

APEX MICROTECHNOLOGY CORPORATION
RELIABILITY PREDICTION
PA07M/883

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	B
Environment is Gf	Ground, Fixed
Case temperature is	40 C
Internal Power Dissipation =	25 W
Supply voltage is +/-	25 V
An AC signal is applied.	
Product introduction date:	01-Oct-80

The results of this prediction are:

0.31 failures per million hours; or,
MTBF=3179 thousand hours.

Transistors, Low Frequency, Bipolar:

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

Q1		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125	
Usage:	Vstress = 0.65	Vpwr = 0.65	Ic = 0.0003	Vs = 0.0163	Power = 0.0002	
Lb	PiT	PiR	PiS	Nc	Tj = 40.022	
0.00074	1.405565	1.0698	0.0473	1		5.27E-05
Q2		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125	
Usage:	Vstress = 1.65	Vpwr = 1.65	Ic = 0.0003	Vs = 0.0413	Power = 0.0004	
Lb	PiT	PiR	PiS	Nc	Tj = 40.056	
0.00074	1.406589	1.0698	0.0511	1		5.69E-05
Q7,19,20,21		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125	
Usage:	Vstress = 0.65	Vpwr = 0.65	Ic = 1E-05	Vs = 0.0163	Power = 7E-06	
Lb	PiT	PiR	PiS	Nc	Tj = 40.001	
0.00074	1.404925	1.0698	0.0473	4		0.000211
Q11		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125	
Usage:	Vstress = 1.4	Vpwr = 1.4	Ic = 0.006	Vs = 0.035	Power = 0.0084	
Lb	PiT	PiR	PiS	Nc	Tj = 41.05	
0.00074	1.436986	1.0698	0.0502	1		5.71E-05
Q18		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125	
Usage:	Vstress = 3.1	Vpwr = 3.1	Ic = 1E-05	Vs = 0.0775	Power = 3E-05	
Lb	PiT	PiR	PiS	Nc	Tj = 40.004	
0.00074	1.405017	1.0698	0.0572	1		6.36E-05
Q3		Volts = 120	Watts = 1.2	Tj = 200	'K/W= 145.83	
Usage:	Vstress = 45.4	Vpwr = 23.5	Ic = 0.008	Vs = 0.3783	Power = 0.188	
Lb	PiT	PiR	PiS	Nc	Tj = 67.417	
0.00074	2.420376	1.0698	0.1454	1		0.000279
Q8		Volts = 140	Watts = 1.2	Tj = 200	'K/W= 145.83	
Usage:	Vstress = 42	Vpwr = 20.65	Ic = 0.0003	Vs = 0.3	Power = 0.0056	
Lb	PiT	PiR	PiS	Nc	Tj = 40.813	
0.00074	1.429702	1.0698	0.1141	1		0.000129
Q9		Volts = 140	Watts = 1.2	Tj = 200	'K/W= 145.83	
Usage:	Vstress = 41.15	Vpwr = 19.8	Ic = 0.0003	Vs = 0.2939	Power = 0.0053	
Lb	PiT	PiR	PiS	Nc	Tj = 40.78	
0.00074	1.428675	1.0698	0.1119	1		0.000127

Q10 Volts = 140 Watts = 1.2 Tj = 200 'K/W= 145.83
Usage: Vstress = 41.2 Vpwr = 41.2 Ic = 0.0034 Vs = 0.2943 Power = 0.1405
Lb PiT PiR PiS Nc Tj = 60.488
0.00074 2.127418 1.0698 0.1121 1 0.000189

Q15 Volts = 140 Watts = 1.2 Tj = 200 'K/W= 145.83
Usage: Vstress = 40.5 Vpwr = 21.5 Ic = 0.0007 Vs = 0.2893 Power = 0.0155
Lb PiT PiR PiS Nc Tj = 42.258
0.00074 1.474517 1.0698 0.1103 1 0.000129

Q16 Volts = 140 Watts = 1.2 Tj = 200 'K/W= 145.83
Usage: Vstress = 45.3 Vpwr = 22.65 Ic = 0.008 Vs = 0.3236 Power = 0.1812
Lb PiT PiR PiS Nc Tj = 66.425
0.00074 2.376859 1.0698 0.1227 1 0.000231

Q6,17 Volts = 100 Watts = 83 Tj = 200 'K/W= 2.1084
Usage: Vstress = 47 Fraction Output Pwr = 1/ 1 Vs = 0.47 Power = 25
Lb PiT PiR PiS Nc Tj = 92.711
0.00074 3.718932 5.1293 0.1932 2 0.005454

Q4 Volts = 20 Watts = 0.38 Tj = 150 'K/W= 328.95
Usage: Vstress = 1.6 Vpwr = 1.6 Ic = 0.0005 Vs = 0.08 Power = 0.0008
Lb PiT PiR PiS Nc Tj = 40.255
0.00074 1.412653 0.6991 0.0577 1 4.21E-05

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

Q12A,B Volts = 50 Watts = 4 Tj = 150 'K/W= 31.25
Usage: Vpwr = 3.45 Id = 0.0003 Power = 0.0009
Lb PiT PiR PiS Nc Tj = 40.029
0.0045 1.363621 2 0.012273

Capacitors, ceramic general purpose type CK:
Lp = Lb * PiT * PiC * PiV Lb = 0.00099

C1 Volts = 100 pF = 1000
Usage: Vstress = 46 S = 0.46
Lb PiT PiC Pi V Nc
0.00099 1.92167 0.288 1.4506 1 0.000796

C4 Volts = 100 pF = 2200
Usage: Vstress = 1.4 S = 0.014
Lb PiT PiC Pi V Nc
0.00099 1.92167 0.31 1 1 0.000589

C2		Volts = 100	pF = 120				
Usage:	Vstress = 44			S =		0.44	
Lb	PiT	PiC	Pi V			Nc	
0.00099	1.92167	0.238	1.3944			1	0.000632

C3		Volts = 200	pF = 150				
Usage:	Vstress = 4.05			S =		0.0203	
Lb	PiT	PiC	Pi V			Nc	
0.00099	1.92167	0.243	1			1	0.000463

C5		Volts = 200	pF = 150				
Usage:	Vstress = 0.87			S =		0.0044	
Lb	PiT	PiC	Pi V			Nc	
0.00099	1.92167	0.243	1			1	0.000463

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

Diodes, Zener, $L_b = 0.002$

D1,2		Volts = 3.1	Watts = 2.5	Tj =	175	'K/W= 60	
Usage:			Ic = 0.0035			Power = 0.0109	
Lb	PiT	PiS	PiC			Nc	Tj = 40.651
0.002	1.38035	1	2			2	0.011043

D1,4		Volts = 3.1	Watts = 2.5	Tj =	175	'K/W= 60	
Usage:			Ic = 0.0004			Power = 0.0012	
Lb	PiT	PiS	PiC			Nc	Tj = 40.07
0.002	1.364704	1	2			1	0.005459

Sum of all components 0.038736

Hybrid microcircuit:

$L_p = \sum L_c * (1 + .2 * P_{iE}) * P_{iF} * P_{iQ} * P_{iL}$
 0.038736 1.4 5.8 1 1

Total failures per million hours = 0.3145
 Mean time between failures = 3E+06