

APEX MICROTECHNOLOGY CORPORATION  
RELIABILITY PREDICTION  
PA04

by

Granger Scofield

Date of prediction: 16-Feb-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 =	75 W
Supply voltage is +/-	75 V
An AC signal is applied.	
Product introduction date:	01-Jun-94

The results of this prediction are:

29.2 failures per million hours; or,  
MTBF=34.3 thousand hours.

## Transistors, Low Frequency, Bipolar:

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

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

Transistors, Low Frequency, Si JFET: Lb = 0.0045

Lp = Lb \* PiT

Q28-31		Volts = 450	Watts = 0.38	Tj = 150	'K/W= 328.95	0
Usage:		Vpwr = 1.5	Id = 5E-11		Power = 8E-11	
Lb	PiT			Nc	Tj = 55	
0.0045	1.805485			4		0.032499

Transistors, Low Frequency, Si MOSFET: Lb = 0.012

Lp = Lb \* PiT

Q6,8,24,27		Volts = 200	Watts = 156.25	Tj = 150	'K/W= 0.8	
Usage:		Fraction Output Pwr = 1/	2		Power = 37.5	
Lb	PiT			Nc	Tj = 85	
0.012	2.952454			4		0.141718

Q1		Volts = 450	Watts = 15	Tj = 150	'K/W= 8.3333	
Usage:		Vpwr = 3.5	Id = 0.003		Power = 0.0105	
Lb	PiT			Nc	Tj = 55.088	
0.012	1.808313			1		0.0217

Q2		Volts = 450	Watts = 15	Tj = 150	'K/W= 8.3333	
Usage:		Vpwr = 68.8	Id = 0.01		Power = 0.688	
Lb	PiT			Nc	Tj = 60.733	
0.012	1.997014			1		0.023964

Q10		Volts = 450	Watts = 15	Tj = 150	'K/W= 8.3333	
Usage:		Vpwr = 68.7	Id = 0.006		Power = 0.4122	
Lb	PiT			Nc	Tj = 58.435	
0.012	1.918713			1		0.023025

Q14,15		Volts = 450	Watts = 15	Tj = 150	'K/W= 8.3333	
Usage:		Vpwr = 75	Id = 0.003		Power = 0.225	
Lb	PiT			Nc	Tj = 56.875	
0.012	1.866729			2		0.044801

Q17		Volts = 450	Watts = 15	Tj = 150	'K/W= 8.3333	
Usage:		Vpwr = 7	Id = 0.01		Power = 0.07	
Lb	PiT			Nc	Tj = 55.583	
0.012	1.824395			1		0.021893

Q20		Volts = 450	Watts = 15	Tj = 150	'K/W= 8.3333	
Usage:		Vpwr = 72	Id = 0.01		Power = 0.72	
Lb	PiT			Nc	Tj = 61	
0.012	2.006232			1		0.024075

Capacitors, ceramic general purpose type CK:

$L_p = L_b * PiT * PiC * PiV$        $L_b =$       0.00099

C2			Volts = 50	pF = 470				
Usage:	Vstress = 0.8				S =		0.016	
Lb	PiT	PiC	Pi V			Nc		
0.00099	3.478655	0.269	1			1		0.000928

C1			Volts = 50	pF = 15000				
Usage:	Vstress = 9.6				S =		0.192	
Lb	PiT	PiC	Pi V			Nc		
0.00099	3.478655	0.368	1.0328			1		0.001309

Diodes, Low Frequency:

$L_p = L_b * PiT * PiS * PiC$

Diodes, Switching,  $L_b =$       0.001

D2,3			Volts = 100	Watts = 0.38	Tj = 175	'K/W= 394.74		
Usage:			Volts = 72	Ic = 1E-05	Vs = 0.72	Power = 7E-06		
Lb	PiT	PiS	PiC			Nc	Tj = 55.003	
0.001	2.582548	0.45	2			2		0.00465

D4			Volts = 100	Watts = 0.38	Tj = 175	'K/W= 394.74		
Usage:			Volts = 1.8	Ic = 1E-06	Vs = 0.018	Power = 7E-07		
Lb	PiT	PiS	PiC			Nc	Tj = 55	
0.001	2.582377	0.054	2			1		0.000279

D5			Volts = 100	Watts = 0.38	Tj = 175	'K/W= 394.74		
Usage:			Volts = 0.65	Ic = 0.003	Vs = 0.0065	Power = 0.002		
Lb	PiT	PiS	PiC			Nc	Tj = 55.77	
0.001	2.639967	0.054	2			1		0.000285

Diodes, Zener,  $L_b =$       0.002

D1			Volts = 3.1	Watts = 2.5	Tj = 175	'K/W= 60		
Usage:				Ic = 0.003		Power = 0.0093		
Lb	PiT	PiS	PiC			Nc	Tj = 55.558	
0.002	1.823571	1	2			1		0.007294

D6			Volts = 5	Watts = 1.6	Tj = 175	'K/W= 93.75		
Usage:				Ic = 0.003		Power = 0.015		
Lb	PiT	PiS	PiC			Nc	Tj = 56.406	
0.002	1.851292	1	2			1		0.007405

Sum of all components      0.359297

Hybrid microcircuit:

$$L_p = \sum L_c (1 + 2 \cdot P_i E) \cdot P_i F \cdot P_i Q \cdot P_i L$$

$$0.359297 \cdot 1.4 \cdot 5.8 \cdot 10 \cdot 1$$

Total failures per million hours = 29.175

Mean time between failures = 34276