Gripping – also a question of communication

In the process of implementing mechatronics for gripping systems, the selection of communication interfaces is becoming increasingly important. One look at the world's most comprehensive mechatronics portfolio for gripping systems reveals that there are no standard solutions. For those who want to harness the potential of communication between components, controls and higher-level systems while on a more conservative budget, a wise decision is to analyze the concrete requirements before making an investment.

In its strategy framework for mechatronics, SCHUNK makes a distinction between three communication segments: digital I/O, IO-Link and industrial Ethernet and bus interfaces. Gripping system components with IO-Link and industrial Ethernet interfaces (PROFINET, EtherCAT and EtherNet/IP) in particular are gaining in importance alongside the long-established PROFIBUS and CAN bus interfaces. This is in line with the overall development: More than 21 million PROFINET nodes have already been installed worldwide, more than 8 million at IO-Link. and the trend is rising. Control and electronics manufacturers such as Siemens, Beckhoff, Bosch and Rockwell Automation as well as robotics manufacturers such as KUKA, FANUC or Mitsubishi are regarded as the primary drivers of modern standards. Component suppliers such as SCHUNK, whose aim is to cover the entire market by offering a comprehensive and extensive product range, have to master the entire spectrum from communication to control. Ultimately, we expect their components to work flawlessly with every PLC and every robot control system.

Tiered mechatronics program

In addition to the continuous expansion of its robust and durable pneumatic components, SCHUNK also developed an equally sophisticated mechatronics program early on. It was initially based on three pillars. Firstly: robust components such as the 24V small components gripper (EGP), which is controlled via digital I/O and is able to replace existing pneumatic components one-for-one. Secondly: Components such as the SCHUNK EGA long-stroke gripper, which can be connected to commercially available servomotors via motor adapters, making them very easy to adapt to existing control environments. And finally: Components such as the highest-category C-certified PROFINET SCHUNK EGL universal gripper, with completely integrated motor, control technology and intelligence, and controlled via industrial Ethernet interfaces. In addition, the program has been gradually expanded, for example with components using the IO-Link interface. The reasons for this include the falling price for IO-Link nodes, the openness and simplicity of IO-Link, the simplified installation process as well as the increasing demand for parameterization and diagnostics options. Since that time, the mechatronic 24V universal gripper SCHUNK PGN-plus-E and the mechatronic 24V small components gripper SCHUNK EGP have been available with IO-Link interface. That makes it all the more important for system builders, integrators and users to know the advantages as well as the technical limitations of the individual interfaces so they can truly weigh the options.

Digital I/O for simple applications

Grippers with digital I/O are the entry-level choice into the world of mechatronic handling. When switching from pneumatic to mechatronic gripping systems for the first time, control via digital I/O proves especially advantageous, as the control principle is the same and no programming knowledge is required. For this very reason, the SCHUNK EGP, which was conceived for small parts handling, was able to achieve market success very early on. The most powerful electrical small components gripper with integrated electronics on the market scores points with its high speed and high gripping force. Brushless and thus maintenance-free servomotors as well as powerful junction roller guides ensure a high level of efficiency. Its gripping force can be adjusted in two or four increments depending on the size. In the speed version, the closing time is just 0.03 s. The control reaches its limits with digital I/O if additional functions are required other than the simple opening and closing of the grippers and the step-by-step setting of the gripping force. These additional functions may include setting different strokes or gripping forces cycle by cycle or monitoring process data. None of this is possible with digital I/O.

IO-Link transmits parameterization and diagnostics data

SCHUNK grippers with IO-Link interface on the other hand, are able to transmit parameterization and diagnostics data via a digital point-to-point connection. Additionally this reduces the wiring work required and the number of interface and connector variants in the system. The two SCHUNK PGN-plus-E and SCHUNK EGP IO-Link powerhouses are based on the tried-and-tested mega-sellers from the SCHUNK range and meet the IO-Link Class B standard as well as comply with the IO-Link specifications for both software and hardware. With this, SCHUNK is continuing the success story of its proven flagship products. Both IO-Link grippers can be integrated easily and intuitively into the production environment and put into operation with minimal effort. A single cable for control and voltage supply is sufficient for operation of the gripper and for it to receive data from the higher-level control or transmit this to it. The gripper reports to the higher-level control via the IODD (IO Device Description). Whereas to date only binary switching conditions (on/off) or analog signals were transferred, parameters such as position and gripping speed can be defined centrally and modified in ongoing system operation due to IO-Link. The gripping force too can be adapted to the respective workpiece in the software settings so that handling scenarios with deformation-sensitive parts can also be realized. This increases flexibility within the application. In extreme cases, the parameters can be adapted from cycle to cycle. If malfunctions and errors occur, the user can intervene at that precise point. This leads to immense time savings during commissioning or when replacing the gripper. An integrated diagnostics function permanently monitors the status of the grippers and automatically transmits errors to the higher-level control. In addition, system operators can store any maintenance intervals for the system on the tool. Setting parameters that, following a change of machine variant, previously had to be redetermined in a time-intensive process by means of teaching, approaching and correction, are stored on the control system and are therefore available immediately with IO-Link grippers. The universality of the IO-Link standard definitely has its advantages. IO-Link masters are compatible with other communication protocols such as Modbus/TCP. One disadvantage, on the other hand, can be that communication via IO-Link always requires an IO-Link master, which necessarily increases the investment, requires programming and restricts data throughput. That means that the IO-Link system is not truly capable of real-time communication. When extra features such as cameras, sensors or additional data are required, communication via IO-Link also reaches its limits.

Industrial Ethernet enables real-time control

SCHUNK grippers using the industrial Ethernet interface (PROFINET, EtherCAT, Ethernet/IP) allow for significantly higher functionality than grippers that are controlled via digital I/O or IO-Link. This is the only way to set the referencing type to block, speed, current travel or workpiece. The setting of this referencing type alone would exceed the capabilities of grippers equipped with an IO-Link interface. Other functionalities are also possible, such as measuring, positioning, connecting to a web server for commissioning, or connecting to a gateway for data evaluation via ERP systems or cloud solutions. The best example: the SCHUNK EGL with PROFINET interface. Power, diversity, and intelligence is united in the world's first highest category C-certified PROFINET universal gripper with integrated electronics. Its high-performance PROFINET interface creates the best prerequisites for real-time process regulation and maximum performance. With a variable gripping force between 50 N and 600 N, the compact gripper covers a wide range of components. In force-fit gripping, it can handle a wide range of parts up to 3 kg alternately – circuit boards in the electronics industry as well as components in the assembly of consumer goods or in mechanical engineering. In the process, the finger position, closing speed, and gripping force can be freely programmed within the maximum stroke of 42.5 mm per finger. In order to shorten the cycle time, the fingers can also be pre-positioned wherever necessary with a speed of up to 150 mm/s. Future releases, which will then include the high-performance EtherCAT and Ethernet/IP interfaces, are already being planned at SCHUNK. Moreover, at the Hannover Messe, SCHUNK will showcase a flexible mechatronic gripper with a long stroke for a wide variety of industrial applications. This gripper is also controlled via PROFINET and positions its fingers extraordinarily fast.

Functionality paves the way for technology

The basic principle is that every type of control – be it pneumatic or electrical – as well as any type of communication interface has its specific advantages and disadvantages. Offering general recommendations is not possible. That is

why the gripping system specialists at SCHUNK always recommend looking at each application and its respective requirements on an individual level. If you only need to pick up a workpiece and have no further demands on the gripping process, then you can confidently rely on pneumatically controlled or electrically controlled grippers with digital I/O. This reduces the amount of commissioning work involved and limits the control complexity – not to mention the investment costs. For applications that require intermediate positions for example, grippers with IO-Link may be a consideration. Alternatively, pneumatic grippers with mechanical limitations, springs or externally guided grippers could also be used, for example. Grippers with industrial Ethernet interfaces, on the other hand, are especially suitable if implementing real-time control is required, or if special referencing is needed or process data is collected. According to SCHUNK recommendations, in order to achieve the best price-performance ratio, the functionality required should always pave the way for the technology used. This is exactly the strategy pursued by SCHUNK in its own consultations. With an increase in functionality, comes an increase in investment and integration expenditures. That is why SCHUNK recommends conducting an individual needs analysis for each application. The basic principle is: The functionality required should always pave the way for the technology used.