Embedded System Design Techniques™

Building Your Own Internet Connected PLC

Class 1: PLC Fundamentals

April 23rd, 2018

Jacob Beningo

Presented by:

DesignNews

CEC CONTINUING EDUCATION CENTER

Digi-Key ELECTRONICS

Course Overview

Topics:

- **PLC Fundamentals**
- Designing a PLC
- PLC Software Design Part 1
- PLC Software Design Part 2
- PLC Application Design

The Lecturer – Jacob Beningo

Jacob Beningo

Principal Consultant

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- : Jacob_Beningo
- : Beningo Engineering
- : JacobBeningo
- EDN : Embedded Basics
- ARM Connected Community

Consulting

- Advising
- Coaching
- Content
- Consulting
- Training

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www.beningo.com

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Jacobs CEC Courses

CEC 2013 – 2015

- Fundamentals of Embedded Software (2013)
- Mastering the Software Design Cycle (2014)
- Python for Embedded Systems(2014)
- Software Architecture Design (2014)
- Baremetal C (2015)
- Mastering the ARM Cortex-M Processor (2015)
- Writing Portable and Robust Firmware in C (2015)
- Design Patterns and the Internet (2015)

CEC 2016 - 2017

- Bootloader Design for MCUs (2016)
- Rapid Prototyping w/ Micro Python (2016)
- Debugging (2016)
- Professional Firmware (2016)
- API's and HAL's February 2017
- Baremetal to RTOS April 2017
- Designing IoT Sensor Nodes July 2017
- From C to C++ October 2017

CEC 2018

- Connecting Edge Devices (March 2018)
- Building an IoT Connected PLC (April 2018)

Side Topics 2018

- Bootloader Design
- RTOS Workshop
- Debugging Techniques

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Session Overview

- Introduction
- PLC Ladder Logic
- PLC Ladder Execution

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Introduction

Definition:

A Programmable Logic Controller (PLC) is a ruggedized computer used to automate a specific process in an industrial application.

i.e. Assembly lines, amusement rides, electrical automation

Introduction

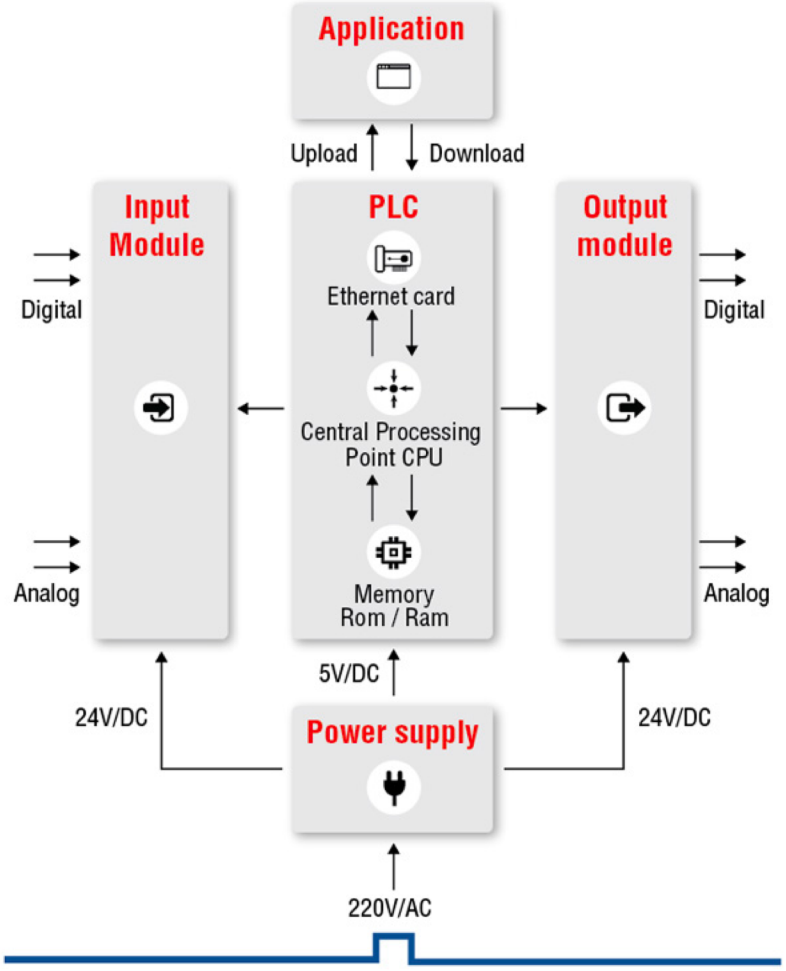


Image Source:
unitronicspic.com

Introduction

Introduction

PLC Ladder Logic

Ladder logic (LD) is a visual schematic like language that incorporates the machine logic on how the controller will be behave.

- IEC 61131-3 defines the PLC Logic symbols
- Designed for technicians
- A useful reference for PLC design is plcacademy.com

PLC Ladder Logic

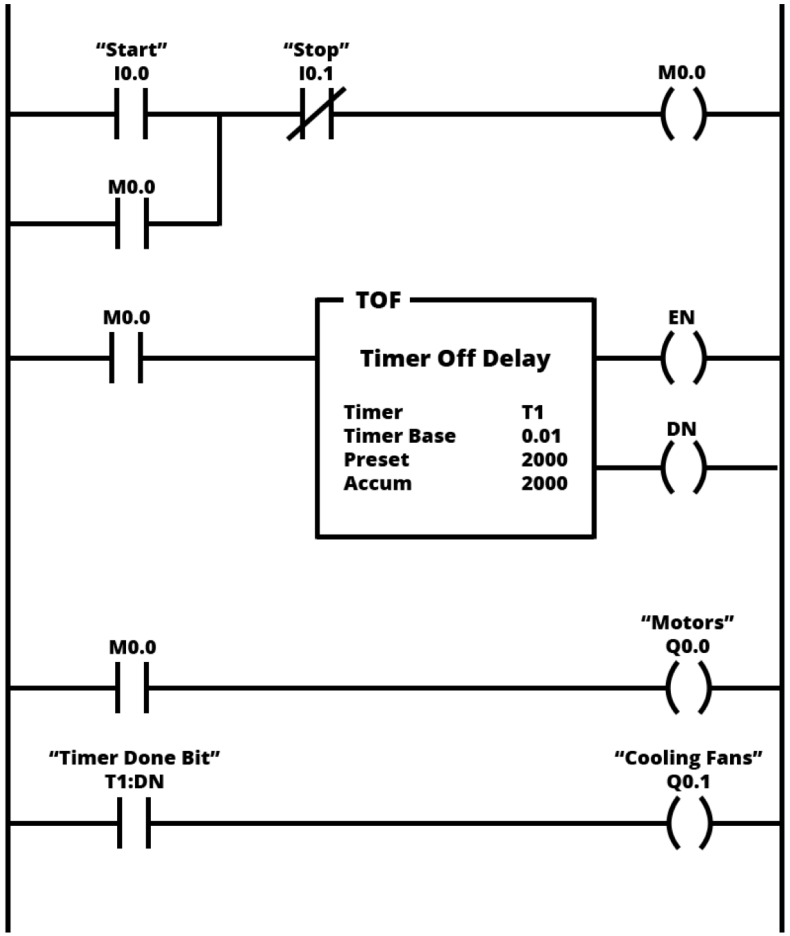
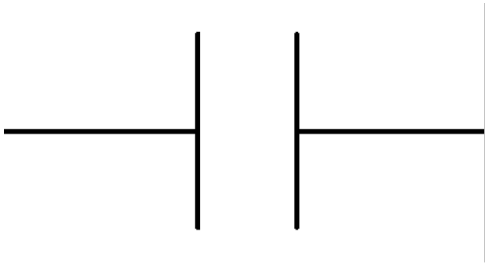


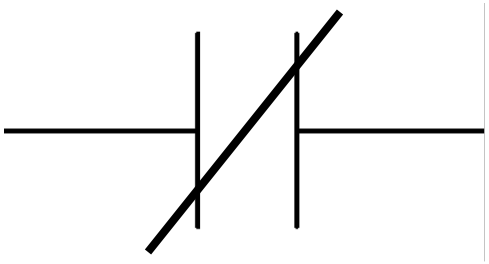
Image Source:
plcacademy.com

PLC Ladder Logic



Normally Open Contact

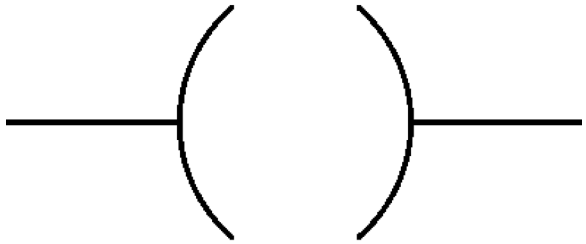
(if closed)



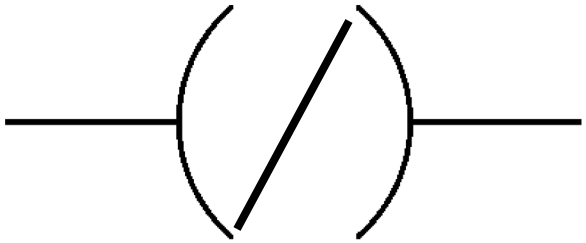
Normally Closed Contact

(if open)

PLC Ladder Logic



Coil (Output)



Coil Negate (Output)

PLC Ladder Execution

How is the ladder executed?

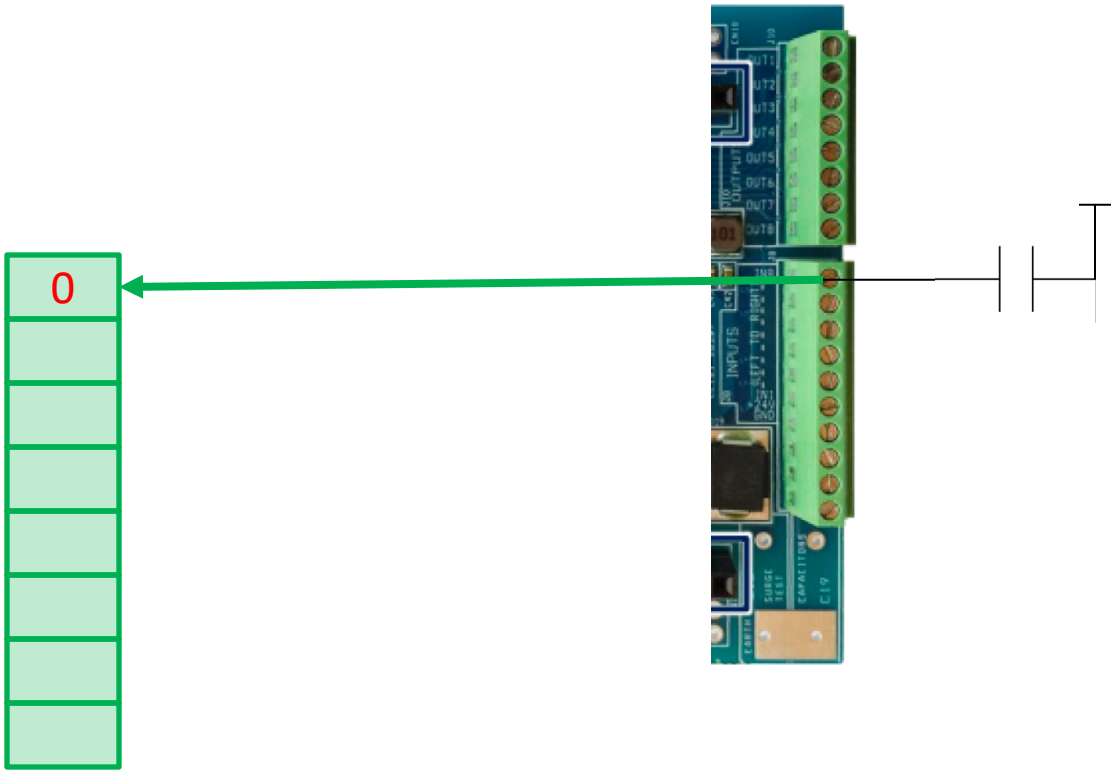
1) Inputs are scanned
2) Logic is executed
3) Outputs are set
4) Other activities are completed
5) Repeat

Typical scan time is ~ 1 ms

PLC Ladder Execution

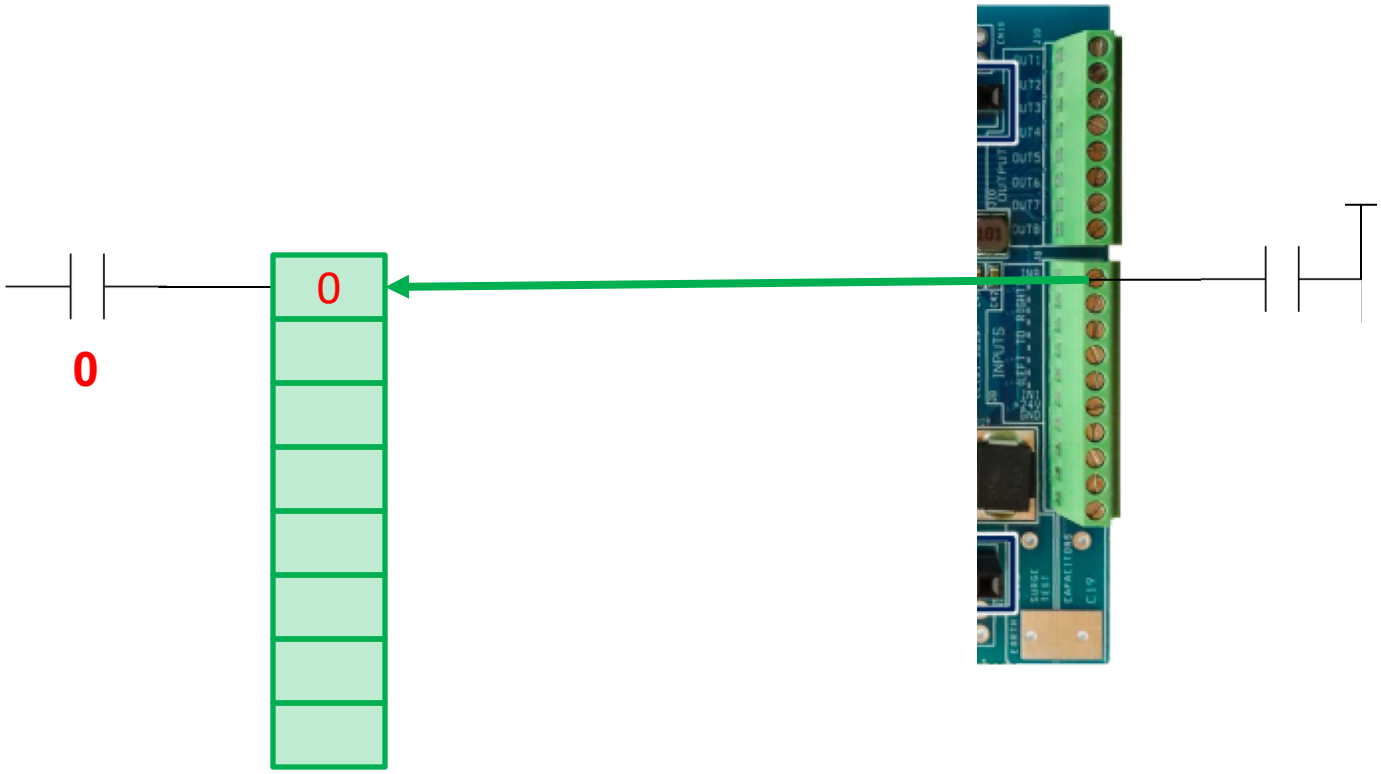
1) Scan the inputs

0 – Switch is open
1 – Switch is closed



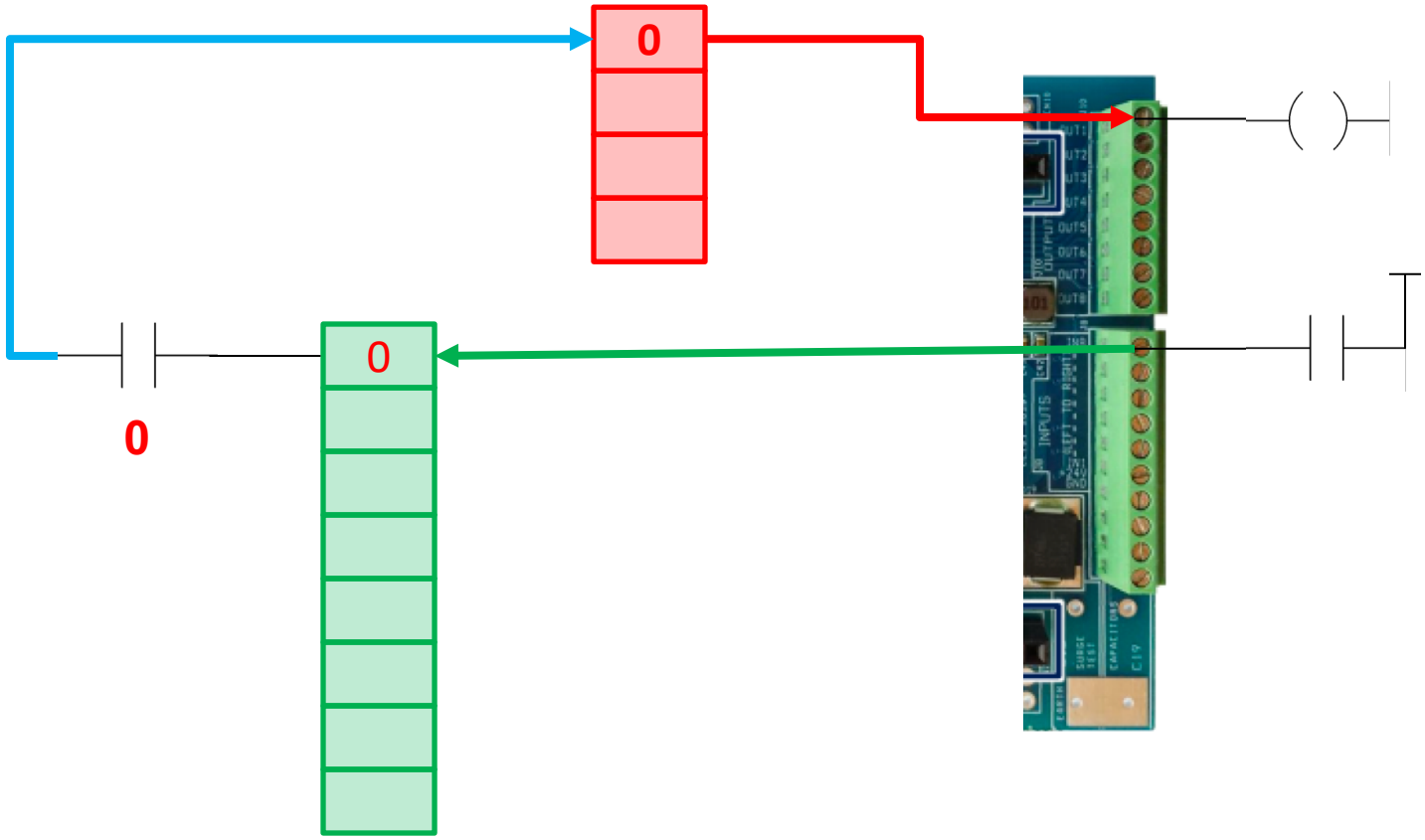
PLC Ladder Execution

2) Execute the Logic

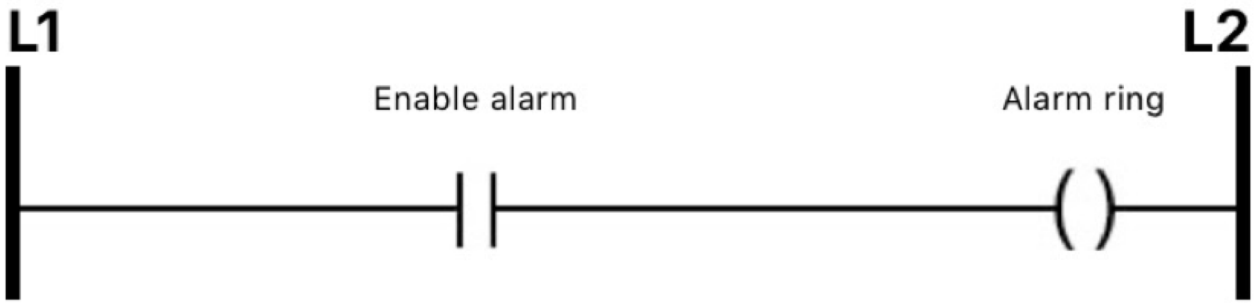


PLC Ladder Execution

3) Set the outputs



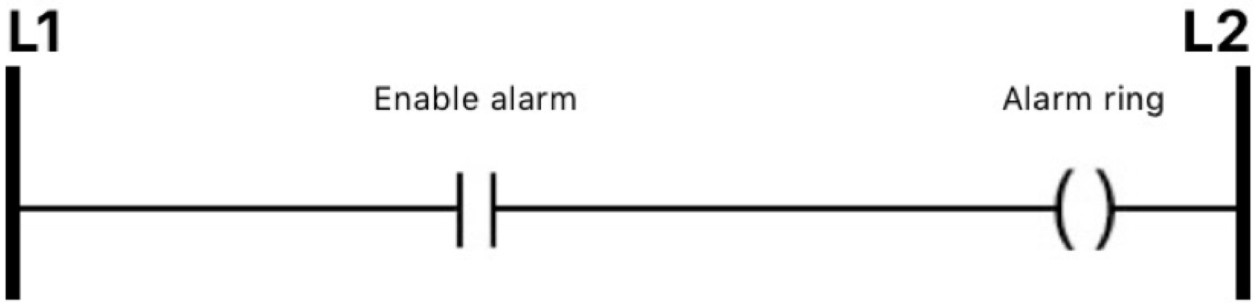
PLC Design Patterns



Execution Sequence

1) If Enable alarm is closed, input is 1
2) Output will be set to 1

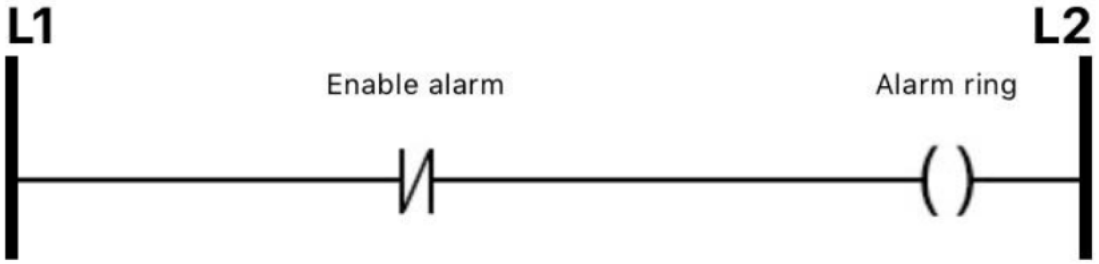
PLC Design Patterns



Execution Sequence

1) If Enable alarm is open, input is 0
2) Output will be set to 0

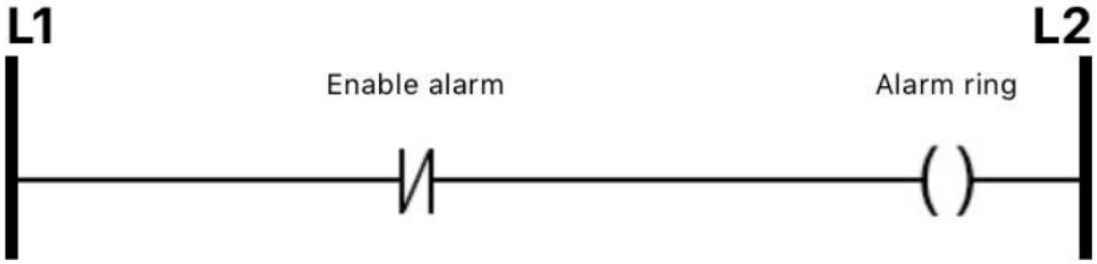
PLC Design Patterns



Execution Sequence

1) If Enable alarm is **closed**, input is 0
2) Output will be set to 0

PLC Design Patterns



Execution Sequence

1) If Enable alarm is open, input is 1
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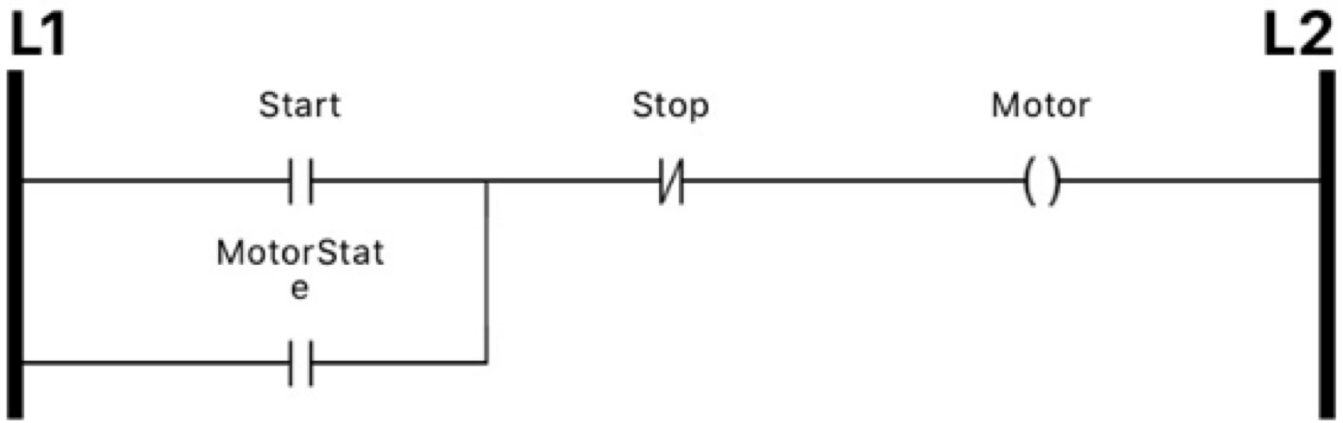
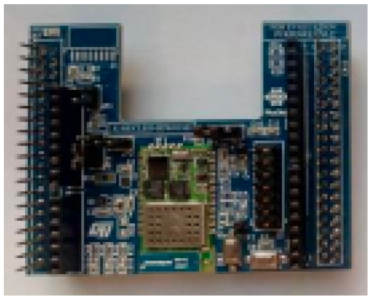
PLC Design Patterns



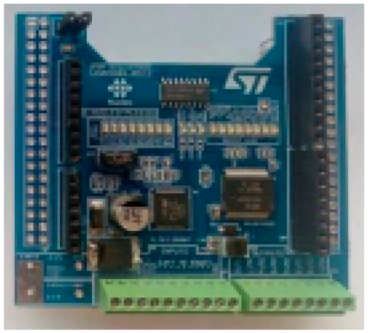
What You will need …

Nucleo-401RE

X-Nucelo-IDW01M01



X-Nucelo-PLC01A1



X-Nucleo-OUT01A1

Power Supply

A light snack …

Additional Resources

- Download Course Material for
  - C/C++ Doxygen Templates
  - Example source code
  - Blog
  - YouTube Videos
- Embedded Bytes Newsletter
  - http://bit.ly/1BAHYXm

From www.beningo.com under

- Blog > CEC – Building Your own Internet Connected PLC