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Author: Dr. Vincenzo Quaranta
CIRA Italian Aerospace Research Center, Capua, Italy

Mr. Pasquale Vitiello
CIRA Italian Aerospace Research Center, Capua, Italy
Mrs. Assunta Sorrentino
Italy
Dr. Ignazio Dimino
CIRA Italian Aerospace Research Center, Capua, Italy
Mr. Giuseppe Guidotti
CIRA Italian Aerospace Research Center, Capua, Italy
Mr. Paolo Vernillo
CIRA Italian Aerospace Research Center, Capua, Italy
Dr. Vito Salvatore
CIRA Italian Aerospace Research Center, Capua, Italy

NUMERICAL AND EXPERIMENTAL ACTIVITIES TO ASSESS THE COMPATIBILITY OF THE IXV MOCK-UP CUSTOM AVIONIC SYSTEMS WITH THE SPLASH DOWN SHOCK LOADS.

Abstract

This paper describes the experimental and numerical activities performed by CIRA to assess the compliance of some critical items of the IXV mock-up custom avionic systems with the shock loads induced by the sea landing splash down. The objective of the IXV Mock-up System Drop Test was to demonstrate that the individually qualified Descent and Recovery Sub-system (DRS) are able to guarantee the safe recovery of the IXV vehicle. The primary objective of the test has been achieved by dropping the IXV test bed from an appropriate altitude in order to reach as far as feasible and as far as practical representative IXV descent flight conditions. All the components of the custom avionic systems were individually compliant to the standard MIL883C and then they were able to sustain the splash loads with an acceptable margin. However, there is a concern relevant to the amplification of the loads that might be caused by the resonance of the structure and, in particular, the resonance of the printed circuit board (PCB). The resonance could cause the deflection or an acceleration of the PCB that could be excessive for the soldered components. The herein proposed approach consisted in the study of the avionic boxes, by means of numerical predictive FE model and experimental characterizations. Since qualification models of the avionic boxes is not available and it is not advisable to execute shock acceptance test on the flight hardware, the proposed solution consisted to address the concerns mainly by numerical analysis. An FE model for each custom avionic system has been created using the 3D model provided by the manufacturer. Then the numerical free-free model has been validated and refined using the experimental dynamic characterization. Once an accurate model of the avionic system was available, the splash loads has been applied to the model through an Shock Response Spectrum (SRS) FE analysis. The resulting mechanical load on the junction's elements and the deflection of the PCB has been calculated. The stress levels on selected points on the PCB surface (i.e. junction points, pin connectors of soldered components,...) have been then compared with the PCB allowable strength to provide the necessary level of confidence about the PCB survivability against the splashdown loads. The FEM results showed

that the applicable SRS produces level of displacements/stresses were enough lower than the allowable for the PCB and the obtained margins are considered good.