KLS'S GOGTE INSTITUTE OF TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING

CREINTORS AUTOMATION SOLUTIONS PVT.LTD.

PRESENTS

HONOR'S PROGRAM IN PLC PROGRAMMING

Syllabus of Course

1. Basics of PLC

2. PLC Programming

3. SCADA Programming

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Timers

All PLC’ s have timer instructions. Timers are output instructions that are internal to the programmable logic controller. Timers provide timed control of the devices that they activate or de-activate.

Basic functions of timer

Timers are used to delay an action.
Timers are used to run an operation for a predetermined period of time.
Timers are also used to record the total accumulated time of continuous or intermediate events.

The Timer is identified as T4 i.e. identifier is T and file is 4.

There are 256 timers available in each file. Timers 0 through 255 are available

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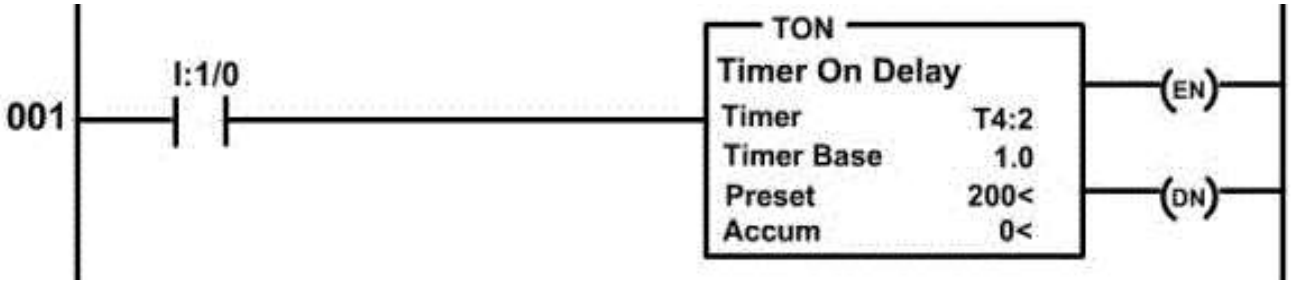
Timer’ s instructions

Timers consists of following parts: timer address, preset value, timer base, and accumulated value, as shown in figure below



In the above figure , term instruction name is, timer on delay (TON), timer base is 1.0 seconds, timer address is T4:2, accumulated value of zero(0) and a preset value of 200.
Each timer instruction has three very useful status bits. These bits are timer enable (E N), timer timing (TT), and timer done(DN).

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There are 3 types of timers: On- delay timer, Off-delay timer, and retentive timer.

On delay timer

Use this instruction to program a time delay after instructions become true.
On – delay timers are used when an action is to begin a specified time after the input becomes true.
For example, a certain step in the manufacturing is to begin 45 seconds after a signal is received from a limit switch. The 45- seconds delay is the on-delay timers preset value.

Off- delay timer

Off- delay timer instructions is used to program a time delay to begin after rung input goes off.

As an example, when an external cooling fan on a motor is provided, the fan has to run all the time the motor is running and also for certain time (say 10min) after the motor is turned off. This is a ten minute off- delay timer. The ten-minute timing period begins as soon as the motor is turned off.

Retentive timer

Retentive timer is a timer which retains the accumulated value in case of power loss, change of processor mode or rung state going from true to false (rung state transition).

Retentive timer can be used to track the running time of a motor for its maintenance purpose. Each time the motor is turned off, the timer will remember the motor's elapsed running time. The next time the motor is turned on, the time will increase from there. This timer can be reset by using a reset instruction.

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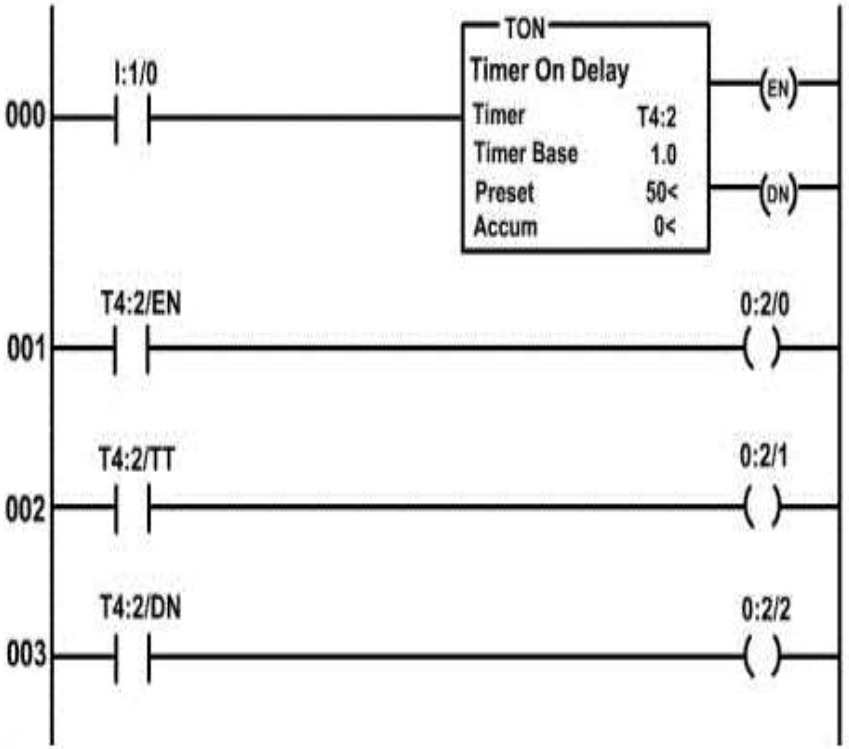
ON Delay Timer



The above figure is used to explain the on-delay timer instruction.
Here, T4:2 represents timer file 4, timer element 2, preset value is 50, accumulated value is 0 and timer base is 1 second.

- As long as the instruction I:1/0 is true, the on-delay timer T4:2 will increment every one second toward its preset value of 50 seconds. The accumulated value displays the current number of seconds that passed. When the accumulated value is equal to the preset value, the timer's done bit will get energized or set. So when the timer's done bit gets energized, the rung 003, instruction T4:3/DN becomes true and logical continuity is passed and the output O:2/2 gets energized.

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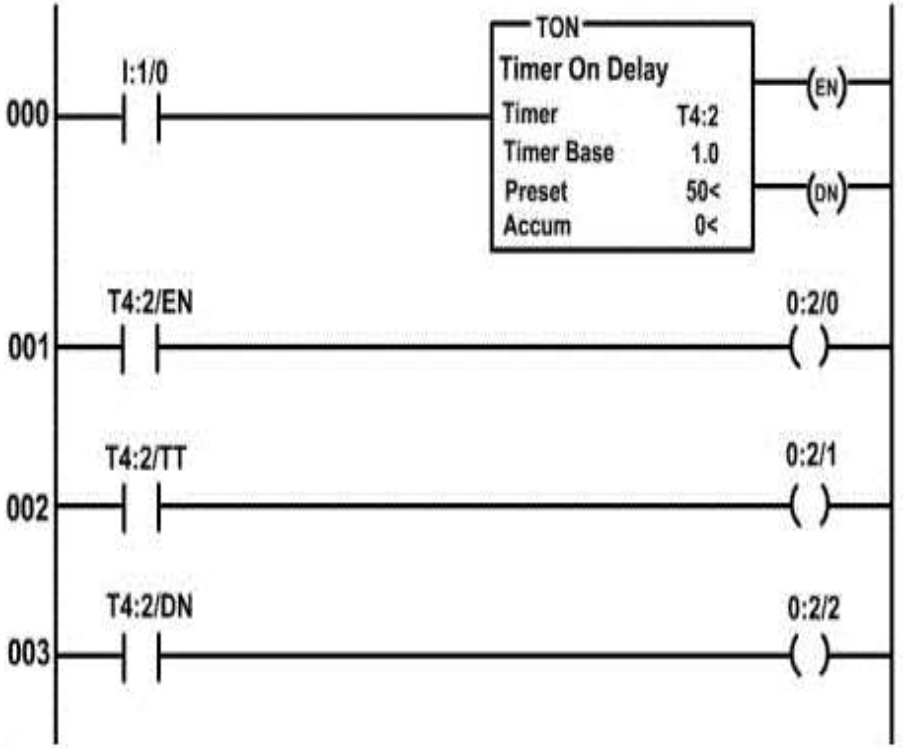

- As long as the I:1/0 is true, the timer instruction is enabled. Hence, rung 000 becomes true and logical continuity is passed and the output O:2/0 is energized.

Note: An on-delay timer is not retentive in nature.so any loss of continuity to the timer instruction on rung 000 will cause the timer to reset itself to an accumulated value of 0.

- When the timer is timing i.e rung 000 is true and accumulated value is less than preset value, timer timing bit(TT) is true. So the rung 002 becomes true i.e instruction T4:2/TT is true and output instruction O:2/1 is energized.

Note: As long as the rung 000 is true i.e instruction I:1/0 is true, the timer instruction is considered enabled. The enable bit will be true when the timer timing bit is true. Timer enable bit is set as long as there is logical continuity through all input instructions to the timer instruction, no matter the relationship between the preset value and accumulated value. When the rung goes false, the enable bit is reset.

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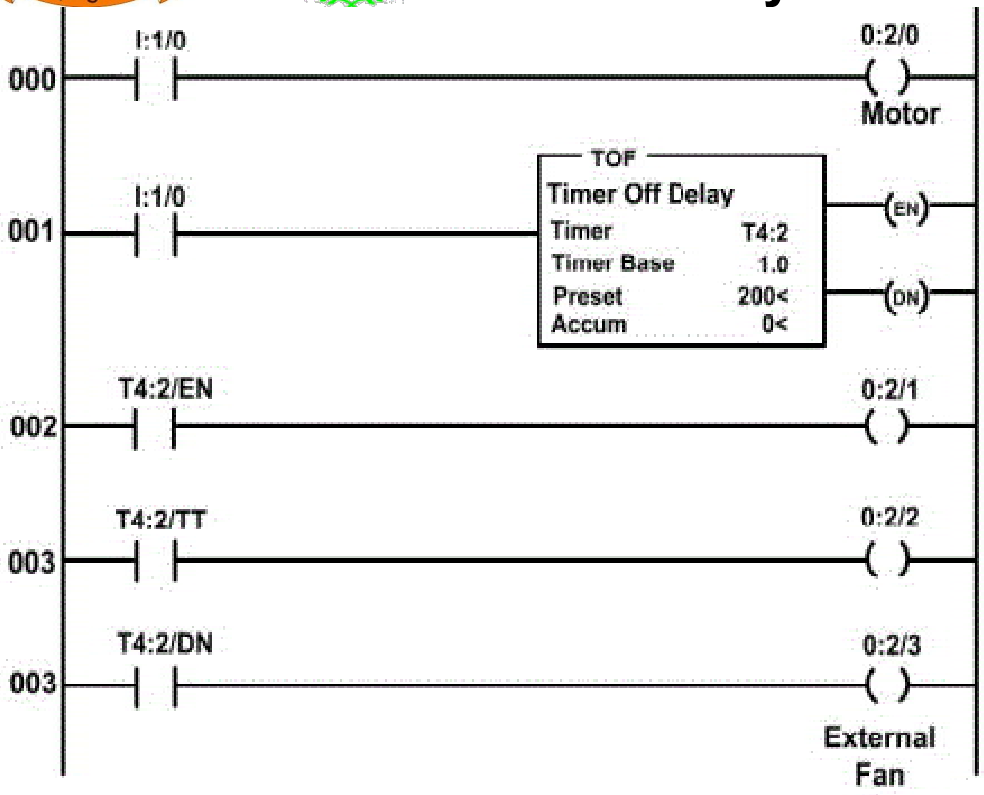
OFF Delay Timer



The figure is used to explain the off-delay timer instruction. Here, T4:2 represents timer file 4, timer element 2, preset value is 200, accumulated value is 0 and timer base is 1 second.

· As an example, consider an external cooling fan on a motor which has to run all the time when the motor is running and also for 200 seconds after the motor is turned off. For this purpose, we use 200- second off-delay timer. The 200-second timing cycle begins when the motor is turned off.

When the instruction I:1/0 is true, the motor is turned on i.e instruction O:2/0 becomes true. In other words, rung 000 becomes true. When the instruction I:1/0 is true, rung 001 becomes true, which will make the off-delay timer T4:2 enable. So as long as the instruction I:1/0 is true, the timer enable bit, EN, is true and hence, rung 002 become true, which in turn makes the output instruction O:2/1 true. The done bit is set as long as the rung 001 is true i.e the done bit is set when the enable bit is set. So the rung 004 is true. Hence, the external cooling fan is energized i.e instruction O:2/3 is true. So at this point, both motor and

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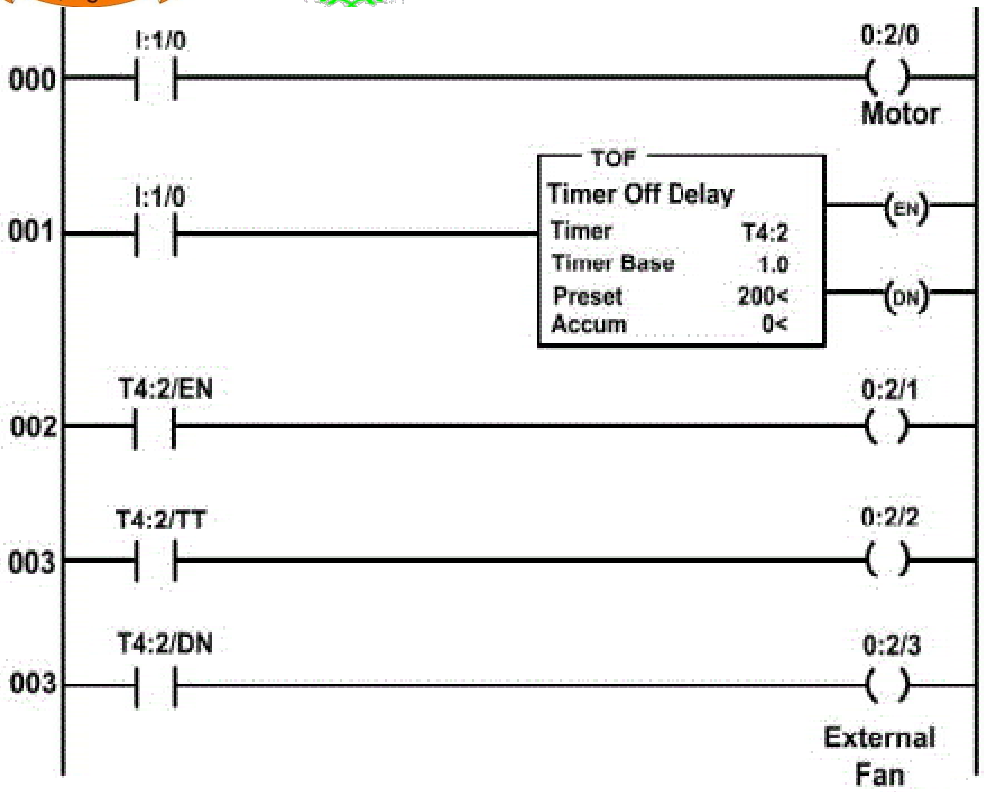

When the motor is turned off, i.e the instruction I:1/0 becomes false, the output instruction O:2/0(motor) becomes false and motor is turned off. When rung 001 transitions from true to false, the TOF(off-delay timer) instruction begins timing. The done bit and the external cooling fan(O:2/3) will still remains on, or true, for the preset value of 200 seconds.

The time period between the point when the rung becomes false and the point when the 200 seconds preset time expires for T4:2 is called delay after the input goes false, or the off-delay. The timers done bit and its associated output stay true until the off-delay of 200- seconds expires. The time expires when the accumulated value reaches the preset value. When the input instruction I:1/0 goes from true to false, the timer enable bit (EN) is reset and timer timing bit(TT) is set. The timer will start timing at this point. The timer timing bit(EN) becomes true whenever the rung transitions from true to false and the accumulated value

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Retentive Timer

Retentive timer instruction is used when we want to retain the accumulated value through power loss, processor mode change, or change in the rung state from true to false. The retentive timer instruction will measure the cumulative time period for which its rung is true. One of the example of retentive timer is that, it can be used to track the running time of a motor for maintenance purpose. The retentive timer is used to track the accumulated time the motor has run. In our example , our motor needs maintenance after 3600 seconds or, one hour of running time. Each time the motor is turned off, the timer needs to remember the motors total elapsed running time. The next time the motor is turned on, the timer will increase the accumulated running time from where it is left off. When the total accumulated motor running time has been reached, a maintenance remainder pilot light will be lit. A retentive timer is used in this application.

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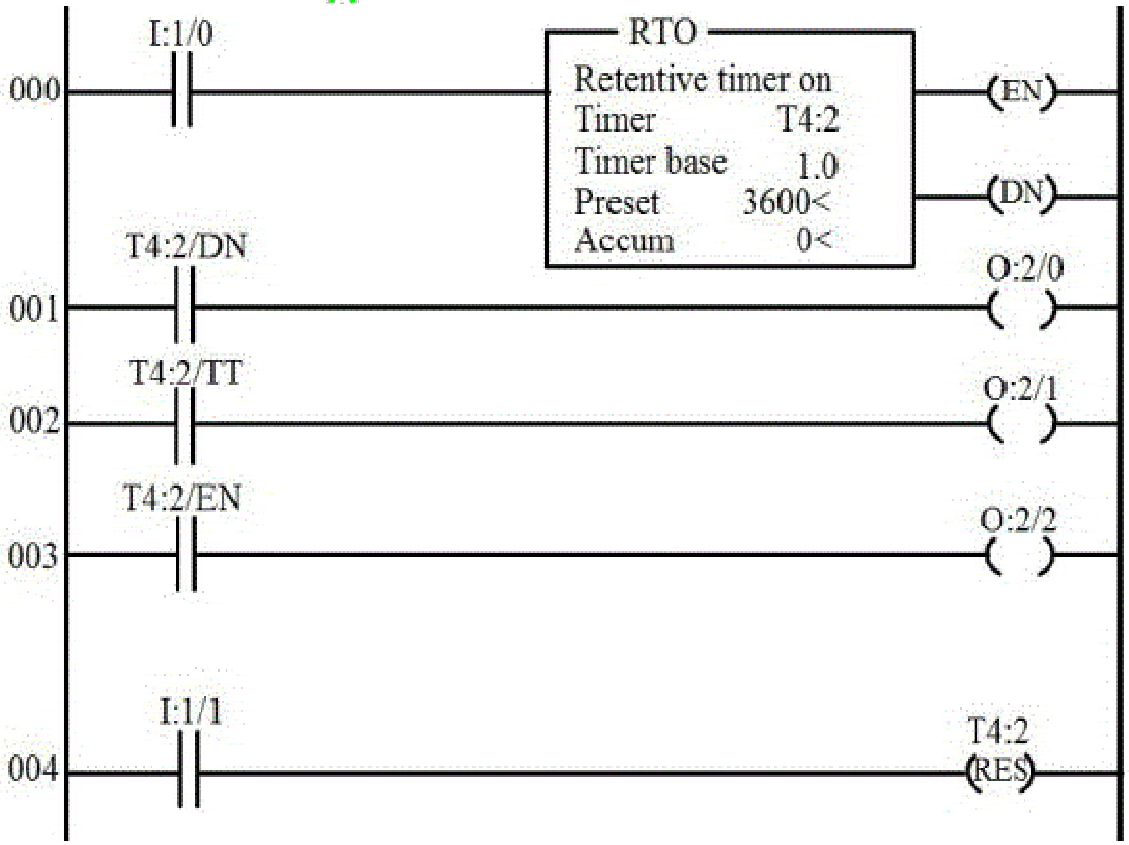

Here, T4:2 represents timer file 4, timer element 2, preset value is 3600, accumulated value is 0 and timer base is 1 second. The retentive timer on, RTO instruction, behaves similar to the timer-on delay instruction, with exception that when the RTO instruction goes false, it will retain its accumulated value.

The retentive timer will retain its accumulated value during the following conditions:

· When its rung goes false.

· When processor losses power. But, the battery for memory back up must be in good condition.

· When the processor faults.

· When the processor operating mode is changed from remote run or remote test to remote program mode.

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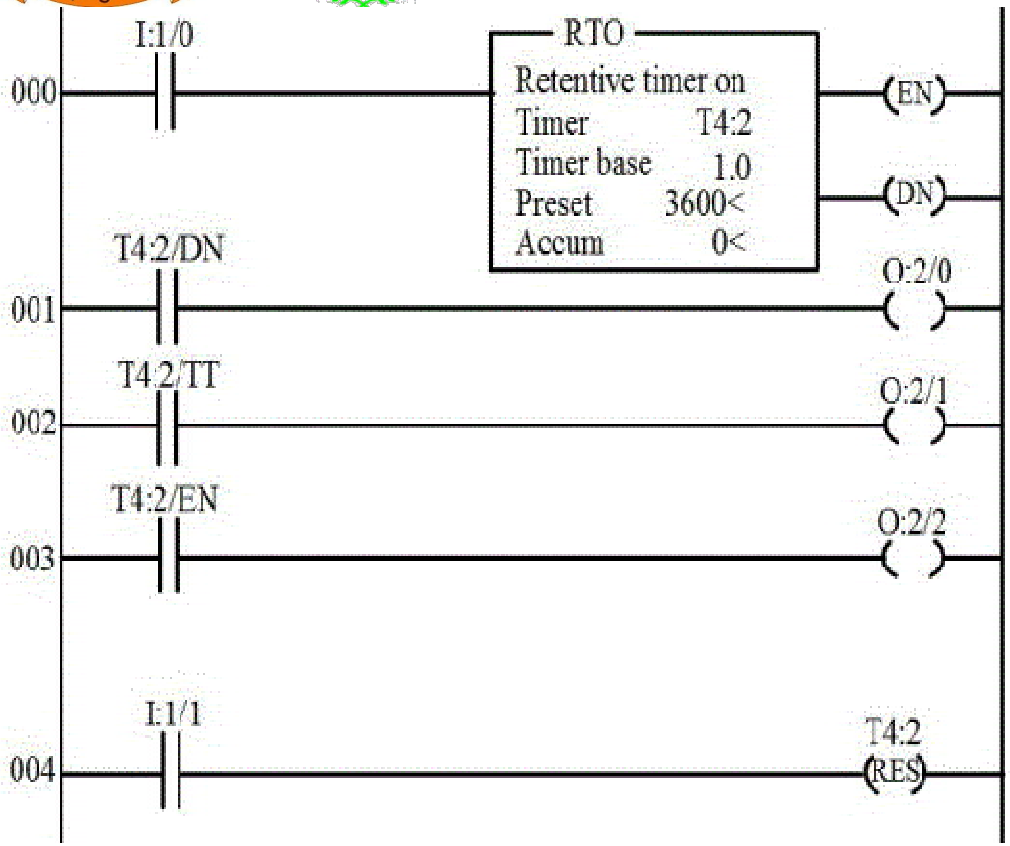

Timer timing bit (TT), bit 14, is on rung 002. This bit is set anytime the rung conditions are true and the timer times. The timer times whenever the rung is true and the accumulated value is less than the preset value. When the done bit is set, the timer timing bit resets. So in our example, the timer timing bit will be set or true, whenever input I:1/0 is true and as long as the accumulated value is less than the preset value of 3600 seconds. Output O:2/1 will be on or true when the timer is timing between 0 second and 3600 seconds. As the done bit is set and O:2/0 turns on, the timer timing bit goes false and O:2/1 turns off.

The reset instruction

In order to reset the accumulated value of retentive timer, a reset instruction is used. The address of the reset instruction must match the address of the timer that is to be reset. Only one address is allowed per reset instruction. In rung 004, I:1/1 instruction is used to reset the timer T4:2. This signal comes from a momentary normally open push button field device, Pressing this push button will reset the RTO's accumulated value back to 0.

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COUNTER

A PLC counter is a function block that counts up or down until it reaches a limit. When the limit is reached the output is set.

There are two types of counter i.e. Counter Up and Counter Down.

Up Counter - Up counter is an increment counter. which means it counts “up” with each off-to-on transition input to its “CU” input.

Down Counter - Up counter is an decrement counter. which means it counts “down” with each off-to-on transition input to its “CU” input.

The Counter is identifed as C5 i.e. identifier is C and file is 5.

There are 256 timers available in each file. Timers 0 through 255 are available

Each Counter instruction has useful status bits. These bits are counter enable (EN), counter done(DN).

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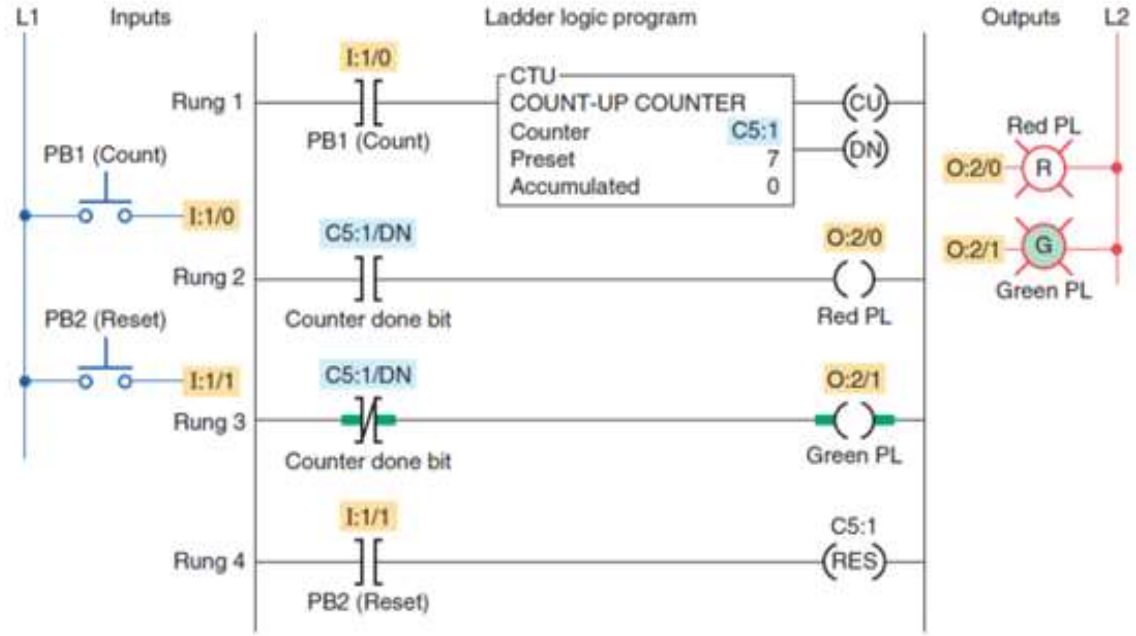
UP COUNTER



1. Operating pushbutton PB1 provides the off-to-on transition pulses that are counted by the counter.
2. The preset value of the counter is set to 7.
3. Each false-to-true transition of rung 1 increases the counter's accumulated value by 1.

4. After 7 pulses, or counts, when the preset counter value equals the accumulated counter value, output DN is energized.
5. As a result, rung 2 becomes true and energizes output O:2/0 to switch the red pilot light on.
6. At the same time, rung 3 becomes false and de-energizes output O:2/1 to switch the green pilot light off.
7. The counter is reset by closing pushbutton PB2, which makes rung 4 true and resets the accumulated count to zero.
8. Counting can resume when rung 4 goes false again.

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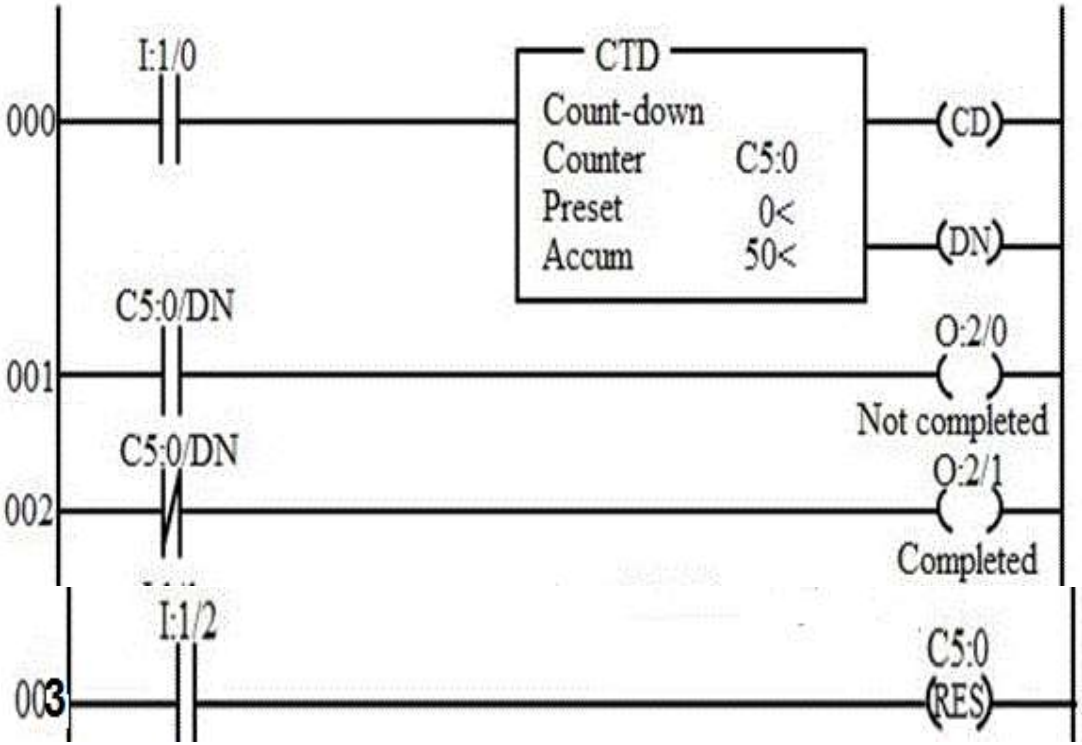
DOWN COUNTER



1. The Accumulated value of the counter is set to 50.
2. The preset value is 0. Each time input I:1/0 transitions from off to on, the accumulated value will be decremented by one decimal value. The done bit will true during the entire count from 50 to 0
3. In both rung 001 and 002 the done bit is used. In rung 001, done bit is used as normally open instruction.The output a lamp used to display the status of the process (not completed state).

3. As the done bit will be true during the entire count from 50 to 0, the logical continuity will be established in rung 000 during the entire count from 50 to 0 and not completed lamp (O:2/0) will be glowing. In rung 002, the done bit is used as normally closed instruction. The output a lamp used to display the status of the process (completed state). So when the accumulated value decreases and becomes equal to preset value (in this case 0), done bit of the counter is reset. So in rung 002, logical continuity is established and completed lamp (O:2/1) becomes energized. In other word our process completed status is displayed. Rung 004 is used to reset the counter


THANK YOU