

Applications in mobile machines

Intelligent dialogue modules and networked operating panels with CANopen interface

Life today cannot be imagined without electronics in modern motor vehicles and mobile machines. Many necessary and convenient functions could not be implemented without electronic systems. In contrast to electronics in consumer goods and “normal” industrial applications such as packaging machines and conveyors the requirements for components for mobile use are much higher in order to achieve sufficient operational reliability in all situations.

By Dietmar Brüß*

The mobile machines and installations are often specially tailored to their applications and are thus high quality capital goods. To ensure high uptime of these cost-intensive machines and installations an extensive, easy and reliable system diagnosis for fast direct fault location by the operators is needed. Safe and clear operation via displays adapted to the respective operating situation can avoid incorrect handling. The operating and system states must be stored for statistics and documentation via a process data acquisition.

Market requirements

Due to increasing legal requirements for the machine manufacturers the systems are becoming more and more complex. Economically, this can only be sensibly solved by using networked electronic systems which reduce wiring complexity.



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The dialogue monitor PDM360 for example is such a user interface.

The bus system enables a decentralised arrangement of the powerful input/output modules close to the sensors and actuators. They are mounted where the signals are generated or required. In addition, the components must be easy to mount and handle in case of service. This is achieved by the mechanical design as well as easy and clear integration during programming.

Last but not least the components and devices used must withstand the extreme mechanical, climatic and electrical requirements and reliably fulfil the assigned tasks for a long time.

The only goal of meeting the above-mentioned market requirements is the development of reliable, cost-optimised and competitive machines.

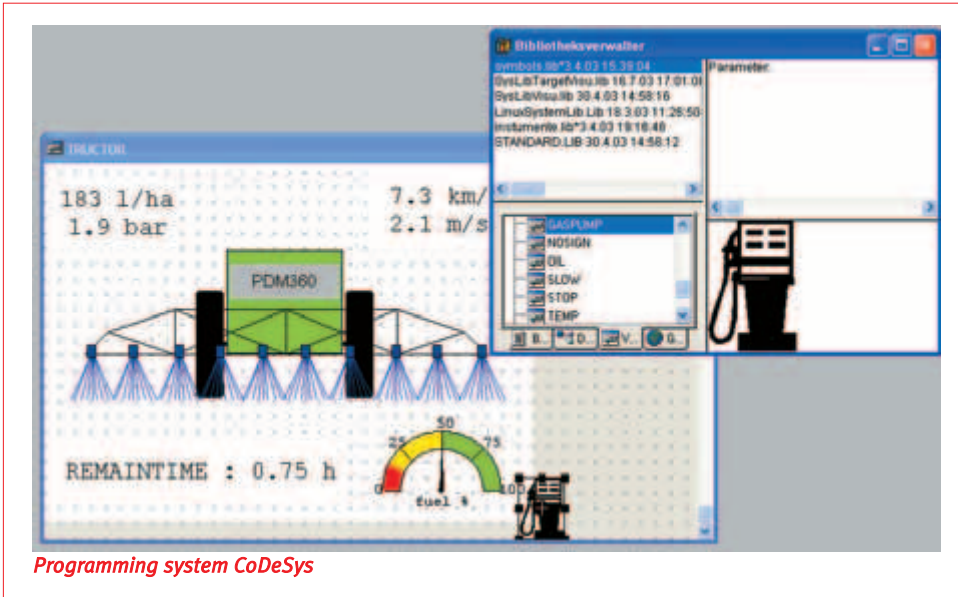
Electronics in mobile machines

Mainly the extreme impact and shock-related mechanical stress and the use at low or very high operating temperatures require a careful selection of the components. Since often a direct influence of dirt, moisture and water cannot be excluded locally, high protection rating and special selection of the materials are needed for the devices.

In addition to the mechanical influences and environmental conditions, electrical interference affecting the whole system and individual devices has to be taken into

account. A wide voltage range and adapted protection measures allow reliable operation of the devices even in case of large voltage fluctuations of the battery/generator system and high conducted and radiated interference.

For device networking the CAN bus has met with success in the last years. Whereas for the large number of cars special, optimised and adapted protocols are used, the CANopen protocol has become indispensable in mobile machines. Manufacturer and industry-specific protocols, such as diagnostic engine data according



Programming system CoDeSys

to SAE J 1939, the agricultural bus system (ISO bus or LBS) or the truck-trailer interface of the trucks can be coupled to the machine process via gateways.

Visualisation: Human Machine Interface

Most machines built need a human operator. In the past and today machine states must be indicated and user entries processed. The typical structure of an operating panel with light indicators, pushbuttons, switches and – depending on the machine complexity – additional pointer instruments left its mark on mobile machines and installations until a few years ago. Due to the higher requirements for machines and higher expectations of the users for their “mobile workplace” these concepts are no longer up to date.

Depending on size and complexity of the machine, modern dialogue modules are fitted with text or full graphic display and different operating fields. They provide all functions in one unit that could otherwise only be implemented due to time-consuming and cost-intensive mounting and wiring of individual components. The user receives the information needed from the programmable dialogue module. Only in case of a machine fault additional warnings

and notes for fault elimination are given. Due to this display adapted to the respective situation the operating panels become easier to use. The operator can concentrate on the actual work function and use the machine more effectively.

The service and maintenance crews as well use dialogue modules as an intelligent access to the machine. Due to special pages which

are password-protected, if necessary, parameters can be changed in the machine controller and the operating data stored since the last maintenance can be read.

Process dialogue monitor

The dialogue monitor PDM360 for example is such a user interface. With its powerful 32-bit controller

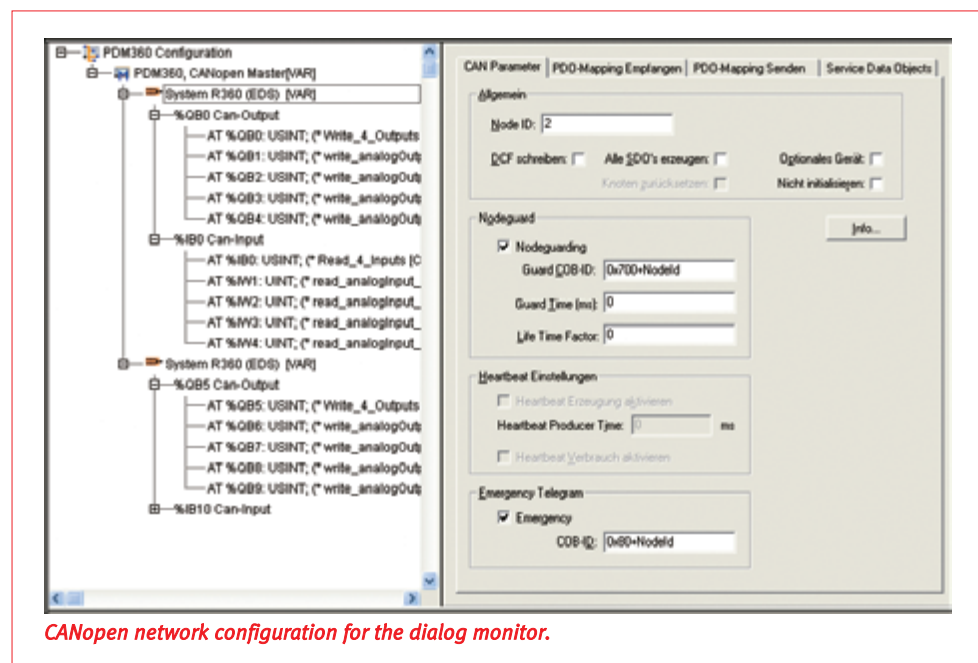
and the flexible programming according to IEC 61131-3 it can be used in almost all applications. Depending on the version the 5.7” graphic display is either a monochrome FSTN or TFT colour display.

The robust housing with the protection rating IP67 and the different mounting options allow use in cabins and outside. It is designed for panel or surface mounting.

The CAN bus and CANopen protocol ensure communication with other system components in the machine. The integrated interfaces like Ethernet, USB, RS232 and 2xCAN together with the Linux operating system form a universal platform for further networking and communication with other CAN devices, networks or the PC. Due to the integrated PCMCIA slot a standardised and flexible interface is available for system expansion.

Programming and network configuration

IEC 61131 is used for programming in many control systems. But for dialogue modules device-specific editors and software tools are often used to design graphical elements. The programming system CoDeSys from 3S-Smart-Software-Solutions



CANopen network configuration for the dialog monitor.

provides a new option which is also used for the PDM360.

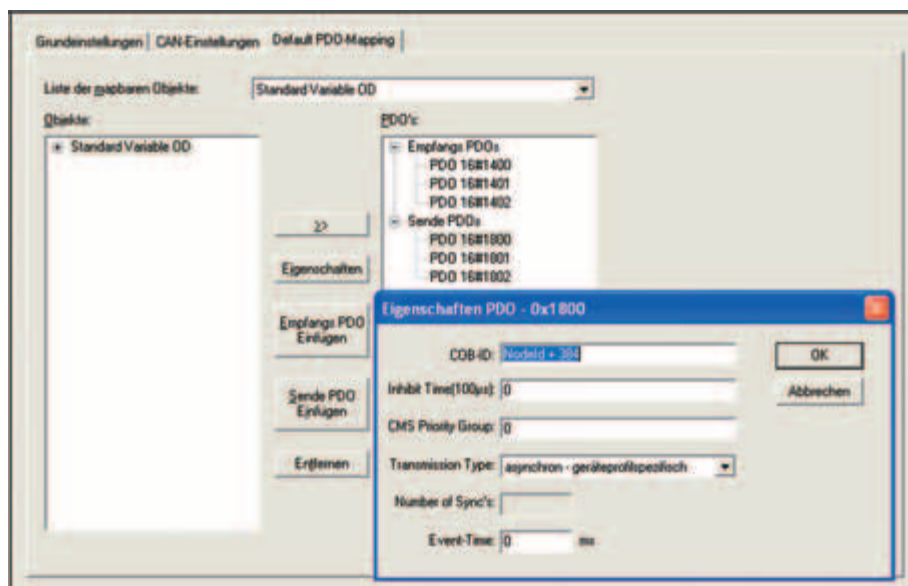
The visualisation editor integrated into the manufacturer-independent programming package has long since been an integral part of the software. With this editor the user can develop static and dynamic visualisation objects and directly show them on the PC or internet browser, e.g. for diagnosis of the connected plc. The target visualisation now provides a new option. Due to this hardware-independent technology the created graphical objects are compiled into the IEC code ST (structured text) before downloading to the dialogue monitor. The run time system processes this code on the device and, in combination with a graphic library, displays the objects which have been created on the PC. At the same time a device-specific control process can be programmed and executed irrespective of the visualisation.

In addition to simple shapes like circles, lines, polygons and text

fields, other available visualisation objects are bar graphs, pointer instruments and integrated bitmaps.



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Konfiguration eines CANopen-Slave mittels EDS über das Objektverzeichnis

Furthermore the objects can be moved, rotated or scaled.

CANopen network configuration

Since dialogue modules normally have no integrated inputs and outputs they are connected to the machine controller in mobile machines via the CAN bus. To do so, the CANopen protocol provides a universal and widely used platform.

If the dialog monitor PDM360 is used as network master, the connected slaves can be projected, parameterized and monitored with the network configurator integrated into the programming software. The process signals are directly available in the dialogue monitor as IEC addresses via the PDOs.

As an alternative, the device configuration of the PDM360 can also be made as a terminal. The device will then be parameterized as CANopen slave. The necessary data objects are defined depending on the application. After completion of this communication interface between the machine controller and dialogue module an electronic data sheet (EDS) is generated. It is then integrated into the software for the network configuration of the ma-

chine controller. The process data objects (PDOs) and service data objects (SDOs) are thus immediately available in the application.

The CANopen configurator is designed so that the application programmer can quickly and reliably install a network capable of running. Using the menu-guided software the master and slave configuration as well as the decentralised input/output modules, sensors and actuators can be parameterized and integrated into the application program easily.

The future – a system for all bus components

The development of the dialogue monitor PDM360 is the first step in direction of a consistent implementation of an all-around programming and configuration system for all bus components. No matter whether controller, input/output or dialogue module, the common platform will replace the different software tools still needed today for series applications in the medium term. In addition to the tools for experts in CAN bus technology which will still be needed in the future, the integrated ecomat mobile system makes this bus technology easy to use for "everybody".