Professional Color Area Sensor CVS1- R
Operation Manual

- Thank you for purchasing the color vision sensor series Color Area Sensor (CVS1R).
- Before operating the product, read this manual thoroughly.
- Keep this manual handy for the future reference.
- This product cannot be used as safety device for human body protection.
- The warranty period of the product is one year from purchase. However, any malfunction due to natural disaster, improper conversion or maintenance shall be excluded from the warranty scope.

1 Before Operation

What is Color Area Sensor?

The Color Area Sensor detects the pixels that contain the same color information as the pre-set color, and measures their number (area). It outputs signal when the number of pixel falls within the specified range. The sensor is suitable for various types of detecting application such as with/without printing detection, mark detection, foreign object detection, and the detection of delicate color difference that is not possible with the color sensor.

Setup Procedure

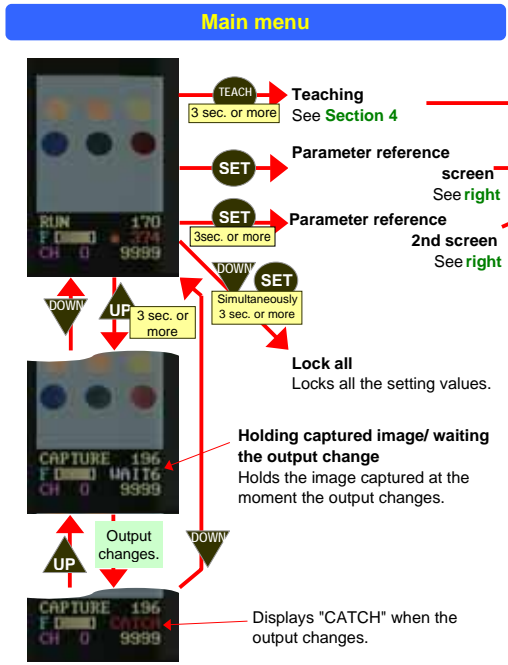You can proceed with the CVS1 setup in the following order.
1) **Optimum initialization for applications** (Section 3)
 Select the optimum INITIAL setting for your application.

2) **Teaching** (Section 4)
 Register the detection color. You can reduce the capture area to eliminate undesired objects.

3) **Setting customization** (Section 5)
 Select settings such as color margin percentage and input/output signals.

Learn the basic operations in Section 2, and start the setup in the order of 1 to 3 above.
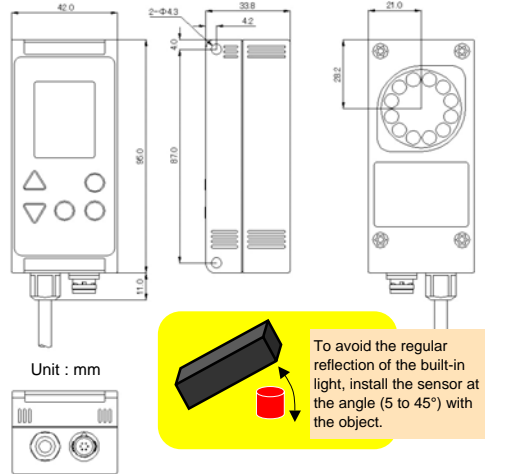
2 Descriptions of LCD display

Main menu

1) **Captured image**
 The image captured by the camera is displayed.

2) **Mode display**
 "RUN" mode is selected in the main menu.

3) **Screen display mode**
 Indicates the current screen mode. (see **right**)

4) **Bank number**
 Indicates the selected bank number (0 to 15).

5) **Detection color**
 Displays the colors to be detected.
 Left: Darkest color, Middle: Middle tone, Right: Brightest color

6) **Color area lower limit**
 Indicates the lower limit of the detection color area.

7) **Color area**
 Indicates the current area of the detection color.
 Orange : Within the specified range
 Green : Out of the specified range

8) **Color area upper limit**
 Indicates the upper limit of the detection color area.

9) **Output status**
 ○ : Output ON ✕ : Output OFF

In the parameter reference screen and the parameter selection screen, items No. 2, 6 and 8 above are respectively replaced with:
10) Parameter 11) Parameter value 12) Response time (unit : 0.1ms)

Main menu

TEACH 3 sec. or more → **Teaching** See Section 4

SET → **Parameter reference screen** See right

SET 3sec. or more → **Parameter reference 2nd screen** See right

SET DOWN 3 sec. or more → **Simultaneously** 3 sec. or more

UP 3 sec. or more

Lock all
Locks all the setting values.

Holding captured image/ waiting the output change
Holds the image captured at the moment the output changes.

Output changes.

Displays "CATCH" when the output changes.

External Dimensions

Unit : mm

To avoid the regular reflection of the built-in light, install the sensor at the angle (5 to 45°) with the object.

Connection of Power Supply and Input/Output Cable

The line colors and signal allocations of power supply and input outlet cable are as follows.

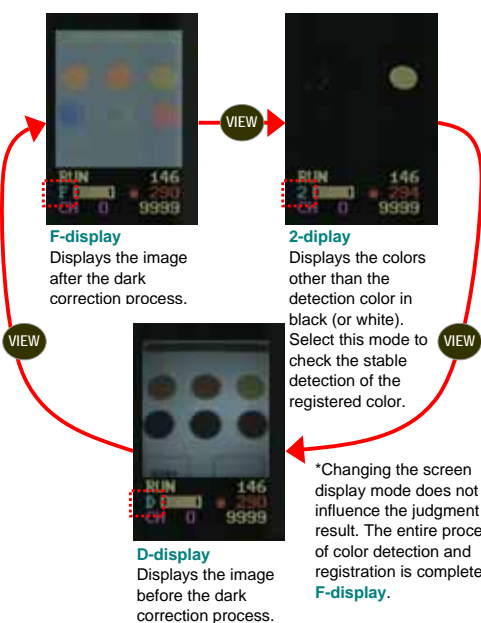| No	Color	Signal
1	Brown	12 - 24 V DC
2	Blue	0V
3	Orange/Black	Bank selection 0 input
4	Yellow/Black	Bank selection 1 input
5	Pink	Bank selection 2/ Teaching input
6	Purple	Bank selection 3/ Synchronous input
7	Black	Output
8	Red/Black	Lower limit out / AuxIn

3 Optimum Initialization for the application

Select the INITIAL setting to initialize the parameter settings using the optimum values for your application.

Application	With/without print	Print on lustered/ transparent material	Delicate color difference	With/without luster
	Expiry date 2004.8.25	2004.8.25		
INITIAL setting	1	2	3	4
COLRFIL	1	1	0	0
KIL BLK	27	27	27	20
LIGHT	3	2 †	3	3
RESOLUT	0	0	1	0
TEACHMD	1	1	1	2
Resolution	200×120	200×120	200×240	200×240
Teaching window	Normal	Normal	Small	Small

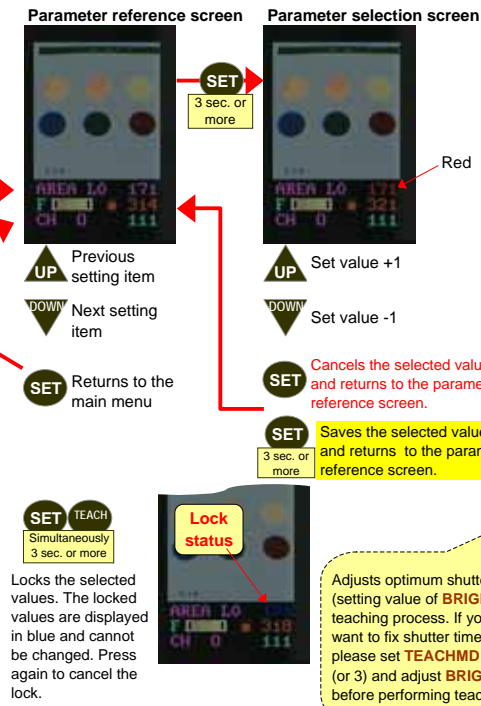| Application	White/Black (on white)	White/Black (on black)	Difference between dark colors	With/without print (on unstable background)
				Expiry date 2004.8.25
INITIAL setting	5	6	7	8
COLRFIL	1	0	0	0
KIL BLK	27	15	30	15
LIGHT	3	3	3	3
RESOLUT	1	1	0	0
TEACHMD	1	1	0	1
Resolution	200×120	200×120	200×240	200×120
Teaching window	Normal	Normal	Small	Normal

*All other settings are initialized together.
† Enables stable detection of printing by using diffused lighting or back lighting to eliminate the influence of luster.
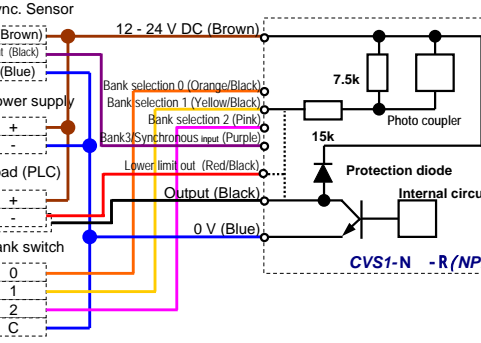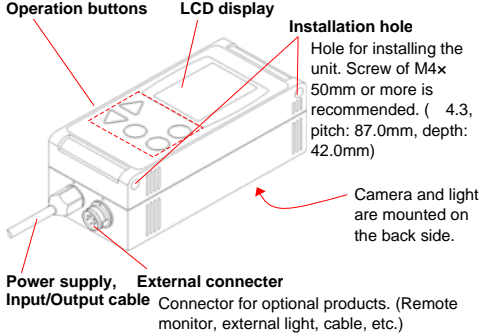
Changing the Screen Display Mode

F-display
Displays the image after the dark correction process.

2-display
Displays the colors other than the detection color in black (or white). Select this mode to check the stable detection of the registered color.

D-display
Displays the image before the dark correction process.

*Changing the screen display mode does not influence the judgment result. The entire procedure of color detection and registration is completed in **F-display**.

Parameter Reference/Selection Screen

Parameter reference screen | **Parameter selection screen**

Red

UP Previous setting item
DOWN Next setting item
SET Returns to the main menu

UP Set value +1
DOWN Set value -1

SET Cancels the selected values and returns to the parameter reference screen.

SET 3 sec. or more Saves the selected values and returns to the parameter reference screen.

SET TEACH Simultaneously 3 sec. or more

Lock status

Locks the selected values. The locked values are displayed in blue and cannot be changed. Press again to cancel the lock.

Adjusts optimum shutter time (setting value of BRIGHT) in teaching process. If you want to fix shutter time, please set TEACHMD to 2 (or 3) and adjust BRIGHT before performing teaching.

Parts Identification

Operation buttons **LCD display**

Installation hole
Hole for installing the unit. Screw of M4× 50mm or more is recommended. (4.3, pitch: 87.0mm, depth: 42.0mm)

Camera and light are mounted on the back side.

Power supply, Input/Output cable **External connecter**
Connector for optional products. (Remote monitor, external light, cable, etc.)

4 Descriptions of Teaching Menu

Teaching Menu Screen

Teaching window
Detects the darkest, middle tone, and brightest colors within the window.
- For delicate color detection : Select smaller area for window view.
- For stable detection in broader color range : Select larger area for window view.
- For character detection (TEACHMD=1,3) : Select larger area for window view to include both the characters and background colors.

Automatically switches between - display and 2-display.

In 2-display, ensure that only the color you register is displayed.

Teaching Point 1.

SET 3 sec. or more — Saves the teaching results and exits the menu.

TEACH — Selects the window operating function.

SET — Switches the teaching point between Point 1 and Point 2.

UP/DOWN — Performs the displayed option of the parameter (changing window position, window size and captured area).

TEACH 3 sec. or more — Cancels teaching.

Teaching Point 2.

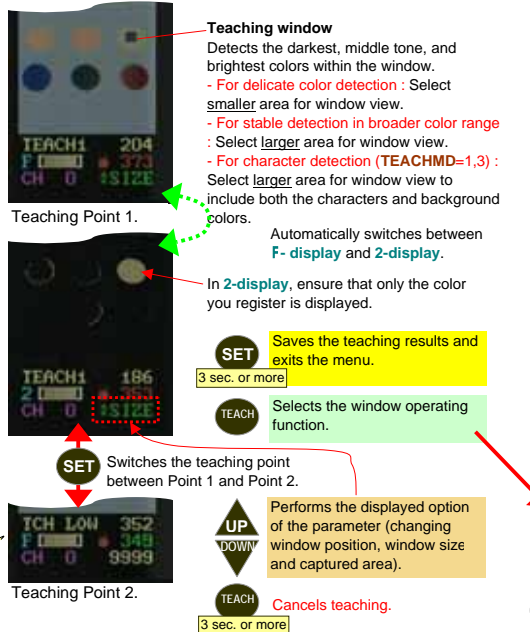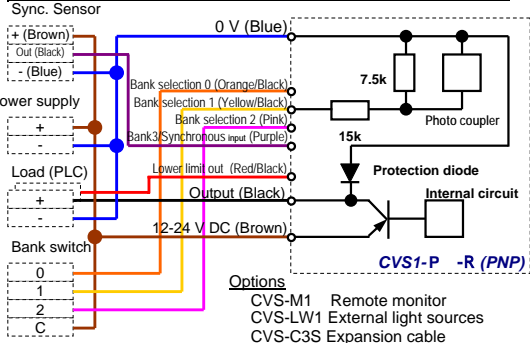For details of 1-point teaching, 2-point teaching, and Upper/Lower limit teaching, refer to **AREA LO, AREA HI**.

5 Settings

Select the settings before teaching.
Adjust the settings after teaching to optimize the detection performance.
Parameter reference 2nd screen
*The functions in purple display contain the setting values for each bank.

Function	Setting range (Initial value)	Description
Color area lower limit AREA LO	0 to 9999 (5000)	Selects the lower limit of color detection area. It is automatically selected according to the teaching mode. (1-point teach: Half area, 2-point teach: the average value of Point 1 and 2, Upper/Lower limit teach: Point 2 area)*1
Color area upper limit AREA HI	0 to 9999 (0)	Selects the upper limit of color detection area.*1 **0** : Sets the upper limit to 9999. In teaching, only the color area lower limit is registered. **1 or over** : Selects Upper/Lower limit teaching. The color detection area of Point 1 teaching is registered as the upper limit.
Bank selection BANK	0 to 18 (17)	Selects a bank selecting option.*2 **0 to 15** : Selects the set bank. ("Bank selection 2 input" is the external teaching input.) **16** :Selects a bank by an external input. ("Bank selection 2 input" is the external teaching input.) **17** : Selects a bank by an external input. ("Bank selection 2 input" is available./An expansion input can be used as the external teaching input.) **18** : Selects a bank by an external input. ("Bank selection 2 input" is available./An expansion input is used as "Bank selection 3 input". The original "Bank selection 3 input" can be used as a synchronization input.) *"Outside area range (outside)" setting has priority over the expansion input.
Screen brightness BRIGHT	0 to 255 (100)	Selects the screen brightness (=shutter time). The optimum value is normally selected during teaching. 1 step value corresponds to 54.5μs of shutter time. *1 To capture a fast-moving object, select the value according to the moving speed and switch to the fixed brightness teaching (TEACHMD=2 or 3). Setting value = 18 × Detection width (mm) ÷ Object moving speed (m/s)
Color margin percentage COLOR%	0 to 127 (20)	Selects the margin for the color registered in teaching. The value obtained by the following formula is stored: Color width in teaching window × TEACH% setting value ÷ 10. After teaching, select a smaller value (5 to 20) for delicate color detection, or a larger value (over 20) for stable detection in the broader color range.
Color filter COLRFIL	0 to 3 (0)	Selects the filtering option of the captured image. **0** : Calculates the RGB rate by pixel. Secures stable color detection against variable luminance influenced by shadow formation and lighting variation. Not suitable for black and gray. **1** : Corrects the brightness based on the brightness of the right end of screen. Suitable for black and gray detection such as black characters on white background. **2, 3** : Functions as 0 and 1, and doubles the screen brightness.
Area hysteresis HYSTRSY	0 to 200 (10)	Selects the hysteresis of color area upper/lower limits. 1 step value corresponds to 0.1% of the full screen (9999).
Input time constant IN FILT	0 to 4 (4)	Selects the bank selection and the time constant for external teaching signal (filter-out time). **0** : 160μs, **1** : 2.5ms, **2** : 5ms **3** : 7.5ms, **4** : 10ms (Each value±20%) *Synchronous input is constantly 40μs.
Set value initialization INITIAL	0 to 15 (0)	**1 to 8** : Initializes to the optimum setting values for each application. (Section 3) **15** : Initializes to the standard default values.
Darkness correction KIL BLK	0 to 31 (27)	Selects the correction rate against the variable luminance due to shadow formation of object or lighting variation. 0 to 10 : Very low rate to view the luminance such as LED lighting. 10 to 20 : Slightly low rate to separate black and gray. 24 to 28 : Standard rate for normal condition. (Corresponds to COLRFIL=1) 29 to 31 : Rate for differentiating specially dark colors.

Function	Setting range (Initial value)	Description
LCD up/down reverse LCD VIEW	0 to 3 (0)	0 : Normal display 1 : Reverses the LCD display vertically. Select 1 when installing the unit upside-down. 2, 3 : Functions as 0 and 1 on the condition that the remote monitor (CVS-M1) is connected. LCD display turns off if no button operation is detected for a minute. NTSC composite video signal is output from the external connection port.
Light ON/OFF LIGHT	0 to 3 (1)	Controls the internal and external lighting. 0 : Internal light-OFF, External light-ON 1 : Internal light-ON, External light-ON 2, 3 : Internal light-ON, External light-ON. When "SYNCHRO=1,3" is selected, the light turns ON only during image capture*4.
Maximum display area MAXAREA	0 to 9999 (9999)	Selects the maximum area. Use the function to directly read the displayed value in AREA LO or AREA HI as the area value.
OFF delay time OFFDELAY	0 to 5000 (0)	Delays turning OFF of the output. Allows it to turn off when the judgment result remains in OFF condition continuously for over the selected delay time (unit: ms).
ON delay time ON DELAY	0 to 5000 (0)	Delays turning ON of the output. Allows it to turn on when the judgment result remains in ON condition continuously for over the selected delay time (unit: ms).
One-shot ONESHOT	0, 1 (0)	Select "1" to keep the output ON for the off-delay time after the output turns on.
Outside area range OUTSIDE	0 to 3 (0)	0 : Output ON within the specified area range. 1 : Output ON outside the specified area range. *5 2, 3 : Functions as 0 and 1. "Bank selection 1 input" performs detection when the area exceeds the lower limit.
Resolution RESOLUT	0, 1 (1)	Select the number of pixels taken out from the image sensor. 0 : High resolution (240 x 200) Suitable to detect delicate color difference and thin characters. 1 : High speed (240 x 100) Suitable to shorten the response time retaining the current capture area.
Synchronization input delay time SYNCDLY	0 to 255 (0)	Selects the delay time of synchronization input. The synchronization signal input (bank selection 3 input) delays for the period of the setting value x 64μs. Suitable for fine adjustment of image capture timing.
Synchronization input SYNCHRO	0 to 4 (4)	Selects the synchronization input setting. When set to 0 to 3, "bank selection 3 input" is assigned to the synchronization input. The capturing conditions are as follows.*6 0 : While the synchronization input is Off 1 : When the synchronization input is switched from On to Off 2 : While the synchronization input is On 3 : When the synchronization input is switched from Off to On 4 : Captures images independently.
Teaching enable TEACHEN	0 to 3 (0)	0 : Enables changing the teaching window and its position, and the capture area. 1 : Prohibits changing the capture area. 2 : Prohibits changing the teaching window and the capture area. 3 : Prohibits entering teaching mode.
Teaching mode TEACHMD	0 to 3 (0)	0 : Normal teaching. Determines the darkest and brightest colors in the teaching window, and selects the detection color within the range between them. 1 : Stain and character detection teaching. Selects a dark color in the teaching window as the detection color. 2, 3 : Functions as 0 and 1. Performs teaching without changing the brightness (BRIGHT).
Teaching color margin TEACH%	0 to 30 (15)	Selects the color detection margin in teaching. (Refer for the details to COLOR%.)
Temperature compensation level TEMPCMP	0 to 255 (30)	Adjusts the setting against the deviation in color detection due to variable temperature. (Available only when both COLRFIL=0,2 and RESOLUT=1 are selected.) Perform teaching at low temperature and adjust the setting at high temperature to obtain the optimum value.
Language selection LANG	0/1 (0)	Selects a display language. 0: English/ 1: Japanese
Lighting brightness LED BRI	0 to 255 (170)	Adjusts the brightness of the internal lighting. 0 is the swithing-off state. 255 is the brightest state.
Lighting brightness difference LED PAN	0 to 100 (50)	Changes the ratio of the brightness of the upper lighting to the lower lighting of the internal lighting. 0 : Only the upper lighting is turned on. 50 : Upper and lower lightings are turned on at the same brightness. 100: Only the lower lighting is turned on.
Communication speed BAUD	0 to 3 (3)	Selects the communication speed. 0 9600bps/1 14400bps/2 57600bps/3 115200bps
BankCopy BNKCOPY	0 to 15 (0)	Select a destination bank. Copy the current bank to the destination bank.
Expansion display EXV	0 to 3 (0)	Displays the internal state only on the body LCD. 0 Not displayed/1 Blue color display /2 Green color display 3 Red color display
Img Select IMG SEL	0 to 7 (0)	Select the input image. 0 Original /1 Exponential /2 Red color /3 Green 4 Blue color /5 Low intensity /6 Mid intensity /7 Special

*1 The maximum value is adjustable using the MAXAREA setting.
*2 The bank selection input specifies the bank number using binary digit. (Ex. For Bank 10, set the bank selection 1 and 3 to ON.)
*3 Time setting longer than the response time is ignored.
*4 Immediately after a button operation, the light does not turns off even during the image capture.
*5 When ON delay time, OFF delay time, and One-shot are activated together, Area hysteresis is deactivated (HYSTRSY=0).
*6 When "SYNCHRO=1,3" is selected, the color area judgment is properly proceeded while the LCD does not display the image captured immediately after any button operation. An array of the right end of the image may appear at left end of the display, but does not interfere with the performance.

Teaching Procedure

Window vertical magnification/reduction
UP Magnifies the window vertically.
DOWN Reduces the window vertically.

Window Up/Down
UP Moves up the window.
DOWN Moves down the window.

Window horizontal magnification/reduction
UP Magnifies the window horizontally.
DOWN Reduces the window horizontally.

Window Right/Left
UP Moves the window to right.
DOWN Moves the window to left.

Capture area size
UP Sets the window view area as the capture area (Zoom-in).
DOWN Resets the capture area to the full size (Zoom-out).

Full size | Magnified

(1-point teaching) Start — Color is determined.
ON → OFF
3 sec. or more 3 sec. or more

(2-point teaching) Start — Point 1 color is determined. — Point 2 color is determined. / End
ON → OFF → ON
3 sec. or more 3 sec. or more 3 sec.

Timing chart of external teaching (Select "BANK=0 to 16."

Specifications

Model	CVS1	- N10 - R - P10 - R	- N20 - R - P20 - R	- N21 - R - P21 - R	- N40 - R - P40 - R
Detection angle		10°	20		40
Capture range		210 to 270 mm	90 to 150 mm	31 to 39 mm	50 to 100 mm
Capture area (±10%)		40x50 to 55x65 mm	40x50 to 65x75 mm	17x20 mm	50x65 to 100x115 mm
Light source		White LED, 12 pcs			
Supply Voltage		12 - 24 V DC±10%			
Power consumption		Max. 140 mA/24V DC			
Resolution		8x16 to 208x236			
Lamp duration		Approx. 50000 hrs (In normal temperature and humidity. Brightness level down by 1/2 of the initial level)			
Response time		11 ms (Factory setting), 0.6 ms (Min.), 22 ms (Max.)			
Output signal		NPN/PNP open collector output 2 points Max. 100 mA Residual voltage 1.0 V or less			
Input		Bank selection/Synchronous/External teaching input 4points			
Operating temperature		0 °C to 40 °C			
Ambient humidity		35 % to 85 %/RH			
Storage temperature/ humidity		-20 °C to 70 °C, 35 % to 95%/RH			
Vibration/shock resistance		10 to 55 Hz Amplitude 1.5 mm, 500m/s² (10 times)			
Material		ABS / Acryl / Polycarbonate			
Protection structure		IP67			
Weight		Approx. 200 g			

CVS1-N - (NPN)
Sync. Sensor
+ (Brown)
Out (Black)
- (Blue)
12 - 24 V DC (Brown)
Power supply +
Bank selection 0 (Orange/Black)
Bank selection 1 (Yellow/Black)
Bank selection 2 (Pink)
Bank3 Synchronous input (Purple)
Lower limit out (Red/Black)
Load (PLC)
Output (Black)
0 V (Blue)
Bank switch 0 1 2 C
7.5k Photo coupler
15k Protection diode Internal circuit

CVS1-P -R (PNP)
Sync. Sensor
+ (Brown)
Out (Black)
- (Blue)
0 V (Blue)
Power supply +
Bank selection 0 (Orange/Black)
Bank selection 1 (Yellow/Black)
Bank selection 2 (Pink)
Bank3 Synchronous input (Purple)
Lower limit out (Red/Black)
Load (PLC)
Output (Black)
12-24 V DC (Brown)
Bank switch 0 1 2 C
7.5k Photo coupler
15k Protection diode Internal circuit

Options
CVS-M1 Remote monitor
CVS-LW1 External light sources
CVS-C3S Expansion cable