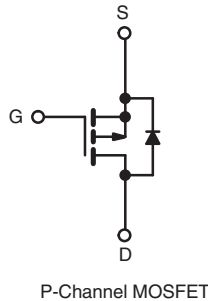
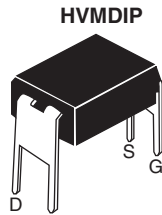


## Power MOSFET

PRODUCT SUMMARY	
$V_{DS}$ (V)	- 200
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = -10$ V   1.5
$Q_g$ (Max.) (nC)	15
$Q_{gs}$ (nC)	3.2
$Q_{gd}$ (nC)	8.4
Configuration	Single



### FEATURES

- Dynamic  $dV/dt$  Rating
- Repetitive Avalanche Rated
- For Automatic Insertion
- End Stackable
- P-Channel
- Fast Switching
- Ease of Paralleling
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS\***  
COMPLIANT

### Note

\* Lead (Pb)-containing terminations are not RoHS-compliant. Exemptions may apply.

### 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 4 pin DIP package is a low cost machine-insertable case style which can be stacked in multiple combinations on standard 0.1" pin centers. The dual drain serves as a thermal link to the mounting surface for power dissipation levels up to 1 W.

ORDERING INFORMATION	
Package	HVMDIP
Lead (Pb)-free	IRFD9220PbF
	SiHFD9220-E3
SnPb	IRFD9220
	SiHFD9220

ABSOLUTE MAXIMUM RATINGS ( $T_A = 25$ °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	$T_A = 25$ °C	- 0.56	A
		$T_A = 100$ °C	- 0.36	
Pulsed Drain Current <sup>a</sup>	$I_{DM}$	- 4.5		
Linear Derating Factor		0.0083	W/°C	
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$	80	mJ	
Avalanche Current <sup>a</sup>	$I_{AR}$	- 0.56	A	
Repetitive Avalanche Energy <sup>a</sup>	$E_{AR}$	0.10	mJ	
Maximum Power Dissipation	$T_A = 25$ °C	$P_D$	1.0	W
Peak Diode Recovery $dV/dt^c$		$dV/dt$	- 5.0	V/ns
Operating Junction and Storage Temperature Range		$T_J, T_{stg}$	- 55 to + 150	°C
Soldering Recommendations (Peak Temperature)	for 10 s		300 <sup>d</sup>	

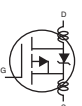

### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = -50$  V, starting  $T_J = 25$  °C,  $L = 17.8$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = -3$  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.



d. 1.6 mm from case.

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	120	°C/W

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	$R_{DS(on)}$	$V_{GS} = -10\text{ V}, I_D = -0.34\text{ A}^b$	-	-	1.5	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = -50\text{ V}, I_D = -0.35\text{ A}^b$	0.55	-	-	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	-	$\mu\text{F}$
Output Capacitance	$C_{oss}$		-	110	-	
Reverse Transfer Capacitance	$C_{rss}$		-	33	-	
Total Gate Charge	$Q_g$	$V_{GS} = -10\text{ V}, I_D = -2.1\text{ A}, V_{DS} = -160\text{ V}$ , see fig. 6 and 13 <sup>b</sup>	-	-	15	nC
Gate-Source Charge	$Q_{gs}$		-	-	3.2	
Gate-Drain Charge	$Q_{gd}$		-	-	8.4	
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 	-	4.0	-	nH
Internal Source Inductance	$L_S$		-	6.0	-	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p-n junction diode 	-	-	-0.56	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$		-	-	-4.5	
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = -0.56\text{ A}, V_{GS} = 0\text{ V}^b$	-	-	-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	$\mu\text{C}$

**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)

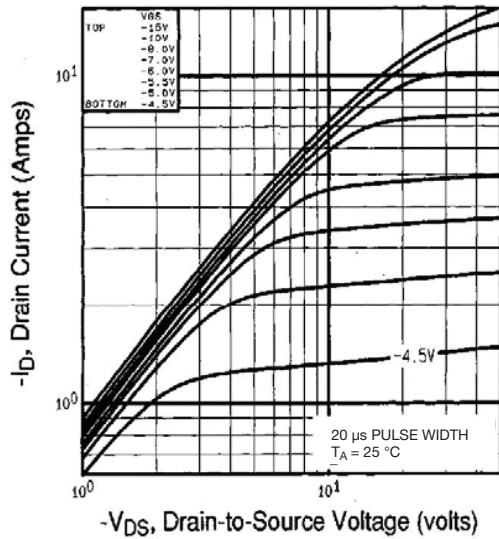


Fig. 1 - Typical Output Characteristics,  $T_A = 25\text{ }^\circ\text{C}$

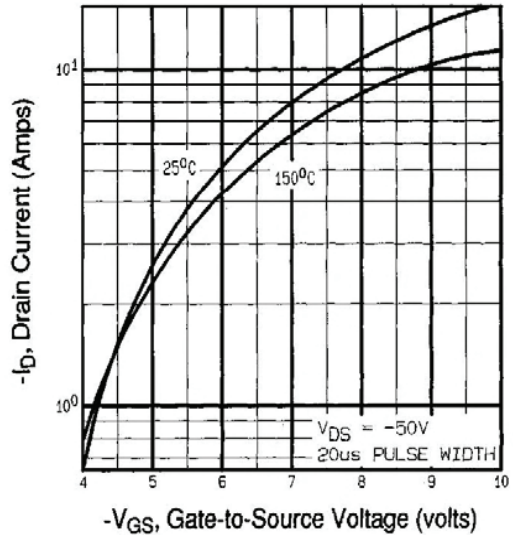


Fig. 3 - Typical Transfer Characteristics

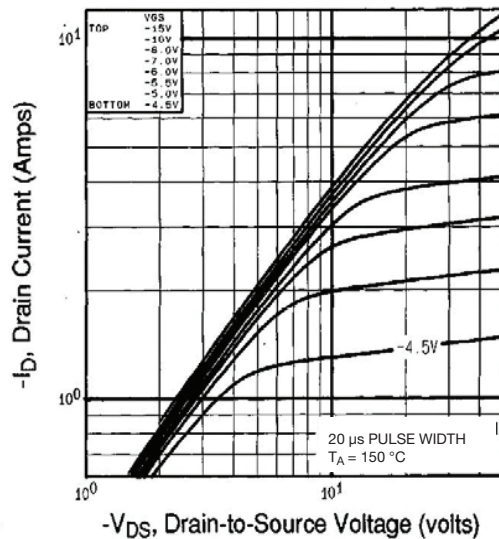


Fig. 2 - Typical Output Characteristics,  $T_A = 150\text{ }^\circ\text{C}$

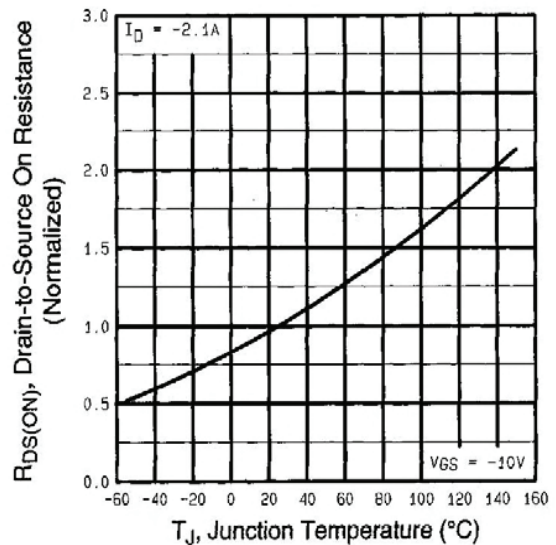


Fig. 4 - Normalized On-Resistance vs. Temperature

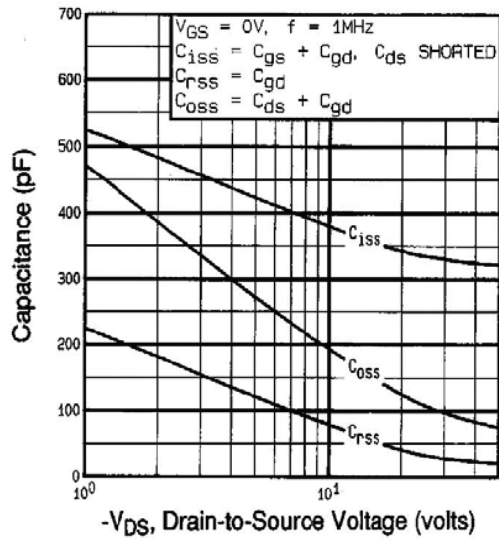


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

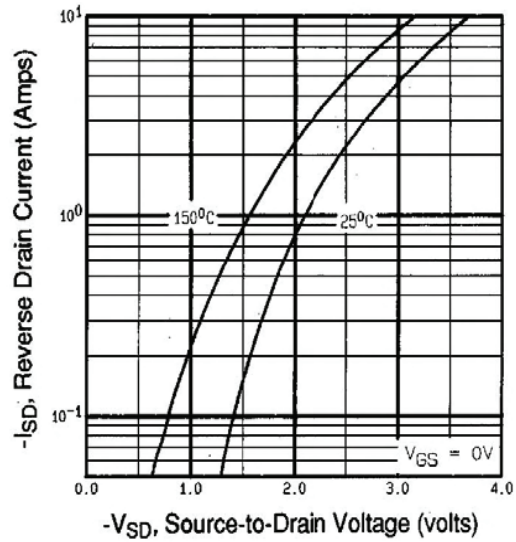


Fig. 7 - Typical Source-Drain Diode Forward Voltage

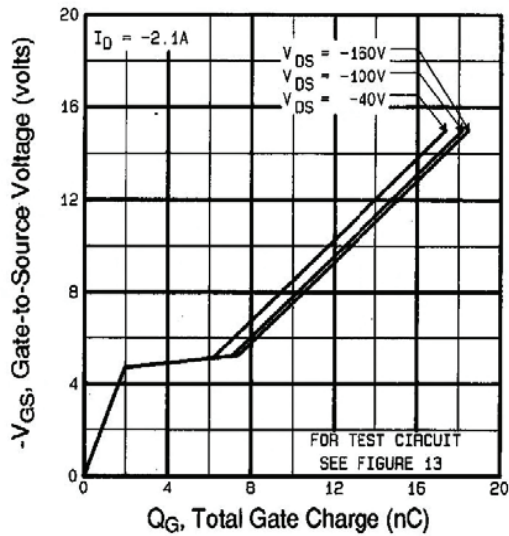


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

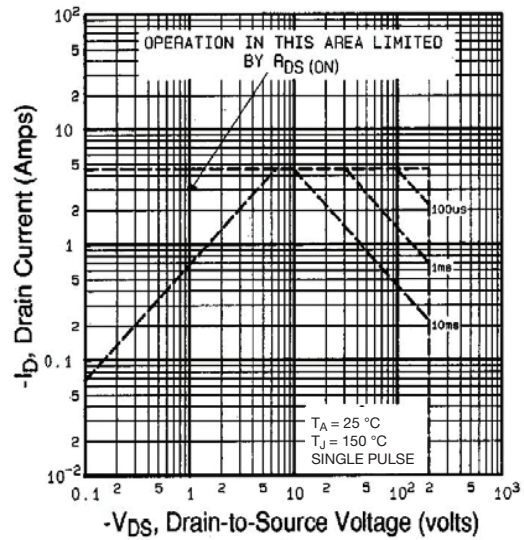


Fig. 8 - Maximum Safe Operating Area

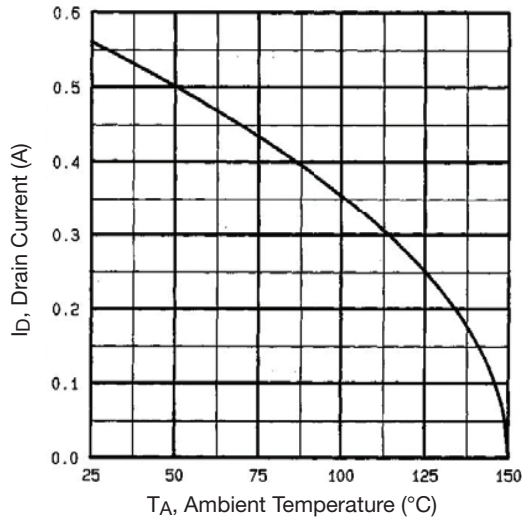


Fig. 9 - Maximum Drain Current vs. Ambient Temperature

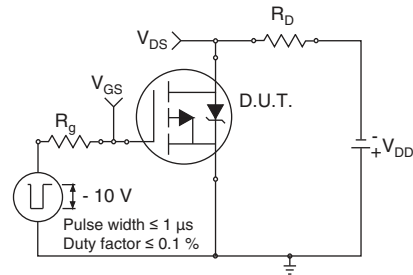


Fig. 10 - Switching Time Test Circuit

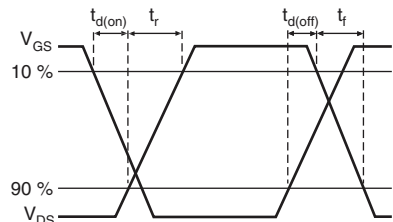


Fig. 11 - Switching Time Waveforms

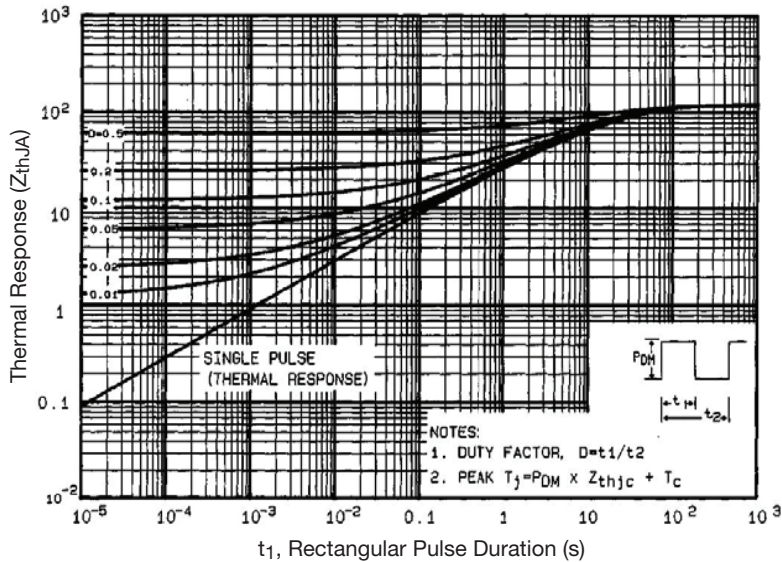


Fig. 12 - Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

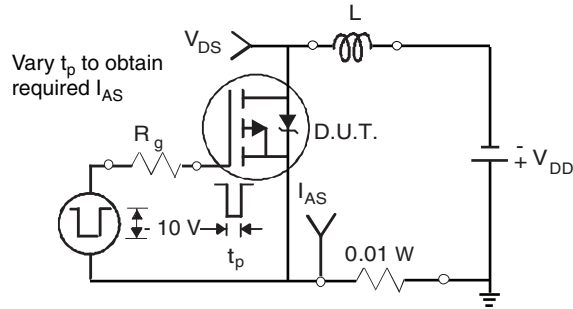


Fig. 13 - Unclamped Inductive Test Circuit

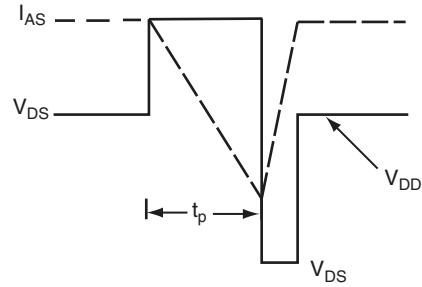


Fig. 14 - Unclamped Inductive Waveforms

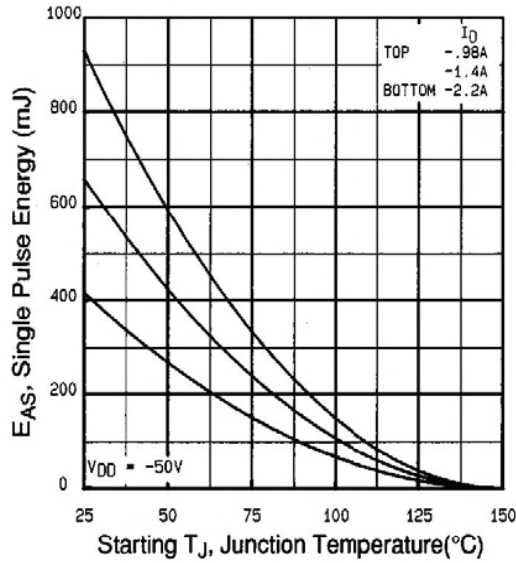


Fig. 15 - Maximum Avalanche Energy vs. Drain Current

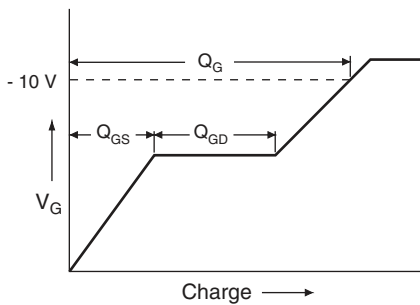


Fig. 16 - Basic Gate Charge Waveform

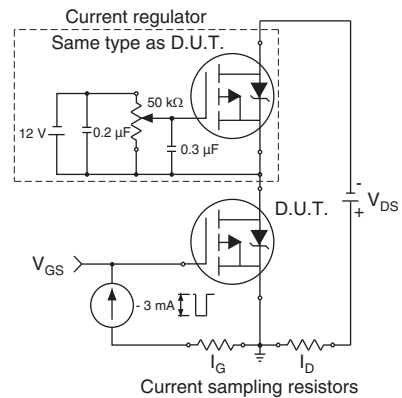
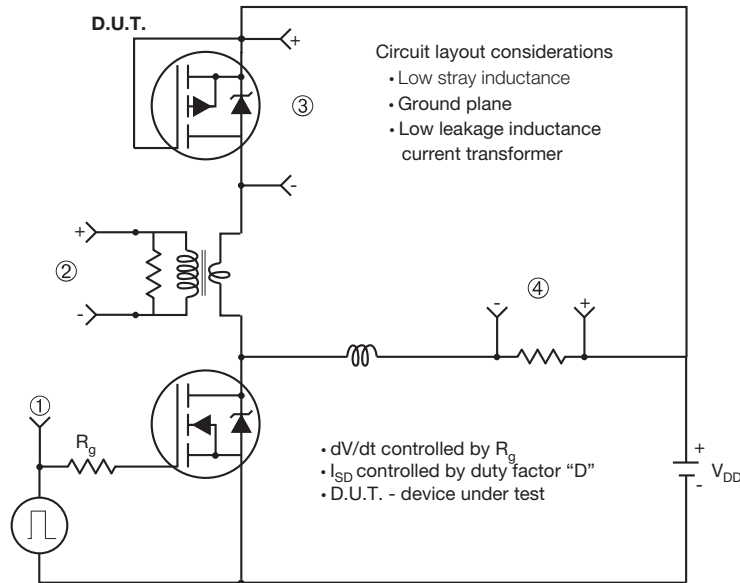
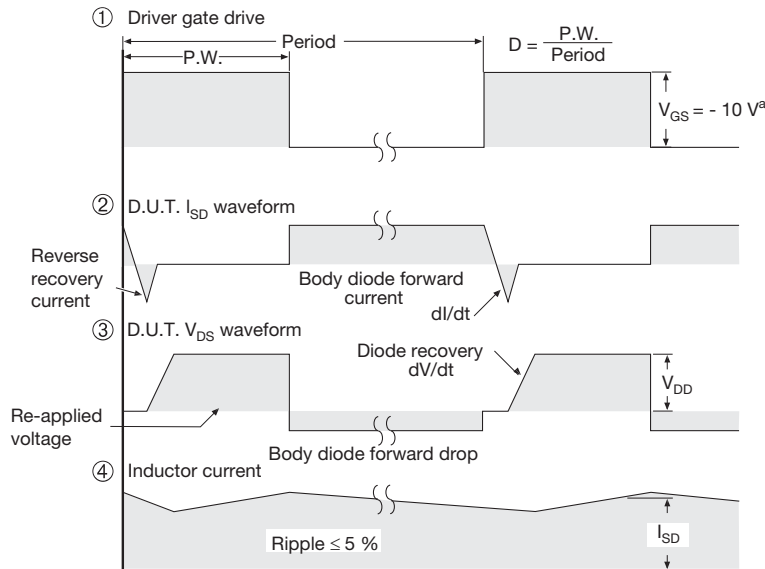


Fig. 17 - Gate Charge Test Circuit

**Peak Diode Recovery dV/dt Test Circuit**



**Note**  
• Compliment N-Channel of D.U.T. for driver



**Fig. 18 - For P-Channel**

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## HVM DIP (High voltage)



DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.310	0.330	7.87	8.38
E	0.300	0.425	7.62	10.79
L	0.270	0.290	6.86	7.36

ECN: X10-0386-Rev. B, 06-Sep-10  
DWG: 5974

### Note

- Package length does not include mold flash, protrusions or gate burrs. Package width does not include interlead flash or protrusions.





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