KEYENCE

NEW **Ultra High-Speed, Flexible Image Processing System**

XG-7000 Series

Comprehensive Machine Vision

Intuitive, Quick, Flexible, High Performance and Fully Customizable

XG-7000 Series

Ver.4.0

The ever-evolving KEYENCE imaging system continues to offer the solutions and support that meet global customer's needs.

Image processing solutions used by the professionals

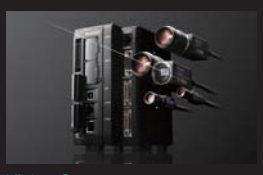
Complete selection including peripherals and free trials

Instant delivery throughout the world

Direct support from a highly trained team

Peripheral Equipment

The majority of the extensive product line up such as cameras, controllers, lighting equipment and peripherals are available for immediate delivery.
KEYENCE offers a complete solution and the support for all your image processing needs.


Vision System


Illumination


Lens


Monitors

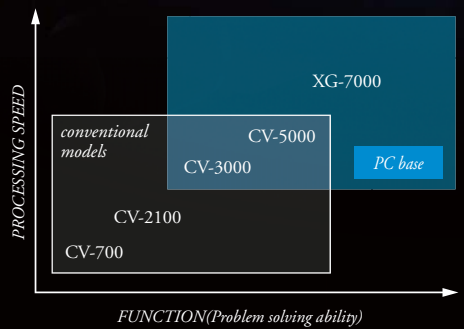
Solve all your application needs

CV-5000 Series

CV-3000 Series

XG-7000 Series

Arrival of the XG-7000 Series



2003

High-speed general-purpose vision system incorporating twin processors and digital transfer camera is released.

2004

Upgrades in features and functionality with the introduction of 2 Megapixel cameras.

2005 to 2008

The CV-3000 and CV-5000 raise the bar for machine vision performance with 4 monochrome / color camera connectivity, unmatched speed, and the industry's most user friendly programming interface.

2010

Providing a new approach to vision with customization and simple operating methods that overcome all hurdles.

XG Performance

Flexible hardware
Powerful Inspection Toolset
User friendly interface
Intuitive programming flow
Increasing speed, stability and quality to stay at the forefront of the vision market

Cameras

Simultaneous capture of up to 4 cameras.
14 color and monochrome camera options

High speed (7x) 310K & 2 Megapixel
High resolution 5 Megapixel
Ultra small 12 mm (0.47")

HARDWARE page10
CAMERAS page12
PRE-PROCESSING page14

Hardware

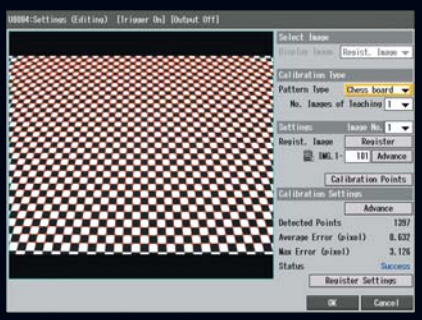
Reliable and ultra high-speed hardware design

3+1 Processor
Solid state hard drive
Integrated lighting controller
5 Megapixel camera support

Pre-Processing

Optimizing the image using advanced pre-processing functions

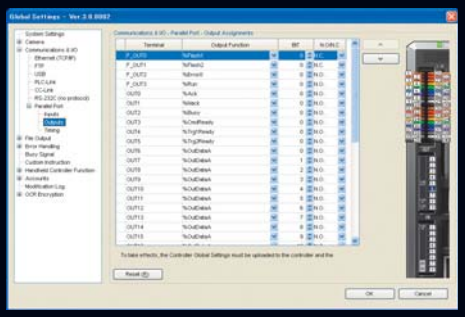
Filters
Image operation
Calibration unit
Color processing



Tool Set

Abundant inspection algorithms,
variables and calculations.

- Stain
- Trend edge
- Trend edge stain
- OCR
- 2D
- Image calibration
- Pattern search
- Calculation / Scripting
- Loop
- Branching



Input/Output

Simpler, customizable control

- Discrete I/O
- FTP server
- EtherNet/IP
- TCP/IP
- RS-232
- CC-Link
- PLC-Link
- USB

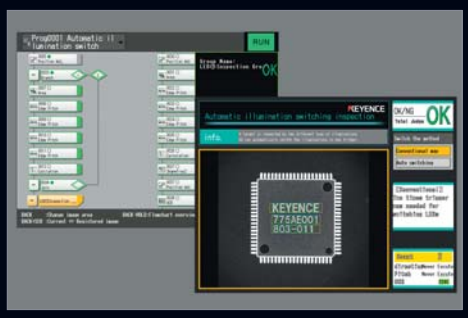
EtherNet/IP™

TOOL SET page18
INTERFACE OPTIONS page22
INPUT OUTPUT page25
VISION EDITOR Additional Brochure

GUI Creation

A custom user-interface anybody can use

- Vision terminal
- Simulator +
- Mouse operation
- Simple pendant adjustment



VisionEditor

Development of a complete vision solution

- C Plug In
- ActiveX Control
- Flowchart creation
- Debugging
- Testing
- Customization

2WAY APPROACH

PC:

Conduct
on-line/off-line
image processing
using a PC

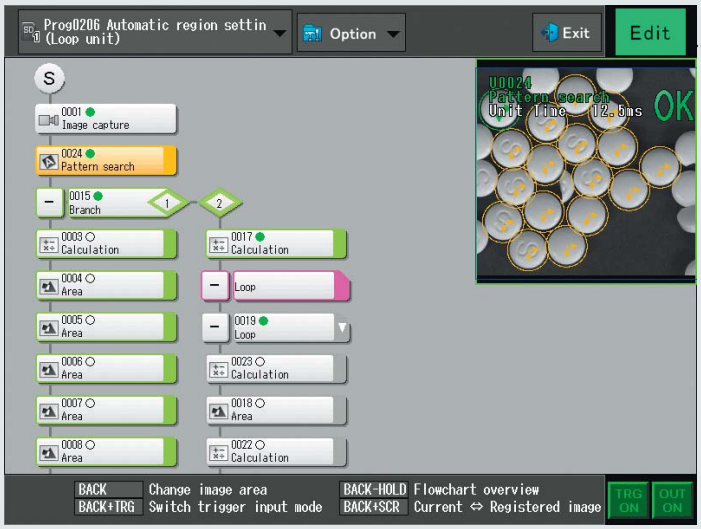
Controller:

Online editing
of program settings
without stopping
production

VisionEditor

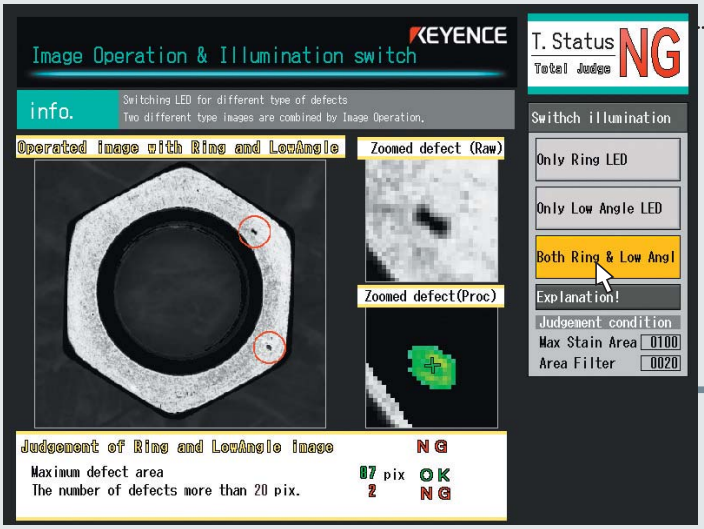
Advanced program development
with PC software

Simple setup using the handheld controller



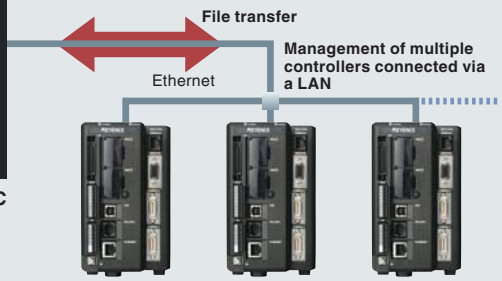
Creation of a program can be done on-line using the handheld controller. After creation, verification and editing can be conducted to increase the inspection accuracy without stopping the line using the 'Online Re-Test' function during operation. This allows the re-testing of stored images even during operation based on images saved to the internal buffer or to an FTP server. Program changes can be tested on-site without influencing the current production.

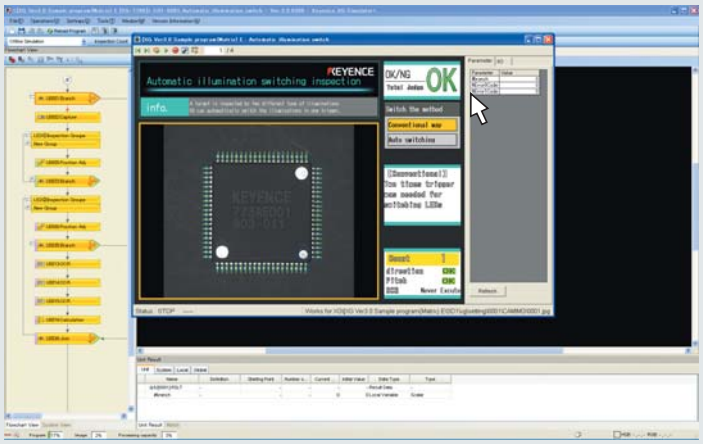
PC interaction with mouse control



PC

Programs can be created and settings can be easily adjusted on the PC while on-line. Image processing being conducted on-site or in a separate factory location can be accessed in real-time on a PC screen, and easily adjusted with a mouse. Furthermore, multiple controllers can be connected simultaneously via a network, so a PC can be used in place of a VGA monitor for setup and interfacing purposes.





Settings can also be verified offline. Using stored images output by the controller during operation, the PC simulator mimics on-site result data on a simple simulator.
Even if the equipment cannot be stopped, the statistical analysis function of the simulator conducts the same action as the actual controller. After confirming the optimal settings with the simulator, the program setting can be uploaded to the controller providing seamless and efficient interaction with the controller.

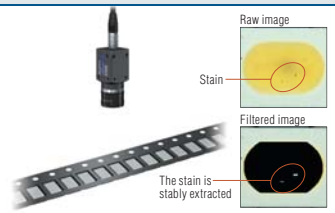
Uploading/ downloading settings

APPLICATIONS

Part Identification/ Defect Inspection

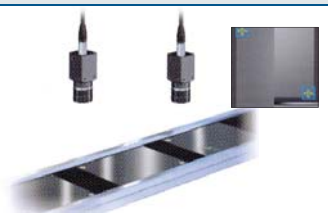
Measurement/ Positioning

Electrical/Electronic



Visual inspection of chip (SMD) LEDs

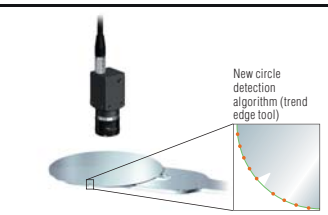
Multi-directional inspection of electronic parts



LCD alignment

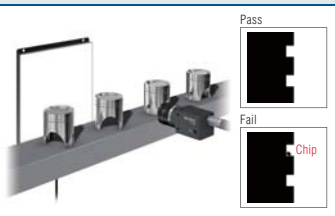
Visual inspection of a chip capacitor

Visual inspection of crystal oscillators

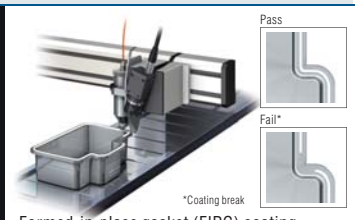


A virtual circle is determined from the partial arc of a wafer to output the wafer center

Automotive/Metal

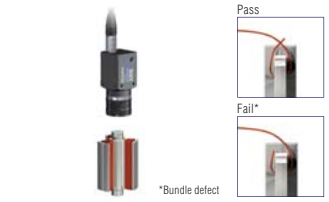


Checking for adhering piston chips



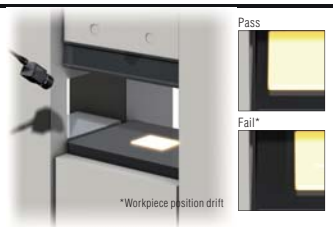
Formed-in-place gasket (FIPG) coating inspection

Identifying incorrect connecting rods



Inspecting motor wire bundles and checking for solder defects

Camshaft mold cavity inspections



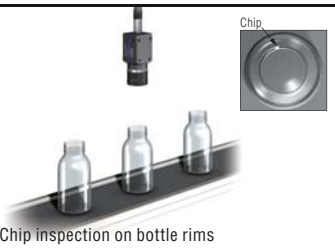
Checking workpiece seating in hot-forging dies

Food, Pharmaceutical and Others

Flaw inspection on the bottom of cans

Interior inspection of containers

Label inspection (position/appearance)



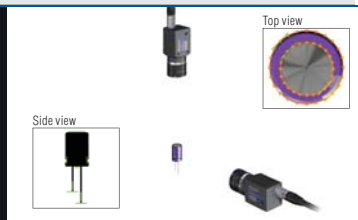
Chip inspection on bottle rims

Inspection of pinholes and foreign materials on a sheet

Dimensional measurement of bottle rims

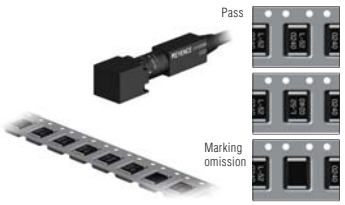
Color Inspection/OCR/ 2D Code Reading/Counting

Electrical/Electronic

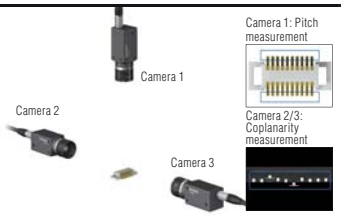


Dimensional/visual inspection of capacitors

Character recognition of part numbers and 2D code reading



Checking orientation through embossed tape



Simultaneous measurement of pitch and coplanarity

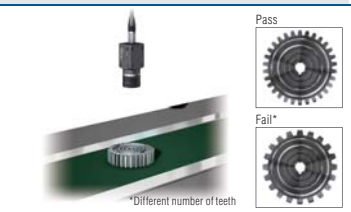
Detecting BAT marks with red ink

Checking the wafer position in a rack

Automotive/Metal

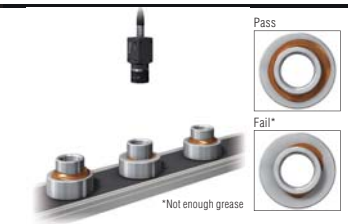
Detecting bead positions

Detecting incorrectly assembled fuse boxes



Detecting wrong gears

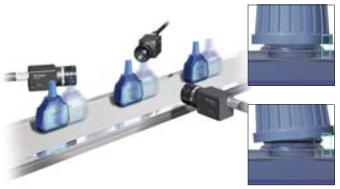
Random picking of bushing parts by robots



Detecting amount of grease applied to parts

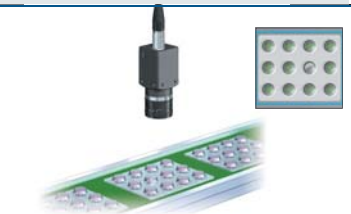
Checking for missing O-rings or O-ring misalignment during EGR valve assembly

Food, Pharmaceutical and Others

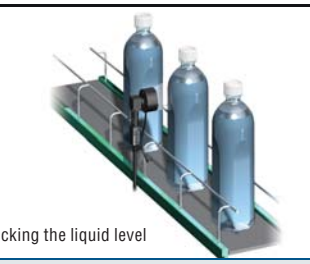


Checking improperly closed caps

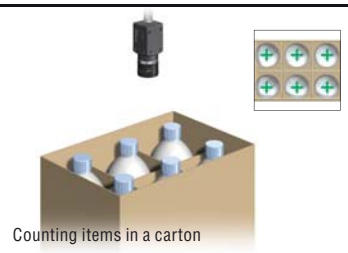
Inspection of expiration date



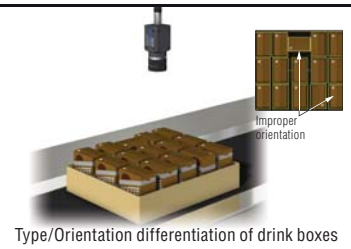
Counting the number of tablets



Checking the liquid level



Counting items in a carton



Type/Orientation differentiation of drink boxes

All in One Controller with Parallel Processing Ensures High Performance with Greater Reliability Than a PC

FASTEST IN THE INDUSTRY

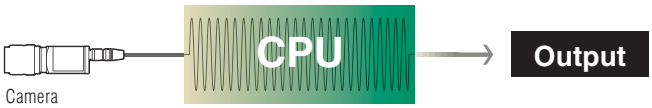
"3 + 1" Processor System: Ultra High-Speed, Parallel Processing

3+1 Processor

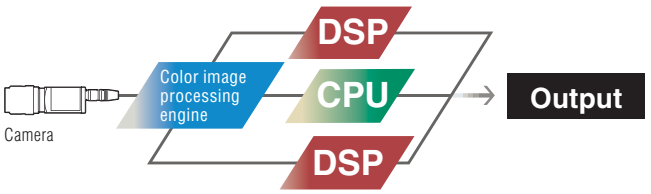
KEYENCE always strives to create the industry standard and best performance for ASIC/CPU based vision systems. Placing a heavy emphasis on the benefits of parallel processing and processor architecture has helped keep KEYENCE at the forefront of technology. In addition to the "A.C.E.II" (color image processing engine), KEYENCE has achieved stable, high-speed processing by combining 2 DSPs (image processing and screen display) and a RISC-CPU for overall control and communication into one dedicated hardware package.

[Comparison with conventional processing]

Conventional



XG-7000 Series



Achieving faster processing speeds by sharing imaging processing tasks between multiple processors.

Example of ultra high-speed processing

Electric component surface inspection 3 ms

Using a 7x high-speed 310,000-pixel color camera with a 240 CCD line field of view to capture edge angle, an inspection containing position correction, binary area and color defect inspections takes 3 ms !

Highly Reliable Fan-Less/ Solid State Drive (SSD) Design

Fans and conventional HDD's have moving components that will eventually wear out. By not having moving components, long-term continuous reliable operation is possible. The XG-7000 Series has sophisticated heat dissipation technology allowing for a fan-less design even while putting heavy loads on processors running at ultra high speeds. In addition, this design is particle emission-free and therefore suitable for use in clean-room environments.

Fan-less

Conventional HDD

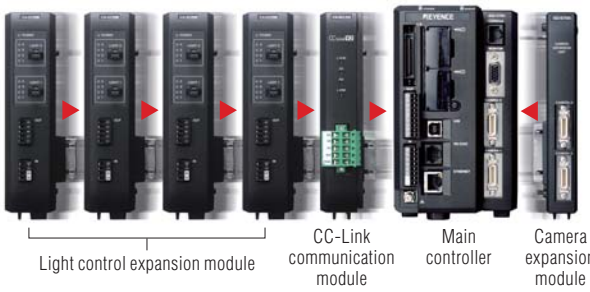
EXPANDABLE HARDWARE

KEYENCE Continues to Develop Innovative Hardware Resulting in the World's First Expandable Machine Vision Controller

INDUSTRY FIRST

Expandable Controller

By connecting additional modules to the side of the controller, the optimum system can be setup as well as allowing future expansion when needed.



INDUSTRY FIRST

Multi-Camera, Simultaneous Acquisition

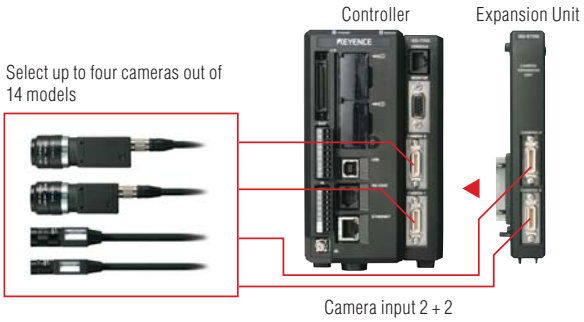
3+1 Processor

The XG-7000 Series allows for the seamless use of up to 14 different camera models. Depending on the inspection required, the most suitable camera can be selected and combined with other cameras on the same controller. For instance camera 1 and 2 could be high speed monochrome cameras for simple part position, where as camera 3 could be a 5 million pixel color camera for part quality inspection. Up to 4 cameras can be connected by adding the camera expansion module. The system runs all 4 cameras simultaneously*, (including the data-intensive 5 million-pixel color camera).

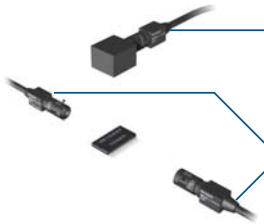
This controller flexibility also allows for easy upgrading and changes to be made based on changes in the inspection criteria. If another camera is needed, it can be specified based on the task required and easily added to the system.

* Connection of 1 million-pixel or more cameras is limited to the XG-7502/7702 only, 5 million-pixel camera connection limited to the XG-7702 only

[Multi-camera system]



[Combination examples]



Camera 1

Molding flaw inspections, print inspections

2 million-pixel compact color camera + side view unit

Camera 2, 3

Coplanarity inspection

2 million-pixel monochrome compact cameras

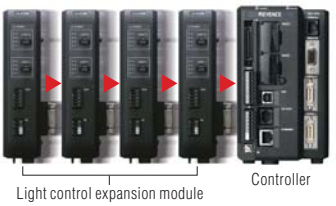
When conducting inspections using several cameras simultaneously, the total system cost can be kept down by selecting the optimal camera for the required inspection. In the case above both color and monochrome cameras are used.

WORLD'S FIRST

LED Light Control Expansion Unit

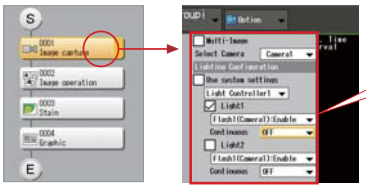
Easily control dedicated lighting without any extra wiring

Up to 4 lighting expansion modules can be connected to the main controller. Each single unit has 2 lighting connections (connector and terminal style) so that up to eight 12 or 24 VDC lights can be connected.



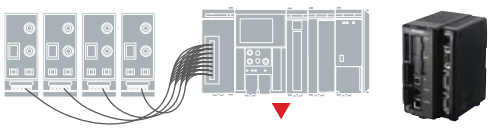
Light settings

Lighting can be easily controlled as part of the image processing flowchart by setting the lighting conditions in the light settings tab within the image capture unit. By using multiple image capture units with different lighting patterns or intensities within a single processing flowchart, multiple image capture and advanced light sequencing is made easy. In addition, as the light intensity value is a variable that can be referenced, dynamic changes can be made to a program after an inspection has been processed.



The ON/OFF status, strobing and intensity of 8 lights is possible in each image capture unit.

Conventional methods require PLC control with large numbers of I/O.



No I/O allocation, no wiring and no PLC programming is necessary

CAMERAS

Wide Range of Camera Variety Covering Every Possible Need and Performance Criteria

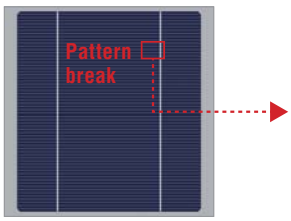
WIDEST RANGE

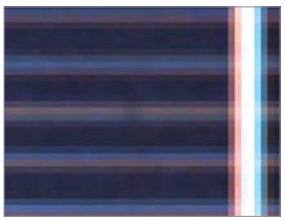
Select the Best Camera for the Application

Whether the application calls for high quality inspection with a color megapixel camera, fast processing inspection with a 7x high-speed camera, or mounting a compact camera in a tight environment, the wide variety of XG-7000 Series camera line-up can provide the ideal solution.

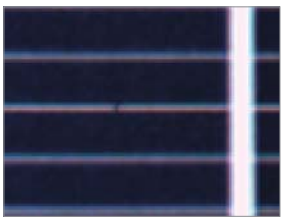
Type		Model	Specification	CCD capture range (pixels)	Image transfer time (ms)
5 million-pixel camera series	 11x 5MEGA DIGITAL	XG-H500M	11x high-speed monochrome	2432 × 2050	61.2
		XG-H500C	11x high-speed color	2432 × 2050	61.2
2 million-pixel camera series	 7x MEGA DIGITAL	XG-H200M	7x high-speed monochrome	1600 × 1200	29.2
		XG-H200C	7x high-speed color	1600 × 1200	29.2
	 MEGA DIGITAL	XG-200M	Monochrome	1600 × 1200	59
		XG-200C	Color	1600 × 1200	59
	 SUPER-SMALL DIGITAL	XG-S200M	Ultra-compact monochrome	1600 × 1200	59
		XG-S200C	Ultra-compact color	1600 × 1200	59
310,000 pixel camera series	 7x HI-SPEED DIGITAL	XG-H035M	7x high-speed monochrome	640 × 480	4.7
		XG-H035C	7x high-speed color	640 × 480	4.7
	 HI-SPEED DIGITAL	XG-035M	Monochrome	640 × 480	16.7
		XG-035C	Color	640 × 480	16.7
	 ULTRA-SMALL DIGITAL	XG-S035M	Ultra-compact monochrome	640 × 480	16.7
		XG-S035C	Ultra-compact color	640 × 480	16.7

[Difference in defect detection ability based on number of pixels]

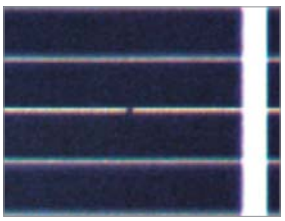




310,000 pixels
Lines are out of focus and cannot be detected.



2 million pixels
Broken pattern is out of focus and lacks the clarity for an accurate inspection. The image requires a smaller field of view.



5 million pixels
Details appear sharp and the break can be accurately detected.

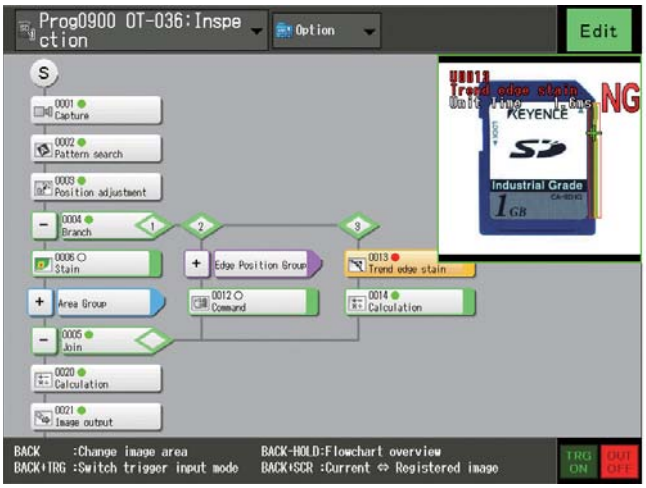
CONTROLLER OPERATION

Direct Flowchart Interaction and Manipulation Without PC Software

NEW

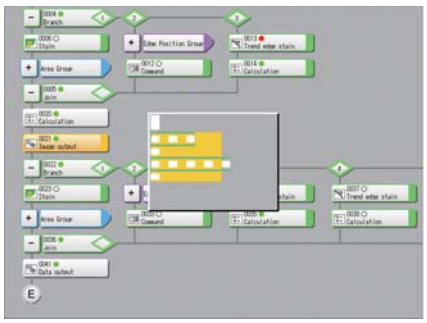
Controller Flowchart Editing Gives the User Complete Control

The controller supports direct interaction with the image processing flowchart without a PC. Enabling editing, addition, movement and configuration of different vision units with the handheld console. With the easy to navigate GUI, the time taken to make adjustments is kept to a minimum.



Overall flow chart display

The full flowchart can be displayed on screen for a full view of the operation. Navigation on large scale flowcharts is quick, easy and stress free as the area needing to be viewed can be selected from the map with the display cursor.



Unit operation & judgment display

Each unit on the flowchart has an indicator to show whether it is being processed and its pass/fail status (OK/NG). This enables current state of the image processing flow to be easily checked at a glance.

[Mark display]
- ● **Unit processed, judgment - pass (OK)**
- ● **Unit processed, judgment - fail (NG)**
- ○ **Unit not processed**

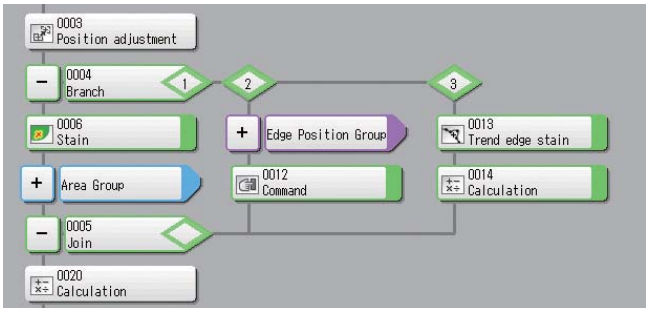
Unit direct view

The detailed results and settings of a unit can be verified simply by placing the cursor over the relevant unit on the flowchart.

Display unit results, show calculation terms, and the individual unit processing time

Conditional branching

The conditional branching used in an image processing flowchart can also be configured and displayed. Branches can be displayed in different colors and minimized to help with effective programming.



Conventional model

Conventional systems have a single flow structure. So a "jump to" command is required making navigation and understanding very hard.

- Image acquisition
- Search
- Condition branching
- Defect
- Area
- Dimension measurements
- Burr chip
- Output

Real branching structure

The XG-7000's intuitive design shows the branches as physical divides allowing for easy understanding and navigation. Units can be simply inserted in the correct branch as required making setup changes quick and simple.

IMAGE OPTIMIZATION

Create the Optimal Image for Processing in Real Time Based on the Raw Camera Image

PREPROCESSING FILTERS

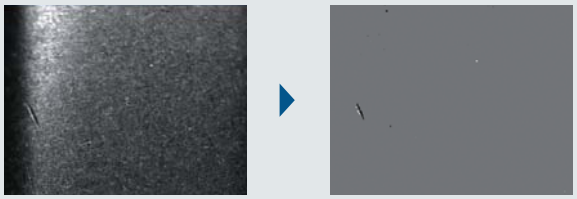
Highlight and Improve features that previously could not be seen. Remove features and aspects of an image for stable inspection.

The XG-7000 Series includes 21 types of preprocessing image enhancement filters that can dramatically improve the raw camera image based on changes that are caused from differences in the target or the targets environment. In using these original KEYENCE filters correctly, an optimal image for processing can be created resulting in an improvement in inspection stability and performance. This can help reduce mis-detection and inspection errors and give a high level of confidence to using machine vision.

Shading Correction (Real Time)

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 gray 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.

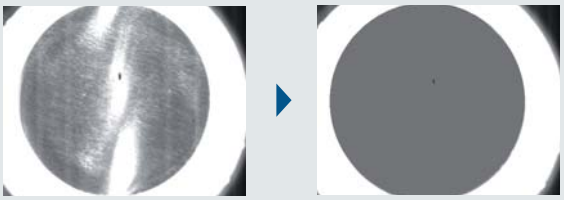
Surface quality on a metal roller



Original image | After preprocessing

Shading correction can be used to extract just bright, dark or both bright and dark defects depending on the nature of the surface and image needing to be created.

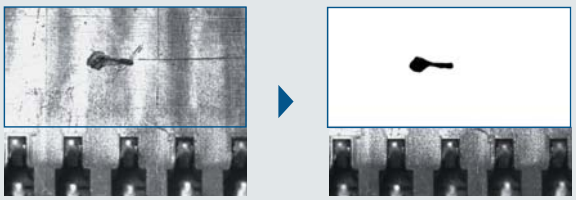
Stain detection on the bottom of a can



Original image | After preprocessing

By cancelling out the hot-spots caused by changes in the target surface a uniform background with the strain present can be created.

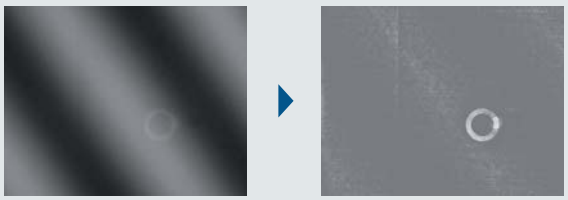
Defect detection on connector housing



Original image | After preprocessing

The rough background causing uneven illumination is cancelled, yet the defect remains.

Glass panel alignment



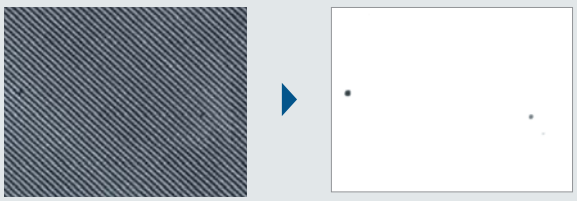
Original image | After preprocessing

The structural shadows are cancelled leaving the defect clearly visible.

Blur Filter (Bidirectional Smoothing)

With this image enhancement filter, any fine background patterns or image noise can be blended into the background and removed. This filter can be used numerous times to get the desired level of blending as well as in individual directions to keep a distinct aspect to one dimension of the image.

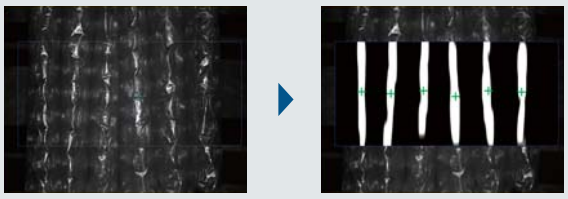
Foreign particle detection on a striped pattern



Original image | After preprocessing

By eliminating the striped texture to the target, the foreign particles can be detected.

Counting individual parts in packaging



Original image | After preprocessing

The filter is applied to image in one direction resulting in the packaging being removed and leaving the parts to be perfectly visible.

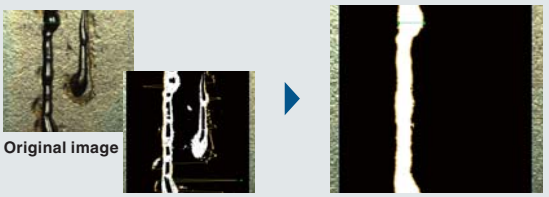
INDUSTRY FIRST

Blob Filter

Blob filtering of certain grouped image elements based on attributes (surface area, shape size etc), enables only the desired areas to be processed.

Width measurement of a welded section

Measuring the width of a weld after cancelling shadows, dents and removing spatter & excess from the weld section.

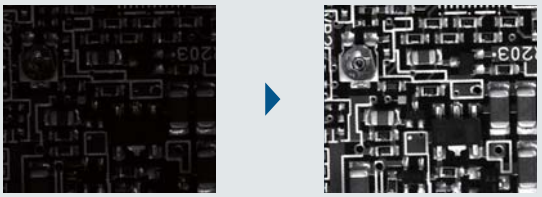


Contrast Conversion

The contrast conversion filter helps enhance contrast by emphasizing or reducing ranges of gray scale without causing shadows or overexposure. This helps increase edge strength, unify levels of gray or reduce noise on an image.

Defining PCB components and connections

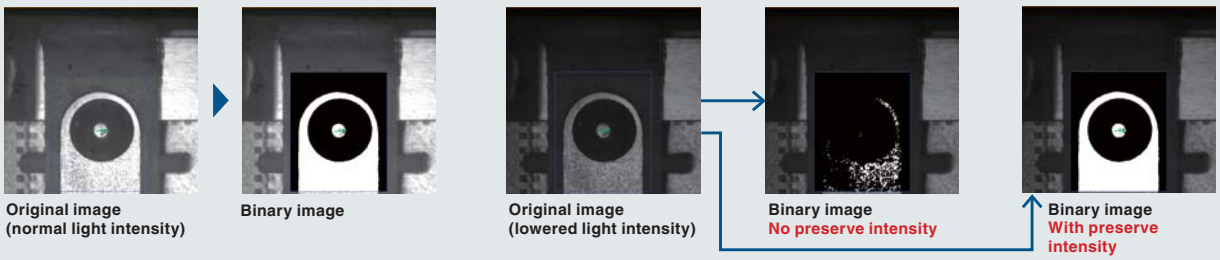
By increasing the difference between the board and mounted components the areas for inspection are easily highlighted.



Preserve Intensity (Illumination compensation)

The Preserve Intensity filter automatically corrects for any intensity changes in the image due to light deterioration or external lighting fluctuations. The level of intensity in the captured image is compared to a pre-determined standard on a reference image and the difference is applied before processing.

Screw position inspection



For each inspection unit, you can combine filters creating optimal images for an inspection.

Multiple processing

A total of 21 types of preprocessing filters can be set and each filter can be processed up to 13 times per unit. For each unit, filters can be combined together in the optimal combination for that single inspection.

Filter order and sequencing

The preprocessing sequence can be easily changed by moving filters up and down the list.

On-screen effects and results

Preprocessing results are displayed in real-time on the screen. Making it quick and easy to see and set the optimal combination in the minimal time.

IMAGE CALCULATION FUNCTION

Create a single image from multiple images through a host of advanced image combining functions

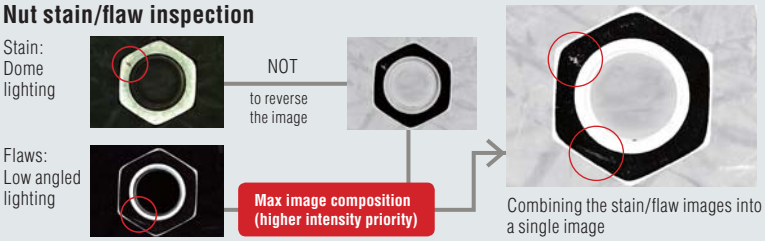
The XG-7000 Series has a multitude of image calculation functions, including mathematical (addition, subtraction, multiplication, division), logical operations, bit calculations, rotating/parallel translations, zoom, trapezoidal correction and pixel number conversion. Being able to combine multiple images into one resolves a number of issues that have made some conventional inspections difficult.

Image calculation example 1

Multi-Lighting and Image Composition

Even with defects on the same target, optimal lighting can differ for different cases of flaws (projections/depressions) and stains (shade intensity). Although two image captures and two different lighting techniques are used for individual defect inspection of the target. The combination of the two images and defects can be put together to be processed and displayed together.

Nut stain/flaw inspection



Conventionally

As the two defect inspections have to be separated due to the need for different lighting so the total number of defects, total defect size or overall target pass / fail can not be easily put together for a single target.

Image calculation

Judgments can now be conducted to the same standard as inspections previously implemented visually, including the area judgment of total stains or flaw.

Image calculation example 2

Changing Light Intensity and Image Composition

Targets can often have different types of defects requiring different lighting methods for stable detection eg (scratches / burrs and surface stains). The flexibility of the XG-7000 means multiple lighting patterns can be cycled through and tools applied ensuring correct inspection of the part. At the same time the image operation function enables composite images to be created so all the detected defects can be shown on screen and processed at once per inspection.

Aluminum cast hole inspection

NEW CALIBRATION FUNCTION

Image calibration including tilt, and lens distortion correction

The XG-7000 removes conventional image processing problems caused by camera mounting angle and lens distortion. The camera can be calibrated precisely, orientated about its axis and have its origin offset from its location for true measurement, scaling and position processing.

Tilt correction

The calibration function corrects for the camera angle that occurs during mounting. Unlike trapezoidal correction, this accurately corrects the entire image by making use of numerous calibration patterns across its field of view. This resultant normalized image is also effective for image processing when forced to mount the camera at an angle due to space restrictions.

Location and inspection of disk marks

Resolves the problem of differing target shapes and orientations during part/feature searches.

Original image | Calibrated image

Lens distortion correction

The calibration function also corrects for lens distortion. A uniform image can be acquired on the entire screen, allowing for accurate dimensional measurements, positioning and part inspection to be achieved.

Width measurement of a solar battery cell

Resolves the problem of differing measurement results at the center and edges of the image area due to lens distortion.

Original image | Calibrated image

COLOR PROCESSING

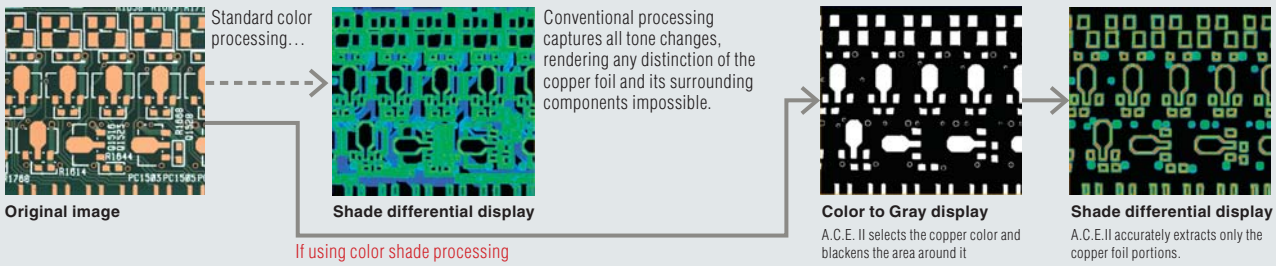
Optimal color processing for stable inspections using the new color extraction engine “A.C.E.II”

The XG-7000 Series is equipped with a new color extraction engine. The A.C.E.II is based on the HSB color model (closest color model to the human sensory system) to attain high color extraction performance that stabilizes previously unstable color processing schemes. The XG-7000 Series also feature “fine color processing” to extract full color information exactly the way the camera captures it. This technology significantly broadens the range of color processing applications previously accomplished by machine vision systems.

Color to Gray Processing

Color to Gray processing can optimize the shade gradation using hue, saturation, and brightness. This makes it possible to convert images with low contrast into images with defined shade differences. Unlike conventional full color processing, which picks up all tone changes and makes distinction difficult, color shade processing can optimize the shade difference between a user-specified color and the background.

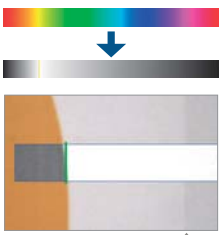
Extraction of copper foil on printed circuit boards



KEYENCE’s original color shade processing

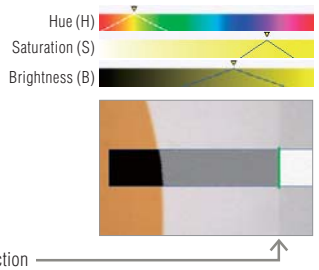
Standard color shade processing

This process converts all colors to a certain level of grey. Making similar or close colors hard to differentiate between, as well as not accounting for saturation and brightness levels and potential changes.



KEYENCE color to gray processing

Unlike conventional color extraction where small color changes are hard to distinguish and saturation & brightness are not accounted for, the KEYENCE color extraction works with all three aspects. As Hue, Saturation & Brightness are all adjustable, small changes in color or shade can be adjusted for and reliable stable processing is ensured.



Fine Color Processing

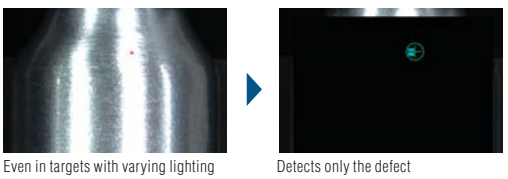
Fine color processing directly processes full color information exactly as the color camera captures it. This is ideal for detecting stains on sheets, films and non-woven cloths where the stain can appear in any color with respect to the background. No setup is required for color extraction, allowing users to complete the inspection with one simple operation.

Foreign particle detection on a non-woven cloth

Overcoming the weaknesses of full color processing

Intensity cancellation function (glare removal)

The newly added intensity cancellation function solves a common problem of detecting all the changes when using full color processing on color images. This function delivers stable detection performance by ignoring glare and lighting variations on the target background, and detecting only the area where hue and saturation differences exist.



DEFECT INSPECTION TOOLS

Fast and Easy Implementation of Complex Vision Algorithms with KEYENCE's Original Toolset

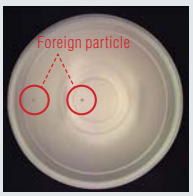
STAIN INSPECTION TOOL

A wide array of setting parameters and strong visualization tools makes this the industry standard in surface defect inspection.

The stain inspection tool finds defects such as stains and flaws by comparing the intensity of a user defined pixel grouping to that of its surroundings. For stable reliable inspections, stains can be grouped and filtered based on size, shape and contrast level. In addition the contrast view enables real time visualization on the performance of the tool to a user both during run and setup modes. Helping enable easy setup whilst maintaining consistent performance allowing for quick easy on machine tuning.

Foreign particle detection on the inside of a container

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 of the container, however, stain inspection mode can compare the differences with the surroundings, allowing reliable detection of only the foreign particles.



Original image


Binary image


Stain inspection mode (stability screen)

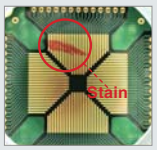
Contrast View Display

Using the colors blue, light blue, green, yellow and red, the contrast view display assigns a color 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 in comparison with the background or noise.

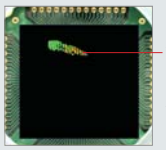
Bad mark detection on PCBs (Contrast view)

The contrast view can be used not only during setup, but also during operation. Leading to practical uses including the highlighting of potential areas of false detection and the verification of the current settings.

Original image



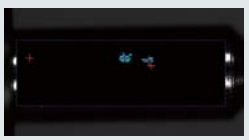
Contrast view display

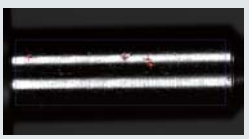


The relationship between contrast view colors and the stain level (guideline)

Dent detection on a metal shaft surface


Initial confirmation there is a greater stain level for the dents and scratches (green & red) than the background


Visually adjusting the optimal parameters whilst using the contrast view display


Stable detection during processing

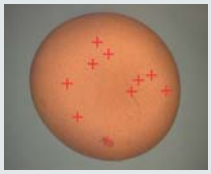
INDUSTRY FIRST

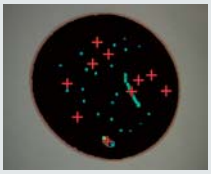
Grouping Filter

Various group filter settings are also available for the stain tool to enable processing and sorting of stains and defects. Filters include basic fill and area based functions as well as degree of circularity, major axes length, aspect ratios and axis ratios. Such settings support the filtering of defects for more efficient pass/fail and sorting applications based on defect size and shape.

Crack detection of a tablet (before grouping filter)

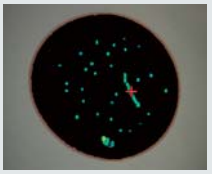
The stain tool also picks out the granules and other changes that are of a similar stain level.





Crack detection of a tablet (after grouping filter)

Filtering of defects down to long thin cracks only using area and axis ratio.



TREND EDGE STAIN INSPECTION TOOL

Optimized multi-point profile inspection for burr/chip applications

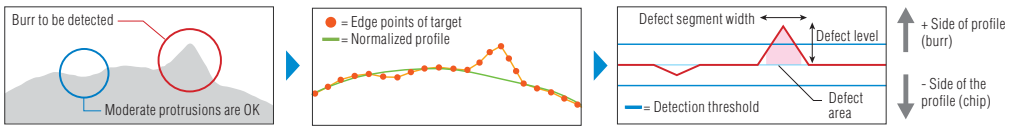
This tool extracts the profile from the edge of a target and uses it to recognize slight differences such as burrs and chips. In addition to simple geometric shapes such as circles and straight lines the tool can also be used on complex contours such as ovals, and continually adjusting free form curves.

Loose Cable Winding Inspection

Even if the standard target shape changes from target to target during a process the free curve will still map the normal profile of the target. At the same time lots of individual edge points are detected ensuring the projection is recognized as well.

Extensive Parameter Settings Support Various Defects

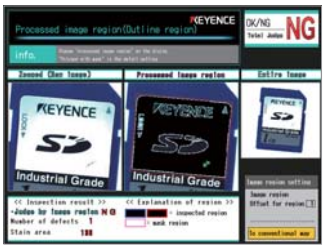
Due to the wide range of parameters, it is possible to filter out defects based on inspection criteria. Optimal settings can be chosen based on aspects such as +/- defects (burrs/chips), defect level, width and area.



FIRST IN ITS CLASS PROCESSED IMAGE REGION FUNCTION

Map the inspection region to the ever changing target image or setup complex fixed inspection regions

The XG gives a wide range of image inspection region options. Simple (rectangle, circles, arcs etc) and complex shapes (multi-node, multi-region) can be easily drawn on the image. Additionally, a region can be designated and mapped to the binary boundaries of an image for ever changing target shape and size inspections. The vision inspection region can adjust for geometric shapes like circles and straight lines or more complex contours such as ovals or free-from curves.



Stain detection on a plastic mold

Automatic inspection region adjustment on complex shapes based on their binary image. Enabling stable detection on any target even without position adjustment.

[Image differentiation processing filters]

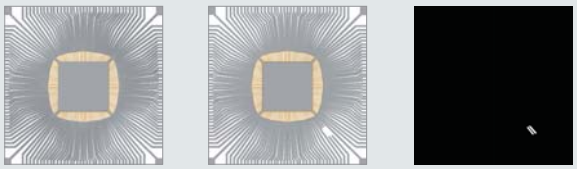
Subtraction

Produces the difference from two images by subtracting the input image from the master (registered image).

Real-time image extraction

As this filter processes in real time on the acquired image only, so part movement doesn't affect the image used for defect inspection. The filter extracts the small areas of change (such as stains and defects) in the image, where as the larger and uniform areas (such as the edge lines and background) are removed. Leaving a stable image for stain detection.

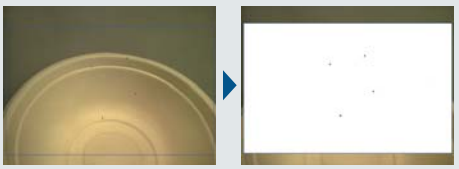
Lead frame chip inspection



Registered image (good part) | Input image (defect) | Differential image

As a true subtraction is performed even complex targets with defects can be easily processed as the difference is left over on a uniform background.

Foreign particle inspection inside a cup



Original image | After preprocessing

As part position is not always repeatable so stable defect detection is still possible as the edge line, border and background are removed from the initial raw acquired image.

POSITION AND DIMENSION INSPECTION SOLUTIONS

Sophisticated Dimension Profiling Tools

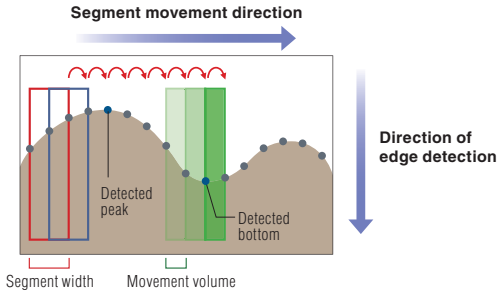
TREND EDGE FUNCTION

Measure profiles within a single designated area

The Trend Edge tool detects edges at user-specified pitches within the inspection region and outputs all data for each detected point, in addition to the maximum, minimum and average values. Previously, this required multiple inspection regions and calculation settings, but now the same inspection can be completed by configuring a single trend edge inspection tool. The multiple edge points obtained can also be used to draw approximated best fit lines and circles for further processing.

[Detection principle]

The Trend Edge tool cascades from one segment to the next scanning for an edge based on the segment shift width. As edges are detected so the width (trend edge width tool) and position (trend edge position tool) for each segment is calculated.



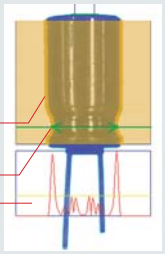
Condenser profile measurement

Multiple measurements and identification of narrow or wide points across a single target are easily possible with one single tool.

Each segment edge position can be clearly identified for easy confirmation

Primary target identification

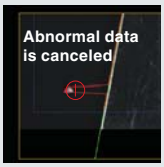
Easy definitive settings are possible with the edge waveform that can be displayed per segment.



Linear processing

Detecting the position of glass substrate edges

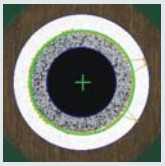
The trend edge tool can map a virtual straight line from all of the edge positions along a substrates edge. With the ability to filter and ignore abnormal points the virtual straight line can be used for accurate position, angle, reference and geometric data.



Circular/Arc processing

Detecting PCB hole centers

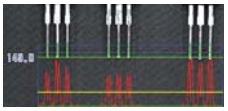
Trend edge can calculate the center position and diameter of a circle by detecting multiple edge points around a curve, using this data to project a best fit circle. Abnormal edge positions can be filtered and ignored before drawing the virtual circle to allow for reliable measurements.



[Other image inspection tools]

Edge tools

In addition to the powerful trend edge tools, basic edge tools can be used as well for inspection and positional referencing. These edge tools include edge position, edge width, edge pitch, edge gap, edge angle, and edge pairs.

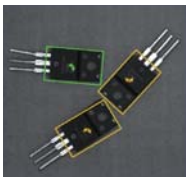


Edge inspection tools

Edge position	Finds the absolute position of multiple detected edges
Edge width	Finds the width between multiple detected edges
Center pitch	Finds the center pitch between multiple edges
Gap pitch	Finds the gap pitch between multiple edges
Edge angle	Finds the angle between two edges
Edge Pairs	Finds the width between multiple edges after pairing edges based on detecting criteria

Pattern search tools

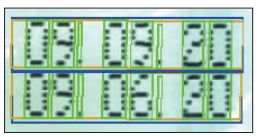
The XG-7000 Series makes full use of the fast 3+1 processor architecture, processing 25 times faster than a conventional system for a full 360 degree pattern match. Using high speed normalized correlation, matching is ensured to be more stable and quicker than ever before even with lighting variations. Due to the dedicated hardware, multiple patterns and the intensive processing of 5 million pixel images can all be performed in a short time resulting in stable XY position and full 360 degree angle data.



Search conditions: Search area of 512 x 480, pattern area of 128 x 128, 360 degrees of rotation, single detection

OCR tools

Stable and powerful OCR is easily possible with the OCR toolset on the XG-7000. User defined characters can be imported into a fully customizable library along with standard fonts. Flexible tuning and setup is also made possible with a variety of methods for character extraction and detection.



Recognition and processing of special characters

Stable extraction and processing of characters in an arc

Automatic calendar support

Based on the internal clock of the XG-7000 controller the OCR toolset can be setup with offsets, zero suppression and date time tolerances for any date/ time inspection.

Date and time encryption support

Encrypted dates and times can also be recognized through cross referencing to a user defined lookup table.

Selectable character extraction methods

Characters can be extracted in 3 different ways based on the appearance of the string. Methods include automatic based on edge detection principles, ratio for equal spaced characters and fixed for user selection of individual characters.

Recognition correlation and stability level reporting

Each character match results in a best, next best correlation percentage match and stability level. These three items can be used in setup as a guide for the stability of the inspection as well as a quick identifier in production for helping prevent any potential quality problems before they happen.

NEW 2D CODE READER UNIT

Simultaneously identify and process with the new 2D code reader tool

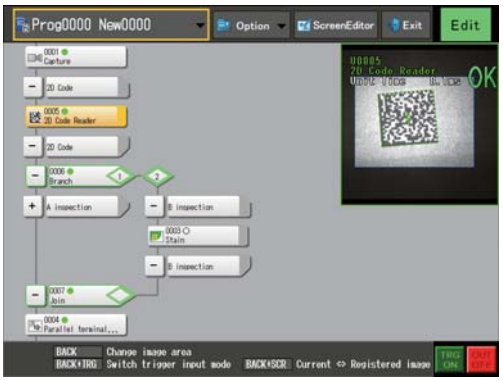
The inclusion of a 2D code reading tool enables the XG-7000 Series to not only read codes but also perform vision based inspections on targets. By removing the need for both a conventional 2D code reader and a camera for image processing, space, time and money can all be saved with the use of this tool.

Associate multiple inspections with product type based on identification.

DataMatrix

QR code

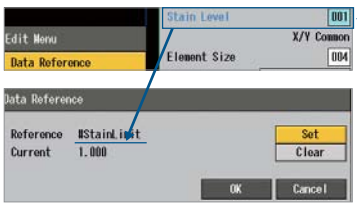
Easy processing and product changeovers can be performed based on the read code and flowchart branching.



VARIABLES

Freely share parameters, results and values throughout the whole vision program

Variables can be used as a means to change parameters, process results or store numerical values. This gives the XG-7000 Series the ultimate in flexibility for internal processing and interacting with menus and external devices. Such a degree of flexibility enables the system to be fully designed and used as desired without restrictions.



Storing the 'stain level' parameter of the stain unit as the variable #stain_level

#stain_level

Locations where a variable is referenced are highlighted in blue

Variables can be assigned to almost any parameter and can be freely shared or changed within the flow or through external control.

- Shared settings between multiple units…
- Changes via menus…
- Branching and processing control…
- Result processing and on-screen display…

WIDEST RANGE CALCULATIONS

Powerful script based calculation functionality

Over 100 functions are available for use in the calculation unit of the XG-7000 Series. Essential for processing and customization, calculations can be used to perform a variety of tasks include variable definition, geometric processing, mathematical equations, scripting and logic based functions. Calculation units also support, copy and paste, comment entry and error checking functions for full flexibility.

Multiple calculation input

Multiple equations can be specified in one calculation unit for script like processing.

Up to 5000 characters per calculation unit NEW

With a large amount of space to enter calculations, scripts and comments, any function should be possible to process.

Copy and paste support

Quick, easy creation and replication

```
@a=!U[0019].RSLT.TMS
#area_flag[@a]=!U[0018].RSLT.UJG
```

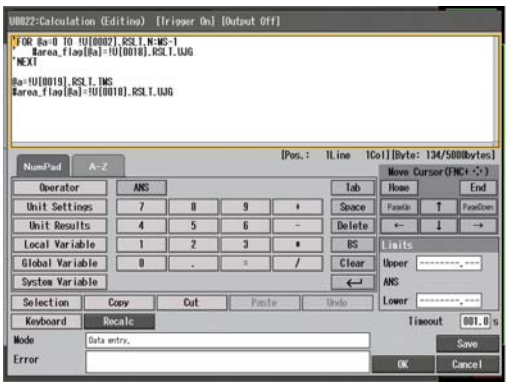
Desired area highlighted

Error checking function

In the event that calculations are mis-entered the error checking function can display the error and location making corrections quick and easy.

Error	(5 Line 4 Col) The parameter or result data is invalid.

Error display



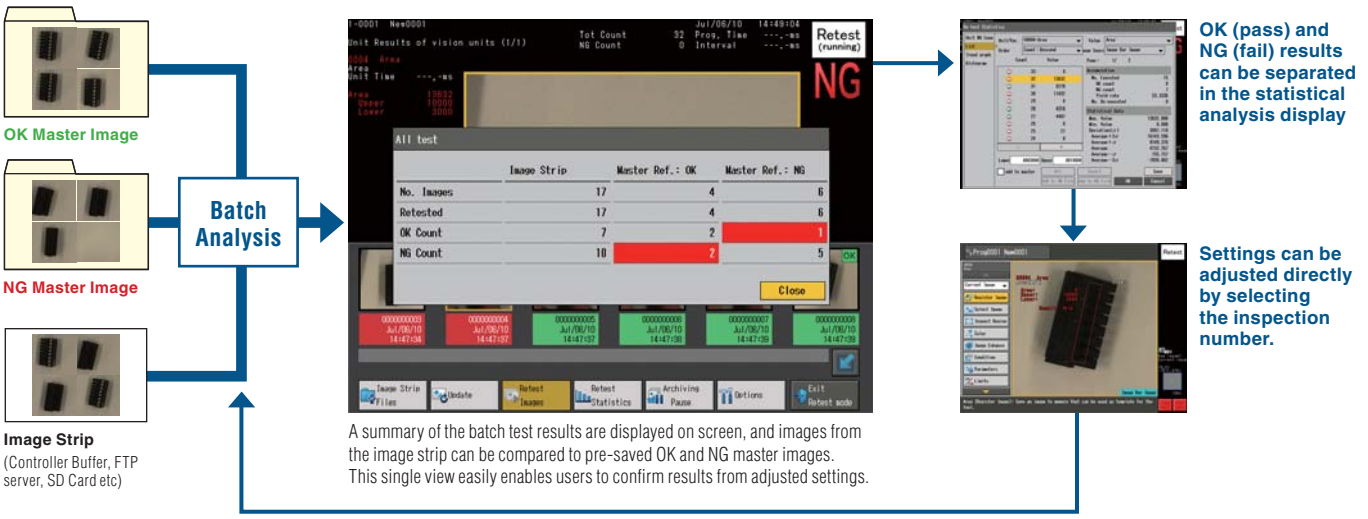
UTILITIES

New Tools Designed to Assist with Online Performance Tracking and Reporting

NEW

Online OK/NG Batch Analysis

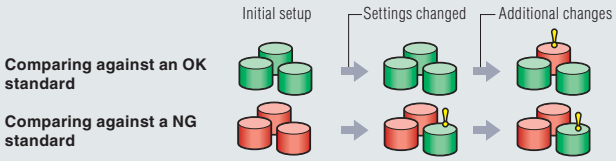
While the system is processing parts online, the batch results from a series of images (taken from the main memory, a SD card or the FTP server) can be displayed. This allows for the easy confirmation of changes in settings without affecting inspection performance. In addition to the batch testing, Master OK (pass) and NG (fail) images can also be used for comparison purposes. The batch analysis function makes it very easy for a user to fully understand a systems performance at any time without having to collect data or take the system offline.



A summary of the batch test results are displayed on screen, and images from the image strip can be compared to pre-saved OK and NG master images. This single view easily enables users to confirm results from adjusted settings.

Conventional performance analysis

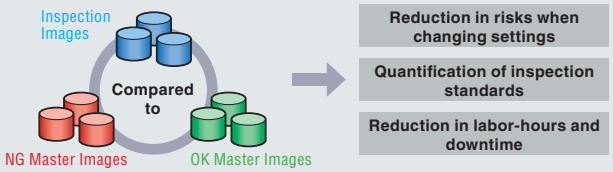
When initially dialling in a system or making modifications to existing settings, it becomes very easy to loose sight of the original requirements of the inspection. OK images become NG and vice versa and it becomes harder and harder to meet the desired standard.



"?" indicates the effect of altered parameters when compared to the standard.

Batch Testing

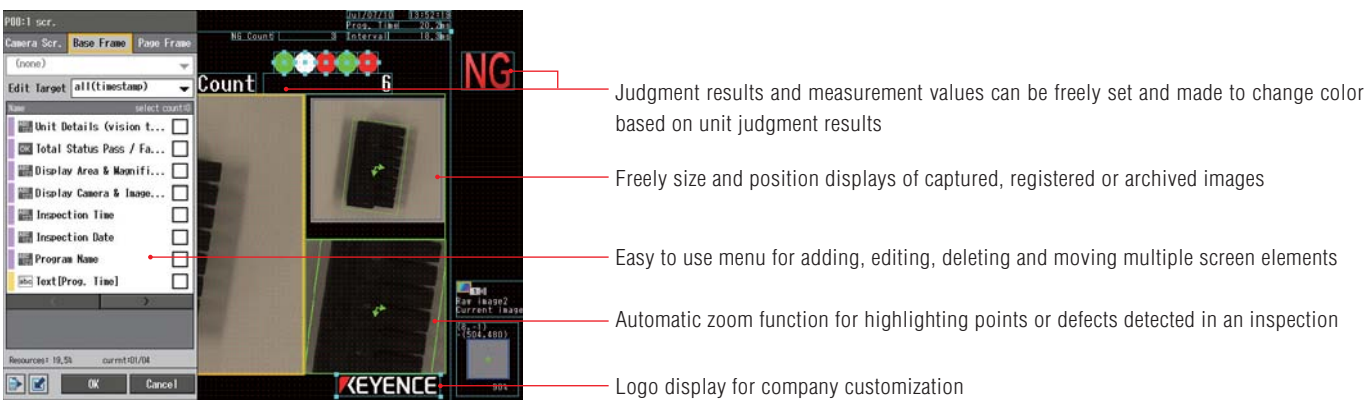
By retesting images against master images, it is easy to confirm whether there are any changes in the inspection standards compared to the initial standard. If changes have occurred having master OK and NG images to work with makes it simple to compare and adjust settings without affecting the original intent of the inspection.



NEW

Customized Screens and Interfaces

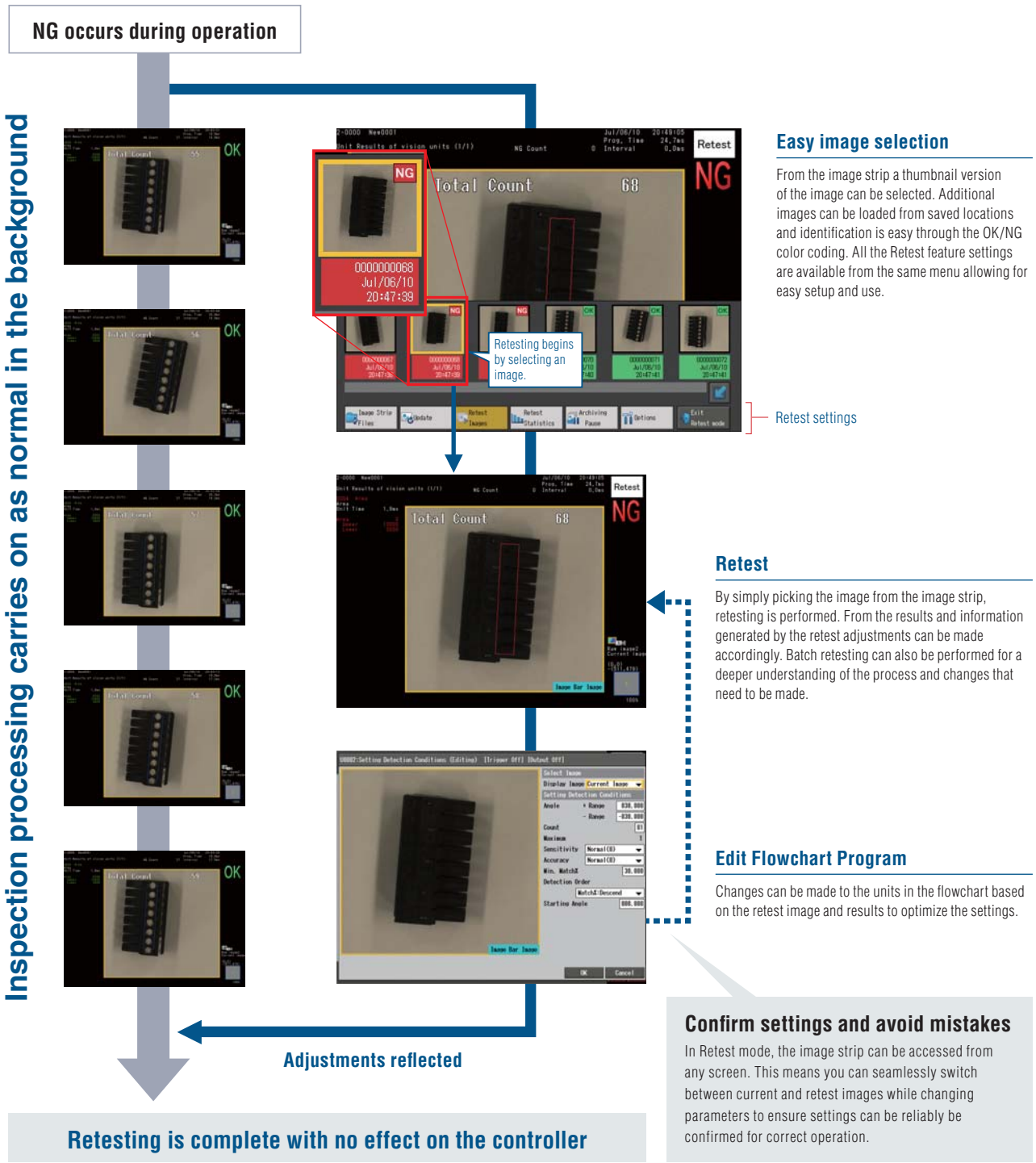
The XG-7000 Series supports the creation of custom screens directly on the controller. A fully customized screen can be easily created to display a wide range of results, images or graphics as required. Multiple intuitive screens can be designed for different views of the image processing results



NEW

Online Re-testing and Flowchart Editing

The Retest function of the XG-7000 Series allows images stored from inspections to be selected, retested, and edits to be made while the controller still fully processes other inspections online. This allows the user to make program adjustments in order to optimize the settings without effecting the current inspection process or causing any downtime on the machine.



Easy image selection

From the image strip a thumbnail version of the image can be selected. Additional images can be loaded from saved locations and identification is easy through the OK/NG color coding. All the Retest feature settings are available from the same menu allowing for easy setup and use.

Retest

By simply picking the image from the image strip, retesting is performed. From the results and information generated by the retest adjustments can be made accordingly. Batch retesting can also be performed for a deeper understanding of the process and changes that need to be made.

Edit Flowchart Program

Changes can be made to the units in the flowchart based on the retest image and results to optimize the settings.

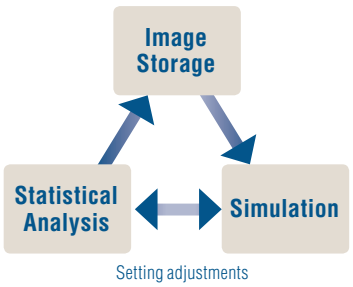
Confirm settings and avoid mistakes

In Retest mode, the image strip can be accessed from any screen. This means you can seamlessly switch between current and retest images while changing parameters to ensure settings can be reliably be confirmed for correct operation.

Save only the desired images for analysis and simulation

The image output buffer enables images to be streamed to a variety of external devices (such as an FTP server) making it easy to test and analyze with the simulator software and statistical functions of the XG-7000 Series. Being able to define how and what images are stored where significantly helps with the separation, analysis and retesting of failed inspections. Using the simulator and statistical tools together makes the correction and the optimization of settings very easy.

[Setting optimization using the XG-7000 Series]



Required items for setting optimization

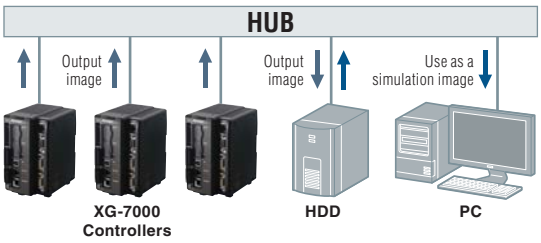
Image Storage	▌Save a large volume of images ▌Specify locations based on conditions
Simulation	▌Work with the XG-7000 Series controller environment for testing on a PC ▌Re-test and simulate results with stored images
Statistical Analysis	▌Superior analysis and understanding of processed items ▌Automatic generation of statistical results including maximum, minimum, yield and standard deviation.

NEW

FTP Images Direct to a Network or HDD Drive

Images can not only be saved directly to the SD card used in the controller but also transferred directly to NAS* (Network Attached Storage) through a LAN connection. Long-term image storage can also be conducted by connecting an easily sourced large capacity (10Gb, 100Gb, 1Tb etc) external HDD. In addition, by using the image output buffering option, continuous NG images will not be lost.

* NAS refers to a storage device that is designed for use on networks and contains file server software. Unlike USB based external drives that can be only connected point to point and need to be configured, a NAS device becomes immediately part of the network when it is connected, making it available for all other devices to use. Thus simplifying data browsing and file sharing.



Multiple PC Software simulations can be easily managed and run from the images transferred by FTP. By defining a folder the XG-7000 controller can directly output the images to the correct location on the PC for the individual simulator to reference.

STRONGER NEW ABILITIES

PC Simulation and Remote Support via a PC and Mouse

Interact directly with the XG-7000 GUI via your PC and mouse. Existing settings can be tested and simulated with saved images via the PC simulator. Furthermore, the XG Vision Terminal software offers remote connectivity and data logging capability

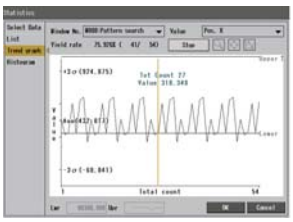
NEW

Fully interact with the system with a mouse

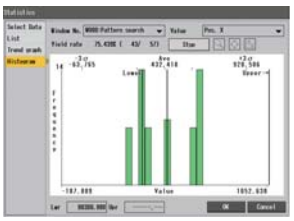
Process up to 50000 images with Simulator+

Statistical Analysis Function

Any measurement data or variable value can be displayed as a trend graph or histogram. The result data includes information on yield rates as well as standard statistical data (such as max., min., average, SD and 6 values). Up to 100,000 data points can be plotted and saved, allowing for processes to be tracked and optimal settings to be set and recorded.



Trend graph

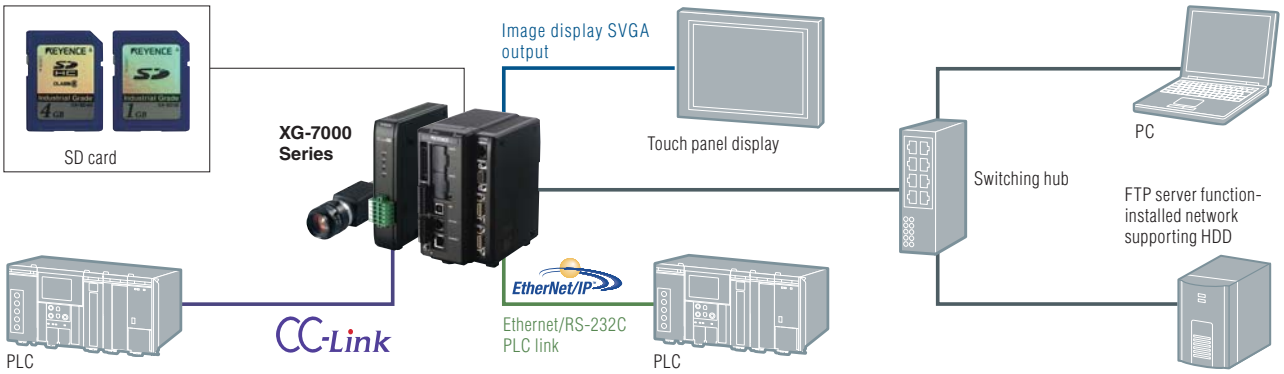


Histogram

COMMUNICATION INTERFACE

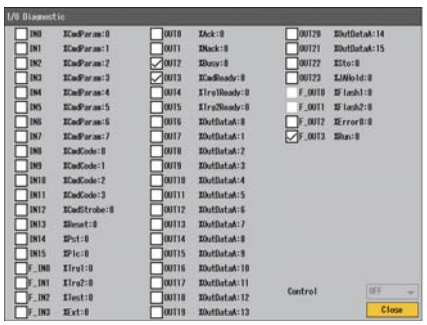
A diverse selection of integration options and utilities for use in any facility

The XG-7000 Series supports a wide range of interfaces, protocols and I/O devices. Ranging from CC-Link, PLC-Link, Ethernet IP, USB, RS-232C, discrete I/O and SD cards. All these combined give the XG-7000 the ultimate flexibility for easy integration. Coupled with easy to use monitoring tools, integration man hours and costs can be easily reduced.

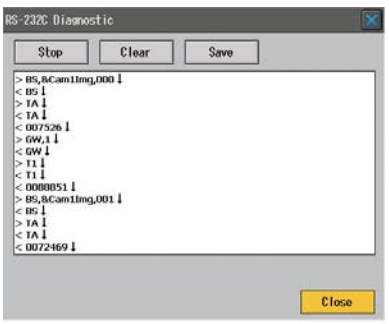


Communication Monitoring Tools

The XG-7000 Series comes fully equipped with on-controller monitoring tools to aid with debugging and installation. Wiring and I/O connections can be easily confirmed with the I/O diagnostic tool and RS-232C communication can be monitored reducing human error and any potential installation oversights.



I/O monitor



RS-232C monitor

Ethernet IP Support

EtherNet/IP™

To enable easy integration into many existing facilities across many industries the XG-7000 Series fully supports Ethernet IP communication. Connectivity can be established with any PLC supporting Ethernet IP via a standard LAN network.

INDUSTRY FIRST

CC-Link Unit (Supports Ver.1.10 and 2.00)

Smooth easy PLC connectivity

Remote device communication is possible by connecting a CC-Link device (such as a PLC) and the CA-NCL10E (connected to the side of the main controller). Smooth and easy integration of the XG-7000 into the PLC is possible with simple wiring, connectivity and setting through the PLC link function.

* The CC-Link is a registered trademark of the Mitsubishi Electric Corporation.

INTERFACE

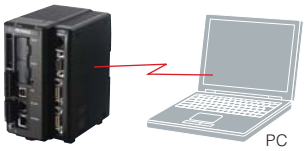
FIRST IN THE INDUSTRY Removable mass storage capability

First in the industry to support the SDHC standard*, allowing information to be saved to removable mass storage SD cards up to 4 GB. Two SD slots are available as a standard giving total storage capacity to 8Gb. All files including setting files, configuration data and measurement result data can be stored and read at high speeds.

* Reading SDHC (high capacity SD cards) with a PC requires a dedicated card reader (commercially available).

USB 2.0 port

The USB connection allows for easy 1-2-1 PC connectivity for the transfer of settings, image and measurement based data.



LED lighting and CC link expansion modules

Connect the light expansion module (CA-DC20E) and the CC-Link communication module (CA-NCL10E).

Light control expansion module **CA-DC20E**

CC-Link module **CA-NCL10E**

Camera port

Quick easy connection of any camera with quick disconnect camera cables. Max length up to 51 m 167.3'.

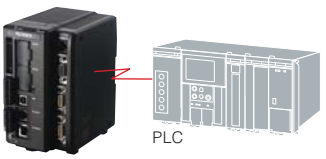
Camera expansion module

Connect the XG-E700 camera expansion module when 3 or 4 cameras are needing to be used

Camera expansion unit **XG-E700**

RS-232C communication

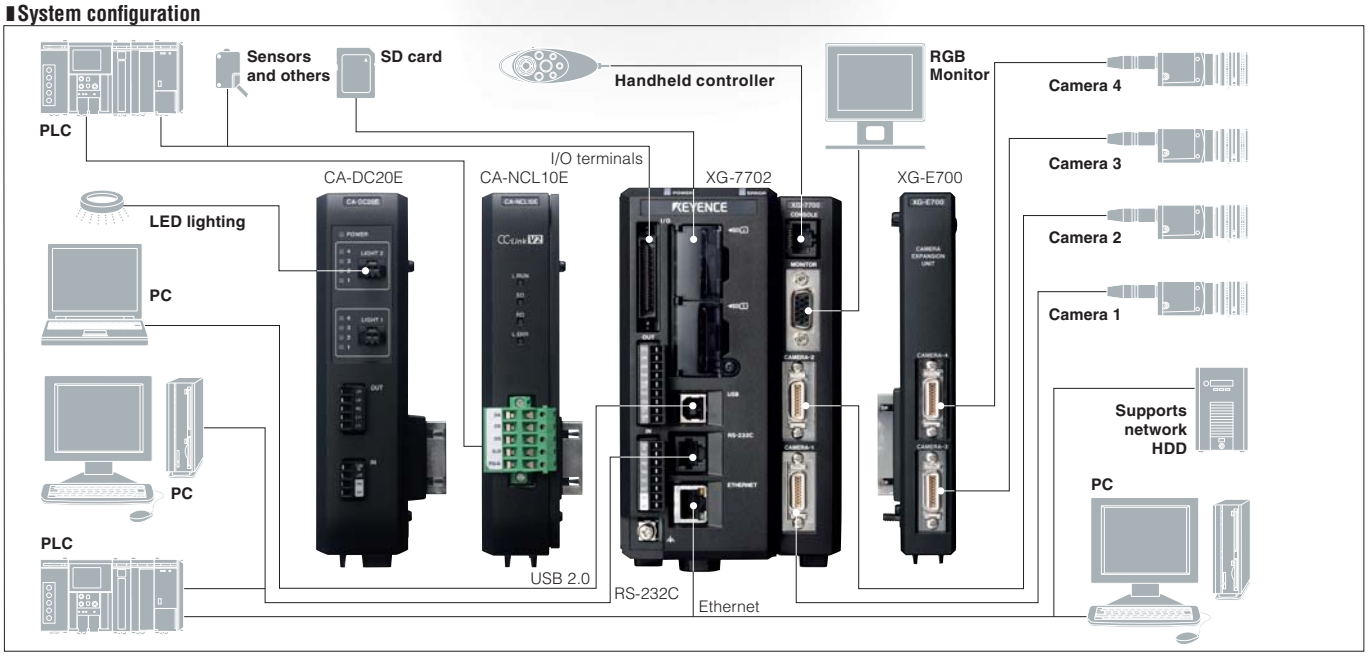
Basic RS-232C or pre-configured settings (based on standard PLC manufacture parameters) via the PLC link function. Giving direction communication to PLC data memories without additional ladder programming.



FIRST IN THE INDUSTRY Ethernet (TCP/IP, Ethernet IP) communication (PLC Link / FTP / Remote Connectivity)

The 1 Gbps Ethernet port can be used as a Ethernet IP or PLC link connection, ensuring easy connectivity and control among various PLC's without the need for complex ladder logic. The same port can be used for the connection of FTP server and NAS devices, as well as enabling remote management of multiple controllers via a single PC on a LAN.

System configuration



PRODUCT LINEUP

Controllers

5000,000-pixel camera supporting high-speed, high-capacity controller
XG-7702(P)

2000,000-pixel camera supporting high-speed controller
XG-7502(P)

310,000-pixel camera dedicated controller
XG-7002(P)

Camera expansion module
XG-E700

LED light control expansion module
CA-DC20E

CC-Link module
CA-NCL10E

Handheld controller
OP-84231
OP-84236
(blank)

Image processing system integration software
XG-H7NE2

Windows 2000
Professional
Windows XP
Home Edition/ Professional
Windows Vista
Home Basic/ Home Premium/ Business/Ultimate/ Enterprise
Windows 7
Home Premium/ Professional/ Ultimate/Enterprise

5 megapixel cameras

11x high-speed color camera
XG-H500C

11x high-speed monochrome camera
XG-H500M

2 megapixel cameras

7x high-speed color camera
XG-H200C

7x high-speed monochrome camera
XG-H200M

Color camera
XG-200C

Monochrome camera
XG-200M

Ultra-compact color camera
XG-S200C

Ultra-compact monochrome camera
XG-S200M

310,000 pixel cameras

7x high-speed color camera
XG-H035C

7x high-speed monochrome camera
XG-H035M

Color camera
XG-035C

Monochrome camera
XG-035M

Ultra-compact color camera
XG-S035C

Ultra-compact monochrome camera
XG-S035M

Camera Cables

L-type connector

Camera cables

Type	Connector shape	Cable length					
		1 m (3.3')	3 m (9.8')	5 m (16.4')	10 m (32.8')	17 m (55.8')	Extension cable
Standard-speed camera cable	Straight	CA-CN1	CA-CN3	CA-CN5	CA-CN10	CA-CN17*	—
	L-type	—	CA-CN3L	CA-CN5L	CA-CN10L	CA-CN17L*	—
Standard high flex robot cable	Straight	—	CA-CN3R	CA-CN5R	CA-CN10R	CA-CN17R*	CA-CN7RE (7 m 23.0')
High-speed camera cable	Straight	—	CA-CH3	CA-CH5	CA-CH10	—	—
	L-type	—	CA-CH3L	CA-CH5L	CA-CH10L	—	—
High-speed high flex robot cable	Straight	—	CA-CH3R	CA-CH5R	CA-CH10R	—	—

* Cables cannot be used with 2 Mega and 5 Mega pixel cameras.

Extension Cables

Camera cables may be extended up to 51 m (167.3') or 30 m (98.4').

The maximum extension length varies according to the camera model.

The dedicated extension cable is necessary in order to connect a repeater to a camera or a repeater to a repeater.

Amplifier for extension cables
CA-CNX10U
(for standard cameras)
CA-CHX10U
(for high-speed cameras)

Extension cables (camera to amplifier)

Type	Cable length		
	3 m (9.8')	10 m (32.8')	17 m (55.8')
Standard-speed camera cable	CA-CN3X	CA-CN10X	CA-CN17X
Standard high flex robot cable	CA-CN3RX	CA-CN10RX	CA-CN17RX
Standard L-type cable	CA-CN3LX	CA-CN10LX	CA-CN17LX
High-speed camera cable	CA-CH3X	CA-CH10X	—
High-speed high flex robot cable	—	CA-CH10RX	—

Cables must be used with deditcated amplifier.

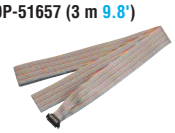
Accessories

Monitor cable
OP-66842 (3 m 9.8')
OP-87055 (10 m 32.8')

Industrial SD card
CA-SD4G: 4GB (SDHC)
CA-SD1G: 1GB
OP-87133: 512MB

Parallel I/O & Data Output Cables

Parallel I/O cable
OP-51657 (3 m 9.8')



1Gbps Ethernet cable
OP-66843 (3 m 9.8')

USB cable
OP-66844 (2 m 6.6')

RS-232C communication cable
OP-26487 (2.5 m 8.2')

RS-232C cable conversion connector
OP-26486: 9 pins
OP-26485: 25 pins

LED Lighting Cables

Y split cable
CA-D1W (1 m 3.3')

Connector to terminal
OP-84457 (1 m 3.3')

Standard cable
CA-D2 (2 m 6.6')
CA-D5 (5 m 16.4')

High flex robot cable
CA-D3R (3 m 9.8')
CA-D5R (5 m 16.4')
CA-D10R (10 m 32.8')
CA-D17R (17 m 55.8')

SPECIFICATIONS (SOFTWARE)

Model			XG-H7NE2 (XG VisionEditor)
Unit configuration			Maximum 1000 units per program (depending on internal memory capacity).
Image Input		**Image acquisition**	Supports the simultaneous capture of up to 4 cameras. Supports multiple combinations, repeat capturing and background capturing Supports delayed trigger functionality for correct image acquisition. Configuration of lighting (via the CA-DC20E) for image acquisition. Also supports parameter variable referencing.
Vision toolset	**Common specifications**	**Processing regions**	Shapes include: rectangle, rotating rectangle, circle, oval, ring arc, polygon (up to 12 sides), composite area (32 regions, including masks), processed (binary) image region. Also supports parameter variable referencing.
		Pre-processing filters	Filters: expand, shrink, average, median, edge enhancement, edge extraction X, edge extraction Y, Sobel, Prewitt, Roberts, Laplacian, binary, subtraction, preserve intensity, contrast conversion, real-time differential, real-time shade correction, blur (softening), custom (3x3 or 5x5), custom (advance) (maximum 21x21 convolution, expansion, shrink), blob, Processing: Multiple processing of the same filter (up to 9 times) (for binary, subtraction, preserve intensity, contrast conversion, real-time differential, real-time shade correction, blur (softening), blob filter processing is once only), filter combination (13 stacks) (for binary, subtraction and blob can only be used once). Also supports parameter variable referencing.
		Color extraction function (valid for color cameras only)	Color to binary conversion, color shade processing, fine color (stain mode only), RGB average (Color correlates with HSB color space). Also supports variable parameter referencing.
		Scaling	Ability to turn ON or OFF scaling coefficients for the X,Y and length measurements for each camera. Also supports parameter variable referencing.
		Selectable Execution	Selection of whether to allow unit processing on controller or XG VisionEditor only. Also supports parameter variable referencing.
	Area	**Area**	Count the number of white or black pixels in a region.
	Positional	**Pattern Search**	360 degree rotation and recognition of up to 99 patterns. Support for up to 4 mask regions, origin and reference point adjustment. Processing based on post image operation variables or registered (saved) images.
		Edge Position	Simultaneous position measurements of up to 3600 edge points in a linear or radial (circle, arc) fashion.
		Trend Edge Position	Average, maximum, minimum position, angle (when using circumference and arcs) measurements in a single region divided up into a maximum of 5000 segments. Best fit line and circle processing (using least square method) including abnormal point removal.
		Blob	Center of gravity position, major axis inclination (180 degrees/360 degrees conversion) measurements of up to 9999 blobs.
	Inspection and measurement	**Edge Width**	Measurement of the distance between two edges (outer, inner, or specified).
		Edge Pitch	Up to 1800 Edge Pitch / Center Pitch (calculated from two edges) measurements from detected edge points.
		Edge Angle	Measurement of the angle based on the straight line connecting two detected edge points.
		Edge Pairs	Up to 1800 Edge Pitch / Center Pitch measurements (based on pairs of edges) detected by 2 separate scans.
		Trend Edge Width	Average, maximum, minimum width measurements between two edges (outer, inner) in a single region divided up into a maximum of 5000 segments.
		Blob	Center of gravity, major axis inclination (180 degrees/360 degrees conversion), area, ferret diameter, circumference length, circularity, major axis parallel circumscribed rectangle, major axis length of the equivalent ellipse, minor axis length, major axis/minor axis comparison of up to 9999 groups of pixels.
		Stain	Detects flaw/stains through segment average intensity comparison within the defined region. Supports differential stain detection through the subtraction filter. Through the grouping function processing and filtering of up to 99 individual stains/defects. Supports the use of fine color detection for color based stain detection. Supports differential color representative contrast display.
		Trend Edge Stain	Detects the location of variations in shape (projections or depressions) against a standard model line (straight line, circle, oval and free curve) derived from the normal target profile as defects.
		Intensity	Measures pixel intensity value, and can be used as a reference for the preserve intensity filter.
		Color inspection (valid for color cameras only)	RGB and HSB colorspace measurements.
		OCR	Alphanumeric and user defined symbol optical recognition of a maximum of 40 characters (20 per 2 lines) based on a pre-registered library of automatic and fixed extracted characters. Supports a library that can store a maximum of 200 characters including 20 user defined characters. Tolerances can be based on alphanumeric comparison, date & time and encrypted data time / shift codes with zero suppression and offset capabilities.
		2D Code Reader	Supports reading up to 512 characters of a 2D code (QR code: Model1, Model 2, Micro QR, DataMatrix/rectangle DataMatrix (ECC200)) and up to 16 reference judgment conditions. Supports data splitting into 8 partitions and calendar reference (zero suppress and offset functions included).
Position Adjustment		**Position Adjustment**	Supports X, Y +/- 180 degree adjustment data from units, calculations and variables for positional correction of other tools based on 1 or 2 point correction.
Flowchart Control		**Branch/Join**	Conditional branching of the flowchart (up to 64 splits). Also supports parameter variable referencing
		Looping	Repeatable unit processing. Also supports parameter variable referencing
		Break	Loop exit
		End	Finish image processing flowchart
Calculation & Image Processing		**Numerical/Scripting**	Direct input of up to 5000 characters for multi calculation and scripting purposes. Individual result based on time out settings and overall result (ANS) ANS. Basic functions: addition, subtraction, multiplication, division, surplus, power Conditional binary operators: inverse (NOT), logical multiplication (AND), logical sum (OR), exclusive OR (XOR) Comparative operators: equal to, not equal to, greater than, lesser than, greater than or equal to, lesser than or equal to Mathematical functions: absolute value, circular variable substitution, straight-line variable substitution, positional variable substitution, character encoding conversion, average, average array processing, average index, average index (array processing), rounding up, radian -> angle conversion, Napier's number (e), rounding down, natural logarithm, common logarithm, maximum value, maximum value (array processing), maximum value index, maximum value index (array processing), minimum value, minimum value (array processing), minimum value index, minimum value index (array processing), circumference ratio (pi), angle -> radian conversion, rounding, sort, square, square root, sum (array processing) Trigonometric functions: sine value, cosine value, tangent value, arcsine value, arccosine value, arc tangent value, arc tangent value (P1/P2) Geometric operation functions: center angle, 2 point angle, angle width, circle detection (3 point specification), circle detection (array processing), circle tangent point detection, coordinate system conversion, coordinate system conversion 2, distance between two points, intersection point of 2 circle, intersection point of circle and line, straight-line detection (2 point specification), straight-line detection (array processing), angle of two lines, straight-line angle, distance between a point and straight-line, distance between a point and a straight-line (signed), intersection point with a perpendicular line, bisector, center point, rotation, center of rotation, perpendicular bisector, pixel coordinates -> world coordinate conversion, world coordinates -> pixel coordinate conversion, multiple point calibration, vector addition, vector subtraction, vector cross product, vector inner product Calendar functions: date offset (year/month/day) Bit functions: logical multiplication (AND), inversion (NOT), logical add (OR), exclusive OR (XOR), bit combining Statement: FOR, FOR TO, NEXT, EXIT FOR, IF, IF THEN, END IF, DO WHILE, LOOP, EXIT DO, User comments, row continuation Supports error checking functionality.
		Image Operation	Create images based on multi image processing or through mathematical processing Image operation: conducts operations between images, supporting combinations 1x1, nx1 and nxn (to a maximum of 32 images) Conversion: conducts processing on a single image Image Operation Functions: Add, Subtract, Absolute Difference, Average, Multiply (with normalization), Multiply (without normalization), Max, Min, AND, OR, XOR, NAND, NOR, XNOR Conversion Functions: Add, Subtract, Absolute Difference, Multiply, Rotate/Translate, Zoom, Trapezoid Adjustment, Pixel Value Conversion, Blob Filter, NOT, AND, OR, XOR, NAND, NOR, XNOR, Right Bit Shift, Left Bit Shift
		C Plug In	C language source files can be compiled for both controller and PC simulation environments. (Supported compilers: For the controller: Texas Instruments C6000 Code Generation Tools 6.0.11, For the PC: Microsoft Visual Studio 2005/2008/2010, Visual C++ 2008/2010 Express Edition.) Supports access to pixel values from the specified image variable. Local variables, global variables, system variables values, setting parameters, and result data can be passed for referencing and rewriting. Supports Visual Studio debugging.
		Calibration	Correction of images and processing due to lens distortion and camera placement. Supports both correction of coordinate position and image for correct processing. Supports adjustable calibration via multiple images (up to 16), data point selection (up to 4000 points per image) and region selection. Calibration teaching pattern (grid and dot pattern) are also available to be printed out.
Timing and Processing Control		**Pause**	Pauses the processing flow for a specified time (0ms to 1 hour). Also supports parameter variable referencing.
		Timer	Start a user defined timer (0-7)
		Timer conditions apply	Pauses the processing flow until the expiration of a user time (0-7)
		Terminal I/O Delay	Pauses the processing flow based on the AND / OR conditional changes of terminal block and parallel input, output signals (edge/level, ON/OFF, falling edge, rising edge) Supports CC-Link and EtherNet/IP communication.
		Variable Delay	Pauses the processing flow based on the AND / OR conditional comparison of variables and numerical values
		User Menu Delay	Pauses the flow until the opened menu is closed.

SPECIFICATIONS (SOFTWARE)

Model			XG-H7NE2 (XG VisionEditor)
Graphics		On-screen Graphics	Display characters (fixed, numerical, active text, decimal conversion), graphics (rectangle, rotated rectangle, circle, oval, ring, arc, point, line, table, polygon), result data and variables. Along with support for parameter variable referencing.
Outputs		Terminal / I/O Output	Assign data and results to 28 I/O terminals, with support for cyclic strobing (up to 8 cycles) through multiple series of data.
		Data Output	Allows the output of up to 256 data or results items per unit to different locations including SD cards, RS-232, Ethernet, CC-Link, EtherNet/IP, PLC-Link and PC Applications. Includes support for skipping of non-processed units, filenames, folder allocation, customized output data format and processing (image/output) priority.
		Image Output	Allows the output of images to different locations including SD cards, FTP and PC applications. Includes support for filenames, folder allocation and processing (image/output) priority
Command		Command Execution	Issue various commands for controller functions based on image processing.
Common to All Units		Total Status Processing	Overall output giving a logical OR result output based on allocated units results
		Total Error Processing	Overall error output giving a logical OR result output based on allocated units error results.
GUI Interface	Screens	Screens	Up to 100 screens per program, with support for external switching and access via user group / user accounts.
		Frames	Up to 99 frames per program to host graphics, data and values, with support for external switching.
		Image Displays	Up to 5 image displays for associating with displaying camera images, registered images or archived images. Support for displaying different process views of images and unit processing.
		Elements	Image display, base frame, page frame Basic elements (values, characters, active character, horizontal lines, vertical lines, points, rectangles, circles, polygons, ruled lines) Built-in elements (Image display, inspection date, inspection time, camera screen information, zoom information, OK/NG status, logo (BMP file), vision unit results, non-vision unit results, variable list, unit judgment list, unit list)
	Menus	Menu settings	Allows for the creation of up to 900 users defined menus per program with support for external control and display. Menus can be used to interact with settings via variables and support numerous command functions as well as other menus display operation.
		Menu elements	Text, numerical input box, drop-down menu, normal button, confirmation button
		Built-in Menus	Region setting dialog, image registration menu, color extraction menu, statistical analysis menu, image archive menu, library character registration menu, unit edit menu, view toolbar, image bar, function menu, program conversion menu, file management menu, I/O monitor menu, RS-232C monitor menu, user login menu, date/time setting menu, save settings menu, rename program menu, copy/delete programs menu, loading/saving programs menu, SD Card 2 removal menu, resources menu, setting operation dialog, variable settings menu, total status settings menu, unit total error settings menu, scaling settings menu, image buffer menu, statistical analysis settings menu, image archive settings menu, camera selection menu, FTP settings menu, variable changing settings. The region settings, color extraction, library character registration menu support changes based on direct unit selection. The image registration menu supports re-referencing of position adjustment parameters. Supports direct changes to unit settings based on allowed unit editing settings except for C Plug In units. Supports the selection of files and processing of files for cutting, copying and pasting to various SD locations.
Variables		Local Variable	Define up to 10000 variables (numerical, positional, line and circle based) per program each being able to be set as an array (up to 10000 elements) and having support for comments and value retention during program changes.
		Global Variable	Define up to 1024 variables (numerical, positional, line and circle based) per controller (dependent on controller menu) each being able to be set as an array and having support for comments and value retention during program changes.
		Image Variable	Define up to 512 variables (image) per program each being able to be set as an array (up to 512 elements) and having support for comments and image operation processing.
Simulation	XG-H7NE2 (VisionEditor)	Offline Simulation Mode	Enables offline simulation of BMP, JPEG images (256 maximum) that have either been stored on a PC or loaded in through a connected controller.
		Online Simulation Mode	Enables online simulation based on live images being obtained from a connected controller via Ethernet or USB. Also supports external trigger synchronization and image archive.
		Image Archive Mode	Enables reproduction of inspections based on image archive images (BMP, JPG, 256 maximum) and result data that has been previously recorded.
	Simulator+	Offline simulation	Enables offline simulation on a PC, working with the GUI of the XG controller operating through the XG VisionEditor software, allowing the testing of up to 50000 images and processing of statistical data. Supports mouse operation.
Development Functions	Creation	Flowchart/Program	Creation, editing and deletion of all components used in image processing in a flowchart format. Supports split view, zoom, multiple unit movement, multi region alignment, grouping of units (including locking), repeat pasting, selective pasting, unit ID renumbering, breakpoint setting, step control, group viewing, editing and control directly on the controller.
		Processing View	Facilitates displaying of differing image types based on processing in the flowchart including live images, single unit processing, multi unit processing, color extraction (color camera), image enhance filters and contrast display.
		Screen Management	Management of screens, elements and menu interfaces available on the controller in a hierarchal format. Supports the verification of user group screens, the editing of screens and menus, and the displaying of result components sorting.
		Screen Editor	Allows for elements and menus to be used and dragged while creating the GUI. Supports writing/reading display patterns, frames and elements allowing for screen parts to be freely moved, positioned, edited and layered accordingly. Grid or free formatting can be used for aligning elements correctly.
		Parts List	Provides a list of all the available parts (units, functions, commands, screens etc) that can be called up during the development of a solution.
		Statistical Settings	Specify the logging of up to 256 items each with a maximum of 100000 data points for statistical analysis. Data can be viewed, analyzed and limits changed based on user group and account access permissions.
		Image Archive Settings	Specify up to 8 image archives for storing images and data from inspections. Each archive has the ability to be customized to save a set number of images based on a particular condition. Image archives support series image and data accumulation, preceding image and data accumulation and replay modes both on controller and in XG VisionEditor. Images and results can also be output to SD cards, PC applications and FTP servers for storage and retesting.
		Buffer/Processing Control	Customization of the buffer and handling of images captured while other processing is being performed.
		System Settings	Ability to edit controller system settings including: controller naming, controller language settings, registered image format, menu opacity, controller unit processing, operational settings on the flow display screen, default camera settings, I/O (including terminal assignment, %JAHold signal customization (one-shot, latching, synchronization with STO), output file name, processing errors, busy conditions, customized commands, handheld controller operation, accounts, operation logs, and OCR date/time encryption
		Password Protection and Security	Password protection of program files allowing program editing via XG VisionEditor only. Cross referencing of individual unique controller ID's for copyright protection.

SPECIFICATIONS (SOFTWARE/CONTROLLER)

Model			XG-H7NE2 (XG VisionEditor)
Development Functions	Testing and Debugging	Unit Results	Verify unit parameters, results, local and global variable initial and current values from processing during simulation. Also supports the changing of variables.
		Watch	Combine multiple data into 1 of 4 views for verification of multiple parts of the process during simulation.
		Log	Continual log of unit results and errors or units processed during simulation
		Variable Reference List	Verification of variable referencing throughout the image processing flowchart.
		Check	Verification of version, settings and finding of errors in the image processing flowchart and screen. Displays error location and details for easy quick debugging.
		Find	Search for unit references, variables, setting parameters and result data used in the image processing flowchart. Summarized results display of find function for referencing and locating of results.
		Unit List	Summarized list of unit settings from units used in the image processing flowchart with support for changing parameters.
		Statistical Analysis	Show statistical results from simulation including summary data (maximum, minimum, standard deviation, 3σ, OK/NG frequency, yield), trend graphs (supporting the simultaneous comparison display of 4 items) and histograms for up to 1000 data points. Support for the changing of upper and lower limits of any monitored data.
		User Processing View	Up to 16 views for displaying differing image types based on user selection including live images, single unit processing, multi unit processing, color extraction (color camera), image enhance filters and contrast display.
		Status bar	Displaying % resources used of each memory (program memory, image memory, processing memory) based upon current program settings. Displays the mouse position, HSB and RGB values when over an image and image processing buffer parameters.
		Layout	Customization of 5 different XG VisionEditor screen layouts each with the ability to be reset.
	File Transfer/ System/ Program Management	System View	Upload/download various program data and other files to the controller via Ethernet or USB connection. Management of multiple workspaces and programs stored on the PC. Support for the importing and exporting of single settings and the transferring of files between programs.
		Copy to Clipboard	Gives the ability to create supporting documentation by copying various settings to the Windows clipboard for the pasting in another Windows program.
		Version Control	Control and upgrading of program and other file versions.
	Controller Management	Remote Connection	Remote control and operation (via keyboard or mouse) of a connected controller (via Ethernet or USB) using the XG GUI.
		Image Archive	Verification and management of image archive and result data of a connected controller (via Ethernet or USB).
		Trace log viewer	Enables you to save the inspection settings, flow, unit, commands, collection of terminal operation conditions and log data of the controller connected via Ethernet or USB
		Variable Re-Write	Capability for rewriting local, global and system variables in online mode for a connected controller (via Ethernet or USB).
		Mode Changing	Verify and switch modes (online mode/offline mode/remote capture mode) of a controller connected (via Ethernet or USB).
	Controller Adjustment	Processing Management	Allocation of memory and resources for online unit editing and use of the UT command.
		Edit Unit Settings	Selection of which units can be edited directly on the controller. Control over the level of changes capable based on user group and accounts. Control over the using of commands for displaying unit edit menus.
PC Specifications	Operating Systems		Microsoft Windows 2000 Professional SP4 or later Microsoft Windows XP Home Edition/Professional SP2 or later Microsoft Windows Vista Home Basic, Home Premium, Business, Ultimate, Enterprise Microsoft Windows 7 Home Premium, Professional, Ultimate, Enterprise 64-bit operating systems are not supported.
	PC		- CPU: Minimum requirements: Core 2 Duo 1.06 GHz or higher is recommended: Core 2 Duo 1.80 GHz or higher - RAM: 1 GB or higher (2 GB or higher recommended) - HDD: At least 500 MB of free space* Space is required for saving separate image data - Monitor: 1024x768 dots or higher (1280x1024 dots or higher is recommended) - DVD drive: A CD/DVD drive capable of reading the software CD-ROM - USB port: If a USB is to be used, a USB 2.0 port is essential Either an internet connection or means of receiving the activation code license electronically.
Licensing			License required for full activation. Information for receiving a license / activation code includes, company details, user ID and CD serial number.
Additional Software		XG Vision Terminal	License free remote support, data logging (image and data output), and file management PC software for use with up to 8 connected controllers (via Ethernet or USB).
		USB Driver	USB driver (license free) specifically for connecting a XG-7000 controller via USB to either the XG VisionEditor, XG Vision Terminal or XG Simulator+ software. Supplied with XG VisionEditor, Vision Terminal and Simulator+.

The number of possible settings amongst all listed items depends on the main unit memory capacity.

■ Controller (XG-7702/7502/7002/7002A)

Model	NPN	XG-7702	XG-7502	XG-7002	XG-7002A
	PNP	XG-7702P	XG-7502P	XG-7002P	—*1
Supported Resolution		•With XG-H500C/H500M connected 5 mega-pixel mode: 2432(H) x 2050(V), approx. 4.99 mega-pixels •With XG-200C/S200C/H200C/200M/ S200M/ H200M connected 2 mega-pixel mode: 1600(H) x 1200(V), approx. 1.92 mega-pixels 1 mega-pixel mode: 1024(H) x960(V), approx. 980,000 pixels •With XG-035C/S035C/H035C/035M/ S035M/ H035M connected 310 k pixel mode: 640(H) x 480(V), approx.310,000 pixels 240 k pixel mode: 512(H) x480(V), approx. 240,000 pixels	•With XG-200C/S200C/H200C/200M/ S200M/ H200M connected 2 mega-pixel mode: 1600(H) x 1200(V), approx. 1.92 mega-pixels 1 mega-pixel mode: 1024(H) x 960(V), approx. 980,000pixels •With XG-035C/S035C/H035C/035M/ S035M/ H035M connected 310 k pixel mode: 640(H) x 480(V), approx. 310,000 pixels 240 k pixel mode: 512(H) x 480(V), approx. 240,000 pixels	•310 k pixel mode: 640(H) x 480(V), approx. 310,000 pixels •240 k pixel mode: 512(H) x 480(V), approx. 240,000 pixels	640(H) x 480(V), approx. 310,000pixels
Camera Connectivity		Two color/monochrome cameras (Compatible with (XG-H500C/200C/S200C/ H200C/035C/S035C/ H035C/H500M/200M/S200M/ H200M/035M/S035M/ H035M, mixed connection possible)	Two color/monochrome cameras (Compatible with (XG-200C/S200C/H200C/ 035C/S035C/H035C/200M/ S200M/H200M/035M/ S035M/H035M, mixed connection possible)	Two color/monochrome cameras (XG-035C/S035C/H035C/035M/ S035M/H035M can be connected. Mixed connection is possible.)	Two monochrome cameras (CA-CM20: KEYENCE or •XC-HR50/XC-HR57/XC-56/XC-ST50/XC-EI50/ XC-EI30/XC-EU50 : Sony •CS8550Di/CS8570D/CS8560D: Toshiba Teli)
		Two extra cameras and up to four cameras total can be connected by using expansion unit XG-E700.			Two extra cameras and up to four cameras total can be connected by using expansion unit XG-E700A.
	Trigger input	4-camera simultaneous capture/individual capture can be selected (when XG-E700 is not connected, images from up to two cameras can be captured at the same time)			4-camera simultaneous capture/ individual capture can be selected (when XG-E700 is not connected, images from up to two cameras can be captured at the same time)
Image Processor		DSP (High-speed)		DSP	DSP (High-speed)
Program Memory		SD cards 1 and 2 can each hold 1000 programs (depending on the size of the SD card and the size of the programs), external switching possible			
Screen Capacity		Maximum 1000 screens for each program (depending on SD card size), Image compression also available.			

*1 For PNP output type, contact your local KEYENCE office.

SPECIFICATIONS (CONTROLLER)

Model			NPN	XG-7702	XG-7502	XG-7002	XG-7002A
			PNP	XG-7702P	XG-7502P	XG-7002P	—[*1]
Editing	Program Editing			Supports the creation, deletion, copying and renaming of programs in edit mode, adding/editing units/flowchart (image acquisition/vision tools/position adjustment/program control/operations/timing/display/commands), variable settings/total judgment settings/Unit total error settings/scaling adjustment settings/camera model settings/image buffer settings/statistical settings/image archive settings/FTP output settings /variable changing dialog/registered image batch updating/position adjustment reference position batch updating/screen editing			
	System Settings			Supports the editing of system settings during offline mode, general (controller name/date and time settings/language settings/registered image type/menu opacity/unit execution/startup mode) basic camera (camera settings/white balance settings), I/O settings (external terminals/Ethernet (TCP/IP), Ethernet IP,/RS-232C/PLC link/CC-Link EtherNet/IP), date/time encryption (OCR), and custom command settings			
	Retest			Supports retest that uses accumulative history images, selected image files, and master images (selected from the image bar) and inspection setting editing (nonstop option selection available). Supports the interlocking function with statistics through batch test.			
SD Card Specifications				• 2x SD Card slots (SDHC compatible) • Compatible with OP-87133 (512MB), CA-SD1G (1GB: installed standard to SD1), and CA-SD4G (4GB:SDHC)	• 2x SD Card slots (SDHC compatible) • Compatible with OP-87133 (512MB: installed standard to SD1), CA-SD1G (1GB), and CA-SD4G (4GB:SDHC)		
Image Capture Settings	Image Processing Area			Specify a 980,000-pixel area (1024 (H) x 960 (V)) in any position as the image processing area within 1,920,000 pixels (1,000,000-pixel mode) Specify a 240,000-pixel area (512 (H) x 480 (V)) or 310,000-pixel area (640 (H) x 480 (V)) in any position as the processing area within 320,000 pixels[*2]	Specify a 240,000-pixel area (512 (H) x 480 (V)) or a 310,000-pixel area (640 (H) x 480 (V)) in any position as the processing area within 320,000 pixels[*2]	Not applicable	
	Scanning method (monochrome cameras only)			Progressive/Interlace			Progressive/Interlace (XC-ST50, XC-E*** are fixed interlace)
	CCD start/end function			Enables the choosing of the start/end line within the image capture range. Possible to variable reference the capture start line (possible to change each image capture in the capture startup line). (The XG-H200C and H200M do not allow less than 100 lines to be specified)			Start/End lines cannot be specified. CCD area is predetermined by camera specification settings. (XC-ST50, XC-E*** area is fixed)
Image and Processing Correction	Camera gain adjustment			Camera CCD sensitivity, offset and span adjustments. Also supports the changing of the shift and span of the CCD for 16 different levels (including separate RGB elements when using color cameras).			
	White balance adjustment (color camera only)			Manual setting with white target			
	Image Inversion			Supports inverting the image to the left or right			
	Scaling			Allows the setting and application of individual scaling values to X, Y and length result data, along with the support for using variables.			
Support Functions	Statistics	Data Points		Maximum of 100,000 points per item, maximum of 256 items (supports exporting to SD card/maximum of 1024 points per item for the retest statistics function)			
		Results		Maximum, minimum, average value, deviation (σ, 3σ), summary of processing, including OK/NG count			
	Image Archive			Enables the accumulation of archived images (specified below) to the main controller memory.			
				- Up to 1013 images (monochrome camera, 240,000 pixels) - Up to 501 images (monochrome camera, 310,000 pixels) - Up to 245 images (monochrome camera, 1,000,000 pixels) - Up to 117 images (monochrome camera, 2,000,000 pixels) - Up to 40 images (monochrome camera, 5,000,000 pixels) - Up to 1008 images (color camera, 240,000 pixels) - Up to 498 images (color camera, 310,000 pixels) - Up to 240 images (color camera, 1,000,000 pixels) - Up to 112 images (color camera, 2,000,000 pixels) - Up to 35 images (color camera, 5,000,000 pixels)	- Up to 501 images (monochrome camera, 240,000 pixels) - Up to 245 images (monochrome camera, 310,000 pixels) - Up to 117 images (monochrome camera, 1,000,000 pixels) - Up to 53 images (monochrome camera, 2,000,000 pixels) - Up to 496 images (color camera, 240,000 pixels) - Up to 242 images (color camera, 310,000 pixels) - Up to 112 images (color camera, 1,000,000 pixels) - Up to 48 images (color camera, 2,000,000 pixels)	- Up to 501 images (monochrome camera, 240,000 pixels) - Up to 245 images (monochrome camera, 310,000 pixels) - Up to 496 images (color camera, 240,000 pixels) - Up to 242 images (color camera, 310,000 pixels)	Up to 245 images (CA-CM20: 310,000 pixels)
				Enables the simultaneously running up to 8 image archives that can reference different targets. Supports the overwriting or accumulation of the data modes. Supports result data accumulation to correspond with the images for replaying the image archive. Supports outputting of the image archive to SD cards, PC applications and FTP servers.			
	Programming Assistance	Screen Magnification		Gives the ability to magnify the screen from 4% to 2500% during operation, while enabling the control of the display position of via external controls depending on the commands issued (individual magnification settings possible for multiple screen displays)			
		Edge Waveform Display		Enables the display of the edge differential waveform graph and associated numerical data during operation			
		Profile Display		Enables the display of the detected profile for the trend edge position, trend edge width, and trend edge defects during operation			
		Stability Display		Enables the display of the stain detection (stain level) contrast view during operation			
		Character Extraction Display		Enables the display of the automatic extraction projection waveform graph of OCR during operation			
		Defect Waveform Display		Enables the display of the defect level waveform for trend edge defects during operation			
		Variable Changing Dialog		Enables the verification/changing of selected local variables, global variables, and system variables values (only verification for system variables). Supports grouping setting and specifying display patterns during operation.			
	Data Save Functionality			Supports the direct saving of data results, captured images (compression possible), image archive images compression possible, statistical analysis data, RS-232C communication logs, setting details, the direct saving of operation logs during inspections (not including setting details) and the current image from any camera during offline mode.			
	Other			Image capture function, user account switching function, file management function, I/O monitor, RS-232C monitor (including log saving function)			
Interface	Assignable Input			• 20 (including four high speed designed for trigger input) • Input rating 26.4V or lower, 2mA or grater (3mA or grater for high speed input terminal)			
	Assignable Output			• 28 (including four high speed outputs designed for pulse outputting to external device) • NPN type: NPN open collector Maximum 50 mA (30 V or less) PNP type: PNP open collector 50 mA (30 V or less)[*3]			
	Monitor output			Analog RGB output, SVGA 800 x 600 (24 bit color, 60 Hz)			
	Operation indicators			Power, Error LED display			
	RS-232C			Numerical data output and control input/output enabled, up to a maximum baud rate of 115200 bps.			
	PLC link			• Numerical data output and control input/output enabled via the RS-232C port or Ethernet port (Cannot be used with CC-Link or EtherNet/IP) • Following PLCs are supported via link unit:[*4] KEYENCE: KV-700 Series, KV-1000 Series, KV-3000 Series, KV-5000 Series Mitsubishi Electric: A Series (RS-232C only), Q Series, L Series OMRON: SYSMAC C Series (RS-232C only), CJ/CJ1/CJ2 Series, YASKAWA Electric Corporation: MP900 Series (only RS-232C available)/MP2000 Series			
	Ethernet			• Numerical data output, and control input/output enabled. • Uploading and downloading program settings, simulations, data, including image data can be sent or received • 1000BASE-T/100BASE-TX/10BASE-T • Compatible with FTP server (when image archive is used)			
	USB			• Uploading and downloading programs settings, simulations, data, and images when using KEYENCE PC software. • USB2.0			
	CC-Link			• By connecting the optional CC-Link expansion module CA-NCL10E, numerical value input/output and control input/output are enabled. Do not use to connect to PLC-Link or EtherNet/IP. • Compatible to the Ver.1.10 remote device station, and Ver.2.00 remote device station			
	EtherNet/IP			• Numerical value and control input/output using the Ethernet port enabled. • Cyclic (implicit) communication (max. 1436 bytes) possible. • Explicit message communication possible.	• Maximum connections: 32. • In conformity with conformance test Version.A7 • Cannot be used in conjunction with PLC-link/CC-Link.		
	Handheld Controller			• By using the optional OP-84231 (OP-84236 blank version) direct interaction with the controller and program settings is possible. • Buttons can be assigned individual operations • Buttons can be activated/deactivated based on user groups			
Language				Japanese/English/Simplified Chinese/Traditional Chinese			
Illumination control				By connecting the optional illumination expansion module CA-DC20E, Control usage and intensity of LED illumination (12V, 24V) is possible			
Rating	Power supply voltage			24 VDC positive and negative to 10%			
	Current consumption			• 2.4 A (2 cameras at maximum load) • 3.2 A (4 cameras at maximum load)	• 2.2 A (2 cameras at maximum load) • 2.8 A (4 cameras at maximum load)	• 2.2 A (2 cameras at maximum load) • 2.6 A (4 cameras at maximum load)	
Environmental resistance	Ambient temperature			• For two cameras connected: 0 to 50°C 32 to 122 °F (0 to 45°C 32 to 113 °F with min. 1 mega-pixel camera connected) • For four cameras connected: 0 to 45°C 32 to 113 °F	0 to 50°C 32 to 122 °F	0 to 50°C 32 to 122 °F (With four cameras connected: 0 to 45°C 32 to 113 °F)	
	Ambient operating humidity			35 to 85% RH (no condensation)			
Weight				Approx. 1250 g		Approx. 1300 g	

*2 310,000 pixels when connecting XG-H035C/H035M, so 640 (H) x 480 (V) cannot be selected.
*3 In regard to the PNP output type, please contact KEYENCE.
*4 Models that install the Ethernet port to the CPU unit support Ethernet port direct connection.

SPECIFICATIONS (CAMERA)

Camera (XG-H500C/XG-H500M/XG-H200C/XG-H200M)

Model		Camera (XG-H500C/XG-H500M) *5	Camera (XG-H200C/XG-H200M) *5
CCD		2/3-inch color CCD image receiving element, 11x high-speed reading using square-pixel, 5,050,000 pixels (XG-H500C)/2/3-inch monochrome CCD image receiving element, 11x high-speed reading using square-pixel, 5,050,000 pixels (XG-H500M)/ Unit cell size 3.45 µm x 3.45 µm 0.14 x 0.14 Mil	1/1.8-inch color CCD image receiving element, 7x high-speed reading using square-pixel, 2,010,000 pixels (XG-H200C)/1/1.8-inch monochrome CCD image receiving element, 7x high-speed reading using square-pixel, 2,010,000 pixels (XG-H200M)/Unit cell size 4.4 µm x 4.4 µm 0.17 x 0.17 Mil
Resolution		4,990,000 pixels 2432 (H) x 2050 (V)	1,920,000 pixels 1600 (H) x 1200 (V) *6
Scanning system		Progressive (61.2 ms) Interlace: XG-H500M only (40.3 ms)	Progressive (29.2 ms: 2,000,000-pixel mode 24.2 ms: 1,000,000-pixel mode) Interlace: XG-H200M only (16.1 ms: 2,000,000-pixel mode 13.6 ms: 1,000,000-pixel mode)
Pixel transfer frequency		130 MHz (65 MHz x 2 ch)	82MHz (41MHz x 2 ch)
Transfer system		Digital serial transfer	
Electronic shutter		1/15, 1/30, 1/60, 1/120, 1/240, 1/500, 1/1000, 1/2000, 1/5000, 1/10000, 1/20000 0.05 msec to 9000 msec can be set with numeric values	
Lens mount		C mount	
Environmental resistance	Ambient temperature	0 to 40°C 32 to 104 °F	
	Relative humidity	35 to 85%RH (No condensation)	
Weight		Approx. 130 g (not including the lens)	

*5 Only the high-speed camera cable can be used (CA-CHxx).
*6 In 1,000,000-pixel mode 980,000-pixels (1024 x 960) serve as the processing area.

Camera (XG-H035C/XG-H035M)

Model		Camera (XG-H035C/XG-H035M) *7
CCD		1/3-inch color CCD image receiving element, 7x high-speed reading using square-pixel, 340,000 pixels (XG-H035C)/1/3-inch monochrome CCD image receiving element, 7x high-speed reading using square-pixel, 340,000 pixels (XG-H035M)/Unit cell size 7.4 µm x 7.4 µm 0.29 x 0.29 Mil
Resolution		310,000 pixels 640 (H) x 480 (V) *8
Scanning system		Progressive (4.7 ms) Interlace: XG-H035M only (2.5 ms)
Pixel transfer frequency		80MHz (40MHz x 2 ch)
Transfer system		Digital serial transfer
Electronic shutter		1/15, 1/30, 1/60, 1/120, 1/240, 1/500, 1/1000, 1/2000, 1/5000, 1/10000, 1/20000 0.05 msec to 9000 msec can be set with numeric values
Lens mount		C mount
Environmental resistance	Ambient temperature	0 to 40°C 32 to 104 °F
	Relative humidity	35 to 85%RH (No condensation)
Weight		Approx. 120 g (not including the lens)

*7 Only the high-speed camera cable can be used (CA-CHxx).
*8 In 310,000-pixel mode, 310,000 pixels (640 x 480) serve as the processing area. In 240,000-pixel mode, 240,000 pixels (512 x 480) serve as the processing area.

Camera (XG-200C/XG-200M/XG-S200C/XG-S200M)

Model		Camera (XG-200C/XG-200M) *9	Camera (XG-S200C/XG-S200M) *9
CCD		1/1.8-inch color CCD image receiving element, square-pixel/all-pixel reading, 2,010,000 pixels (XG-200C)/1/1.8-inch monochrome CCD image receiving element, square-pixel/all-pixel reading, 2,010,000 pixels (XG-200M)/Unit cell size 4.4 µm x 4.4 µm 0.17 x 0.17 Mil	1/1.8-inch color CCD image receiving element, square-pixel/all-pixel reading, 2,010,000 pixels (XG-S200C)/ 1/1.8-inch monochrome CCD image receiving element, square-pixel/all-pixel reading, 2,010,000 pixels (XG-S200M)/Unit cell size 4.4 µm x 4.4 µm 0.17 x 0.17 Mil
Resolution		1,920,000 pixels 1600 (H) x 1200 (V) *10	
Scanning system		Progressive (58.5 ms: 2,000,000-pixel mode 47.6 ms: 1,000,000-pixel mode) Interlace: XG-200M only (32.7 ms: 2,000,000-pixel mode 27.0 ms: 1,000,000-pixel mode)	Progressive (58.5 ms: 2,000,000-pixel mode 47.6 ms: 1,000,000-pixel mode) Interlace: XG-S200M only (32.7 ms: 2,000,000-pixel mode 27.0 ms: 1,000,000-pixel mode)
Pixel transfer frequency		40 MHz	
Transfer system		Digital serial transfer	
Electronic shutter		1/15, 1/30, 1/60, 1/120, 1/240, 1/500, 1/1000, 1/2000, 1/5000, 1/10000, 1/20000 0.05 msec to 9000 msec can be set with numeric values	
Lens mount		C mount	Special mount (M15.5 P0.5 male)
Environmental resistance	Ambient temperature	0 to 40°C 32 to 104 °F	Head: 0 to 40°C 32 to 104 °F, relay unit: 0 to 40°C 32 to 104 °F (however, 35°C 95 °F maximum in partial capturing 50 lines or lower)
	Relative humidity	35 to 85%RH (No condensation)	
Weight		Approx. 110 g (not including the lens)	Head: Approx. 210 g (including the cable, not the lens), relay unit: Approx. 70 g

*9 The camera cable CA-CN17/L/R (17 m 55.8') and repeater cable CA-CN 17X/17LX/RX (17 m 55.8') cannot be used.
*10 1,000,000-pixel mode 980,000 pixels (1024 x 960) serve as the processing area.

Camera (XG-035C/XG-035M/XG-S035C/XG-S035M)

Model		Camera (XG-035C/XG-035M)	Camera (XG-S035C/XG-S035M) *11
CCD		1/3-inch color CCD image receiving element, 2x high-speed reading using square-pixel, 350,000 pixels (XG-035C)/1/3-inch monochrome CCD image receiving element, 2x high-speed reading using square-pixel, 350,000 pixels (XG-035M)/Unit cell size 7.4 µm x 7.4 µm 0.29 x 0.29 Mil	1/3-inch color CCD image receiving element, 2x high-speed reading using square-pixel, 350,000 pixels (XG-S035C)/1/3-inch monochrome CCD image receiving element, 2x high-speed reading using square-pixel, 350,000 pixels (XG-S035M)/ Unit cell size 7.4 µm x 7.4 µm 0.29 x 0.29 Mil
Resolution		320,000 pixels 656 (H) x 492 (V) *12	
Scanning system		Progressive (16.0 ms) Interlace: XG-035M only (8.8 ms)	Progressive (16.0 ms) Interlace: XG-S035M only (8.8 ms)
Pixel transfer frequency		24.5 sMHz	
Transfer system		Digital serial transfer	
Electronic shutter		1/15, 1/30, 1/60, 1/120, 1/240, 1/500, 1/1000, 1/2000, 1/5000, 1/10000, 1/20000 0.05 msec to 9000 msec can be set with numeric values	
Lens mount		C mount	Special mount (M10.5 P0.5 male)
Environmental resistance	Ambient temperature	0 to 50°C 32 to 122 °F	Head: 0 to 50°C 32 to 122 °F, relay unit: 0 to 40°C 32 to 104 °F
	Relative humidity	35 to 85%RH (No condensation)	
Weight		Approx. 100 g (not including the lens)	Head: Approx. 160 g (including the cable, not the lens) relay unit: Approx. 70 g

*11 The camera cable CA-CN17/L/R (17 m 55.8') and repeater cable CA-CN 17X/17LX/RX (17 m 55.8') cannot be used.
*12 310,000-pixel mode 310,000 pixels (640 x 480) serve as the processing area. 240,000-pixel mode, 240,000 pixels (512 x 480) serve as the processing area.

Light control expansion module CA-DC20E

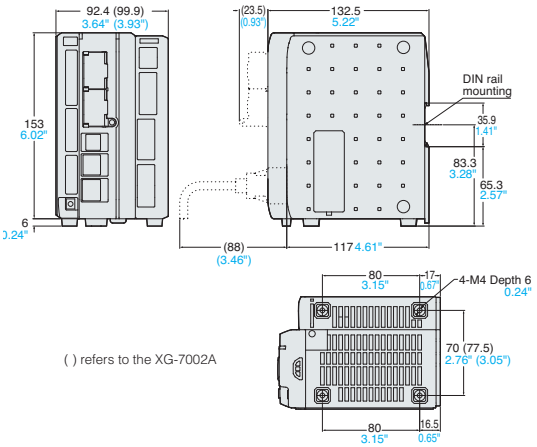
Output	Light control method	(1) Constant voltage control method (direct current light) (2) pulse width modulation method (emission frequency 100 kHz) [Controller setting conversion]
	Intensity range	255 level digital [Controller setting conversion]
	Number of connection points	2 CH (Enables LED connector connection and terminal block connection)
	Voltage	DC 12 V/DC 24 V [DIP switch conversion]
	Capacity	Maximum 40 W (however, 30 W/1 CH)
	Synchronization	FLASH output synchronization / continuous lighting [Controller setting conversion]
	Response speed	(1) Constant voltage control Under 10 ms During 12 V output Under 20 ms During 24 V output (2) pulse width modulation method Under 1 ms During 12/24 V output
Input	Forced light stop	Input rating maximum 26.4 V, minimum 2 mA
Display	LED display	Light intensity display green/orange (over 128) Error displayed red (all lit)
Rating	Power voltage	DC 24 V ±10%
	Power consumption	3.0 A (12 V output at maximum load) 6.5 A (24 V output at maximum load)
Environmental resistance *13	Ambient temperature	0 to 50°C 32 to 122 °F *14
	Relative humidity	35 to 85%RH (No condensation)
Weight		Approx. 590 g

*13 The environmental resistance of the LED lighting is ambient temperature of 0 to 40°C 32 to 104 °F, relative humidity 35 to 65% (no condensation)
*14 You will be restricted by the ambient temperature tolerance of the connected controller

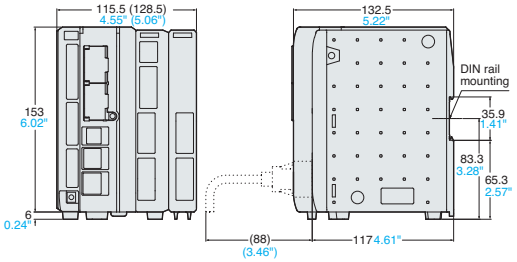
DIMENSIONS

Unit: mm inch

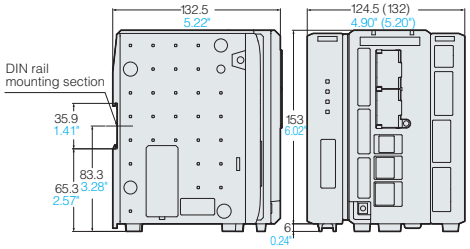
Controller
XG-7702(P)/7502(P)/7002(P)



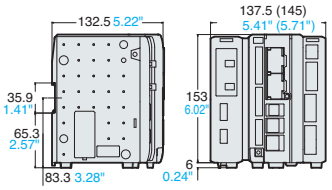
When mounting camera expansion module
XG-E700



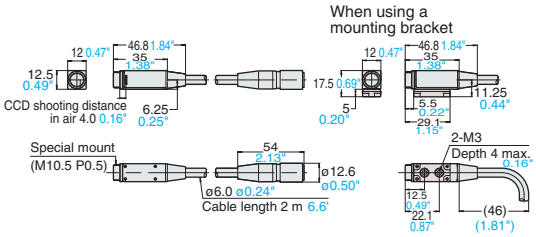
When mounting CC-Link module
CA-NCL10E



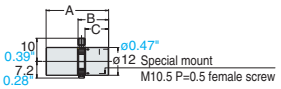
When mounting light expansion module
CA-DC20E



Camera
XG-S035CH/XG-S035MH

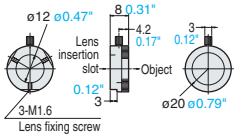


Lens CA-LSx

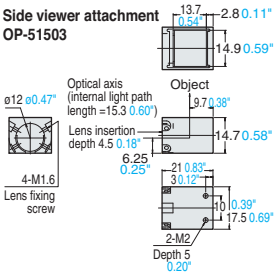


	CA-LS4	CA-LS6	CA-LS16	CA-LS30
A	16.7 0.66"	21.3 0.84"	20.4 0.80"	27 1.06"
B	11.5 0.45"	15.9 0.63"	10.2 0.40"	13.2 0.52"
C	8.5 0.33"	12.9 0.51"	7.2 0.28"	10.2 0.40"

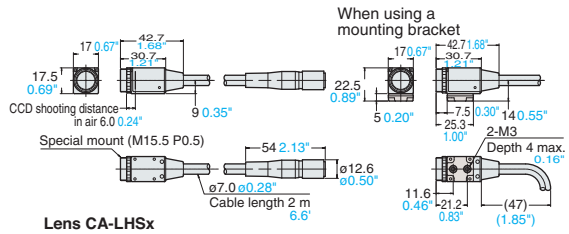
Polarization filter OP-51502



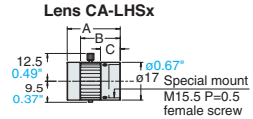
Side viewer attachment OP-51503



Camera
XG-S200CH/XG-S200MH

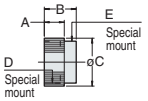


Lens CA-LHSx



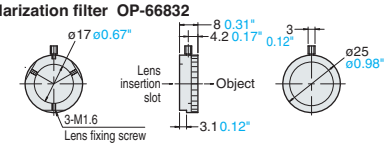
	CA-LHS8	CA-LHS16	CA-LHS25	CA-LHS50
A	40.4 1.59"	23.9 0.94"	24.9 0.98"	40.4 1.59"
B	28.6 1.13"	17.9 0.7"	18.6 0.73"	27.1 1.07"
C	19.6 0.77"	8.9 0.35"	9.6 0.38"	18.1 0.71"

Close-up ring OP-51500 (5 mm 0.20")/ OP-51501 (10 mm 0.39")/ OP-66830 (5 mm 0.20")/ OP-66831 (10 mm 0.39")

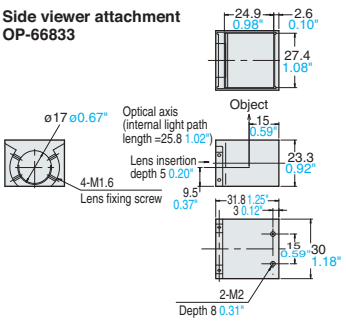


	OP-51500	OP-51501	OP-66830	OP-66831
A	5 0.20"	10 0.39"	5 0.20"	10 0.39"
B	8 0.31"	13 0.51"	8 0.31"	13 0.51"
C	12 0.47"	12 0.47"	17 0.67"	17 0.67"
D	M10.5 P=0.5 female screw		M15.5 P=0.5 female screw	
E	M10.5 P=0.5 male screw		M15.5 P=0.5 male screw	

Polarization filter OP-66832



Side viewer attachment OP-66833

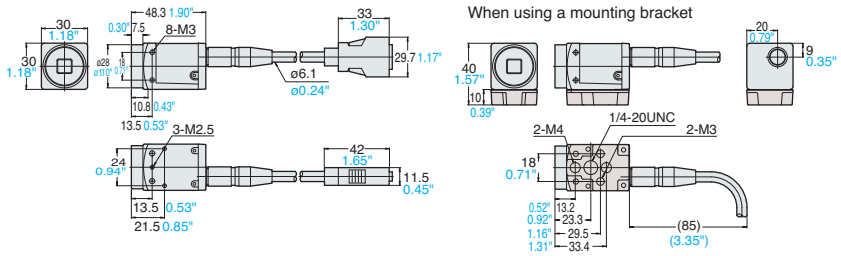


DIMENSIONS

Unit: mm inch

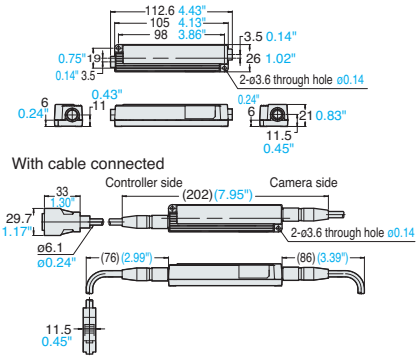
Camera

XG-035C/XG-035M



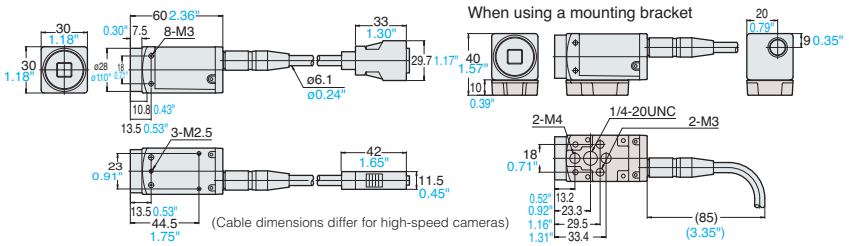
Camera control unit

XG-S200CU/XG-S200MU/XG-S035CU/XG-S035MU



Camera

XG-H500C/XG-H500M/XG-H200C/XG-H200M/XG-200C/XG-200M/XG-H035C/XG-H035M

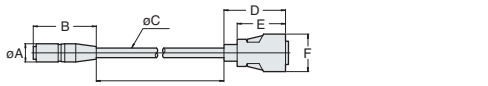


Camera cable
CA-CN1 (1 m) 3.3' / CA-CN3 (3 m) 9.8' / CA-CN5 (5 m) 16.4' / CA-CN10 (10 m) 32.8' / CA-CN17 (17 m) 55.8'

High-flex camera cable
CA-CN3R (3 m) 9.8' / CA-CN5R (5 m) 16.4' / CA-CN10R (10 m) 32.8' / CA-CN17R (17 m) 55.8'

Cable dedicated for high-speed cameras
CA-CH3 (3 m) 9.8' / CA-CH5 (5 m) 16.4' / CA-CH10 (10 m) 32.8'

High-flex cable dedicated for high-speed cameras
CA-CH3R (3 m) 9.8' / CA-CH5R (5 m) 16.4' / CA-CH10R (10 m) 32.8'

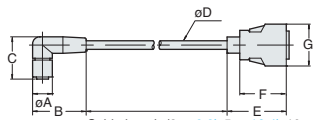


Cable length (1 m 3.3', 3 m 9.8', 5 m 16.4', 10 m 32.8', 17 m 55.8')

	A	B	C	D	E	F
CA-CNx	12.5 0.49"	43 1.69"	6.1 0.24"	42 1.65"	33 1.30"	29.7 1.17"
CA-CNxR	14.0 0.55"	54 2.13"	6.6 0.26"	42 1.65"	33 1.30"	29.7 1.17"
CA-CHx	12.5 0.49"	43 1.69"	7.2 0.28"	41 1.61"	31 1.22"	31.4 1.24"
CA-CHxR	14.0 0.55"	54 2.13"	7.6 0.30"	41 1.61"	31 1.22"	31.4 1.24"

L-shaped connector camera cable
CA-CN3L (3 m) 9.8' / CA-CN5L (5 m) 16.4' / CA-CN10L (10 m) 32.8' / CA-CN17L (17 m) 55.8'

L-shaped connector cable for high-speed cameras
CA-CH3L (3 m) 9.8' / CA-CH5L (5 m) 16.4' / CA-CH10L (10 m) 32.8'



Cable length (3 m 9.8', 5 m 16.4', 10 m 32.8', 17 m 55.8')

	A	B	C	D	E	F	G
L-shaped connector camera cable CA-CNxL	14 0.55"	38 1.50"	30 1.18"	6.1 0.24"	42 1.65"	33 1.30"	29.7 1.17"
L-shaped connector cable for high-speed cameras CA-CHxL	14 0.55"	38 1.50"	30 1.18"	7.2 0.28"	41 1.61"	31 1.22"	31.4 1.24"

Please refer to the "Vision System Peripheral Equipment catalog" in regards to any dimensional diagrams of additional devices that have not been included here.

Additional KEYENCE Vision Systems

STANDARD TYPE

CV-5000 Series

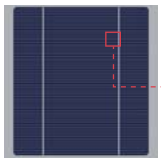
INDUSTRY LEADING SYSTEM

- Multiple vision processing and image enhancement tools
- High performance 3+1 processing architecture
- Sophisticated blur and shading correction filters

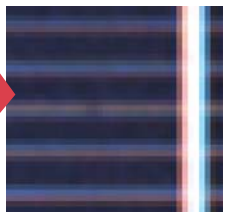
11x Ultra High Speed 5 Megapixel Camera

11x 5MEGA DIGITAL

Full support for 4x ultra high speed 5 Megapixel cameras for unsurpassed high accuracy image processing.



Solar Cell Inspection



Conventional (310,000 pixel) camera: The defect cannot be recognized

5 Megapixel camera: The break in the pattern is clearly visible

Expandable Architecture

eXpandable CONTROLLER

Eliminate the need for wiring and complex PLC programs with KEYENCE's unique expandable controller design. Giving you the ability to control lighting and I/O all in one system and program.

Trend Edge Defect Detection

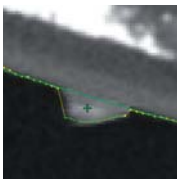
Packaged with the industries original "Trend Edge Defect" detection for easy detection of chips and burrs.

Burr/chip detection of a plastic mold

Outline trace image

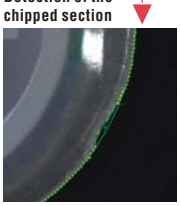
The target profile is automatically detected and the free curve model line calculated accordingly (shown in green).

Detection of the burr section



The burred section deviates from the model line, and is therefore detected as a flaw.

Detection of the chipped section



Even very moderate chips that were conventionally difficult to detect can now be reliably detected.

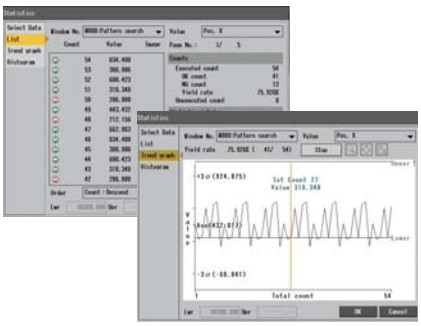
BASIC TYPE

CV-3000 SO Series

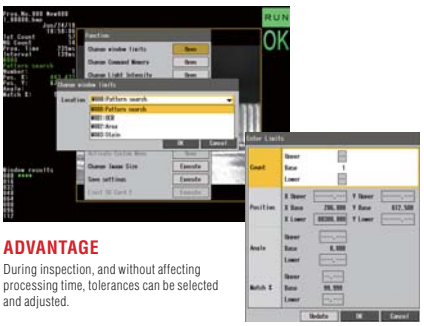
LOADED WITH FUNCTIONALITY AND UTILITIES PERFECTED FROM THE CV-5000 AND CV-3000 SERIES

Statistical Functions

Verify inspections and adjust limits based on statistical data.



Real-time Limit Adjustment

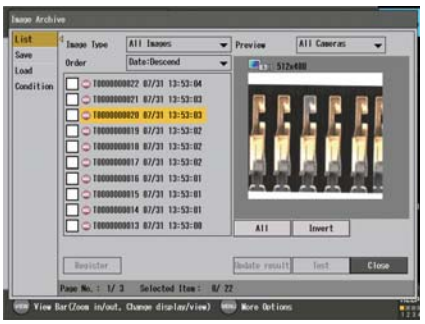


ADVANTAGE

During inspection, and without affecting processing time, tolerances can be selected and adjusted.

Image Archive

Store, evaluate, re-test and adjust settings based on archived images



After Sales Support

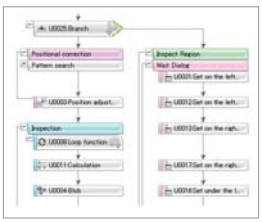
Here at KEYENCE we pride ourself on the quality of our after sales support on all our products and the XG-7000 Series is no exception. We offer many different types of support to assist with using KEYENCE's range of machine vision systems. In addition to our technically trained workforce, support services include: free training workshops, free software upgrades, example programs, technical guides, online resources and dedicated technical support.

XG-7000 User Support Webpage http://www.visionsystem.com

In addition to the standard KEYENCE websites, there is a dedicated XG-7000 Series support website that is specifically designed for providing answers to questions, example programs and software to assist any XG-7000 user.

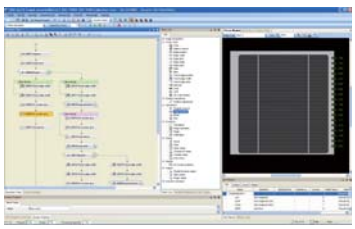
Example programs

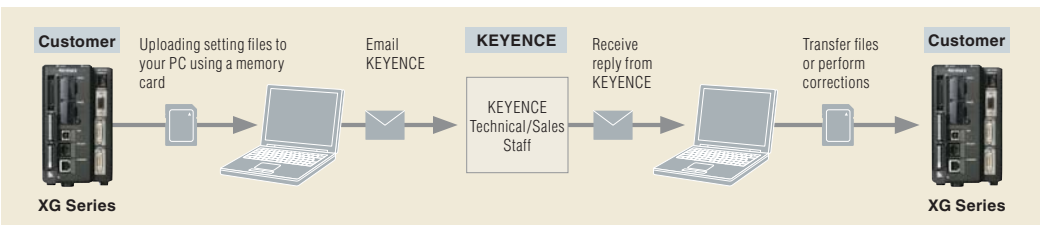
Example programs can be downloaded with easy to use instructions enabling you to benefit from and gain experience on all the XG-7000 Series has to offer.



Free remote support and testing with the XG Simulator+

The "XG Simulator+" software can be downloaded free of charge from the XG-7000 User Support webpage enabling remote testing and support of any XG 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.





KEYENCE

CALL TOLL FREE | TO CONTACT YOUR LOCAL OFFICE 1-888-KEYENCE 1-888-539-3623

www.keyence.com

SAFETY INFORMATION
Please read the instruction manual carefully in order to safely operate any KEYENCE product.

KEYENCE CORPORATION OF AMERICA

Corporate Office 669 River Drive, Suite 403, Elmwood Park, NJ 07407 PHONE: 201-930-0100 FAX: 201-930-0099 E-mail: keyence@keyence.com
Sales & Marketing Head Office 1100 North Arlington Heights Road, Suite 350, Itasca, IL 60143 PHONE: 888-539-3623 FAX: 630-285-1316

■ Regional offices

AL	Birmingham	CO	Denver	IN	Indianapolis	MI	Detroit	NJ	Elmwood Park	OH	Cincinnati	SC	Greenville	TX	Dallas
CA	N.California	FL	Tampa	KS	Kansas City	MI	Grand Rapids	NY	Rochester	OH	Cleveland	TN	Knoxville	VA	Richmond
CA	Los Angeles	GA	Atlanta	KY	Louisville	MN	Minneapolis	NC	Charlotte	OR	Portland	TN	Nashville	WA	Seattle
		IL	Chicago	MA	Boston	MO	St. Louis	NC	Raleigh	PA	Philadelphia	TX	Austin		

KEYENCE CANADA INC.

Head Office PHONE: 905-696-9970 FAX: 905-696-8340 E-mail: keyencecanada@keyence.com
Montreal PHONE: 514-694-4740 FAX: 514-694-3206

KEYENCE MEXICO S.A. DE C.V.

PHONE: +52-81-8220-7900 FAX: +52-81-8220-9097
E-mail: keyencemexico@keyence.com

KEYENCE GLOBAL HEADQUARTERS

1-3-14, Higashi-Nakajima, Higashi-Yodogawa-ku, Osaka, 533-8555, Japan PHONE: +81-6-6379-2211

KA1-1011

XG-KA-C2-E 1021-4 611444 Printed in Japan