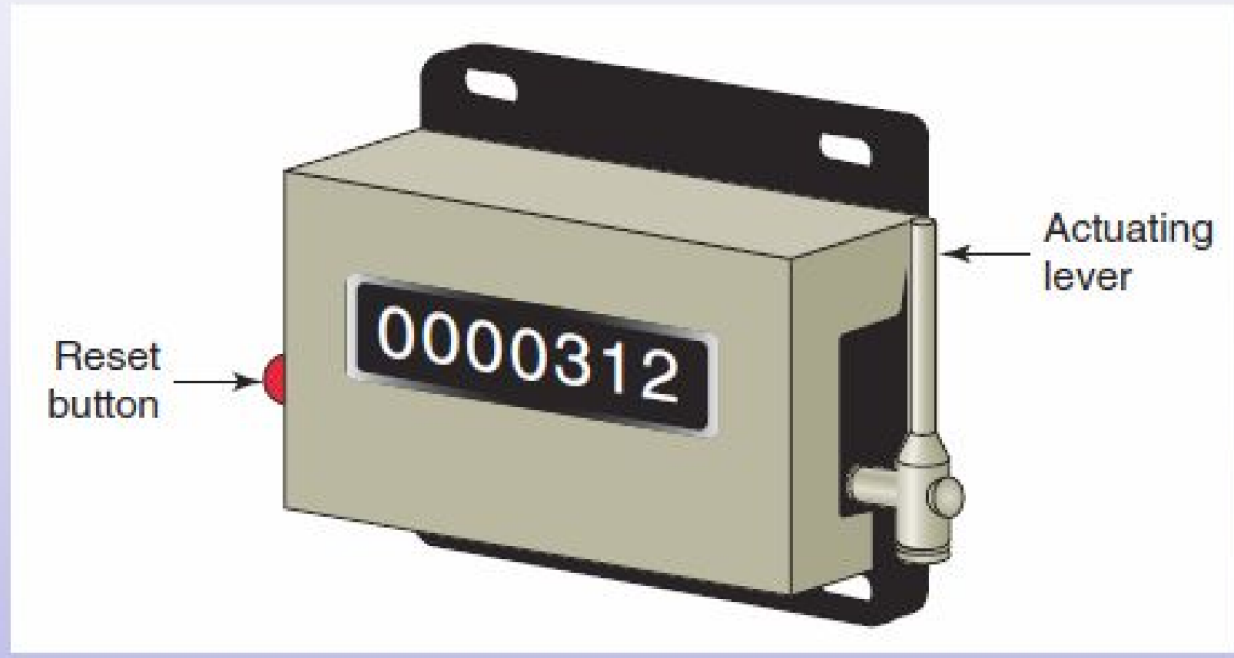
Chapter 8

Programming Counters

8.1

Counter Instructions

Programmed counters **serve the same function as** ***mechanical*** **counters.**



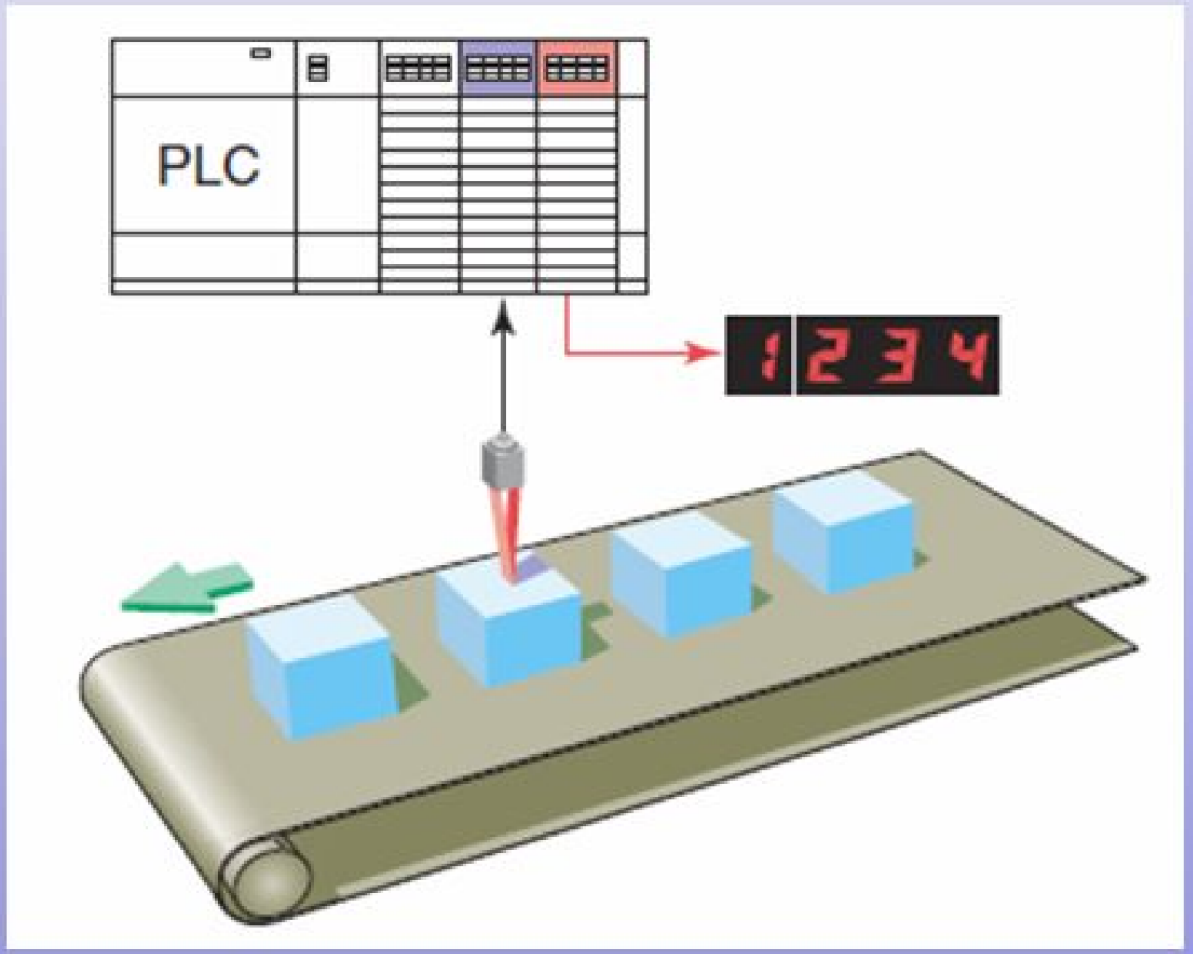
Every time the actuating lever is moved over, the counter adds one number.

Resetting to zero is done with a pushbutton located on the side of the unit.

Electronic counters **can count up, count down, or be combined to count up and down.**

Although the majority of counters used in industry are up-counters, numerous applications require the implementation of down-counters or of combination up/down-counters.

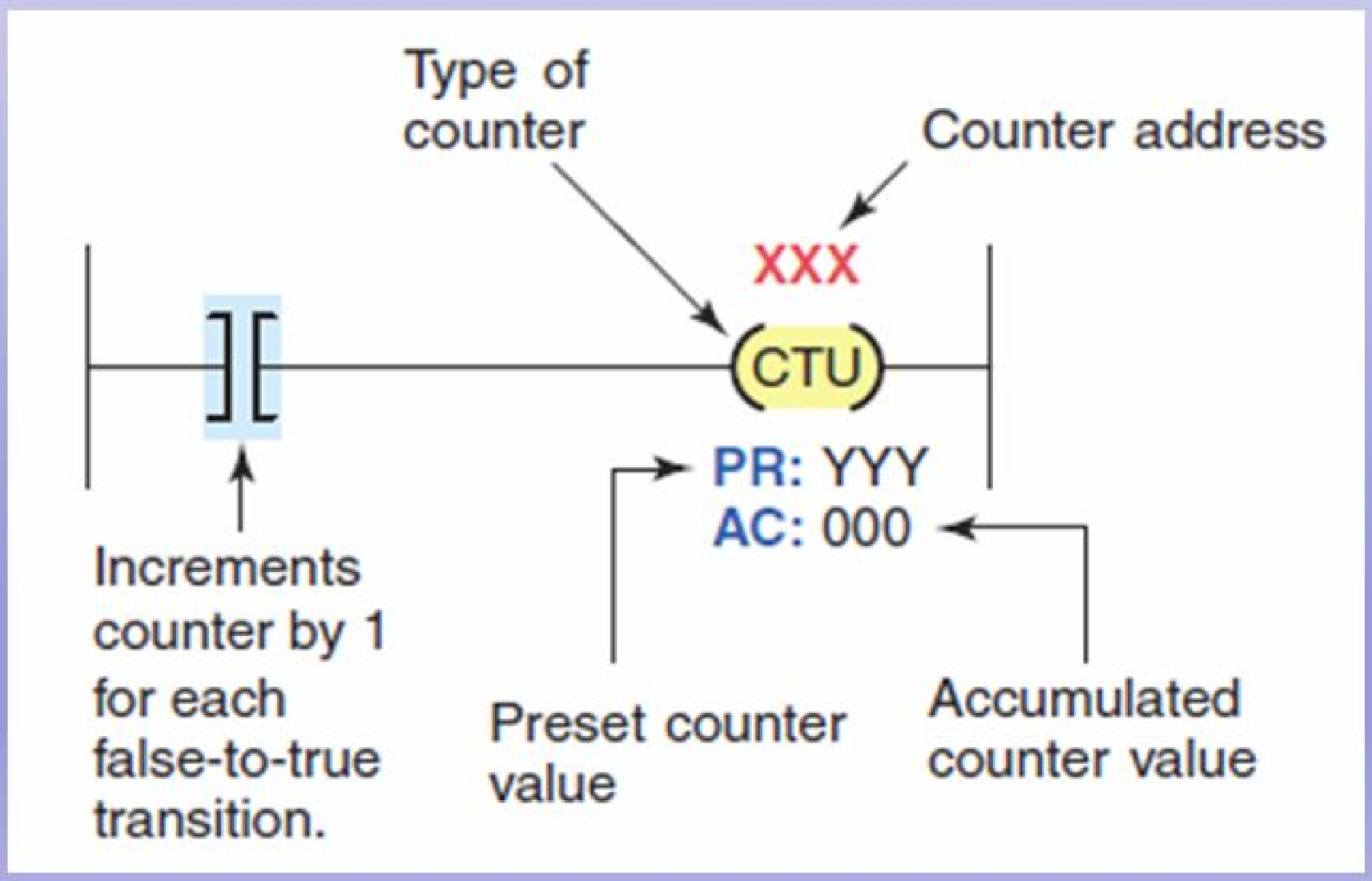
All PLC manufacturers offer some form of counter instruction.



One common counter application is keeping track of the number of items moving past a given point.

PLC counter instructions are *similar to timers* except that they do not operate on an internal clock but are dependent on *external or program sources* for counting

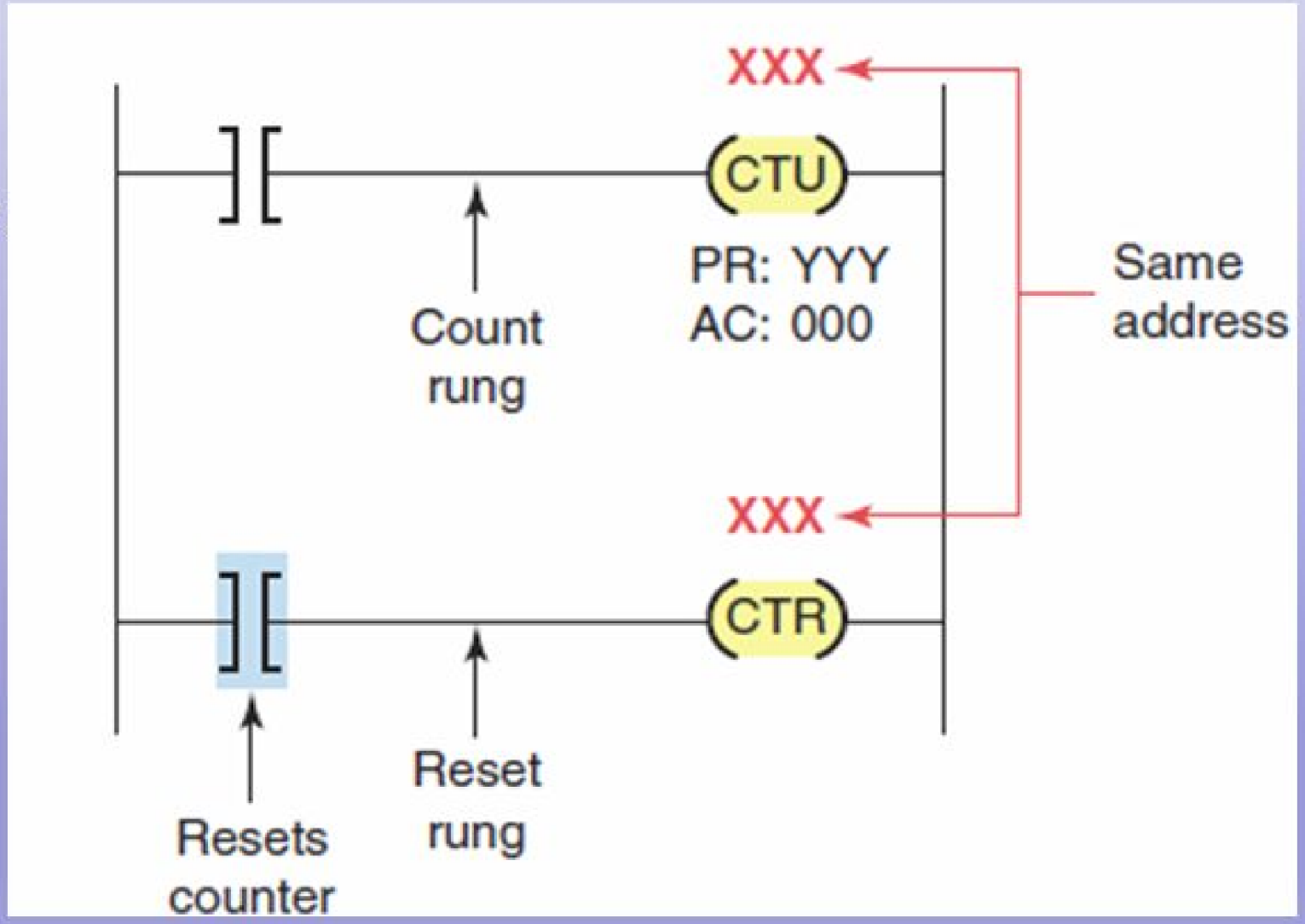
Generic **coil-formatted** up-counter instruction.



The *counter reset instruction* must be used in conjunction with the counter instruction.

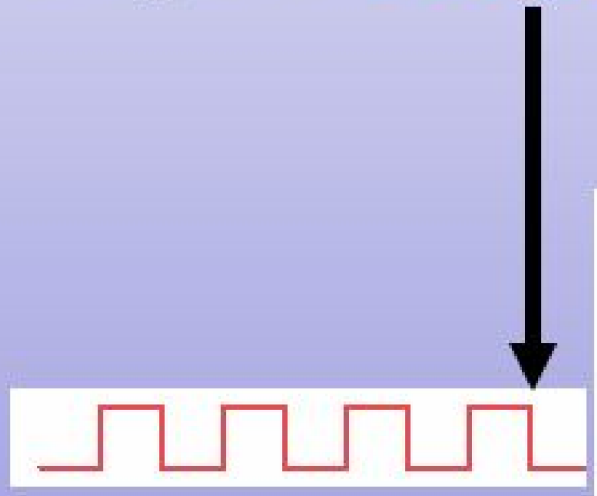
The counter reset coil is given the same address as the counter that it is to reset.

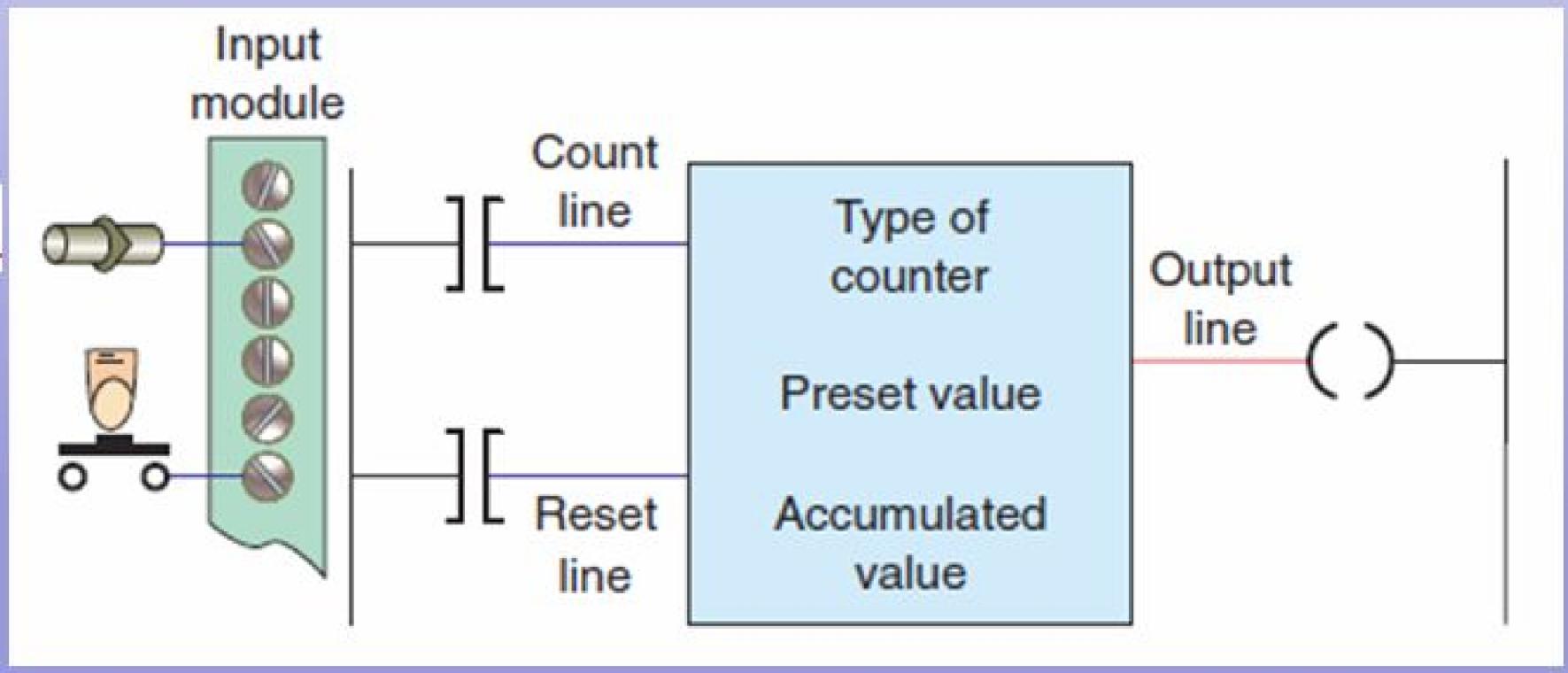
Up-counters are always reset to zero.



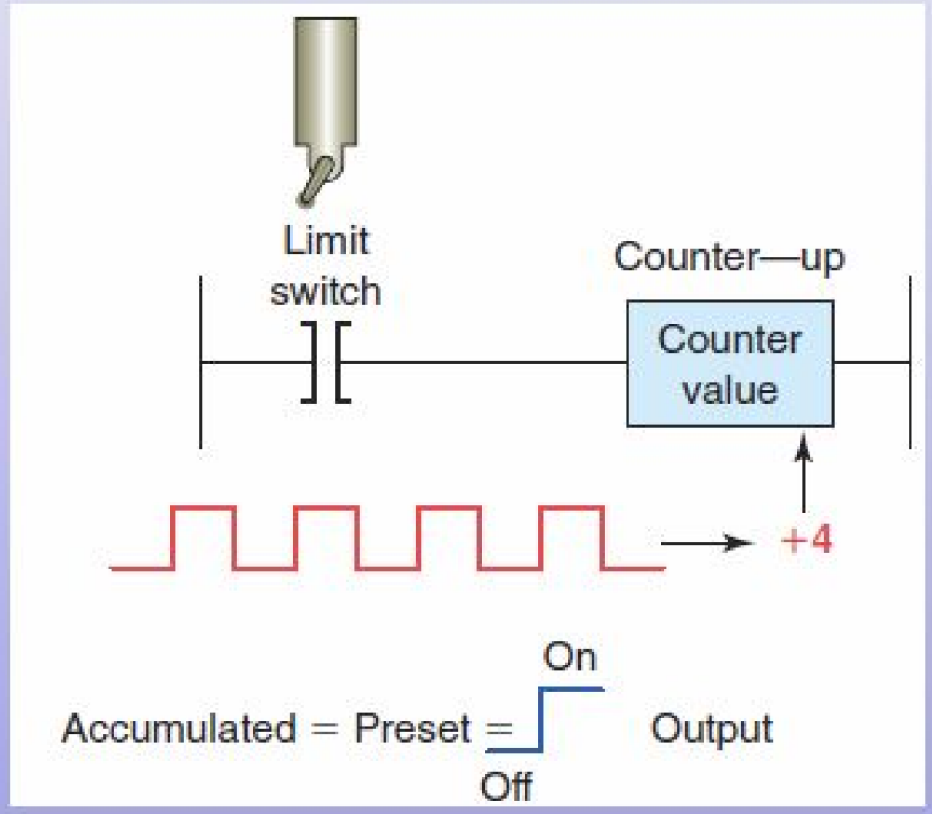
Generic *block-formatted* counter.

All PLC counters operate, or count, on the leading edge or off-to-on transition of the input condition.



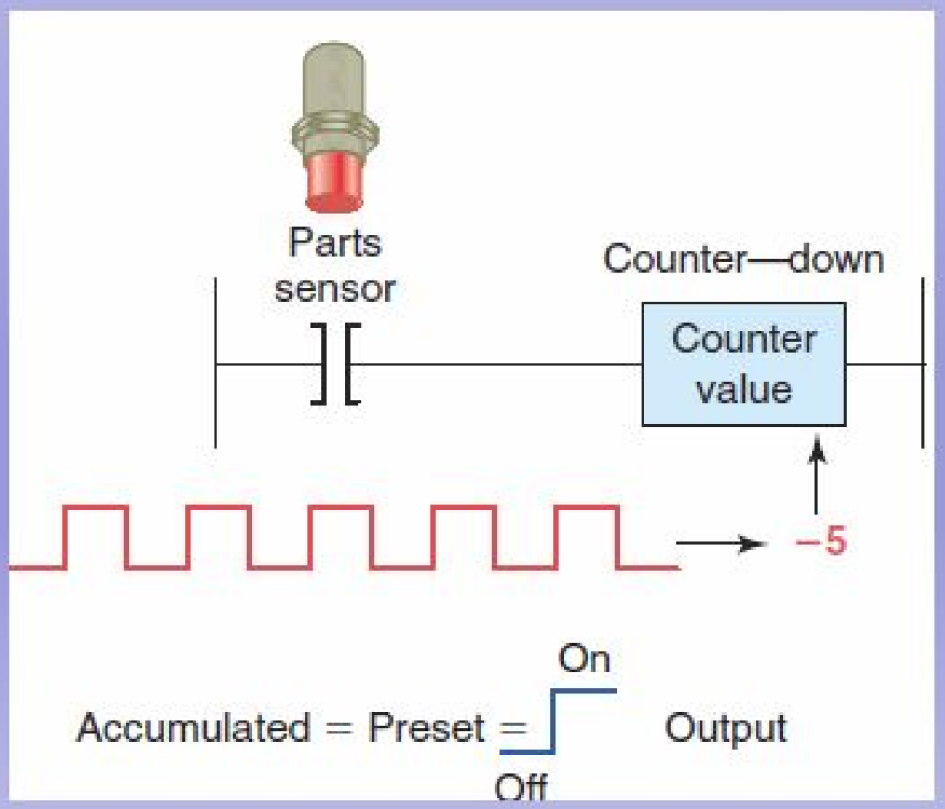


PLC counters can be programmed to *count up* to a preset value or to *count down* to a preset value.



The up-counter is incremented by 1 each time the rung containing the counter is energized.

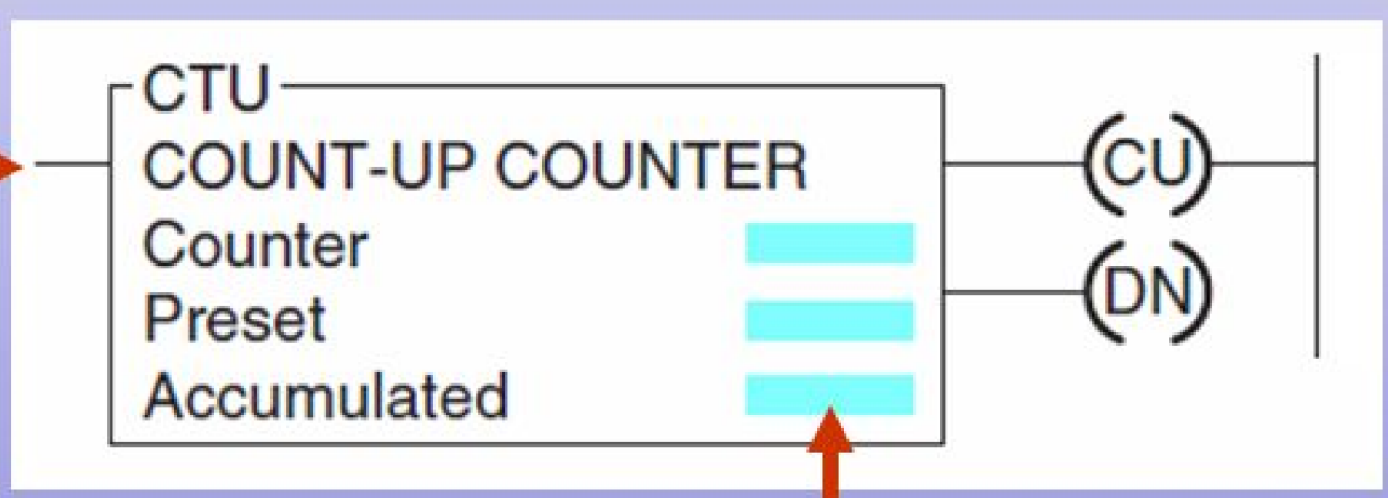
The down-counter decrements by 1 each time the rung containing the counter is energized.



8.2

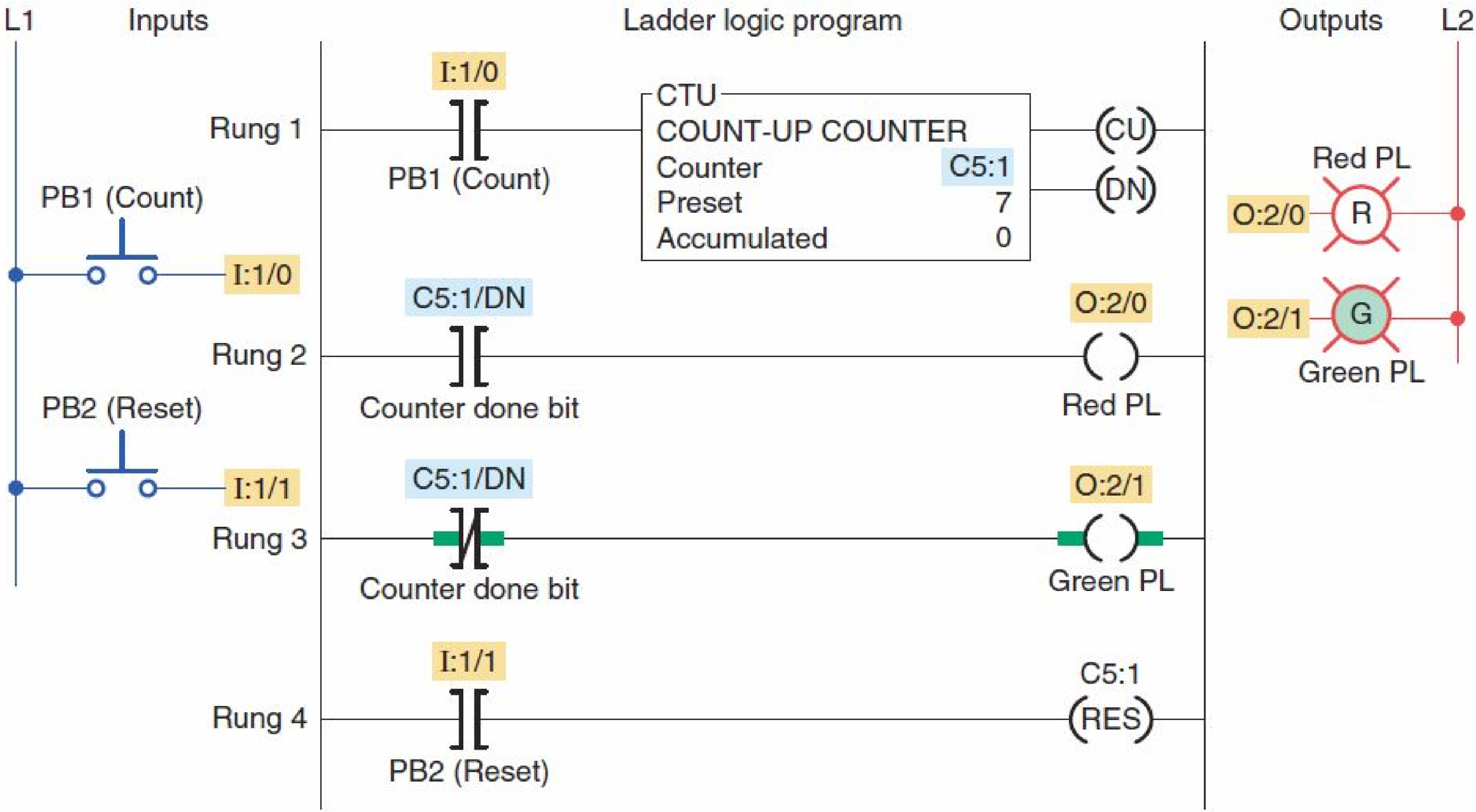
Up-Counter

The *up-counter* is used to *count false-to-true* transitions of an input instruction and then *trigger an event* after a required number of counts or transitions.

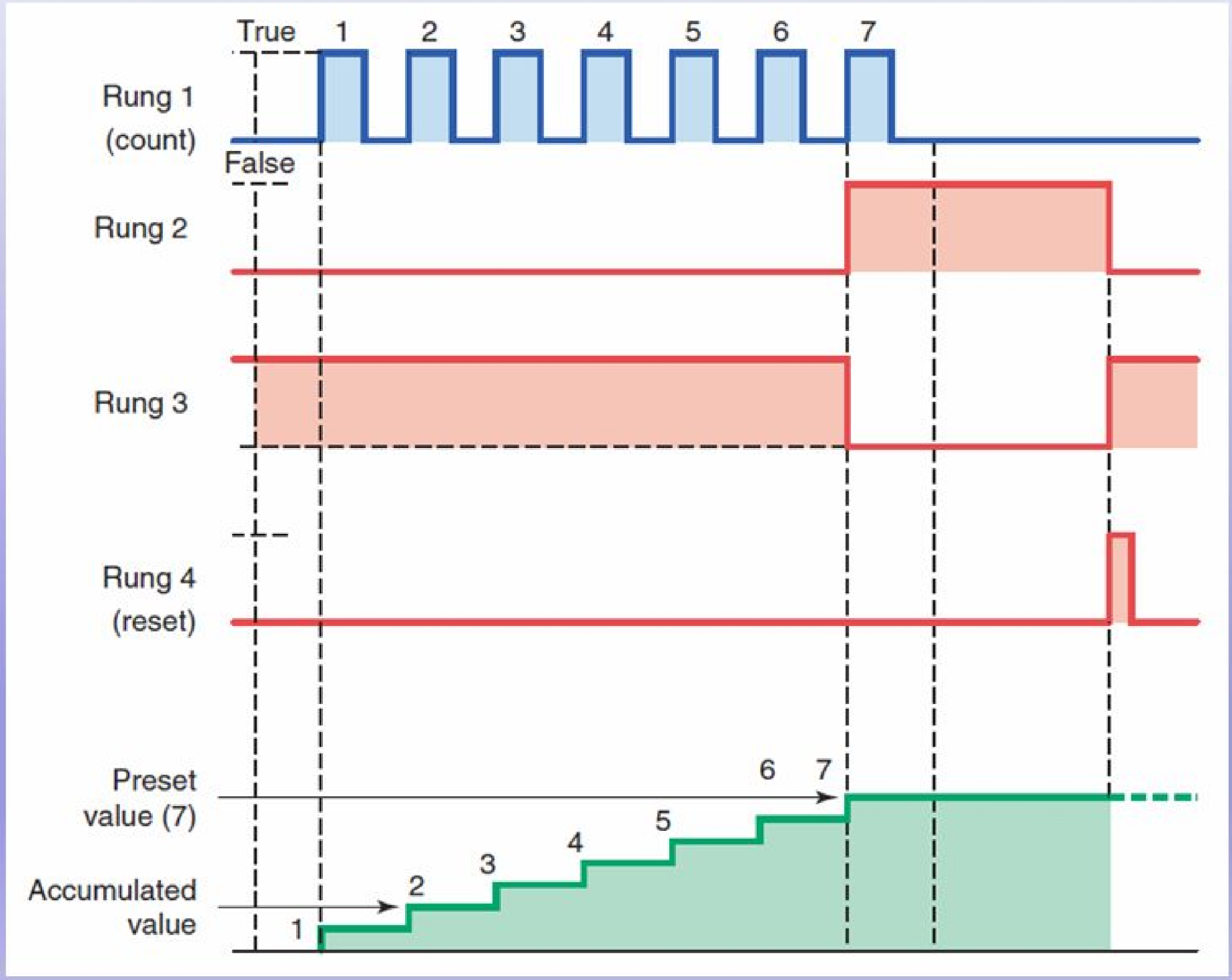


The up-counter output instruction will increment its accumulated value by 1 each time the counted event occurs.

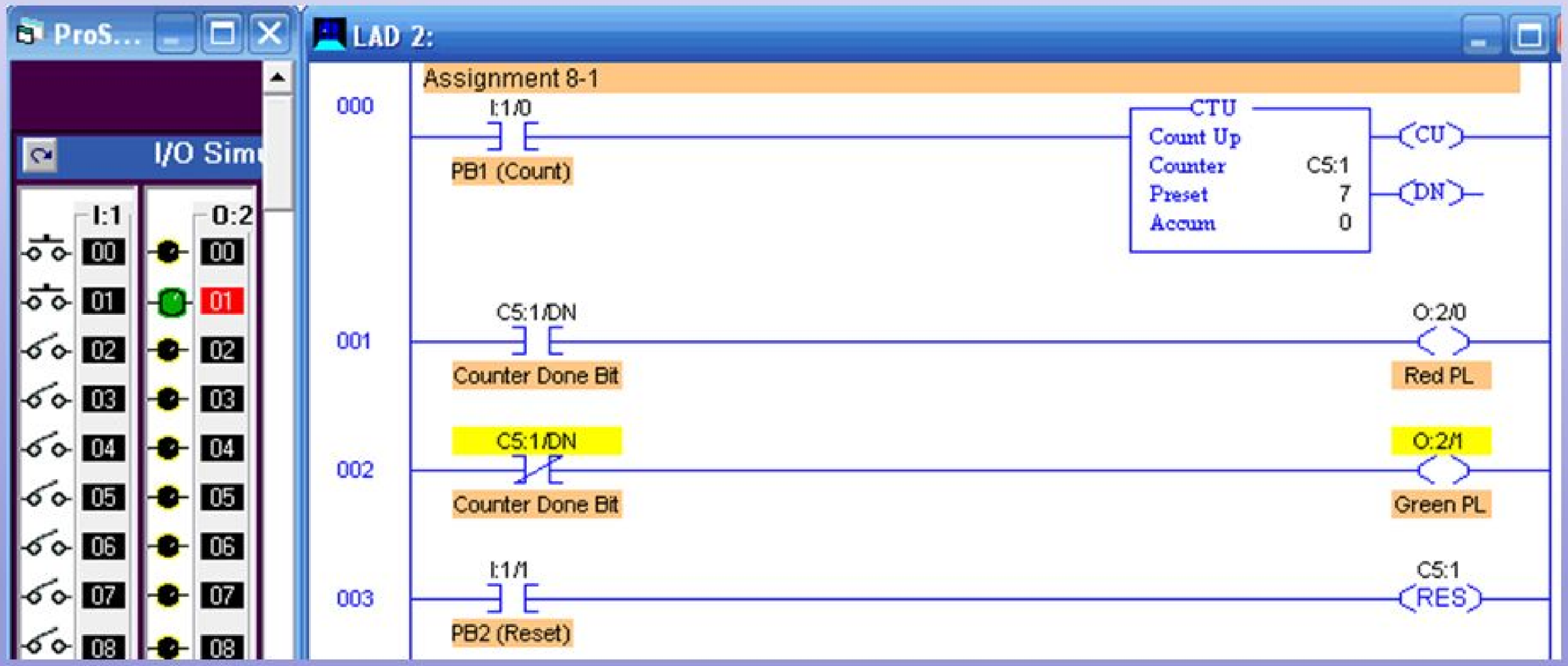
SLC 500 Up-Counter *program*



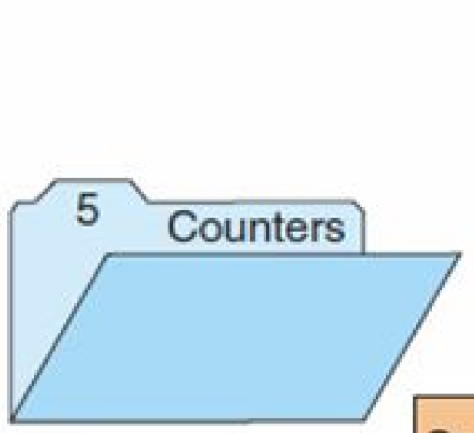
SLC 500 Up-Counter *timing diagram*



Simulated Up-Counter program



The Allen-Bradley SLC 500 counter file is *file 5.*



File type → C5:3 ← Counter number

File number → C5:3

Counter address																	
C5:3	Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
C5:3.0	Word 0	CU	CD	DN	OV	UN	UA	Internal use (not addressable)									
C5:3.1	Word 1	Preset value															
C5:3.2	Word 2	Accumulated value															

Counter Table

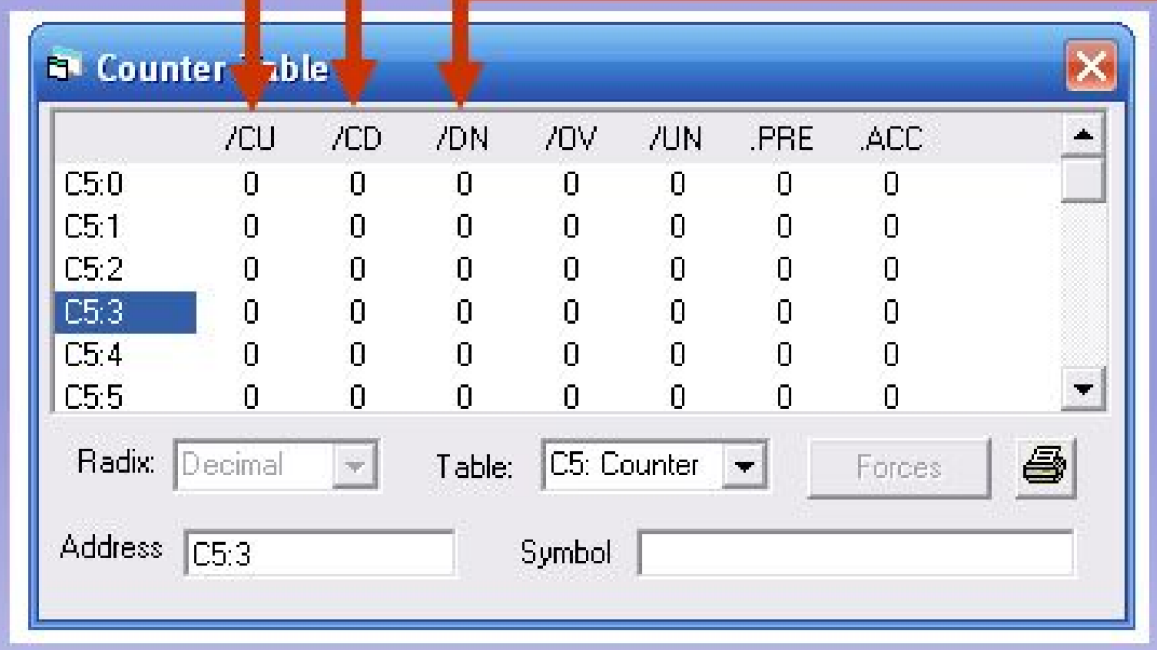
	/CU	/CD	/DN	/OV	/UN	/UA	.PRE	.ACC
C5:0	0	0	0	0	0	0	0	0
C5:1	0	0	0	0	0	0	0	0
C5:2	0	0	0	0	0	0	0	0
C5:3	0	0	0	0	0	0	50	0
C5:4	0	0	0	0	0	0	0	0
C5:5	0	0	0	0	0	0	0	0

Address C5:3 Table: C5: Counter

Count-Up (CU) enable bit - is true (1) whenever the count-up counter instruction is **true**.

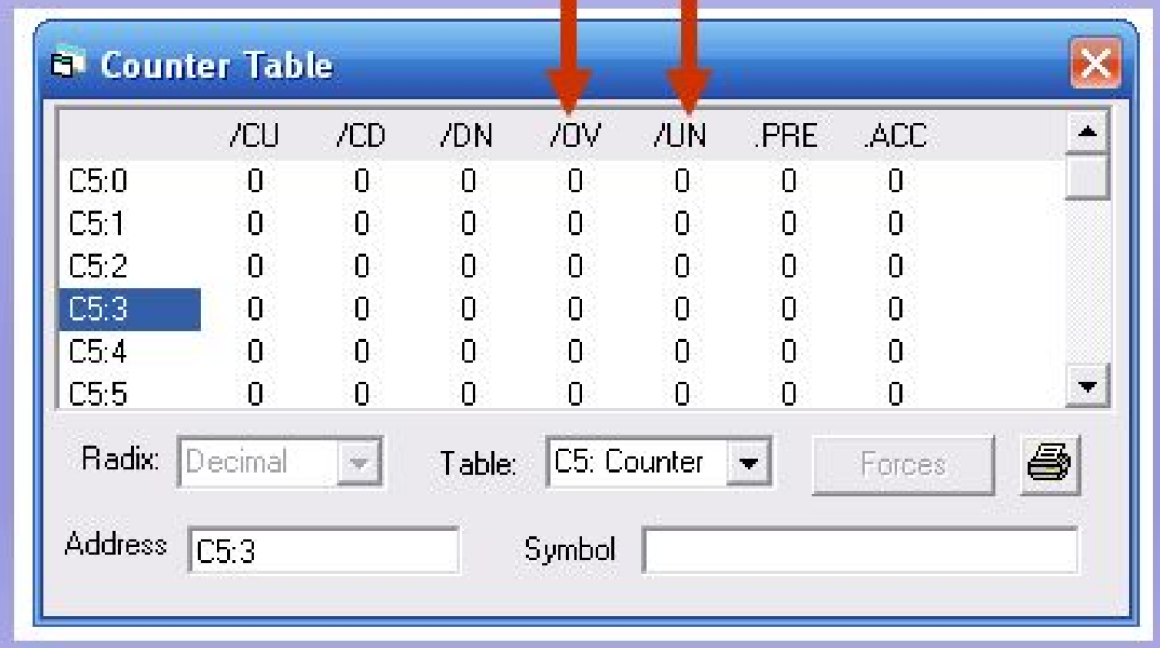
Count-Down (CD) enable bit - is true (1) whenever the count-down counter instruction is **true**.

Done (DN) bit - is true (1) whenever the **accumulated** value is **equal** to or **greater** than the preset value of the counter, for either the count-up or the count-down counter.



Overflow (OV) bit is - true (1) whenever the counter counts past its maximum value, 32,767. On the next count, the counter will wrap around to -32,768 and will continue counting to 0.

Underflow (UN) bit is - true when the counter counts below -32,768. The counter will wrap around to +132,767 and continue counting down toward 0.



Update Accumulator (UA) bit- is used in conjunction with an external high-speed counter.

The preset value (PRE) word - specifies the value that the counter must count to before it changes the state of the done bit.

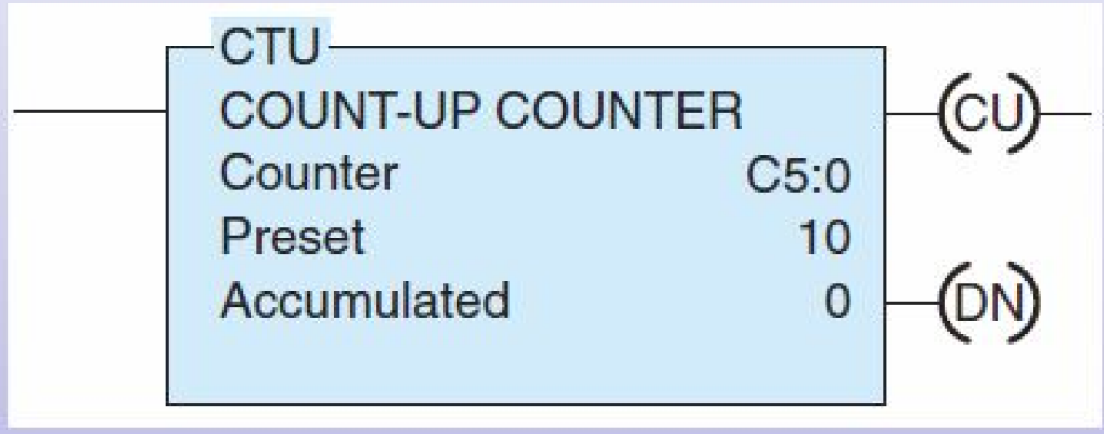
The accumulated value (ACC) word - is the current count based on the number of times the rung goes from false to true.

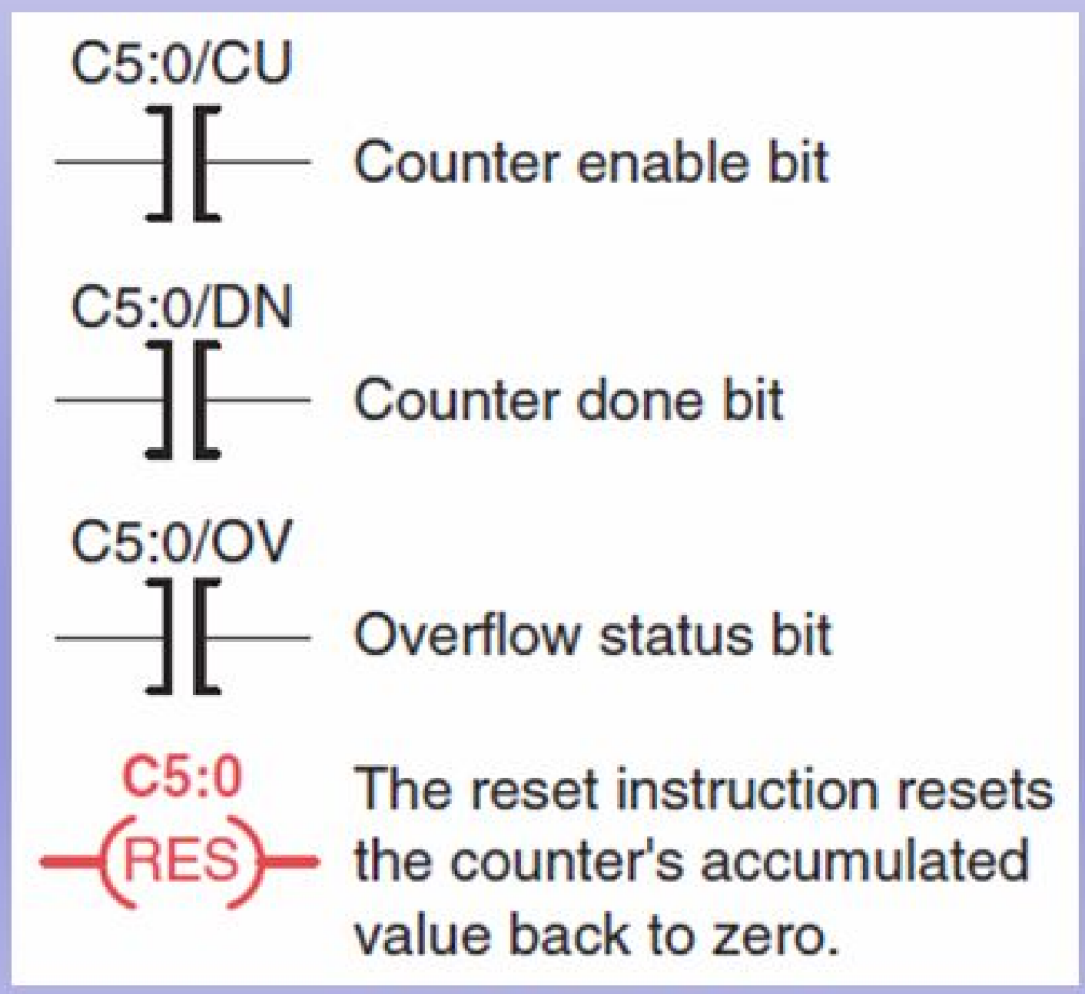
Counter Table

	/CU	/CD	/DN	/OV	/UN	/UA	.PRE	.ACC
C5:0	0	0	0	0	0	0	0	0
C5:1	0	0	0	0	0	0	0	0
C5:2	0	0	0	0	0	0	0	0
C5:3	0	0	0	0	0	0	50	0
C5:4	0	0	0	0	0	0	0	0
C5:5	0	0	0	0	0	0	0	0

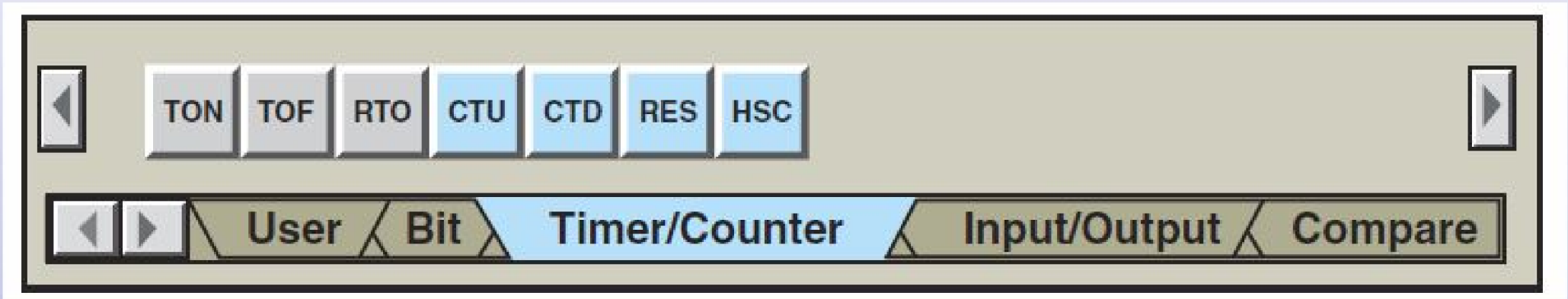
Address C5:3 Table: C5: Counter

SLC 500 up-counter instruction.





Timer/counter menu from the RSLogix toolbar.

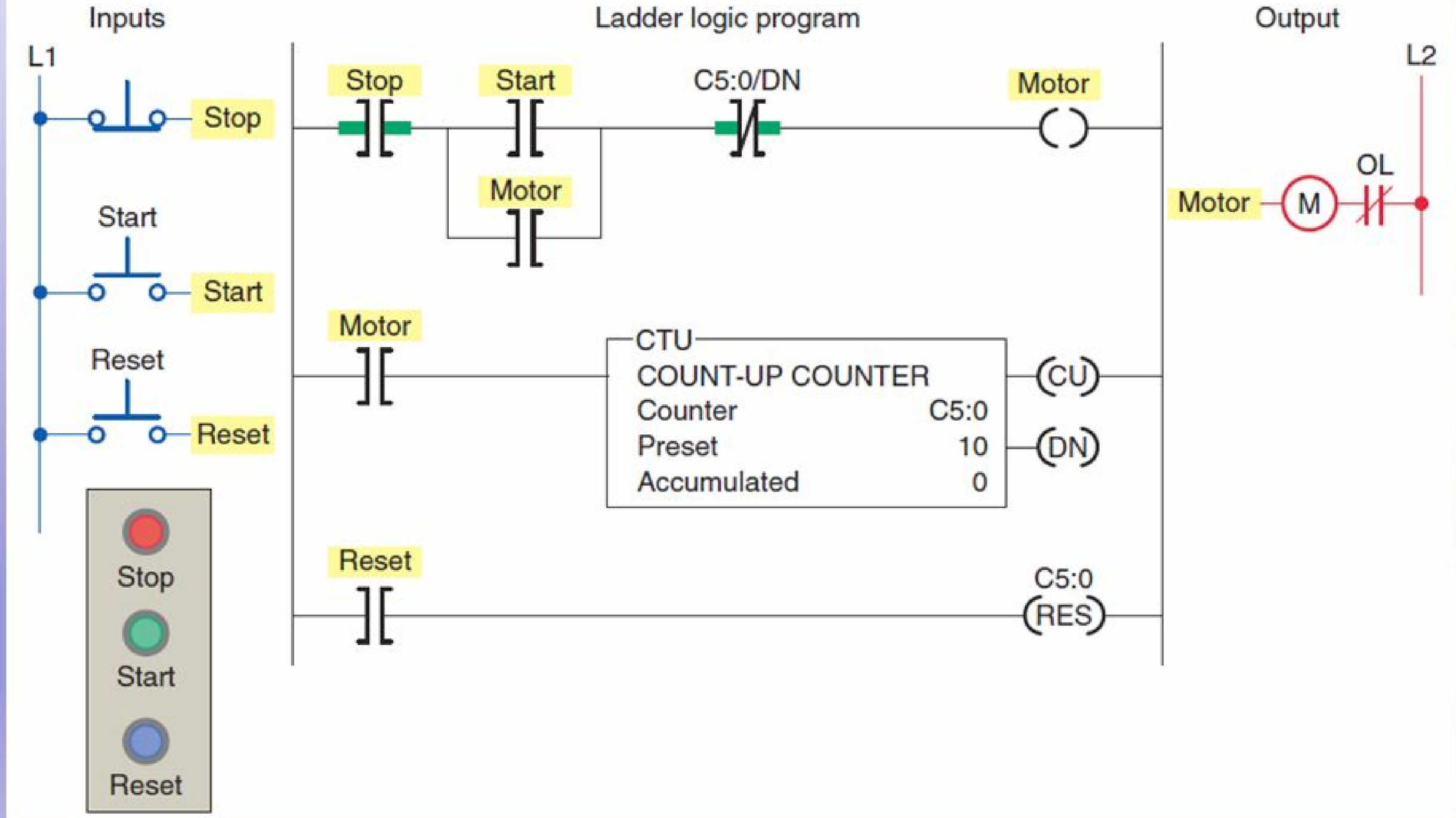


CTU (Count-Up) Increments the accumulated value at each false-to-true transition and retains the accumulated value when an off/on power cycle occurs.

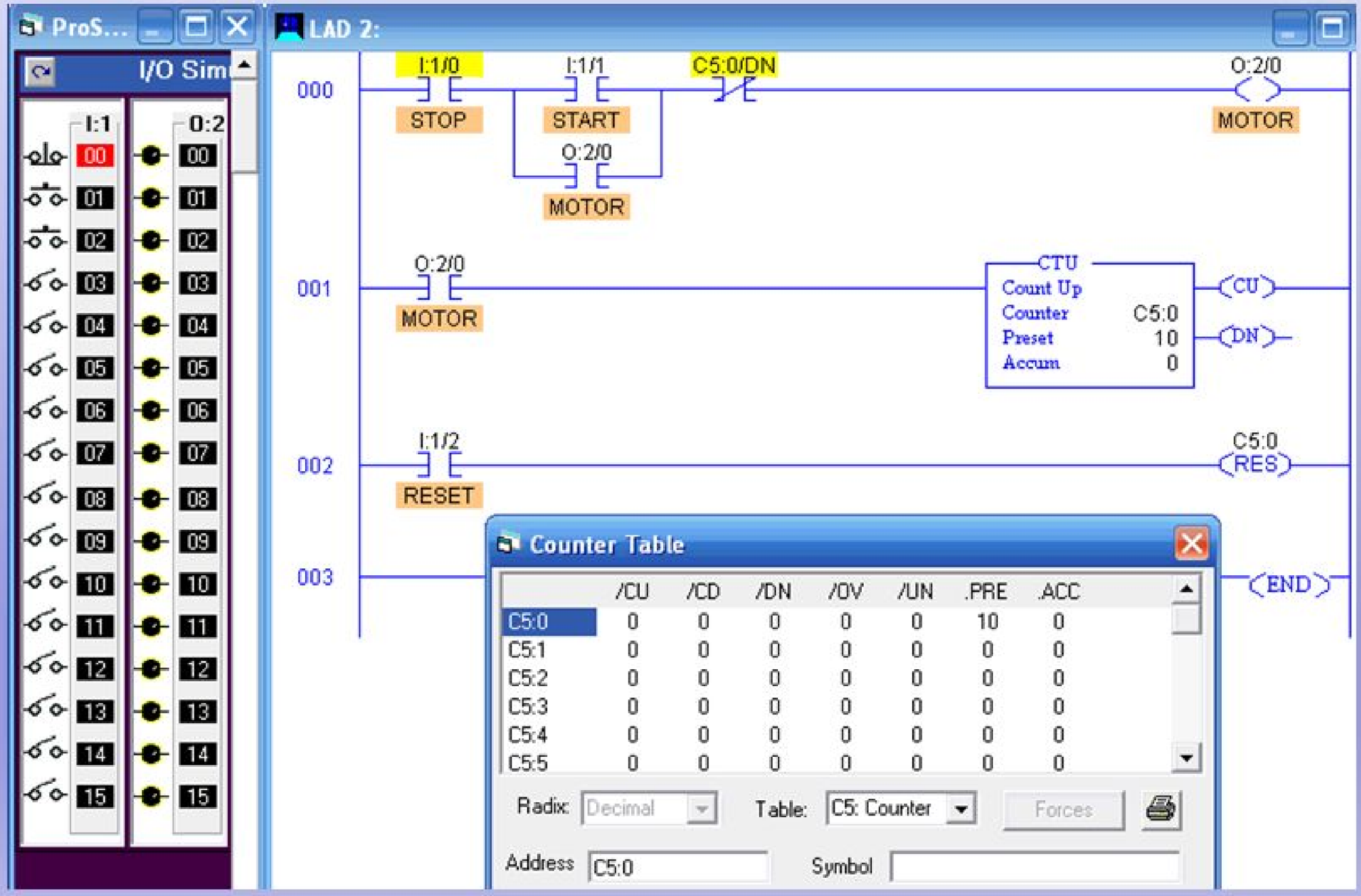
CTD (Count-Down) Decrements the accumulated value at each false-to-true transition and retains the accumulated value when an on/off power cycle occurs.

HSC (High-Speed Counter) Counts high-speed pulses from a high-speed input.

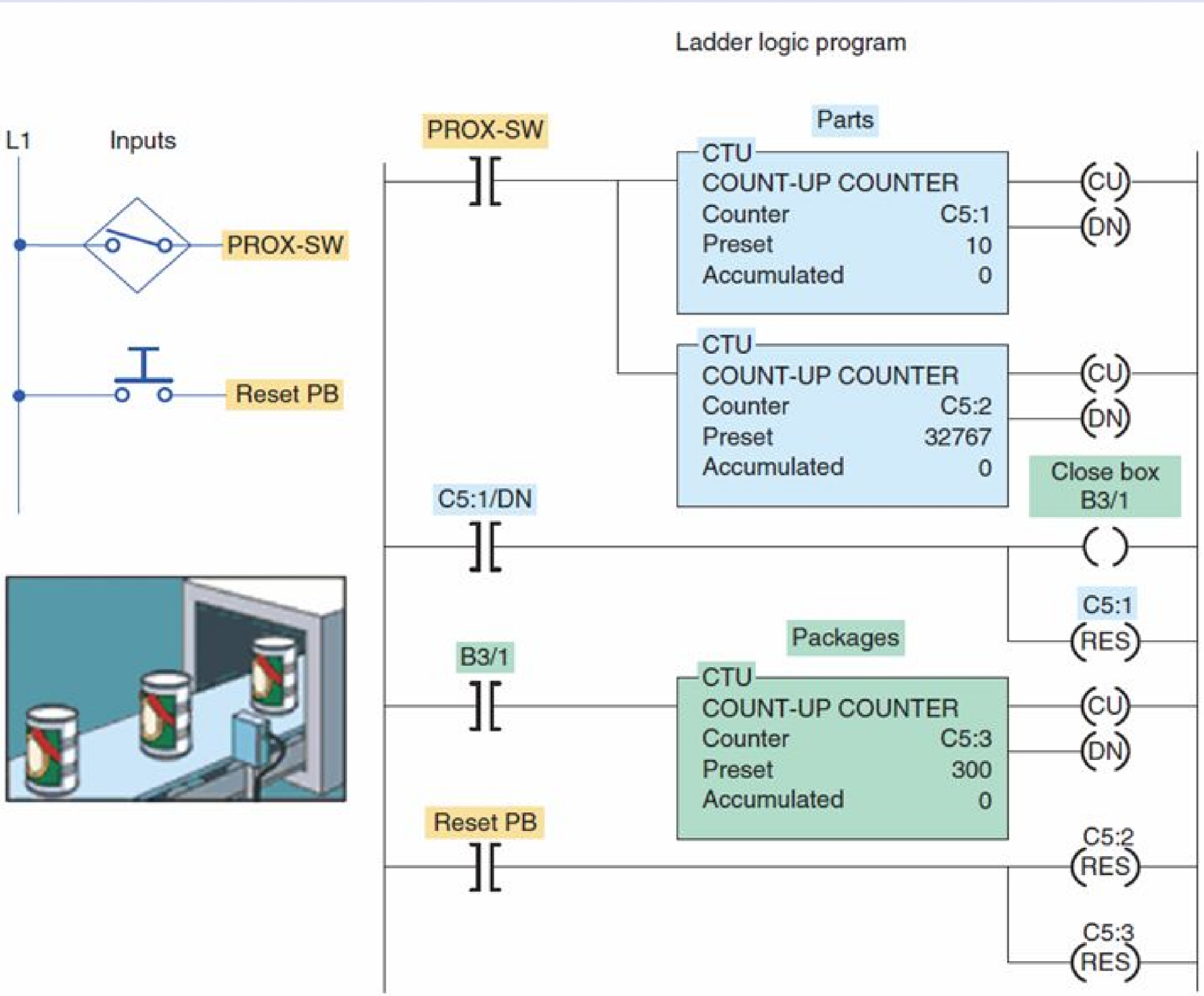
PLC *counter program* used to stop a motor from running after 10 operations.



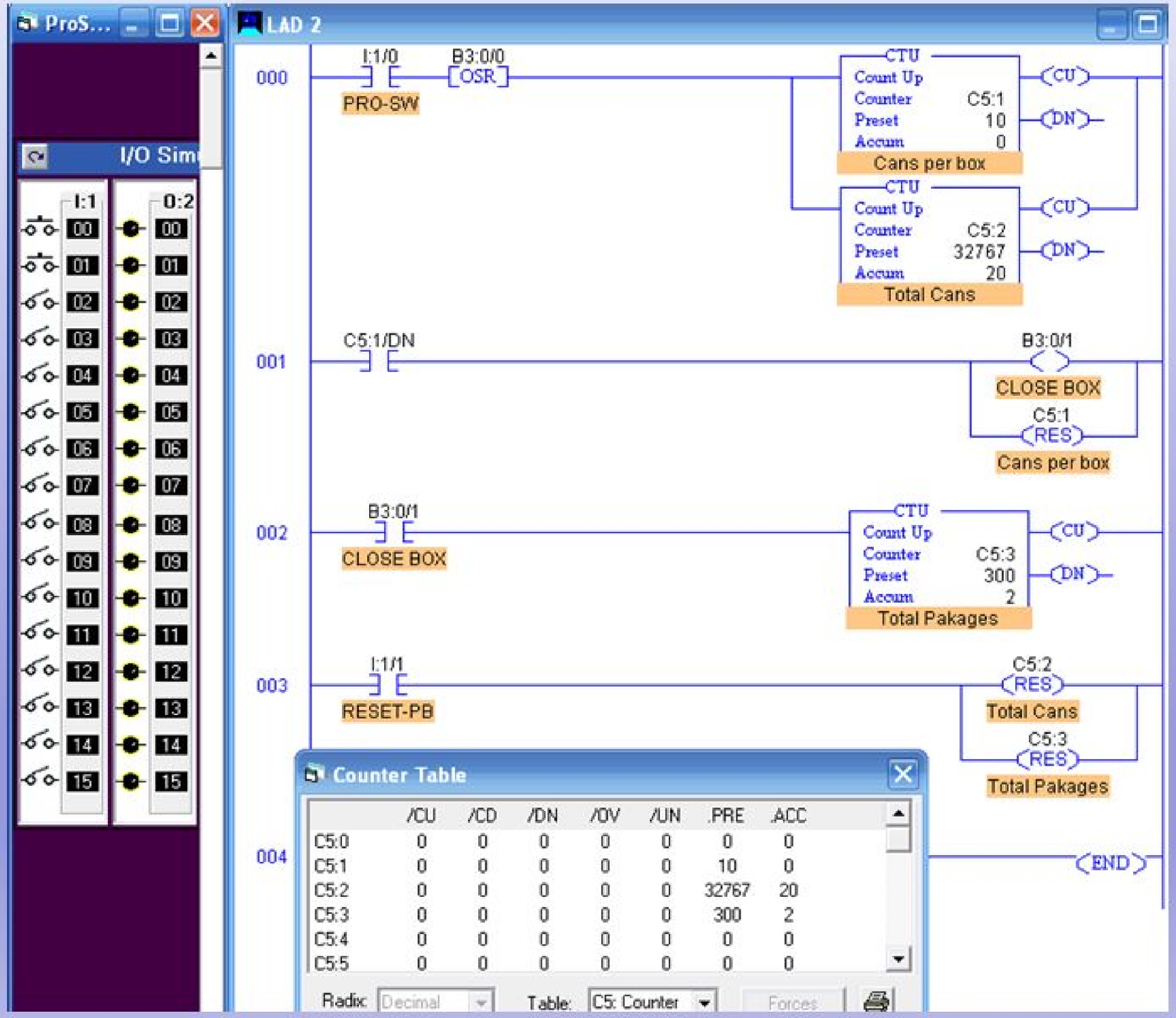
Simulated counter program used to stop a motor from running after 10 operations.



Can-counting program that uses three up-counters.

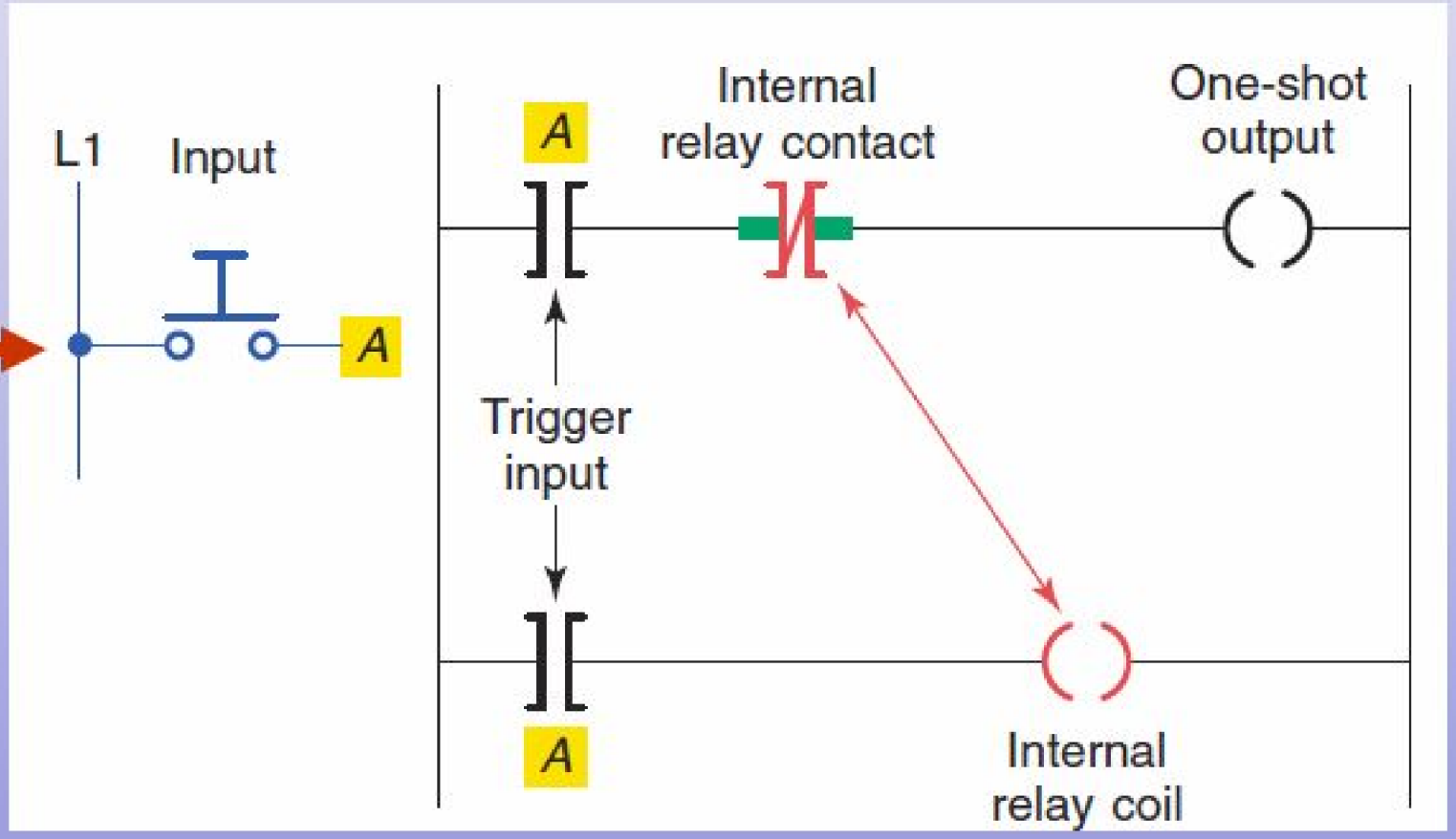


Simulated can-counting program.



A *one-shot*, or *transitional*, contact is often used to automatically clear or reset a counter.

The one-shot can be triggered from a momentary signal or from a signal that comes on and stays on for some time.

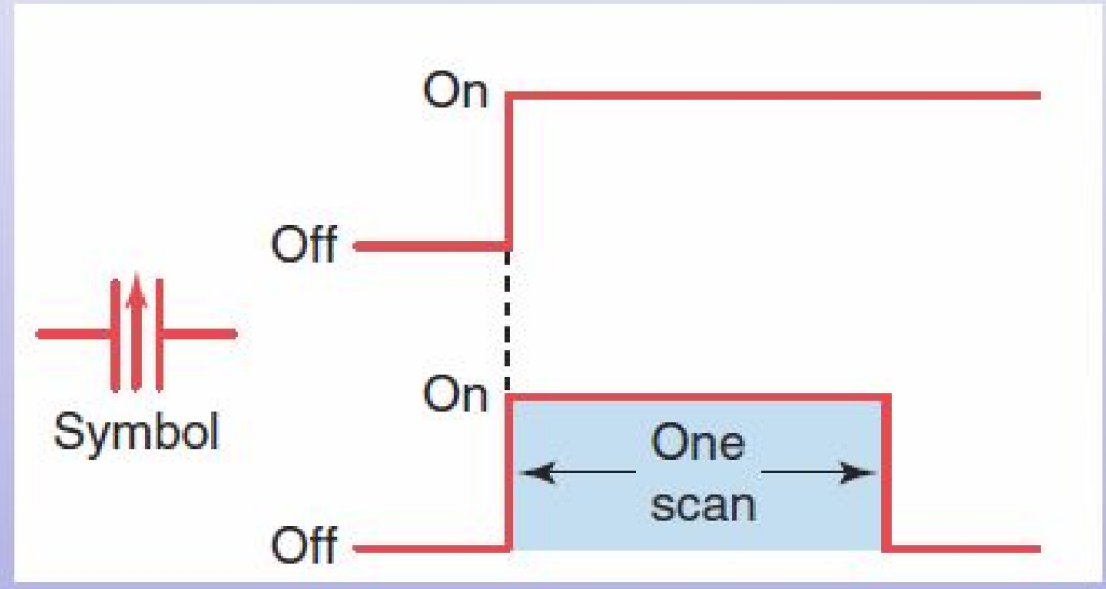


It stays on for one scan only and then goes off.

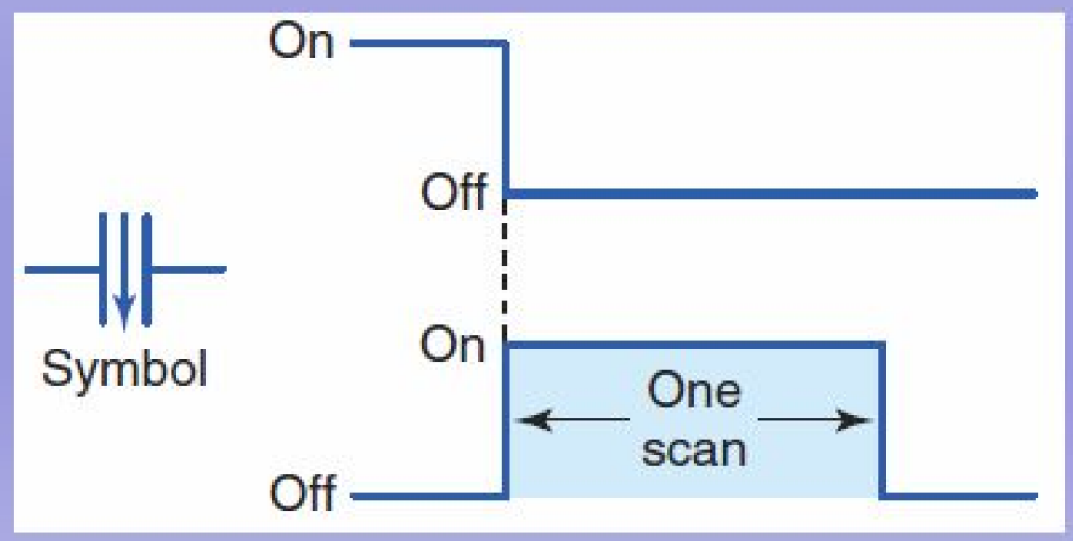
It stays off until the trigger goes off, and then comes on again.

Some PLCs provide *transitional contacts* or one-shot instructions.

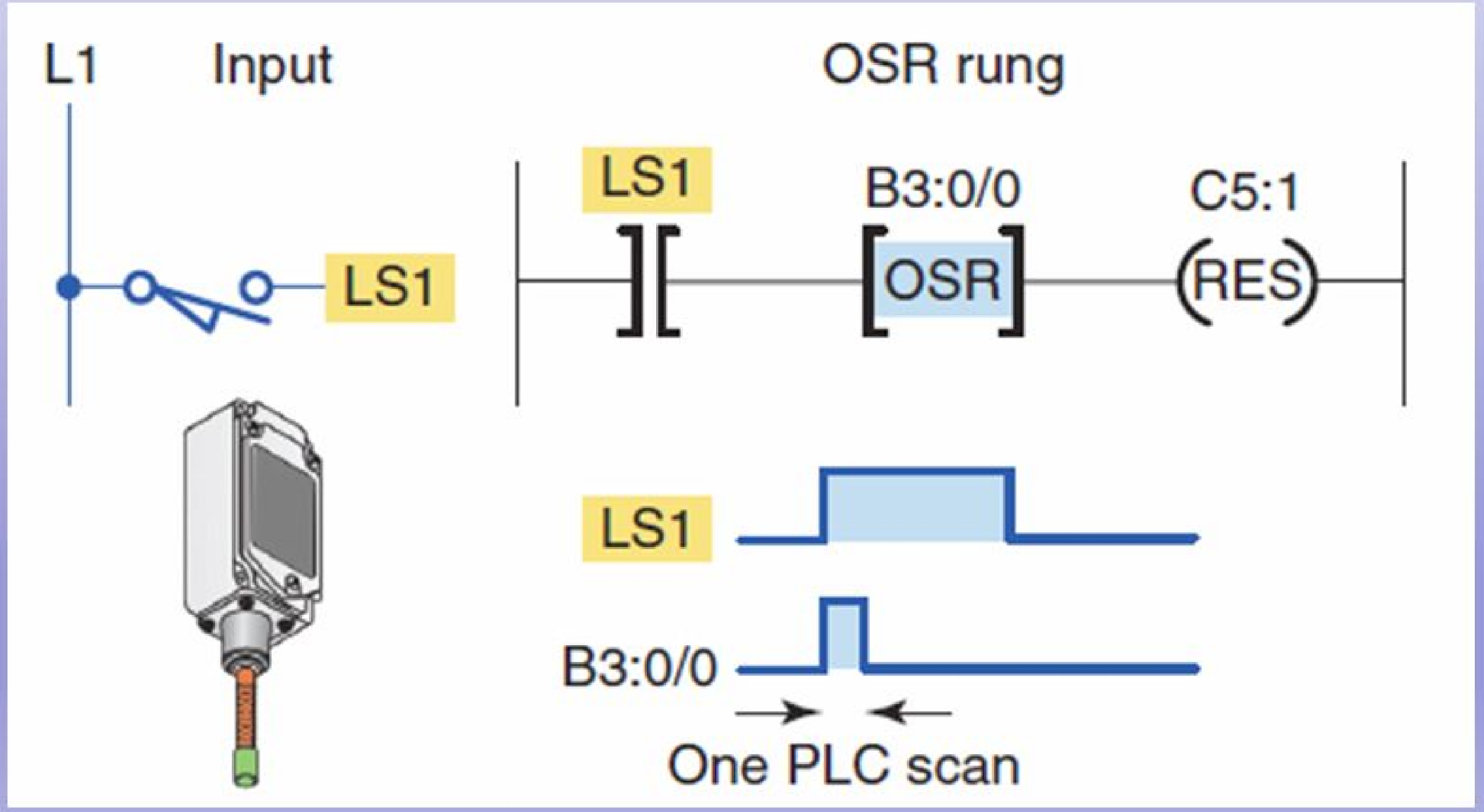
The off-to-on transitional contact provides a one-shot pulse when the trigger signal makes a off-to-on transition.



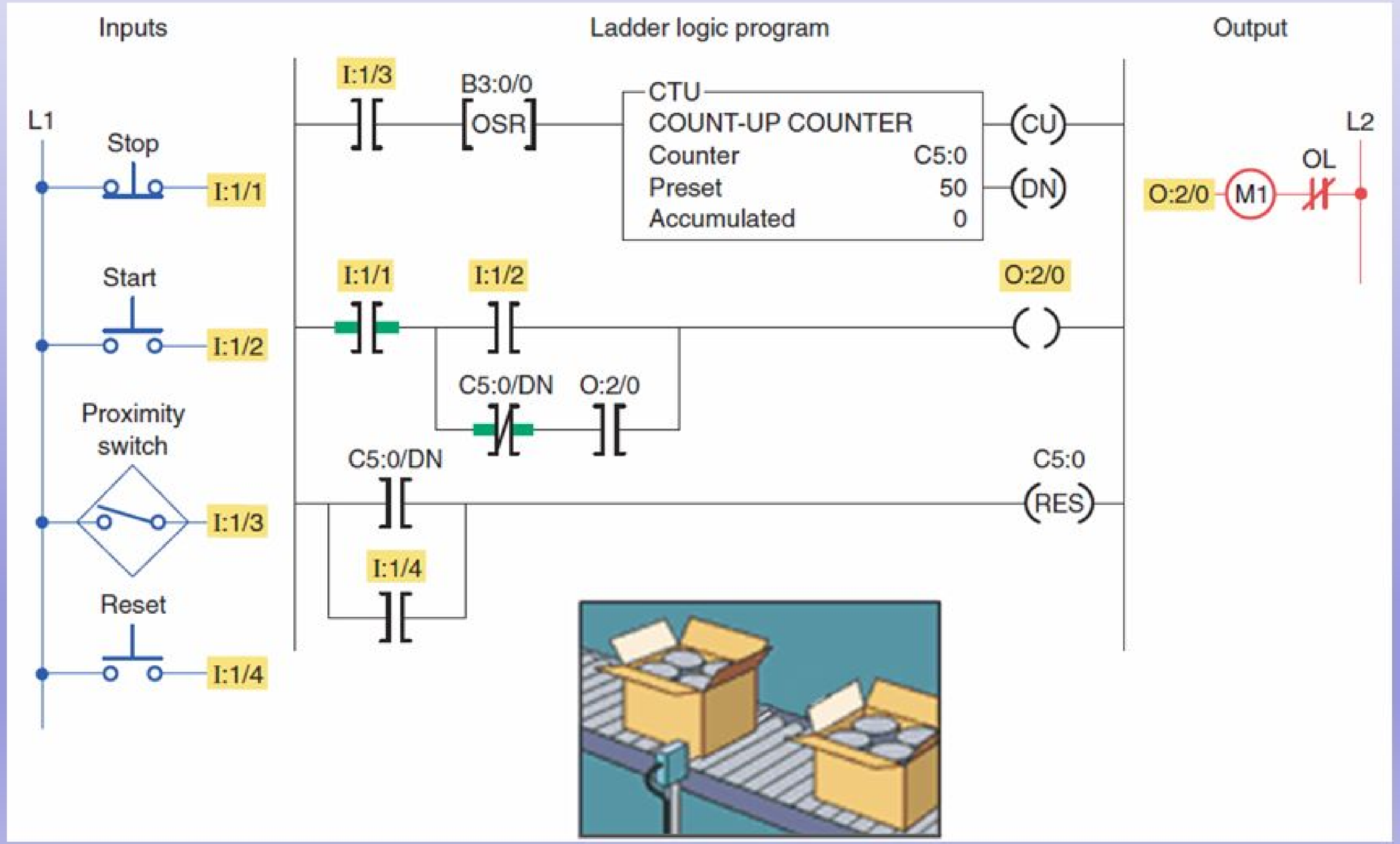
The on-to-off transitional contact provides a one-shot pulse when the trigger signal makes a on-to-off transition.



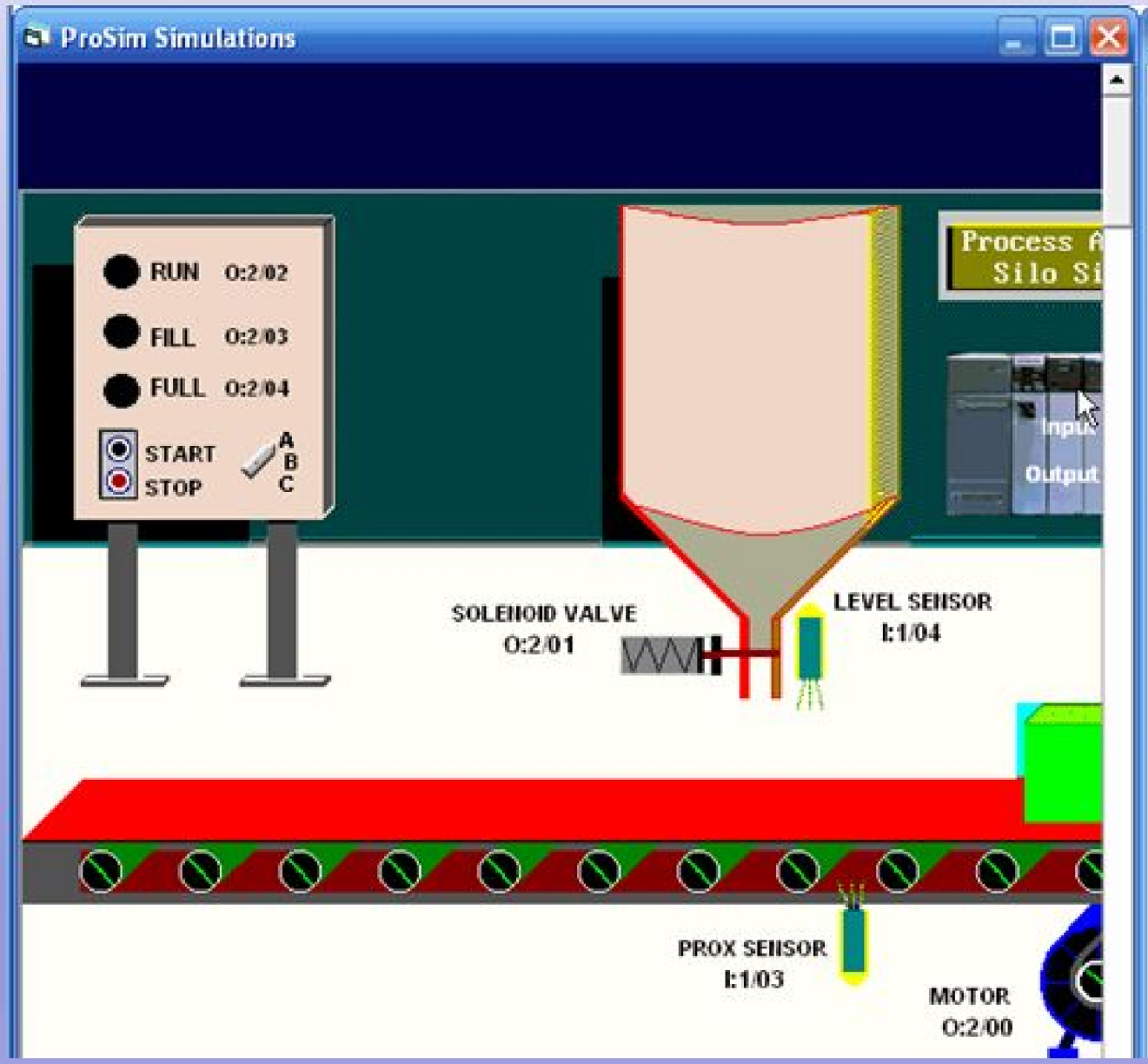
The Allen-Bradley SLC 500 one-shot rising *(OSR)* instruction is an input instruction that triggers an event to occur one time.

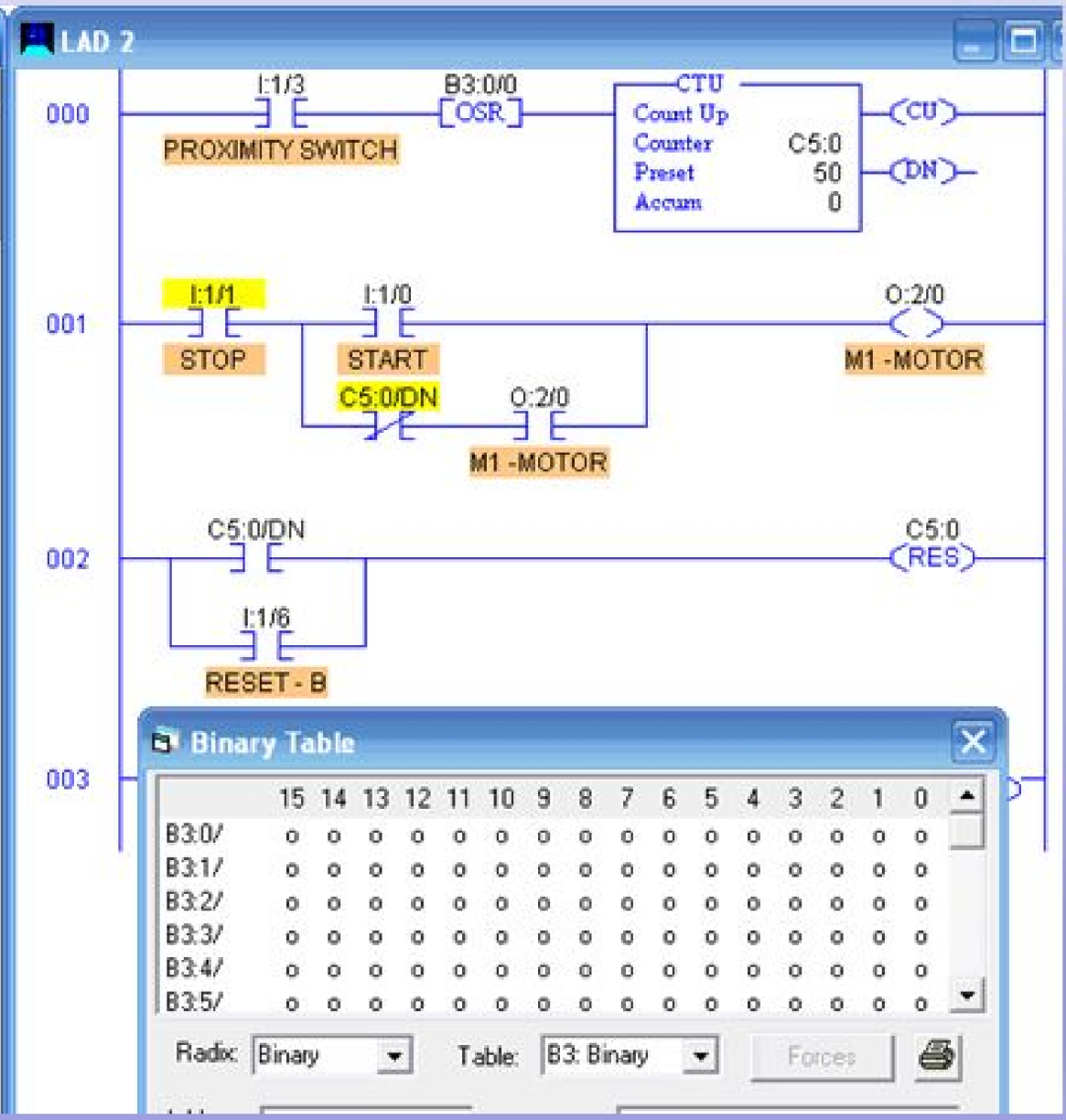


Up-counter with a programmed *one-shot rising (OSR)* off-to-on transitional contact instruction.

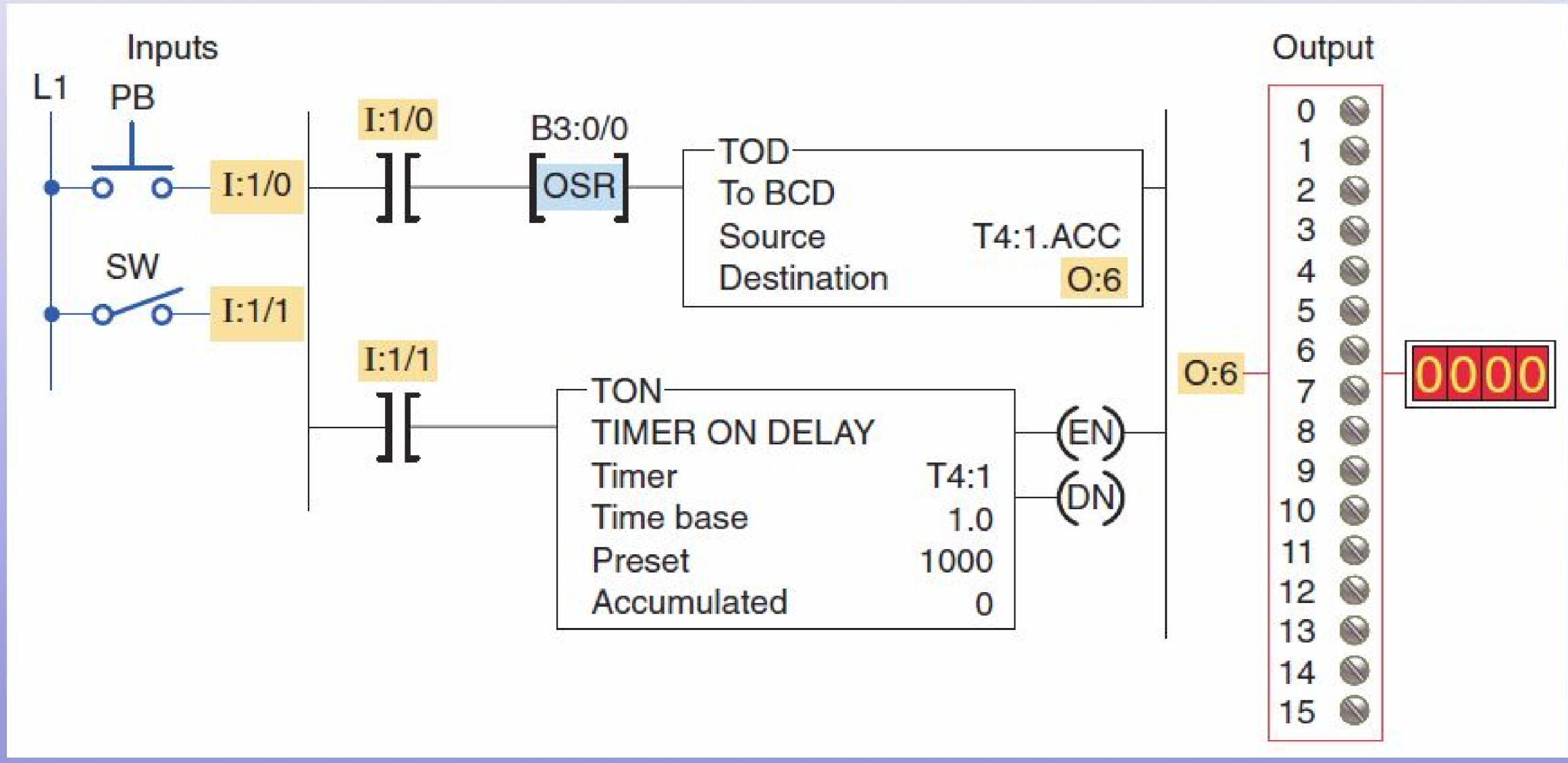


Simulated up-counter with a programmed one-shot rising (OSR) contact instruction.



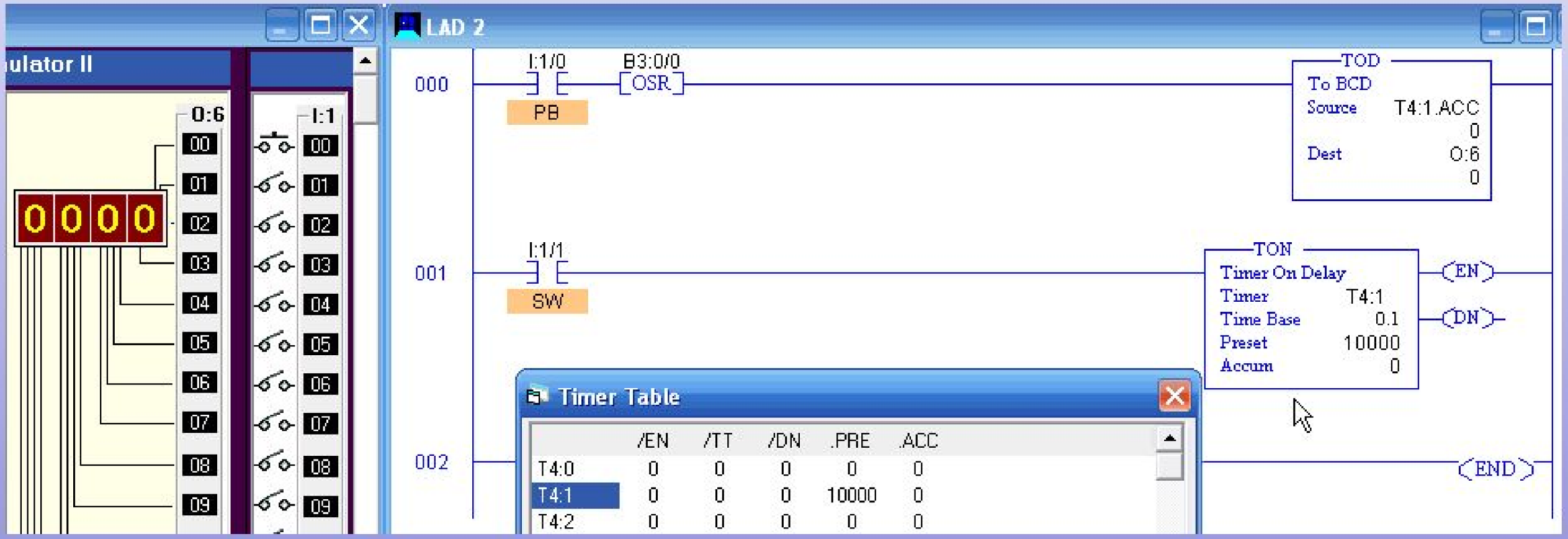


OSR instruction used to freeze rapidly displayed LED values.

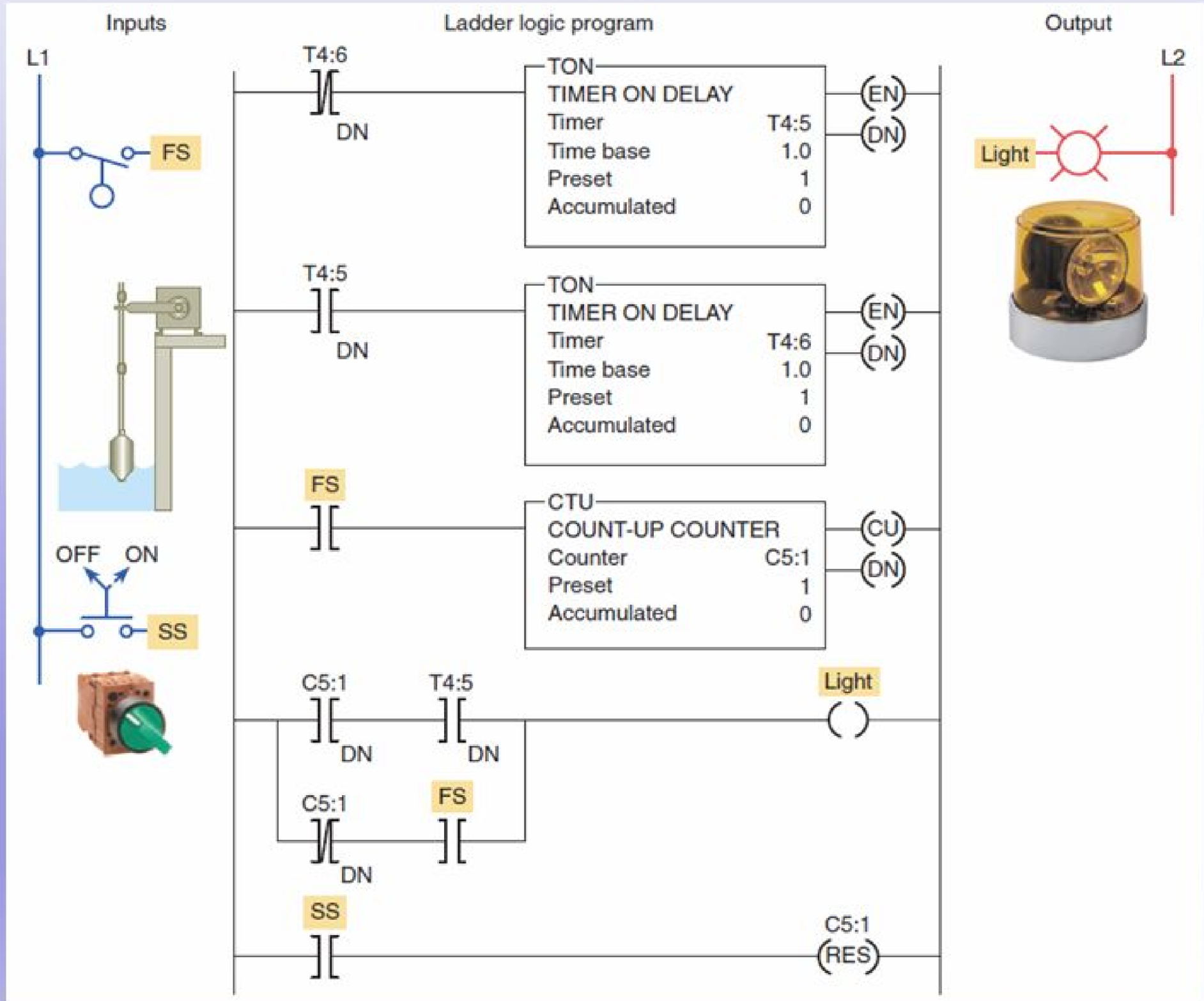


Closing the momentary pushbutton PB (I:1/0) will freeze and display the value at that point in time.

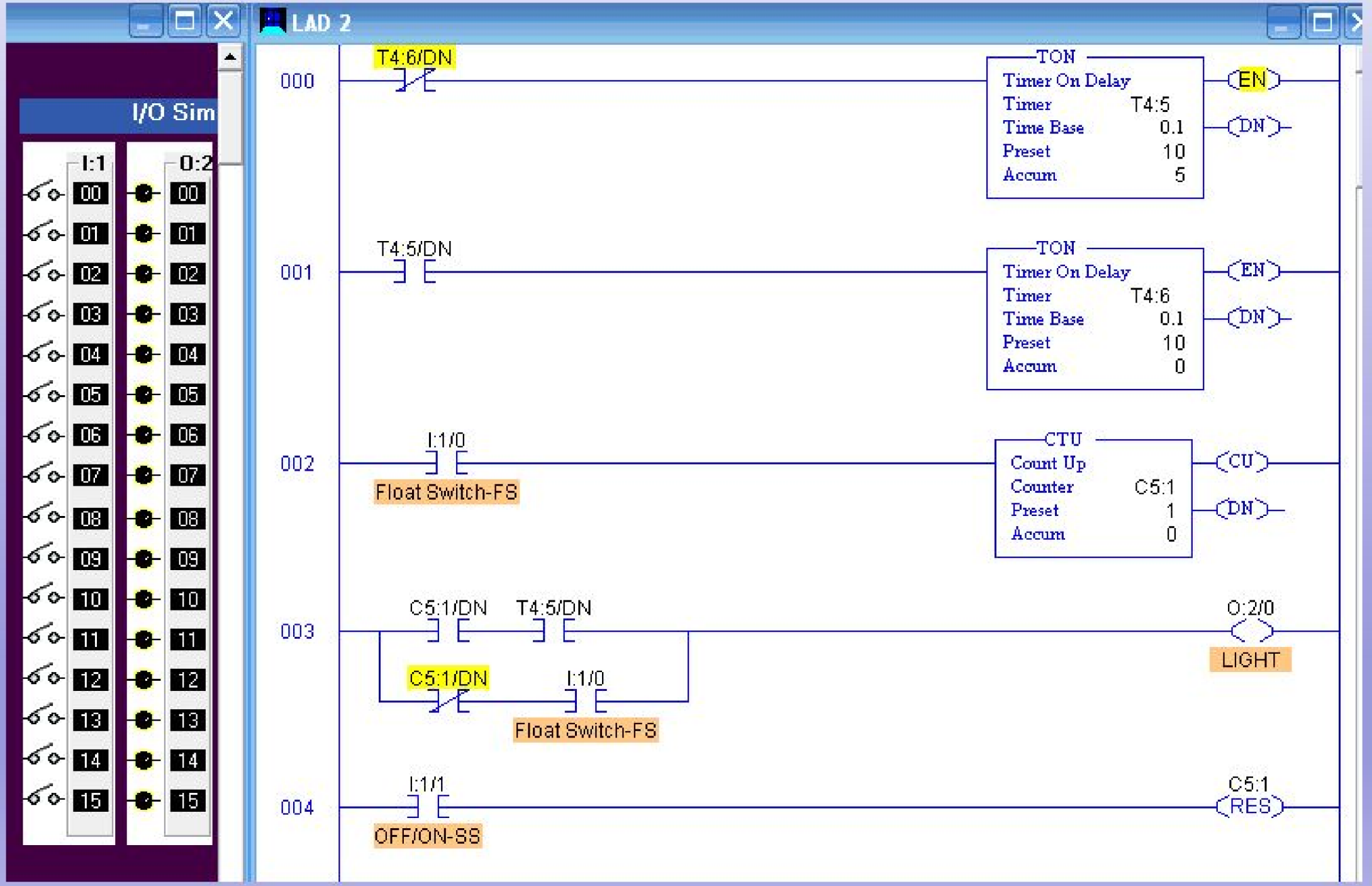
Simulation of OSR instruction used to freeze rapidly displayed LED values.



Alarm monitor program.



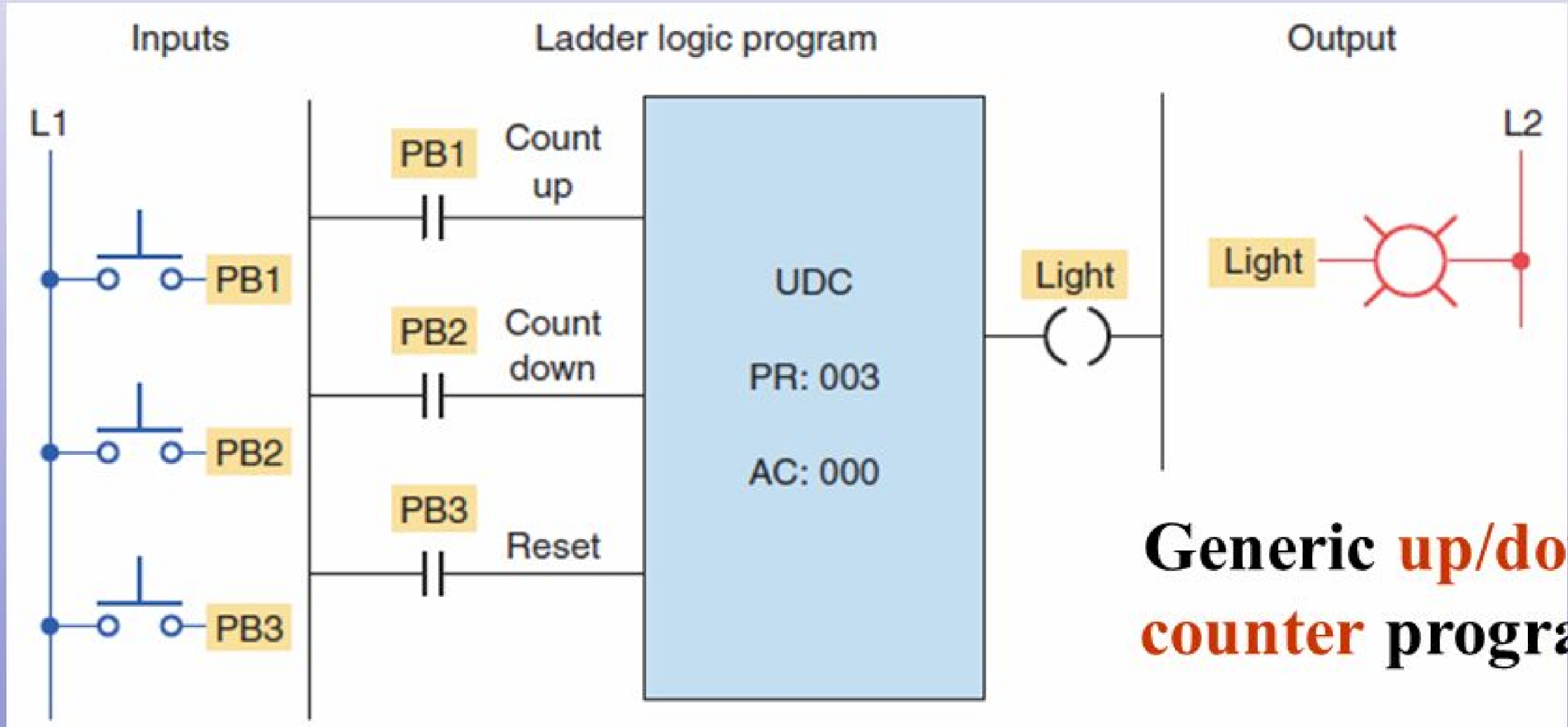
Simulated alarm monitor program.



8.3

Down-Counter

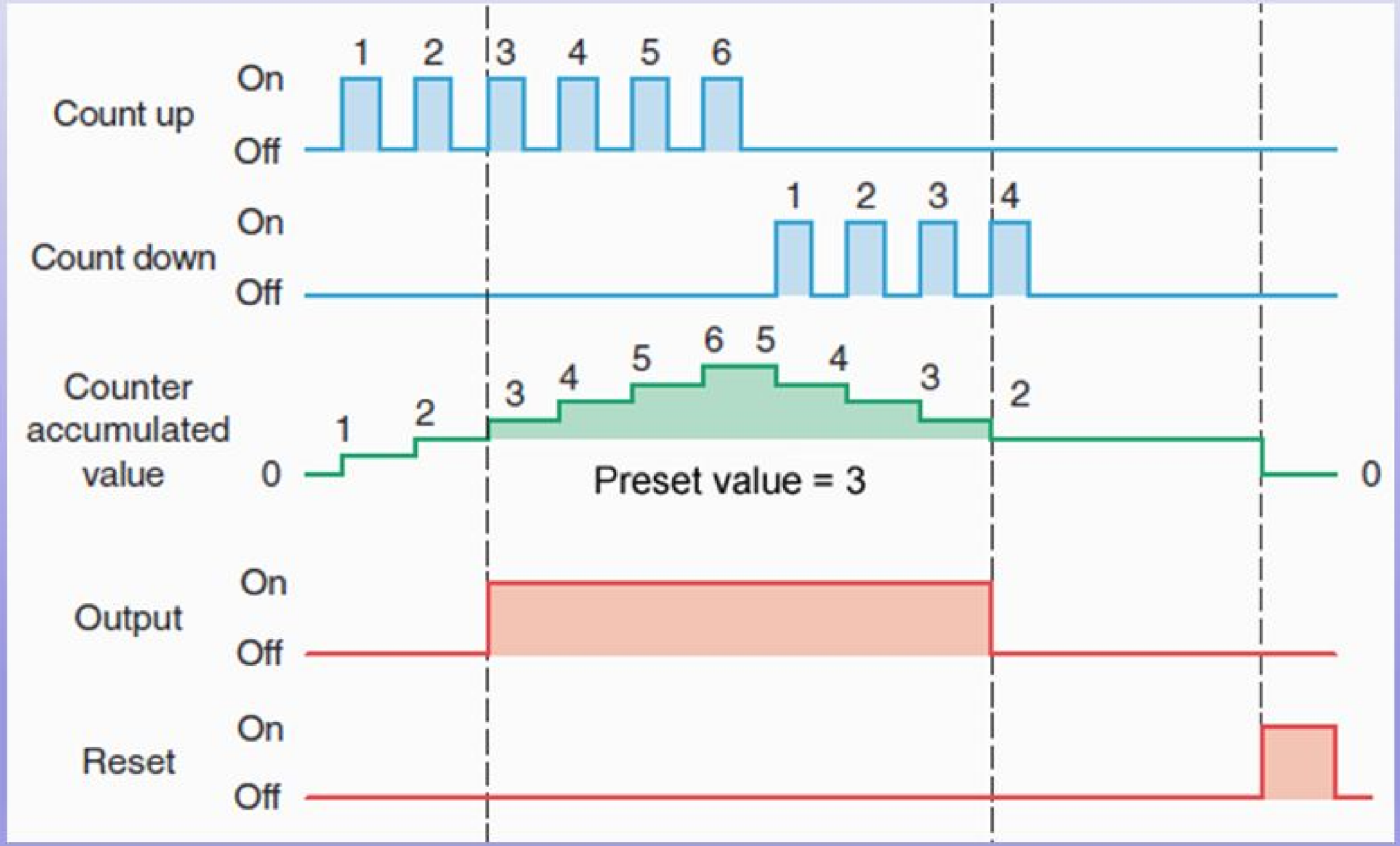
A down-counter will count down or decrement by 1 each time the counted event occurs.



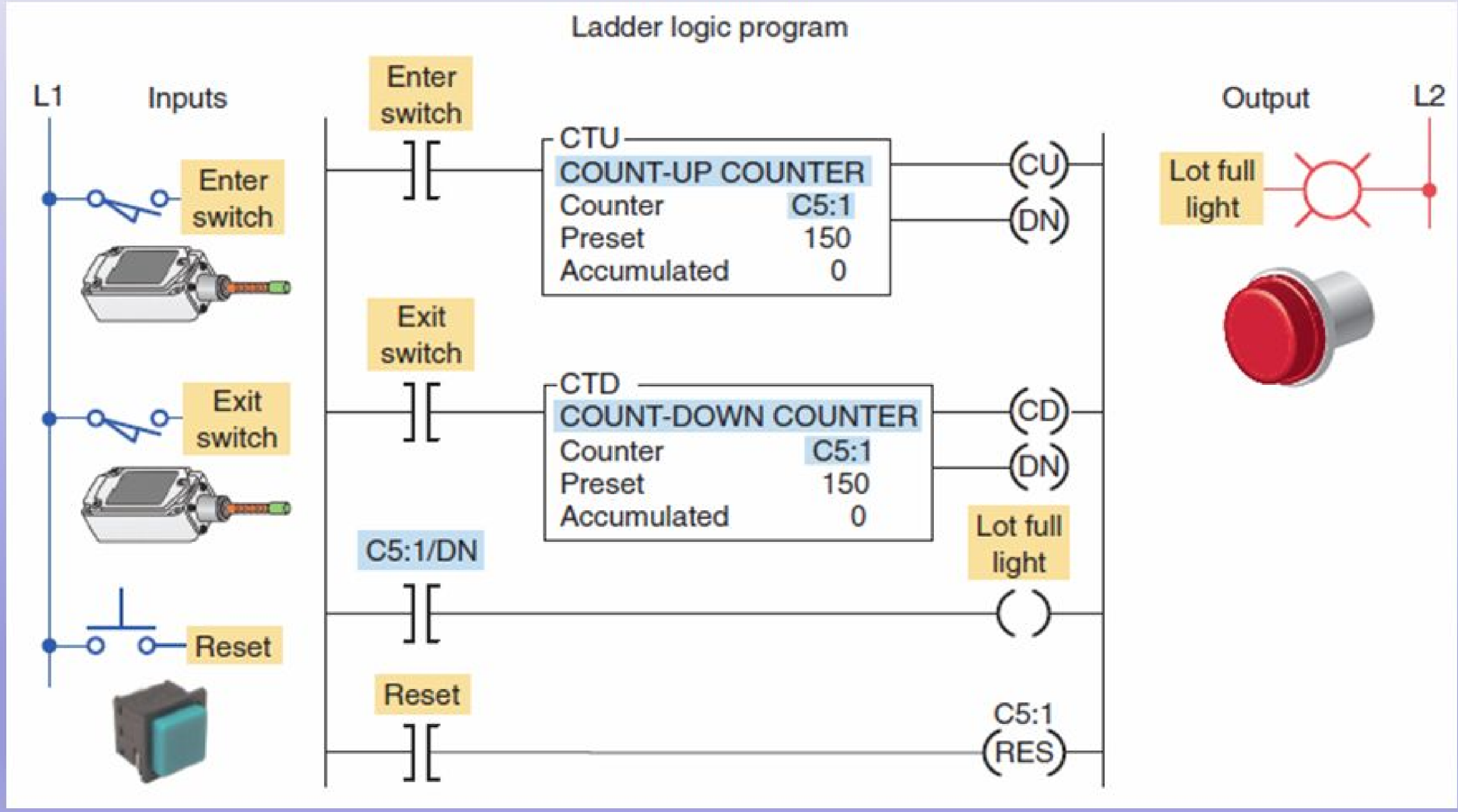
Generic up/down counter program.

Normally the down-counter is used in conjunction with the up-counter to form an up/down-counter.

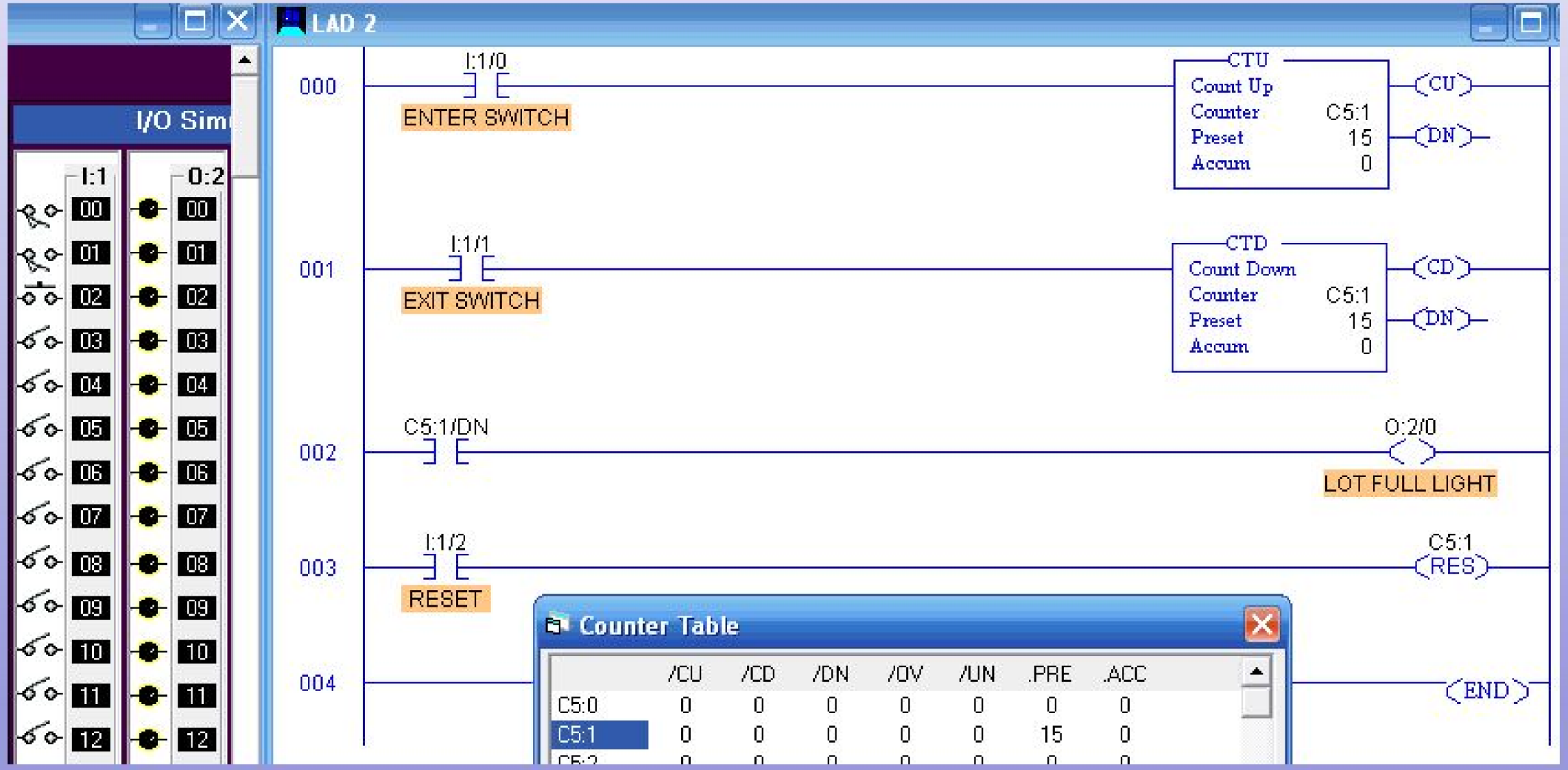
Up/down counter program counting diagram.



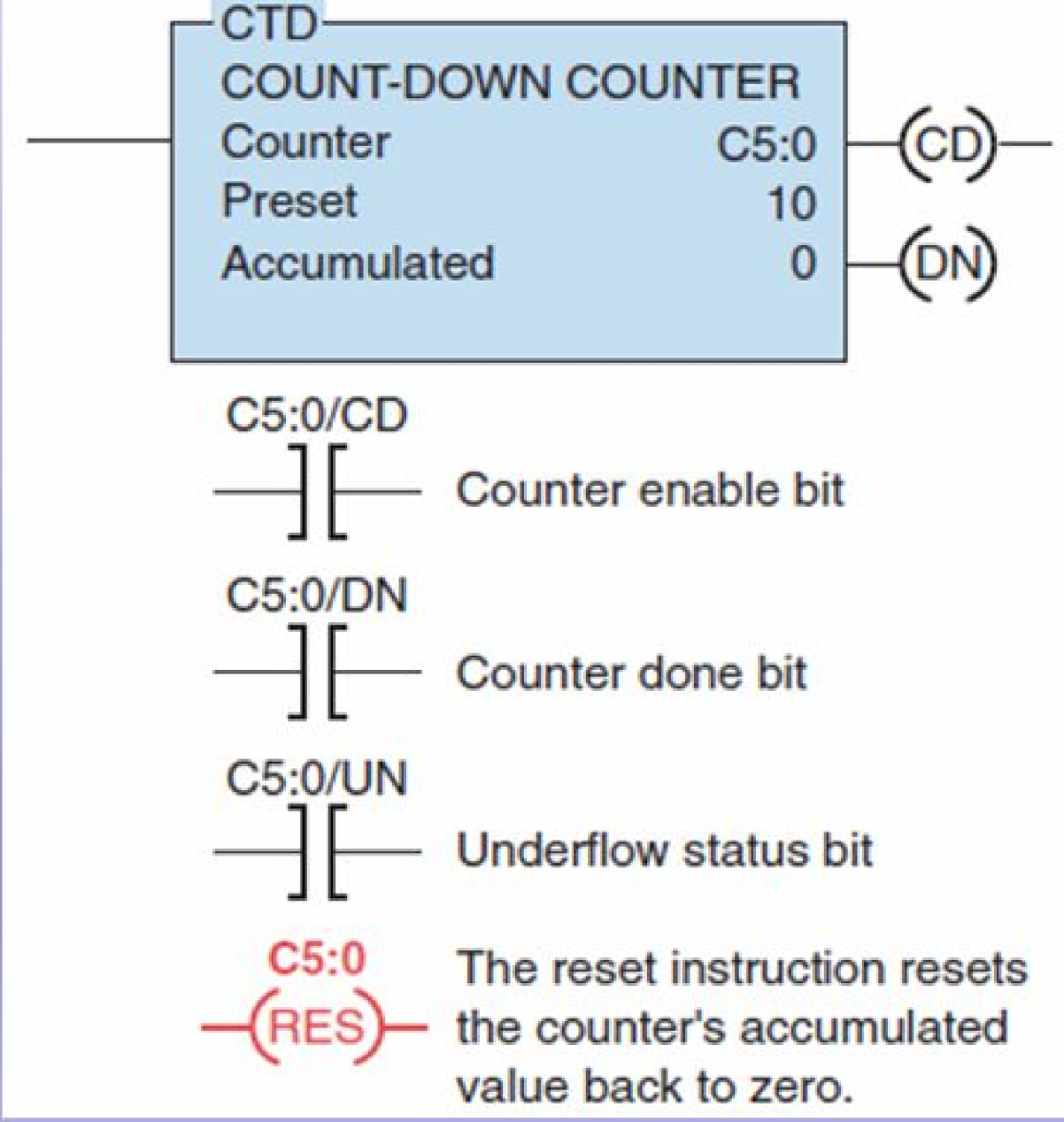
Parking garage counter program.

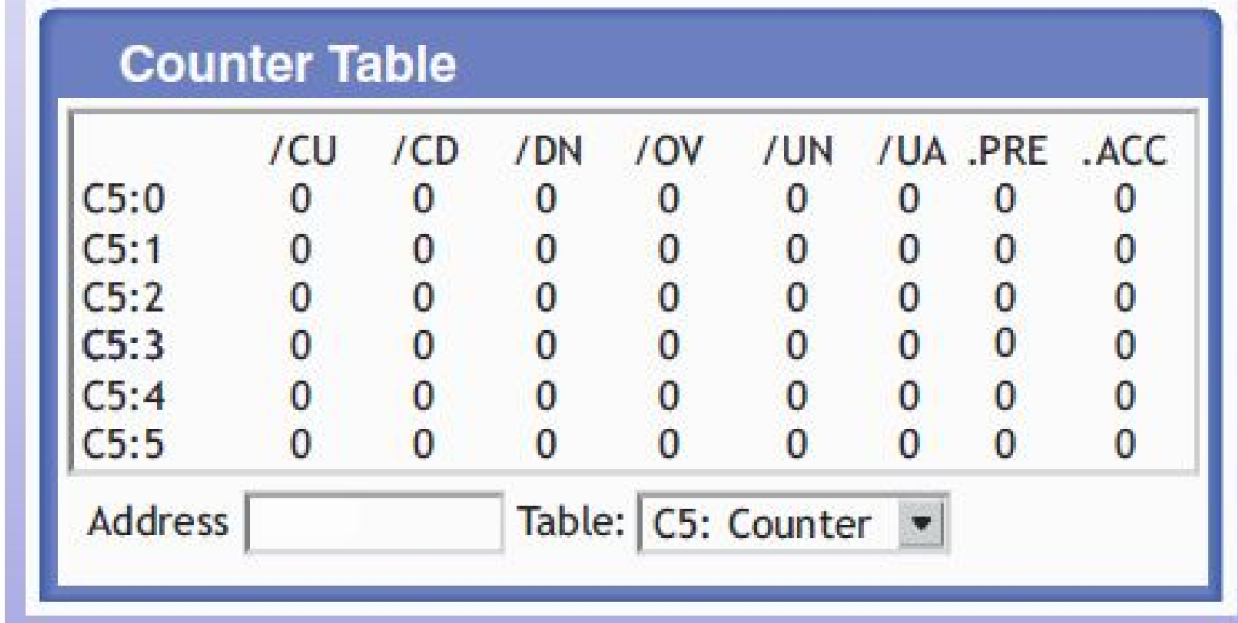


Simulated parking garage counter program.



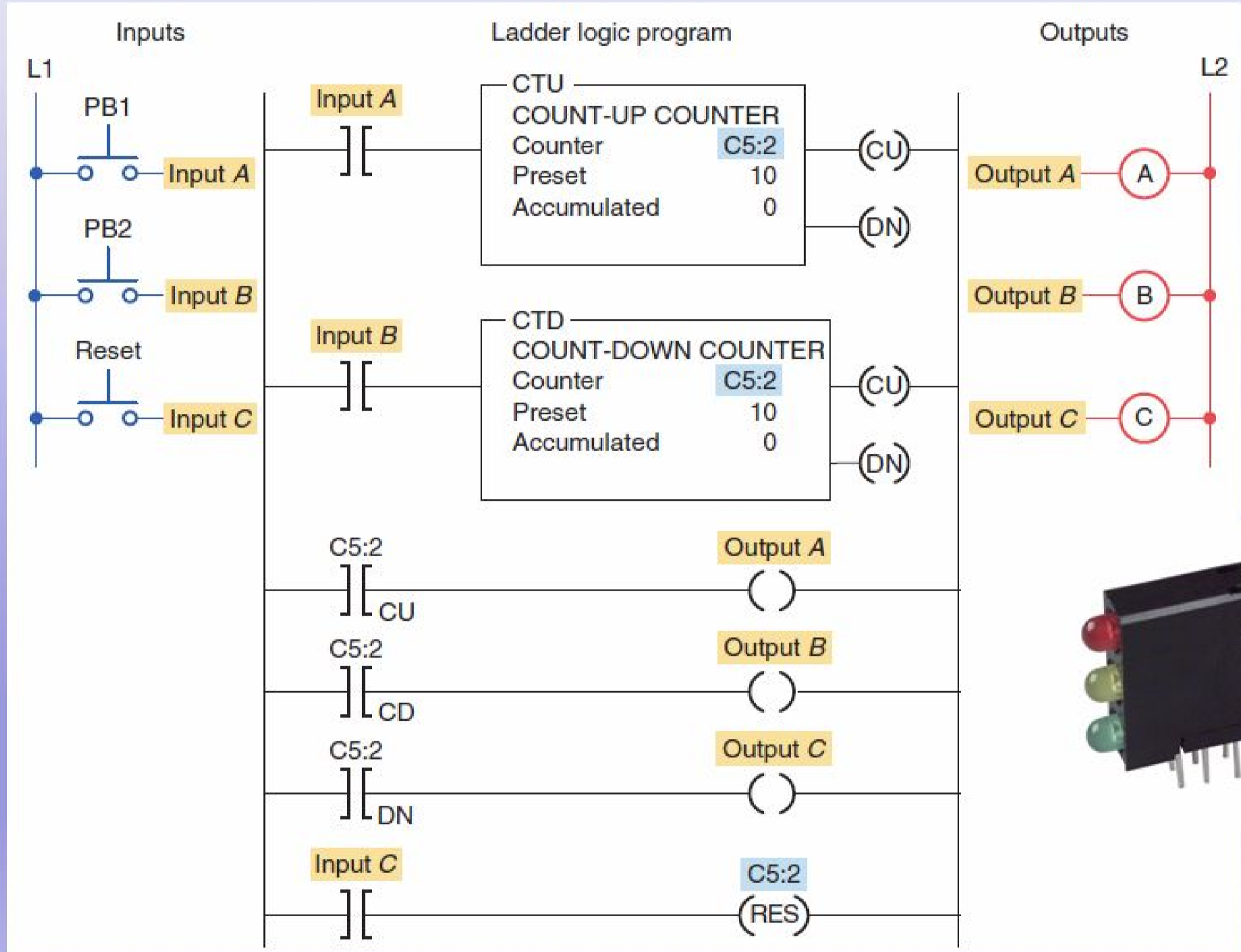
Count-down counter instruction used as part of the SLC 500 controller instruction set.



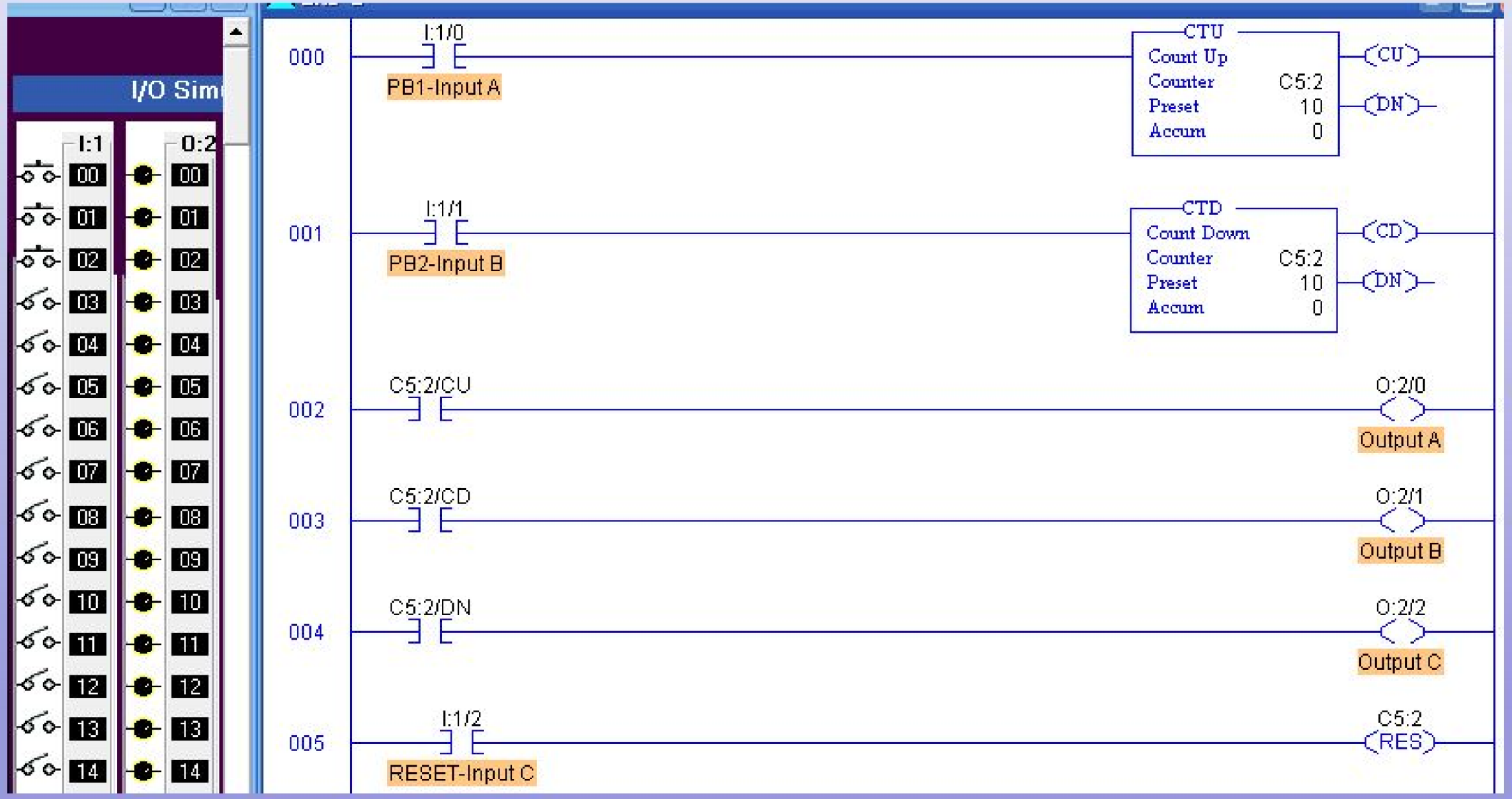


The information to be entered into the instruction is the same as for the count-up instruction.

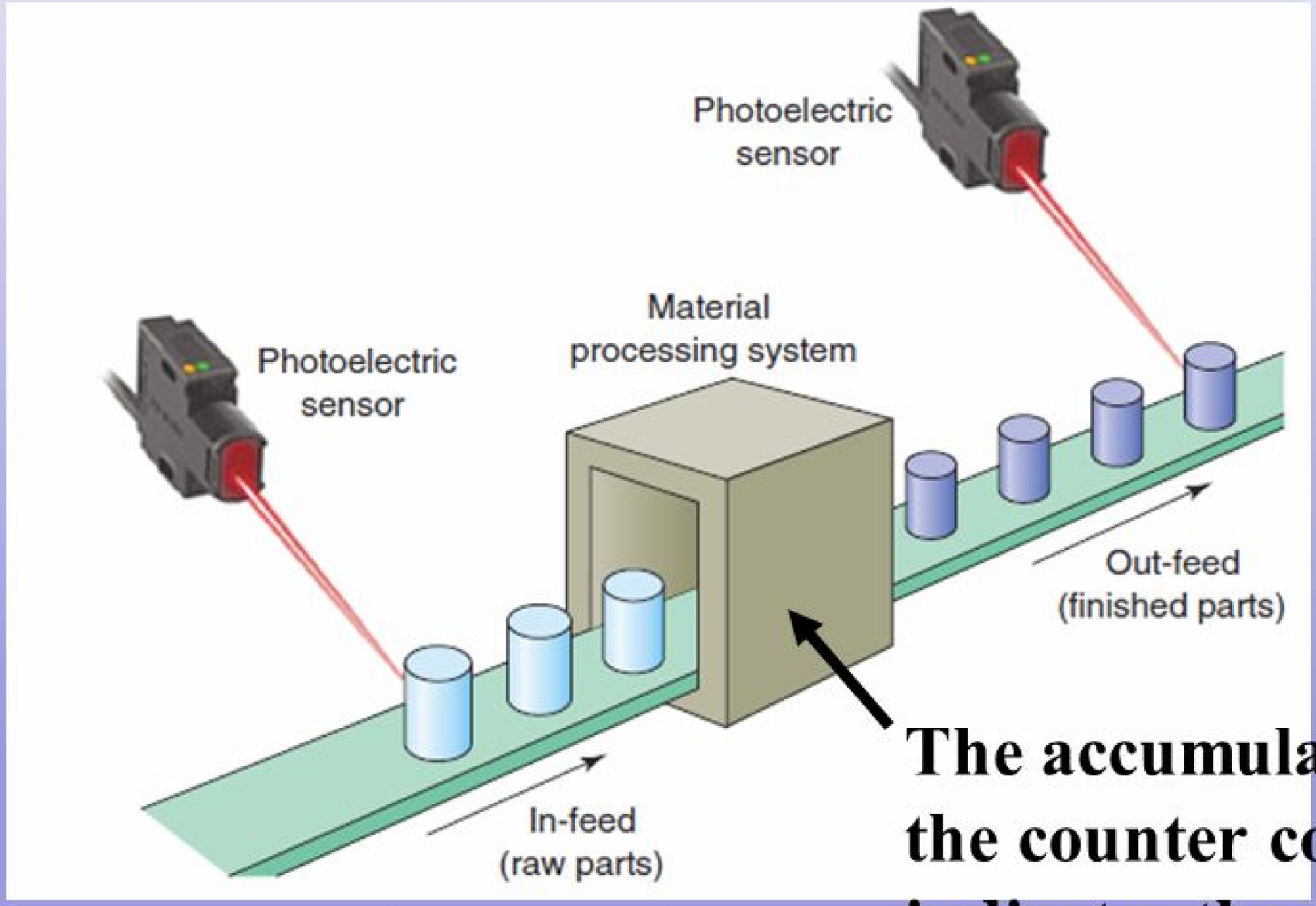
Up/down-counter program.



Simulated up/down-counter program.

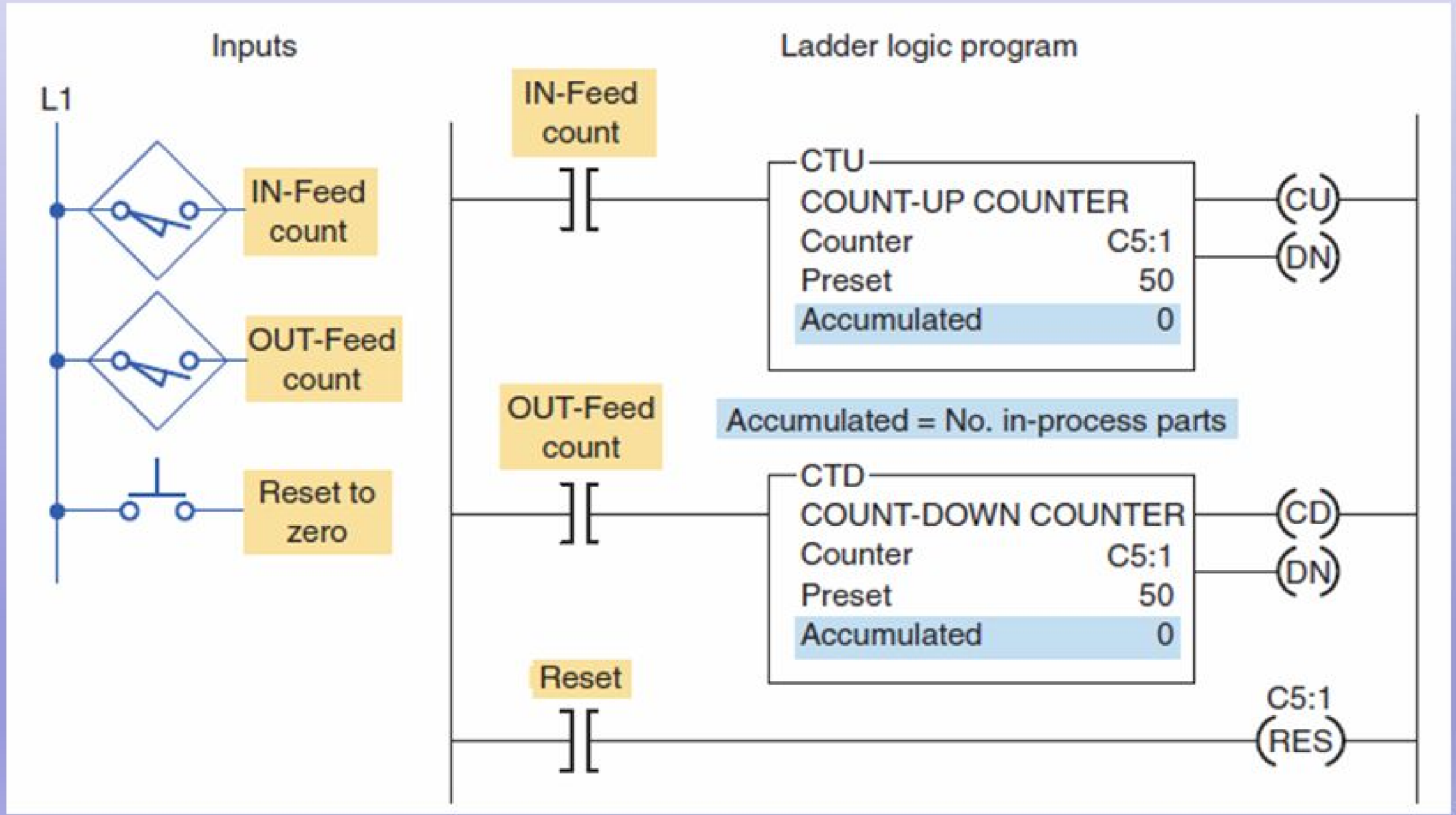


Program that provides continuous monitoring of items in process.

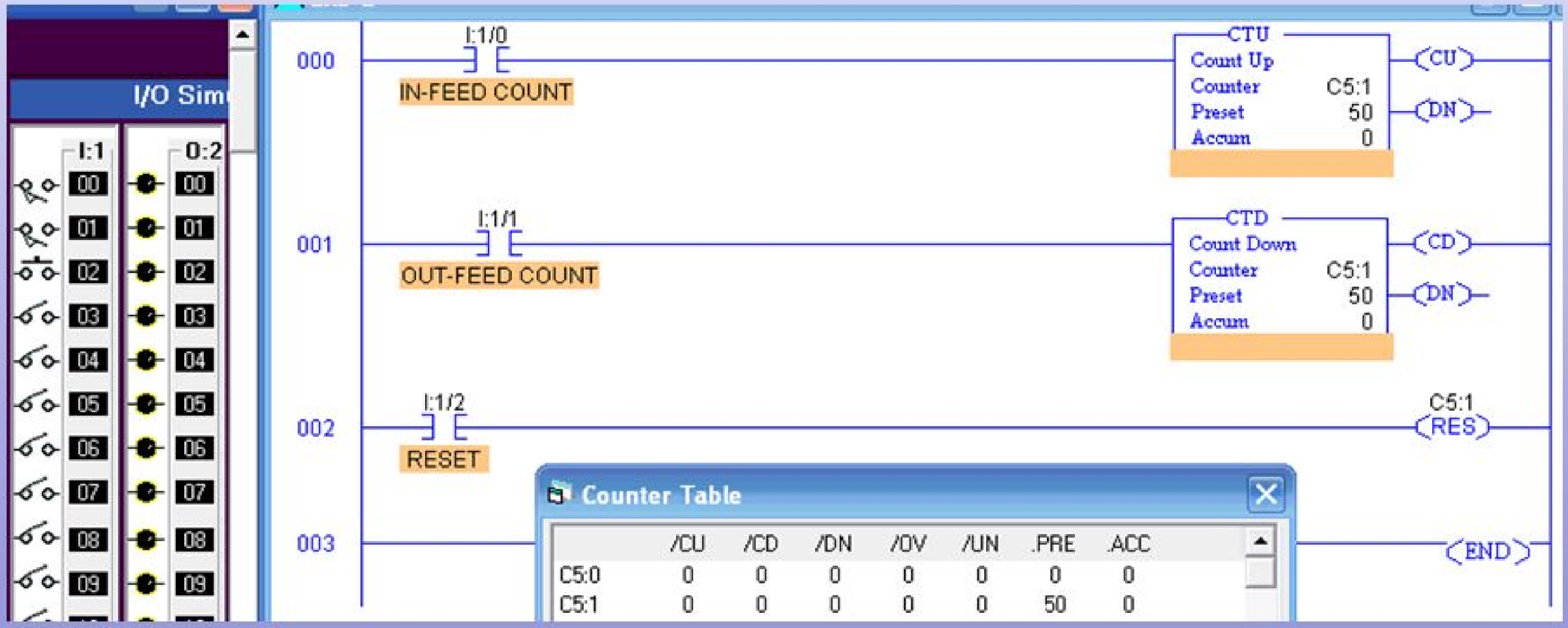


The accumulated count of the counter continuously indicates the number of in-process parts.

Program that provides continuous monitoring of items in process.



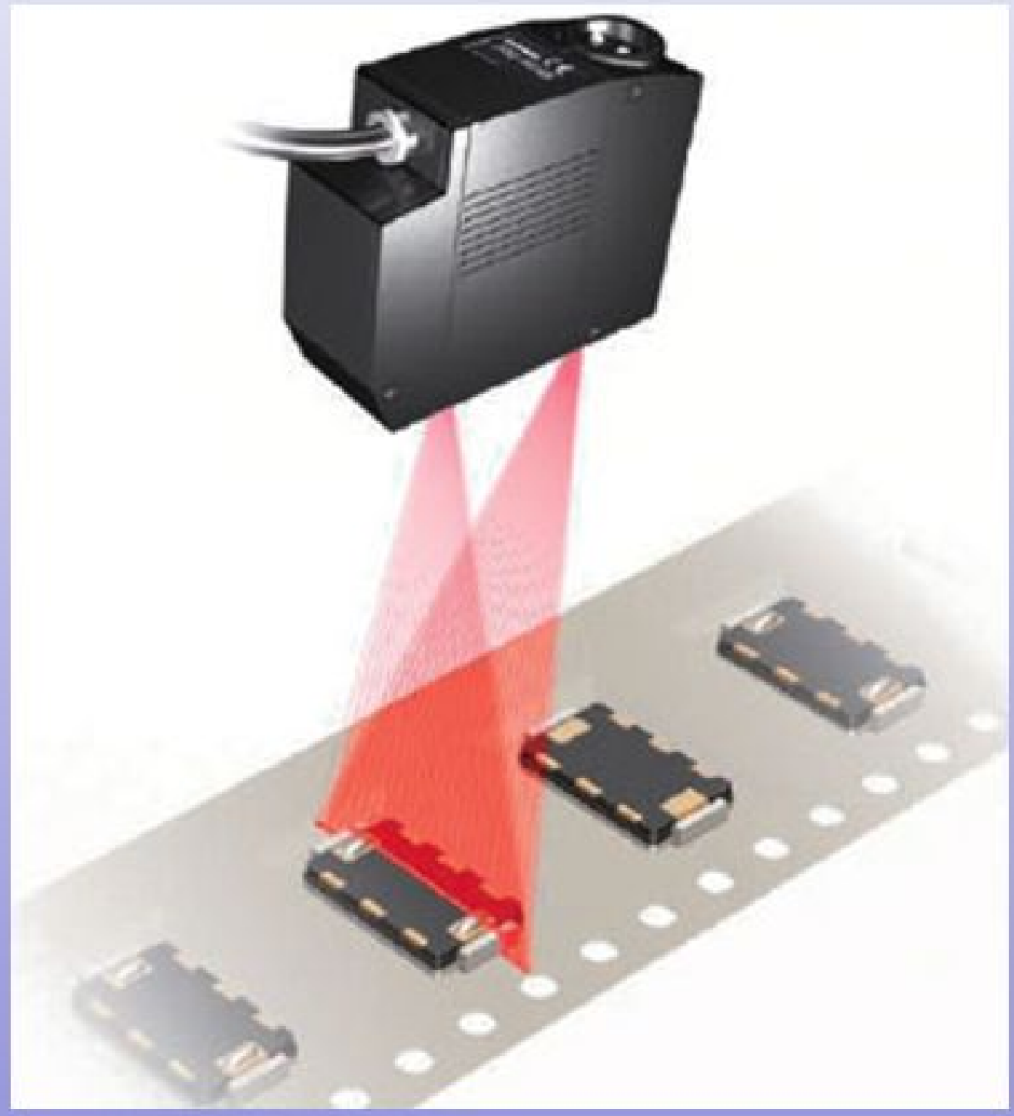
Simulated program that provides continuous monitoring of items in process.



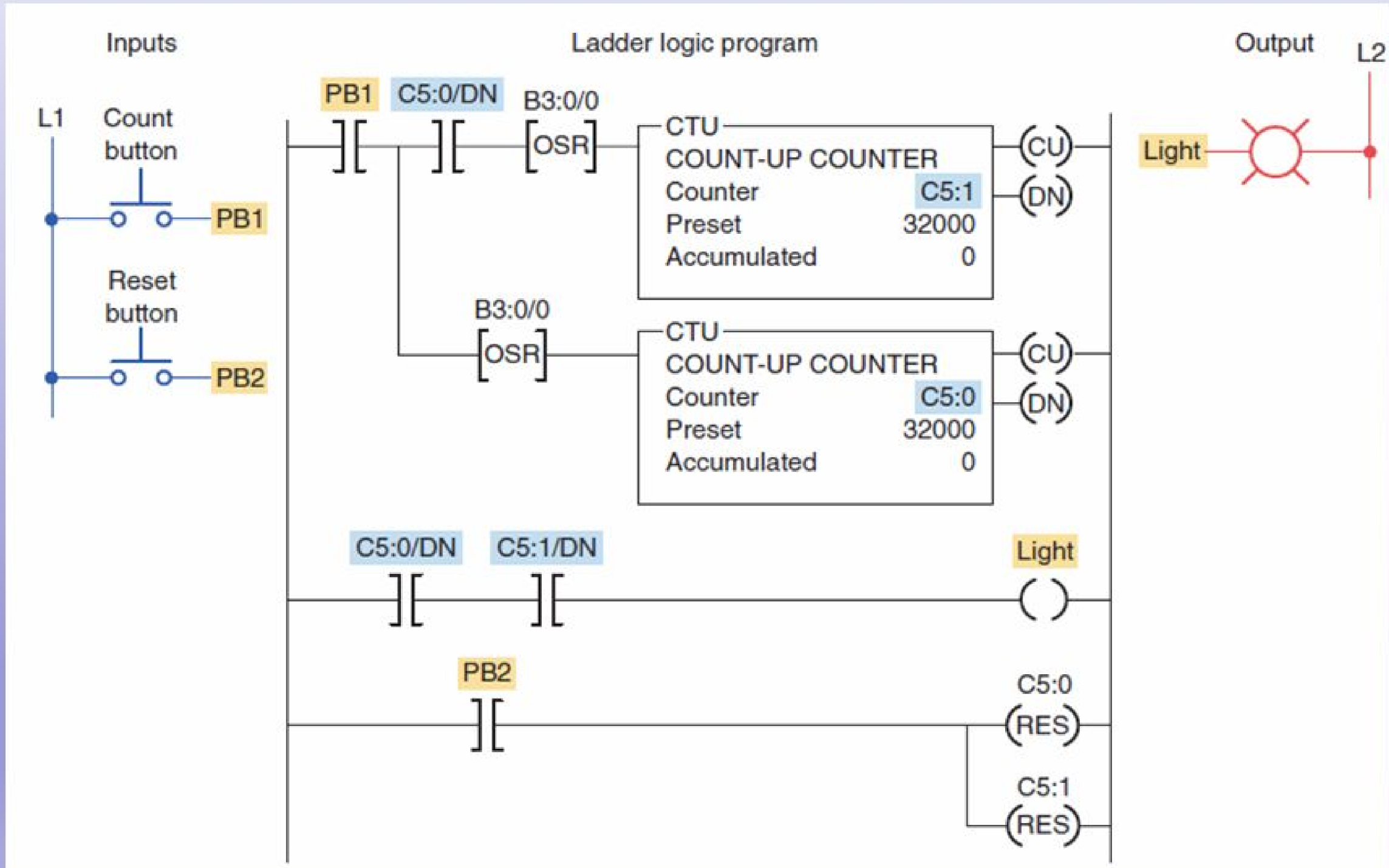
8.4

Cascading Counters

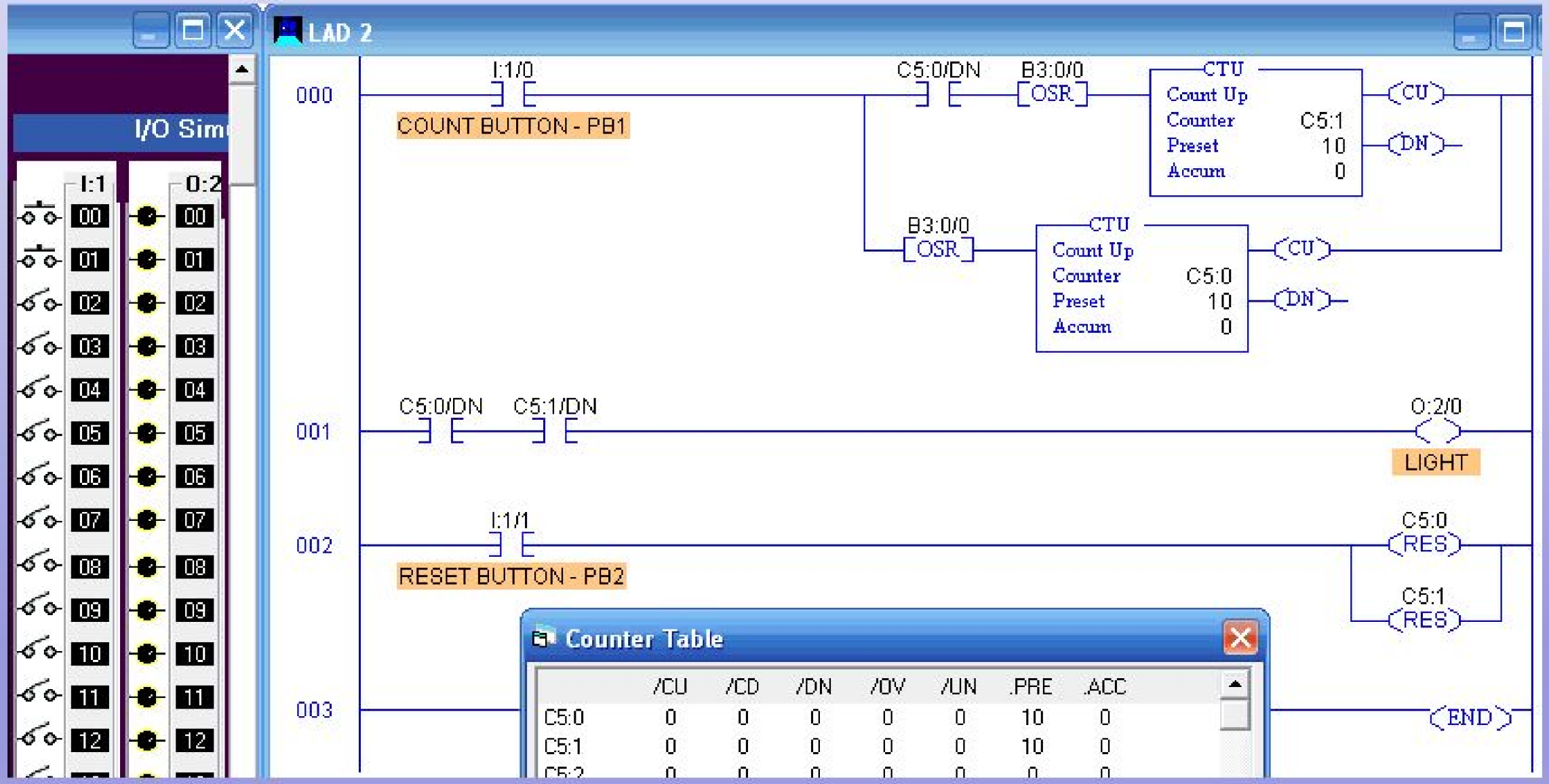
Depending on the application, it may be necessary to count events that exceed the maximum number allowable per counter instruction. One way of accomplishing this count is by *interconnecting, or cascading*, two counters.



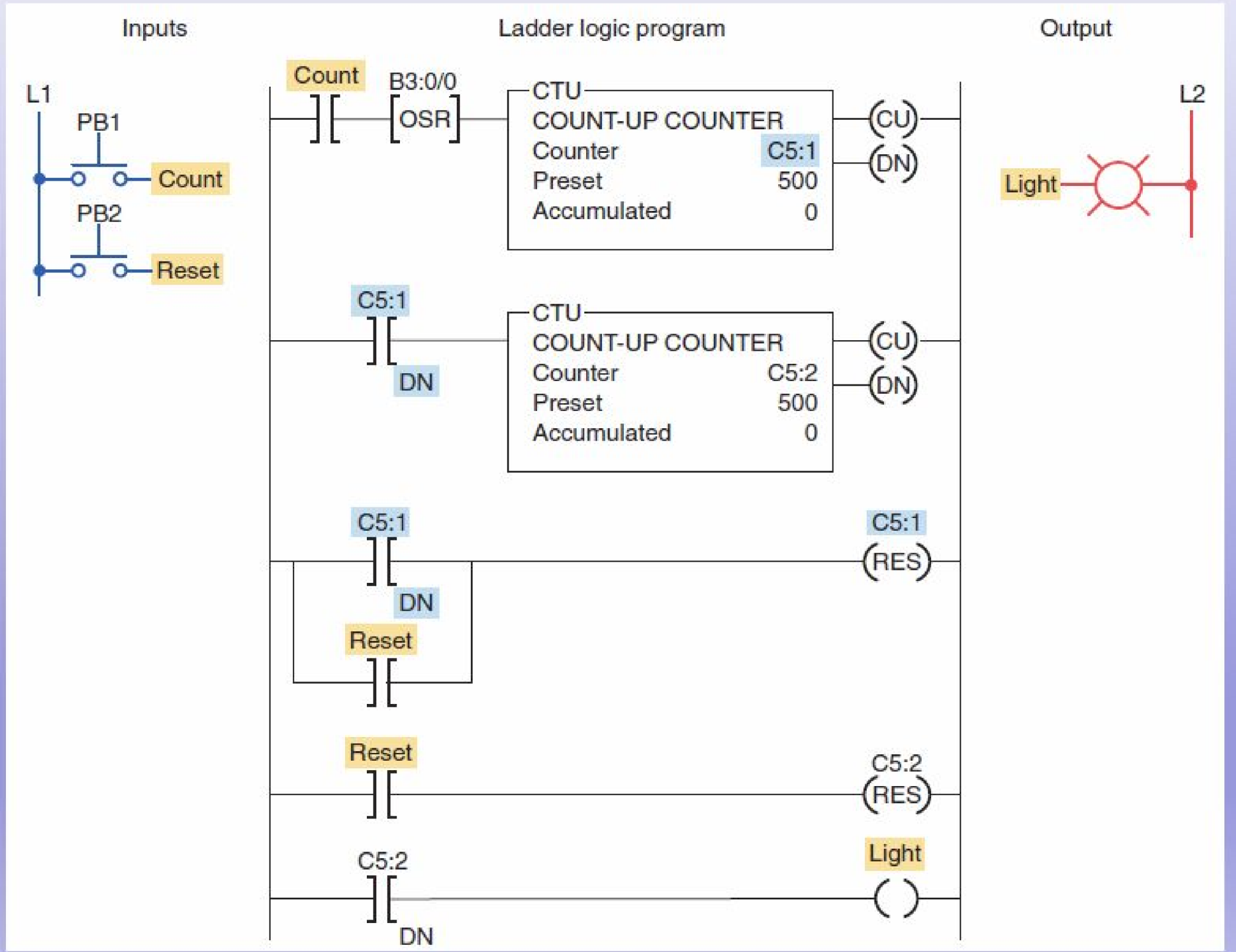
Counting beyond the maximum count program.



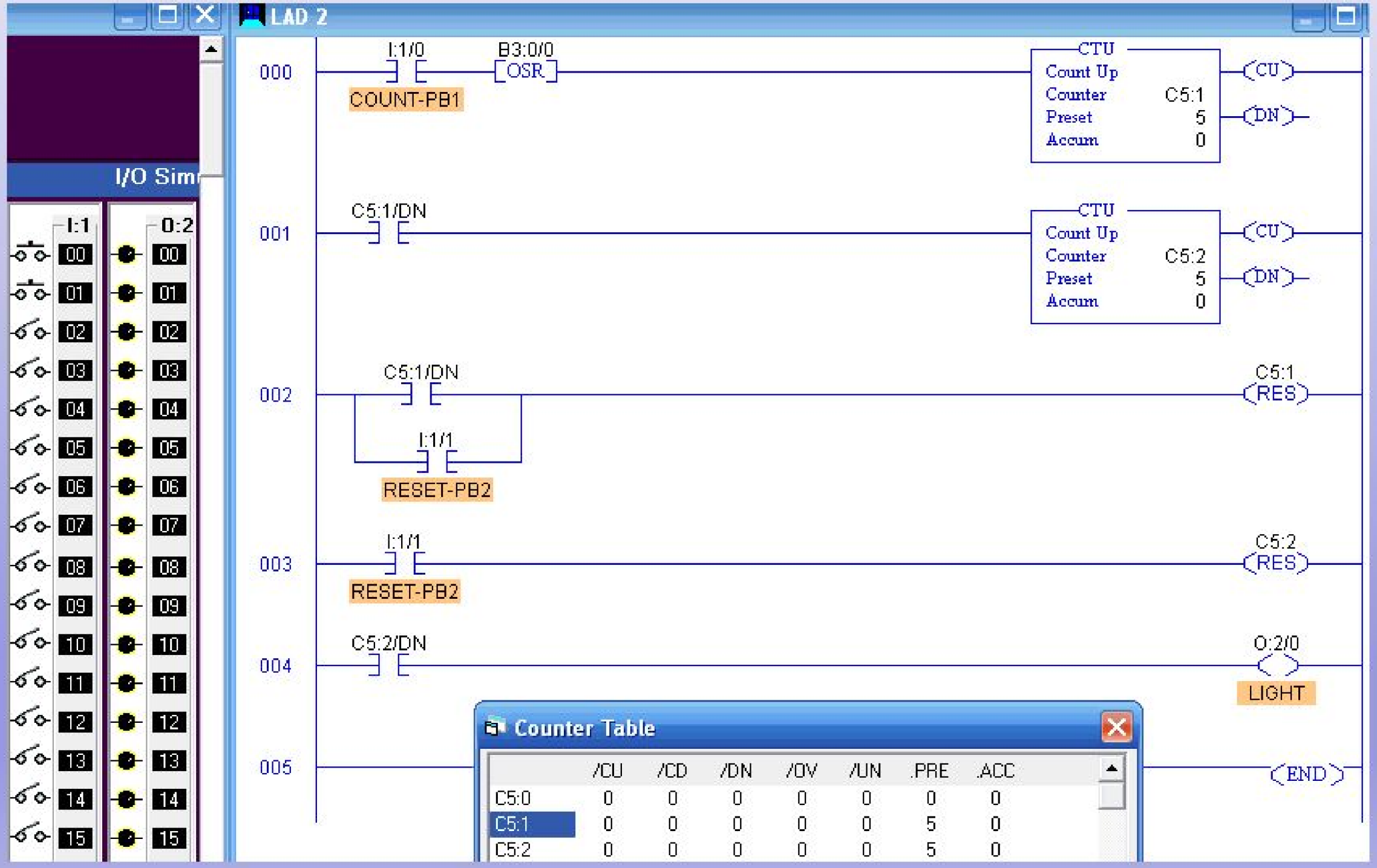
Simulated counting beyond the maximum count program.



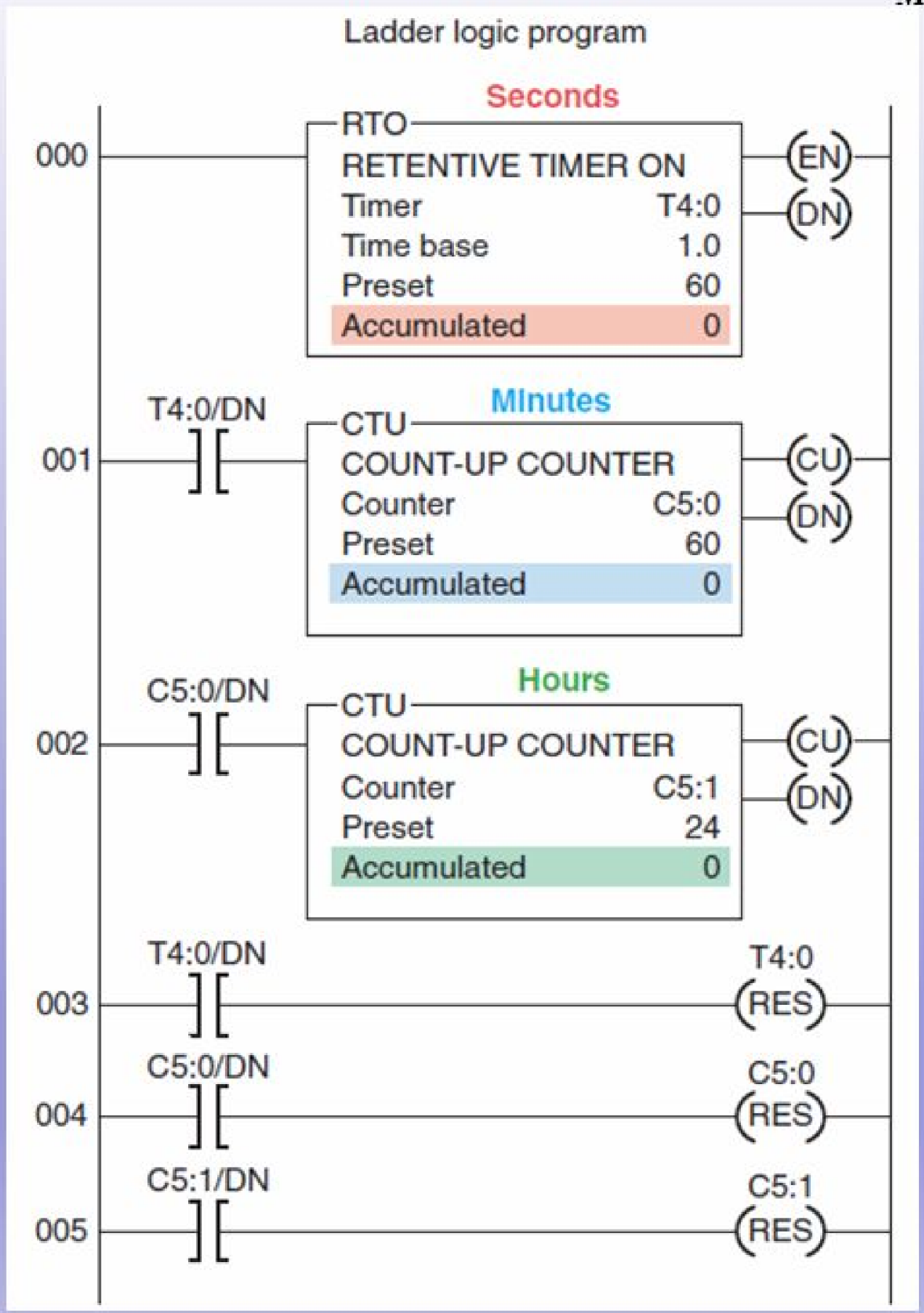
Cascading counters for *extremely large counts.*



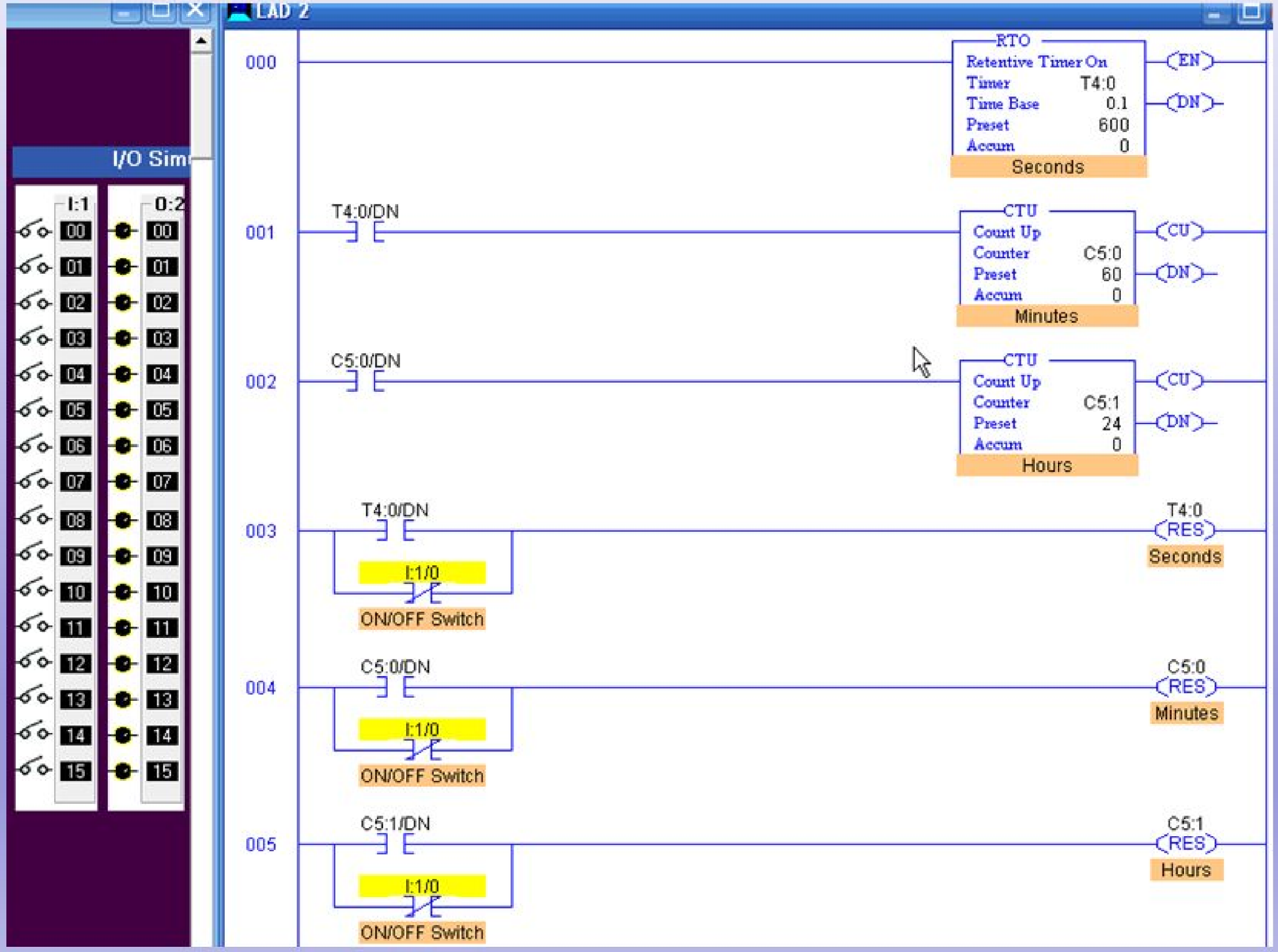
Simulated program for extremely large counts.



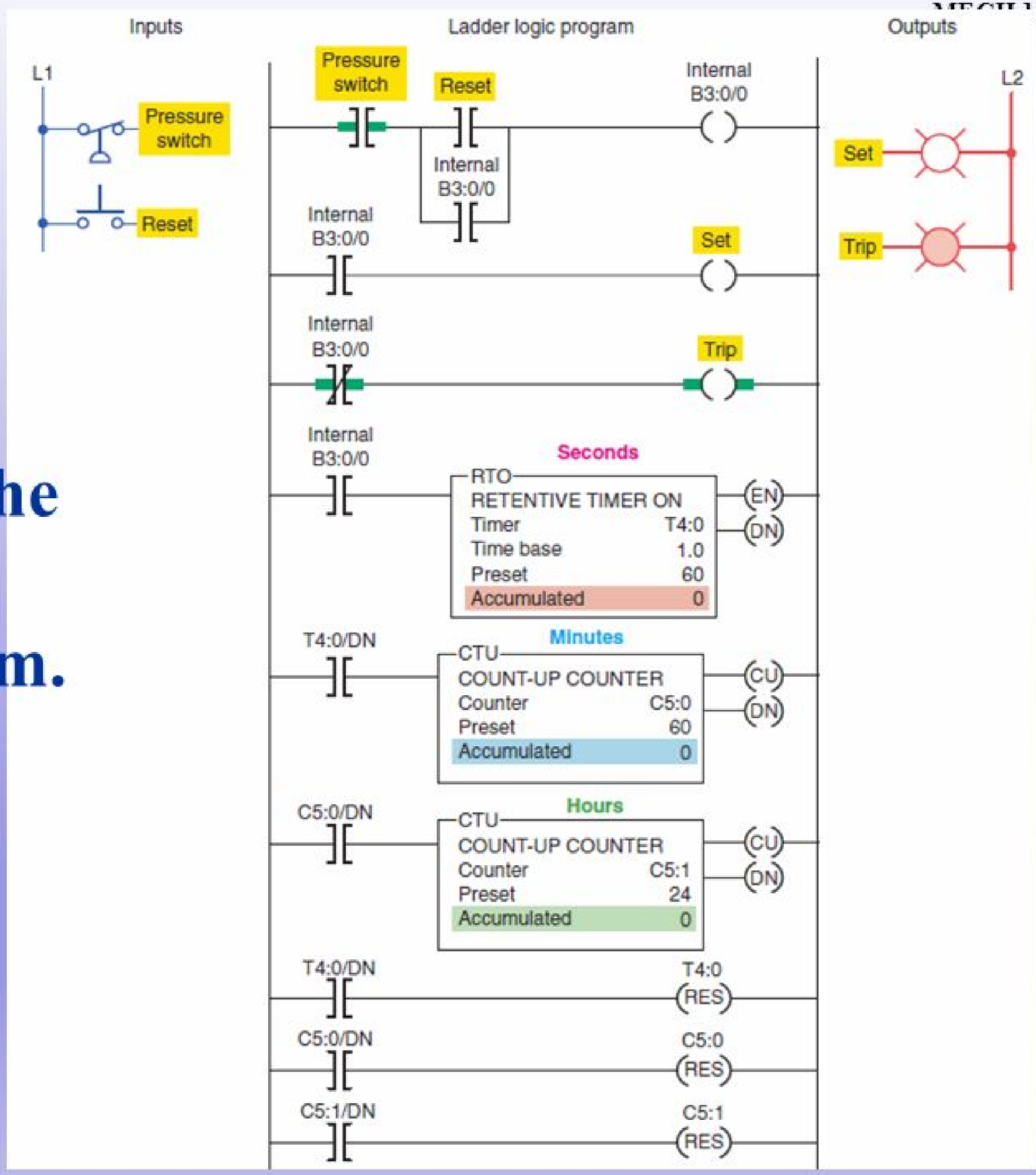
24-hour clock program.



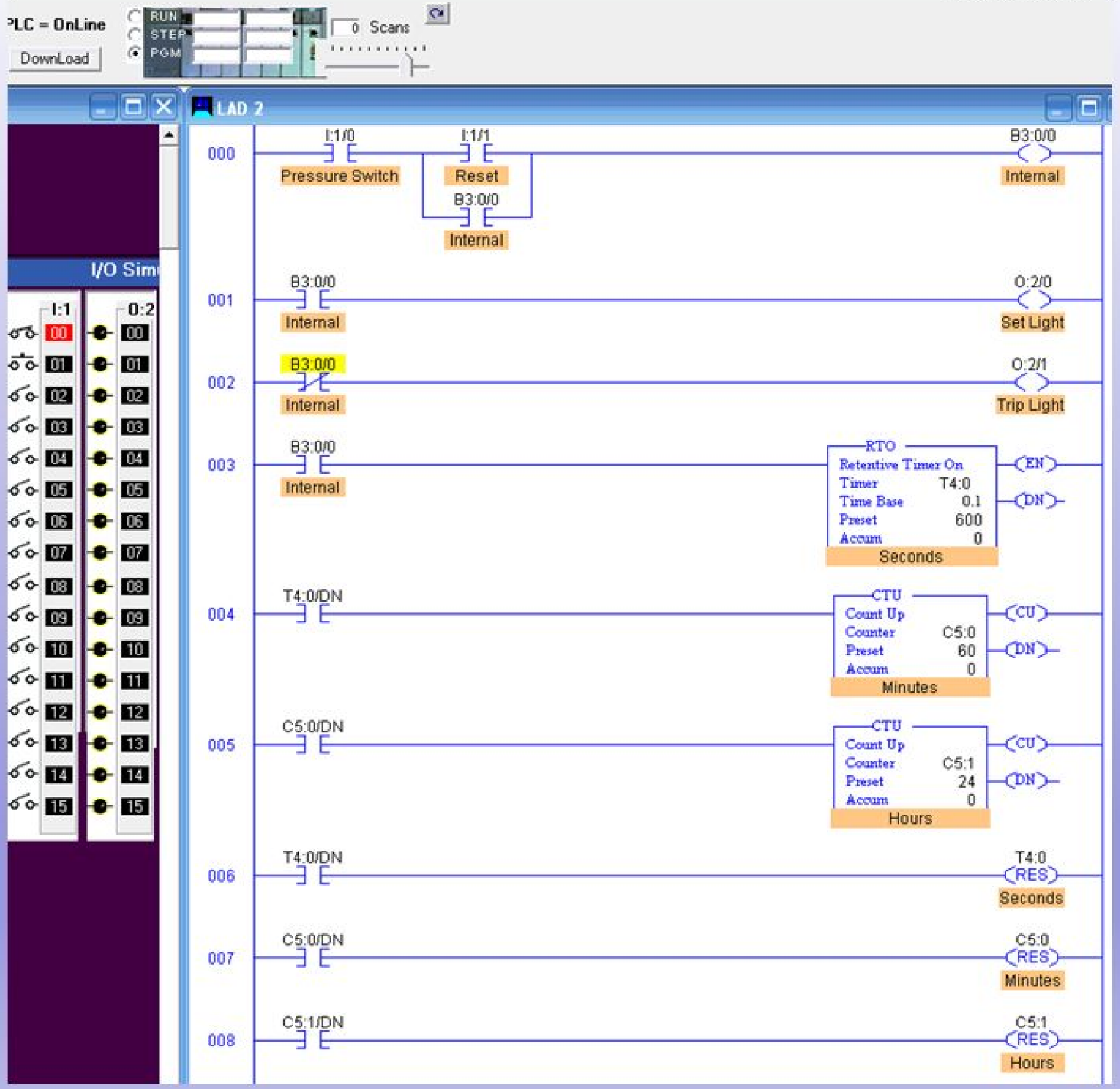
Simulated 24-hour clock program.



Monitoring the time of an event program.



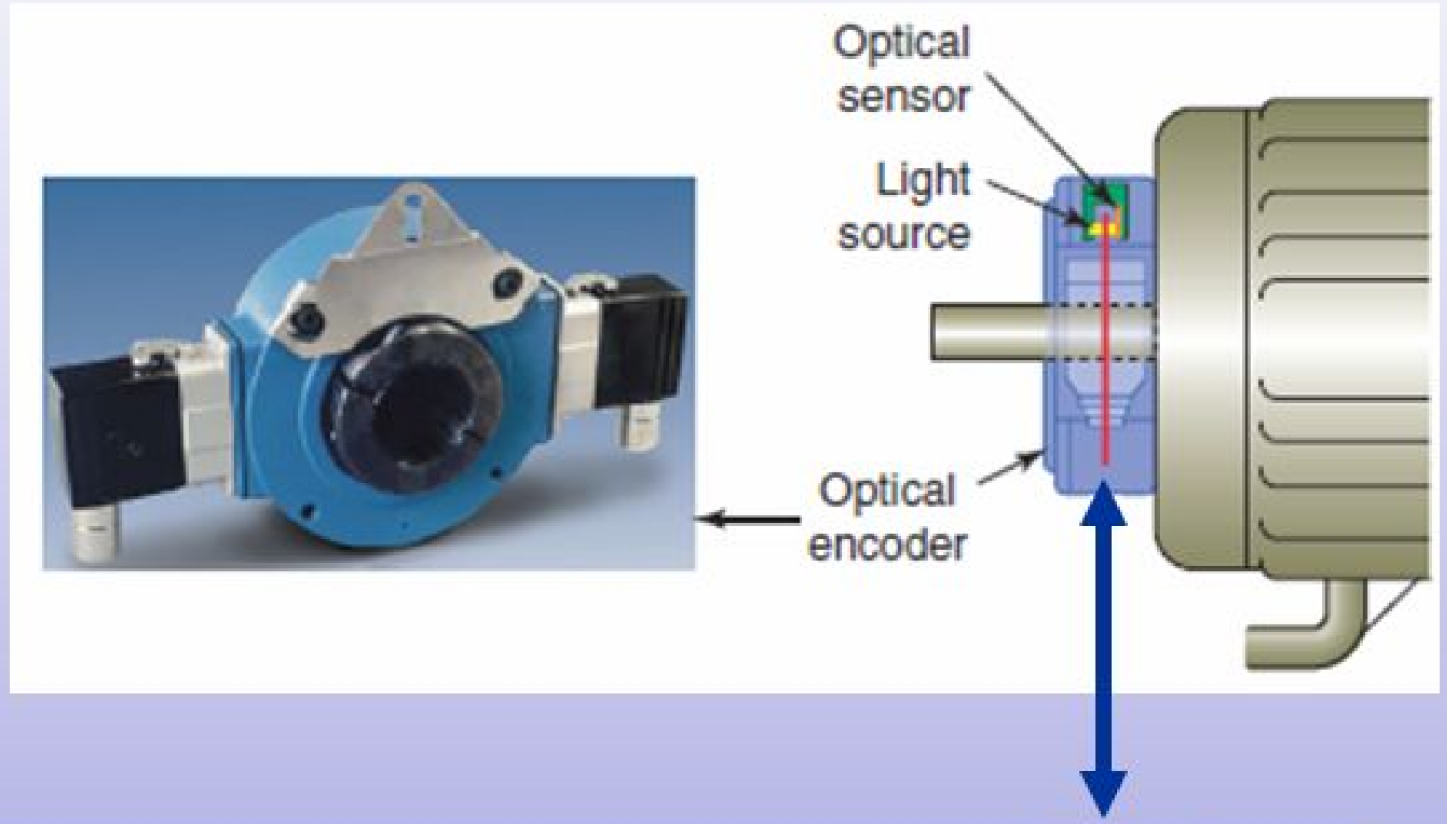
***Simulated* time of an event program.**

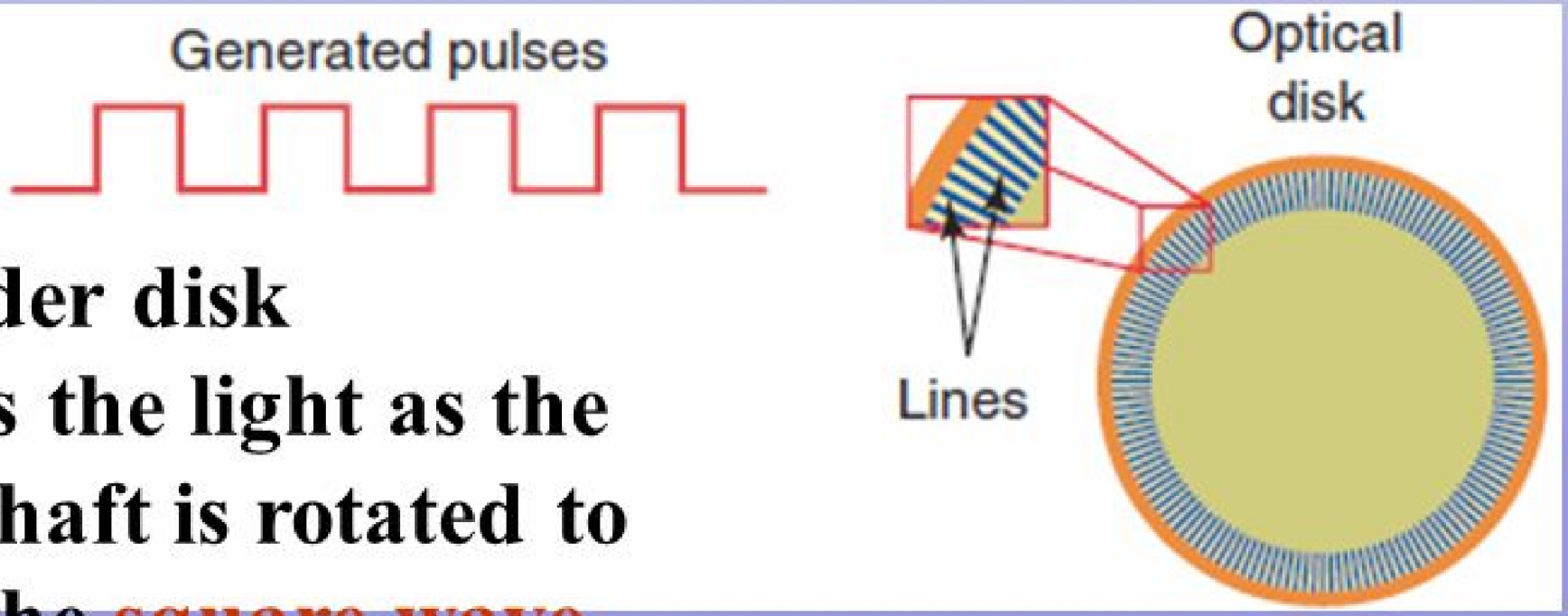


8.5

Incremental Encoder-Counter Applications

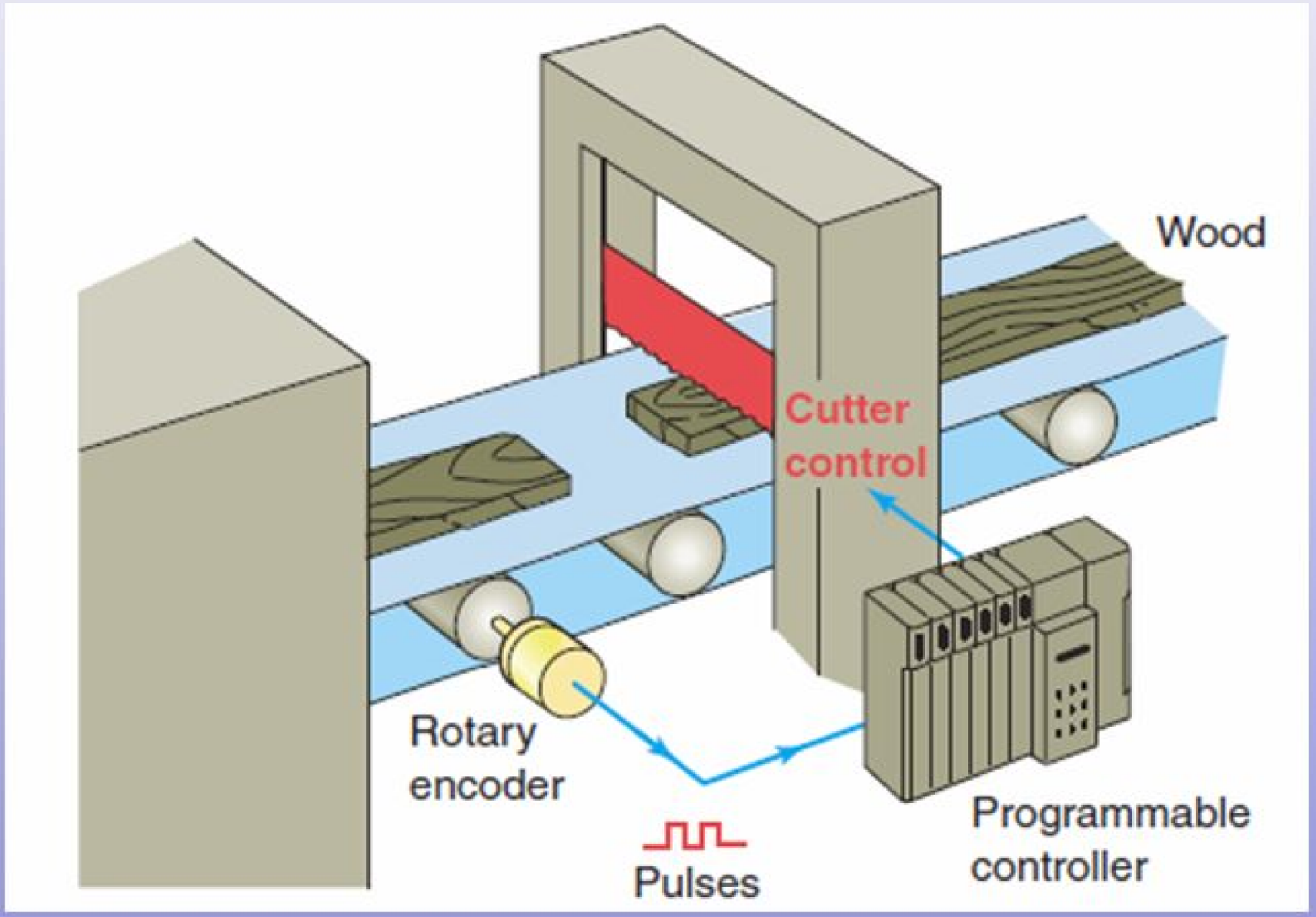
The incremental *optical encoder* creates a series of square waves as its shaft is rotated.





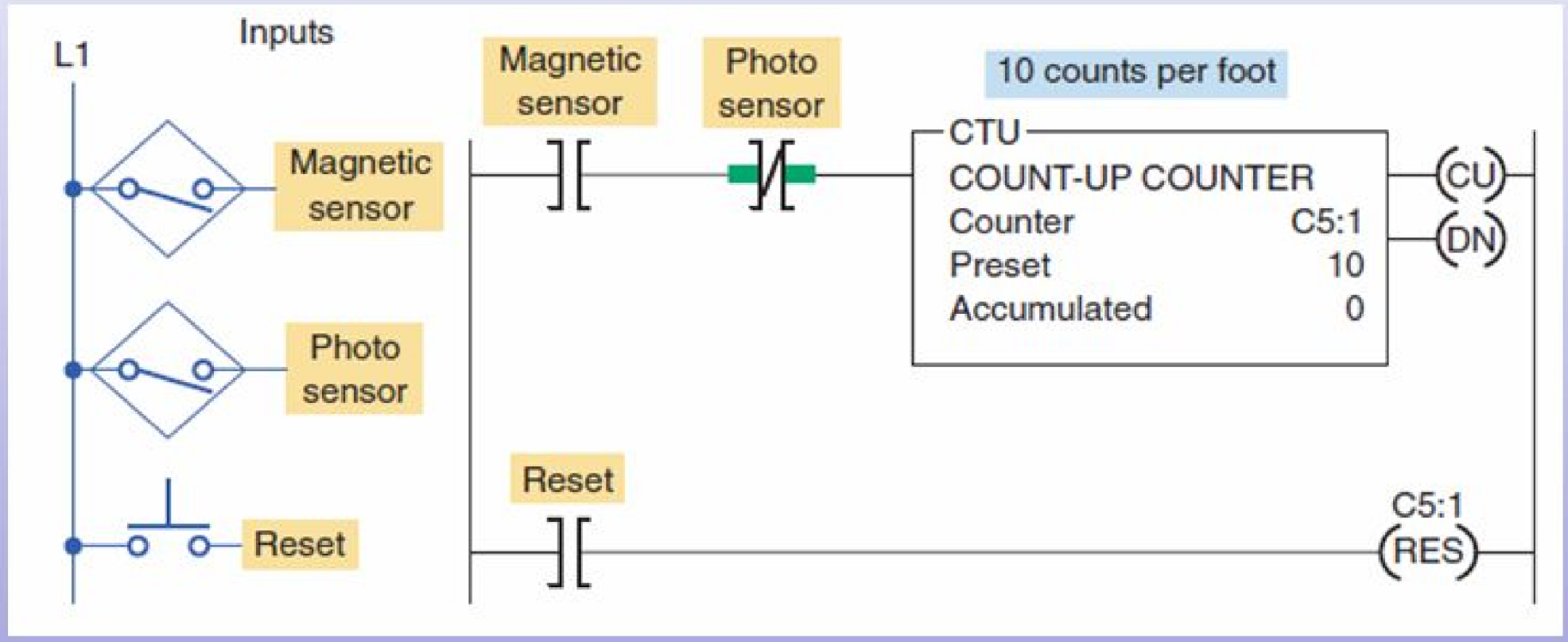
The encoder disk interrupts the light as the encoder shaft is rotated to produce the square wave output waveform.

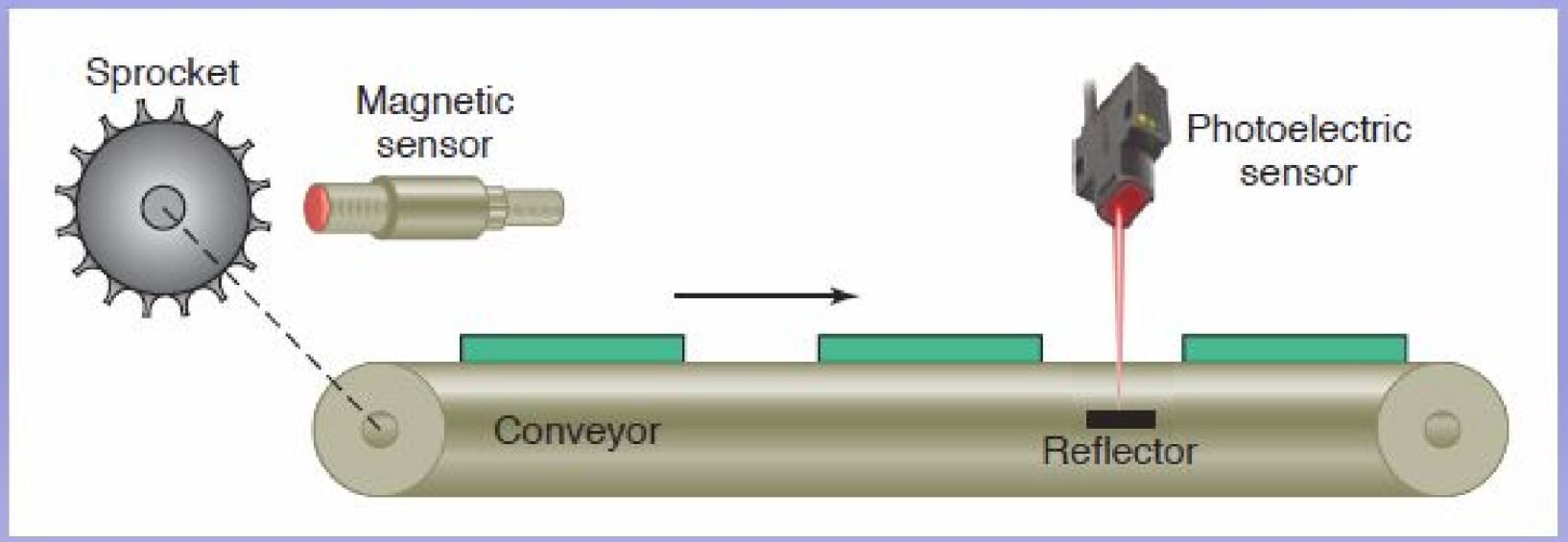
Cutting objects to a specified length.



The object is advanced for a specified distance and measured by encoder pulses to determine the correct length for cutting.

Counter program used for length measurement.

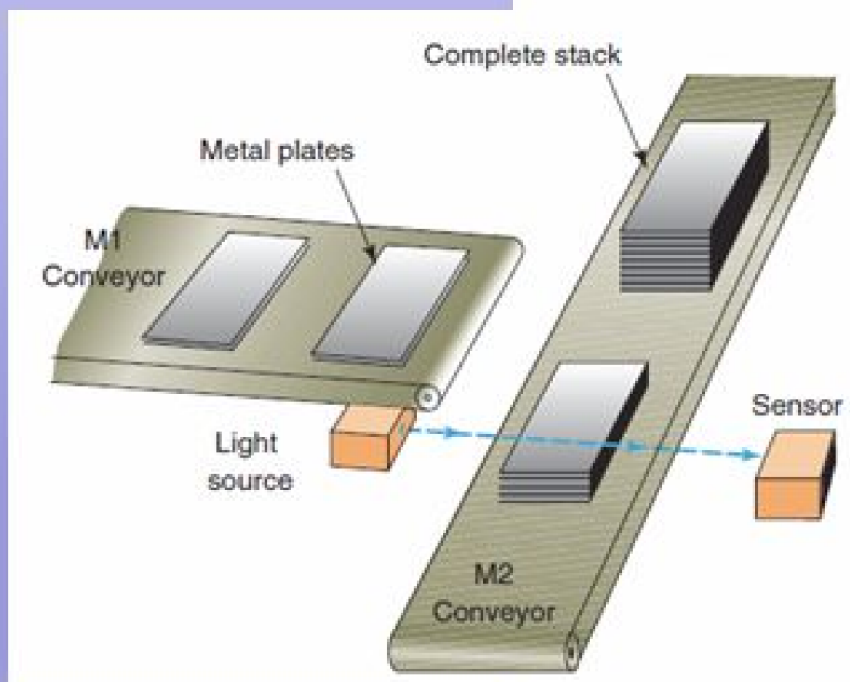


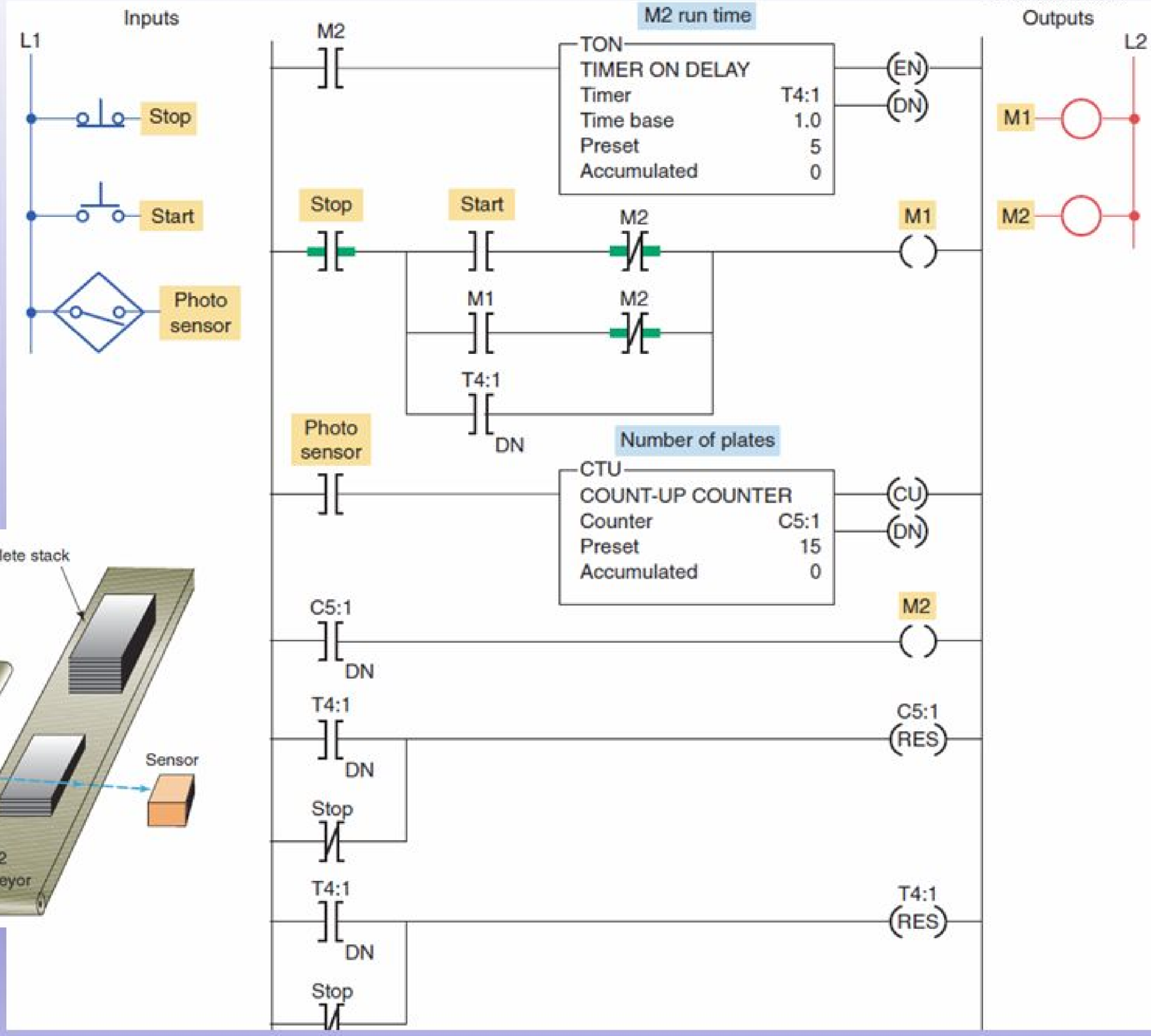


8.6

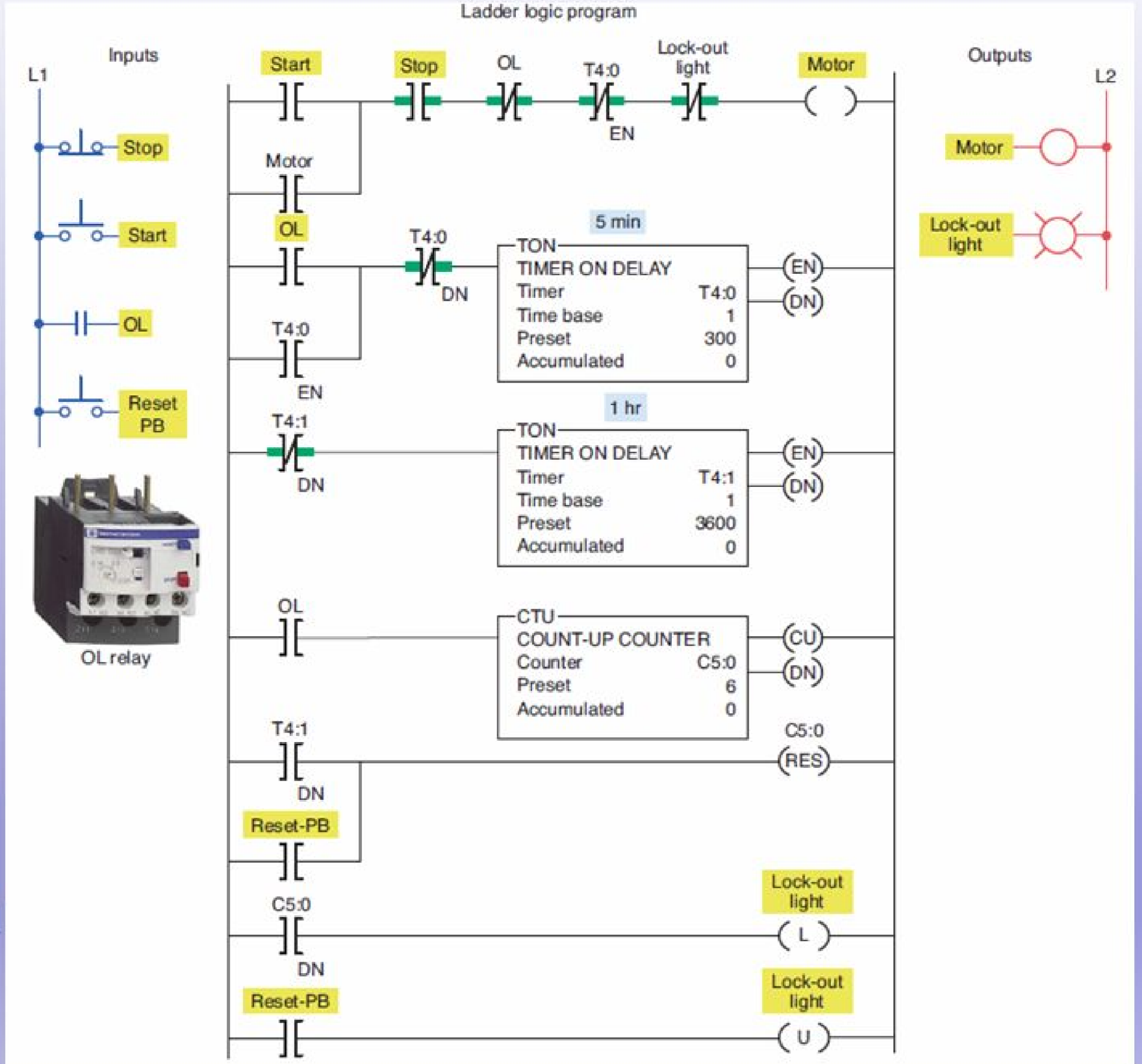
Combining Counter and Timer Functions

Automatic stacking program

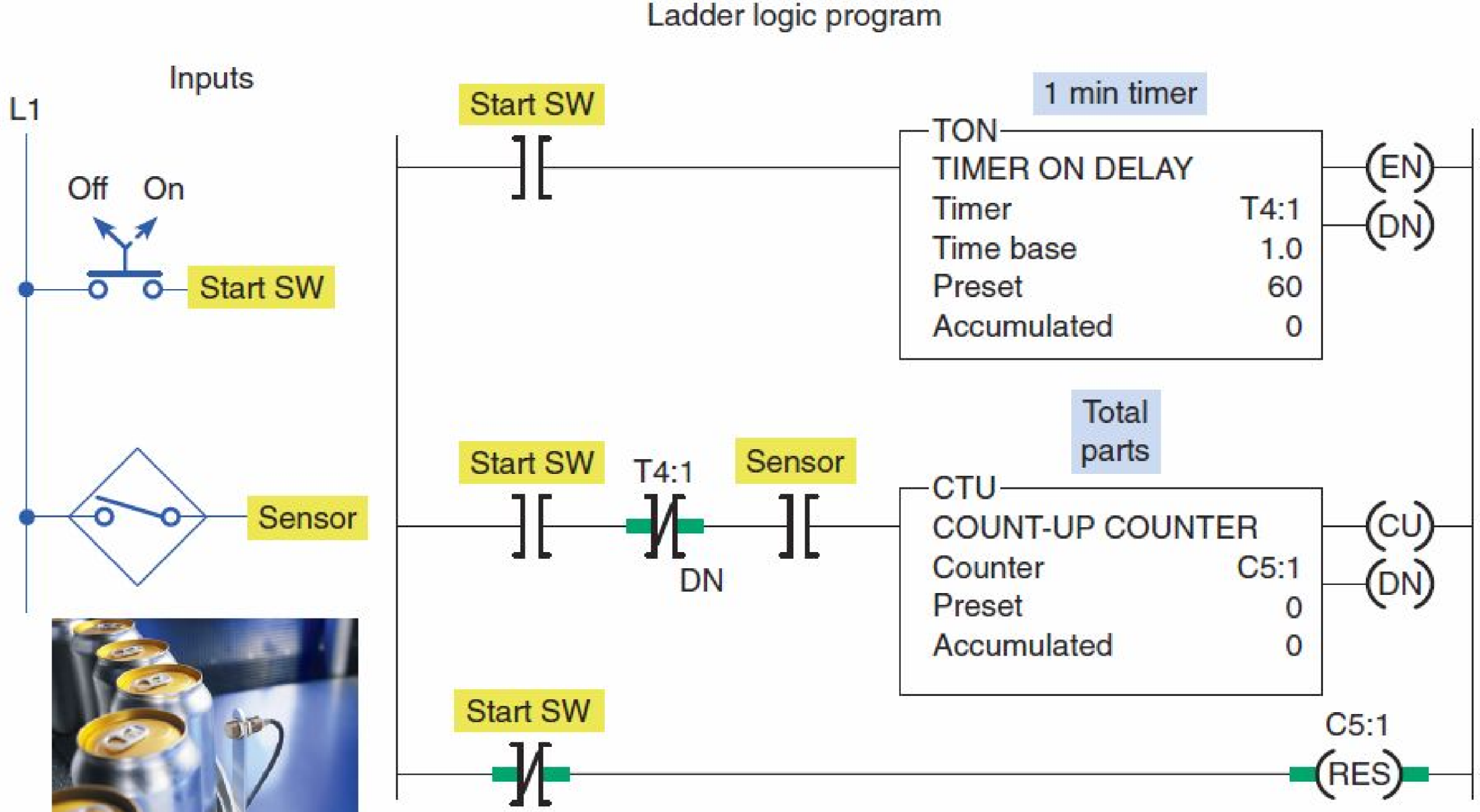




Motor lock-out program



Product flow rate program.



Timer driving a counter to produce an extremely long time-delay period.