

APEX MICROTECHNOLOGY CORPORATION
RELIABILITY PREDICTION
PA07

by

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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 =	25 W
Supply voltage is +/-	25 V
An AC signal is applied.	
Product introduction date:	01-Oct-80

The results of this prediction are:

3.15 failures per million hours; or,
MTBF=318 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			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:

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

0.038736 1.4 5.8 10 1

Total failures per million hours = 3.1454

Mean time between failures = 317928