

## Power MOSFET

PRODUCT SUMMARY	
$V_{DS}$ (V)	-50
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = -10$ V   0.28
$Q_g$ max. (nC)	26
$Q_{gs}$ (nC)	6.2
$Q_{gd}$ (nC)	8.6
Configuration	Single

### FEATURES

- P-channel versatility
- Compact plastic package
- Fast switching
- Low drive current
- 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)

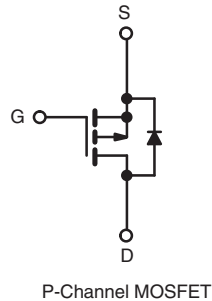
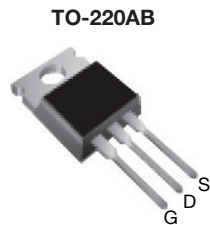

**RoHS**  
COMPLIANT

### DESCRIPTION

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

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

P-channel power MOSFETs 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	TO-220AB
Lead (Pb)-free	IRF9Z20PbF

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	$V_{GS}$ at -10 V	$I_D$	$T_C = 25^\circ\text{C}$	-9.7
			$T_C = 100^\circ\text{C}$	-6.1
Pulsed Drain Current <sup>a</sup>		$I_{DM}$	-39	A
Linear Derating Factor			0.32	W/ $^\circ\text{C}$
Inductive Current, Clamped	L = 100 $\mu\text{H}$	$I_{LM}$	-39	A
Unclamped Inductive Current (Avalanche current)		$I_L$	-2.2	A
Maximum Power Dissipation	$T_C = 25^\circ\text{C}$	$P_D$	40	W
Operating Junction and Storage Temperature Range		$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$
Soldering Recommendations (Peak temperature) <sup>c</sup>	for 10 s		300	

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 14).
- $V_{DD} = -25$  V, starting  $T_J = 25^\circ\text{C}$ , L = 100  $\mu\text{H}$ ,  $R_g = 25 \Omega$
- 0.063" (1.6 mm) from case.



THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	80	°C/W
Case-to-Sink, Flat, Greased Surface	$R_{thCS}$	1.0	-	
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	3.1	

SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , 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	$\mu\text{A}$
		$V_{DS} = \text{max. rating} \times 0.8$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$		-	-	-1000	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = -10\text{ V}$	$I_D = -5.6\text{ A}^b$	-	0.20	0.28	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 2 \times V_{GS}$ , $I_{DS} = -5.6\text{ A}^b$		2.3	3.5	-	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. 9		-	480	-	pF
Output Capacitance	$C_{oss}$			-	320	-	
Reverse Transfer Capacitance	$C_{riss}$			-	58	-	
Total Gate Charge	$Q_g$	$V_{GS} = -10\text{ V}$	$I_D = -9.7\text{ A}$ , $V_{DS} = -0.8\text{ max. rating}$ , see fig. 17	-	17	26	nC
Gate-Source Charge	$Q_{gs}$			-	4.1	6.2	
Gate-Drain Charge	$Q_{gd}$			-	5.7	8.6	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -25\text{ V}$ , $I_D = -9.7\text{ A}$ , $R_g = 18\text{ }\Omega$ , $R_D = 2.4\text{ }\Omega$ , see fig. 16 (MOSFET switching times are essentially independent of operating temperature)		-	8.2	12	ns
Rise Time	$t_r$			-	57	86	
Turn-Off Delay Time	$t_{d(off)}$			-	12	18	
Fall Time	$t_f$			-	25	38	
Internal Drain Inductance	$L_D$	Between lead, 6 mm (0.25") from package and center of die contact		-	4.5	-	nH
Internal Source Inductance	$L_S$			-	7.5	-	
<b>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode		-	-	-9.7	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$			-	-	-39	
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_S = -9.7\text{ A}$ , $V_{GS} = 0\text{ V}^b$		-	-	-6.3	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_F = -9.7\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$		56	110	280	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**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 14).
- b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .



TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

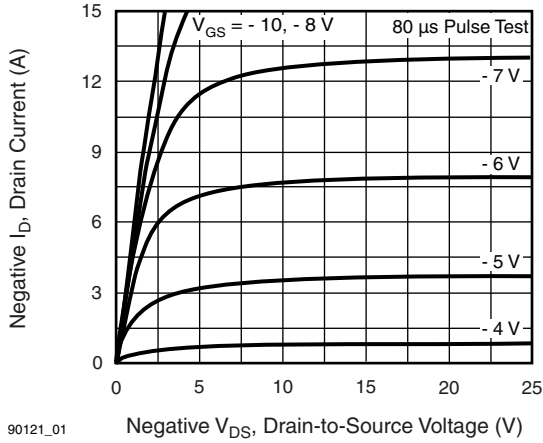


Fig. 1 - Typical Output Characteristics

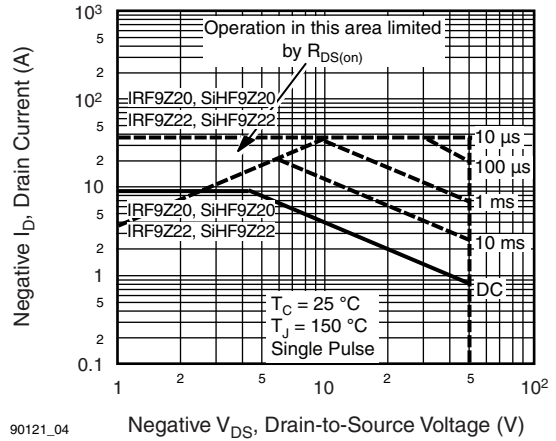


Fig. 4 - Maximum Safe Operating Area

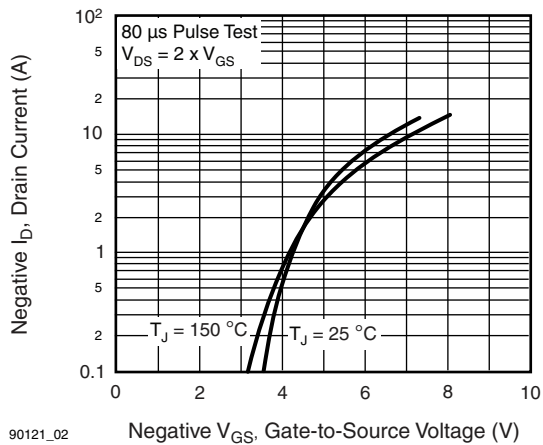


Fig. 2 - Typical Transfer Characteristics

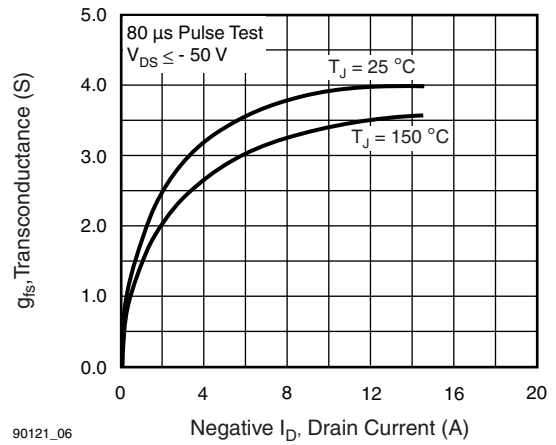


Fig. 5 - Typical Transconductance vs. Drain Current

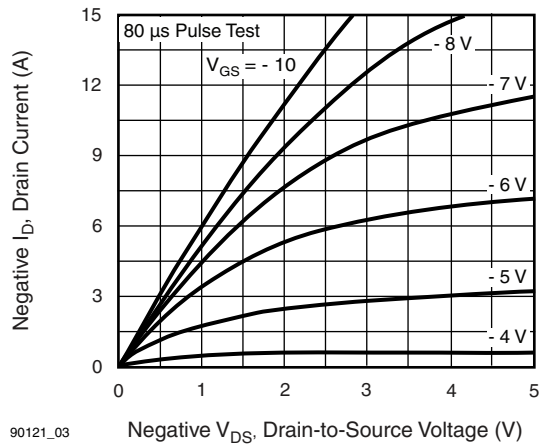


Fig. 3 - Typical Saturation Characteristics

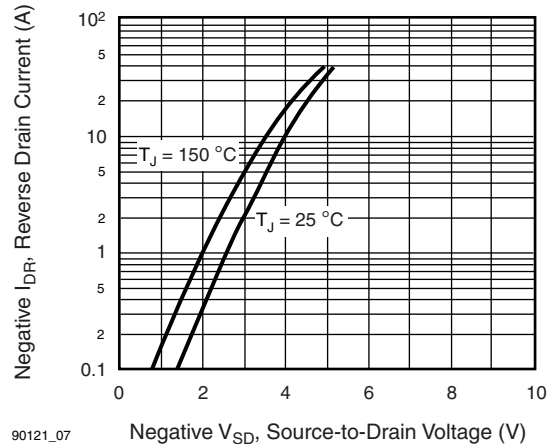


Fig. 6 - Typical Source-Drain Diode Forward Voltage

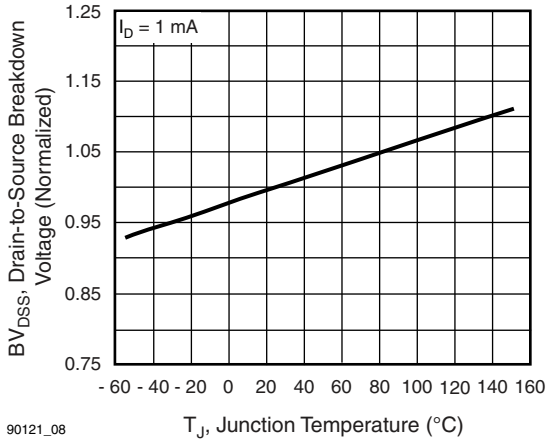


Fig. 7 - Breakdown Voltage vs. Temperature

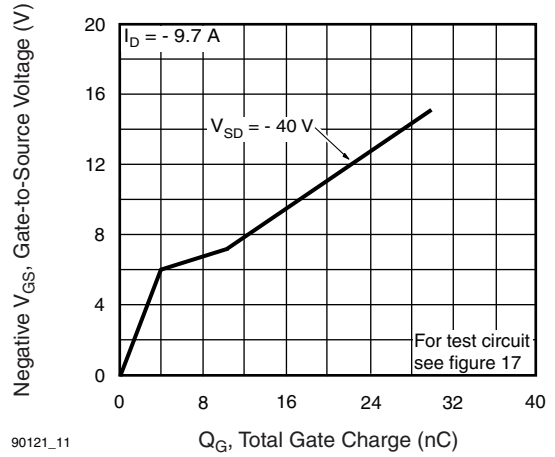


Fig. 10 - Typical Gate Charge vs. Gate-to-Source Voltage

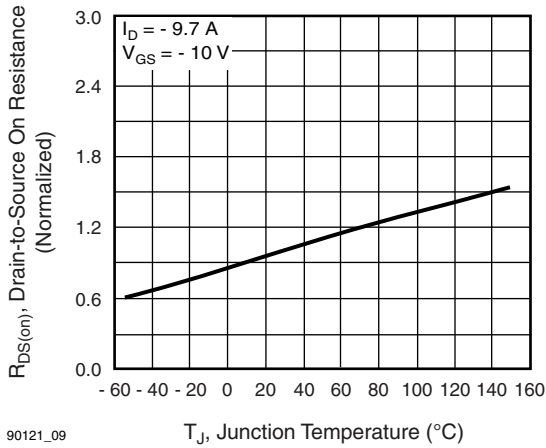


Fig. 8 - Normalized On-Resistance vs. Temperature

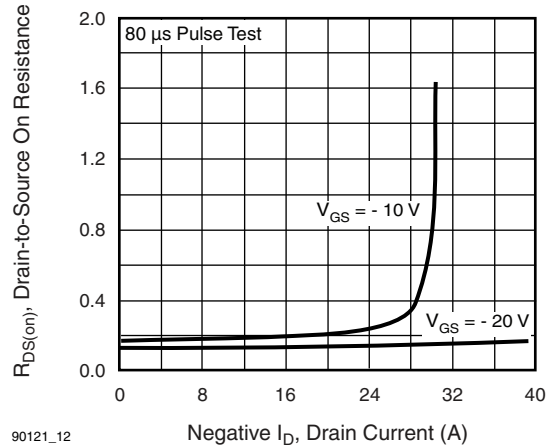


Fig. 11 - Typical On-Resistance vs. Drain Current

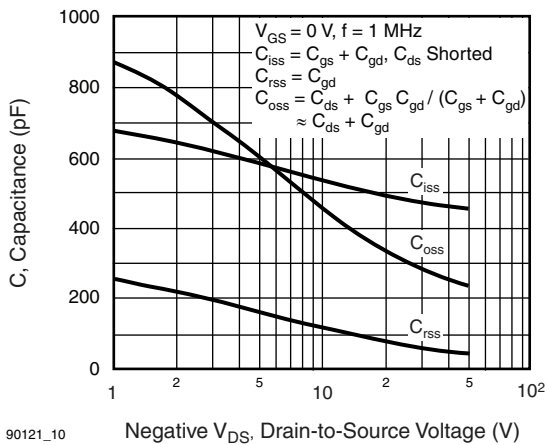


Fig. 9 - Typical Capacitance vs. Drain-to-Source Voltage

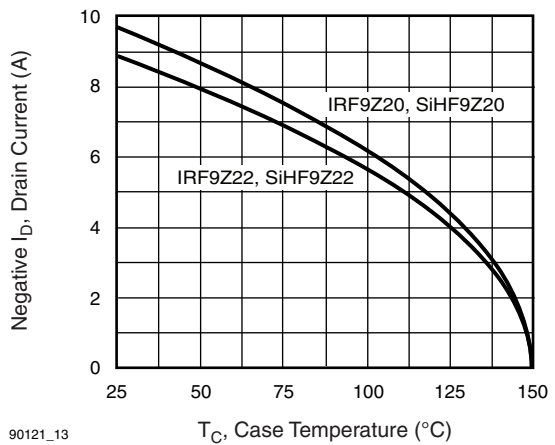


Fig. 12 - Maximum Drain Current vs. Case Temperature

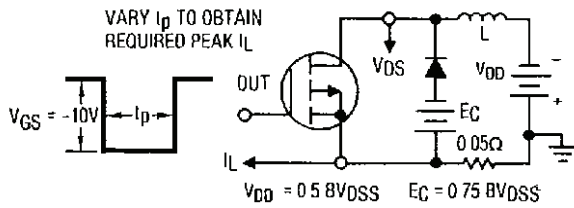


Fig. 13a - Unclamped Inductive Test Circuit

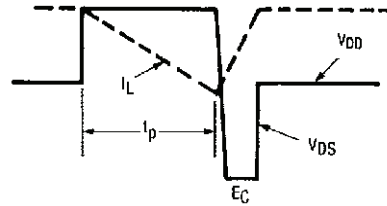
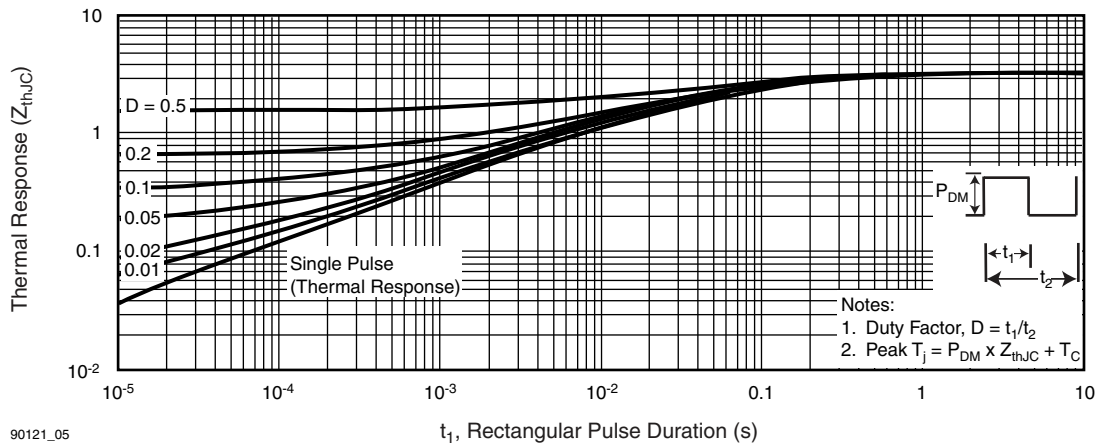


Fig. 13b - Unclamped Inductive Load Test Waveforms



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Fig. 14 - Maximum Effective Transient Thermal Impedance, Junction-to-Case vs. Pulse Duration

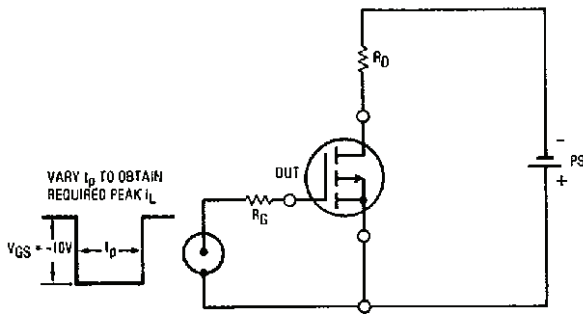


Fig. 15 - Switching Time Test Circuit

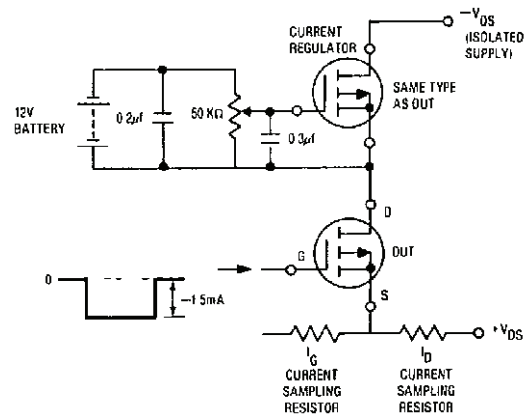


Fig. 16 - Gate Charge Test Circuit

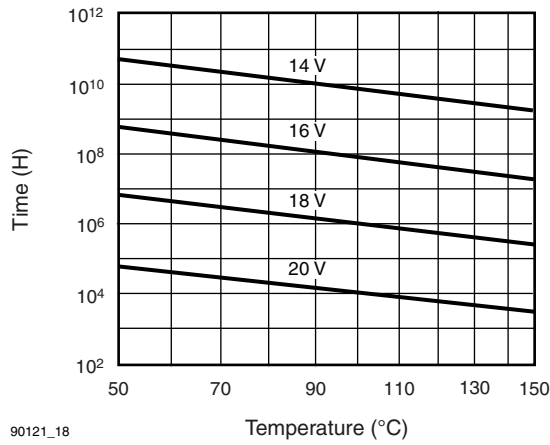


Fig. 17 - Typical Time to Accumulated 1 % Gate Failure

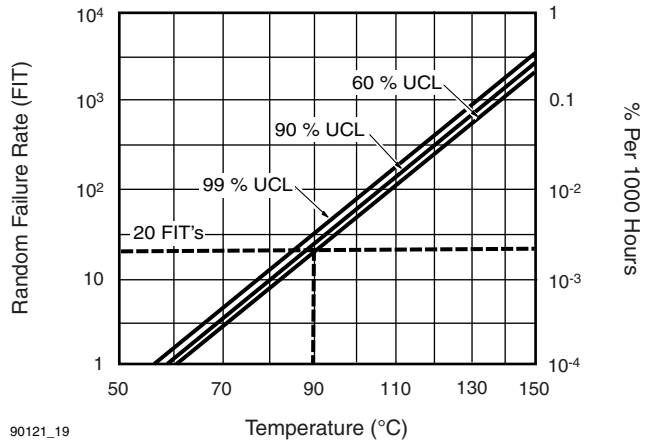
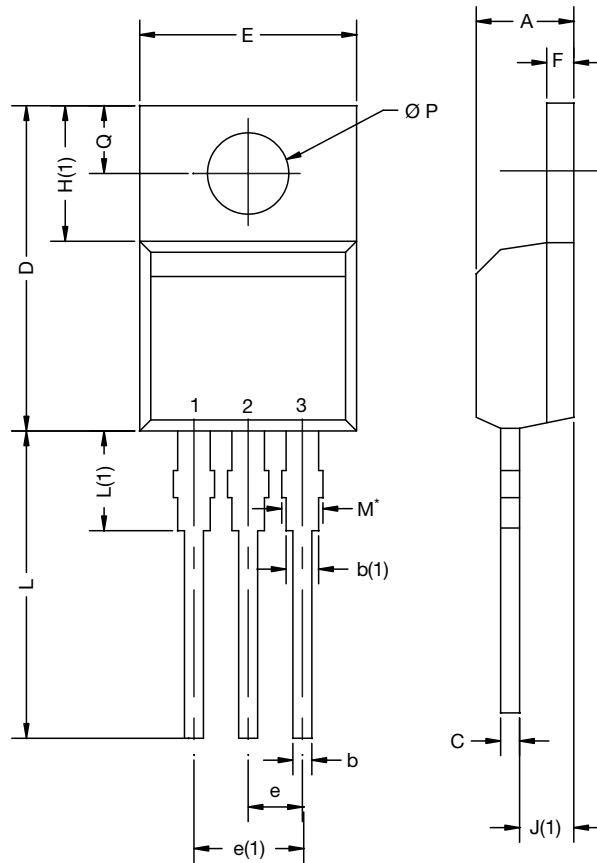


Fig. 18 - Typical High Temperature Reverse Bias (HTRB) Failure Rate

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### TO-220-1



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.24	4.65	0.167	0.183
b	0.69	1.02	0.027	0.040
b(1)	1.14	1.78	0.045	0.070
c	0.36	0.61	0.014	0.024
D	14.33	15.85	0.564	0.624
E	9.96	10.52	0.392	0.414
e	2.41	2.67	0.095	0.105
e(1)	4.88	5.28	0.192	0.208
F	1.14	1.40	0.045	0.055
H(1)	6.10	6.71	0.240	0.264
J(1)	2.41	2.92	0.095	0.115
L	13.36	14.40	0.526	0.567
L(1)	3.33	4.04	0.131	0.159
$\varnothing P$	3.53	3.94	0.139	0.155
Q	2.54	3.00	0.100	0.118

ECN: E21-0621-Rev. D, 04-Nov-2021  
DWG: 6031

#### Note

- $M^*$  = 0.052 inches to 0.064 inches (dimension including protrusion), heatsink hole for HVM



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