# APEX MICROTECHNOLOGY CORPORATION <br> RELIABILITY PREDICTION <br> PA88 

by

Granger Scofield

Date of prediction: 15-Mar-01

This reliability prediction is based on MIL-HDBK-217F, December 2, 1991 including Notice 2, February 28, 1995.

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Conditions of this prediction are as follows:
    Hybrid quality level is Commercial
    Environment is Gf Ground, Fixed
    Case temperature is 40 C
    Internal Power Dissipation = 5 W
    Supply voltage is +/- }180\mathrm{ V
    An AC signal is applied.
    Product introduction date: 01-Aug-88
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    The results of this prediction are:
        20.7 failures per million hours; or,
        \(M T B F=48.3\) thousand hours.
    | Transistors, Low Frequency, Bipolar: |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathrm{Lp}=\mathrm{Lb}$ * PiT * PiR * PiS |  |  |  |  |  |  |  |  |  |  |
| Q12,17 |  | Volts $=$ | 40 | Watts = | 1.2 | $\mathrm{Tj}=$ | 175 | 'K/W= | 125 |  |
| Usage: | Vstress $=1.3$ | Vpwr = | 1.3 | $\mathrm{lc}=$ | 1E-05 | $\mathrm{Vs}=$ | 0.0325 | Power = | $1 \mathrm{E}-05$ |  |
| Lb | PiT | PiR | PiS |  |  |  | Nc | $\mathrm{Tj}=$ | 40.002 |  |
| 0.00074 | 1.404949 | 1.0698 | 0.0498 |  |  |  | 2 |  |  | 0.000111 |
| Q1 |  | Volts $=$ | 120 | Watts = | 1.2 | $\mathrm{Tj}=$ | 200 | 'K/W= | 145.83 |  |
| Usage: | Vstress $=0.65$ | Vpwr = | 0.65 | $\mathrm{lc}=$ | 8E-05 | Vs $=$ | 0.0054 | Power = | 5E-05 |  |
| Lb | PiT | PiR | PiS |  |  |  | Nc | $\mathrm{Tj}=$ | 40.007 |  |
| 0.00074 | 1.405116 | 1.0698 | 0.0458 |  |  |  | 1 |  |  | 5.09E-05 |
| Q2 |  | Volts $=$ | 140 | Watts = | 1.2 | $\mathrm{Tj}=$ | 200 | 'K/W= | 145.83 |  |
| Usage: | Vstress $=4.3$ | Vpwr $=$ | 4.3 | $\mathrm{lc}=$ | 8E-05 | Vs $=$ | 0.0307 | Power = | 0.0003 |  |
| Lb | PiT | PiR | PiS |  |  |  | Nc | $\mathrm{Tj}=$ | 40.047 |  |
| 0.00074 | 1.406326 | 1.0698 | 0.0495 |  |  |  | 1 |  |  | 5.51E-05 |
| Transistors, Low Frequency, Si JFET: |  |  | $\mathrm{Lb}=$ | 0.0045 |  |  |  |  |  |  |
| Lp = Lb * PiT |  |  |  |  |  |  |  |  |  |  |
| Q10A,B |  | Volts $=$ | 50 | Watts = | 4 | $\mathrm{Tj}=$ | 150 | 'K/W= | 31.25 |  |
| Usage: |  | Vpwr $=$ | 3 | $\mathrm{ld}=$ | 8E-05 |  |  | Power = | 0.0002 |  |
| Lb | PiT |  |  |  |  |  | Nc | $\mathrm{Tj}=$ | 40.007 |  |
| 0.0045 | 1.36303 |  |  |  |  |  | 2 |  |  | 0.012267 |
| Q19 |  | Volts = | 30 | Watts = | 0.8 | $\mathrm{Tj}=$ | 150 | 'K/W= | 156.25 |  |
| Usage: |  | Vpwr $=$ | 1.5 | $\mathrm{ld}=$ | 1E-06 |  |  | Power = | $2 \mathrm{E}-06$ |  |
| Lb | PiT |  |  |  |  |  | Nc | $\mathrm{Tj}=$ | 40 |  |
| 0.0045 | 1.362848 |  |  |  |  |  | 2 |  |  | 0.012266 |
| Transistors, Low Frequency, Si MOSFET: Lb = |  |  |  | 0.012 |  |  |  |  |  |  |
| Lp = Lb * PiT |  |  |  |  |  |  |  |  |  |  |
| Q9,18 |  | Volts = | 450 | Watts = | 25 | $\mathrm{Tj}=$ | 150 | 'K/W= | 5 |  |
| Usage: |  | Fraction Output Pwr $=1 /$ |  |  | 1 |  |  | Power $=$ | 5 |  |
| Lb | PiT |  |  |  |  |  | Nc | $\mathrm{Tj}=$ | 65 |  |
| 0.012 | 2.147846 |  |  |  |  |  | 2 |  |  | 0.051548 |
| Q3 |  | Volts $=$ | 450 | Watts = | 4 | $\mathrm{Tj}=$ | 150 | 'K/W= | 31.25 |  |
| Usage: |  | Vpwr $=$ | 175.7 | $\mathrm{ld}=$ | 3E-05 |  |  | Power = | 0.0053 |  |
| Lb | PiT |  |  |  |  |  | Nc | $\mathrm{Tj}=$ | 40.165 |  |
| 0.012 | 1.367257 |  |  |  |  |  | 1 |  |  | 0.016407 |


| Q4 |  | Volts $=$ | 450 | Watts = | 4 | $\mathrm{Tj}=$ | 150 | 'K/W= | 31.25 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Usage: |  | Vpwr = | 350.9 | $\mathrm{ld}=$ | 8E-05 |  |  | Power = | 0.0263 |  |
| Lb | PiT |  |  |  |  |  | Nc | Tj = | 40.822 |  |
| 0.012 | 1.384985 |  |  |  |  |  | 1 |  |  | 0.01662 |
| Q5,14 |  | Volts = | 450 | Watts = | 4 | $\mathrm{Tj}=$ | 150 | 'K/W= | 31.25 |  |
| Usage: |  | Vpwr = | 3 | $\mathrm{ld}=$ | 8E-05 |  |  | Power = | 0.0002 |  |
| Lb | PiT |  |  |  |  |  | Nc | $\mathrm{Tj}=$ | 40.007 |  |
| 0.012 | 1.36303 |  |  |  |  |  | 2 |  |  | 0.032713 |
| Q6 |  | Volts $=$ | 450 | Watts = | 4 | $\mathrm{Tj}=$ | 150 | 'K/W= | 31.25 |  |
| Usage: |  | Vpwr = | 171 | $\mathrm{ld}=$ | 8E-05 |  |  | Power = | 0.0128 |  |
| Lb | PiT |  |  |  |  |  | Nc | $\mathrm{Tj}=$ | 40.401 |  |
| 0.012 | 1.373602 |  |  |  |  |  | 1 |  |  | 0.016483 |
| Q7 |  | Volts = | 450 | Watts = | 4 | $\mathrm{Tj}=$ | 150 | 'K/W= | 31.25 |  |
| Usage: |  | Vpwr = | 170.8 | $\mathrm{ld}=$ | 8E-05 |  |  | Power = | 0.0128 |  |
| Lb | PiT |  |  |  |  |  | Nc | $\mathrm{Tj}=$ | 40.4 |  |
| 0.012 | 1.37359 |  |  |  |  |  | 1 |  |  | 0.016483 |
| Q11 |  | Volts $=$ | 450 | Watts = | 4 | $\mathrm{Tj}=$ | 150 | 'K/W= | 31.25 |  |
| Usage: |  | Vpwr $=$ | 6 | $\mathrm{ld}=$ | 0.0004 |  |  | Power = | 0.0024 |  |
| Lb | PiT |  |  |  |  |  | Nc | $\mathrm{Tj}=$ | 40.075 |  |
| 0.012 | 1.364851 |  |  |  |  |  | 1 |  |  | 0.016378 |
| Q13 |  | Volts = | 450 | Watts = | 4 | $\mathrm{Tj}=$ | 150 | 'K/W= | 31.25 |  |
| Usage: |  | Vpwr = | 176 | $\mathrm{ld}=$ | 0.0002 |  |  | Power = | 0.0317 |  |
| Lb | PiT |  |  |  |  |  | Nc | $\mathrm{Tj}=$ | 40.99 |  |
| 0.012 | 1.389527 |  |  |  |  |  | 1 |  |  | 0.016674 |
| Q15,16 |  | Volts $=$ | 450 | Watts = | 4 | $\mathrm{Tj}=$ | 150 | 'K/W= | 31.25 |  |
| Usage: |  | Vpwr = | 171 | $\mathrm{ld}=$ | 0.0005 |  |  | Power = | 0.077 |  |
| Lb | PiT |  |  |  |  |  | Nc | $\mathrm{Tj}=$ | 42.405 |  |
| 0.012 | 1.428266 |  |  |  |  |  | 2 |  |  | 0.034278 |

Capacitors, ceramic general purpose type CK:

| Lp $=$ Lb * PiT * PiC * PiV |  | Lb = |  |
| :--- | :--- | :--- | :--- |
|  |  |  |  |
| C3 |  | Volts = |  |
| Usage: | Vstress $=$ | 6 |  |
| Lb | PiT | PiC | Pi V |
| 0.00099 | 1.92167 | 0.243 | 1.0001 |

0.00099
$\mathrm{pF}=\quad 150$
$S=\quad 0.03$
Nc
1
0.000463

| C1 |  |  | Volts $=$ | 100 | $\mathrm{pF}=$ | 470 |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Usage: | Vstress $=$ | 6 |  |  |  |  | $S=$ | 0.06 |  |  |  |
| Lb | PiT | PiC | Pi V |  |  |  |  | Nc |  |  |  |
| 0.00099 | 1.92167 | 0.269 | 1.001 |  |  |  |  | 1 |  |  | 0.000513 |
| C2 |  |  | Volts = | 100 | $\mathrm{pF}=$ | 470 |  |  |  |  |  |
| Usage: | Vstress = | 1.5 |  |  |  |  | $\mathrm{S}=$ | 0.015 |  |  |  |
| Lb | PiT | PiC | Pi V |  |  |  |  | Nc |  |  |  |
| 0.00099 | 1.92167 | 0.269 | 1 |  |  |  |  | 1 |  |  | 0.000513 |
| Diodes, Low Frequency: |  |  |  |  |  |  |  |  |  |  |  |
| $\mathrm{Lp}=\mathrm{Lb}$ * PiT * PiS * PiC |  |  |  |  |  |  |  |  |  |  |  |
| Diodes, Switching, Lb = |  |  | 0.001 |  |  |  |  |  |  |  |  |
| D4,5 |  |  | Volts = | 100 | Watts $=$ | 0.38 | $\mathrm{Tj}=$ | 175 | 'K/W= | 394.74 |  |
| Usage: |  |  | Volts = | 2.5 | $\mathrm{lc}=$ | 1E-05 | Vs = | 0.025 | Power = | 7E-06 |  |
| Lb | PiT | PiS | PiC |  |  |  |  | Nc | $\mathrm{Tj}=$ | 40.003 |  |
| 0.001 | 1.644053 | 0.054 | 2 |  |  |  |  | 2 |  |  | 0.000355 |
| Diodes, Zener, Lb = |  |  | 0.002 |  |  |  |  |  |  |  |  |
| D1,2 |  |  | Volts = | 3.1 | Watts $=$ | 2.5 | $\mathrm{Tj}=$ | 175 | 'K/W= | 60 |  |
| Usage: |  |  |  |  | Ic = | 8E-05 |  |  | Power = | 0.0002 |  |
| Lb | PiT | PiS | PiC |  |  |  |  | Nc | Tj = | 40.014 |  |
| 0.002 | 1.363215 | 1 | 2 |  |  |  |  | 2 |  |  | 0.010906 |

Hybrid microcircuit:
Lp=sumLc*(1+.2*PiE) * PiF * PiQ * PiL

| 0.255084 | 1.4 | 5.8 | 10 | 1 |
| :--- | :--- | :--- | :--- | :--- |

Total failures per million hours $=\quad 20.713$
Mean time between failures $=\quad 48279$

