I/O Configuration

0	Bul.1763	MicroLogix 1100 Series B
1		
2		
3		
4		

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	6	No	363
DOBUSINESS	7	LADDER	12	No	692
OUTPUT2SIM	14	LADDER	3	No	52
SIMULATION	15	LADDER	20	No	617

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

LAD 3 - USER_FAULT --- Total Rungs in File = 2

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 NO 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
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1:Film not at BOTTOM
I:0/3
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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 0000h<
Source B 240 240<
Dest N7:20 0000h<

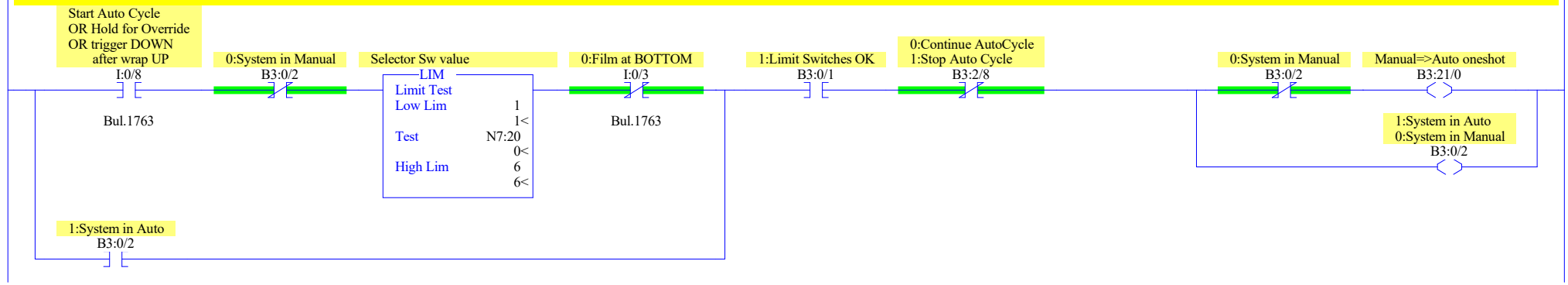
Selector Sw value

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

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
- Run a TOF when in Auto mode, which TOF's output will be 1 for 50cs after leaving Auto Mode

0002



If transition to Auto Mode occurred during this scan cycle:
- Latch input states to Input Buffer (Wrap Pattern Enable; Wrap UP/DOWN)
  - so changing those input states during Auto Mode will have no effect
- 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
- Assign overwrap timer preset values per overwrap inputs
- Calculate last turntable encoder pulse count before one full wrap

In Auto mode:

1) Start turntable rotation at BOTTOM

2.1) EITHER [Wrap UP/DOWN] input is 1 =>
  - Move Film Carriage UP, stop at TOP Limit Switch
  - Make banding wraps at TOP, plus overwrap
  - Move Film Carriage DOWN, stop at BOTTOM Limit Switch
  - Make banding wraps at BOTTOM, plus overwrap
  - Stop turntable rotation

2.2) OR [Wrap UP/DOWN] input is 0 (Wrap UP only) =>
  - Start turntable rotation at BOTTOM
  - Make banding wraps at BOTTOM, plus 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

3) Leave Auto Mode

0003

Manual=>Auto oneshot
B3:21/0

Latched input buffer

AND
Bitwise AND
Source A I:0.0 0000h<
Source B 1023 1023<
Dest B3:11 0000h<

Preset wraps @ TOP

MOV
Move
Source N7:20 0<
Dest C5:2.PRE 6<

Preset wraps @BOTTOM

MOV
Move
Source N7:20 0<
Dest C5:3.PRE 6<

BOTTOM
Overwrap Preset

MOV
Move
Source 225 225<
Dest T4:0.PRE 350<


Over wrap A
I:0/10
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Over wrap B
I:0/11
Bul.1763
BOTTOM
Overwrap Preset
MOV
Move
Source
350
350<
Dest
T4:0.PRE
350<
Over wrap B
I:0/11
Bul.1763
BOTTOM
Overwrap Preset
MOV
Move
Source
550
550<
Dest
T4:0.PRE
350<
Last pulse before
one full wrap
SUB
Subtract
Source A
C5:0.PRE
112<
Source B
1
1<
Dest
N7:9
111<
Turntable wrapper has an encoder that generates 112 input pulses per single wrap (one revolution), but only count them when Film Carriage is at TOP or BOTTOM
0004
1:Turntable encoder
pulse on
I:0/0
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0:Film at TOP
I:0/2
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0:Film at BOTTOM
I:0/3
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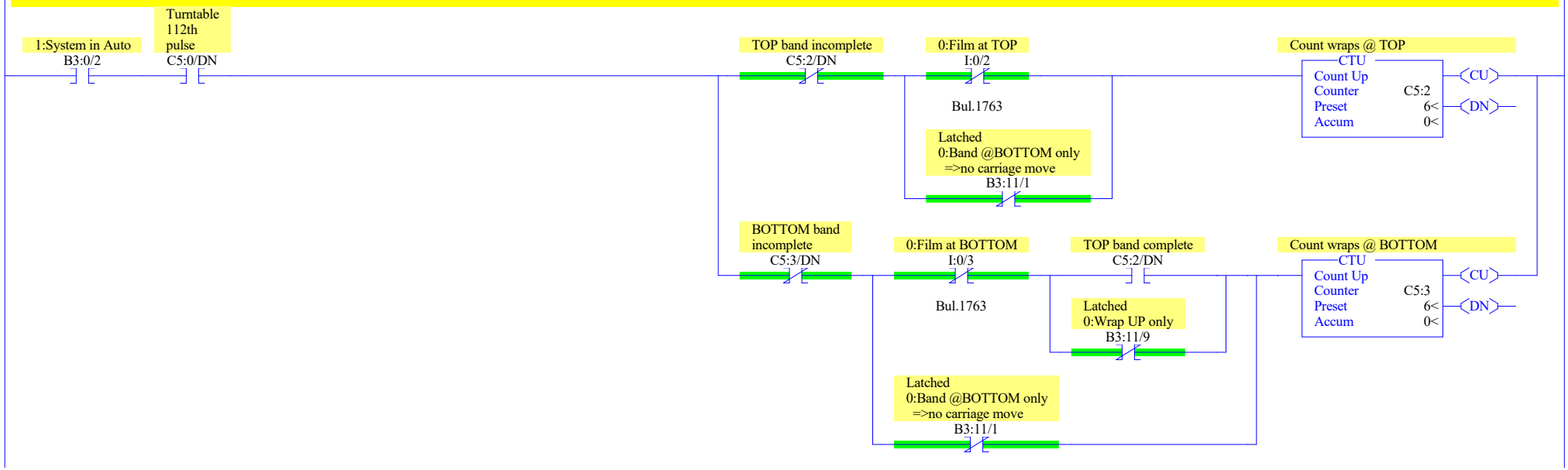
Count turntable
pulses 112 per wrap?
CTU
Count Up
Counter
C5:0
Preset
112<
Accum
0<
CU
DN
0005
END

Every time the Turntable encoder pulse input counter completes 112 pulses, increment the TOP or BOTTOM wrap counter apropo the current state
- I am pretty sure this is more complicated than it needs to be.

- The basic requirement to increment the TOP wrap counter is that the Film Carriage is at the TOP limit switch,
  - WHETHER that is after the BOTTOM wraps were counted when the Wrap Pattern is UP only,
  - OR that is before the BOTTOM wraps will be counted later when the Wrap Pattern is UP/DOWN
N.B. The Film Carriage at TOP limit switch condition may be overridden by the Overwrap timer

- The basic requirement to increment the BOTTOM wrap counter is that the Film Carriage is at the BOTTOM limit swtich
  - WHETHER that is before the TOP wraps are to be counted when the Wrap Pattern is UP only,
  - OR that is after the TOP wraps were counted when the Wrap Pattern is UP/DOWN
N.B. the TOP wraps completed check for Wrap Pattern UP/DOWN may be overriden by the T4:6 timer done bit when inpu I:0.0/1 value is 0

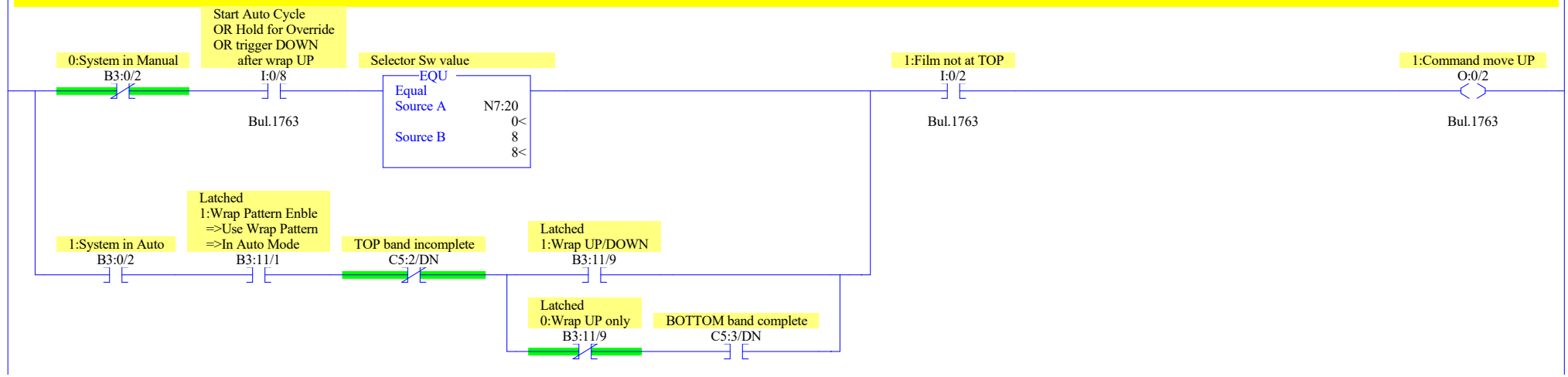
0000



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.

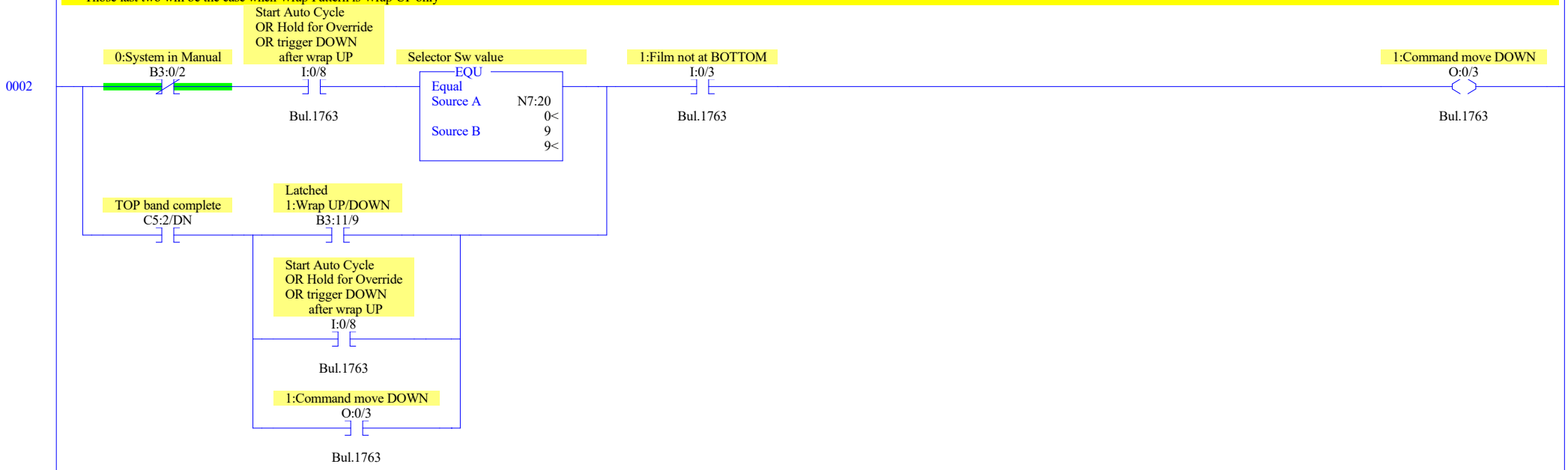
* Don't need to check if Limit Switches are OK because [Film not at TOP] ensures they are
** [Latched Wrap Pattern Enabled] is only 1 if already in Auto Mode
*** [TOP band incomplete] will be 1when to stop Film Carriage moving up when it is at BOTTOM the second time for [Wrap UP/DOWN].

0001

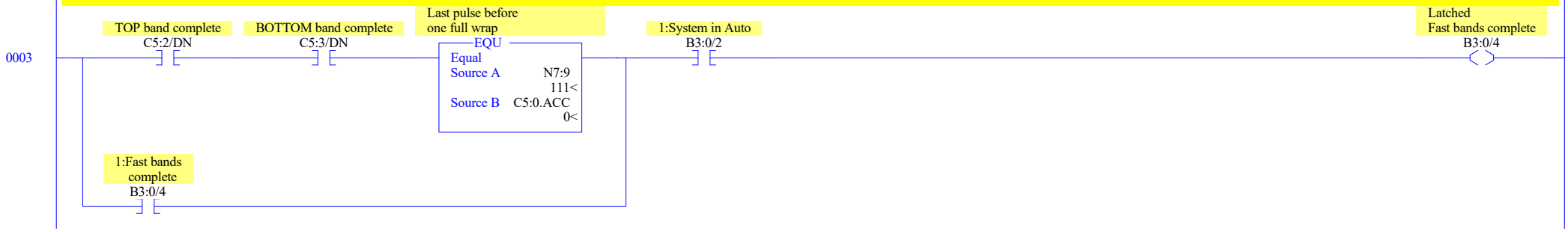


Move Film Carriage DOWN until (i.e. if not) at BOTTOM*
- Manual: if Start button is pressed AND Selector Switch value is 9.
- Auto: if
  - Film Carriage has completed the TOP band**,
  - AND
    - EITHER BOTTOM band is to be done last,
    - OR Start button pressed***,
    - OR Film Carriage is already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

1:System in Auto
B3:0/2

0:Fast bands incomplete
B3:0/4

FAST wrap
O:0/1

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275cs TON post-FINAL wraps

TOF
Timer Off Delay
Timer T4:30
Time Base 0.01
Preset 275<
Accum 0<

EN
DN

Run Turntable at SLOW wrap speed
- Manual: if Start button is pressed AND Selector Switch value is 7.
- Auto: for 275cs after FAST wrap speed stops; TOP and BOTTOM bands created at this slow speed are SLOW bands

0005

0:System in Manual
B3:0/2

Start Auto Cycle
OR Hold for Override
OR trigger DOWN
after wrap UP
I:0/8

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Selector Sw value

EQU
Equal
Source A N7:20
0<
Source B 7
7<

SLOW wrap
O:0/0

Bul.1763

275cs TON post-FINAL wraps
T4:30/TT

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

0006

First Pass
S:1/15

0:System in Manual
B3:0/2

Fault Routine to clear band counters

JSR
Jump To Subroutine
SBR File Number U:3

Evaluate Auto stop condition

0007

1:System in Auto
B3:0/2

FINAL wraps complete plus 275cs
T4:30/DN

0:Film at BOTTOM
I:0/3

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0:Continue AutoCycle
1:Stop Auto Cycle
B3:2/8

1:Film not at BOTTOM
I:0/3

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Flash repeat trigger
T4:2/DN

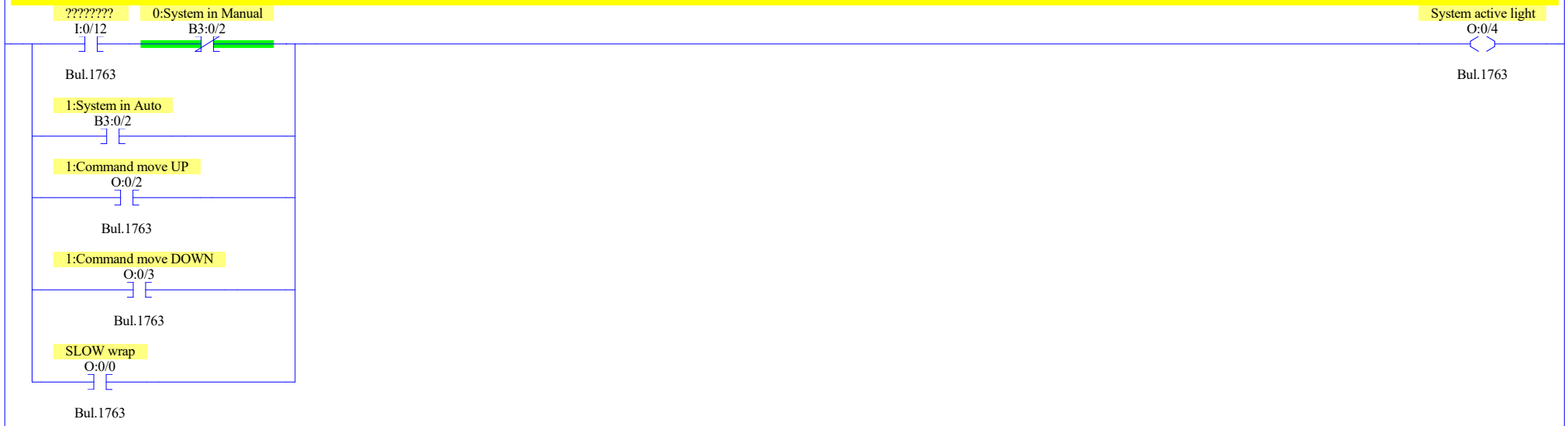
75cs flash ON/50cs flash OFF for Film Carriage DOWN after wrap UP

TON
Timer On Delay
Timer T4:2
Time Base 0.01
Preset 125<
Accum 0<

EN
DN

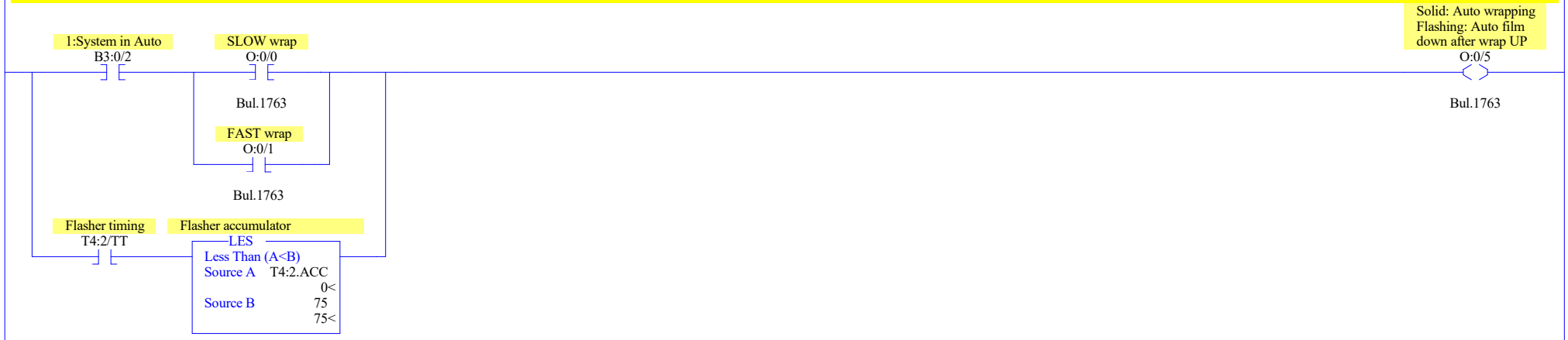
Control the System Active indicator (light?)
- This is the only place I:0.0/12 is used; I have no idea of its actual purpose

0008



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 of [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

Turntable 112th pulse
C5:0/DN

1:Film not at TOP
I:0/2
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1:Film not at BOTTOM
I:0/3
Bul.1763

0:System in Manual
B3:0/2

Turntable pulse count

CLR
Clear
Dest C5:0.ACC
0<

0011

END

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
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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 ????????
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
	0000h<
Source B	-8192
	-8192<
Dest	I:0.0
	0000h<

INPUT Word

OR

Bitwise Inclusive OR

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

0019

END