

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      Pi V    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:  
 $L_p = L_b * P_{iT} * P_{iS} * P_{iC}$

Diodes, Zener,  $L_b = 0.002$

D1,2			Volts = 3.1	Watts = 2.5	Tj = 175	'K/W= 60		
Usage:				Ic = 0.001		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:

$L_p = \sum L_c * (1 + .2 * P_{iE}) * P_{iF} * P_{iQ} * P_{iL}$   
0.081961 1.4 5.8 10 1

Total failures per million hours = 6.6552

Mean time between failures = 150258