SPACEWIRE PHYSICAL LAYER FAULT ISOLATION

Session: Test, SpaceWire Components

Long Paper

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ABSTRACT

The SpaceWire physical layer is required to use Low Voltage Differential Signalling (LVDS) as defined in the document ANSI/TIA/EIA-644 (A).

It has been shown that a likely failure mode in such drivers can result in high fault currents that can propagate between SpaceWire links and cause catastrophic failure of systems - including redundant systems when cross-strapping is used. Great care must be taken in power systems to limit such excessive effects.

ANSI/TIA/EIA-644-A specifies required driver output levels and behaviour - it does not require any particular implementation, and thus alternative drive circuits can be chosen – in particular, the use of a resistor network is permitted – which offers a reliable method for limiting output current under fault conditions.

The often-seen resistor network is not the only network that meets the LVDS standard. There are alternatives that both further improve safety and reduce power consumption - to less than 10mW per driver (2 drivers per SpaceWire link). Thus, it is possible, at no penalty in mass or power consumption, to limit fault currents to levels that contain the fault and significantly reduce the risk of secondary damage.

We begin by describing the usual (LVDS) physical layer implementation, its consequence and power system requirement implications. We then consider receiver protection and its limitations and describe alternative driver designs and show how they can significantly reduce the undesirable effects resulting from component failure.