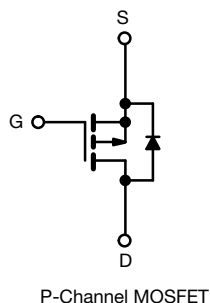
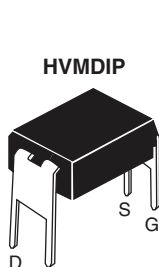


Power MOSFET



P-Channel MOSFET

FEATURES

- Dynamic dV/dt rating
- Repetitive avalanche rated
- For automatic insertion
- End stackable
- P-channel
- Fast switching
- 175 °C operating temperature
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



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	

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 servers as a thermal link to the mounting surface for power dissipation levels up to 1 W.

ORDERING INFORMATION

Package	HVMDIP
Lead (Pb)-free	IRFD9024PbF

ABSOLUTE MAXIMUM RATINGS ($T_A = 25$ °C, unless otherwise noted)

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-source voltage	V_{DS}	-60	V
Gate-source voltage	V_{GS}	± 20	
Continuous drain current	I_D	$T_A = 25$ °C	A
		$T_A = 100$ °C	
Pulsed drain current ^a	I_{DM}	-13	
Linear derating factor		0.0083	W/°C
Single pulse avalanche energy ^b	E_{AS}	140	mJ
Repetitive avalanche current ^a	I_{AR}	-1.6	A
Repetitive avalanche energy ^a	E_{AR}	0.13	mJ
Maximum power dissipation	P_D	1.3	W
Peak diode recovery dv/dt ^c	dV/dt	-4.5	V/ns
Operating junction and storage temperature range	T_J, T_{stg}	-55 to + 175	°C
Soldering rRecommendations (peak temperature) ^d	For 10 s	300 ^d	

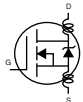
Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- $V_{DD} = -25$ V, starting $T_J = 25$ °C, $L = 15$ mH, $R_g = 25$ Ω , $I_{AS} = -3.2$ A (see fig. 12)
- $I_{SD} \leq -11$ A, $dI/dt \leq 140$ A/ μ s, $V_{DD} \leq V_{DS}$, $T_J \leq 175$ °C
- 1.6 mm from case

THERMAL RESISTANCE RATINGS

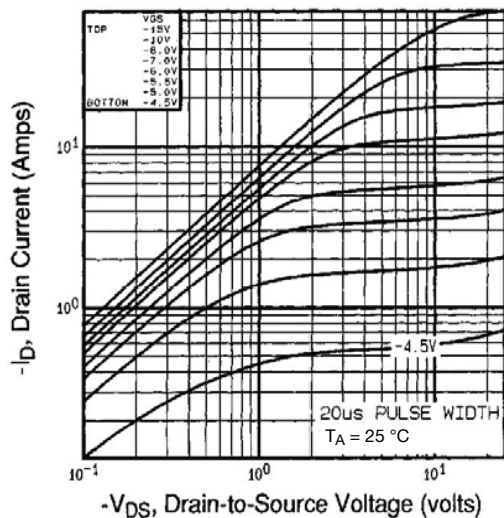
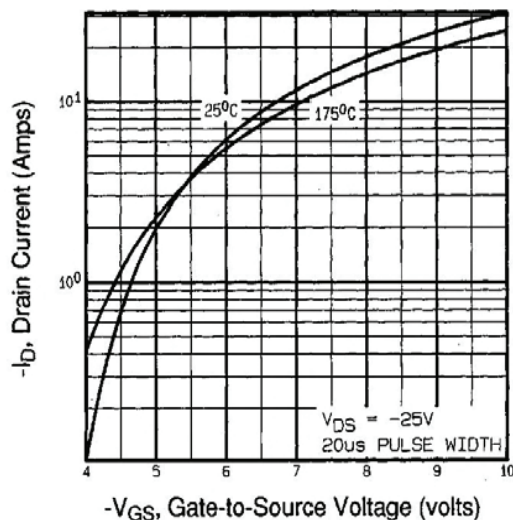
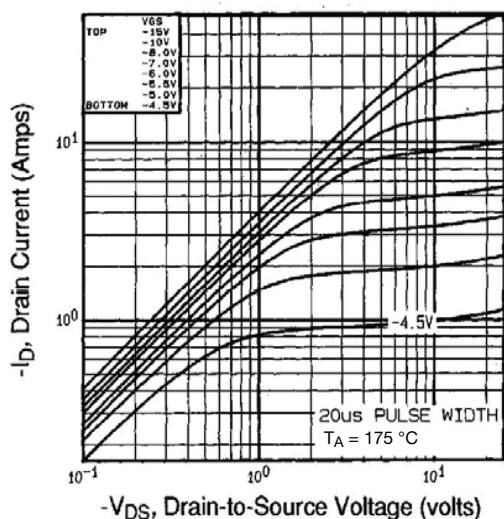
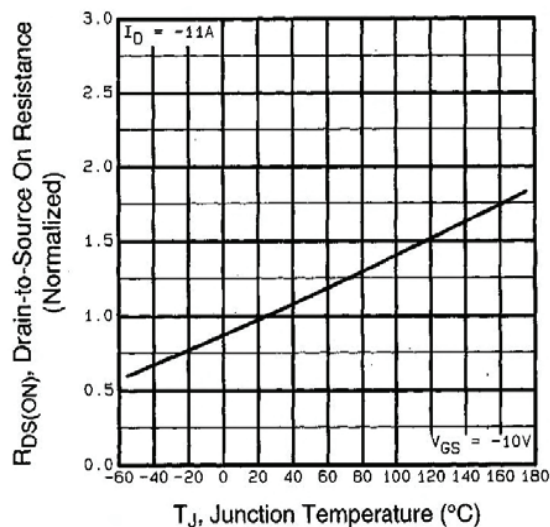
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	120	°C/W

SPECIFICATIONS ($T_J = 25\text{ °C}$, unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	V _{DS}	V _{GS} = 0 V, I _D = -250 μA		-60	-	-	V
V _{DS} Temperature Coefficient	ΔV _{DS} /T _J	Reference to 25 °C, I _D = -1 mA		-	-0.056	-	V/°C
Gate-Source Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = -250 μA		-2.0	-	-4.0	V
Gate-Source Leakage	I _{GSS}	V _{GS} = ± 20 V		-	-	± 100	nA
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = -60 V, V _{GS} = 0 V		-	-	-100	μA
		V _{DS} = -48 V, V _{GS} = 0 V, T _J = 150 °C		-	-	-500	
Drain-Source On-State Resistance	R _{DS(on)}	V _{GS} = -10 V	I _D = -0.96 A ^b	-	-	0.28	Ω
Forward Transconductance	g _{fs}	V _{DS} = -25 V, I _D = -0.96 A ^b		1.3	-	-	S
Dynamic							
Input Capacitance	C _{iss}	V _{GS} = 0 V V _{DS} = -25 V f = 1.0 MHz, see fig. 5		-	570	-	pF
Output Capacitance	C _{oss}			-	360	-	
Reverse Transfer Capacitance	C _{rss}			-	65	-	
Total Gate Charge	Q _g	V _{GS} = -10 V	I _D = -11 A, V _{DS} = -48 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 V, I _D = -11 A R _g = 18 Ω, R _D = 2.5 Ω, 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 		-	4.0	-	nH
Internal Source Inductance	L _S			-	6.0	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I _S	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	-1.6	A
Pulsed Diode Forward Current ^a	I _{SM}			-	-	-13	
Body Diode Voltage	V _{SD}	T _J = 25 °C, I _S = -1.6 A, V _{GS} = 0 V ^b		-	-	-6.3	V
Body Diode Reverse Recovery Time	t _{rr}	T _J = 25 °C, I _F = -11 A, dI/dt = 100 A/μs ^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, $T_A = 25^\circ\text{C}$

Fig. 2 - Typical Transfer Characteristics

Fig. 1 - Typical Output Characteristics, $T_A = 175^\circ\text{C}$

Fig. 3 - Normalized On-Resistance vs. Temperature

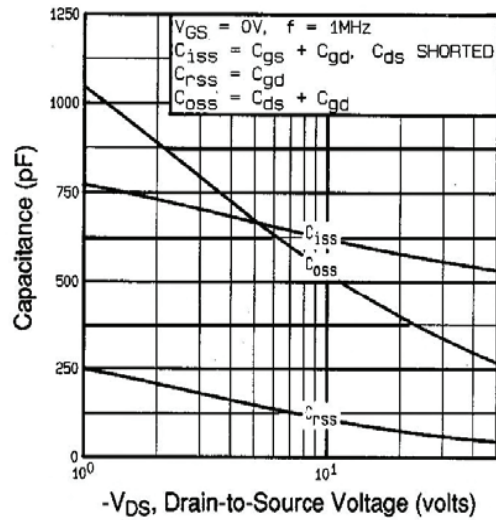


Fig. 4 - Typical Capacitance vs. Drain-to-Source Voltage

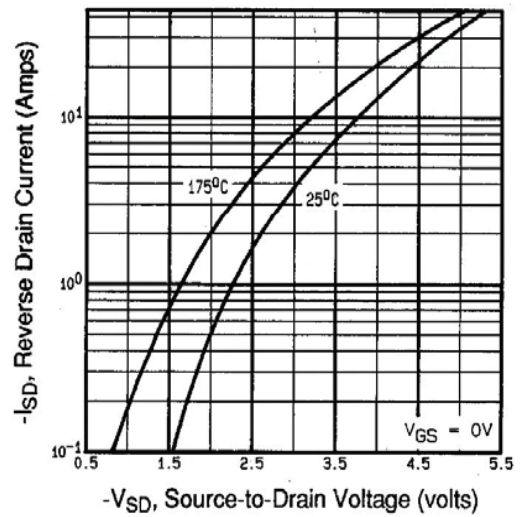


Fig. 6 - Typical Source-Drain Diode Forward Voltage

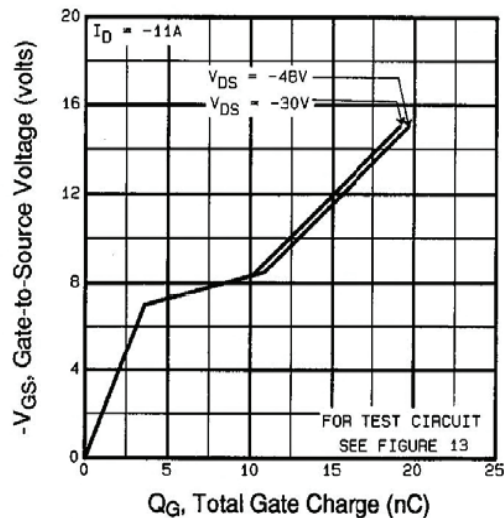


Fig. 5 - Typical Gate Charge vs. Gate-to-Source Voltage

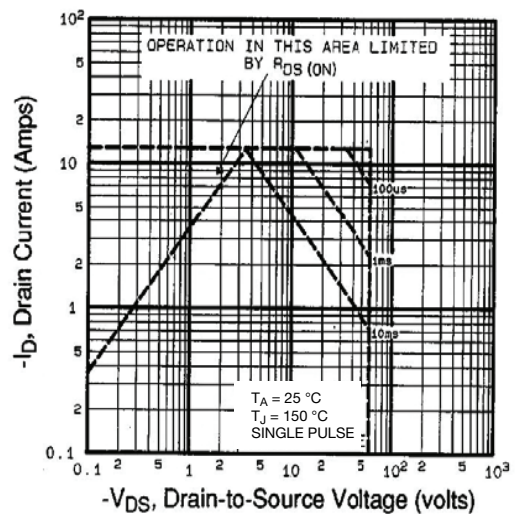
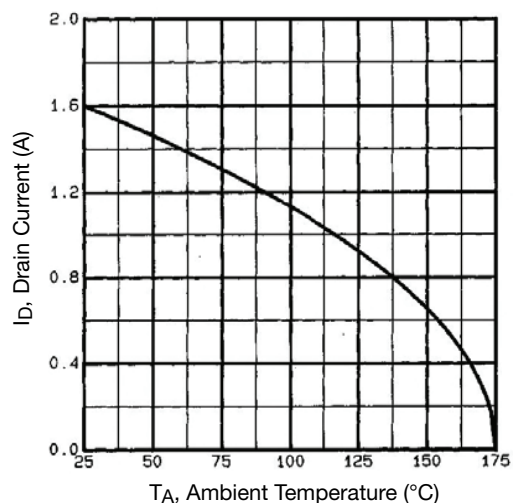
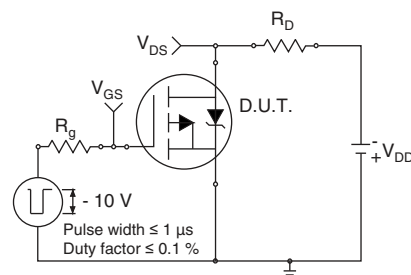
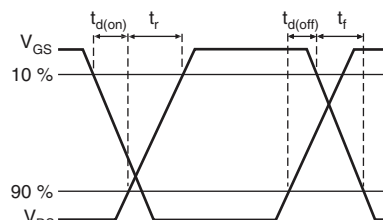
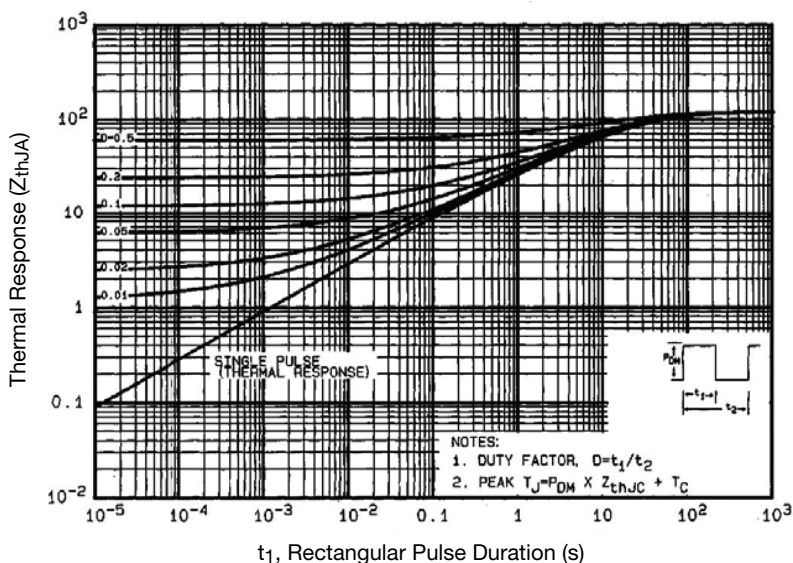
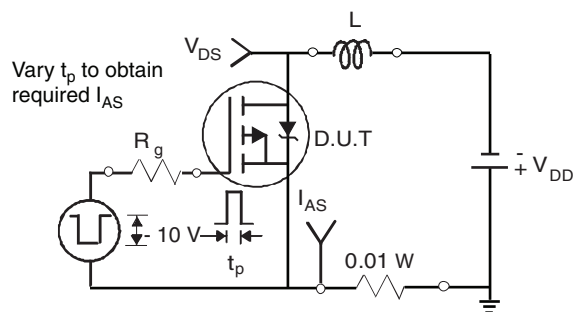
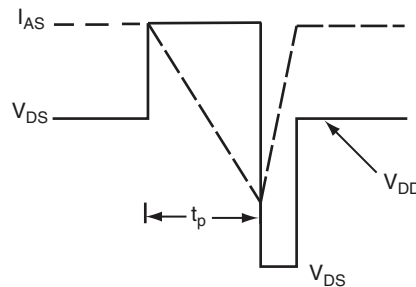
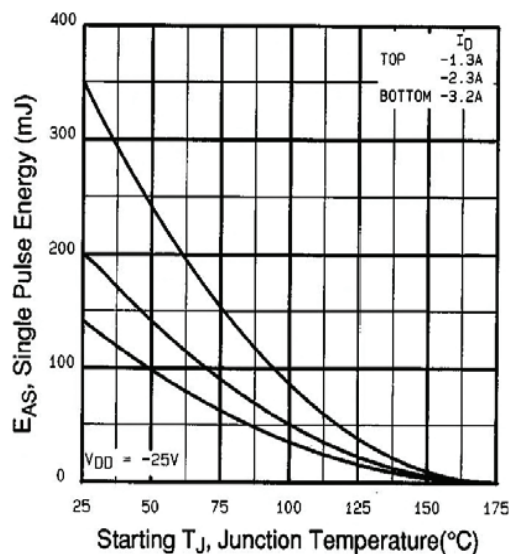
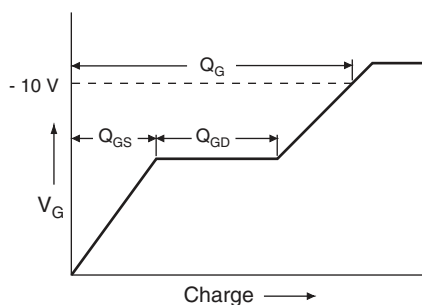
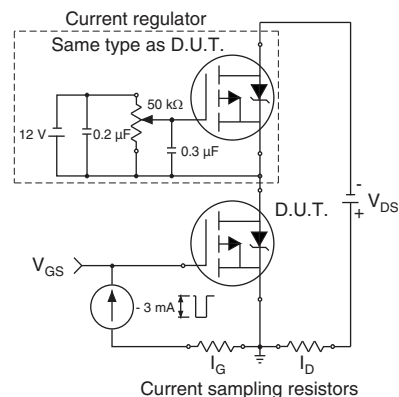


Fig. 7 - Maximum Safe Operating Area


Fig. 8 - Maximum Drain Current vs. Ambient Temperature

Fig. 10a - Switching Time Test Circuit

Fig. 10b - Switching Time Waveforms

Fig. 9 - Maximum Effective Transient Thermal Impedance, Junction-to-Ambient


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

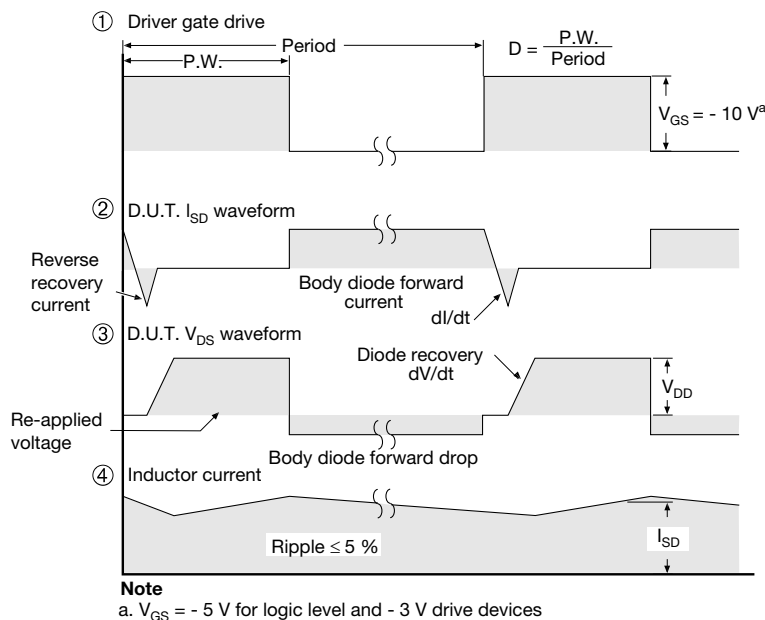
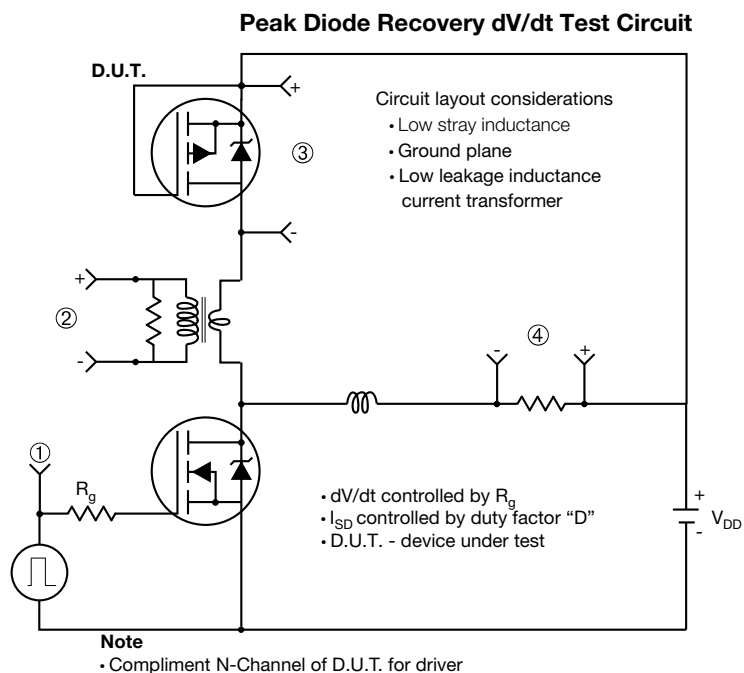


Fig. 10 - For P-Channel

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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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