Chapter 2

SpaceWire: The Standard and EMC/EMI Aspects

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ABSTRACT

SpaceWire is a point-to-point bit shipping protocol for high-speed data communication links and networks providing equipment compatibility and seamless component reusability. It has found great application in many space missions reducing the development cost, offering architectural flexibility and improving reliability. This chapter delves into the standard describing the SpaceWire, focusing on the lower levels that play a key role in the electromagnetic behavior of the system and concern cable assemblies, shielding, bonding, and grounding. Findings regarding emissions affecting spacecraft components are presented as well as other EMC issues that have an impact on the system performance. Recent developments and upcoming updates to the standard are also presented and discussed.

INTRODUCTION

SpaceWire is a standard for high speed data communication links and networks for use on spacecraft. SpaceWire was defined in the European Cooperation for Space Standardization (ECSS) standard ECSS-E50-12A in 2003. The SpaceWire standard was authored by Steve Parkes, University of Dundee with contributions from many individuals within the SpaceWire Working Group from European Space Agency (ESA), European Space Industry, Academia and NASA. It was replaced by ECSS-E-ST-50-12C (ECSS Secretariat, 2008) in order to ensure the standard was in...
SpaceWire


The Standard specifies the physical interconnection media and data communication protocols to enable the reliable sending of data at high-speeds, between 2 Mb/s and 400 Mb/s, from one unit to another. SpaceWire links are full-duplex, point-to-point, and serial data communication links. Since the SpaceWire standard was first published by the European Cooperation for Space Standardization, it has been adopted by ESA, National Aeronautics and Space Administration (NASA), Japan Aerospace Exploration Agency (JAXA) and Roscosmos State Corporation for Space Activities (ROSCOSMOS) for many missions and is being widely used on scientific, Earth observation, commercial and other spacecraft. High-profile missions using SpaceWire include: Gaia, ExoMars, Bepi-Colombo, GOES-R, Lunar Reconnaissance Orbiter, ASTRO-H and James Webb Space Telescope, (Parkes, 2012).

The needs of spacecraft on-board data handling applications has given rise to SpaceWire technology. The Standard provides a formal basis for the exploitation of SpaceWire in a wide range of on-board processing systems. For example the integration and testing of complex on-board subsystems with ground support equipment connecting directly into the on-board data-handling subsystem. SpaceWire aims to offer equipment compatibility and reusability for components and subsystems. This means directly connecting a component made for one subsystem to another and operating without issues and readily use systems in one mission that were developed for another mission, thus reducing the cost of development, offering architectural flexibility, improving reliability and most importantly increasing the amount of scientific work that can be achieved within a limited budget (ECSS Secretariat, 2008).

Since the publication of ECSS-E-ST-50-12C standard (ECSS Secretariat, 2008), the engineering and scientific community have applied the guidelines that it dictates in many missions. Practical applications highlighted best practices as well as problems. Different applications called for different designs, some of them were hard to implement while maintain conformity with the standard. This fact led the European Cooperation for Space Standardization in 2012 to start the long process of updating the Standard including the experience of the past and the needs of the future. Working Group ECSS-E-ST-50-12-C Rev. 1 WG, is preparing Revision 1 of the standard (ECSS-E-ST-50-12C Rev. 1 Working Group, 2015). While the draft of the Revision. 1, currently under public review, is not a formal standard and cannot be referenced as such, it is a clear indicator of the direction the Standard is headed, its evolution to overcome many of the earlier version’s shortcomings. Additionally since the Standard’s publication at 2008, the ESCC Detail Specification No. 3902/003 was
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