

APEX MICROTECHNOLOGY CORPORATION
RELIABILITY PREDICTION
PA81J

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 +/-	50 V
An AC signal is applied.	
Product introduction date:	
	15-May-86

The results of this prediction are:

3.84 failures per million hours; or,
MTBF=260 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-08	Vs = 0.0325	Power = 1E-08		
Lb	PiT	PiR	PiS	Nc	Tj = 40		
0.00074	1.4049	1.0698	0.0498	1			5.54E-05
11		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	0.0491	1			5.51E-05
Q6,17		Volts = 300	Watts = 26	Tj = 150	'K/W= 4.8077		
Usage:	Vstress = 95	Fraction Output Pwr = 1/ 1		Vs = 0.3167	Power = 5		
Lb	PiT	PiR	PiS	Nc	Tj = 64.038		
0.00074	2.274314	3.3384	0.1201	2			0.00135
Q8,9		Volts = 300	Watts = 1.15	Tj = 150	'K/W= 108.7		
Usage:	Vstress = 40.3	Vpwr = 40.3	Ic = 0.0005	Vs = 0.1343	Power = 0.0202		
Lb	PiT	PiR	PiS	Nc	Tj = 42.19		
0.00074	1.472407	1.0531	0.0682	2			0.000157
Q15		Volts = 300	Watts = 1.15	Tj = 150	'K/W= 108.7		
Usage:	Vstress = 41.6	Vpwr = 41.6	Ic = 0.0012	Vs = 0.1387	Power = 0.0483		
Lb	PiT	PiR	PiS	Nc	Tj = 45.245		
0.00074	1.570326	1.0531	0.0692	1			8.46E-05
Q3,16		Volts = 300	Watts = 1.15	Tj = 150	'K/W= 108.7		
Usage:	Vstress = 92.9	Vpwr = 48.3	Ic = 0.003	Vs = 0.3097	Power = 0.1449		
Lb	PiT	PiR	PiS	Nc	Tj = 55.75		
0.00074	1.941657	1.0531	0.1175	2			0.000356
Q5		Volts = 300	Watts = 1.15	Tj = 150	'K/W= 108.7		
Usage:	Vstress = 40.2	Vpwr = 40.2	Ic = 0.0002	Vs = 0.134	Power = 0.0064		
Lb	PiT	PiR	PiS	Nc	Tj = 40.699		
0.00074	1.426207	1.0531	0.0682	1			7.58E-05
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	0.0498	1			3.63E-05
Q2,4		Volts = 20	Watts = 0.38	Tj = 150	'K/W= 328.95		
Usage:	Vstress = 3	Vpwr = 1.55	Ic = 0.005	Vs = 0.15	Power = 0.0078		
Lb	PiT	PiR	PiS	Nc	Tj = 42.549		
0.00074	1.48369	0.6991	0.0716	2			0.00011

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 = 91.6	Id = 0.0014			Power = 0.131
Lb	PiT				Nc	Tj = 45.458
0.0045	1.514333				1	0.006814

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 = 92.7			S =	0.309	
Lb	PiT	PiC	Pi V		Nc	
0.00099	1.92167	0.201	1.1366		1	0.000434

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, $L_b = 0.002$

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

D1,4				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 0.047351

Hybrid microcircuit:

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

0.047351 1.4 5.8 10 1

Total failures per million hours = 3.8449

Mean time between failures = 260087