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COMARS+ INSTRUMENTATION PACKAGE OF THE EXOMARS SCHIAPARELLI LANDER AND ITS FLIGHT PERFORMANCE

Abstract

COMARS+ instrumentation package was developed to measure aerothermal parameters on the back cover of the ExoMars Schiaparelli lander during the entry phase. The aerothermal sensors called COMARS combine four discrete sensors measuring static pressure, total heat flux, temperature and radiative heat flux. The electronic box of the payload is used for amplification, conditioning and multiplexing of the sensor signals. The design of the payload was mainly carried out using numerical tools. To validate the design an extensive qualification test campaign was conducted on a set of qualification models. The tests included vibration and shock tests to simulate launch loads and stage separation shocks. Thermal tests under vacuum condition were performed to simulate the thermal environment of the capsule during the different flight phases. Furthermore electromagnetic compatibility tests were conducted to check that the payload is compatible with the electromagnetic environment of the capsule and does not emit electromagnetic energy that could cause electromagnetic interference in other devices. For the sensor heads located on the ExoMars back cover radiation tests were carried out to verify their radiation hardness. Finally the bioburden reduction process was demonstrated on the qualification hardware to show the compliance with the planetary protection requirements. To test the actual heat flux, pressure and infrared radiation measurement under representative conditions, aerothermal tests were performed in an arc-heated wind tunnel facility. After passing all acceptance tests, the COMARS+ flight hardware was integrated into the Schiaparelli capsule and launched on top of the Proton launcher on 14th March 2016. All COMARS+ sensors operated nominally during the complete entry phase, but the complete set of COMARS+ flight data was stored in the mass memory of the lander for transmission after landing, which was not possible due to the anomaly that led to the failure of Schiaparelli shortly before landing. Nevertheless, a subset of the COMARS+ flight data was transmitted real-time during the entry by Schiaparelli and were successfully received by the TGO Orbiter, with the exception of the plasma black-out phase. Back cover surface pressure, total heat flux rate and radiative heat flux were measured successfully. Measured back cover total heat fluxes are below the sizing total heat flux level of the back cover TPS which suggests, that the design margins for the back cover TPS design can be reduced for future missions.