Lecture 42

PNEUMATIC CIRCUIT DESIGN USING PLC

Learning Objectives

Upon completion of this chapter, Student should be able to

- Define PLC and its function
- Explain the difference between hard wired control and PLC control
- Explain the different section of PLC
- List the advantages of PLC over electromagnetic relays.
- Explain the functions of major components of PLC
- Explain various programming approaches used in PLC
- Describe the functions of memory functions, timers and counters
- Convert the logic functions into ladder diagram
- Design PLC circuits for single and multi actuators

1.1 Introduction

A programmable logic controller (PLC) is essentially a user friendly micro-processor based microcomputer, consisting of hardware and software, designed to control the operation of Industrial equipment and processes. An important advantage of the PLC is that it can be easily programmed and reprogrammed. PLC has tremendous impact on Industrial control and instrumentation due to its high reliability and flexibility at the design and implementation stages. The decreasing cost of microprocessor with increasing facilities in them is acting as catalyst in their widening scope of applications. In recent years, PLC are being used in place of electromechanical relays or cam operated logic controllers to control fluid power systems. Modern day PLCs are developed into a sophisticated and highly versatile control system component capable of performing complex mathematics functions and operate at fast microprocessor speeds. Some leading PLC manufacturers are ABB, Allen Bradley, Honeywell, Siemens, GE Fanuc, Mitsubishi, Modicon, Omron etc.

1.2 PLC – Defined

PLC can be defined as digital electronic device that uses a programmable memory to store instructions and to implement functions such as logic, sequencing, counting, timing and arithmetic in order to control machine, processes and instrumentation

PLC is user –friendly digital computer used for making logic decisions and providing output. It consists of solid state digital elements and is a replacement for hard-wired electro-mechanical relays to control pneumatic systems.

The term 'programmable logic controller' is defined as follows by IEC 1131 (PLC standard) part 1

"A digitally operating electronic system, designed for use in an industrial environment, which uses a programmable memory for the internal storage of user- oriented instructions for implementing specific functions such as logic , sequencing , timing , counting and arithmetic, to control through digital or analog inputs and outputs, various types of machines or processes. Both the PC and its associated peripherals are designed so that they can easily integrated into an industrial control system and easily used in all their intended function"

PLC is quite similar to digital computers. They also have certain features which are specific to logic controllers. They are

1. PLC are rugged and designed to withstand vibrations, temperature , humidity and noise
2. The interfacing for input and output is part of the controller
3. They are easily programmable and primarily use logic and switching functions

1.3 Hard-wired control systems

In hard wired control systems, relays are used. For example: In Electricalcontrol, the wiring of control elements such as sensors, solenoids, counters etc. are through relays control. Such relay controlled systems are also called as hard-wired control system because any modification in control program involves rewiring of the circuit. Therefore, hardwired controls are cumbersome and difficult to modify when production requirement changes regularly. Hard-wired control systems are difficult to maintain because any small problem in design could be a major problem in terms of tracing and rewiring.

Hard wired control systems consists of three division

1. Input section – Consists of push –buttons, switches and sensors. They transfer signals to the processing section

2. Processing section –Consists of relay coils and contacts. They determined the relationship between the inputs received and outputs required

3. Output section –Consists of solenoids, lamps, and contactor coils etc. The processed signals are transferred to this section.

1.4 PLC Systems.

PLC systems offer number of advantages over hard wired electromechanical relay control systems. Unlike the electromechanical relays, PLCs are not hard-wired to perform specific functions. Thus, when system operation requirement change, a software program is readily changed instead of having to physically rewire relays. In addition, PLCs are more reliable, faster in operation, smaller in size, and can be readily expanded.

PLC systems consists of three division

1. Input section – Consists of push –buttons, switches and sensors which are connected to specific input addresses in the program. They transfer address information to the processing **section**

2. Processing section –The microprocessor receives the input signals from input sections and executes the information (called instructions) in the software program and sends the processed signals to output section

3. Output section –Takes the signal from processing section and modify the signal from the processor to operate output devices connected to specific output addresses.

Advantages of PLCs over Electromechanical relays

The PLC replaces electromechanical relays due to their following advantages

a. PLCs are more reliable and faster in operation
b. They are compact and can be expanded easily
c. They require less electrical power
d. They are less expensive when compared to Hardwired systems of same number of control functions
e. Hard-wired electromechanical relays lack flexibility. For example, when system operation requirement change, then the relays have to be rewired.
f. PLCs have very few hardware failures when compared to electro-mechanical relays
g. Special functions such as time-delay actions and counters , can be easily performed using PLCs

Comparison between Relay and PLC is presented in **Table 1.1**

Table 1.1 Comparison between Relay and PLC

Features	**Electromechanical relay**	**PLC**
Size of the controller	Bulky	Compact
Programming	Time consuming	Easy
Flexibility	Rewiring required	Reprogramming required
Cost	Expensive	Less expensive
Maintenance	Poor	Minimum
Fault finding and troubleshooting	Difficult	Easy to identify fault and repair

1.5 MAJOR COMPONENTS OF PLC

As discussed earlier, A PLC is essentially a microcomputer consisting of hardware and software. The major components are

1. Power Supply module
2. Input module
3. Central processing unit
4. Output modules
5. Software

a)Power supply module:

Usually input output modules require 24V DC and processor require 5V DC. Usually power supply is integral part of PLC. Power supply units convert 120/230 V AC line voltage to standard supply of 24 VDC or 5V DC using standard rectifier circuits

b)Input module

Input devices include push buttons, sensors, potentiometers, pressure switches. The function of the input module is to covert high voltages from input devices to low level logic voltages that the CPU uses internally for processing.

Input module can process both analog input and digital input. Digital inputs are more preferred in Industry.

c)Analog input module is used to convert analog signal form analog devices like temperature sensors, pressure sensors etc. to digital signals using ADC (Analog –to digital convertor). Analog signal is varying voltage in the range of 0-12 V or current in the range of 5-20 mA. These values of current or voltage is converted into integer value (say16 bit word)

Digital `is used to convert signal digital input to 5V digital signals that CPU uses internally to execute a user program.

d)Central processing unit

The central processing unit controls and processes all operations within the PLC and hence called brain of the PLC. The CPU can perform various arithmetic and data manipulation function with the local and remotely located Input/output sections. Further, the processor can perform many communication functions it needs to interface with a personal computer, remote Input/Output, other PLCs and peripheral devices

Functions of CPU are :

1. It receives input from various sensing devices and switches
2. It executes the user program
3. It makes various decisions to control the operation of the equipment or process
4. It can perform various arithmetic and data manipulation functions
5. It delivers corresponding output signals to various load control devices such as relay coils and solenoids

e)Output module

Output devices include contactor coils, solenoid coils, lamps, etc. Output module amplifies the low–level logic signals generated by the CPU and pass these modified signals to the final control elements to operate the output devices.

f) Software

PLC consists of two parts: Operating systems and user program. The PLC operating system provides effective support ranging from the creation of project structure to the creation of user programs. The OS system is accessed through a graphical user interface window (also known as Main window). The main window contains all the functions needed to set up a project , configure the hardware , write and test programs. User program can be written in any standard PLC programming language like ladder diagram or statement list.

While processing a PLC program, the CPU scans and executes the main program cyclically;A program scan cycle consists of sequential operations that include input scan, program scan, and output scan. In the input scan, the CPU updates the process image input table, in the output scan;

the CPU updates the process image output table. After the completion of each scan cycle, the CPU returns to the beginning of the next cycle and again repeats the cycle. The time taken to scan one program is called scan –cycle time.

1.6 PROGRAMMING OF PLC

There are various approaches for entering the program into PLC they are

1. Ladder diagram based
2. Low level based on Boolean expressions
3. Functional blocks
4. High level language

Most of the programming methods used today for PLC are based on the ladder logic diagram. Therefore the concept of ladder diagram is explained in the following sections

The PLC programming based on the use of ladder diagram involves writing a program in a similar manner to drawing a switching circuit. The ladder logic diagram is converted into PLC ladder diagram by using the conventions of PLC ladder diagram constructions. This method requires the use of simple keyboard and CRT with minimum graphic capability to display the symbols, representing components and their inter relationship in the ladder logic diagram. The components are of two types, contact and coils. Contacts are used to represent input switches, relay contacts and similar elements. Coils are used to represent load such as solenoids, relays, timers, counters etc. The programmer inputs the ladder diagram rung by rung into the PLC memory with the CRT displaying the results for verification.

The ladder diagram has two vertical sides (also called rungs) (**Figure 1.1**). The left side line represent line with a positive voltage and right side represent a line with zero voltage. Between these two sides are the horizontal rungs for the assumed power flow. The symbols representing the various program elements are placed on the rungs in order to realize the required control task.

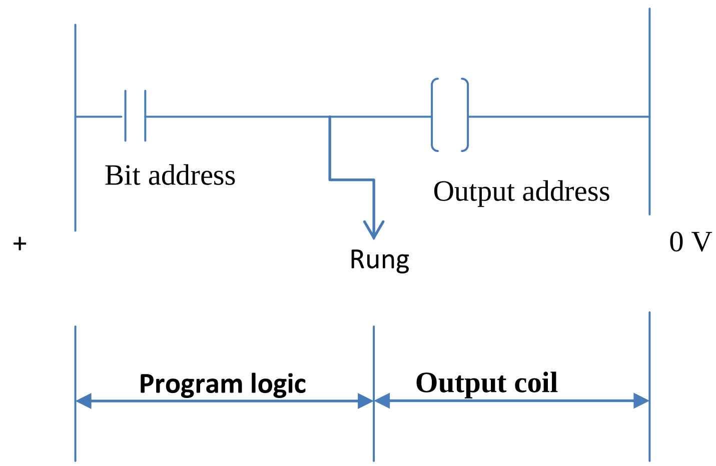


Figure 1.1 Ladder diagram

There are five program elements/operations commonly used in PLC ladder diagram they are

1. PLC Bit logic operations
2. Timer Operations
3. Counter operations
4. Comparison operations
5. Arithmetic operations.

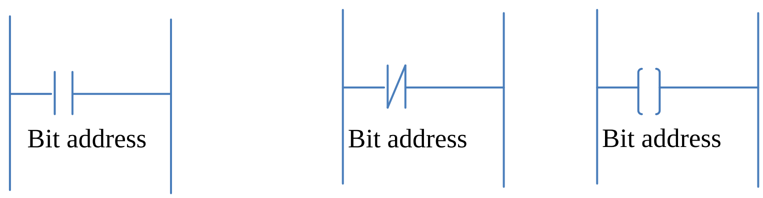
1 PLC bit logic operations : Some important programming elements for bit logic operations are

a) NO contact
b) NC contact
c) Coil

Each of these elements can be selected from the program window. NO and NC elements should not be confused with the hardware NO and NC contacts of switching devices.

NO Contact of PLC:

The PLC representation of NO contact is given in Figure 1.2. This contact scans for the signal state ON (1) at the specified bit address. Power flows through NO contact if the scanned bit address has a signal state ON (1). This contact is used for scanning the signal state of input devices or output devices or other internal program elements.



NO program contact **NC program contact** **PLC coil**

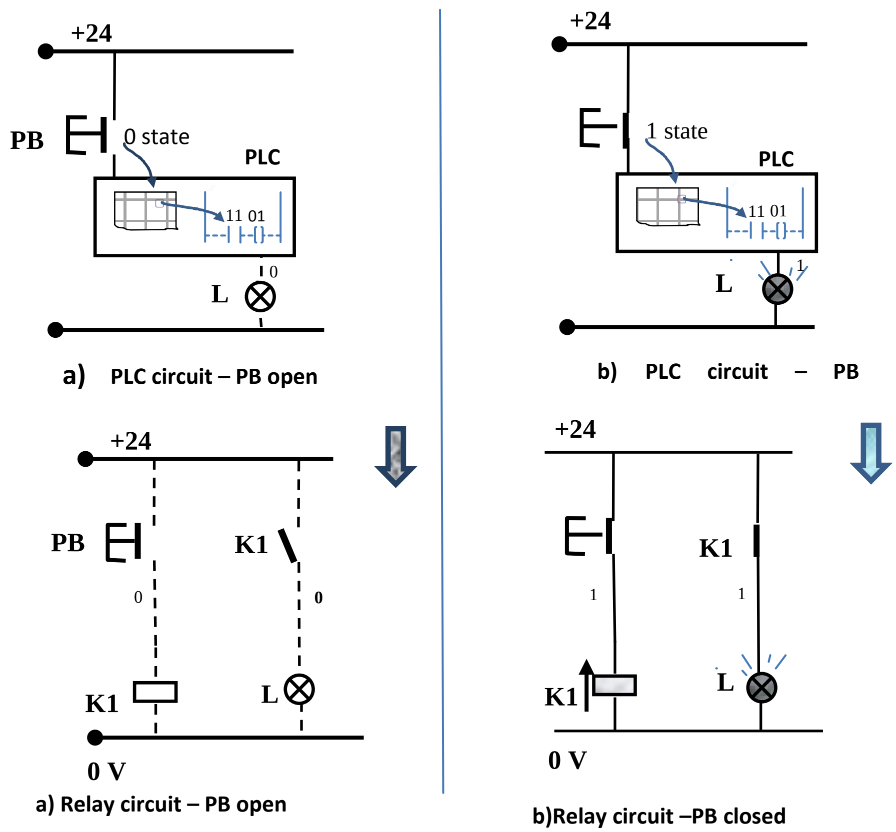


Figure 1.2 PLC circuit with NO contact position using NO push button

NC Contact of PLC:

The PLC representation of NC contact is given in **Figure 1.3** This contact scans for the signal state OFF (0) at the specified bit address. Power flows through NC contact if the scanned bit address has a signal state OFF (0). This contact is used for scanning the signal state of input devices or output devices or other internal program elements. **Figure 1.4** shows PLC circuit with NC contact position using NO push button. **Figure 1.5** shows PLC circuit with NC contact position using NC push button.

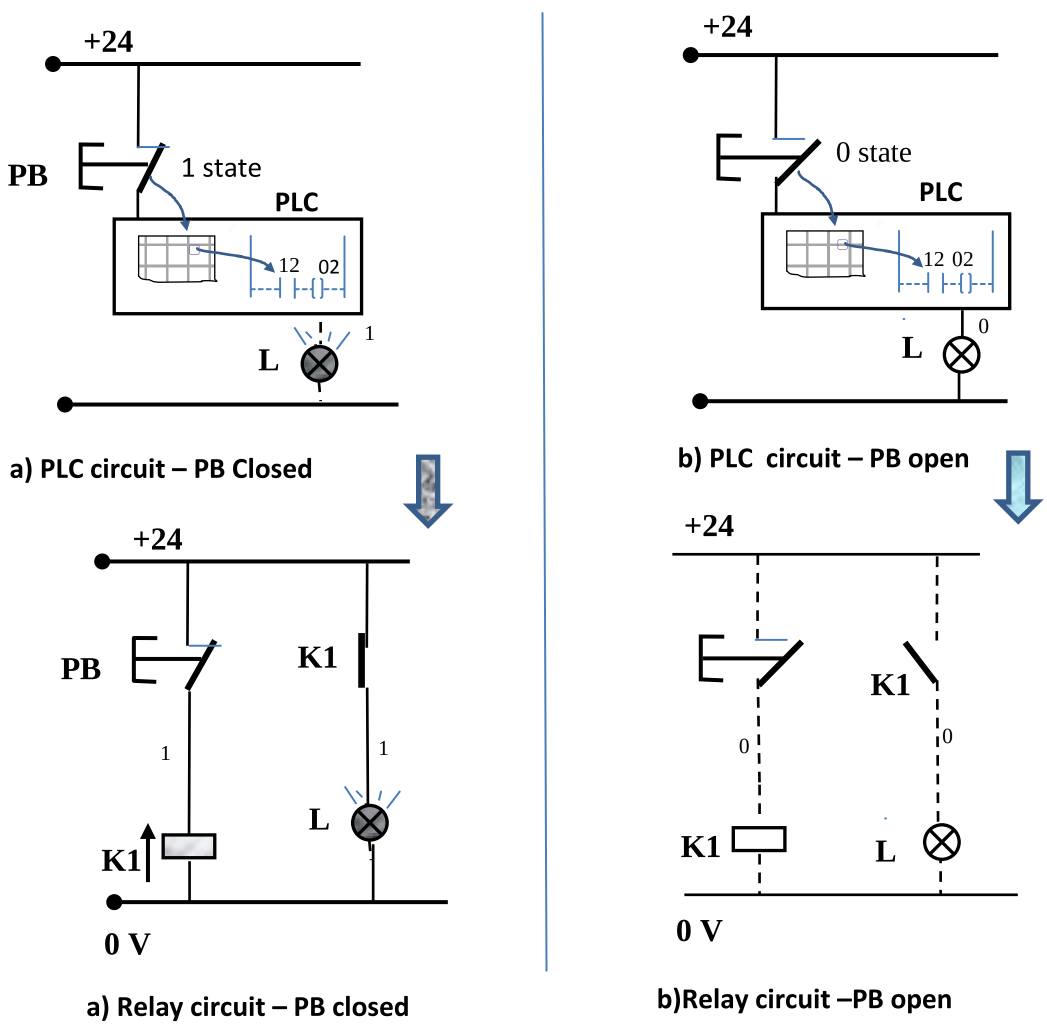


Figure 1.3 **PLC circuit with NO contact position using NC push button**

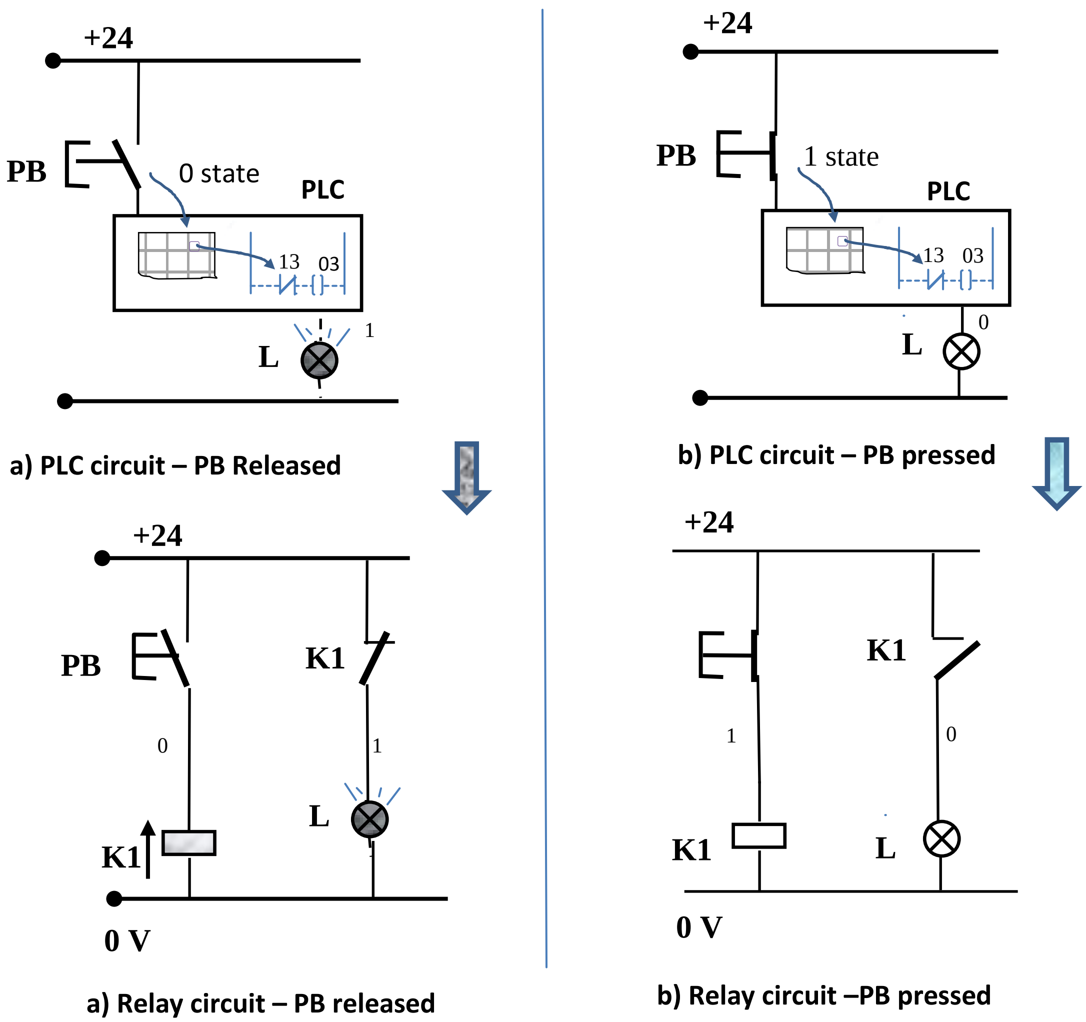


Figure 1.4 **PLC circuit with NC contact position using NO push button**

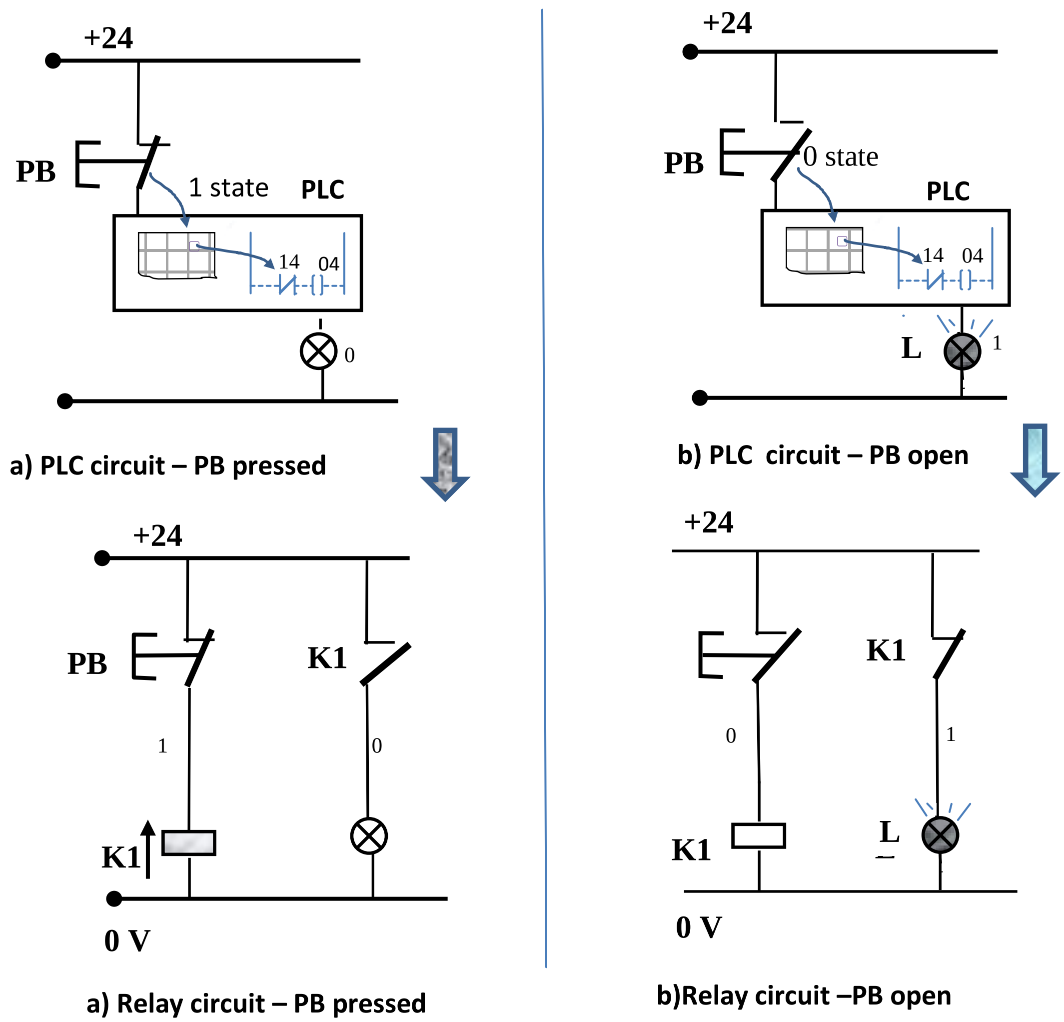


Figure 1.5 PLC circuit with NC contact position using NC push button

1.7 PLC TIMERS

Many control tasks require the programming of time. For example, cylinder 2 is to extend, if the cylinder 1 is retracted- but only after a delay of few seconds. The timers of a PLC are realised in the form of software modules and are based on the generation of digital timing. Memory space is allocated in system memory to store the values of the delay time. The represnetion of the timer address varies from manufacturer to manufacturer. For sake of understanding we shall as T1, T2 for timer addresses. The typical number of timers available in commerical PLC are 64, 128, 256 , 512 or even more. To explictiy reset timer, an RLO of 1 has to be appled at the reset port.

There are two types of PLC timer

PLC on delay timer : The timer will be ON state when it recieves a start input siganl and The signal state of output changes to 0 from 1 , when preset timing is reached. The signal state of the output changes from 0 to 1 when preset time has been reached with reference to change of RLO (Result of logic operation) from 0 to 1(ON) at the start input .Functional diagram is shown in **Figure 1.6**

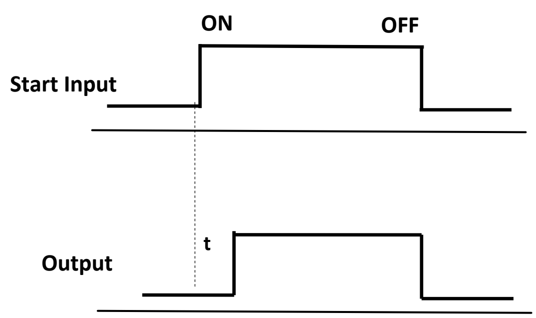
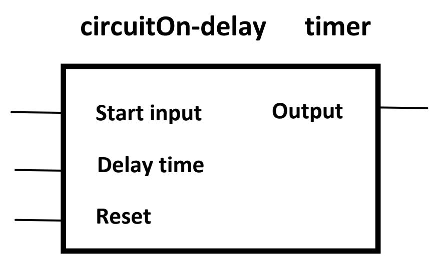
Timing diagram	**Symbol**
	

Figure 1.6 : PLC On delay timer

PLC off delay timer : The timer will be ON state when it recieves a start input siganl and The signal state of output changes to 1from 0 , when preset timing is reached. The signal state of the output changes from 1 to 0 when preset time has been reached with reference to change of RLO from 1 to 0(OFF) at the start input. Functional diagram is shown in **Figure 1.7**

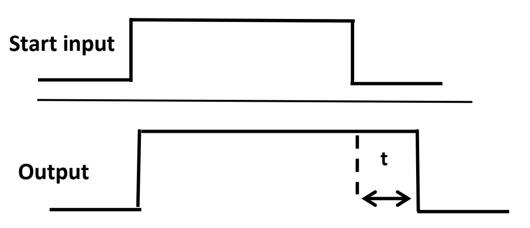
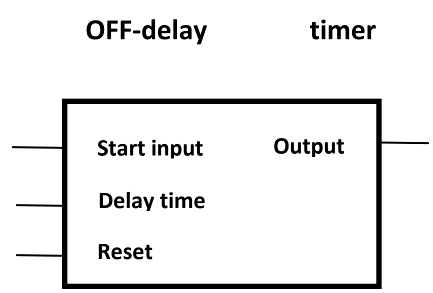
Timing diagram	**Symbol**
	

Figure 1.7 : PLC OFF delay timer

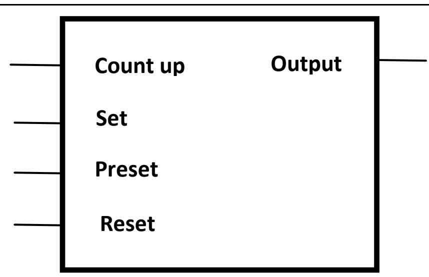
1.8 PLC COUNTERS

Counters are used to detect pieces numbers and events. Controllers frequently need to operate with counters in practice. For example: a counter in circuit is required if exactly 20 identical components are to be conveyed to a converyor belt via a sorting device.

There are two basic counter types a) Count Up b) Count down

When the input to count up counter goes true the accumulator value will increase by 1 (no matter how long the input is true). If the accumulator value reaches the preset value the counter bit will be set. A count down counter will decrease the accumulator value until the preset vaule is reached. Symbols are shown in **Figure 1.8**

Up counter



Down counter

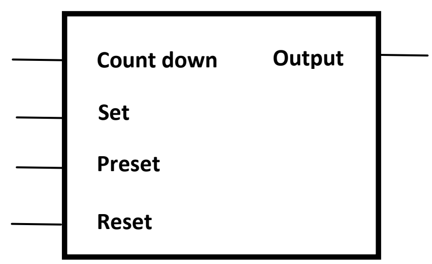


Figure 1.8 : Up and down counter

1.9 PLC Memory elements

Memory elements are used to store intermediate values. Memory function are achieved using flags (bit memory locations) and system memory. Specified bit memory can be set or reset using a set coil. A latch in ladder logic uses one instruction to latch and a second instruction to unlatch, as shown in **Figure 1.9**. The output with an S inside will turn the output D on when the input A becomes true. D will stay on even if A turns off. Output D will turn off if input B becomes true and output with a R inside becomes True.

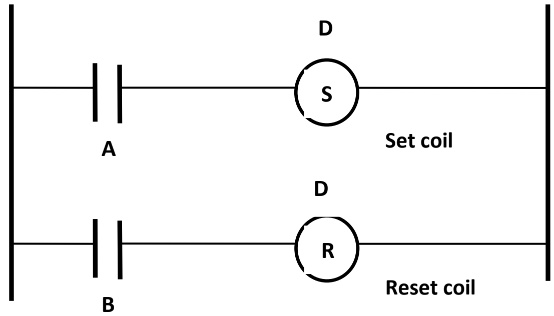


Figure 1.9 a ladder logic latch

Both set coil and reset coil can be combined in one box as shown in **Figure 1.10**. Following instructions are to be followed while writing a program for memory function

- Setting up a memory location
- Resetting up a memory location

The memory address locations vary from manufacturer to manufacturer. For sake of simplicity we shall use M1, M2 … to represent memory. Number of bit memories available in PLC for memory are 1024, 2048 8192 and more.

If the power flows either momentarily or continuously to the set coil, the specified memory address is set to signal state 1. If power flows momentarily or continuously to the reset coil , the corresponding memory address is reset to signal state 0. If there is no power in the set input or reset input, the memory address remains unaffected. The output of the memory function can be accessed through either NO or NC program element

Set reset memory	**Reset set memory bloc**

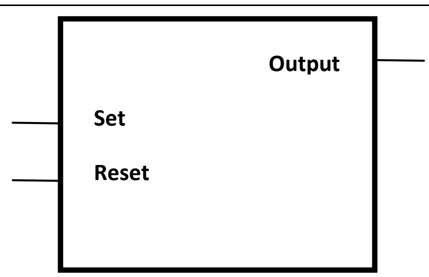
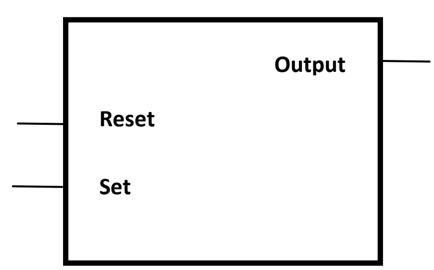

	

Figure 1.10 : Memort box representation	

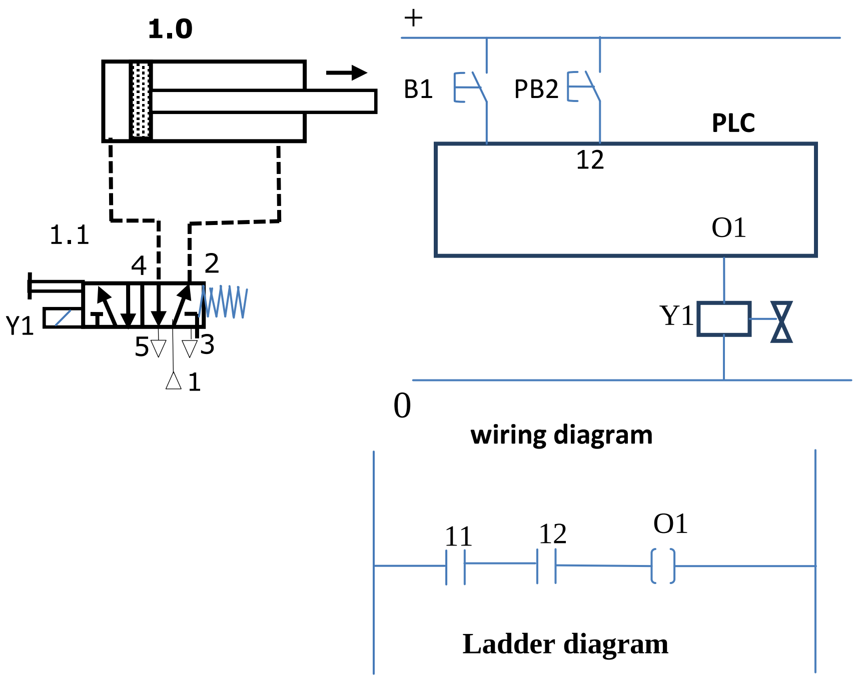
Set and reset functions are combined in one memory box as shown in Figure 1.10. They can be further classified into two categories

a) Memory box with set priority
b) Memory box with reset priority

The functions of a memory box are similar to the memory coils. In the memory box with set priority, the associated memory address is set when signal state 1 appears simultaneously at both the set and reset inputs. In the memory box with reset priority, the associated memory address is reset when signal state 1 appears simultaneously at both reset and set inputs. This concept is similar to Dominant ON and Dominant OFF functions of electrical latching circuits discussed in chapter lecture 41

Example 1 : Double acting cylinder is used to perform machinng operation. Pneumatic cylinder is advanced by pressing two push buttons simultaneously. If any one of the push button is released, cylinder comes back to start position. Draw the pneumatic circuit, PLC wiring diagram and ladder diagram to implement this task.

Solution is shown in Figure 1.11



Assignment Table	
PB1	11
PB2	12
Y1	01

Figure 1.11 a) Pneumatic diagram b) wiring diagram c) ladder diagram

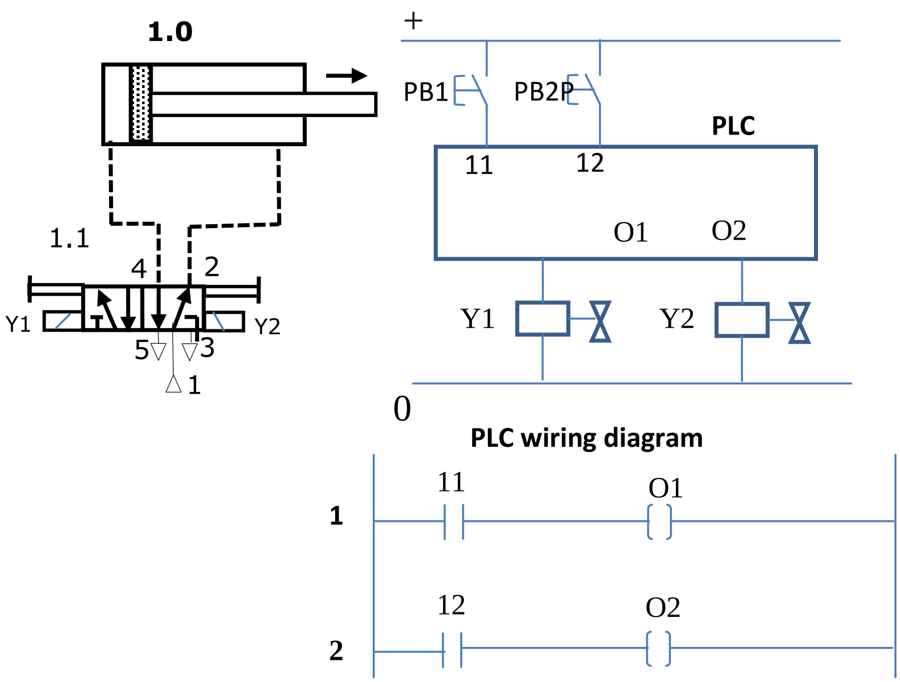
As shown in the PLC wiring diaram , The pushbuttons PB1 and PB2 are connected at memory address I1 and I2. I1 and I2 are connected in series in ladder diagram to relase this AND logic funtion.

When the push buttons PB1 and PB2 are pressed simultaneously, the addresses I1 and I 2 turn to state 1 from state 0 , as a result power flows thorugh the coil and there will be output at coil 01. Output at the coil 01 operated the solenoid coil and cylinder moves foraward to do the required operation.

If any one of PB1 and PB2 is pressed, then corresponding bit addresses turns to 0, since I1 and I2 are in series , if any of them turns to 0 state , there will not be any outout at 01 and thus solenoid is deenergised and returns back.

Example 2 : Double acting cylinder is used to perform forward and return motion. Pneumatic cylinder is advanced by pressing push buttons PB1. Cylinder is returned by pressing push button PB2. Draw the pneumatic circuit, PLC wiring diagram and ladder diagram to implement this task.

Solution is shown in Figure 1.12



Assignment Table	
PB1	11
PB2	12
Y1	01
Y2	02

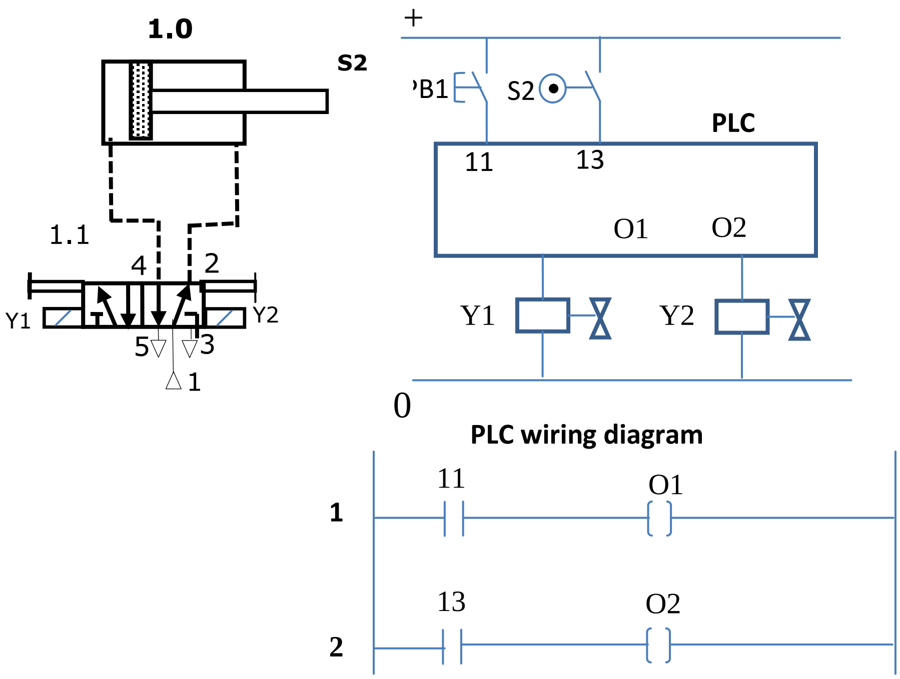
Figure 1.12 **a) Pneumatic diagram b) wiring diagram c) ladder diagram PLC**

PLC Wiring diagram and Ladder diagrams are shown in Figure 1.7. when the pushbutton PB1 is pressed state of the address I1 turns to 1 and thus there will be output 01. The output of 01 operates the solenoid Y1 and cylinder moves forward,

When the cylinder reaches the extreme forward position, and Push button PB2 is operated , the state of address I2 turns to 1 and thus there will be output 02. The output of 02 operates the solenoid Y2 and cylinder return back to initial position.

Example 3 : Double acting cylinder is used to perform forward and return automatically after reaching the extreme forward position. Pneumatic cylinder is advanced by pressing push buttons PB1. Draw the pneumatic circuit, PLC wiring diagram and ladder diagram to implement this task.

Solution is shown in Figure 1.13



Assignment Table	
PB1	11
S2	13
Y1	01
Y2	02

Figure 1.13 a) Pneumatic diagram b) wiring diagram c) ladder diagram

PLC Wiring diagram and Ladder diagrams are shown in Figure 1.7. when the pushbutton PB1 is pressed state of the address I1 turns to 1 and thus there will be output 01. The output of 01 operates the solenoid Y1 and cylinder moves forward,

When the cylinder reaches the extreme forward position, and Limit switch S2 is operated , the state of address I3 turns to 1 and thus there will be output 02. The output of 02 operates the solenoid Y2 and cylinder return back to initial position.

Example 4 : Double acting cylinder is used to perform pressing operation. Cylinder has to move forward when PB1 button is pressed and return for set time of 20 seconds before it automatically returns to intial position. Limit switch S2 is used for end sensing of the forward motion of the cylinder. Draw the pneumatic circuit, PLC wiring diagram and ladder diagram to implement this task.

Solution is shown in Figure 1.14

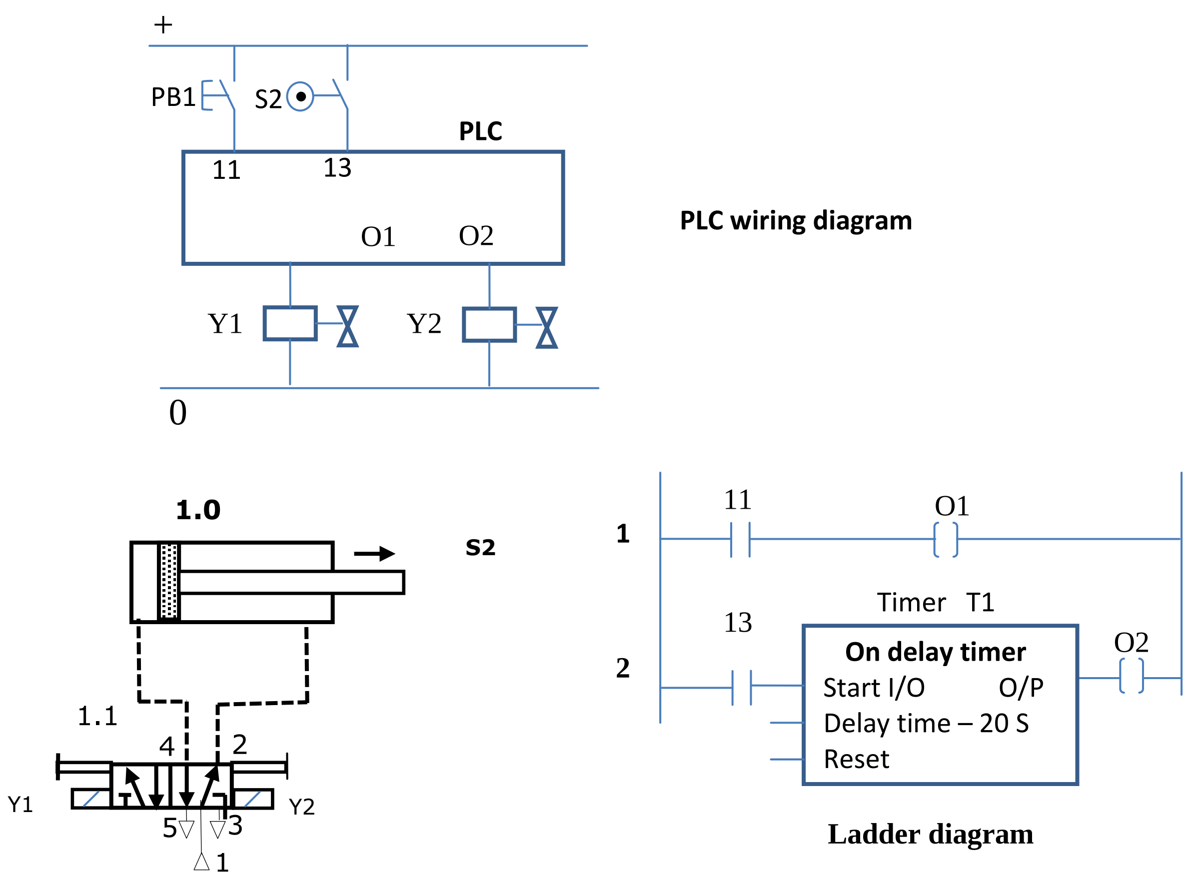


Figure 1.14 a) Pneumatic diagram b) wiring diagram c) ladder diagram

When PB1 is pressed, address I1 input state goes to 1 and there is an output at O1. Due to output at O1, the solenoid coil Y1 is operated and cylinder moves forward. When cylinder reaches end position , limit switch S2 is operated and as a result address I3 changes to 1 and consequently starts the timer T1. The signal state of timer T1 changes to 1 after 20 seconds is reached. At the end of 20 seconds there will be output from Timer T1 set output O2. Coil Y2 is energised thus causing the return motion of the cylinder.

Example 5 : Double acting cylinder is used to perform continuous to and fro motion. Cylinder has to move forward when PB1 button is pressed and once to and fro reciprocation starts it should continue till stop button PB2 is pressed. Limit swithces are used for end position sensing. Draw the pneumatic circuit, PLC wiring diagram and ladder diagram to implement this task.

Solution is shown in Figure 1.15

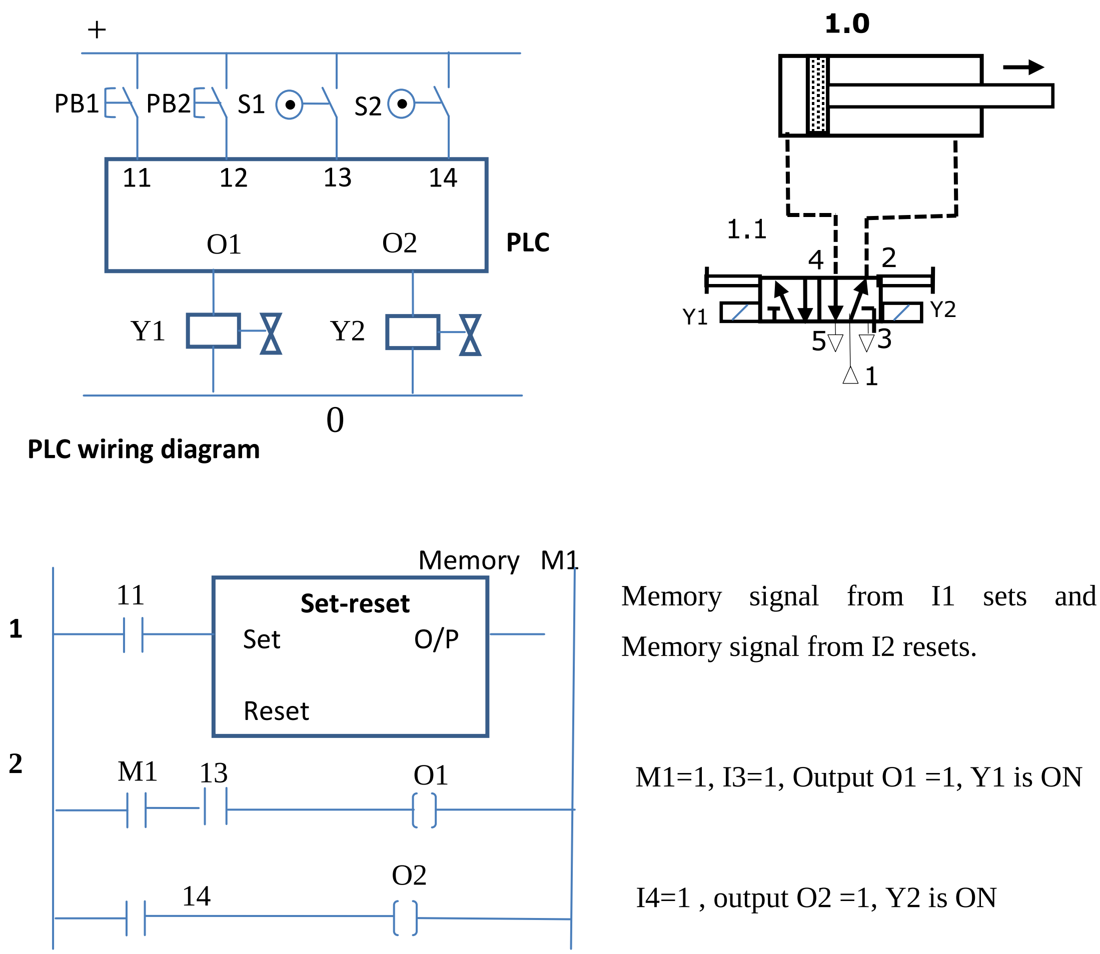
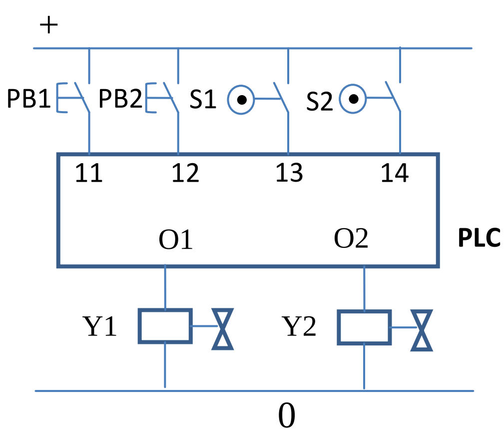


Figure 1.15 a) Pneumatic diagram b) wiring diagram c) ladder diagram

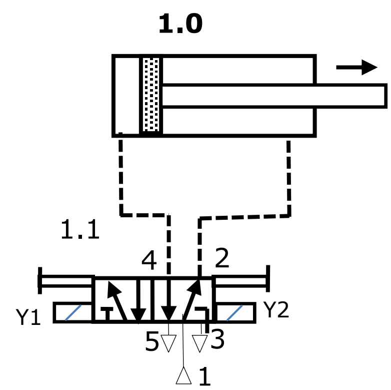
The start and stop operations can be implemented using memory flag with address M1 that is set by PB1 and reset by PB2. The state of the memory element M1 is scanned through an NO contact, is combined in series with the state of sensor S1 to get start and stop controls.

Example 6 : Double acting cylinder is used to perform to and fro operation. Cylinder has to move forward when PB1 button is pressed and continue to and fro motion till 10 cycles of operations is performed. Draw the pneumatic circuit, PLC wiring diagram and ladder diagram to implement this task.

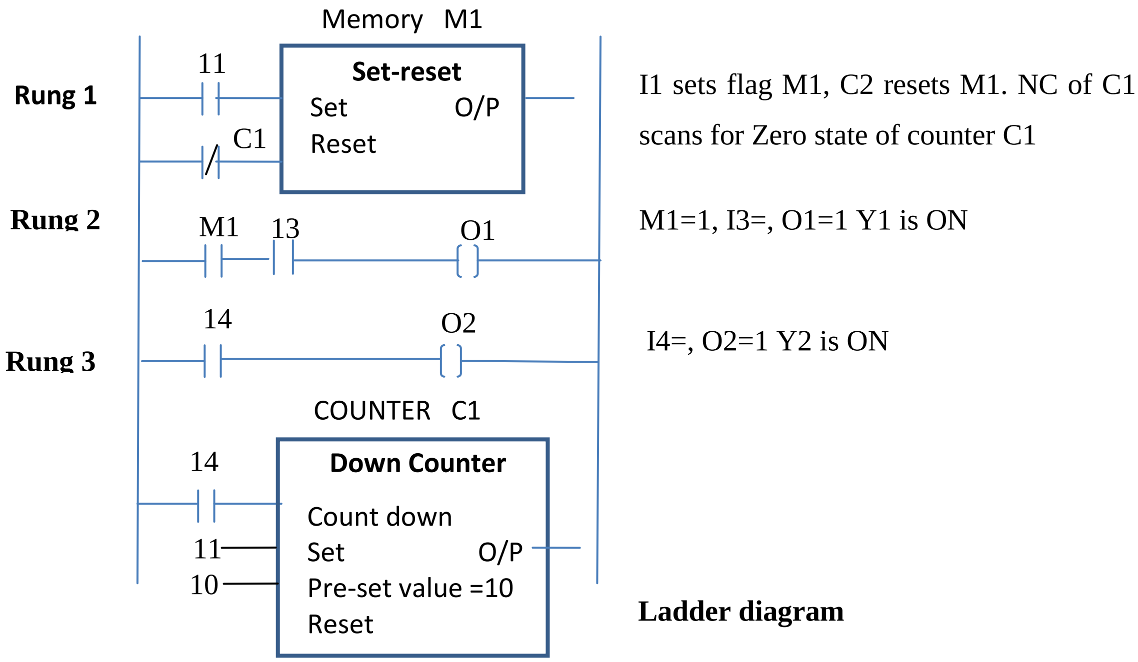
Solution is shown in Figure 1.16



PLC wiring diagram



Pneumatic diagram



Ladder diagram

The fully automatic operation of cylinder can be obtained as earlier using limit switch S1 and S2. Start and stop operation can be implemented using memory flag with address M1 that is set by PB1 at I1 and reset by NC contact of a down counter. The state of memory flag M1 scanned through an NO contact (rung 2) is combined in series with the state sensor S1 to get start and stop controls.

Example 7 : Draw the pneumatic circuit, PLC wiring diagram and ladder diagram to implement A+B+B-A- sequence.

Solution is shown in Figure 1.17 and Figure 1.18

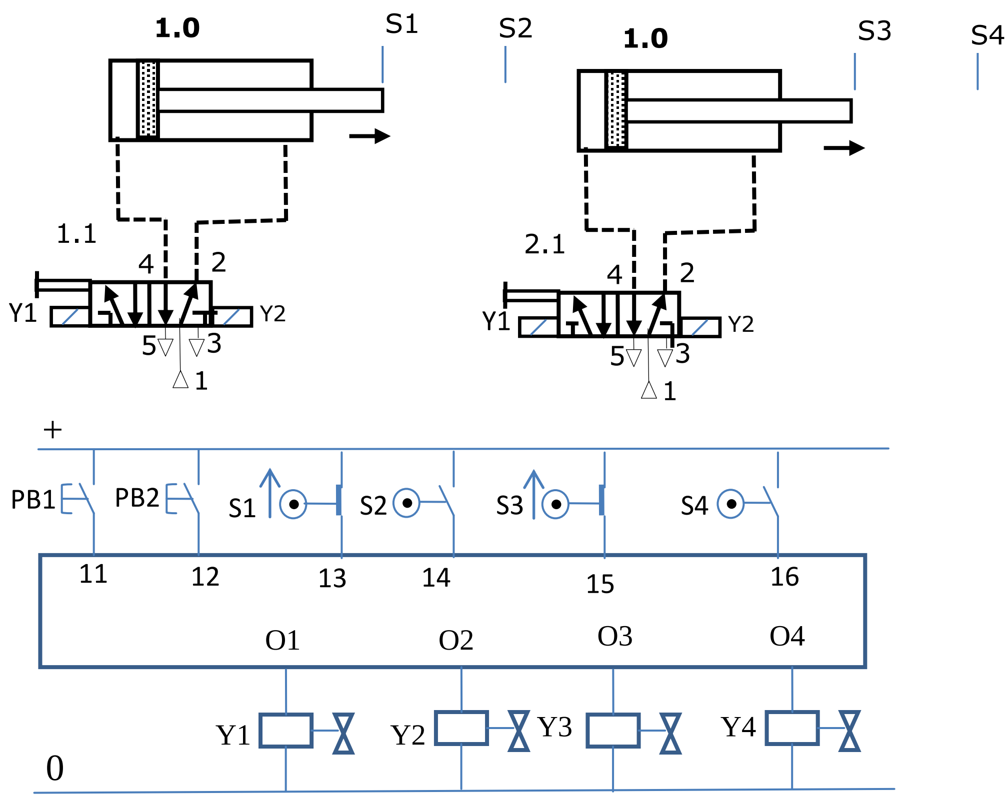


Figure 1.17 PLC wiring diagram

In this sequence circuit, PB2 is used to initiate the program. Pressing PB2 causes the last memory state M4 to set and all other memory flags M1, M2 and M3 to reset. Initially S1 and S3 are actuated and generate outputs.

Condition 1: Pressing PB1 sets Memory flag M1 and resets Memory flag M4. Solenoid Y1 is energised. Cylinder A extends (A+). Sensor S1 is deactivated once A travels and S2 is activated when end position is reached.

Condition 2: When S2 is actuated, memory M2 is set and Memory flag M1 is reset. Solenoid Y3 is energised. Cylinder B extends (B+). Sensor S3 is deactivated once B travels and S4 is activated when end position is reached.

Condition 3: When S4 is actuated, memory M3 is set and Memory flag M2 is reset. Solenoid Y4 is energised. Cylinder B retracts (B-). Sensor S4 is deactivated once B travels and S3 is activated when initial position is reached

Condition 4: When S3 is actuated, memory M4 is set and Memory flag M3 is reset. Solenoid Y2 is energised. Cylinder A retracts (A-). Sensor S2 is deactivated once B travels and S1 is activated when initial position is reached

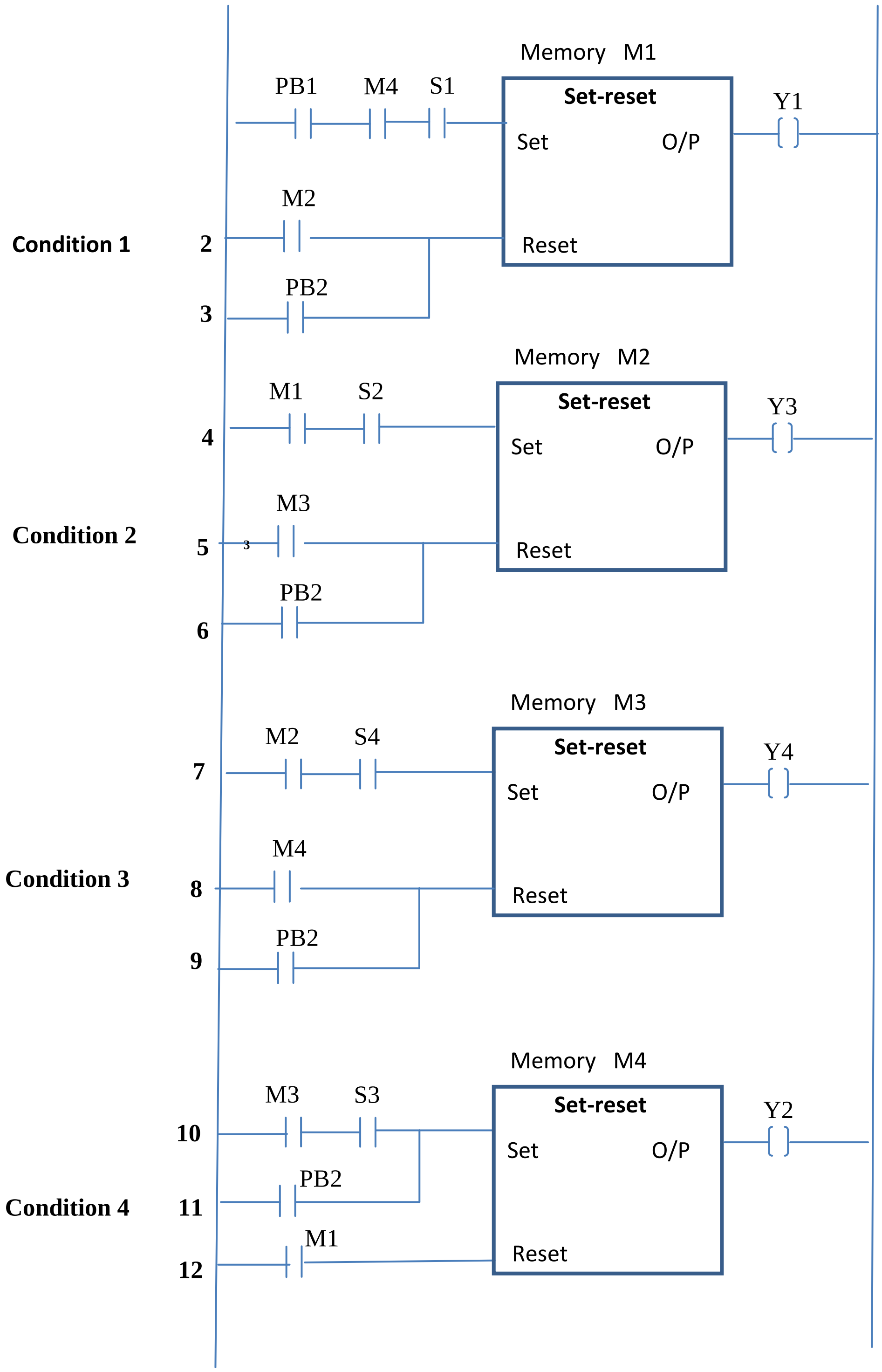


Figure 1.18 Ladder diagram

1.11 Areas of Application of a PLC

Every system or machine has a controller, depending on the type of technology used, controller can be divided into pneumatic, hydraulic, electrical and electronic controllers. Frequently we use combination of different technologies. Furthermore, differentiation is made between hard wired programmable and programmable logic controller. The first is used primarily in cases, where any reprogramming by the user is out of the question and job size warrants the development of a special controller. Typical application for such controllers can be found in automatic washing machine, video cameras, and cars.

However, if the job size does not warrant the development of special controllers or if the user is to have the facility of making simple or independent program changes, or of setting timers and counters, then the use of universal controllers, where the program is written to an electronic memory, is the preferred option. The PLC represents such a universal controller. It can be used for different applications and via the program installed in its memory , provides the user with a simple means of changing , extending and optimising control processes.

PLC are widely used in Industries due to following reasons.

- Cost of PLC automation is less and PLC is very versatile
- PLC can be commissioned and installed easily
- Programming of PLC is quite simple. Ladder programming is flexible
- They are not hard wired control. They can be programmed and reprogrammed to accommodate frequent changes in program
- Monitoring of on line work process is easy, therefore trouble shooting and maintenance of PLC is not a difficult task
- They can be classified as low cost automation devices
- They can be used in harsh environment where humidity and temperature are high. Their working is not effected by vibration and shock
- They can be used to execute complex mathematical algorithms, servomotor control, Stepping control, axis control, self – diagnosis, on line monitoring, condition monitoring, system trouble shooting, communicating to other PLCs, data acquisition, Networking, storage and report generation

- PLC are most suitable for low cost automation, where frequent changes to the control requirement would be expected during their operational life like in Batch type of production systems.

1.12 PLC standards

Previously valid PLC standards focussing mainly on PLC programming were generally used in Europe at end of the seventies. This included non-networked PLC system, which primarily execute logic operations on binary signals. DIN 19 239, for example, specifies programming language which possess the corresponding language commands for these applications.

Since 1992, an international standard now exists for programmable logic controllers and associated peripheral devices like programming and diagnostic tools, testing equipment, man to machine interfaces.

In 1992, IEC 1131 standards were developed as an open framework for PLC architecture. The second edition of IEC 1131 (Known as IEC 61131) was published in 2003. The new IEC standard consists of five parts

- Part 1 : General information
- Part 2 : Equipment requirement and tests
- Part 3 : programming languages
- Part 4 : User guidelines in preparation with IEC
- Part 5: Messaging service specification

Parts 1 to 2 of this standard were adopted unamended as European standard EN 61 131, parts 1 to 2. As such, they also hold the status of a German standard. Part 3 of new IEC deals with programming languages and defines two graphical and two textural PLC programming language standards. The standard also defines both graphical and textual sequential function chart elements to organise programs for sequential and parallel control processing. It is now possible to program PLC using following languages

- IL- Instruction list
- ST – structural text
- LD – Ladder diagram
- FBD - Functional block diagram
- SFC- Sequential function chart

The purpose of the new standard was to define and standardize the design and functionality of a PLC and the languages required for programming to the extent where users were able to operate using different PLC systems without any particular difficulties.

Large number o f major PLC suppliers are members of association called PLCopen which supports IEC 1131. Allen Bradley, Klockner–Moeller, Phillips Siemens or Mitsubishi to mention a few.

Objective Type Questions

1. The most important sections of PLC are input section, output section and ------
2. The Structure of PLC consists of power supply module, CPU, I/O modules and --------
3. User program can be written in any standard PLC programming language like statement list and ------------------
4. The AND function combines the bit addresses of inputs and produces an RLO (Results of logic operation) of ..... when all the inputs are scanned for 1
5. The function of timer is to provide ------------------ between work operations

State True or False

1. Hard wired control systems are used widely when production requirements change regularly

2. Relay controls are less expensive compared to PLC controls

3 While processing a PLC program, CPU scans and executes the main program cyclically.

4. The NO and NC PLC program contact is same as the hardware NO and NC contacts.

5. The OR function combines the bit addresses of inputs and produces an RLO (Results of logic operation) of 1 when any one or more of inputs are scanned for 1.

Review Questions

1. What is a hard wired control? what are its disadvantages

2. List five differences between PLC control and Relay control

3. List three input devices commonly used in PLC control

4. Explain the working of functions of CPU , Input and output module and memory in PLC

5. Mention few applications of PLC

6. What are the functions of timer in PLC

7. Briefly explain the structure of PLC

8. Differentiate between ON time delay and OFF time delay with help of symbols

9. What is meant by bit logic operations in relation to a PLC

10. Give functions of following PLC program elements a) Program coil b) NC contact c) NO contact d) Set coil e) reset coil f) Set-reset box g) reset-set box h) on delay timer i) off delay timer j) up counter k) down counter

Answers

Fill in the Blanks

1. Program section
2. Software
3. Ladder diagram
4. 1(one)
5. delay

State True or False

1. False
2. False
3. True
4. False
5. True