CSE-3103: Microprocessor and Microcontroller

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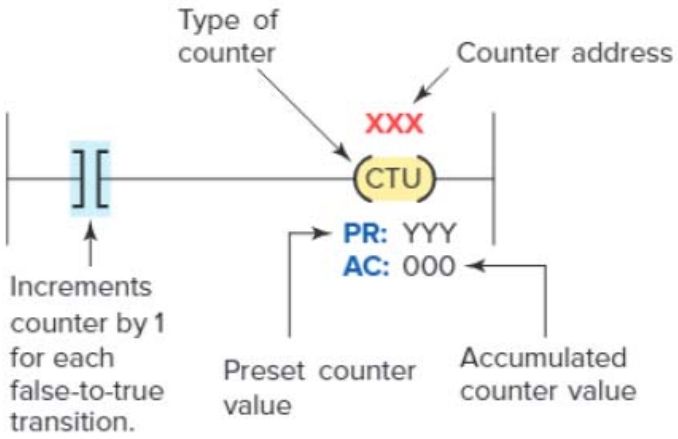
Counter Instructions

Electronic counters →
- count up,
- count down,
- combined to count up and down.

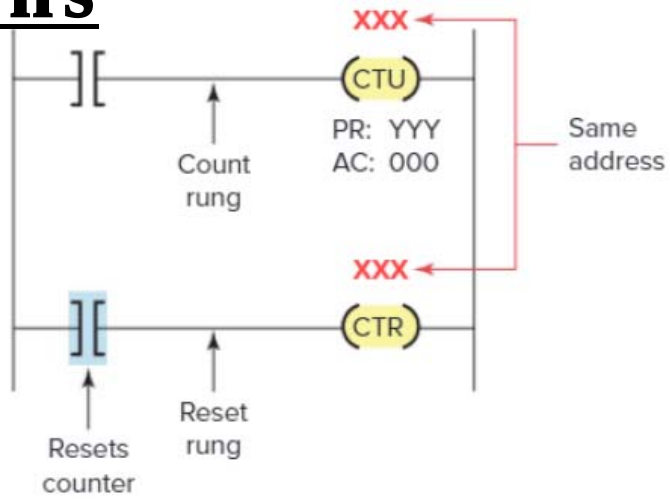
2 methods to represent counter within PLC's ladder logic program →
- coil format,
- block format.

Coil-formatted up-counter instruction →
- counter rung makes false-to-true transition →
  - increments its accumulated value by 1.
- accumulated count = preset count →
  - counter output is energized or set to 1.
- part of instruction →
  - Counter type,
  - Counter address,
  - Counter preset value,
  - Accumulated count.

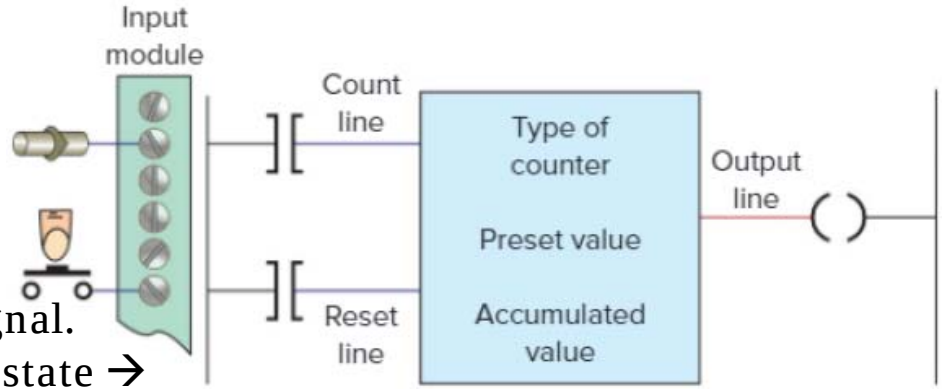


Counter Instructions

Coil-formatted counter instruction with
separate instruction for resetting counter →
programmed →
reference address of counter reset coil (CTR) =
reference address of counter (CTU) that it is to reset.



Block-formatted counter →
instruction block =
type of counter (up or down),
counter's preset value,
accumulated or current value.
2 input conditions =
count and reset.



PLC counters operate on leading edge of input signal.
count input transfers from off state to on state →
counter will either increment or decrement.
counter will not operate on trailing edge, or on-to-off transition.

Counter Instructions

Counting sequence of up-counter and down-counter →

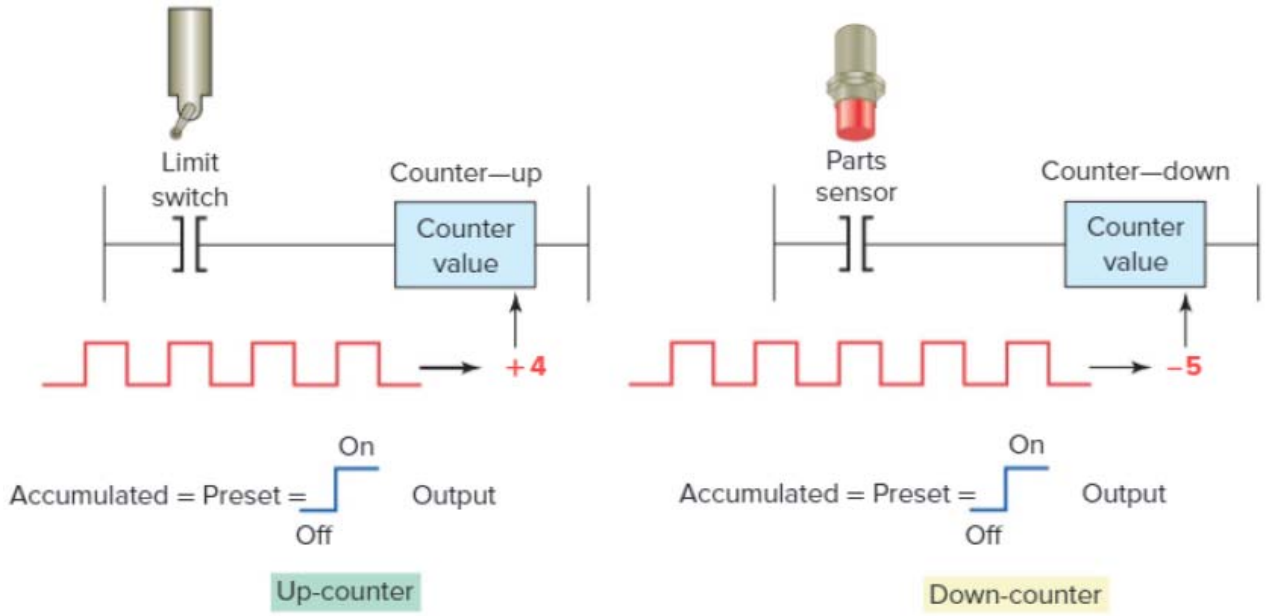
value indicated by counter = accumulated value.

counter will increment or decrement until

accumulated value of counter = preset value.

counter reset →

counter accumulated value = predetermined value.



Up-Counter

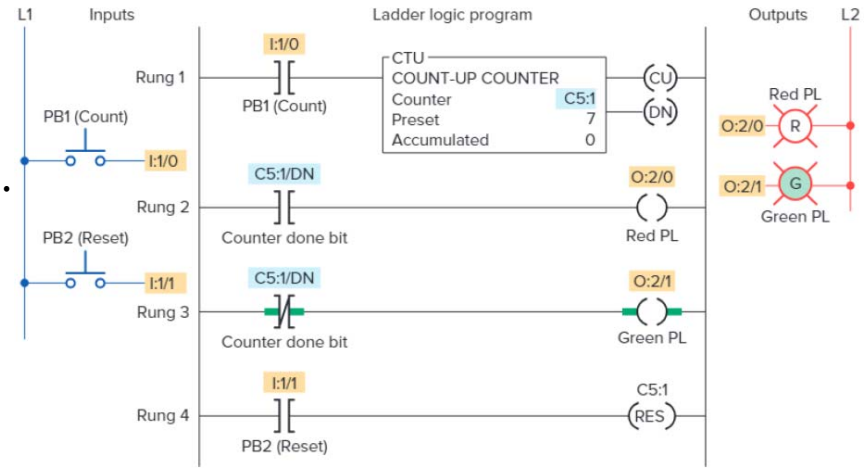
Up-counter →

output instruction,

instruction = false-to-true transitions →

increment its accumulated value.

after required number of counts = trigger event.



Operation of SLC 500 count-up counter →

accumulated count = 7 →

turn red pilot light on,

turn green pilot light off.

operating pushbutton PB1 provides off-to-on transition pulses,

transitions are counted by counter.

preset value of counter is set for 7.

each false-to-true transition of rung →

increases counter's accumulated value by 1.

output O:2/1 is energized as long as accumulated value < 7.

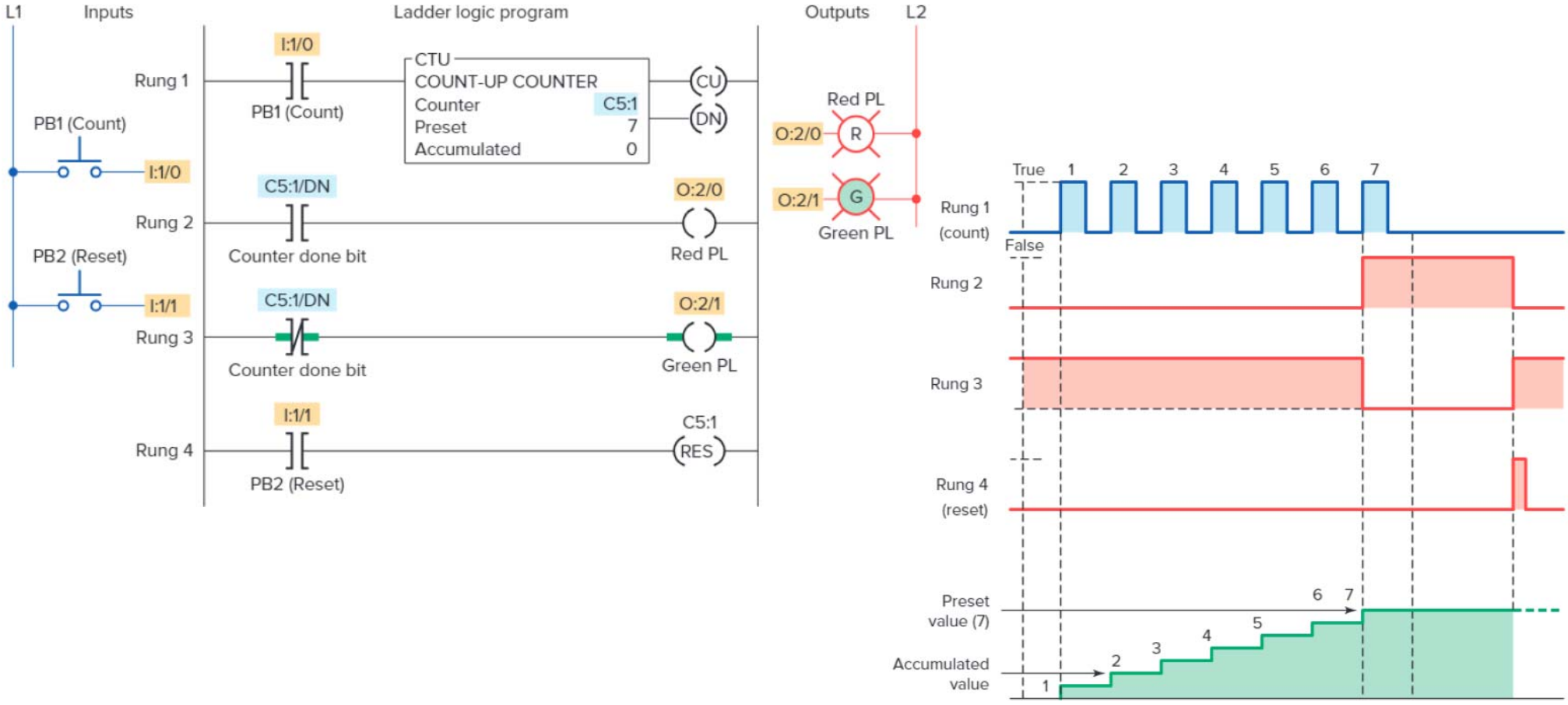
after 7 pulses →

preset counter value = accumulated counter value,

output DN is energized.

Up-Counter

Operation of SLC 500 count-up counter →



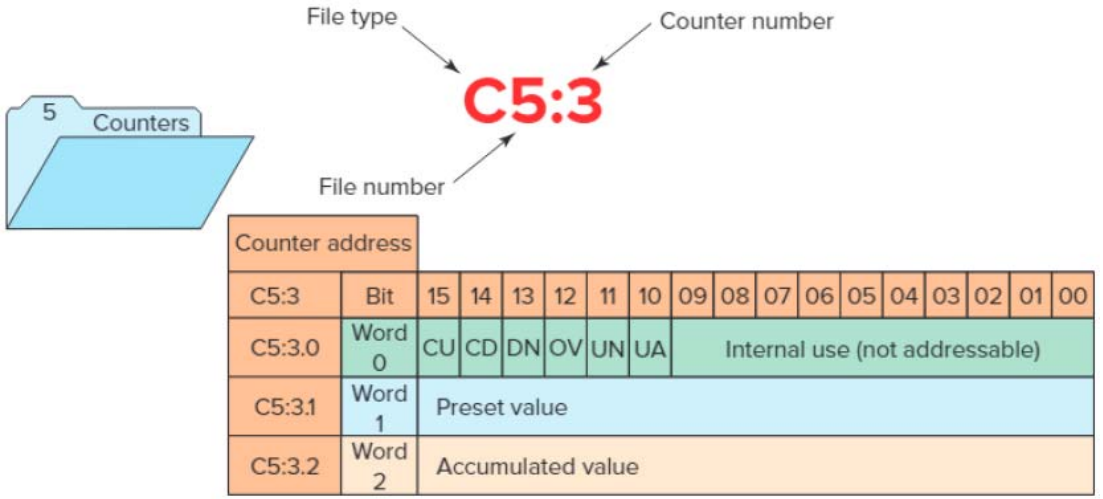
Up-Counter

Operation of SLC 500 count-up counter →

rung 2 becomes true,
energizes output O:2/0 = switch on red pilot light.
at same time, rung 3 becomes false,
de-energizes output O:2/1 = switch off green pilot light.
counter is reset by closing pushbutton PB2 →
rung 4 becomes true,
accumulated count = zero.
counting can resume when rung 4 goes false again.

Allen-Bradley SLC 500 counter file →

= file 5.
each counter = three 16-bit words,
3 data words →
control word,
preset word,
accumulated word.
collectively called counter element.
up to 256 counter elements.



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															

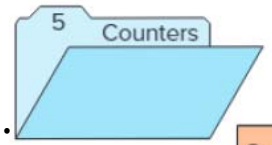
Up-Counter

Allen-Bradley SLC 500 counter file →

3 data words shares same base address,
base address = address of counter itself.

Addresses for counter file 5, counter element 3 (C5:3) →

C5 = counter file 5,
:3 = counter element 3 (0-255 counter elements per file).
address →
C5:3/DN = done bit.
C5:3/CU = count-up enable bit.
C5:3/CD = count-down enable bit.
C5:3/OV = overflow bit.
C5:3/UN = underflow bit.
C5:3/UA = update accumulator bit.



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															

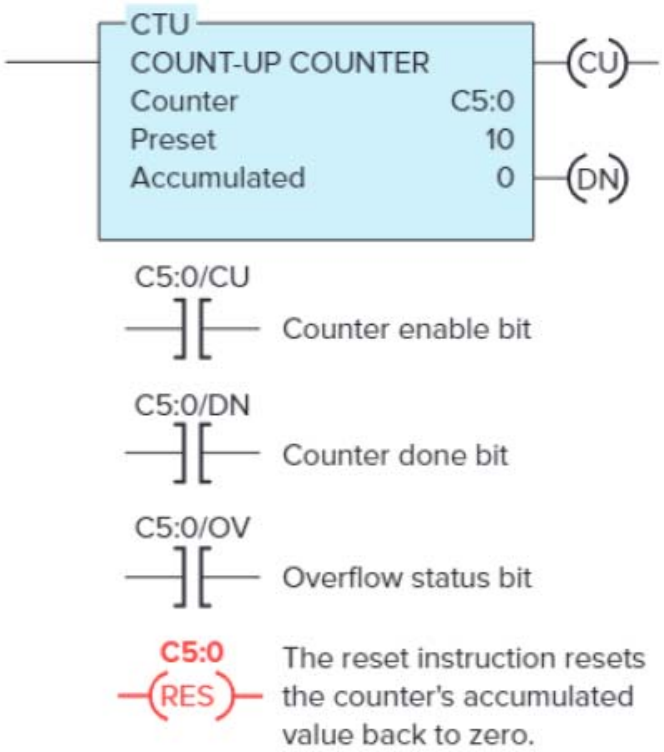
Up-Counter

Count-up counter instruction →

used in SLC 500 controller instruction set.
address for counters = C5:0 to C5:255.
information to be entered →
Counter Number →
come from counter file.
C5:0 = counter file 5, counter 0.

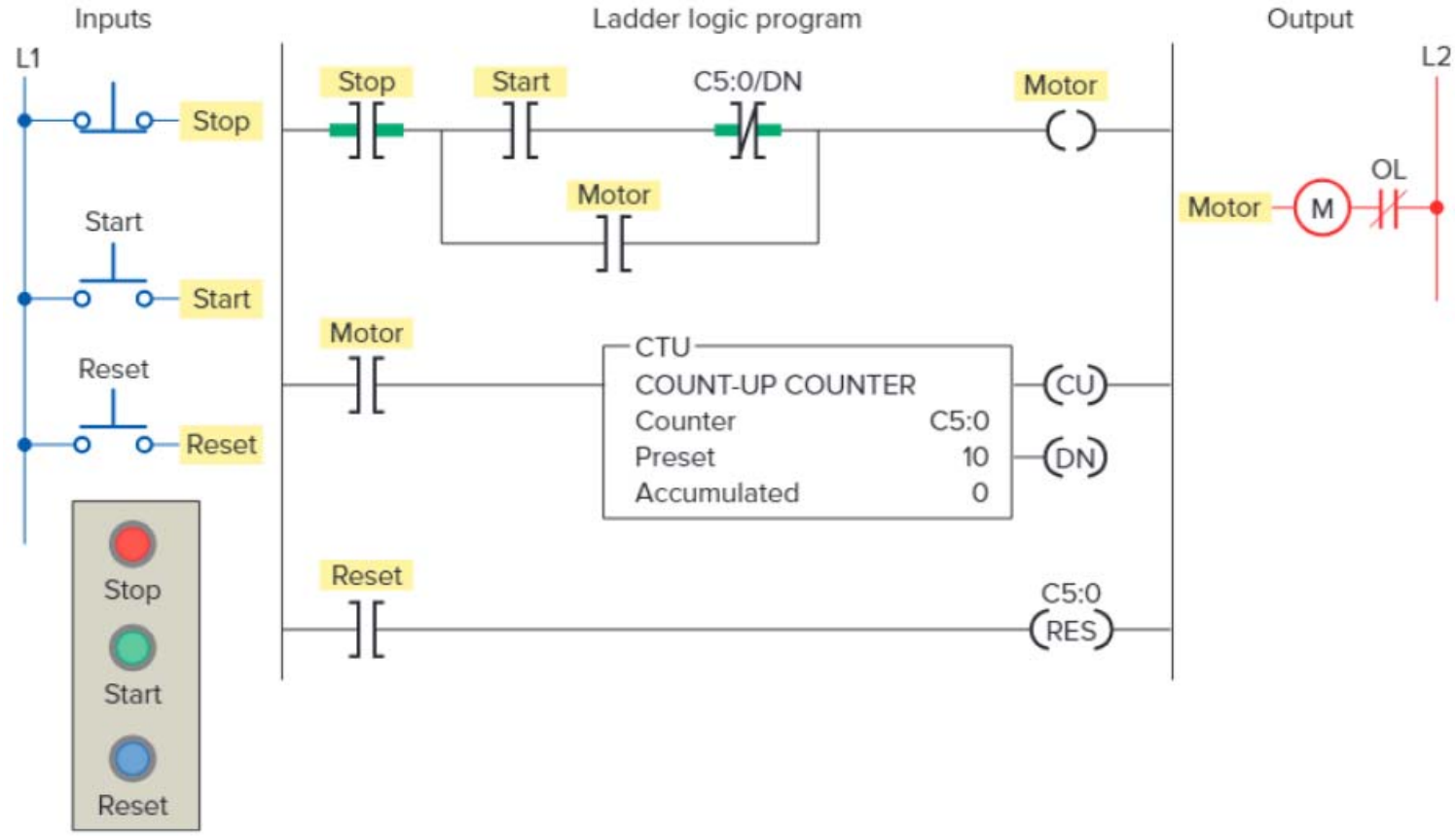
Preset Value →
from -32,768 to +32,767.
example preset value = 10.

Accumulated Value →
from -32,768 to +32,767.
example value = 0.
reset instruction → accumulated value = 0.



Up-Counter

PLC counter program used to stop motor from running after 10 operations.
operation of program →



Up-Counter

PLC counter program used to stop motor from running after 10 operations.
operation of program →

up-counter C5:0 counts number of on/off times motor starts.

preset value of counter = 10.

counter done bit examine-off instruction is programmed
in series with motor output instruction.

motor output examine-on instruction is used to increment
accumulated value of counter for each off/on operation.

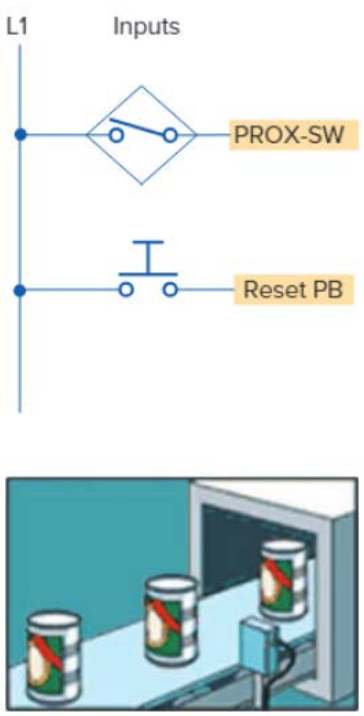
after count of 10 is reached →
counter done bit examine-off instruction goes false
preventing motor from being started.

closure of reset pushbutton resets accumulated count to zero.

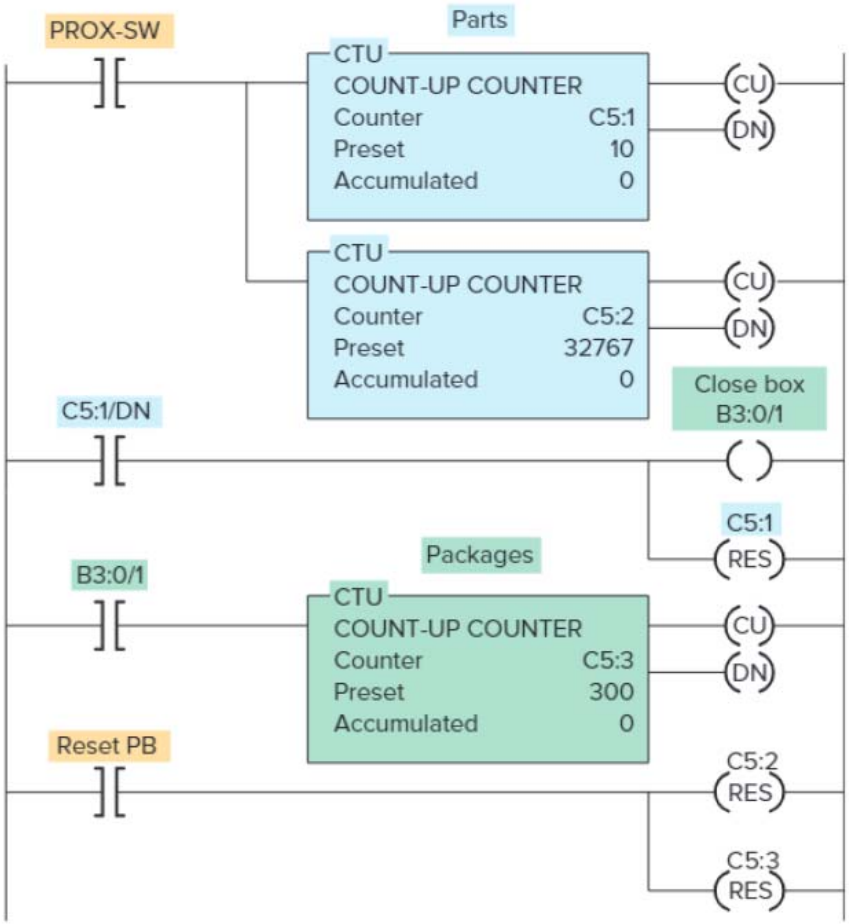
Up-Counter

PLC can-counting program that uses three up-counters.

operation of program →



Ladder logic program



Up-Counter

PLC can-counting program that uses three up-counters.
operation of program →

counter C5:2 counts total number of cans
coming off assembly line for final packaging.

each package must contain 10 parts.

10 cans are detected →
counter C5:1 sets bit B3:0/1 to initiate box closing sequence.

counter C5:3 counts total number of packages filled in day.
maximum number of packages per day is 300.

pushbutton is used to restart total part and
package count from zero daily.

Program Control Instructions

Program control instructions →
output-type instructions,
referred to as override instructions,
certain conditions are met →
enable or disable block of logic program,
move execution of program from one place to another place.

Program control commands →

JMP	Jump to Label	Jump forward/backward to corresponding label instruction
LBL	Label	Specifies label location
JSR	Jump to Subroutine	Jump to designated subroutine instruction
RET	Return from Subroutine	Exits current subroutine and returns to previous condition
SBR	Subroutine	Identifies subroutine program
TND	Temporary End	Makes temporary end that halts program execution
MCR	Master Control Reset	Clears all set non-retentive output rungs between paired MCR instructions
SUS	Suspend	Identifies conditions for debugging and system troubleshooting