

A modular I/O system in an enhanced degree of protection demonstrates flexibility

Out of the switch cabinet into the field

The trend in the field of automation technology to a distributed design with modular peripheral devices remains unchanged. The use of Profibus in particular is growing continually in the fieldbus technology field. By the end of 2007 the Profibus user organization – Profibus-Nutzerorganisation e. V. (PNO) – has made it its objective to double the number of installed bases to 20 million stations. Alone 2.6 million new stations in 2004 meant a growth in sales of 30 % compared to the previous year. Now the question is how are decentral peripheral devices structured!

A whole range of I/O systems from different manufacturers are available for the IP20 area within the control cabinet which cover the entire range – from cost-optimised low-cost systems to high-end systems – with exceptional levels of availability featuring channel-related diagnostics and further features such as “Hot Swapping” or the separation of connection technology and electronics.

It is now particularly easy to take the existing systems and to install them in an installation housing directly on the machine. This may reduce the cable lengths to the sensors but does not offer any particular advantages. It is still necessary to invest a lot of time to lead out the sensor cables, to put them through the cable glands and to connect them to the IP20 bus terminals. Unfortunately polarity reversal errors with the cabling occur which has a negative effect on the little commissioning time that there is.

If the fieldbus nodes then have to be extended by a few signals, chaos may ensue. Further cable glands must be installed in the installation housing and in the worst case scenario no more space will be available in the housing. This is exactly the point at which the IP67 fieldbus devices come into play. It is only possible to comprehensively implement the distributed automation technology concept with high-performance and flexible IP67 fieldbus devices.

Only high-performance fieldbus devices are considered for decentral automation

TURCK covers all the relevant areas in the automation pyramid in the sensor, interface, connection and fieldbus technology fields. Here the area of fieldbus technology has become an important part of the business in the last few years and is developing with above average growth.

The number of fieldbus nodes which can be mounted directly in the system due to the enhanced degree of protection will account for a 15 % share in sales in the coming year. One reason for the success are the modular and flexible IP67 I/O systems. The objective during the development of the modular IP67 I/O system BL67 was to retain the flexibility of the IP20 fieldbus devices and to eliminate the weak points.

Due to the compact design of the components and a module width of just 32 mm for the expansions, the fieldbus nodes can be situated in a space-saving manner directly at the machine or in the production line. Areas of application are for example the wood processing industry in the press line areas. Another similar field concentrates on the manufacture of formed concrete parts. Both application examples feature a high degree of automation and demand high-performance I/O systems, which are used to detect a large number of different signal types.

The development objective was to retain flexibility

The humidity is less of a problem here than could be assumed in an IP67 environment. With these applications the compatibility with the very fine and sometimes aggressive dusts is a more defining factor. One of the most extreme environments can be found on tooling machines.

There the fieldbus devices are subject to a humid environment where they must withstand splashes from liquids such as drilling emulsions and a spray consisting of oily dusts. These areas of application can be found for example in the body shop areas of the automobile industry.

Wherever it is possible, the once mighty control cabinets and panels are starting to disappear from the field. Installation housings in the field are also disappearing. In this manner the distances to the sensors/actuators are kept short and the use of prefabricated cables reduces the effort and expense of wiring and potential sources of error.



Engineering and maintenance

In order to compare the different I/O systems with one another, it is not simply sufficient to compare the hardware costs and functionalities with each other. The entire service life of the system must be considered. Here an additional component must be taken into consideration: the I/O-Assistant software which is provided free-of-charge. This tool accompanies the user through all phases of the system.

The first steps involved are the engineering of the modular fieldbus stations. This includes the components which are required, the type designations and the associated ordering numbers. This is not very complicated with the BL67 system so that a software package is necessary, however it is an optional and high-performance tool which can be used in all phases of the project.

The software provides savings in time and effort, when the stations are graphically represented using it, and documentation including ordering lists, drawings, dimensional drawings and parameter lists are created directly. The software will only indicate the logically useful base modules for the respective electronics modules and calculates the maximum total currents of the digital inputs and outputs.

The user will also be issued with a warning indicating that a new power supply may be required if it should prove relevant. The next decisive stage is the commissioning phase. The user can connect his PC with the I/O-Assistant via a serial service cable with the BL67 gateway, and read in all online digital and analogue inputs and set or provide all digital and analogue outputs with values. In this manner the entire wiring as well as all sensors and actuators can be simply checked.

It is not necessary for example, to put the PLC with the Profibus master into operation in order to check the sensors. This can be performed with the software beforehand. Commissioning times can be reduced considerably as a direct result. If however problems still occur the software can be used for diagnostics.

It is not necessary to search through the bits and bytes for the exact cause of the error as all diagnostics are displayed directly in plain text. The full range of functionality of the I/O-Assistant is also available with the Ethernet gateways along the entire Ethernet network. All fieldbus stations can be maintained from a central point.

The system structure

The modular I/O system consists of the gateway and the extension modules. The gateway is the "head" station in charge of communication with the fieldbus. The decision for the selection of a particular fieldbus is today no longer based on the I/O system. Therefore a solution with fieldbus-specific head stations is an ideal solution as they serve as the gateway between the internal system bus and the fieldbus.

They are available for the Profibus DP, DeviceNet and CANopen bus systems. The Ethernet gateways supports three protocols in order to serve all demands: Modbus TCP, Profinet I0 and Ethernet IP. It does not matter which Ethernet protocol will eventually become the most established.

Thus the BL67 is open for the conventional fieldbusses, and is also independent on the manufacturers of PLCs. The Ethernet standard with the 4-pole D-coded M12 connectors guarantees IP67 degree of protection. With M12/RJ45 converters it is possible to use existing Ethernet networks. The gateways can be integrated into the configuration tools of various control manufacturers using GSD or EDS files.

The system relies on the existing cabling concepts which have already been well proved in the IP67 field. M12 round connectors are used for the gateways for Profibus and CANopen; the DeviceNet gateway features 7/8" connectors. This Plug&Play concept offers various benefits: commissioning is simplified as wiring errors are more seldom. Initial installation, expansions of an existing system and maintenance require even less time. This offers a lot of potential for savings particularly for machine and system builders who disassemble their products after commissioning only to reassemble them at the customers. Assembly and installation onsite can be completed using less qualified personnel.

Modules can be exchanged during operation

Precision expansion with modules

In addition to the different gateways the BL67 features a wide range of expansion modules which guarantee a fieldbus node combination to suit the application. The extensions are mounted to the right of the gateway. There is no need to implement a backplane. The expansion modules stand out due to the separation of the connection technology (base modules) and the electronics.

The base modules come with a choice of M8, M12, M23 and 7/8" plug-in connections and can be freely combined with the electronic modules. If a module in the system has to be exchanged, it can be performed during ongoing operation (hot-swap) due to independent wiring and the separate the base and electronic modules. The electronic modules are plugged into the base modules from above and then fixed with 2 screws.

The mechanical coding prevents faulty insertion of the wrong electronic module during servicing. Depending on the demands, modules with digital inputs and outputs are available in PNP, NPN and high-end. The PNP and NPN are "simple" modules and provide standard diagnostics.

The high-end modules offer exact channel-by-channel based diagnostics and also possess further features such as switch over of the effective direction, programmable filter times and the short-circuit behaviour, and freely configurable channels for inputs or outputs. Accordingly, the diagnostics concept can be matched to suit demands precisely. The analogue input and output modules are available for current (0/4 to 20 mA) and voltage [-10 V/0 V up to +10V) as well as PT and thermo element inputs in two channel versions. The four channel analogue inputs can be configured for current or voltage and reduce the hardware costs. The technology modules with SSI and serial interface (RS 232, RS 485 /422) round off the product range. A large variety of available signals provide flexibility.

Also important in terms of a high level of system availability is a selective (discriminative) power supply. On the one hand the inputs are provided in the gateway or via the power feeding modules with current limitation. It is thus impossible for the current to exceed 4 A during a short-circuit, and only the potential groups or system sections directly affected fail. The largest part of the system continues to be available, and an evaluation can be performed via the respective diagnostics. On the other hand signals can be arranged into potential groups with the power-feeding modules or the outputs can be simply resupplied with load voltage.

A safety-relevant shutdown of the supply can be performed by switching off on all poles. This concept also contributes to another technology which results due to the relocation of the I/O systems in the system: the integration of pneumatics in electronic systems. The first approach with BL67 is a remote switch off of valve blocks. Multichannel digital output modules with up to 16 channels are available for this purpose. The principle of separation of electronics and connection technology comes into its own here. The optimum terminations can be selected to suit the applications. Passive junctions and valve blocks can be integrated into the system using M23 multicore base modules.

The author

Markus Ingenerf
is product specialist for BL67
within the product marketing team of
Hans Turck GmbH, Mülheim.