RELIABILITY PREDICTION REPORT

FOR THE

WT12-A VERSION 1.2

Prepared by

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1.0 INTRODUCTION AND SUMMARY

This document presents the Bluegiga Technologies Reliability Prediction Report performed on the WT12-A Version 1.2. It was analyzed for Mean Time Between Failure (MTBF) in accordance with Task 203 of MIL-STD-785B; paragraph 2.4 of Task 100 of MIL-STD-756B; and the Parts Count Analysis method of MIL-HDBK-217F(N1/2), Appendix A.

The WT12-A Version 1.2 was found to have a Mean Time Between Failure (MTBF) of 2,490,722.06 hours of operation. This statement is fully supported by the reliability mathematical model presented in Section 3.0, the Table 1 Failure Rate Data Summary and the detailed reliability parts count failure rate data tables presented in the Appendix A of this report.

1.1 Scope

This report reflects the WT12-A Version 1.2 reliability design analysis performed from project inception through the issue date of this document. This report is limited to electronic parts.

1.2 Objectives

Through this report, Bluegiga Technologies seeks to provide a prediction of the WT12-A Version 1.2 MTBF, to evaluate it's current and potential reliability, to provide information in order to assist in directing and planning for reliability and related program efforts and to identify design features which are critical to reliability.

2.0 APPLICABLE DOCUMENTS

2.1 Military Specification Documents

MIL-STD-756B, N1, 31 August 1982	Reliability Modeling and Prediction
MIL-STD-785B, 15 September 1980	Reliability Program for Systems and Equipment Development and Production

MIL-HDBK-217F(N1/2), 10 July 1992/28 February 1995	Reliability Prediction of Electronic Equipment

2.2 Commercial/Bellcore Documents

TR-332, Issue 6, December 1997	Technical Reference, Bellcore Method 1, “Reliability Prediction Procedure for Electronic Equipment” (A Module of RQGR, FR-796).

2.3 Bluegiga Technologies Documents

WT12-A Version 1.2	Parts Lists and Engineering Drawings

3.0 RELIABILITY ANALYSIS

3.1 Reliability Analysis Methodology

The parts count method of reliability prediction used in this analysis is MIL-HDBK-217F(N1/2), “Reliability Prediction Procedure for Electronic Equipment”, Appendix A.

3.2 Reliability Mathematical Model

The Reliability model MTBF reflects the reliability of all electrical parts in the equipment. Their failure rates are summarized in Table 1, by assembly, and presented in appendices tables by part type.

The Mathematical Model used in determining the WT12-A Version 1.2 reliability is known as the series model. This model is based on the equation:

$$R(t) = e^{-\lambda t}$$

Where:

$R(t) =$ Reliability of the WT12-A Version 1.2

$t =$ Elapsed operation time, in hours

RELIABILITY PARTS COUNT FAILURE RATE DATA SUMMARY

Table 1, WT12-A Version 1.2

Assembly/ Parts List	Quantity	Failure Rate in Parts Per Million Hours	
		Total	Quantity x Total
WT12-A Version 1.2/ 12.10.2009 PRa Revision: 1.2	1	0.4015	0.4015

Total System Failure Rate = 0.4015 Parts Per Million Hours.

Total System Mean Time Between Failure (MTBF) = 2,490,722.06 Hours.

$\lambda =$ WT12-A Version 1.2 failure rate, in parts per million hours (ppmh)

The assumption is that if any part fails during operation, the WT12-A Version 1.2 is considered to have failed as a whole, and maintenance is required. The reliability of the WT12-A Version 1.2, $R(t)$, is the combined probability of the individual parts reliability, where the unit contains quantity n parts:

$$R(t) = \prod_{i=1}^{n} R(t)_i$$

Where: $R(t)_i =$ reliability of part, i, over time, t, $e^{-\lambda_i t}$

The summation of all WT12-A Version 1.2 part failure rates provides the system failure rate, see Table 1. Thus, the system MTBF is determined by taking the reciprocal of the summation of the failure rates of all the WT12-A Version 1.2 parts:

$$MTBF = \int_{\circ}^{\infty} R(t)dt = 1/\sum_{i=1}^{n} \lambda_i$$

The analysis presented in this report contains no redundancy. Thus, the total WT12-A Version 1.2 MTBF is 2,409,722.06 hours of operation.

The parts count reliability prediction method reflects the generic part types, quantities and qualities used, and considers the operational environment impact. These factors are combined in the following mathematical model:

$$\lambda_A = \sum_{i=1}^{n} N_i(\lambda_G \pi_Q)_i$$

where:

$\lambda_A =$ total failure rate (parts per million hours) of the WT12-A Version 1.2.

$\lambda_G =$ generic failure rate for a given environment for the ith generic part of an assembly.

$\pi_Q =$ quality factor for the ith generic part of an assembly.

$N_i =$ quantity of the ith generic part of an assembly.

$n =$ number of different generic part categories.

The failure rate model modifiers, quantity, quality factor and generic failure rate are listed under their respective columns in the appendix tables.

The modifiers are numerical multipliers for the individual generic parts failure rate. The quality factor, π_Q, designation is listed in the data tabulation Specification/Quality Level column for each part.

3.3 Quality Factors

Bluegiga Technologies' use of commercial or mil-spec parts throughout the WT12-A Version 1.2 is reflected in the quality factors, presented in the tables of Appendix A. The exact quality is presented for each part under the specification and quality factor columns of the failure rate data sheets.

The learning factor, π_L, is equal to 1.0 for Bluegiga Technologies' production conditions and field experience.

3.4 Environmental Conditions

All part generic failure rates include the effects of environment factors. The appropriate environment factor for the WT12-A Version 1.2 is Ground Benign (G_B). For G_B the semiconductor junction temperature, T_J, is 50 degrees Celsius, and the other parts ambient temperature, T_A, is 30 degrees Celsius.

3.5 Parts Count Failure Rate Calculations

The parts count reliability prediction procedure conducted on the WT12-A Version 1.2 provides the data upon which part failure rates are assigned for reliability prediction. The failure rate model of each component was determined and the associated failure rates were calculated and listed in the data tabulation sheets of the appendices using the generic reliability failure rates determined per MIL-HDBK-217F, Notice 1/2, Appendix A, “Parts Count Reliability Prediction”.

The various failure rate model modifiers are listed in the appendices on detailed Failure Rate Data tables under "π" columns for each factor. The "π" factors are numerical multipliers for parts quality levels. The Quality "π" factor, π_Q, is determined from the part procurement specification or information available at the time of analysis.

APPENDIX A

Reliability Parts Count Failure Rate Data Tabulation
for the
WT12-A Version 1.2

RELIABILITY PARTS COUNT FAILURE RATE DATA

System: WT12-A Version 1.2 **Page 1**

Assembly: WT12-A Version 1.2

Parts List: 12.10.2009 PRa Revision: 1.2

Environment: Ground, Benign (GB)

Description/ Generic Part Type	Specification/ Quality Level	Quantity	Quality Factor (Pi Q)	Failure Rate in Parts Per Million Hours	
				Generic	Total
Integrated Circuit/ MOS, Digital 3001-10000 Gates	Mil-M-38510/ B	1	1.00	0.04900	0.04900
Integrated Circuit/ MOS, PROM 256K-1M Bits	Mil-M-38510/ B	1	1.00	0.01200	0.01200
Transistor/ Si. Field Effect (f <= 400MHz)	Mil-S-19500/ JAN	1	2.40	0.01400	0.03360
Resistor/ RM Fixed Film Chip	Mil-R-55342/ Mil-Spec	7	3.00	0.00370	0.07770
Capacitor/ CDR Ceramic Chip	Mil-C-55681/ Mil-Spec	14	3.00	0.00078	0.03276
Filter/	Mil-T-27/ Mil-Spec	1	1.00	0.02300	0.02300
Coil/ Radio Frequency, Fixed	Mil-C-15305/ Mil-Spec	3	1.00	0.00170	0.00510
Interconnect Assy./ Printed Circuit Board (PCB)	Mil-Spec	1	1.00	0.05300	0.05300
Crystal/ Quartz	Mil-C-3098/ Mil-Spec	1	1.00	0.03200	0.03200

RELIABILITY PARTS COUNT FAILURE RATE DATA

System: WT12-A Version 1.2

Assembly: WT12-A Version 1.2

Parts List: 19.01.2006 TR Revision: 1.0

Environment: Ground, Benign (GB)

Description/ Generic Part Type	Specification/ Quality Level	Quantity	Quality Factor (Pi Q)	Failure Rate in Parts Per Million Hours	
				Generic	Total
Antenna AT3216	Mil-Spec	1	1.00	0.08333	0.08333

Total Assembly Quantity of Parts = 31

Total Assembly Failure Rate = 0.4015 Parts Per Million Hours.