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RELIABILITY AND MAINTAINABILITY PREDICTIONS for the FX-30 SYSTEM DEVICES

SimPhonics, Inc. Tampa, Florida		TITLE: RELIABILITY AND MAINTAINABILITY PREDICTIONS for the FX-30 SYSTEM DEVICES	
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1.0 INTRODUCTION

This prediction report is a structured approach to evaluating the Reliability & Maintainability of the design by assigning probabilities and the resulting effect on the system.

2.0 APPLICABLE DOCUMENTS

MIL-STD-785B	RELIABILITY PROGRAM
MIL-STD-470A	MAINTAINABILITY PROGRAM
MIL-HDBK-472	MAINTAINABILITY PREDICTION PROGRAM
MIL-HDBK-217F	RELIABILITY PREDICTION OF ELECTRONIC EQUIPMENT
RADC EEMD-1	ELECTRONIC EQUIPMENT MAINTAINABILITY DATA
RADC MRD-18	MICROCIRCUIT DEVICE RELIABILITY
RADC	RADC RELIABILITY ENGINEER'S TOOL-KIT

3.0 RELIABILITY PREDICTION

Sources used to develop the reliability prediction in order of precedence are MIL-HDBK-217, RADC MRD-18 and manufacturers data.

In general, these predictions were performed assuming worst case conditions of stress per derating policy and temperature (40 degrees C). This insures added confidence that the equipment will meet the MTBF goals under all specified conditions while operating in a ground Benign environment.

The prediction method 2004 of MIL-STD-756B was used as guidance. This method assumes the time to failure is exponentially distributed and all systems are modeled in series. Generally the expression for part failure rate is:

$$item\lambda = \sum_{i=1}^{n} n_i (\lambda GQ)_i ,$$

Where:

$Item\lambda = total\ failiure\ rate$

$G_i = generic failiure rate\ for\ the\ ith\ generic part$

$Q_i = quality\ factor\ for\ the\ ith\ generic part$

$n_i = quantity\ of\ the\ ith\ generic part$

$n = number\ of\ different\ generic part catagories$

3.1 Total System Reliability Prediction

The reliability predictions are depicted within worksheet, Table 3.1-1. Because the system is a series model with no redundancy, a block diagram is not required. All necessary information is outlined on the worksheet.

Table 3.1-1 Reliability Prediction Worksheet

RELIABILITY PREDICTION
WORKSHEET
Maintenance: Organizational
Method: MIL-HDBK-217F

Part Name / Number	Fail Rate	Quantity	Total Fail Rate	Maintenance Repair	Maintenance Replace	Predicted MTBF	Predicted MTTR
Computer / RM5330	28.13	1.0	28.13		X	35,549	0.21
CPU / 486DX-50	7.71	1.0	7.71		X	129,702	0.17
Hard Drive / 290 MB	8.20	1.0	8.20		X	121,951	0.12
Floppy Drive / FD505-5.25	10.00	1.0	10.00		X	100,000	0.12
RAM 1MB /MM0256	1.00	1.0	2.00		X	500,000	0.10
DSP Card C30/SM5001-11	7.71	1.0	38.55		X	25,940	0.11
Analog I/O Card/SM6001-10	17.79	1.0	17.79		X	56,211	0.11
Analog I/O Card/SM6001-20	17.99	1.0	17.99		X	55,586	0.11
Analog I/O Card/SM6001-30	18.19	1.0	18.19		X	54,975	0.11
Analog I/O Card/SM6001-40	18.39	1.0	18.39		X	54,377	0.11
VME/PC Link / Model 406	8.26	1.0	8.26		X	121,065	0.11
PC/VME Dual Port / 400-201	14.68	1.0	14.68		X	68,120	0.11
SYSTEM MTBF = 5266							

4.0 MAINTAINABILITY PREDICTIONS

The maintainability prediction presented herein complies with MIL-STD-470A. Sources used to develop this maintainability prediction in order of precedence are RADC EEMD-1, manufacturers data, and RADC tool-kit.

MTTR values are weight averaged for the system. They are a summation of active repair times during a given period of time, divided by the total number of malfunctions during the same time interval given by the expression.

$$MTTR = \frac{\sum \alpha\lambda R_p}{\sum \alpha\lambda},$$

$$Where:$$

$$\alpha = duty\ cycle$$

$$\lambda = failiure\ rate\ of\ the\ item$$

$$R_p = repair\ time\ of\ item$$

This maintainability prediction has been prepared for the organizational level of maintenance. It is based on the concept that repair at this level will consist of replacement of the lowest replaceable units of the system :

The prediction has been generated using MIL-HDBK-472 as a guide. All calculations of interchange, disassembly, and reassembly are based on an analysis of the assembly drawings and information obtained from subcontractors. This system is designed to have a maximum corrective maintenance downtime of 90 minutes or less for unscheduled organizational level maintenance.

4.1 Total System Maintainability Prediction

The elemental maintenance tasks included in the MTTR requirement were fault location, fault isolation, disassembly, interchange, align and checkout. The Maintainability worksheet Figure 4.1-1 outlines the maintainability times of the major cards of the system.

Table 4.1-1 Maintainability Prediction Worksheet

MAINTAINABILITY PREDICTION WORKSHEET
Maintenance Level: Organizational
Method: MIL-HDBK-472

Part Name/No.	Fail Rate	Qty	Total Fail Rate	Loc	ISO	Dis-Assy	Intr-Chg	Re-Assy	Align/ Checkout	Repair Time R_p	Fail Rate X R_p	R_p in Hours
Computer / RM5330	28.13	1.0	28.13	2.0	2.0	1.5	2.0	2.0	3.0	12.5	351.63	0.21
CPU / 486DX-50	7.71	1.0	7.71	2.0	2.0	2.0	1.0	1.0	2.0	10.0	77.10	0.17
Hard Drive / 290 MB	8.20	1.0	8.20	2.0	1.0	1.0	1.0	1.0	1.0	7.0	57.40	0.12
Floppy Drive / FD505-5.25	10.0	1.0	10.00	2.0	1.0	1.0	1.0	1.0	1.0	7.0	70.00	0.12
RAM 1MB /MM0256	1.00	1.0	1.00	2.0	1.0	1.0	0.5	0.5	1.0	6.0	6.00	0.10
DSP Card C30/SM5001-11	7.71	1.0	7.71	2.0	1.0	1.0	0.5	1.0	1.0	6.5	50.12	0.11
Analog I/O Card/SM6001-10	17.79	1.0	17.79	2.0	1.0	1.0	0.5	1.0	1.0	6.5	115.64	0.11
Analog I/O Card/SM6001-20	17.99	1.0	17.99	2.0	1.0	1.0	0.5	1.0	1.0	6.5	116.94	0.11
Analog I/O Card/SM6001-30	18.19	1.0	18.19	2.0	1.0	1.0	0.5	1.0	1.0	6.5	118.24	0.11
Analog I/O Card/SM6001-40	18.39	1.0	18.39	2.0	1.0	1.0	0.5	1.0	1.0	6.5	119.54	0.11
VME/PC Link / Model 406	8.26	1.0	8.26	2.0	1.0	1.0	0.5	1.0	1.0	6.5	53.69	0.11
PC/VME Dual Port / 400-201	14.68	1.0	14.68	2.0	1.0	1.0	0.5	1.0	1.0	6.5	95.42	0.11
SYSTEM MTTR = 7.79 Min = 0.13 Hour												