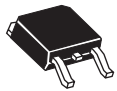


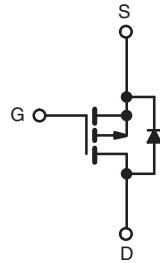
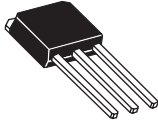
Power MOSFET

PRODUCT SUMMARY		
V_{DS} (V)	- 60	
$R_{DS(on)}$ (Ω)	$V_{GS} = -10$ V	0.28
Q_g (Max.) (nC)	19	
Q_{gs} (nC)	5.4	
Q_{gd} (nC)	11	
Configuration	Single	

DPAK
(TO-252)



IPAK
(TO-251)



P-Channel MOSFET

FEATURES

- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- Surface Mount (IRFR9024/SiHFR9024)
- Straight Lead (IRFU9024/SiHFU9024)
- Available in Tape and Reel
- P-Channel
- Fast Switching
- 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)	DPAK (TO-252)	IPAK (TO-251)
Lead (Pb)-free	IRFR9024PbF	IRFR9024TRPbF ^a	IRFR9024TRLPbF ^a	IRFR9024TRRPbF ^a	IRFU9024PbF
	SiHFR9024-E3	SiHFR9024T-E3 ^a	SiHFR9024TL-E3 ^a	SiHFR9024TR-E3 ^a	SiHFU9024-E3
SnPb	IRFR9024	IRFR9024TR ^a	IRFR9024TRL ^a	-	IRFU9024
	SiHFR9024	SiHFR9024T ^a	SiHFR9024TL ^a	-	SiHFU9024

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}		- 60	V
Gate-Source Voltage	V_{GS}		± 20	
Continuous Drain Current	V_{GS} at - 10 V	$T_C = 25^\circ\text{C}$	- 8.8	A
		$T_C = 100^\circ\text{C}$	- 5.6	
Pulsed Drain Current ^a	I_{DM}		- 35	W/ $^\circ\text{C}$
Linear Derating Factor			0.33	
Linear Derating Factor (PCB Mount) ^e			0.020	
Single Pulse Avalanche Energy ^b	E_{AS}		300	mJ
Repetitive Avalanche Current ^a	I_{AR}		- 8.8	A
Repetitive Avalanche Energy ^a	E_{AR}		5.0	mJ
Maximum Power Dissipation	$T_C = 25^\circ\text{C}$		42	W
Maximum Power Dissipation (PCB Mount) ^e	$T_A = 25^\circ\text{C}$		2.5	
Peak Diode Recovery dV/dt ^c	dV/dt		- 4.5	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 ^d	

Notes


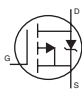
- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = -25$ V, starting $T_J = 25^\circ\text{C}$, $L = 4.5$ mH, $R_G = 25 \Omega$, $I_{AS} = -8.8$ A (see fig. 12).
- $I_{SD} \leq -11$ A, $dI/dt \leq 140$ A/ μs , $V_{DD} \leq V_{DS}$, $T_J \leq 150^\circ\text{C}$.
- 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) ^a	R_{thJA}	-	-	50	
Maximum Junction-to-Case (Drain)	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
Static							
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 $25\text{ }^\circ\text{C}$, $I_D = 1\text{ mA}$		-	- 0.063	-	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}	$V_{GS} = \pm 20\text{ V}$		-	-	± 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = - 60\text{ V}, V_{GS} = 0\text{ V}$		-	-	- 100	μA
		$V_{DS} = - 48\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	- 500	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = - 10\text{ V}$	$I_D = - 5.3\text{ A}^b$	-	-	0.28	Ω
Forward Transconductance	g_{fs}	$V_{DS} = - 25\text{ V}, I_D = - 5.3\text{ A}$		2.9	-	-	S
Dynamic							
Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V}, V_{DS} = - 25\text{ V}, f = 1.0\text{ MHz}$		-	570	-	pF
Output Capacitance	C_{oss}			-	360	-	
Reverse Transfer Capacitance	C_{riss}			-	65	-	
Total Gate Charge	Q_g	$V_{GS} = - 10\text{ V}$	$I_D = - 11\text{ A}, V_{DS} = - 48\text{ V},$ see fig. 6 and 13 ^b	-	-	19	nC
Gate-Source Charge	Q_{gs}			-	-	5.4	
Gate-Drain Charge	Q_{gd}			-	-	11	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = - 30\text{ V}, I_D = - 11\text{ A}, R_G = 18\text{ }\Omega, R_D = 2.5\text{ }\Omega,$ see fig. 10 ^b		-	13	-	ns
Rise Time	t_r			-	68	-	
Turn-Off Delay Time	$t_{d(off)}$			-	15	-	
Fall Time	t_f			-	29	-	
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	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	- 8.8	A
Pulsed Diode Forward Current ^a	I_{SM}			-	-	- 35	
Body Diode Voltage	V_{SD}	$T_J = 25\text{ }^\circ\text{C}, I_S = - 8.8\text{ A}, V_{GS} = 0\text{ V}^b$		-	-	- 6.3	V
Body Diode Reverse Recovery Time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}, I_F = - 11\text{ A}, di/dt = 100\text{ A}/\mu\text{s}^b$		-	100	200	ns
Body Diode Reverse Recovery Charge	Q_{rr}			-	0.32	0.64	μC
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

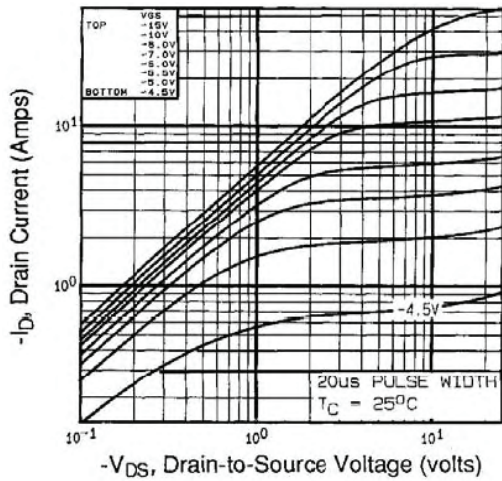


Fig. 1 - Typical Output Characteristics, $T_C = 25^\circ\text{C}$

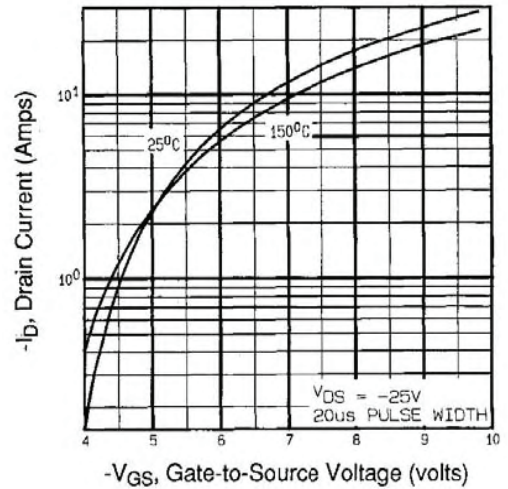


Fig. 3 - Typical Transfer Characteristics

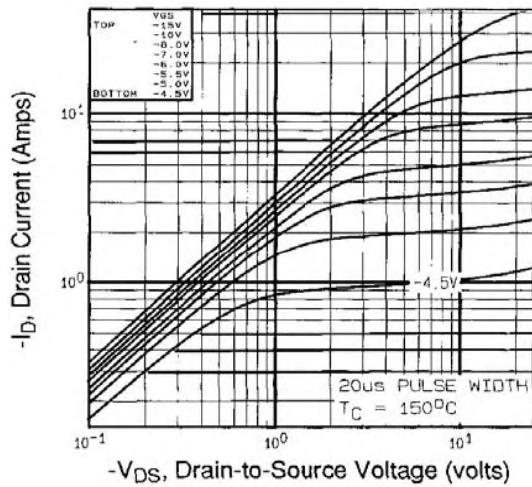


Fig. 2 - Typical Output Characteristics, $T_C = 150^\circ\text{C}$

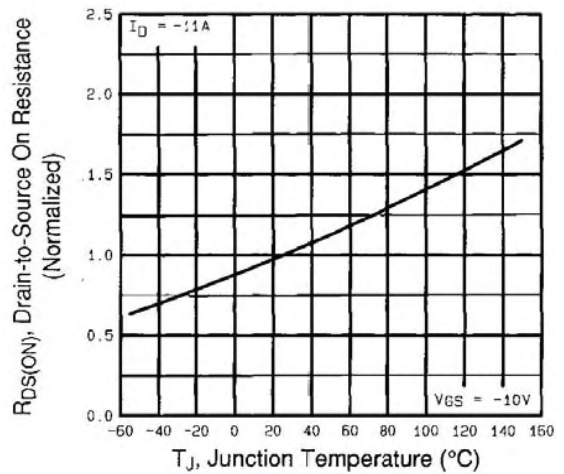


Fig. 4 - Normalized On-Resistance vs. Temperature

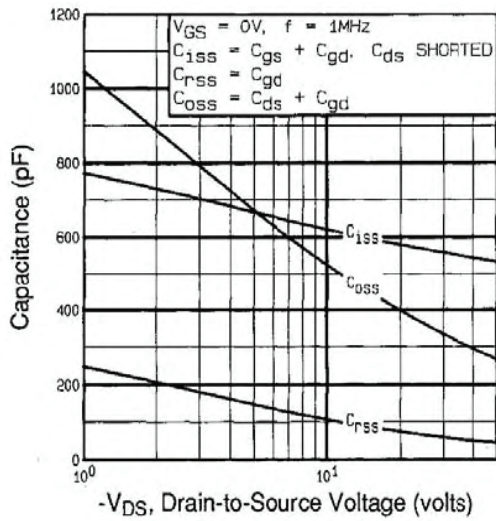


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

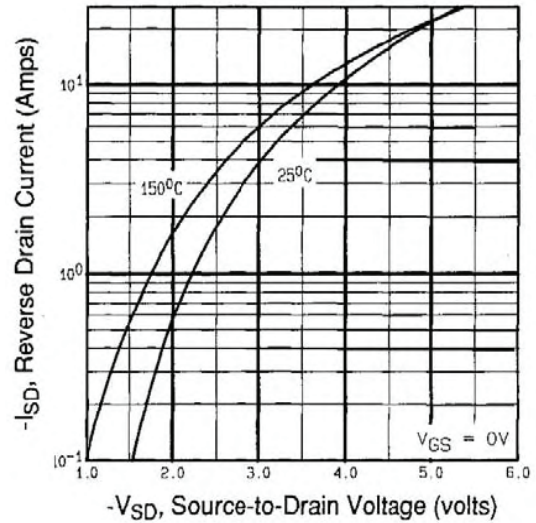


Fig. 7 - Typical Source-Drain Diode Forward Voltage

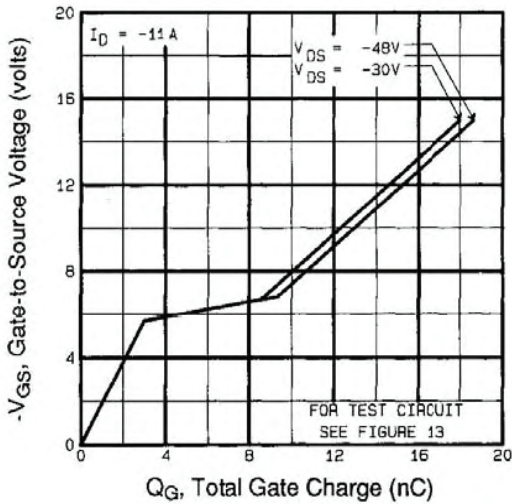


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

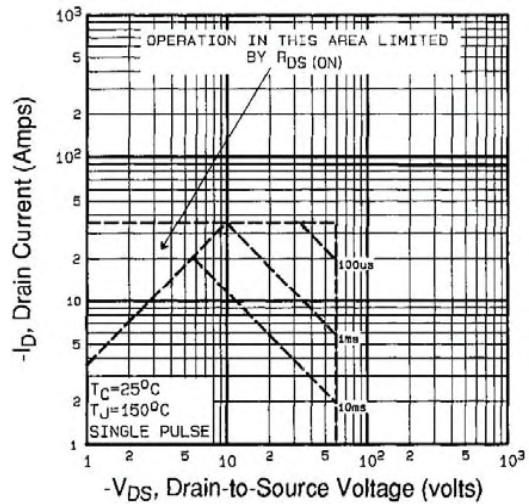


Fig. 8 - Maximum Safe Operating Area

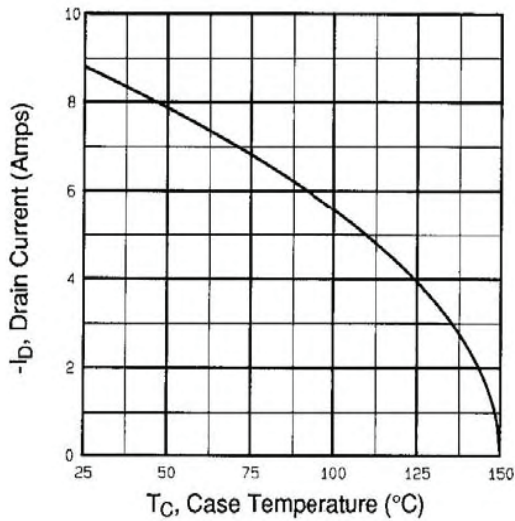


Fig. 9 - Maximum Drain Current vs. Case Temperature

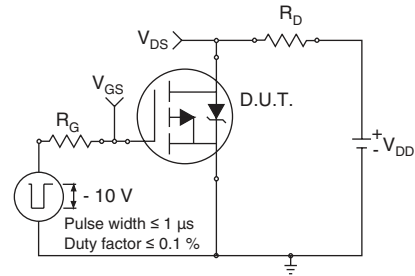


Fig. 10a - Switching Time Test Circuit

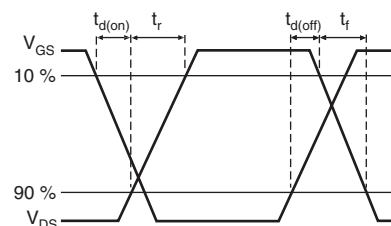


Fig. 10b - Switching Time Waveforms

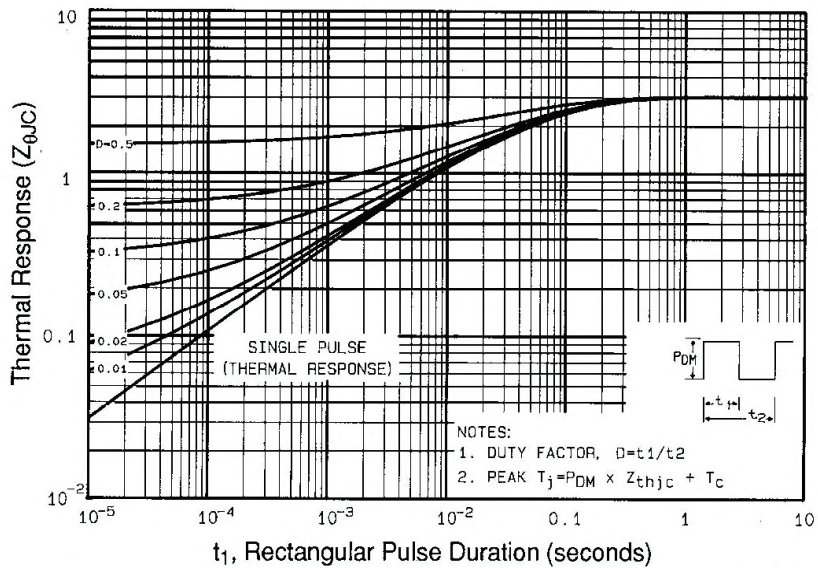


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

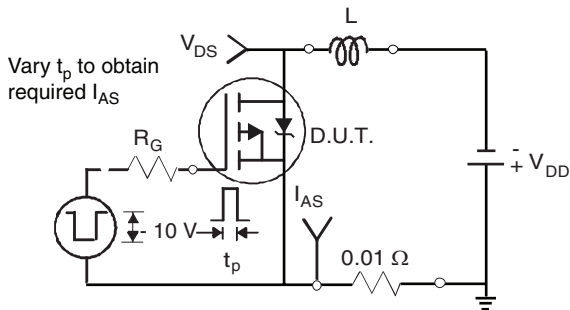


Fig. 12a - Unclamped Inductive Test Circuit

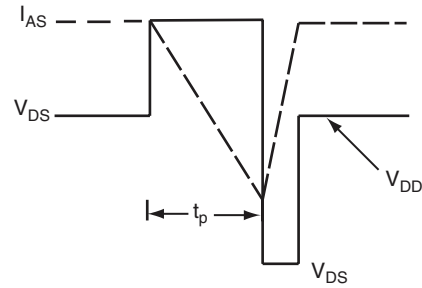


Fig. 12b - Unclamped Inductive Waveforms

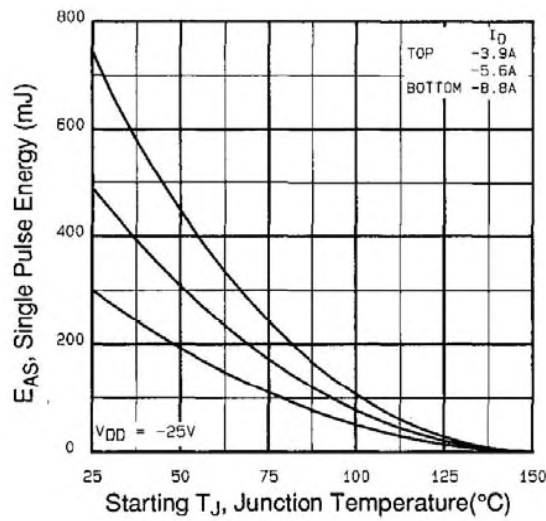


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

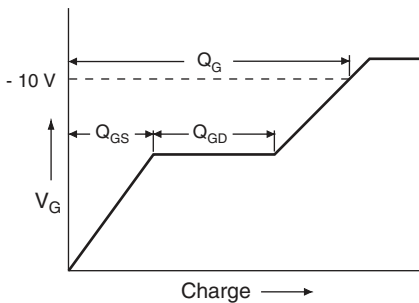


Fig. 13a - Basic Gate Charge Waveform

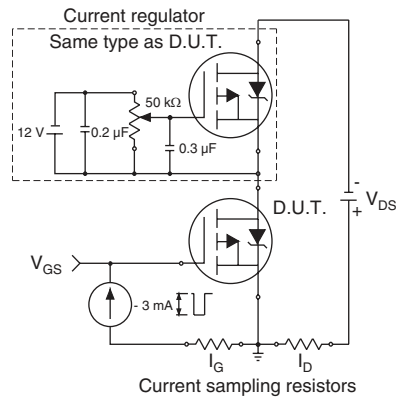
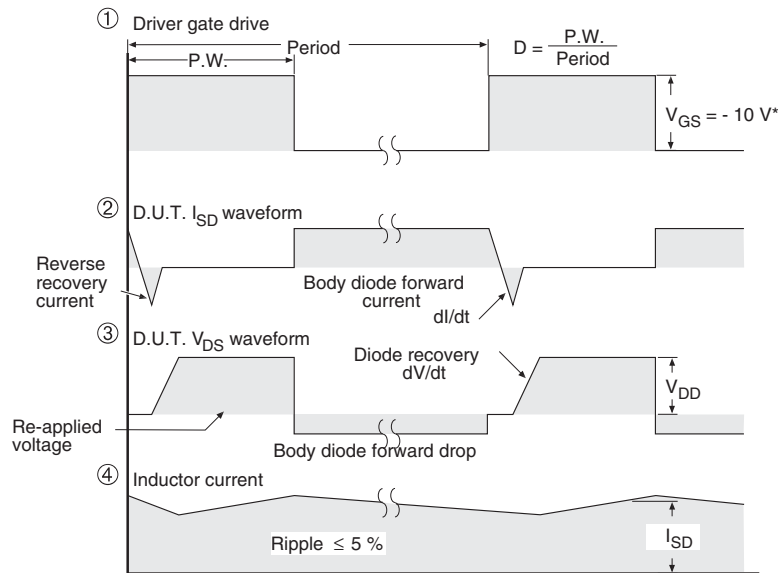
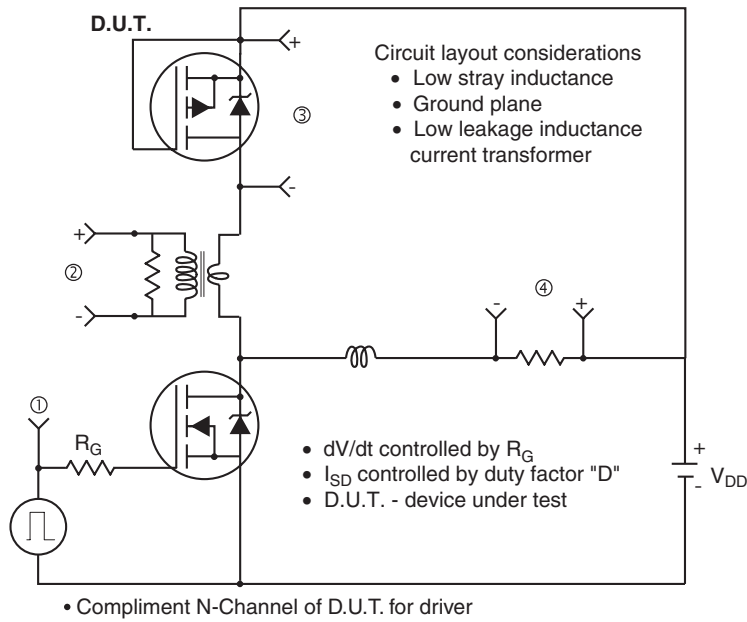


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



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

Fig. 14 - For P-Channel

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