

APEX MICROTECHNOLOGY CORPORATION
RELIABILITY PREDICTION
PA08

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 +/-	135 V
An AC signal is applied.	
Product introduction date:	01-Mar-83

The results of this prediction are:

6.66 failures per million hours; or,
MTBF=150 thousand hours.

Transistors, Low Frequency, Bipolar:

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

Q18		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125		
Usage:	Vstress = 3.1	Vpwr = 3.1	Ic = 1E-06	Vs = 0.0775	Power = 3E-06		
Lb	PiT	PiR	PiS	Nc	Tj = 40		
0.00074	1.404912	1.0698	0.0572	1			6.36E-05
Q7		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125		
Usage:	Vstress = 1	Vpwr = 1	Ic = 1E-06	Vs = 0.025	Power = 1E-06		
Lb	PiT	PiR	PiS	Nc	Tj = 40		
0.00074	1.404904	1.0698	0.0486	1			5.41E-05
Q11		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125		
Usage:	Vstress = 1.3	Vpwr = 1.3	Ic = 0.003	Vs = 0.0325	Power = 0.0039		
Lb	PiT	PiR	PiS	Nc	Tj = 40.488		
0.00074	1.419733	1.0698	0.0498	1			5.59E-05
Q19		Volts = 40	Watts = 1.2	Tj = 175	'K/W= 125		
Usage:	Vstress = 1.3	Vpwr = 1.3	Ic = 1E-06	Vs = 0.0325	Power = 1E-06		
Lb	PiT	PiR	PiS	Nc	Tj = 40		
0.00074	1.404905	1.0698	0.0498	1			5.54E-05
Q6,17		Volts = 300	Watts = 26	Tj = 150	'K/W= 4.8077		
Usage:	Vstress = 267.5	Fraction Output Pwr = 1/	1	Vs = 0.8917	Power = 5		
Lb	PiT	PiR	PiS	Nc	Tj = 64.038		
0.00074	2.274314	3.3384	0.714	2			0.008023
Q3,16		Volts = 300	Watts = 1.15	Tj = 150	'K/W= 108.7		
Usage:	Vstress = 265.7	Vpwr = 133	Ic = 0.003	Vs = 0.8857	Power = 0.399		
Lb	PiT	PiR	PiS	Nc	Tj = 83.37		
0.00074	3.19605	1.0531	0.7008	2			0.003491
Q5		Volts = 300	Watts = 1.15	Tj = 150	'K/W= 108.7		
Usage:	Vstress = 126.2	Vpwr = 126.2	Ic = 0.0002	Vs = 0.4207	Power = 0.0202		
Lb	PiT	PiR	PiS	Nc	Tj = 42.195		
0.00074	1.47255	1.0531	0.1658	1			0.00019
Q8,9		Volts = 300	Watts = 1.15	Tj = 150	'K/W= 108.7		
Usage:	Vstress = 125.6	Vpwr = 125.6	Ic = 0.0005	Vs = 0.4187	Power = 0.0628		
Lb	PiT	PiR	PiS	Nc	Tj = 46.826		
0.00074	1.622742	1.0531	0.1648	2			0.000417

Q15		Volts =	300	Watts =	1.15	Tj =	150	'K/W=	108.7	
Usage:	Vstress =	127.6	Vpwr =	127.6	Ic =	0.0012	Vs =	0.4253	Power =	0.148
Lb	PiT		PiR	PiS			Nc	Tj =	56.089	
0.00074	1.954549		1.0531	0.1682			1		0.000256	
Q1		Volts =	20	Watts =	0.38	Tj =	150	'K/W=	328.95	
Usage:	Vstress =	0.6	Vpwr =	0.6	Ic =	0.0005	Vs =	0.03	Power =	0.0003
Lb	PiT		PiR	PiS			Nc	Tj =	40.099	
0.00074	1.407894		0.6991	0.0494			1		3.6E-05	
Q2		Volts =	20	Watts =	0.38	Tj =	150	'K/W=	328.95	
Usage:	Vstress =	1.67	Vpwr =	1.67	Ic =	0.0005	Vs =	0.0835	Power =	0.0008
Lb	PiT		PiR	PiS			Nc	Tj =	40.275	
0.00074	1.413244		0.6991	0.0583			1		4.26E-05	
Q4		Volts =	20	Watts =	0.38	Tj =	150	'K/W=	328.95	
Usage:	Vstress =	1.3	Vpwr =	1.3	Ic =	0.0005	Vs =	0.065	Power =	0.0006
Lb	PiT		PiR	PiS			Nc	Tj =	40.197	
0.00074	1.410872		0.6991	0.055			1		4.02E-05	
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	Id =	0.0005			Power =	0.0025
Lb	PiT						Nc	Tj =	40.078	
0.0045	1.364935						2		0.012284	
Transistors, Low Frequency, Si MOSFET: Lb = 0.012										
Lp = Lb * PiT										
Q10		Volts =	450	Watts =	2.25	Tj =	150	'K/W=	55.556	
Usage:			Vpwr =	261.8	Id =	0.001			Power =	0.2618
Lb	PiT						Nc	Tj =	54.544	
0.012	1.790807						2		0.042979	
Capacitors, ceramic general purpose type CK:										
Lp = Lb * PiT * PiC * PiV Lb = 0.00099										
C4		Volts =	200	pF =	150					
Usage:	Vstress =	6.4				S =	0.032			
Lb	PiT	PiC	PiV				Nc			
0.00099	1.92167	0.243	1.0002				1		0.000463	

C3				Volts =	300	pF =	18			
Usage:	Vstress =	265						S =		0.8833
Lb	PiT	PiC	Pi V						Nc	
0.00099	1.92167	0.201	4.191						1	0.001602
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
C1				Volts =	45	pF =	47			
Usage:	Vstress =	1.2						S =		0.0267
Lb	PiT	PiC	Pi V						Nc	
0.00099	1.92167	0.219	1.0001						1	0.000417

Diodes, Low Frequency:

$Lp = Lb * PiT * PiS * PiC$

Diodes, Zener, Lb = 0.002

D1,2				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						2		0.010943	
											Sum of all components	0.081961

Hybrid microcircuit:

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

0.081961 1.4 5.8 10 1

Total failures per million hours = 6.6552
Mean time between failures = 150258