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ACTL - Programmable Internet Router

eWON500 & 2001

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Failure Rate & MTBF Assessment Report

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	Date & Signature	

1 Table of Contents

2 Revision History

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Issue Date	Version	Revised by	Nature of the revision
18/03/2004		Pierre Becquart	Initial issue

3 Distribution list

Name	Position	Company
David Baldwin	Group Leader²Hardware R&D	ACTL
Serge Bassem	Mgg Director	ACTL

4 References

4.1 Normative references

Reference	Title	Revision
ISO 9000:2000	Quality management systems - Fundamentals and vocabulary	Dec 2000
ISO 9001:2000	Quality management systems - Requirements	Dec 2000
MIL-HDBK-217	Reliability Prediction of Electronic Equipment	F Notice 2

4.2 Related documents

Reference	Title	Revision
eWON500_2001_IN_ENG16.	eWON500 & 2001 hardware user manual	1.6

5 Introduction

This document contains the failure rate and MTBF assessment for the Programmable Internet Router eWON500 and related P/N based on the same hardware. This report was prepared in order to predict the failure rates of the power supply based on mathematical models as published in standard MIL-HDBK-217 F incl. Notice 2, Part 2 (parts stress method).

6 Equipment Description

The equipment is documented by a hardware manual with reference eWON500_2001_IN_ENG16. This document is avaialble on request, or downloadable from the eWON web site www.ewon.biz.

The eWON is a terminal enabling access to technical data, whatever their format is. It is configurable by web pages. It is secure because it meets the toughest industrial standards and has restricted access features required in open networks. The hardware platform of the eWON500 & 2001 is basically the same except that the eWON2001 has an embedded modem (PSTN or GSM/GPRS).

Description of the hardware platform

- Processor ARM clocked @ 75Mhz, 8Mb SDRAM, 8 Mb Flash
- Backed up real time clock (RTC) with 24 Hours autonomy
  (option battery for 10 years autonomy available)
- External power supply 12-24 VDC +/- 20%
- 1 Ethernet port 10/100Mb BaseTx
- 1 Sérial port configurable in RS232/RS422/RS485
- 1 digital input (DI)
- 1 digital output (DO)
- DIN rail mounting compliant with EN50022 (latch)
- Environmental conditions (operating):
  Ambient T°: from 0°C to +40°C
  Humidity: from 0 to 80% non condensing

Functions of the eWON500, Ethernet Gateway

- Compatibility with MODBUS, UNITELWAY and DF1 protocols
- Data acquisition
- Web server – fully customizable web pages
- Programmable by BASIC scripts
- Alarm management
- Report generation

Functions of the eWON2001, RAS Modem RAS and PIR

The eWON2001 basically features the same functions as the eWON500, but thanks to its embedded modem (PSTN or GSM/GPRS), it features in addition, the following functions:

Remote Access Server functions

- Remote Access Server (RAS) and TCP/IP Server
- PAP/CHAP Authentication
- Login/password
- Remote network access
- User access control
- Security : Integrated firewall (NAT, IP filtering,…)
- Conventional and internet call-back

Programmable Industrial Router functions

- Automatic routing of protocols
- Pre-configured routing tables
- Programmable routing from I/O and tag names (BASIC)

7 MTBF Summary

Predicted MTBF values for duty cycles of 100 % and 50 % and different temperatures are shown in Table 2.

Envir. Temp.	Duty Cycle	MTBF	Details
30 °C	100 %	276.000 hours	List A
40 °C	100 %	146.000 hours	List B

Table 1: MTBF SUMMARY

The detailed analysis contained in list A and B is available on request and under certain conditions (NDA agreement).

8 Reliability Assessment

8.1 Mathematical Models

The assessed device is made out of passive and active electronic components. In this particular case, the device structure does not justify to break it down in different sub-assemblies. Some specific parts (battery, gold-cap capacitor) have been excluded of the calculation either because they are normally subject to wear and are easily replaceable items. The optional modem piggy-backs are also excluded from the assessment. These sub-assemblies have been chosen from leading manufacturers to ensure consistent MTBF figures with those of the eWON500 & 2001.

If an element failure rate is constant over time, the reliability for a single series element can be expressed as the following exponential distribution.

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

where:

$R(t)_i$ = the probability of survival for a single series element for a given operating time t
e = the base of the natural logarithm
λ_i = a constant representing the ith element failure rate
t = the element operating time

If each exponentially distributed series element is independent, the series system reliability function can be expressed as the following product.

$$R(t)_{series} = \prod_{i=1}^{n} e^{-\lambda_i t}$$

where:

$R(t)_{series}$ = the probability of survival for a series system for a given operating time *t*.
e = the base of the natural logarithm
λ_i = a constant representing the ith element failure rate
t = the element operating time

If each element is independent, it can be shown that the failure rate for an exponential distribution series system is the sum of the failure rates of the individual elements.

$$\lambda_{series} = \sum_{i=1}^{n} \lambda_i = \lambda_1 + \lambda_2 + \lambda_3 + \ldots + \lambda_n$$

where:
λ_{series} = a constant representing a series system failure rate
λ_i = a constant representing the i^{th} element failure rate
λ_1 = a constant representing the first element failure rate
λ_2 = a constant representing the second element failure rate
λ_3 = a constant representing the third element failure rate
λ_n = a constant representing the last element failure rate

and

$$R(t)_{series} = e^{-\lambda_{series} t}$$

where:

$R(t)_{series}$ = the probability of survival for a series system for a given operating time t
e = the base of the natural logarithm
λ_{series} = a constant representing the series system failure rate
t = the series system operating time

The mean time to failure ($MTBF$) for an exponentially distributed single element or series system can be determined from the reliability function or, as shown below, directly from the failure rate.

$$MTBF = \int_0^\infty R(t)_i \, dt$$

$$MTBF = \int_0^\infty e^{-\lambda_i t} dt = \frac{1}{\lambda_i}$$

$$MTBF = \int_0^\infty e^{-\lambda_{seriessystem} t} dt = \frac{1}{\lambda_{seriessystem}}$$

where:

$MTBF_i$ = the mean time between failure of single series element
$MTBF_{seriessystem}$ = the mean time between failure of the series system
λ_i = the constant failure rate of the ith element
$\lambda_{seriessystem}$ = the constant failure rate of a series system
e = the base of the natural logarithm
t = the series system operating time

For a series system with exponentially distributed elements the, $MTBF_{series}$ can be expressed as shown below.

$$MTBF_{series} = \frac{1}{\lambda_1 + \lambda_2 + \lambda_3 + ... + \lambda_n}$$

where:

$MTBF_{series}$ = the mean time between failure for a series system
λ_1 = a constant representing the 1st series element failure rate
λ_2 = a constant representing the 2nd series element failure rate
λ_3 = a constant representing the 3rd series element failure rate
λ_n = a constant representing the nth series element failure rate

8.2 Data Sources and Assumptions

In order to perform a failure rate assessment, several assumptions have to be made to minimize the complexity of the analysis.

1. Basis for the calculation was „Parts-Stress“ according to MIL-HDBK-217 F, notice 2.
2. Environmental factor „Ground Benign». according to MIL-HDBK-217 has been used
3. Failure rate of mechanical components (screws, chassis, etc) has been considered as negligible.

Exclusions:

- (Optional) Battery
- (Optional) Modems
- C71 Goldcap (RTC backup capacitor)

8.3 Reliability Assessment Details

The results of the failure rate assessments at 30 °C and 40°C environmental temperatures and 100 % duty cycle respectively are listed in separate documents available on request (subject to NDA agreement).

Failure rates given in the detailed tables are given in *Failures per Million Hours* (fpmh).

9 Detailed failure rate lists

The following failure rates lists are available on request (under specific NDA agreement).

Reference	**BOM Revision**	**Title**
Listing A	1.12	eWON500 – 30°C – duty cycle 100%
Listing B	1.12	eWON500 – 40°C – duty cycle 100%