Ladder Diagram

→ A graphical way of rep logical flow and control.

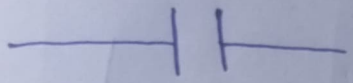
→ Used as a graphical computer language for simulating and testing control programs for programmable logic controllers (PLCs).

→ Used as the symbolic programming language used in industries to communicate with PLCs.

→ Called as "ladder" diagram - they look like a ladder with horizontal and vertical rails.

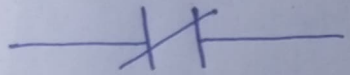
- With such a diagram the power supply for the ckt is always shows as two vertical lines, with the rest of the ckt as horizontal lines.
- The power lines, or rails, as are the vertical sides of a ladder, with the horizontal ckt lines ~~ckt~~ similar to the rungs of the ladder.
- The horizontal rungs show only the control portion of the ckt.
- The ~~vertical~~ left vertical leg represent power supply and right vertical leg represents the ground state.

Ladder Diagram Symbols



NO contact.

Normally Open Contact.



NC Contact.

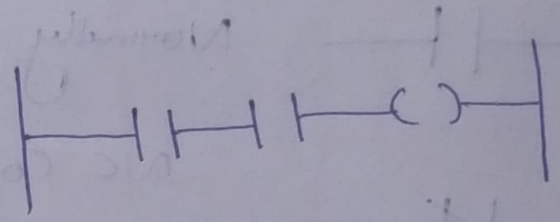
Normally closed Contact.

Output Coil.

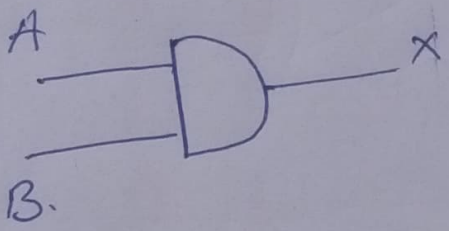
Bit Instructions

AND logic Function

A	B	X
0	0	0
0	1	0
1	0	0
1	1	1

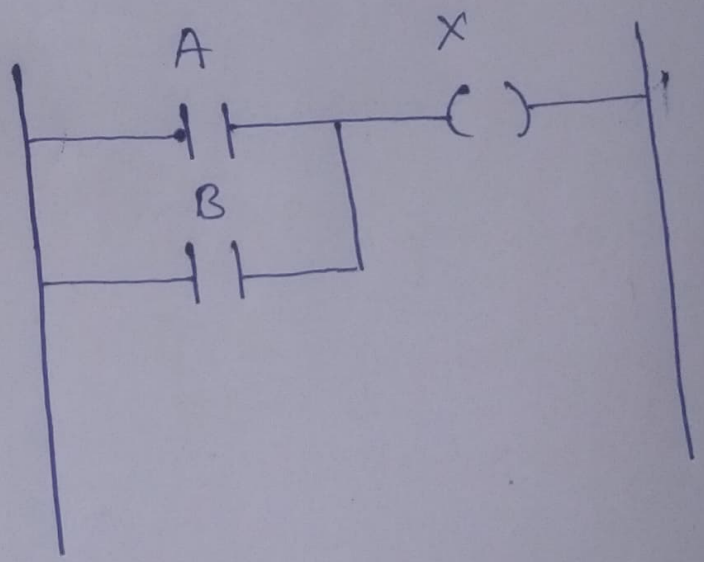


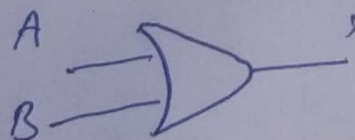
$A \cdot B = X$



OR logic Function

A	B	X
0	0	0
0	1	1
0	1	1
1	0	1
1	1	1

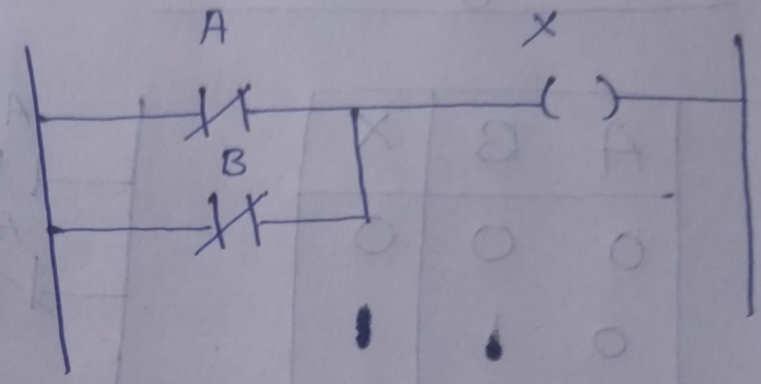




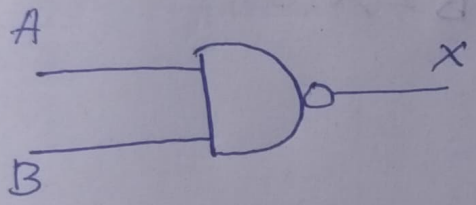
$A + B = X$

NAND Logic Function

A	B	X
0	0	1
0	1	1
1	0	1
1	1	0

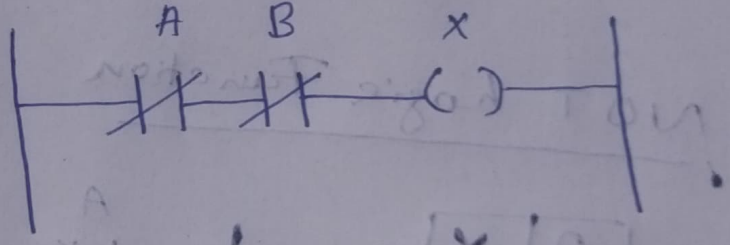


$\overline{A.B} = X$

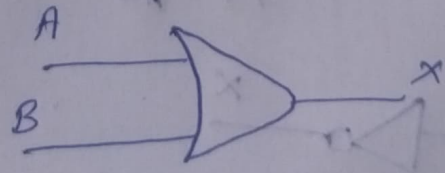


NOR Logic Function

A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

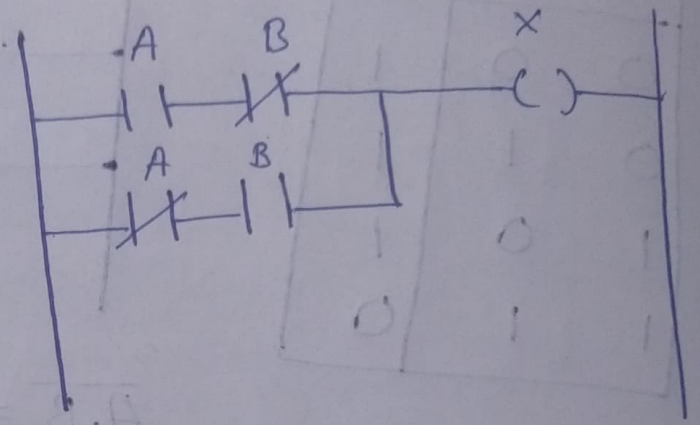


$X = \overline{A+B}$

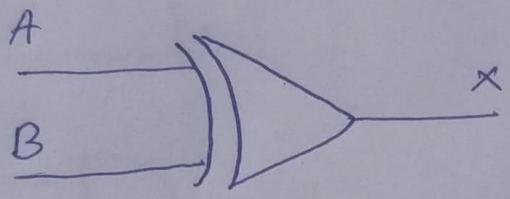


XOR logic Function

A	B	X
0	0	0
0	1	1
1	0	1
1	1	0

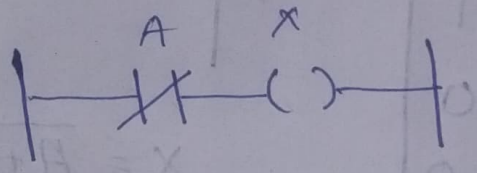


$A\bar{B} + \bar{A}B = X.$

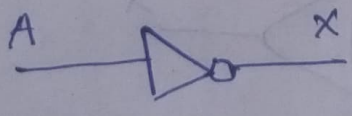


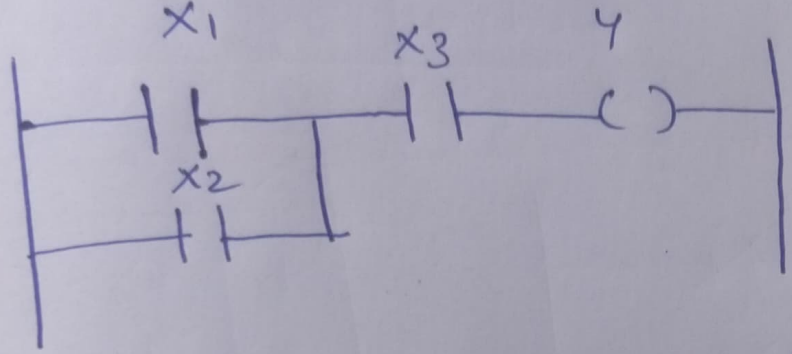
NOT logic Function

A	X
0	1
1	0

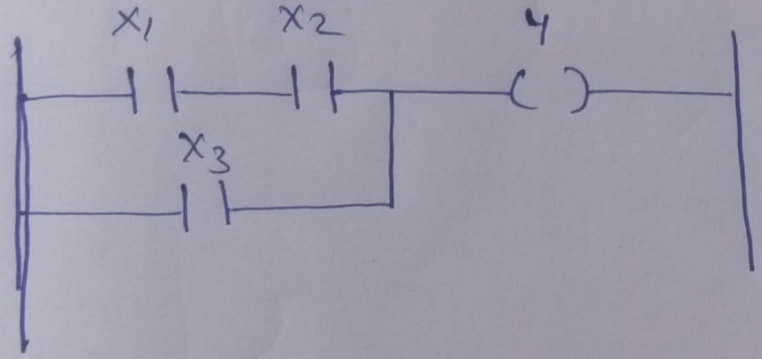


$\bar{A} = X$





$Y = (X_1 + X_2) X_3$.

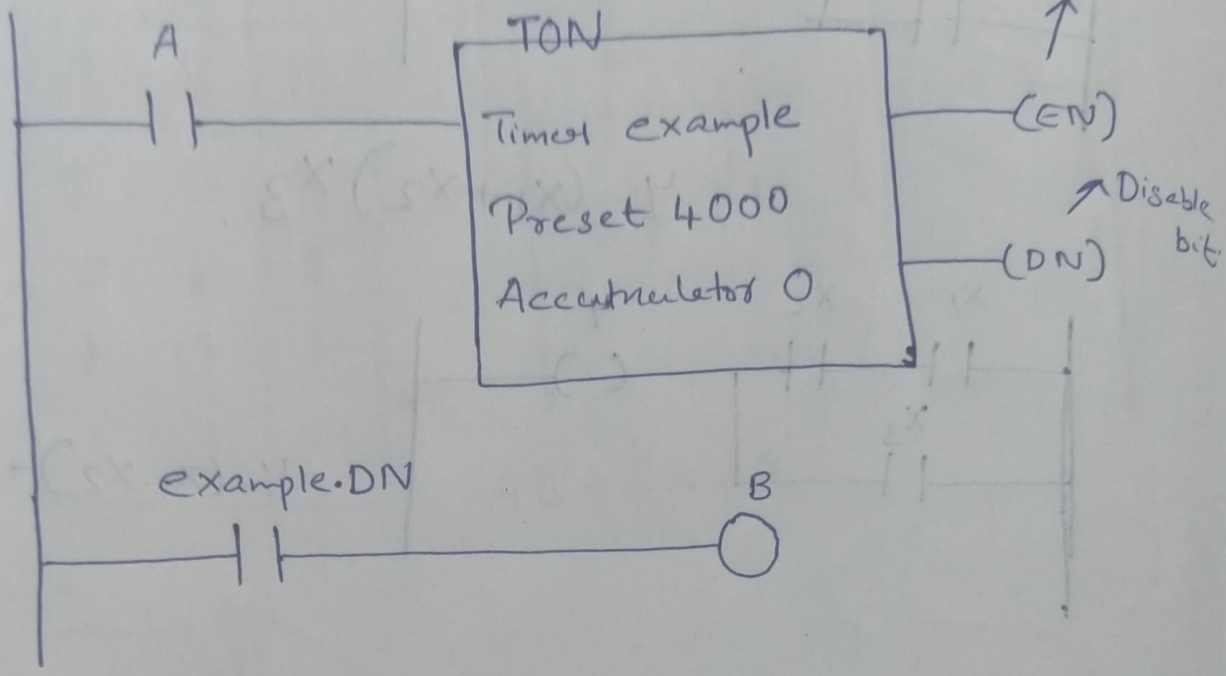


$Y = (X_1 \cdot X_2) + X_3$.

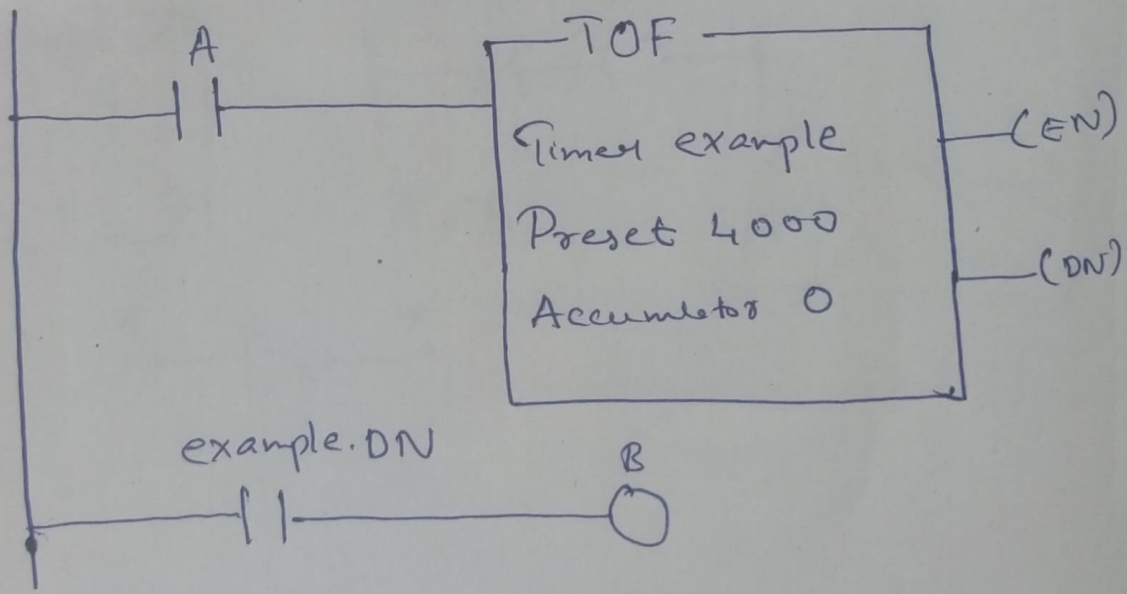
Timers

- A timer is a device that introduce a time delay in a circuit or system during its ON or OFF conditions.
- PLC timer, the time delay is introduced by programming.
- An on-delay timer will wait for a set of time after a line of ladder logic has been true before turning on, but it will turn-off immediately.
- An off-delay timer will turn on immediately when a line of ladder logic is true, but it will delay before turning off.

ON Delay Timer



OFF Delay Timer



Counters

- Counters are used to count the number of items produced and the number of operations performed.
- PLC Counter has a Sensor + Count operations, which is processed by Software.
- By using PLC Counter the failure rate is reduced and the accuracy level is increased.

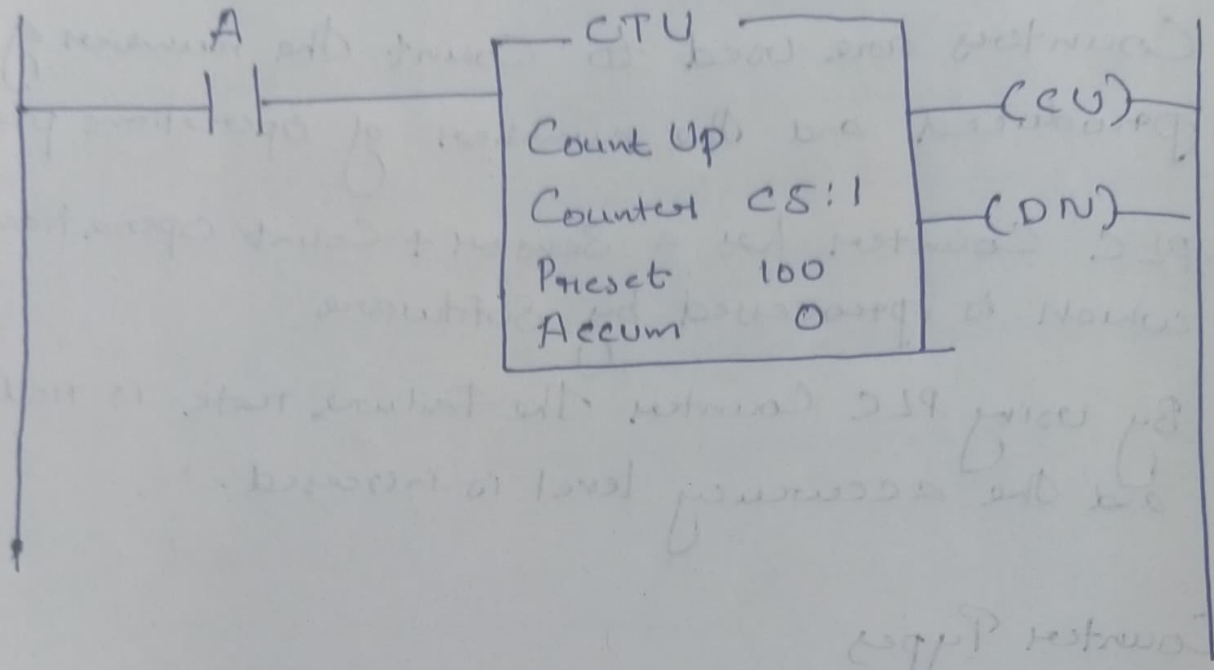
Counter Types

→ There are two basic counter types :-
Count-up / up-counter and Count-down / down-counter.

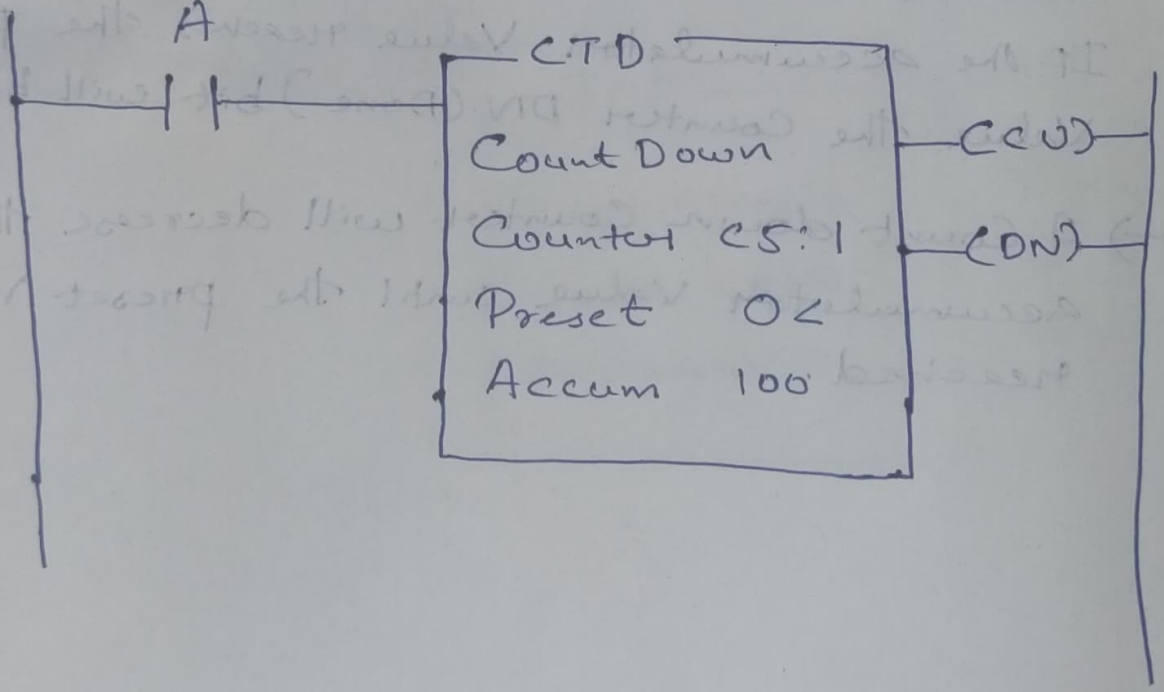
→ When the input to a Count-up counter gorse true the accumulator Value will increase by 1. If the accumulator Value reaches the preset Value the counter DN (Done) bit will be set.

→ A Count down counter will decrease the accumulator Value until the preset Value is reached.

Count-up Counter



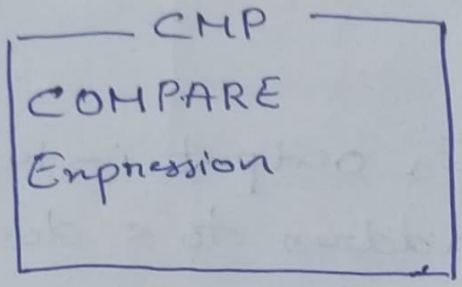
Count-down-Counter

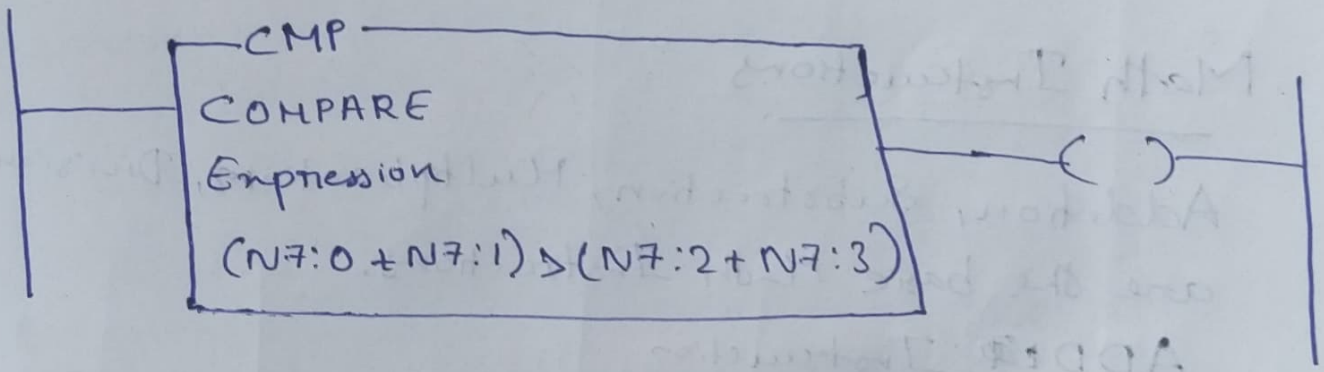


Compare Instruction

Compare (CMP)

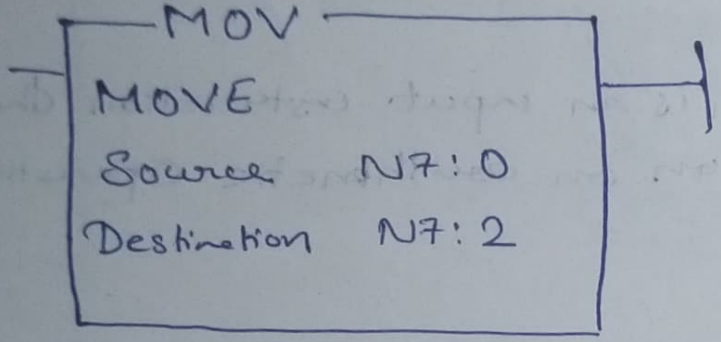
The CMP instruction is an input instruction that performs a comparision on arithmetic operations.





The CMP Instruction tells the PLC processor if the sum of the values in N7:0 and N7:1 is greater than the sum of the values in N7:2 and N7:3 set output bit.

Move Instruction

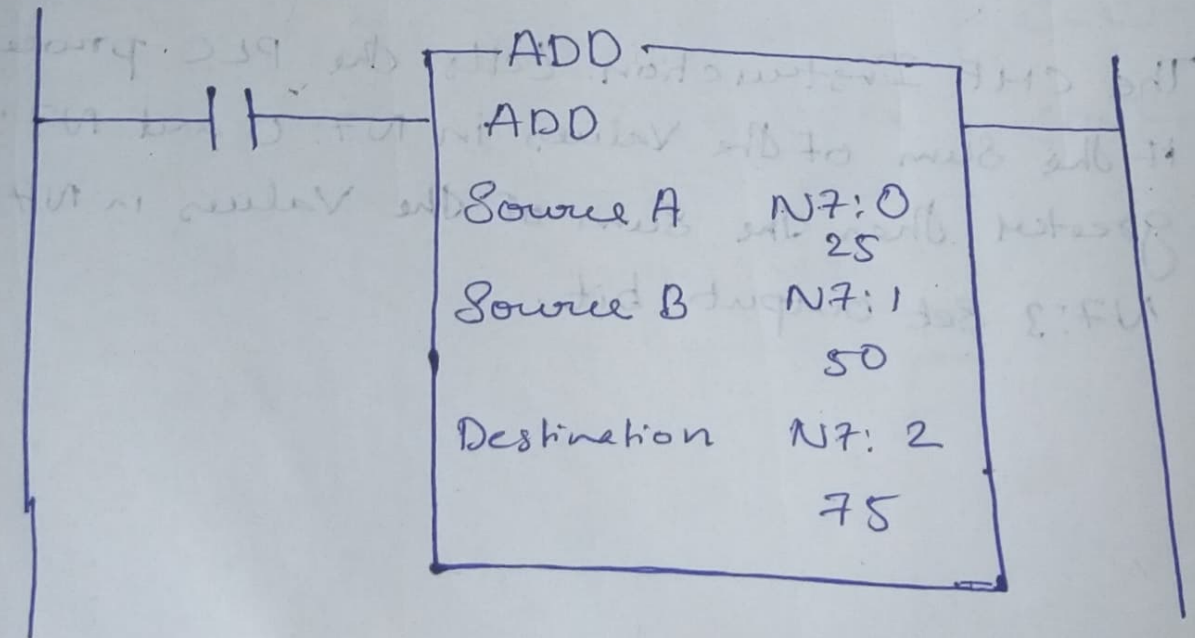


The MOV instruction is an output instruction that copies the source address to a destination.

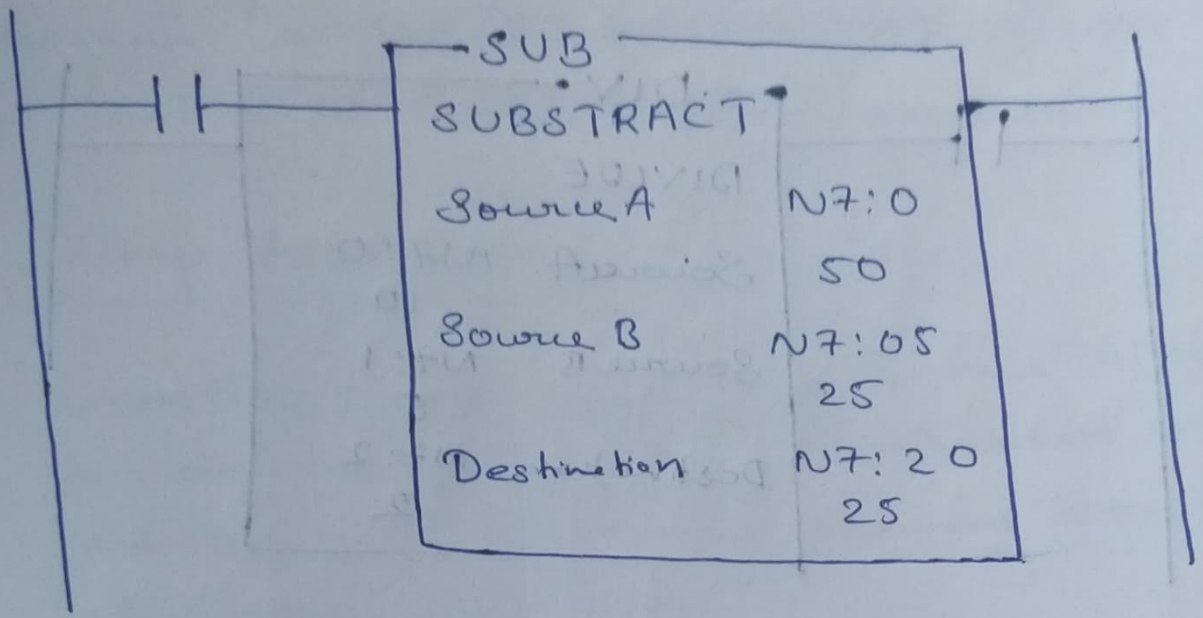
Math Instructions

Addition, Substraction, Multiplication, Division are the basic Math Instructions.

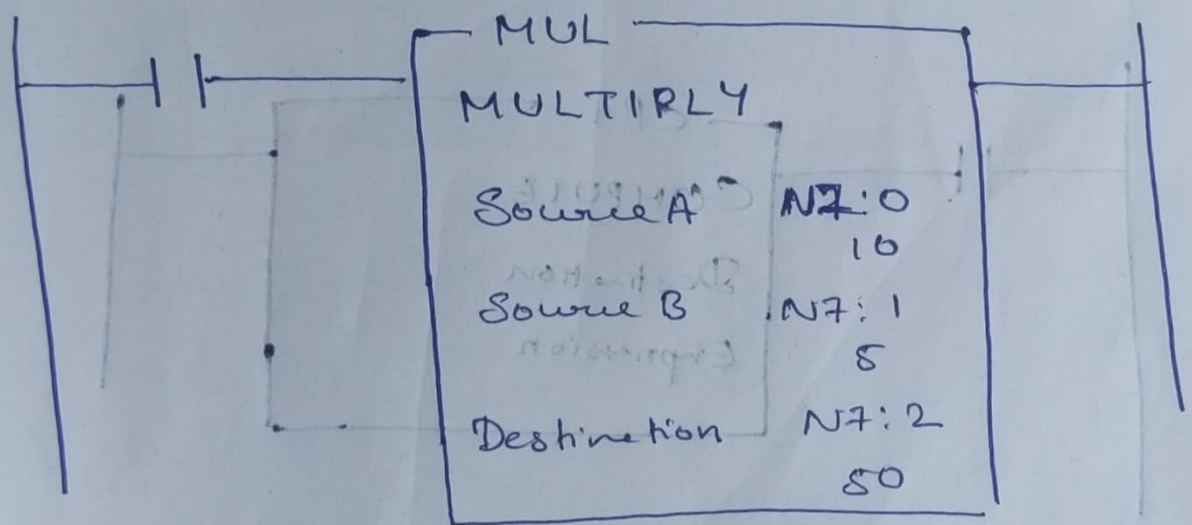
ADD Instruction



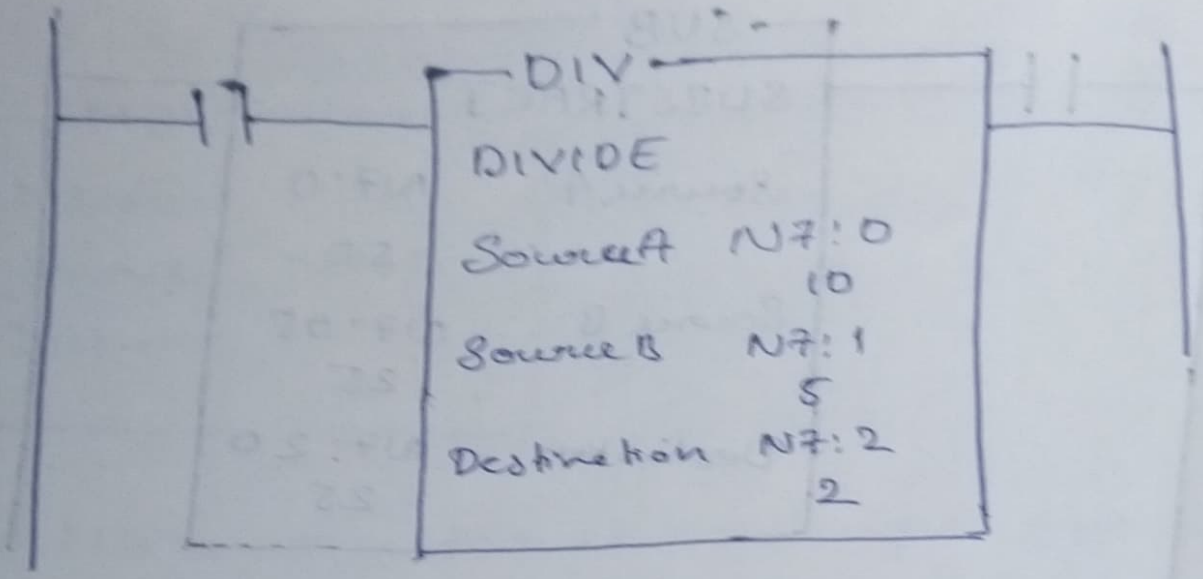
Substract Instruction



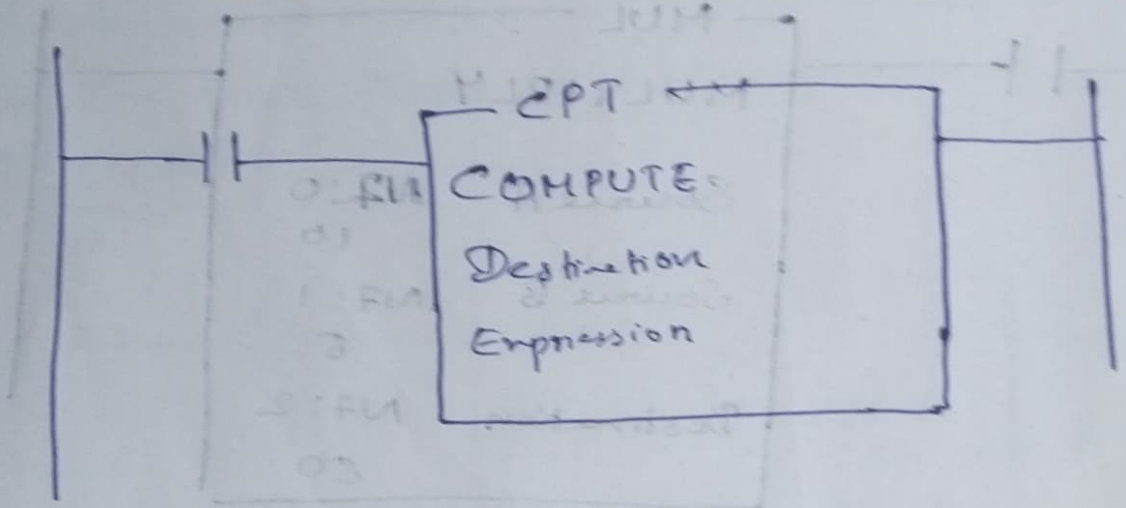
Multiply Instruction



Division Instruction



Compute Instruction



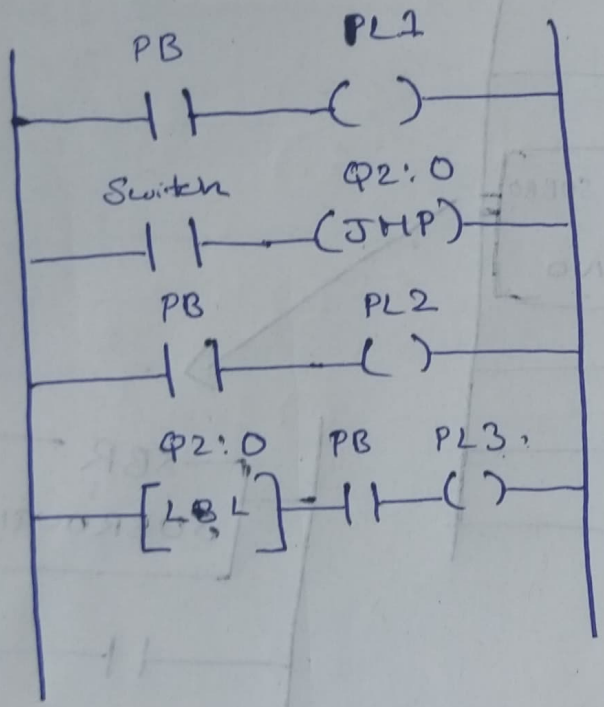
The CPT (Compute) instruction is an output instruction that performs the operation you define in the expression and write the result into the destination address.

Program Control Instruction

Program Control Instruction changes the flow or control of ladder program execution.

Jump Instruction

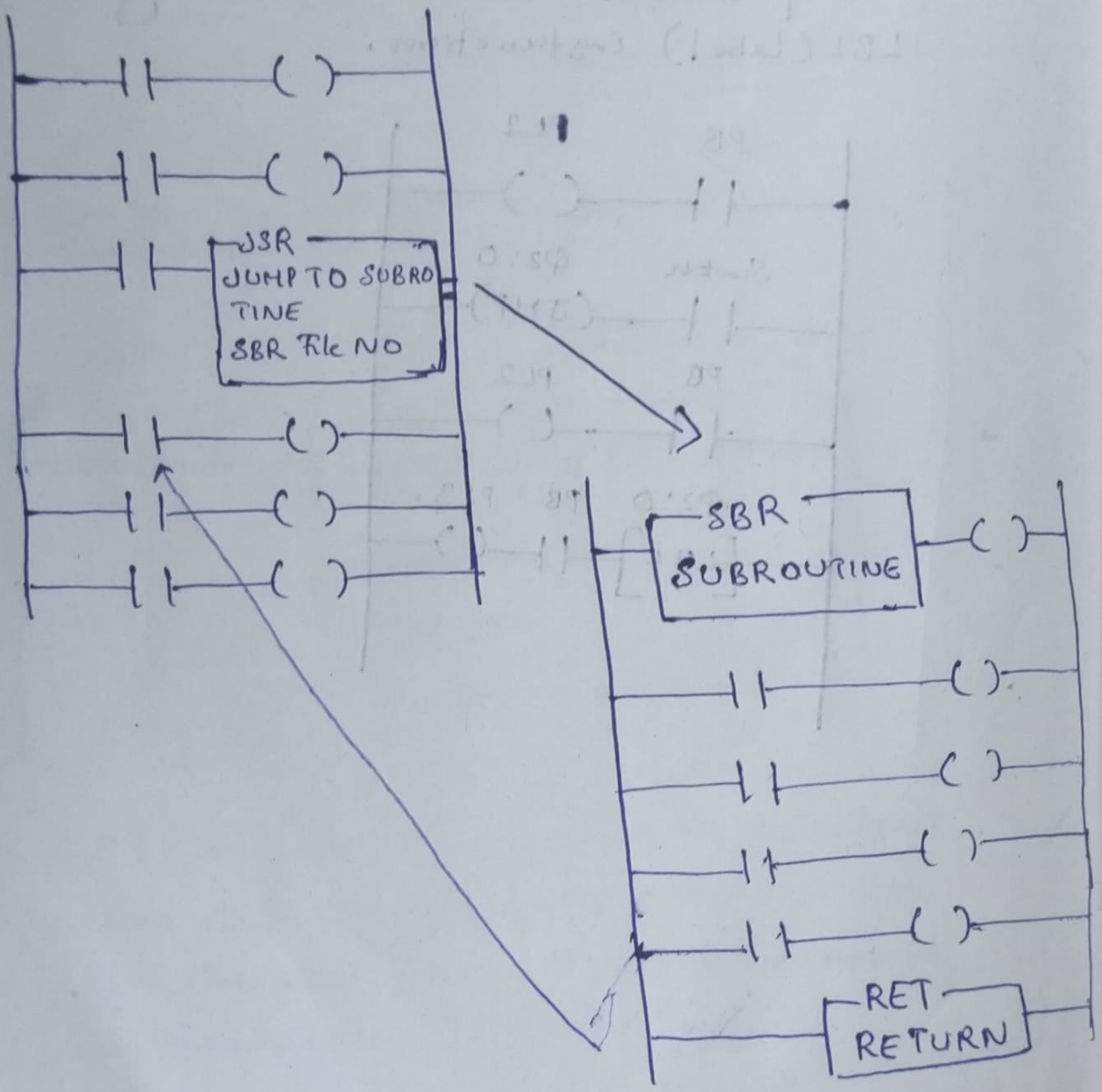
→ When the jump instruction is true all logic between the jump and label instruction is bypassed and processor continous scanning after the LBL(label) instruction.



Subroutine Instruction

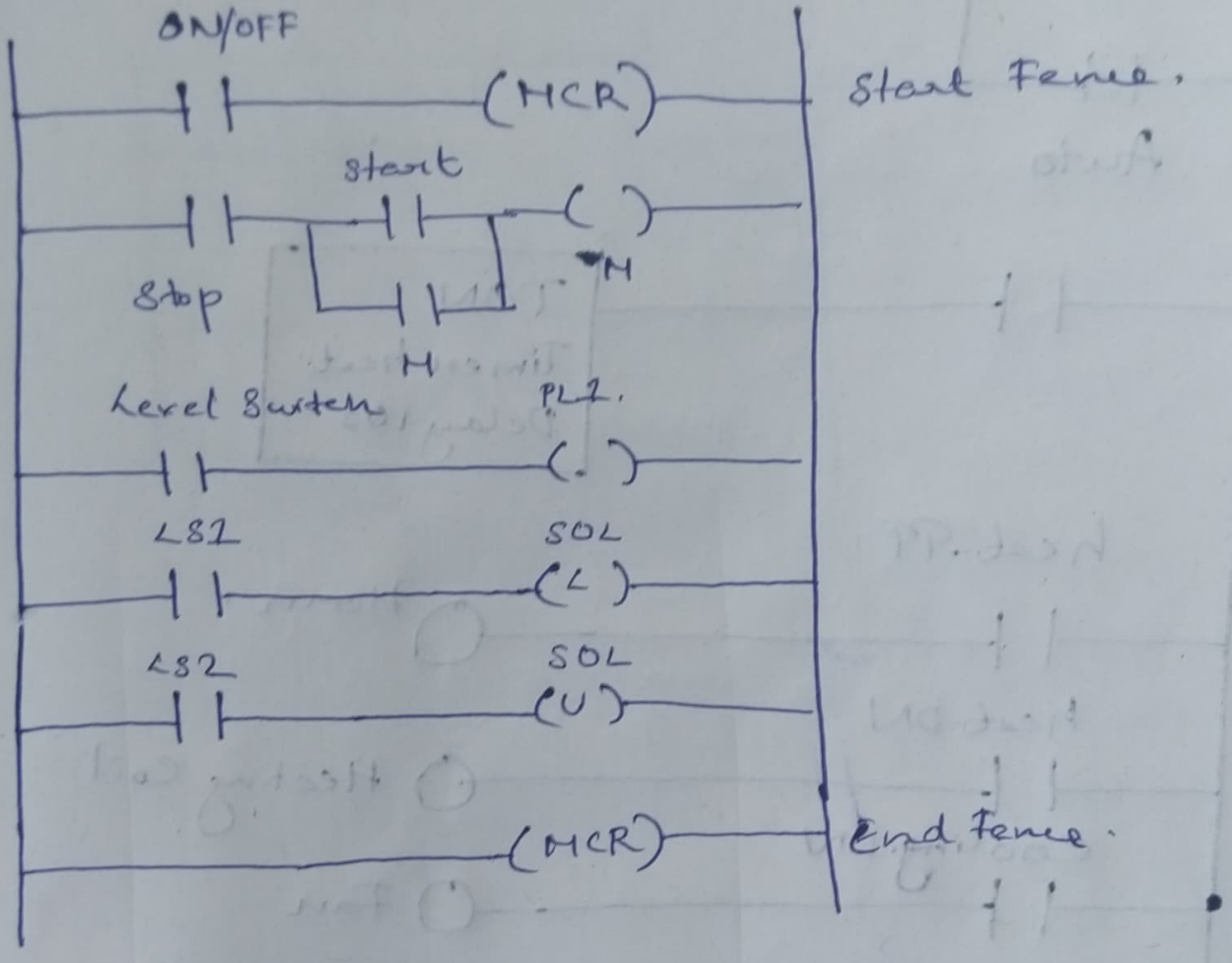
Jump to Subroutine (JSR), Subroutine (SBR), and Return (RET)

The JSR, SBR and RET instructions direct the processor to go to a seperate subroutine file within the ladder program, scan the subroutine file once and return back.

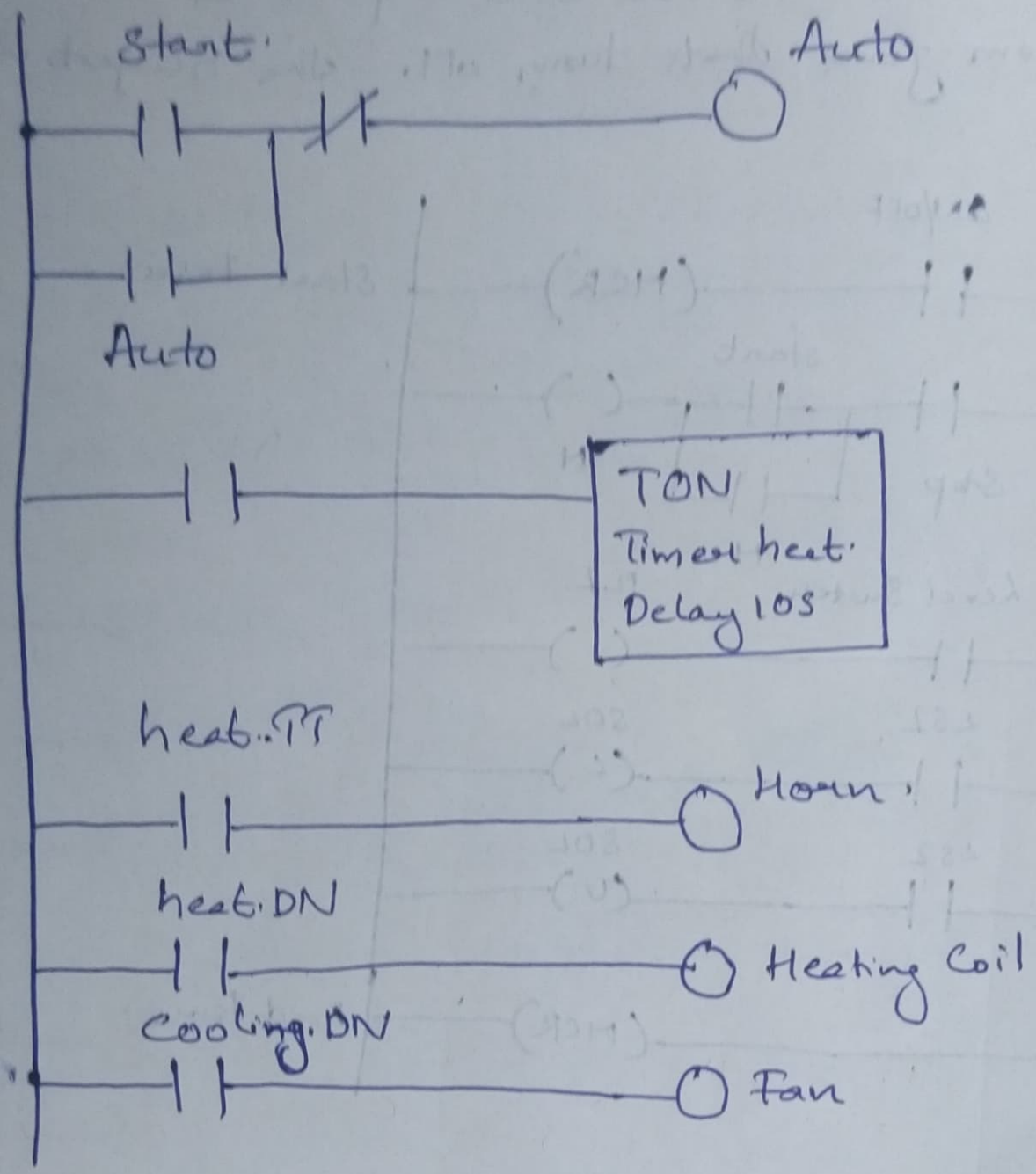


Master Control Reset (MCR) Instruction

MCR instructions are used in pairs to create program zones that turn off the outputs in zones.

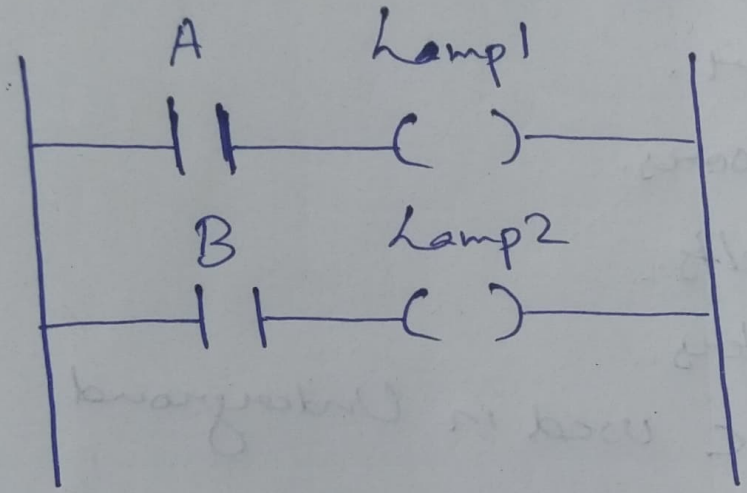


Control of A Heating Oven



Q) Develop a ladder program for the following conditions.

1) Lamp 1 active when Input A occurs.
2) Lamp 2 active when input B occurs.



PLC Applications

1) Road Traffic Signals.
2) The Automatic Car Wash.
3) The Elevators.
4) Automatic Doors.
5) Conveyor Belts.
6) Roller Coasters.
7) Real time PLC used in Underground Coal Mine.
8) PLC is used in water level Sensing.
9) PLC is used in Smart grid System to Monitor and Detect Fault Conditions.
10) PLC is used in Automatic Bottle or liquid Filling Systems.