

Electro Magnetic Compatibility and Performance at Ultra-Low Frequencies in Electronic System for Sensing and Actuation of Test Mass of the Inertial Sensor LISA and LISA Pathfinder

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The inertial sensor electronics developed for the space mission LISA Pathfinder and its future European cornerstone mission LISA were confronted with the greatest design challenges in the field of low noise at ultra-low frequency, not imposed on any electronics before. To maintain the signal integrity the EMC was an important design aspect during the development. This electronics will hopefully demonstrate the free fall of the inertial sensor reference body at an unprecedented level of its residual acceleration needed to detect gravitational waves.

This tutorial starts with an introduction to the space mission and its electronics and is followed by the key requirements for the electronics. The EMC design rules are then addressed on system and printed circuit board levels. The influence of EMI on the low-frequency electronics performance and related cable shielding is summarized based on experience gained during breadboarding and testing of the flight hardware.

Since the noise performance at sub-Hertz frequencies is not specified by the manufacturers of the electronic parts the existing knowledge in this field is very rare. The electronics performance in this frequency band is influenced by various environmental noise sources, dominated by electromagnetic and thermal origin. The presented test results show the achieved level of performance at 1 mHz frequency and point to the future work necessary to achieve the LISA mission goals where the electronics sensitivity is required at 0.1 mHz frequency.

