INLINE 3D MAKES NEW INSPECTIONS POSSIBLE
3D Inspection Makes the Impossible Possible

Robust

× OCR
× Orientation
× Presence/Absence

THE ONLY COMPLETE 3D SOLUTION

3 Keys to 3D Success

Character inspection on black rubber.
The LJ-V (Laser profile scanner) enables stable detection of various workpieces with ultra-high speed profiling of 64,000 profiles per second. 3D image processing is available for almost any workpiece by processing the profile data using the CV-X/XG-X Series.

**Accurate**

- ×3D Measurement
- ×Flatness and Warpage
- ×Multiple Calculation

**BEST LASER PROFILING TECHNOLOGY**
**BEST 3D IMAGE PROCESSING**
**BEST PRESENTATION WITH ENCODER**

Coplanarity and pitch measurement

**NEW**

*Inline 3D Inspection Image Processing System*
LJ-V connection-compatible
CV-X Series/XG-X Series
Height/dimension inspection

Improving yields by visualizing height information

2D inspection

Low contrast inspection of characters on a metal surface

Reading was not stable using only intensity information.

Not affected by background or noise

3D inspection solves it!

Canceling uneven backgrounds allows for stable OCR inspection.

Coplanarity inspection of electronic components

With 2D inspection, it is impossible to determine height information.

Quantifying height information

3D inspection solves it!

3D inspection of the terminals allows for judgment based on height.
Profile inspection

Ensuring stable detection through inspection using both intensity and height information

Inspection of solder fillet

2D inspection

Excessive solder

Inspection was not stable using only intensity information.

Checking X, Y, and Z with one unit

3D inspection solves it!

Adding the height (Z) information to X/Y information enables inspection using volume or cross sectional area.

Profile inspection of adhesive applications

2D inspection

Dependng on the background color, low contrast inspection is not stable.

Not affected by contrast

3D inspection solves it!

Unlike conventional detection based on contrast differences in intensity information, profile changes and breaks can be detected easily.
The CV-X/XG-X 3D image processing system enables processing that was impossible with the LJ-V profile scanner only.

**LJ-V7200**

- **Inspection of pock and dent shapes on rubber-coated cables**
  - **Conventional laser displacement sensor** Difficult to detect dents on curved surfaces and gentle depressions.
  - **LJ-V + CV-X/XG-X** Ensures stable detection even for high-speed production lines.

**LJ-V7060**

- **Inspection of width, height, and volume of sealants**
  - **Conventional laser displacement sensor** Difficult to inspect area and volume with displacement sensors.
  - **LJ-V + CV-X/XG-X** Enables flexible inspection of height, width, and volume, etc.

**LJ-V7300**

- **Measurement of flatness of clutch plates**
  - **Conventional contact-type displacement sensor and laser displacement sensor** Difficult to perform stable inspection due to the influence of the overall waviness or inclination of each product.
  - **LJ-V + CV-X/XG-X** Ensures stable inspection by individually correcting variation among products.
A combination with the LJ-V profile scanner enables detection that used to be impossible with image processing only.

**LJ-V7080**

- **Shape inspection of welding on tailored blanks**
  - Conventional camera: Inspection with cameras was difficult due to the unstable surface condition of workpieces.
  - LJ-V + CV-X/XG-X: Stable inspection is possible without being influenced by the surface condition of workpieces.

**LJ-V7060**

- **OCR for card numbers**
  - Conventional camera: OCR was difficult due to the influence of the background.
  - LJ-V + CV-X/XG-X: Stable OCR is possible on any kind of card.

**LJ-V7060**

- **Inspection of soldering bridge/volume**
  - Conventional camera: Inspection was difficult due to the influence of PCB patterns and soldered surface conditions.
  - LJ-V + CV-X/XG-X: Ensures inspection of presence, bridge, and volume of soldering.
The laser light is projected in a horizontal line by the cylindrical lens and diffusely reflects on the target object. This reflected light is formed on the HSE3-CMOS and by detecting changes in position and shape, profile shapes are measured. These profile shapes are then transferred to the CV-X/XG-X controller to achieve image processing using 3D data.

**Making stable measurements of any target possible even at ultra high speed**

**HSE3-CMOS**  
*HS = High Speed, E3 = Enhanced Eye Emulation*

The LJ-V7000 Series is equipped with the newly developed HSE3-CMOS. In addition to improved speed, the dynamic range has been further improved over the established and conventional E3-CMOS. Even with the extremely short exposure time of 64 kHz (15.6 μs) it has achieved sensitivity that allows it to reliably measure a range of surfaces from black (small amount of reflection) surfaces to those with luster (large amount of reflection) due to its wide dynamic range.

**Stopped target**

- **Conventional model**  
  Measurement is impossible due to insufficient light intensity.

- **LJ-V HSE3-CMOS**  
  All ranges could be measured.

**Moving target**

**DYNAMIC RANGE 2400x**

- Because there is even less light intensity, the measurement could not be performed at all.

- Even though the exposure time is short, all ranges could be measured without issue.
## Blue laser optical system

The LJ-V7000 Series is the first 2D laser displacement sensor in the world to adopt a blue laser. A sharp line beam is formed on the light-receiving element by focusing a short wavelength 405 nm laser to its maximum limit with a 2D Ernostar lens. This generates a stabilized high-precision profile. Also, the received light density for the laser has been increased to successfully secure a greater level of received light intensity. This achieves ultra-stable and highly accurate measurement with all types of targets that are typically difficult to detect.

## Double polarization function

We have developed the world’s first double polarization function, which distinguishes and cancels multiple reflection light that acts as an obstacle to measurement. Light is shined on the intersection between the X-polarization and Y-polarization to calculate differences in the amount of received light for each unit of image capture data. Multiple reflection light has the characteristic of generating differences in the amount of received light for X-polarization and Y-polarization, and this characteristic is used to cancel data for areas that have large differences. The power of this function is demonstrated in the measurement of metals with complex shapes and complicated areas.

### Actual example

- **Conventional model**
  - Captured image
  - The strong influence of the diffuse reflected light causes errors in the data.
- **LJ-V Series**
  - Captured image
  - LJ-V Series cancels the diffuse reflected light to perform stable measurements.
A new input unit (CA-E100LJ/E110LJ) has been developed that can be connected directly to the LJ-V head. This allows the LJ-V to be set from the CV-XG-X controller.

**LJ-V head direct connection**

Configuring the LJ-V settings

The settings of the LJ-V head can be completed with the CV-XG-X controller. Since settings changed within the image capture unit are reflected in the height image in real time, optimum settings can be made quickly.

Profile capture setting

The wave pattern of a received-light image can also be displayed with the CV-XG-X controller.

**Line scan interval adjustment function**

This tool calculates the line scan interval to display a captured image with an aspect ratio of 1:1. The optimum method can be selected, including conversion from measurement results and actual dimensions or calculation from encoder specifications.

Enter necessary information and press the “Parameter Calculation” button, and the interval is adjusted to achieve an equal XY ratio!
**3D controller display**

The controller can display 3D images in various program settings. 3D display is possible even on the operation screen, which provides flexible operation views such as side-by-side display of images before and after measurement processing.

**Operation screen**

An image after height extraction and a 3D image are displayed side-by-side and updated for every measurement.

**Zero plane display**

The zero plane used for measurement (measurement reference plane) can also be displayed as an on-screen graphic. This allows visual confirmation of measurement status.

**3D observation utilities**

Specify a desired profile for the captured height image to observe details. A number of tools are included to allow you to check the height or height difference on the profile with easy operations. This allows simple inspection and setting optimization.

**The following measurements are possible for an arbitrary profile line:**

- Height
- Level Difference
- Position
- Center Position
- Width
- Angle from Horizontal
- Angle Formed by Two Lines
- Radius of Circle
- Cross-Section Area
- Points Distance
- Point/Line Distance

**Measurement example 1: Cross-Section Area**

**Measurement example 2: Level Difference**

**Measurement example 3: Points Distance**
Easy 3D Shape and Appearance Inspection

Inline visualization and quantification of 3D shapes

3D dimensions/geometry

In most cases, dimension and geometry measurement based on image processing requires complicated arithmetic processing. The XG-X Series offers the 3D Dimensions/Geometry tool category to complete this complicated processing simply by clicking on the image. Pre-defined point/line information of other tools can also be referenced, so that inspection settings can be configured for simpler and easier operation.

- Perform 3D geometric operations for complex-shaped objects with ease

<table>
<thead>
<tr>
<th>Calculation Type</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>Points Distance, Point/Line Distance, Point/Plane Distance, Lines Distance, Line/Plane Distance, Planes Distance</td>
</tr>
<tr>
<td>Angle</td>
<td>Angle Between Two Lines, Angle Between Line and Plane, Angle Between Two Planes</td>
</tr>
<tr>
<td>Point</td>
<td>Point, Intersection of Two Lines, Line/Plane Intersection, Midpoint of Points, Point Between Point and Line, Intersection of Point/Line, Intersection of Point/Plane</td>
</tr>
<tr>
<td>Line</td>
<td>Line, Line Defined by Two Points, Center Line Between Point and Plane, Line Projection onto Plane, Line Between Planes</td>
</tr>
<tr>
<td>Plane</td>
<td>Plane, Center Plane Between Two Points, Center Plane Between Point and Plane, Plane Determined by Point and Line, Plane Determined by Two Lines</td>
</tr>
<tr>
<td>Sphere</td>
<td>Sphere</td>
</tr>
</tbody>
</table>
Incorporated measurement tool capable of capturing actual shapes

Profile measurement / Continuous profile measurement  
XG-X Only

Challenges with conventional methods (using general-purpose 2D profile measurement)

- Because the position where the cross-section profile can be obtained is fixed, the target must be fixed using a jig or other means.
- Cross-section profiles can only be obtained from one direction.

With 3D profile measurement

- Corrections can be performed according to the position of the target, allowing for accurate measurement of the same location regardless of how the target is positioned.
- Cross-section profiles can be obtained from any position and at any angle.

Position adjustment for accurate measurement of the same location feature even if the position of the target varies

- LEVEL DIFFERENCE
  - Measures the height difference from a reference point to a measurement point.

- DEFECT DETECTION
  - Determines any deviation from the reference line to the profile line within the measurement range and measures the area of each deviation.

15 different measurement tools to cover all assumed 3D dimension inspections

Profile inspection in up to 16,384 sections within a single area for recognition of extremely small changes  
XG-X Only

Profile measurement can be performed continuously for obtained cross sectional shapes and 3D shapes. This tool is effective for inspecting welding seams and other continuous targets as well as targets that need to be inspected from all angles such as solder. It can measure multiple cross sectional views to extract subtle changes in the profile.

Profile inspection of welding

Profile inspection of solder

- This tool continuously measures height or cross sectional area and calculates the difference between the maximum and minimum values to achieve stable inspection.
- This tool can inspect the shape of solder from 360 degrees to extract subtle surface changes.
Vibration correction

Vibrations that occur during workpiece transfer and others are analyzed in real time, making it possible to extract only the necessary data.

Conventionally

After Processing

Vibrations that occur during workpiece transfer were included in the measured data.

The vibrational components are removed and it is possible to obtain the true shape of the workpiece.

2-head dead angle cut

This makes it possible to generate high-precision 3D images without noises and dead angles that exceed the limit of the triangulation system.
**Spike noise cut**

A sudden spike-shaped noise is eliminated, making stable measurements possible.

<table>
<thead>
<tr>
<th>Conventionally</th>
<th>Spike Noise Cut</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurements may become unstable due to spike-shaped noises occurring in such areas as the workpiece end face.</td>
<td>Spike noises alone are removed, realizing stable measurements.</td>
</tr>
</tbody>
</table>

**Simultaneous acquisition of grayscale image**

By acquiring the grayscale image from the LJ-V, inspections and position adjustment are made possible.

**Height Image**

**Grayscale Image**

By acquiring the height image and grayscale image simultaneously, such things as character inspection and position adjustment using the image of a part without height difference become possible. This makes a wider range of applications possible.

*Note: This function is supported in particular models only. For details, please inquire of our sales representatives.*

**Programmable Encoder**

The number of pulses/rev. can be freely set making it possible to easily obtain the best 1:1 image ratio possible.

(Setting can be configured freely between 64 and 150000 pulses per rotation.)

Unlike with conventional products, there’s no need to select encoders based on such aspects as the rotation speed of the shaft, the roller diameter, and consideration for the field of view.

- **High-resolution, high-speed output**
  Support for up to 150000 pulses/revolution allow for high-resolution output at a minimum of 0.0024° (8.64 seconds). High-speed output is also possible at a maximum output frequency of 1.6 MHz.

- **IP65-compatible**
  Added consideration for environmental resistance has resulted in a design that is even more resistant to water and dust, making devices easier to use in the workplace. (This does not include the head or shaft area.)

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

**Controller setting screen**

The number of pulses/rev. can be freely set making it possible to easily obtain the best 1:1 image ratio possible.

(Setting can be configured freely between 64 and 150000 pulses per rotation.)

Unlike with conventional products, there’s no need to select encoders based on such aspects as the rotation speed of the shaft, the roller diameter, and consideration for the field of view.

**Installation image**

**Dedicated encoder**

**CA-EN100H**
Height Measurement Tool

Measuring height, area, and volume from 3D data

Inspection using 16-bit height data is processed. Simply by setting a region to inspect, maximum height, minimum height, convex area, concave area, convex volume, concave volume and others can be measured. More flexible inspection is achieved by specifying an arbitrary plane on the screen as the zero plane.

Zero plane specification

As the reference plane for height measurement, a “zero plane” can be specified separately for each workpiece. This always ensures stable measurement even if workpieces change their orientation. You can also specify a different reference plane for each measurement point. In addition, setting a free-form plane for zero plane specification is also possible. This allows for calculation of such properties as height and depth on a curved surface.

Before correction

After correction

Even if a workpiece is inclined, the zero plane is automatically set according to the workpiece to obtain an accurate shape.

Height and volume of burrs can be measured even on metal curved-surfaces using the free-form plane as a reference surface.

3D enables inspection beyond the limits of image processing

Easy detection with 3D measurement

3D measurement makes it easy to detect flaws that used to be difficult to detect without advanced lighting techniques. Flaws can be inspected with their real depth.
Based on 3D data, a grayscale image is automatically generated with emphasis on the height you want to check. This allows you to continuously use all conventional leading CV-X/XG-X functions.

Targets hard to detect with conventional image processing can now be detected by combining, for example, free-form plane extraction and OCR.

Area cameras cannot detect dents because images are shaded due to the influence of complex curves and surface irregularities. Inspection becomes possible by extracting height change of points based on the information of a free-form plane.

Supports 3D viewer using the controller
Real-time 3D display is possible using the controller. The 3D viewer allows more reliable settings and more visible operations as well as a zero plane display.

Image Region Generator Tool
Creates a dynamic region according to height
This tool converts a specified height range into a virtual inspection region. Even if a workpiece shape changes, a region is automatically created accordingly.

All of the CV-X/XG-X’s conventional functions can still be used by converting 3D data to grayscale images
Height extraction
Based on 3D data, a grayscale image is automatically generated with emphasis on the height you want to check. This allows you to continuously use all conventional leading CV-X/XG-X functions. Targets hard to detect with conventional image processing can now be detected by combining, for example, free-form plane extraction and OCR.

Also supports difficult-to-detect workpieces by extracting concavities and convexities from free-form plane shapes
Area cameras cannot detect dents because images are shaded due to the influence of complex curves and surface irregularities. Inspection becomes possible by extracting height change of points based on the information of a free-form plane.
**Hardware**

- **Head unit**
  - Ultra high-accuracy specular reflection: LJ-V7020K/LJ-V7020B
  - Ultra high-accuracy: LJ-V7020/LJ-V7020B
  - High-accuracy specular reflection: LJ-V7060K/LJ-V7060KB
  - High-accuracy: LJ-V7060/LJ-V7060B

**Measurement range**
- Width: 39 mm 1.54" ±0.06"
- Width: 32 mm 1.26" ±0.05"
- Width: 25 mm 0.98" ±0.04"
- Width: 13.5 mm 0.53" ±0.02"

**Profile data**
- X-axis: 20 μm 0.0000788" ±0.0000056" ±0.0000037"
- X-axis: 5 μm 0.0000197" ±0.0000013" ±0.0000008"

**Repeatability**
- X-axis: 0.4 μm 0.0000167" ±0.0000053" ±0.0000034"
- X-axis: 5 μm 0.0000197" ±0.0000013" ±0.0000008"

**Middle range**
- LJ-V7080/LJ-V7080B

**Measurement range**
- Width: 62 mm 2.44" ±0.15" ±0.09"

**Profile data**
- X-axis: 50 μm 0.001969" ±0.000126" ±0.000079"

**Repeatability**
- X-axis: 0.5 μm 0.0000267" ±0.0000158" ±0.0000098"

**Long range**
- LJ-V7200/LJ-V7200B

**Measurement range**
- Width: 240 mm 9.45" ±0.15" ±0.09"

**Profile data**
- X-axis: 100 μm 0.003937" ±0.000236" ±0.000145"

**Repeatability**
- X-axis: 1 μm 0.0000407" ±0.0000263" ±0.0000158"

**Ultra long range**
- LJ-V7300/LJ-V7300B

**Measurement range**
- Width: 446 mm 17.52" ±0.15" ±0.09"

**Profile data**
- X-axis: 300 μm 0.011811" ±0.007884" ±0.004706"

**Repeatability**
- X-axis: 5 μm 0.0000197" ±0.0000123" ±0.0000078"

The model with B at the end is Luminance output type.
**SYSTEM CONFIGURATION (CV-X482F/XG-X2802+LJ-V)**

![Diagram showing system configuration](image)

**Specifications of mixed connection for CV-X482F/XG-X2802**

Combination of CV-X482F/XG-X2802 and CA-E100LJ/E110LJ

<table>
<thead>
<tr>
<th>CV-X482F/XG-X2802 + CA-E100LJ/E110LJ</th>
<th>CV-X482F/XG-X2802 + CA-E100LJ/E110LJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA-E100LJ/E110LJ</td>
<td>CA-E100</td>
</tr>
</tbody>
</table>

21 megapixel cameras cannot be connected when LJ-V is connected with CV-X482F
Controller

CV-X482F/CV-X482LJ

XG-X2802/XG-X2802LJ

Head

LJ-V head

High-speed 2D/3D Laser Scanner

LJ-V Series

Options

Cable for LJ-V Series

LJ-V head connection cable

CB-B5E (5 m 16.4"

CB-B10E (10 m 32.8"

CB-B20E (20 m 65.6"

Expansion unit

LJ-V input unit

CA-E100LJ/E110LJ

Area camera input unit

CA-E100

LED light control expansion unit

CA-DC40E

LumiTrax™ supporting light control expansion unit

CA-DC50E

CC-Link unit

CA-NCL20E

Monitor/touch panel

Multi-touch enabled 12" touch panel

CA-MP120T

12" LCD color monitor

CA-MP120

Monitor stand for CA-MP120T/MP120

OP-87262

Screen protector for CA-MP120T

OP-87263

Pole-mounting bracket for CA-MP120T/MP120

OP-42279

Touch Panel Cable

OP-87255 (3 m 9.8"

OP-87529 (10 m 32.8"

RGB monitor cable

OP-86842 (3 m 9.8"

OP-87055 (10 m 32.8"

* Refer to page 18 for details.
### Communication cable

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Model</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extension I/O cable</td>
<td>OP-51657</td>
<td>3 m 9.8”</td>
</tr>
<tr>
<td>Communication cable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9-pin: OP-26486</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-pin: OP-26485</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9-pin SYSMAC: OP-84384</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9-pin MELSEC: OP-86930</td>
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</tr>
</tbody>
</table>

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

### RS-232 communication cable

<table>
<thead>
<tr>
<th>Model</th>
<th>Length</th>
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</thead>
<tbody>
<tr>
<td>OP-26487</td>
<td>2.5 m 8.2”</td>
</tr>
</tbody>
</table>

**Note:** For the MELSEC-FX model OP-26486.

### Ethernet cable

<table>
<thead>
<tr>
<th>Model</th>
<th>Length</th>
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</thead>
<tbody>
<tr>
<td>OP-66843</td>
<td>3 m 9.8”</td>
</tr>
</tbody>
</table>

### USB cable

<table>
<thead>
<tr>
<th>Model</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>OP-66844</td>
<td>2 m 6.6”</td>
</tr>
</tbody>
</table>

### Other

<table>
<thead>
<tr>
<th>Component</th>
<th>Model</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image processing system integration software</td>
<td>XG-H1XA</td>
<td></td>
</tr>
<tr>
<td>SD card (industrial grade)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 GB: CA-SD16G</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 GB: CA-SD4G</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 GB: CA-SD1G</td>
<td></td>
<td></td>
</tr>
<tr>
<td>512 MB: OP-87133</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handheld controller (USB)</td>
<td>OP-87983</td>
<td>Dedicated to the XG-X2802</td>
</tr>
<tr>
<td>Dedicated mouse</td>
<td>OP-87506</td>
<td>Mouse stand</td>
</tr>
<tr>
<td>Dedicated mouse</td>
<td>OP-87601</td>
<td></td>
</tr>
<tr>
<td>24 VDC power supply</td>
<td>CA-U4/U5</td>
<td></td>
</tr>
<tr>
<td>Dedicated encoder</td>
<td>CA-EN100H</td>
<td></td>
</tr>
<tr>
<td>Encoder relay unit</td>
<td>CA-EN100U</td>
<td></td>
</tr>
<tr>
<td>Encoder head cable</td>
<td>CA-EN5 (5 m 16.4”)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA-EN10 (10 m 32.8”)</td>
<td></td>
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</tbody>
</table>