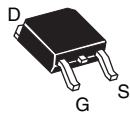


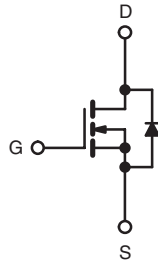
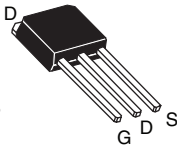
## Power MOSFET

PRODUCT SUMMARY		
$V_{DS}$ (V)	250	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10$ V	1.1
$Q_g$ (Max.) (nC)	14	
$Q_{gs}$ (nC)	2.7	
$Q_{gd}$ (nC)	7.8	
Configuration	Single	

DPAK  
(TO-252)



IPAK  
(TO-251)



N-Channel MOSFET

### FEATURES

- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- Surface Mount (IRFR224, SiHFR224)
- Straight Lead (IRFU224, SiHFU224)
- Available in Tape and Reel
- Fast Switching
- Ease of Paralleling
- Lead (Pb)-free 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.

ORDERING INFORMATION				
Package	DPAK (TO-252)	DPAK (TO-252)	DPAK (TO-252)	IPAK (TO-251)
Lead (Pb)-free	IRFR224PbF	IRFR224TRPbF <sup>a</sup>	IRFR224TRLPbF <sup>a</sup>	IRFU224PbF
	SiHFR224-E3	SiHFR224T-E3 <sup>a</sup>	SiHFR224TL-E3 <sup>a</sup>	SiHFU224-E3
SnPb	IRFR224	IRFR224TR <sup>a</sup>	IRFR224TRL <sup>a</sup>	IRFU224
	SiHFR224	SiHFR224T <sup>a</sup>	SiHFR224TL <sup>a</sup>	SiHFU224

**Note**

a. See device orientation.

ABSOLUTE MAXIMUM RATINGS $T_C = 25$ °C, unless otherwise noted				
PARAMETER	SYMBOL		LIMIT	UNIT
Drain-Source Voltage	$V_{DS}$		250	V
Gate-Source Voltage	$V_{GS}$		$\pm 20$	
Continuous Drain Current	$V_{GS}$ at 10 V	$T_C = 25$ °C	3.8	A
		$T_C = 100$ °C	2.4	
Pulsed Drain Current <sup>a</sup>	$I_{DM}$		15	
Linear Derating Factor			0.33	W/°C
Linear Derating Factor (PCB Mount) <sup>e</sup>			0.020	
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$		130	mJ
Repetitive Avalanche Current <sup>a</sup>	$I_{AR}$		3.8	A
Repetitive Avalanche Energy <sup>a</sup>	$E_{AR}$		4.2	mJ
Maximum Power Dissipation	$T_C = 25$ °C		42	W
Maximum Power Dissipation (PCB Mount) <sup>e</sup>	$T_A = 25$ °C		2.5	
Peak Diode Recovery dV/dt <sup>c</sup>	dV/dt		4.8	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$		- 55 to + 150	°C
Soldering Recommendations (Peak Temperature)	for 10 s		260 <sup>d</sup>	

**Notes**

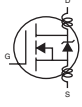
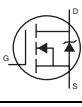
- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 50$  V; starting  $T_J = 25$  °C,  $L = 14$  mH,  $R_G = 25$   $\Omega$ ,  $I_{AS} = 3.8$  A (see fig. 12).
- $I_{SD} \leq 3.8$  A,  $dI/dt \leq 90$  A/ $\mu$ s,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150$  °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	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient (PCB Mount) <sup>a</sup>	$R_{thJA}$	-	50	°C/W
Maximum Junction-to-Ambient	$R_{thJA}$	-	110	
Maximum Junction-to-Case	$R_{thJC}$	-	3.0	

### 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	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		250	-	- V	
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$		-	0.36	- 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	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}$		-	-	$\pm 100\text{ nA}$	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 250\text{ V}, V_{GS} = 0\text{ V}$		-	-	25 $\mu\text{A}$	
		$V_{DS} = 200\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	250 $\mu\text{A}$	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 2.3\text{ A}^b$	-	-	1.1 $\Omega$	
Forward Transconductance	$g_{fs}$	$V_{DS} = 50\text{ V}, I_D = 2.3\text{ A}^b$		1.5	-	- 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 <sup>c</sup>		-	260	-	
Output Capacitance	$C_{oss}$			-	77	-	pF
Reverse Transfer Capacitance	$C_{rss}$			-	15	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}$	$I_D = 4.4\text{ A}, V_{DS} = 200\text{ V}$ , see fig. 6 and 13 <sup>b, c</sup>	-	-	14	
Gate-Source Charge	$Q_{gs}$			-	-	2.7	nC
Gate-Drain Charge	$Q_{gd}$			-	-	7.8	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 125\text{ V}, I_D = 4.4\text{ A}, R_G = 18\text{ }\Omega, R_D = 28\text{ }\Omega$ , see fig. 10 <sup>b, c</sup>		-	7.0	-	
Rise Time	$t_r$			-	13	-	ns
Turn-Off Delay Time	$t_{d(off)}$			-	20	-	
Fall Time	$t_f$			-	12	-	
Internal Drain Inductance	$L_D$	Between lead, 6 mm (0.25") from package and center of die contact 		-	4.5	-	
Internal Source Inductance	$L_S$			-	7.5	-	nH
<b>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	3.8	
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$			-	-	15	A
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = 3.8\text{ A}, V_{GS} = 0\text{ V}^b$		-	-	1.8 V	
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = 4.4\text{ A}, di/dt = 100\text{ A}/\mu\text{s}^b$		-	200	400 ns	
Body Diode Reverse Recovery Charge	$Q_{rr}$			-	0.93	1.9 $\mu\text{C}$	
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

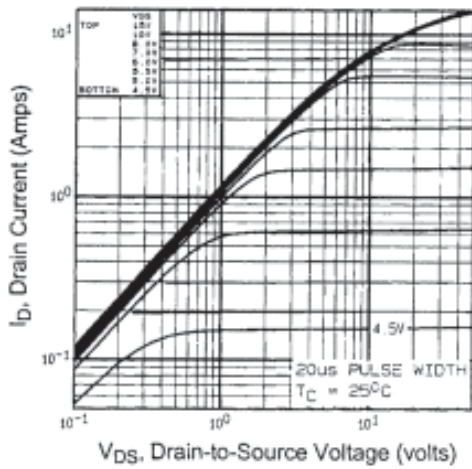


Fig. 1 - Typical Output Characteristics, T<sub>C</sub> = 25 °C

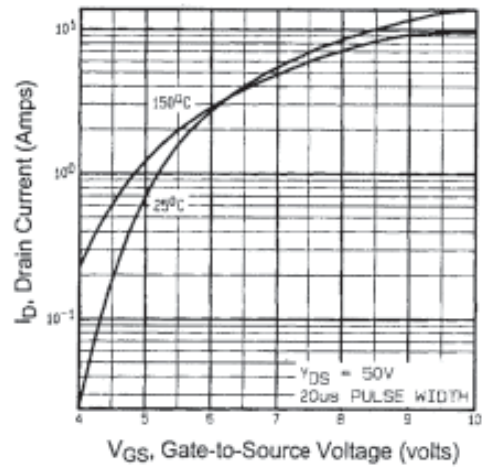


Fig. 3 - Typical Transfer Characteristics

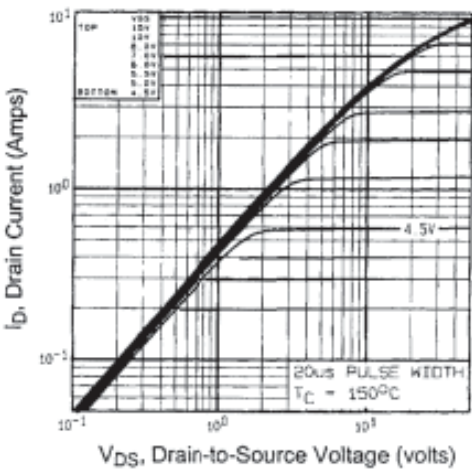


Fig. 2 - Typical Output Characteristics, T<sub>C</sub> = 150 °C

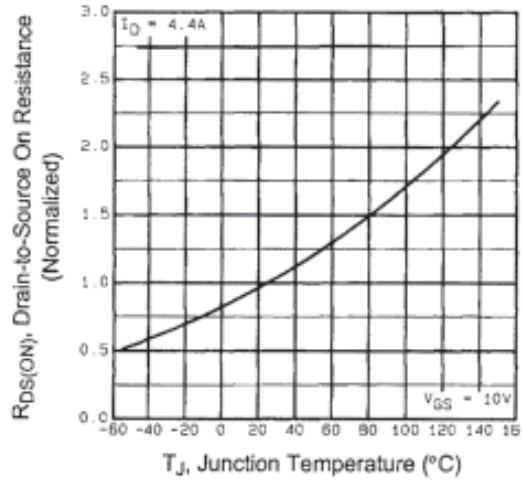


Fig. 4 - Normalized On-Resistance vs. Temperature

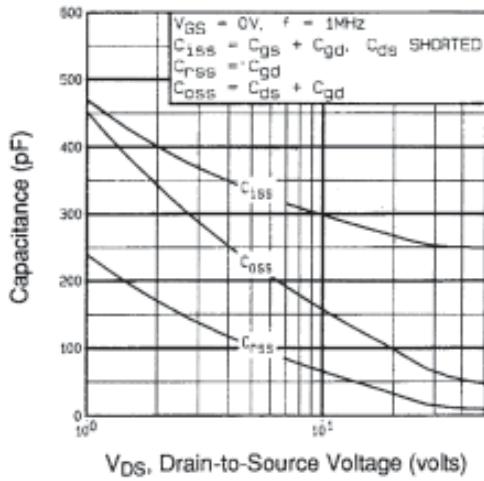


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

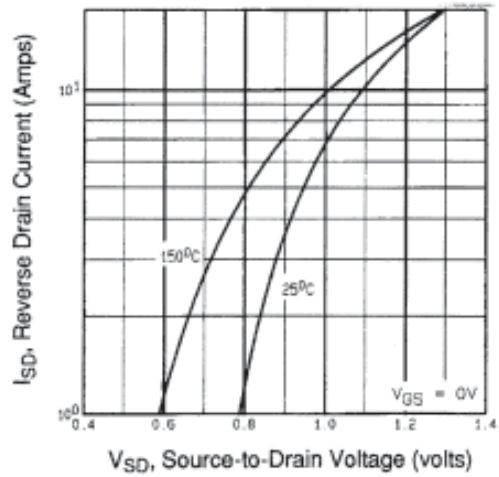


Fig. 7 - Typical Source-Drain Diode Forward Voltage

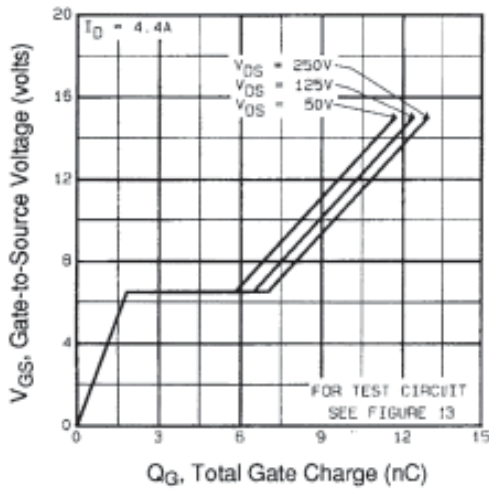


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

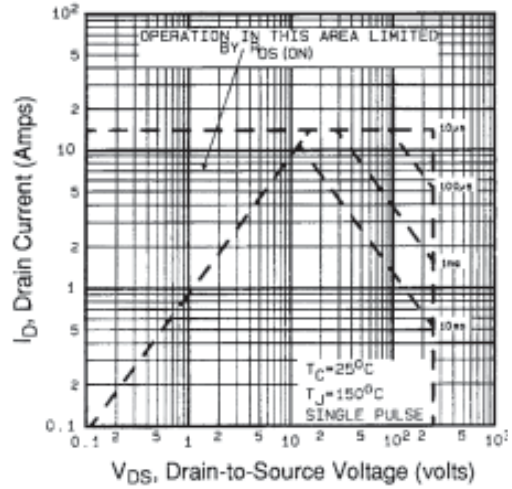


Fig. 8 - Maximum Safe Operating Area

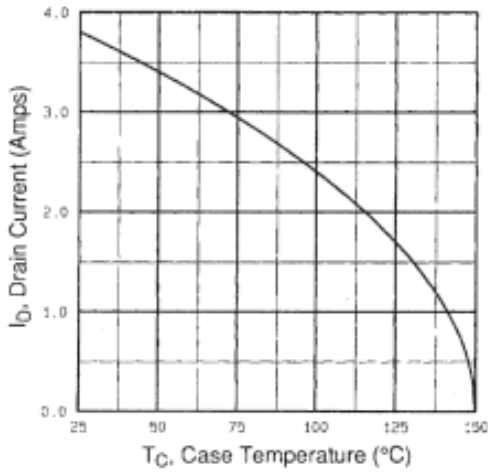


Fig. 9 - Maximum Drain Current vs. Case Temperature

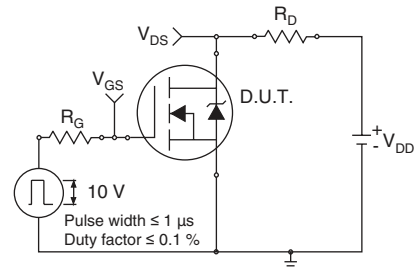


Fig. 10a - Switching Time Test Circuit

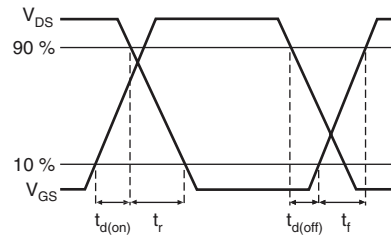


Fig. 10b - Switching Time Waveforms

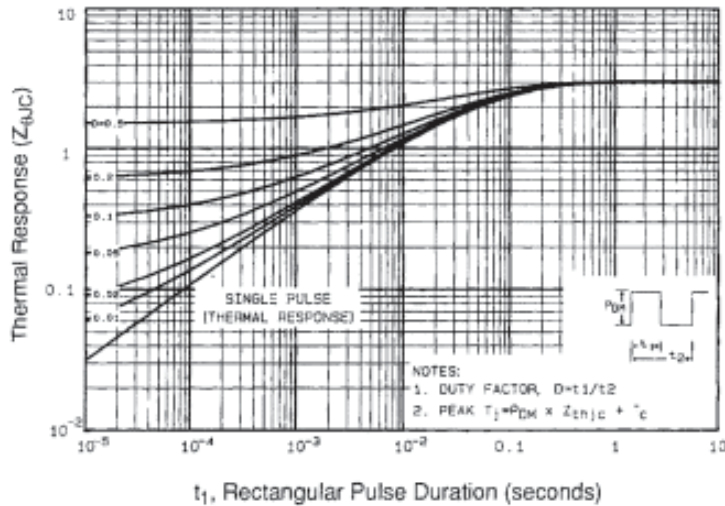


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

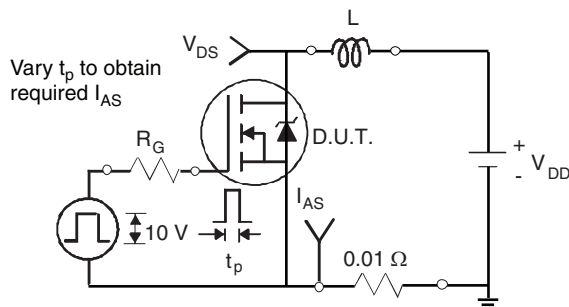


Fig. 12a - Unclamped Inductive Test Circuit

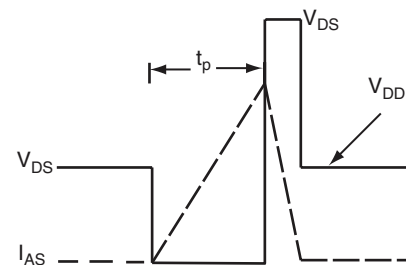


Fig. 12b - Unclamped Inductive Waveforms

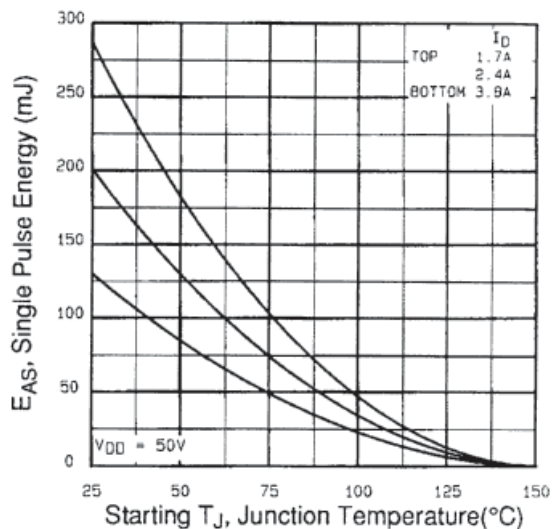


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

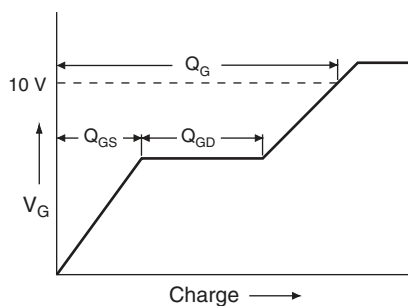


Fig. 13a - Basic Gate Charge Waveform

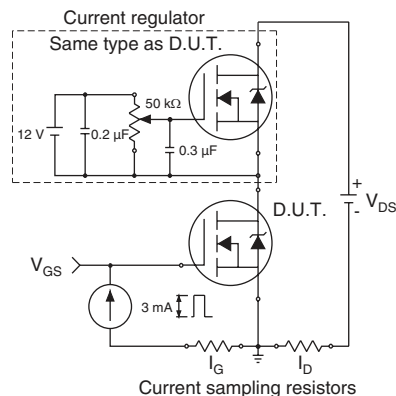
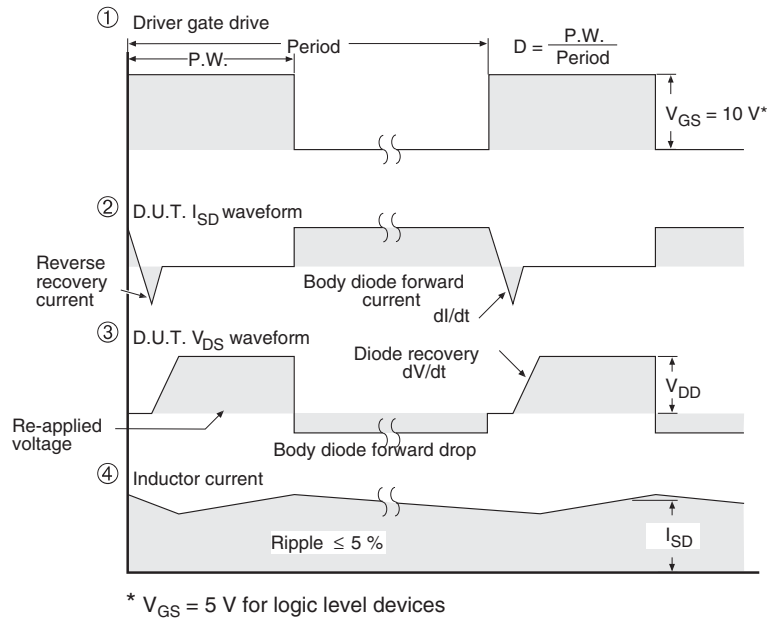
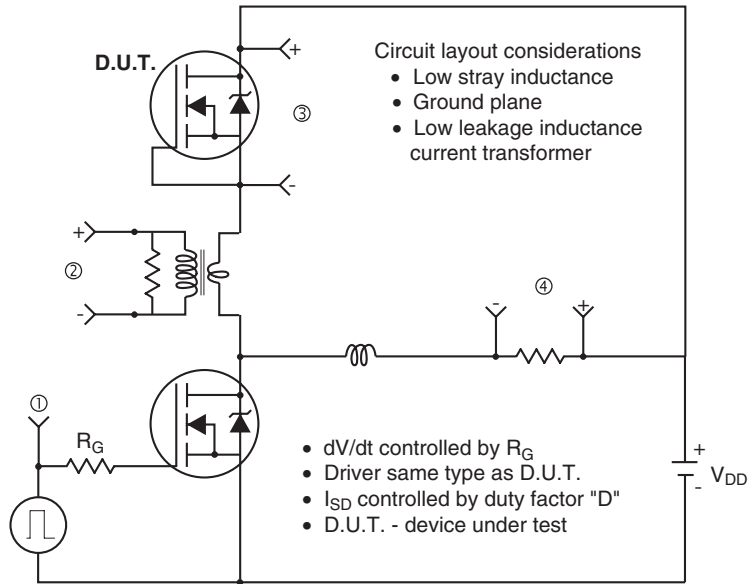


Fig. 13b - Gate Charge Test Circuit

## Peak Diode Recovery dV/dt Test Circuit



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

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