

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:

$$L_p = C_1 * PiT$$

| | | | | | |
|--------|----------------|---------------|----------|-----------------|----------|
| 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:

$$L_p = L_b * PiT * PiR * PiS$$

| | | | | | |
|--------------|----------------|-------------|--------------|------------|---------------|
| 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 |

| | | | | | | | | |
|---------|----------------|-------|-------------|-------------|-----------|--|--|----------|
| 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:

$L_p = L_b * P_{iT} * P_{iS} * P_{iC}$

Diodes, Switching, $L_b = 0.001$

| | | | | | | | | |
|--------|----------|-------|--------------|--------------|-------------|--------------|--|----------|
| 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, $L_b = 0.002$

| | | | | | | | | |
|--------|----------|-----|-------------|--------------|----------|----------------|--|----------|
| 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:

$L_p = L_b * P_{iT} * P_{iR}$ $L_b = 0.027$

D8,9 Watts = 6.9444 $T_j = 150$ 'K/W= 18

Usage: Power = 0.03

| | | | | | |
|-------|----------|----------|-------|---------|----------|
| L_b | P_{iT} | P_{iR} | N_c | $T_j =$ | 55.54 |
| 0.027 | 1.925266 | 1 | 2 | | 0.103964 |

Sum of all components 0.362745

Hybrid microcircuit:

$L_p = \sum L_c * (1 + .2 * P_{iE}) * P_{iF} * P_{iQ} * P_{iL}$

| | | | | |
|----------|-----|-----|----|---|
| 0.362745 | 1.4 | 5.8 | 10 | 1 |
|----------|-----|-----|----|---|

Total failures per million hours = 29.455

Mean time between failures = 33950