Sauer-Danfoss has developed the Plus+1 safety protocol suitable for CAN networks. It can be used as an add-on for CANopen, J1939, or Isobus (ISO 11783). The company also provides safety products, which implement this protocol.

THE PLUS+1 PROTOCOL HAS BEEN CONFIRMED BY TÜV Süd (Germany) to meet the requirements of SIL-2 (IEC 61508). It is applicable to all three standardized application layers used in mobile machinery (CANopen, Isobus, and J1939). The safety protocol extension can be implemented using existing standard CAN devices, enabling mobile off-highway machine OEMs (original equipment manufacturer) to achieve functional safety requirements more easily without the need for costly specialized hardware.

“Our CAN Safety Message establishes a new industry standard for functional safety communication,” said Marco Tacke, Product Marketing Manager of the Software Solutions Services group at Sauer-Danfoss. “Existing methods for sending safety-relevant information over CAN are limited. Our flexible, powerful new solution helps OEMs meet the demands of safety legislation, reduce development and certification costs and accelerate time to market.”

All off-highway mobile equipment exported to or manufactured in the European Union must meet European Machinery Directive 2006/42/EC. Some international standards, such as ISO 13849 and IEC 62061, have been harmonized to provide a “presumption of conformity” with the Machinery Directive. Both standards refer to IEC 61508 and encourage the use of SIL-certified devices and software.

The CAN Safety Message analysis includes calculations for 256 nodes on a bus with a 1 MHz rate at a 1-ms refresh time. The worst-case probability for failure (8.25e-10) per hour (PFH) fulfills the requirements for SIL-2 certification.

The CAN Safety Message Safety Data Group (SDG) consists of two CAN data messages: The Safety Data Message (SDM), which contains the data considered to be safety-critical and non-safety-critical data; and the Safety Header Message (SHM), which contains the Running Number and CRC Signature. The SHM is used by the receiver to validate the SDM data and is sent after the SDM with a minimum delay. The SDG is transmitted periodically and is only valid if both CAN messages are received properly — without failure and within time.

“The CAN Safety Message offers easy adoption of simple and well-known procedures and a transparent evaluation method with clear documentation,” Tacke said. “Our whitepaper for the Plus+1 protocol is available for free download under Functional Safety at the company’s website.

At Bauma 2013, the company exhibited host controllers, dedicated ECUs, hydraulic devices as well as sensors supporting the Plus+1 protocol. Related tools were also introduced. “Our tools make it easy for OEMs to get up and running with safety data transmitted over CAN,” Tacke said.

Fan drive control supports the Plus+1 protocol

The FDC fan drive controller for H1 pumps supports the above-mentioned proprietary safety protocol. It utilizes closed-circuit technology to meet customer demand for more efficient and robust hydraulic cooling fan systems in Tier 4-compliant (non-road emission standard) mobile off-highway equipment applications. The product meets cooling system fan power requirements in machines above 20 kW. It is available for 12-V or 24-V powered systems.

With the implementation of Tier 4 diesel engine emissions regulations, many off-highway equipment manufacturers are migrating from belt-driven fan drive systems to more efficient hydraulic modulating fan drives. Unlike belt-driven systems, which operate the fan at a fixed speed at least as fast as required under the most demanding cooling conditions, modulating hydraulic fan drives continuously adjust fan speed to the lowest level required to maintain proper cooling. The variable-flow functionality of FDC for H1 pumps provide increased efficiency over gear-pump and many open circuit systems, offering Tier 4 equipment designers significant power and fuel savings in most operating conditions.

“Compared to previous generations, new Tier 4 engines occupy more space in the engine compartment and have increased cooling requirements,” said Branko Horvat, Director of Product Marketing Managers for the Propel Sales business area at Sauer-Danfoss. “The hydraulic FDC for H1 pumps offers superior fan drive efficiency, enabling OEM designers to offset increased cooling demand, reclaim lost engine power and improves fuel economy in the majority of operating conditions. The product will enhance the performance of future generations of machines in a broad variety of applications."

In addition to proportional forward control that enables modulating hydraulic FDC, the H1 pump family offers the reversibility and zero-speed capability that are inherent in robust closed-circuit systems. FDC can automatically reverse the direction of the fan to purge trapped dirt and debris and restore cooling to peak efficiency. The product also offers the ability to stop the fan completely in circumstances where cooling needs are minimal. “FDC for H1 pumps achieves reversibility without the need for larger, more complex and costly plumbing,” Horvat said. “Zero-speed capability can be beneficial in extremely cold conditions where power is better utilized for warming up the vehicle.”

Another benefit of a closed-circuit system is what occurs in the event of a controller or electrical failure. The fault position of the pump is toward full forward displacement, enabling the fan to run at full speed to maintain the integrity of the cooling system on the vehicle. Maximum fan speed is determined by the pressure limiter setting.