CHAPTER 2

TERMINOLOGY

TERMINOLOGIES

1. Control System
2. Reference Input
3. Controlled Variable
4. Disturbance
5. Feedback Element

1. Control System is..

- Components that connected to system or process that want to be controlled.

- 5 basic element of control system:

  i. Reference signal generator
  ii. Measurement element
  iii. Comparator
  iv. Controller
  v. Actuator

2. REFERENCE INPUT:

- Is a signal to start a system.
- Ex: such as temperature, pressure and level.
- Fix value.

3. CONTROLLED VARIABLE:

- Is a signal or variable that is controlled at its output.
- Ex: Temperature, pressure and level.
- Fix value.

4. DISTURBANCE:

- Element that disturb a control signal in control system.
- Can be from within the system itself or external.

5. FEEDBACK ELEMENT

- Element that use to send output signal to be compared with input signal by comparator in closed loop system.

2.6 OPEN LOOP CONTROL SYSTEM:

- Output does not affect the function of the entire system.

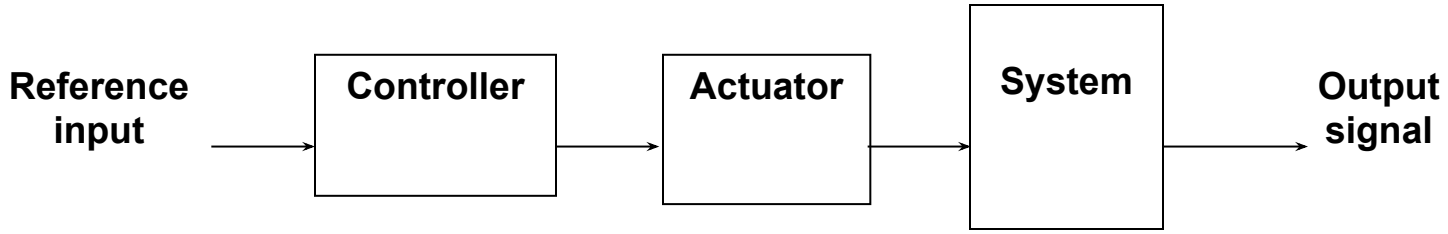


Fig. 1: Block diagram of Open loop control system

2.6.1 EXAMPLE : Street Lighting System

- Commonly a system that using timer.
- ON and OFF at specific time
  (Night = ON and Day = OFF)
- Duration within ON and OFF is set up bytimer.

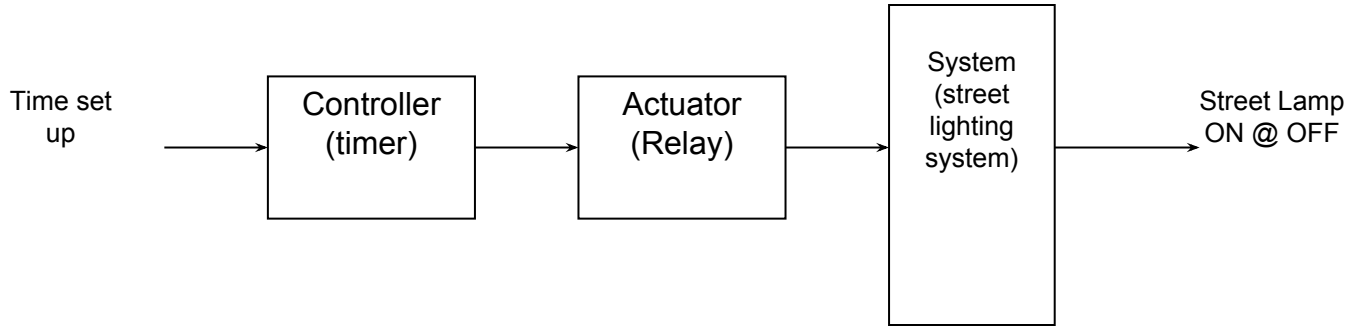


Fig. 2: Block diagram of Street Lighting System using Open loop control system

2.7 CLOSED LOOP CONTROL SYSTEM

- Also known as Feedback Control System
- System Output affect the control function of the entire system.

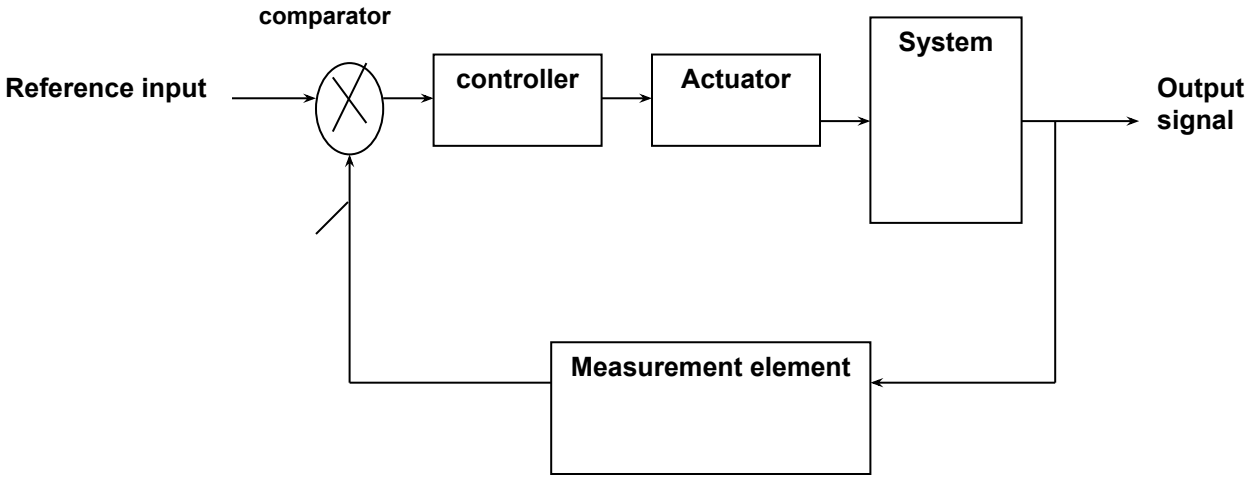
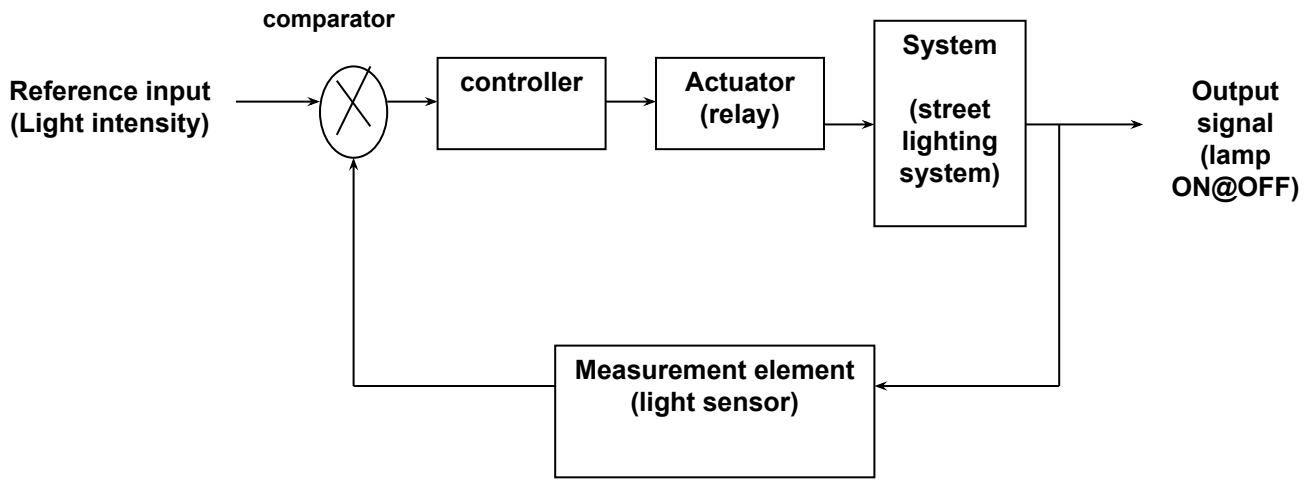


Fig. 3: Block Diagram of Closed Loop System

2.7 EXAMPLE : STREET LIGHTING SYSTEM

- Commonly a system that using sensor as input element.
- ON and OFF automatically as the light sensor detect the light regardless of the particular time.
- Dark = ON and Bright = OFF)



2.8 COMPUTERISED CONTROL SYSTEM

- A control system that use a computer as a controller.
- This system can be represented by the block diagram as in figure 5.

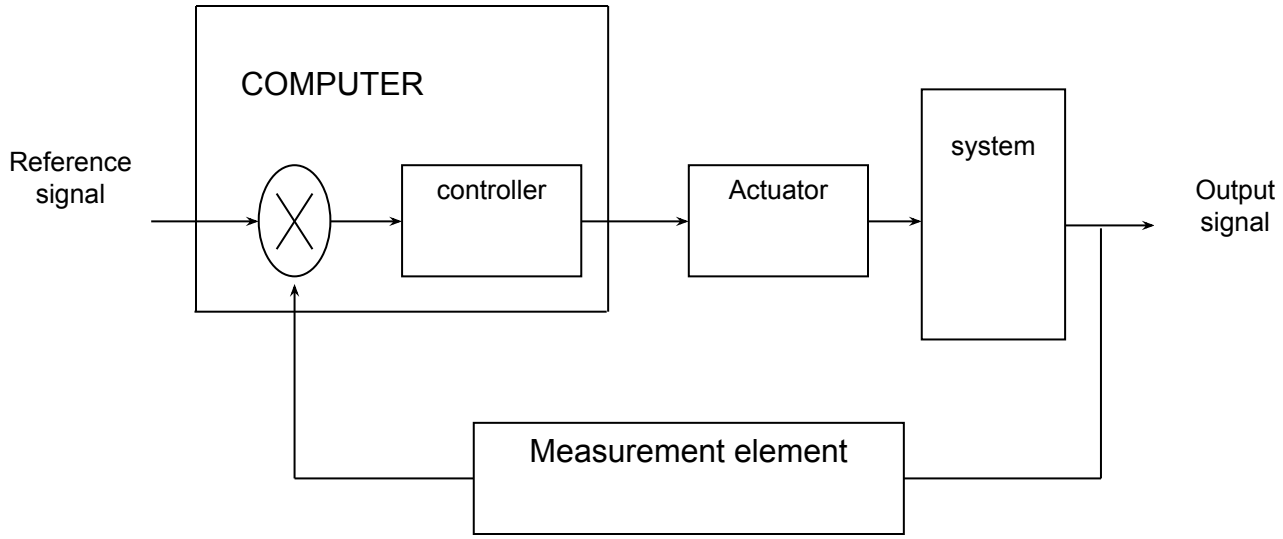


Fig. 5: Block Diagram of Closed Loop System

2.9COMPARISON

Open Loop System (OLS)	Close Loop System (CLS)
Easy to design	The design is complicated or Complex.
The accuracy depends on the calibration elements	The system is very accurate.
less instability problem.	problems of instability.
Unable to reduce the impact of non-linearity.	Non-linearity effects can be minimized.

INTRODUCTION TO PLC

2. Explain PLC
    - 2.1.1 Define PLC terminologies
    - 2.1.2 Explain PLC background
    - 2.1.3 Explain PLC functions
    - 2.1.4 List and explain the types and advantages of PLC.

2.1.1 Define PLC

What is Programmable Logic Controller (PLC) ?

Definition: National Electrical Manufacturers Association US (NEMA)

A PLC is a digital operating electronic apparatus which uses a programmable memory for internal storage of instruction for implementing specific function such as logic, sequencing, timing, counting and arithmetic to control through analog or digital input/output modules various types of machines or process.

Define PLC terminologies:

- Several different terms used to described programmable controllers:

  i. PLC –Programmable Logic Controller (UK origin)
  ii. PC – Programmable controller (US origin)

- Most referring to the functional operation of the machine.
- PLC has been used in this text to avoid confusion with the personal computer.

2.1.2 Explain PLC background

PLC Development factors:

i. needs for low-cost
ii. Flexible
iii. Easily commissioned/ smart usage

Historical Background:

In 1968, a group of engineers from General Motors developed the concept of PLC with an initial specification. The PLC must be:

i. Easy to program.

ii. Not need rewiring the control system if change the program.

iii. Smaller in size, cheaper and high reliability.

iv. simple construction and low maintenance

v. Cost- competitive

2.1.3 PLC functions

CONTROL TYPE:	FUNCTIONS
Sequence Control	i. Conventional Relay Control Logic replacer ii. Timers/ Counter ii. PCB Card controller replacer v. Auto/Semi-auto/Manual control of machine and process.
Advanced/ Sophisticated Control	i. Arithmetic operation (+, -, × , ÷) ii. Information Handling ii. Analog Control (Temperature, Pressure) v. P.I.D (Proportional Integral Derivation) v. Servo Motor Control vi. Stepper Motor control

PLC functions:

CONTROL TYPE:	FUNCTIONS
Supervisory Control	i. Process monitoring and alarm. ii. Fault Diagnostic and monitoring iii. Interfacing with Computer (RS-232C/RS 422) iv. Printer/ ASCII Interfacing v. Factory Automation Networking vi. Local Area Network (LAN) vii. Wide Area Network (WAN) viii. Factory Automation (F.A), Flexible Manufacturing System (F.M.S) & Computer Integrated Manufacturing (C.I.M).

PLC Size:

- **Small :**
  - it covers units with up to 128 I/O's and memories up to 2 Kbytes.
  - Capable of providing simple to advance levels or machine controls.

- **Medium :**
  - Have up to 2048 I/O's and memories up to 32 Kbytes.

- **Large :**
  - The most sophisticated units of the PLC family. They have up to 8192 I/O and memories up to 750 Kbytes.
  - Can control individual production processes or entire plant.

2.1.4 Types of PLC Construction:

i. Compact PLC
ii. Modular PLC
iii. PLC Plug-in Card

Manufacturer: OMRON, Allen Bradley, Mitsubishi, NAIS, Siemens, Toshiba, Festo etc.

2.1.4 Types of PLC Construction:

i. Compact PLC:

Figure 1: Compact PLC

i. Modular PLC

Figure 2: Modular PLC

iii. PLC Plug-in Card

Figure 3: Plug-in Card PLC

ADVANTAGES OF USING PLC:

- Shorter project implementation time.
- Easier modification
- Project cost can be accurately calculated.
- Shorter training time required.
- Design easily changed using software (changes and addition to specifications can be processed by software.
- A wide range of control application
- Easy maintenance.
- High Reliability
- Standardization of Controller hardware.
- Able to withstand Harsh plant/process environments (Operate normally under severe conditions of temperature, humidity, voltage fluctuations and noises).

TOPIC 3

PLC HARDWARE DESIGN

3.0 PLC HARDWARE DESIGN

3.1 Processor Architecture for PLC:

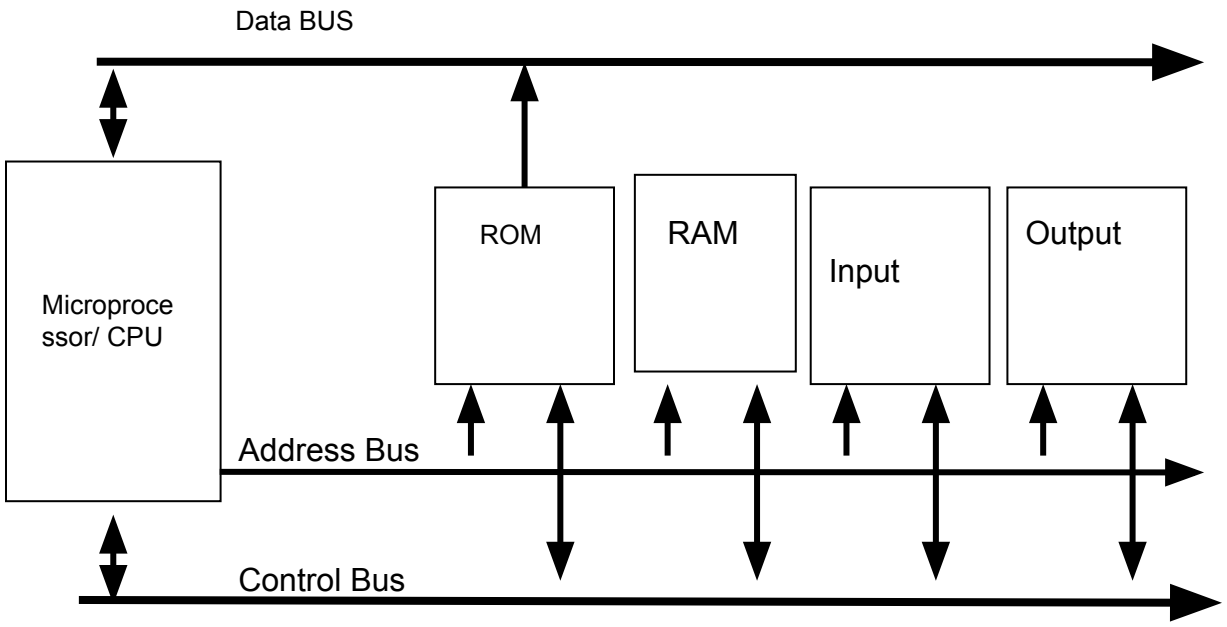


Figure 4: Design of Basic Microcomputer

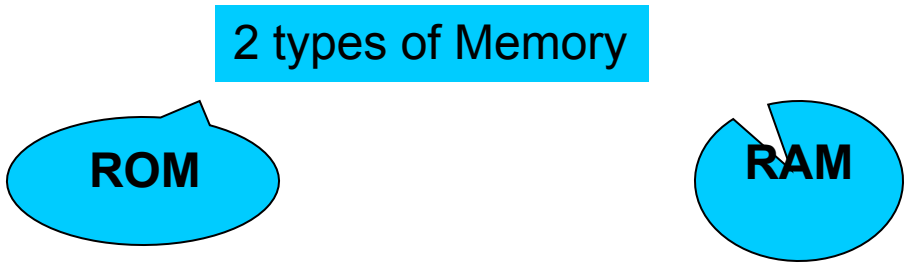
3.1.1 FUNCTION OF EACH BLOCK:

a. Central Processing Unit (CPU)

- The CPU controls, monitors and supervises all operations within PLC.
- It is also caries out programmed instructions stored in the memory.
- An internal communications highway also known as a bus system, carries information to and from the CPU, memory and I/O units under the control of the CPU.

b. Memory Unit

- For storage of programs.
- The user's ladder logic program, the state of I/O in the memory of PLC.
- The main program and the other programs necessary for the operation of PLC.
- The organization of the data and information in the memory is called memory map.



TYPES OF MEMORY:

RAM Random Access Memory	ROM Read Only Memory (read)
This memory can be read from and written to.	This memory can be read only
Storing all user's programs	Storing all system's program
Entire contents will be lost if power is switched off.	Memory content remain when the power is switched off.

c. Input/ Output (*I/O*) Unit

- **Input Unit:**

  Function as a medium that connects the external input devices

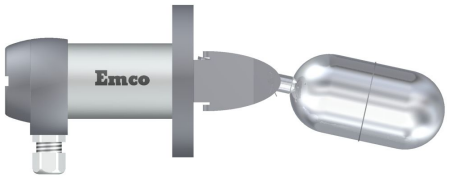
  (Switch, sensor & timer)

- **Output Unit:**

  Function as a medium that connects the external output devices to the CPU within PLC.

  (Lamp, motor & solenoid)

INPUT DEVICES:

Push Button	 JXB2-BC42
Limit Switch	
Thumbwheel SW	
Level SW	
Flow SW	

INPUT DEVICES:

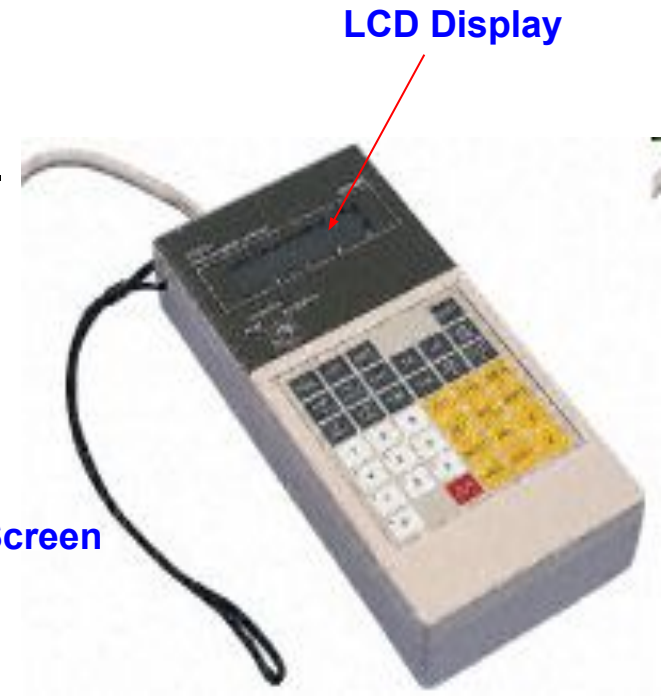
Motor	
Solenoid	
LED Display	
Heater Coil	
Lamp	

d. Display and Indicator Unit

Referring to PLC standard display Internal Relay:

- Console's LCD Display
  if user use Mnemonic Code Programming.

- Monitor Screen
  if user use software programming method.



e.Housing Unit

Protect PLC circuit and internal component

f. Programming Unit

Consist of 2 devices:

i. Programming Console

ii. Computer

g. Secondary Storage Unit

This unit related to CPU where all program and information were kept.

h. Power Supply Unit:

Supplies DC power to the Central Processing Unit, Input Unit and Output Unit.

i. Printing Unit

Used to print control system programming that controlled by PLC wether graphically or text.