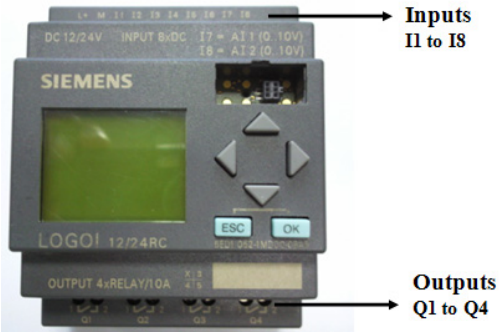
معهد التكنولوجيا التطبيقية

INSTITUTE OF APPLIED TECHNOLOGY

PLC

Module 3:
Hardware and Terminology



PREPARED BY

IAT Curriculum Unit

Jan 2010

Module 3:
Hardware and Terminology

Module Objectives

Upon successful completion of this module, students should be able to:

1. demonstrate understanding of the various PLC models and the LOGO! features.
2. define which areas of application are particularly important as far as digital mini controllers in industry and trade are concerned.
3. identify the major parts of a LOGO! in the Edutrainer Compact and describe their function.
4. demonstrate understanding of the functions and the parts of the Conveyor Belt Application.
5. connect input and ouptut devices and program the LOGO! to perform simple tasks.

Module Contents:

3.1 Introduction to LOGO! Controller

PLCs come in a variety of models, some of which are shown in figure 3.1

Figure 3.1: PLC Models

LOGO! Controller

LOGO! is a digital mini controller which is a simplified version of a PLC.

Figure 3.2: LOGO! & PLC Comparison

The Advantages of a LOGO! controller are as follows:

- Low price
- Simpler programming and less functions
- Only digital inputs and outputs
- Includes operating and display unit

LOGO! Applications

The following are examples of mini controller applications in trade and industry.

Lighting control systems

Monitoring

Door control systems

Machine control systems

Conveying devices

Irrigation technology

Figure 3.3: LOGO! Applications

3.2 PLC Hardware & Terminology

The main parts of a PLC are as shown in figure 3.4

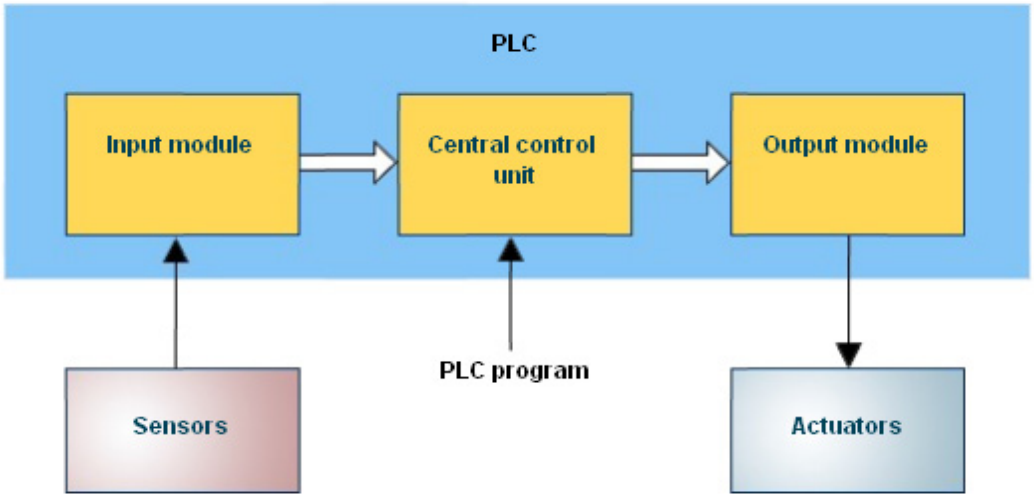


Figure 3.4: PLC Parts

Input Module

The input module consists of the digital inputs and the analog inputs.

Digital Inputs

Digital inputs recognises either the ON or OFF condition from the input sensors. Pushbuttons, toggle switches, limit switches, proximity switches are examples of sensors. Fig 3.5 shows the sensors connected to the PLC digital inputs.

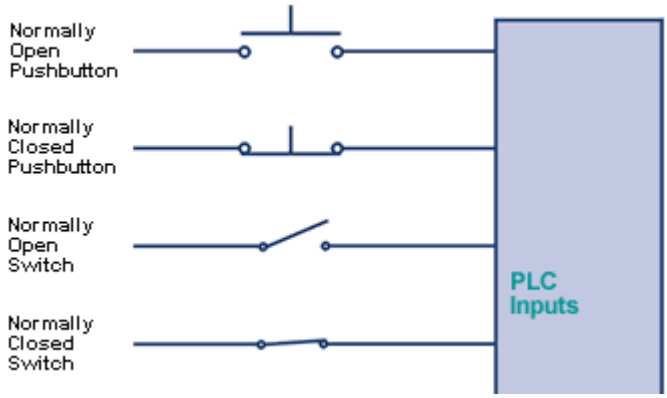


Figure 3.5: Sensors connected to PLC Digital Inputs

Analog Inputs

The PLC analog input can accept signals that are varying (analog). In the example shown, a level transmitter checks the level of liquid in the tank and provides a varying voltage to the PLC input.

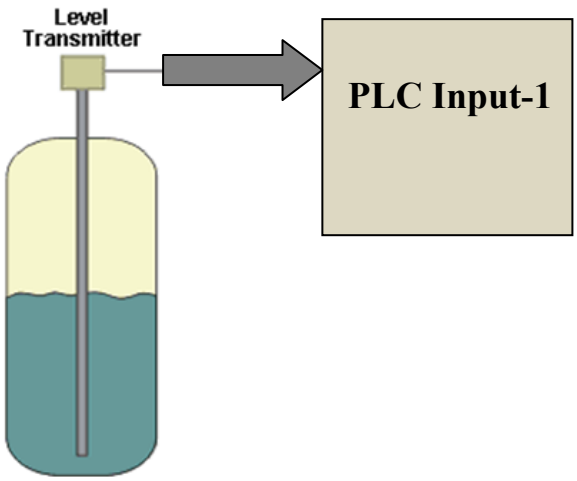


Figure 3.6:Analog Input Example

Output Module

The output module consists of digital outputs and analog outputs.

Digital Output

Digital output can either be ON or OFF. Solenoids, contactor coils and lamps are usually connected to digital outputs. In the example shown in fig 3.7 the lamp can be turned ON or OFF by the PLC output.

Figure 3.7: Digital Output Example

Analog Output

The analog output gives a varying signal that could drive an analog meter. Examples of analog meter outputs are speed, weight, and temperature.

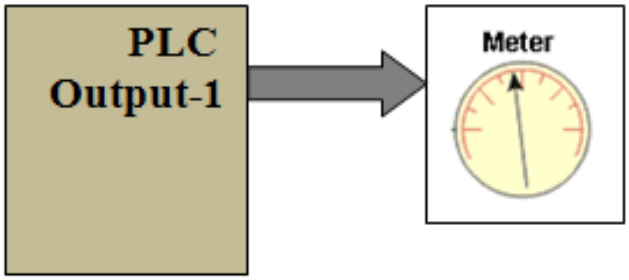


Figure 3.8: Analog Output Example

Central Control Unit

The Central Control Unit contains the Central Processor which is the brain of the PLC. The CPU monitors the inputs and makes decisions based on instructions in its program memory. It performs counting, timing, data comparison and sequential operations.

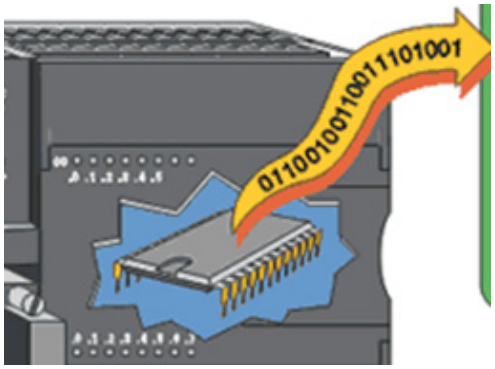


Figure 3.9: Central Processor Unit

Sensor

A sensor is an input device that senses a physical condition and converts it to an electrical signal. The pushbutton shown in figure 3.10 sends an electrical signal to the PLC's input informing the condition of the pushbutton's contacts.

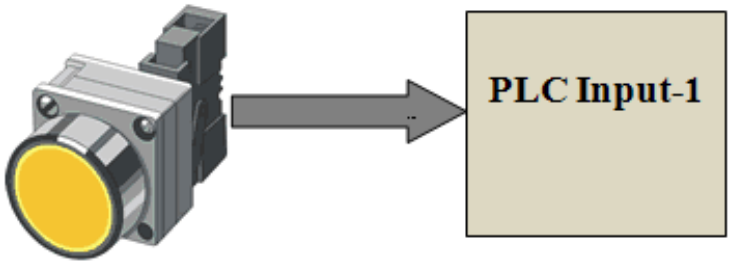


Figure 3.10: Sensor Example

Actuator

Actuators convert electrical signals from PLC outputs into physical conditions. A motor starter (in fig 3.11) is an example of an actuator. It will either start or stop the motor depending on the state of the PLC output.

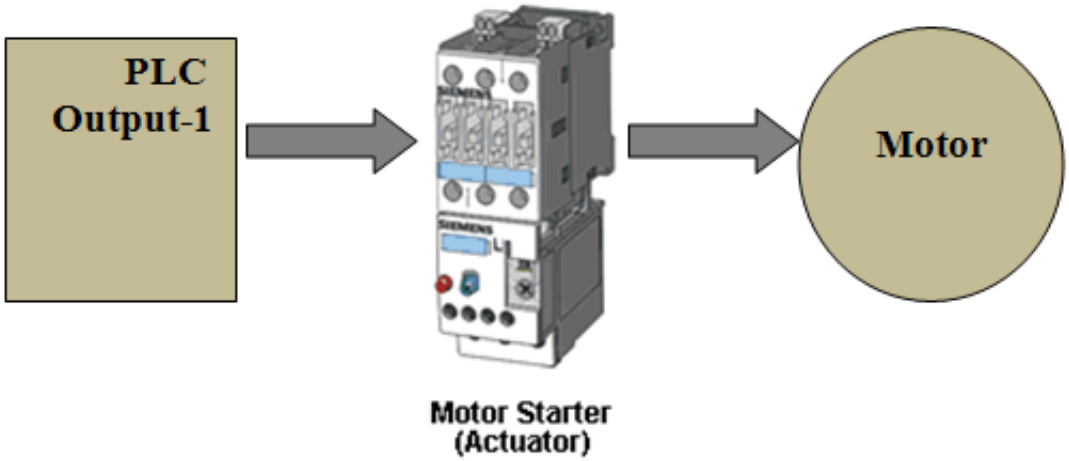


Figure 3.11: Actuator Example

3.3 LOGO! Hardware

LOGO! is a universal logic module made by Siemens. The LOGO! Edutrainer Compact includes the following LOGO! parts and accessories:

- LOGO! Basic Module
- LOGO! Expansion modules
- Power supply Unit
- Interface Unit
- Programming Cable
- I/O Data Cable

Figure 3.12: LOGO! Basic & Expansion Modules on Edutrainer Compact

LOGO! Basic Module

LOGO!12/24 RC is the LOGO! controller that will be used in our applications.

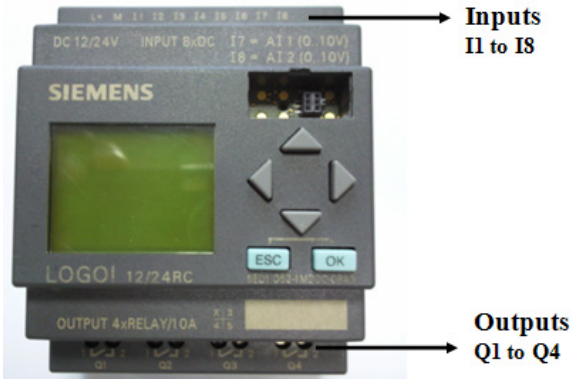


Figure 3.13: LOGO! Basic Module

1. Inputs: The LOGO! Basic Module has 8 inputs and they are designated as I_1, I_2, I_3, …. I_8. Inputs I_1 to I_6 are digital inputs, and the inputs I_7 and I_8 can function as digital or analog.
2. Outputs: The LOGO! has 4 digital outputs Q1, Q2, Q3, Q4.

Expansion Modules

Each LOGO! digital expansion module provides additional 4 digital inputs and 4 digital outputs. Figure 3.14 shows the 2 Digital LOGO! Expansion modules.

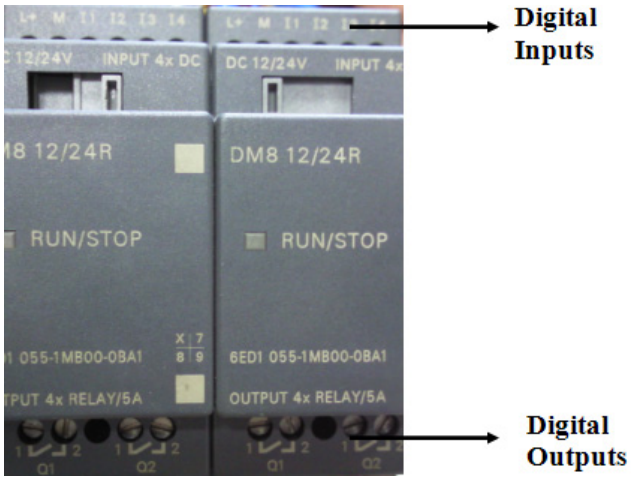


Figure 3.14: LOGO! Digital Expansion Modules

Power Supply

The LOGO! 12/24 RC operates on a 24V power supply.

Figure 3.15: LOGO! Power Supply Unit

Interface Unit

This unit interfaces the LOGO! Controller with the EduTrainer's sensors and one actuator. It receives the control signals from the LOGO! controller through the I/O Data cable. It contains an LED for every input and output that helps visualize the signals, and makes troubleshooting easier.

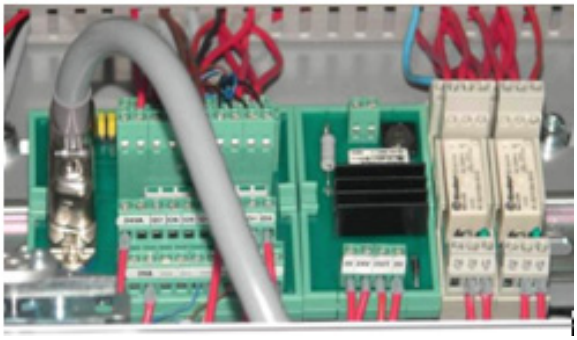


Figure 3.16: Interface Unit

Programming Cable

Figure 3.17: Programming Cable

I/O Data Cable

Figure 3.18: I/O Data Cable

The table below lists the examples of LOGO! input devices:

Digital Input Devices	Analog Input Devices
Switch	Thermocouple
Push Button	Potentiometer
Inductive Sensors	Ultrasonic Sensor
Capacitive Sensors	Pressure Sensor
Optical Sensors	Level Detector

Connecting the power supply

PLC devices need an electrical power supply that can be either an AC, or DC supply. LOGO! 12/24RC needs a DC supply. Fig. 3.19 shows the method of wiring the DC power supply to the LOGO! Module.

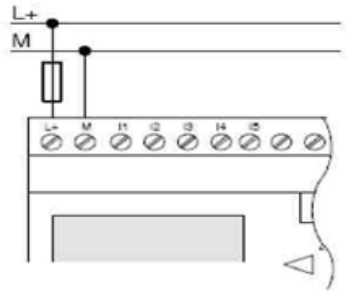


Figure 3.19: Connecting LOGO! to power supply

Connecting LOGO! Inputs

Figure 3.20 shows the hardware/wiring details of connecting the inputs to the LOGO! Switch S1 is connected to I1 and switch S2 is connected to I2.

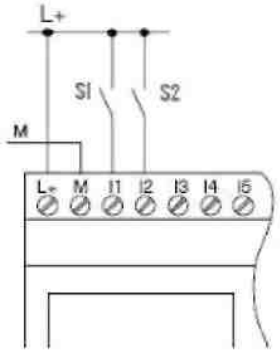


Figure 3.20: Connecting inputs

Connecting LOGO! Outputs

LOGO! …**R**… version is equipped with relay outputs. The potential of the relay contacts is isolated from the power supply and the inputs. As shown in fig 3.21, various loads can be connected to the relay outputs, for example, lamps, motors, relays etc.

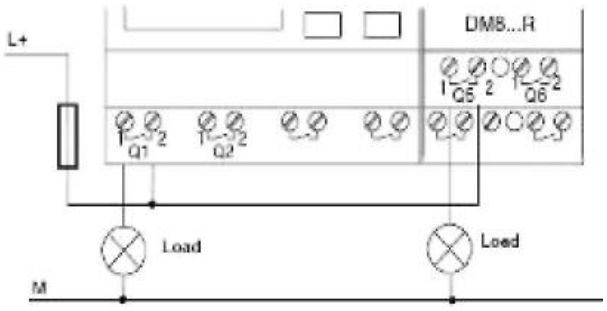


Figure 3.21: Connecting loads to outputs

Reference table for PLC and Interface Unit

Inputs	PLC side	Interface Unit side
Green push button (N.O.)	I1	…
Red push button (N.C.)	I2	…
White push button (N.O.)	I3	…
Selector Switch	I4	…
Emergency Jumper	I5	…
Sensor number (8)	I9	I0
Sensor number (14)	I10	I1
Sensor number (17)	I11	I2
Sensor number (9)	I12	I3
Sensor number (20-a)	I13	I4
Sensor number (20-b)	I14	I5

Outputs	PLC side	Interface Unit side
Green Light	Q1	…
White Light	Q2	…
Table Forward	Q5	O0
Table Backward	Q6	O1
Branching Arm	Q7	O2
Conveyor belt Motor	Q8	O3

3.4 Conveyor Belt Application parts

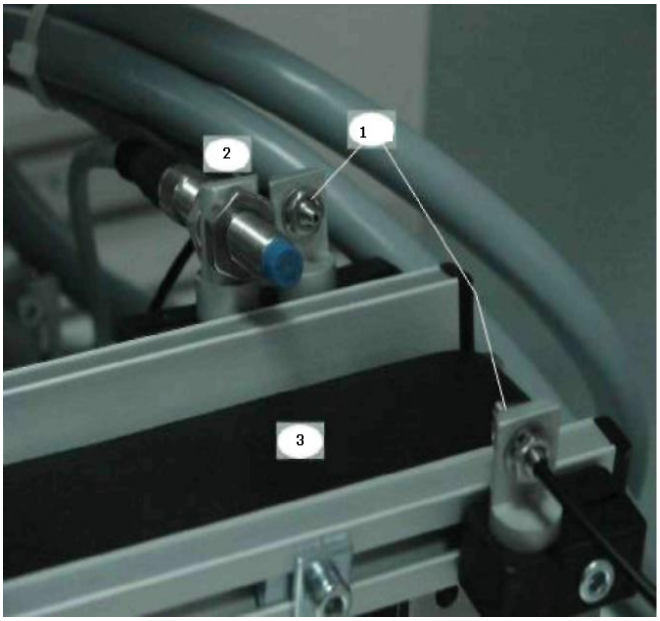
The parts of the Conveyor Belt application are indicated below along with their functions.

Sensors:

1. **Optoelectronic sensors: Fiber optic barrier**
   This sensor is used to detect the presence of a work piece regardless of its color and material.

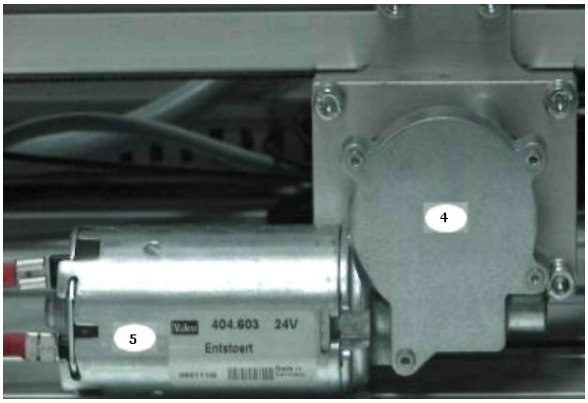
2. **Inductive Sensor**
   This sensor is used to detect metal parts, and its detection distance is up to 4 mm.

3. **Conveyor Belt**
   This is the transportation media on which the work pieces are transported.



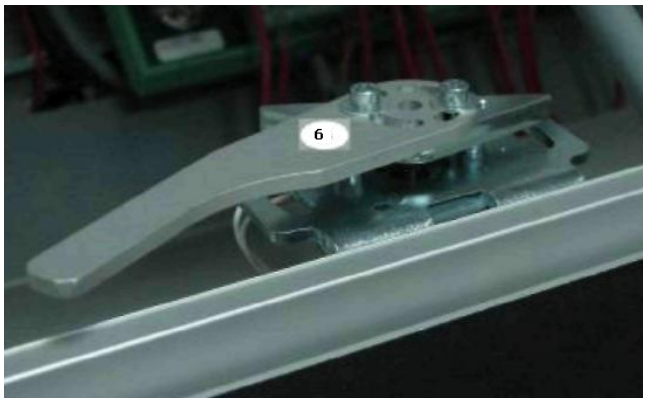
4. **DC Motor**
   It moves the conveyor belt with the aid of the gearbox.

5. **Gear Box**
   It is used to decrease the speed and to increase the torque.



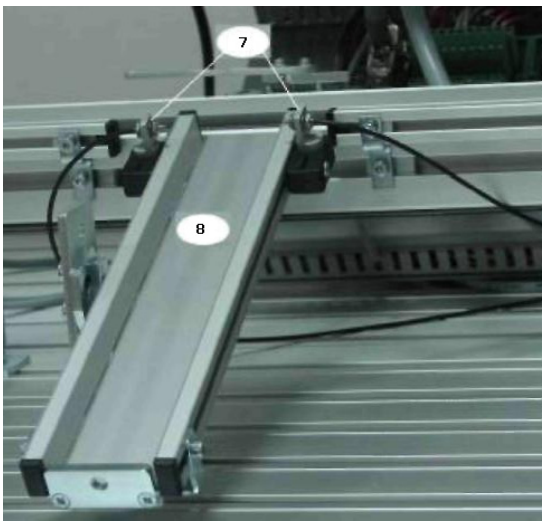
6**. Branching Module**

This is a motorized assembly by which branching of the work pieces are done.



7. **Fiber optic barrier**

This sensor is used to detect the passing of a work piece regardless of its color and material.



8. **Slide**

This is the place to hold the branched work pieces.

3.5 Lab Activity 1

Objective: To familiarize with the LOGO! Interface Unit and the expansion modules

Procedure:

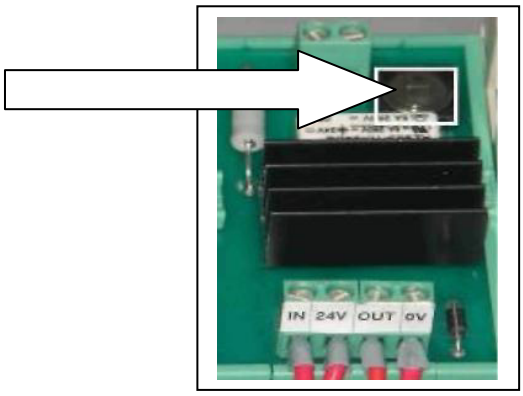
1. Press the push button found in the conveyor motor control unit, and comment on your observation.

   .....

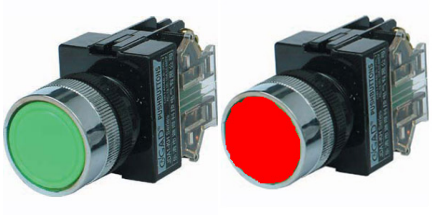
   .....

   .....

   .....



2. Connect a *green external push button* to *I0* of the Interface unit and a *red external push button* to *I1* of the Interface unit (see the reference table for PLC and Interface unit).



   Note: Green push buttons are Normally Open (NO) while the red ones are Normally Closed(NC).

3. Press each of the pushbuttons, and observe the LEDs of the Interface unit. Comment on your observation.

   .....

   .....

   .....

4. Draw the function block diagram for the following action:
   - Switch ON the conveyor belt (connected to output O3-Interface Unit) when the green push button is pressed, and
   - Switch it OFF when the red push button is pressed.

Run the program and complete the statements below:

The conveyor belt starts when ……

……

The conveyor belt stops when ……

……

5. Use the **memory function block** (RS-Latch) to implement the same operation and observe the result. Draw the function block diagram

6. Replace the output from O3 to O5 and modify your program to run the conveyor belt. Draw the function block diagram with the changes done:

3.6 Lab Activity 2

Objective: To test the function of the optical sensor connected to the Interface Unit.

Procedure:

1. Connect the optical sensor shown to Input I3 of Interface unit.

2. Notice the status of LEDs of the Interfacing unit when there is no object in front of the sensor; write your observation below:

   ……

   ……

3. Move your hand forward and backward in front of the same sensor and observe the status of LEDs of the Interfacing unit. Comment on your observation.

   ……

   ……

4. Create a program using the counter block that could count the movement of your hand 10 times, and turn ON the light connected at Q1-PLC once the counter completes 10 counts.

3.7 Module Exercise

1. Give three examples of each of the following:

Analog Input	Analog Output
……	……
……..	……..
……..	……..
Digital Input	Digital Output
……	……
……..	……..
……..	……..

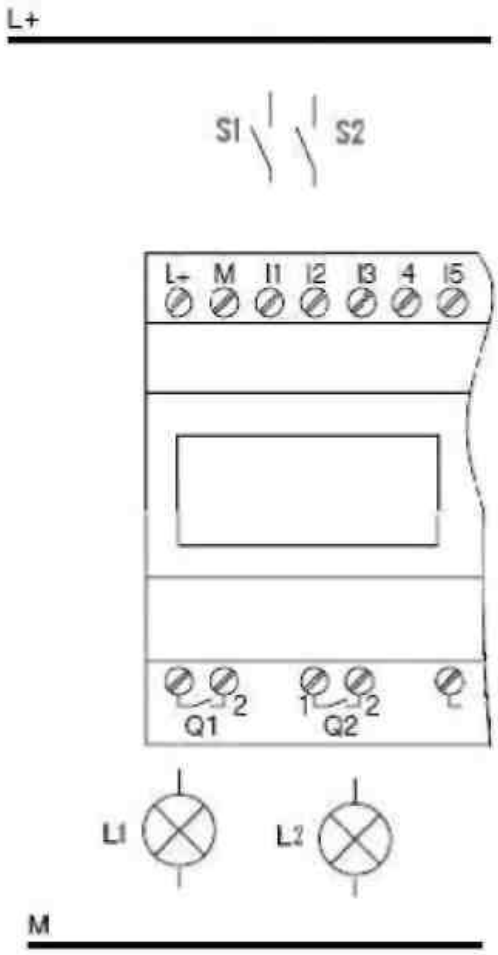
2. What is the purpose of using expansion modules?

……

……

3. Complete the wiring for a LOGO! PLC application in which lamp L1 must be ON if switch S1 or switch S2 is pressed, and lamp L2 must be OFF if switch S2 is pressed. Also draw the function Block Diagram.

   S1 : I1
   L1 : Q1
   S2 : I2
   L2: Q2



Function Block Diagram:

Notes

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