Vision Sensor

NEW

▣ Features

- Light integrated vision sensor
- Minimized image distortion with global shutter method
- Proprietary technology to block optical interference to improve optical performance (patent)
- Stronger in environment of vibration or impact with lens cover detachment prevention technology
- Various inspection function
  : Alignment, brightness, contrast, area, edge, shape comparison, length, angle, diameter, object counting, color identification, area of color, object of color counting
- Inspection test with simulator
- Flexible response to changing work environment by setting 32 work groups (64 inspection items for each work group)
- Saving data to FTP server
- Free vision sensor program (Vision Master)
  : Inspection simulator, managing parameter and work group, monitoring inspection result, inspection result FTP transmission, multilingual support, Etc.
- Protection structure IP67 (IEC standard)

⚠ Please read "Safety Considerations" in instruction manual before using.

▣ Manual

For the detail information and instructions, please refer to user manual, and be sure to follow cautions written in the technical description (catalog, homepage).
Visit our homepage (**www.autonics.com**) to download manuals.

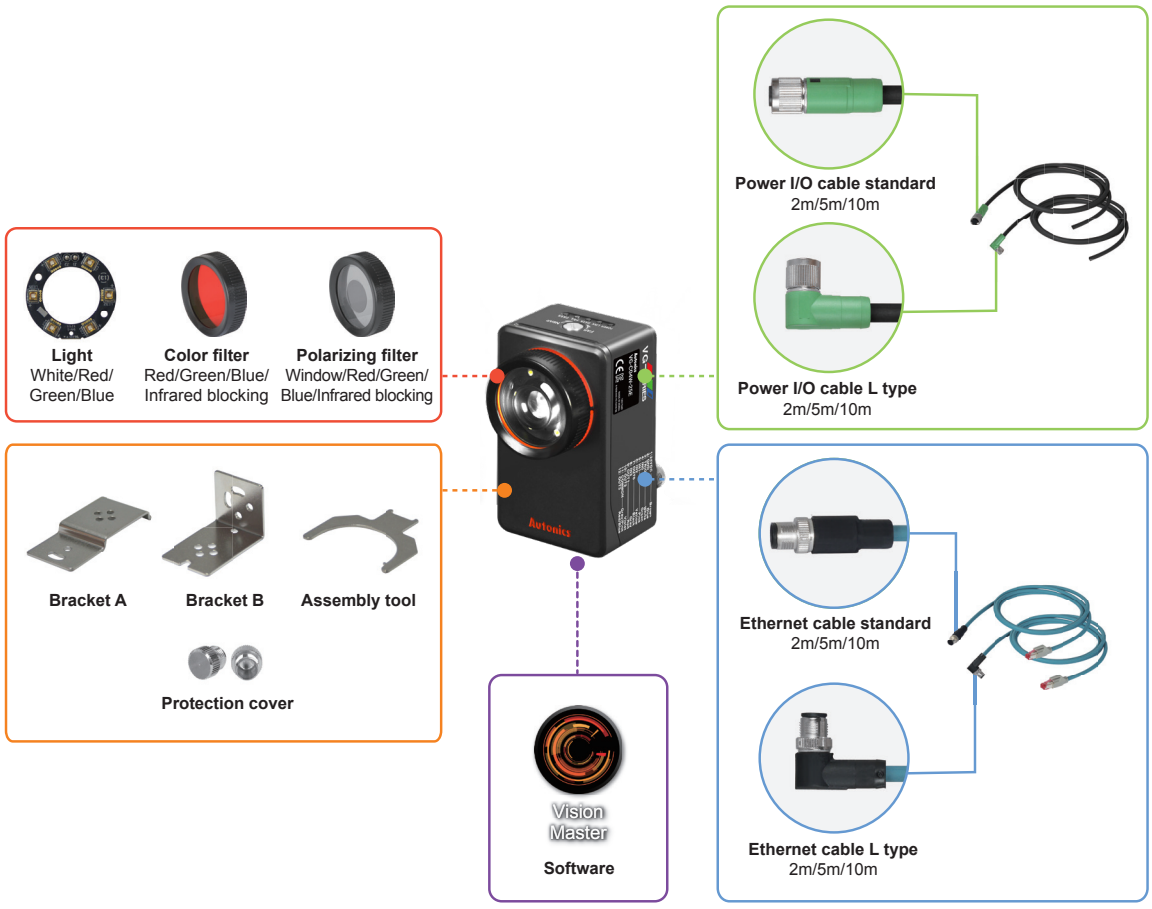
▣ Ordering Information

V	G	–	M	04	W	–	8	E

Communication	**E**	Ethernet communication (TCP/IP)
Effective focal length	**8**	8mm
	16	16mm
	25	25mm
Light※1	**W**	White
	R	Red
	G	Green
	B	Blue
Resolution (pixel)	**04**	752×480
Image element	**M**	Mono CMOS
	C	Color CMOS
Type	**G**	General inspection
Item	**V**	Vision sensor

※1: Light can be purchased separately.

▣ Overall Configuration Diagram



▣ Accessories

◎ Assembly tool
● ASST-VG

◎ Bracket A
● BK-VG-A

▣ Sold Separately

◎ Light
● LR-W-06-VG (white)
● LR-R-06-VG (red)
● LR-G-06-VG (green)
● LR-B-06-VG (blue)

◎ Bracket B
● BK-VG-B

◎ Protection cover
● P96-M12-1

※Protection cover protects the unused connector from foreign object.
When installing, hand tighten.

◎ Color filter
● FL-R-VG (red)
● FL-G-VG (greed)
● FL-B-VG (blue)
● FL-IC-VG (infrared blocking)

◎ Polarizing filter
● FL-P-VG (window)
● FL-RP-VG (red)
● FL-GP-VG (green)
● FL-BP-VG (blue)
● FL-ICP-VG (infrared blocking)

◎ Power I/O cable
● Standard
CID-2-VG (2m)
CID-5-VG (5m)
CID-10-VG (10m)

● L type
CLD-2-VG (2m)
CLD-5-VG (5m)
CLD-10-VG (10m)

◎ Ethernet cable
● Standard
CIR-2-VG (2m)
CIR-5-VG (5m)
CIR-10-VG (10m)

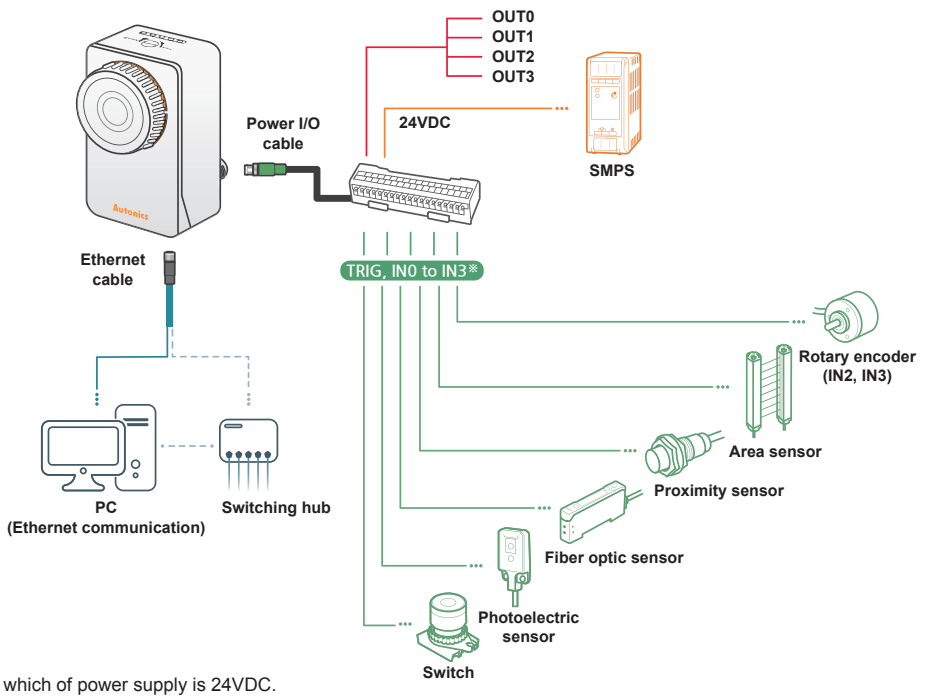
● L type
CLR-2-VG (2m)
CLR-5-VG (5m)
CLR-10-VG (10m)

▣ Specifications

Model		VG-M04□-8E	VG-M04□-16E	VG-M04□-25E	VG-C04□-8E	VG-C04□-16E	VG-C04□-25E
Effective focal length		8mm	16mm	25mm	8mm	16mm	25mm
Min. working distance		50mm	100mm	200mm	50mm	100mm	200mm
Power supply		24VDC⎓ (±10%)					
Power consumption		1A					
Inspection	Inspection item	Alignment, brightness, contrast, area, edge, shape comparison, length, angle, diameter, object counting			Alignment, brightness※2, contrast※2, area※2, edge, shape comparison※2, length, angle, diameter, object counting※2, color identification, area of color, object of color counting		
	Work group	32					
	Simultaneous inspection	64					
	Camera frame per second※1	Max. 60fps					
Image snap	Image filter	Preprocessing, external filter (color filter, polarizing filter)					
	Image element	1/3 inch mono CMOS			1/3 inch color CMOS		
	Resolution	752×480 pixel					
	Camera frame per second※1	Max. 60fps					
	Shutter	Global shutter					
	Exposure time	20 to 10,000μs					
Light	ON/OFF method	Pulse					
	Color	White, red, green, blue					
Trigger mode		External trigger, internal trigger, free-run trigger					
Input	Signal	Rated input 24VDC⎓ (±10%)					
	Type	External trigger input (TRIG), encoder input (IN2, IN3), work group change (IN0 to IN3)					
Output	Signal	NPN or PNP open collector output Max. 24VDC⎓ 50mA, residual voltage: max. 1.2VDC⎓					
	Type	Control output (OUT0 to OUT3) : inspection completion, inspection result, external light trigger, alarm, camera busy					
	FTP transmission	Possible					
Communication		Ethernet (TCP/IP), 100BASE-TX/10BASE-T					
Protection circuit		Output short over current protection circuit					
Indicator		• Power indicator (POWER), Ethernet connection indicator (LINK), pass indicator (PASS): green LED • Data transmission indicator (DATA): orange LED • Failure indicator (FAIL): red LED					
Insulation resistance		Over 20MΩ (at 500VDC megger)					
Dielectric strength		500VAC 50/60Hz for 1 min					
Vibration		1.5mm amplitude at frequency of 10 to 55Hz (for 1 min) in each X, Y, Z direction for 2 hours					
Shock		300m/s^2 (approx. 30G) in each X, Y, Z direction for 3 times					
Environment	Ambient temp.	0 to 45℃, storage: -20 to 70℃					
	Ambient humi.	35 to 85%RH, storage: 35 to 85%RH					
Protection structure		IP67 (IEC standard)					
Material		Case: aluminum, lens cover/focus adjuster: polycarbonate, cable: polyurethane					
Accessories		Assembly tool, bracket A, mounting screw: 2					
Sold separately		Light, color filter, polarizing filter, power I/O cable, Ethernet cable, bracket B, protection cover					
Approval		CE					
Weight※3		Approx. 415g (approx. 273g)	Approx. 416g (approx. 274g)	Approx. 416g (approx. 274g)	Approx. 415g (approx. 273g)	Approx. 416g (approx. 274g)	Approx. 416g (approx. 274g)

※1: The number of camera frames per second can be different by image setting or inspection item.
※2: These inspection items convert a color image to a mono color image to inspect data.
※3: The weight includes packaging. The weight in parenthesis is for unit only.
※Environment resistance is rated at no freezing or condensation.

▣ Connections



※Use the product which of power supply is 24VDC.
When selecting a product, please refer to Autonics selection guide.

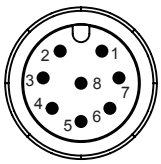
◎ Power I/O cable (M12 12-pin connector)

Pin arrangement

Pin No.	Cable color	Signal	Function	
1	Brown	24VDC	24VDC	
2	Blue	GND	GND	
3	White	TRIG	Trigger input	
4	Green	IN0	Work group change Bit 0	Work group change Clock
5	Pink	IN1	Work group change Bit 1	Work group change Data
6	Yellow	IN2	Work group change Bit 2	Encoder - Up counter - Quadrature A
8	Gray	IN3	Work group change Bit 3	Encoder - Down counter - Quadrature B
11	Gray/Pink	COMMON	COMMON	
7	Black	OUT0	Inspection completion, inspection result, external light trigger, alarm, camera busy	
9	Red	OUT1		
10	Purple	OUT2		
12	Red/Blue	OUT3		

◎ Ethernet cable (M12 8-pin/RJ45 connector)

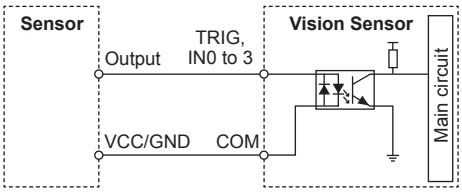
Pin arrangement



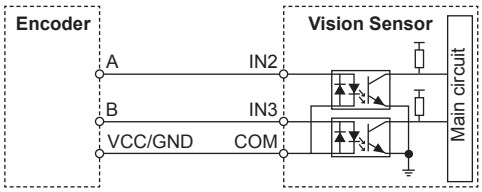
M12 8-pin		Cable color	RJ45	
Pin No.	Signal		Pin No.	Signal
6	RX+	White/Orange	1	TX+
4	RX-	Orange	2	TX-
5	TX+	White/Green	3	RX+
8	TX-	Green	6	RX-
1	—	White/Blue	5	—
7	—	Blue	4	—
2	—	White/Brown	7	—
3	—	Brown	8	—

▣ Input Circuit Diagram

● **External trigger input (TRIG)**
Work group change input (IN0 to IN3)

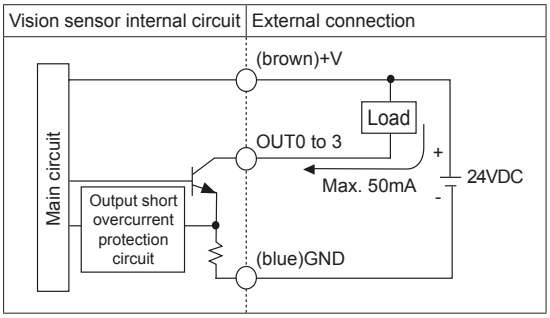


● **Encoder input (IN2, IN3)**

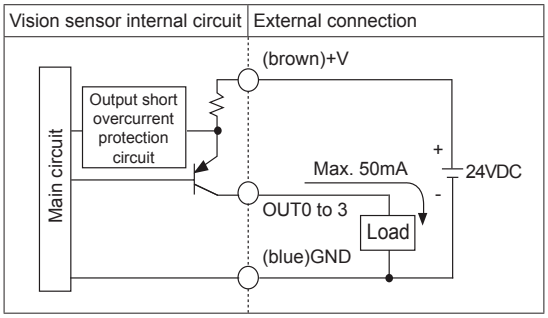


▣ Control Output Circuit Diagram

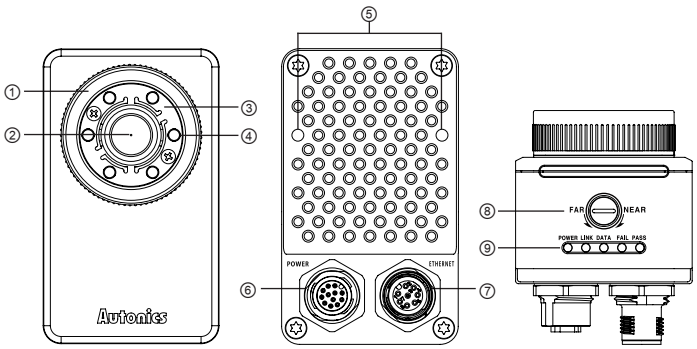
● **NPN open collector output**



● **PNP open collector output**



▣ Unit Description

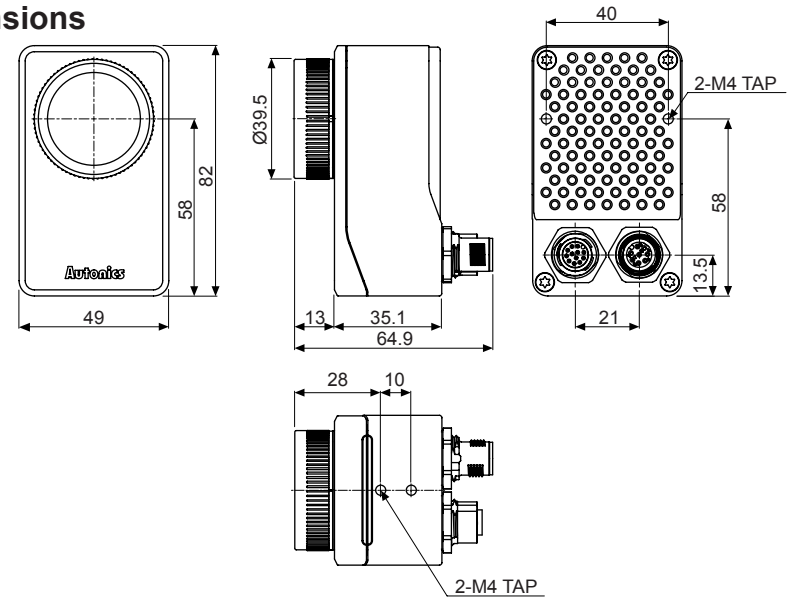


① Lens cover: Front cover of lens
※In case using a filter (color filter/polarizing filter), separate the lens cover with the assembly tool before insert the filter.
② Lens: There are 8mm, 16mm, 25mm models by effective focal length.
③ Light cover: Light cover fixes inner LED lights.
④ Light: Inner LED lights
※In order to change the light, separate lens cover and light cover.
⑤ Bracket mounting hole on back side: Install the vision master from the back side using bracket B.
⑥ Power I/O connector: Connect the power I/O cable.
⑦ Ethernet connector: Connect the Ethernet cable. It is for TCP/IP communication.
⑧ Focus adjuster: After fixing vision sensor, adjust focus by the rotating focus adjuster.
⑨ Indicators

Indicators		Color	Descriptions
POWER	Power indicator	Green LED	Turns ON when power is supplied.
LINK	Ethernet connection indicator	Green LED	Turns ON when vision sensor is connected with PC (Ethernet communication).
DATA	Data transmission indicator	Orange LED	Flashes when data is transmitted from vision sensor to PC.
FAIL	Failure indicator	Red LED	Flashes when detects failure during work group inspection.
PASS	Pass indicator	Green LED	Flashes when passed inspection during work group inspection.

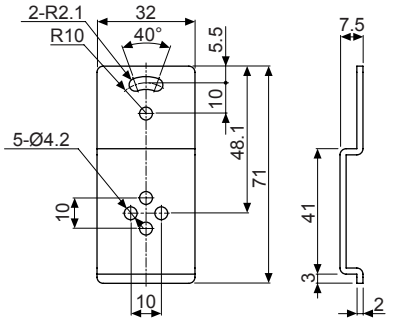
▣ Dimensions

(unit: mm)



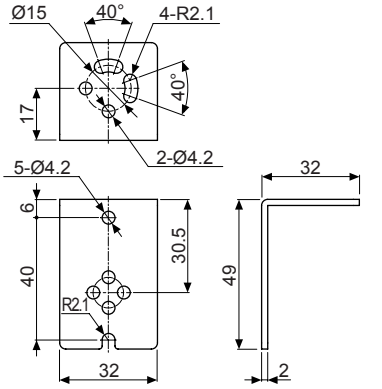
◎ Accessory

● **Bracket A (BK-VG-A)**



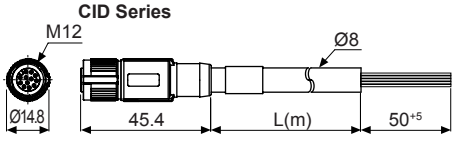
◎ Sold separately

● **Bracket B (BK-VG-B)**

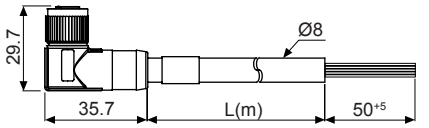


● **Power I/O cable (M12 12-pin connector)**

CID Series



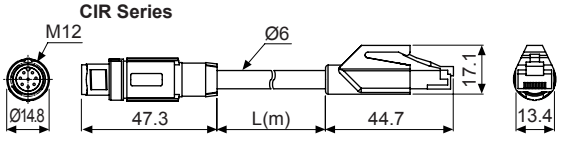
CLD Series



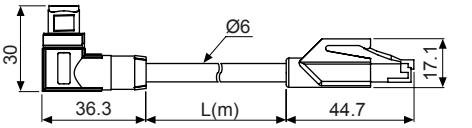
Type	Model	L
Standard	CID-2-VG	2m
	CID-5-VG	5m
	CID-10-VG	10m
L type	CLD-2-VG	2m
	CLD-5-VG	5m
	CLD-10-VG	10m

● **Ethernet cable (M12 8-pin/RJ45 connector)**

CIR Series



CLR Series



Type	Model	L
Standard	CIR-2-VG	2m
	CIR-5-VG	5m
	CIR-10-VG	10m
L type	CLR-2-VG	2m
	CLR-5-VG	5m
	CLR-10-VG	10m

▣ Installation

Installing vision sensor
- Checking working distance and FOV by effective focal length
- Bracket installation (fixing vision sensor)

→

Installing software
- Installing the vision sensor program, Vision Master, to PC

→

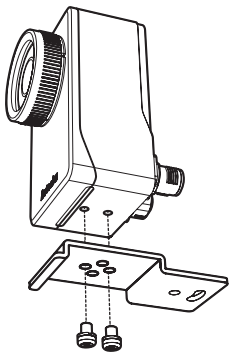
Connecting vision sensor and PC
- Setting network from Vision Master

→

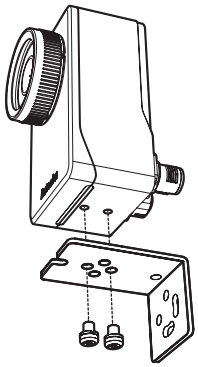
Adjusting vision sensor focus
- Running Vision Master and activating the 'Focusing Guide' function in the camera setting menu
- Adjusting focus with focus adjuster

◎ Bracket installation

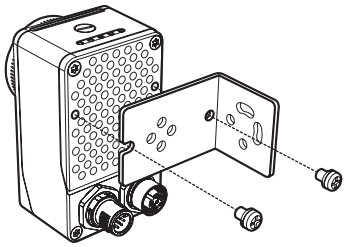
● **Install horizontally from the bottom - bracket A (accessory)**



● **Install vertically from the bottom - bracket B (sold separately)**

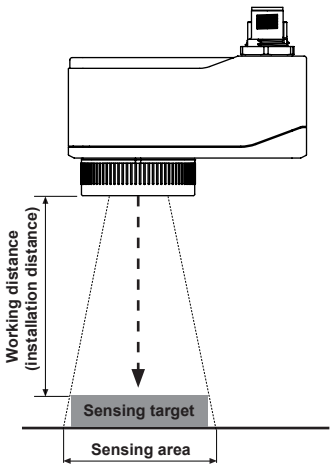


● **Install vertically from the back side − bracket B (sold separately)**



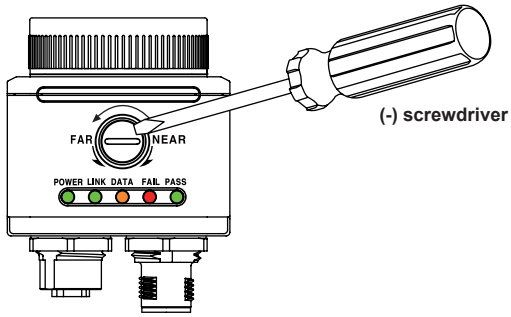
◎ Installation position

Place the sensing target at the center of the vision sensor lens.



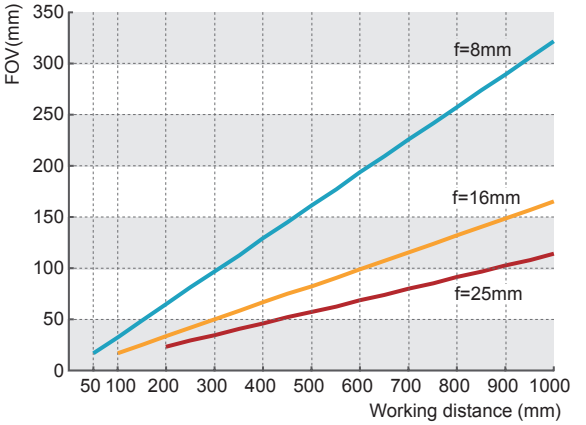
◎ Focus adjustment

After installing and running Vision Master, use the focusing guide function to adjust the focus.
Using (-) screwdriver, turn focus adjuster to right and left to adjust the focus.



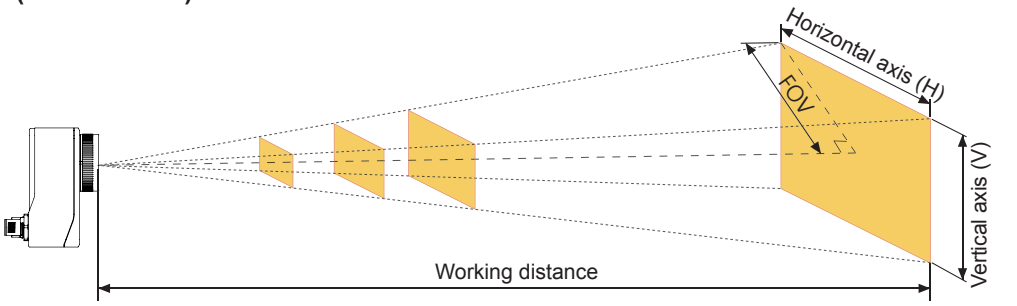
▣ Working Distance and FOV by Effective Focal Length

◎ Working distance



Effective focal length (f)	8mm	16mm	25mm
Min. working distance	50mm	100mm	200mm
Brightness	F2.0	F2.5	F2.5

◎ FOV (Field of view)



● Sensing range by effective focal length (unit: mm)

Effective focal length	Working distance	50	100	200	300	400	500	600	700	800	900	1,000
8mm	FOV	16	32	64	96	129	161	193	255	257	289	322
	Horizontal axis (H)	27	54	108	163	217	271	325	380	434	488	542
	Vertical axis (V)	17	35	69	104	138	173	208	242	277	311	346
16mm	FOV	—	16	33	49	66	82	99	155	132	148	165
	Horizontal axis (H)	—	28	56	83	111	139	167	195	222	250	278
	Vertical axis (V)	—	18	35	53	71	89	106	124	142	160	177
25mm	FOV	—	—	23	34	46	57	68	80	91	103	114
	Horizontal axis (H)	—	—	38	58	77	96	115	134	154	173	192
	Vertical axis (V)	—	—	25	37	49	61	74	86	98	110	123

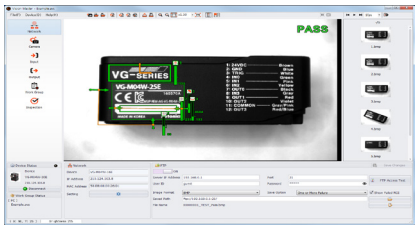
▣ Vision Sensor Program [Vision Master]

Vision Master is the vision sensor program that allows setting of vision sensor parameters and management of monitoring data such as inspection status and status information.

<Computer specification for using software>

Item	Minimum specifications
System	32bit (×86) or 64bit (×64) processor over 1GHz
Operations	Microsoft Windows 7/8/10
Memory	1GB+
Hard disk	400MB+ of available hard disk space
VGA	Resolution: 1024×768 or higher
Others	RJ45 Ethernet port

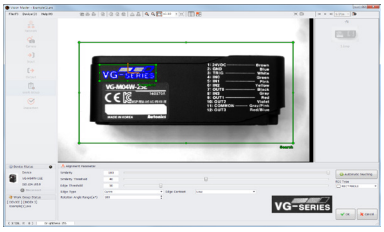
<Vision Master execution screen>



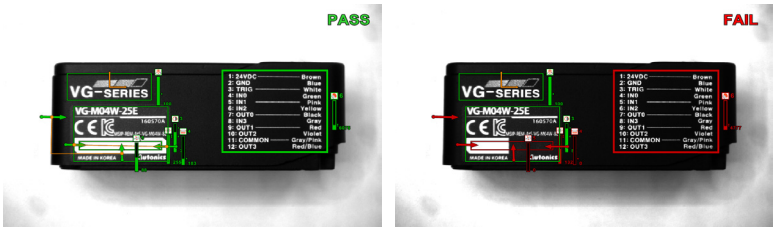
※Vision sensor is connected with Vision Master in Ethernet (TCP/IP) communication.
※For initial IP address of vision sensor, refer to the following table. Configure the network settings of vision sensor via Vision Master.

IP address	192.168.0.2
Subnet mask	255.255.255.0
Gateway	192.168.0.1

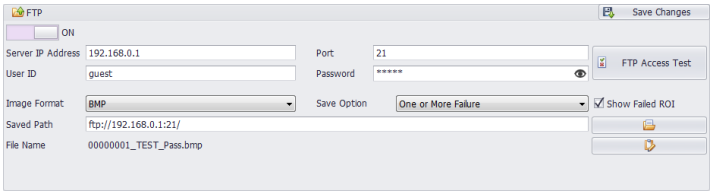
<Inspection setting screen>



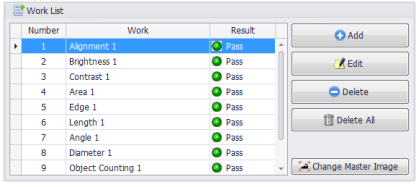
<Inspection executing screen>



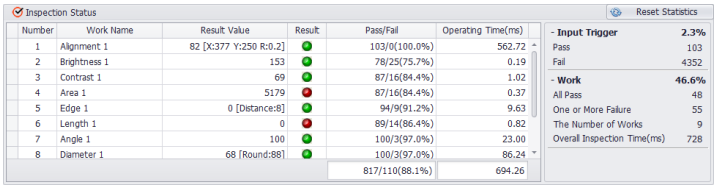
<FTP transmission setting screen>



<Registered inspections in work group>



<Inspection status monitoring screen>



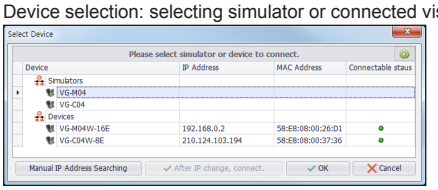
◎ Vision Master Work Flow

● Setting mode

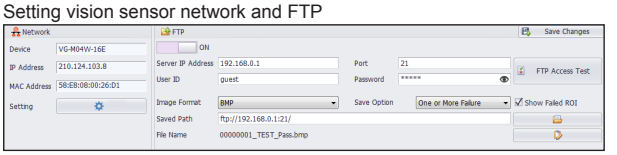
Setting mode

Network setting and device connection

① Device selection: selecting simulator or connected vision sensor



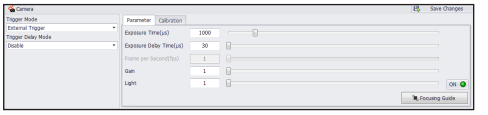
② Setting vision sensor network and FTP



Camera setting

Input image shooting setting

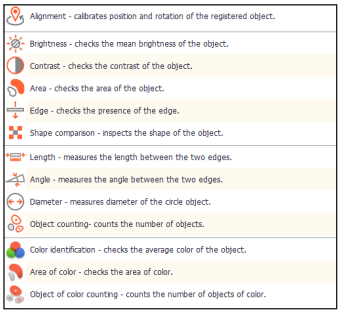
- Trigger mode, camera exposure time, exposure delay time, frame per second, gain, light setting, calibration



Work group setting (max. 32)

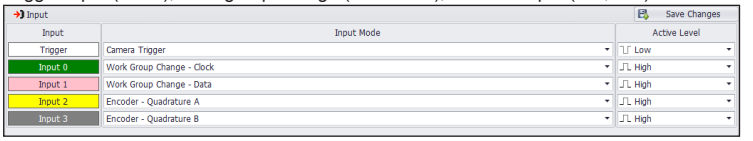
① Shooting inspection target or opening image file
② Selecting inspection item
- Alignment, brightness, contrast, area, edge, shape compraison, length, angel, diameter, object counting, color identification, area of color, object of color counting

③ ROI setting
④ Setting inspection parameter and registering inspection
⑤ Registering additional inspection (max. 64 for each work group)

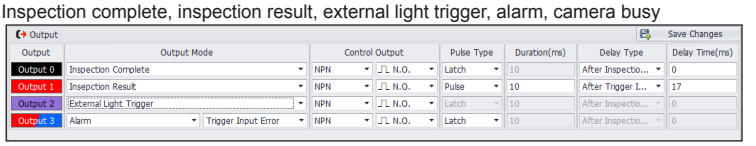


Input/Output setting

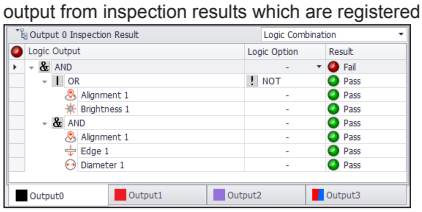
① Input setting
- Trigger input (TRIG), work group change (IN0 to IN3), encoder input (IN2, IN3)



② Output setting
- Inspection complete, inspection result, external light trigger, alarm, camera busy

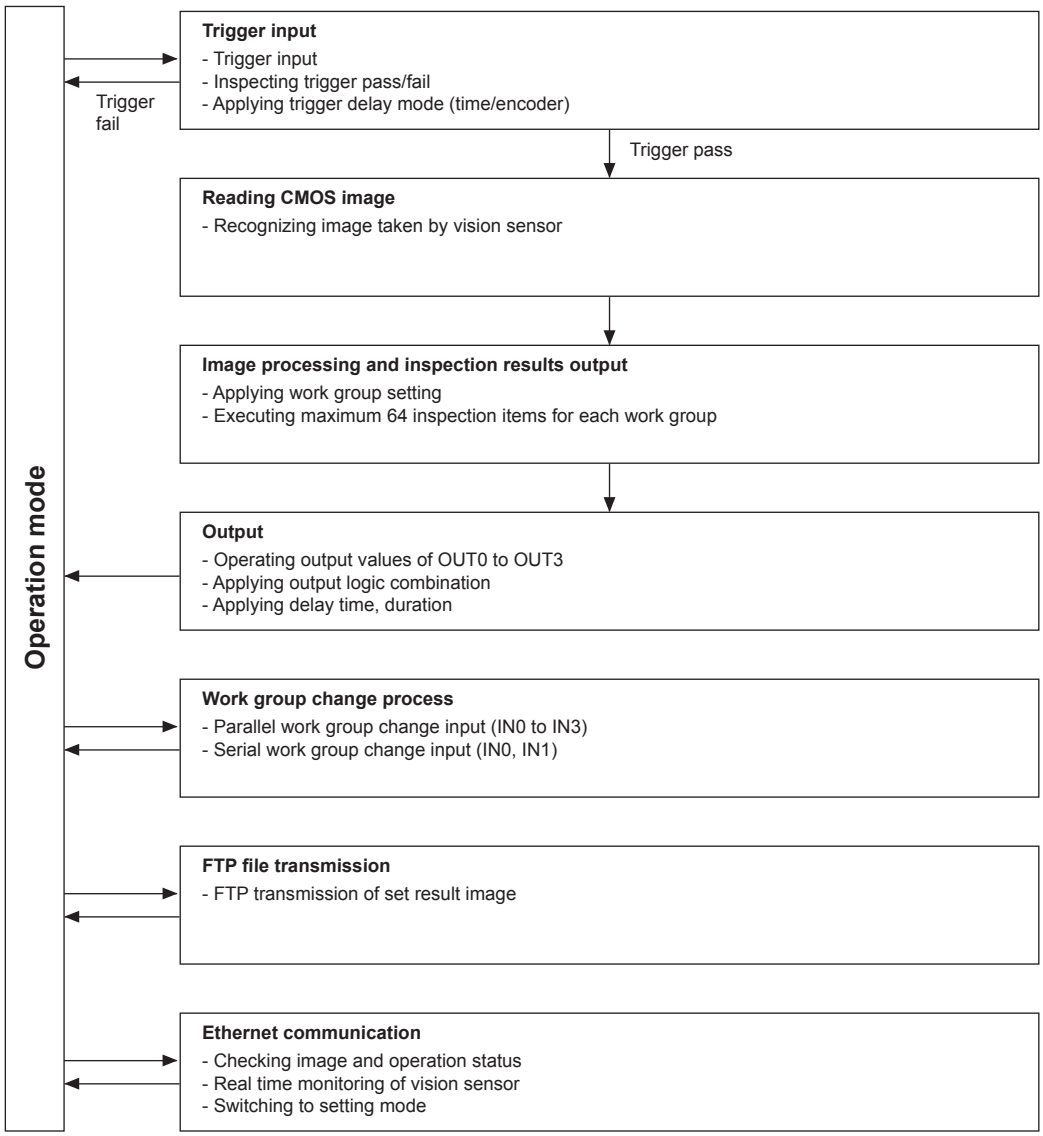


- Output logic combination: with logic combination operator, setting conditions for result output from inspection results which are registered in work group



Inspection - operation mode

● **Operation mode**



◎ Inspection function

<table>
<tr><th>Item</th><th colspan="3">Description</th></tr>
<tr><td rowspan="2">Alignment</td><td colspan="3">Compares features of the registered image and input image to search for a similar pattern position, and inspects the input image with information of the searched pattern position and rotation angle.</td></tr>
<tr><td><Template>
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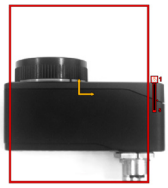
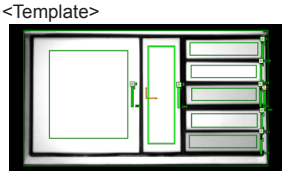
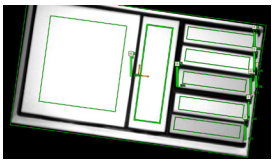
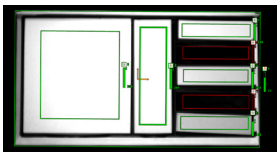
  </td></tr>
<tr><td rowspan="2">Brightness</td><td colspan="3">Inspects brightness of the ROI in the input image based on the mean brightness value of the ROI (Region of Interest) in the registered image.</td></tr>
<tr><td><Template>
  </td><td><Pass>
  </td><td><Fail>
  </td></tr>
<tr><td rowspan="2">Contrast</td><td colspan="3">Inspects contrast of the ROI in the input image based on contrast of the ROI in the registered image.</td></tr>
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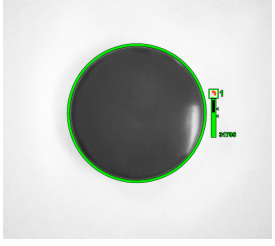
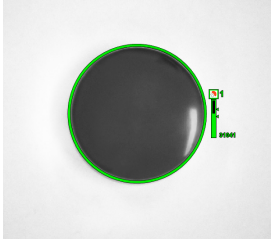
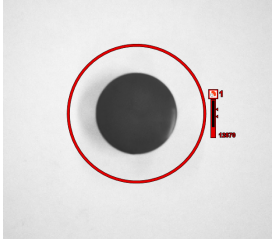
<tr><td rowspan="2">Area</td><td colspan="3">Inspects the ROI area of the input image based on the ROI area of the image registered by user.</td></tr>
<tr><td><Template>
  </td><td><Pass>
  </td><td><Fail>
  </td></tr>
<tr><td rowspan="2">Edge</td><td colspan="3">Inspects the direction of the edge in the input image based on the edge registered by user in the same area.</td></tr>
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<tr><td rowspan="2">Shape comparison</td><td colspan="3">Compares shape of object in the ROI registered by user and that of the input image.</td></tr>
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 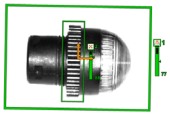 </td><td><Fail>
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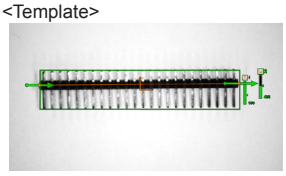
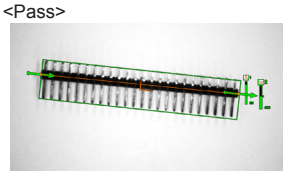
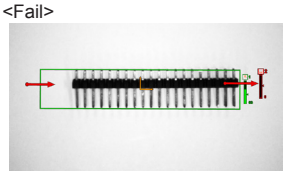
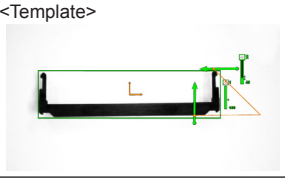
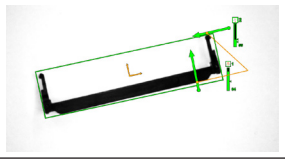
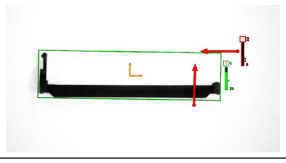
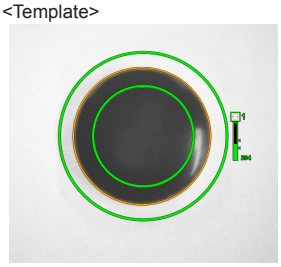
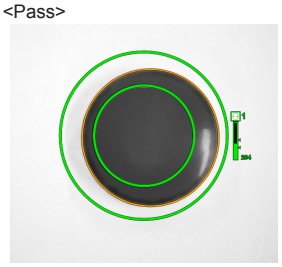
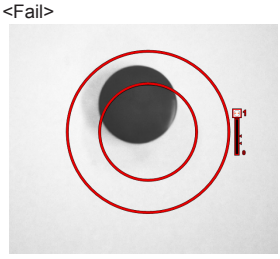
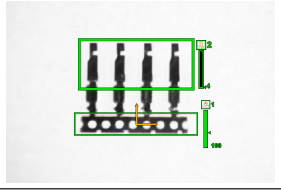
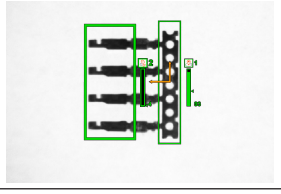
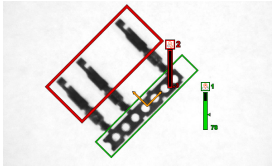
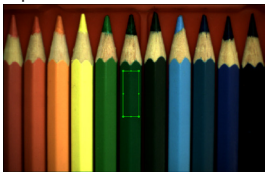
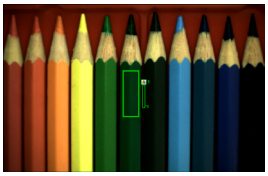
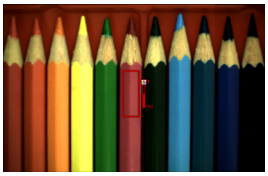
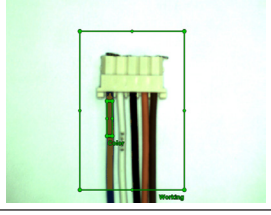
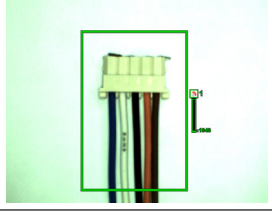
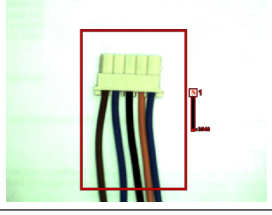
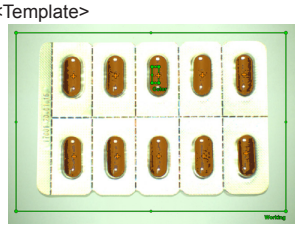
Item	Description		
Length	Inspects the input image based on the length between two edges registered by user.		
	<Template> 	<Pass> 	<Fail> 
Angle	Inspects the input image based on the angle between two edges registered by user.		
	<Template> 	<Pass> 	<Fail> 
Diameter	Inspects the input image based on the area between two circles registered by user.		
	<Template> 	<Pass> 	<Fail> 
Object counting	Compares the number of objects in the ROI which is in the image registered by user and that in the input image.		
	<Template> 	<Pass> 	<Fail> 
Color identification	Compares color of the ROI registered by user and that of the input image.		
	<Template> 	<Pass> 	<Fail> 
Area of color	Compares the area of a certain color in the ROI registered by user and that in the input image.		
	<Template> 	<Pass> 	<Fail> 

※These examples include position alignment. (except area, diameter, color identification, area of color, and object of color counting inspection)
※Color identification, area of color, and object of color counting are only for VG-C Series.

◎ Inspection function

Item	Description		
Object of color counting	Compares the number of objects in a certain color which are in the ROI of registered image and that of the input image.		
	<Template> 	<Pass>	<Fail>

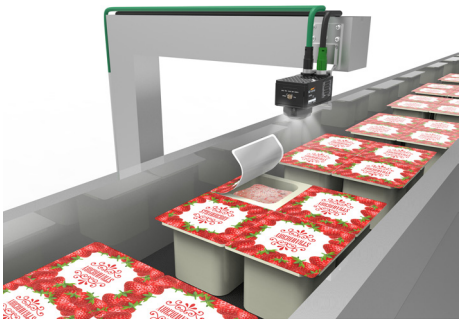
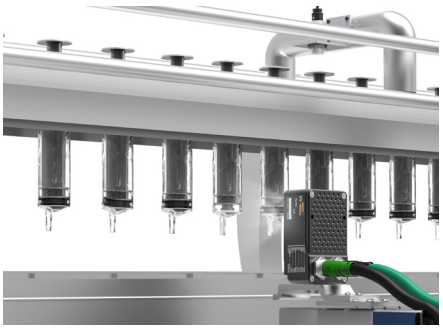
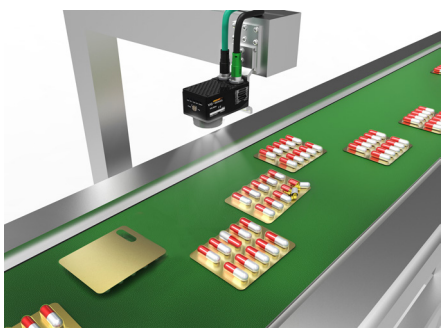
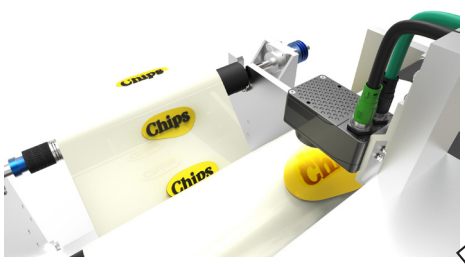
※These examples include position alignment. (except area, diameter, color identification, area of color, and object of color counting inspection)
※Color identification, area of color, and object of color counting are only for VG-C Series.

▣ Proper Usage

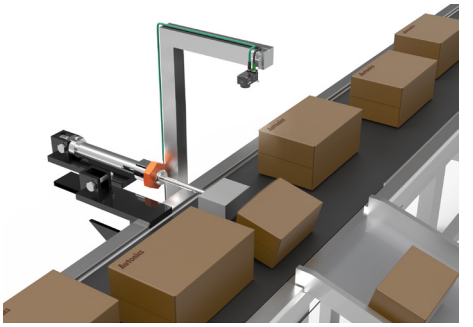
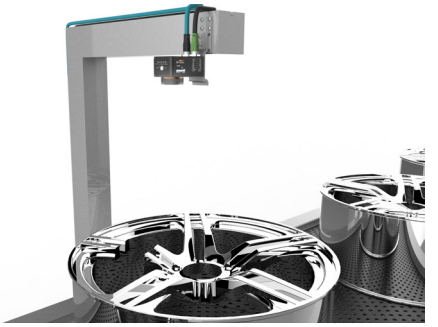
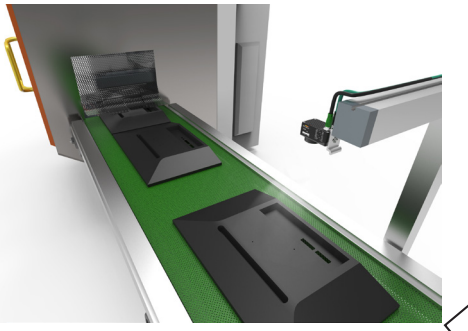
◎ Cautions during Use

- Follow instructions in Cautions during Use. Otherwise, it may cause unexpected accidents.
- 24VDC power supply should be insulated and limited voltage/current or Class 2, SELV power supply device.
- In order to avoid malfunction from static electricity or noise, ground shield wire of the power I/O cable.
- Do not disconnect the power supply while setting operation or saving set information.
  It may cause data loss.
- Do not disconnect the power supply while updating firmware. It may cause product damage.
- Keep optical section of the sensor away from the contact with water, dust and oil.
  It may cause malfunction.
- When changing the light or filter, use the assembly tool and observe installation instruction.
- When the sensor is not used for a long time, separate the power cable and to store.
- When connecting network, connection must be operated by technical expert.
- In the following case, disconnect the power supply immediately. It may cause fire or product damage.
  ① When water or foreign substance is detected in the product
  ② When the product is dropped or case is damaged
  ③ When smoke or smell is detected from the product
- Do not use the product in the place where strong magnetic field or electric noise is generated.
- This unit may be used in the following environments.
  ① Indoor (in the environment conditions in specifications)
  ② Altitude max. 2,000m
  ③ Pollution degree 2
  ④ Installation category II

▣ Applications

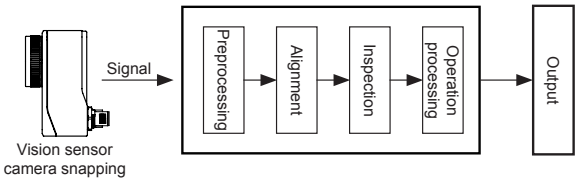
Sensing presence of text on the food container	Sensing the sealing status of the container
	
Sensing the printing status of the cosmetic case	**Sensing presence or defect of the syringe rubber seal**
	
Sensing a different kind, number, or defect of the pill	**Sensing presence or defect of the component**
	
Sensing the number of containers	**Sensing the printing and marking status of the package**
	

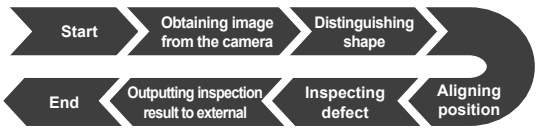
▣ Applications

Sensing the size of the product box	Sensing the component shape of the spark plug
	
Sensing the component shape of the automobile wheel	Sensing finishing status of injection
	

▣ Vision Sensor Overview

Vision sensor takes a picture of the sensing target and distinguishes features through image processing to output data or inspection result.





• Human and vision sensor

Item	Human	Vision sensor
Accuracy (error)	Subjective data according to a worker	Objective data by constant input
	Possibility of error occurrence according to worker's condition	Upgrading function and accuracy by system update
Continuity	Worker shift according to working time	Continuous work
Rapidity	Slower inspection speed due to limited inspection and distinction	Faster inspection speed according to the system configuration
Proficiency	Requiring worker's proficiency (training time)	Directly usable right after installing the system
Cost	A steady increase of personnel expenses	No additional cost after initial installation
Output	No output function, direct inspection and result input by workers	Various output with communication

• Photoelectric sensor and vision sensor

A vision sensor can replace multiple photoelectric sensor and can be connected with another device to set various input/ output options.

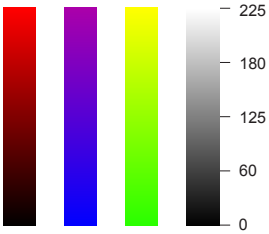
Item	Photoelectric sensor	Vision sensor
Performance	Low	High
Setting	Simple	Flexibly settable with communication setting according to environment
Main application (inspection)	Simple sensing of presence	Sensing target object with various inspection function (alignment, brightness, contrast, area, edge, length, angle, diameter, object counting)

▣ Use of Light and Filter

◎ Light

In order to get an image of stable quality, it is important to select the proper light for material, shape and gloss of the sensing target and brightness of the place.

◎ Color filter

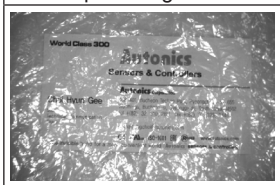
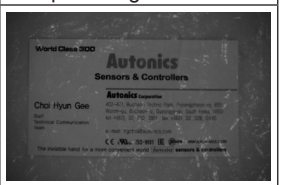
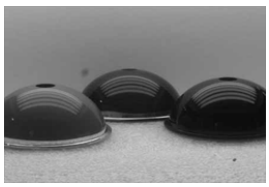


Based on the contrast of color, making darker parts darker, while maintaining overall color

◎ Infrared cut-off filter

Without infrared cut-off filter	With infrared cut-off filter
→ Focused on the heater	→ Focused on the safety net

◎ Polarizing filter: cutting diffuse reflection

Without polarizing filter	With polarizing filter
	
	
→ Worse visibility	→ Better visibility

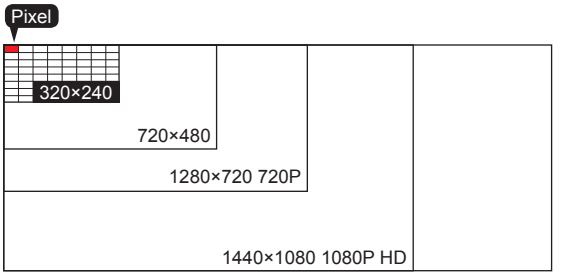
※Diffuse reflection: light is reflected from the uneven surface and scattered at many angles.

▣ Glossary

◎ Pixel

An image is made up of the square dots which are not divided, and the square dots, the smallest unit of an image, is called 'Pixel'.

The more pixels the image has, the more precise and detailed the image is.



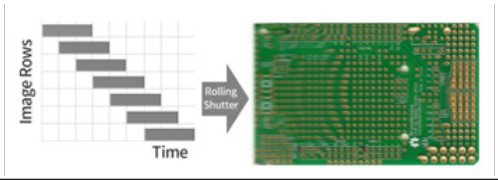
High number of pixels

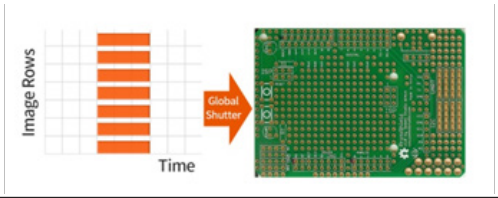
Median number of pixels

Low number of pixels

◎ Shutter function

Shutter is the entrance of light to enter into the camera, and controls exposure with opening/closing time.

Rolling Shutter

This method captures an images by scanning screen horizontally or vertically. Since the exposure timing of the sensor is different, image distortion can occur.

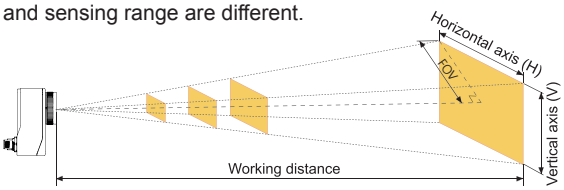
Global Shutter

This method captures the whole part of an image at the same time. When taking pictures of fast moving object, this method helps take pictures without image distortion.

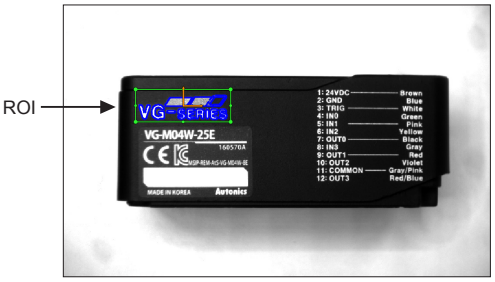
◎ CMOS (Complementary Metal Oxide Semiconductor) image sensor

Measurement method	Acquires an image by converting the signal of each pixel
Features	- Low power consumption - Stronger to impact or vibration - Faster by Individual A/D conversion - Minimized interference with operation by pixel - Economical price
Application	Object recognition, distance measurement, ultrafast camera shooting

◎ FOV (Field of View)

FOV is the size of the area that can be inspected at one time, and it is the area that vision sensor can see. Depending on the effective focal length, working distance and sensing range are different.



◎ ROI (Region of Interest)

ROI is the area of interest to inspect in the image captured by the camera.