Geophysical Research Abstracts
Vol. 15, EGU2013-4799, 2013
EGU General Assembly 2013

Design and Testing of a Controller for the Martian Atmosphere Pressure and Humidity Instrument DREAMS-P/H

Timo Tapani Nikkanen, Walter Schmidt, Maria Genzer, Ari-Matti Harri, and Harri Haukka
Finnish Meteorological Institute, Earth Observation, Helsinki, Finland (walter.schmidt@fmi.fi, +358 29539 4658)

The European Space Agency (ESA), driven by the goal of performing a soft landing on Mars, is planning to launch the Entry, descent and landing Demonstrator Module (EDM)[1] simultaneously with the Trace Gas Orbiter (TGO) as a part of the ExoMars program towards Mars in 2016. As a secondary objective, the EDM will gather meteorological data and observe the electrical environment of the landing site with its Dust characterisation, Risk assessment, and Environmental Analyser on the Martian Surface (DREAMS). The Finnish Meteorological Institute (FMI) is participating in the project by designing, building and testing a pressure and a humidity instrument for Mars, named DREAMS-P and DREAMS-H, respectively. The instruments are based on previous FMI designs, including ones flown on board the Huygens, Phoenix and Mars Science Laboratory.[2]

Traditionally, the FMI pressure and humidity instruments have been controlled by an FPGA. However, the need to incorporate more autonomy and modifiability into instruments, cut the development time and component costs, stimulated interest to study a Commercial Off-The-Shelf (COTS) Microcontroller Unit (MCU) based instrument design. Thus, in the DREAMS-P/H design, an automotive MCU is used as the instrument controller. The MCU has been qualified for space by tests in and outside FMI.

The DREAMS-P/H controller command and data interface utilizes a RS-422 connection to receive telecommands from and to transmit data to the Central Electronics Unit (CEU) of the DREAMS science package. The two pressure transducers of DREAMS-P and one humidity transducer of DREAMS-H are controlled by a single MCU. The MCU controls the power flow for each transducer and performs pulse counting measurements on sensor and reference channels to retrieve scientific data. Pressure and humidity measurements are scheduled and set up according to a configuration table assigned to each transducer. The configuration tables can be modified during the flight. The whole software is entirely interrupt driven, thus the MCU goes into a power saving standby mode whenever possible. Any measurement or other operation can be stopped by simply interrupting the controller with a telecommand.

Software and functional tests of the DREAMS-P/H controller are needed to verify the performance of the instrument in nominal conditions and the correct operation and error detection in anomalous conditions. The nominal conditions tests range from simple functional and performance tests, to longer simulations of continued operation and measurements. Continued operation simulations can be implemented by executing accelerated runs of the expected normal measurement cycles. On the contrary, anomalous conditions tests are used to verify that the controller can handle bad telecommands or anomalous operation of the instrument transducers, for example in the case of malfunctioning sensors. Bad telecommand tests are done by feeding illegal parameters or scrambled telecommands to the controller. Malfunctioning sensors can be simulated by modifying the signals coming from the sensors and reference channels. All expected use cases and all imagined unexpected operating circumstances are studied to ensure that the system is robust. This also makes the planned modification of the design for other future missions easier and safer.

Reference:

[1] ESA ExoMars EDM mission: http://exploration.esa.int/science-e/www/object/index.cfm?fobjectid=47852
[2] FMI Space Projects website: http://space.fmi.fi/index.php?id=23