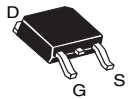


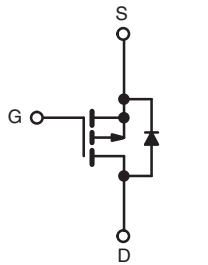
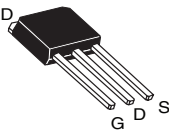
## Power MOSFET

PRODUCT SUMMARY	
$V_{DS}$ (V)	- 200
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = -10$ V   1.5
$Q_g$ (Max.) (nC)	20
$Q_{gs}$ (nC)	3.3
$Q_{gd}$ (nC)	11
Configuration	Single

DPAK (TO-252)



IPAK (TO-251)



P-Channel MOSFET

### FEATURES

- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- Surface Mount (IRFR9220, SiHFR9220)
- Straight Lead (IRFU9220, SiHFU9220)
- Available in Tape and Reel
- P-Channel
- Fast Switching
- Lead (Pb)-free Available



Available  
**RoHS\***  
COMPLIANT

### DESCRIPTION

Third Power MOSFETs technology is the key to Vishay advanced line of Power MOSFET transistors. The efficient geometry and unique processing of the Power MOSFETs design achieve very low on-state resistance combined with high transconductance and extreme device ruggedness. 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	IRFR9220PbF	IIRFR9220TRLPbF <sup>a</sup>	IRFR9220TRRPbF <sup>a</sup>	IRFR9220TRPbF <sup>a</sup>	IRFU9220PbF
	SiHFR9220-E3	SiHFR9220TL-E3 <sup>a</sup>	SiHFR9220TR-E3 <sup>a</sup>	SiHFR9220T-E3 <sup>a</sup>	SiHFU9220-E3
SnPb	IRFR9220	IRFR9220TRL <sup>a</sup>	IRFR9220TRR <sup>a</sup>	IRFR9220TR <sup>a</sup>	IRFU9220
	SiHFR9220	SiHFR9220TL <sup>a</sup>	SiHFR9220TR <sup>a</sup>	SiHFR9220T <sup>a</sup>	SiHFU9220

#### Note

a. See device orientation.

ABSOLUTE MAXIMUM RATINGS $T_C = 25$ °C, unless otherwise noted			
PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	$V_{DS}$	- 200	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	
Continuous Drain Current	$V_{GS}$ at -10 V	$T_C = 25$ °C	- 3.6
		$T_C = 100$ °C	- 2.3
Pulsed Drain Current <sup>a</sup>		$I_{DM}$	- 14
Linear Derating Factor			0.33
Linear Derating Factor (PCB Mount) <sup>e</sup>			0.020
Single Pulse Avalanche Energy <sup>b</sup>		$E_{AS}$	310
Repetitive Avalanche Current <sup>a</sup>		$I_{AR}$	- 3.6
Repetitive Avalanche Energy <sup>a</sup>		$E_{AR}$	4.2
Maximum Power Dissipation	$T_C = 25$ °C	$P_D$	42
Maximum Power Dissipation (PCB Mount) <sup>e</sup>	$T_A = 25$ °C		2.5
Peak Diode Recovery dV/dt <sup>c</sup>		dV/dt	- 5.0
Operating Junction and Storage Temperature Range		$T_J, T_{stg}$	- 55 to + 150
Soldering Recommendations (Peak Temperature)	for 10 s		260 <sup>d</sup>

#### Notes

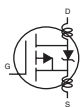
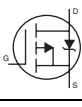
- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = -50$  V, Starting  $T_J = 25$  °C,  $L = 35$  mH,  $R_G = 25$   $\Omega$ ,  $I_{AS} = -3.6$  A (see fig. 12).
- $I_{SD} \leq -3.9$  A,  $dI/dt \leq 95$  A/ $\mu$ s,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150$  °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	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)	$R_{thJC}$	-	-	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	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$		-200	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = -1\text{ mA}$		-	-0.22	-	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	$I_{DSS}$	$V_{DS} = -200\text{ V}, V_{GS} = 0\text{ V}$		-	-	-100	$\mu\text{A}$
		$V_{DS} = -160\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	-500	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = -10\text{ V}$	$I_D = -2.2\text{ A}^b$	-	-	1.5	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = -50\text{ V}, I_D = -2.2\text{ A}$		1.1	-	-	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		-	340	-	pF
Output Capacitance	$C_{oss}$			-	110	-	
Reverse Transfer Capacitance	$C_{rss}$			-	33	-	
Total Gate Charge	$Q_g$	$V_{GS} = -10\text{ V}$	$I_D = -3.9\text{ A}, V_{DS} = -160\text{ V}$ , see fig. 6 and 13 <sup>b</sup>	-	-	20	nC
Gate-Source Charge	$Q_{GS}$			-	-	3.3	
Gate-Drain Charge	$Q_{GD}$			-	-	11	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -100\text{ V}, I_D = -3.9\text{ A}, R_G = 18\text{ }\Omega, R_D = 24\text{ }\Omega$ , see fig. 10 <sup>b</sup>		-	8.8	-	ns
Rise Time	$t_r$			-	27	-	
Turn-Off Delay Time	$t_{d(off)}$			-	7.3	-	
Fall Time	$t_f$			-	19	-	
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 		-	-	-3.6	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$			-	-	-14	
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = -3.6\text{ A}, V_{GS} = 0\text{ V}^b$		-	-	-6.3	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = -3.9\text{ A}, di/dt = 100\text{ A}/\mu\text{s}^b$		-	150	300	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$			-	0.97	2.0	$\mu\text{C}$
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  $\leq 2\%$ .



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

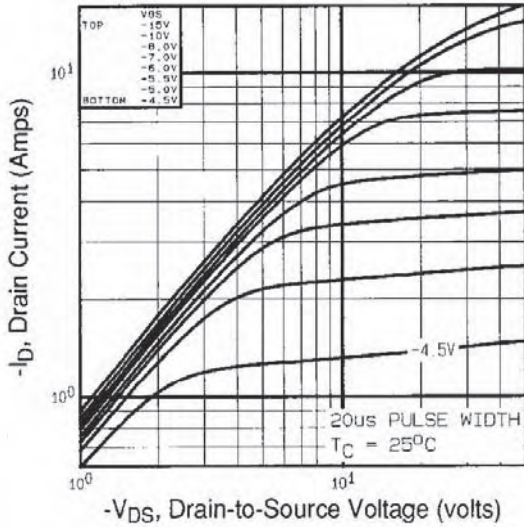


Fig. 1 - Typical Output Characteristics,  $T_C = 25\text{ }^\circ\text{C}$

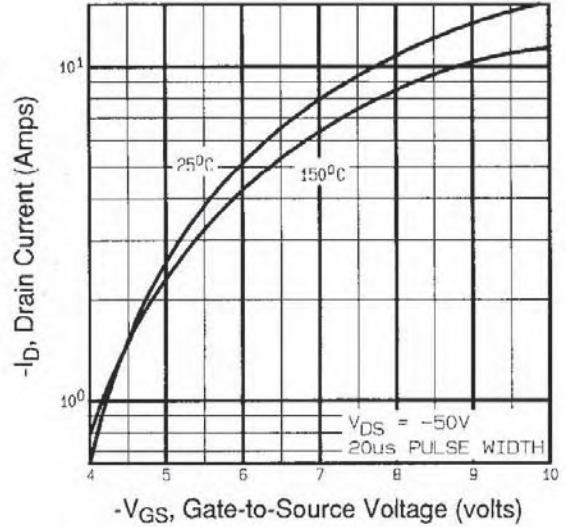


Fig. 3 - Typical Transfer Characteristics

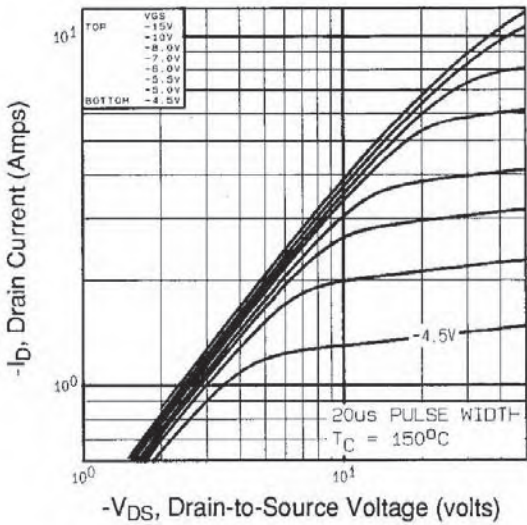


Fig. 2 - Typical Output Characteristics,  $T_C = 150\text{ }^\circ\text{C}$

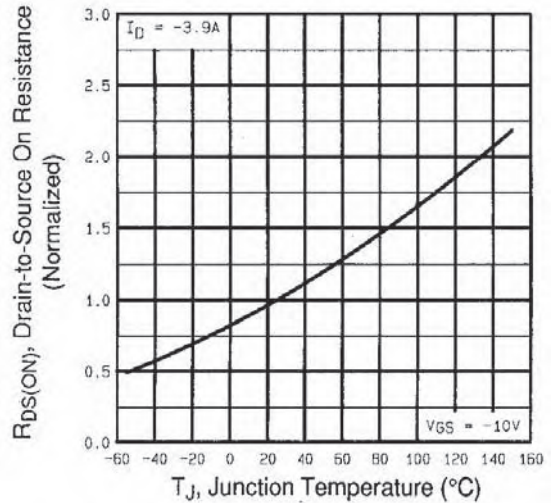


Fig. 4 - Normalized On-Resistance vs. Temperature

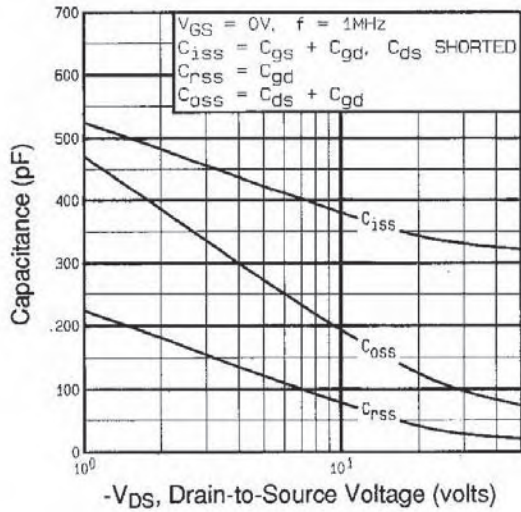


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

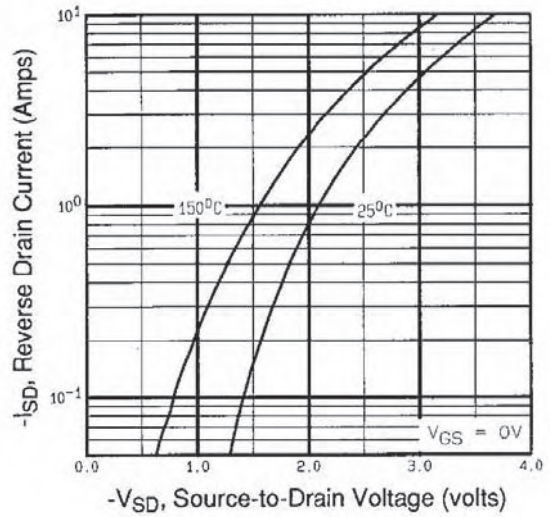


Fig. 7 - Typical Source-Drain Diode Forward Voltage

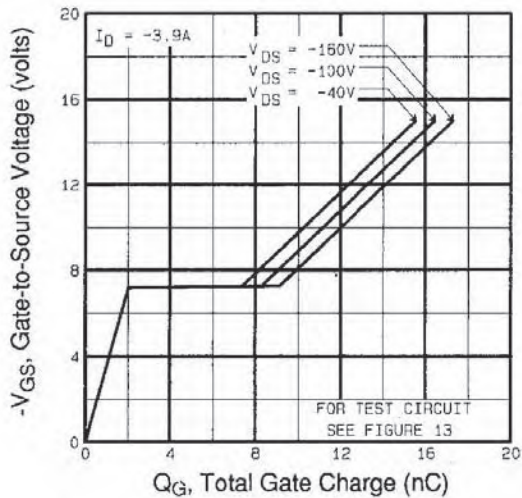


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

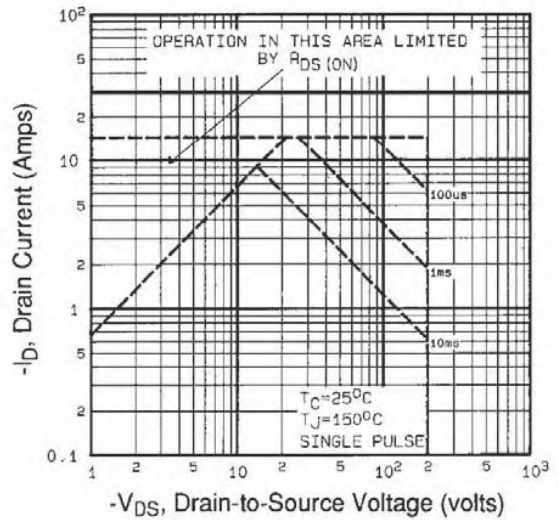


Fig. 8 - Maximum Safe Operating Area

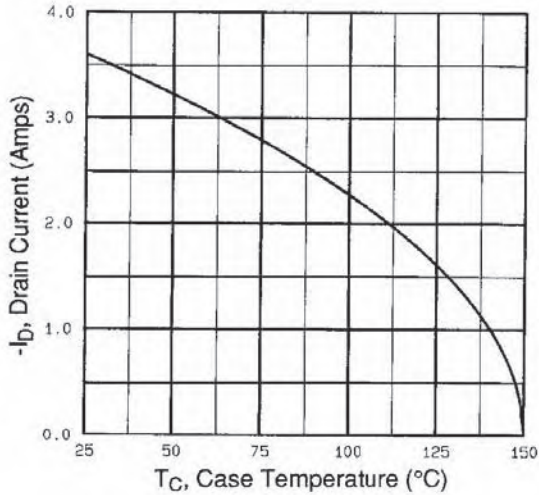


Fig. 9 - Maximum Drain Current vs. Case Temperature

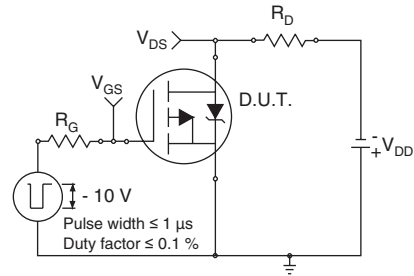


Fig. 10a - Switching Time Test Circuit

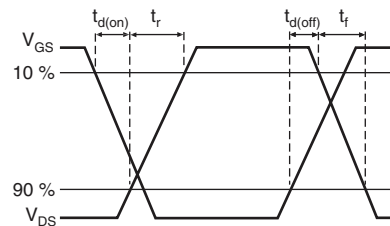


Fig. 10b - Switching Time Waveforms

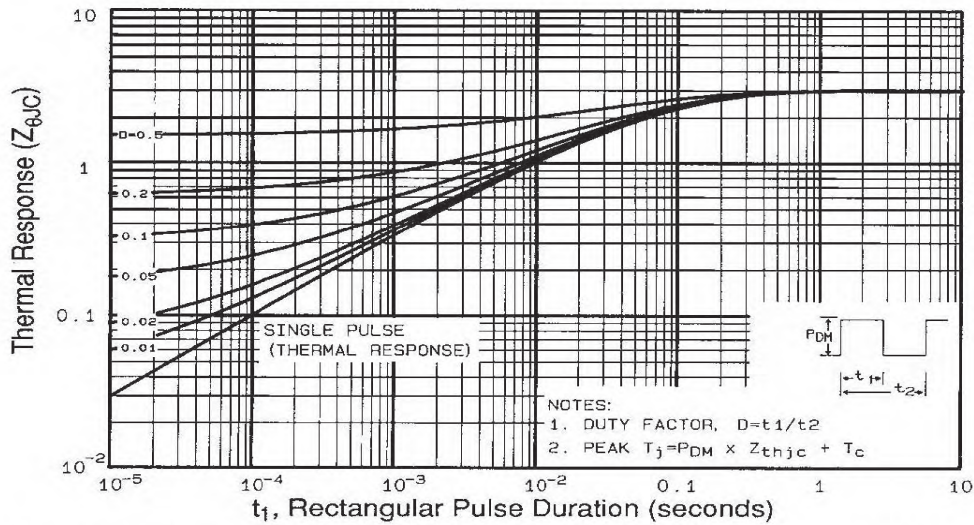


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

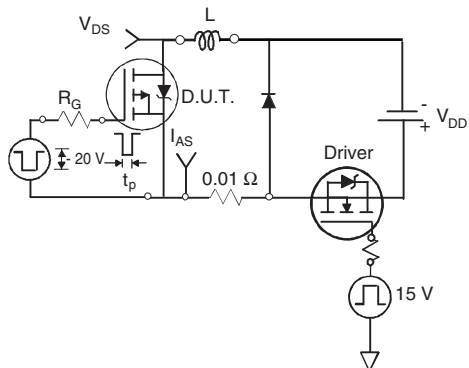


Fig. 12a - Unclamped Inductive Test Circuit

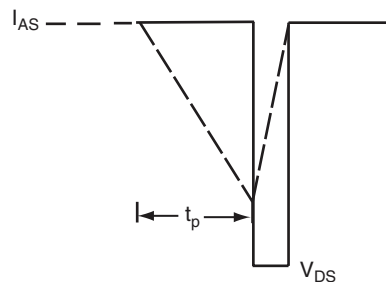


Fig. 12b - Unclamped Inductive Waveforms

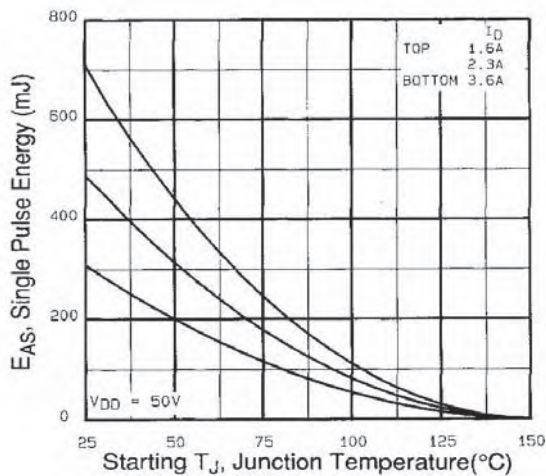


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

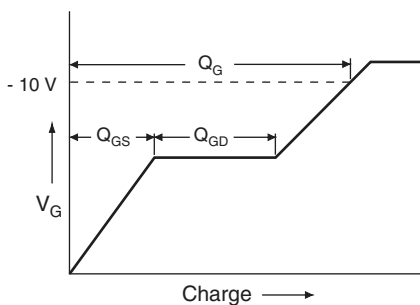


Fig. 13a - Basic Gate Charge Waveform

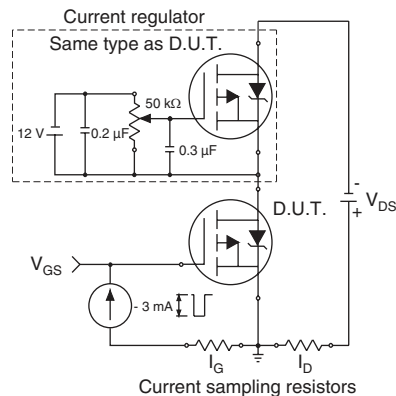
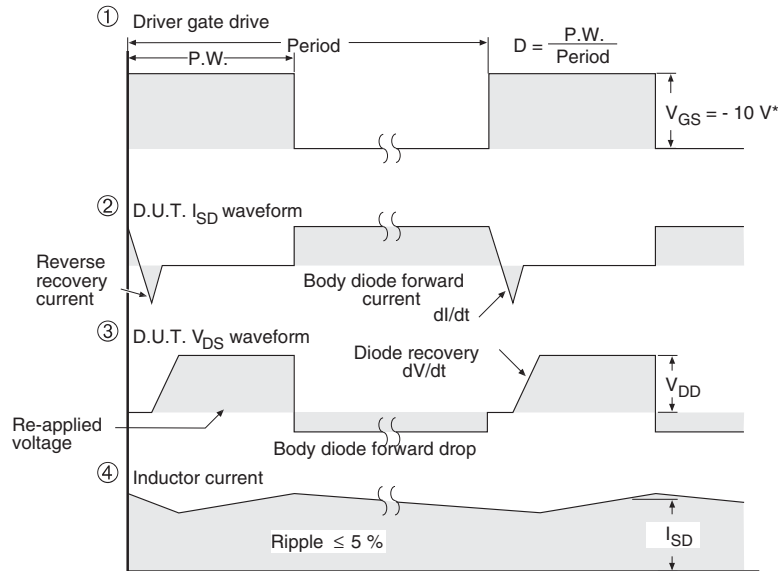
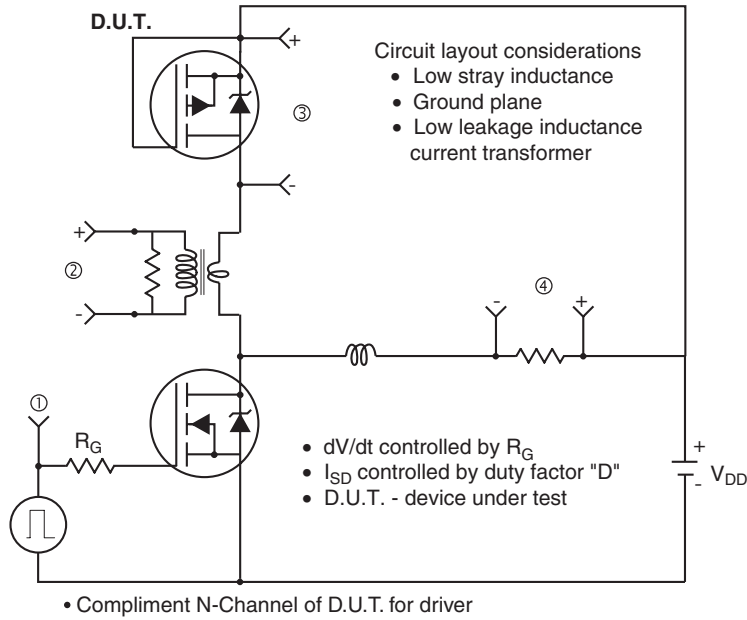


Fig. 13b - Gate Charge Test Circuit

## Peak Diode Recovery dV/dt Test Circuit



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

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

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