Test Project

Task D

Mechatronics

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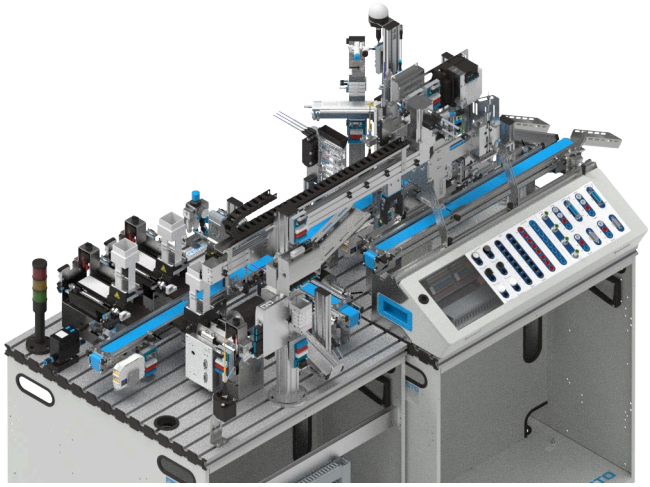
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Introduction to Test Project D

Optimization of a production line including 3-Magazin Station, SkillsConveyor Station

TMAX	INFORMATION
150 min + 60 min	Also on file server

Scenario



- A customer wants to pick up the system today (from Task A to C) and make a final check.
  But he has additional requests.
- To make the system smarter, the customer wants to add an RFID System and the newest type of Stepper Motor Controller
- It is your decision to add the new RFID-System, and Stepper Motor Controller during the Competition time.
- The customer wants to see how the order/products can be completed in a secure process.
- The entire production time is recorded only with the new items.
- Air consumption also goes into product costs. Therefore, the best efficient system is to search with the new items.
- The customer would like to process orders in which 1-3 different types of workpieces can be selected on the HMI.
  The orders are started once by a "Start order" signal.
- At the time of evaluation, at least one order must be run and deliver the desired result like in Task C.

RFID-Function

You have to write the number of the workpiece on the RFID chip, which corresponds to the order position of the workpieces on the output slide. WP 1 on slide = RFID Number: 1, WP 2 on slide = RFID Number: 2, …

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Attention

Air Flow calculation

Calculate the air flow in your PLC and show it at the HMI in field 8.2.

Take the information on how to use the flowmeter from the "General Tasks Information C-6M".

Some data about the Sensor:

- Analog Output: 0 – 10 Volt
- Air flow range: 0,5 -200 liter/min

New Stepper Controller

Note- cables: to connect the new Motor Controller use the motor cable, the encoder cable, ref. sensor and power supply of the old motor controller. The mechanical limit switches can stay connected at the old motor controller. Limit switches in the new motor controller are software limit switches and set as follows.

Note- Limit Switches

The reference switch is the zero (0) point of the axis. The negative software limit ist set to -10 mm and the positive software limit is set to 501 mm. Accordingly the usable stroke of the axis is 511 mm.

The limit of the velocity is set to 0.3 m/s. Make sure that no faster movement is configured. Any higher velocity will lead to an error.

Assemble the not used cables in the best professional way. (Don't cut them)

Initial Positions

See Task A, B, C

HMI Design and Function

Design and function, see also Task A to C

Flow chart Legend and Notes (see flow chart)

L: INDICATORS/LIGHTS/COUNTER: Like Task C

B: BUTTONS: Like Task C

WP: WORKPIECE STATE: Like Task C

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Your Task

Your task is to measure the airflow, to optimize the production process to produce one (1) order in the shortest possible time and with most air efficiency to bring out the desired result with a writing process on an RFID – Chip and newes Stepper Motor controller.

Your task is complete when:

1. The production line has been assembled mechanically, wired correctly, connected and its correct operation is guaranteed also with the added new technology components.
2. Correct execution of the program with PLC activation (based on evaluation with PLC) is guaranteed.
3. The system meets the specifications (in accordance with the 'Agreement on Professional Practice and HMI judgement).

The system will be sent to the customer as soon as you are finished. You will have no opportunity to make improvements later.

Optimization procedure

Target

- Fast, energy efficient and dependable production line with a RFID writing system, newes motor controller and process modifications
- Conditions:
  - It is allowed to modify your PLC – programs.
  - The focus on energy consumption is on air over the total system.
  - Maximum 6 bar working pressure/maximum 24 Volt power supply.
  - No collisions are allowed (products touching each other is not a collision).
  - During your commissioning, evaluation and testing you can stop the calculation of the flow-sensor via the stop function in the RECORDER mode, see "General Task Information".
  - It is allowed to adjust/move the sensors and modules in the same groove within the station, but the function must remain the same.
  - It is not allowed to use tape in the production line.
  - **Note:** The RFID-System and new Stepper Motor can be used or not. But it will influence the marking if it is not used.

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Exceptions

- More than one (1) workpiece on the production system is allowed.
- Press "Start order" only one (1) time (the order is running automatically).
- Open end block at the conveyor end (left) of the 3MS. Products may fall out.
- The products are moving in the system without manual help.
- No evaluation about behavior of the lamps except "Start lamp" at beginning of evaluation and signal lamps at the end. ==> see also Flow Chart
- The timing of production time and air flow measurement stops when the GREEN, RED and YELLOW signal tower is on (3MS) and the order is completed.

Note:
The evaluation is finished after checking the RFID value and the numbers of balls in the Workpiece.

There are no marks for the preparation time.

After a max. time of 150 minutes +60 minutes optimization the system must be prepared to run:

- All modules and components are fixed and adjusted.
- The station layout must be the same as in the tasks before.
- The stations are ready to get the start signal via the "Start order" button at the HMI.
- The "Start lamp" must be ON (HMI).

After the working time three (3) members of the evaluation team will take the production time and note the air consumption displayed on the sensor in the 3MS. The average of these three (3) times will be calculated for each.

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Important notes about condition of the evaluation

Preparation

Connect the PLC board with the I/O terminals, switch key to the position AUTO (HMI), start the PLC, no programming cable and no communication between PC and PLC, valve for air opened. All modules in the stations are empty.
You will get time to check that before the evaluation!

Function Operation mode and signals:

The initial run is on your responsibility. Evaluated can be only the result after the initial run.

Task D, SC-ID D1: Function Quality of production and signals

- Start from the required initial position.
- Put at least four (4) Workpieces into Magazine 1, Magazine 2, Magazine 3* and on the Magazine Slide* (will never get empty)
- Put at least four (4) caps in the magazine of the Module Assembling
- Process required for the assessment see also in the Flowchart
- Attention: When the function stops with one product in the station, the evaluation is finished. (no manual help allowed)
- (Second (2nd) chance possible with WP selection by evaluation team)

Task D, SC-ID D2: Air consumption

Air consumption evaluation (only if the maximum number of points is achieved for PLC and at least 66,67% points for professional practice judgement!)

Task D, SC-ID D3 and D4: Process time and Working Time

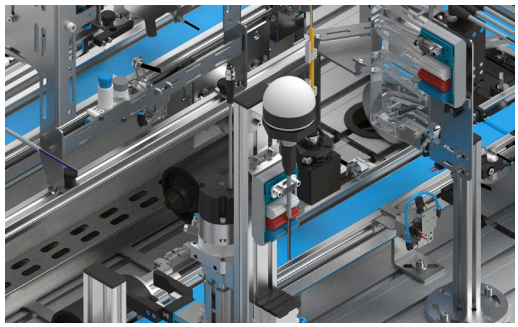
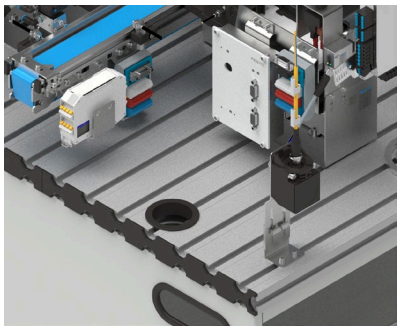
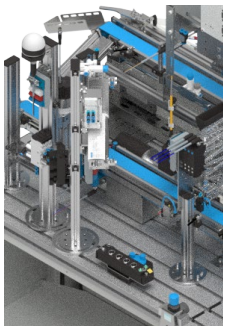
Time evaluation (only if the maximum number of points is achieved for PLC and at least 66,67% points for professional practice judgement

Task D, SC-ID D5: PP-Judgement

Based on the SAG document

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Mechanical Part

RFID-SENSOR ON BELT (WRITE)	RFID-SENSOR ON PROFILPLATE (READ)	RFID-INTERFACE TO NETWORK
		

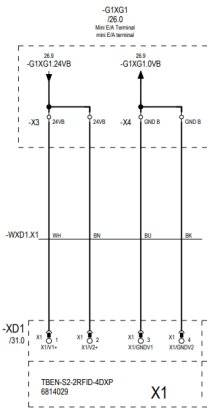
Definition of Stack Magazines[1]

MODULE: MAGAZINE IN 3MS	BLACK	RED	SILVER
Back - left hand side (1)	**X**		
Back - right hand side (2)		**X**	
Front - single other side of Mag1 and Mag2(3)			**X**
Expected weight with Workpiece+cap+RFID inlay [gr]/ Volt [V] (0-10V) (without balls)	**15 gr / 1,5 V**	**15 gr / 1,5 V**	**16 gr / 1,6 V**
Toleranz	**+- 1g / +- 0,1V**	**+- 1g / +- 0,1V**	**+- 1g / +- 0,1V**
Number of balls	2	4	6

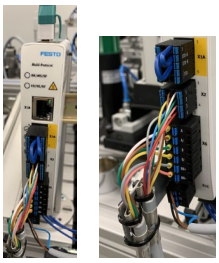
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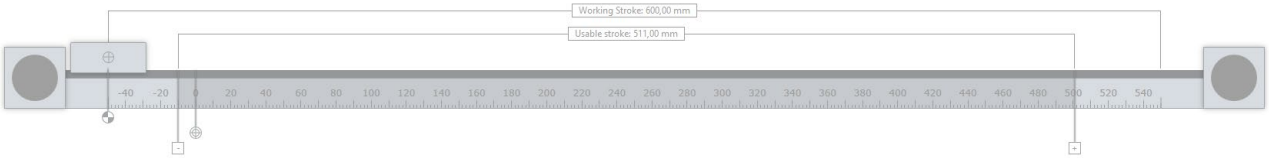
Electrical part

Power supply of RFID Gateway



Picture wired Stepper controler

PLACE OF ASSEMBLING	HOW TO FIX THE "OLD" CABLE
	



Positions of the Stepper Motor

DEFINITION	ACTION
Ref.	Reference Drive
Pos 1	Place WP on SkillsConveyor
Pos 2	Pickup WP from conveyor 300mm
Pos 3	Place WP on Slide (Pos 16)

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CIRCUIT DIAGRAM (COMPLETE SEE DATA)

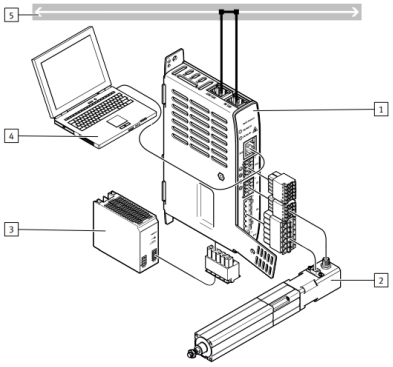


Fig. 2: System structure (example)

1 Servo drive CMMT-ST
2 Stepper motor or EC motor with drive
3 Fixed power supply (or supplies) for logic and load voltage supply (PELV)
4 PC with Ethernet connection for parameterisation
5 Bus/network

7.3 Connection example

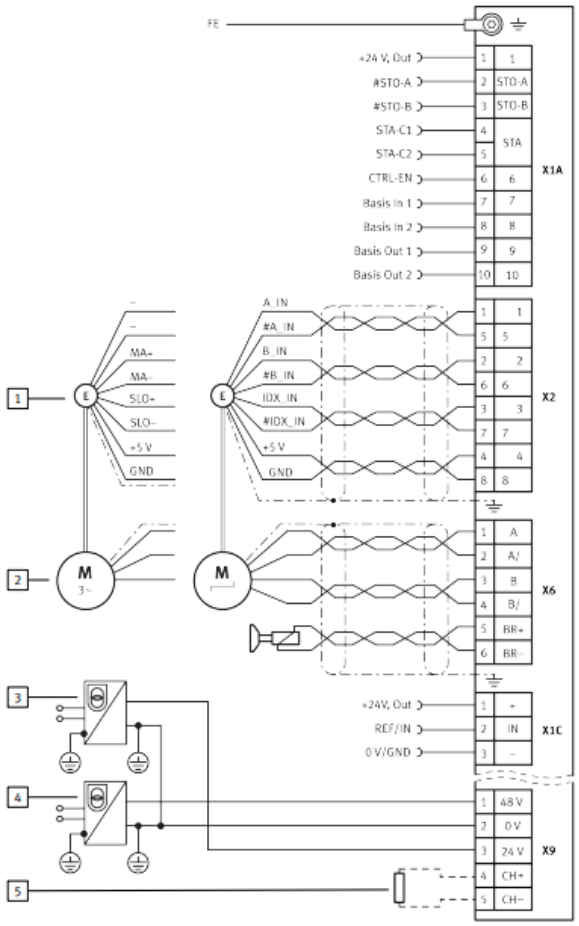
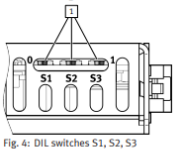


Fig. 7: Connection example

1 BiSS-C or incremental encoder
2 EC motor or stepper motor
3 PELV fixed power supply for logic voltage (24 V)
4 PELV fixed power supply for load voltage supply (24 V ... 48 V)
5 Braking resistor, optional

4.3 Setting bus protocol

The CMMT-ST-C8-1C-MP-S0 product variant supports multiple bus protocols.
The following options are available for setting the protocol:
- Configuration in the CMMT-ST plug-in
- Direct setting with DIL switches S1 to S3



1 DIL switches S1, S2, S3

Fig. 4: DIL switches S1, S2, S3

The switches can be adjusted with a small slotted head screwdriver.
The switch position is evaluated once when the device is started. A change in the switch position therefore only takes effect after the device has been restarted.

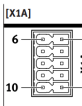
Protocols supported by the firmware version used ➔ 1.2 Applicable documents, manual/online help plug-in, software, function, fieldbus, device profile.

Protocol	S3	S2	S1
Parameterisation	0	0	0
PROFINET	0	0	1
EtherCAT	0	1	0
EtherNet/IP, Modbus TCP	0	1	1
Parameterisation	1	1	1

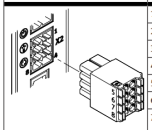
Tab. 9: Bus protocol switch setting

5.4 Installation for operation without safety function

For operation without the safety subfunction, wire inputs X1A.2 to X1A.5 as follows:

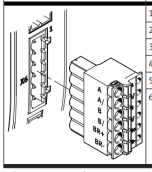
[X1A]	Pin	Type	Identifier	Function
	X1A.2	Digital input	#STO-A	supplies each one with 24 V
	X1A.3		#STO-B	
	X1A.4	Contact	STA-C1	do not connect
	X1A.5		STA-C2	

Tab. 7: Circuitry of inputs and outputs without safety sub-function

[X2]	Pin	Function	Description	Mating plug labelling
	1	A_IN	A signal input	1
	2	B_IN	B signal input	2
	3	IDX_IN	Index signal input	3
	4	+5 V	5 V encoder supply	4
	5	#A_IN	A signal input, inverse	5
	6	#B_IN	B signal input, inverse	6
	7	#IDX_IN	Index signal input, inverse	7
	8	GND	Reference potential of encoder supply	8

Tab. 20: Incremental encoders with AB signals (quadrature encoder)

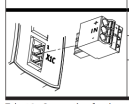
Pin allocation for connecting a stepper motor:

[X6]	Pin	Function	Description	Mating plug labelling
	1	A	String A	A
	2	A/	String A/	A/
	3	B	String B	B
	4	B/	String B/	B/
	5	Br+	Brake +24 V	Br+
	6	Br–/0 V	Brake 0 V	Br–

Tab. 27: Motor phase connection for connecting a stepper motor

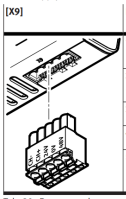
7.4.2 [X1C], reference switch/limit switch

The connection [X1C] is located on the front of the device and is used to connect the reference switch or a limit switch.

[X1C]	Pin	Function	Description	Mating plug labelling
	1	+24 V, out	+ 24 V DC output (fused)	+
	2	REF/IN	Reference signal/limit switch signal	IN
	3	0 V/GND	Reference potential, reference switch	–

Tab. 18: Connection for the reference switch/limit switch

Power supply

[X9]	Pin	Function	Description	Mating plug labelling
	1	+ 48 V	Power supply for the load circuit 24 V DC to 48 V DC	48 V
	2	0 V	Reference potential for the load and logic voltage	0 V
	3	+24 V	Power supply for the logic circuit 24 V DC	24 V
	4	CH+	Braking resistor positive connection	CH+
	5	CH–	Braking resistor negative connection	CH–

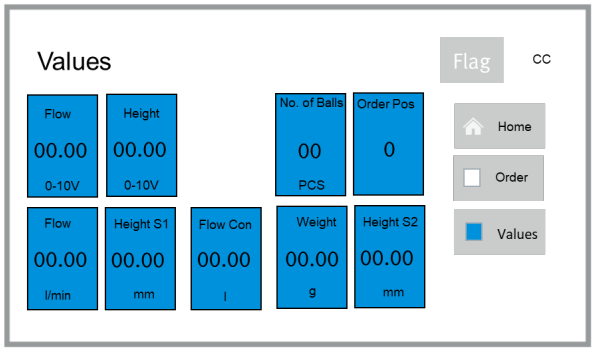
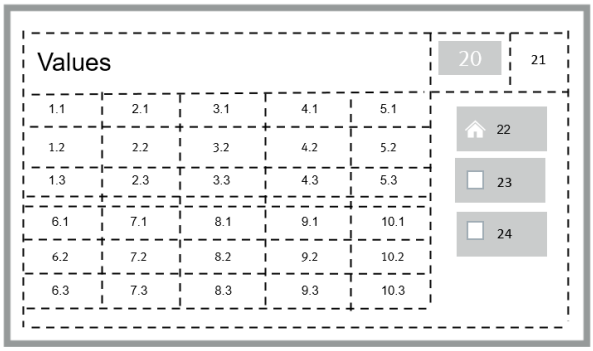
Tab. 30: Power supply

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Control Part

HMI Design and Function

Page “VALUES”

HMI – DESIGN PAGE “VALUES”	FIELD NO
	

FIELD	TEXT	FUNCTION	SHAPE	COLOUR
5.1	Order Pos	Label		Text: black
5.2	0	Dynamic value	Rectangle	Fill: blue Text: black
5.3				
8.1	Flow Con	Label		Text: black
8.2	00.00	Dynamic value	Rectangle	Fill: blue Text: black
8.3	l	Label		Text: black

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