

APEX MICROTECHNOLOGY CORPORATION
RELIABILITY PREDICTION
PA88

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 =	5 W
Supply voltage is +/-	180 V
An AC signal is applied.	
Product introduction date:	01-Aug-88

The results of this prediction are:

20.7 failures per million hours; or,
MTBF=48.3 thousand hours.

Transistors, Low Frequency, Bipolar:

$L_p = L_b * PiT * PiR * PiS$

Q12,17		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125	
Usage:	Vstress = 1.3	Vpwr = 1.3	Ic = 1E-05	Vs = 0.0325	Power = 1E-05	
Lb	PiT	PiR	PiS	Nc	Tj = 40.002	
0.00074	1.404949	1.0698	0.0498	2		0.000111

Q1		Volts = 120	Watts = 1.2	Tj = 200	'K/W= 145.83	
Usage:	Vstress = 0.65	Vpwr = 0.65	Ic = 8E-05	Vs = 0.0054	Power = 5E-05	
Lb	PiT	PiR	PiS	Nc	Tj = 40.007	
0.00074	1.405116	1.0698	0.0458	1		5.09E-05

Q2		Volts = 140	Watts = 1.2	Tj = 200	'K/W= 145.83	
Usage:	Vstress = 4.3	Vpwr = 4.3	Ic = 8E-05	Vs = 0.0307	Power = 0.0003	
Lb	PiT	PiR	PiS	Nc	Tj = 40.047	
0.00074	1.406326	1.0698	0.0495	1		5.51E-05

Transistors, Low Frequency, Si JFET: Lb = 0.0045

$L_p = L_b * PiT$

Q10A,B		Volts = 50	Watts = 4	Tj = 150	'K/W= 31.25	
Usage:		Vpwr = 3	Id = 8E-05		Power = 0.0002	
Lb	PiT			Nc	Tj = 40.007	
0.0045	1.36303			2		0.012267

Q19		Volts = 30	Watts = 0.8	Tj = 150	'K/W= 156.25	
Usage:		Vpwr = 1.5	Id = 1E-06		Power = 2E-06	
Lb	PiT			Nc	Tj = 40	
0.0045	1.362848			2		0.012266

Transistors, Low Frequency, Si MOSFET: Lb = 0.012

$L_p = L_b * PiT$

Q9,18		Volts = 450	Watts = 25	Tj = 150	'K/W= 5	
Usage:		Fraction Output Pwr = 1/	1		Power = 5	
Lb	PiT			Nc	Tj = 65	
0.012	2.147846			2		0.051548

Q3		Volts = 450	Watts = 4	Tj = 150	'K/W= 31.25	
Usage:		Vpwr = 175.7	Id = 3E-05		Power = 0.0053	
Lb	PiT			Nc	Tj = 40.165	
0.012	1.367257			1		0.016407

Q4		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 350.9	Id = 8E-05			Power = 0.0263	
Lb	PiT				Nc	Tj = 40.822	
0.012	1.384985				1		0.01662
Q5,14		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 3	Id = 8E-05			Power = 0.0002	
Lb	PiT				Nc	Tj = 40.007	
0.012	1.36303				2		0.032713
Q6		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 171	Id = 8E-05			Power = 0.0128	
Lb	PiT				Nc	Tj = 40.401	
0.012	1.373602				1		0.016483
Q7		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 170.8	Id = 8E-05			Power = 0.0128	
Lb	PiT				Nc	Tj = 40.4	
0.012	1.37359				1		0.016483
Q11		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 6	Id = 0.0004			Power = 0.0024	
Lb	PiT				Nc	Tj = 40.075	
0.012	1.364851				1		0.016378
Q13		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 176	Id = 0.0002			Power = 0.0317	
Lb	PiT				Nc	Tj = 40.99	
0.012	1.389527				1		0.016674
Q15,16		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 171	Id = 0.0005			Power = 0.077	
Lb	PiT				Nc	Tj = 42.405	
0.012	1.428266				2		0.034278

Capacitors, ceramic general purpose type CK:

$L_p = L_b * PiT * PiC * PiV$ $L_b =$ 0.00099

C3		Volts = 200	pF = 150				
Usage:	Vstress = 6			S =	0.03		
Lb	PiT	PiC	PiV		Nc		
0.00099	1.92167	0.243	1.0001		1		0.000463

C1	Volts =	100	pF =	470		
Usage:	Vstress =	6	S =	0.06		
Lb	PiT	PiC	Pi V	Nc		
0.00099	1.92167	0.269	1.001	1		0.000513

C2	Volts =	100	pF =	470		
Usage:	Vstress =	1.5	S =	0.015		
Lb	PiT	PiC	Pi V	Nc		
0.00099	1.92167	0.269	1	1		0.000513

Diodes, Low Frequency:

$Lp = Lb * PiT * PiS * PiC$

Diodes, Switching, Lb = 0.001

D4,5	Volts =	100	Watts =	0.38	Tj =	175	'K/W=	394.74
Usage:	Volts =	2.5	Ic =	1E-05	Vs =	0.025	Power =	7E-06
Lb	PiT	PiS	PiC	Nc	Tj =	40.003		
0.001	1.644053	0.054	2	2				0.000355

Diodes, Zener, Lb = 0.002

D1,2	Volts =	3.1	Watts =	2.5	Tj =	175	'K/W=	60
Usage:	Ic =	8E-05	Power =	0.0002				
Lb	PiT	PiS	PiC	Nc	Tj =	40.014		
0.002	1.363215	1	2	2				0.010906

Sum of all components 0.255084

Hybrid microcircuit:

$Lp = \text{sum} Lc * (1 + .2 * PiE) * PiF * PiQ * PiL$

0.255084	1.4	5.8	10	1
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Total failures per million hours = 20.713

Mean time between failures = 48279