

## Power MOSFET

### PRODUCT SUMMARY

$V_{DS}$ (V)	- 50	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = - 10$ V	0.50
$Q_g$ (Max.) (nC)	11	
$Q_{gs}$ (nC)	3.8	
$Q_{gd}$ (nC)	4.1	
Configuration	Single	

### FEATURES

- For Automatic Insertion
- Compact, End Stackable
- Fast Switching
- Low Drive Current
- Easy Paralleled
- Excellent Temperature Stability
- P-Channel Versatility
- Compliant to RoHS Directive 2002/95/EC

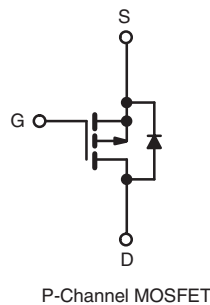
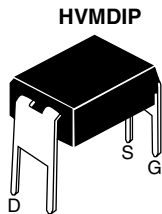

**RoHS\***  
 COMPLIANT

### DESCRIPTION

The HVMDIP technology is the key to Vishay's advanced line of power MOSFET transistors. The efficient geometry and unique processing of the HVMDIP design achieves very low on-state resistance combined with high transconductance and extreme device ruggedness.

The p-channel HVMDIPs are designed for application which require the convenience of reverse polarity operation. They retain all of the features of the more common n-channel HVMDIPs such as voltage control, very fast switching, ease of paralleling, and excellent temperature stability.

P-channels HVMDIPs are intended for use in power stages where complementary symmetry with n-channel devices offers circuit simplification. They are also very useful in drive stages because of the circuit versatility offered by the reverse polarity connection. Applications include motor control, audio amplifiers, switched mode converters, control circuits and pulse amplifiers.



### ORDERING INFORMATION

Package	HVMDIP
Lead (Pb)-free	IRFD9010PbF
	SiHFD9010-E3
SnPb	IRFD9010
	SiHFD9010

### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^\circ\text{C}$ , unless otherwise noted)

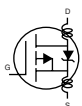

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	$V_{DS}$	- 50	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	
Continuous Drain Current	$I_D$	$V_{GS}$ at - 10 V	A
		$T_C = 25^\circ\text{C}$	
		$T_C = 100^\circ\text{C}$	- 0.68
Pulsed Drain Current <sup>a</sup>	$I_{DM}$	- 8.8	
Linear Derating Factor		0.01	W/ $^\circ\text{C}$
Inductive Current, Clamped	$I_{LM}$	- 8.8	A
Inductive Current, Unclamped (Avalanche Current)	$I_L$	- 1.5	
Maximum Power Dissipation	$P_D$	1	W
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to + 150	$^\circ\text{C}$
Soldering Recommendations (Peak Temperature)		for 10 s	

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = - 25$  V, starting  $T_J = 25^\circ\text{C}$ ,  $L = 52$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = - 2.0$  A (see fig. 12).
- $I_{SD} \leq - 4.0$  A,  $dI/dt \leq 75$  A/ $\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 175^\circ\text{C}$ .
- 1.6 mm from case.

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

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

SPECIFICATIONS ( $T_J = 25^{\circ}\text{C}$ , unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = -250\ \mu\text{A}$	- 50	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25^{\circ}\text{C}$ , $I_D = -1\ \text{mA}$	-	- 0.091	-	$\text{V}/^{\circ}\text{C}$
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\ \mu\text{A}$	- 2.0	-	- 4.0	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 20\ \text{V}$	-	-	$\pm 500$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -50\ \text{V}, V_{GS} = 0\ \text{V}$	-	-	- 250	$\mu\text{A}$
		$V_{DS} = -40\ \text{V}, V_{GS} = 0\ \text{V}, T_J = 125^{\circ}\text{C}$	-	-	- 1000	
On-State Drain Current	$I_{D(on)}$	$V_{GS} = 10\ \text{V}$   $V_{DS} > I_{D(on)} \times R_{DS(on)}$ max.	- 1.1	-	-	A
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = -10\ \text{V}$   $I_D = -0.58\ \text{A}^b$	-	0.35	0.50	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = -20\ \text{V}, I_D = -2.4\ \text{A}$	1.7	2.5	-	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	-	240	-	pF
Output Capacitance	$C_{oss}$		-	160	-	
Reverse Transfer Capacitance	$C_{rss}$		-	30	-	
Total Gate Charge	$Q_g$	$V_{GS} = -10\ \text{V}$   $I_D = -4.7\ \text{A}, V_{DS} = 0.8\ \text{V}$ see fig. 6 and 13 <sup>b</sup>	-	7.2	11	nC
Gate-Source Charge	$Q_{GS}$		-	2.5	3.8	
Gate-Drain Charge	$Q_{GD}$		-	2.7	4.1	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -25\ \text{V}, I_D = -4.7\ \text{A}$ $R_g = 24\ \Omega, R_D = 5.6\ \Omega,$ see fig. 10 <sup>b</sup>	-	6.1	9.2	ns
Rise Time	$t_r$		-	47	71	
Turn-Off Delay Time	$t_{d(off)}$		-	13	20	
Fall Time	$t_f$		-	39	59	
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 	-	-	- 1.1	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$		-	-	- 8.8	
Body Diode Voltage	$V_{SD}$	$T_J = 25^{\circ}\text{C}, I_S = -0.7\ \text{A}, V_{GS} = 0\ \text{V}^b$	-	-	- 5.5	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25^{\circ}\text{C}, I_F = -4.7\ \text{A}, dI/dt = 100\ \text{A}/\mu\text{s}^b$	33	75	160	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$		0.090	0.22	0.52	$\mu\text{C}$
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  $\leq 300\ \mu\text{s}$ ; duty cycle  $\leq 2\ \%$ .

## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

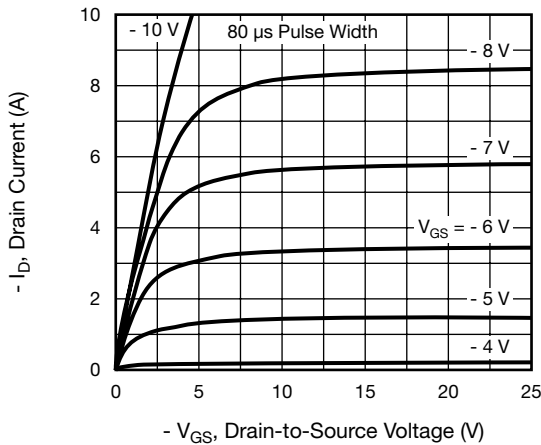


Fig. 1 - Typical Output Characteristics

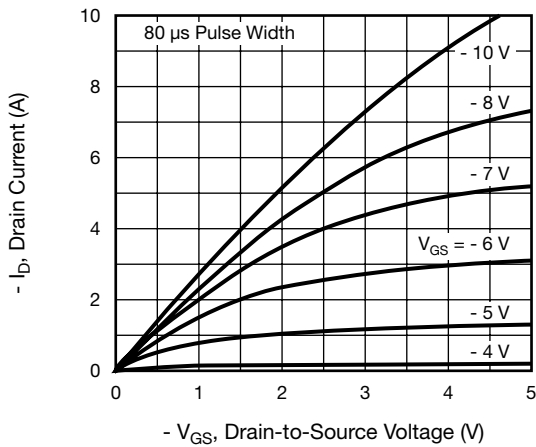


Fig. 2 - Typical Output Characteristics

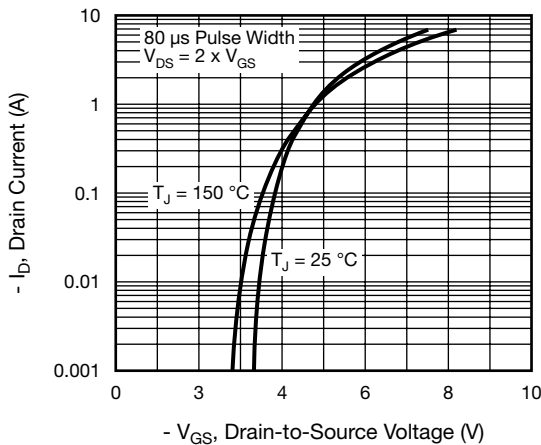


Fig. 3 - Typical Transfer Characteristics

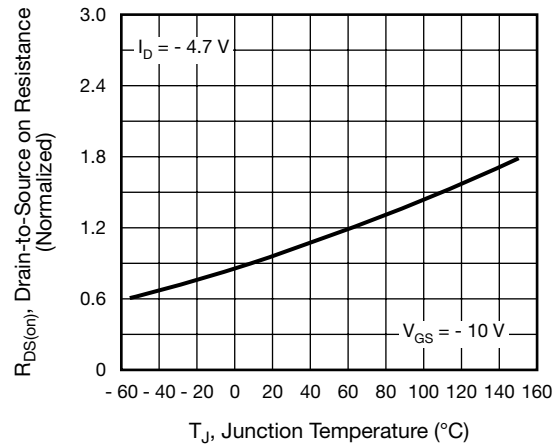


Fig. 4 - Normalized On-Resistance vs. Temperature

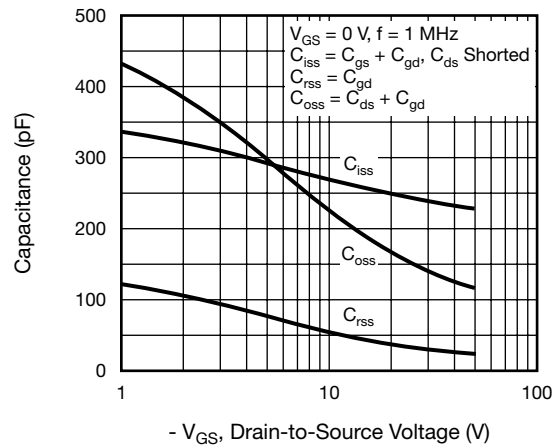


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

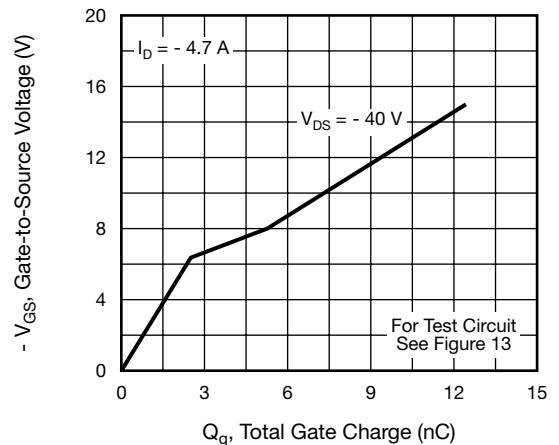
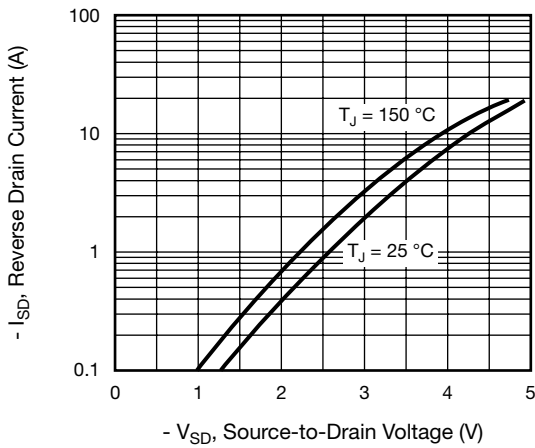
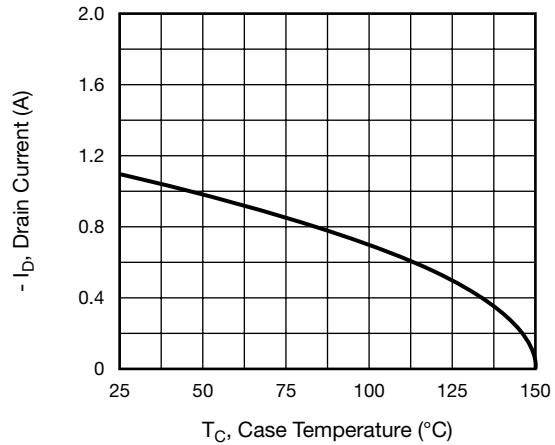


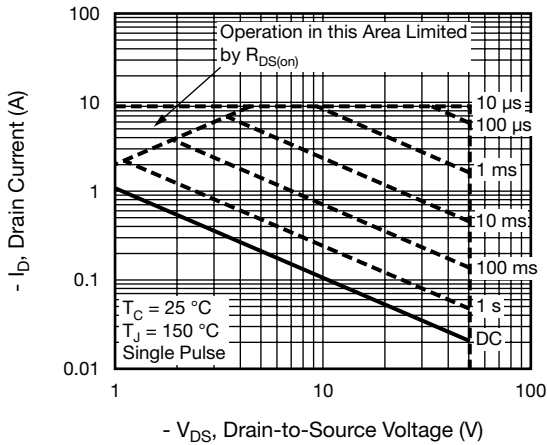
Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage



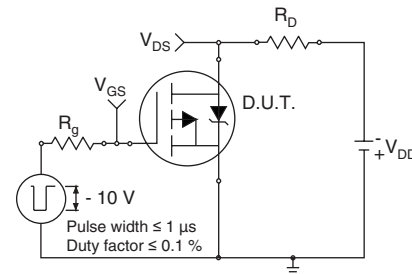
**Fig. 7 - Typical Source-Drain Diode Forward Voltage**



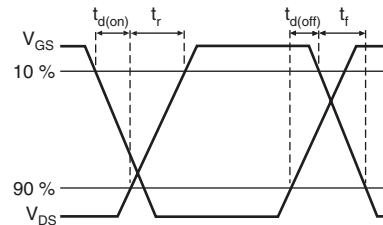
**Fig. 9 - Maximum Drain Current vs. Case Temperature**



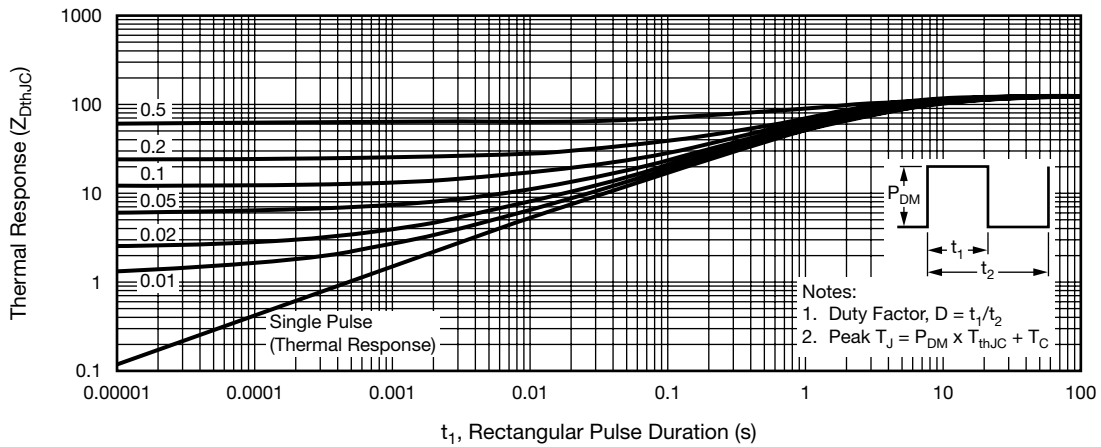
**Fig. 8 - Maximum Safe Operating Area**



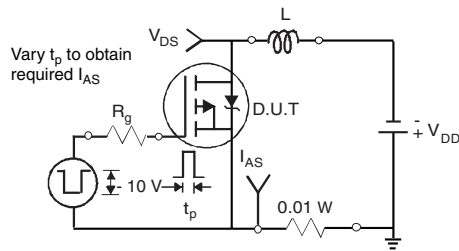
**Fig. 10a - Switching Time Test Circuit**



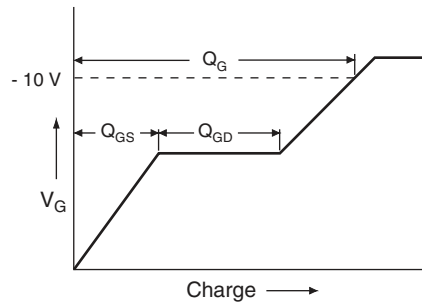
**Fig. 10b - Switching Time Waveforms**



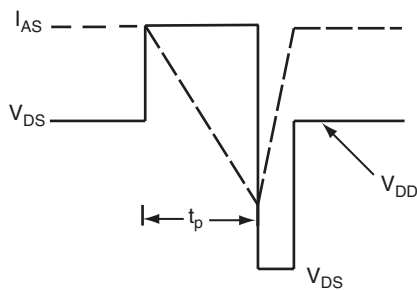
**Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case**



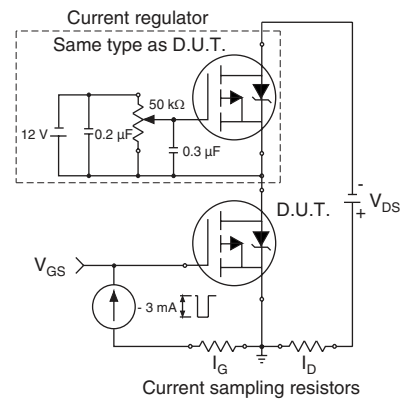
**Fig. 12a - Unclamped Inductive Test Circuit**



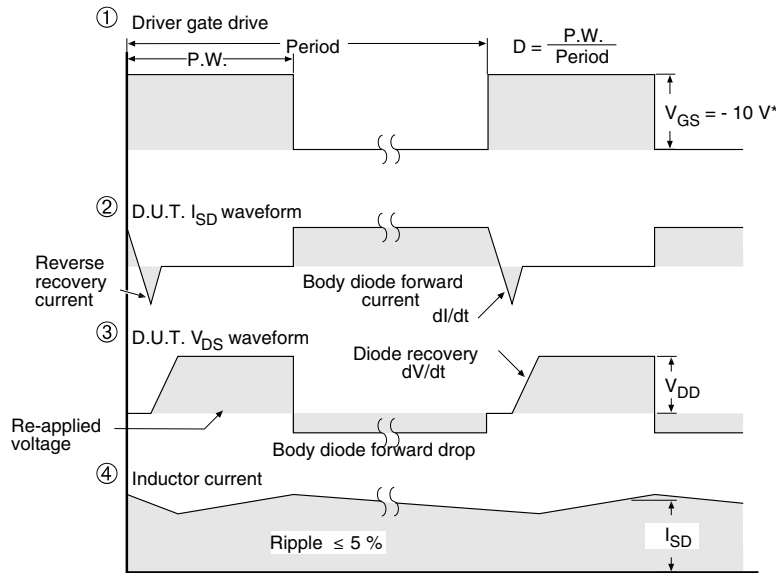
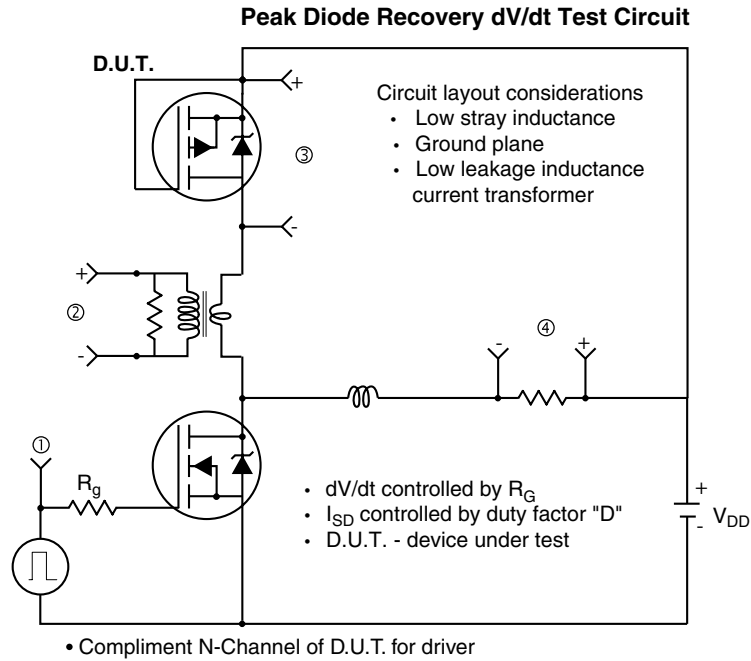
**Fig. 13a - Basic Gate Charge Waveform**



**Fig. 12b - Unclamped Inductive Waveforms**



**Fig. 13b - Gate Charge Test Circuit**



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

Fig. 14 - For P-Channel

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