



## Power MOSFET

PRODUCT SUMMARY		
$V_{DS}$ (V)	- 100	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = - 10$ V	1.2
$Q_g$ (Max.) (nC)	8.7	
$Q_{gs}$ (nC)	2.2	
$Q_{gd}$ (nC)	4.1	
Configuration	Single	

### FEATURES

- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- Surface Mount (IRFR9110/SiHFR9110)
- Straight Lead (IRFU9110/SiHFU9110)
- Available in Tape and Reel
- P-Channel
- Fast Switching
- Lead (Pb)-free Available



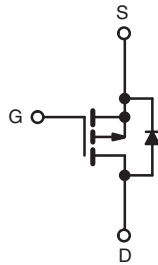
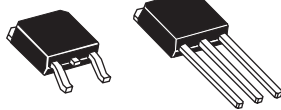
Available  
**RoHS\***  
COMPLIANT

### 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 DPAK is designed for surface mounting using vapor phase, infrared, or wave soldering techniques. The straight lead version (IRFU/SiHFU Series) is for through-hole mounting applications. Power dissipation levels up to 1.5 W are possible in typical surface mount applications.

DPAK (TO-252)      IPAK (TO-251)



P-Channel MOSFET

ORDERING INFORMATION				
Package	DPAK (TO-252)	DPAK (TO-252)	DPAK (TO-252)	IPAK (TO-251)
Lead (Pb)-free	IRFR9110PbF	IRFR9110TRLPbF <sup>a</sup>	IRFR9110TRPbF <sup>a</sup>	IRFU9110PbF
	SiHFR9110-E3	SiHFR9110TLE3 <sup>a</sup>	SiHFR9110TE3 <sup>a</sup>	SiHFU9110-E3
SnPb	IRFR9110	IRFR9110TRL <sup>a</sup>	IRFR9110TR <sup>a</sup>	IRFU9110
	SiHFR9110	SiHFR9110TL <sup>a</sup>	SiHFR9110T <sup>a</sup>	SiHFU9110

#### Note

a. See device orientation.

ABSOLUTE MAXIMUM RATINGS $T_C = 25^\circ\text{C}$ , 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	$T_C = 25^\circ\text{C}$	- 3.1	A
		$T_C = 100^\circ\text{C}$	- 2.0	
Pulsed Drain Current <sup>a</sup>	$I_{DM}$		- 12	W/ $^\circ\text{C}$
Linear Derating Factor			0.20	
Linear Derating Factor (PCB Mount) <sup>e</sup>			0.020	
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$		140	mJ
Repetitive Avalanche Current <sup>a</sup>	$I_{AR}$		- 3.1	A
Repetitive Avalanche Energy <sup>a</sup>	$E_{AR}$		2.5	mJ
Maximum Power Dissipation	$T_C = 25^\circ\text{C}$		25	W
Maximum Power Dissipation (PCB Mount) <sup>e</sup>	$T_A = 25^\circ\text{C}$		2.5	
Peak Diode Recovery dV/dt <sup>c</sup>			- 5.5	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$		- 55 to + 150	$^\circ\text{C}$
Soldering Recommendations (Peak Temperature)	for 10 s		260 <sup>d</sup>	

#### Notes



- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = - 25$  V, starting  $T_J = 25^\circ\text{C}$ ,  $L = 21$  mH,  $R_G = 25 \Omega$ ,  $I_{AS} = - 3.1$  A (see fig. 12).
- $I_{SD} \leq - 4.0$  A,  $dI/dt \leq 75$  A/ $\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150^\circ\text{C}$ .
- 1.6 mm from case.
- When mounted on 1" square PCB (FR-4 or G-10 material).

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

THERMAL RESISTANCE RATINGS					
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	-	110	°C/W
Maximum Junction-to-Ambient (PCB Mount) <sup>a</sup>	$R_{thJA}$	-	-	50	
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	-	5.0	

**Note**

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

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	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		- 100	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$		-	- 0.093	-	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	$I_{DSS}$	$V_{DS} = - 100\text{ V}, V_{GS} = 0\text{ V}$		-	-	- 100	$\mu\text{A}$
		$V_{DS} = - 80\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	- 500	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = - 10\text{ V}$	$I_D = - 1.9\text{ A}^b$	-	-	1.2	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = - 50\text{ V}, I_D = - 1.9\text{ A}$		0.97	-	-	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		-	200	-	pF
Output Capacitance	$C_{oss}$			-	94	-	
Reverse Transfer Capacitance	$C_{rss}$			-	18	-	
Total Gate Charge	$Q_g$	$V_{GS} = - 10\text{ V}$	$I_D = - 4.0\text{ A}, V_{DS} = - 80\text{ V}$ , see fig. 6 and 13 <sup>b</sup>	-	-	8.7	nC
Gate-Source Charge	$Q_{gs}$			-	-	2.2	
Gate-Drain Charge	$Q_{gd}$			-	-	4.1	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = - 50\text{ V}, I_D = - 4.0\text{ A}, R_G = 24\text{ }\Omega, R_D = 11\text{ }\Omega$ , see fig. 10 <sup>b</sup>		-	10	-	ns
Rise Time	$t_r$			-	27	-	
Turn-Off Delay Time	$t_{d(off)}$			-	15	-	
Fall Time	$t_f$			-	17	-	
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 		-	-	- 3.1	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$			-	-	- 12	
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = - 3.1\text{ A}, V_{GS} = 0\text{ V}^b$		-	-	- 5.5	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = - 4.0\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}^b$		-	80	160	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$			-	0.17	0.30	$\mu\text{C}$
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  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .

**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted

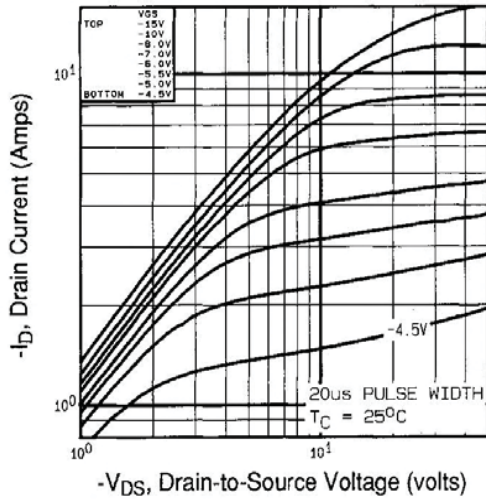


Fig. 1 - Typical Output Characteristics,  $T_C = 25\text{ }^\circ\text{C}$

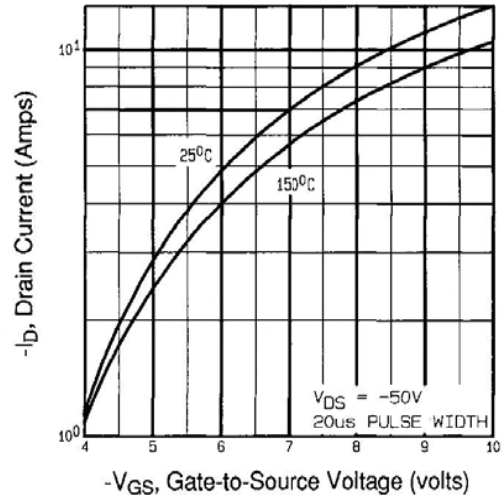


Fig. 3 - Typical Transfer Characteristics

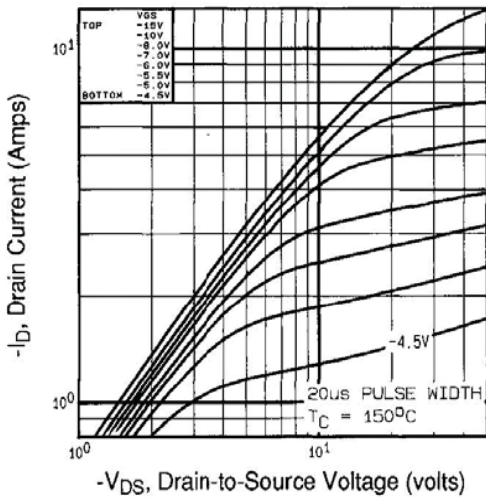


Fig. 2 - Typical Output Characteristics,  $T_C = 150\text{ }^\circ\text{C}$

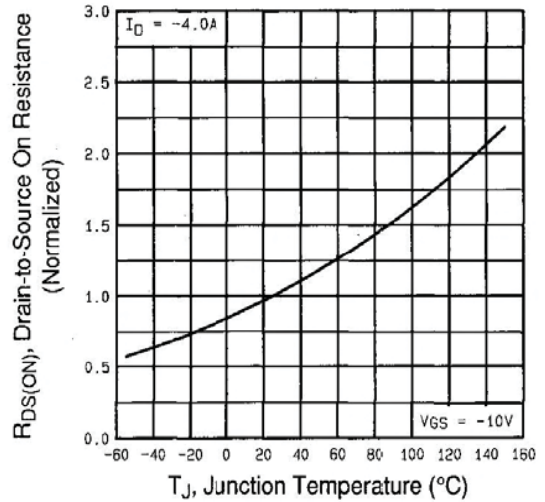


Fig. 4 - Normalized On-Resistance vs. Temperature

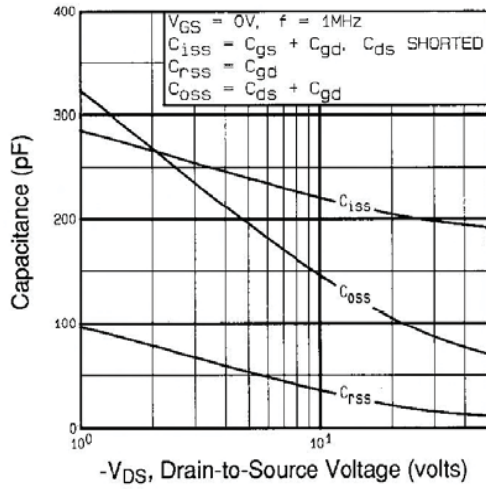


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

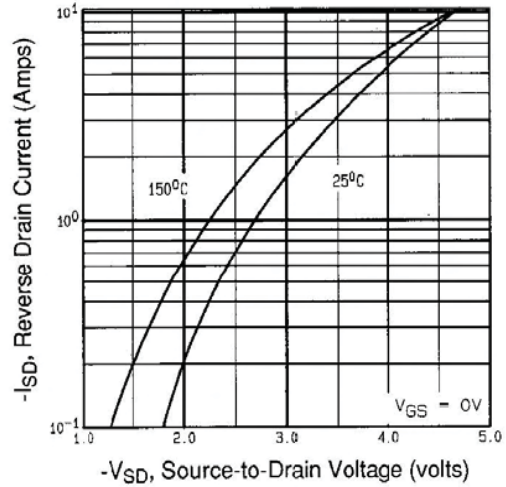


Fig. 7 - Typical Source-Drain Diode Forward Voltage

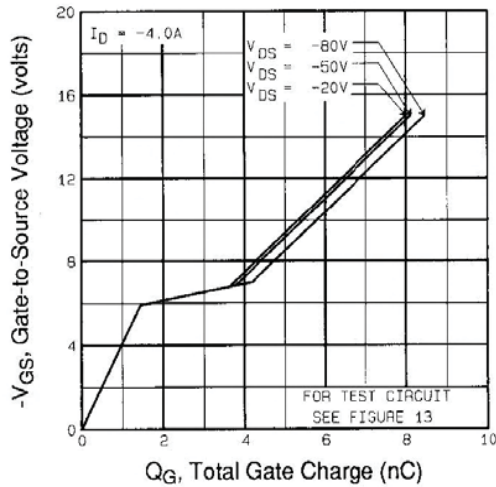


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

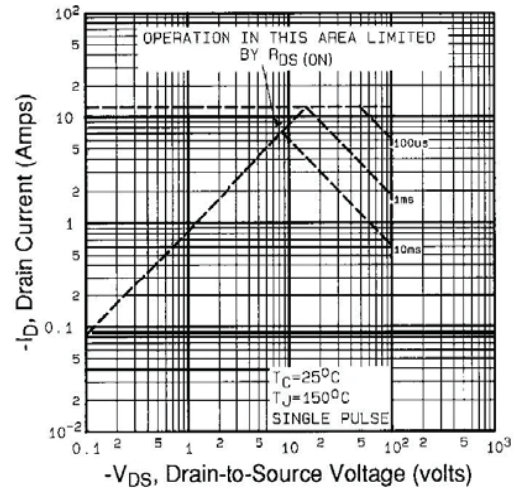


Fig. 8 - Maximum Safe Operating Area

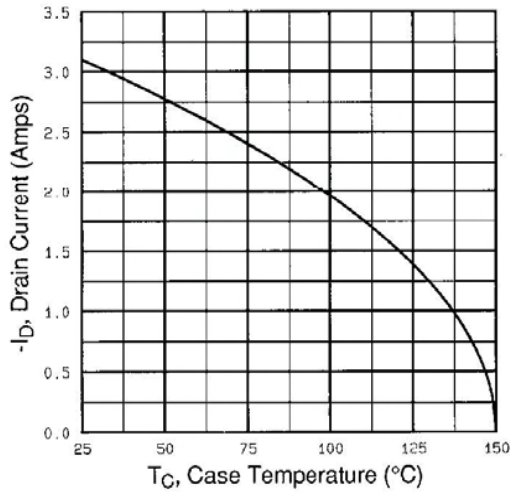


Fig. 9 - Maximum Drain Current vs. Case Temperature

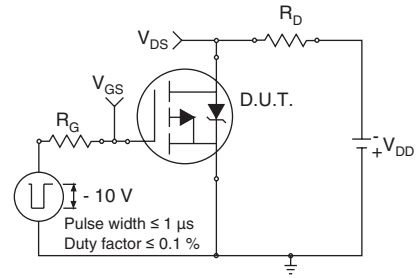


Fig. 10a - Switching Time Test Circuit

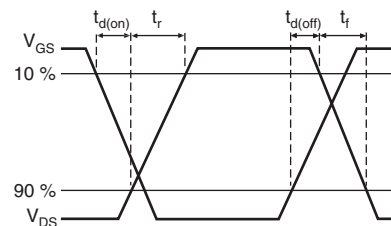


Fig. 10b - Switching Time Waveforms

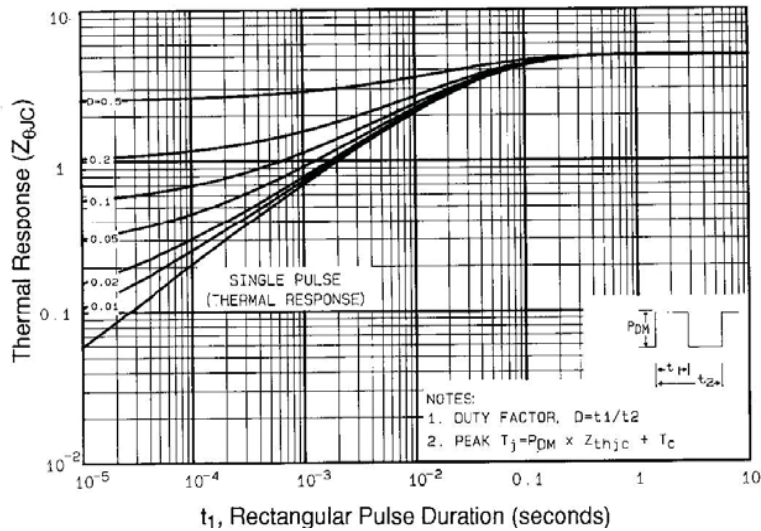


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

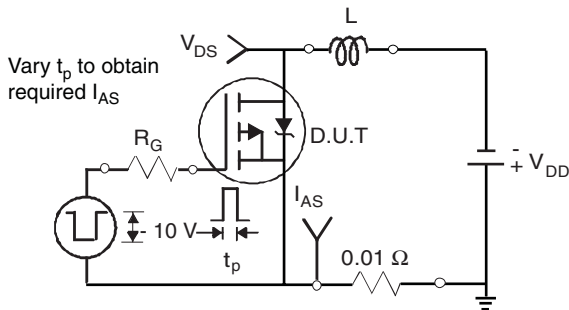


Fig. 12a - Unclamped Inductive Test Circuit

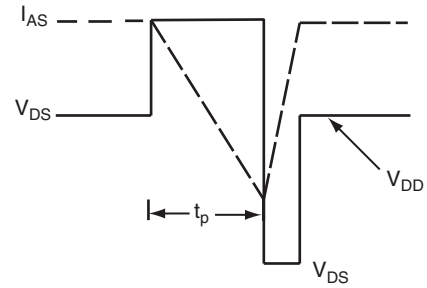


Fig. 12b - Unclamped Inductive Waveforms

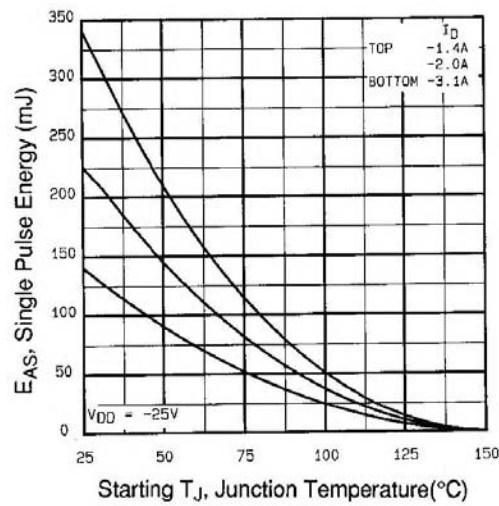


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

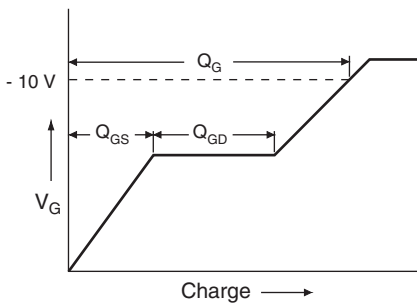


Fig. 13a - Basic Gate Charge Waveform

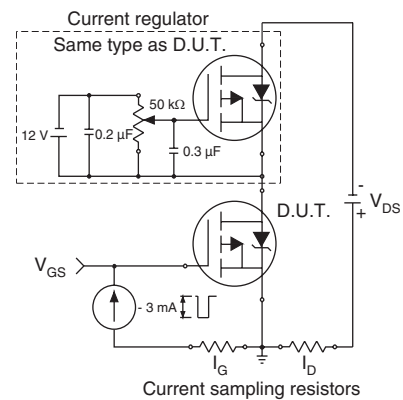
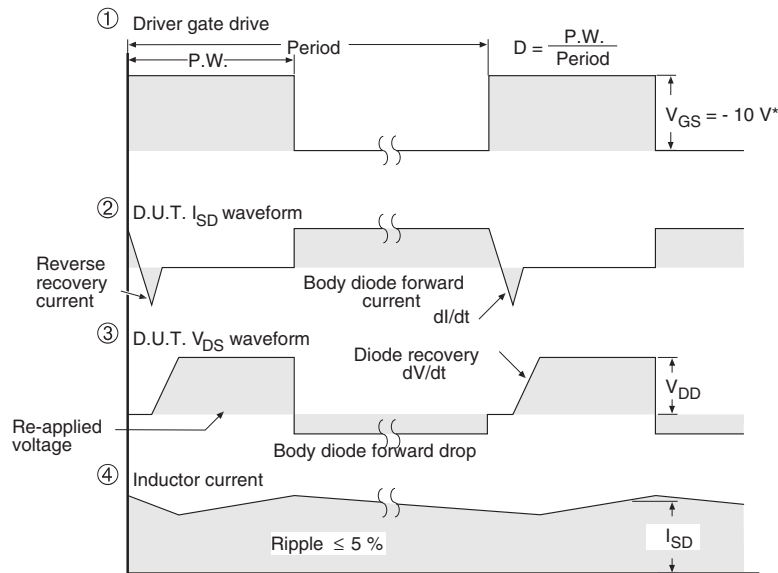
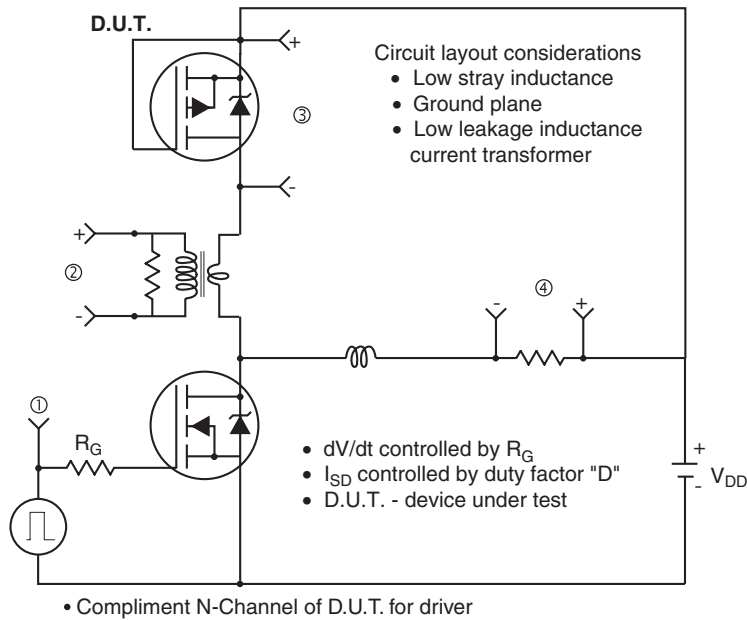


Fig. 13b - Gate Charge Test Circuit

## Peak Diode Recovery $dV/dt$ Test Circuit



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

**Fig. 14 - For P-Channel**

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