Multi-controllers in process automation

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The P-open controller family is used in several process automation applications. Connectable via CANopen these multi-controller devices provide different features. They can be individually configured and easily be programmed with standard tools. Integration into wide area networks is supported by specific devices also connectable to CANopen networks.

In the competitive business of modern automation solutions using field buses, two opposing approaches are found: control systems with "centralized software and decentralized I/O hardware" and in opposite "standalone function modules plus centralized IPC with standard software". Because of the highly modularized design of production plants, the solution with stand-alone and intelligent sub-systems seems logical. Open bus systems such as CAN/CANopen, and off-the-shelf programming tools based on IEC 61131 and Windows support the combination of modules from different manufacturers. This distribution of tasks enables expert knowledge to be applied optimally, and provides solutions "with the best components" available on the market. For machine builders and end-users alike, this results in a competitive edge. Tailored solutions for individual tasks are available quickly and reliably. The integration into communication networks - a company's Intranets or worldwide - is done with standard, well-tried components. Today, many of the main tasks in processing plants and machines are already being performed by multi-function controllers, whereby various control loops are monitored and controlled independently.

* KS 800: Multi-controller for eight temperature loops with switching and continuous outputs

Already in the early 70's, a Philips division (predecessor of PMA) had started manufacturing digital multi-loop temperature controllers. Based on the archetype, the 19-inch "Multiplastomatic" with eight control loops, the modern digital single-loop controllers of the KS series were developed. They were used together with the 12-loop modules "TEMP" and "LCT" in the Philips systems PMC 1000 and P8 respectively. The latest device is the KS 800, which represents the experience gathered in more than two decades. It makes all this expertise available in open systems, i.e. for linking into PLCs from any manufacturer by means of CANopen, DeviceNet, or Profibus-DP. The KS 800 offers eight universal inputs for the direct connection of sensors and freely configurable control modes. For example, 8 analog outputs can be assigned freely to any of the heating/cooling or simple on/off outputs, thus providing direct control of the optimum type of actuator. Heating current monitoring is a standard feature. Practically all known procedures for precise temperature control, such as start-up circuit, special automatic set-point selection, etc. are implemented as integral software functions. Control parameters are defined automatically and without delay during start-up, or at set point without overshoot. A mouse click activates the required function in the Engineering Tool and the controller performs the assigned tasks reliably. An increase in the number of control loops is achieved simply by means of extension modules without overloading the central PLC or operating terminal. This is because all algorithms are executed independently by the stand-alone modules to-

Fig. 1: Ettlinger D-I-M control cabinet - "The complete automation system for of a multi-component injection molder is shown in this space-saving design, thanks to the compact, intelligent modules and the direct wiring to the sensors and actuators."

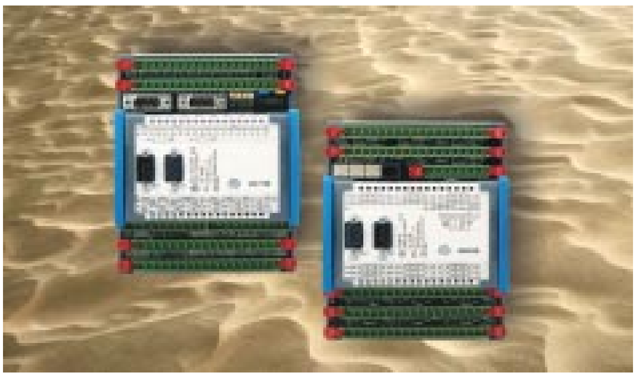

Fig. 2: KS 816 with DC 150 - "Combining the DC 150 and KS 816 modules results in a decentralized data logger."

gether with the monitoring of sensors and actuators.

** KS 816: Intelligent transmitters/controllers for 16 loops with positioning outputs via CANopen*

The KS 816 is a 16-channel transmitter with universal inputs that are connected directly to the relevant sensors. Every channel can be assigned to individual control algorithms for switching or continuous output. However, the control outputs are available via CANopen, e.g. for operating the respective actuators on-site. In this way, field wiring is reduced considerably, possible sources of error are eliminated, and interference pick-up is diminished. Apart from the decentralized structure, another great advantage is the possibility to use compact, cost-effective multiple actuators such as the LS 800 or 3-phase switching modules and solid-state relays with heat sinks.

** DC 150: A fast sequencing and control module with multiple communication paths*

Equipped with a 32-bit CPU, the DC 150 scans its on-board digital inputs/outputs (8 each) as well as the 8 analog I/O in less than 1 ms. Two field-bus ports (two CAN or one Profibus-DP and one CAN) enable the unit to address sensors and actuators, and to permit communication with the automation system. Up to 9 Mbytes in the form of flash memory are available, e.g. for storing process data together with time stamps from the internal real-time clock. This combination allows decentralized logbooks to be generated for time-critical data, which can be accessed at any time for subsequent processing.

Local operating terminals and modems can be connected via the standard serial interfaces. Thus, the DC 150 is a very fast, decentralized module with numerous functions for complex control tasks that are configured quickly via the Engineering Tool.

** Direct integration into an Intranet via Ethernet bridge*

The PU 10X modules comprise fast, 32-bit CPUs with 16 digital on-board I/O and diverse field bus interfaces. For example, the PU 104 has two separate CAN ports (for a local and a wide area network respectively), whilst the integration of the entire automation system into an existing company Intranet is done via the built-in Ethernet port with TCP/IP protocol.

With the P-open system, it is possible to do the programming from a central point, with direct access to every node in the system - a decisive advantage over conventional distributed systems with a separate serial interface for the relevant programming unit. By means of the corresponding Engineering Tool, every intelligent module is accessible via a nodal link or the superior operating/ visualizing system, e.g. for modifying its configuration or engineering, or for data retrieval.

Every module in the system is identified automatically (without configuration switches); they initialize themselves, and allow convenient and fast commissioning, maintenance, and remote diagnosis via software tools and CAN communication. Running under Windows, these software tools are already available for standard industrial PCs, and provide practice-proven solutions for reliable communication using the public telephone network. For this, the user's installation only requires an authorized support station for the plant and the modules.

Especially with complex processes, this gives the relevant experts detailed on-line information about plant operation. Without leaving their office, they have access to process values, error messages, and even the parameter setting of the individual automation modules, thus enabling specific suggestions and help to be given to the operators and technicians on site. In practice, this means worldwide and immediate remote service and support.

Furthermore, in case of a disturbance, the available remote equipment allows fully automatic dialing of predefined telephone numbers. For this purpose, system compatible modules such as "Whisper" and components from the "T-Box" range provide fully automatic

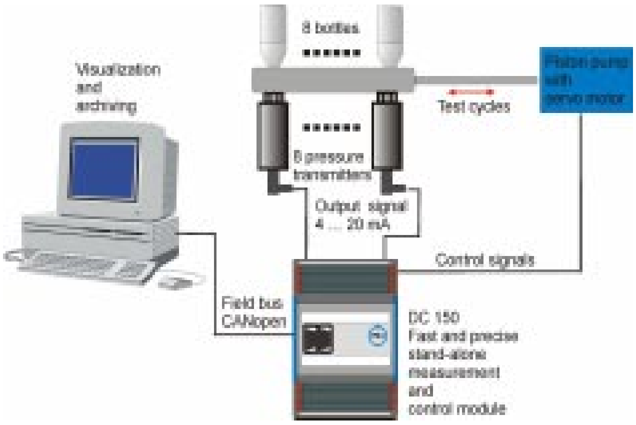

Fig. 3: Bottle testing plant - "Just one DC 150 module executes the complex test cycle of this bottle testing plant and transmits pre-processed data to the PC."

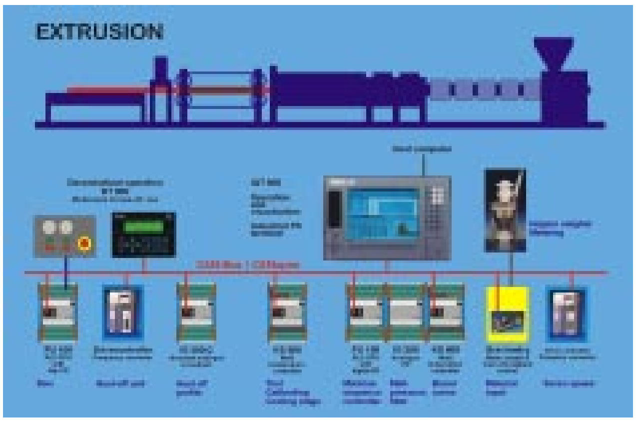

Fig. 4: Extrusion line - "Particularly in widely-distributed plants (like this profile extrusion line) the advantages of decentralized stand-alone modules and their simple integration into a CANopen network are demonstrated.

and reliable data exchange with existing plants, also via the Internet.

Application examples

In water treatment plants, low-cost devices such as the KS 816 with the DC 150 (for data logging plus various PLC functions) measure the process values and transmit them to the central station automatically or on demand. Located in decentralized stations they do not require an on-site industrial PC.

Fast, complex plastics processing machines benefit from the parallel availability of functions offered by standalone modules. For instance, the DC 150 is used with the KS 800, an IPC, and CAN displacement sensors during micro-injection molding of multi-component parts. In large blow-molding plants and injection molders, operational transparency is greatly increased by the use of independent, decentralized modules. The fully controlled parison profiles matches perfectly to the visualization and operating facilities by optimum assignment of the relevant tasks.

With hot-runner control, all application-specific operational requirements for up to 160 zones or more are fulfilled reliably, e.g. with KS 800 modules and an industrial PC with "touch-screen" operation.

In the case of large plants with distributed temperature control loops and independent processing stages, for example the coextrusion of tubes and profiles, slit dies for films, sheets, and laminating, with calendars, and the manufacture of filaments, etc., the advantages become apparent in a drastic reduction of wiring and the increased process transparency during start-up and continuous operation. Precise control and similar benefits have been observed in testing plant and equipment, distillation plants, and semiconductor manufacturing.

For example, a DC 150 module was fitted in a compact test station for plastic bottles, thus reducing the previous amount of electronic equipment significantly. Eight analog pressure sensors are connected directly to the DC 150. By means of a controlled piston pump, test cycles involving pressure changes and vacuum are executed within a few seconds. During each cycle, the value for collapse (decisive for defining the quality of the bottle's wall thickness) must be determined within a few milliseconds. Performing this test in parallel for all 8 bottles, plus evaluating and storing the results is no problem for the DC 150 module. At the end of each test sequence, the results and a table with the computed values are transmitted (CAN with CANopen protocol) to a PC for subsequent visualization and recording.

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