HSLU Hochschule Luzern

Bachelor-Thesis 2023
Bachelor of Science in Elektrotechnik und Informationstechnologie

UHF Ground Station Implementation

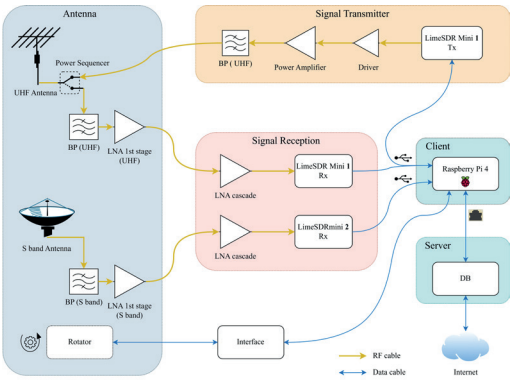

Abb. 1: Block diagram GS

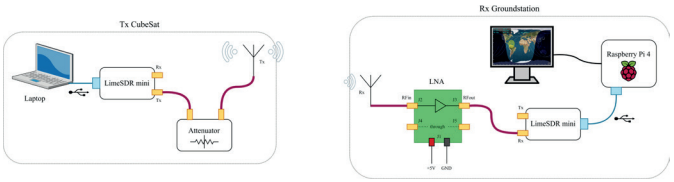

Abb. 2: Wireless transmission test

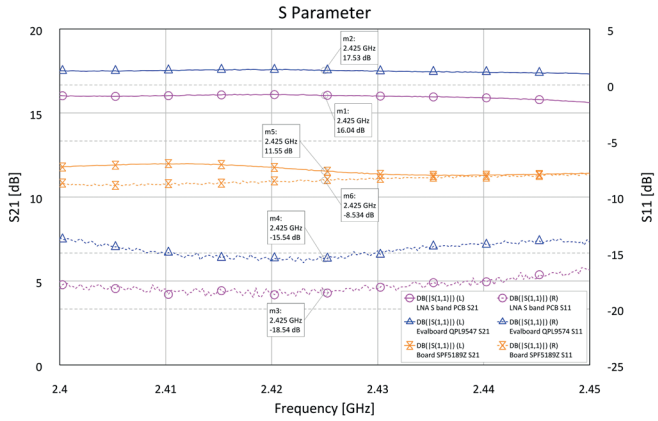

Abb. 3: S Parameter

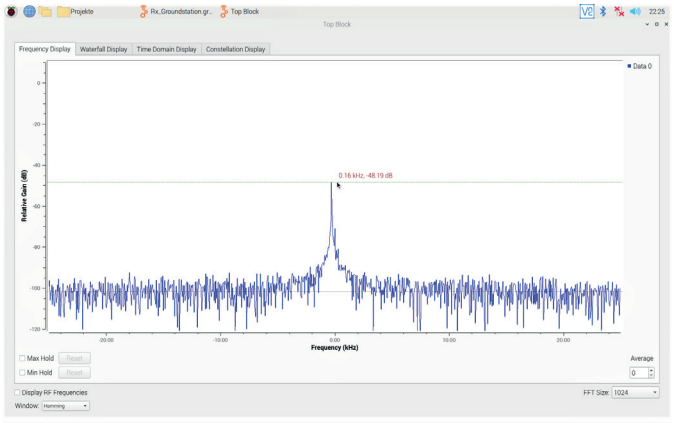

Abb. 4: Received Signal

Problem

The CubeSat team from ARIS wants to develop and operate their first nanosatellite. This nanosatellite, or CubeSat, has been planned as the first mission with the name Swiss Artificial Gravity Experiment (SAGE).

Without reliable communication, the SAGE mission cannot succeed. A CubeSat, however good, can be developed, but it is useless if it can neither receive nor transmit a signal. The challenge is to ensure a data link between the CubeSat and the ground station (GS).

Solution Concept

The topology and surrounding transmitter stations at the future location of the ground station at ETHZ on Hönggerberg were investigated. Based on possible orbital data of the satellite, a link budget was calculated. At the system level, a possible concept (see Figure 1) is shown that fulfil the requirements of the CubeSat team SAGE and the global open source network SatNOGS.

Implementation

One low-noise amplifier (LNA) each was developed and assembled for the two frequency ranges UHF and S band. A microstrip filter for the frequency range in the S band was developed and manufactured. A wireless transmission test (see Figure 2) was carried out with two LimeSDR mini, one LNA, one Raspberry Pi 4 and two antennas.

Result

The two self-developed and assembled LNA made of FR-4 printed circuit board material show comparatively beneficial properties (see Figure 3) to purchased reference products. A microstrip filter developed in-house for the 2.425 GHz frequency range shows an attenuation of -3 dB in the passband. The LNA in the UHF frequency range improves the signal-to-noise ratio (SNR) for wireless signal transmission to a received signal of -48.19 dB (see Figure 4).

Outlook

After the modulation type (like BPSK, QPSK, MSK or FSK) has been determined, another wireless transmission test should be repeated. This test is more meaningful if the recommended final antennas are used, as they have different directivity and the associated gain to the antenna used.

Diplomand
Portmann Martin

Dozent
Dr. G. Wichmann

Themengebiet
Nachrichtentechnik/Signal Processing und Technische Informatik

Projektpartner
Akademische Raumfahrt Initiative Schweiz (ARIS)