Course description

# Smart Sensors for Smart Systems

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| | Level of difficulty | Intermediate |
| | Learning time | 9,0 h |
| | Additionally recommended learning media | Basics of Smart Sensors (evaluation), Smart Sensors - First Steps (tutorial) |
| | Course type | eLab |
| | Theme category | Factory Automation |

After completing the training, the trainees know the different sensor types and their advantages and disadvantages compared to classic sensors. They are able to parameterize intelligent IO-Link sensors, load configurations and integrate them into a PLC project. They understand the basic features of the IO-Link protocol, can integrate IO-Link-based components into the plant network and display them visually via the HMI. In the context of maintenance, the learners know about the advantages of intelligent sensors and can derive maintenance measures.

| No. | Task | Method | Competency level | Content | Competencies | Learning time | HW/ SW dependend |
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| **Learning unit 1: Basics Smart Sensors** | | | | | | | |
| 1 | I4.0 and Smart Sensors | Guidance text supported Method | Knowledge | ▪ Smart sensors<br>▪ Smart factory<br>▪ IoT<br>▪ Big Data<br>▪ Industry 4.0<br>▪ 5C architecture pyramid | ▪ Know the term Smart Sensor.<br>▪ Can reflect the difference between smart and conventional sensors.<br>▪ Know the possibilities of smart sensors in the context of Industry 4.0.<br>▪ Know the term Internet of Things and the influence in the context of Industry 4.0.<br>▪ Know the term Big Data and the influence in the context of Industry 4.0.<br>▪ Know the basic idea of an intelligent factory (Smart Factory).<br>▪ Can reflect the benefits of a Smart Factory.<br>▪ Can classify smart sensors using the 5C architecture pyramid.<br>▪ Can reflect on and classify the knowledge gained. | 60 min. | No |
| 2 | Functions and interfaces of smart sensors | Guidance text supported Method | Evaluate | ▪ Structure and mode of operation<br>▪ Advantages/ Disadvantages<br>▪ IO-Link<br>▪ PRFINET<br>▪ Turck<br>▪ TIA Portal<br>▪ PROFINET<br>▪ IOOD file<br>▪ Connector and pin assignment | ▪ Know the structure of intelligent sensors.<br>▪ Know how smart sensors work.<br>▪ Can reflect the advantages of smart sensors to conventional sensors.<br>▪ Know the interfaces of intelligent sensors.<br>▪ Know the network standard for IO-Link communication and how it works.<br>▪ Know the IO-Link connectors and their pin assignment.<br>▪ Know the different IO-Link operating modes.<br>▪ Know the concept of IOOD files and their use in IO-Link communication.<br>▪ Know the advantages of IO-Link communication compared to other communication types.<br>▪ Know the term PROFINET and its characteristics.<br>▪ Can reflect on and classify the knowledge gained. | 60 min. | No |

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|-----|------|--------|------------------|---------|--------------|---------------|-------------------|
| **Learning unit 2: Intelligent Sensors in Production** | | | | | | | |
| 3 | Design and function of the ultrasonic sensor | Technical experiment | Evaluate | ▪ Structure and function<br>▪ Parameterization<br>▪ Ultrasonic sensor<br>▪ IO-Link device and master<br>▪ Network<br>▪ Dashboard<br>▪ Network communication<br>▪ Network<br>▪ System configuration | ▪ Know the structure and operation of the ultrasonic sensor.<br>▪ Know the common applications of an ultrasonic sensor.<br>▪ Can select a sensor type for a specific application.<br>▪ Can analyze and interpret values of the sensor.<br>▪ Can change parameters of ultrasonic sensors and document the effects of the change.<br>▪ Can commission the connection between an ultrasonic sensor (IO-Link device) and the IO-Link master and establish a network connection to a PC.<br>▪ Can read data via a dashboard.<br>▪ Can reproduce the operation of the sensor.<br>▪ Can document knowledge gained.<br>▪ Can transfer the behavior of the sensor to a plant configuration.<br>▪ Can reflect on and classify the knowledge gained. | 90 min. | Yes |
| 4 | Commissioning of intelligent sensors and display of process values | Guided text based method | Apply | ▪ GDSML file<br>▪ Technical documentation<br>▪ TIA - Portal<br>▪ PROFINET<br>▪ Variable data<br>▪ Interfaces<br>▪ Laser distance sensors<br>▪ Ultrasonic sensor<br>▪ Capacitive sensor | ▪ Know the device description and interface description of various smart sensors.<br>▪ Can load and interpret data into a controller.<br>▪ Can interpret the interface description and implement it in TIA.<br>▪ Can configure the smart sensors in TIA.<br>▪ Can read out process data of the smart sensors in TIA.<br>▪ Can reflect on the knowledge gained. | 60 min. | Yes |

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| 5 | Parameterization of a Smart Laser Distance Sensor | Explore | Apply | ▪ PACTware<br>▪ Laser distance sensor<br>▪ Parameterize IO-Link module<br>▪ IO-Link communication protocol<br>▪ Smart maintenance | ▪ Can manually parameterize a smart sensor.<br>▪ Know the basic terms/functions of the sensor (switching point, etc.).<br>▪ Know the operating principles of the different types of laser distance sensors.<br>▪ Know the advantages and disadvantages of laser distance sensors.<br>▪ Can perform the parameterization of a laser distance sensor by means of a configuration file.<br>▪ Know the data retention mode and can use it for the parameterization of the laser distance sensor.<br>▪ Know the advantages of IO-Link in the context of Smart Maintenance.<br>▪ Can assess the impact of smart sensors on a production facility.<br>▪ Know the challenges for companies in the course of digitalization.<br>▪ Can reflect on the knowledge gained. | 90 min. | Yes |
| 6 | Parameterization of Smart Sensors via the PLC | Explore | Apply | ▪ TIA Portal<br>▪ Smart maintenance<br>▪ Commissioning<br>▪ Function test<br>▪ HMI<br>▪ Parameterize IO-Link module<br>▪ Measured value exceeded<br>▪ Commissioning | ▪ Know the capabilities of smart sensors compared to traditional sensors.<br>▪ Know the possibilities of an intelligent sensor and its advantages in the context of Smart Maintenance.<br>▪ Know the different areas of Smart Maintenance.<br>▪ Can interpret and classify a PLC program for reading or writing parameter data.<br>▪ Can extend a PLC program to read or write parameter data.<br>▪ Can perform a commissioning properly.<br>▪ Can perform a functional test.<br>▪ Can display measured value overruns via an HMI.<br>▪ Can derive concrete measures for intelligent maintenance.<br>▪ Can reflect on and classify the knowledge gained. | 90 min. | Yes |

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| 7 | Parameterization of a Smart Capacitive Sensor | Lead text | Apply | ▪ Capacitive sensor<br>▪ Parameterization<br>▪ IO-Link<br>▪ TIA Portal<br>▪ Application area<br>▪ Role concept | ▪ Know the structure and operation of an intelligent capacitive sensor.<br>▪ Can configure the intelligent capacitive sensor.<br>▪ Know the basic parameters of the sensor.<br>▪ Know the limits of the sensor (environment/material etc.).<br>▪ Can give examples of the optimum area of application for the sensor.<br>▪ Know the different access rights (employee / contractor -maintenance).<br>▪ Can set up the different access authorizations (read data/ control system/ set values).<br>▪ Know the different data of interest to different roles in a company (management I manufacturing I logistics).<br>▪ Can reflect on and classify the knowledge gained. | 90 min. | Yes |
| 8 | Environment and quality | Case study | Create | ▪ Environmental protection<br>▪ IT-Security<br>▪ Quality assurance<br>▪ Energy efficiency<br>▪ Opportunities and risks | ▪ Can assess the impact on production of using smart sensors.<br>▪ Can name concrete measures where smart sensors can be usefully applied in the context of quality, logistics and environmental protection and energy efficiency.<br>▪ Know the risks of networked systems (IT security).<br>▪ Can transfer the knowledge gained to another context.<br>▪ Can reflect and reproduce the knowledge gained. | 30 min. | No |