



SNE Industrial Fieldbus Interface

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Programmable logic controllers (PLCs) have very limited diagnostic and no prognostic capabilities, while current smart sensor designs do not have the capability to communicate over Fieldbus networks. The aim is to interface smart sensors with PLCs so that health and status information, such as failure mode identification and measurement tolerance, can be communicated via an industrial Fieldbus such as ControlNet.

The SNE Industrial Fieldbus Interface (SIFI) is an embedded device that acts as a communication module in a networked smart sensor. The purpose is to enable a smart sensor to communicate health and status information to other devices, such as PLCs, via an industrial Fieldbus networking protocol. The SNE (Smart Network Element) is attached to a commercial off-the-shelf Anybus-S interface module through the SIFI. Numerous Anybus-S modules are available,

each one designed to interface with a specific Fieldbus. Development of the SIFI focused on communications using the ControlNet protocol, but any of the Anybus-S modules can be used.

The SIFI communicates with the Anybus module via a data buffer and mailbox system on the Anybus module, and supplies power to the module. The Anybus module transmits and receives data on the Fieldbus using the proper protocol. The SIFI is intended to be connected to other existing SNE modules in order to monitor the health and status of a transducer. The SIFI can also monitor aspects of its own health using an on-board watchdog timer and voltage monitors. The SIFI also has the hardware to drive a touchscreen LCD (liquid crystal display) unit for manual configuration and status monitoring.

The SIFI communicates with the Anybus module via a data buffer and

mailbox system located on the Anybus module. The SIFI also has headers to connect with the digital and analog SNE modules. A microcontroller is used to control communications with the Anybus module. The microcontroller is capable of processing data either received from or to be transferred to the Anybus module.

Communication is via a parallel interface. The microcontroller is also connected to a real-time clock and 128 kB of external non-volatile FRAM (ferroelectric RAM) memory. For internal diagnostics, the microcontroller is connected to a watchdog timer and is capable of monitoring the levels of the ± 12 V and ± 10 V voltages.

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Composite Thermal Switch

This switch can be incorporated in portable electronic devices like cell phones, PDAs, laptop computers, and battery-powered electric vehicles.

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Lithium primary and lithium ion secondary batteries provide high specific energy and energy density. The use of these batteries also helps to reduce launch weight. Both primary and secondary cells can be packaged as high-rate cells, which can present a threat to crew and equipment in the event of external or internal short circuits. Overheating of the cell interior from high current flows induced by short circuits can result in exothermic reactions in lithium primary cells and fully charged lithium ion secondary cells. Venting of the cell case, ejection of cell components, and fire have been reported in both types of cells, resulting from abuse,

cell imperfections, or faulty electronic control design.

A switch has been developed that consists of a thin layer of composite material made from nanoscale particles of nickel and Teflon that conducts electrons at room temperature and switches to an insulator at an elevated temperature, thus interrupting current flow to prevent thermal runaway caused by internal short circuits. The material is placed within the cell, as a thin layer incorporated within the anode and/or the cathode, to control excess currents from metal-to-metal or metal-to-carbon shorts that might result from cell crush or a manufacturing defect. The safety of high-rate cells is thus

improved, preventing serious injury to personnel and sensitive equipment located near the battery. The use of recently available nanoscale particles of nickel and Teflon permits an improved, homogeneous material with the potential to be fine-tuned to a unique switch temperature, sufficiently below the onset of a catastrophic chemical reaction. The smaller particles also permit the formation of a thinner control film layer (< 50 μm), which can be incorporated into commercial high-rate lithium primary and secondary cells.

The innovation permits incorporation in current lithium and lithium-ion cell designs with a minimal impact on