INTRODUCTION TO THE NORM IEC 61131 (PLC, SOFTPLC AND SLOTPLC) AND IEC 61499 (DCS), STANDARD FOR INDUSTRIAL PROGRAMMING CONTROLLERS.
1. Concept of Industrial Automation

2....

7. Final
1. Concept of Industrial Automation

2....

7. Final

IEC 61131-3/ IEC 61499

Concept of Industrial Automation

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Overview...

LD: LADDER DIAGRAM (CONTACT DIAGRAM)

IEC 61131

READ INPUT
- CONTROL ALGORITHM
- ALARM ALGORITHM
- OPERATIONS ALGORITHM
- COMMUNICATION ALGORITHM

WRITE OUTPUT

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1....
2. Overview...
3....
7. Final

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Overview...

FDB: Functional Diagram Block

IEC 61131

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Overview...

AN "ON"
= L 0.0
A A L 0.0
AN "AUTO_MOT_BOM_AG_1"
A "MAN_MOT_BOM_AG_1"
A "A_BOMB_AG_1"
A "F1_BOM_AG_1"
A "F2_AUTO_BOM_AG_1"
= "COND_NB1"
A L 0.0
A "AO.0.ON_BOM_AG_ALI_01"
AN "RUN_MOT_BOM_AG_1"
L SST#2S
SD T 93
A L 0.0
A( 0 "FALLA_MOT_BOM_AG_1"
0 T 93
) S "A_BOMB_AG_1"
A L 0.0
A "RESET_ALARMAS_HMI_KOP"
AN "FALLA_MOT_BOM_AG_1"
AN T 93
R "A_BOMB_AG_1"
A L 0.0
A( 0 "A_BOMB_AG_1"
A "MASTABLEIS"
0 "TEST_ALARMAS"
0 "M_TEST_ALARMAS_HMI"
) = "AO.1.FALLA_BOM_AG_ALI_01"
IEC 61131-3/ IEC 61499 STANDARD FOR INDUSTRIAL PROGRAMMING

Overview...

1... 2. Overview...
3.... 7. Final

```plaintext
1  FUNCTION "RST_AUT_MAN" : VOID
2  TITLE =
3  VERSION : 0.0
4
5  VAR_INPUT
6      AUTO : BOOL ; //OIDEN DX AUTOMATICO
7      MAN : BOOL ; //OIDEN DX MANUAL
8      T_SP_AUTO : BOOL ; //SW TRANSFER SF AUTO
9      SP_AUTO : REAL ; //SP AUTO
10     T_AN_ON : BOOL ; //SW TRANSFER ANALOGA
11     SP_T_AN : REAL ; //SP TRANSFER ANALOGA
12     MV_AUTO : REAL ; //MV AUTO DEL PID
13     T_RSE_MAN : TIMER ; //TIEMPO REBOCIA A MANUAL
14     T_RSE_AUTO : TIMER ; //TIEMPO REBOCIA A AUTO
15  END_VAR
16  VAR_OUTPUT
17     A_MAN_ON : BOOL ; //A MAN ON DEL PID
18     A_MAN : REAL ; //A MAN DEL PID
19     A_SP_INT : REAL ; //A SP INT DEL PID
20  END_VAR
21  VAR_IN_OUT
22     TEMP_AUTO : BOOL ;
23     T_RSE_BIT_MAN : BOOL ;
24     T_TEE_BIT_AUTO : BOOL ;
25     DE_HST_MAN : REAL ;
26     DE_SP_AUTO : REAL ;
27  END_VAR
28  BEGIN
29  NETWORK
30  TITLE =
31
32      UN = "ON";
33      UN = "L 0.0;
34      UN = "L 0.0;
35      UN = "L 0.0;
36      UN = "L 0.0;
37      UN = "L 0.0;
38      UN = "L 0.0;
39      UN = "L 0.0;
40      UN = "L 0.0;
41  END_FUNCTION
```

IEC 61131

ST: Structured Text
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Overview...

1....

2. Overview...

3....

7. Final

IEC 61131

SFC: Sequencial Function Charts

READ INPUT

- CONTROL ALGORITHM
- ALARM ALGORITHM
- OPERATIONS MODES ALGORITHM
- COMMUNICATION ALGORITHM

WRITE OUTPUT
Overview…

IEC 61499

CFC: Continuous Function Charts or ECC: Executions Function charts
IEC 61131-3/ IEC 61499 STANDARD FOR INDUSTRIAL PROGRAMMING

Enviroment…

Oriented to Sampled and Hold Theorem (User Cycle)

Oriented to Process (Flow Diagram)

Programming
Esp. Engineer

Process
Engineer

CFC (IEC 61499)

LD (IEC 61131)

ST

FDB

SFC (IEC 61131)

More Friendly
More Memory
Processor

READ INPUT
- CONTROL ALGORITHM
- ALARM ALGORITHM
- OPERATIONS MODES ALGORITHM
- COMMUNICATION ALGORITHM

WRITE OUTPUT

2....
3. Enviroment
4....
7. Final

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1/5. **CONTROL GOAL:** Start and stop a Induction motor by mean of a retention scheme implemented with a PLC.

2/5. **INPUTS/OUTPUTS TABLE:**

<table>
<thead>
<tr>
<th>Input</th>
<th>Description</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1</td>
<td>SB0 - STOP PULS</td>
<td>NC</td>
<td>1</td>
</tr>
<tr>
<td>I2</td>
<td>SB1 - START PULS</td>
<td>NO</td>
<td>0</td>
</tr>
<tr>
<td>I3</td>
<td>QM1 - BREAKER</td>
<td>NO</td>
<td>1</td>
</tr>
<tr>
<td>I4</td>
<td>AUXKM1 - OF KM1</td>
<td>NO</td>
<td>0</td>
</tr>
<tr>
<td>I5</td>
<td>FR1 - OVERLOAD</td>
<td>NO</td>
<td>1</td>
</tr>
<tr>
<td>Q1</td>
<td>KM1 - CONTACTOR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q2</td>
<td>HL1 - LIGHT KM1 FUNCTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q3</td>
<td>HL2 - LIGHT FR1 FAULT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q4</td>
<td>HL3 - LIGHT QM1 FAULT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3/5. PLC CONNECTING

Example...
Example...

4. Basic Programming concept by means of an example
4/5. LADDER DIAGRAM.

Segment 1

Segment 2

Segment 3

Segment 4

5/5. ANOTHER PRESENTATIONS

Segmento 1

Segmento 2

Segmento 3

Segmento 4

3....

4. Basic Programming concept by means of an example

5....

7. Final
3....

4. Basic Programming concept by means of an example

5....

7. Final
3....

4. Basic Programming concept by means of an example

5....

7. Final

4/5. LADDER DIAGRAM.

5/5. ANOTHER PRESENTATIONS

KM1 = (SB1 Or AUXKM1) And SB0 And QM1 And FR1

HL1 = AUXKM1

HL2 = Not(FR1)

HL3 = Not(QM1)
3....

4. Basic Programming concept by means of an example

5....

7. Final
4/5. LADDER DIAGRAM.

3....

4. Basic Programming concept by means of an example

5....

7. Final

5/5. ANOTHER PRESENTATIONS

IF ((SB1 Or AUXKM1) And SB0 And QM1 And FR1) THEN
   KM1 = 1
ELSE
   KM1 = 0
END IF

IF  AUXKM1 THEN
   HL1 = 1
ELSE
   HL1 = 0
END IF

IF Not(FR1) THEN
   HL2 = 1
ELSE
   HL2 = 0
END IF

IF Not(QM1) THEN
   HL3 = 1
ELSE
   HL3= 0
END IF

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IEC 61131-3/ IEC 61499 STANDARD FOR INDUSTRIAL PROGRAMMING

Standard IEC 61131 ...

• IEC 61131 standard for normalization of programming with control stations based in PLC, SOFTPLC and SLOTPLC.
• Originally, part of IEC 65.
• Standard since August of 1992.
• PLCOPEN (www.plcopen.org) is Technical support of norm.

It consists of eight sections:

Section 1. General information of the norm.
- Definitions and glossary of the norm.
- Define the functional structure of the Industrial Control Station (inputs, outputs, basic communication to programming, memory and electrical connections)

Section 2. Specifications and test of equipments.
- Define electricals, mechanical and functionals requires.
- Define information supplies for the manufacturers.
- Define methods and procedures to test equipments quality.
Section 3. Programming Languages: Interface between programmer and control system.
- Define Programming languages to more frequently use, syntactics y semantics rules, the fundamental instructions set, test and application media and equipment.


Section 5. Communications: Services for communication between programmer and final user.
- Define digital communication between a controller in real time (PLC, SoftPLC o Slot PLC) y a device that support IEC 61131-3 standard. Not define, the communication in DCS or decentralized periphery (Remote I/O).
  - Define data consistency.
  - Define diagnostic information and hardware status present to final user.
Section 6. In study.

Section 7. Fuzzy Control:
- Define basics elements of this strategy.

Section 8. Guides to application and implementation of programming languages.
- Oriented to software’s implementers.
Commons Elements and Programming Language...

- **Data Type**: Booleans, Integers, Reals, Byte, Word, Time Stamp (date), Strings y users data types.
- **Tags**: For explicit address or control hardware (inputs, outputs, memory, etc.). Define like locals or globals.
- **Software Model**: Define Configuration, Resources and Tasks.
- **Program Organization Units (POUs)**: In functions (ADD, ABS, SQRT, SIN, COS, etc.), Bloques de Función (FBs), Programm Blocks.
- **Flow Chart or Sequential Function (SFC)**.

- **LD**: Ladder Diagram or Electric Contact diagram.
- **IL**: Instructions List (Pseudo-assembler)
- **FBD**: Functional Blocks Diagrams or electronic logic gates
- **ST**: Structured Text, based in Pascal.

Courtesy of www.plcopen.org
Software’s Model: Configuration, Resource and tasks.

4....

5. Standard IEC 61131....

6....

7. Final

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Courtesy of www.plcopen.org
How use the norm/standard?

**Direct Implementation:** By means of Manufactures software

**By means of thirds:**

**CoDeSys: The standard in controller and PLC programming according to IEC 61131-3**

CoDeSys (Controller Development System) is a comprehensive software tool for industrial automation technology. Basically it consists of two parts: the programming system CoDeSys and the runtime system CoDeSys SP. The runtime system turns any device into an IEC 61131-3 controller programmable with CoDeSys. Integrated compilers make sure that the program code is processed with optimal speed.

- The application development Workbench provides all of the internationally standard IEC61131 control languages.
- The ISaGRAF series of toolkits give you the ability to write your own I/O drivers, add market specific function blocks, connect to higher level systems, or conveniently brand label the product. This becomes a unique packaging or your own value added intellectual property.

www.3s-software.com

www.isagraf.com
The **Model-View-Control (MVC)** approach has become a popular design pattern. In the MVC pattern, the system is first modeled and visualized, then the controller is developed and tested, and later the model of the plant is substituted by interfaces to the real plant.

**a. Steps:**
- Development of Models of the plant (continuous/discrete) and of the controller
- Build a sound visualization
- Build a Human Machine Interface
- Simulate the System

**b. Results:**
- Model of the System (uncontrolled Dynamics, Structure, Interface)
- System is controlled (Control, HMI, Visualization)
- Simulation runs on PC
- Model is then to be substituted with Service Interface Function Blocks
7. Final

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Thanks you

Adolfo Ortiz Rosas  www.colplc.com