

APEX MICROTECHNOLOGY CORPORATION  
RELIABILITY PREDICTION  
PA85

by

Granger Scofield

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 +/-	175 V
An AC signal is applied.	
Product introduction date:	01-Nov-87

The results of this prediction are:

27.3 failures per million hours; or,  
MTBF=36.7 thousand hours.

Transistors, Low Frequency, Bipolar:

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

Q12,17                      Volts = 40          Watts = 1.2      Tj =                      175      'K/W= 125  
 Usage:    Vstress = 2.15    Vpwr = 2.15      Ic =            1E-05    Vs =                      0.0538    Power = 2E-05  
 Lb        PiT                      PiR      PiS                      Nc        Tj =            40.003  
 0.00074    1.404981            1.0698    0.0532                      2    0.000118

Q1                                      Volts = 120        Watts = 1.2      Tj =                      200      'K/W= 145.83  
 Usage:    Vstress = 0.65    Vpwr = 0.65      Ic =            0.0024    Vs =                      0.0054    Power = 0.0016  
 Lb        PiT                      PiR      PiS                      Nc        Tj =            40.23  
 0.00074    1.411895            1.0698    0.0458                      1    5.11E-05

Q2                                      Volts = 120        Watts = 1.2      Tj =                      200      'K/W= 145.83  
 Usage:    Vstress = 5.22    Vpwr = 5.22      Ic =            0.0025    Vs =                      0.0435    Power = 0.0129  
 Lb        PiT                      PiR      PiS                      Nc        Tj =            41.888  
 0.00074    1.462957            1.0698    0.0515                      1    5.96E-05

Transistors, Low Frequency, Si JFET:    Lb =    0.0045

$L_p = L_b * P_{iT}$

Q10A,B                      Volts = 25          Watts = 0.55      Tj =                      150      'K/W= 227.27  
 Usage:                              Vpwr = 3.285      Id =            0.0025                      Power = 0.0082  
 Lb        PiT    Nc        Tj =            41.859  
 0.0045    1.413239    2    0.012719

Transistors, Low Frequency, Si MOSFET: Lb = 0.012

$L_p = L_b * P_{iT}$

Q6,7                                      Volts = 450        Watts = 4          Tj =                      150      'K/W= 31.25  
 Usage:                              Vpwr = 167        Id =            0.0025                      Power = 0.4142  
 Lb        PiT    Nc        Tj =            52.943  
 0.012    1.73982    2    0.041756

Q13                                      Volts = 450        Watts = 4          Tj =                      150      'K/W= 31.25  
 Usage:                              Vpwr = 170        Id =            0.0051                      Power = 0.8687  
 Lb        PiT    Nc        Tj =            67.147  
 0.012    2.226457    1    0.026717

Q5,14                                      Volts = 450        Watts = 4          Tj =                      150      'K/W= 31.25  
 Usage:                              Vpwr = 2.7        Id =            0.001                      Power = 0.0027  
 Lb        PiT    Nc        Tj =            40.084  
 0.012    1.365102    2    0.032762

Q4,15		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 340.7	Id = 0.001			Power = 0.3407	
Lb	PiT				Nc	Tj = 50.647	
0.012	1.668443				2		0.040043
Q16		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 166.5	Id = 0.013			Power = 2.1645	
Lb	PiT				Nc	Tj = 107.64	
0.012	4.06522				1		0.048783
Q3		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 166.5	Id = 0.0002			Power = 0.025	
Lb	PiT				Nc	Tj = 40.78	
0.012	1.38385				1		0.016606
Q8		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 171	Id = 0.013			Power = 2.223	
Lb	PiT				Nc	Tj = 109.47	
0.012	4.164685				1		0.049976
Q11		Volts = 450	Watts = 4	Tj =	150	'K/W= 31.25	
Usage:		Vpwr = 5	Id = 0.0126			Power = 0.063	
Lb	PiT				Nc	Tj = 41.969	
0.012	1.416252				1		0.016995
Q9,18		Volts = 450	Watts = 50	Tj =	150	'K/W= 2.5	
Usage:		Fraction Output Pwr = 1/	1			Power = 5	
Lb	PiT				Nc	Tj = 52.5	
0.012	1.725908				2		0.041422

Capacitors, ceramic general purpose type CK:

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

C6		Volts = 100	pF = 15000				
Usage:	Vstress = 4.6			S =		0.046	
Lb	PiT	PiC	Pi V		Nc		
0.00099	1.92167	0.368	1.0005		1		0.0007

C4		Volts = 100	pF = 15000				
Usage:	Vstress = 5.7			S =		0.057	
Lb	PiT	PiC	Pi V		Nc		
0.00099	1.92167	0.368	1.0009		1		0.000701

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 = 1.6				S = 0.016	
Lb	PiT	PiC	Pi V		Nc	
0.00099	1.92167	0.269	1		1	0.000513

## Diodes, Low Frequency:

$$L_p = L_b * P_iT * P_iS * P_iC$$

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		1	0.005471

Sum of all components 0.335907

## Hybrid microcircuit:

$$L_p = \text{sum}L_c * (1 + .2 * P_iE) * P_iF * P_iQ * P_iL$$

0.335907 1.4 5.8 10 1

Total failures per million hours = 27.276

Mean time between failures = 36663