

APEX MICROTECHNOLOGY CORPORATION
RELIABILITY PREDICTION
PA05

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 =	100 W
Supply voltage is +/-	45 V
An AC signal is applied.	
Product introduction date:	01-Jun-94

The results of this prediction are:

25.5 failures per million hours; or,
MTBF=39.2 thousand hours.

Transistors, Low Frequency, Bipolar:

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

Q15,18		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125	
Usage:	Vstress = 0.65	Vpwr = 0.65	Ic = 0.002	Vs = 0.0163	Power = 0.0013	
Lb	PiT	PiR	PiS	Nc	Tj = 40.163	
0.00074	1.409832	1.0698	0.0473	2		0.000106
Q24		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125	
Usage:	Vstress = 3.3	Vpwr = 0.65	Ic = 0.02	Vs = 0.0825	Power = 0.013	
Lb	PiT	PiR	PiS	Nc	Tj = 41.625	
0.00074	1.454773	1.0698	0.0581	1		6.69E-05
Q37		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125	
Usage:	Vstress = 4.4	Vpwr = 4.4	Ic = 1E-05	Vs = 1E-05	Power = 4E-05	
Lb	PiT	PiR	PiS	Nc	Tj = 40.006	
0.00074	1.405067	1.0698	0.045	1		5.01E-05
Q12		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125	
Usage:	Vstress = 3.3	Vpwr = 0.65	Ic = 0.005	Vs = 0.0825	Power = 0.0033	
Lb	PiT	PiR	PiS	Nc	Tj = 40.406	
0.00074	1.417254	1.0698	0.0581	1		6.52E-05
Q13		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125	
Usage:	Vstress = 4	Vpwr = 4	Ic = 0.005	Vs = 0.1	Power = 0.02	
Lb	PiT	PiR	PiS	Nc	Tj = 42.5	
0.00074	1.482136	1.0698	0.0614	1		7.2E-05
Q14		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125	
Usage:	Vstress = 3.3	Vpwr = 0.65	Ic = 0.02	Vs = 0.0825	Power = 0.013	
Lb	PiT	PiR	PiS	Nc	Tj = 41.625	
0.00074	1.454773	1.0698	0.0581	1		6.69E-05
Q21,23		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125	
Usage:	Vstress = 0.65	Vpwr = 0.65	Ic = 0.002	Vs = 0.0163	Power = 0.0013	
Lb	PiT	PiR	PiS	Nc	Tj = 40.163	
0.00074	1.409832	1.0698	0.0473	2		0.000106
Q1,2		Volts = 60	Watts = 1.2	Tj = 175	'K/W= 125	
Usage:	Vstress = 3.1	Vpwr = 3.1	Ic = 1E-05	Vs = 0.0517	Power = 3E-05	
Lb	PiT	PiR	PiS	Nc	Tj = 40.004	
0.00074	1.405017	1.0698	0.0528	2		0.000117

Q3		Volts = 120	Watts = 1.2	Tj = 200	'K/W= 145.83	
Usage:	Vstress = 86.3	Vpwr = 41.3	Ic = 1E-05	Vs = 0.7192	Power = 0.0004	
Lb	PiT	PIR	PIs	Nc	Tj = 40.06	
0.00074	1.406727	1.0698	0.4182	1		0.000466
Q6,27		Volts = 120	Watts = 1.2	Tj = 200	'K/W= 145.83	
Usage:	Vstress = 0.65	Vpwr = 0.65	Ic = 0.02	Vs = 0.0054	Power = 0.013	
Lb	PiT	PIR	PIs	Nc	Tj = 41.896	
0.00074	1.463204	1.0698	0.0458	2		0.000106
Q10,33		Volts = 120	Watts = 1.2	Tj = 200	'K/W= 145.83	
Usage:	Vstress = 81.9	Vpwr = 42.3	Ic = 0.004	Vs = 0.6825	Power = 0.1692	
Lb	PiT	PIR	PIs	Nc	Tj = 64.675	
0.00074	2.301364	1.0698	0.3733	2		0.00136
Q11		Volts = 120	Watts = 1.2	Tj = 200	'K/W= 145.83	
Usage:	Vstress = 75.3	Vpwr = 75.3	Ic = 0.003	Vs = 0.6275	Power = 0.2259	
Lb	PiT	PIR	PIs	Nc	Tj = 72.944	
0.00074	2.672835	1.0698	0.3148	1		0.000666
Q4,25		Volts = 140	Watts = 1.2	Tj = 200	'K/W= 145.83	
Usage:	Vstress = 81.9	Vpwr = 42.3	Ic = 0.004	Vs = 0.585	Power = 0.1692	
Lb	PiT	PIR	PIs	Nc	Tj = 64.675	
0.00074	2.301364	1.0698	0.2759	2		0.001005
Q9,31		Volts = 140	Watts = 1.2	Tj = 200	'K/W= 145.83	
Usage:	Vstress = 0.65	Vpwr = 0.65	Ic = 0.02	Vs = 0.0046	Power = 0.013	
Lb	PiT	PIR	PIs	Nc	Tj = 41.896	
0.00074	1.463204	1.0698	0.0457	2		0.000106
Q26		Volts = 140	Watts = 1.2	Tj = 200	'K/W= 145.83	
Usage:	Vstress = 75.3	Vpwr = 75.3	Ic = 0.003	Vs = 0.5379	Power = 0.2259	
Lb	PiT	PIR	PIs	Nc	Tj = 72.944	
0.00074	2.672835	1.0698	0.2384	1		0.000504
Transistors, Low Frequency, Si JFET:		Lb = 0.0045				
Lp = Lb * PiT						
Q19,20,35,36		Volts = 30	Watts = 0.8	Tj = 150	'K/W= 156.25	
Usage:		Vpwr = 1.35	Id = 2E-09		Power = 3E-09	
Lb	PiT			Nc	Tj = 40	
0.0045	1.362841			4		0.024531

Transistors, Low Frequency, Si MOSFET: Lb = 0.012

Lp = Lb * PiT

Q5,7		Volts = 100	Watts = 187.5	Tj =	175	'K/W= 0.8	
Usage:		Fraction Output Pwr = 1/	2			Power = 50	
Lb	PiT				Nc	Tj = 80	
0.012	2.735936				2		0.065662
Q29,32		Volts = 100	Watts = 187.5	Tj =	175	'K/W= 0.8	
Usage:		Fraction Output Pwr = 1/	2			Power = 50	
Lb	PiT				Nc	Tj = 80	
0.012	2.735936				2		0.065662
Q22		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 4.2	Id = 0.01			Power = 0.042	
Lb	PiT				Nc	Tj = 41.313	
0.012	1.398295				1		0.01678
Q16,17		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 46.1	Id = 0.005			Power = 0.2305	
Lb	PiT				Nc	Tj = 47.203	
0.012	1.565058				2		0.037561
Q28		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 42.9	Id = 0.02			Power = 0.858	
Lb	PiT				Nc	Tj = 66.813	
0.012	2.214093				1		0.026569
Q30		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 39	Id = 0.01			Power = 0.39	
Lb	PiT				Nc	Tj = 52.188	
0.012	1.716127				1		0.020594
Q34		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 3.5	Id = 0.003			Power = 0.0105	
Lb	PiT				Nc	Tj = 40.328	
0.012	1.371647				1		0.01646
Q8		Volts = 450	Watts = 35	Tj =	150	'K/W= 3.5714	
Usage:		Vpwr = 42.9	Id = 0.02			Power = 0.858	
Lb	PiT				Nc	Tj = 43.064	
0.012	1.446575				1		0.017359

Capacitors, ceramic general purpose type CK:

$L_p = L_b * P_{iT} * P_{iC} * P_{iV}$ $L_b =$ 0.00099

C1			Volts = 50	pF = 47				
Usage:	Vstress = 1.6				S =		0.032	
Lb	PiT	PiC	Pi V			Nc		
0.00099	1.92167	0.219	1.0002			1		0.000417

C2			Volts = 50	pF = 15000				
Usage:	Vstress = 6.6				S =		0.132	
Lb	PiT	PiC	Pi V			Nc		
0.00099	1.92167	0.368	1.0106			1		0.000708

Diodes, Low Frequency:

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

Diodes, Switching, $L_b =$ 0.001

D5			Volts = 100	Watts = 0.38	Tj = 175	'K/W= 394.74		
Usage:			Volts = 3.3	Ic = 1E-05	Vs = 0.033	Power = 7E-06		
Lb	PiT	PiS	PiC			Nc	Tj = 40.003	
0.001	1.644053	0.054	2			1		0.000178

Diodes, Zener, $L_b =$ 0.002

D1			Volts = 5	Watts = 1.6	Tj = 175	'K/W= 93.75		
Usage:				Ic = 0.003		Power = 0.015		
Lb	PiT	PiS	PiC			Nc	Tj = 41.406	
0.002	1.400851	1	2			1		0.005603

D2,4			Volts = 3.1	Watts = 2.5	Tj = 175	'K/W= 60		
Usage:				Ic = 0.003		Power = 0.0093		
Lb	PiT	PiS	PiC			Nc	Tj = 40.558	
0.002	1.377839	1	2			2		0.011023

Sum of all components 0.31397

Hybrid microcircuit:

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

0.31397	1.4	5.8	10	1
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Total failures per million hours = 25.494

Mean time between failures = 39224