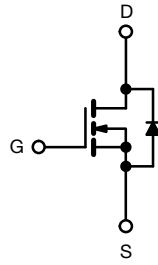
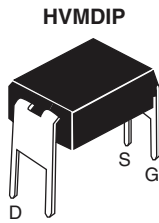


Power MOSFET



N-Channel MOSFET

FEATURES

- Dynamic dV/dt rating
- For Automatic insertion
- End stackable
- 175 °C operating temperature
- Fast switching
- Ease of paralleling
- Simple drive requirements
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


RoHS
COMPLIANT

PRODUCT SUMMARY

V_{DS} (V)	60	
$R_{DS(on)}$ (Ω)	$V_{GS} = 10$ V	0.10
Q_g (Max.) (nC)	25	
Q_{gs} (nC)	5.8	
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 serves as a thermal link to the mounting surface for power dissipation levels up to 1 W.

ORDERING INFORMATION

Package	HVMDIP
Lead (Pb)-free	IRFD024PbF

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

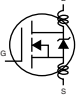

PARAMETER	SYMBOL	LIMIT	UNIT	
Drain-source voltage	V_{DS}	60	V	
Gate-source voltage	V_{GS}	± 20		
Continuous drain current	V_{GS} at 10 V	$T_A = 25$ °C	A	
		$T_A = 100$ °C		
Pulsed drain current ^a	I_{DM}	20		
Linear derating factor		0.0083	W/°C	
Single pulse avalanche energy ^b	E_{AS}	91	mJ	
Maximum power dissipation	$T_A = 25$ °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) ^d	For 10 s	300		

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- $V_{DD} = 25$ V, starting $T_J = 25$ °C, $L = 16$ mH, $R_g = 25$ Ω , $I_{AS} = 2.5$ A (see fig. 12)
- $I_{SD} \leq 17$ 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 ($T_J = 25\text{ }^\circ\text{C}$, 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 $25\text{ }^\circ\text{C}$, $I_D = 1\text{ mA}$	-	0.061	-	V/ $^\circ\text{C}$
Gate-source threshold voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	2.0	-	-	V
Gate-source leakage	I_{GSS}	$V_{GS} = \pm 20\text{ V}$	-	-	± 100	nA
Zero gate voltage drain current	I_{DSS}	$V_{DS} = 60\text{ V}$, $V_{GS} = 0\text{ V}$	-	-	25	μA
		$V_{DS} = 48\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$	-	-	250	
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$ $I_D = 1.5\text{ A}^b$	-	-	0.10	Ω
Forward transconductance	g_{fs}	$V_{DS} = 25\text{ V}$, $I_D = 1.5\text{ A}^b$	0.90	-	-	S
Dynamic						
Input capacitance	C_{iss}	$V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1.0\text{ MHz}$, see fig. 5	-	640	-	μF
Output capacitance	C_{oss}		-	360	-	
Reverse transfer capacitance	C_{rss}		-	79	-	
Total gate charge	Q_g	$V_{GS} = 10\text{ V}$ $I_D = 17\text{ A}$, $V_{DS} = 48\text{ V}$, see fig. 6 and 13 ^b	-	-	25	nC
Gate-source charge	Q_{gs}		-	-	5.8	
Gate-drain charge	Q_{gd}		-	-	11	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 30\text{ V}$, $I_D = 17\text{ A}$, $R_g = 18\text{ }\Omega$, $R_D = 1.7\text{ }\Omega$, see fig. 10 ^b	-	13	-	ns
Rise time	t_r		-	58	-	
Turn-off delay time	$t_{d(off)}$		-	25	-	
Fall time	t_f		-	42	-	
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 	-	-	2.5	A
Pulsed diode forward current ^a	I_{SM}		-	-	20	
Body diode voltage	V_{SD}	$T_J = 25\text{ }^\circ\text{C}$, $I_S = 2.5\text{ A}$, $V_{GS} = 0\text{ V}^b$	-	-	1.5	V
Body diode reverse recovery time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}$, $I_F = 17\text{ A}$, $dI/dt = 100\text{ A}/\mu\text{s}^b$	-	80	180	ns
Body diode reverse recovery charge	Q_{rr}		-	0.29	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 $\leq 2\text{ }\%$

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

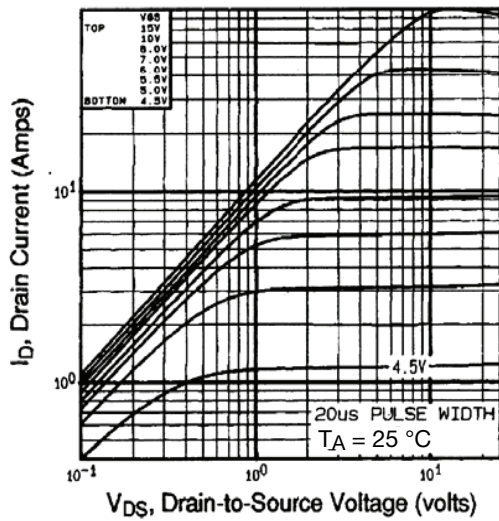


Fig. 1 - Typical Output Characteristics, $T_A = 25\text{ }^\circ\text{C}$

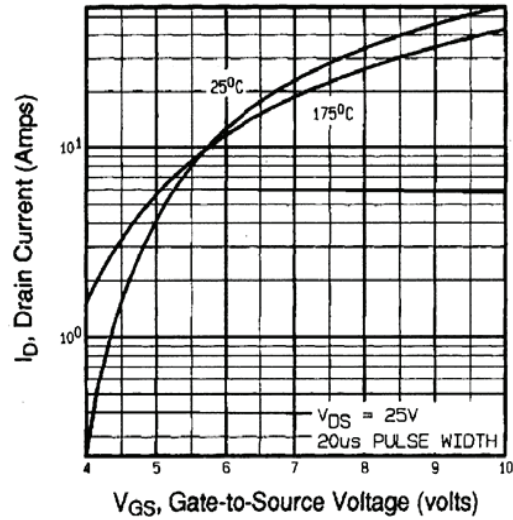


Fig. 2 - Typical Transfer Characteristics

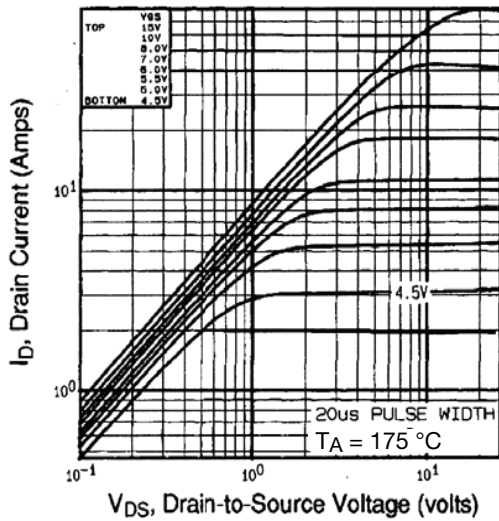


Fig. 1 - Typical Output Characteristics, $T_A = 175\text{ }^\circ\text{C}$

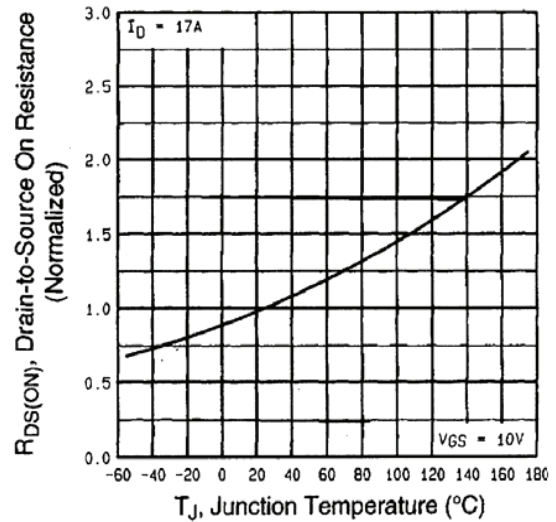


Fig. 3 - Normalized On-Resistance vs. Temperature

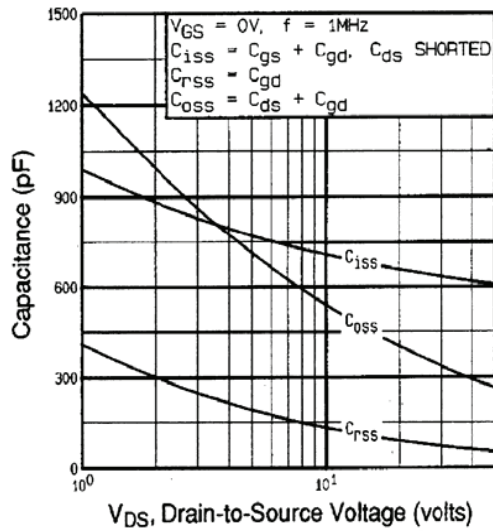


Fig. 4 - Typical Capacitance vs. Drain-to-Source Voltage

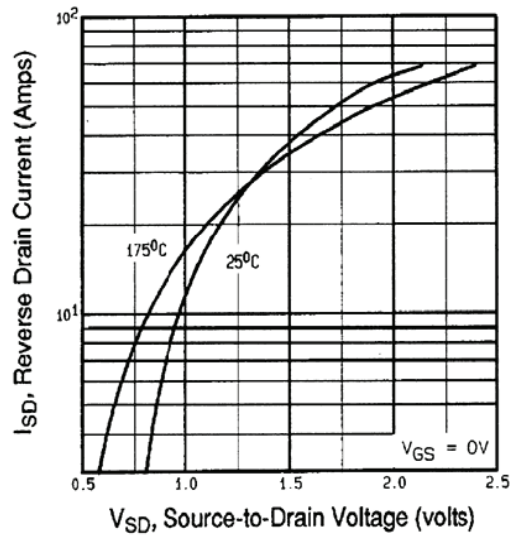


Fig. 6 - Typical Source-Drain Diode Forward Voltage

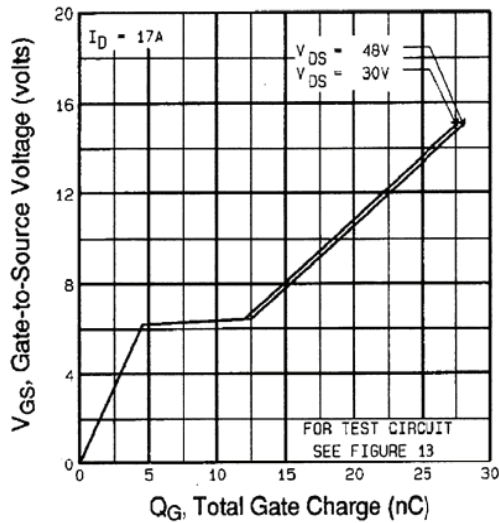


Fig. 5 - Typical Gate Charge vs. Gate-to-Source Voltage

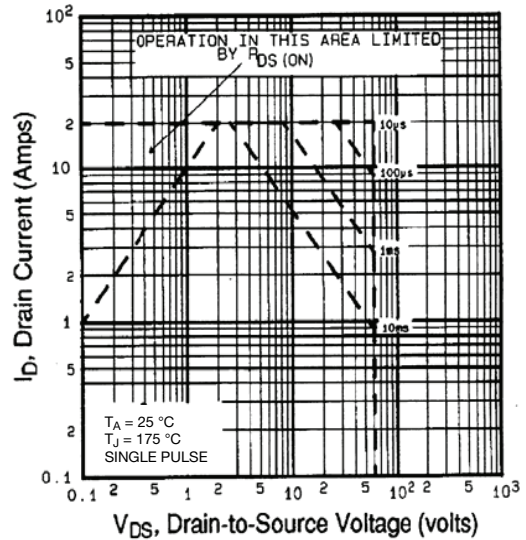


Fig. 2 - Maximum Safe Operating Area

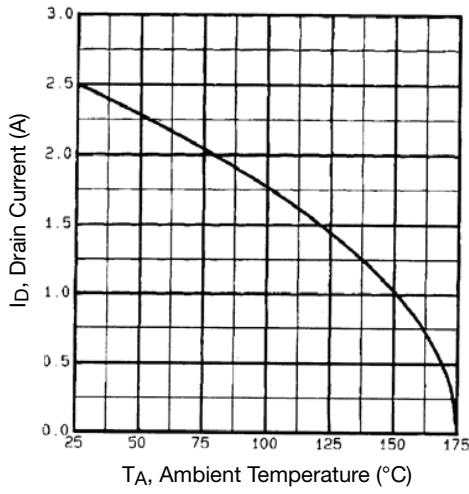


Fig. 7 - Maximum Drain Current vs. Ambient Temperature

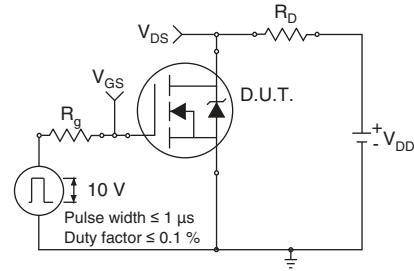


Fig. 10a - Switching Time Test Circuit

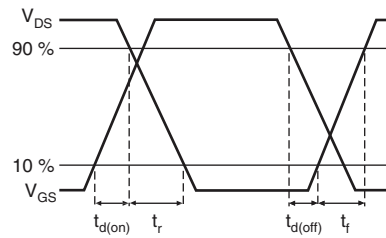


Fig. 10b - Switching Time Waveforms

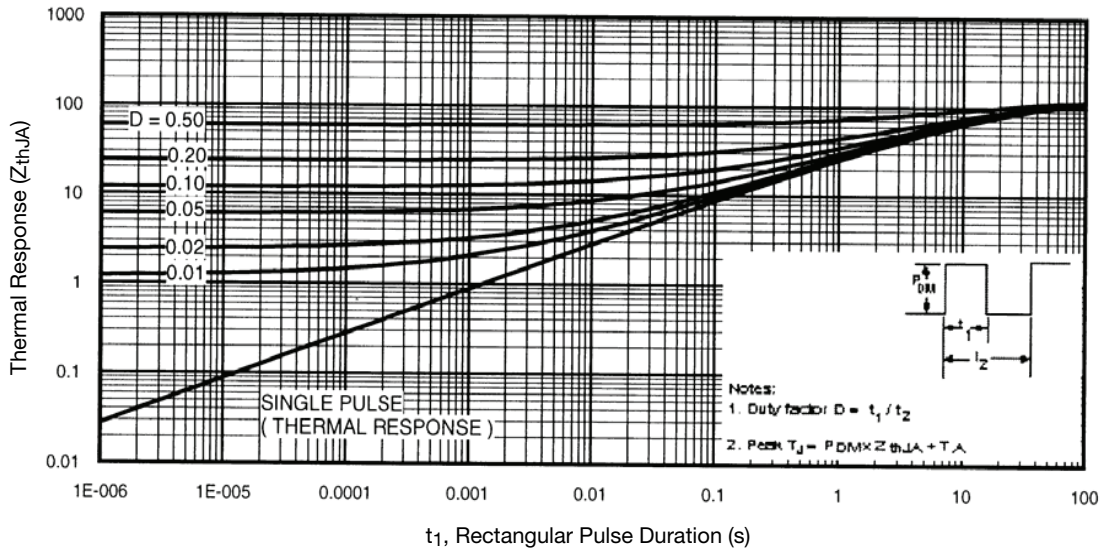


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

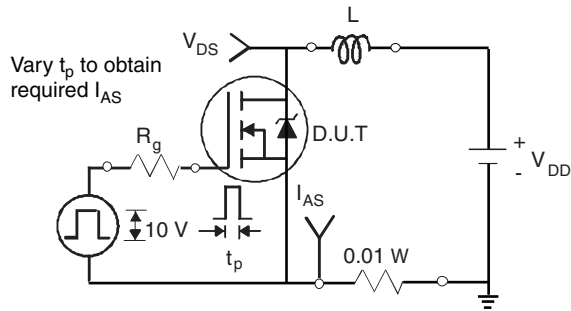


Fig. 12a - Unclamped Inductive Test Circuit

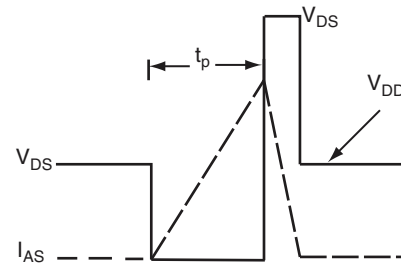


Fig. 12b - Unclamped Inductive Waveforms

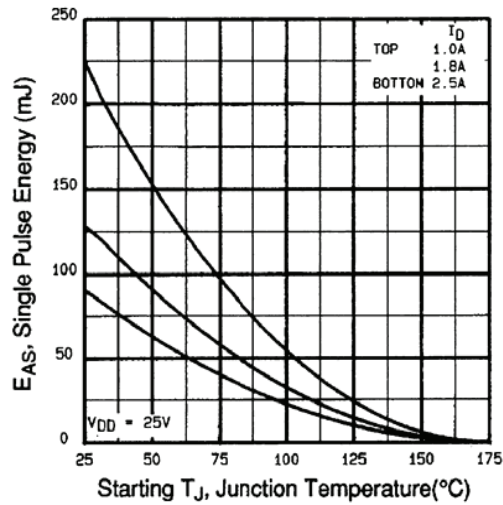


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

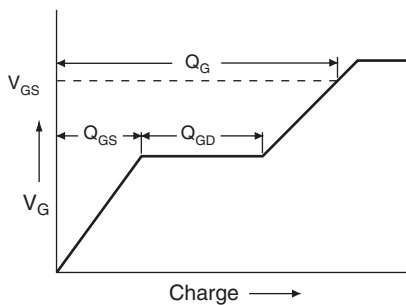


Fig. 13a - Basic Gate Charge Waveform

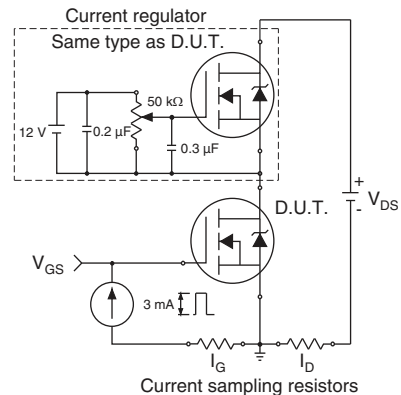
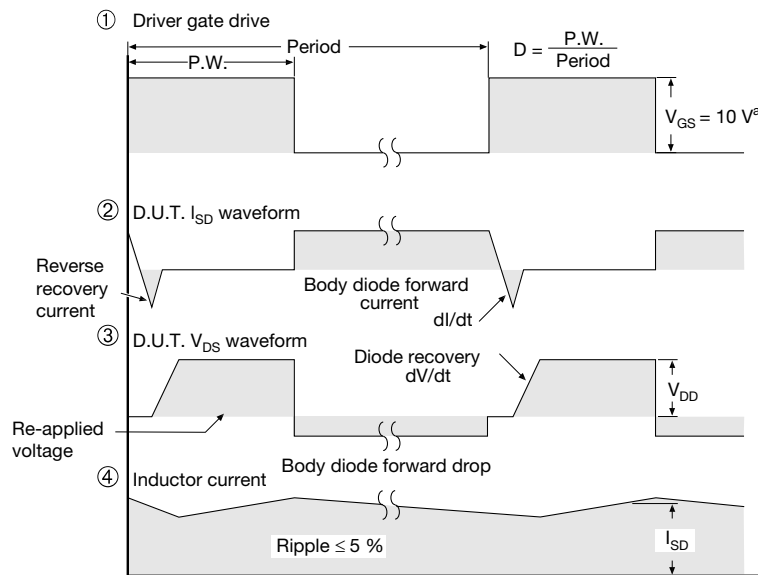
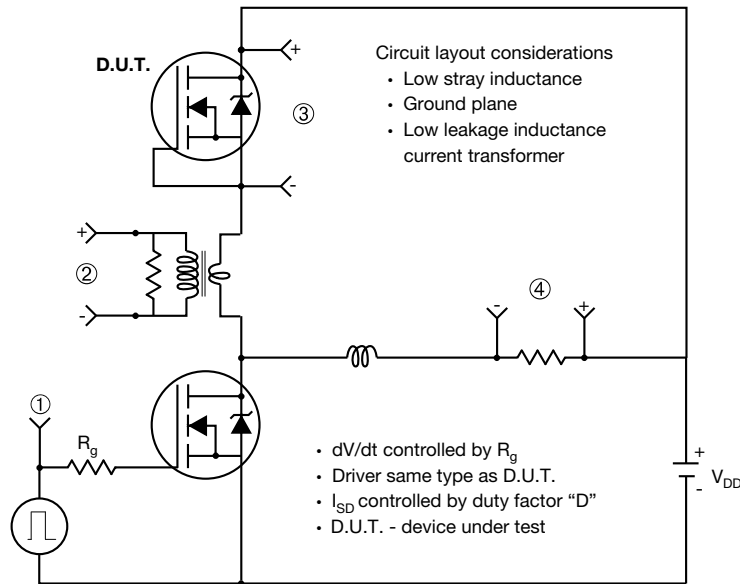


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



Note

a. $V_{GS} = 5\text{ V}$ for logic level devices

Fig. 14 - For N-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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