Classification : Report	Reliability Prediction Report

Reliability Prediction Report

The details of the system are as follows :

1. Date : 2004-10-11
2. Model : SS110 v1.0
3. Quantity : 1
4. Analyst : SENA

5. Results

Name	Failure Rate	MTBF	Remark
SS110 v1.0	1.346721 Fits	742,544 Hours	84.77 years

* Failure Rate Unit = Failure Per Million Hour(10^6)

Standard : MIL-HDBK-217F Notice2 Failure Distribution : Exponential Operating Temperature : 25 °C Operating Stress : 50% (Voltage, Current, Power)

Reliability Prediction Report

Contents

I. Purpose

A reliability prediction is simply the analysis of parts and components in an effort to predict the rate at which an item will fail. A reliability prediction is one of the most common forms of reliability analyses. These predictions can help development engineers make decisions about component selection, stress levels and different designs.

II. Terms

1. MTBF (Mean Time Between Failure)

The average between failure occurrences. The sum of the operating time of a machine divided by the total number of failures.

2. MTTF (Mean Time To Failure)

A basic measure of system reliability for non-repairable items: The total number of life units of an item divided by the total number of failures within that population, during a particular measurement interval under stated conditions.

3. Failure

An event when machinery/equipment is not available to produce parts at specified conditions when scheduled or is not capable of producing parts or perform scheduled operations to specification. For every failure, an action is required.

4. Failure Rate
Number of failures per unit of gross operating period in terms of time, events, cycles, or number of parts.

5. Reliability
The probability that machinery/equipment can perform continuously, without failure, for a specified interval of time when operating under stated conditions.

6. Availability
A measure of the degree to which machinery/equipment is in an operable and committable state at any point in time. Specifically, the percent of time that machinery/equipment will be operable when needed.

III. Analysis Methods

1) Model : MIL-HDBK-217

This handbook contains two methods of reliability prediction such as Part Stress Analysis and part Count. These methods vary in degree of information needed to apply them

1-1) Part Stress Methods
Part Stress Analysis Methods requires a greater amount of detailed information and is applicable during the later design phase when actual hardware and circuits being designed.

1-2) Parts Count Methods
Parts Count Methods required less information, generally part quantities, quality level and the application environment. The Parts Count Methods will usally result in a more conservative estimate of system reliability than the Parts Stress Method.

1-3) equation for calculation

MIL-HDBK-217F Gate/Logic Arrays and Microprocessor Equations

$$\lambda_P = (C_1\pi_T + C_2\pi_E)\pi_Q\pi_L$$

where:

$C_1 =$	Die Complexity Failure Rate
$\pi_T =$	Temperature Factor
$C_2 =$	Package Failure Rate
$\pi_E =$	Environment Factor
$\pi_Q =$	Quality Factor
$\pi_L =$	Learning Factor

MIL-HDBK-217F Memories Equations

$$\lambda_P = (C_1\pi_T + C_2\pi_E + \lambda_{cyc})\pi_Q\pi_L$$

where:

$C_1 =$	Die Complexity Failure Rate
$\pi_T =$	Temperature Factor
$C_2 =$	Package Failure Rate
$\pi_E =$	Environment Factor
$\lambda_{cyc} =$	EEPROM Read/Write Cycling Induced Failure Rate
$\pi_Q =$	Quality Factor
$\pi_L =$	Learning Factor

MIL-HDBK-217F VHSIC/VHSIC-Like and VLSI CMOS Equations

$$\lambda_P = \lambda_{BD}\pi_{MFG}\pi_T\pi_{CD} + \lambda_{BP}\pi_E\pi_Q\pi_{PT} + \lambda_{EOS}$$

where:

λ_{BD} =	Die Base Failure Rate
π_{MFG} =	Manufacturing Process Correction Factor
π_T =	Temperature Factor
π_{CD} =	Die Complexity Correction Factor
λ_{BP} =	Package Base Failure Rate
π_E =	Environment Factor
π_Q =	Quality Factor
π_{PT} =	Package Type Correction Factor
λ_{EOS} =	Electrical Overstress Failure Rate

MIL-HDBK-217F GaAs MMIC and Digital Devices Equations

$$\lambda_P = (C_1\pi_T\pi_A + C_2\pi_E)\pi_L\pi_Q$$

where:

C_1 =	Die Complexity Failure Rate
π_T =	Temperature Factor
π_A =	Device Application Factor
C_2 =	Package Failure Rate
π_E =	Environment Factor
π_L =	Learning Factor
π_Q =	Quality Factor

Failure Rate(λ) = $1X10^6$ Hours

MTBF=1/λ

2) Model : Bellcore(Telcordia) TR-332

The Bellcore reliability prediction model was originally developed by AT&T Bell Labs. Bell Labs modified the equations from MIL-HDBK-217 to better represent what their equipment was experiencing in the field. The main concepts between MIL-HDBK-217 and Bellcore were very similar, but Bellcore added the ability to take into account burn-in, field, and laboratory testing. This added ability has made the Bellcore standard very popular with commercial organizations. The current version of Telcordia is Issue 1, and follows Bellcore Issue 6 in order of release. Telcordia Issue 1 was released in May 2001.
Telcordia also supports the ability to perform a parts count or part stress analysis, but in Telcordia, these different calculations are referred to as Calculation Methods. Telcordia offers ten different Calculation Methods. Each of these Methods is designed to take into account different information. This information can include stress data, burn-in data, field data, or laboratory test data.

Failure Rate(λ)= $1X10^9$ Hours (FITs)
MTBF=$1/\lambda$

Bellcore Method I – Case 1 Equations

Device Steady-State Failure rate = λ_{SSi}

$$\lambda_{SSi} = \lambda_{Gi}\pi_{Qi}\pi_{Si}\pi_{Ti}$$

where:

λ_{Gi} =	Generic steady-state failure rate for the *ith* device
π_{Qi} =	Quality Factor for the *ith* device
π_{Si} =	Stress Factor = based on 50% stress (value of 1.0)
π_{Ti} =	Temperature Factor = based on 40°C temperature (value of 1.0)

Bellcore Method I – Case 2 Equations

Same as Method 1 – Case 1 above.

Bellcore Method I – Case 3 Equations

Device Steady-State Failure rate = λ_{SSi}

$\lambda_{SSi} = \lambda_{Gi}\pi_{Qi}\pi_{Si}\pi_{Ti}$

where:

λ_{Gi} =	Generic steady-state failure rate for the *ith* device
π_{Qi} =	Quality Factor for the *ith* device
π_{Si} =	Stress Factor for the *ith* device
π_{Ti} =	Temperature Factor for the *ith* device due to normal operating temperature during the steady state

Bellcore Method II Equations

Method II Equations are based on the same basic principles as Method I. The calculation of the Device Steady-State Failure rate (λ_{SSi}) is the same as Method I with the only difference being the possible calculation of λ^*_{Gi}. The basic equation is as follows:

$$\lambda_{SSi} = \lambda^*_{Gi}\pi_{Qi}\pi_{Si}\pi_{Ti}$$

where:

λ^*_{Gi} =	Base steady-state failure rate for the *ith* device
π_{Qi} =	Quality Factor for the *ith* device
π_{Si} =	Stress Factor for the *ith* device
π_{Ti} =	Temperature Factor for the *ith* device due to normal operating temperature during the steady state

The basis for the calculation of λ^*_{Gi} is outlined below for each different case:

Bellcore Method II – Case L1 Equations

If $T_1 \leq 10{,}000$, then:

$$\lambda^*_{Gi} = [2 + n] \;/\; [(2/\lambda_{Gi}) + (4 \times 10^{-6}) N_0 (T_1)^{0.25} \pi_Q]$$

If $T_1 > 10{,}000$, then:

$$\lambda^*_{Gi} = [2 + n] \;/\; [(2/\lambda_{Gi}) + ((3 \times 10^{-5}) + (T_1 \times 10^{-9})) N_0 \pi_Q]$$

where:

$n =$	The number of failures in the laboratory test
$\lambda_{Gi} =$	Generic steady-state failure rate for the *ith* device
$N_0 =$	Number of devices on test
$T_1 =$	Effective time on test in hours
$\pi_Q =$	Device Quality Factor

Bellcore Method II – Case L2 Equations

If $T_1 \leq 10{,}000$, then:

$$\lambda^*_{Gi} = [2 + n] / [(2/\lambda_G) + (4 \times 10^{-6}) N_0 (T_1)^{0.25}]$$

If $T_1 > 10{,}000$, then:

$$\lambda^*_{Gi} = [2 + n] \;/\; [(2/\lambda_G) + ((3 \times 10^{-5}) + (T_1 \times 10^{-9})) N_0]$$

where:

$n =$	The number of failures in the laboratory test
$\lambda_G =$	Generic failure rate
$N_0 =$	Number of units on test
$T_1 =$	Effective time on test in hours

Bellcore Method II – Case L3 Equations

$$\lambda^{*}_{\mathrm{Gi}} = [2 + \mathrm{n}] \;/\; [(2/\lambda_{\mathrm{Gi}}) + (4 \times 10^{-6})\mathrm{N}_0 \mathrm{W} \pi_{\mathrm{Q}}]$$

where:

$n =$	The number of failures in the laboratory test
$\lambda_{\mathrm{Gi}} =$	Generic steady-state failure rate for the *ith* device
$\mathrm{N}_0 =$	Number of devices on test
$\pi_{\mathrm{Q}} =$	Device Quality Factor
$\mathrm{W} =$	Special time factor

If $\mathrm{T}_1 + \mathrm{T}_e \leq 10{,}000$, then: $\mathrm{W} = (\mathrm{T}_1 + \mathrm{T}_e)^{0.25} - \mathrm{T}_e^{0.25}$

If $\mathrm{T}_1 + \mathrm{T}_e > 10{,}000 \geq \mathrm{T}_e$, then:

$$\mathrm{W} = ((\mathrm{T}_1 + \mathrm{T}_e)/4000) + 7.5 - \mathrm{T}_e^{0.25}$$

If $\mathrm{T}_e > 10{,}000$, then: $\mathrm{W} = \mathrm{T}_1/4000$

where:

$\mathrm{T}_1 =$	The effective time on test
$\mathrm{T}_e =$	Total effective burn-in time for devices as defined: $\mathrm{T}_e = A_{b,d} t_{b,d}$ where: $A_{b,d}$ = temperature acceleration factor due to device burn-in $t_{b,d}$ = device burn-in time (hours)
$\mathrm{N}_0 =$	Number of devices on test
$\pi_{\mathrm{Q}} =$	Device Quality Factor
$\mathrm{W} =$	Special time factor

Bellcore Method II – Case L4 Equations

$\lambda^*_{Gi} = [2 + n] \ / \ [(2 / \lambda_{Gi}) + (4 \times 10^{-6}) N_0 W]$

where:

$n =$	The number of failures in the laboratory test
$\lambda_{Gi} =$	Generic steady-state failure rate for the *ith* device
$N_0 =$	Number of devices on test
$W =$	Special time factor

If $T_1 + T_e \leq 10{,}000$, then: $W = (T_1 + T_e)^{0.25} - T_e^{0.25}$

If $T_1 + T_e > 10{,}000 \geq T_e$, then:

$$W = ((T_1 + T_e) / 4000) + 7.5 - T_e^{0.25}$$

If $T_e > 10{,}000$, then: $W = T_1 / 4000$

where:

$T_1 =$	The effective time on test
$T_e =$	Total effective burn-in time for devices as defined: $$T_e = T^*_{b,d} + A_{b,u} t_{b,u}$$ where: $T^*_{b,d}$ = average device effective burn-in time; $A_{b,u}$ = temperature acceleration factor due to device burn-in; $t_{b,u}$ = device burn-in time (hours)
$N_0 =$	Number of devices on test
$\pi_Q =$	Device Quality Factor
$W =$	Special time factor

Bellcore Method III Equations

Due to the complexity and detail of the calculations for Method III, the equations have not been included for reference here. Refer to the Bellcore "Reliability Prediction Procedure for Electronic Equipment" for all details regarding Method III equations.

RDF 2000

RDF 2000 is the new version of the CNET UTEC80810 reliability prediction standard that covers most of the same components as MIL-HDBK-217. The models take into account power on/off cycling as well as temperature cycling and are very complex with predictions for integrated circuits requiring information on equipment outside ambient and print circuit ambient temperatures, type of technology, number of transistors, year of manufacture, junction temperature, working time ratio, storage time ratio, thermal expansion characteristics, number of thermal cycles, thermal amplitude of variation, application of the device, as well as per transistor, technology related and package related base failure rates. As this standard becomes more widely used it could become the international successor to the US MIL-HDBK-217

NPRD-95 data

NPRD-95 data provides failure rates for a wide variety of items, including mechanical and electromechanical parts and assemblies. The document provides detailed failure rate data on over 25,000 parts for numerous part categories grouped by environment and quality level. Because the data does not include time-to-failure, the document is forced to report average failure rates to account for both defects and wearout. Cumulatively, the database represents approximately 2.5 trillion part hours and 387,000 failures accumulated from the early 1970's through 1994. The environments addressed include the same ones covered by MIL-HDBK-217; however, data is often very limited for some environments and specific part types. For these cases, it then becomes necessary to use the "rolled up" estimates provided, which make use of all data available for a broader class of parts and environments. Although the data book approach is generally thought to be less desirable, it remains an economical means of estimating "ballpark" reliability for mechanical components.

Reliability Prediction Report

Part Number SS110 V1.0
Date 2004 10, 11
Environment GB, GC
Temperature 25

MIL-HDBK-217FN2
Failure Rate 1.346721
MTBF 742,544

Assembly Name	Part Number	Ref Des	Qty	Failure Rate	MTBF	Reliability
SS110 V1.0	SS110 V1.0	SS110 V1.0	1.00	1.346721	742,544	.9999

Reliability Prediction Report

Part Number	SS110 V1.0
Date	2004 10, 11
Environment	GB, GC
Temperature	25

MIL-HDBK-217FN2

Failure Rate	1.346721
MTBF	742,544

Part Number	Description	Category	Pi Factors	Qty	Failure Rate	MTBF
XPC855TZP50D4	CPU	Integrated Circuit	C1: 0.140000 C2: 0.015045 Pi E: 0.500000 Pi FY: 4.000000 Pi L: 1.000000 Pi Q: 2.000000 Pi T: 0.597863 Model Failure Rate: 0.182446	1.00	.18	5,481,062.96
CS-306	Crystal	Miscellaneous	Lambda B: 0.014484 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.000000 Model Failure Rate: 0.014484	1.00	.01	69,041,314.30
SX-6	Crystal	Miscellaneous	Lambda B: 0.027256 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.000000 Model Failure Rate: 0.027256	1.00	.03	36,688,541.36
SCO-103	Oscillator	Other	Model Failure Rate: 0.062560	1.00	.06	15,984,750.49
SCO-103	Oscillator	Other	Model Failure Rate: 0.062560	1.00	.06	15,984,750.49
HY57V281620HCT-H	Dram Memory	Integrated Circuit	C1: 0.010000 C2: 0.010235 Lambda Cyc: 0.000000 Pi E: 0.500000 Pi FY: 4.000000 Pi L: 1.000000 Pi Q: 2.000000 Pi T: 0.100000 Model Failure Rate: 0.012235	2.00	.02	40,866,299.43

Reliability Prediction Report

Part Number SS110 V1.0
Date 2004 10, 11
Environment GB, GC
Temperature 25

MIL-HDBK-217FN2
Failure Rate 1.346721
MTBF 742,544

Part Number	Description	Category	Pi Factors	Qty	Failure Rate	MTBF
AM29DL640D90EI	Flash Memory	Integrated Circuit	C1: 0.006800 C2: 0.015045 Lambda Cyc: 0.000000 Pi E: 0.500000 Pi FY: 4.000000 Pi L: 1.000000 Pi Q: 10.000000 Pi T: 0.100000 Model Failure Rate: 0.082023	1.00	.08	12,191,646.29
AT24C01A-10SC-2.7	EEprom Serial	Integrated Circuit	C1: 0.000850 C2: 0.002645 Lambda Cyc: 0.003194 Pi E: 0.500000 Pi FY: 4.000000 Pi L: 1.000000 Pi Q: 1.000000 Pi T: 0.100000 Model Failure Rate: 0.004602	1.00	4.60e-003	217,318,634.10
LXT972ALC A4	IC-Custom	Integrated Circuit	C1: 0.002500 C2: 0.005593 Pi E: 0.500000 Pi FY: 4.000000 Pi L: 1.000000 Pi Q: 2.000000 Pi T: 0.100000 Model Failure Rate: 0.006093	1.00	6.09e-003	164,135,671.12

Reliability Prediction Report

Part Number SS110 V1.0
Date 2004 10, 11
Environment GB, GC
Temperature 25

MIL-HDBK-217FN2
Failure Rate 1.346721
MTBF 742,544

Part Number	Description	Category	Pi Factors	Qty	Failure Rate	MTBF
XC9572XL-10-VQ64	IC-Cpld	Integrated Circuit	C1: 0.140000 C2: 0.015045 Pi E: 0.500000 Pi FY: 4.000000 Pi L: 1.000000 Pi Q: 2.000000 Pi T: 0.100000 Model Failure Rate: 0.043045	1.00	.04	23,231,677.10
ST16C2550	IC-UART	Integrated Circuit	C1: 0.010000 C2: 0.004841 Pi E: 0.500000 Pi FY: 4.000000 Pi L: 1.000000 Pi Q: 2.000000 Pi T: 0.100000 Model Failure Rate: 0.006841	1.00	6.84e-003	146,167,639.98
LM1085IS-5.0	IC-Regulator	Integrated Circuit	C1: 0.010000 C2: 0.005593 Pi E: 0.500000 Pi FY: 4.000000 Pi L: 1.000000 Pi Q: 2.000000 Pi T: 0.100000 Model Failure Rate: 0.007593	1.00	7.59e-003	131,708,561.43
LT1086CM-3.3	IC-Regulator	Integrated Circuit	C1: 0.010000 C2: 0.004841 Pi E: 0.500000 Pi FY: 4.000000 Pi L: 1.000000 Pi Q: 2.000000 Pi T: 0.100000 Model Failure Rate: 0.006841	1.00	6.84e-003	146,167,639.98

Reliability Prediction Report

Part Number	SS110 V1.0
Date	2004 10, 11
Environment	GB, GC
Temperature	25

MIL-HDBK-217FN2

Failure Rate	1.346721
MTBF	742,544

Part Number	Description	Category	Pi Factors	Qty	Failure Rate	MTBF
LTC1314CS	IC-Regulator	Integrated Circuit	C1: 0.010000 C2: 0.004841 Pi E: 0.500000 Pi FY: 4.000000 Pi L: 1.000000 Pi Q: 2.000000 Pi T: 0.100000 Model Failure Rate: 0.006841	1.00	6.84e-003	146,167,639.98
MAX704TCSA	IC-Reset	Integrated Circuit	C1: 0.010000 C2: 0.004841 Pi E: 0.500000 Pi FY: 4.000000 Pi L: 1.000000 Pi Q: 2.000000 Pi T: 0.100000 Model Failure Rate: 0.006841	1.00	6.84e-003	146,167,639.98
SM8578BV	IC-RTC	Integrated Circuit	C1: 0.010000 C2: 0.004841 Pi E: 0.500000 Pi FY: 4.000000 Pi L: 1.000000 Pi Q: 2.000000 Pi T: 0.100000 Model Failure Rate: 0.006841	1.00	6.84e-003	146,167,639.98
SP3243ECA	IC-RS232	Integrated Circuit	C1: 0.010000 C2: 0.010235 Pi E: 0.500000 Pi FY: 4.000000 Pi L: 1.000000 Pi Q: 1.000000 Pi T: 0.100000 Model Failure Rate: 0.006118	2.00	.01	81,732,598.85

Reliability Prediction Report

Part Number SS110 V1.0
Date 2004 10, 11
Environment GB, GC
Temperature 25

MIL-HDBK-217FN2
Failure Rate 1.346721
MTBF 742,544

Part Number	Description	Category	Pi Factors	Qty	Failure Rate	MTBF
SP3485CN	IC-RS485	Integrated Circuit	C1: 0.010000 C2: 0.010235 Pi E: 0.500000 Pi FY: 4.000000 Pi L: 1.000000 Pi Q: 1.000000 Pi T: 0.100000 Model Failure Rate: 0.006118	2.00	.01	81,732,598.85
74LCX14MTC	IC-TTL	Integrated Circuit	C1: 0.002500 C2: 0.006225 Pi E: 0.500000 Pi FY: 4.000000 Pi L: 1.000000 Pi Q: 2.000000 Pi T: 0.100000 Model Failure Rate: 0.006725	1.00	6.72e-003	148,704,772.40
74LCX541WM	IC-TTL	Integrated Circuit	C1: 0.002500 C2: 0.009150 Pi E: 0.500000 Pi FY: 4.000000 Pi L: 1.000000 Pi Q: 2.000000 Pi T: 0.100000 Model Failure Rate: 0.009650	7.00	.07	14,804,049.33
74LCX573WM	IC-TTL	Integrated Circuit	C1: 0.002500 C2: 0.009150 Pi E: 0.500000 Pi FY: 4.000000 Pi L: 1.000000 Pi Q: 2.000000 Pi T: 0.100000 Model Failure Rate: 0.009650	4.00	.04	25,907,086.32

Reliability Prediction Report

Part Number	SS110 V1.0
Date	2004 10, 11
Environment	GB, GC
Temperature	25

MIL-HDBK-217FN2

Failure Rate	1.346721
MTBF	742,544

Part Number	Description	Category	Pi Factors	Qty	Failure Rate	MTBF
74LCX574WM	IC-TTL	Integrated Circuit	C1: 0.002500 C2: 0.009150 Pi E: 0.500000 Pi FY: 4.000000 Pi L: 1.000000 Pi Q: 2.000000 Pi T: 0.100000 Model Failure Rate: 0.009650	1.00	9.65e-003	103,628,345.29
BL-R5132B	LED Diode	Semiconductor	Lambda B: 0.000230 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.000000 Pi T: 1.000000 Model Failure Rate: 0.000230	1.00	2.30e-004	4,347,826,086.96
BL-R2132B	LED Diode	Semiconductor	Lambda B: 0.000230 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.000000 Pi T: 1.000000 Model Failure Rate: 0.000230	3.00	6.90e-004	1,449,275,362.32
BL-R3132B	LED Diode	Semiconductor	Lambda B: 0.000230 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.000000 Pi T: 1.000000 Model Failure Rate: 0.000230	2.00	4.60e-004	2,173,913,043.48
SAM5280 / BYCOLOR	LED Diode	Semiconductor	Lambda B: 0.000230 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.000000 Pi T: 1.000000 Model Failure Rate: 0.000230	1.00	2.30e-004	4,347,826,086.96

Reliability Prediction Report

Part Number SS110 V1.0
Date 2004 10, 11
Environment GB, GC
Temperature 25

MIL-HDBK-217FN2
Failure Rate 1.346721
MTBF 742,544

Part Number	Description	Category	Pi Factors	Qty	Failure Rate	MTBF
LED HOLDER 7MM	LED Holder 7mm	Other	Model Failure Rate: 0.000800	6.00	4.80e-003	208,333,333.33
LED HOLDER 7MM	LED Holder 5mm	Other	Model Failure Rate: 0.000800	1.00	8.00e-004	1,250,000,000.00
CM1608K-601T02	SMD Bead	Inductor	Lambda B: 0.000030 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.000000 Pi T: 1.000000 Model Failure Rate: 0.000030	4.00	1.20e-004	8,333,333,333.33
TANTAL	SMD Capacitor	Capacitor	Lambda B: 0.000400 Pi C: 1.698244 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.500000 Pi SR: 1.000000 Pi T: 1.000000 Pi V: 1.001015 Model Failure Rate: 0.001020	8.00	8.16e-003	122,551,376.88
TANTAL	SMD Capacitor	Capacitor	Lambda B: 0.000400 Pi C: 1.698244 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.500000 Pi SR: 1.000000 Pi T: 1.000000 Pi V: 1.001015 Model Failure Rate: 0.001020	3.00	3.06e-003	326,803,671.68

Reliability Prediction Report

Part Number	SS110 V1.0
Date	2004 10, 11
Environment	GB, GC
Temperature	25

MIL-HDBK-217FN2
Failure Rate 1.346721
MTBF 742,544

Part Number	Description	Category	Pi Factors	Qty	Failure Rate	MTBF
TANTAL	SMD Capacitor	Capacitor	Lambda B: 0.000400 Pi C: 2.884032 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.500000 Pi SR: 1.000000 Pi T: 1.000000 Pi V: 1.001015 Model Failure Rate: 0.001732	1.00	1.73e-003	577,308,805.85
0.01?	SMD Capacitor	Capacitor	Lambda B: 0.002000 Pi C: 0.660693 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.500000 Pi SR: 1.000000 Pi T: 1.000000 Pi V: 1.296296 Model Failure Rate: 0.002569	15.00	.04	25,946,764.31
0.1?	SMD Capacitor	Capacitor	Lambda B: 0.002000 Pi C: 0.812831 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.500000 Pi SR: 1.000000 Pi T: 1.000000 Pi V: 1.296296 Model Failure Rate: 0.003161	57.00	.18	5,550,084.67

Reliability Prediction Report

Part Number SS110 V1.0
Date 2004 10, 11
Environment GB, GC
Temperature 25

MIL-HDBK-217FN2
Failure Rate 1.346721
MTBF 742,544

Part Number	Description	Category	Pi Factors	Qty	Failure Rate	MTBF
10?	SMD Capacitor	Capacitor	Lambda B: 0.002000 Pi C: 0.354813 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.500000 Pi SR: 1.000000 Pi T: 1.000000 Pi V: 1.296296 Model Failure Rate: 0.001380	2.00	2.76e-003	362,363,519.73
18?	SMD Capacitor	Capacitor	Lambda B: 0.002000 Pi C: 0.354813 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.500000 Pi SR: 1.000000 Pi T: 1.000000 Pi V: 1.296296 Model Failure Rate: 0.001380	2.00	2.76e-003	362,363,519.73
20?	SMD Capacitor	Capacitor	Lambda B: 0.002000 Pi C: 0.377653 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.500000 Pi SR: 1.000000 Pi T: 1.000000 Pi V: 1.296296 Model Failure Rate: 0.001469	2.00	2.94e-003	340,448,770.28

Reliability Prediction Report

Part Number	SS110 V1.0		
Date	2004 10, 11	MIL-HDBK-217FN2	
Environment	GB, GC	Failure Rate	1.346721
Temperature	25	MTBF	742,544

Part Number	Description	Category	Pi Factors	Qty	Failure Rate	MTBF
33?	SMD Capacitor	Capacitor	Lambda B: 0.002000 Pi C: 0.395063 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.500000 Pi SR: 1.000000 Pi T: 1.000000 Pi V: 1.296296 Model Failure Rate: 0.001536	14.00	.02	46,492,208.29
270?	SMD Capacitor	Capacitor	Lambda B: 0.002000 Pi C: 0.477334 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.500000 Pi SR: 1.000000 Pi T: 1.000000 Pi V: 1.296296 Model Failure Rate: 0.001856	2.00	3.71e-003	269,352,946.45
SMDA15C-8	TVS Diode	Semiconductor	Lambda B: 0.001300 Pi C: 1.000000 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.000000 Pi S: 1.000000 Pi T: 1.000000 Model Failure Rate: 0.001300	2.00	2.60e-003	384,615,384.62

Reliability Prediction Report

Part Number SS110 V1.0
Date 2004 10, 11
Environment GB, GC
Temperature 25

MIL-HDBK-217FN2
Failure Rate 1.346721
MTBF 742,544

Part Number	Description	Category	Pi Factors	Qty	Failure Rate	MTBF
0.001?	Capacitor Surge	Capacitor	Lambda B: 0.002000 Pi C: 0.537032 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.500000 Pi SR: 1.000000 Pi T: 1.000000 Pi V: 1.296296 Model Failure Rate: 0.002088	3.00	6.27e-003	159,607,468.17
CHEMICAL,100?	Capacitor Chemical	Capacitor	Lambda B: 0.002000 Pi C: 1.513561 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.500000 Pi SR: 1.000000 Pi T: 1.000000 Pi V: 1.296296 Model Failure Rate: 0.005886	1.00	5.89e-003	169,892,600.92
8.2MH	Power Inductor	Inductor	Lambda B: 0.000030 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 1.000000 Pi T: 1.000000 Model Failure Rate: 0.000030	1.00	3.00e-005	33,333,333,333.33
LL4148	SMD Diode	Semiconductor	Lambda B: 0.001000 Pi C: 1.000000 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 5.500000 Pi S: 0.420328 Pi T: 1.000000 Model Failure Rate: 0.002312	1.00	2.31e-003	432,562,705.86

Reliability Prediction Report

Part Number	SS110 V1.0
Date	2004 10, 11
Environment	GB, GC
Temperature	25

MIL-HDBK-217FN2

Failure Rate	1.346721
MTBF	742,544

Part Number	Description	Category	Pi Factors	Qty	Failure Rate	MTBF
SS14/1N5819_SMD	SMD Diode	Semiconductor	Lambda B: 0.003800 Pi C: 1.000000 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 5.500000 Pi S: 0.420328 Pi T: 1.000000 Model Failure Rate: 0.008785	2.00	.02	56,916,145.51
MMDF3N02HD	SMD MOSFET	Semiconductor	Lambda B: 0.012000 Pi A: 0.700000 Pi E: 1.000000 Pi FY: 4.000000 Pi Q: 5.500000 Pi T: 1.000000 Model Failure Rate: 0.046200	2.00	.09	10,822,510.82
0?	SMD Resistor	Resistor	Lambda B: 0.003700 Pi E: 1.000000 Pi FY: 4.000000 Pi P: 0.017509 Pi Q: 1.000000 Pi S: 0.710000 Pi T: 1.000000 Model Failure Rate: 4.59962E-5	2.00	9.20e-005	10,870,452,215.08
0?	SMD Resistor	Resistor	Lambda B: 0.003700 Pi E: 1.000000 Pi FY: 4.000000 Pi P: 0.017509 Pi Q: 1.000000 Pi S: 0.710000 Pi T: 1.000000 Model Failure Rate: 4.59962E-5	15.00	6.90e-004	1,449,393,628.68

Reliability Prediction Report

Part Number SS110 V1.0
Date 2004 10, 11
Environment GB, GC
Temperature 25

MIL-HDBK-217FN2
Failure Rate 1.346721
MTBF 742,544

Part Number	Description	Category	Pi Factors	Qty	Failure Rate	MTBF
100?	SMD Resistor	Resistor	Lambda B: 0.003700 Pi E: 1.000000 Pi FY: 4.000000 Pi P: 0.017509 Pi Q: 1.000000 Pi S: 0.710000 Pi T: 1.000000 Model Failure Rate: 4.59962E-5	1.00	4.60e-005	21,740,904,430.16
10?	SMD Resistor	Resistor	Lambda B: 0.003700 Pi E: 1.000000 Pi FY: 4.000000 Pi P: 0.017509 Pi Q: 1.000000 Pi S: 0.710000 Pi T: 1.000000 Model Failure Rate: 4.59962E-5	38.00	1.75e-003	572,129,063.95
1?	SMD Resistor	Resistor	Lambda B: 0.003700 Pi E: 1.000000 Pi FY: 4.000000 Pi P: 0.042980 Pi Q: 1.000000 Pi S: 0.710001 Pi T: 1.000000 Model Failure Rate: 1.12907E-4	19.00	2.15e-003	466,147,816.38
22.1?	SMD Resistor	Resistor	Lambda B: 0.003700 Pi E: 1.000000 Pi FY: 4.000000 Pi P: 0.009370 Pi Q: 1.000000 Pi S: 0.710000 Pi T: 1.000000 Model Failure Rate: 2.46152E-5	1.00	2.46e-005	40,625,348,297.21

Reliability Prediction Report

Part Number SS110 V1.0
Date 2004 10, 11
Environment GB, GC
Temperature 25

MIL-HDBK-217FN2
Failure Rate 1.346721
MTBF 742,544

Part Number	Description	Category	Pi Factors	Qty	Failure Rate	MTBF
220?	SMD Resistor	Resistor	Lambda B: 0.003700 Pi E: 1.000000 Pi FY: 4.000000 Pi P: 0.017509 Pi Q: 1.000000 Pi S: 0.710000 Pi T: 1.000000 Model Failure Rate: 4.59962E-5	8.00	3.68e-004	2,717,613,053.77
22?	SMD Resistor	Resistor	Lambda B: 0.003700 Pi E: 1.000000 Pi FY: 4.000000 Pi P: 0.017509 Pi Q: 1.000000 Pi S: 0.710000 Pi T: 1.000000 Model Failure Rate: 4.59962E-5	4.00	1.84e-004	5,435,226,107.54
3.3?	SMD Resistor	Resistor	Lambda B: 0.003700 Pi E: 1.000000 Pi FY: 4.000000 Pi P: 0.015068 Pi Q: 1.000000 Pi S: 0.710000 Pi T: 1.000000 Model Failure Rate: 3.95848E-5	16.00	6.33e-004	1,578,889,995.79
4.7?	SMD Resistor	Resistor	Lambda B: 0.003700 Pi E: 1.000000 Pi FY: 4.000000 Pi P: 0.017509 Pi Q: 1.000000 Pi S: 0.710000 Pi T: 1.000000 Model Failure Rate: 4.59962E-5	5.00	2.30e-004	4,348,180,886.03

Reliability Prediction Report

Part Number	SS110 V1.0		
Date	2004 10, 11	MIL-HDBK-217FN2	
Environment	GB, GC	Failure Rate	1.346721
Temperature	25	MTBF	742,544

Part Number	Description	Category	Pi Factors	Qty	Failure Rate	MTBF
49.9?	SMD Resistor	Resistor	Lambda B: 0.003700 Pi E: 1.000000 Pi FY: 4.000000 Pi P: 0.009370 Pi Q: 1.000000 Pi S: 0.710000 Pi T: 1.000000 Model Failure Rate: 2.46152E-5	7.00	1.72e-004	5,803,621,185.32
SOCKET-BATTERY	Socket-Battery	Other	Model Failure Rate: 0.002318	1.00	2.32e-003	431,430,900.00
SOCKET-JUMPER	Socket-Jumper	Other	Model Failure Rate: 0.009319	1.00	9.32e-003	107,302,000.00
SOCKET-JUMPER	Socket-Jumper	Other	Model Failure Rate: 0.009319	1.00	9.32e-003	107,302,000.00
5569-02A1-BL	Socket-Jack	Other	Model Failure Rate: 4.57558E-6	1.00	4.58e-006	218,551,700,000.00
61126-050CAH	Socket-PCMCIA	Other	Model Failure Rate: 0.111807	1.00	.11	8,944,000.00
STP-1236A	Switch Push	Switching Device	Lambda B: 0.100000 Pi C: 1.000000 Pi E: 1.000000 Pi FY: 4.000000 Pi L: 1.003914 Pi Q: 1.000000 Model Failure Rate: 0.100391	1.00	.10	9,961,013.69
9006-880S-OPEN	RJ-45 Conn	Other	Model Failure Rate: 0.004576	2.00	9.15e-003	109,275,850.00
XFATM6-COMBO1-4S	RJ-45 Combo	Other	Model Failure Rate: 4.57558E-6	1.00	4.58e-006	218,551,700,000.00

Percentage Summary

Part Type	Quantity	% Quantity	Failure Rate	% Failure Rate
IC, Logic	14.00	4.75	0.128616	9.55
IC, Memory	4.00	1.36	0.111095	8.25
IC, Microproc	2.00	0.68	0.225491	16.74
IC, Linear	10.00	3.39	0.066270	4.92
Trans, FET	2.00	0.68	0.092400	6.86
Diode	5.00	1.69	0.022482	1.67
Opto-elec	7.00	2.37	0.001610	0.12
Res, Fixed	116.00	39.32	0.006333	0.47
Cap, Fixed	110.00	37.29	0.277499	20.61
Ind, Coil	5.00	1.69	0.000150	0.01
Switch	1.00	0.34	0.100391	7.45
Crystal	2.00	0.68	0.041741	3.10
NPRD Part	17.00	5.76	0.272643	20.24

First Year Dropout

Month	Failure Rate	Expected # of Failures	Avg. Cumulative Failure Rate
1	9.589268	0.000028	38.357049
2	5.701813	0.000033	22.807235
3	4.206729	0.000037	16.826902
4	3.390318	0.000040	13.561261
5	2.867860	0.000042	11.471430
6	2.501336	0.000044	10.005334
7	2.228240	0.000046	8.912950
8	2.015895	0.000047	8.063573
9	1.845456	0.000048	7.381814
10	1.705240	0.000050	6.820952
11	1.587599	0.000051	6.350391
12	1.487303	0.000052	5.949206