Test Project

Task C

Mechatronics

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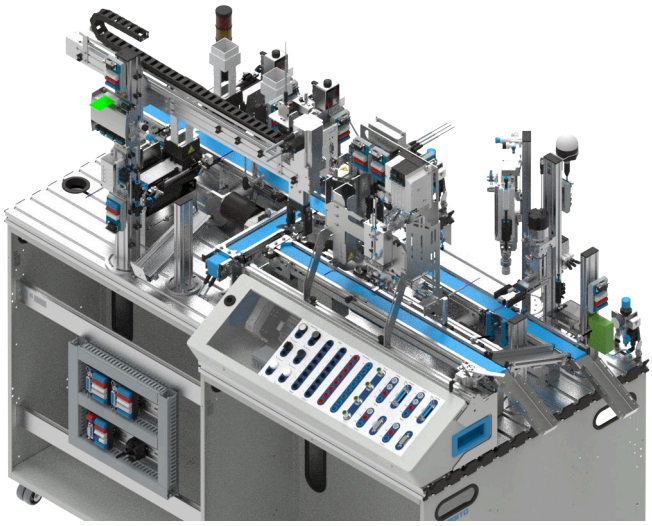
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Introduction to Test Project C

Assembly, programming and commissioning of a production line including 3-Magazine Station with Handling Stepper and conveyor belt, SkillsConveyor Station with Module “Assembling” and Lift&Turn, Module Ball Filling, Module Scale and Pick&Place

TMAX	INFORMATION
300 min	Also on file server

Scenario



- The customer would like to expand his production plant from delivery B (Task A and Task B).
- A customer would like to add process functions to his production plant from delivery B (Task A+B) and adapt his process.
- The workpieces need a quality check to fill up with balls and get sorted and collected by orders.
- These new funktions consists of:
  - Module Scale
  - Module Ball filling
  - Module Pick&Place
- The customer wants to know the total number of balls that were filled during one order.
- You have to make sure that you can bring the system to the initial position before the evaluation starts from the initial Position. See also “Important notes about condition of the evaluation”
- For the initial run the system will be free of workpieces.
- It is possible that in the 3MS are products with some bad workpieces that make a bad cap assembling. This is simulated by an inlay.
- The slide from Task A/B has to move to Station 3MS

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- Products with bad cap assembling are transported to the slide at SKC.
- Products with bad weight are transported to the slide at Conveyor 700 mm.
- Products belonging to the order, filled with correct number of balls and assembled cap are transported to the slide at Module Handling Stepper in Station 3MS.
- The following magazine definitions and number of balls in the workpiece must be observed: see "Definition of Stack Magazines"
- The modules and components must be installed as shown in the pictures.

Attention

- Wrong product includes the wrong workpiece type from a magazine and the wrong orientation of the product.
- Order is "COMPLETE" when the full order is delivered to the slide position.
- After each order, workpieces behind the stopper and on the slides have to be taken away manually. See also flowchart.
- If a product is wrong, the system has to continue to process workpieces until the order is completed successfully.
- An error in the weight will be simulated by an inlay.
- The Module Pick & Place is to connect to the "Balluff" IO-Link Device
- Note: Handle the load-cell with care!
- All unused components and documentation in english must be stored in a box at the end of the Competition Day.
- Place the pallet after the initial run in front of the stopper coming from the Module Pick and Place
- [1]weight and voltage are average values depending on the tolerances of WP/Caps

Place of Assembling at Module P&P

NOTE
IO-Link device on Module P&P connect as follows:
Connect the IO-Link device with your IO-Link Master via the M12 Connectors at the SkillsConveyor.
SimuBox evaluation will be done via the provided C-Interface on the mini IO-Terminal.
You can find the IODD on the file server.
The IO-Link device must be connected and used.
The IO-Link device is "connected" if the green light UB and Aux is on.

MODULE FOR FUNCTION CHECK	CHECKING TIME [MINUTES]
Pick&Place	30
Scaling	30

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HMI Design and Function

Page “Home”, “Order”, “Value”

See also Task A+B

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 assembled mechanically, wired correctly, connected and its correct operation is guaranteed (based on evaluation using the simulation box).

   Function and wiring of the I/O Terminal of the station have to be checked using 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. See also “Important notes about condition of the evaluation”
3. The system meets the specifications (in accordance with the Agreement on Judgement in Professional Practice, HMI).

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

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. Magazines, conveyor and slides are empty.
You will get time to check that before the evaluation!

Function Operation mode and signals:

The initial run is your responsibility. Evaluation will be only the result after the initial run.

Task C, SC-ID C1: Function Quality of production and signals (2nd chance possible)

Start from the required initial position.

Put at least 4 Workpieces into Magazine 1, Magazine 2, Magazine 3*, on the Magazine Slide* (will never get empty) and fill Magazine of Module Ball Filling

Put at least four (4) caps in the magazine of the Module Assembling

Attention: When the function stops with one (1) product in the station, the evaluation is finished. (No manual help allowed)

During the evaluation at least two (2) orders must have been executed and delivered to the selected position.

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

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). And on the **slide with the separator** (first (1st) correct colour and orientation but with cap assembling simulation ring, second (2nd) correct). Select only one WP to produce.

For the 2nd order Competitor selects one (1) type of workpiece for the evaluation and puts it correctly oriented and coloured into a **second (2nd)** magazine.

Attention: When the function stops with one (1) product in the station then the evaluation is finished. (No manual help allowed)

Task C, SC-ID C2: I/O Allocation

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

Task C, SC-ID C3, C4 and C5: HMI Design, PP-Judgement and Workplace management

Based on the SAG document

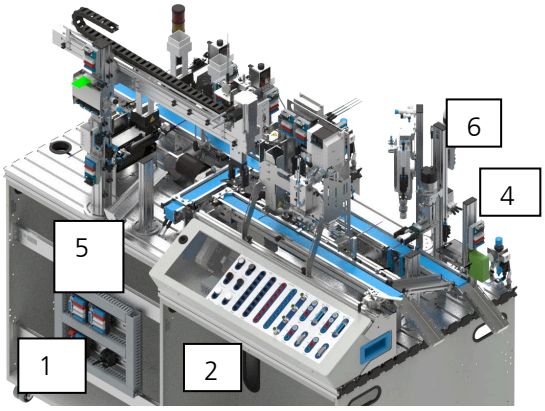
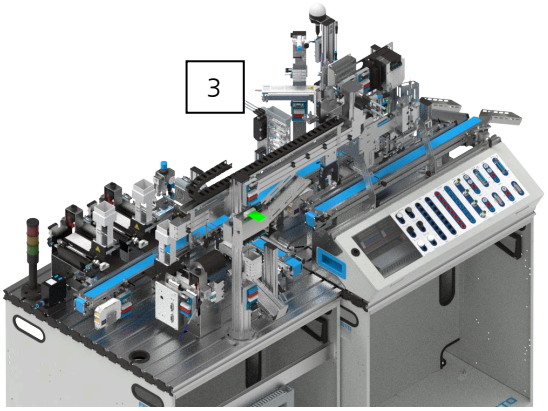
Task C, SC-ID C4: Working Time

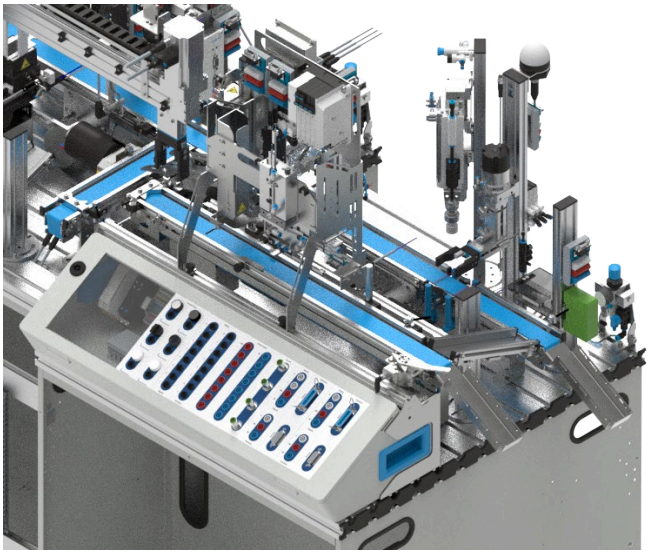
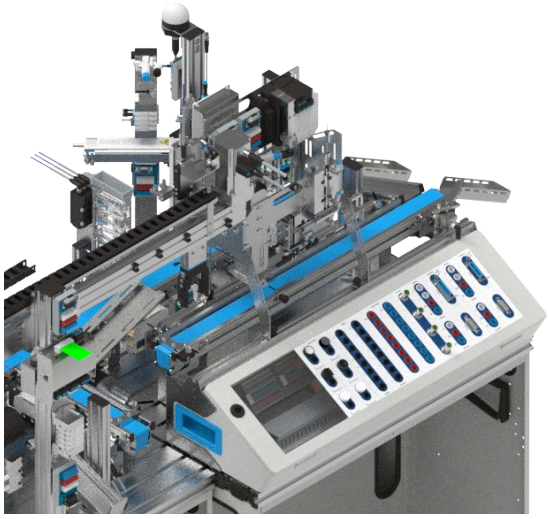
Time evaluation (only if 100% of points is achieved for PLC with WP selection by Experts and simulation box function and at least 66,67% points each for judgement in professional practice, HMI design)

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Mechanical Part

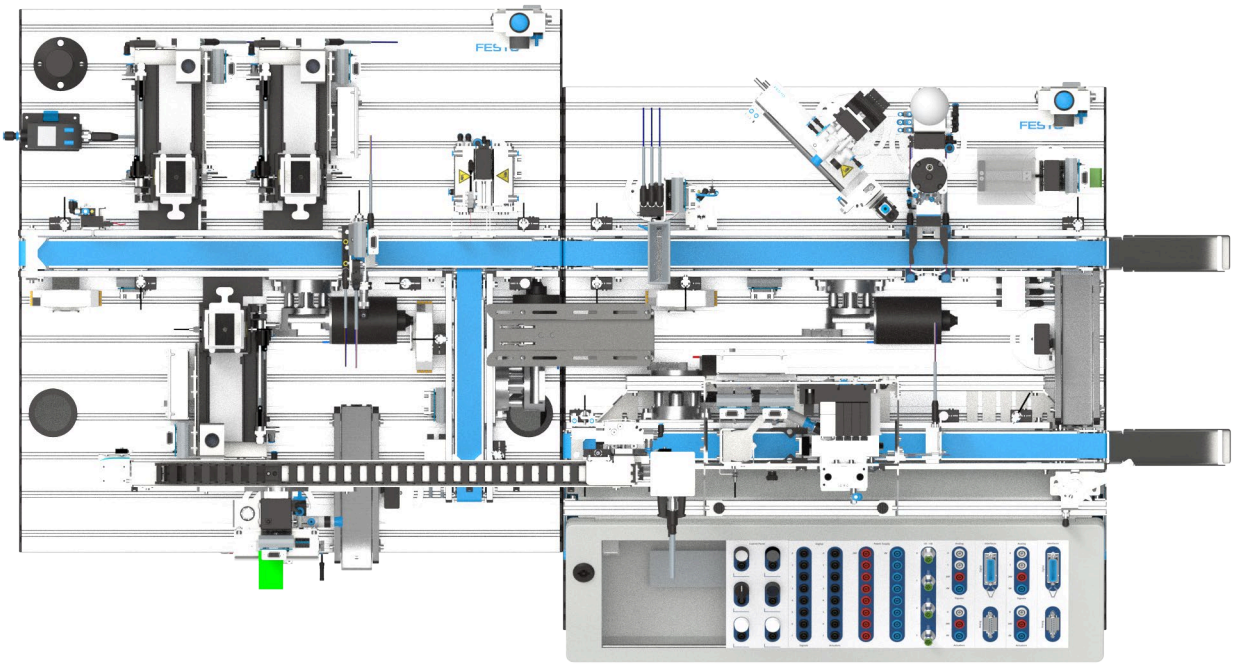
Production line layout

SYSTEM LAYOUT VIEW FROM RIGHT HAND SIDE	SYSTEM LAYOUT VIEW FROM LEFT HAND SIDE
	
1. 3-Magazine Station (3MS)	2. Skills Conveyor Station (SCS)
3. Module Ball Filling	4. Module Scale
5. Slide in 3MS	6. Pick and Place

DETAILS OF SKILLSCONVEYOR STATION (SCS)	
	

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SYSTEM LAYOUT – TOP VIEW

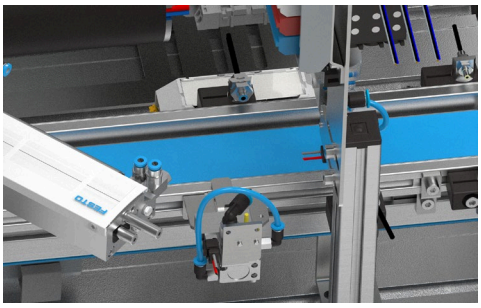
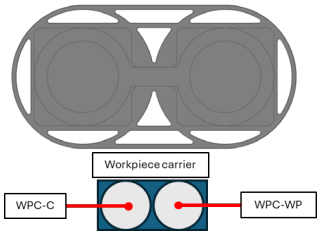
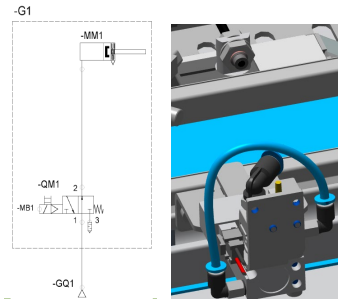


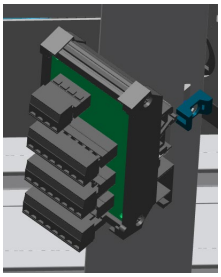
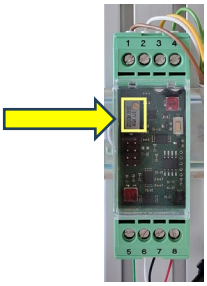
Definition of Stack Magazines[1]

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 [gr]/ Volt [V] (0-10V) (without balls)	**12,2 gr / 1,22 V**	**12,2 gr / 1,22 V**	**13,2 gr / 1,32 V**
Tolerance	**+- 1g / +- 0,1V**	**+- 1g / +- 0,1V**	**+- 1g / +- 0,1V**
Number of balls	2	4	6

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Different views

KOMBI L&T-P&P-STOPPER-BALL FILLING	WORKPIECE CARRIER/CARRIER	STOPPER AT CONVEYOR
		

ASSEMBLY OF IO-LINK DEVICE PLACE OF ASSEMBLING AT MODULE P&P	INLAY FOR WEIGHT ERROR	REFERENCE PART FOR SCALE (61GR)	POTI FOR AMPLIFIER AT SCALLING MODULE
			

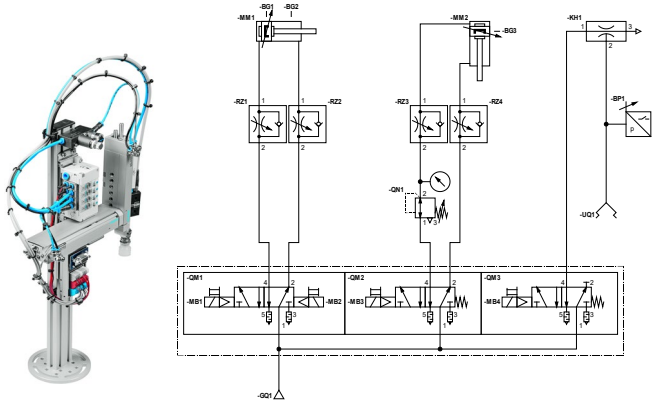
Electrical part

Communication and bit pattern code between Stepper Motor controller and PLC

BIT 0	BIT 1	STROBE/START	DEFINITION	ACTION
0	0	I	Ref.	Reference Drive
I	0	I	Pos 1	Place WP on SkillsConveyor (P9)
0	I	I	Pos 2	Pickup WP from conveyor 300mm (P7)
I	I	I	Pos 3	Place WP on Slide (P16)

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Details of Module: Pick and Place Vakuum Gripper and wiring allocation Mini-Terminal

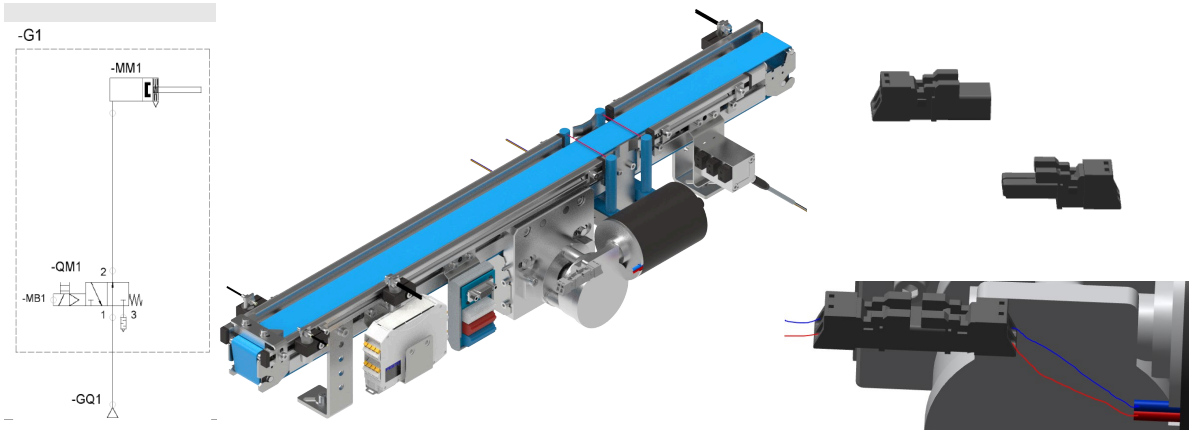


PIN ON SUB-D	COLOUR DIN47100	PIN I/O MINI-TERMINAL	PIN - FUNCTION	PIN I/O TERMINAL FILL IN	FUNCTION VIA IO LINK
1	White	1	I0		Gripper (slide) is retracted
2	Brown	7	Q0		Move gripper back (retract slide)
3	Green	2	I1		Gripper (slide) is extended
4	Yellow	8	Q1		Move gripper forward (extend slide)
5	Grey	3	I2		Gripper (Z-axis) is up
6	Pink	9	Q2		Move gripper (Z-axis) down
7	Blue	4	I3		Vacuum is okay (on/active)
8	Red	10	Q3		Vacuum on
9	Black	5	AI0		Not used
10	Violet	6	AI1		Not used
11	Grey-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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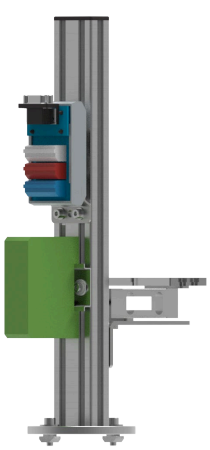
Details of Module: Conveyor 700x 40 and wiring allocation mini terminal

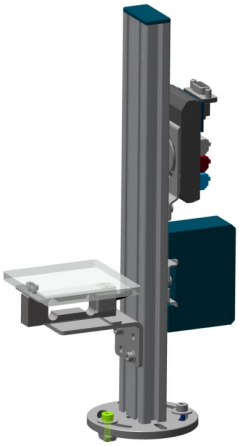


PIN ON SUB-D	COLOUR DIN47100	PIN I/O MINI-TERMINAL	PIN - FUNCTION	PIN I/O TERMINAL FILL IN	FUNCTION	POS
1	White	1	I0		WP at conveyor start/right	14
2	Brown	7	Q0		run belt to right hand side direction	
3	Green	2	I1		WP at right light barrier	15-R
4	Yellow	8	Q1		run belt to left hand side direction	
5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

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Details of Module: Scaling and wiring allocation Mini-Terminal.



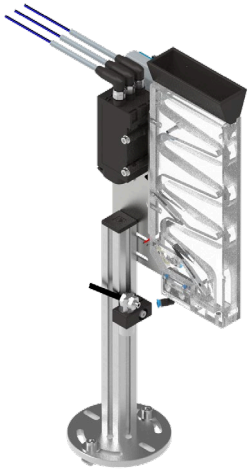


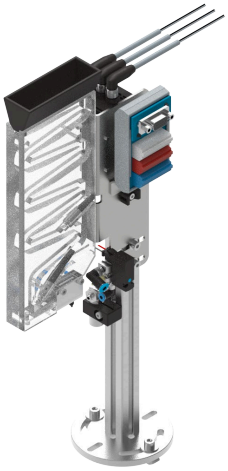


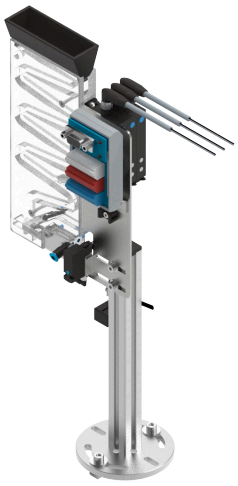
PIN ON SUB-D	COLOUR DIN47100	PIN I/O MINI-TERMINAL	PIN - FUNCTION	PIN I/O TERMINAL FILL IN	FUNCTION
1	White	1	I0		Not used
2	Brown	7	Q0		Set Tare (Zero)
3	Green	2	I1		Not used
4	Yellow	8	Q1		Not used
5	Grey	3	I2		Not used
6	Pink	9	Q2		Not used
7	Blue	4	I3		Not used
8	Red	10	Q3		Not used
9	Black	5	AI0		Analogue value (weight)
10	Violet	6	AI1		Not used
11	Grey-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		

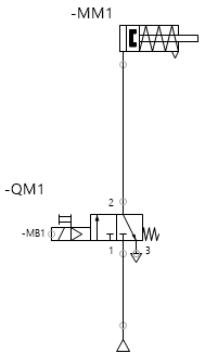
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Details of Module: Ball Filling and wiring allocation Mini-Terminal









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: filling level low
2	Brown	7	Q0		Extend cylinder
3	Green	2	I1		Optical sensor: not empty
4	Yellow	8	Q1		Not used
5	Grey	3	I2		WP on conveyor for filling
6	Pink	9	Q2		Not used
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	Grey-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 (Station 2 - SCS)

FRONT PLATE INTERFACE XG1: I/O TERMINAL: -XG10 (IN), SIGNAL INDICATES	
DI 0 – DO 7: no changes (see Task B)	

Front plate Interface XG1: I/O Terminal: -XG11 (OUT), signal set	
DO 0 – DO 7: no changes (see Task B)	

FRONT PLATE INTERFACE XG3: I/O TERMINAL: -XG12 (IN), SIGNAL INDICATES	
DI 0 – DI 2: Module Lift Turn: no changes (see Task B)	
DI 3: Module Lift Turn: Gripper at Module Scalling	
DI 4: Module Ball filling: optical sensor: filling level low	
DI 5: Module Ball filling: optical sensor: not empty	
DI 6: Module Ball filling: WP on conveyor for filling	

FRONT PLATE INTERFACE XG3: I/O TERMINAL: -XG13 (OUT), SIGNAL SET	
DO 0: Module Conveyor 700: Extend stopper	
DO 1: Module Scale: Set Tare (Zero)	
DO 2: Module Ball filling: Extend cylinder	

FRONT PLATE INTERFACE XG2 VIA XG10: I/O TERMINAL ANALOG: (IN) MEASURING VIA EXT. CONNECTORS	
AI 0: Module Identification: Optical sensor (height sensor analogue)	No.0: Measuring with the multimeter: red reference WP upside down = (5,5V +/- 0,2 V)
AI 1: Module scale: analogue value	No.1: Measuring with the multimeter: Aluminum reference WP = 61g (6,1V +/- 0,1 V)

FRONT PLATE IO-LINK TERMINAL -XG5 VIA XG14	
Module Assembling:	

FRONT PLATE IO-LINK TERMINAL -XG6 VIA XG15	
Module IO-Link Lamp	

FRONT PLATE IO-LINK TERMINAL -XG7 VIA XG16	
Module Pick&Place	

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Control Part

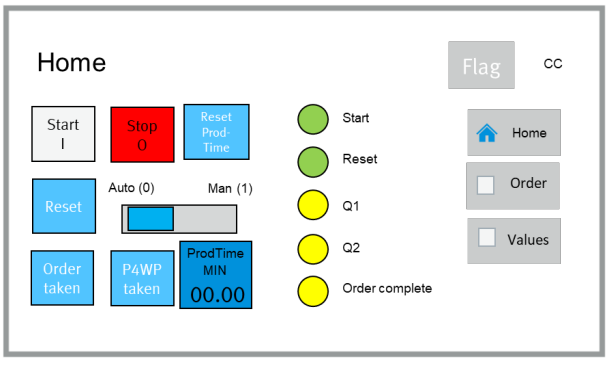
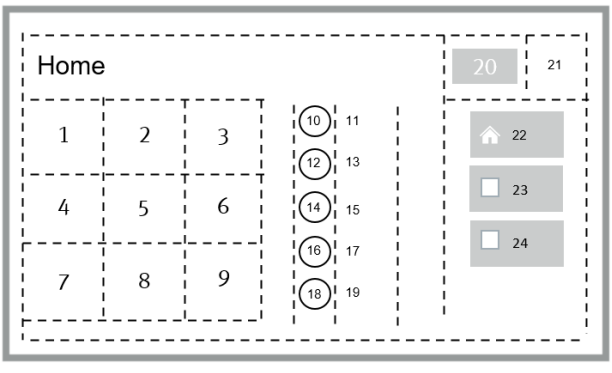
Initial position

3-MAGAZINE STATION (3MS) ==> SEE TASK B

SKILLS-CONVEYOR-STATION (SCS): WITHOUT PALLET
Module Conveyor700: Motor off, Stopper extended, empty (not relevant during the process, only for the initial position run)
Module SkillsConveyor: Switch open, Motor off, empty (not relevant during the process, only for the initial)
Module Lift and Turn: Gripper closed, Gripper up, Gripper at Position Conveyor 700 (P15)
Module Assembling: Magazine empty (not relevant during the process, only for the initial position run), Gripper up, Gripper open, Gripper retracted, Stopper extended
Module Pick and Place: Vacuum off, Gripper up, Gripper retracted
Module Ball Filling: filled with balls, slider retracted

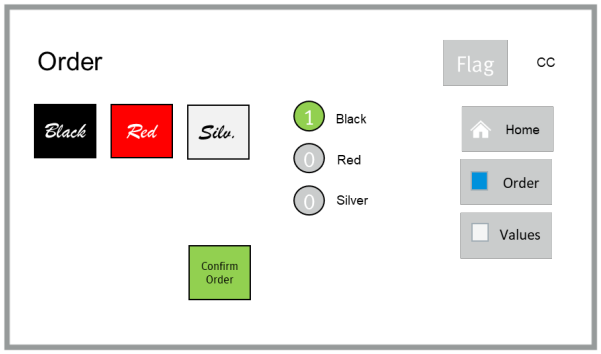
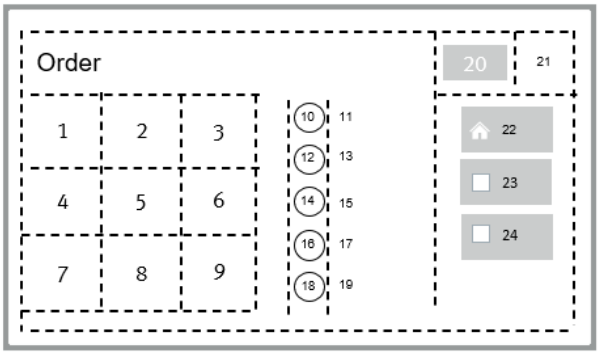
HMI Design and Function

Page“Home”

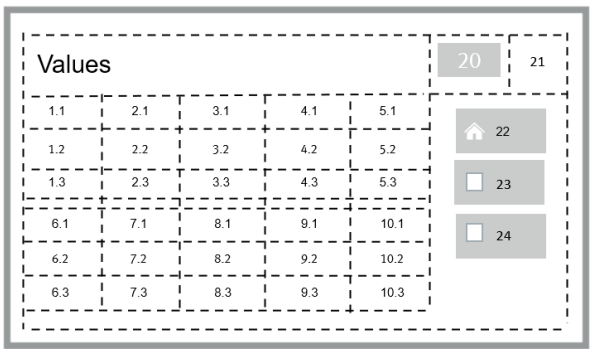
PAGE “HOME”	FIELD NO
	

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Page “Order”

HMI – DESIGN PAGE “ORDER”	FIELD NO
	

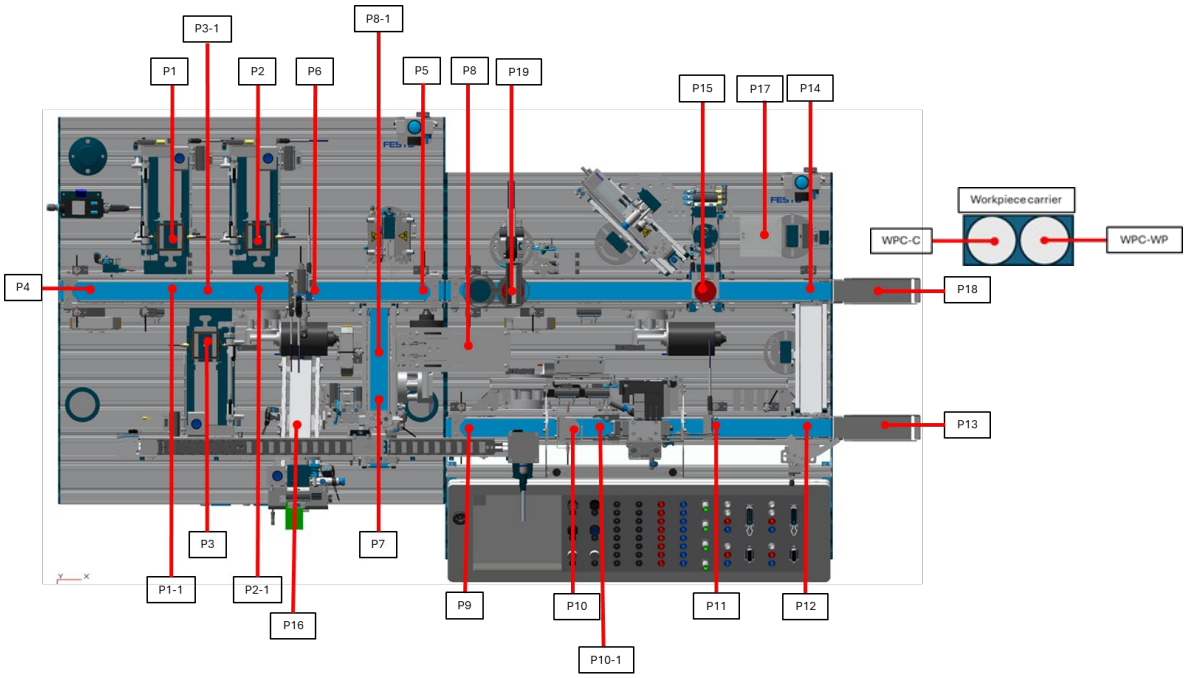
Page “VALUES”

HMI – DESIGN PAGE “VALUES”	FIELD NO
	

FIELD	TEXT	FUNCTION	SHAPE	COLOUR
4.1	No. of Balls	Label		Text: black
4.2	00	Dynamic value	Rectangle	Fill: blue Text: black
4.3	PCS	Label		Text: black
9.1	Weight	Label		Text: black
9.2	00.00	Dynamic value	Rectangle	Fill: blue Text: black
9.3	g	Label		Text: black

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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 B10 = P4WP 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 L18 = P4WP taken L19 = IO-Link lamp	WP1 = black WP2 = red WP3 = silver WPX = Any wrong workpiece (wrong according to the selection) WP usd = workpiece upside down WP+C = workpiece with cap WP+C+B = workpiece with cap and balls WPC: Workpiece Carrier: WPC-C: place for cap WPC-WP: place for WP

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