

## Mean time between failures for model 786A

Accelerometers with lower MTBF values result in higher costs for permanently installed vibration sensors.

Mean time between failures (MTBF) represents the average expected time that will elapse between failures of like units under like conditions. Purchasers should consider the MTBF of accelerometers before buying them. Accelerometers with a low (short) MTBF result in higher costs due to the manpower for troubleshooting and replacement of bad accelerometers and lost data associated with the more frequent failures.

The Department of Defense developed a calculation to be used for electronic systems and circuits. Military Handbook MIL-HDBK-217 provides guidance for computing the MTBF for hermetically sealed electronic circuits. The 786A is sealed to a leak rate of  $1 \times 10^{-8}$  cc/sec and is considered to be truly hermetically sealed. An analysis of failures indicates that the hybrid circuit board and connections are the only parts to fail due to normal environmental exposure. The piezoelectric sensing element does not play a significant role in failures.

### Total hybrid failure rate ( $\lambda_p$ )

$$\lambda_p = [\sum N_C \lambda_C] (1 + 0.2 \pi_E) \pi_F \pi_Q \pi_L \text{ failures per 1,000,000 hours}$$

Where

- $N_C$  = number of each particular component
- $\lambda_C$  = failure rate of each particular component
- $\pi_E$  = environmental factor
- $\pi_F$  = hybrid function factor
- $\pi_Q$  = quality (screening) factor
- $\pi_L$  = longevity (experience) factor

N is determined simply from the part or connection count, all other factors are determined through reference to MIL-HDBK-217 for the particular component or element.

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Values for 786A accelerometer

N components/elements	60° C	120° C
48 connections	.018122	.018122
4 plated through holes	.000041	.000041
1 crystal	.0058	.0058
1 bipolar transistor	.00029	.000773
1 FET	.0135	.0324
3 diodes	.00731	.027655
3 capacitors	.016082	.13992
5 resistors	.00363	.00594
Individual $N_C \lambda_C$	.064775	.230651

**Calculated total hybrid failure rate (786A):**

@ 60° C  
 $\lambda_p = [.064775] 70.18$   
= 4.5459 per  $10^6$  hrs  
= 219,978 hrs MTBF

@ 120° C  
 $\lambda_p = [.230651] 70.18$   
= 16.187087 per  $10^6$  hrs  
= 61,778 hrs MTBF