Program File List

Name	Number	Type	Rungs	Debug	Bytes
[SYSTEM]	0	SYS	0	No	0
	1	SYS	0	No	0
MAIN_PROG	2	LADDER	7	No	71
USER_FAULT	3	LADDER	2	No	25
INPUTCHECK	5	LADDER	10	No	456
DOBUSINESS	7	LADDER	12	No	699
OUTPUT2SIM	14	LADDER	3	No	52
SIMULATION	15	LADDER	20	No	617

LAD 2 - MAIN_PROG --- Total Rungs in File = 7

Reset wrap counter accumulators for either First Pass or system is in manual mode

0000

Count wraps @ TOP

CLR
Clear
Dest C5:2.ACC
0

Count wraps @ BOTTOM

CLR
Clear
Dest C5:3.ACC
0

0001

END

Validate Film Carriage Limit switches:
- Both are Normally Open switches i.e.
  - input value is 1 when carriage is ***NOT*** at limit
  - input value is 0 when carriage is at limit switch
- Film Carriage cannot be at both limit switches at the same time
  - i.e. both limit switch input value cannot be 0 at the same time
  - So at least one input value must be 1 at all times, otherwise something is wrong
- If both input values are 0, it is likely that at least one of the switches has a fault

0000

1:Film not at TOP
I:0
2
Bul.1763

1:Film not at BOTTOM
I:0
3
Bul.1763

1:Limit Switches OK
0:Bad Limit Switch
=> both active
B3:0
1

Input selector switch
- A value in the range 1-6 is a wrap count for the Auto Cycle.
- A value in the range 7-9 is for manually controlling an output (Film Carriage motion or Turntable rotation)

Parse Selector Switch value: extract discrete input bits [4567] via mask; shift to range 0-15

0001

Selector Sw value

AND
Bitwise AND
Source A I:0.0 0102h<
Source B 240 240<
Dest N7:20 0000h<

Selector Sw value

DIV
Divide
Source A N7:20 0<
Source B 16 16<
Dest N7:20 0<

Calculate last turntable encoder pulse count before one full wrap

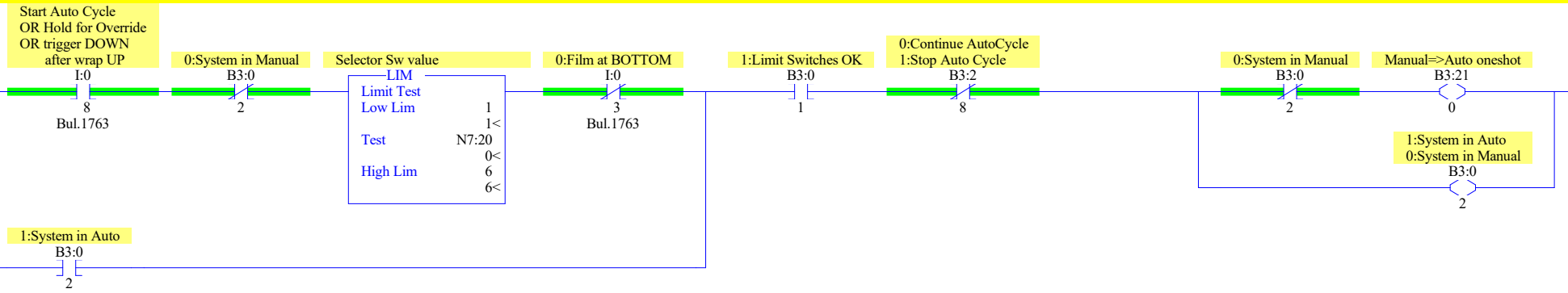
0002

Last pulse before one full wrap

SUB
Subtract
Source A C5:0.PRE 112<
Source B 1 1<
Dest N7:9 111<

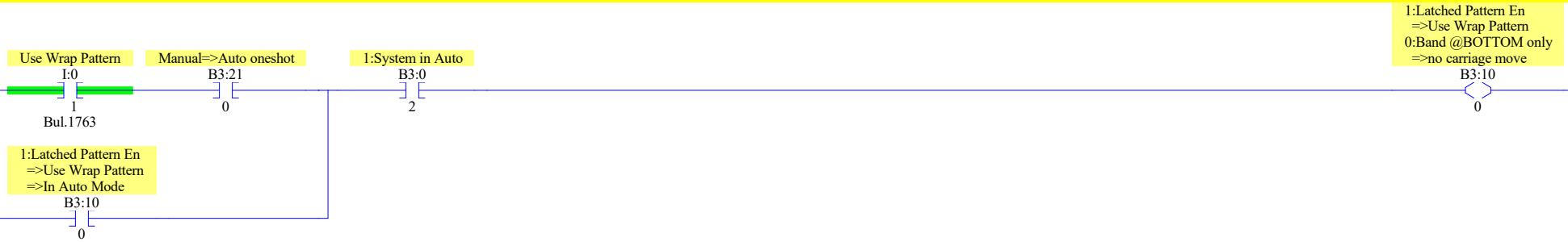
Auto wrap mode
- Canonical Start/Stop Circuit pattern
  - Start condition: ALL OF Start button is pressed, AND System is in Manual, AND Selector switch value is in range 1-6, AND Film Carriage is at bottom
  - Stop condition: EITHER Limit switches are not valid (cf, Rung 0000 above), OR Auto Cycle Stop condition is active
  - Seal-in/Run: System Auto/Manual bit
Also
- Assign 1 to value of oneshot bit on the scan cycle when Auto Mode starts

0003



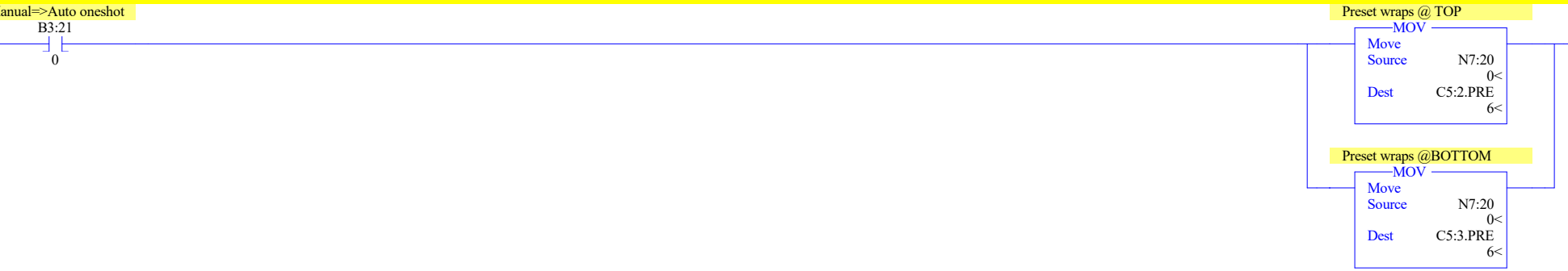
If BOTH transition to Auto Mode occurred during this scan cycle, AND input I:0.0/1 value is 1, then latch a bit to enable banding at TOP and BOTTOM per the Wrap Pattern as long as system is in Auto mode
If this bit value is 0, then do not use the Wrap Pattern, and instead band once at the BOTTOM and never move the Film Carriage UP and DOWN

0004



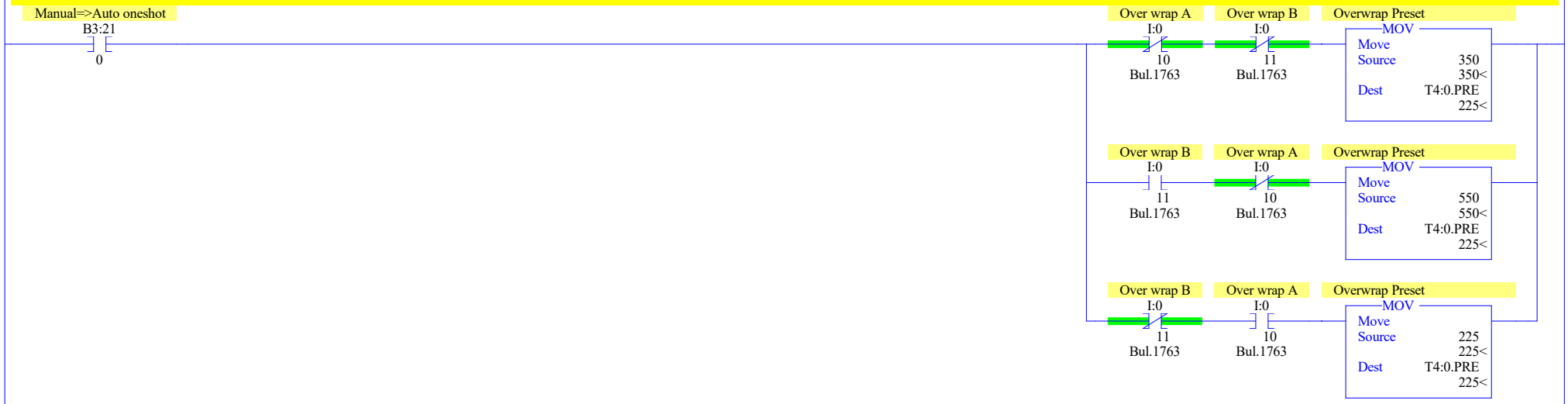
If transition to Auto Mode occurred during this scan cycle, update wrap counters' presets to current selector switch value (1-6)
*** N.B. selector switch values outside that range have special meanings (manual turntable or carriage motion) amd are ignored here

0005



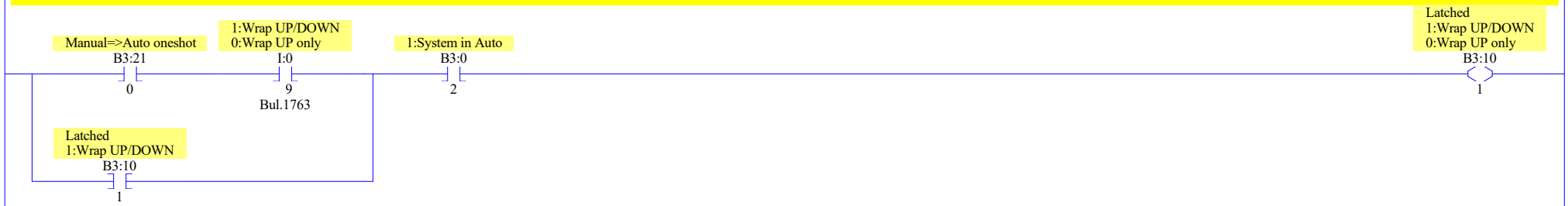
If transition to Auto Mode occurred during this scan cycle, assign overwrap timer preset values per overwrap inputs

0006



Evaluate Wrap UP/DOWN input switch state, and latch on first scan of Auto mode
- EITHER [Wrap UP/DOWN] input is 1 =>
 - Start turntable rotation at BOTTOM
 - Move Film Carriage UP, stop at TOP Limit Switch
 - Make banding wraps at TOP, sans overwrap
 - Move Film Carriage DOWN, stop at BOTTOM Limit Switch
 - Make banding wraps at BOTTOM, plus overwrap
 - Stop turntable rotation, leave Auto Mode
- OR [Wrap UP/DOWN] input is 0 (Wrap UP only) =>
 - Start turntable rotation at BOTTOM
 - Make banding wraps at BOTTOM, sans overwrap
 - Move File Carriage UP, stop at TOP Limit Switch
 - Make banding wraps at TOP, plus overwrap
 - Stop Turntable rotation
 - Flash light, wait for operator to (cut film and then) press Start
 - Move Film Carriage DOWN, stop at BOTTOM Limit Switch
 - Leave Auto Mode

0007



Turntable wrapper has an encoder that generates 112 input pulses per single wrap (one revolution), but only ocunt them when Film Carriage is at TOP or BOTTOM

0008

1:Turntable encoder pulse on
I:0
0
Bul.1763

0:Film at TOP
I:0
2
Bul.1763

0:Film at BOTTOM
I:0
3
Bul.1763

Count turntable pulses 112 per wrap?

CTU
Count Up
Counter C5:0
Preset 112<
Accum 0<

CU
DN

0009

END

Every time the Turntable encoder pulse input counter completes 112 pulses, increment the TOP or BOTTOM wrap counter apropo the current state

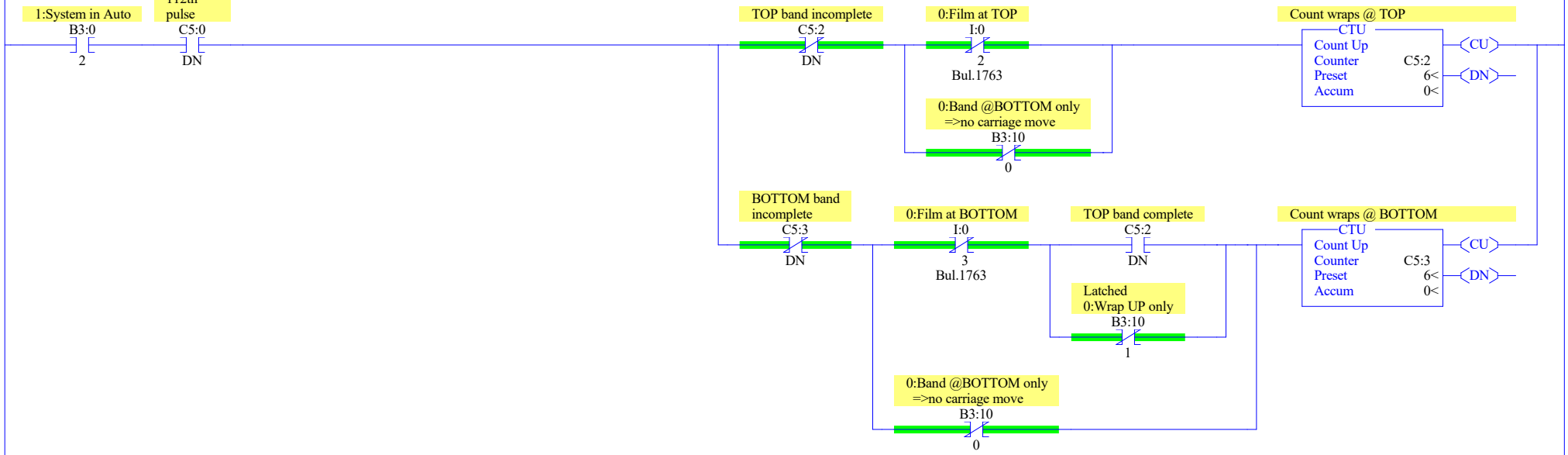
- The basic requirement to increment the TOP band counter is that the Film Carriage is at the TOP limit switch,
  - WHETHER that is after the BOTTOM bands were completed when the Wrap Pattern is UP only,
  - OR that is before the BOTTOM bands are to be completed later when the Wrap Pattern is UP/DOWN

N.B. The Film Carriage at TOP limit switch condition may be overridden by disabling the Use Wrap Pattern input

- The basic requirement to increment the BOTTOM band counter is that the Film Carriage is at the BOTTOM limit swtich
  - WHETHER that is before the TOP bands are to be completed when the Wrap Pattern is UP only,
  - OR that is after the TOP bands were completed when the Wrap Pattern is UP/DOWN

N.B. the TOP band completed check for Wrap Pattern UP/DOWN may be overridden by disabling the Use Wrap Pattern input

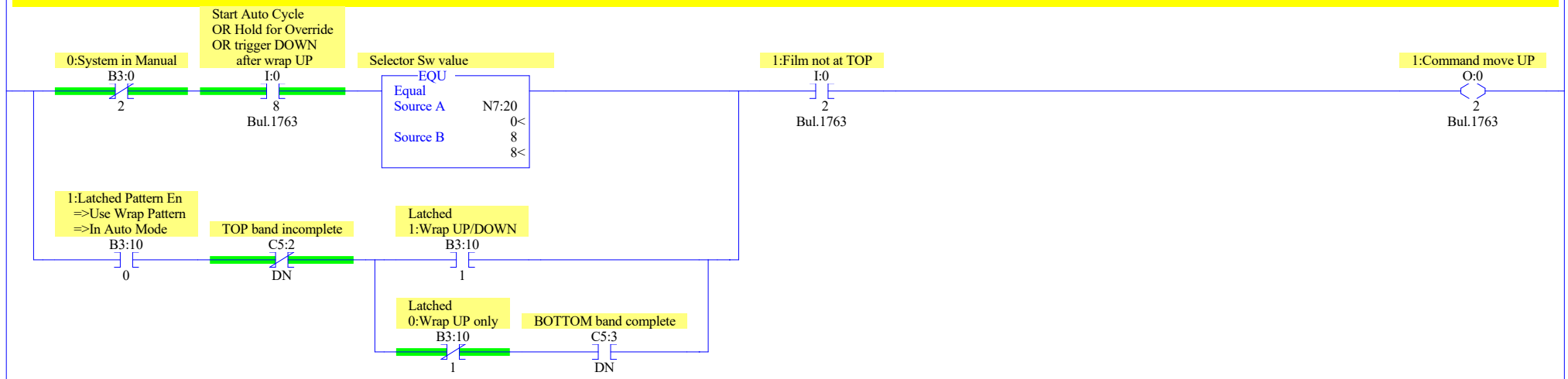
0000



Move Film Carriage UP until (i.e. if not) at TOP*
- Manual: if Start button is pressed AND Selector Switch value is 8.
- Auto: if
  - Film Carriage is allowed to got UP then DOWN**,
  - AND Film Carriage has not been to the TOP yet***,
  - AND
    - EITHER TOP band is to be done first***,
    - OR BOTTOM band is to be done first.

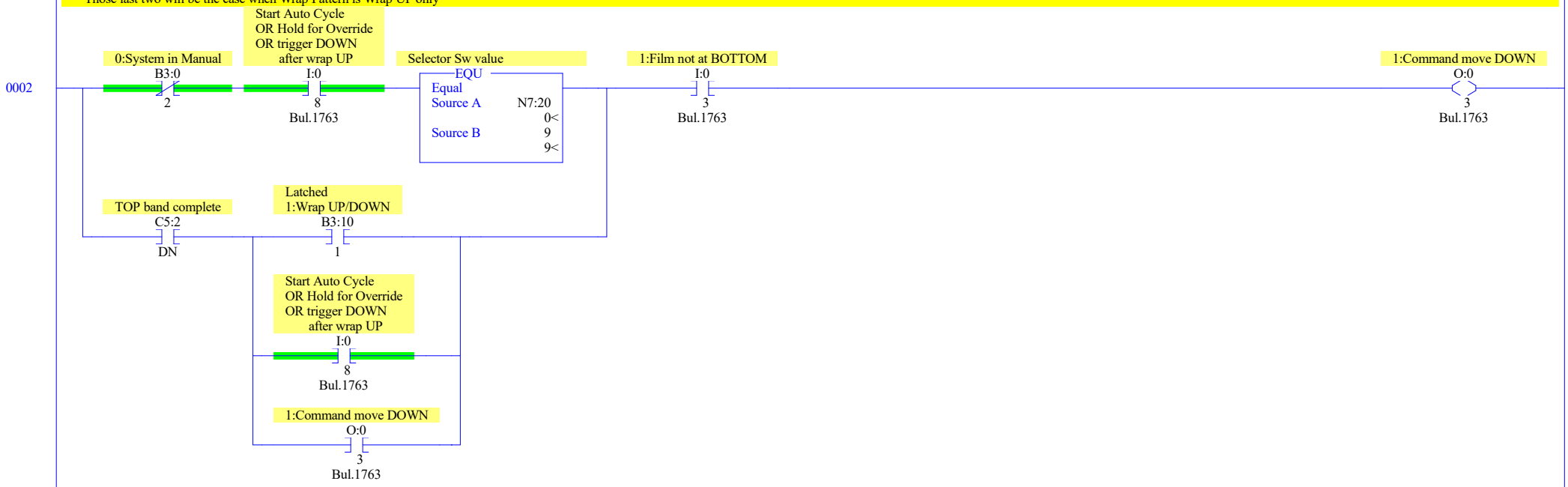
* Don't need to check if Limit Switches are OK because [Film not at TOP] ensures they are
** [Latched Wrap Pattern Enabled] is only 1 if already in Auto Mode
*** [TOP band incomplete] will be 1when to stop Film Carriage moving up when it is at BOTTOM the second time for [Wrap UP/DOWN].

0001

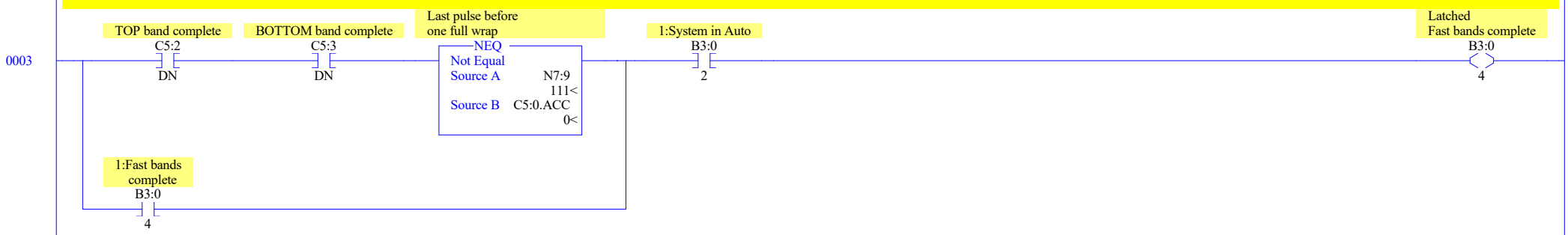


Move Film Carriage DOWN until (i.e. if not) at BOTTOM*
- Manual: if Start button is pressed AND Selector Switch value is 9.
- Auto: if
  - Film Carriage has completed the TOP band**,
  - AND
    - EITHER BOTTOM band is to be done last,
    - OR Start button pressed***,
    - OR Film Carriage is already moving down***.

* Don't need to check if Limit Switches are OK because [Film not at BOTTOM] ensures they are
** Film Carriage would not be away from BOTTOM unless [Wrap Pattern Enabled]
  - Also TOP band can only be complete if system is in Auto Mode, because TOP band count is cleared to 0 in Manual
*** Those last two will be the case when Wrap Pattern is Wrap UP only

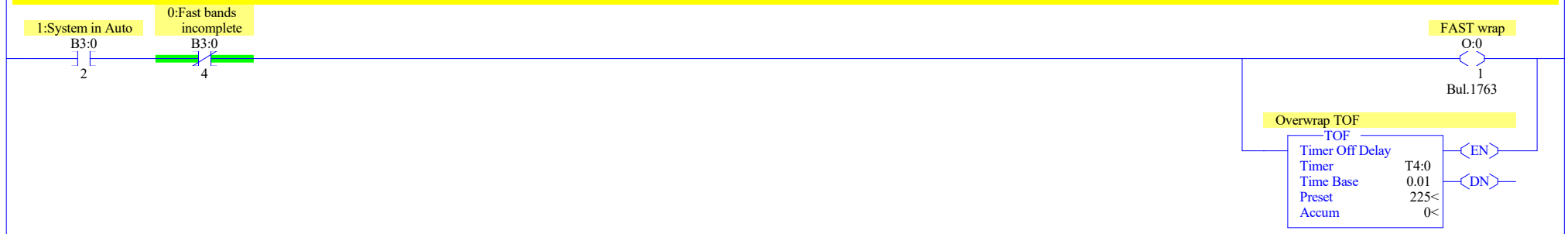


Latch a bit to mark the end of the FAST bands in Auto Mode, which is when
- TOP and BOTTOM band counters are complete
- Turntable encoder counter is 1 pulse short of another wrap



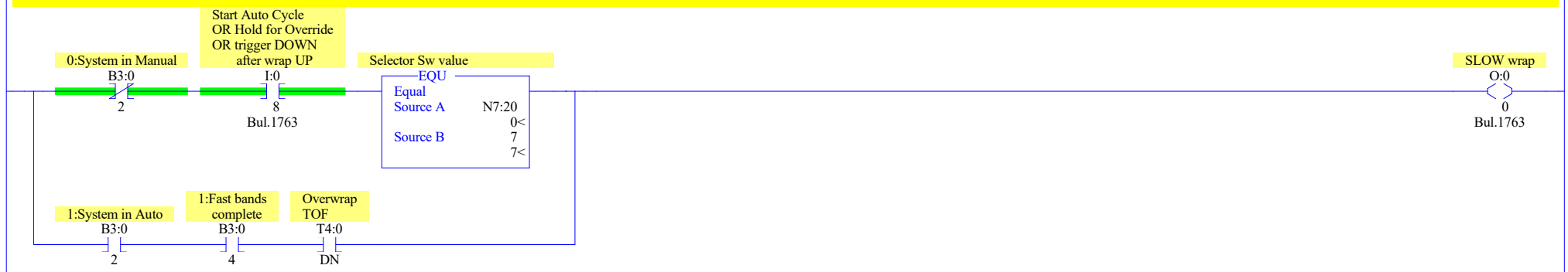
Run Turntable at FAST wrap speed in Auto Mode, until these FAST bands are complete
Also arm a TOF that will be used to drive Turntable at SLOW wrap speed after that

0004



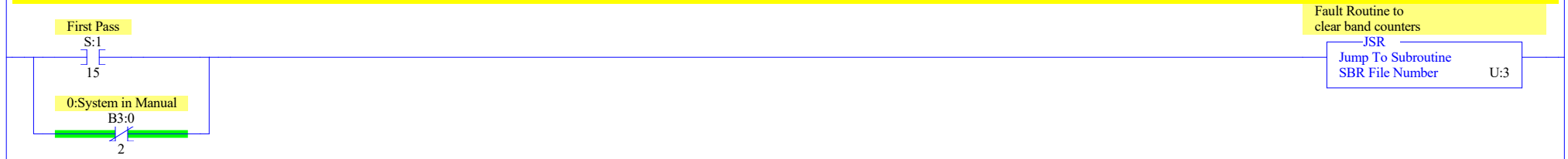
Run Turntable at SLOW wrap speed
- Manual: if Start button is pressed AND Selector Switch value is 7.
- Auto: for Overwrap TOF duration after FAST wrap speed stops; TOP and BOTTOM bands created at this slow speed are SLOW bands

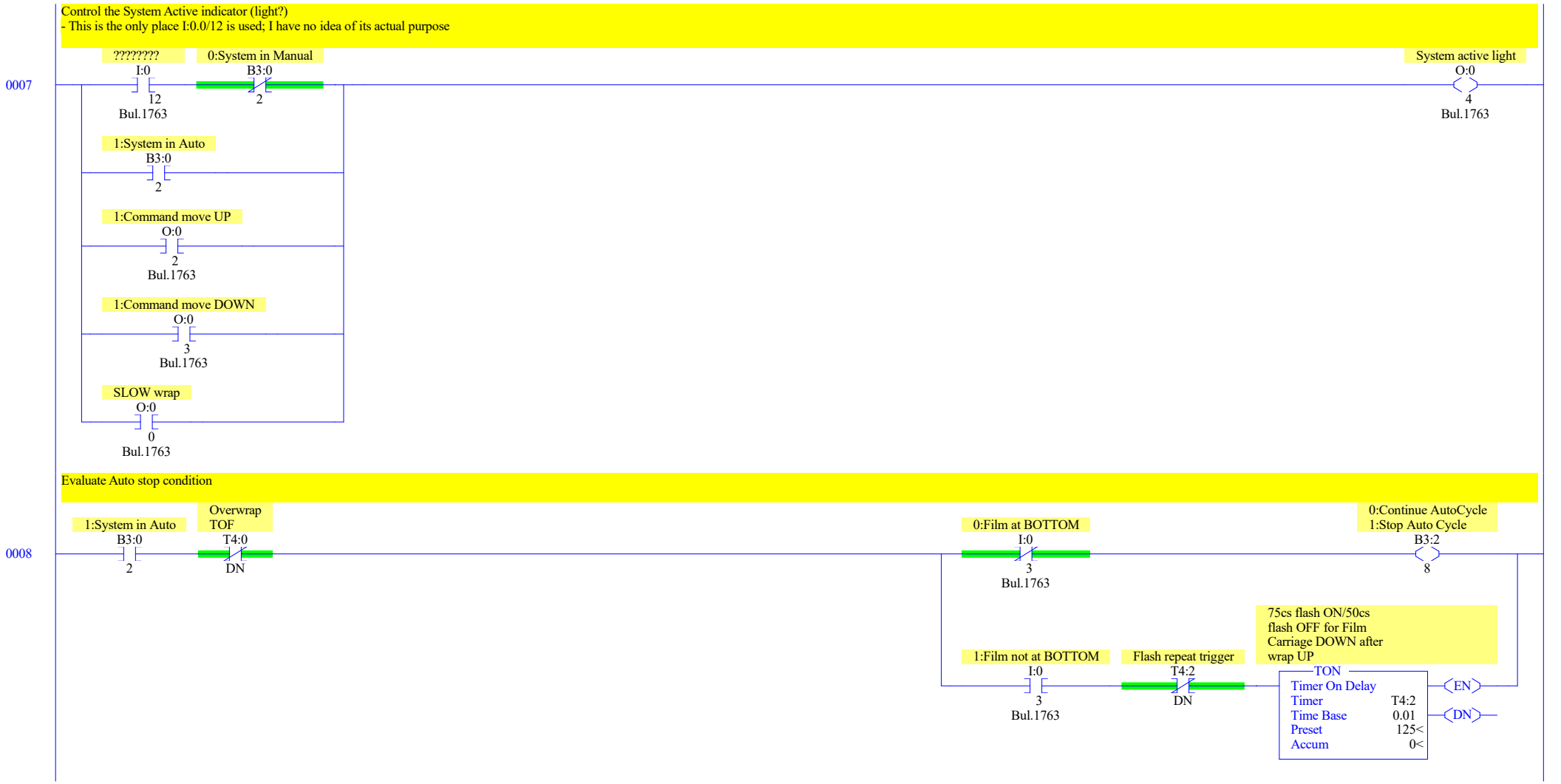
0005



Reset wrap counter accumulators for either First Pass or system is in manual mode

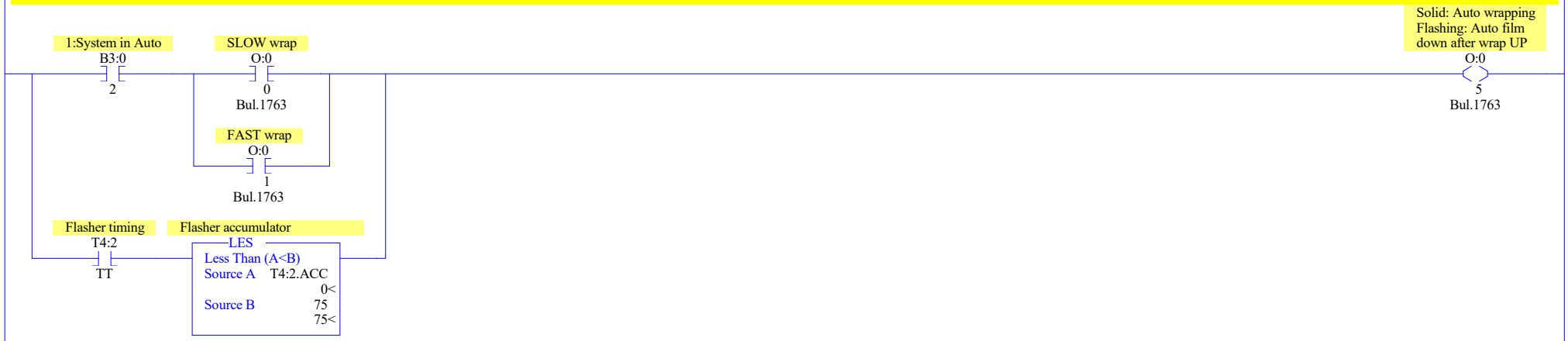
0006




Control the System Active indicator (light?)
- This is the only place I:0.0/12 is used; I have no idea of its actual purpose
0007
???????
I:0
12
Bul.1763
0:System in Manual
B3:0
2
System active light
O:0
4
Bul.1763
1:System in Auto
B3:0
2
1:Command move UP
O:0
2
Bul.1763
1:Command move DOWN
O:0
3
Bul.1763
SLOW wrap
O:0
0
Bul.1763
Evaluate Auto stop condition
0008
1:System in Auto
B3:0
2
Overwrap TOF
T4:0
DN
0:Film at BOTTOM
I:0
3
Bul.1763
0:Continue AutoCycle
1:Stop Auto Cycle
B3:2
8
75cs flash ON/50cs flash OFF for Film Carriage DOWN after wrap UP
1:Film not at BOTTOM
I:0
3
Bul.1763
Flash repeat trigger
T4:2
DN
TON
Timer On Delay
Timer T4:2
Time Base 0.01
Preset 125<
Accum 0<
EN
DN

Control the wrapping/down status light
- On solid while wrapping in Auto
- Flashing for Wrap UP only from TOP band completed until Film Carriage is at BOTTOM (end of cycle)

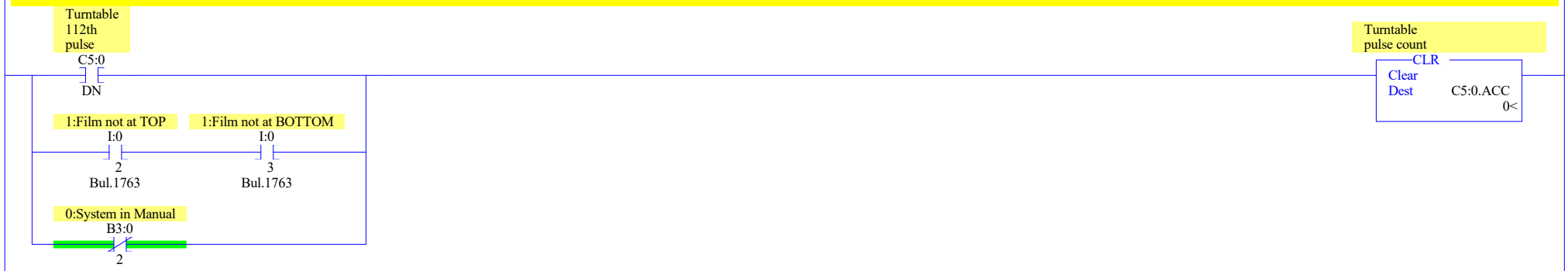
0009



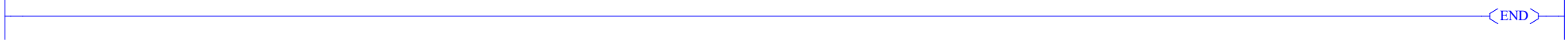
Reset turntable encoder counter accumulator for any of various conditions:
- As each single full wrap is completed
  - N.B. C5:0/DN bit will be a one-shot
- Film Carriage is between both TOP and BOTTOM Limit Switches
- System is in Manual Mode

N.B. Instead or [RESet counter object], which also clears .CU bit, clearing .ACC to 0 prevents
increment during the next scan cycle when counter instruction input trigger is still True

0010



0011



LAD 14 - OUTPUT2SIM --- Total Rungs in File = 3

Copy calculated PLC outputs to Simulator Buffer for use by Simulation routine

0000

Simulator Buffer
PLC Output Word

AND
Bitwise AND
Source A O:0.0
0000h<
Source B 63
63<
Dest N7:101
0000h<

If Simulator is active, then clear actual outputs (O:0.0/0 through O:0.0/5), so simulation activities will not effect physical device operations

0001

0:Disable Simulation
1:Use Simulation
N7:99
0

AND
Bitwise AND
Source A O:0.0
0000h<
Source B -64
-64<
Dest O:0.0
0000h<

0002

END

Simulate the wrapping system using internal memory (N7:90 - N7:101)

Do nothing in this routine if simulation is disabled

0000

0:Disable Simulation
1:Use Simulation
N7:99
0

RET
Return

Transfer the six output values, which were saved to the Simulation Buffer at the end of the last program scan in [LAD 14 OUTPUT2SIM], back into the output word

0001

AND
Bitwise AND
Source A O:0.0 0000h<
Source B -64 -64<
Dest O:0.0 0000h<

OR
Bitwise Inclusive OR
Source A O:0.0 0000h<
Source B N7:101 0000h<
Dest O:0.0 0000h<

Simulate turntable rotation if the SLOW or FAST Wrop outputs are on

0002

SLOW wrap
O:0
0
Bul.1763

Simulated Turntable encoder 0-8191
ADD
Add
Source A N7:95 0<
Source B 3 3<
Dest N7:95 0<

FAST wrap
O:0
1
Bul.1763

Simulated Turntable encoder 0-8191
ADD
Add
Source A N7:95 0<
Source B 4 4<
Dest N7:95 0<

Simulated Turntable encoder 0-8191
AND
Bitwise AND
Source A N7:95 0000h<
Source B 8191 8191<
Dest N7:95 0000h<

Simulate Film Carriage movement if the UP or DOWN commands are active
Simulate Film Carriage position hysteresis from inertia near the limit switches

0003

1:Command move UP
O:0
2
Bul.1763

Simulated Position Film Carriage 0:BOTTOM 10000:TOP

LES
Less Than (A<B)
Source A N7:94 0<
Source B 10000 10000<

Simulated Position Film Carriage 0:BOTTOM 10000:TOP

ADD
Add
Source A N7:94 0<
Source B 1 1<
Dest N7:94 0<

Simulated Position Film Carriage 0:BOTTOM 10000:TOP

GEQ
Grtr Than or Eql (A>=B)
Source A N7:94 0<
Source B 9700 9700<

Simulated Position Film Carriage 0:BOTTOM 10000:TOP

MOV
Move
Source 10000 10000<
Dest N7:94 0<

0004

1:Command move DOWN
O:0
3
Bul.1763

Simulated Position Film Carriage 0:BOTTOM 10000:TOP

GRT
Greater Than (A>B)
Source A N7:94 0<
Source B 0 0<

Simulated Position Film Carriage 0:BOTTOM 10000:TOP

SUB
Subtract
Source A N7:94 0<
Source B 1 1<
Dest N7:94 0<

Simulated Position Film Carriage 0:BOTTOM 10000:TOP

LEQ
Less Than or Eql (A<=B)
Source A N7:94 0<
Source B 300 300<

Simulated Position Film Carriage 0:BOTTOM 10000:TOP

MOV
Move
Source 0 0<
Dest N7:94 0<

Simulate Turntable Encoder position from Bit 6 of the Turntable position calculated above

0005

Simulated Turntable encoder 0-8191
N7:95
6

Simulated I:0.0/0 Table Pulse
N7:100
0

Simulate Unknown Input I:0.0/1 state from the appropriate integer in simulation memory

0006

Simulated INPUT I:0.0/1 ???????? Bit 0
N7:97
0

Simulated I:0.0/1 Wrap Patt En
N7:100
1

Simulate Film Carriage at TOP and at BOTTOM Limit Switches' states from the Film Carriage position calculated above

0007

Simulated Position
Film Carriage
0:BOTTOM
10000:TOP

LES
Less Than (A<B)
Source A N7:94
0<
Source B 9700
9700<

Simulated
I:0.0/2 Not @TOP
N7:100
2

0008

Simulated Position
Film Carriage
0:BOTTOM
10000:TOP

GRT
Greater Than (A>B)
Source A N7:94
0<
Source B 300
300<

Simulated
I:0.0/3 Not @BOTTOM
N7:100
3

Simulate the four bits' states of the Selector Switch manual input from the appropriate simulation memory integer

0009

Simulated Hand INPUT
Selector switch
1-6:Wrap count
7:Rotate 8:UP 9:DOWN
N7:91
0

Simulated
I:0.0/4 Sel Sw Bit 0
N7:100
4

0010

Simulated Hand INPUT
Selector switch
1-6:Wrap count
7:Rotate 8:UP 9:DOWN
N7:91
1

Simulated
I:0.0/5 Sel Sw Bit 1
N7:100
5

0011

Simulated Hand INPUT
Selector switch
1-6:Wrap count
7:Rotate 8:UP 9:DOWN
N7:91
2

Simulated
I:0.0/6 Sel Sw Bit 2
N7:100
6

0012

Simulated Hand INPUT
Selector switch
1-6:Wrap count
7:Rotate 8:UP 9:DOWN
N7:91
3

Simulated
I:0.0/7 Sel Sw Bit 3
N7:100
7

Simulate the Start Button's state from the value appropriate simulation memory integer
- If that integer value is 0, then the Start state is released
- If that integer value is positive, then Start Button's state is pressed but simulated as such for a limited duration
- If that integer value is negative, then the Start Button's state is pressed until the integer value is changed

0013

Simulated Hand INPUT
Start button
0: Released
<0: Infinite press
>0: Finite press

NEQ
Not Equal
Source A N7:90 0<
Source B 0 0<

Simulated
I:0.0/8 Start Button
N7:100
8

Simulated Hand INPUT
Start button
0: Released
<0: Infinite press
>0: Finite press

GRT
Greater Than (A>B)
Source A N7:90 0<
Source B 0 0<

Simulated Hand INPUT
Start button
0: Released
<0: Infinite press
>0: Finite press

SUB
Subtract
Source A N7:90 0<
Source B 1 1<
Dest N7:90 0<

Simulate the remaining inputs' values from the value of the appropriate simulation memory integers
- Wrap Pattern
- Overwrap
- Unknown Input I:0.0/12

0014

Simulated Hand INPUT
Wrap pattern
0:UP 1:UP/DOWN
N7:93
0

Simulated
I:0.0/9 Wrap UP/DOWN
N7:100
9

0015

Simulated Hand INPUT
Overwrap
0:Off 1:Low 2:High
N7:92
0

Simulated
I:0.0/10 Overwrap A
N7:100
10

0016

Simulated Hand INPUT
Overwrap
0:Off 1:Low 2:High
N7:92
1

Simulated
I:0.0/11 Overwrap B
N7:100
11

0017

Simulated INPUT
I:0.0/12 ????????
Bit 0
N7:98
0

Simulated
I:0.0/12 ????????
N7:100
12

Overwrite the PLCs inputs' memory with the simulated input states

0018

Simulated INPUT Word

AND

Bitwise AND

Source A	N7:100
	0000h<
Source B	8191
	8191<
Dest	N7:100
	0000h<

INPUT Word

AND

Bitwise AND

Source A	I:0.0
	0102h<
Source B	-8192
	-8192<
Dest	I:0.0
	0102h<

INPUT Word

OR

Bitwise Inclusive OR

Source A	I:0.0
	0102h<
Source B	N7:100
	0000h<
Dest	I:0.0
	0102h<

0019

END