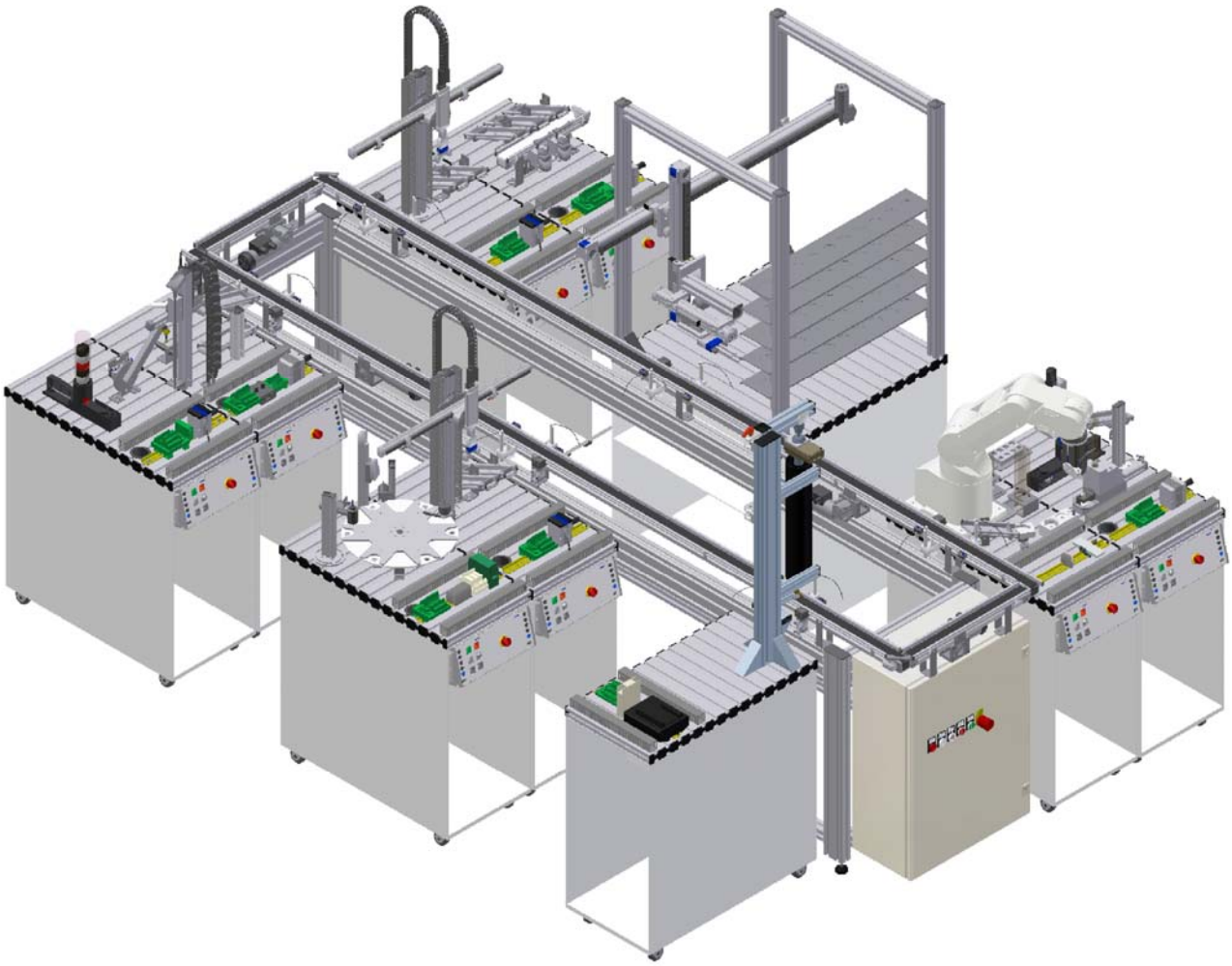
FESTO

MPS 500

Manual



This document consists of 4 parts, divided up into:

- Part A contains the manual of the system or station.
- Part B, in as far as present, contains a collection of exercises together with the relevant solutions or additional information.
- Part C contains the circuit diagram of the system or station.
- Part D contains the data sheets of the system or station.

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Author:	Schober / Espenberger
Graphics:	Schober / Espenberger
Layout:	Schober

Internet: www.festo.com/didactic

e-mail: did@festo.com

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1. Introduction

1.1. General information MPS500

This manual describes the handling of a MPS500 system. It contains explanations and descriptions of all the processes required for operation. Description of facts ensues partly by means of graphics or images, which are to serve an easier understanding.

The MPS500 system is a successively expandable system consisting of individual stations. However, the central unit is always the transport system. For this reason, this manual is not only a general manual, but also a station manual for the transport system. Each one of the other stations possesses its own manual.

Operation is not dependant on the operating position the material flow is being started from. Still, the sequential order of the stations require adherence, as it is pre-defined in the PLC-program.

The MPS500 system is designed in such a way, that the amount and kind of MPS-stations attached is of no importance. A complete processing cycle of the work-piece is always warranted. For this, the transport system is required under any circumstances.

In complete set-up, the work-piece is isolated from the distribution station to be transferred to the test station. The test station checks the condition of the work-pieces, ejects rejects in case of occurrence and transfers the faultless pieces to the transport station. Consequently, the product input into the system ensues from the distribution station. In case no distribution station exists in the system, the work-piece can be placed onto a work-piece carrier, anywhere in the system. It is to be noted that no work-piece carriers are to be retrieved from the system.
The processing station is equipped by means of a PIC-alfa station. The work-piece receives processing, followed by testing. The PIC-alfa station returns the work-piece to the transport station.
The work-piece is tested for shape tolerance in the vision station.
The robot station assembles a model cylinder from a basic body.
The AS/RS station is able to store work-pieces and, on demand, returns them to the system.
In the sorting/commissioning station the work-pieces can be re-retrieved from the system. The work-pieces are transported from the transport system station to the sorting station by means of a PIC-alfa station, where the work-pieces are arranged according to colour, ready for product output. From the commissioning station the work-pieces are not released by colour, but by the number of pieces. Each time 18 pieces are being commissioned. The three upper slides are on stand-by for the work-pieces, the fourth slide is for parts storage in the adjustment process.

Testing of the work-pieces for their condition, according to type, is required in the stations, as the work-piece carriers are distinguishable by their drillings on the underside, but they do not carry any work-piece information. Only this warrants correct processing.

1.2. Transport system station

The transport system station is responsible for the transport of the work-pieces within the system, which consists of various stations. A transport system comes into action for faultless long distance transferral of a work-piece between stations.

The transport system requires several components for the work-pieces to be positioned and transferred onto other stations from the transport system station. Some of them are: work-piece carriers, palettes and index units. A detailed description can be found in the respective chapters.

For identification, the work-piece carriers are equipped with an I/O-ident system. Each work-piece carrier is equipped with its individual number, as realised by a varied amount of drillings on its underside. Thus it is possible to provide them with a specification on their way. Up to max. 8 work-piece carriers can be run in one system.

Control of the transport system is realised by a Siemens PLC, for which a control cabinet is available, mounted onto the basic frame of the station. The station's internal data transmission ensues by an ASi-bus. Transmission to the other stations is realised by an exactly defined I/O-interface.

1.3. Short cuts

In this technical documentation the following abbreviations are being used:

- WT = work-piece carrier
- AP = operating position
- IX = index unit
- ST = stopper
- VS = virtual stopper!

2. General safety instructions

2.1. Use according to regulations

This installation has been developed and produced exclusively for training purposes in the fields of automation and communication. The training company, as well as the instructors are to ensure, that the trainees pay strict attention to the safety precautions, as described in the accompanying manuals.

Festo Didactic accepts no liability charges for possible damages to any trainee of the training company and/or further third parties, which might occur during use/operation of the installation, if it is not part of a true training situation; except Festo Didactic caused such damages deliberately or by negligence.

Due to the product liability law and various EC-directives, the following directions are required from and are to be strictly observed by the operator.

2.2. Handling the system

2.2.1. Dangers in handling the machine

The installation has been constructed technologically up to date and in conformance with the recognised rules of safety engineering. Nevertheless, during operation it is possible that harm might be caused to the user or third parties or that the installation or other property might get damaged. Therefore, the installation has to be handled according to specified operational use in perfect technical condition only.

Safety endangering malfunctions are not to be tolerated during training and have to be removed immediately.

2.2.2. Safety precautions in standard operation

Put the installation into operation only, once all of the protection settings are fully functional.

At least, before starting operation, check the installation for externally visible damages and for the reliability of the safety devices.

Do not reach into the installation while in operation.

Before circuit design, circuit disassembly and circuit modification: switch off compressed air and power supply.

General safety regulations are to be observed: DIN 58126 and VDE 0100.

2.2.3. **Dangers due to electric current**

As soon as maintenance is completed, check the function reliability of the safety devices.

Only trained experts in electric or electronic engineering are permitted to carry out work on the electric supply system.

The terminal boxes are to be kept closed at all times. Access must be permitted only under supervision of a member of the training staff.

Do not activate electric limit valves manually during fault search. Tools are to be used.

Only low voltage 24VDC is to be used.

2.2.4. **Dangers due to pneumatic energy**

Accidents might occur due to bouncing off tubes, caused by air pressure. Interrupt air pressure supply immediately.

Caution! When the air pressure supply is activated, cylinders may move in or out.

Do not uncouple any tubes under air pressure supply. Exception: Fault finding. In this case, keep on holding the end of the tube.

Do not exceed the permissible operating pressure. See data sheets.

2.2.5. Maintenance – Servicing – Malfunction removal

Carry out adjustments and inspections as instructed, in accordance with the specified intervals.

Secure the compressed air and electricity supplies to prevent unintentional start-up.

During all of the inspections, maintenance and repair work, the machine must be de-energised and de-pressurised and secured against accidental restart.

All screw connections released during maintenance, inspection or repair work must be checked to ensure correct re-tightening.

2.2.6. Organisational measures

All existing safety devices must be checked at regular intervals.

2.3. Personnel

2.3.1. Notes on personnel

Basically two situations have to be considered, concerning matters on personnel.

- Activities during training operations
- Activities outside training operations

2.3.2. Training operations

Trainees are permitted to work with the machine only under strict supervision of an experienced person or an instructor.

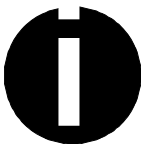
Activities of trouble-shooting and fault correction are to be checked by the instructor. Special care should be taken regarding safety aspects.

2.3.3. Outside training operations

Activities in the areas of maintenance, service and repair are to be carried out by persons with appropriate technical qualifications only.

2.3.4. **Safety symbols**

In this manual the following danger designations and signs are being used:

This symbol indicates an immediate threat to a persons health or life.	 DANGER !
Failure to pay attention to this symbol may result in serious health damage, which may even lead to life-threatening injuries.	
This symbol emphasises important information for correct machine handling.	 IMPORTANT
Failure to pay attention to this symbol may result in damages to the machine or to its surroundings.	
This symbol indicates operational tips and especially useful directions.	 INFORMATION
This symbol assists you to make optimal use of all of your machine's functions.	

3. Start-up

3.1. Transport

For the delivery of the stations, care is to be taken that the transport of the stations is to be executed by a suitable transport vehicle only. The weight amounts up to 500 kg, depending on the station.

The route of transport is to be cleared in advance, to be accessible to the transport vehicle. Installation of warning signs or barriers may be required.

The transport boxes are to be opened with care, as additional components, such as computers may be contained in the delivery, which are to be protected from falling out.

Once the transport box has been opened and the possibly contained additional components removed, the station can be taken out to be transported to its destination by means of two fork-lifts or one fork-lift truck.

Please check the stability of all of the profile connectors by means of an Allen key size 6. The connectors may have come loose during transport, due to inevitable vibration.

Pay special attention to all protruding components. Sensors and similar small parts are very easily damaged in case of improper transport.

The stations are not to be picked up by or even under the mounted feet – increased risk of becoming trapped or contused.

3.2. Set-up

3.2.1. General information

The installation is to be set up in a frost-free room with maximum relative air humidity of 70%.

In countries with an atmospheric humidity over 70% and temperatures above 25 degrees Celsius are the premises to provide an air-conditioning system for constant surroundings conditions.

To comply with the levels of the regulatory guidelines, sources of electrical interference such as welding plants, large motors and contactors are to be checked for electromagnetic compatibility in advance and screened where necessary.

To ensure faultless operation a load-bearing floor is required to avoid settling.

Allow sufficient distance between the installation and the wall of the room.

Any dust originating from construction work has to be kept off the installation (by covering).

The transport system station is the central element in this system. All of the other stations are in connection with this station. For this reason, it is necessary to examine the condition of the premises in detail before set-up.

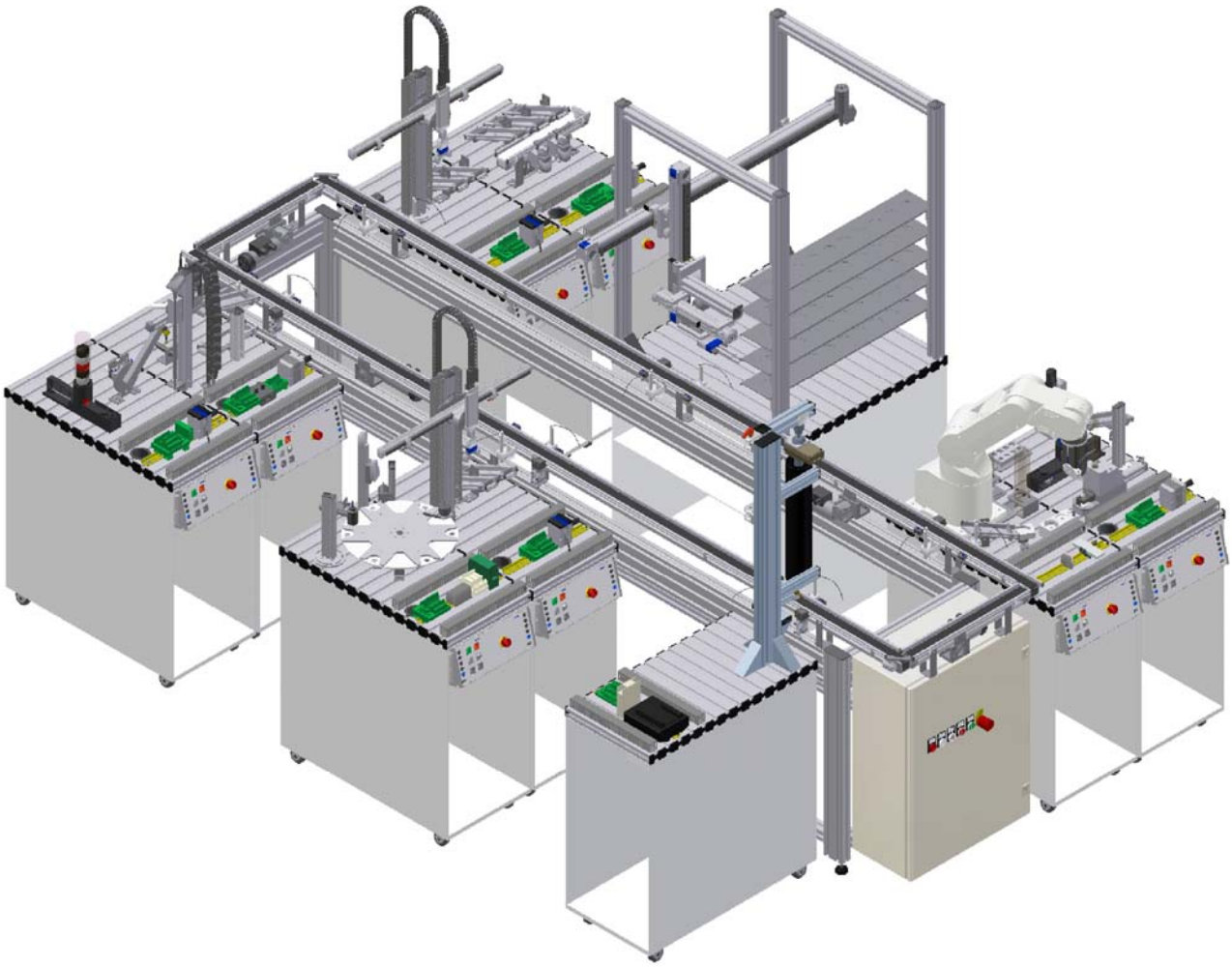
Once the set-up position has been decided upon, the system can be installed in this position. At first, the room has to be measured, if not done so previously. The measures of all of the stations have to be marked roughly onto the floor space (i.e. with adhesive tape), to avoid shifting at a later stage.

Now, the conveyor belt can be adjusted to an even level, by means of a spirit-level. The belt should be adjusted to the height of 896 mm, the height of the transport belt itself.

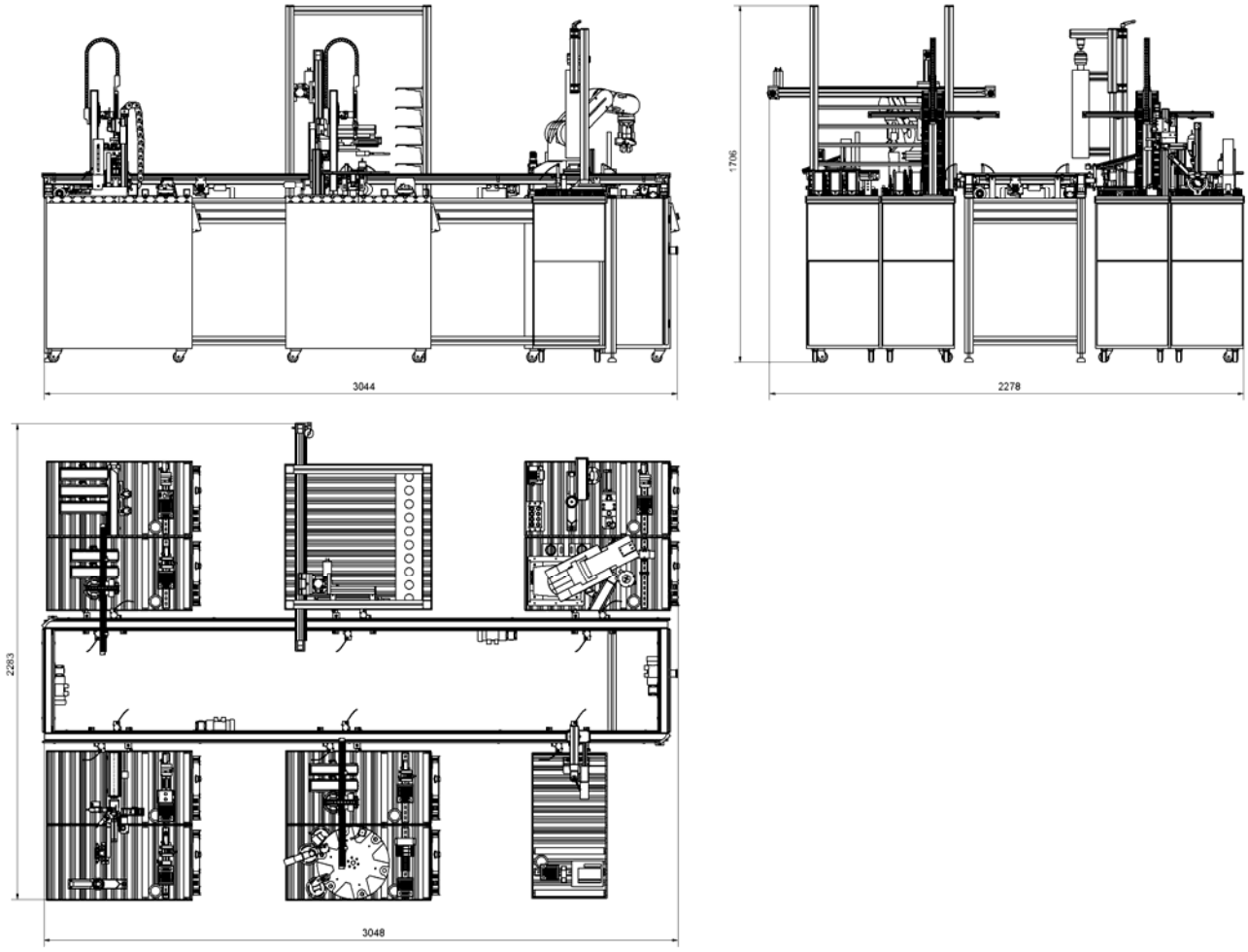
The transport system is to be screwed firmly to the ground by means of mounting brackets, as soon as the transport system has been adjusted.

All of the other stations are positioned at their set-up position, to be connected with the transport system station by means of assembly aids.

The following shows a complete set-up situation adapted to a more basic area design. The stations are to be adjusted as shown, to warrant faultless work-piece transfer.



Set-up situation MPS500 example



Dimensional drawing of set-up MPS500 example

3.3. Commissioning

Commissioning of the system can ensue only, once all of the stations are connected to their definite position.

The transport system station possesses several components, which require connection before start-up. This process is described in the following chapters. All the other station's descriptions can be found in the relative station manual.

3.3.1. Pneumatic commissioning

The mechanic set-up requires to be completed. In the beginning, the station is to be connected to the pneumatic system in the room. The maintenance unit for this is situated at one of the feet of the station's basic frame. The quick coupling plug has a nominal size of 5 mm. In case the existing system is equipped with 7.9 mm nominal size, it is possible to exchange the quick coupling plug of the maintenance unit with a larger one (adapter 1/8 on 1/4 required).
Once this has ensued, the station can be supplied with 6 bar and the pneumatic commissioning is concluded.

3.3.2. Electric commissioning

At this point, the system requires to be supplied with electric voltage
The control cabinet for controlling the station is supplied with 230V voltage. The cable contained in the delivery possesses a standard plug with protective covering, which is to be plugged into a sufficiently secured plug. Distribution boards are included in the delivery, for the connection of the other stations as well. In case an extension is required for the cable of the distribution board, it is to be executed by a trained expert only. For the operators, the socket is to be secured.

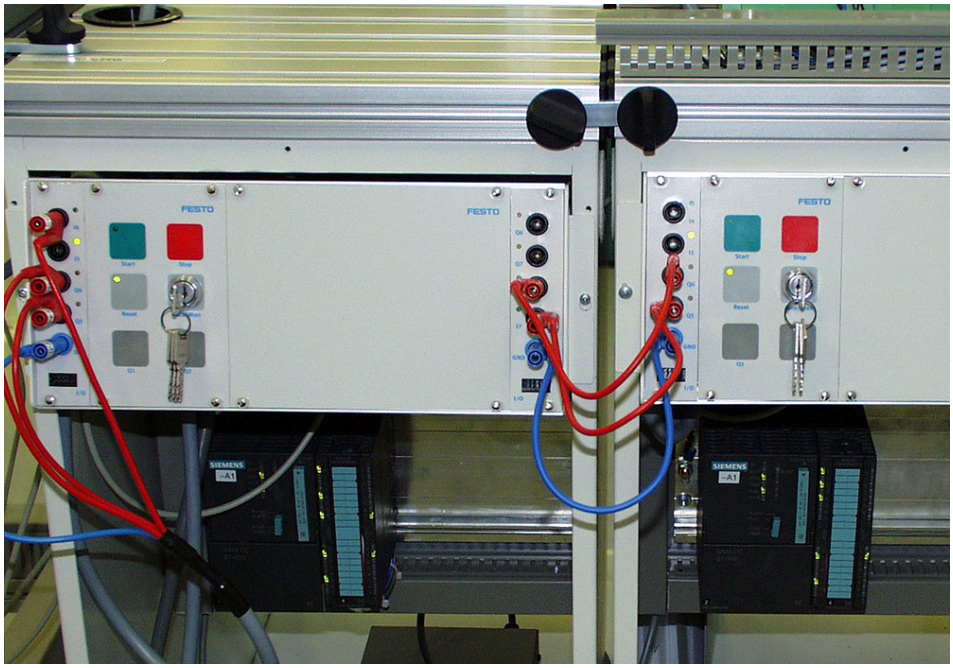
For avoidance of problems during the operational process, individual protection (16A) of the installation is recommended.

Attention has to be paid to the correct polarity of the power supply plug, as only one phase of the main switch is to be de-activated in the transport system station.

3.3.3. Establishing communication connections with I/O-coupling

The internal communication lines of the transport system station are hard-wired and do not require connection or plugging in.

The communication connections to the other stations are to be set up according to the following examples. The examples are kept on general terms, and as such are valid for all of the stations. Deviations from standard are especially referred to.



Example I/O-connectors example

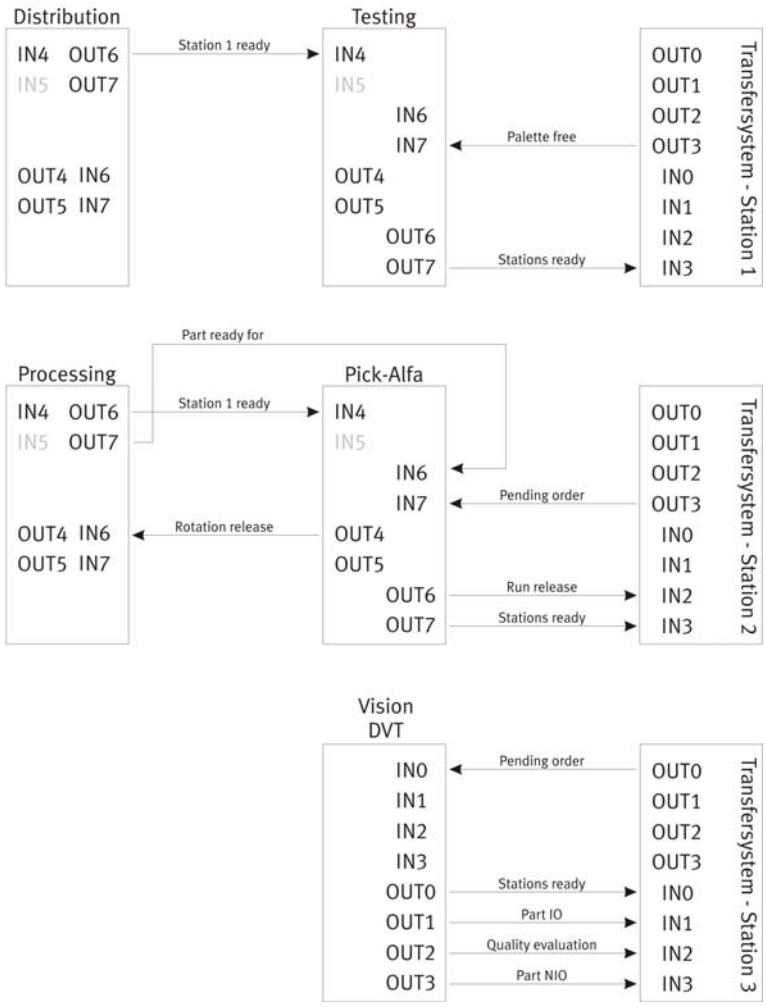
For the system to “know” that stations are present and processing can occur in the stations, they are to be connected to the system by means of I/O-connectors. Each time, the connectors are established by means of the control panel – not in case of the robot and the vision station, as these are directly connected to the respective control devices (see the following drawings).

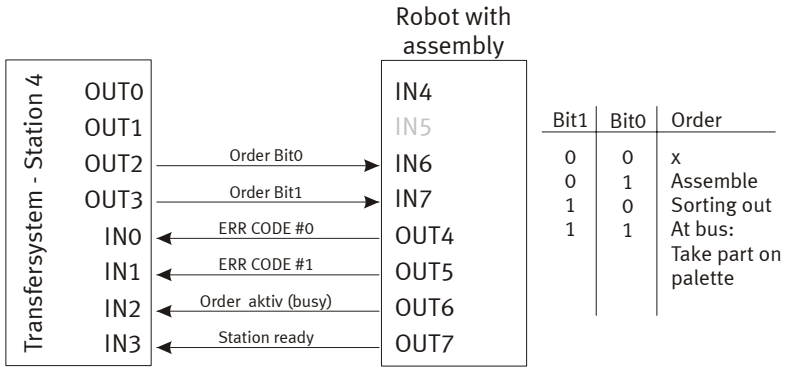
For more detailed information, the connection possibilities are listed below:

1. Connection by lab lines 4mm plug on both sides between MPS–stations
2. Connection by I/O – one side cable 4 mm plug / one side SYS-link plug between transport system and MPS–stations
3. Connection by I/O – one side 37 pin Sub D-plug / one side SYS–link plug between transport system and vision station
4. Connection by I/O – one side Phönix-plug / one side SYS–link plug between AS/RS station and transport system
5. Connection by I/O – one side SYS–link plug / one side SYS–link plug between robot station (RIA-BOX) and transport system

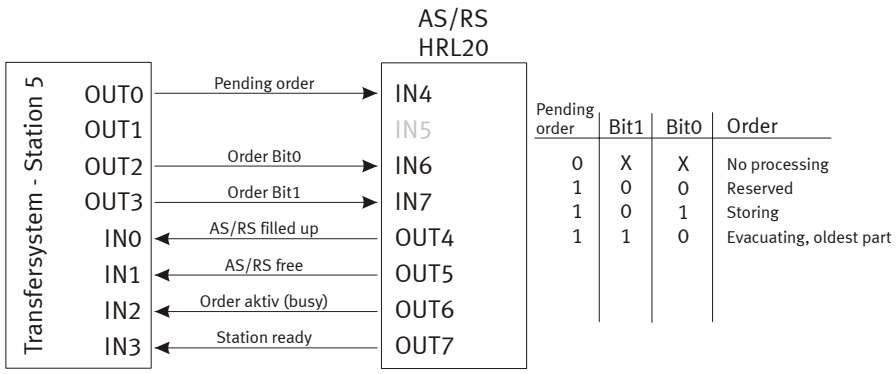
The connections are shown as graphics on the following pages.

FMS50 Summary of the I/O-Communication for MPS Rel.C

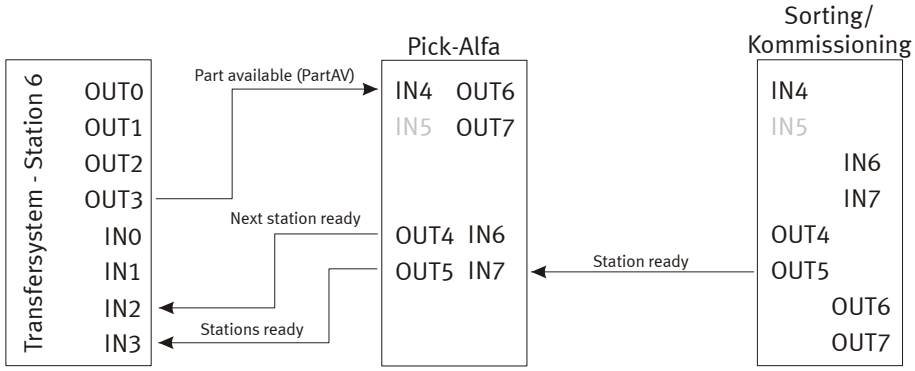


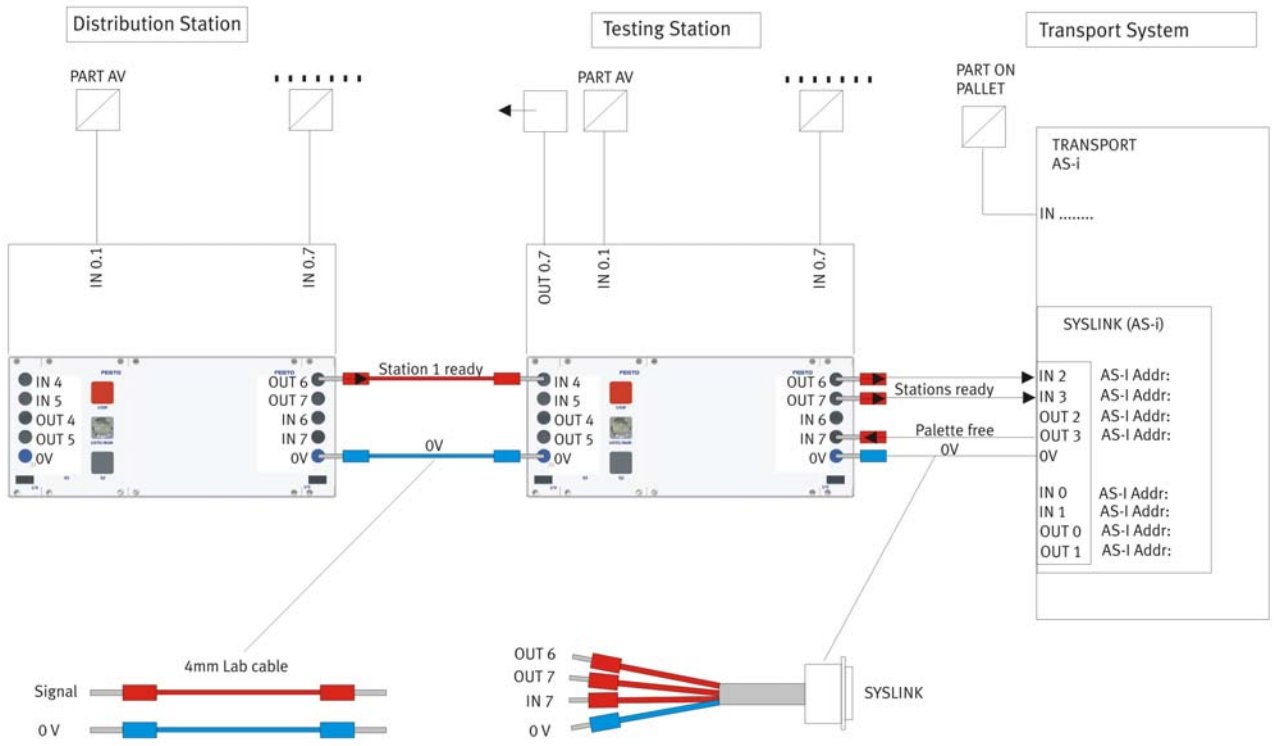


Bit1	Bit0	Order
0	0	x
0	1	Assemble
1	0	Sorting out
1	1	At bus: Take part on palette

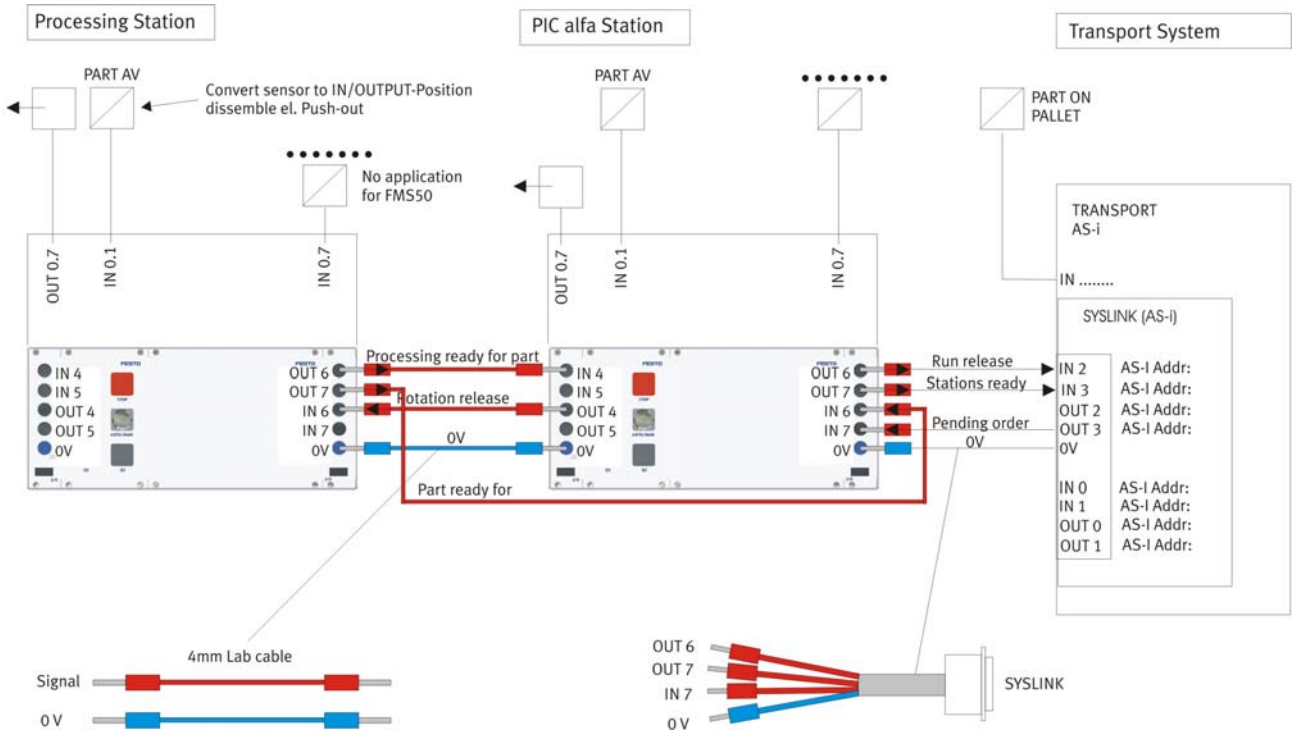


Pending order	Bit1	Bit0	Order
0	X	X	No processing
1	0	0	Reserved
1	0	1	Storing
1	1	0	Evacuating, oldest part

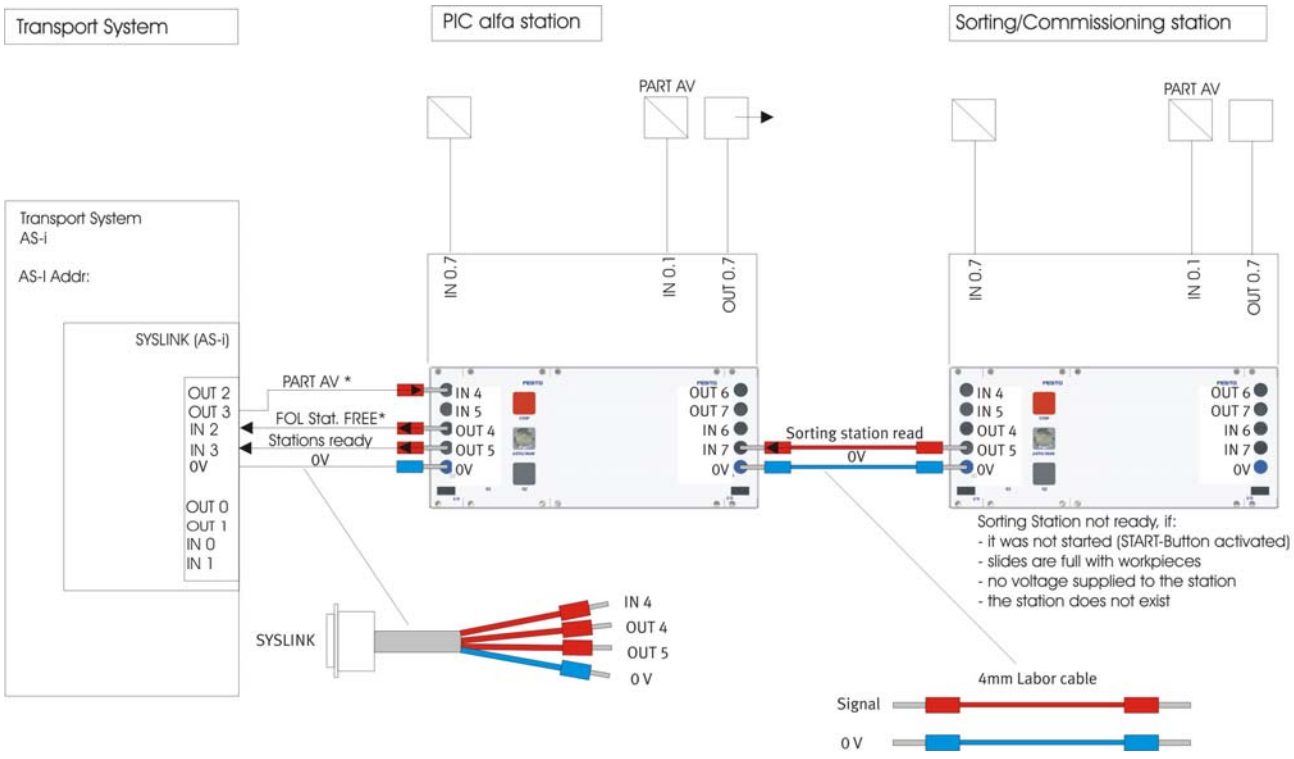




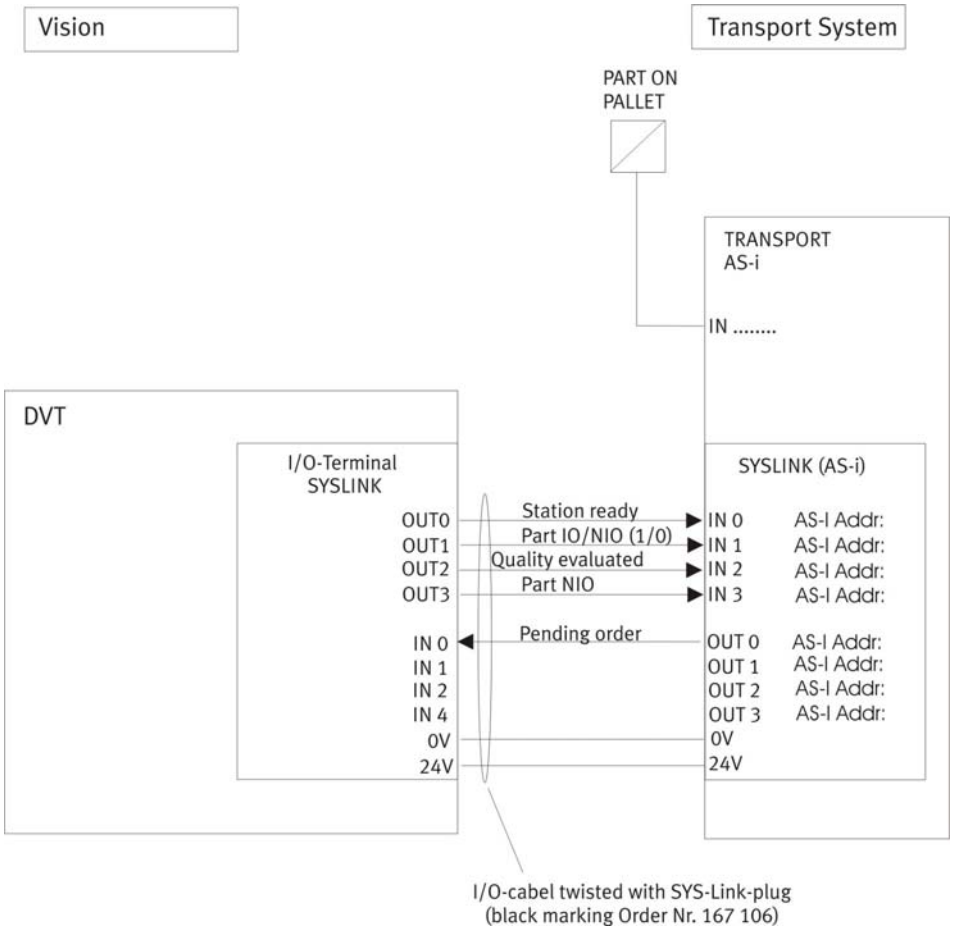
Connection Distribution station – Test – Transport system



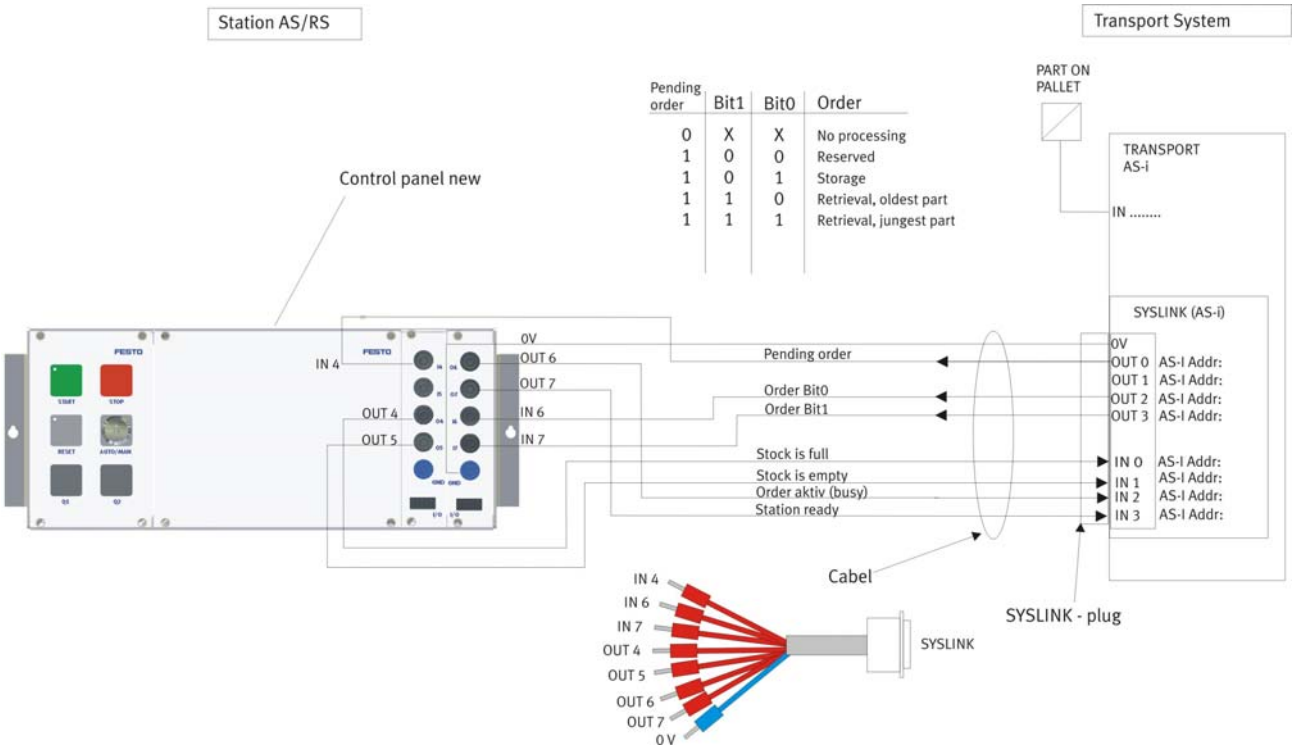
Connection Processing station - PIC-alfa – Transport system



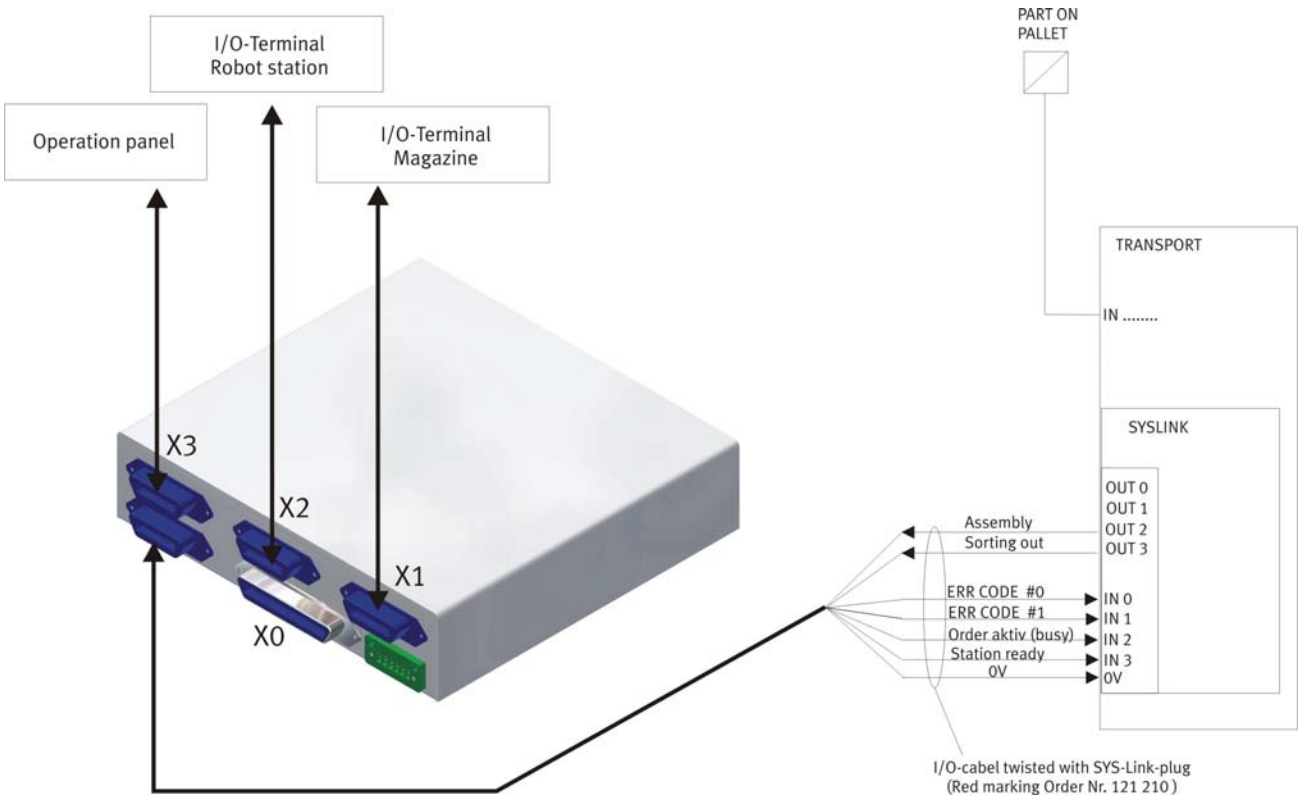
Connection Sorting station - PIC-alfa – Transport system



Connection Vision station –Transport system



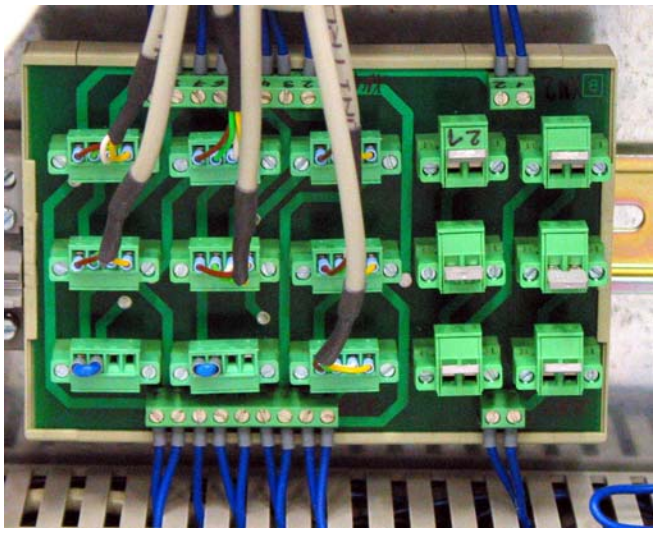
Connection AS/RS station - Transport system



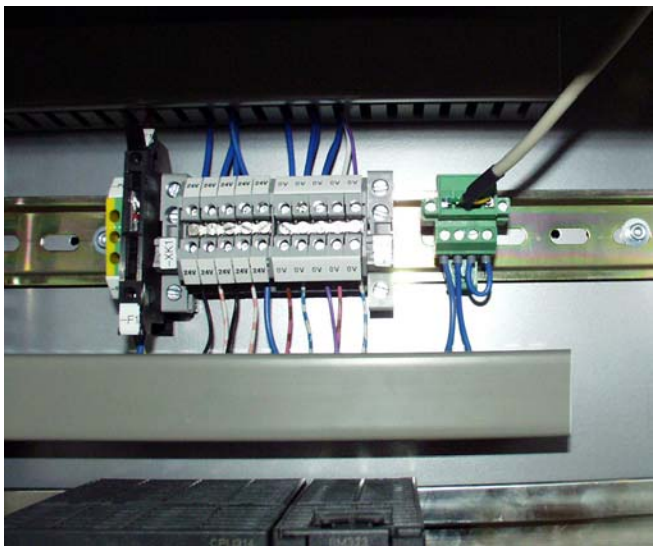
Connection Robot station - Transport system

3.3.4. EMERGENCY-STOP system

The emergency-stop system is to be de-activated for transport. The connector possibilities are listed below and are to be re-activated during start-up. The complete emergency-stop system is described in the chapter “EMERGENCY-STOP”.



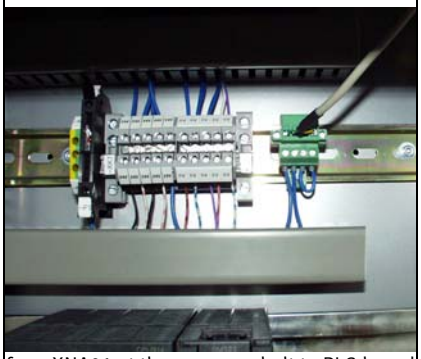
EMERGENCY-STOP connectors in control cabinet / conveyor belt



Example EMERGENCY-STOP connector on MPS- board

All of the EMERGENCY-STOP connectors required can be established according to this example.

Plugs with links are to be inserted into the unoccupied operating positions, as shown in the picture above.

Plug	Type	Device	Example
XNA11	2-pin Phönix 2 Contacts for EMERGENCY-STOP switch	External EMERGENCY-STOP switch	 from XNA11 to external EMERGENGY-STOP
XNA01	4-pin Phönix 2 Contacts for EMERGENCY-STOP, 2 Contacts for feedback	e.g. Test station	 from XNA01 at the conveyor belt to PLC-board

See also chapter EMERGENCY-STOP.

3.4. Start-up process

For the MPS500-installation the first start-up has been executed in the factory already.

For the installation to be ready for operation execute the following directions:

1. Mains supply 230 V AC for power supply unit, connect control cabinet of transport system and commissioning station.
2. Power supply unit 24V DC with connections +24V/0V/earth are connected correctly to the stations and activated (except for robot: only after adjustment of the transport system).
3. Each station is supplied with ca. 6 bar compressed air.
4. I/O-communication connectors (laboratory plugs) are connected according to communication plan.
5. All of the PLC-programs are loaded into the respective controls. The controls are switched to RUN and the red error indicators of the controls are not on.
6. All of the EMERGENCY-STOP signal generators (push-buttons, door contact, light barriers, a.s.o.) are not to be switched on, i.e. activated.
7. Activate the main switch of the transport system station.
8. Acknowledge the EMERGENCY-STOP of the control cabinet of the transport system.
9. Remove all of the work-pieces from the installation, i.e. stations:
   - Remove work-pieces from the palettes on the transport system
   - Clear the storage shelves of the AS/RS station (HRL20)
   - Clear the slides of the sorting/commissioning station
10. The magazines of all of the stations are to be stocked up:
    - Magazines (piston, spring and cover) of the robot station with assembly
    - Fill magazine of the distribution station with basic bodies
11. Now adjust the stations and the transport system (see chapter – Operation).

4. Operation

The chapter Operation describes the control units required for the operation, as well as start-up and close-down of the system.

4.1. General notes on operation

The stations demand strict adherence to certain rules of operation. Negligence in observing these rules may cause errors in the stations' processes. Also, damage to bodily health may not be excluded.

Strict observance of the following rules is demanded.

4.1.1. Handling regulations

- Manual interference during the stations' operation is prohibited.
- In case of larger audiences, a mechanical barrier of the station is required.
- It is prohibited to pull off any cables while under voltage supply.
- Any kind of liquid is to be kept from the installation, at all times.

4.1.2. Operating regulations

- The stations are to be operated from trained personnel only.
- Operation is to ensue according to operating instructions.
- Uncontrolled random pressing of the various switches/push-buttons of the control units is to be omitted.
- No work-piece carriers are to be removed from the system.

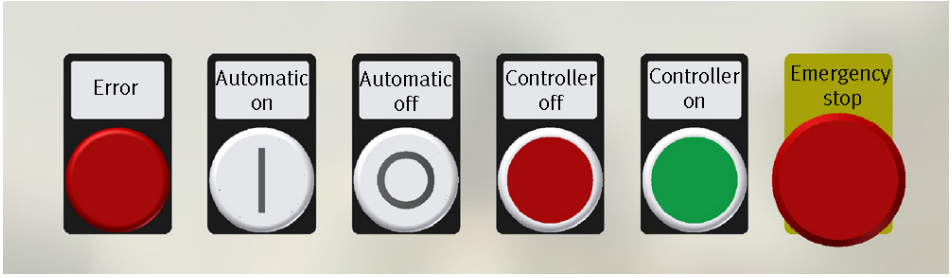
Operation of the system ensues by means of several control units, as described below.

4.2. Transport system station

The control elements of the control cabinet of the transport system station are required for the start-up of the transport system and, as such, the complete system.

Main switch Transport system station

The main switch is located on the side of the control cabinet of the transport system station, supplying the control cabinet of the transport system station with voltage. The conveyor belts and the system can only be started, once the control cabinet receives voltage supply.



Control elements Transport system station

Name	Element	Function	
Error	H8	Flashes	Indicator Acknowledge error
Automatic on	H5	Flashes	Indicator Start-up request
		Light on	Indicator Installation in operation
	S5	Start up installation	
Automatic off	H6	Light on	Indicator Controller off
	S6	Switch off motors of the conveyor belts	
Controller off	H1	Light on	Indicator Controller off
	S1	Transport system is being completely de-activated (cp. EMERGENCY-STOP).	
Controller on	H3	Light on	Indicator Request Acknowledge EMERGENCY-STOP
	S3	Acknowledge EMERGENCY-STOP	
EMERGENCY-STOP	S2	De-activate control / EMERGENCY-STOP function	

The table assists in operating the transport system station. All of the push-buttons and lamps are described within.

Error indication/analysis is described in the chapter “Fault finding”.

4.3. Adjustment

4.3.1. Requirements

The MPS-stations of distribution, testing, processing, PIC-alfa and sorting can be started with the adjustment process, as following.

At first, adjustment of the distribution station is absolutely required, if the swivel arm of the distribution station is located above the following test station!

The adjustment process (is also to be executed after STOP- or EMERGENCY-STOP activation) is independent from the switch position of the key actuator AUTO/MANU.

4.3.2. Adjustment process of MPS-stations

1. RESET- Lamp is lit up → Request for adjustment.
2. RESET- Activate push-button.
3. Station moves to basic position.
4. The START-lamp indicates arrival in basic position.
5. AUTO/MAN - turn key actuator to 'AUTO' position (continuous cycle).
6. Activate START push-button → Station is in operation (no indication)

4.3.3. Adjustment process commissioning and AS/RS station

Due to station-specific reasons, the commissioning and AS/RS stations require a different adjustment process from that of the MPS-stations:

1. The EMERGENCY-STOP system is activated (no signal generator is active; EMERGENCY-STOP – switch unit acknowledged).
2. AUTO/ MAN - Turn key actuator to 'MAN'! (—). Adjustment process can commence only, once switch is in this position.
3. RESET- Lamp flashes → Request for adjustment.
4. RESET- Activate push-button → Station moves to basic position:
   - AS/RS station: at first the axles move to their reference points and afterwards return to their basic positions.
   - Commissioning: the belt is to be activated and afterwards checked for remaining work-pieces.
5. The RESET-lamp indicates arrival in basic position.
6. The START-lamp flashes, as a request for starting up operation of the station.
7. AUTO/MAN - Turn key actuator to 'AUTO' position.(|).
8. Activate START push-button → Station is in operation → START-lamp flashes.

4.4. Automatic

4.4.1. Conditions and automatic start-up

1. MPS-stations are ready for automatic mode after the adjustment process.
2. Unlock EMERGENCY-STOP of the transport system station and acknowledge.
3. 'AUTOMATIC ON' - Lamp flashes fast → Request for start-up of the transport system.
4. 'AUTOMATIC ON' - Activate push-button → Transfer system starts up.
5. Operational condition is indicated by the 'AUTOMATIC ON'-lamp.
6. Only at this point activate the robot controller. The procedure of commissioning of the robot assembly is described separately.

4.5. Error and error acknowledgement

In case an error occurs in the transfer system, it is shown by a slowly flashing 'AUTOMATIC ON'-lamp. As soon as the error has been eliminated, it can be acknowledged with the 'AUTOMATIC ON'-push-button.

Possible errors: e.g. a palette with work-piece arrives at the stopping station for distribution/testing.

All further errors are described in the chapter “Fault finding”.

4.5.1. Error indication of the MPS-stations

Station	Indicator light H1	Indicator light H2
Distribution	Magazine empty	
Testing	Work-piece red / silver	Work-piece black / silver
PIC-alfa (Processing)	Wait until processing of work-piece is concluded	
Processing	Processing in operation	
Sorting	Slide(s) full	

As a rule, the production process commences with the distribution station, where a cylinder basic body is isolated and transferred to the system by means of the test station. In case no distribution station is included in the system, it is possible to place the cylinder onto a work-piece carrier at any place of the transport system. Processing of the work-piece ensues from the “place of equipment” onwards.

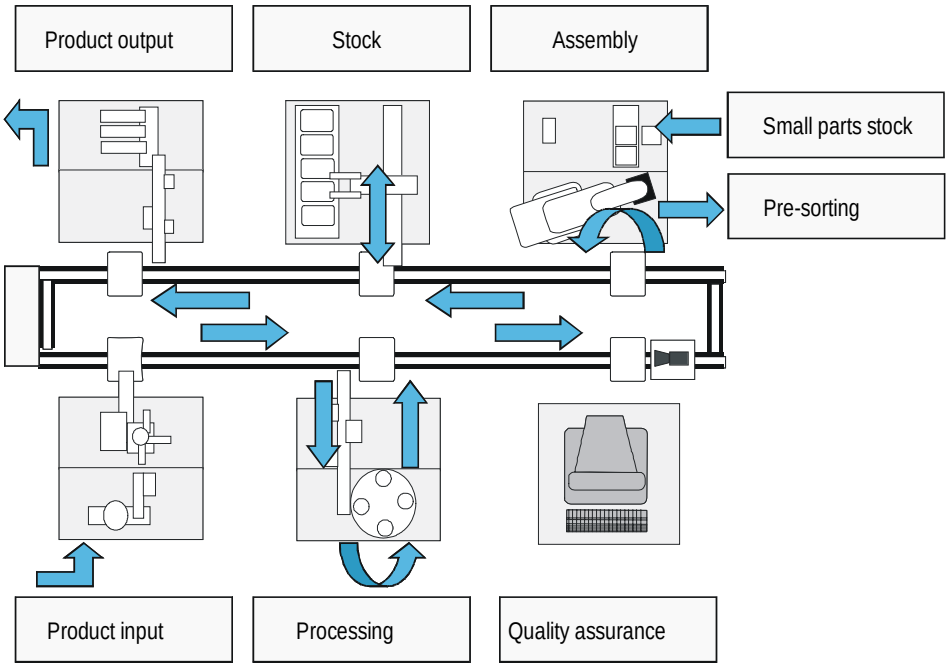
4.6. Process description

The following process description is limited to the transport system station. The processes of the other stations are described in the respective manuals.

1. A WT moves onto the stopper ST 1, which is extended in basic position.
2. The pallet code is read out.
3. The sensor WT at stopper ST 1 is activated.
4. After processing a signal is returned to the stopper.
5. Stopper ST 1 opens up and the WT is released, if the following congestion stretch is released. The congestion stretch is controlled by a congestion sensor and the signal is changing from 1 to 0 (negative edge) if the congestion stretch is released.
6. After crossing the sensor WT at stopper ST1 the stopper ST1 closes up again.
7. The next WT moves onto stopper ST1.

4.7. Material flow

The MPS500 installation reacts flexible to the changes during the production process and controls the material flow according to circumstances. For this, various starting conditions are described.



Layout of material flow of the MPS500 System

The following icons are used for the representation of the material flow.

Legend

Station ready

Station not ready

Station active

4.7.1. Condition 1 – material flow from product input to product output

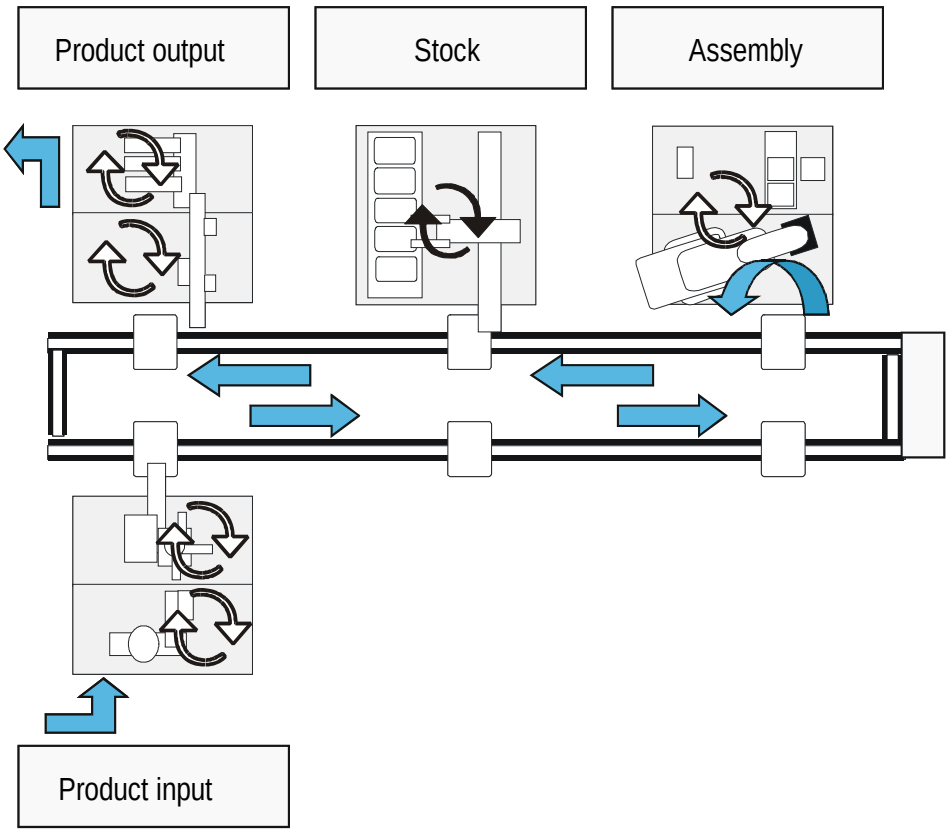
The installation has been put to operation, according to instructions.

The product input – the distribution station can isolate work-pieces (magazines are filled) and the work-piece transfer of the test station functions faultless, ready to commence operational processing.

The robot assembly station is ready for the assembly of cylinders.

The AS/RS station is ready for operation and parts-storage (stock is empty).

The product output is ready, i.e. the PIC-alfa and sorting stations are ready for operation and parts can be accepted.



Condition 1 for material flow

4.7.2. Condition 2 – material flow from product input to stock

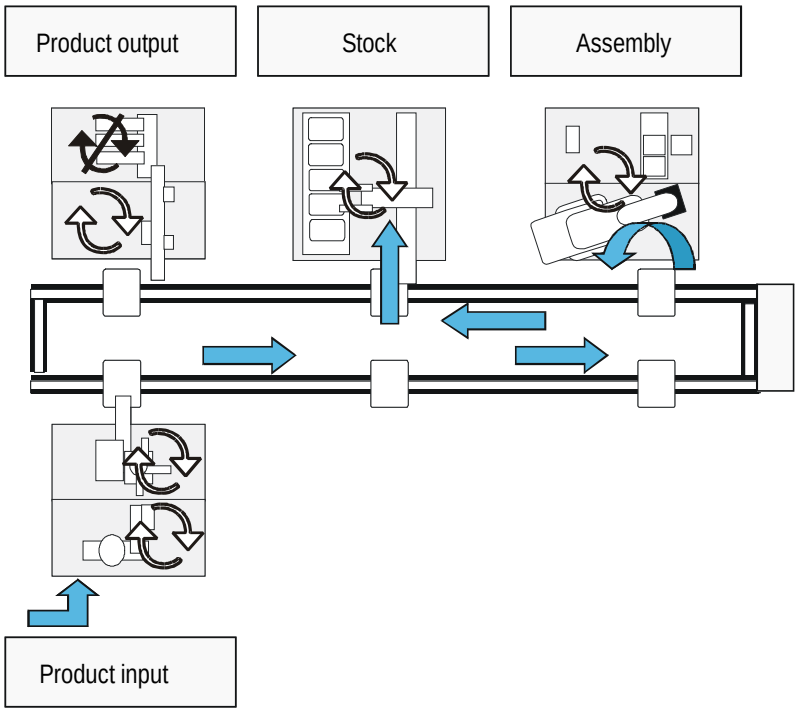
The installation has been put to operation, according to instructions.

The product input – the distribution station can isolate work-pieces (magazines are filled and the work-piece transfer of the test station functions faultless, ready to commence operational processing.

The robot assembly station is ready for the assembly of cylinders.

The AS/RS station is ready for operation and parts-storage (stock is empty).

The product output is not ready:
i.e. the PIC-alfa station is ready for operation, but the sorting station is not ready yet. The possibility is now, that the sorting station has not been activated or adjusted/started or already executed a sorting process (all 3 slides are occupied).



Condition 2 for material flow

In case parts are still remaining between stock and product output, they are placed onto a buffer slide by PIC-alfa.

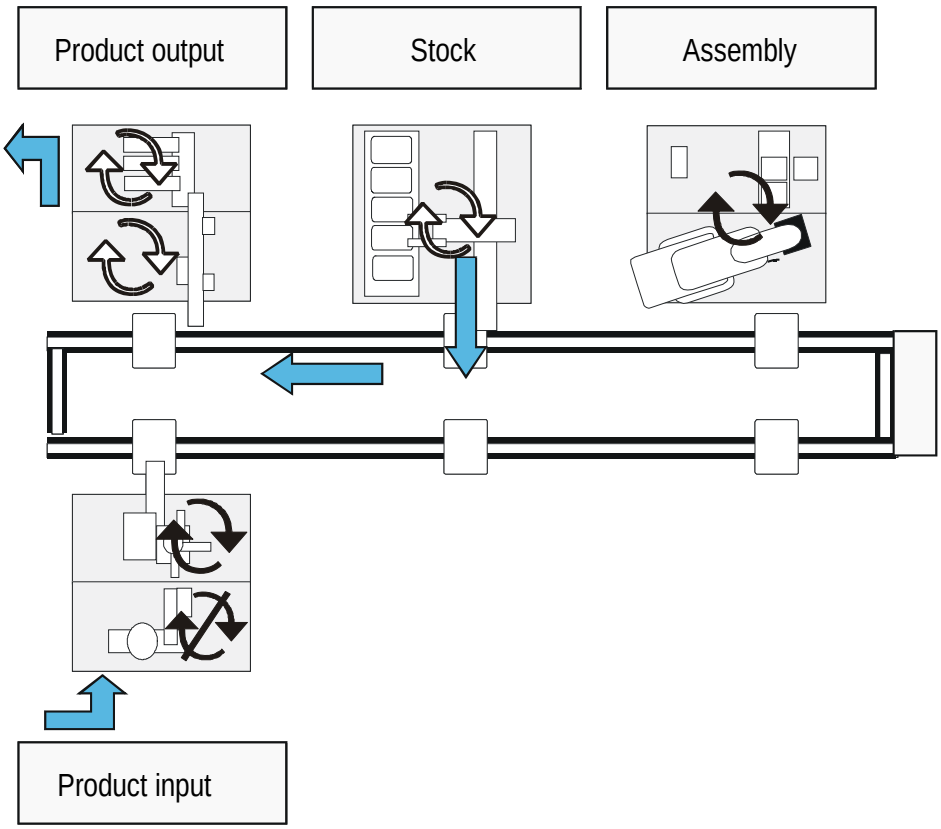
4.7.3. Condition 3 – material flow from stock to product output

The installation is in operation. The magazine of the distribution station is empty, and not ready as such. For this reason it is impossible for the test station to place any work-pieces onto the palettes. The empty palettes are allowed to pass the operating position.

The robot assembly station cannot be supplied with basic bodies, therefore production of cylinders cannot ensue.

The AS/RS station is ready for operation and parts can be stored or retrieved, as the stock contains parts and is not full up. Parts arriving on palettes are allowed to pass through to the product output. Empty palettes are equipped with parts from the stock (retrieval).

The product output is ready, e.g. the PIC-alfa and sorting stations are ready for operation and able to sort parts.



Condition 3 for material flow

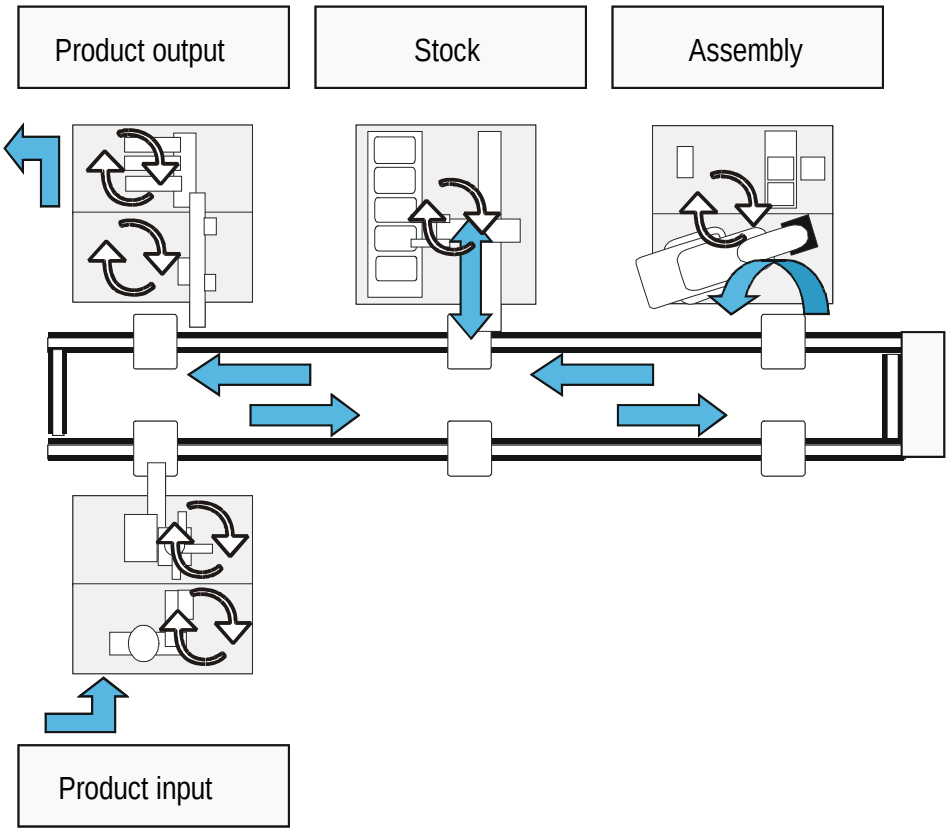
4.7.4. Condition 4 – material flow mixed operation

The installation is in operation. The distribution station can isolate work-pieces (magazine stocked up) and the test station transfers work-pieces onto palettes.

The robot assembly station assembles cylinders.

The product output is ready, e.g. the PIC-alfa and sorting stations are ready for operation, cylinder sorting.

The AS/RS station is ready for operation and is able to store or retrieve parts, as the stock contains parts and is not full up. Parts arriving on palettes are allowed to pass through to the product output. Empty palettes are equipped with parts from the stock (retrieval).



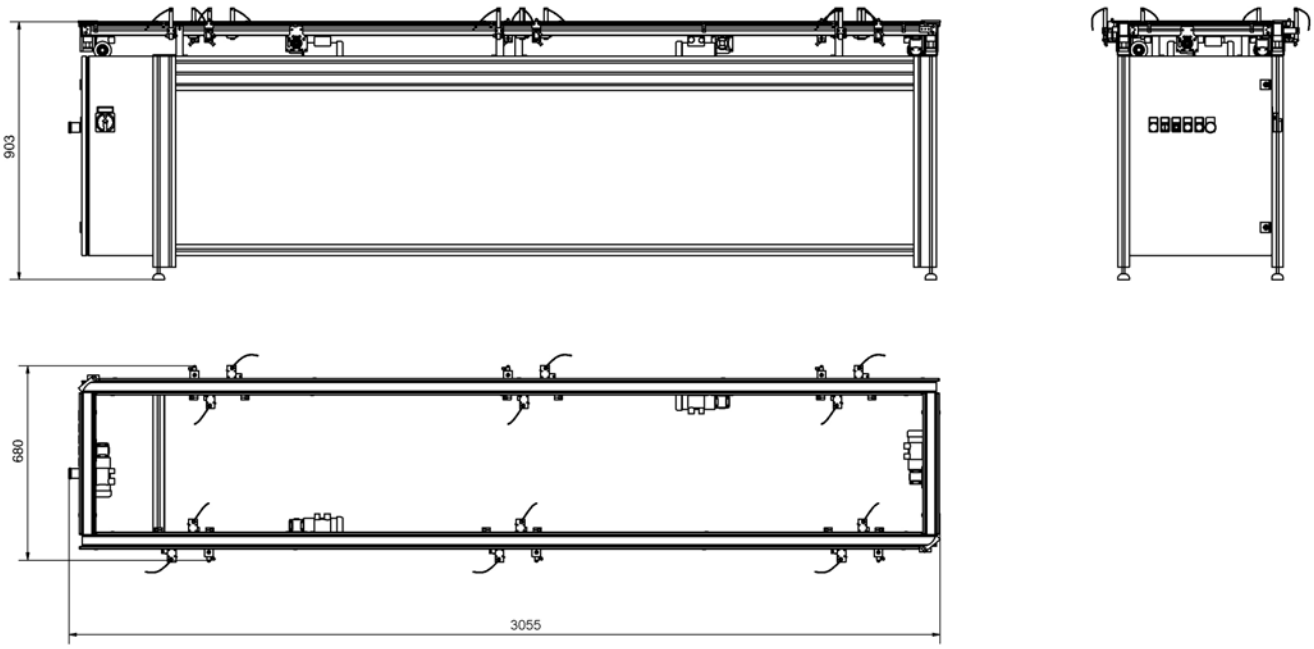
Condition 4 for material flow

5. Technology

This chapter refers to the technical connections of the transport system station.

The technical drawings and technical data below are very helpful to facilitate the set-up of the station. The technical data of the premises is to be checked before set-up of the station.

The load capacity of the ground, the sizes of the doors and access are to suit the system's dimensions.



Technical drawing Transport system station

Pos.	Designation	Measurements
1	Width	500 mm
2	Max. width with stoppers	720 mm
3	Length	3000 mm
4	Max. length with stoppers	3050 mm
5	Belt height	895 mm
6	Min. belt height	905 mm
7	Max. belt height	885 mm
8	Belt width	40 mm
9	Belt speed	9 m/min.
10	Voltage of motor	230 V
11	Torque	8,7 N/cm
12	Current consumption	24 W
13	Start-up current	0,11 A
14	Speed	2600 1/min
15	Speed outlet gear	74,29 1/min
16	Transmission ratio gear	35:1
17	Weight	Ca. 400 kg
18	Max. amount of work-piece carriers	8

The transport system station contains 6 operating positions. Any of the MPS-stations can be placed in any of the 6 operating positions. The following description relates to the standard system.

5.1. Operating position 1

The distribution and test MPS-stations are situated in operating position 1. The work-pieces are isolated in the distribution station and transferred to the test station. The distribution station is not connected directly to the transport system. It is located beside the test station. The test station is connected to the transport system, and additionally to work-piece testing it executes the work-piece transfer to the transport system.

The material flow is started from this operating position.

5.2. Operating position 2

The PIC-alfa station is located in operating position 2. It takes care of the material transport to the processing station, which is situated directly beside the PIC-alfa station executes the drilling of a hole and testing afterwards.

5.3. Operating position 3

A vision system is mounted to operating position 3. The camera is mounted directly onto the transport system and is located above the operating position, which renders turning the work-piece superfluous. The evaluation system of the camera is situated on a MPS-carriage or operating table.

5.4. Operating position 4

The robot assembly station is located at operating position 4, consisting of 2 MPS-carriers, whereby the robot RV-2AJ is mounted onto the carrier, which itself is directly situated beside the transport system. The robot executes the handling of the work-pieces and assembly components. At this point, a model cylinder is assembled by the robot.

5.5. Operating position 5

At operating position 5, the AS/RS station is available for material storage, where the work-pieces can be stored and retrieved.

5.6. Operating position 6

The Sorting or commissioning station is situated in operating position 6. By means of a PIC-alfa station, which is directly connected to the transport system, it receives its work-pieces to sort them according to cylinder colouring.

At this operating position the material flow is concluded.

6. Pneumatics

The work-piece carriers are stopped of a pneumatic cylinders. The valve required for the control consist of one CPE10 single valve.

6.1. The valve

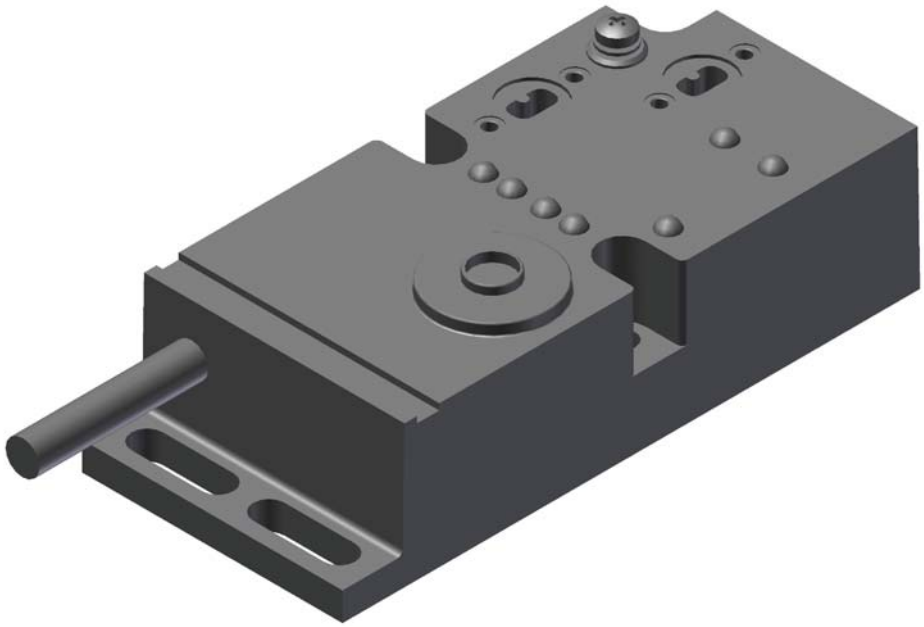
Example Valve CPE10

This valve terminal is especially configured for the transport system.

Pos.	Designation	
1	Order number	161 868
2	Order designation	CPE10-M1H-5L-Mt
3	Order number cable	MZB9-2E..AZ

The valve is controlled via ASI, to connected the valve with the ASI-bus the valve interface is necessary.

6.2. The valve interface



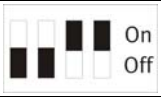
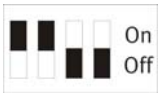
Example valve interface ASI-EVA

The valve is wired with the valve interface. Optional it is possible to connect to inputs to the interface.

Pos.	Designation	
1	Order number	196 087
2	Order designation	ASI-EVA-K1-2E1A-Z
3	Outputs	1
4	Inputs	2

LED display		
ASI-LED (green)	**Fault-LED (red)**	**Description**
On	Off	Asi-Interface voltage applied, no fault
Off	Off	No Asi-Interface voltage on bus
Flashing	On	Asi-Interface address not set (equals zero)
On	Flashing	Short circuit / overload at inputs
Off	Flashing	Short circuit / overload at outputs
flashing	On	Failure of bus communication (Watchdog expired)
AUX PWR-LED (green)		**Description**
On		Load voltage applied
Off		Load voltage applied
Status-LED (green/yellow)		**Description**
on		1- Signal at In/Output
off		0- Signal at In/Output

6.2.1. Configuration the additional power supply (load voltage)

Setting	**DIP switch setting ***	
With load voltage ** (factory setting)		1,2: off 3,4: on
With load voltage *** (seal the “24V DC” connection with blanking plug type ASI-SD-FK-BL))		1,2: on 3,4: off
* Black = pressed ** The outputs/valves are provided with power via the additional supply *** The outputs/valves are provided with power via the Asi-Interface bus		

6.3. Pneumatic connection

The pressure in the supply line must not exceed 10 bar.

A fine filter has to be installed, to prevent contamination by rust or similar contamination.

A stop cock is required for the supply of the system.

The pressure regulators installed in the system should be set in between 6 and 5 bar. The filter and water separators require maintenance according to the instructions of this documentation.

Maintenance unit

7. Electrical system

To this chapter belongs the connection of all of the supply cables and communication cables required for the operation of the system.

To present you with a better overview of the contact lines used in the installation, they are explained as following.

7.1. Supply voltage

The transport system is delivered with the appropriate power supply plug covered by protective contact, which is to be plugged into a socket, fixed according to standard. The voltage amounts to 230 V.

The customer is required to ensure, that the supply net is duly earthed and does not possess fault current monitoring.

In case several devices of the installation are to be activated simultaneously, they can be connected to a distribution board with switch, within the scope of the permissible total output.

The power supply (24VDC) of the transport system station outside the control cabinet ensues by means of a 2-pin cable. The voltage supply is the 24V power supply unit in the station. The 24V can be tapped by the clamps.

Voltage supply Transport system

7.2. Control cabinet

The control cabinet is set up as shown in the picture below. The individual components are designated.

Example control cabinet Transport system

The frequency converter generates the voltage required for the motors.

The ASi-power supply unit supplies not only the ASi-voltage of 30,5 V, but also the supply voltage of 24V for the control cabinet and the transport system.

The other components are described in detail in the respective chapters.

7.3. EMERGENCY-STOP system

The EMERGENCY-STOP system is controlled centrally by the transport system station. In the control cabinet of the station an EMERGENCY-STOP switch device is located, which is connected to all of the operating positions and all external EMERGENCY-STOP devices.

7.3.1. External EMERGENCY-STOP device

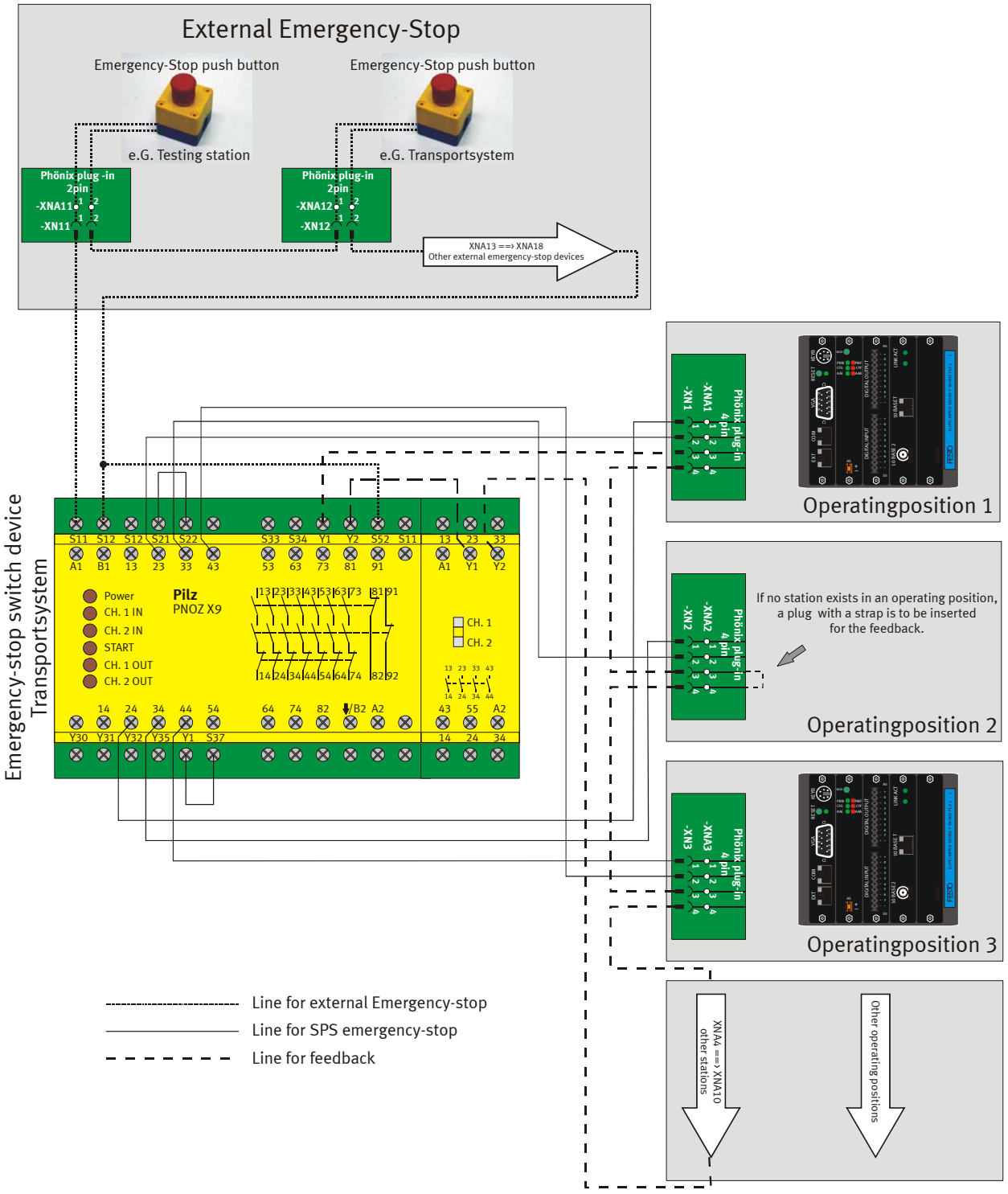
Example: external EMERGENCY-STOP Transport system station

The external EMERGENCY-STOP devices are controlled by a 2-pin cable. The devices are connected to the 2-pin Phönix plug-in contact. In case no device is plugged in, the contact is to be established with a strapped plug.

7.3.2. EMERGENCY-STOP at the PLC-board

The PLC-boards are connected to the 4-pin plug-in contacts. In this case 2 lines are for the feedback (station available) and 2 lines for the EMERGENCY-STOP of the PLC-board.

An exception is made by the commissioning station, as it requires to be controlled by 2 4-pin cables. A 4-pin cable leads to the PLC-board, as it is the case for all other stations. However, the second cable leads to the station’s frequency converter, which again is controlled separately.



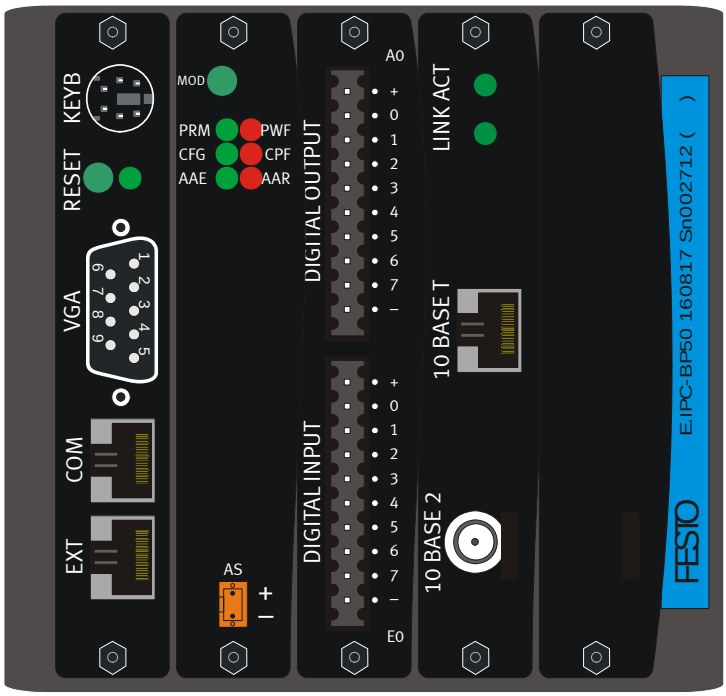
8. Control system

Control of the transport system station is taken on by a PLC (memory programmed control). Function of the PLC is the control of the transport system station. Additionally, it serves the higher purpose of retaining communicating with the other stations, which occurs by a defined I/O-interface. Consequently, the control takes on a master function in the complete control layout.

For this, the control for the transport system, of the Festo IPC group, consists of several modules.

8.1. Control set-up

No.	Switch position	Modul	Name	Comment
1	-	Controller	HC 20	
2	1	ASI card	CP 96	For external communication
3	1	I/O-card	OM 21	For operation
4	2	Ethernet card	CP 14	For external communication
5				Not used



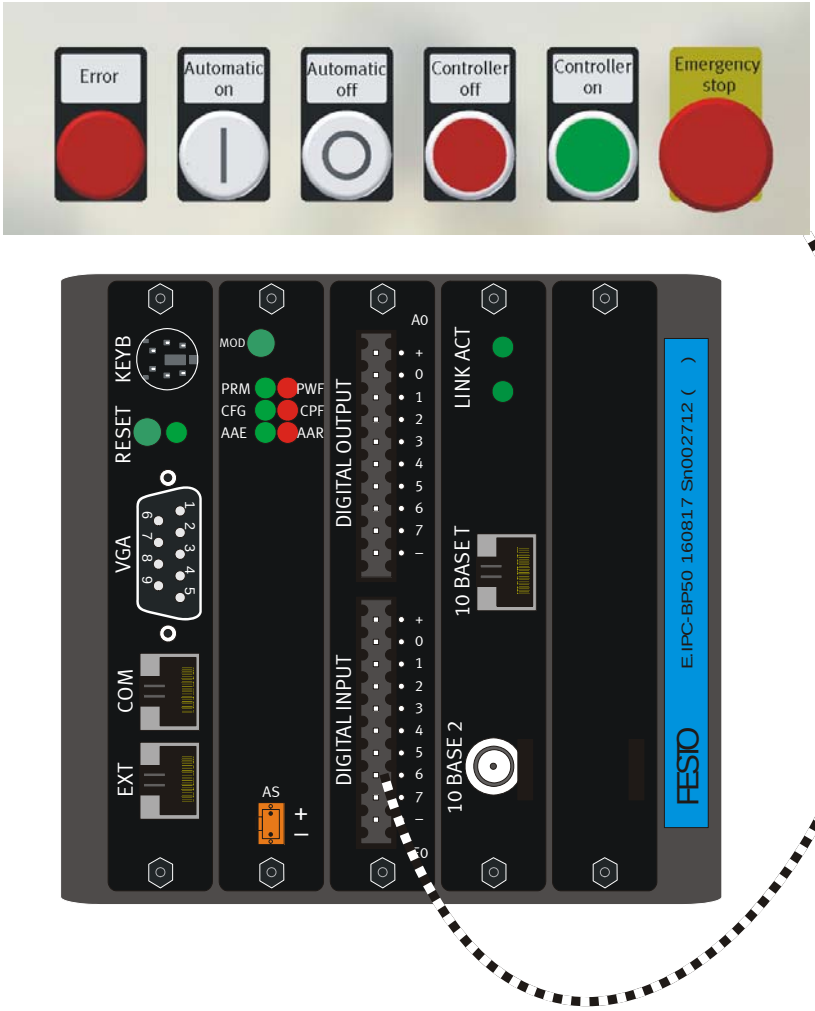
Control Station Transport system

8.2. Wiring

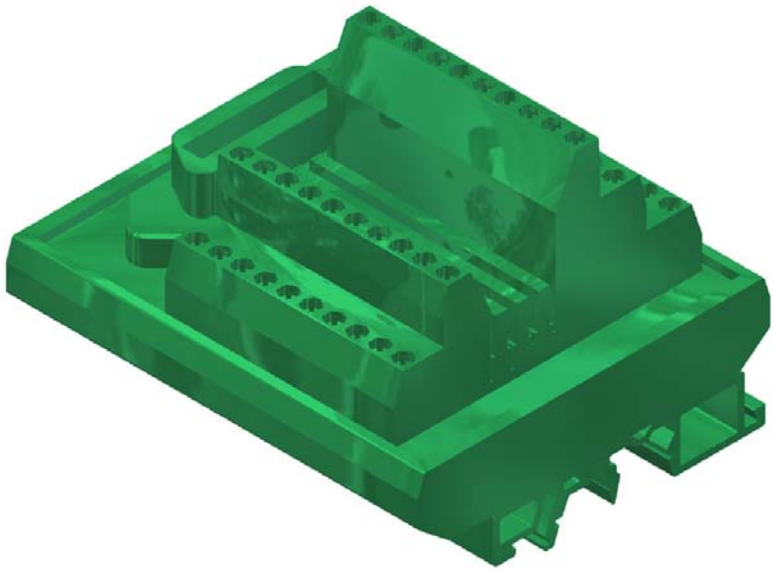
The station's internal wiring and the wiring to the other stations is explained as following.

8.2.1. I/O-components

The control elements are directly connected to the control of the transport system station.

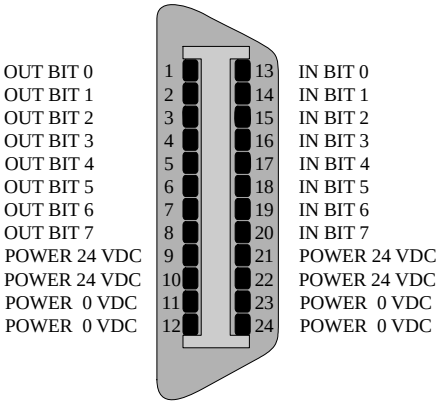


The I/O-interface is standardized to guarantee faultless communication. The I/O-terminal is available to all of the operating positions.



Data I/O-terminal

Technical data		
	Plug type	IEEE 488 24-pin
	Inputs	8 (from which 4 are connected)
	Outputs	8 (from which 4 are connected)
	Current consumption	Max. 1A each PIN
	Supply voltage	24VDC



syslink pin assignment

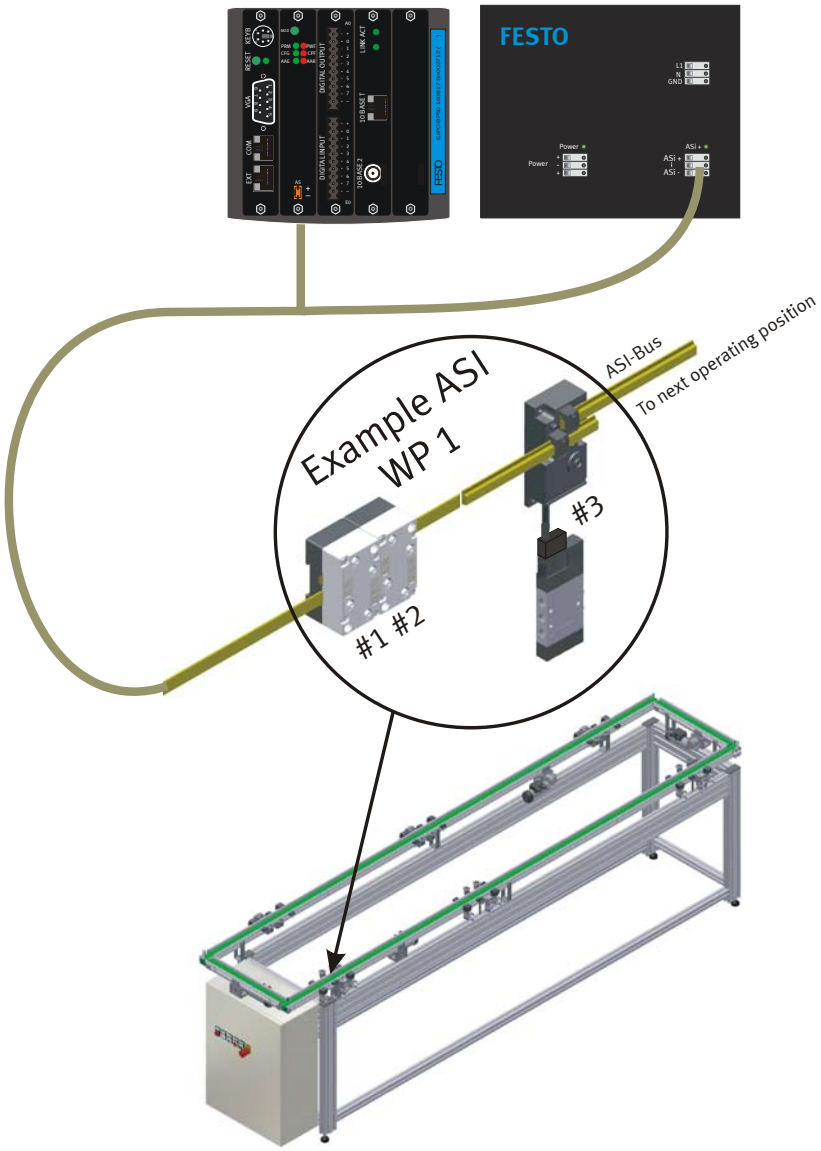
01	Bit 0	Output word	white	13	Bit 0	Input word	grey-pink
02	Bit 1	Output word	brown	14	Bit 1	Input word	red-blue
03	Bit 2	Output word	green	15	Bit 2	Input word	white-green
04	Bit 3	Output word	yellow	16	Bit 3	Input word	brown-green
05	Bit 4	Output word	grey	17	Bit 4	Input word	white-yellow
06	Bit 5	Output word	pink	18	Bit 5	Input word	yellow-brown
07	Bit 6	Output word	blue	19	Bit 6	Input word	white-grey
08	Bit 7	Output word	red	20	Bit 7	Input word	grey-brown
09	24 V	Power supply	black	21	24 V	Power supply	white-pink
10				22			
11	0 V	Power supply	pink-brown	23	0 V	Power supply	white-blue
12	0 V	Power supply	purple	24			

Allocation I/O-terminal

Clamp	Bit	Function	Colour	Clamp	Bit	Function	Colour
01	0	Output	white	13	0	Input	Grey-pink
02	1	Output	brown	14	1	Input	Red-blue
03	2	Output	green	15	2	Input	White-green
04	3	Output	yellow	16	3	Input	Brown-green
05	4	Output	grey	17	4	Input	White-yellow
06	5	Output	pink	18	5	Input	Yellow-brown
07	6	Output	blue	19	6	Input	White-grey
08	7	Output	red	20	7	Input	Grey-brown
09	24 V	Voltage supply	black	21	24V	Voltage supply	White-pink
10				22			
11	0V	Voltage supply	pink-brown	23	0V	Voltage supply	White-blue
12	0V	Voltage supply	purple	24			

8.2.2. **ASi-participant**

The ASi-participants are connected to the control by means of a yellow ASi-cable, protected against polarity by its shape. The amount of ASi-participants is limited. Up to max. 31 participants can be connected to an ASi-circuit.



Example ASi-wiring

As the internal I/O-mapping of the control only starts showing singularity from ASi-address 02 onwards, allocation of ASi-address 01 is omitted.

ASi-assignation
Operating position 1

ASi-address	Module	Function	Designation	Text
02	4 I-FK Inputs Segment 1	Input I1	B10.1	Work-piece carrier at stopper ST1
		Input I2	B10.2	Congestion sensor
		Input I3	B10.3	Workpiece on workpiece carrier
		Input I4	B10.4	Workpiece counter
03	2 I/1O-EVA-MF-2E1A-Z In/outputs Segment 1	Input I1	B10.5	Stopper ST1 is released
		Input I2		Not used
		Output O1	Y10.1	Release stopper ST1
04	4I/O-3RG90 In/Outputs Segment 1	Input I1		I/O-coupling Input 1
		Input I2		I/O-coupling Input 2
		Input I3		I/O-coupling Input 3
		Input I4		I/O-coupling Input 4
		Output O1		I/O-coupling output 1
		Output O2		I/O-coupling output 2
		Output O3		I/O-coupling output 3
		Output O4		I/O-coupling output 4

ASi-allocation
Operating position 2

ASi-address	Module	Function	Designation	Text
05	4 I-FK Inputs Segment 2	Input I1	B20.1	Work-piece carrier at stopper ST2
		Input I2	B20.2	Congestion sensor
		Input I3	B20.3	Workpiece on workpiece carrier
		Input I4	B20.4	Workpiece counter
06	2 I/1O-EVA-MF-2E1A-Z In/outputs Segment 1	Input I1	B20.5	Stopper ST2 is released
		Input I2		Not used
		Output O1	Y20.1	Release stopper ST2
07	4I/O-3RG90 In/Outputs Segment 2	Input I1		I/O-coupling Input 1
		Input I2		I/O-coupling Input 2
		Input I3		I/O-coupling Input 3
		Input I4		I/O-coupling Input 4
		Output O1		I/O-coupling output 1
		Output O2		I/O-coupling output 2
		Output O3		I/O-coupling output 3
		Output O4		I/O-coupling output 4

ASi-allocation
Operating position 3

ASi-address	Module	Function	Designation	Text
08	4 I-FK Inputs Segment 3	Input I1	B30.1	Work-piece carrier at stopper ST3
		Input I2	B30.2	Congestion sensor
		Input I3	B30.3	Workpiece on workpiece carrier
		Input I4	B30.4	Workpiece counter
09	2 I/1O-EVA-MF-2E1A-Z In/outputs Segment 1	Input I1	B30.5	Stopper ST3 is released
		Input I2		Not used
		Output O1	Y30.1	Release stopper ST3
10	4I/O-3RG90 In/Outputs Segment 3	Input I1		I/O-coupling Input 1
		Input I2		I/O-coupling Input 2
		Input I3		I/O-coupling Input 3
		Input I4		I/O-coupling Input 4
		Output O1		I/O-coupling output 1
		Output O2		I/O-coupling output 2
		Output O3		I/O-coupling output 3
		Output O4		I/O-coupling output 4

ASi-allocation
Operating position 4

ASi-address	Module	Function	Designation	Text
11	4 I-FK Inputs Segment 4	Input I1	B40.1	Work-piece carrier at stopper ST4
		Input I2	B40.2	Congestion sensor
		Input I3	B40.3	Workpiece on workpiece carrier
		Input I4	B40.4	Workpiece counter
12	2 I/1O-EVA-MF-2E1A-Z In/outputs Segment 1	Input I1	B40.5	Stopper ST4 is released
		Input I2		Not used
		Output O1	Y40.1	Release stopper ST4
13	4I/O-3RG90 In/Outputs Segment 4	Input I1		I/O-coupling Input 1
		Input I2		I/O-coupling Input 2
		Input I3		I/O-coupling Input 3
		Input I4		I/O-coupling Input 4
		Output O1		I/O-coupling output 1
		Output O2		I/O-coupling output 2
		Output O3		I/O-coupling output 3
		Output O4		I/O-coupling output 4

ASi-allocation
Operating position 5

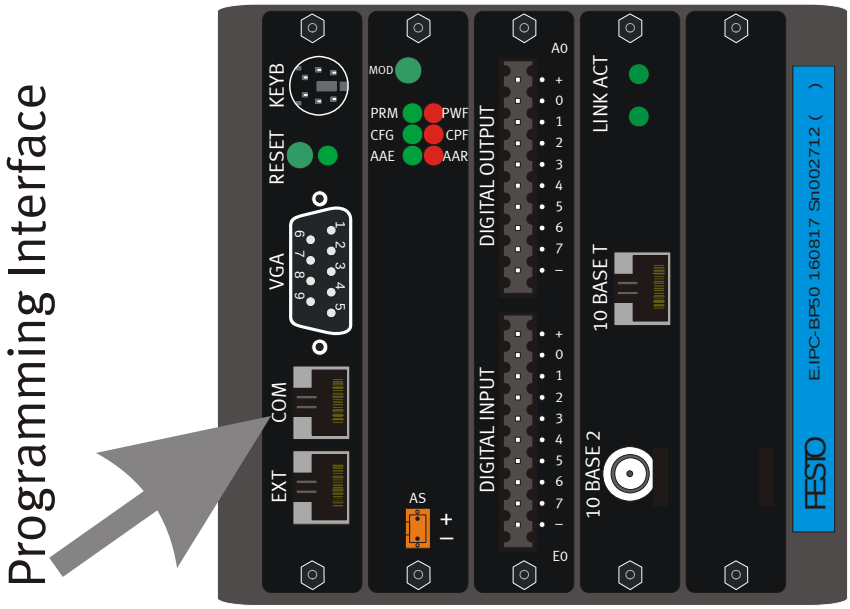
ASi-address	Module	Function	Designation	Text
14	4 I-FK Inputs Segment 5	Input I1	B50.1	Work-piece carrier at stopper ST5
		Input I2	B50.2	Congestion sensor
		Input I3	B50.3	Workpiece on workpiece carrier
		Input I4	B50.4	Workpiece counter
15	2 I/1O-EVA-MF-2E1A-Z In/outputs Segment 1	Input I1	B50.5	Stopper ST5 is released
		Input I2		Not used
		Output O1	Y50.1	Release stopper ST5
16	4I/O-3RG90 In/Outputs Segment 5	Input I1		I/O-coupling Input 1
		Input I2		I/O-coupling Input 2
		Input I3		I/O-coupling Input 3
		Input I4		I/O-coupling Input 4
		Output O1		I/O-coupling output 1
		Output O2		I/O-coupling output 2
		Output O3		I/O-coupling output 3
		Output O4		I/O-coupling output 4

ASi-allocation
Operating position 6

ASi-address	Module	Function	Designation	Text
17	4 I-FK Inputs Segment 6	Input I1	B60.1	Work-piece carrier at stopper ST6
		Input I2	B60.2	Congestion sensor
		Input I3	B60.3	Workpiece on workpiece carrier
		Input I4	B60.4	Workpiece counter
18	2 I/1O-EVA-MF-2E1A-Z In/outputs Segment 1	Input I1	B60.5	Stopper ST6 is released
		Input I2		Not used
		Output O1	Y60.1	Release stopper ST6
19	4I/O-3RG90 In/Outputs Segment 6	Input I1		I/O-coupling Input 1
		Input I2		I/O-coupling Input 2
		Input I3		I/O-coupling Input 3
		Input I4		I/O-coupling Input 4
		Output O1		I/O-coupling output 1
		Output O2		I/O-coupling output 2
		Output O3		I/O-coupling output 3
		Output O4		I/O-coupling output 4

8.3. Programming

In this chapter, it is not possible to refer in detail to the programming of a PLC-control. However, the interface is shown below. The allocation list provides easy and clear programming . The ASi-tables in this chapter are also very helpful in speeding up allocation processes.



Example Programming interface

The IPC in the switchgear cabinet is programmed from the computer via the serial cable (RS232 cable). The serial-cable is plugged into the RS 232 interface on the programming computer and is connected directly to the IPC-Controller (HC 20 com 1). Therefor a special plug connector is necessary. (PS1 SM14/ Ordernumber 188 935)

9. Fault finding

This error list has been drawn up to restore operation of the system as soon as possible, after the appearance of an error.

Error	Error correction
Palette with work-piece arrives in the test stopping station. Only empty palettes are to reach this point.	Retrieve work-piece from palette and acknowledge error in transfer system.
The commissioning station is not ready and the AS/RS station is full. Now, a palette with work-pieces arrives in the AS/RS stopping station.	Retrieve work-piece from palette. Clear the commissioning slides of the commissioning station. Re-start station by activating the STARTpush-button (new). Acknowledge error in the transfer system.
A work-piece is placed incorrectly onto the empty palette in the stopping station by the (air) slide of the test station. Work-piece is not in fixture or is not placed in range of the light barrier.	Place work-piece manually into palette's work-piece reception (in processing direction - right rear-end).
Palette with work-piece waits at the stopping station of PIC-alfa/sorting or commissioning and no action ensues. PIC-alfa is not ready or not started up.	Palettes are to be retrieved from the stopping station only, once the work-piece has been retrieved from PIC-alfa.
EMERGENCY-STOP has been activated. The robot controller still keeps on bleeping after the EMERGENCY-STOP switch device has been acknowledged.	An EMERGENCY-STOP unit requires separate acknowledgement. Activate the RESET key of the controller or 'ERROR/RESET' of the teachbox.

Installation conditions	Action
For product output, max. 18 parts can be commissioned onto 3 slides by the commissioning station. The START-lamp begins to flash, once a commissioning process has been concluded (slides full).	All 3 of the slides are to be cleared. Activate START push-button. Commissioning station is ready for operation again.
Palette with work-piece waits at stopping station PIC-alfa/commissioning.	Work-piece is to be retrieved from palette by PIC-alfa. Poss. start-up of PIC-alfa.
Palette with work-piece waits at stopping station PIC-alfa/sorting.	PIC-alfa and sorting station are not ready, e.g. not activated, not adjusted or one of the sorting slides is full. → poss. retrieve work-pieces from slides → adjust stations and start up → poss. activate voltage supply or pressure Once the cause has been removed, activate the START push-button.
Palette with work-piece waits at PIC-alfa /processing. Work-piece has been processed and placed on palette of PIC-alfa. No release of the palette ensues at this point.	Processing station is not ready. Sensor B8 „work-piece present“ is possibly not adjusted properly– requires re-adjustment.