Phase B

RF Test for the Antenna Deployment System Test Report

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RECORD OF REVISIONS

ISS/REV	Date	Modifications	Created/modified by
1/0	23/06/2007	Initial issue	Igor Bilogrevic Chris Grandgeorge Garikoitz Madinabeitia

1 AS RUN TEST PROCEDURE

- Put a table on the rotating platform to place the satellite at right position
- Place the sensor antenna at right position (3 meters distant from SwissCube)
- Place the Swisscube's antennas at right position
- Connect and check sensor antenna and rotating platform connections
- Plug in the coaxial cable at VHF SwissCube's antenna and at the wall (via a SMA-to-N adaptor)
- Plug in the coaxial cable outside the chamber to the power amplifier
- Connect the power amplifier to the signal generator
- Connect sensor antenna to the spectrum analyzer
- Turn down all the power levels on the instruments
- Calibrate instruments
- Start testing
- Monitor the power amplifier levels
- Look at spectrum analyzer and mark on a separate sheet the values of the electric field for the frequency of 437.5 MHz for that particular position of the satellite.
- Rotate the platform by 2 degree and iterate until 360 degrees are measured.
- Enter the chamber, bend the VHF antenna of 10°
- Start testing
- Monitor the power amplifier levels
- Look at spectrum analyzer and mark on a separate sheet the values of the electric field for the frequency of 437.5 MHz for that particular position of the satellite.
- Rotate the platform by 2 degree and iterate from until 360 degrees are measured.
- Enter the chamber, position and plug the UHF antenna
- Start testing
- Monitor the power amplifier levels
- Look at spectrum analyzer and mark on a separate sheet the values of the electric field for the frequency of 145 MHz for that particular position of the satellite.
- Rotate the platform by 2 degree and iterate from until 360 degrees are measured.

2 FACILITY DATA

Test done in an anechoic chamber in 25°C

3 TEST ARTICLE DATA

3.1 Power Levels and Cable Losses

3.1.1 145 MHz: Biconical antenna transmitter

Output power delivered to transmission line:	17.3 dBm	(measured)
Power amplifier → antenna cable losses:	1 dB	(measured)
Typical biconical antenna gain at 145 MHz:	0.8 dBi	(estimate)
Final power delivered to antenna:	*Pt = 16.3 dBm = 42.66 mW*	

3.1.2 145 MHz: Monopole antenna receiver straight (SwissCube)

Antenna → Spectrum analyzer cable losses:	3 dB	(specifications)
Max received power at 145 MHz:	- 6 dBm	(measured)
Min received power at 145 MHz:	- 24.6 dBm	(measured)
Final max received power at 145 MHz:	*-3 dBm*	
Final min received power at 145 MHz:	*- 21.6 dBm*	

3.1.3 145 MHz: Monopole antenna receiver bent (SwissCube)

Antenna → Spectrum analyzer cable losses:	3 dB	(specifications)
Max received power at 145 MHz:	- 6.7 dBm	(measured)
Min received power at 145 MHz:	- 28.9 dBm	(measured)
Final max received power at 145 MHz:	*-3.7 dBm*	
Final min received power at 145 MHz:	*- 25.9 dBm*	

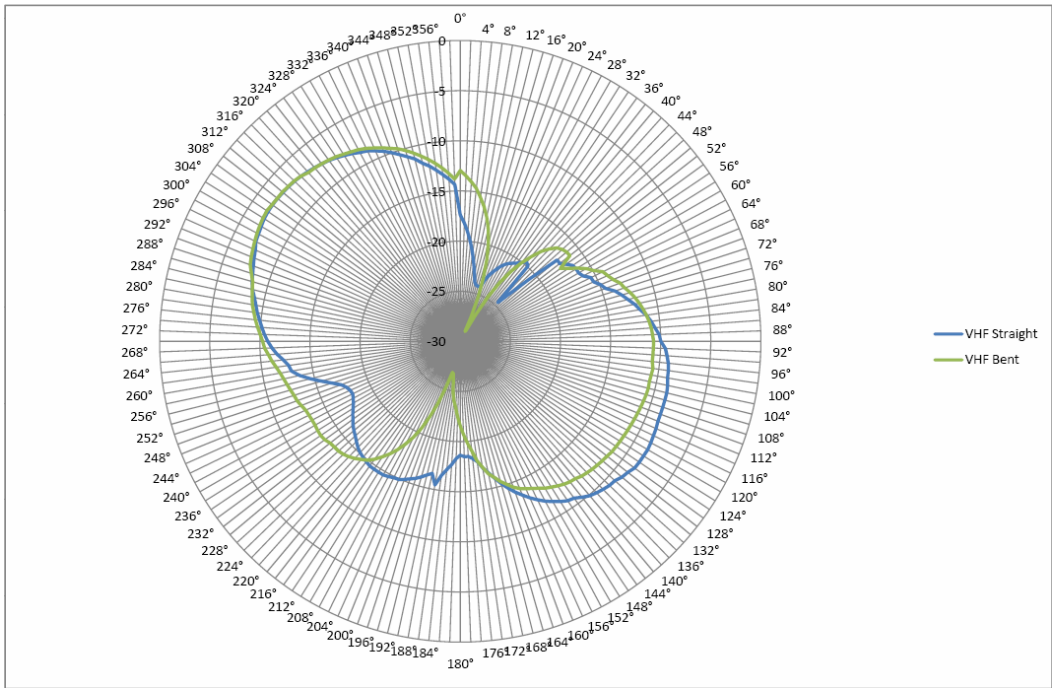
3.1.4 437.5 MHz: Monopole antenna transmitter (SwissCube)

Output power delivered to transmission line:	17.3 dBm	(measured)
Power amplifier → antenna cable losses:	5.4 dB	(specifications)
Final power delivered to antenna:	*Pt = 11.9 dBm = 15.5 mW*	

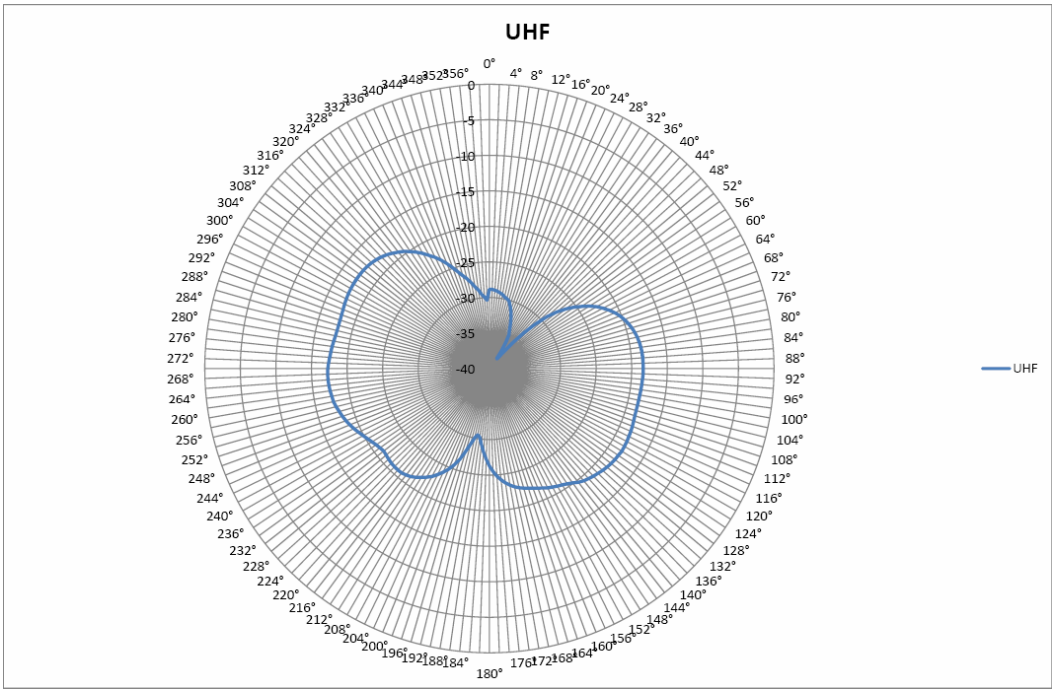
3.1.5 437.5 MHz: Log-periodic antenna receiver

Antenna → Spectrum analyzer cable losses:	1.5 dB	(estimate)
Max received power at 437.5 MHz:	- 17.25 dBm	(measured)
Min received power at 437.5 MHz:	- 30.4 dBm	(measured)
Final max received power at 437.5 MHz:	*-15.75 dBm*	
Final min received power at 437.5 MHz:	*- 28.9 dBm*	

3.2 VHF Antenna reception



3.3 UHF Antenna transmission



Rough measurements are in the tables of Appendix 1

4 EVALUATION OF THE TEST DATA

The VHF antenna test results show us that the influence of a 10° bent antenna is acceptable.

The UHF antenna test results show us that the monopoles have a symmetric radiation pattern just as in the simulations.

5 SUMMARY OF THE TEST EVALUATION AND CONCLUSION

With the results the test provided us, we are able to compute the SwissCube antennas' maximal and minimal gains by using the Friis transmission equation:

$$\frac{P_r}{P_t} = G_t G_r \left(\frac{\lambda}{4\pi R}\right)^2$$

Where Pr and Pt are received and transmitted power [W], Gt and Gr are the antenna gains [dBi] of the transmitter and receiver antenna, λ the wavelength and R the distance between the antennas [both in meters].

Taking into account the cable losses, the gains are:

Antenna	Measured max gain [dBi]	Simulated max gain [dBi]	Measured min gain [dBi]	Simulated min gain [dBi]
VHF straight	**4.9 dBi**	**2.25 dBi**	**0 dBi**	**- 1.65 dBi**
VHF bent	**4.13 dBi**	**2.29 dBi**	**0 dBi**	**- 1.55 dBi**
UHF	**3.57 dBi**	**3.37 dBi**	**0.17 dBi**	**- 1.59 dBi**

Table 1 : Antenna measurements and simulations results

We can conclude that the results are similar to the ones obtained by the simulations and even better in terms of maximal and minimal gain.

The SwissCube antenna configuration is therefore correctly sized.