



Andhra Pradesh State Skill Development Corporation



The image consists of two main parts. On the left, there is a teal-colored diagram illustrating an LMS (Learning Management System). It features a central computer monitor displaying the 'LMS' logo, surrounded by various icons and labels: 'courses' (top), 'documentation' (top right), 'tracking' (right), 'e-learning management' (bottom right), 'education' (bottom left), 'system' (left), and 'software' (top left). On the right, there is a photograph of three individuals (two men and one woman) wearing headsets and working on desktop computers in what appears to be a call center or customer service environment.

Basics of PLC

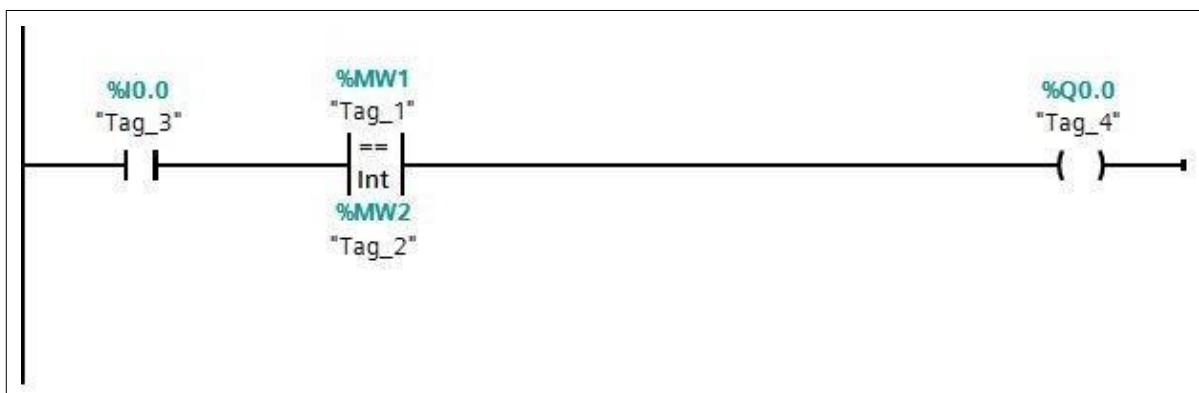
**Introduction to Math Functions and
Comparator Operations**



Basic Mathematical Functions: Comparison Operations

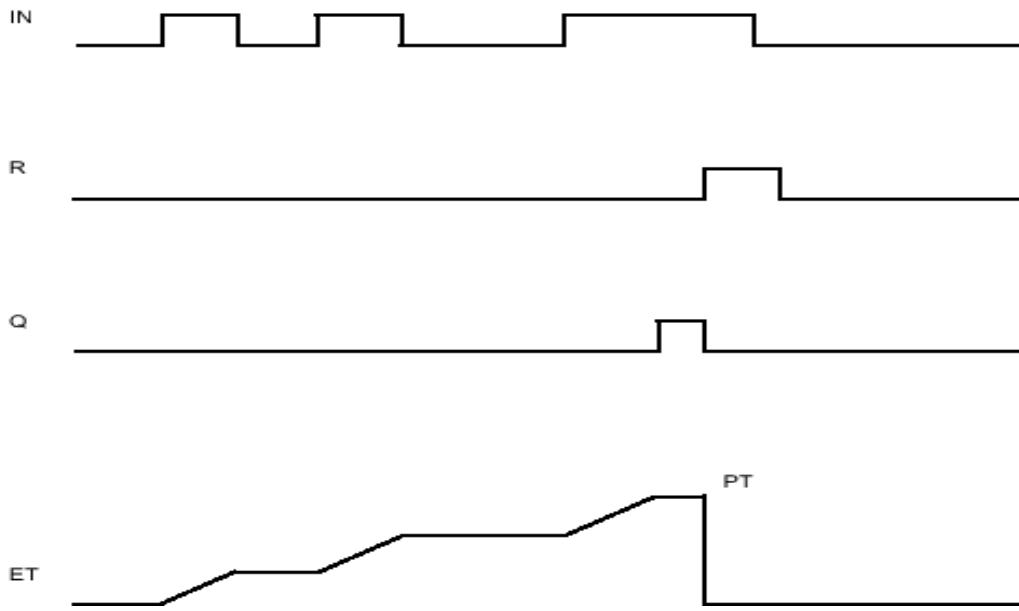
1. CMP (==):Equal

You can use the "Equal" instruction to determine if a first comparison value (<Operand1>) is equal to a second comparison value (<Operand2>).



Pulse timing diagram

The following figure shows the pulse timing diagram of the "Time accumulator" instruction:



If the condition of the comparison is fulfilled, the instruction returns the result of logic operation (RLO) "1". If the comparison condition is not fulfilled, the instruction returns RLO "0".



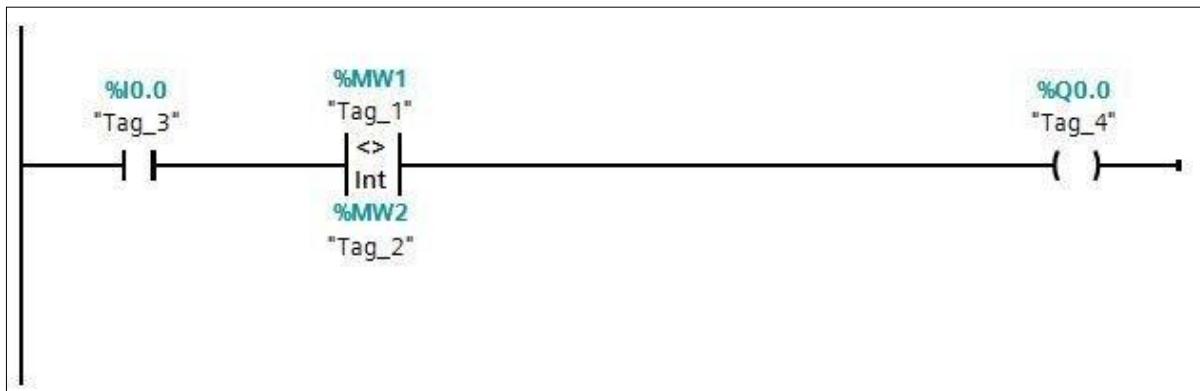
Parameters

| Parameter | Declaration | Data type | Description |
|-----------|-------------|--|-------------------------|
| Operand 1 | Input | integers, floating-point numbers, TIME, DATE | First comparison value |
| Operand 2 | Input | integers, floating-point numbers, TIME, DATE | Second value to compare |

1. $CMP(<>)$: Not equal

You can use the "Not equal" instruction to determine if a first comparison value (<Operand1>) is not equal to a second comparison value (<Operand2>).

If the condition of the comparison is fulfilled, the instruction returns the result of logic operation (RLO) "1". If the comparison condition is not fulfilled, the instruction returns RLO "0".



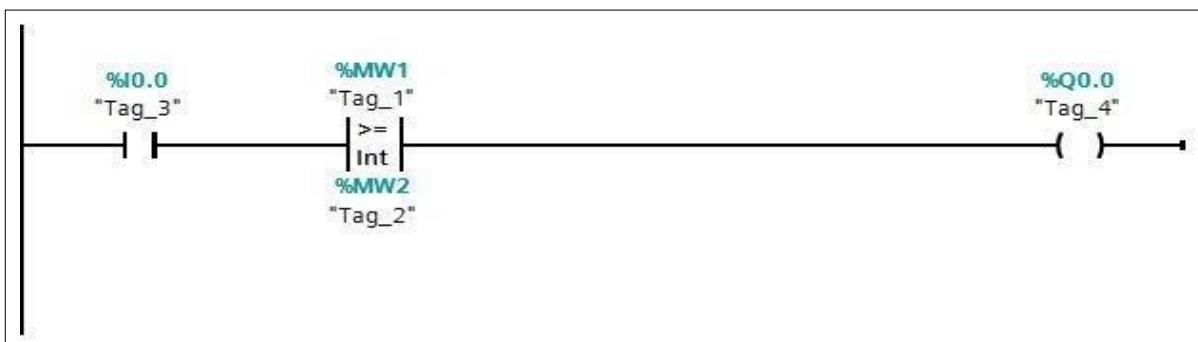
Parameters

| Parameter | Declaration | Data type | Description |
|-----------|-------------|--|-------------------------|
| Operand 1 | Input | integers, floating-point numbers, TIME, DATE | First comparison value |
| Operand 2 | Input | integers, floating-point numbers, TIME, DATE | Second value to compare |

2. $CMP(>=)$: Greater or equal



You can use the "Greater or equal" instruction to determine if a first comparison value (<Operand1>) is greater than or equal to a second comparison value (<Operand2>). Both values to be compared must be of the same data type. If the condition of the comparison is fulfilled, the instruction returns the result of logic operation (RLO) "1". If the comparison condition is not fulfilled, the instruction returns RLO "0".



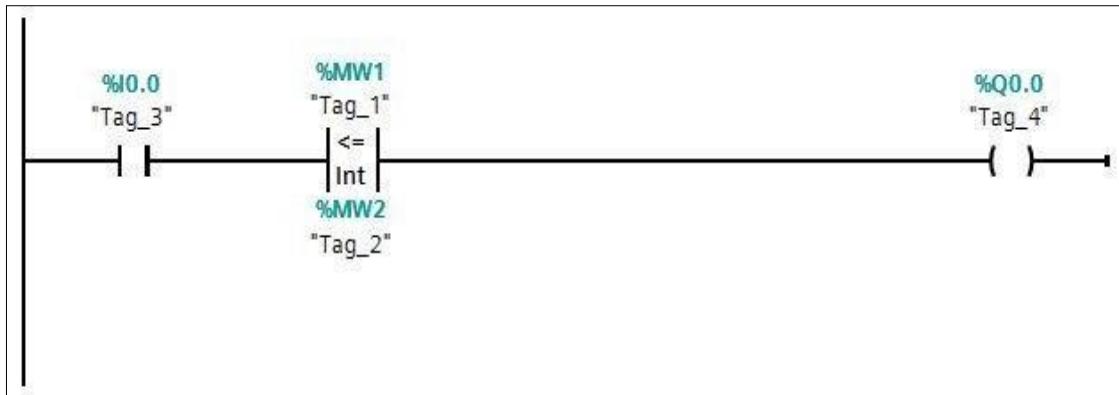
Parameters

| Parameter | Declaration | Data type | Description |
|-----------|-------------|--|-------------------------|
| Operand 1 | Input | integers, floating-point numbers, TIME, DATE | First comparison value |
| Operand 2 | Input | integers, floating-point numbers, TIME, DATE | Second value to compare |

1. *CMP(<=): Less or equal*

You can use the "Less or equal" instruction to determine if a first comparison value (<Operand1>) is less than or equal to a second comparison value (<Operand2>). Both values to be compared must be of the same data type.

If the condition of the comparison is fulfilled, the instruction returns the result of logic operation (RLO)=1. If the comparison condition is not fulfilled, the instruction returns RLO=0.



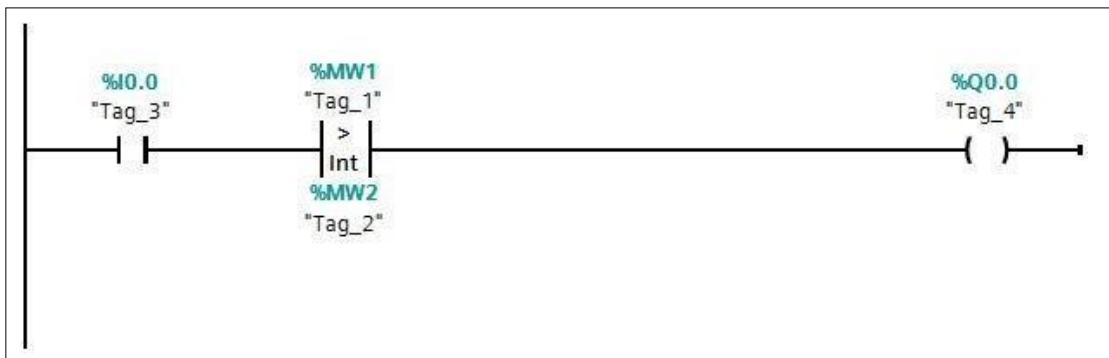
Parameters

| Parameter | Declaration | Data type | Description |
|-----------|-------------|--|-------------------------|
| Operand 1 | Input | integers, floating-point numbers, TIME, DATE | First comparison value |
| Operand 2 | Input | integers, floating-point numbers, TIME, DATE | Second value to compare |

2. *CMP(>): Greater than*

You can use the "Greater than" instruction to determine if a first comparison value (<Operand1>) is greater than a second comparison value (<Operand2>). Both values to be compared must be of the same data type.

If the condition of the comparison is fulfilled, the instruction returns the result of logic operation (RLO) "1". If the comparison condition is not fulfilled, the instruction returns RLO "0".





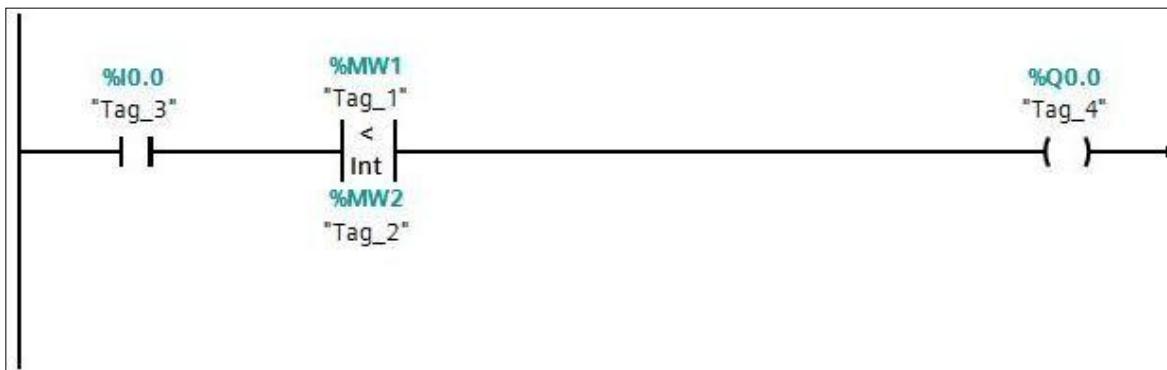
Parameters

| Parameter | Declaration | Data type | Description |
|-----------|-------------|--|-------------------------|
| Operand 1 | Input | integers, floating-point numbers, TIME, DATE | First comparison value |
| Operand 2 | Input | integers, floating-point numbers, TIME, DATE | Second value to compare |

1. *CMP <: Less than*

You can use the "Less than" instruction to determine if a first comparison value (<Operand1>) is less than a second comparison value (<Operand2>). Both values to be compared must be of the same data type.

If the condition of the comparison is fulfilled, the instruction returns the result of logic operation (RLO) "1". If the comparison condition is not fulfilled, the instruction returns RLO "0".



Parameters

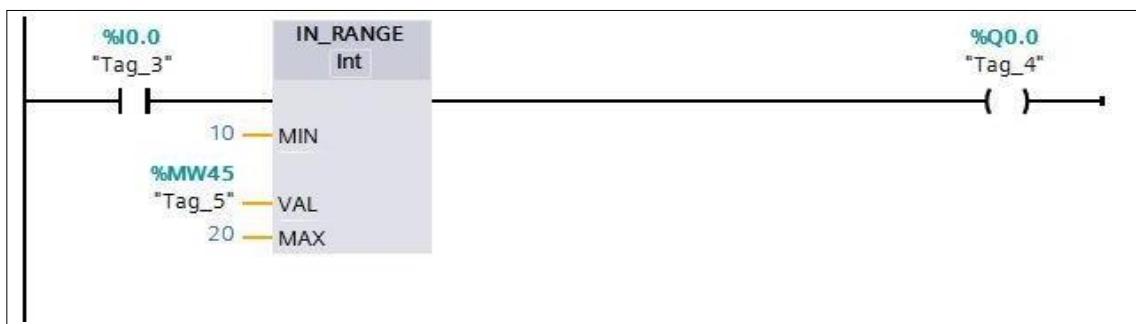
| Parameter | Declaration | Data type | Description |
|-----------|-------------|--|-------------------------|
| Operand 1 | Input | integers, floating-point numbers, TIME, DATE | First comparison value |
| Operand 2 | Input | integers, floating-point numbers, TIME, DATE | Second value to compare |

1. *IN_RANGE: Value within range*

You can use the "Value within range" instruction to determine if the value at the VAL input is within a specific value range.



You specify the limits of the value range with the MIN and MAX inputs. The "Value within range" instruction compares the value at the VAL input with the values of the MIN and MAX inputs and sends the result to the box output. If the value at the VAL input fulfills the comparison $\text{MIN} \leq \text{VAL}$ or $\text{VAL} \leq \text{MAX}$, the box output has the signal state "1". If the comparison is not fulfilled, the box output has the signal state



"0".

If the box input has the signal state "0", the "Value within range" instruction is not executed. The comparison function can only execute if the values to be compared are of the same data type and the box input is interconnected.

Parameters

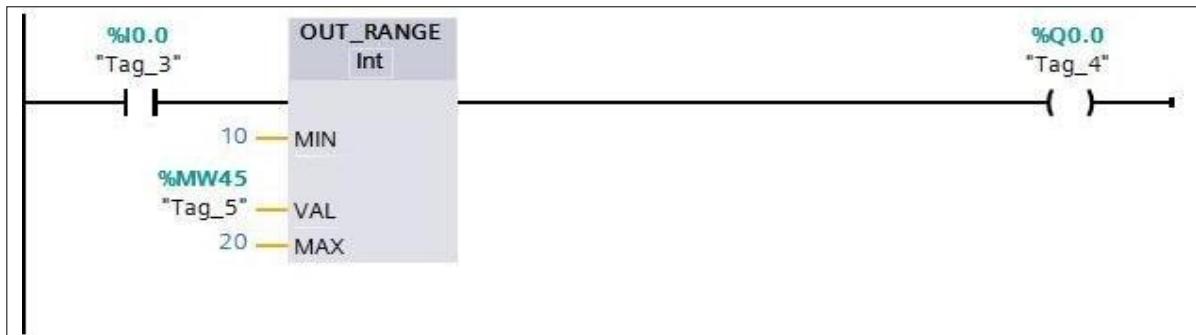
| Parameter | Declaration | Data type | Description |
|-----------|-------------|----------------------------------|--|
| Input | Input | BOOL | Result of the previous logic operation |
| MIN | Input | Integers, floating-point numbers | Low limit of the value range |
| VAL | Input | Integers, floating-point numbers | Comparison value |
| MAX | Input | Integers, floating-point numbers | High limit of the value range |
| Output | Output | BOOL | Result of the comparison |

2. OUT_RANGE: Value outside range

You can use the "Value outside range" instruction to determine if the value at the VAL input is outside a specific value range.



You specify the limits of the value range with the MIN and MAX inputs. The "Value outside range" instruction compares the value at the VAL input with the values of the MIN and MAX inputs and sends the result to the box output. If the value at the VAL input fulfills the comparison MIN > VAL or VAL > MAX, the box output has the signal state "1". The box output also has the signal state "1" if a specified operand with the REAL data type shows an invalid value.



The box output returns the signal state "0", if the value at input VAL does not satisfy the MIN > VAL or VAL > MAX condition.

If the box input has the signal state "0", the "Value outside range" instruction is not executed. The comparison function can only execute if the values to be compared are of the same data type and the box input is interconnected.

Parameters

| Parameter | Declaration | Data type | Description |
|-----------|-------------|----------------------------------|--|
| Input | Input | BOOL | Result of the previous logic operation |
| MIN | Input | Integers, floating-point numbers | Low limit of the value range |
| VAL | Input | Integers, floating-point numbers | Comparison value |
| MAX | Input | Integers, floating-point numbers | High limit of the value range |
| Output | Output | BOOL | Result of the comparison |