

## AS-Interface Slaves for frequency inverters

*Intelligent slaves to connect frequency inverters to the Bussystem which networks binary sensors and actuators.*

*The AS-Interface has become the standard bussystem to network binary sensors and actuators at the lowest field level. In industrial plants the problems of electrical drive technology have been solved conventionally. The following article is about how to combine frequency inverters and the AS-Interface in an effective way and what advantages the user gets using this combination.*

### PREFACE

The AS-Interface has established itself as fieldbus system for the lowest field level. All leading suppliers offer AS-Interface components because of its ease of handling and the high cabling flexibility, and especially the low costs for the user. The product range starts with different types of masters and gateways, and expands to include integrated AS-i sensors, I/O modules for cabinet mounting (IP20) and field mounting (IP67) as well as intelligent actuators. The multifunctional variable speed drives of different suppliers are used for machinery building as well as for industrial plants. The frequency inverters' possibilities to optimize processes and to save energy can be particularly effective in new innovative machines and plants when used in combination with communication interfaces, which integrate the drives in the best possible way into the automation environment. This environment is also influenced by sensors. For this reason Bihl+Wiedemann has developed AS-i slaves together with the various drives suppliers to solve these Automation problems which do not need the use of powerful fieldbus systems thus saving costs for the user.

### OPERATIONS OF AS-I SLAVES FOR FREQUENCY INVERTERS

The example of a production line demonstrates the benefits which result out of the use of frequency inverters in combination with the AS-Interface. Figure 1 shows a production line with 12 conveyor belts. Each conveyor belt is variable speed driven. The power cabling between frequency inverter and the decentrally located motors is conventionally installed. The parallel wiring starts at the central cabinet and ends at the particular motor. This parallel wiring means a big cabinet with all PLC I/O slots as well as all frequency inverters inside.

Figure 2 shows a cabling alternative for the same production line, with frequency inverters or frequency inverter motors decentrally located and communicating via AS-interface. In opposite to the parallel power wiring only two cables go through the plant - the AS-Interface to transmit the control signals and the the power bus.

As you can see from this example there are possibilities to minimize the cabinet and the power cabling if AS-Interface is used in combination with decentrally

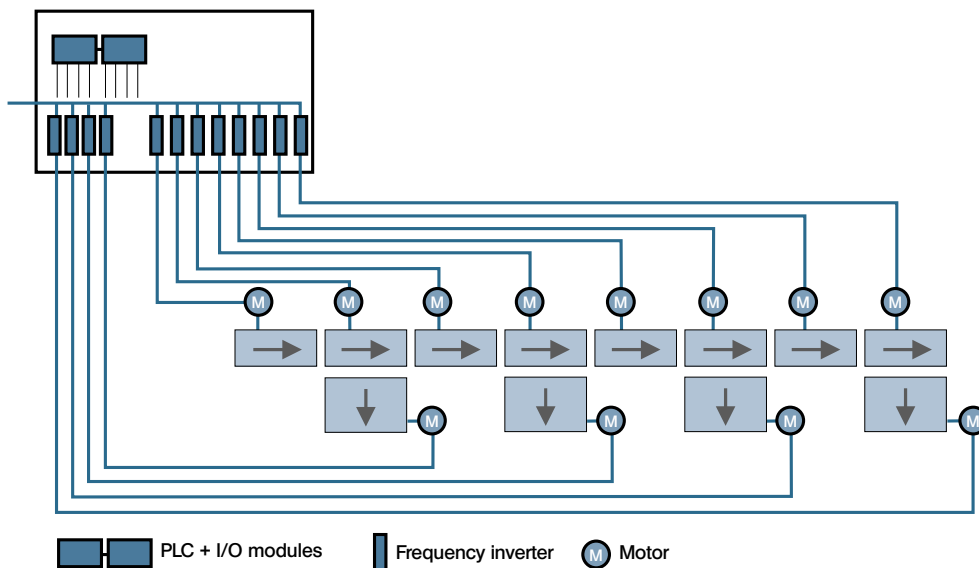


Figure 1. Traditional concept with parallel wiring.

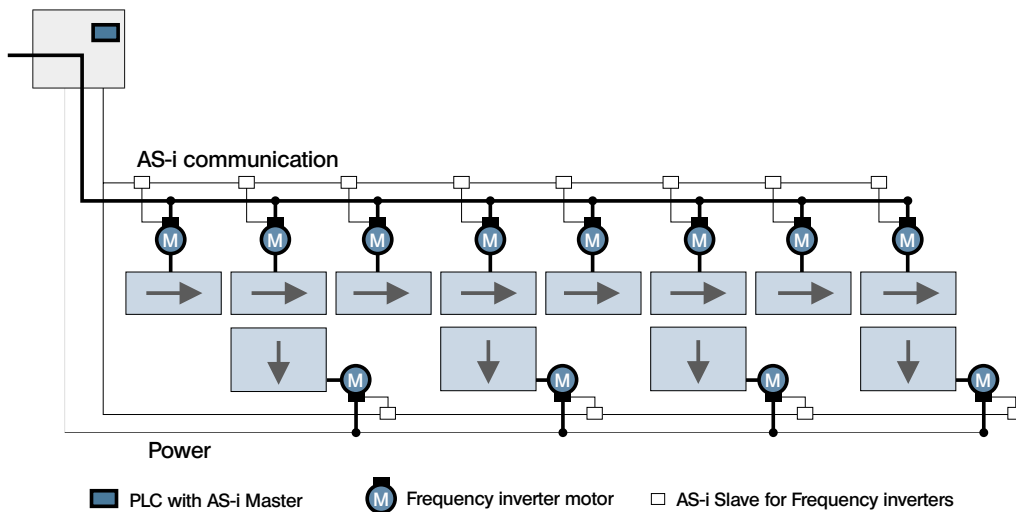


Figure 2. Concept with decentral frequency inverter motors communicating via AS-Interface.

used frequency inverters. Further advantages are the possibility to design modular plant structures, to minimize the installation time and test time. This all leads to an earlier start of production which means less „dead“ money.

To connect frequency inverters and frequency inverter motors to the AS-Interface Bihl+Wiedemann offers slave modules in protection class IP20 for frequency inverters and in protection class IP65 for frequency inverter motors (see Figure 3). The main operation fields of these AS-i slaves are transport systems, filling and packaging machines as well as handling machines. Up to now AS-i slaves have mostly been used in protection class IP20. These slaves are mounted together with a frequency inverter in a decentral clamp case near to the motor. But these slaves are also used in machines' cabinets e.g. easy packaging machines, with the PLC only having an AS-i master to connect the decentralized I/O modules. The slaves in protection class IP65 are used in combination with frequency inverter motors. In particular integrated frequency inverters are suitable for easy decentralized plants with the nodes communicating via AS-Interface.



Figure 3. AS-i slaves for frequency inverters with IP20 and IP65 protection class.

## FUNCTIONS

The AS-i slaves for frequency inverters and frequency inverter motors consists of a 4I/4O module as a AS-i bus interface as well as a serial interface to communicate with the frequency inverter. The respective inverter protocol is implemented on the slave. The serial communication between the AS-i slave and the frequency inverter is invisible to the user. This means the slave can be used as a normal 4I/4O module resp. analog module. On the other side the access via the serial interface of the inverter offers the best possible connection to use the large functionality of the frequency inverter. The use of the serial interface also reduces the cabling between AS-i slave and frequency inverter. Similar to the As-Interface, the frequency inverter is connected using a two wire cable. The AS-i slaves with a high protection class can be used in an identical way to devices for cabinet mounting. This allows frequency inverters from different suppliers can be used in the same way.

Which functionality is implemented on the AS-i slaves? This question can best be answered with application samples. Often multi-speed motors have been replaced by a combination of frequency inverter and motor. For these applications the AS-Interface is particularly suited. The user has just to set a few bits in his application program and various speeds can be adjusted. In „normal operation“ the AS-i Slave devices work as 4I/4O modules for AS-i. With the use of the 4 AS-i output data bits per AS-i Slave up to 7 preset speeds as well as the direction (forward/ reverse direction) can be controlled. The frequency inverter sends bit status information to the PLC via the 4 AS-i input data. This offers the possibility to evaluate diagnostic messages from the inverter in the PLC. A communication error between Frequency inverter and AS-i slave will of course be detected and displayed via the AS-i input data.

In transportation plants there is often a need to have 1 or 2 binary sensors near the driving motor e.g. to stop the conveyor belt in case of a tail back or to increase the speed in case of shortage of products on the belt. The AS-i slaves for frequency inverters can be parameterized so that 2 digital inputs of the inverter are read from the AS-i slave via the serial interface and transmitted to the PLC via AS-i. So switches, sensors etc. can be directly connected to the inverter and the status information will be transmitted to PLC. In that way an additional I/O module can be saved.

Further, it is very important to detect a component's failure quickly and replace the component if necessary. The monitoring of the frequency inverter's status information has already been described. But with the AS-i slaves for frequency inverters it is furthermore possible to store the inverter's parameter set inside the slave. This offers the possibility for a very quick inverter exchange. The damaged inverter has just to be replaced by a new one and the parameter set will be downloaded from the AS-i slave to the inverter.

Setpoint values and ramps can also be transmitted to the inverter via AS-Interface. This can be demonstrated with Figure 4 which shows a production line at a glassworks at PLM in Bad Muender. After the actual bottle manufacturing the bottles are transported on conveyor belts through various stations till at the end the bottles will be palletized and packed. Here you can see a station of the production line where bottles are coming in rows with four bottles and at the end are transported one bottle after another. The 4 conveyor belts are driven with 4 different but co-ordinated speeds. With each glass production job, various types and volumes of bottles will be transported through the same production line. To achieve this requires a very flexible controlled application. In that case the PLC's software is written such that only the diameter and the number of bottles per hour has to be given from the user to the controller. Resultant from these 2 parameters the different belt speeds are calculated within the PLC and are transmitted via the AS-i analogue protocol to the AS-i slaves and so to the frequency inverters. Figure 5 shows an integrated frequency inverter in combination with an AS-i slave with IP65 protection. The whole plant could be operated in this way especially with the use of the AS-i slaves for frequency inverter motors. Through the use of these devices it was possible to fulfill all control tasks with the AS-Interface. The alternative



Figure 4. a production line at a glassworks at PLM in Bad Muender.



Figure 5. AS-i slave in combination with a frequency inverter motor

was to operate the whole application with a more powerful bus system. The disadvantages in such a case would be the higher component costs and that the binary I/O signals have to be connected via I/O boxes with at least 8 I/Os. This would mean a step back to the parallel wiring of binary sensors and actuators. The second alternative was to network the frequency inverter motors via a more powerful fieldbus system and to scan the binary I/O data with a gateway between the superior fieldbus system and the AS-Interface. Again, the costs would be higher compared with a pure AS-Interface solution.

In summary, the reasons for the use of the AS-Interface in combination with frequency inverters and frequency inverter motors are:

- Reduction of cost intensive power cabling
- 1 power bus instead of many motor cables
- 1 data bus instead of many single cables
- AS-Interface eases and shortens the commissioning time and test time of the plants
- Very simple to extend a plant
- The search for failures and errors can be reduced to the minimum.
- Smaller cabinets
- Less I/O cards for the PLC
- Physical allocation of frequency inverter and motor
- Vendor independence: The users choose the inverter they wish to use. With a change to another vendor everything that has to do with AS-Interface is nearly identical. Thus the effort of software changes can be reduced to the minimum.
- Make modular plant concepts possible
- The down-time of the plant can be reduced.
- The whole concept is very cost-efficient compared to other solutions.

## UPSHOTS

The AS-Interface - originally designed to network binary sensors and actuators - offers in combination with the AS-i slaves for frequency inverters and decentralizes frequency inverter motors a possibility to create new plant structures together with drives. The AS-

Interface's advantages (low costs, high flexibility, easy handling) can be combined with the functionality of frequency inverters, especially frequency inverter motors in an efficient way. This concept provides the user a real alternative to create new solutions for machines and plant which were formerly operated with more powerful fieldbus systems ■

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*Lutz Bieberstein, 31 years old, right after graduating in mechanical engineering and business administration at the Technical University Darmstadt in 1995 he started at Bihl+Wiedemann GmbH in Mannheim, Germany. Today he is Head of Sales and Marketing.*

# ***AD POLYHEDRA***