THE MOTION FUNCTION OF ASDA-A2

To Audience

Material level

This material is for the PR functions of ASDA-A2.
The audience should know the basic operation of Delta Servo system in advance.

Revision

February 21, 2011.

The Contents

System Information

System parameter, Monitor parameter, and Data array.

PR Mode

Homing mode, Constant speed mode, Position control mode, Jump mode, Write parameter mode, and PUU and PR instruction dispatching skeleton.

Capture

The settings and applications.

Compare

The settings and applications.

System Information (1)

System Parameter

Applied to function settings or commands, for example P1-01 control mode and output direction selections.

Monitor Parameter

For monitoring status of servo operating, for example, speed, position, torque…,etc.

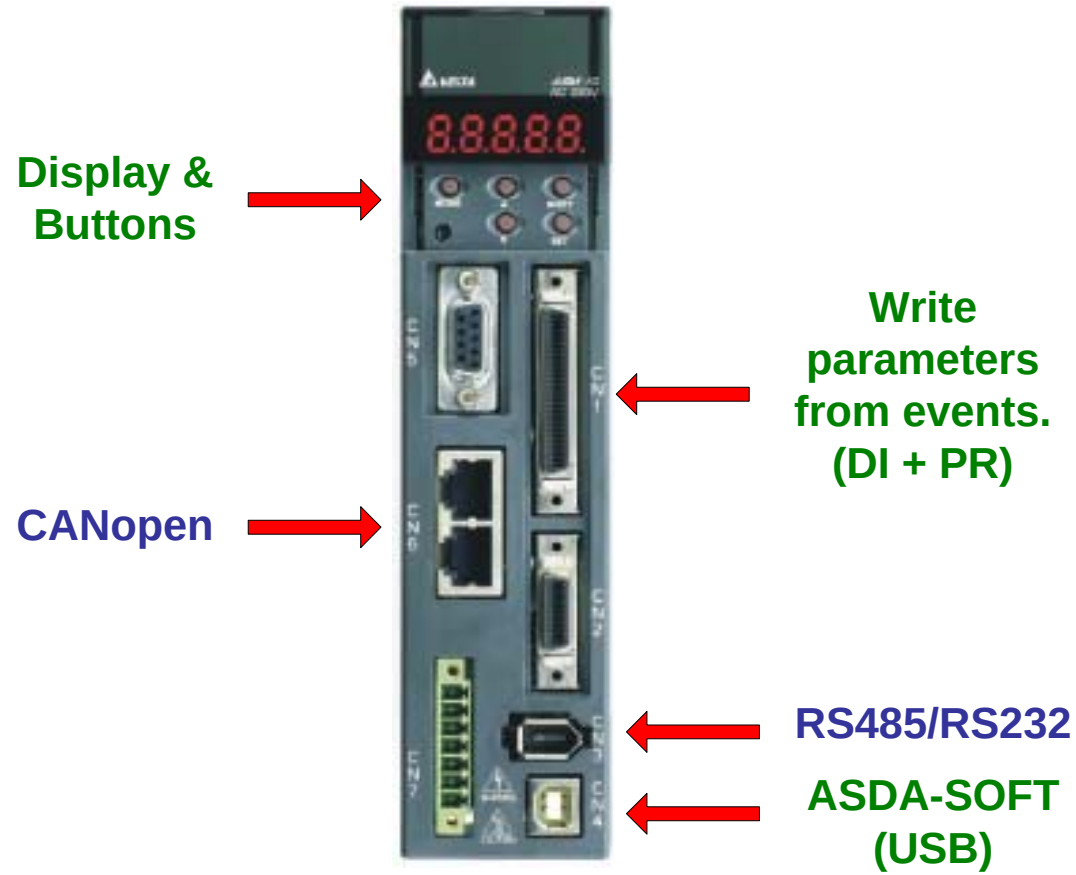
Data Array

The place to keep the data for functions of CAPTURE, COMPARE, and E-CAM.

System Information (2)

System Parameter

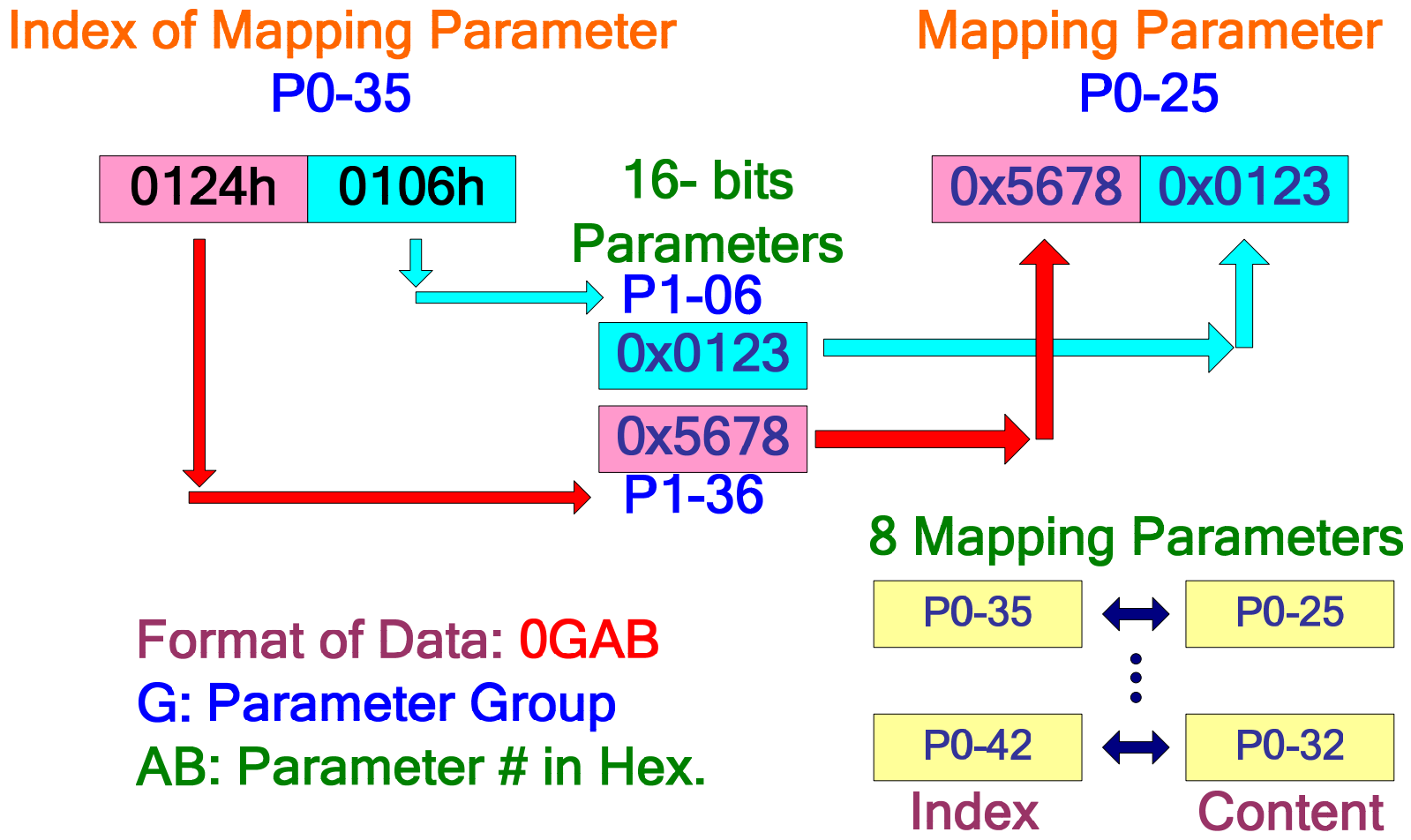
The format for parameter is P?-??. There are 16-bit and 32-bit parameters which can be read/written via several ways.



System Information (3)

Mapping Parameter (1)

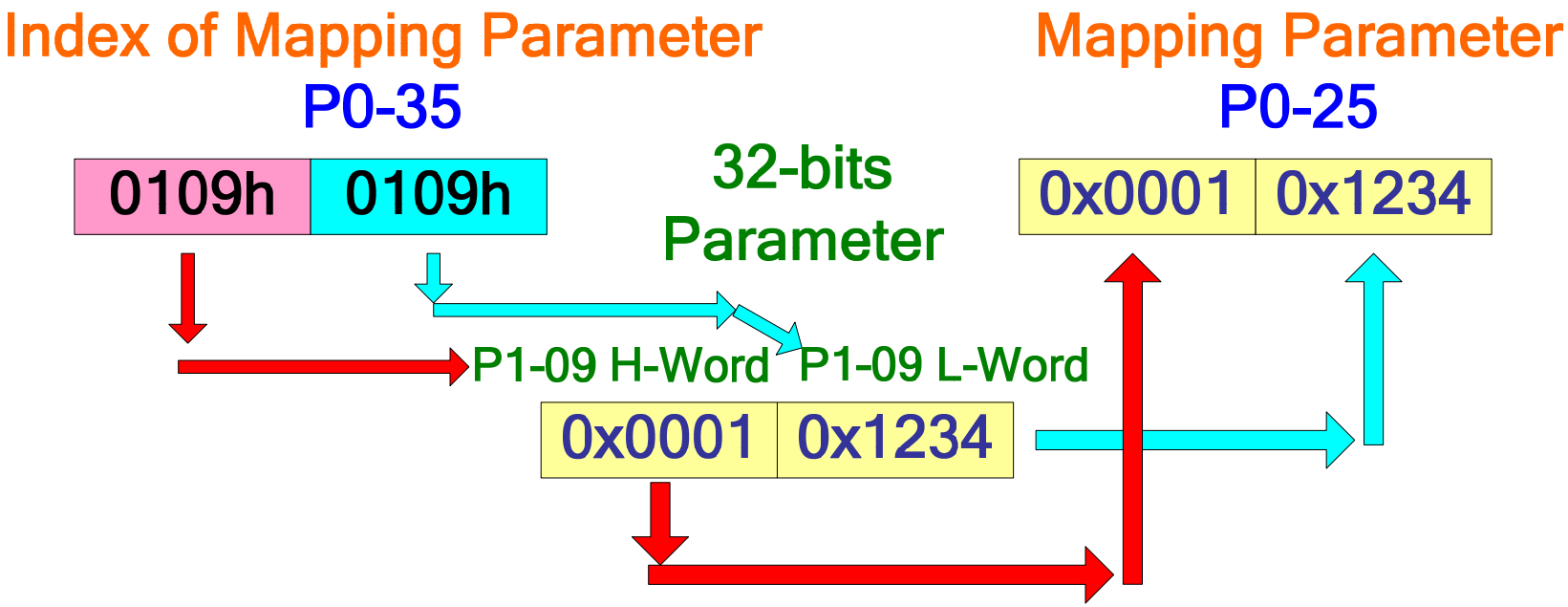
An index to any parameters for block read/write and an example of 16-bit parameters mapped.



System Information (4)

Mapping Parameter (2)

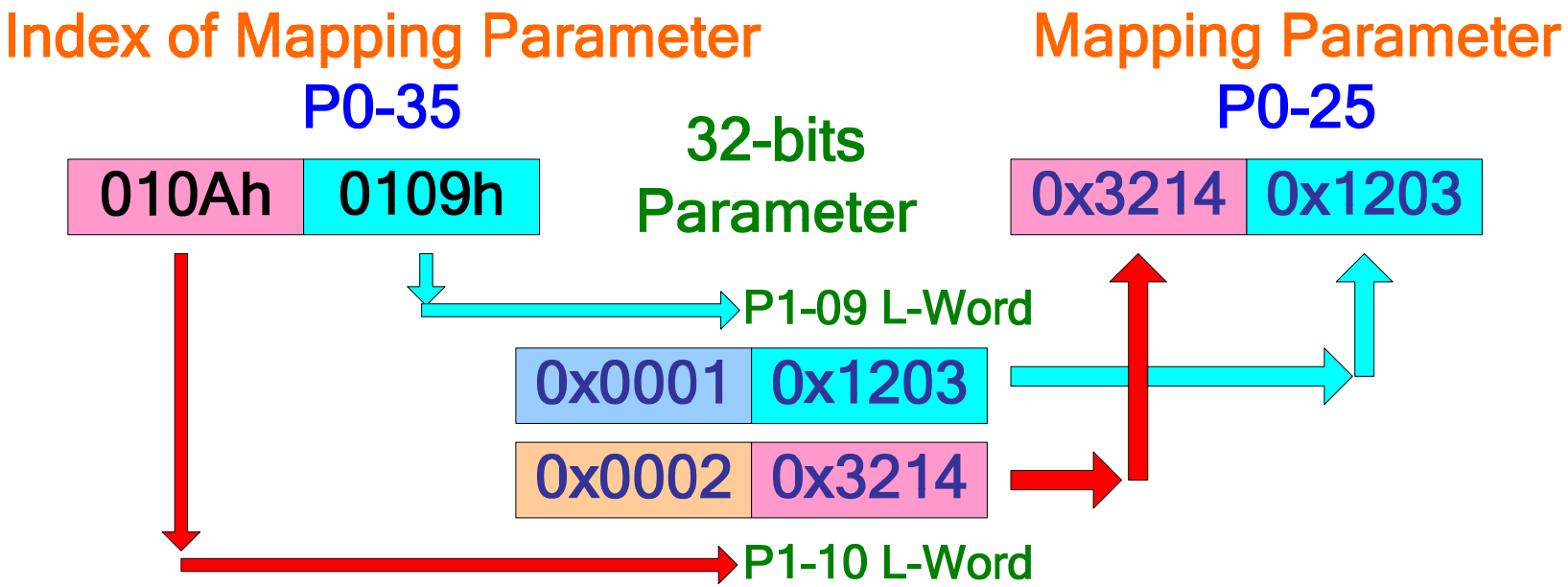
An example of 32-bit parameter mapped.



System Information (5)

Mapping Parameter (3)

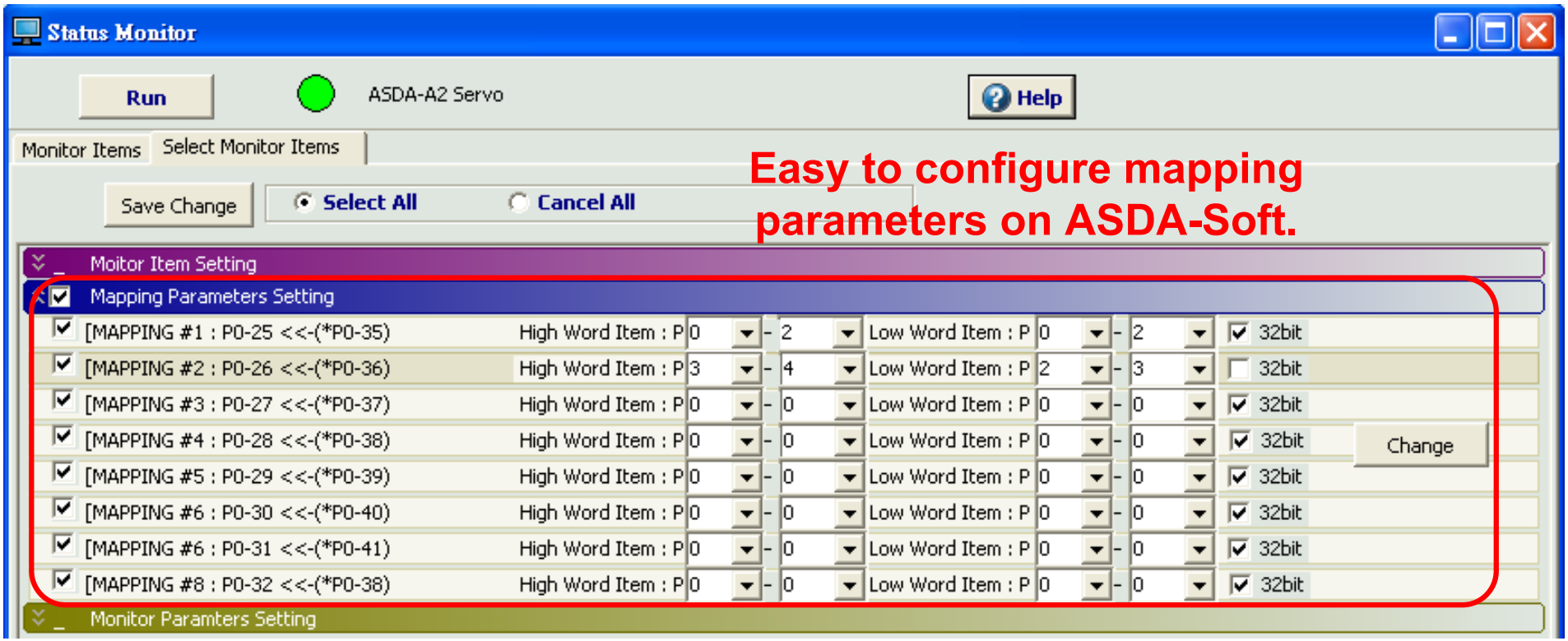
An example of 32-bit parameters mapped partially.



System Information (6)

Mapping Parameter (4)

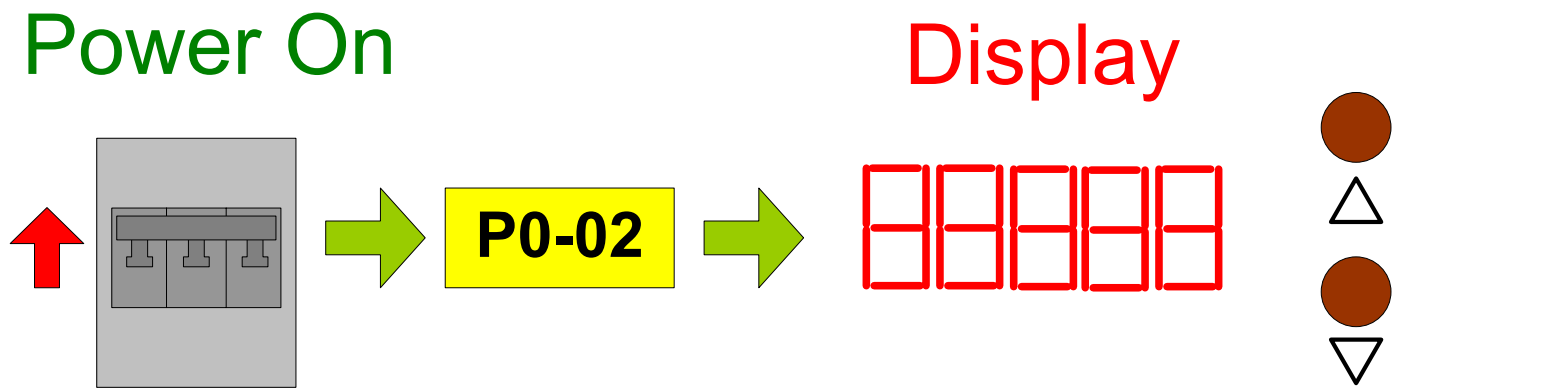
On ASDA-Soft there is an easy way to configure mapping parameters while it is on-line.



System Information (7)

Status Monitoring (1)

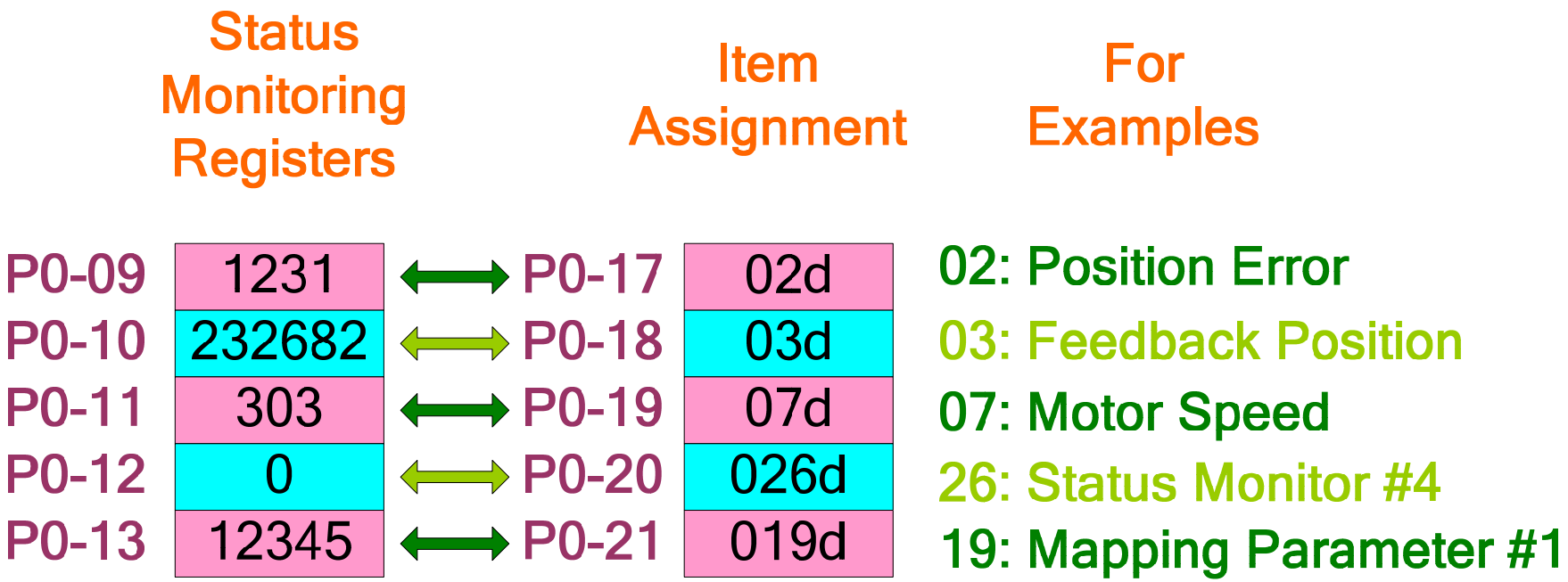
When power on, the status set in P0-02 will be shown on display. The up and down buttons can apply to change the status shown on display.



System Information (8)

Status Monitoring (2)

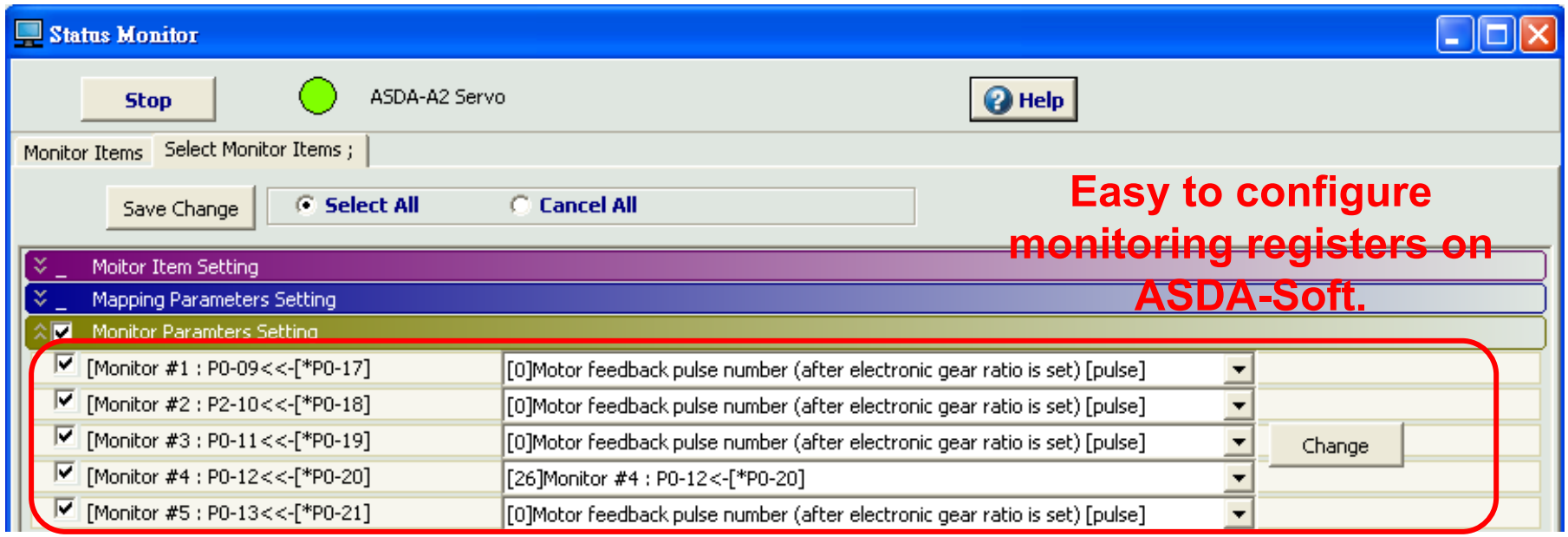
There are 5 status monitoring registers and more than 60 items pre-defined in ASDA-A2 (listed in chapter 7 on manual) for accessing the internal status of servo drive.



System Information (9)

Status Monitoring (3)

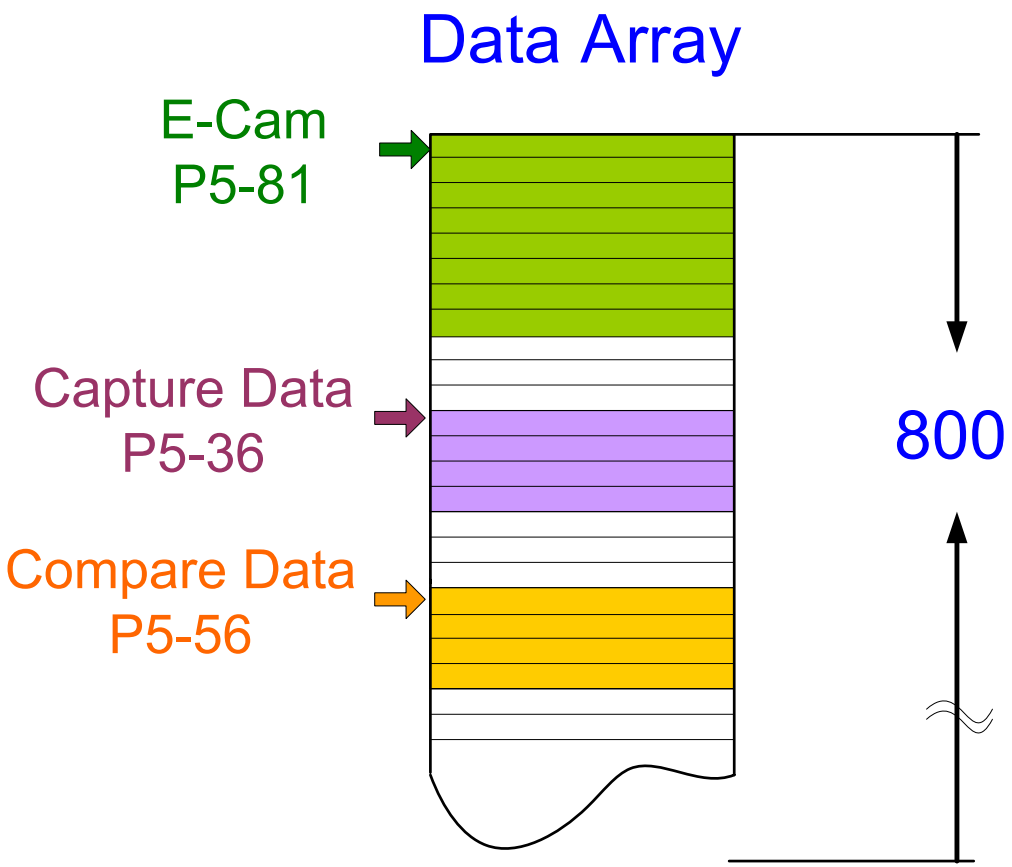
While the PC is being connected to the servo drive, the ASDA-soft can be used to set up the monitoring registers.



System Information (10)

Data Array

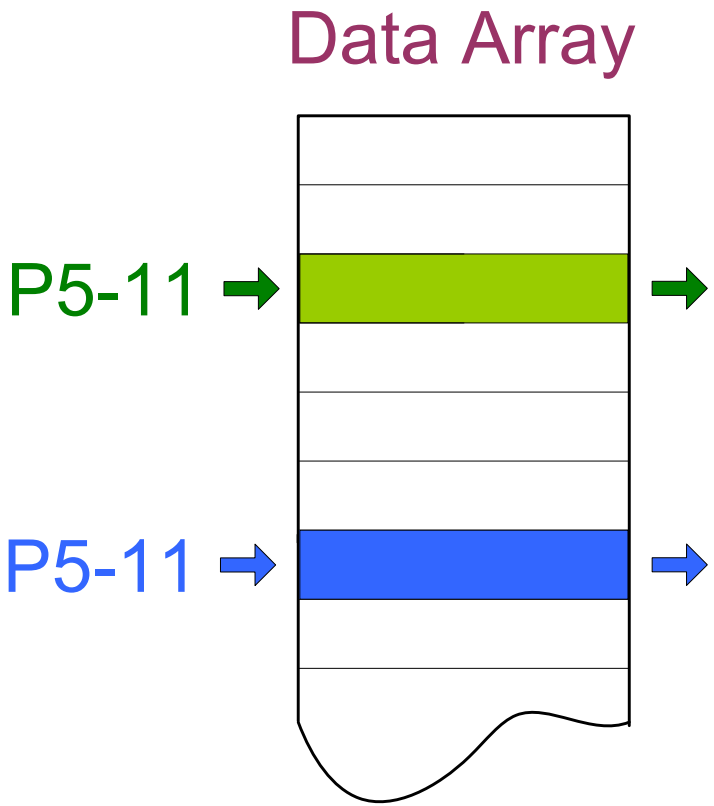
The data array can keep data for E-Cam, Capture function, and Compare function with maximum to 800 records (all together to max. 800 records).



System Information (11)

Access to Data Array

There is one index working along with two read/write windows for accessing data array. For some hosts resending data several times while communication, it had better to put the index P5-11 every time before read/write.



P5-12 R/W Window

Panel Read: P5-11 unchanged
Panel Write: P5-11=P5-11+1
Communication Read: P5-11=P5-11+1
Communication Write: P5-11=P5-11+1

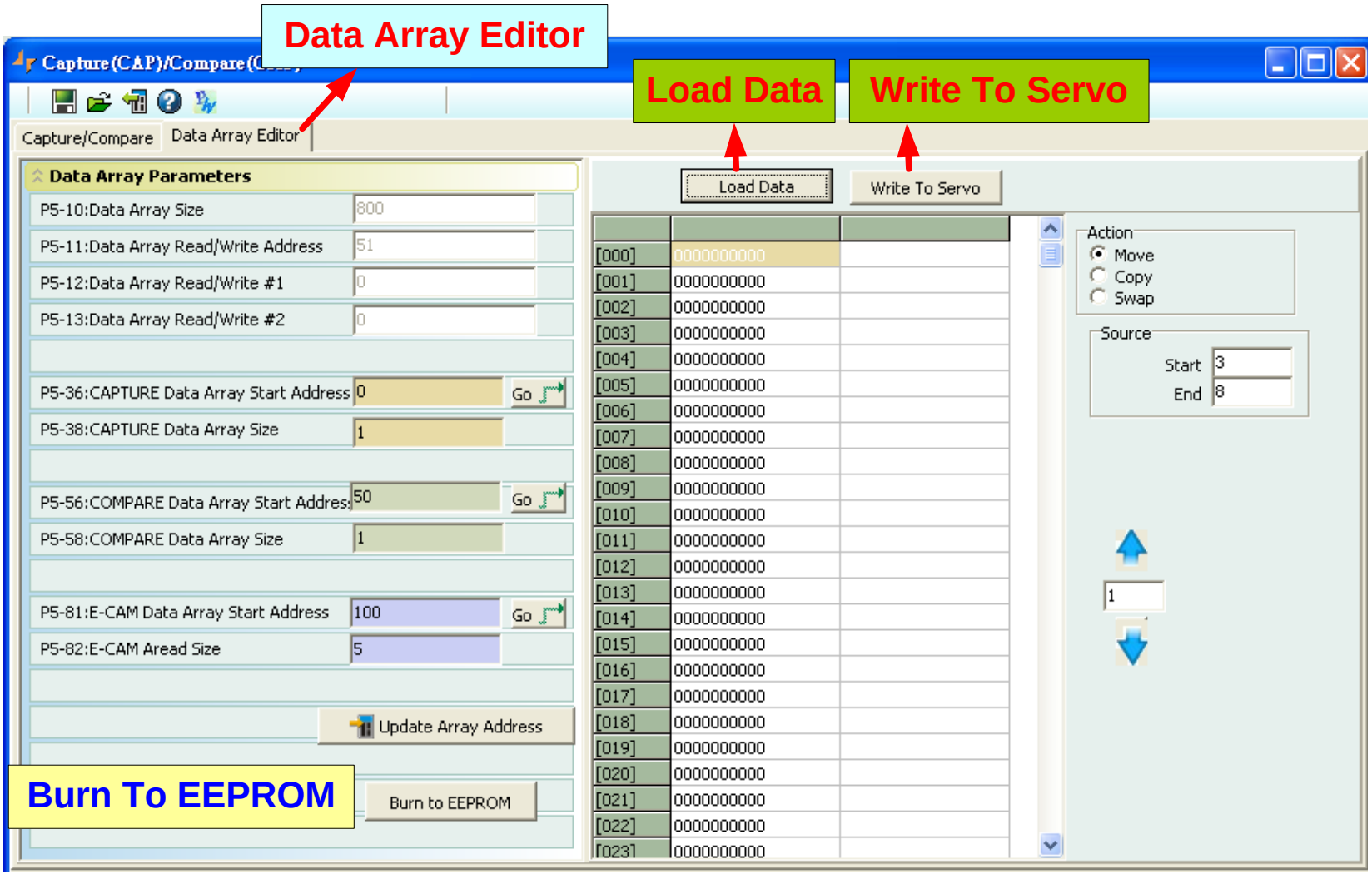
P5-13 R/W Window

Panel Read: P5-11=P5-11+1
Panel Write: Inhibition
Communication Read: P5-11=P5-11+1
Communication Write: P5-11=P5-11+1

System Information (12)

Edit Data Array

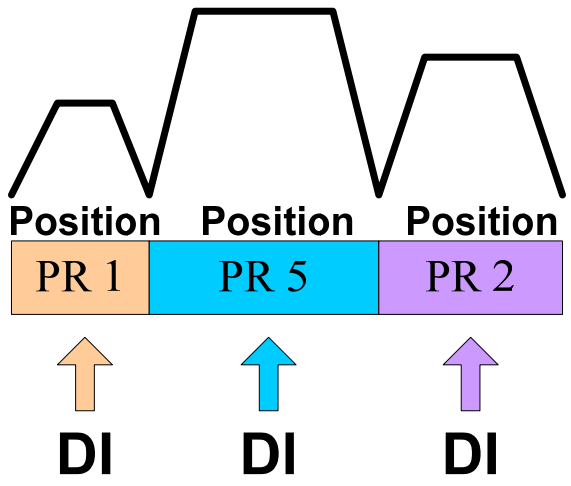
The ASDA-Soft integrates convenient function for editing data array.



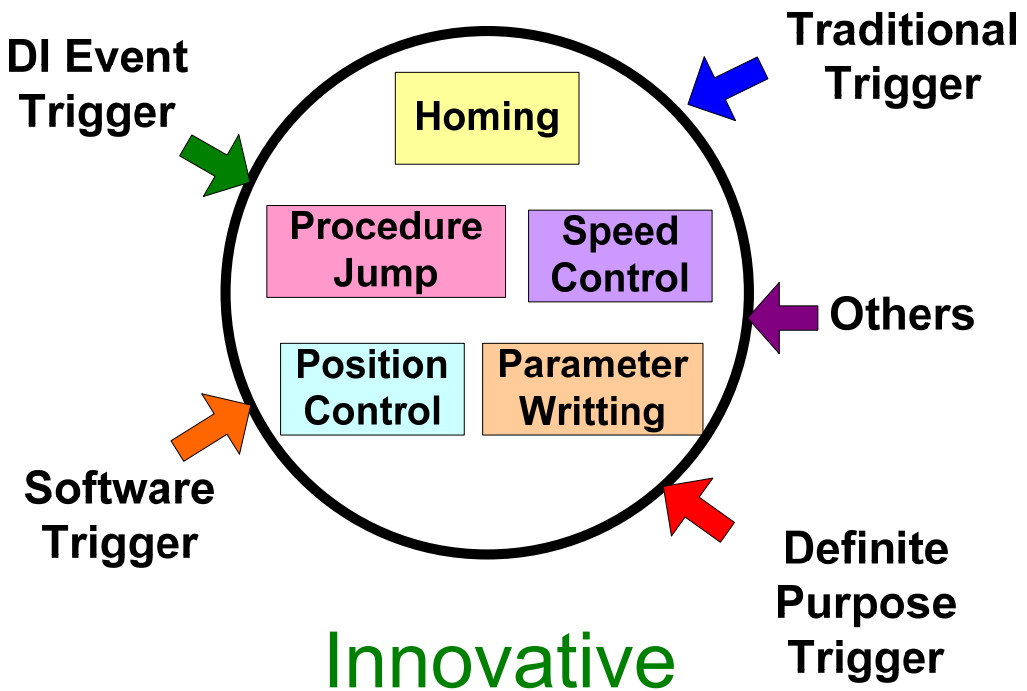
The New PR Mode

What's news?

The PR cannot be interpreted as "Point to Point" control. It does beyond that. The servo is capable to change its working profile under PR mode instantaneously. There are 64 PRs available.



Point-to-point Control



Innovative PR Mode

The Sub-modes Under PR Mode

Homing Mode

More than 35 selections are available.

Constant Speed Mode

Speed control function with profile pre-defined.

Position Control Mode

There are 4 types of commands under this mode, and they are absolute command, relative command, incremental command, and capture relative command.

Jump Mode

The jump command can go to any PR when executed.

Write Parameter Mode

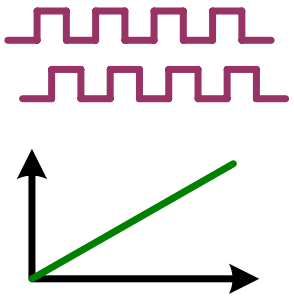
The system parameter can be changed by Write Parameter function any time.

The Direction

The New Definition

The FORWARD direction is defined as feedback PUU (position) increasing. The parameter P1-01.Z can change the definition of rotational direction.

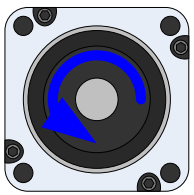
Positive Command



In P5-18, number is increasing.

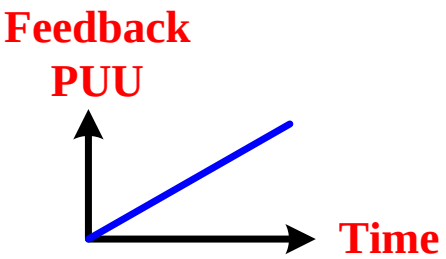
Positive Direction Definition

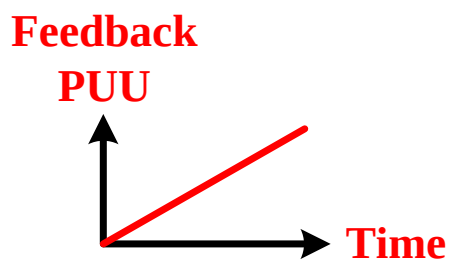
P1-01.Z=0



P1-01.Z=1

PC Scope





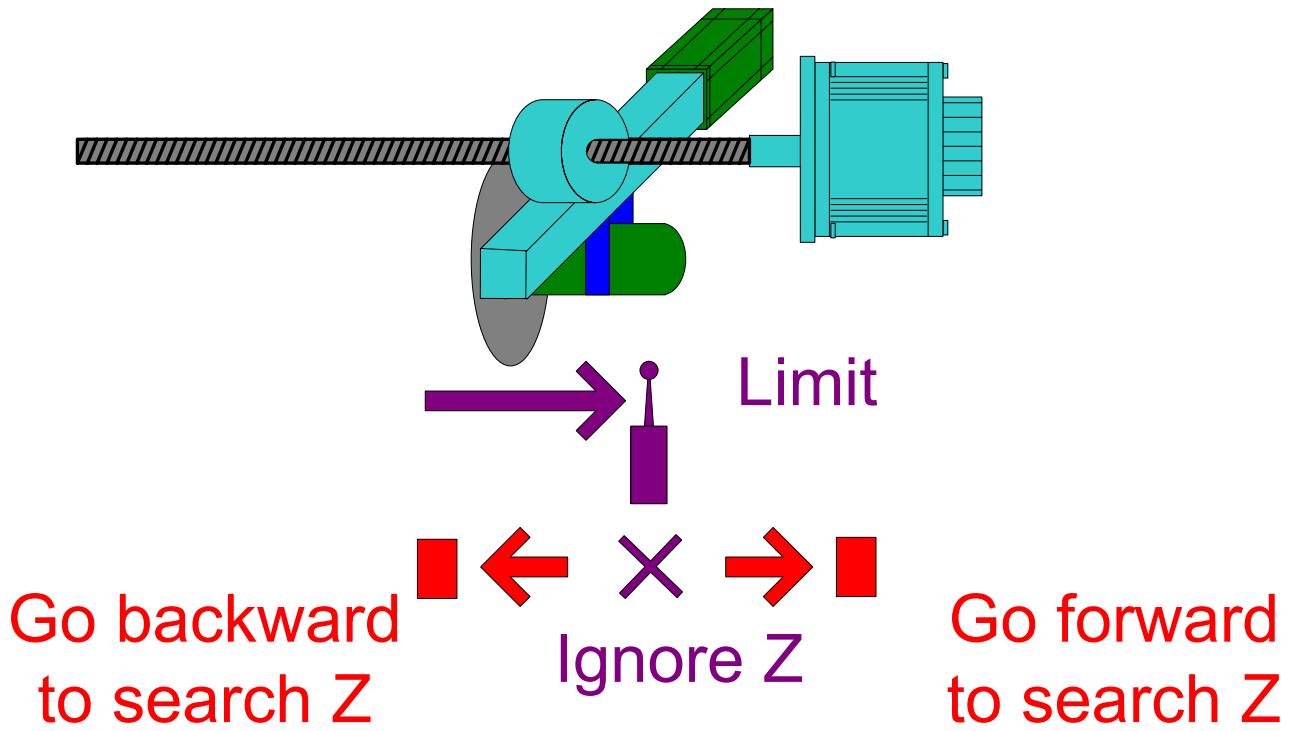
The Homing Mode (1)

Reference to Limit

X0: Move forward to PL assigned as home.

X1: Move backward to NL assigned as home.

Y: Y=0 Return to Z; Y=1 Go ahead to Z; Y=2 Do not search Z.



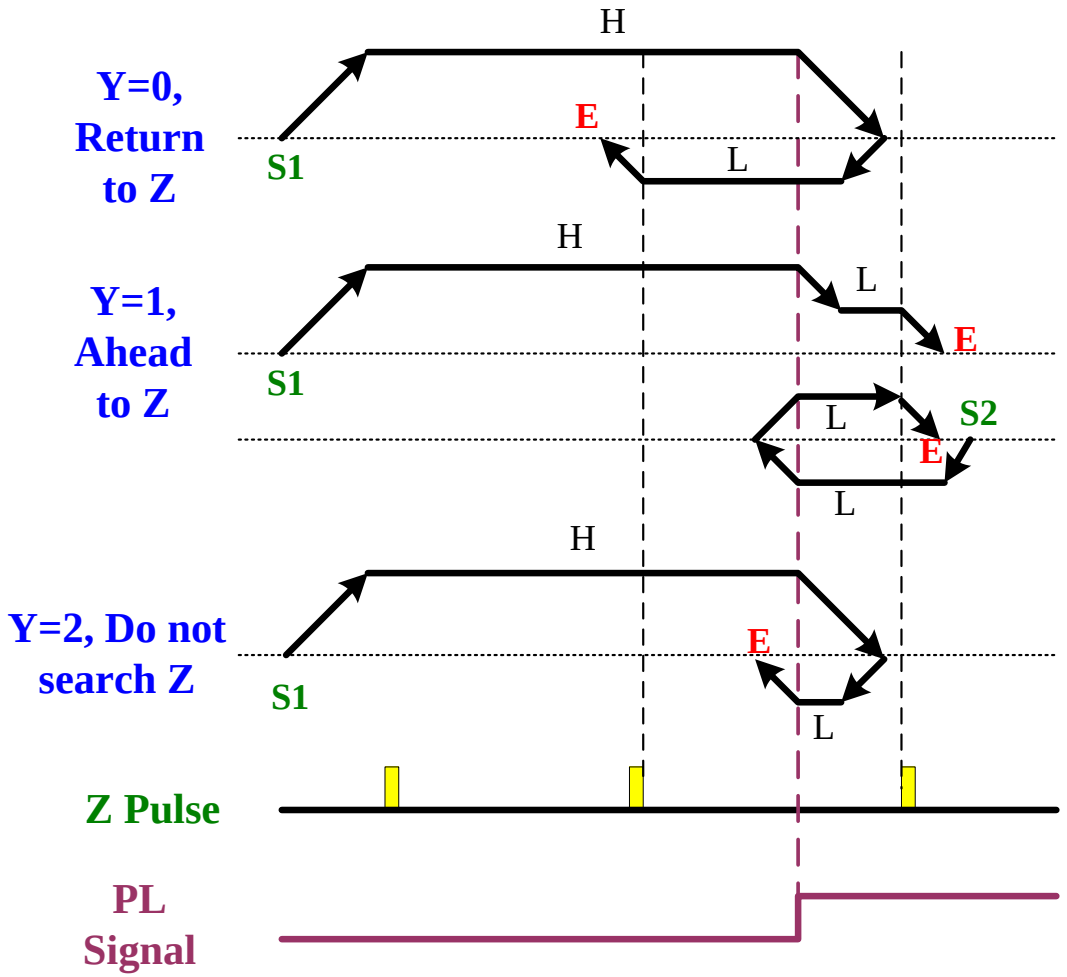
The Homing Mode (2)

Reference to Limit

X0: Move forward to PL assigned as home.

X1: Move backward to NL assigned as home.

Y: Y=0 Return to Z; Y=1 Go ahead to Z; Y=2 Do not search Z.



The Homing Mode (3)

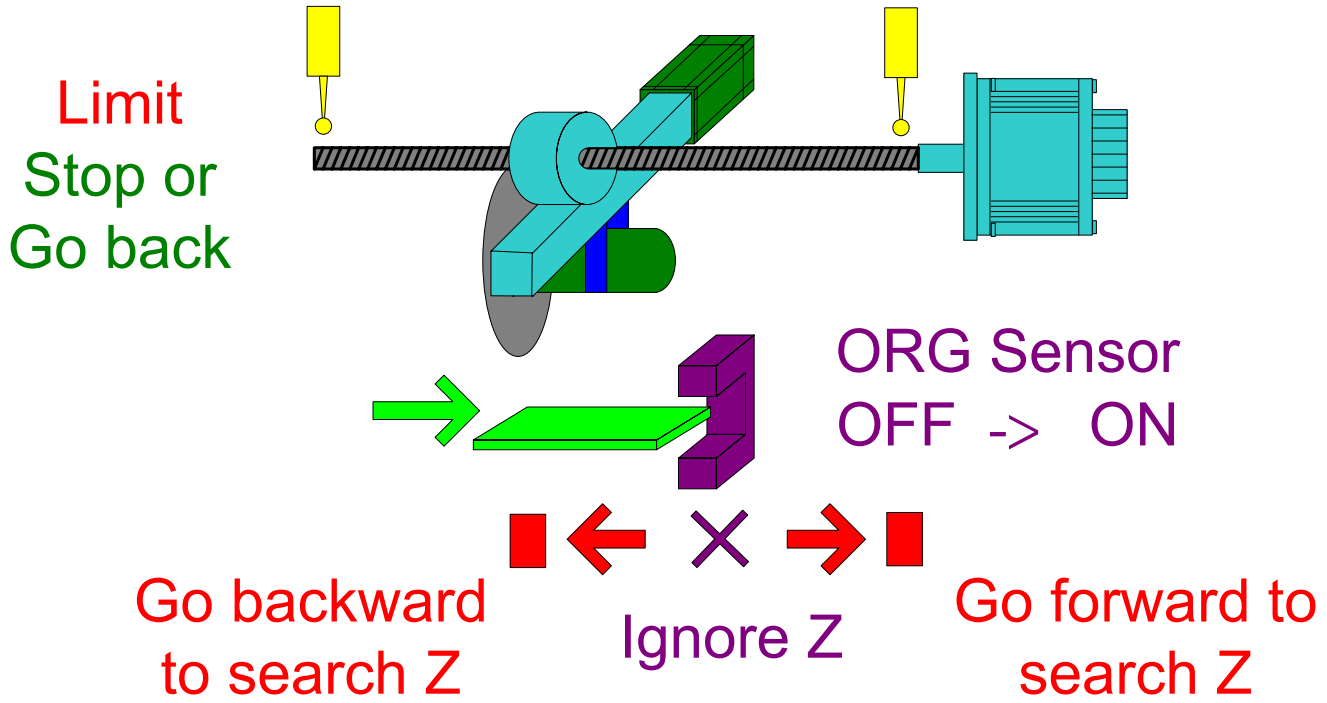
Reference to Home Sensor

X2: Move forward to home sensor (ORGP: OFF->ON).

X3: Move backward to home sensor (ORGP: OFF->ON).

Y: Y=0 Return to Z; Y=1 Go ahead to Z; Y=2 Do not search Z.

Z: Z=0 Stop and Warn; Z=1 Reverse automatically.



The Homing Mode (4)

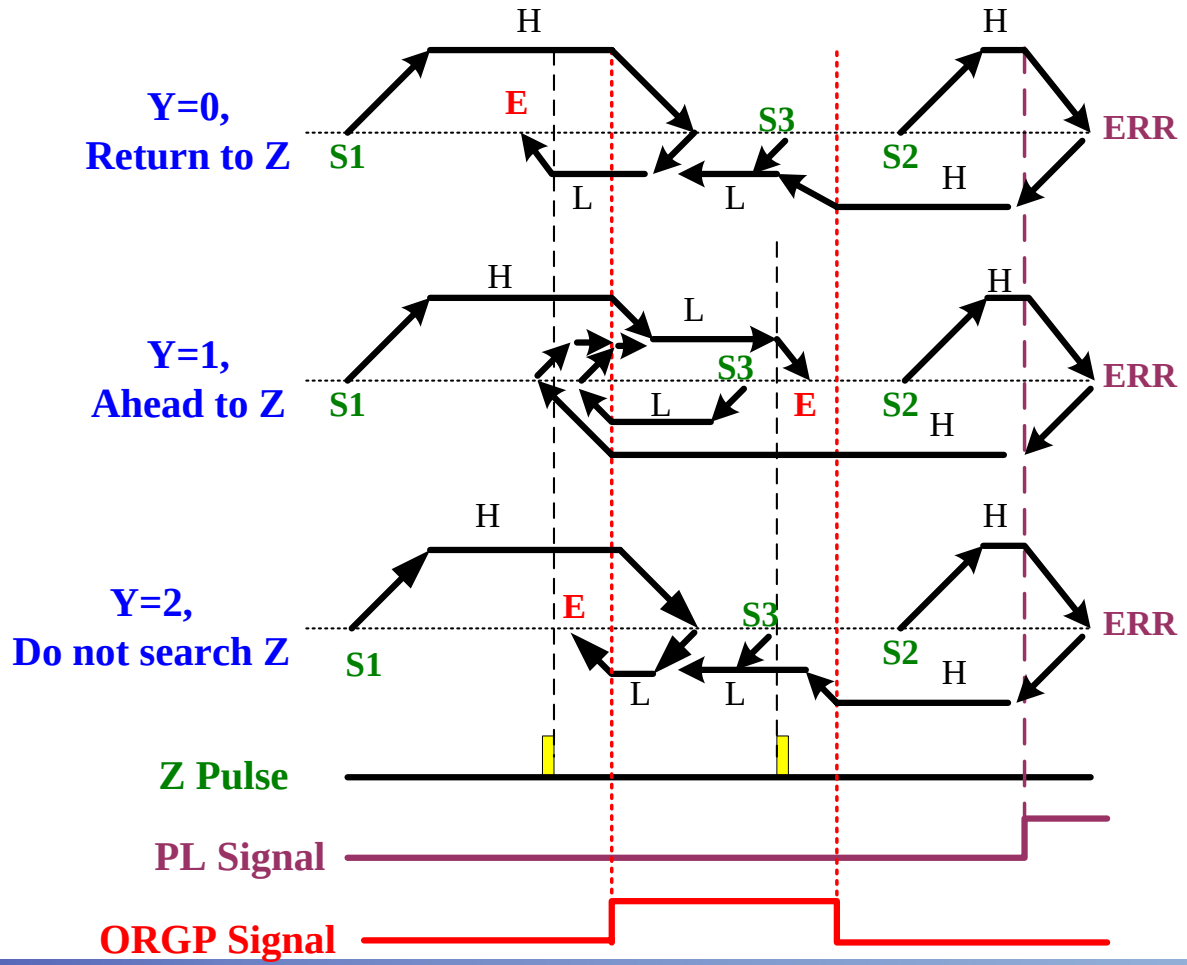
Reference to Home Sensor

X2: Move forward to home sensor (ORGP: OFF->ON).

X3: Move backward to home sensor (ORGP: OFF->ON).

Y: Y=0 Return to Z; Y=1 Go ahead to Z; Y=2 Do not search Z.

Z: Z=0 Stop and Warn; Z=1 Reverse automatically.



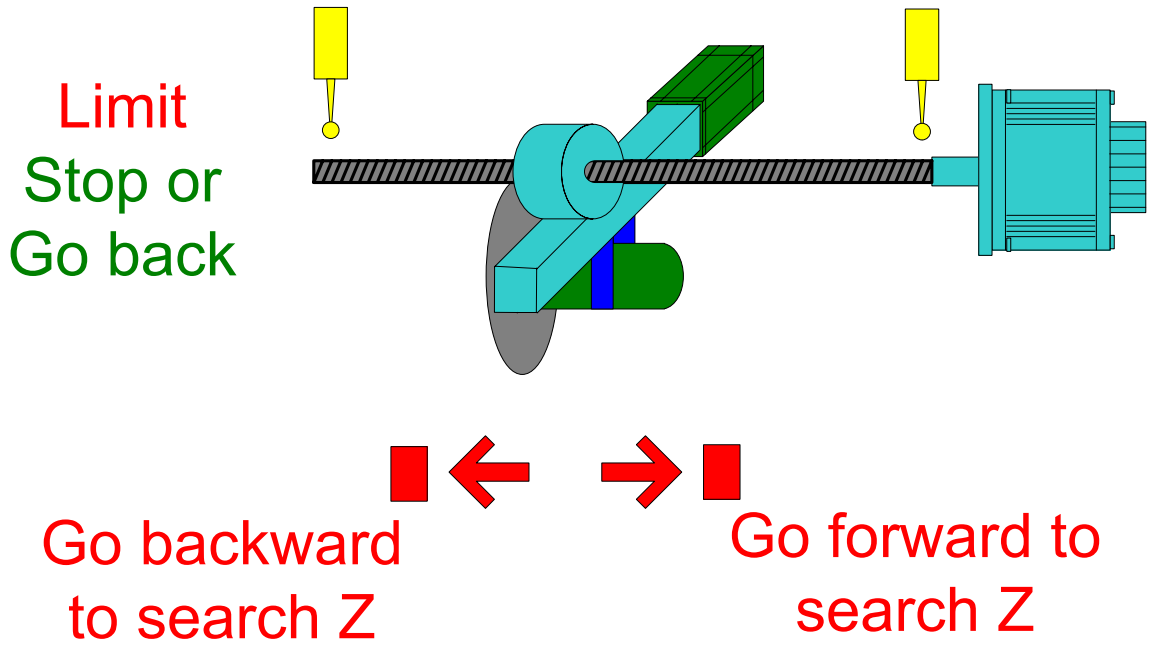
The Homing Mode (5)

Reference to Z Pulse

X4: Move forward to Z pulse.

X5: Move backward to Z pulse.

Z: Z=0 Stop and Warn; Z=1 Reverse automatically.



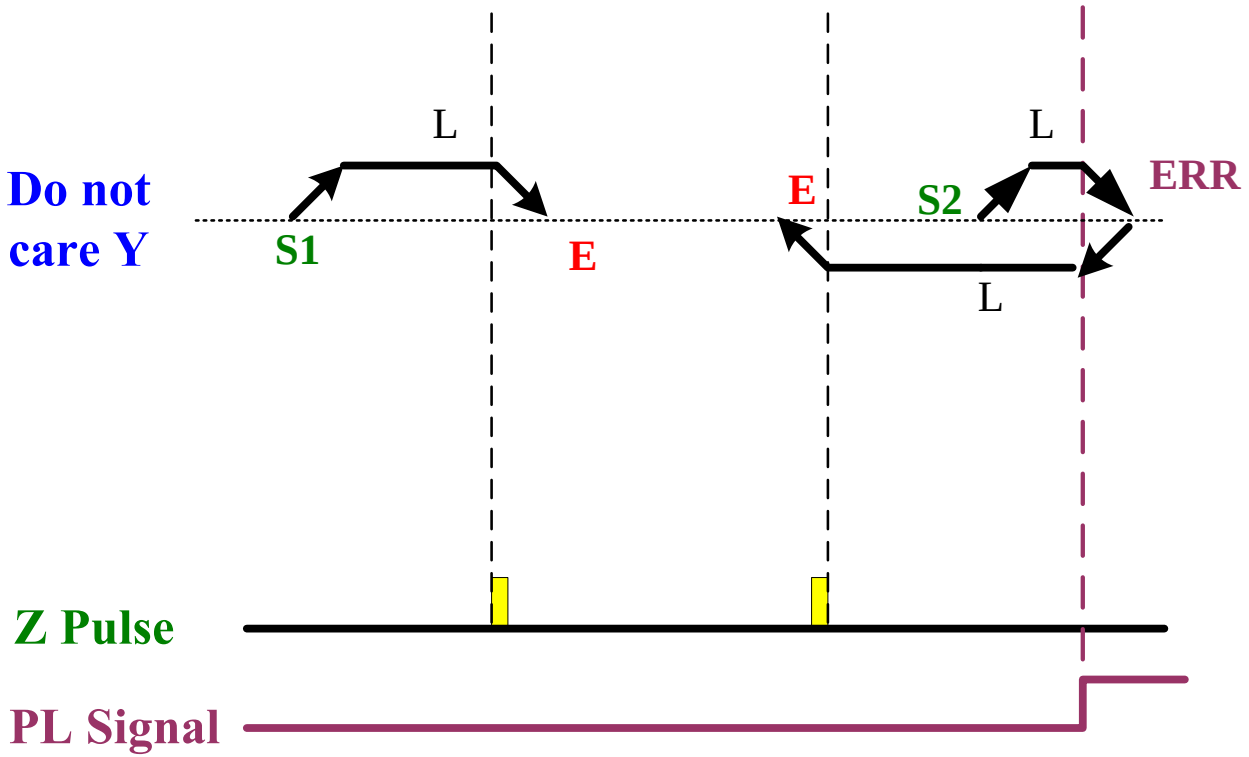
The Homing Mode (6)

Reference to Z Pulse

X4: Move forward to Z pulse.

X5: Move backward to Z pulse.

Z: Z=0 Stop and Warn; Z=1 Reverse automatically.



The Homing Mode (7)

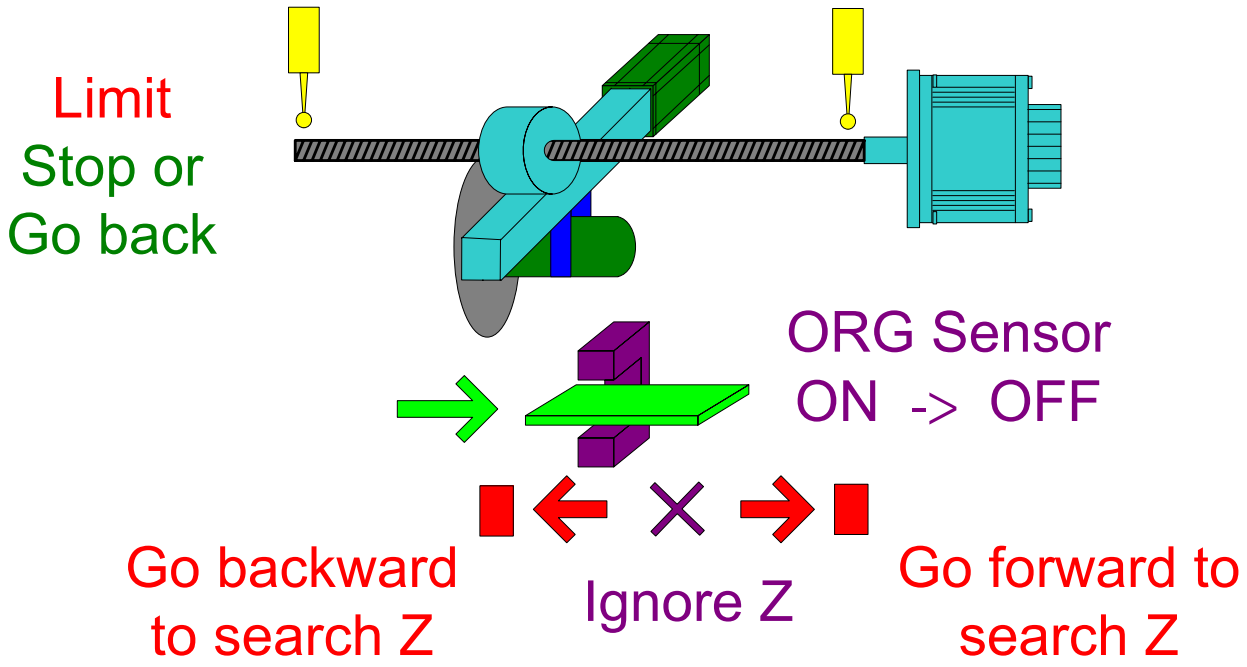
Reference to Home Sensor

X2: Move forward to home sensor (ORGP: ON->OFF).

X3: Move backward to home sensor (ORGP: ON->OFF).

Y: Y=0 Return to Z; Y=1 Go ahead to Z; Y=2 Do not search Z.

Z: Z=0 Stop and Warn; Z=1 Reverse automatically.



The Homing Mode (8)

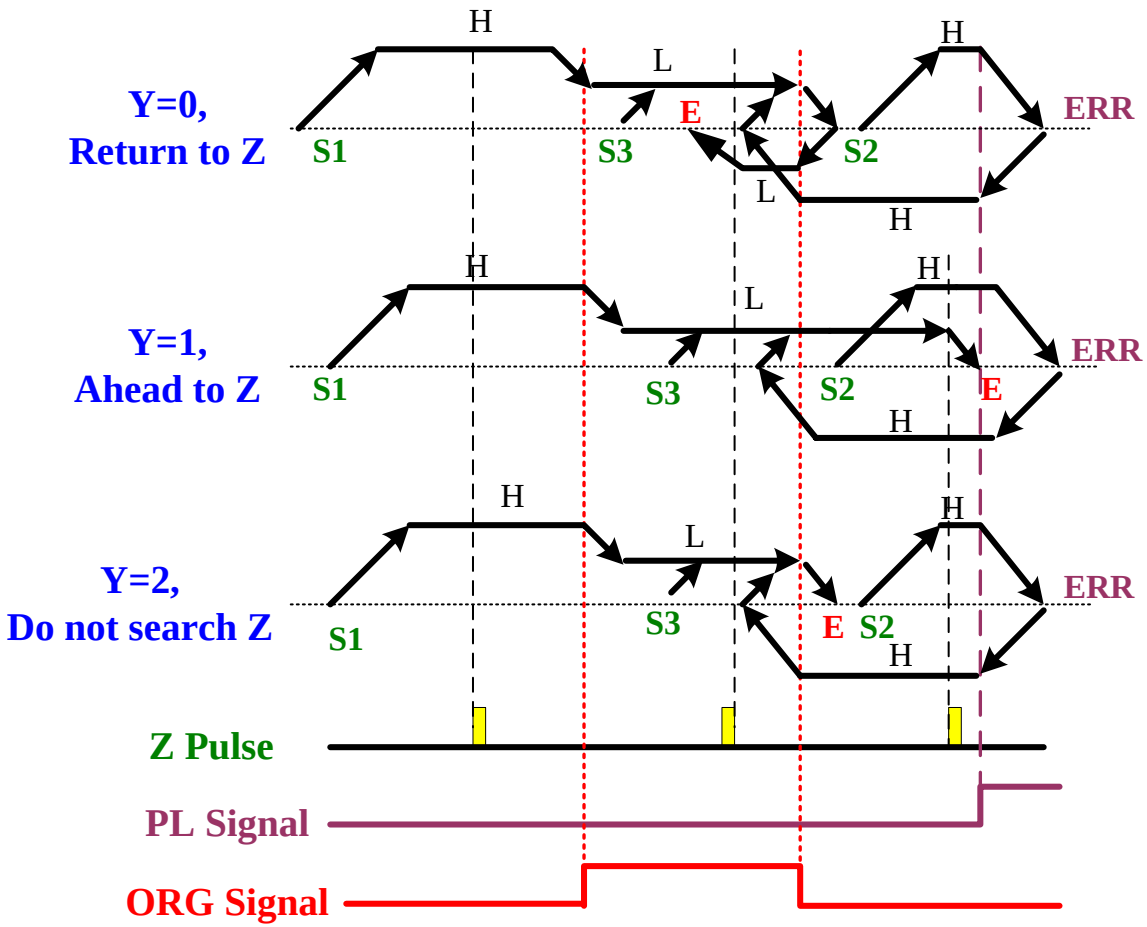
Reference to Home Sensor

X2: Move forward to home sensor (ORGP: ON->OFF).

X3: Move backward to home sensor (ORGP: ON->OFF).

Y: Y=0 Return to Z; Y=1 Go ahead to Z; Y=2 Do not search Z.

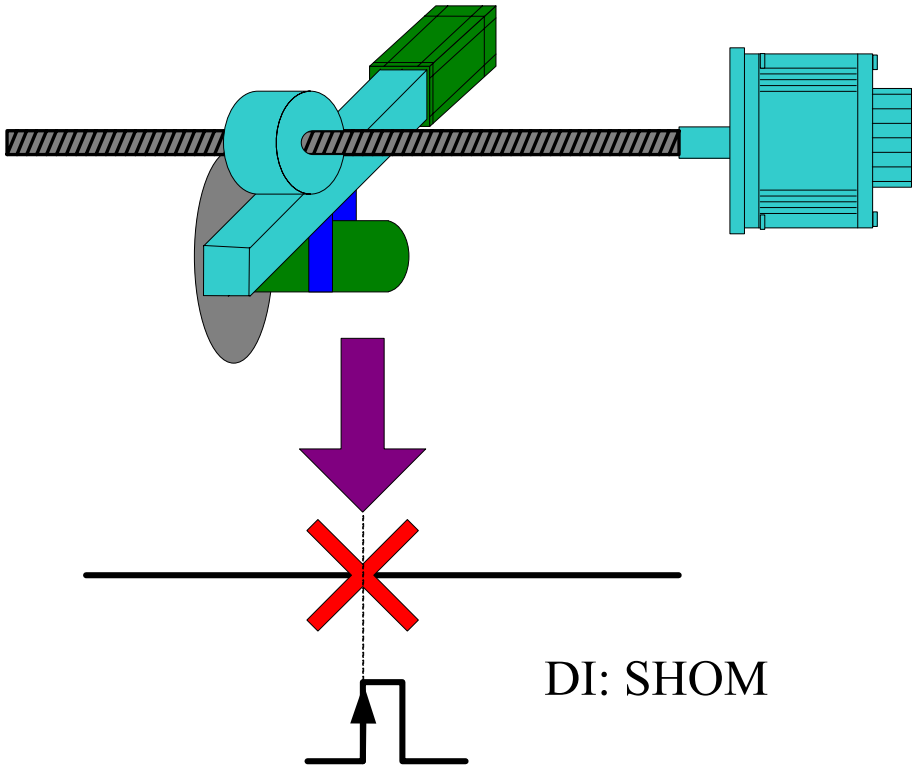
Z: Z=0 Stop and Warn; Z=1 Reverse automatically.



The Homing Mode (9)

Reference to Current Position

X8: Regarding current position as home position.

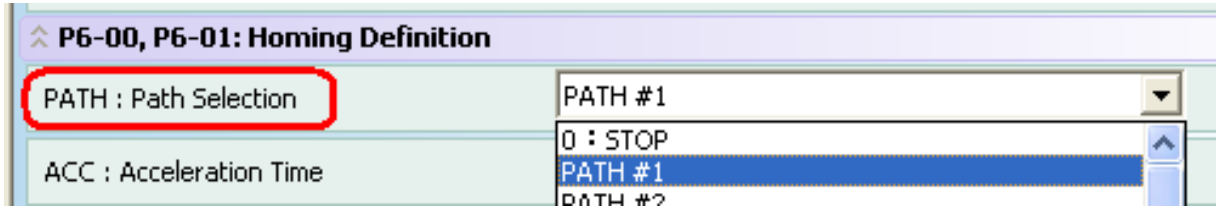


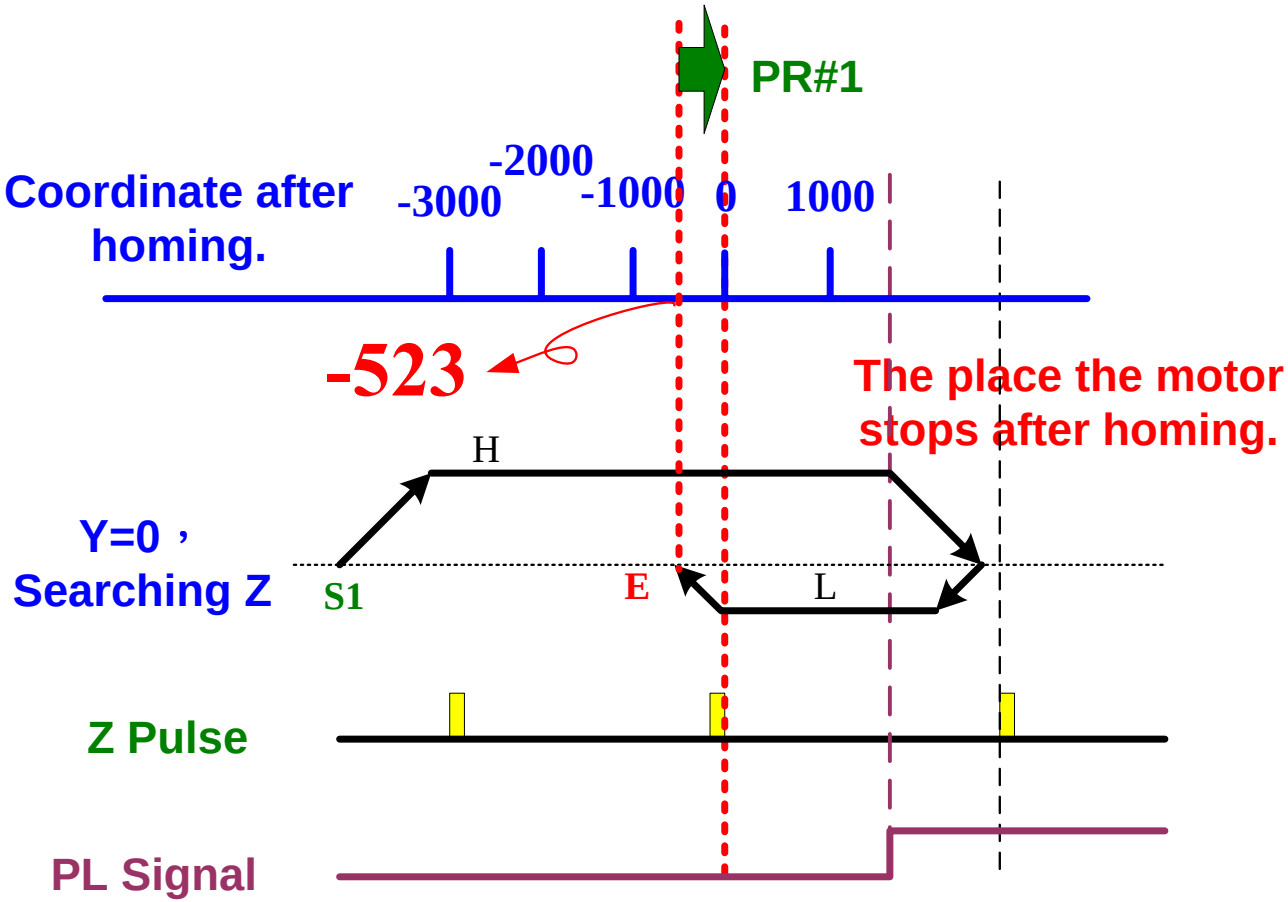
The home position is defined to the place the motor stops at the moment of SHOM signal triggered.

The Homing Mode (10)

The Position & Coordinate after Homing

After homing, the motor will stop at a place close to home but not exactly at home except the mode X=8. Another PR can be called to move the motor to the coordinate zero or any place.

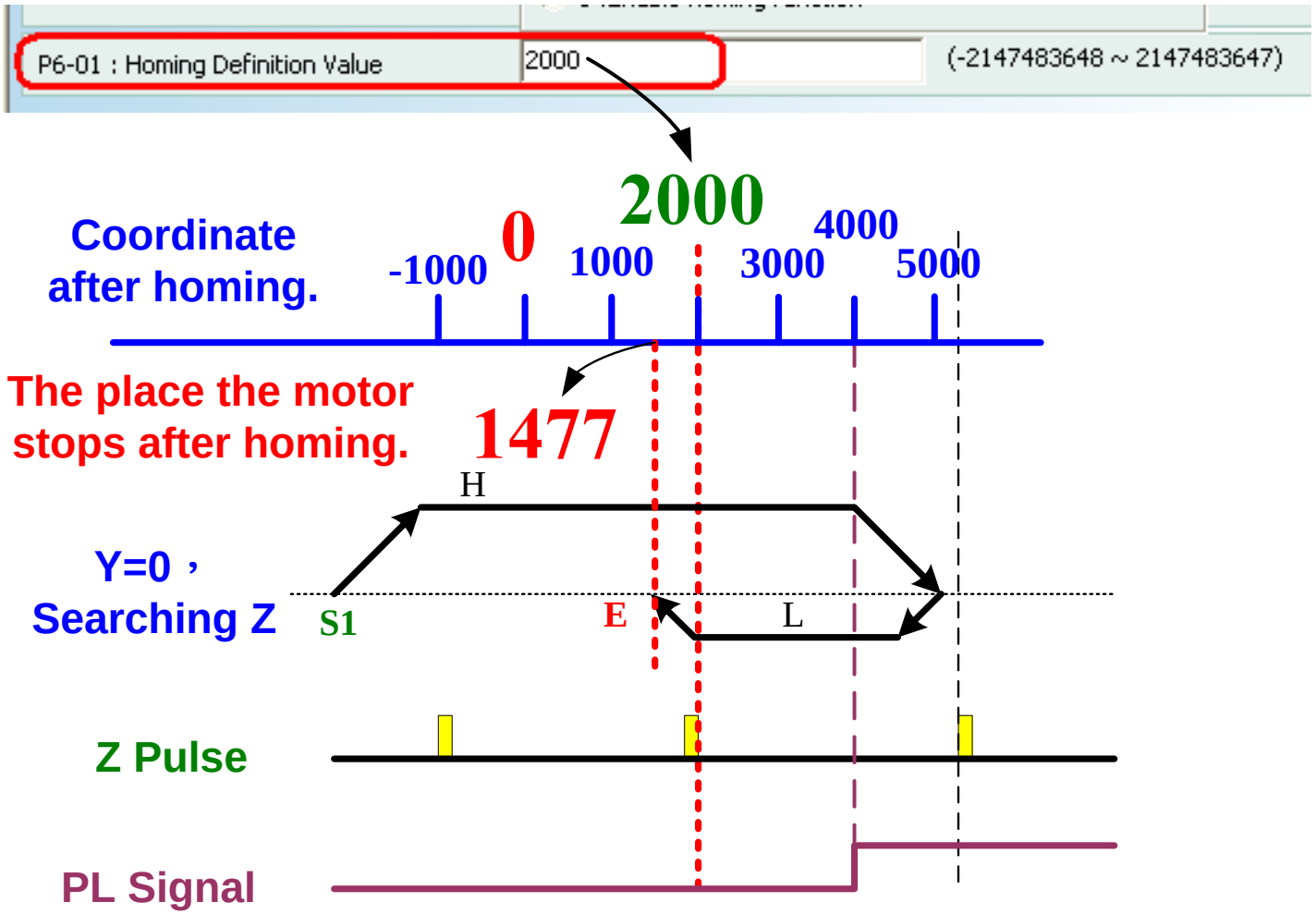




The Homing Mode (11)

Coordinate Offset

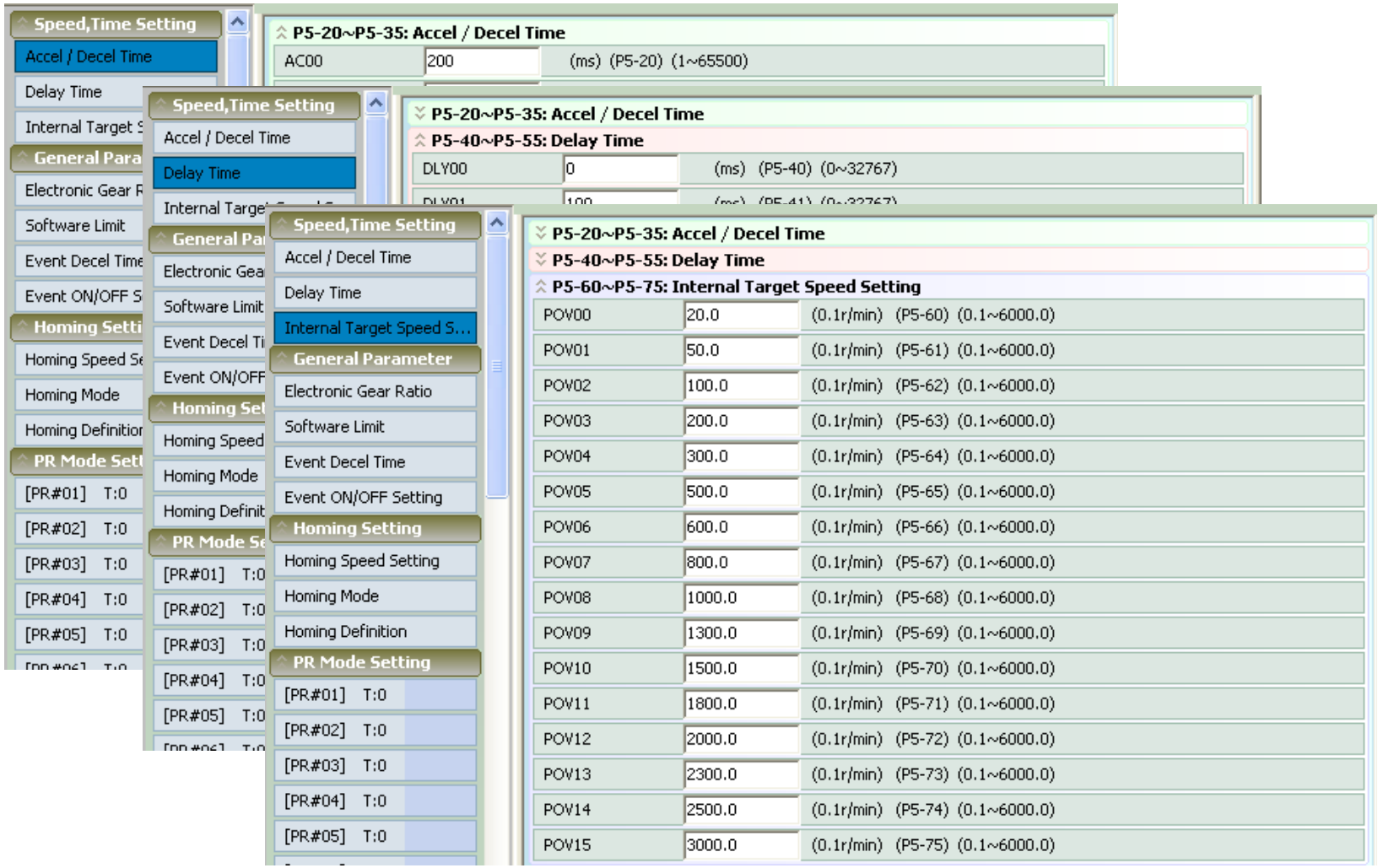
The home reference point can be defined to any value to its coordinate called the coordinate offset.



The Sharing Data

Data for All PRs

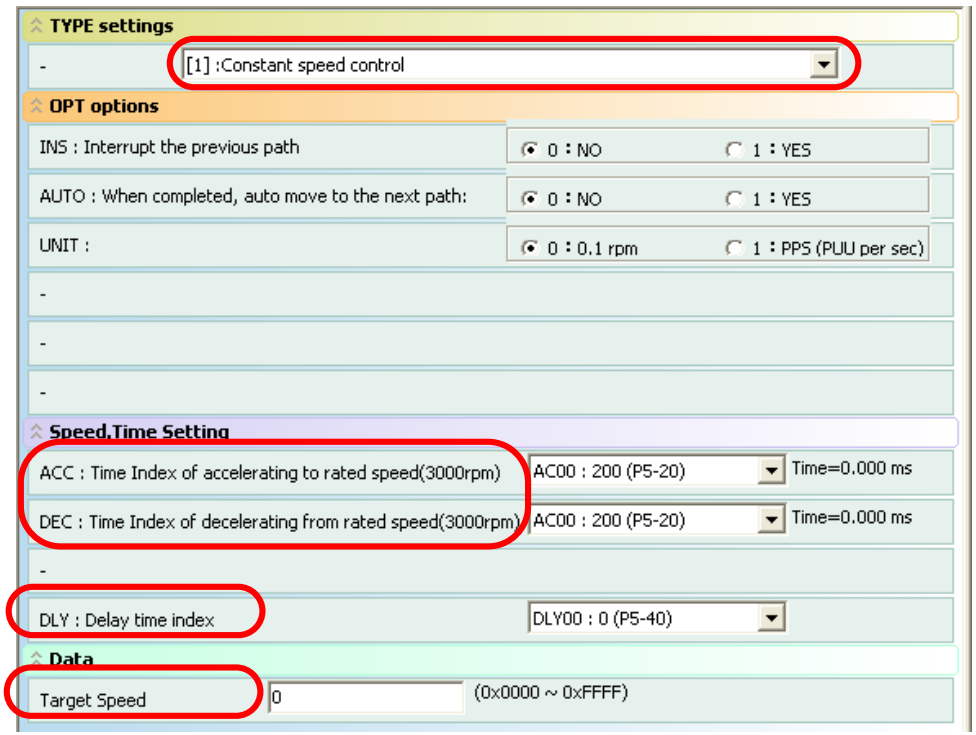
The acceleration/deceleration time, delay time, and target speed are shared with all 64 PRs.

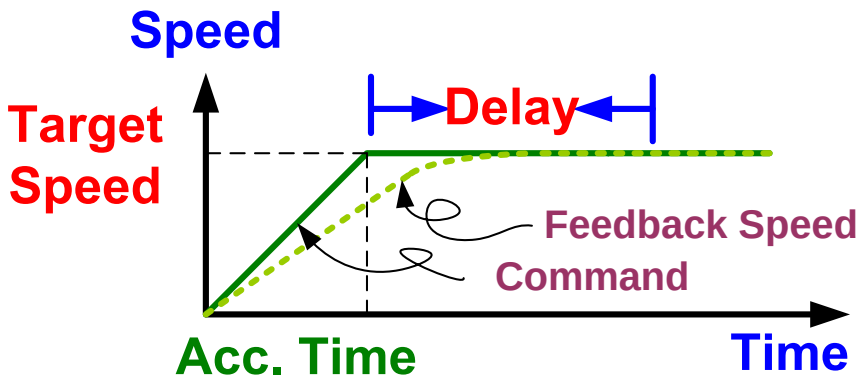


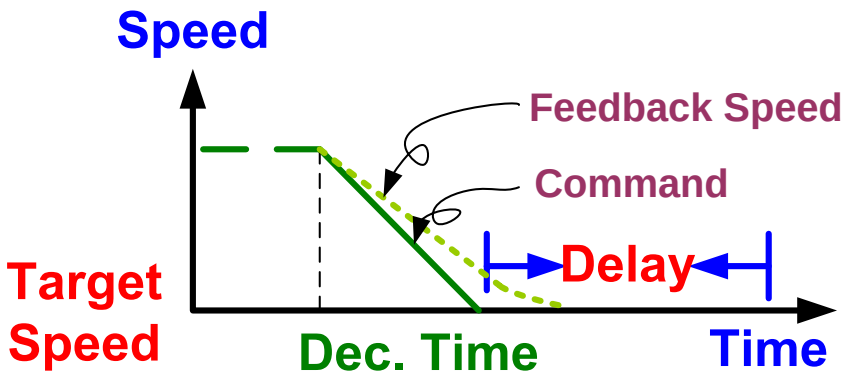
The Constant Speed Mode (1)

Speed Control of PR

The acceleration/deceleration time along with target speed can be configured. The Delay Time is defined from the view of command.





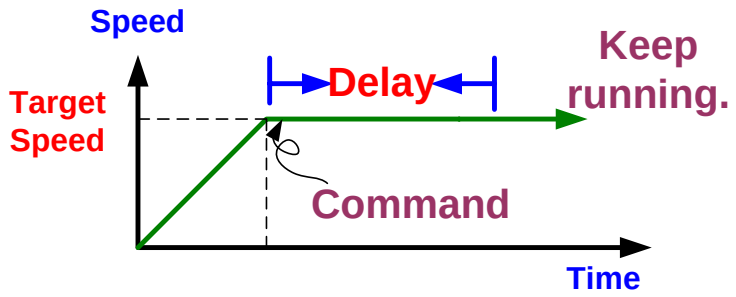


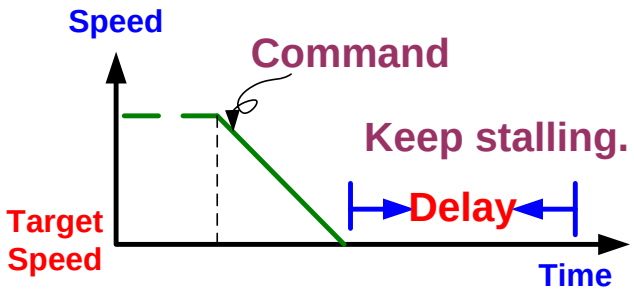
The Constant Speed Mode (2)

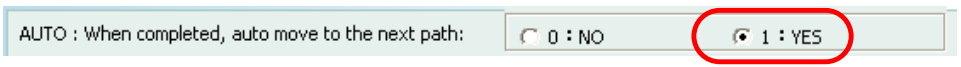
Move to the Next PR

The procedure can be set if it moves to the next PR when the current PR finished. The delay time will delay the timing of enforcement to the next PR.

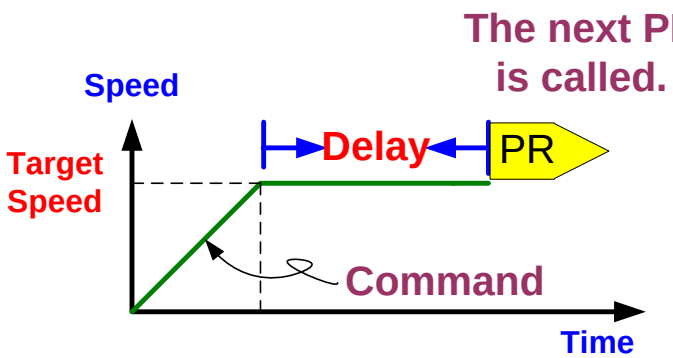
Stop at the current PR.

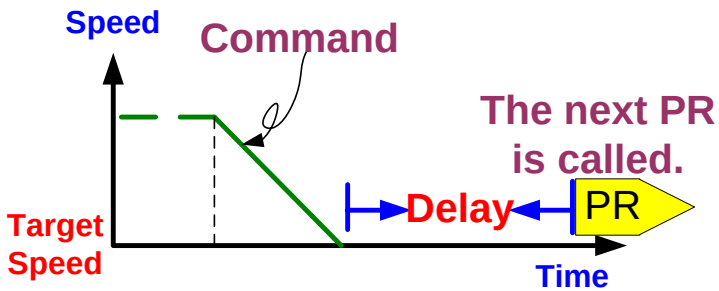






Call the next PR after finishing current PR.





The Position Mode (1)

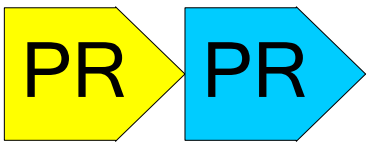
Position Control of PR

There are two sub-types with 4 different kinds of position commands respectively under Position Control Mode.

Command	Type 2	Type 3
Absolute Command	✓	✓
Relative Command	✓	✓
Incremental Command	✓	✓
Cap. Relative Command	✓	✓

Type 2:
The procedure will be stopped after finishing the current PR.

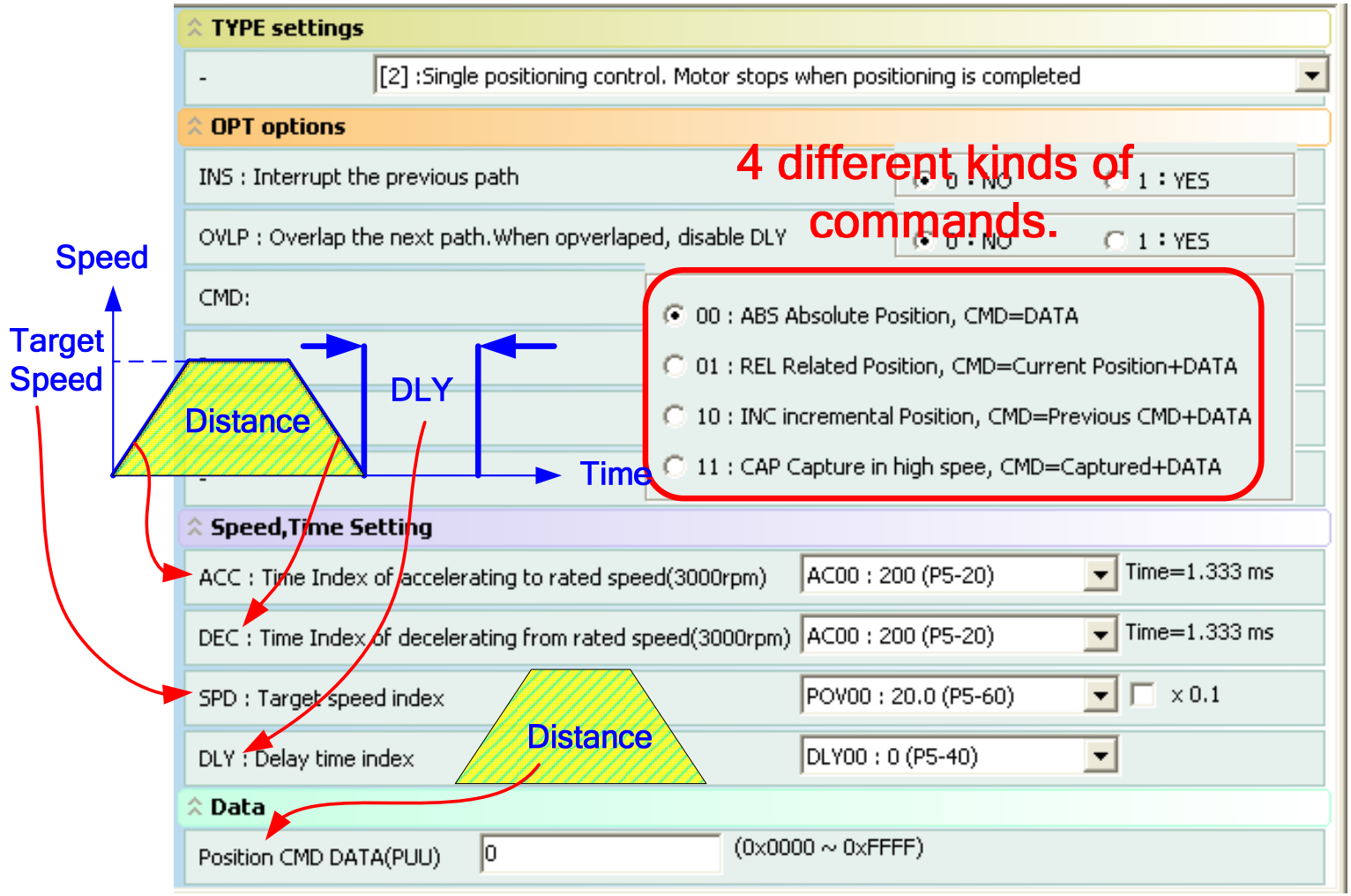
Type 3:
The NEXT PR will be called after finishing the current PR.



The Position Mode (2)

Motion Profile of Position Control

The Acceleration/Deceleration time, Target speed, Delay time and Distance can be set.

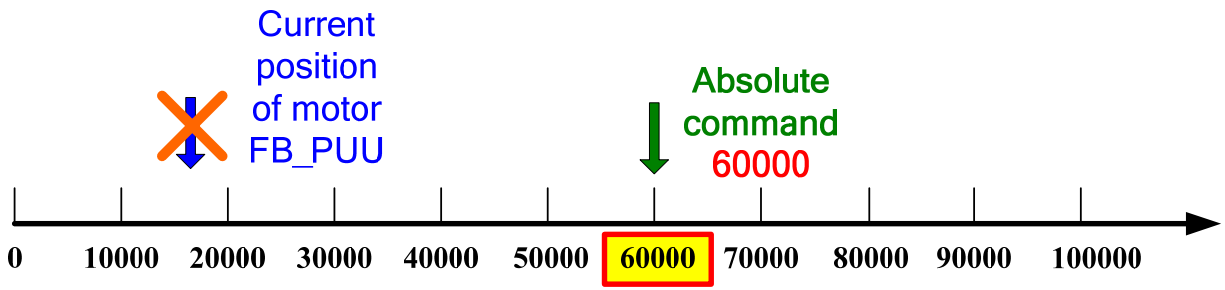


The Position Mode (3)

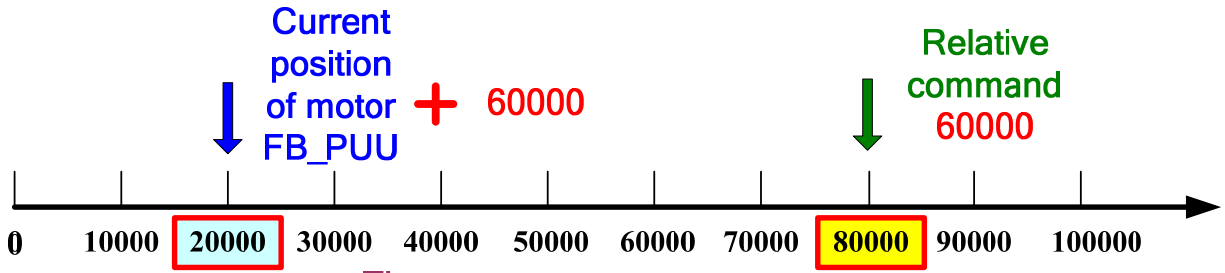
4 Different Types of Position Commands

The Absolute, Relative, Incremental, and Capture Relative commands.

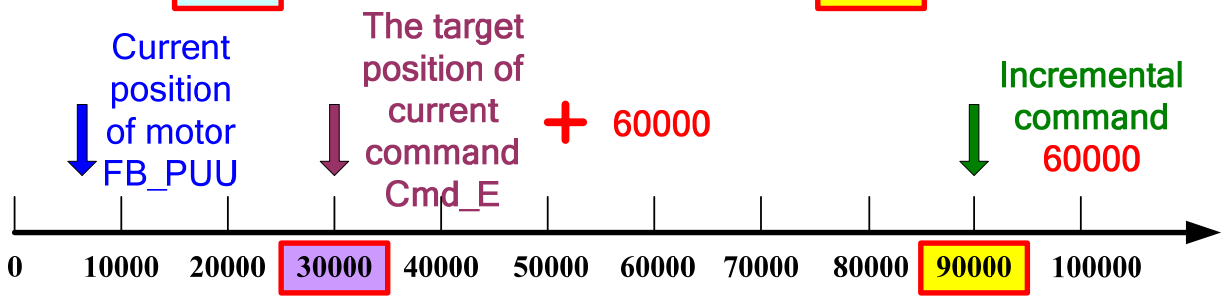
Absolute command 60000



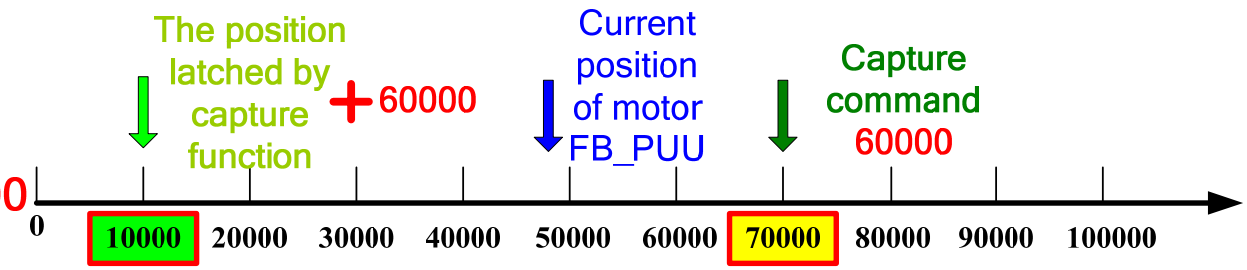
Relative command 60000



Incremental command 60000



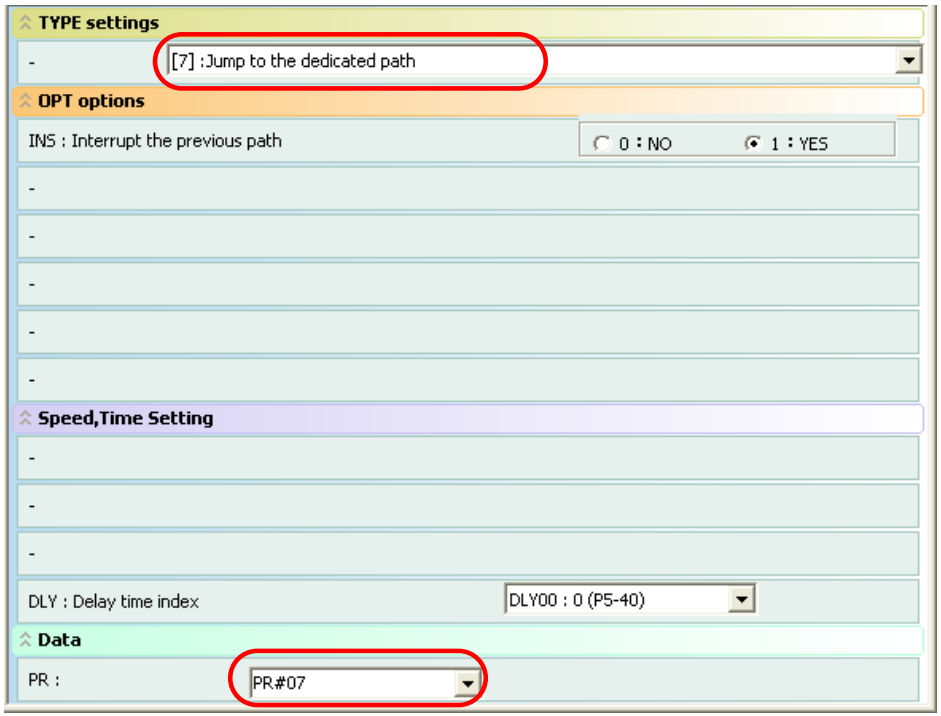
Cap. Relative command 60000

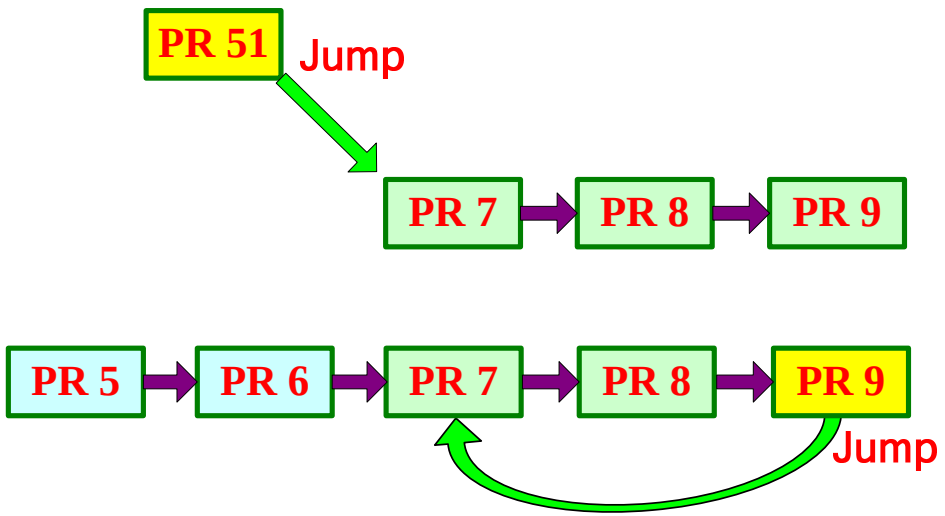


The Jump Mode

Switch the Procedure

The jump function can call any PR.

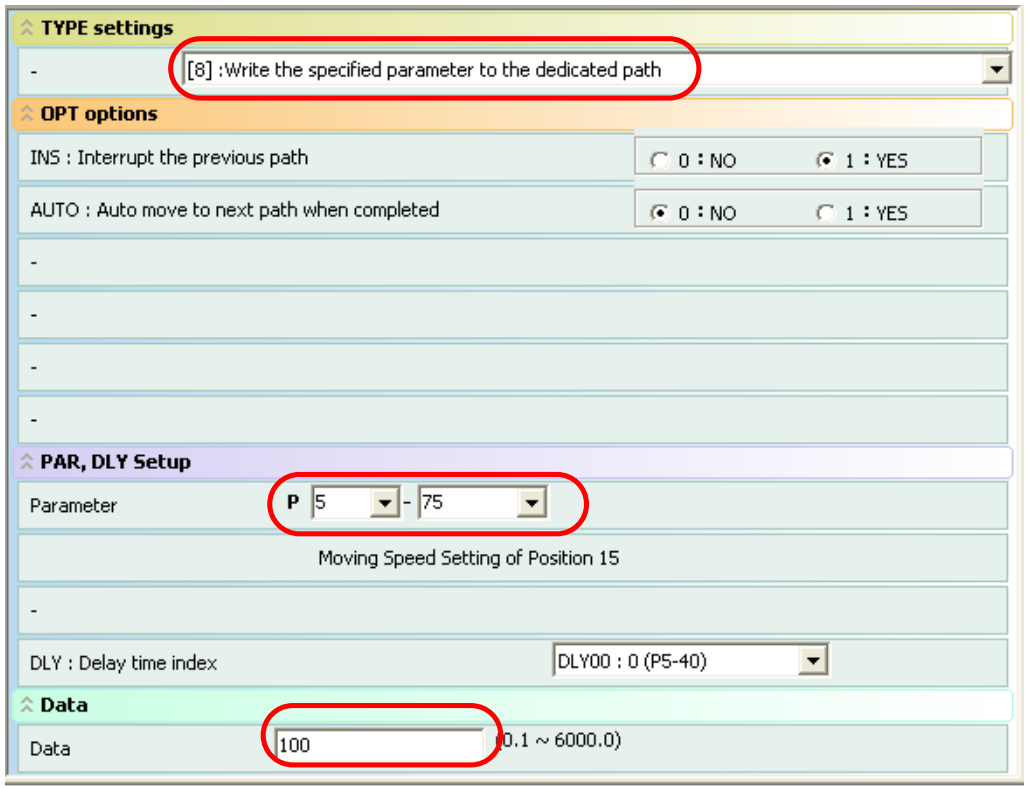


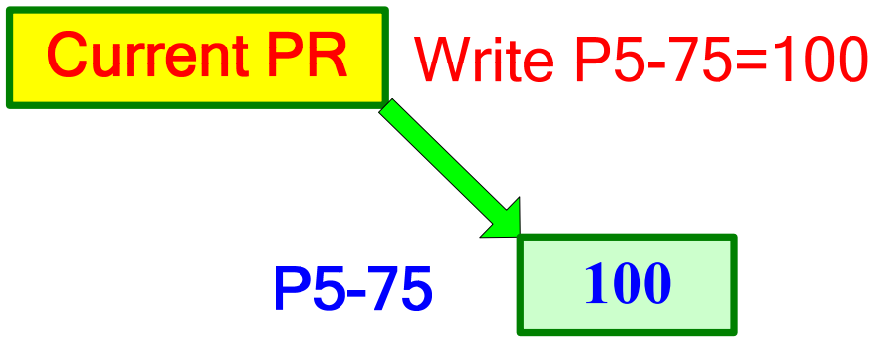


The Write Parameter Mode

Change Parameter with PR

The Write Parameter PR can be used to change any of parameters in the Servo Drive.

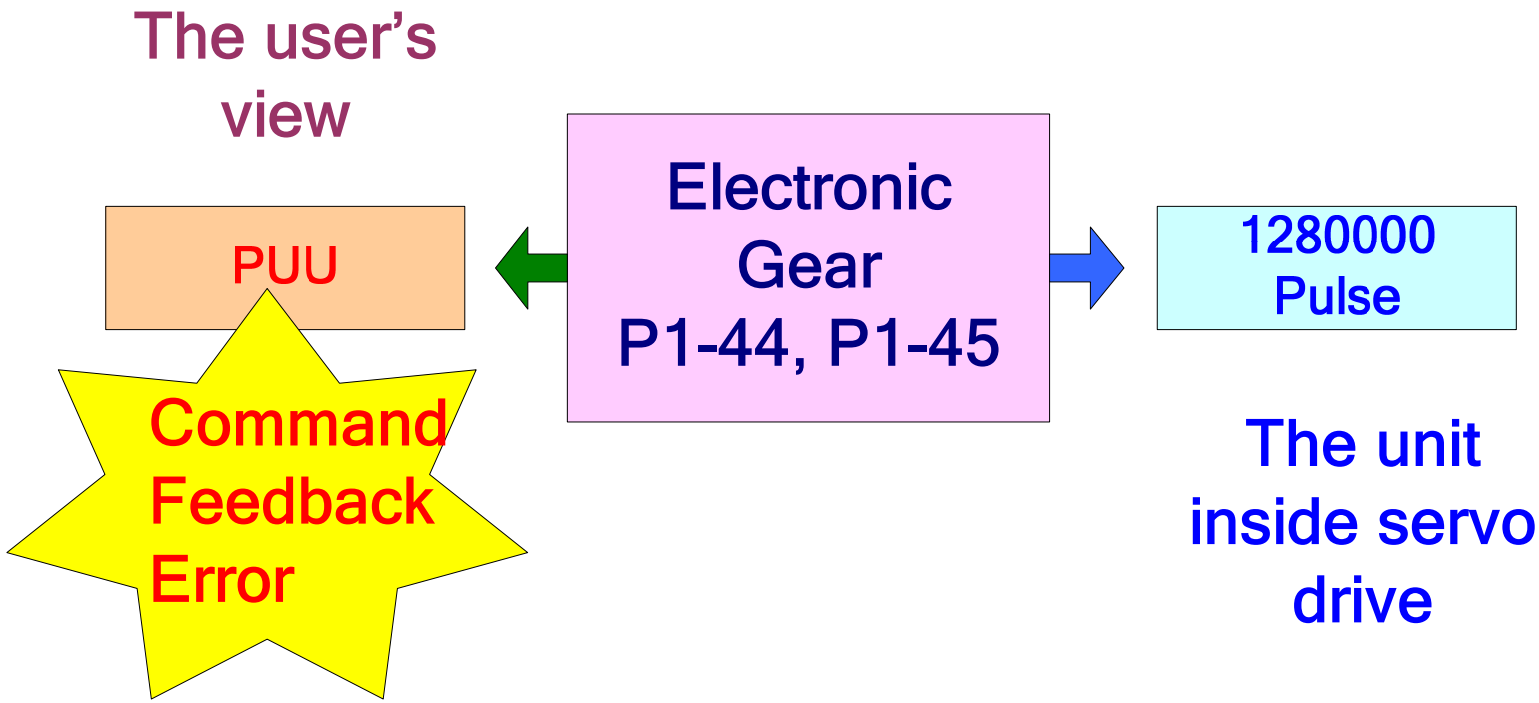




What is PUU?

Pulse of User Unit

The PUU is a unit which is scaled by the electronic gear. This will bring out an advantage, and that is "YOU SEE WHAT YOU COMMAND". For example, if you send 10000 PUU for command and you can read from the feedback 10000 PUU and ignore the Electronic Gear Ratio.



Some Monitoring Variables

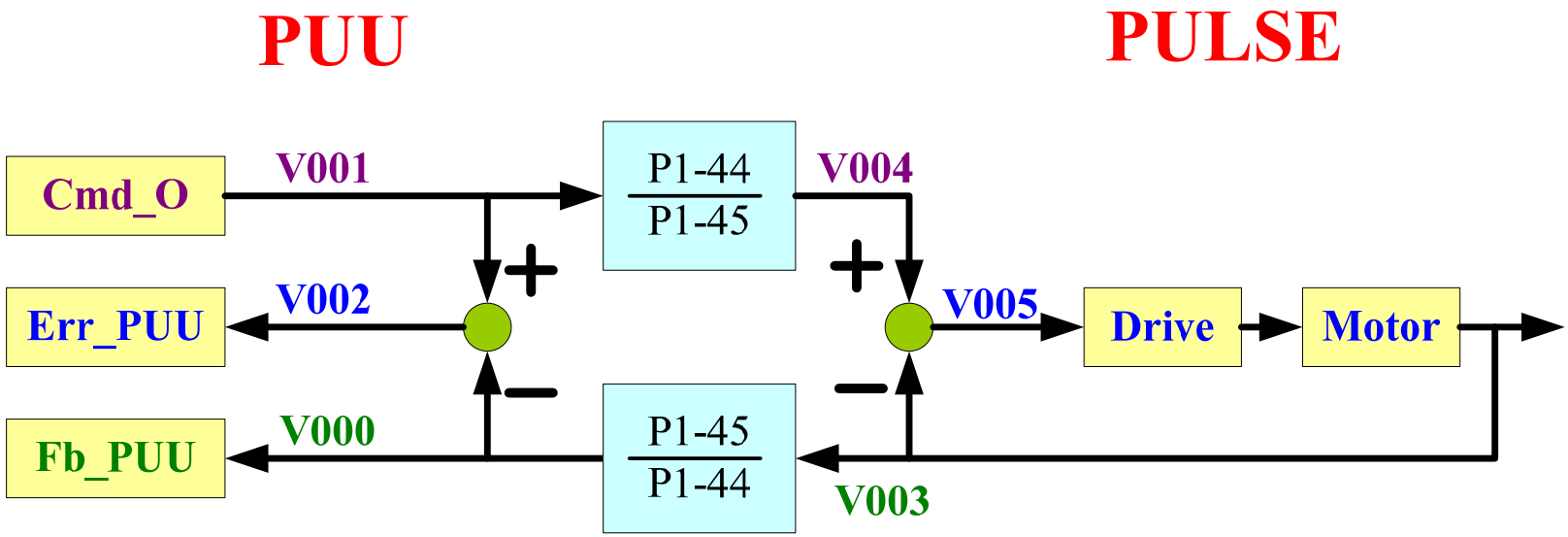
A Close Look to Command's Execution

Cmd_O: The intermediate command .

Cmd_E(V064): The target position of command.

Fb_PUU: The current (feedback) position of motor.

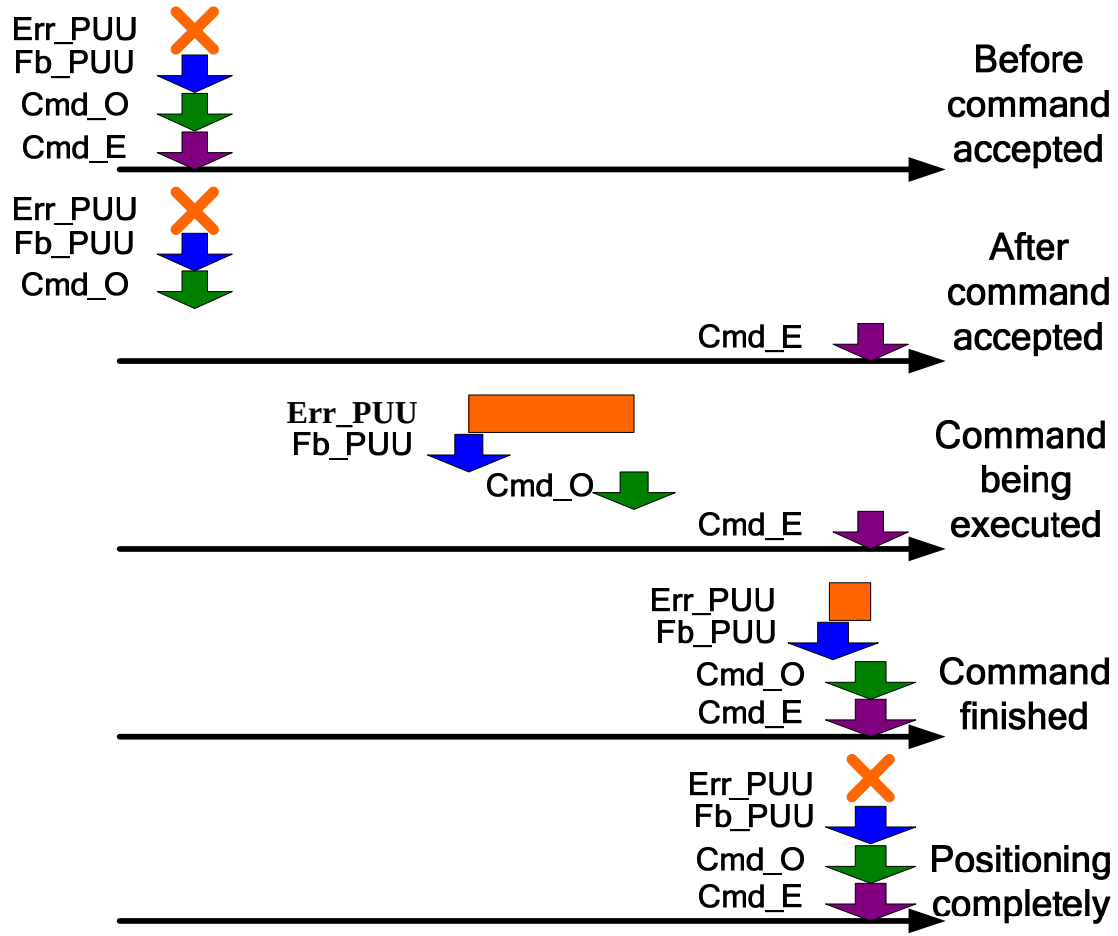
Err_PUU: The position error = (Cmd_O – Fb_PUU).



Example of Monitoring Variables(1)

A Position Command Example

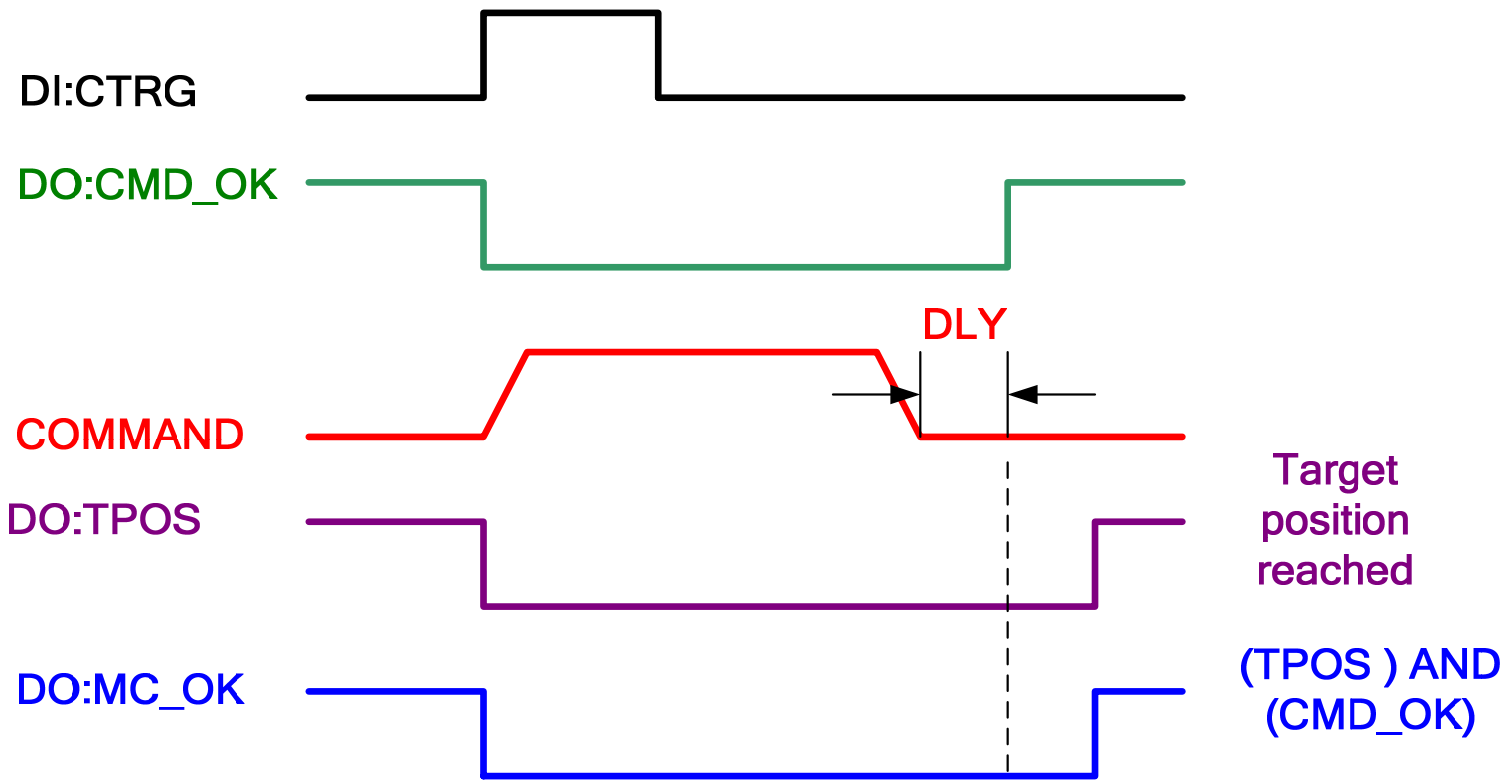
The final destination will be known at the moment command accepted, and the motor needs time to accomplish the command.



Example of Monitoring Variables(2)

The Signal Out

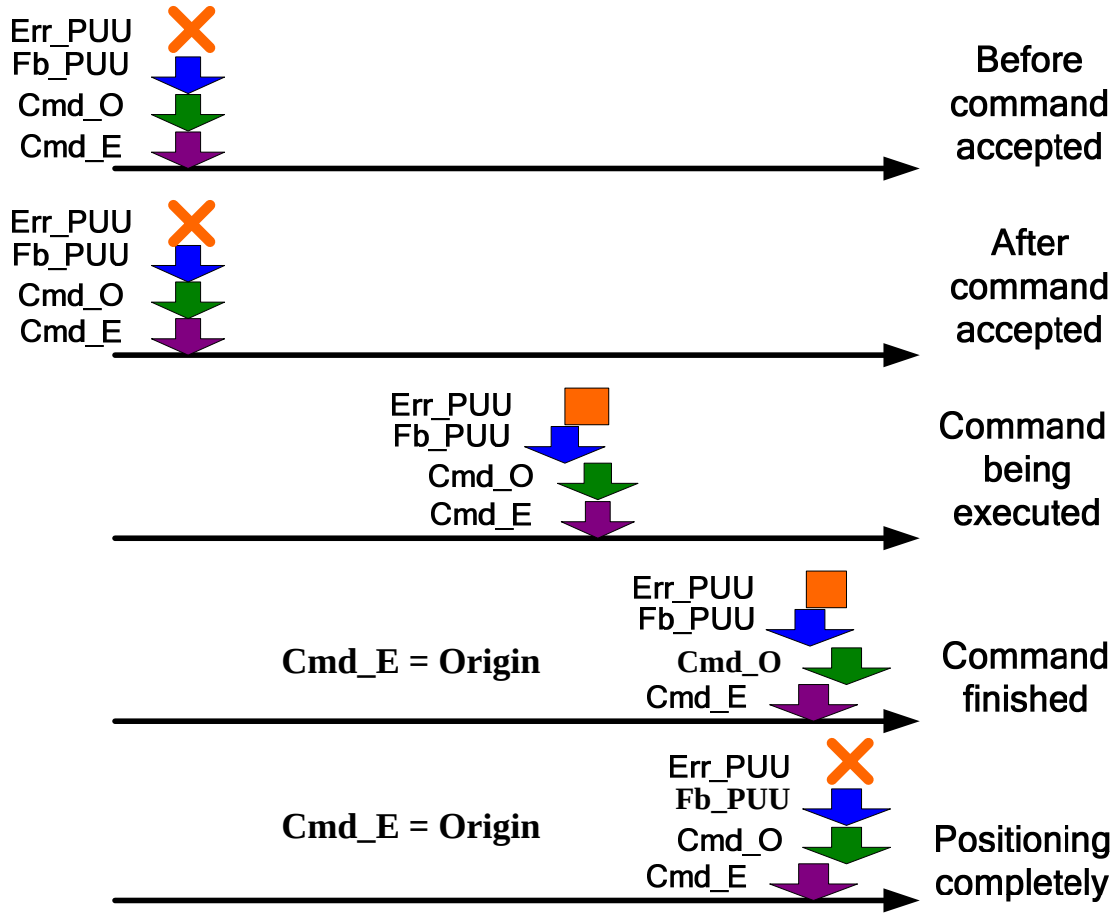
A digital output called MC_OK is designed for signaling the completion of command.



Example of Monitoring Variables(3)

A Homing Command Example

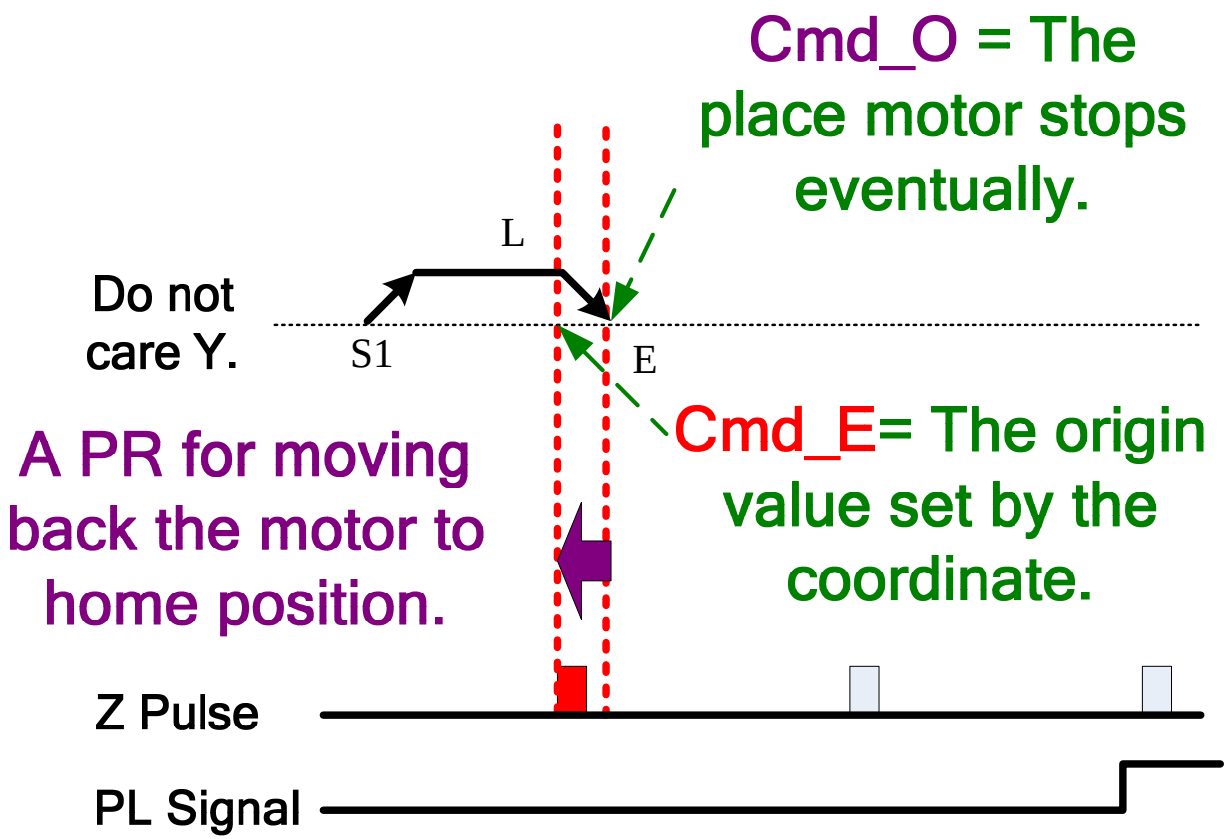
The final destination Cmd_E cannot be known until the motor travels across the home. Once the place known, it need a short distance to reduce its speed to zero.



Example of Monitoring Variables(4)

A Homing Command Motion Profile

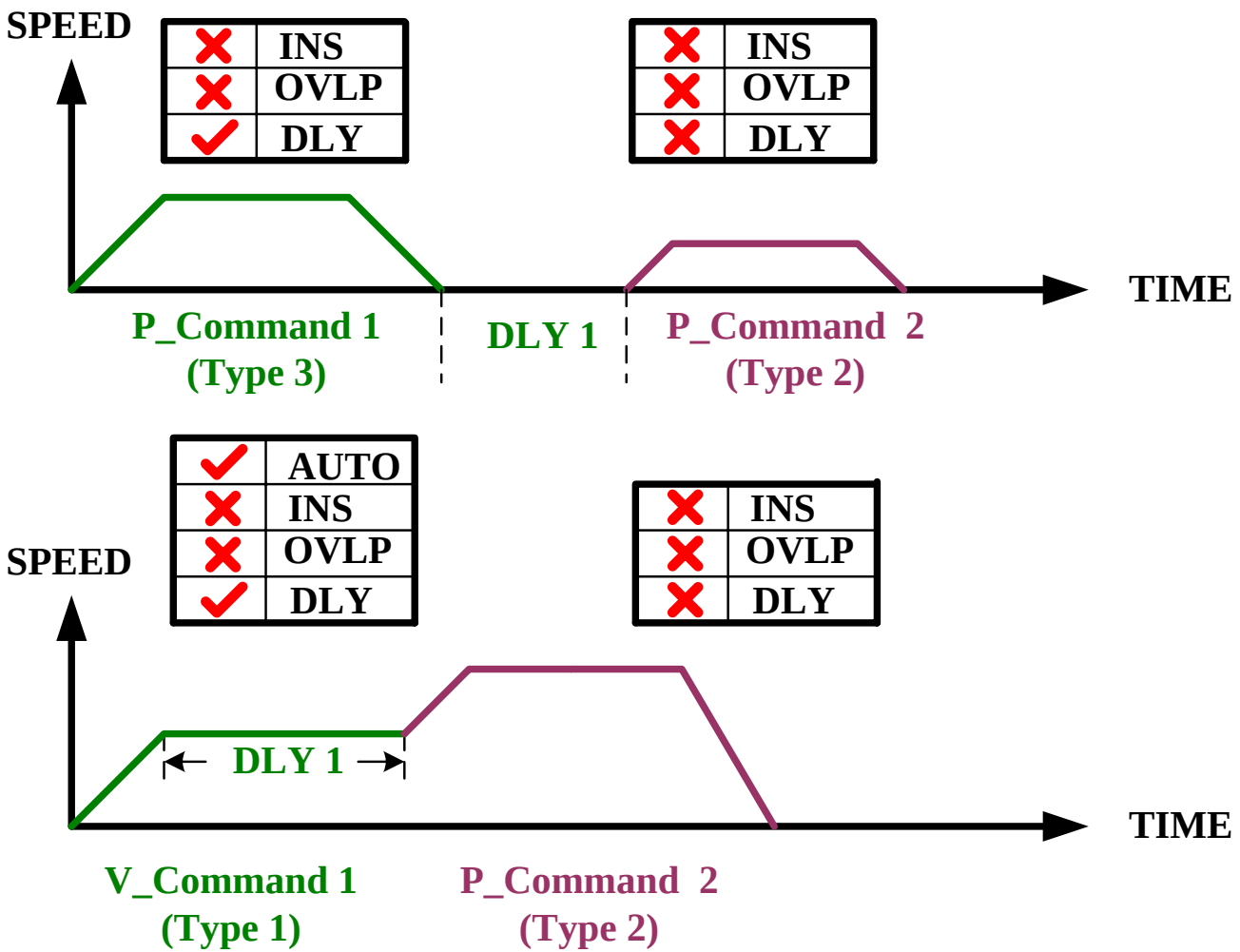
If there doesn't have any PR executed after homing, the Cmd_O and Cmd_E is not the same on ASDA-A2.



Motion Command (1)

Sequential Command on PR

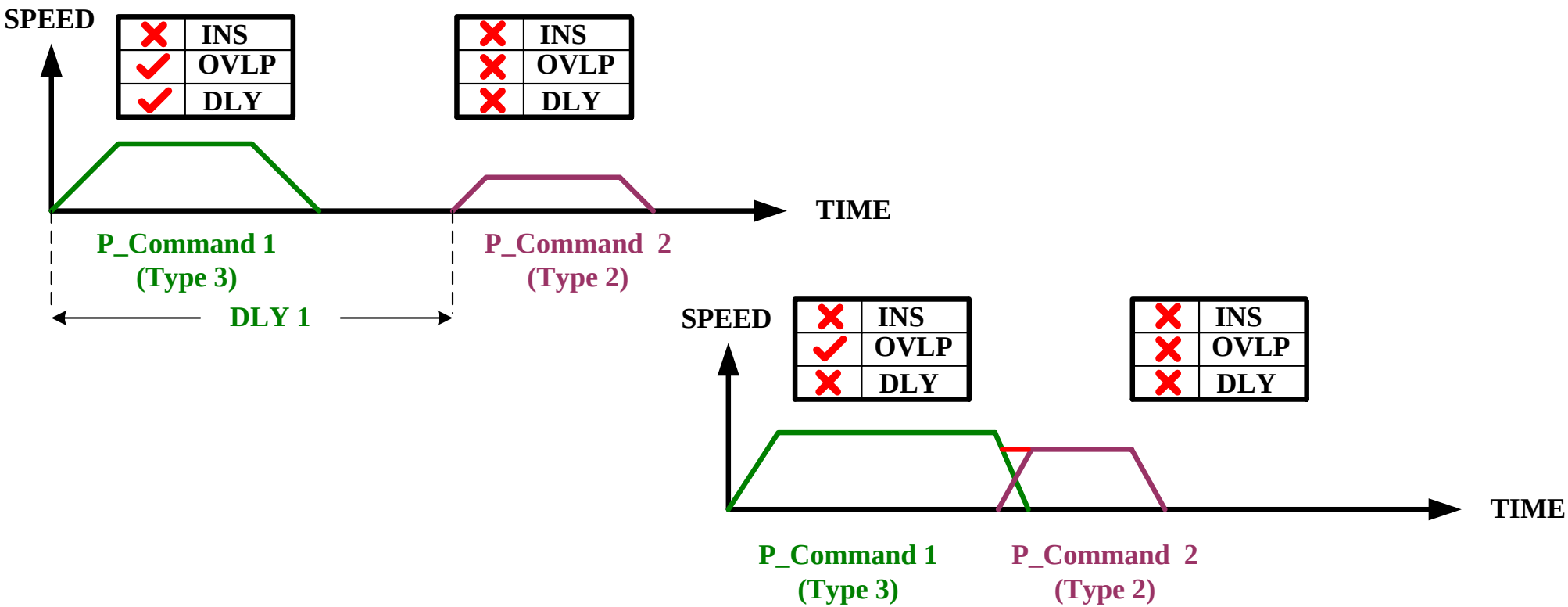
A command will be executed only when the previous command completed.



Motion Command (2)

Overlap Command on PR

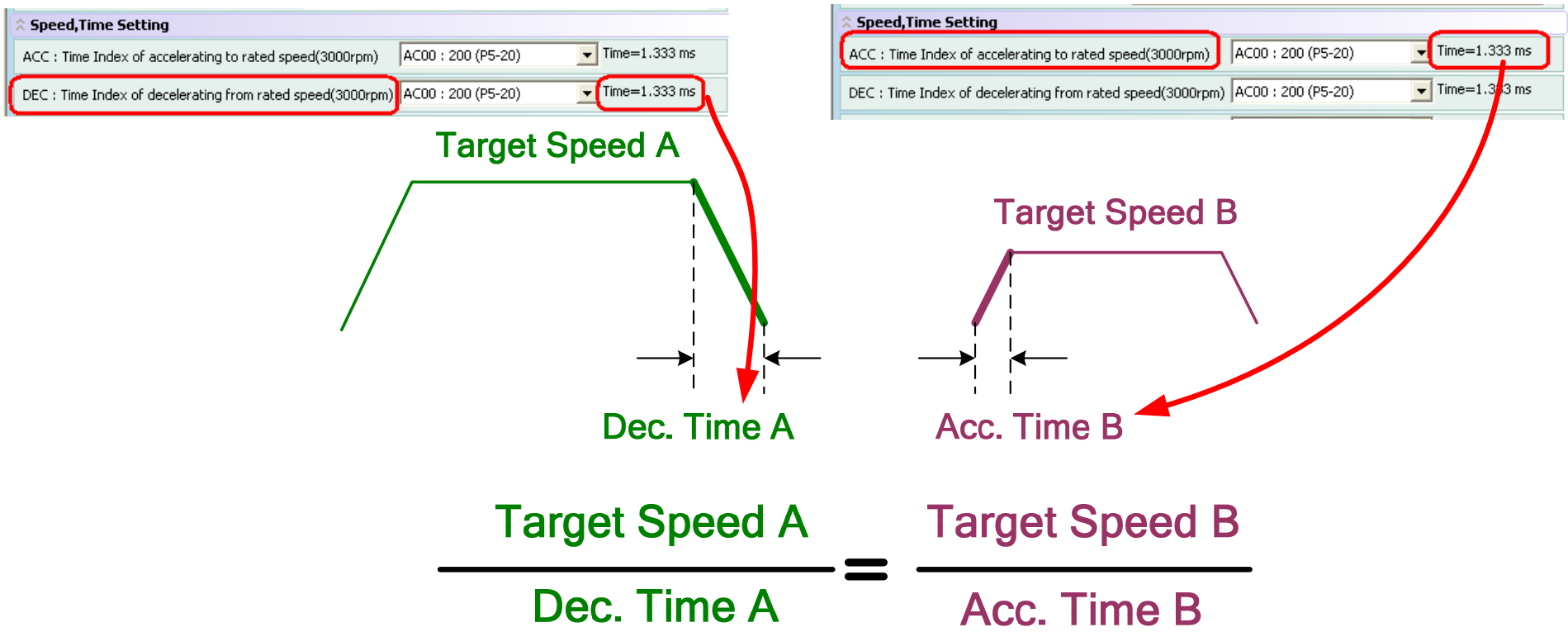
The second command will be executed after delay time or during deceleration period. A long delay time at the first command will affect the timing of second command. Zero delay is recommended for overlap application.



Motion Command (3)

How to Make Overlap Command on PR

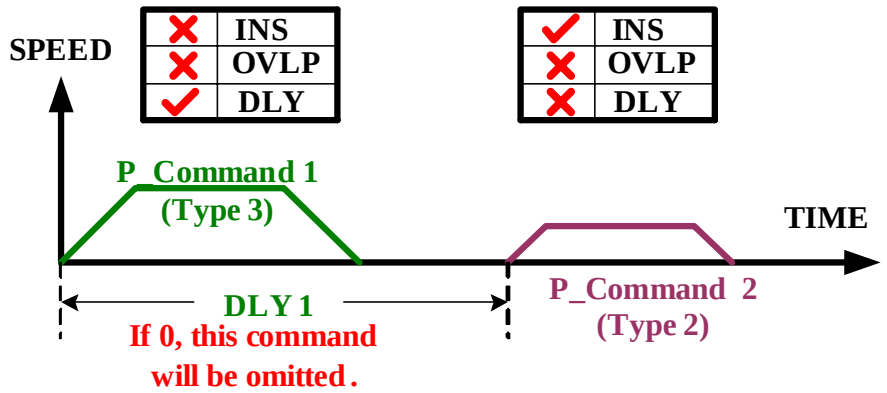
If the ratio for deceleration in front command is the same as the ratio for acceleration in the tail command, it can form a good shape of overlap command .



Motion Command (4)

Internal Insertion Command on PR

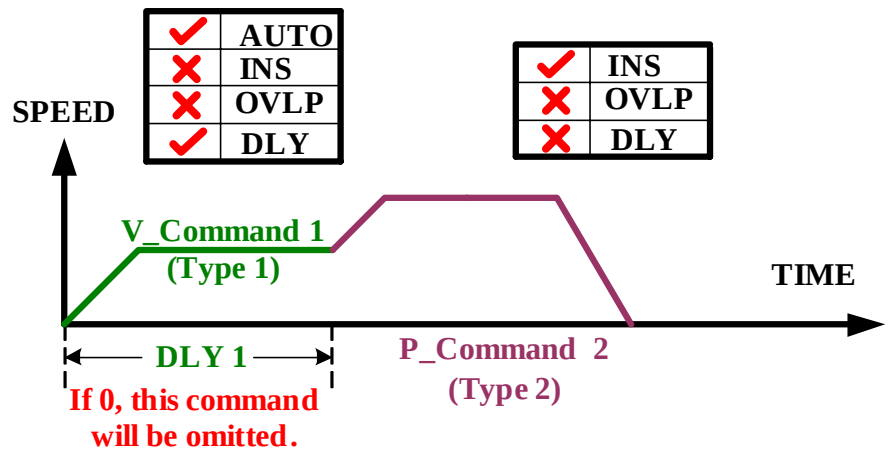
The second command will insert the first command to be a new command. The final result depends on the types of commands. The delay time gets function.



The final destination:

Absolute : Cmd_E = command

Relative, Incremental:
Cmd_E = last Cmd_E + command



The final destination:

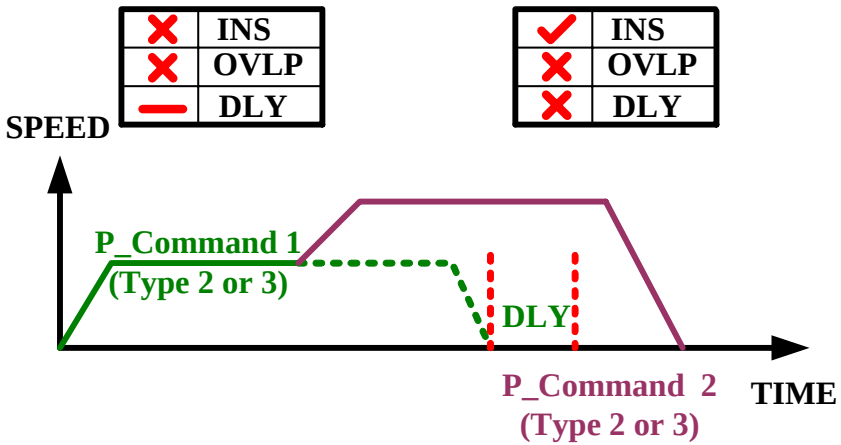
Absolute : Cmd_E = command

Relative, Incremental:
Cmd_E = last Cmd_E + command

Motion Command (5)

External Insertion Command on PR

The external insertion will change the command being executed at the moment it inserted. The delay time is not a matter for external insertion.



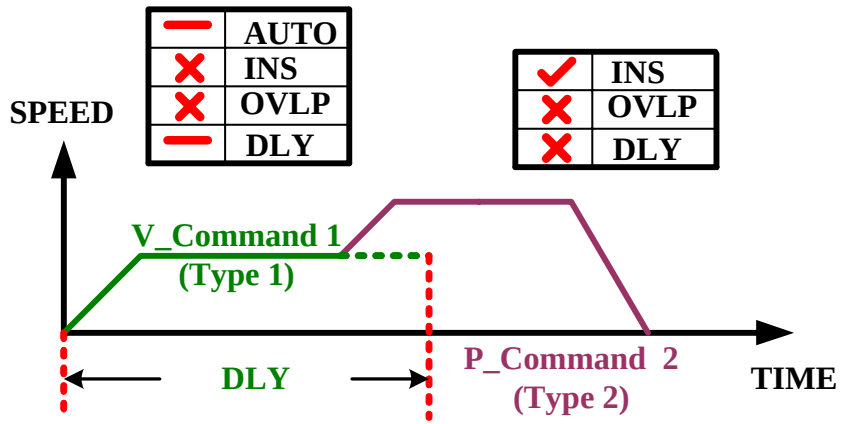
The final destination:

Absolute ：Cmd_E = command

Relative ：Cmd_E = Fb_PUU + command

Incremental ：Cmd_E = last Cmd_E + command

Cap. Relative : Data captured + Command



The final destination:

Absolute ：Cmd_E = command

Relative ：Cmd_E = Fb_PUU + command

Incremental ：Cmd_E = last Cmd_E + command

Cap. Relative : Data captured + Command

Triggering PR

The Ways to Call a PR

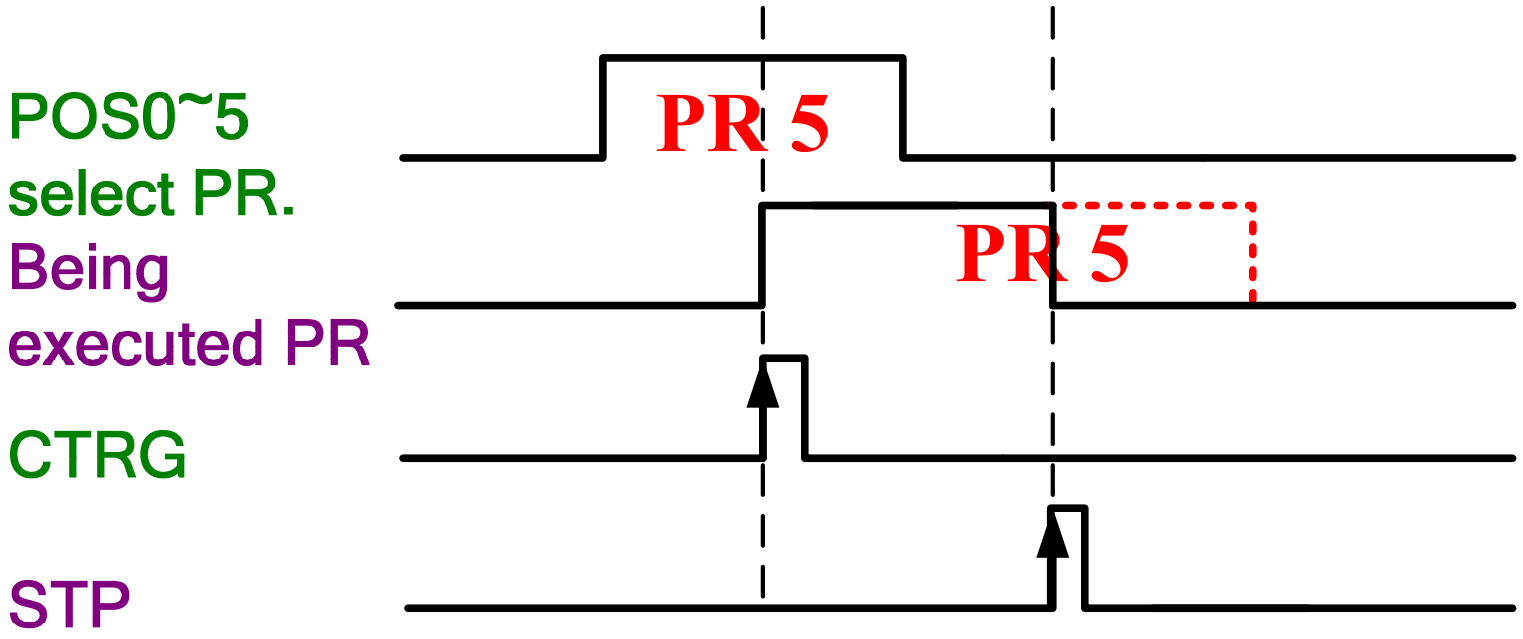
There are several ways to call a PR.

CTRG: Trigger the PR selected by DIs (POS0~POS5).
STP: Terminate the running PR .
P5-7: Use PR identification to call a PR.
SHOM: Start to run homing procedure (PR0).
EV1~4 (rising edge): Event can be used to call a PR.
EV1~4 (falling edge): Event can be used to call a PR.
Others: PR#50 is called when Capture function finished, and a specific PR can be assigned after E-Cam disengaging.

CTRG and STP

Digital DI to Trigger PR

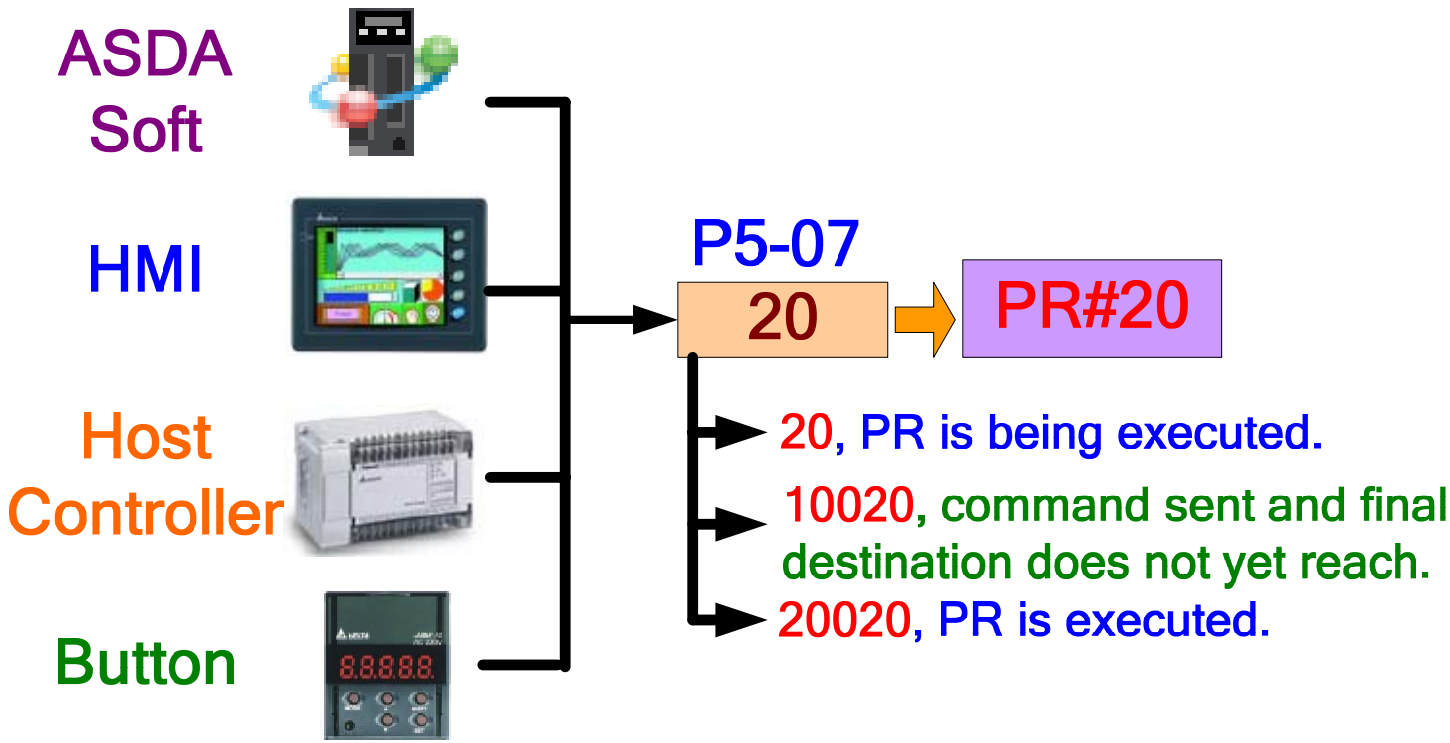
The CTRG is used to trigger PR selected by POS0~5 where STP can stop a running PR.



P5-07

Writing ID to Call PR

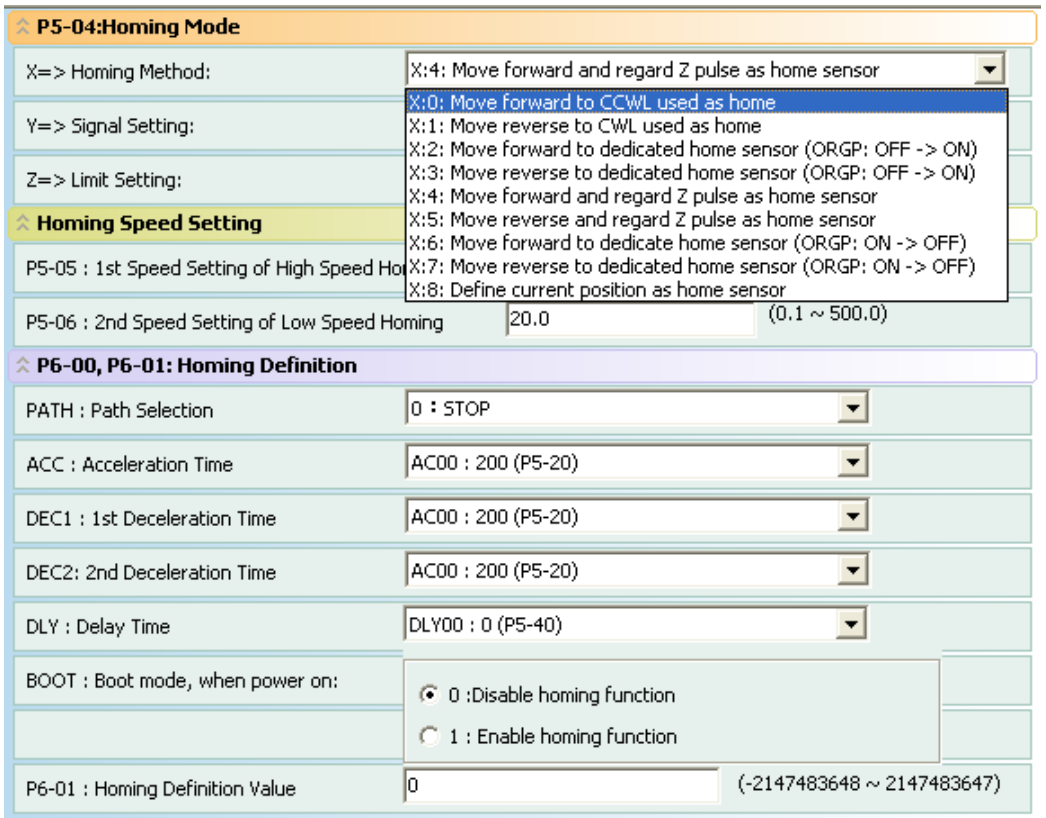
The number from 0 to 63 can be put into P5-07 to call a PR respectively. PR#0 is defined as homing procedure. The P5-07 will reply appropriate message about the result of executing PR.



SHOM

Start Homing Procedure

The digital input function can be applied to start a homing procedure that is PR0 in ASDA-A2.



SHOM

=

PR0

Events

4 Events

There are 4 events with rising and falling edges can be set to trigger a specific PR.

DI=0x39(EV1),
0x3A(EV2),
0x3B(EV3), or
0x3C(EV4).

1 → P5-98 Rising edge events to PRs

EV4	EV3	EV2	EV1

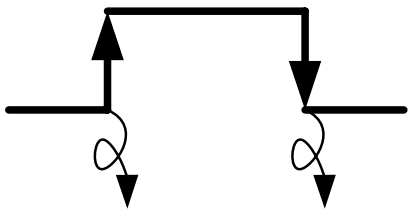
2 → P5-99 Falling edge events to PRs

EV4	EV3	EV2	EV1

Setting	1	2	3	4	5	6	7	8	9	A	B	C	D
PR#	51	52	53	54	55	56	57	58	59	60	61	62	63

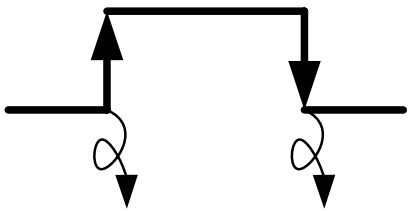
P5-98=0x0602

P5-99=0x0903



EV1= PR#52

EV1= PR#53



EV3= PR#56

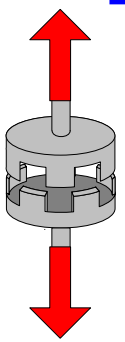
EV3= PR#59

Other Triggers

E-Cam and Capture Function

The E-Cam function can call a specific PR when disengaged, where the Capture function will call PR#50 when finished.

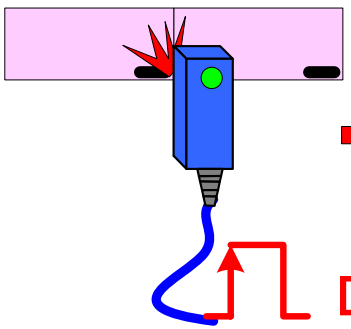
E-Cam disengaged.



Disengaging conditions.
P5-88.U= 2,4, or 6

→ Call any PR set by P5-88.BA.

Capture function finished.

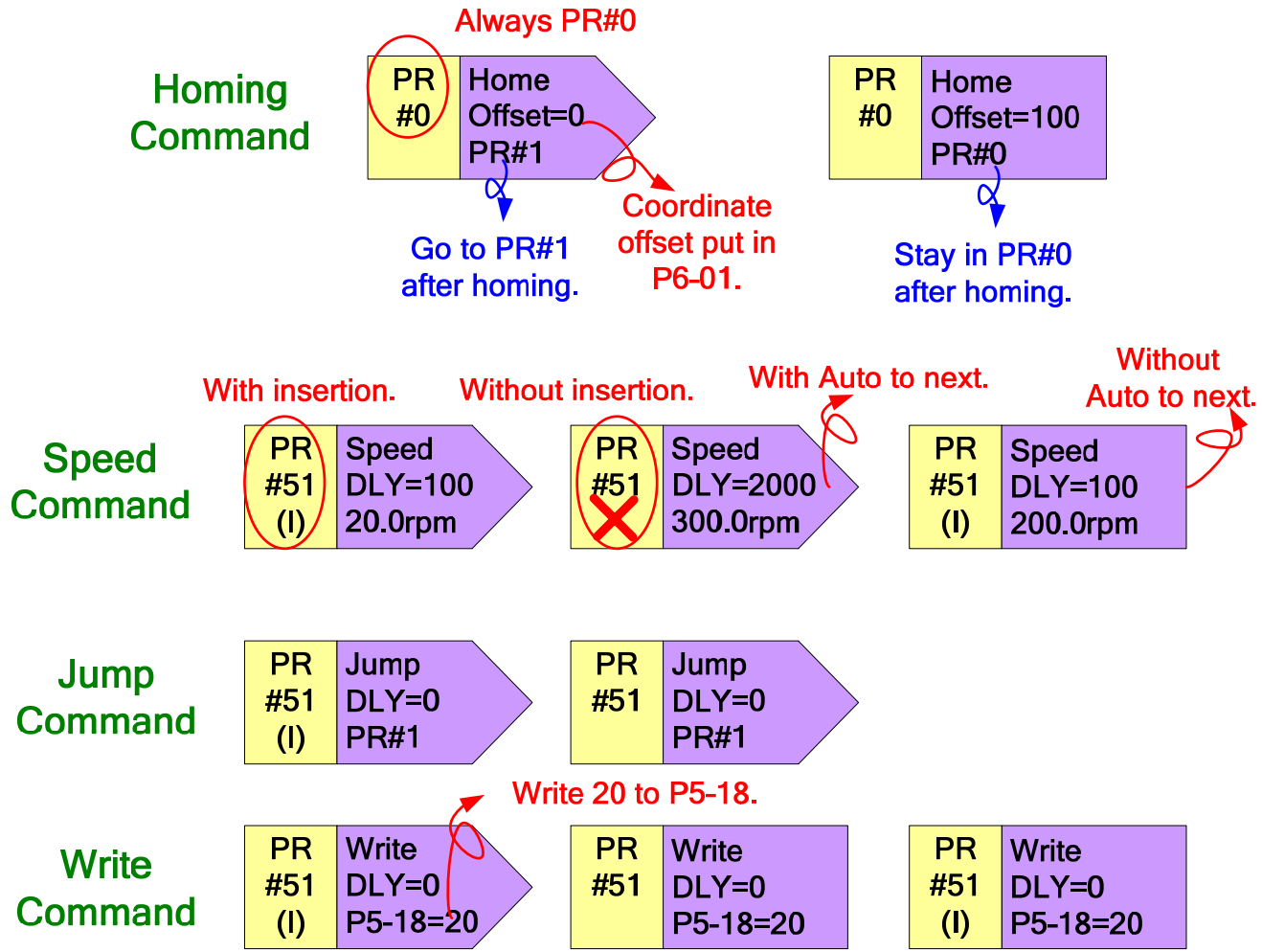


→ P5-38 = P5-38 - 1 → P5-38= =0 → True → Bit 3 of P5-39.X ==1 → True → PR#50

Some Definitions (1)

In Convention We do

There will come with some notations that are commonly used in ASDA-A2 group.

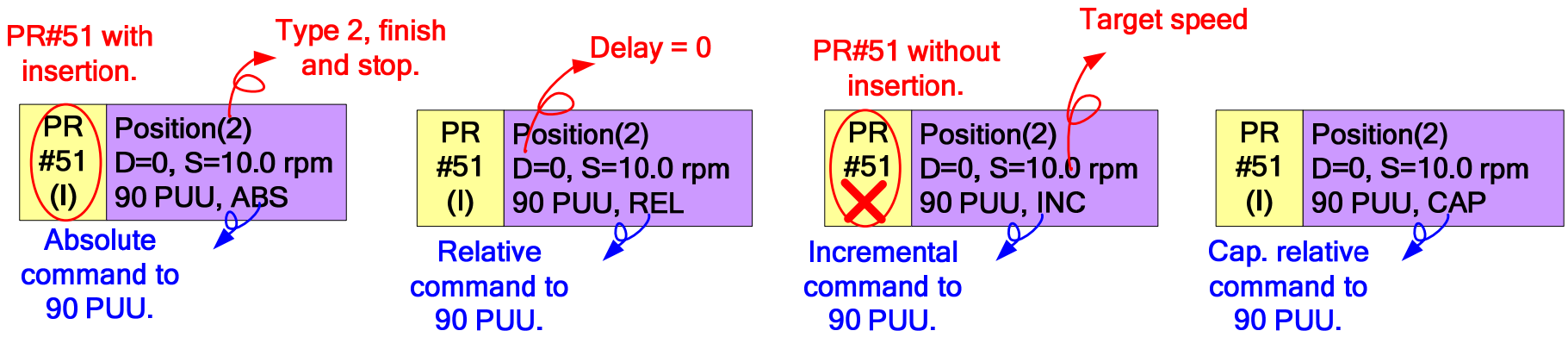


Some Definitions (2)

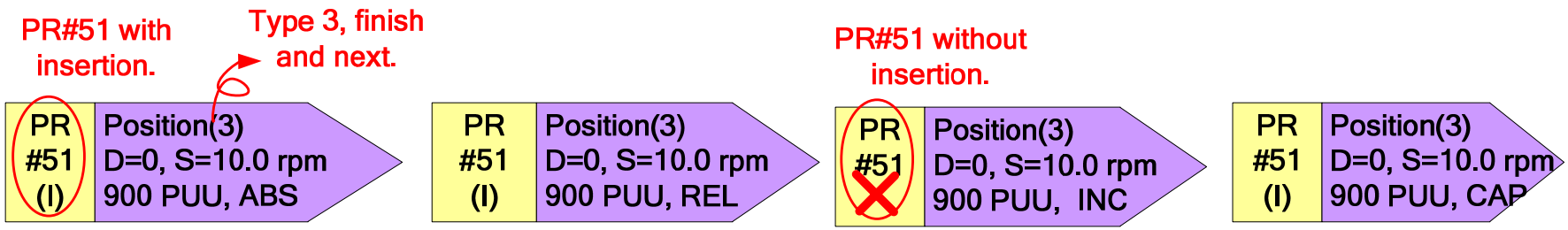
The Advantage We Get

Following the convention will be easier for other people in this group to understand your process.

Type 2 position command



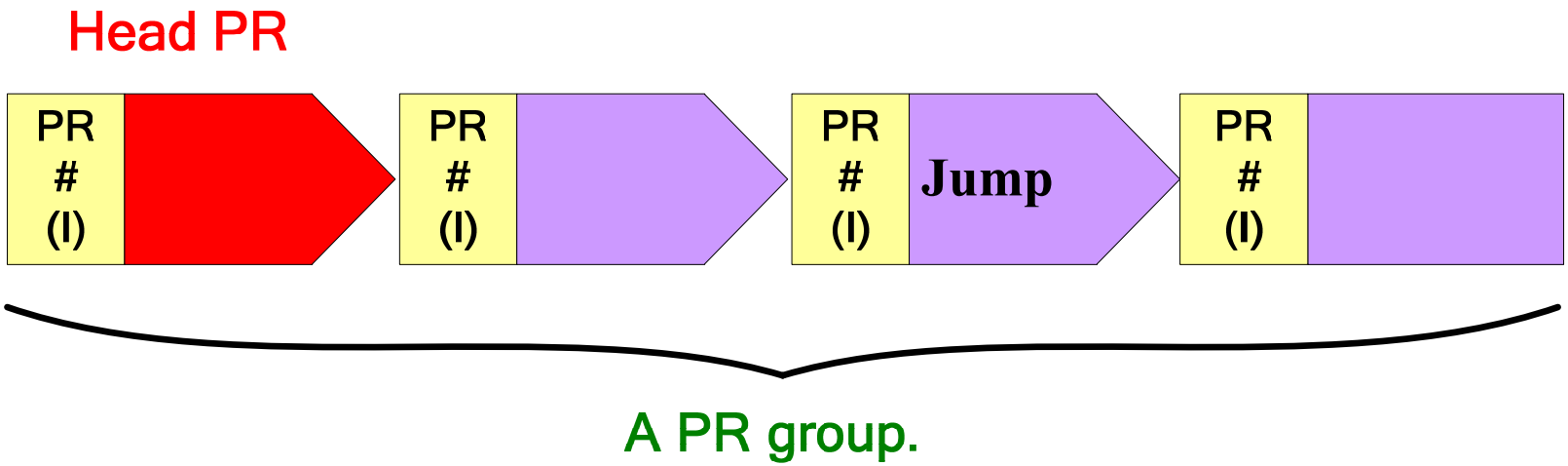
Type 3 position command



Some Definitions (3)

Head PR & PR group

The Head PR is the first PR in a PR group linked by AUTO or Jump command.



How the PR Arranged

Priority

High ← → Low

CTRG | STP | P5-07 | SHOM | EV1~4(↓) | EV1~4(↑)

PR Queue

PR Queue (first in first out)

Every 1 ms, it will issue a HEAD PR command if any HEAD PR is waiting in the PR queue.

The new HEAD PR issued by PR Queue will terminate the PR group being executed in the PR Executor.

PR Executor

PR Executor

1. The PR Executor will dispatch every single PR in the PR group to the next level if it is a PR with motion function (Type 1 Constant Speed Control, Type 2 Position, and Type 3 Position to Next).
2. The Type 7 Jump and Type 8 Write Parameter will be finished in PR Executor.
3. Eight consecutive PRs with INS set can be guaranteed to be executed within 1 ms in PR Executor.

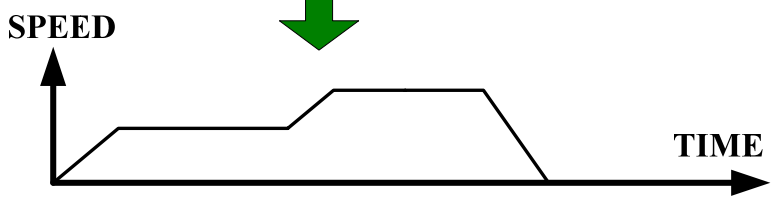
Sequential / Insertion / Overlap

Motion Command Generator

Motion Command Generator

1. The motion command will be generated here.
2. It could be sequential, insertion, and overlap.

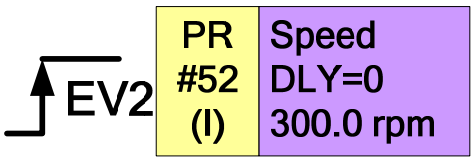
Output Motion Profile



Test Sample (1)

How many PRs?

This example can be used to test the PR Queue and how many PRs can be executed within one ms (8 PRs are guaranteed in Delta design specification) .

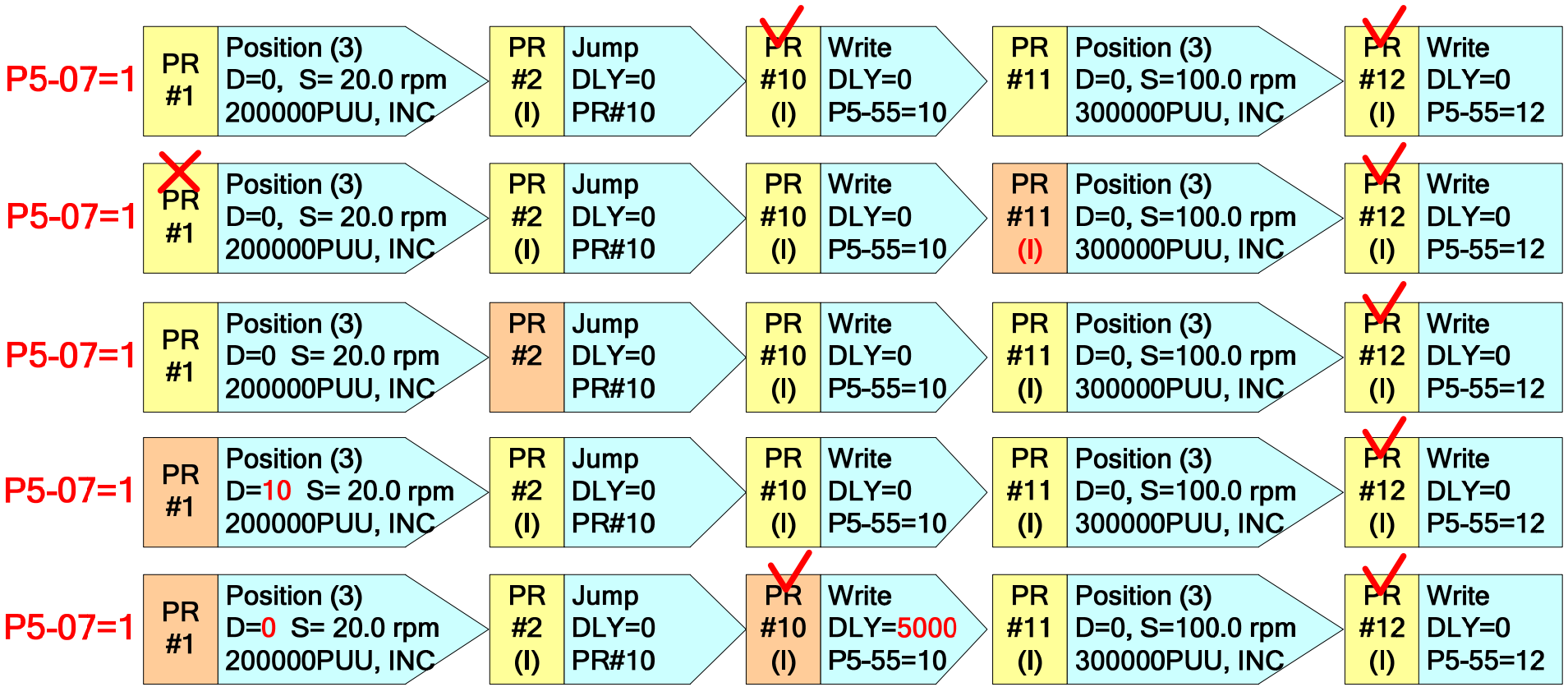


P2-11 (DI2) = 0x139 (EV1)
P2-12 (DI3) = 0x13A (EV2)
P5-98 = 0x21
P3-06 = 0x6
When P4-07=0x6, the EV1 and EV2 will be initiated simultaneously. Read P5-55.
Change DLY=1ms in PR#1, repeat the test and read P5-55 again.

Test Sample (2)

The Way of PR Executor

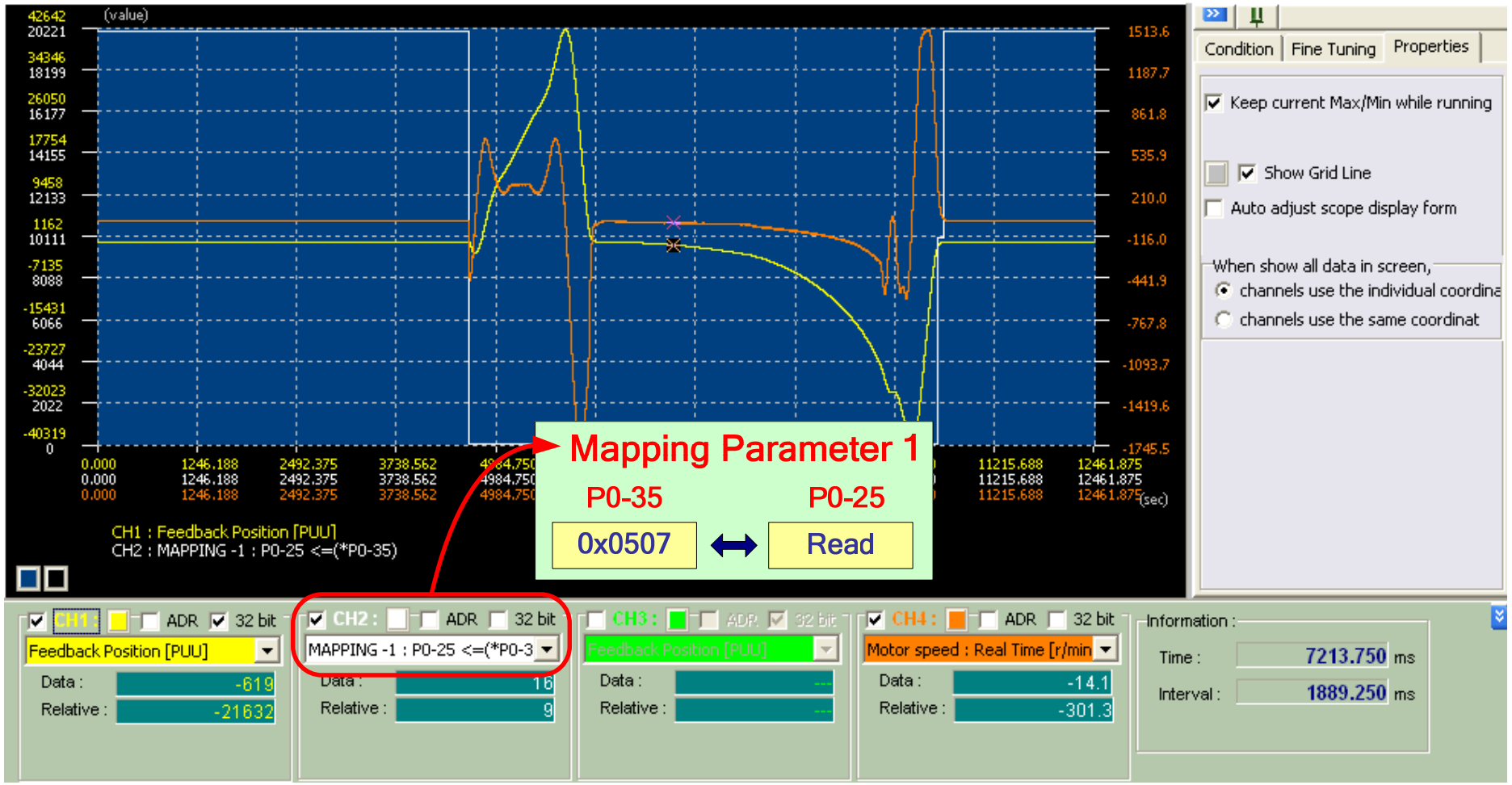
This example can explain the way of PR Executor . The PC scope is a good tool to examine the example.



PR Debug

To Monitor the PR Procedure

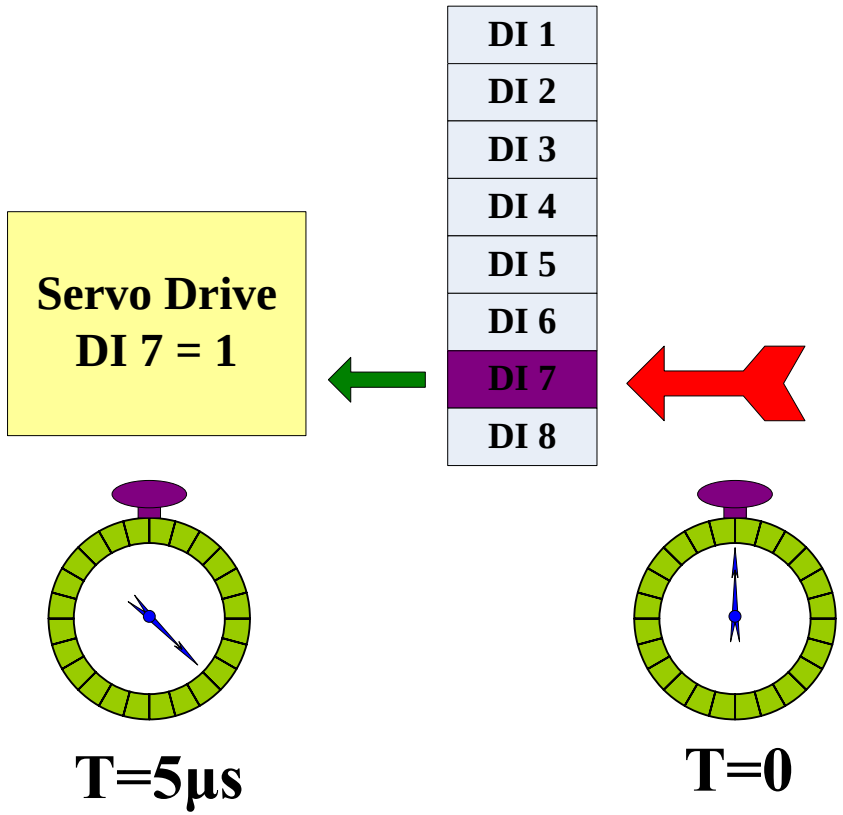
The execution of PR procedure can be monitored from PC scope via mapping parameters.



High Speed Digital Input

DI7

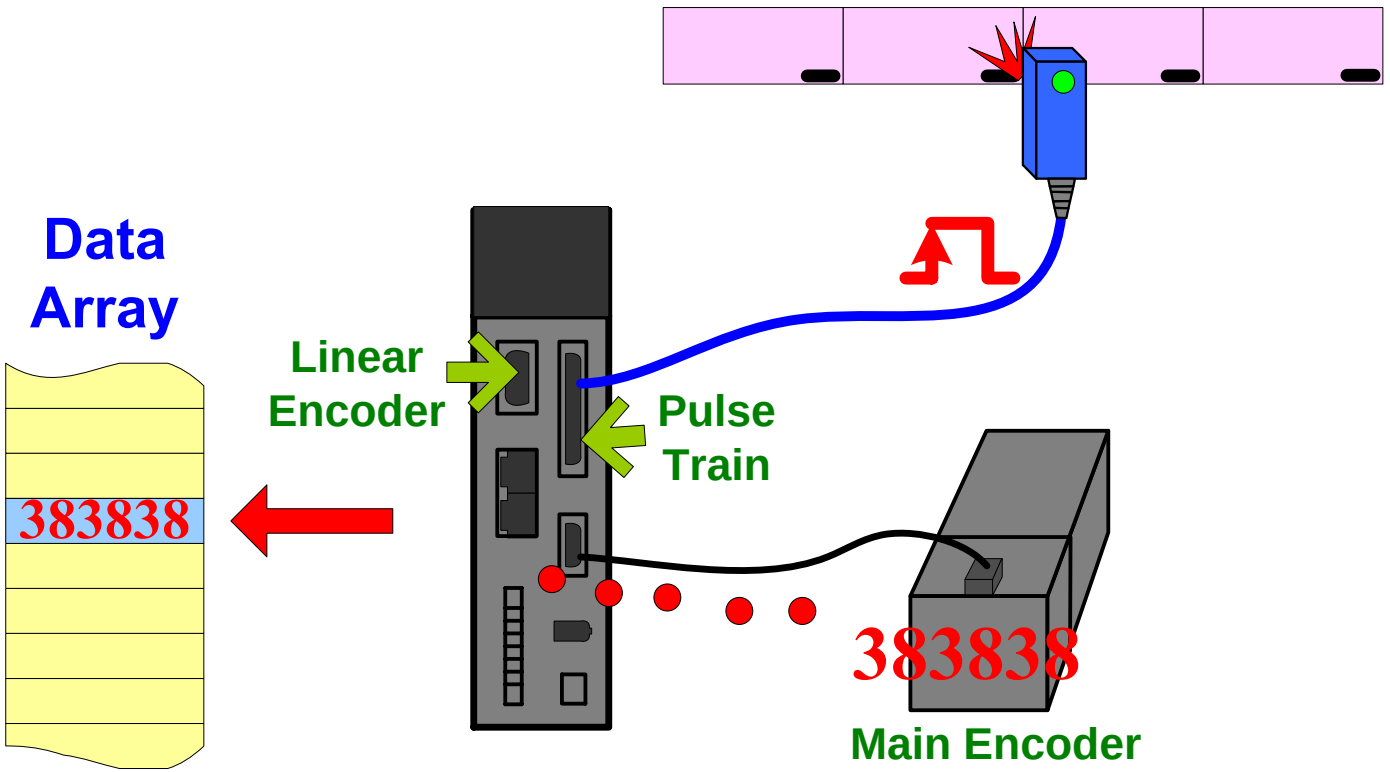
The DI7 is the only one high speed digital input in ASDA-A2. It takes only 5 μs to admit the signal changed. The other digital inputs need 0.5 ms. This DI is obligated to use to do Capture job.



The Position Latch Function (1)

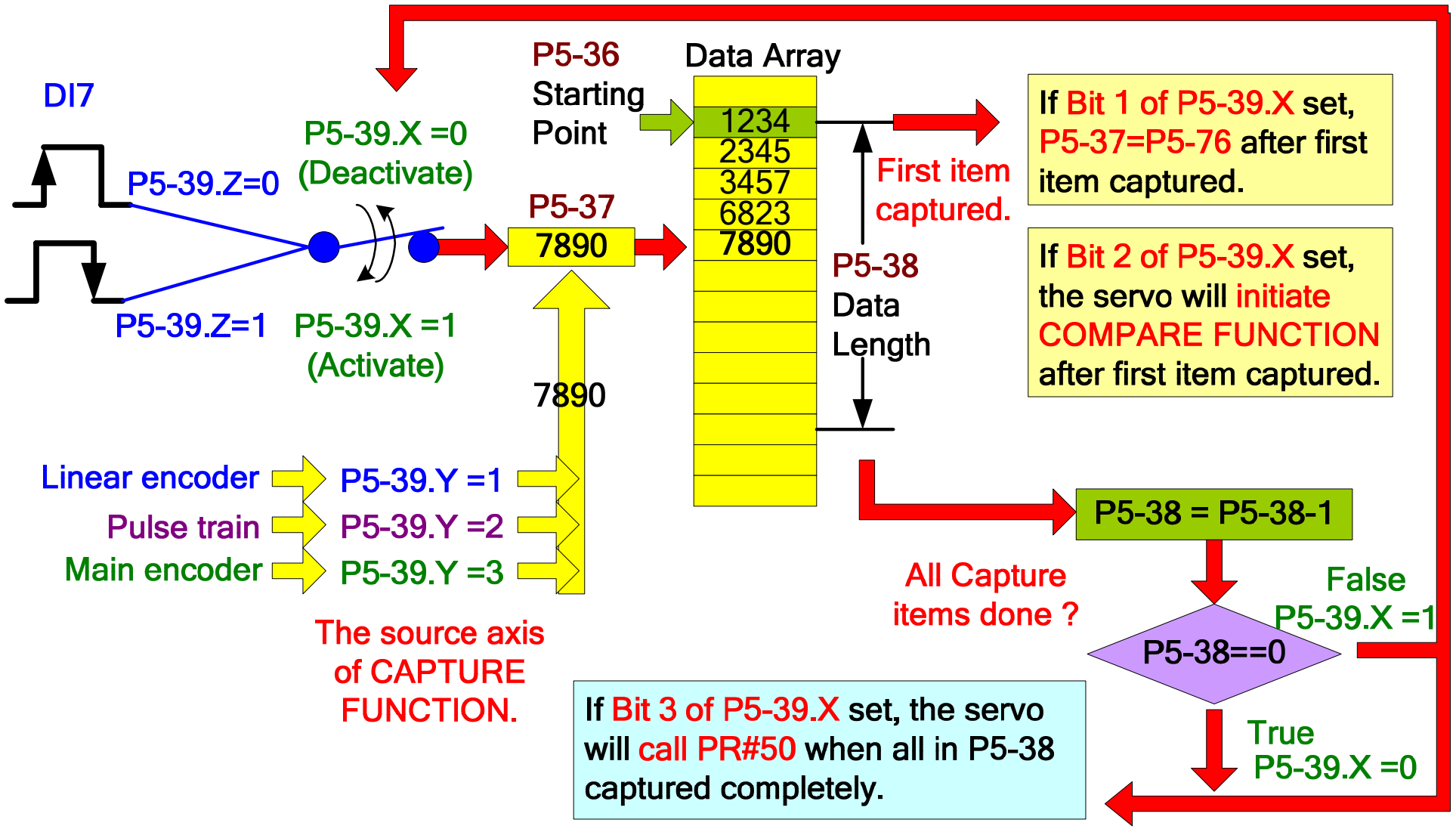
The Capture Function

The Capture function can be applied to latch a reference position which could be the signal of main encoder, linear encoder, or pulse train. It is possible to record 800 items with max. length of data array.



The Position Latch Function (2)

The Settings of Capture Function

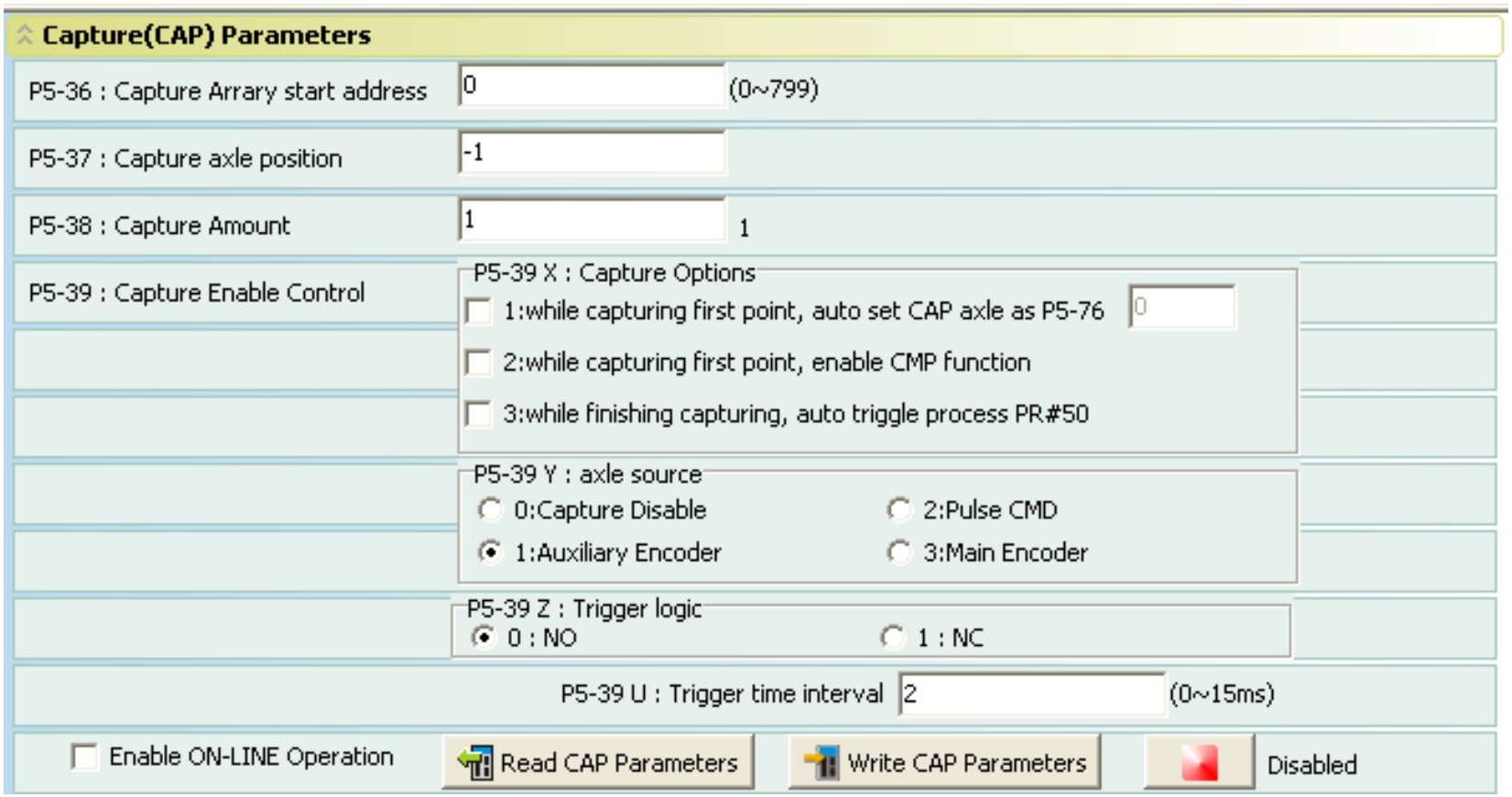


The Position Latch Function (3)

The Capture Function on Software

There is a convenient way to TEST Capture function.

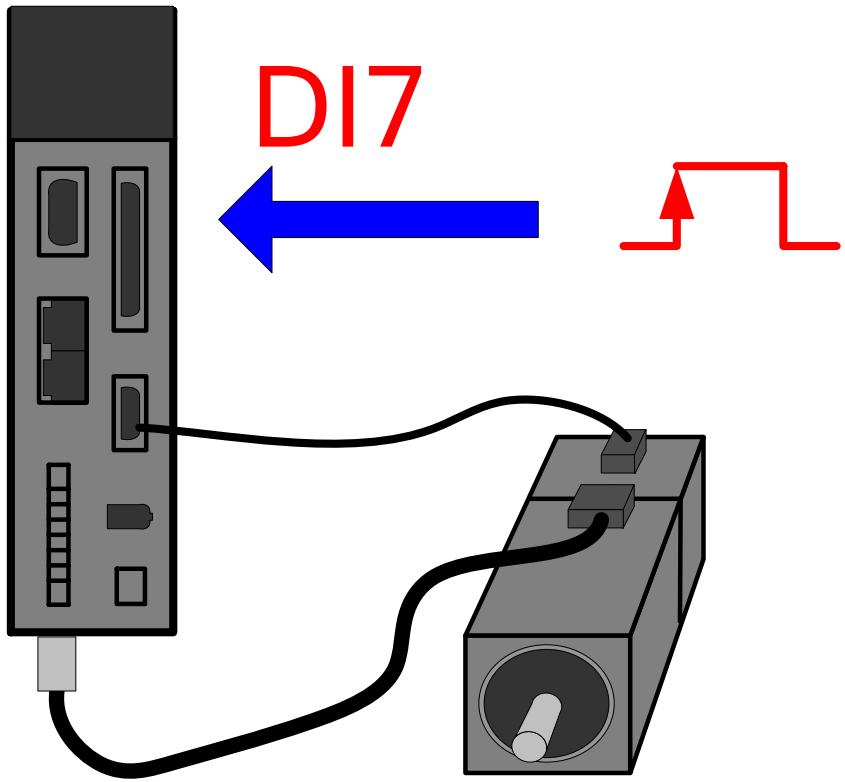
Most of the application, you have to set the Capture from PR with writing function.



The Position Latch Function (4)

Physical Signal Only

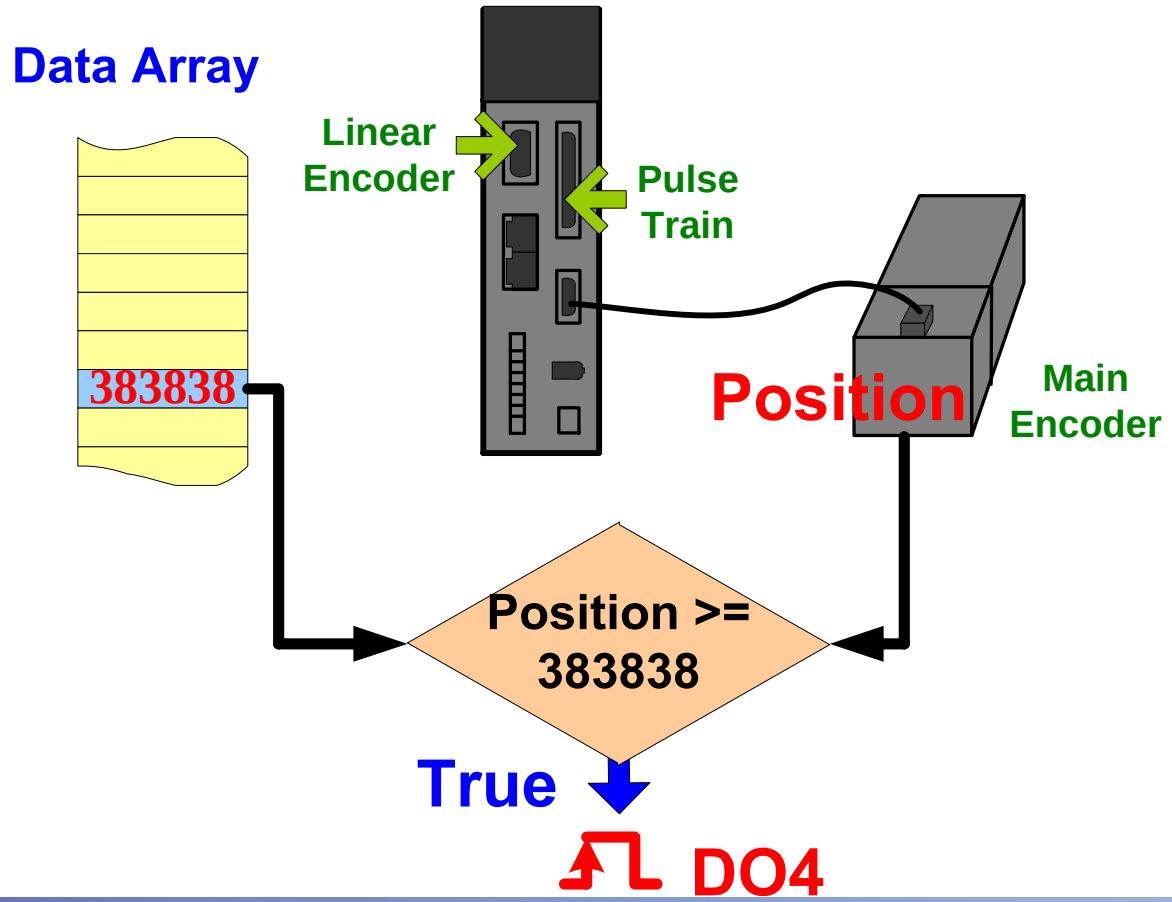
The signal to DI7 for Capture function cannot be simulated from software. The ONLY one way is real signal to DI7.



The Position Detection Function (1)

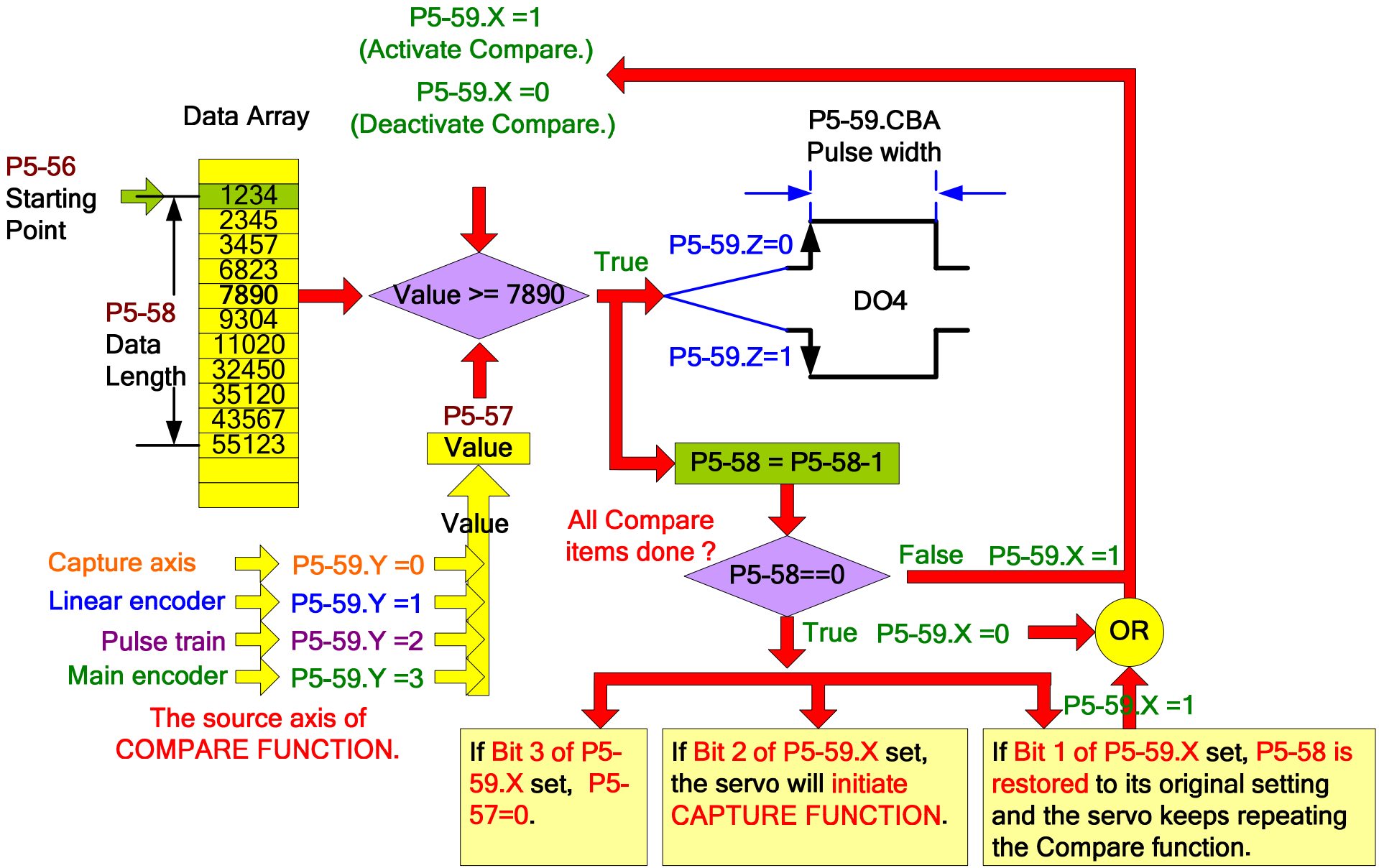
The Compare Function

The Compare function is a reverse process of the Capture function. The items stored in data array will be compared to the signal of a physical axis (main encoder, linear encoder, or pulse train).



The Position Detection Function (2)

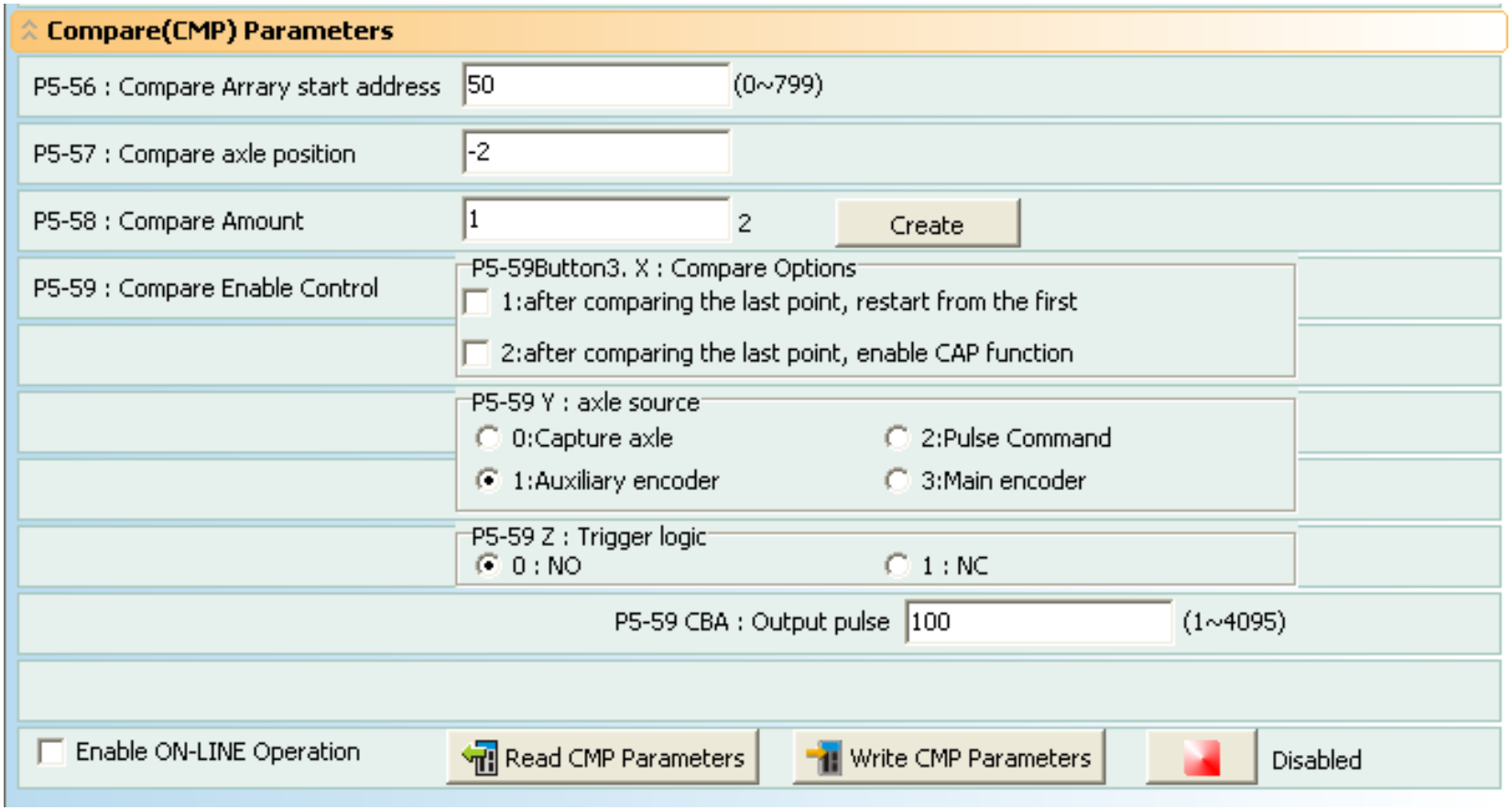
The Settings of Compare Function



The Position Detection Function (3)

The Compare Function on Software

There is also a fast way to TEST Compare function from software. Most of the applications must be set by PR with writing function.



The Position Detection Function (4)

To Read the Output of Compare Function

There are several ways to read Compare output DO4.

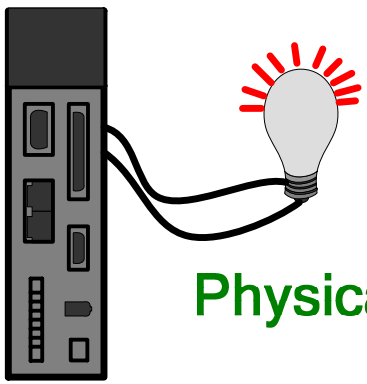
Monitor Parameter

1 P0-09 Read ⟷ P0-17 40d

Mapping Parameter

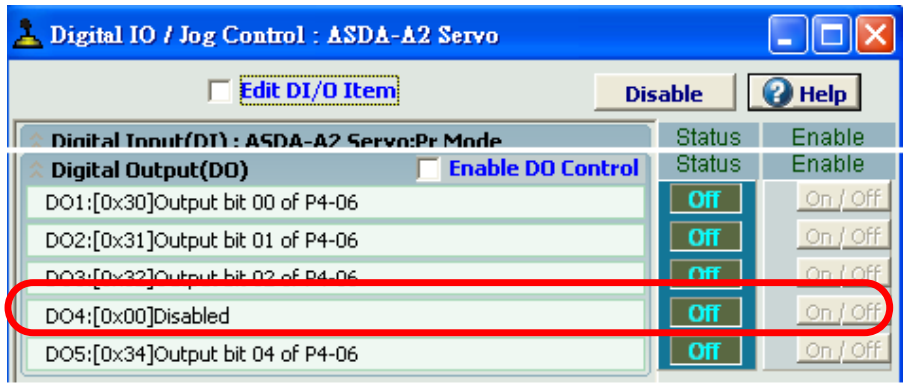
2 P0-35 0x0409 ⟷ P0-25 Read

3



Physical wiring

4

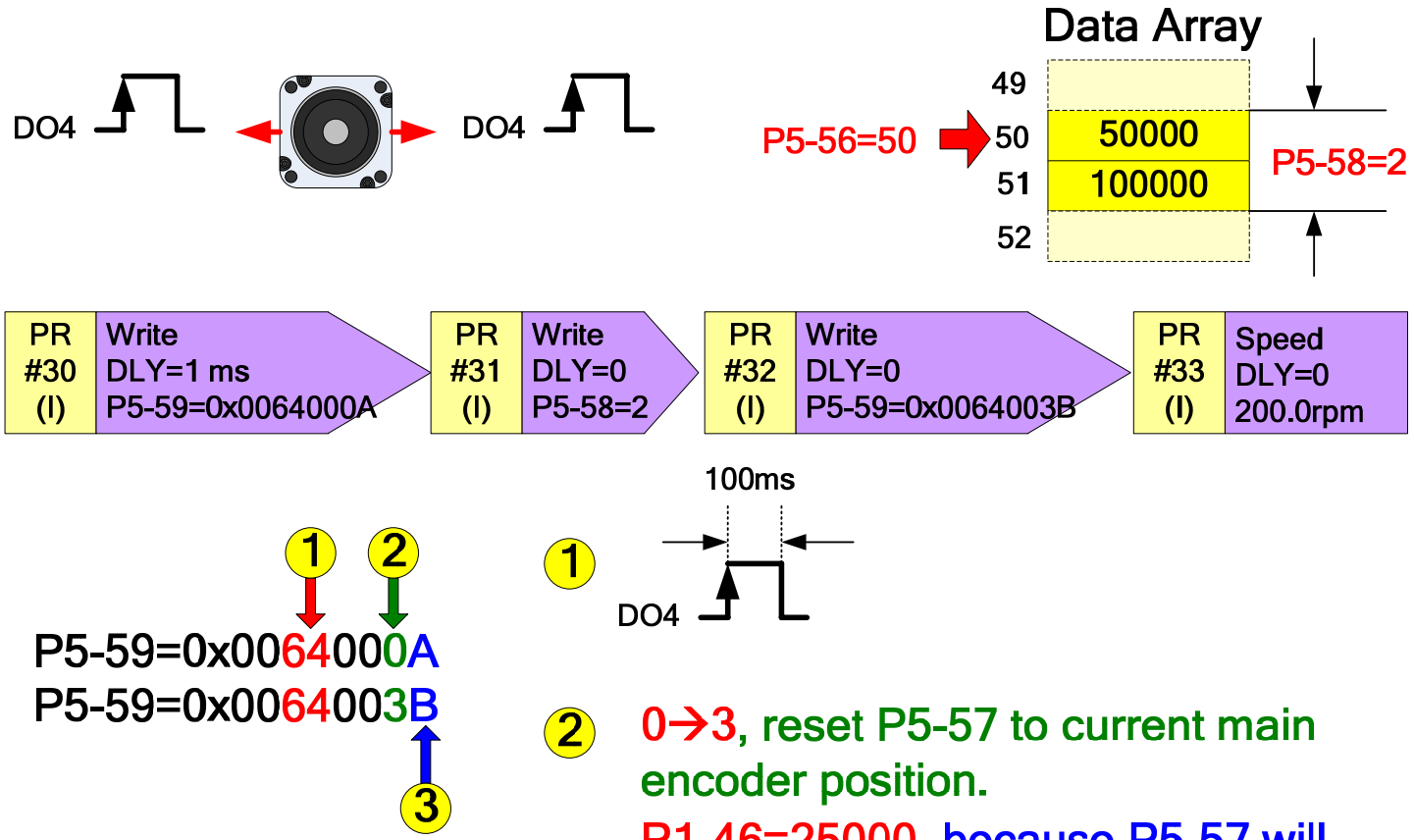


Function code assigned is not needed.

Capture/Compare Application (1)

The Compare Function

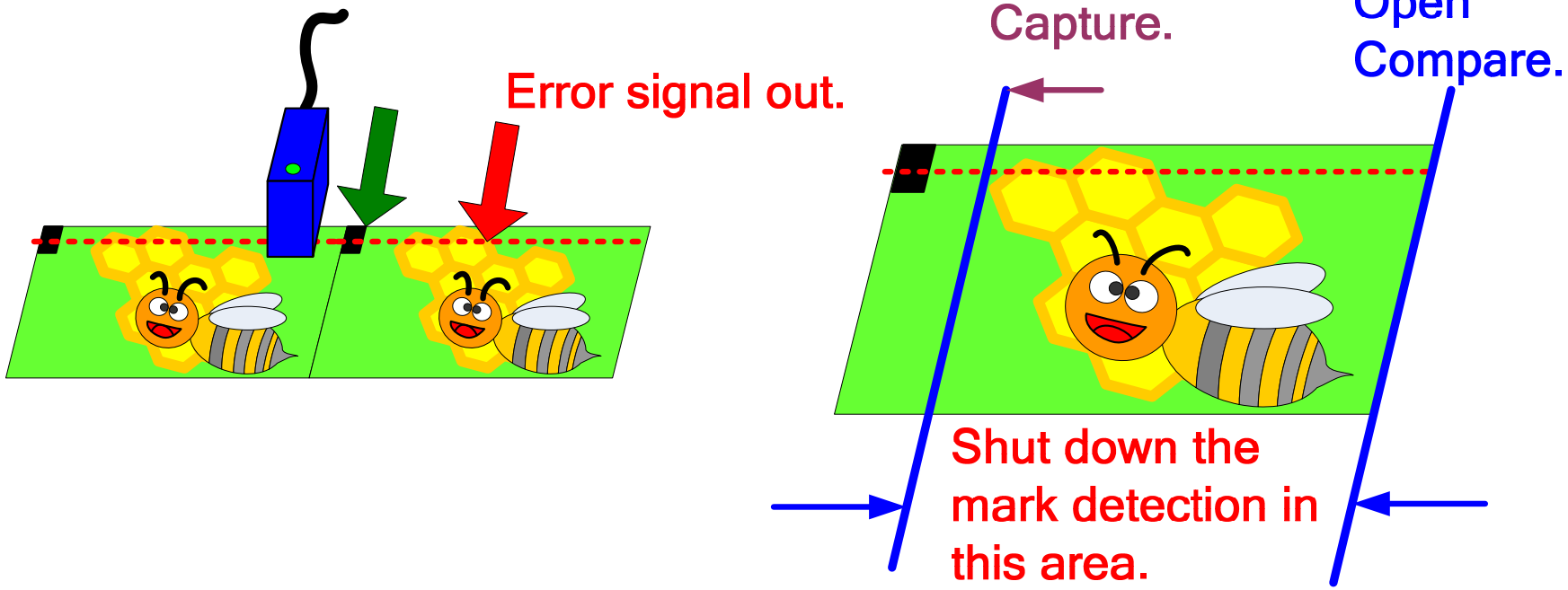
This application will send signal out every half a turn.



Capture/Compare Application (2)

The Masking

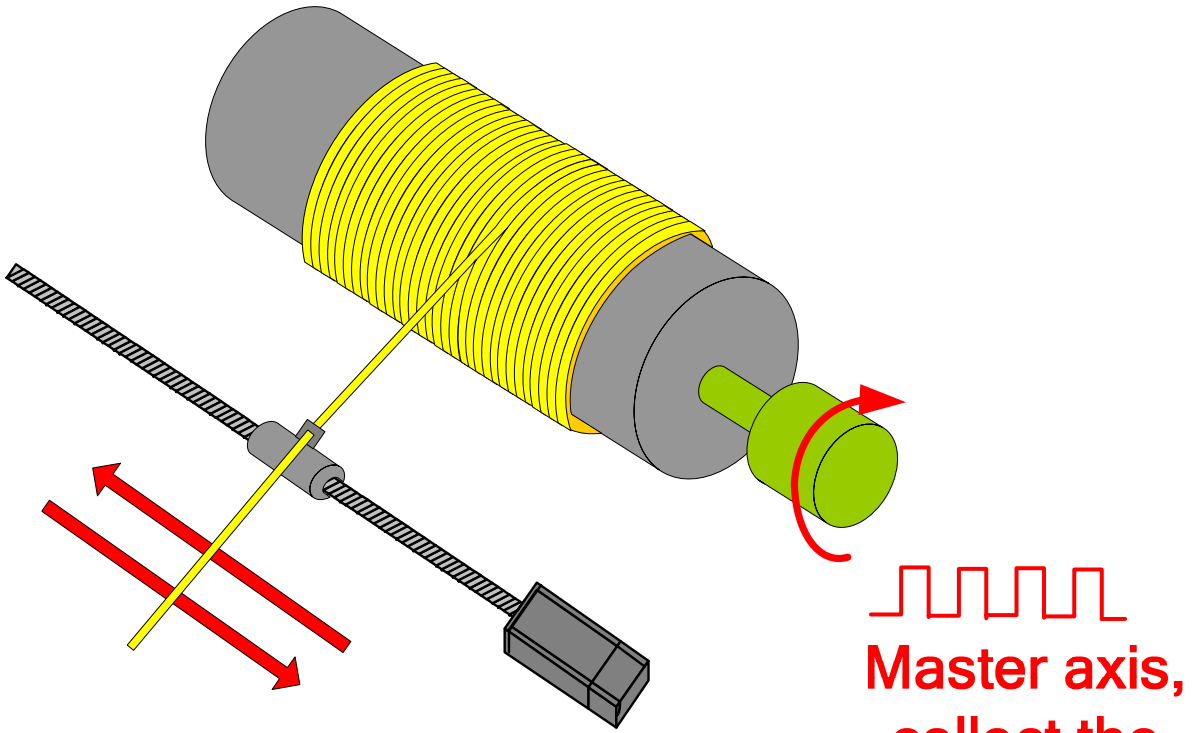
For some packing machines, there are always some patterns printed on the packing films. It is very important for the mark reading sensor to send out the right signal from mark.



A PR Example (1)

A Winding Machine

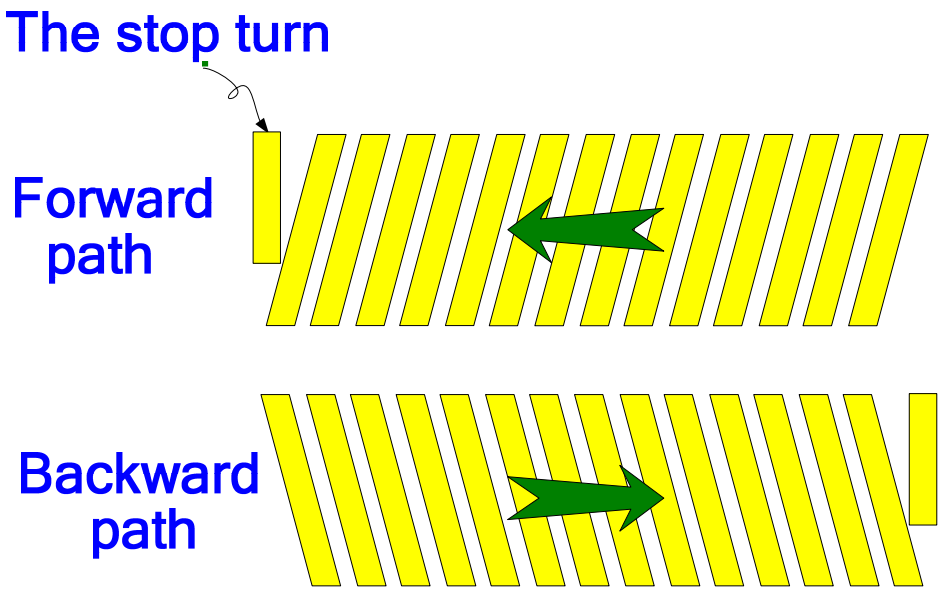
This example is going to demonstrate the powerful of PR, and it is a simplified demo compared to the real application.

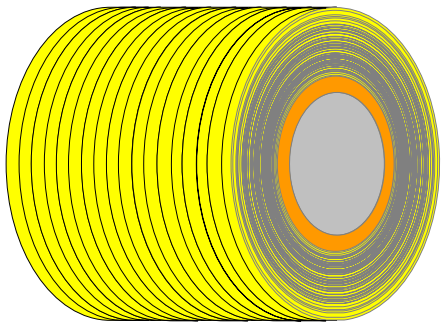


A PR Example (2)

The Result and Different Layers

This final work is on the right hand side where it comes from layer overlapped by layer on the left hand side.

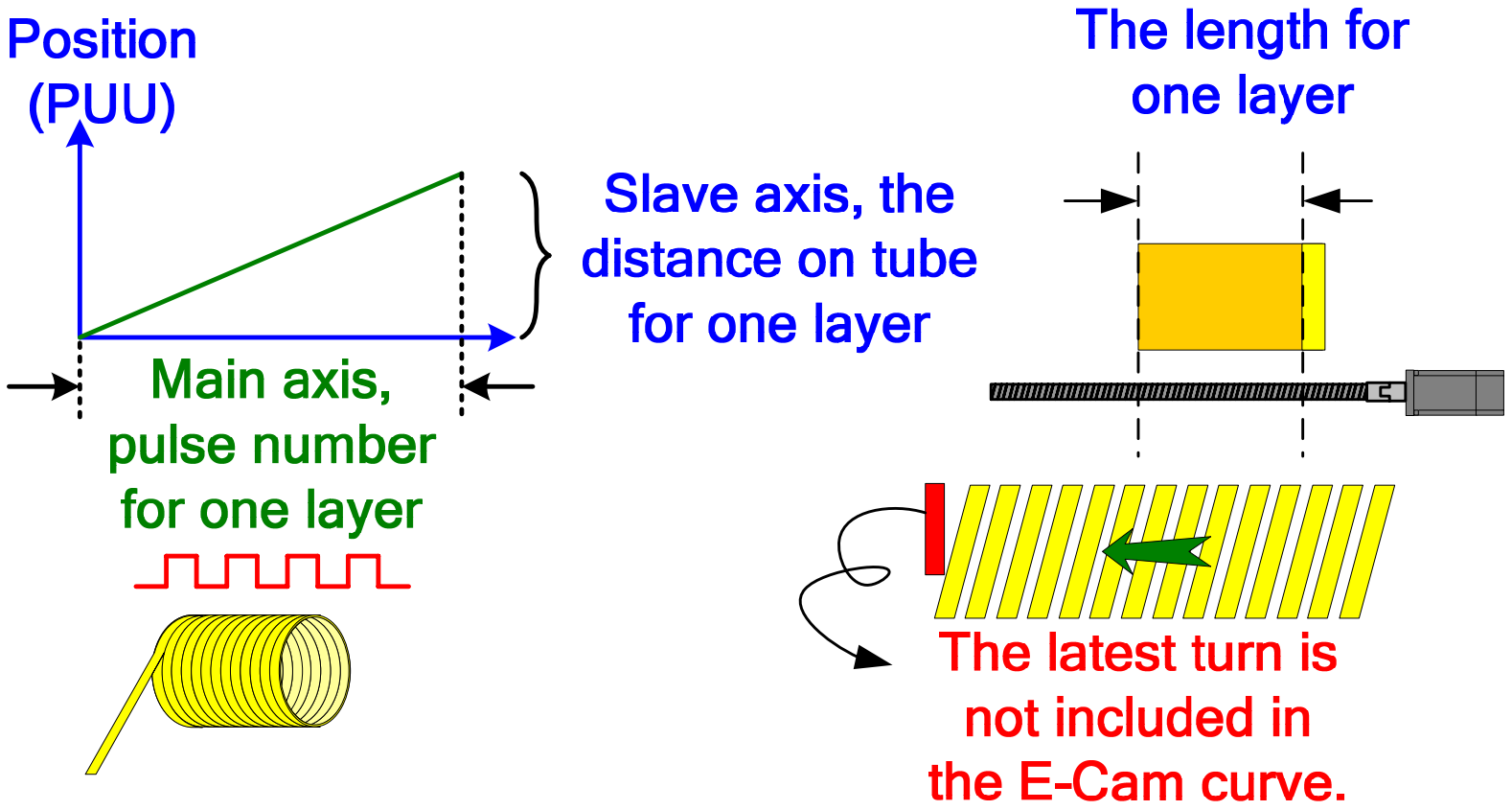




A PR Example (3)

A Quick Look at the E-Cam Curve

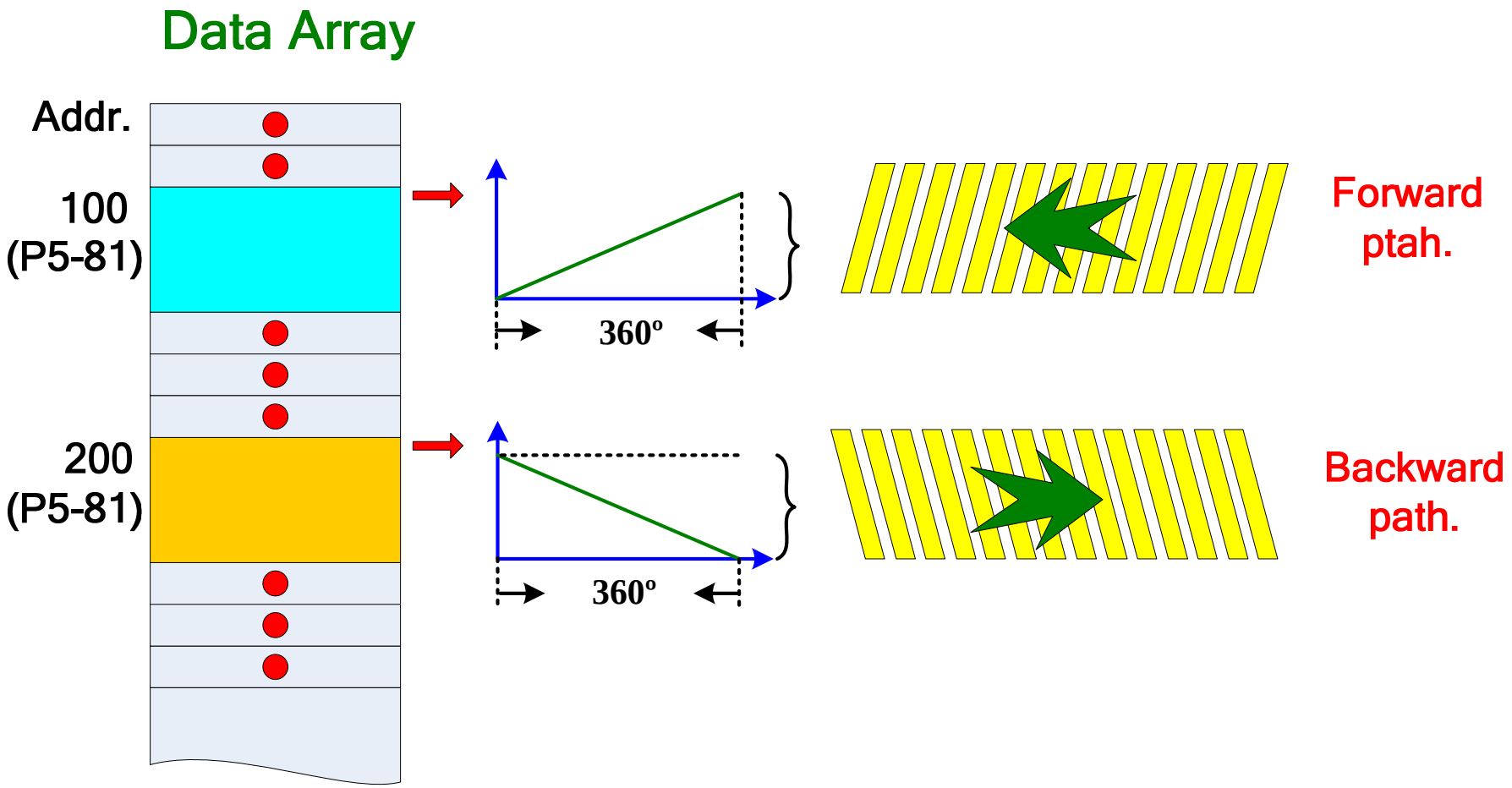
The horizontal axis stands for the main axis where the pulse will be sent out while winding and the vertical axis represents for the distance of allocating band on tube.



A PR Example (4)

Where are the E-Cam curves?

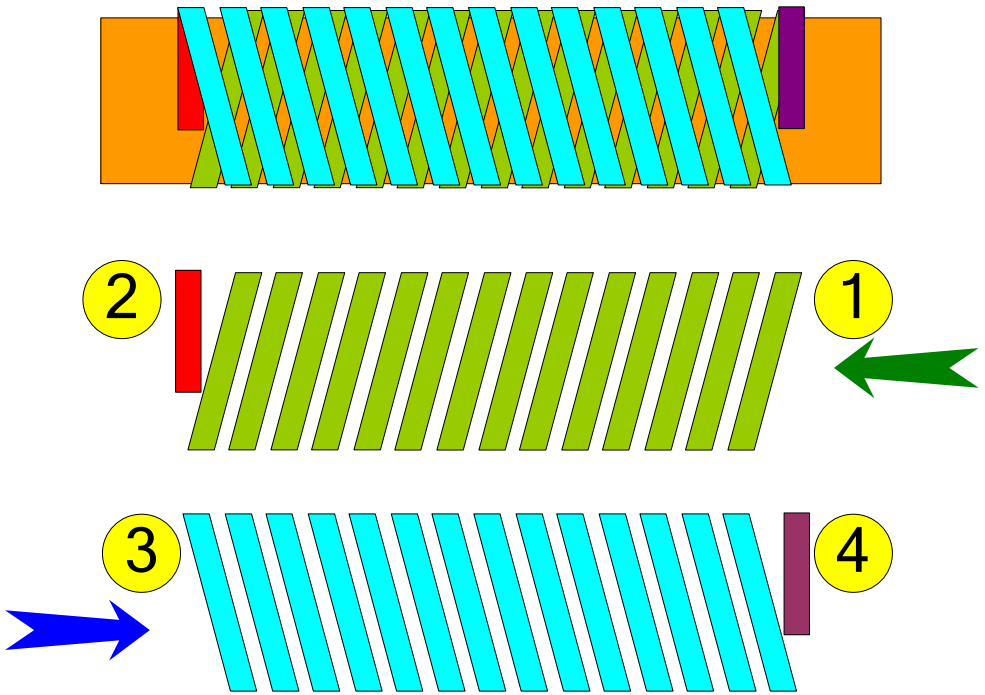
The E-Cam curves are stored in the data array as below.



A PR Example (5)

How's the cycle?

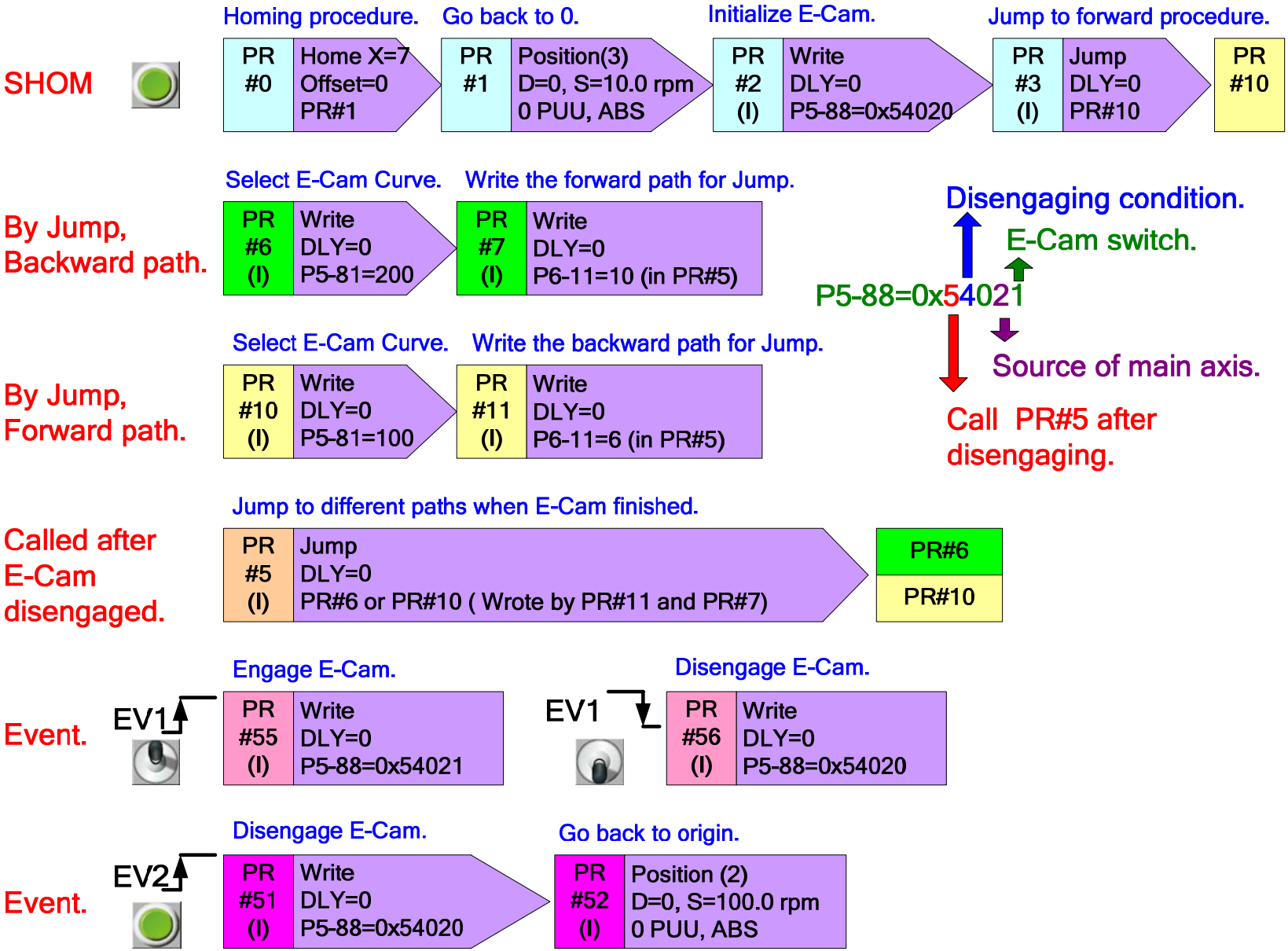
The system will go forward, stop at the end, go backward, stop at the other end, and keep repeating the procedure until finishing the whole winding. The phase 2 and 4 are set by E-Cam function on ASDA-A2.



1. Forward path
2. Forward end (stop for certain number of pulses)
3. Backward path
4. Backward end (stop for certain number of pulses)

A PR Example (6)

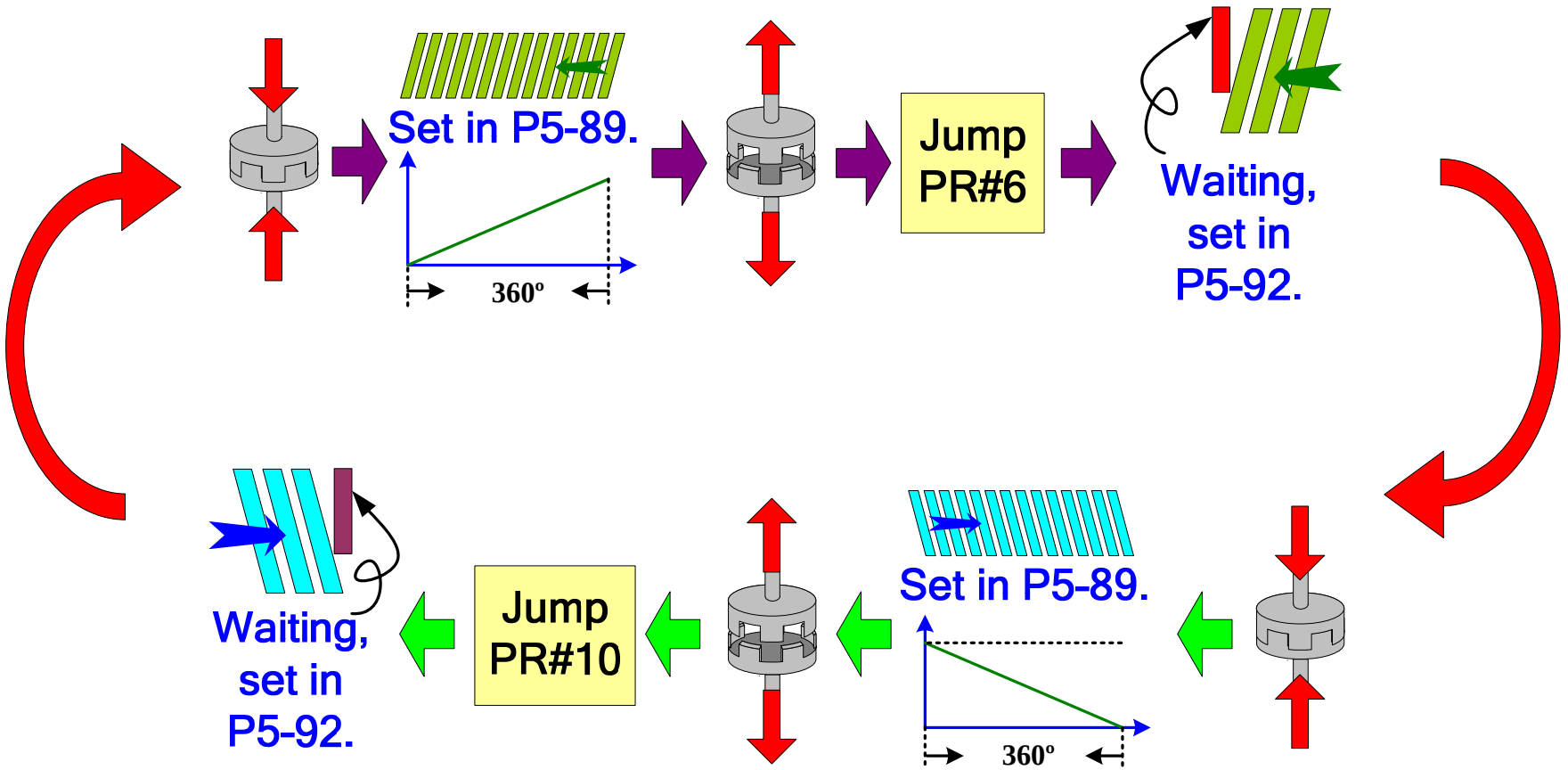
The PRs



A PR Example (7)

The Whole Cycle

E-Cam disengaging condition set to P5-88.U=4.



Thank You