APEX MICROTECHNOLOGY CORPORATION
RELIABILITY PREDICTION
SA01

by

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15-Mar-01

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

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= | | 5 | W |
| Supply voltage is + | | 78 | V |
| An AC signal is applied. | | | |
| Product introduction date: | | 15-Nov-96 | |

The results of this prediction are:

29.5 failures per million hours; or,
MTBF=34 thousand hours.

Monolithic Bipolar and MOS Linear Devices:
Lp = C1 * PiT

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| IC1 | #/Pins = | 7 | Watts = | 1 | Tj = | 150 | #/Qs = | 96 | | |
| Usage: | Vstress = | 12 | Watts = | 0.018 | | | Max Tj = | 57.25 | | |
| C1 | PiT | | | | | | | Nc | | |
| 0.01 | 1.184462 | | | | | | | 1 | | 0.011845 |
| IC2 | #/Pins = | 20 | Watts = | 2 | Tj = | 150 | #/Qs = | 96 | | |
| Usage: | Vstress = | 11.3 | Watts = | 0.274 | | | Max Tj = | 72.127 | | |
| C1 | PiT | | | | | | | Nc | | |
| 0.01 | 3.170333 | | | | | | | 1 | | 0.031703 |

Transistors, Low Frequency, Bipolar:
Lp = Lb * PiT * PiR * PiS

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|---|---|---|---|---|---|---|---|---|---|---|
| Q5,6 | | | Volts = | 40 | Watts = | 1.2 | Tj = | 175 | 'K/W= | 125 |
| Usage: | Vstress = | 12 | Vpwr = | 6 | Ic = | 0.002 | Vs = | 0.3 | Power = | 0.012 |
| Lb | PiT | | PiR | PiS | | | | Nc | Tj = | 56.5 |
| 0.00074 | 1.970285 | | 1.0698 | 0.1141 | | | | 2 | | 0.000356 |
| Q22 | | | Volts = | 40 | Watts = | 1.2 | Tj = | 175 | 'K/W= | 125 |
| Usage: | Vstress = | 12 | Vpwr = | 12 | Ic = | 1E-06 | Vs = | 0.3 | Power = | 1E-05 |
| Lb | PiT | | PiR | PiS | | | | Nc | Tj = | 55.002 |
| 0.00074 | 1.913372 | | 1.0698 | 0.1141 | | | | 1 | | 0.000173 |
| Q17,18,20,21 | | | Volts = | 60 | Watts = | 1.2 | Tj = | 175 | 'K/W= | 125 |
| Usage: | Vstress = | 12 | Vpwr = | 12 | Ic = | 1E-06 | Vs = | 0.2 | Power = | 1E-05 |
| Lb | PiT | | PiR | PiS | | | | Nc | Tj = | 55.002 |
| 0.00074 | 1.913372 | | 1.0698 | 0.0837 | | | | 4 | | 0.000507 |
| Q3 | | | Volts = | 100 | Watts = | 3.9 | Tj = | 175 | 'K/W= | 38.462 |
| Usage: | Vstress = | 66.7 | Vpwr = | 66.7 | Ic = | 0.01 | Vs = | 0.667 | Power = | 0.667 |
| Lb | PiT | | PiR | PiS | | | | Nc | Tj = | 80.654 |
| 0.00074 | 3.053728 | | 1.6546 | 0.3558 | | | | 1 | | 0.00133 |
| Q11,12 | | | Volts = | 300 | Watts = | 1.15 | Tj = | 150 | 'K/W= | 108.7 |
| Usage: | Vstress = | 66 | Vpwr = | 66 | Ic = | 0.002 | Vs = | 0.22 | Power = | 0.132 |
| Lb | PiT | | PiR | PiS | | | | Nc | Tj = | 69.348 |
| 0.00074 | 2.506665 | | 1.0531 | 0.089 | | | | 2 | | 0.000348 |
| Q19 | | | Volts = | 300 | Watts = | 1.15 | Tj = | 150 | 'K/W= | 108.7 |
| Usage: | Vstress = | 78 | Vpwr = | 78 | Ic = | 1E-06 | Vs = | 0.26 | Power = | 8E-05 |
| Lb | PiT | | PiR | PiS | | | | Nc | Tj = | 55.008 |
| 0.00074 | 1.913635 | | 1.0531 | 0.1008 | | | | 1 | | 0.00015 |

Transistors, Low Frequency, Si JFET: Lb = 0.0045
Lp = Lb * PiT

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|---|---|---|---|---|---|---|---|---|---|
| Q4,7 | | Volts = | 30 | Watts = | 0.8 | Tj = | 150 | 'K/W= | 156.25 | |
| Usage: | | Vpwr = | 12 | Id = | 0.005 | | | Power = | 0.06 | |
| Lb | PiT | | | | | | Nc | Tj = | 64.375 | |
| 0.0045 | 2.125303 | | | | | | 2 | | | 0.019128 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Q20A,B | | Volts = | 25 | Watts = | 0.55 | Tj = | 150 | 'K/W= | 227.27 | |
| Usage: | | Vpwr = | 4 | Id = | 0.0022 | | | Power = | 0.0088 | |
| Lb | PiT | | | | | | Nc | Tj = | 57 | |
| 0.0045 | 1.87086 | | | | | | 2 | | | 0.016838 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Q11 | | Volts = | 300 | Watts = | 3 | Tj = | 150 | 'K/W= | 41.667 | |
| Usage: | | Vpwr = | 115 | Id = | 0.001 | | | Power = | 0.115 | |
| Lb | PiT | | | | | | Nc | Tj = | 59.792 | |
| 0.0045 | 1.964685 | | | | | | 2 | | | 0.017682 |

Transistors, Low Frequency, Si MOSFET: Lb = 0.012
Lp = Lb * PiT

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|---|---|---|---|---|---|---|---|---|---|
| Q13,14 | | Volts = | 100 | Watts = | 150 | Tj = | 175 | 'K/W= | 1 | |
| Usage: | | Fraction Output Pwr = 1/ | | | 4 | | | Power = | 1.25 | |
| Lb | PiT | | | | | | Nc | Tj = | 56.25 | |
| 0.012 | 1.846165 | | | | | | 2 | | | 0.044308 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Q9,10 | | Volts = | 100 | Watts = | 125 | Tj = | 150 | 'K/W= | 1 | |
| Usage: | | Fraction Output Pwr = 1/ | | | 4 | | | Power = | 1.25 | |
| Lb | PiT | | | | | | Nc | Tj = | 56.25 | |
| 0.012 | 1.846165 | | | | | | 2 | | | 0.044308 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Q1 | | Volts = | 450 | Watts = | 2.25 | Tj = | 150 | 'K/W= | 55.556 | |
| Usage: | | Vpwr = | 65.4 | Id = | 0.002 | | | Power = | 0.1308 | |
| Lb | PiT | | | | | | Nc | Tj = | 62.267 | |
| 0.012 | 2.050397 | | | | | | 1 | | | 0.024605 |

Capacitors, ceramic general purpose type CK:
Lp = Lb * PiT * PiC * PiV Lb = 0.00099

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C4,5 | | | Volts = | 25 | pF = | 1000 | | | | |
| Usage: | Vstress = | 0.65 | | | | | S = | 0.026 | | |
| Lb | PiT | PiC | Pi V | | | | | Nc | | |
| 0.00099 | 3.478655 | 0.288 | 1.0001 | | | | | 2 | | 0.001987 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C12 | | | Volts = | 25 | pF = | 1000 | | | | |
| Usage: | Vstress = | 12 | | | | | S = | 0.48 | | |
| Lb | PiT | PiC | Pi V | | | | | Nc | | |
| 0.00099 | 3.478655 | 0.288 | 1.512 | | | | | 1 | | 0.001502 |

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|---|---|---|---|---|---|---|---|---|---|---|
| C6 | | | Volts = | 50 | pF = | 10000 | | | | |
| Usage: | Vstress = | 7.5 | | | | | S = | 0.15 | | |
| Lb | PiT | PiC | Pi V | | | | | Nc | | |
| 0.00099 | 3.478655 | 0.355 | 1.0156 | | | | | 1 | | 0.001241 |
| C3 | | | Volts = | 100 | pF = | 680 | | | | |
| Usage: | Vstress = | 7.5 | | | | | S = | 0.075 | | |
| Lb | PiT | PiC | Pi V | | | | | Nc | | |
| 0.00099 | 3.478655 | 0.279 | 1.002 | | | | | 1 | | 0.000961 |
| C2 | | | Volts = | 25 | pF = | 100000 | | | | |
| Usage: | Vstress = | 12 | | | | | S = | 0.48 | | |
| Lb | PiT | PiC | Pi V | | | | | Nc | | |
| 0.00099 | 3.478655 | 0.437 | 1.512 | | | | | 1 | | 0.002273 |
| C1 | | | Volts = | 25 | pF = | 470000 | | | | |
| Usage: | Vstress = | 11.3 | | | | | S = | 0.452 | | |
| Lb | PiT | PiC | Pi V | | | | | Nc | | |
| 0.00099 | 3.478655 | 0.502 | 1.4275 | | | | | 1 | | 0.002467 |

Diodes, Low Frequency:
Lp = Lb * PiT * PiS * PiC

Diodes, Switching, Lb = 0.001

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| D6,7 | | | Volts = | 100 | Watts = | 0.38 | Tj = | 175 | 'K/W= | 394.74 |
| Usage: | | | Volts = | 0.65 | Ic = | 0.002 | Vs = | 0.0065 | | |
| Lb | PiT | PiS | PiC | | | | | Nc | Tj = | 55 |
| 0.001 | 2.582357 | 0.054 | 2 | | | | | 2 | | 0.000558 |

Diodes, Zener, Lb = 0.002

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| D4,5 | | | Volts = | 5.6 | Watts = | 1.35 | Tj = | 175 | 'K/W= | 111.11 |
| Usage: | | | | | Ic = | 0.002 | | | Power = | 0.0112 |
| Lb | PiT | PiS | PiC | | | | | Nc | Tj = | 56.244 |
| 0.002 | 1.845983 | 1 | 2 | | | | | 2 | | 0.014768 |
| D2,3 | | | Volts = | 12 | Watts = | 1.39 | Tj = | 175 | 'K/W= | 107.91 |
| Usage: | | | | | Ic = | 0.0143 | | | Power = | 0.171 |
| Lb | PiT | PiS | PiC | | | | | Nc | Tj = | 73.453 |
| 0.002 | 2.468044 | 1 | 2 | | | | | 2 | | 0.019744 |

Diodes, Schottky:

Lp = Lb * PiT * PiR  Lb = 0.027

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| D8,9 | | | Watts = | 6.9444 | Tj = | 150 | 'K/W= | 18 | |
| Usage: | | | | | | | Power = | 0.03 | |
| Lb | PiT | PiR | | | | Nc | Tj = | 55.54 | |
| 0.027 | 1.925266 | 1 | | | | 2 | | | 0.103964 |

Sum of all components 0.362745

Hybrid microcircuit:

| Lp=sumLc*(1+.2*PiE) | * PiF | * PiQ | * PiL |
|---|---|---|---|
| 0.362745 | 1.4 | 5.8 | 10 | 1 |

Total failures per million hours = 29.455

Mean time between failures = 33950