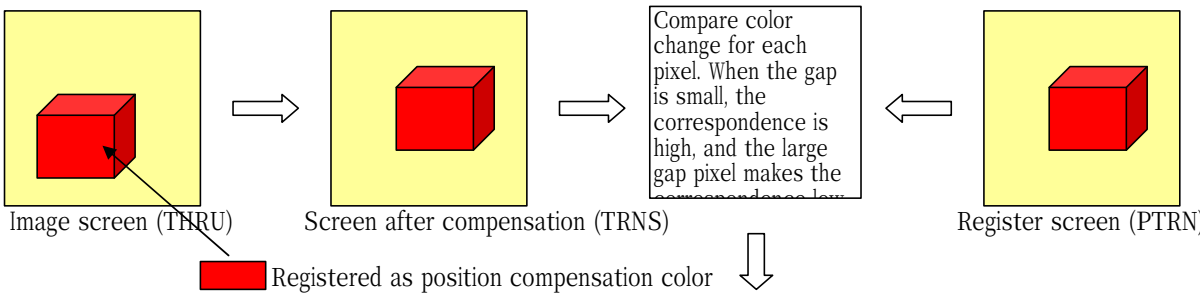
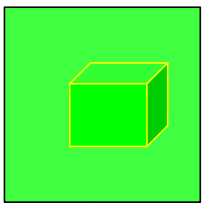
FAQ (Frequently Asked Questions) **2004.1.21 OPTEX FA**

Contents

(1) What is the processing method of Pattern Comparison?



Screen after compensati R=250, G=255, B=150
Register screen: R=248, G=255, B=160
→Calculate gap of R, G, and B
Rd = |250-248| = 2
Gd = |255-255| = 0
Bd = |150-160| = 10
Use the largest value in this gap (In this case, 10 of Bd)
Diminish the value (15-CMPSENSE) from 10.
When COMPSENSE=10, 10-(15-10)=5 is the color gap volume.


Comparison screen (COMP)

The correspondence calculation depends on if CMP LACK=0 or not.
When COMP LACK = 0, obtain the average value of color gap amount of all pixels (except for masking part), and diminish the value from 100.
Correspondence = 100 - (average color gap amount of all pixels) @CMP LACK=0

When CMP LACK>0, integrate the color gap volume of all pixels,
obtain value divided by 2^(15-CMP LACK), and diminish the value from 100.
Correspondence = 100 - (integrated value of color gap volume for all pixels)÷{2^(15-CMP LACK) @CMP LACK>

Unlike the conventional image processing ,
CVS2 processes color images by comparison.
This allows multiple-color processing at the same time
which is not available for monochromatic processing through a color filter.

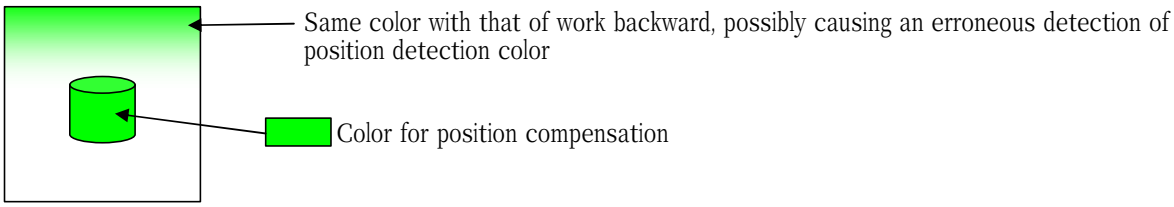
(2) What is SAVE PATTERN?

・The mask screen is used as it is.
・The current image screen is saved to the register screen (comparison target screen).
・The color for position/rotation compensation is used as it is, but the coordination, distance, and pixel of the compensation color are revised.

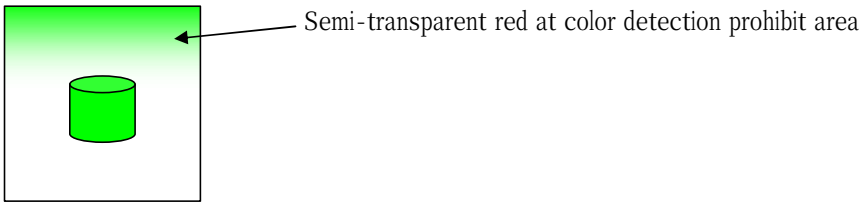
(3) What is the application of COLOR WINDOW?

CVS1 can change the image range by ZOOM function of teaching.
When there is a color similar to the detection color in the screen corner for example, narrowing the image range can avoid the erroneous detection.

In CVS2, the image range only need to be changed by four patterns by SCREEN setting.
When there is an area where compensation color is to be excluded from the detection, limit the detection area in COLOR WINDOW to avoid erroneous detection.



Limit the color detection range in COLOR WINDOW.



(4) How we can change the setting value by STD TEACH, ROTATION, and MASK EDITOR?

The normal setting flow is as follows:

Select change option by referring to set valu
↓
Press SET for 3 sec or more
↓
Set value turns to red
↓
Press UP/DOWN to change the value
↓
Press SET for 3 sec or more to write

To change the set value in teaching or mask edition, the flow is different:

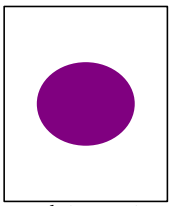
Switch teaching function by SET/EXIT
↓
e.g. ▲: WIDE ▼: NARROW COLOR
↓
Press UP/DOWN to change the value

There is no longer need of every "Pressing SET for 3 sec" to enter editing mode or determining the value.
Determining the teaching and masking edition (by pressing SET for 3 sec) can write the setting change.
Pressing EXIT does not return the value before the setting change.

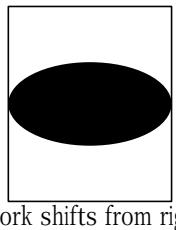
(5) How can we successfully take the work image moving in high speed?

Influence of blur caused by shutter timing

When the work moves during the shutter open, the color looks different by being mixed with the next color.



Work is static



Work shifts from right to left

In this case, problem happens such as erroneous detection of position compensation value, or poor correspondence

To solve these problems, the shorter shutter time is helpful.
The following equation shows a correlation between work moving speed, blur amount, and shutter time:

Blur amount (mm) = Work moving speed (m/s) × Shutter set value (0.1ms) ÷ 10

e.g. When Work moving speed =0.5(m/s) and Shutter set value =60, the blurred amount is: 3(mm)

To inspect a small crack or thin characters in a moving work, the range size to detect the blur amount needs to be set as follows:

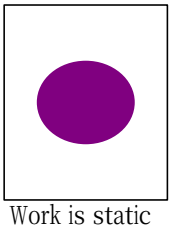
SHUTTER set value = detection size (mm) ÷ work moving speed (m/s) × 10

e.g. To detect a character of 1 (mm) in the work moving with the speed of 0.5(m/s),
the set value for SHUTTER is 20.

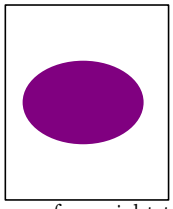
STEP 1. Set the necessary shutter time.
STEP 2. Increase the set value of IMG GAIN or DAR CMP so that the work image is bright in the THRU screen.
STEP 3. When there is much noise in the screen, increase the brightness by either making the distance between sensor and work close or adding an external lighting, and return to STEP 2.

Shape change influenced by rolling shutter

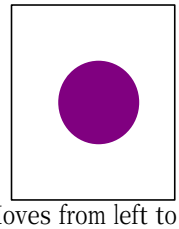
In the image sensor of CVS2, the shutter opens from right to left in the screen.
The open time is 54.5 μs for each column.
When the work moves from right to left in the sensor, the image is magnified laterally.
When the work moves from left to right, the image is shrunken horizontally.



Work is static

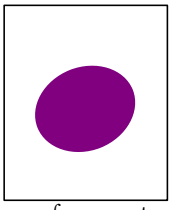


Moves from right to left

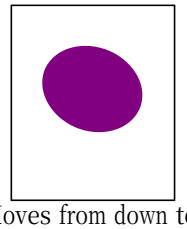


Moves from left to right

When the work moves upward or downward, the image is deformed.



Moves from up to down



Moves from down to up

The deformation amount can be obtained by the following formula:

$$\text{Deformation amount(mm)} = \frac{\text{Work moving speed (m/s)} \times \text{Size of static work (mm)} \times \text{Lateral resolution}}{18.35 \times \text{Lateral image area width (mm)}}$$

Lateral resolution = 208 (RESOLUTN=0)
Lateral resolution = 104 (RESOLUTN=1)

e.g. When Work moving speed = 0.5(m/s), Size of static work = 15(mm) , Lateral resolution = 208,
Lateral image area width = 50(mm), the deformation is:
0.5×15×208÷(18.35×50) = 1.7mm

The counteraction is either decreasing the resolution (RESOLUTN=0) or decreasing the work moving speed.
If the work moving speed does not vary drastically, teaching with the work moving allows the detection of correct sl

(6) How we can distinguish DARK CMP, IMG GAIN, and SHUTTER?

●To distinguish bright colors and dark colors (Black, Grey, and White)→ Decrease **DARK CMP** value

Black work (LIVE screen)

Black work (THRU screen)

When **DARK CMP**(darkness compensation) is initially 27,
the black work can be distinguished from the white background.

Grey work (LIVE screen)

Grey work (THRU screen)

The gray work, however, cannot be distinguished because the darkness compensation function makes it white, the same color with the background.

Decreasing **DARK CMP** value makes the gray color appear.
In the THRU screen, it can be distinguished from the white background.
Setting the value too small makes the brightness compensation invalid, to cause an erroneous detection according to the fluctuation of disturbance or lighting.
Do not apply too small a value.

●Counteraction for short shutter time (1) → Increase **DARK CMP**

To take an image of work moving in a high speed, a shorter shutter time is required to reduce blur.
Refer to:
(5) How can we successfully take the work image moving in high speed?
This makes the screen too dark to activate the darkness compensation function.

Increase the **DARK CMP** value, so that the dark pixels can be compensated.

This enables to obtain the image close to the one of longer shutte time, but the overall color tone is whitish, allowing much noise.

Some compensation means are necessary, such as applying short distance between the sensor and the work, or providing an extern lighting.

Tip

$$\text{Brightness} \propto = \frac{\text{Shutter time X lighting brightness}}{(\text{Distance between sensor and work})^2}$$

When the distance is half, the brightness becomes quadruple.

●Counteractions for shorter shutter time (2) → Increase **IMG GAIN**

Increasing **IMG GAIN** (Image Sensor Gain) makes the screen bright. This helps to compensate the short shutter time.

However, the noise is increased in this case, accordingly.
The screen noise increases and color tone becomes whitish.

The color detection accuracy decreases, and the position compensation accuracy decreases, to make the color identification difficult.
As a counteraction to increase **DARK CMP**, use **IMG GAIN** only for the application in which black, gray, and white cannot be distinguished.

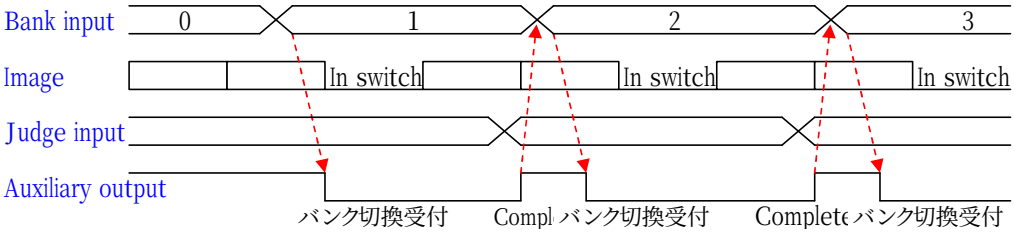
(7) What is the application of auxiliary output?

The auxiliary output function can be switched by AUX OUT. Here is the information on the function and application for each set value.

AUX OUT=0 : Ready

Function: turns OFF when receiving the bank switch input, and ON at the timing when the judge output is triggered at a new bank.

Application: by switching the bank one by one from PLC, and judges at which bank the correspondence can be obtained (for sort application).

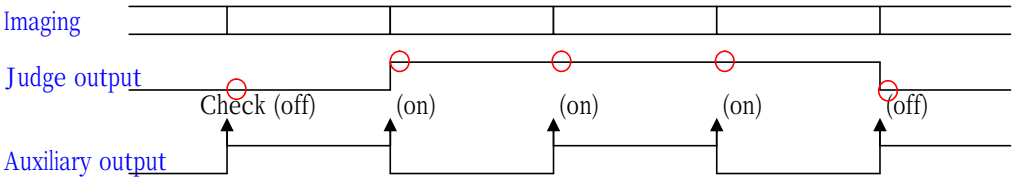


AUXOUT = 1 : Judge timing

Function: reverses the auxiliary output when the judge result is given after taking the image.

Application: contributes to the response speed of the post processing of judge output, by getting information right at the judge result.

At PLC side, the auxiliary output is to be detected both for rising and decaying edges. Check the judge output ON/OFF at that time, then the simultaneous processing with CVS2 is available.



AUXOUT = 2 : lighting timing

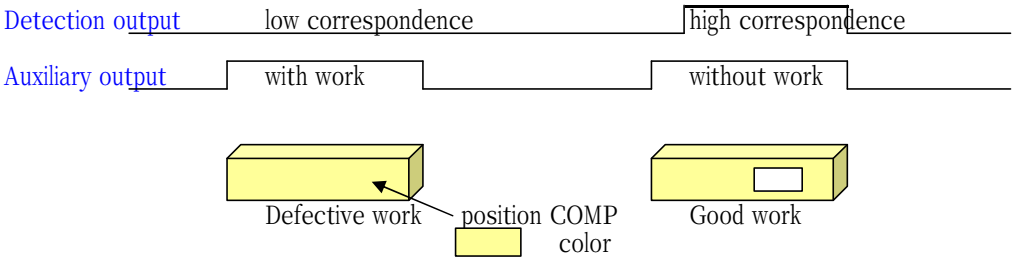
Function: turns ON while the lighting is lit

Application: When set to SYNCHRON<4(simultaneous input), the lighting is lit only for the time of image. CVS-LW1 In using a commercial lighting other than CVS-LW1, set so that the lighting is only lit when the auxiliary output is ON. This contributes to a reduction of power consumption and a long life of lighting.

AUXOUT = 3 : Output within tolerance of position/magnification/rotation compensation

Function: turns the auxiliary output ON when the position/magnification/rotation compensation is within each tolerance (MAGNIFY%, POSIT% X, POSIT% Y, ROTATE%).

Application: The auxiliary output is ON with the position compensation color, and this can detect the work presence When the work has poor correspondence with the registered screen, the judge output turns OFF, to give the judgment of defective work.



(8)Is it true to use CVS2 as a two-color area sensor?

Register two colors, for position compensation and for rotation compensation. With this setting, using the auxiliary output for judge output allow CVS be used as a two-color area sensor.

■Registering color 1

Register the color to be detected by STD TEACH.

■Registering color 2

Register another color to be detected by ROTATION.

■Setting

AUX OUT =3

When MAGNIFY% =0, the auxiliary output is turned ON if the registered color pixels (area) are more than half of the total.

What application is suitable?

- The case with unstable correspondence with large error, even though rotation compensation is required.
- The case when various setting including masking edit is troublesome.
- The case when the work moving speed varies, causing the variation in shape or blur amount.

(9) How we can distinguish CMP LACK, CMPLEVEL, and CMPSENSE?

●To judge a small amount of pixels due to character difference, positioning, breakage inspection: → **CMP LACK**

Positioning OK

Position shifted

(Magnify)

The yellow part is position shift

At CMP LACK=0, the correspondence decreases only 100→96 with a slight position shift.

To reflect a slight difference in pixels to correspondence, increase CMP LACK.

Take an image of work at OK, gradually increase the set value of CMP LACK.

Correspondence is a little affected.

Positioning OK

Too large a value gives an excessive drop of correspondence. Determine the value just before this happens.

Position shifted

Shifting a position slightly could decrease the correspondence at once.
Now the slight position shift can be stably detected.

Tip

When CMP LACK=0, the correspondence of the area with masking cleared is averaged. Even if there is a pixel which correspondence is poor at one part, this does not affect the entire correspondence if the other parts have high correspondence.

When CMP LACK is more than 1, the pixels with low correspondence are integrated, and the integrated values are divided by a specified value (= $2^{(15\text{-CMP LACK})}$). This is why the entire correspondence decreases along with the pixels of low correspondence, in regardless of the area size of masking released.

●To detect slight color difference → **CMPSENSE**

Color arrangement:OK

Color arrangement:NG

This example shows the detection if the middle orange color is not switched to the right thinner orange color.
In the initial setting, OK shows the correspondence 97, whereas NG shows it 94, a smaller difference in correspondence.

Point

To detect a slight color difference, sometimes the correspondence may be decreased by tone shift due to temperature change. Changing the value of TEMPCOMP can adjust the characteristics of temperature and color ton

Color arrangement:OK

Color arrangement:NG

To increase the sensitivity to color difference, increase the CMPSENSE value.

OK:74, NG:62, thus the difference increased than the previous case. However, since the correspondence threshold is 70, the value 74 for OK is not the best value yet.
Change the threshold value to the one middle of OK and NG, 67 ((72+62)÷2 = 67).

Color arrangement:OK

Color arrangement:NG

The threshold value of correspondence can be changed by CMPLEVEL..

●To adjust correspondence threshold value → **CMPLEVEL**

(10) What is the typical application of MAGNIFY%, POSIT% X, POSIT% Y, and ROTATE%?

●The distance between the sensor and work fluctuates → Magnification/Shrinking compensation by **MAGNIFY%**

This is a screen where the teaching of blue square of the sample work is completed.

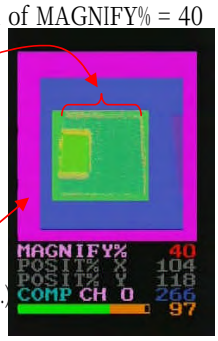
The initial value for MAGNIFY% is 0, and the magnifying/shrinking compensation does not activate.

Operation of MAGNIFY% = 0

When the distance between sensor and work is small, the work image becomes larger.

This is why the correspondence is low at the color border.

Operation of MAGNIFY% = 40



When the distance between sensor and work is small, the image is first shrunken, to be compared with the registered screen. (the surrounding color is pink, for it is out of the image range due to shrinking process.)

When the distance between sensor and work is large, the work image becomes smaller.

Since the background is compared with the work surrounding in the registered screen, the correspondence is low.

When the distance between sensor and work is large, the image is first magnified, to be compared w the registered screen.

Tips

The magnifying/shrinking compensation uses a same magnifying power for the entire screen. Therefore, when the different magnifying powers are used between the upper and lower parts of the screen, error is inevitable.
The application to identify the slight pixel difference as thin character difference or work crack is not suitable for magnifying/shrinking compensation..

●To detect by work colored area → Adjust area margin by **MAGNIFY%**

Set AUX OUT to 3 to use the auxiliary output.

Using the teaching with position compensation (STD TEACH), perform teaching by selecting the color for detection target.
(Detection target color)

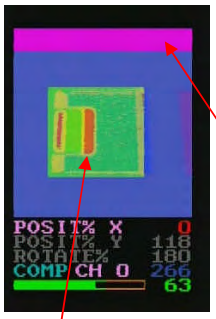
If this color area is within the range of: area at registration ×(128±MAGNIFY%)÷128, the auxiliary output turns ON.

This sample shows an area decreased a little, but this manages to turn auxiliary output ON because of the setting of MAGNIFY%=14.

In this case, the auxiliary output turns ON when the area is within the range of:
(128±14)÷128 = 0.89 times to 1.11 times.
※The values relating to color area such as current area or upper/lower limit values cannot be revi

HELP info:
When the color for rotation compensation is additionally registered (by performing ROTATION), the auxiliary output turns ON only when both colors are within the area range →Refer to (8) Is it true to use CVS2 as two-color area sensor?

●To perform pattern matching and positioning → Set the direction of positioning and accuracy by **POSIT% X/Y**



Teaching with position compensation and using small setting value of POSIT% X or POSIT% Y can limit the range of position compensation.

Here the lateral position compensation does not work since POSIT% X (lateral position compensation range) is 0.
(The vertical position compensation works, indicating the pink color showing out of range here)

By compensating the work position vertically to meet to the lateral position, the correspondence becomes high. This is the positioning.

Without the lateral position compensation, the target is shifted.

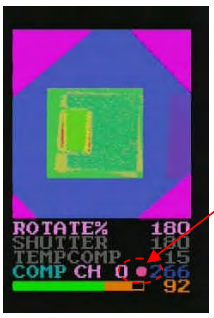
※To perform vertical positioning, decrease the value of POSIT% Y.

●To trigger NG for the shifted work in more than specified angle→ Limit the angle for rotation compensation by ROTATE%

In this screen, the yellow color is specified to compensation color by STD TEACH (Teaching with position compensation), and the blue color is specified to compensation color by ROTATION Teaching with rotation compensation).

Position comp. color

Rotation comp. color



Even if the work angle is shifted, the rotation is given in the same direction with that in the registered screen.

When AUX OUT is set to 3, the auxiliary output is turned ON since the angle is within the compensation range.

When ROTATE% (Rotation compensation range) is small, the compensation is limited within the range of specified angle.

When the angle shift is more than that specified by ROTATE%, the auxiliary output is turned OFF. This can detect the work angle shift.