HOW TO OPERATE E-CAM ON ASDA-A2

To Audience

Advance level

This slide will teach electronic cam on ASDA-A2.
For better understanding the content, the new PR of ASDA-A2 should be known.

Revision

February 21, 2011.

The Contents

Parameters of E-Cam

Master sources, Clutch, Master E-Gear, E-Cam curve, Slave E-Gear.

Rotary Shear

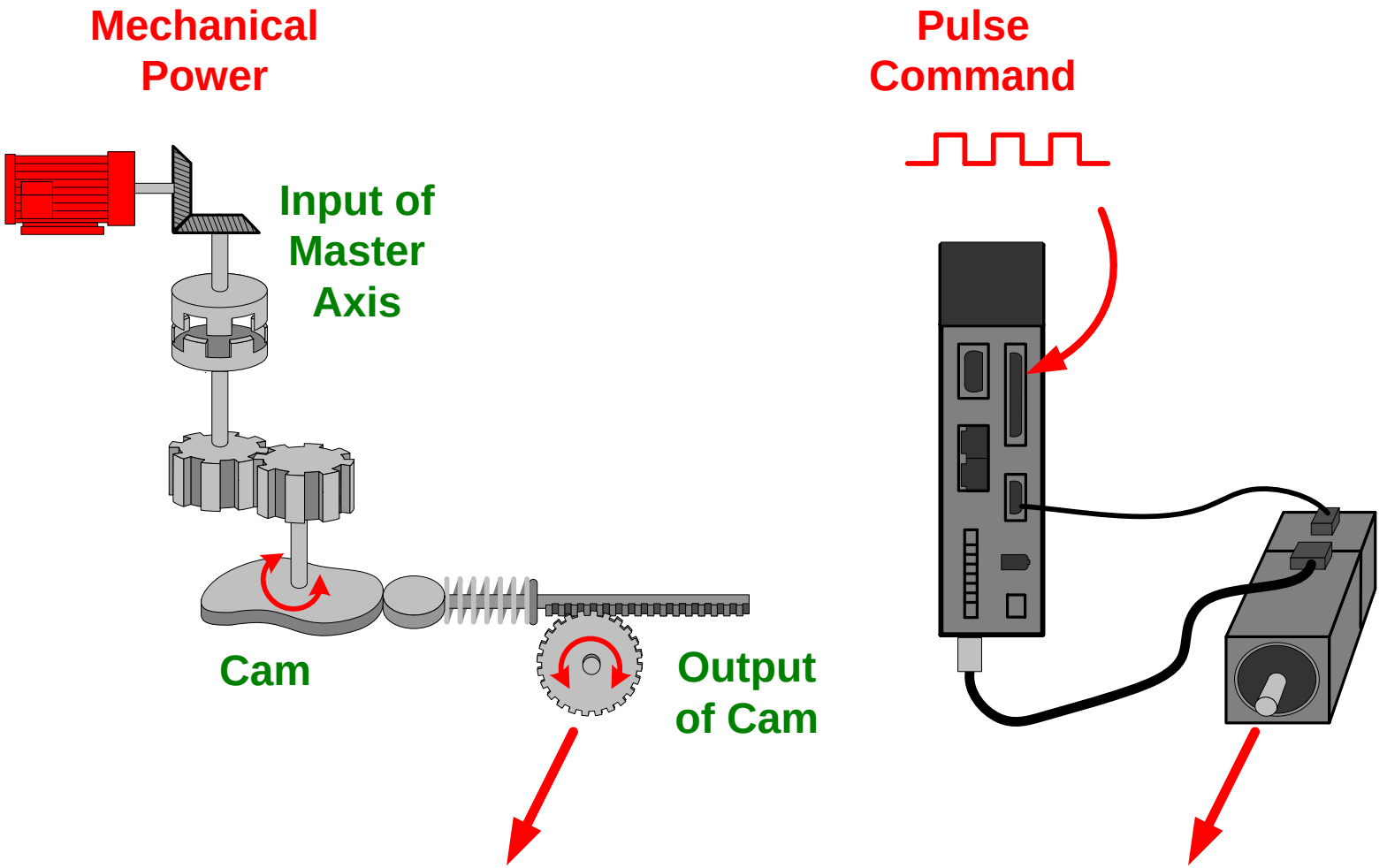
Background knowledge, E-Cam curve of rotary shear, Mark tracking function

Flying Shear

Background knowledge, E-Cam curve of flying shear, An application.

Electronic Cam (1)

From Machine Cam to Electronic Cam

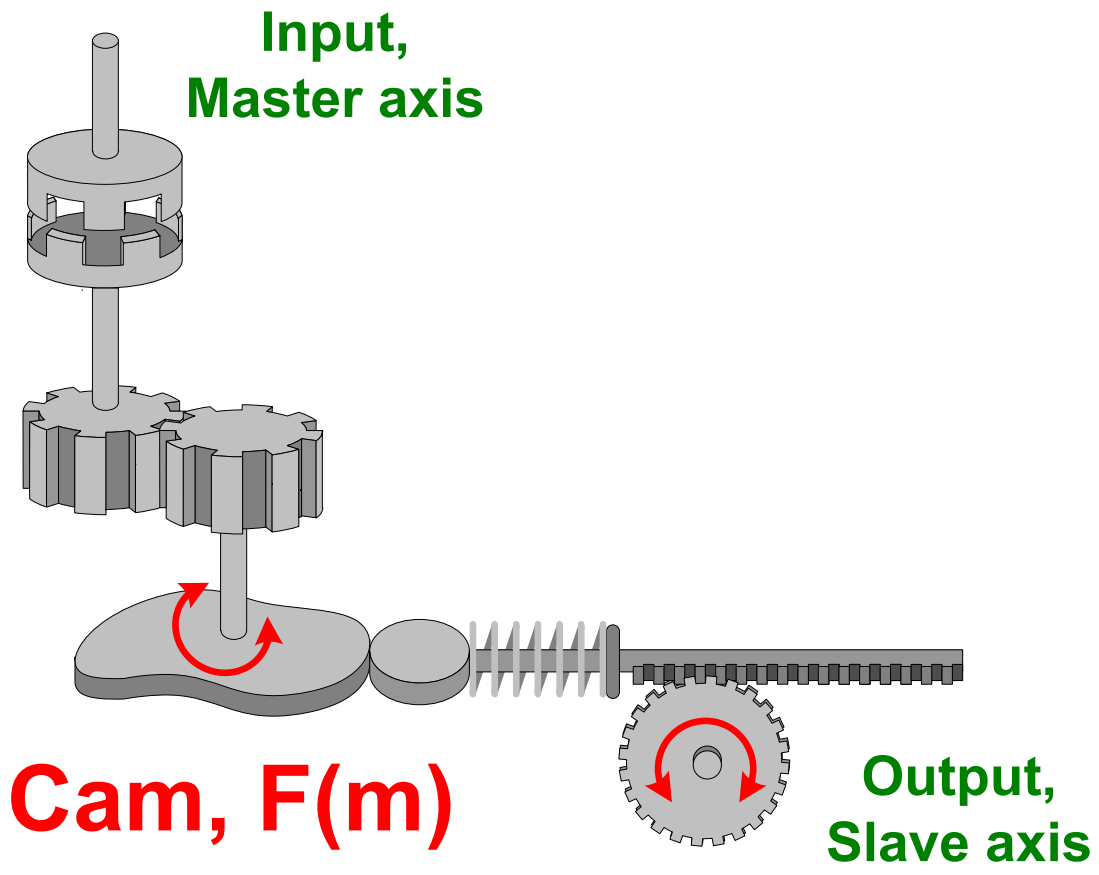


If both of the axes work in the same manner, the Servo system can be used to replace the mechanical CAM.

Electronic Cam (2)

What is E-Cam?

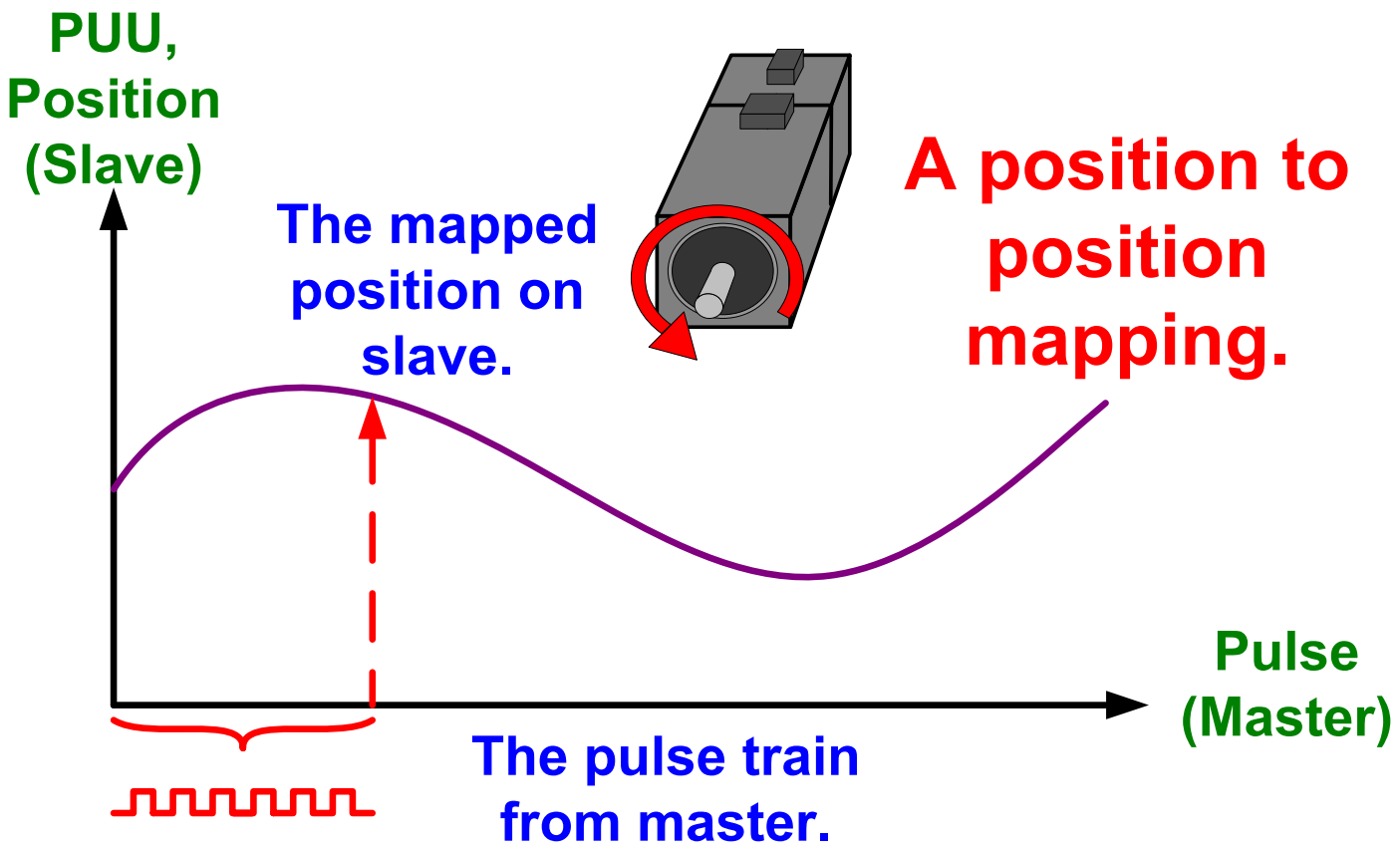
The slave axis is as a function of the master axis. And the function defines a pattern with which the slave follows the master.



Electronic Cam (3)

More on the Function

The horizontal axis is for the master, and vertical axis is for the slave.



E-Cam Parameters

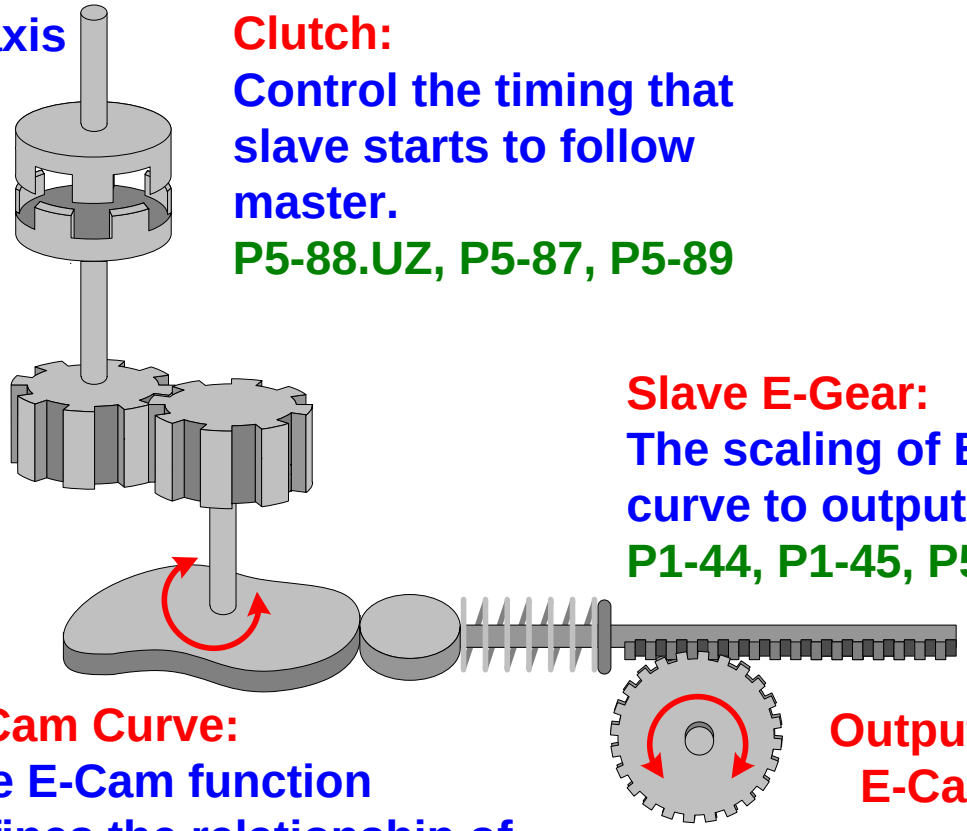
What's on ASDA-A2?

There are some parameters of E-Cam system as below.

Master Axis:
Sources of main axis
P5-88.Y

Clutch:
Control the timing that slave starts to follow master.
P5-88.UZ, P5-87, P5-89

Master E-Gear:
The scaling of command pulse.
P5-83, P5-84



Slave E-Gear:
The scaling of E-Cam curve to output.
P1-44, P1-45, P5-19

E-Cam Curve:
The E-Cam function defines the relationship of master and slave.
P5-81,P5-82,P5-85

Output of E-Cam

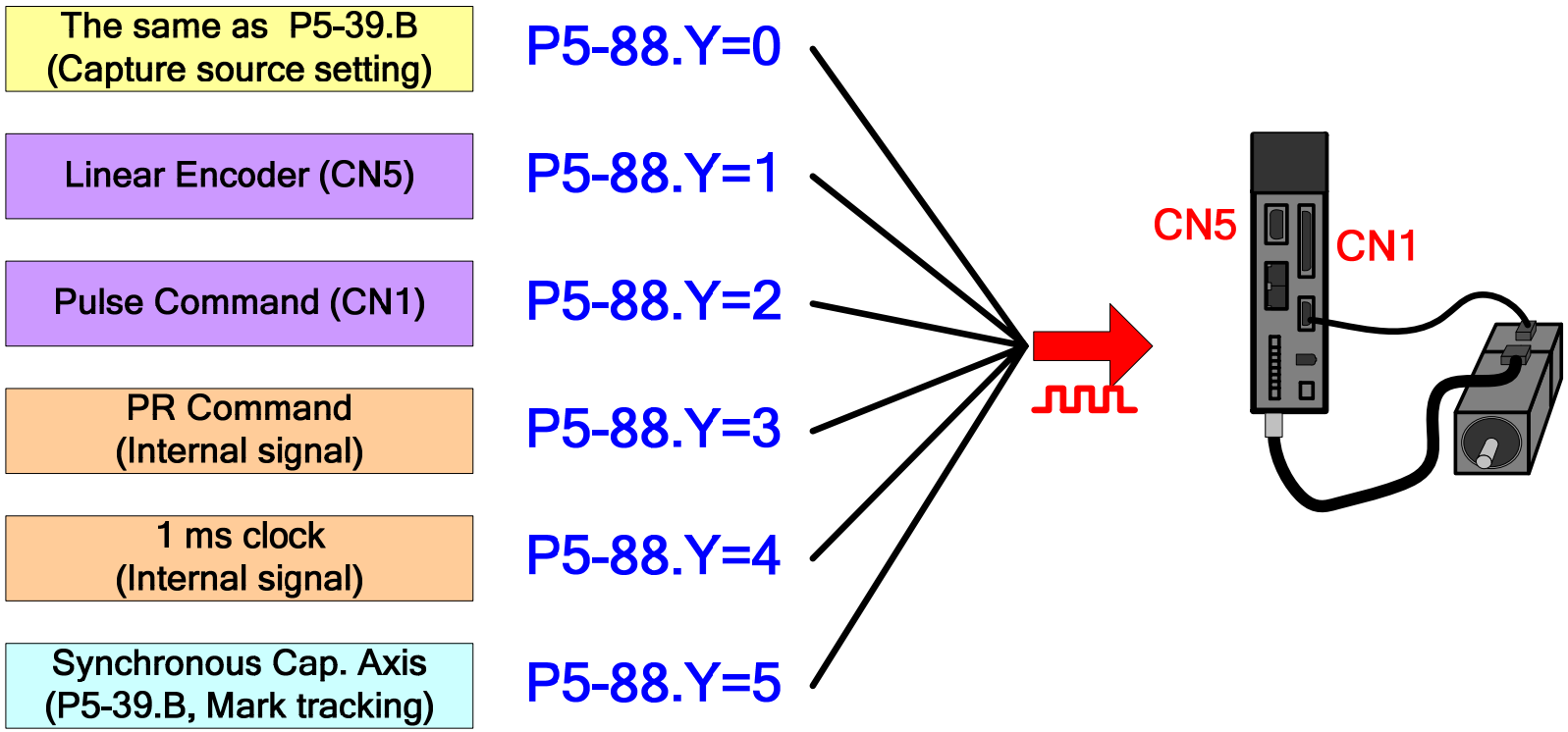
Sources of Master Axis (1)

6 Sources of Master Axis

Two of those are virtual signals and the remaining four ones are physical signals.

P5-88 E-Cam Settings

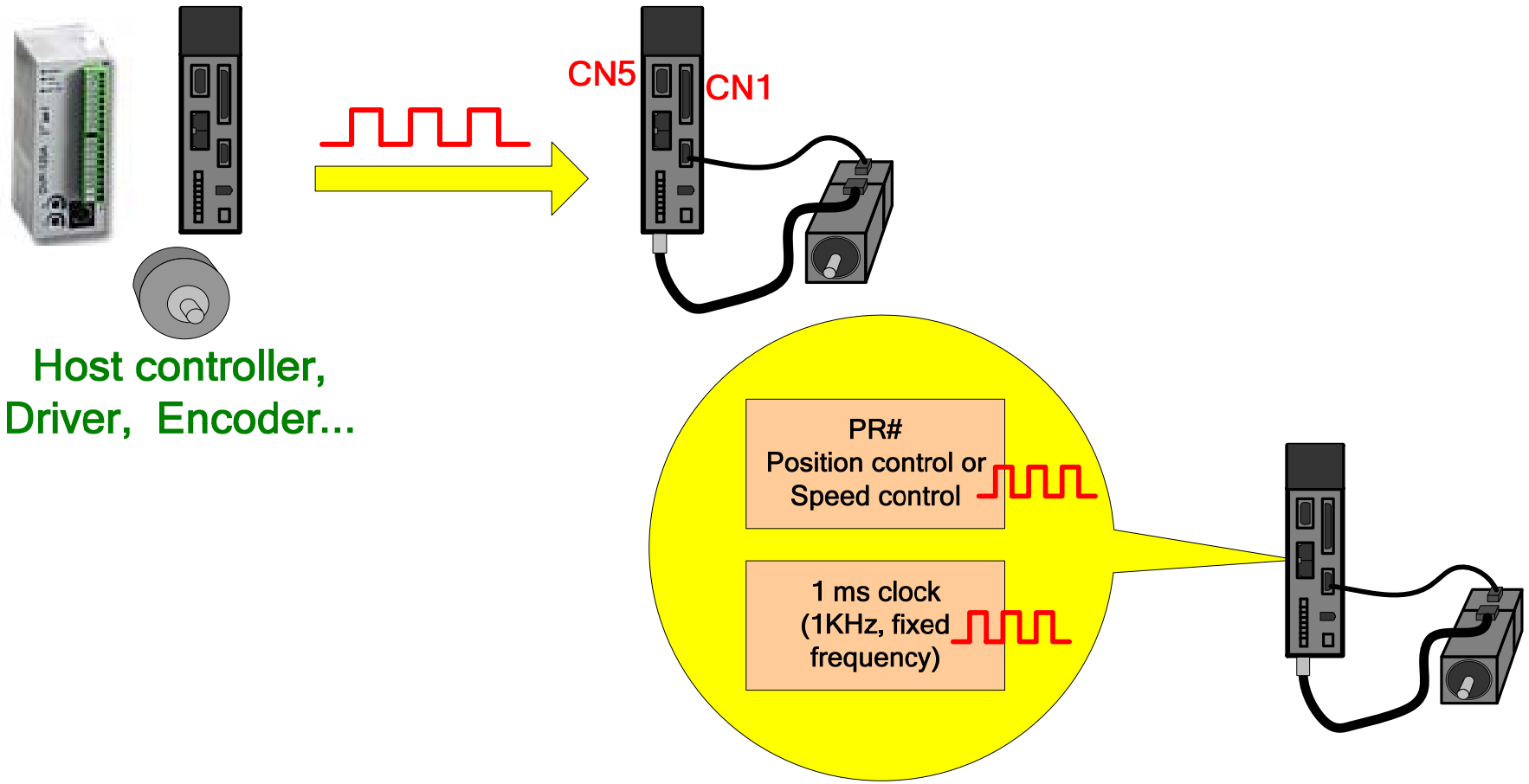
High Word			Low Word			
S	0	BA	U	Z	Y	X
0~2	-	00~3F	0~8	0~2	0~5	0~1



Sources of Master Axis (2)

Physical and Virtual Axes

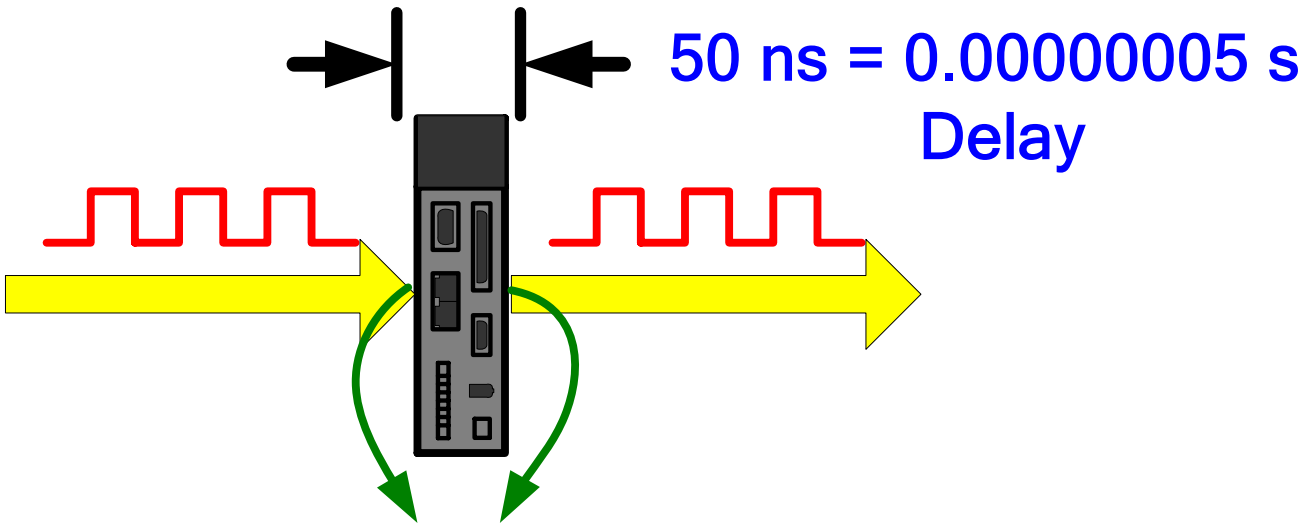
The virtual signal is a convenient design for test E-Cam without physical master signals. All the physical signals get into Servo via CN1 or CN5.



Sources of Master Axis (3)

Pulse By-pass

There sometimes requests several slaves to follow the same master. ASDA-A2 is integrated a function called pulse by-pass which can deliver the receiving pulse train to the next stage. The passing wouldn't have any attenuation since ASDA-A2 works as a repeater. The delay time for one pass is 50 ns.

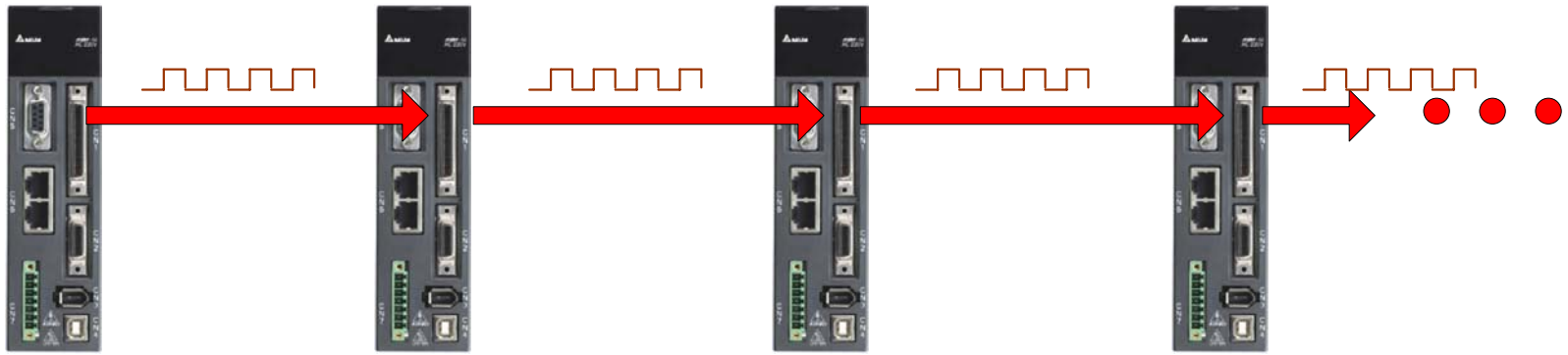


Signal strength is the same, no attenuation.

Sources of Master Axis (4)

Pulse By-pass by CN1

P1-74.B=2 is set for pulse by-pass from CN1.

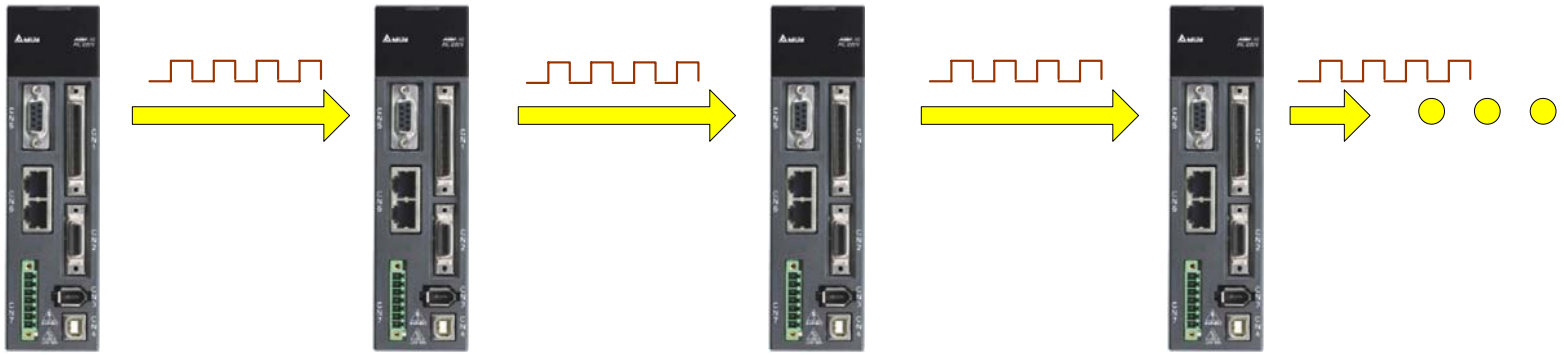


Main	Slave 1	Slave 1	Slave 2	Slave 2	Slave 3	Slave 3
CN1	CN1	CN1	CN1	CN1	CN1	CN1
OA,	Pulse,	OA,	Pulse,	OA,	Pulse,	OA,
/OA,	/Pulse,	/OA,	/Pulse,	/OA,	/Pulse,	/OA,
OB,	Sign,	OB,	Sign,	OB,	Sign,	OB,
/OB	/Sign	/OB	/Sign	/OB	/Sign	/OB
	P1-74.B = 2		P1-74.B = 2		P1-74.B = 2	

Sources of Master Axis (5)

Pulse By-pass by CN5

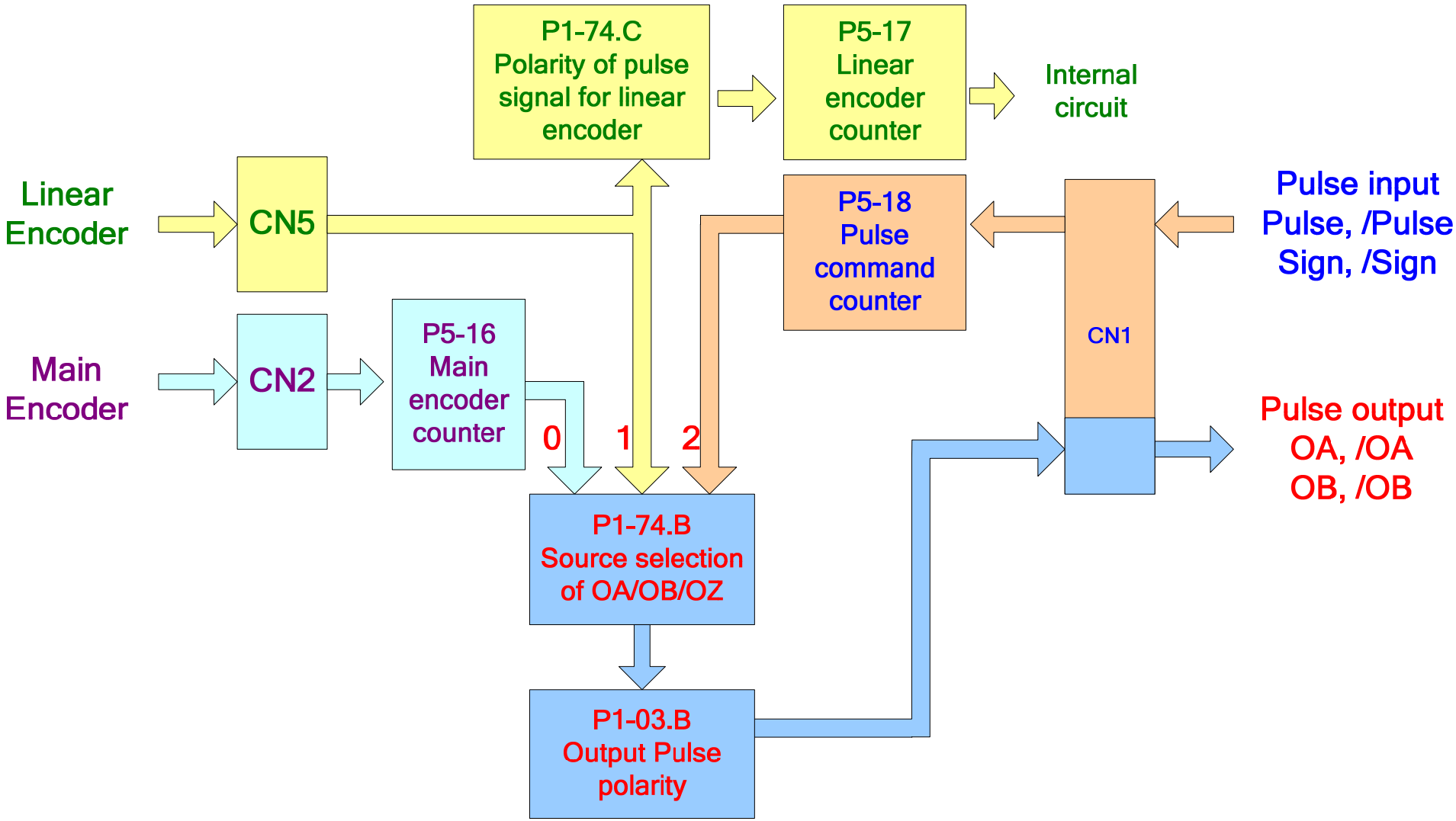
P1-74.B=1 is set for pulse by-pass from CN5.



Main	Slave 1	Slave 1	Slave 2	Slave 2	Slave 3	Slave 3
CN1	CN5	CN1	CN5	CN1	CN5	CN1
OA,	Opt A,	OA,	Opt A,	OA,	Opt A,	OA,
/OA,	/Opt A,	/OA,	/Opt A,	/OA,	/Opt A,	/OA,
OB,	Opt B,	OB,	Opt B,	OB,	Opt B,	OB,
/OB	/Opt B	/OB	/Opt B	/OB	/Opt B	/OB
	P1-74.B = 1		P1-74.B = 1		P1-74.B = 1	

Sources of Master Axis (6)

Pulse Flow Diagram



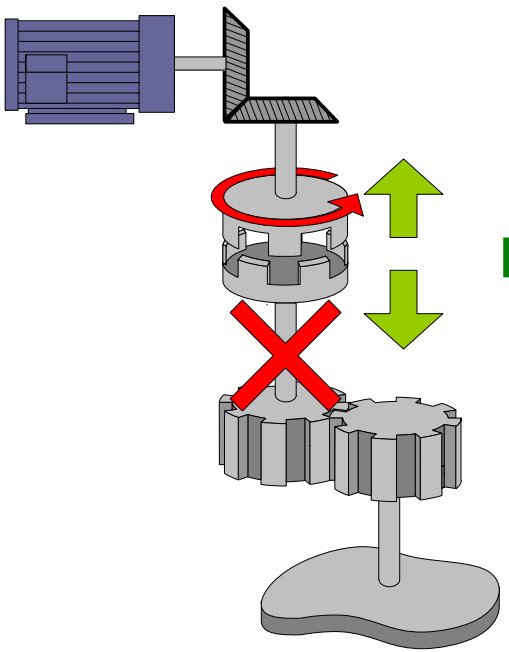
Clutch (1)

Timing Controller

The clutch will set the timing of slave axis to follow the command of master axis.

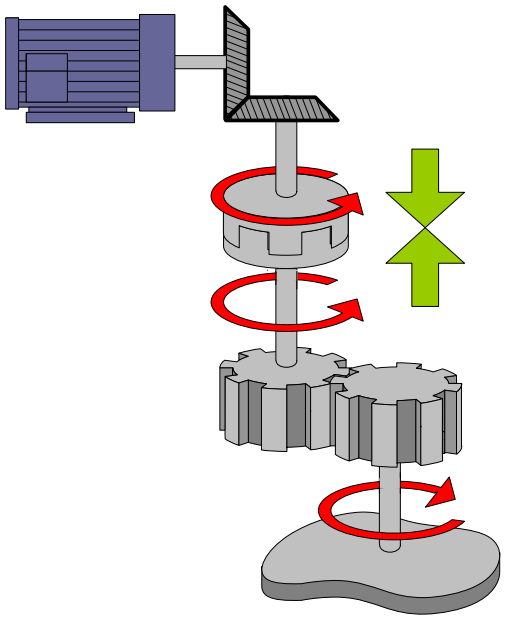
P5-88
E-Cam Settings

High Word			Low Word			
S	0	BA	U	Z	Y	X
0~2	-	00~3F	0~8	0~2	0~5	0~1



P5-88.U
Disengaging

Cam



P5-88.Z
Engaging

Cam

Clutch (2)

Engaging Timing Control

Three conditions to engage the clutch.

P5-88
E-Cam Settings

High Word			Low Word			
S	0	BA	U	Z	Y	X
0~2	-	00~3F	0~8	0~2	0~5	0~1

Engage immediately when E-Cam enabled. (P5-88.X=1)

Digital signal enabled. (DI=0x36, DI Cam ON)

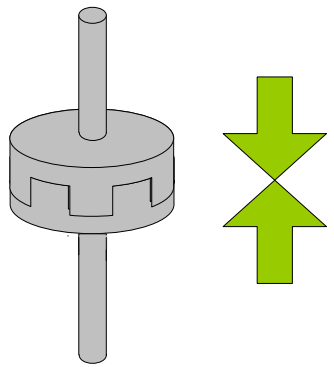
Any action of Capture function.

P5-88.Z=0

P5-88.Z=1

P5-88.Z=2

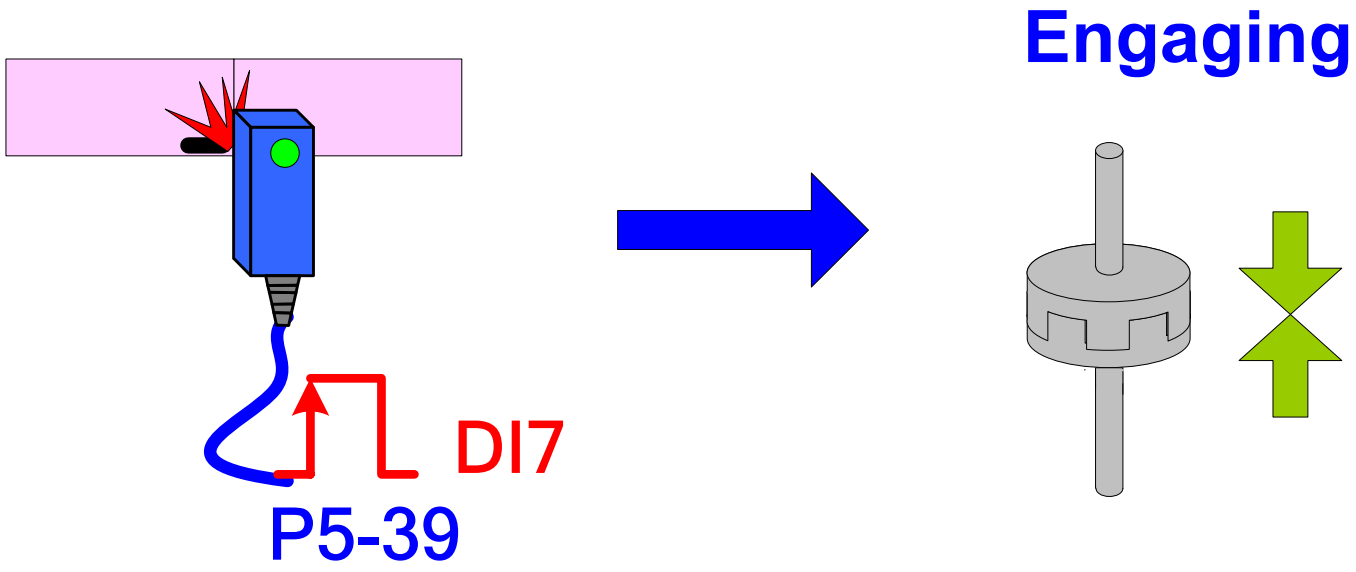
Engaging



Clutch (3)

Why Capture function?

The Capture function is designed to activate E-Cam because of its high speed input. When the Capture function fetches the position, it will bring the E-Cam function enforcement simultaneously. Sometimes, the position that Capture function gets is not for any purpose.

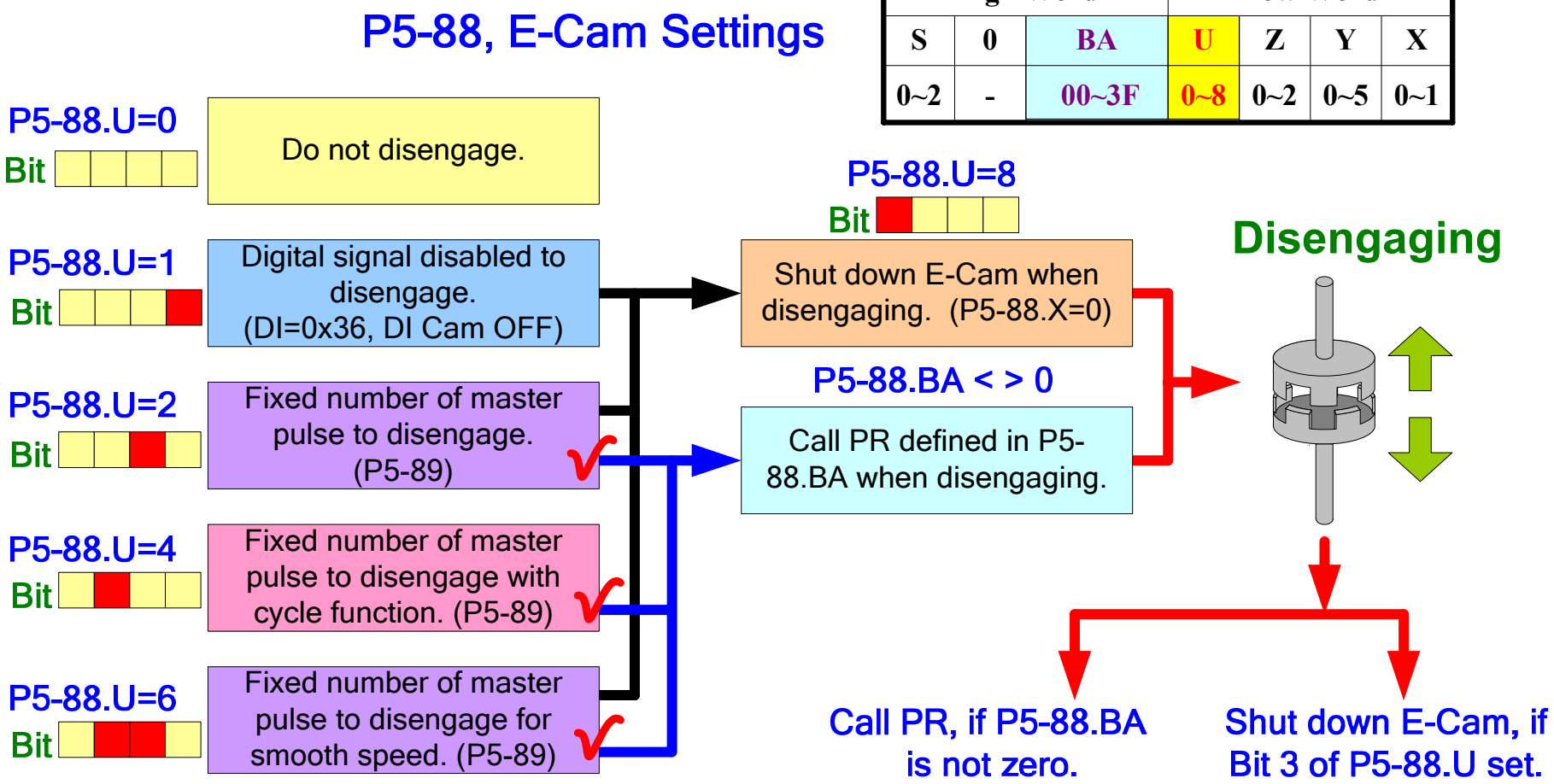


Clutch (4)

Disengaging Timing Control

Multi-conditions can be set with Bit-OR. The condition 2, 4, and 6 are mutually exclusive; that is, only one of them can be selected.

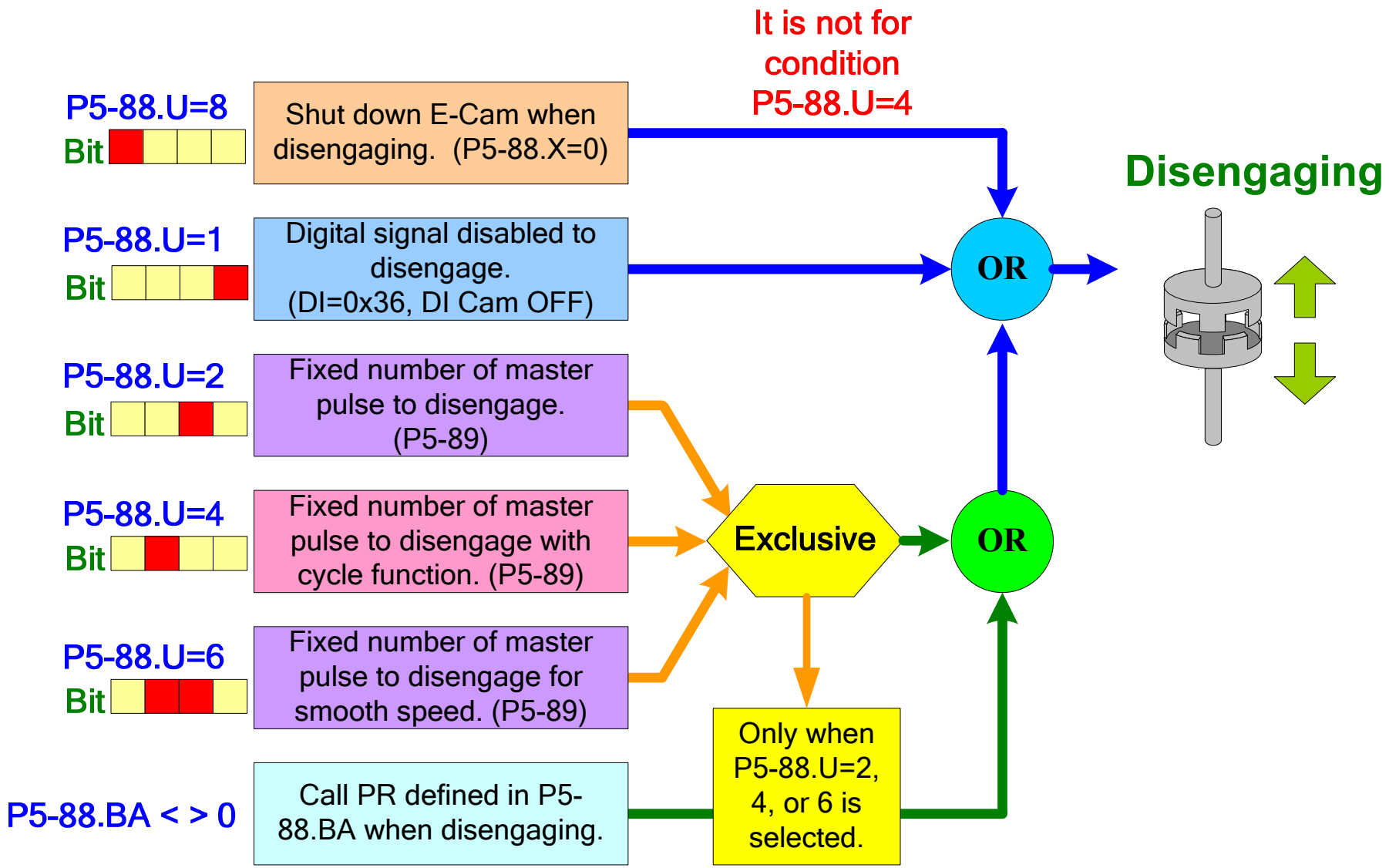
High Word			Low Word			
S	0	BA	U	Z	Y	X
0~2	-	00~3F	0~8	0~2	0~5	0~1



Clutch (5)

Bit-OR for Multi-Selection

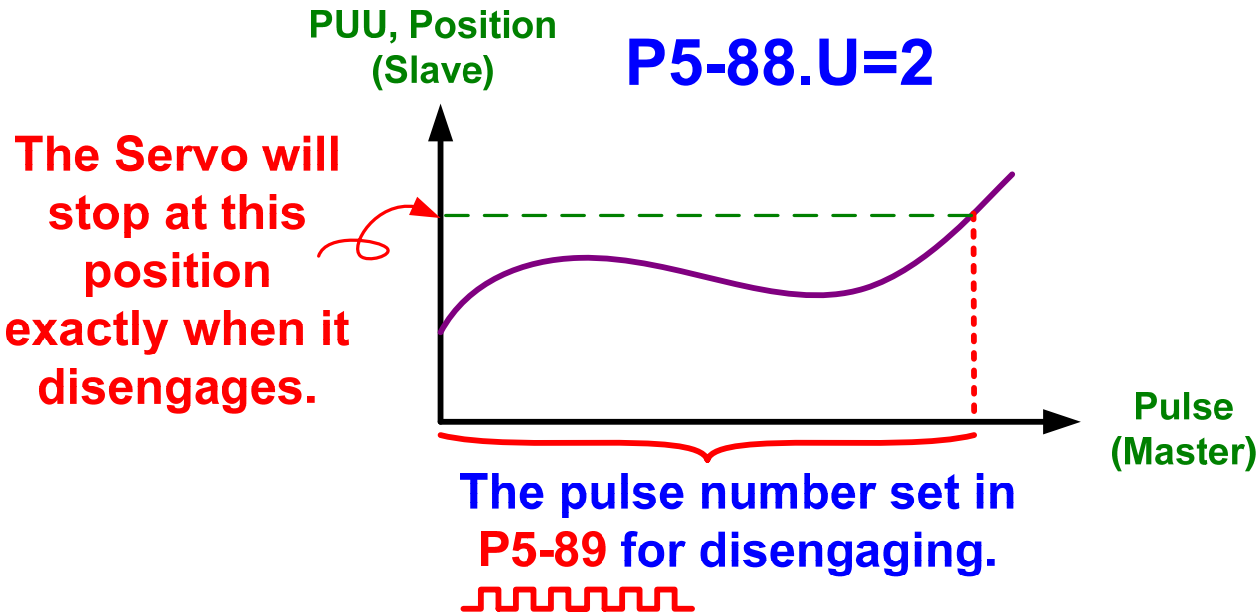
The Bit-OR combination is as below.

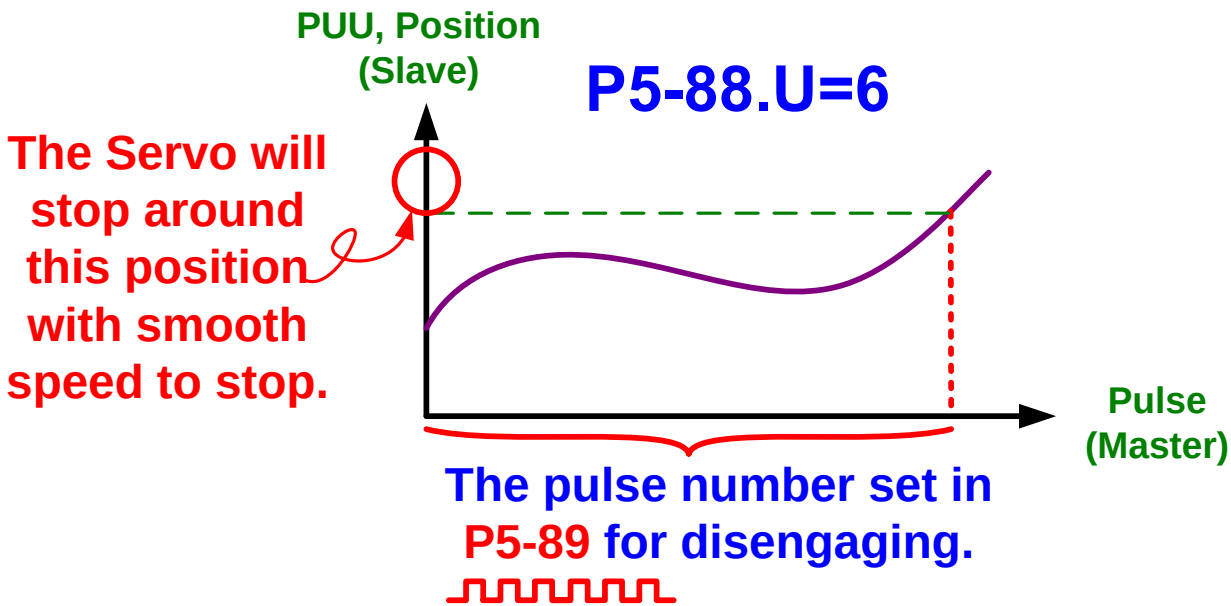


Clutch (6)

Select 2 or 6 to Disengage

Disengaging with fixed number of master pulses. The focus of condition 2 is accuracy of position while the condition 6 is for smooth speed to stop.

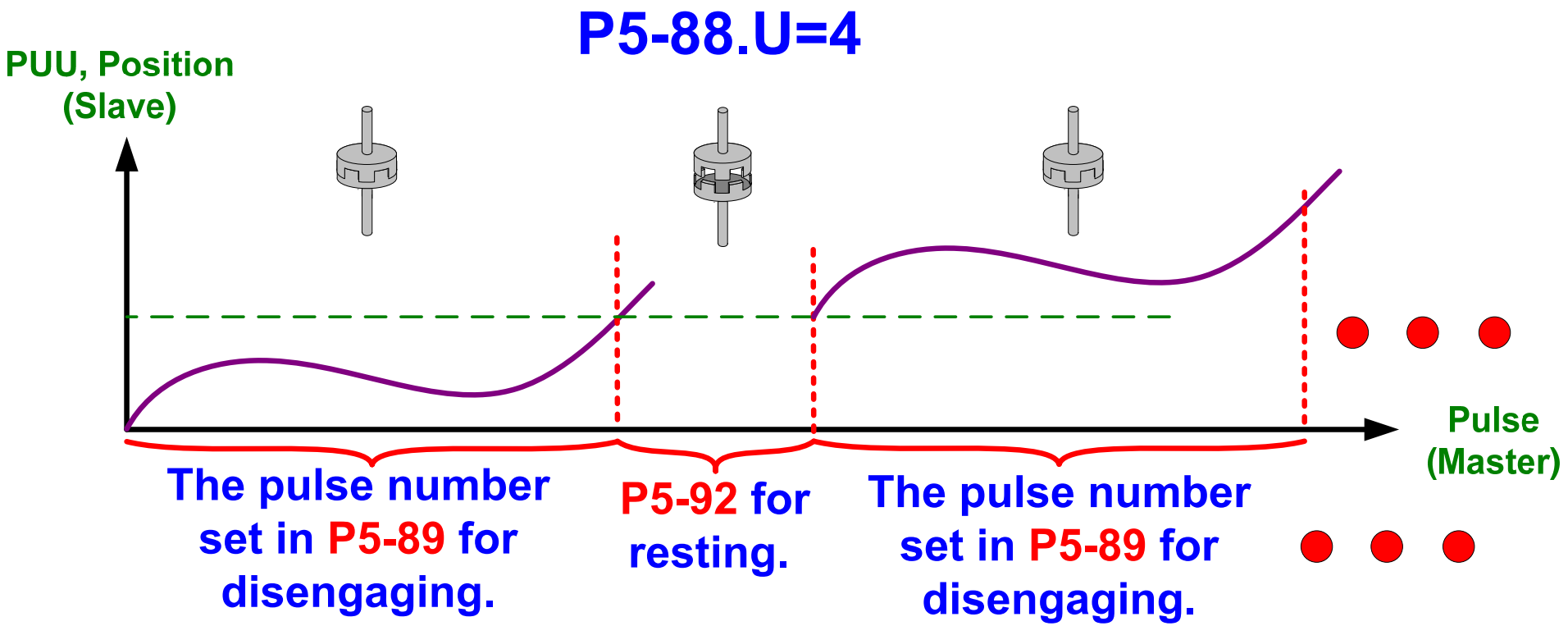




Clutch (7)

Select 4 to Disengage

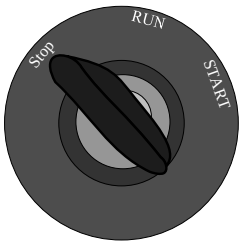
Disengage with fixed number of master pulses, take a rest for certain pulse number set in P5-92, and engage again to repeat the cycle until other commands put to stop.



Clutch (8)

An Inactive System & Disengaging a System

An inactive E-Cam system is a system with shutting down E-Cam function, and the disengaged E-Cam system has a working one but the motor is not running.



Inactive E-Cam (Shut down E-Cam Function)

Disengaged E-Cam (In neutral gear)

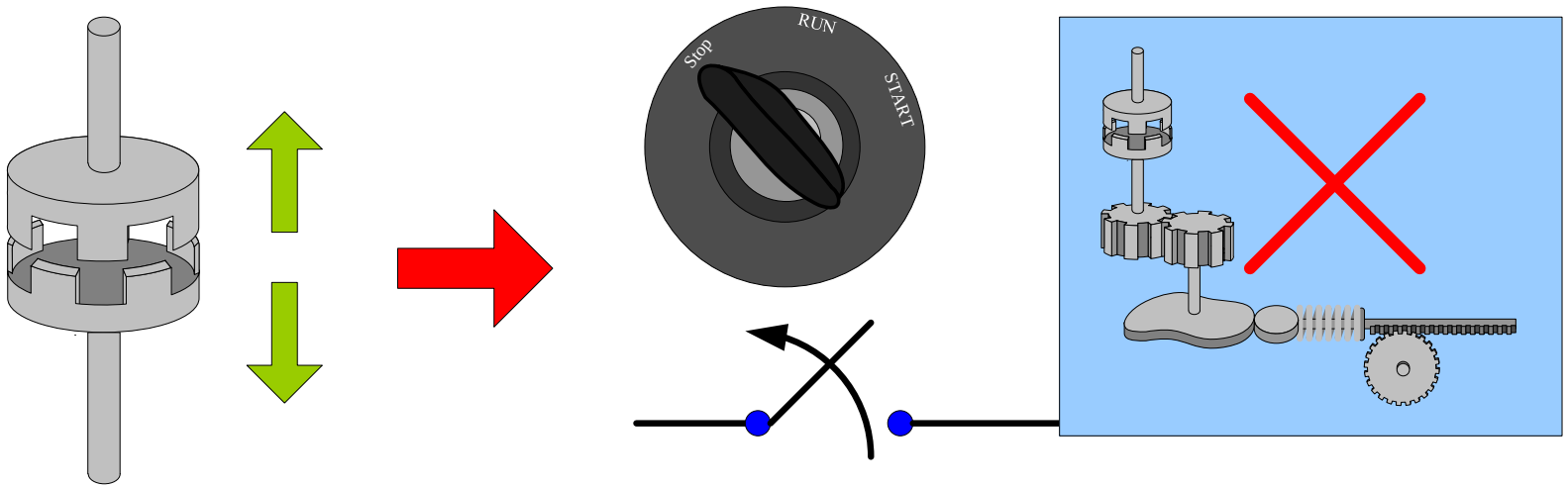
Clutch (9)

Set 8 to Shut Down E-Cam

The Bit 3 of P5-88.U can set to stop the operation of E-Cam when disengaging.

Disengaging

Shut down E-Cam.



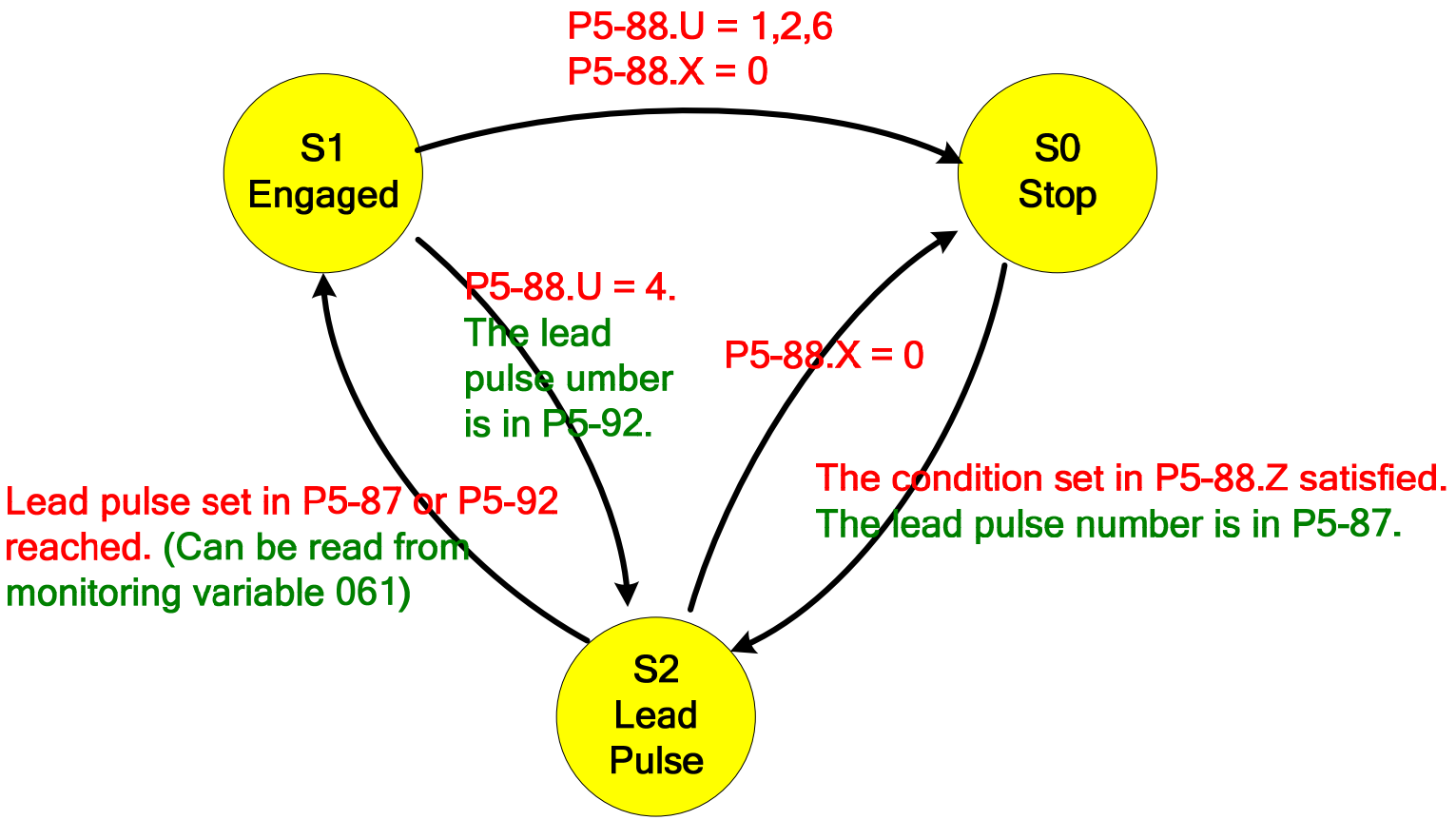
Clutch (10)

The State-transition of E-Cam

There are 3 states to indicate the status of the E-Cam system.

P5-88,
E-Cam Settings

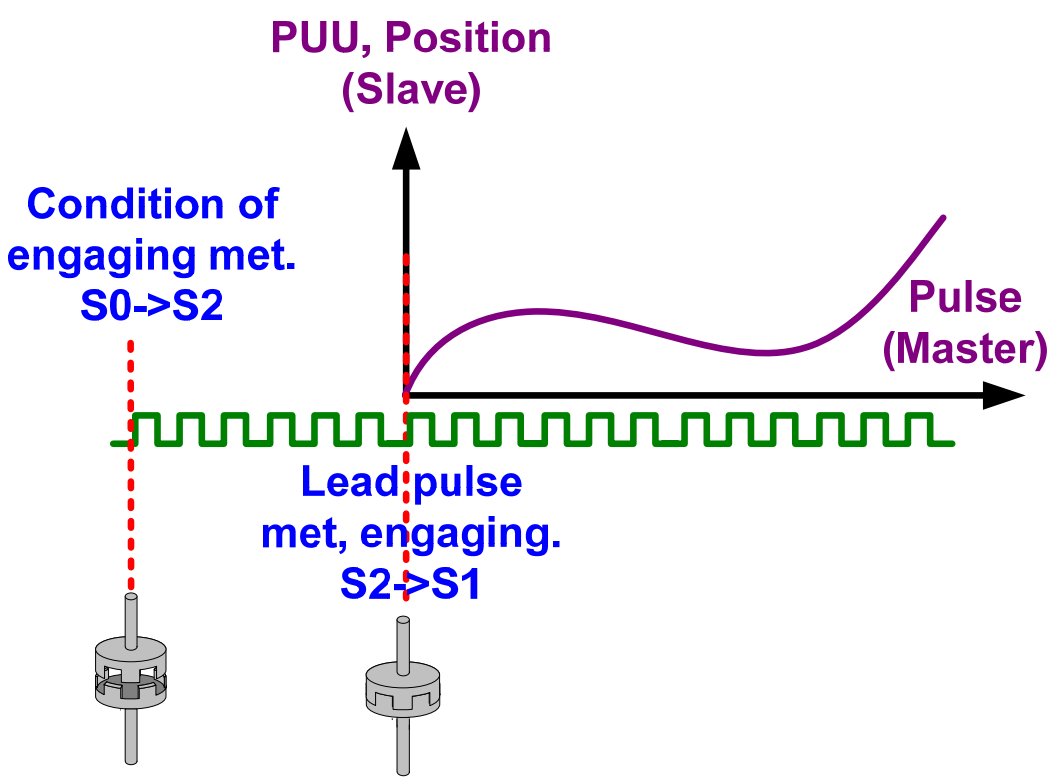
High Word			Low Word			
S	0	BA	U	Z	Y	X
0~2	-	00~3F	0~8	0~2	0~5	0~1

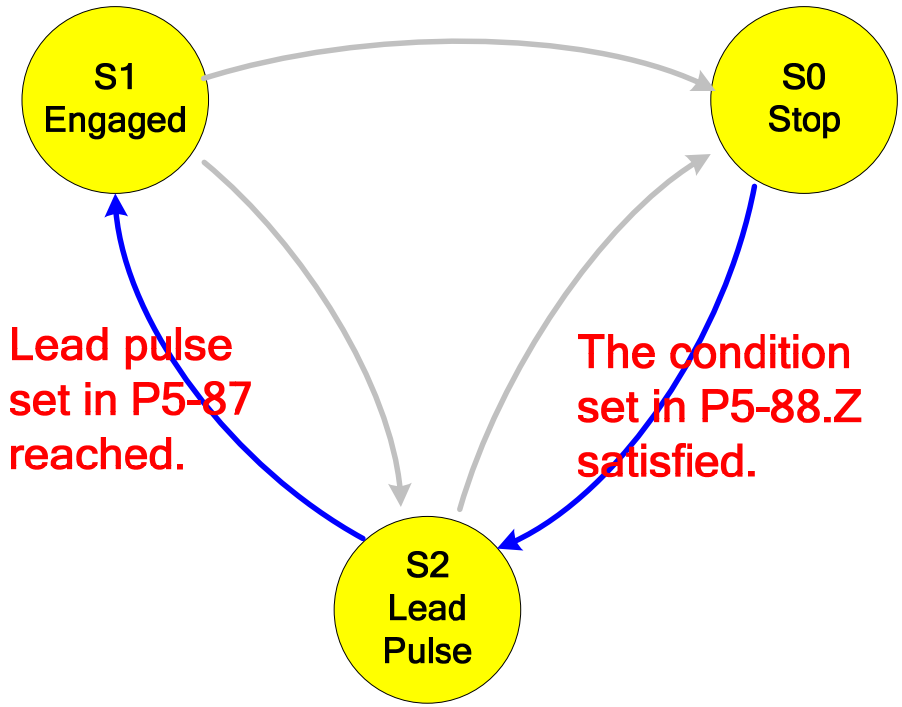


Clutch (11)

The One-Time-Deal Lead Pulse

There are two parameters for lead pulse which is a delay for clutch to get engaging when its engaging condition met. P5-87 is one time deal.

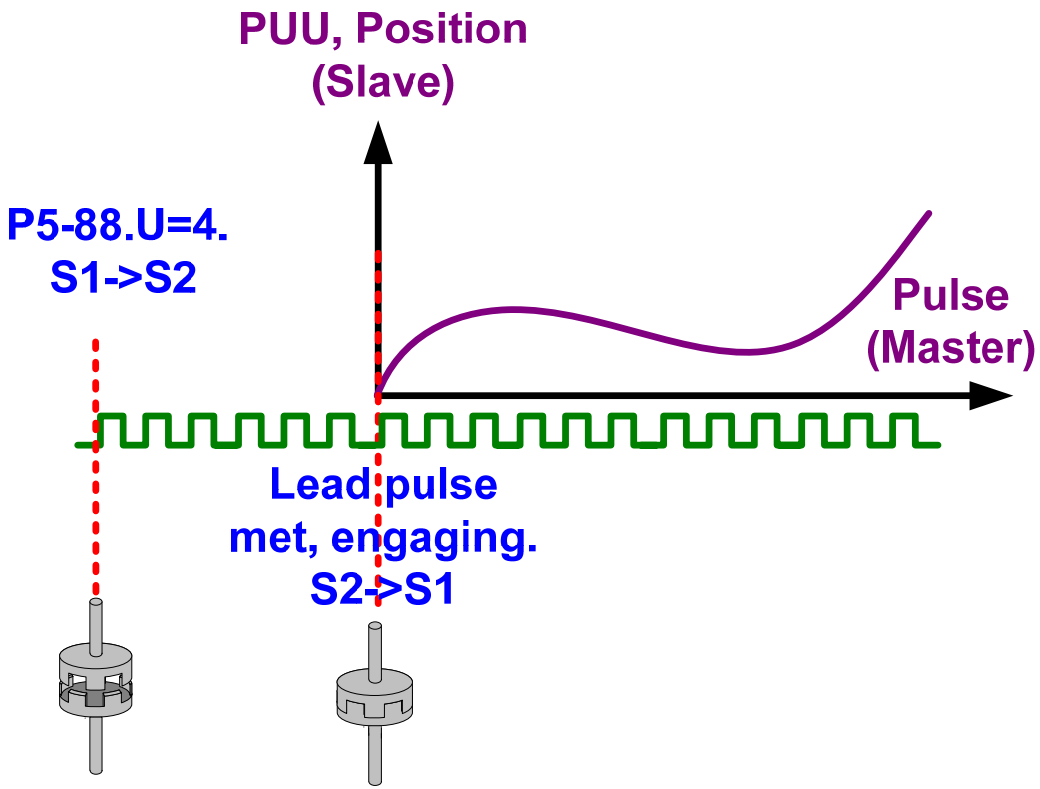


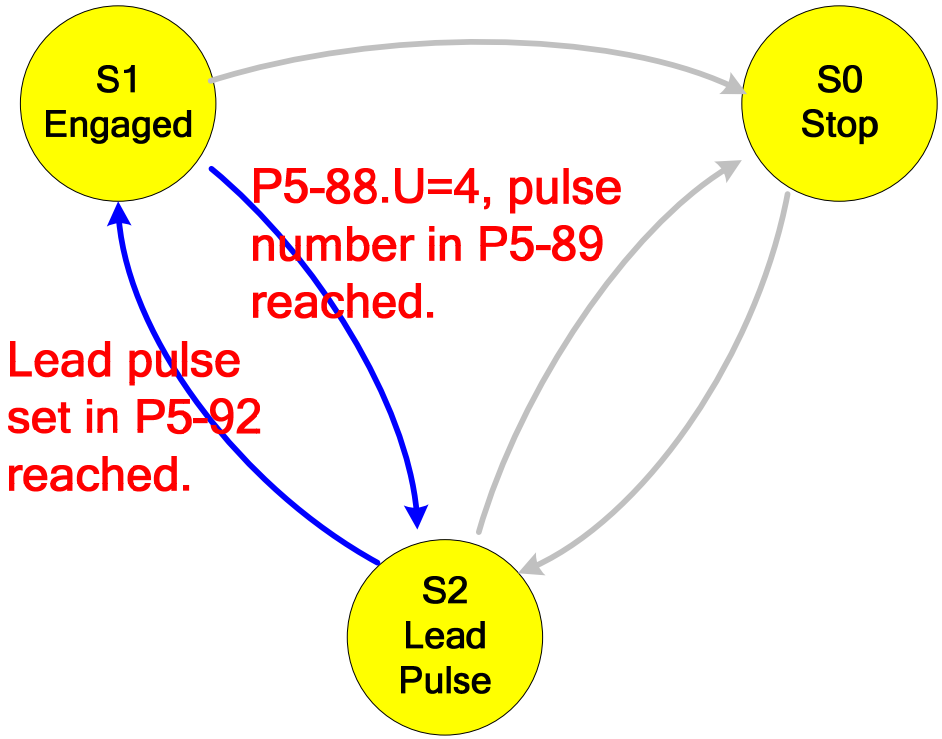


Clutch (12)

The Cyclic Lead Pulse

The number of lead pulse is P5-92 is a cyclic one associated with disengaging condition 4.

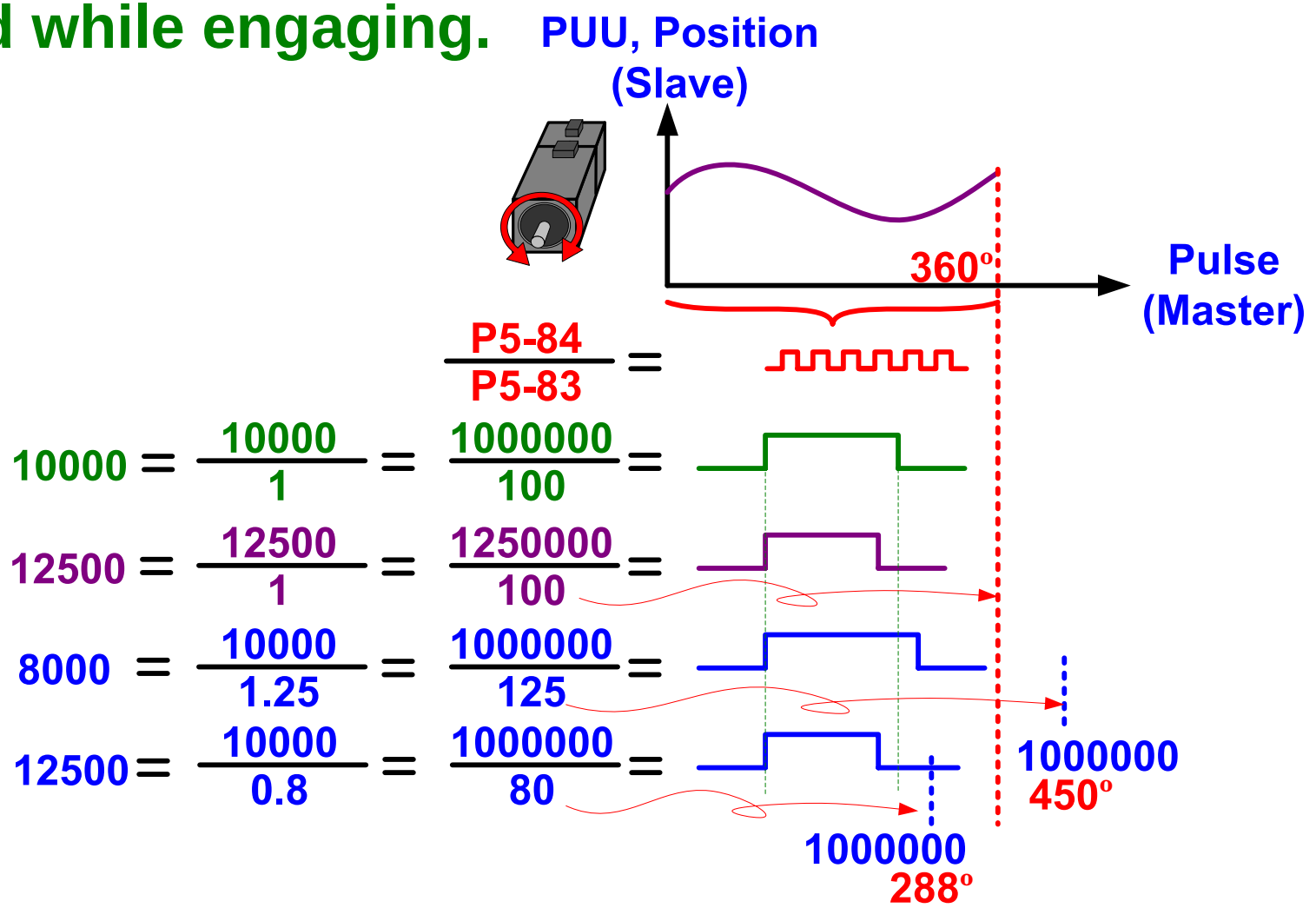




Master E-Gear

The Resolution of Pulse Command

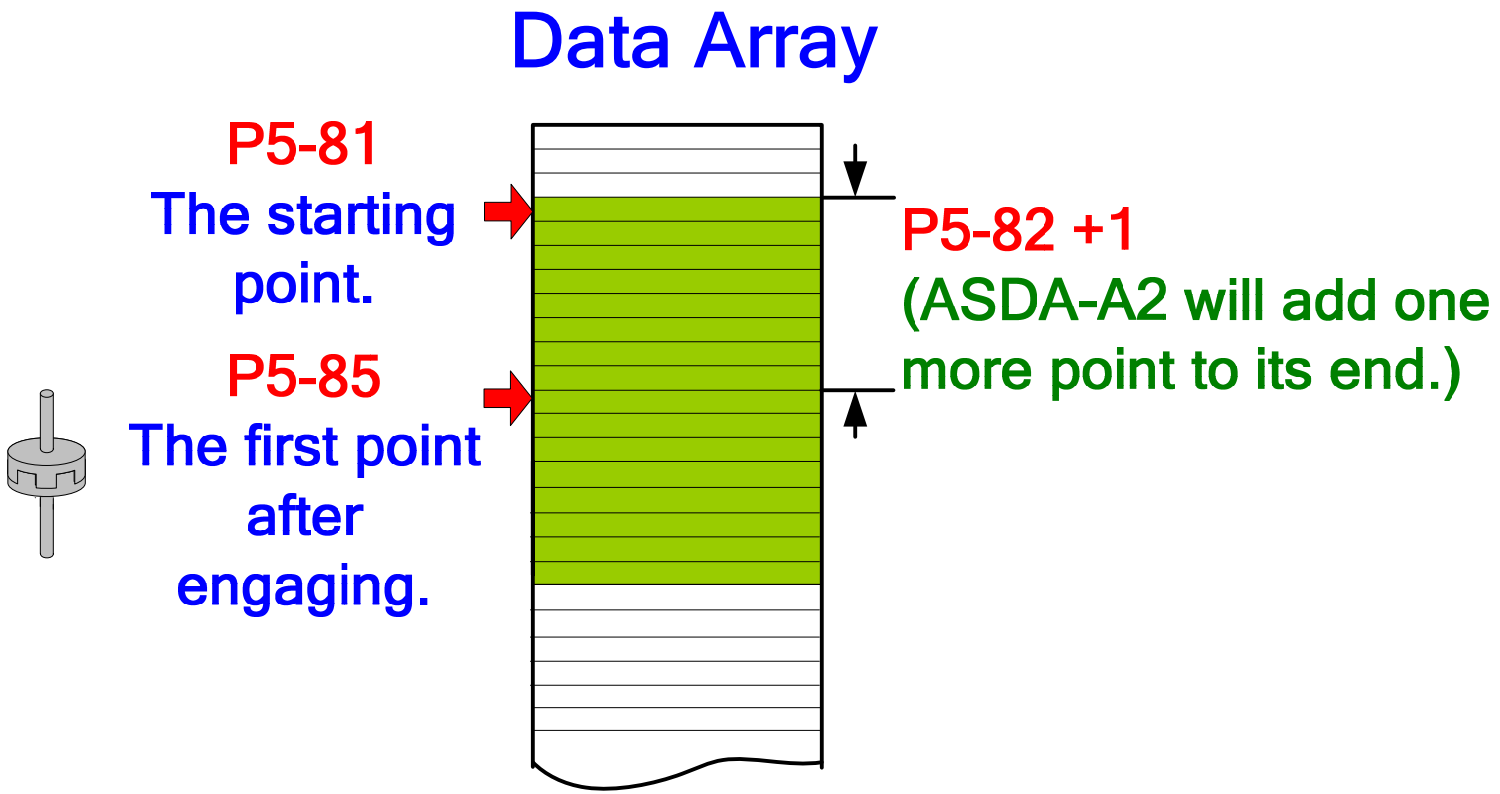
The master E-Gear (electronic gear) will change the resolution of master pulse command. The P5-83 can be adjusted while engaging.



E-Cam Curve (1)

Where is the E-Cam curve?

The curve is stored in the data array. P5-81 notes its start point where P5-82 +1 (720+1, maximum items of one E-Cam curve) is for its length. P5-85 is the initial point where the E-Cam engaged.

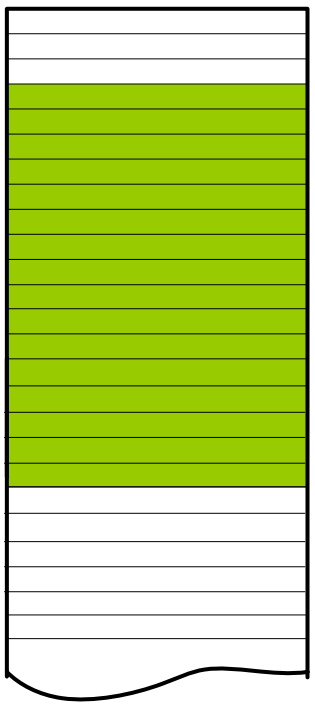


E-Cam Curve (2)

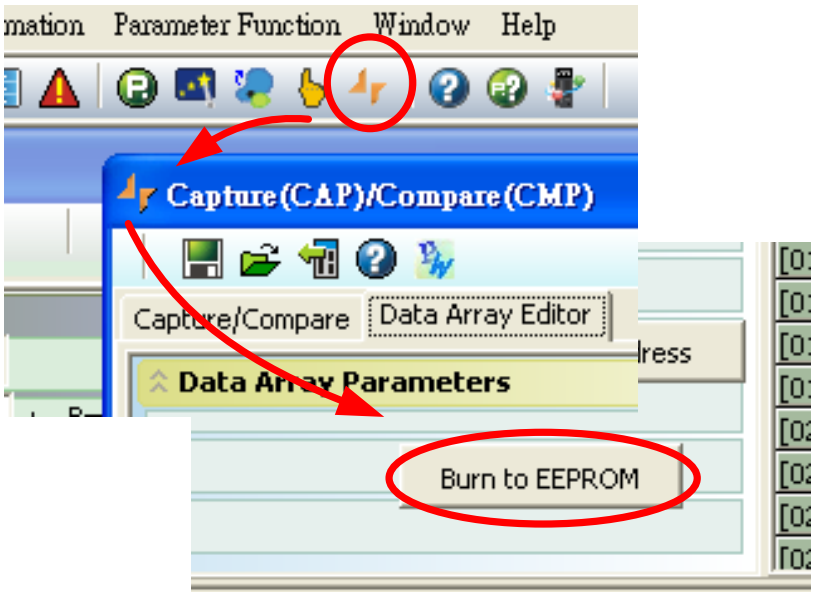
Backup the Curve Into EEPROM

When it is downloaded, it is in the RAM. Some processes can be used to put the curve into EEPROM for permanently keeping even power off.

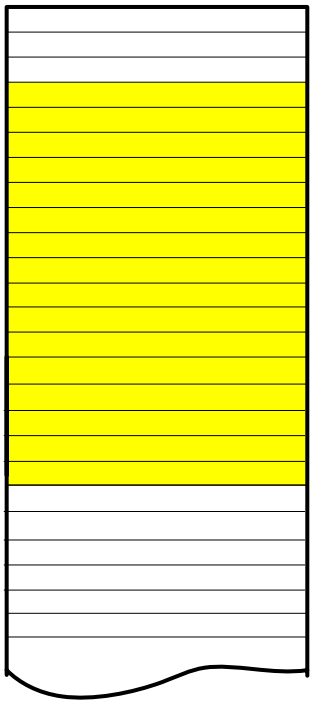
Data Array
In RAM



1. Set P2-08 to 30 then 35.
2. Use ASDA-Soft.



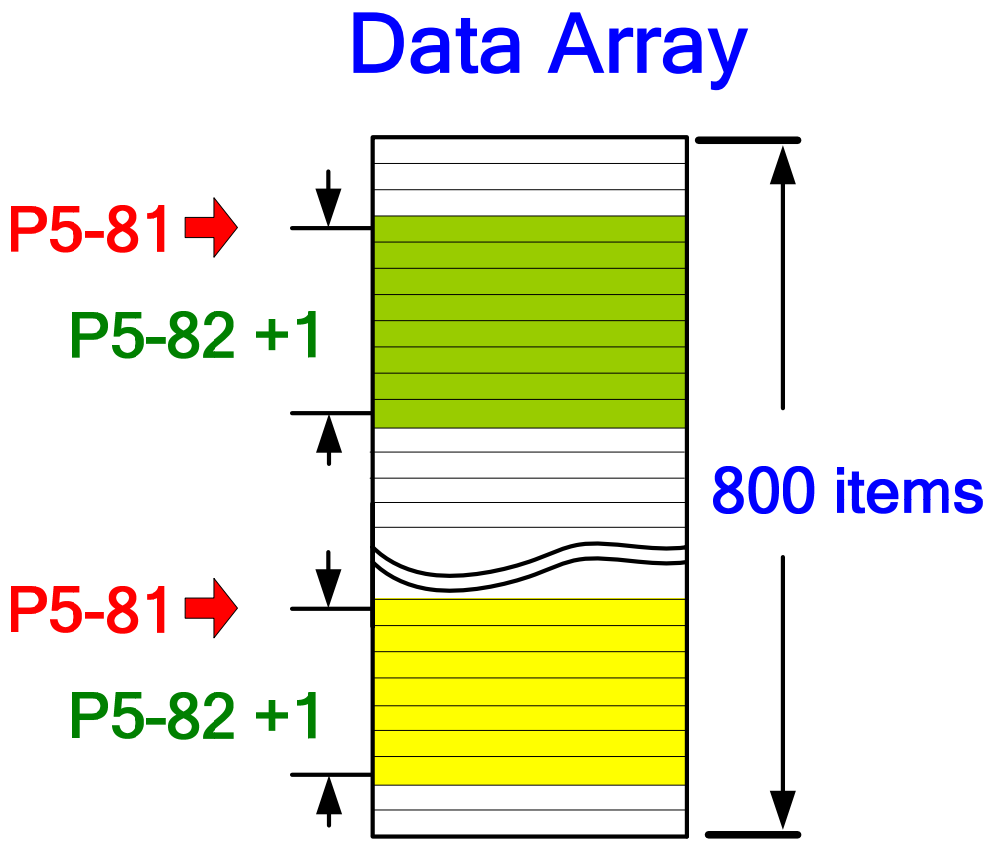
Data Array
In EEPROM



E-Cam Curve (3)

Capability of Multiple Curves

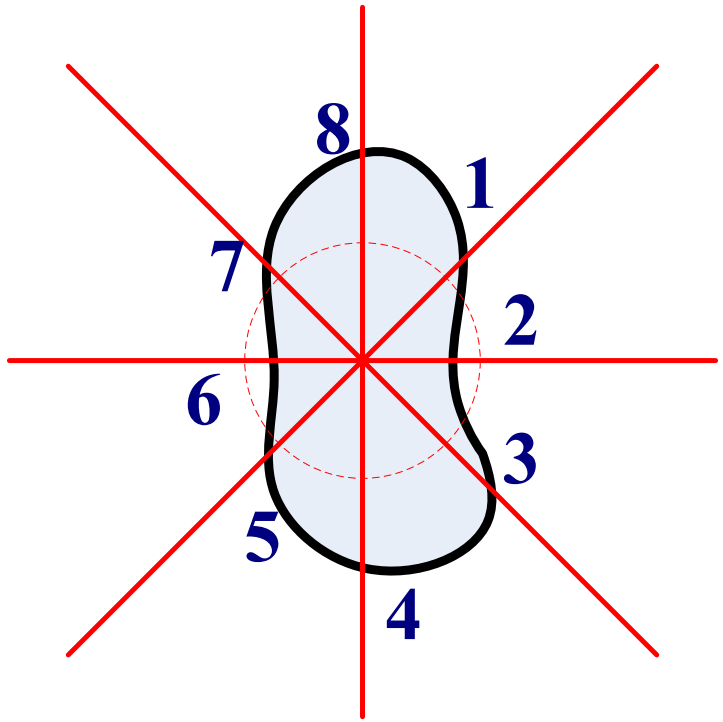
Multiple E-Cam curves can be stored in data array up to the limit of 800 items. (721 items for one single E-Cam curve)



E-Cam Curve (4)

An Example of Making Curves- Division

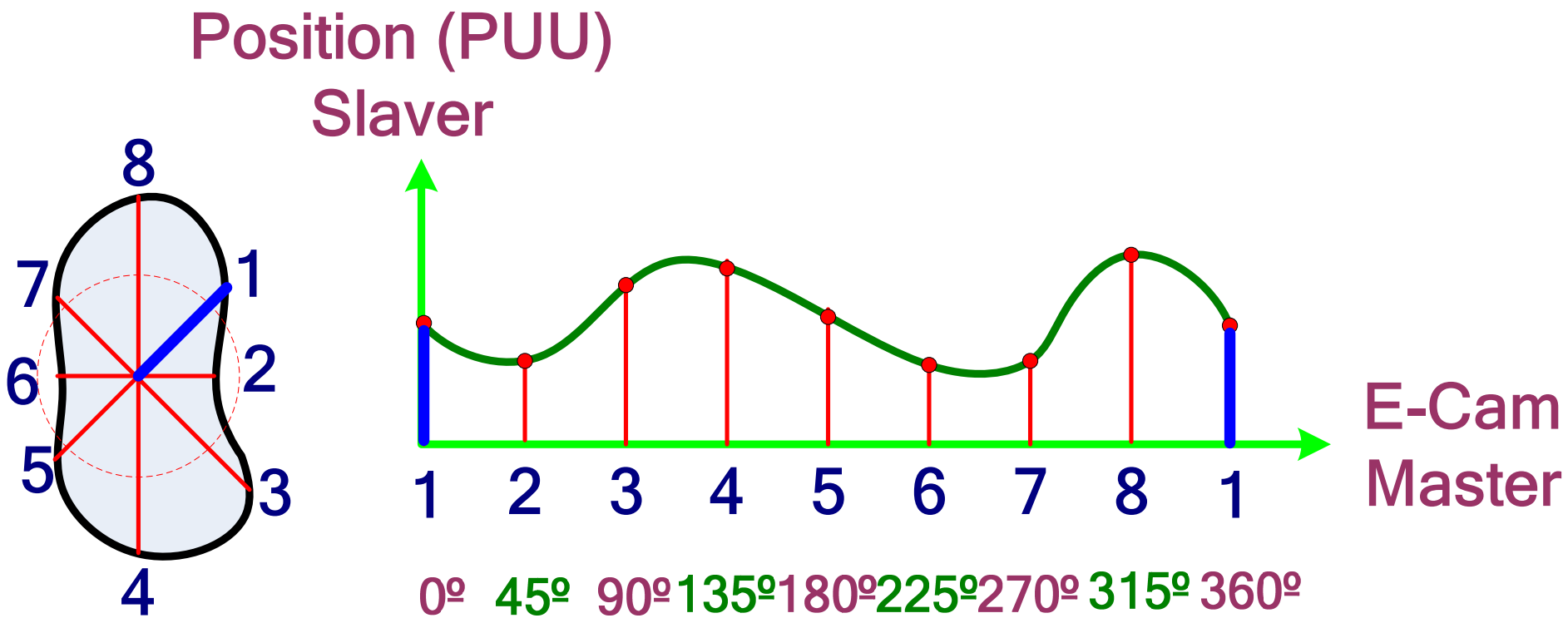
There are many ways to make an E-Cam curve. This is one of them called Table Filling Creation. Divide the Cam to certain equal parts, 8 for example. There will be 9 points recorded in the data array. 720 divisions are maximum number for one curve.



E-Cam Curve (5)

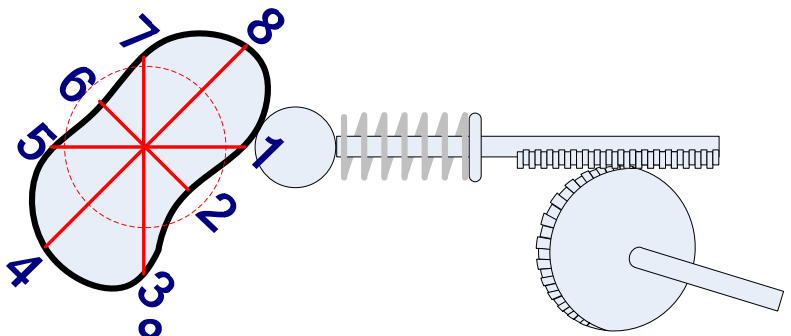
Measure the Length

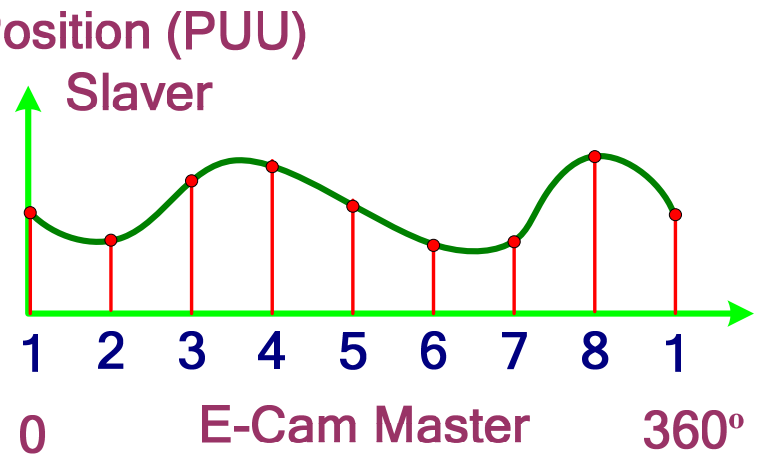
Record the distances of the center to cam edge from #1 to #8 respectively.

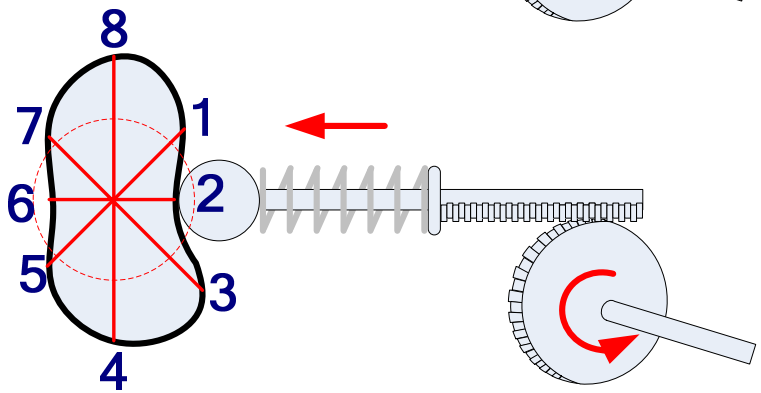


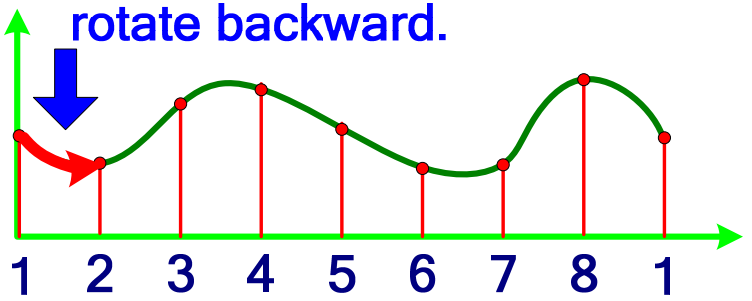
E-Cam Curve (6)

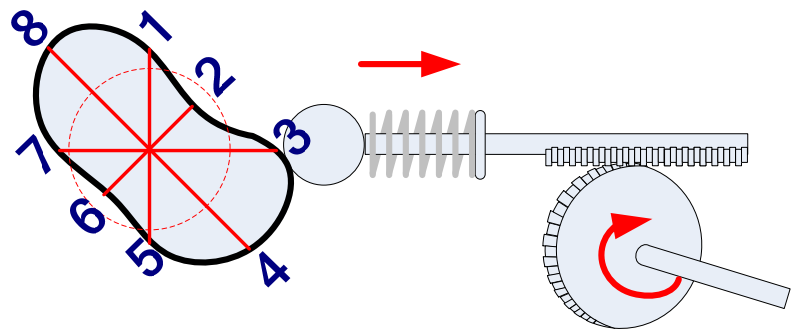
This is the curve.

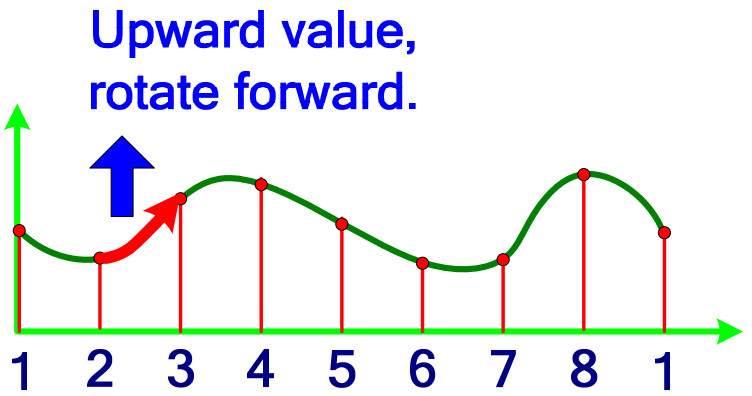








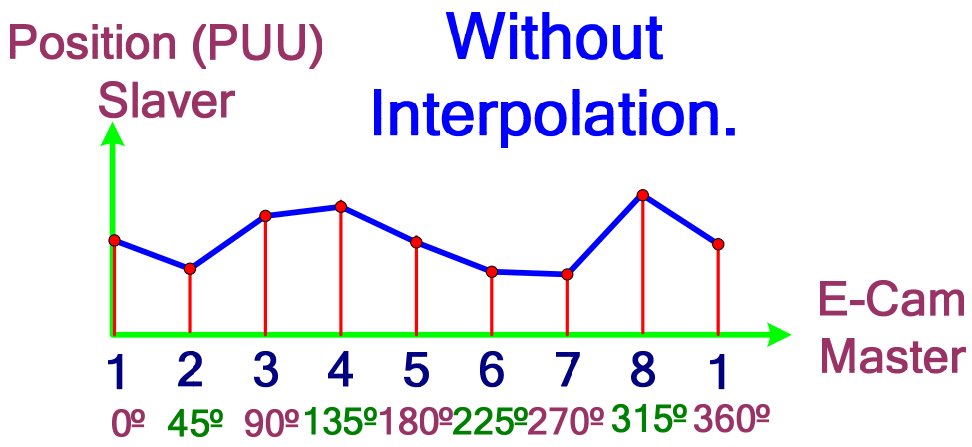


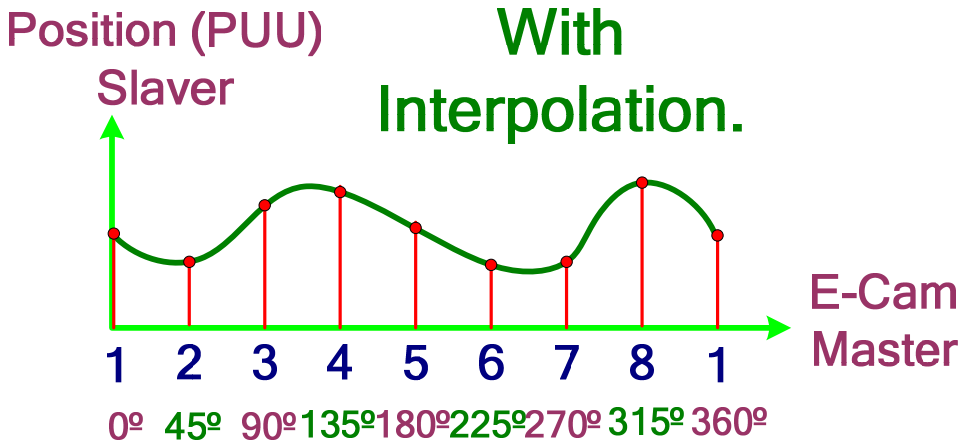


E-Cam Curve (7)

Interpolation on E-Cam Curve

ASAD-A2 employs a cubic function for interpolation. That is why limit points can form a smooth position curve for E-Cam system.

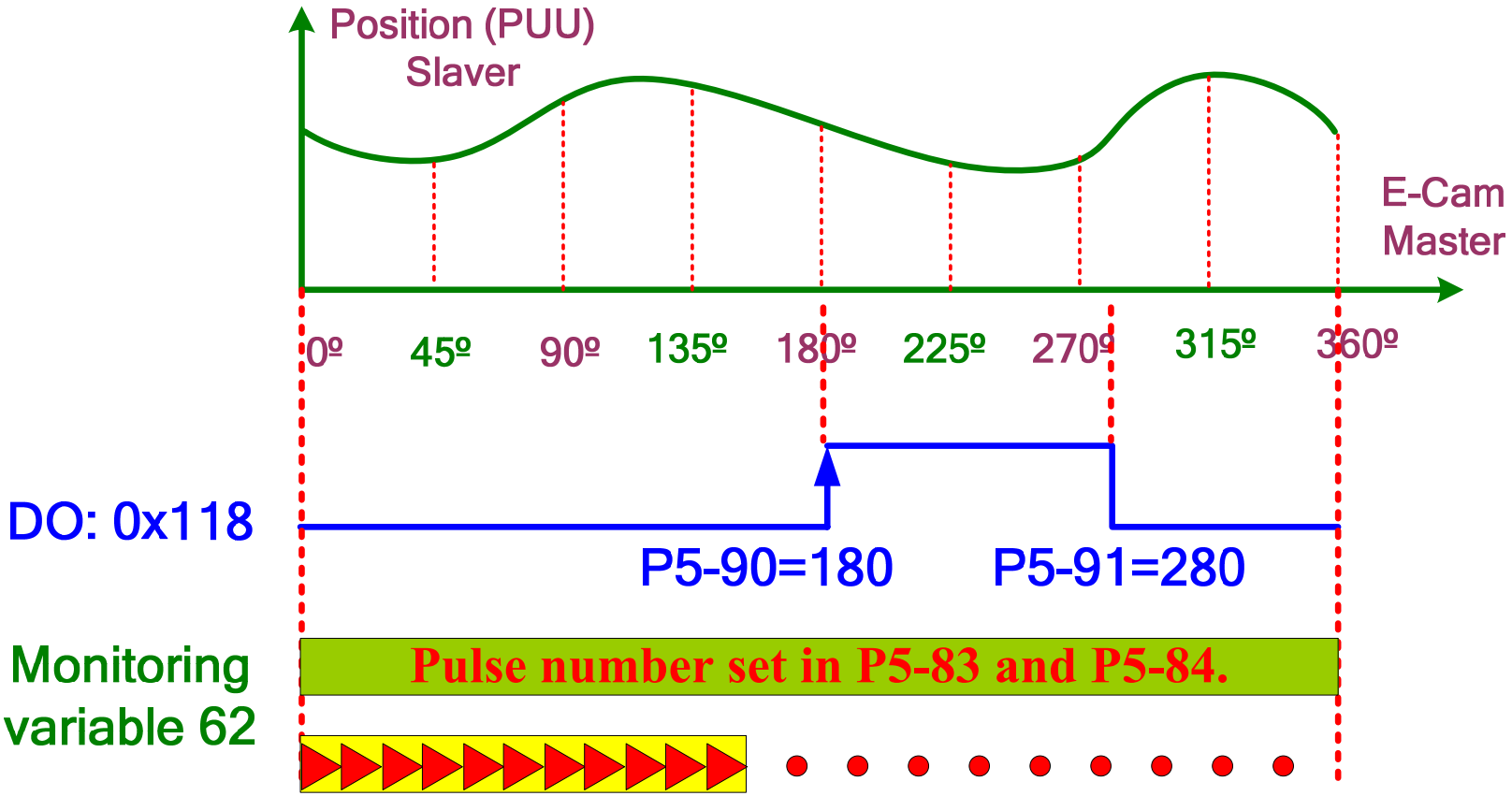




E-Cam Curve (8)

The Progressing of Master Command

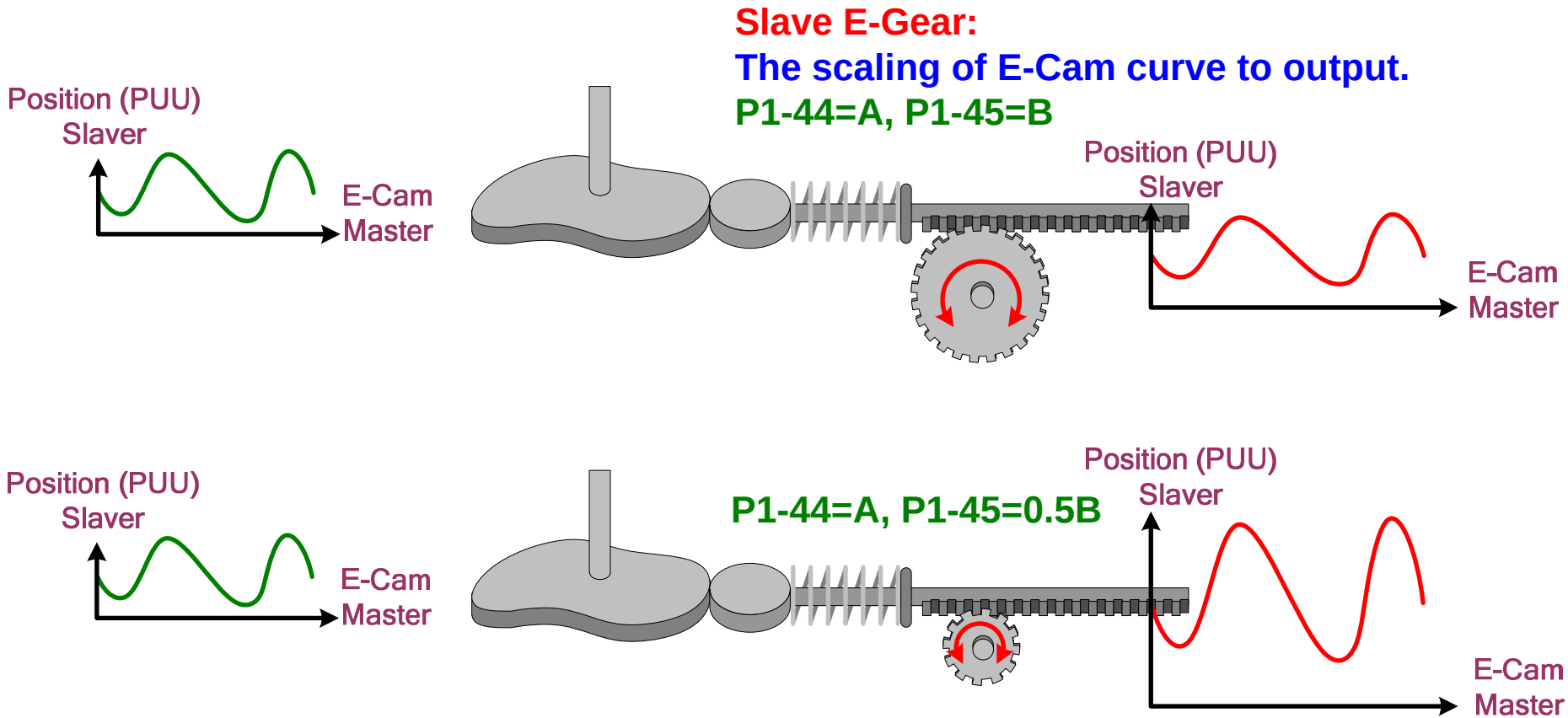
The progressing of E-Cam curve can be known by a digital output or the monitoring function code 62 (3Eh).



Slave E-Gear

The Servo E-Gear

The slave E-Gear is the same as the system E-Gear which is defined by P1-44 and P1-45. Any changes on Slave E-Gear will be kept when E-Cam disengaged, and the changed E-Gear ratio remains to be working.

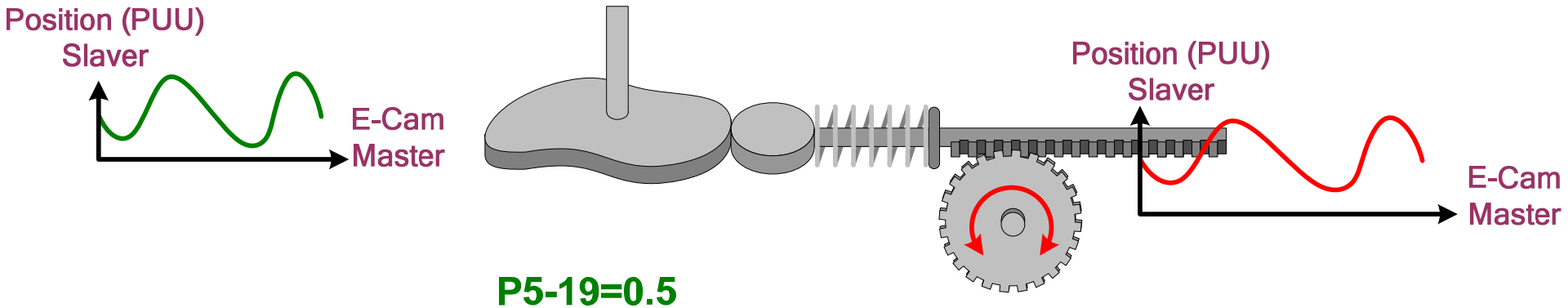


E-Cam Curve Scaling (1)

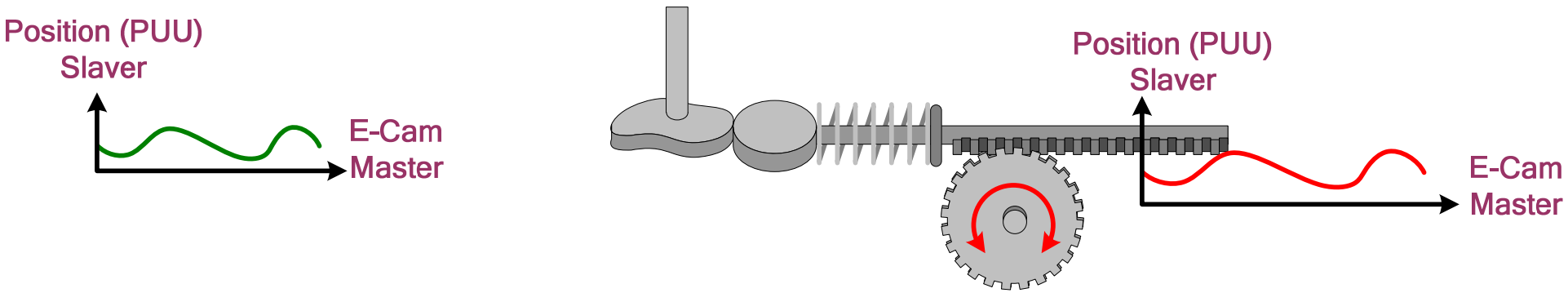
Scale the Command to Output

This parameter P5-19 will bring out the same affection as the slave E-Gear, but it is only for E-Cam system.

E-Cam Curve Scaling :
P5-19=1



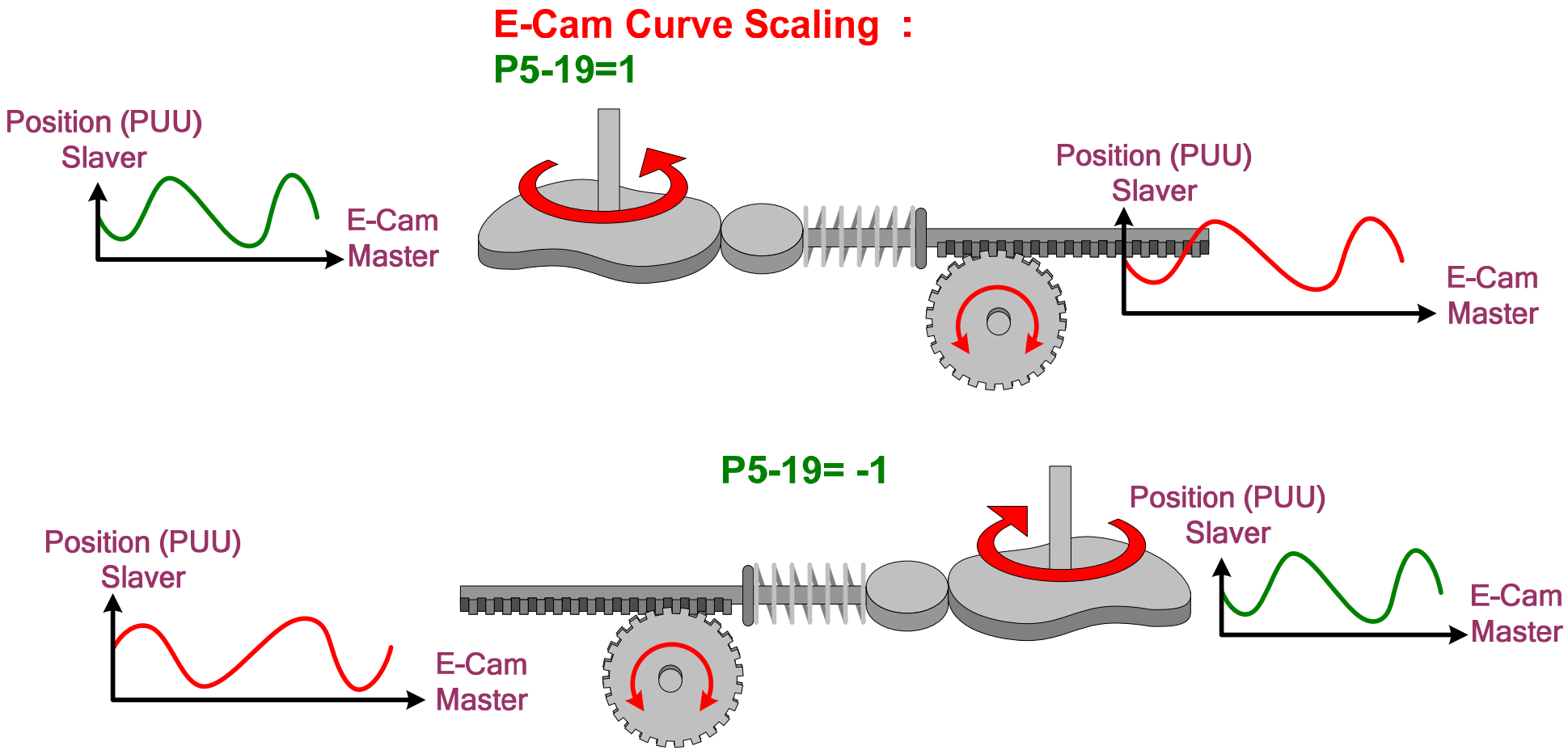
P5-19=0.5



E-Cam Curve Scaling (2)

A Negative Scaling

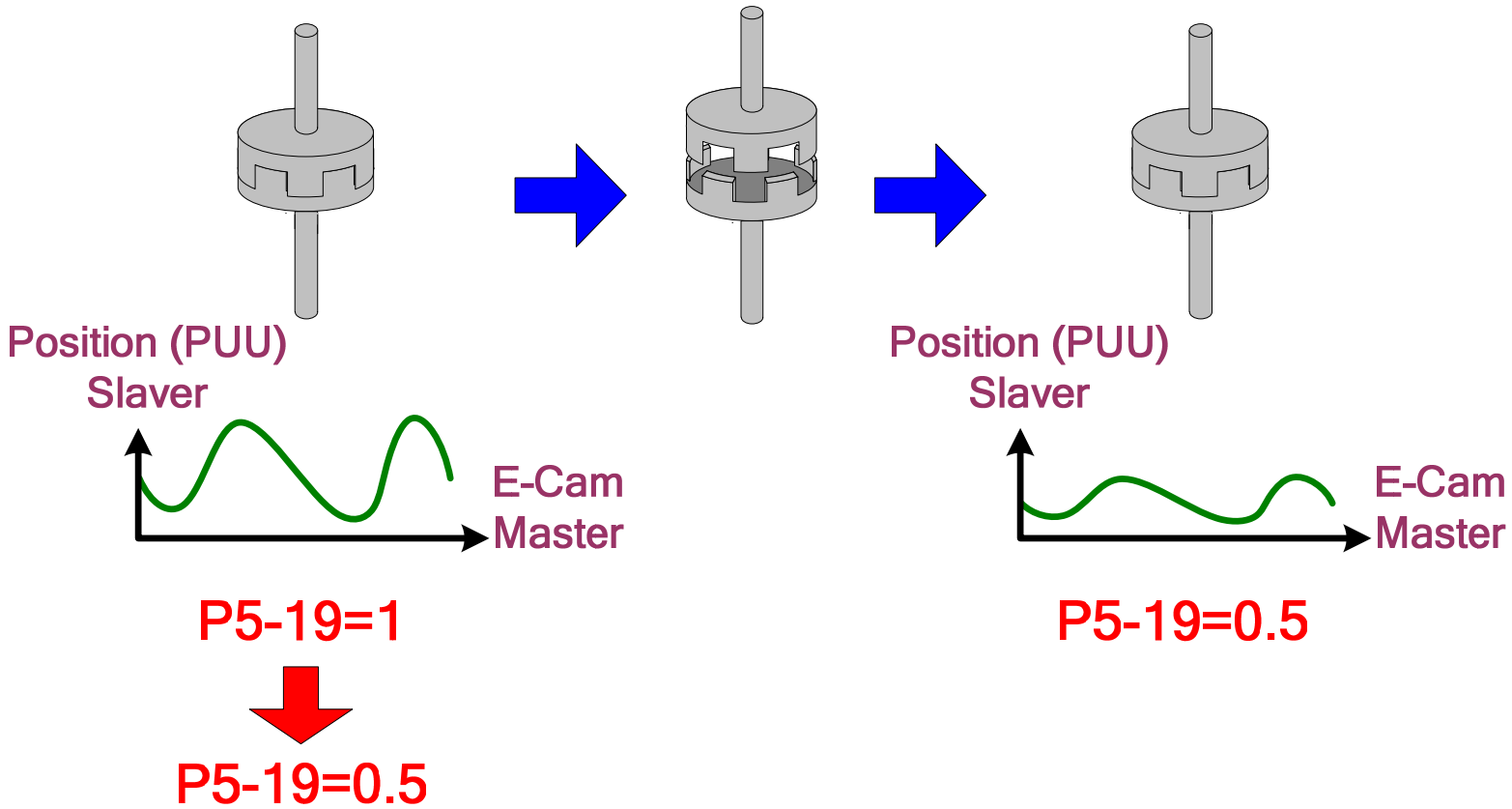
If P5-19 is set to negative, the result will have a upside down curve compared to P5-19 is a positive value.



E-Cam Curve Scaling (3)

The Range of P5-19

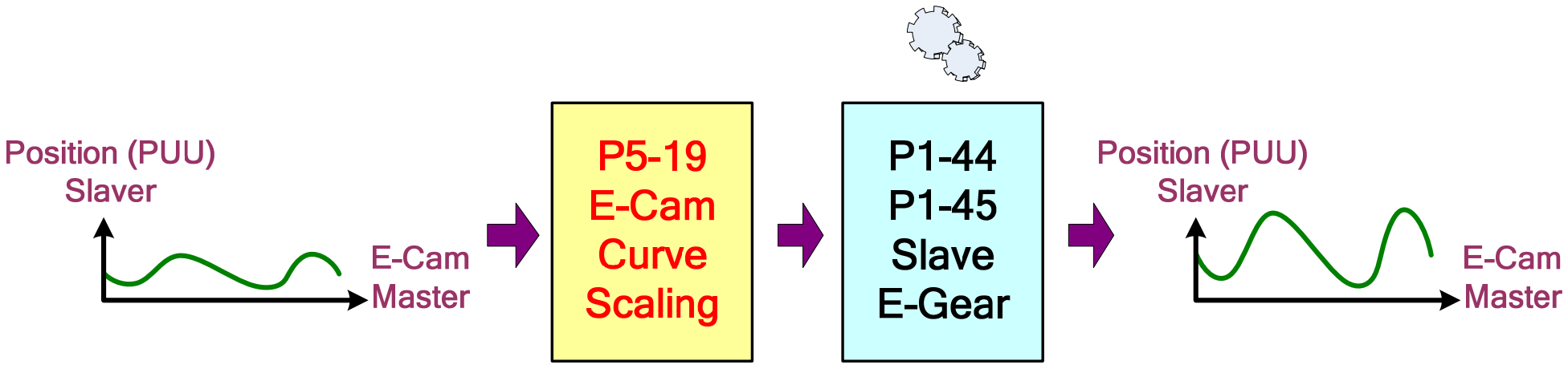
Range of P5-19 is:-2147.000000 ~ 2147.000000 with minimum scale of 0.000001. The change or P5-19 will be put into enforcement when the E-Cam re-engaged.



E-Cam Curve Scaling (4)

Curve Scaling Functions

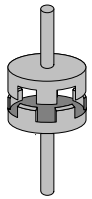
The E-Cam command (curve) goes through P5-19 and slave E-Gear.



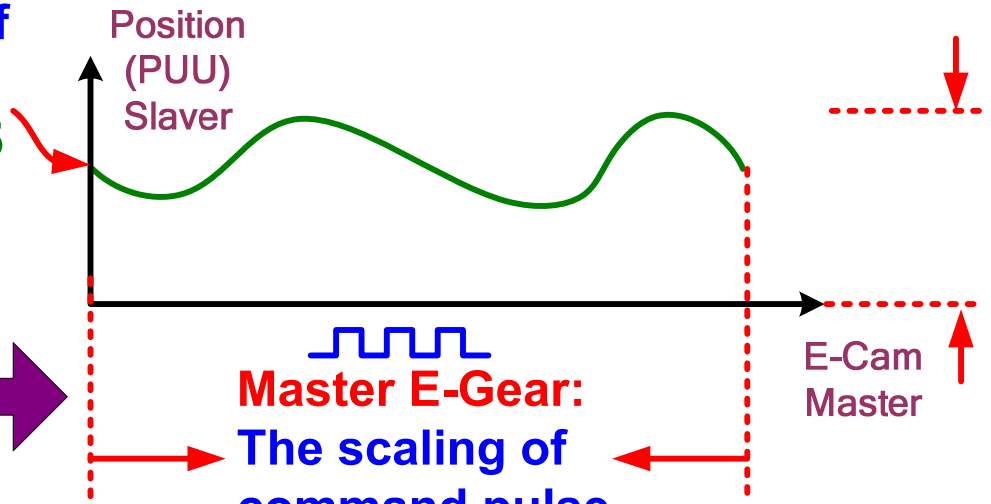
A Short Summary

The Parameters from the View of E-Cam Curve

E-Cam Curve:
The E-Cam function defines the relationship of master and slave.
P5-81,P5-82,P5-85



Clutch:
Control the timing that slave starts to follow master.
P5-88.UZ, P5-87,P5-92, P5-89



Slave E-Gear:
The scaling of E-Cam curve to output.
P1-44, P1-45
P5-19

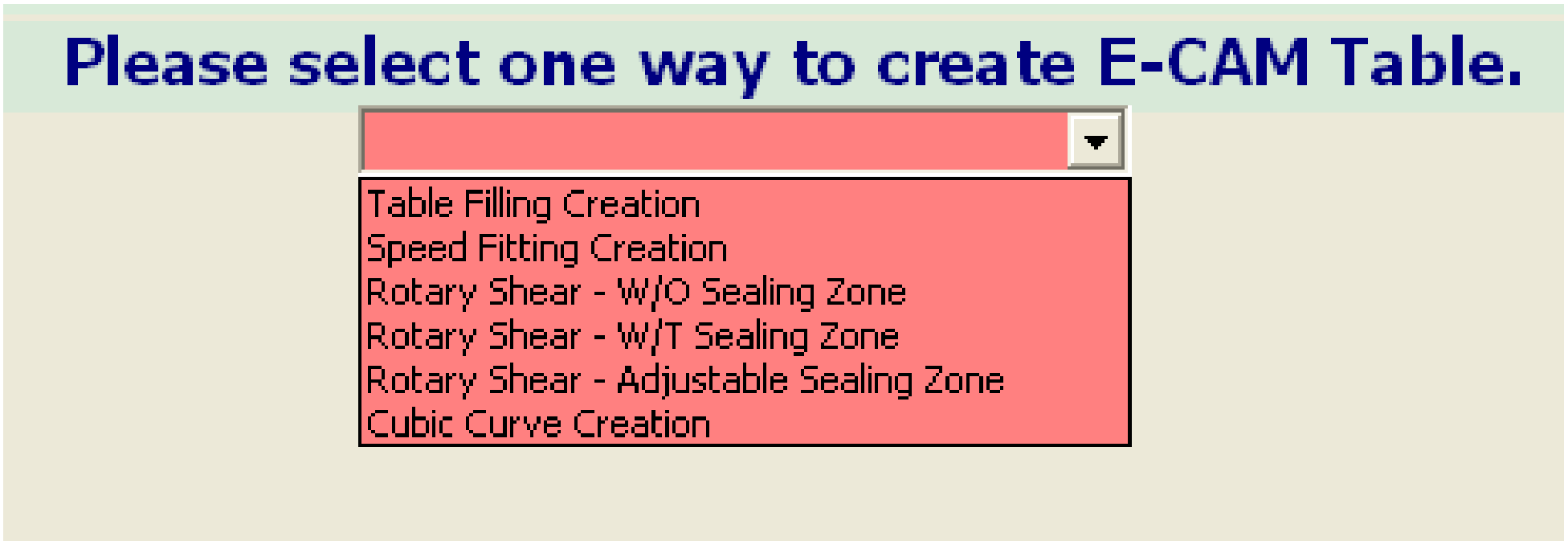
Master Axis:
Sources of main axis
P5-88.Y

Master E-Gear:
The scaling of command pulse.
P5-83, P5-84

E-Cam Curve on Software (1)

Convenient Ways of Making Curve

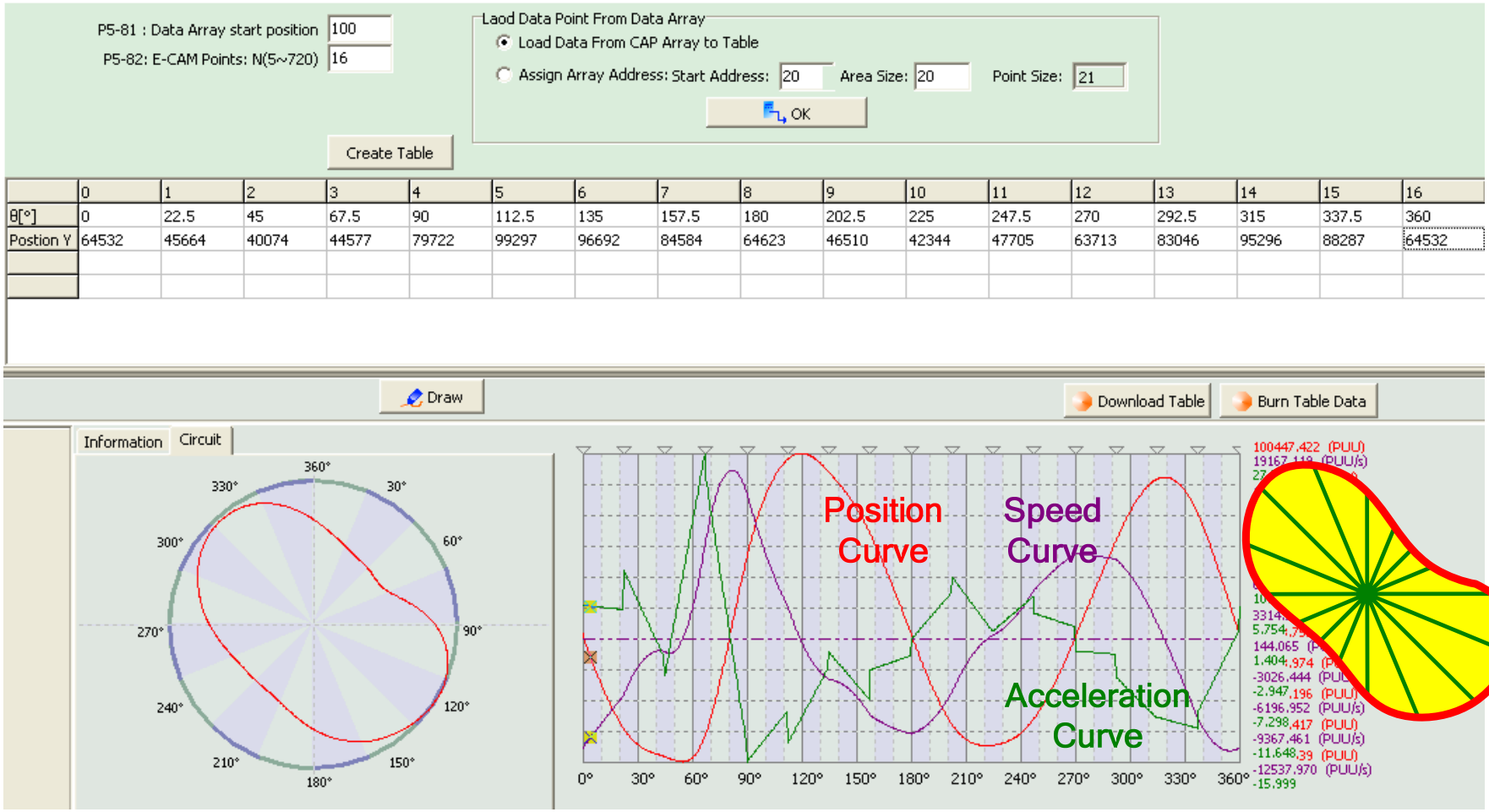
There are several ways to make E-Cam Curve with ASDA-Soft.



E-Cam Curve on Software (2)

Table Filling Creation (1)

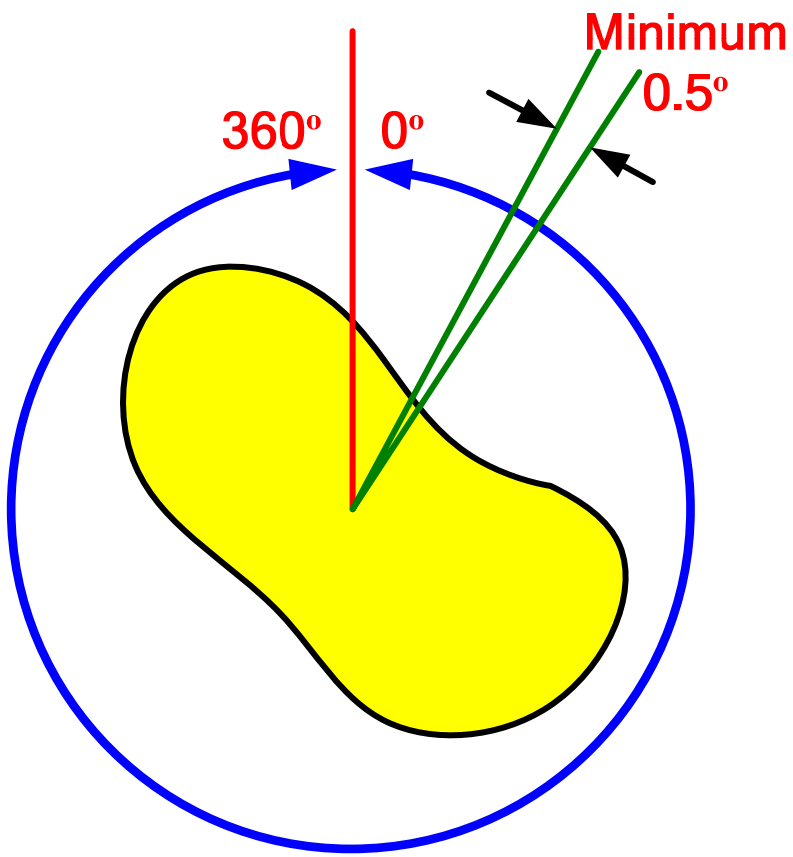
This method focuses on the position-to-position application like mechanical cam.



E-Cam Curve on Software (3)

Table Filling Creation (2)

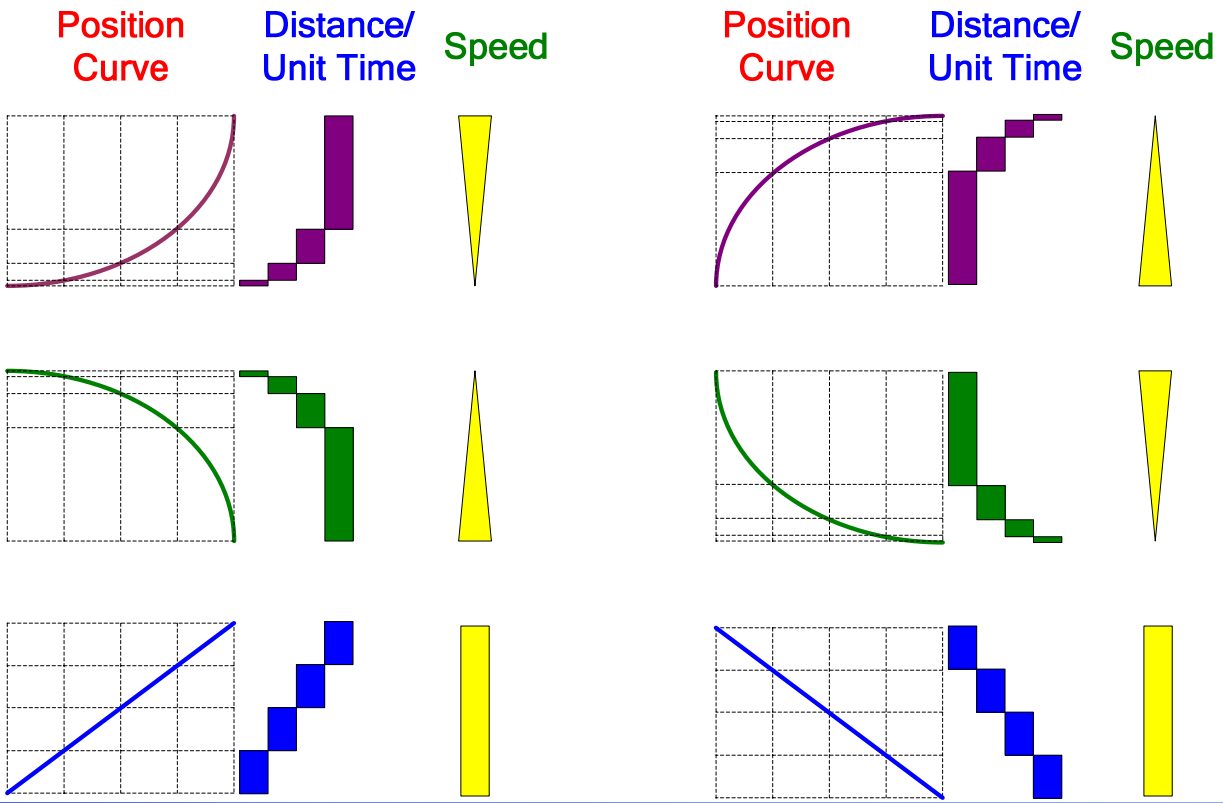
For any kinds of E-Cam curves, there 720 divisions (721 points) are the maximum possible. The minimum resolution is 0.5 degree with equal division of 360^{o} .



E-Cam Curve on Software (4)

The Relation of Position and Speed

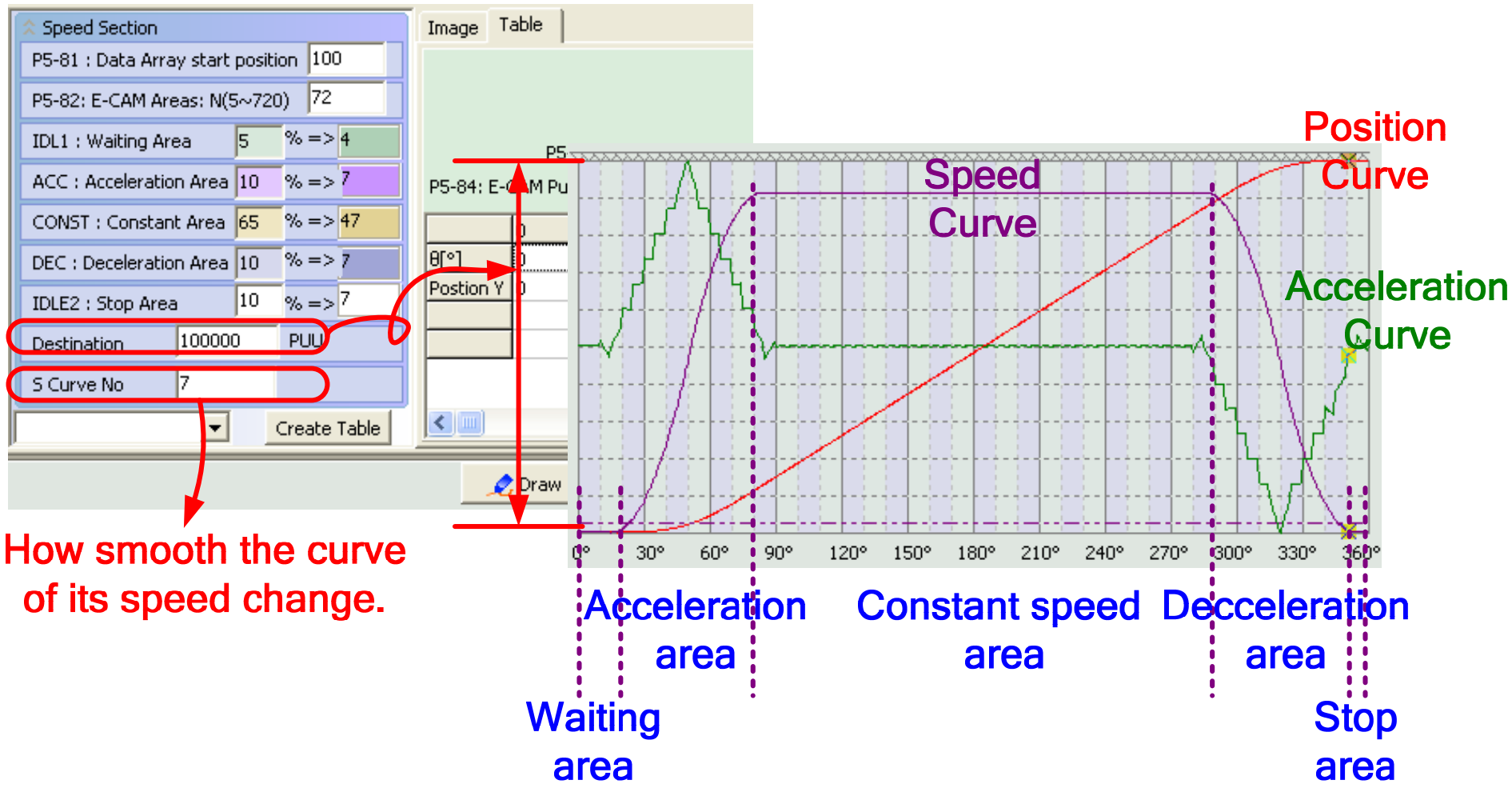
The speed is derivative of its position. With the method of Table Filling Creation, the speed of motor should be always kept in mind for avoiding abrupt speed change.



E-Cam Curve on Software (5)

Speed Fitting Creation

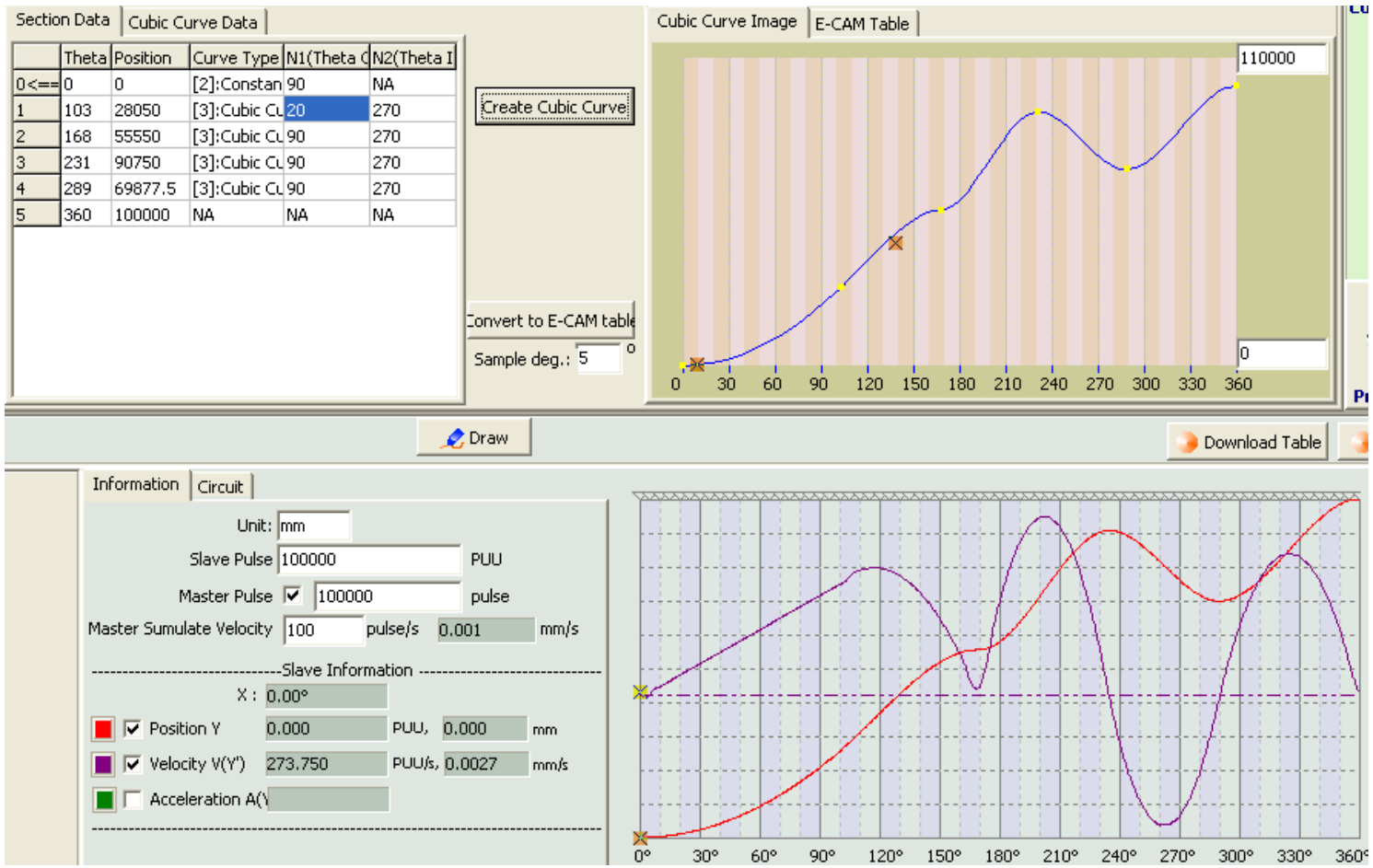
For the application the speed is the most important factor, the Speed Fitting Creation is used.



E-Cam Curve on Software (6)

Cubic Curve Creation (1)

This is a very powerful tool to make E-Cam curve whose position and speed can be well arranged.

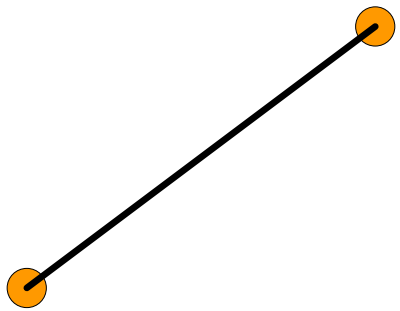


E-Cam Curve on Software (7)

Cubic Curve Creation (2)

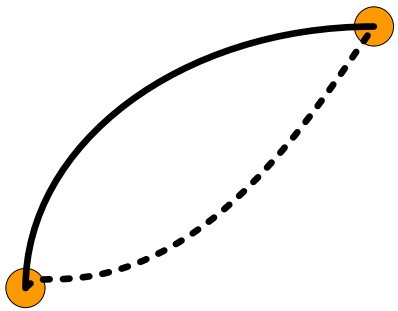
Between tow points, it could be straight line, monotonic curve, or S-curve (cubic curve).

1



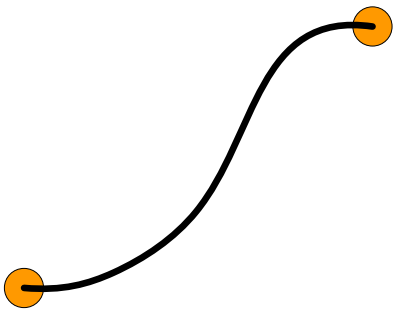
Straight Line

2



Monotonically Increasing /Decreasing Curve

3

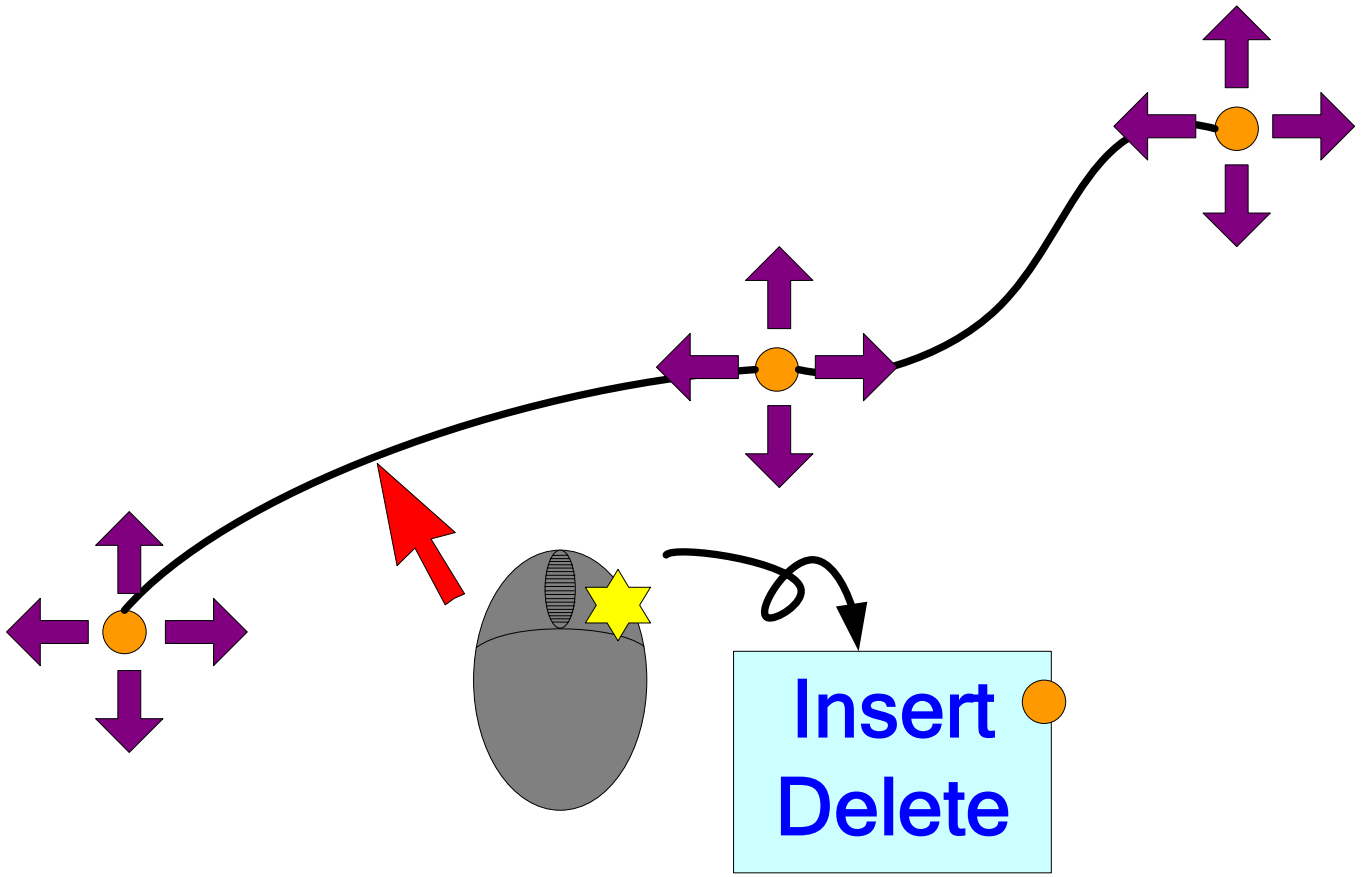


S-Curve

E-Cam Curve on Software (8)

Cubic Curve Creation (3)

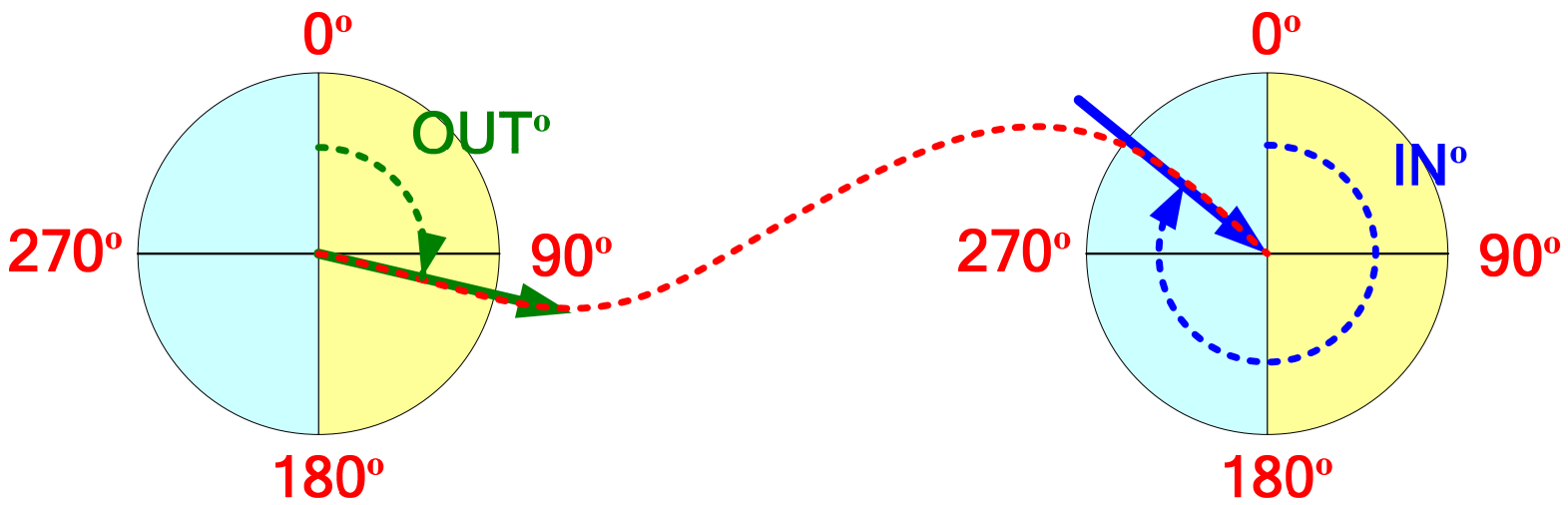
Between any two points, any number of points can be inserted. Any point can be taken out from the curve. The distance between two points is variable.



E-Cam Curve on Software (9)

Cubic Curve Creation (4)

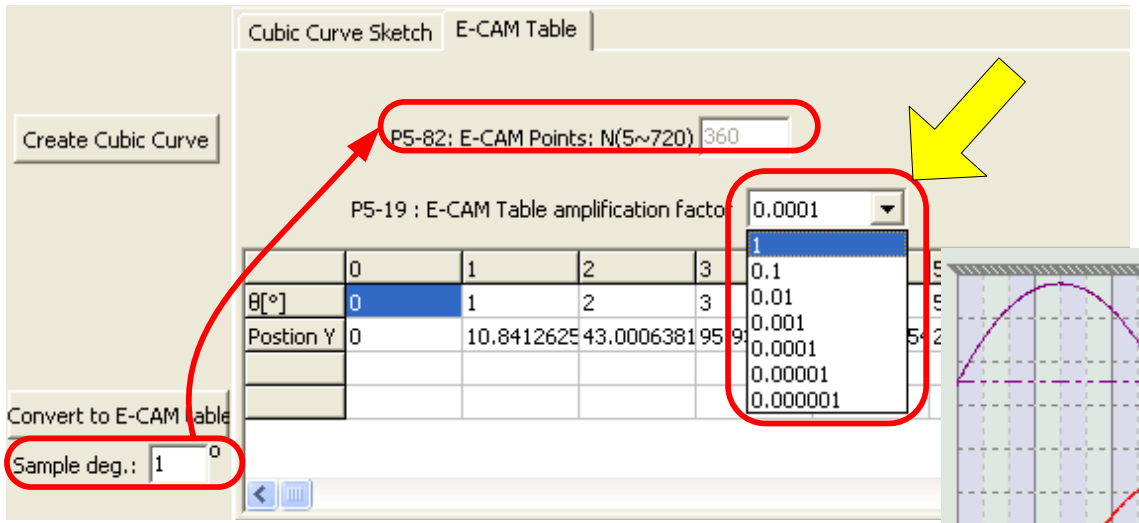
The departure and arrival angles of a S-curve curve can be defined. For the monotonic function, the departure angle can be assigned. To test the angles of departure and arrival for a smooth running speed is a necessary procedure of making E-Cam curve.

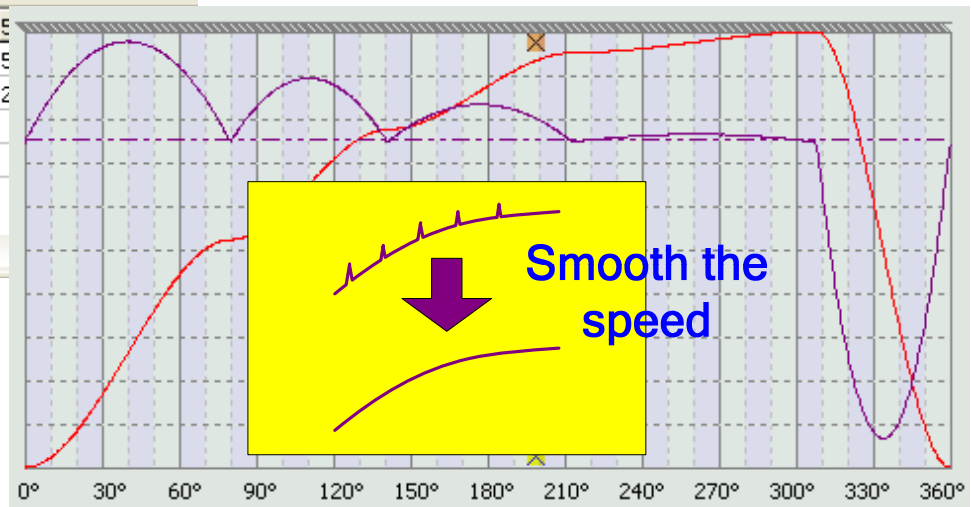


E-Cam Curve on Software (10)

Cubic Curve Creation (5)

When the sampling rate is set to 1 to have a more accurate curve, it could have a small speed vibration because of derivative from position to speed. The slave E-Gear can be used for taking more digits of fraction to conquer this problem.



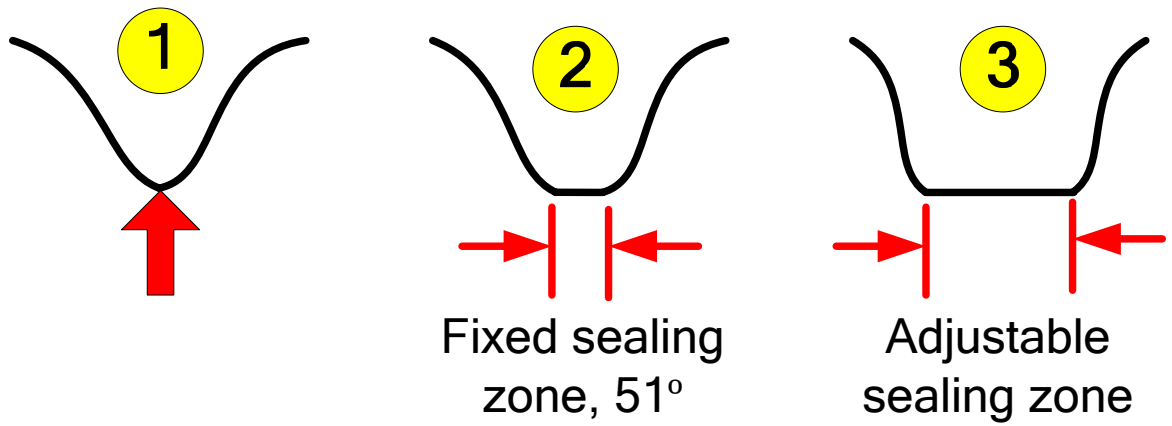


E-Cam Curve on Software (11)

Rotary Shear

There are many rotary shear curves offered on ASDA-A2. They can be generated by PC-Software or by Servo Drive with macro commands.

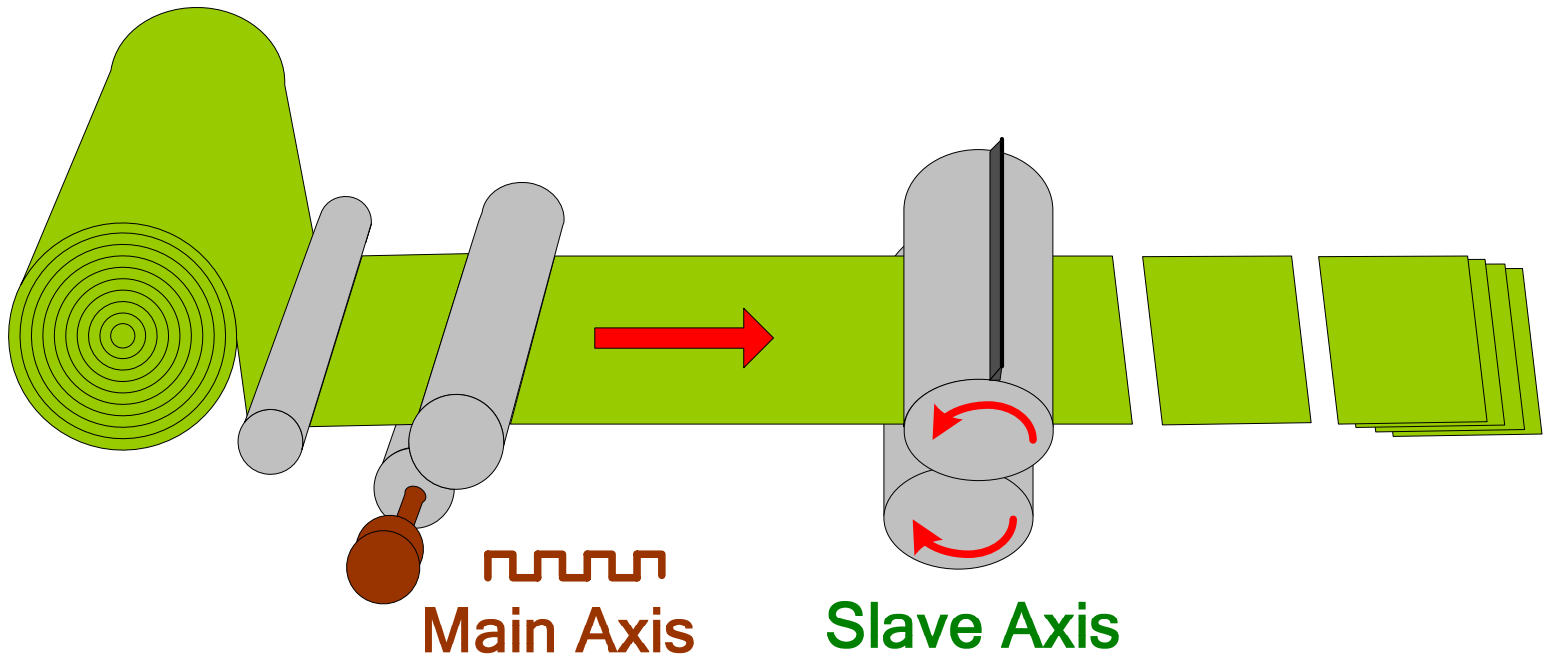
Curves of Rotary Shear		Servo Drive	PC Software
W/O Sealing Zone	1	No	✓
W/T Sealing Zone	2	✓	✓
Adjustable Sealing Zone	3	✓	✓



Introduction to Rotary Shear (1)

Cut Without Stop

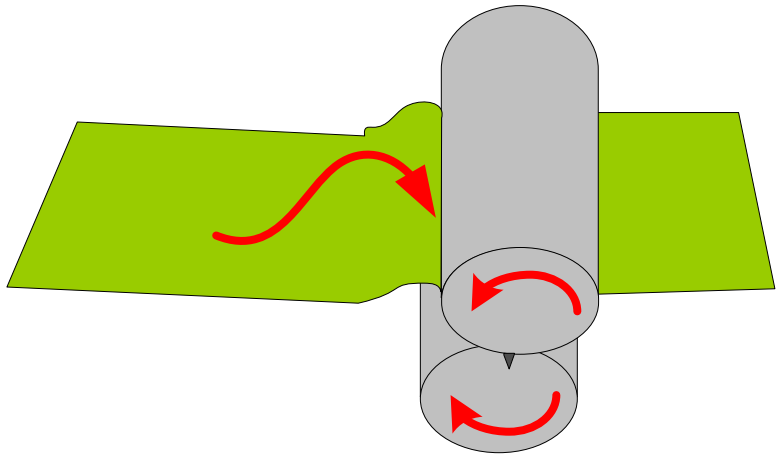
The rotary shear will cut material without stop at the cutting moment. The RELATIVE ZERO SPEED is important while cutting, and the CUTTING LENGTH is point as well.



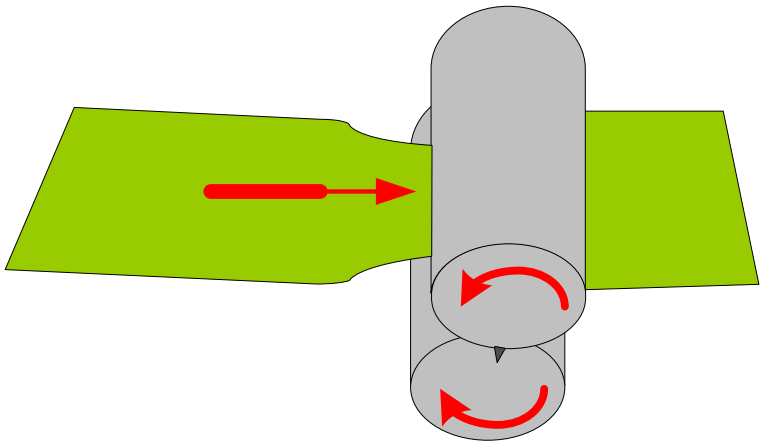
Introduction to Rotary Shear (2)

Why Relative Zero Speed?

The relative zero speed is a secret of smooth cut.



Fast Material

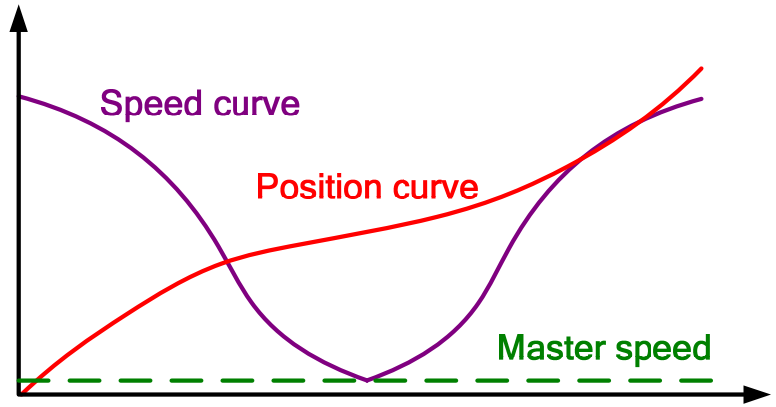


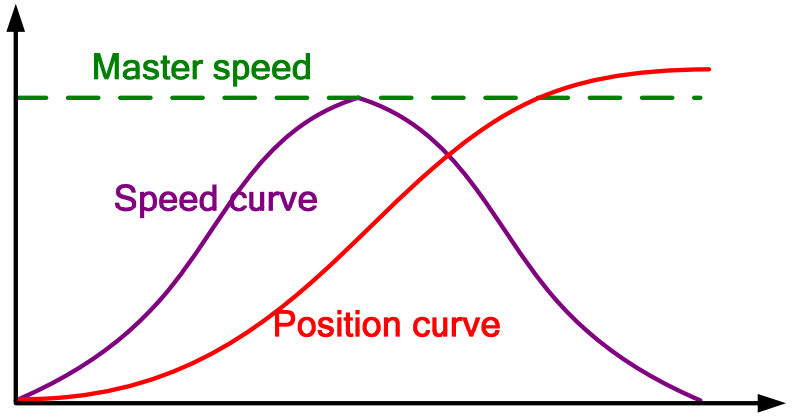
Slow Material

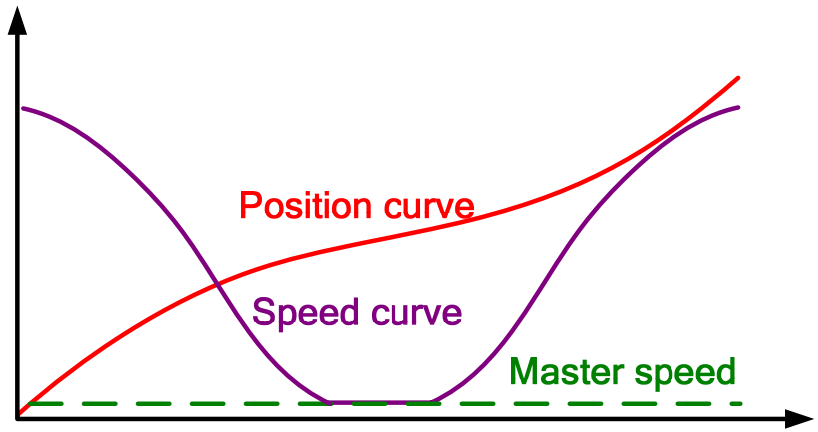
Introduction to Rotary Shear (3)

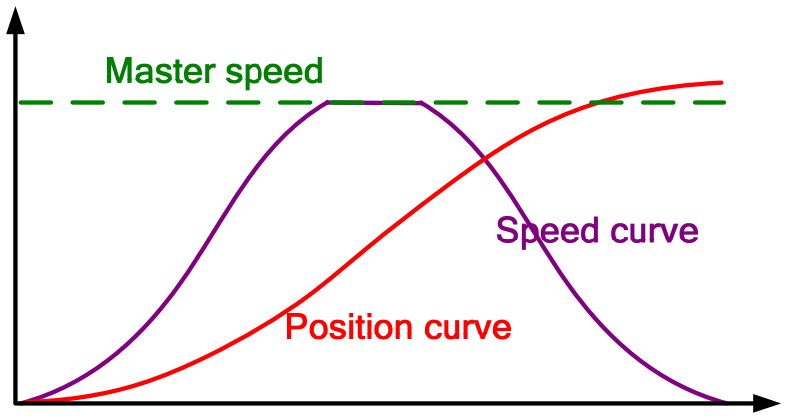
The Curves of Rotary Shear

The curves with sealing zone and without sealing zone.





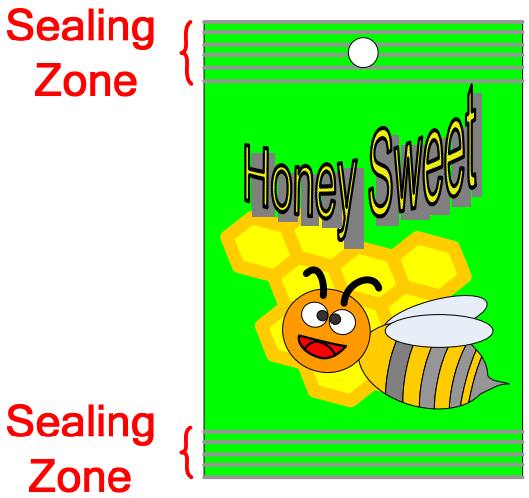


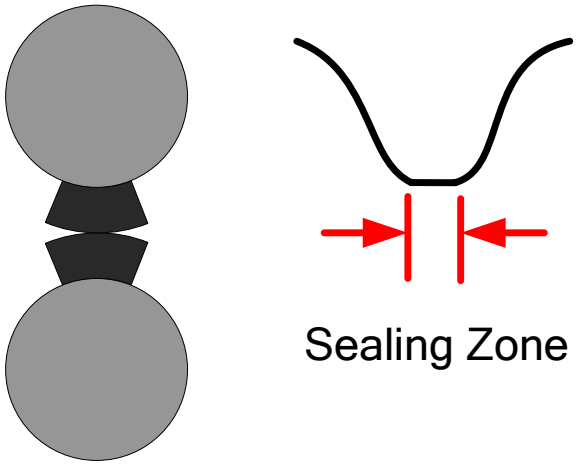


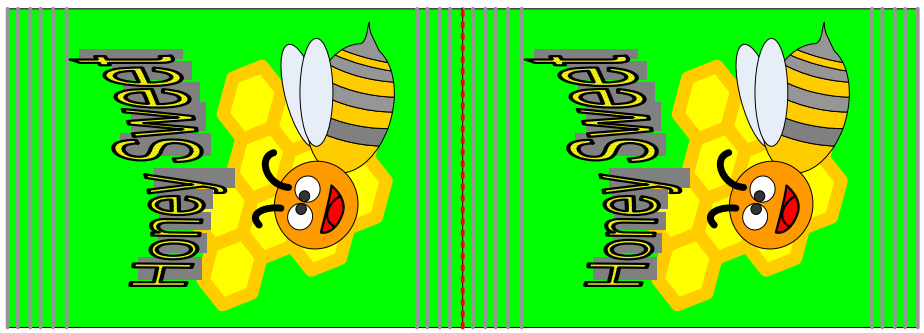
Introduction to Rotary Shear (4)

The Sealing Zone

For some packing, the sealing zones are at both of its ends. The wide cutter is needed to this kind of cutting.



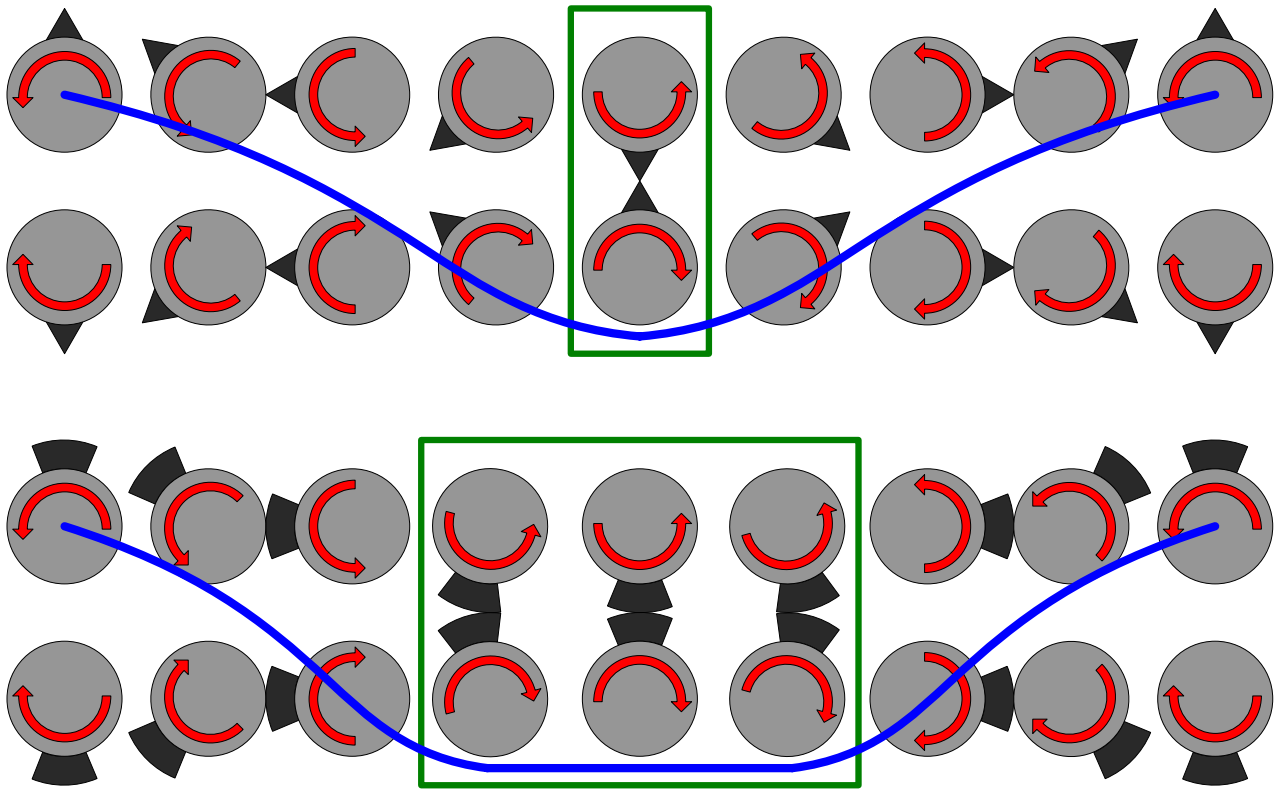




Introduction to Rotary Shear (5)

The Relation of Curve and Cutter (1)

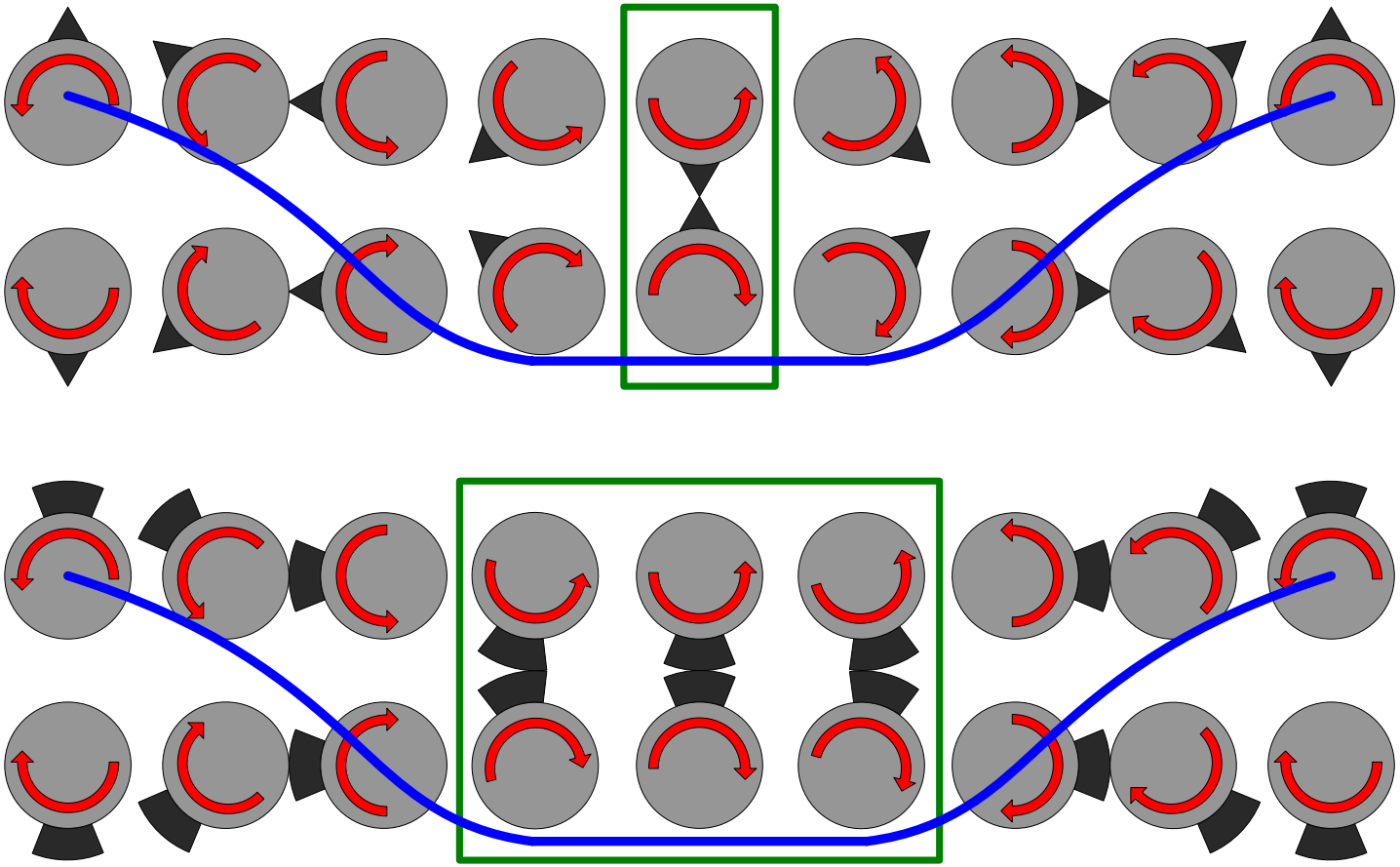
The relative zero speed zone will guarantee the smooth cut without destroying the material. This picture explains why a zero speed zone is necessary for the wide cutters.



Introduction to Rotary Shear (6)

The Relation of Curve and Cutter (2)

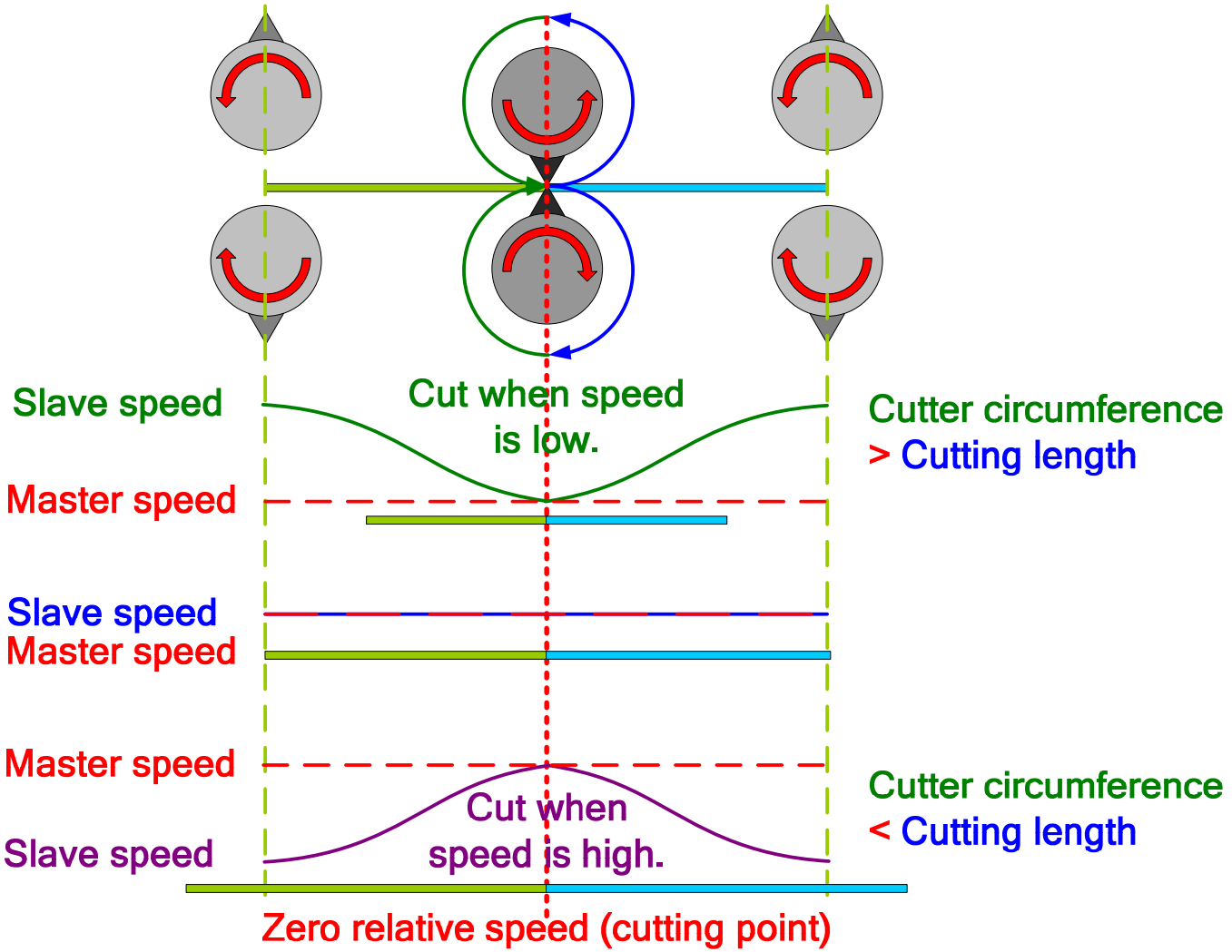
The curve with wide relative zero speed zone can be used for sharp cutter, too .



Introduction to Rotary Shear (7)

Cutter Circumference V.S. Cutting Length

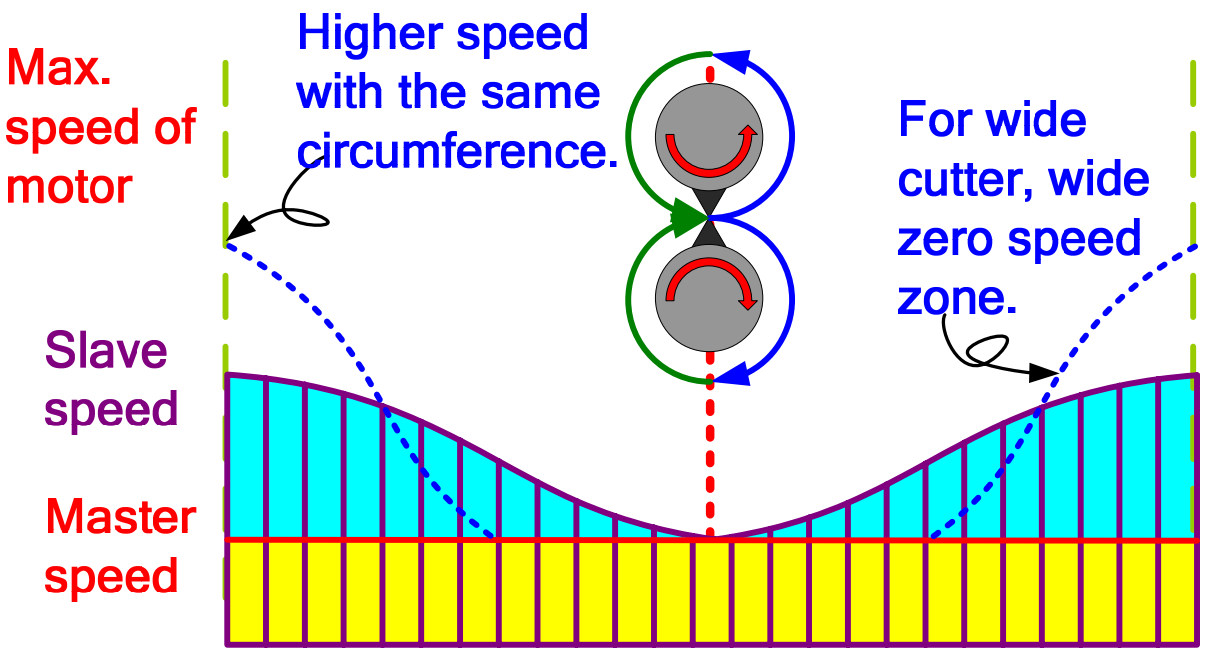
The ratio of cutter circumference and cutting length will define the slave's rotating speed.



Introduction to Rotary Shear (8)

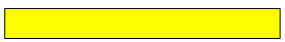
The Speed Difference

The speed difference is applied to adjust the cutting length from the theory. The winder the relative zero speed zone, the less flexible its range of cutting length.

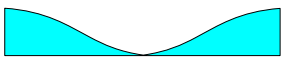


$$\int V\,dt = \text{Distance}$$

The distance of slave.
(the circumference of cutter)



The distance of master.
(the cutting length)

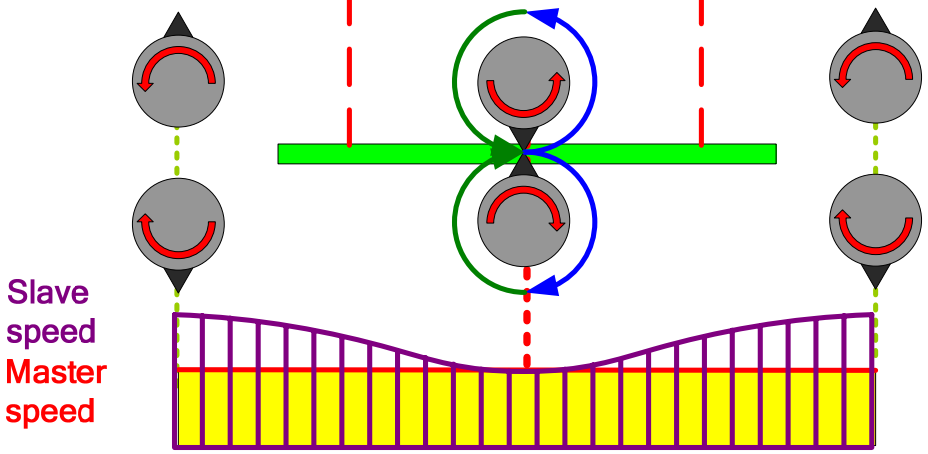


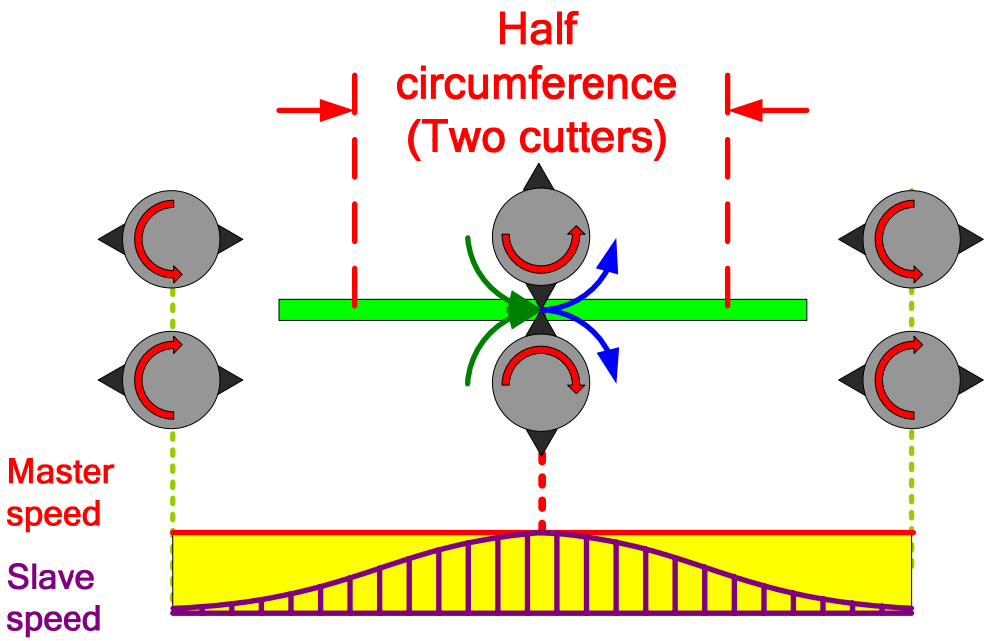
The extra traveling distance of slave.

Introduction to Rotary Shear (9)

More Cutters

The ratio of cutter circumference to cutting length will be changed when the cutters increased. More cutters, shorter cut is possible.

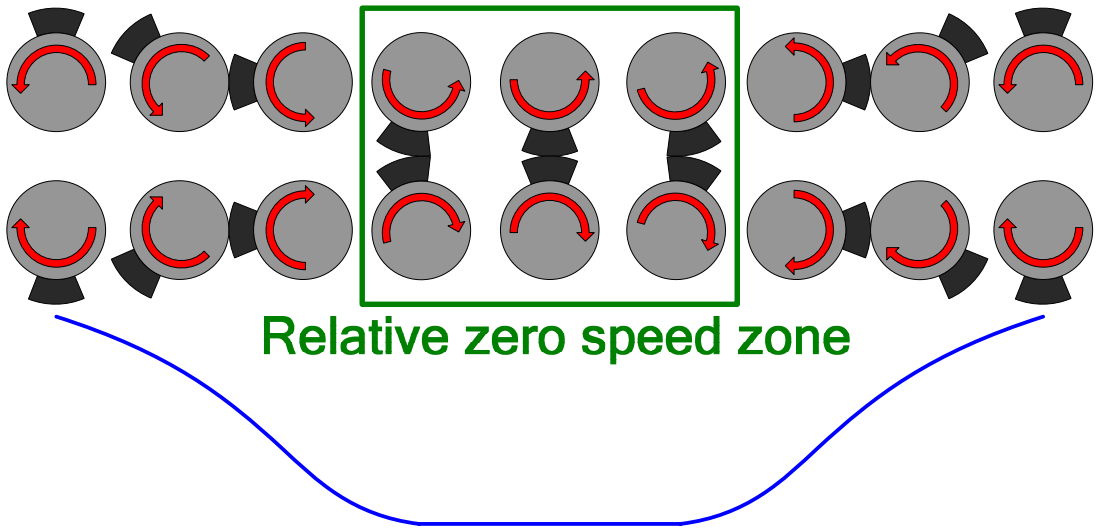




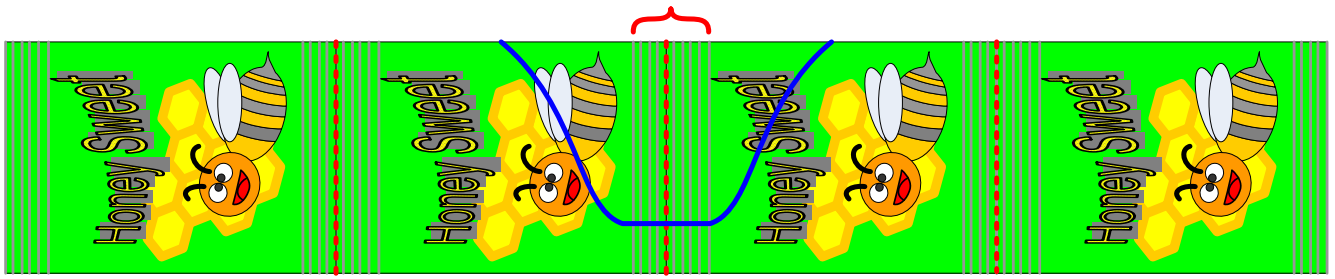
Introduction to Rotary Shear (10)

The Degree of Sealing Zone

The zone is defined from material instead of cutter.



?º (Relative zero speed zone)

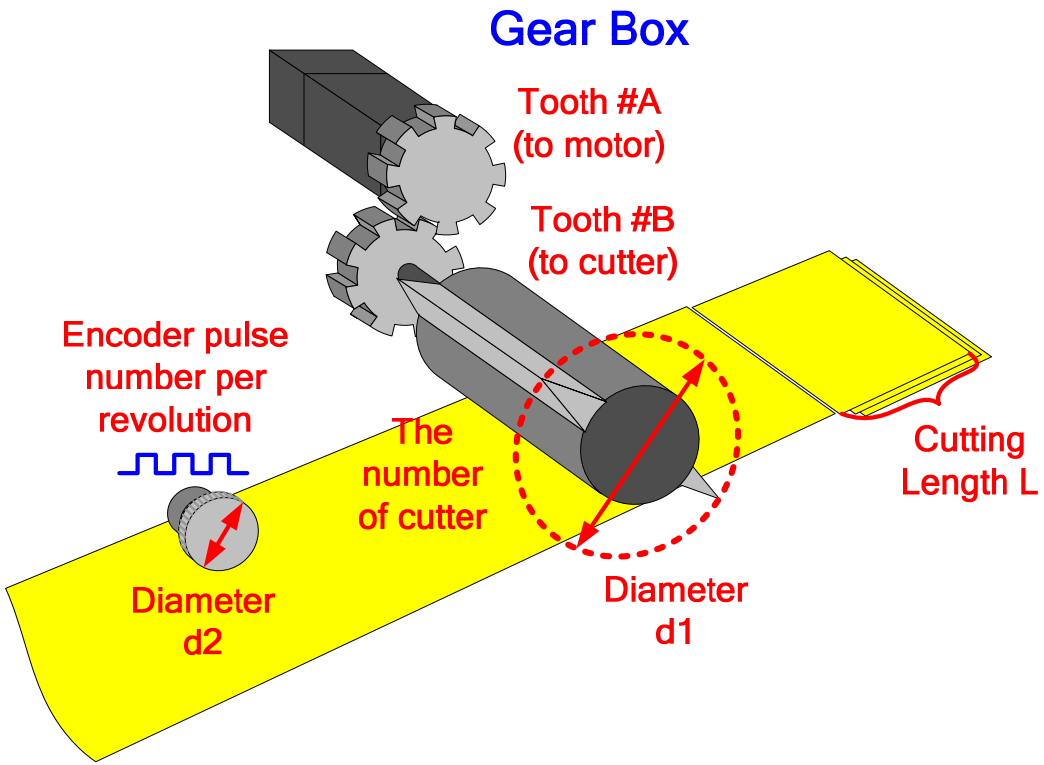


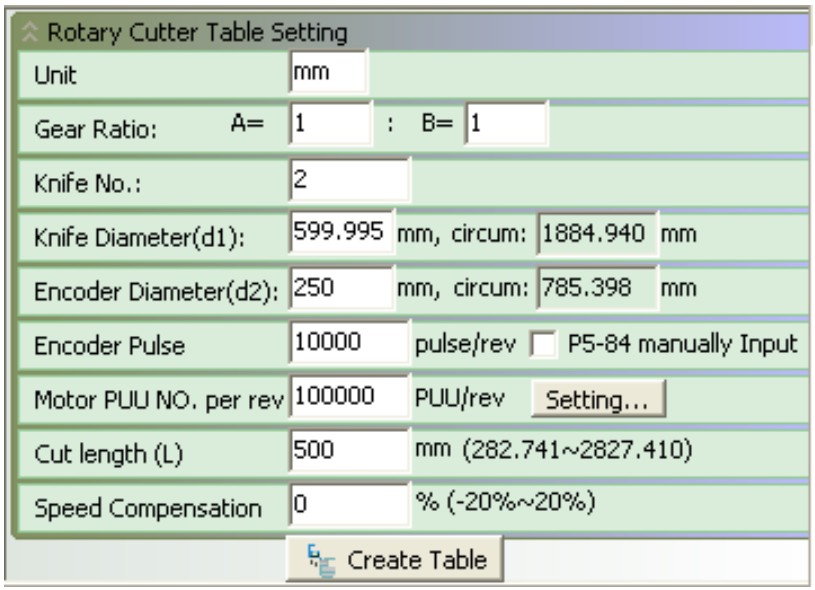
360º (One cycle of curve)

Rotary Shear Curve (1)

The Curve on PC-Software

The PC-Software is integrated curve assistant. Some mechanical specifications are needed to make rotary shear curve.

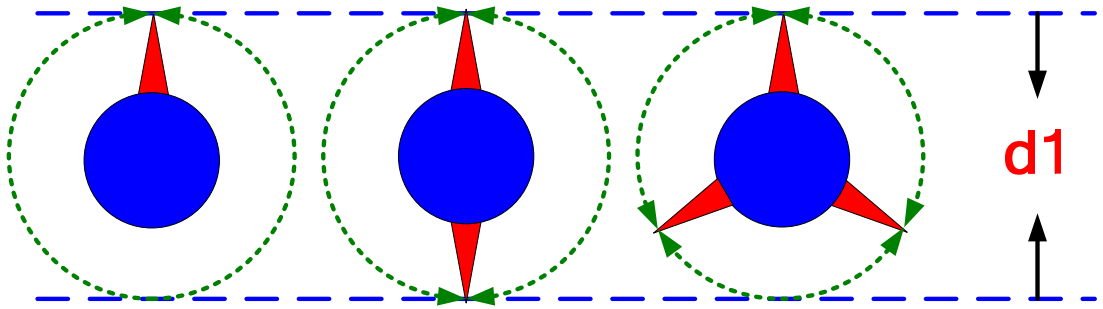


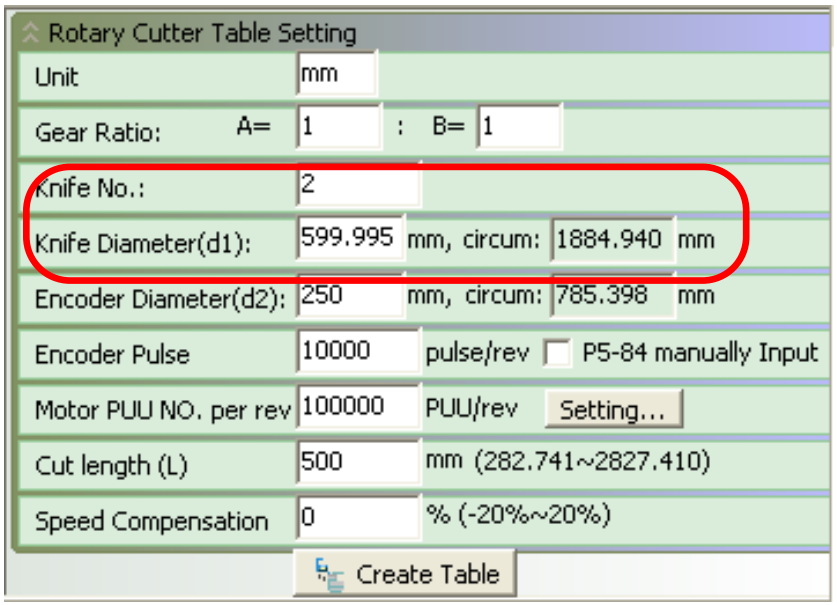


Rotary Shear Curve (2)

The Number and Diameter of Cutters

The number of cutters is flexible. All the cutters should be allocated equally to the cutter set. The “knife diameter” for from the view of its cutter tips. No matter how many cutters there are, the “knife diameter” should be the same.

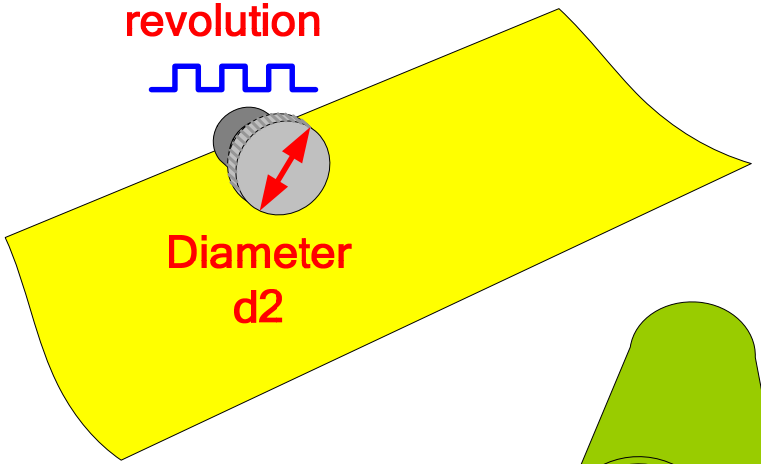


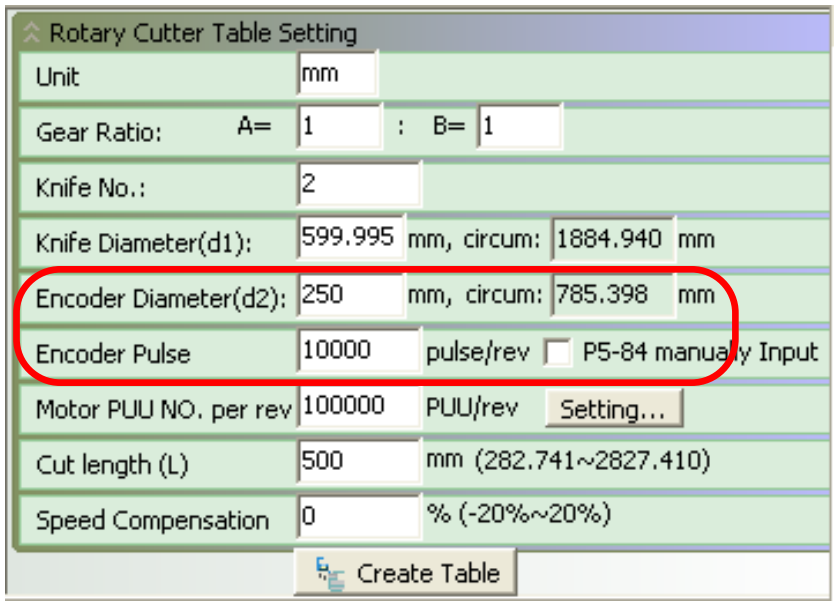


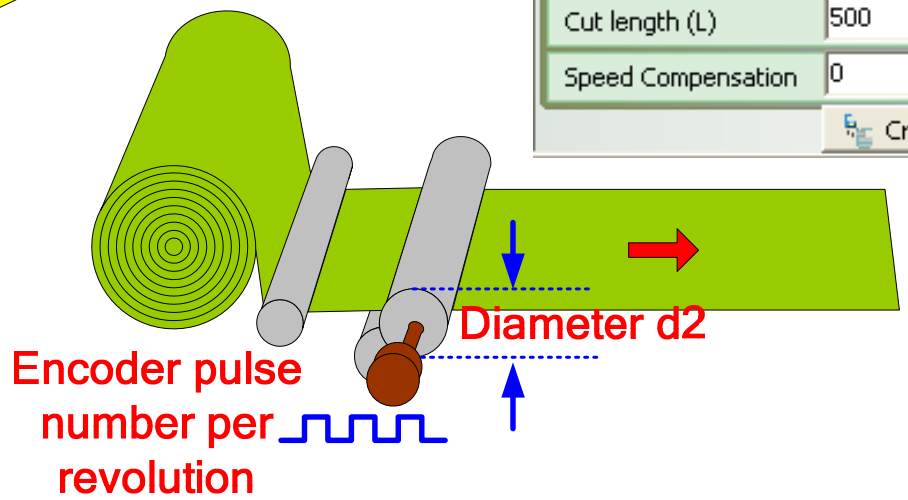
Rotary Shear Curve (3)

The Number of Pulse and Diameter of Encoder

The diameter of encoder is the mechanism whose rotating along with material fed to cutters. The resolution of an encoder should be known.



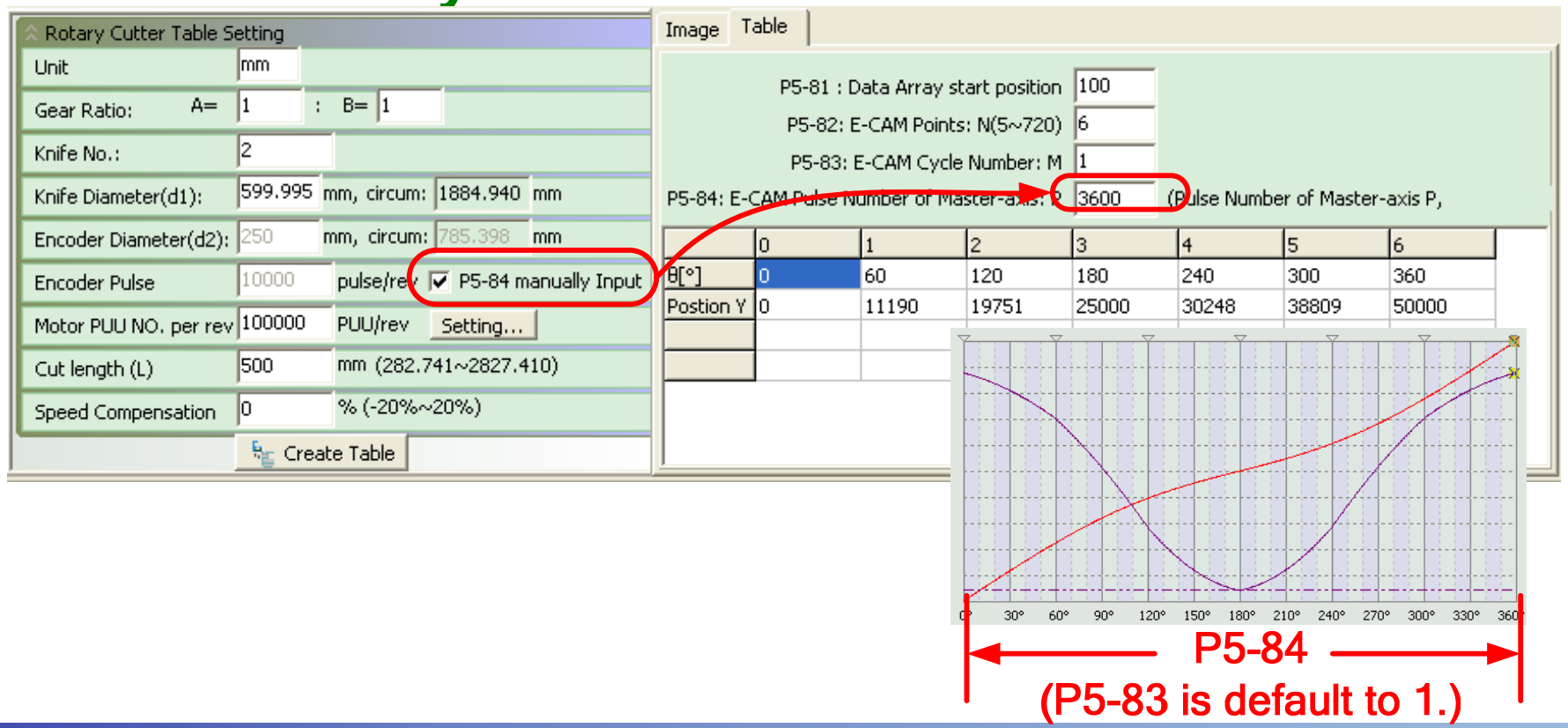




Rotary Shear Curve (4)

The Case the Number of Pulse Known

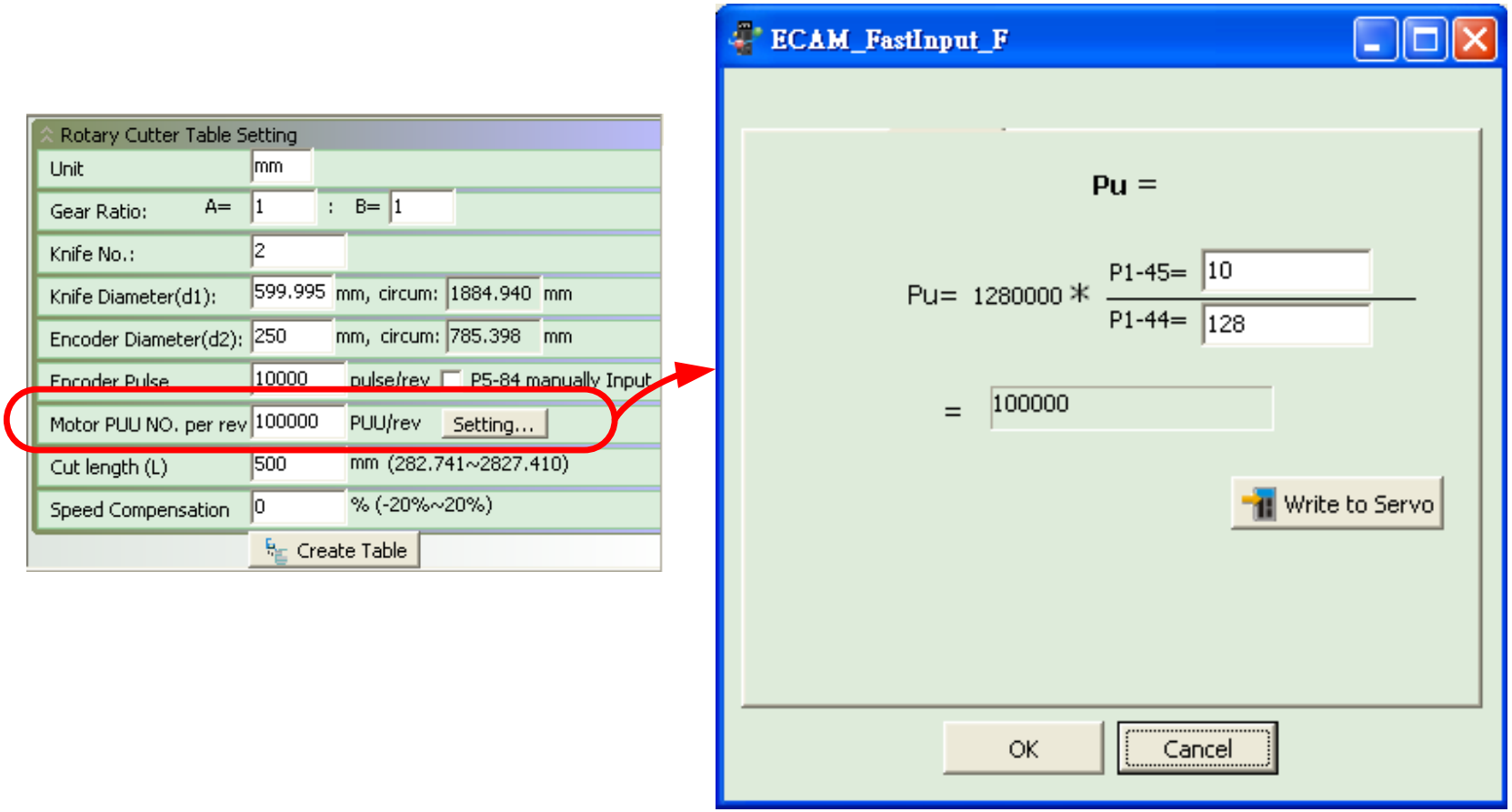
For the case the pulse number of master already known, it is not necessary to enter the encoder diameter and resolution of master. Check the box of "P5-84 manually input", and have the number of pulse in P5-84 directly.



Rotary Shear Curve (5)

The Slave E-Gear

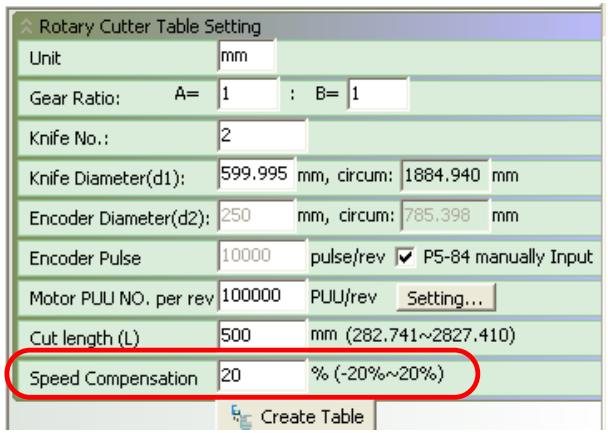
The slave E-Gear can be set.

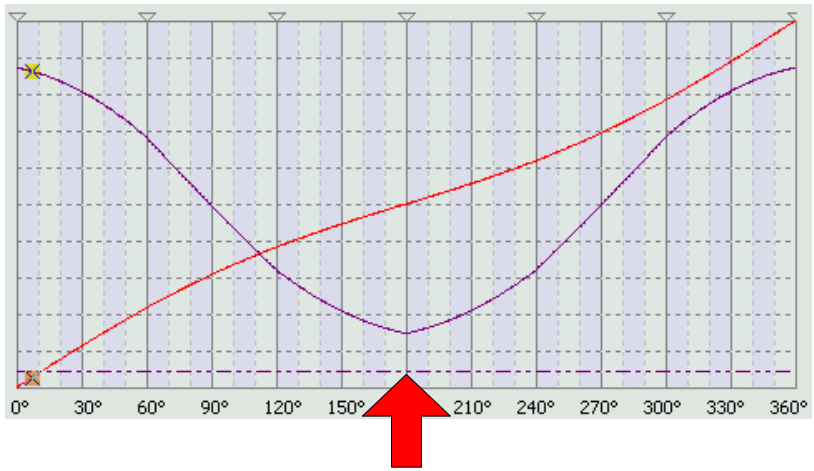


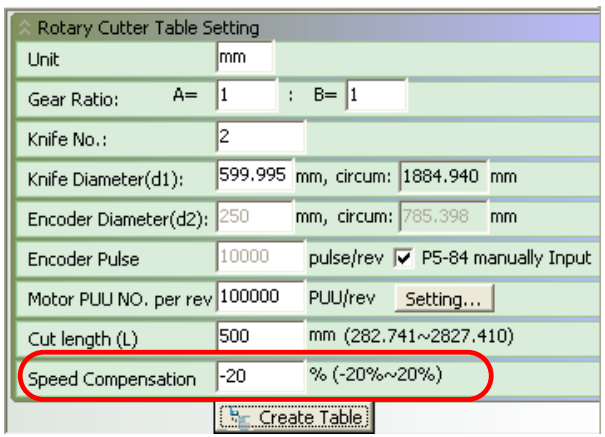
Rotary Shear Curve (6)

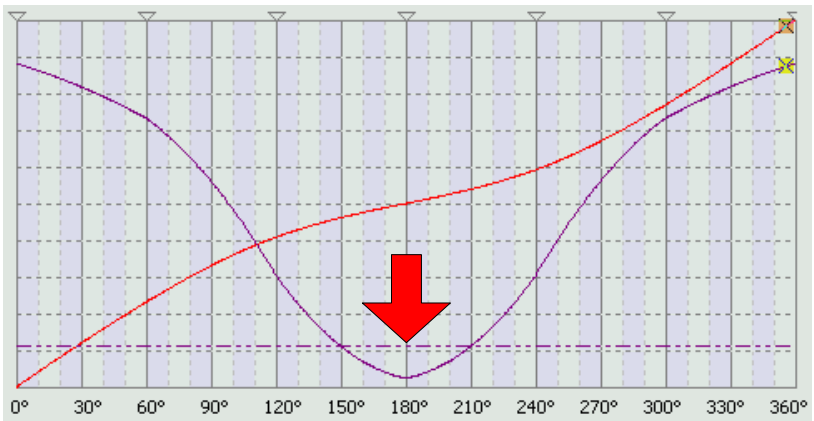
The Speed Compensation

The relative zero speed can be adjusted for certain purposes. It could be higher or lower than the master's speed.





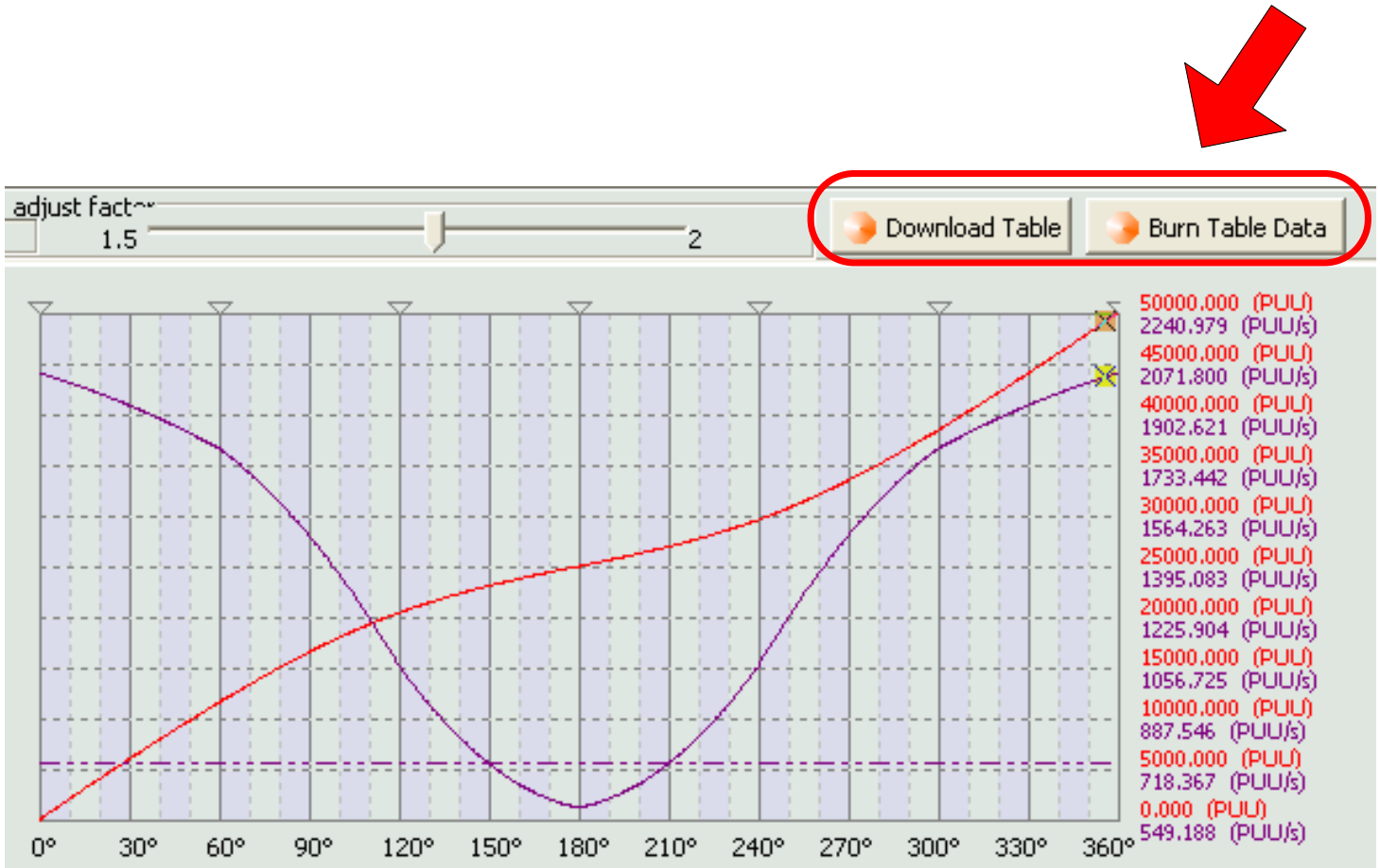




Rotary Shear Curve (7)

Download and Burn the E-Cam Curve

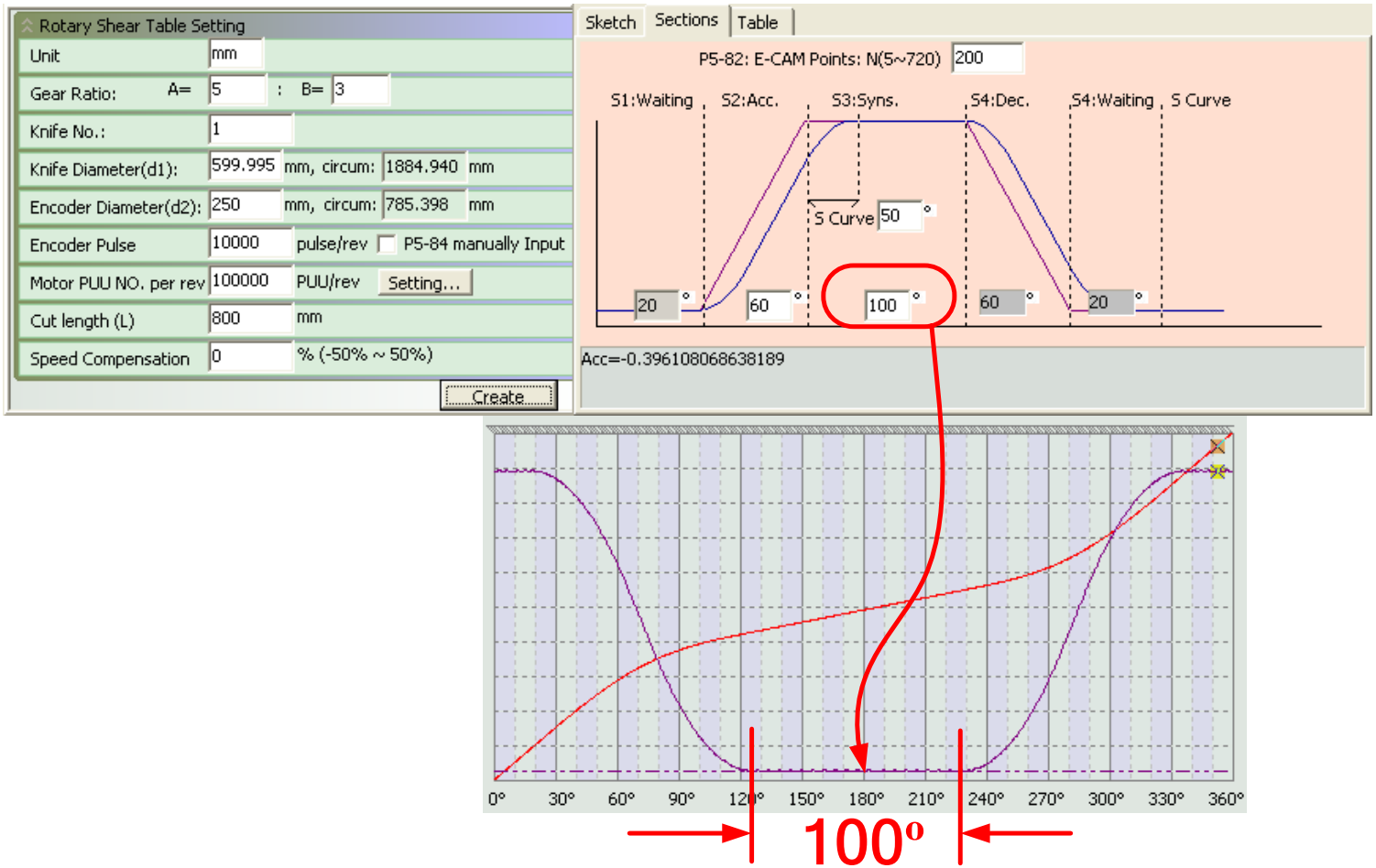
If the curve will be kept inside the drive after power off, the BURN shout be executed.



Rotary Shear Curve (9)

Curve of Adjustable Relative Zero Speed Zone

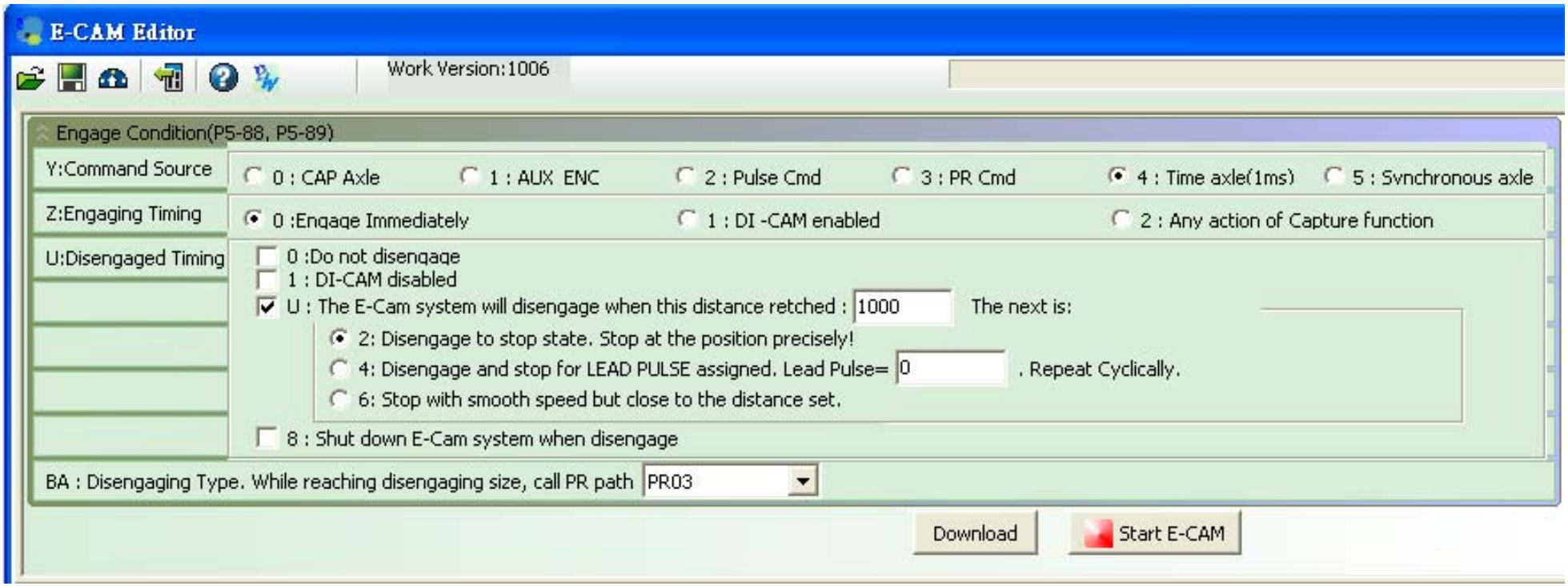
ADSA-A2 has a curve assistant of rotary shear for adjusting the width of curve for its relative zero speed zone (sealing zone).



Rotary Shear Curve (10)

Quick Way to Test E-Cam Curve

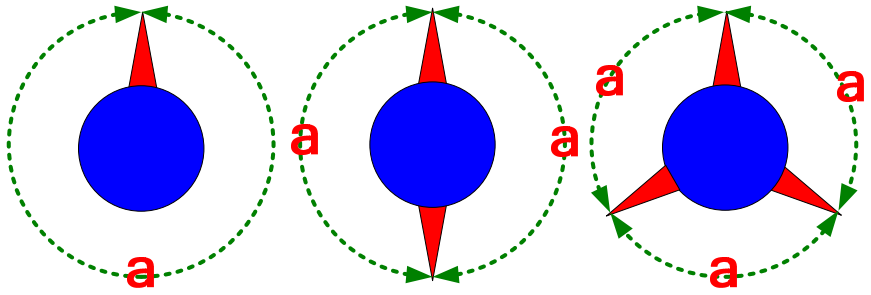
The software is built a quick E-Cam operating screen for test of your E-Cam curve. You can just set the master source to internal 1 ms clock for simulating the curve.

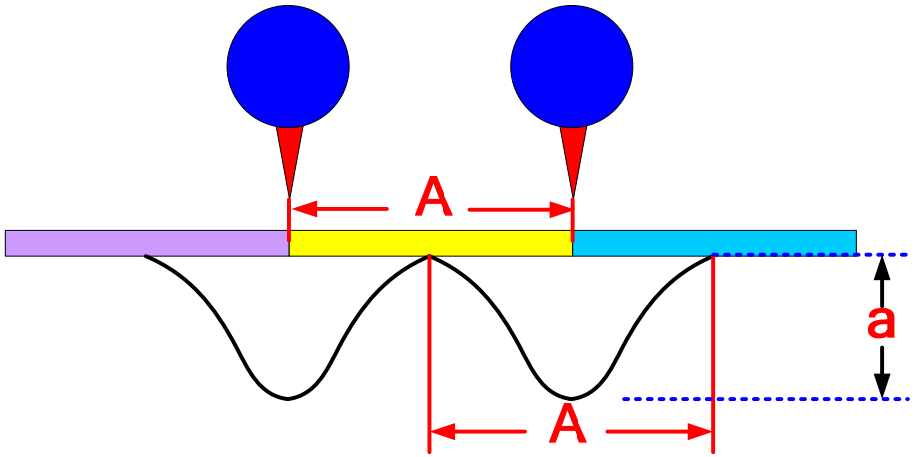


Rotary Shear Curve (11)

The Limits of Curve on PC Software

There are some limits of making rotary shear curves on ASDA-soft.





$$R\ (\text{Length Ratio}) = \frac{A}{a}$$

W/O Sealing Zone: R: 0.3~3

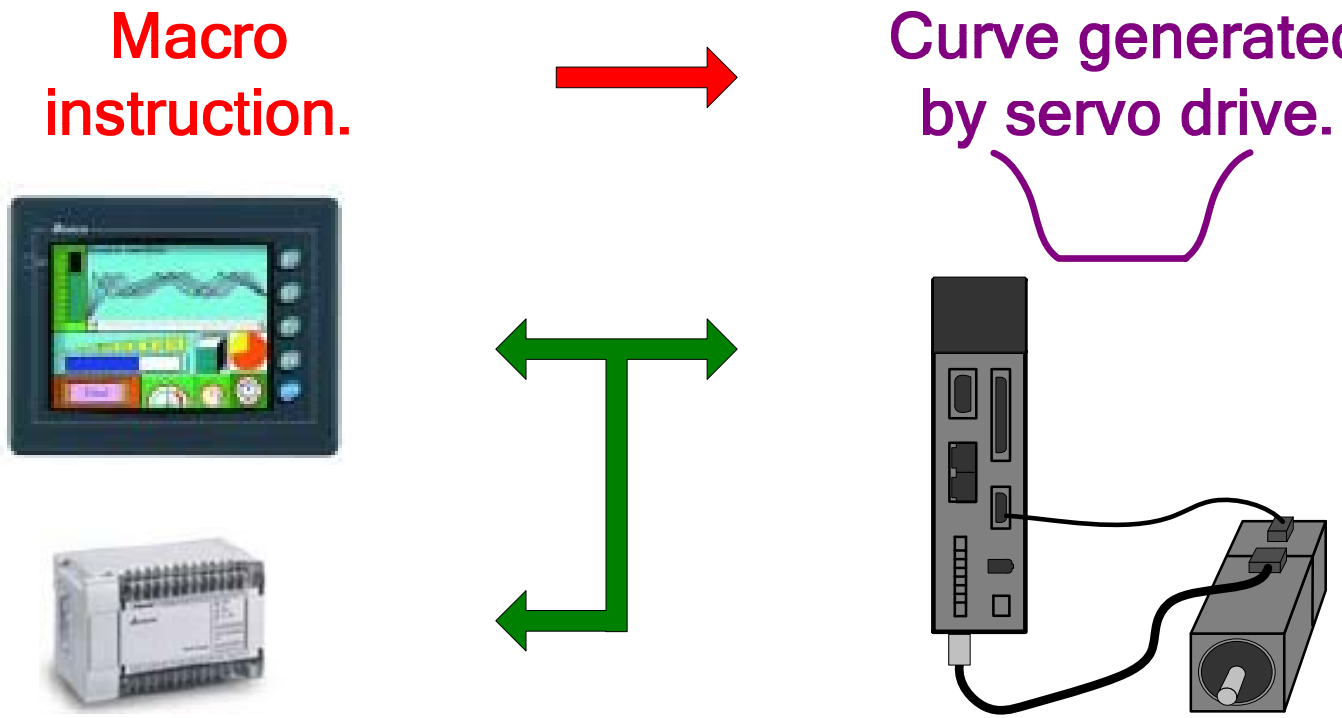
W/T Sealing Zone: R: 0.07~2.5

Adjustable Sealing Zone: 1.88 > R* Speed_compensation

Curve Made On Drive (1)

Macro Instructions

Using the macro instructions on ASDA-A2 is capable to generate E-Cam curve for rotary shear. This features is designed for the convenience of applications whose cutting lengths changing frequently.

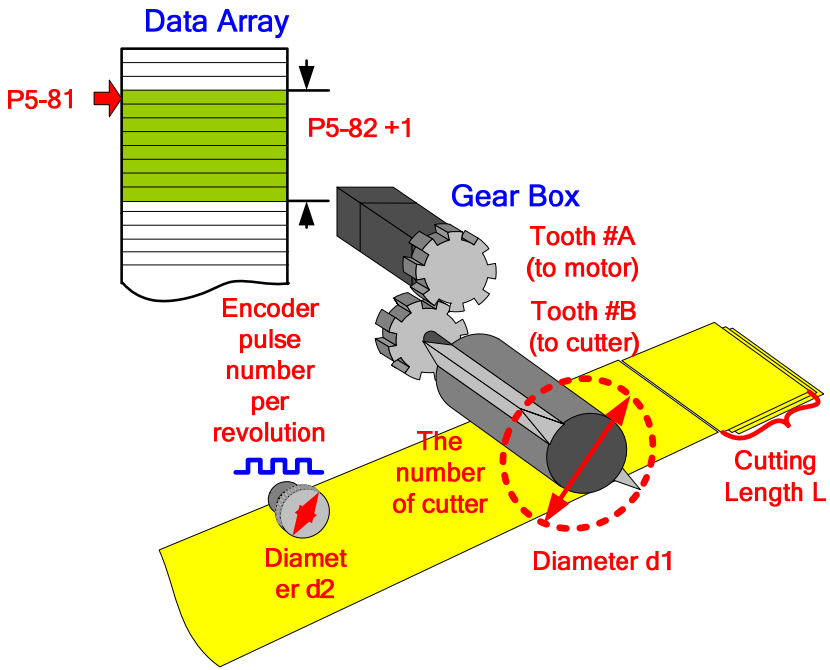


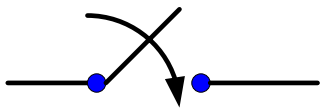
Curve Made On Drive (2)

How to Use Macro Instruction

Put all the parameters requested into their fields, launch the instruction, and check the result.

1 Enter parameters. → 2 Launch macro instruction. → 3 Check the result.





Success
or
Failure

Curve Made On Drive (3)

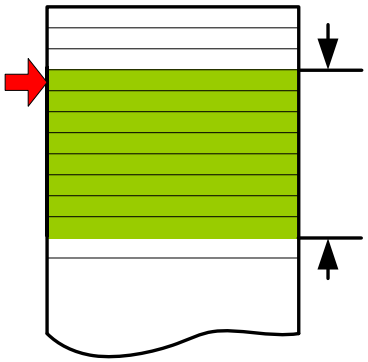
Marco Instruction P5-97=6 (1)

This macro instruction will generate the curve with fixed sealing zone 51°. Set the data array address, P1-44 and P1-45 (slave E-Gear) for the E-Cam curve.

Data Array

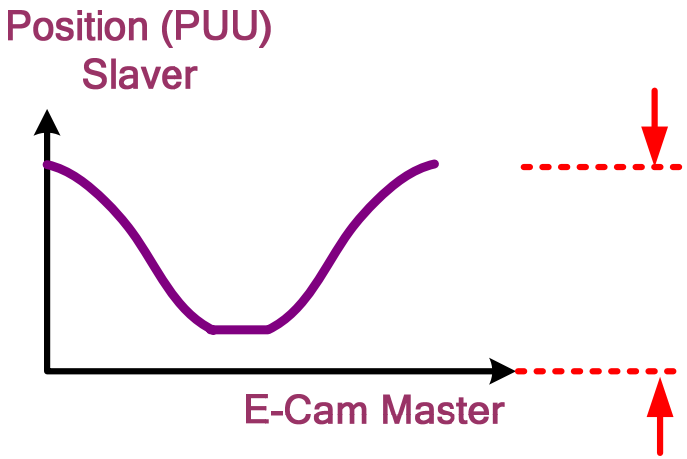
1

P5-81
The starting point.
P5-85=0



P5-82 =7 (7+1 items)
(This number is always 7 for this macro instruction.)

2

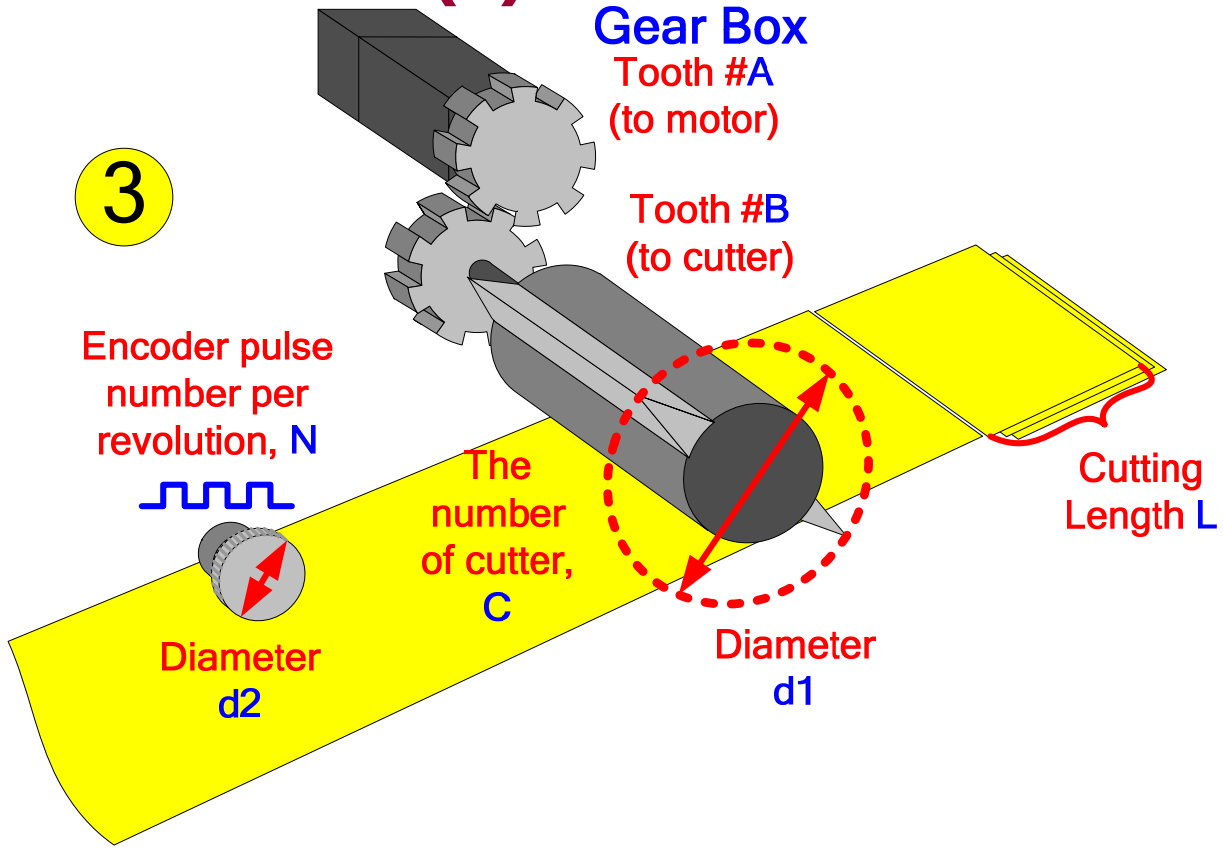


Slave E-Gear:
The scaling of E-Cam curve to output.
P1-44, P1-45, P5-19

Curve Made On Drive (4)

Marco Instruction P5-97=6 (2)

Calculate and enter the following parameters.



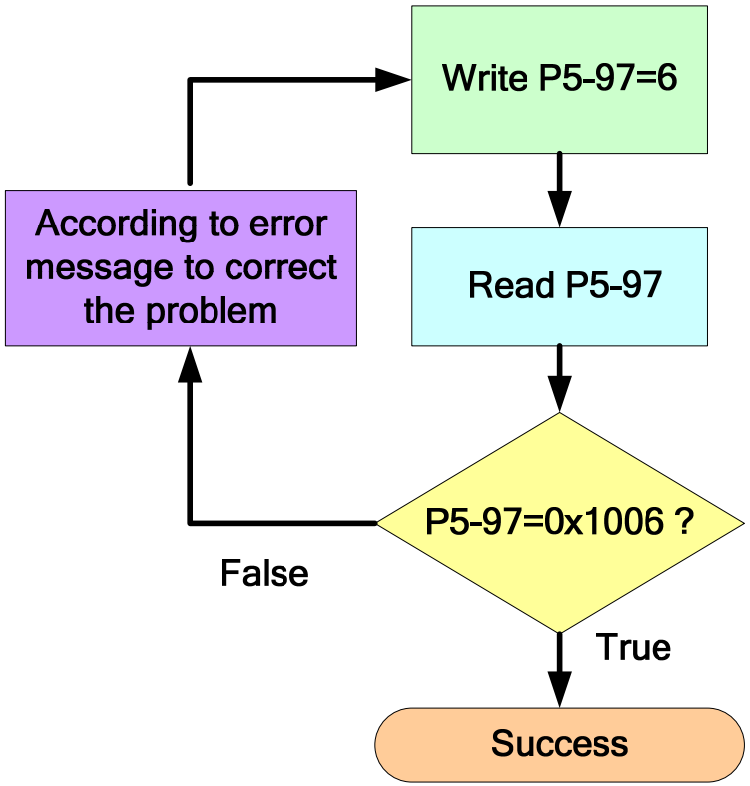
P5-83 = 1
P5-84 = N / (π * d2 (mm)) * L (mm), (How many pulses for L)
P5-94 = A * C
P5-95 = B
P5-96 = L (mm) / (π * d1 (mm)) * C * Vc * 1000000

Vc = Velocity compensator, Vc=1, do not compnesate.
Vc = 0.9, slower speed to 90%, Vc=1.1, faster speed to 110% .

Curve Made On Drive (5)

Marco Instruction P5-97=6 (3)

Execute the macro instruction and check the result.



List of error codes from P5-97 for #6 macro instruction.

F061h: The E-Cam is engaging and disengage it first.

F062h: P5-94 must be in the range of 1~65535.

F063h: P5-95 must be in the range of 1~65535.

F064h: P5-96 must be in the range of 300000~2500000.

F065h: P5-81 is defined too close the to top of data array.

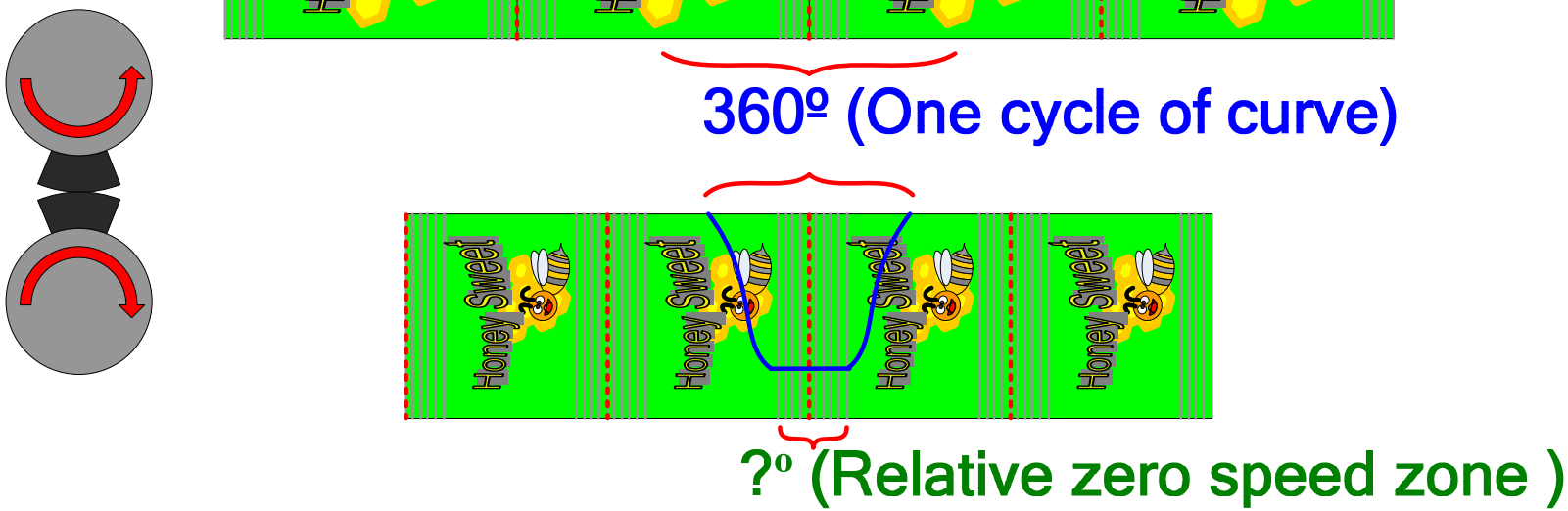
F066h: P5-82 must be number 7.

F067h: Overflow, reduce both the numbers of P1-44 and P1-45 in the same ratio; that is, the original ratio can be kept with small numbers of P1-44 and p1-45. (1280:100 → 128:10)

Curve Made On Drive (6)

Marco Instruction P5-97=7 (1)

With a wide cutter when the cutting length changed, the zero speed zone will change because that the definition of this zone is from material instead of cutter. That is one important reason why this macro designed.



Curve Made On Drive (7)

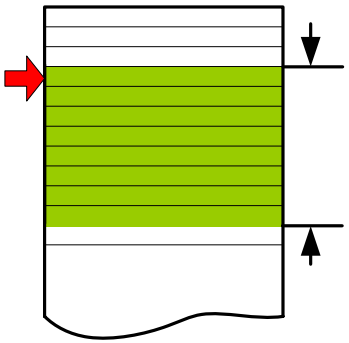
Marco Instruction P5-97=7 (2)

Set the parameters for data array and slave E-Gear. To set P5-82=72 is better for curve shape and this is highly recommended.

1

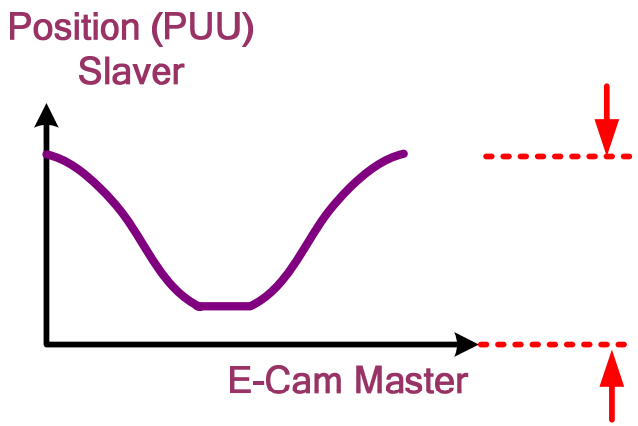
Data Array

P5-81
The starting point.
P5-85=0



P5-82 =30~72 (30+1 ~ 72+1 items)
(Highly recommend to set the P5-82 to 72.)

2



Slave E-Gear:
The scaling of E-Cam curve to output.
P1-44, P1-45, P5-19

Curve Made On Drive (8)

Marco Instruction P5-97=7 (3)

The waiting zones, acceleration/deceleration zones, S-curve smoothing zones, and relative zero speed zone should be allocated well.

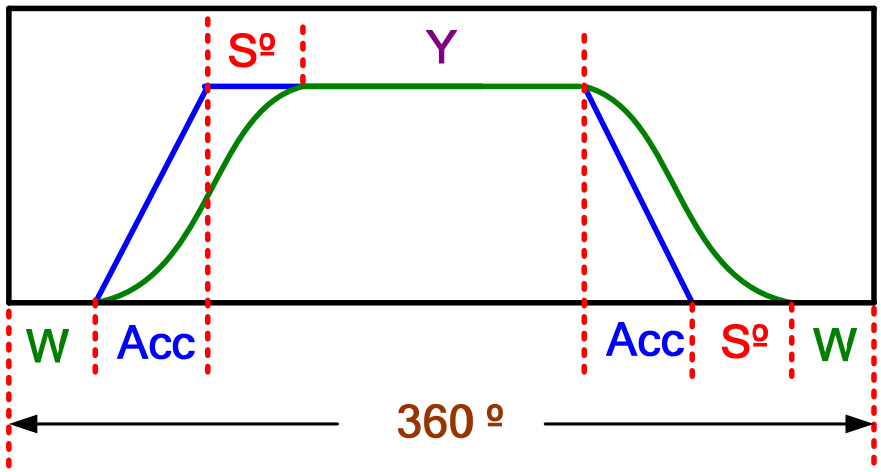
3

$360^o = 2W + 2Acc + 2S^o + Y$

$S^o = (2^S) * 360 / (P5\text{-}82)$

P5-82=72

S	1	2	3	4
S^o	10^o	20^o	40^o	80^o

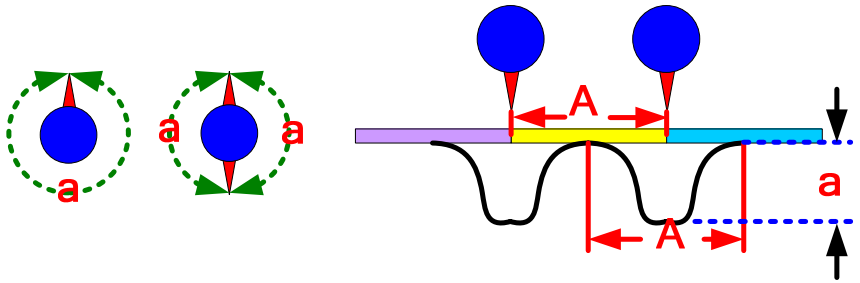


	P5-93.H (Hex.)	P5-93.L (Hex.)
P5-93	16 bits (S level, 1~4)	16 bits (W ,0~170º)
P5-94	32 bits (Y, relative zero speed zone, 0~330º, Decimal)	

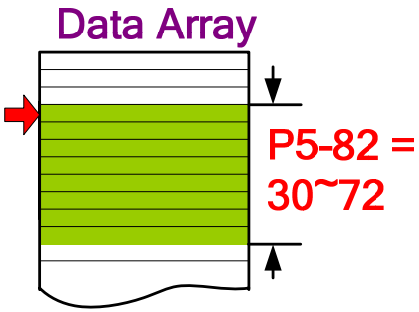
Curve Made On Drive (9)

Marco Instruction P5-97=7 (4)

The waiting zone has more restrictions. The term below should be followed, too.



R (Length Ratio) = A / a



	P5-93.H (Hex.)	P5-93.L (Hex.)
P5-93	16 bits (S level, 1~4)	16 bits (W ,0~170º)
P5-94	32 bits (Y, relative zero speed zone, 0~330º, Decimal)	

$360^{o} = 2W + 2Acc + 2S^{o} + Y$

$W' = 180 + 360/(P5\text{-}82) - 360/R + (P5\text{-}94)/2$

W<W', Error Code F07A, Enlarge waiting zone or shorten relative zero speed zone.

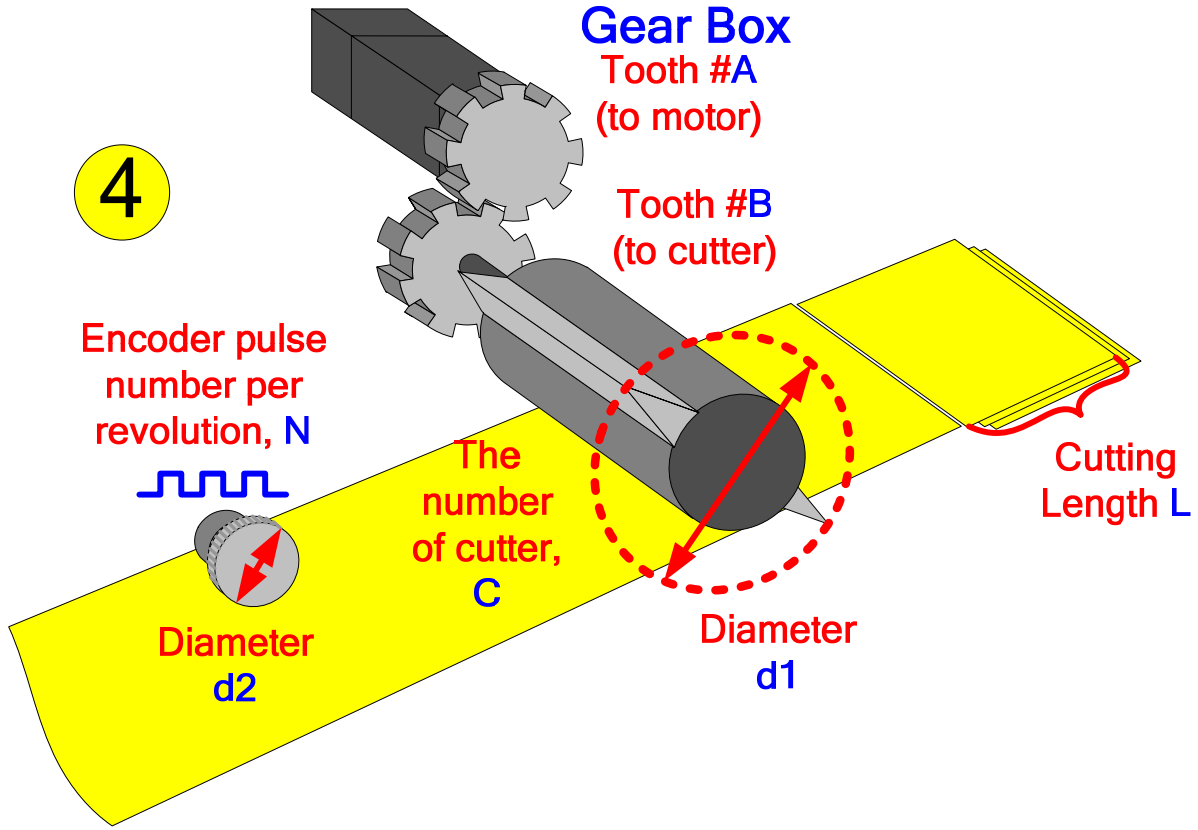
W=W', The starting speed of curve is zero.

W>W', The starting speed of curve is greater than zero.

Curve Made On Drive (10)

Marco Instruction P5-97=7 (5)

Calculate and enter the following parameters.



P5-83 = 1

P5-84 = N / (π * d2 (mm)) * L (mm), (How many pulses for L)

P5-95.H (in Hexadecimal) = A * C

P5-95.L (in Hexadecimal) = B

P5-95	P5-95.H (Hex.)	P5-95.L(Hex.)
	16 bits (A x C)	16 bits (B)

P5-96 = L (mm) / (π * d1 (mm)) * C * Vc * 1000000

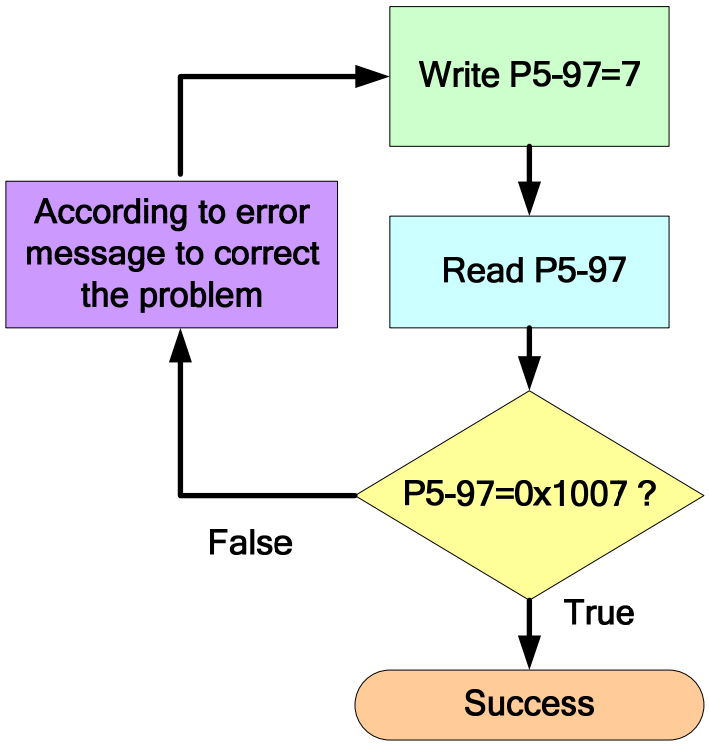
Vc = Velocity compensator, Vc=1, do not compnesate.

Vc = 0.9, slower speed to 90%, Vc=1.1, faster speed to 110% .

Curve Made On Drive (11)

Marco Instruction P5-97=7 (6)

Execute the macro instruction and check the result.



List of error codes from P5-97 for #7 macro instruction.

F071h: The E-Cam is engaging and disengage it first.

F072h: P5-94 must be in the range of 0~330.

F073h: P5-93.H (Hex.) must be in the range of 1~4.

F074h: P5-93.L (Hex.) must be in the range of 0~170 (Dec.).

F075h: P5-96 must be in the range of 50000~5000000.

F076h: P5-82 must be in the range of 30~72.

F077h: P5-81 is defined too close to the top of data array.

F078h: Overflow, reduce both the numbers of P1-44 and P1-45 in the same ratio; that is, the original ratio can be kept with small numbers of P1-44 and p1-45.
(1280:100 → 128:10)

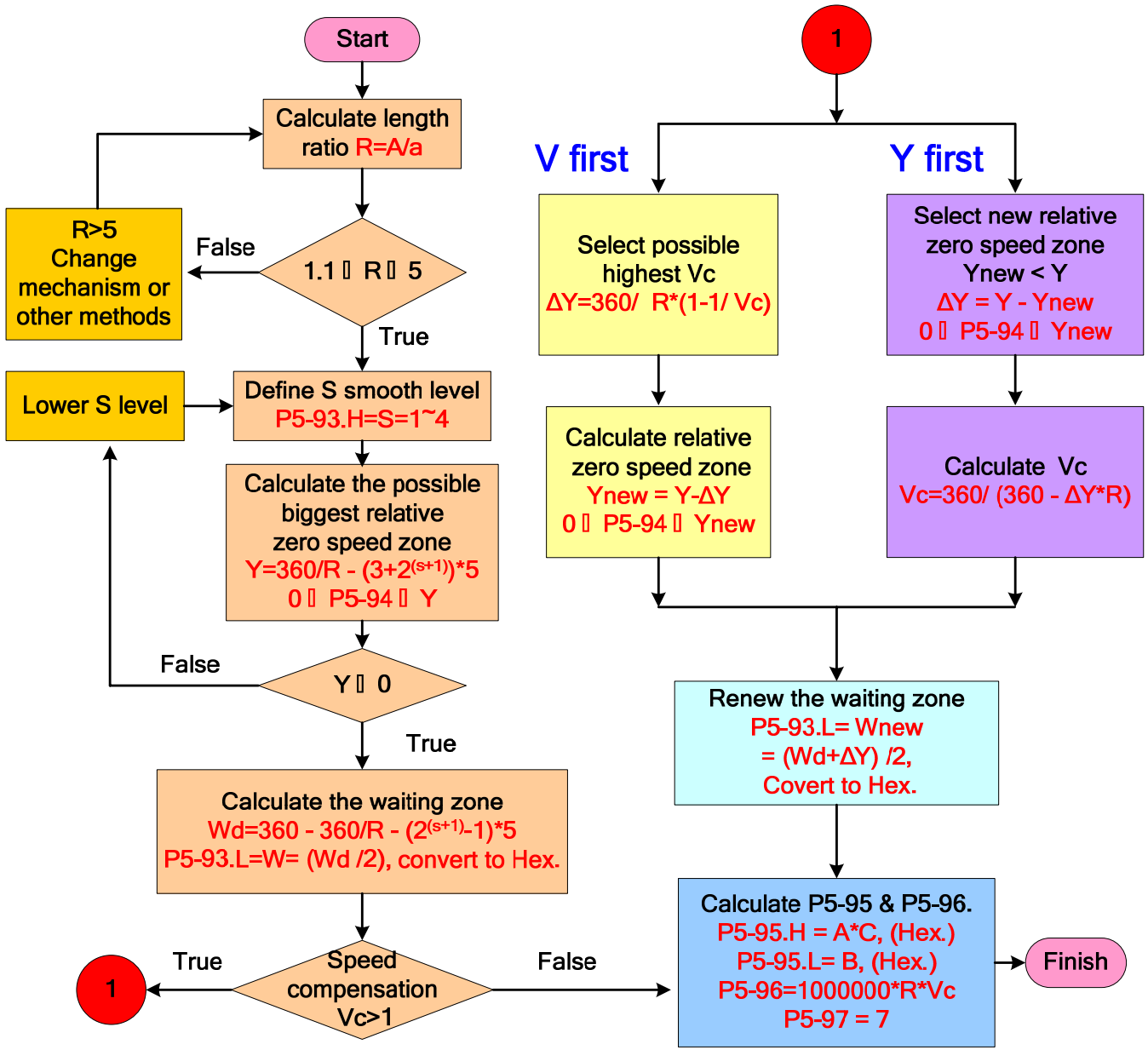
F079h: Acc zone not big enough, smaller W, Y or S.

F07Ah: Waiting zone not big enough, bigger W or smaller Y.

Curve Made On Drive (12)

Marco Instruction P5-97=7 (7)

The error free curve making procedure is for R=1.1~5 where R is Length Ratio ,and P5-82=72. This method is used to evaluate the possible biggest sealing zone.



Curve Made On Drive (13)

Marco Instruction P5-97=7 (8)

The table is for the case of R=0.05~1.09 and P5-82=72.

P5-93.H=S=1~4; P5-93.L=W=(Wd/2), (Hex.)

P5-94=Y; P5-95.H=A*C, (Hex.); P5-95.L=B, (Hex.)

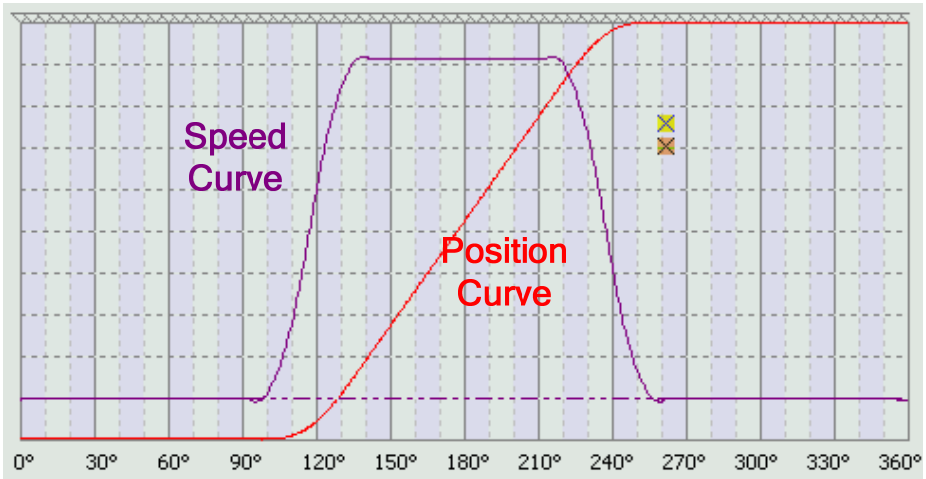
P5-96 = 1000000 * R * Vc; P5-97=7

S=1 Wd=0º~150º Y=0º~150º Wd=0º~(150º-Δχ) Y=0º~(150º+Δχ) Wd=0º~(150º+Δχ) Y=0º~(150º-Δχ)	S=2 Wd=0º~140º Y=0º~150º Wd=0º~(140º-Δχ) Y=0º~(150º+Δχ) Wd=0º~(140º+Δχ) Y=0º~(150º-Δχ)
S=3 Wd=0º~110º Y=0º~110º Wd=0º~(110º-Δχ) Y=0º~(110º+Δχ) Wd=0º~(110º+Δχ) Y=0º~(110º-Δχ)	S=4 Wd=0º~50º Y=0º~30º Wd=0º~(50º-Δχ) Y=0º~(30º+Δχ) Wd=0º~(50º+Δχ) Y=0º~(30º-Δχ)

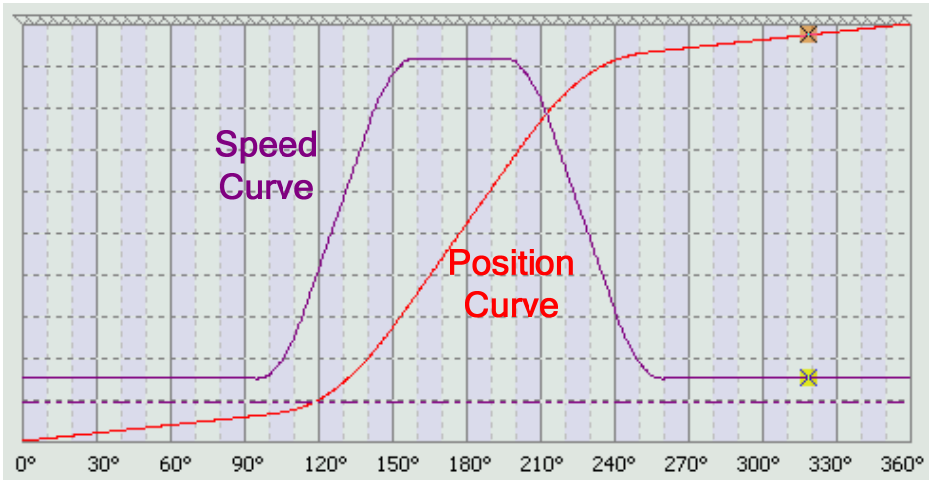
Curve Made On Drive (14)

Sample (1)

R=3 ; P5-82=72 ; P5-93.H=S=2 ; Vc=1;
P5-94=Y (Sealing zone)= 360º/3 - (3+2^(2+1))*5º = 65º;
Wd=360º - 360º/3 - (2^(2+1)-1)*5º = 205º ;
P5-93.L =(205/2)d =66h;
P5-95.H= A*C=1 ; P5-95.L=B=1 ; P5-95=0x00010001;
P5-96 = 1000000 * R * Vc =3000000 ; P5-97=7.



P5-82=72 P5-93=0x00020066 P5-94=65
P5-95=0x00010001 P5-96=3000000



P5-82=72 P5-93=0x00020066 P5-94=30
P5-95=0x00010001 P5-96=3000000

Curve Made On Drive (15)

Sample (2)

Continue to Sample (1) and change the Vc to 1.2.

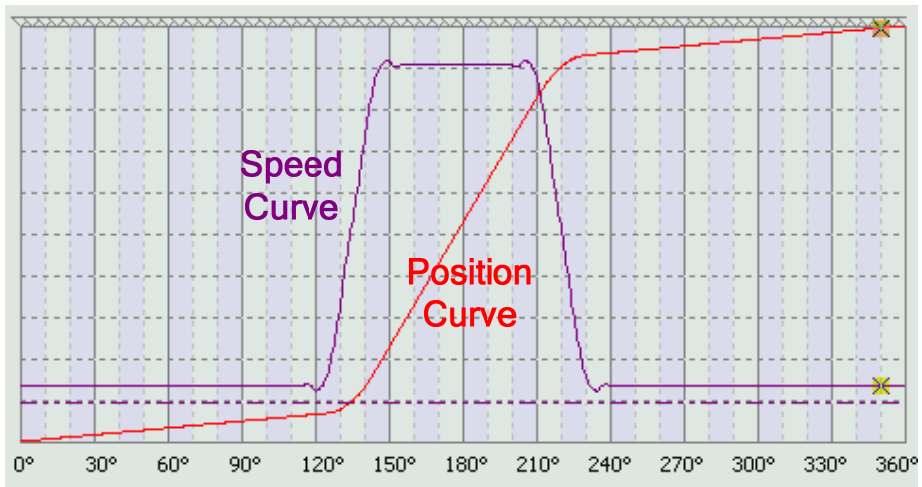
ΔY = 360º/3 * (1 - 1/1.2) = 20º;

Ynew = 65º -20º = 45º;

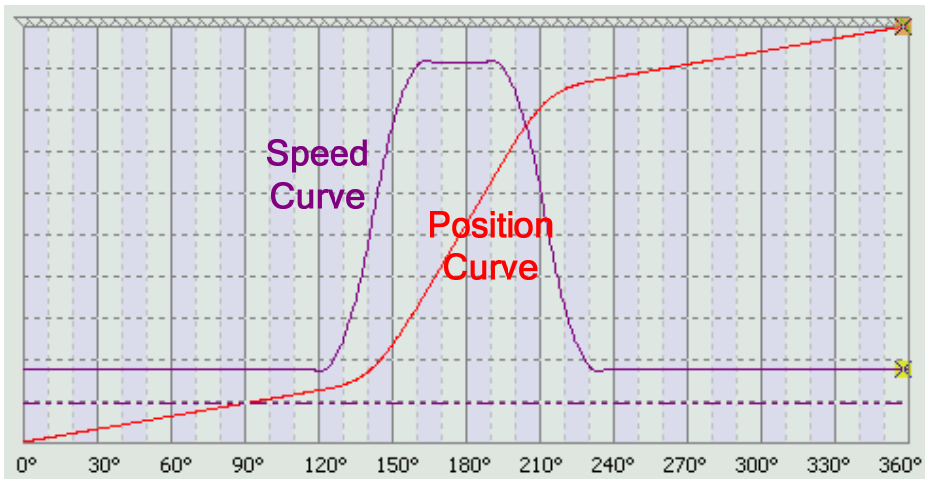
Wd = 205º+ 45º =250º ; P5-93.L= Wnew = (250/2)d=7Dh;

P5-96 = 1000000 * R * Vc =100000*3*1.2=3600000;

P5-97=7.



P5-82=72 P5-93=0x0002007D P5-94=45
P5-95=0x00010001 P5-96=3600000

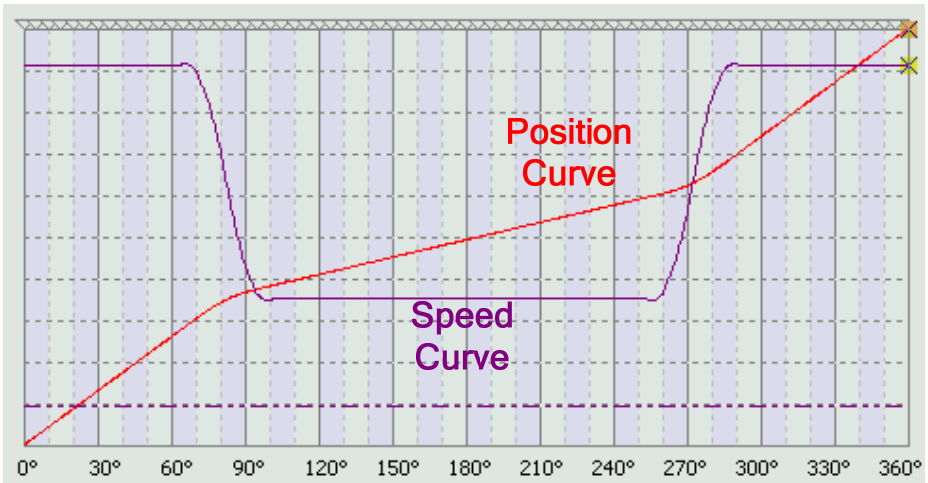


P5-82=72 P5-93=0x0002007D P5-94=20
P5-95=0x00010001 P5-96=3600000

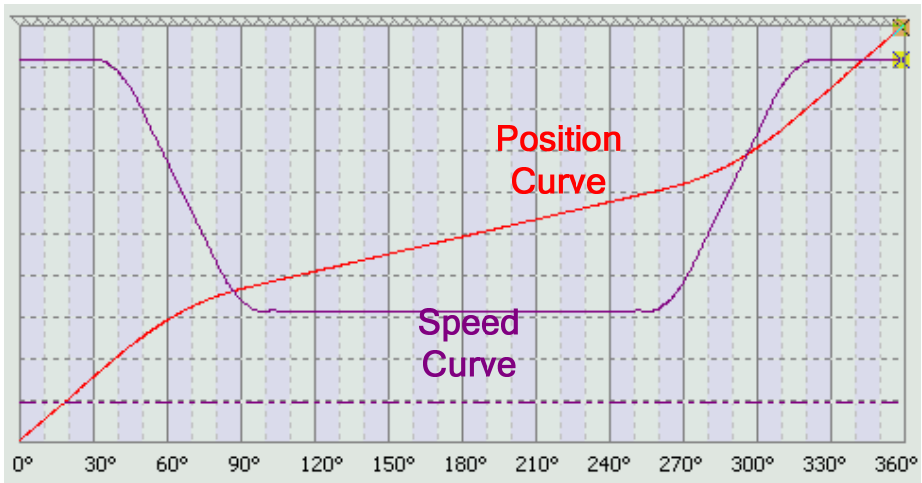
Curve Made On Drive (16)

Sample (3)

R=0.5 ; P5-82=N=72 ; P5-93.H=S=2 ; Vc=1;
Wd=0º~ 140º ; P5-94=Y= 0º ~150º;
P5-93.L=W=(140/2)d=46h;
P5-95.H= A*C=1 ; P5-95.L=B=1 ; P5-95=0x00010001;
P5-96 = 1000000 * R * Vc =500000 ; P5-97=7.



P5-82=72 P5-93=0x00020046 P5-94=150
P5-95=0x00010001 P5-96=500000

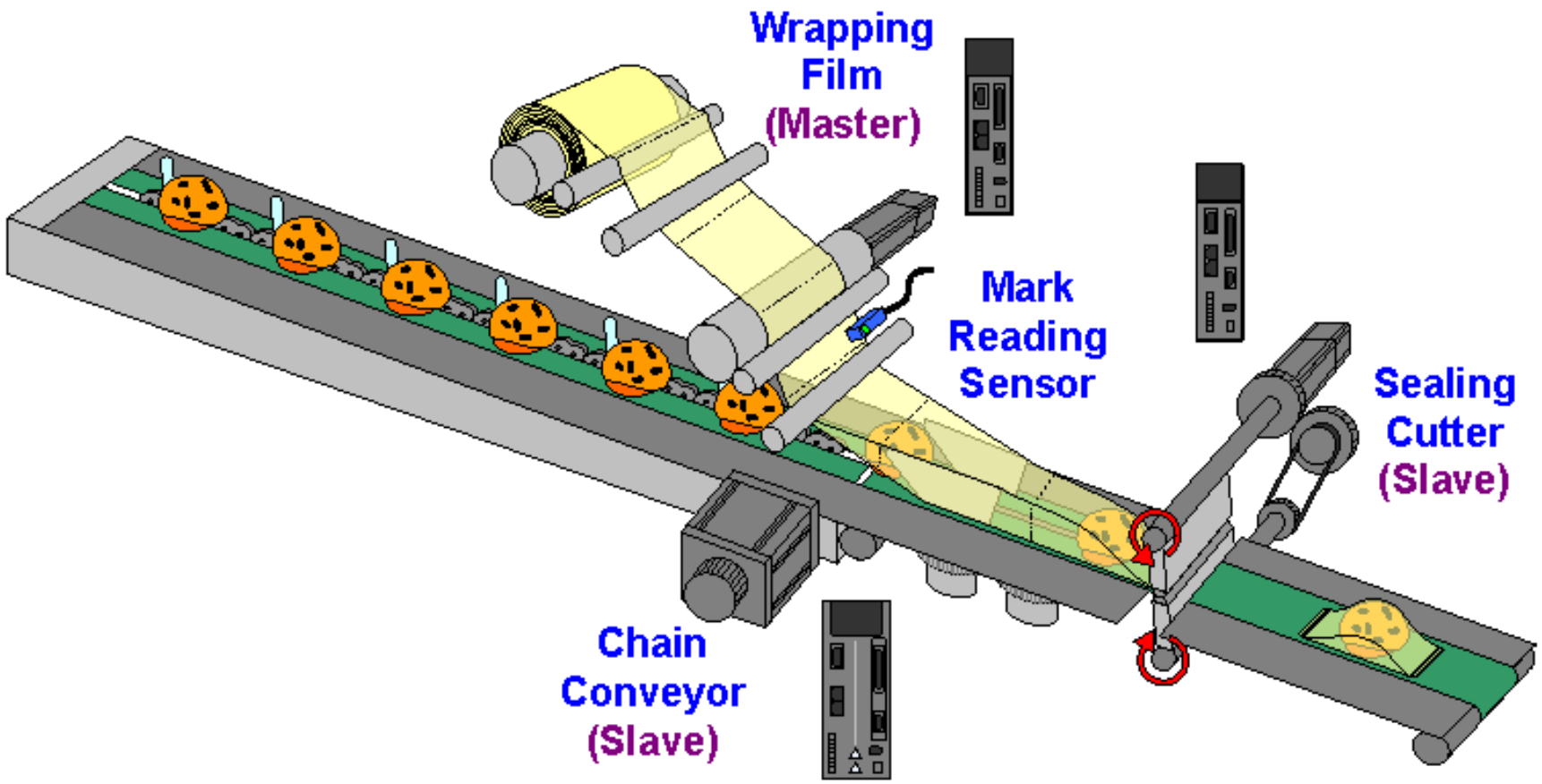


P5-82=72 P5-93=0x00020026 P5-94=150
P5-95=0x00010001 P5-96=500000

Synchronous Capture Axis (1)

An Application

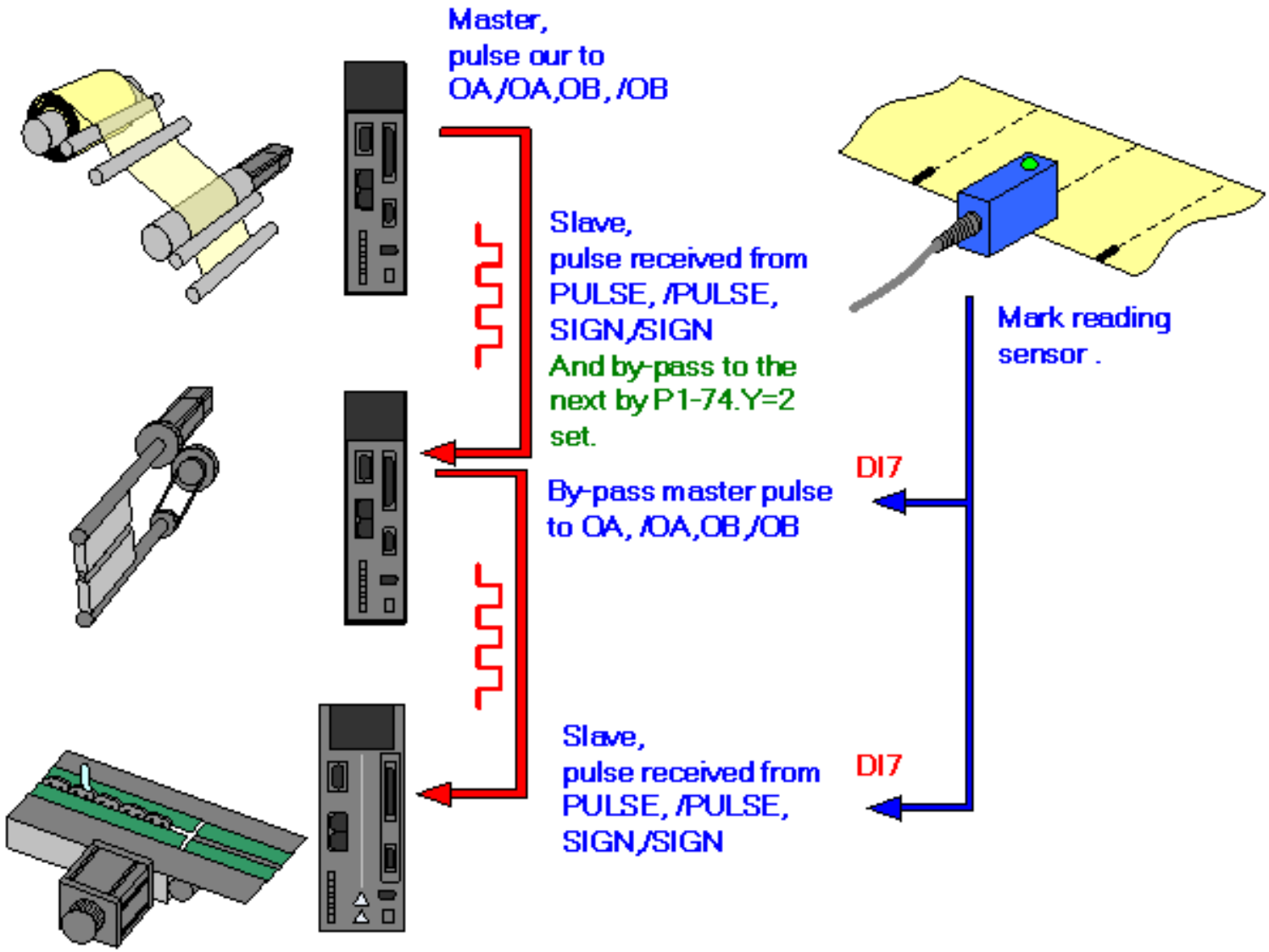
On a packing machine, the cutter and chain conveyor need to follow the film sending speed.



Synchronous Capture Axis (2)

How They Connected

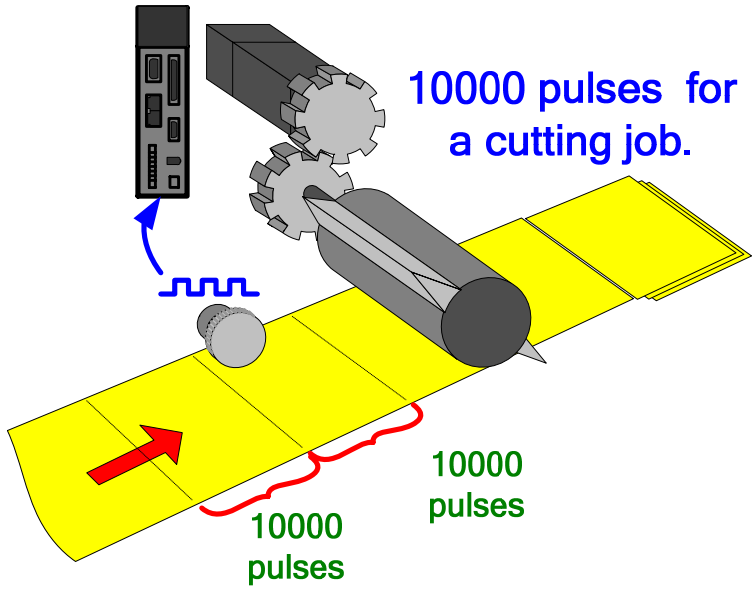
The wiring is as below.

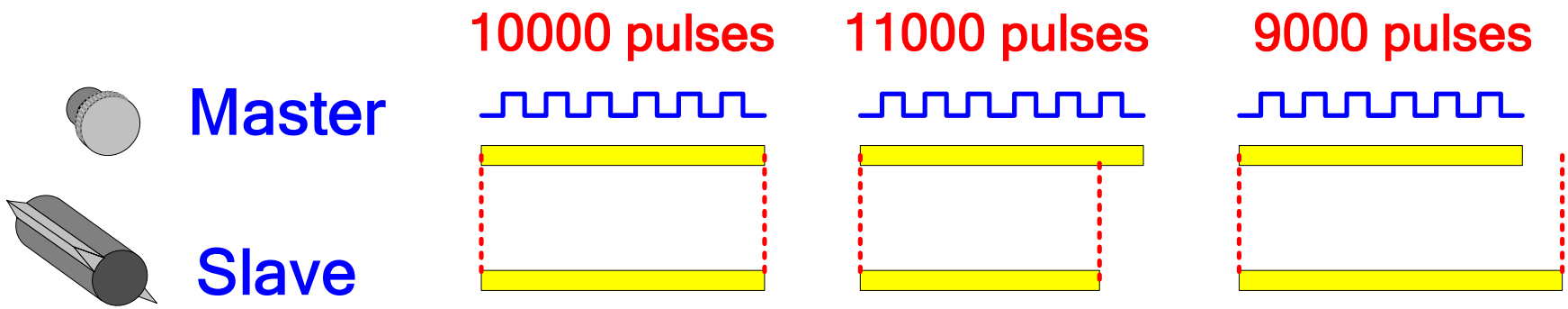


Synchronous Capture Axis (3)

The Cause of Cutting at Wrong Place

If the master axis cannot keep consistence to its setting length for number of pulse, the slave cannot cut in the correct place.

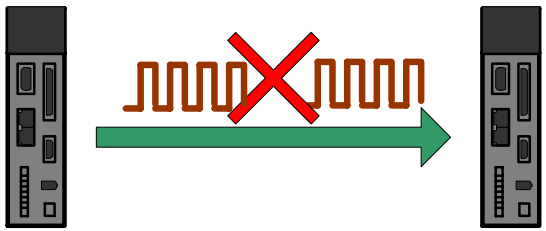




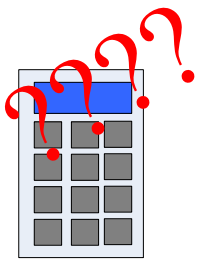
Synchronous Capture Axis (4)

Some Possibilities of Causes

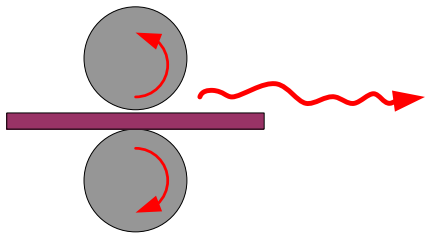
There are many possibilities could caused the film deformed, which will lead to cut in a wrong position. If some of the pulse missing, it has the same wrong result.



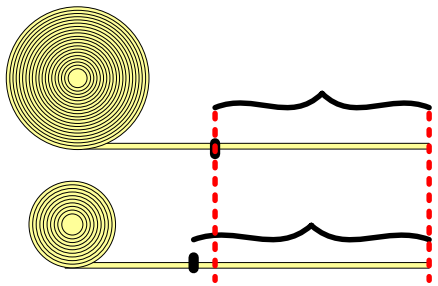
Pulse missing



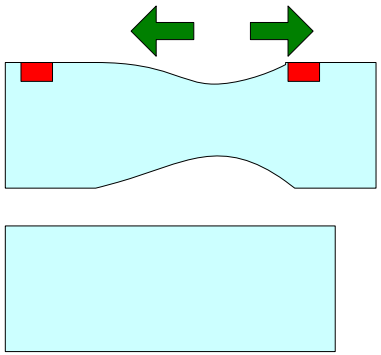
Calculation or accumulation error



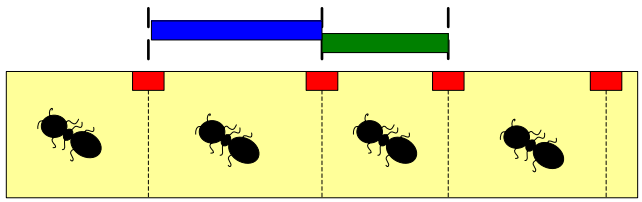
Get slipping on roller



Material nature



Film on poor tension mechanism

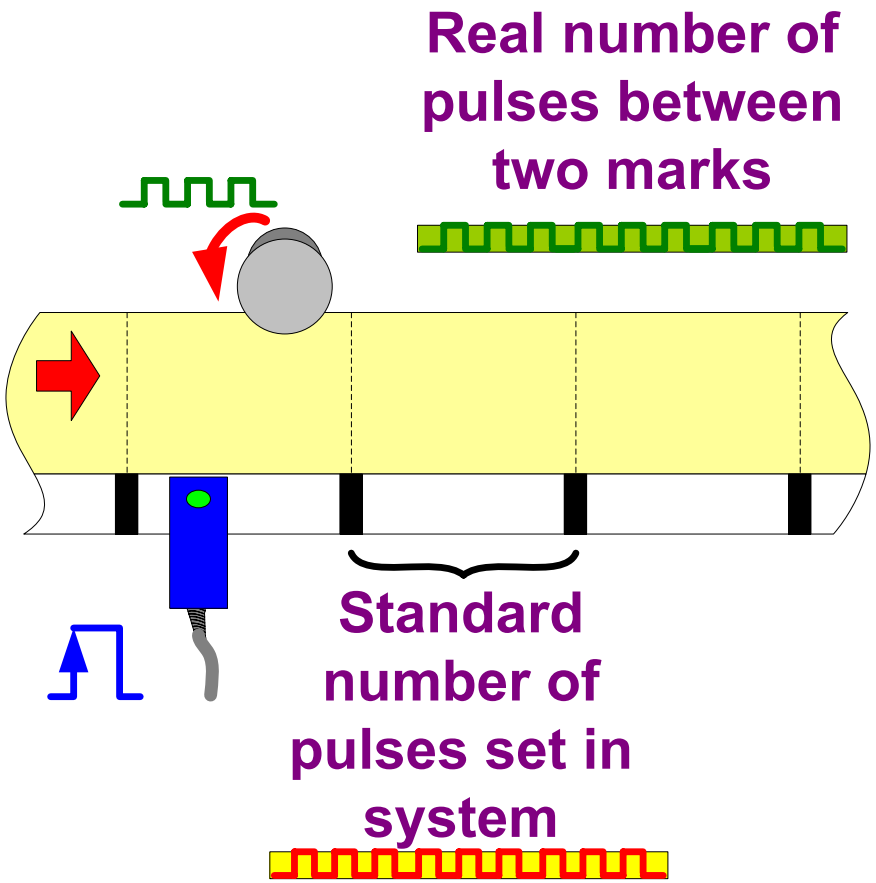


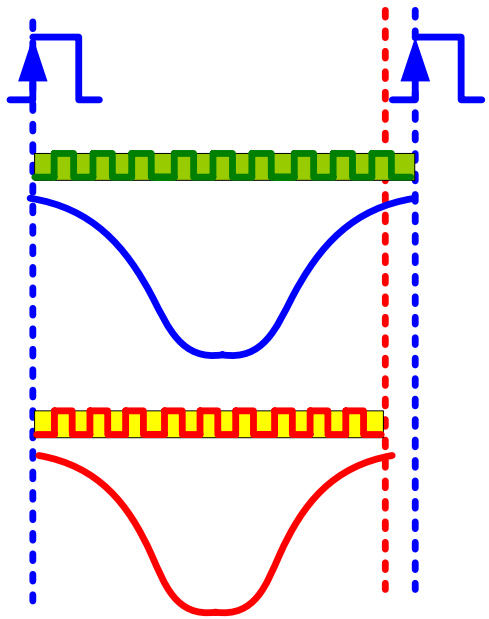
Mark distance printed not consistent

Synchronous Capture Axis (5)

The Treatment

If the cutting length can be adjusted acceding to the real length between two marks, this problem can be solved.



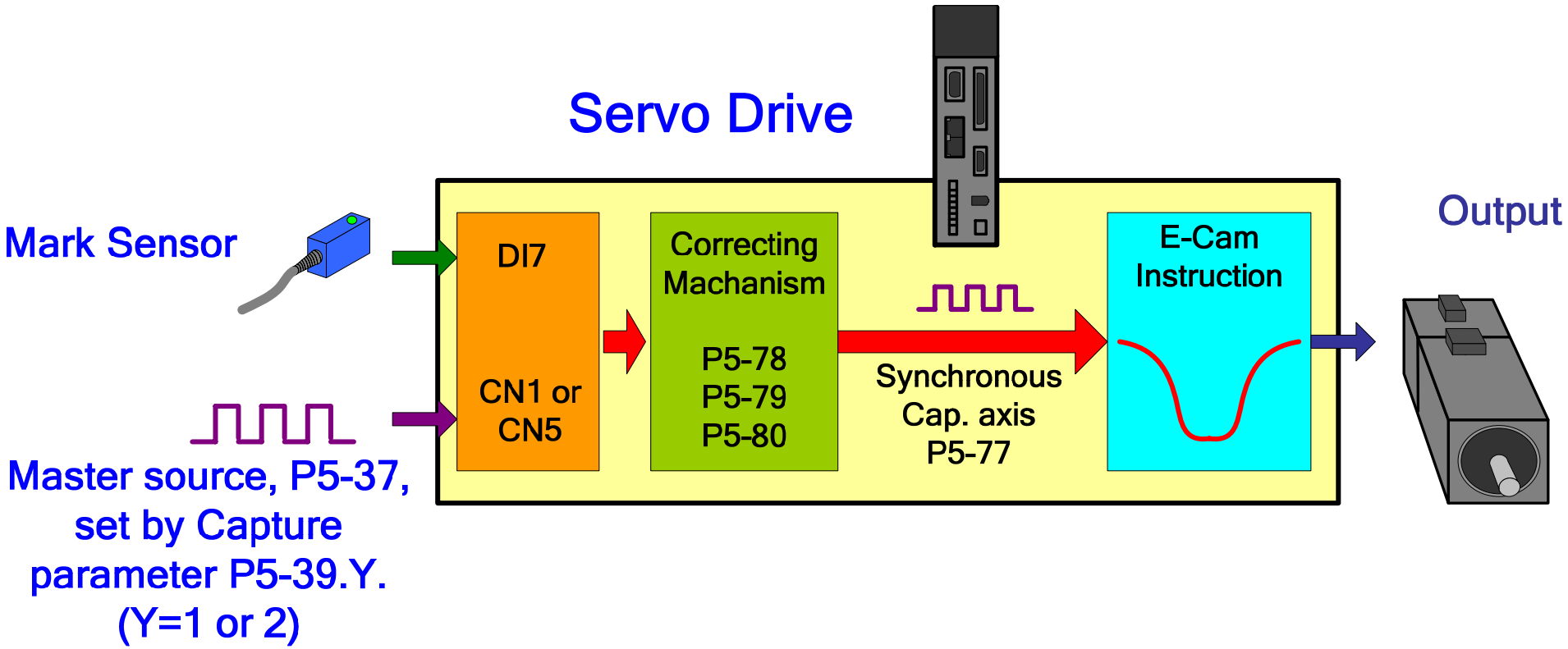


The difference will be the base for cutting length adjusted.

Synchronous Capture Axis (6)

The Mark Tracking Function

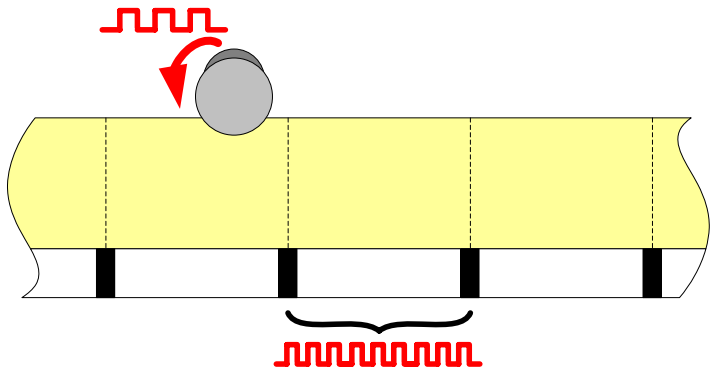
ASDA-A2 is integrated a feature which will adjust its cutting length according to the difference from comparing the pulse number received to the standard one .



Synchronous Capture Axis (7)

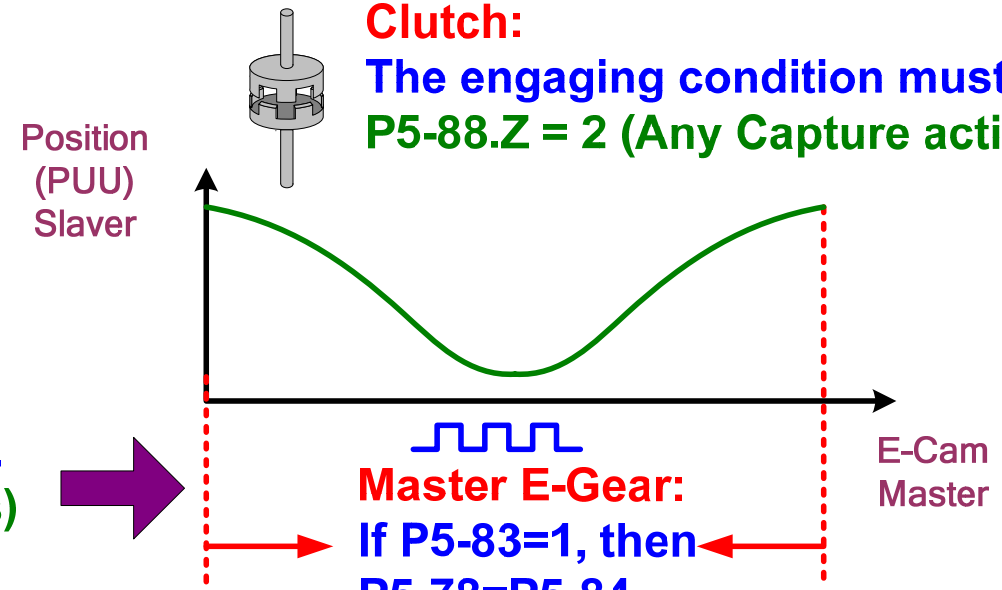
The Settings

Some parameters for Synchronous Capture Axis are mandatory to certain values. The remaining parameter on E-Cam still need to be set according to your application, disengaging condition for example.



P5-78, pulse number between two marks.

Master Axis:
The source of main axis must be 5.
P5-88.Y=5 (Synchronous Cap. Axis)



Clutch:
The engaging condition must be 2.
P5-88.Z = 2 (Any Capture action.)

Master E-Gear:
If P5-83=1, then
P5-78=P5-84.
P5-83, P5-84

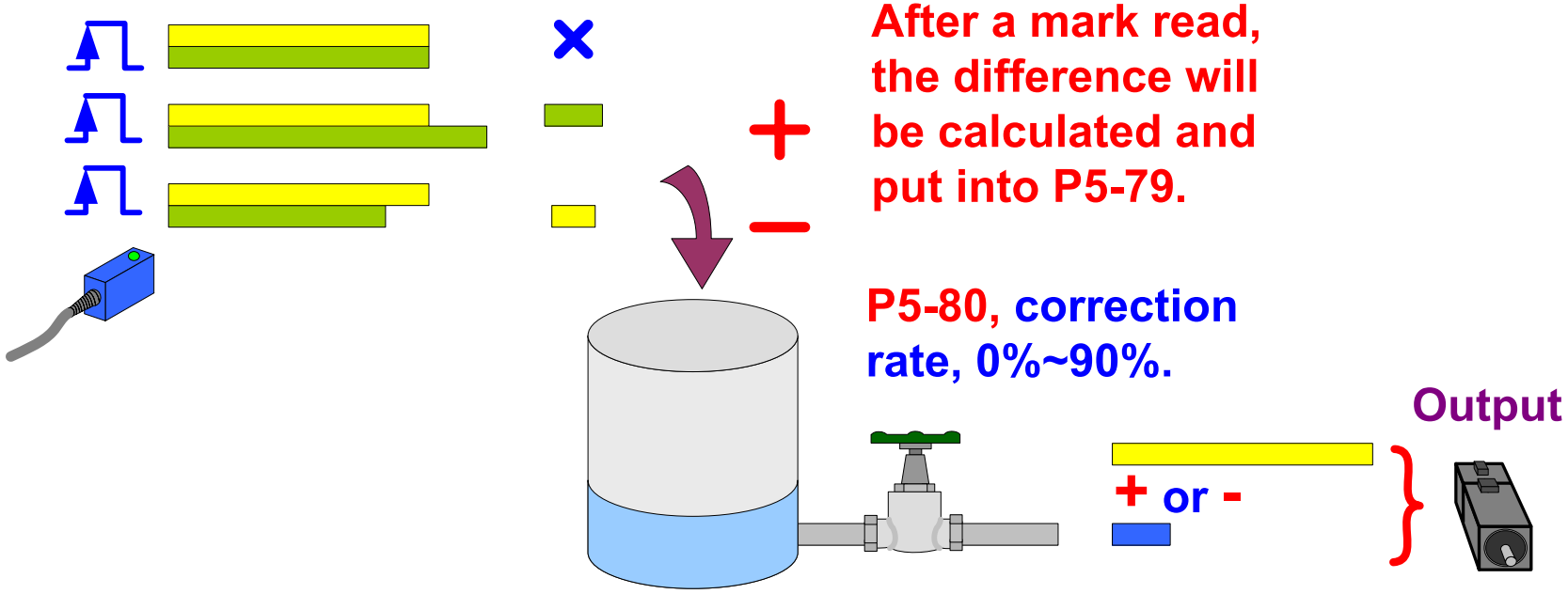
Synchronous Capture Axis (8)

Some more Parameters

P5-80 is the correction rate where P5-79 is error pulse counters.

P5-78, standard number of pulse between two marks.

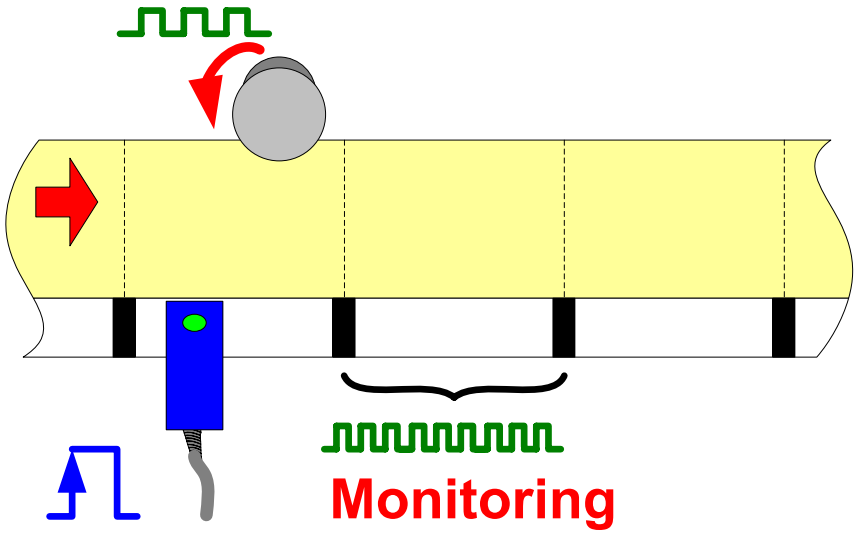
Real number of pulse between two marks from master.



Synchronous Capture Axis (9)

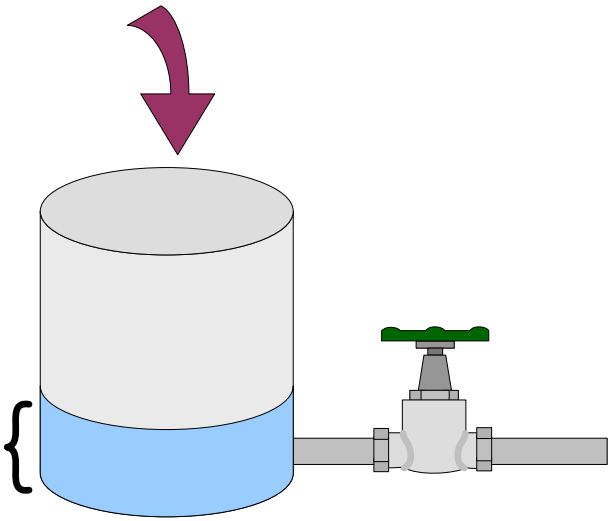
Two Useful Monitoring Variables

The monitoring function code 81(51h) is the pulse number from master between two marks. And 84(54h) is for error counter P5-79.



Monitoring variable 81 (51h).

Monitoring variable 84 (54h).

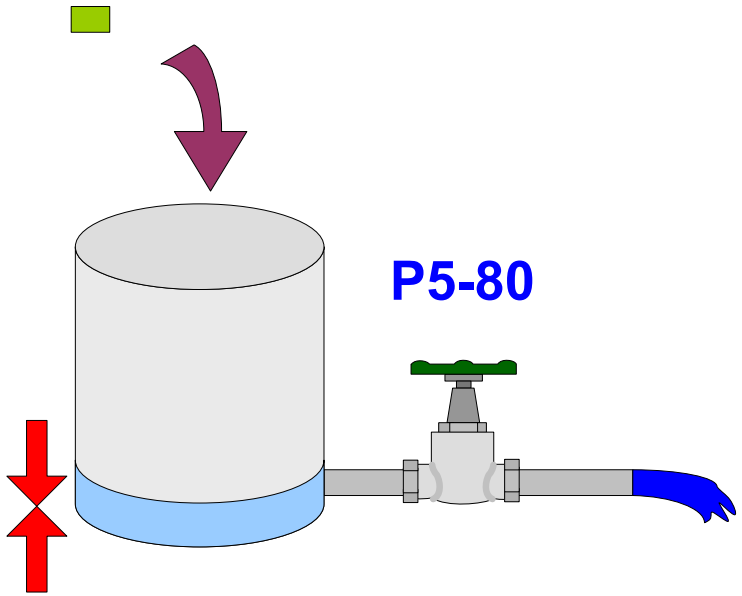


P5-79, error counter of pulse for Synchronous Capture axis.

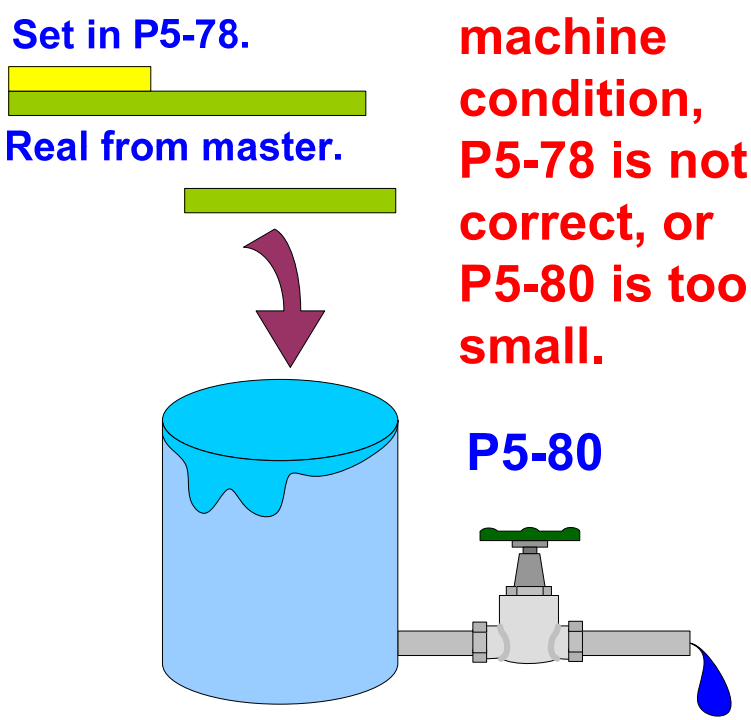
Synchronous Capture Axis (10)

What should be correct?

The value in P5-79 (error counter) should be always close to zero by a small positive or negative number. If it keeps increasing/decreasing in one direction, there could be poor machine conditions or inappropriate parameters set.



For a correct system,
P5-79 is always close to zero.



Poor machine condition, P5-78 is not correct, or P5-80 is too small.

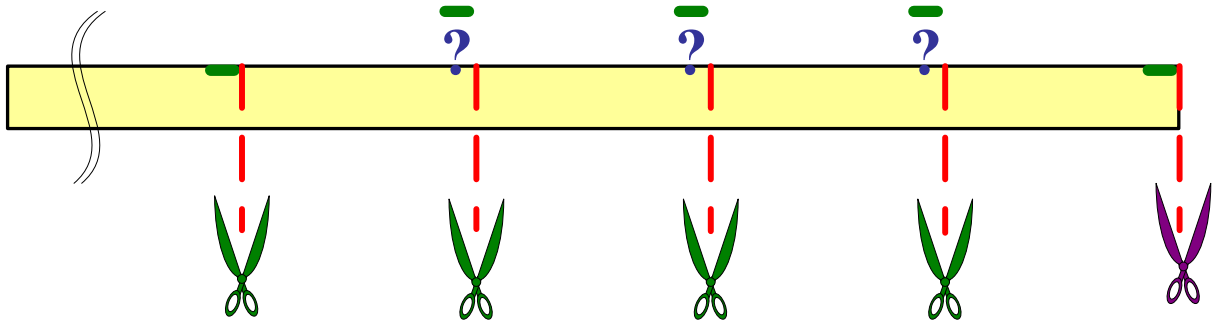
P5-79, error counter.

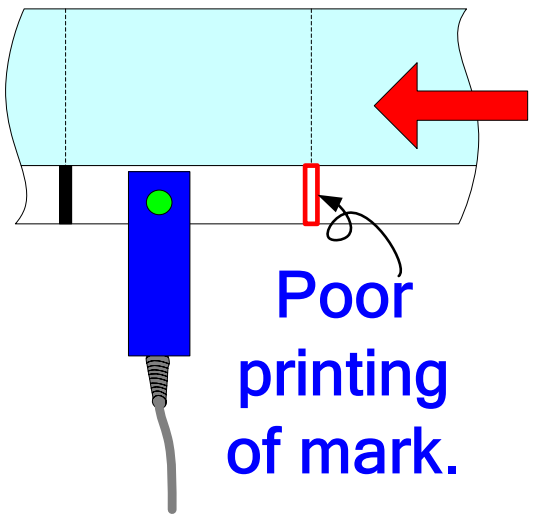
Synchronous Capture Axis (11)

Mark Missing

Once the mark is missing, the current cutting length will be kept for the next cut until the mark reading recovers. And the system can adjust the cutting length again when mark reading is functional.

Marks cannot be read. Cut the length the same as the last cut with successful mark read.

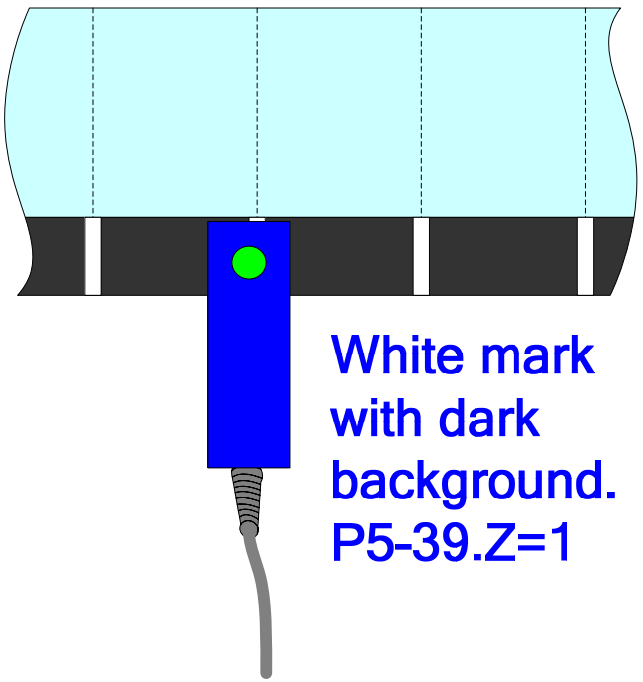




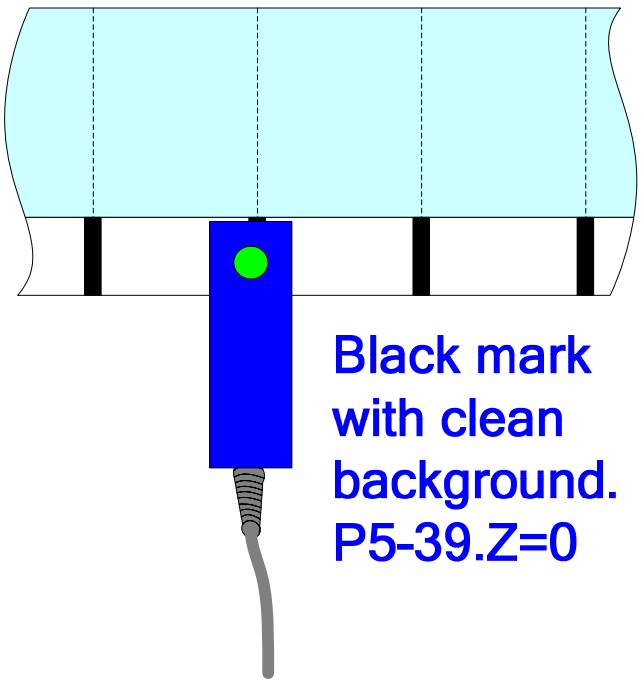
Synchronous Capture Axis (12)

Black Mark or White Mark

Positive or negative printed of mark can be read on ASDA-A2 with one parameter set.



White mark with dark background. P5-39.Z=1



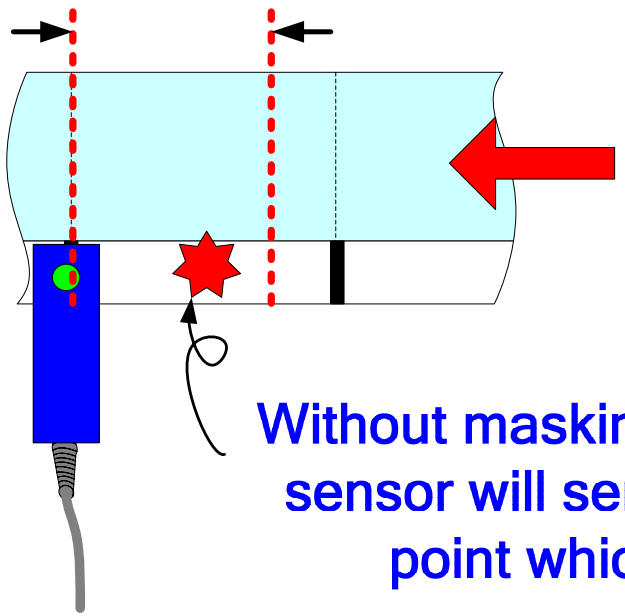
Black mark with clean background. P5-39.Z=0

Synchronous Capture Axis (13)

Masking Function

In order to have higher correct reading of mark by avoiding some stains or pattern printed, the masking function, which is fulfilled by Capture and Compare functions, will be used.

In this area, the mark reading function will be disabled and it can reduce the possibility of wrong signal of mark.

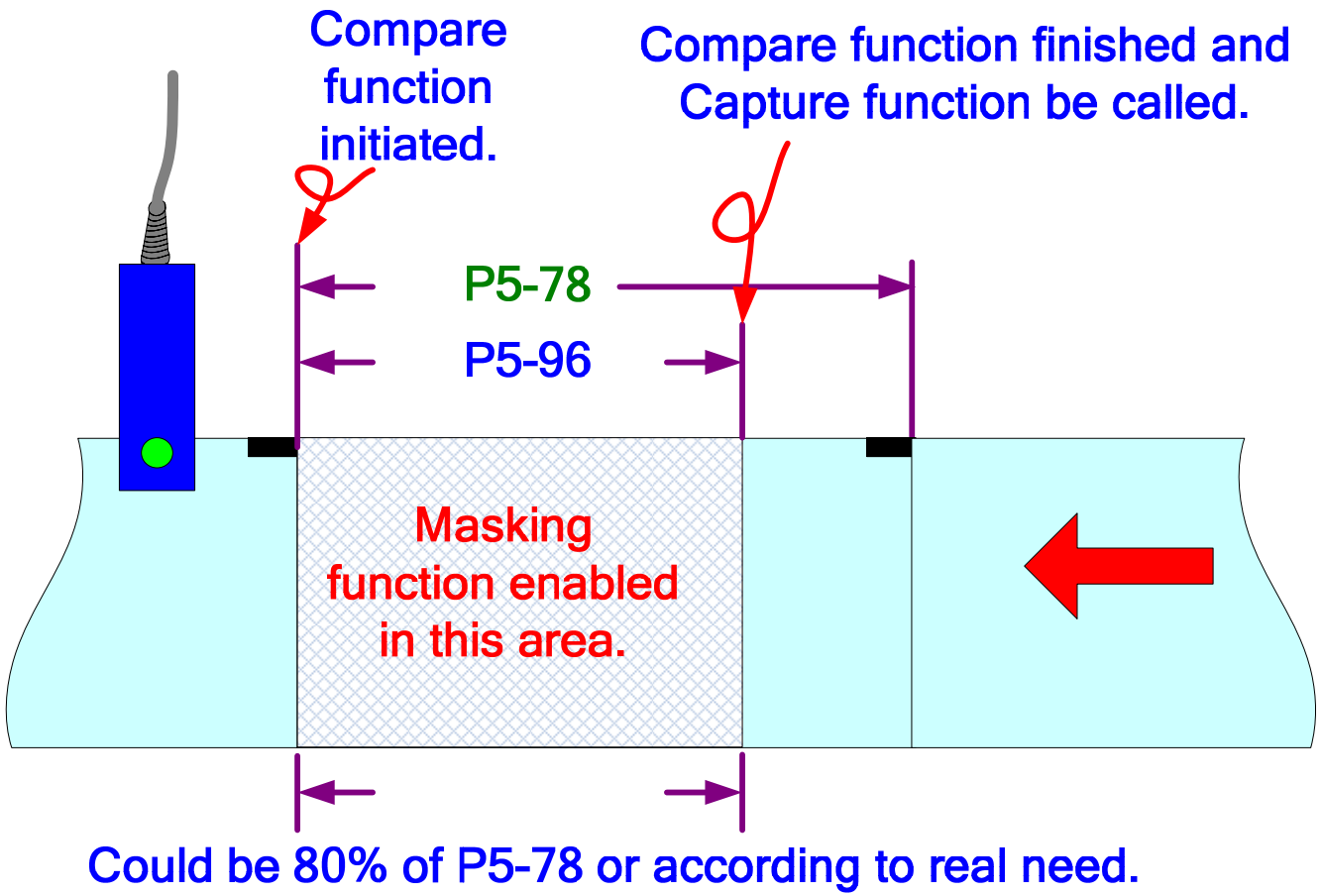


Without masking function, the mark sensor will send signal out at this point which is unwanted.

Synchronous Capture Axis (14)

Macro Instruction for Capture and Compare

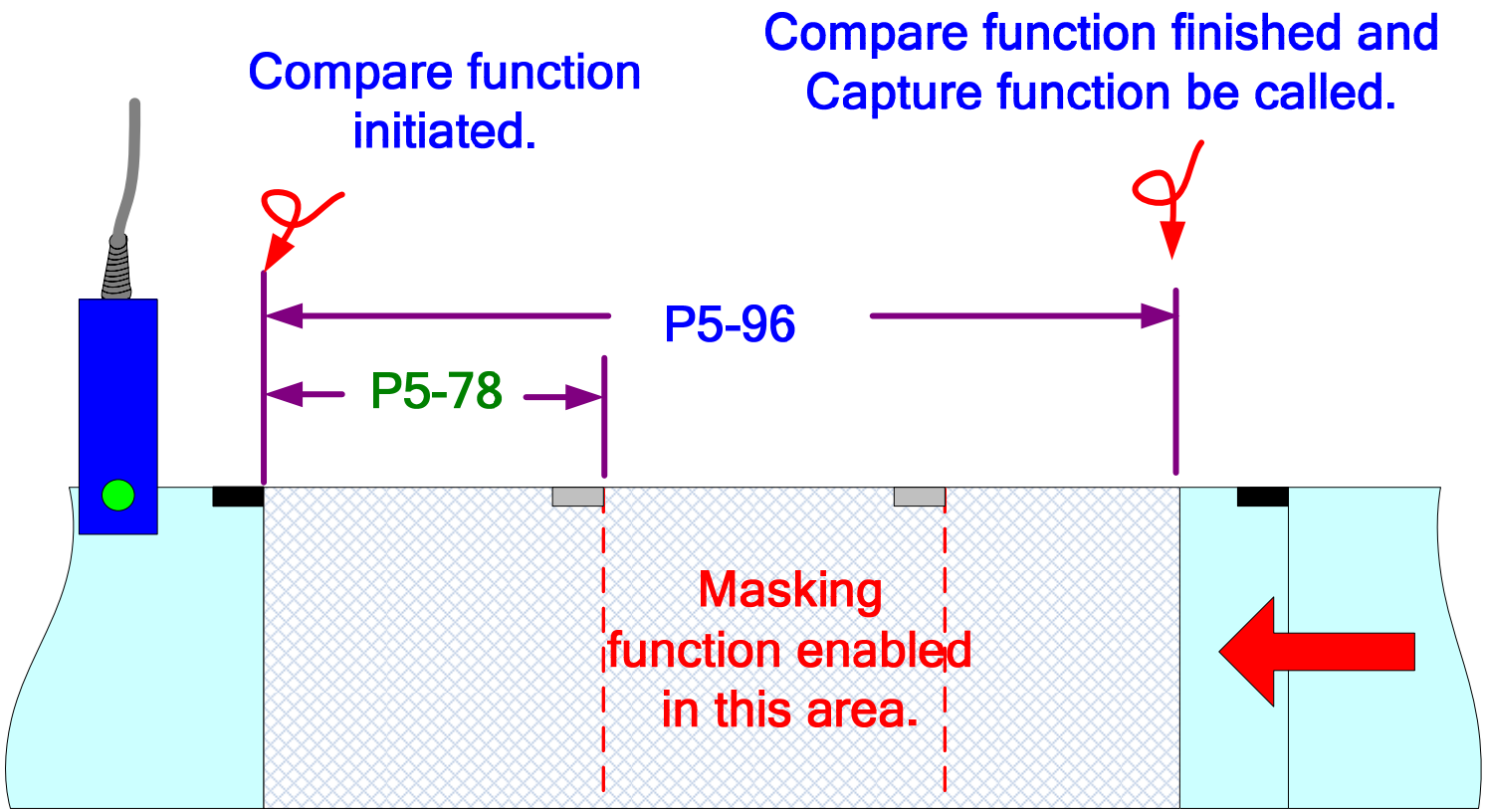
P5-97=1 is the macro instruction for coordinating the sequence of Capture and Compare functions. The masking length should be set appropriately in P5-96.



Synchronous Capture Axis (15)

Long Masking Distance

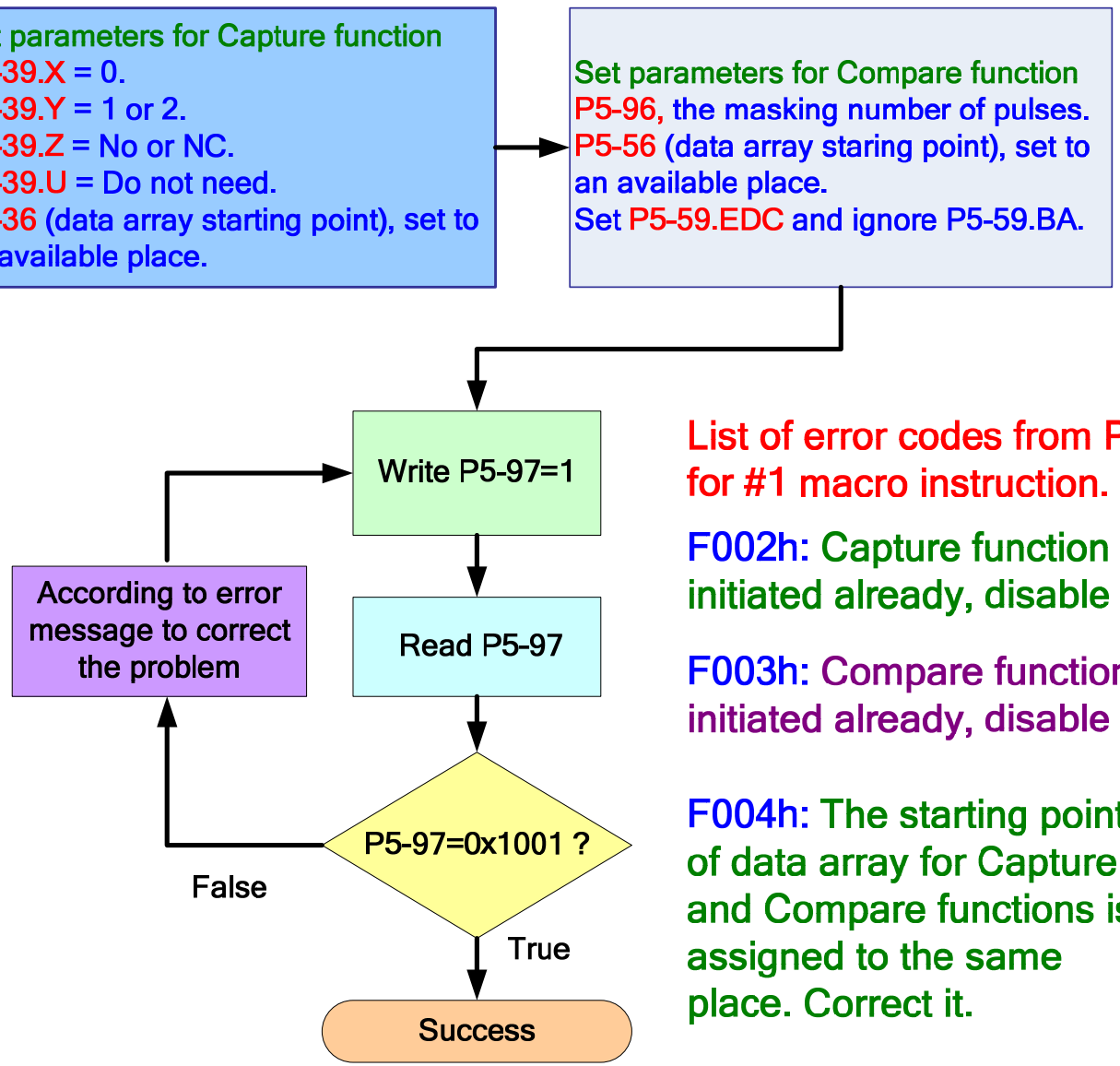
For some applications if every mark read is not necessary, the masking distance can be set to as long as needed.



Synchronous Capture Axis (16)

Macro Instruction P5-97=1

The procedure of switching between Capture and Compare functions associated with its masking length cyclically will be done by this macro instruction.



List of error codes from P5-97 for #1 macro instruction.

F002h: Capture function initiated already, disable it.

F003h: Compare function initiated already, disable it.

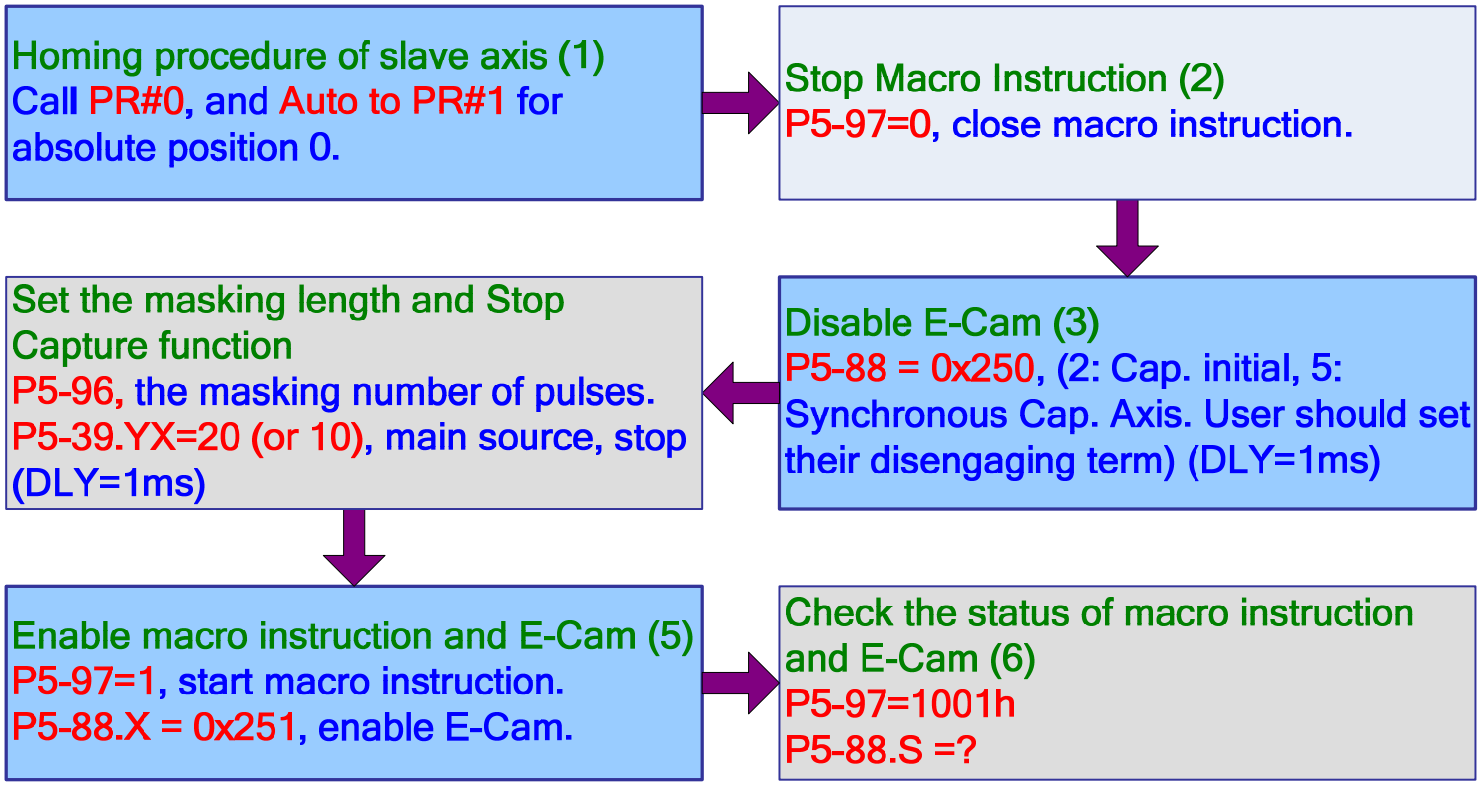
F004h: The starting point of data array for Capture and Compare functions is assigned to the same place. Correct it.

Synchronous Capture Axis (17)

Flowing Chart of Synchronous Cap. Axis

These settings are not done by PR-Write and should be well prepared at first.
1. E-Cam curve is ready in the servo drive.
2. All the parameters of E-Cam are done. (P1-44, P1-45, P5-19, P5-81~85)
3. P5-36, and P5-56 are assigned appropriate.
4. Set P5-59.EDC, and ignore P5-59.BA.
5. The homing procedure is well defined.
6. P5-78, pulse number between 2 marks.
7. P5-80, correcting rate (1%~90%).

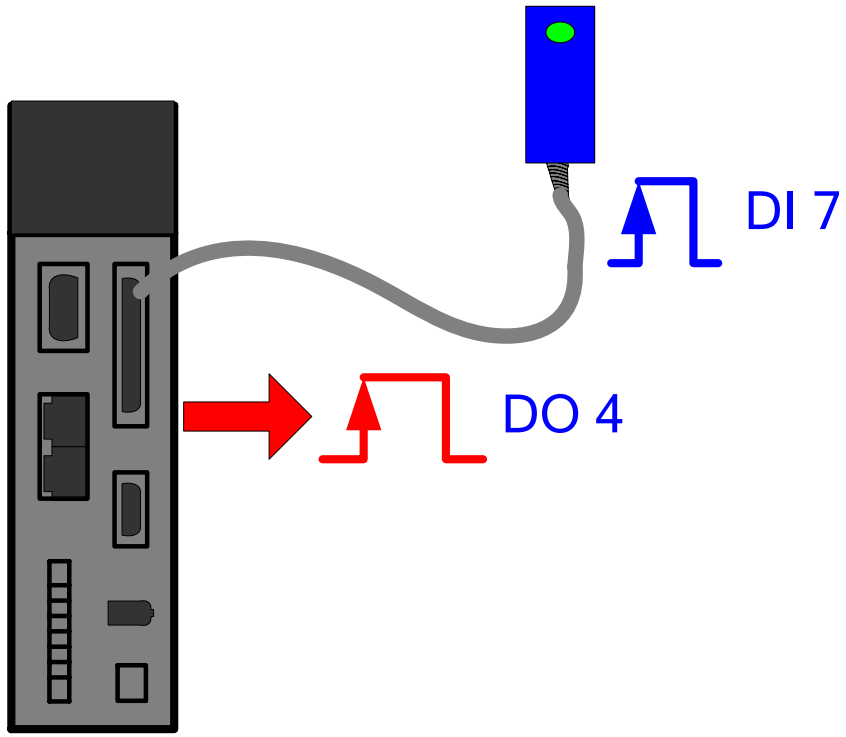
The procedures below are done by PR-Write.



Synchronous Capture Axis (18)

DI7 and DO4

While applying Synchronous Capture Axis function, do not assign any function codes to DI7 and DO4 respectively. The Capture function needs DI7 while the Compare function will send signal to DO4.



Synchronous Capture Axis (19)

The PR Sample

This is a sample of how to start an E-Cam system. The users can modified this one to fit their own applications.

Procedure for normal starting and revising masking length.

1

PR	Homing procedure.	Go back to 0.	Stop macro instruction.	Stop E-Cam.	
#0	Home X=? Offset=0 PR#1	#1 Position(3) D=0, S=10.0 rpm 0 PUU, ABS	#2 (I) Write DLY=0 ms P5-97=0	#3 (I) Write DLY=0 ms P5-88=0x0250	#4 (I)

PR	Stop Capture function.	The number of pulse for masking length.	Start macro instruction.	Start E-Cam.
#4 (I)	Write DLY=1 ms P5-39=0x0020	#5 (I) Write DLY=0 ms P5-96=8000	#6 (I) Write DLY=0 ms P5-97=1	#7 (I) Write DLY=0 ms P5-88=0x0251

For some changes (E-Cam curve for example), it should be called. After the parameters set, call 1 to start system again.

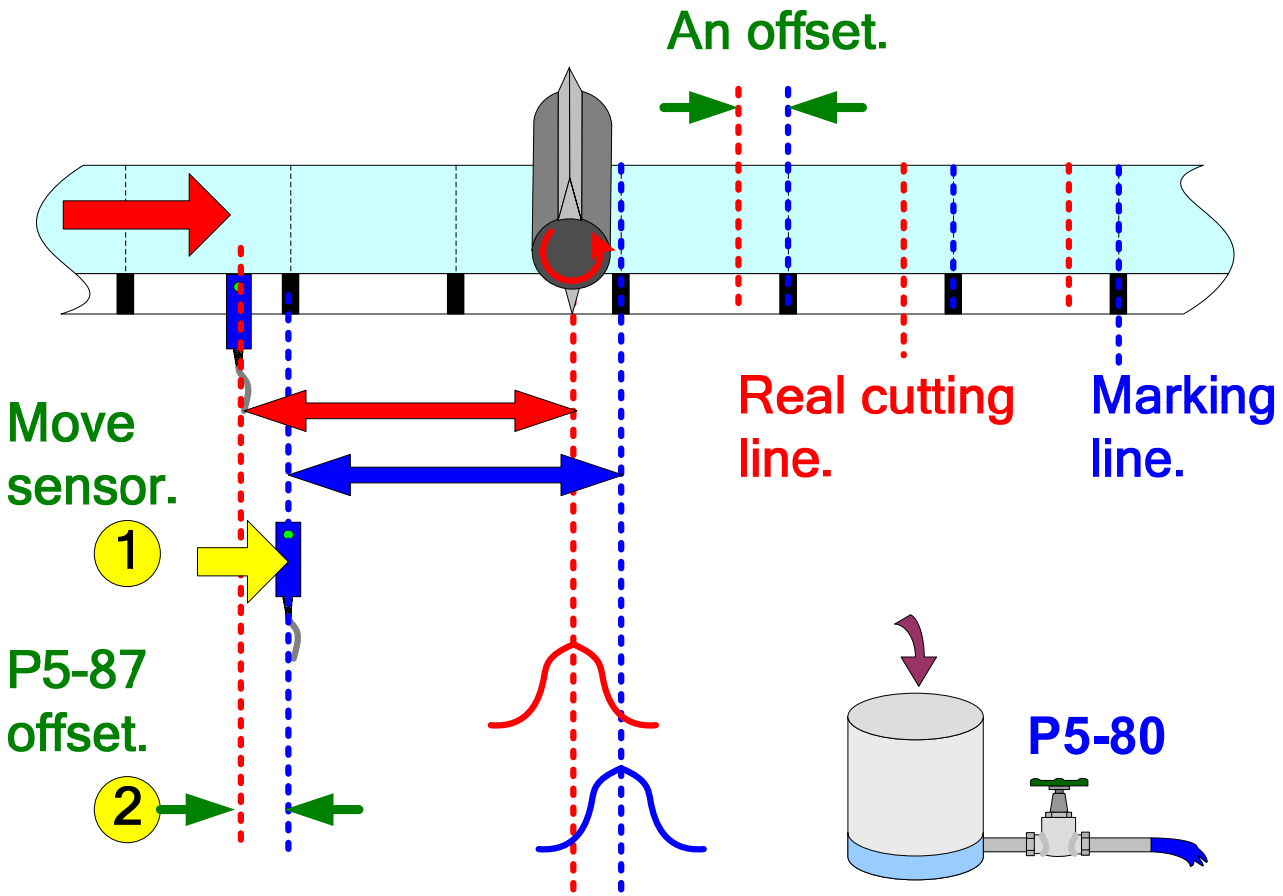
2

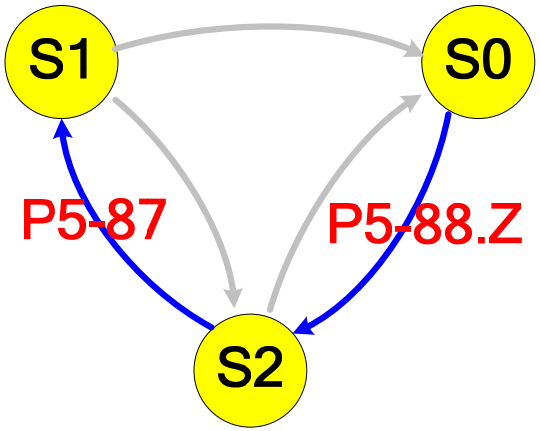
PR	Stop macro instruction.	Stop E-Cam.	Stop Capture function.
#10 (I)	Write DLY=0 ms P5-97=0	#11 (I) Write DLY=1 ms P5-88=0x0250	#12 (I) Write DLY=0 ms P5-39=0x0020

Synchronous Capture Axis (20)

Offset Tuning Dynamically

The P5-79 can be used to adjust the offset without stopping the system.





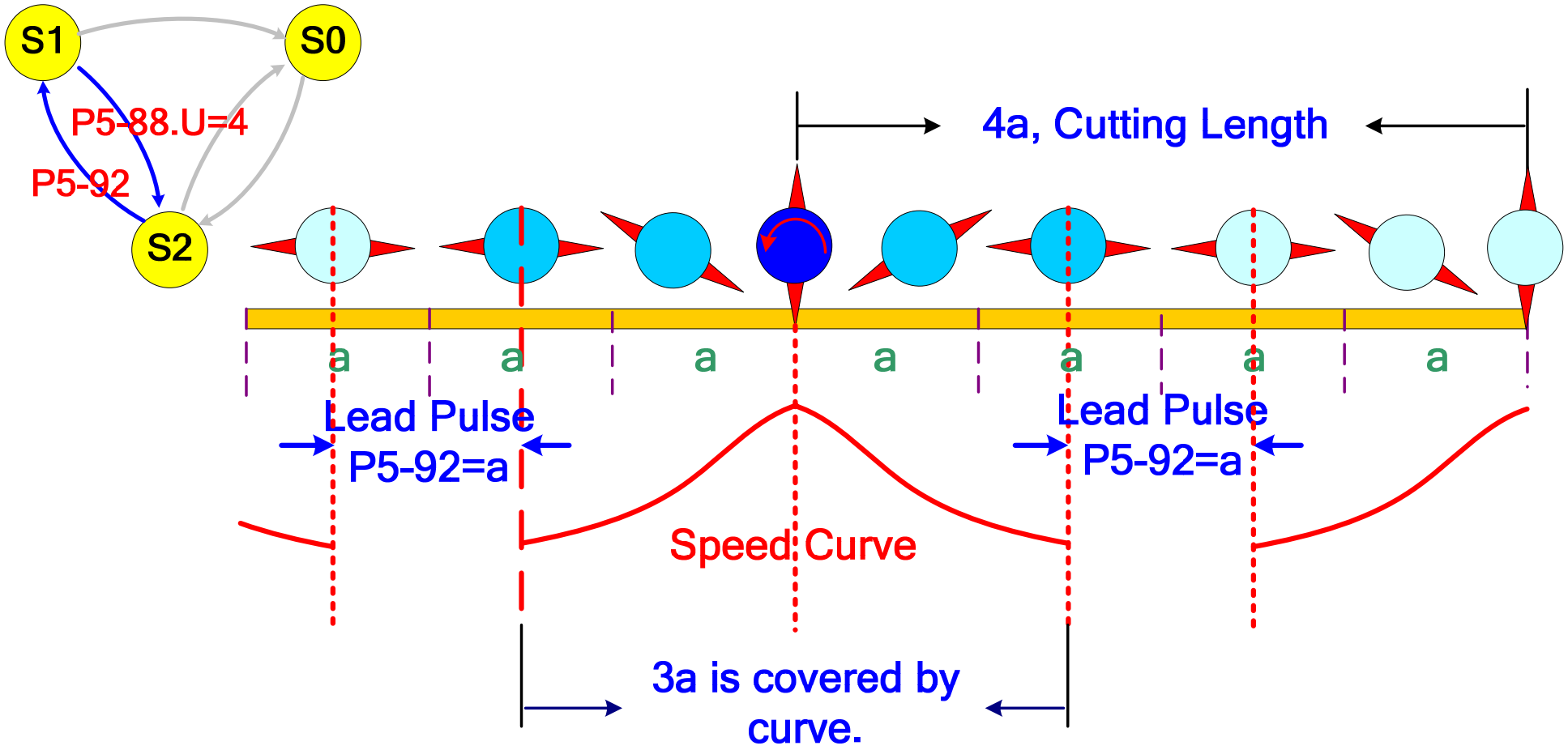
P5-87= P5-79 (1) + P5-79(2) +…

Manually key in P5-79 for testing offset. When the cutting position is correct, sum up all the values into P5-87.

Tips of Application (1)

Cutting Longer Length than Curve Can Do

The Number 4 disengaging term can be used to the case whose cutting length is longer than its E-Cam curve design.

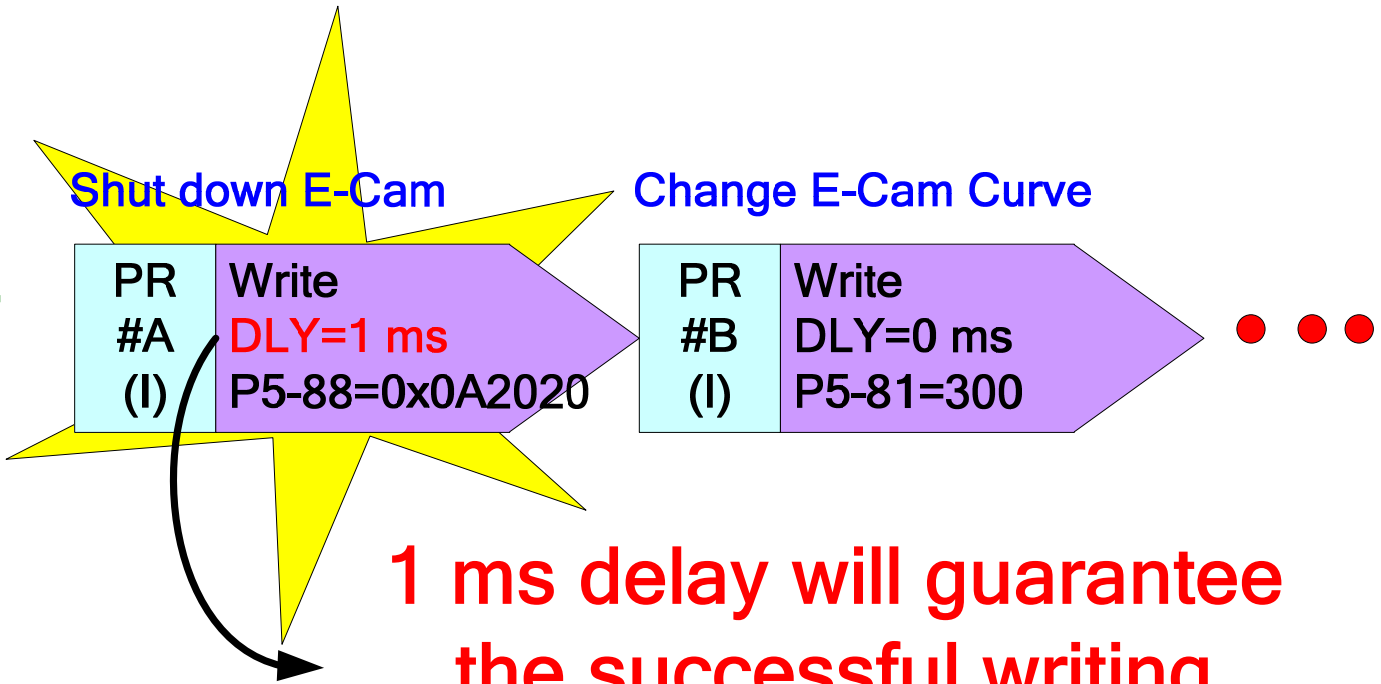


Tips of Application (2)

One millisecond Delay in PR

The one millisecond delay sometimes is necessary to guarantee the following PRs will have the correct operation. 1 ms delay can make sure the PR will have monopoly time without overlapped it content.

P5-88.U=2
(Disengage when P5-89 reached.)
P5-88.BA = PR#A

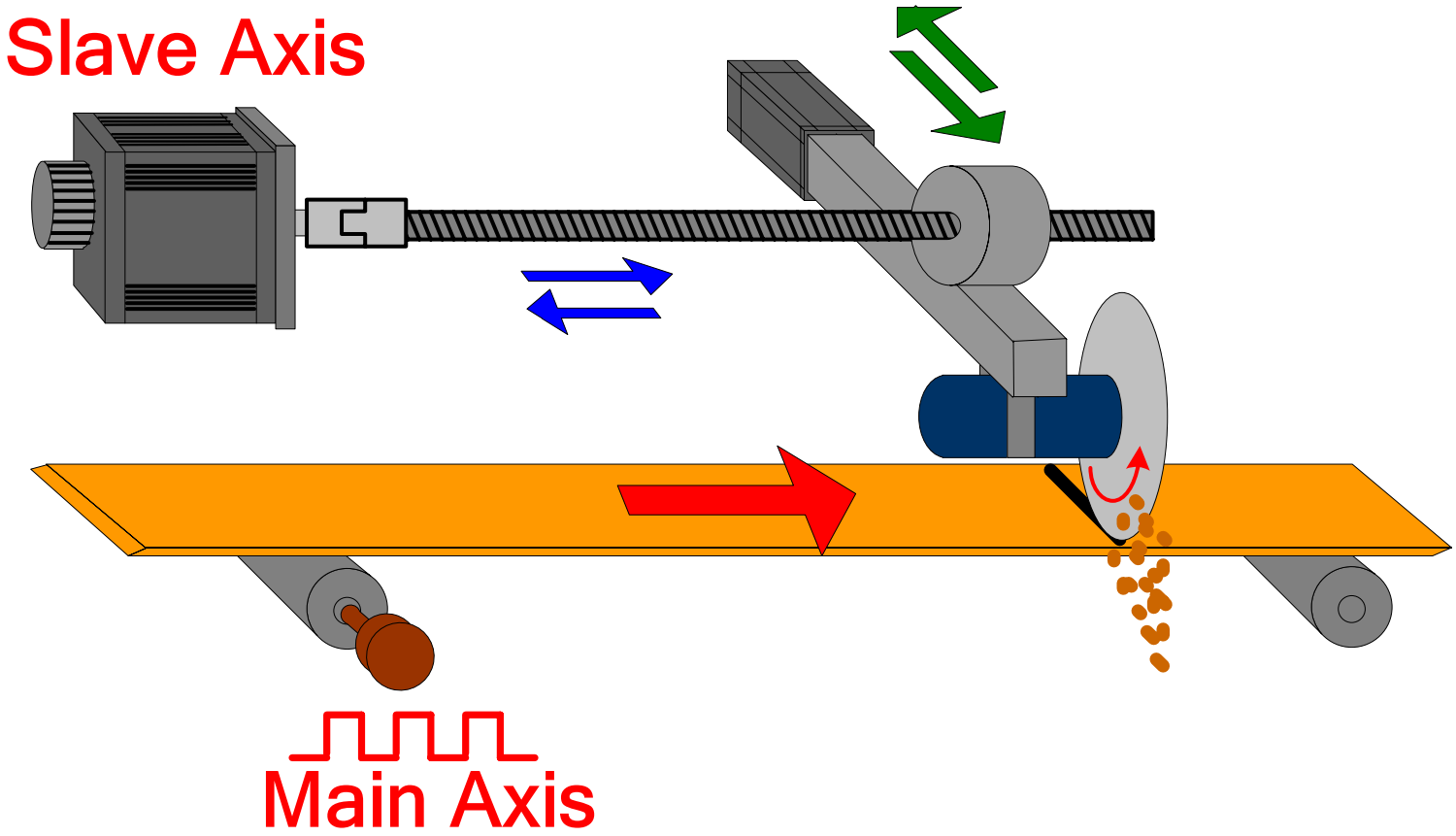


1 ms delay will guarantee the successful writing without interrupting.

Flying Shear (1)

What is it?

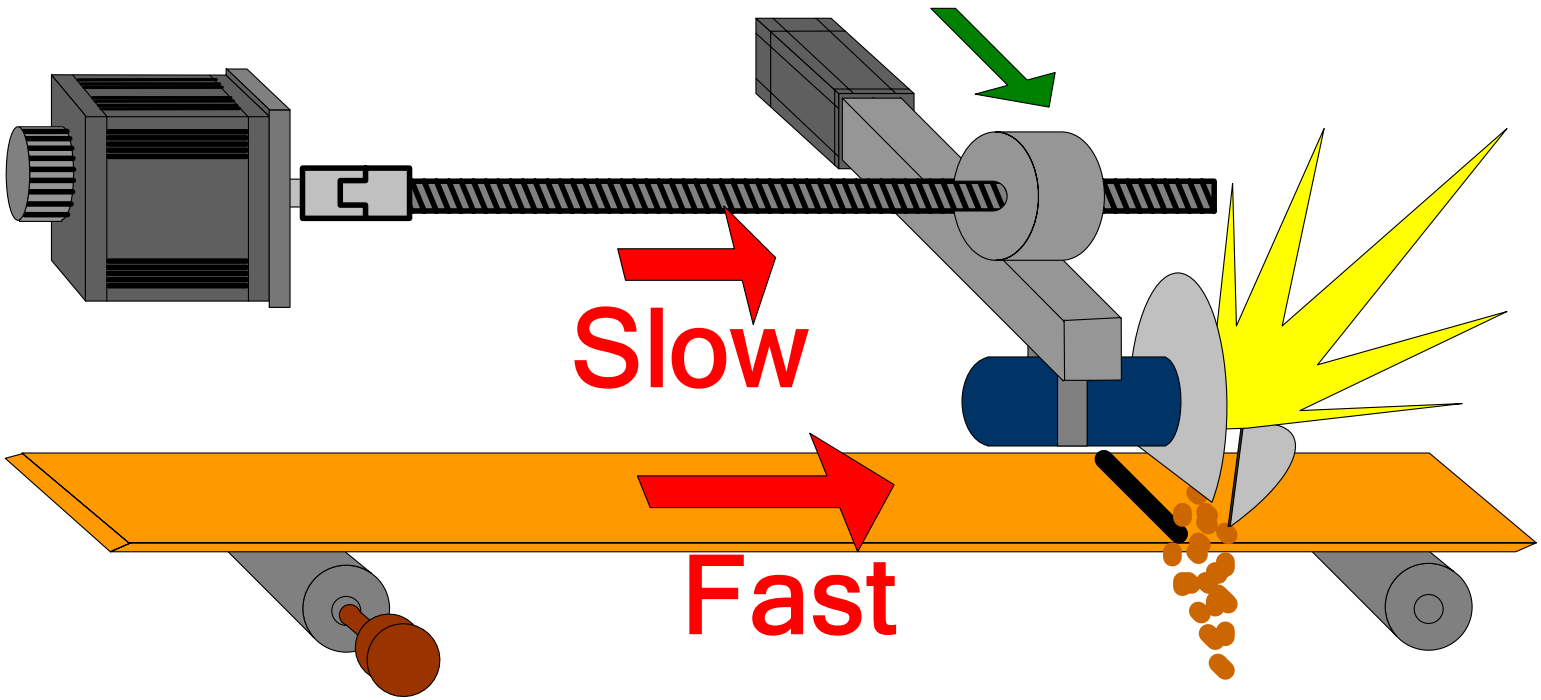
The flying saw will travel along with its material by a long relative zero speed zone. It is cutting without stopping. The relative zero speed zone should be long enough for the flying saw to finish its cutting job.



Flying Shear (2)

What is the problem of speed difference?

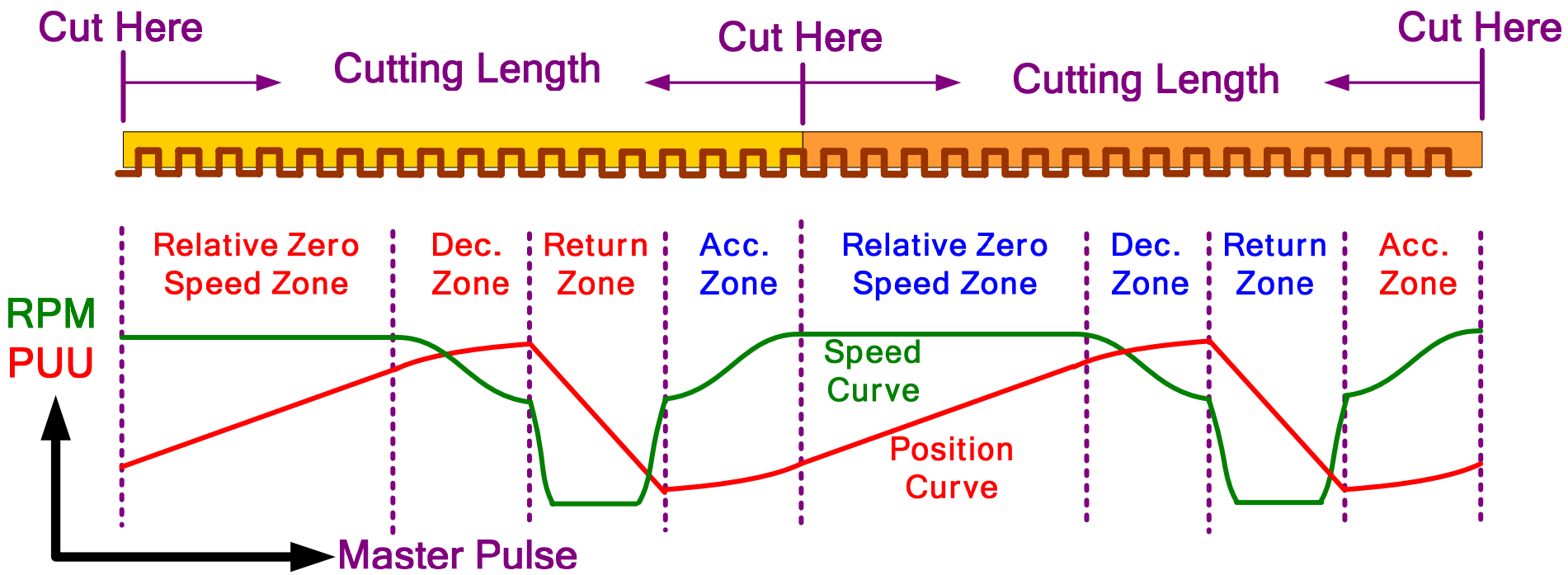
If relative speed exists while cutting, it could damage the machine.



Flying Shear (3)

The Full-engaging Application

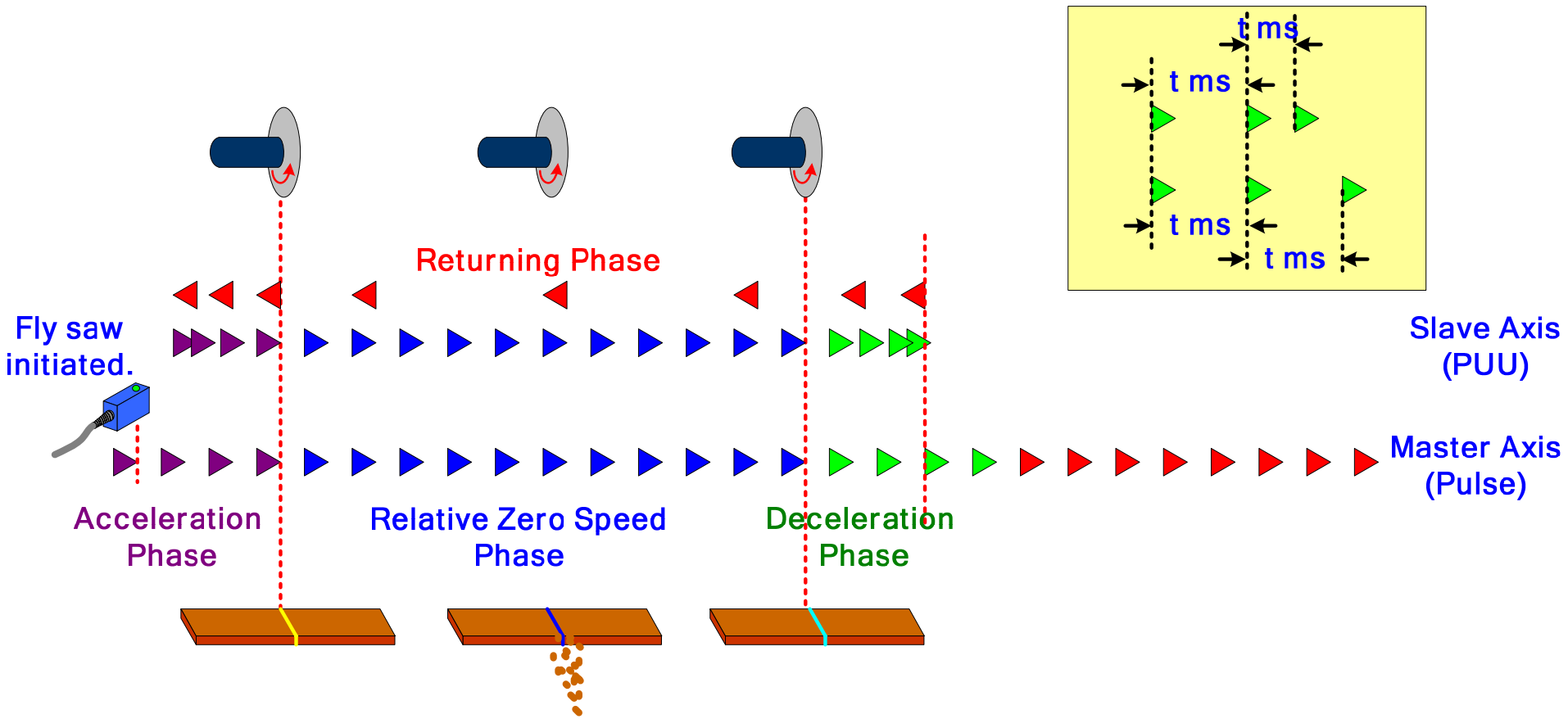
The E-Cam keeps engaging once it starts the cycle. There will be Acceleration zone, Relative zero speed zone, Deceleration zone, and Return zone in a cycle.



Flying Shear (4)

The Cycle

The time span between every two dot is identical no matter how the distance or direction is.

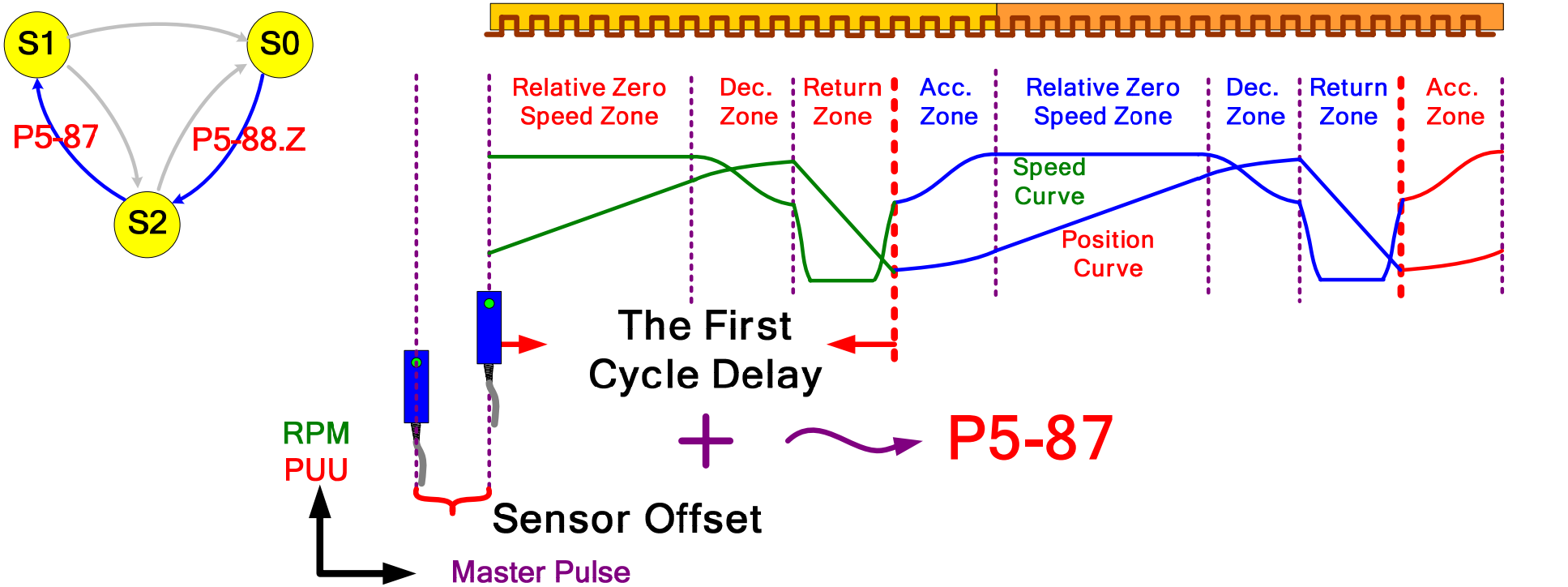


Depict the positions of master and slave axes every t ms.

Flying Shear (5)

The Beginning of the First Cycle

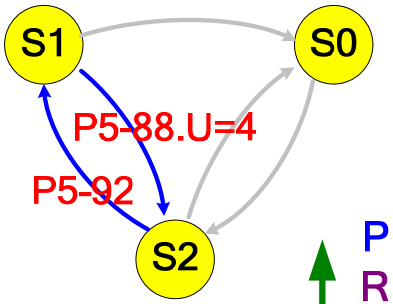
A cycle always starts from Acceleration phase. Therefore, for the first cycle, a delay of initiating cycle is necessary. The P5-87 is the right parameter to this application.

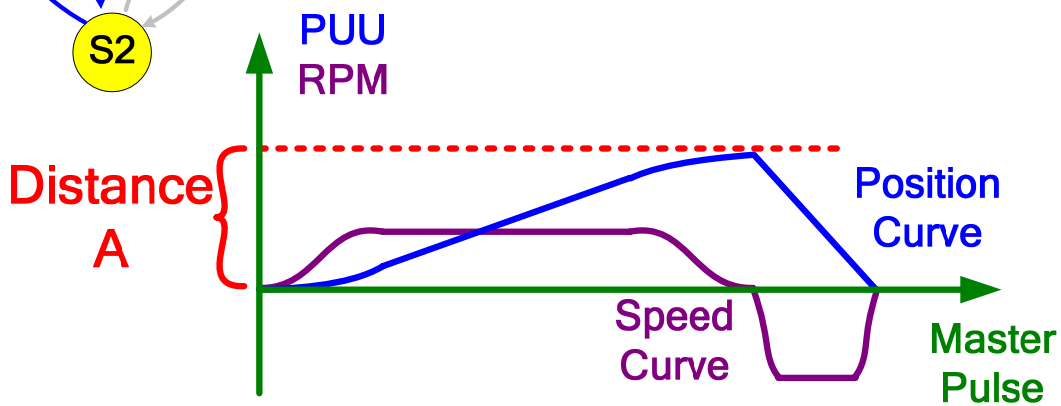


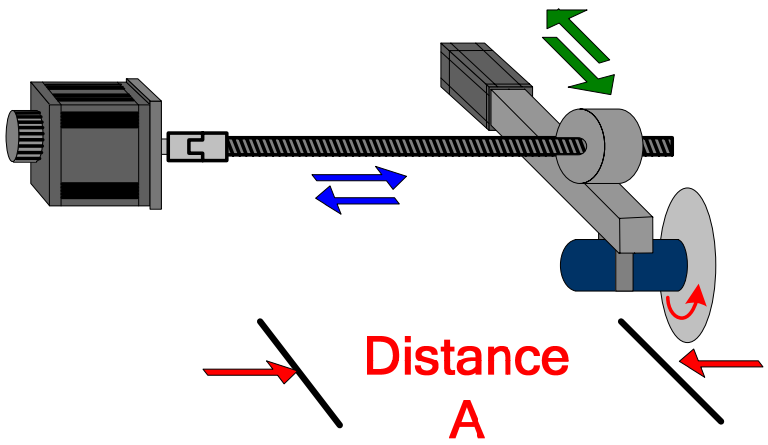
Flying Shear (6)

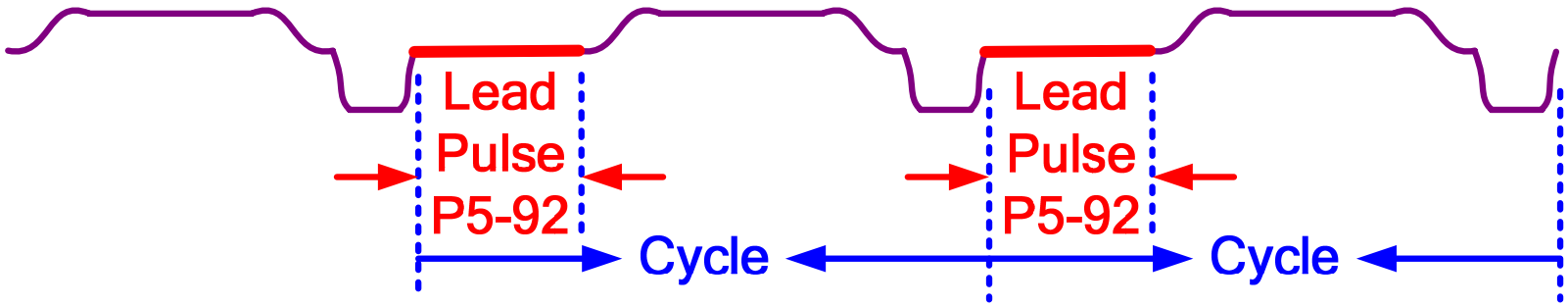
Cutting a Longer Length than Curve Set

The #4 disengaging term with LEAD PULSE can be used.





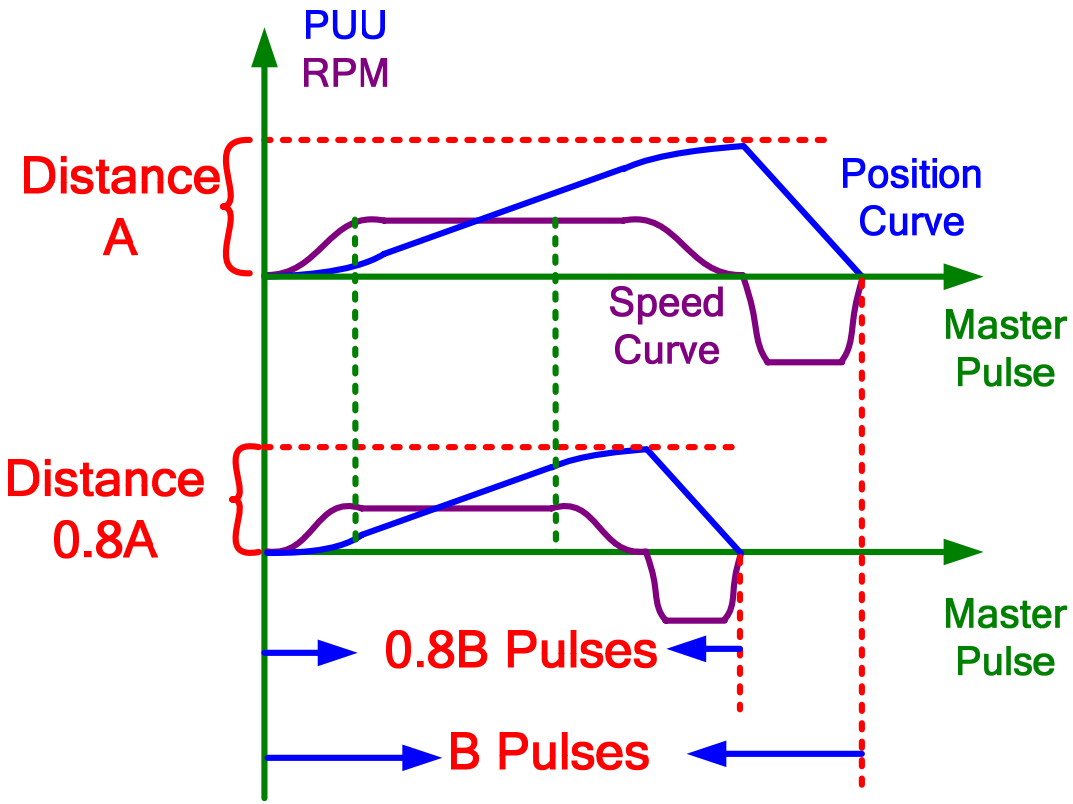


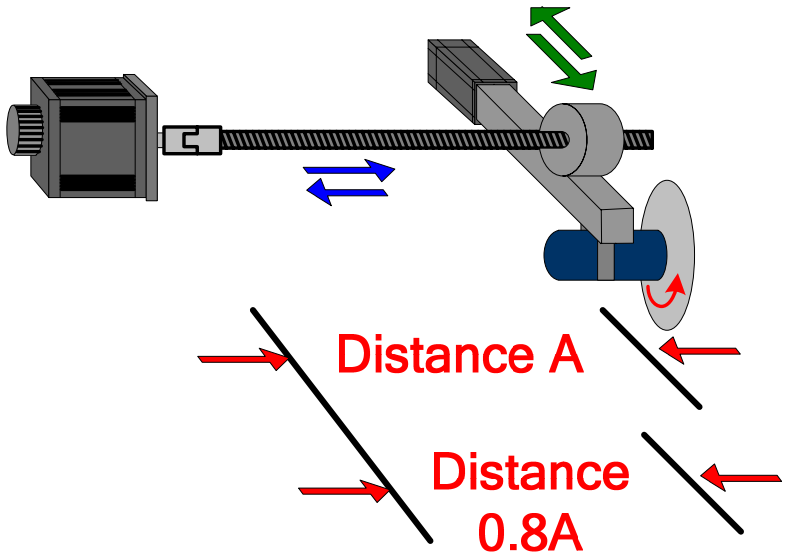


Flying Shear (7)

Cutting a Shorter Length than Curve Set

The P5-19 for scaling curve can be used.



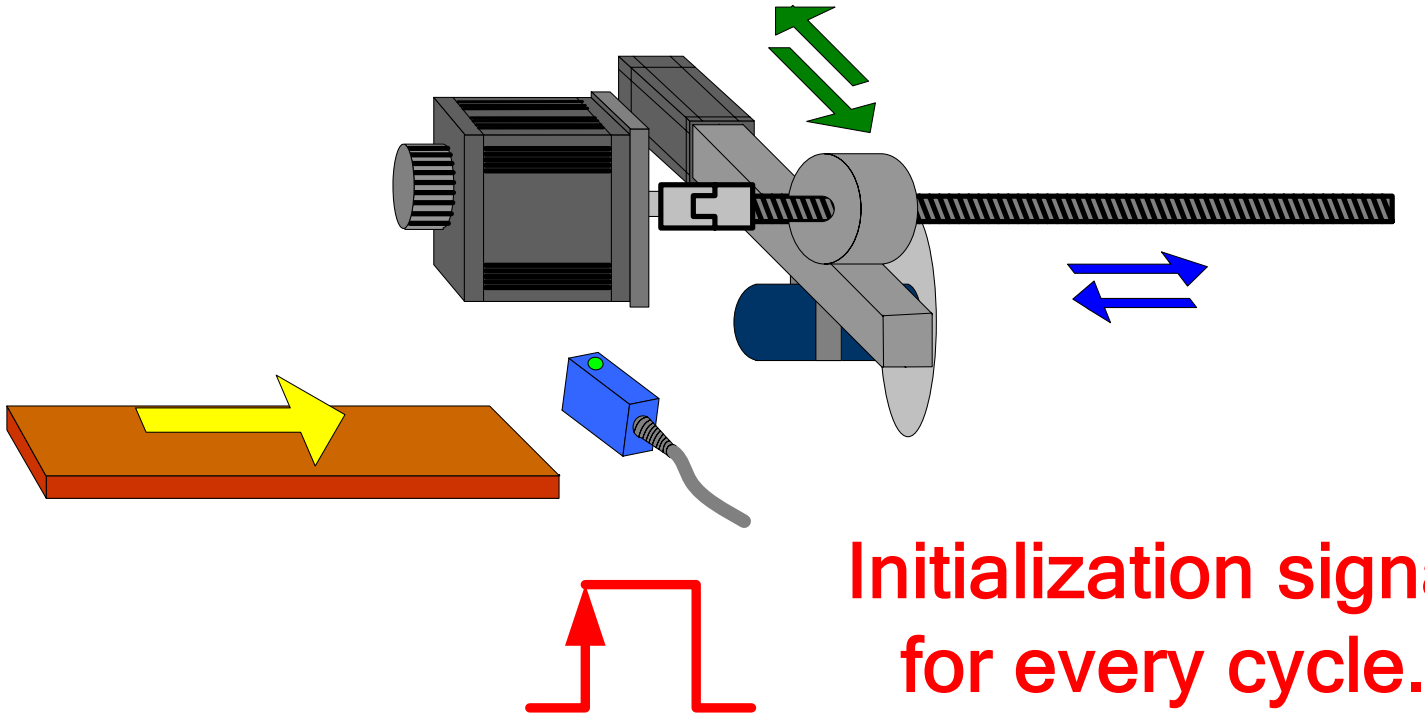


The relative zero speed zone will be shortened. Check if it is long enough for flying saw to finish cutting job.

Flying Shear (8)

The Partial-engaging Application

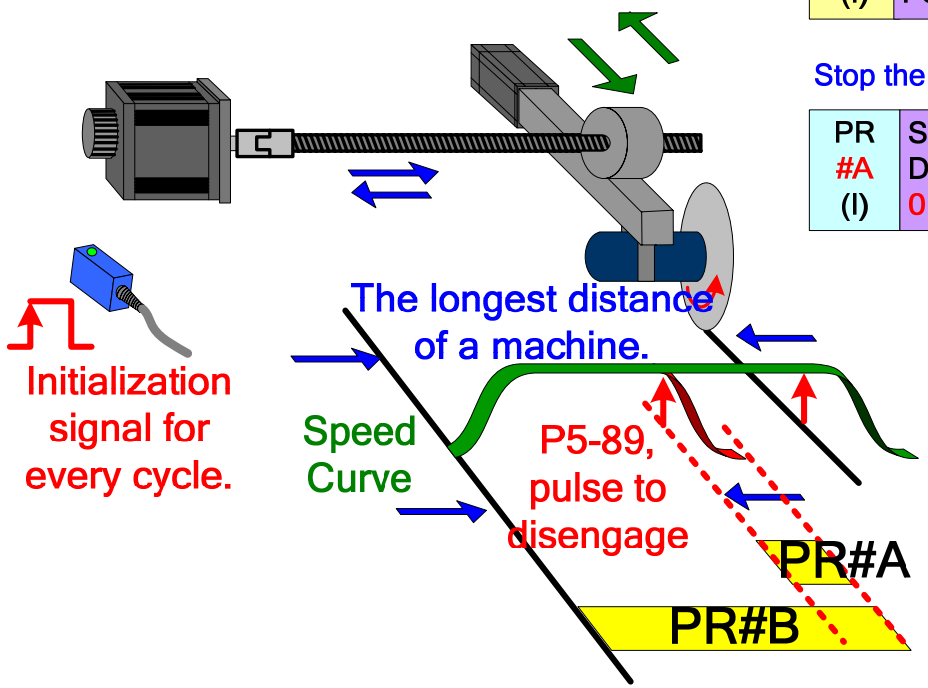
For the application with available initiation signal every cycle, the E-Cam can be disengaged every cycle and engaged in the next.



Flying Shear (9)

A Curve with Long Relative Zero Speed Zone

A curve with relative zero speed zone longer than the distance of a machine can move is made for all shorter cutting cases.



P5-88.Y=0, P5-88.Z=2, P5-88.U=E (6+8), P5-88.BA=PR#A

Reset Capture.

PR	Write
#1	DLY=0 ms
(I)	P5-39=0x020

Reset E-Cam.

PR	Write
#2	DLY=0 ms
(I)	P5-88=0x0AE200

Jump to Initial procedure.

PR	Jump
#3	DLY=0 ms
(I)	PR#C

PR #C

Stop the motor.

PR	Speed
#A	DLY=0 ms
(I)	0 rpm

Go back home position.

PR	Position (3)
#B	D=0, S=1000 rpm
(I)	0 PUU, ABS

Initial Capture Function (1).

PR	Write
#C	DLY=0 ms
	P5-38=1

PR #D (I)

Initial Capture Function (2).

PR	Write
#D	DLY=0 ms
(I)	P5-39=0x021

Initial E-Cam.

PR	Write
#E	DLY=0 ms
(I)	P5-88=0x0AE201

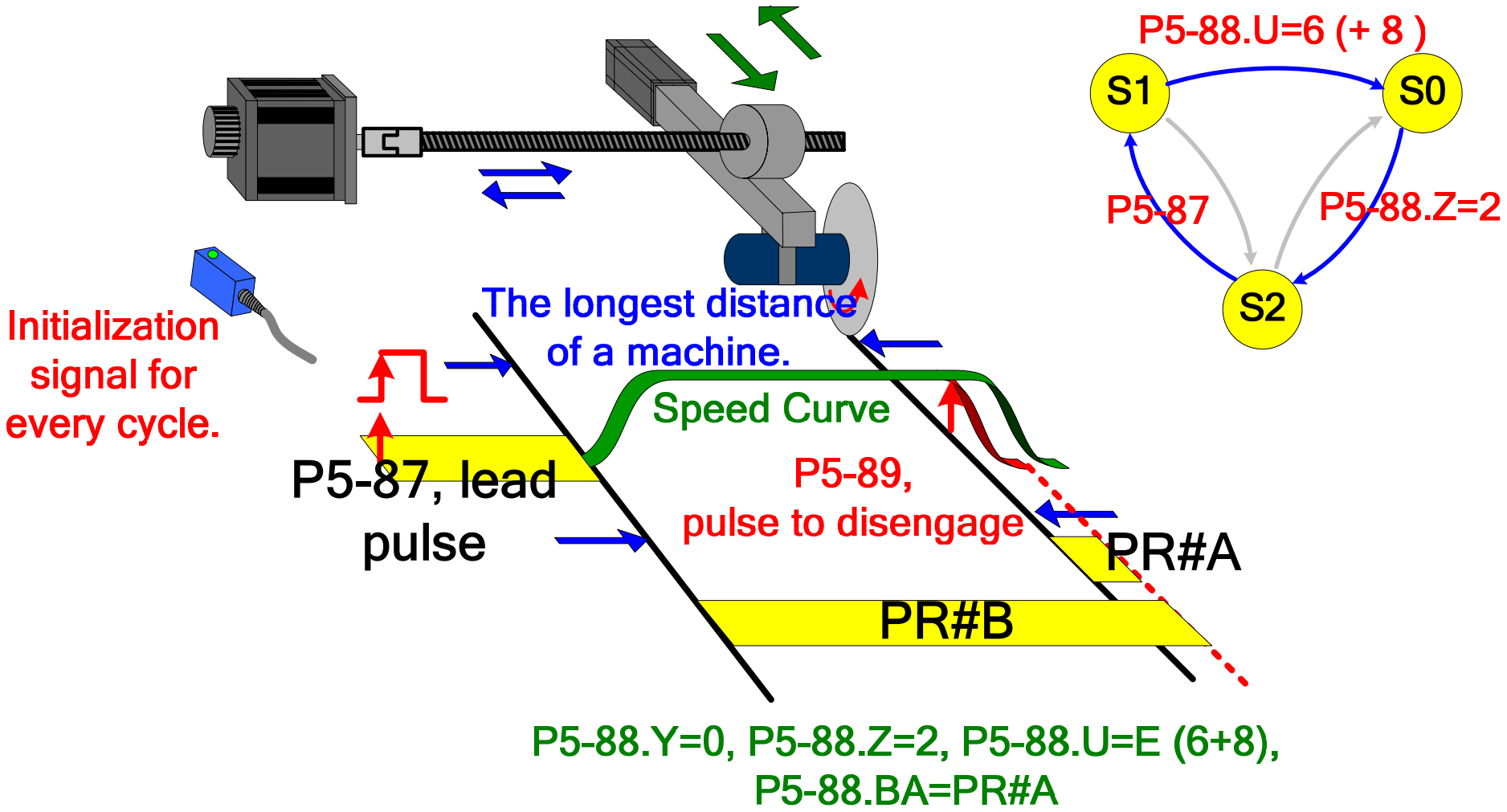
PR #1 (I) This PR is called at the first time.

PR #A (I) This PR is called when E-Cam disengaging.

Flying Shear (10)

Long Cutting Length of Partial-engaging

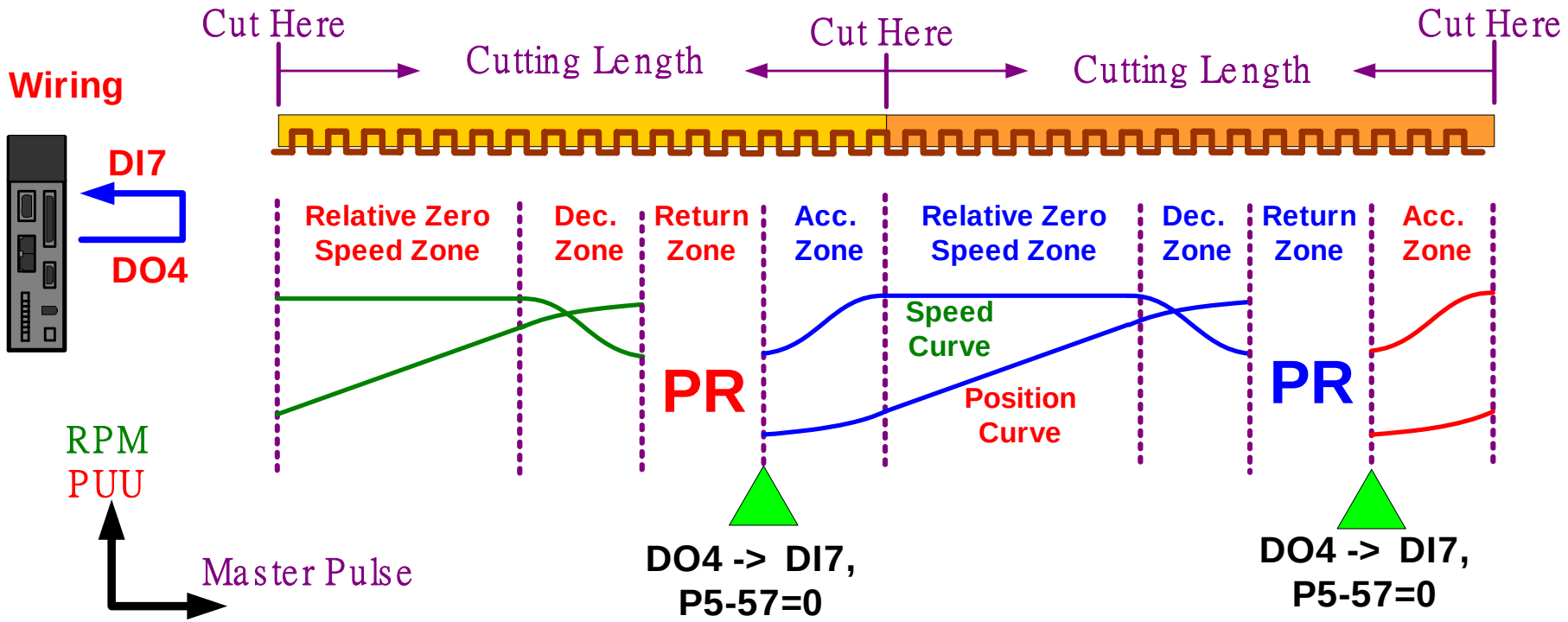
When the cutting length is longer than the machine path, P5-87 is set for enlarging cutting length.



Flying Shear (11)

Capture and Compare for Initialization Signal

The Compare function can be used to generate initialization signal every cycle.



Compare data array: The pulse number of cutting length.

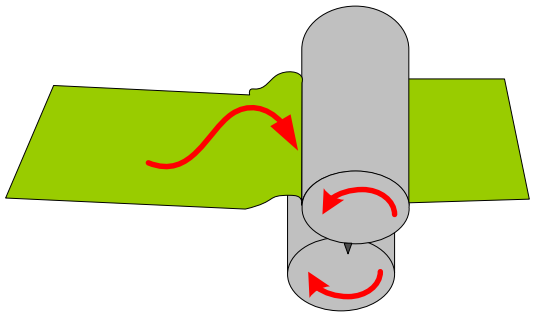
P5-58=1, compare only one item per cycle.

P5-59.X: Bit 3: Reset P5-57 when finishing all comparisons.
Bit 1: Cycle mode, keep comparing without stop.
Bit 0: Start comparing.

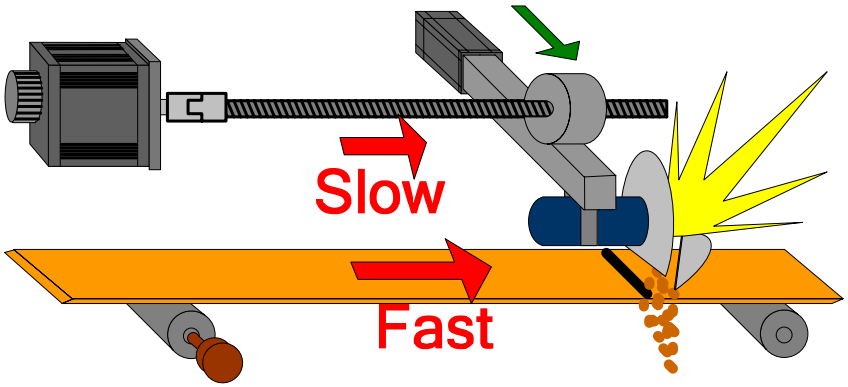
Important Notice

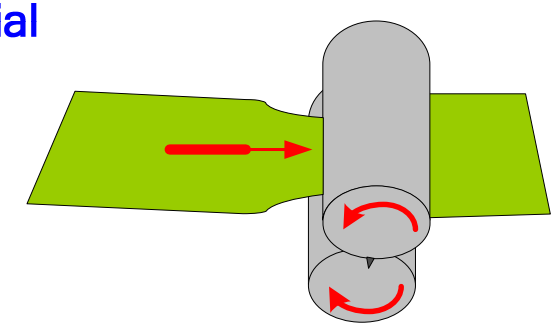
Do Not Use Synchronous Cap. Axis on Flying Saw

The flying shear should NOT be used associated with Synchronous Capture Axis. The speed adjustment will lead to damage a machine. This is because of its mechanism is different from rotary shear.



Fast Material



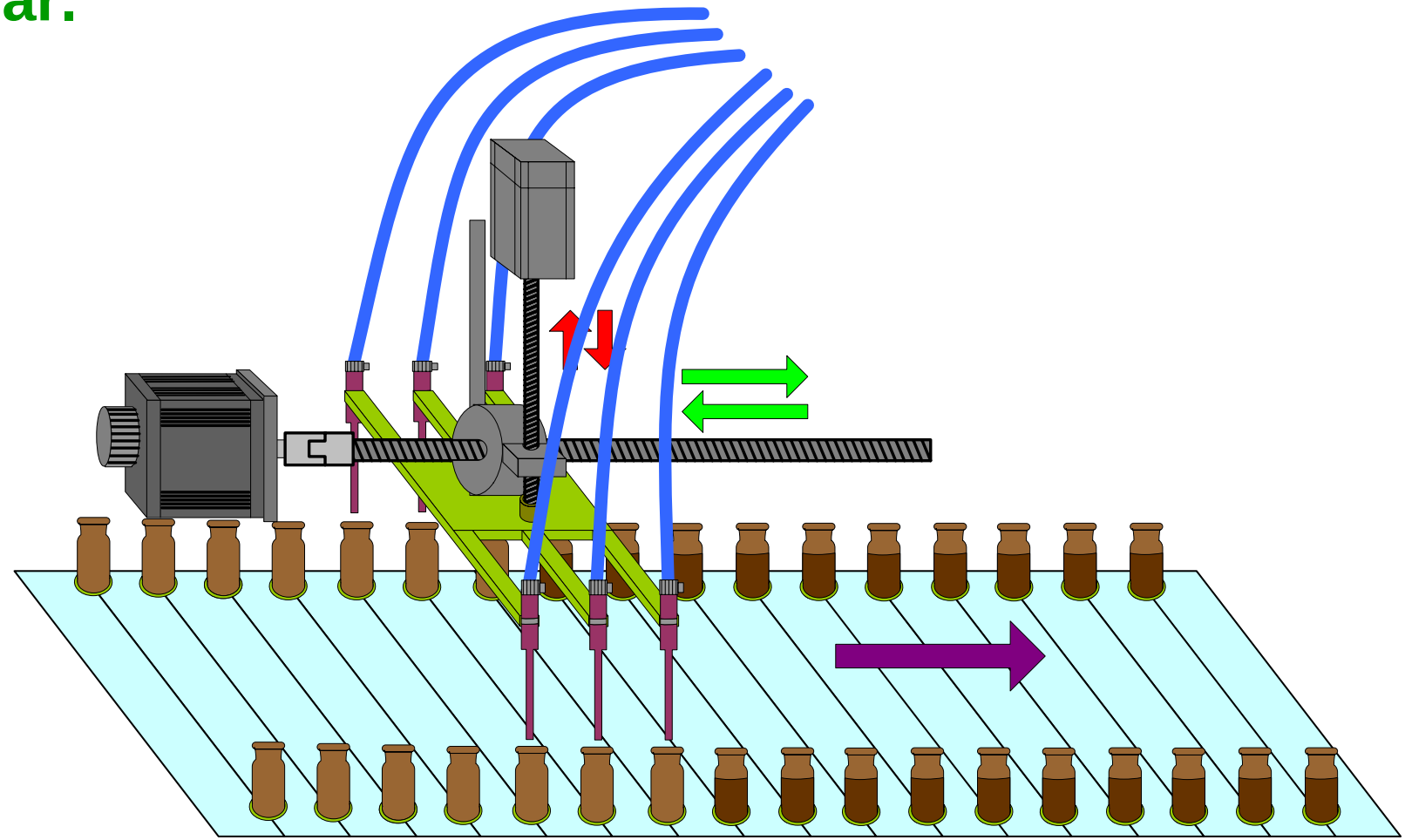


Slow Material

Example of Flying Shear (1)

The Filling Machine

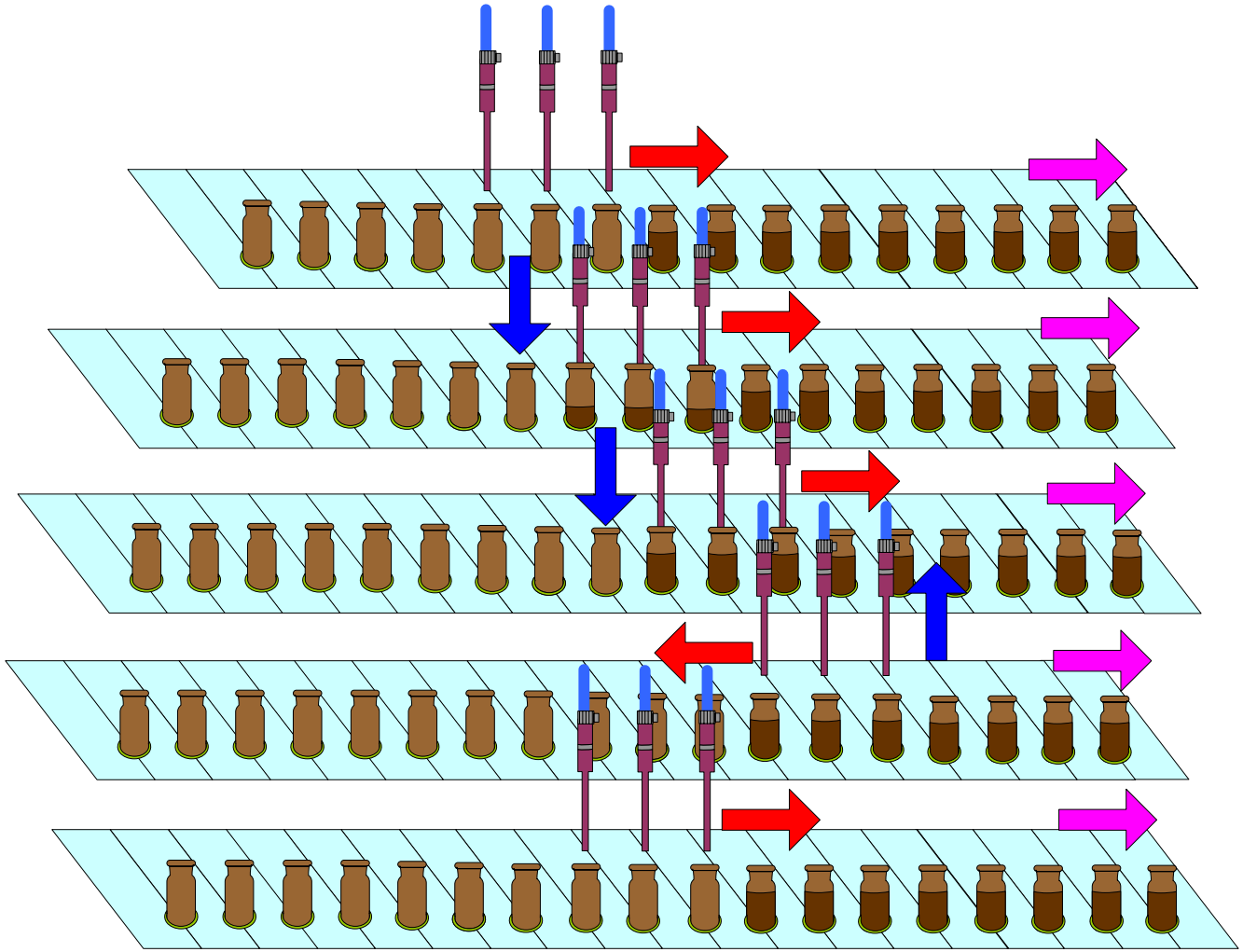
The filling machine shares the same theory of flying shear.



Example of Flying Shear (2)

How it works?

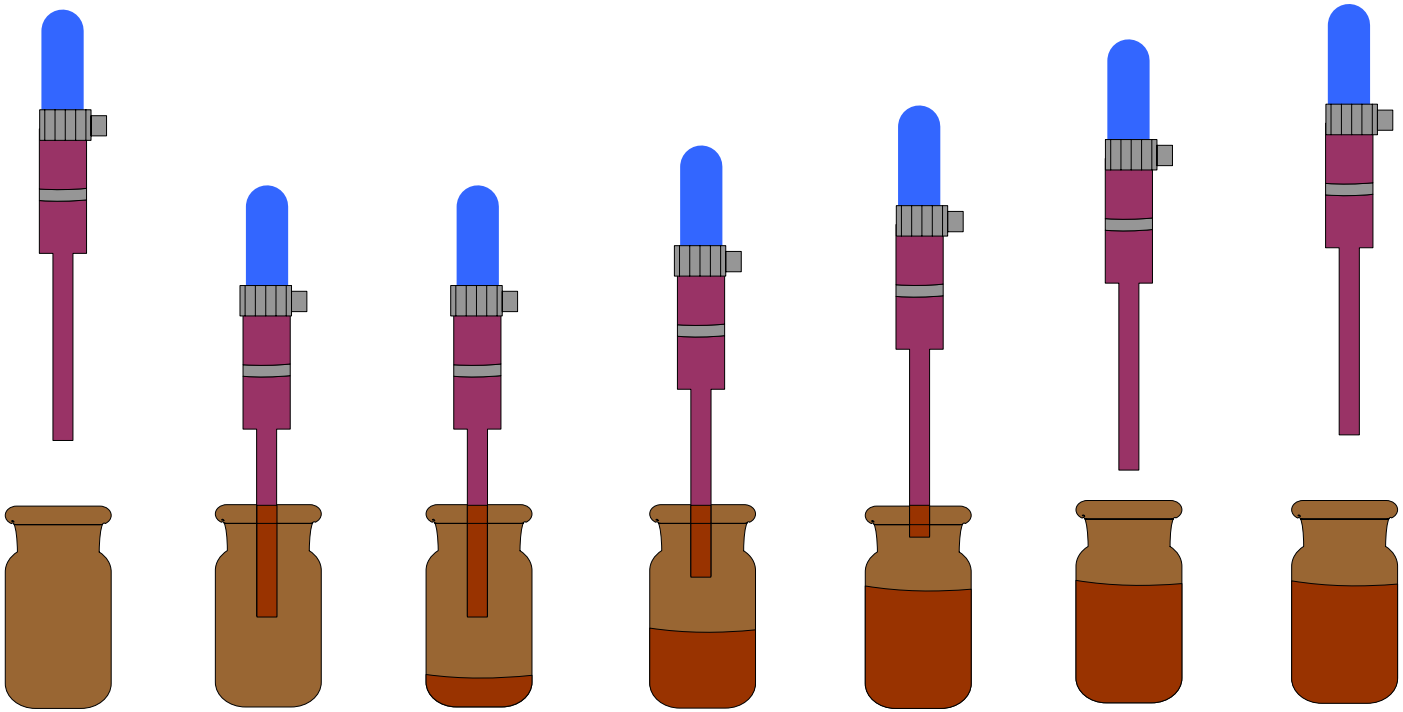
Every set of bottles will send out initialization signal for its cycle. The filling pins will have a relative zero speed with the whole bottle sets while filling.



Example of Flying Shear (3)

The Filling Pins

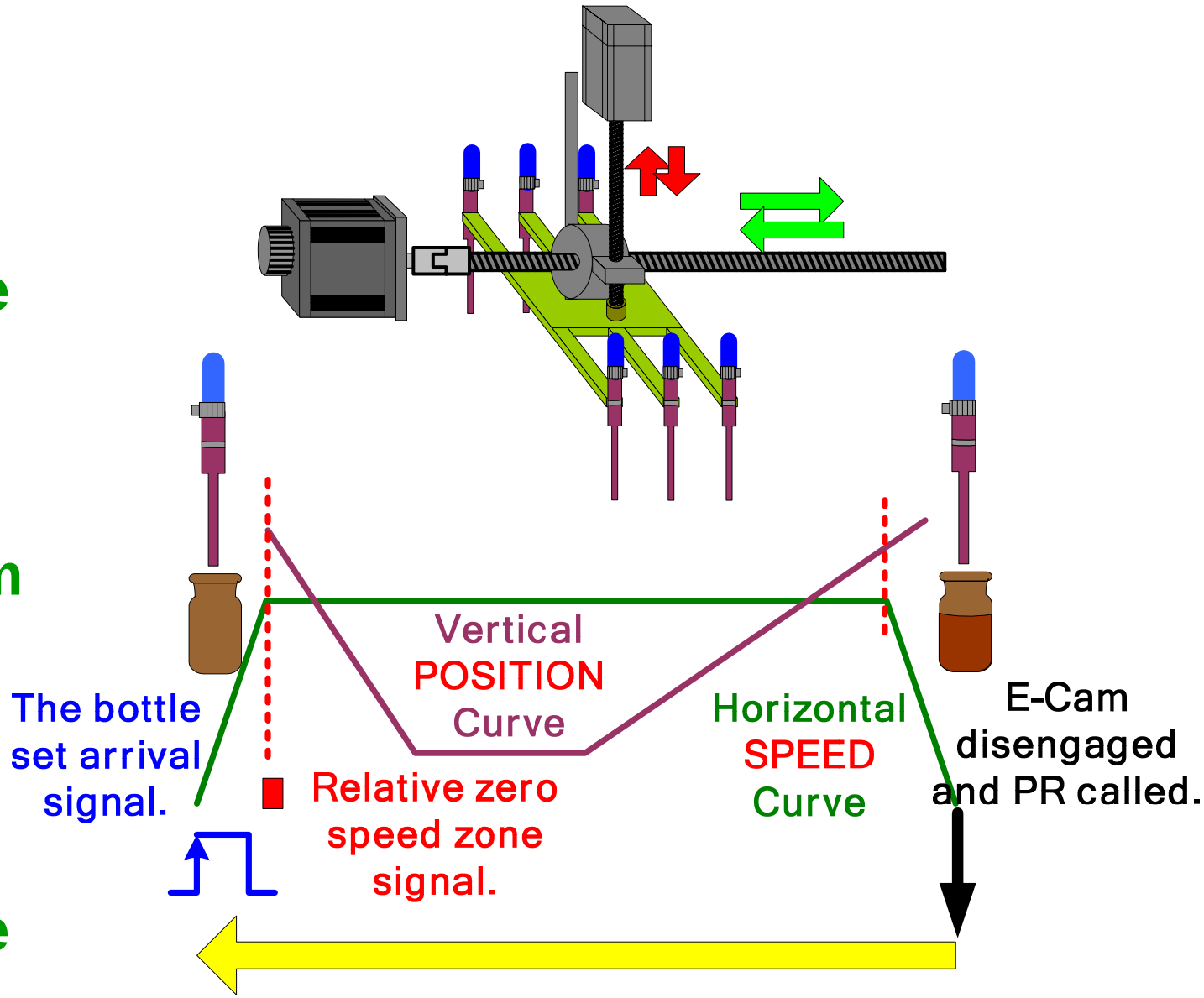
The whole filling pins will go down into the bottles and pour liquid into bottles at the relative zero speed zone.



Example of Flying Shear (4)

The E-Cam Curves

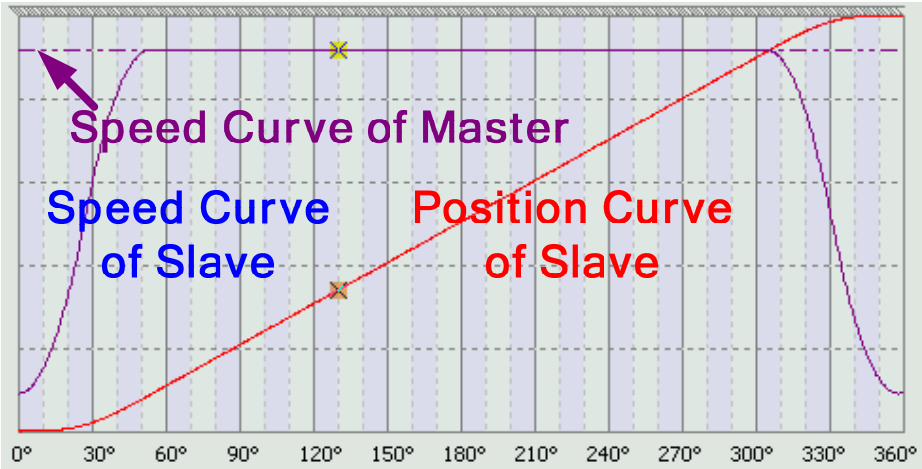
Two E-Cam curves is for coordinating the system of vertical and horizontal movement. From the bottle set arrival signal triggered to the pin set moved home by PR, the cycle is.

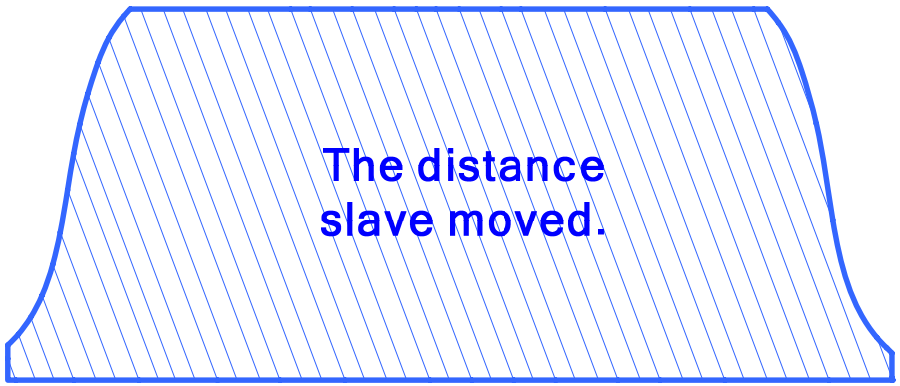


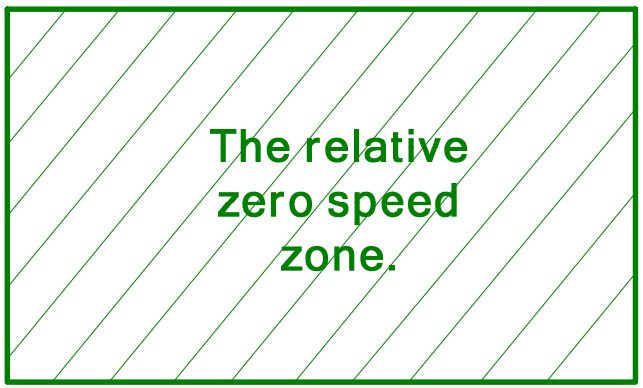
Example of Flying Shear (5)

The Travelling Distances

The main axis always moves longer distance than the one of slave.





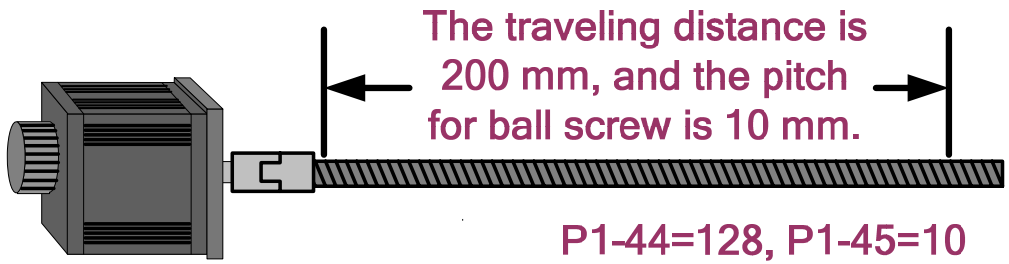


Example of Flying Shear (6)

The Specification of System

The master and slave specifications are as below.

Specification on Slave.



P1-44=128, P1-45=10
(100000 PUU for one revolution on servo drive)

200 mm / 10mm = 20 (turns), for the whole traveling distance.
100000 PUU * 20 = 2000000 PUU, command for the whole traveling distance.
100000 PUU / 10 mm = 10000 PUU/mm.

Specification on Master.

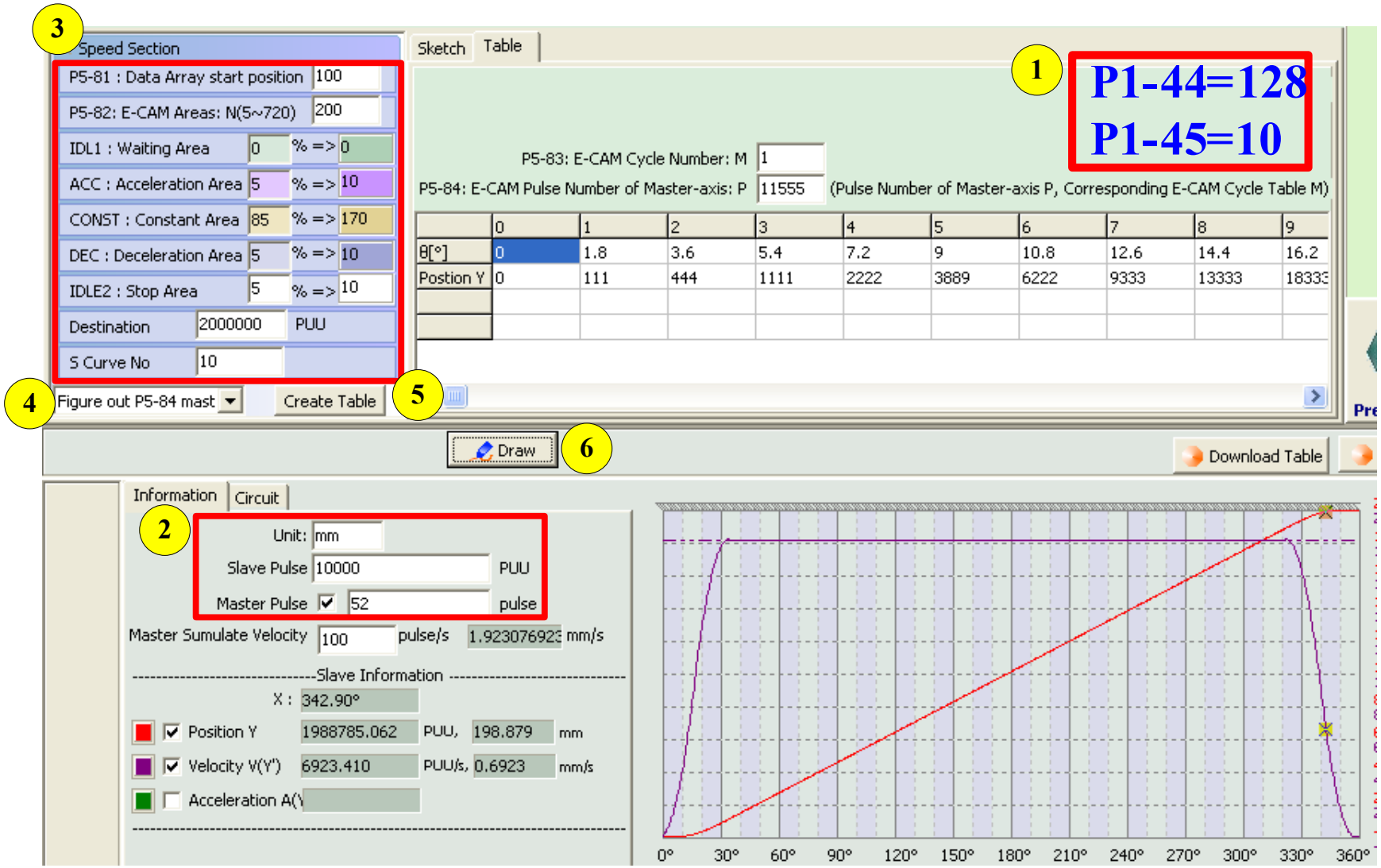
Encoder Pulse: 52 pulse / mm.

The distance of master will be greater than 200 mm.
200 * 52 =10400 (pulse)

Example of Flying Shear (7)

Start to Make Curve (1)

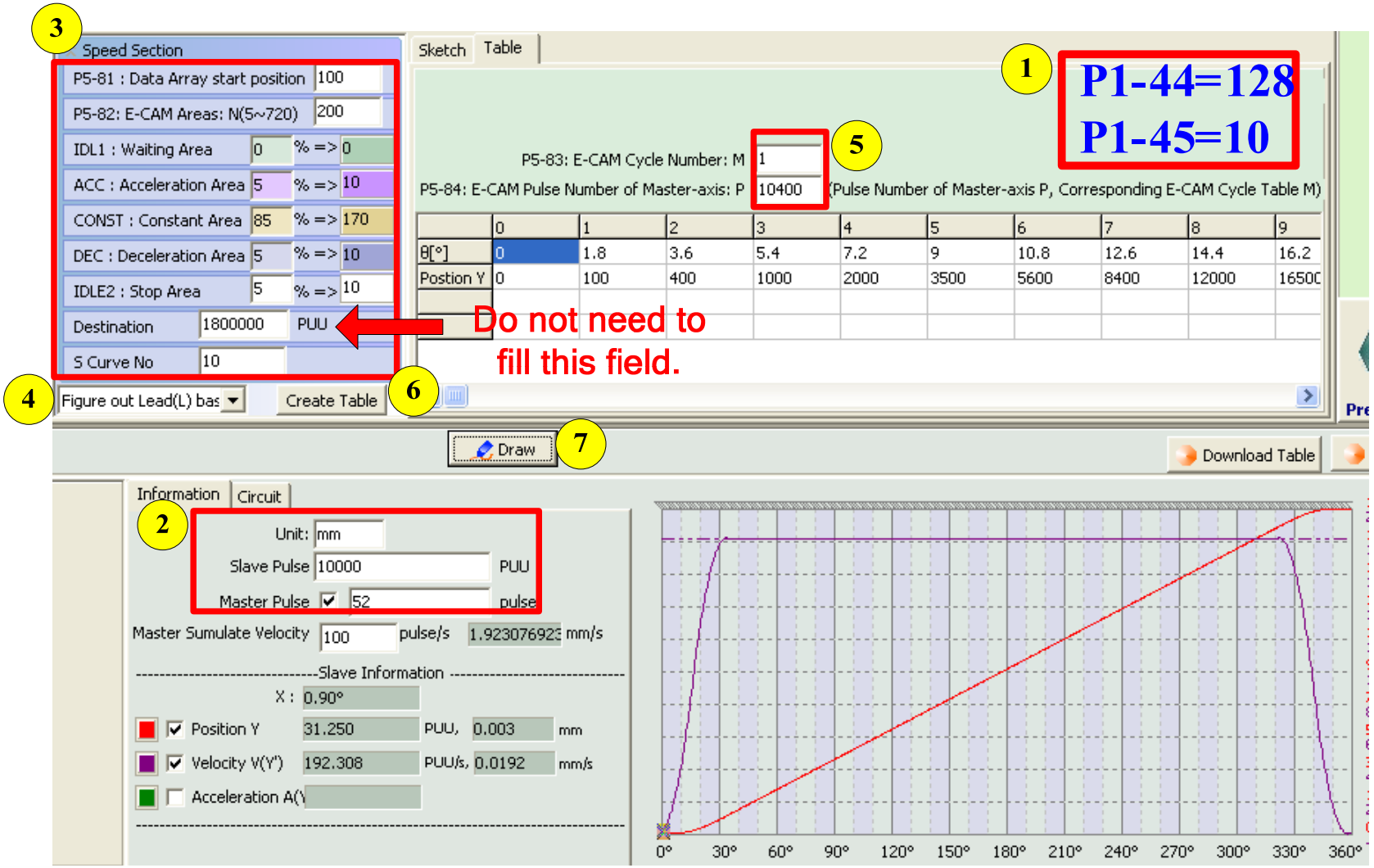
Base on the slave distance to make the E-Cam Curve.



Example of Flying Shear (8)

Start to Make Curve (2)

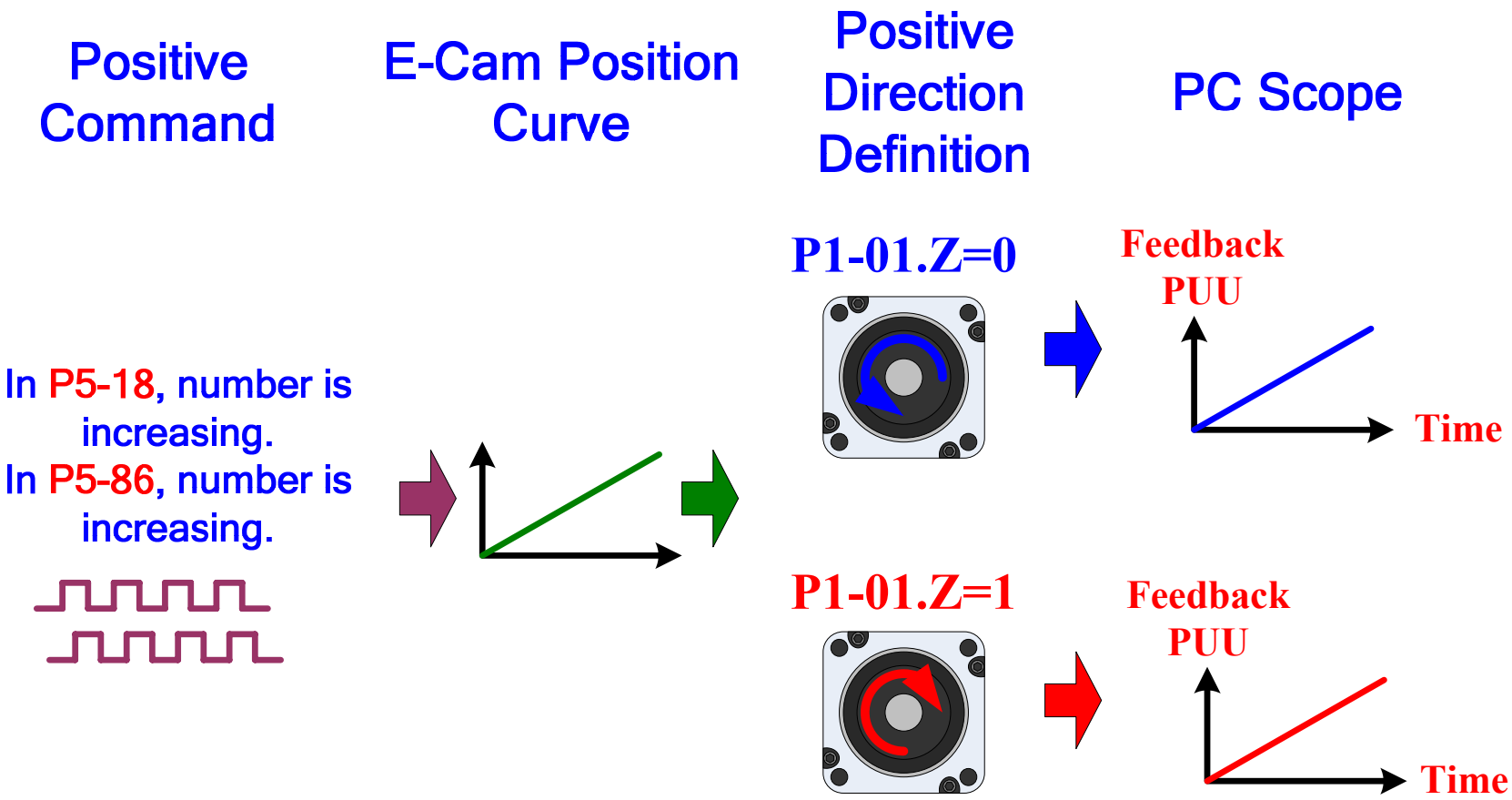
For some application, it could base on the distance of master.



Example of Flying Shear (9)

The Direction of Servo System

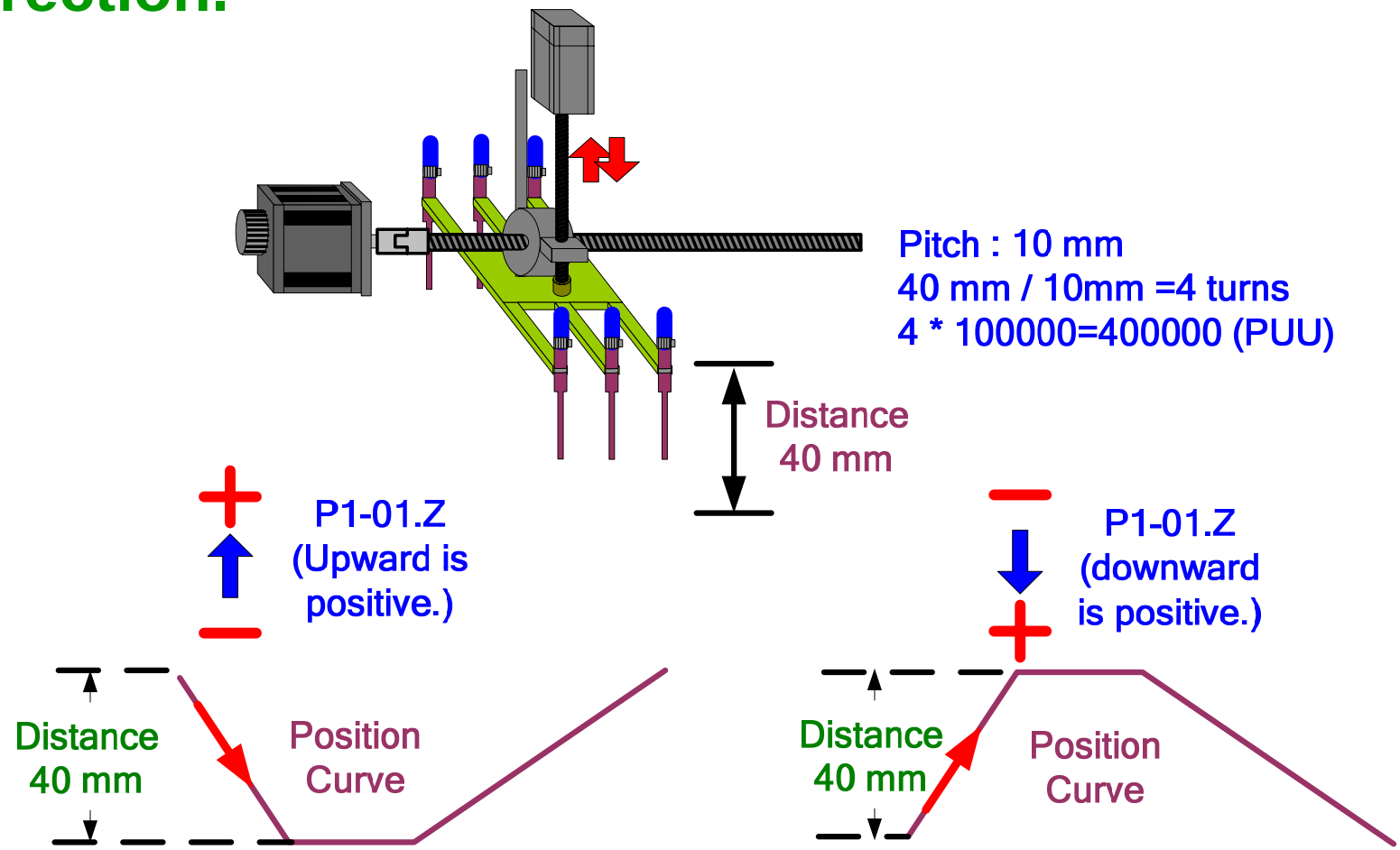
The definition of POSITIVE direction is by increasing ENCODER PULSE NUMBER.



Example of Flying Shear (10)

The Filling Axis

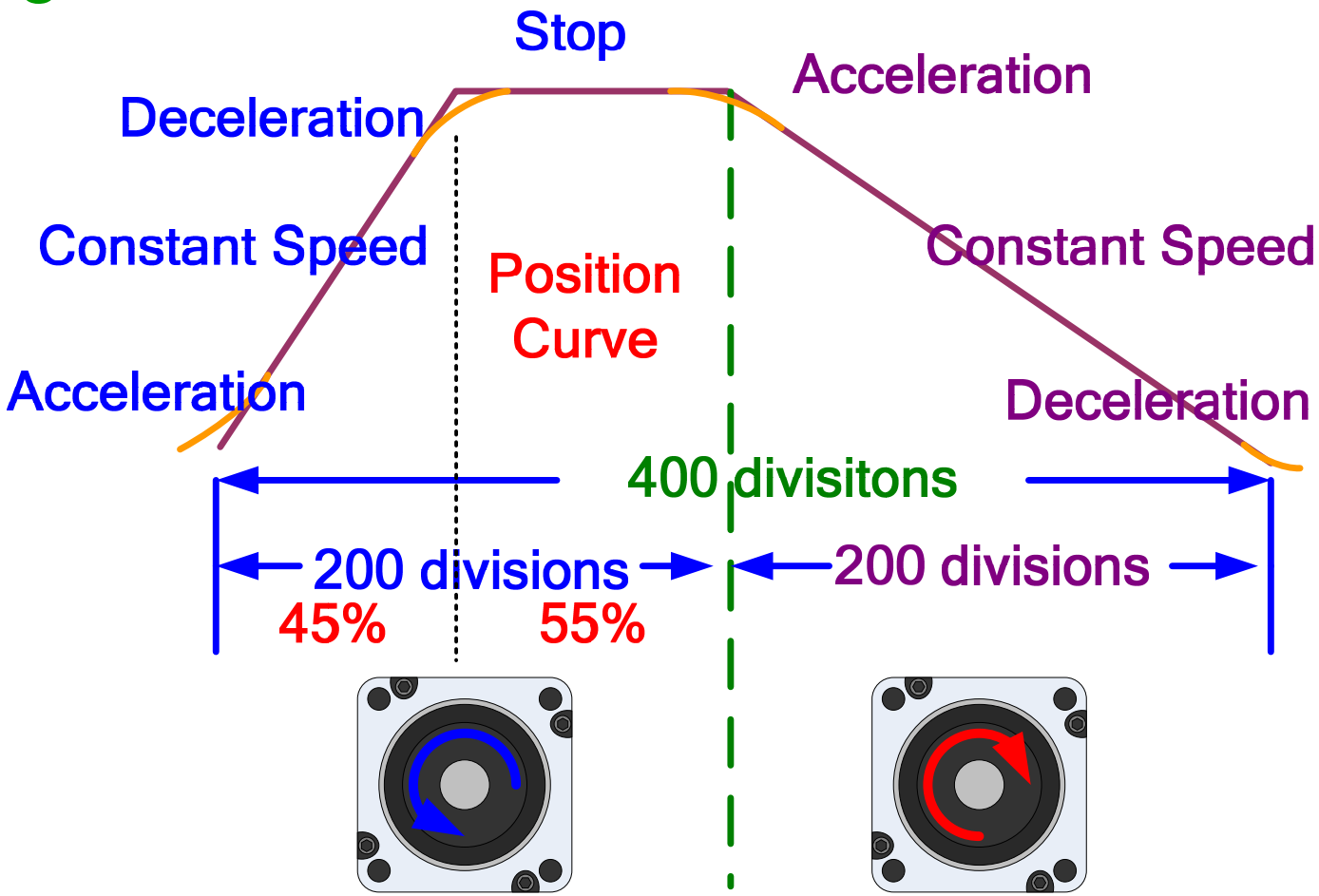
The definition of POSITIVE direction should be always kept in mind. P1-01.Z can be used to define the direction.



Example of Flying Shear (11)

The E-Cam Curve Making

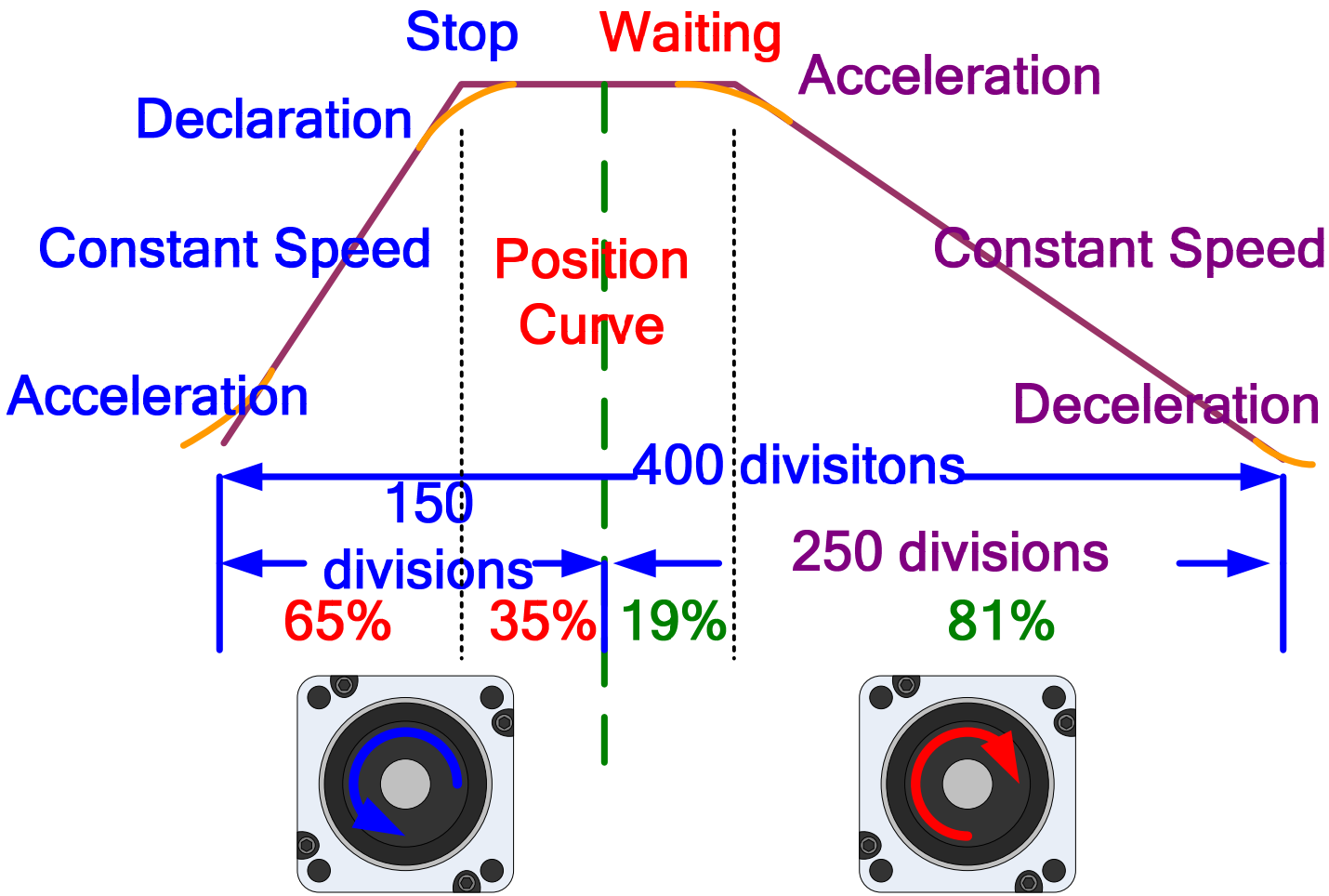
This is the method of making curves partially. Separate the curve into different parts with the same rotating direction.



Example of Flying Shear (12)

Another Separating Way

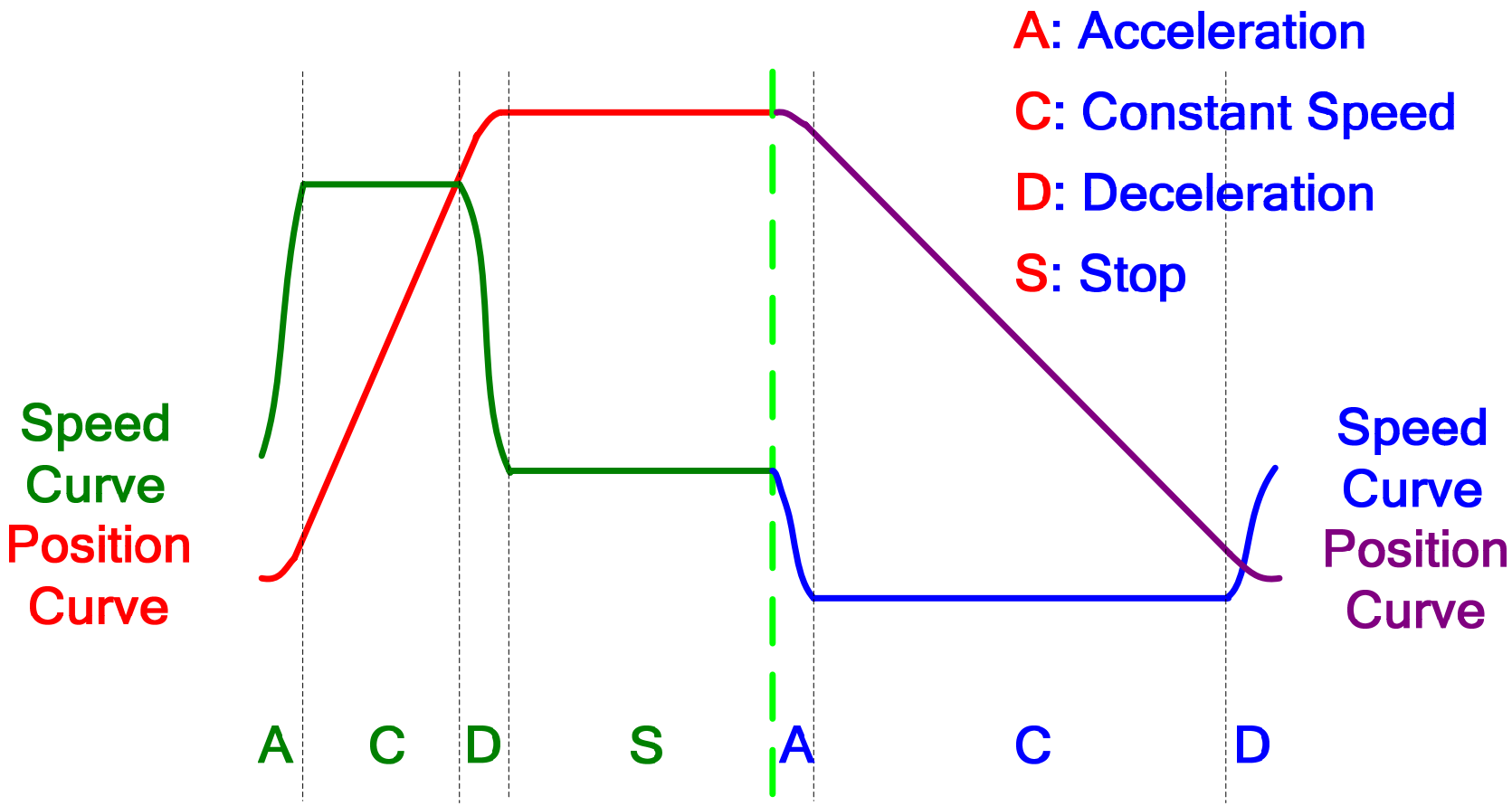
The same idea as previous one, the curve with the same rotating direction is put in the same area.



Example of Flying Shear (13)

Position Curve V.S. Speed Curve

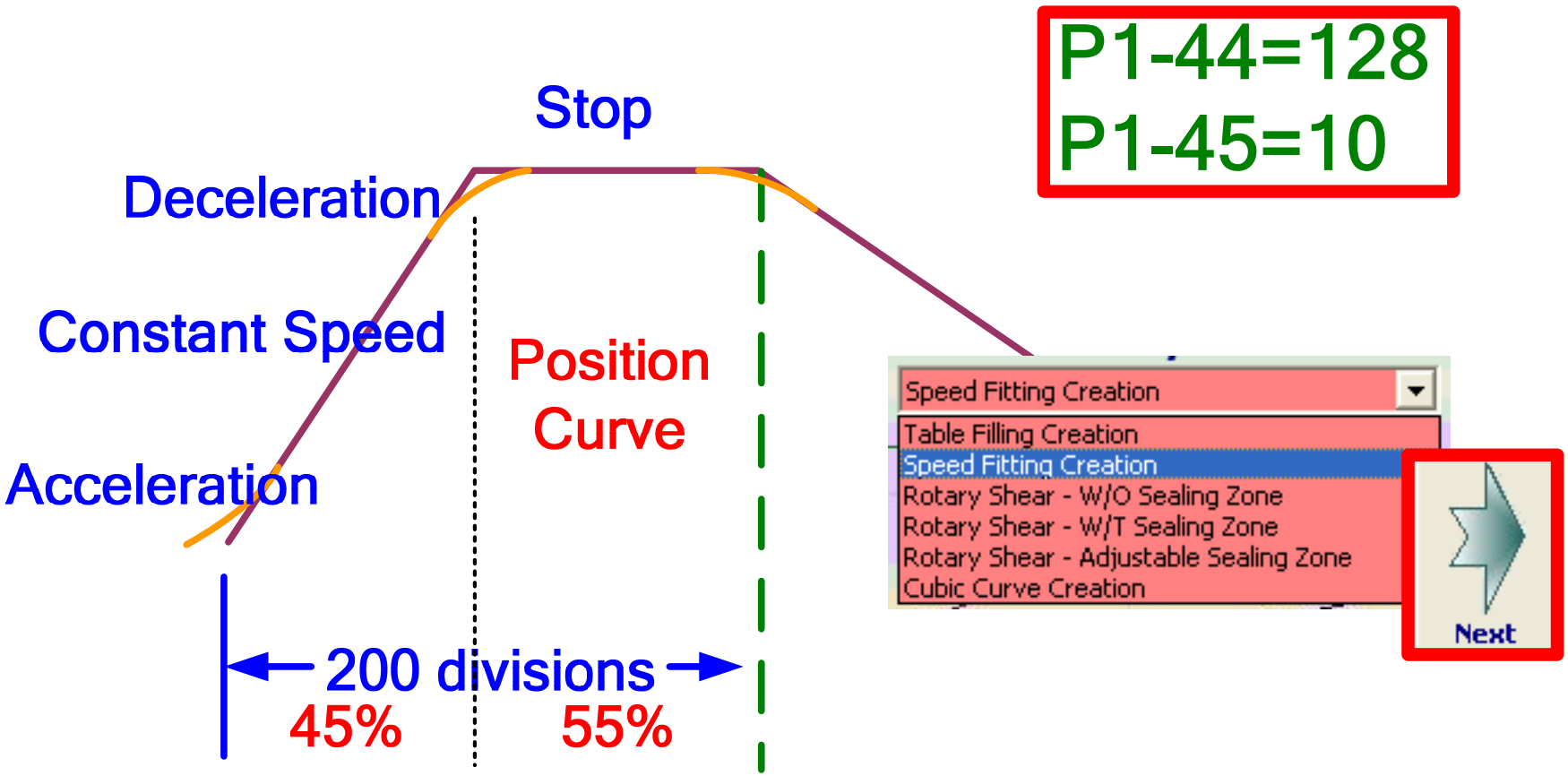
The relation of speed and position.



Example of Flying Shear (14)

The First Part of Curve

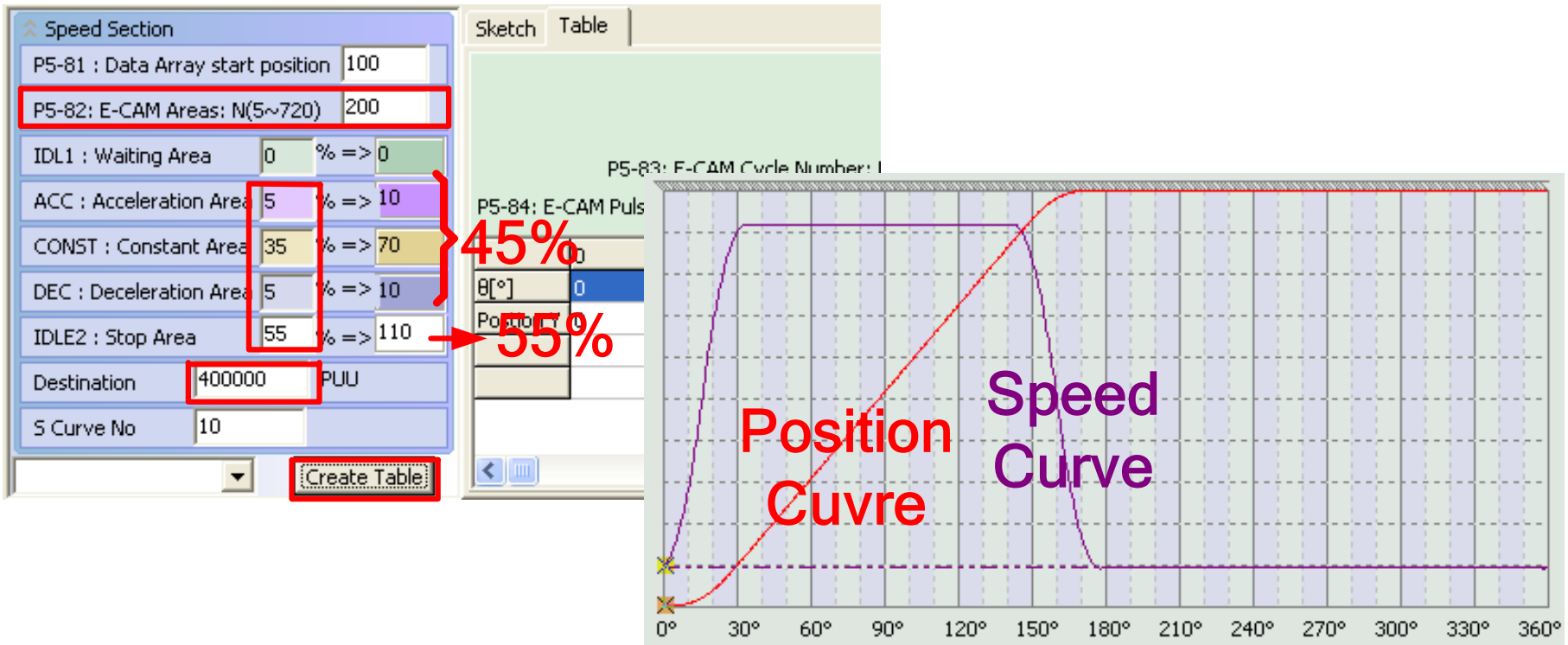
Follow the step for the first part of curve.



Example of Flying Shear (15)

Arrange the Curve Appropriately

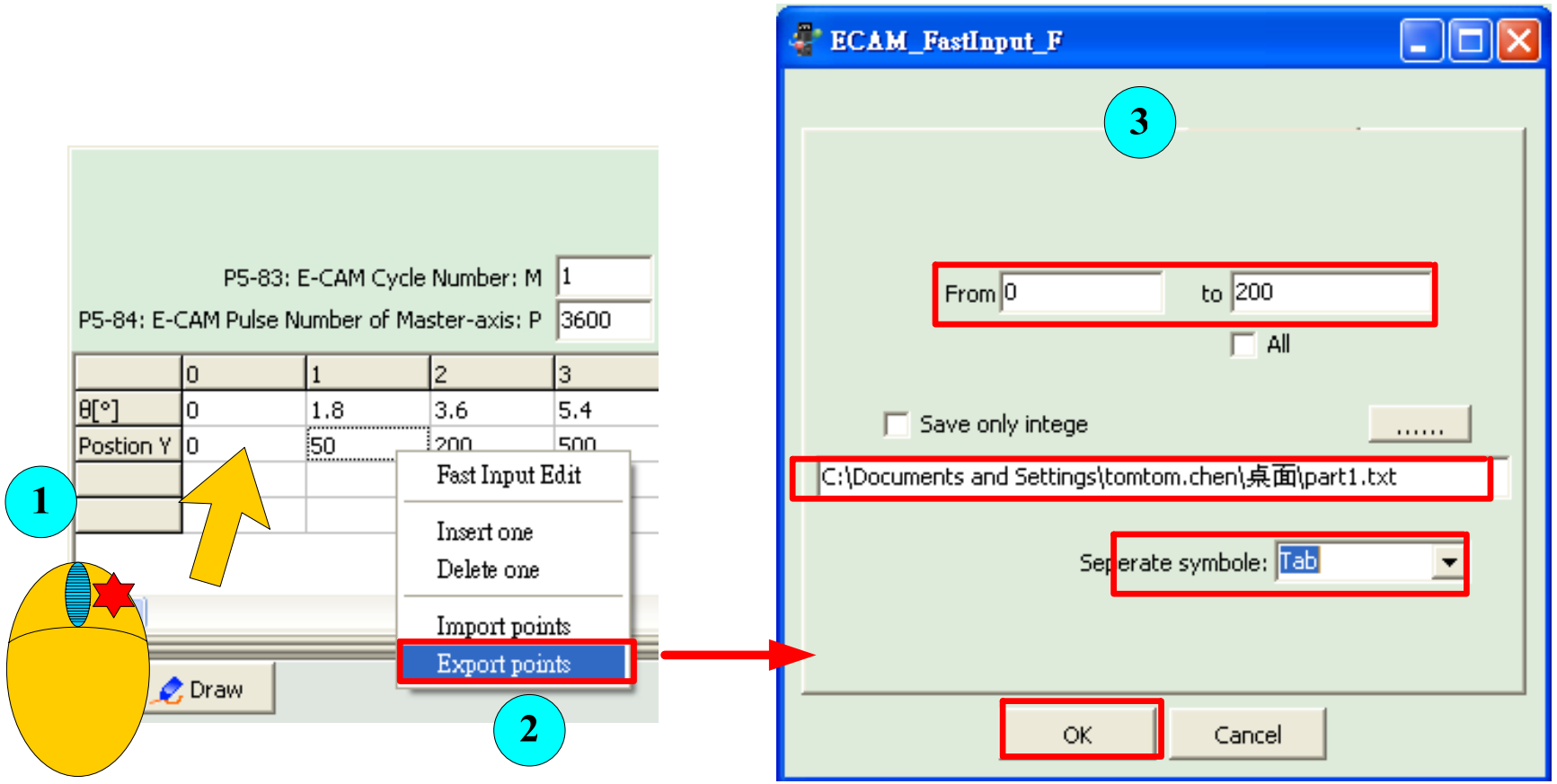
The percentage for different areas and distance should be kept as its sketch.



Example of Flying Shear (16)

Export the First Part of Curve

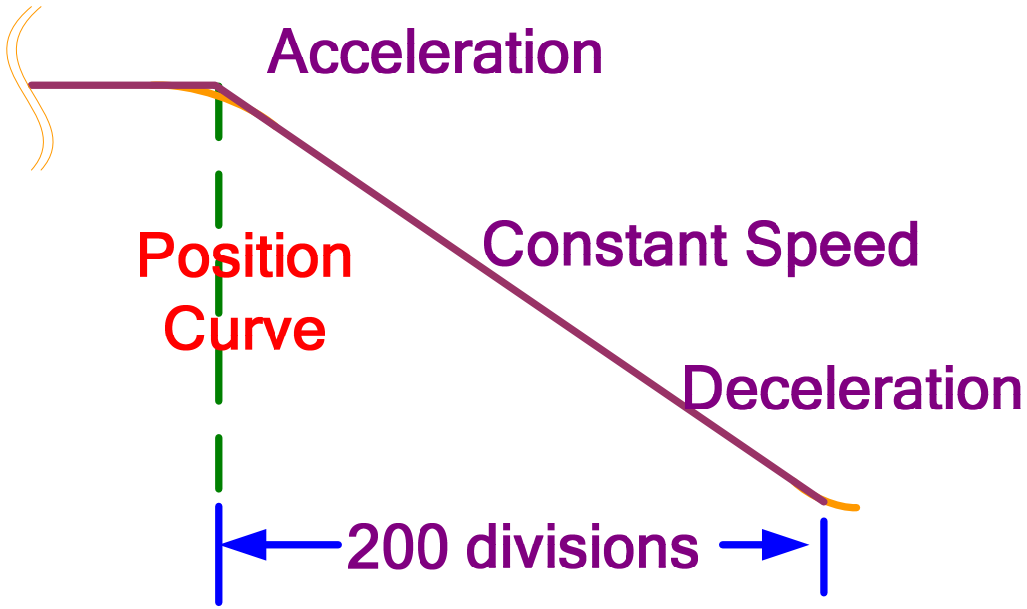
Export the first part of curve for later usage.

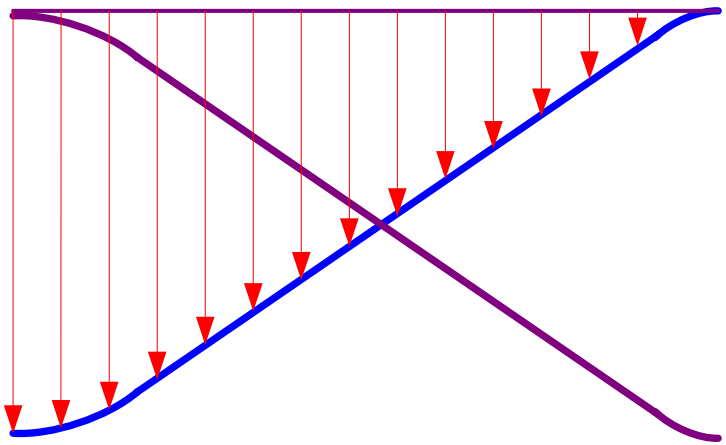


Example of Flying Shear (17)

The Second Part of Curve

The curve will be upside down by some mathematical operation.

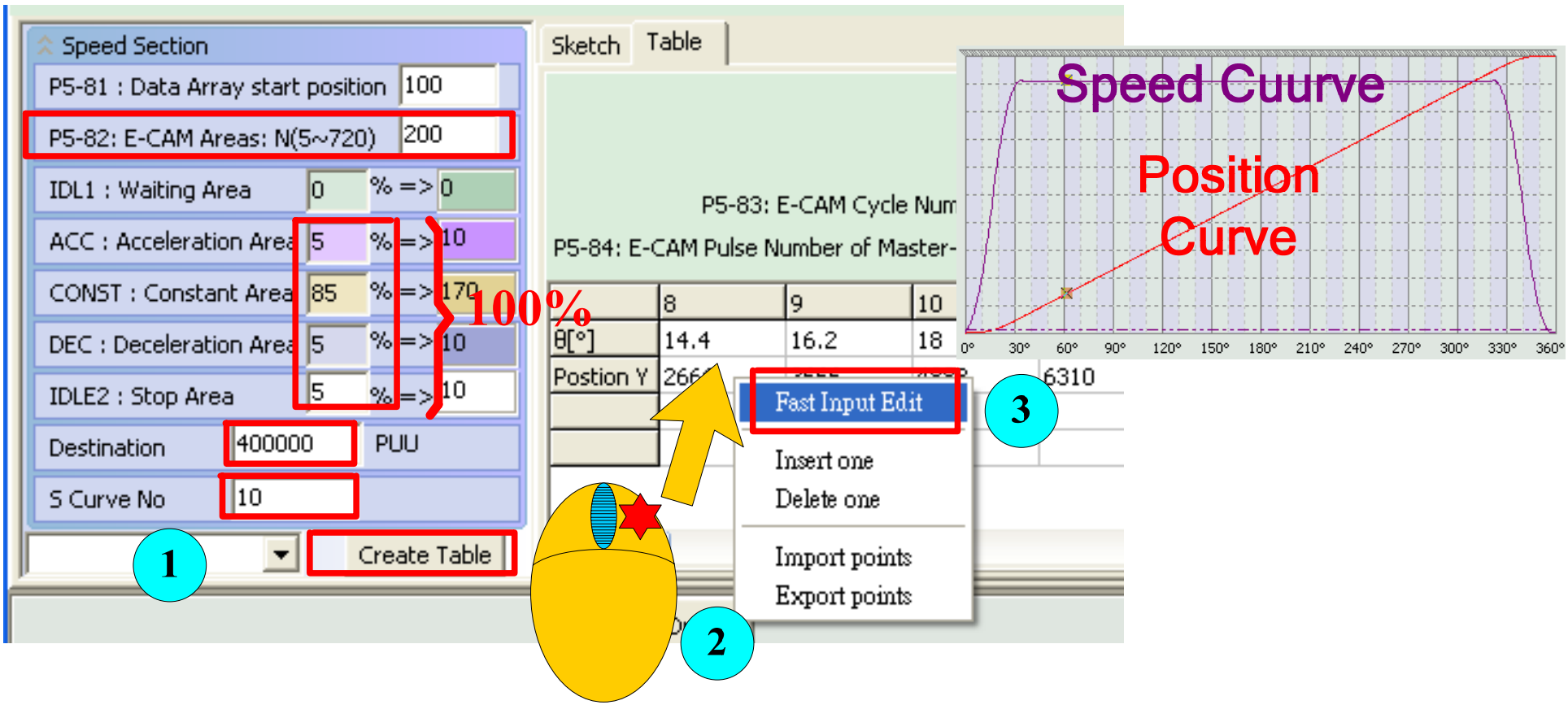




Example of Flying Shear (18)

Create the Second Part of Curve

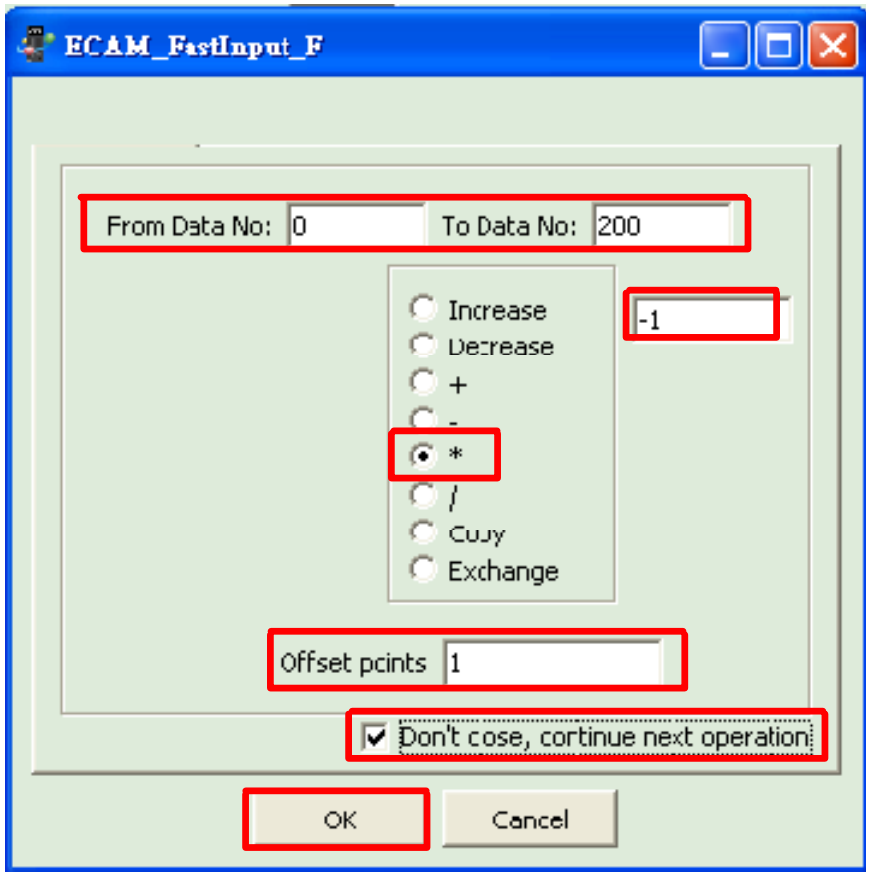
The distance and percentage should be kept as sketch.

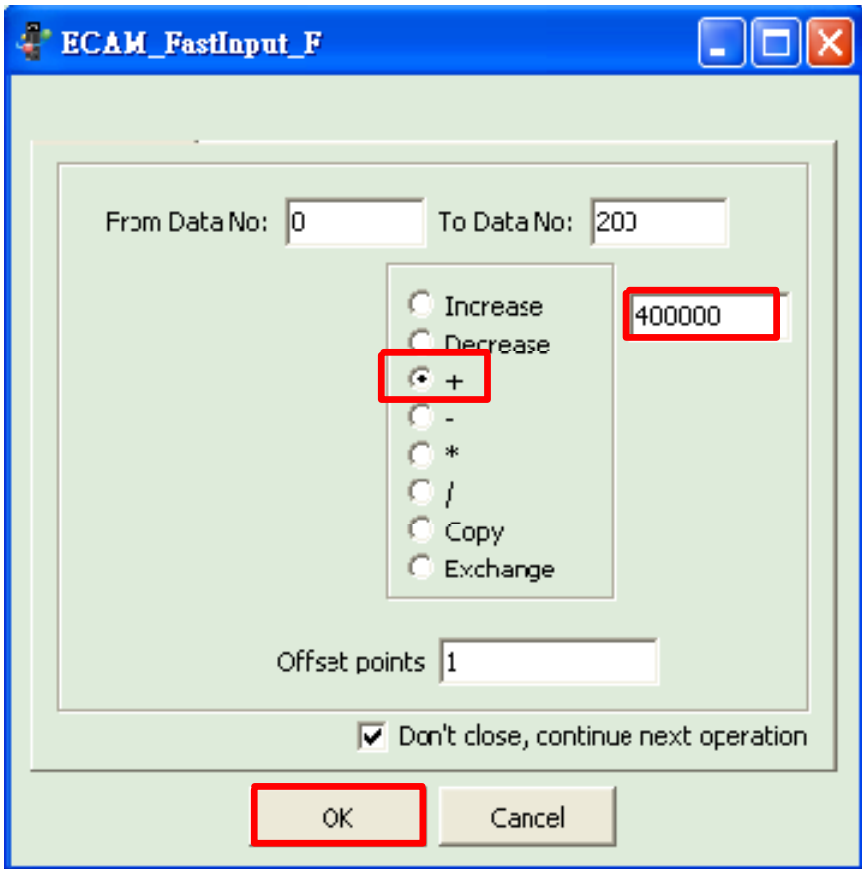


Example of Flying Shear (19)

Upside Down the Curve

Time all the data by -1, and then add all of them with maximum value of the curve.

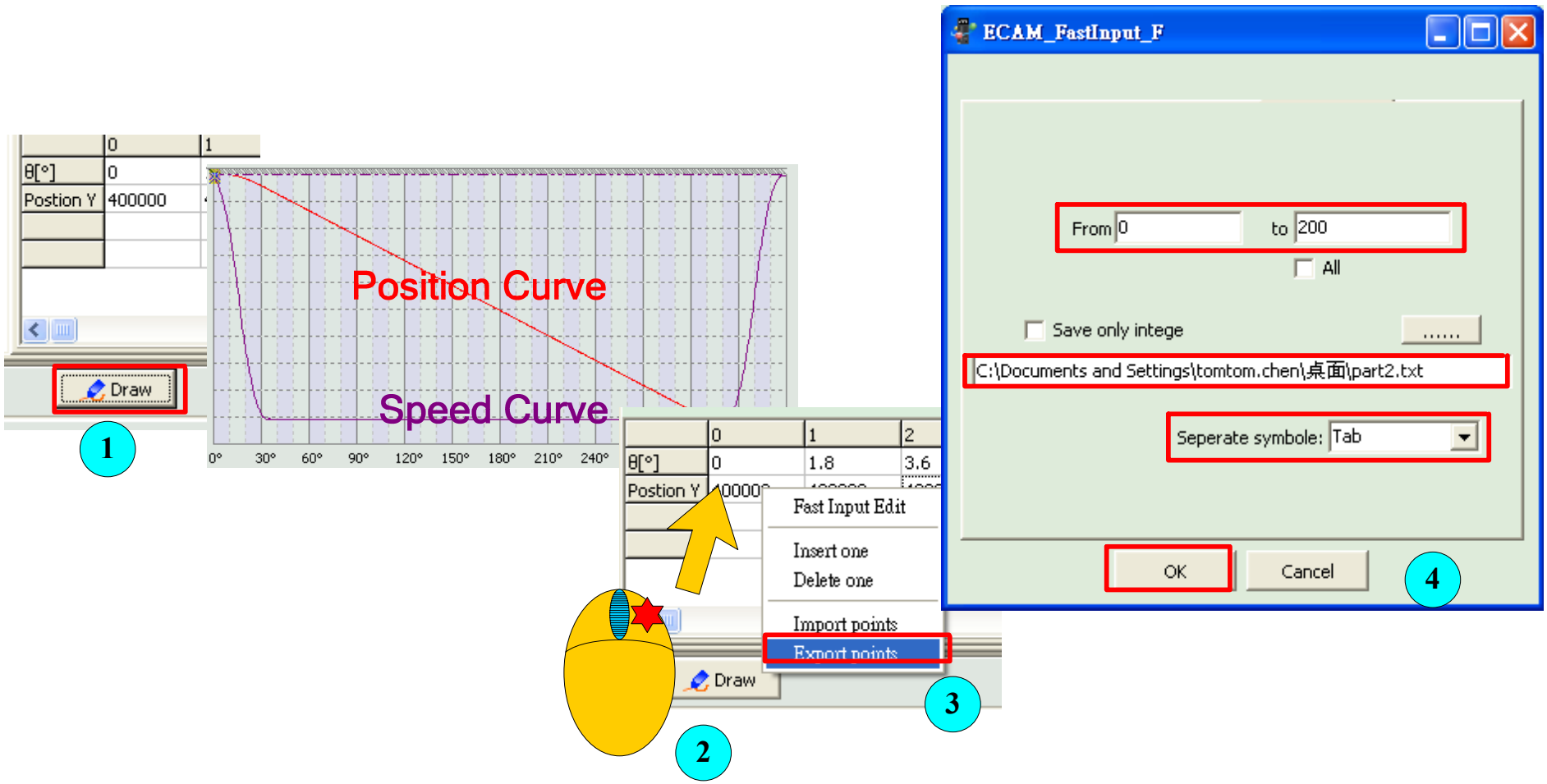




Example of Flying Shear (20)

Export the Second Part of Curve

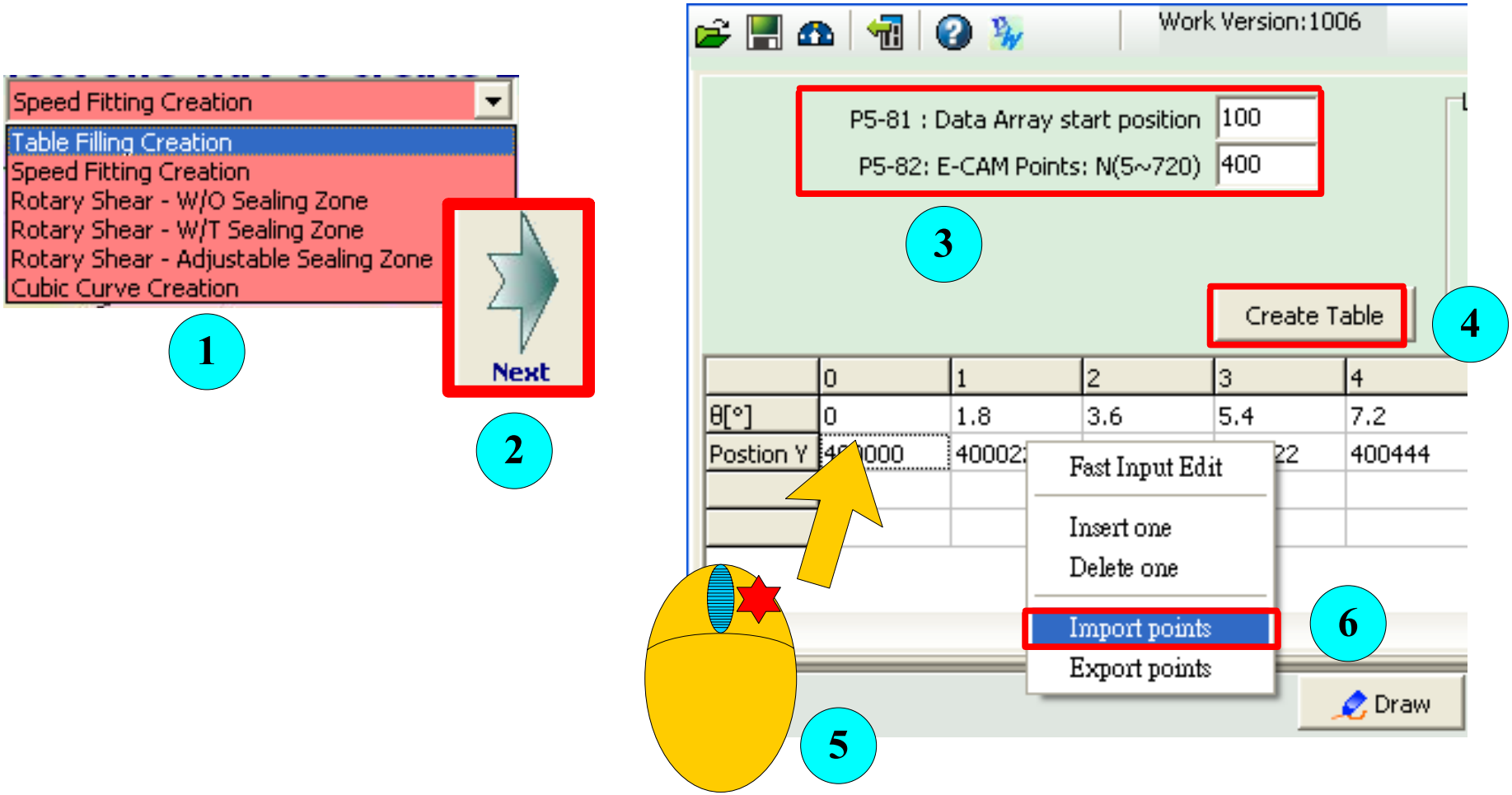
Draw the curve, and export it to a file.



Example of Flying Shear (21)

Merge Them

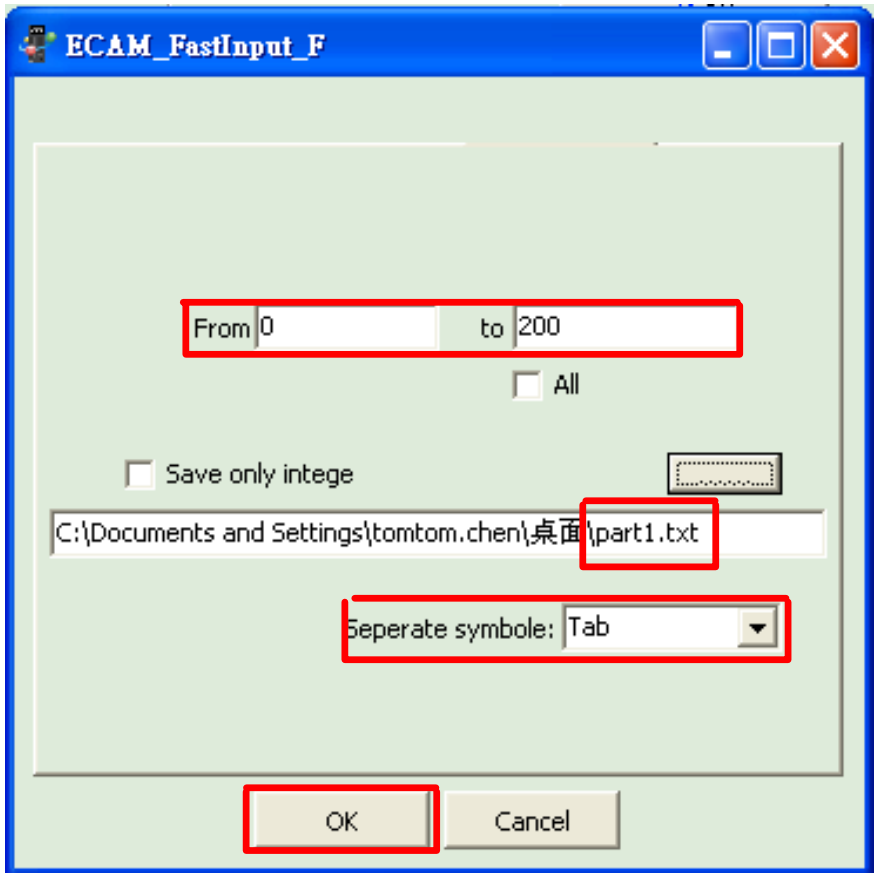
Open the “Table Filling Creation” for merging the partial curves. The total data items are 400.

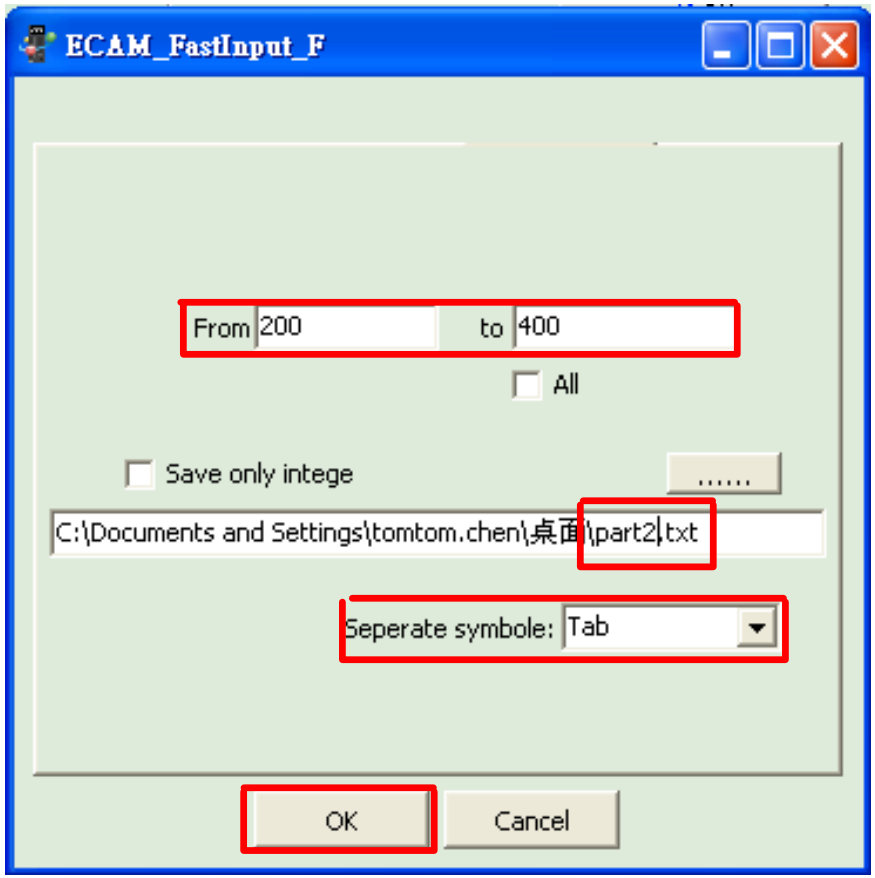


Example of Flying Shear (22)

Import Both of Them

Import the files saved from previous operation.

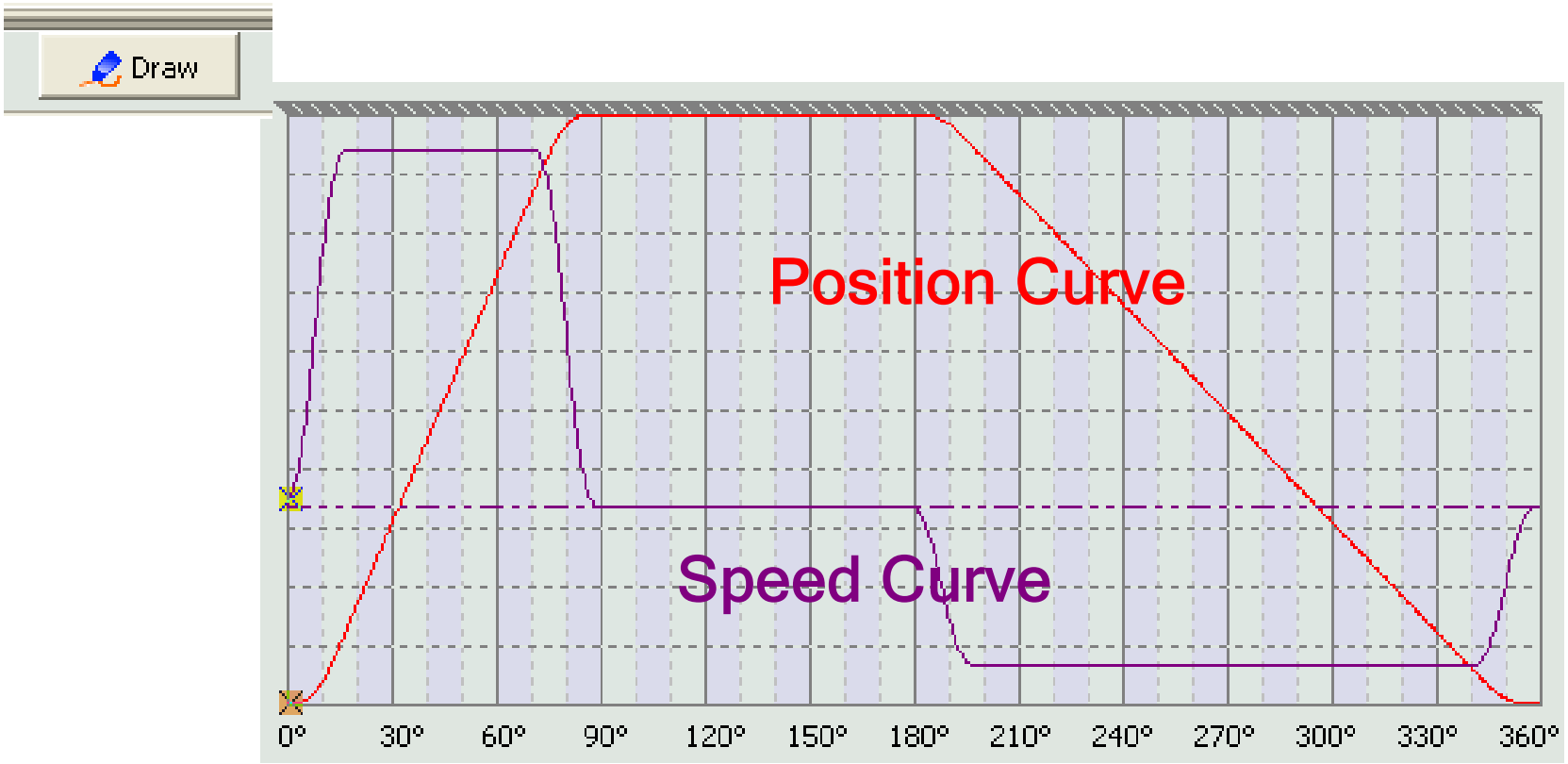




Example of Flying Shear (23)

Draw the Whole Curve

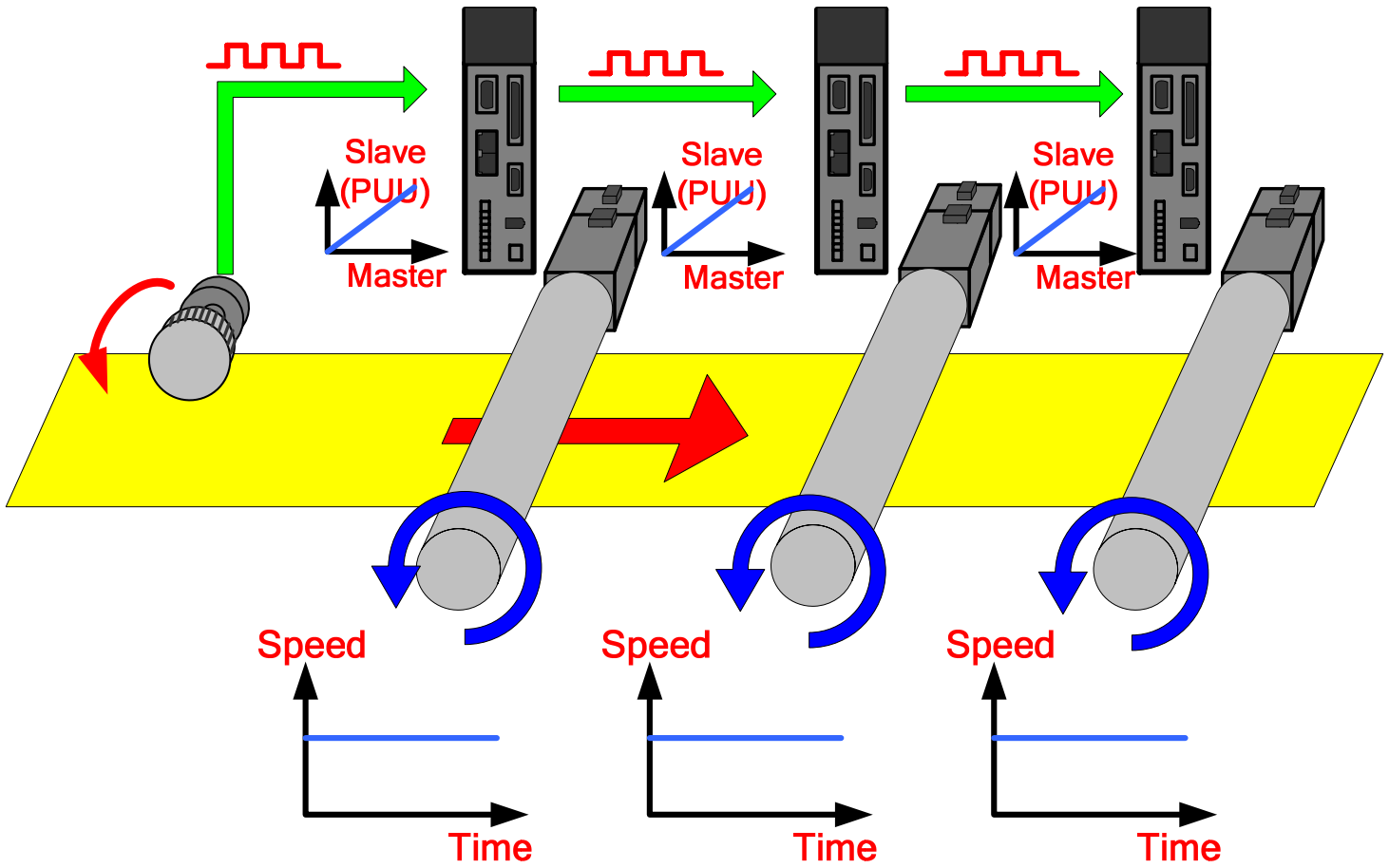
Draw the curve. It is ready to download.



The Command Overlapped (1)

PR and E-Cam

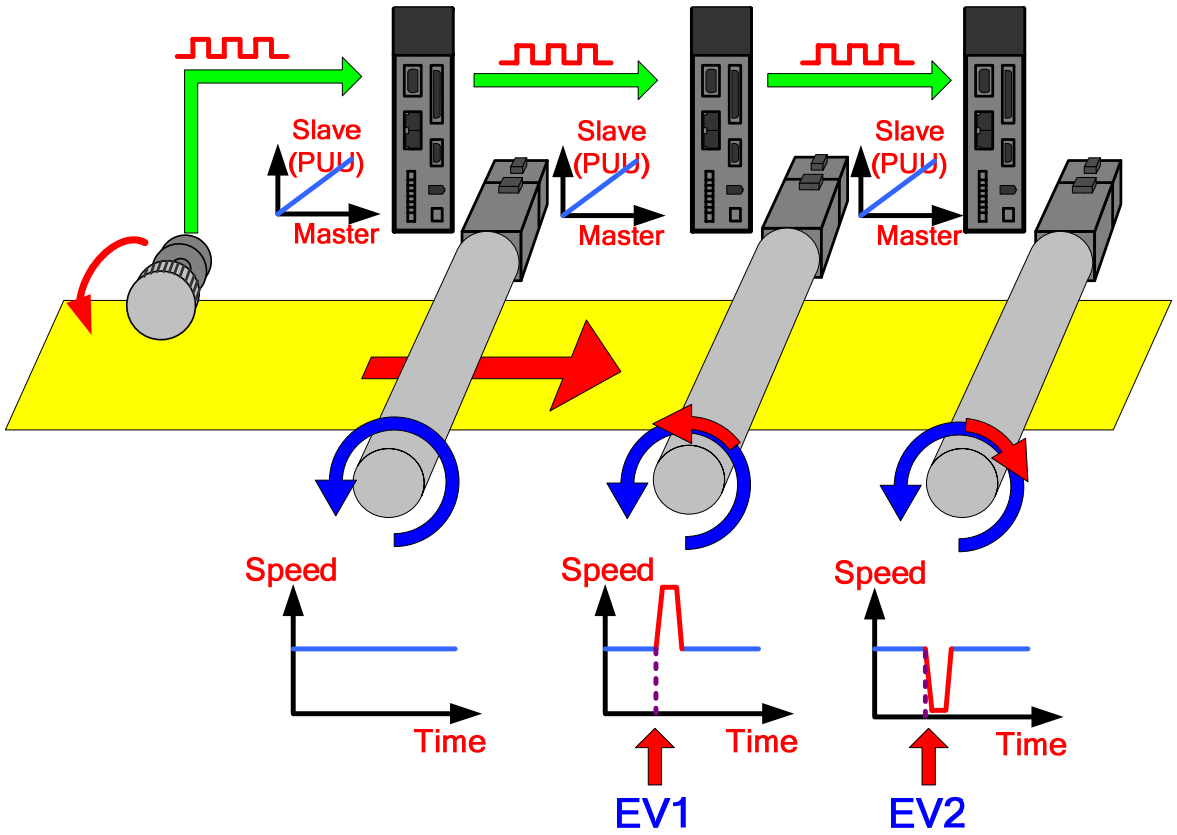
The PR and E-Cam commands can be overlapped while the E-Cam is running. This picture is an application for phase control.



The Command Overlapped (2)

Phase Shift

An event can be used for phase shifting. The positive shifting can work only when the positive speed can set higher than the speed of E-Cam.



EV1

The target speed is higher than E-Cam.

PR	Position (2)
#A	D=0 ms, S=2000 rpm 5000 PUU, INC

EV2

The target speed is lower than E-Cam.

PR	Position (2)
#B	D=0 ms, S=200 rpm -5000 PUU, INC

Why My E-Cam Do Not Work (1)

The Master Pulse

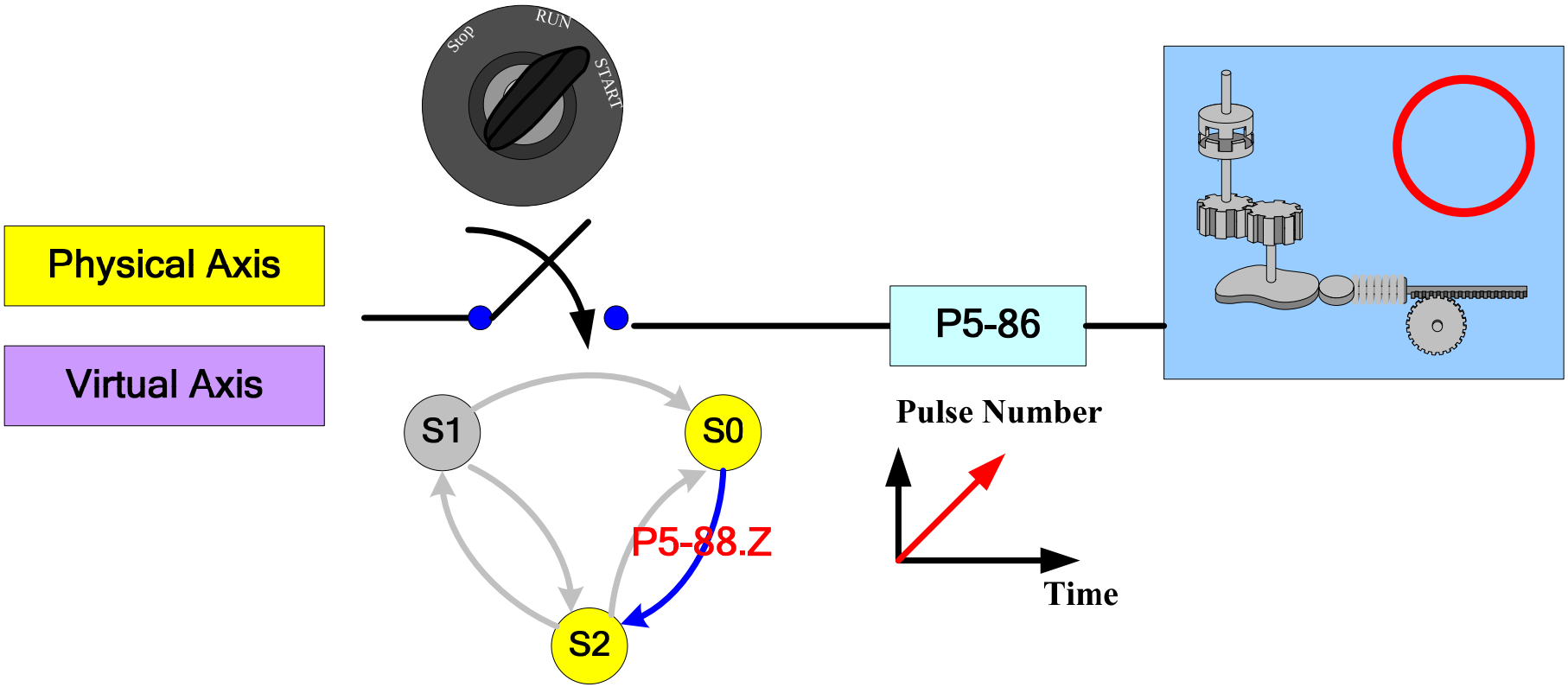
The master pulse should be checked first. Always POSITIVE thinking. The positive direction of pulse train is mandatory for applying E-Cam.

The same as P5-39.B (Capture source setting)	P5-88.Y=0, check P5-17 or P5-18
Linear Encoder (CN5)	P5-88.Y=1, check P5-17
Pulse Command (CN1)	P5-88.Y=2, check P5-18
PR Command (Internal signal)	P5-88.Y=3, no physical signal
1 ms clock (Internal signal)	P5-88.Y=4, no physical signal
Cap. Synchronous Axis (P5-39.B, Mark tracking)	P5-88.Y=5, check P5-17 or P5-18

Why My E-Cam Do Not Work (2)

The Master Axis

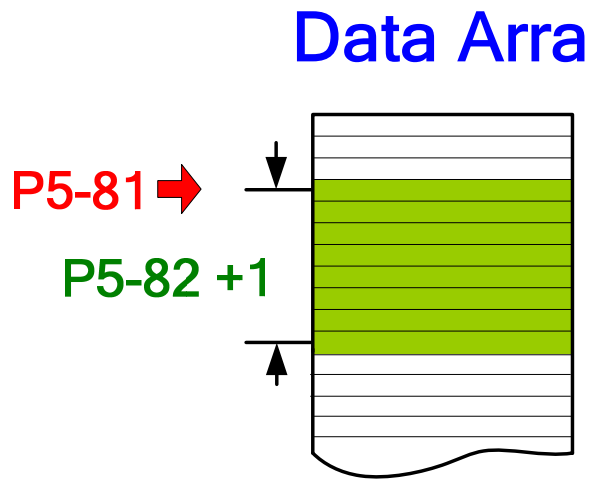
When the E-Cam is activated (P5-88.X=1), the pulse will be counted in P5-86. The P5-86 should be an increasing number. If not, reverse the pulse direction (not motor direction).



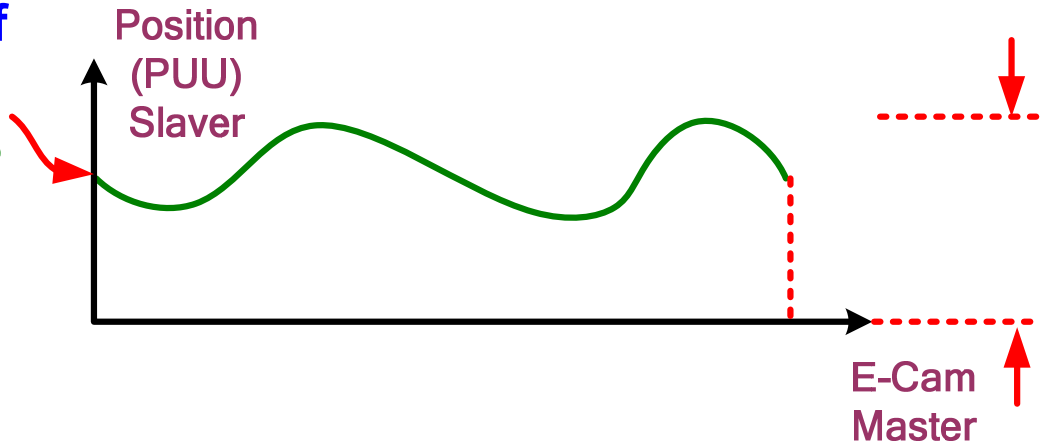
Why My E-Cam Do Not Work (3)

The E-Cam Curve

Check if E-Cam Curve is properly downloaded in the data array. Check the P5-19 if it is a correct ratio, for example, 0.000001 or 1.



E-Cam Curve:
The E-Cam function defining the relationship of master and slave.
P5-81,P5-82,P5-85



Slave E-Gear:
The scaling of E-Cam curve to output.
P1-44, P1-45
P5-19

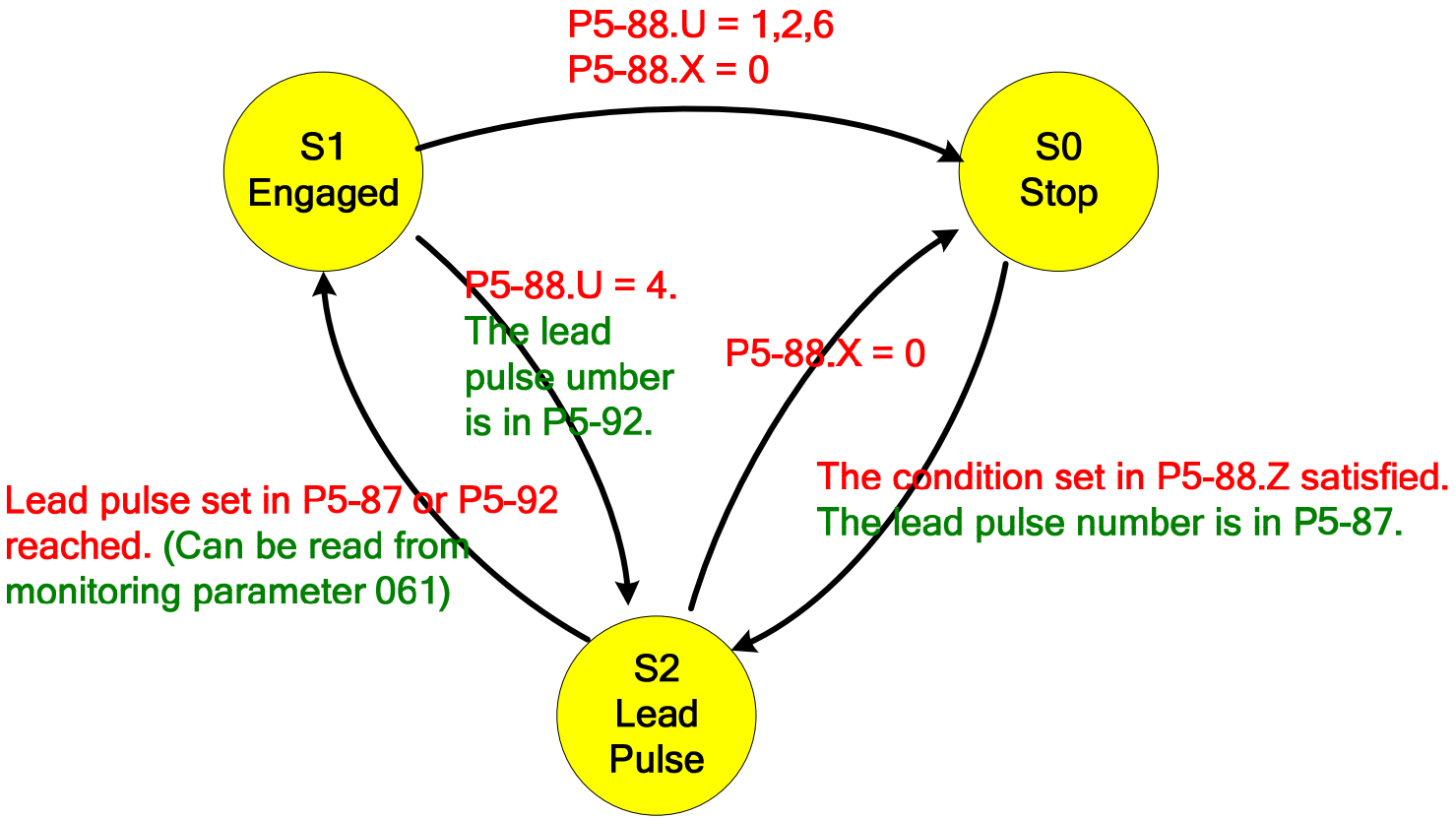
Why My E-Cam Do Not Work (4)

The Clutch Status

The status of the clutch can be checked from P5-88.S.

P5-88,
E-Cam Settings

High Byte			Low Byte			
S	0	BA	U	Z	Y	X
0~2	-	00~3F	0~8	0~2	0~5	0~1



Thank You