Chocolate Packaging Machine Solution

WJ Solution Center

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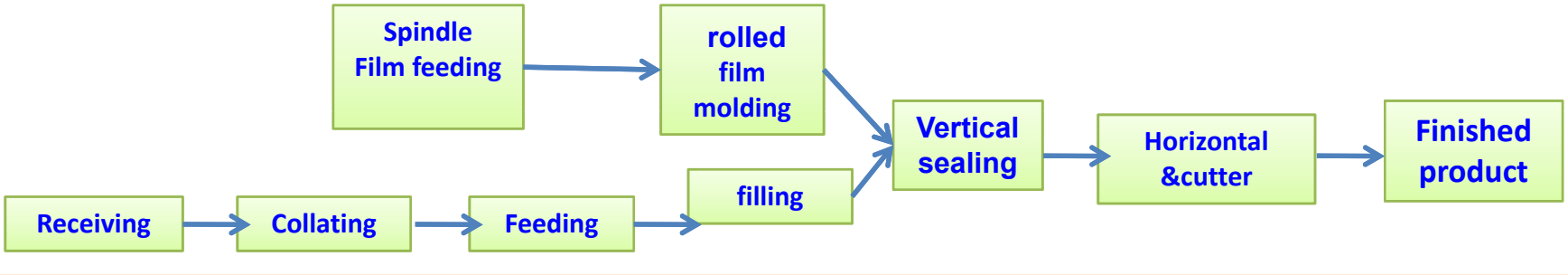
Process Description of Packaging Machine

Process Description

Chocolate pillow-pack wrapping machine turns chocolate teeming line from Horizontal to Vertical by collating mechanism, and sends the Chocolate into chain hook accurately by servo feeding mechanism. The chain hook and film feeding go ahead synchronously. Use the color mark and the proximity switch to detect the location of film feeding and chain hook separately. After the compound thin film is converted to the rolled sealing film by forming machine, the vertical heat sealing will be performed. At this time, the candies will move toward the rolled sealing film and pass through the horizontal sealing and cutting position.

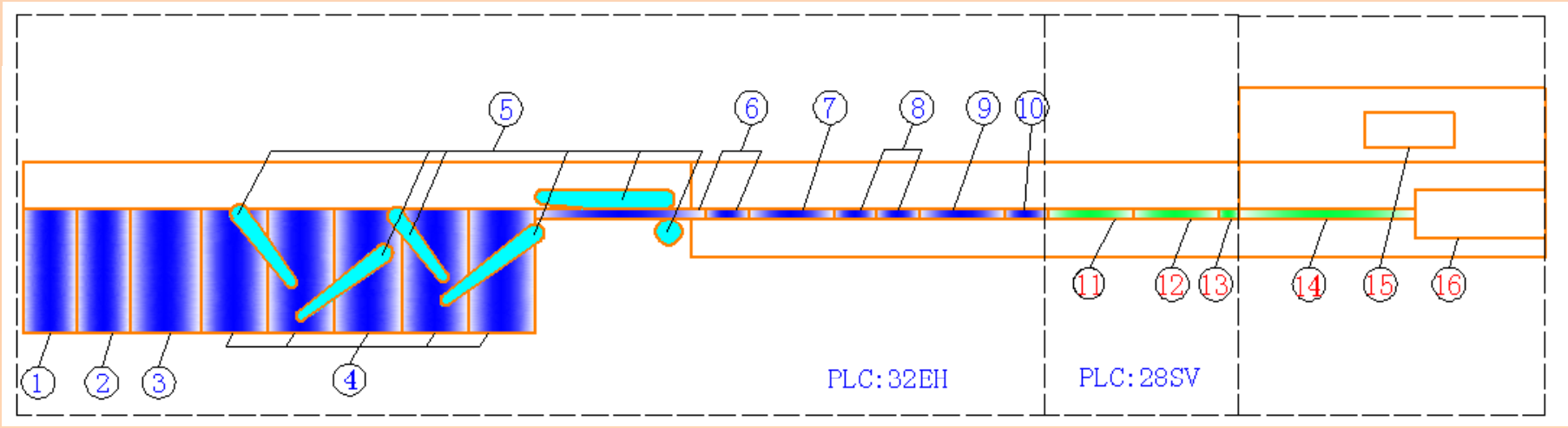


System Configuration

Appearance of Device

System Configuration

System Diagram



1～10:　ten VFD－M AC motor drives

1～3：　receiving belt

4～5：　snakelike collating belt

6～10：straight collating belt

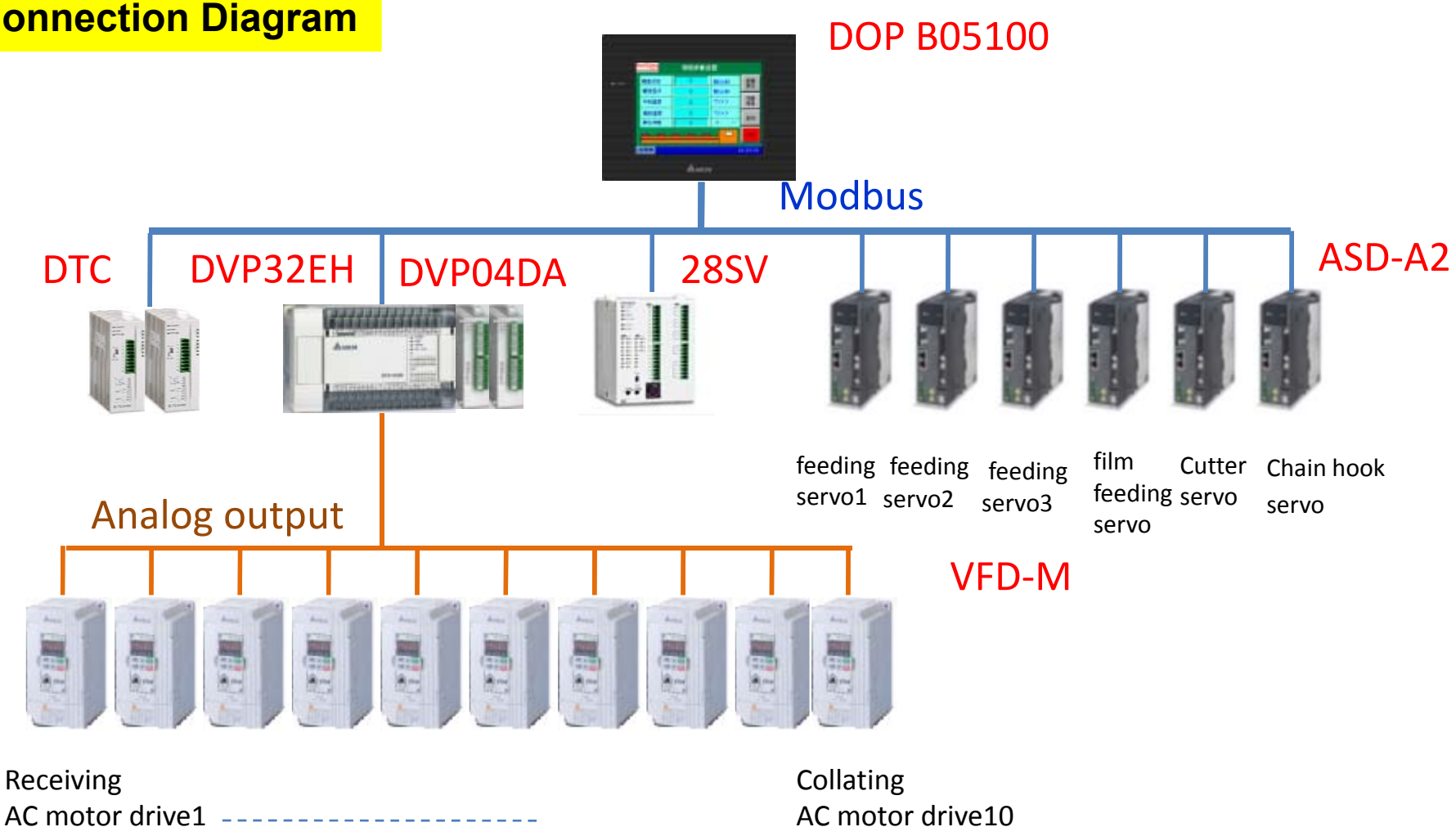
11～16: six ASDA-A2 AC servo drives

11～13: feeding belt

14～19: machine head（chain hook、film feeding、cutter）

System Configuration

Connection Diagram



System Configuration

Partial Figure 1

Receiving：

The chocolate teeming line belt will move and stop following the rhythm. The receiving belt is used for eliminating the gap of time and location of each batch of candy.

Snakelike collating：

Draw the chocolate from horizontal arrangement into vertical arrangement. Then send it to the straight collating area.

Straight collating：

Make a buffer function to the fluctuation of the amount of candy feeding by the pouring machine. Make sure that the chocolate on the collecting belt which is in the feeding part is neither empty nor crowd.

System Configuration

Partial Figure 2

Note :It's a picture of candy machine，and the structure function is the same as chocolate packing machine.

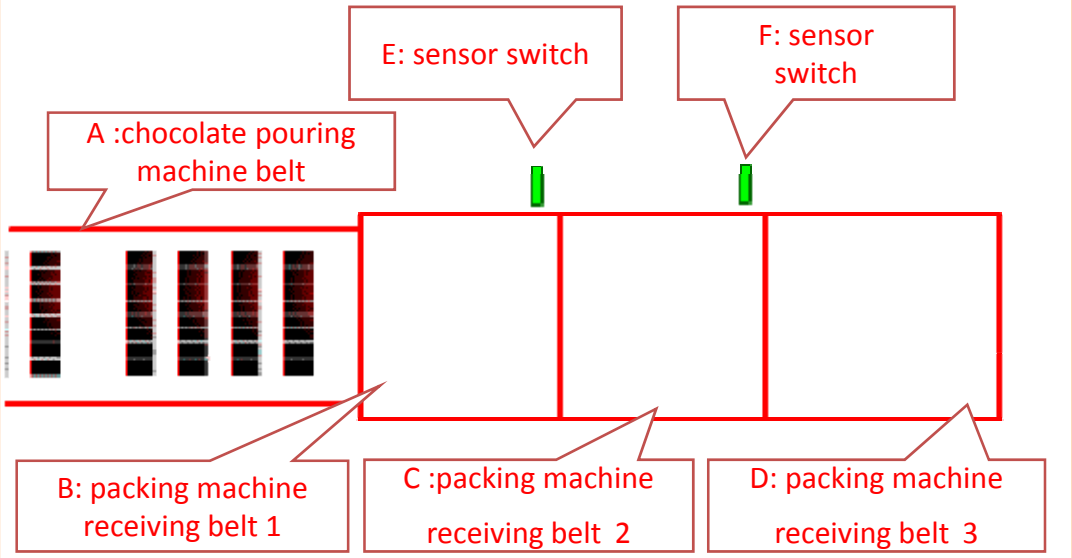
feeding：

Use a sensor to check the position difference between chocolate and chain hook. The belt's acceleration and deceleration controlled by servo will send the chocolate into the chain hook accurately.

machine head (chain hook、cutter 、film feeding)：

Chain hook plays the role of chocolate separation.And the cutter will cut the package material into bags .The heating device on the machine head has action on horizontal sealing, the vertical seal wheel has action both on film feeding and vertical sealing.

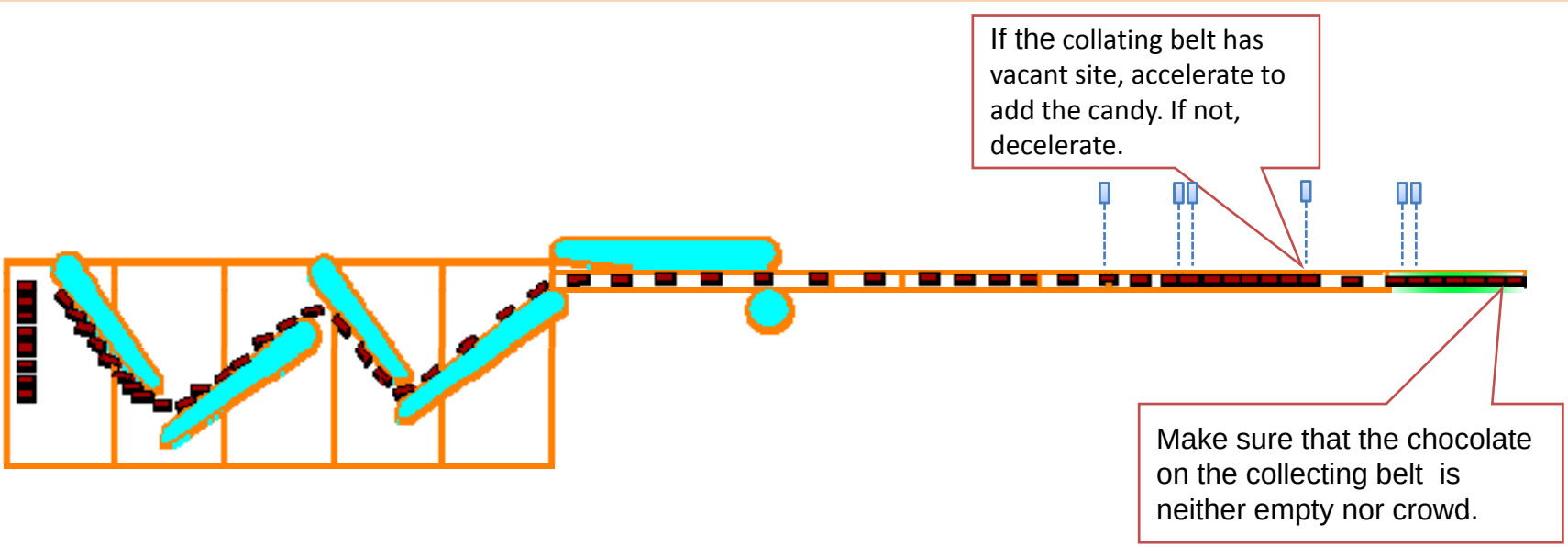
Receiving Operation



Receiving:

The teeming line belt is controlled by the splitter , moving and stopping following the rhythm.
The receiving belt is used for eliminating the gap of time and location of each batch of candy.

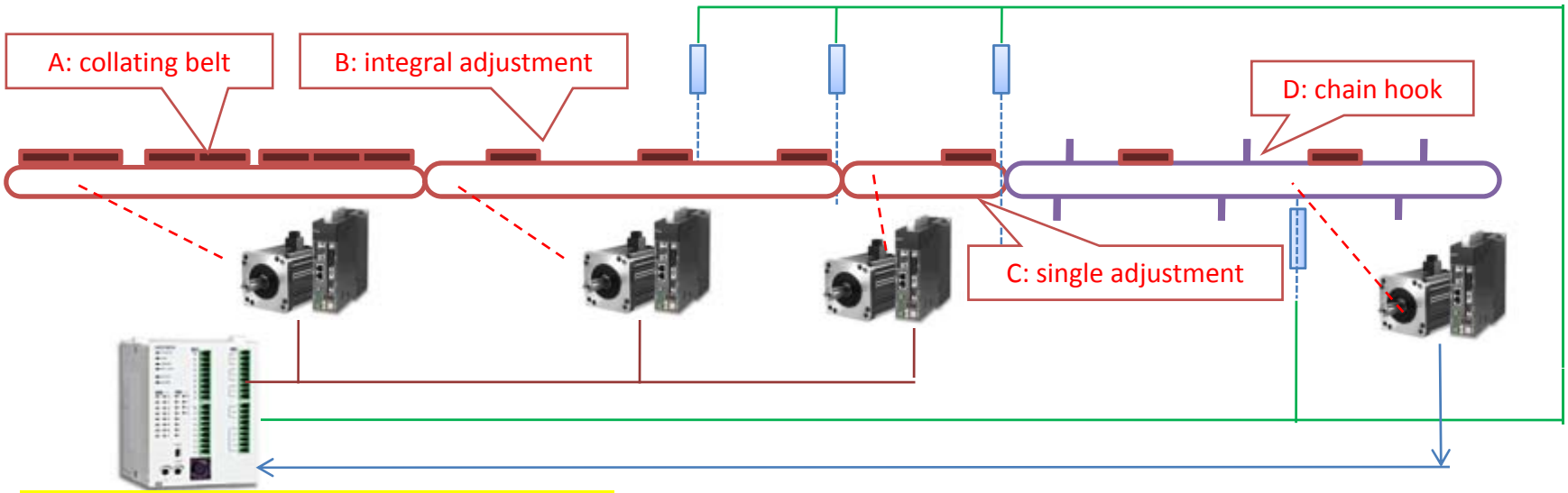
Collating Operation



Collating:

Turn the chocolate on the receiving belt from horizontal to vertical. At the same time ,make a buffer function to the fluctuation of the amount of candy. Make sure that the chocolate on the collecting belt which is in the feeding part is neither empty nor crowd, to avoid the phenomenon that the bag is empty or excessive.

Feeding Operation 1



System planning description :

A: Collecting belt

It has function of collecting. The head and tail of the candy on the belt is connecting on the whole.

B: Integral adjustment bell

Usually it moves with the chain hook synchronously. Via the differential value of the speed, divide each batch of candy on the A belt into equal distance the same as chain pitch. Use the sensor to compare the location deviation between chocolate and chain hook, to determine both of two belts' acceleration and deceleration. And then the location deviation of all the candy will be eliminated. The higher the speed, the easier the deviation will be eliminated in short time. But at the same time, you have to consider that if the speed is overlarge, there will be slippage between chocolate and belt.

Sending Operation 2

C: Individual adjustment belt

Usually it moves with the chain hook synchronously, and the function is the same as B belt. Because the length of C belt is the same as chain pitch, so it's not affect any other chocolate when C belt is accelerate or decelerate. It's mainly consider that there will be slippage when little chocolate is under high speed. As a result, it need two-stage adjustment.

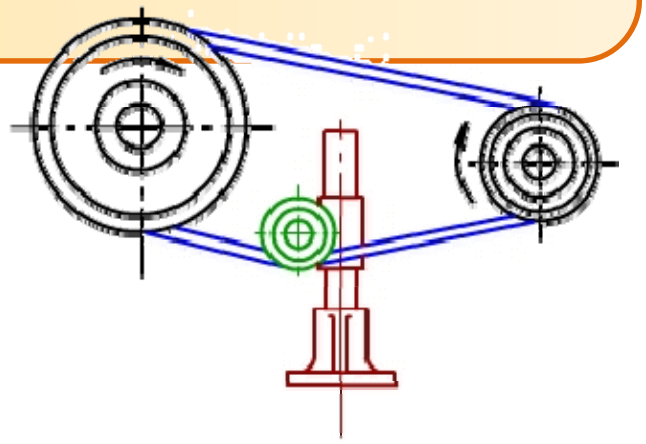
Other matters：

In order to increase the friction force between chocolate and belt ,all of A、B and C belts need air draft hole.

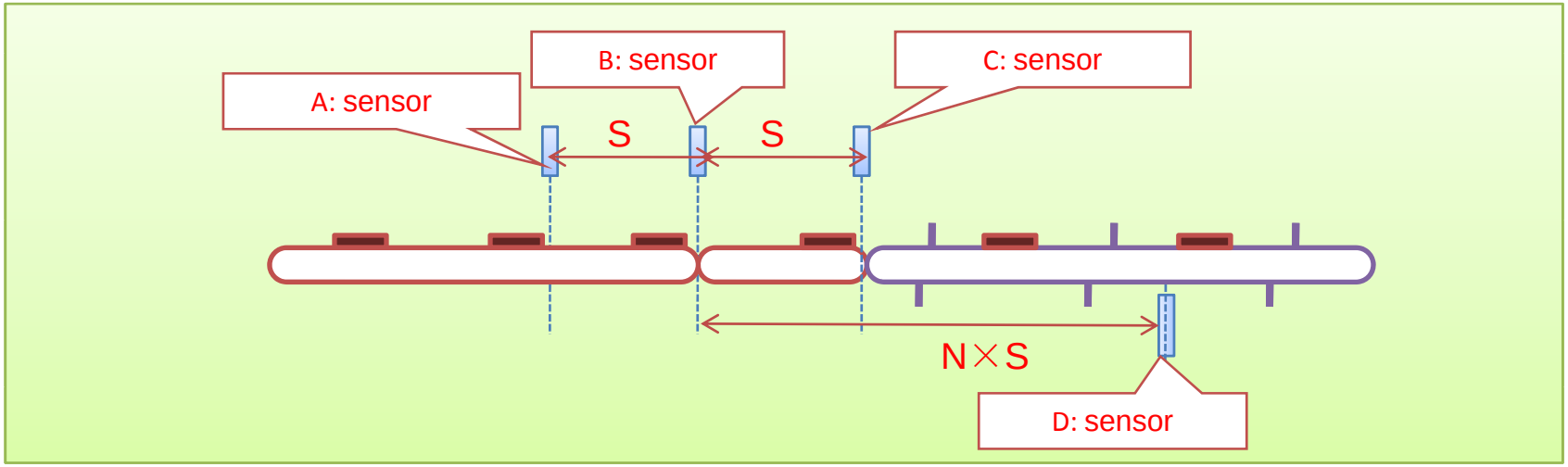
The belts need enough tension , to avoid the slippage between the belt wheels and the belts.

The height difference at the joint of two belts is not allowed.

The sensor switch must be located accurately (See P for specific).



Feeding Operation 3

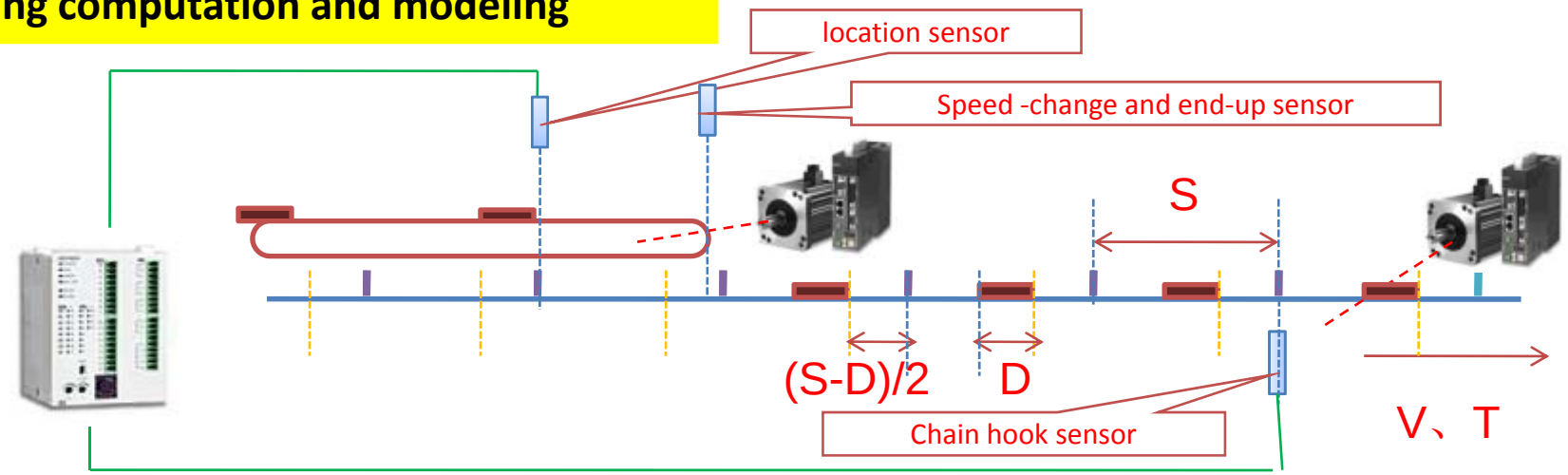


installation instruction :

Install B sensor at the joint of integral adjustment belt and individual adjustment belt.
And others take B as the datum.

The distance from A sensor to B sensor is "S" (S is chain pitch)
The distance from C sensor to B sensor is "S"
The distance from D sensor to B sensor is "N×S" (N is integer)

Feeding computation and modeling



The integral and individual adjustment belts are similar, so take integral adjustment belt for example.

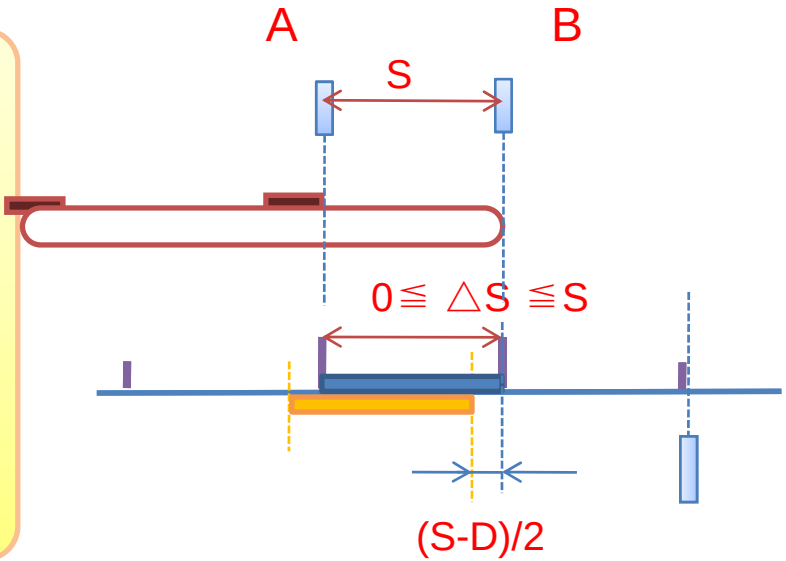
The chain hook servo system and the film feeding servo are synchronized. Now, assume that it is constant motion and the speed is "V"，chain pitch is "S", the time for packing a chocolate is "T". That is, "T" is the time for chain hook to move a distance of "S" at the speed of "V".

Because of the equal chain pitch, the ring chain can be regarded as the chain belt which is infinitely long.

If you want to locate the candy in the middle of the belt, you can adjust the distance from the front edge of chocolate to the chain hook. When the distance is (S-D)/2,(marked by the orange hidden line in the picture), it's sure that the chocolate is in the middle. In the following text, we call the orange hidden line the target line.

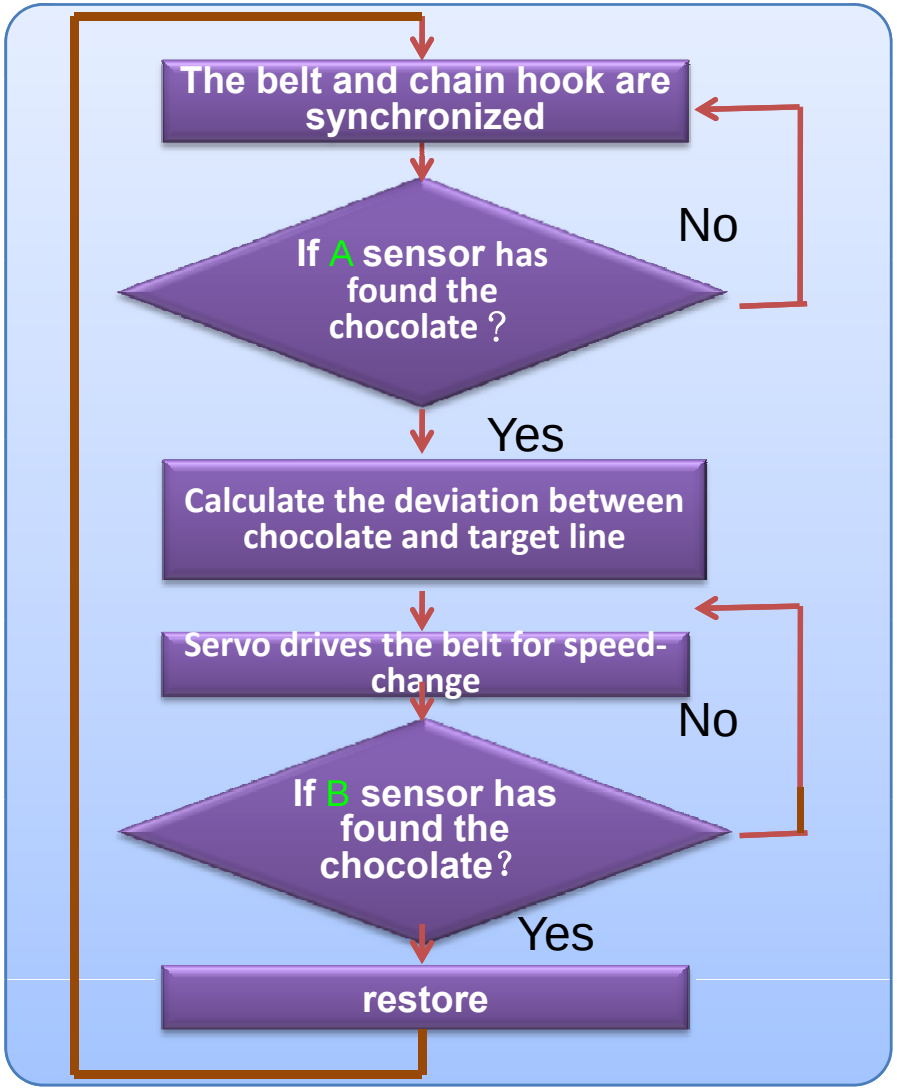
Deviation correcting Operation

When the chain hook passes through the sensor, PLC will read the position pulse of chain hook servo system (S_{Chain}). Every other T,S_{Chain} will update once. When the chocolate is found by the sensor, PLC will read the position pulse of chain hook servo system (S_{Candy}). If $\triangle S = S_{Candy} - S_{Chain}$,when the machine is start, chain hook always is the first one to be found. Therefore, $\triangle S \geqq 0$ & $\triangle S \leqq S$.

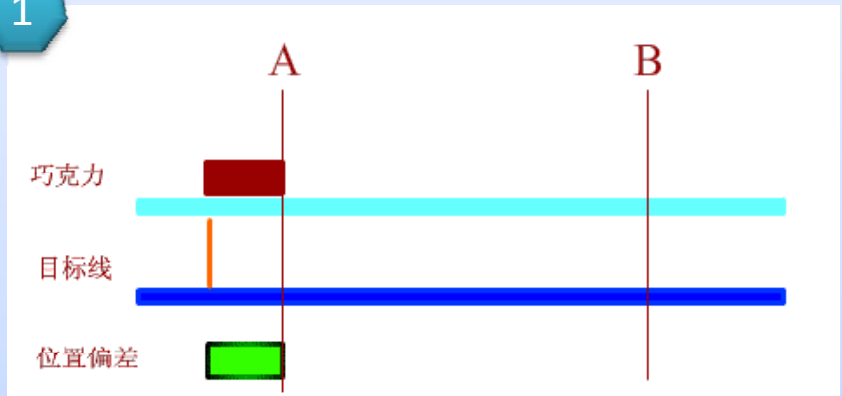


- The blue section is the area of chain hook ,and the orange is the area of target line which always fall behind the chain hook (S-D)/2 .
- If chocolate hasn't met the A sensor, it and chain hook are synchronized and runs at the speed of "V". Or else, A sensor measures the distance between chocolate and target line, then chocolate will accelerate at the point of A to catch up the line or decelerate to wait for the next. Chocolate must run at a desirable speed which is in the speed-change range. In addition, chocolate should arrive at the point of "B" the same moment as target line, then still moves with chain hook synchronously.

Position deviation correction



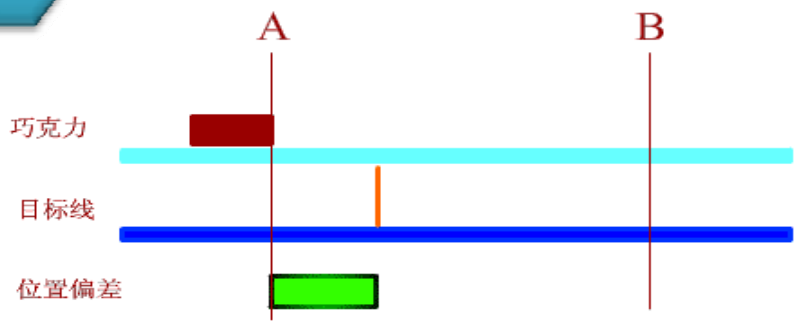
1



If chocolate is in advance of the target line，it should decelerate and wait for the line.

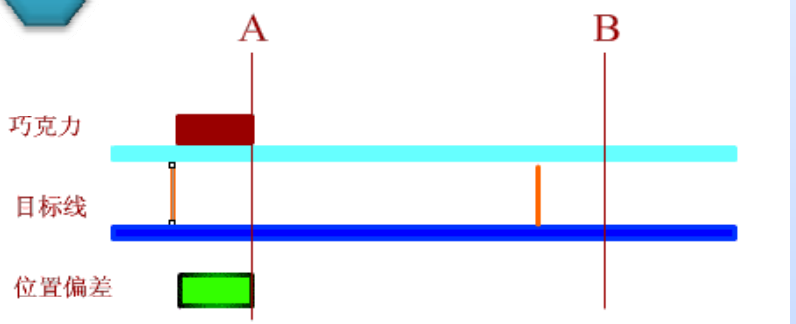
Position deviation correction

2



If chocolate is not much behind the target line, it should accelerate and catch up the line.

3

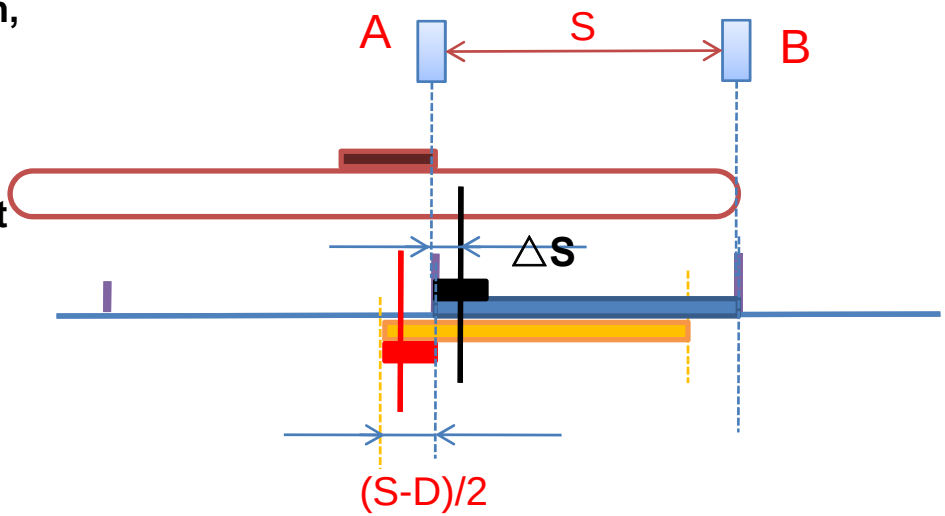


If chocolate falls behind too much, it should decelerate and wait for the next target line.

Deviation correcting calculation

If the target line is in the area of the red section, that is:$-(S-D)/2 \leqq \triangle S' \leqq 0$**, the interval of chain hook is:**$0 \leqq \triangle S \leqq (S-D)/2$

Obviously, chocolate has to decelerate to wait for the target line. If chocolate runs from "A" at a speed of "V'" and then stop at "B". Assume that the travel time is "t" .



then:

$S = V' \times t$

The target line runs at the speed of "V" in the time of "t".

So the range ability is:

$S' = S + (S-D)/2 - \triangle S = V \times t$

Because of the equal "t", it can be seen that :

$$V' = \frac{S}{\frac{3S-D}{2} - \Delta S} V$$

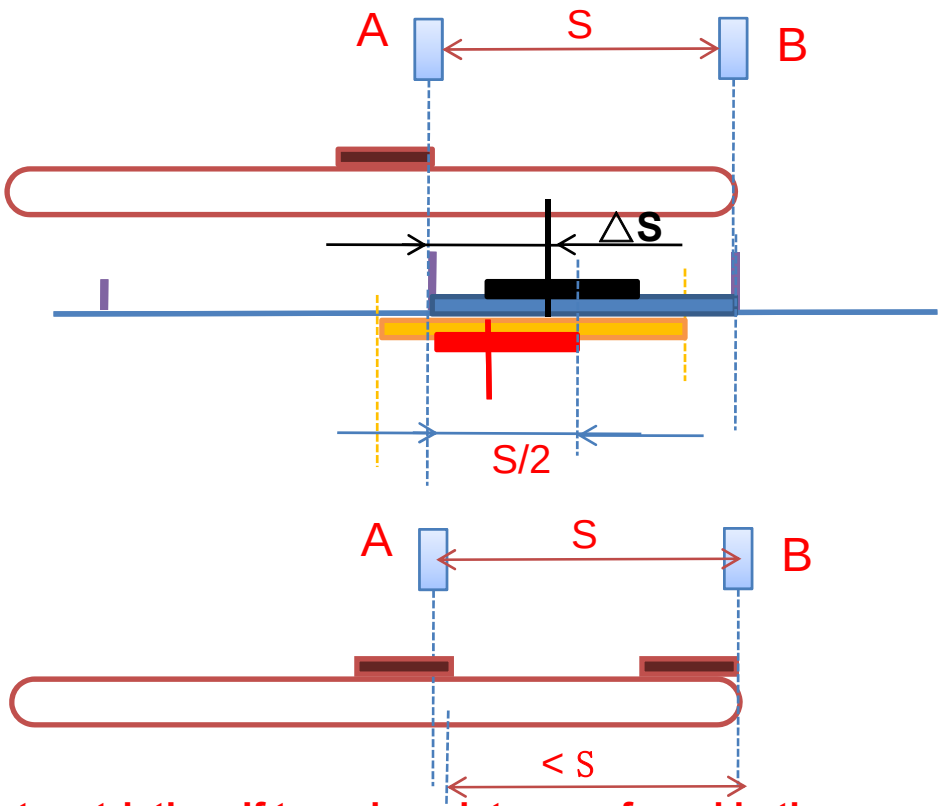
Deviation correcting calculation

In order to avoid excessive speed and the situation shown in the down-right picture, set the limit as the position which is located at a S/2 distance from A sensor.
If the target line is in the red area， that is:
$0 \leqq \triangle S' \leqq S/2$
The range of chain hook is：
$(S-D)/2 \leqq \triangle S \leqq (2S-D)/2$
Obviously, chocolate has to accelerate to catch up the target line. If chocolate runs from "A" at a speed of "V"" and then stop at "B". Assume that the travel time is "t" . then:
$S = V' \times t$

The target line runs at the speed of "V" in the time of "t".
So the range ability is：
$S' = S - (\triangle S - (S-D)/2) = V \times t$

Because of the equal "t", it can be seen that :

$$V' = \frac{S}{\frac{3S-D}{2} - \Delta S} V$$



Without restriction, If two chocolates are found in the same time of "T", the next one is likely to cause that the servo drive may accelerate too fast, and the first one may have large position deviation. On the individual adjustment belt , there may be the appearance that two chocolates are catching up the same target line, and it easily cause both of the two chocolates being sent into the same chain hook. Therefore, the chocolate should decelerate to wait for the next target line.

Deviation correcting calculation

If the target line is in the red area， that is:

S/2≦ △S’ ≦S- （S-D）/2

The range of chain hook is：

(2S-D)/2≦ △S ≦S

Obviously, chocolate is catching up the target line. If chocolate runs from “A” at a speed of “V”” and then stop at “B”. Assume that the travel time is “t” . then:

S＝V’× t

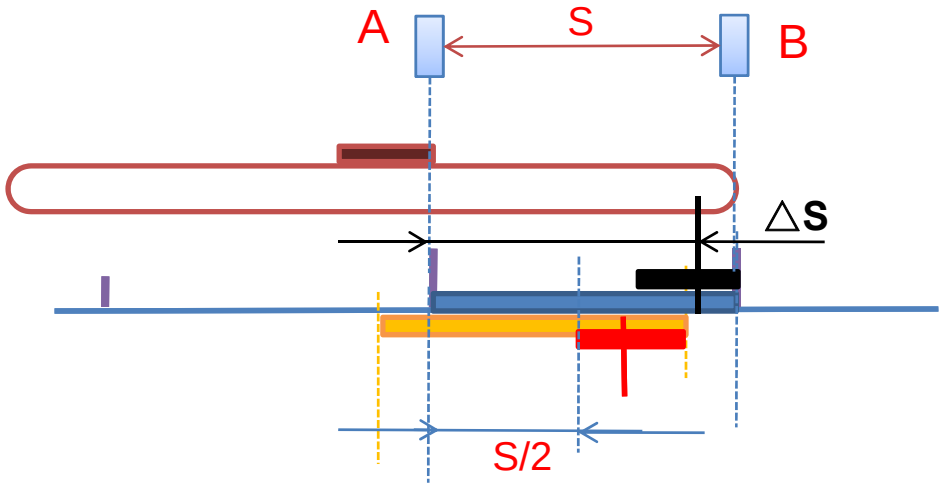
The target line runs at the speed of “V” in the time of “T+ t”.

So the range ability is：

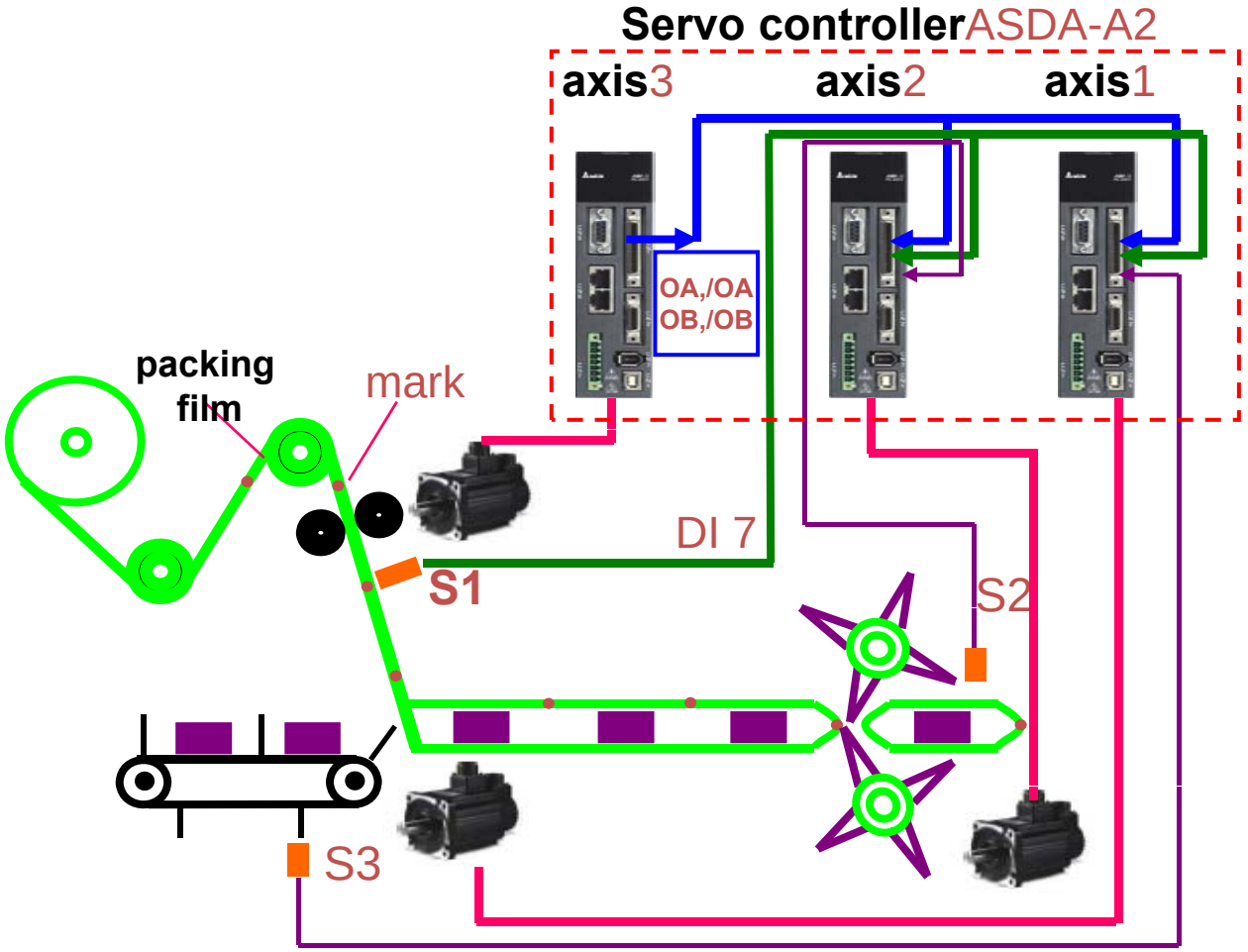
S’=2S－（△S－(S-D)/2）=V×t

Because of the equal “t”, it can be seen that :

$$V' = \frac{S}{\frac{5S - D}{2} - \Delta S} V$$



System structure of machine head



Introduction of system structure

1.Films Feeding Axis (Axis 3)

This axis adopts speed control as the main axis of the system. It sends the pulse commands to cutter axis and candies feeding axis.

2. Cutter Axis (Axis 2)

This axis operates with the master axis by using built-in E-CAM function of PR mode (internal position control mode). The pulse sources are from OA,/OA and OB,/OB signals of films feeding axis (main axis). The rotary cutting function of E-CAM is used to perform synchronization control. When the servo drive detects S1 signal of color mark sensor, E-CAM will be activated and start operating. During E-CAM operation, the servo drive will capture S1 signal and use Capture SYNC Axis (color mark compensation) parameter to adjust the E-CAM speed and ensure the precise cutting position.

3. Feeding Axis (Axis 3)

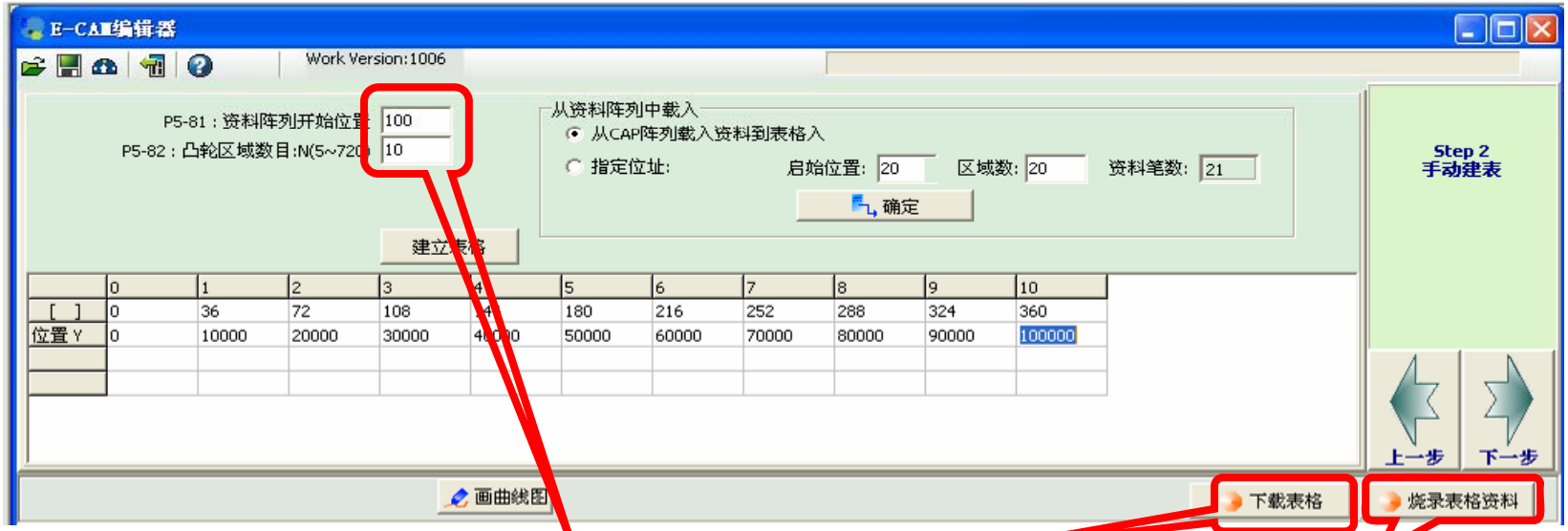
This axis operates with the master axis by using built-in E-CAM function of PR mode (internal position control mode). The pulse sources are from OA,/OA and OB,/OB signals of films feeding axis (main axis). The synchronization of E-CAM and the film feeding axis are synchronously controlled. Then refer to the color mark to perform the self-regulation of candy position.

Customer mechanical parameter

The gear ratio of tension film roller is 1：3.The output pulse number of each round of film feeding axis is 10000,that is ,film feeding axis is P1-46=2500.So,in the above table, the number of encoder pulse is 30000.

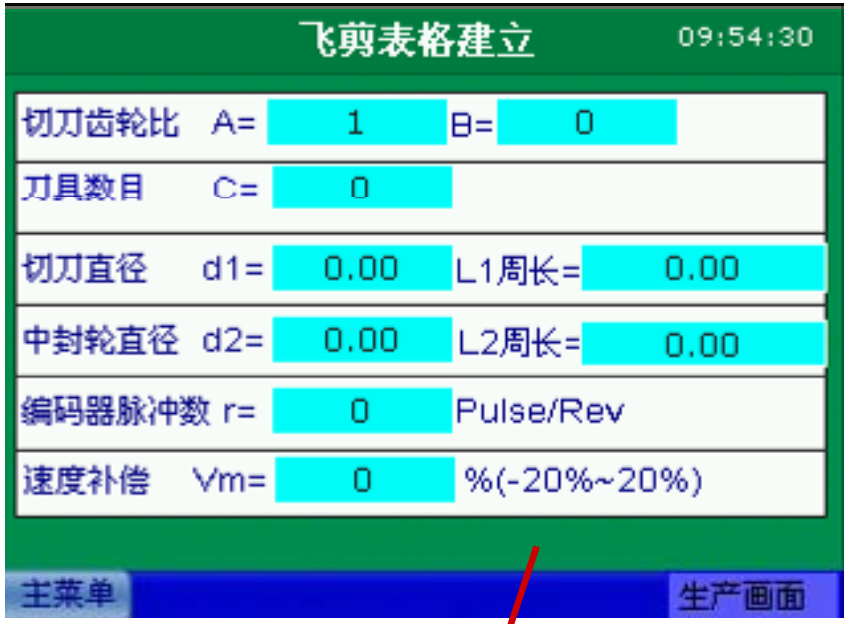
Creating the curve of chain hook axis

Chain hook mechanical parameter: the motor runs for one rotation, the chain Hook moves a chain distance.
Electronic gear ratio settings of chain hook axis is P1-44=128 P1-45=10
The master axis sends a cutting length, which corresponds to a chain distance of the chain hook (E-CAM).
The E-CAM curve is shown in the following table, which is created by using "manually establish the table " option. For more detailed parameter settings, refer to the specific system parameters in parameters files.



After inputting the data, set P5-81andP5-82,then press "download the table" → "copy the table data"

Flying shear curve changed by HMI program



The parameters of flying shear curve can be input by HMI.

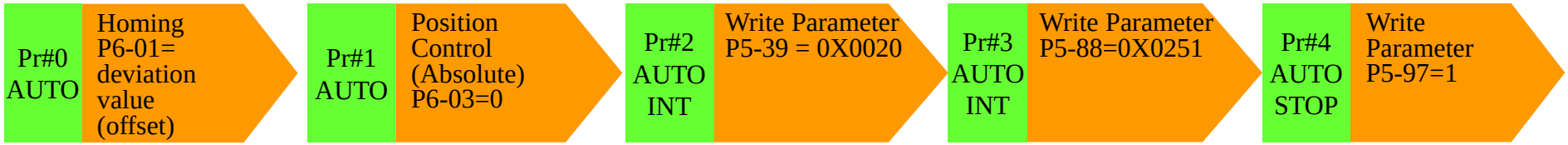
Cutting length setting

After pressing the "parameter confirmed", establish the flying shear form, then download to the server drive.

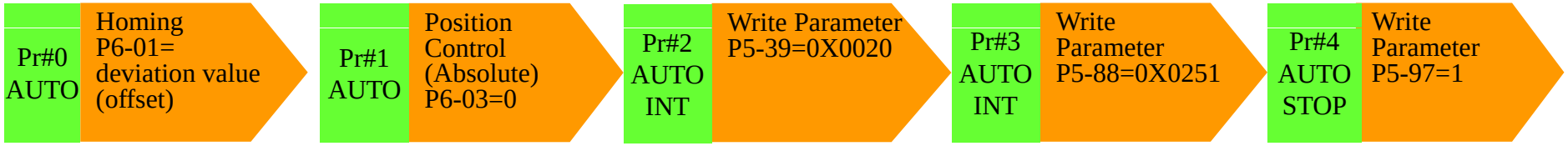
Settings of Servo Parameters

Use E-CAM parameters (Pr mode) of ASDA-A2 series to satisfy the needs of high speed applications. For more detailed settings, please refer to the descriptions below:

Chain Hook Control



Rotary Cutter Control



Parameter Settings:

P5-39=0X0020: Capture source is pulse command

P5-88=0X0251: E-CAM source setting is CAPTURE SYNC AXIS

Engage timing: Any point of CAPTURE AXIS

Disengage timing: Do not disengage

P5-97=1: Enable macro command, i.e. enable CAPTURE SYNC AXIS

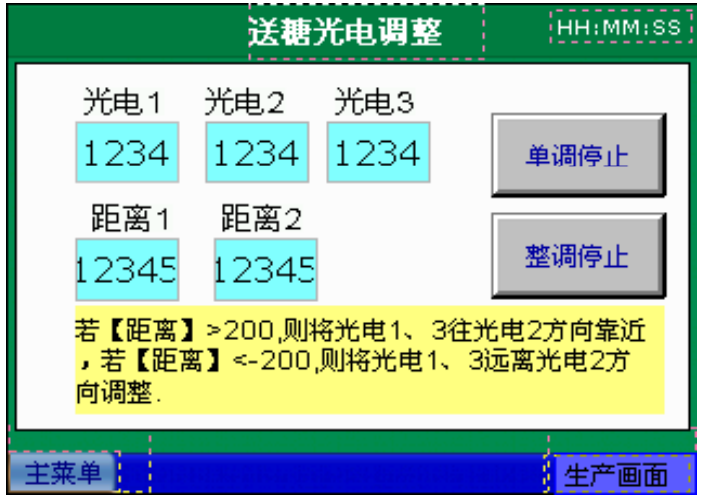
Main parameter setting of chain hook and cutter shaft

Gain parameter	Relevant parameters of E-CAM	DI/DO
P1-37	P1-00=0	P2-10=0X0101
P2-00	P1-74=2	P2-11=0X0127
P2-02	P1-76=1.05*(maximum speed of spindle)	P2-12=0X0102
P2-04	P5-39	P2-13=0X0124
P2-06	P5-78	P2-18=0X0101
P2-25	P5-79	P2-19=0X0111
P2-26	P5-80	P2-20=0X0109
P2-47=1	P5-83	P2-22=0X0107
P2-53=50	P5-84	
	P5-87	
	P5-88	
	P5-96	
	P5-97	

Steps of Machine Debugging

Sending sensor adjustment

A. In the page of 【parameter setting】, set the parameters of 【candy length setting】. It is advised that the length of chocolate is around 30mm.
B. In the page of 【production screen】, under the circumstance of 【automatic】, firstly set 【speed setting】=100, then press 【work preparation】.
C. Enter the screen of 【feeding sensor adjustment】, press the buttons of 【 Individual adjustment stop】 and【 Integral adjustment stop】. Now the feeding belt is at a constant speed, if put two candies on it ,the distance between them is stay the same.
D. Put the chocolate on the collecting belt, in the page of 【feeding sensor adjustment】, adjust it according to the prompt.
E. When both of distance1 and distance2 are in the range of -200 to 200,it is reasonable .Enter【 Individual adjustment stop 】and【 Integral adjustment stop 】, then quit the screen of【 feeding sensor adjustment 】.All the adjustments are complete.



Steps of Machine Debugging

Servo system adjustment for machine head

1.Estimate the ratio of inertias of loading.

2.Please adjust the gain, setting P2-47=1.

3.Program the E-CAM curve and set the correlation parameter.

4. Manual operation.

a, In the mode of spindle inching, inch the spindle at the speed of 5~10rpm.

b. Trigger the signal of color code.

c. The chain hook and the cutter run with the spindle.

If the spindle is running but the E-CAM shaft, please make your choice of following parameter:

P1-74=2

Whether P5-86 changes following the spindle

P5-88?=251

P5-97?=1

P5-19?=1000000

Steps of Machine Debugging

Servo system adjustment for machine head

5.Confirm the pulse direction of E-CAM shaft spindle.

Examine the parameter P5-37of chain hook and cutter, make sure that it is a positive value and is increased in process of operation. If not, please change the input direction of pulse.

6. Trail of packing film cutting

When cutting, check if the setting value of P5-79 is around zero.

If the value of P5-79 increases in one direction:

a. Check if the signal of color mark is normal.

b. Check if the film feeding roller has slipped.

c. Check if P5-78 is set correctly.

Common Problem& Solution

Q1.On the receiving belt, the line space of candy is in disorder.

A： a, Please check whether the sensor is in right location and whether the lighting distance is desirable.

b, Please make sure the space between the candy which is on the upstream production lines is equal.

Q2.Candy is dropped at the end of snakelike belt.

A： a, The speed of packing is too low and the candy unable to pull-down.

b, Please make sure the snakelike belt is accurately placed .

c, Please make sure the directive wheel is accurately placed .

Q3.When feeding ,two chocolates are send into the same chain hook at the same time.

A： a, The amount of candy is inaccurate, and the speed of packing is too low ,as a result ,the candy on the collecting belt is crowd.

b, If the ambient temperature is overheat ,it will lead the chocolate to bonding together .

Common Problem& Solution

Q4.When feeding ,the chocolate fly off.

A: a, Please make sure that the sensor is installed at the correct position.

b, Please check whether the lighting height is suitably adjusted, especially at the joint of the belts.

c, please check that the belt is not slipped.

d, Please check that the air draft system is normal.

e, Please make sure that the belt for candy is clean.

f, please make sure the underside of the candy is smooth, or else, the air draft doesn't work.

g, The amount of candy is inaccurate, and the speed of packing is lower than feeding.

Q5.Empty package is too much.

A: a, The amount of candy is inaccurate, and the speed of packing is higher than feeding.

b, The yield of upstream production line is less than normal.

Common Problem& Solution

Q6.The drive shaft works but not the chain hook or cutter.

A: Please make sure that the E-CAM curve has been downloaded to the drive.

Q7.The length of cutting and setting is not equal.

A: Please check that the mechanical parameter in flying shear form is set correctly.

Q8.Though the length of cutting has been accurately adjusted, in a while, there are different lengths.

A: a, Please make sure of normal signal of the color code.

b, Please check that the film feeding roller is not slipped.

c, Whether P5-96 is correctly set.

Q9.The position deviation is increased when the speed is also increased.

A: Increase the setting value of P2-02 and P2-53 with the specifications of the machine.

Q10.The speed of cutting offset correction is slow.

A: Increase the setting value of P5-80 suitably .

Thank you!

To learn more about Delta,
please visit www.deltaww.com