

APEX MICROTECHNOLOGY CORPORATION  
RELIABILITY PREDICTION  
PA83

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 +/-	120 V
An AC signal is applied.	
Product introduction date:	01-May-81

The results of this prediction are:

4.43 failures per million hours; or,  
MTBF=225.5 thousand hours.

## Transistors, Low Frequency, Bipolar:

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

Q7		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125		
Usage:	Vstress = 1.3	Vpwr = 1.3	Ic = 1E-06	Vs = 0.0325	Power = 1E-06		
Lb	PiT	PiR	PiS	Nc	Tj = 40		
0.00074	1.404905	1.0698	0.04977	1			5.54E-05
Q11		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125		
Usage:	Vstress = 1.13	Vpwr = 1.13	Ic = 0.003	Vs = 0.0283	Power = 0.0034		
Lb	PiT	PiR	PiS	Nc	Tj = 40.424		
0.00074	1.417787	1.0698	0.049119	1			5.51E-05
Q6,17		Volts = 300	Watts = 26	Tj = 150	'K/W= 4.8077		
Usage:	Vstress = 235	Fraction Output Pwr = 1/	1	Vs = 0.7833	Power = 5		
Lb	PiT	PiR	PiS	Nc	Tj = 64.038		
0.00074	2.274314	3.3384	0.510298	2			0.005734
Q8,9		Volts = 300	Watts = 1.15	Tj = 150	'K/W= 108.7		
Usage:	Vstress = 110.3	Vpwr = 110.3	Ic = 0.0005	Vs = 0.3677	Power = 0.0552		
Lb	PiT	PiR	PiS	Nc	Tj = 45.995		
0.00074	1.595022	1.0531	0.140672	1			0.000175
Q15		Volts = 300	Watts = 1.15	Tj = 150	'K/W= 108.7		
Usage:	Vstress = 111.6	Vpwr = 111.6	Ic = 0.0012	Vs = 0.372	Power = 0.1295		
Lb	PiT	PiR	PiS	Nc	Tj = 54.071		
0.00074	1.87862	1.0531	0.142574	1			0.000209
Q3,16		Volts = 300	Watts = 1.15	Tj = 150	'K/W= 108.7		
Usage:	Vstress = 232.9	Vpwr = 118.3	Ic = 4E-09	Vs = 0.7763	Power = 5E-07		
Lb	PiT	PiR	PiS	Nc	Tj = 40		
0.00074	1.404902	1.0531	0.499344	2			0.001093
Q5		Volts = 300	Watts = 1.15	Tj = 150	'K/W= 108.7		
Usage:	Vstress = 110.2	Vpwr = 110.2	Ic = 0.0002	Vs = 0.3673	Power = 0.0176		
Lb	PiT	PiR	PiS	Nc	Tj = 41.917		
0.00074	1.46385	1.0531	0.140526	1			0.00016
Q1		Volts = 20	Watts = 0.38	Tj = 150	'K/W= 328.95		
Usage:	Vstress = 0.65	Vpwr = 0.65	Ic = 0.0005	Vs = 0.0325	Power = 0.0003		
Lb	PiT	PiR	PiS	Nc	Tj = 40.107		
0.00074	1.408144	0.6991	0.04977	1			3.63E-05

Q2,4		Volts = 20	Watts = 0.38	Tj =	150	'K/W= 328.95	
Usage:	Vstress = 3	Vpwr = 1.55	Ic = 0.0005	Vs =	0.15	Power = 0.0008	
Lb	PiT	PiR	PiS		Nc	Tj = 40.255	
0.00074	1.412643	0.6991	0.071641		2		0.000105

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

Q12		Volts = 50	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 5.4	Id = 0.0005			Power = 0.0027	
Lb	PiT				Nc	Tj = 40.084	
0.0045	1.365102				2		0.012286

Q13,14		Volts = 30	Watts = 0.8	Tj =	150	'K/W= 156.25	
Usage:		Vpwr = 5.03	Id = 2E-09			Power = 1E-08	
Lb	PiT				Nc	Tj = 40	
0.0045	1.362841				2		0.012266

Q10		Volts = 300	Watts = 3	Tj =	150	'K/W= 41.667	
Usage:		Vpwr = 231.6	Id = 0.0014			Power = 0.3312	
Lb	PiT				Nc	Tj = 53.8	
0.0045	1.766976				1		0.007951

Capacitors, ceramic general purpose type CK:

Lp = Lb \* PiT \* PiC \* PiV      Lb = 0.00099

C2		Volts = 100	pF = 1000				
Usage:	Vstress = 1			S =	0.01		
Lb	PiT	PiC	Pi V		Nc		
0.00099	1.92167	0.288	1		1		0.000549

C5,6		Volts = 200	pF = 100				
Usage:	Vstress = 1			S =	0.005		
Lb	PiT	PiC	Pi V		Nc		
0.00099	1.92167	0.234	1		2		0.000892

C4		Volts = 200	pF = 150				
Usage:	Vstress = 6.4			S =	0.032		
Lb	PiT	PiC	Pi V		Nc		
0.00099	1.92167	0.243	1.0002		1		0.000463

C3		Volts = 300	pF = 18				
Usage:	Vstress = 232.7			S =	0.7757		
Lb	PiT	PiC	Pi V		Nc		
0.00099	1.92167	0.201	3.1606		1		0.001208

C1		Volts = 45	pF = 47			
Usage:	Vstress = 1.05			S =	0.0233	
Lb	PiT	PiC	Pi V		Nc	
0.00099	1.92167	0.219	1.0001		1	0.000417

Diodes, Low Frequency:

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

Diodes, Zener, Lb = 0.002

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

D2		Volts = 3.1	Watts = 2.5	Tj = 175	'K/W= 60	
Usage:			Ic = 0.0014		Power = 0.0044	
Lb	PiT	PiS	PiC		Nc	Tj = 40.266
0.002	1.369977	1	2		1	0.00548

Sum of all components 0.054605

Hybrid microcircuit:

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

0.054605 1.4 5.8 10 1

Total failures per million hours = 4.433924

Mean time between failures = 225533.9