

APEX MICROTECHNOLOGY CORPORATION
RELIABILITY PREDICTION
PA85

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.

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 +/-	175 V
An AC signal is applied.	
Product introduction date:	01-Nov-87

The results of this prediction are:

27.3 failures per million hours; or,
MTBF=36.7 thousand hours.

Transistors, Low Frequency, Bipolar:

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

Q12,17	Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125
Usage: Vstress = 2.15	Vpwr = 2.15	Ic = 1E-05	Vs = 0.0538	Power = 2E-05
Lb PiT	PiR PiS	Nc	Tj = 40.003	
0.00074 1.404981	1.0698 0.0532	2		0.000118

Q1	Volts = 120	Watts = 1.2	Tj = 200	'K/W= 145.83
Usage: Vstress = 0.65	Vpwr = 0.65	Ic = 0.0024	Vs = 0.0054	Power = 0.0016
Lb PiT	PiR PiS	Nc	Tj = 40.23	
0.00074 1.411895	1.0698 0.0458	1		5.11E-05

Q2	Volts = 120	Watts = 1.2	Tj = 200	'K/W= 145.83
Usage: Vstress = 5.22	Vpwr = 5.22	Ic = 0.0025	Vs = 0.0435	Power = 0.0129
Lb PiT	PiR PiS	Nc	Tj = 41.888	
0.00074 1.462957	1.0698 0.0515	1		5.96E-05

Transistors, Low Frequency, Si JFET: Lb = 0.0045

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

Q10A,B	Volts = 25	Watts = 0.55	Tj = 150	'K/W= 227.27
Usage: Vpwr = 3.285	Id = 0.0025			Power = 0.0082
Lb PiT		Nc	Tj = 41.859	
0.0045 1.413239		2		0.012719

Transistors, Low Frequency, Si MOSFET: Lb = 0.012

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

Q6,7	Volts = 450	Watts = 4	Tj = 150	'K/W= 31.25
Usage: Vpwr = 167	Id = 0.0025			Power = 0.4142
Lb PiT		Nc	Tj = 52.943	
0.012 1.73982		2		0.041756

Q13	Volts = 450	Watts = 4	Tj = 150	'K/W= 31.25
Usage: Vpwr = 170	Id = 0.0051			Power = 0.8687
Lb PiT		Nc	Tj = 67.147	
0.012 2.226457		1		0.026717

Q5,14	Volts = 450	Watts = 4	Tj = 150	'K/W= 31.25
Usage: Vpwr = 2.7	Id = 0.001			Power = 0.0027
Lb PiT		Nc	Tj = 40.084	
0.012 1.365102		2		0.032762

Q4,15		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 340.7	Id = 0.001			Power = 0.3407	
Lb	PiT				Nc	Tj = 50.647	
0.012	1.668443				2		0.040043
Q16		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 166.5	Id = 0.013			Power = 2.1645	
Lb	PiT				Nc	Tj = 107.64	
0.012	4.06522				1		0.048783
Q3		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 166.5	Id = 0.0002			Power = 0.025	
Lb	PiT				Nc	Tj = 40.78	
0.012	1.38385				1		0.016606
Q8		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 171	Id = 0.013			Power = 2.223	
Lb	PiT				Nc	Tj = 109.47	
0.012	4.164685				1		0.049976
Q11		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 5	Id = 0.0126			Power = 0.063	
Lb	PiT				Nc	Tj = 41.969	
0.012	1.416252				1		0.016995
Q9,18		Volts = 450	Watts = 50	Tj =	150	'K/W= 2.5	
Usage:		Fraction Output Pwr = 1/	1			Power = 5	
Lb	PiT				Nc	Tj = 52.5	
0.012	1.725908				2		0.041422

Capacitors, ceramic general purpose type CK:

$$L_p = L_b * P_iT * P_iC * P_iV \quad L_b = 0.00099$$

C6		Volts = 100	pF = 15000				
Usage:	Vstress = 4.6			S =		0.046	
Lb	PiT	PiC	Pi V		Nc		
0.00099	1.92167	0.368	1.0005		1		0.0007
C4		Volts = 100	pF = 15000				
Usage:	Vstress = 5.7			S =		0.057	
Lb	PiT	PiC	Pi V		Nc		
0.00099	1.92167	0.368	1.0009		1		0.000701

C1 Volts = 100 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 pF = 470
 Usage: Vstress = 1.6 S = 0.016
 Lb PiT PiC Pi V Nc
 0.00099 1.92167 0.269 1 1 0.000513

Diodes, Low Frequency:
 $L_p = L_b * P_{iT} * P_{iS} * P_{iC}$

Diodes, Zener, Lb = 0.002

D1,2 Volts = 3.1 Watts = 2.5 Tj = 175 'K/W= 60
 Usage: I_c = 0.001 Power = 0.0031
 Lb PiT PiS PiC Nc Tj = 40.186
 0.002 1.367828 1 2 1 0.005471

Sum of all components 0.335907

Hybrid microcircuit:
 $L_p = \sum L_c * (1 + .2 * P_{iE}) * P_{iF} * P_{iQ} * P_{iL}$
 0.335907 1.4 5.8 10 1

Total failures per million hours = 27.276
 Mean time between failures = 36663