Lift

Program and implement for a PLC the time-delay, counting and memorisation functions of a GRAFCET.
1. Presentation of the equipment

This equipment, managed by a programmable logic controller (PLC), simulates the operation of a building lift model serving five levels. It is used to understand the programming and implementation of a PLC and to study the various functions of a grafcet.

The elevator is made up of an operative part and of a control part mounted on a support equipped with cables for connection to the operative part.

1.1 Composition

- The operative part represents a five-level elevator model equipped with:
  - Call pushbuttons (on the landings and in the cabin)
  - Door closure detectors
  - Cabin position sensors
  - Limit switch sensors
  - A display
  - An emergency stop button
- The control part consists of a PLC (TSX Micro or TSX Twido according to option) containing the module operating program.
1.2 Data

- Mechanical data
  - Control part
    - Height: 300 mm; Width: 470 mm; Depth: 540 mm
    - Weight: 5 kg
  - Operative part
    - Height: 1015 mm; Width: 615 mm; Depth: 635 mm
    - Weight: 24 kg

- Electrical data
  - The bench is supplied by a single-phase 230 VAC electrical network
  - Voltage: 230 VAC + single-phase earth ± 10 %
  - Frequency: 50/60 Hz ± 5 %
  - Output power supply: 24 VDC 2 A
  - 2P + earth socket connection
  - Power absorbed: 130 VA
  - Protection class: I
  - The electrical network must contain, upstream of the bench, an RCD (Residual Current Device) with a sensitivity ≤ 30 mA class AC (not supplied).

- Technical data of the main components
  - TSX Micro PLC or TSX Twido PLC (according to option)
  - Sensors: 2 limit switch sensors, 5 cabin detectors, 5 door detectors
  - Two flat connection cables: 37 and 25 conductors
1.3 **Main functions**

The teaching equipment is designed to simulate operation of a building lift model serving five levels with landing door contacts, cabin detection at each floor, floor call buttons in the cabin and on each landing, together with a numerical display.

The equipment can be used in manual mode; manual control of the cabin, action on the pushbuttons.

The control part is used to program elevator operation: automatic return journey of cabin, stopping at a floor, floor number display.
2. Teaching

2.1 Presentation of teaching

- The teaching objective of the "lift" equipment is to treat the programming and implementation of a PLC and to study the grafcet.
- The "lift" equipment is used to:
  - Learn how to implement a PLC
  - Study the grafcet: time delay, counting and memorisation functions
  - Manage priorities and distribute tasks
  - It is intended for the following channels:

<table>
<thead>
<tr>
<th>Professional</th>
<th>High school</th>
<th>University Engineering school</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical engineering</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Industrial Computing Automation</td>
<td></td>
<td>☐</td>
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<tr>
<td>Mechanical engineering</td>
<td></td>
<td></td>
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<tr>
<td>General education</td>
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<td></td>
</tr>
</tbody>
</table>

- Exercises that can be performed using the "elevator" equipment:
  These consist of a teacher's document with answers and a trainee document.

- Introductory exercises
  - Exercise 1: Cabin manual control
    - Transcription of an operating analysis into an electrical diagram
    - Programming of a electrical diagram in "LADDER" graphic language
  - Exercise 2: Moving the cabin by brief action on the pushbuttons
    - Carrying out a memory function by self-supply contact
  - Exercise 3: Automatic return journey of the cabin (see example on page 8)
    - Use of SEQUENTIAL and POSTERIOR processing operations
  - Exercise 4: Cabin return journey with stopping at the fifth floor
    - Programming a time delay relay
    - Modification of a program (SEQUENTIAL and POSTERIOR processing operations)
- Exercise 5: Operation with blocking
  - Production of a grafcet with sequence selection
  - Programming operation of the lift using operation with blocking
  - Working on internal bit variables

Summarising exercises.
- Exercise 1: Blocking operation
  - Work on words
  - Program skip.
  - Programming an operation with blocking on the lift by using the internal words.
- Exercise 2: Collective down operation
  - Programming a collective down operation of the lift
  - Use of work on words
- Exercise 3: Collective Up - Down operation
  - Using work on words: comparison block, operation block
  - Implementation of complete operation of the lift
- Exercise 4: Stop processing, floor number display (complete program)
  - Programming the 7-segment displays
  - Using the "bit string" variable"
2.2 Teaching example

Introductory hands-on exercises - Automatic return journey of cabin

**Variables used**

<table>
<thead>
<tr>
<th>Description</th>
<th>Sensors / Actuators</th>
<th>PLC addresses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabin pushbutton floor 1</td>
<td>S1</td>
<td>%I 3.1</td>
</tr>
<tr>
<td>Cabin at 1st floor</td>
<td>D1</td>
<td>%I 1.2</td>
</tr>
<tr>
<td>Cabin at 5th floor</td>
<td>D5</td>
<td>%I 1.6</td>
</tr>
<tr>
<td>Up</td>
<td>KM1</td>
<td>%Q 2.0</td>
</tr>
<tr>
<td>Down</td>
<td>KM2</td>
<td>%Q 2.1</td>
</tr>
</tbody>
</table>
Exercise 3 - Automatic return journey of cabin

(See the online help: “Grafset, description of graphic symbols and description of specific objects”)

Introduction

- Aim of the Exercise
  - Use of SEQUENTIAL and POSTERIOR processing operations.

- Knowledge required
  - See the online help: “Grafset, description of graphic symbols and description of specific objects”.

Exercise

- Description
  - Program a GRAFCET in PL7 Micro language to allow the cabin to make a return journey.

  Operation
  - Press pushbutton S1 to start the installation. The lift will then go up to the 5th floor, stop and come back down to the 1st floor.

- Work requested
  1 - Select the grafset Programming (CHART)
  2 - Program:
     - the graph and the receptivities associated with the transitions in sequential processing,
     - the actions associated with steps in posterior processing (POST).
  3 - Transfer and check operation on the device.
  4 - View progression of the GRAFCET in connected mode and in RUN mode
  5 - Create an animation table to view evolution of outputs.
Answers to Exercise 3

- Programming
  - See the program print-out below.
- Comments
  - Sequential processing allows input of the graph and the associated transitions.
- Points to remember
  - Posterior processing is used to write the actions associated with the steps using the step bits %X0.
- Exercise 3 - program print-out

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(1): "Automatic return journey of cabin"

---

CHART - PAGG0 %X1(1)=%X2(2)

---

MARK
%4.1

SYMBOL
S_1

COMMENT: --
Cabin pushbutton floor 1

---

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Exercise 3 - program print-out (continued)

CHART - PAGE 2 \%10(2) \to \%10(3)

CHART - PAGE 0

CHART - PAGE 1 \%10(3) \to \%10(1)

CHART - PAGE 0

CHART - PAGE 1 \%10(3) \to \%10(1)

MAST-POST

("Exercise 3: Automatic return journey of cabin")

("Exercise 3")

MARK
\%2
\%Q2.0
\%Q2.1
\%32
\%30
\%1.2
\%1.1
\%1.0

SYMBOL
\%Q2.0
\%Q2.1
\%1.2
\%1.1
\%1.0

COMMENT
MIN1
UP
MIN2
DOWN
3. **Elements supplied with the equipment**

3.1 **Equipment supplied**

- Complete assembly with cables (reference MD1AE257 or MD1AE257TW according to option).
- Operative part (reference MD1AE254).
- Control part (reference MD1AE256 or MD1AE256TW according to option).
- Flat connection cables.

3.2 **Equipment not supplied**

- Programming software

3.3 **Documentation**

- Exercise manual, reference MD1AD257P or MD1AE257TW (according to option).
- A CD Rom containing:
  - the technical and teaching manual "pdf" format
  - reference Manual "pdf" format
  - PLCs Implementation Manual in the "pdf" format
  - the hands-on exercise programs for PLC

3.4 **Details**

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