



Creating and managing tons of documentation

How we use \LaTeX in AcubeSAT

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16 October 2019

Open Source CubeSat Workshop

Documents

- Simple
- Fast
- Consistent



Step 1: Tool

```
\section{Clock drift tests}
```

```
\subsection{USB}
```

We have performed no tests on USB's operation on clock drift.
According to the USB specifications:

```
\begin{quote}
```

```
\begin{itemize}
```

```
\item High speed data is clocked at 480.00Mb/s
```

```
\item Full speed data is clocked at 12.000Mb/s
```

```
\item Low speed data is clocked at 1.50Mb/s
```

```
\end{itemize}
```

```
\end{quote}
```

USB 1 clock speed is specified as

```
\( \SI{48}{\mega\hertz} \) with
```

a tolerance of ± 500 ppm,

often reduced to a ± 100 ppm by

systems engineers \footnote{doc, p. 6}

```
\subsection{Communication between STM32F1 & STM32L4}
```

We performed CAN communication tests between the STM32L4S9ZIT6 MCU on the OBC EM, and the STM32F103C8T6 MCU on the blue pill, using the following parameters:

```
\begin{itemize}
```

```
\item Time Quantum:  $1000$  ns
```

```
\end{itemize}
```

LaTeX



- Open-source
- Flexibility
- Consistency
- Version-controlled documents
- ...



- Learning curve
- Difficult to install
- ...



Step 2: Document ID

AcubeSAT-###-* *-\$\$\$



Step 2: Document ID

AcubeSAT-OBC-BT-o28




Step 2: Document ID

AcubeSAT-EPS-MI-003



Step 3: Create

Documentation Helper BOT 4:13 PM
(edited)

 Documentation Numbering Helper

First, choose the type of document you are about to write:

GEN: General

ADC: Attitude Determination & Control

COM: Communications

EPS: Electrical Power

OBC: On-Board Data Handling

SCI: Science Unit

STR: Structural


SYE: Systems Engineering

THE: Thermal

TRA: Trajectory

COL: Collaboration

Documentation Helper BOT 4:13 PM
(edited)

 Documentation Numbering Helper

Current result:

AcubeSAT-COM

Choose the type of your document:

« E: Experimentation & Development

B: Research & Technical Background


M: Meeting Outcomes


T: Technical Specification

G: Technical Guides & Handbooks

O: Generic & Operational

Documentation Helper BOT 4:13 PM
(edited)

 Documentation Numbering Helper

You are done! [Download your .tex file](#)  For more information about the next steps, [read here](#). The resulting documentation ID is:

AcubeSAT-COM-G-011

- COM: Communications
- « Technical Guides & Handbooks

«

Start over



Step 4: Write

The screenshot displays the Overleaf editor interface for a document titled "AcubeSAT Documentation". The left sidebar shows a file tree with folders like COL, media, COM, EPS, and General, containing various .tex and .png files. The main editor area shows LaTeX source code with line numbers 182 to 299. The code defines parameters for clock speed, tolerance, and communication tests. The right pane shows the rendered PDF with a graph of crystal resonator drift and a section on clock drift impact on bit error rate.

Figure 1: Crystal resonator drift with age

control times (TIM1/TIM8 and TIM15/16/17) and an interrupt is generated to inform the software about the failure (Clock Security System Interrupt CSSI), allowing the MCU to perform rescue operations.

1.1 Impact of clock drift on Bit Error Rate

Considering a naive digital signal sampler (Figure 2) that samples every T_s (or with a sampling frequency f_s), one bit is lost when the difference between the clock becomes a factor of T_s , i.e. when $\Delta t > nT_s$ for the first time $\forall n \in \mathbb{N}^+$.

We will now calculate the interval required for the first bit error, given that the two clocks are initially perfectly in sync. The signal is transmitted with a T_s sampling period, while the drifting clock samples with T_d . The first time where a failure occurs is:

$$\Delta t = T_s \quad (1)$$

or:

$$nT_s = nT_d = T_s \quad (2)$$

4

Clock Failure Testing

AcubeSAT-OBCE-01

Clock failure test

bits until error

<https://github.com/overleaf/overleaf>



Step 5: Browse

GEN

COL

ADC

COM

EPS

OBC

SCI

STR

SYE

THE

TRA

















AcubeSAT

INVALID

DOCUMENTATION

CATEGORIES


AcubeSAT Documentation List

ID	SUBSYSTEM	TITLE	DOWNLOAD	THUMBNAIL	AUTHOR	DATE
AcubeSAT-SYE-TG-001	Systems Engineering	AcubeSAT System Modes Technical Specification, Generic	  		Retselis Anastasios...	23 September 2019
AcubeSAT-OBC-G-010	OBC	YAFFS Specification Technical Guides & Handbooks	  		Orestis Ousoultzoglou	22 September 2019
AcubeSAT-OBC-EC-010	OBC	Clock Failure Testing Experimentation & Development, Components	  		Konstantinos Kanavo...	21 September 2019
AcubeSAT-OBC-BH-029	OBC	Research on Dual MCU Architecture Research & Technical Background, Theoretical	  		Orestis Ousoultzoglou	21 September

<https://helit.org/mm/docList/public>



Step 6: Final Result



AcubeSAT


AcubeSAT System Modes

AcubeSAT-SYE-TG-001

Rafaela Anastasiou-Faidon

September 23, 2019

Version: 0.3




Aristotle University of Thessaloniki

Aristotle Space and Aeronautics Team

CubeSat Project

2019

1



Turnstile antenna design and feeding study

AcubeSAT-COM-BH-028

Contents

- 1 Introduction 3
- 2 Theory background 3
 - 2.1 Boundary Conditions 3
 - 2.2 Image Theory 4
 - 2.3 Monopole antenna 5
 - 2.4 Shunt monopoles 6
 - 2.5 Turnstile antenna 7
- 3 Antenna design 9
 - 3.1 Monopole design 9
 - 3.2 Turnstile design 11


Changelog

Date	Version	Document Status	Comments
19/08/2019	0.2	INTERNALLY RELEASED	Final Version
18/08/2019	0.4	DRAFT	Spelling and Grammatical check
17/08/2019	0.3	DRAFT	Antenna Design
16/08/2019	0.2	DRAFT	Theory
15/08/2019	0.1	DRAFT	Initial revision

This is the latest version of this document (0.5) as of August 19, 2019. Newer versions might be available at <https://halit.org/ua/doclist/acubeSAT-COM-BH-028>.

Documentation template version v1.5-dev

2



Turnstile antenna design and feeding study

AcubeSAT-COM-BH-028

Theory background

1 Introduction

AcubeSAT is going to use the UHF band when it comes to telemetry and telecommands (TTTC), which is commonly used in CubeSat missions for the same purpose. In launchers' interior we must have the predicted dimensions for our 3U CubeSat and at the same time our antenna (which I'm going to present to you later in this report) because it occupies a lot of space. So, there is a need to deploy it because the existence of mechanical part protrusion is forbidden. Our deployment system will be approximately the same with UPsat's.

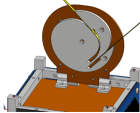


Figure 1: UPsat's deployment system

We were interested in using an omnidirectional antenna which can provide circular polarization so that we do not have that much polarization losses (the enormous distance of our link imposes it). The deployment system above gives us the capability to use two monopole antennas. So, the idea is to examine if we could combine two monopoles in a way that will make them operate-radiate as a turnstile antenna. The turnstile antenna is a combination of two orthogonal dipoles fed with equal amplitudes and quadrature phase and this antenna is capable of producing circularly polarized field in the direction normal to the dipoles' plane 0° and -90° for Right Handed Circular polarization, called RHCP. Let's say that the dipoles are along the x - and y -axis. The combination radiates Left Handed Circular polarization in the $-z$ direction. The existence of a ground plane changes the sense of circular polarization of the wave radiated in the $-z$ direction and adds to the direct radiated wave ($+z$ direction).

2 Theory background

2.1 Boundary Conditions

Suppose that we have a locally plane boundary in space described by a point and a unit normal vector \hat{n} that points from region 1 (x, y, z, r_1) to region 2 (x, y, z, r_2). We

3

7

