MITSUBISHI ELECTRIC

Changes for the Better

Automating the World

FACTORY AUTOMATION

MELSEC iQ-R System Recorder Use Case

MELSEC iQ-R series

Our Factory Automation business is focused on "Automating the World" to make it a better, more sustainable environment supporting manufacturing and society, celebrating diversity and contributing towards an active and fulfilling role.

SUSTAINABLE DEVELOPMENT GOALS

The Mitsubishi Electric Group is actively solving social issues, such as decarbonization and labor shortages, by providing production sites with energy-saving equipment and solutions that utilize automation systems, thereby helping towards a sustainable society.

Mitsubishi Electric is involved in many areas including the following:

Energy and Electric Systems
A wide range of power and electrical products from generators to large-scale displays.

Electronic Devices
A wide portfolio of cutting-edge semiconductor devices for systems and products.

Home Appliance
Dependable consumer products like air conditioners and home entertainment systems.

Information and Communication Systems
Commercial and consumer-centric equipment, products and systems.

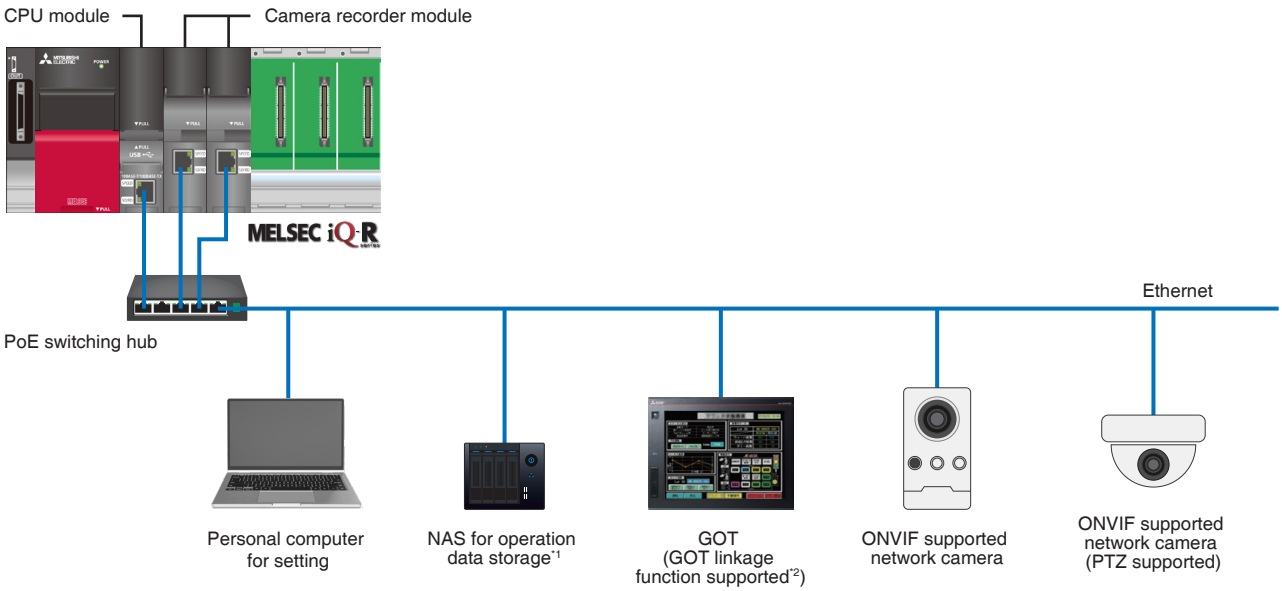
Industrial Automation Systems
Maximizing productivity and efficiency with cutting-edge automation technology.

Record the entire operating status of the system and perform simple analysis

The system recorder is a corrective maintenance solution that "records the entire operating state of the system" when an error occurs, and allows "simple analysis" to significantly reduce downtime.

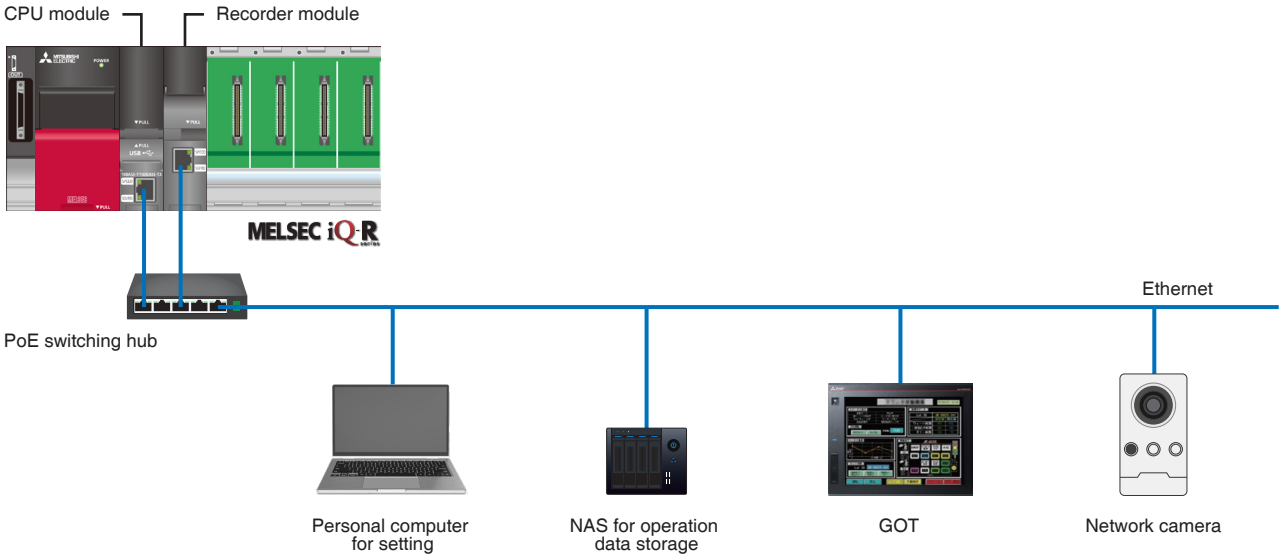
System configuration image

For the camera recorder module



*1 Not necessary because the device operation data can be saved in a SD memory card of the camera recorder module.
*2 It is possible to check the live video of the network camera and adjust PTZ.

For the recorder module



Troubleshooting cases utilizing the system recorder

Case 1 Monitoring of entire line

Defective products were detected during inspection, but it is not clear which process is the cause.

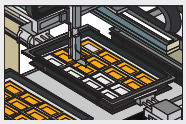
Page.6

Case 2 Identification of abnormal areas

Abnormalities occur at multiple locations irregularly, making it impossible to identify the abnormal areas.

Page.7

Case 3 Workpiece drop due to a suction error



An error occurred in a workpiece transportation device using a suction mechanism, but the error cause cannot be identified.

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Case 4 Printing failure

A QR code printing failure was detected, but the cause cannot be identified.

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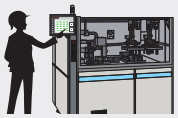
Case 5 Chuck error

Although the video was checked for identifying the cause, the conditions of the auto switches were still unclear.

Page.10

Case 6 Human error (Incorrect product type)



It is desirable to correctly understand the details of the erroneous operation for future guidance and consideration of improvement.

Page.11

Case 7 Handling troubles from a remote place

It is desirable to correctly understand the situation and cause of the trouble without visiting the site.

Page.12

Case 8 Trouble analysis using past data

An attempt to check the condition when the error occurred failed since the project has been overwritten.

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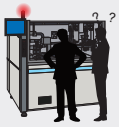
Case 9 Analyzing servo troubles together



Although the sensor has detected a drop of a workpiece, no workpiece has dropped and the cause of the error cannot be determined.

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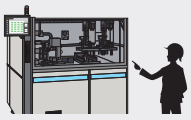
Case 10 Non-alarm stop



If a stop without alarm occurs, it is desirable to notice it and analyze the cause as soon as possible, but it is difficult for operators to constantly monitor the device.

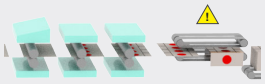
Page.15

Case 11 Detection of "unusual" operations

Although the video immediately before the error occurrence was checked, the error cause cannot be identified.

Page.16

Case 12 Trouble analysis across devices



An error occurred in the box making process, but the cause cannot be identified because the data in the other processes immediately before the error occurrence had not been collected.

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Function introduction

Page.18, 19, 20

System recorder-related products

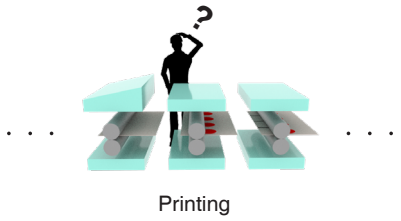
Page.21

Case 1 Monitoring of entire line

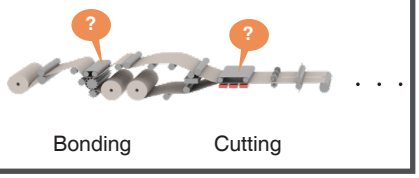
Camera recorder module | Recorder module

1 Defects are detected in the inspection process of the product line.

2 Defects occur even after adjusting the part that seems to be the problem.

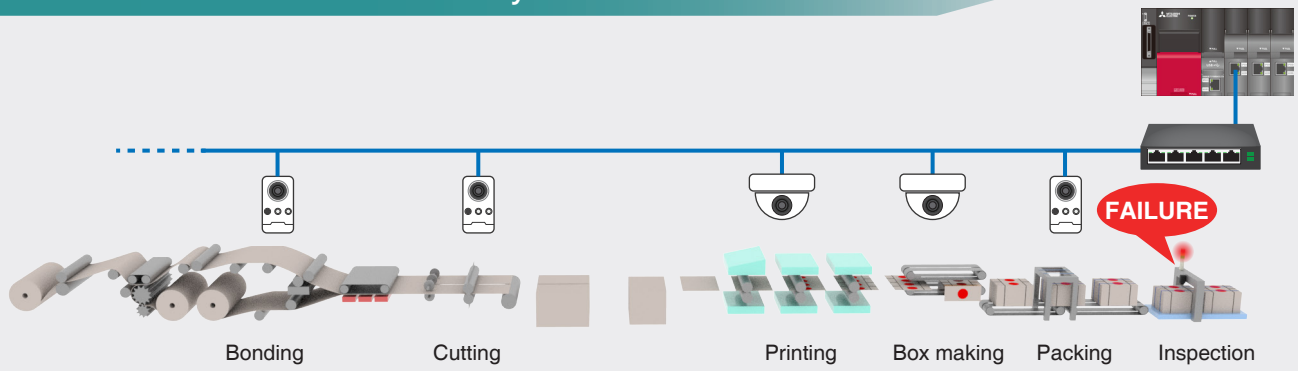


3 There may be the factors somewhere in the previous process, but it cannot be identified.



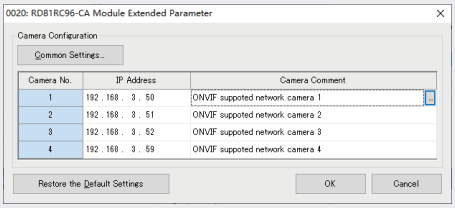
Identify the cause in multiple processes.

Cause identification with the system recorder



1 With a camera recorder module, multiple network cameras can be connected to a single programmable controller.

LOG **GX Works3**



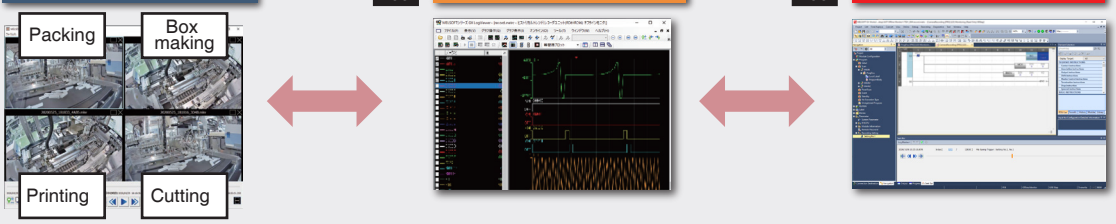
2 It conforms to the network standard ONVIF Profile S, and can be connected to a wide variety of cameras.

ONVIF supported network camera (PTZ supported)

ONVIF supported network camera

3 Acquire video and log data of the entire process, and use various tools to check and analyze the data against the video at once to identify the cause.

GX VideoViewer | LOG **GX LogViewer** | LOG **GX Works3**

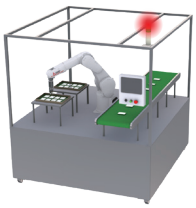


Monitoring of the entire production line with multiple cameras helps to determine the cause among multiple factors.

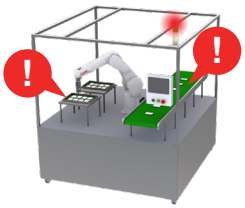
Case 2 Identification of abnormal areas

Camera recorder module | Recorder module

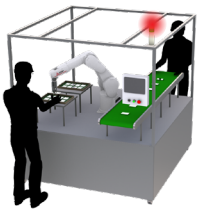
1 A short time breakdown occurs frequently in the assembly process using robots.



2 Abnormalities occur at multiple locations irregularly, making it impossible to identify the abnormal areas.

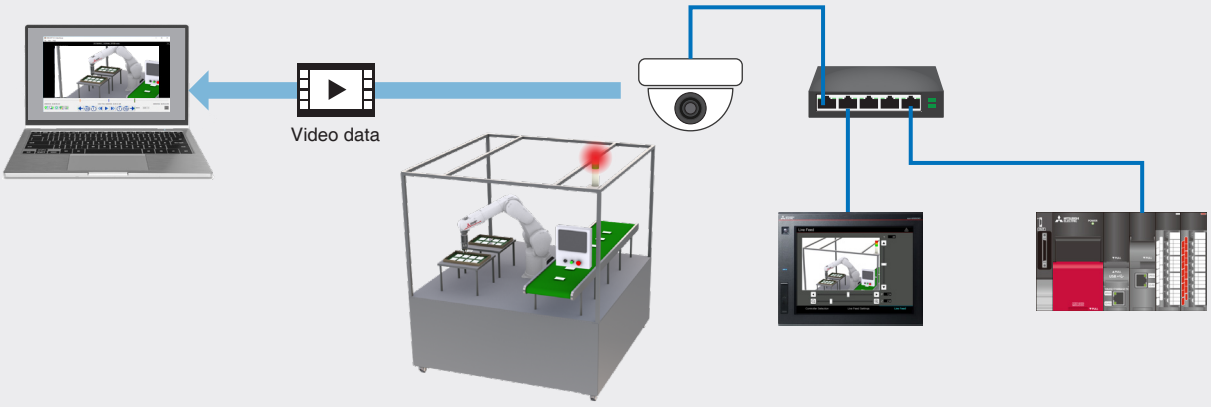


3 It is necessary to stop the machine and conduct a full inspection to determine the cause.

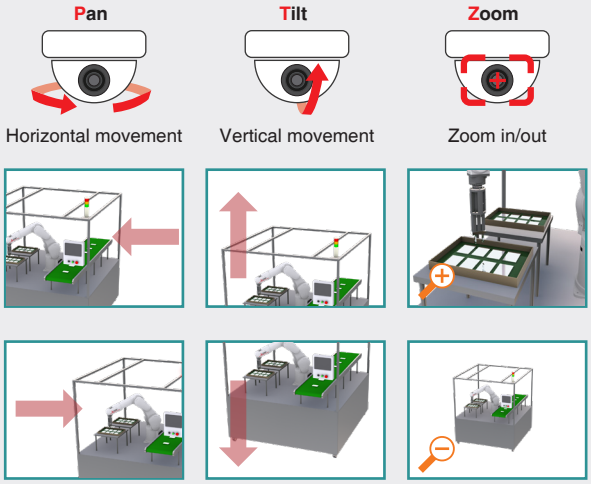


Identify the error cause without stopping the machine.

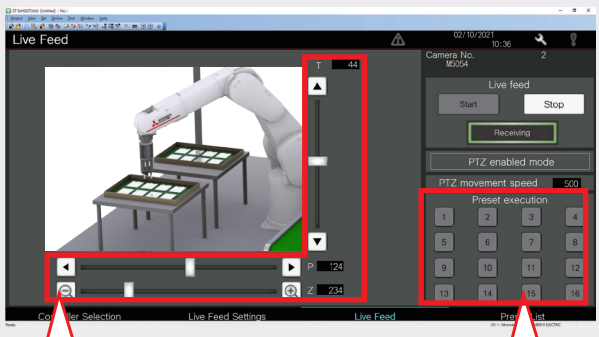
Cause identification with the system recorder



1 Move the camera and zoom in the area that seems to be the cause with **the pan-tilt-zoom (PTZ) function** of the camera recorder module.



2 The recording status can be changed for each process by using the GOT operation screen and PTZ control commands from the programmable controller.



PTZ operation

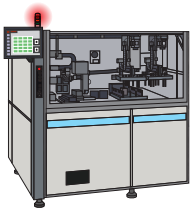
Preset execution enables instantaneous switching to a preset recording position.

The camera adjustment function (PTZ) of ONVIF supported network cameras enables identification of the cause with the machine in operation.

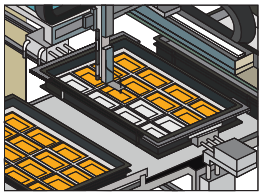
Case 3 Workpiece drop due to a suction error

Camera recorder module | Recorder module

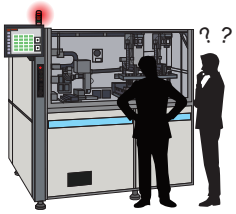
1 An error occurred in a workpiece transportation device using a suction mechanism.



2 Although the device was checked, the workpiece was not mounted in the specified position, and no visible error was shown.



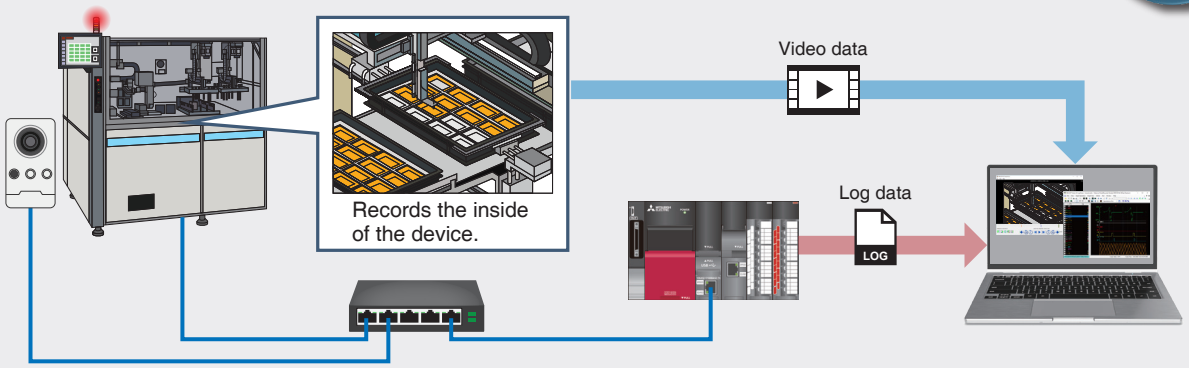
3 No one knows the condition of the device at the error occurrence since there is usually no operator around the device.



Unable to identify the device error.

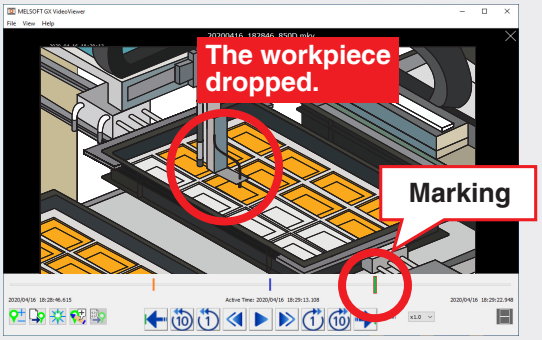
Cause identification with the system recorder

Log marker function Page 18



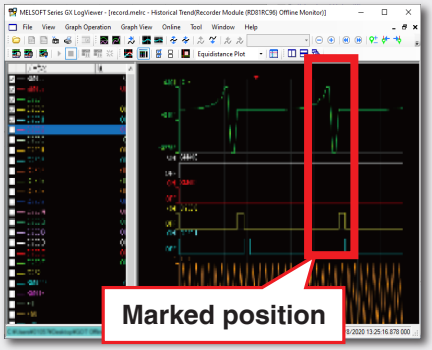
1 Checking the recorded video before the issue occurred has shown the moment that the workpiece was dropped from the suction part.
Mark the corresponding position on the seek bar with the **log marker function**.

GX VideoViewer



2 Checking the data around the marked time has shown that the vacuum pressure decreased before the "suction OFF" command was turned on.

GX LogViewer



Although the vacuum pressure error occurred in the suction part, the cause could not be identified since the dropped workpiece was **accidentally** mounted in the incorrect position without alignment.

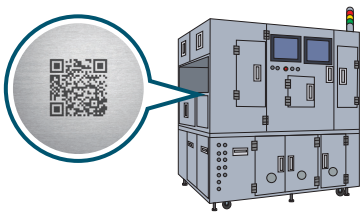
The system recorder has determined that the cause was the vacuum pressure in the suction part.

Case 4 Printing failure

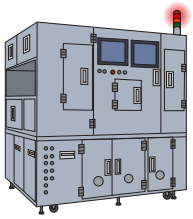
Camera recorder module

Recorder module

1 QR code printing with a laser marking device



2 A QR code printing failure was detected in the finishing process.



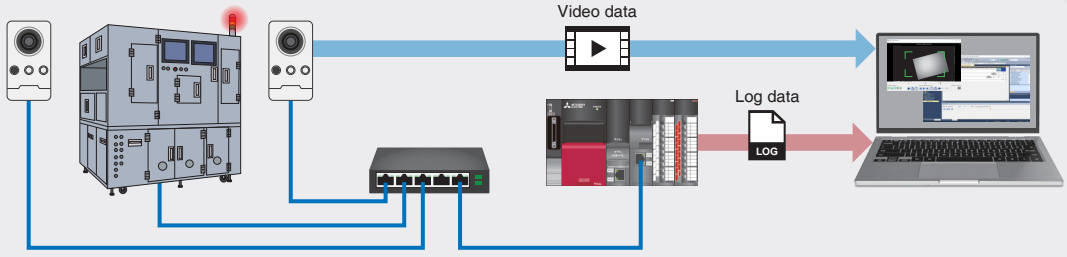
3 Possible causes are...
The workpiece was misaligned from the specified position.
A control failure occurred in the laser marker.

Passed	Failed
	

Unable to identify the cause of the printing failure.

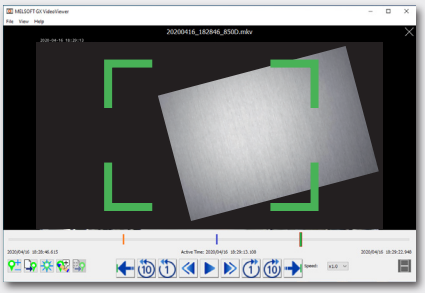
Cause identification with the system recorder

Offline monitoring Page 18



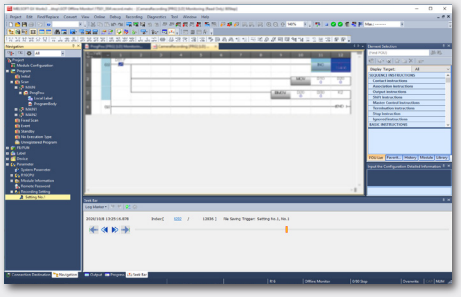
1 Checking the workpiece on which the printing failure occurred by rewinding the video has shown that the workpiece was misaligned significantly from the specified position.

GX VideoViewer

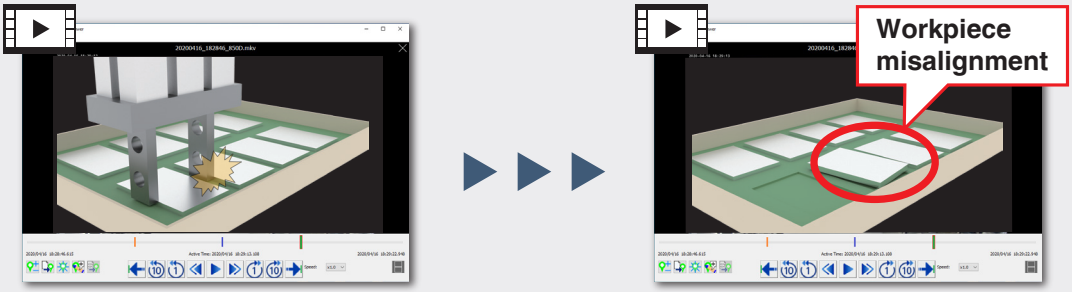


2 **The offline monitoring function** has shown that there was no problem in transportation since the auto switches of the air chuck cylinder operated normally.

LOG GX Works3



3 Rewinding the video further has determined that the chuck contacted with the workpiece when picking up the previous workpiece, which caused the workpiece to be significantly misaligned from the specified position.



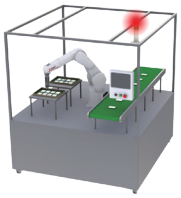
The system recorder has determined that the cause of the printing failure was the workpiece misalignment.

Case 5 Chuck error

Camera recorder module | Recorder module

1 An error occurred in the auto switches of the air chuck on edge of the robot.

2 Although all the auto switches were checked, they were ON in the normal states, and the error cause could not be identified.



3 Checking the video could not identify the cause since the conditions of the auto switches were not recorded.

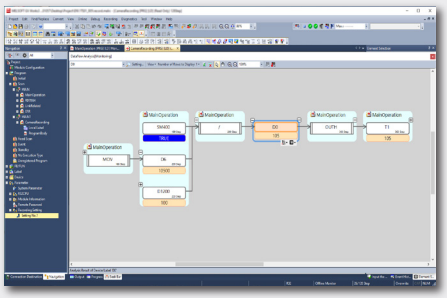
Unable to identify the error location in the device.

Cause identification with the system recorder

Offline monitoring Page 18
Data flow analysis function Page 19

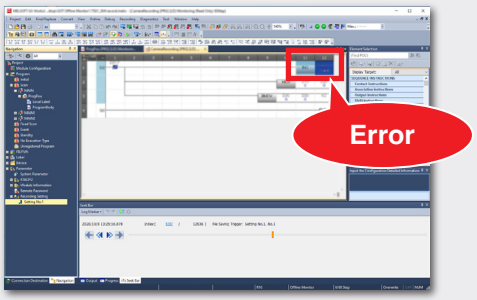
1 Check the item that can be an error cause by using the **data flow analysis function**.

LOG **GX Works3**



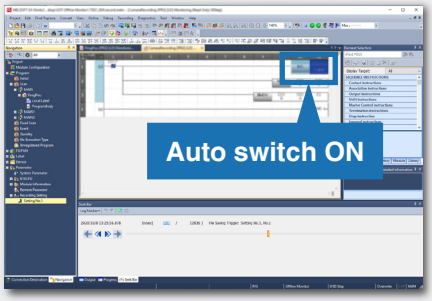
2 When the operation at the error occurrence was reproduced by **the offline monitoring function**, an auto switch did not turn on, and an error occurred.

LOG **GX Works3**

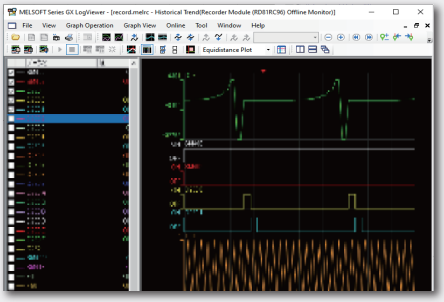


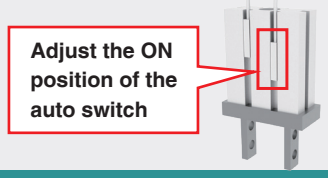
3 An auto switch turned on a few seconds after the error occurred. Checking the condition of the corresponding chuck in GX LogViewer has determined that the trigger of the auto switch was OFF (timed out) when the workpiece was gripped.

LOG **GX Works3**



LOG **GX LogViewer**





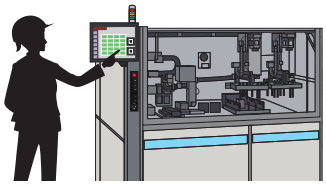
It has been determined that the error can be avoided by finely adjusting the ON position of the auto switch attached to the chuck.

The system recorder has determined that the cause was the ON position of the auto switch.

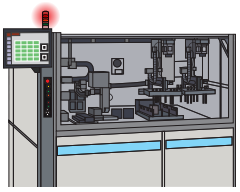
Case 6 Human error (Incorrect product type)

Camera recorder module | Recorder module

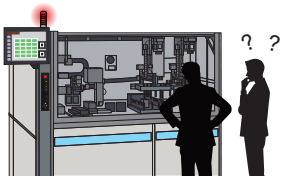
1 An operator inputs the workpiece machining conditions.



2 An error was found in the finishing check.



3 It is desirable to correctly understand the details of the erroneous operation for future guidance and consideration of improvement.

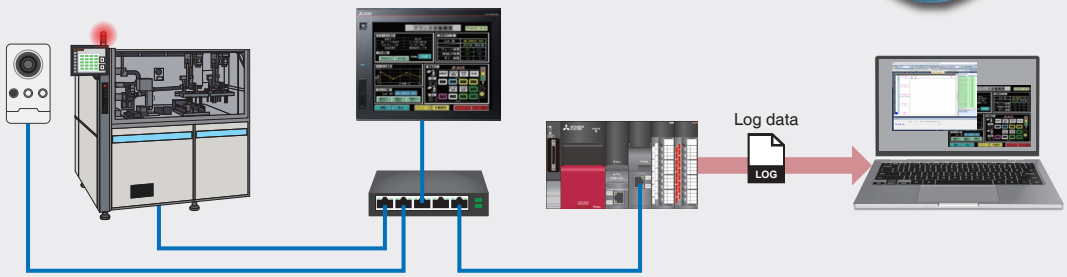


Correctly understand what the cause was.

Cause identification with the system recorder

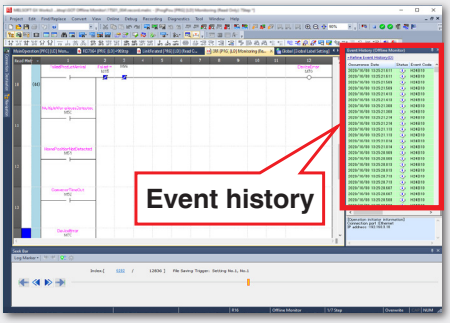
Offline monitoring Page 18

Event history Page 19



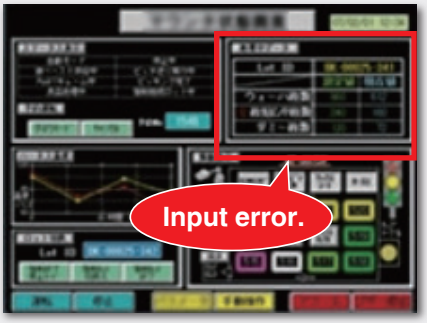
1 The operation before the error occurrence was checked in the **event history**.

LOG **GX Works3**

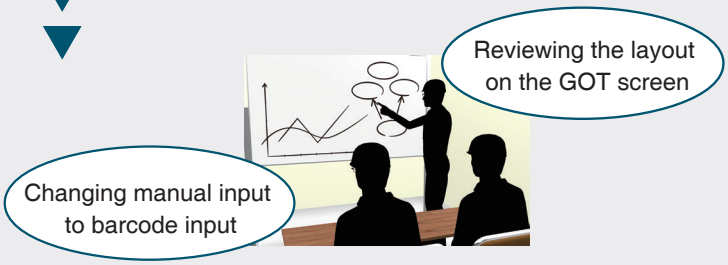


2 The GOT **offline monitor function** was linked to the event history to reproduce the GOT operation.

LOG **GT Designer3**



When the error actually occurred, reviewing the operation details to prevent recurrence and others were considered.



The cause can be identified with the system recorder, and the appropriate preventive measures against recurrence can be considered.

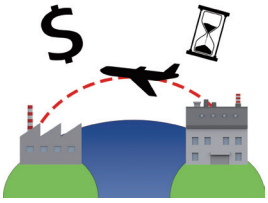
Case 7 Handling errors from a remote place

Camera recorder module | Recorder module

1 An error occurred on the site of another branch (overseas).

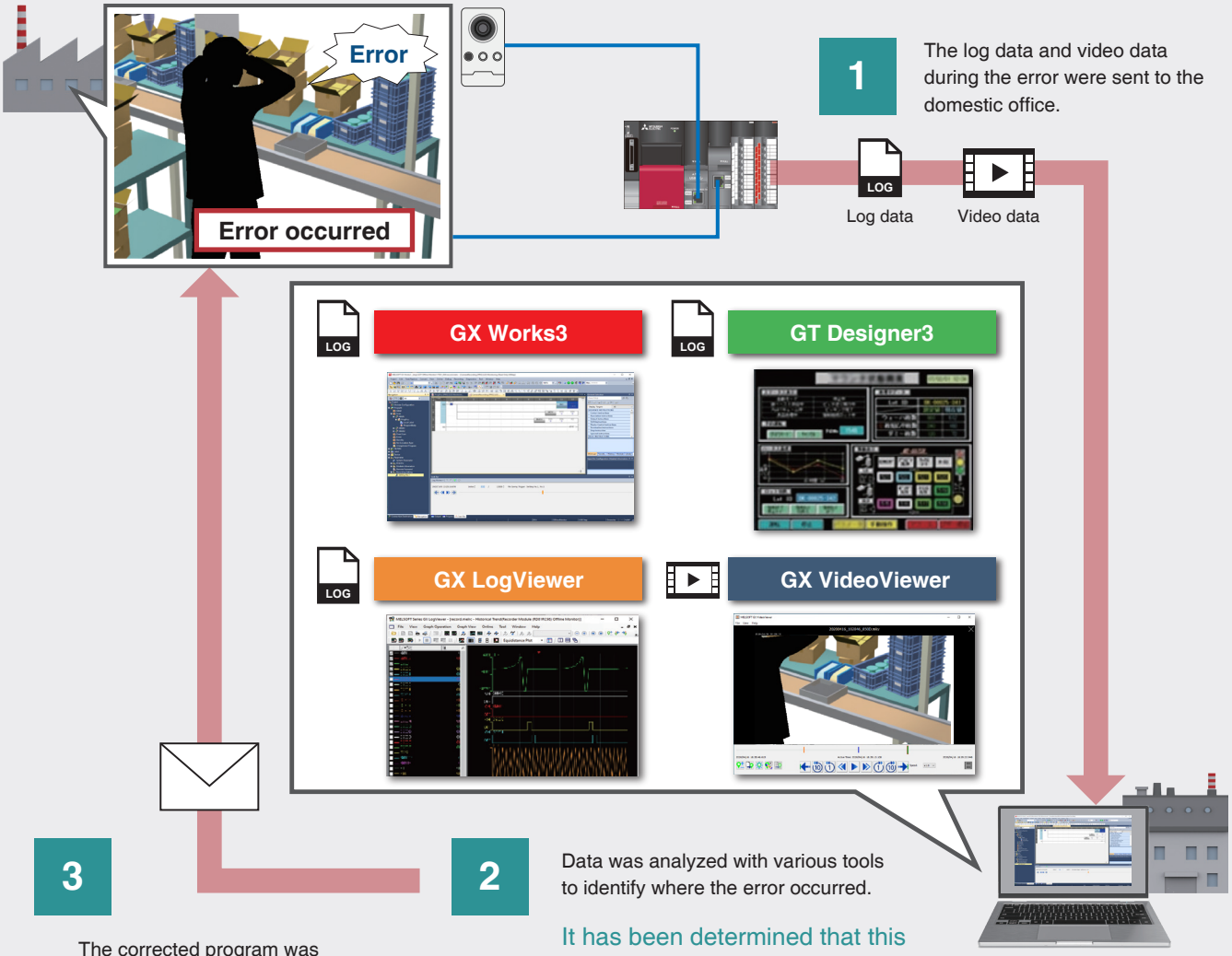
2 The error occurred at the site location could not be correctly understood over the phone.

3 Since the cause cannot be identified without directly checking the hardware, traveling to the country costs time and money.



Identify the cause without visiting the site.

Cause identification with the system recorder



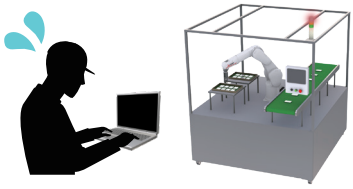
The system recorder can significantly reduce man-hours and costs for handling errors.

Case 8 Trouble analysis using past data

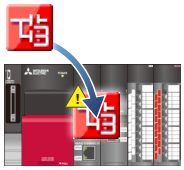
Camera recorder module | Recorder module

1 Failure (error) occurred.

2 Although an operator on the site modified the program to see how it works, the failure could not be corrected.

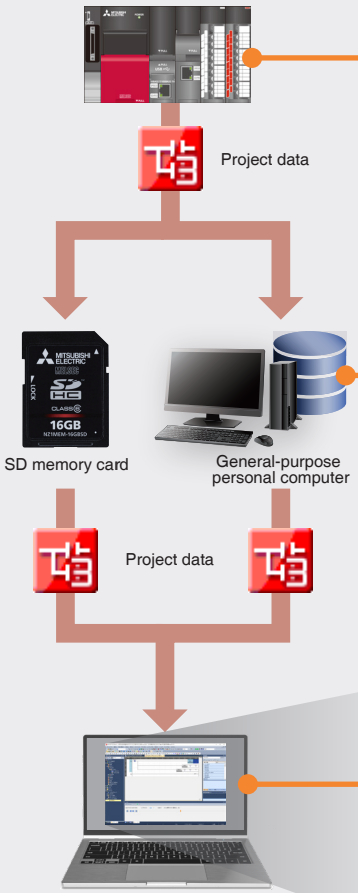


3 An attempt to check the condition when the error occurred failed since the project has been overwritten.



Check the project when the error occurred.

Cause identification with the system recorder

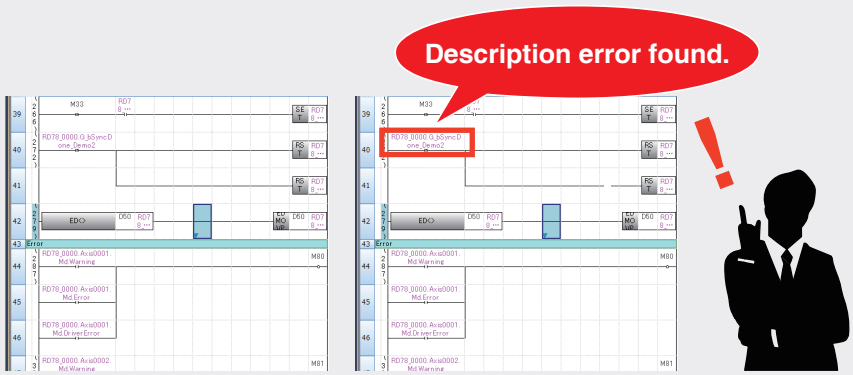


1 The project data is **automatically** saved by using a trigger device. **Any time** this trigger is turned on, the operation data is saved. When enabled, every device change is recorded within the saved data.

Save project data automatically or at any time using **the project data save function**.

2 The project data saved in the SD memory card or general-purpose personal computer is read and used to replay the recording file.

3 Since multiple project data sets in the past can be saved, the project data when the error occurred and the one before that can be analyzed together.

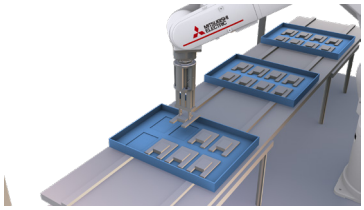


The system recorder allows users to review past project data to identify the cause of errors.

Case 9 Analyzing servo troubles together

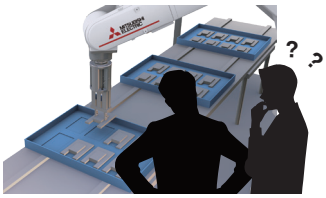
Camera recorder module | Recorder module

1 The sensor that detects the load during transportation turned on.



2 An alarm indicating that a drop of an object was detected has occurred.

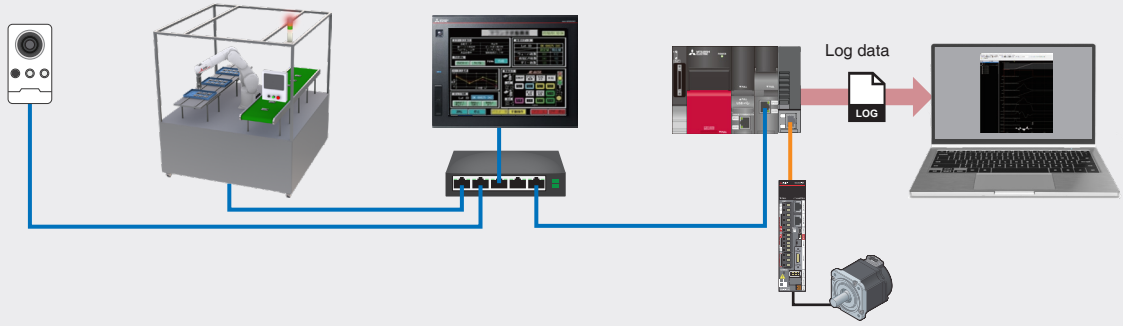
3 When the site was checked, no workpiece has dropped and the sensors work properly.



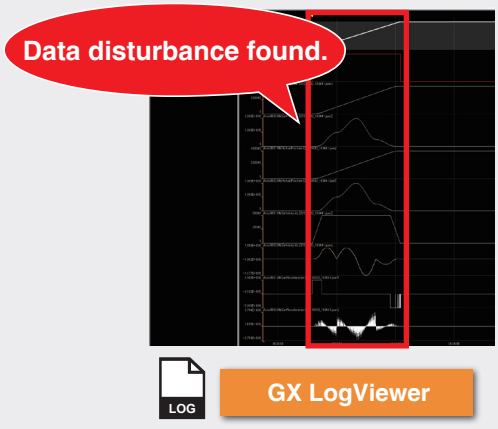
Analyze multiple data sets together to identify the cause.

Cause identification with the system recorder

By displaying the logging data of both the recorder module and motion module in the same window, the relationship between the control data and axis data can be analyzed by matching the start time with **one click.**

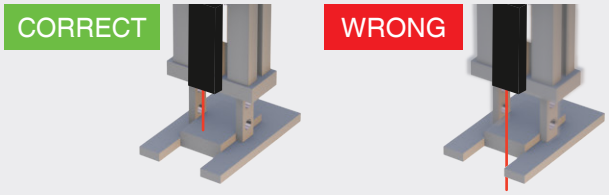


1 By comparing the logging data of the current value of the servo amplifier with the data when the sensor is turned off using **the waveform superimposition function** of GX LogViewer, the disturbance of the current value data of the servo amplifier is confirmed.



2 The ball screw of the target axis was found to have a foreign object (metal powder, etc.) caught in it.

It has been determined that this trouble was caused by "a foreign object in the ball screw, which caused vibration during the transportation and temporarily shifted the workpiece from the sensor check position for workpiece detection."

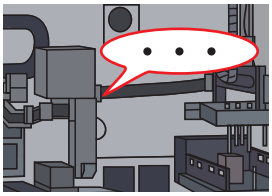


The system recorder has determined that the cause was deviation from the sensor check position for workpiece detection.

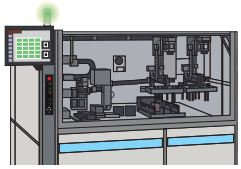
Case 10 Non-alarm stop

Camera recorder module | Recorder module

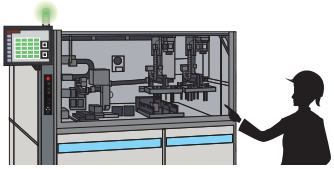
1 A device stopped without alarm due to some error.



2 The operation status of the device before/after the stop cannot be checked because no alarm has been activated.



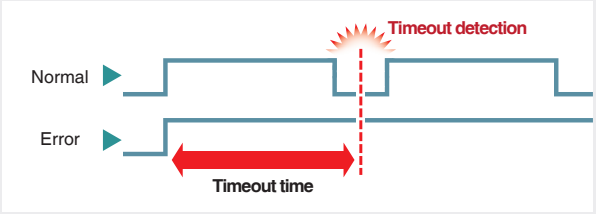
3 It is difficult for operators to constantly monitor the device operation and changes in device/label data for analysis.



Easily analyze the cause of the device stop without alarm.

Cause identification with the system recorder

1 For the file saving trigger of the system recorder, timeout time can be set.
If there is no change in the specified device within the set timeout time, a timeout is detected.



2 No program is required for the timeout detection setting.

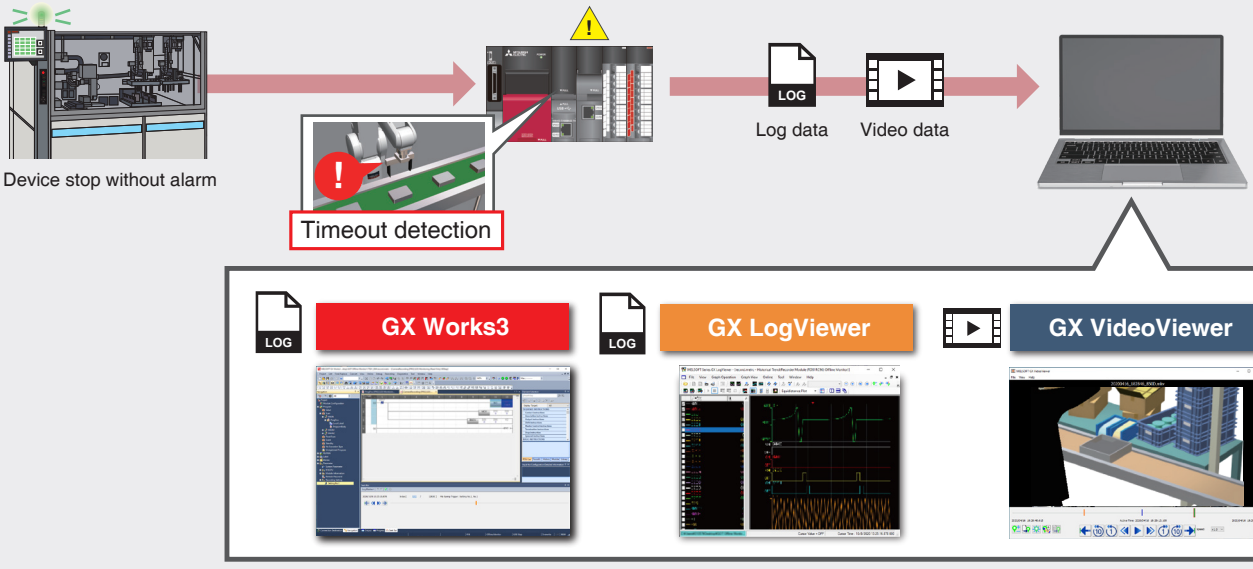
LOG GX Works3

Setting Item

File Saving Trigger Setting

No.	Device	Establishment Condition	Time-out Period	Unit	Comment
1	M0	↑	30	[Second]	File saving trigger
2		↑	30	[Second]	

3 Timeout time can be set for triggers for sensor input signals and actuator output signals.
The entire video and operation data of the device at the stop without alarm can be recorded and simple analysis can be performed without adding a program to activate an alarm.

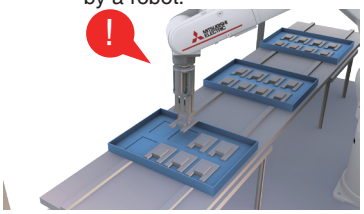


The system recorder automates the device monitoring at stop without alarm and contributes to the reduction of downtime.

Case 11 Detection of "unusual" operations

Camera recorder module | Recorder module

1 An error occurred during workpiece transportation by a robot.



2 It is desirable to analyze the trouble cause by using the video of the device recorded with the system recorder.

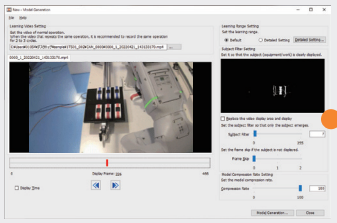
3 The device movement in the video is too fast, making it difficult to identify "unusual" and abnormal operations that could be the trouble cause.

Identify "unusual" operations more easily without time and effort.

Cause identification with the system recorder

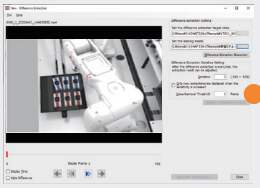
Difference extraction function Page 20

Video data at normal operation



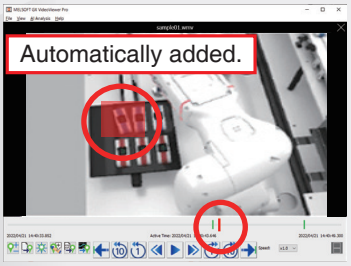
1 AI learns the video of the device at normal operation to generate a normal model.

Video data at error occurrence



2 The video of the device at error occurrence and the generated normal model are compared to extract differences.

3 Log markers are automatically added to the timing of differences = "unusual" operations.
Then, videos and operation data of the device are compared to analyze the error cause.

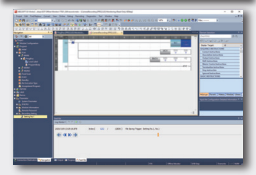


Maisart

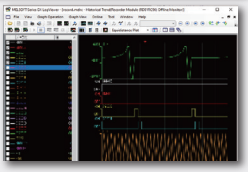
Log markers automatically added can be used in various tools.
They can be checked and analyzed together with the video.

GX VideoViewer Pro

LOG GX Works3



LOG GX LogViewer

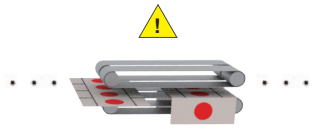


GX VideoViewer Pro facilitates identifying "unusual" operations and reduces the time required for simple analysis.

Case 12 Trouble analysis across devices

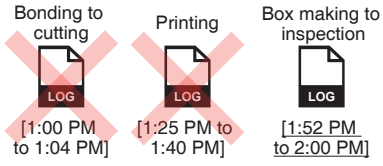
Camera recorder module | Recorder module

1 An error occurred in the box making process in the production line.



2 It is desirable to check the data in the other processes in the same time series to identify the cause.

3 Because the data in the other processes in the same time series was not collected, each data cannot be checked with the timeline matched.



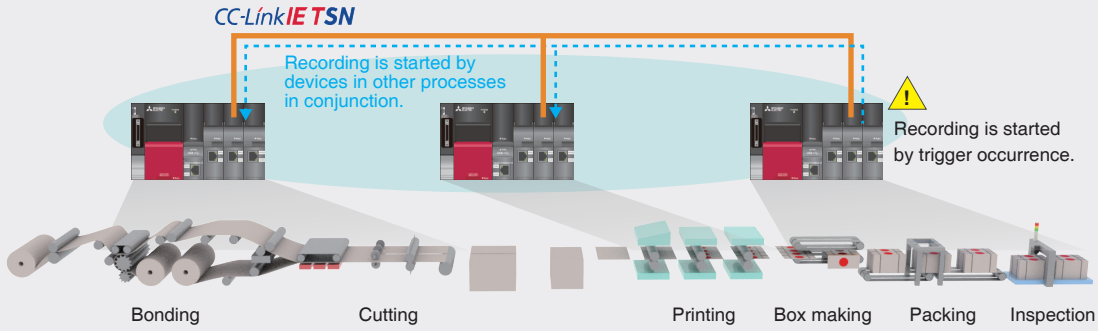
Check multiple data in the same timeline.

Co-recording function Page 20

Cause identification with the system recorder

1 When one of the recording devices*1 detects an error and executes recording, the other recording devices within the operating range can also execute recording in conjunction via CC-Link IE TSN.

*1 A generic term for devices which have the recording function or servo system recorder function such as camera recorder modules and Motion modules



2 Recording devices that are used to start recording at different timings can be switched to co-recording with the setting configured just by one step.

LOG **GX Works3**

Item	Setting Value
Co-recording Setting	Configure the co-recording setting.
Co-recording Setting	Use

Just specifying this in each recording device

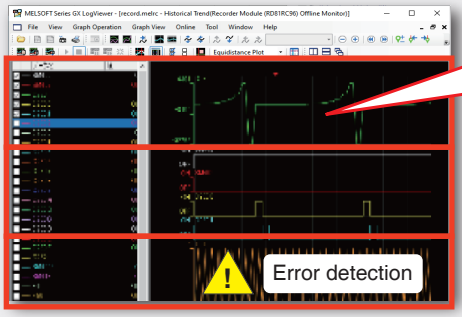
3 The control data and video of each device at error occurrence can be collected and the waveform data can be checked at once.

LOG **GX LogViewer**

Bonding to cutting

Printing

Box making to inspection



Actual error cause

Although the error was detected in the box making process, it was found that the cause of the abnormality was in the bonding process as a result of analyzing the entire system.

The system recorder facilitates checking the error cause across devices.

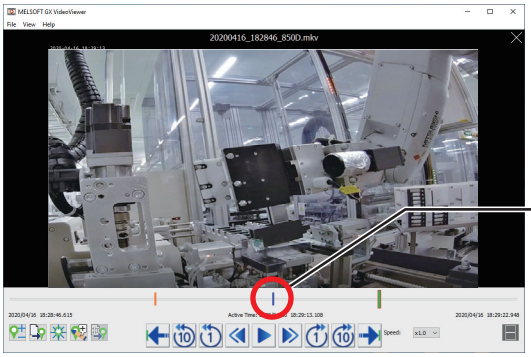
Function introduction

Log marker function

GX Works3 | GX LogViewer | GX VideoViewer

- ✓ The video recorded when a trouble occurred can be saved with marks (log markers) added to the positions to be focused.
- ✓ The log markers added to GX VideoViewer can be synchronized with GX Works3 and GX LogViewer to check the program operation and others.
- ✓ Log markers can be shared among related parties even when they are at distant locations each other.

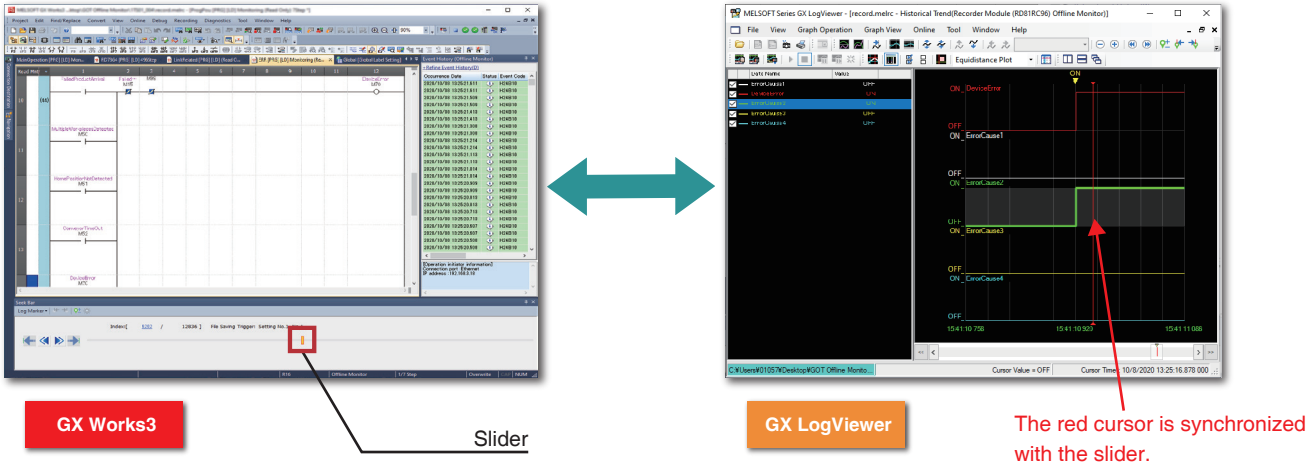
GX VideoViewer



Offline monitor

GX Works3 | GX LogViewer | GT Designer3

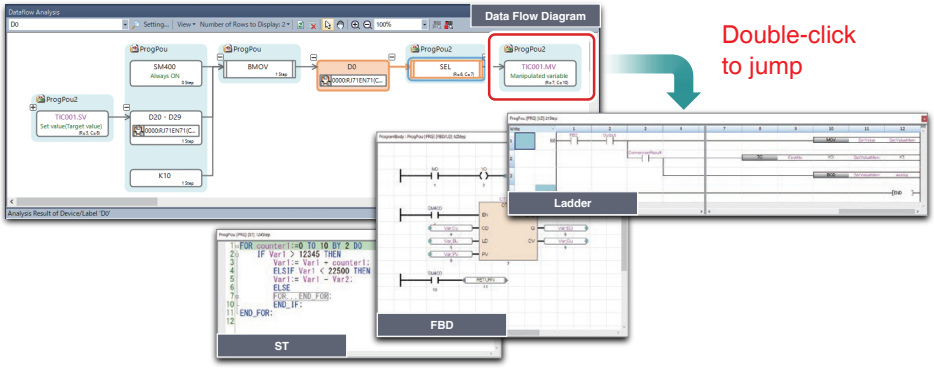
- ✓ By performing a replay on the offline monitor using each data saved in the recorder module, the status at the trouble occurrence can be reproduced on the engineering tool.
- ✓ The circuit (program transition) can be monitored in GX Works3, and the waveform data can be checked in GX LogViewer. By moving the slider on the seek bar in GX Works3, the program, waveform data, and operation history can be replayed in synchronization.



Data flow analysis function

GX Works3

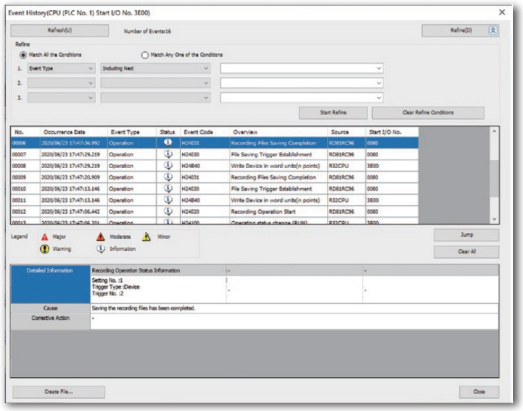
- ✓ A device flowchart is automatically created from the program of GX Works3, and the related data is visually displayed.
- ✓ Comments and instruction diagrams are also displayed in the flowchart.
- ✓ Double-clicking an item in the flowchart jumps to the window for the corresponding device/label.



Event operation history

GX Works3

- ✓ Since device/label operations from external devices can be recorded as the event history, "when, where, how, and which device/label has been changed" can be accurately understood.



Recording targets

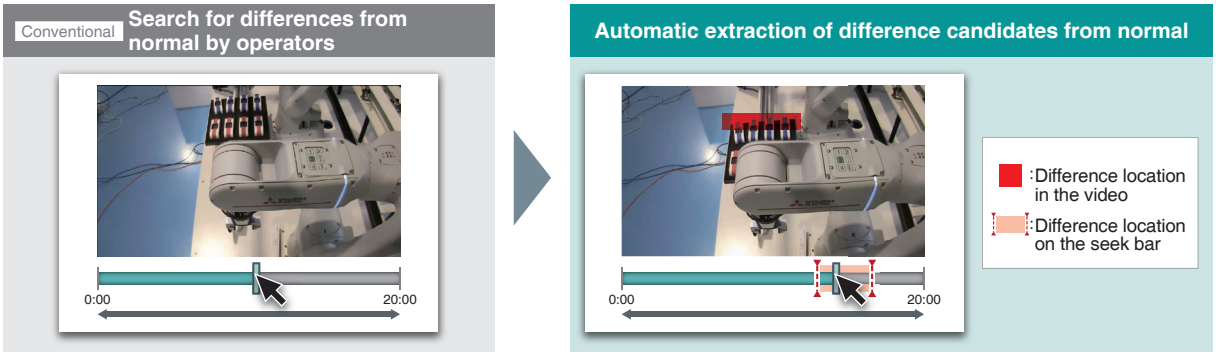
- Operations from the engineering tool
- Data writing to device/label by SLMP
- Data writing to device with an instruction
(Writing from another station or another CPU)
- Data writing to device by simple CPU communication
(Writing from the communication target)

Function introduction

AI Difference extraction function

GX VideoViewer Pro | Maisart

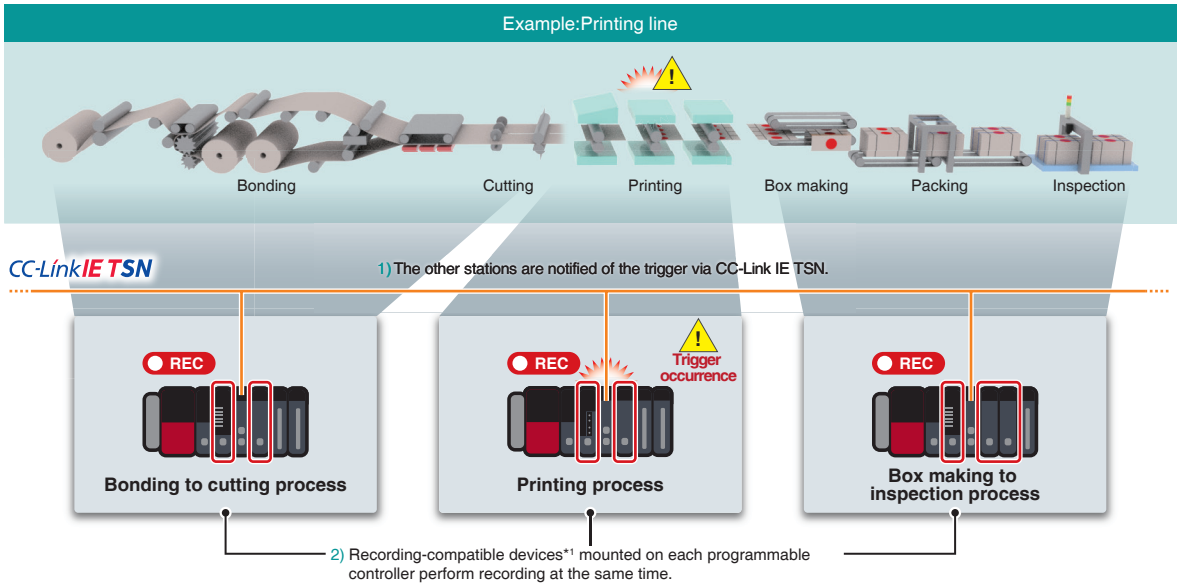
- ✓ Without deep learning, AI analyzes "appearance" and "movement" using its own algorithm to extract differences, facilitating the error analysis.
- ✓ The difference extraction can be performed in two steps: normal model generation and difference extraction.
- ✓ Differences from the normal pattern are extracted from the video and log markers are automatically added to the video and seek bar, allowing operators to identify the error occurrence location at a glance. Log markers can be synchronized with other applications.



Co-recording function

GX Works3 | GX LogViewer

- ✓ When one of the recording-compatible devices detects an error and performs recording, all the other recording-compatible devices in the system record data in conjunction.
- ✓ Even in a large production line, detected errors can be notified via CC-Link IE TSN.
- ✓ Videos and log data at the same time as an error detection in a device are also collected by the other recording-compatible devices, allowing error causes across multiple devices/programmable controllers to be checked while matching the timeline.



*1. The recorder module, camera recorder module, and Motion CPU module are compatible with recording. The Motion module will be compatible with recording soon.

System recorder-related products

Camera recorder module - RD81RC96-CA
Recorder module - RD81RC96

RD81RC96-CA/
RD81RC96

All the device/label data before and after an error has occurred is automatically sampled with timestamps per scan.

Motion module - RD78GH, RD78G
Servo amplifier - MR-J5 series

MR-J5-G RD78G

At an error occurrence, information on all the actual driver axes is automatically sampled from the motion module and servo amplifier. The information based on the sampling results of the command and feedback values during the issue can be used for troubleshooting.

Camera recording package

When the recorder module is used, the camera recording package for instructing the network camera when to record video consists of function blocks (FBs) and a connection manual. For details on how to obtain the software, please contact your local Mitsubishi Electric sales office or representative.

GX VideoViewer

The recorded video can be checked in GX VideoViewer or within a general-purpose video player software.
GX VideoViewer is independent of the engineering tool. For details on how to obtain the software, please contact your local Mitsubishi Electric sales office or representative.

GX VideoViewer Pro

In addition to the functions of GX VideoViewer, this software automatically extracts differences from the normal status and facilitates identifying error causes by using original AI technology. Log markers are automatically added to the differences found, and they can be checked using other engineering tools. For details on how to obtain the software, please contact your local Mitsubishi Electric sales office or representative.

GX Works3, GX LogViewer, GT Designer3

GX Works3 is a next-generation engineering software which contributes to reduction in development costs with its intuitive programming environment.
GX LogViewer is a dedicated viewer for displaying/analyzing the sampled logging files with simple operations.
GT Designer3 is screen design software for the Mitsubishi Electric Graphic Operation Terminal GOT2000 series.

For the specifications of each product, refer to the iQ Platform-compatible PAC System Recorder (L(NA)08736ENG) or Mitsubishi Electric Factory Automation Global Website.

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Mitsubishi Electric's e-F@ctory concept utilizes both FA and IT technologies, to reduce the total cost of development, production and maintenance, with the aim of achieving manufacturing that is a "step ahead of the times". It is supported by the e-F@ctory Alliance Partners covering software, devices, and system integration, creating the optimal e-F@ctory architecture to meet the end users needs and investment plans.

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L(NA)08734ENG-F 2304(CDS)

New publication, effective April 2023.
Specifications are subject to change without notice.