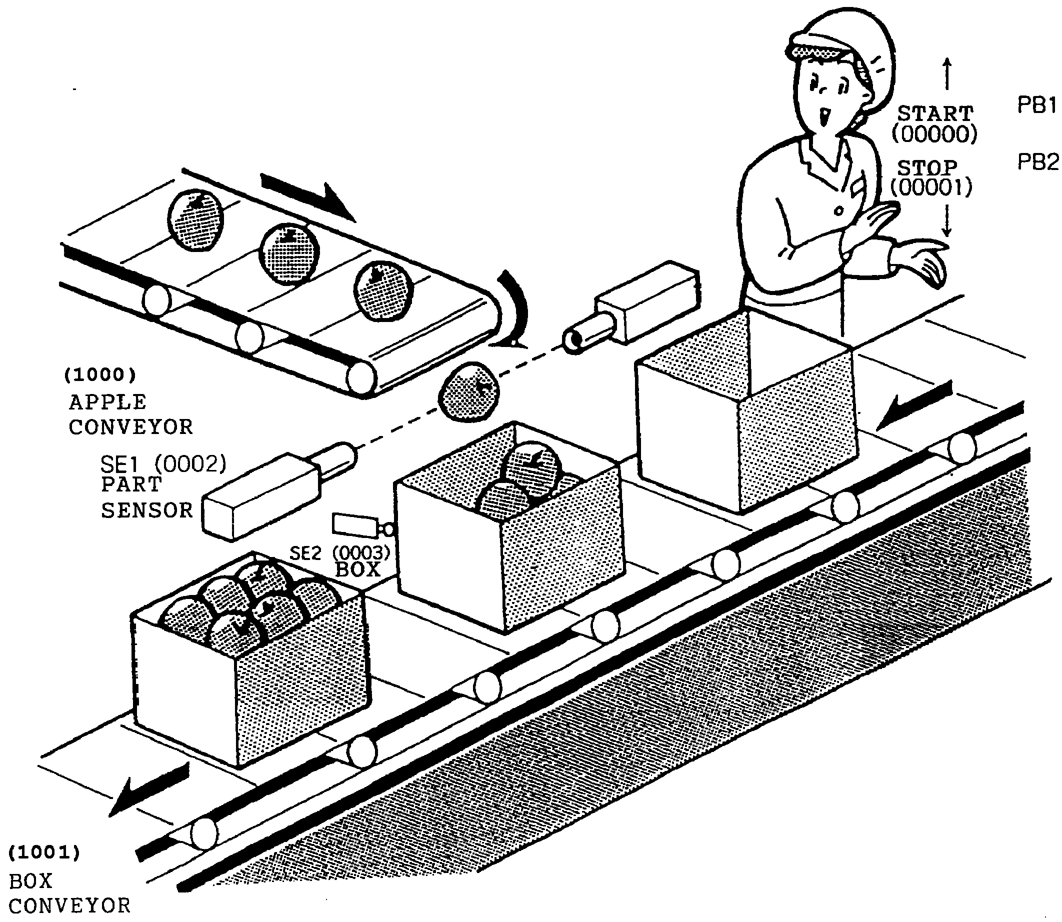
6. APPLICATION EXAMPLES OF BASIC COMMANDS

❑ Example : Packaging Line Control

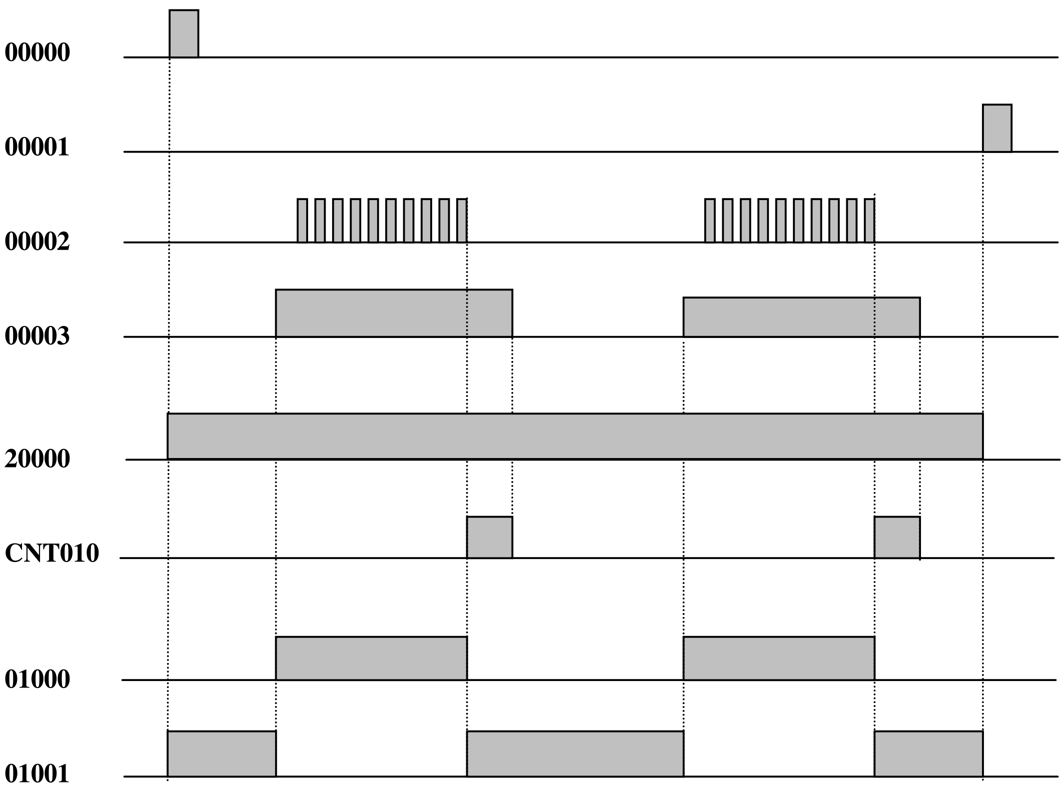


❑ Operation

When PB1 (START Push Botton) is pressed, the box conveyor moves. Upon detection of box present, the box conveyor stops and the Apple conveyor starts. Part sensor will count for 10 apples. Apple conveyor stops and box conveyor starts again. Counter will be reset and operation repeats until PB2 (STOP Push Button) is pressed.

Input	Devices
00000	START Push Button (PB1)
00001	STOP Push Button (PB2)
00002	Part Present (SE1)
00003	Box Present (SE2)

Output	Devices
01000	Apple Conveyor
01001	Box Conveyor

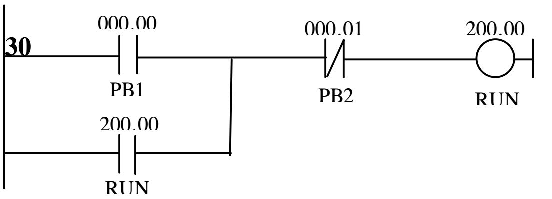


6. APPLICATION EXAMPLES OF BASIC COMMANDS

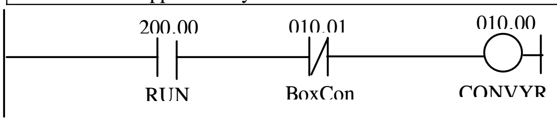
Ladder diagram : Main 1 Network 1

Main 1 – Packaging Packaging line control for Apples

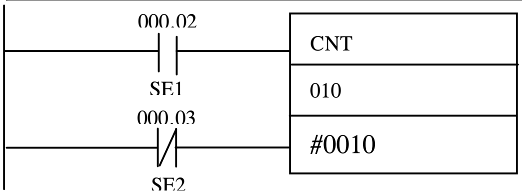
Network 1 – Start condition



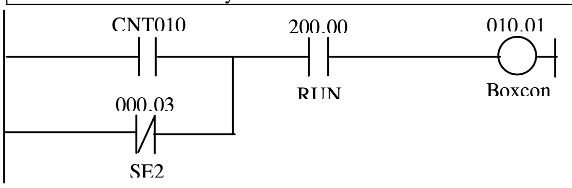
Network 2 – Apple conveyor



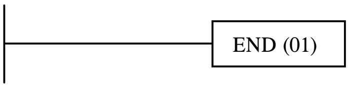
Network 3 – Counter Counter preset at 10



Network 4 – Box conveyor



Network 5 - END

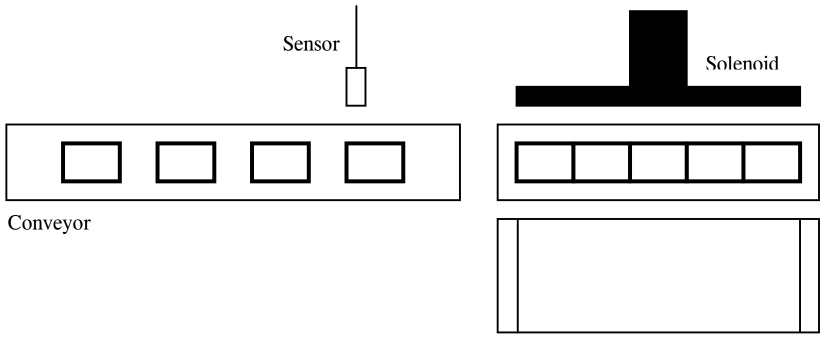


Address	Instruction	Data
0000	LD	00000
0001	OR	20000
0002	AND NOT	00001
0003	OUT	20000
0004	LD	20000
0005	AND NOT	01001
0006	OUT	01000
0007	LD	00002

Address	instruction	Data
0008	LD NOT	00003
0009	CNT	010
		#0010
0010	LD CNT	010
0011	OR NOT	00003
0012	AND	20000
0013	OUT	01001
0014	END (01)	

❑ Application #3 : Control Circuit For Packaging Machine

The control circuit is used to detect and count the number of products being carried on an assembly line. When it counts five products, the circuit energizes a solenoid. The solenoid is energized for a period of two seconds and is then shunt off, causing it to retract.

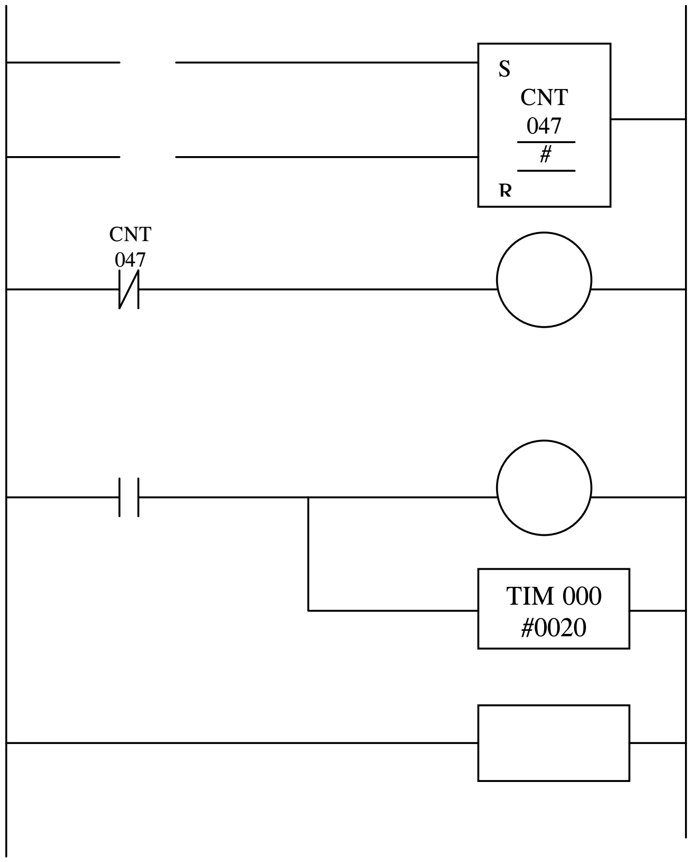


Input	Device
00000	Sensor

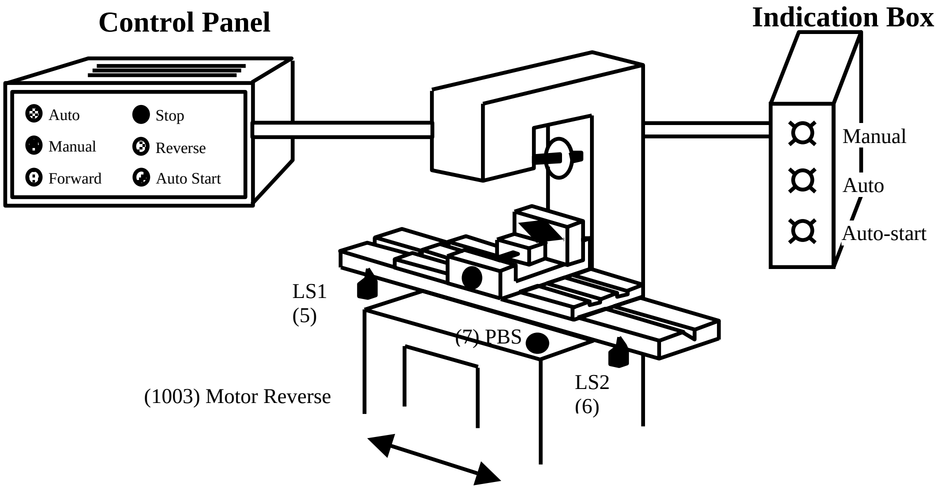
Output	Device
01000	Conveyor
01001	Solenoid

Others	
CNT 047	Product counter
TIM 000	Solenoid energizer timer

Question: Fill in the gaps below to make this circuit operate.



❑ Application #4 : Drilling Control Operation



- **I/O Assignments**

Input	Device
00000	Auto Switch
00001	Manual
00002	Forward Switch (SW1)
00003	Stop Switch (SW2)
00004	Reverse Switch (SW3)
00005	Limit Switch (LS1)
00006	Limit Switch (LS2)
00007	Auto Start Button (PBS)

Output	Device
1000	Auto Indicator
1001	Manual Indicator
1002	Motor Forward
1003	Motor Reverse
1004	Auto Start Indicator

- **Procedure**

1. Manual Operation

1.1 When SW1 is ON, Motor moves forward. It can be stopped by SW2. When the drill touches LS2, the Motor is cut-off.

1.2 When SW3 is ON, Motor moves in reverse. It can be stopped by SW2. When he drill touches LS1, the Motor is cut-off.

2. Auto-cycle

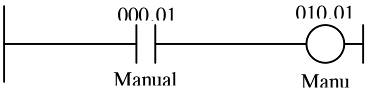
2.1 When PB and LS1 is ON, the Motor moves forward until LS2 is activated. The Timer then starts timing down. The Motor reverses when the timer reaches 2 seconds. When it returns to LS1 position, the cycle is repeated.

Answer

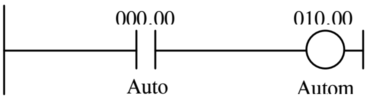
Ladder diagram : Main 1 Network 1

Main 1 – Drilling Control
Drilling control operation

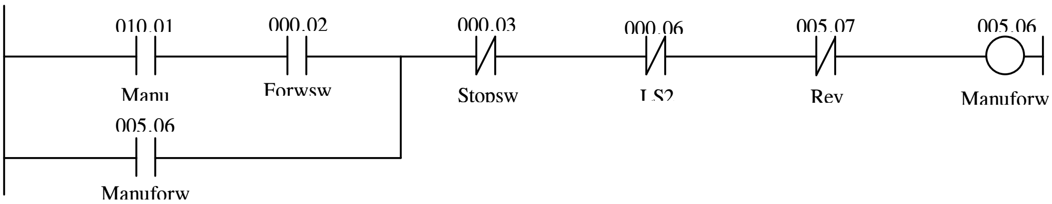
Network 1 – Manual indication



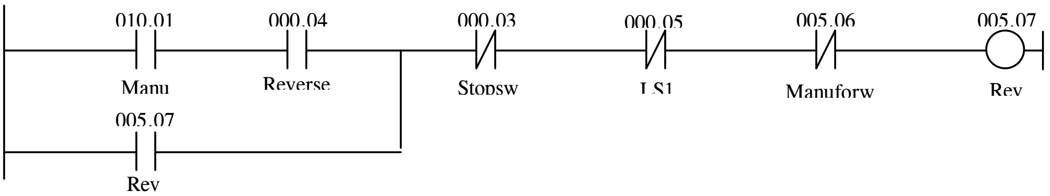
Network 2 – Auto indication



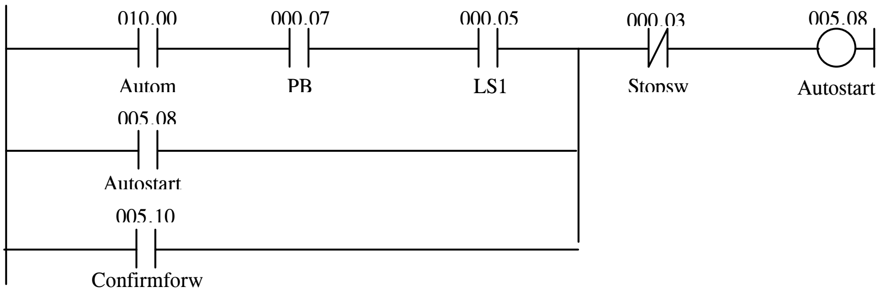
Network 3 – Manual forward



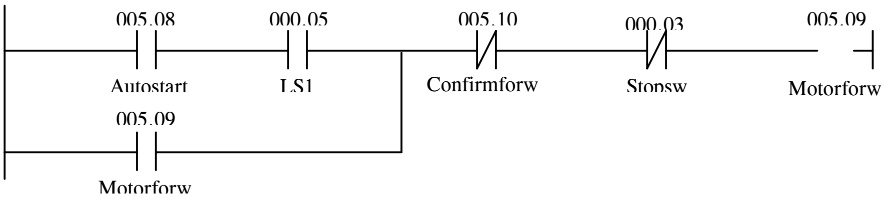
Network 4 – Manual reverse



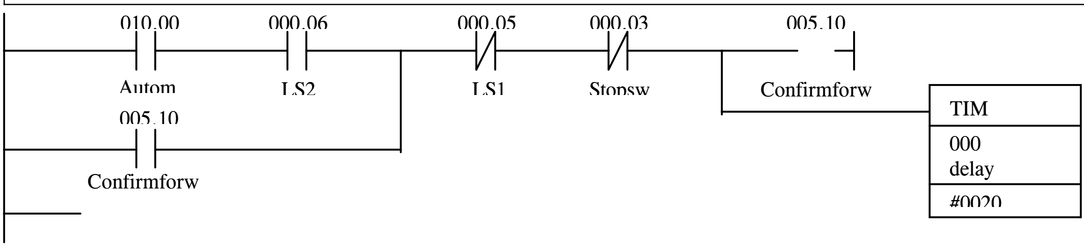
Network 5 – Auto start



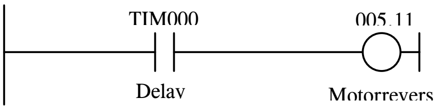
Network 6 – Motor forward



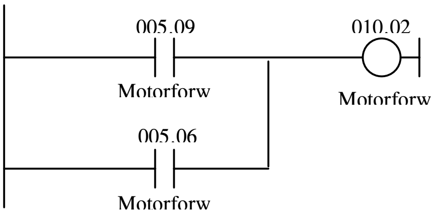
Network 7 – Confirm forward



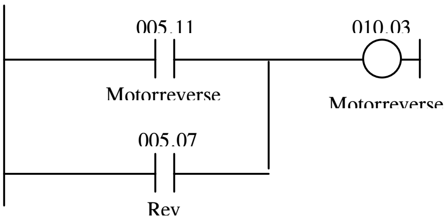
Network 8 – Motor reverse



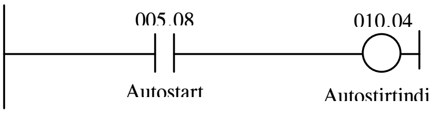
Network 9 – Motor forward



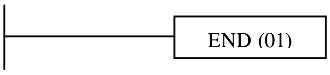
Network 10 – Motor reverse



Network 11 – Autostart
Autostart indicator



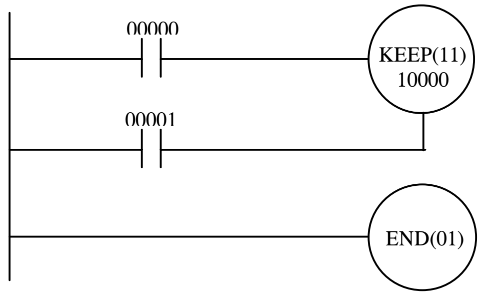
Network 12 – End



❑ KEEP(11) – Latching relay

KEEP is used as a latch. It maintains an ON or OFF state of a bit until one of its two inputs sets or resets it. If the KEEP function is used together with a HR relay, the state of the latched output is retained even during a power failure.

Ladder diagram

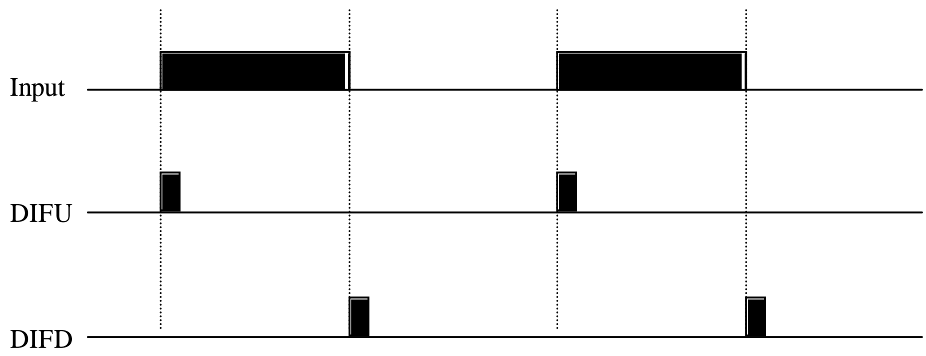


Mnemonic codes

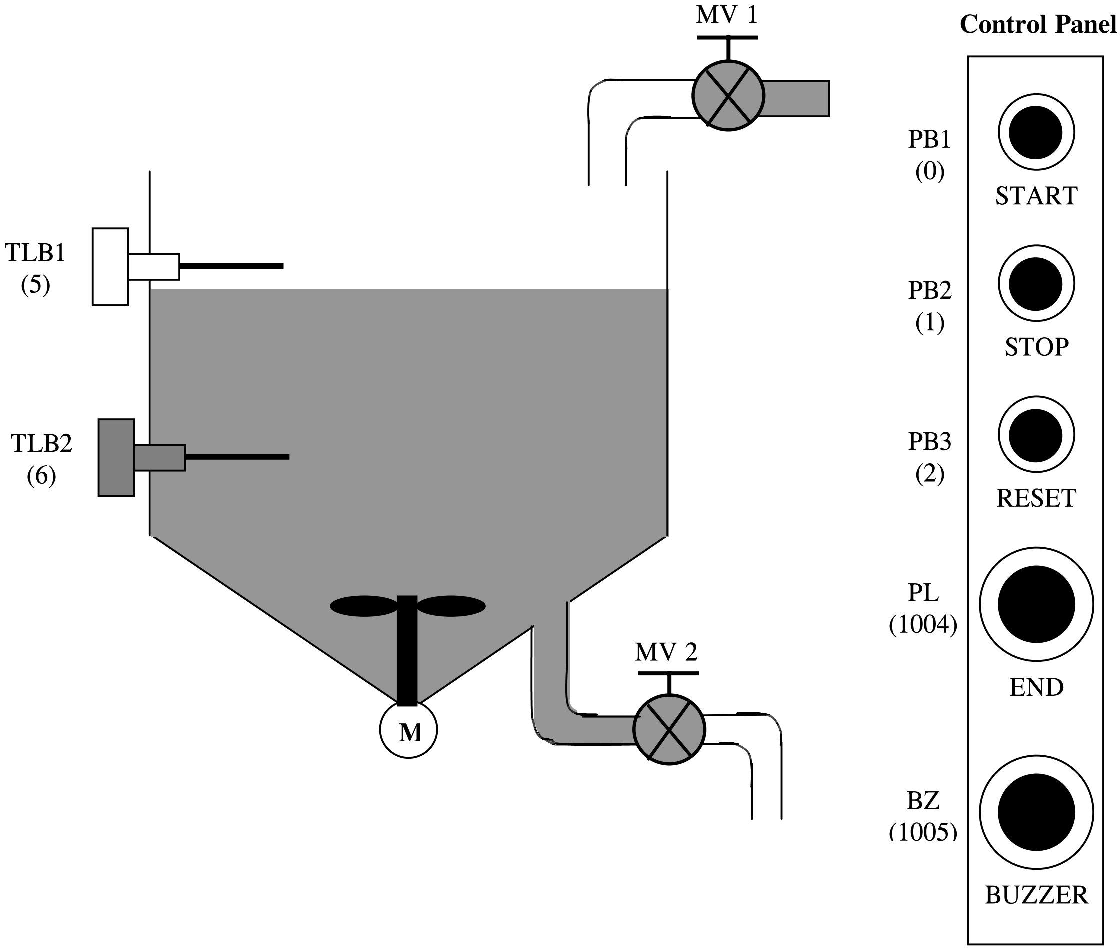
Address	Instruction	Data
0000	LD	00000
0001	LD	00001
0002	KEEP(11)	10000
0003	END(01)	

❑ DIFU(13) and DIFD(14) – Differentiation

DIFU and DIFD turns an output ON for one scan only.
DIFU turns its output ON when it detects an OFF -> ON transistion in its input signal.
DIFD turns its output ON when it detects an ON -> OFF transistion in its input signal.



Application #5: Filling/Draining Control Operation



- **I/O Assignments**

Input	Device
00000	Start Button (PB1)
00001	Stop Button (PB2)
00002	Reset Button (PB3)
00005	Upper Level Switch (TLB1)
00006	Lower Level Switch (TLB2)

Output	Device
01000	Water Supply Valve (MV1)
01001	Drain Valve (MV2)
01002	Stirring Motor (M)
01004	End Indicator
01005	Buzzer

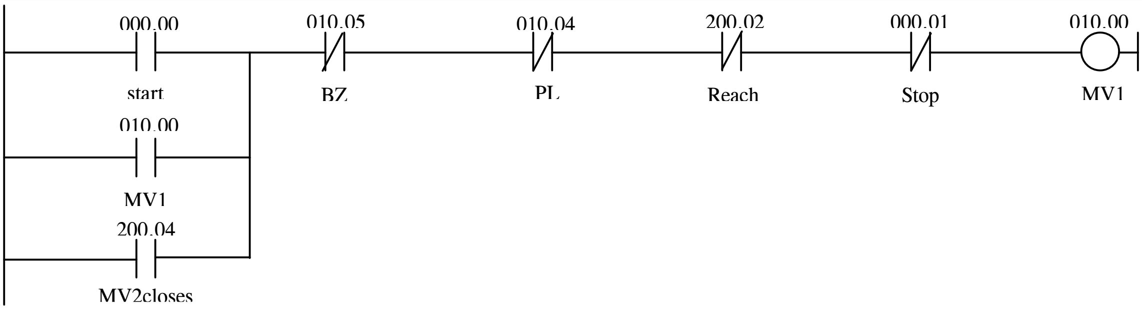
- **Procedure**

1. As the PB1 is pressed, MV1 opens and the water begins to fill the tank. At the same time, the stirring motor M starts operations.
2. When the water level passes TLB2 and reaches TLB1, the MV1 closes and the stirring motor stops.
3. Next, MV2 opens and starts draining the water. When the water levels drops below TLB2, MV2 closes.
4. When the cycle of operation has repeated four times, the operation END indicator illuminates, and the filling and draining operation will not restart even if PB1 is pressed.

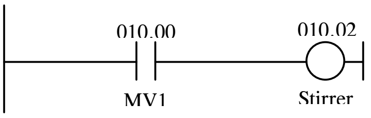
Ladder diagram : Main 1 Network 1

Main 1 – Fill / Draining
Filling / Draining control operation

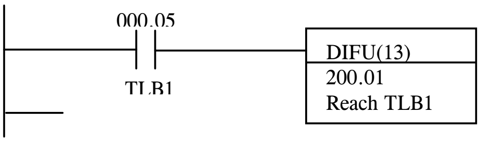
Network 1 – Start condition



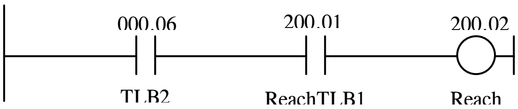
Network 2 – Stirring



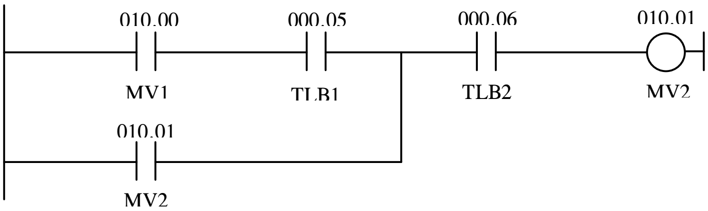
Network 3 – Reach TLB 1



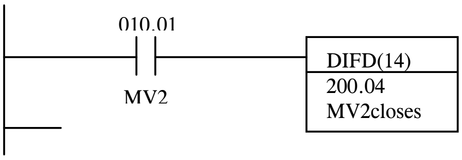
Network 4 – Water reach TLB



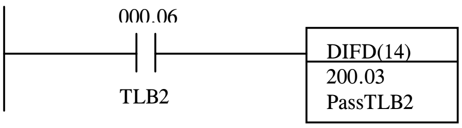
Network 5 – Drain



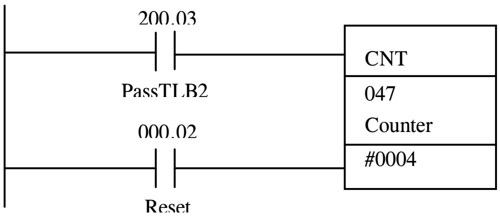
Network 6 – MV2 closes



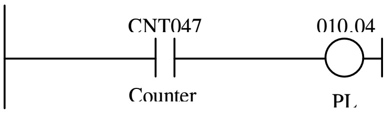
Network 7 – Pass TLB2



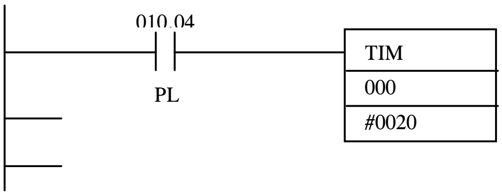
Network 8 – Counter
Counter preset at 4



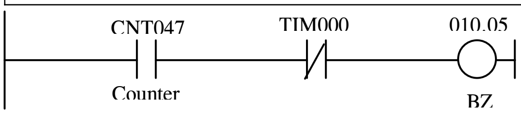
Network 9 – End indication



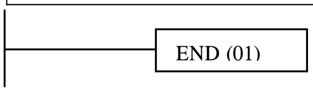
Network 10 – Delay
Delay for 2 seconds



Network 11 – Buzzer



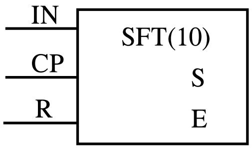
Network 12 – End



❑ Shift Register – SFT(10)

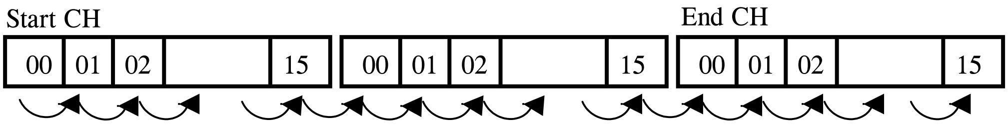
Shift Register (SFT) shifts a 16-bit data in specified channel by 1 bit. Although this instruction shifts data within channels, both a start channel and an end channel must be specified as the data.

Ladder diagram



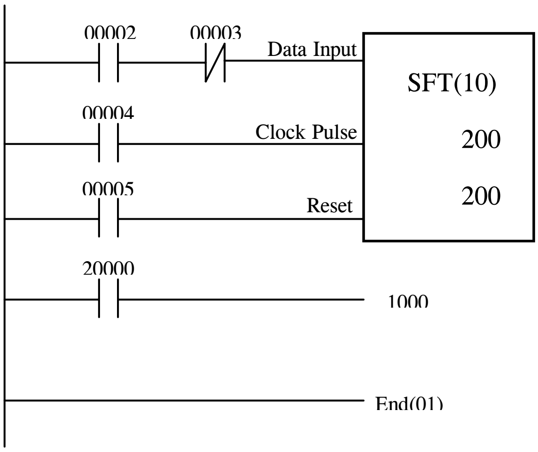
Operand Data Areas

I/O, Internal auxiliary Relay
Holding Relay



Example circuit

Ladder Diagram



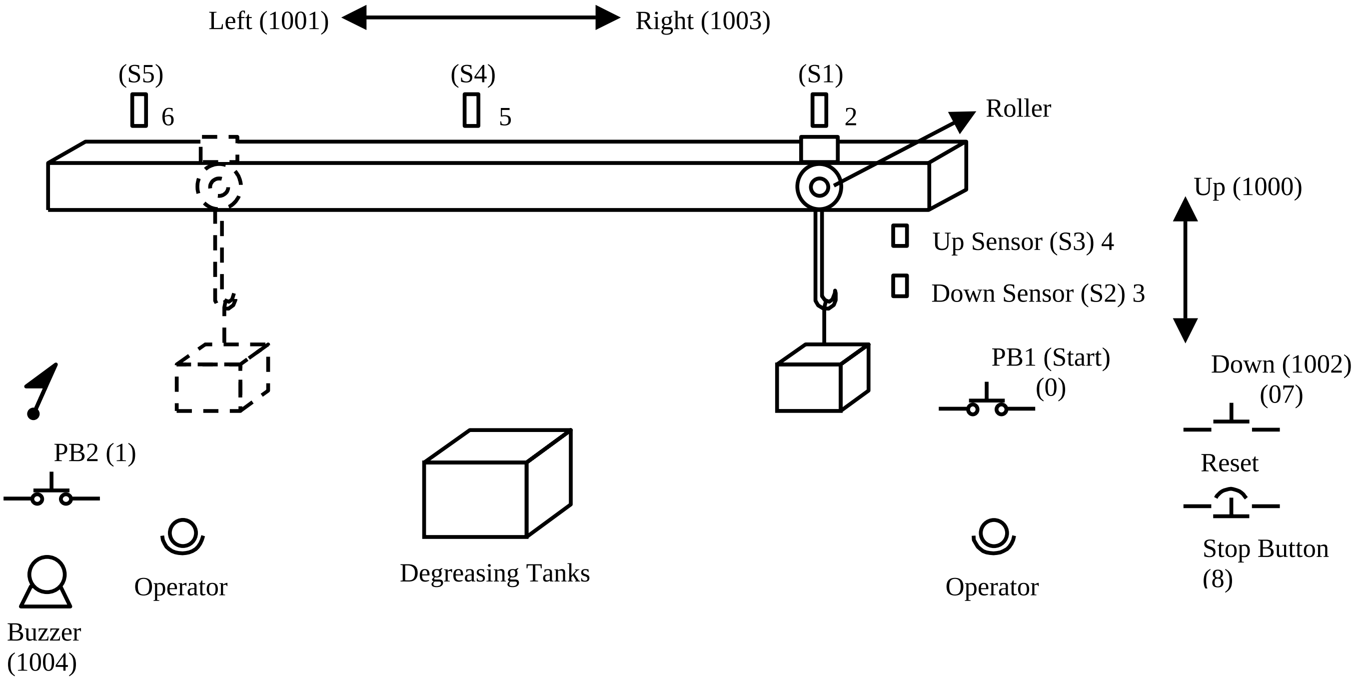
Mnemonic code

Address	Instruction	Data
0000	LD	00002
0001	AND NOT	00003
0002	LD	00004
0003	LD	00005
0004	SFT(10)	
		200
		200
0005	LD	20000
0006	OUT	1000
0003	END(01)	

- **Note :** When a reset input is applied to the Shift Register, all 16 bits are reset together. If the Holding Relay area is used, the data are retained during power failure.

❑ Application #6: Overhead Crane Control of Degreasing Operation

In this application, the part needs to be degreased in the degreasing tank before being passed to the next section.



When the PB1 is pressed, the roller will coil up the hook until the up-sensor (S3). The hook will then transverse left (via 01001) until it reaches the S4 position.

It will then stop and lower the product into the degreasing tank. When it reaches down to S2, the product will stay in the degreasing tank for 20 seconds. After the time is up, the product is lifted up and transverse left until S5 position and stop. It continue to come down. Until the down position, where the Buzzer will sound. The operator will collect the product and press the PB2 to return the crane back to the home position.

At anytime, the Stop Push Button can stop the crane from moving. Upon release, it will continue from where it stops. The Reset Push Button is used when you want to start over again from the beginning.

- **I/O Assignment**

Input	Device
00000	PB1 (Start button)
00001	PB2 (Return button)
00002	S1 (Sensor 1)
00003	S2 (Down sensor)
00004	S3 (Up sensor)
00005	S4 (Degrease sensor)
00006	S5 (End sensor)
00007	RST (Reset button)
00008	Stop (Stop button latch)

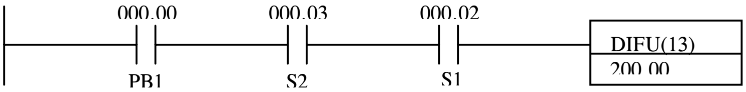
Output	Device
01000	Up motor
01001	Left motor
01002	Down motor
01003	Right motor
01004	Buzzer

6. APPLICATION EXAMPLES OF BASIC COMMANDS

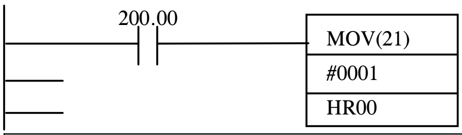
Ladder diagram : Main 1 Network 1

Main 1 –
Program for degreasing tank

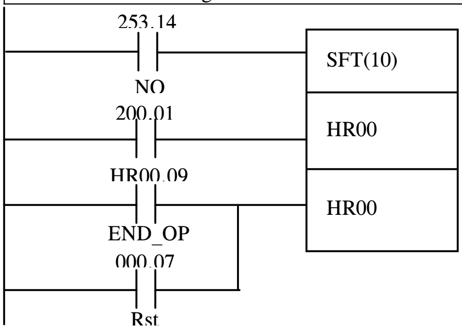
Network 1 – Start
Start operation



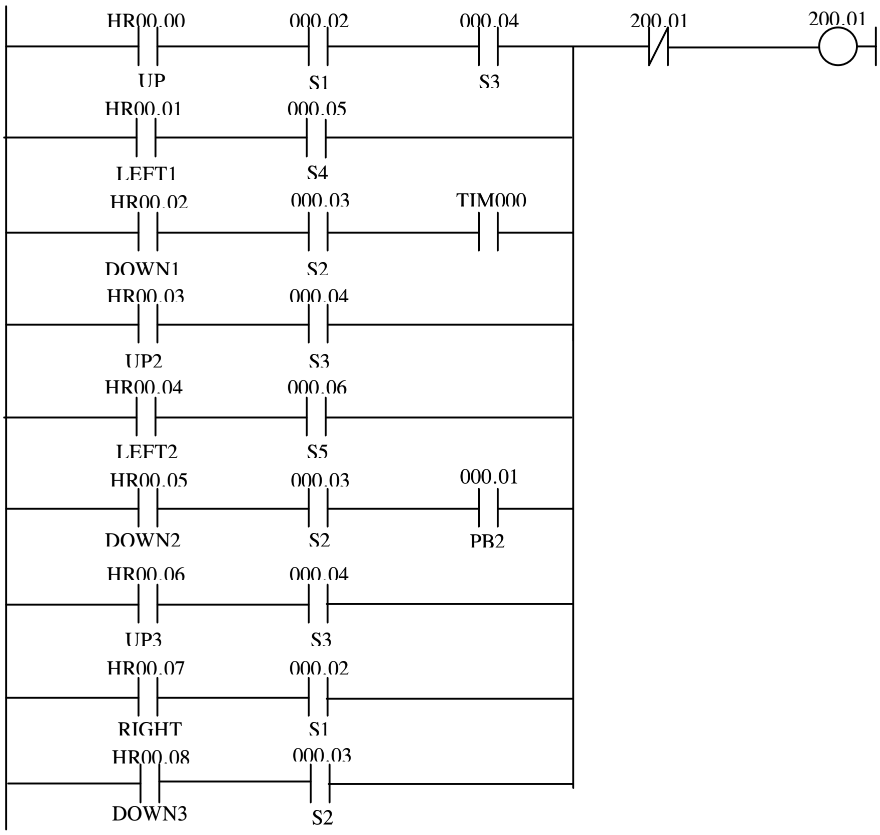
Network 2 – Set 1st bit on
Set 1st bit of HR 00 on



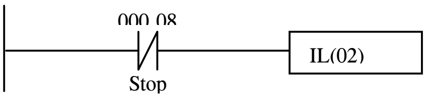
Network 3 – Shift Register



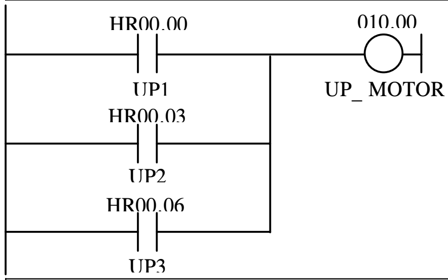
Network 4 – Shift operation
The shift register clock input to control the sequence of operation



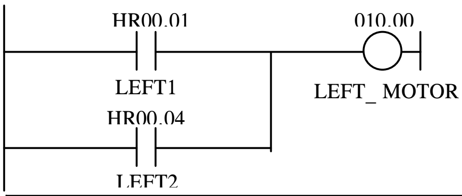
Network 5 – Interlock



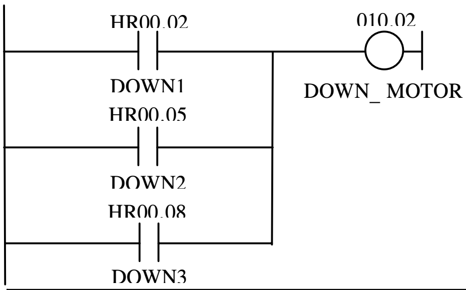
Network 6 – Up



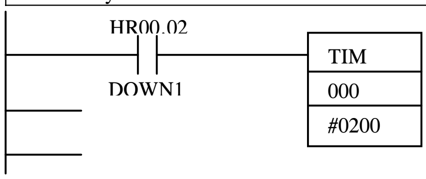
Network 7 – Left



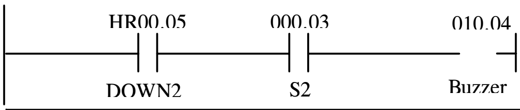
Network 8 – Down



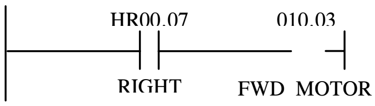
Network 9 – Time delay
Time delay for 20 secs



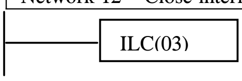
Network 10 – Buzzer



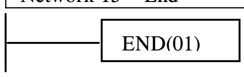
Network 11 – Right



Network 12 – Close interlock

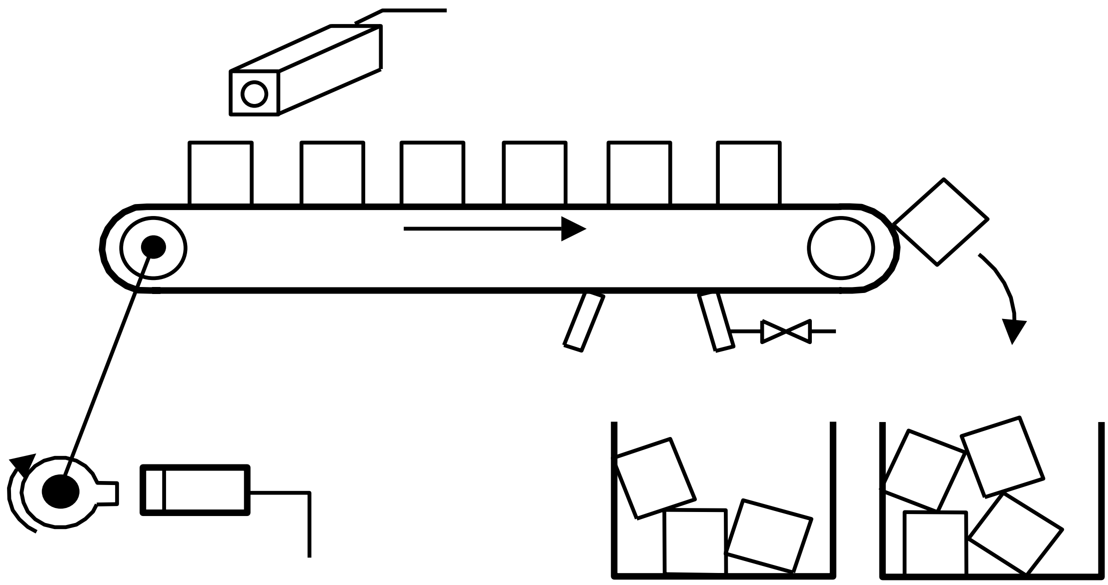


Network 13 – End



❑ Application #7: Parts Sorting

In this application, effective products are detected and rejected from those being carried on the conveyor.

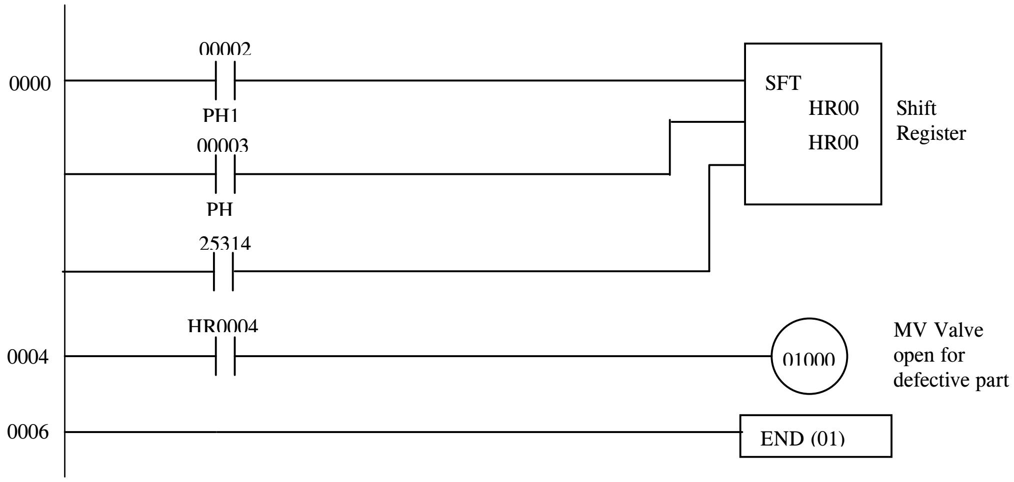


Photoelectric sensor (PH1) serves as the data input to the shift register. The signal output from this sensor turns ON when a defective product has been detected; otherwise it remains OFF.

Photoelectric sensor (PH2) is used as a clock generator that serves as the clock input to the shift register. It generates one pulse each time the product, spaced at a fixed interval from each other, has traveled a predetermined distance.

From the moment a defective product is detected by PH1, it is traced by the shift register until the product arrives at the predetermined position on the conveyor where it is ejected by the magnetic valve MV.

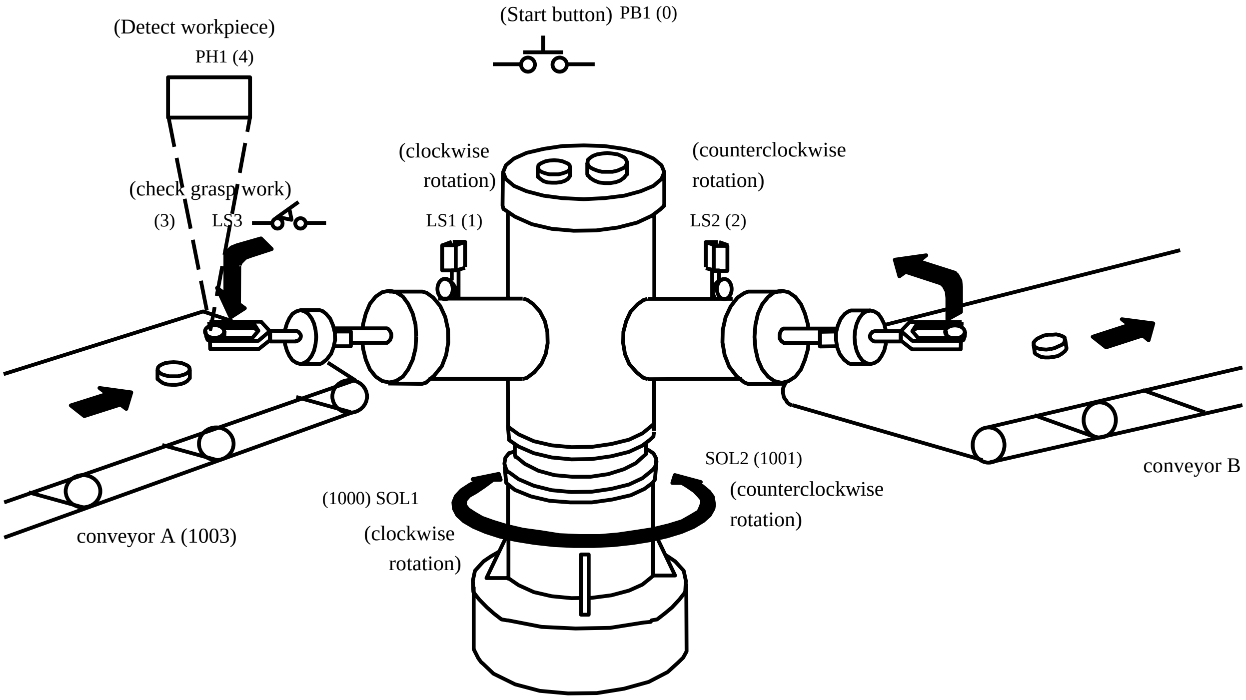
Ladder diagram



Mnemonic codes

Address	Instruction	Data
0000	LD	00002
0001	LD	00003
0002	LD	25314
0003	SFT	HR00
		HR00
0004	LD	HR0004
0005	OUT	01000
0006	END(01)	

❑ Application #8: Robot Movement Control



This kind of robot is seen in many automated factories. As is apparent from the figure, this robot picks up a work being carried on conveyor A and places it on conveyor B.

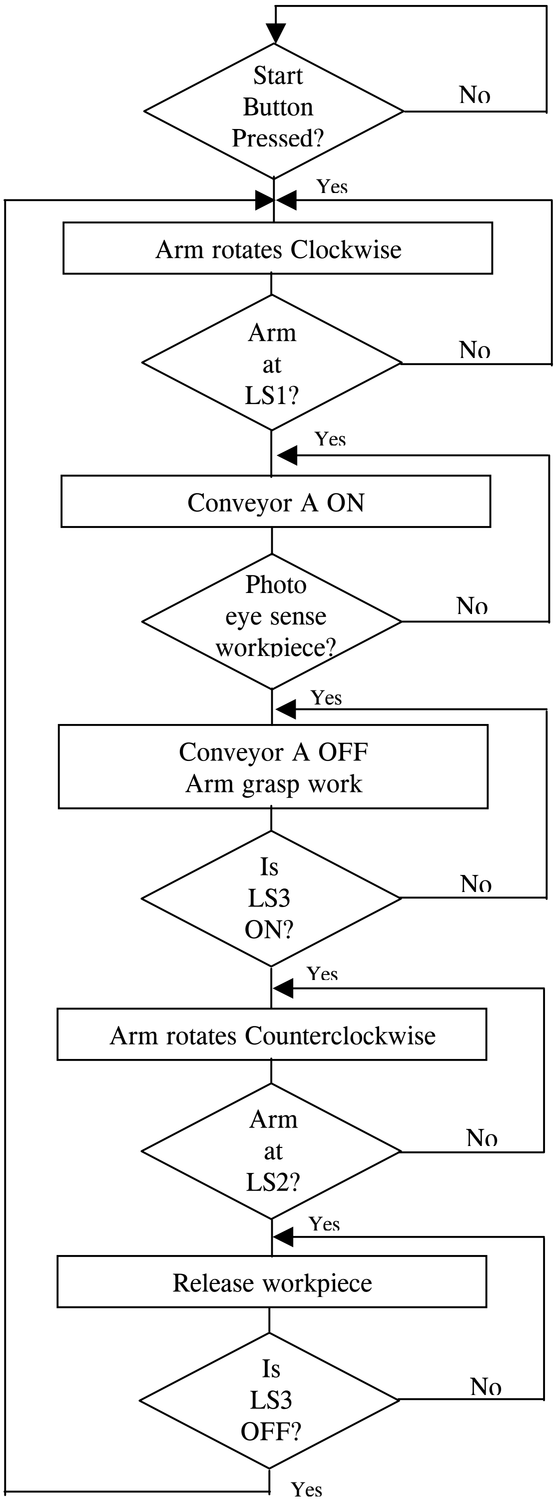
The operations and conditions are as follows:
1. When the start button is pressed, the robot rotates its arm clockwise.
2. When the robot arm has moved to the position of the work on the conveyor A, arm grasps the work.
3. When the arm has grasped the work, it rotates counterclockwise.
4. When the arm has rotated to the position of conveyor B, it releases the work.

- **I/O Assignment**

Input	Devices
0000	PB1 (start button)
0001	LS1 (clockwise rotation)
0002	LS2 (counterclockwise rotation)
0003	LS3 (checking grasped work)
0004	PH1 (detect workpiece)
0005	Stop button
0006	Reset button

Output	Devices
1000	Sol 1 (clockwise rotation)
1001	Sol 2 (counterclockwise rotation)
1002	Sol 3 (grasping work)
1003	Conveyor A

- **Procedure**

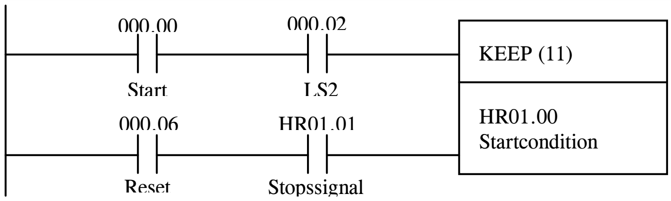


6. APPLICATION EXAMPLES OF BASIC COMMANDS

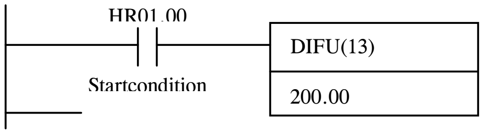
Ladder diagram : Main 1 Network 1

Main 1 – Robot control
This program demonstrates that the Robot picks up a work piece from conveyor A and places it on conveyor B.

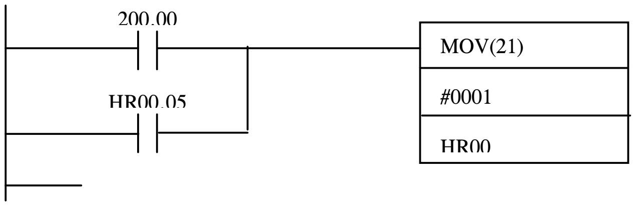
Network 1 – Start condition



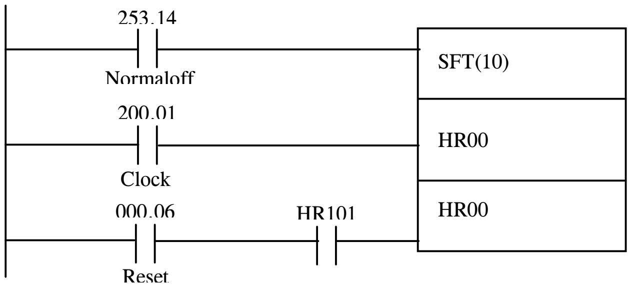
Network 2 – Start



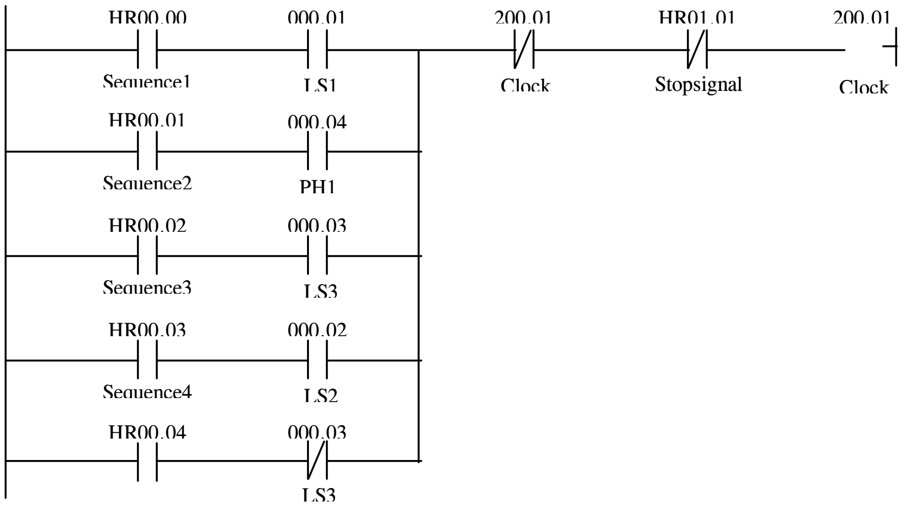
Network 3 – Set 1st bit on
Set 1st bit of HR 00 on



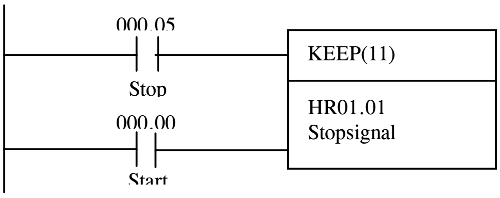
Network 4 - Shift register



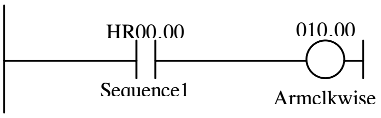
Network 5 – Clock input
Clock input to shift register to control sequence of operation



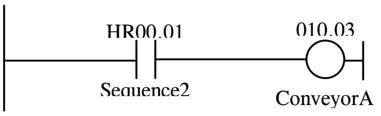
Network 6 – Stop condition



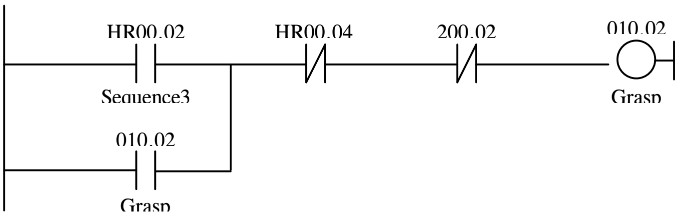
Network 7 – Arm clockwise



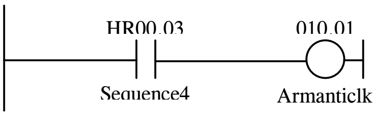
Network 8 – Conveyor A



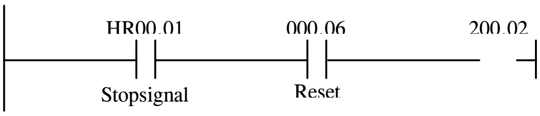
Network 9 – Grasp



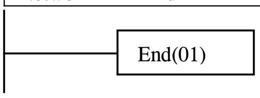
Network 10 – Arm anticlockwise



Network 11 – Reset
Reset after stop

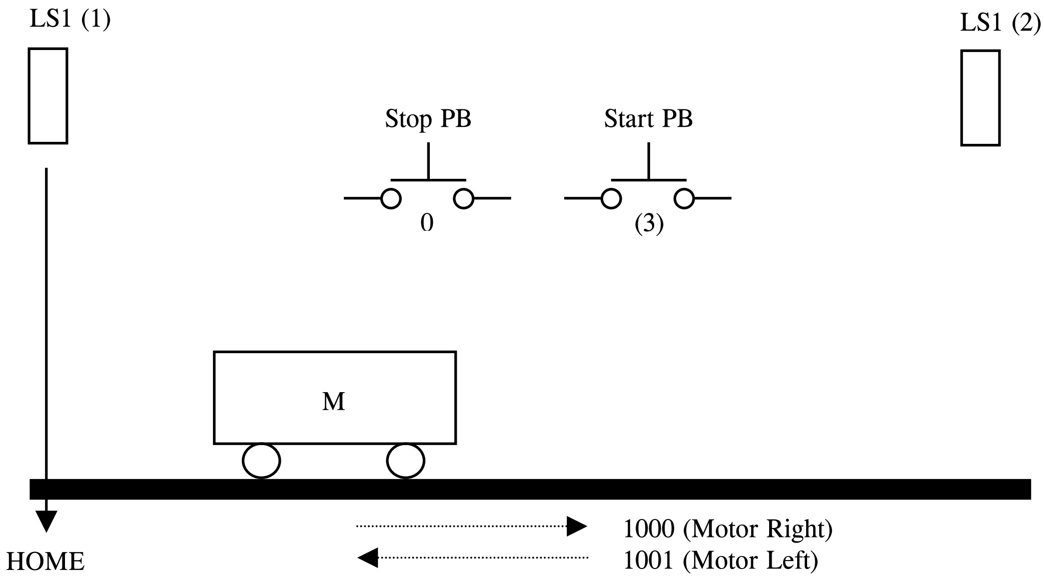


Network 12 – End



Application #9: A Simple Sequence Control Concept

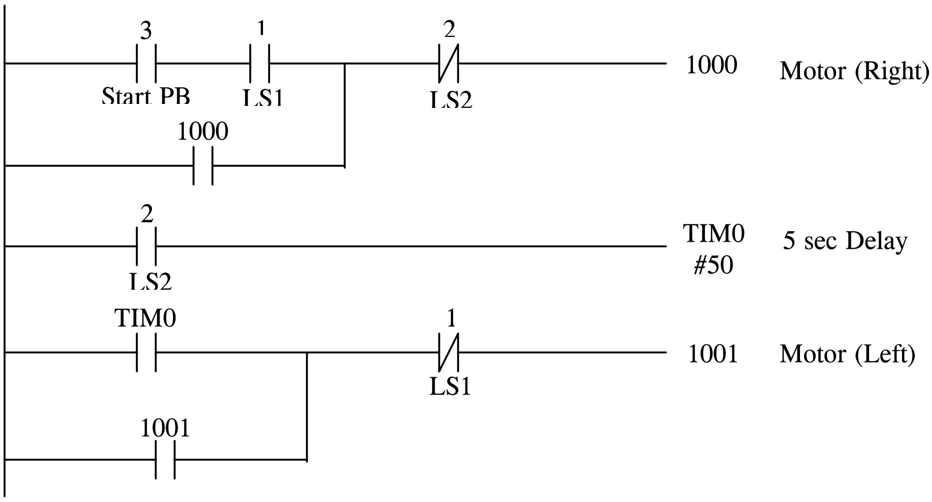
When the start button is pushed, the motor (M) will move from left to right. When LS2 is ON, the Motor stops, delay for 5 seconds and then moves back to Home. When LS1 (Home) is ON, Motor cuts off, signifying that the sequence is completed.



- **I/O Assignment**

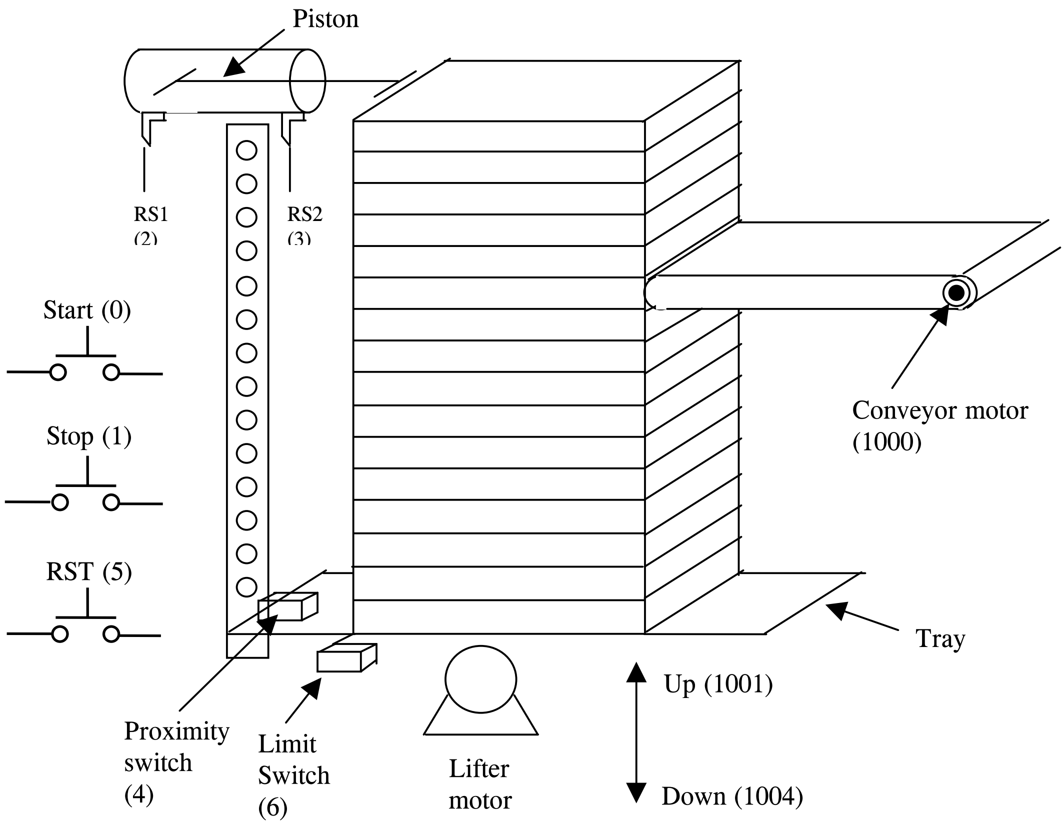
Input	Devices
00000	Stop PB
00001	LS1 (HOME)
00002	LS2
00003	Start PB

Output	Devices
01000	Motor (right)
01001	Motor (Left)



6. APPLICATION EXAMPLES OF BASIC COMMANDS

❑ Example : PBC Packing Conveyor



In this application, a lifter motor is used to lift a tray of PCB boards up, before being pushed by the piston onto the conveyor for packing.

When the start button is pressed, the conveyor motor and the lifter motor will turn on. The proximity switch will temporarily stop the lifter motor for the piston to push the PCB onto the conveyor belt.

After the PCB is pushed, the piston will retract and the lifter motor starts again. The whole procedure will repeat itself thereafter.

6. APPLICATION EXAMPLES OF BASIC COMMANDS

When all the PCBs have been pushed onto the conveyor belt, the lifter motor will move down until the limit switch (LSW) is being activated. Thereafter, the whole procedure can only be started by the start switch.

- **I/O Assignment**

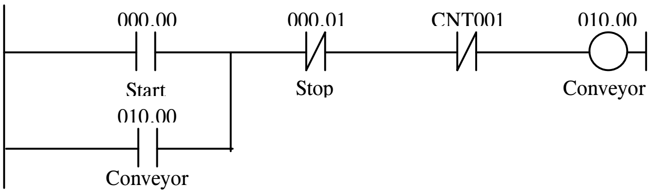
Input	Device
00000	Start Push Button
00001	Stop Push Button
00002	RS1 (Left Limit)
00003	RS2 (Right Limit)
00004	Proximity Switch
00005	Reset
00006	Limit Switch

Output	Device
01000	Conveyor motor
01001	Up Lifter motor
01002	Right piston
01003	Left piston
01004	Down lifter motor

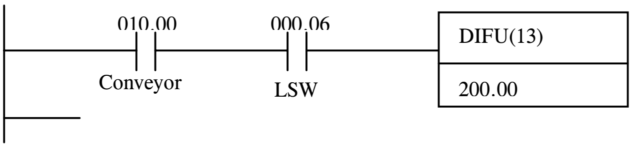
Ladder diagram : Main 1 Network 1

Main1 –
PCB packing conveyor program utilising (Conventional method)

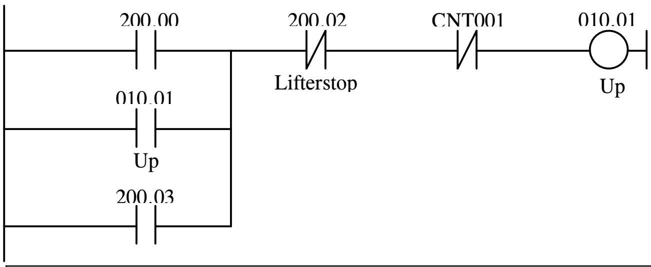
Network 1 –
Start / Stop control



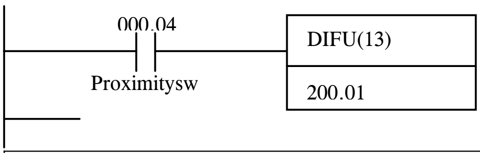
Network 2 – Left limit
Left limit reached for piston



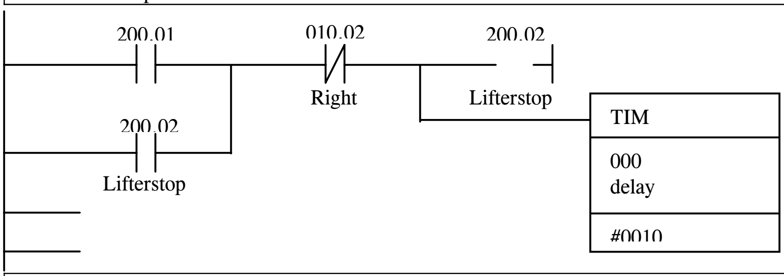
Network 3 – Lifter up
Lifter motor up



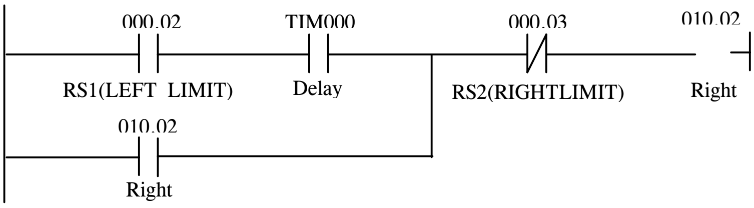
Network 4 – Index switch
Proximity switch detect the next index of PCB



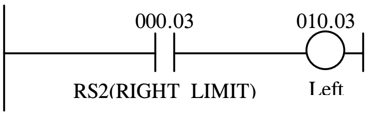
Network 5 – Lifter up
Lift the PCB up one after another



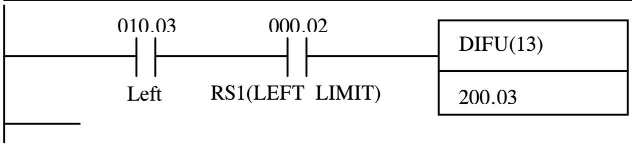
Network 6 – Pistonright



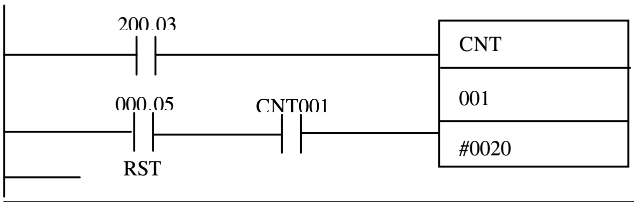
Network 7 – Pistonleft
Move piston after right limit is reached



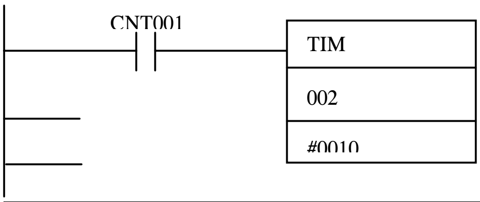
Network 8 – Pistonleft



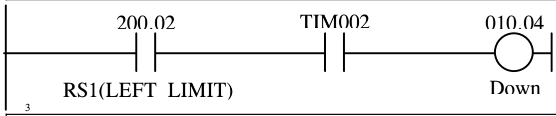
Network 9 – Counter
Counter preset at 20



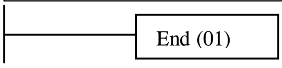
Network 10 – Delay of 1 sec



Network 11 – Liftdown



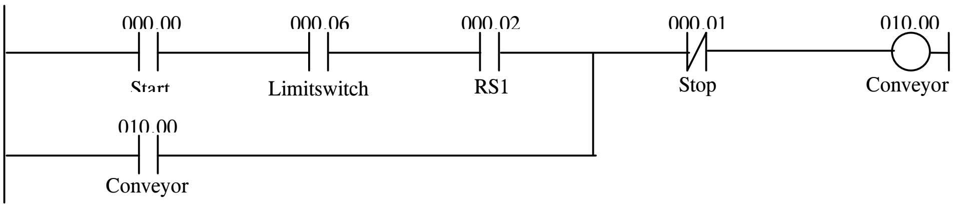
Network 12 – End



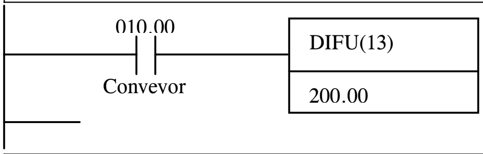
Ladder Diagram : Main 1 Network 1

Main 1 – SFT (10) method
PCB packing conveyor program utilising (shift register method)

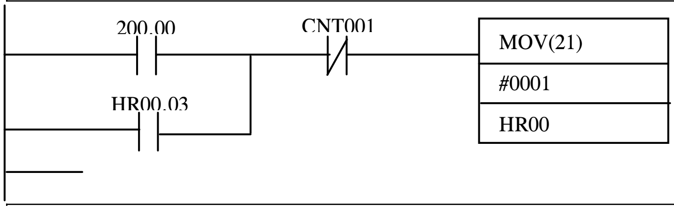
Network 1 – Conveyor



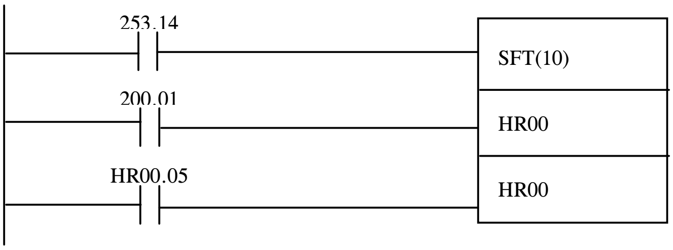
Network 2 – Set bit



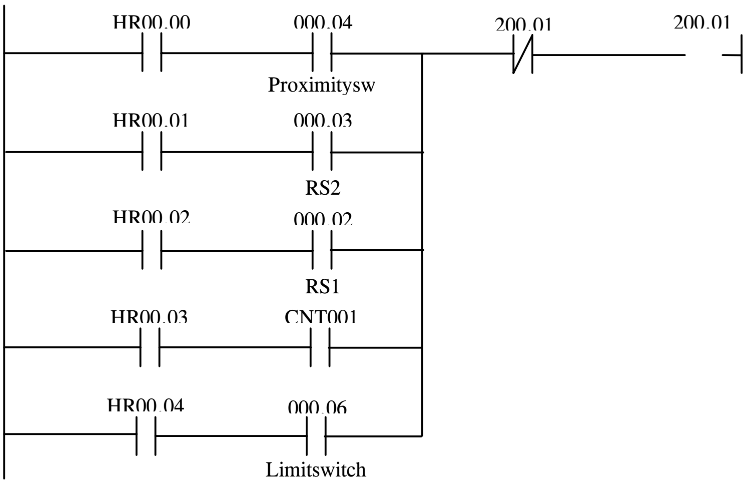
Network 3 – Set 1st bit
Set first bit of HR 00 on



Network 4 – Shift register



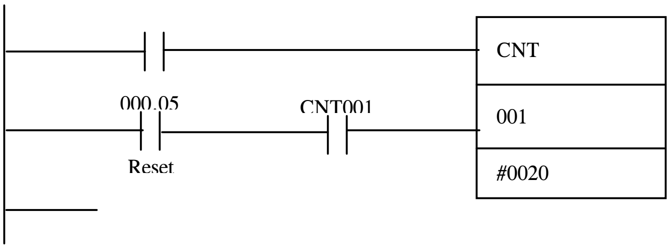
Network 5 – Clock
Clock input to shift register to control sequence of operations



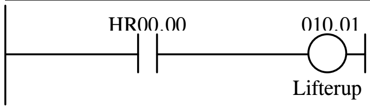
Network 6 – Counter

HR00.02

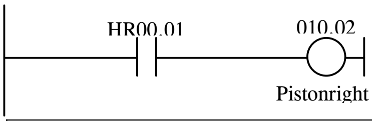
Counter preset at 20



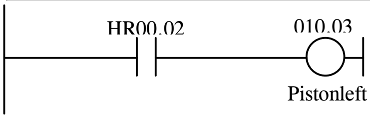
Network 7 – Lifter up



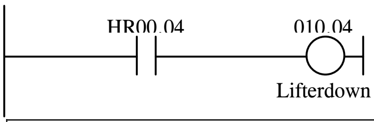
Network 8 – Piston right



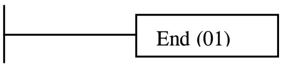
Network 9 – Piston left



Network 10 –Lifter down

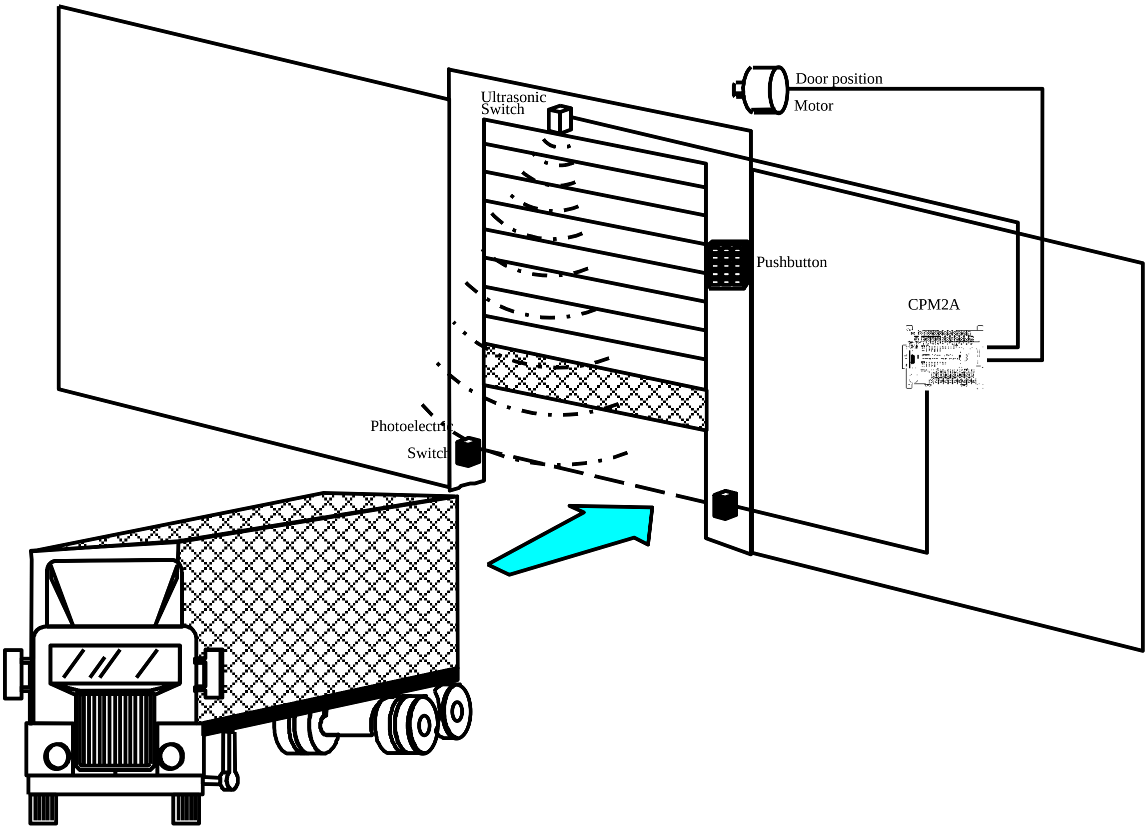


Network 11 – End



❑ Application #10: Automatic Control Of Warehouse Door

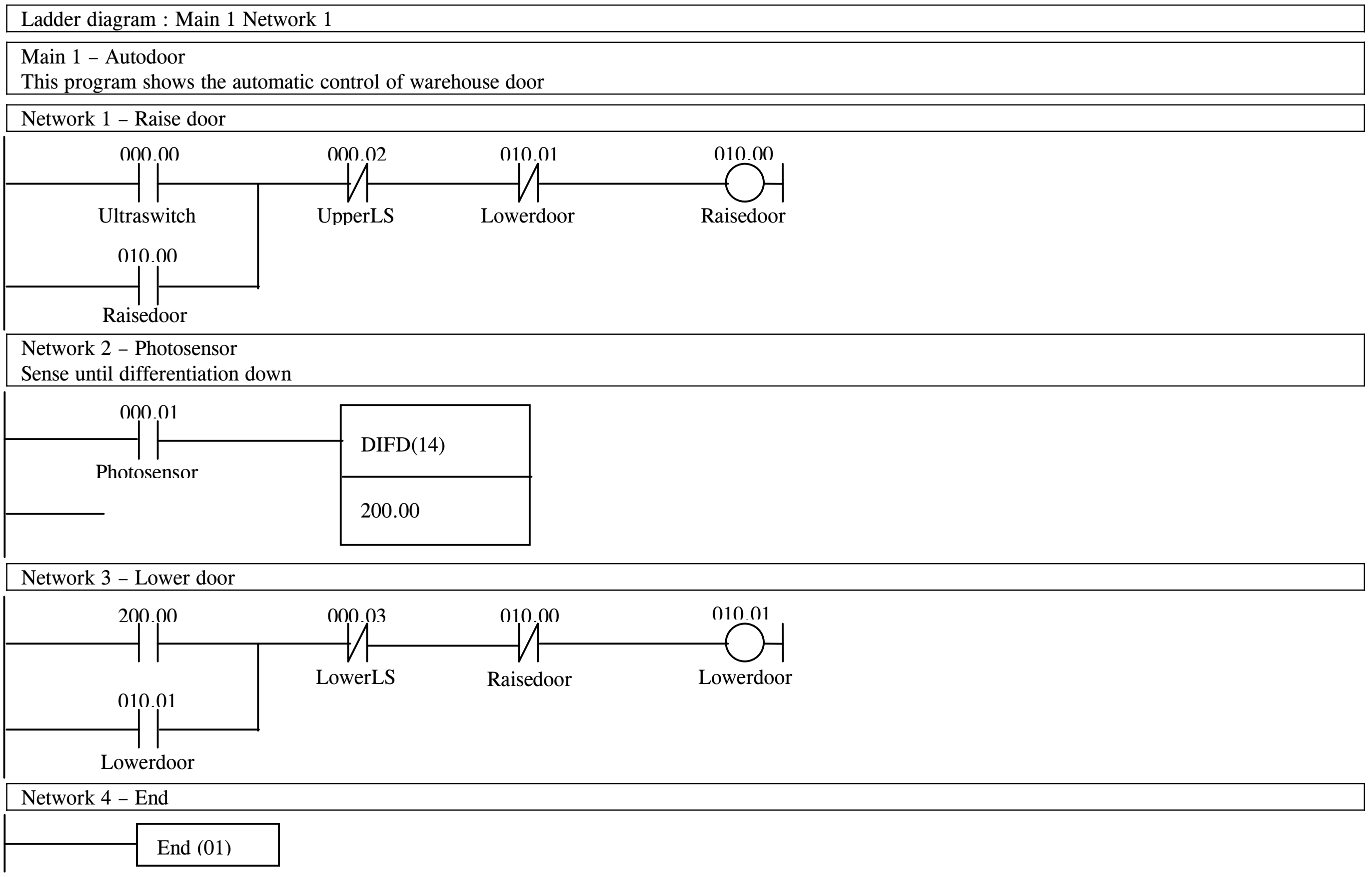
The input ultrasonic switch is employed to detect the presence of an approaching vehicle. A separate photosensor detects the passing of a vehicle via the interruption of the light beam. In response to these signals, the control circuit controls the outputs that drive the motor of the door for opening and closing.



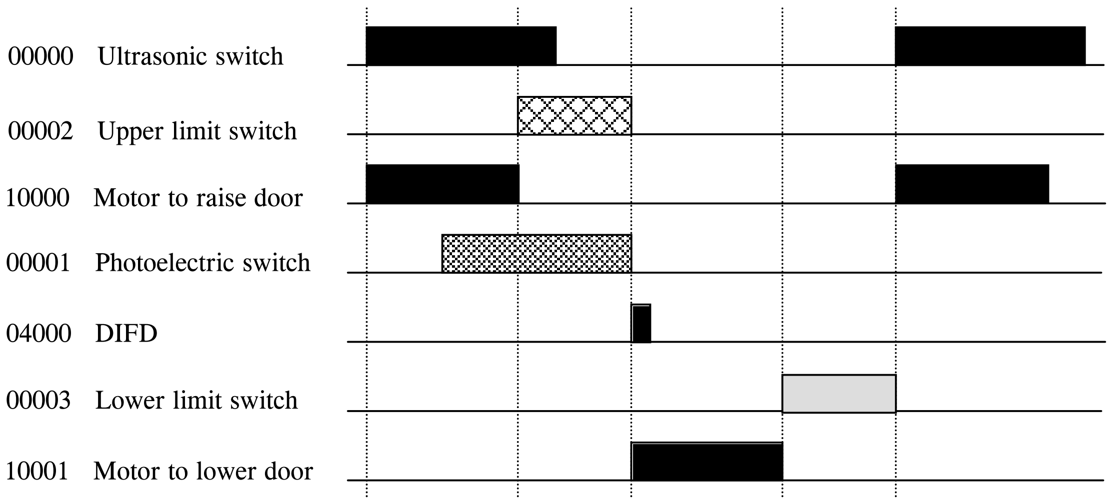
- **I/O Assignment**

Input	Devices
00000	Ultrasonic switch
00001	Photoelectric switch
00002	Door upper limit switch
00003	Door lower limit switch

Output	Devices
01000	Motor to raise door
01001	Motor to lower door

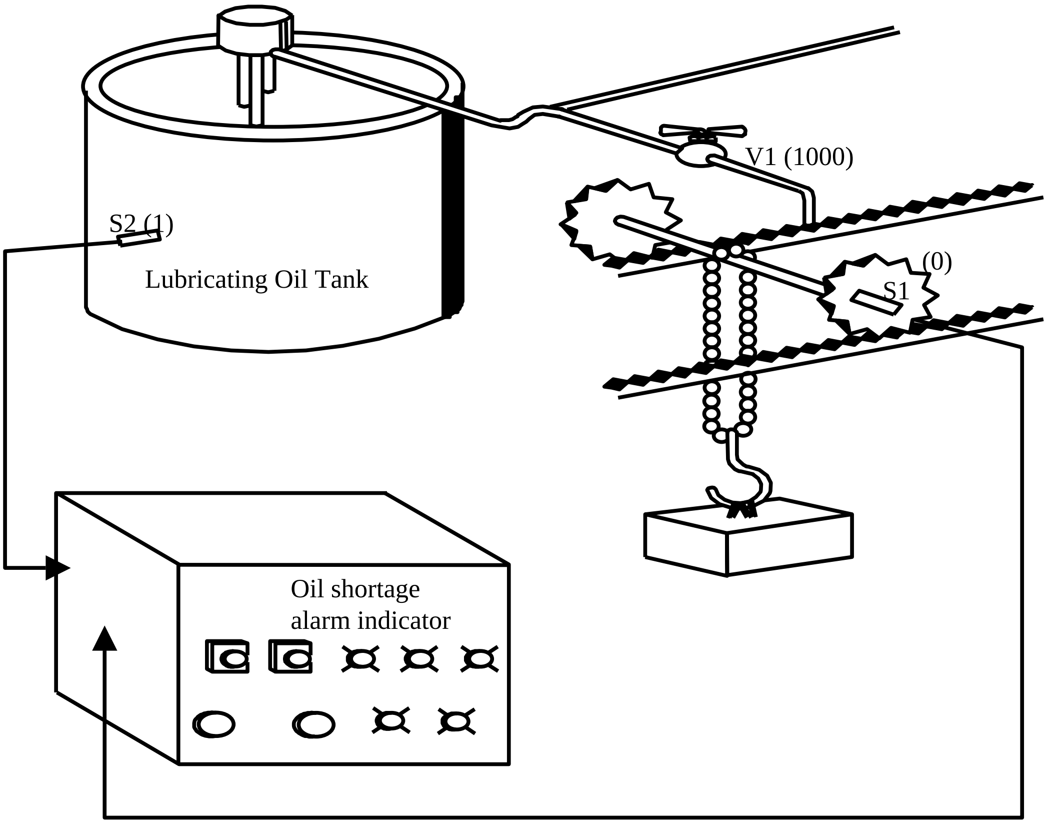


Timing diagram



❑ Application #11: Automatic Lubrication of Gear

When the gear is moved towards S1, the sensor S1 will detect the gear and signal the electromagnetic valve for oil supply on the gear. The valve (V1) will open for a short period of time, supplying a predetermined quantity of oil. When sensor S2 sense that the lubricating tank oil level is low, the oil shortage alarm indicator will be ON.



- **I/O Assignment**

Input	Devices
00000	Position detection (S1)
00001	Lower limit of oil (S2)

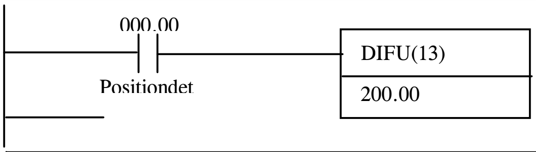
Output	Devices
01000	Electromagnetic valve for oil supply (V1)
01001	Oil shortage alarm indicator

6. APPLICATION EXAMPLES OF BASIC COMMANDS

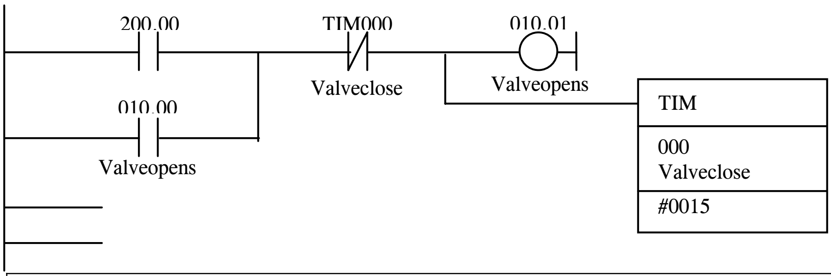
Ladder Diagram : Main 1 Network 1

Main 1 – Auto lubricate
Auto lubricate of gear

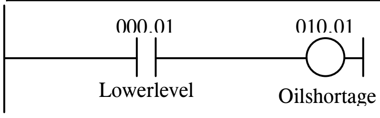
Network 1 – Start



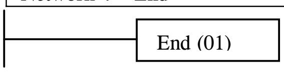
Network 2 – Open valve
Open valve and delay 1.5 sec



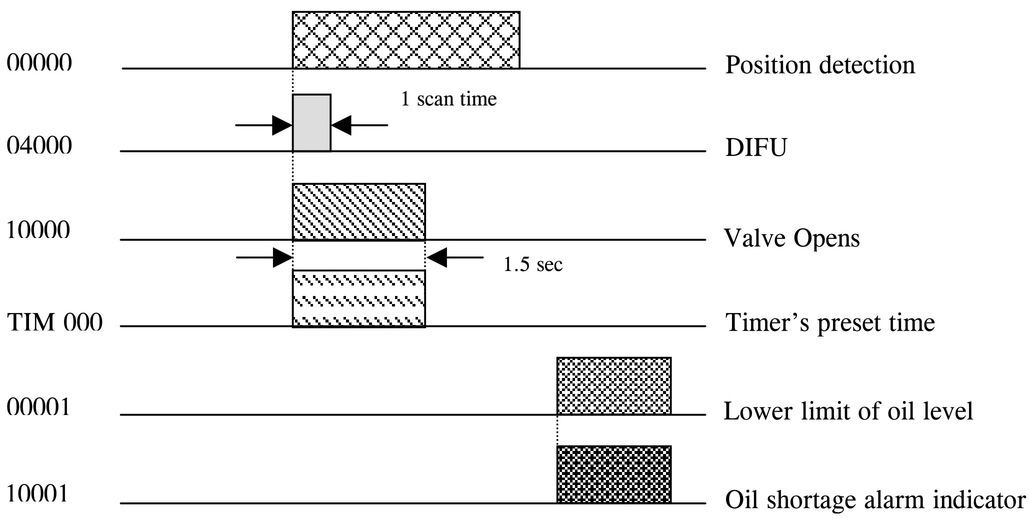
Network 3 – Oil shortage



Network 4 – End

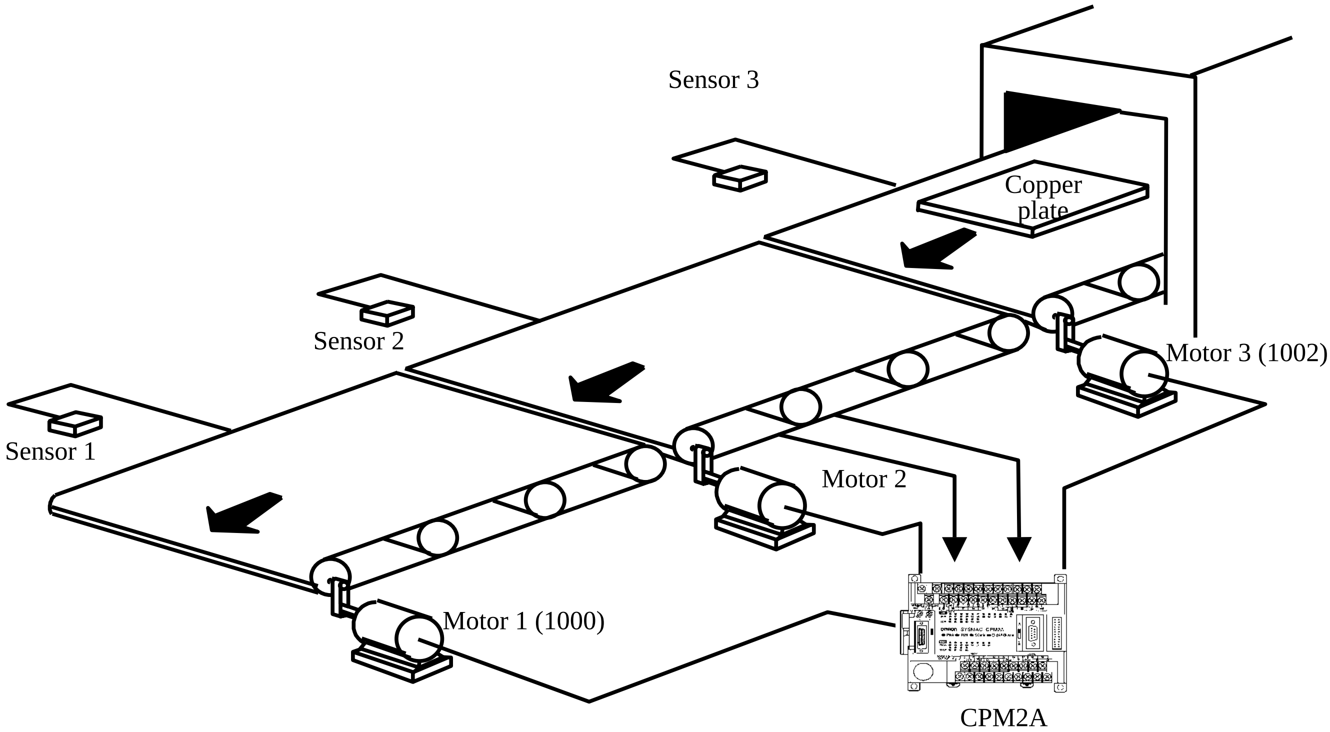


Timing diagram



Application #12: Conveyor Belt Motor Control

In this application, the PLC is used to start and stop the motors of a segmented conveyor belt. This allows only belt sections carrying an object (i.e. mental plate) to move. The position of a mental plate is detected by a proximity switch located next to each belt segment. As long as the plate is within the detecting range of the switch, the motor will work. If the plate moves beyond the range, a timer is activated and when this set time has lapsed, the motor of that belt stops.



- **I/O Assignment**

Input	Devices
00000	Sensor 1
00001	Sensor 2
00002	Sensor 3

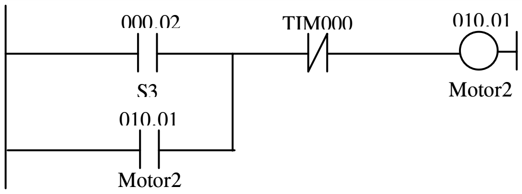
Output	Devices
01000	Motor 1
01001	Motor 2
01002	Motor 3

6. APPLICATION EXAMPLES OF BASIC COMMANDS

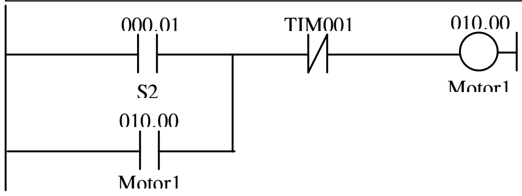
Ladder diagram : Main 1 Network 1

Main 1 – Conveyorcontrol
Conveyor belt control application

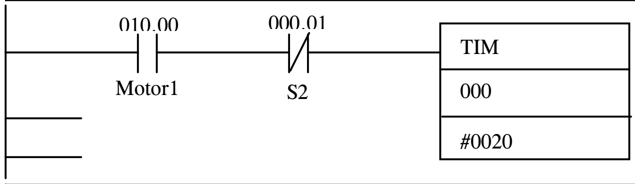
Network 1 – Motor2



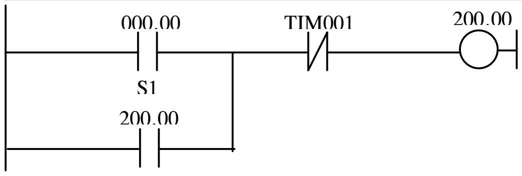
Network 2 – Motor1



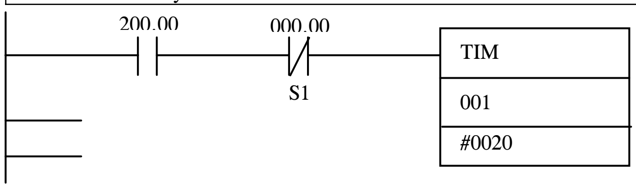
Network 3 – Delay for 2sec



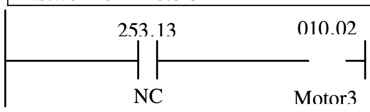
Network 4 – Sensor1



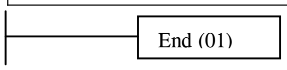
Network 5 – Delay for 2sec



Network 6 – Motor3



Network 7 – End



- **Operation :**

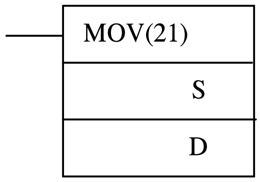
a) Motor 2 turns ON when Sensor 3 detects the product
b) Motor 2 is ON until Motor 1 is turned ON and product is out of detection range of Sensor 2
c) Motor 1 turns ON when Sensor 2 detects the product
d) Motor 1 is ON until product is out of detection range of Sensor 1

6. APPLICATION EXAMPLES OF BASIC COMMANDS

❑ Move – MOV(21)

MOV transfer source data (either the data in a specified channel or a four digit hexadecimal constant) to a destination channel. Therefore, MOV requires two data parameters to be specified: the source channel or constant and the destination channel.

Ladder Symbols

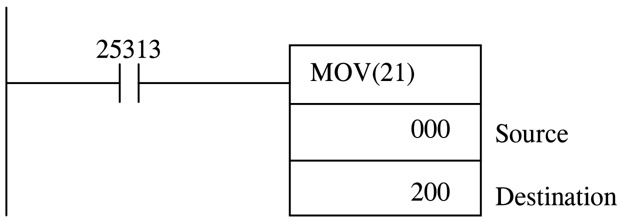


Operand Data Areas

S: Source channel
IR, SR, AR, DM, HR, TC, LR, #

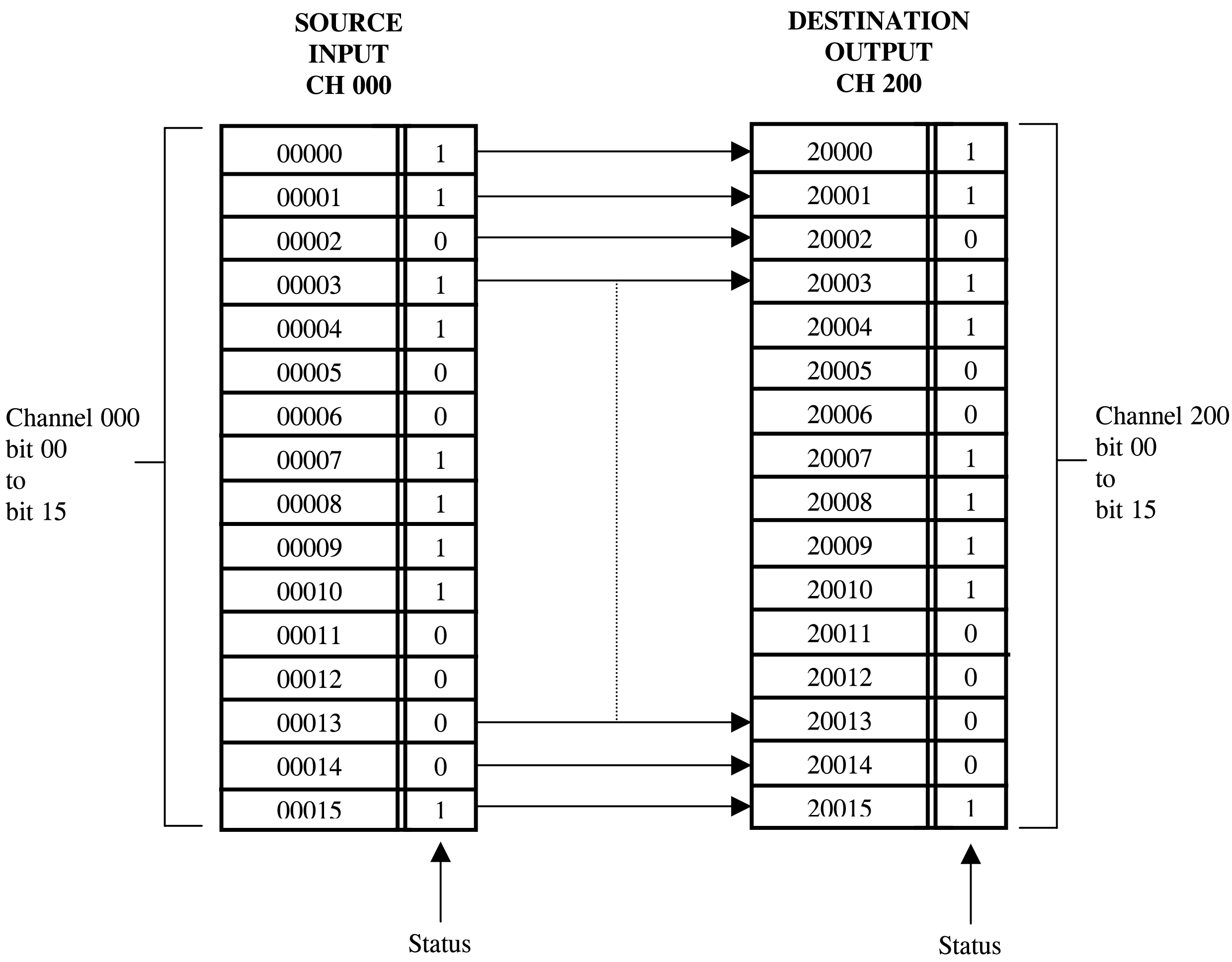
D: Destination channel
IR, AR, DM, HR, LR

Example circuit
Ladder diagram



Address	Instruction	Data
0000	LD	25313
0001	MOV(21)	
		000
		200
0003	END(01)	

The following diagram illustrates the MOV operation:

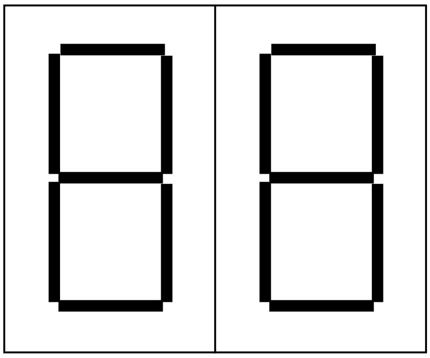


In this case, data in Input Channel 000 is moved to Output Channel 200.

❑ Application #13: Display Error Code Of Machine To Aid In Tracing The Source Of The Problem

1. Activation of error input signal 00001 to 00004 will sound an alarm and at the same time display the error code.
2. Input 00005 serves to reset the error code displayed upon machine recovery.

Error code



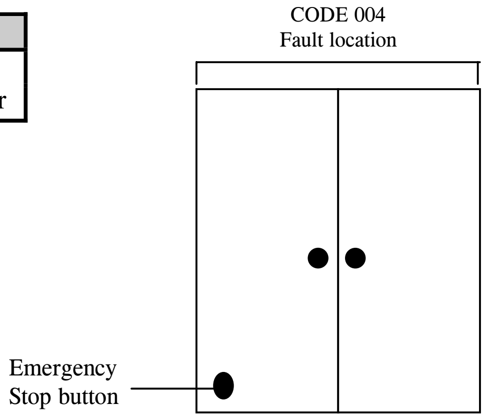
Code	Fault location
001	Feeding section problem Check Sensor No: S01 Check Limit Switch No: L03
002	Labeling Unit Fault Check Contactor No: C01
003	Conveyor Jam Check Label Sensor No: S05
004	Emergency stop Check Emergency Stop button

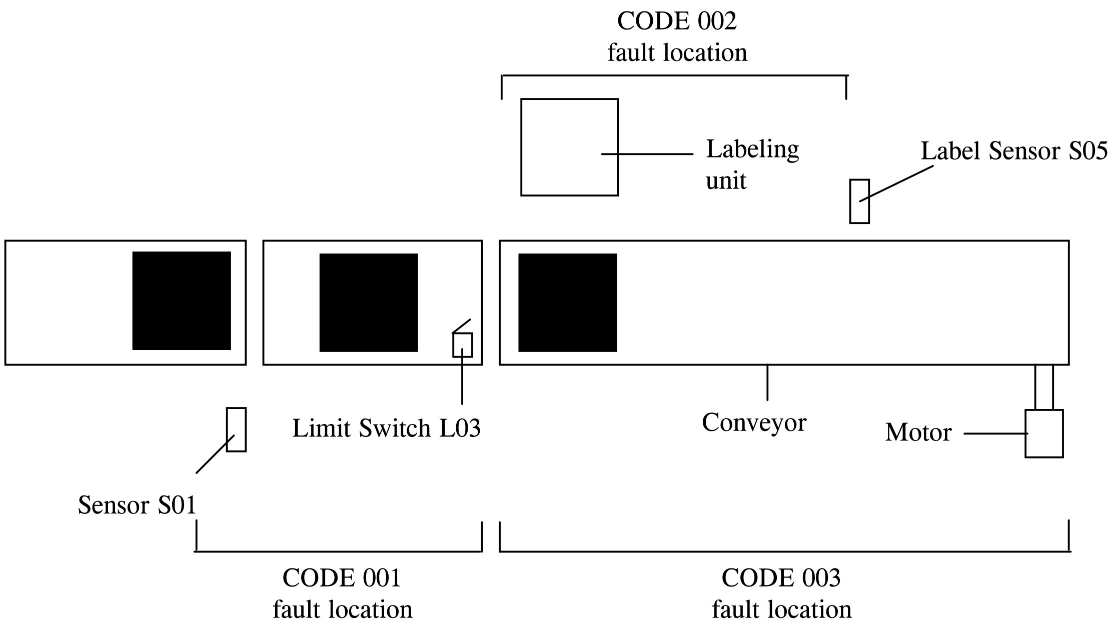
Diagram

I/O Assignment

Input	Devices
00001	PB1
00002	PB2
00003	PB3
00004	PB4

Output	Devices
1000	Alarm Annunicator

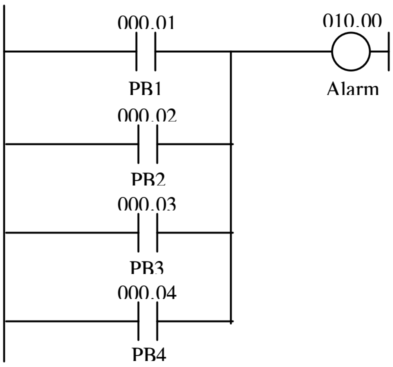




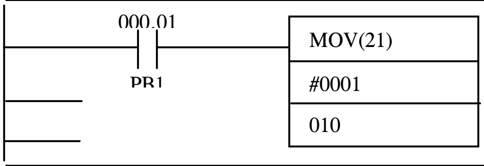
Ladder Diagram : Main 1 Network 1

Main 1 – Error Display
Display error code of machine to aid tracing source of problem

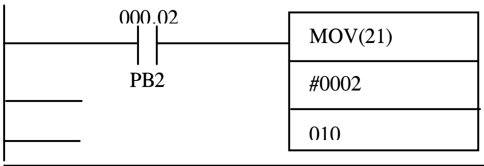
Network 1 - Alarm



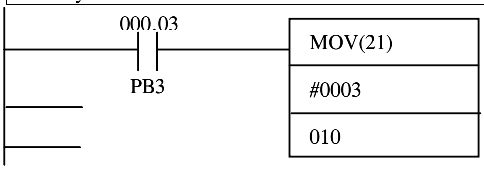
Network 2 – Code 1
Feeding Problem



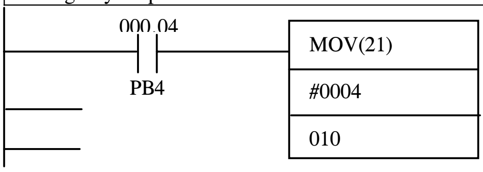
Network 3 – Code 2
No Label



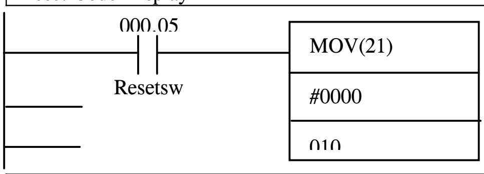
Network 4 – Code 3
Conveyor Jam



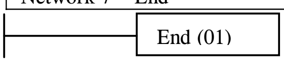
Network 5 – Code 4
Emergency Stop



Network 6 – Code 5
Reset Code Display



Network 7 – End



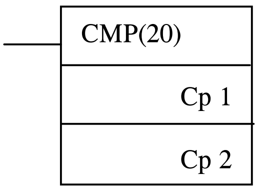
6. APPLICATION EXAMPLES OF BASIC COMMANDS

❑ Compare – CMP(20)

Compare (CMP) is used to compare the data in a specific channel, with the data in another channel, or a four-digit, hexadecimal constant. Therefore, two data must be specified immediately after the CMP(20) instruction.

Operand Data Areas

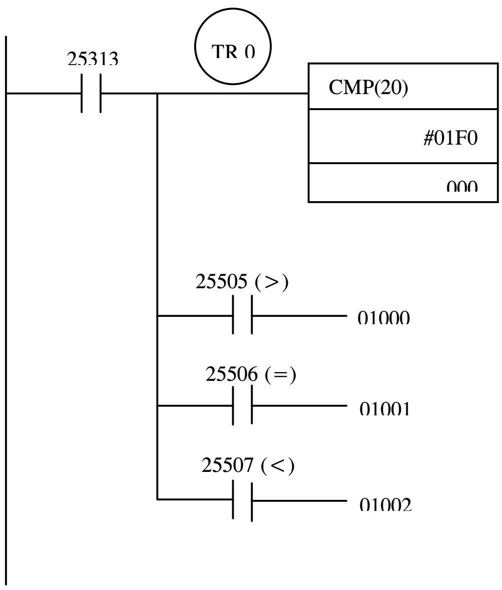
Ladder Symbols



Cp : First compare word
IR, SR, AR, DM, HR, TC, LR, #

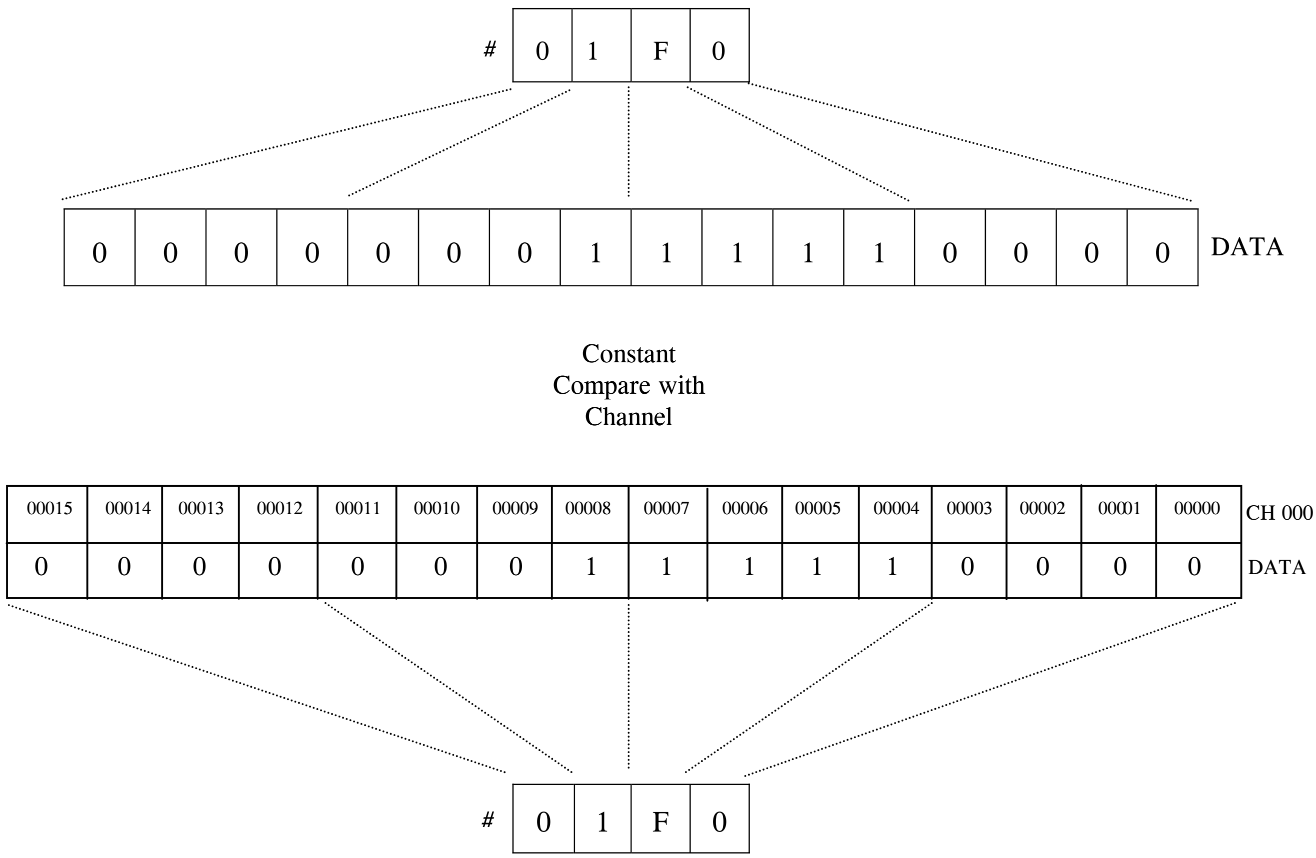
Cp2 : Second compare word
IR, SR, AR, DM, HR, TC, LR, #

Example circuit
Ladder diagram



Address	Instruction	Data
0000	LD	25313
0001	OUT	TR 0
0002	CMP(20)	-
		#01F0
		000
0003	AND	25505
0004	OUT	01000
0005	LD	TR 0
0006	AND	25506
0007	OUT	01001
0008	LD	TR 0
0009	AND	25507
0010	OUT	01002

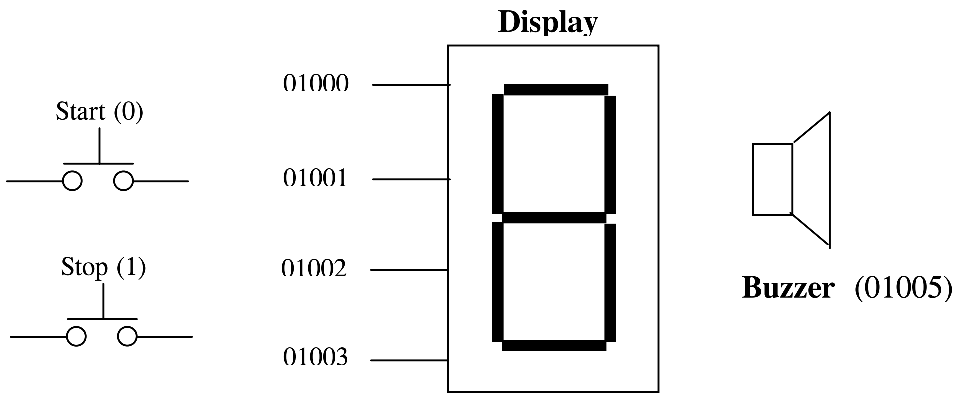
The following diagram illustrates the CMP operation



If the constant (#01F0) is ***equal*** to Channel 000 data, special relay 25506 turns ON. However, special relay 25505 will turn ON if the constant is ***greater*** than Channel 000 data and special relay 25507 will turn ON if the constant is ***less*** than Channel 000 data. At any one time, only one result is true, either relay 25505(>) or 25506(=) or 25507(<) is ON.

6. APPLICATION EXAMPLES OF BASIC COMMANDS

❑ Example : A Time-out Warning



In this application, a 7-segment display & a buzzer is connected to the PLC. When the start button is pressed, the display will display a 9 and therefore will decrement until 0 before the buzzer is being sound. These type of circuit can be used as a warning circuit.

- **I/O Assignment**

Input	Device
00000	Start PB
00001	Stop PB

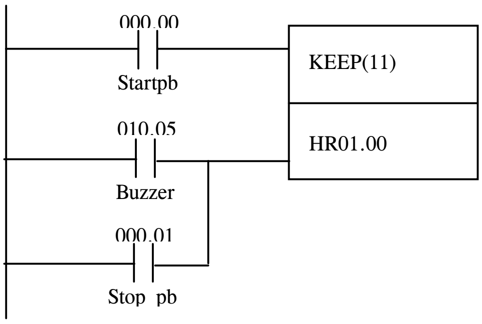
Output	Device
01000 to 01003	7-segment display
01005	Buzzer

6. APPLICATION EXAMPLES OF BASIC COMMANDS

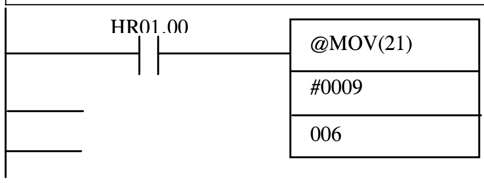
Ladder Diagram : Main 1 Network 1

Main 1 –
Program to display 9 before decrement it to 0

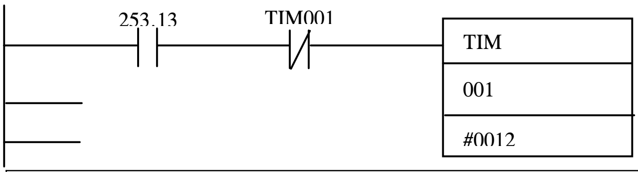
Network 1 –
Using the holding relay to decrement after every pulse



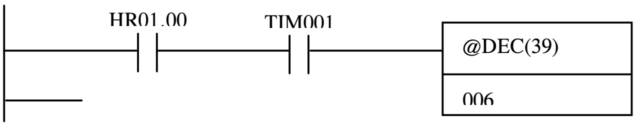
Network 2 – Move 9
Move 9 to channel 6



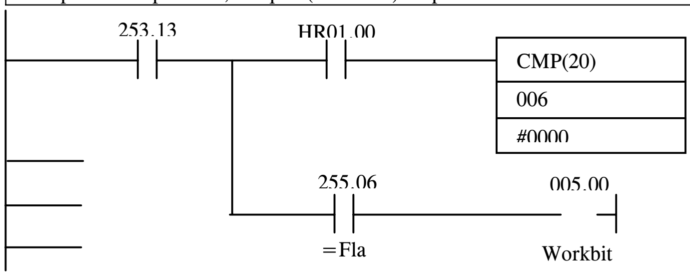
Network 3 – Timer
To produce an ON/OFF pulse



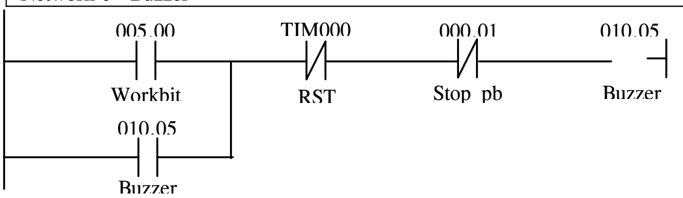
Network 4 – Decrement
Decrement every execution



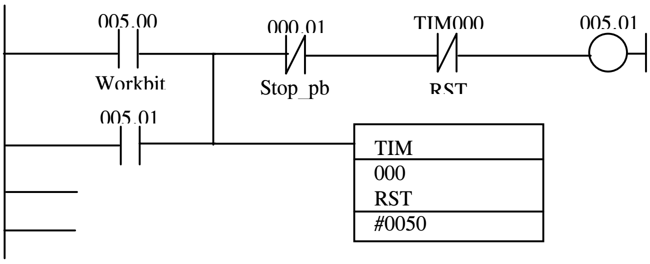
Network 5 –
Compare the o/p with 0, if equal (25506 on) output 00500 turn on



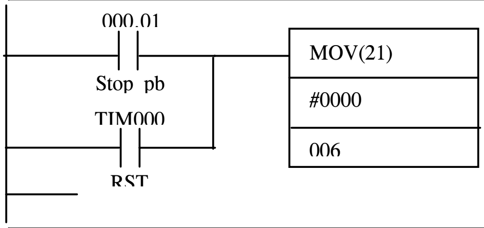
Network 6 - Buzzer



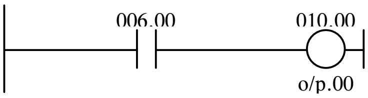
Network 7 –
Timer to cut the sound of buzzer



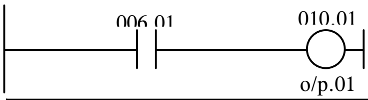
Network 8 – Stop
Reset channel 10



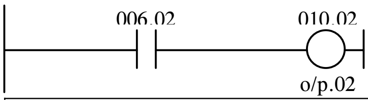
Network 9 – Segment1display



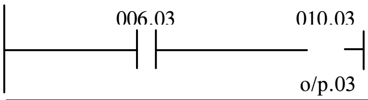
Network 10 – Segment2display



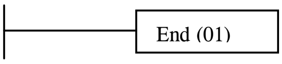
Network 11 – Segment3display



Network 12 – Segment4display



Network 13 – End



Notes : Instruction with @Sign will execute on the rising edge only.
It means that the instruction will execute for one scan only.

6. APPLICATION EXAMPLES OF BASIC COMMANDS

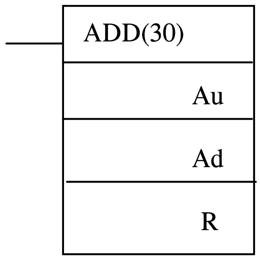
< < < Program to Display 9 before Decrement it to 0 > > >

Address	Instruction	Data	Comment	Comment Statement
00000	LD	00000		
00001	LD	01005	Start Pb	
		OR 1		
00002	KEEP(11)	HR 0100		Holding Relay
00003	LD	HR 0100		
00004	@MOV(21)			Move 9 to
		# 0009		
		6		
00005	LD	25313		
00006	AND NOT TIM	001		
00007	TIM	1		
		#0012		
00008	LD	HR 0100		
00009	AND TIM	1	Clk Pulse	
00010	@DEC(39)			Decrement o/p every clk
		6		
00011	LD	25313		
00012	OUT TR	0		
00013	AND	HR 0100		
00014	CMP(20)			Compare the o/p with
		6		
		# 0000		
00015	LD TR	0		
00016	AND	25506		Condition meet ON bit On BUZZER
00017	OUT	00500		
00018	LD	00500		
00019	OR	01005		
00020	AND NOT TIM	0		
00021	AND NOT	1		
00022	OUT	01005		
00023	LD	00500		
00024	OR	00501		
00025	OUT TR	0		
00026	AND NOT	1		
00027	AND NOT	TIM 000		
00028	OUT	00501		
00029	LD TR	0		Timer to cut the buzzer
	TIM	000		
00030		# 0050		
00031	LD	00001	STOP PB	RESET CH
00032	OR	TIM 000		
00033	MOV(21)			
		# 0000		
		6		
00034	LD	600		1
00035	OUT	1000		
00036	LD	601		2
00037	OUT	1001		
00038	LD	602		4
00039	OUT	1002		
00040	LD	603		8
00041	OUT	1003		
00042	END(01)			

Add – ADD(30)

ADD totals the data in two different channels, or one channel and a constant and then outputs the sum to a third channel.
Therefore, three data parameters must be specified : an augend, an addend and a result channel.

Ladder Symbols



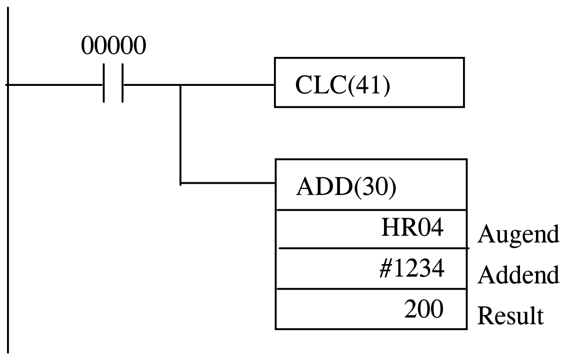
Operand Data Areas

Au: Augend channel
IR, SR, AR, DM, HR, TC, LR, #

Ad: Addend channel
IR, SR, AR, DM, HR, TC, LR, #

R: Result channel
IR, AR, DM, HR, LR

Example circuit
Ladder diagram



Address	Instruction	Data
0000	LD	00000
0001	CLC(41)	
0002	ADD(30)	
		HR04
		#1234
		200
0004	END(01)	

In the program, when input 00000 is turned ON, the data in internal relay **HR040** is added to the constant **1234**. The result of the addition is output to **CH 200**. If a carry is generated as a result of the addition, the carry flag (special relay 25504) is turned ON. If the result of the addition is 0000, special relay 25506 (the "=" flag) is turned ON.

The following diagram illustrates the ADD operation.

Augend

Internal auxiliary relay CH HR04

04000	2^0	
04001	2^1	
04002	2^2	10^0
04003	2^3	
04004	2^0	
04005	2^1	
04006	2^2	10^1
04007	2^3	
04008	2^0	
04009	2^1	
04010	2^2	10^2
04011	2^3	
04012	2^0	
04013	2^1	
04014	2^2	10^3
04015	2^3	

Addend

+ 1234 +

carry
25504

0

Result

CH 200

10000	2^0	
10001	2^1	
10002	2^2	10^0
10003	2^3	
10004	2^0	
10005	2^1	
10006	2^2	10^1
10007	2^3	
10008	2^0	
10009	2^1	
10010	2^2	10^2
10011	2^3	
10012	2^0	
10013	2^1	
10014	2^2	10^3
10015	2^3	

carry
25504

0/1

In the above example, before executing ADD, the Carry Flag/CY (special relay 25504) is turned OFF by the Clear Carry (CLC). The addition and subtraction instructions include CY in the calculation as well as in the result. Be sure to clear CY if its previous status is not required in the calculation, and to use the result placed in CY, if required, before it is changed by execution of any other instruction.

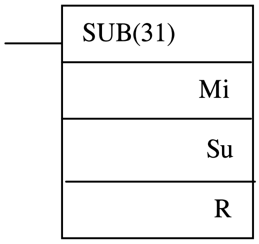
The augend and addend must be in **BCD**, if not special relay 25503 (Error Flag) is turned ON and ADD is not executed.

ADD is executed each time the CPU scans the program. To execute it only once.

❑ Subtract – SUB(31)

SUB finds the difference between the data in one channel and the data in another channel or a constant, and then outputs the result to a third channel.
Therefore, three data must be specified : an minuend, an subtrahend and a result channel.

Ladder Symbols



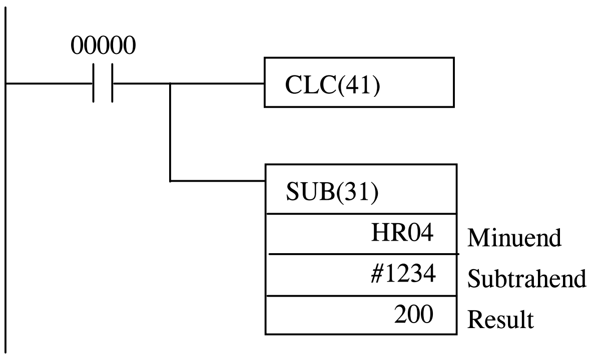
Operand Data Areas

Mi: Minuend channel
IR, SR, AR, DM, HR, TC, LR, #

Su: Subtrahend channel
IR, SR, AR, DM, HR, TC, LR, #

R: Result channel
IR, AR, DM, HR, LR

Example circuit
Ladder diagram



Address	Instruction	Data
0000	LD	00000
0001	CLC(41)	
0002	SUB(31)	
		HR04
		#1234
		200
0004	END(01)	

In the above example, before executing SUB, the Carry Flag (special relay 25504) is turned OFF by the Clear Carry (CLC). The addition and subtraction instructions include CY in the calculation as well as in the result. Be sure to clear CY if its previous status is not required in the calculation, and to use the result placed in CY, if required, before it is changed by execution of any other instruction.

The minuend and subtrahend must be in **BCD**, if not special relay 25503 (Error Flag) is turned ON and ADD is not executed.

SUB is executed each time the CPU scans the program. To execute it only once.

Application #14: Measuring The Life Of A Cutting Knife

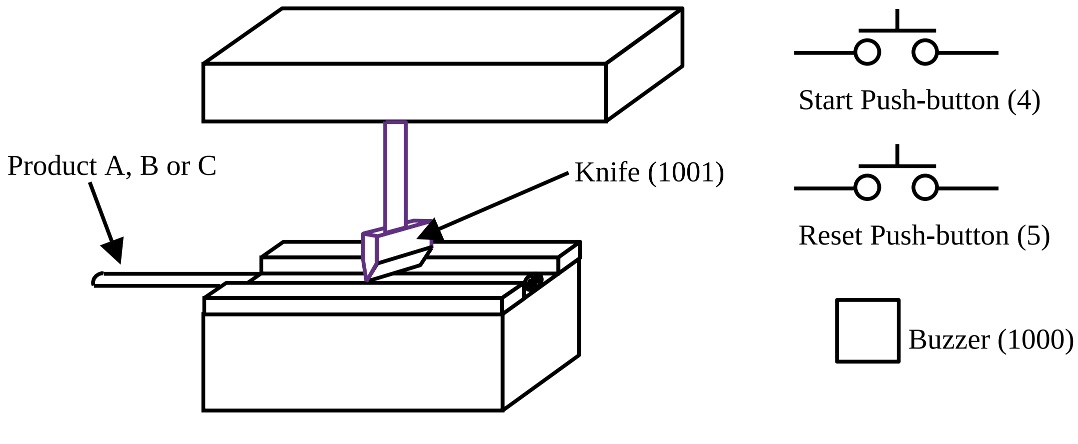
A knife is used to cut 3 products A, B and C and has to be changed after cutting 1000 pieces of A or 500 pieces of B or 100 pieces of C. but the products come at random. A buzzer is sound when the life of the knife is up.

3 sensors are assign to differentiate the 3 products. Another sensor is used to signal cutting completion. A pushbutton to start the process.

- **I/O Assignment**

Input	Device
00000	Cutter Sensor
00001	Product A
00002	Product B
00003	Product C
00004	Start pushbutton
00005	Reset

Output	Device
01000	Buzzer
01001	Cutter (Knife)



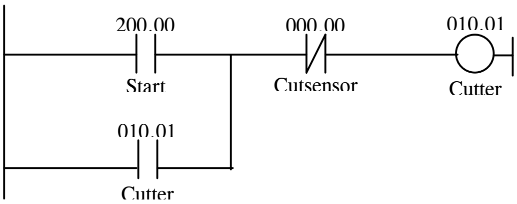
Cutting Machine

6. APPLICATION EXAMPLES OF BASIC COMMANDS

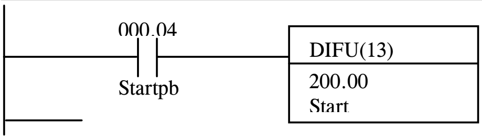
Ladder Diagram : Main 1 Network 1

Main 1 – Knife lift
Application : Measuring the life of a cutting life

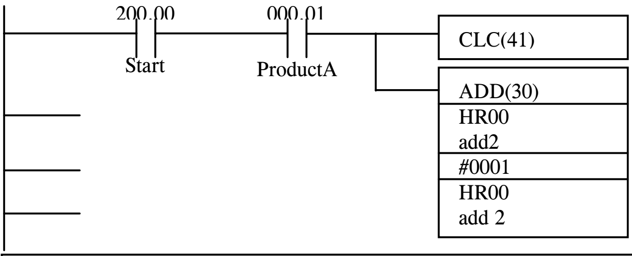
Network 1 – Cutter
Cutter activation



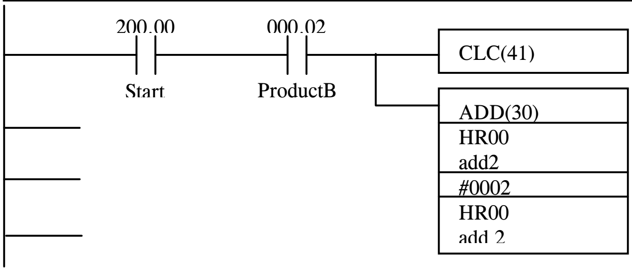
Network 2 – Cutter
Cutter start pushbutton



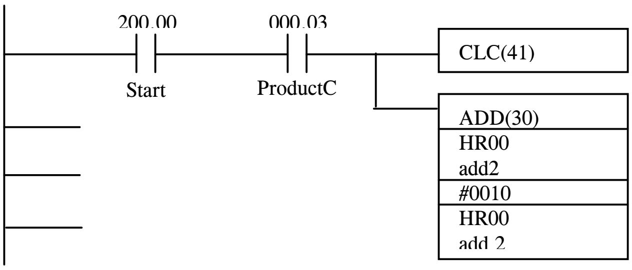
Network 3 – Add 1



Network 4 – Add 2



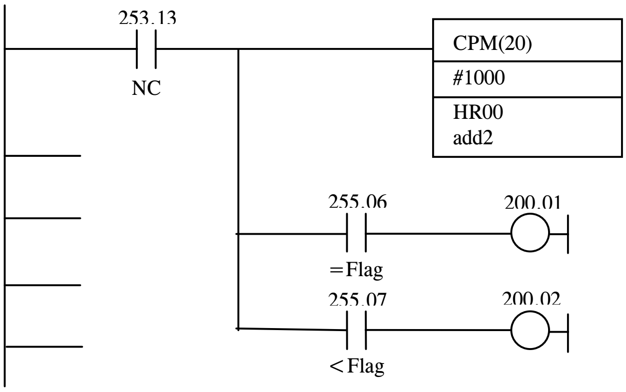
Network 5 – Add 10



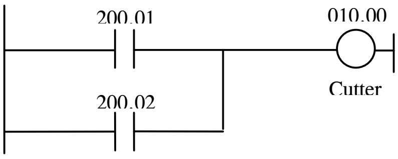
Mnemonic codes

Address	Instruction	Data
0000	LD	20000
0001	OR	01001
0002	AND NOT	00000
0003	OUT	01001
0004	LD	00004
0005	DIFU(13)	20000
0006	LD	20000
0007	AND	00001
0008	CLC(41)	
0009	ADD(30)	
		HR00
		#0001
		HR00
0010	LD	20000
0011	AND	00002
0012	CLC(41)	
0013	ADD(30)	
		HR00
		#0002
		HR00
0014	LD	20000
0015	AND	00003
0016	CLC(41)	
0017	ADD(30)	
		HR00
		#0010
		HR00

Network 6 – Compare

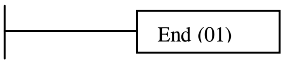


Network 7 – Buzzer



Network 8 – Reset

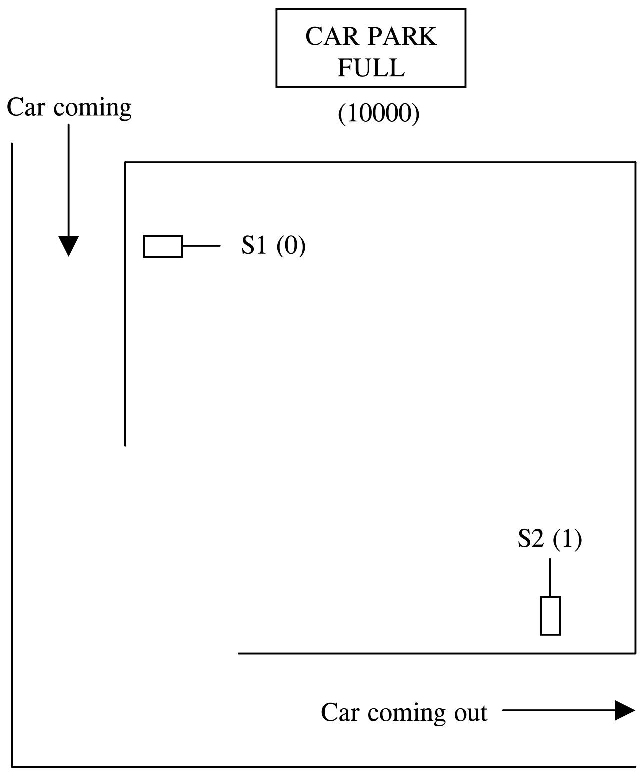
Network 9 – End



Address	Instruction	Data
0015	LD	25313
0016	OUT	TR 0
0017	CMP(20)	-
		#1000
		HR00
0018	AND	25506
019	OUT	20001
0020	LD	TR 0
0021	AND	25507
0022	OUT	20002
0023	LD	20001
0024	OR	20002
0025	OUT	01000
0026	LD	00005
0027	MOV(21)	-
		# 0000
		HR00
0028	END(01)	

Application #15: Car Park Control

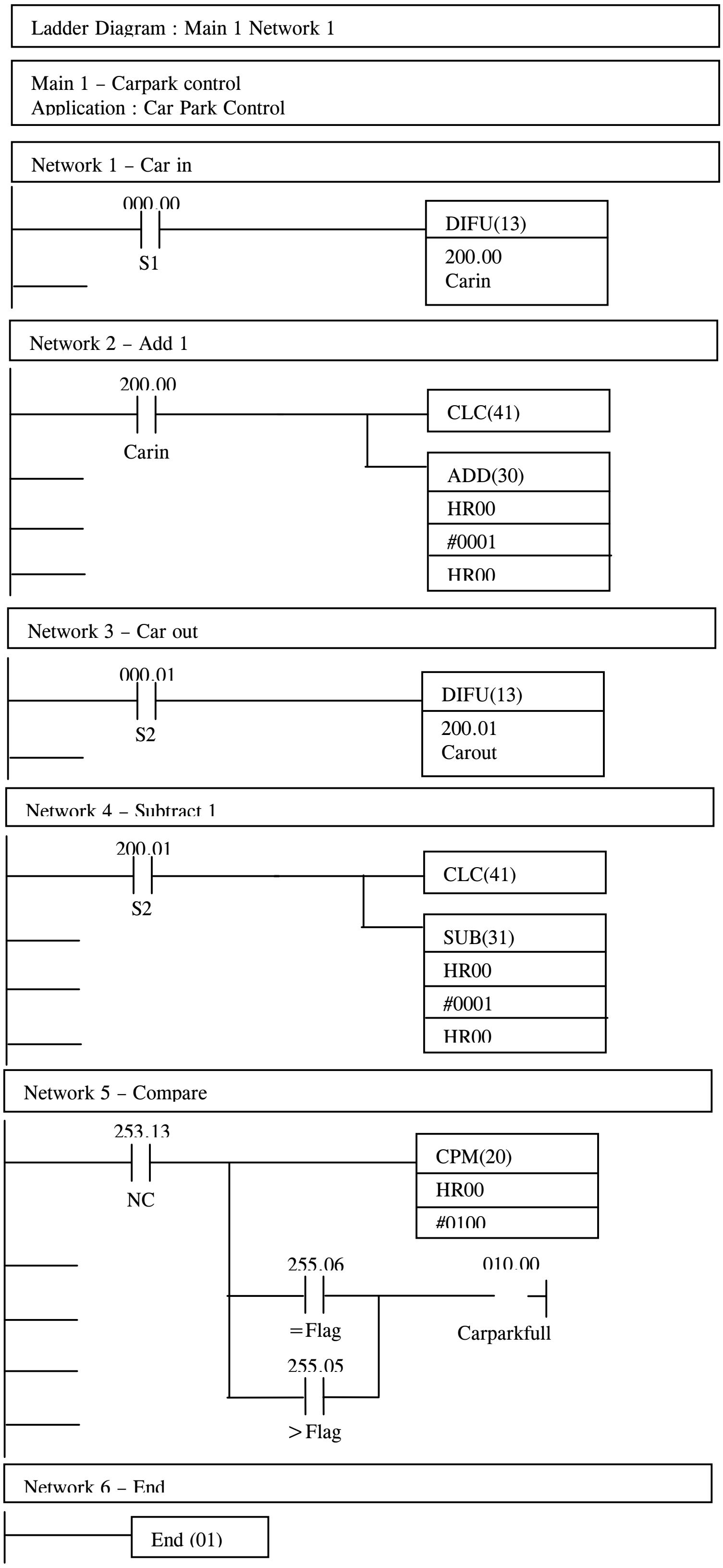
This is a simple car park control system that allows only a maximum of 100 cars parking space. Everytime a car comes in, the PLC will automatically add one through sensor S1. Any car that goes out will automatically be subtracted by one through sensor S2. When 100 cars are registered, the car park full sign will be lighted to inform oncoming vehicles not to enter.



- **I/O Assignment**

Input	Device
00000	Sensor S1
00001	Sensor S2

Output	Device
01000	Car Park Full Sign

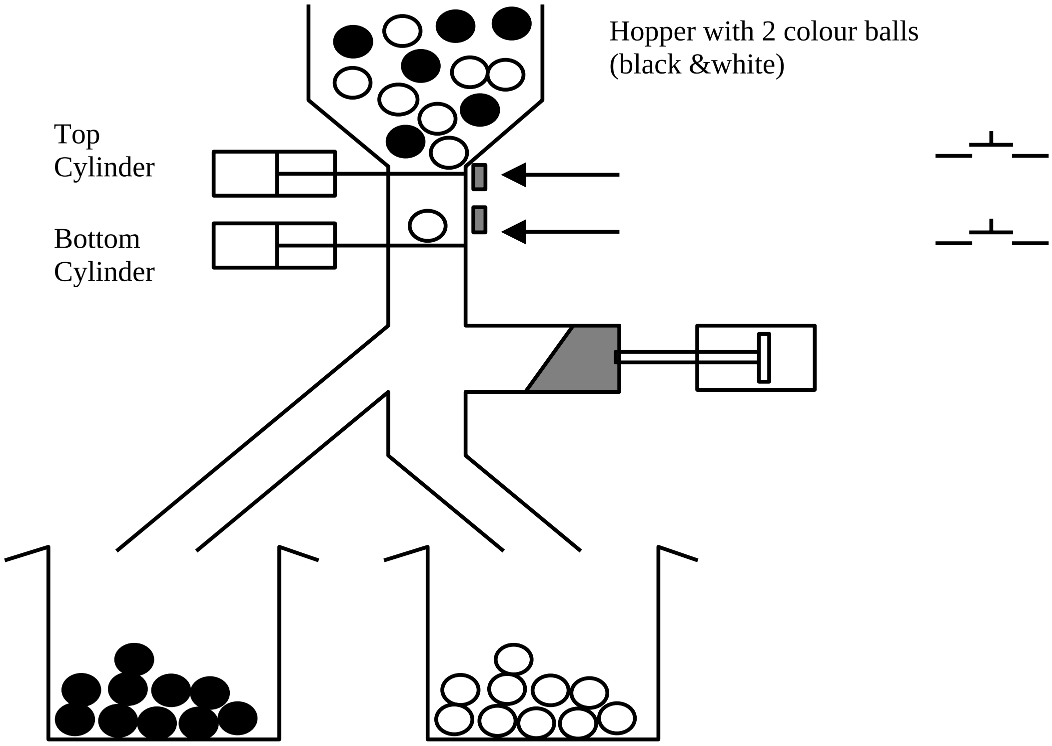


Mnemonic codes

Address	Instruction	Data
0000	LD	00000
0001	DIFU(13)	20000
0002	LD	20000
0003	CLC(41)	
0004	ADD(30)	
		HR00
		#0001
		HR00
0005	LD	00001
0006	DIFU(13)	20001
0007	LD	20001
0008	CLC(41)	
0009	SUB(31)	
		HR00
		#0001
		HR00
0010	LD	25313
0011	OUT	TR 0
0012	CMP(20)	
		HR00
		#0100
0013	AND	25506
0014	LD	TR 0
0015	AND	25505
0016	OR LD	
0017	OUT	01000
0018	END(01)	

6. APPLICATION EXAMPLES OF BASIC COMMANDS

❑ Example: Ball Sorter Mechanism



In this application, the system is to sort out the black & white balls into 2 different container.

The start button will start the operation, Ball sensor (S1) will sense the presence of the ball in the hopper. The top solenoid will release the ball for the colour sensor (S2) to differentiate the colour before being release into the container.

- **I/O Assignment**

Input	Device
00000	Start PB
00001	Ball sensor (S1)
00002	Colour sensor (S2)
00003	Stop PB

Output	Device
01000	Top cylinder
01001	Bottom cylinder
01002	Pusher