

# D6.9.6 MTBF

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## Mean Time Between Failure for an STM ATB

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Document ID	D6.9.6
Version	2.0
Revision	521690
Author	AVO
Reviewed	521690 ,STMA-76877
Approved	521690 ,STMA-76949
Archive	SID-ERTMS-10001257
Date:	2020/06/03 11:37

# Authorization

Compiled by: AVE  Signature/E-sign: 521690 ,STMA-76919	Date: 2020/06/03 20:51
Reviewed by: AIO  Signature/E-sign: 521690 ,STMA-76877	Date: 2020/06/03 11:38
Approved by: AXO  Signature/E-sign: 521690 ,STMA-76949	Date: 2020/06/04 12:25


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## 1 Preface



### 1.1 References

#### Text, STMA-14296 - Reference documents

All the documents references used in this document can be found in the document  [P6.1](#)



[Bibliography](#) available in the Polarion folder  [Processes](#)

#### Abbreviations, definitions and terminology

An overview of the abbreviations, definitions and terminology used in this document can be found in document  [P6.2 List of abbreviations, definitions and terms](#) available in the Polarion folder  [Processes](#)

#### Requirement identification

The STM ATB project makes use of an automated requirement management system. In this system each requirement has been identified as a work item. Each work item has been

automatically assigned with a unique ID, with the format "STMA-<number>". As a result requirement ID's are not in logical order. An overview of all the used STMA-numbers is given in document  [P6.3 Requirement Overview](#) available in the Polarion folder  [Processes](#)

## 2 Introduction

**Text, STMA-73808** - To verify the requirements about the Reliability, Availability, Maintainability and Safety (RAMS), it is necessary to calculate the Mean Time Between Failure (MTBF). Since the mean time between failures also relies on the mean time to repair, which is out of control of the STM ATB development, this document will describe the calculation of the Mean Time To Failure (MTTF).

## 3 Calculation

**Test Definition, STMA-73827** - The availability of the STM ATB will be demonstrated with the calculation of the MTTF.


**Test Definition, STMA-73992** - The availability of the SAP board will be demonstrated with the calculation of the MTTF.

### 3.1 Approach

**Text, STMA-73810** - The methodology used is based on the Technical Report 62380 of the International Electrotechnical Commission, reference number IEC/TR 62380:2004.

**Text, STMA-76755** - The calculation is based on the components that are used and is therefore dependent on the design revision. The design revision used is listed in the table below.

Board	Revision
BP	STM-ATB-BP-002
DIO+PS	STM-ATB-DIO-002
AIN	STM-ATB-AIN-002
SAP	STM-ATB-SAP-003

**Text, STMA-76749** - The mission profile for the STM ATB is based on a daily power cycle. The board temperature is set to 40 degrees Celsius with a temperature change of 15 degrees Celsius, in alignment with  [STMA-8656](#).

**Text, STMA-73820** - The calculation of the Mean Time To Failure is documented and processed

in a spreadsheet. It is required to use Microsoft Excel with enabled macros to perform the calculation.

**Text, STMA-73835** - The results of the protection devices, predominantly the gas tubes, have a significant impact on the FIT rate of the STM ATB. The gas tubes protect the analog inputs for the ATB antennas, but are only triggered in case a short-circuit current through the tracks is interrupted in rolling stock or by the traction power supply. This event is estimated to be very rare, however a measure to protect the analog inputs for the possibly destructive effects of a short-circuit current interruption through the tracks was deemed necessary. This measure is the implementation of gas tubes in parallel with the analog inputs to improve the reliability of the system. Since this measure is solely to improve the reliability of the system, it is contradictory that this measure would reduce the FIT rate significantly.

With these argument and the estimation that the protection devices are hardly triggered, all protection devices are excluded from the FIT rate calculation.

To show the effect of the LEDs, which are solely implemented for visual indication to manufacturing, installation and maintenance staff, another FIT rate is calculated without the effect of the LEDs.

In case an LED would be defective during the operational life cycle, a STM ATB unit can be replaced during the normal maintenance interval of the rolling stock. Scheduling of an accelerated maintenance interval is not required in this case.

### 3.2 Results

**Test Case Result, STMA-73812** - The results are stored in the container below.

[Mean Time To Failure spreadsheet](#)

The final result is given in the table below.

Total STM ATB FIT rate (*)	5274.21
Total STM ATB FIT rate (#)	4820.05

Conversion to years yields:

Mean Time To Failure (*)	21.6 years
Mean Time To Failure (#)	23.7 years

(\*): excludes protection devices

(#): excludes protection devices and LEDs


**Test Case Result, STMA-73991 - SAP Board results**


Total SAP Board FIT rate (*)	1975
Total SAP Board FIT rate (#)	1520

(\*): excludes protection devices

(#): excludes protection devices and LEDs

## 4 Conclusion

**Text, STMA-73843** - The requirement of the STM ATB for the mean time between failure is given in  **STMA-2868**. Conversion of  $2 \cdot 10^{-4}$ /hour to a FIT rate is equal to  $2 \cdot 10^5$  FIT.

The results in  **STMA-73812** show that this requirement is met.