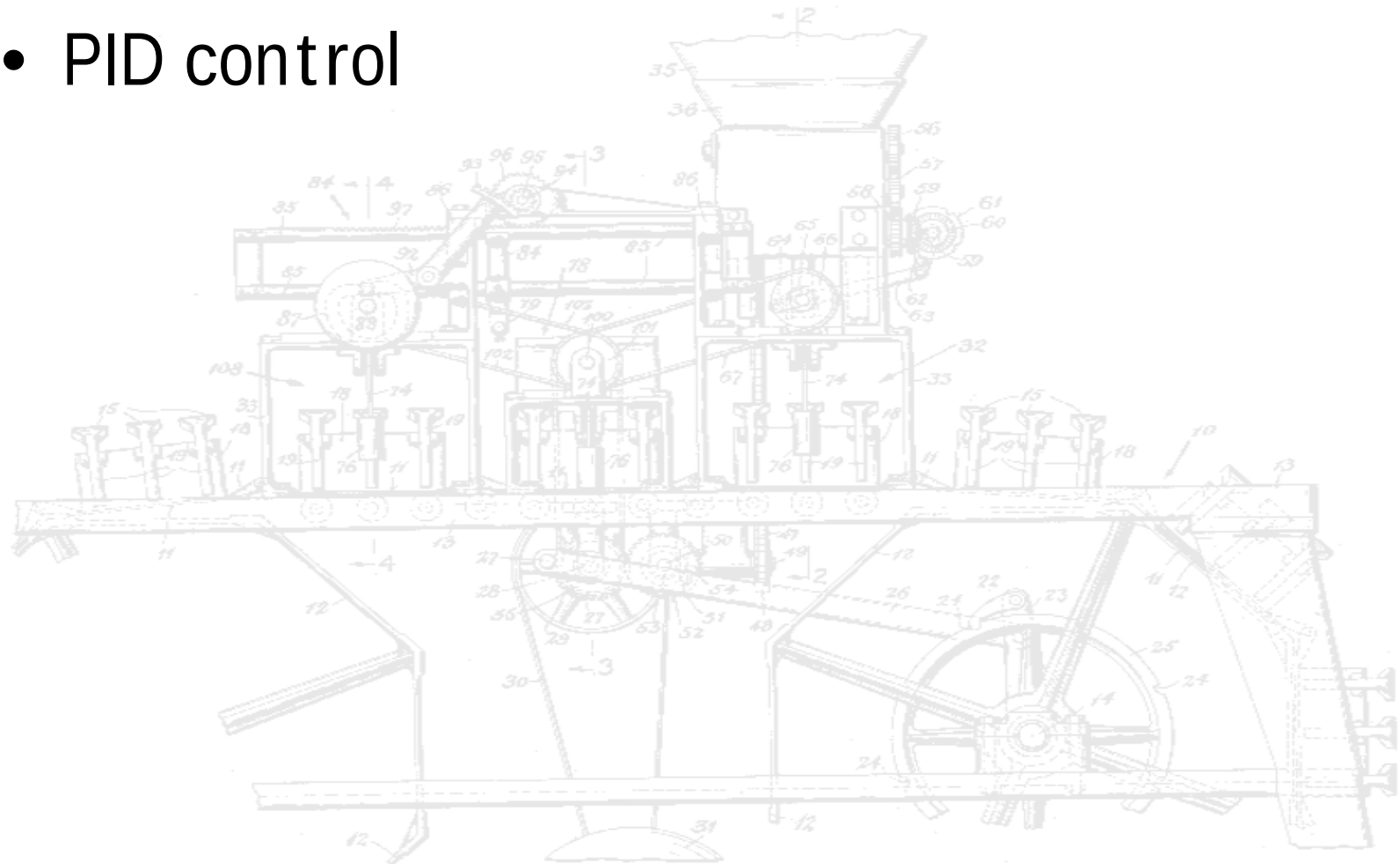
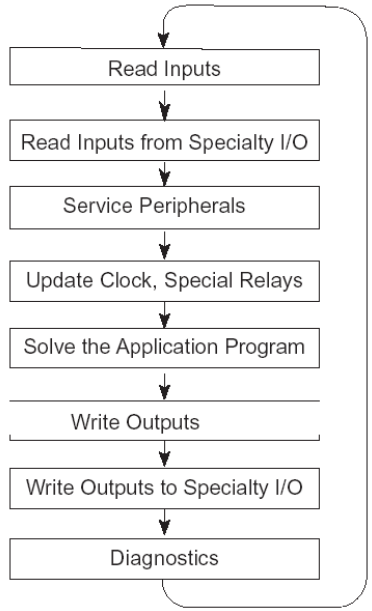
Proportional Control with the PLC

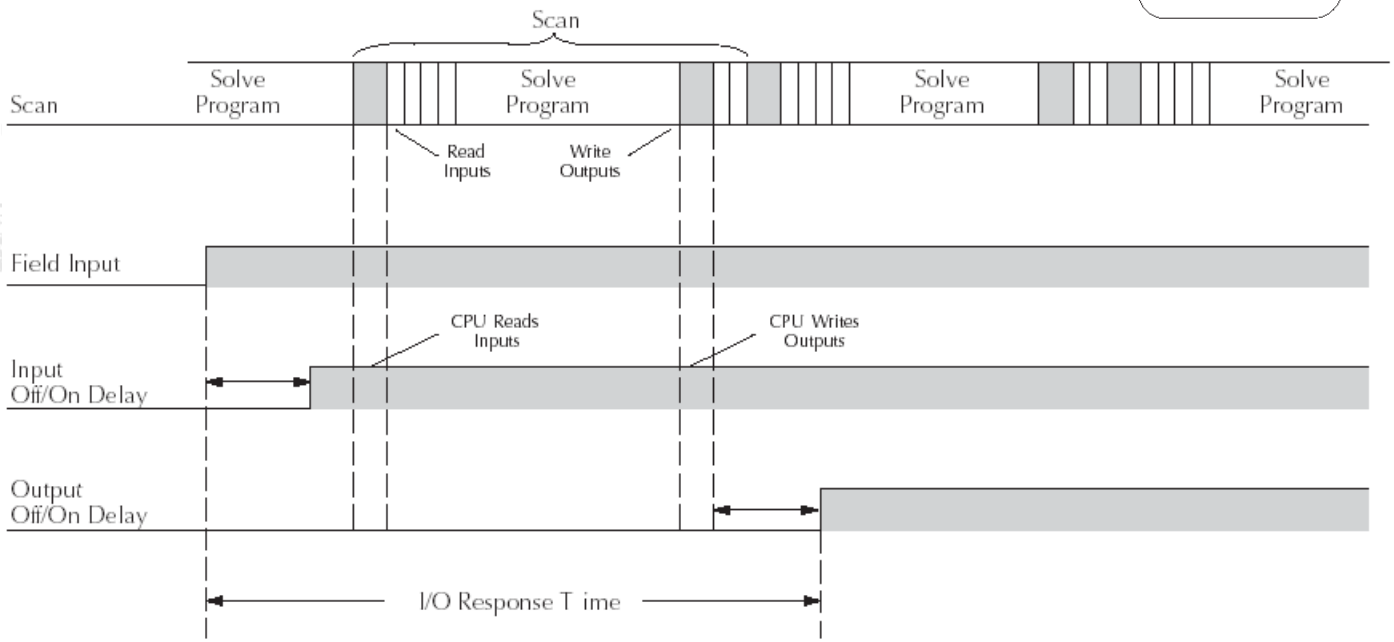
- High Speed Input
- Pulse Output
- PID control



PLC Input/Output Timing

- PLC scan time:
  - Read inputs
  - Solve logic
  - Write outputs



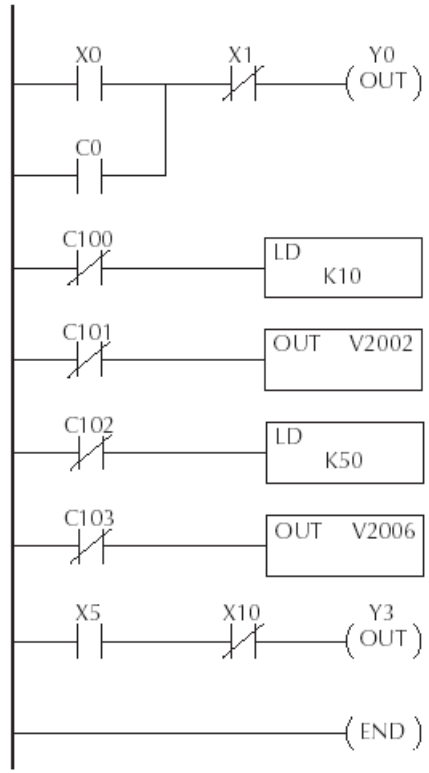


PLC Input/Output Timing

- Total scan time:
  - 0.95msec min
  - 5.2msec max

Instruction	Time
STR X0	.67 µs
OR C0	.51 µs
ANDN X1	.51 µs
OUT Y0	1.82 µs
STRN C100	.67 µs
LD K10	9.00 µs
STRN C101	.67 µs
OUT V2002	9.3 µs
STRN C102	.67 µs
LD K50	9.00 µs
STRN C103	.67 µs
OUT V2006	1.82 µs
STR X5	.51 µs
ANDN X10	.51 µs
OUT Y3	1.82 µs
END	12.80 µs
SUBT OTAL	51.11 µs

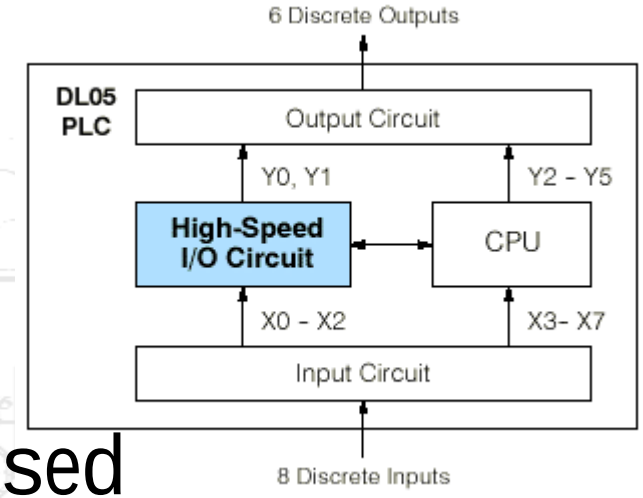
Overhead	DL06
Minimum	746.2 µs
Maximum	4352.4 µs



TOTAL TIME = (Program execution time + Overhead) x 1.18

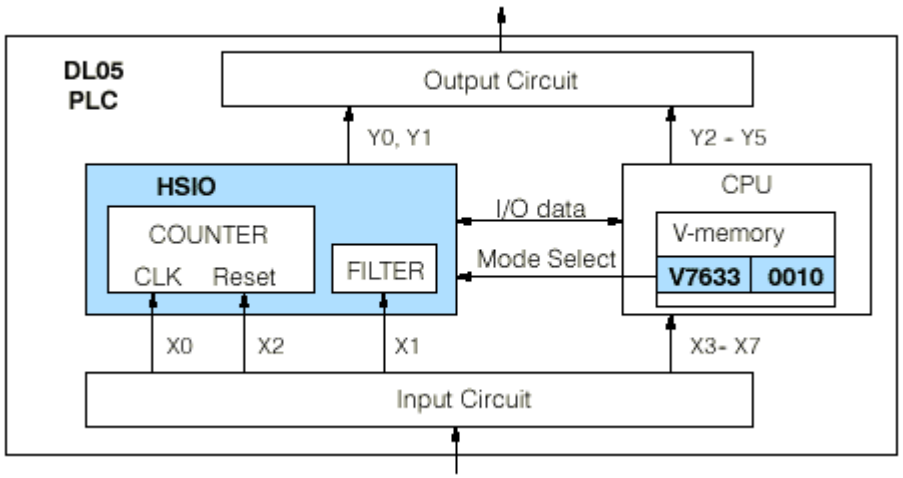
High Speed Input/Output

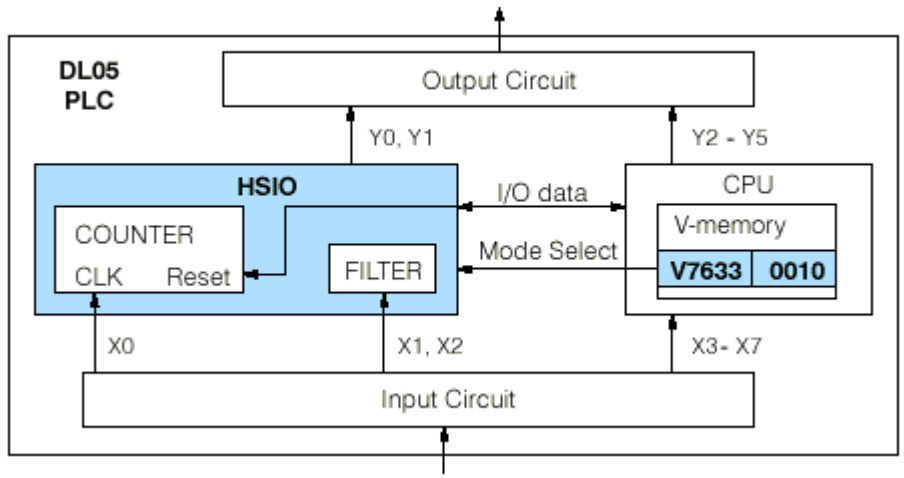
- High speed counters
  - Use X0,X1, and X2
- Pulse Output
  - Uses Y0 and Y1
- One of six modes can be used
  - Mode 10: High speed counter
  - Mode 20: Quadrature counter
  - Mode 30: Pulse Output
  - Mode 40: High speed interrupt
  - Mode 50: Narrow pulse capture
  - Mode 60: Narrow pulse reject (normal mode)



Mode 10 - High Speed Counter

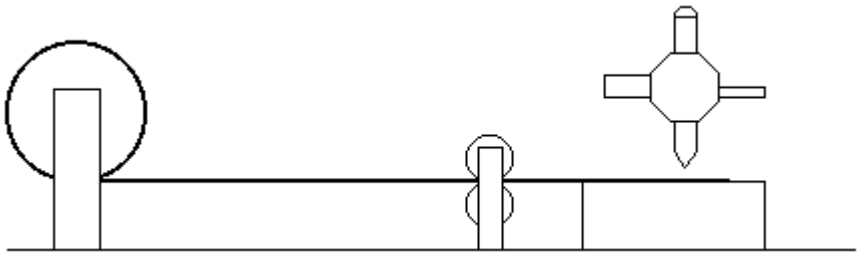
- Up counter, counts to 99,999,999
- Up to 5kHz input rate (incr. on X0 low->hi)
- Count is compared to preset values to generate events.
- Reset can be X2 or ladder logic





Mode 10 high Speed Counter

Used for applications like cut-to-length



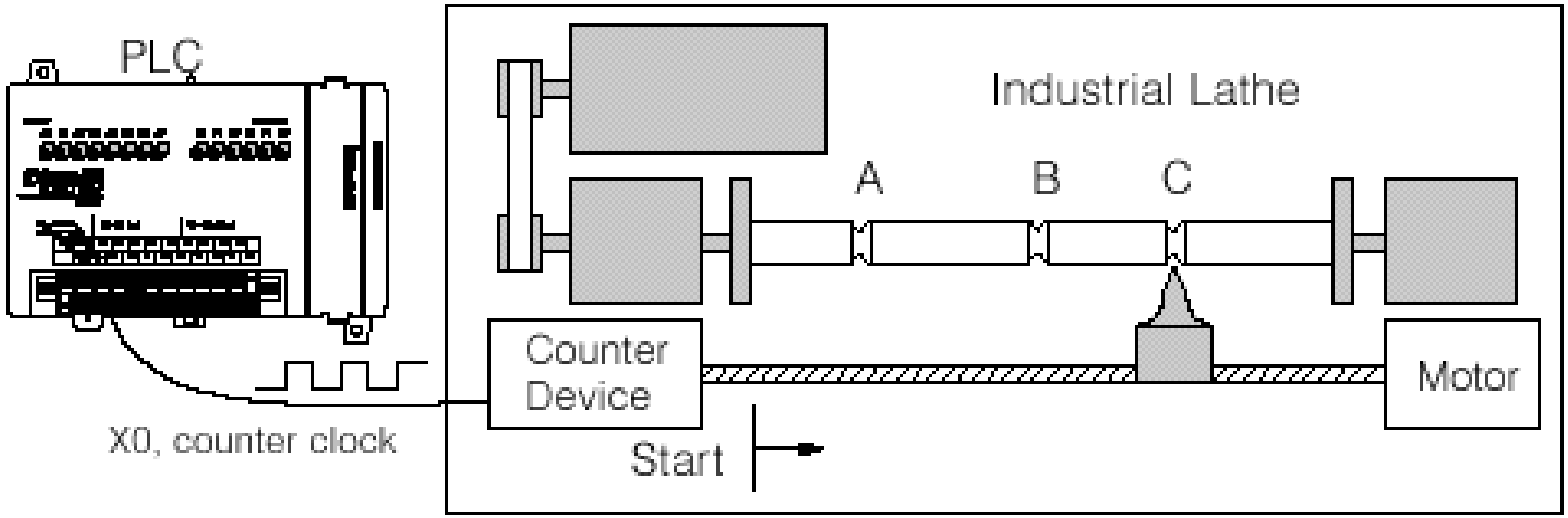
$$\text{Preset} = \frac{\frac{\text{cnts}}{\text{rev}} \cdot \text{dist}}{\pi \cdot \text{D}} = \frac{4096 \cdot 12}{31.416} = 1565$$

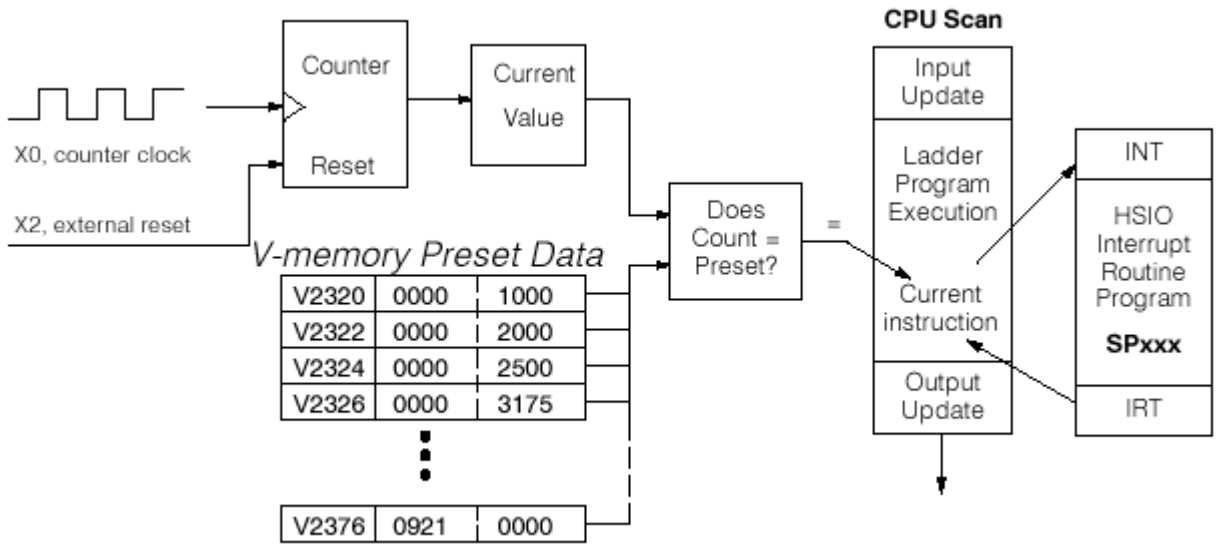
Ex:

- 4096cnt/rev enc
- 10cm diam roller
- rotate turret and operate at 12, 20, 28, and 30cm
- Presets are:

  1565, 2608, 3651, 3913

Mode 10 high Speed Counter





Mode 10 high Speed Counter

- Setup consists of writing values to several special memory locations

Input	Configuration Register	Function	Hex Code Required
X0	V7634	Counter Clock	0001
X1	V7635	Filtered Input	xx06, xx = filter time 0 - 99 ms (BCD)
X2	V7636	Counter Reset (no interrupt)	0007* (default) 0207*
		Counter Reset (with interrupt)	0107* 0307*
		FIltered Input	xx06, xx = filter time 0 - 99 ms (BCD)

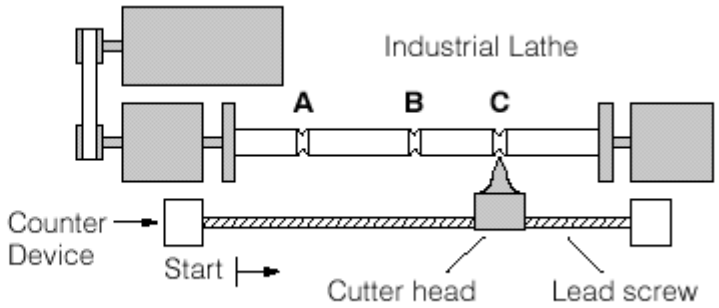
Preset	Preset V-memory Register	Special Relay Number	Preset	Preset V-memory Register	Special Relay Number
1	V2321 / V2320	SP540	13	V2351 / V2350	SP554
2	V2323 / V2322	SP541	14	V2353 / V2352	SP555
3	V2325 / V2324	SP542	15	V2355 / V2354	SP556
4	V2327 / V2326	SP543	16	V2357 / V2356	SP557
5	V2331 / V2330	SP544	17	V2361 / V2360	SP560
6	V2333 / V2332	SP545	18	V2363 / V2362	SP561
7	V2335 / V2334	SP546	19	V2365 / V2364	SP562
8	V2337 / V2336	SP547	20	V2367 / V2366	SP563
9	V2341 / V2340	SP550	21	V2371 / V2370	SP564
10	V2343 / V2342	SP551	22	V2373 / V2372	SP565
11	V2345 / V2344	SP552	23	V2375 / V2374	SP566
12	V2347 / V2346	SP553	24	V2377 / V2376	SP567

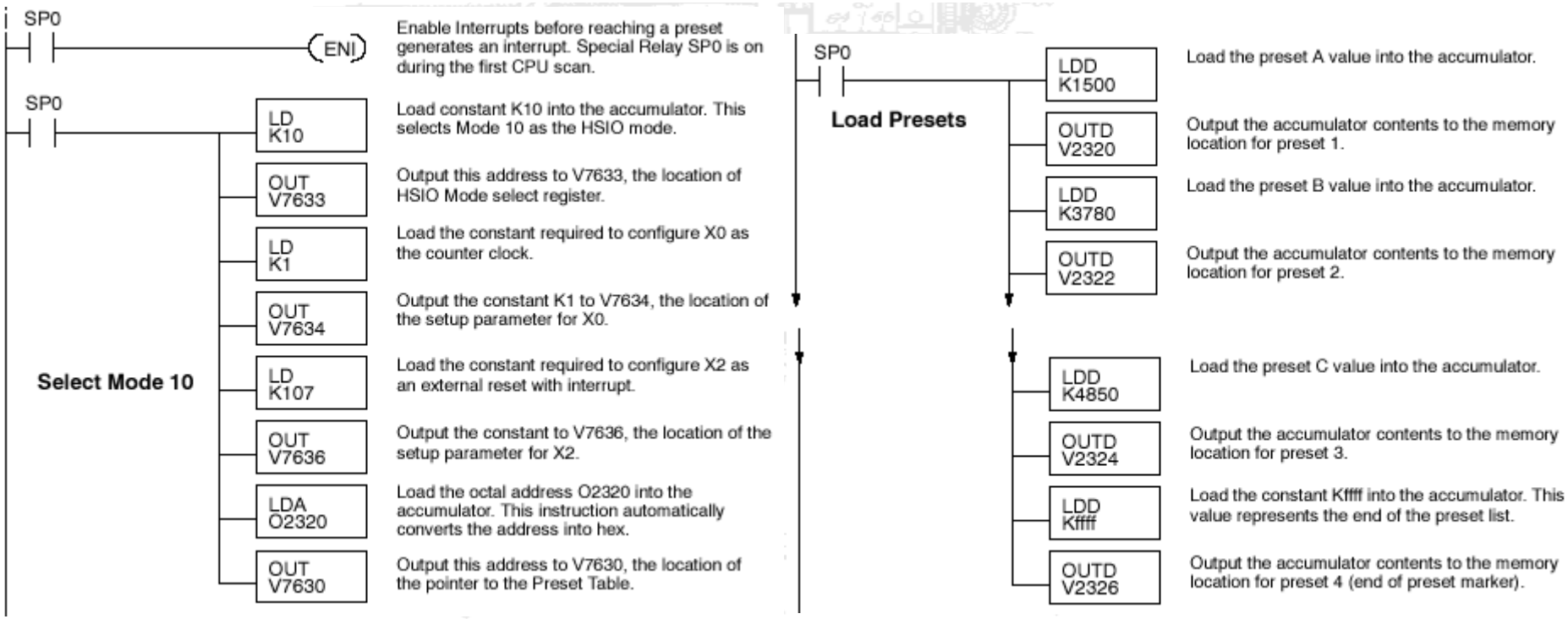
Mode 10 high Speed Counter

Preset Data

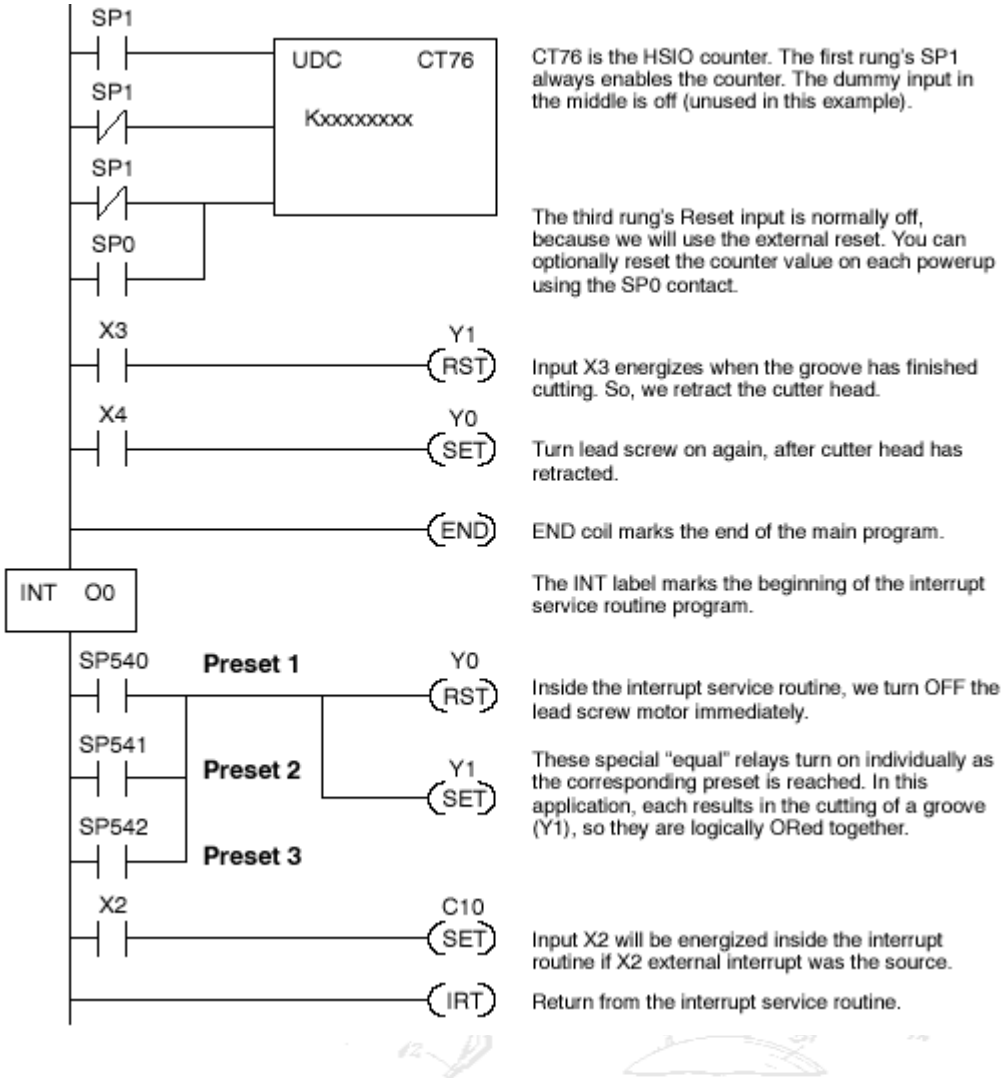
A	V2320	0000	1500
B	V2322	0000	3780
C	V2324	0000	4850
	V2326	0000	FFFF

I/O Assignments
X3 - Cutter head extended
X4 - Cutter head retracted
Y0 - Lead screw motor
Y1 - Cutter head solenoid





Mode 10 High Speed Counter



CT76 is the HSIO counter. The first rung's SP1 always enables the counter. The dummy input in the middle is off (unused in this example).

The third rung's Reset input is normally off, because we will use the external reset. You can optionally reset the counter value on each powerup using the SP0 contact.

Input X3 energizes when the groove has finished cutting. So, we retract the cutter head.

Turn lead screw on again, after cutter head has retracted.

END coil marks the end of the main program.

The INT label marks the beginning of the interrupt service routine program.

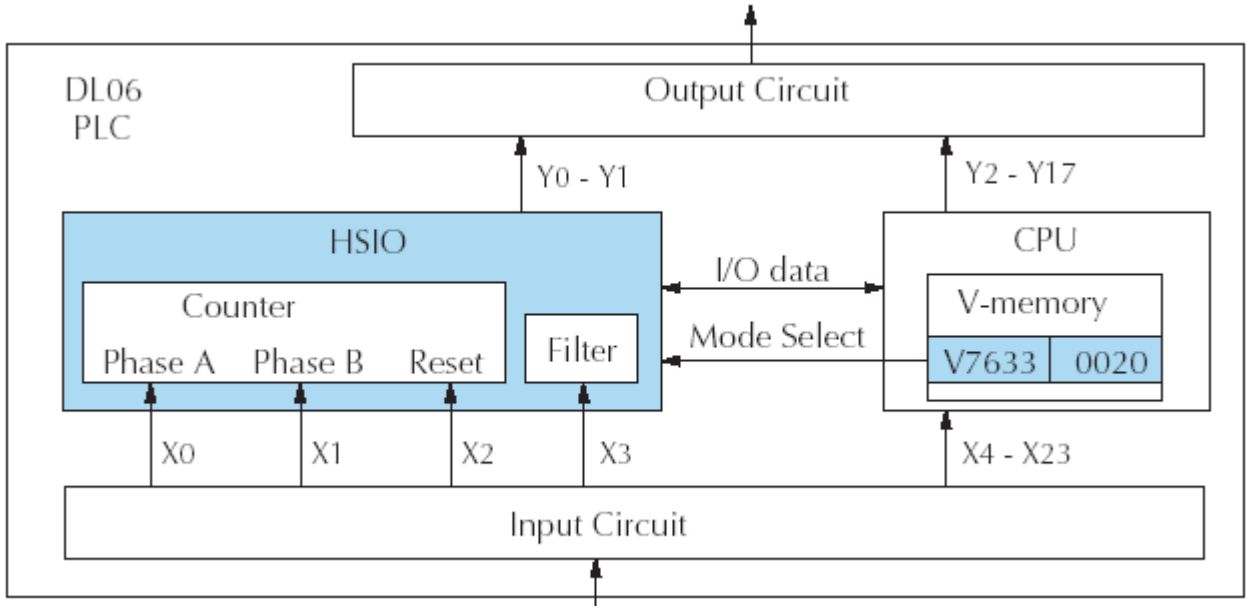
Inside the interrupt service routine, we turn OFF the lead screw motor immediately.

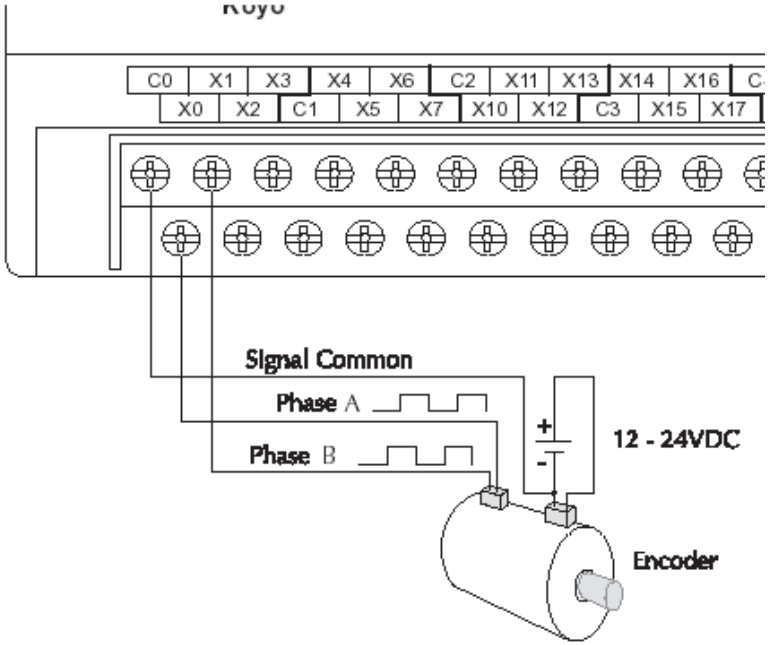
These special "equal" relays turn on individually as the corresponding preset is reached. In this application, each results in the cutting of a groove (Y1), so they are logically ORed together.

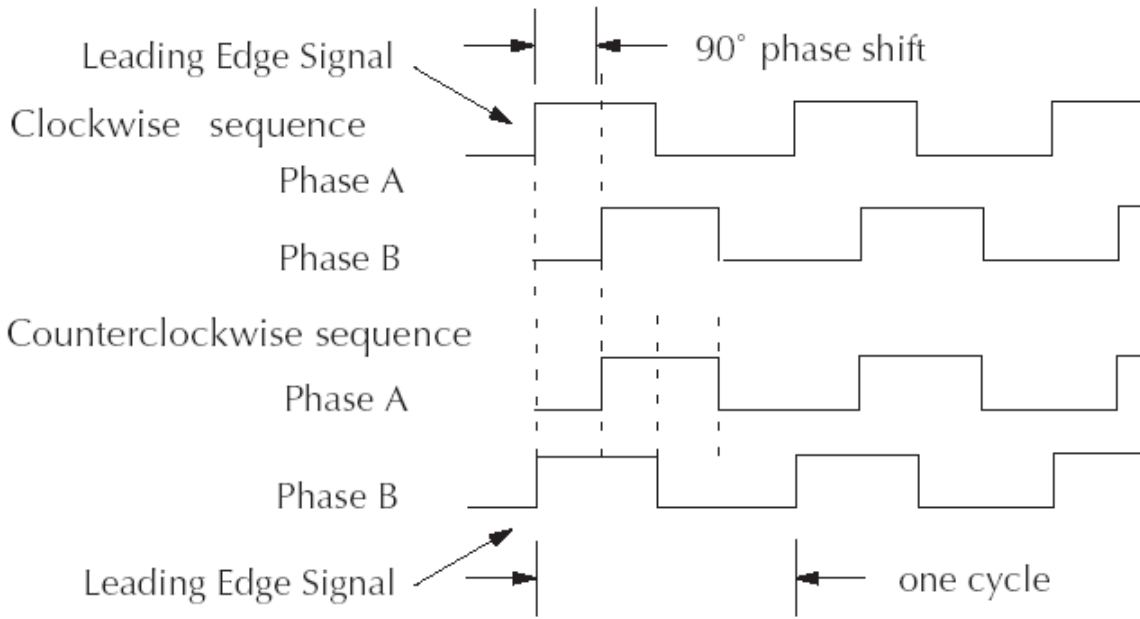
Input X2 will be energized inside the interrupt routine if X2 external interrupt was the source.

Return from the interrupt service routine.

Mode 20 Quadrature Counter



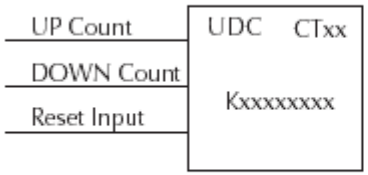




Mode 20 Configuration

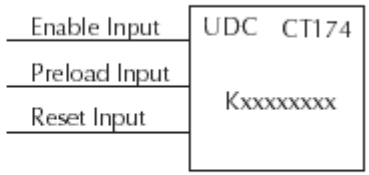
Input	Configuration Register	Function	Hex Code Required
X0	V7634	Up counting	0202 (standard, absolute)
			0302 (standard, incremental)
		Phase A	0002 (quadrature, absolute) (default)
			0102 (quadrature, incremental)
			1002 (quadrature, absolute) 4x counting*
			1102 (quadrature, incremental) 4x counting*
X1	V7635	Down counting or Phase B	0000
X2	V7636	Counter Reset (no interrupt)	0007** (default) 0207**
		Counter Reset (with interrupt)	0107** 0307**
		Pulse input	0005
		Filtered input	xx06 (xx = filter time, 0 - 99ms (BCD)
X3	V7637	Pulse input	0005
		Filtered input	xx06 (xx = filter time, 0 - 99ms (BCD) (default)

Standard Counter Function



Counts UP and DOWN
Preload counter by write to value
Reset input is internal only

HSIO Counter Function



Counts UP and DOWN (from X0, X1)
Can use Preload Input to change count
Reset may be internal or external