Panasonic
ideas for life

Machine Vision System

IMAGECHECKER PV200

High End Performance in a Compact Body

Hardware

Color and grey images can be simultaneously captured for inspection.

In addition, the "3+1" Quad processor provides ultra-high speed parallel processing, significantly reducing the inspection time.
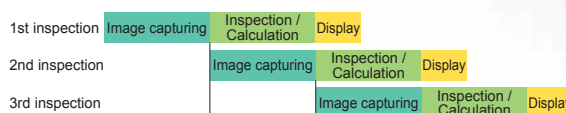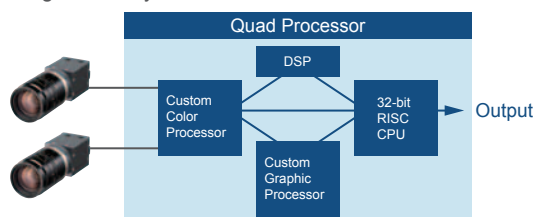
Features are condensed into the ultra-compact body guaranteeing outstanding usability.

50 mm / 1.97 in
116.5 mm / 4.59 in
148 mm / 5.83 in

DIN-rail mountable

## ⦿ Quad processor, DSP processing & Pipeline processing

"3 + 1" Quad processor for high speed processing

Consists of a processor exclusively for image capture and transfer, a high-speed RISC-CPU, image-processing DSP, and a processor exclusively for display processing

- Pipeline processing by the Quad processor enables concurrent operation of the image capture process and inspection process.
- Ease of operation is increased, because data R (read) / W (write) (see page 10) and display layout switching operations are possible in the RUN mode.
- DSP processing: High-speed DSP is a processor dedicated for realtime image and grey pre-process filtering.
- High reliability, fan-less, standalone hardware

Quad Processor

DSP

Custom Color Processor → 32-bit RISC CPU → Output

Custom Graphic Processor

	Image capturing	Inspection / Calculation	Display
1st inspection	Image capturing	Inspection / Calculation	Display
2nd inspection	Image capturing	Inspection / Calculation	Display
3rd inspection	Image capturing	Inspection / Calculation	Display

With pipeline (parallel) processing, image capturing and inspection can execute at the same time.
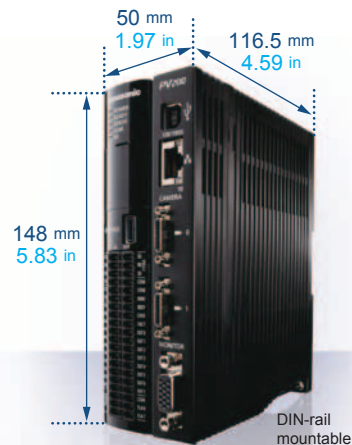
⦿ Two cameras, including a combination of color and grey cameras, can be simultaneously connected.

High definition color and grey cameras can be simultaneously connected. Inspections with color and grey images can be conducted concurrently.
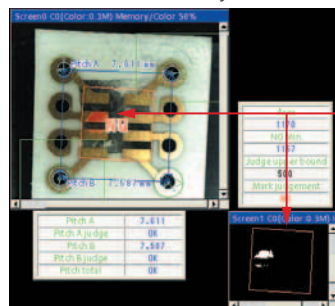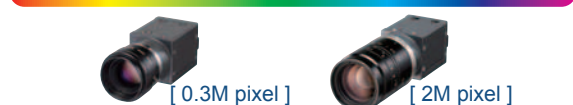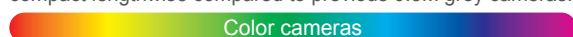
Color images clearly show red bad marks, which are difficult to detect with grey images.

⦿ Color / Grey combination inspection system

High accuracy inspection

Grey image → Color image

Preprocess

Grey conversion → Color extraction

Grey preprocess (Can be enabled/disabled) | Grey preprocess (Can be enabled/disabled) | Grey preprocess (Can be enabled/disabled)

Available checkers

Binary window	Smart matching	Connector (grey edge)
Grey window	Flaw detection	Smart edge (circles)
Grey edge	Connector (binary window)	Smart edge (line)
Feature extraction	Connector (grey window)	etc.

Color window

Grey conversion

Highly flexible grey conversion is possible, because each coefficient can be freely specified for each RGB value of a color image.

Color image

Grey conversion

Foreign substance   Hair

Foreign substance   Hair

⦿ Camera selections

High accuracy inspection

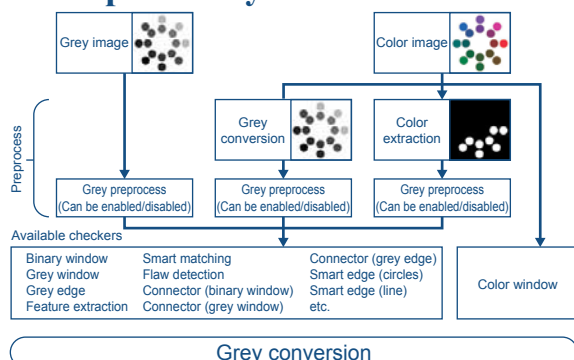Six types of cameras, including a 4M grey camera, are available with the system.

0.3M compact grey camera has been added to the product line-up. The body is approximately 20 mm 0.79 in more compact lengthwise compared to previous 0.3M grey cameras.
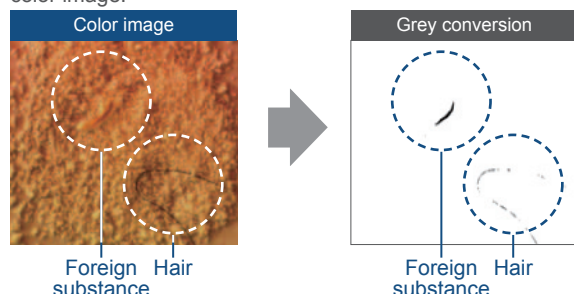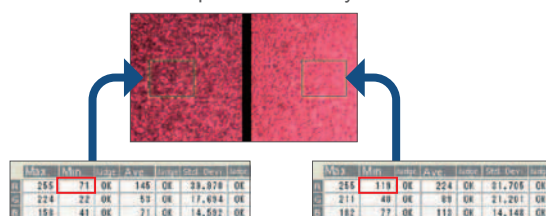
Color cameras

[0.3M pixel]   [2M pixel]

Grey cameras

new

[0.3M pixel]   [0.3M pixel compact]   [2M pixel]   [4M pixel]

*A dedicated cable is required for connecting.

*The 4M camera cannot be used in combination with another type of camera.

Color window

The maximum, minimum, average, and deviation of RGB values can be obtained. Results can be used for numerical calculations and outputted externally.

Max	Min	Judge	Ave	Judge	Std. Dev.	Judge
255	71	OK	145	OK	39,070	OK
224	22	OK	53	OK	17,604	OK
158	41	OK	71	OK	14,592	OK

Max	Min	Judge	Ave	Judge	Std. Dev.	Judge
255	119	OK	224	OK	31,705	OK
211	48	OK	89	OK	21,201	OK
182	77	OK	110	OK	14,148	OK

Color extraction

Colors in different color phases can be simultaneously extracted and inspected by using one inspection checker.

Color image
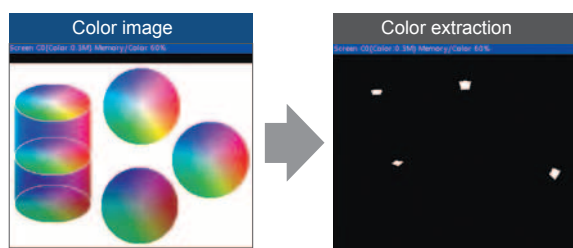
Color extraction
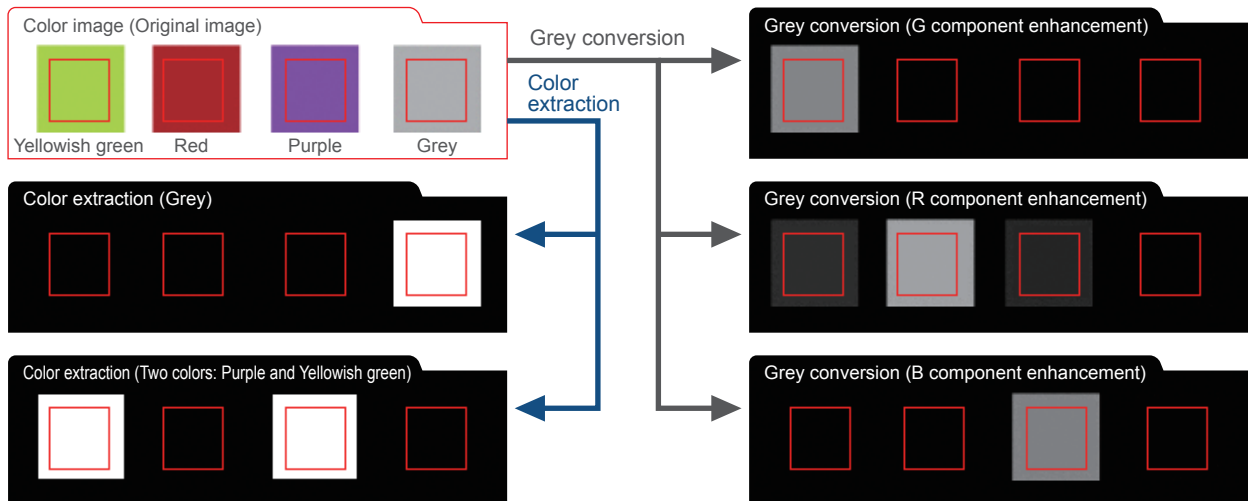
Purple and red orange is extracted.

Preprocessing

Grey conversion / Color extraction

• Grey conversion: Max. 16 groups/camera

The conversion coefficients are set for the color image RGB greyscale value and the image is converted to grey. Each RGB coefficient can be set freely (-1,000 to +1,000). This makes it difficult for the inspection to be affected by color changes, such as by the removal of low saturation (low coloration) or non-color parts and by target color enhancement, caused by lighting fluctuations.

• Color extraction: Max. 128 colors/type (one camera, expansion mode)

Utilizing the parameters H (Hue), S (Saturation) and V (Value), which resemble the way humans perceive differences in color, multiple colors (max. 128 colors) can be extracted simultaneously.

Color image (Original image)
Yellowish green   Red   Purple   Grey

Grey conversion

Color extraction

Grey conversion (G component enhancement)

Color extraction (Grey)

Grey conversion (R component enhancement)

Color extraction (Two colors: Purple and Yellowish green)

Grey conversion (B component enhancement)

Grey preprocess filters

High accuracy inspection *Man-hour reduction*

21 types of grey preprocess filters are available. Reliable inspections are possible even under non-uniform lighting conditions or in the case of images with noise.

• Preprocess filters: 21 types   • Preprocess groups: Max. 16 groups/camera   • Preprocess steps: Max. 10 steps/group

Main purpose	Filter name	
Flaw detection	• Tophat • Dynamic	• Grey difference
Noise removal	• Dilation • Erosion	• Erosion → Dilation • Dilation → Erosion
Image adjustment	• Rotation • Reflect	

Main purpose	Filter name		
Contour enhancement	• Sobel • Prewitt	• Laplacian • Edge extraction X	• Edge extraction Y • Sharpen
Blurring	• Median • Smoothing		
Contrast enhancement	• Auto correction • Grey cut	• Area averaging • Correction settings	

Application example	Original image	Processed image
Checking container lids for adhesion of foreign substances **Filter used** **[Tophat]**		
Checking films / sheets for scratches / wrinkles **Filter used** **[Grey difference, Area averaging]**		
Detecting dirt on transparent sheets **Filter used** **[Dynamic]**		

Application example	Original image	Processed image
Extracting printed characters (deleting the background) **Filter used** **[Dynamic]**		
Checking the inside of containers for adhesion of foreign substances **Filter used** **[Grey difference, Tophat]**		
Checking sintered parts for breaks / cracks **Filter used** **[Grey difference, Tophat]**		

Checker Functions

⚪ Smart edge (Circle)/(Line)

Complicated inspection processes can be easily performed with highly accurate measurements.

A function for accurate approximation of circles/lines
This function detects a maximum of 3,000 edge points for a line and 3,600 for a circle in one area, dramatically improving the accuracy of the dimension and position measurements.

Operation principle

1. A Grey edge scanning area is created, and edge points in the area are searched to detect the contour of the object.

2. Virtual circles and approximate straight lines can be identified with a high degree of accuracy based on the target edge points.

3. Pass (OK) /fail (NG) evaluations are made based on the measured values (radius, diameter, and width), deviations, circularity, straightness, and the number of edges outside the area.
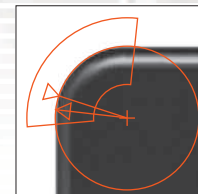
Smart edge (circle) setting example
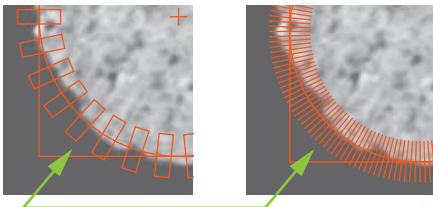
One cell can have a minimum width of one pixel (linear scanning), and a maximum of 3,600 cells can be set per 0.1°.
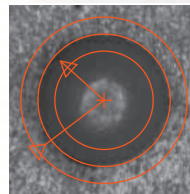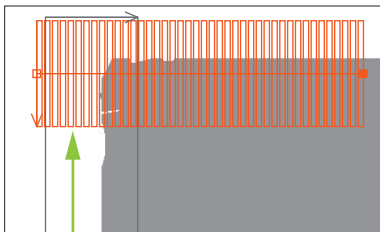
The center of the virtual circle, radius, diameter, circularity, and ring width can be measured.
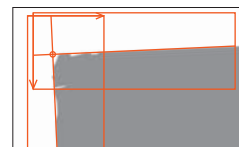
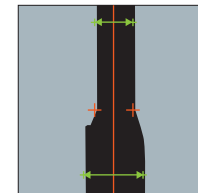The center and radius of the corner are measured.

Smart edge (line) setting example
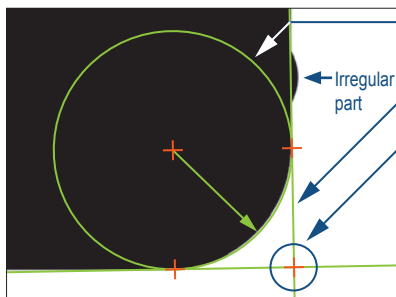
A maximum of 3,000 cells can be set.

The influence of surface imperfections is eliminated to accurately detect the target straight line by approximation.

Imperfections along a target sample can be analyzed for maximum and minimum values.

⚪ Geometry calculation

Virtual circle
Irregular part
Approximate straight line
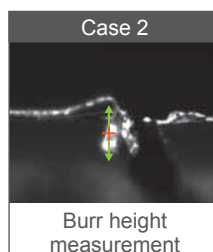Intersection of two lines

Distances, intersections, and median lines can be detected.

This function detects the distance between two points, the intersection of two lines, the median line of two lines, the perpendicular distance, and an approximate ellipse. In combination with Smart edge (circle) / (line), this function recognizes the object as a geometric figure, allowing the coordinates, distances, dimensions, and angles to be obtained without preparing calculation formulas.
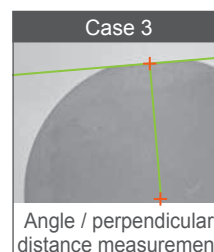
Applications
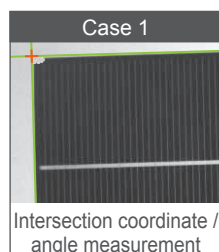
Case 1	Case 2	Case 3	Case 4
Intersection coordinate / angle measurement	Burr height measurement	Angle / perpendicular distance measurement	Warpage height measurement

⭕ Flaw detection [High accuracy inspection] [Man-hour reduction]
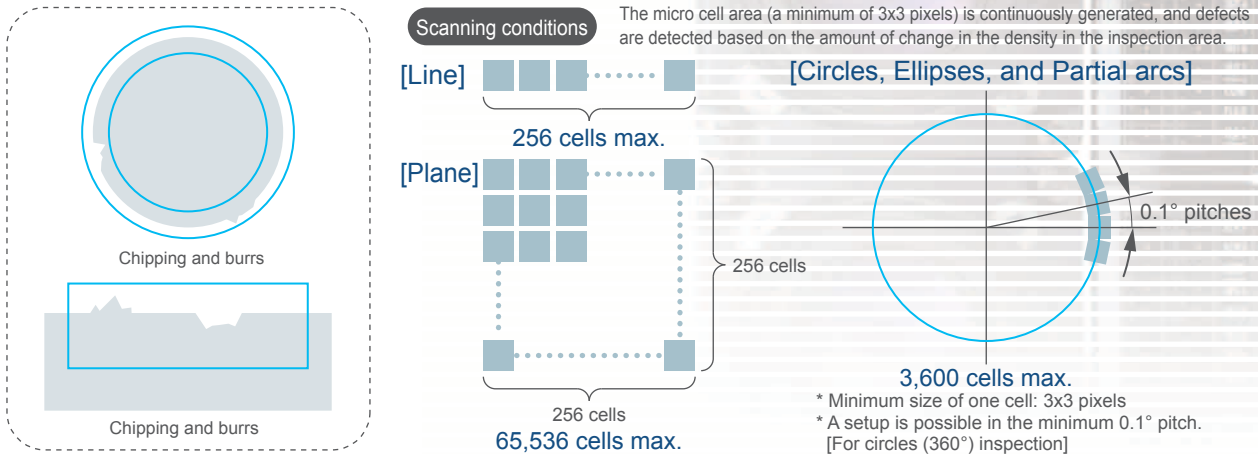
This function is ideal for critical appearance inspections, such as scratches, stains, chipped edges, burrs, and other flaws in objects. The inspection is carried out by comparing a target's greyscale image with neighboring parts, which helps in the detection of minor scratches, stains, and chips.
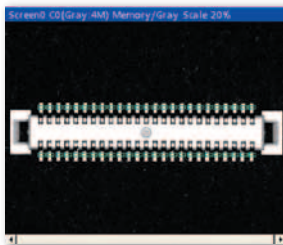
Chipping and burrs

Chipping and burrs

Scanning conditions

The micro cell area (a minimum of 3x3 pixels) is continuously generated, and defects are detected based on the amount of change in the density in the inspection area.

[Line]

256 cells max.

[Plane]

256 cells

256 cells

65,536 cells max.

[Circles, Ellipses, and Partial arcs]

0.1° pitches

3,600 cells max.
* Minimum size of one cell: 3x3 pixels
* A setup is possible in the minimum 0.1° pitch.
  [For circles (360°) inspection]

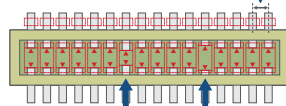## ⭕ Connector checker [High accuracy inspection] [Man-hour reduction]

Setup for connector inspection has been burdensome up to now. Now inspection can be accomplished by creating one area. This enables a great man-hour reduction.

Inspection example

Screen0 C0(Gray,4M) Memory/Gray Scale 20%

Pin coplanarity inspection

This function detects raised pins. In the same way as the pin pitch inspection, setting simply adjusts the position using one checker and then inputting the number of pins.
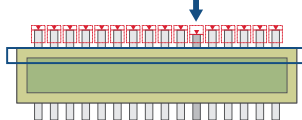
Pin pitch inspection

This function measures the distance between the edges of each pair of adjacent pins and evaluates the results based on the preset upper and lower limits. Data of the "start point", "end point", and "number of pins" should be input.

Inside pin gap inspection

This function inspects the gap between facing ends of pins. Simply input the number of pins. The upper and lower limits of the gap can be set.
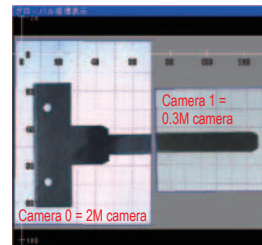
⭕ Coordinate calibration [new]

Setting and calculation is possible, linking the camera image with the actual dimensions.

Link two images

Global coordinates between two cameras are generated and both results are quoted to enable direct calculation.

Camera 1 = 0.3M camera

Camera 0 = 2M camera

113.937 (mm)

Calculation is possible mixing the separate detected data by two cameras.

Dynamic calibration

Conveyance differences arising during stage and index conveyance are adjusted each time to enable stable measuring of the work dimensions.

Reference point 2: Matching

Reference point 1: Matching
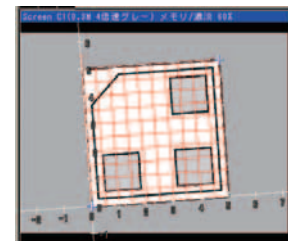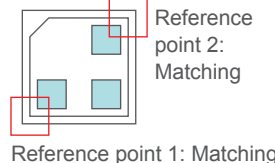
⭕ Our unique algorithm for ultra high speed processing

Parallel processing by Quad processor and our unique algorithm ensure outstanding ultra high speed inspections.

[Execution processing speed]   Unit: msec

Checker fuctions (Note 1)	640 × 480	1,600 × 1,200	2,048 × 2,048
Binary window	0.5	1.7	3.3
Grayscale window	0.4	1.5	2.9
Binary edge	2.1	11.3	23.7
Grayscale edge	8.7	54.0	117.2
Feature extraction	1.1	3.8	6.9
Smart matching (Note 2)	5.0	32.3	63.5
Contour matching (Note 3)	26.4	111.3	329.4

[Execution processing speed]   Unit: msec

Filter functions	640 × 480	1,600 × 1,200	2,048 × 2,048
5 x 5 Dilation	0.8	3.7	7.6
5 x 5 Erosion	0.8	3.7	7.6
5 x 5 Smoothing	1.2	5.8	13.1
5 x 5 Edge extraction X	0.8	3.3	6.6
5 x 5 Edge extraction Y	0.8	3.3	6.8
5 x 5 Prewitt	1.9	9.9	21.5
5 x 5 Sobel	1.9	10.5	21.7
Image rotation	1.9	11.5	24.8
Grey conversion (Note 4)	1.2	5.1	–
Color extraction (Note 4)	0.5	2.4	–

Notes: 1) The processing speed above is a reference value based on default settings.
Processing speed vary depending on the image being inspected.
2) Template: 128 x 128, Without rotation
3) Template: 128 x 128, Rotation: ±30 °, Scale: ±5 °
4) When using a color camera.

Product Lineup

Function item	PV200					PV200 MC	PV500V2	
Controller unit	Color and greyscale combination					High speed grey processing	High speed, high productivity	
	new					new		
	Image processing with top-level accuracy in its class is available with a surprisingly small number of man-hours required for programming.					0.3M grey compact limited edition special value camera with all the functions of the PV200.	"4 + 1" Penta processor enables extremely fast parallel processing. Verification of NG (failed) images and program corrections are possible while inspecting all items without stopping the production line.	
Number of connected cameras max.	2					2	4	
Camera — Pixel	0.3M	2M	0.3M	2M	4M	0.3M (Note 2)	0.3M	2M
Camera — Grey/Color	Color		Grey			Grey	Grey	
Camera — Shutter speed	30 µs to 1,000 ms (Set in increments of 10 µs)					100 µs to 500 ms (Set in increments of 10 µs)	30 µs to 1,000 ms (Set in increments of 10 µs)	
Monitor display	VGA					VGA	XGA	
Processing methods	Color, Greyscale, Binary					Greyscale, Binary	Greyscale, Binary	
No. of product types max. (Note 1)	256 types					256 types	25,600 types	
Maximum settable number of checkers (Note 1)	1,000 checkers/product type max.					1,000 checkers/product type max.	1,000 checkers/product type max.	
Major inspection functions (Checkers) ○ : Applicable model — Position adjustment, Position/rotation adjustment	○					○	○	
Area size adjustment	○					○	○	
Binary window/Binary edge	○					○	○	
Feature extraction	○					○	○	
Character recognition (neural network)	—					—	—	
Grey window/Grey edge	○					○	○	
Smart matching	○					○	○	
Contour matching	○					○	—	
Flaw detection	○					○	○	
Connector (binary window, grey window, grey edge)	○					○	○	
Smart edge (circles) / (line)	○					○	○	
Geometry calculation	○					○	○	
Character/Figure drawing	○					○	○	
Others								
Numerical calculation/Judgment output	1,000 formula/product type max.					1,000 formulas/product type max.	1,000 formula/product type max.	
Data R/W	160 data					160 data	320 data	
Execution mode — Execution all	Execution of all checkers					Execution of all checkers	Execution of all checkers	
Execution mode — Branch execution	0 to 9 can be set.					0 to 9 can be set.	0 to 9 can be set.	
Execution mode — Designated execution	0 to 9 can be set.					0 to 9 can be set.	0 to 9 can be set.	
Password protection	○ (Select menu)					○ (Select menu)	○	
Image preprocess/Image conversion	Preprocessing filters: 21 types, for each product type 16 groups/camera, 10 stages max.					Preprocessing filters: 21 types, for each product type 16 groups/camera, 10 stages max.	Preprocessing filters: 21 types, for each product type 5 groups/camera, 10 stages max.	
Others							Program editing/testing in RUN mode	
Interface — RS232C	1 port					1 port	1 port	
Interface — Ethernet	○					○	○	
Interface — SD/SDHC	○					○	○	
Interface — USB	○					○	○	
Interface — Parallel input/output	14 inputs, 15 outputs					14 inputs, 15 outputs	PHOENIX terminal: 14 inputs, 15 outputs / MIL terminal: 32 inputs, 32 outputs	
Setup tool software	Vision PVWIN200 Off-line simulation					Vision PVWIN200 Off-line simulation	Vision PVWIN Off-line simulation	
Recommended monitor (cable)	ANPVM11021 (ANMX83313)					ANPVM11021 (ANMX83313)	ANPVM11021 (ANMX83313)	

Notes:
1) Depend on the setting data size. 2) Only 0.3M grey compact camera can be connected.