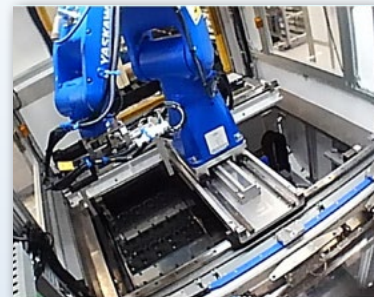
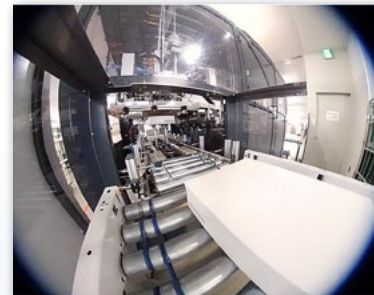


Using Cameras with a PLC Troubleshooting Case Study

Programmable Controller
KV-8000A Series

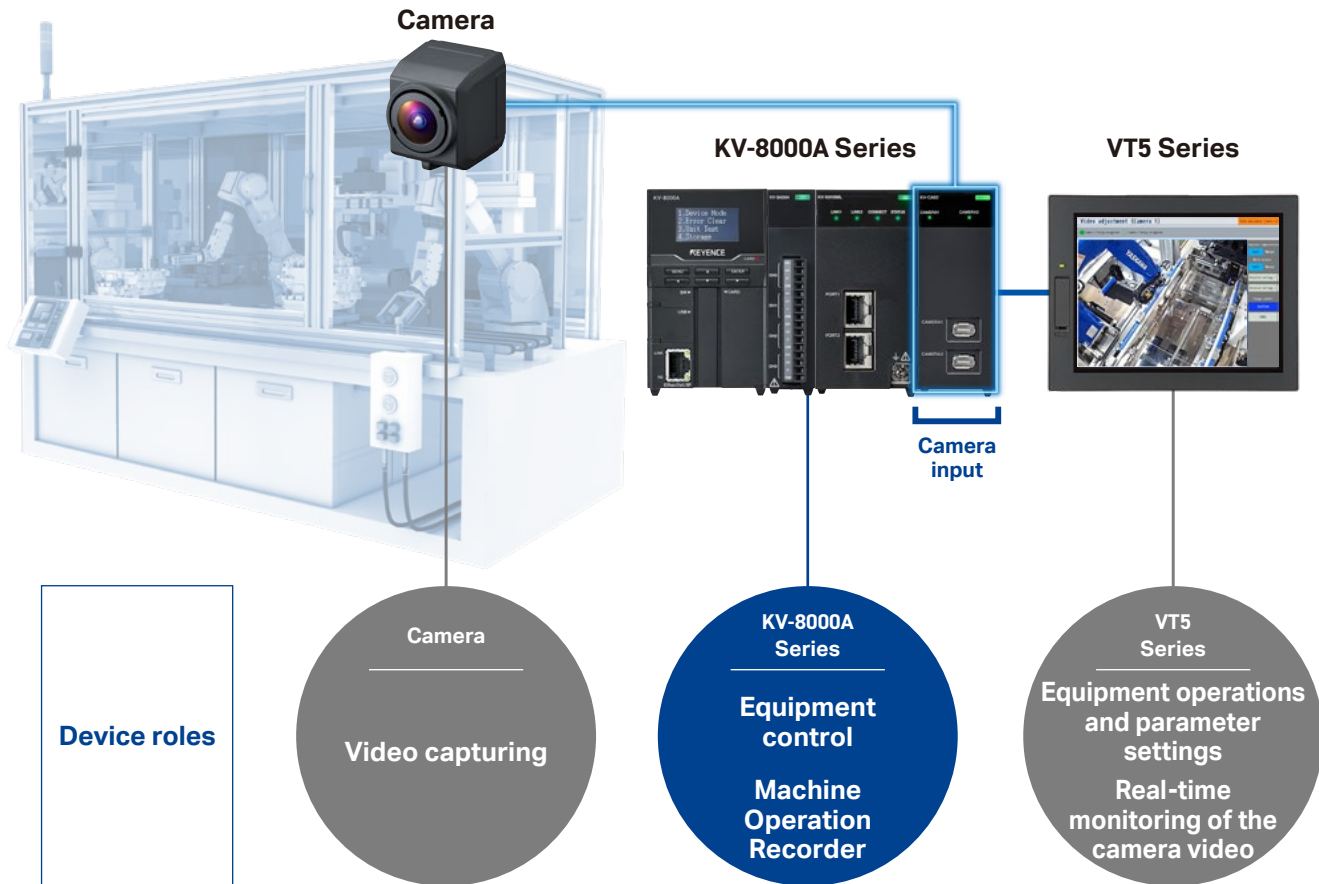


Troubleshooting with equipment PLCs

Using the Machine Operation Recorder function while controlling equipment

Equipment problems are recorded (with the Machine Operation Recorder function) at the same time as equipment is controlled.

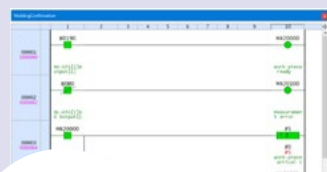
The camera records before and after a problem occurs, all the devices of the PLC for each scan, and the operation history of the operator are all recorded.



Equipment PLC

Details that can be recorded with the Machine Operation Recorder function

Ladder operations, camera video, and the operation history can all be linked and played back.



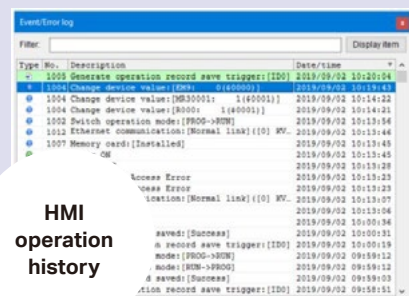
Equipment PLC ladder/signals

The behavior of all devices can be checked each scan.



Camera video

Mechanical, target, and human movements are recorded with two types of cameras.



HMI operation history

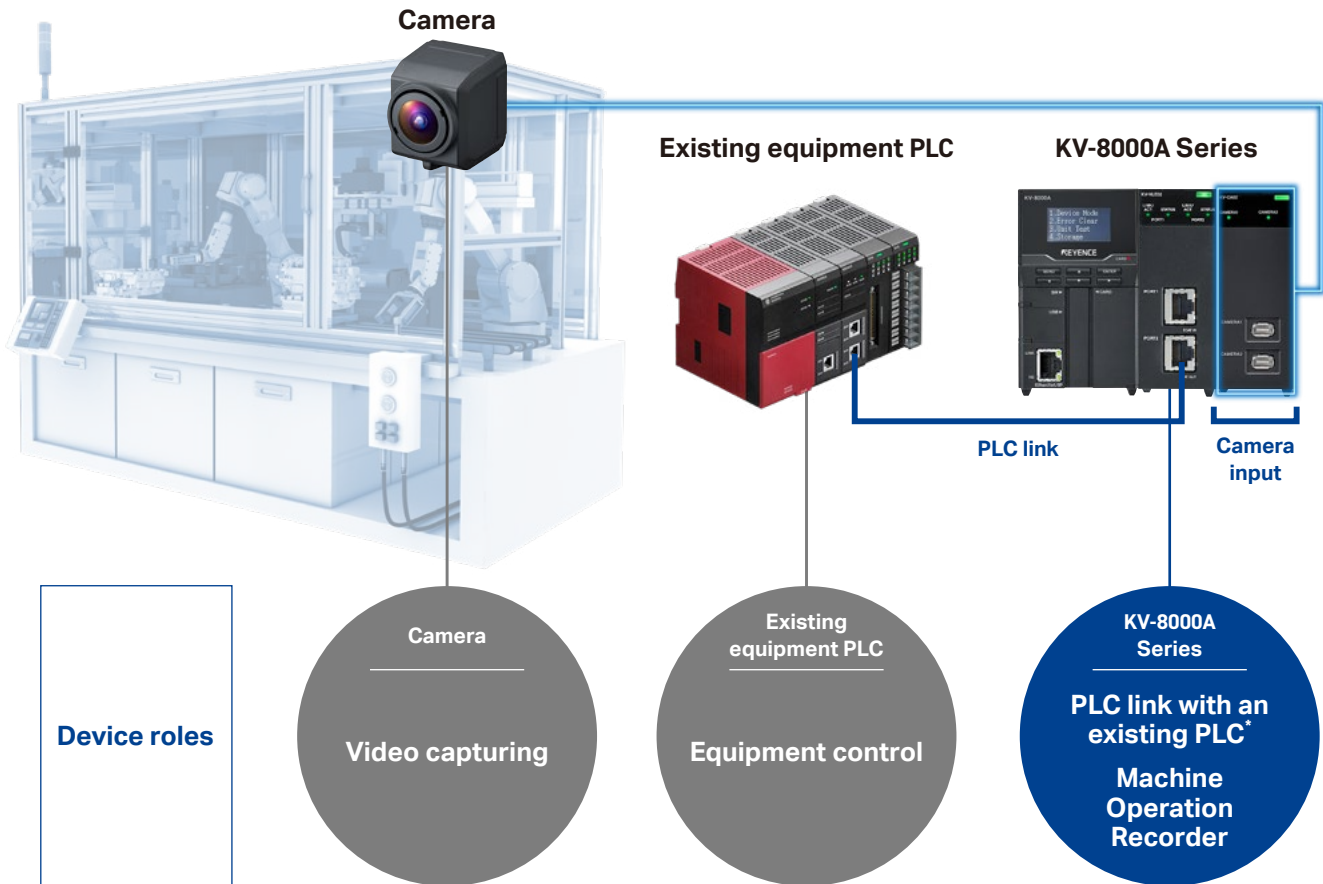
The operation history from the HMI and the inputs from the host PC are recorded.

Troubleshooting Existing installations with added PLCs

Using the Machine Operation Recorder function with it added to existing equipment

Equipment problems are recorded (with the Machine Operation Recorder function) by acquiring signals from an existing PLC in a program-less manner.

The camera records before and after a problem occurs and specific devices at each communication cycle are recorded.



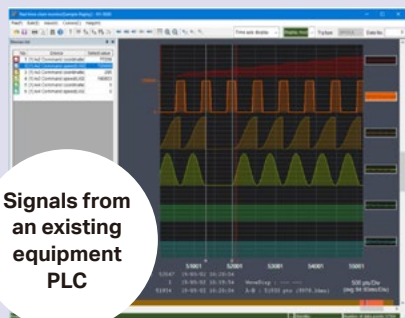
* The KV-XLE02 or KV-XL202/ XL402 is required.

PLC added to an existing installation

Details that can be recorded with the Machine Operation Recorder function

Changes to specific devices and the camera video can be linked and played back.

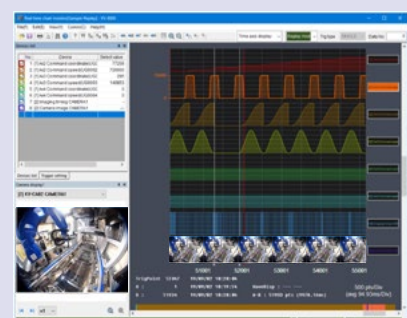
Linked playback even when added to an existing installation



Linked devices can be checked at each communication cycle.



Mechanical operation and human interaction are recorded with two types of cameras.



1 Robot path

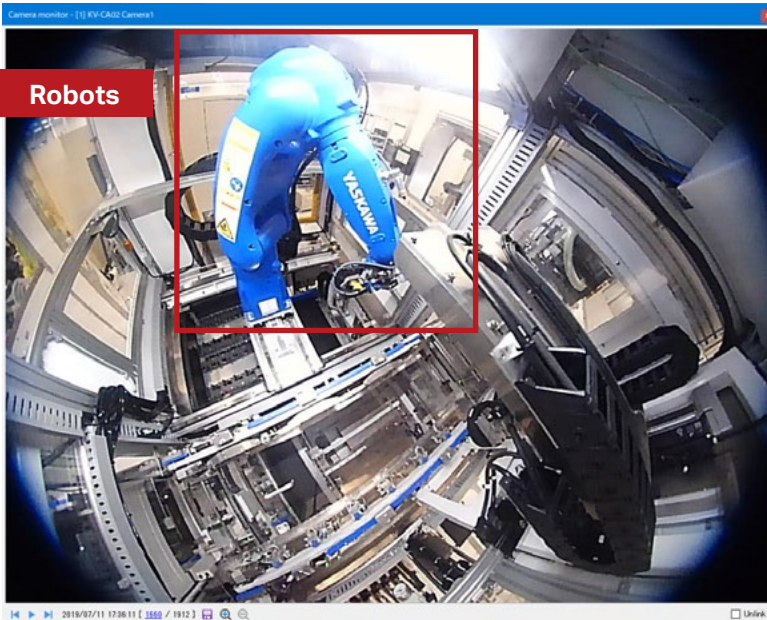
Conventional

It is difficult to isolate the causes of problems in processes that use robots.

▼ Solved with the Machine Operation Recorder function

KV-8000A

The behavior of the robot is recorded, enabling quick identification of the cause.



Camera target

Robot behavior (path)

Installation results

- Because video of the problem is recorded, the issue can be identified immediately even in situations where operators are not close to the machine, such as unmanned lines.
- The cause—be it the robot, the operator, or something else—can be isolated in the initial response to the problem.

Camera used:

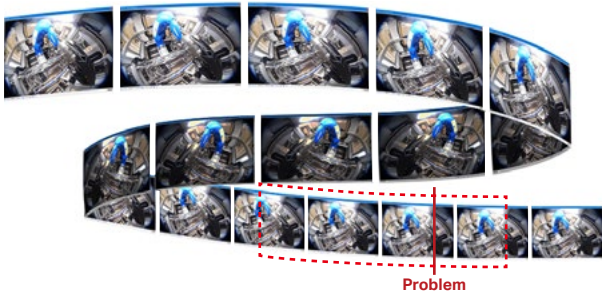
Wide field and high-resolution camera KV-CA1W

Troubleshooting details

Equipment Added to existing installation

Just the data before and after the occurrence of a problem is recorded.

The KV-8000A can automatically record just the data before and after the occurrence of a problem. This makes it possible to immediately understand the situation by eliminating the hassle of searching for the scenes to view.



Automatic recording just before and after the problem

Eliminating the hassle of searching for the scenes to view makes it possible to understand the situation in the minimal amount of time.

Equipment

Judgment is fast during the initial response to isolate the cause.

The operation history of the operator is retained and is synchronized with the robot behavior. This makes it possible to accurately and quickly isolate the cause during the initial response to the problem.

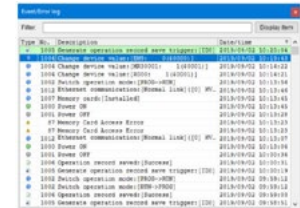
1 Use the camera to check the operation of the robot.

Isolate the mechanical cause.



2 Use events to check the operation history.

Isolate the human cause.



2 Robotic hand

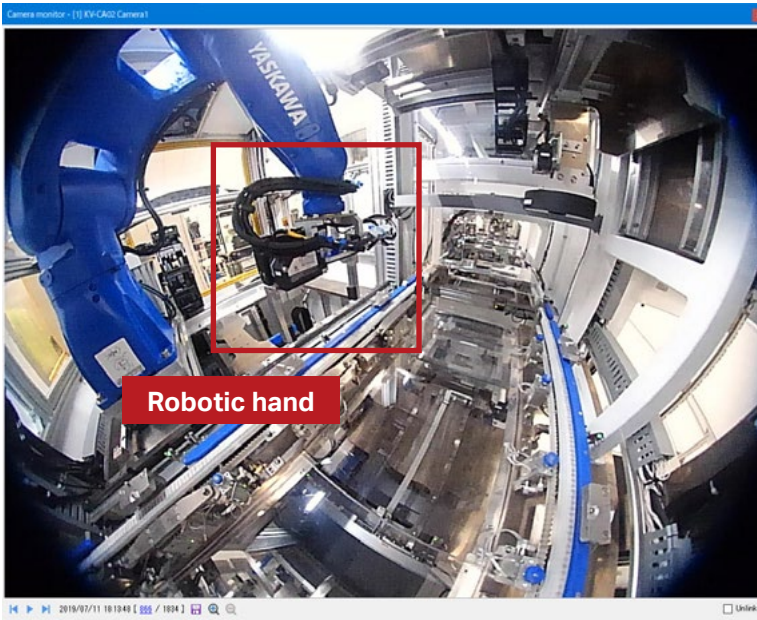
Conventional

Transferring defects/quality defects occur with unknown causes in a process that uses a robot.

Solved with the Machine Operation Recorder function

KV-8000A

The status of both the robotic hand and the ladder execution are known, so the investigation can be quick.



Camera target

- The robotic hand as it grips the target
- The welding status
- The target assembly status

Installation results

- The program execution status and the operation of the robotic hand at the time of the problem can be linked and played back, which makes it easy to investigate the cause.
- The original video is retained, so the operation can be checked without needing to use pendant operations and other such work that requires specialized knowledge.

Camera used:

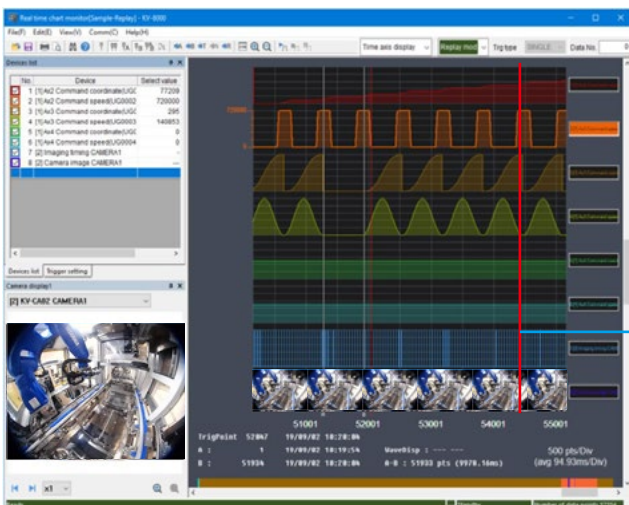
Wide field and high-resolution camera KV-CA1W

Troubleshooting details

Equipment Added to existing installation

Quickly investigate the cause with linked playback.

The robot operations and the ladder execution status can be checked in the same chronological order. The status before and after the problem occurs can be checked with video and waveforms, which leads to quick identification of the cause.



Problem occurrence

Ladder execution status
(Cycle changes before and after the problem)

These can be linked and played back in the same chronological order.

Robot operations
(Robot operations before and after the problem)



3 Mechanical mechanisms

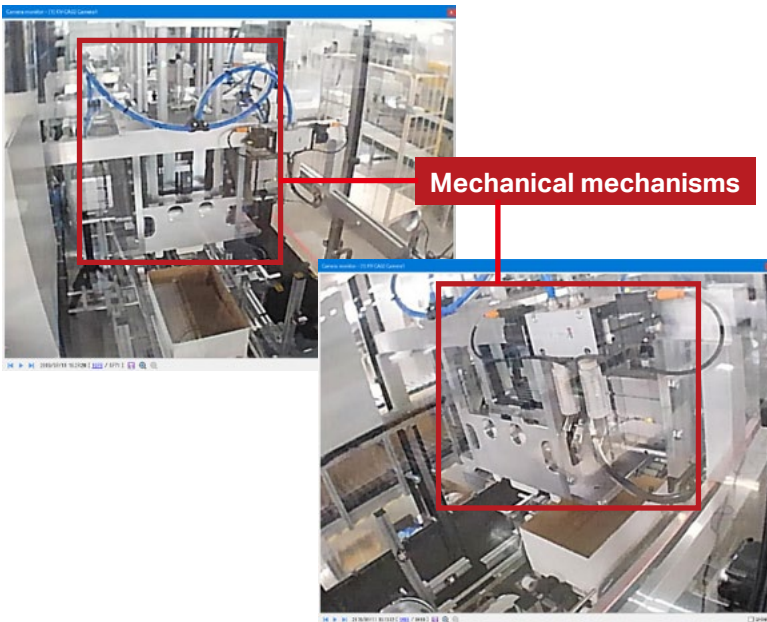
Conventional

- After a problem has occurred, it is not possible to judge whether the issue was mechanical.
- The system needs to be restored quickly, but it is not possible to tell whether the mechanical status is OK to restart the system.

▼ Solved with the Machine Operation Recorder function

KV-8000A

It is possible to determine whether the cause of the problem was mechanical without having to wait for the problem to occur again.



Camera target

- Mechanical parts of the target processing section
- Suctioned transfer
- Sensor installation status

Installation results

- The mechanical mechanisms can be recorded, which enables prompt analysis without the need to wait on-site for the problem to occur again.
- The status of the mechanical mechanisms when a problem occurs can be recorded automatically, so there is no need to stop equipment in order to investigate the cause.

Camera used:

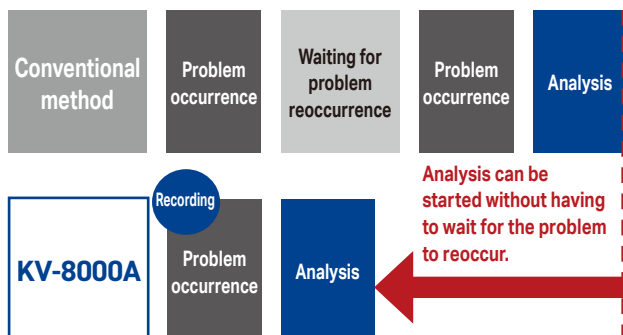
Compact standard camera
KV-CA1H

Troubleshooting details

Equipment Added to existing installation

Automatic recording enables prompt analysis.

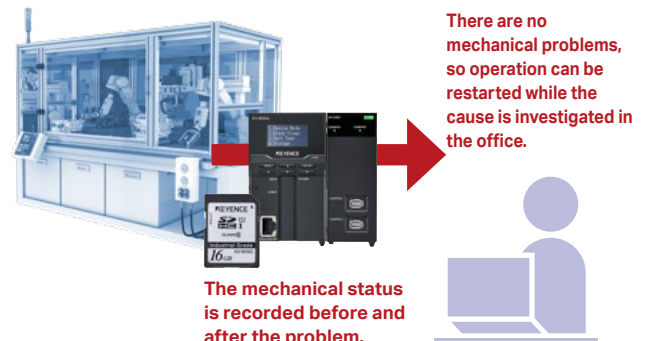
The problem can be recorded automatically, so analysis can be started without having to wait for the problem to reoccur. This eliminates the time and effort spent in waiting for a reoccurrence and leads to prompt solutions.



Equipment Added to existing installation

The cause can even be investigated during operation.

The mechanical status when a problem occurs is recorded, so it is possible to judge whether the system can be restarted. The cause can be investigated without having to stop the equipment, which maintains the operation rate.



4 Overall equipment

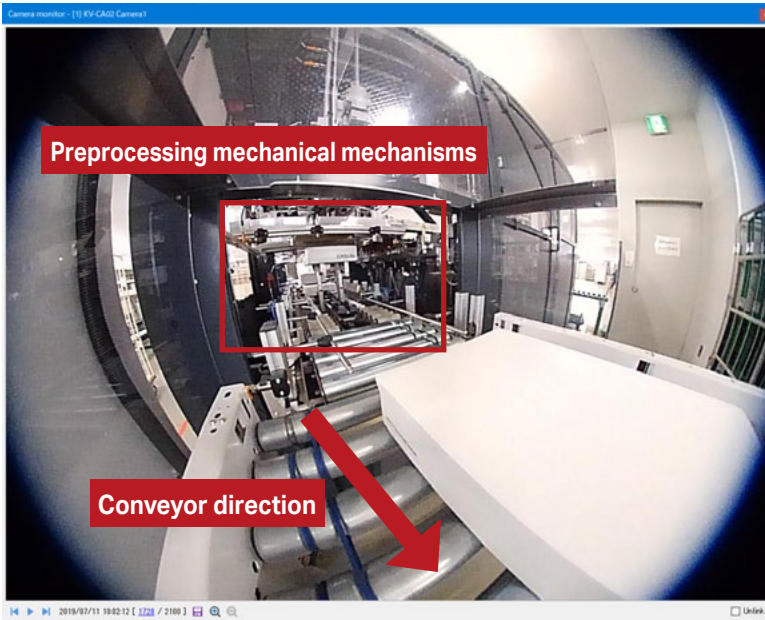
Conventional

- It is not possible to predict where problems will occur.
- Operators cannot notice changes in the locations that are normally difficult to see.

▼ **Solved with the Machine Operation Recorder function**

KV-8000A

A wide field and high-resolution camera makes it possible to check the overall equipment as well as the locations that are difficult to see.



Camera target

From the unloader to the preprocessing

Installation results

- Operators can notice changes in the locations where it is difficult for people to enter or where it is difficult to perform visual checks.
- If it is not possible to predict the locations where problems will occur, overall equipment changes can be captured with a wide field camera.

Camera used:

Wide field and high-resolution camera **KV-CA1W**

Troubleshooting details

Equipment Added to existing installation

Record the locations that are difficult to see.

A wide field and high-resolution camera makes it possible to record (with high resolution) the overall machine as well as the locations that are normally difficult to see. This is useful in detecting problems that cannot be anticipated in advance.



Even when zoomed in, the target and the mechanical mechanisms can be checked sufficiently.

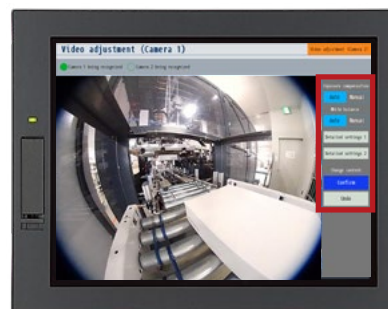


KV-CA1W

Equipment Added to existing installation

Real-time monitoring is possible.

By installing cameras, the locations that are difficult for operators to see can be checked in real time with video on the HMI. A sample screen is also available and can be put to use immediately.



VT5 Series

On the HMI screen, settings such as the image quality and exposure can be fine-tuned.

5 Operator line of flow

Conventional

It is not possible to check whether the operator line of flow is optimal when a problem occurs.

▼ **Solved with the Machine Operation Recorder function**

KV-8000A

The operator line of flow when a problem occurs is known.



Camera target

Operator line of flow

Installation results

- The operator line of flow when a problem, for which recovery takes a long time, occurs is known. This makes it possible to implement countermeasures such as changing the equipment layout.
- The record data can be converted into a video file, which makes it easy to share this data with and deploy this data to other workers.

Camera used:

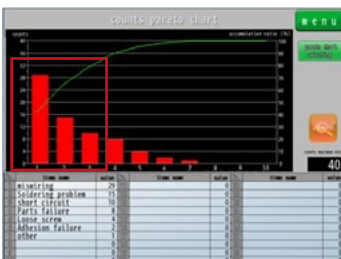
Wide field and high-resolution camera **KV-CA1W**

Troubleshooting details

Equipment **Increase the operation rate by improving the line of flow.**

To increase the operation rate, it is important to reduce the time and effort spent handling problems for which recovery takes a long time. By subcategorizing alarms and recording the operator line of flow when the corresponding alarm occurs, it is possible to consider countermeasures. Furthermore, recorded videos can be output as .AVI files, so videos containing lines of flow after countermeasures have been implemented can be shared with other operators to prompt them to improve their own lines of flow.

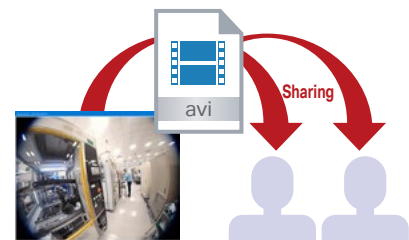
1 Use a Pareto alarm chart to subcategorize the problems that take time to recover from.



2 Record the operator line of flow when the corresponding problem occurs, analyzing the cause of the long recovery time.



3 Generate an .AVI file of the line of flow after implementing countermeasures and share this file with other operators as an improvement procedure.



6 Operator countermeasure

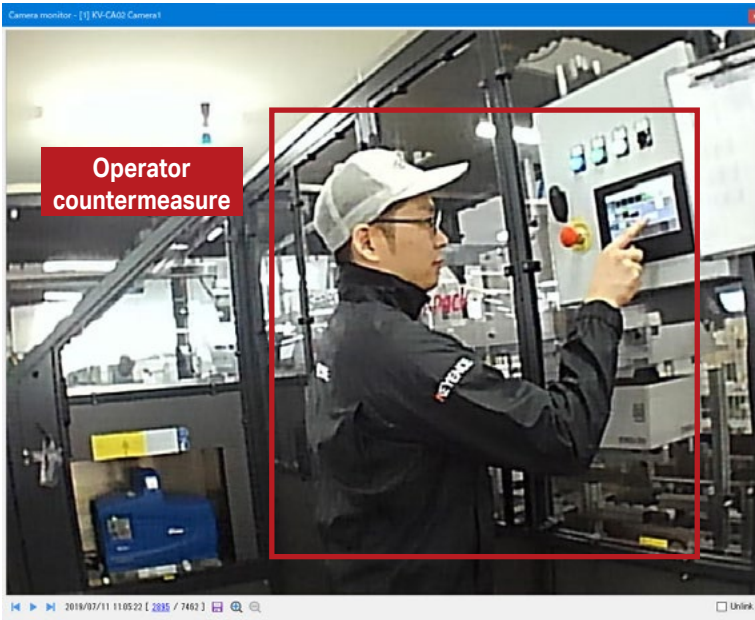
Conventional

It is difficult to accurately grasp the countermeasure details when a problem occurs.

Solved with the Machine Operation Recorder function

KV-8000A

The countermeasure details are captured as a video, so the situation can be understood accurately.



Camera target

Operator countermeasure details

Installation results

- Operators can accurately grasp the countermeasure without having to ask questions.
- The appropriateness of the operations directly before the problem and of the countermeasure details after the problem can be checked.

Camera used:

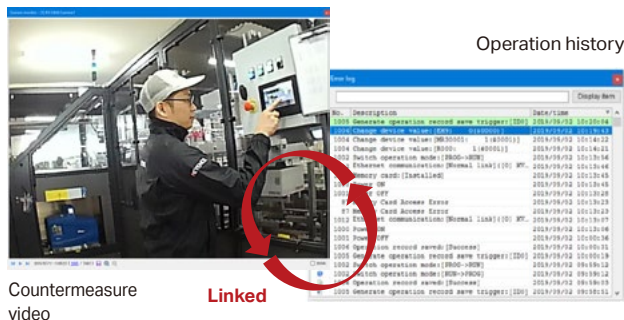
Compact standard camera
KV-CA1H

Troubleshooting details

Equipment Added to existing installation

Operators can accurately grasp the operation details without having to ask questions.

The countermeasure details when a problem occurs can be recorded as a video, which makes it possible to accurately grasp the situation. Furthermore, the HMI operation history can be recorded in the same chronological order, which is useful in troubleshooting.



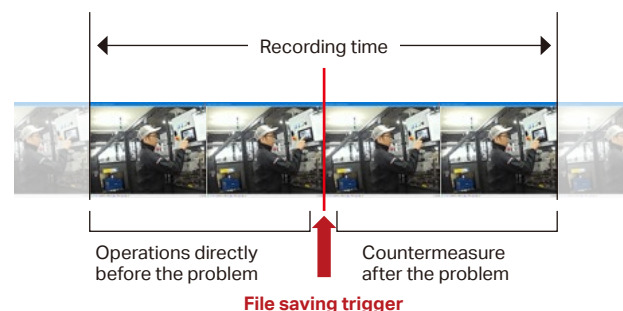
Countermeasure video

Linked

Equipment Added to existing installation

The operation details before and after the problem are understood.

Information can be recorded both before and after a problem occurs: were operations related to the trouble occurrence performed in advance, were the countermeasures after the problem occurred appropriate?



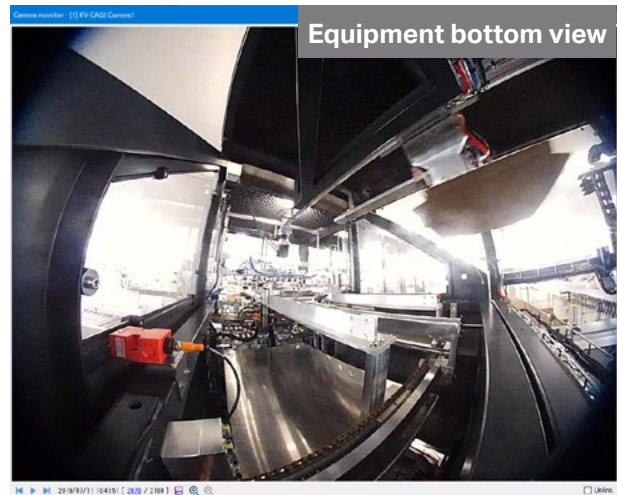
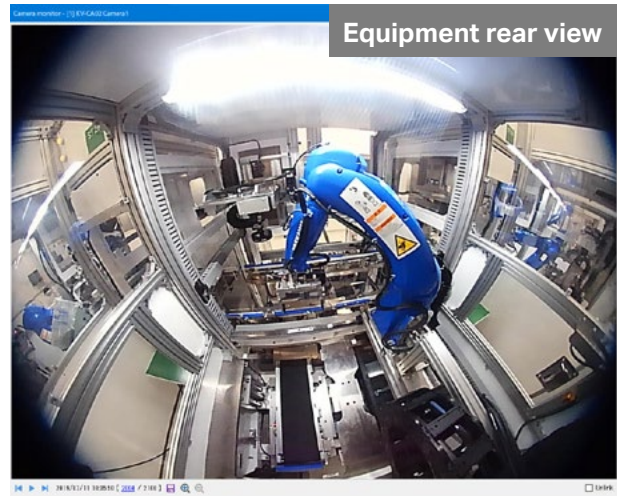
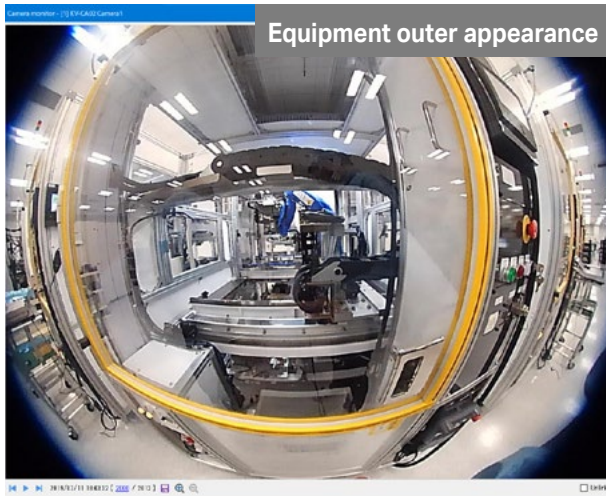
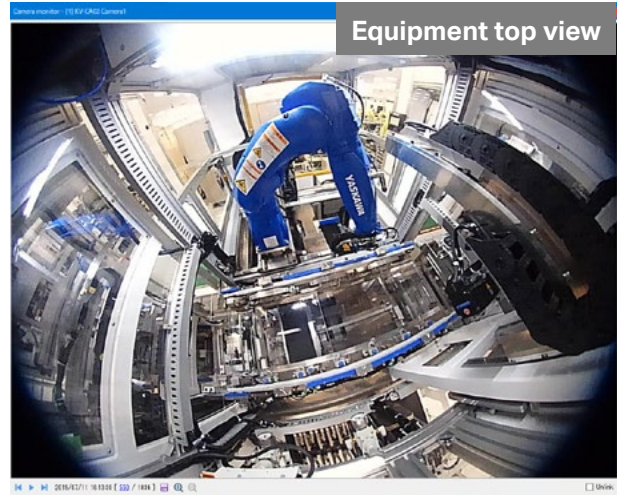
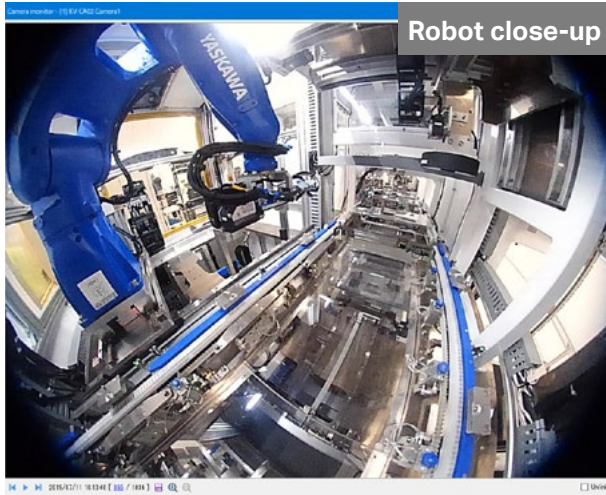
Operations directly before the problem

File saving trigger

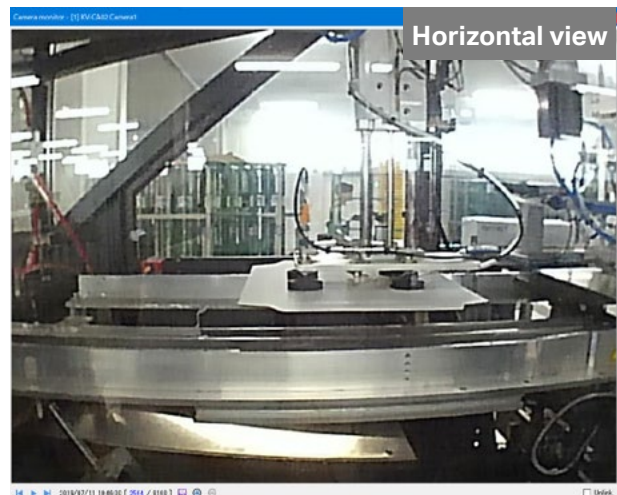
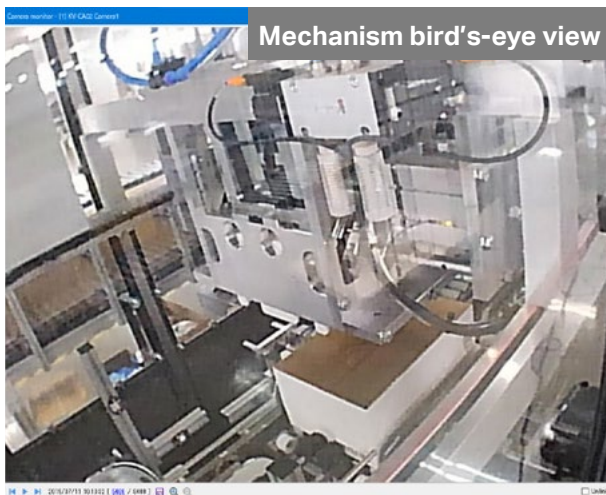
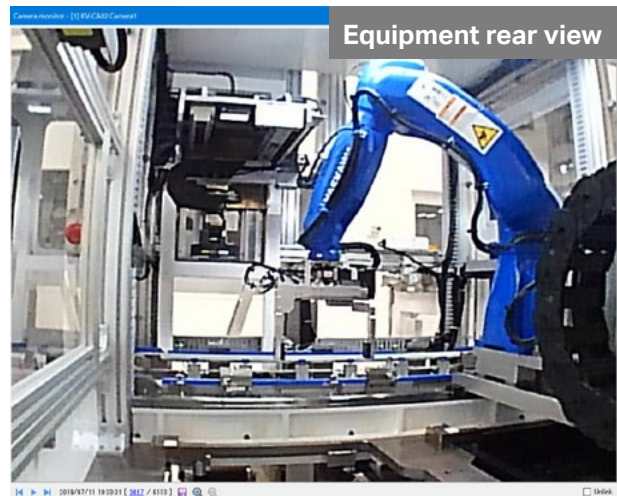
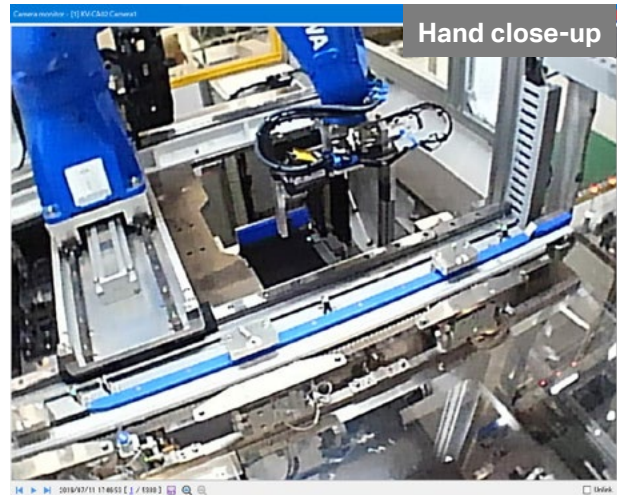
Countermeasure after the problem

Operator line of flow

Wide field and high-resolution camera KV-CA1W



Compact standard camera KV-CA1H



CPU



CPU unit KV-8000A

- LD instruction execution speed: 0.96 μ s
- Program capacity: 1500 k steps maximum
- Machine Operation Recorder function
- EtherNet/IP® port

SD card



Industrial SD card KV-M16G/M4G

- SLC standard
- Recording capacity: 16 GB/4 GB

Camera input



Camera input unit KV-CA02

- Maximum number of connected units per system: 4
- Number of camera input ports: 2
- Camera hot swapping supported



Camera cable KV-C5/C10/C20

- Cable length: 5 m [16.4'](#)/10 m [32.8'](#)/
20 m [65.6'](#)

Camera



Compact standard camera KV-CA1H

- Resolution: 640 (H) × 480 (V)
- Frame rate: 10/30/120 fps
- Viewing angle:
 - Horizontal viewing angle: Approximately 60°
 - Vertical viewing angle: Approximately 47°



Mounting adapter OP-88386

- For mounting on a stand
(The stand must be prepared separately.)



Wide field and high-resolution camera KV-CA1W

- Resolution: 1280 (H) × 960 (V)
- Frame rate: 10/30 fps
- Viewing angle:
 - Horizontal viewing angle: Approximately 180°
 - Vertical viewing angle: Approximately 150°



Adjustable bracket OP-88387

- For mounting on a pole
(Separately prepare a support pole with a diameter of 12 mm [0.47"](#).)

Shared camera options

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