Phase C

Antenna Test Procedure

Prepared by:

Igor Bilogrevic

Chris Grandgeorge

Garikoitz Madinabeitia

Checked by: Marie Dumont

Approved by:

•

Space Center - EPFL
Lausanne
Switzerland

•

14/08/2007

•

Space Center

RECORD OF REVISIONS

ISS/REV	Date	Modifications	Created/modified by
1/0	02/04/2007	Initial issue	Igor Bilogrevic, Garikoitz Madinabeitia, Chris Grandgeorge
1/1	08/04/2007	Reviewed	Marie Dumont
1/2	31/05/2007	Updated	Igor Bilogrevic
1/3	04/06/2007	Removed comments	Igor Bilogrevic

1 TEST OBJECTIVES

First of all we want to see the radiation patterns and gains in real conditions scenario and secondly we want to check if there are important differences between the straight and the bent antennas with a 10° deflection angle.

2 IDENTIFICATION AND CONFIGURATION OF THE TEST ARTICLE

The test will be held in an anechoic chamber at EPFL (ELL building).

The SwissCube will be fixed on a rotating platform in the middle of the chamber. The platform can turn around Oz axis and go up and down along Oz.

The platform will turn around the Oz axis at steps of 1 degree per measurements. The antennas will be horizontally placed (Oxy plan).

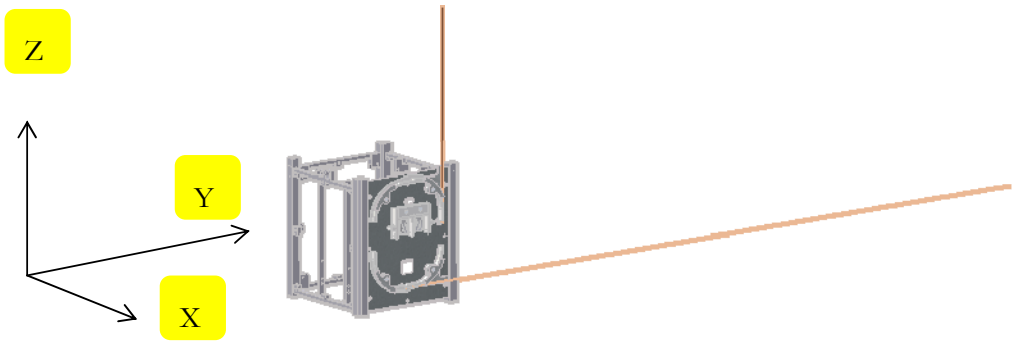

Figure 1 : Antenna's axes

3 TEST SET-UP IDENTIFICATION

The colleted data will be the intensity of the antenna's radiation expressed in dBi (10*log(Power/Power_of_isotropic_antenna)).

3.1 Ground support equipment and manuals

The necessary equipment will be:

- Anechoic chamber (figure 2)
- Satellite with antennas (figure 3)
- Coaxial cables and connectors (SMC, SMA and N-type) (figure 4, 5 and figure 6)
- Power amplifier (figure 7)
- Signal generator(figure 8)
- Electromagnetic fields sensors (log-periodic and biconic antennas) (figure 9)
- Spectrum analyzer (figure 10)

3.2 Instruments (including accuracy and calibration data)

The anechoic chamber is a 6m x 7m rectangular chamber which contains the moving platform (on which the satellite will be fixed), a sensor antenna (that can be used either for sending or receiving) and lot of isolating material to avoid reflections of the electromagnetic waves from the walls or the ground. The moving platform can move at the rate of 1 degree per measurement and the sensor antenna has a minimal sensitivity of 1 mV/m (electric field).

The SwissCube has two monopole antennas for communication. One operates in the VHF frequency band (145 MHz) and the other in the UHF frequency band (437.5 MHz). The first one is for the uplink, i.e. it will be receiving telecommands from the ground station, the second one is for downlink, i.e it will be sending telemetry and science information to the ground station.

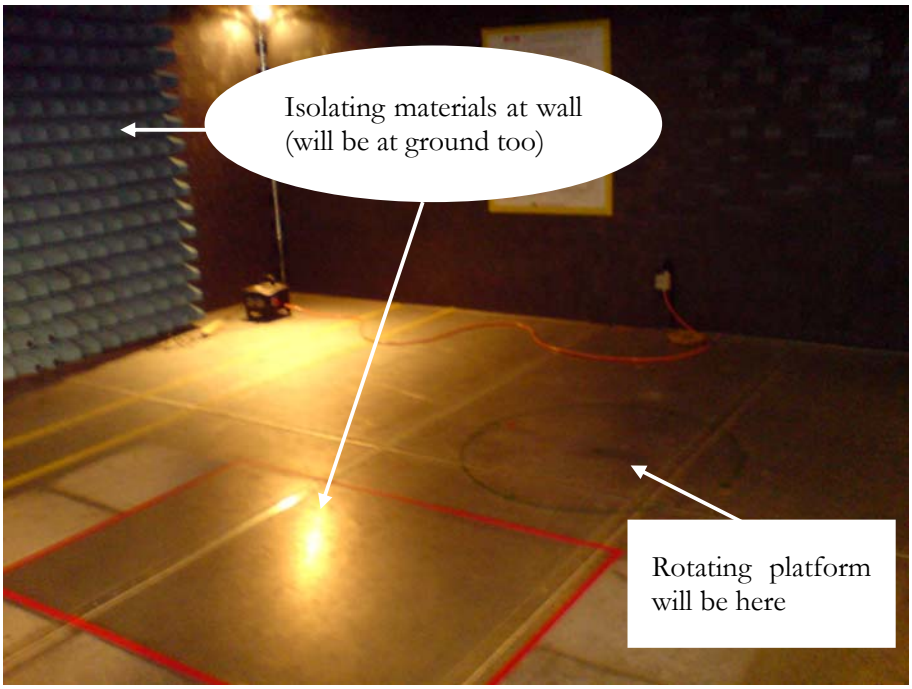

Figure 2 : Anechoic chamber, building ELL at EPFL

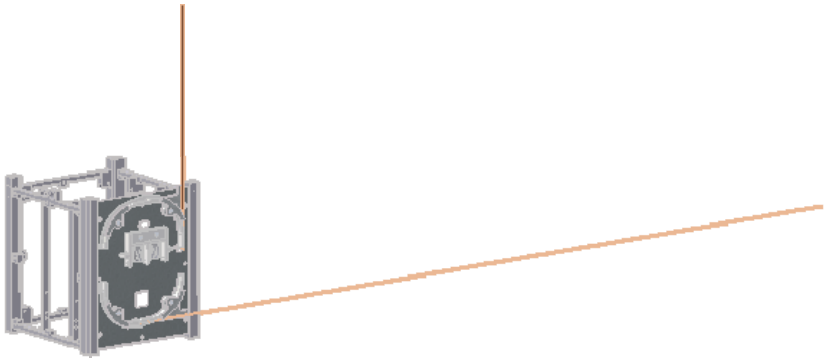

Figure 3 : SwissCube with the two monopole antennas (the long one is the VHF at 145 MHz and the short one is the UHF 437.5 MHz)

The coaxial cables are of type RG 188 A/U (www.hubersuhner.ch, see attachment). At 150 MHz, the attenuation is 0.3 dB/m at max and at 450 MHz is 0.5 dB/m. The connectors will be of type SMC (figure 5) at the satellite interface and N-type (figure 7) at the wall in the chamber. Between the two we will use and SMA-to-N adaptor since we have the SMA (figure 6) connector. All the

connectors and cables have an impedance of 50 Ohms. The cable that will connect the antennas to the wall is the above mentioned coaxial RG 188 A/U.

Figure 4 : SMC cable connector

Figure 5 : SMA cable connector

Figure 6 : N-type cable connector

The power amplifier can deliver up to 100 Watts.

Figure 7 : Power amplifier

The signal generator can generate sinusoids at frequencies starting from some hundreds of kHz up to some GHz. Therefore it is suitable for our testing purposes. We will need a power amplifier since the generator can give only 0.1 W at its output.

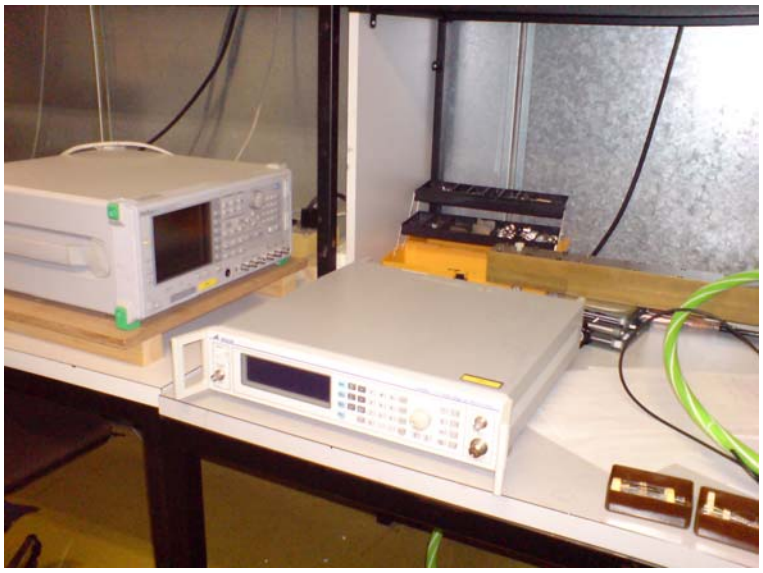

Figure 8 : Signal generator

The log-periodic sensor antenna has a minimal sensitivity of 1 mV/meter and it will be used for reception sensing at 437.5 MHz.

Figure 9 : Sensor antenna (log-periodic)

The spectrum analyzer will be measuring the signal intensity at a given frequency and position of the antennas. It offers the possibility to put on a floppy disc the raw data. It has a resolution of 500 points over the screen.

Figure 10 : Spectrum analyzer

4 TEST CONDITIONS

4.1 Test levels and duration

We plan to start with an emitting power at the antennas of 20 Watts in order to see the shape of the radiation patterns.

Afterwards we will go down to 1 Watt (or even less) if the sensors permit that.

We will do four measurements (UHF antenna straight & bent, VHF antenna straight & bent) for every power level.

In order to set up the chamber, satellite, instruments and for the tests we will need two afternoons (10 hours).

4.2 Tolerances

The tolerances will be determined by the sensor sensitivities.

4.3 Data acquisition

The data will be collected by a spectrum analyzer placed outside the chamber and, if needed, on a floppy disc too.

5 STEP BY STEP INSTRUCTION FOR OPERATION

5.1 Test preparation

1. Make sure that the anechoic chamber is free (5 minutes).
2. Place the sensor antenna at right position (10 minutes).
3. Place the rotating platform at right position (10 minutes).
4. Put the isolating materials on the ground. (30 minutes)
5. Check sensor antenna and rotating platform connections (10 minutes).
6. Put the SwissCube on the platform and fix it.
7. Plug in the coaxial cable at UHF SwissCube's antenna and at the wall (via a SMA-to-N adaptor) (5 minutes).
8. Plug in the coaxial cable outside the chamber to the power amplifier (1 minute).
9. Connect the power amplifier to the signal generator (1 minute).
10. Connect sensor antenna to the spectrum analyzer (1 minute).
11. Turn down all the power levels on the instruments (5 minutes).
12. Calibrate instruments (5 minutes).
13. Ask Zweiacker and Zurcher for check-up (20 minutes).
14. Start testing.
15. Monitor the power amplifier levels.
16. Look at spectrum analyzer and mark on a separate sheet the values of the electric field for the frequency of 437.5 MHz (or 145 MHz) for that particular position of the satellite.
17. Rotate the platform by 1 degree and iterate from point 15 until 360 degrees are measured.
18. Do that for each antenna.

Please see figure 11 for an example of the test procedure.

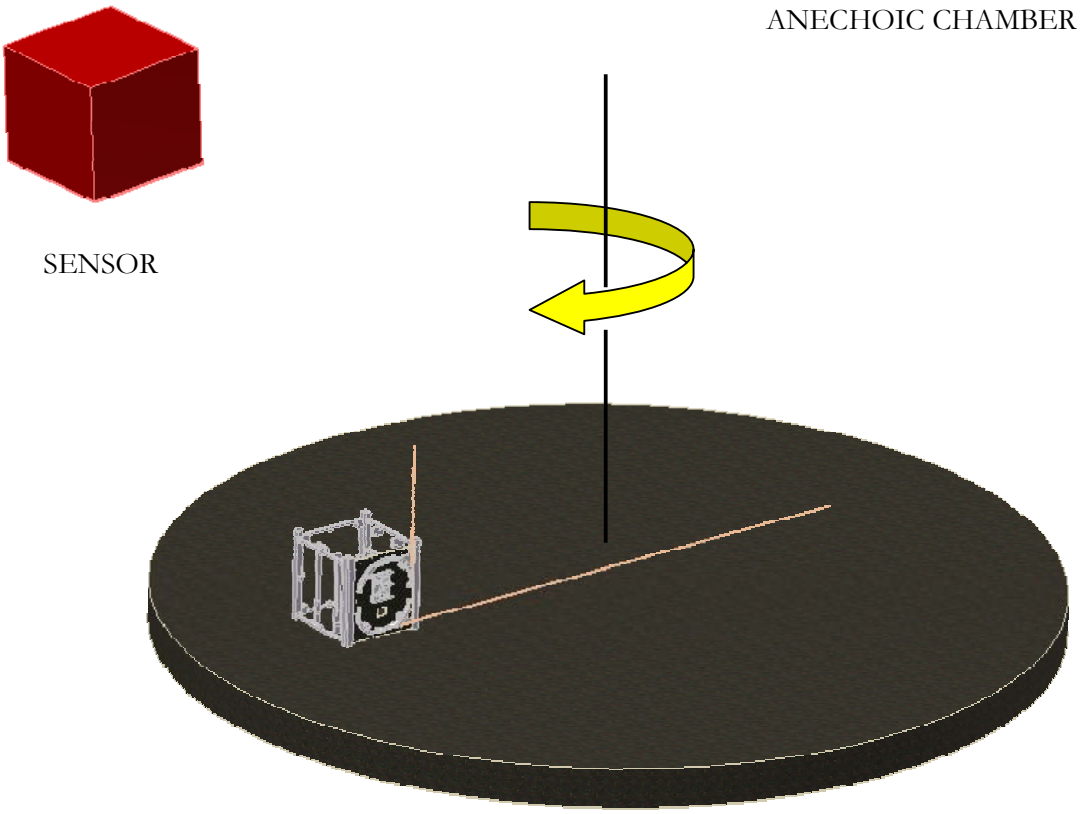

Figure 11 : Measures on the VHF straight antenna

5.2 Pass-fail criteria

There are no pass-fail criteria since the purpose of the test is just to measure and collect information data.

5.3 Past test activities

This will be the first antenna test.

6 SAFETY AND SECURITY INSTRUCTIONS

No person should be present in the chamber during the tests for security reasons.

7 PERSONAL REQUIRED AND RESPONSIBILITY

The required persons are the responsible for the chamber Pierre Zweiacker, the EPFL antenna expert Jean-François Zurcher, the SwissCube responsible Muriel Noca, the students involved in the tests Garikoitz Madinabeitia, Chris Grandgeorge and Igor Bilogrevic.