

Ice resurfacing machines with CAN control systems

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Due to the rapid technological progress in the past few years, electronics have become more important in off-highway vehicles, such as agricultural and construction machinery, cranes, and high-tech ice resurfacing machines. The future generation of ice resurfacing machines will apply even more innovative electronics to offer additional specific features for automated control in off-highway vehicles and to reduce complexity and costs.

TTControl - TTTech Off-Highway (www.ttcontrol.com) is a subsidiary of TTTech Computertechnik, and is specialized in electronic control systems for off-highway vehicles, cooperated with WM-Mulser in an innovative development project for the next generation of high-tech ice resurfacing machines. The WM Evolution ice resurfacing machine combines the experience of WM-Mulser as a renowned manufacturer of high-capacity ice resurfacing machines with the technological know-how of TTControl, who provided WM Evolution's entire elec-



Fig. 1: The WM Evolution ice resurfacing machine is based on a CAN control system

tronic system. WM Evolution offers state-of-the-art technology with complex control functions for consistent ice resurfacing. It works with a new drive concept for perfect division of traction, a user-friendly control system, optimized hydraulic oil cooling and operates at a very low noise level. The vehicle is available with a diesel engine, a gasoline engine, or even with an electric motor. Due to its highly developed technology, it is capable of meeting all the requirements for efficient and con-

sistent ice resurfacing. It reduces cost of operation for two reasons: it saves time by operating very efficiently, and consumes less fuel per hour of operation, therefore reducing energy cost and operational expenses. The automatic control of engine RPM in all models provides constant RPM under various load conditions. The control units TTC 200 and VisionPlus constitute the technical core of the electronic system in the vehicle. The TTC 200 is a programmable electronic control unit for sensor/actuator management. A number of configurable I/Os allow its use with different sensor and actuator types. The integrated MPC555 40-MHz micro-controller supplies processing power. All inputs and outputs are protected against electrical surges and short circuits and are suitable for diagnosis. The device was designed to comply with IEC 61508. In the vehicle, the TTC 200

controls major functions such as vehicle movement, opening and closing of the snow tank cap, the edger, the rotating side brush, the horizontal and vertical augers that collect and convey snow into the tank, and the conditioner. All safety-critical functions in the machine run on the controller. In addition, the device identifies whether the machine works with an electric motor, a diesel or a gasoline engine and automatically runs the correct configuration of the program.

The Vision product family offers solutions for off-highway cockpit visualization. The device provides two CAN controllers, one of which was used for this project. Units can drive a variety of LCDs from 16,4 cm up to 26,4 cm color for the display of images, virtual indicators such as bars or arrows, and text with different sizes and colors. The display can be programmed in C or with CoDeSys. The human machine interface (HMI) offers a CAN interface, a variety of digital I/Os, the option to connect external keyboards via LIN or the use of a touch screen.

In the vehicle, a VisionPlus control unit is implemented for cockpit visualization and for advanced machine functions. A central color display allows monitoring of vehicle parameters such as speed, fuel status, or operating hours. In addition, menu navigation for machine configuration is available via the display. A command keyboard is linked to the HMI via LIN. ►

Simulates a network master

Bihl and Wiedemann (www.bihl-wiedemann.com) offers the Master Simulator device for CANopen and DeviceNet. With the device that simulates a network master, users can read input data, write output data and display diagnostic data without any

additional master device in the network. The devices can be used for testing purposes as well as for demonstration of functionality at a customer's site. Also developers may use the device to check slaves and to adjust software for product tests, says the company. (mm)

It controls, among other things, the automatic water refueling and the washing facilities of the machine.

The software package running on the controllers was developed by TTControl and includes remote maintenance. The control units are connected via two CAN networks, both use a proprietary CAN-based higher-layer protocol. The first network is for the diesel or gas engine, the second for the electric machinery. The diesel and gas engine network is used by just two participants, the VisionPlus and the TTC 200. The second network includes a TTS 200 and seven other ECUs. The seven ECUs control the electric motors of the vehicle. Both networks operate at 500 kbit/s and use 11-bit CAN-IDs. The bus load is just under 30% so as to provide jitter-free data transfer, which is possible at around about 1/3 of the overall bus capacity. All process data is sent periodically. No event-triggered data was used so as to keep the bus load constant and to avoid worst case scenarios, which are hard to calculate. The diesel and gas engine network



Fig. 2: The vehicle uses two CAN networks, one for the engine and one for the electric machinery

between the VisionPlus and the TTC 200 uses CANopen PDO-alikes, which are as much bandwidth-optimized as possible. It becomes easy to adapt, activate, or deactivate certain machine parameters by connecting the vehicle via a network cable to a PC. The maintenance system keeps error logs and records of sys-

tem operation. "The complete electronic control solution from TTControl covers all relevant driving, steering and visualization functions in our WM Evolution. Obtaining all system components from one source helped to considerably accelerate development and integration processes", said Wolfgang Mulser, Head of Engineering at WM-Mulser GmbH. The electronic control system provides the vehicle with multiple upgrade capabilities. New functions can easily be implemented by changing the soft-

ware. This provides great flexibility and time savings to system developers. Even changing control units in an existing system is significantly eased, since all parameters of the boxes are stored in an external memory device. The system automatically detects the changing of a controller and downloads the logged pa-

rameters from the memory device. As it is possible to perform remote diagnosis via the Internet, maintenance of machines all over the world is available at lower operating costs.

"WM Evolution represents a new generation of technically complex ice resurfacing machines with sophisticated communication architecture. It benefits considerably from the flexibility and safety features of the electronic control system", stated Bernhard Leimegger, WM-Mulser's consultant for machine safety. By employing the vehicle, customers also benefit from greater convenience. Features such as a large, heatable driver's cab with windshield defroster heating, a customized graphic color display and an easily accessible engine compartment for maintenance increase user friendliness. The growing need to save time, energy and money while maintaining ice surfaces will lead to the deployment of even more extra functions and innovations in the ice resurfacing machines of the future.

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Automotive software update

Recent updates of Dspace's (www.dspace.de) software include the simplified handling of CAN setups (RTI Bypass Blockset) and the support of standard and extended identifiers on the same CAN channel (RTI CAN MultiMessage Blockset 2.0).

The version 1.5 of the Real-Time Interface (RTI) CAN MultiMessage Blocksets, combined with the ControlDesk experiment software, allows CAN raw data to be monitored, including filtering, and logged to a CSV file. The connection to the CAN Navigator saves work, especially for hardware-in-the-loop ap-

plications with large CAN message packets, says the company. The Navigator's hierarchical tree view can be used to switch between CAN setups and database container (DBC) files during run time. Version 2.2.2 of the RTI Bypass Blockset supports additional I/O boards for access to electronic control units via the CAN Calibration Protocol (CPP) and XCP on CAN: the DS2202 board, the DS2211 board, and its predecessor the DS2210. Combined with other products, these allow ECU-internal data to be captured in real-time via CCP or XCP-on-CAN. The XCP-on-CAN gateway functionality makes it possible

for several tools to communicate with an ECU simultaneously via XCP, with only one XCP service instance mapped to the ECU. For example, a bypassing system and a calibration system can access the ECU quasi-independently of one another.

The RTI Bypass Blockset is a Simulink blockset that allows convenient, dialog-based configuration of bypass applications and real-time communication with an ECU.

API for third party interfaces

Softing (www.softing.com) provides the D-PDU appli-

cation programming interface (API) for their own and third party interfaces and for diagnostic tool sets (DTS). The software is available for the company's own series of Edic CAN interfaces or for interfaces e.g. by Vector and Etas. Of course this also means that the company's Edic interfaces can be used for programming and diagnose with third party tools. The software supports KWP2000 on CAN (CAN Diagnostics), UDS on CAN, and other CAN communication. The ASAM MCD-3D and MVCI-compatible D server DTS-COS support the API as additional default interface to the hardware interface.

(mm)

Software