KEYENCE

Customizable Vision System

Supports Line Scan Cameras XG-X Series

Complete Line Scan Camera Solution

XG-X Series

All the experience with area cameras can now be used with line scan cameras

Robust hardware providing stable performance

The same ease-of-use of area cameras is available with a line scan camera system

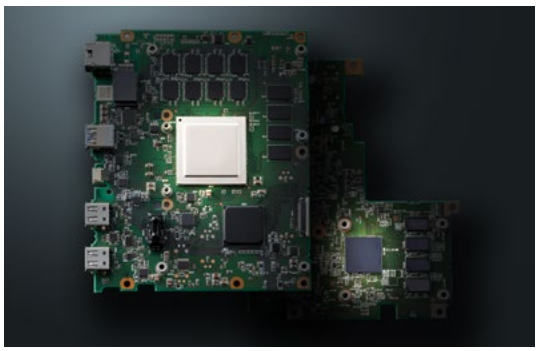
Image optimisation algorithms for stable appearance inspection

Unique stand-alone system supporting line scan cameras

- Stable performance is possible for any application.

The most powerful and advanced hardware in the image processing market

- High-speed inspection is made possible by 14 core parallel processing.

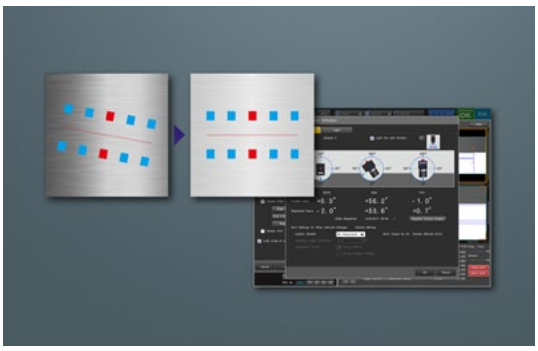


Ultra-compact, high-speed line scan camera

- The world's smallest line scan camera with up to 8192 pixels.
- Diverse lens lineup allows flexible installation.
- Mixed connection with area cameras or laser profiler heads is possible.

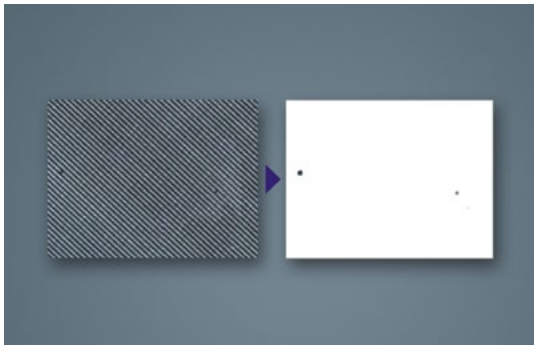
Easy camera setup

- Equipped with LED pointer to instantly identify camera capture position
- Line Scan Camera Adjustment Navigator reduces camera setup to four simple steps



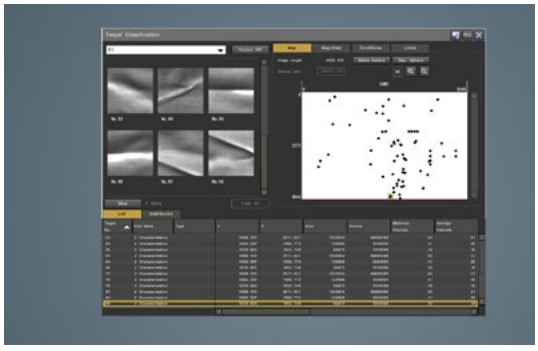
Unique image processing algorithms to extract the toughest features

- Robust preprocessing filters eliminate problem factors.
- Expanded custom filters satisfy every need.



Robust defect detection and analysis

- Appearance inspection tools allow the use of various parameters and visualisation.
- Defect extraction tools to meet any need.
- Target classification function helps organise data and maintain proper inspection.

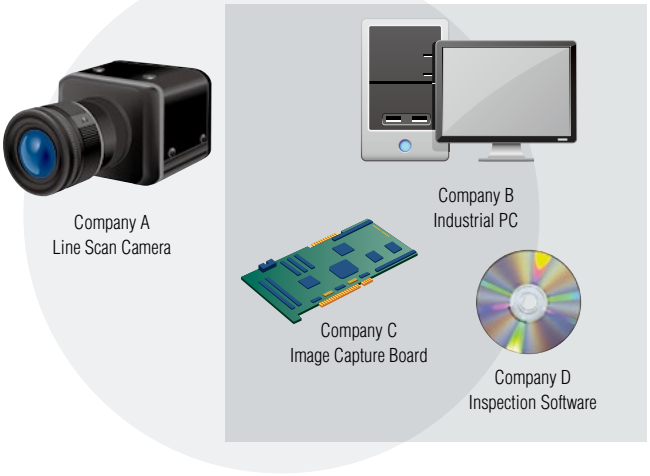


A highly-flexible vision system that can be used quickly with simple camera set up and connection

The controller with interchangeable camera modules makes it easy to incorporate a line scan inspection system that traditionally could only be done with complex, specialised machinery.

XG-X LINE SCAN SYSTEM

CONVENTIONAL LINE SCAN SYSTEM



Provides stable performance for every application

The controller-based hardware design provides stable performance even in challenging factory automation environments. Loaded with features to easily maintain a worry-free inspection.

Hardware concepts

Hardware tough enough to handle continuous long-term operation.
Built-in firmware eliminates issues with PC-based solutions.

Quickly recover from accidents that can occur.
Program settings saved on the SD card can be easily inserted into another controller.

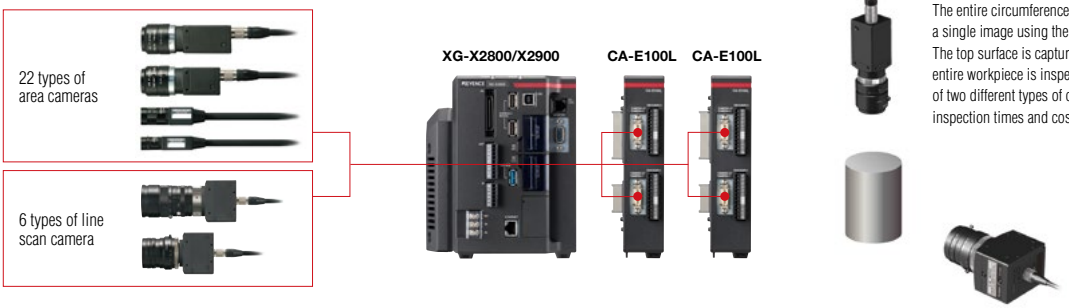
Eliminate any compatibility issues between components.
All-in-one design offers the best specifications for every application.

Non-inspection relates functions do not effect the inspection.
Advanced parallel processing using 14 cores, the largest offering in the industry, allows simultaneous operation of image processing, display, and communication.

Multi-Camera, Simultaneous Acquisition System

The XG-X Series offers the choice of up to 22 types of area cameras and 6 types of line scan cameras. This allows the same XG-X programming interface to be used no matter which camera is connected and provides the flexibility to easily adapt to changes that may occur with the inspection criteria.

MULTI -CAMERA SYSTEM

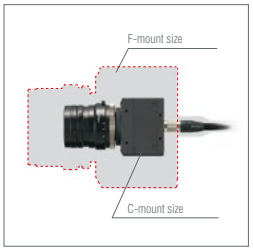


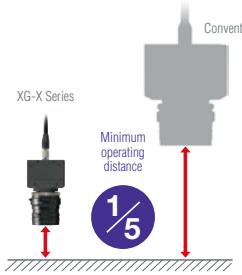
DIFFERENT CAMERA COMBINATION EXAMPLE

The entire circumference of the cylinder side is captured into a single image using the line scan camera while it is rotated. The top surface is captured with an area camera and the entire workpiece is inspected in one cycle. The combination of two different types of cameras results in reduced inspection times and cost.

Unique support for C-mount lenses with a high-definition pixel count of 4096 pixels

The industry's smallest line scan camera is achieved with the adoption of a high-sensitivity, compact CMOS image sensor. By supporting C-mount lenses, the lineup of available lenses has been greatly expanded. This results in high flexibility in the installation conditions allowing mounting in spaces that were impossible with conventional line scan systems.





Support for C-mount lenses allows for the use of lenses with short focal lengths. The minimum operating distance has been reduced to approximately 1/5 of conventional systems.

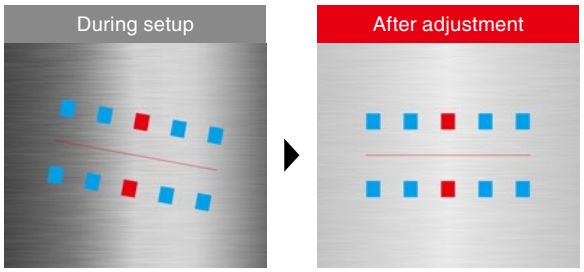
EXAMPLE

Comparison of the WD required for a field of view of 100 mm

Line Scan Camera with LED Pointer

Cameras come equipped with LED pointers. These pointers make it possible to instantly identify the location being imaged when the camera is installed.

Supported cameras: CA-HL02MX/HL04MX/HL08MX



Instantly identify when the light axis has shifted on the target.

Line Scan Camera Settings Navigator

Sensors are installed in the camera and lighting in order to digitally control the position of each. This reduces the time needed for previously time-consuming optical axis alignment.

Line Scan Camera side

LED lighting side

A user-friendly design that makes it easy to install line scan camera solutions

Ease-of-use has been emphasised in order to reduce the amount of time, effort and difficulty of implementing a line scan camera, which have traditionally been issues with conventional line scan camera installations. The XG-X Series is equipped with an interface that makes it easy to understand and install the line scan camera into the application.

Supports LumiTrax™ specular reflection mode

Model	Applicable lens	Maximum number of pixels	Max. expanded image size	Scan speed	Line scan rate
CA-HL02MX	1" C-mount lens	2048	2048 × 16,384	6.1 µs/line	165 kHz
CA-HL04MX	1" C-mount lens	4096	4096 × 16,384	10.2 µs/line	97.7 kHz
CA-HL08MX	2" special mount (M 40 P 0.75) lens*1	8192	8192 × 8192	10.2 µs/line	97.7 kHz

Model	Applicable lens	Maximum number of pixels	Max. expanded image size	Scan speed	Line scan rate
XG-HL02M	1" C-mount lens	2048	2048 × 16,384	24 µs/line	41.7 kHz
XG-HL04M	1" C-mount lens	4096	4096 × 16,384	24 µs/line	41.7 kHz
XG-HL08M	2" special mount (M 40 P 0.75) lens*1	8192	8192 × 8192	45 µs/line	22.2 kHz

*1 F-mount lenses are also supported with the F-mount conversion adapter.

Specialised lens lineup for large image sensors

Model	Description	XG-HL02M/ HL04M CA-HL02MX/ HL04MX	XG-HL08M/ CA-HL08MX
CA-LHE12	High-resolution Lens Supporting 1" Image Sensors (C-mount) (Focal point 12 mm)	✓	—
CA-LHE16	High-resolution Lens Supporting 1" Image Sensors (C-mount) (Focal point 16 mm)	✓	—
CA-LHE25	High-resolution Lens Supporting 1" Image Sensors (C-mount) (Focal point 25 mm)	✓	—
CA-LHE35	High-resolution Lens Supporting 1" Image Sensors (C-mount) (Focal point 35 mm)	✓	—
CA-LHE50	High-resolution Lens Supporting 1" Image Sensors (C-mount) (Focal point 50 mm)	✓	—
CA-LHW8	High-resolution lens supporting 1" image sensors (C-mount) (Focal point 8 mm)	✓	—
CA-LHW12	High-resolution lens supporting 1" image sensors (C-mount) (Focal point 12 mm)	✓	—
CA-LHW16	High-resolution lens supporting 1" image sensors (C-mount) (Focal point 16 mm)	✓	—
CA-LHW25	High-resolution lens supporting 1" image sensors (C-mount) (Focal point 25 mm)	✓	—
CA-LHW35	High-resolution lens supporting 1" image sensors (C-mount) (Focal point 35 mm)	✓	—
CA-LHW50	High-resolution lens supporting 1" image sensors (C-mount) (Focal point 50 mm)	✓	—
CA-LM0210	Macro lens supporting 1" image sensors (C-mount) (Optical magnification ×0.25 to ×1.0)	✓	—
CA-LHT18	Macro lens supporting 2" image sensors (M40P0.75) (Focal point 18 mm)	—	✓
CA-LHT25	Macro lens supporting 2" image sensors (M40P0.75) (Focal point 25 mm)	—	✓
CA-LHT35	Macro lens supporting 2" image sensors (M40P0.75) (Focal point 35 mm)	—	✓
CA-LML0210	Macro lens supporting 2" image sensors (M40P0.75) (Optical magnification ×0.25 to ×1.0)	—	✓
OP-87319	F-mount conversion adapter	—	✓
OP-87337	Dedicated mounting stand for the macro lens	✓	✓

Lighting for standard line capture

Model	Length
CA-DZW5	50 mm
CA-DZW15D	150 mm
CA-DZW30D	300 mm
CA-DZW45D	450 mm

● Use with CA-DC40E/DC21E in DC Mode.

Lighting for LumiTrax™ specular reflection mode

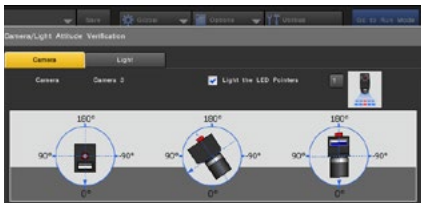
Model	Illumination width (Reference)
CA-DZW10X	120 mm
CA-DZW30X	324 mm
CA-DZW50X	525 mm

Simple 4-step Line Scan Camera Settings Navigator

Quick image generation

STEP 1

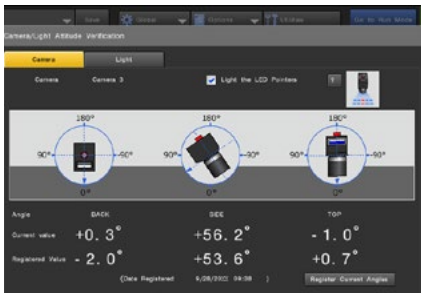
Turn on the LED pointer and align the optical axis



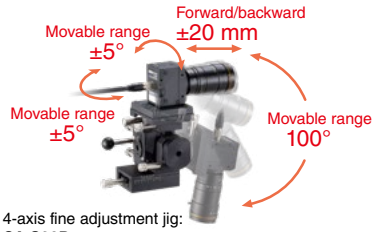
To turn on a camera's LED pointer, simply check the box.

STEP 2

Adjust the angle of the line scan camera and the LED lighting



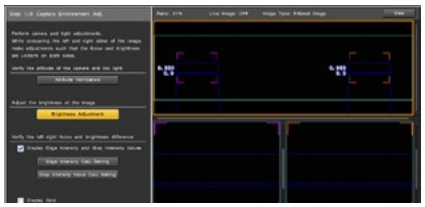
The positions of cameras and lights can both be checked using numerical values for the front, side, and top. Adjustment is even easier when using the dedicated jig.



4-axis fine adjustment jig:
CA-S20D

STEP 3

Set the focus and brightness of the line scan camera



The focus and brightness are also represented numerically, allowing for value-based adjustment.

STEP 4

Set the X/Y imaging ratio

Using a dedicated encoder enables automatic calculation of the optimal X/Y imaging ratio at the push of a button.

Encoder relay unit
CA-EN100U

Dedicated encoder
CA-EN100H

▮ High-resolution, high-speed output

Programmable up to 150,000 pulses/revolution allows for high-resolution output at a minimum of 0.0024°. High-speed output is also possible at a maximum output frequency of 1.6 MHz.

▮ IP65-compatible

Rugged design offers resistance to water and dust allowing use in a variety of industrial environments.
(This does not include the head or shaft areas.)

* If there is a chance that the shaft through-hole area will be exposed to oil droplets, use a cover or take other necessary precautions.

The advantages of implementing line scan cameras

Compared to area cameras that capture the entire image in one capture, line scan cameras, which build the image by capturing one line of pixels at a time, have the following advantages depending on the type of application.

ADVANTAGE 1

High-quality image with uniform lighting

Lighting only needs to be applied to a single area of the workpiece which results in a more evenly lit target compared to an area type camera.

ADVANTAGE 2

Expanded image of the side surface of a cylinder

Because the entire circumference of a cylinder can be inspected as a single image, the inspection program can be set up very easily.

ADVANTAGE 3

Extremely detailed inspection

Since the image is generated line by line in the target movement direction, a much larger pixel array can be used compared to an area camera resulting in drastically improved inspection accuracy.

ADVANTAGE 4

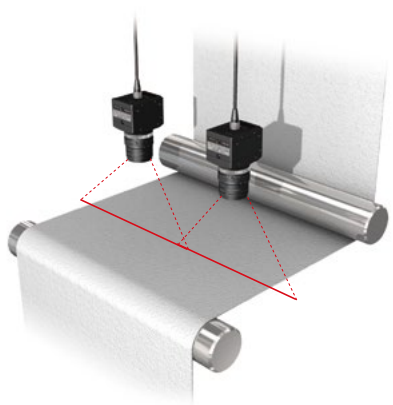
Reduced inspection completion time

The XG-X Series allows inspection on fast moving lines due to high-speed camera scanning and processing.

Applications

CONTINUOUS INSPECTION

[Illustration of inspection] Appearance inspection of non-woven fabric



Area camera

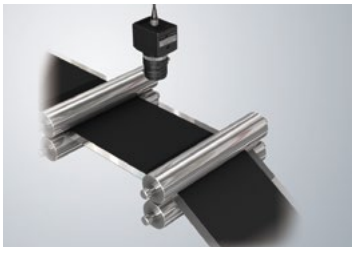
Seven 5 megapixel cameras (2432 × 2050 pixels) are used.

An image is captured while an area of the sheet is projected. To inspect the target continuously, you need to capture multiple images overlapping each other to prevent the omission of inspection areas. Since multiple cameras are used side by side, you also need to adjust their positions considering the overlapping area between the cameras.

Line scan camera

Two cameras of the XG-HL08M (8192 pixels) are used.

Images are captured continuously within the inspection area. You can achieve continuous inspection without omission by just specifying the overlap line between the images that requires actual processing. There is no need to calculate the overlap. Since fewer cameras are used, the adjustment between cameras is greatly simplified. Furthermore, the inspection software allows checking of defective images or the coordinates of defects in the history data.



Dimensional inspection of a rubber sheet

Width measurement, which typically requires 2 area cameras on each edge, is performed with a single, high-resolution line scan camera, resulting in increased accuracy and reductions in cost.

Inspection of pinholes and dirt on a sheet

Achieves visual inspection of foreign objects, flaws, and pinholes on film or sheets on a high-speed production line.

Visual inspection of stamped metal material

High-speed inspection is performed on pressed parts that are continuously punched. High-speed inspection at resolutions that are much higher than conventional devices is achieved, leading to improved inspection accuracy.

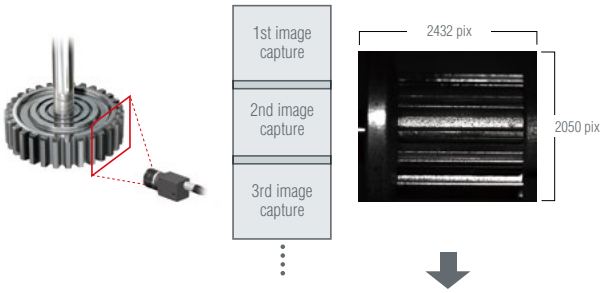
CYLINDER INSPECTION

ADVANTAGE 1 ADVANTAGE 2

EXAMPLE: VISUAL INSPECTION OF A GEAR

With an area camera

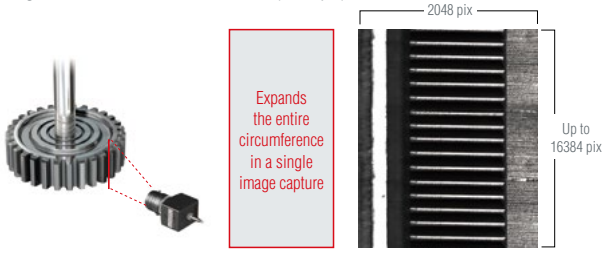
Using a 5 megapixel area camera (2432 × 2050 pix)



Captures a single area of the part in one image. Since it is a round part, inspection is difficult due to the radius and uneven lighting. Also, multiple overlapping inspections need to be performed to analyse the entire circumference.

With a line scan camera

Using the XG-HL02M line scan camera (2048 pix)



Captures the image one line at a time and then expands the entire circumference into one single image. Lighting is very uniform and the inspection of the whole part is done in one process. Inspection accuracy is greatly improved and processing time is reduced.

Appearance of pistons

The line scan camera allows various inspections of such as blowholes in the land part or irregular printing in the coated part.

Visual inspection of a bearing

Achieves the visual inspection of curved surfaces, which is difficult to perform with an area camera, by capturing stabilised images with even lighting.

Visual inspection of a roller

Defects on the surface of long metal rollers can be inspected with high-accuracy using one or two line scan cameras.

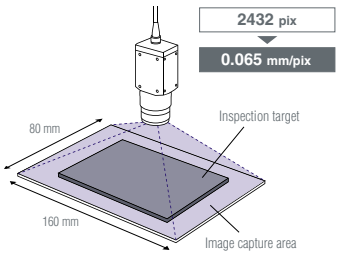
SHEET INSPECTION

ADVANTAGE 1 ADVANTAGE 3

EXAMPLE: VISUAL INSPECTION OF ALUMINIUM FOIL

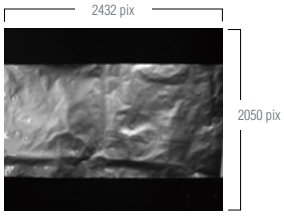
With an area camera

Using a 5 megapixel area camera (2432 × 2050 pix)



160 mm/2432 pix

Field of view X | Number of pixels

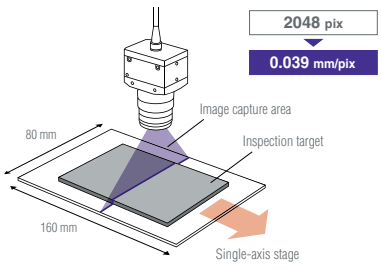


The entire workpiece is displayed but there are unnecessary void areas on the top and bottom

When using an area type camera to inspect the entire workpiece, it is difficult to obtain even lighting over the whole surface. Also, the pixel array in the XY direction is limited by the camera so multiple image captures may be necessary to secure a resolution that can satisfy the application.

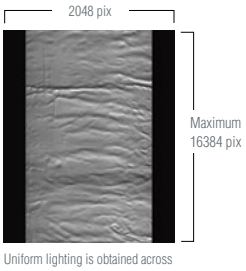
With a line scan camera

Using the XG-HL02M line scan camera (2048 pix)



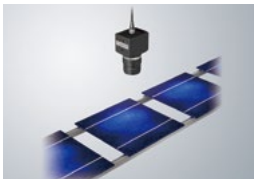
80 mm/2048 pix

Field of view X | Number of pixels



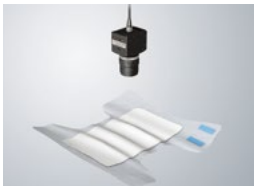
Uniform lighting is obtained across the entire part surface.

When using a line scan camera, only the X direction pixel array is fixed based off the camera while the Y direction is expanded according to the part movement direction. Much larger pixel arrays are possible with up to 8192 × 8192 pixels (or 4096 × 16384) in one single image. Very high detection accuracy is realised in one inspection process.



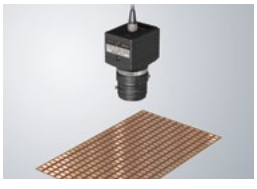
Inspection of broken solar cell patterns

By using a high-pixel line scan camera to generate a detailed image of patterns printed on a solar cell, high-accuracy inspection is possible.



Appearance inspection of sanitary products

The camera can be installed in a small clearance next to a conveyor to achieve various inspections for stains, smudges, or misaligned tapes.



Visual inspection after printing electrodes

By using line scan cameras with line lights for targets that require a wide-field, uniform lighting is achieved and high-definition inspection is possible.

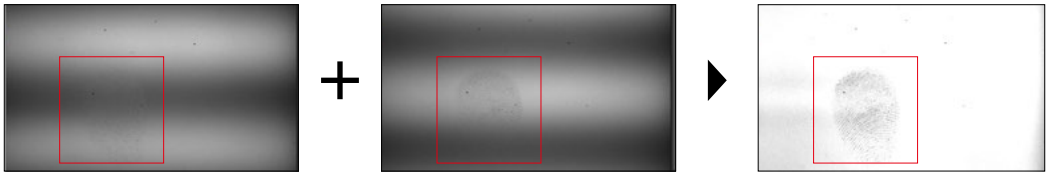
LumiTrax™ specular reflection mode

Various defects can occur due to a target's material or processing methods. With LumiTrax™ specular reflection mode, multiple images can be generated from a single image capture, allowing users to select the best image for detecting each type of targeted defect.

Using the dedicated lighting allows for looped image capturing while the position of the emitted stripe pattern is changed in high-speed.

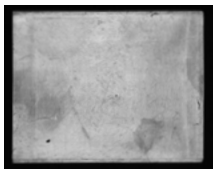
Images with different stripe patterns are combined.

An image with only the defective area extracted is created.



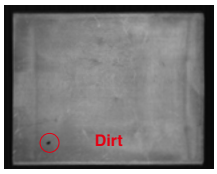
Different calculation methods are used to create multiple images.

Main image types created through a single captured image

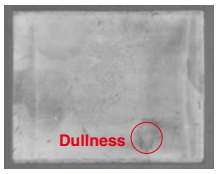


Normal image

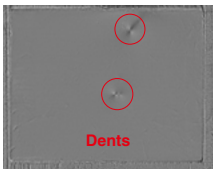
Specular reflection image



Diffuse reflection image



Gloss ratio image



Shape image

Image type	Image creation method	Main applications
Normal image	Averaging of all captured images	Determination of the overall image and as a basis for position correction
Specular reflection image	Extraction of only specular reflection areas of the striped pattern	Inspection of glossy surfaces for linear flaws, rubbing flaws, etc.
Diffuse reflection image	Extraction of diffuse reflections by comparing normal images and specular reflection images	Inspection of foreign particles and dirt
Gloss ratio image	Extraction of variations in gloss by comparing specular reflection images and diffuse reflection images	Inspection of surface dullness and flaws on cylinders and other surfaces
Shape image	Extraction of changes such as uneven surfaces through analysis of waviness that occurs in the striped pattern	Inspection of dents, shallow unevenness, etc.

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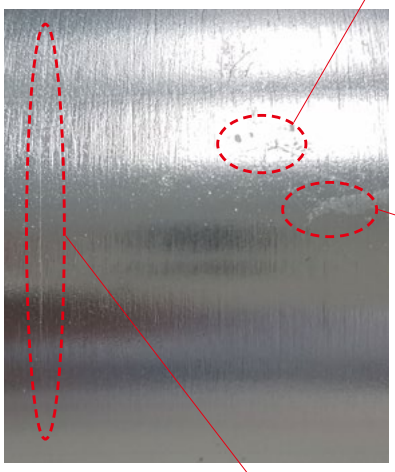
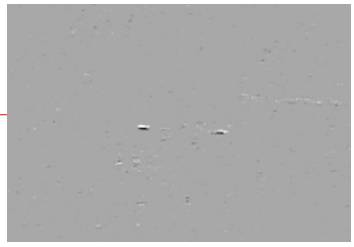
A variety of defects detected at once Applying multiple generated images for analysis

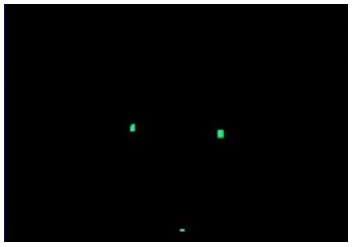
Surface inspections of metal cylinders (bearings, etc.)



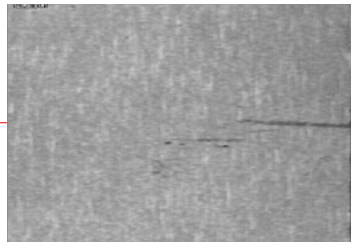
LumiTrax™ image

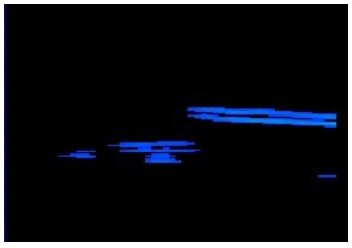
Processed image



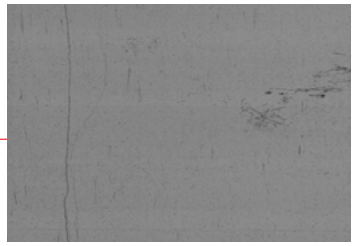


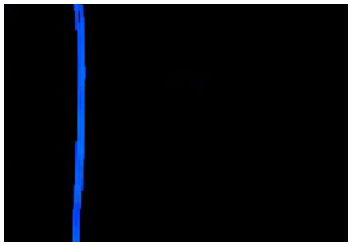
Pinholes and surface unevenness





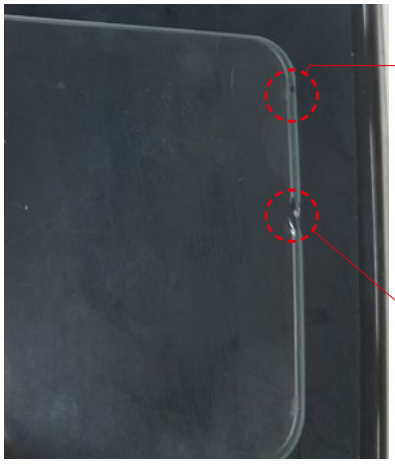
Linear flaws





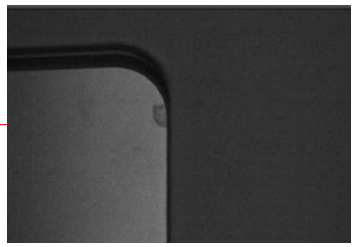
Streaking

Glass (mobile devices, etc.)

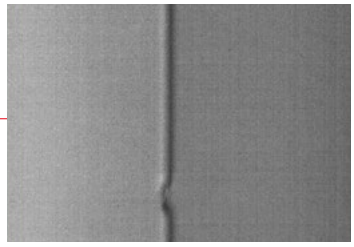


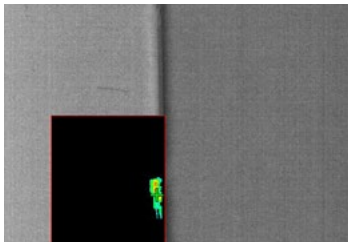
LumiTrax™ image

Processed image



Dirt on screen





Flaws on edges

CONTACT YOUR NEAREST OFFICE FOR RELEASE STATUS

CHALLENGES WITH CONVENTIONAL MODELS

Collective inspection of various defects—each with different conditions—without changing the inspection conditions

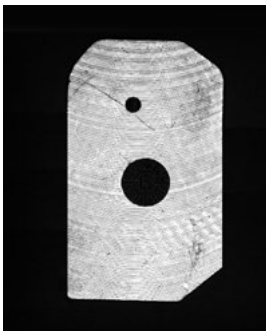
Decreased yield due to unclear judgements between normal areas and defective areas

SOLUTION

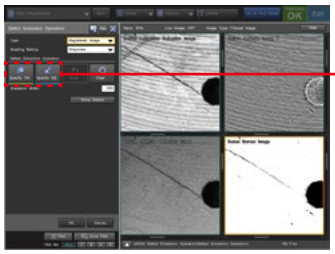
Extraction of defects by reducing influence from surface conditions

Image calculation function (Defect extraction)

The LumiTrax™ specular reflection mode allows for easy separation of normal areas and defective areas simply by clicking on the multiple images generated.
Because multiple imaging conditions are used, extraction according to the characteristics of the defect is possible.

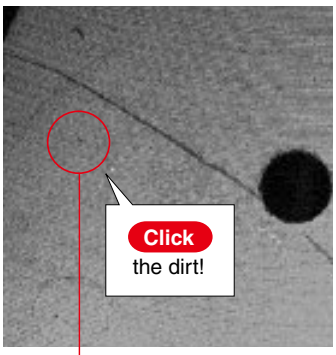


Inspecting for dirt, linear flaws, and pinholes generated on the same surface

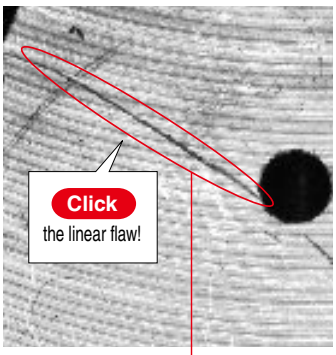


Users separately extract normal areas and defective areas from the captured image.

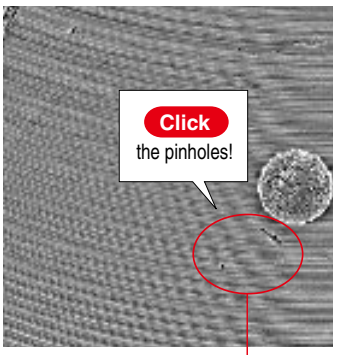
Diffuse reflection image



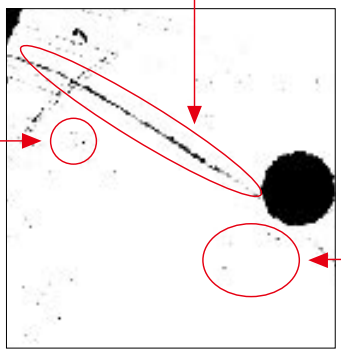
Specular reflection image



Shape image



Extracted image



Clicked defects are cut out.

CHALLENGES WITH CONVENTIONAL MODELS

Inspections in square, circular, or polygonal measurement areas

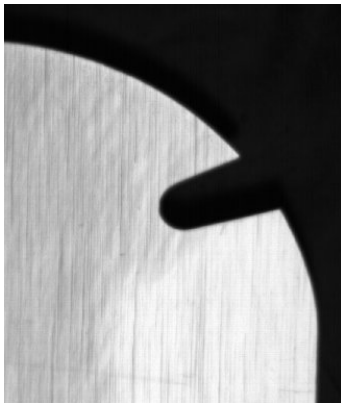
Oversight occurs with targets that have complicated contour shapes

SOLUTION

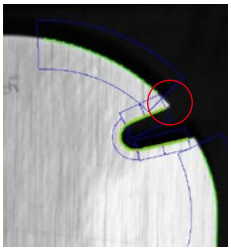
Detection of burrs and flaws that occur with complicated contours

Multi-Profile defect

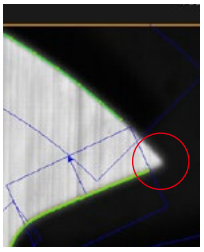
Extraction of complex shapes is possible simply by clicking the contour area. Reference lines are generated even for rounded surfaces and acute corners.
Any burrs or flaws detected beyond a reference line are considered defects.



Conventional method

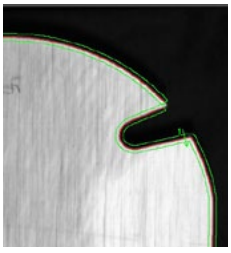


Inspection is performed through a combination of 20 circles and polygons.

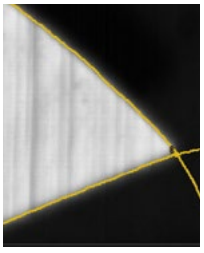


Dead zones still occur at the end surfaces.

Multi-Profile defect



Simply click on the edge of the surface to be inspected.



Regions are automatically generated along the contour with no dead angles.

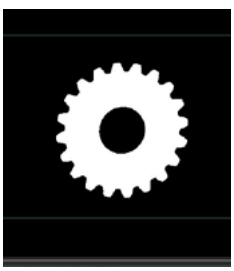
SOLUTION

Detection of burrs and flaws that occur with complicated contours

Contour Region Generator

As with Multi-Profile defect, extraction of complex shapes is possible simply by clicking the contour area. Areas within the outline can then be specified as the inspection area.

Simply click on the edge of the surface to be inspected.



The surface defined by the selected contour is extracted.

Inspection is performed only for the specified surface.

PREPROCESSING FILTERS

Bring out hard to see features and hide unwanted detections.

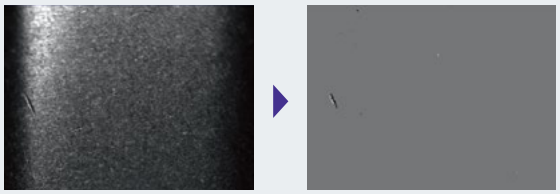
A vast number of preprocessing filters have been incorporated to dramatically improve condition changes caused by target status or the external environment.
Based on KEYENCE's unique algorithm, these filters allow generation of images best suited for each inspection to improve stability and reduce needless rejections due to false detection.

Shading Correction

Shading correction is a real time filter that evens out any large random shadows or glare on a target surface, leaving behind smaller defined points which are often associated to being flaws or defects. As this is a grey scale processing filter, it dynamically changes the processed image based on the input image rather than being based on a fixed binary setting level. This ensures consistency with target variation and changes in the raw image.

Cancel unwanted shading on metallic curved surfaces

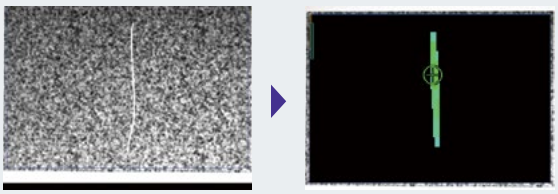
Cancels uneven lighting produced by curved surface areas on cylindrical workpieces and extracts only arbitrary flaws such as bright or dark defects.



Original image　　Image after processing

Cancelling the surface roughness of resin products

The system detects only long linear flaws without being affected by surface roughness. While minute flaws are cancelled, only relevant flaws are detected stably.

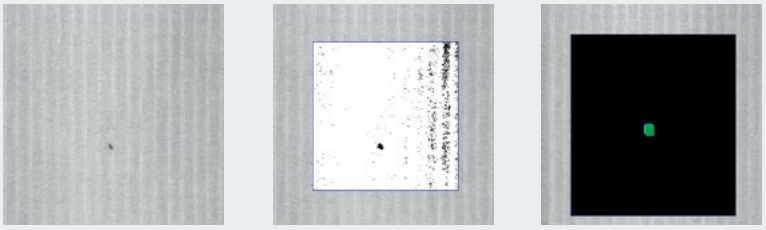


Original image　　Corrected image

DEFECT TOOL

Flexible and reliable defect detection

The defect tool detects flaws and other defects by checking for consistent intensity across a region.
In addition to stable detection ability, the tool also features a function that will filter the desired defects to detect, by size, intensity difference, shape, and count.



Original image　　Binary image　　Defect tool (contrast view)

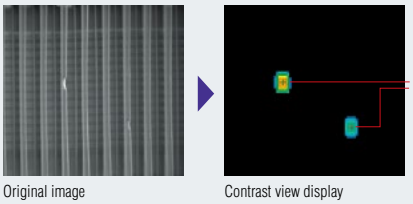
Inspection of non-woven fabric for foreign particles

Conventional binary processing would not be able to detect the foreign particles as there is very little contrast between the particles and the dark portions caused by an uneven surface. The Defect tool can compare the differences with the surroundings, allowing reliable detection of only the foreign particles.

Contrast view display

Using the colours blue, light blue, green, yellow and red, the contrast view display assigns a colour to defects according to the intensity difference between them and the surrounding area. The contrast view display updates in real time, so you are able to see the defect position and intensity differences, allowing visual and intuitive confirmation of the differences between the defect you want to detect and the background or noise.

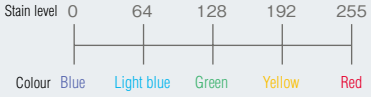
Detecting chipped resin parts



Original image　　Contrast view display

Display is possible not only during setting but also during operation. This function is useful in various scenarios, such as checking if the current parameters are optimum, or pursuing the cause of false detection during operation.

The relationship between contrast view colours and the defect level (guideline)



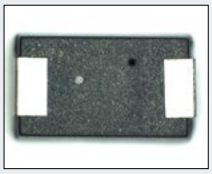
GREYSCALE BLOB TOOL

Characteristics features × Intensity information = Defect extraction to meet any needs

The greyscale blob tool allows targets to be identified and classified based on greyscale rather than binary data. This enables characterisation and filtering of detected targets based on actual image data. Additional information for classifying and identifying defects that cannot be obtained through binarisation such as volume and level of change is also possible with this tool.

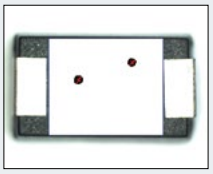
Differentiation of a variety of defects on a condenser

●Light & dark defects



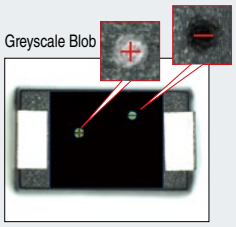
Sorting bright and dark defects.

Blob (binary)



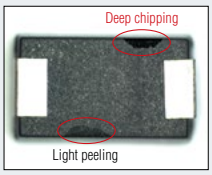
After binary conversion, both defects look alike.

Greyscale Blob



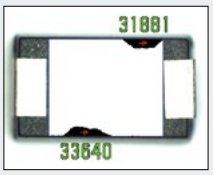
Divides defects into bright (displayed as +) and dark (displayed as -).

●Shallow and deep defects



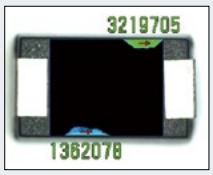
Differentiating between deep chipping and light peeling.

Blob (binary): Area measurement



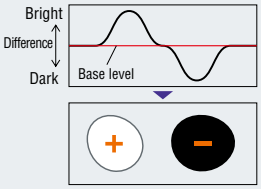
With area there is no noticeable difference.

Greyscale Blob: Volume



Differentiation is achieved by measuring the volume for each shade.

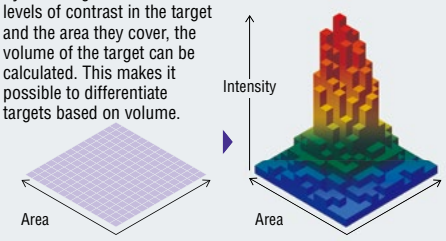
Sorting defects



The characterisation tool uses a base reference value and the contrast of the defect to sort targets into bright and dark types.

Calculating volume

By detecting the different levels of contrast in the target and the area they cover, the volume of the target can be calculated. This makes it possible to differentiate targets based on volume.

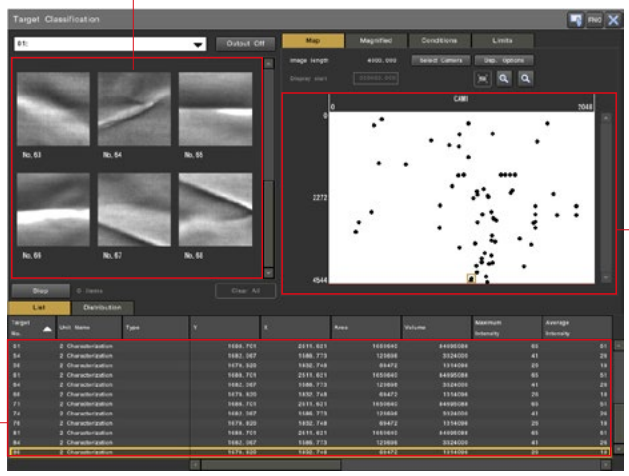


Target classification function

A utility that classifies detected targets based on defined features and then shows a mapping display and thumbnail images of the targets.

Desired targets or unwanted flaws can be detected using the variety of inspection tools that are available on the XG Series. The detected targets can then be automatically classified and sorted based off user-defined conditions. The thumbnail image of each defect can be displayed and output to an SD card or a FTP drive. The mapping display allows the confirmation of detected target positions even if the work piece is a curved shape or large sheet.

The detected targets are automatically extracted to a specified size and displayed as thumbnail images.



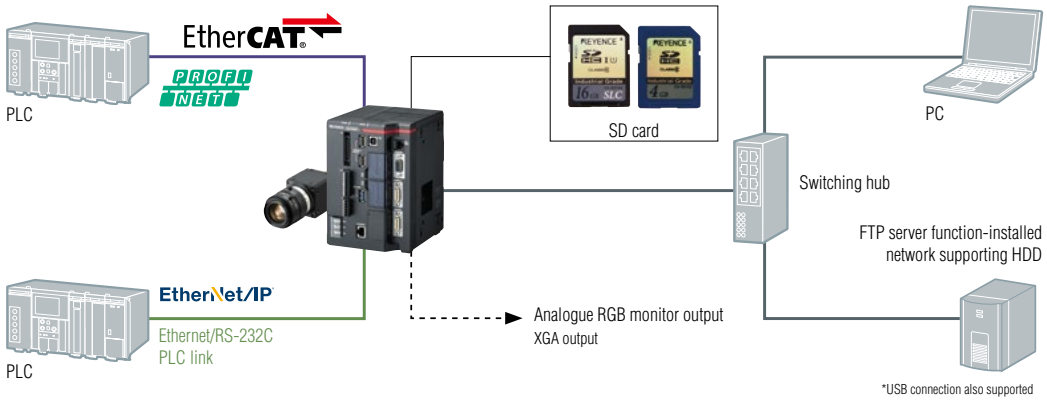
The measured data for each detected target is displayed in the results list.

The mapping results for each classification condition are displayed in the viewer.

COMMUNICATION INTERFACE

Save image and data for analysis and simulation

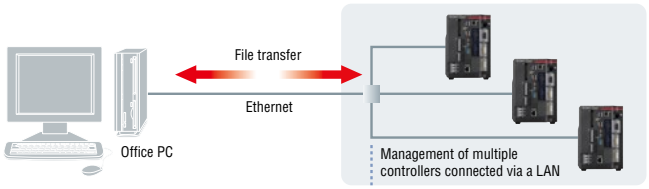
Supports a variety of connections between PLCs from various manufacturers and exchanges results and commands via the data memory just by selecting the connection destination manufacturer/device. As standard, the main unit is equipped with I/O, RS-232C, Ethernet, USB, and SD card slots. Furthermore, it is also possible to check communication with the communication monitor. This achieves significant reductions in cost, time, and effort.



EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Remote data logging & monitoring software XG-X VisionTerminal

The XG-X VisionTerminal software enables the remote monitoring, logging and support of any XG-X Series controller connected to a PC via a standard network. Maintenance man-hours, down-time and business trips can be significantly reduced as problems can be resolved remotely with the transfer of setting files and image data.

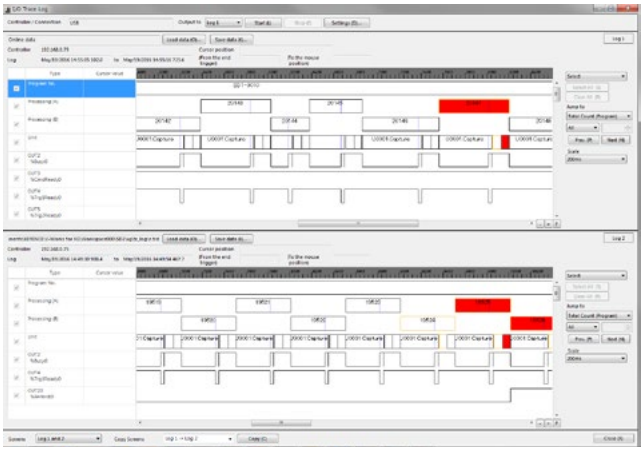


Main functions

Remote desktop function ... Enables the verification and remote operation of a connected controller, without extra data being sent and interfering with controller processing.
Logging function ..... Enables the display, logging of measurement results and storage of image data to a PC folder from an inspection with any connected controller. This function also supports the accumulation output buffer of the controller to ensure complete data collection.
File acquisition function .... Enables the transferring of setting data files and image data files between the XG-X Series controller and a PC.

Trace log function

The trace log function is a great tool to help with processing and I/O troubleshooting. Giving integrators and developers the capability for checking and monitoring the sequencing of units being processed, I/O signals and commands.
The results display can be split and the processing time for each unit along with other information can be easily displayed. The trace log can also be saved and be used at a later date as a reference guide.



EtherNet/IP® support

To enable easy integration into many existing facilities across many industries the XG-X Series fully supports EtherNet/IP®. communication. Connectivity can be established with any PLC supporting EtherNet/IP®. via a standard LAN network.

PROFINET compatible

PROFINET is an open industrial Ethernet standard that has been equipped with high flexibility and high speed for automation control in a variety of industries and it has been included as part of the communication functions for the XG-X Series. If a compatible device is present, it is possible to communicate via the LAN port on the main unit regardless of vendor.

Support for EtherCAT® Communication

EtherCAT® communication supported by adding an EtherCAT® module to the XG-X Series Controller. This enables fast-cycle communication at rates as low as 500 µs.
Also equipped with a monitoring function to confirm communications, allowing for quick troubleshooting.

USB 3.0 hard disk drive connection supported

Images and result data can be saved on a large capacity storage device up to 2 TB via USB connection. You can output data immediately after connecting the device to the controller without any network connections.

Programmable Encoder

The number of pulses/rev. can be programmed making it possible to easily obtain the best 1:1 image ratio possible. (Settings can be configured between 64 and 150000 pulses per rotation.) Unlike with conventional products, there's no need to select encoders based on such aspects as the rotation speed of the shaft, the roller diameter, and consideration for the field of view.

Encoder relay unit
CA-EN100U

Dedicated encoder
CA-EN100H

▮ High-resolution, high-speed output

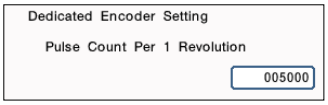
Support for up to 150,000 pulses/revolution allows for high-resolution output at a minimum of 0.0024° (8.64 seconds). High-speed output is also possible at a maximum output frequency of 1.6 MHz.

▮ IP65-compatible

Added consideration for environmental resistance has resulted in a design that is even more resistant to water and dust. (This does not include the head or shaft areas.)

* If there is a chance that the shaft through-hole area will be exposed to oil droplets, use a cover or take other necessary precautions.

Controller setting screen



Controller

Line scan camera/
XT/XR/21/64 megapixel
camera-compatible
XG-X2800
XG-X2900

Expansion unit

Area camera
input unit
CA-E100

High-resolution area
camera input unit
CA-E200

Dedicated to the
XG-X2000 Series

Line scan camera
input unit
CA-E100L

Dedicated to the
XG-X2000 Series

XR camera
input unit
CA-E100T

Dedicated to the
XG-X2000 Series

XT camera
input unit
CA-E200T

Dedicated to the
XG-X2000 Series

High-speed
transmission line
scan camera
input unit
CA-E200L

Dedicated to the
XG-X2000 Series

LED light control
expansion unit
CA-DC40E

LumiTrax™-
compatible light
control expansion
unit
CA-DC50E[*1]

Multi-Spectrum/pattern projection/
LumiTrax™ specular reflection
mode-compatible light control
expansion unit
CA-DC60E

Dedicated to the
XG-X2000 Series

CC-Link unit
CA-NCL20E

EtherCAT® unit
CA-NEC20E

PROFINET
module
CA-NPN20E

EtherNet/IP® module
CA-NEP20E

*1 LumiTrax™ mode is unavailable when used with the XG-X1000 Series.
CA-DRWxX lights can be used as standard high-intensity lighting.

Accessories

Camera cables

L-shaped
connector

Models

Cable type	Connector shape	Camera cable length				Extension cable	Repeater cable
		3 m	5 m	10 m	17 m	5 m, 10 m	3 m, 5 m, 10 m
Standard	Straight	**CA-CH3**	**CA-CH5**	**CA-CH10**	—	—	**CA-CH3X** (3 m) **CA-CH10X** (10 m)
	L-shaped	**CA-CH3L**	**CA-CH5L**	**CA-CH10L**	—	—	—
High-flex, environment-resistant	Straight	—	**CA-CH5BP**	**CA-CH10BP**	—	**CA-CH5BPE** (5 m)	—
High-flex	Straight	**CA-CH3R**	**CA-CH5R**	**CA-CH10R**	**CA-CH17R**[*1]	—	**CA-CH3BX** (3 m) **CA-CH5BX** (5 m) **CA-CH10BX** (10 m)
For high-speed transmission cameras	Straight	**CA-CF3**	**CA-CF5**	**CA-CF10**	—	**CA-CF5E** (5 m) **CA-CF10E** (10 m)	—
	L-shaped	**CA-CF3L**	**CA-CF5L**	**CA-CF10L**	—	—	—

*1 The max. cable length varies depending on the use of extension cables/amplifiers. Contact KEYENCE for details.

Camera cable compatibility

Cable type	Area cameras					Line scan cameras
	CA-HF6400x/HF2100x	**CA-H500x/H200x/H035x**	**CA-H500xX/H200xX/ H048xX**	**CA-200x/035x**	**CA-HS200x/HS035x**	**CA-HLxMX**
CA-CH3 (L/R)	—	✓	✓	✓	✓	—
CA-CH5 (L/R/BP)	—	✓	✓	✓	✓	—
CA-CH10 (L/R/BP)	—	✓	✓	✓	✓	—
CA-CH17R	—	—	—	*1	—	—
CA-CF3 (L)	✓	—	—	—	—	✓
CA-CF5 (L)	✓	—	—	—	—	✓
CA-CF10 (L)	✓	—	—	—	—	✓

*1 The CA-CH17R cable can only be used for connecting the CA-035x camera.

Amplifier for extension cables
CA-CHX10U

Camera cables can be extended up to 37 m*.

* The maximum length varies depending on the camera model. Contact us for details.

The dedicated extension cable is necessary in order to connect an amplifier to a camera or between two amplifiers. Contact KEYENCE for details.

XT camera cable
CA-CD2 (2 m)
CA-CD5 (5 m)
CA-CD10 (10 m)

XT power supply cable
OP-88356 (2 m)
OP-88357 (5 m)
OP-88358 (10 m)

Camera lineup

		Model	Applicable lens	Maximum number of pixels	Max. expanded image size	Scan speed	Line scan rate
Line scan options	 Supports LumiTrax™ specular reflection mode	**CA-HL02MX**	1 in. C-mount	2048	2048 × 16,384	6.1 µs/line	165 kHz
		CA-HL04MX	1 in. C-mount	4096	4096 × 16,384	10.2 µs/line	97.7 kHz
		CA-HL08MX	2 in. (M40 P0.75) lens*1	8192	8192 × 8192	10.2 µs/line	97.7 kHz
		**XG-HL02M**	1 in. C-mount	2048	2048 × 16,384	24 µs/line	41.7 kHz
		XG-HL04M	1 in. C-mount	4096	4096 × 16,384	24 µs/line	41.7 kHz
		XG-HL08M	2 in. (M40 P0.75) lens*1	8192	8192 × 8192	45 µs/line	22.2 kHz

*1 F-mount lenses are also supported with the F-mount conversion adapter.

		Model	Specification	Function	Capture range (pixels)	Image transfer time
64 megapixel camera series		**CA-HF6400M** **CA-HF6400C**	90× high-speed monochrome 88× high-speed colour	High speed	8192 × 7808	57.6 ms 59.2 ms
21 megapixel camera series		**CA-HF2100M** **CA-HF2100C**	85× high-speed monochrome 85× high-speed colour	High speed	5104 × 4092	20.2 ms
5 megapixel camera series		**CA-H500MX** **CA-H500CX**	16× high-speed monochrome 16× high-speed colour	High speed, high performance*1	2432 × 2040	27.7 ms 29.2 ms
		**CA-H500M** **CA-H500C**	16× high-speed monochrome 16× high-speed colour	High speed, environment resistant*2	2432 × 2050	28.4 ms
2 megapixel camera series		**CA-H200MX** **CA-H200CX**	16× high-speed monochrome 16× high-speed colour	High speed, high performance*1	1600 × 1200	11.7 ms
		**CA-H200M** **CA-H200C**	16× high-speed monochrome 16× high-speed colour	High speed, environment resistant*2	1600 × 1200	11.8 ms
		**CA-200M** **CA-200C**	Monochrome Colour	Environment resistant*2	1600 × 1200	56.5 ms
		**CA-HS200M** **CA-HS200C**	16× high-speed compact monochrome 16× high-speed compact colour	High speed, compact	1600 × 1200	14.2 ms
0.47 megapixel camera series		**CA-H048MX** **CA-H048CX**	16× high-speed monochrome 16× high-speed colour	High speed, high performance*1	784 × 596	2.9 ms
					512 × 480	1.7 ms
0.31 megapixel camera series		**CA-H035M** **CA-H035C**	16× high-speed monochrome 16× high-speed colour	High speed, environment resistant*2	640 × 480	2.9 ms
		**CA-035M** **CA-035C**	Monochrome Colour	Environment resistant*2	640 × 480	16.5 ms
		**CA-HS035M** **CA-HS035C**	7× high-speed compact monochrome 7× high-speed compact colour	High speed, compact	640 × 480	4.5 ms

*1 Colour cameras support LumiTrax™ image capture and pattern projection lighting, and monochrome cameras support LumiTrax™ image capture, Multi-Spectrum image capture, pattern projection lighting, and LumiTrax™ specular reflection mode image capture.
*2 To use this camera as an IP64-rated, environment-resistant camera, use it with a KEYENCE-specified IP64-rated lens and an environment-resistant cable.

3D cameras

		Model	Field of view XY (Reference distance)	Z range (from reference distance)	Repeatability (σ)
XT		**XT-024**	24 × 24 mm	±2 mm	±0.5 µm
		XT-060	60 × 60 mm	±6 mm	±1 µm
XR		**XR-HT15M**	12.5 × 12.5 mm	±1.5 mm	1 µm*1
		XR-HT40M	35.5 × 35.5 mm	±5.0 mm	2 µm*1

*1 Value for KEYENCE standard plane workpieces when binning is ON and a 3 × 3 average filter is used once.

CONTACT YOUR NEAREST OFFICE FOR RELEASE STATUS

Monitor/Touch panel

Multi-touch enabled 12" touch panel
CA-MP120T
12" colour LCD monitor
CA-MP120

CA-MP120T/MP120 monitor stand
OP-87262

CA-MP120T protective film
OP-87263

Options for CA-MP120T
For XG-X Series:
OP-87264
(Touch panel modular RS-232C cable, 3 m)
OP-87265
(Touch panel modular RS-232C cable, 10 m)

CA-MP120T/MP120 pole-mounting bracket
OP-42279

Monitor cable
OP-66842 (3 m)
OP-87055 (10 m)

*A RGB monitor cable and touch panel RS-232C cable are required when using the CA-MP120T.

Communication cable

Parallel I/O cable
OP-51657
(3 m)

Communication cable conversion connector
OP-26486: 9 pins
For 9-pin SYSMAC: **OP-84384**
For 9-pin MELSEC: **OP-86930**

*When connecting the MELSEC-FX, which requires a 9-pin connection, use the OP-26486.

RS-232C communication cable
OP-26487
(2.5 m)

1 Gbps Ethernet cable
OP-66843
(3 m)

USB cable
OP-66844
(2 m)

Others

Image processing system integration software
XG-H1XE
XG-X Vision Editor Software Licence

USB handheld controller (USB)
OP-87983

Dedicated mouse
OP-87506
Mouse stand
OP-87601

Industrial SD card
CA-SD16G: 16 GB
CA-SD4G: 4 GB
CA-SD1G: 1 GB

Dedicated 24 VDC power supply
CA-U4
CA-U5

4-axis fine adjustment jig for camera
CA-S20D

Fan unit (for replacement)
CA-F100
*Dedicated to the XG-X2800

The XG-X Series manual set OP-M**** is not included with the controller.
A PDF version is included with the integrated development environment software XG-H1XE.

VisionDatabase Dedicated Database for Vision System

Database software
CA-H1DB

Add-on card for additional controller functions
CA-AD1

Programmable Encoder

Encoder head unit
CA-EN100H

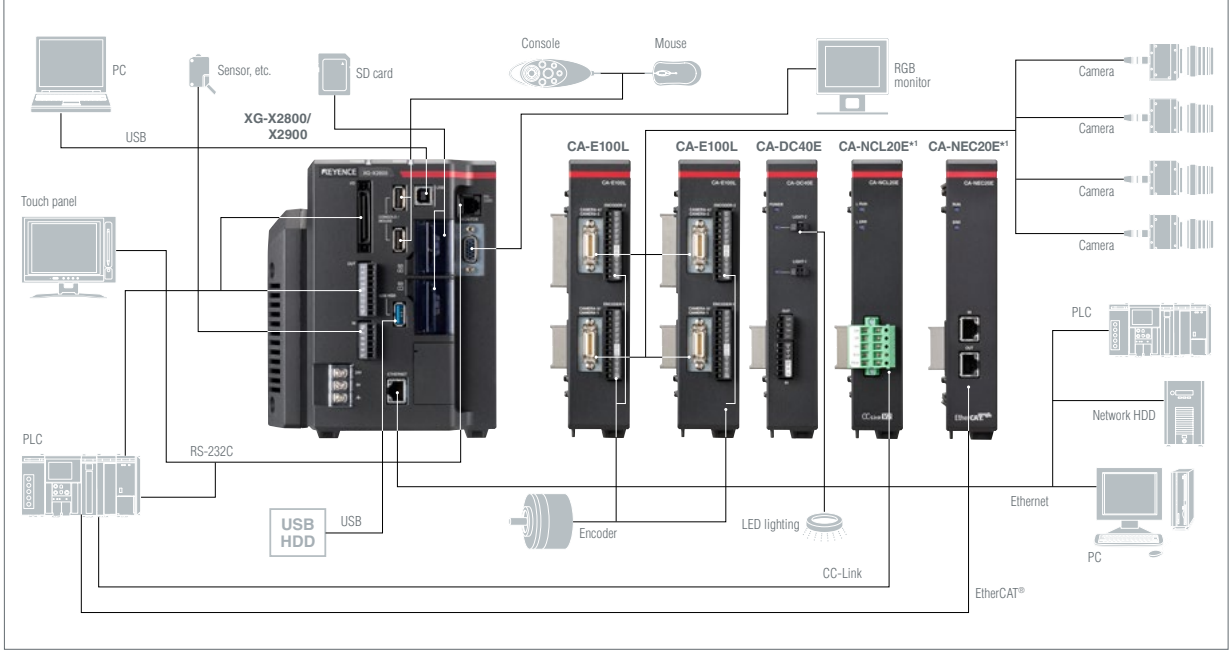
Encoder relay unit
CA-EN100U

Encoder head cable
CA-EN5 (5 m)
CA-EN10 (10 m)

CONTACT YOUR NEAREST OFFICE FOR RELEASE STATUS

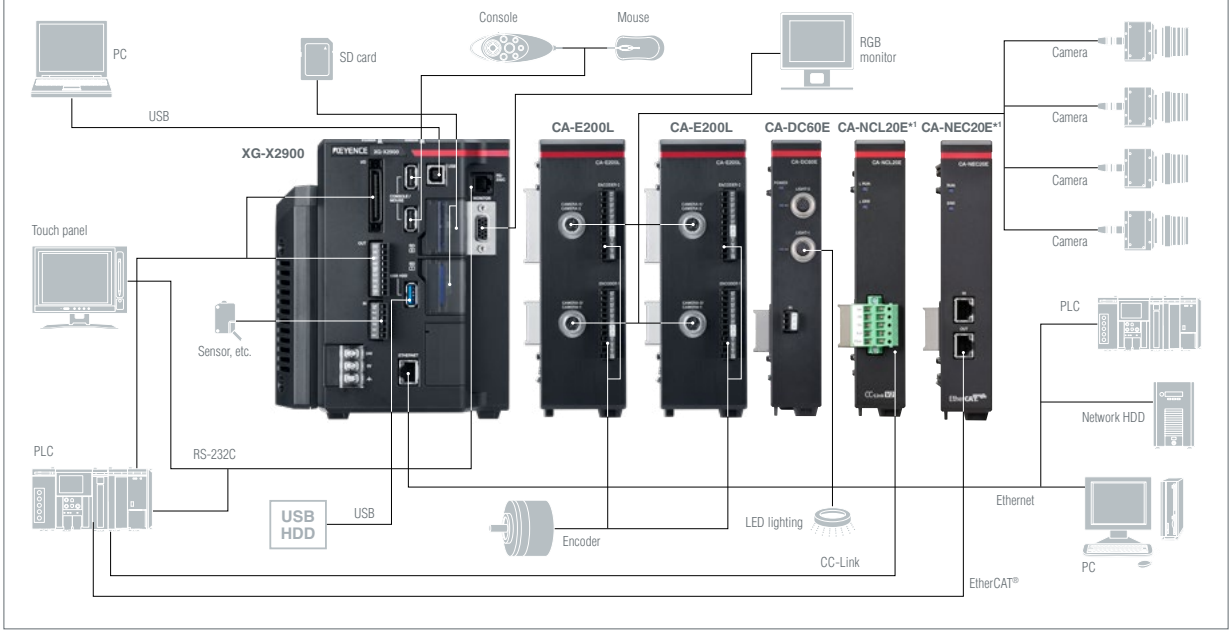
XG-X System Configuration Diagram

System configuration diagram XG-X2800/X2900 (When connected to a line scan camera)



XG-X System Configuration Diagram when Using a Line Scan Camera in LumiTrax™ Specular Reflection Mode

System configuration diagram XG-X2900



*1 CA-NCL20E and CA-NEC20E cannot be connected simultaneously.

Specifications (Controller)

▮ Controller (XG-X2800)

Model		XG-X2800	
Camera input*1		• With area camera input unit CA-E100 connected: 2 colour/monochrome cameras per CA-E100, up to 4 cameras via a maximum of 2 units can be connected. • With line scan camera input unit CA-E100L connected: 2 line scan cameras or two monochrome/colour cameras per CA-E100L, 4 cameras max. with 2 camera input units • With high-speed line scan camera unit CA-E200L connected: 2 high-speed line scan cameras per CA-E200L, 4 cameras max. with 2 camera input units	• With XR camera input unit CA-E100T connected: 1 3D camera per CA-E100T, 2 cameras max. with 2 camera input units • With XT camera input unit CA-E200T connected: 1 XT camera per CA-E200T, 2 cameras max. with 2 camera input units
	Trigger input	Simultaneous/individual capture with up to 4 cameras/heads can be selected (up to 2 cameras/heads for simultaneous capture when one camera input unit is connected)	
Supported cameras/ Number of pixels	Area camera	• CA-035C/HS035C/H035C/035M/HS035M/H035M 0.31 megapixel mode: 640 (H) × 480 (V), approx. 0.31 megapixels 0.24 megapixel mode: 512 (H) × 480 (V), approx. 0.24 megapixels • CA-H048CX/H048MX 0.47 megapixel mode: 784 (H) × 596 (V), approx. 0.47 megapixels 0.31 megapixel mode: 640 (H) × 480 (V), approx. 0.31 megapixels 0.24 megapixel mode: 512 (H) × 480 (V), approx. 0.24 megapixels • CA-200C/HS200C/H200C/200M/HS200M/H200M 2 megapixel mode: 1600 (H) × 1200 (V), approx. 1.92 megapixels 1 megapixel mode: 1024 (H) × 960 (V), approx. 0.98 megapixels	• CA-H200CX/H200MX 2 megapixel mode: 1600 (H) × 1200 (V), approx. 1.92 megapixels • CA-H500C/H500M 5 megapixel mode: 2432 (H) × 2050 (V), approx. 4.99 megapixels • CA-H500CX/H500MX 5 megapixel mode: 2432 (H) × 2040 (V), approx. 4.96 megapixels 2 megapixel mode: 1600 (H) × 1200 (V), approx. 1.92 megapixels • CA-HF2100C/HF2100M 21 megapixel mode: 5104 (H) × 4092 (V), approx. 20.89 megapixels 5 megapixel mode: 2432 (H) × 2050 (V), approx. 4.99 megapixels
	High-speed line scan camera	• CA-HL08MX 8192 (H) × 8192 (L), approx. 67.11 megapixels • CA-HL04MX 4096 (H) × 16384 (L), approx. 67.11 megapixels	• CA-HL02MX 2048 (H) × 16384 (L), approx. 33.55 megapixels
	XR camera	• XR-HT40M 2048 (H) × 2048 (L), approx. 4.19 megapixels	• XR-HT15M 1408 (H) × 1408 (L), approx. 1.98 megapixels
	XT camera	XT-024/060 3072 (H) × 3072 (V), approx. 9.44 megapixels	
Main image processor		DSP (Fast type)	
Program memory		Up to 1000 settings (depending on SD card capacity and setting contents) for SD card 1 and SD card 2 individually and external switching is possible	
Screen capacity		Maximum 1000 screens for each program (depending on SD card size), Image compression, Support for image registration and partial image registration from a position-corrected image, Externally switchable according to variables.	
Memory card		• SD card slot × 2 • Supports OP-87133 (512 MB), CA-SD1G (1 GB: standard equipment on the SD1 slot), CA-SD4G (4 GB), and CA-SD16G (16 GB)	
Image archive		• Can store the image amounts listed below as an archive to the image memory of the main unit	
	Area camera	• Max. 12757 images (monochrome camera, 0.24 megapixels) • Max. 10221 images (monochrome camera, 0.31 megapixels) • Max. 6730 images (monochrome camera, 0.47 megapixels) • Max. 1638 images (monochrome camera, 2 megapixels) • Max. 613 images (monochrome camera, 5 megapixels) • Max. 122 images (monochrome camera, 21 megapixels)	• Max. 12441 images (colour camera, 0.24 megapixels) • Max. 9998 images (colour camera, 0.31 megapixels) • Max. 6609 images (colour camera, 0.47 megapixels) • Max. 1598 images (colour camera, 2 megapixels) • Max. 583 images (colour camera, 5 megapixels) • Max. 110 images (colour camera, 21 megapixels)
	Line Scan Camera	• Max. 71 images (CA-HL02MX continuous capture, 2048 × 16384 pixels) • Max. 151 images (CA-HL02MX continuous capture, 2048 × 8192 pixels) • Max. 71 images (CA-HL02MX individual capture, 2048 × 16384 pixels) • Max. 31 images (CA-HL04MX continuous capture, 4096 × 16384 pixels)	• Max. 68 images (CA-HL04MX continuous capture, 4096 × 8192 pixels) • Max. 31 images (CA-HL04MX individual capture, 4096 × 16384 pixels) • Max. 28 images (CA-HL08MX continuous capture, 8192 × 8192 pixels) • Max. 31 images (CA-HL08MX individual capture, 8192 × 8192 pixels)
	XR camera	• Max. 494 images (XR 15 mm type, height image and greyscale image saved) • Max. 2028 images (XR 15 mm type, binning: ON, height image and greyscale image saved)	• Max. 220 images (XR 40 mm type, height image and greyscale image saved) • Max. 953 images (XR 40 mm type, binning: ON, height image and greyscale image saved)
	XT camera	• Max. 192 images (XT-024/060, binning ON, or binning OFF with narrow field of view)	• Max. 40 images (XT-024/060, binning OFF, or binning ON with expansion)
Interface	Assignable input	• 20 connection points (including four high-speed terminals that can be assigned to trigger input) • Input rating: 26.4 V or lower, or 1.2 mA or greater (2.2 mA or greater for high-speed input terminals)	
	Assignable output	• 28 connection points (including four high-speed terminals that can be assigned to external trigger-linked FLASH output) • Photo MOSFET*2: Max.50 mA (30 V or less)	
	Encoder input	• When the CA-E100L/E200L is connected: 2 inputs per unit, 4 inputs total for 2 units max. • RS-422 line-driver output (Multi-drop support*3, Supports 5 V output included: max. 150 mA) and open collector output (24 V devices only with CA-E100L/E200L) included	
	Monitor output	Analogue RGB output, XGA (1024 × 768, 24-bit colour)	
	Unit indicators	Power, ERROR LED display	
	RS-232C	• Functionality switchable between numerical data output, control input/output, and CA Series touch panel interface (Cannot be used in conjunction with PLC links using RS-232C) • Supports a maximum baud rate of 230400 bps	
	PLC link	• Can output numerical values and perform control input/output using the Ethernet or RS-232C port (Cannot be used in conjunction with CC-Link, EtherNet/IP®, PROFINET, EtherCAT®) • The following PLCs are supported via link unit*4: KEYENCE: KV-8000/7000/5000/3000/1000/700 Series, KV Nano Series Mitsubishi Electric: MELSEC iQ-R/L/Q Series, MELSEC A Series, (RS-232C only), MELSEC iQ-F Series, MELSEC FX Series (RS-232C only) OMRON: SYSMAC CJ2/CJ1/CS1 Series, SYSMAC C Series (RS-232C only), SYSMAC CP1 Series YASKAWA Electric Corporation: MP2000 Series/MP900 Series (RS-232C only)	
	Ethernet	• Can output numerical values and perform control input/output • Connecting to KEYENCE PC application software enables not only the above functions but also makes it possible to upload and download inspection settings, perform a variety of simulations, send and receive a variety of data including image data, and use the remote desktop function. • Supports FTP client and server functions, an SFTP Client function, a VNC server function (for non-PC clients, only displaying the monitor screen is supported), and a BOOTP function • Jumbo frame support (when connected to CA-NEC20E/NEP20E/NPN20)	
	USB	• Connecting to KEYENCE PC application software makes it possible to output numerical values, perform control I/O, upload and download inspection settings, perform a variety of simulations, send and receive a variety of data including image data, and use the remote desktop function. • Dedicated to USB 2.0	
	CC-Link	• By connecting the optional CC-Link unit CA-NCL20E, numerical value output and control input/output are enabled (Cannot be used in conjunction with PLC-Link, EtherNet/IP®, PROFINET or EtherCAT®) • Supports ver. 1.10 and ver. 2.00 remote device stations	
	EtherCAT®	• Connecting the optional EtherCAT® unit CA-NEC20E enables numerical value output and control input/output (Cannot be used in conjunction with PLC-Link, CC-Link, EtherNet/IP®, or PROFINET.) • Process data object communication (cyclic communication) (Input: max. 536 bytes, output: max. 532 bytes) • Message communication (non-cyclic communication) • Supports CoE • Explicit Device Identification • Conforms to conformance test V2.1.0.2.	
	EtherNet/IP®	• Numerical data input/output and control input/output enabled via the Ethernet port or optional CA-NEP20E EtherNet/IP® unit (Cannot be used in conjunction with PLC-link, CC-Link, PROFINET or EtherCAT®) • Supports cyclic communication (max. 1436 bytes) and message communication • Maximum connections: 32 (Ethernet port) / 1: Exclusive Owner, 4: Input Only (CA-NEP20E) • Conforms to conformance test Version.CT15 (Ethernet port) / CT16 (CA-NEP20E)	
	PROFINET	• Numerical data input/output and control input/output enabled via the Ethernet port or optional CA-NPN20E PROFINET unit (Cannot be used in conjunction with PLC-link, CC-Link, EtherNet/IP®, or EtherCAT®) • Supports cyclic communication (max. 1408 bytes (Ethernet port) / 1248 bytes (CA-NPN20E)) • Supports non-cyclic communication (recorded data) • Conforms to Conformance Class A (Ethernet port) / C (CA-NPN20E)	
	SNTP	Unit's date and time auto-corrects when unit is connected to SNTP server	
	USB console	• Possible to control various menus via an optional USB console (OP-87983) • Supports the assignment of operations to console buttons	
	Mouse	Possible to control various menus via an optional dedicated mouse (OP-87506)	
	Touch panel	• Settings can be operated from a CA Series touch panel using the RS-232C port (Cannot be used in conjunction with RS-232C no-protocol communication or PLC links using RS-232C) • Supports dedicated touch menus and operation buttons	
	USB HDD	• By connecting the HDD (max. 2 TB) to the dedicated USB port (supports USB 3.0, bus-powered, rated output 900 mA), image and other data can be output	
Language		Japanese/English/Simplified Chinese/Traditional Chinese/German (initial language set at first startup)	
Illumination control		By connecting the optional light expansion unit CA-DC40E/DC50E/DC60E, lighting and intensity control for the LED illumination is possible.*5	
Cooling fan		CA-F100 fan unit is included (attached) to the controller.	
Rating	Voltage	24 VDC ±10%	
	Current consumption	5.3 A	
Environmental resistance	Operating ambient temperature	0 to 45°C (when installed on a DIN rail)/0 to 40°C (when installed on a surface)	
	Operating ambient humidity	35 to 85% RH (no condensation)	
Weight		Approx. 1750 g	

*1 At least one camera input unit is required (controller has no built-in camera inputs). *2 The output common can be configured for NPN or PNP input devices.
*3 Supported on the CA-E100L/E200L. *4 Models equipped with the Ethernet port in the CPU unit support Ethernet port direct connection. *5 Up to 8 light control expansion units can be connected (max. two CA-DC50E/DC60E units out of 8).

▮ Controller (XG-X2900)

Model		XG-X2900	
Camera input*1		• With area camera input unit CA-E100 connected: 2 colour/monochrome cameras per CA-E100, up to 4 cameras via a maximum of 2 units can be connected. • With line scan camera input unit CA-E100L connected: 2 line scan cameras or two monochrome/colour cameras per CA-E100L, 4 cameras max. with 2 camera input units • With high-speed line scan camera unit CA-E200L connected: 2 high-speed line scan cameras per CA-E200L, 4 cameras max. with 2 camera input units	• With XR camera input unit CA-E100T connected: 1 3D camera per CA-E100T, 2 cameras max. with 2 camera input units • With XT camera input unit CA-E200T connected: 1 XT camera per CA-E200T, 2 cameras max. with 2 camera input units
	Trigger input	Simultaneous/individual capture with up to 4 cameras/heads can be selected (up to 2 cameras/heads for simultaneous capture when one camera input unit is connected)	
Supported cameras/ Number of pixels	Area camera	• CA-035C/HS035C/H035C/035M/HS035M/H035M 0.31 megapixel mode: 640 (H) × 480 (V), approx. 0.31 megapixels 0.24 megapixel mode: 512 (H) × 480 (V), approx. 0.24 megapixels • CA-H048CX/H048MX 0.47 megapixel mode: 784 (H) × 596 (V), approx. 0.47 megapixels 0.31 megapixel mode: 640 (H) × 480 (V), approx. 0.31 megapixels 0.24 megapixel mode: 512 (H) × 480 (V), approx. 0.24 megapixels • CA-200C/HS200C/H200C/200M/HS200M/H200M 2 megapixel mode: 1600 (H) × 1200 (V), approx. 1.92 megapixels 1 megapixel mode: 1024 (H) × 960 (V), approx. 0.98 megapixels • CA-H200CX/H200MX 2 megapixel mode: 1600 (H) × 1200 (V), approx. 1.92 megapixels	• CA-H500C/H500M 5 megapixel mode: 2432 (H) × 2050 (V), approx. 4.99 megapixels • CA-H500CX/H500MX 5 megapixel mode: 2432 (H) × 2040 (V), approx. 4.96 megapixels 2 megapixel mode: 1600 (H) × 1200 (V), approx. 1.92 megapixels • CA-HF2100C/HF2100M 21 megapixel mode: 5104 (H) × 4092 (V), approx. 20.89 megapixels 5 megapixel mode: 2432 (H) × 2050 (V), approx. 4.99 megapixels • CA-HF6400C/HF6400M 64 megapixel mode: 8192 (H) × 7808 (V), approx. 63.96 megapixels 41 megapixel mode: 7168 (H) × 5768 (V), approx. 41.35 megapixels 21 megapixel mode: 5104 (H) × 4092 (V), approx. 20.89 megapixels
	High-speed line scan camera	• CA-HL08MX 8192 (H) × 8192 (L), approx. 67.11 megapixels • CA-HL04MX 4096 (H) × 16384 (L), approx. 67.11 megapixels	• CA-HL02MX 2048 (H) × 16384 (L), approx. 33.55 megapixels
	XR camera	• XR-HT40M 2048 (H) × 2048 (L), approx. 4.19 megapixels	• XR-HT15M 1408 (H) × 1408 (L), approx. 1.98 megapixels
	XT camera	• XT-024/060 3072 (H) × 3072 (V), approx. 9.44 megapixels	
Main image processor		DSP (Fast type)	
Program memory		Up to 1000 settings (depending on SD card capacity and setting contents) for SD card 1 and SD card 2 individually and external switching is possible	
Screen capacity		Maximum 1000 screens for each program (depending on SD card size), Image compression, Support for image registration and partial image registration from a position-corrected image, Externally switchable according to variables.	
Memory card		• SD card slot × 2 • Supports OP-87133 (512 MB), CA-SD1G (1 GB), CA-SD4G (4 GB: standard equipment on the SD1 slot), and CA-SD16G (16 GB)	
Image archive		Can store the image amounts listed below as an archive to the image memory of the main unit	
	Area camera	• Max. 29005 images (monochrome camera, 0.24 megapixels) • Max. 23241 images (monochrome camera, 0.31 megapixels) • Max. 15306 images (monochrome camera, 0.47 megapixels) • Max. 3732 images (monochrome camera, 2 megapixels) • Max. 1421 images (monochrome camera, 5 megapixels) • Max. 307 images (monochrome camera, 21 megapixels)	• Max. 28297 images (colour camera, 0.24 megapixels) • Max. 22744 images (colour camera, 0.31 megapixels) • Max. 15043 images (colour camera, 0.47 megapixels) • Max. 3675 images (colour camera, 2 megapixels) • Max. 1386 images (colour camera, 5 megapixels) • Max. 292 images (colour camera, 21 megapixels)
	Line Scan Camera	• Max. 185 images (CA-HL02MX continuous capture, 2048 × 16384 pixels) • Max. 387 images (CA-HL02MX continuous capture, 2048 × 8192 pixels) • Max. 185 images (CA-HL02MX individual capture, 2048 × 16384 pixels) • Max. 88 images (CA-HL04MX, continuous capture, 4096 × 16384 pixels)	• Max. 182 images (CA-HL04MX continuous capture, 4096 × 8192 pixels) • Max. 88 images (CA-HL04MX individual capture, 4096 × 16384 pixels) • Max. 85 images (CA-HL08MX continuous capture, 8192 × 8192 pixels) • Max. 88 images (CA-HL08MX individual capture, 8192 × 8192 pixels)
	XR camera	• Max. 1170 images (XR 15 mm type, height image and greyscale image saved) • Max. 4729 images (XR 15 mm type, binning: ON, height image and greyscale image saved)	• Max. 540 images (XR 40 mm type, height image and greyscale image saved) • Max. 2231 images (XR 40 mm type, binning: ON, height image and greyscale image saved)
	XT camera	• Max. 534 images (XT-024/060, binning ON, or binning OFF with narrow field of view)	• Max. 125 images (XT-024/060, binning OFF, or binning ON with expansion)
Interface	Assignable input	• 20 connection points (including four high-speed terminals that can be assigned to trigger input) • Input rating: 26.4 V or lower, or 1.2 mA or greater (2.2 mA or greater for high-speed input terminals)	
	Assignable output	• 28 connection points (including four high-speed terminals that can be assigned to external trigger-linked FLASH output) • Photo MOSFET*2: Max.50 mA (30 V or less)	
	Encoder input	• When the CA-E100L/E200L is connected: 2 inputs per unit, 4 inputs total for 2 units max. • RS-422 line-driver output (Multi-drop support*3, Supports 5 V output included: max. 150 mA) and open collector output (24 V devices only with CA-E100L/E200L) included	
	Monitor output	Analogue RGB output, XGA (1024 × 768, 24-bit colour)	
	Unit indicators	Power, ERROR LED display	
	RS-232C	• Functionality switchable between numerical data output, control input/output, and CA Series touch panel interface (Cannot be used in conjunction with PLC links using RS-232C) • Supports a maximum baud rate of 230400 bps	
	PLC link	• Numerical data output and control input/output enabled via the RS-232C port or Ethernet port (Cannot be used in conjunction with CC-Link, EtherNet/IP®, PROFINET or EtherCAT®) • The following PLCs are supported via link unit*4: KEYENCE: KV-8000/7000/5000/3000/1000/700 Series, KV Nano Series Mitsubishi Electric: MELSEC iQ-R/L/Q Series, MELSEC A Series, (RS-232C only), MELSEC iQ-F Series, MELSEC FX Series (RS-232C only) OMRON: SYSMAC CJ2/CJ1/CS1 Series, SYSMAC C Series (RS-232C only), SYSMAC CP1 Series YASKAWA Electric Corporation: MP2000 Series/MP900 Series (RS-232C only)	
	Ethernet	• Can output numerical values and perform control input/output • Connecting to KEYENCE PC application software enables not only the above functions but also makes it possible to upload and download inspection settings, perform a variety of simulations, send and receive a variety of data including image data, and use the remote desktop function. • Supports FTP client and server functions, an SFTP Client function, a VNC server function (for non-PC clients, only displaying the monitor screen is supported), and a BOOTP function • Jumbo frame support (when connected to CA-NEC20E/NEP20E/NPN20)	
	USB	• Connecting to KEYENCE PC application software makes it possible to output numerical values, perform control I/O, upload and download inspection settings, perform a variety of simulations, send and receive a variety of data including image data, and use the remote desktop function. • Dedicated to USB 2.0	
	CC-Link	• By connecting the optional CC-Link unit CA-NCL20E, numerical value output and control input/output are enabled (Cannot be used in conjunction with PLC-Link, EtherNet/IP®, PROFINET or EtherCAT®) • Supports ver. 1.10 and ver. 2.00 remote device stations	
	EtherCAT®	• Connecting the optional EtherCAT® unit CA-NEC20E enables numerical value output and control input/output (Cannot be used in conjunction with PLC-Link, CC-Link, EtherNet/IP® or PROFINET.) • Process data object communication (cyclic communication) (Input: max. 536 bytes, output: max. 532 bytes) • Message communication (non-cyclic communication) • Supports CoE • Explicit Device Identification • Conforms to conformance test V2.1.0.2.	
	EtherNet/IP®	• Numerical data input/output and control input/output enabled via the Ethernet port or optional CA-NEP20E EtherNet/IP® unit (Cannot be used in conjunction with PLC-link, CC-Link, PROFINET or EtherCAT®) • Supports cyclic communication (max. 1436 bytes) and message communication • Maximum connections: 32 (Ethernet port) / 1: Exclusive Owner, 4: Input Only (CA-NEP20E) • Conforms to conformance test Version.CT15 (Ethernet port) / CT16 (CA-NEP20E)	
	PROFINET	• Numerical data input/output and control input/output enabled via the Ethernet port or optional CA-NPN20E PROFINET unit (Cannot be used in conjunction with PLC-link, CC-Link, EtherNet/IP®, or EtherCAT®) • Supports cyclic communication (max. 1408 bytes (Ethernet port) / 1248 bytes (CA-NPN20E)) • Supports non-cyclic communication (recorded data) • Conforms to Conformance Class A (Ethernet port) / C (CA-NPN20E)	
	SNTP	Unit's date and time auto-corrects when unit is connected to SNTP server	
	USB console	• Possible to control various menus via an optional USB console (OP-87983) • Supports the assignment of operations to console buttons	
	Mouse	Possible to control various menus via an optional dedicated mouse (OP-87506)	
	Touch panel	• Settings can be operated from a CA Series touch panel using the RS-232C port (Cannot be used in conjunction with RS-232C no-protocol communication or PLC links using RS-232C) • Supports dedicated touch menus and operation buttons	
	USB HDD	• By connecting the HDD (max. 2 TB) to the dedicated USB port (supports USB 3.0, bus-powered, rated output 900 mA), image and other data can be output	
Language		Japanese/English/Simplified Chinese/Traditional Chinese/German (initial language set at first startup)	
Illumination control		By connecting the optional light expansion unit CA-DC40E/DC50E/DC60E, lighting and intensity control for the LED illumination is possible.*5	
Cooling fan		CA-F100 fan unit is included (attached) to the controller.	
Rating	Voltage	24 VDC ±10%	
	Current consumption	5.3 A	
Environmental resistance	Operating ambient temperature	0 to 45°C (when installed on a DIN rail)/0 to 40°C (when installed on a surface)	
	Operating ambient humidity	35 to 85% RH (no condensation)	
Weight		Approx. 1750 g	

*1 At least one camera input unit is required (controller has no built-in camera inputs). *2 The output common can be configured for NPN or PNP input devices.
*3 Supported on the CA-E100L/E200L. *4 Models equipped with the Ethernet port in the CPU unit support Ethernet port direct connection. *5 Up to 8 light control expansion units can be connected (max. two CA-DC50E/DC60E units out of 8).

Specifications (Camera)

■ High-speed line scan camera (CA-HL02MX/HL04MX/HL08MX)

Model		CA-HL02MX		CA-HL04MX			CA-HL08MX	
Image receiving element		15.4 mm monochrome CMOS image receiving element, 30× high-speed reading using square-pixel		15.4 mm monochrome CMOS image receiving element, 32× high-speed reading using square-pixel			30.8 mm monochrome CMOS image receiving element, 64× high-speed reading using square-pixel	
Unit cell size		15 µm × 7.5 µm*1	7.5 µm × 7.5 µm	15 µm × 7.5 µm*1	7.5 µm × 7.5 µm	3.75 µm × 3.75 µm	7.5 µm × 7.5 µm	3.75 µm × 3.75 µm
Valid pixel count	Processing area (individual)	1024 pixels 1024 (H) × 16384 (L) 1024 (H) × 16384 (V)	2048 pixels 2048 (H) × 16384 (L) 2048 (H) × 16384 (V)	1024 pixels 1024 (H) × 16384 (L) 1024 (H) × 16384 (V)	2048 pixels 2048 (H) × 16384 (L) 2048 (H) × 16384 (V)	4096 pixels 4096 (H) × 16384 (L) 4096 (H) × 16384 (V)	4096 pixels 4096 (H) × 16384 (L) 4096 (H) × 16384 (V)	8192 pixels 8192 (H) × 8192 (L) 8192 (H) × 8192 (V)
	Processing area (continuous)							
Minimum scan time		6.1 µs (165 kHz)*2		6.1 µs (165 kHz)*2		10.2 µs (97.7 kHz)*2	6.1 µs (165 kHz)*2	10.2 µs (97.7 kHz)*2
	LumiTrax™ (in specular reflection mode)	48.5 µs (20.6 kHz)*2		48.5 µs (20.6 kHz)*2		81.9 µs (12.2 kHz)*2	48.5 µs (20.6 kHz)*2	81.9 µs (12.2 kHz)*2
Pixel transfer frequency		188 MHz, 15×	375 MHz, 30×	188 MHz, 15×	375 MHz, 30×	400 MHz, 32×	750 MHz, 60×	800 MHz, 64×
Transfer system		Digital serial transfer						
Electronic shutter		User-defined settings (2 µs to 20,000 µs, max. shutter speed limited to 4 µsec less than line scan interval during operation)						
Function		Shading correction (setting saved in camera)						
		Installation auxiliary function (LED pointer / Mounting angle monitor)						
		Binning function						
Lens mount		C-mount		C-mount			Special mount (M40 P0.75)	
Environmental resistance	Ambient temperature	0 to 40°C						
	Ambient humidity	35 to 85% RH (No condensation)						
Weight		Approx. 350 g (not including lens)		Approx. 350 g (not including lens)			Approx. 310 g (not including lens)	

*1 When using the binning function to use information from multiple image receiving elements for individual pixel data.
*2 When the line scan interval is configured for use with an encoder. When time-specified, the scan time may be lengthened by up to 1 µsec.

■ Line scan camera (XG-HL02M/HL04M/HL08M)

Model		XG-HL02M	XG-HL04M	XG-HL08M
Image receiving element		14.3 mm monochrome CMOS image receiving element, 8× high-speed reading using square-pixel (output × 2), 2048 pixels Unit cell size 7 µm × 7 µm	14.3 mm monochrome CMOS image receiving element, 16× high-speed reading using square-pixel (output × 4), 4096 pixels Unit cell size 3.5 µm × 3.5 µm	28.7 mm monochrome CMOS image receiving element, 16× high-speed reading using square-pixel (output × 8), 8192 pixels Unit cell size 3.5 µm × 3.5 µm
Valid pixel count	Processing area (individual)	2048 pixels 2048 (H) × 16384 (L) 2048 (H) × 16384 (V)	4096 pixels 4096 (H) × 16384 (L) 4096 (H) × 16384 (V)	8192 pixels 8192 (H) × 8192 (L) 8192 (H) × 8192 (L)
	Processing area (continuous)			
Minimum scan time		24 µs (41.7 kHz)	24 µs (41.7 kHz)	45 µs (22.2 kHz)
Pixel transfer frequency		100 MHz (50 MHz × 2 ch), 8×	200 MHz (50 MHz × 4 ch), 16×	200 MHz (25 MHz × 8 ch), 16×
Transfer system		Digital serial transfer		
Electronic shutter		User-defined setting (2 µs to 20000 µs)*1		
Function		Shading correction function to correct for uneven lighting (setting saved in the camera)		
Lens mount		C-mount	C-mount	Special mount (M40 P0.75)
Environmental resistance	Ambient temperature	0 to +40°C		
	Ambient humidity	35 to 85% RH (No condensation)		
Weight		Approx. 340 g (not including lens)	Approx. 350 g (not including lens)	Approx. 310 g (not including lens)

*1 The maximum shutter time is limited to 3 µs less than the line trigger cycle setting.

Specifications (Software)

Supported OS and recommended running environment for XG-H1XE

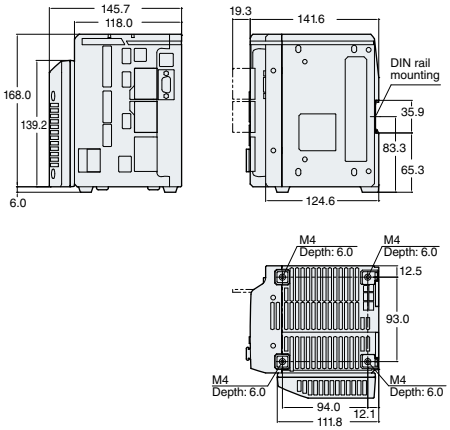
Supported OS	• Microsoft Windows 10 Home, Pro, Enterprise (64 bit version) • Microsoft Windows 7 Home Premium, Professional, Ultimate, Enterprise (64 bit version) • Cannot be used with an OS that is not listed above.
Running environment	• CPU: Intel® Core™ i3 processor equivalent or higher • RAM: 8 GB or more • HDD: 8 GB or more (with additional space for storing images required) Besides these, if installation of Microsoft .NET Framework is necessary, 4.5 GB or more of free space is required in addition to the above. • Monitor: 1024 × 768 pixels or more (1280 × 1024 pixels or more recommended). • An internet connection for accessing the webpage for submitting the activation code request and a means of receiving activation code via e-mail is required.

* Microsoft is either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.
Intel and Intel Core are registered trademarks of Intel Corporation in the United States and other countries.

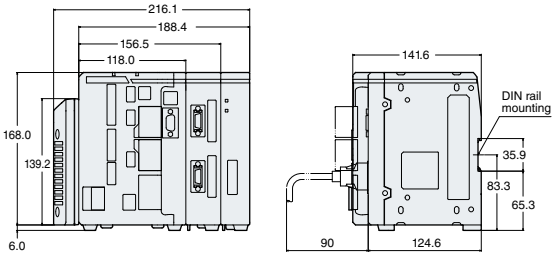
Unit: mm

Controller

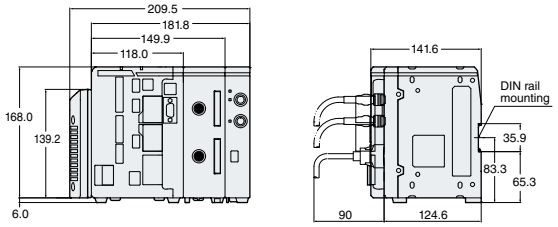
▮ Controller **XG-X2800/X2900**



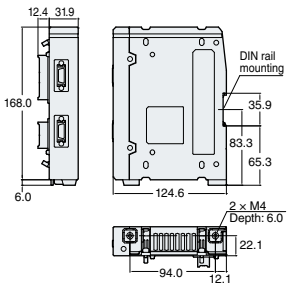
▮ When mounting line scan camera input unit **CA-E100L**/CC-Link unit **CA-NCL20E**



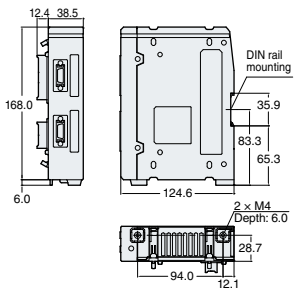
▮ When connected to line scan camera input unit **CA-E200L** / light control expansion unit **CA-DC60E**



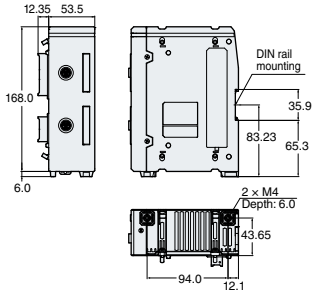
▮ Area camera input unit **CA-E100**



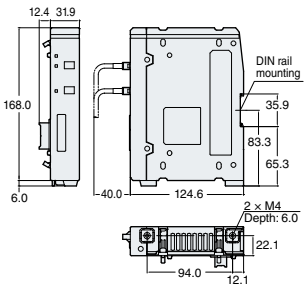
▮ Line scan camera input unit **CA-E100L**



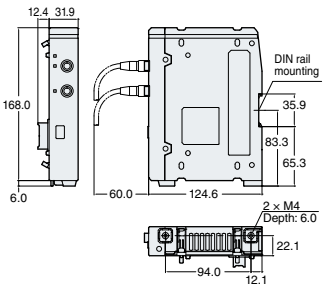
▮ Line Scan Camera Input Unit **CA-E200L**



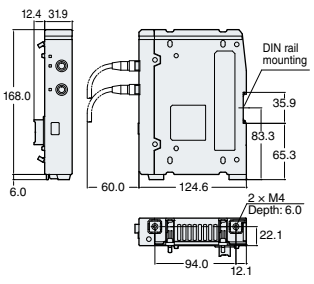
▮ Light control expansion module **CA-DC40E**



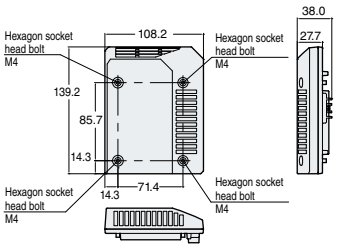
▮ Light control expansion module **CA-DC50E**



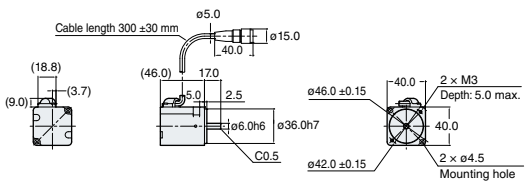
▮ Light control expansion module **CA-DC60E**



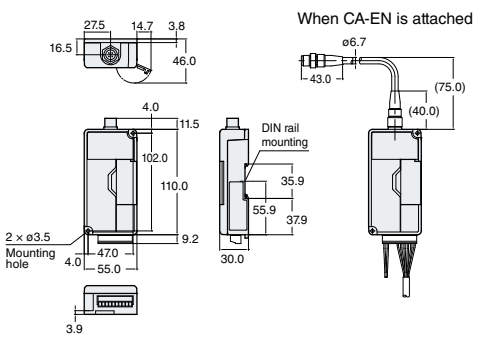
▮ Fan unit **CA-F100**



▮ Dedicated encoder **CA-EN100H**



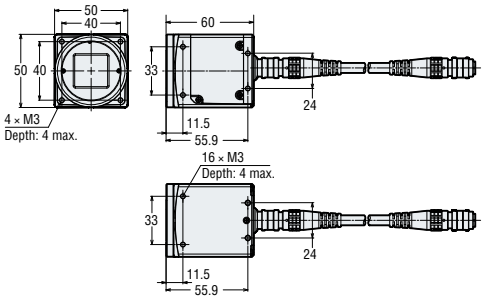
▮ Encoder relay unit **CA-EN100U**



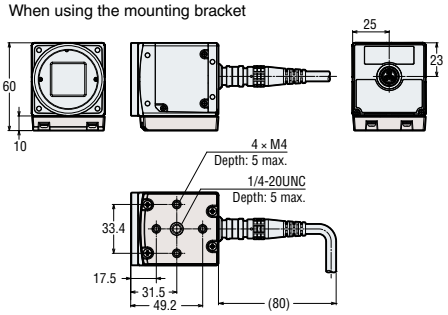
Dimensions

Camera

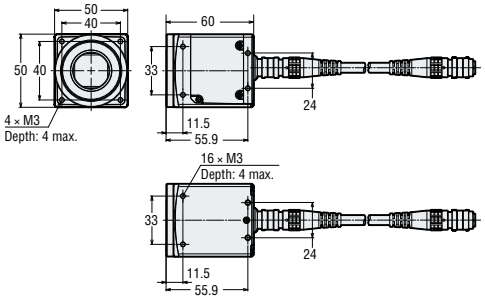
Camera **CA-HF6400C/CA-HF6400M**



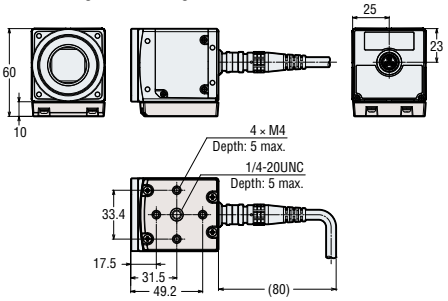
When using the mounting bracket



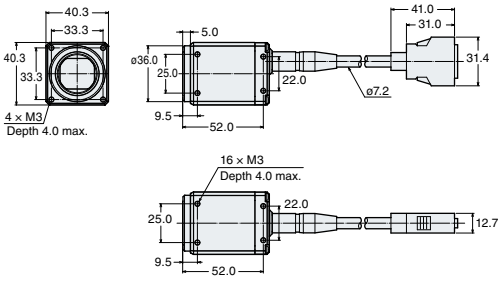
Camera **CA-HF2100C/CA-HF2100M**



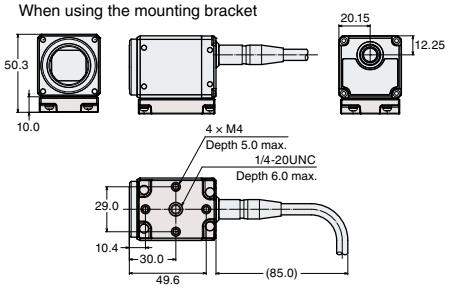
When using the mounting bracket



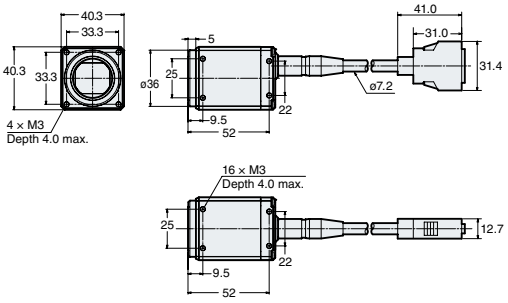
Camera **CA-H500C/CA-H500M/CA-H200C/CA-H200M/CA-200C/CA-200M/CA-H035C/CA-H035M/CA-035C/CA-035M**



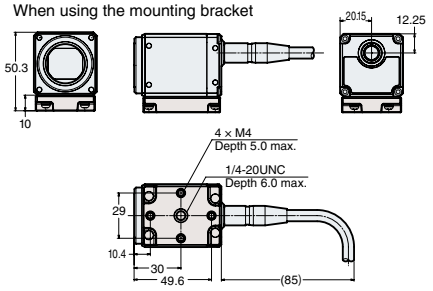
When using the mounting bracket



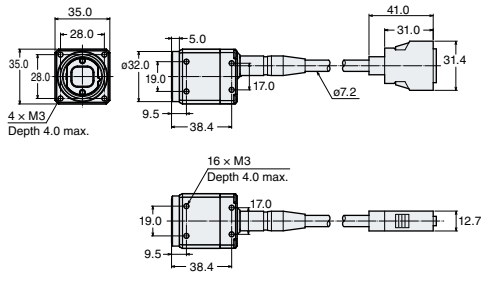
Camera **CA-H500CX/CA-H500MX/CA-H200CX/CA-H200MX**



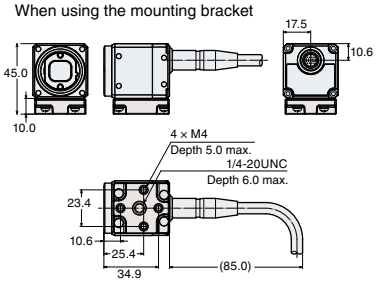
When using the mounting bracket



Camera **CA-HX048C/CA-HX048M**

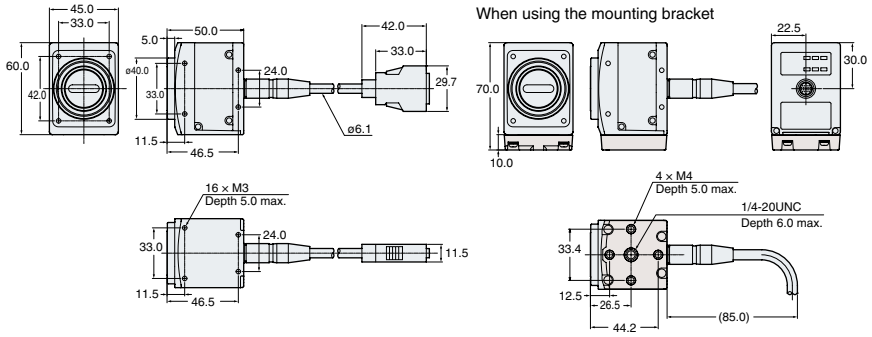


When using the mounting bracket



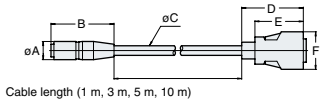
Unit: mm

▮ Line scan camera **XG-HL02M**/**XG-HL04M**



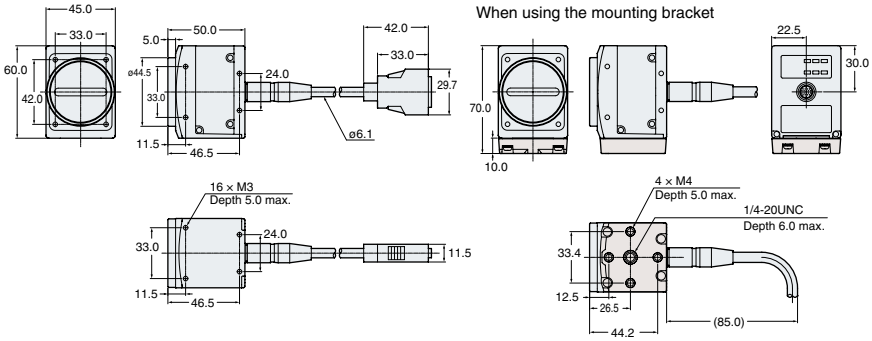
▮ Camera cable
CA-CH3 (3 m)/
CA-CH5 (5 m)/
CA-CH10 (10 m)

▮ High-flex camera cable
CA-CH3R (3 m)/
CA-CH5R (5 m)/
CA-CH10R (10 m)

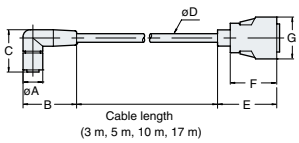


	A	B	C	D	E	F
CA-CHx	12.5	43	7.2	41	31	31.4
CA-CHxR	14.0	54	7.6	41	31	31.4

▮ Line scan camera **XG-HL08M**

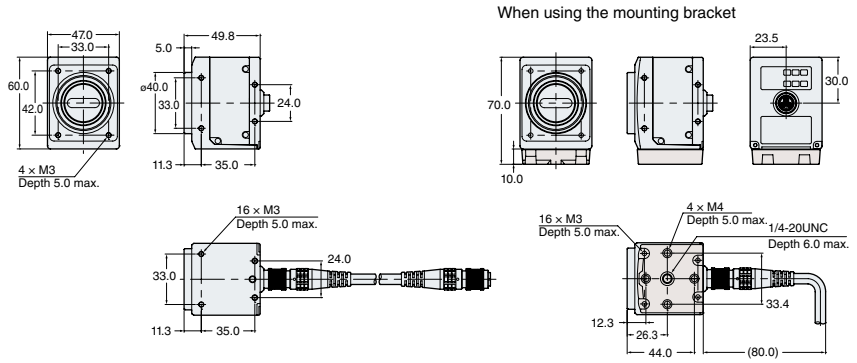


▮ L-shaped connector camera cable
CA-CH3L (3 m)/**CA-CH5L** (5 m)/**CA-CH10L** (10 m)

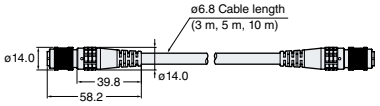


	A	B	C	D	E	F	G
CA-CHxL	14	38	30	7.2	41	31	31.4

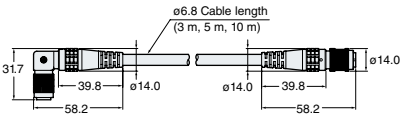
▮ High-Speed Line Scan Camera **CA-HL02MX/HL04MX**



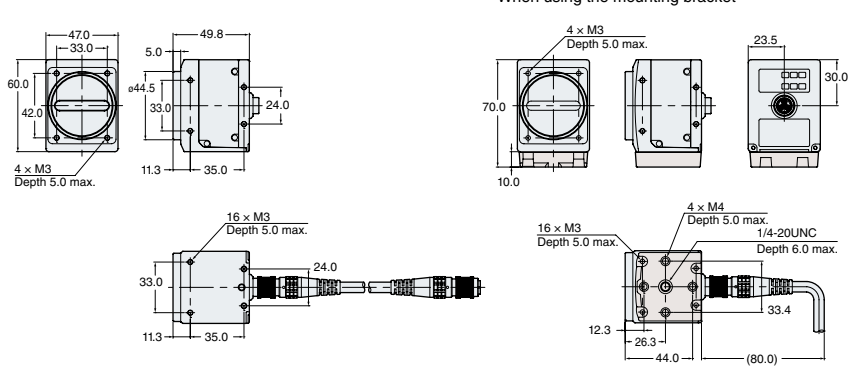
▮ Cable for High-Speed Line Scan Camera
CA-CF3(3 m)**/CA-CF5**(5 m)**/CA-CF10**(10 m)



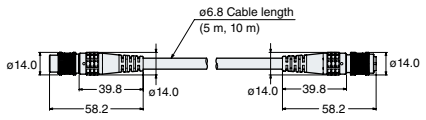
▮ Right Angle Connector Cable for High-Speed Line Scan Camera
CA-CF3L(3 m)**/CA-CF5L**(5 m)**/CA-CF10L**(10 m)



▮ High-Speed Line Scan Camera **CA-HL08MX**



▮ Extension Cable Connector for High-Speed Line Scan Camera
CA-CF5E(5 m)**/CA-CF10E**(10 m)



- CA-CF5E/CF10E is an extension cable only, and cannot be used by itself. It is used to connect a CA-CFx/CFxL with the controller.
- Up to two CA-CF5E cables can be connected.
  (Example: CA-CF10E + CA-CF5E + CA-CF5 = 20 m)
- The number of connectible extension cables varies according to the number of available channels set for the camera.
  4 ch: 10 m
  2 ch or 1 ch: 20 m

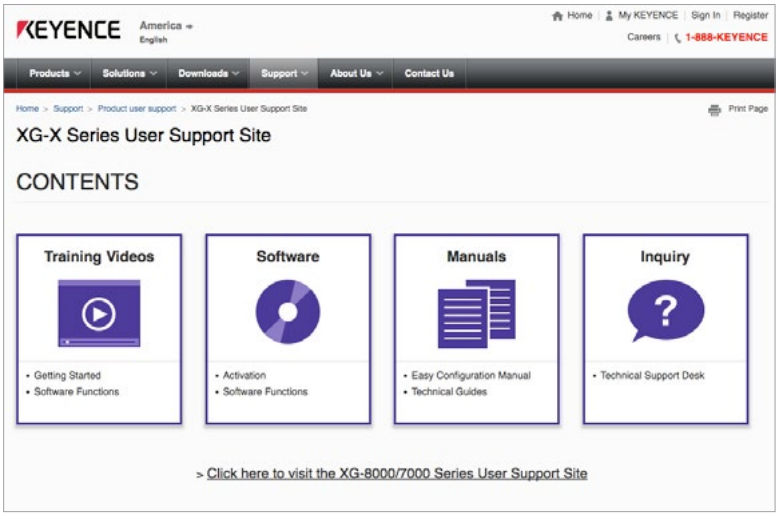
Refer to the Vision System Peripheral Equipment catalogue for dimension diagrams for lenses and close-up rings.

AFTER SALES SUPPORT

Here at KEYENCE we pride ourself on the quality of our after sales support on all our products and the XG-X Series is no exception. We offer many different types of support to assist with using KEYENCE's range of machine vision systems. In addition to our technically trained workforce, support services include: training workshops, free software upgrades, example programs, technical guides, online resources and dedicated technical support.

XG-X Series User Support Webpage **www.keyence.com/xgxus**

In addition to the standard KEYENCE websites, there is a dedicated XG-X Series support website that is specifically designed for providing answers to questions, example programs and software to assist any XG-X user.

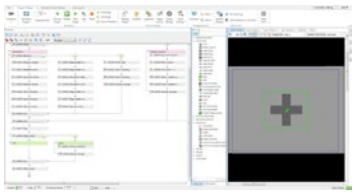


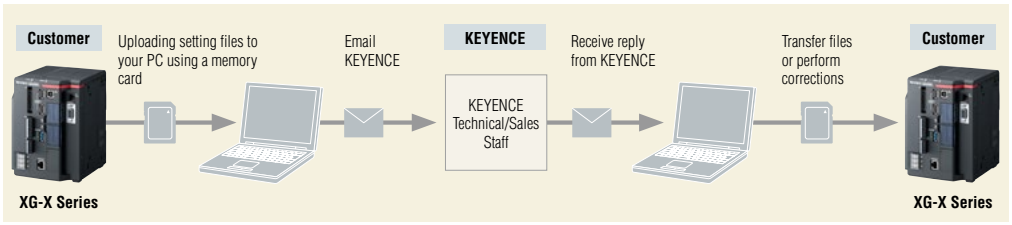
XG-X Training Videos

Our XG-X Getting Started movies will help you quickly get accustomed to the XG-X Series. These videos are informative and easy to follow and cover everything from programming vision tools to setting up I/O!

Free remote support and testing with the XG-X Simulator+

The XG-X Simulator+ software can be downloaded free of charge from the XG-X User Support webpage enabling remote testing and support of any XG-X program.
By emailing images and setting files directly to KEYENCE technical support, we can answer any questions you may have concerning your application or program. New applications can also be sent directly to KEYENCE for free testing and evaluation by dedicated application engineers.





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