

The following technical paper abstract information was recently submitted in connection with session DOD104,Electronics

Offer Number: 14DOD-0028

Paper Title: Serial Communication Wiring Fault Detection and Isolation

Author:

Tamir Sigal

Sital Technology

17

Israel

+972 972 9763 3300

tamir@sitaltech.com

Abstract: Modern aircraft rely on tens of electronic modules which communicate over a complex wiring system. Wiring faults are very hard to detect and time consuming problems. Wiring faults may be mistaken with component faults, which result in unneeded component replacements and unnecessary connectors and harness disassembly. Intermittent wiring faults are among the most frustrating, complex to solve and expensive to diagnose aircraft problem which in many case recorded as No Fault Found report.

Sital developed a technology to detect and isolate communication wire faults including intermittent faults during bus operation while the wires are live. Our technology is based on Passive Time Domain Reflectometry (pTDR).

pTDR is a patented technology, which constantly measures reflections of energy on an operating serial communication bus, like Mil-Std-1553, CAN, Arinc 629 or similar, to detect signal distortion which is a result of wiring fault (disconnection/short). pTDR technology runs during normal system operation without disturbing the standard bus activity.

pTDR Theory

Impedance

When all wires and units are properly connected and the bus is terminated, the transmitted energy is absorbed by the termination resistors at both ends of the bus. In order for the energy to spread equally through the bus, all wires, units and terminators must have the same electrical impedance (Z_0). Any change of impedance in the bus will result in distortion of the signals travelling through the bus. In most cases, changes of impedance are caused by a disconnection on the bus (infinite impedance), a short circuit (zero impedance) or a missing termination resistor (high impedance).

Reflections -

The signals travel in the wires at a speed close to the speed of light. When the energy meets a point of inconsistent impedance it bounces back and travels in the opposite direction. This reflection is added to the transmitted signal and distorts it.

Reflections are actually the same transmitted signal, but at lower power and shifted in time.

The time shift is related to the location of the bus fault and the point of measurement.

pTDR measures these reflections to determine wire faults.

pTDR Deployment

pTDR implementation does not require any changes to the network, terminals or data transmissions. It uses the existing terminals and messages to measure distortions and report problems as they occur. It is the only way to diagnose intermittent wiring faults that occur only in the air.

If the system is aware of the topology of the bus, length of cables and location of terminals, then it is able to pin-point the location of a fault, in an accuracy of nanosecond.

Sital's pTDR™ technology is capable of detecting wiring problems such as disconnections, short-circuits, and others.

pTDR Added Value:

- Capture first wire intermittent failure
- Early detection of wires faults
- Reduce “No-Trouble-Found” for wires failures
- Distinguish wire Vs. module failures
- Increase repair efficiency
- Reduce false module replacement
- Add diagnostics capabilities

pTDR is implemented in multiple vehicle assembly plants and selected service garages of a major OEM and has proven savings of thousands man hour in fault detection.