FUNcube Mission Requirements Specification

Summary

This document provides the top level mission requirements specification for the FUNcube satellite.

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0.1 DRAFT	07.10.09		WU / GS	ALL	Initial draft
0.2 DRAFT	15.10.09		WU	ALL	Revised
0.3 DRAFT	22.10.09		WU		Revised
0.4 DRAFT	05.09.10		JD, GS		Included Fitter Messages Requirement

List of TBD's and TBC's

TBC/TBD	*Location*	*Subject*	*Due date*	*Action by*

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1. Introduction

FUNcube is an educational project with the goal of enthusing and educating youngsters about radio, space, physics and electronics, by constructing and launching a small satellite, based on the CubeSat standard. The target audience consists of primary and secondary school pupils. It will serve to provide an in-orbit counterpart to GB4FUN.

The satellite itself will be built by an experienced team of radio amateurs and space engineering professionals, using off the shelf components and subsystems, which have an adequate heritage in space, thereby reducing project risk, schedule and cost.

The primary objective is to provide an in-orbit tool for science education outreach and hands-on training in space, science and radio. Included in the project is the development of simple hand held VHF receive equipment connected to the USB port or soundcard of a computer or net/laptop. This will enable the reception of live data from space from the playground.

This would be done through the provision of a telemetry system that is suitable for easy reception. Furthermore, the satellite contains a materials science experiment, from which the school children can receive telemetry data which they can compare to the results they obtained from similar reference experiments in the classroom.

Its secondary objective is to provide a linear amateur radio UHF to VHF transponder which can be used by radio amateurs worldwide and can be used to demonstrate radio communications to schoolchildren and students of all ages.

Additionally the satellite will be available for use by GB4FUN for satellite communication, telemetry and command demonstrations.

2. Mission objectives

The primary and secondary mission objectives are summarized below.

1. Provide an in-orbit tool for science education and outreach, by means of the following:
    a. Perform a materials science experiment in space
    b. Provide for telemetry which is receivable by un-trained teachers and schoolchildren using a handheld receiver
    c. Provide a message service similar to Text/Twitter messages. These messages to be uploadable by designated control stations, and to be transmitted. These messages to be known as "Fitter" messages.

2. Provide a linear transponder which can be used by radio amateurs to make 2-way radio contacts using a modest equipment setup

3. Mission requirements and constraints

3.1 General mission requirements

3.1.1 **Project outreach**

The mission shall be compatible with the goals defined in the FUNcube project outreach plan

3.1.2 **Working language**

The project shall use the English language.

3.1.3 **Unit use**

Throughout the mission, metric (SI) units shall be used

3.2 Operational Mission Requirements

3.2.1 **Mission Operational Phasing**

The mission shall at least incorporate the following phases:
a) Launch Phase
b) Commissioning Phase
c) Operations Phase
d) De-Commissioning Phase

3.2.2 **Mission Schedule**

Mission operations shall start after deployment from the launch adapter once on orbit

3.2.3 **Design Lifetime**

The mission shall have a design lifetime of at least 1 year

3.3 Constraints

3.3.1 **Use of off-the-shelf subsystems**

The satellite design shall use as much off-the shelf subsystems as possible to reduce complexity, development time and technical, programmatic and financial risk of the mission to a minimum

3.3.2 **Legislation**

The mission shall comply with international legislation and regulations

4. System requirements and constraints

4.1 General system requirements

4.1.1 Linear transponder

The satellite shall provide for the inclusion of a linear transponder

4.1.2 Materials science experiment

The satellite shall provide for the inclusion of a materials science experiment

4.1.3 Frequency use

The satellite shall communicate on frequencies within the Amateur Satellite Service bands

4.1.4 Ground segment

The satellite shall be designed to operate with a bespoke handheld ground receiver and GUI telemetry display software

4.1.5 CubeSat Spec

The satellite dimensions shall comply to the CubeSat form factor requirements as laid out in the Cubesat Design specification rev. 12 document

4.1.6 Testability and verification

The satellite shall be designed such that testing and verification of the satellite is possible using a minimum of specially developed Ground Support Equipment

4.2 Functional system requirements

4.2.1 Telemetry downlink

The satellite shall provide for a telemetry downlink (including Fitter Messages) which can be received using a handheld receiver

4.2.2 Audible telemetry

The satellite telemetry shall be audible and recognisable by the human ear when received with a handheld receiver

4.2.3 Linear transponder

The satellite shall be capable of providing a linear transponder function which can be used by radio amateurs to make 2-way radio contacts using a modest equipment setup

4.2.4 Battery End Of Life mode

When the batteries reach their “end-of-life” the satellite shall still be capable of functioning in sunlight

4.3 Constraints

4.3.1 Orbit

The satellite shall be designed and manufactured to be suitable for flight in any orbit between 500 and 900km and at any inclination larger than 50 degrees

4.3.2 Launch vehicle compatibility

The satellite shall be compatible with the verification and acceptance requirements for auxiliary payloads as defined for the VEGA, Dnepr, PSLV and Soyuz launch vehicles