

## **FAS-200 SPECIAL EDITION INDUSTRY 4.0:** **MECHATRONICS FOR INDUSTRY 4.0**

**FAS-200 SE I4.0** system provides professional training by simulating a real industrial assembly process and including several Industry 4.0 technologies. The system consists of a compact Flexible Automated Assembly Cell with five different manufacturing stages:

**1.Assembly → 2.Manipulation → 3.Quality Inspection → 4.Transfer → 5.Warehouse & Expedition**



**FAS-200 SE I4.0** has been designed as a compact trainer, tailored for Mechatronics & Robotics students and in order to develop the skills in the most demanded 4.0 technologies and be prepared for the Industry 4.0 new challenges.

The technologies integrated in FAS-200 SE I4.0 are listed as follows:

- Advanced electropneumatics
- Vacuum technology
- Sensors
- UID (Unique Product Identifiers): RFID identification systems & Binary identification systems
- IO-link Smart sensors
- IO-link Smart light & sound
- Artificial vision
- Servo-controlled electric actuators
- Industrial controllers (Ethernet IP communication)
- Artificial vision
- HMI
- Augmented reality
- Distributed I/Os
- Troubleshooting simulation systems
- Collaborative robots (optional)

All the hardware elements of the system are industrial ensuring the quality, long life and robustness of the system.

**FAS-200 SE I4.0** integrates a Manufacturing Management HMI Application for managing the production process, which includes the following functions:

- Assembly configuration and tracking
- Production order management
- Warehouse
- Expedition
- Quality Inspection

## HOW TO ORDER

FAS-200 SE I4.0 can be configured with the following PLC brands and models:

	SIEMENS	SIEMENS	OMRON	ALLEN BRADLEY
	S7-1200	S7-1500	CP1L-E	MICROLOGIX
<b>FAS-200 SE I4.0 - Pneumatic configuration</b>	SAI4429	SAI4431	SAI4433	SAI4435
<b>FAS-200 SE I4.0 - Cobot configuration</b>	SAI4430	SAI4432	SAI4434	SAI4436



## FAS-200 SE I4.0, STATIONS AND QUANTITIES

The system is composed by the following stations and quantities:

- FAS-209: LID CLASSIFICATION- QUANTITY: 1

The function of the station is to feed and to check the lid.



The part to be assembled is a lid. There are three lid options depending on the material: anodised aluminium, blue plastic and white plastic. Each lid has two different heights, regardless of the material.

The station is formed by a 450x600x900mm height-adjustable aluminium structure on which the components used to perform the process are mounted, which include a block of control solenoid valves in the case of pneumatic components and a no material indication lamp.

The electrical panel is on the front, from which the station is controlled.

It also includes the control keypad, with the following buttons and indicator lights: start, stop and reset (with lamp) buttons, continuous/single cycle selector and disconnecting switch and endorsed emergency stop button.

On one side of the station there is an air treatment unit comprising a 5µm filter with a pressure controller, pressure gauge, manual 3/2 stop valve.

The station comprises the following modules:

#### - Dividing plate:

Made from anodised aluminium, this module is used as an alternative rotary drive system, such that with each rotary movement it advances 45 degrees. This is achieved by a pneumatic pusher cylinder with oscillating drive. It also has another two limiter cylinders operating alternately, one of them moving which holds the plate while it turns, and the other fixed, which locks it once the turning movement has stopped so that the plate is held firmly in place, and the pusher cylinder can return to its initial position to wait for a new cycle. This module has the following components and characteristics:

- Actuators:

- Compact double acting pusher cylinder, Ø25 and 40mm stroke, with speed controllers and initial position switch. Controlled by a single 5/2 solenoid valve.

- Limits: 2 compact cylinders, Ø16, 10mm stroke. Controlled by a single 5/2 solenoid valve.

- Sensors:

- Auto switch, reed type.



### - Feeding the lid

The lids are stored in a gravity feeder including two pneumatic grippers with two parallel-opening jaws. This module has the following components and characteristics:

- Storage capacity: minimum 19 lids.
- Actuators:
  - 2 gripper with two parallel-opening jaws. Controlled by 5/2 solenoid valve.
- Sensors:
  - Presence sensor: fibre optic photocell.



### - Material detection:

Two measurements are taken to determine the lid material using inductive, and photoelectrical detectors. This module has the following components and characteristics:

- Sensors:
  - Inductive detector.
  - Smart photoelectric detector, with IOLink technology.



### - Lid measuring station:

The lid height is measured using a pneumatic cylinder that moves a plunger with regulated pressure until it touches the lid. This cylinder includes a digital transducer that sends a linear encoder with pulse output, depending on the cylinder's stroke. This module has the following components and characteristics:

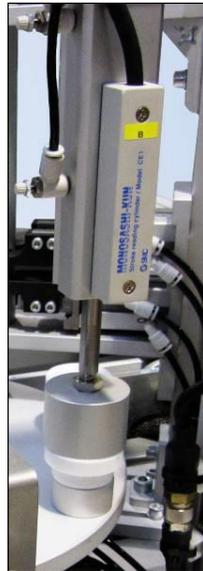
- Actuators:

- Double acting cylinder with stroke reading, Ø20 and 50mm stroke, with speed controllers. Controlled by a single 5/2 solenoid valve.

- Sensors:

- Linear encoder built into the cylinder.

-Pressure regulator.



### - Smart IOlink devices:

The system includes IOlink devices with Smart features:

- **IOlink valve manifold:** number of valve operation counter for predictive maintenance, power supply failure detection, short circuit detection, abnormal internal temperature, internal failure detection.
- **IOlink smart photoelectric sensor:** eight color detection, remote monitoring and diagnosis.
- **IOlink smart light device & sound:** 7 colour LED emission, 8 sounds emission, remote monitoring and diagnosis.



**- Breakdown generation system:**

The station has the possibility of generating up to 16 breakdowns or malfunctions. For this purpose a box is assembled on the side of the station structure, inside which there are 16 switches to activate the same number of breakdowns. When a switch is activated a breakdown occurs in one of the station components. To access these switches, the box lid has to be opened, which can be locked.



**- Electrical control panel:**

All of the pneumatic cables and tubing are properly identified and labelled at both ends.



- Mounted on a 375x700mm mesh
- Accessible electrical connection terminal box with power input and coded I/O.
- It includes 110-240VAC/24VDC power supply unit.
- 1 control PLC wired and programmed to operate the module with 10 digital inputs and 7 digital outputs connected to the hardware.
- IOlink master device with Ethernet standard connection.
- Industrial communication via standard Ethernet for communication with the other modules.

- **FAS-210: LID REJECTION/TRANSFER STATION- QUANTITY: 1**

The function of the station is to reject the incorrect lids and to assembly the correct ones.



The part to be assembled is a lid. There are six lid insertion options depending on the material: metal, anodised aluminium, black plastic, black nylon and white plastic or white nylon. Each lid has two different heights, regardless of the material.

The station is formed by a 450x600x900mm height-adjustable aluminium structure, on which the components used to perform the process are mounted, which include a block of control solenoid valves in the case of pneumatic components.

The electrical panel is on the front, from which the station is controlled.

It also includes the control keypad, with the following buttons and indicator lights: start, stop and reset (with lamp) buttons, continuous/single cycle selector and disconnecting switch and endorsed emergency stop button.

On one side of the station there is an air treatment unit comprising a 5µm filter with a pressure controller, pressure gauge, manual 3/2 stop valve.

The station comprises the following modules:

### -Removal of the incorrect lid module:

It consists of a handling device that, when it receives the command, removes the lid from the plate. It consists of two pneumatic shafts that have three vacuum pads as the terminal elements. Each one contains a pneumatic cylinder with parallel rods. This module has the following components and characteristics:

- Actuators:

- Horizontal axis: Double acting parallel-rod cylinder, Ø15 and 100mm stroke, with speed controllers and initial and end position switches. Controlled by a double 5/2 solenoid valve.

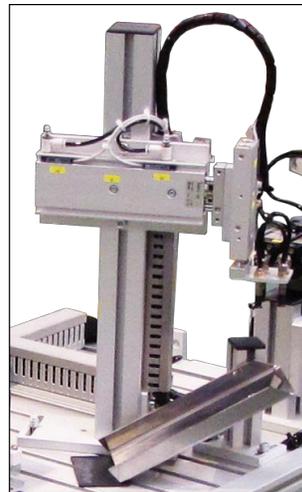
- Vertical axis: Double acting parallel-rod cylinder, Ø10 and 50mm stroke, with speed controllers and start position switch. Controlled by a single 5/2 solenoid valve.

- Fixing arm: 3 Ø8 vacuum pads, with vacuum ejector. Controlled by a single 3/2 solenoid valve.

- Sensors:

- Auto switches, reed type.

- PNP output vacuum switch.



### - Lid insertion module:

The lid is inserted in the assembly by a handling device formed by a rotoliner unit with a gripper with two parallel-opening jaws. This module has the following components and characteristics:

#### - Actuators:

- Compact linear and rotary drive cylinder, Ø32, 25mm stroke, with speed controllers and initial and end of stroke position switches during linear movement and 0° and 180° during rotary movement. Controlled by two single 5/2 solenoid valves.

- Fixing arm: Pneumatic grippers with two parallel-opening jaws. Controlled by a single 5/2 solenoid valve.

#### - Sensors:

- Auto switches, reed type.



### - Breakdown generation system:

The station has the possibility of generating up to 16 breakdowns or malfunctions. For this purpose a box is assembled on the side of the station structure, inside which there are 16 switches to activate the same number of breakdowns. When a switch is activated a breakdown occurs in one of the station components. To access these switches, the box lid has to be opened, which can be locked.



### - Electrical control panel:

All of the pneumatic cables and tubing are properly identified and labelled at both ends.



- Mounted on a 375x700mm mesh
- Accessible electrical connection terminal box with power input and coded I/O.
- It includes 110-240VAC/24VDC power supply.
- 1 control PLC wired and programmed to operate the module with 12 digital inputs and 10 digital outputs connected to the hardware.
- Industrial communication via standard Ethernet for communication with the other modules.

- **FAS-216: STORAGE STATION- QUANTITY: 1**

The function of this station is to automatically store the finished product.



The assembly to be stored is a turning mechanism formed by a 65x65x32mm anodised aluminium block with an opening at the top, 32mm diameter, and an opening in the bottom, 28mm diameter.

The station is formed by a 450x600x900mm height-adjustable aluminium structure, on which the components used to perform the process are mounted, which include a block of control solenoid valves in the case of pneumatic components.

The electrical panel is on the front, from which the station is controlled.

It also includes the control keypad, with the following buttons and indicator lights: start, stop and reset (with lamp) buttons, continuous/single cycle selector and disconnecting switch and endorsed emergency stop button.

On one side of the station there is an air treatment unit comprising a 5µm filter with a pressure controller, pressure gauge and manual 3/2 stop valve.

The station comprises the following modules:

### - Vertical axis:

The vertical axis is formed by a parallel rod pneumatic cylinder to which a platform is attached with four vacuum pads to hold the part. This module has the following components and characteristics:

- Actuators:

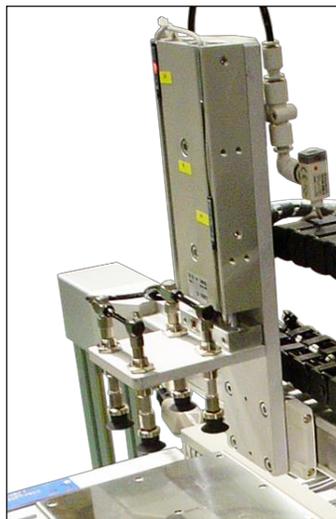
Double acting parallel-rod cylinder, Ø20 and 75mm stroke, with speed controllers and initial and end position switches. Controlled by a single 5/2 solenoid valve.

- Holding system: 4 Ø16 vacuum pads, with vacuum ejector. Controlled by a single 3/2 solenoid valve.

- Sensors:

- Auto switches, reed type.

- PNP output digital vacuum pressure switch.



### - Positioning axis:

The system to position the assembly at the different points on the desktop surface is formed by two linear axis: one of them electric and the other one pneumatic. This module has the following components and characteristics:

- Actuators:

- 1 linear servodriven actuator.

- 1 double effect parallel-rod cylinder: Ø20 and 75mm stroke, with speed controllers and initial and end position switches. Controlled by a double 5/2 solenoid valve.

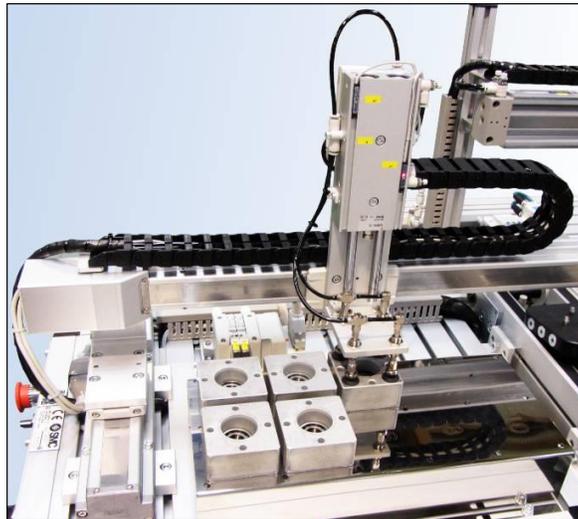
- Sensors:

- Auto switches, reed type.

### **-Warehouse and expedition:**

A horizontal warehouse with 8 positions is integrated in the station. Each position on the warehouse is numbered and identified.

The expedition of the assembly is done by means of two different ramps. One of them is dedicated for finished and verified products and, the other one, for those products which have not passed the quality inspection verification.



### **-HMI screen:**

A 7" capacitive tactile colour screen is integrated in order to control the Manufacturing Management Application. This screen has a resolution of 800x480, 600 cd/m<sup>2</sup> brightness, ARM CORTEX A8 processor, RAM 256 MB DDR3.

HMI programming software is included.



The screen includes a Manufacturing Management HMI Application with the following features and menus:

- Product configuration and tracking
- Production order management
- Warehouse
- Expedition
- Quality Inspection

**- Electrical control panel:**

All of the pneumatic cables and tubing are properly identified and labelled at both ends.



- Mounted on a 375x700mm mesh
- Accessible electrical connection terminal box with power input and coded I/O.
- It includes 110-240VAC/24VDC power supply unit.

- It includes 1 servodriver to control the motors built into the linear actuator.
- It includes programming software and cable for the servodriver.
- 1 control PLC wired and programmed to operate the module with 13 digital inputs and 12 digital outputs connected to the hardware.
- Industrial communication via standard Ethernet for communication with the other modules.

- **FAS-230 - LINEAR TRANSFER FOR 3 STATIONS – QUANTITY: 1.**

The pallet transport system is formed by an aluminium structure that connects the three process stations. It includes a 24VDC motor, mechanical stoppers and binary reading devices for the pallets. It also allows to configure different lay-outs and to extend the system in the future.

Additionally RFID reading /writing antennas and the artificial vision module is installed on the transfer.



The transfer module includes three different stop positions with the following components and characteristics:

- Actuators:

- 1 compact double acting cylinders, Ø32, 25mm stroke. Controlled by single 5/2 solenoid valves.
- Sensors:
  - 3 inductive detectors.
  - 1 microswitch.
- Distributed I/O Ethernet device.
- Size: 1800x315 mm. Height: 940 mm.

### -Artificial vision device:

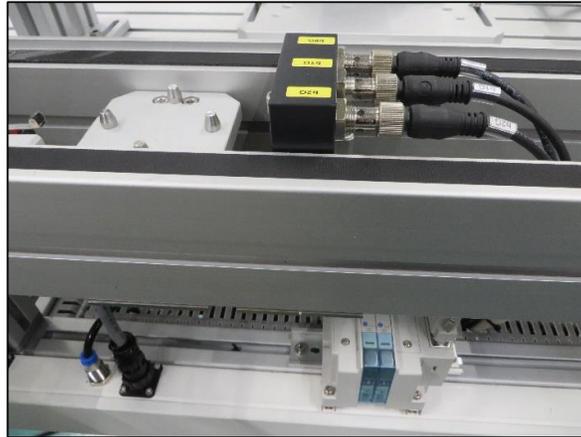
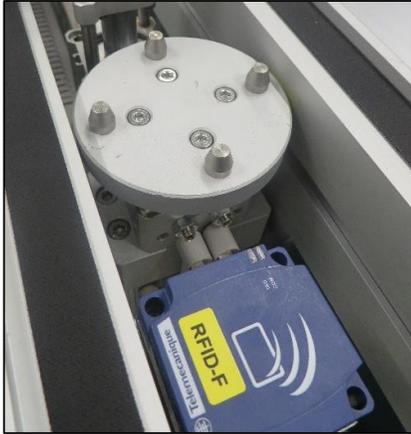
An artificial vision camera is included in the transfer in order to verify that the assembly has been done in a proper way. The camera is a Real Color type, 752 x 480 1/3" CMOS, PNP connection, IP67 protection with 7 input signals and 3 output signals. Programming software is included.



### -UID (Unique Identifier):

In order to identify the assembled product, two technologies have been integrated in FAS-200 4.0 VERSION:

- **RFID:** two antennas for reading/writing information on the RFID tags attached to the pallets.
- **Binary identification:** 3 inductive detectors are used to identify the pallet.



- **FAS-213-COLLABORATIVE ROBOTIC STATION (OPTIONAL):**

Station FAS-210 can be changed by station FAS-213 in which the assembly and lid rejection is carried out by a collaborative robot (cobot) Universal Robots UR-3 with the following features:

- Collaborative operation: 15 advanced safety features which are adjustable. Safety feature with TÜV NORD certification. Tested in accordance with standards: EN ISO 13849:2008 PLd
- Payload: 3 Kg.
- Range: 500 mm
- Imprint: 128 mm in diameter.
- Degrees of freedom: 6. Radius of action (x5) 360° and (x1) Infinite
- Offline programming and simulation software can be downloaded from the website free of charge.
- Pneumatic gripper and electrovalve included.
- Controller unit, a teaching box included.

The cobot station includes an electrical control panel where all of the pneumatic cables and tubing are properly identified and labelled at both ends.

- Mounted on a 375x700mm mesh
- Accessible electrical connection terminal box with power input and coded I/O.
- It includes 110-240VAC/24 VDC and 110-240VAC/5VDC power supply units.
- A PLC will manage the I/Os of the system and will be connected to the robot controller unit.

