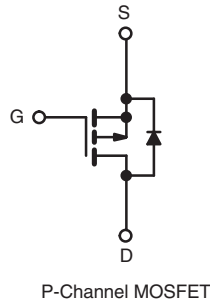
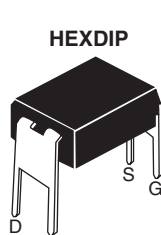


Power MOSFET

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	



FEATURES

- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- For Automatic Insertion
- End Stackable
- P-Channel
- Fast Switching
- 175 °C Operating Temperature
- 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 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	HEXDIP
Lead (Pb)-free	IRFD9024PbF
	SiHFD9024-E3
SnPb	IRFD9024
	SiHFD9024

ABSOLUTE MAXIMUM RATINGS $T_C = 25$ °C, unless otherwise noted				
PARAMETER	SYMBOL	LIMIT	UNIT	
Drain-Source Voltage	V_{DS}	- 60	V	
Gate-Source Voltage	V_{GS}	± 20		
Continuous Drain Current	V_{GS} at - 10 V	$T_C = 25$ °C	- 1.6	A
		$T_C = 100$ °C	- 1.1	
Pulsed Drain Current ^a	I_{DM}	- 13		
Linear Derating Factor		0.0083	W/°C	
Single Pulse Avalanche Energy ^b	E_{AS}	140	mJ	
Avalanche Current ^a	I_{AR}	- 1.6	A	
Repetitive Avalanche Energy ^a	E_{AR}	0.13	mJ	
Maximum Power Dissipation	$T_C = 25$ °C	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 Recommendations (Peak Temperature)	for 10 s		300 ^d	

Notes

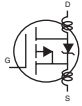

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = -25$ V, starting $T_J = 25$ °C, $L = 15$ mH, $R_G = 25$ Ω , $I_{AS} = -3.2$ A (see fig. 12).
- $I_{SD} \leq -11$ A, $dI/dt \leq 140$ A/ μ s, $V_{DD} \leq V_{DS}$, $T_J \leq 175$ °C.
- 1.6 mm from case.

* 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	°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}	$V_{GS} = 0\text{ V}$, $I_D = -250\text{ }\mu\text{A}$	-60	-	-	V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C , $I_D = -1\text{ mA}$	-	-0.056	-	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
		$V_{DS} = -48\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 150\text{ °C}$	-	-	-500	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = -10\text{ V}$, $I_D = -0.96\text{ A}^b$	-	-	0.28	Ω
Forward Transconductance	g_{fs}	$V_{DS} = -25\text{ V}$, $I_D = -0.96\text{ A}^b$	1.3	-	-	S
Dynamic						
Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V}$ $V_{DS} = -25\text{ V}$ $f = 1.0\text{ MHz}$, see fig. 5	-	570	-	pF
Output Capacitance	C_{oss}		-	360	-	
Reverse Transfer Capacitance	C_{rss}		-	65	-	
Total Gate Charge	Q_g	$V_{GS} = -10\text{ V}$, $I_D = -11\text{ A}$, $V_{DS} = -48\text{ V}$ 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	-	4.0	-	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}	$T_J = 25\text{ °C}$, $I_S = -1.6\text{ A}$, $V_{GS} = 0\text{ V}^b$	-	-	-6.3	V
Body Diode Reverse Recovery Time	t_{rr}	$T_J = 25\text{ °C}$, $I_F = -11\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}^b$	-	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

- 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

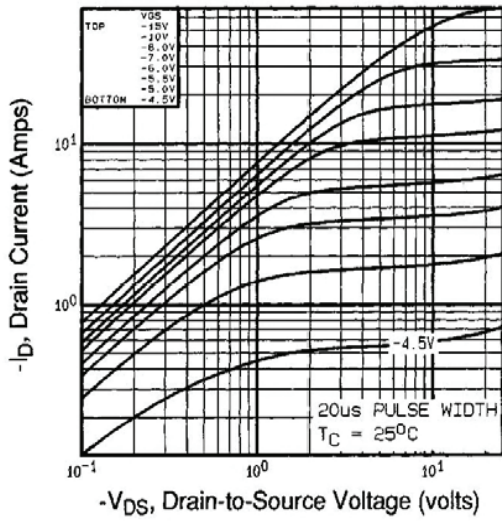


Fig. 1 - Typical Output Characteristics, $T_C = 25^\circ\text{C}$

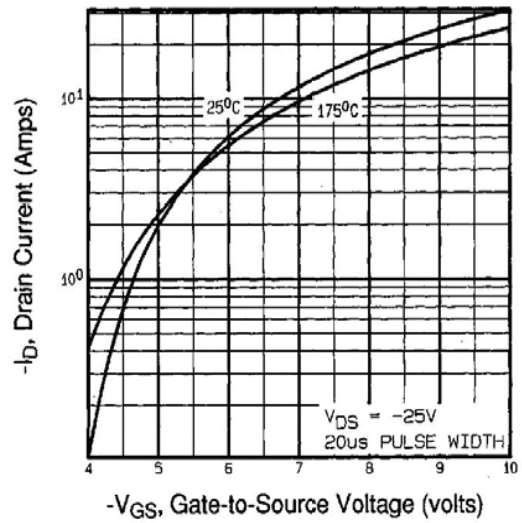


Fig. 3 - Typical Transfer Characteristics

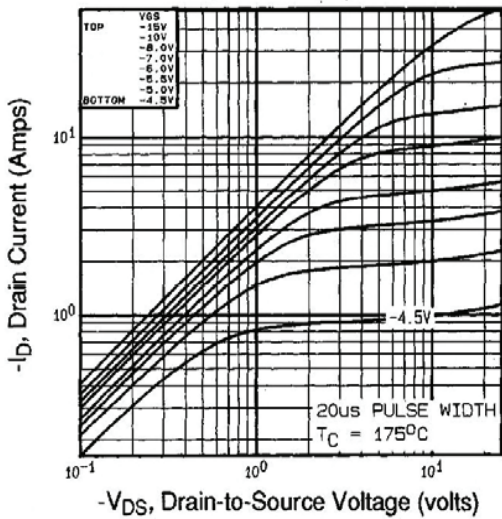


Fig. 2 - Typical Output Characteristics, $T_C = 175^\circ\text{C}$

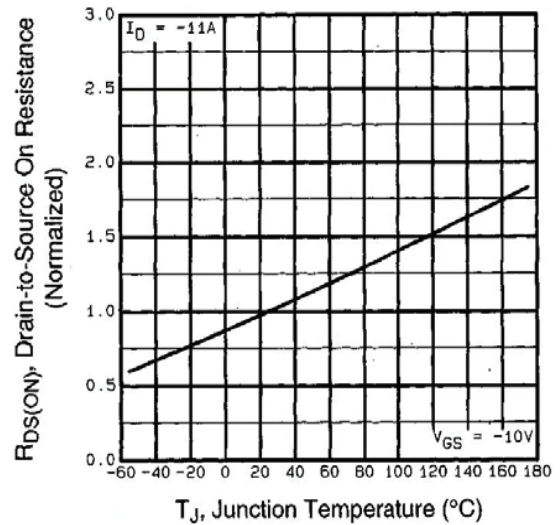


Fig. 4 - Normalized On-Resistance vs. Temperature

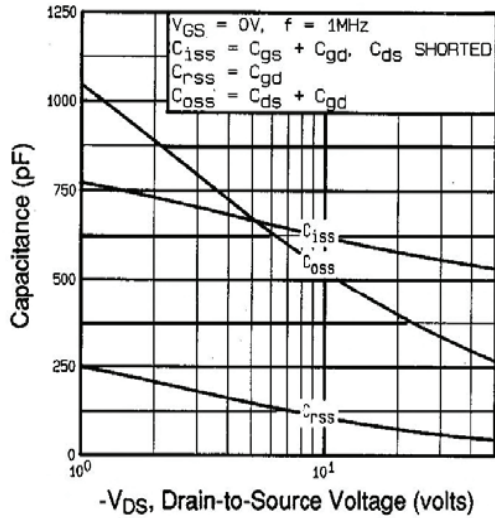


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

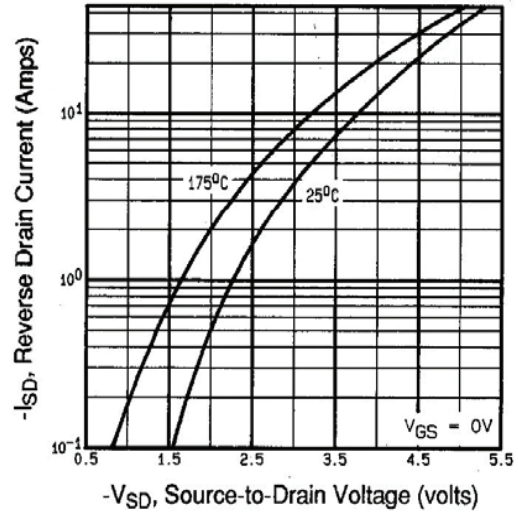


Fig. 7 - Typical Source-Drain Diode Forward Voltage

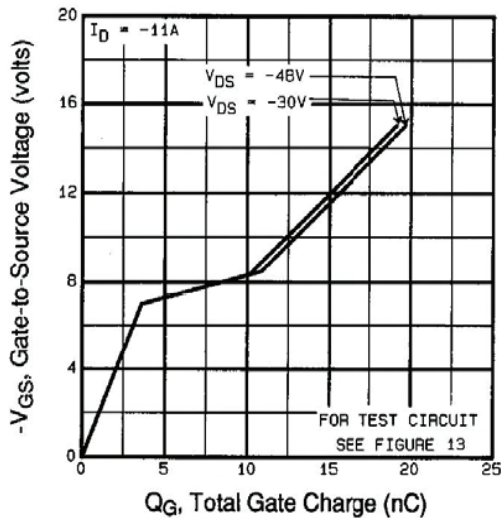


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

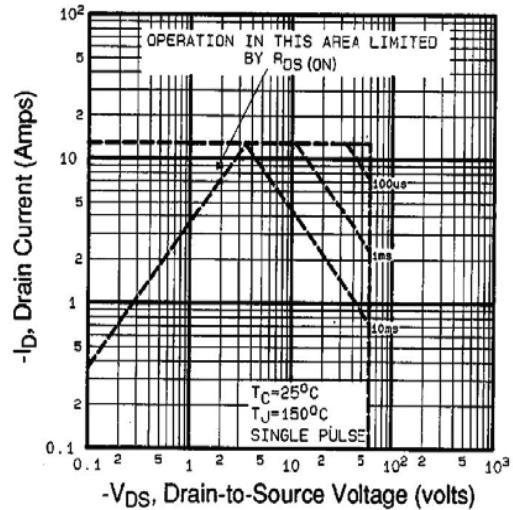


Fig. 8 - Maximum Safe Operating Area

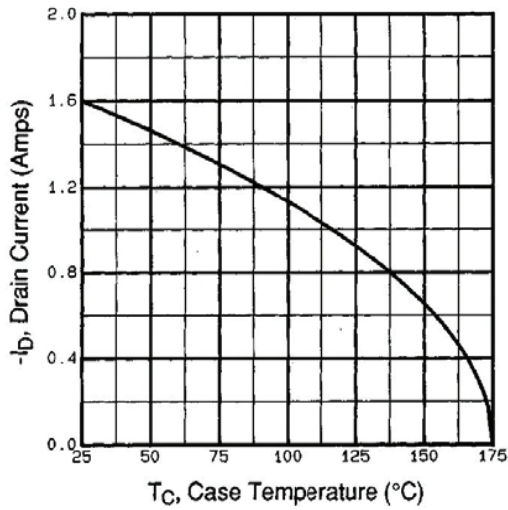


Fig. 9 - Maximum Drain Current vs. Case Temperature

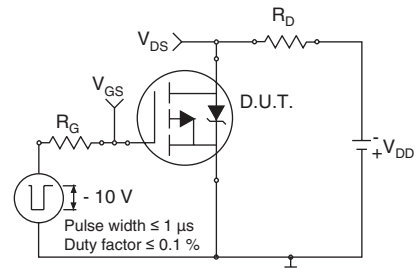


Fig. 10a - Switching Time Test Circuit

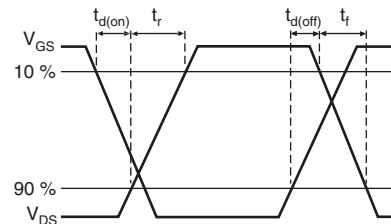


Fig. 10b - Switching Time Waveforms

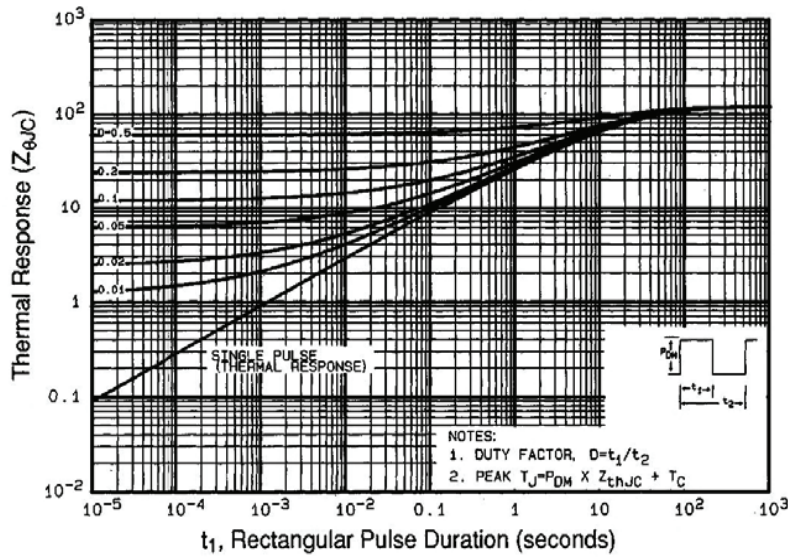


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

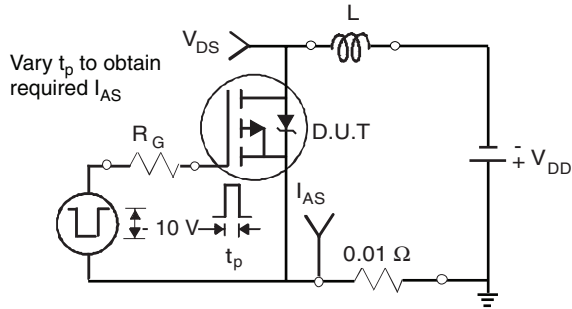


Fig. 12a - Unclamped Inductive Test Circuit

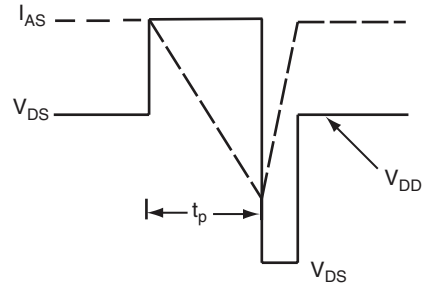


Fig. 12b - Unclamped Inductive Waveforms

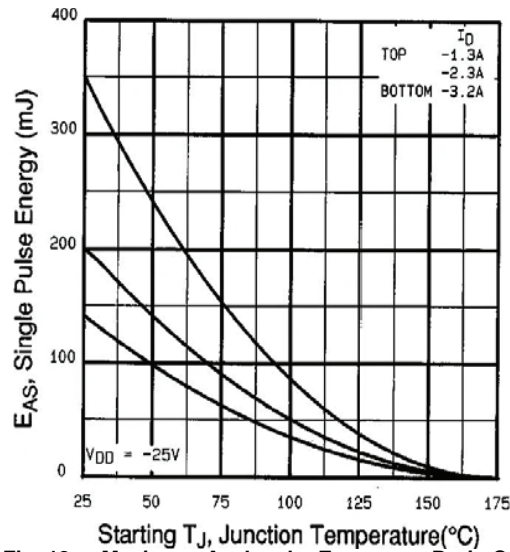


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

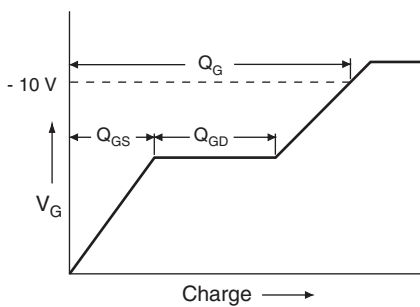


Fig. 13a - Basic Gate Charge Waveform

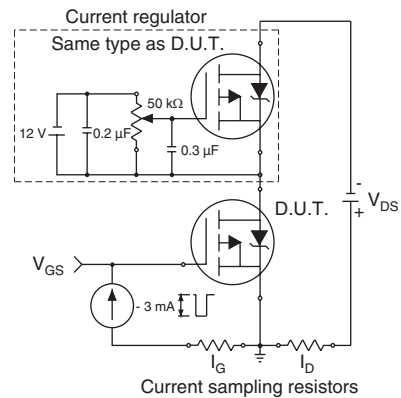
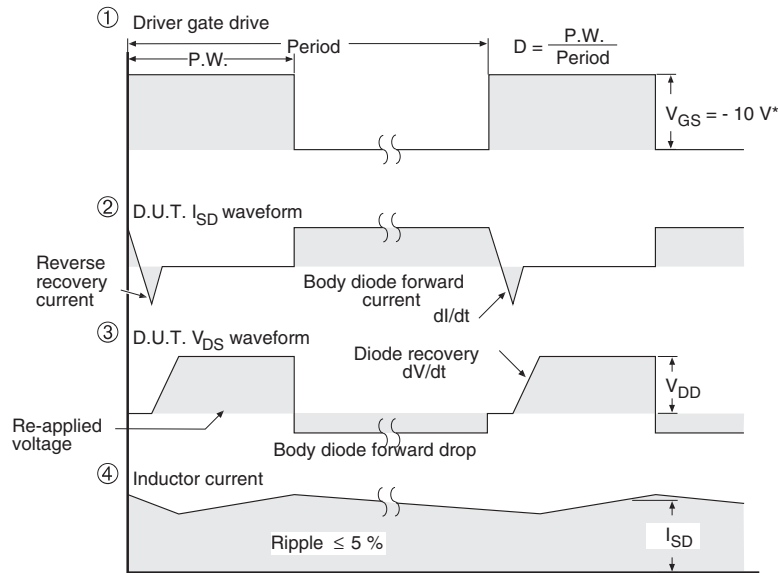
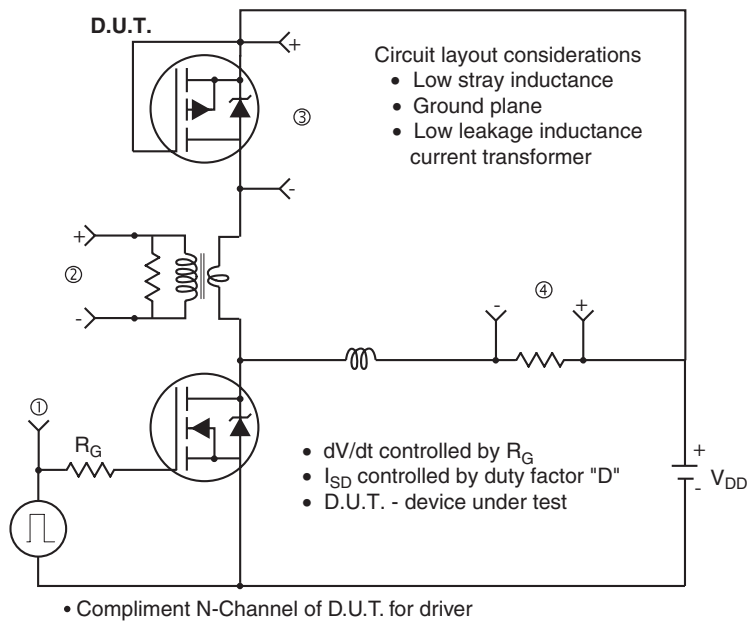


Fig. 13b - Gate Charge Test Circuit

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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