

## Power MOSFET



N-Channel MOSFET

### FEATURES

- For automatic insertion
- Compact, end stackable
- Fast switching
- Ease of paralleling
- Excellent temperature stability
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**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. HVMDIPs feature all of the established advantages of MOSFETs such as voltage control, very fast switching, ease of paralleling, and temperature stability of the electrical parameters.

The HVMDIP 4 pin, dual-in-line package brings the advantages of HVMDIPs to high volume applications where automatic PC board insertion is desirable, such as circuit boards for computers, printers, telecommunications equipment, and consumer products. Their compatibility with automatic insertion equipment, low-profile and end stackable features represent the state-of-the-art in power device packaging.

PRODUCT SUMMARY	
$V_{DS}$ (V)	50
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10\text{ V}$ 0.10
$Q_g$ (Max.) (nC)	24
$Q_{gs}$ (nC)	7.1
$Q_{gd}$ (nC)	7.1
Configuration	Single

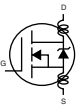

ORDERING INFORMATION	
Package	HVMDIP
Lead (Pb)-free	IRFD020PbF

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted)				
PARAMETER	SYMBOL		LIMIT	UNIT
Drain-source voltage <sup>a</sup>	$V_{DS}$		50	V
Gate-source voltage	$V_{GS}$		$\pm 20$	
Continuous drain current	$V_{GS}$ at 10 V	$T_C = 25\text{ }^\circ\text{C}$	2.4	A
		$T_C = 100\text{ }^\circ\text{C}$	1.5	
Pulsed drain current <sup>a</sup>	$I_{DM}$		19	
Linear derating factor			0.0080	W/ $^\circ\text{C}$
Inductive current, clamped	L = 100 $\mu\text{H}$		19	A
Unclamped inductive current (avalanche current) <sup>c</sup>			2.2	
Maximum power dissipation	$T_C = 25\text{ }^\circ\text{C}$		1.0	W
Operating junction and storage temperature range	$T_J, T_{stg}$		- 55 to + 150	$^\circ\text{C}$
Soldering recommendations (peak temperature)	For 10 s		300 <sup>d</sup>	

#### Notes

- $T_J = 25\text{ }^\circ\text{C}$  to  $150\text{ }^\circ\text{C}$
- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{DD} = 25\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ , L = 100  $\mu\text{H}$ ,  $R_g = 25\text{ }\Omega$
- 1.6 mm from case

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

<b>SPECIFICATIONS</b> ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
<b>Static</b>							
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		50	-	-	V
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	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}$		-	-	$\pm 500$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = \text{max. rating}, V_{GS} = 0\text{ V}$		-	-	250	$\mu\text{A}$
		$V_{DS} = \text{max. rating} \times 0.8, V_{GS} = 0\text{ V}, T_C = 125$		-	-	1000	
On-State Drain Current <sup>b</sup>	$I_{D(on)}$	$V_{GS} = 10\text{ V}$	$V_{DS} > I_{D(on)} \times R_{DS(on)} \text{ max.}$	2.4	-	-	A
Drain-Source On-State Resistance <sup>b</sup>	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 1.4\text{ A}$	-	0.080	0.10	$\Omega$
Forward Transconductance <sup>b</sup>	$g_{fs}$	$V_{DS} = 20\text{ V}, I_D = 7.5\text{ A}$		4.9	7.3	-	S
<b>Dynamic</b>							
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1.0\text{ MHz}$		-	400	-	$\mu\text{F}$
Output Capacitance	$C_{oss}$			-	260	-	
Reverse Transfer Capacitance	$C_{rss}$			-	44	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}$	$I_D = 15\text{ A}, V_{DS} = \text{max. rating} \times 0.8$	-	16	24	nC
Gate-Source Charge	$Q_{gs}$			-	4.7	7.1	
Gate-Drain Charge	$Q_{gd}$			-	4.7	7.1	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 25\text{ V}, I_D = 15\text{ A}, R_g = 18\text{ }\Omega, R_D = 1.7\text{ }\Omega$		-	8.7	13	ns
Rise Time	$t_r$			-	55	83	
Turn-Off Delay Time	$t_{d(off)}$			-	16	24	
Fall Time	$t_f$			-	26	39	
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 		-	-	2.4	A
Pulsed Diode Forward Current <sup>c</sup>	$I_{SM}$			-	-	19	
Body Diode Voltage <sup>a</sup>	$V_{SD}$	$T_C = 25\text{ }^\circ\text{C}, I_S = 2.4\text{ A}, V_{GS} = 0\text{ V}$		-	-	1.4	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = 15\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$		57	130	310	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$			0.17	0.34	0.85	$\mu\text{C}$
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )					

**Notes**

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$
- $V_{DD} = 25\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 100\text{ }\mu\text{H}$ ,  $R_g = 25\text{ }\Omega$

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

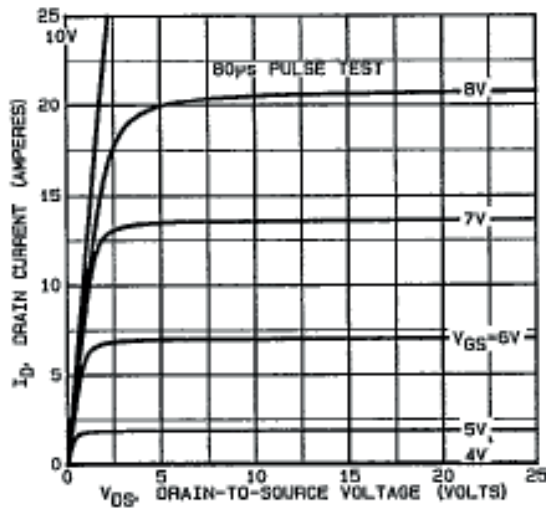


Fig. 1 - Typical Output Characteristics

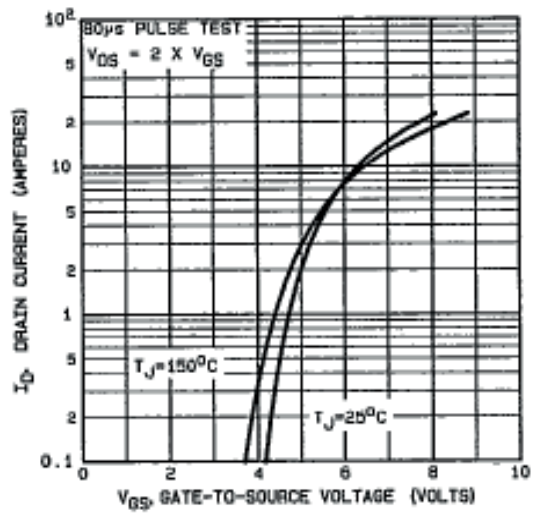


Fig. 3 - Typical Transfer Characteristics

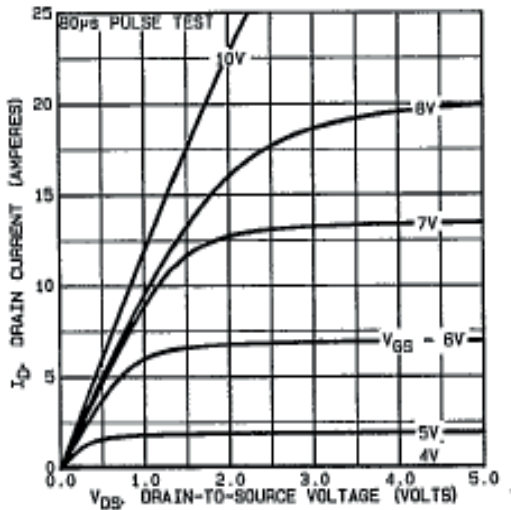


Fig. 2 - Typical Output Characteristics

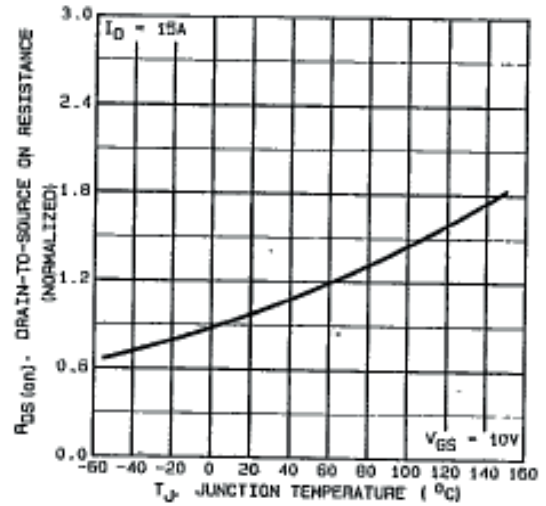


Fig. 4 - Normalized On-Resistance vs. Temperature

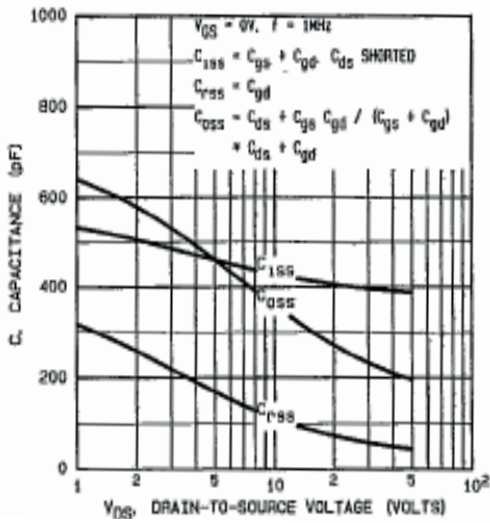


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

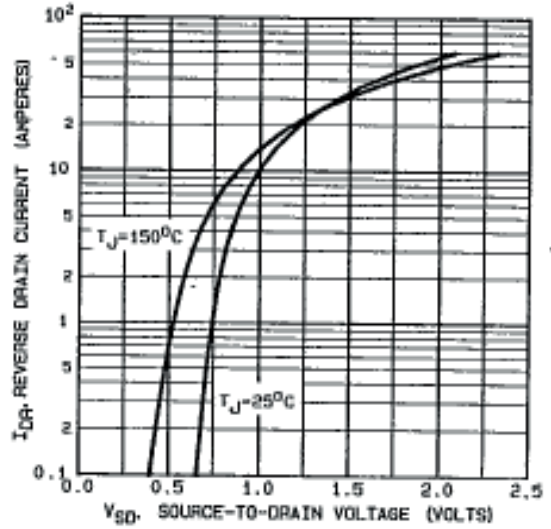


Fig. 7 - Typical Source-Drain Diode Forward Voltage

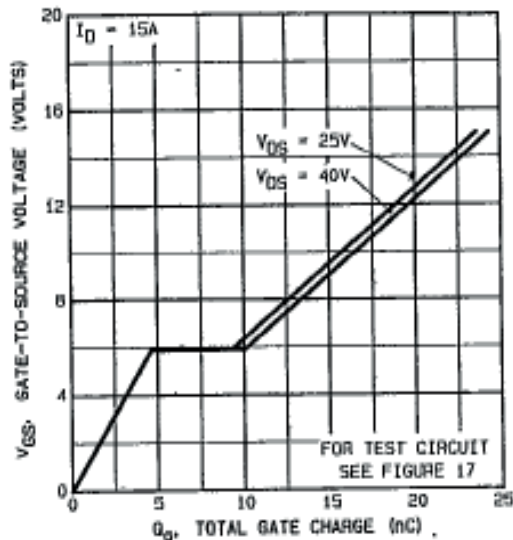


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

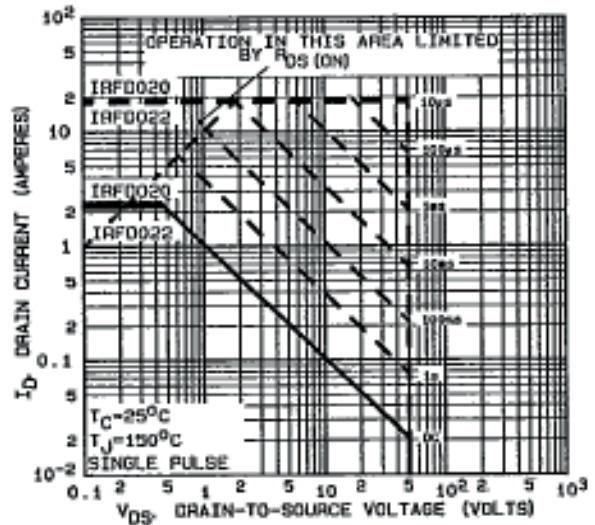


Fig. 8 - Maximum Safe Operating Area

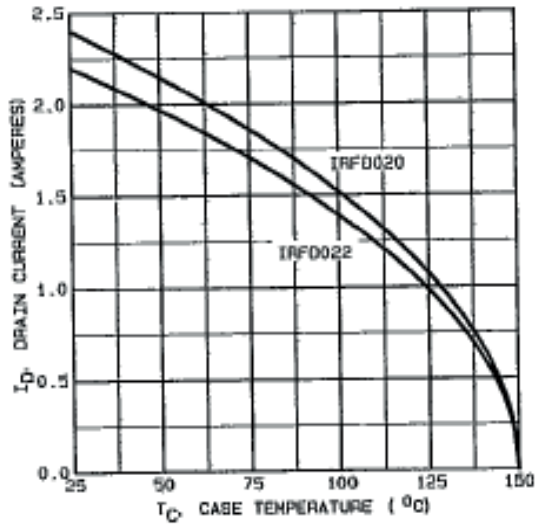


Fig. 9 - Maximum Drain Current vs. Ambient Temperature

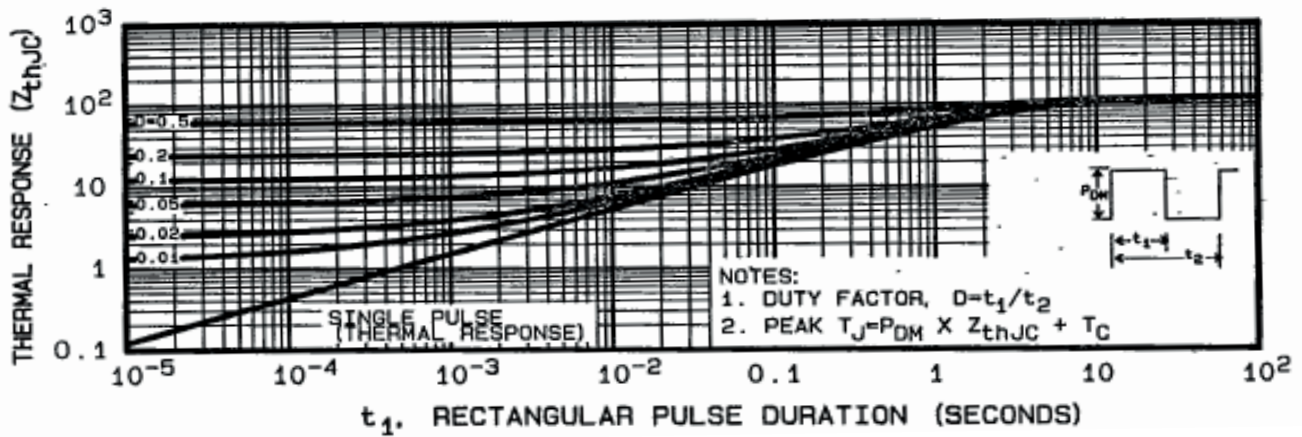


Fig. 10 - Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

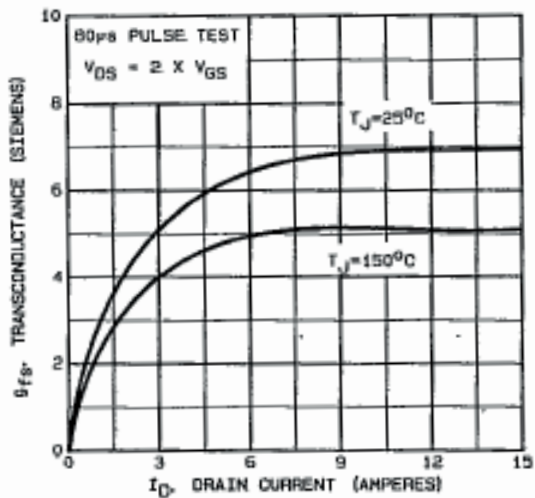


Fig. 11 - Typical Transconductance vs. Drain Current

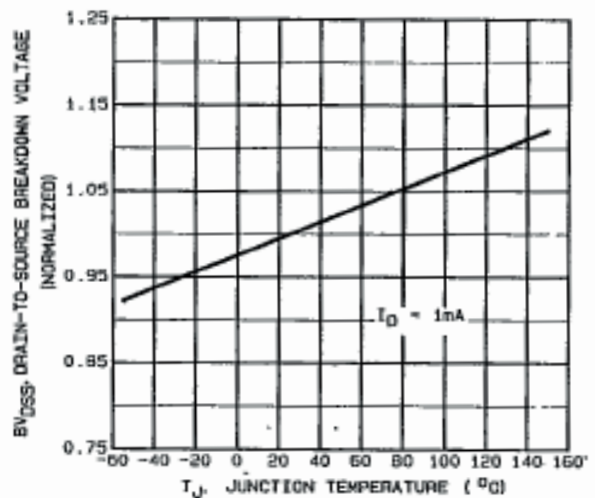


Fig. 12 - Breakdown Voltage vs. Temperature



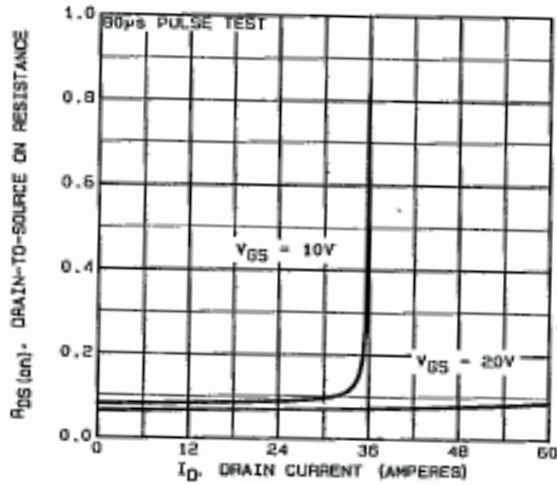


Fig. 13 - Typical on-Resistance vs. Drain Current

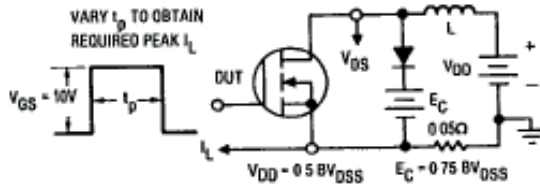


Fig. 14a - Clamped Inductive Test Circuit

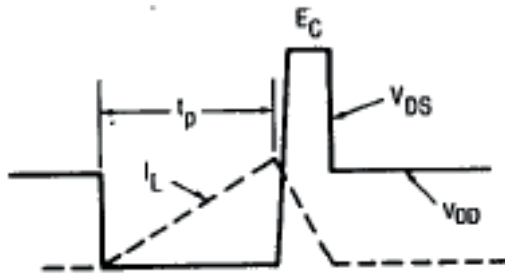


Fig. 14b - Clamped Inductive Waveforms

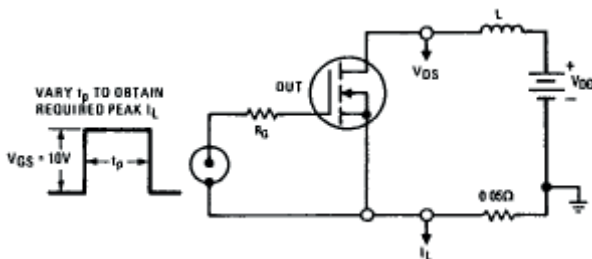


Fig. 15a - Unclamped Inductive Test Circuit

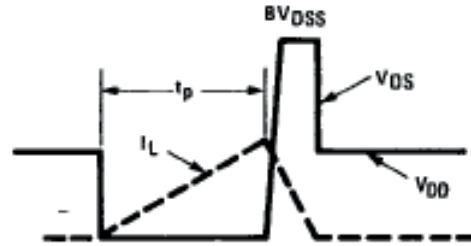


Fig. 15a - Unclamped Inductive Load Test Waveforms

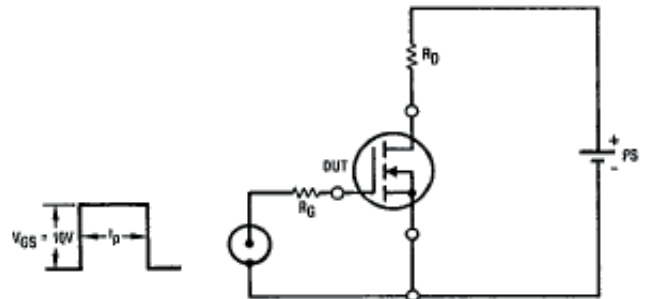


Fig. 16 - Switching Time Test Circuit

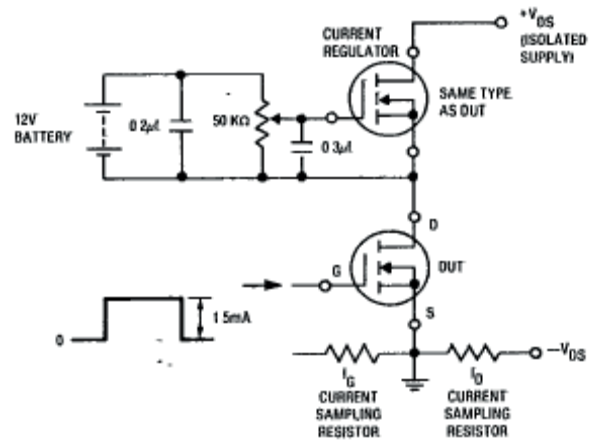


Fig. 17 - Gate Charge Test Circuit

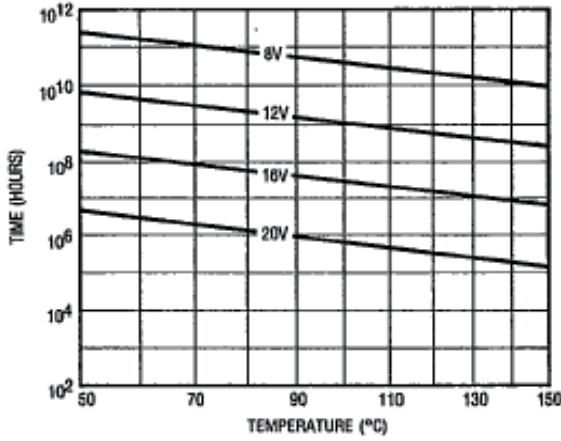


Fig. 18 - Typical Time to Accumulated 1 % Gate Failure

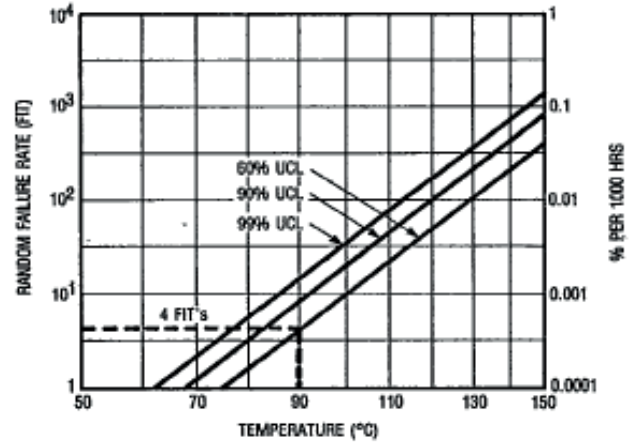
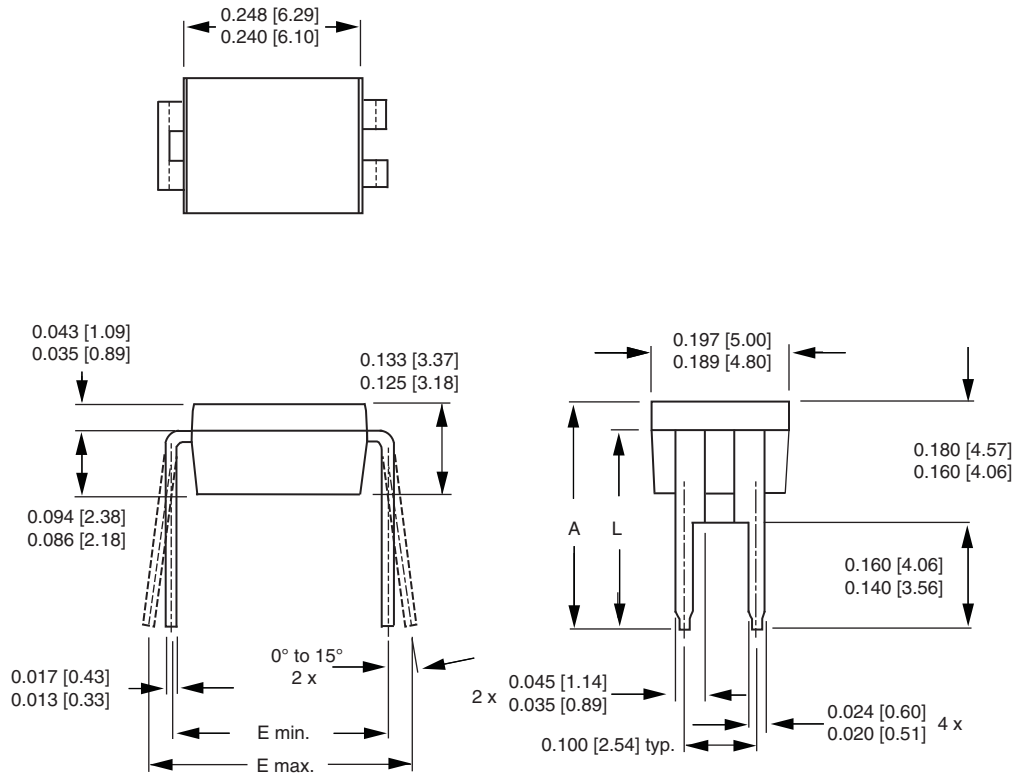


Fig. 19 - Typical High Temperature Reverse Bias (HTRB) Failure Rate

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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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