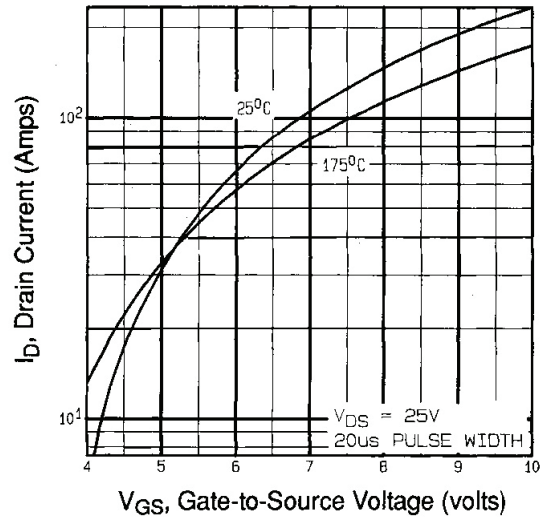


Fig. 3 - Typical Transfer Characteristics

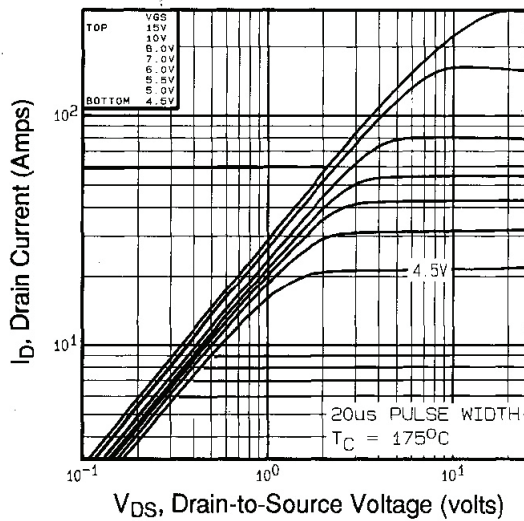


Fig. 2 - Typical Output Characteristics,  $T_C = 175^\circ\text{C}$

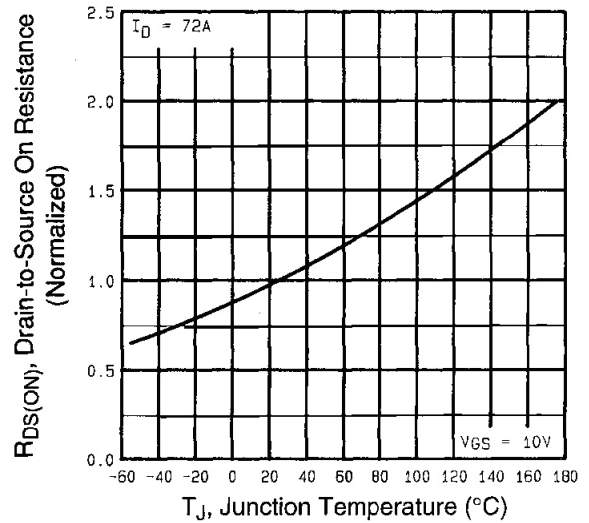


Fig. 4 - Normalized On-Resistance vs. Temperature

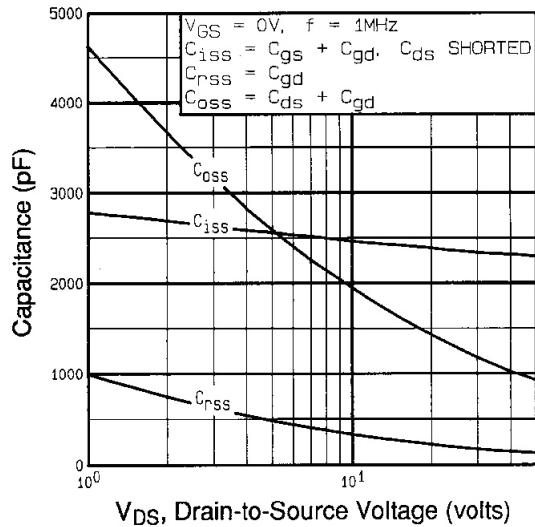


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

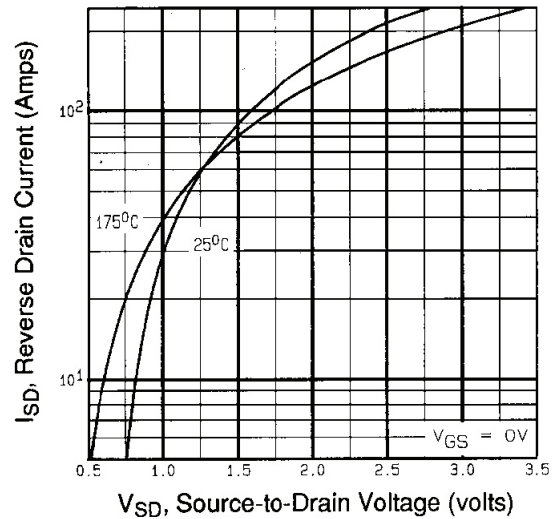


Fig. 7 - Typical Source-Drain Diode Forward Voltage

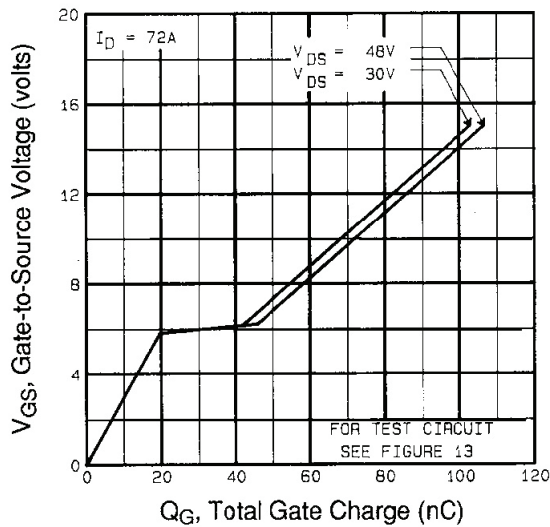


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

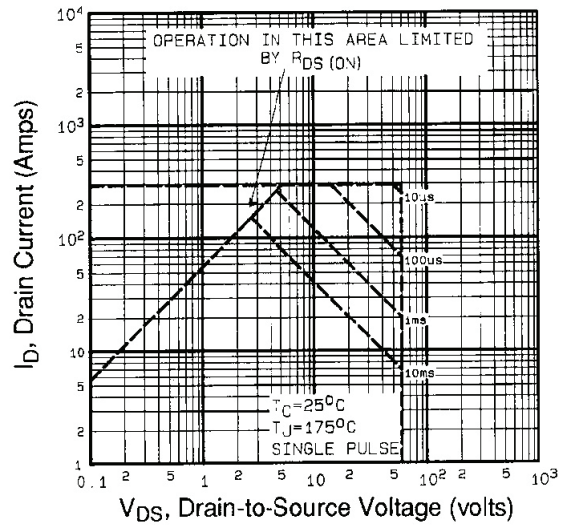


Fig. 8 - Maximum Safe Operating Area

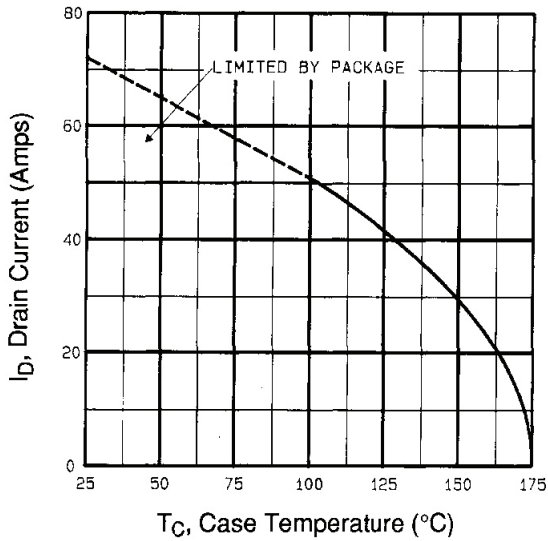


Fig. 9 - Maximum Drain Current vs. Case Temperature

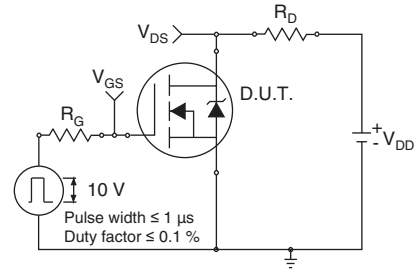


Fig. 10a - Switching Time Test Circuit

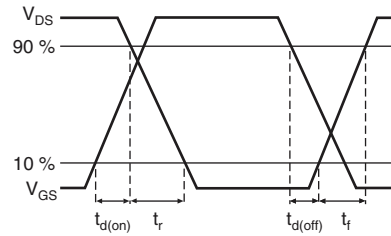


Fig. 10b - Switching Time Waveforms

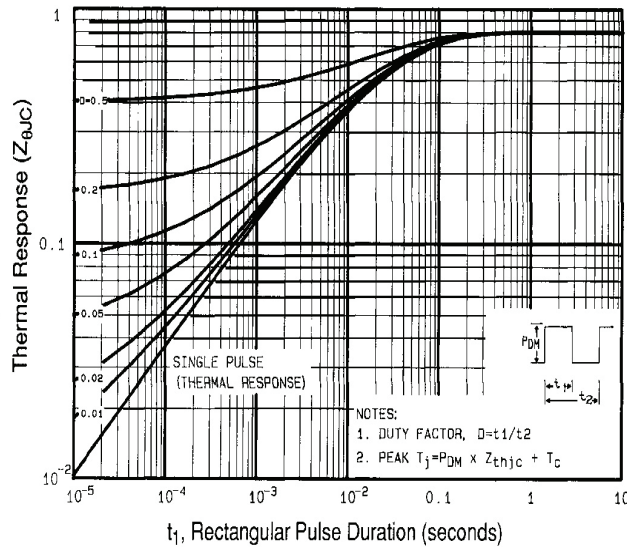


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

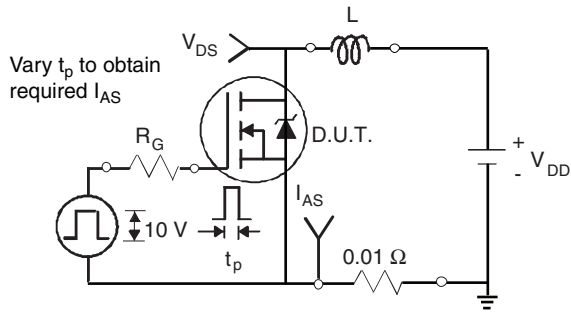


Fig. 12a - Unclamped Inductive Test Circuit

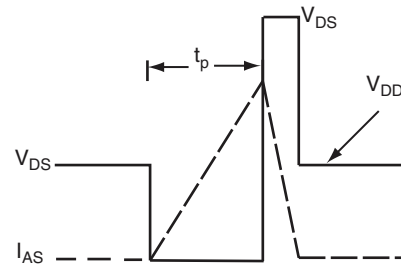


Fig. 12b - Unclamped Inductive Waveforms

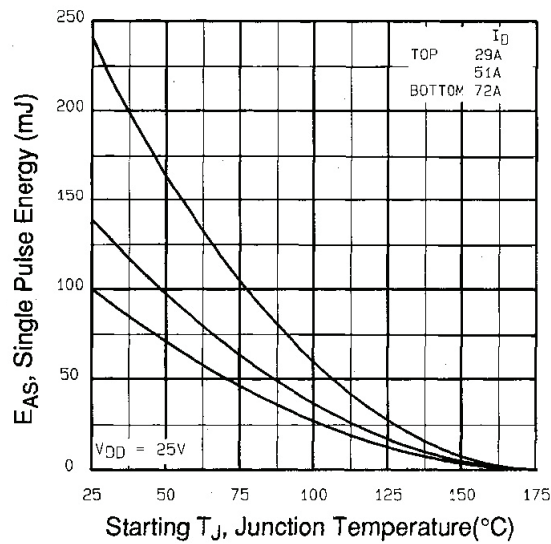


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

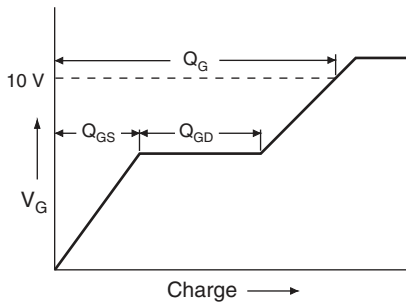


Fig. 13a - Basic Gate Charge Waveform

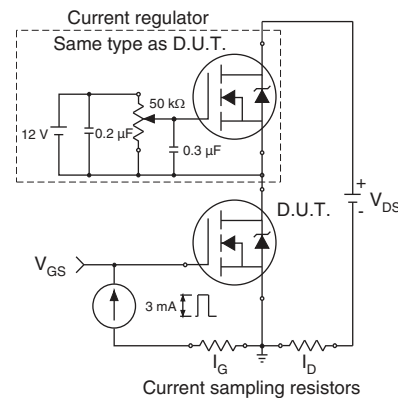
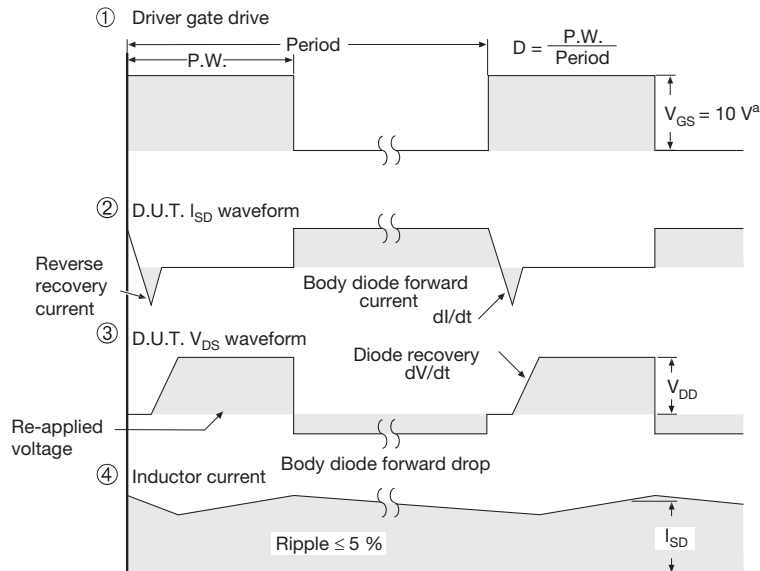
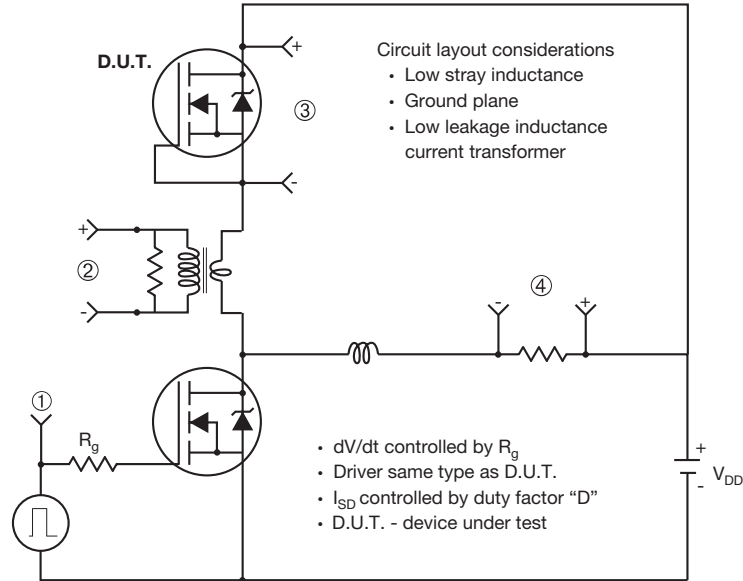


Fig. 13b - Gate Charge Test Circuit

### Peak Diode Recovery dV/dt Test Circuit



**Note**

a.  $V_{GS} = 5 V$  for logic level devices

**Fig. 14 - For N-Channel**

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