# APEX MICROTECHNOLOGY CORPORATION RELIABILITY PREDICTION <br> PA0 4 

by

Date of prediction: 16-Feb-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 55 C
    Internal Power Dissipation = 75 W
    Supply voltage is +/- 75 V
    An AC signal is applied.
    Product introduction date: 01-Jun-94
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    The results of this prediction are:
        29.2 failures per million hours; or,
        \(M T B F=34.3\) thousand hours.
    Transistors, Low Frequency, Bipolar:
$\mathrm{Lp}=\mathrm{Lb}$ * PiT * PiR * PiS

| Q13,18 |  |  | Volts = | 40 | Watts = | 1.2 | $\mathrm{Tj}=$ | 175 | 'K/W= | 125 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Usage: | Vstress $=$ |  | Vpwr = | 1.3 | $\mathrm{lc}=$ | 1E-05 | Vs $=$ | 0.0325 | Power $=$ | 1E-05 |  |
| Lb | PiT |  | PiR | PiS |  |  |  | Nc | $\mathrm{Tj}=$ | 55.002 |  |
| 0.00074 | 1.913377 |  | 1.0698 | 0.0498 |  |  |  | 2 |  |  | 0.000151 |
| Q21 |  |  | Volts = | 40 | Watts = | 1.2 | $\mathrm{Tj}=$ | 175 | 'K/W= | 125 |  |
| Usage: | Vstress $=$ | 0.65 | Vpwr = | 0.65 | $\mathrm{lc}=$ | 0.003 | Vs $=$ | 0.0163 | Power $=$ | 0.002 |  |
| Lb | PiT |  | PiR | PiS |  |  |  | Nc | $\mathrm{Tj}=$ | 55.244 |  |
| 0.00074 | 1.922495 |  | 1.0698 | 0.0473 |  |  |  | 1 |  |  | 7.2E-05 |
| Q22 |  |  | Volts = | 40 | Watts = | 1.2 | $\mathrm{Tj}=$ | 175 | 'K/W= | 125 |  |
| Usage: | Vstress = | 3.5 | Vpwr = | 3.5 | $\mathrm{lc}=$ | 0.003 | Vs = | 0.0875 | Power $=$ | 0.0105 |  |
| Lb | PiT |  | PiR | PiS |  |  |  | Nc | $\mathrm{Tj}=$ | 56.313 |  |
| 0.00074 | 1.963101 |  | 1.0698 | 0.059 |  |  |  | 1 |  |  | 9.17E-05 |
| Q5,26 |  |  | Volts = | 300 | Watts = | 1.15 | $\mathrm{Tj}=$ | 150 | 'K/W= | 108.7 |  |
| Usage: | Vstress $=$ | 144 | Vpwr = | 72 | $\mathrm{lc}=$ | 0.002 | Vs $=$ | 0.48 | Power $=$ | 0.144 |  |
| Lb | PiT |  | PiR | PiS |  |  |  | Nc | $\mathrm{Tj}=$ | 70.652 |  |
| 0.00074 | 2.566109 |  | 1.0531 | 0.1993 |  |  |  | 2 |  |  | 0.000797 |
| Q7,9,23,25 |  |  | Volts = | 300 | Watts = | 1.15 | $\mathrm{Tj}=$ | 150 | 'K/W= | 108.7 |  |
| Usage: | Vstress = | 0.65 | Vpwr = | 0.65 | $\mathrm{lc}=$ | 0.01 | $\mathrm{Vs}=$ | 0.0022 | Power = | 0.0065 |  |
| Lb | PiT |  | PiR | PiS |  |  |  | Nc | $\mathrm{Tj}=$ | 55.707 |  |
| 0.00074 | 1.940006 |  | 1.0531 | 0.0453 |  |  |  | 4 |  |  | 0.000274 |
| Q11,16 |  |  | Volts = | 300 | Watts = | 1.15 | $\mathrm{Tj}=$ | 150 | 'K/W= | 108.7 |  |
| Usage: | Vstress $=$ | 138 | Vpwr = | 138 | $\mathrm{lc}=$ | 0.003 | Vs $=$ | 0.46 | Power $=$ | 0.414 |  |
| Lb | PiT |  | PiR | PiS |  |  |  | Nc | $\mathrm{Tj}=$ | 100 |  |
| 0.00074 | 4.16368 |  | 1.0531 | 0.1873 |  |  |  | 2 |  |  | 0.001215 |
| Q12 |  |  | Volts = | 300 | Watts = | 1.15 | $\mathrm{Tj}=$ | 150 | 'K/W= | 108.7 |  |
| Usage: | Vstress = | 134 | Vpwr = | 134 | $\mathrm{lc}=$ | 0.002 | Vs = | 0.4467 | Power $=$ | 0.268 |  |
| Lb | PiT |  | PiR | PiS |  |  |  | Nc | $\mathrm{Tj}=$ | 84.13 |  |
| 0.00074 | 3.236699 |  | 1.0531 | 0.1797 |  |  |  | 1 |  |  | 0.000453 |
| Q19 |  |  | Volts = | 300 | Watts = | 1.15 | $\mathrm{Tj}=$ | 150 | 'K/W= | 108.7 |  |
| Usage: | Vstress = | 148.4 | Vpwr = | 73.4 | $\mathrm{lc}=$ | 0.002 | $\mathrm{Vs}=$ | 0.4947 | Power $=$ | 0.1468 |  |
| Lb | PiT |  | PiR | PiS |  |  |  | Nc | $\mathrm{Tj}=$ | 70.957 |  |
| 0.00074 | 2.580115 |  | 1.0531 | 0.2085 |  |  |  | 1 |  |  | 0.000419 |


| Transistors $\mathrm{Lp}=\mathrm{Lb} \text { * } \mathrm{P}$ | s, Low Frequ <br> iT | i JFET: |  | 0.0045 |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Q28-31 |  | Volts | 450 | Watts = | 0.38 | $\mathrm{Tj}=$ | 150 | 'K/W= | 328.95 | 0 |
| Usage: |  | Vpwr | 1.5 | $\mathrm{ld}=$ | 5E-11 |  |  | Power = | 8E-11 |  |
| Lb | PiT |  |  |  |  |  | Nc | $\mathrm{Tj}=$ | 55 |  |
| 0.0045 | 1.805485 |  |  |  |  |  | 4 |  |  | 0.032499 |
| Transistors, Low Frequency, Si MOSFET: Lb $=$ $L p=L b *$ PiT |  |  |  | 0.012 |  |  |  |  |  |  |
| Q6,8,24,27 |  | Volts |  | Watts = | 156.25 | $\mathrm{Tj}=$ | 150 | 'K/W= | 0.8 |  |
| Usage: |  | Fraction Output Pwr = 1/ |  |  | 2 |  |  | Power = | 37.5 |  |
| Lb | PiT |  |  |  |  |  | Nc | $\mathrm{Tj}=$ | 85 |  |
| 0.012 | 2.952454 |  |  |  |  |  | 4 |  |  | 0.141718 |
| Q1 |  | Volts |  | Watts $=$ | 15 | $\mathrm{Tj}=$ | 150 | 'K/W= | 8.3333 |  |
| Usage: |  | Vpwr | 3.5 | $\mathrm{ld}=$ | 0.003 |  |  | Power $=$ | 0.0105 |  |
| Lb | PiT |  |  |  |  |  | Nc | $\mathrm{Tj}=$ | 55.088 |  |
| 0.012 | 1.808313 |  |  |  |  |  | 1 |  |  | 0.0217 |
| Q2 |  | Volts | 450 | Watts = | 15 | $\mathrm{Tj}=$ | 150 | 'K/W= | 8.3333 |  |
| Usage: |  | Vpwr $=$ | 68.8 | $\mathrm{ld}=$ | 0.01 |  |  | Power = | 0.688 |  |
| Lb | PiT |  |  |  |  |  | Nc | $\mathrm{Tj}=$ | 60.733 |  |
| 0.012 | 1.997014 |  |  |  |  |  | 1 |  |  | 0.023964 |
| Q10 |  | Volts $=$ | 450 | Watts = | 15 | $\mathrm{Tj}=$ | 150 | 'K/W= | 8.3333 |  |
| Usage: |  | Vpwr $=$ | 68.7 | $\mathrm{ld}=$ | 0.006 |  |  | Power $=$ | 0.4122 |  |
| Lb | PiT |  |  |  |  |  | Nc | $\mathrm{Tj}=$ | 58.435 |  |
| 0.012 | 1.918713 |  |  |  |  |  | 1 |  |  | 0.023025 |
| Q14,15 |  | Volts $=$ | 450 | Watts = | 15 | $\mathrm{Tj}=$ | 150 | 'K/W= | 8.3333 |  |
| Usage: |  | Vpwr $=$ | 75 | $\mathrm{ld}=$ | 0.003 |  |  | Power $=$ | 0.225 |  |
| Lb | PiT |  |  |  |  |  | Nc | $\mathrm{Tj}=$ | 56.875 |  |
| 0.012 | 1.866729 |  |  |  |  |  | 2 |  |  | 0.044801 |
| Q17 |  | Volts $=$ | 450 | Watts = | 15 | $\mathrm{Tj}=$ | 150 | 'K/W= | 8.3333 |  |
| Usage: |  | Vpwr $=$ | 7 | $\mathrm{ld}=$ | 0.01 |  |  | Power $=$ | 0.07 |  |
| Lb | PiT |  |  |  |  |  | Nc | $\mathrm{Tj}=$ | 55.583 |  |
| 0.012 | 1.824395 |  |  |  |  |  | 1 |  |  | 0.021893 |
| Q20 |  | Volts $=$ | 450 | Watts = | 15 | $\mathrm{Tj}=$ | 150 | 'K/W= | 8.3333 |  |
| Usage: |  | Vpwr $=$ | 72 | $\mathrm{ld}=$ | 0.01 |  |  | Power = | 0.72 |  |
| Lb | PiT |  |  |  |  |  | Nc | $\mathrm{Tj}=$ | 61 |  |
| 0.012 | 2.006232 |  |  |  |  |  | 1 |  |  | 0.024075 |

Capacitors, ceramic general purpose type CK:

| $L p=L b^{*}$ | PiT * PiC * P |  | Lb $=$ |  | 0.000 |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| C2 |  |  | Volts = | 50 | $\mathrm{pF}=$ | 470 |  |  |
| Usage: | Vstress $=$ | 0.8 |  |  |  |  | S = | 0.016 |
| Lb | PiT | PiC | Pi V |  |  |  |  | Nc |
| 0.00099 | 3.478655 | 0.269 | 1 |  |  |  |  | 1 |
| C1 |  |  | Volts = | 50 | $\mathrm{pF}=$ | 15000 |  |  |
| Usage: | Vstress = |  |  |  |  |  | $S=$ | 0.192 |
| Lb | PiT | PiC | PiV |  |  |  |  | Nc |
| 0.00099 | 3.478655 | 0.368 | 1.0328 |  |  |  |  | 1 |

0.000928
0.001309

Diodes, Low Frequency:
$\mathrm{Lp}=\mathrm{Lb}$ * PiT * PiS * PiC

Diodes, Switching, Lb $=\quad 0.001$

| D2,3 |  |  | Volts = | 100 | Watts = | 0.38 | $\mathrm{Tj}=$ | 175 | 'K/W= | 394.74 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Usage: |  |  | Volts = | 72 | $\mathrm{lc}=$ | 1E-05 | Vs = | 0.72 | Power = | 7E-06 |  |
| Lb | PiT | PiS | PiC |  |  |  |  | Nc | $\mathrm{Tj}=$ | 55.003 |  |
| 0.001 | 2.582548 | 0.45 | 2 |  |  |  |  | 2 |  |  | 0.00465 |
| D4 |  |  | Volts = | 100 | Watts = | 0.38 | $\mathrm{Tj}=$ | 175 | 'K/W= | 394.74 |  |
| Usage: |  |  | Volts = | 1.8 | $\mathrm{lc}=$ | 1E-06 | Vs = | 0.018 | Power $=$ | 7E-07 |  |
| Lb | PiT | PiS | PiC |  |  |  |  | Nc | $\mathrm{Tj}=$ | 55 |  |
| 0.001 | 2.582377 | 0.054 | 2 |  |  |  |  | 1 |  |  | 0.000279 |
| D5 |  |  | Volts = | 100 | Watts = | 0.38 | $\mathrm{Tj}=$ | 175 | 'K/W= | 394.74 |  |
| Usage: |  |  | Volts = | 0.65 | $\mathrm{lc}=$ | 0.003 | Vs = | 0.0065 | Power = | 0.002 |  |
| Lb | PiT | PiS | PiC |  |  |  |  | Nc | $\mathrm{Tj}=$ | 55.77 |  |
| 0.001 | 2.639967 | 0.054 | 2 |  |  |  |  | 1 |  |  | 0.000285 |

Diodes, Zener, Lb =
0.002


Hybrid microcircuit:
$\mathrm{Lp}=$ sumLc*(1+.2*PiE) * PiF * PiQ * PiL $\begin{array}{lllll}0.359297 & 1.4 & 5.8 & 10 & 1\end{array}$

Total failures per million hours $=\quad 29.175$
Mean time between failures = 34276

