Test Project

Task A1

Mechatronics

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Content

Introduction to Test Project A1 ..... **3**
Assembly, programming and commissioning of a 3 Magazine Station (3MS) with Conveyor and Modules 3
Scenario 3
Attention 4
HMI Design and Function 4
Page "Home" *4*
Page "Order" *4*
Your task **5**
Important notes about condition of the evaluation 6
Task A1, SC-ID A1: Function Operation mode and signals: *6*
Task A1, SC-ID A2: Function Quality of production and signals *6*
Notes for second (2nd) chance without Expert WP selection (reduced marks) *6*
Task A1, SC-ID A3: I/O Allocation *6*
Task A1, SC-ID A4 and A5: HMI Design, PP-Judgement and Workplace management *6*
Task A1, SC-ID A6: Working Time *6*
Mechanical Part **7**
Production line layout 3 – Magazine station (3MS) 7
Assembly of the Motor at the Conveyor System 8
Definition of Stack Magazines 8
Initial position 8
Different views 8
Electrical part **9**
Allocation checked with Simulation Box on the wiring board 12
Control Part **14**
HMI Design and Function "HOME" 14
HMI Design and Function "Order" 16
HMI Design and Function "VALUES" 17
HMI – DESIGN PAGE "Values" *17*
Positions 18
Flow chart Legend and Notes (see flow chart) 18

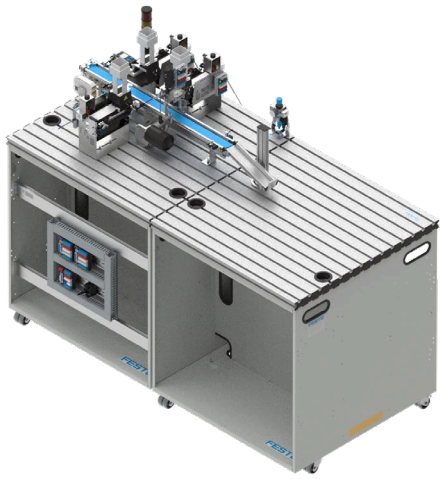
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Introduction to Test Project A1

Assembly, programming and commissioning of a 3 Magazine Station (3MS) with Conveyor and Modules

TMAX	INFORMATION
S180 min + 60 min	Also on file server

Scenario



- A customer would like to add a subsystem to his production plant. This subsystem consists of a Module Conveyor (700 mm), three (3) Module Magazine, which can be used for workpieces, a stopper, a Module Identification, Signal tower and a flowmeter.
- The products are three types of workpieces red/silver/black.
- The customer would like to process orders in which 1-3 different types of workpieces can be selected on the HMI.
  Each order is started by a start signal.
- During the evaluation at least two (2) orders must have been executed and delivered to the slide position.
- During an initial position run it has to be checked whether the conveyor and the magazines are empty. During that process the products in the station are transported to the left-hand side behind the stopper. As soon as all (max. three (3)) products are behind the stopper they have to be taken away.
- The Module Identification checks the colour and the orientation of the product.
  The storage position of the order is on slide and the incorrect products behind the stoper at the left-hand side. Empty the slide and the belt behind the stopper by following the Flowchart.
- The Modules must be installed as shown in the pictures.
- The position of the Module Identification should be chosen sensibly on the Module Conveyor by yourself.
- A signal tower makes the status of the station visible and has to be installed as shown.
- A flow sensor measures the air consumption of the entire system and the HMI displays the current voltage value. The flow sensor must be installed in the specified area.

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Attention

- Each Magazine can provide each type of workpeace. The magazines will be randomly filled.
- Wrong product includes the wrong workpiece type from a magazine and the wrong orientation of the workpiece.
- Order is "COMPLETE" when the full order is delivered to the slide position.
- After each order workpieces behind the stopper or on the slide, are to be taken away manually as also shown in the flowchart.
- If a product is wrong, the system has to continue to process workpieces until the order is completed successfully.
- You have two (2) light barrier fibre optics and three (3) light reflex fibre optics. It's your decision which type of fibre sensor you use on which of the three locations along the conveyor.
  Only three (3) have to be used!
- For each magazine you have one light barrier fibre optics.
- Note: A max number of fasteners is available. If more is needed only standard ones are provided.
- All unused components and documentation in english must be stored in a box at the end of the Competition day.
- Note: Install the end stopper for this task at the left-hand side and make sure that there is enough space for three (3) products. (image is just a reference!)
- Teach the analog sensor for the following settings:
  - Conveyor level: 1 Volt
  - 50 mm: 10 Volt
  - Finally, the red reference WP upside-down should show a value of 5,5 Volt +/- 0,2V
  - A value less than 0,8 volt is to handle as failed/error/not upside-down
  - The voltage value will be measured at the additional clamps on the wiring board
- For used asteriks see general task information
- Preassembled Modules:

MODULE FOR FUNCTION CHECK	CHECKING TIME [MINUTES]
1x Stack Magazine	30

HMI Design and Function

Page "Home"

- Field 9: Reset to 00:00 by field 3 "Reset Prod-Time", Start time by Field 1 "Start I", Stop time with "Order complete"
- The function of Field 3 and 9 will be checked in Task B and have to be ready in Task C for the Production Time assessment.

Page "Order"

- The desired type of the workpiece can be selected using the three (3) buttons (field 1-3).
  Each time you press the button, the number of the selected type is increased by one (1) and the corresponding lamp turns on (field 10, 12, 14).
  The maximum number of one type is three (3). If the button is pressed again, the number is set back to zero (0) and the lamp turns off.
- The font of field 1-3 is just an example. You can use also another good readable font.

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Your task

Assemble, wire and tube the production line on the profile plate according to this documentation and commission the system.

Your task is complete when:

1. The station has been mechanically assembled, correctly wired, connected and its correct operation is guaranteed (based on evaluation using the simulation box).
   The Function and wiring of the I/O Terminal for the station have to be checked using the simulation box.
   Preparation: Connect the simulation box to the I/O Terminal (Output 0-7: signal 1 or 0); (Input 0-7: signal 1 or 0)
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 Standard and Assessment Guide for Judgement in Professional Practice, HMI design and Workplace management).

The system will be sent to the customer as soon as you are finished. You will have no opportunity to make improvements later. Hardware problems during the evaluation phase can be solved during the next task.

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Important notes about condition of the evaluation

Task A1, SC-ID A1: Function Operation mode and signals:

- 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 is opened. Magazines, conveyor and slide are empty.
  You will get time to check that before the evaluation!
- (Second (2nd) chance possible)

Task A1, SC-ID A2: Function Quality of production and signals

- Start from the initial position.
- Put at least four (4) types of WP into the Magazine 1, Magazine 2, Magazine 3*
- Attention: When the function stops with one (1) product in the station, the evaluation ends. (No manual help allowed)

Notes for second (2nd) chance without Expert WP selection (reduced marks)

- Possible only once per day.
- Start from the initial position.
- For the first (1st) order Competitor selects three (3) types of workpieces for the evaluation and puts them into **one (1)** magazine (First (1st) upside down, second (2nd) wrong colour, third (3rd) correct).
- For the second (2nd) order Competitor selects one (1) type of workpiece for the evaluation and puts it correct oriented and coloured into a **second** (2nd) magazine after the first (1st) order is completed.
- Attention: When the function stops with one (1) product in the station, the evaluation ends. (No manual help allowed)

Task A1, SC-ID A3: I/O Allocation

Based on the allocation lists and the required place of the I/O – Terminals (IO-Boards and Modules)

Task A1, SC-ID A4 and A5: HMI Design, PP-Judgement and Workplace management

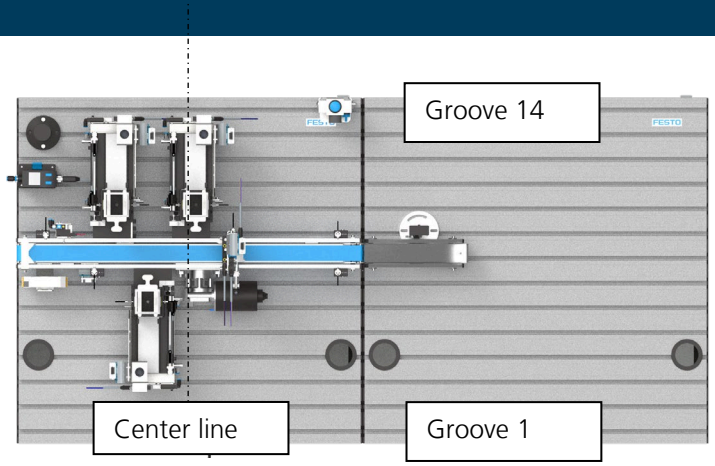
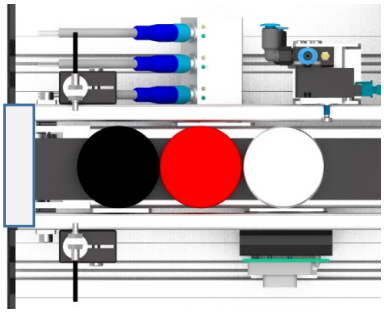
Based on the SAG document

Task A1, SC-ID A6: Working Time

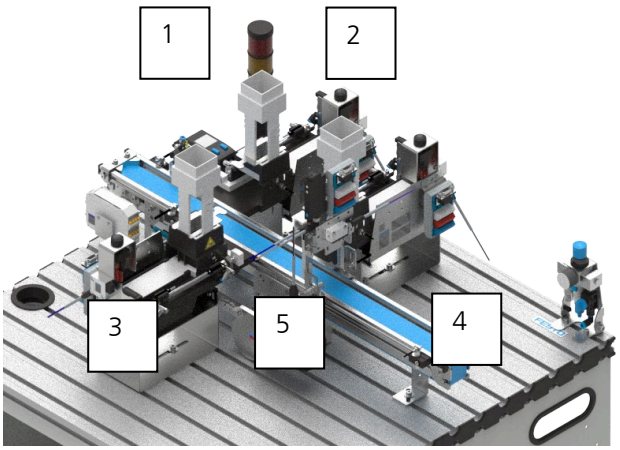
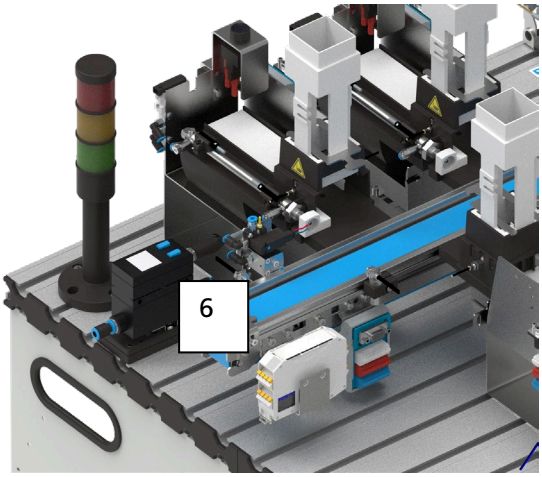
Time evaluation (only if 100% of points are achieved for PLC with WP selection by Experts and simulation box function and at least 66,67% points each for judgement in professional practice, HMI design and Workplace management).

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Mechanical Part

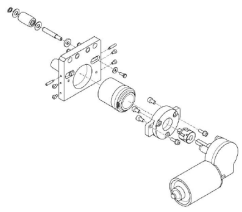
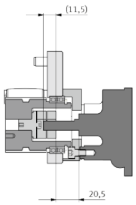
SYSTEM LAYOUT TOP VIEW	BEHIND THE STOPPER
	

Production line layout 3 – Magazine station (3MS)

SYSTEM LAYOUT VIEW FROM RIGHT HAND SIDE	SYSTEM LAYOUT VIEW FROM LEFT HAND SIDE
	
1. Module Magazine 1	2. Module Magazine 2
3. Module Magazine 3	4. Module Conveyor (700 mm)
5. Module Identification	6. Stopper, Flow Sensor, Signal Tower

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Assembly of the Motor at the Conveyor System

1	2
	

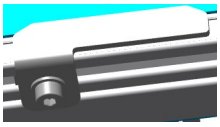
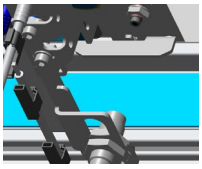
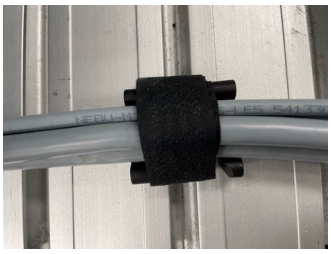
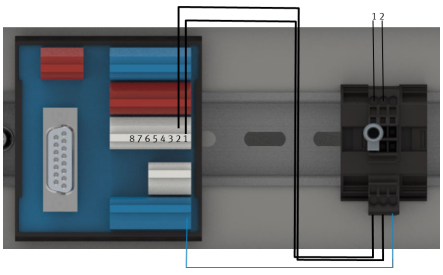
Definition of Stack Magazines

MODULE: MAGAZINE IN 3MS	BLACK	RED	SILVER
Back - left hand side (1)	X	X	X
Back - right hand side (2)	X	X	X
Front - single other side of Mag1 and Mag2(3)	X	X	X

Initial position

MODULE: MAGAZINE IN 3MS
Module Conveyor: Motor off, Stopper extended, Empty (not relevant during the process, only for the initial position run)
Module Magazine 1 - 3: Ejecting arm retraced, Empty (not relevant during the process, only for the initial position run)

Different views

FOR COLLISION FREE MOVEMENTS	CABLE HOLDER ON THE PROFILE PLATE ONLY WITH VELCRO FASTENER!	WIRING OF THE AI-MEASURING LOCATIONS ON THE WIRING BOARD
 		

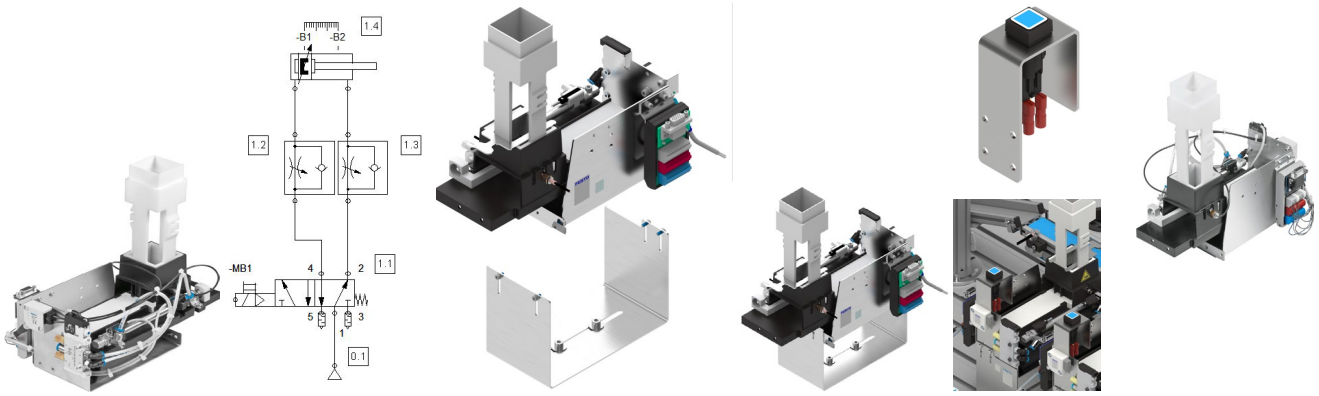
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Electrical part

Add and connect the signal tower along with the general information from C-6M!

Add and connect the flow sensor to the 3MS to measure the total flow of the System along with the general information from C-6M!

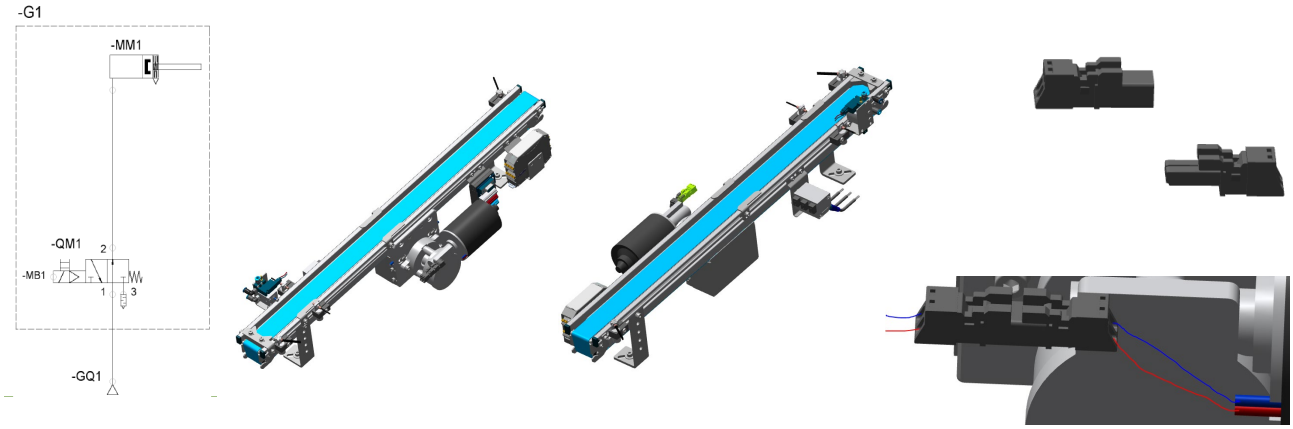
Details of Module: Magazine (more on USB-Stick) and wiring allocation Mini-Terminal



PIN ON SUB-D	COLOUR DIN47100	PIN I/O MINI-TERMINAL	PIN - FUNCTION	PIN I/O TERMINAL FILL IN	FUNCTION
1	White	1	I0		Ejector retracted
2	Brown	7	Q0		Extend ejector
3	Green	2	I1		Ejector extended
4	Yellow	8	Q1		Control lamp
5	Gray	3	I2		Magazine empty
6	Pink	9	Q2		Not used
7	Blue	4	I3		Button
8	Red	10	Q3		Not used
9	Black	5	AI0		Not used
10	Violet	6	AI1		Not used
11	Gray-rose	11+12	AQ0		Not used
12	Red-Blue	24VA	VCC-Out		
13	White-Green	24VB	VCC – In		
14	Brown-Green	GND A	GND Out		
15	White-yellow	GND B	GND In		

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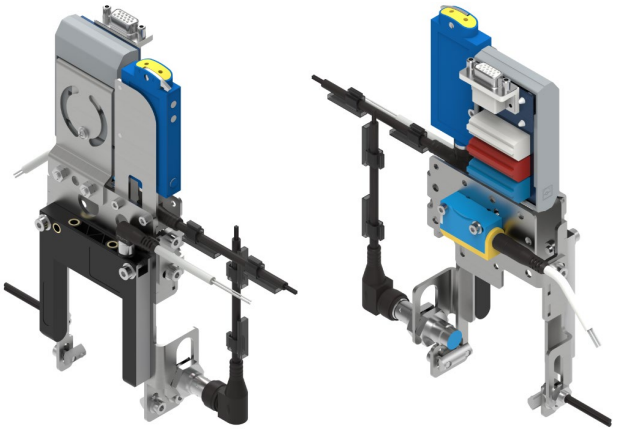
Details of Module: Conveyor 700x 40 (more on USB – stick) and wiring allocation mini terminal



PIN ON SUB-D	COLOUR DIN47100	PIN I/O MINI-TERMINAL	PIN - FUNCTION	PIN I/O TERMINAL FILL IN	FUNCTION	POS.
1	White	1	I0		WP at conveyor start/left	4
2	Brown	7	Q0		run belt to right hand side direction	
3	Green	2	I1		WP at stopper position	
4	Yellow	8	Q1		run belt to left hand side direction	
5	Gray	3	I2		WP not at conveyor end position/right	5
	Pink	9	Q2		Retract stopper	
7	Blue	4	I3		Not used	
8	Red	10	Q3		Not used	
9	Black	5	AI0		Not used	
10	Violet	6	AI1		Not used	
11	Gray-rose	11+12	AQ0		Not used	
12	Red-blue	24VA	VCC-Out			
13	White-green	24VB	VCC – In			
14	Brown-green	GND A	GND Out			
15	White-yellow	GND B	GND In			

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Details of Module: Identification and wiring allocation Mini-Terminal



PIN ON SUB-D	COLOUR DIN47100	PIN I/O MINI-TERMINAL	PIN - FUNCTION	PIN I/O TERMINAL FILL IN	FUNCTION
1	White	1	I0		Optical sensor (light barrier): WP present at Pos 6
2	Brown	7	Q0		Not used
3	Green	2	I1		Optical sensor (reflex light): WP is not black
4	Yellow	8	Q1		Not used
5	Grav	3	I2		Inductive sensor
6	Pink	9	Q2		Not used
7	Blue	4	I3		Not used
8	Red	10	Q3		Not used
9	Black	5	AI0		Optical sensor (height sensor analogue)
10	Violet	6	AI1		Not used
11	Gray-Rose	11+12	AQ0		Not used
12	Red-Blue	24VA	VCC-Out		
13	White-Green	24VB	VCC – In		
14	Brown-Green	GND A	GND Out		
15	White-yellow	GND B	GND In		

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Allocation checked with Simulation Box on the wiring board

I/O TERMINAL: T1 (IN) 1 SIGNAL INDICATES	
DI 0: Module Conveyor: WP at conveyor start/left	
DI 1: Module Conveyor: WP at stopper position	
DI 2: Module Conveyor: WP not at conveyor end position/right	
DI 3: Module Magazine 1: Ejector retracted	
DI 4: Module Magazine 1: Ejector extended	
DI 5: Module Magazine 1: Magazine empty	
DI 6: Module Magazine 2: Ejector retracted	
DI 7: Module Magazine 2: Ejector extended	

I/O Terminal: T1 (OUT), 1 signal indicates	
DO 0: Module Conveyor: run belt to right hand side direction	
DO 1: Module Conveyor: run belt to left hand side direction	
DO 2: Module Conveyor: Retract stopper	
DO 3: Module Magazine 1: Extend ejector	
DO 4: Module Magazine 1: Control lamp	
DO 5: Module Magazine 2: Extend ejector	
DO 6: Module Magazine 2: Control lamp	
DO 7: not used	

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I/O TERMINAL: T2 (IN) 1 SIGNAL INDICATES	
DI 0: Module Magazine 2: Magazine empty	
DI 1: Module Magazine 3: Ejector retracted	
DI 2: Module Magazine 3: Ejector extended	
DI 3: Module Magazine 3: Magazine empty	
DI 4: Module Identification: Optical sensor (light barrier): WP present	
DI 5: Module Identification: Optical sensor (reflex light): WP is not black	
DI 6: Module Identification: Inductive sensor	
DI 7: not used	

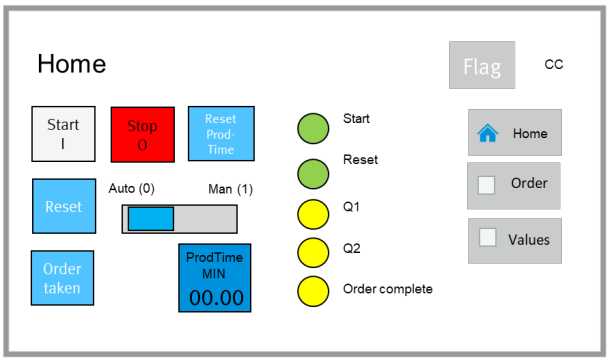
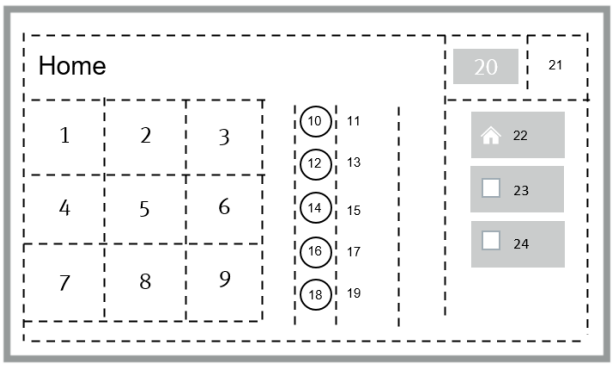
I/O Terminal: T2 (OUT) 1 signal indicates	
DO 0: Module Magazine 3: Extend ejector	
DO 1: Module Magazine 3: Control lamp	
DO 2: Module Signal Tower: Green	
DO 3: Module Signal Tower: Yellow	
DO 4: Module Signal Tower: Red	

I/O TERMINAL ANALOG: (IN) MEASURING VIA EXT. CONNECTORS	
AI 0: Module Identification: Optical sensor (height sensor analogue)	No. 1: Measuring with the multimeter: red reference WP upside down = (5,5V +/- 0,2 V)
AI 1: Flow Sensor	Nr. 2: Measuring with the multimeter

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Control Part

HMI Design and Function “HOME”

HMI – DESIGN PAGE “HOME”	FIELD NO
	

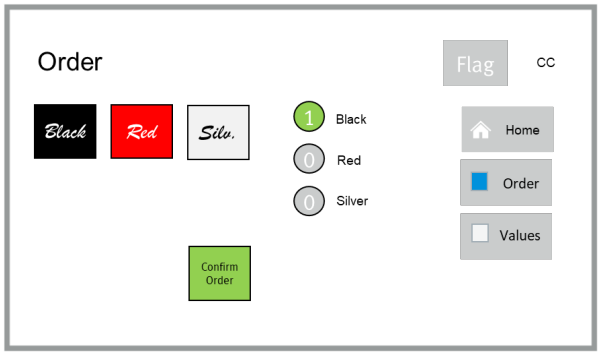
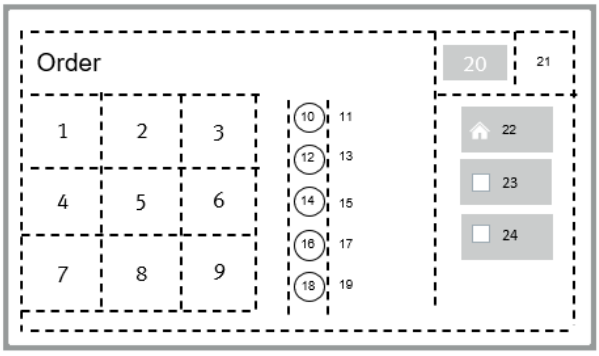
FIELD	TEXT	FUNCTION	SHAPE	COLOUR
1	Start I	Push button	Square with text	Fill: light gray Text: black
2	Stop 0	Push button	Square with text	Fill: red Text: black
3	Reset Prod-Time	Push button	Square with text	Fill: blue Text: white
4	Reset	Push button	Square with text	Fill: blue Text: white
5/6	Auto (0) Man (1)	Label		Text: black
5/6		Switch position dynamic	Depends on HMI availability	Fill: gray/blue
7	Order taken	Push button	Square with text	Fill: blue Text: white
9	ProdTime MIN 00.00	Dynamic value	Square with text	Fill: blue Text: black
10		Start – Lamp	Circle	Fill: gray (0) green (1)
11	Start	Label		Text: black

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FIELD	TEXT	FUNCTION	SHAPE	COLOUR
12		Reset – Lamp	Circle	Fill: gray (0) green (1)
13	Reset	Label		Text: black
14		Q1 – Lamp	Circle	Fill: white (0) yellow (1)
15	Q1	Label		Text: black
16		Q2 – Lamp	Circle	Fill: white (0) yellow (1)
17	Q2	Label		Text: black
18		Order complete – Lamp	Circle	Fill: white (0) yellow (1)
19	Order complete	Label		Text: black
20		Picture	Rectangle	Fill: Flag of your country
21	[Country Code]	Label (capital letter)		Text: black
22	Home	Switch to “Home”	Rectangle background	Fill: gray
		Lamp	House	Fill: white (0) blue (1) if selected
23	Order	Switch to “Order”	Rectangle background	Fill: gray
		Lamp	Square	Fill: white (0) blue (1) if selected
24	Values	Switch to “Values”	Rectangle	Fill: gray
		Lamp	Square	Fill: white (0) blue (1) if selected

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HMI Design and Function “Order”

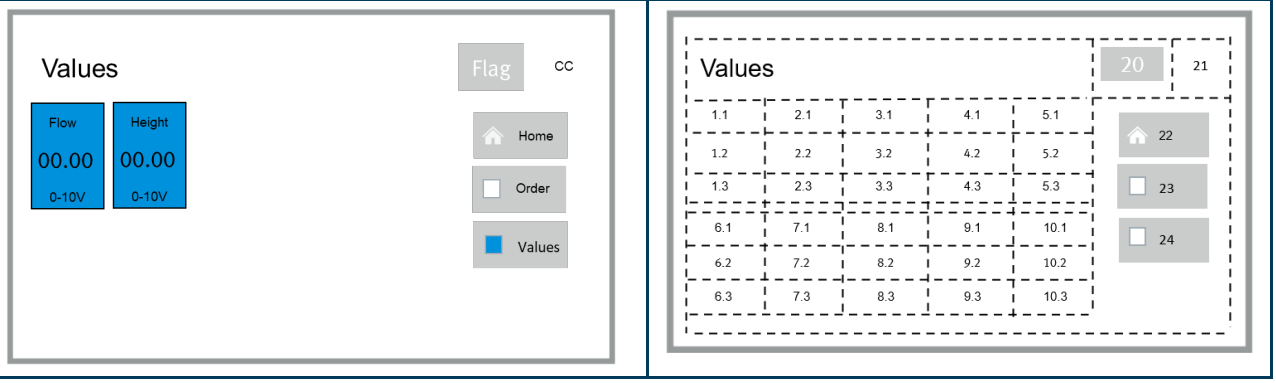
HMI – DESIGN PAGE “ORDER”	FIELD NO
	

FIELD	TEXT	FUNCTION	SHAPE	COLOUR
1	Black	Push button	Square with text	Fill: black Text: white
2	Red	Push button	Square with text	Fill: red Text: white
3	Silv.	Push button	Square with text	Fill: light gray Text: black
9	Confirm Order	Push button	Square with text	Fill: green (0) blue (1) if selected Text: black
10		Black selected - Lamp	Circle	Fill: gray (value = 0) green (value 1 - 3)
	“number of black”	Amount value 0-3	Dynamic text	Text: white
11	Black	Label		Text: black
12		Red selected - Lamp	Circle	Fill: gray (value = 0) green (value 1 - 3)
	“number of red”	Amount value 0-3	Dynamic text	Text: white
13	Red	Label		Text: black
14		Silver selected - Lamp	Circle	Fill: gray (value = 0) green (value 1 - 3)
	“number of Silver”	Amount value 0-3	Dynamic text	Text: white
15	Silver	Label		Text: black
20 - 24	See also “Home” page			

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HMI Design and Function “VALUES”

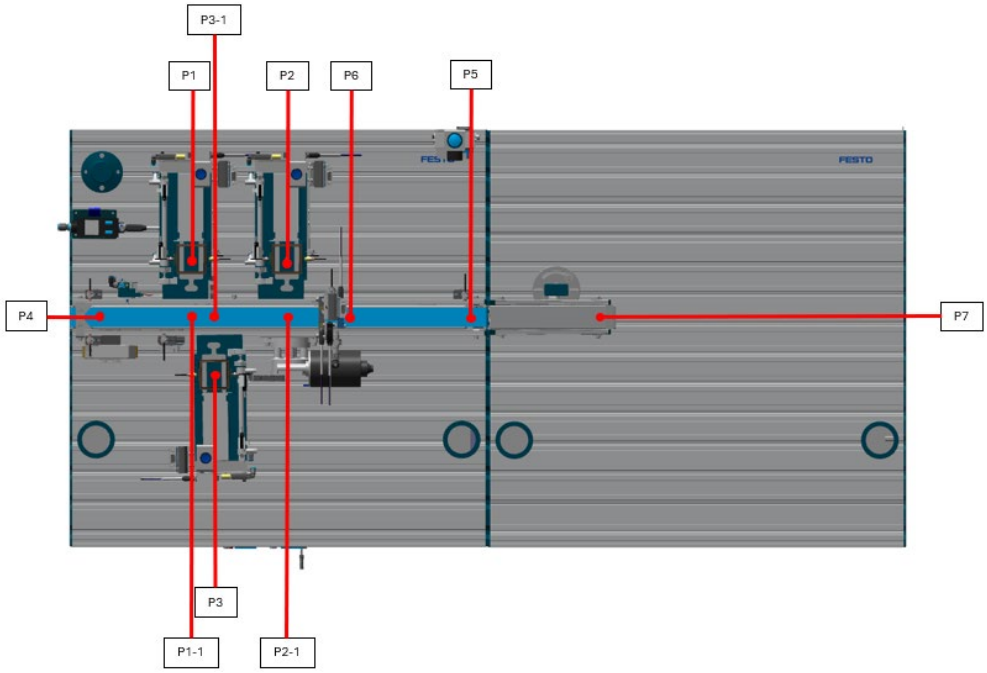
FIELD NO



FIELD	TEXT	FUNCTION	SHAPE	COLOUR
1.1	Flow	Label		Text: black
1.2	00.00	Dynamic value	Rectangle	Fill: blue Text: black
1.3	0 - 10V	Label		Text: black
2.1	Height	Label		Text: black
2.2	00.00	Dynamic value	Rectangle	Fill: blue Text: black
2.3	0 – 10V	Label		Text: black
20 - 24	See also “Home” and “Order”			

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Positions



Flow chart Legend and Notes (see flow chart)

B: BUTTONS	L: INDICATORS/LIGHTS/ COUNTER	WP: WORKPIECE STATE
B1 = START B2 = STOP B3 = AUTO(0)/MAN(1) B4 = RESET B5 = SELECT black B6 = SELECT red B7 = SELECT silver B8 = Confirm Order B9 = Order taken	L1 = HMI: START L2 = HMI: RESET L3 = HMI: Q1 (Wrong colour/usd) L4 = HMI: Q2 (Correct colour) L5 = HMI: black**** L6 = HMI: red**** L7 = HMI: silver**** L8 = HMI: Number of ordered black L9 = HMI: Number of ordered red L10 = HMI: Number of ordered silver L11 = HMI: Order complete L12 = SIGNAL TOWER: Green L13 = SIGNAL TOWER: Yellow L14 = SIGNAL TOWER: Red L15 = Lamp Magazin 1 L16 = Lamp Magazin 2 L17 = Lamp Magazin 3	WP1 = black WP2 = red WP3 = silver WPX = Any wrong workpiece (wrong according to the selection) WP usd = Workpiece upside down

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