STUDENTS' SPACE ASSOCIATION

THE FACULTY OF POWER AND AERONAUTICAL ENGINEERING
WARSAW UNIVERSITY OF TECHNOLOGY

# PW-SAT2

## PRELIMINARY REQUIREMENTS REVIEW

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## *Communication*

Phase A of PW-Sat2 project

1.1 EN

pw-sat.pl

**2014-05-08**



**Abstract**

The following document is a part of the summary of phase A of the student satellite project PW-Sat2. It describes the satellite's communication system, selected components, power balance and the proposed locations for the Ground Station.

The document is published as a part of:

PW-Sat2 – Preliminary Requirements Review

**REVISIONS**

| Version | Date | Changes | Responsible |
|---|---|---|---|
| | | Polish version of the document. | Tomasz Rybarski |
| 1.0 EN | 2014-05-08 | English version of the document | Tomasz Rybarski |
| 1.0 EN | 2014-05-08 | Editing | Dominik Roszkowski |
| 1.0.1 EN | 2014-07-02 | Small editorial changes | Dominik Roszkowski |
| 1.1 | 2017-03-21 | Disclaimer added – out of date doc | Dominik Roszkowski |

**Attention** Phase A documentation may be outdated in many points. Please do not depend on Phase B or Phase A documents only. Current documentation is available on the project website pw-sat.pl

This document is also available in Polish.

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# 1 INTRODUCTION

## 1.1 SELECTED COMPONENTS

The VHF downlink and UHF uplink communications module is responsible for receiving commands, sending telemetry and payload data.

It has been decided to buy an existing communications module along with an antenna module. Modules designed by ISIS Space have been considered. The technical specification of the communications module [1] is obtained from the manufacturer's website. The antenna module is presented on the image [2] below:

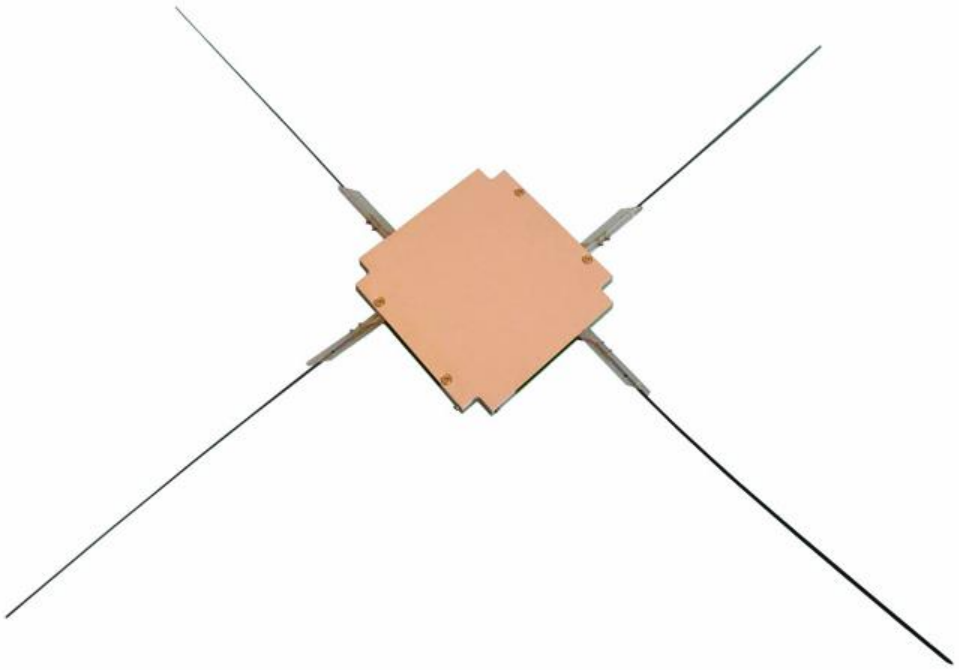


**Figure 1-1 ISIS antenna module.**

The transmission module (downlink) covers the VHF band (130-160 MHz frequency range), while the receiver (uplink) is designed to operate in the UHF band covering the frequencies 400 – 450 MHz.

The exact frequencies match these reserved for PW-Sat1 and are the following: 145.900 MHz (transmitter) and 435.020 MHz (receiver)

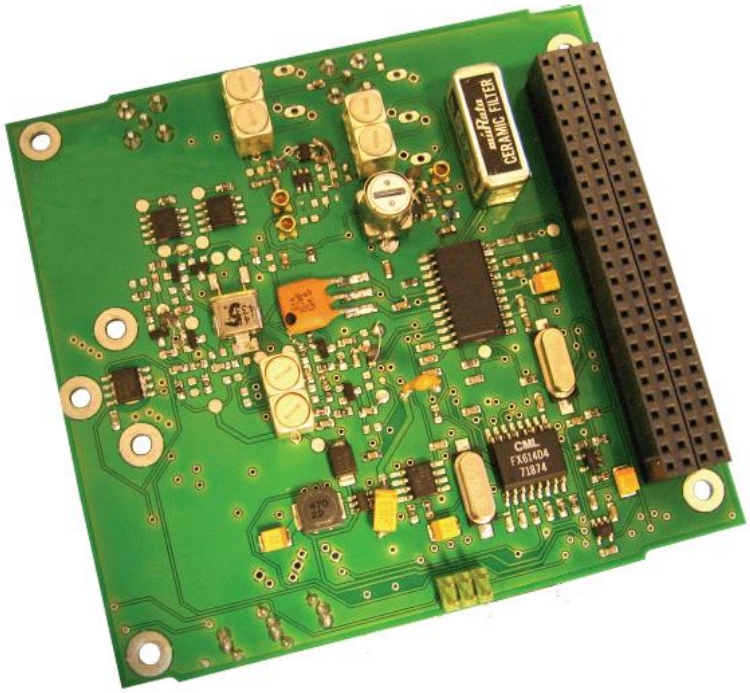


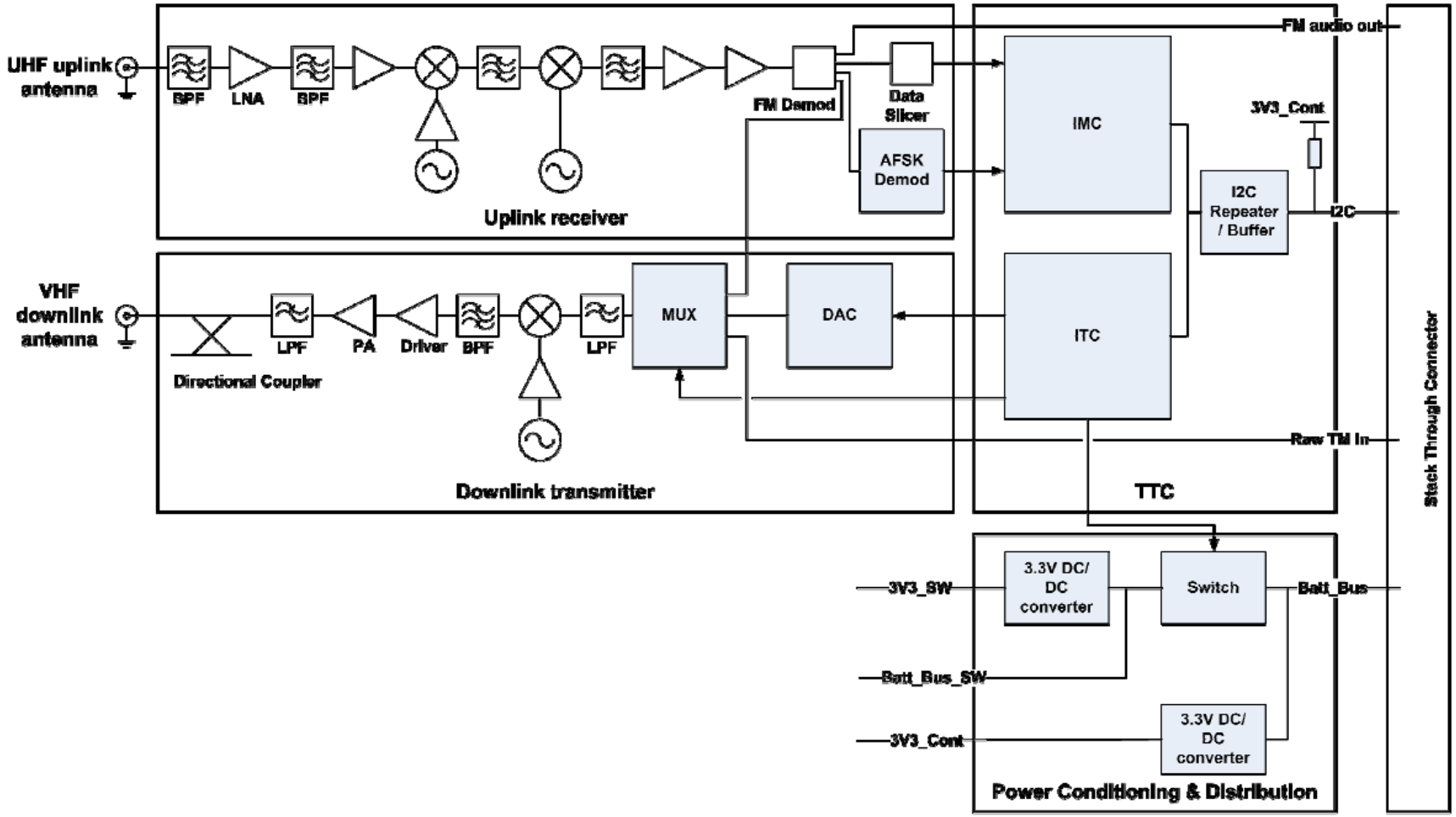

**Figure 1-2 ISIS communications module.**

## 1.2 TECHNICAL PARAMETERS

| Transmitter parameters | |
|---|---|
| Power output | 200 mW (22 dBm) |
| Data rate | 9600 bps (max) |
| Modulation | BPSK |
| **Receiver parameters** | |
| Sensitivity | - 104 dBm |
| Bit Error Rate | 10e-5 |
| Modulation | AFSK |
| **Power consumption** | |
| Transmission mode | < 1.55 W |
| Receiving mode | < 0.2 W |
| Supply voltage | 6.5 – 12.5 VDC |

**Table 1-1 Technical parameters of transmitter and receiver**

## 1.3 MODULE BLOCK DIAGRAM



# 2 RADIO LINK POWER BALANCE

1. Attenuation of the transmitter – antenna path (feeder, connectors, etc.)

$$L_{FTX} = -1.5 \text{ dB}$$

2. Attenuation in free space

$$L_{FS} = 32.45 + 20\log(f_{[MHz]}) + 20\log(d_{[km]})$$

The following assumptions were made:

- frequency 435.020 MHz (transmitter on Earth, receiver on board of the satellite)

a) For the orbit of 600 km (d = 600 km)

$$L_{FS} = 32.45 + 20\log(435.020) + 20\log(600) = 140.78 \text{ dB}$$

b) For the orbit of 700 km (d = 700 km)

$$L_{FS} = 32.45 + 20\log(435.020) + 20\log(700) = 142.12 \text{ dB}$$

# 3 GROUND STATION

The GS team was also formed in Phase A. This teams responsibility was either building a new ground station or improving the existing one. . Finally the project of building a new station has been abandoned due to lack of funds and necessity. Cooperation has been established with already existing stations which have agreed on participating in communication with the satellite after launch.

**Current Ground Stations taken into account:**

1. Ground Station of the Faculty of Electronics and Information Technology, Warsaw University of Technology, Warsaw, Poland.
2. BRITE Ground Station, Nicolaus Copernicus Astronomical Center, Warsaw, Poland.
3. Ground Station of the ISIS company, Delft, Netherlands

Additionally it is considered to use this GENSO (*Global Educational Network for Satellite Operations*) network [3]. Unfortunately there is a risk associated with this solution since the network is not yet built.

# 4 REFERENCE

[1] ISIS - http://www.cubesatshop.com/index.php?page=shop.product_details&flypage=flypage.tpl&product_id=73&category_id=5&option=com_virtuemart&Itemid=67

[2] ISIS - http://www.cubesatshop.com/index.php?page=shop.product_details&flypage=flypage.tpl&product_id=66&category_id=6&option=com_virtuemart&Itemid=70

[3] GENSO - http://www.esa.int/Education/How_GENSO_works