MITSUBISHI ELECTRIC

Edge Computing Software

iQ Edgecross

Real-time Data Analyzer User's Manual

-SW1DND-RDA-M

SAFETY PRECAUTIONS

(Read these precautions before using this product.)

Before using this product, please read this manual and the relevant manuals carefully and pay full attention to safety to handle the product correctly.

The precautions given in this manual are concerned with this product only. For the safety precautions of the programmable controller system, refer to the user's manual for the CPU module used.

In this manual, the safety precautions are classified into two levels: "⚠ WARNING" and "⚠ CAUTION".

⚠ **WARNING**	Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.
⚠ **CAUTION**	Indicates that incorrect handling may cause hazardous conditions, resulting in minor or moderate injury or property damage.

Under some circumstances, failure to observe the precautions given under "⚠ CAUTION" may lead to serious consequences.

Observe the precautions of both levels because they are important for personal and system safety.

Make sure that the end users read this manual and then keep the manual in a safe place for future reference.

[Design Precautions]

⚠ WARNING

- To perform an operation, such as data change or operating status change, to running devices, such as a programmable controller, servo, robot, or server, from an industrial PC equipped with this product, configure an interlock circuit outside of the devices so that the entire system always operates to the safety side. Additionally, read this manual carefully and ensure the safety before operations.
  Especially, in the above mentioned operations that are performed from external devices through network, any problems on devices may not be dealt with promptly due to an abnormal data communication.
- Configure a safety circuit outside of an industrial PC equipped with this product so that the entire system operates to the safely side even when a fault occurs in the PC.
  Failure to do so may result in an accident due to an incorrect output or malfunction.

[Design Precautions]

⚠ CAUTION

- During application of each setting, do not perform the operation that forcibly turns the industrial PC equipped with this product OFF.
  Otherwise, the data will be undefined and resetting and re-registering data will be required.
  Additionally, doing so may cause the malfunction of this product.

[Security Precautions]

⚠WARNING

- To maintain the security (confidentiality, integrity, and availability) of access target devices and the system against unauthorized access, denial-of-service (DoS) attacks, computer viruses, and other cyberattacks from external devices via the network, take appropriate measures such as firewalls, virtual private networks (VPNs), and antivirus solutions.

CONDITIONS OF USE FOR THE PRODUCT

(1) This software shall be used under the following conditions;
i) that any failure occurred in this software, if any, shall not lead to any serious accident.
ii) that the backup and/or fail-safe functions are systematically performed outside the devices in the cases of any failure occurred in this software.

(2) Mitsubishi Electric assumes no responsibility and liability (including but not limited to, default liability, defect liability, quality assurance responsibility, tort liability, product liability) for the quality, performance, and safety of both this software and products using this software.

(3) Mitsubishi Electric shall have no responsibility or liability for any problems involving this software and system trouble caused by DoS attacks, unauthorized access, computer viruses, and other cyberattacks.

INTRODUCTION

Thank you for purchasing Real-time Data Analyzer.
This manual describes the performance specifications, procedures before operation, and troubleshooting of this product.
Before using this product, please read this manual and the relevant manuals carefully, and develop familiarity with the functions and performance of this product to handle correctly.
Note that the menu names and operating procedures may differ depending on an operating system in use and its version.
When reading this manual, replace the names and procedures with the applicable ones as necessary.
Please make sure that the end users read this manual.

CONTENTS

PART 3 Real-time Statistic Diagnosis Tool

RELEVANT MANUALS

Manual name [manual number]	Description	Available form
Real-time Data Analyzer User's Manual [SH-081873ENG] (this manual)	Specifications, procedure before operation, functions, and troubleshooting of Real-time Data Analyzer	e-Manual PDF

Point

e-Manual refers to the Mitsubishi Electric FA electronic book manuals that can be browsed using a dedicated tool.

e-Manual has the following features:

- Required information can be cross-searched in multiple manuals.
- Other manuals can be accessed from the links in the manual.
- Hardware specifications of each part can be found from the product figures.
- Pages that users often browse can be bookmarked.
- Sample programs can be copied to an engineering tool.

TERMS

Unless otherwise specified, this manual uses the following terms.

Term	Description
Correlation matrix	A matrix created based on the reference CSV file. It is used for advanced analysis.
Data collection	Processing to collect data for data diagnosis and data analysis.
Data collector	A software component that collects data in production sites through each network. It is provided by vendors for each network and connection target devices.
Data diagnosis	Processing to diagnose if collected data matches preset conditions.
Data modification	Processing to modify collected data into a form suitable for analysis and diagnostic. Further modifications can also be made to the data modified once.
Dataset	A group of data in a read CSV file. It is used for a logic.
Detection	It is to indicate that waveforms are different, as a diagnosis result.
Detection sensitivity	The difficulty of determination that a waveform is similar or dissimilar, as a result of similarity diagnosis. It is difficult to make the determination as the detection sensitivity is higher. (The proportion of waveforms determined to be different increases.)
Diagnosis result	A diagnosis result data. (0: similar, 1:different)
Diagnosis result data	A general term for information on a diagnostic result passed to Real-time Flow Manger after the similarity diagnosis.
Different state	A diagnosis result that indicates 'similarity score < similarity score threshold'.
Edge application	Software that performs various processing for data utilization in production sites using the functions provided by Edgecross in the edge computing area.
Edge computing	An information processing method and area, for not only collecting and analyzing data in production sites in real-time, and feed backing the data, but summarizing the production site data and sharing information with IT systems efficiently with the hardware and software in production sites.
Edgecross	A software platform that implements specifications and concepts for realizing manufacturing solutions by the FA-IT collaboration centering on the edge computing.
Edgecross Basic Software	The name of the software product that implements the Edgecross function.
Feedback	Processing to report a detection result when diagnosed data matches a condition.
GX LogViewer	A software product that has a function to display an inspection waveform and the similarity scores on a graph in real time and a function to display the graph of a diagnosis result file.
Historical data definition file	A CSV file that stores the definition information of a reference waveform file.
Industrial PC	A PC specialized for industrial use with features such as high reliability, environmental resistance, and long-term supply.
Inspection waveform	Waveform data to be diagnosed.
Internal database	Data group that software included in Real-time Statistic Diagnosis Tool uses to share data.
MQTT	An abbreviation for MQ Telemetry Transport. MQ Telemetry Transport is a lightweight message communication protocol using TCP/IP, and the standard is published as an open protocol.
MQTT broker	An application that acts as an intermediary between applications that distribute messages and ones that receive the messages by using MQTT.
Partial matrix	A matrix that includes only necessary data extracted by removing incorrect variables and exclusive variables from the whole matrix.

Term	Description
Process	A generic term for the processing of data collection, data modification, data diagnosis, and feedback that compose a process flow.
Process flow	An execution unit of sequential processing performed by Real-time Flow Manager, consisting of data collection, data modification, data diagnosis, and feedback.
Processing flow execution control	A control processing that executes and controls a series of processing flow performed in the process for realizing a certain purpose or application using data, and processes the data efficiently (the data includes stream data).
Publishing data definition file	A file that stores the information to set the publishing data to an Edge application in advance.
Real-time data processing	A function that realizes the real-time diagnosis and feedback of the production site data. It is composed of the processing flow execution control and stream data processing.
Real-time Flow Designer	The name of the software component that performs operation setting of Real-time Flow Manager.
Real-time Flow Manager	The name of the Windows version software component that implements the real-time data processing.
Reference waveform	A group of one or more reference waveform files in which waveforms to be referenced for diagnosis are recorded. The main purpose of a waveform similarity diagnosis is determining whether a waveform is similar with a reference waveform or not.
Reference waveform file	A CSV file in which waveforms to be referenced for diagnostic is recorded.
Reference waveform learning data	Data that stores the learning result of a reference waveform. The property of the reference waveform is recorded. By using this data for the similarity diagnosis instead of a reference waveform, the similarity equivalent to a comparison using the reference waveform can be determined at high speed.
Reference waveform learning data file	A file which stores reference waveform learning data.
Response data definition file	A file that stores the information in order to send response definitions to Real-time Flow Designer.
Response data file	A CSV file which is output when an edge application completed a data analysis and detected an error.
Section	The unit of data used in Real-time Statistic Diagnosis Tool. In Real-time Statistic Diagnosis Tool, an analysis or diagnosis is performed for each section.
Setting file	A file that saves the setting contents edited in Similar Waveform Recognition Tool (extension: .swrcfg).
Similar state	A diagnosis result that indicates 'similarity score ≥ similarity score threshold'.
Similar waveform recognition	Refers to the following functions: • Learning a reference waveform and creating a reference waveform learning data • Interface to enter an inspection waveform or output diagnosis result data • Diagnosing the similarity between a reference waveform and an inspection waveform at high speed by using reference waveform learning data • Outputting a diagnosis result in a CSV file
Similarity diagnosis	Processing to obtain the similarity between a reference waveform and an inspection waveform at high speed by using information of the reference waveform recorded in reference waveform learning data.
Stream data processing	A function that cuts data continuously generated in the appropriate unit for data analysis and distributes it to the edge application.
Unit	A unit of a setting in Real-time Statistic Diagnosis Tool. It can be defined and used for each CSV file format to be read.
Waveform learning	Processing to learn the property of a reference waveform and create reference waveform learning data in which the learning information is recorded.
Whole matrix	The original matrix of a created correlation matrix.

PART 1 Real-time Data Analyzer

This part explains Real-time Data Analyzer.

1 Real-time Data Analyzer

Real-time Data Analyzer is an edge application that analyzes the data of a production site offline and diagnose the data in real time.

Real-time Data Analyzer consists of the following edge applications:

Edge application	Description
Similar Waveform Recognition Tool	AI-equipped edge application. This application calculates the similarity between the waveform to be referenced and an inspection waveform at high-speed and detects the differences of the inspection waveform by using the data created by learning the reference waveform.
Real-time Statistic Diagnosis Tool	Edge application that diagnoses the waveform data according to the rules which is derived in a statistic method or multivariate analysis and determines whether the data is OK or NG.

By installing this product in an industrial PC and using with Real-time Flow Manager, the data collected by Real-time Flow Manager is analyzed offline and diagnosed in real time. (☞ Page 12 Offline analysis, Page 13 Real-time diagnosis)

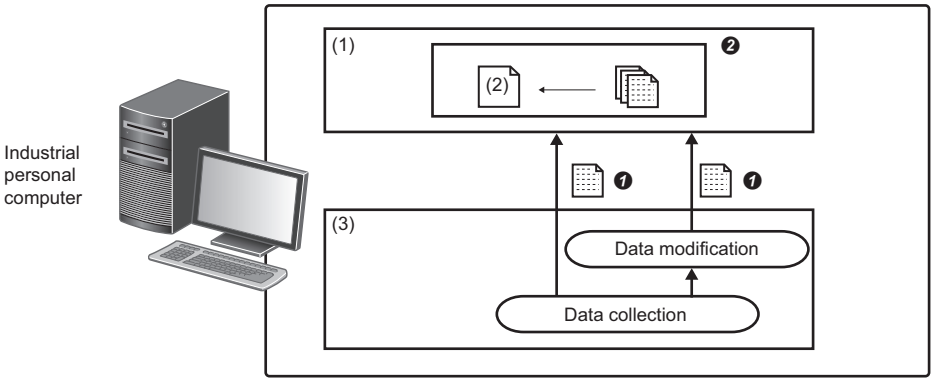
For Real-time Flow Manager, refer to the following manual.

📖Edgecross Basic Software for Windows User's Manual

Offline analysis

This creates rules to enable users to analyze and diagnose data collected from a production site.

The following figure describes the flow of offline analysis.



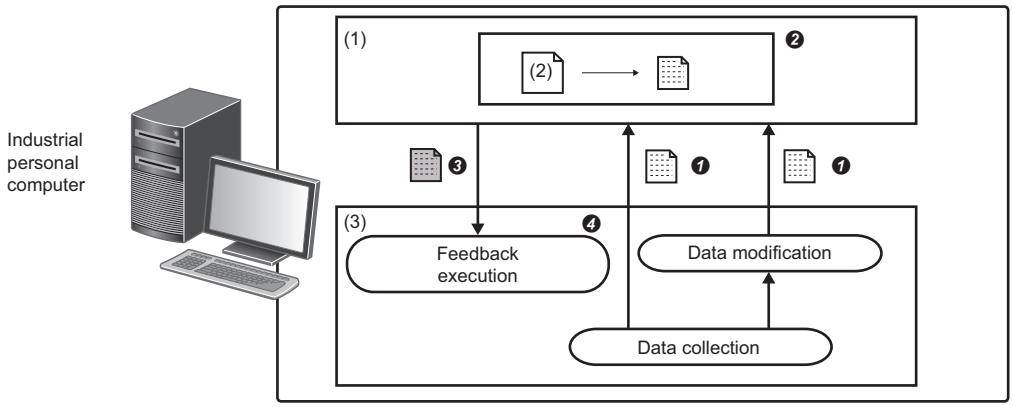
(1) Real-time Data Analyzer
(2) Diagnosis rule
(3) Real-time Flow Manager

❶ Real-time Flow Manage outputs the data collected in the data collection process as a file. (Data will be modified in the data modification process as necessary.)

❷ A user creates diagnosis rules in Real-time Data Analyzer based on the file of the output collection data.

Real-time diagnosis

This diagnoses data collected from a production site in real time according to the diagnosis rules created in offline analysis. The following figure describes the flow of real-time diagnosis.



(1) Real-time Data Analyzer
(2) Diagnosis rule
(3) Real-time Flow Manager

❶ Real-time Flow Manage outputs the data collected in the data collection process. (Data will be modified in the data modification process as necessary.)

❷ Real-time Data Analyzer diagnoses collected data which was output by Real-time Flow Manager according to diagnosis rules created in offline analysis.

❸ Real-time Data Analyzer outputs the diagnosis result data.

❹ Real-time Flow Manager sends a feedback based on the diagnosis result data.

2 SPECIFICATIONS

This chapter shows the functional and operational specifications of Real-time Data Analyzer.

2.1 Functional Specifications

This section shows the functional specifications of Real-time Data Analyzer.

Restriction

Surrogate pair characters are not available in Real-time Data Analyzer.

Similar Waveform Recognition Tool

The following shows the functional specifications of Similar Waveform Recognition Tool.

Item			Specification
Waveform learning function	Reference waveform file	File format	CSV file
		Number of files[*1]	1 or more (no limitation)
	Reference waveform	Lower limit of number of records[*2,*3]	• To satisfy the restrictions of the waveform learning function: Records should be more than 4 times of the unit waveform width and temporally consecutive in one or more sections. • To enable the minimum diagnosis operation: Records in which the basic cycle of a reference waveform is 4 cycles or more and temporally consecutive in one or more sections. • To enable the practical operation: Records in which the basic cycle of a reference waveform is 16 cycles or more and temporally consecutive in one or more sections.
		Upper limit of number of records	1000000
		Data type[*4]	Numerical type (decimal notation or exponent notation)
		Value range[*5]	• To satisfy the restrictions of the waveform learning function: -2.11996057443428e+152 to 2.11996057443428e+152 • Practical value range: -9.00719925474099e+12 to 9.00719925474099e+12

Item				Specification
Data diagnosis function	Input data (Publishing data)	Inspection waveform	Description	Waveform data which is sent from Real-time Flow Manager and to be diagnosed in a similarity diagnosis
			Data name	Any name (Set in Real-time Flow Designer)
			Data type	• INT • UINT • DINT • UDINT • REAL • LREAL
			Number of input	1 to 64
	Output data*6 (Response data)	Number of different detection (number of diagnosis results determined to be different)*7	Description	Number of diagnosis results determined to be different among all similarity diagnoses in progress It will be '0' when all diagnosis results are determined to be similar. In other cases, it will be '1' or more according to the number of diagnosis results determined to be different.*8
			Data name	DifferenceCount
			Data type	UINT
			Number of output	1
			Value range	• Maximum value: Number of operation settings applied to a similarity diagnosis • Minimum value: 0
		Relative similarity score (gap of a similarity score and a similarity score threshold)*9	Description	Gap between a similarity score and similarity score threshold acquired in each individual similarity diagnosis The value will be '0' or more in a similarity diagnosis determined to be similar, or lower than '0' in a similarity diagnosis determined to be different.
			Data name	Any name (Set in Similar Waveform Recognition Tool)
			Data type	REAL
			Number of output	1 to 64 (Same as the input number of an inspection waveform)
			Value range	• Maximum value: 100 - similarity score threshold • Minimum value: 0 - similarity score threshold
		Diagnosis result	Description	Individual similarity diagnosis result
			Data name	Any name (Set in Similar Waveform Recognition Tool)
			Data type	UINT
			Number of output	1 to 64 (Same as the input number of an inspection waveform)
			Value range	• 0: Similar • 1: Different

*1 Sequentially numbered files are read in the file name order. When records stored in the successively read files are continuous in time, it is considered as one unit of waveform data.

*2 If the temporally consecutive record is less than 4 times of the unit waveform width, the section can not be analyzed and is discarded.

*3 When the stability of a waveform is low, the diagnosis precision is decreased and a false detection may be reported because the tendency of waveforms can not be grasped within the number of records mentioned in this item. To solve this issue, increase the number of records used for the learning.

*4 The data types that there are 500 steps or more from the minimum value to the maximum value are recommended.

*5 When a waveform that contains an extremely large or small value is diagnosed, a small change may not be applied to the similarity score, or the similarity score may greatly be reduced because a slight change is considered as a large one.

*6 It is used as input data for the feedback function of Real-time Flow Manager.

*7 To provide feedback when at least one difference is detected in a result of similarity diagnosis, set the condition to 'DifferenceCount > 0'.

*8 When the diagnosis status is in the 'preparing for diagnosis' or 'suspended' state, the number of diagnosis results determined to be different is counted as shown below according to each situation.
Before a diagnosis starts: The number is not counted since the diagnosis is not yet performed.
When a diagnosis status changed from 'similar' to 'suspended' or 'preparing for diagnosis': The number is not counted since the diagnosis status is determined to be similar.
When a diagnosis status changed from 'different' to 'suspended' or 'preparing for diagnosis': The number is counted since the diagnosis status is determined to be different.

*9 To provide feedback when a difference is detected in a result of specific similarity diagnosis, set the condition to 'Gap of a similarity score and a similarity score threshold < 0'.

Real-time Statistic Diagnosis Tool

The following shows the functional specifications of Real-time Statistic Diagnosis Tool.
In the following table, MVA refers to the multivariate analysis (single central value format) of the simple analysis and simple diagnosis, and GB refers to the guard band.

Item				Specification
Response data file	File name			(Unit name)_(YYYY_mm_dd HH_MM_ss.ms[*1]).csv
	Output data	TIME	Data type	DATETIME
			Output content	End time of a diagnosis section (YYYY/MM/DD hh:mm:ss.ms)
		RESULT	Data type	BOOL
			Output content	Value (1) indicating that an error is detected in a diagnosis
		TYPE	Data type	INT
			Output content	Numeric value indicating the diagnosis type • 1: Simple diagnosis (SPC) • 2: Simple diagnosis (Guard band) • 3: Simple diagnosis (Multivariate analysis (single central value format), calculation type = T2) • 4: Simple diagnosis (Multivariate analysis (single central value format), calculation type = Q) • 5: Simple diagnosis (Multivariate analysis (single central value format), calculation type = KNN) • 6: Simple diagnosis (Multivariate analysis (single central value format), calculation type = MT) • 7: Simple diagnosis (Multivariate analysis (single central value format), calculation type = EU) • 10: Analysis logic, diagnostic logic
		NAME	Data type	STRING
			Output content	• Simple diagnosis: Diagnosis name specified in a simple diagnosis[*2] • Analysis logic, diagnostic logic: Logic name[*2]

Item				Specification
Diagnosis result detail information file	File name			(Unit name)_(diagnosis type (SPC, GB, or MVA))_(time at which an error was detected (YYYY_mm_dd HH_MM_ss_ms[*1])).csv[*3]
	File format	Delimiter		Comma (,)
		Line feed code		CRLF(0x0D, 0x0A)
		Character code		Shift JIS
		Number of columns		13 to 51 columns
		Number of rows		2 rows (header row and data row)
	Output data	EQ[*4]	Data type	STRING
			Output content[*5]	Equipment
		UNIT[*4]	Data type	STRING
			Output content[*5]	Unit name
		SECTION[*4]	Data type	STRING
			Output content[*5]	Extended section name (blank if not set)
		DIAG_NAME[*4]	Data type	STRING
			Output content[*5]	Diagnosis name
		DIAG_TYPE[*4]	Data type	STRING
			Output content[*5]	Diagnosis type (SPC, GB, or MVA)
		STATISTICS[*4]	Data type	STRING
			Output content[*5]	• SPC and MVA: Type of selected statistics • GB: Blank
		TYPE[*4]	Data type	STRING
			Output content[*5]	SPC: Decision rule (☞ Page 191 Default SPC rule) MVA: Calculation type[*6*7*8] (☞ Page 205 Screen configuration) GB: Condition of fault judgement sections (It is output in the format of "(number of error occurrences)/(number of judgement sections).")
		THRESHOLD[*4] (For GB, 'THRESHOLD**' ('**' is a two-digit value starting with '00.'))	Data type	LREAL
			Output content[*5]	SPC: Threshold values (1 to 5 sigma, management upper and lower limits, or toward center) when a decision rule is set to use the threshold values for judgement[*9] MVA: Upper limit set as a reference GB: Guard band value at the time when an error was detected (A guard band value corresponding to the value in the "VALUE**" column is output for each error section. In addition '**' in the column name "THRESHOLD**" is the value same as '**' in the corresponding "VALUE**" column.)
		START_TIME[*4]	Data type	DATETIME
			Output content[*5]	Section start time (YYYY/mm/dd HH:MM:ss.ms[*1])
		END_TIME[*4]	Data type	DATETIME
			Output content[*5]	Section end time (YYYY/mm/dd HH:MM:ss.ms[*1])
		DETECT_TIME[*4]	Data type	DATETIME
			Output content[*5]	• SPC and MVA: Blank (Data time is displayed with the section start and end time since it is determined by calculating the statistics of the section.) • GB: Time at which an error was detected (YYYY/mm/dd HH:MM:ss.ms[*1])
		VARIABLE[*4]	Data type	STRING
			Output content[*5]	Diagnosis target variable name (It is output by delimiting the variable names of calculation sources with '/' if the value of a diagnosis target is calculated from multiple variables.)

Item				Specification
Diagnosis result detail information file	Output data	VALUE**[*4] '**' is a two-digit value starting with '00.'	Data type	LREAL
			Output content[*5]	Value of a diagnosis target ■Details on the value SPC: The output value differs depending on the decision rule. • Other than 1 to 5 sigma: Sigma value of statistics calculated for each section • Other rules: Statistics calculated for each section MVA: Result of calculation selected for the calculation type GB: Value measured when an error was detected ■Number of output columns When a diagnosis requires multiple fault judgement sections, the value is output for the number of the following sections by setting each column name as "VALUE**." (Up to 20 sections (VALUE00 to VALUE19)) • SPC and MVA: Fault judgement sections • GB: Sections in which an error occurred

*1 Up to three digits are output.
*2 To cooperate with Real-time Flow Manager, set the name from 1 to 32 characters.
*3 (Example) When a unit name is 'S001': S001_SPC_2017_03_15_19_47_53_789.csv
*4 Output in the header row.
*5 Output in the data row.
*6 When the calculation type is T2 or Q, the calculation type is output followed by the number of principal components which is output in the format of "/(number of principal components)."
*7 The calculation type (the number of principal components if the calculation type is T2 or Q) is output followed by the condition of fault judgement section which is output in the format of "(number of error occurrences)/(number of judgement sections)."
*8 (Example) T2: T2/2(2/3)
(Example) MT: MT(2/3)
*9 Blank if a decision rule is set not to use the threshold values for judgement.

2.2 Operational Specifications

This section shows the operational specifications of Real-time Data Analyzer.

Operating status

The following shows the operating status of Real-time Data Analyzer.

Similar Waveform Recognition Tool

The following table shows the operating status of Similar Waveform Recognition Tool.

Functions that can be executed vary depending on the operating status of Similar Waveform Recognition Tool.

○: Executable, ×: Not executable

Status	Description	Function			
		Waveform learning	Similarity diagnosis setting	Diagnosis status display	Connection with GX LogViewer
Stop	A state in which the similarity diagnosis is in stand-by	○	○	×	×
Run	A state in which the similarity diagnosis is in operation	○	×	○	○

Real-time Statistic Diagnosis Tool

The following table shows the operating status of Real-time Statistic Diagnosis Tool.

In Real-time Statistic Diagnosis Tool, the software configuring the real time statistical diagnostics tool, Reader, Analyzer, and Monitor, has the operating status individually.

For the software configuration, refer to the following:

☞ Page 109 Configuration Software

■ Reader

Status	Description
Setting editable mode	A state in which the settings of Reader can be edited
CSV file reading mode	A state waiting for storing a CSV file in a specified folder A CSV file will be read automatically after stored in a specified folder

■ Analyzer

Status	Description
Stopped	A state in which either a diagnosis rule is not set or a diagnosis is not performed even after a CSV file was read by Reader
Diagnosing	A state in which the CSV file is read by Reader and a diagnosis can be performed according to the set diagnosis rule

■ Monitor

Status	Description
Stopped	A state in which the response data file is not output even when an error is detected in a diagnosis
Diagnosing	A state in which the response data file when an error is detected in a diagnosis

Operation when an error occurs

When an error occurs in Real-time Data Analyzer, an error message is displayed on the top of the screen.

3 FUNCTION LIST

This section shows the function list of Real-time Data Analyzer.

3.1 Function List of Similar Waveform Recognition Tool

This following table shows the function list of Similar Waveform Recognition Tool.
An offline analysis and real-time diagnosis are included in the waveform learning function and the data diagnosis function respectively.

Function	Description	Reference
Waveform learning function	To create the reference waveform learning data used for similar waveform recognition. It extracts unit waveforms from a reference waveform for diagnosing the similarity.	Page 36 WAVEFORM LEARNING
Data diagnosis function	To monitor an inspection waveform and notify Real-time Flow Manager of a waveform determined to be different, that is the similarity score is lower than a threshold value, if found. In addition, monitoring of an inspection waveform can be paused by setting a condition for its publishing data that was input from Real-time Flow Manager.	Page 38 DATA DIAGNOSIS
GX LogViewer interaction function	To display the diagnostic status of a similar waveform recognition in GX LogViewer.	Page 90 GX LogViewer COOPERATION

3.2 Function List of Real-time Statistic Diagnosis Tool

This following table shows the function list of Real-time Statistic Diagnosis Tool.

Offline analysis and real-time diagnostic is included in the data analysis/diagnostic function.

Function			Description	Reference
CSV file reading function			To read a CSV file output to a specified folder.	Page 124 Reader
Data analysis/ diagnostic function	Display function	—	To display the data of a read CSV file.	—
		Read data display	To display data of a CSV file as a waveform. Analysis by overlapping or connecting data can be performed.	Page 164 Displaying Read Data
		Read data statistics display	To calculate and display the statistics of CSV file data. The changes of statistics and correlation of data can be analyzed.	Page 179 Displaying Read Data Statistics
		Read data frequency display	To perform STFT conversion and display the spectrogram, or perform Wavelet conversion and display the scalogram on data in a CSV file. Facility failure can be analyzed by visualizing the frequencies.	Page 182 Displaying Read Data Frequency
	Simple analysis/ diagnosis function	—	To analyze and diagnose data by operating GUI.	—
		SPC	To calculate the statistics for each unit of collected data and diagnose it according to the SPC rule. A sign of failure can be detected based on the changes of statistics.	Page 188 SPC
		Multivariate analysis (single central value format)	To detect an event to be a trigger based on the model of the multivariate analysis result.	Page 204 Multivariate Analysis (Single Central Value Format)
		Guard band diagnosis	To diagnose data by using a guard band created based on the normal waveform data. The upper and lower limit values can be specified without using the reference waveform.	Page 211 Guard Band Diagnosis
	Advanced analysis function	—	To perform multivariate analysis by the correlation analysis, multiple regression analysis, or Mahalanobis-Taguchi method.	—
		Correlation matrix creating	To create a correlation matrix for correlation analysis.	Page 218 Creating Correlation Matrix
		Multiple regression analysis (LMR)	To perform multiple regression calculation by selecting one objective variable and multiple explanatory variables to obtain the correlation between multiple variables.	Page 238 Multiple Regression Analysis (LMR)
		Maharanobis - Taguchi method (MT)	To collect the sample of multiple variables to be referenced and calculate the Mahalanobis distance for the standard section and the changes in variation based on the correlation of multiple variables.	Page 245 Maharanobis - Taguchi method (MT)
	Analysis logic - diagnostic logic operation function	—	Functions to create arbitrary analysis logic/diagnostic logic	—
		Logic editing	To edit the analysis and diagnostic logics.	Page 250 Editing Logics
		Logic variable setting	To edit variables used in the analysis and diagnostic logics.	Page 351 Setting logic variable
	Data display function after execution		To display multiple waveforms in a single area. Analysis with the display method by connecting multiple sections of single data or overlapping different data in the same section can be performed.	Page 359 Displaying Data after Running

Function			Description	Reference
Data analysis/ diagnostic function	Diagnostic result display function	—	To display the simple diagnosis result or diagnostic logic execution result.	—
		Simple diagnosis result display	To display the result of simple diagnostic (SPC, multivariate analysis, or guard band diagnosis).	Page 368 Displaying a Result of Simple diagnosis
		Diagnostic logic result display	To display the result of diagnostic logic (expansion trace GB, SPC diagnostic, log writing, and error notification).	Page 376 Displaying a Diagnostic Logic Result
	Management function		To manage data used in Real-time Statistic Diagnosis Tool. Data to be displayed can be selected or narrowed down.	Page 378 Management
	Option setting function	—	To set the setting on Real-time Statistic Diagnosis Tool.	—
		Data management setting	To set the setting on data management.	Page 383 Data Management Setting
		Waveform display setting	To set the setting on the waveform display.	Page 384 Waveform Display Setting
		Logic setting	To set the setting on logics.	Page 385 Logic Setting
	Programmable controller cooperation function		To diagnose data in a programmable controller in real time according to the diagnosis rule created in Real-time Statistic Diagnosis Tool.	Page 386 Programmable Controller CPU Cooperation Function
Diagnostic result notification function			To issue an alarm when an error is detected in a diagnostic result.	Page 407 Monitor

4 PROCEDURE BEFORE OPERATION

This chapter shows the procedure from start-up to operation of Real-time Data Analyzer.

Operating procedure

1. Install Real-time Data Analyzer in an industrial PC.

For the installation procedure and the operating environment of Real-time Data Analyzer, refer to the following document.

📖Real-time Data Analyzer Installation Instructions

2. Start License Manager and register the license of the Real-time Data Analyzer.

☞ Page 25 License Manager

3. Start Similar Waveform Recognition Tool or the Real-time Statistic Diagnosis Tool.

☞ Page 29 Startup Method

To switch the display language of Similar Waveform Recognition Tool or Real-time Statistic Diagnosis Tool, use the utility for switching language.

For details, refer to the following:

☞ Page 29 Display Language Switching

4. Install Edgecross Basic Software in the industrial PC.

It can also be installed in an industrial PC in which Real-time Data Analyzer is not installed.

5. Start the operation of Similar Waveform Recognition Tool or Real-time Statistic Diagnosis Tool.

☞ Page 44 PROCEDURE TO USE Similar Waveform Recognition Tool, Page 113 PROCEDURE TO USE Real-time Statistic Diagnosis Tool

Exclusion setting in antivirus software

When running Real-time Data Analyzer on an industrial PC where an antivirus software is installed, the antivirus software may affect the Real-time Data Analyzer behavior. Exclude the following folders from the monitoring targets in the antivirus software settings.

For the setting methods, refer to the manual for each antivirus software.

- Installation destination folder for Real-time Data Analyzer
- Storage destination folder for a reference waveform file*1(☞ Page 63 Reference Waveform Learning Data File Creation Setting Screen)

*1 Exclude this when learning a waveform.

- Output destination folder for a reference waveform learning data file(☞ Page 63 Reference Waveform Learning Data File Creation Setting Screen)
- Save destination folder for a diagnosis result file*2(☞ Page 69 Operation Setting Screen)

*2 Exclude this when diagnosing similarity.

- Following files and folders of Windows

  Pagefile.sys

  *.pst

  %systemroot%\System32\Spool

  %systemroot%\SoftwareDistribution\Datastore

  %windir%\Security\Database

  %allusersprofile%\NTUser.pol

  %systemroot%\system32\GroupPolicy\Machine\registry.pol

  %systemroot%\system32\GroupPolicy\User\registry.pol
- Reader equipment data folder (☞ Page 128 Folder Definition)
- CSV input folder (☞ Page 128 Folder Definition)
- RSD dataset folder (☞ Page 128 Folder Definition)

For the folders which should be excluded from the monitoring targets among the folders which are set by using Edgecross Basic Software, refer to the following manual.

📖Edgecross Basic Software for Windows User's Manual

4.1 License Manager

License Manager is used to register and delete the license of Real-time Data Analyzer and check the status.
The license of Real-time Data Analyzer is authenticated in the subscription method.
The type of license is as follows:

License	Description	Procedure before registration
Temporary license	It is valid for 14 days from the time when starting Real-time Data Analyzer after installed.	☞ Page 28 Registration procedure of a temporary license
Subscription license	It is valid in the specified period after issuing the license. The expiration date can be checked in License Manager.	☞ Page 28 Registration procedure of a subscription license

Precautions

- Make sure that the clock setting on Windows is correct before registering a license file for the first time to an industrial PC in which Real-time Data Analyzer is installed. If the set time on Windows is shifted forward or backward for 24 hours or more after a license file is registered, the license authentication will fail.
- The license expires at 0:00:00 on the next day of its expiration date. The license expiration is checked by using UTC time as a standard. Therefore, it is not affected by daylight saving time. (For a temporary license, it will expire on the next day of the date when the license expiration date becomes less than one day (at 0:00:00 in local time).)

Startup method

Operating procedure

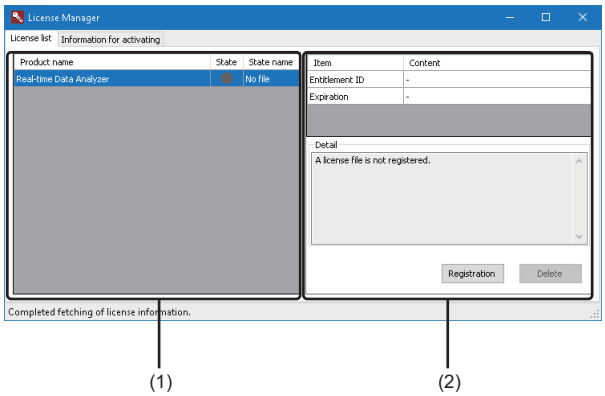
1. Start License Manager from "Mitsubishi Electric Edgecross Software" in Windows Start.

Point

The display language of License Manager is the same as the language set for the operating system.

Screen configuration

Window



Displayed items

Item		Description
[License list] tab	(1) Product name list	A list of products subject to the license management and its status are displayed. ■Product name Names of the products subject to the license management are displayed. ■State/State name The license statuses of each product are displayed. • "Success": Authentication succeeded • "Failure": Authentication failed • "Temporary": Temporary license in use • "No file": No license file
	(2) Detailed information	The detailed information of a selected product is displayed. ■Entitlement ID The entitlement ID of the subscription license in use is displayed. '-' is displayed in any of the following cases. • The temporary license is used. • The entitlement ID cannot be displayed (In a case such as when an incorrect license file is registered or a license file is not included etc.) ■License expiration The expiration date of either the temporary license or subscription license is displayed. In a case such as when an incorrect license file is registered or a license file is not included, the license expiration date cannot be displayed and '-' is displayed instead. • Temporary license It is displayed as 'Days Remaining: {XX}' (XX: 1 to 14) If the expiration date is less than one day, it will be displayed as 'Less than 1day'. • Subscription license The expiration date (local time) is displayed in the format 'YYYY/MM/DD hh:mm'. ■Details of status When "Failure" or "No file" is displayed in "State name", the detailed information is displayed. • "Failure" is displayed in "State name": The error code and its detailed information are displayed. (☞ Page 27 Error description) • "No file" is displayed in "State name": The message "A license file is not registered." is displayed. When "Success" or "Temporary" is displayed in "State name", '-' is displayed.
	[Registration] button	Click this to register the license file of a selected product at the first time or update a registered license file to new one. Select a license file in the "Open" screen which appears by clicking this button.
	[Delete] button*1	Click this to delete the registered license file of a selected product or migrate Real-time Data Analyzer to another industrial PC.
[Information for activating] tab	Hardware code	The code created based on the hardware-specific information necessary for application of a license file is displayed.

*1 It cannot be selected when "No file" is displayed in "State name".

Error description

The following table shows the error descriptions displayed in "Detail" and the corrective actions when "Failure" is displayed in "State name".

Error code	Error description	Cause	Corrective action
210018	There are problems with the license file that is registered.	• The license file is corrupted. • A license file issued for another industrial PC is specified. • The license file was replaced with one other than an Edgecross Basic Software license file.	Register the correct license file issued for the industrial PC in use.
		After registering a license file for the first time to the industrial PC in use, the date and time was changed and the time on Windows was shifted before the license issue date and time.	Change the time on Windows to the time after the license issue date and time.
		• An Ethernet port or wireless LAN of the industrial PC is disabled. • An external Ethernet adapter in use is removed.	• Enable the Ethernet port or wireless LAN of the industrial PC. • Connect the external Ethernet adapter.
210026	The Windows time has changed.	After registering a license file for the first time to the industrial PC in use, the date and time was changed and the time on Windows was shifted forward or backward for 24 hours or more.	Please consult your local Mitsubishi representative.
210037	The license has expired.	The temporary license expired.	Please contact your local Mitsubishi representative and acquire a new license, then register the license.
214109		The subscription license expired.	
Other error codes	A system error has occurred.	Errors that seems not to occur in actual operation occurred due to an internal operation of the software.	Please contact your local Mitsubishi representative and acquire a new license, then register the license.

Registration procedure of a temporary license

This section shows the procedure for registering a temporary license.

Operating procedure

1. Click the [Registration] button in the [License list] tab in the "License Manager" screen.
2. Select 'RDA_Temp.elic' stored in the installation destination folder of Real-time Data Analyzer, and click the [Open] button.

Registration procedure of a subscription license

This section shows the procedure for registering a subscription license.

Operating procedure

1. Check the entitlement ID shown in the Entitlement ID Notification.

When renewing a license, check also the entitlement ID in use which is displayed in "Entitlement ID" in the [License list] tab in the "License Manager" screen.

2. Check the hardware code displayed in "Hardware code" in the "Information for activating" tab in the "License Manager" screen.
3. Access to the web form for issuing licenses, then enter the following information and apply for the license.

- Entitlement ID
- Entitlement ID in use (only for a license renewal)
- Hardware code
- User information (company name, customer name, phone number, address, e-mail address, and others)

For the web form for issuing licenses, refer to the Real-time Data Analyzer License Application Instructions.

4. Save the license file delivered to the entered e-mail address into a folder on the industrial PC in which Real-time Data Analyzer is installed.
5. Click the [Registration] button in the [License list] tab in the "License Manager" screen.
6. Select the license file saved in step 4, and click the [Open] button.

Precautions

- When checking the hardware code, enable only the Ethernet port which is used all the time while Real-time Data Analyzer is operating. License authentication may fail if the Ethernet port is disabled after obtaining and registering a license file[*1].

*1 It is the same as when removing an external Ethernet adapter or disabling the wireless LAN.

- Be sure to enter the correct e-mail address carefully to receive a license file without fail.
- Do not change the license file extension (.elic).
- Use this product with a temporary license while waiting for a license issuance after the application. If a temporary license expires before obtaining a license, please contact your local Mitsubishi representative to reissue a temporary license.

4.2 Startup Method

This section shows the startup method of Real-time Data Analyzer.

Similar Waveform Recognition Tool

Operating procedure

1. Start Real-time Data Analyzer from "Mitsubishi Electric Edgecross Software" in Windows Start.
2. Double-click 'Similar Wave Recognition Tool'.

Real-time Statistic Diagnosis Tool

Operating procedure

1. Start Real-time Data Analyzer from "Mitsubishi Electric Edgecross Software" in Windows Start.
2. Double-click 'Real-time Statistic Diagnosis Tool'.

4.3 Display Language Switching

Real-time Data Analyzer supports multiple language, so the display language such as one on the menu can be switched by using the utility for switching language.

Operating procedure

1. Close Real-time Statistic Diagnosis Tool (Reader, Analyzer, and Monitor) if it is being used.
2. Start Real-time Data Analyzer from "Mitsubishi Electric Edgecross Software" in Windows Start.
3. Double-click 'RDA_Language-Switching'.

The utility for switching language is started.

Point

The display language of the utility for switching language follows the language setting of the operating system.

4. Select a display language and click the [Apply] button.

Precautions

- Set both the display language of the operating system and the system locale according to the language setting of Real-time Statistic Diagnosis Tool to be started. Otherwise, the correct language may not be applied or characters may be garbled in Real-time Statistic Diagnosis Tool.
- When changing the display language, the following settings in Real-time Statistic Diagnosis Tool are initialized according to the changed language so reset the settings as necessary. However, for the following settings in Analyzer and Monitor, the contents previously set are applied because the settings are remained for each switching display language.
  Reader: Folder definition (☞ Page 128 Folder Definition)
  Analyzer: Management (☞ Page 378 Management), Data management setting (☞ Page 383 Data Management Setting), Waveform display setting (☞ Page 384 Waveform Display Setting), Logic setting (☞ Page 385 Logic Setting)
  Monitor: Monitor setting (☞ Page 410 Monitor Setting)
- When switching the display language, set the following folders, which are set in Reader of Real-time Statistic Diagnosis Tool, different from ones previously used before language switching. Otherwise, characters may be garbled because the data in the language corresponding to the display language is saved in the following folders.
  Reader equipment data folder
  RSD dataset folder

MEMO

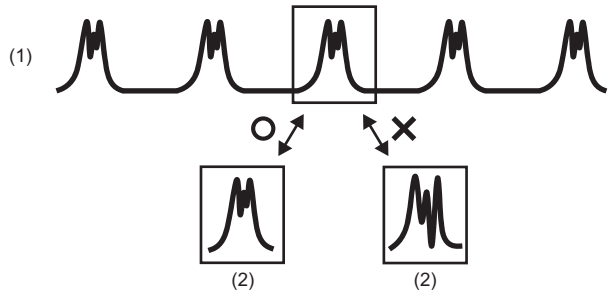
PART 2 Similar Waveform Recognition Tool

This part explains Similar Waveform Recognition Tool.

5 OVERVIEW

Similar Waveform Recognition Tool is an edge application that consists of the following functions.

- A function for learning the given cyclic waveform to be a reference (reference waveform) automatically. Even a waveform of which the cycle is not constant or a waveform in which multiple patterns are switched, their waveforms are learned as the characteristic of the normal cyclic waveforms.
- A function for diagnosing the similarity between a waveform (inspection waveform) input as a diagnosis target and a learned waveform at high-speed and calculating an index for representing similarity (similarity score)
- A function for notifying both Real-time Flow Manager and users of the diagnosis result calculated based on the similarity score



(1) Reference waveform
(2) Inspection waveform

The following processes are necessary to analyze waveform data in Similar Waveform Recognition Tool.

1. Data analysis phase

A diagnosis criterion (reference waveform learning data) for an inspection waveform used for data diagnosis is created based on data collected by Real-time Flow Manager. (☞ Page 36 WAVEFORM LEARNING)

In this phase, a data logging flow of Real-time Flow Manager is performed.

For a data logging flow, refer to the following manual.

📖Edgecross Basic Software for Windows User's Manual

2. Data diagnosis phase

An inspection waveform is monitored and a waveform different from the reference waveform, that is the similarity score is lower than a threshold value, is notified to Real-time Flow Manager if found. (☞ Page 38 DATA DIAGNOSIS)

In this phase, a data diagnosis flow of Real-time Flow Manager is performed.

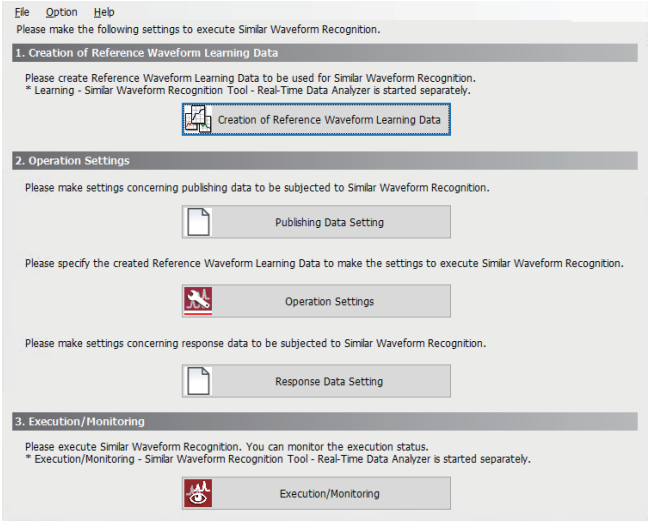
For a data diagnosis flow, refer to the following manual.

📖Edgecross Basic Software for Windows User's Manual

5.1 Home screen

This screen is displayed when starting Similar Waveform Recognition Tool.
All setting items are displayed.

Window



Displayed items

■ Menu configuration

Menu item		Description	Reference
File	Import Settings	To load a setting file exported by using the [Export Settings] menu to Similar Waveform Recognition Tool.*1	Page 34 Setting file import
	Export Settings	To save the setting contents edited in Similar Waveform Recognition Tool as a setting file.*2	Page 34 Setting file export
	Initialize All Settings	To initialize the contents set after starting Similar Waveform Recognition Tool to those at the start-up.	—
	Exit	To exit Similar Waveform Recognition Tool.	—
Option	Edgecross Link Setting	To set parameters for cooperating with Real-time Flow Manager in MQTT communication.	Page 35 Edgecross Link Setting
Help	Manual	To start e-Manual Viewer and display the manual.	—
	Version Information	To display the version information of Real-time Data Analyzer.	—

*1 An error occurs if a setting file is imported in Real-time Data Analyzer the version of which is older than the one used for exporting the file.

*2 Up to 200 characters can be set in the file path of a file name.

■ Screen configuration

Item	Description	Reference
[Creation of Reference Waveform Learning Data] button	Click this to create reference waveform learning data.	Page 62 CREATING REFERENCE WAVEFORM LEARNING DATA
[Publishing Data Setting] button	Click this to set publishing data.	Page 65 PUBLISHING DATA SETTING
[Operation Settings] button	Click this to set the operation setting for similarity diagnosis.	Page 68 OPERATION SETTING
[Response Data Setting] button	Click this to set response data.	Page 75 RESPONSE DATA SETTING
[Execution/Monitoring] button	Click this to start or stop a similarity diagnosis and display both the execution status of each operation setting and the waveform monitor.	Page 77 EXECUTION/MONITORING OF SIMILAR WAVEFORM RECOGNITION

Setting file import

The following shows the procedure and considerations for importing a setting file.

Procedure

The procedure for importing a setting file is as follows.

1. Install Real-time Data Analyzer in a import destination industrial PC.

This step is not necessary if importing a setting file in the same industrial PC as the one used at the time of export.

2. Select [File] ⇨ [Import Settings] to import the setting file.

3. If any of the steps in the following section is not performed before exporting the setting file, perform them.

This step is not necessary if all the steps are performed before the export.

☞ Page 44 PROCEDURE TO USE Similar Waveform Recognition Tool

Point

If the settings of Real-time Statistic Diagnosis Tool have been configured, its current settings will be overwritten by importing a setting file. It is recommended to export the current settings for a backup before importing the file.

Considerations

Considerations for importing a setting file are as follows.

- If any of the settings (example: IP address) in the "Edge Application Diagnosis Setting" screen of Real-time Flow Designer is changed after importing a setting file, perform the operations in steps 2 and later described in the following:

☞ Page 50 Data Diagnosis Setting

- To operate Similar Waveform Recognition Tool with the settings of when exporting a setting file even if the file and folder configuration is different from the one at the time of the export, copy the corresponding files and folders after importing a setting file. Files and folders that are required to be copied are shown in the following table.

Screen	Item	File/folder required to be copied
Reference Waveform Learning Data File Creation setting (☞ Page 63 Reference Waveform Learning Data File Creation Setting Screen)	Folder to save the Reference Waveform File	• Folder set for this item*1 • File stored in the set folder*1
	Output folder	Folder set for this item*1
Response Data Setting (☞ Page 75 RESPONSE DATA SETTING)	[Response data definition file output] button	Response data definition file output with the settings at the time of export*2,*3
Operation Settings (☞ Page 69 Operation Setting Screen)	Reference waveform learning data file	• File set for this item*2 • Folder in which a setting file is stored*2

*1 It is not required to be copied when not performing a waveform learning.

*2 It is not required to be copied when not performing a similarity diagnosis.

*3 It is not required to be copied when satisfying any of the following conditions:
A response data definition file has already been read in the "Edge Application Diagnosis Setting" screen of Real-time Flow Designer.
A response data definition file will be output after importing a setting file.

Setting file export

The following shows the considerations for exporting a setting file.

Considerations

Considerations for exporting a setting file are as follows.

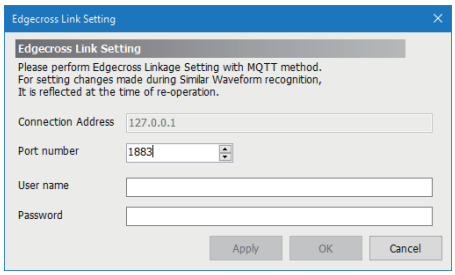
- Export targets are the setting contents in each screen only; files and folders themselves are not exported. If there is a possibility to delete or move any of the files or folders, it is recommended to back them up when exporting a setting file.

Edgecross Link Setting

Set parameters for cooperating with Real-time Flow Manager in MQTT communication.

Window

Select [Option] ⇨ [Edgecross Link Setting].

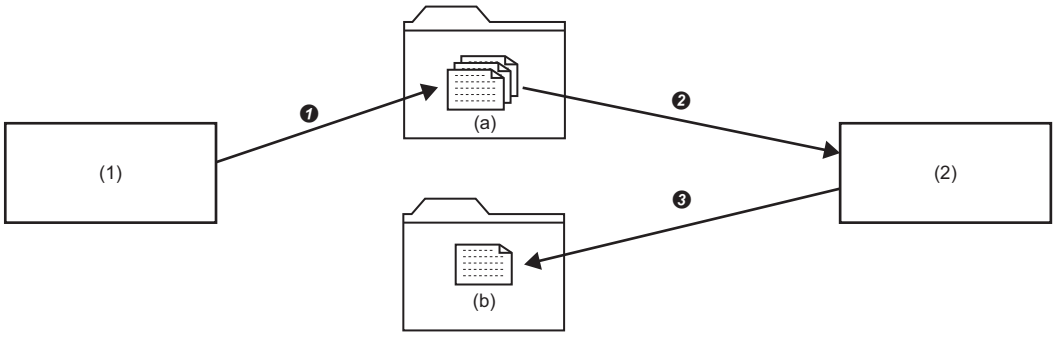


Displayed items

Item	Description	Consideration
Connection Address	The IP address of an MQTT broker of a connection destination is displayed. The value is fixed to '127.0.0.1' (localhost).	—
Port number	Set the port number (1024 to 65535).	Set the same port number as one set for an MQTT broker used.
User name	Set a user name (up to 32 characters).	Set the same user name as one set for an MQTT broker used.
Password	Set a password (up to 32 characters).	Set the same password as one set for an MQTT broker used.
[Apply] button	Click this to apply the set contents.	—
[OK] button	Click this to apply the set contents and close the screen.	—

6 WAVEFORM LEARNING

The waveform learning function creates a diagnosis criterion (reference waveform learning data) of an inspection waveform used for data diagnosis based on data collected by Real-time Flow Manager.

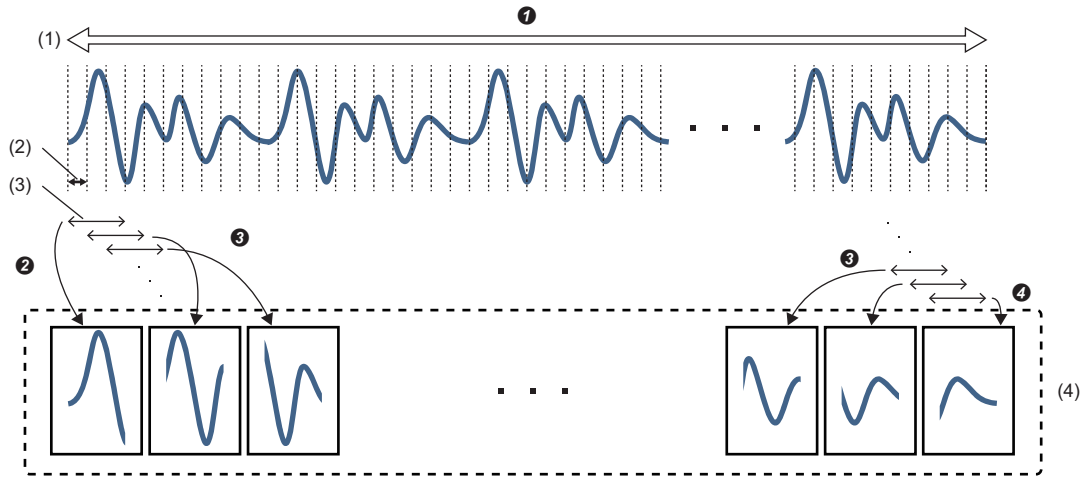


(1) Real-time Flow Manager
(2) Similar waveform recognition (waveform learning)
(a) Reference waveform file
(b) Reference waveform learning data file

❶ Saving waveform data collected by Real-time Flow Manager
❷ Learning based on the reference waveform file
❸ Outputting the learning data to a file

6.1 Operation Overview in Waveform Learning

This section shows the operation overview in waveform learning.
The partial waveform group is created by extracting waveforms for the number of records of the unit waveform width from a reference waveform group in a learning period while shifting the waveform by one record.
The partial waveform group is used as an index to see how similar a waveform is to the inspection waveform when performing a data diagnosis flow.
Detailed operations in waveform learning are as follows:
❶Importing a waveform for the period specified as the learning period
❷ Analyzing and learning the shape of waveforms (partial waveform) for the number of records specified in the unit waveform width
❸ Repeating ❷ for each record (collection cycle)
❹ Completing both learning all partial waveforms in a learning period and saving them in a reference waveform learning data file, and ending the analysis.



(1) Learning period
(2) Collection interval
(3) Unit waveform width
(4) Partial waveform group

MEMO

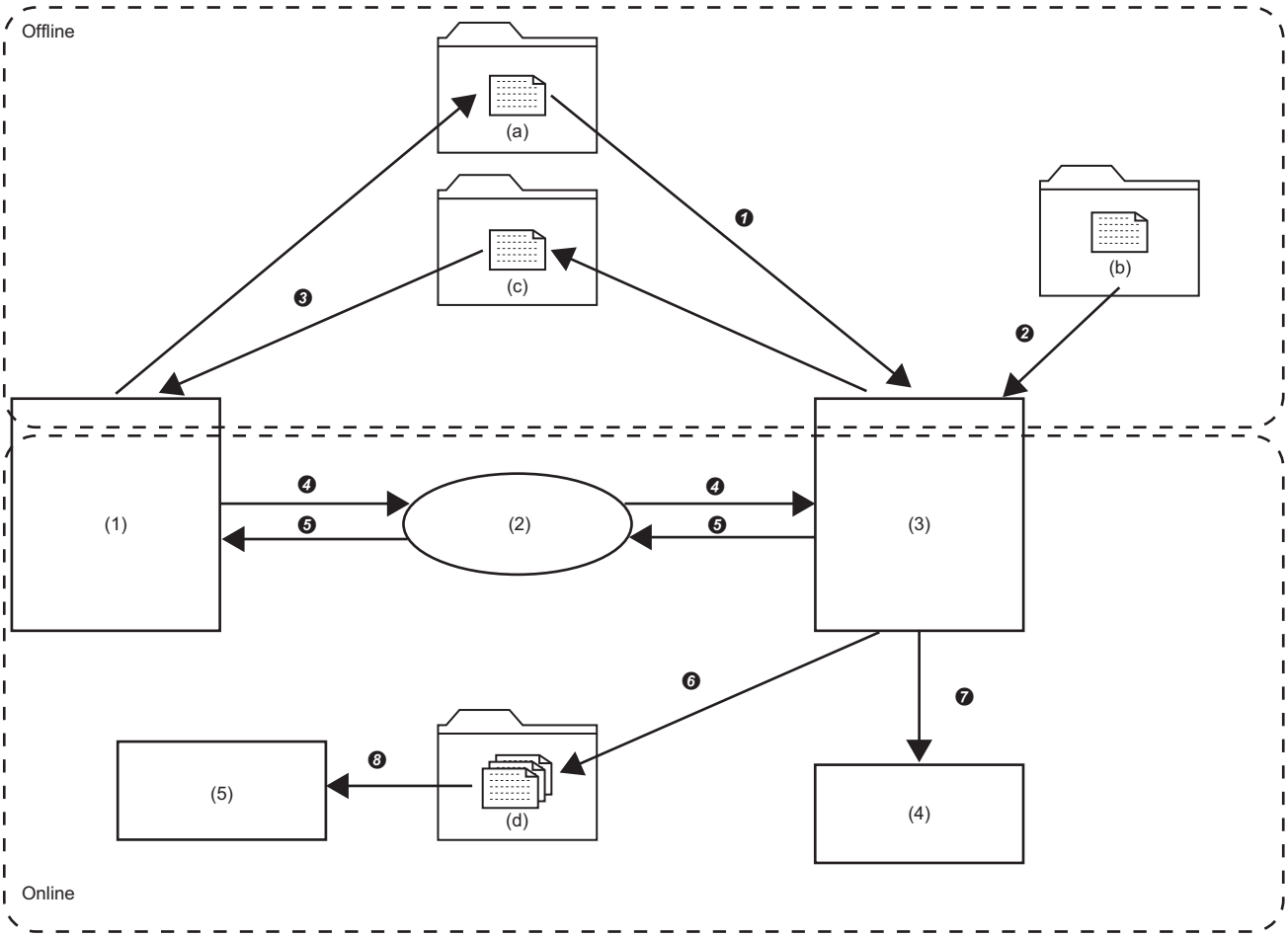
7 DATA DIAGNOSIS

The data diagnosis function monitors an inspection waveform and notifies Real-time Flow Manager of the number of waveforms different from the reference waveform, that is the similarity score is lower than a threshold value, and the gap between a similarity score and similarity score threshold acquired in each individual similarity diagnosis.
In addition, a similarity diagnosis can be paused by monitoring publishing data on the specified conditions. (☞ Page 43 Pause of Similarity Diagnosis)
An inspection waveform are displayed in real time by connecting to GX LogViewer. (☞ Page 90 Similar waveform recognition monitor)
A diagnosed inspection waveform and the diagnosis result data is saved in a file (outputting the diagnosis result file) and the diagnosis status can be checked after the diagnosis.
For a diagnosis result file, refer to the following:
☞ Page 81 OUTPUTTING DIAGNOSIS RESULT FILE
For the display of a diagnosis result file in GX LogViewer, refer to the following:
☞ Page 91 Diagnosis result file display

Point

- GX LogViewer is installed at the same time when installing Real-time Data Analyzer.
- When the load on an industrial PC is high, the limit of the processing performance may be exceeded and the similarity diagnosis may stop. Before starting an actual operation, monitor the load of the PC and check that a similarity diagnosis does not stop by following the procedure described in the following section.

☞ Page 54 Starting a Temporary Operation



(1) Real-time Flow Manager
(2) MQTT broker
(3) Similar waveform recognition (similarity diagnosis)
(4) GX LogViewer
(5) GX LogViewer or others
(a) Publishing data definition file
(b) Reference waveform learning data file
(c) Response data definition file
(d) Diagnosis result file

❶ Acquiring the information, such as the name and the data type, of an inspection waveform to receive in MQTT communication by using the publishing data definition file*1

*1 It can be used only the publishing data definition file which was output in the edge application diagnosis (MQTT) setting of Real-time Flow Designer.

❷ Comparing the reference waveform with an inspection waveform and evaluating the similarity (Calculating the similarity score)

❸ Acquiring the information, such as the name and the data type, of a diagnosis result to receive in MQTT communication by using the response data definition file

❹ Inputting an inspection waveform

❺ Outputting the diagnosis result data

❻ Saving both the diagnosed inspection waveform and the diagnosis result data in a file

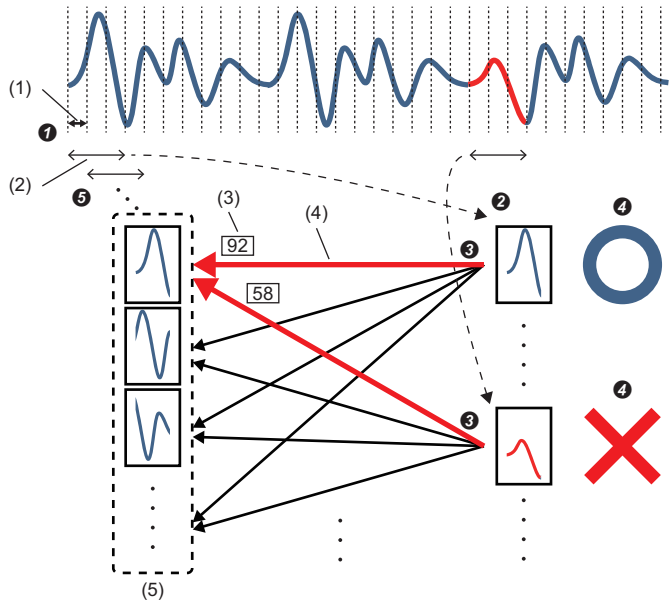
❼ Reporting the diagnosis result in real time

❽ Checking the diagnosis status by using the diagnosis result file

7.1 Operation Overview in Similarity Diagnosis

This section shows the operation overview in similarity diagnosis.
When performing a data diagnosis flow, the partial waveform group created in waveform learning and a waveform acquired by extracting an inspection waveform into a unit waveform width are compared and the similarity score of each is calculated.
Among the multiple similarity scores, the highest one will be the similarity score as the diagnosis result.
When the calculated similarity score is higher than the similarity score threshold corresponding to the detection sensitivity, the waveform is determined to be similar. If the score is lower, the waveform is determined to be different.
Detailed operations in similarity diagnosis are as follows:
❶ Collecting data every collection interval
❷ Extracting data for the unit waveform width
❸ Comparing the partial waveform group saved in waveform learning with the waveform extracted in ❷, and calculating the similarity score of each partial waveform
❹Determining the waveform whether it is similar or different. It is determined to be similar when the highest similarity score calculated in ❸ is higher than the similarity score threshold corresponding to the detection sensitivity, and it is determined to be different if the score is lower. (The highest similarity score will be the similarity score as the diagnosis result.)
❺ Shifting the unit waveform width backward by the number of records specified in the data diagnosis cycle
❻ Repeating ❷ to ❺

Ex.
When the similarity score threshold corresponding to the detection sensitivity is 65:

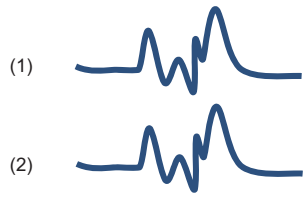


○: It is determined as a normal waveform because the highest similarity score '92' is higher than the similarity score threshold '65' corresponding to the detection sensitivity.
×: It is determined as an abnormal waveform because the highest similarity score '58' is lower than the similarity score threshold '65' corresponding to the detection sensitivity.
(1) Collection interval
(2) Unit waveform width
(3) Highest similarity score
(4) Most similar partial waveform
(5) Partial waveform group

7.2 Similarity Score

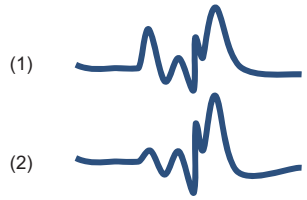
The similarity score is an index value that indicates how similar an inspection waveform and a reference waveform are. The value of the similarity score is in the range from 0 to 100. When a reference waveform and an inspection waveform is completely matched, the similarity score will be '100'. When an inspection waveform is surely determined as abnormal comparing to a reference waveform, the similarity score will be '0'.
However, due to the effects of the optimization processing for high-speed calculation or slight fluctuation on the time axis of collection data, the similarity score may not be 100 even if an inspection waveform and a reference waveform are completely matched. (In this case, the similarity score marks a high score such as '99' or '98'.)

- Comparison of waveforms to be completely matched (Similarity score = 100)



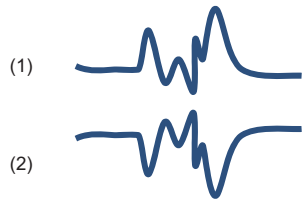
(1) Reference waveform
(2) Inspection waveform

- Comparison of waveforms to be possibly determined as abnormal (Similarity score = 50)



(1) Reference waveform
(2) Inspection waveform

- Comparison of waveforms to be surely determined as abnormal (Similarity score = 0)



(1) Reference waveform
(2) Inspection waveform

Precautions

- Even if a reference waveform and an inspection waveform are smooth (fluctuation is small), the similarity score fluctuation may increase because of the effects of the optimization processing for high-speed calculation or the jitter (slight fluctuation on the time axis) of collection data.
- Even if the shapes of a reference waveform and an inspection waveform are completely matched, the similarity score may be extremely low because of the slight fluctuation of the data collection timing.
- Set the detection sensitivity considering the above contents.

7.3 Similarity Score Threshold List

The similarity score threshold list is the index data to determine the appropriate detection sensitivity by using the value of a similarity score corresponding to the inspection sensitivity (1 to 6) calculated in waveform learning.
The values of the similarity score threshold list differ depending on the property of the reference waveform. The more similar the shapes of the periodic waveforms included in the reference waveform, the values of the similarity score threshold list tend to increase.
When the shape of each periodic waveform included in the reference waveform has no fluctuations or its fluctuations are too small (triangle wave, for example), the similarity score may become 100; this increases false detection even with little deviation. Decrease the sensitivity for detection if a waveform that should not be detected is incorrectly detected.

- Waveform that the similarity score threshold is high

Reference waveform	Similarity score threshold list	
	Detection sensitivity	Similarity score
	6	97
	5	92
	4	86
	3	80
	2	73
	1	66

- Waveform that the similarity score threshold is low

Reference waveform	Similarity score threshold list	
	Detection sensitivity	Similarity score
	6	82
	5	76
	4	71
	3	66
	2	60
	1	55

- Waveform without fluctuations or one whose fluctuations are too small

Reference waveform	Similarity score threshold list	
	Detection sensitivity	Similarity score
	6	100
	5	100
	4	100
	3	100
	2	100
	1	50

7.4 Pause of Similarity Diagnosis

A similarity diagnosis can be paused by monitoring publishing data on the specified conditions.
By pausing the diagnosis when an error such as an emergency stop of equipment occurs, the diagnosis result is not determined to be different and an expected result can be obtained.
In addition, up to eight units of publishing data can be monitored on the specified conditions per publishing data definition file.
The diagnosis can be paused when any or all of the conditions are satisfied.
Available comparison operators and constant values to compare for each type of publishing data are as follows.

Data type	Operator	Constant value to compare
BOOL	=, ≠	TRUE, FALSE
INT	=, ≠, <, ≤, >, ≥	-32768 to 32767 (integer)
UINT		0 to 65535 (integer)
DINT		-2147483648 to 2147483647 (integer)
UDINT		0 to 4294967295 (integer)
REAL*1		• 0 • 1.17550E - 38 (absolute value) to 3.40282E + 38 (absolute value)
LREAL*1		• 0 • 2.22507385850721E - 308 (absolute value) to 1.79769313486231E + 308 (absolute value)
STRING	=, ≠	String (ASCII)*2
WSTRING	=, ≠	String (Unicode)*3

*1 When the data type is REAL or LREAL, the result may not be determined correctly due to a floating point error.
*2 The following strings are excluded:
U+0000 to U+001F, and U+007F
*3 The following strings are excluded:
U+0000 to U+001F, U+007F to U+00A0, U+00AD, U+2028, and U+2029

8 PROCEDURE TO USE Similar Waveform Recognition Tool

This chapter shows the diagnosis procedure by cooperating Similar Waveform Recognition Tool and Real-time Flow Manager. Since Similar Waveform Recognition Tool can cooperate with Real-time Flow Manager that is installed in another industrial PC, data does not need to be collected or diagnosed in a same industrial PC; therefore, load on the industrial PC can be reduced.

Operating procedure

1. Create a diagnosis criterion (reference waveform learning data) for an inspection waveform used for data diagnosis based on data collected in a data logging flow of Real-time Flow Manager.

☞ Page 45 Data Analysis Setting

2. Create both the operation setting for similarity diagnosis by using the created reference waveform learning data file and the data diagnosis flow setting by using Real-time Flow Designer.

☞ Page 50 Data Diagnosis Setting

3. Perform a data diagnosis flow and adjust both the detection sensitivity and data diagnosis cycle.

☞ Page 54 Starting a Temporary Operation

4. Start an actual operation.

☞ Page 57 Starting an Actual Operation

Precautions

- When logging in the industrial PC by using the remote log-in function of Windows or unlocking a screen on the PC while Similar Waveform Recognition Tool is running, the error message 'Loss of the publishing data received from the Edgecross side is found.' appears and the tool may stop operating[*1]. Even when the error message does not appear, a diagnosis may not performed in real time or distribution of a diagnosis result to Real-time Flow Manager may be delayed.
  Therefore, it is recommended to use the tool after logging in by using the remote log-in function of Windows or setting not to unlock screens.

*1 When the operation is stopped, switch the operating status of Real-time Flow Manager to STOP , then to RUN again.

- When cooperating with Real-time Flow Manager that is installed in another industrial PC, a communication error may occur due to network disconnection or others. If an expected diagnosis result cannot be obtained, check if a communication error has occurred in the diagnostic screen of Real-time Flow Designer.

8.1 Data Analysis Setting

This section shows the procedure for creating a diagnosis criterion (reference waveform learning data) for an inspection waveform used for data diagnosis based on data collected in the data logging flow of Real-time Flow Manager.

Operating procedure

1. Create a data logging flow setting by using Real-time Flow Designer.

☞ Page 46 Creating the data logging flow setting

2. Perform a data logging flow with the created data logging flow setting and acquire a reference waveform.

☞ Page 49 Acquiring a reference waveform

3. Create reference waveform learning data by using Similar Waveform Recognition Tool.

☞ Page 49 Creating reference waveform learning data

Creating the data logging flow setting

A data logging flow setting can be created by using Real-time Flow Designer.

For details on each setting, refer to the following:

Edgecross Basic Software for Windows User's Manual

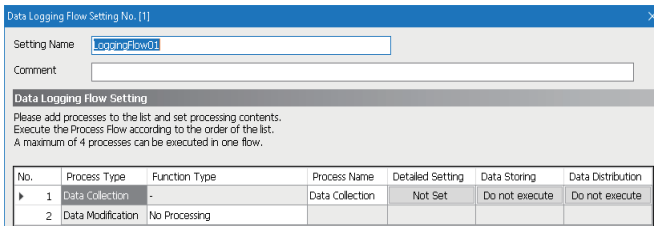
Point

- A diagnosis in a similar waveform recognition is suitable for data in which dates and times are arranged at regular intervals in chronological order, so set a collection interval to be constant.
- Set the setting so as not to occur an error such as the collection cycle exceeded event. (☞ Page 415 Similar Waveform Recognition Tool)
- Include the data storing setting (file saving) in a data logging flow setting in order to create a CSV file (reference waveform file) including a reference waveform used for waveform learning.

Operating procedure

1. Start Real-time Flow Designer.
2. Click "Data Logging Flow Setting" in the edit item tree.
3. Click the [Edit] button.

The "Data Logging Flow Setting" screen appears.



4. Set the setting for data collection.

The following table shows the considerations for the setting.

Item	Consideration
Data collector setting	• It is recommended to use a data collector that reduces variations of collected data.
Collection data setting	The following types of data are not available for waveform learning and similar waveform recognition. • BOOL type*1 • LINT type • ULINT type • STRING type*1 • WSTRING type*1
Collection interval	Set a collection interval so that change of a waveform to be collected can be detected.

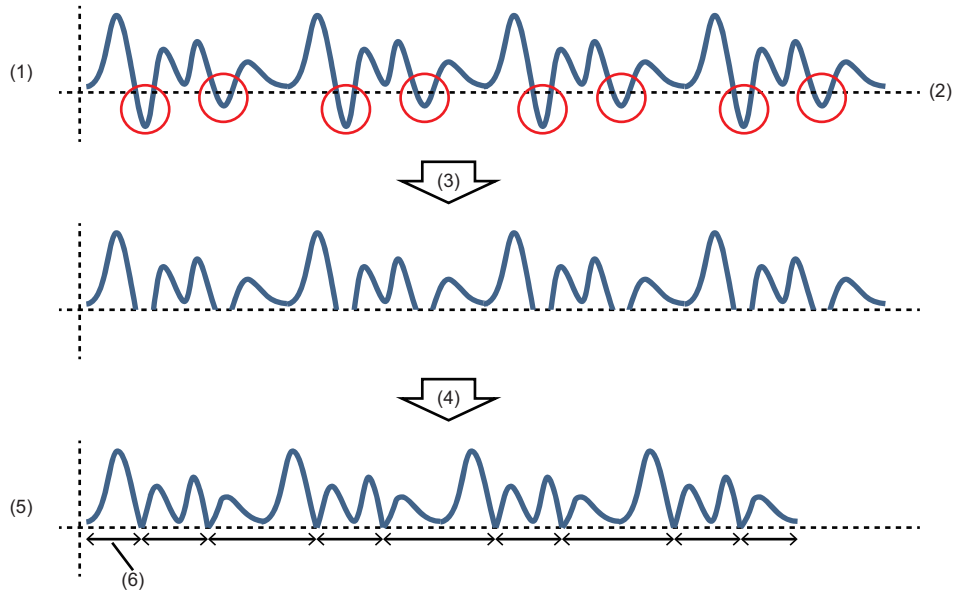
*1 It can be used to pause a similarity diagnosis. (☞ Page 43 Pause of Similarity Diagnosis)

5. Set the data modification setting as necessary.

With data modification, some dates and times may not be continuous in chronological order at regular interval. Make sure that the number of units of continuous data in which dates and times are arranged at regular intervals in chronological order is the number of records four times or more of the unit waveform width at least.

Ex.

When modifying data to extract values which are less than a certain condition and if a section in which the dates and times are continuous are less than four times of a unit waveform width, a similar waveform can not be detected and it is determined as abnormal.



(1) Collected data
(2) Condition value
(3) Data extraction (values less than the condition value are extracted.)
(4) Arrangement in which data is continuous
(5) Modified data
(6) Section in which the dates and times are continuous

6. Set the data storing setting.

The following table shows the considerations for the setting.

Item	Consideration
Executable form	Select "File".
Output data setting	The following types of data are not available for waveform learning and similar waveform recognition. • BOOL type*1 • LINT type • ULINT type • STRING type*1 • WSTRING type*1 In the following cases, waveform learning and similar waveform recognition cannot be performed with Similar Waveform Recognition Tool in Real-time Data Analyzer whose version is 1.00A. • The data type is REAL and the number of digits after the decimal point is set to 6 or more. • The data type is LREAL and the number of digits after the decimal point is set to 15 or more.
Date and time format	Output the date and time which allows for representing the minimum unit of a collection interval. ■Example • When the collection interval is 100 ms: Representation down to hundreds place of millisecond is necessary ("YYYY/MM/DD hh:mm:ss.s"). • When the collection interval is 5 ms: Representation down to ones place of millisecond is necessary ("YYYY/MM/DD hh:mm:ss.sss"). When any of the following reserved words is used, waveform learning and similar waveform recognition cannot be performed with Similar Waveform Recognition Tool in Real-time Data Analyzer whose version is 1.00A. • '.sssss' • '.ssssss' • '.sssssss' • '.ssssssss' • '.sssssssss' • '.ns'

*1 It can be used to pause a similarity diagnosis. (☞ Page 43 Pause of Similarity Diagnosis)

Acquiring a reference waveform

According to the created data logging flow setting, acquire a reference waveform by executing the data logging flow.
For performing a data logging flow, refer to the following:
📖Edgecross Basic Software for Windows User's Manual
To improve the diagnosis precision, refer to the following section and take a necessary action.
☞ Page 92 Waveforms Used for Similar Waveform Recognition
☞ Page 94 Input Waveform (Reference Waveform) and Setting Items in Waveform Learning

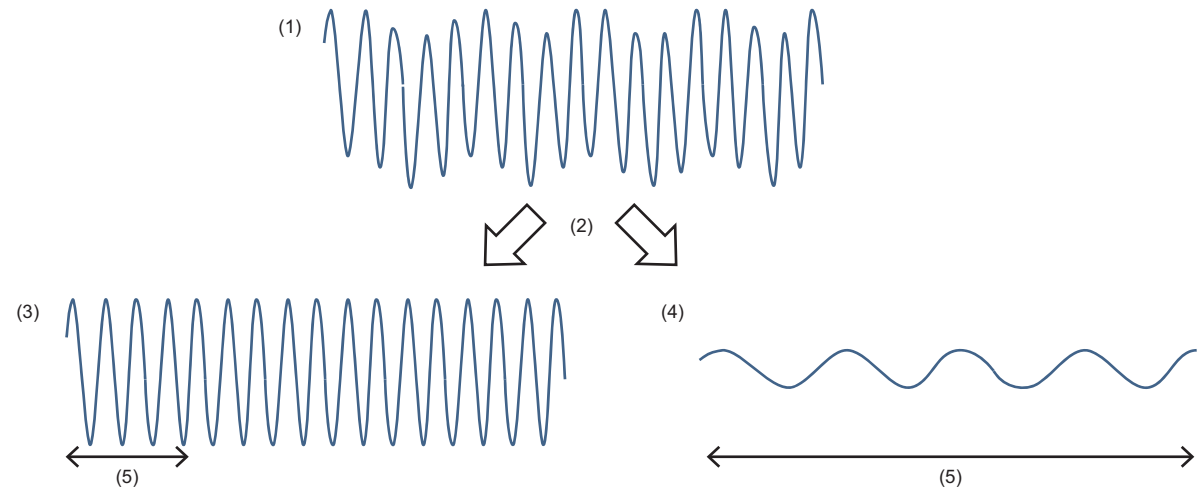
Point

- For similar waveform recognition, depending on the properties of waveforms, some are suitable for diagnosis but others are not. Therefore, it is recommended to select waveforms supposed to be a reference waveform by checking them in advance. (☞ Page 92 Waveforms Used for Similar Waveform Recognition)
- If fluctuation or deviation is large in a waveform which is in the normal state, more accurate reference waveform learning data can be created by increasing the number of records to be acquired. The number of records to be a reference depends on the property of a waveform so adjust it in a temporary operation. (☞ Page 54 Starting a Temporary Operation)

Precautions

- Acquire a reference waveform in which no data is missing. Otherwise, diagnosis may not performed properly.
- For a reference waveform, it is necessary to collect data to include waveforms for at least four cycles*1 of the periodic waveform to be input. When only waveforms for four cycles are used for waveform learning, expected diagnosis accuracy is rarely acquired. Therefore, it is recommended to acquire as much data as possible within the creation time. (☞ Page 416 Industrial PC (operation-guaranteed environment))

*1 If a long-cycle ripple is included in a waveform to be collected, take into consideration for the cycle of such a waveform and acquire data.



(1) Acquired data
(2) Separating for each waveform component
(3) Principal component
(4) Ripple component
(5) Waveform for 4 cycles

Creating reference waveform learning data

Create reference waveform learning data by using Similar Waveform Recognition Tool. (☞ Page 62 CREATING REFERENCE WAVEFORM LEARNING DATA)
To improve the diagnosis precision, refer to the following section and take a necessary action.
☞ Page 92 Waveforms Used for Similar Waveform Recognition
☞ Page 94 Input Waveform (Reference Waveform) and Setting Items in Waveform Learning

8.2 Data Diagnosis Setting

This section shows the procedure for creating both the operation setting for similarity diagnosis by using the created reference waveform learning data file and the data diagnosis flow setting by using Real-time Flow Designer.

Operating procedure

1. Set up an MQTT broker in an industrial PC in which Similar Waveform Recognition Tool is installed.

For the setup of an MQTT broker, refer to the following:

Edgecross Basic Software for Windows User's Manual

2. Create a publishing data definition file by using Real-time Flow Designer.

☞ Page 51 Creating a publishing data definition file

3. Set the settings for cooperating with Real-time Flow Manager in MQTT communication by using Similar Waveform Recognition Tool.

☞ Page 35 Edgecross Link Setting

4. Set the publishing data by using Similar Waveform Recognition Tool.

☞ Page 65 PUBLISHING DATA SETTING

5. Set the operation setting for similarity diagnosis by using Similar Waveform Recognition Tool.

☞ Page 68 OPERATION SETTING

6. Set the response data and output a response data definition file by using Similar Waveform Recognition Tool.

☞ Page 75 RESPONSE DATA SETTING

7. Read the response data definition file by using Real-time Flow Designer.

☞ Page 53 Reading a response data definition file

8. Create a data diagnosis flow by using Real-time Flow Designer.

☞ Page 53 Creating the data diagnosis flow setting

Point

To create multiple data diagnosis flows, repeat from step 2 to 8 for each data diagnosis flow. However, step 3 can be skipped if already set once.

Precautions

- Do not set one publishing data definition file to multiple publishing data settings. An error occurs when setting the publishing data.
- In the loading of a response data definition file, do not specify the same file for multiple data diagnosis flow setting. Otherwise, input and output data will be inconsistency between an edge application and Real-time Flow Manager and a diagnosis will not be performed properly.
- If data missing occurs in the collected data, it may be erroneously diagnosed that there is a difference in a waveform. Therefore, set the settings so that no data missing occurs in collected data.
- If there is data including a surrogate pair character in a publishing data definition file, the file cannot be read with Similar Waveform Recognition Tool in Real-time Data Analyzer whose version is 1.02C or earlier.

Creating a publishing data definition file

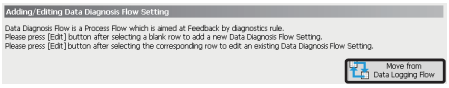
A publishing data definition file can be created by using Real-time Flow Designer.

For details on each setting, refer to the following:

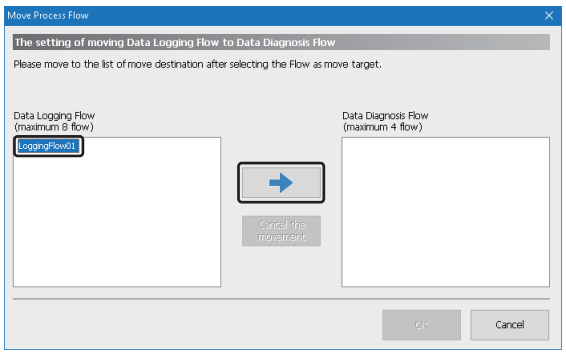
Edgecross Basic Software for Windows User's Manual

Operating procedure

1. Start Real-time Flow Designer.
2. Click "Data Diagnosis Flow Setting" in the edit item tree.
3. Click the [Move from Data Logging Flow] button.



4. Select a flow set in "Data Logging Flow Setting" and click the [⇨] button.

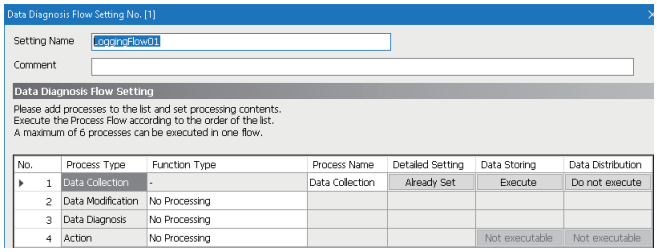


5. Click the [OK] button.

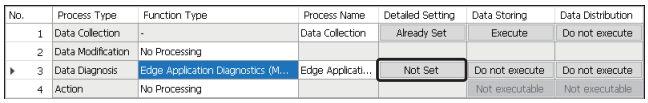
The flow set in "Data Logging Flow Setting" moves to "Data Diagnosis Flow Setting".

6. Click the [Edit] button.

The "Data Diagnosis Flow Setting" screen appears.



7. Select "Edge Application Diagnosis (MQTT)" in the "Function Type" column of a data diagnosis, then click the cell of the "Detailed Setting" column.



8. Set each item in the [Destination] tab in an edge application diagnosis (MQTT) setting.

The following table shows the considerations for the setting.

Item	Consideration
Host name/IP address	Set the same host name or IP address as the one for an industrial PC in which Similar Waveform Recognition Tool is installed.
Port number	Set the same port number as one set for an MQTT broker used. Otherwise, an MQTT communication to Similar Waveform Recognition Tool fails and a diagnosis is not performed.
User authentication information (user name and password)	Set the same user authentication information, user name and password, as one set for an MQTT broker used.
Communication encryption setting	Do not use this setting because Similar Waveform Recognition Tool does not support the encryption of MQTT communication. If used, an MQTT communication to Similar Waveform Recognition Tool fails and a diagnosis is not performed.
Client ID setting	Do not set it in Similar Waveform Recognition Tool.

9. Set each item in the [Output Data] tab in an edge application diagnosis (MQTT) setting.

The following table shows the considerations for the setting.

Item	Consideration
Output data setting	The following types of data are not available for waveform learning and similar waveform recognition. • BOOL type*1 • LINT type • ULINT type • STRING type*1 • WSTRING type*1

*1 It can be used to pause a similarity diagnosis. (☞ Page 43 Pause of Similarity Diagnosis)

10. Set each item in the [Definition output] tab in an edge application diagnosis (MQTT) setting, then click the [Publishing Data Definition File output] button.

The following table shows the considerations for the setting.

Item	Consideration
Confirm existence of the Edge application at the time of delivery	Select this checkbox to detect that a similarity diagnosis stops in Real-time Statistic Diagnosis Tool.
Topic name specification	Do not set it in Similar Waveform Recognition Tool.
Client ID setting	Do not set it in Similar Waveform Recognition Tool.

Precautions

- After outputting a publishing data definition file, do not operate the screen until the following procedure is completed.

☞ Page 53 Reading a response data definition file

- The name of a publishing data definition file should indicate that it is used in Similar Waveform Recognition Tool and which data diagnostic flow corresponds to the file.
- When changing the data diagnosis flow setting that was set between the start and the end of output of a publishing data definition file, initialize the operation setting of similarity diagnosis or delete the setting related to the publishing data setting corresponding to the data diagnosis flow setting in the "Operation Settings" screen. Then, re-create the publishing data definition file.

☞ Page 68 OPERATION SETTING

Reading a response data definition file

A response data definition file can be read by using Real-time Flow Designer.
For details on each setting, refer to the following:
📖Edgecross Basic Software for Windows User's Manual

Operating procedure

1. Click the [Get Response Data definition] button in the [Response Data] tab in an edge application diagnosis (MQTT) setting.
2. Select the response data definition file which was out put in the following setting.

☞ Page 75 RESPONSE DATA SETTING

An error occurs in Real-time Flow Manager if a different file is specified.
Select the response data definition file which was output according to the publishing data definition file loaded in the publishing data setting described in the following section (The name set in the setting is included in the response data definition file). If a wrong file is selected, a diagnosis will not be performed properly.

☞ Page 65 PUBLISHING DATA SETTING

3. Click the [OK] button without changing the output data setting name.

Creating the data diagnosis flow setting

A data diagnosis flow setting can be created by using Real-time Flow Designer.
For details on each setting, refer to the following:
📖Edgecross Basic Software for Windows User's Manual

Operating procedure

1. Set the feedback setting.
2. Click the [OK] button.

8.3 Starting a Temporary Operation

This section shows the procedure for performing a data diagnosis flow and adjusting both the detection sensitivity and data diagnosis cycle.

Operating procedure

1. Start an MQTT broker.

For the startup method of an MQTT broker, refer to the following:

📖Edgecross Basic Software for Windows User's Manual

2. Perform a similarity diagnosis by using Similar Waveform Recognition Tool.

☞ Page 77 EXECUTION/MONITORING OF SIMILAR WAVEFORM RECOGNITION

3. Switch the operating status of Real-time Flow Manager to RUN and perform a data diagnosis flow by using Real-time Flow Designer.

For the method for switching the operating status of Real-time Flow Manager, refer to the following:

📖Edgecross Basic Software for Windows User's Manual

Point

If the operating procedure from step 1 to 3 is not followed in the order, an error such as an MQTT transmission data overflow error occurs in Real-time Flow Manager.

4. Monitor the "Similar Waveform Recognition execution status detailed monitoring" screen and the CPU usage rate, and adjust both the detection sensitivity and data diagnosis cycle.

☞ Page 79 Similar Waveform Recognition Execution Status Detailed Monitoring Screen
☞ Page 55 Detection sensitivity adjustment
☞ Page 56 Data diagnosis cycle adjustment

Point

- In a temporary operation, collect only the data determined to be similar.
- The optimum detection sensitivity differs depending on the stability of a reference waveform (magnitude of fluctuation and/or amount of noise).
- If similarity is diagnosed when the load on the industrial PC is high, the diagnosis may stop or data missing may occur in the collected data and it may be erroneously diagnosed that there is a difference in a waveform. Adjust the data diagnosis cycle and the load to other applications so that the load on the PC is not too high.
- When configuring the data diagnosis setting, the detection sensitivity can also be adjusted either by adjusting its level with the slider while checking the similarity score threshold displayed in the "Operation Setting" screen or by entering the similarity score threshold directly in the screen. (☞ Page 69 Operation Setting Screen)
  After starting a temporary operation, adjust the detective sensitivity by checking the "Similar Waveform Recognition execution status detailed monitoring" screen. (☞ Page 55 Detection sensitivity adjustment)

5. To stop the diagnosis function of Real-time Flow Manager, follow step 6 and 7 shown below to stop the data diagnosis flow.

6. Switch the operating status of Real-time Flow Manager to STOP by using Real-time Flow Designer.

7. Perform the similarity diagnosis by using Similar Waveform Recognition Tool.

Point

If the operating procedure from step 6 to 7 is not followed in the order, an error such as an MQTT transmission data overflow error occurs in Real-time Flow Manager.

Detection sensitivity adjustment

Perform the following procedure to determine the detection sensitivity.

1. Perform a data diagnosis flow until the lowest similarity score is stable, and then check the lowest value.
2. Check the similarity score threshold list.
3. Compare the lowest similarity score with the values in the similarity score threshold list, and then determine the detection sensitivity that corresponds to the similarity score threshold list not exceeding the lowest similarity score.

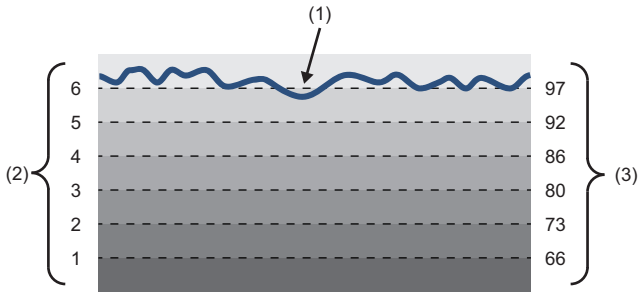
For details on the similarity score and similarity score threshold list, refer to the following:

☞ Page 41 Similarity Score
☞ Page 42 Similarity Score Threshold List

■ Example of detection sensitivity adjustment

• When the amplitude of the similarity score is small (stable waveform data that is small fluctuation and little noise):

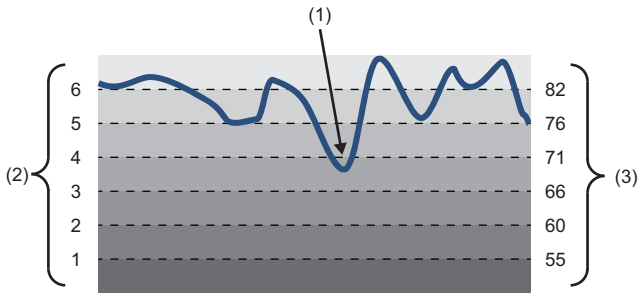
If the following result is acquired by executing a data diagnosis flow for a certain period, set the detection sensitivity to 5.



(1) Lowest similarity score = 95
(2) Detection sensitivity
(3) Similarity score threshold list

• When the amplitude of the similarity score is large (unstable waveform data that is large fluctuation and much noise):

If the following result is acquired by executing a data diagnosis flow for a certain period, set the detection sensitivity to 3.



(1) Lowest similarity score = 68
(2) Detection sensitivity
(3) Similarity score threshold list

Precautions

- The example of detection sensitivity adjustment is a guide only. In an actual operation, adjust the detection sensitivity in a user's discretion.
- The optimum detection sensitivity differs depending on the stability of a reference waveform (magnitude of fluctuation and/or amount of noise).
- When the lowest similarity score is lower than a value of the similarity score threshold list corresponding to detection sensitivity 1, review the procedure because the following contents are considered.

Check point	Review method
The reference waveform is waveform data unsuitable for similar waveform recognition.	Refer to the following section and check whether the reference waveform is waveform data suitable for similar waveform recognition. ☞ Page 92 Waveforms Used for Similar Waveform Recognition
The date and time interval of the reference waveform and that of the inspection waveform are not matched.	Check whether the collection interval set in the data logging flow setting is the same as that of the data diagnostic flow setting. ☞ Page 46 Creating the data logging flow setting ☞ Page 53 Reading a response data definition file
The number of records of the reference waveform is too few.	Refer to the following section and increase the number of records of the reference waveform to be acquired. ☞ Page 49 Acquiring a reference waveform Refer to the following section and extend the learning period. ☞ Page 49 Creating reference waveform learning data
Data different from the reference waveform is set to an inspection waveform.	Check whether data to be collected is the same between the data logging flow setting and the data diagnostic flow setting. ☞ Page 46 Creating the data logging flow setting ☞ Page 53 Reading a response data definition file

Data diagnosis cycle adjustment

Fluctuate the data diagnosis cycle in the range from the lower and upper limits shown below to determine the cycle in which the load on CPU is not too high.

- Lower limit value: Quarter of the unit waveform width or a value calculated by '100 ÷ collection interval (msec)', whichever is smaller
- Recommended value: Quarter of the unit waveform width
- Upper limit value: Half of the unit waveform width

Precautions

The detection precision will be decreased when the data diagnosis cycle which is greater than the half of a unit waveform width is set.

8.4 Starting an Actual Operation

An actual operation is started.

Precautions

If an expected diagnosis result cannot be obtained or any other problems occur after starting the operation, refer to the following:

☞ Page 98 TROUBLESHOOTING BY SYMPTOM

Checking the diagnosis status after starting an actual operation

Monitoring the similarity diagnosis status and the diagnosis information

By using Similar Waveform Recognition Tool, the similarity diagnosis status (such as the operating status and diagnosis status) and the diagnosis information (such as a similarity score and the number of times of difference detections) can be monitored to check whether a similarity diagnosis is performed properly.

☞ Page 77 EXECUTION/MONITORING OF SIMILAR WAVEFORM RECOGNITION

Monitoring the graphs of an inspection waveform and the similarity score

By using GX LogViewer, an inspection waveform and the similarity score can be monitored.

☞ Page 90 Similar waveform recognition monitor

Checking a waveform when a difference is detected

By using GX LogViewer, each waveform graph when a difference is detected can be checked.

☞ Page 91 Diagnosis result file display

To do so, select "Only difference condition" for "Output Settings" in "Diagnosis Result file saving setting."

☞ Page 69 Operation Setting Screen

For a diagnosis result file, refer to the following:

☞ Page 81 OUTPUTTING DIAGNOSIS RESULT FILE

Checking the result of a similarity diagnosis

In a diagnosis result file, the result of a similarity diagnosis (whether an inspection waveform is similar to or different from a reference waveform) can be checked.

To do so, select "Fixed cycle output" for "Output Settings" in "Diagnosis Result file saving setting."

☞ Page 69 Operation Setting Screen

For a diagnosis result file, refer to the following:

☞ Page 81 OUTPUTTING DIAGNOSIS RESULT FILE

Changing any settings after starting an actual operation

Changing the detection sensitivity setting or diagnosis result file saving setting

The following shows the procedure for restarting a diagnosis when changing the detection sensitivity setting or diagnosis result file saving setting in the "Operation Settings" screen after starting an actual operation.

Operating procedure

1. Click the [Stop Operation] button in the "Real-time Flow Manager Diagnostics" screen of Real-time Flow Manager to stop its operation.

For the method for displaying the "Real-time Flow Manager Diagnostics" screen, refer to the following:

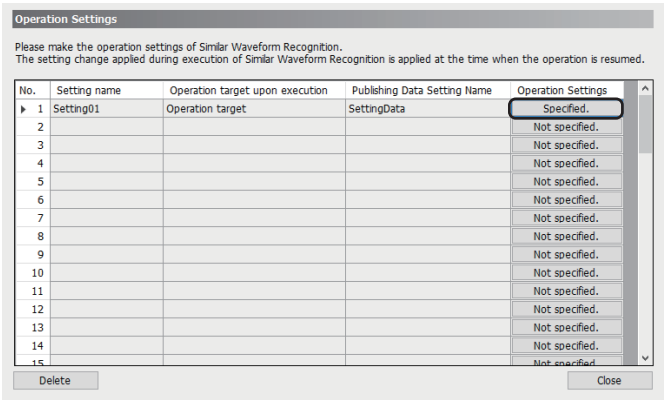
📖Edgecross Basic Software for Windows User's Manual

2. Click the [Stop Operation] button in "Operation status" in the "Execution/Monitoring of Similar Waveform Recognition" screen of Similar Waveform Recognition Tool to stop its operation.

☞ Page 77 EXECUTION/MONITORING OF SIMILAR WAVEFORM RECOGNITION

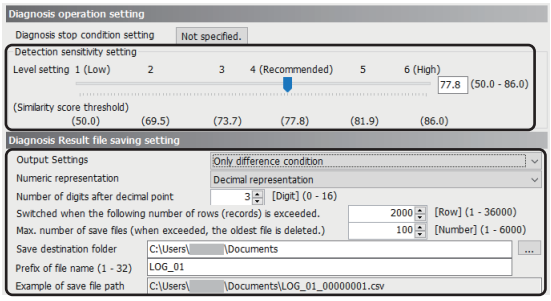
3. Click the "Operation Settings" column for a setting to be changed in the "Operation Settings" screen of Similar Waveform Recognition Tool.

☞ Page 68 OPERATION SETTING



4. Change the detection sensitivity setting or the diagnosis result file saving setting.

☞ Page 69 Operation Setting Screen



5. Click the [Start Operation] button in "Operation status" in the "Execution/Monitoring of Similar Waveform Recognition" screen of Similar Waveform Recognition Tool to restart its operation.

☞ Page 77 EXECUTION/MONITORING OF SIMILAR WAVEFORM RECOGNITION

6. Click the [Start Operation] button in the "Real-time Flow Manager Diagnostics" screen of Real-time Flow Manager to restart its operation.

Precautions

- The diagnosis result file saving setting is set for each diagnosis; therefore, it is required to change the setting per diagnosis.
- After restarting a diagnosis, check the "Similar Waveform Recognition execution status detailed monitoring" screen and adjust the detection sensitivity so that it corresponds to the similarity score threshold not exceeding the lowest similarity score.
- To stop outputting diagnosis result files to move the files or change the diagnosis result file saving setting, click [Suppress] button in "Diagnosis Result File output status (Fixed cycle output)" of the "Execution/Monitoring of Similar Waveform Recognition" screen in Similar Waveform Recognition Tool. (To restart the output, click the [Cancel suppression] button.)

☞ Page 77 EXECUTION/MONITORING OF SIMILAR WAVEFORM RECOGNITION

Changing a response data setting

The following shows the procedure for changing a response data setting after starting an actual operation.

Operating procedure

1. Click the [Stop Operation] button in the "Real-time Flow Manager Diagnostics" screen of Real-time Flow Manager to stop its operation.

For the method for displaying the "Real-time Flow Manager Diagnostics" screen, refer to the following:

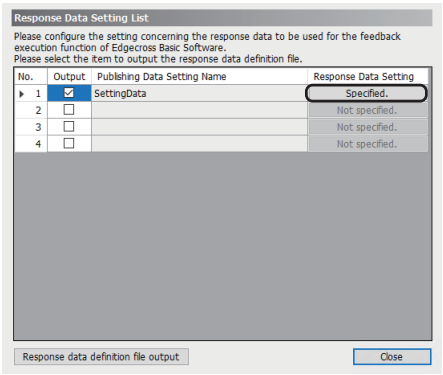
📖Edgecross Basic Software for Windows User's Manual

2. Click the [Stop Operation] button in "Operation status" in the "Execution/Monitoring of Similar Waveform Recognition" screen of Similar Waveform Recognition Tool to stop its operation.

☞ Page 77 EXECUTION/MONITORING OF SIMILAR WAVEFORM RECOGNITION

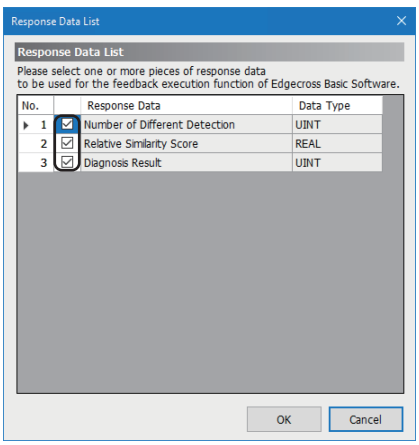
3. Click the "Response Data Setting" column for a setting to be changed in the "Response Data Setting List" screen of Similar Waveform Recognition Tool.

☞ Page 75 RESPONSE DATA SETTING



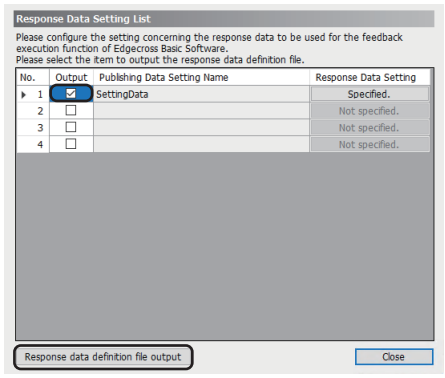
4. Select response data to be output in the "Response Data List" screen.

☞ Page 76 Response Data List Screen



5. Select the checkbox in the "Output" Column for a setting to output its response data definition file in the "Response Data Setting List" screen, and click the [Response data definition file output] button.

☞ Page 75 RESPONSE DATA SETTING

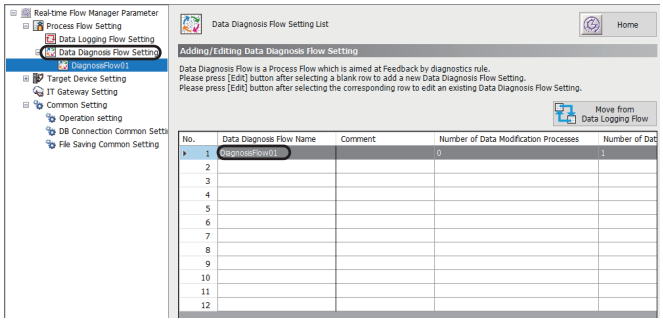


6. Click "Data Diagnosis Flow Setting" in the edit item tree of Real-time Flow Designer.

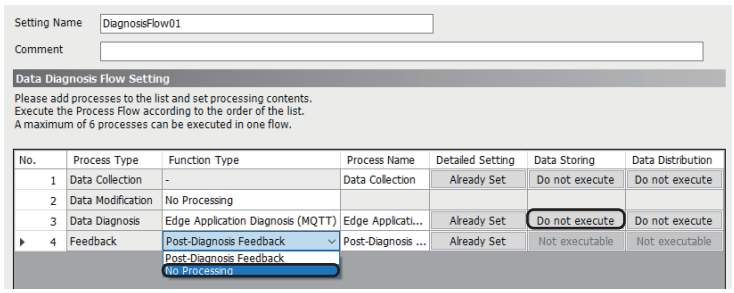
The data diagnosis flow setting list is displayed.

7. Select a data diagnosis flow to be changed.

The "Data Diagnosis Flow Setting" screen opens.

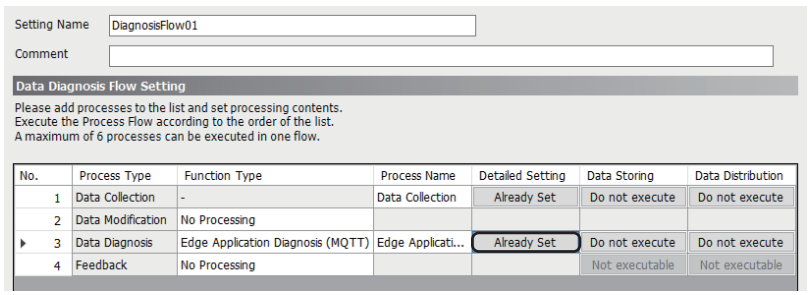


8. Change the setting in the "Data Storing" column for the "Data Diagnosis" process type to "Do not execute" if it is set to "Execute." In addition, if "Already set" is displayed in the "Detailed Setting" column for the "Feedback" process type, change the function type to "No Processing."



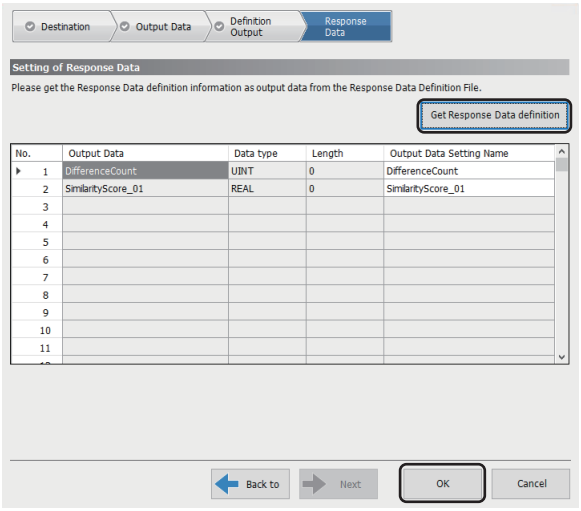
9. Click [Already Set] in the "Detailed Setting" column for the "Data Diagnosis" process type in the "Data Diagnosis Flow Setting" screen.

The "Edge Application Diagnosis Setting" screen appears.

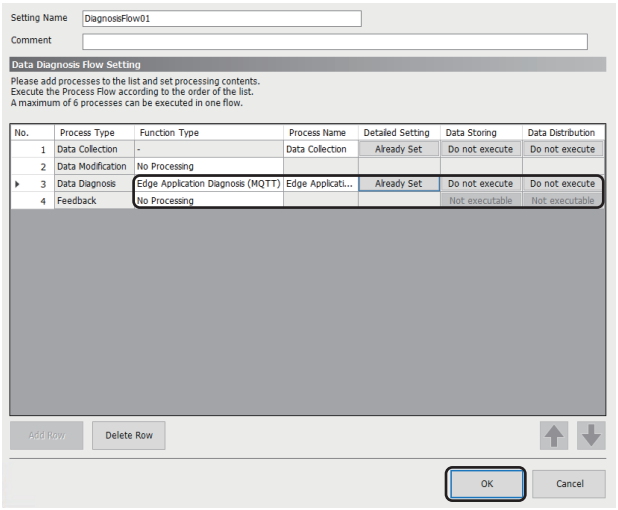


10. Click the [Get Response Result Definition] button in the [Response Data] tab of the "Edge Application Diagnosis Setting" screen to select the response data definition file.

11. Click the [OK] button.



12. Set the data diagnosis setting and feedback setting, and click the [OK] button.



13. Click the [Start Operation] button in "Operation status" in the "Execution/Monitoring of Similar Waveform Recognition" screen of Similar Waveform Recognition Tool to restart its operation.

☞ Page 77 EXECUTION/MONITORING OF SIMILAR WAVEFORM RECOGNITION

14. Click the [Start Operation] button in the "Real-time Flow Manager Diagnostics" screen of Real-time Flow Manager to restart its operation.

Precautions

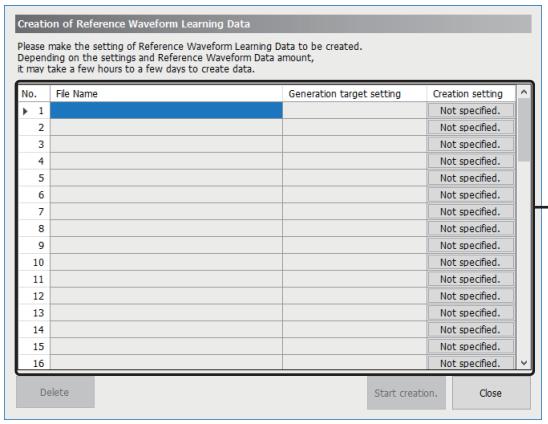
- When changing a response data setting in Similar Waveform Recognition Tool, it is required to change the setting in Real-time Flow Designer as well. Therefore, back up the setting in advance.
- When changing a response data setting in Similar Waveform Recognition Tool, it is required to read the definition information of the response data of which the setting is changed in Real-time Flow Designer. Otherwise, an error occurs in Real-time Flow Designer.

9 CREATING REFERENCE WAVEFORM LEARNING DATA

This chapter shows the settings for creating reference waveform learning data.
Up to 64 units of reference waveform learning data can be created at once.

Window

Click the [Creation of Reference Waveform Learning Data] button.



Displayed items

Item		Description	Reference
(1) Setting list	—	The list of reference waveform learning data file creation settings is displayed.	—
	File Name	The file name of reference waveform learning data set in the "Reference Waveform Learning Data File Creation setting" screen is displayed.	—
	Generation target setting	The content set for "Generation target setting" in the "Reference Waveform Learning Data File Creation setting" screen is displayed.	—
	Creation setting	Click this to open the "Reference Waveform Learning Data File Creation setting" screen.	Page 63 Reference Waveform Learning Data File Creation Setting Screen
[Delete] button		Click this to delete the setting on the selected row. When an error occurs while deleting multiple rows, the settings on the rows before the error occurred will be deleted.	—
[Start creation.] button		Click this to start creating reference waveform learning data.	—

Point

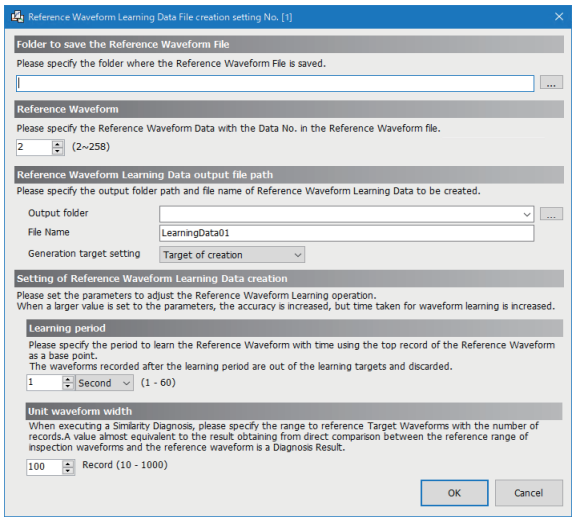
By clicking the [Cancel] button in the screen displayed while creating reference waveform learning data, the processing is canceled. However, the reference waveform learning data created before the cancellation is not deleted.

9.1 Reference Waveform Learning Data File Creation Setting Screen

This section shows the detailed setting for creating reference waveform learning data.

Window

Click the "Creation setting" column in the setting list.



Displayed items

Item	Description	Consideration
Folder to save the Reference Waveform File[*1]	Set the folder path containing a file used as a reference waveform (up to 204 characters). It can be set in the "Browse For Folder" screen displayed by clicking the [...] button.	• The DATATYPE folder that stores a historical data definition file which is in the file save destination folder of a data logging flow should be stored together. • Do not store a CSV file other than one used as a reference waveform. • Store only a CSV file and a historical data definition file that were output in one data logging flow. Otherwise, creating a reference waveform learning data may fail, or created reference waveform data may not be accurate. • It is recommended to specify a folder other than one used as a file save destination of the data logging flow in operation. • Note the following content If specifying a folder used as a file save destination of the data logging flow. When specifying the folder, waveform learning is performed without checking that the saved data has no problem. If any abnormal waveform is included in a reference waveform, it is determined to be normal and expected operation is not performed.
Reference Waveform[*2]	Set a data number to be a reference waveform (2 to 258).	The following types of data are not available for waveform learning. • BOOL type • LINT type • ULINT type • STRING type • WSTRING type

Item		Description	Consideration
Reference Waveform Learning Data output file path	Output folder[*1,*3]	Set the path of a folder in which created reference waveform learning data is output (up to 246 characters). It can be set in the "Browse For Folder" screen displayed by clicking the [...] button.	Specify a local folder.
	File Name[*3]	Set a file name of created reference waveform learning data (1 to 250 characters).	—
	Generation target setting	Set whether to create reference waveform learning data with this setting. For setting only, select the "Out of generation target".	—
Setting of Reference Waveform Learning Data creation	Learning period	Specify the period for learning a reference waveform with time starting from the first record of the reference waveform. Waveforms recorded after the learning period are not included in the learning and discarded.	• Set the period so that the number of records in the learning period is within 1000000. • Depending on the property of a waveform used for the creation, learning may not be performed even if the number of records in learning period is within 1000000 (Analytical limit over error). Shorten the learning period in this case. • When an learning period is set long, the precision is high, but the time for waveform learning will be long. (☞ Page 415 Similar Waveform Recognition Tool) • The learning period is determined based on the date and time of records. When the date and time of records in the learning period is shifted back and forth due to the daylight saving time adjustment or clock setting change, the record in the period is increased or decreased. Consider the above and then set the learning period.
	Unit waveform width	Specify the range to reference an inspection waveform with the number of records for a similarity diagnosis. A value which is almost equivalent to the result obtained by comparing the reference range of an inspection waveform with a reference waveform will be the diagnosis result.	For accurate diagnosis, set the number of records for the unit waveform width so that a characteristic waveform such as an impulse waveform which appears cyclically can be included.
[OK] button		Click this to apply the set contents and close the screen.	—

*1 Do not specify a folder with the encryption attribute enabled.

*2 The data number is determined as follows based on output data of which the checkbox in the "Output" column is selected in the [Output Data] tab in the "Data Storing Setting" screen. (N = The number counted from the top of the output data of which the checkbox in the "output" column is selected)
"Data Storing Setting" screen for a data collection process: N+2
"Data Storing Setting" screen for a data modification process: N+1

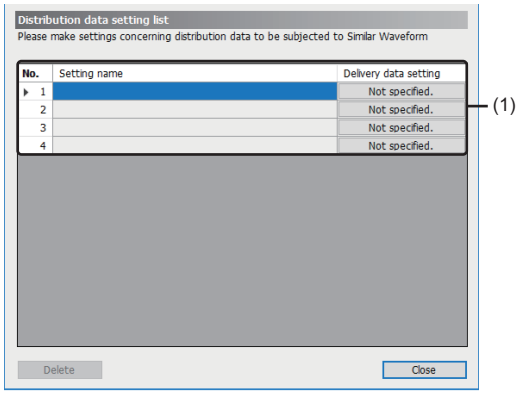
*3 The total number of characters in the names of an output destination folder and file name should be within 259 characters.

10 PUBLISHING DATA SETTING

This chapter shows the setting of publishing data.

Window

Click the [Publishing Data Setting] button.



Displayed items

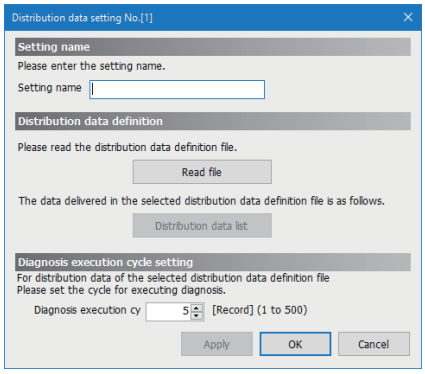
Item		Description	Reference
(1) Setting list	—	The list of publishing data settings is displayed. One publishing data setting corresponds to one data diagnosis flow.	—
	Setting name	The name set in the "Publishing Data Setting" screen is displayed.	—
	Publishing Data Setting	Click this to open the "Publishing Data Setting" screen.	Page 66 Publishing Data Setting Screen
[Delete] button		Click this to delete the setting on the selected row. When an error occurs while deleting multiple rows, the settings on the rows before the error occurred will be deleted.	—

10.1 Publishing Data Setting Screen

This section shows the detailed setting of publishing data.

Window

Click the "Publishing Data Setting" column in the setting list.



Displayed items

Item		Description	Consideration	Reference
Setting name		Set the name of publishing data setting (1 to 239 characters).	—	—
Publishing data definition	[Read file] button	Click this to set a publishing data definition file. It can be set in the "Select publishing data definition file" screen displayed by clicking this button.*1	Set a publishing data definition file which was output in the following section. ☞ Page 51 Creating a publishing data definition file	—
	[Publishing data list] button	Click this to open the "Publishing data list" screen.	Check that it is the same as data which was set as the output target in the following section. ☞ Page 51 Creating a publishing data definition file	Page 67 Publishing Data List Screen
Diagnosis execution cycle setting	Diagnosis execution cycle	Set the number of records to be an inspection waveform needs to be input for one similarity diagnosis	The recommended value and the upper limit value are as follows: • Recommended value: Quarter of the unit waveform width*2 or a value calculated by '100 ÷ collection interval (msec)', whichever is smaller • Upper limit value: Half of the unit waveform width*2	—
[Apply] button		Click this to apply the setting.	—	—
[OK] button		Click this to close the screen after the setting is applied.	—	—

*1 When any name is not set in "Setting name", the name of a selected publishing data definition file is set instead.

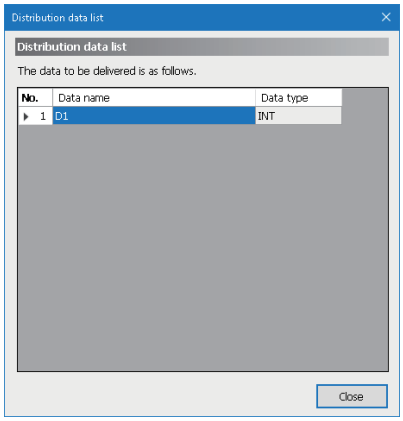
*2 The value after the decimal point is rounded off.

10.2 Publishing Data List Screen

This section shows the list of publishing data.

Window

Click the [Publishing data list] button in the "Publishing Data Setting" screen.



Displayed items

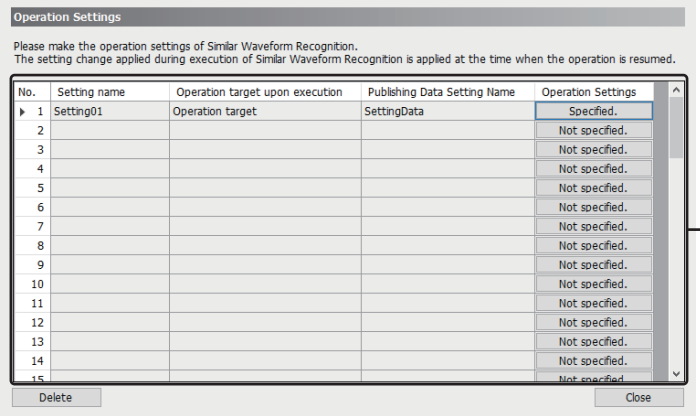
Item	Description	Consideration
Data name	The name of publishing data is displayed.	Check that it is the same as data which was set as the output target in the following section. ☞ Page 51 Creating a publishing data definition file
Data type	The type of publishing data is displayed.	

11 OPERATION SETTING

This chapter shows the operation setting of similar waveform recognition.

Window

Click the [Operation Settings] button.



Displayed items

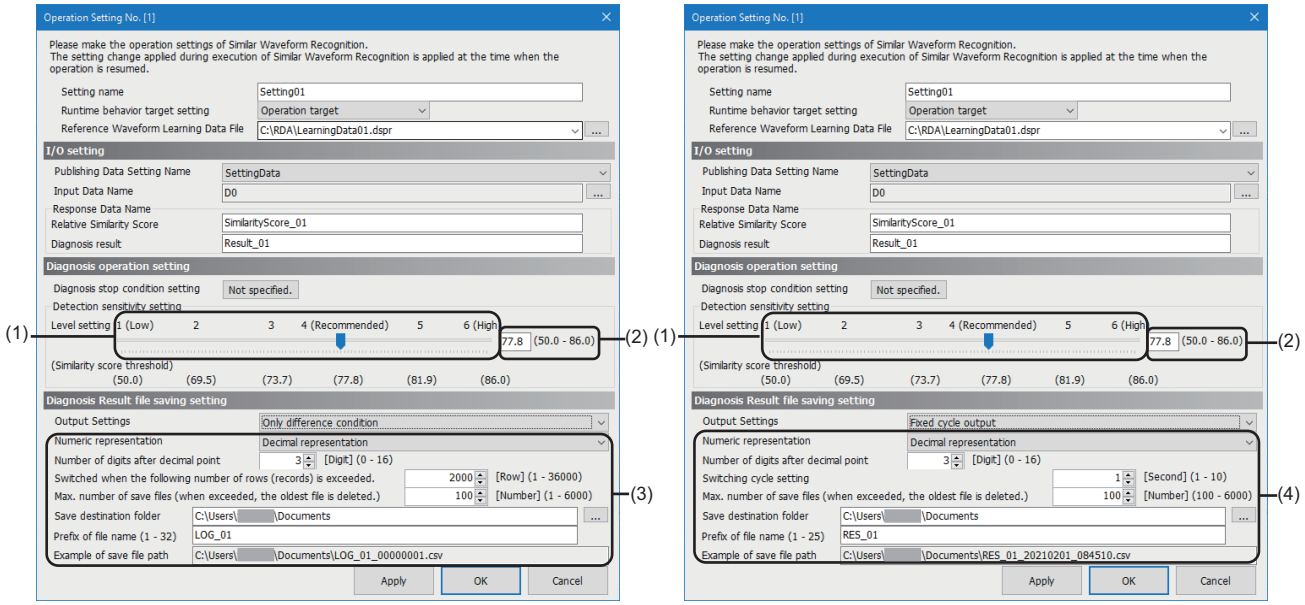
Item		Description	Reference
(1) Setting list	—	The list of operation settings is displayed.	—
	Setting name	The name set in the "Operation Settings" screen is displayed.	—
	Operation target upon execution	The content set for "Runtime behavior target setting" in the "Operation Settings" screen is displayed.	—
	Publishing Data Setting Name	The name set in "Publishing Data Setting Name" in the "Operation Settings" screen is displayed.	—
	Operation Settings	Click this to open the "Operation Settings" screen.	Page 69 Operation Setting Screen
[Delete] button		Click this to delete the setting on the selected row. When an error occurs while deleting multiple rows, the settings on the rows before the error occurred will be deleted.	—

11.1 Operation Setting Screen

This section shows the detailed operation setting of similar waveform recognition.

Window

Click the "Operation Settings" column in the setting list.



Displayed items

Item		Description	Consideration	Reference
Setting name		Set the name of an operation setting (up to 32 characters).*1 • The following are displayed to avoid name duplication by default. Setting01, Setting02, Setting03, ...	—	—
Runtime behavior target setting		Set whether to perform a similarity diagnosis with this setting contents. For the operation setting of a similarity diagnosis only, select the "Out of generation target".	—	—
Reference Waveform Learning Data File		Set the path of a reference waveform learning data file (up to 259 characters). It can be set in the "Selection of Reference Waveform Learning Data File" screen displayed by clicking the [...] button.	• Set a file created in Similar Waveform Recognition Tool.	—
I/O setting	Publishing Data Setting Name	Select the name of a publishing data setting to be used among the publishing data settings set in the following section. ☞ Page 65 PUBLISHING DATA SETTING	If this item is changed, the contents set in the "Diagnosis Stop Condition Setting" screen will be blank. ☞ Page 74 Diagnosis Stop Condition Setting Screen	—
	Input Data Name	Select publishing data to be an inspection waveform. Publishing data can be selected in the "Publishing data list" screen displayed by clicking the [...] button.	The input data name corresponding to the publishing data setting selected in "Publishing Data Setting Name" is selected.	Page 73 Publishing Data List Screen
	Response Data Name	Set the name of relative similarity score that is output as a diagnosis result and the name of the diagnosis result (1 to 32 characters). They are displayed by default as follows: • Relative Similarity Score: SimilarityScore_XX • Diagnosis Result: Result_XX (XX: Operation setting number (01 to 64))	For details on response data, refer to the following: ☞ Page 14 Similar Waveform Recognition Tool	—

Item		Description	Consideration	Reference
Diagnosis operation setting	Diagnosis stop condition setting	Set the stop condition of a diagnosis.	—	Page 74 Diagnosis Stop Condition Setting Screen
	Detection sensitivity setting	Set the sensitivity for determining that an inspection waveform is different from a reference waveform with either of the following methods: • (1) Using the slider: Set the detection sensitivity by using the slider.[*2,*3] • (2) Entering a value directly: Set the detection sensitivity by entering a similarity score threshold directly.[*4,*5] The slider position and the entered value link with each other. For the similarity score for each detection sensitivity level, refer to the following: ☞ Page 42 Similarity Score Threshold List	• The higher the sensitivity is set, the more frequently a difference is detected. • The lower the sensitivity is set, the higher the possibility that a difference is missed is. • To change the detection sensitivity setting after starting an actual operation, refer to the following: ☞ Page 58 Changing the detection sensitivity setting or diagnosis result file saving setting • When setting the detection sensitivity by selecting a level between 1 to 6, the similarity score threshold that has six decimal places is set according to the selected level, not the displayed value. • When setting the detection sensitivity by selecting any point between levels with the slider or by entering the similarity score threshold directly, the displayed similarity score threshold, which has one decimal place, is set.	—

Item			Description	Consideration	Reference
Diagnosis Result file saving setting	Output Settings		Set the output setting of a diagnosis result file. • Not output: A diagnosis result file is not output. • Only difference condition: A diagnosis result file that includes only results determined to be different is output.*6 • Fixed cycle output: A diagnosis result file that includes results determined to be similar and different is output periodically during a diagnosis.	• Select "Only difference condition" to display a graph of data when a difference is detected in GX LogViewer. • Select "Fixed cycle output" to check an inspection waveform and diagnosis result in another application. • If selecting "Fixed cycle output," a diagnosis result file is output during the diagnosis; therefore, secure free space on a disk in advance. • To change the output setting after starting an actual operation, refer to the following: ☞ Page 58 Changing the detection sensitivity setting or diagnosis result file saving setting	Page 87 Operational Specifications
	(3) Only difference condition	Numeric representation	Set the numeric representation of numerical values to be output in a diagnosis result file. • Decimal representation • Index representation	—	—
		Number of digits after decimal point	Set the number of digits (0 to 15) after the decimal point of a numerical value to be output in a diagnosis result file.	• Up to 15 digits can be set when outputting the diagnosis result file with Similar Waveform Recognition Tool in Real-time Data Analyzer whose version is 1.02C or earlier. • Up to 16 digits can be set when outputting the diagnosis result file with Similar Waveform Recognition Tool in Real-time Data Analyzer whose version is 1.03D or later.	—
		Switched when the following number of rows (records) is exceeded.*7	Set the number of rows of data to be stored in one file. A diagnosis result file is output when the set number of rows is exceeded.	• If the number of specified rows is small, the load on Windows will be high because a saved file is frequently created. In this case, review the setting to increase the number of rows.	—
		Max. number of save files (when exceeded, the oldest file is deleted.)*7	Set the upper limit number of files to be stored in one folder. Files are deleted in chronological order when the set number of files is exceeded.	—	—
		Save destination folder	Set the save destination of a diagnosis result file (up to 213 characters). It can also be set in the "Browse For Folder" screen displayed by clicking the [...] button.	Refer to the following: ☞ Page 72 Considerations for setting a save destination folder	—
		Prefix of file name*7	Set the prefix of a diagnosis result file name. It is displayed by default as follows: • LOG_XX (XX: Operation setting number (01 to 64))	• Set a file name prefix that is different from the ones output in other applications.	—
		Example of save file path	The save file path is displayed according to the current setting.	—	—

Item			Description	Consideration	Reference
Diagnosis Result file saving setting	(4) Fixed cycle output	Numeric representation	Set the numeric representation of numerical values to be output in a diagnosis result file. • Decimal representation • Index representation	—	—
		Number of digits after decimal point	Set the number of digits (0 to 15) after the decimal point of a numerical value to be output in a diagnosis result file.	—	—
		Switching cycle setting*7	Set the cycle to switch diagnosis result files. After starting a diagnosis, recorded diagnosis results are output in one file in the set cycle.	—	—
		Max. number of save files (when exceeded, the oldest file is deleted.)*7	Set the upper limit number of files to be stored in one folder. Files are deleted in chronological order when the set number of files is exceeded.	• If the oldest file cannot be deleted, the latest file is saved in addition to the upper limit number of files.	—
		Save destination folder	Set the save destination of a diagnosis result file (up to 213 characters). It can also be set in the "Browse For Folder" screen displayed by clicking the [...] button.	Refer to the following: ☞ Page 72 Considerations for setting a save destination folder	—
		Prefix of file name*7	Set the prefix of a diagnosis result file name. It is displayed by default as follows: • RES_XX (XX: Operation setting number (01 to 64))	Set a file name prefix that is different from the ones output in other applications.	—
		Example of save file path	The save file path is displayed according to the current setting.	—	—
[Apply] button			Click this to apply the setting.	—	—
[OK] button			Click this to close the screen after the setting is applied.	—	—

*1 The same name can not be used for operation settings.
*2 Available only when a reference waveform learning data file is selected.
*3 When a reference waveform learning data file is selected, the similarity score thresholds are displayed in "(Similarity score threshold)" according to the file content. (If not selected, '-' is displayed.)
*4 The recommended value is displayed by default.
'-' is displayed and a value cannot be entered if a reference waveform learning data file is not selected.
*5 A value can be specified down to the first decimal place.
*6 The result is not output while the similarity diagnosis is paused.
*7 The default value is restored if the output setting is changed (to "Only difference condition" or "Fixed cycle output").

■ Considerations for setting a save destination folder

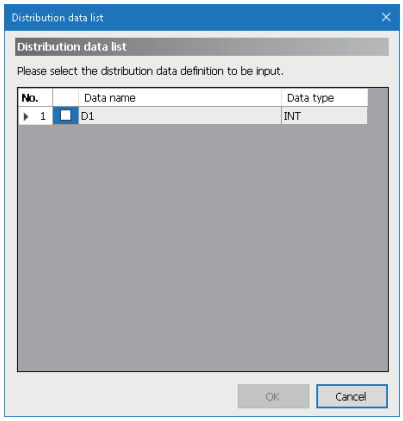
- When setting a folder with restricted access as a save destination folder, check that 'Modify,' 'Read,' and 'Write' are allowed for the account of the save destination.
- In the antivirus software settings, exclude a save destination folder from the monitoring targets. (☞ Page 24 Exclusion setting in antivirus software)
- When creating a file other than one to be processed (file the name of which matches the rules of the name of a file to be processed) in a save destination folder, the operation is not guaranteed.
- Do not save a large number of files or folders to a save destination folder; otherwise, starting the operation may take time or fail.

11.2 Publishing Data List Screen

This section shows the screen for selecting publishing data to be an inspection waveform.

Window

Click the [Publishing data list] button in the "Operation Settings" screen.



Displayed items

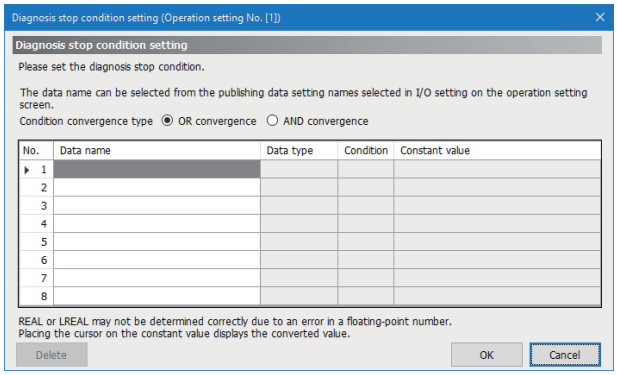
Item	Description
Data name	The name of publishing data is displayed. Select the checkbox of publishing data to be an inspection waveform.
Data type	The type of publishing data is displayed.

11.3 Diagnosis Stop Condition Setting Screen

This section shows the condition settings to stop a diagnosis.

Window

Click the [Not specified.] or [Specified.] button for the diagnosis stop condition setting in the "Operation Settings" screen.



Displayed items

Item	Description
Condition Convergence Type	Select a combination type for conditions. • AND Convergence: A diagnosis is stopped when all the conditions are satisfied. • OR Convergence: A diagnosis is stopped when any of the conditions is satisfied.
Data name	Select publishing data to set conditions.
Data type	The data type of selected publishing data is displayed.
Condition	Select a comparison operator.*1,*2
Constant value	Specify a constant value to compare.*1,*2
[Delete] button	Click this to delete a selected row.

*1 It will be blank and cannot be set if "Data name" is blank.

*2 Available comparison operators and constant values to compare depend on the data type. For details, refer to the following:

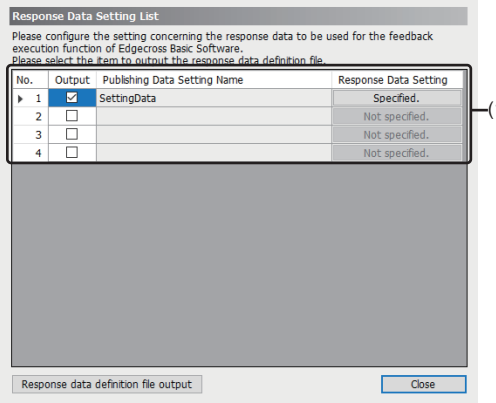
☞ Page 43 Pause of Similarity Diagnosis

12 RESPONSE DATA SETTING

This chapter shows the setting of response data.

Window

Click the [Response Data Setting] button.



Displayed items

Item		Description	Reference
(1) Setting list	Output	Select the checkbox of a publishing data setting to output its response data definition file.	—
	Publishing Data Setting Name	The name of a publishing data setting is displayed.	Page 65 PUBLISHING DATA SETTING
	Response Data Setting	Click this to display the "Response Data List" screen.	Page 76 Response Data List Screen
[Response data definition file output] button*1,*2		Click this to output a response data definition file*3 per publishing data setting for which the checkbox in the "Output" column is selected. (Response data definition files according to the number of selected publishing data settings are output at once.) Select the destination to save files in the "Browse For Folder" screen that appears by clicking this button.	—

*1 Can be clicked when a checkbox in the "Output" column is selected.

*2 To read an output response data definition file in Real-time Flow Designer, refer to the following:
☞ Page 53 Reading a response data definition file

*3 A file name is assigned as follows:
(Publishing data setting name)_Outputdata

Precautions

- If a response data name is changed in the "Operation Settings" screen of Similar Waveform Recognition Tool after reading the response data definition file in Real-time Flow Designer, it is required to redo from step 5 shown in the following:

☞ Page 50 Data Diagnosis Setting

- To change response data after starting an actual operation, refer to the following:

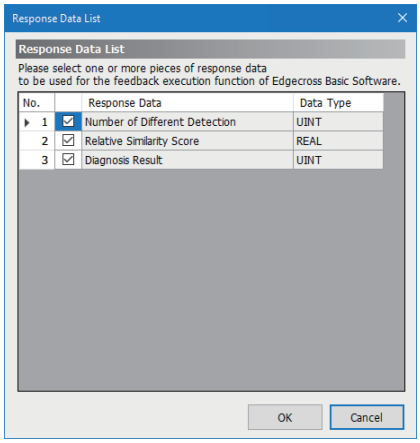
☞ Page 59 Changing a response data setting

12.1 Response Data List Screen

This section shows the screen for selecting response data to be output.

Window

Click the "Response Data Setting" column in the setting list.



Displayed items

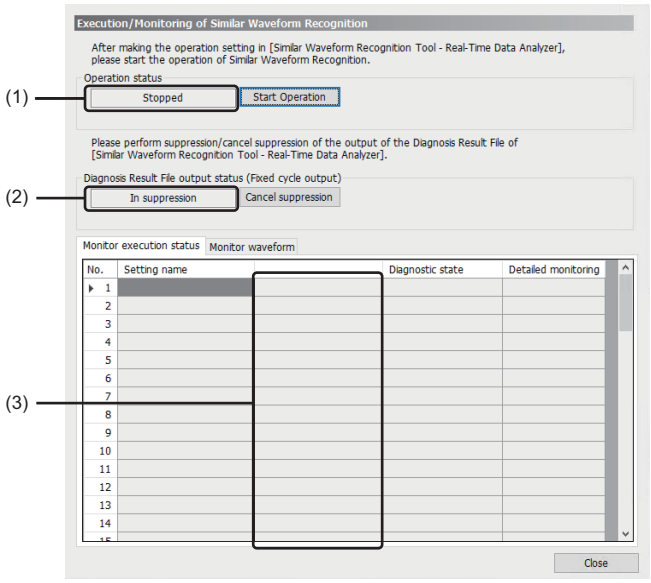
Item	Description
Response Data	Response data (number of different detection, relative similarity score, and diagnosis result) is displayed. Select the checkbox of response data to be output. For details on response data, refer to the following: ☞ Page 14 Similar Waveform Recognition Tool
Data Type	The type of response data is displayed.

13 EXECUTION/MONITORING OF SIMILAR WAVEFORM RECOGNITION

This section shows the operation for starting or stopping a similarity diagnosis and displaying both the execution status of each operation setting and the waveform monitor.

Window

Click the [Execution/Monitoring] button.



Displayed items

Item		Description	Reference
Operation status	(1) Operating status	The operating status of a similarity diagnosis is displayed. • Execution ongoing: A diagnosis is being performed. • Stopped: A diagnosis is not performed. • Transition to execution: Reference waveform learning data is being read in order to perform a diagnosis. • Transition to stop: Completion of a similarity diagnosis or diagnosis result file saving is being waited in order to stop a diagnosis.	—
	[Start Operation]/[Stop Operation] button	Click this to start or stop a similarity diagnosis.	—
Diagnosis Result File output status (Fixed cycle output)	(2) File output status*1,*2	The output status of a diagnosis result file is displayed. (When "Fixed cycle output" is selected for "Output Settings") • In suppression: Processing for outputting a diagnosis result file is stopped. • Canceling suppression: Processing for outputting a diagnosis result file is in progress.	—
	[Suppress]/[Cancel suppression] button*3,*4	Click this to switch the output operation for a diagnosis result file. (When "Fixed cycle output" is selected for "Output Settings") • [Suppress] button: To suspend the output of a file in a fixed cycle.*5 • [Cancel suppression] button: To resume the output of a file in a fixed cycle.	—
[Monitor execution status] tab*6	Setting name*2,*7	The name set in the "Operation Settings" screen is displayed.	Page 69 Operation Setting Screen
	(3) Runtime behavior target setting*2,*7	The content set for "Runtime behavior target setting" in the "Operation Settings" screen is displayed.	Page 69 Operation Setting Screen
	Diagnostic state*2,*7,*8	The diagnosis status of a similarity diagnosis is displayed. • Similarity: The similarity score is higher than a threshold value and the diagnosis stop condition is not satisfied. • Difference: The similarity score is lower than a threshold value and the diagnosis stop condition is not satisfied. • Preparing for diagnosis: A continuous waveform which can be diagnosed has not been input yet and the diagnosis stop condition is not satisfied. • Suspended: The diagnosis stop condition is satisfied. It will be blank when "Out of operation target" is displayed in 'Runtime behavior target setting'.	—
	Detailed monitoring	Click this to open the "Similar Waveform Recognition execution status detailed monitoring" screen. It will be blank when "Stopped" is displayed in "Operation status" or "Out of operation target" is displayed in "Runtime behavior target setting."	Page 79 Similar Waveform Recognition Execution Status Detailed Monitoring Screen
[Monitor waveform] tab	[Start GX LogViewer] button	Click this to start GX LogViewer and monitor a waveform in which a diagnosis is being executed.	Page 90 Similar waveform recognition monitor

*1 If the output status is "In suppression," a diagnosis is continued but a diagnosis result file is not output.
*2 When stopping the operation of a similarity diagnosis after starting the operation, content displayed right before stopping remains.
*3 If either of the following conditions is met, the change in the file output status is not applied to the actual operation.
- The operating status of a similarity diagnosis is not "Execution ongoing."
- "Fixed cycle output" is not selected for "Output Settings" in "Diagnosis Result file saving setting."
*4 Can be used for organizing a folder. For example, a diagnosis result file can be moved to another folder by suspending the file output.
*5 If the operation is suspended during a similarity diagnosis, a file is also output at that timing as well.
*6 When "Execution ongoing" is displayed in 'Operation Settings', the display content in the [Monitor execution status] tab is updated every one second.
*7 Blank before starting the first similarity diagnosis.
*8 "Preparing for diagnosis" is displayed immediately after the diagnosis stop condition turned from satisfied to unsatisfied.

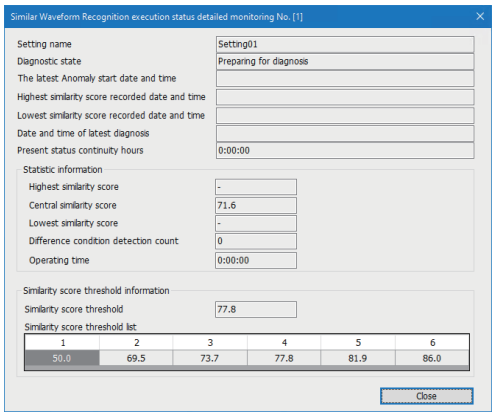
13.1 Similar Waveform Recognition Execution Status Detailed Monitoring Screen

This section shows the details of the status of a similarity diagnosis being performed.

The display contents except for "Similarity score threshold list" are updated every one second.

Window

Click the "Detailed monitoring" column in the [Monitor execution status] tab.



Displayed items

Item		Description	Reference
Setting name		The name set in the "Operation Settings" screen is displayed.	Page 69 Operation Setting Screen
Diagnostic state*1		The diagnosis status of a similarity diagnosis is displayed. • Similarity: The similarity score is higher than a threshold value and the diagnosis stop condition is not satisfied. • Difference: The similarity score is lower than a threshold value and the diagnosis stop condition is not satisfied. • Preparing for diagnosis: A continuous waveform which can be diagnosed has not been input yet and the diagnosis stop condition is not satisfied. • Suspended: The diagnosis stop condition is satisfied.	—
The latest Anomaly start date and time*2		The last date and time when "Difference" is displayed in "Diagnostic state" is displayed.	—
Highest similarity score recorded date and time*2		The date and time when the highest similarity score was recorded is displayed.	—
Lowest similarity score recorded date and time*2		The date and time when the lowest similarity score was recorded is displayed.	—
Date and time of latest diagnosis*2		The date and time (local time) of the last diagnosis is displayed.	—
Present status continuity hours		The elapsed time since the diagnosis status was changed to the current one is displayed (hh:mm:ss).*3	—
Statistic information	Highest similarity score	The highest similarity score is displayed (one decimal place).*4*5	—
	Central similarity score	The median of the highest and lowest similarity scores is displayed (one decimal place).*5*6	—
	Lowest similarity score	The lowest similarity score is displayed (one decimal place).*4*5	—
	Difference condition detection count	The number of times that "Difference" is displayed in "Diagnostic state" is displayed.*7	—
	Operating time	The elapsed time since the first reference waveform was input after starting a similarity diagnosis is displayed (hh:mm:ss)*3.	—
Similarity score threshold information	Similarity score threshold	Both the set detection sensitivity and the similarity score threshold corresponding to the reference waveform learning data are displayed (one decimal place).	—
	Similarity score threshold list	The similarity score threshold corresponding to the detection sensitivity 1 to 6 is displayed (one decimal place).*8	—

*1 "Preparing for diagnosis" is displayed immediately after the diagnosis stop condition turned from satisfied to unsatisfied.

*2 It is displayed according to the format 'yyyy/MM/dd HH:mm:ss.sssssssss'. (Zero padding is applied to numbers (nine digits) from milliseconds to nanoseconds.)
*3 The upper limit of a display value is '9999:59:59'. It is displayed when a value reaches the upper limit.
*4 '-' is displayed while preparing for a diagnosis (when the operation of a similarity diagnosis has just started).
*5 The value is not updated while pausing a diagnosis or preparing for it (when the diagnosis has just restarted after pausing or stopping it).
*6 The median calculated from the learning data is displayed while preparing for a diagnosis (when the operation of a similarity diagnosis has just started).
*7 The upper limit of a display value is '999999999'. It is displayed when a value reaches the upper limit.
*8 The similarity score threshold when starting a similarity diagnosis is displayed. (The value will not be updated.)

14 OUTPUTTING DIAGNOSIS RESULT FILE

A diagnosis result file records the diagnosis result of an inspection waveform in the CSV format.
Content that is output in the file differs depending on the output setting in "Diagnosis Result file saving setting" of the "Operation Settings" screen.
☞ Page 69 Operation Setting Screen

When "Only difference condition" is selected for "Output Settings"

A file that recorded only results determined to be different is output.
The output content can be checked in a graph by using GX LogViewer.
For details, refer to the following:
☞ Page 91 Diagnosis result file display
The following information is recorded in a diagnosis result file:

- Inspection waveform when a diagnosis was performed
- Similarity score when an inspection waveform and reference waveform learning data are compared
- A piece of reference waveform that is considered to correspond to the inspection waveform with the lowest similarity score, in the range of an inspection waveform recorded in the file.

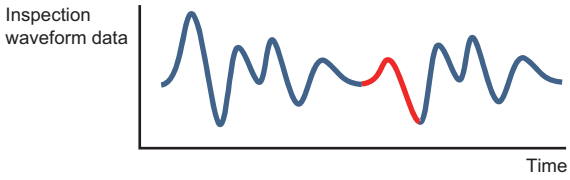
When "Fixed cycle output" is selected for "Output Settings"

A file that recorded inspection waveforms and their diagnosis results (similar or different) is output in a fixed cycle.
An output file can be checked in another application such as Excel®.
The following information is recorded in a diagnosis result file:

- Inspection waveforms to which a similarity diagnosis was being performed
- Diagnosis results (similar or different)

Point

In Excel, a diagnosis result file can be checked in a graph as shown below. (Blue: similar, red: different)



Precautions

- To check a diagnosis result file in another application, use a copied file.
- A diagnosis result file depends on the amount of an inspection waveform that is published from Real-time Flow Manager when performing a diagnosis. Therefore, the data volume of an output file may vary.
- For a fixed cycle output, the oldest files are deleted if the number of saved files exceeds the set upper limit. To continue saving diagnosis result files, it is required to save (copy) the files to another folder.

14.1 File Specifications

This section shows the specifications of a diagnosis result file.

Item	Specification		Range
File name (When "Only difference condition" is selected for "Output Settings")	The format of a file name is 'Prefix_suffix.extension'.		45 characters
	Prefix	Any character(s)	32 characters
	Suffix	An eight-digit sequential number (hexadecimal) is added. (It is sequentially incremented from 00000001 to FFFFFFFF.) When saving a file with the prefix same as one saved in a save destination, the suffix is incremented from the maximum prefix.	00000001 to FFFFFFFF*1,*2
	Extension	csv	—
File name (When "Fixed output cycle" is selected for "Output Settings")	The format of a file name is 'Prefix_suffix.extension.'*3*4		45 characters
	Prefix	Any character(s)	25 characters
	Suffix	YYYYMMDD_hhmmss • YYYYMMDD: Year, month, day • hhmmss: Hour, minute, second	—
	Extension	csv	—
File format	csv		—
Character encode	UTF-8 (with BOM)*5		—
Save destination	Any location		—
File size	Not defined		—

*1 If the number of output files exceeds a specified number of files, files are compared by using the eight-digit sequential number of the end of a file name, and deleted in ascending order.

*2 When the file name suffix of an output file reaches 'FFFFFFFF,' take either of the following corrective actions:
- Move all files in a save destination folder to another folder and click the [Start Operation] button in the "Execution/Monitoring of Similar Waveform Recognition" screen.
- Set another path for the save destination folder.

*3 If the number of output files exceeds a specified number of files, files are deleted in chronological order.

*4 The output content differs depending on the diagnosis status. Refer to the following:

*5 It will be Shift JIS when outputting a diagnosis result file with Similar Waveform Recognition Tool in Real-time Data Analyzer whose version is 1.02C or earlier.

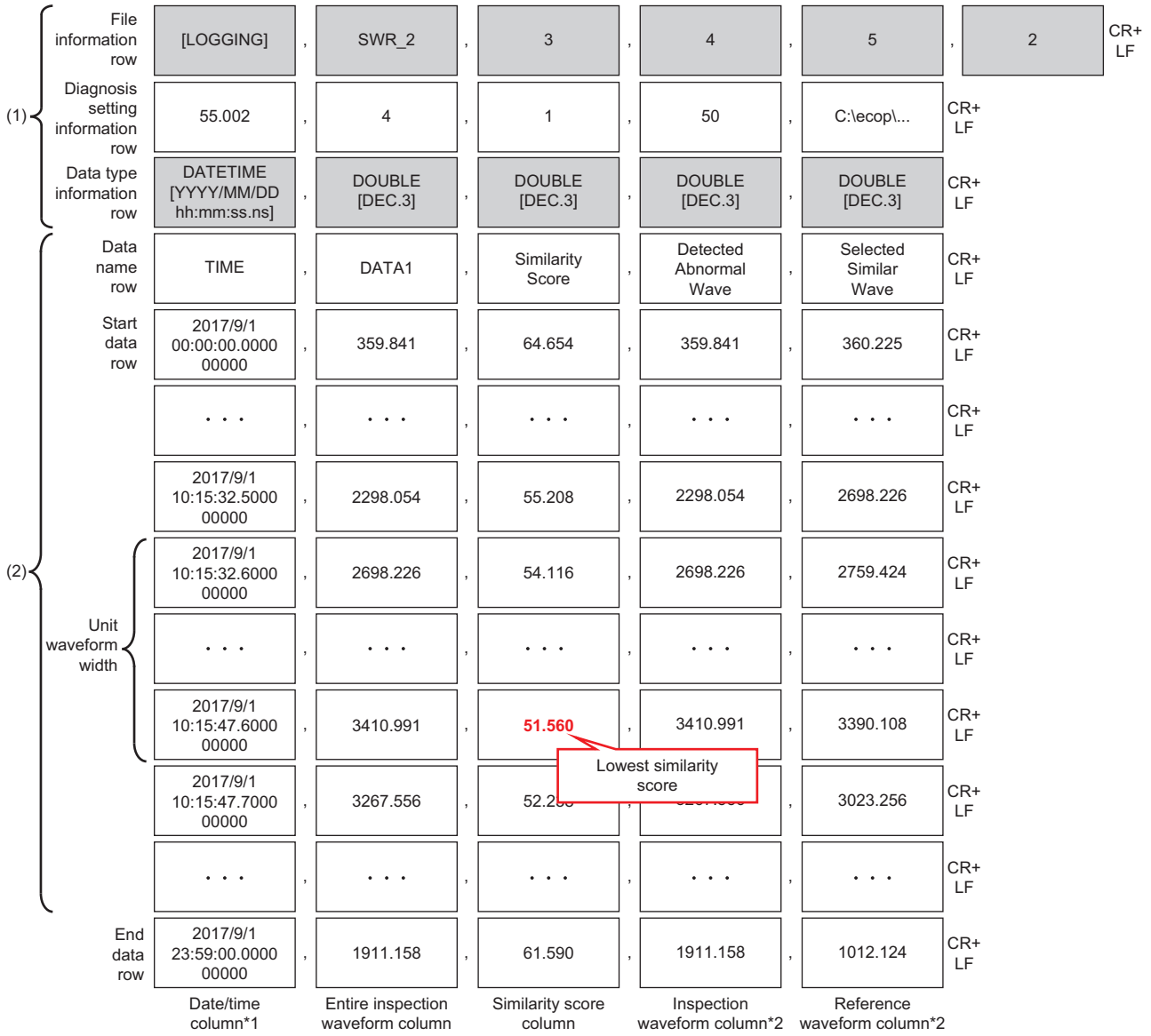
Precautions

- Set a file name prefix that is different from the ones output in other applications. If it is duplicated, review the setting.
- If the number of rows specified in the following item is small, the load on Windows will be high because a saved file is frequently created: "Switched when the following number of rows (records) is exceeded." in the "Operation Settings" screen. In this case, review the setting to increase the number of rows.
- Do not allow other applications to access a diagnosis result file while outputting the file; otherwise, creating/updating files may fail and cause an error.
- For considerations for a folder to save a diagnosis result file, refer to the following:

☞ Page 72 Considerations for setting a save destination folder

14.2 File Structure (When "Only difference condition" is selected for "Output Settings")

The following figure shows the structure of a diagnosis result file that is output when "Only difference condition" is selected for "Output Settings."



(1) Header
(2) Data

*1 When outputting a diagnosis result file with Similar Waveform Recognition Tool in Real-time Data Analyzer whose version is 1.03D or later, numbers less than a second are displayed up to nine digits with zero padding.
When outputting a diagnosis result file with Similar Waveform Recognition Tool in Real-time Data Analyzer whose version is 1.02C or earlier, numbers less than a second are displayed up to three digits with zero padding.
(Example) When the time stamp is 2019/1/10 3:59:00.01
Version 1.03D or later: 2019/1/10 3:59:00.010000000
Version 1.02C or earlier: 2019/1/10 3:59:00.010

*2 The inspection waveform and the reference waveform used for the determination when the lowest similarity score was detected are output for a number of the unit waveform width.

The following table shows the details of each data column.

Column	Item	Description
1st column	Date and time	The time stamp of a record is output.
2nd column	Entire inspection waveform	The value of an inspection waveform is output.
3rd column	Similarity score	A similarity score*1 is output.
4th column	Inspection waveform	The value of an inspection waveform is output.
5th column	Reference waveform	The value of a reference waveform is output.

*1 The output content differs depending on the diagnosis status. Refer to the following:
☞ Data content that is output for each diagnosis status

File information row

Column	Item	Description
1st column	File type	'[LOGGING]' is output.
2nd column	File version	'SWR_2' is output.*1
3rd column	Number for data type information row	'3' is output.
4th column	Number for data name row	'4' is output.
5th column	Number for data starting rows	'5' is output.
6th column	Number for diagnosis setting information row	'2' is output.

*1 'ECBS_1' will be output when outputting a diagnosis result file with Similar Waveform Recognition Tool in Real-time Data Analyzer whose version is 1.02C or earlier.

Diagnosis setting information row

Column	Item	Description
1st column	Similarity score threshold	The similarity score threshold (six decimal places) corresponding to the detection sensitivity is output.
2nd column	Detection sensitivity	The set detection sensitivity is output.
3rd column	Diagnosis execution cycle	The set diagnosis execution cycle is output.
4th column	Unit waveform width	The unit waveform width of reference waveform learning data is output.
5th column	Reference waveform learning data path	The file path of reference waveform learning data is output.

Data type information row

The data type corresponding to each data column is output.
However, when outputting a diagnosis result file with Similar Waveform Recognition Tool in Real-time Data Analyzer whose version is 1.02C or earlier, the data type of the date and time column will be DATETIME [YYYY/MM/DD hh:mm:ss.sss].

14.3 File Structure (When "Fixed output cycle" is selected for "Output Settings")

The following figure shows the structure of a diagnosis result file that is output when "Fixed cycle output" is selected for "Output Settings."

(1)	File information row	[LOGGING]	SWR_2	3	4	5	2	CR+LF
	Diagnosis setting information row	55.002	4	1	50	C:\ecop\...		CR+LF
	Data type information row	DATETIME [YYYY/MM/DD hh:mm:ss.ns]	DOUBLE [DEC.3]	DOUBLE [DEC.3]	DOUBLE [DEC.3]	DOUBLE [DEC.3]	DIAGRESULT	CR+LF
(2)	Data name row	TIME	DATA1	Similarity Score	Detected Abnormal Wave	Selected Similar Wave	Diagnosis Result	CR+LF
	Start data row	2017/9/1 00:00:00.0000 00000	359.841	100	359.841	360.225	0	CR+LF
		. . .	. . .	. . .	. . .	. . .	. . .	CR+LF
		2017/9/1 10:15:32.5000 00000	2298.054	55.208	2298.054	2698.226	0	CR+LF
		2017/9/1 10:15:32.6000 00000	2698.226	54.116	2698.226	2759.424	1	CR+LF
		. . .	. . .	. . .	. . .	. . .	. . .	CR+LF
		2017/9/1 10:15:47.6000 00000	3410.991	51.560	3410.991	3390.108	1	CR+LF
		2017/9/1 10:15:47.7000 00000	3267.556	52.238	3267.556	3023.256	1	CR+LF
		. . .	. . .	. . .	. . .	. . .	. . .	CR+LF
	End data row	2017/9/1 23:59:00.0000 00000	1911.158	61.590	1911.158	1012.124	0	CR+LF
		Date/time column*1	Entire inspection waveform column	Similarity score column	Inspection waveform column	Reference waveform column	Diagnosis result column	

(1) Header
(2) Data

*1 The value less than a second is displayed with zero padding up to the 9th digit.

The following table shows the details of each data column.

Column	Item	Description
1st column	Date and time	The time stamp of a record is output.
2nd column	Entire inspection waveform	The value of an inspection waveform is output.
3rd column	Similarity score	A similarity score*1 is output.
4th column	Inspection waveform	The value of an inspection waveform is output.
5th column	Reference waveform	The value of a reference waveform is output.
6th column	Diagnosis result	The diagnosis result ('0' or '1')*1 is output. • 0: Similar • 1: Different

*1 The output content differs depending on the diagnosis status. Refer to the following:
☞ Data content that is output for each diagnosis status

• Data content that is output for each diagnosis status

The following shows the data content that is output for each status of a similarity diagnosis.

Item	Output content for each diagnosis status			
	Preparing for diagnosis	Similarity	Difference	Suspended
Similarity score	100	Not defined	Not defined	—*1
Diagnosis result	0	0	1	—*1

*1 A diagnosis file is not output if the diagnosis status is "Suspended."

File information row

Column	Item	Description
1st column	File type	'[LOGGING]' is output.
2nd column	File version	'SWR_2' is output.
3rd column	Number for data type information row	'3' is output.
4th column	Number for data name row	'4' is output.
5th column	Number for data starting rows	'5' is output.
6th column	Number for diagnosis setting information row	'2' is output.

Diagnosis setting information row

Column	Item	Description
1st column	Similarity score threshold	The similarity score threshold (six decimal places) corresponding to the detection sensitivity is output.
2nd column	Detection sensitivity	The set detection sensitivity is output.
3rd column	Diagnosis execution cycle	The set diagnosis execution cycle is output.
4th column	Unit waveform width	The unit waveform width of reference waveform learning data is output.
5th column	Reference waveform learning data path	The file path of reference waveform learning data is output.

Data type information row

The data type corresponding to each data column is output.

14.4 Operational Specifications

This section shows the operational specifications for outputting a diagnosis result file.

A diagnosis result file is output when a diagnosis is performed or when any of the following conditions are satisfied.

Output condition	Reference
Only difference condition	Page 87 When "Only difference condition" is set as a condition to output a diagnosis result file
Fixed cycle output	Page 88 When "Fixed cycle output" is set as a condition to output a diagnosis result file

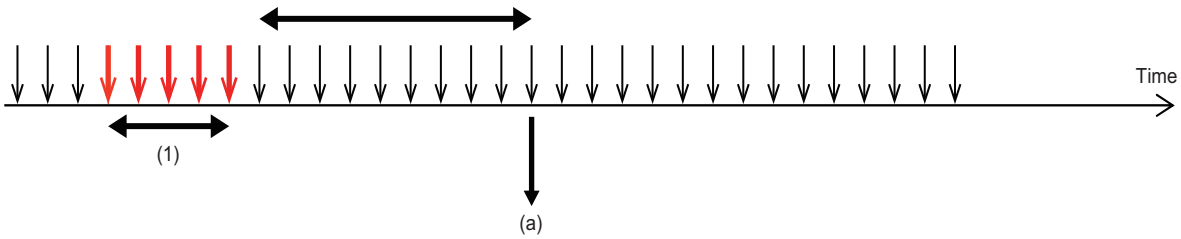
When "Only difference condition" is set as a condition to output a diagnosis result file

Data within the different state period is output.

A file is output at the timing when the different state period ends.

Whether the different state period has ended or not is determined as follows:

- The similar state is detected ten times in a row.



↓ : Similar state

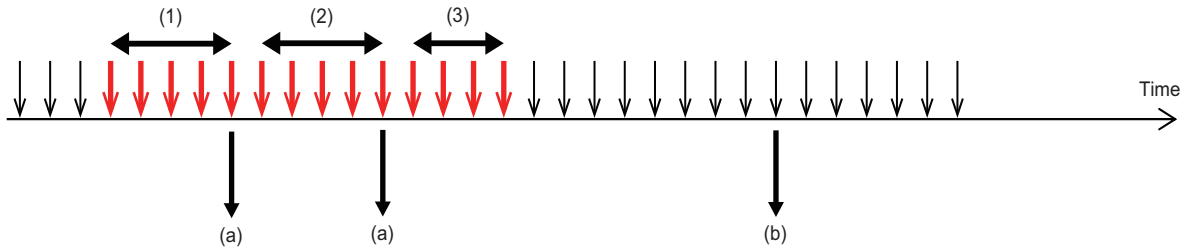
↓ : Different state

(1) Different state period

(a) A file is output because the similar state was detected ten times in a row.

In the similar state period, if the row in which a diagnosis result file is switched is reached, the result so far will be output to the current file and the subsequent result will be recorded in the next file.

The file to be output when the number of file switching row is '5' is described below:



↓ : Similar state

↓ : Different state

(1) Different state period 1

(2) Different state period 2

(3) Different state period 3

(a) A file is output as the file switching row (5) is reached.

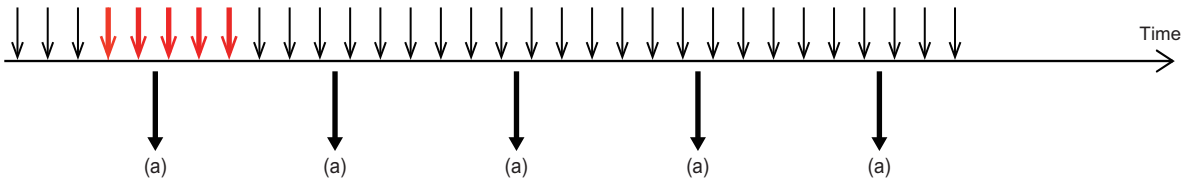
(b) A file is output as the similar state was detected ten times in a row.

When "Fixed cycle output" is set as a condition to output a diagnosis result file

Data within the execution period of a similarity diagnosis is output in a file.

Once the operation of a similarity diagnosis is started and the diagnosis is performed (an inspection waveform is determined to be similar or different), data is accumulated as a diagnosis result file, and the inspection waveform and its diagnosis result are output in the CSV file format according to the cycle set in "Diagnosis Result file saving setting" of the "Operation Settings" screen.

The timings to output a file are as follows:

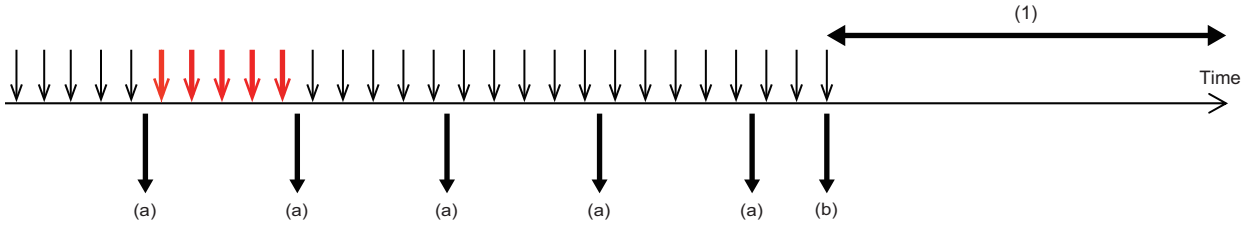


↓ : Similar state

↓ : Different state

(a) A file is output in the set cycle.

If a diagnosis is stopped or paused, a file is output at that time.



↓ : Similar state

↓ : Different state

(1) A diagnosis is stopped or paused. (A file is not output while stopping or pausing a diagnosis.)

(a) A file is output in the set cycle.

(b) A file is output as a diagnosis is stopped or paused.

Point

- A fixed cycle output is started after the diagnosis status turns from "Preparing for diagnosis" to "Similarity" or "Difference."
- Outputting a diagnosis file during a diagnosis can be suspended. (☞ Page 77 EXECUTION/ MONITORING OF SIMILAR WAVEFORM RECOGNITION)
- While referring to a diagnosis result file, the oldest file may not be deleted even if the set maximum number of saved files is reached. However, the latest file is stored even if the oldest file cannot be deleted. (In this case, the number of saved files will be 'set maximum number of saved files + 1.')

Precautions

- Data is not accumulated as a diagnosis result file while pausing a diagnosis or suspending the file output.
- If the file output is resumed while preparing for a diagnosis, data accumulated while preparing for the diagnosis is output. However, it is output only when any data is accumulated.
- When outputting data accumulated while preparing for a diagnosis, the similarity score is output as 100 since the diagnosis is not performed.
- If a diagnosis result file cannot be saved to a save destination folder, up to 10 files are accumulated and they will be saved when the save destination folder becomes available. However, if there are more than 10 files to be accumulated, files are deleted in chronological order.
- The time stamp of an output file may not be consistent with the cycle set in "Switching cycle setting" of "Diagnosis Result file saving setting."

• A reference waveform is determined when a diagnosis is performed.

(Example) Timing to determine a reference waveform when the unit waveform width is five records and the diagnosis execution cycle is three records

No.	Time stamp	Inspection waveform	Number of accumulated inspection waveforms	Diagnosis execution cycle	
1	01:00:00	-61.925	1	0	(1)
2	01:00:01	-65.113	2	0	(1)
3	01:00:02	-59.335	3	0	(1)
4	01:00:03	-38.017	4	0	(1)
5	01:00:04	-29.051	5	0	(2)
6	01:00:05	-10.721	6	1	(3)
7	01:00:06	-2.951	7	2	(3)
8	01:00:07	3.824	8	3	(4)

(1) An inspection waveform for the unit waveform width is accumulated.
(2) A diagnosis is performed as an inspection waveform for the unit waveform width is accumulated. (A reference waveform that is the most similar to the inspection waveform No.1 to 5 is determined.)
(3) An inspection waveform is accumulated as it is not in the diagnosis execution cycle.
(4) A diagnosis is performed as it is in the diagnosis execution cycle. (A reference waveform that is the most similar to the inspection waveform No.4 to 8 is determined.)
: Unit to determine a reference waveform (for (2))
: Unit to determine a reference waveform (for (4))

If a diagnosis result file is output before a reference waveform is determined, an inspection waveform is output for the content of reference waveform (SelectedSimilarWave).

(Example) Case in which an inspection waveform is output for the content of reference waveform (SelectedSimilarWave) when the unit waveform width is five records and the diagnosis execution cycle is three records

No.	Time stamp	Inspection waveform	Number of accumulated inspection waveforms	Diagnosis execution cycle	
1	01:00:00	-61.925	1	0	(1)
2	01:00:01	-65.113	2	0	(1)
3	01:00:02	-59.335	3	0	(1)
4	01:00:03	-38.017	4	0	(1)
5	01:00:04	-29.051	5	0	(2)
6	01:00:05	-10.721	6	1	(3)
7	01:00:06	-2.951	7	2	(4)

(1) An inspection waveform for the unit waveform width is accumulated.
(2) A diagnosis is performed as an inspection waveform for the unit waveform width is accumulated. (A reference waveform that is the most similar to the inspection waveform No.1 to 5 is output.)
(3) An inspection waveform is accumulated as it is not in the diagnosis execution cycle.
(4) An inspection waveform is accumulated since it is not in the diagnosis execution cycle. (The inspection waveform is output for the content of reference waveform (SelectedSimilarWave) since a diagnosis is not performed.)
: A reference waveform is output.
: An inspection waveform is output.

15 GX LogViewer COOPERATION

The following functions can be performed by using Similar Waveform Recognition Tool and GX LogViewer together.

Function	Description	Reference
Similar waveform recognition monitor	To check the following data with a graph in real time: an inspection waveform which is input for a similarity diagnosis and the variations of a similarity score acquired as a diagnosis result.	Page 90 Similar waveform recognition monitor
Diagnosis result file display	To check the content of a diagnosis result file by graphing it.	Page 91 Diagnosis result file display

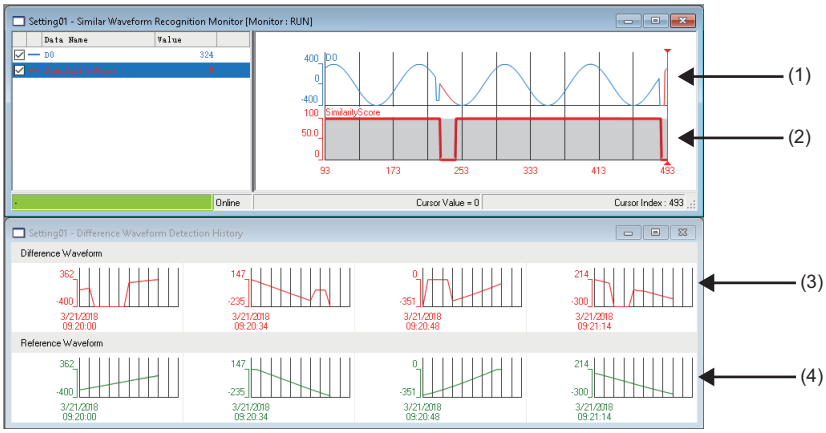
For GX LogViewer, refer to the following manual.

GX LogViewer Version 1 Operating Manual

GX LogViewer Version 1 Operating Manual (Edgecross)

15.1 Similar waveform recognition monitor

By connecting GX LogViewer with Similar Waveform Recognition Tool, the following data can be checked: an inspection waveform which is input for a similarity diagnosis and the variations of a similarity score acquired as a diagnosis result.



Displayed items

Item	Description
(1) Inspection waveform monitor	An inspection waveform to be input is displayed in real time. When a diagnosis result is determined to be different, an inspection waveform is displayed in a different color from the one for when the result is determined to be similar. While a diagnosis is paused, an inspection waveform is displayed in a same color as the one for when the result is determined to be similar.
(2) Similarity score monitor	A similarity score to be a diagnosis result is displayed in real time. While a diagnosis is paused, the similarity score is 100.
(3) Different waveform	A waveform diagnosed as different from the reference waveform is displayed for each unit waveform width. Up to four different waveforms can be displayed and waveforms are deleted in chronological order.
(4) Reference waveform	The snapshots of the reference waveform most similar to a different waveform being displayed are displayed for each unit waveform width.

Considerations

■ Number of simultaneously-displayed diagnoses

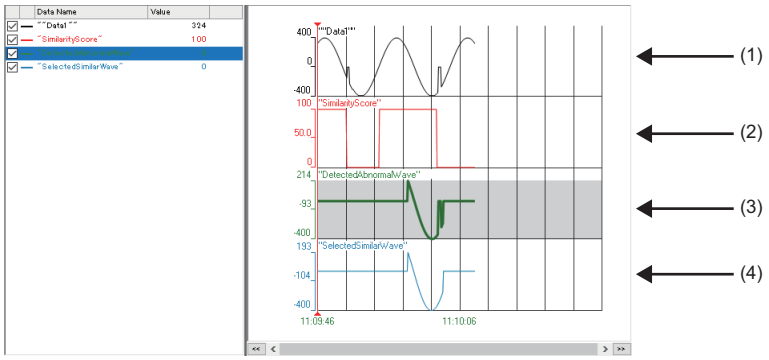
- Number of simultaneously-displayed diagnoses is two in maximum.

■ Operating status of a similarity diagnosis

- A similarity diagnosis to be monitored must be in operation. If the diagnosis is stopped, the similar waveform recognition monitor function is also stopped.
- When a similarity diagnosis is performed again, it is necessary to perform the similar waveform recognition monitor function again.

15.2 Diagnosis result file display

The contents of a diagnosis result file which was output by Similar Waveform Recognition Tool can be displayed with the contents similar to those displayed when the similar waveform recognition monitor function was performed.



Displayed items

Item	Description
(1) Inspection waveform	An inspection waveform included in a diagnosis result file is displayed.
(2) Similarity score	A similarity score included in a diagnosis result file is displayed.
(3) Different waveform	An inspection waveform which is considered to be a different waveform with the lowest similarity score in a diagnosis result file is displayed for each unit waveform width.
(4) Reference waveform	The reference waveform most similar to a different waveform being displayed is displayed for each unit waveform width.

Precautions

- An error occurs when displaying a diagnosis result file output with Similar Waveform Recognition Tool in Real-time Data Analyzer whose version is 1.03D or later in GX LogViewer whose version is 1.88S or earlier. In this case, display the file after updating GX LogViewer to version 1.90U or later.
- While a similarity diagnosis is paused, a diagnosis result file is not output.
- An error occurs when reading an output diagnosis result file if "Fixed cycle output" is selected for "Output Settings" in "Diagnosis Result file saving setting" of the "Operation Settings" screen.

16 CONSIDERATIONS FOR SIMILAR WAVEFORM RECOGNITION

The following shows the considerations for similar waveform recognition.

16.1 Waveforms Used for Similar Waveform Recognition

Similar waveform recognition is a function to learn a normal waveform and detect an error when a waveform different from the normal one is input. It is suited to determine a cyclic waveform in which the same pattern of waveforms are repeated at regular interval.

The cycle of a cyclic waveform is not limited, but parameters must be set according to the cycle. (☞ Page 94 Input Waveform (Reference Waveform) and Setting Items in Waveform Learning)

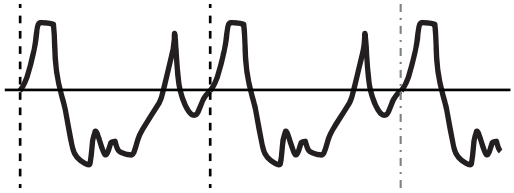
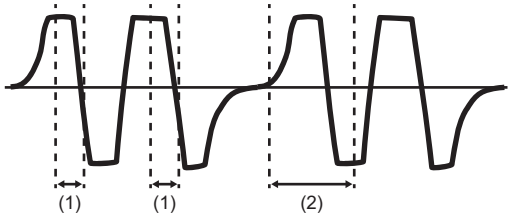
Observe the following to ensure more accurate diagnosis result in a similar waveform recognition.

- Specify an appropriate unit waveform width to include a specific waveform. (☞ Page 94 Input Waveform (Reference Waveform) and Setting Items in Waveform Learning)
- The unit waveform width has the upper limit, so make the collection cycle longer or modify data so that all records[*1] in a specific waveform is included in the unit waveform width.

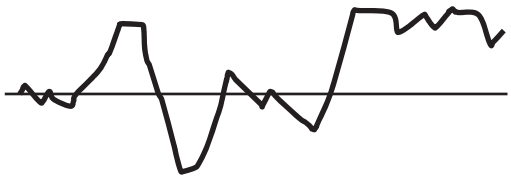
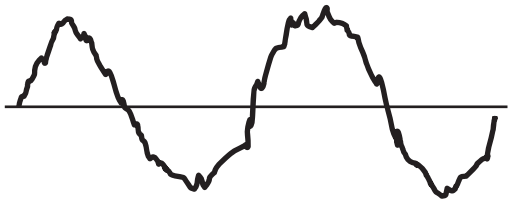
*1 Data per row is referred to as a 'record'.

- Use data with resolution which allows for detecting a difference in a specific waveform. (It is recommended data with 500 steps or more of resolution from minimum value to maximum value.)
  If the resolution is too low, an expected diagnosis result may not be acquired.
  (Example) To detect the level difference '0.5' of a waveform of which the minimum value is '0.0' and the maximum value is '1000.0', resolution '0.5' or higher is necessary.
- The input waveform value should be within the range from '2.11996057443428e+152' to '-2.11996057443428e+152'.
  Note that the range suitable for similar waveform recognition is '9.00719925474099e+12' to '-9.00719925474099e+12'.

Properties of a waveform suitable for similar waveform recognition

Waveform property	Example	Remarks
Cyclic and amplitude is not too small.		—
Multiple patterns of correct phenomena are recorded.		The interval is not required to be even. While two or more phenomena can be diagnosed, too many phenomena increases the possibility of incorrect determination.
The unit waveform width is not too short for one phenomenon.	 (1) Too short and may be confused with other portions. (2) Suitable because it includes a feature for distinction from other portions.	If a single phenomenon is too long to be included in the unit waveform width, shorten the collection cycle.

Properties of a waveform not suitable for similar waveform recognition

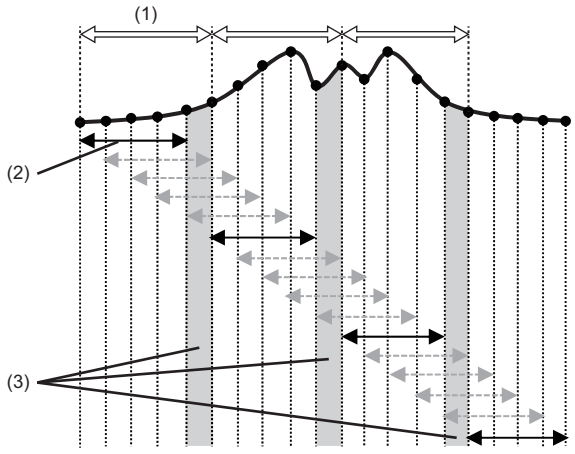
Waveform property	Example	Remarks
Not cyclic		—
Waveforms with different cycles are overlapped (noise or others).		While this example shows a case where a short-cycle waveform is overlapped, a long-cycle waveform also decreases the determination accuracy.
Attribute is too small for resolution.		It is recommended data with 500 steps or more of resolution from minimum value to maximum value.

16.2 Input Waveform (Reference Waveform) and Setting Items in Waveform Learning

- For accurate learning and waveform monitoring, set the number of records for the unit waveform width so that a characteristic waveform such as an impulse waveform which appears cyclically can be included. However, it cannot be set exceeding the learning period.
- For learning waveforms, input only waveforms in the similar state. If a waveform with an error is input or some noise is included on a waveform, the determination accuracy may be decreased.
  If a fluctuation or deviation is large in waveforms in the similar state, more accurate reference waveform learning data can be generated by extending the learning period.
- When the collected data is not enough for the learning period, learning will end at the end of the collected data.
  In addition, learning will also end when the collected data is enough for the learning period and the learning period is longer than the period equivalent to 1000000 records.
- The number of records of a reference waveform necessary for waveform learning must be four times or more of the unit waveform width within a section in which dates and times are arranged at regular intervals in chronological order. However, even if the above condition is satisfied, sufficient diagnostic accuracy is not guaranteed. To increase the accuracy, extend the learning period so that the number of records of reference waveform is longer than four times of unit waveform width.

16.3 Setting Items for a Data Diagnostic Flow

- Set the same collection cycle to the data analysis phase and data diagnosis phase. Otherwise, the determination will be inaccurate.
- If the collection cycle is shorter than the processing period, waveform monitoring processing cannot complete and a process data buffer overflow error occurs. In this case, lengthen the collection cycle or the data diagnosis period. (When changing the collection cycle, it is required to redo from the data analysis phase.)
- If the data diagnosis cycle is too long comparing the unit waveform width, waveform monitoring becomes sparse and a gap is made in the monitoring. Therefore, be sure to set a value for data diagnosis cycle which is appropriate for the unit waveform width. (Half of the unit waveform width is a guide)



(1) Data diagnosis period = 5
(2) Unit waveform width*1 = 5
(3) Waveform monitoring unperformed period

*1 Number of contact points (records).

16.4 Restrictions on Reference Waveform Learning Data Once Created

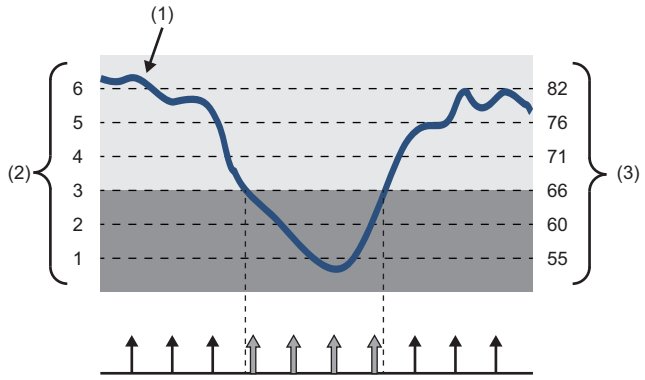
- Reference waveform learning data once created cannot be changed.
- The reference waveform learning data created once cannot be enhanced by making it learning again.

16.5 Number of Times of Detection

In similar waveform recognition, differences are output multiple times successively for one continuous difference. In order not to feed back for every time, make an inhibition period for a feedback execution.

Ex.

Case in which the detection sensitivity is 3:



→: Determined to be similar
⇒: Determined to be different
(1) Similarity score
(2) Detection sensitivity
(3) Similarity score threshold list

16.6 Relativity between Collection Data Transmission Delay and a Diagnosis Result

When collecting data by using a data collector in which the transmission delay occurs, the values of an inspection waveform may be fluctuated because of inconstant transmission delay time. If it occurs, a waveform with a high similarity may be determined to be different, and vice versa. If an expected diagnosis result is not obtained by such a data collector, use a different data collector of which the fluctuation of transmission delay time is not large or shorten the collection interval.
The relativity between the similarity score and the fluctuation of a waveform included in a reference waveform is as follows:

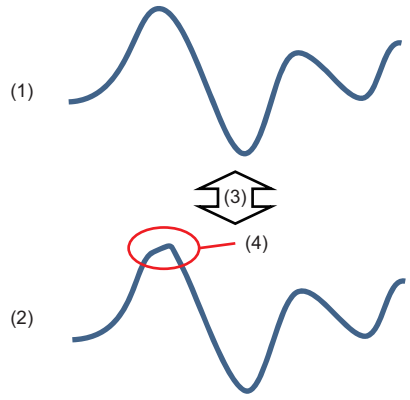
Reference waveform group status	Similarity score status
Little fluctuation	• Similarity score tends to be high. • Slight misalignment of waveform greatly affects the similarity score.
Lot of fluctuation	• Similarity score tends to be low. • Slight misalignment of waveform does not greatly affect the similarity score.

Point

For the transmission delay time, refer to the manual of the data collector to use.

Example of a diagnosis in which a similarity score is determined lower than expected

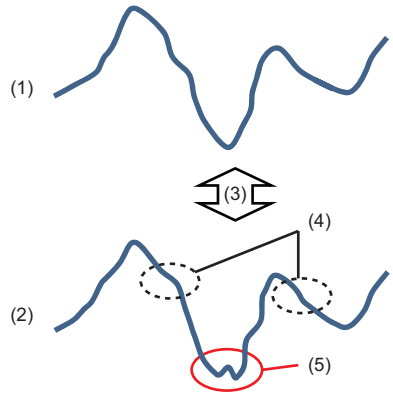
A reference waveform similar to an inspection waveform after fluctuation is not found, so it is determined to be different.



(1) Reference waveform
(2) Inspection waveform
(3) Waveforms are compared.
(4) Fluctuation is generated.

Example of a diagnosis in which a similarity score is determined higher than expected

The similarity is increased with the learning of the reference waveform similar to an inspection waveform after fluctuation, so it is determined to be similar.



(1) Reference waveform
(2) Inspection waveform
(3) Waveforms are compared.
(4) Partially fluctuates
(5) Abnormal waveform to detect

17 TROUBLESHOOTING BY SYMPTOM

If a function of Similar Waveform Recognition Tool does not perform properly, check the applicable items in the following and troubleshoot the error.

Symptom	Check item	Corrective action
Failed to learn a waveform.	Is the number of records of the reference waveform equal to or greater than a value of the unit waveform width × 4?	Increase the recording time of the reference waveform, and use a reference waveform equal to or greater than a value of the unit waveform width × 4. (The minimum required number of records is a value of the unit waveform width × 4. Use a reference waveform of longer time to increase accuracy.) ☞ Page 49 Acquiring a reference waveform ☞ Page 49 Creating reference waveform learning data
Failed to learn a waveform using a reference waveform collected by Real-time Flow Manager due to a time stamp error.	Is the number of digits of the reserved word included in the time stamp format coincident with the number of digits of the time stamp?	Re-collect a reference waveform by using Real-time Flow Manager.
Failed to read a publishing data definition file.	Does the version of Similar Waveform Recognition Tool support the one of Edgecross Basic Software in which the publishing data definition file was created?	Re-read the publishing data definition file that was created in Edgecross Basic Software supported by the version of Similar Waveform Recognition Tool. ☞ Page 449 Similar Waveform Recognition Tool

Symptom	Check item	Corrective action
A waveform that should not be detected may be detected incorrectly.	Can a change of a waveform of input data be detected?	• Decrease the collection interval to detect a change of a waveform of input data. • Increase the unit waveform width to include a characteristic waveform. ☞ Page 46 Creating the data logging flow setting
	Is an input waveform with a same condition as when recording a reference waveform used?	• Check the setting of Real-time Flow Designer, and use a same setting as when learning a waveform. • Check whether the system environment has a same condition as when recording a reference waveform, and match the condition. ☞ Page 46 Creating the data logging flow setting ☞ Page 53 Reading a response data definition file
	Are noise or others in processing target input data superimposed?	• Decrease the sensitivity for detection in order not to incorrectly detect a waveform that should not be detected. • Take measures against noise and congestion. • Increase the accuracy by increasing the amount of a reference waveform in waveform learning. • Use the data modification function to remove the noise. ☞ Page 92 Waveforms Used for Similar Waveform Recognition ☞ Page 49 Acquiring a reference waveform ☞ Page 49 Creating reference waveform learning data ☞ Page 55 Detection sensitivity adjustment
	Are ripples with long cycles or others superimposed on processing target input data?	• Decrease the sensitivity for detection in order not to incorrectly detect a waveform that should not be detected. • Take measures against noise and congestion. • Increase the accuracy by increasing the amount of a reference waveform to be equal to or greater than four cycles of a long cycle waveform in waveform learning. • Use the data modification function to remove the noise. ☞ Page 92 Waveforms Used for Similar Waveform Recognition ☞ Page 49 Acquiring a reference waveform ☞ Page 49 Creating reference waveform learning data ☞ Page 56 Data diagnosis cycle adjustment
	Is data the cycle of which fluctuates a processing target?	• Decrease the sensitivity for detection in order not to incorrectly detect a waveform that should not be detected. • Decrease the unit waveform width in the range in which a characteristic waveform can be included. • Increase the accuracy by increasing the amount of a reference waveform in waveform learning. ☞ Page 46 Creating the data logging flow setting ☞ Page 49 Creating reference waveform learning data
	Is a reference waveform learning data file created by a processing target used?	• Specify a correct reference waveform learning data file. • Record the processing target, and use the data as a reference waveform to create data diagnosis parameters. ☞ Page 49 Creating reference waveform learning data
	Is a data collector the transmission delay time of which fluctuates widely used?	• Use a data collector the transmission delay time of which fluctuates narrowly. • Decrease the collection interval less than the interval at which a value of data to be collected is updated. ☞ Page 46 Creating the data logging flow setting ☞ Page 96 Relativity between Collection Data Transmission Delay and a Diagnosis Result
	Does a reference waveform included in the analysis period exceed 1000000 records?	Reduce the number of records included in the analysis period to 1000000 or less. ☞ Page 49 Creating reference waveform learning data
	Is a similarity score low even when it is not applicable to the above patterns?	• Extend the recording time of a reference waveform to be entered when learning a waveform, and increase the analysis period. • Decrease the sensitivity for detection in order not to incorrectly detect a waveform that should not be detected. ☞ Page 41 Similarity Score ☞ Page 49 Acquiring a reference waveform ☞ Page 49 Creating reference waveform learning data ☞ Page 55 Detection sensitivity adjustment
	Is the sensitivity for detection too high?	• If setting the detection sensitivity by adjusting the level, lower the level. • If setting the detection sensitivity by entering a value directly, set a lower value.

Symptom	Check item	Corrective action
A waveform that should be detected may be missed.	Is the unit waveform width too short?	Increase the unit waveform width to include a characteristic waveform. ☞ Page 49 Creating reference waveform learning data
	Is the sensitivity for detection high enough?	• If setting the detection sensitivity by adjusting the level, increase the level. • If setting the detection sensitivity by entering a value directly, set a higher value.
	Can a change of a waveform of input data be detected?	• Decrease the collection interval to detect a change of a waveform of input data. • Increase the unit waveform width to include a characteristic waveform. ☞ Page 46 Creating the data logging flow setting ☞ Page 49 Creating reference waveform learning data
	Is an input waveform with a same condition as when recording a reference waveform used?	• Check the setting of Real-time Flow Designer, and use a same setting as when learning a waveform. • Check whether the system environment has a same condition as when recording a reference waveform, and match the condition. ☞ Page 46 Creating the data logging flow setting ☞ Page 53 Reading a response data definition file
	Is data missing in the reference waveform?	Use a reference waveform in which no data is missing to learn a waveform. ☞ Page 46 Creating the data logging flow setting ☞ Page 49 Acquiring a reference waveform
	Has data missing occurred in a data collector?	• Increase the cycle for performing a data diagnosis. • Decrease the unit waveform width. • Terminate any unnecessary applications. • Reduce the number of similarity diagnosis settings. • Increase the collection interval. • Reduce the number of data logging flows or data diagnosis flows of Real-time Flow Manager. • Reduce the load of other applications.
	Is an error included in a reference waveform to be entered when learning a waveform?	Use data in which an error is not included, and create reference waveform learning data. ☞ Page 49 Acquiring a reference waveform
	Is the length of a reference waveform to be entered when learning a waveform sufficient?	Extend the recording time of a reference waveform to be entered when learning a waveform, and increase the analysis period. ☞ Page 49 Acquiring a reference waveform ☞ Page 49 Creating reference waveform learning data
	Is the resolution of the level of a reference waveform sufficient?	• Decrease the collection cycle so that the resolution will be 500 or more. • Increase the unit waveform width to include a characteristic waveform. • Use an input waveform with a resolution higher than a level difference that should be detected. (When detecting the level difference of '0.5', the resolution must be equal to or less than '0.5'.) ☞ Page 92 Waveforms Used for Similar Waveform Recognition ☞ Page 46 Creating the data logging flow setting ☞ Page 49 Acquiring a reference waveform ☞ Page 49 Creating reference waveform learning data
	Is a data collector the transmission delay time of which fluctuates widely used?	• Use a data collector the transmission delay time of which fluctuates narrowly. • Decrease the collection interval less than the interval at which a value of data to be collected is updated. ☞ Page 46 Creating the data logging flow setting ☞ Page 96 Relativity between Collection Data Transmission Delay and a Diagnosis Result
	Is the cycle for performing a data diagnosis equal to or less than the one-half of a unit waveform width?	Decrease the cycle for performing a data diagnosis to equal to or less than the one-half of the unit waveform width. ☞ Page 56 Data diagnosis cycle adjustment
	Does a reference waveform included in the analysis period exceed 1000000 records?	Reduce the number of records included in the analysis period to 1000000 or less. ☞ Page 49 Creating reference waveform learning data
	Has a communication error occurred between Real-time Flow Manager and an MQTT broker when cooperating with Real-time Flow Manager that is installed in another industrial PC?	• Check the communication cable status. • Check if there is any problem in communication settings or route between Real-time Flow Manager and the MQTT broker. • Increase the collection interval. • Reduce the number of units of data output from Real-time Flow Manager. ☞ Page 51 Creating a publishing data definition file ☞ Page 53 Creating the data diagnosis flow setting
	Is the industrial PC in which Edgecross Basic Software is installed running?	Run the industrial PC in which Edgecross Basic Software is installed.

Symptom	Check item	Corrective action
The status will be in the state in which the different state is always detected.	Is the sensitivity for detection too high?	• If setting the detection sensitivity by adjusting the level, lower the level. • If setting the detection sensitivity by entering a value directly, set a lower value.
	Is a reference waveform learning data file created by a processing target used?	• Specify a correct data reference waveform learning data file. • Record the processing target, and use the data as a reference waveform to create a reference waveform learning data file. ☞ Page 49 Creating reference waveform learning data
	Can a change of a waveform of input data be detected?	• Decrease the collection interval to detect a change of a waveform of input data. • Increase the unit waveform width to include a characteristic waveform. ☞ Page 46 Creating the data logging flow setting ☞ Page 49 Creating reference waveform learning data
	Is an input waveform with a same condition as when recording a reference waveform used?	• Check the setting of Real-time Flow Designer, and use a same setting as when learning a waveform. • Check whether the system environment has a same condition as when recording a reference waveform, and match the condition. ☞ Page 46 Creating the data logging flow setting ☞ Page 53 Reading a response data definition file
	Has a communication error occurred between Real-time Flow Manager and an MQTT broker when cooperating with Real-time Flow Manager that is installed in another industrial PC?	• Check the communication cable status. • Check if there is any problem in communication settings or route between Real-time Flow Manager and the MQTT broker. • Increase the collection interval. • Reduce the number of units of data output from Real-time Flow Manager. ☞ Page 51 Creating a publishing data definition file ☞ Page 53 Creating the data diagnosis flow setting
	Is the industrial PC in which Edgecross Basic Software is installed running?	Run the industrial PC in which Edgecross Basic Software is installed.
The status will be in the state in which the similar state is always detected.	Is a value of processing target input data changed?	Check the connection with a device, collection settings, or others. ☞ Page 49 Acquiring a reference waveform
	Can a change of a waveform of input data be detected?	• Decrease the collection interval to detect a change of a waveform of input data. • Increase the unit waveform width to include a characteristic waveform. ☞ Page 46 Creating the data logging flow setting ☞ Page 49 Creating reference waveform learning data
	Has a communication error occurred between Real-time Flow Manager and an MQTT broker when cooperating with Real-time Flow Manager that is installed in another industrial PC?	• Check the communication cable status. • Check if there is any problem in communication settings or route between Real-time Flow Manager and the MQTT broker. • Increase the collection interval. • Reduce the number of units of data output from Real-time Flow Manager. ☞ Page 51 Creating a publishing data definition file ☞ Page 53 Creating the data diagnosis flow setting
	Is the industrial PC in which Edgecross Basic Software is installed running?	Run the industrial PC in which Edgecross Basic Software is installed.
	Is the detection sensitivity too low?	• If setting the detection sensitivity by adjusting the level, increase the level. • If setting the detection sensitivity by entering a value directly, set a higher value.

Symptom	Check item	Corrective action
The load on an industrial PC is high.	Is the load on an industrial PC high?	• Increase the cycle for performing a data diagnosis. • Decrease the unit waveform width. • Terminate any unnecessary applications. • Reduce the number of similarity diagnosis settings. • Increase the collection interval. • Reduce the number of data logging flows or data diagnosis flows of Real-time Flow Manager. • Reduce the load of other applications. • Change the environment settings for Windows. ☞ Page 431 Environment Settings for an Industrial PC where Real-time Data Analyzer Runs • Set the following items so that they will be executed when Real-time Data Analyzer is not running: Windows Update Optimize Drives Disk Cleanup • If selecting "Only difference condition" for "Output Settings" in "Diagnosis Result file saving setting," increase the number of rows for switching files. • If selecting "Fixed cycle output" for "Output Settings" in "Diagnosis Result file saving setting," increase the cycle for switching files.
A similarity diagnosis stopped.	Did a diagnosis stop because the limit of processing performance was exceeded?	
"Error in the number of connections" is displayed when opening the operation setting while performing the similar waveform recognition monitor function of GX LogViewer.	Is a same operation setting as the opened one to be monitored in a tool other than GX LogViewer being operated?	End monitoring of the same operation setting in another GX LogViewer.
The following message appears when loading a diagnosis result file in GX LogViewer. 'The Data Logging file cannot be displayed because the file version is too new or the file is not corresponding to the tool.'	Is the version of GX LogViewer 1.90U or later?	Please contact your local Mitsubishi representative and acquire the latest GX LogViewer, then install it.
"Preparing for diagnosis" is displayed as the operating status in the "Execution/Monitoring of Similar Waveform Recognition" screen even though a similarity diagnosis is started.	Is a publishing data definition file which was output from a data diagnosis flow different from one to be diagnosed loaded?	Reset the publishing data setting and load the publishing data definition file which was output from the data diagnosis flow to be diagnosed.
	Is an operation of Real-time Flow Manager started?	Start the operation of Real-time Flow Manager.
	Did an error occur in Real-time Flow Manager?	Clear the error in Real-time Flow Manager.
	Has a communication error occurred between Real-time Flow Manager and an MQTT broker when cooperating with Real-time Flow Manager that is installed in another industrial PC?	• Check the communication cable status. • Check if there is any problem in communication settings or route between Real-time Flow Manager and the MQTT broker. • Increase the collection interval. • Reduce the number of units of data output from Real-time Flow Manager. ☞ Page 51 Creating a publishing data definition file ☞ Page 53 Creating the data diagnosis flow setting
	Is the industrial PC in which Edgecross Basic Software is installed running?	Run the industrial PC in which Edgecross Basic Software is installed.
"A communication message of unsupported version was received." is displayed during a similarity diagnosis.	Does the version of Similar Waveform Recognition Tool support the one of Edgecross Basic Software?	Use Edgecross Basic Software which is supported by the version of Similar Waveform Recognition Tool. ☞ Page 449 Similar Waveform Recognition Tool
"An invalid communication message was received." is displayed during a similarity diagnosis.	Is there any difference in the contents of the edge application diagnosis (MQTT) setting of Real-time Flow Designer and the publishing data setting of Similar Waveform Recognition Tool?	Output the publishing data definition file again in the edge application diagnosis (MQTT) setting of Real-time Flow Designer and reset the publishing data setting of Similar Waveform Recognition Tool.

Symptom	Check item	Corrective action
Contents in the screen are not displayed properly.	Is a value other than 100% set for "Change the size of text, apps, and other items" in Windows?	• Change the value to 100% for "Change the size of text, apps, and other items". • For Windows 10 (version 1703 or later)[*1], the display of a screen can be enlarged with high DPI scaling by using a Windows 10 function[*2]. ❶ Select the execution file[*3,*4], then select [Properties] on the right-click menu. ❷ Select the checkbox of "Override high DPI scaling behavior. Scaling performed by:" in the [Compatibility] tab, then select "System" from the pull-down list. ❸ Click the [OK] button.
The same error occurs even after the corrective action was taken.	Is antivirus software installed?	Refer to the following section and configure the setting to exclude folders from monitoring targets of antivirus software. ☞ Page 24 Exclusion setting in antivirus software
The diagnosis status does not turn to the 'suspended' state.	Is content of publishing data consistent with that of a diagnosis stop condition?	Review the settings of the diagnosis stop condition.
	Has a communication error occurred between Real-time Flow Manager and an MQTT broker when cooperating with Real-time Flow Manager that is installed in another industrial PC?	• Check the communication cable status. • Check if there is any problem in communication settings or route between Real-time Flow Manager and the MQTT broker. • Increase the collection interval. • Reduce the number of units of data output from Real-time Flow Manager. ☞ Page 51 Creating a publishing data definition file ☞ Page 53 Creating the data diagnosis flow setting
	Is the industrial PC in which Edgecross Basic Software is installed running?	Run the industrial PC in which Edgecross Basic Software is installed.
The diagnosis status does not turn to the 'preparing for diagnosis' state from the 'suspended' state.	Is content of publishing data consistent with that of a diagnosis stop condition?	Review the settings of the diagnosis stop condition.
	Has a communication error occurred between Real-time Flow Manager and an MQTT broker when cooperating with Real-time Flow Manager that is installed in another industrial PC?	• Check the communication cable status. • Check if there is any problem in communication settings or route between Real-time Flow Manager and the MQTT broker. • Increase the collection interval. • Reduce the number of units of data output from Real-time Flow Manager. ☞ Page 51 Creating a publishing data definition file ☞ Page 53 Creating the data diagnosis flow setting
	Is the industrial PC in which Edgecross Basic Software is installed running?	Run the industrial PC in which Edgecross Basic Software is installed.
Unable to display an inspection waveform and its diagnosis result in a graph in another application.	Are an inspection waveform and its diagnosis result (similar or different) displayed properly in a graph?	• Check if "Fixed cycle output" is selected for "Output Settings" in "Diagnosis Result file saving setting." • Check if the file to be displayed in a graph is a diagnosis result file. • Check if a cycle for switching diagnosis result files is long.
	Can the diagnosis result file to be displayed in a graph be read?	
	Does the diagnosis result file to be displayed in a graph exist?	
A diagnosis result file is not stored even when "Canceling suppression" is displayed in "Diagnosis Result File output status (Fixed cycle output)" of the "Execution/Monitoring of Similar Waveform Recognition" screen.	Is "Only difference condition" selected for "Output Settings" in "Diagnosis Result file saving setting"?	• Check if a large value is set for the number of rows for switching diagnosis result files. • Check if the save destination folder for the diagnosis result file is correct. • Check if the operating status of Real-time Flow Manager is STOP or if an error occurs in Real-time Flow Manager.
	Is "Fixed cycle output" selected for "Output Settings" in "Diagnosis Result file saving setting"?	• Check if a cycle for switching diagnosis result files is long. • Check if the save destination folder for the diagnosis result file is correct. • Check if the operating status of Real-time Flow Manager is STOP or if an error occurs in Real-time Flow Manager.
	Is "Not output" selected for "Output Settings" in "Diagnosis Result file saving setting"?	Change the output setting for a diagnosis result file.
	Is there enough free space in a disk specified as the save destination?	Secure free space in the disk.
	Can a diagnosis result file be updated?	• Check if the diagnosis result file is being accessed. • Check if the save destination folder for the diagnosis result file is correct.

Symptom	Check item	Corrective action
File output does not stop even if "In suppression" is displayed in "Diagnosis Result File output status (Fixed cycle output)" of the "Execution/Monitoring of Similar Waveform Recognition" screen.	Is "Fixed cycle output" selected for "Output Settings" in "Diagnosis Result file saving setting"?	Change the output setting for a diagnosis result file.
Unable to select a diagnosis result as an execution condition for feedback in Real-time Flow Designer.	Is an item that is desired to set as a feedback condition displayed as output data after acquiring the definition information of response data?	• Check if the definition information of selected response data is correct. • Check if the item is selected in the response data list.
The message "The Reference Waveform Learning Data File may have been damaged." is displayed in the diagnosis operation setting.	Is reference waveform learning data that is used in the diagnosis operation setting correct?	• Set the reference waveform learning data file again. • Re-create the reference waveform learning data file, and set the file again.
The number of saved diagnosis result files exceeds the set upper limit.	Can a diagnosis result file be deleted?	Check if the diagnosis result file is being accessed.
Display language is different from the one that has been set.	Does a user have the access right to the folder in which Real-time Data Analyzer is stored?	Perform the following procedure. ❶Right-click the folder in which Real-time Data Analyzer is stored[*5]. ❷Select [Properties], and click the [Security] tab. ❸Click the [Edit] button. ❹Click the name of a logged in user. ❺ Select the checkbox of "Allow" in "Permissions."
Failed to export settings.	Does a user have the access right to the folder in which Real-time Data Analyzer is stored?	Perform the following procedure. ❶Right-click the folder in which Real-time Data Analyzer is stored[*5]. ❷Select [Properties], and click the [Security] tab. ❸Click the [Edit] button. ❹Click the name of a logged in user. ❺ Select the checkbox of "Allow" in "Permissions."
The message "Failed to import the settings." is displayed when importing settings.	Is the version of Real-time Data Analyzer the latest?	Upgrade Real-time Data Analyzer to the latest version.
An error with code 5604H has occurred in the Real-time Flow Manager diagnosis.	Is the operating status 'Execution ongoing' in the "Execution/Monitoring of Similar Waveform Recognition" screen?	Stop the operation of Similar Waveform Recognition Tool and Real-time Flow Manager. Then, start the operation again in order from Similar Waveform Recognition Tool to Real-time Flow Manager.
	Is a publishing data definition file which was output from a data diagnosis flow different from one to be diagnosed loaded?	Reset the publishing data setting and load the publishing data definition file which was output from the data diagnosis flow to be diagnosed.

*1 The Windows version can be checked by the following procedure.
❶ Press Windows key + R, or start "Run" from "Windows System" in Windows Start.
❷ Enter 'winver' in the "Run" screen.
❸ Check the version in the displayed screen.

*2 The display will be blurred by enlarging.
The following lists the setting values for "Change the size of text, apps, and other items" and the recommended display resolution for each setting value in Windows 10.
Setting value: 100%, display resolution: 1280 × 800 dots or more
Setting value: 125%, display resolution: 2048 × 1536 dots or more
Setting value: 150%, display resolution: 2048 × 1536 dots or more
Setting value: 175%, display resolution: 2880 × 1620 dots or more
Setting value: 200%, display resolution: 2880 × 1620 dots or more
Setting value: 225%, display resolution: 3840 × 2160 dots or more
Setting value: 250%, display resolution: 3840 × 2160 dots or more

*3 The execution file is stored in the folder in which Real-Time Data Analyzer is installed.
The following are examples of storage locations.
(Example) When the installation destination folder is set as the default:
Screen for creating reference waveform learning data: C:\Mitsubishi Electric Edgecross Software\RDA\RWR\StandardWaveDataCreation.exe (☞ Page 62 CREATING REFERENCE WAVEFORM LEARNING DATA)
Home screen, a screen for the publishing data setting, and a screen for the operation setting: C:\Mitsubishi Electric Edgecross Software\RDA\RWR\SimilarWaveRecognitionConfig.exe(☞ Page 33 Home screen, Page 65 PUBLISHING DATA SETTING, Page 68 OPERATION SETTING)
Screen for executing or monitoring the similar waveform recognition: C:\Mitsubishi Electric Edgecross Software\RDA\RWR\SimilarWaveRecognitionMonitor.exe (☞ Page 77 EXECUTION/MONITORING OF SIMILAR WAVEFORM RECOGNITION)

*4 The following are examples of storage locations for the execution file selected when enlarging the display of a screen of License

Manager and the utility for switching language.
(Example) When the installation destination folder is set as the default:
License Manager: C:\Mitsubishi Electric Edgecross Software\License Manager\License Manager.exe
Utility for switching language: C:\Mitsubishi Electric Edgecross Software\RDA\LanguageSwitchingUtility\RDA_LanguageSwitchingUtility.exe

*5 It is stored under the folder specified when installing Real-time Data Analyzer.
The following is an example of a storage location.
(Example) When the installation destination folder is set as the default:
C:\Mitsubishi Electric Edgecross Software\RDA

MEMO

PART 3 Real-time Statistic Diagnosis Tool

This part explains Real-time Statistic Diagnosis Tool.

18 OVERVIEW

Real-time Statistic Diagnosis Tool is an edge application that analyzes and diagnoses data in a CSV file output in Real-time Flow Manager by using a statistical method or multivariate analysis.
The following operations are mainly performed in Real-time Statistic Diagnosis Tool.

- Reading a CSV file and creating the diagnosis roles by analyzing data in the CSV file
- Diagnosing data based on the set rules, and outputting a response data file and reporting an error by displaying a pop-up message when an error is detected.

Precautions

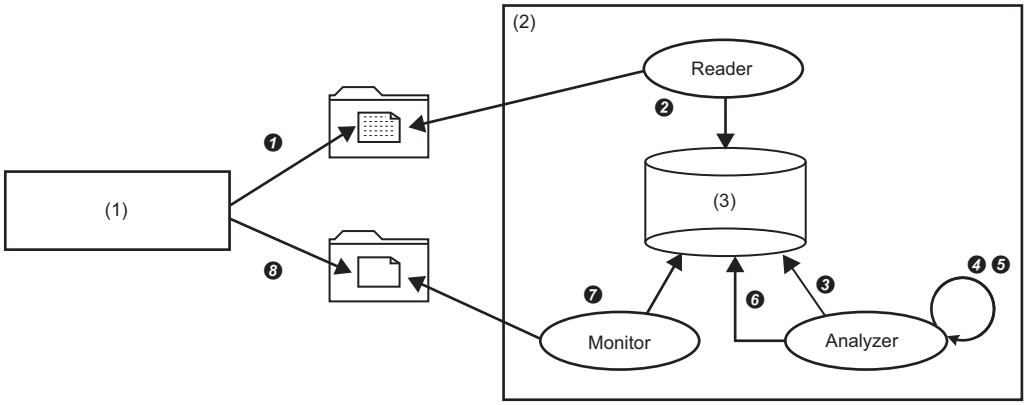
- Do not use any functions and/or menu items that are not mentioned in this manual. If using, please take full responsibility for the operations. (The operations are not guaranteed.)
- When using Real-time Statistic Diagnosis Tool, a mouse and keyboard are required.
- When a numerical value entered in the text box exceeds the maximum value or falls below the minimum value which can be entered, the entered value will be replaced with the maximum or minimum value at the time when the focus moves to another location.
- When an entered value is not fully displayed in the text box, it can be checked by placing the mouse cursor on it. If 256 or more characters (single-byte) are entered, '...' is displayed for the exceeded characters.

18.1 Configuration Software

Real-time Statistic Diagnosis Tool consists of the following software.

Software	Description	Reference
Reader	To read a CSV file output to a specified folder and register it to the internal database.	Page 124 Reader
Analyzer	To analyze and diagnose data registered to the internal database by Reader.	Page 163 Analyzer
Monitor	To diagnose whether an error is detected by Analyzer. After a diagnostic, the detection result is displayed on a screen and the response data file is output.	Page 407 Monitor

The following describes the operation flow of each unit of software when cooperating with Real-time Flow Manager.



(1) Real-time Flow Manager
(2) Real-time Statistic Diagnosis Tool
(3) Internal database

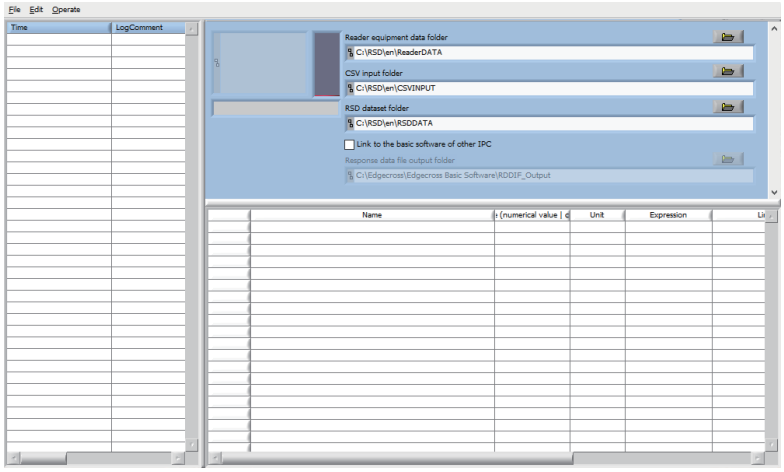
❶ Real-time Flow Manager outputs data collected in a production site to a specified folder as a CSV file.
❷ Reader reads the CSV file and registers it into the internal database of Real-time Statistic Diagnosis Tool.*1
❸ Analyzer references the data registered into the internal database.
❹ A user analyzes the data offline and set collection data to be diagnosed and diagnosis rules by using Analyzer.
❺ Analyzer starts a diagnosis according to the set diagnosis rules.
❻ When an error is detected, Analyzer registers it into the internal database.
❼ Monitor monitors whether Analyzer registers an error into the internal database, then outputs a response data file to a specified folder when the registration of an error is detected.
❽ Real-time Flow Manager checks the output of a response data file and provides feedback when the output is detected.

*1 Data registered into the internal database can regularly be deleted. For details, refer to the following section.
☞ Page 142 Deleting read data

Screen configuration

The following shows the screen configurations of each unit of software.

Reader



For screen items, refer to the following chapter.

☞ Page 124 Reader

■ Menu configuration

Menu item			Description	Reference
File	Select unit definition*1		To select a unit definition.	—
	Variable list export*2		To export the variable list.	Page 151 Exporting the variable list
	Variable list export*2		To import a CSV file exported in the [Variable list export] menu.	Page 151 Importing the variable list
	Switch to CSV reading mode*3		To switch the state in which a CSV file is read automatically.	Page 161 Switching the Operation Mode to CSV File Reading Mode
	Switch to setting edit mode*4		To switch the state in which a CSV file is read automatically to the state in which a unit definition can be edited.	Page 141 Editing Settings
Edit	Restore		Do not use this.	—
	Redoing		Do not use this.	—
Operation	Auto delete data setting	Do not delete it.	To disable the automatic deletion of data.	Page 142 Deleting read data
		2 days to 360 days	To set the number of day for how many days of data to retain when enabling the automatic deletion.	
	Data deletion (manual)	Delete all data	To delete all data.	
	Data interpolation		To interpolate insufficient data or delete extra data when the data interval of a CSV file is larger or smaller than the sampling interval which was set in a unit definition.	Page 143 Interpolating data
	Moving and deleting units		To change the unit order or delete units in a batch.	Page 153 Moving/Batch-deleting units

*1 Displayed when 'Reader equipment data folder' is defined, and enabled to select after a unit definition is added.

*2 Displayed when a unit definition is selected.

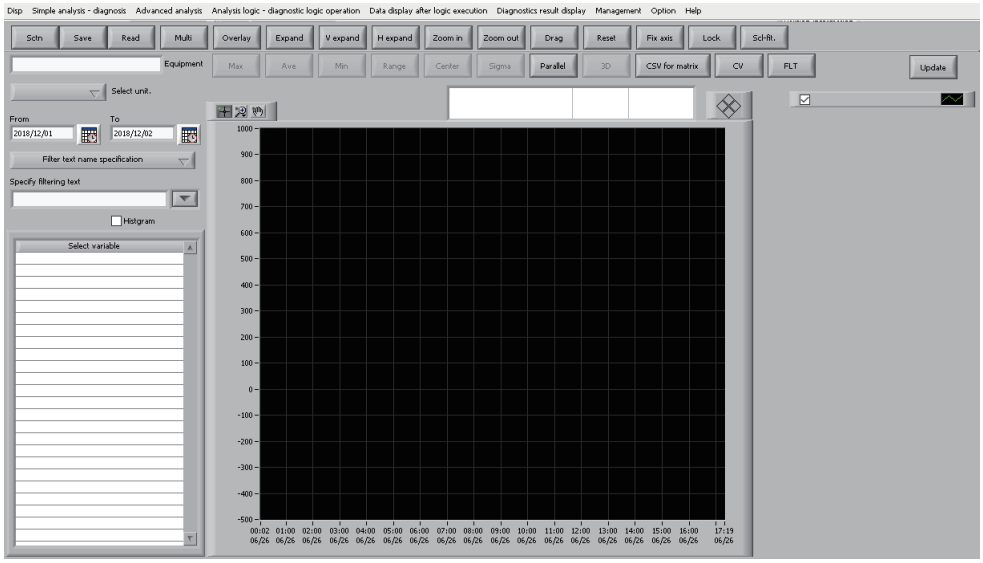
*3 It is displayed in 'setting edit mode'.

☞ Page 141 Editing Settings

*4 It is displayed in 'CSV reading mode'.

☞ Page 161 Switching the Operation Mode to CSV File Reading Mode

Analyzer



For screen items, refer to the following chapter.

☞ Page 163 Analyzer

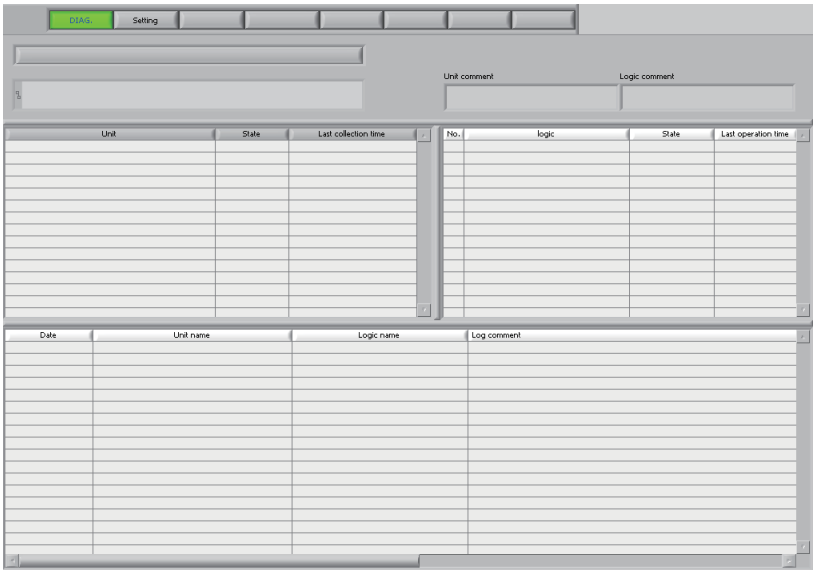
■ Menu configuration

Menu item		Description	Reference
Disp	Read data	To display data saved in a CSV file in a waveform.	Page 164 Displaying Read Data
	Read data statistics	To display the statistic of data saved in a CSV file.	Page 179 Displaying Read Data Statistics
	Read data frequency	To display the frequency of data saved in a CSV file.	Page 182 Displaying Read Data Frequency
Simple analysis - Simple diagnosis	SPC	To diagnose data saved in a CSV file according to the SPC rules.	Page 188 SPC
	MVA	To diagnose the statistic of data saved in a CSV file in multivariate analysis (MVA).	Page 204 Multivariate Analysis (Single Central Value Format)
	Guard band	To create a guard band of data saved in a CSV file and perform a diagnostic.	Page 211 Guard Band Diagnosis
Advanced analysis	Create correlation matrix	To perform a correlation analysis by creating a correlation matrix.	Page 218 Creating Correlation Matrix
	Multiple regression analysis (LMR)	To calculate the correlation among multiple variables and predict the values of variables by multiple regression equation.	Page 238 Multiple Regression Analysis (LMR)
	Maharanobis - Taguchi method (MT)	To monitor the variations based on the correlation of variations between multiple variables.	Page 245 Maharanobis - Taguchi method (MT)
Analysis logic - diagnostic logic operation	Logic editing	To edit an analysis logic and a diagnostic logic operation.	Page 250 Editing Logics
	Logic variable setting	To edit a variable used in an analysis logic and a diagnostic logic.	Page 351 Setting logic variable
Data display after logic execution	Data display after execution (single)	To display the result of a logic performed.	Page 359 Displaying Data after Running
Diagnostics result display	Simple diagnosis result display	To display a result of data which is currently being diagnosed by any method of 'SPC', 'MVA', or 'Guard band'.	Page 368 Displaying a Result of Simple diagnosis
	Diagnostic logic result display	To display a log written by a logic.	Page 376 Displaying a Diagnostic Logic Result
Management	Dataset	To manage data used in Real-time Statistic Diagnosis Tool.	Page 378 Management
Option	Setting	To set the following settings regarding to Real-time Statistic Diagnosis Tool. Setting for data management Setting for waveform display Setting for logics	Page 383 Data Management Setting Page 384 Waveform Display Setting Page 385 Logic Setting

Menu item		Description	Reference
Help	Manual	To start e-Manual Viewer and display the manual.*1	—
	Version Information	To display the version information of Real-time Data Analyzer.	

*1 The English manual appears when the display language of Real-time Data Analyzer is set to Chinese.

Monitor



For screen items, refer to the following chapter.

☞ Page 407 Monitor

19 PROCEDURE TO USE Real-time Statistic Diagnosis Tool

This chapter shows the procedure to perform a diagnosis by using Real-time Statistic Diagnosis Tool and Real-time Flow Manager.
Real-time Statistic Diagnosis Tool can cooperate with Real-time Flow Manager that is installed in another industrial PC.

Operating procedure

1. Output a CSV file to be analyzed in Real-time Flow Manager, and display and analyze data saved in the output CSV file in Real-time Statistic Diagnosis Tool to consider and create diagnosis rules.

☞ Page 113 Data Analysis Setting

2. Output a CSV file to be diagnosed in Real-time Flow Manager, and diagnose data saved in the output CSV file in Real-time Statistic Diagnosis Tool according to the created diagnosis rules.

☞ Page 116 Data Diagnosis Setting

Point

To migrate settings of Real-time Statistic Diagnosis Tool to the tool in another industrial PC, refer to the following:

☞ Page 120 Migrating settings to Real-time Statistic Diagnosis Tool in another industrial PC

19.1 Data Analysis Setting

This section shows the procedure to create a diagnosis rule in Real-time Statistic Diagnosis Tool by using a CSV file output in a data logging flow in Real-time Flow Manager.

Operating procedure

1. Define a folder used in Real-time Statistic Diagnosis Tool by using Reader.

☞ Page 128 Folder Definition

2. Create a data logging flow setting by using Real-time Flow Designer.

☞ Page 114 Creating the data logging flow setting

3. Perform a data logging flow in the created data logging flow setting.

For performing a data logging flow, refer to the following:

Edgecross Basic Software for Windows User's Manual

4. By using Reader, define the format of a CSV file to be read and output a response data definition file.

☞ Page 130 Adding a Unit Definition

5. By using Reader, set the settings to read a CSV file automatically in Real-time Statistic Diagnosis Tool.

☞ Page 161 Switching the Operation Mode to CSV File Reading Mode

6. Display and analyze the read CSV file and create the diagnosis rules by using Analyzer.

☞ Page 163 Analyzer

Creating the data logging flow setting

Create the data logging flow setting by using Real-time Flow Designer.

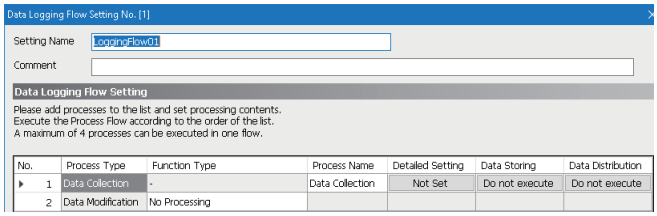
For details on each setting, refer to the following:

Edgecross Basic Software for Windows User's Manual

Operating procedure

1. Start Real-time Flow Designer.
2. Click "Data Logging Flow Setting" in the edit item tree.
3. Click the [Edit] button.

The "Data Logging Flow Setting" screen appears.

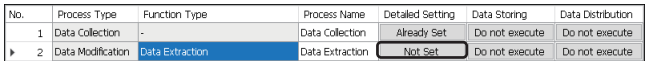


4. Set the setting for data collection.
5. Set the data modification setting as necessary.

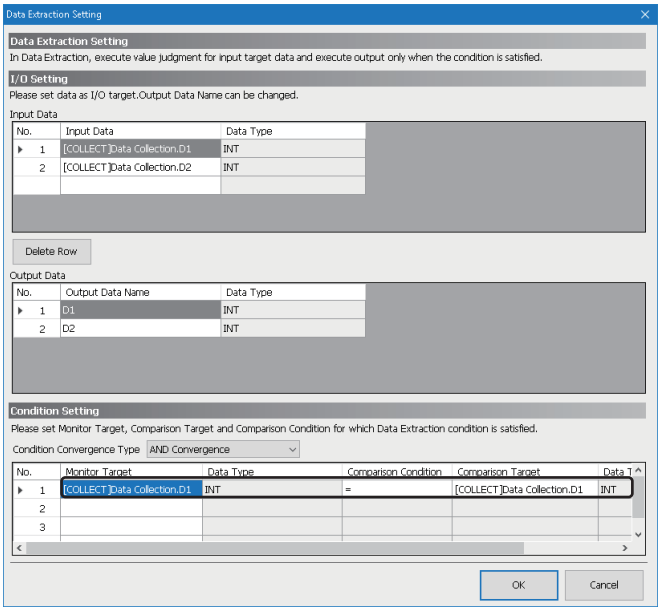
Point

When setting the data modification setting, steps 6 to 8 are unnecessary.

6. Select "Data Extraction" for "Function Type" for data modification, and click the "Detailed Setting" column.



7. Set any of data set for "Input Data" to "Monitor Target" and "Comparison Target", and set "=" for "Comparison Condition".



8. Click the [OK] button.

9. Set the data storing setting for the last data modification process.

The following table shows the considerations for the setting.

Item	Consideration
Executable form	Select "File".
File Format	Select "CSV file (Shift_JIS)".
Output Format	Specify it according to the data type of data to be output as follows: • The data type is UINT, UDINT, or ULINT: Specify "Integer Format".*1 • The data type is REAL or LREAL: Specify "Decimal Format" (set the number of digits after the decimal point up to 7 digits) or "Index Format".
Date and time format	Set any of the following:*2 • YYYY/MM/DD hh:mm:ss.000 ('000' is optional.) • YYYYMMDDhhmmss000 ('000' is optional.)
Save Destination Folder	Set 'UNIT' folder in the CSV input folder defined in the following section. ☞ Page 128 Folder Definition
Prefix of file name	Set a string from 1 to 12 characters or that of 14 or more characters.

*1 When specifying "Hexadecimal Format", it is regarded as a character string in Real-time Statistic Diagnosis Tool.

*2 If date and time data cannot be recognized, it is converted into '1904/01/01 00:00:00' in Real-time Statistic Diagnosis Tool.

19.2 Data Diagnosis Setting

This section shows the procedure to perform a diagnosis according to the diagnosis rule by using a CSV file to be diagnosed that is output in a data diagnosis flow in Real-time Flow Manager.
Real-time Statistic Diagnosis Tool outputs a response data file when an error is detected in a diagnosis.
Real-time Flow Manager detects the output of a response data file and feeds back which is set in Real-time Flow Designer.

Precautions

To cooperate with Real-time Flow Manager that is installed in another industrial PC, set a storage destination folder for a response data file in the industrial PC ((installation destination of Edgecross Basic Software)\Edgecross\Edgecross Basic Software\RDDIF_Output) as a shared folder which can be read and written.

Operating procedure

1. Create a data diagnosis flow setting by using Real-time Flow Designer.
☞ Page 117 Creating the data diagnosis flow setting

2. By using Monitor, set the settings to output a response data file when an error is detected in a diagnosis.
☞ Page 407 Monitor

Point

To cooperate with Real-time Flow Manager that is installed in another industrial PC, specify a response data file output folder by using Reader.
☞ Page 119 Cooperation with Real-time Flow Manager installed in another industrial PC

3. By using Analyzer, start a diagnosis.
☞ Page 163 Analyzer

4. Perform a data diagnosis flow in the created data diagnosis flow setting.
For performing a data diagnosis flow, refer to the following:
📖Edgecross Basic Software for Windows User's Manual

Point

After starting an industrial PC, Real-time Statistic Diagnosis Tool cannot automatically turn into a state in which a diagnosis can be performed. Starting Real-time Statistic Diagnosis Tool and performing 'Switch to CSV file reading mode' in Reader are required. (☞ Page 161 Switching the Operation Mode to CSV File Reading Mode)

Creating the data diagnosis flow setting

Create a data diagnosis flow setting by using Real-time Flow Designer.

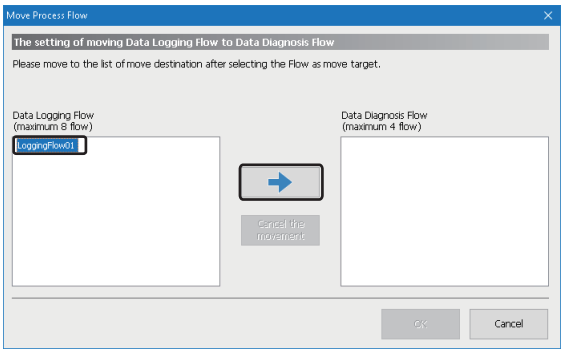
For details on each setting, refer to the following:

📖Edgecross Basic Software for Windows User's Manual

Operating procedure

1. Start Real-time Flow Designer.
2. Click "Data Diagnosis Flow Setting" in the edit item tree of Real-time Flow Designer.
3. Click the [Move from Data Logging Flow] button.

4. Select a flow set in "Data Logging Flow Setting" and click the [⇨] button.

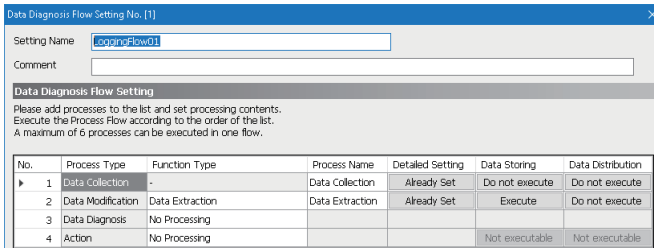


5. Click the [OK] button.

The flow set in "Data Logging Flow Setting" moves to "Data Diagnosis Flow Setting".

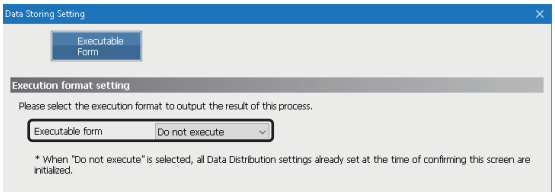
6. Click the [Edit] button.

The "Data Diagnosis Flow Setting" screen appears.



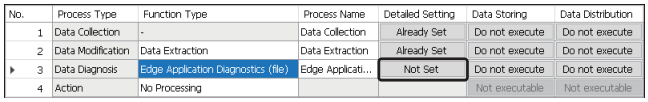
7. Click the "Data Storing" column of the last data modification process.

8. Select "Do not execute" for "Executable form" in the [Executable form] tab.



9. Click the [OK] button.

10. Select "Edge Application Diagnosis (file)" in the "Function Type" column of a data diagnosis, then click the cell of the "Detailed Setting" column.



11. Set the settings for the [Output Data] tab, [Output Option] tab, and [Save File] tab of the edge application diagnosis (file) setting same as the data storing setting set in the following section.

☞ Page 114 Creating the data logging flow setting

12. Click the [Get Response Result Definition] button in the [Response Data] tab of the edge application diagnosis (file) setting to select a response data definition file that is output in the following section.

☞ Page 130 Adding a Unit Definition

13. Click the [OK] button.

14. Set the settings for feedback.

15. Click the [OK] button.

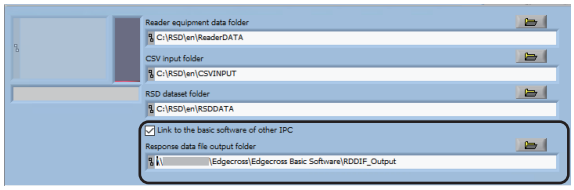
Cooperation with Real-time Flow Manager installed in another industrial PC

To cooperate with Real-time Flow Manager that is installed in another industrial PC, specify a response data file output folder by using Reader.

Operating procedure

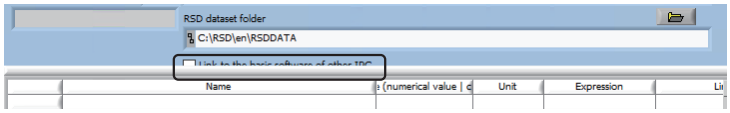
1. Select the checkbox of "Link to the basic software of other IPC."
2. Specify the storage destination folder ((installation destination of Edgecross Basic Software)\Edgecross\Edgecross Basic Software\RDDIF_Output)*1 for a response data file in "Response data file output folder."

*1 Specify a folder path which can be recognized in Windows.



Precautions

- In the following case, the items of "Link to the basic software of other IPC" are displayed behind the variable list as shown below: Real-time Data Analyzer whose version is 1.05F or later is installed in an industrial PC in which the Real-time Data Analyzer whose version is 1.04E or earlier has been installed before.
  If so, adjust the width of the variable list.



- When the capacity of an output destination drive for a response data file is insufficient, the output stops. It will start again when the insufficiency is resolved. (Response data output while the capacity is insufficient is discarded.)
- When setting a folder path in "Response data file output folder," set the path so that the path length of a response data file to be output does not exceed 259 characters. For the name of a response data file, refer to the following:

☞ Page 16 Real-time Statistic Diagnosis Tool

- When the folder set in "Response data file output folder" is changed, restart Analyzer and Monitor.

19.3 Migrating settings to Real-time Statistic Diagnosis Tool in another industrial PC

This section shows the procedure for migrating settings of Real-time Statistic Diagnosis Tool to the tool in another industrial PC.

Exporting and importing a setting file (extension: rsd) is required by using the project file setting utility. (☞ Page 121 Project File Setting Utility)

Operating procedure

1. Perform the following procedure in a migration source industrial PC.

☞ Page 120 Procedure to be performed in a migration source industrial PC

2. Perform the following procedure in a migration destination industrial PC.

☞ Page 120 Procedure to be performed in a migration destination industrial PC

Procedure to be performed in a migration source industrial PC

1. Check that a diagnosis can be performed normally in Real-time Statistic Diagnosis Tool.

2. Start the project file setting utility.

☞ Page 121 Startup method

3. Export a setting file.

☞ Page 122 Export procedure

Procedure to be performed in a migration destination industrial PC

1. Install Real-time Data Analyzer.

This step is not necessary if migrating settings to an industrial PC in which it is already installed.

2. Use the utility for switching language, and set the same language as the display language of the migration source Real-time Data Analyzer.

☞ Page 29 Display Language Switching

3. Start Real-time Statistic Diagnosis Tool.

☞ Page 29 Real-time Statistic Diagnosis Tool

4. Set each folder in Reader according to the environment of the migration destination industrial PC.

☞ Page 128 Folder Definition

5. Start the project file setting utility.

☞ Page 121 Startup method

6. Import the setting file exported in the migration source industrial PC.

☞ Page 123 Import procedure

Point

If the settings of Real-time Statistic Diagnosis Tool have been configured, its current settings will be overwritten by importing a setting file. It is recommended to export the current settings for a backup before importing the file.

7. Select the exported unit for "Switch Pattern" in the dataset settings of Analyzer.

☞ Page 378 Management

19.4 Project File Setting Utility

This section shows the procedure to export and import a setting file by using the project file setting utility.

Startup method

Operating procedure

1. Start Real-time Data Analyzer from "Mitsubishi Electric Edgecross Software" in Windows Start.
2. Double-click 'ProjectFile Utility.'

Point

The display language of the project file setting utility follows the language set in the utility for switching language.

☞ Page 29 Display Language Switching

Considerations

- The display language in Real-time Statistic Diagnosis Tool needs to be the same when exporting and importing a file.
- If file contents had been set in a language different from the one at the time of export, those contents cannot be exported.
- Only the settings stored in 'Reader equipment data folder' or 'RSD dataset folder' can be exported; however, the following settings are not exported.
  Settings for creating a correlation matrix (☞ Page 218 Creating Correlation Matrix)
  Data management settings (☞ Page 383 Data Management Setting)
  Monitor settings (☞ Page 410 Monitor Setting)
- A setting file cannot be exported when the save destination folder for the file saved by clicking any of the following buttons is not 'Reader equipment data folder' or 'RSD dataset folder.' In this case, move the file manually to the migration destination as necessary.

Screen	Button	Reference
Read data display	• [Save] button • [CSV for matrix] button	Page 164 Displaying Read Data
Read data statistics display	• [Save] button • [CSV for matrix] button	Page 179 Displaying Read Data Statistics
Read data frequency display	• [Save] button • [CSV for matrix] button	Page 182 Displaying Read Data Frequency
SPC	• [Save] button • [CSV for matrix] button	Page 188 SPC
Multivariate analysis (single central value format)	• [Save] button • [CSV for matrix] button • [Save criterion.] button	Page 204 Multivariate Analysis (Single Central Value Format)
Guard band diagnosis	• [Save] button • [CSV for matrix] button • [Save GB] button	Page 211 Guard Band Diagnosis

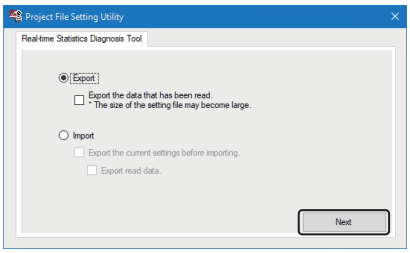
Export procedure

Operating procedure

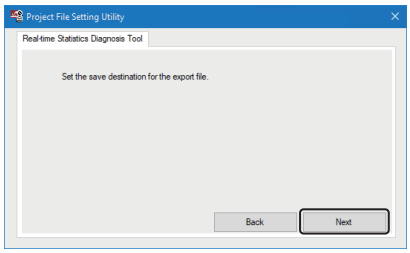
1. Select [Export].
2. To export data that has already been read[*1], select the checkbox of "Export the data that has been read."

*1 If so, unit data can be recovered in the Real-time Statistic Diagnosis Tool to which the setting file is migrated. (☞ Page 158 Recovering unit data)

3. Click the [Next] button.



4. Click the [Next] button.



5. Specify the save destination folder path of the file to be exported to and the file name[*1], then click the [Save] button.

*1 The number of characters that can be specified is as follows:
Folder path: up to 247 characters
File path: up to 259 characters

Point

- File export can be cancelled by clicking the [Cancel] button in the screen displayed while exporting a file.
- Standard space required for export is as follows. (Required space depends on a setting file.)
  (Size of 'Reader equipment data folder' + size of 'RSD dataset folder') × 2

Import procedure

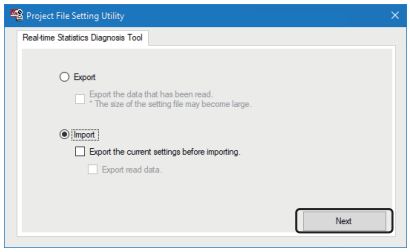
Operating procedure

1. Select [Import].
2. To export the current Real-time Statistic Diagnosis Tool settings before import, select the checkbox of "Export the current settings before importing."

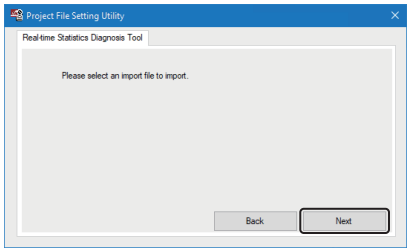
To export data that has already been read as well[*1], select the checkbox of "Export read data."

*1 If so, unit data can be recovered in the Real-time Statistic Diagnosis Tool to which the setting file is migrated. (☞ Page 158 Recovering unit data)

3. Click the [Next] button.



4. Click the [Next] button.



5. Select the setting file to be imported[*1], then click the [Open] button.

*1 The number of characters that can be specified is as follows:
Folder path: up to 247 characters
File path: up to 259 characters

6. When selecting the checkbox of "Export the current settings before importing.," perform steps 4 and 5.

☞ Page 122 Export procedure

Point

- When performing step 6, a setting file is imported after exported.
- File export or import can be cancelled by clicking the [Cancel] button in the screen displayed while exporting/importing a file; however, note that it may take time to roll back the settings when cancelling the import.
- Standard space required for export is as follows. (Required space depends on a setting file.)
  (Size of 'Reader equipment data folder' + size of 'RSD dataset folder') × 2
- Standard space required for import is as follows. (Required space depends on a setting file.)
  (Size of an import target setting file × 9) + (size of 'Reader equipment data folder' + size of 'RSD dataset folder') × 2

20 Reader

This software reads a CSV file that was output to a specified folder.
The following shows the operating procedure of Reader.

Operating procedure

1. Define a folder used in Reader.

☞ Page 128 Folder Definition

2. Add a definition of a CSV file to be read.

☞ Page 130 Adding a Unit Definition

3. Edit a setting.

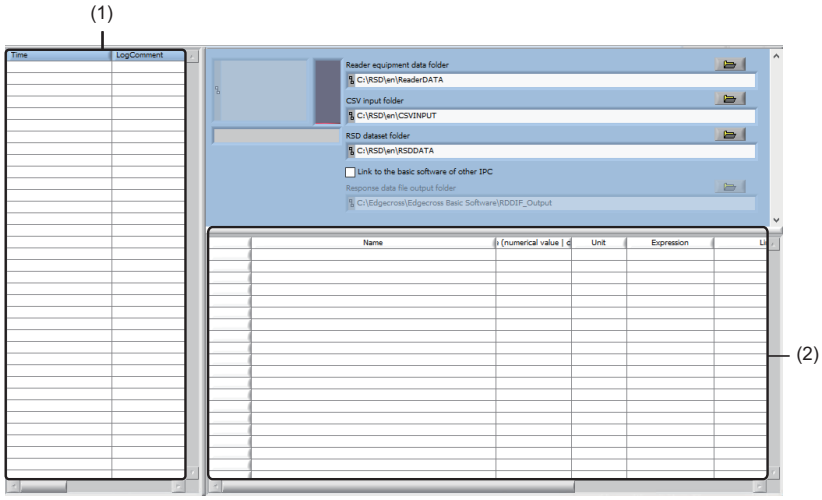
☞ Page 141 Editing Settings

4. Switch the status to the one for reading a CSV file automatically.

☞ Page 161 Switching the Operation Mode to CSV File Reading Mode

20.1 Screen Configuration

The following shows the screen configuration of Reader.



Displayed items

Item		Description
(1) Log list	Time	A time when a log is output is displayed.
	LogComment	An output log is displayed. For details on a log, refer to the following: ☞ Page 126 Log list displayed in LogComment
Reader equipment data folder*1		Specify the path of a folder storing the settings, data, and others for Reader (up to 256 characters).
CSV input folder*1		Specify the path of a folder storing a CSV file to read in Reader (up to 256 characters).
RSD dataset folder*1		Specify the path of a folder storing the settings and data for Analyzer, data to diagnose in Monitor, and others (up to 256 characters).
Link to the basic software of other IPC		Select this checkbox to cooperate with Real-time Flow Manager that is installed in another industrial PC.
Response data file output folder*1,*2		Specify the folder to store a response data file ((installation destination of Edgecross Basic Software)\Edgecross\Edgecross Basic Software\RDDIF_Output).
(2) Variable list	Name	A variable name is displayed. It can be changed when performing 'Switch to setting edit mode'. ☞ Page 159 Changing a variable name
	Type (numerical value | char)	The data type of a variable is displayed. • String: Text variable. Text data which changes in each section and can be used for filtering sections to display. • Numeric: Trace variable. Numerical value data which changes continuously. • varn: Step variable. Data which does not change continuously and can be used to extract sections. The data type can be changed when performing 'Switch to setting edit mode'. ☞ Page 159 Changing a data type
	Unit	Do not use this.
	Expression	An operational expression can be entered when performing 'Switch to setting edit mode'. The operation result can be used as data in Analyzer. ☞ Page 160 Entering an operational expression
	Limit pair diagnostics	Do not use this.

*1 Do not specify a folder with the encryption attribute enabled.

*2 It can be specified only when the checkbox of "Link to the basic software of other IPC" is selected.

Log list displayed in LogComment

The following table shows the contents displayed in the "LogComment" column.

Item	Description
File was read.	Displayed when CSV data was read successfully.
File was read. (There is an interpolation)	Displayed when CSV data was read successfully and interpolated.
Failed to read file.*1	Displayed when CSV data stored in the CSV input folder was deleted while the data was being read and in other cases.
Because the time stamp that overlapped with existing data existed, data was not updated.	Displayed when CSV data with the time stamp duplicate with or earlier than that of already-read CSV data was added. CSV Data is saved in the following folder under 'Reader equipment data folder'. • Reader_UNIT\YYMMDD\Original\Invalid ('YYMMDD' indicates the current date.)
It became invalid because it was an undefined file.	Displayed when a CSV file which was not specified in the unit definition was read. When this log is displayed, the invalid file is saved in the following folder under 'Reader equipment data folder'. • Reader_UNIT\YYMMDD\Original\Invalid ('YYMMDD' indicates the current date.)
While editing	Displayed when the change of the unit setting was started in the setting edit mode.
Content of the edit was saved.	Displayed when the [Save change] button was clicked.
Edit was canceled.	Displayed when the [Cancel] button was clicked.
Delete unit data - (YYmmss) Start	Displayed when a deletion of the latest unit data specified in the unit data deletion operation was started.
Delete unit data - (YYmmss) End	Displayed when a deletion of the latest unit data specified in the unit data deletion operation was ended.
Delete unit data - Start	Displayed when a deletion of all unit data specified in the unit data deletion operation was started.
Delete unit data - End	Displayed when a deletion of all unit data specified in the unit data deletion operation was ended.
Unit data recovery - Start	Displayed when unit data recovery was specified.
Unit data recovery - Original CSV files have been moved into loading folder.	Displayed when unit data recovery was specified and the recovery data was stored in 'CSV input folder'.
Delete data - Delete all data - Start	Displayed when a manual deletion of all data was started.
Delete data - Delete all data - Finish	Displayed when a manual deletion of all data was ended.
Delete data - YYmmdd Auto	Displayed when data was deleted automatically according to the automatic data deletion setting.
It became invalid because sampling interval of CSV file is incorrect.	Displayed when the difference between the sampling interval which is set in the unit definition and that of the CSV file to be read is large. When this log is displayed, the invalid file is saved in the following folder under 'Reader equipment data folder'. • Reader_UNIT\YYMMDD\Original\Invalid ('YYMMDD' indicates the current date.)

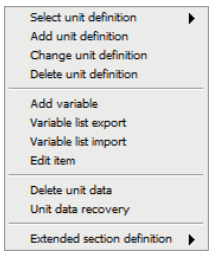
*1 If reading CSV file data fails, the data is discarded.

20.2 Right-click Menu Items

This section shows the right-click menus.

Right-clicking on the variable list

Window



Displayed items

Item		Description
Select unit definition		To select a unit definition.
Add unit definition		To add a unit definition.
Change unit definition		To change a unit definition.
Delete unit definition		To delete a unit definition that is added last.
Add variable		To add the variables of a unit added in 'Adding a Unit Definition.'
Variable list export		To export the variable list.
Variable list import		To import a CSV file exported in 'Exporting the variable list.'
Edit item	—	To edit items in the variable list such as a name, type (numerical value | character), and operation expression.
	String	To change the current type (numerical value | character).
	Numeric	
	varn	
Delete unit data		To delete read data for each unit.
Unit data recovery		To re-read all backup data of a CSV file.
Extended section definition	Add section definition	To define an extended section.

20.3 Folder Definition

The following table shows the folder definitions used in Reader.

Item	Description
Reader equipment data folder*1	Folder storing the settings, data, and others for Reader
CSV input folder*1	Folder storing a CSV file to be read in Reader
RSD dataset folder	Folder storing the settings and data for Analyzer, data to be diagnosed in Monitor, and others

*1 To cooperate with Real-time Flow Manager that is installed in another industrial PC, refer to the following:
☞ Page 129 Cooperation with Real-time Flow Manager installed in another industrial PC

Operating procedure

1. Specify folder paths for "Reader equipment data folder", "CSV input folder", and "RSD dataset folder" (up to 256 characters).

The paths of the folders which are created when Real-time Data Analyzer is installed are set for each field as the default. Any paths can be set but the default paths are preferred under normal use.

2. Select [File] ⇨ [Switch to CSV file reading mode].

Subfolders necessary for operation of Real-time Statistic Diagnosis Tool are created in a specified folder.

Point

By storing a CSV file which is output by Real-time Flow Manager into the 'UNIT' folder under 'CSV input folder', Reader can read the file automatically.

Precautions

- For "Reader equipment data folder" and "RSD dataset folder," only files in local storage (built-in storage or eternal media) can be specified. Folders on a network or shared folder cannot be specified.
- When specifying an external media for "Reader equipment data folder" or "RSD dataset folder," format the media in NTFS format.

For checking if the media is formatted in NTFS format, follow the procedure below:

❶Right-click a target drive and select [Property].

❷Check that "NTFS" is set for "filesys."

- Do not change the drive letter (D→E, for example) after starting a diagnosis. When the letter needs to be changed, set the diagnosis rules again after changing the letter.
- For "Reader equipment data folder," "CSV input folder," "RSD dataset folder," and "Response data file output folder," do not specify a folder and subfolders that are already set in another item or a folder with the encryption attribute enabled.
- When the path set in "Reader equipment data folder," "CSV input folder," or "RSD dataset folder" is changed, restart Analyzer and Monitor.
- When installing over Real-time Data Analyzer or updating it, the folders specified by a user before the overwrite installation or update will be set for "Reader equipment data folder," "CSV input folder," and "RSD dataset folder."
- When setting a folder path in "CSV input folder," set the path so that the path length of a file to be stored in the 'UNIT' folder under 'CSV input folder' does not exceed 259 characters.

- When setting a folder path in "Reader equipment data folder" and "RSD dataset folder," set the path so that the path length of a setting file to be created in the set folder does not exceed 259 characters. The maximum path length of a setting file to be created in the set folder is as follows:

Item	Maximum path length of a setting file
Reader equipment data folder	(Folder set in the item shown left)\ + 100 characters (If the unit name and diagnosis target variable name are 32 characters long each)
RSD dataset folder	(Folder set in the item shown left)\ + 187 characters (If the unit name and diagnosis target variable name are 32 characters long each)

Cooperation with Real-time Flow Manager installed in another industrial PC

To cooperate with Real-time Flow Manager that is installed in another industrial PC, set "CSV input folder" and "Reader equipment data folder" as follows.

- CSV input folder: Specify a shared folder[*1], which can be read and written, on an industrial PC in which Real-time Flow Manager is installed.

*1 Specify a folder path which can be recognized in Windows.

- Reader equipment data folder: Specify a folder that can be referred from an industrial PC in which Real-time Flow Manager is installed.

Precautions

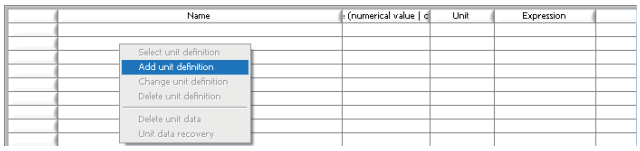
- The processing time may take longer than when cooperating with Real-time Flow Manager installed in a same industrial PC since detection of a read target CSV file requires time.
- If a read target CSV file became undetectable due to the network disconnection, the read operation will start again when the network recovers. However, it may take time depending on the operation environment.

20.4 Adding a Unit Definition

This section shows the operating procedure for specifying a sample CSV file, defining the CSV file to be read in Reader (unit definition), and outputting a response data definition file.
A unit needs to be defined for each process flow defined in Real-time Flow Manager.
Reader extracts a section (unit section) from CSV files and reads the data within the section.

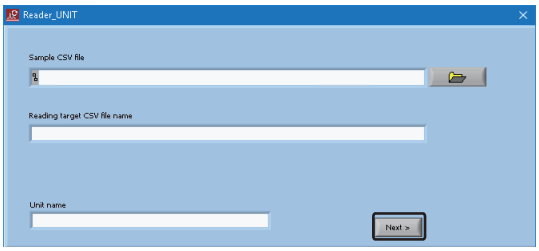
Operating procedure

1. Select [File] ⇨ [Switch to setting edit mode].
2. Click the [Yes.] button.
3. Right-click on the variable list, and select [Add unit definition].



4. Set each item for a sample CSV file and click the [Next] button.

For the considerations for the setting, refer to the following:
☞ Page 135 Considerations for setting a sample CSV file



Item	Description
Sample CSV file*1	Specify the path of a CSV file in the same format as a CSV file to be read in Reader (up to 256 characters).
Reading target CSV file name*2,*3	Specify the name of a CSV file to be read in Reader by using the wild card (*) (up to 256 characters).
Unit name*4	Enter the same character string as that set for "File Name Prefix" in the data storing setting (file saving) in Real-time Flow Designer (up to 32 characters). 📖Edgecross Basic Software for Windows User's Manual

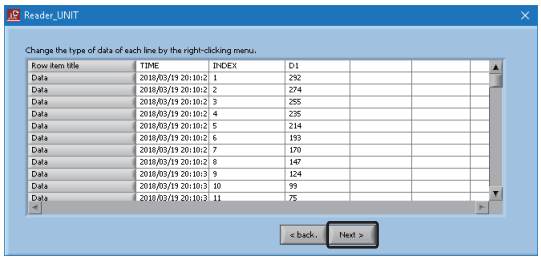
*1 A file in a folder with the encryption attribute enabled cannot be specified.
2 When the name format of a CSV file to be read is 'LOG001_NNNNNNNN.csv', specify it as 'LOG001.csv'.
3 '' (asterisk) is used as a wild card indicating any 0 or more characters.
*4 It is automatically set according to the file name set for "Reading target CSV file name". At the time, unavailable characters for a unit name are removed. Modify the unit name as necessary.
For unavailable characters for a unit name, refer to the following:
☞ Page 427 Real-time Statistic Diagnosis Tool

5. Change the type of data for each row as necessary, and click the [Next] button.*1

*1 For a CSV file output in Real-time Flow Manager, changing the type is not necessary since it is set automatically.

For the considerations on changing the data type, refer to the following:

☞ Page 135 Considerations for setting a type



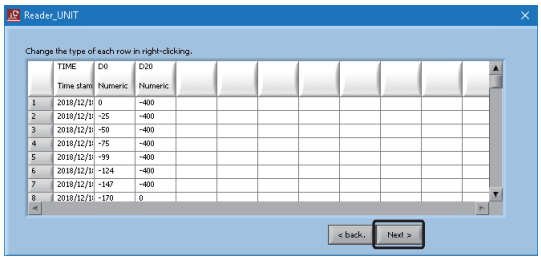
Point

- By clicking a row header (leftmost column), the type of data on the clicked row can be changed. (It can be changed only to "Row item title," "Data," or "Unused.")
- For the first row, the type of data is set to "Row item title" by default. If the type for the first row in the CSV file to be read is not "Row item title," change it.
- For the "Row item title" row, specify the row where the title of each column (variable name) is described.
- Only one row can be specified as "Row item title."

6. Change the data type of data for each column as necessary, and click the [Next] button.

For the considerations for changing column items, refer to the following:

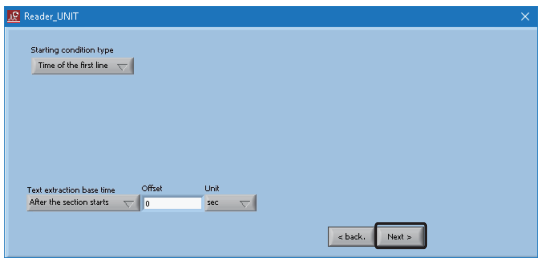
☞ Page 135 Considerations for the settings of column items



Point

- By clicking a column header (top row), the attribute of data on the clicked column can be changed.
- Time stamps are displayed in the first column by default. Change the attribute if the first column of a CSV file to read is not for time stamps.
- Only one time stamp column is necessary.
- Up to 5000 column items (variables) can be defined for a CSV file.

7. Set each item for the start row of data reading and click the [Next] button.



Item	Description
Starting condition type	Set the data extraction setting (start row). For details on the setting, refer to the following: ☞ Page 136 Section start conditions
Text extraction base time	Select the time to extract a text variable value either "After the section starts" or "Before end of section". Set this when setting a value other than that of the first record as a text variable value. ☞ Page 138 Extraction setting of a text variable value for one section
Offset	Set an offset from the time set for "Text extraction base time". Set a positive value when "After the section starts" is selected for "Text extraction base time" and a negative value when "Before end of section" is selected. ☞ Page 138 Extraction setting of a text variable value for one section • When "sec" is selected for "Unit", set this in the range from -86399.9999 to 86399.9999. • When "%" is selected for "Unit", set this in the range from 0 to 100.
Unit	Select either "sec" (second) or "%" for the offset unit. ("%" is for the section length.)

Point

The section start is registered in "Dataset" as an event (time stamp of the occurrence time) with the following name:

• (Unit name)_Start

Events can be used in particular primitives defined in 'Logic editing'.

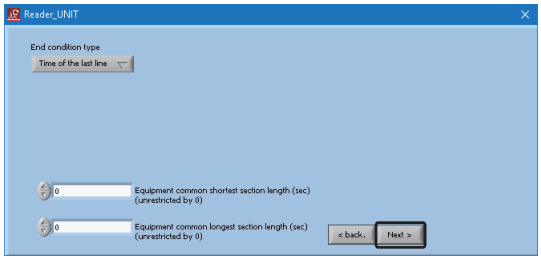
☞ Page 250 Editing Logics

For details on datasets, refer to the following:

☞ Page 378 Management

8. Set each item for the end row of data reading and click the [Next] button.

☞ Page 135 Considerations for setting "End condition type"



Item	Description
End condition type	Set the data extraction setting (end row). For details on the setting, refer to the following: ☞ Page 139 Section end conditions
Equipment common shortest section length (sec)	Set the shortest section length in seconds (0.0000 to 2147483647.0000). If the section end condition is satisfied before the specified length is reached, the section is discarded.
Equipment common longest section length (sec)	Set the longest section length in seconds (0.0000 to 2147483647.0000). If the section end condition is not satisfied when the specified length is reached, the section is discarded.

Point

The section end is registered in "Dataset" as an event (time stamp of the occurrence time) with the following name:

• (Unit name)_End

Events can be used in particular primitives defined in 'Logic editing'.

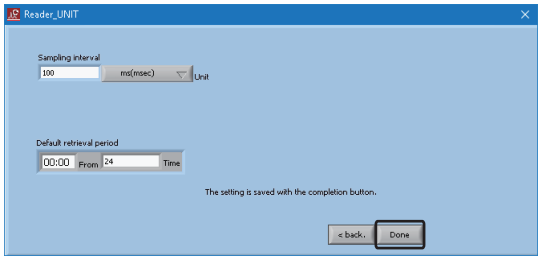
☞ Page 250 Editing Logics

For details on datasets, refer to the following:

☞ Page 378 Management

9. Set each item for sampling interval and click the [Next] button.

☞ Page 135 Considerations for setting sampling interval



Item	Description
Sampling interval	Set the data sampling interval of a CSV file. Set a value and a unit (seconds, milliseconds, or microseconds). • Setting range for 'seconds': 1 to 86400 • Setting range for 'milliseconds': 1 to 86400000 • Setting range for 'microseconds': 1 to 1000000000
Default retrieval period	Set the default display period in the fields of "From" and "To" in each operation screen of the following functions. ☞ Page 164 Displaying Read Data ☞ Page 179 Displaying Read Data Statistics ☞ Page 182 Displaying Read Data Frequency ☞ Page 188 SPC ☞ Page 204 Multivariate Analysis (Single Central Value Format) ☞ Page 211 Guard Band Diagnosis When changing a value in "From", the date and time in "To" is automatically set (0 to 4294967295) by adding the time which is set in this option to the value in "From".

Point

Data interpolation can be performed when data sampled at different intervals are contained.

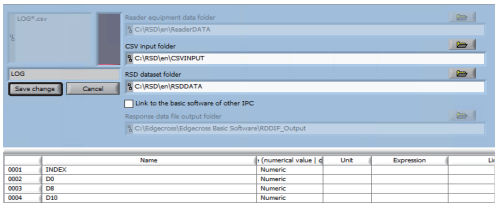
☞ Page 143 Interpolating data

10. Click the [Save change] button.

A response data definition file ((unit name)_DATATYPE.csv) is created in the following folder when clicking the [Save change] button.

• (Folder set in "Reader equipment data folder")\DATATYPE*1

*1 If there is no DATATYPE folder, it will be created at the same time when a response data definition file is created.



11. Click the [Yes.] button.

The set unit definition is saved.

12. Repeat the above procedure to add another unit definition if any.

Point

- To discard the set unit definition, click the [Cancel] button.
- Up to 99 unit definitions can be added.

Restriction

The following restrictions apply when reading a CSV file the data sampling interval of which is set in microseconds or nanoseconds.

- Data in nanoseconds cannot be read.
- In the [Analysis logic - diagnostic logic operation] or [Data display after logic execution] menus of Analyzer, data in less than milliseconds cannot be used.
- In the [Disp] or [Simple analysis - Simple diagnosis] menus of Analyzer, data in microseconds or more can be used, but it is rounded off to milliseconds on the display.

Precautions

■ Considerations for setting a sample CSV file

- A read-only file cannot be specified as a sample CSV file.
- The CSV file format cannot be set if the file is exclusively controlled such as being opened in a different tool and cannot be written.
- The same name as an existing unit already registered cannot be defined.
- Do not rename a unit after it has been defined and data has been acquired. If it is renamed, the unit data acquired before renaming can no longer be referred by Analyzer.

■ Considerations for setting a type

- A file including variables whose names are duplicated cannot be specified as a sample CSV file.
- The following characters cannot be used in a variable name:
  \ (0x5C), / (0x2F), : (0x3A), * (0x2A), ? (0x3F), " (0x22), < (0x3C), > (0x3E), | (0x7C)
  ￥ (0x818f), ／ (0x815e), ： (0x8146), ＊ (0x8196), ？ (0x8148), ” (0x8168), ＜ (0x8183), ＞ (0x8184), ｜ (0x8162)

■ Considerations for the settings of column items

- For reading a column item which was set to "Unused", add the item to the last column of the CSV file and define that file again.
- A new "Unused" column item cannot be set in version 1.08J or later since "Unused" is no longer displayed in the right-click menu for the column header. The column items that were set to "Unused" in version 1.07F or earlier are displayed as "Unused"; however, the setting cannot be changed since the right-click menu is not displayed.

■ Considerations for setting "End condition type"

- Set the section length to at least one second or longer. Otherwise, the data in the created section cannot be used correctly.

■ Considerations for setting sampling interval

- In "Sampling interval", the average sampling interval of a sample CSV file is displayed as the default. Modify it according to the actual sampling interval as necessary.
- Do not set the sampling interval to a value which is greatly differs from the actual sampling interval. Otherwise, an error may occur and Real-time Statistic Diagnosis Tool may not work properly.
- Set the sampling interval of a CSV file as constant as possible.
- When the sampling intervals of a CSV file vary, set the average of the actual sampling interval in "Sampling interval".
- Set the section length to shorter than one day (86400 seconds). If a single section spans one day or longer, data in this section cannot be used in Analyzer.

Section start conditions

The following three conditions are available for the start of a unit section and an extended section.

Precautions

When the start condition is satisfied multiple times before the end condition is satisfied, the last satisfied start condition is used.

■ When setting the section start time to the time of the time stamp at the first row

Operating procedure

1. Select "Time of the first line" for "Starting condition type".

For an extended section, "Offset (sec)" can also be specified.

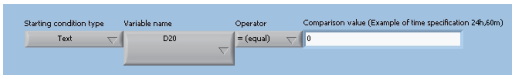
2. The section start position is set to the first row of the CSV file.

■ When setting the section start time to the timing that a text matches, mismatches, or changes to another value

Operating procedure

1. Select "Text" for "Starting condition type".
2. Select a variable for "Variable name". An option the data type of which is "Text" can be selected.
3. Select "= (equal)", "!= (not equal)", or "Changing point" for "Operator".
4. Enter a text to compare in "Comparison value" (up to 32 characters).

For an extended section, "Offset (sec)" can also be specified.



5. The section start position of each option is shown below.

• "=(equal)":

Row where there is a text which matches the text entered in "Comparison value"

• "!=(not equal)":

Row where there is no text which matches the text entered in "Comparison value"

• "Changing point":

Row where the text changes to another one

Point

- When not setting a text as a condition, it is not necessary to enter a text in "Comparison value".
- To set multiple texts with OR condition, enter the values delimited by a comma in "Comparison value".
- When "Changing point" is selected, the section(s) until the current text is changed to another is discarded.
- A wild card (* or ?) can be entered in "Comparison value".
  The wild card '*' represents two or more characters and '?' represents a single character.

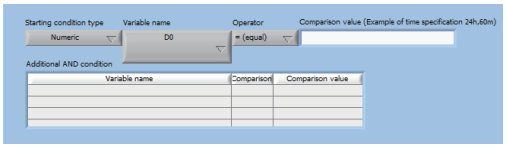
■ When setting the section start time to the timing that a numerical value matches, mismatches, exceeds or falls below the threshold

The section start position of each option is shown below.

Operating procedure

1. Select "Numeric" for "Starting condition type".
2. Select a variable for "Variable name". An option the data type of which is "Numeric" can be selected.
3. Select "= (equal)", "!= (not equal)", "UP(Less than TO greater than or equal)", or "DOWN(Greater than TO less than or equal)" for "Operator".
4. Enter a value to compare in "Comparison value" (up to 32 characters).
5. To add a condition, enter it in "Additional AND condition".

For an extended section, "Offset (sec)" can also be specified.



6. The section start position of each option is shown below.

• "=(equal)":

Row where there is a variable value which matches the value entered in "Comparison value"

• "!=(not equal)":

Row where there is no variable value which matches the value entered in "Comparison value"

• "UP(Less than TO greater than or equal)":

Row where a variable value exceeds the value entered in "Comparison value"

• "DOWN(Greater than TO less than or equal)":

Row where a variable value falls below the value entered in "Comparison value"

Point

- To set multiple numerical values with OR condition, enter the values delimited by a comma in "Comparison value".
- Up to three conditions can be added.

Precautions

For "!= (not equal)", when the set variable changes in a section, the time of the last change is set as the section start time.

Extraction setting of a text variable value for one section

Regardless of how many values are included in a section, only one value can be retained as a text variable value in one section.

By default, the value of the first record in a section is used as a text variable value. However, another value can be used by setting each item of "Text extraction base time" and "Offset".

(1)

(a)

2017/7/1 3:00:00	A	101
2017/7/1 3:00:02	B	102
2017/7/1 3:00:04	C	103
2017/7/1 3:00:06	C	104
2017/7/1 3:00:08	C	105
2017/7/1 3:00:10	C	106

(2)

(b)

2017/7/1 3:00:00	A	101
2017/7/1 3:00:02	B	102
2017/7/1 3:00:04	C	103
2017/7/1 3:00:06	C	104
2017/7/1 3:00:08	C	105
2017/7/1 3:00:10	C	106

(1) When "Text extraction base time" is set to "After the section starts"
(2) When "Text extraction base time" is set to "Before end of section"
(a) Offset from the start row (A positive value is set for "Offset".)
(b) Offset from the end row (A negative value is set for "Offset".)

Precautions

When the following settings are set and if no data is recorded at the time corresponding to the content set for "Offset", a text variable value will not be set.

- "Text extraction base time" is set to "After the section starts" and a negative value is set for "Offset".
- "Text extraction base time" is set to "Before end of section" and a positive value is set for "Offset".

Section end conditions

The following four conditions are available for the end of a unit section and an extended section.

■ When setting the section end time to the time of the time stamp at the last row

Operating procedure

1. Select "Time of the last line" for "End condition type".

For an extended section, "Offset (sec)" can also be specified (negative value only).

2. The section end position is set to the last row of the CSV file.

■ When setting the section end time to the timing that a text matches, mismatches, or changes to another value

Operating procedure

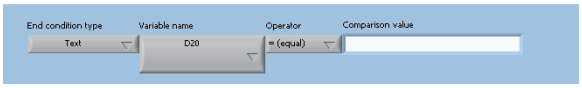
1. Select "Text" for "End condition type".

2. Select a variable for "Variable name". An option the data type of which is "Text" can be selected.

3. Select "= (equal)", "!= (not equal)", or "Changing point" for "Operator".

4. Enter a text to compare in "Comparison value" (up to 32 characters).

For an extended section, "Offset (sec)" can also be specified (negative value only).



5. The section end position of each option is shown below.

• "=(equal)":

Row where there is a text which matches the text entered in "Comparison value"

• "!=(not equal)":

Row where there is no text which matches the text entered in "Comparison value"

• "Changing point":

Row where the text changes to another one

Point

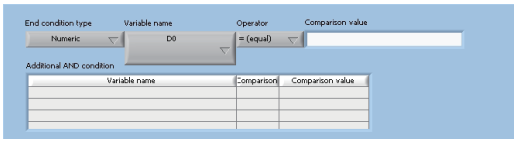
- When not setting a text as a condition, it is not necessary to enter a text in "Comparison value".
- To set multiple texts with OR condition, enter the values delimited by a comma in "Comparison value".
- A wild card (* or ?) can be entered in "Comparison value".
  The wild card '*' represents two or more characters and '?' represents a single character.

■ When setting the section end time to the timing that a numerical value matches, mismatches, exceeds or falls below the threshold

Operating procedure

1. Select "Numeric" for "End condition type".
2. Select a variable for "Variable name". An option the data type of which is "Numeric" can be selected.
3. Select "= (equal)", "!= (not equal)", "UP(Less than TO greater than or equal)", or "DOWN(Greater than TO less than or equal)" for "Operator".
4. Enter a value to compare in "Comparison value" (up to 32 characters).
5. To add a condition, enter it in "Additional AND condition".

For an extended section, "Offset (sec)" can also be specified (negative value only).



6. The section end position of each option is shown below.

• "=(equal)":

Row where there is a variable value which matches the value entered in "Comparison value"

• "!=(not equal)":

Row where there is no variable value which matches the value entered in "Comparison value"

• "UP(Less than TO greater than or equal)":

Row where a variable value exceeds the value entered in "Comparison value"

• "DOWN(Greater than TO less than or equal)":

Row where a variable value falls below the value entered in "Comparison value"

Point

- To set multiple numerical values with OR condition, enter the values delimited by a comma in "Comparison value".
- Up to three conditions can be added.

Precautions

When setting "= (equal)" for "Operator" and '0' for "Comparison value", the time corresponding to the last row of the CSV file is set as the section end time.

■ When setting the section end time to the timing that the next section starts

Operating procedure

1. Select "Until the start of the next section" for "End condition type".
2. The first row of the next section is set to the end position of the current section.

20.5 Editing Settings

Settings can be edited as necessary.

The following table shows the available operations.

Item	Description	Reference
Deleting read data	To delete the data in a read CSV file.	Page 142 Deleting read data
Interpolating data	To interpolate insufficient data or delete extra data when the data interval of a CSV file is larger or smaller than the sampling interval which was set in a unit definition.	Page 143 Interpolating data
Changing a unit definition	To change a unit setting.	Page 145 Changing a unit definition
Deleting a unit definition	To delete the last added unit.	Page 146 Deleting a unit definition
Adding variables	To add the variables of a unit added in 'Adding a Unit Definition.'	Page 147 Adding variables
Exporting the variable list	To export the variable list for modifying it significantly.	Page 151 Exporting the variable list
Importing the variable list	To import a CSV file which was exported by using the [Variable list export] menu.	Page 151 Importing the variable list
Deleting unit data	To delete read data for each unit.	Page 152 Deleting unit data
Moving/Batch-deleting units	To change the unit order or delete units in a batch.	Page 153 Moving/Batch-deleting units
Defining an extended section	To register the extraction method of a different section for a CSV file for which a section definition is set at a unit definition.	Page 154 Defining an extended section
Recovering unit data	To re-read all backup data of read CSV file.	Page 158 Recovering unit data
Changing a variable name	To change a variable name.	Page 159 Changing a variable name
Changing a data type	To change the data type of a variable.	Page 159 Changing a data type
Entering an operational expression	To enter an operational equation and use the operation result in Analyzer.	Page 160 Entering an operational expression

Deleting read data

To prevent read CSV file data from occupying too much disk space, delete the CSV file data registered into the internal database automatically or manually.
Files in the folders set for "Reader equipment data folder" and "RSD dataset folder" can be deleted.

■ Deleting data automatically

Operating procedure

1. Select [Operation] ⇨ [Auto delete data setting]. Select the number of days to store data in the internal database from [2 days] to [360 days].

To set not to delete data automatically, select [Do not delete it.].

Precautions

- Note that the number of days is not the number of calendar days.
- When a new CSV file is read after 00:00:00, all files of which the storage period has expired are deleted.

Ex.
When "2 days" is selected and the following files are stored:
File (2017/01/02)
File (2017/01/09)
File (2017/01/17)
File (2017/01/23)
When a new CSV file is read at 2017/1/30 00:00:01, the files dated 2017/01/02 and 2017/01/09 are deleted.

- When a section spans more than one day, the data is used as one with the time stamp of the last date in the section.

Ex.
When the date of data in a section is from 2017/01/11 23:50:00 to 2017/01/12 00:10:00, it is used as the data on 2017/01/12.
The start date of the section is 2017/01/11, but the data is excluded when the deletion of other data dated 2017/01/11.

■ Deleting data manually

Operating procedure

1. Select [Operation] ⇨ [Data deletion (manual)] ⇨ [Delete all data].

Precautions

- By using the [Delete all data] menu, data of not only the selected unit but also all units is deleted.
- End Analyzer and Monitor before using the [Delete all data] menu.

Interpolating data

By setting the data interpolation, when the data interval of a CSV file is larger or smaller than the value which is set for "Sampling interval" in a unit definition, insufficient data can be interpolated or extra data can be deleted.

Data interpolation (nearest neighbor interpolation*1) or deletion is performed based on the value calculated as 'Length (time) of one section ÷ Sampling interval'.

When there are some data with the same time stamp, the latest data among the data only is retained.

*1 A method for interpolating data by using the original data value that is closest in time

(1)

2017/7/1 3:00:00	1	101
2017/7/1 3:00:02	2	102
2017/7/1 3:00:06	3	104
2017/7/1 3:00:08	4	105
2017/7/1 3:00:10	5	106

(a)

2017/7/1 3:00:00	1	101
2017/7/1 3:00:02	2	102
2017/7/1 3:00:04	2	102
2017/7/1 3:00:06	4	104
2017/7/1 3:00:08	5	105
2017/7/1 3:00:10	6	106

(2)

2017/7/1 3:00:00	1	101
2017/7/1 3:00:02	2	102
2017/7/1 3:00:03	2	102
2017/7/1 3:00:04	3	103
2017/7/1 3:00:06	4	104
2017/7/1 3:00:08	5	105
2017/7/1 3:00:10	6	106

(b)

2017/7/1 3:00:00	1	101
2017/7/1 3:00:02	2	102
~~2017/7/1 3:00:03~~	~~2~~	~~102~~
2017/7/1 3:00:04	3	103
2017/7/1 3:00:06	4	104
2017/7/1 3:00:08	5	105
2017/7/1 3:00:10	6	106

(3)

2017/7/1 3:00:00	1	101
2017/7/1 3:00:02	1	101
2017/7/1 3:00:02	2	102
2017/7/1 3:00:04	3	103
2017/7/1 3:00:06	4	104
2017/7/1 3:00:08	5	105
2017/7/1 3:00:10	6	106

(c)

2017/7/1 3:00:00	1	101
~~2017/7/1 3:00:02~~	~~1~~	~~101~~
2017/7/1 3:00:02	2	102
2017/7/1 3:00:04	3	103
2017/7/1 3:00:06	4	104
2017/7/1 3:00:08	5	105
2017/7/1 3:00:10	6	106

(1) When 'Length (time) of one section ÷ Sampling interval' is greater than 'Number of units of data' (Sampling interval = 2 seconds)
(2) When 'Length (time) of one section ÷ Sampling interval' is smaller than 'Number of units of data' (Sampling interval = 2 seconds)
(3) When there are some data with the same time stamp
(a) Data is interpolated in a missing part.
(b) Unnecessary data is deleted.
(c) Data other than the latest data is deleted.

Point

Even if the data sampling interval is not constant, data will not be interpolated as far as the value calculated by 'Length (time) of one section ÷ Sampling interval' is equal to the number of units of data.

Operating procedure

1. Select [Operation] ⇨ [Data interpolation].

Point

When the [Data interpolation] menu is used, "File was read. (There is an interpolation)" is display in "LogComment".

Precautions

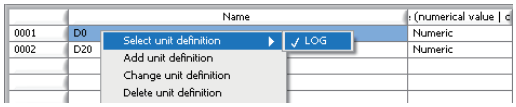
- Setting for data interpolation is applied as the common setting of Reader. Data interpolation cannot be enabled or disabled per unit.
- Data is interpolated when "Time of the first line" is set for "Starting condition type" and "Time of the last line" is set for "End condition type" in a unit definition and the interval between the end time of the previous section and the start time of this section is longer than the sampling interval. However, if the interval is equal to or longer than 100 sampling intervals, data interpolation will not performed.

Changing a unit definition

The following shows the operating procedure for changing the added unit setting.

Operating procedure

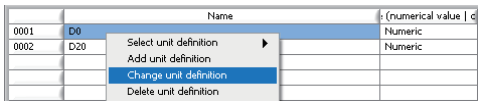
1. Right-click on the variable list, and select a target unit in [Select unit definition].



2. Right-click on the variable list, and select [Change unit definition].

For operations for changing the unit setting, refer to the following section.

☞ Page 130 Adding a Unit Definition



Precautions

If changing the unit definition of a CSV file after reading the file once, perform the following operations:

❶When variables of the target unit are being diagnosed in simple diagnosis of Analyzer, stop the diagnosis.

❷Restart Analyzer and Monitor.

❸When variables of the target unit is used for the logic of Analyzer, edit the logic as necessary.

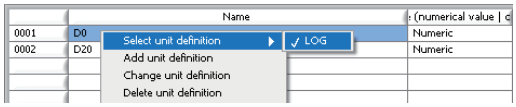
❹When variables of the target unit are used for the simple diagnosis, set the diagnosis rules again.

Deleting a unit definition

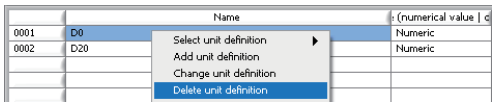
The following shows the operating procedure for deleting the unit that is added last.

Operating procedure

1. Right-click on the variable list, and select the unit that is added last in [Select unit definition].



2. Right-click on the variable list, and select [Delete unit definition].



3. Click the [OK] button.

The unit definition is deleted.

The dataset and the response data definition file of the deleted unit are also deleted.

Precautions

- Unit definitions can be deleted in order from one that is added last, but an arbitrary unit definition cannot be deleted.
- To delete an arbitrary unit definition or multiple unit definitions in a batch, refer to the following:

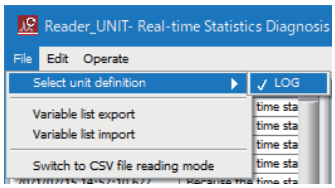
☞ Page 153 Moving/Batch-deleting units

Adding variables

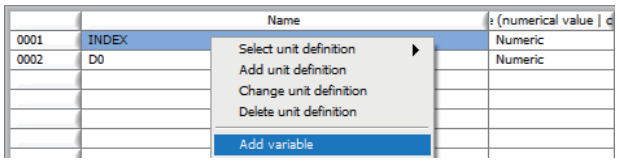
The following shows the operating procedure for adding the variables of a unit added in the following: (☞ Page 130 Adding a Unit Definition)

Operating procedure

1. Select [File] ⇨ [Select unit definition], and select a unit to add its variables.



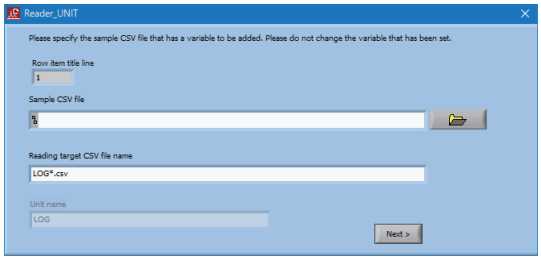
2. Right-click on the variable list, and select [Add variable].



3. Set each item for a sample CSV file and click the [Next] button.

For the considerations for the setting, refer to the following:

☞ Page 135 Considerations for setting a sample CSV file



Item	Description
Row item title line	The row number set to "Row item title line" is displayed.
Sample CSV file*1	Specify the path of a CSV file that includes variables to be added (up to 256 characters).
Reading target CSV file name*2,*3	Specify the name of a CSV file to be read in Reader by using the wild card (*) (up to 256 characters).
Unit name	The set unit name is displayed.

*1 A file in a folder with the encryption attribute enabled cannot be specified.

2 When the name format of a CSV file to be read is 'LOG001_NNNNNNNN.csv', specify it as 'LOG001.csv'.

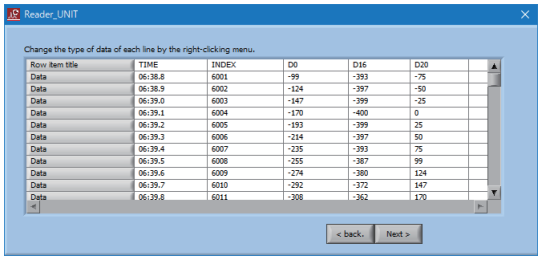
3 '' (asterisk) is used as a wild card indicating any 0 or more characters.

4. Change the type of data for each row as necessary, and click the [Next] button.*1

*1 For a CSV file output in Real-time Flow Manager, changing the type is not necessary since it is set automatically.

For the considerations on changing the data type, refer to the following:

☞ Page 135 Considerations for setting a type



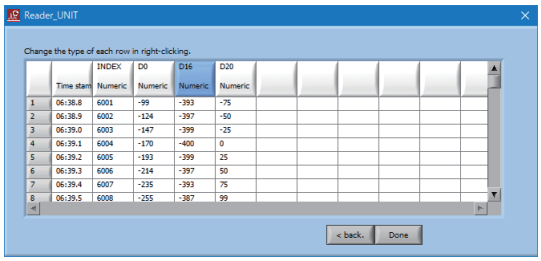
Point

- By clicking a row header (leftmost column), the type of data on the clicked row can be changed. (It can be changed only to "Row item title," "Data," or "Unused.")
- For the "Row item title" row, specify the row where the title of each column (variable name) is described.
- Only one row can be specified as "Row item title."

5. Change the data type of added variables as necessary, and click the [Done] button.

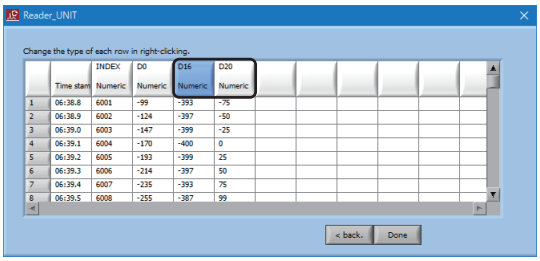
For the considerations for changing column items, refer to the following:

☞ Page 135 Considerations for the settings of column items



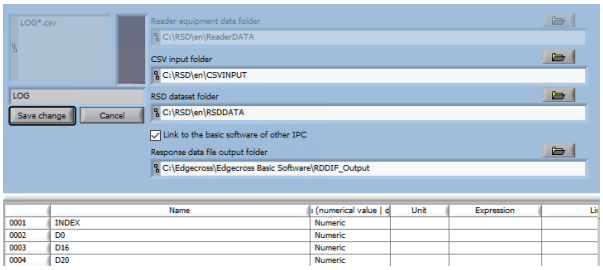
Point

- By clicking a column header (top row), the data type of variable on the clicked column can be changed. However, the data type of variables other than added ones cannot be changed.
  (Example) When adding 'D16' and 'D20,' the data type of only 'D16' and 'D20' can be changed.



- Only one time stamp column is necessary.
- Up to 5000 column items (variables) can be defined for a CSV file.

6. Click the [Save change] button.



7. Click the [Yes.] button.

The set unit definition is saved.

Precautions

- To change a unit definition of a CSV file after reading the file, refer to 'Precautions' described in the following:

☞ Page 145 Changing a unit definition

- If variable names set in a target unit are different from the ones set in a specified CSV file, an error message appears and the variables cannot be added. (The variable names of the time stamp column and unused column do not need to be the same.)

  The following shows examples of CSV files that can be specified and ones that cannot.

(Example) When the following variables are currently set in a target unit

Timestamp	Data1	Data2	Data3	Data4
06:38.8	2.185885	-0.06019	-1670.93	-1576.66
06:38.9	2.298012	-0.21312	-1498.92	-1810.16
06:39.0	2.368962	-0.35411	-1280.68	-2003.96

■ Available CSV files

All the set variables are included and they are aligned the same.

(1) (2)

Time	Data1	Data2	Data3	Data4	Data5	Data6
06:38.8	2.185885	-0.06019	-1670.93	-1576.66	2858.963	2590663
06:38.9	2.298012	-0.21312	-1498.92	-1810.16	2789.161	2283743
06:39.0	2.368962	-0.35411	-1280.68	-2003.96	2628.318	1966945

(1) Variables can be added even if the variable name of the time stamp column is different.
(2) A new variable can be added to the rightmost column if the conditions are satisfied.

■ Unavailable CSV files

• One of the set variables, 'Data4' is missing.

Timestamp	Data1	Data2	Data3		Data5	Data6
06:38.8	2.185885	-0.06019	-1670.93		2858.963	2590663
06:38.9	2.298012	-0.21312	-1498.92		2789.161	2283743
06:39.0	2.368962	-0.35411	-1280.68		2628.318	1966945

• All the set variables are included but they are aligned differently.

Timestamp	Data2	Data3	Data4	Data1	Data5	Data6
06:38.8	-0.06019	-1670.93	-1576.66	2.185885	2858.963	2590663
06:38.9	-0.21312	-1498.92	-1810.16	2.298012	2789.161	2283743
06:39.0	-0.35411	-1280.68	-2003.96	2.368962	2628.318	1966945

• All the set variables are included but they are aligned differently since 'DataX' is inserted.

Timestamp	Data1	DataX	Data2	Data3	Data4	Data5	Data6
06:38.8	2.185885	2.185885	-0.06019	-1670.93	-1576.66	2858.963	2590663
06:38.9	2.298012	2.298012	-0.21312	-1498.92	-1810.16	2789.161	2283743
06:39.0	2.368962	2.368962	-0.35411	-1280.68	-2003.96	2628.318	1966945

DataX	Timestamp	Data1	Data2	Data3	Data4	Data5	Data6
2.185885	06:38.8	2.185885	-0.06019	-1670.93	-1576.66	2858.963	2590663
2.298012	06:38.9	2.298012	-0.21312	-1498.92	-1810.16	2789.161	2283743
2.368962	06:39.0	2.368962	-0.35411	-1280.68	-2003.96	2628.318	1966945

Exporting the variable list

The following shows the operating procedure for exporting the variable list when modifying a large part of the list.

Operating procedure

1. Select [File] ⇨ [Variable list export].
2. Specify the save destination and file name, and click the [OK] button.

The file name is 'UNIT_(unit name)' by default.

3. Edit the contents of the CSV file.

Point

For the path of a file to be exported, up to 255 characters (two characters are used for a double-byte character) including the extension can be specified.

Importing the variable list

The following shows the operating procedure for importing the CSV file which are exported in 'Exporting the variable list'.

Operating procedure

1. Select [File] ⇨ [Variable list import].
2. Specify the name of the exported CSV file and click the [OK] button.

Point

For the path of a file to be imported, up to 255 characters (two characters are used for a double-byte character) including the extension can be specified.

Precautions

- A CSV file that can be imported is only the file that changed the contents of the existing item. In addition, if the number of variables in a CSV file is different from that of the unit definition of import destination, for example when a variable is added or deleted, the CSV file cannot be imported.
- If changing the name or type of a variable and importing a CSV file after reading the file once, perform the following operations:

❶When variables of the target unit are being diagnosed in simple diagnosis of Analyzer, stop the diagnosis.
❷Restart Analyzer and Monitor.
❸When variables of the target unit is used for the logic of Analyzer, edit the logic as necessary.
❹When variables of the target unit are used for the simple diagnosis, set the diagnosis rules again.

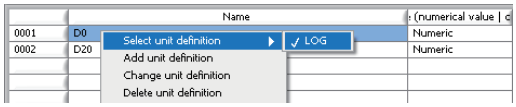
- A CSV file will not be imported if a variable with the same name is included in the file.

Deleting unit data

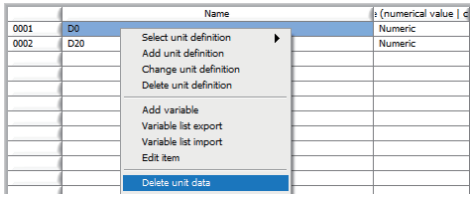
The following shows the operating procedure for deleting read data per unit.

Operating procedure

1. Right-click on the variable list, and select a unit to delete data in [Select unit definition].



2. Right-click on the variable list, and select [Delete unit data].



3. As the period for deleting data, select "All" or "Last 1 day (YYMMDD)".

Precautions

When performing this operation, the dataset corresponding to the period for deleting data is also deleted.

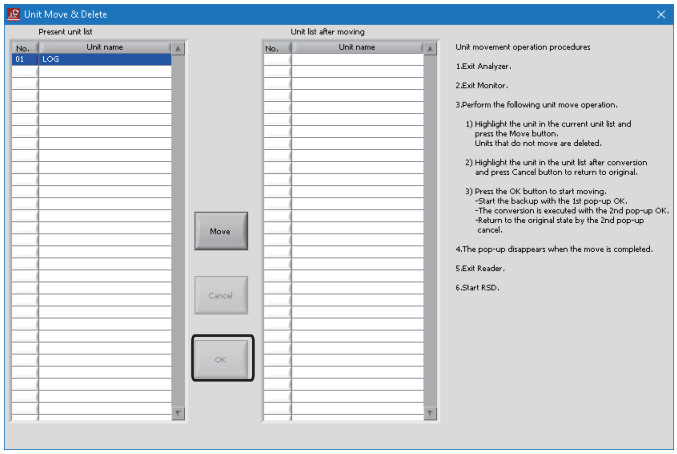
Moving/Batch-deleting units

The following shows the operating procedures for switching the order of units shown in [Select unit definition] menu and deleting all units in a batch.

Operating procedure

1. Select [Operation] ⇨ [Moving and deleting units].
2. Exit Analyzer and Monitor.
3. The current unit definitions are listed in the "Present unit list" in the order of definition.
4. Select units in the order for displaying in the menu and click the [Move] button. Selected units move to the "Unit list after moving".
5. Leave units to be deleted in "Present unit list". After the setting is completed, click the [OK] button.

The response data definition file of a deleted unit is also deleted at the timing when the "Moving and deleting units" screen is closed.



Precautions

- When performing this operation, be sure to move at least one unit. (Deleting all units cannot be performed.)
- After performing this operation, restart Real-time Statistic Diagnosis Tool.
- After performing this operation, units the order of which has been switched will be in the following states:
  All contents of "LogComment" are deleted.
  Logics being diagnosed in Monitor are all stopped. (Perform operations to start the logics as necessary.)

Defining an extended section

Different extraction methods can be registered for a CSV file for which section definition is already configured in unit definition.
An extended section is regarded as a single unit in Analyzer and Monitor.
Multiple extended sections can be registered for each unit. If an extended section in which "Specify time" is selected for "Starting condition type" is defined, only that definition can be registered.

(2)	2017/7/1 3:00:00	A	101	(1)
	2017/7/1 3:00:02	B	102	
	2017/7/1 3:00:04	C	103	
	2017/7/1 3:00:06	C	104	
	2017/7/1 3:00:08	C	105	
	2017/7/1 3:00:10	C	106	

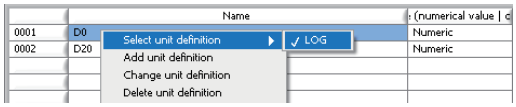
(1) Unit section (section specified in the unit definition)
(2) Extended section

Precautions

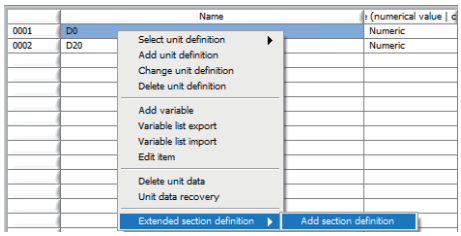
There is no limit of registration for the number of extended sections, but the operation guarantee applies up to ten of them.

Operating procedure

1. Right-click on the variable list, select the [Select unit definition] menu, and select a unit definition for which the extended section is registered.



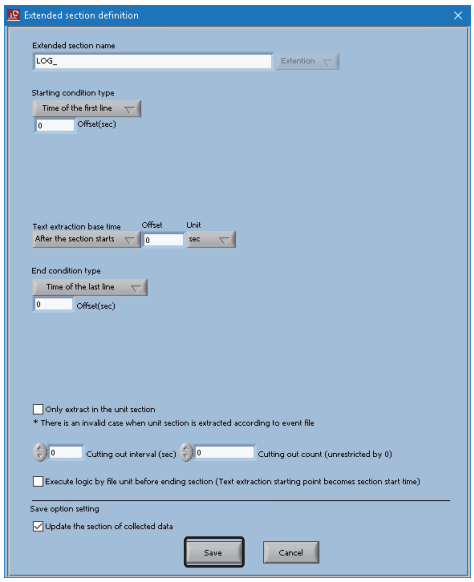
2. Right-click on the variable list, and select [Extended section definition] ⇨ [Add section definition].



3. Set each item and click the [Save] button.

For the considerations for the setting, refer to the following:

☞ Page 156 Considerations for setting for "Extended section name"
☞ Page 156 Considerations for setting for "Starting condition type"
☞ Page 157 Considerations for the setting for "End condition type"
☞ Page 157 Considerations for setting "Only extract in the unit section"
☞ Page 157 Considerations for setting "Cutting out interval"/"Cutting out count"
☞ Page 157 Considerations for setting for "Execute logic by file unit before ending section"
☞ Page 157 Considerations for setting for "Update the section of collected data"



Item	Setting content
Extended section name	Enter an extended section name (up to 32 characters).
Starting condition type	Set the data extraction setting (start row). When "Specify time" is selected, set the time interval starting at 0:00:00 for extracting one section. For details on other settings, refer to the following: ☞ Page 136 Section start conditions
Offset	Specify the time (0.0000 to 2147483647.0000) from when the start condition is satisfied to the beginning of the extended time.
Text extraction base time	Select the time to extract a text variable value either "After the section starts" or "Before end of section". Use this setting when a value which is not the first record value is preferred. ☞ Page 138 Extraction setting of a text variable value for one section
Offset	Set an offset (-2147483647.0000 to 2147483647.0000) from the timing which is set for "Text extraction base time". Set a positive value if "Text extraction base time" is set to "After the section starts" and a negative value if it is set to "Before end of section". ☞ Page 138 Extraction setting of a text variable value for one section
Unit	Select either "sec" (second) or "%" for the offset unit. ("%" is for the section length.)
End condition type	Set the data extraction setting (end row). When "Offset from section head" is selected, specify the time from the start time specified as the start condition to the end of the extended section in seconds for "Offset". (Only a positive value is allowed.)*1 For details on other settings, refer to the following: ☞ Page 139 Section end conditions
Offset	Specify the time (-2147483647.0000 to 2147483647.0000) from when the end condition is satisfied to the end of the extended time.
Only extract in the unit section	Select the checkbox when extracting expanded sections in the section set in the unit definition. Unselect the checkbox when extracting extended sections without regarding unit section.
Cutting out interval/Cutting out count	Set these to extract the extended sections at the specified interval and the number of times, save them for each unit, and perform a logic. • The extraction interval can be set between 0 and 86400. • The number of times of extraction can be set between 0 and 2147483647. When specifying '0', the extended sections are extracted as many as possible within the section.

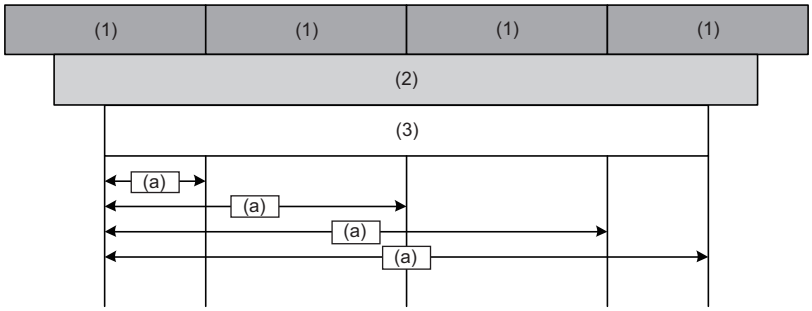
Item	Setting content
Execute logic by file unit before ending section*2	Select the checkbox when extracting extended sections for each CSV file and performing a logic or simple diagnosis for the temporary section which is from the start of the extended section to the extracted position. For the execution image, refer to the following: ☞ Page 156 Performing a logic or a simple diagnosis for each file
Update the section of collected data	Select the checkbox when also extracting sections from data which is already read. While the checkbox is selected, extended sections are extracted from collected data when performing 'Switch to CSV reading mode'. This item is enable only when saving the extended section definitions.

*1 If "Offset from section head" is selected, the extended section cannot be extracted properly when the start condition is satisfied multiple times before the end condition is satisfied.

*2 The temporary section is not saved as a section but only the expansion section is saved.

■ Performing a logic or a simple diagnosis for each file

The following shows an image when performing a logic or a simple diagnosis for each file.



(1) One CSV file
(2) Unit section (section specified in the unit definition)
(3) Extended section
(a) A logic or a simple diagnosis is performed for the temporary section from the start of the extended section to the extracted position.

Precautions

■ Considerations for setting for "Extended section name"

- An extended section is regarded as a single unit in Analyzer or Monitor. To cooperate with Real-time Flow Manager, add the underscore after the extended section name, Otherwise, cooperation will not be performed properly.

Ex.

When the unit name is 'ABCDEFG':

Define the extended section name as 'ABCDEFG_EXT001'.

■ Considerations for setting for "Starting condition type"

- When "Specify time" is selected, the end condition cannot be specified.
- While multiple extended sections can be defined for a single unit, if an extended section in which "Specify time" is selected for "Starting condition type" is defined, another extended section cannot be defined for that unit. If another extended section is defined, extended sections may not be extracted correctly.
- When specifying an additional AND condition (start) for the start condition type of an extended section extraction, AND condition must be satisfied before or at the same time when the start condition is satisfied. Otherwise, the start condition of the extended section extraction cannot be detected.

■ Considerations for the setting for "End condition type"

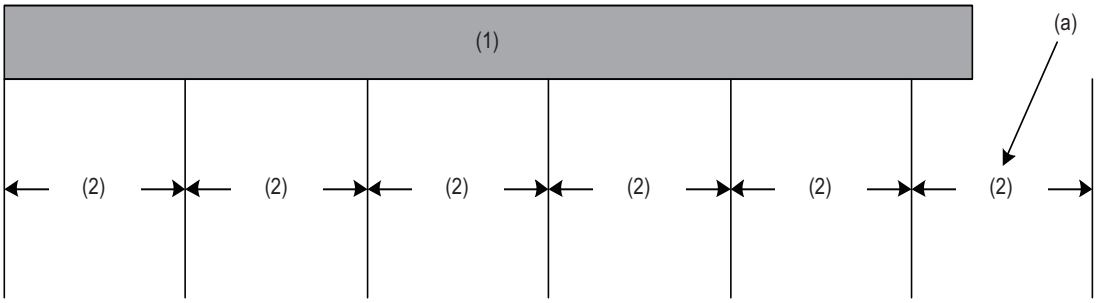
- When "Until the start of the next section" is selected, an offset cannot be specified.
- When "Time of the last line", "Text", or "Numeric" is selected, specify a negative value for the offset. (A positive value cannot be specified.)
- Set the section length to at least one second or longer. Otherwise, the data in the created section cannot be used correctly.
- When specifying an additional AND condition (end) for the end condition type of an extended section extraction, AND condition must be satisfied before or at the same time when the end condition is satisfied. Otherwise, the end condition of the extended section extraction cannot be detected.

■ Considerations for setting "Only extract in the unit section"

- When selecting the checkbox of "Only extract in the unit section", the sections satisfying the start and end conditions within the unit section range are only extracted.

■ Considerations for setting "Cutting out interval"/"Cutting out count"

- Extraction is not performed outside the extended section.



(1) Extended section
(2) Extraction interval
(a) No extraction (outside the extended section)

- When a unit section consists of multiple CSV files and '2' or higher number is specified for the number of times of extraction, extraction may not be performed with the correct number.

■ Considerations for setting for "Execute logic by file unit before ending section"

When any of the following conditions are applied, a logic or a simple diagnosis for the succeeding temporary sections is terminated.

- Deviation from the diagnosis rule has been detected in logic 'Enhanced trace GB' or 'Variable bound pair GB', or simple diagnosis 'Guard band'.

☞ Page 315 Enhanced trace GB, Page 319 Variable limit pair GB, Page 211 Guard Band Diagnosis

- A subsection specified in logic 'Extract subsection' or 'L-1-Section extraction' is extracted.

☞ Page 273 Extract subsection, Page 278 L-1-Section extraction

■ Considerations for setting for "Update the section of collected data"

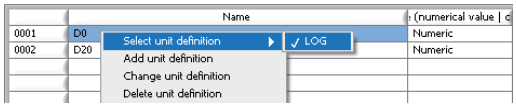
- To use a section extracted from read data in Analyzer, it needs to be restarted.
- This setting is not available for an extended section that "Time of the first line" is selected for "Starting condition type" and "Time of the last line" is specified for "End condition type".

Recovering unit data

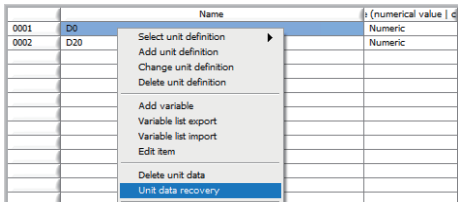
The following shows the operating procedure for read all backup data of a read CSV file again.
This should be operated when the CSV format (row or column type) or the section start or end condition is changed in the unit definition.

Operating procedure

1. Right-click on the variable list, and select a unit to be recovered in [Select unit definition].



2. Right-click on the variable list, and select [Unit data recovery].



3. Click the [OK] button.

Unit data recovery is started and unit data is deleted.

4. The log 'Delete unit data End' is output in the log list.

5. Select [File] ⇨ [Switch to CSV file reading mode].

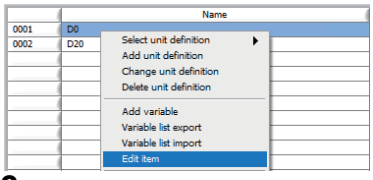
Re-reading all backup data (CSV file) is started.

Changing a variable name

The following shows the operating procedure to change a variable name.
Changing a variable name has no affect on the CSV file reading processing.

Operating procedure

1. Select and right-click an item in the "Name" column in the variable list, and select [Edit item].



2. Enter a name and click the [OK] button.

Precautions

- If changing the name of a variable included in a CSV file after reading the file once, perform the following operations:

❶When variables of the target unit are being diagnosed in simple diagnosis of Analyzer, stop the diagnosis.
❷Restart Analyzer and Monitor.
❸When variables of the target unit is used for the logic of Analyzer, edit the logic as necessary.
❹When variables of the target unit are used for the simple diagnosis, set the diagnosis rules again.

- A variable name cannot be changed to one duplicated with another variable.
- The following characters cannot be used in a variable name:

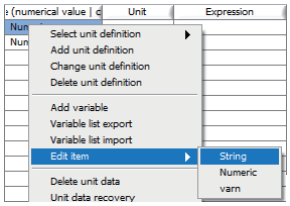
\ (0x5C), / (0x2F), : (0x3A), * (0x2A), ? (0x3F), " (0x22), < (0x3C), > (0x3E), | (0x7C)
￥ (0x818f), ／ (0x815e), ： (0x8146), ＊ (0x8196), ？ (0x8148), ” (0x8168), ＜ (0x8183), ＞ (0x8184), ｜ (0x8162)

Changing a data type

The following shows the operating procedure to change the data type of a variable.

Operating procedure

1. Select and right-click an item in the "Type (numerical value | char)" column in the variable list, and select [String], [Numeric], or [varn] in [Edit item].



Precautions

If changing the type of a variable included in a CSV file after reading the file once, perform the following operations:

❶When variables of the target unit are being diagnosed in simple diagnosis of Analyzer, stop the diagnosis.
❷Restart Analyzer and Monitor.
❸When variables of the target unit is used for the logic of Analyzer, edit the logic as necessary.
❹When variables of the target unit are used for the simple diagnosis, set the diagnosis rules again.

Entering an operational expression

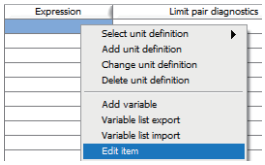
By entering an operational expression, the result can be used as data to be used in Analyzer.

Variable values are represented as 'x'. (Use such as 'x+100')

Symbols that can be used for an operation expression are *, /, +, -, (, and).

Operating procedure

1. Select and right-click an item in the "Expression" column in the variable list, and select [Edit item].



2. Enter an operational expression and click the [OK] button.

20.6 Switching the Operation Mode to CSV File Reading Mode

When a CSV file is stored in 'CSV input folder', Reader automatically switches to the CSV file reading mode.

Operating procedure

Select [File] ⇨ [Switch to CSV file reading mode].

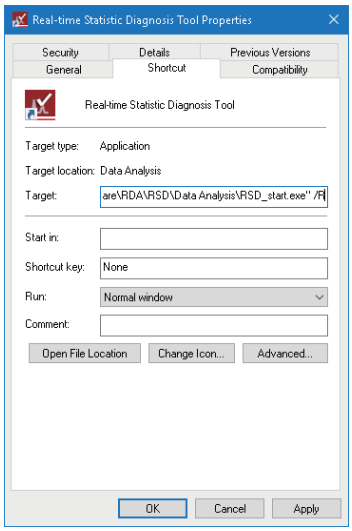
Point

- To edit a unit definition, select [File] ⇨ [Switch to setting edit mode].
- When a unit definition has been added, changed, or deleted, restart Analyzer and Monitor.
- By performing the following procedure when starting Real-time Statistic Diagnosis Tool, Reader will start in the CSV file reading mode, however, if any of the paths set for "Reader equipment data folder", "CSV input folder", and "RSD dataset folder" is not defined, Reader will start in the setting edit mode.

❶ Start Real-time Data Analyzer from "Mitsubishi Electric Edgecross Software" in Windows Start.

❷ Right-click [Real-time Statistic Diagnosis Tool] and select [Properties].

❸ Add ' /R' at the end of the path which is set for "Target" in the property screen.



Precautions

- If the CSV input folder contains a read-only file, Reader cannot read a CSV file.
- When a CSV file which contains data which duplicates data in an already read CSV file or data with the past time stamp is read, this CSV file is regarded to be invalid. Be careful if CSV files can be output after reversing the time or if the time stamp is intentionally set to a future date when diagnosing the data. In this case, the invalidated CSV files are stored in the following folder under the Reader equipment data folder.
  Reader_UNIT\YYMMDD\Original\Invalid ('YYMMDD' indicates the current date.)
- Do not store a file with a name not corresponding to a CSV file name specified in the unit definition to the 'UNIT' folder under 'CSV input folder'. Otherwise, Reader loads the file as an invalid file in the CSV file reading mode and saves it in the following folder under 'Reader equipment data folder'.
  Reader_UNIT\YYMMDD\Original\Invalid
  ('YYMMDD' indicates the current date.)
- Real-time Statistic Diagnosis Tool does not support the daylight saving time. A CSV file containing a time stamp at the end of the daylight saving time may not be read in Reader.
- A CSV file to be loaded into the CSV input folder must have two or more data rows.
- A CSV file to be loaded into the CSV input folder must be the file that the period between the first and last data rows is 10 seconds or longer. If CSV files that the period is shorter than 10 seconds are loaded consecutively, the file loading processing may be delayed.
- When reading a variable of which "Type (numerical value | char)" is "String", the first and last single-byte spaces of the variable value are deleted. (Double-byte spaces are not deleted.)
- When the size of each CSV file to be loaded into the 'CSV input folder' is too large, a memory overflow error occurs and the file may not be read. In this case, reduce the size of each file by reducing the number of variables or that of records in the file. (It is recommended to reduce the file size to 10 M bytes or less.)
- For switching the mode to the CSV file reading mode, the paths set for all "Reader equipment data folder", "CSV input folder", and "RSD dataset folder" need to be defined.
- For reading a CSV file, start Monitor in advance. If a CSV file which is stored in the specified folder cannot be read while the mode is switched to the CSV file reading mode, check whether Monitor is running. (☞ Page 407 Monitor)

21 Analyzer

This software analyzes and diagnoses data in a CSV file.
The following shows the procedure for using Analyzer.

Operating procedure

1. Set the items in the 'Data management setting'.

☞ Page 383 Data Management Setting

2. Analyze data.

- Display and analyze a waveform of read data

☞ Page 164 Displaying Read Data

- Display and analyze statistics of read data

☞ Page 179 Displaying Read Data Statistics

- Display and analyze frequency of read data

☞ Page 182 Displaying Read Data Frequency

- Create a correlation matrix and perform advanced analysis

☞ Page 218 Creating Correlation Matrix
☞ Page 238 Multiple Regression Analysis (LMR)
☞ Page 245 Maharanobis - Taguchi method (MT)

3. When displaying and analyzing a data waveform, a single waveform can be analyzed in detail by configuring a data set.

☞ Page 378 Management
☞ Page 359 Displaying Data after Running

4. Create the diagnosis rule and start diagnosis.

- Apply the SPC rule to statistic and run diagnosis

☞ Page 188 SPC

- Perform a diagnosis in multivariate analysis (single central value format).

☞ Page 204 Multivariate Analysis (Single Central Value Format)

- Set a guard band on the waveform and run diagnosis

☞ Page 211 Guard Band Diagnosis

- Program a diagnostic logic and run diagnosis

☞ Page 250 Editing Logics

21.1 Displaying Read Data

Shows CSV file data read by Reader as a waveform.
Waveforms of data from multiple sections can be overlapped or arranged horizontally for display or analysis.
When arranged horizontally, each section is shown as a single waveform and sections are not consecutive.

Operating procedure

1. Select [Disp] ⇨ [Read data].

2. Select data to read.

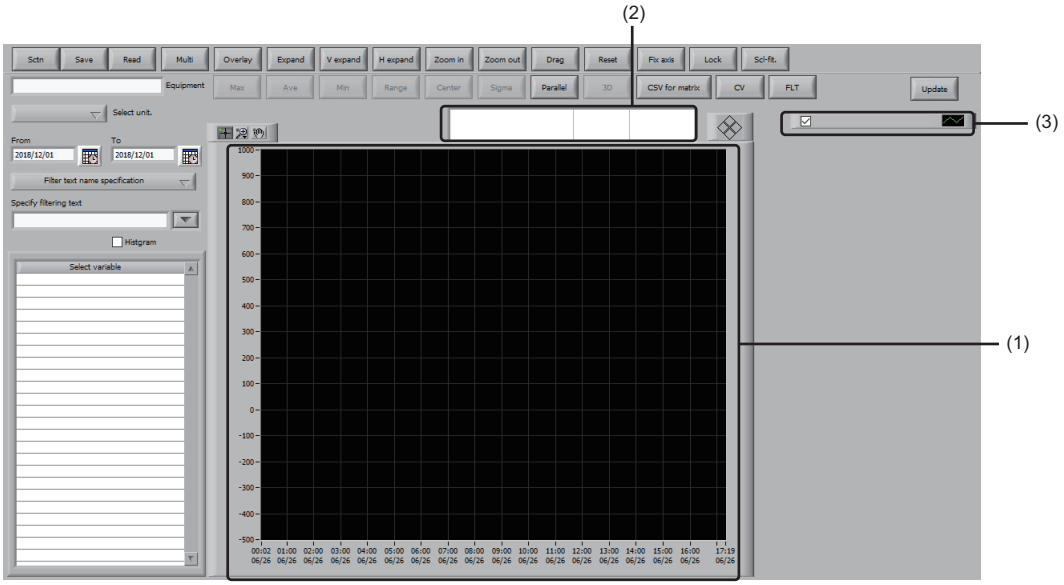
☞ Page 178 Selecting read data

3. Change the display and perform analysis according to the screen structure.

☞ Page 165 Screen configuration

Screen configuration

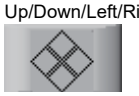
The following shows the screen configuration for displaying read data.



Displayed items

Item		Description
(1) Trend graph (waveform) display screen		The trend graph (waveform) of a variable selected in "Select variable" is displayed. • The vertical axis is automatically scaled according to the maximum and minimum values of the displayed waveform. • When the [Overlay] button is selected, the start time and elapsed time of a single section is displayed in seconds on the horizontal axis. In other cases, the time is shown. The display status of the waveform currently snapped (grabbed) by the cursor can be switched to hide. ☞ Page 169 Hiding a waveform
Equipment		The fixed name "UNIT" is shown. When nothing is displayed, right-click and select 'RSD dataset folder' set in Reader to display "UNIT".
Select unit		Select the unit name or expansion section name to display data. If multiple units (including expansion sections) are defined in the Reader settings, right-click and select other units. When starting Analyzer, the unit which is added last in Reader is displayed by default.
From/To		Specify a section including data to be displayed in the section list. ☞ Page 169 Setting "From/To" The section list is shown by clicking the [Sctn] button. ☞ Page 171 Selecting section list
[Filter text name specification] button		Select a text variable to filter data to view. Text variables are shown when the read CSV file contains text variables.
Specify filtering text		Specify a value of a text variable selected by clicking the [Filter text name specification] button (up to 256 characters). All data for sections for the specified text variable value is shown. • When "*" is specified, all data for sections for which the selected text variable is not null is shown. • When "(null)" is specified, all data for sections for which the selected text variable is null is shown. • When nothing is specified, data for all sections is shown. (Data is not filtered.)
Histogram*1		When the checkbox is selected, the histogram of the data in the display section is displayed. When multiple variables are selected, they are displayed in different colors. (The values on the X and Y axes and the cursor are hidden.)
[Var.] tab*2	Select variable	Select a variable to be displayed for a specified equipment, unit, and period. Multiple variables can be selected and their waveforms can be overlapped.
[EQ Def] tab*3	—	Shows instrumental errors. This function compares variables with the same name between different units. Data from different units can be displayed simultaneously to overlap their waveforms and compare their statistics.
	[Display variable] button	Select a variable to display the instrumental error.
	Equipment	"UNIT" is displayed.
	Unit	Select the name(s) of unit(s) to view data simultaneously.

Item	Description
[Sctn] button	Click this to display the section list. Select data to display in the trend graph (waveform) display screen for each section read by Reader. ☞ Page 171 Selecting section list
[Save] button	Saves information (of which section of which variable) concerning the display data. If the file is saved in a folder other than 'Reader equipment data folder' and 'RSD dataset folder, the file needs to be moved manually to the migration destination when migrating the settings to Real-time Statistic Diagnosis Tool installed in another industrial PC. ☞ Page 120 Migrating settings to Real-time Statistic Diagnosis Tool in another industrial PC, Page 121 Project File Setting Utility
[Read] button	Reads and displays information concerning saved data (of which section of which variable).
[Multi] button	Shows multiple (up to six) variables in separate windows arranged on the screen. Click again to return to the previous display.
[Overlay] button	Overlays data of the selected variables for each section read by Reader. Data for multiple sections as well as multiple data records can be overlaid. Click again to return to the previous display.
[Expand] button*4	Expands a range specified by dragging on the display screen. The same operation as clicking  is performed. (By clicking this button,  is selected.)
[V expand] button*4	Expands a range specified by dragging on the display screen vertically without changing the horizontal scale. The same operation as clicking  is performed. (By clicking this button,  is selected.)
[H expand] button*4	Expands a range specified by dragging on the display screen horizontally without changing the vertical scale. The same operation as clicking  is performed. (By clicking this button,  is selected.)
[Zoom in] button*4	Expands the display around a point clicked on the waveform display screen, gradually as the point is clicked. The same operation as clicking  is performed. (By clicking this button,  is selected.)
[Zoom out] button*4	Reduces the display around a point clicked on the waveform display screen, gradually as the point is clicked. The same operation as clicking  is performed. (By clicking this button,  is selected.)
[Drag] button*4	Drags to move the waveform on the display screen. The same operation as clicking  is performed. (By clicking this button,  is selected.) When selection is canceled and the cursor is displayed, it can be used to select a waveform. For showing or hiding the cursor, refer to the following: ☞ Page 177 Show and Hide Cursor
[Reset] button	Resets the effect of the following buttons and returns the display to the initial state. • [Expand] button,  • [V expand] button,  • [H expand] button,  • [Zoom in] button,  • [Zoom out] button,  • [Drag] button,  The same operation as clicking  is performed. (By clicking this button,  is selected.)
[Fix axis] button	When displaying a waveform, disables automatic adjustment of the upper and lower limit values of the axis and fixes the axis display. Clicking this button again cancels selection.
[Lock] button*1	Locks the displayed waveform and retains its display even when a new variable is selected. Clicking this button again cancels selection.
[Scl-fit.] button*1	Expands each of displayed waveforms so that its amplitude fits the vertical axis range of the area. The values of the vertical axis are aligned with the variable listed top in the "Select variable" list. Amplitudes are aligned for the display purpose only and the data itself is not changed. When output to a CSV file, the original data is output.
[Max] button*3,*5	Calculates the maximum value for each waveform per section, and displays a waveform connecting the maximum values. When the [Overlay] button is selected, the maximum value of the overlapped waveforms is calculated for each step on the horizontal axis, and a waveform connecting the calculated values is shown.
[Ave] button*3,*5	Calculates the average value for each waveform per section, and displays a waveform connecting the average values. When the [Overlay] button is selected, the average value of the overlapped waveforms is calculated for each step on the horizontal axis, and a waveform connecting the calculated values is shown.
[Min] button*3,*5	Calculates the minimum value for each waveform per section, and displays a waveform connecting the minimum values. When the [Overlay] button is selected, the minimum value of the overlapped waveforms is calculated for each step on the horizontal axis, and a waveform connecting the calculated values is shown.

Item	Description
[Range] button[*3,*5]	Calculates the maximum and minimum values for each waveform per section, and displays waveforms connecting the maximum values and connecting the minimum values. When the [Overlay] button is selected, the difference of the maximum and minimum values of the overlapped waveforms is calculated for each step on the horizontal axis, and a waveform connecting the calculated values is shown.
[Center] button[*3,*5]	Calculates the median for each waveform per section, and displays a waveform connecting the medians. When the [Overlay] button is selected, the median value of the overlapped waveforms is calculated for each step on the horizontal axis, and a waveform connecting the calculated values is shown.
[Sigma] button[*3,*5]	Calculates a sigma value for each waveform per section, and displays a waveform connecting the sigma values. When the [Overlay] button is selected, the sigma value of the overlapped waveforms is calculated for each step on the horizontal axis, and a waveform connecting the calculated values is shown.
[Parallel] button	When data in multiple sections is displayed, shifts each unit of data vertically to show them individually. When multiple variables are selected, they are displayed in different colors. In the parallel display, values on Y axis and the cursor will not be displayed.
[3D] button[*6]	Draws a 3D chart for multiple sections of a variable. ☞ Page 173 Drawing a three-dimensional graph
[CSV for matrix] button	Outputs all data shown to a CSV file in the format that can be read by 'Create correlation matrix'. ☞ Page 218 Creating Correlation Matrix A save destination folder for a CSV file to output can be specified arbitrarily. (For the path of a file to be output, up to 255 characters (two characters are used for a double-byte character) including the extension can be specified.) However, do not specify a folder with the encryption attribute enabled. If the file is saved in a folder other than 'Reader equipment data folder' and 'RSD dataset folder, the file needs to be moved manually to the migration destination when migrating the settings to Real-time Statistic Diagnosis Tool installed in another industrial PC. ☞ Page 120 Migrating settings to Real-time Statistic Diagnosis Tool in another industrial PC, Page 121 Project File Setting Utility When data in multiple sections is displayed in the screen of 'Read data display,' data in each section is output as a distinct variable even if there is only one variable in the whole data. (It is output as '[variable name]_XX.' A sequential number is assigned to 'XX' per section.)
[CV] button	Applies 'MA' and/or 'difference' conversion to the vertical axis of the displayed data. ☞ Page 174 Conversion
[FLT] button	Sections a waveform according to changes of the value of the specified variable. ☞ Page 175 Extracting waveforms
[Update] button[*7]	Updates section data to display in the section list to data of the latest date of a loaded CSV file. (The date specified for "From" and "To" are updated.) If filtering the section list, the filtering will be reset. However, hiding of the section list is not reset. ☞ Page 171 Selecting section list
Up/Down/Left/Right button 	Clicking the left or right button moves the cursor on the chart to the left or right, respectively, by one point. The up and down buttons cannot be used. These buttons are effective while the cursor is shown on the chart. For showing or hiding the cursor, refer to the following: ☞ Page 177 Show and Hide Cursor
	When the cursor is displayed, it can be used to select a waveform. For showing or hiding the cursor, refer to the following: ☞ Page 177 Show and Hide Cursor

Item		Description
		Expands a range specified by dragging on the display screen. The same operation as clicking the [Expand] button is performed. (By clicking this button, the [Expand] button is selected.)
		Expands a range specified by dragging on the display screen vertically without changing the horizontal scale. The same operation as clicking the [V expand] button is performed. (By clicking this button, the [V expand] button is selected.)
		Expands a range specified by dragging on the display screen horizontally without changing the vertical scale. The same operation as clicking the [H expand] button is performed. (By clicking this button, the [H expand] button is selected.)
		Resets the effect of the following buttons and returns the display to the initial state. • [Expand] button,  • [V expand] button,  • [H expand] button,  • [Zoom in] button,  • [Zoom out] button,  • [Drag] button,  The same operation as clicking the [Reset] button is performed. (By clicking this button, the [Reset] button is selected.)
		Expands the display around a point clicked on the waveform display screen, gradually as the point is clicked. The same operation as clicking the [Zoom in] button is performed. (By clicking this button, the [Zoom in] button is selected.)
		Reduces the display around a point clicked on the waveform display screen, gradually as the point is clicked. The same operation as clicking the [Zoom out] button is performed. (By clicking this button, the [Zoom out] button is selected.)
		Drags to move the waveform on the display screen. The same operation as clicking the [Drag] button is performed. (By clicking this button, the [Drag] button is selected.) When selection is canceled and the cursor is displayed, it can be used to select a waveform. For showing or hiding the cursor, refer to the following: ☞ Page 177 Show and Hide Cursor
(2) Cursor legend		The legend of the waveform currently snapped (grabbed) by the cursor can be displayed. Effective while the cursor is shown on the chart. For showing or hiding the cursor, refer to the following: ☞ Page 177 Show and Hide Cursor
(3) Chart legend		Shows the legend of the waveform chart. When multiple variables are selected, they are displayed in order from the variable listed top in the "Select variable" list. The chart can be shown or hidden by checking or unchecking the legend. The name of a legend can be changed arbitrarily, but it returns to the original name if selecting a variable again.

*1 Cannot be checked while the [Multi] button is selected.

*2 Not shown if instrumental error display is disabled and only the "Select variable" items are shown.
☞ Page 383 Data Management Setting

*3 It is shown instrumental error display is enabled in the 'Data management setting'.
☞ Page 383 Data Management Setting

*4 One of the [Expand], [V expand], [H expand], [Zoom in], [Zoom out], and [Drag] buttons can be selected. Clicking the same button again cancels its effect.

*5 Only one of the following buttons can be selected simultaneously: [Max], [Ave], [Min], [Range], [Center], and [Sigma] buttons. Clicking the same button again cancels its effect.

*6 Clickable when the [Overlay] button is selected.

*7 The unit name list displayed in "Select unit" is not updated. When updating the list after adding or deleting a unit definition in Reader, restart Analyzer.

Hiding a waveform

The display status of the waveform snapped (grabbed) by the cursor can be switched to hide.

Operating procedure

1. Right-click in the display screen and select [Clear the waves.] from the shortcut menu.

Point

When redisplaying a waveform, select the section corresponding to the hidden waveform in the section list. (When hiding a waveform, the corresponding section will be unselected in the section list.)

☞ Page 171 Selecting section list

Setting "From/To"

Specify a section including data to be displayed in the section list.

The section list is displayed by clicking the [Sctn] button.

☞ Page 171 Selecting section list

Precautions

Section data newly read by Reader is not automatically displayed in Analyzer. To display section data newly read by Reader in Analyzer, set the date in "To" again or click the [Update] button.

■ Setting "From"

Specify the start date of the section data to be displayed in the section list in the format 'HH:MM:SS.sss YYYY/mm/dd'.

The reference time*1 of the latest date of data in a unit selected for "Select unit" is set by default.

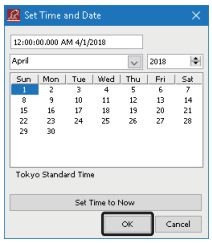
*1 Time which is set for "Default retrieval period" (☞ Page 130 Adding a Unit Definition)

Operating procedure

1. Click .

2. Specify the time and date. After selecting units, click the [OK] button.

Clicking [Set Time to Now] sets the time to the current time.



Point

- 'YYYY/mm/dd' cannot be set by entering values directly.
- Clicking the [Cancel] button discards the setting and closes the "Set Time and Date" screen.
- In each field of "From" and "To", the year, month, and date are displayed. (On the tooltip, the hour, minute, and second are also displayed.)

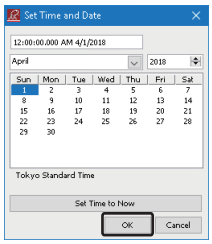
■ Setting "To"

Specify the end date of the section data to be displayed in the section list in the format 'HH:MM:SS.sss YYYY/mm/dd'.
The date and time calculated by adding the time which is set for "Default retrieval period" in 'Add unit definition' of Reader to the time which is set for "From" is set by default.
☞ Page 130 Adding a Unit Definition

Operating procedure

1. Click .

2. Specify the time and date. After selecting units, click the [OK] button.
Clicking [Set Time to Now] sets the time to the current time.



Point

- 'YYYY/mm/dd' cannot be set by entering values directly.
- When changing a unit in "Select unit", the date and time which is set for "To" is changed according to the setting for "Default retrieval period" of the changed unit.
- Clicking the [Cancel] button discards the setting and closes the "Set Time and Date" screen.
- In each field of "From" and "To", the year, month, and date are displayed. (On the tooltip, the hour, minute, and second are also displayed.)

Selecting section list

Click this to display the section list.

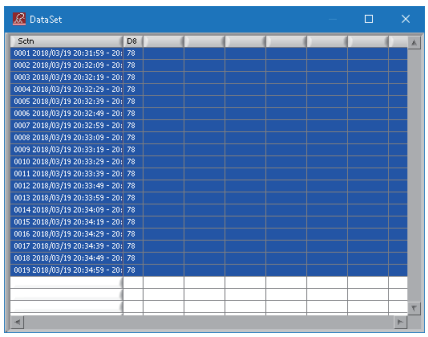
Select data to display in the trend graph (waveform) display screen for each section read by Reader.

The following explains the menu items available by right-clicking on the section list:

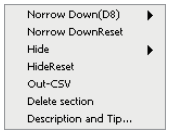
☞ Page 171 Menu items available by right-clicking on the section list

Operating procedure

1. Click the [Sctn] button.
2. Select a section in the section list. Data of a selected section is displayed in the trend graph (waveform) display screen. Data of multiple sections can also be selected.



■ Menu items available by right-clicking on the section list



Item		Description
Narrow Down (column item name)		Filters section data shown in the section list. Data is filtered by the selected text variable value.
Narrow DownReset		Cancels filtering of the section list and returns it to the state before filtering.
Hide	—	Temporarily hides section data shown in the section list.
	Highlight part	Hides the highlighted section data.
	Other than highlight	Hides the section data not highlighted.
HideReset		Cancels hiding of the section list and returns it to the state before hiding.
Out-CSV		Outputs the section list to a CSV file. When selected, the "Out-CSV" screen appears. ☞ Page 172 "Out-CSV" screen
Delete section		Deletes the highlighted section data from the section list.
Description and Tip		Do not use this.

Point

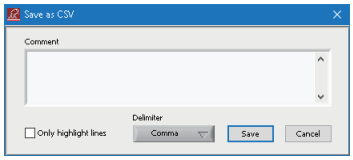
The deleted section data can be restored by deleting "Reader_UNIT\(unit number)_(unit name)\BlockMask.bin" in 'Reader equipment data folder' set in Reader and then restarting Analyzer or choosing [Reset Hiding].

☞ Page 128 Folder Definition

■ "Out-CSV" screen

Window

Right-click on the section list and choose [Out-CSV].



Displayed items

Item	Description
Comment	Insert a text entered in this item in the first row of a CSV file to be saved. "^CSV" is inserted on the line following the comment to indicated the end of the comment.
Only highlight lines	If checked, only the highlighted lines are output to the CSV file.
Delimiter	• Comma: Saves in the CSV format. • Tab: Saves in the text format.
[Save] button	Saves the CSV file by specifying the location and file name. Do not specify a folder with the encryption attribute enabled as a save destination.
[Cancel] button	Discards the setting and closes the "Out-CSV" screen.

Drawing a three-dimensional graph

Draw three-dimensional graph of multiple sections for one variable.

When multiple variables are selected, the value of the variable listed top in the "Select variable" list is shown.

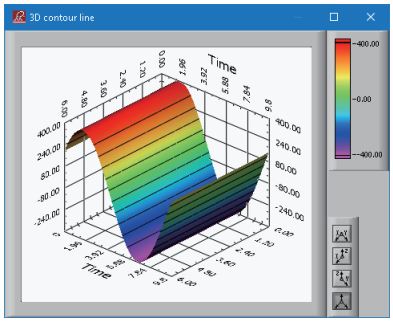
Operating procedure

1. Click the [3D] button.

2. Shows the "3D contour line" screen.

The view point of a drawn three- dimensional graph can be changed by dragging the graph.

The X-axis, Y-axis, and Z-axis represents the section data, time, and variable value, respectively.



3. Switch the graph display by using the following buttons as necessary.

Item	Description
	Displays a graph with X and Y axes.
	Displays a graph with X and Z axes.
	Displays a graph with Y and Z axes.
	Displays a graph with X, Y, and Z axes.

Point

- Data of up to 100 sections is shown.
- The values on Z axis is displayed in different colors.

Conversion

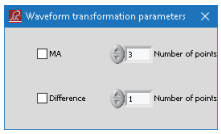
Apply 'MA' and/or 'Difference' conversion to the vertical axis of the displayed data.

Only the odd number of average calculation target points can be specified for moving average conversion.

Operating procedure

1. Click the [CV] button.
2. Set each item.

The vertical axis of the displayed waveform is converted.



Item	Description
MA	When checked, the moving average of up to the current point for the specified points is calculated and shown as the value of the current point. If the current point falls below the specified number of points, the original value is shown.
Num of points	Specify the number of points (3 to 2147483647)*1 to calculate the moving average.
Difference	When checked, the difference between the values of the current point and the point before it for the number of specified points is calculated and shown as the value of the current point. If no value exists at the point before the current point for the number of specified points, "NaN" is shown.
Num of Points	Specify the number of points (-2147483648 to 2147483647) to calculate the difference.

*1 Only odd numbers can be specified.

Extracting waveforms

Sections a waveform according to changes of the value of the specified variable.
A waveform can be extracted by specifying a step variable or waveform.

Point

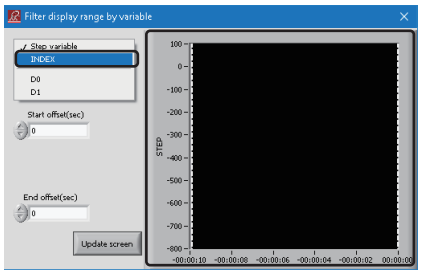
Waveform display reverts to the original state by closing the "Filter display range by variable" screen or clicking the [FLT] button again.

■ Specifying step variable

Operating procedure

1. Click the [FLT] button.
2. Select a step variable and set each item.

The waveform of the selected variable is shown.
A waveform of the topmost section data selected in the section list is displayed.
☞ Page 171 Selecting section list



Item	Description
Start condition	Select a step variable value (-10000.0000 to 10000.0000) for the start condition. The point where the step variable changes to the specified value is the start point of waveform extraction.
Start offset (sec)	Specify an offset from the start condition in seconds (-10000.0000 to 10000.0000). When offsetting backward, specify a negative value. When offsetting forward, specify a positive value.
End condition	Select a step variable value (-10000.0000 to 10000.0000) for the end condition. The point where the step variable changes to the specified value is the end point of waveform extraction.
End offset (sec)	Specify an offset from the end condition in seconds (-10000.0000 to 10000.0000). When offsetting backward, specify a negative value. When offsetting forward, specify a positive value.

3. Click the [Update screen] button.

The part of the waveform with a black background is extracted and displayed in the trend graph (waveform) display screen.

Precautions

- If the start condition is not satisfied, the waveform is not extracted.
- If the end condition is not satisfied, the waveform is extracted to the end of the section.

■ Specifying waveform

Operating procedure

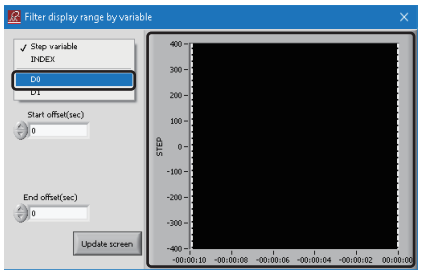
1. Click the [FLT] button.

2. Select a variable other than a step variable and set each item.

The waveform of the selected variable is shown.

A waveform of the topmost section data selected in the section list is displayed.

☞ Page 171 Selecting section list



Item	Description
Start condition	Enter a variable value (-10000.0000 to 10000.0000) to be the start condition and select its change type from the following items. • UP: Value changes from less than the input value to equal to or greater than it. • DOWN: Value changes from greater than the input value to equal to or less than it. The point where the step variable changes to the specified value is the start point of waveform extraction.
Start offset (sec)	Specify an offset from the start condition in seconds (-10000.0000 to 10000.0000). When offsetting backward, specify a negative value. When offsetting forward, specify a positive value.
End condition	Enter a variable value (-10000.0000 to 10000.0000) to be the end condition and select its change type from the following items. • UP: Value changes from less than the input value to equal to or greater than it. • DOWN: Value changes from greater than the input value to equal to or less than it. The point where the step variable changes to the specified value is the end point of waveform extraction.
End offset (sec)	Specify an offset from the end condition in seconds (-10000.0000 to 10000.0000). When offsetting backward, specify a negative value. When offsetting forward, specify a positive value.

3. Click the [Update screen] button.

The part of the waveform with a black background is extracted and displayed in the trend graph (waveform) display screen.

Precautions

- If the start condition is not satisfied, the waveform is not extracted.
- If the end condition is not satisfied, the waveform is extracted to the end of the section.

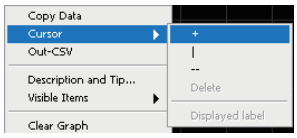
Show and Hide Cursor

Shows and hides the cursor.

The second cursor can also be shown as well.

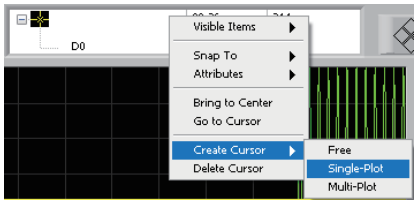
Operating procedure

1. Right-click on the display screen, and select an item from [Cursor].



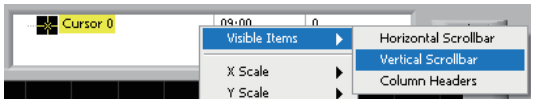
Item	Description
+	Shows the cross-hair cursor.
|	Shows the vertical-bar cursor.
--	Shows the horizontal-bar cursor.
Delete	Hides all cursors shown.
Displayed label	Do not use this.

2. To show the second cursor, right-click on the 'cursor legend', and select [Create Cursor] ⇨ [Single-Plot].



3. Right-click on the 'cursor legend' and select [Display item] ⇨ [Vertical Scrollbar].

The scroll bar is shown in the 'cursor legend'.



Point

- When two cursors are displayed, dragging them can move the cursor position.
- When a cursor is displayed, the time and value of the location on which a waveform is snapped are displayed on the upper left of the trend graph (waveform) display screen.

Selecting read data

Select data to read.

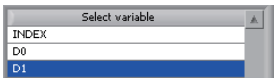
Operating procedure

1. When "UNIT" is not displayed for "Equipment", right-click on the display area of "Equipment".
2. Select the RSD dataset folder set in Reader.

3. "UNIT" is displayed in "Equipment".

4. Select a unit name to display data or an extended section name for "Select unit".

5. Select a variable to display from "Select variable".



Point

"UNIT" is displayed in "Equipment" by satisfying all of the following conditions: A unit name or extended section name can be selected for "Select unit."

❶ Folders are defined in Reader.

☞ Page 128 Folder Definition

❷ The operation for switching the operation mode of Reader to the CSV file reading mode has been performed after the operations in ❶ is completed.

☞ Page 161 Switching the Operation Mode to CSV File Reading Mode

❸ Analyzer is restarted or the [Update] button is clicked after the operation in ❷ is completed.

If a folder defined in Reader is changed, perform the operations in ❷ and ❸ again; otherwise, data of the previous folder may be displayed.

21.2 Displaying Read Data Statistics

Calculates statistic for each variable of data in a CSV file, which was read by Reader, in each section, and display the result by linking the period specified for "From" and "To".
By arranging statistics data for multiple variables in a single window or multiple windows for analysis, changes in statistics can be understood.

Operating procedure

1. Select [Disp] ⇨ [Read data statistics].
2. Select data to read.

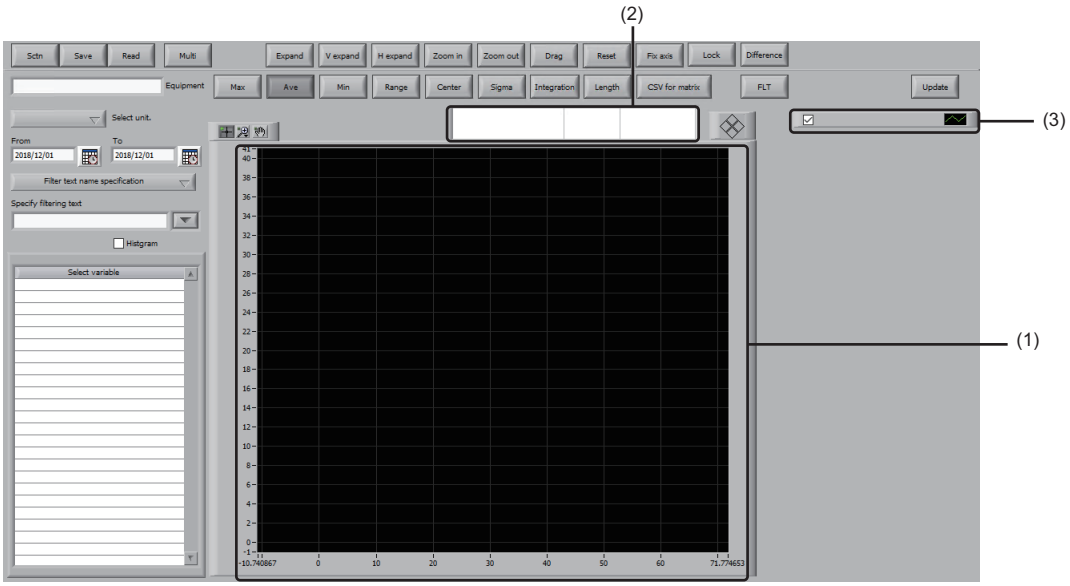
☞ Page 178 Selecting read data

3. Change the display and perform analysis according to the screen structure.

☞ Page 180 Screen configuration

Screen configuration

The following shows the screen configuration for displaying read data statistics.



Displayed items

Item		Description
(1) Trend chart (statistics) display screen		Shows the statistics for a variable selected from the "Select variable" list. • The vertical axis is automatically scaled according to the maximum and minimum values of the displayed waveform. Note that when multiple variables are selected, the vertical axis values are not displayed. • Numbers corresponding to the number of units of data (sections) included in the period specified for "From" and "To" are displayed on the horizontal axis.
[Var.] tab*1	Select variable	Select the statistic of a variable to be displayed for a specified equipment, unit, and period. By selecting multiple variables, the statistics can be displayed vertically.
[Sctn] button		Click this to display the section list. The statistics of all sections are displayed in the statistic display. When selecting the section data in the section list while the cursor is displayed, the waveform of the section is snapped by the cursor. In addition, when snapping a waveform by the cursor, the corresponding section data in the section list is selected. When hiding the data of all sections in the section list, the statistics of all sections before narrowing down or hiding is displayed. ☞ Page 171 Selecting section list
[Multi] button		Shows the statistics of multiple (up to six) variables in separate windows arranged on the screen. Click again to return to the previous display.
[Difference] button		Shows a differential value of two successive points on a waveform. 'Y value of a succeeding point' - 'Y value of a preceding point' is shown. If the Y value is increasing, a positive value is shown.
[Max] button*2		Click this to display the maximum value of a waveform for each section.
[Ave] button*2		Click this to display the average value of a waveform for each section.
[Min] button*2		Click this to display the minimum value of a waveform for each section.
[Range] button*2		Click this to display the difference between the maximum and minimum values of a waveform for each section.
[Center] button*2		Click this to display the median of a waveform for each section.
[Sigma] button*2		Click this to display the standard deviation of a waveform for each section.
[Integration] button*2		Click this to display the integral value (area) for each section.
[Length] button*2		Shows the number seconds from the start point of the waveform per section.
(2) Cursor legend		The legend of the waveform currently snapped (grabbed) by the cursor can be displayed. Effective while the cursor is shown on the chart. For how to show and hide the cursor and cursor legend, refer to the following: ☞ Page 177 Show and Hide Cursor

Item	Description
(3) Chart legend	Shows the legend of the waveform chart. When multiple variables are selected, they are displayed in order from the variable listed top in the "Select variable" list. The chart can be shown or hidden by checking or unchecking the legend. The name of a legend can be changed arbitrarily, but it returns to the original name if selecting a variable again.

*1 Not shown if instrumental error display is disabled and only the "Select variable" items are shown.
☞ Page 383 Data Management Setting

*2 Only one of the following buttons can be selected: [Max], [Ave], [Min], [Range], [Center], [Sigma], [Integration], and [Length] buttons.

The other items are the same as those described in the following section.

☞ Page 165 Screen configuration

Note that the following items are not included.

- [Scl-fit.] button
- [Overlay] button
- [Parallel] button
- [3D] button
- [CV] button

21.3 Displaying Read Data Frequency

Calculates the moving average for the CSV file data read by Reader and displays the result after removing noises.
The frequency filter can also be applied.
Further, a spectrogram after an STFT transformation or a scalogram after a Wavelet transform can be displayed.

Operating procedure

1. Select [Disp] ⇨ [Read data frequency].
2. Select data to read.

☞ Page 187 Selecting read data (frequency display)

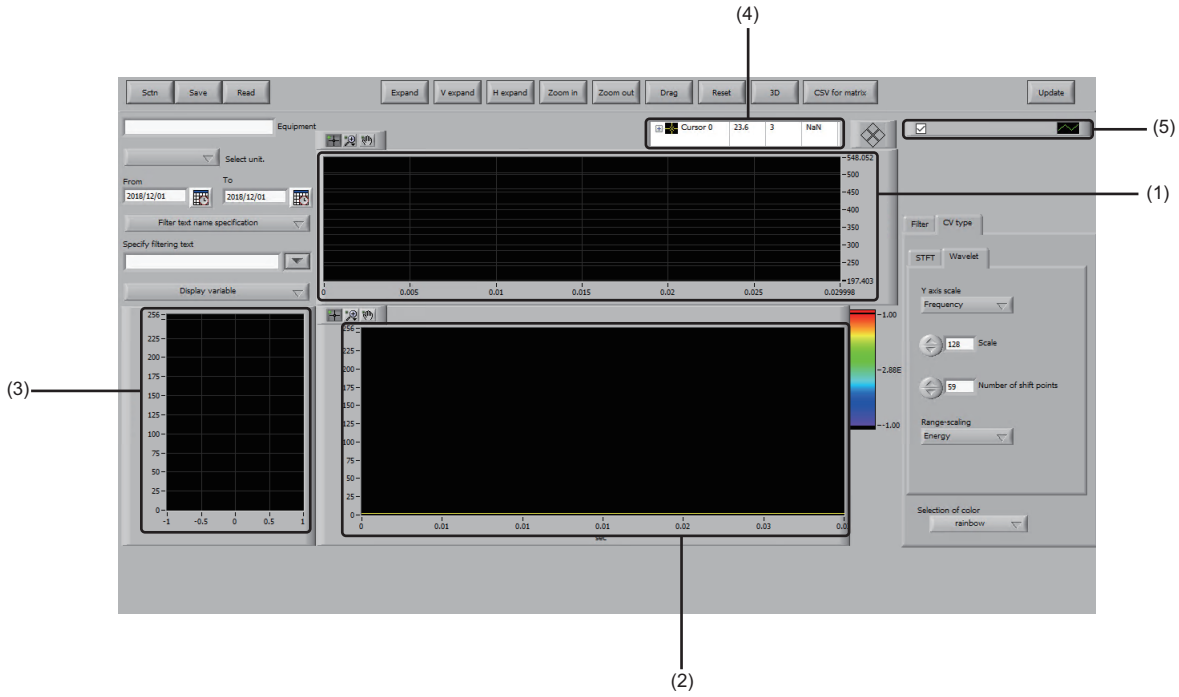
3. Change the display and perform analysis according to the screen structure.

☞ Page 183 Screen configuration

Screen configuration

The following shows the screen configuration for displaying read data frequency.

Window



Displayed items

■ Screen items

Item	Description
(1) Trend graph (waveform) display screen	Shows the waveform for a variable selected by the [Display variable] button. The display status of the waveform currently snapped (grabbed) by the cursor can be switched to hide. ☞ Page 169 Hiding a waveform
(2) Spectrogram/scalogram display screen	Shows the spectrogram/scalogram for a variable selected by the [Display variable] button.
(3) Power spectrum/energy display screen	Shows the power spectrum/energy for a variable selected by the [Display variable] button.
[Display variable] button	Select the frequency of a variable to be displayed for a specified equipment, unit, and period.
[3D] button	Draws a three-dimensional graph of variables for one section. ☞ Page 186 Drawing a three-dimensional graph

Item			Description
[Filter] tab	—		Configures settings related to filtering.
	MA (noise removal)		Performs smoothing using the moving average.
	Frequency filter		• When "Low pass" or "High pass" is selected, specify a value for "Cut-off frequency 1[Low level](Hz)". • When "Band pass" or "Band stop" is selected, specify values for "Cut-off frequency 1[Low level](Hz)" and "Cut-off frequency 2[High level](Hz)". However, a value specified for "Cut-off frequency 1[Low level](Hz)" must be smaller than one specified for "Cut-off frequency 2[High level](Hz)".
	Cut-off frequency 1[Low level](Hz)		Set the low cut-off frequency (0.0000 to 100000.0000).
	Cut-off frequency 2[High level](Hz)		Set the high cut-off frequency (0.0000 to 100000.0000).
	[IIR filter] tab	—	Configures settings related to the IIR (Infinite Impulse Response) filter.
		Topology	Select a topology.
		Degree	Set a degree (0 to 100).
	[FIR filter] tab	—	Configures settings related to the FIR (Finite Impulse Response) filter.
		Tap number	Set the number of taps (0 to 1000).
	Head offset		Set the offset (number of points) to eliminate influence by the leading part of a section. The range of available values is 0 to 1000. The part of the waveform from the lead for the specified offset is inverted and connected to the preceding part. After applying the filter, the lead part of the section for the specified offset is cut off.
	Error		It is lighted in red if an error occurs in the filter setting[*1]. (It is lighted in green if no error occurs.)
[Conversion type] tab	—		Configures settings related to the conversion type.
	STFT	—	Configures settings related to STFT.
		Number of shift points	Set the number of points to switch the sliding window (1 to 1000). By shortening the time step, the time resolution improves but the frequency resolution becomes worse.
		Frequency bin	Set the FFT size (number of points) for STFT. The range of available values is 2 to 512. By increasing the FFT size, the frequency resolution improves.
		Window type	Enter the window information used to calculate STFT.
		Window parameter	• Kaiser window: β parameter • Dolph-Chebyshev window: Proportion s between main robe and side robe • Gauss window: Standard deviation • Other types: Entry is ignored. The default for the window parameter is NaN. The range of available values is '0.000' to '10000.0000'.
		Window length	Set the window length (0 to 10000).
	Wavelet	—	Configures settings related to Wavelet.
		Y axis scale	Select "Frequency" or "Scale". • "Frequency" The vertical axis represents the frequency scale from '0' to 'sampling interval/2'. It is a reverse display to the wavelet scale. • "Scale" The consecutive wavelet calculation is performed using a positive scale. The vertical axis represents the wavelet scale.
		Scale	Set the number of scales used in wavelet calculation (1 to 10000). • The frequency resolution improves for larger scales. • The time resolution improves for smaller scales.
		Number of shift points	Set the number of seconds for shift and conversion (1 to 10000). Calculates the wavelet coefficient per shift. (Discrete wavelet transform)
		Range-scaling	Select "Energy" or "Amplitude". • "Energy" Energy remains the same for all scales. • "Amplitude" Each scale has the maximum value of the frequency response values.
	Selection of color		Selects the color type for the spectrogram/scalogram display screen.

Item	Description
(4) Cursor legend	The legend of the waveform currently snapped (grabbed) by the cursor in the spectrogram/scalogram display screen can be displayed. It is available while the cursor is displayed in the spectrogram/scalogram display screen. For showing or hiding the cursor, refer to the following:*2 ☞ Page 177 Show and Hide Cursor
(5) Chart legend	Shows the legend of the waveform chart. The chart can be shown or hidden by checking or unchecking the legend. The name of a legend can be changed arbitrarily, but it returns to the original name if selecting a variable again.

*1 If an error occurs, a waveform when setting "None" for "Frequency filter" will be displayed.

*2 The cursor can also be displayed in the trend graph (waveform) display screen. (It cannot be displayed in the power spectrum/energy display screen.)

The other items are the same as those described in the following section.

☞ Page 165 Screen configuration

Note that the following items are not included.

- [Multi] button
- [Overlay] button
- [CV] button
- [FLT] button
- [Fix axis] button
- [Lock] button
- [Scl-fit.] button
- [Max] button
- [Min] button
- [Ave] button
- [Range] button
- [Center] button
- [Sigma] button
- [Parallel] button
- Histogram
- [Var.] tab
- [EQ Def] tab

Drawing a three-dimensional graph

Draw a three-dimensional graph for one section of a variable.

When multiple sections are selected, a graph for the section with the smallest number is displayed.

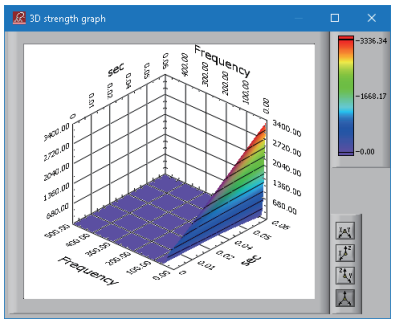
Operating procedure

1. Click the [3D] button.

2. The "3D strength graph" screen appears.

The view point of a drawn three- dimensional graph can be changed by dragging the graph.

The X axis, Y axis, and Z axis indicate time, frequency, and power spectrum (when the conversion type is 'STFT') or energy (when the conversion type is 'Wavelet') respectively.



3. Switch the graph display by using the following buttons as necessary.

Item	Description
	Displays a graph with X and Y axes.
	Displays a graph with X and Z axes.
	Displays a graph with Y and Z axes.
	Displays a graph with X, Y, and Z axes.

Point

The values on Z axis is displayed in different colors.

Selecting read data (frequency display)

Select data to read.

Operating procedure

1. When "UNIT" is not displayed for "Equipment", right-click on the display area of "Equipment".
2. Select the RSD dataset folder set in Reader.

3. "UNIT" is displayed in "Equipment".

4. Select a unit name to display data or an extended section name for "Select unit".

5. Click the [Display variable] button and select a variable.

Point

"UNIT" is displayed in "Equipment" by satisfying all of the following conditions: A unit name or extended section name can be selected for "Select unit."

❶ Folders are defined in Reader.

☞ Page 128 Folder Definition

❷ The operation for switching the operation mode of Reader to the CSV file reading mode has been performed after the operations in ❶ is completed.

☞ Page 161 Switching the Operation Mode to CSV File Reading Mode

❸ Analyzer is restarted or the [Update] button is clicked after the operation in ❷ is completed.

If a folder defined in Reader is changed, perform the operations in ❷ and ❸ again; otherwise, data of the previous folder may be displayed.

21.4 SPC

Calculates statistics of the CSV file data read by Reader per section, and diagnoses the result using the SPC rule.
SPC is a method for visually diagnosing the statistic change of manufacturing data by an abnormality determination rule (SPC rules) defined by JIS.
This method allows for detecting a sign of a failure in advance during the manufacturing process.

Operating procedure

1. Select [Simple analysis - Simple diagnosis] ⇨ [SPC].
2. Select data to read.

☞ Page 178 Selecting read data

3. Select an SPC rule used for diagnosis.

☞ Page 190 Selecting SPC rule

4. Create the SPC standard value.

☞ Page 196 Creating SPC

5. Start diagnosis using the SPC rule.

☞ Page 200 Starting diagnosis using SPC rule

6. If the diagnosis rule is changed after starting diagnosis, the changed rule is used.

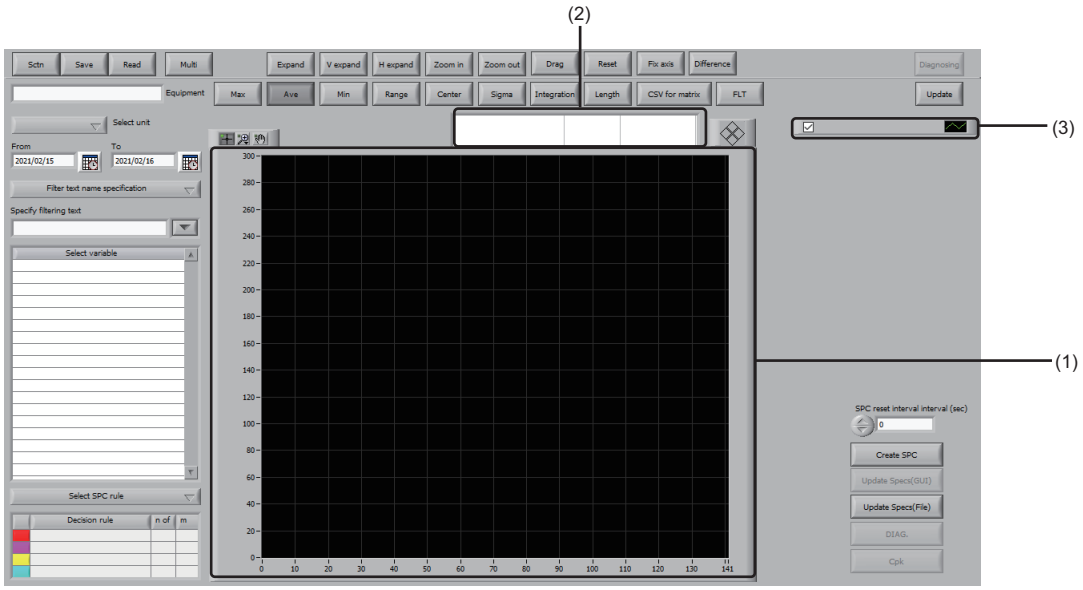
☞ Page 200 Updating diagnosis definition

7. Stops diagnosis.

☞ Page 200 Stopping diagnosis

Screen configuration

The following shows the screen configuration for an SPC diagnosis.



Displayed items

Item	Description
(1) Trend chart (statistics) display screen	Shows the statistics for a variable selected from the "Select variable" list. • The vertical axis is automatically scaled according to the maximum and minimum values of the displayed waveform. Note that when multiple variables are selected, the vertical axis values are not displayed. • Numbers corresponding to the number of units of data (sections) included in the period specified for "From" and "To" are displayed on the horizontal axis.
[Sctn] button	Click this to display the section list. The statistics of all sections are displayed in the statistic display. When selecting the section data in the section list while the cursor is displayed, the waveform of the section is snapped by the cursor. In addition, when snapping a waveform by the cursor, the corresponding section data in the section list is selected. When hiding the data of all sections in the section list, the statistics of all sections before narrowing down or hiding is displayed. ☞ Page 171 Selecting section list
[Difference] button	Shows a differential value of two successive points on a waveform. 'Y value of a succeeding point' - 'Y value of a preceding point' is shown. If the Y value is increasing, a positive value is shown.
[Max] button*1	Click this to display the maximum value of a waveform for each section.
[Ave] button*1	Click this to display the average value of a waveform for each section.
[Min] button*1	Click this to display the minimum value of a waveform for each section.
[Range] button*1	Click this to display the difference between the maximum and minimum values of a waveform for each section.
[Center] button*1	Click this to display the median of a waveform for each section.
[Sigma] button*1	Click this to display the standard deviation of a waveform for each section.
[Integration] button*1	Click this to display the integral value (area) for each section.
[Length] button*1	Shows the number seconds from the start point of the waveform per section.
Select variable	Select the statistic of a variable to be displayed for a specified equipment, unit, and period. By selecting multiple variables, the statistics can be displayed vertically.
[Select SPC rule] button	Click this to select an SPC rule used for diagnosis.
Decision rule	Shows the selected judgment type for the SPC rule.
SPC reset interval interval (sec)	Set the interval between sections in seconds (0 to 10000) to reset the SPC rule count. When '0' is specified, this setting will be disabled.
[Create SPC] button	Click this to create the SPC specification value.
[Update Specs(GUI)] button	Click this to edit SPC specification values.
[Update Specs(File)] button	
[DIAG.] button	Click this to start a diagnosis using the SPC rule.

Item	Description
[Cpk] button	Click this to display the Cpk chart when the SPC specification value is created by clicking the [Create SPC] button. ☞ Page 201 Displaying Cpk chart
[Diagnosing] button	This button is enabled when simple diagnosis (SPC diagnosis, multivariate analysis (single central value format), or guard band diagnosis) is performed. Click this button to open the "Simple diagnosis list under execution" screen. ☞ Page 202 Displaying simple diagnoses being executed
(2) Cursor legend	The legend of the waveform currently snapped (grabbed) by the cursor can be displayed. Effective while the cursor is shown on the chart. For showing or hiding the cursor, refer to the following: ☞ Page 177 Show and Hide Cursor
(3) Chart legend	Shows the legend of the waveform chart. When multiple variables are selected, they are displayed in order from the variable listed top in the "Select variable" list. The chart can be shown or hidden by checking or unchecking the legend. The name of a legend can be changed arbitrarily, but it returns to the original name if selecting a variable again.

*1 Only one of the following buttons can be selected: [Max], [Ave], [Min], [Range], [Center], [Sigma], [Integration], and [Length] buttons.

The other items are the same as those described in the following section.

☞ Page 165 Screen configuration

Note that the following items are not included.

- [Overlay] button
- [CV] button
- [Lock] button
- [Scl-fit.] button
- [Parallel] button
- [3D] button
- Histogram
- [Var.] tab
- [EQ Def] tab

Selecting SPC rule

Select an SPC rule used for diagnosis. Default SPC rules are provided and they can be edited.

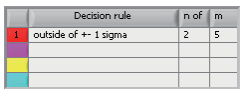
For details, refer to the following:

☞ Page 191 Default SPC rule, Page 194 Editing SPC rule

Operating procedure

1. Click the [Select SPC rule] button to select an SPC rule.

The decision rule is shown in "Decision rule".

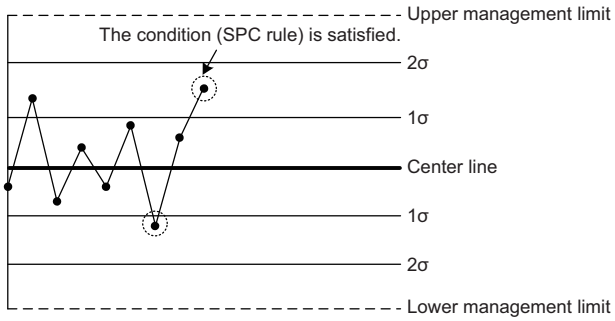


■ Default SPC rule

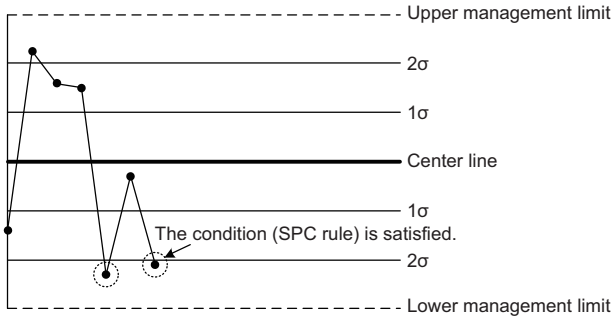
The default SPC rules are shown below.

When the condition is satisfied, it is judged as an error.

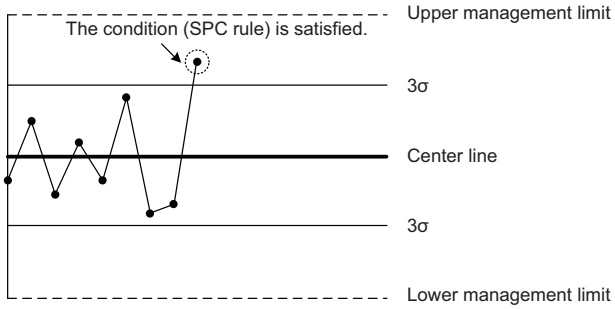
• 1σ outside (2/5): outside of +- 1 sigma (2/5)
2 out of 5 successive points reside outside 1σ.



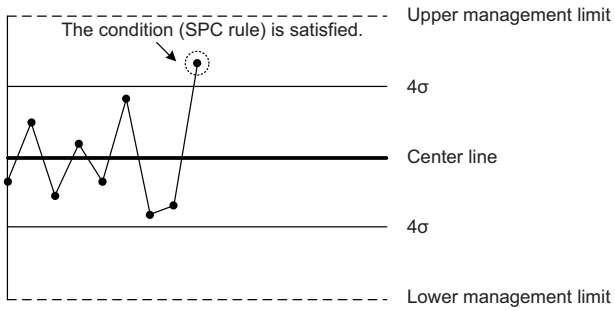
• 2σ outside (2/3): outside of +- 2 sigma (2/3)
2 out of 3 successive points reside outside 2σ.



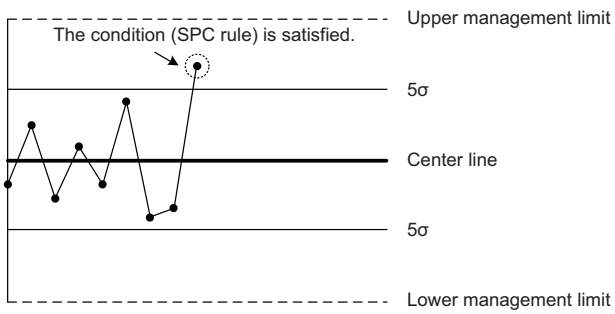
• 3σ outside (1/1): outside of +- 3 sigma (1/1)
1 point resides outside 3σ.



• 4σ outside (1/1): outside of +- 4 sigma (1/1)
1 point resides outside 4σ.

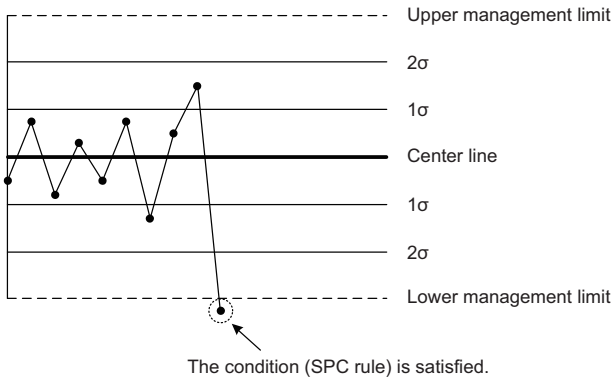


• 5σ outside (1/1): outside of +- 5 sigma (1/1)
1 point resides outside 5σ.



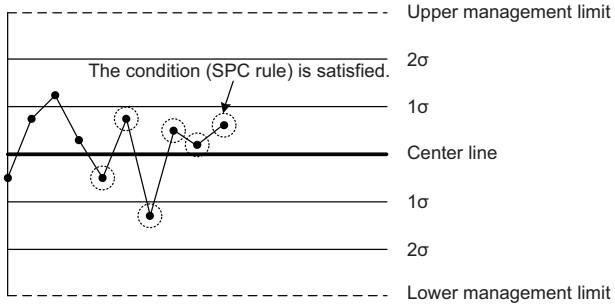
• Management limit level 1(1/1): outside of control limits Lv.1(1/1)

1 point resides outside the upper or lower management limit.



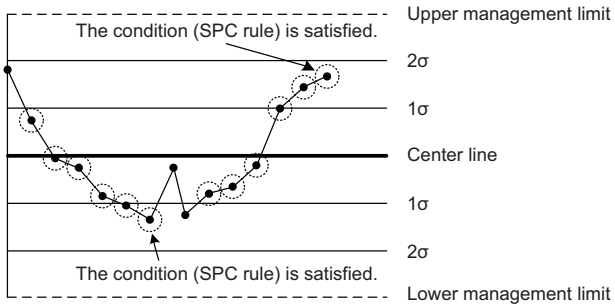
• Alternate increase and decrease (6/6): alternating direction(6/6)

6 points alternately increase and decrease.



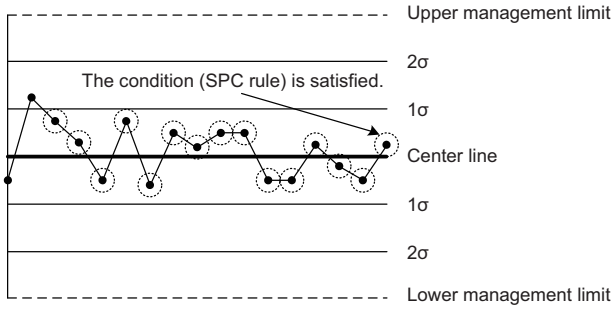
• Increase and decrease (6/6): increasing or decreasing(6/6)

Consecutive 6 points increase or decrease.



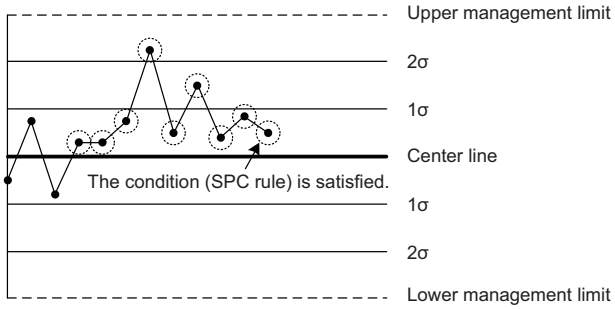
• Toward center (15/15): within one sigma(15/15)

15 successive points reside inside 1σ.

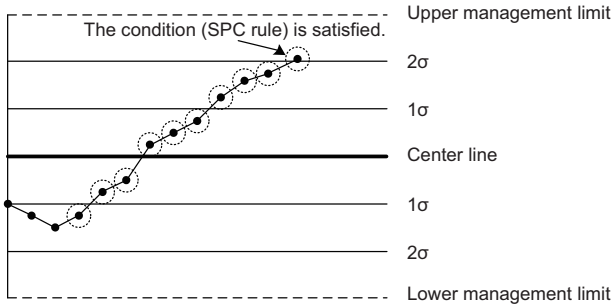


• Continuous (9/9): plot on the same side(9/9)

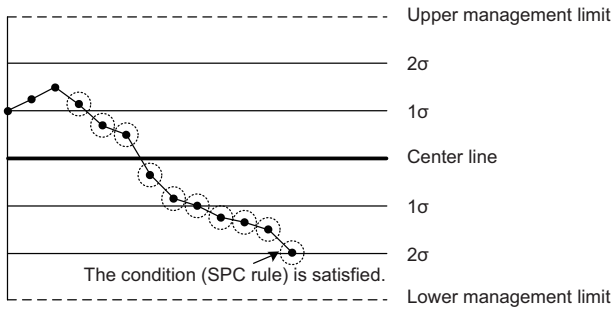
Continuous 9 points reside on the same side of the center line.



• Increase (10/10): increasing(10/10)
Increase (Continuous 10 points increase.)



• Decrease (10/10): decreasing(10/10)
Decrease (Continuous 10 points decrease.)



■ Editing SPC rule

The contents of the SPC rules can be edited or multiple decision rules can be defined for one SPC rule by editing the contents of 'SPCRule.csv'.

A new SPC rule can also be created.

Operating procedure

1. Click the [Update Specs] button.

The folder in which the SPC rules are stored is displayed.

2. Open 'SPCRule.csv' in the folder.
3. Change the value in "SPC rule name" column to an arbitrary name.
4. Change the value in the "Judgment type (n/m)1" column.
5. To specify multiple judgment rules, specify the judgment types in the "Judgment type (n/m)2" and later columns.
6. In the "EWMA& weighting factor" column, specify a weighting factor (smoothing factor) and the number of moving averages of EWMA (Exponentially Weighted Moving Average).
7. When editing completes, save the file.

When clicking the [Select SPC rule] button, a name set for "SPC rule name" is displayed.

In addition, when selecting an SPC rule, a rule specified for "Judgment type (n/m) 1" to "Judgment type (n/m) 4" is displayed in "Decision rule".

Precautions

- After editing the 'SPCRule.csv' file, Analyzer must be restarted.
- The numerical value of the judgment type 'n/m' can be changed to a value satisfying 'n≤m (n>0, m>0)'. For 'n' and 'm', set the number of points (n) to define the timing of an error determination, and it is determined as an error when a condition is satisfied by the specified number of points among consecutive points (m).
- Values of "n" and "m" can be specified within the range from 1 to 20. If a value out of this range is specified, the operation is not guaranteed.
- Other parts of the judgment type than "(n/m)" cannot be changed from the following defaults:
  outside of +- 1 sigma
  outside of +- 2 sigma
  outside of +- 3 sigma
  outside of +- 4 sigma
  outside of +- 5 sigma
  outside of control limits Lv.1
  alternating direction
  increasing or decreasing
  within one sigma
  plot on the same side
  increasing
  decreasing
- If the judgment types (n/m)1 to (n/m)3 are blank, judgment types in the succeeding columns are ignored if any.
- For values to be specified in the "EWMA& weighting factor" column, integer values indicate the number of moving averages and decimal values indicate EWMA weighting factors. When specifying both an integer value more than '1' and a decimal value, the EWMA conversion will not be performed.
- When editing a CSV file in a text editor, be careful not to add or delete control symbols such as commas.
- The 'SPCRule_new.csv' file is stored in the same folder as the 'SPCRule.csv' file. This is the default file of 'SPCRule.csv' of Real-time Statistic Diagnosis Tool which is currently being used. To initialize the 'SPCRule.csv' file after edited, delete the 'SPCRule.csv' file and rename the 'SPCRule_new.csv' file to 'SPCRule.csv'.
- To use a new standard SPC rule which is added when upgrading Real-time Statistic Diagnosis Tool, save the original 'SPCRule.csv' file and rename the copy of the 'SPCRule_new.csv' file to 'SPCRule.csv'. Then, apply the changes of the saved 'SPCRule.csv' file as necessary. (The 'SPCRule.csv' file will not be changed with the update of Real-time Statistic Diagnosis Tool.)
- When any of the following conditions are applied in the selected SPC rule, an error occurs. In this case, modify it in the 'SPCRule_new.csv' file
  In the judgment type (n/m) 1 to 4, the value of 'n' is more than that of 'm' (n > m).
  In the judgment type (n/m) 1 to 4, the value of 'n' or 'm' is less than '1'.
  In the judgment type (n/m) 1 to 4, all of the judgement type are undefined or with incorrect names.

Point

- Judgment is performed in order from the judgment type (n/m)1 to (n/m)4, and stopped when an error is detected.
- There is no restriction on combinations of judgment types which can be defined in "Judgment type (n/m)1" to "Judgment type (n/m)4".

Creating SPC

Create the SPC specification value.

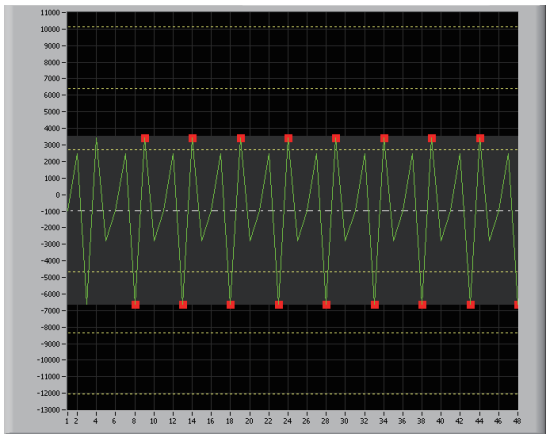
SPC specification values can be modified by editing 'SPC specification value setting file'.

For details, refer to the following:

☞ Page 197 Editing an SPC specification value

Operating procedure

1. Click the [Create SPC] button.
2. Statistic data of the period specified by "From" and "To" is used to calculate the standard deviation (σ), maximum value (upper management limit), and minimum value (lower management limit), and SPC specification values ('SPC specification value setting file') are created based on them.
3. When an error is detected, the ■ mark is plotted for data with the error.



Point

- Since the standard deviation is calculated from the read data, preparing data for sufficient sections ensures creation of an accurate SPC standard value.
- SPC can also be created by specifying a filtering text name. In this case, a file different from the SPC specification value setting file crated without specifying the filtering text name is created.
- Determine which judgment rule was used to detect the error from the color of plotted ■.
  Judgment rule 1: Red
  Judgment rule 2: Pink
  Judgment rule 3: Yellow
  Judgment rule 4: Light blue

Precautions

- The following two patterns of the SPC specification value setting file can be created (one for each) for a single variable:
  When the filtering text name is specified
  When the filtering text name is not specified
  Therefore, if an SPC specification value setting file for the condition when the filtering text name is specified or is not specified has already been created, the [Create SPC] button for the corresponding condition is disabled.
- When multiple variables are selected and a variable for which [Create SPC] has already been done for a certain condition is included in them, the [Create SPC] button for that condition is disabled.
- To create SPC again, open a folder that stores an SPC specification value setting file by clicking the [Update Specs(File)] button, delete the file, select a target variable again, then click the [Create SPC] button.

Editing an SPC specification value

The SPC specification values can be modified by editing an SPC specification value setting file.

An SPC specification value setting file can be edited in the screens displayed by clicking the following buttons:

- [Update Specs(GUI)] button (☞ Page 197 Updating specifications (GUI))
- [Update Specs(File)] button (☞ Page 199 Updating specifications (file))

■ Updating specifications (GUI)

The following shows the operating procedure for editing an SPC specification value setting file by clicking the [Update Specs(GUI)] button.

Precautions

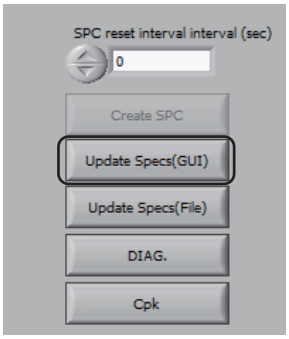
The [Update Specs(GUI)] button can be clicked when all the following conditions are satisfied:

- Only one variable is selected as a diagnosis target.
- An SPC rule is selected.
- An SPC specification value setting file for the diagnosis target variables is created.
- The "Filter display range by variable" screen*1 is not displayed.

*1 Appears by clicking the [FLT] button in the SPC screen.

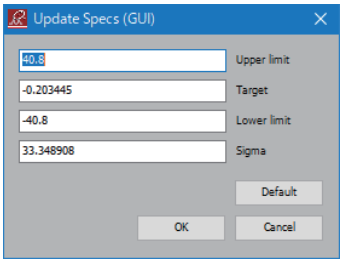
Operating procedure

1. Click the [Update Specs(GUI)] button.



2. Edit SPC specification values (upper limit, target, lower limit, and sigma) in the "Update Specs(GUI)" screen, and click the [OK] button.

The edited SPC specification values are applied to an SPC specification value setting file as well as to a graph in the SPC screen.



Item	Description
Upper limit	Set the upper limit for the management value of statistics selected in the SPC screen.*1*2 By default, the value that is obtained by adding a margin*4 to the maximum value of the statistics for each section included in the period specified for "From" and "To" of a selected variable is set.
Target	Set the value to be used as the center line of statistics selected in the SPC screen.*1*2 By default, the average value of the statistics for each section included in the period specified for "From" and "To" of a selected variable is set.
Lower limit	Set the lower limit for the management value of statistics selected in the SPC screen.*1*2 By default, the value that is obtained by subtracting a margin*4 from the minimum value of the statistics for each section included in the period specified for "From" and "To" of a selected variable is set.
Sigma	Set the standard deviation of statistics selected in the SPC screen.*1*3 By default, the standard deviation (1 sigma) of the statistics for each section included in the period specified for "From" and "To" of a selected variable is set.
[Default] button	Click this to restore the default values for the SPC specification values in the "Update Specs(GUI)" screen.

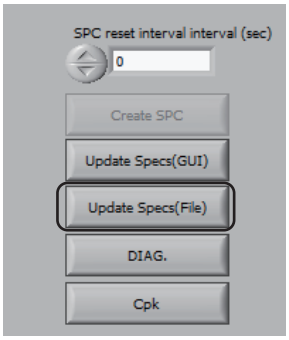
*1 Available number of characters: 1 to 22 characters (significant digits of mantissa: 15 digits)
*2 Available numeric values: 0, 2.22507385850721E-308 (absolute value) to 1.79769313486231E308 (absolute value).
*3 Available numeric values: 0, 2.22507385850721E-308 to 1.79769313486231E308
*4 The margin is 1% of the width from the minimum value to the maximum value of statistic.

■ Updating specifications (file)

The following shows the operating procedure for editing an SPC specification value setting file by clicking the [Update Specs(File)] button.

Operating procedure

1. Click the [Update Specs(File)] button.



2. Select an SPC specification value setting file.

An SPC specification value setting file name is assigned as follows:

File name[*1]: UNIT_(unit name)_(filtering text name)_SPC creation target variable name.csv

*1 When a filtering text name is not specified, it is not displayed.

(Example) When a unit name is LOG, a filtering text name is not specified, and an SPC creation target variable name is D0, the file name is 'UNIT_LOG_D0.csv.'

3. Edit the specification values of "Upper limit," "Lower limit," "Target," and "Sigma" for each statistics data item.

Item	Description
Upper limit	Set the upper limit for the management value. By default, the value that is obtained by adding a margin[*1] to the maximum value of the statistics for each section included in the period specified for "From" and "To" of a selected variable is set.
Lower limit	Set the lower limit for the management value. By default, the value that is obtained by subtracting a margin[*1] from the minimum value of the statistics for each section included in the period specified for "From" and "To" of a selected variable is set.
Target	Set the value to be used as the center line. By default, the average value of the statistics for each section included in the period specified for "From" and "To" of a selected variable is set.
Sigma	Set the standard deviation. By default, the standard deviation (1 sigma) of the statistics for each section included in the period specified for "From" and "To" of a selected variable is set.

*1 The margin is 1% of the width from the minimum value to the maximum value of statistic.

Precautions

- When editing a CSV file in a text editor, be careful not to add or delete control symbols such as commas.

Starting diagnosis using SPC rule

Diagnosis starts using the specified SPC rule.

Operating procedure

1. Click the [DIAG.] button.
2. Click the [Diagnostics start] button.

Point

Clicking the [DIAG.] button ⇨ [Read set value] button reads a setting being diagnosed or stopped.

Precautions

The settings for Monitor must be set in advance to cooperate with Real-time Flow Manager when an error is detected.

☞ Page 407 Monitor

Updating diagnosis definition

If the diagnosis rule is changed after starting diagnosis, the changed rule is used.

Operating procedure

1. Click the [DIAG.] button.
2. Click the [Diagnostics definition update] button.

Stopping diagnosis

Stop diagnosis.

Operating procedure

1. Click the [DIAG.] button.
2. Click the [Stop diagnostics] button.

Displaying Cpk chart

A Cpk chart is displayed in the trend chart (Statistics) display screen when the SPC specification value is created by clicking the [Create SPC] button.

Cpk (process capability index) represents how accurately the production line (process) can manufacture products by an index (numeric value).

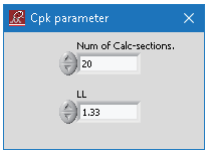
The Cpk value allows for evaluating the process capability.

For details, refer to the following:

☞ Page 201 Evaluating process capability by Cpk value

Operating procedure

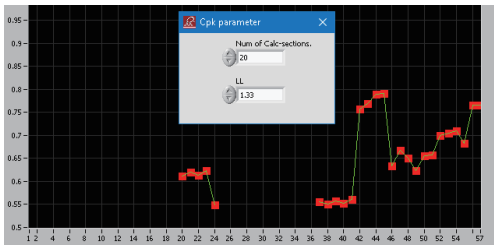
1. Click the [Cpk] button.
2. Set each item.



Item	Description
Num of Calc-sections.	Enter the number of sections used for calculating Cpk (2 to 1000).
Lower limit	Enter the lower limit value of Cpk (0.0000 to 10000.0000).

3. A Cpk chart is shown.

■ mark is plotted for data lower than the specified lower limit of Cpk.



Point

Cpk can be calculated by the following equation:

- Cpk = min{((Upper management limit) - (Average value of specified section)) / 3(σ of specified section), ((Average value of specified section) - (Lower management limit)) / 3(σ of specified section)}

■ Evaluating process capability by Cpk value

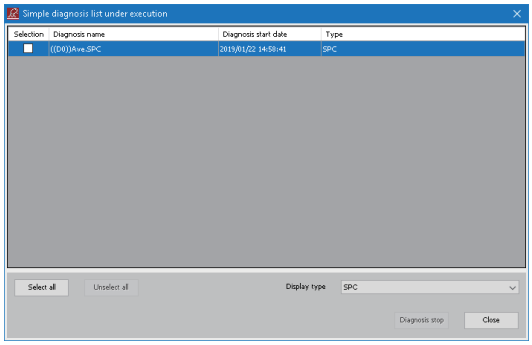
The Cpk value allows for evaluating the process capability as follows:

Cpk value	Description
Cpk≥1.67	Process capability is more than sufficient and there is almost no possibility to produce non-conforming products. A little variation of characteristic values including long-term fluctuation will not be a problem. It the current management is too strict, it can be mitigated.
1.67>Cpk≥1.33	Process capability is sufficient and a problem will not occur if the process is stabilized within this performance range and proper maintenance and management are provided.
1.33>Cpk≥1.00	Process capability exists but is not sufficient. For a critical characteristic, improvement is required to raise Cpk to 1.33 or higher. Continuous improvement is necessary to ensure Cpk is maintained at 1.33 or higher even for the internal specifications.
1.00>Cpk	Process capability is insufficient and it is necessary to inspect all produced products. This results in increase of costs due to additional inspection and yield loss caused by non-conforming products, and requires quick improvement to raise Cpk to 1.00 or higher.

Displaying simple diagnoses being executed

By clicking the [Diagnosing] button during simple diagnosis, diagnoses being executed are displayed in a list. In addition, diagnoses being executed can also be stopped in the list.

Window



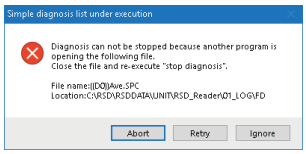
Displayed items

Item	Description
Select	The selected status of the execution target for the [Stop diagnostics] button is displayed. • Selected: Execution target • Not selected: Not execution target
Diagnosis name	The names of simple diagnoses being executed are displayed.
Diagnosis start date	The start date (YYYY/MM/DD hh:mm:ss) of simple diagnosis being executed is displayed.
Type	The type of simple diagnosis is displayed. • SPC: SPC • Multivariate analysis (single central value format) (T2): Multivariate analysis (single central value format) (When "T2" is selected for "Calc type") • Multivariate analysis (single central value format) (Q): Multivariate analysis (single central value format) (When "Q" is selected for "Calc type") • Multivariate analysis (single central value format) (KNN): Multivariate analysis (single central value format) (When "KNN" is selected for "Calc type") • Multivariate analysis (single central value format) (MT): Multivariate analysis (single central value format) (When "MT" is selected for "Calc type") • Multivariate analysis (single central value format) (EU): Multivariate analysis (single central value format) (When "EU" is selected for "Calc type") • Guard band: Guard band
[Select all] button	This button is enabled when there is an item in the list or an item whose checkbox in the "Selection" column is not selected. Click this to select all checkboxes in the "Selection" column of simple diagnoses.
[Unselect all] button	This button is enabled when there is an item whose checkbox in the "Selection" column is selected. Click this to unselect all checkboxes in the "Selection" column of simple diagnoses.
Display type	The type of simple diagnosis to display in the list can be selected. It is selected by default according to the simple diagnosis type of the screen where the [Diagnosing] button is clicked. • All: All types of simple diagnoses are displayed. • SPC: The simple diagnoses using SPC are displayed. • Multivariate analysis (single central value format): The simple diagnoses using Multivariate analysis (single central value format) are displayed. • Guard band: The simple diagnoses using Guard band are displayed.
[Diagnosis stop] button	This button is enabled when there is an item whose checkbox in the "Selection" column is selected. Click this to stop diagnosis for the item whose checkbox in the "Selection" column is selected. If multiple checkboxes in the "Selection" column are selected, they are stopped one by one.

■ When simple diagnosis cannot be stopped

The following screen appears when simple diagnosis being executed cannot be stopped.

Window



Displayed items

Item	Description
[Abort] button	Click this to cancel stopping simple diagnoses succeeding to the diagnosis which could not be stopped.
[Retry] button	Click this button to retry stopping the simple diagnosis which could not be stopped.
[Ignore] button	Click this button to skip the simple diagnosis which could not be stopped. The next simple diagnosis will be stopped if there is another diagnosis to be stopped.

21.5 Multivariate Analysis (Single Central Value Format)

Statistic calculation of each variable for each section of CSV file data read by Reader, multivariate analysis of statistics, creation of a reference waveform, and diagnosis based on the created reference waveform can be performed with simple operations.

Operating procedure

1. Select [Simple analysis - Simple diagnosis] ⇨ [MVA] ⇨ [Single central value format].
2. Select data to read.

☞ Page 178 Selecting read data

3. Create a reference waveform for diagnosis.

☞ Page 208 Creating the reference waveform

4. Start diagnosis.

☞ Page 210 Starting diagnosis

5. If the diagnosis rule is changed after starting diagnosis, the changed rule is used.

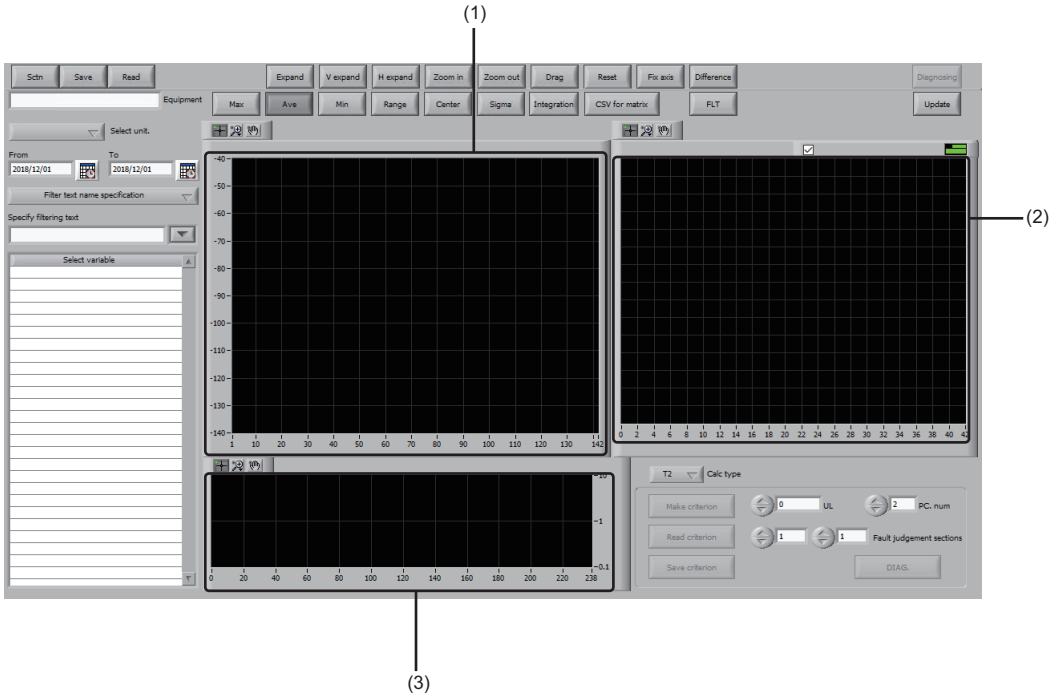
☞ Page 200 Updating diagnosis definition

6. Stops diagnosis.

☞ Page 200 Stopping diagnosis

Screen configuration

The following shows the screen configuration for multivariate analysis (single central value format).



Displayed items

Item	Description
(1) Trend chart (statistics) display screen	Shows the statistics for a variable selected from the "Select variable" list. • The vertical axis is automatically scaled according to the maximum and minimum values of the displayed waveform. Note that when multiple variables are selected, the vertical axis values are not displayed. • Numbers corresponding to the number of units of data (sections) included in the period specified for "From" and "To" are displayed on the horizontal axis.
(2) Histogram/scatter chart/trend graph (reference waveform) display screen	Shows the histogram for a variable selected from the "Select variable" list. When two or more variables are selected from the "Select variable" list, the scatter chart is shown. By clicking the [Make criterion] button, a waveform to be referenced of diagnosis is displayed. ☞ Page 208 Creating the reference waveform
(3) Calculation result display screen	Shows the result of calculation performed on the reference waveform according to the selected calculation type.
Select variable	Select the statistic of a variable to be displayed for a specified equipment, unit, and period. By selecting multiple variables, the statistics can be displayed vertically.
[Sctn] button	Click this to display the section list. The statistics of all sections are displayed in the statistic display. When selecting the section data in the section list while the cursor is displayed, the waveform of the section is snapped by the cursor. In addition, when snapping a waveform by the cursor, the corresponding section data in the section list is selected. When hiding the data of all sections in the section list, the statistics of all sections before narrowing down or hiding is displayed. ☞ Page 171 Selecting section list
[Difference] button	Shows a differential value of two successive points on a waveform. 'Y value of a succeeding point' - 'Y value of a preceding point' is shown. If the Y value is increasing, a positive value is shown.
[Max] button*1	Click this to display the maximum value of a waveform for each section.
[Ave] button*1	Click this to display the average value of a waveform for each section.
[Min] button*1	Click this to display the minimum value of a waveform for each section.
[Range] button*1	Click this to display the difference between the maximum and minimum values of a waveform for each section.
[Center] button*1	Click this to display the median of a waveform for each section.
[Sigma] button*1	Click this to display the standard deviation of a waveform for each section.
[Integration] button*1	Click this to display the integral value (area) for each section.

Item		Description
Calc type	—	Select the calculation type.
	T2	Diagnosis is performed using the Hotelling T2 (Mahalanobis) distance as the upper limit value. Multicollinearity errors can be avoided. The number of principal components needs to be specified for calculation. It is assumed that the Gauss distribution is followed.
	Q	Diagnosis is performed using the Q statistic as the upper limit value. Multicollinearity errors can be avoided. The number of principal components needs to be specified for calculation. It is assumed that the Gauss distribution is followed.
	KNN	Diagnosis is performed using the standardized Euclid distance as the upper limit value. Calculates the average distance from the points in the reference for the number of Ks closest to the diagnostic point. Applied when the distribution includes a non-linear pattern.
	MT	Diagnosis is performed using the MT (Mahalanobis-Taguchi) distance as the upper limit value. A multicollinearity error may occur between highly correlated variables It is assumed that the Gauss distribution is followed.
	EU	Diagnosis is performed using the standardized Euclid distance from the center of gravity of the criterion space (criterion matrix) as the upper limit value. Standardized Euclid distance = ((diagnosis value - average of criterion matrix) / σ of criterion matrix)^2 It is applied when variables are totally not correlated.
Upper limit		Set the upper limit value (0.0000 to 1000.0000) for diagnosis.
PC. num*2		Set the number of principal components (1 or 2).
K number*3		Set the number of Ks (1 to 1000).
Fault judgement sections		Set the number of times of upper limit excess. When the set number is exceeded, an error is detected. Enter the number of error occurrences (1 to 1000) in the left text box and the number of determination sections (1 to 1000) in the right text box. (Example) When entering '2' in the left text box and '5' in the right text box: It is regarded as an error when the upper limit value is exceeded for two or more times in consecutive five sections.
[Make criterion] button		Click this to create the reference waveform.
[Read criterion] button		Click this to read the saved reference waveform. For the path of a file to be read, up to 255 characters (two characters are used for a double-byte character) including the extension can be specified.
[Save criterion.] button		Click this to specify a reference name (up to 255 characters) and save the reference waveform. Setting parameters are not saved. When saving a reference waveform, the following prefixes are set for the file name corresponding to the settings when creating the reference waveform. Set a name after the prefixes since the prefixes cannot be changed. (If they have been changed, an error will occur and the reference waveform cannot be saved.) • UNIT_(unit name)_(statistics name)_(filtering text name)_(filtering text value)_ If the file is saved in a folder other than 'Reader equipment data folder' and 'RSD dataset folder, the file needs to be moved manually to the migration destination when migrating the settings to Real-time Statistic Diagnosis Tool installed in another industrial PC. ☞ Page 120 Migrating settings to Real-time Statistic Diagnosis Tool in another industrial PC, Page 121 Project File Setting Utility
[DIAG.] button		Click this to start diagnosis in multivariate analysis (single central value format).
[Diagnosing] button		This button is enabled when simple diagnosis (SPC diagnosis, multivariate analysis (single central value format), or guard band diagnosis) is performed. Click this button to open the "Simple diagnosis list under execution" screen. ☞ Page 202 Displaying simple diagnoses being executed

*1 Only one of the following buttons can be selected: [Max], [Ave], [Min], [Range], [Center], [Sigma], and [Integration] buttons.
*2 It is displayed when "T2" or "Q" is selected for "Calc type".
*3 Shown when "KNN" is selected for "Calc type".

The other items are the same as those described in the following section.

☞ Page 165 Screen configuration

Note that the following items are not included.

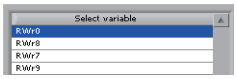
- [Overlay] button
- [Multi] button
- [CV] button
- [Lock] button
- [Scl-fit.] button
- [Parallel] button
- [3D] button
- Histogram
- [Var.] tab
- [EQ Def] tab

Creating the reference waveform

Create a reference waveform for diagnosis.

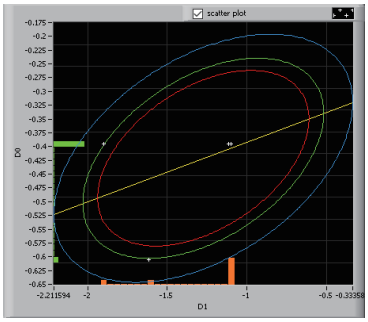
Operating procedure

1. Select multiple variables in the "Select variable" list. Two or more variables must be selected to create the reference waveform.

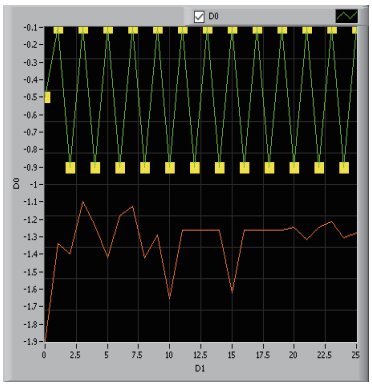


2. The scatter diagram is shown on the histogram/scatter chart/trend graph (reference waveform) display screen.

Probability ellipses for 99%, 95%, and 90% and regression lines are displayed. When correlation exists with the hazard rate of 5%, the background is shown in blue.



3. Click the [Make criterion] button. The reference waveform is displayed in the histogram/scatter chart/trend graph (reference waveform) display screen.



Point

The number of sections of the reference waveform must be equal to or more than the number of the selected variables.

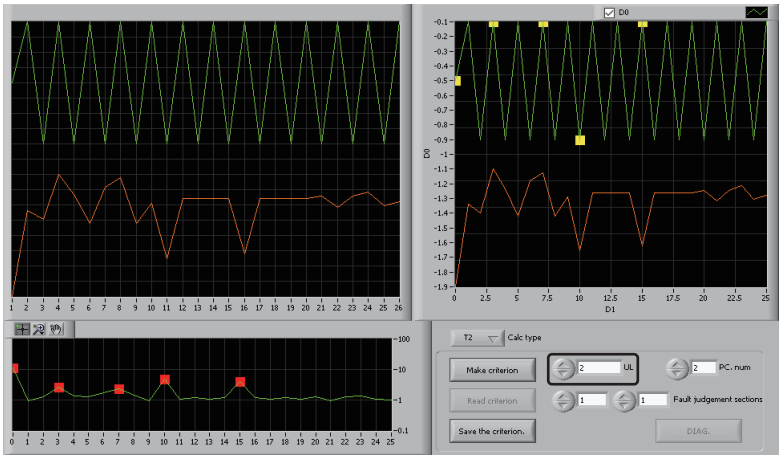
4. Set the calculation type and parameters.

For details on the calculation types and parameters, refer to the following:

☞ Page 205 Screen configuration

5. The calculation result is displayed in the calculation result display screen.

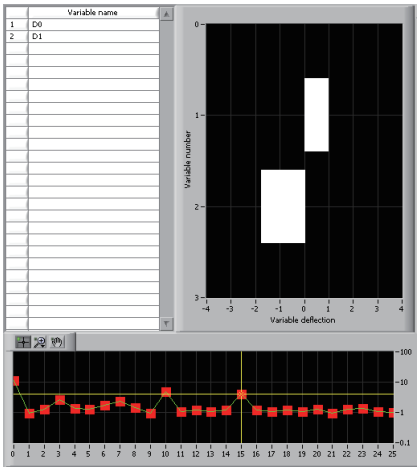
6. When "Upper limit" is less than the maximum value, a marker (reference waveform: yellow, calculation result: red) is displayed at each portion exceeding the maximum value on the histogram/scatter chart/trend graph (reference waveform) display screen and the calculation result display screen.



Point

- The settings in "Fault judgement sections" are not applied to the error markers displayed in the histogram/scatter chart/trend graph (reference waveform) screen. (All error markers are displayed.)
- For the error markers displayed in the 'Calculation result display' screen, the settings in 'Fault judgement sections' are applied.

7. Right-click on the calculation result display screen and select [+], [|], or [--] from [Cursor] to display the cursor.
By snapping a graph using a cursor, the variable deviation graphs for each variable in the snapped section are displayed.

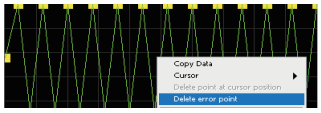


Point

Variable deviation can be calculated by the following equation.
Variable deviation = (variable value in a snapped section - average value of the reference waveform of the variable) / (standard deviation of the reference waveform of the variable)

8. Right-click on the histogram/scatter chart/trend graph (reference waveform) display screen and select [Delete error point].

Delete error sections from the histogram/scatter chart/trend chart (reference waveform) display screen.



Point

When the error sections are deleted, the calculation result display screen is also updated. Determine the upper limit and start diagnosis again with the markers hidden.

Precautions

- Only one reference waveform is created for each unit. In addition, a reference waveform is created for a selected variable and a selected section.
- When a variable of which the statistic does not change is selected, the reference waveform for the variable will not be created.
- When performing a diagnosis after deleting an abnormal section from the reference waveform, click the [DIAG.] button without clicking the [Make criterion] button. If the [Make criterion] button is clicked, the deleted abnormal section will be restored.

Starting diagnosis

Start diagnosis according to the set parameters.

Operating procedure

1. Click the [DIAG.] button.

2. Click the [Diagnostics start] button.

Point

Clicking the [DIAG.] button ⇨ [Read set value] button reads a setting being diagnosed or stopped.

Precautions

- When starting diagnosing, saving or reading the reference waveform (by clicking [Save criterion.] or [Read criterion] button) is required.
- The settings for Monitor must be set in advance to cooperate with Real-time Flow Manager when an error is detected.

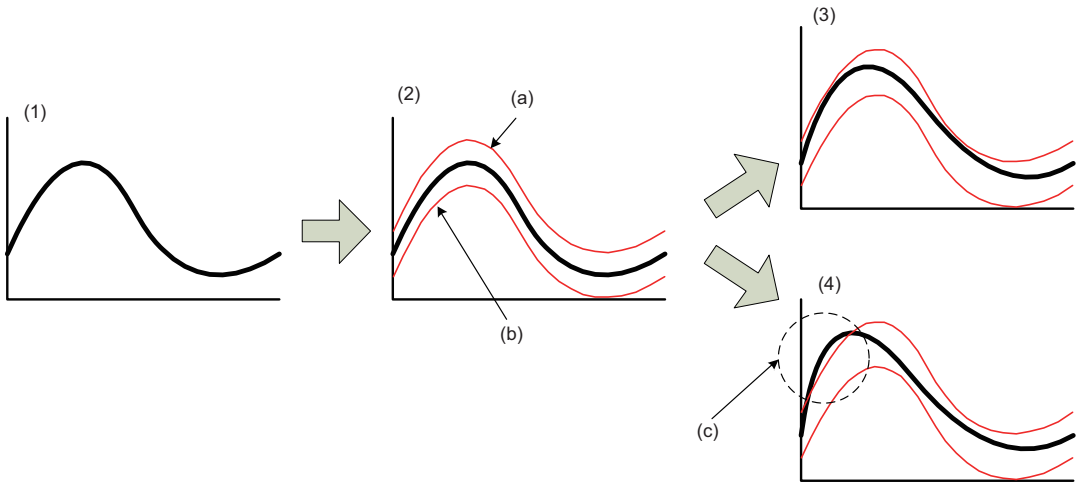
☞ Page 407 Monitor

21.6 Guard Band Diagnosis

Create a guard band to perform a diagnosis by determining the range of values regarded to be normal based on the CSV file data read by Reader.

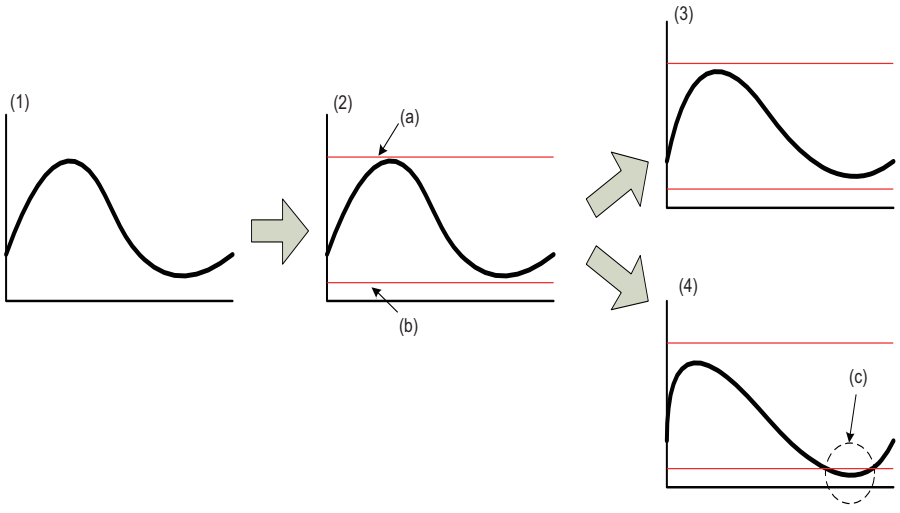
The following two cases are possible for performing a diagnosis using a guard band.

- Diagnosis by creating a guard band based on the reference waveform



(1) Reference waveform
(2) Create a guard band
(3) No error
(4) Error
(a) Guard band upper limit
(b) Guard band lower limit
(c) Error domain

- Performing diagnosis by setting the upper and lower limits



(1) Reference waveform
(2) Set the upper and lower limits
(3) No error
(4) Error
(a) Upper Limit
(b) Lower Limit
(c) Error domain

Point

For a reference waveform, multiple sections can be selected.

Operating procedure

1. Select [Simple analysis - Simple diagnosis] ⇨ [Guard band].
2. Select data to read.

☞ Page 178 Selecting read data

Point

Only one variable can be selected.

3. Select the guard band type.

☞ Page 216 Selecting guard band type

4. Create a guard band.

☞ Page 216 Creating guard band

5. Start diagnosis.

☞ Page 217 Starting guard band diagnosis

6. If the diagnosis rule is changed after starting diagnosis, the changed rule is used.

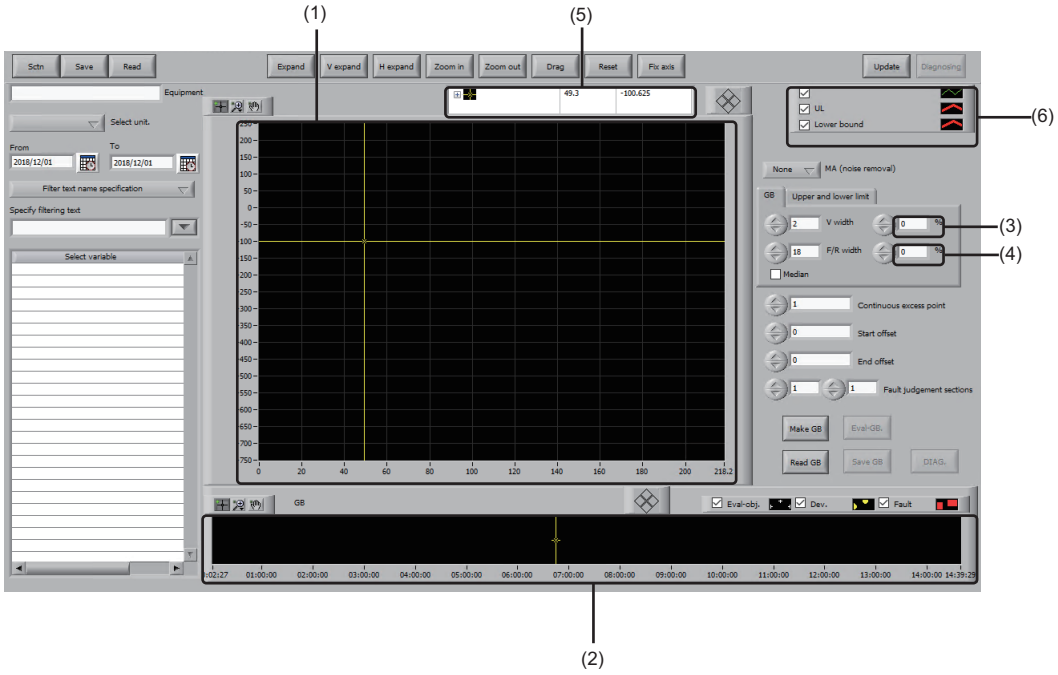
☞ Page 200 Updating diagnosis definition

7. Stops diagnosis.

☞ Page 200 Stopping diagnosis

Screen configuration

The following shows the screen configuration for a guard band diagnosis.



Displayed items

Item		Description
(1) Trend graph (waveform) display screen		Shows the waveform for a variable selected from the "Select variable" list. • The vertical axis is automatically scaled according to the maximum and minimum values of the displayed waveform. • The horizontal axis shows the number of seconds from the start point of the section. The display status of the waveform currently snapped (grabbed) by the cursor can be switched to hide. ☞ Page 169 Hiding a waveform
(2) GB evaluation result display screen		Shows the result of diagnosis performed by clicking the [Eval-GB.] button for data during the period specified by the period specified for "From" and "To".
Select variable		Select a variable to be displayed for a specified equipment, unit, and period. Multiple variables cannot be selected.
MA (noise removal)		Set when calculating the moving average of the waveform, rejecting noises, and creating a GB waveform. Specify the number of points to calculate the moving average.
[GB] tab	—	Set parameters used for creating a guard band based on a waveform. Specify a numeric value or percentage for each parameter to create a guard band.
	V width	Specify a value (0.0000 to 2147483647.0000) that indicates how much a new guard band shifts up or down along the Y axis of a reference waveform. This setting is effective when the "V width (%)" value is '0'.
	(3) V width (%)	Specify the percent of the maximum amplitude (0.000 to 100.0000) that indicates how much a new guard band shifts up or down along the Y axis of a reference waveform. This setting is effective when its value is not "0".
	F/R width	Specify a value (0 to 2147483647) that indicates how much a new guard band shifts left or right along X axis of a reference waveform. This setting is effective when the "F/R width (%)" value is '0'.
	(4) F/R width (%)	Specify the maximum section length (0.000 to 100.0000) that indicates how much a new guard band shifts left or right along X axis of a reference waveform. This setting is effective when its value is not "0".
	Median	Creates a guard band using the median of the displayed waveform as the reference waveform.

Item		Description
[Upper and lower limit] tab	—	Set parameters used for creating a guard band by specifying the upper and lower limits. Enter a number so that the upper limit value is bigger than the lower limit value.
	Upper limit	Specify the upper limit value (-2147483648.0000 to 2147483647.0000).
	Lower limit	Specify the lower limit value (-2147483648.0000 to 2147483647.0000).
Continuous excess point		Specify the number (1 to 2147483647) of consecutive excess points to determine that a value deviates from the guard band. A point in which a value matches with the guard band is also regarded it deviates the guard band.
Start offset		Starting from the start point of a section, specify the positive number of points (0 to 2147483647) at which the guard band is started.
End offset		Specify a number (-2147483648 to 0) of point at which the guard band is ended starting from the section end point.
Fault judgement sections		Specify the total number of consecutive sections and what number section at which a deviation occurs out of the specified consecutive sections to define a diagnosis result as an error. It is regarded as an error when the guard band deviates in the specified section out of the specified number of consecutive sections. Set the numerator (1 to 1000) in the left text box and the denominator (1 to 1000) in the right text box. (Integer only) (Example) When '2' is entered in the left field and '3' is entered in the right field It is judged to be an error when two sections out of three consecutive sections deviate from GB.
[Make GB] button		Create a guard band.
[Eval-GB.] button		Diagnoses data during the period specified by the period specified for "From" and "To" and shows the result in the GB evaluation result area.
[Read GB] button		Reads the saved guard band setting value (save file[*1]) by selecting the value. For the path of a file to be read, up to 255 characters (two characters are used for a double-byte character) including the extension can be specified.
[Save GB] button		Saves the setting value of the guard band in the format of Real-time Data Analyzer or programmable controller. ☞ Page 217 Saving the guard band • The default save file name is shown below. (It can be changed to any name within 255 characters including an extension.) • UNIT_(unit name)_(variable name selected in "Select variable")_(specified filtering text name)_(text value selected for filtering text specification).GB • For the path of a file to be saved, up to 255 characters (two characters are used for a double-byte character) including the extension can be specified. • If the file is saved in a folder other than 'Reader equipment data folder' and 'RSD dataset folder, the file needs to be moved manually to the migration destination when migrating the settings to Real-time Statistic Diagnosis Tool installed in another industrial PC. ☞ Page 120 Migrating settings to Real-time Statistic Diagnosis Tool in another industrial PC, Page 121 Project File Setting Utility
[DIAG.] button		Diagnosis starts using the guard band.
(5) Cursor legend		The legend of the waveform currently snapped (grabbed) by the cursor can be displayed. Effective while the cursor is shown on the chart. For showing or hiding the cursor, refer to the following: ☞ Page 177 Show and Hide Cursor
(6) Chart legend		Shows the legend of the waveform, upper limit, or lower limit chart. The chart can be shown or hidden by checking or unchecking the legend. The name of a legend can be changed arbitrarily, but it returns to the original name if selecting a variable again.
[Diagnosing] button		This button is enabled when simple diagnosis (SPC diagnosis, multivariate analysis (single central value format), or guard band diagnosis) is performed. Click this button to open the "Simple diagnosis list under execution" screen. ☞ Page 202 Displaying simple diagnoses being executed

*1 Only files in the Real-time Data Analyzer format can be read.

The other items are the same as those described in the following section.

☞ Page 165 Screen configuration

Note that the following items are not included.

- [Multi] button
- [Overlay] button
- [3D] button
- [CV] button
- [FLT] button
- [Lock] button
- [Scl-fit.] button
- [Max] button
- [Min] button
- [Ave] button
- [Range] button
- [Center] button
- [Sigma] button
- [Parallel] button
- [CSV for matrix] button
- Histogram
- [Var.] tab
- [EQ Def] tab

Selecting guard band type

Select the guard band type.

Operating procedure

1. Click the [GB] or [Upper and lower limit] tab depending on the type of the guard band to create.
2. Set the parameters for creating the guard band.

For the parameters, refer to the following:

☞ Page 213 Screen configuration

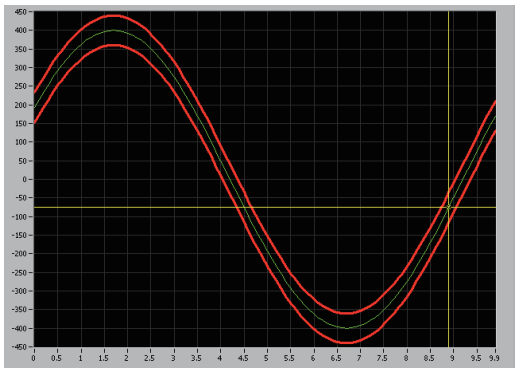
Creating guard band

Create a guard band.

Operating procedure

1. Click the [Make GB] button.

The guard band is created.



Point

When snapping a waveform (reference waveform or guard band) by the cursor, the data number of the snapped area (the number counted from the first waveform) and the number of data points of the entire waveform will be displayed on the upper left in the trend graph (waveform) display screen as follows.

- (data number) / (number of data points)

Starting guard band diagnosis

Diagnosis starts using the created guard band.

Operating procedure

1. Click the [DIAG.] button.
2. Click the [Diagnostics start] button.

Point

Clicking the [DIAG.] button ⇨ [Read set value] button reads a setting being diagnosed.

Precautions

- If the [Diagnosing] button is clicked and the diagnosis file is deleted, the set values are also deleted and cannot read even by clicking the [Read set value] button.
- The settings for Monitor must be set in advance to cooperate with Real-time Flow Manager when an error is detected.

☞ Page 407 Monitor

Saving the guard band

Save upper and lower limit waveforms of a created guard band.

Operating procedure

1. Click the [Save GB] button.

The created guard band is saved.

■ Save format

The following table shows the format when saving a guard band.

Format (extension)	Description
Real-time Data Analyzer format (.GB)	This format is available in Real-time Data Analyzer. Saved guard bands can be read by using the [Read GB] button.
Programmable controller format (.PGB)	This format is available in a programmable controller. For details on this format, refer to the following: ☞ Page 386 Guard band diagnosis

Point

When the extension not corresponding to the selected format is specified, the correct extension is automatically added and the guard band is saved.

21.7 Creating Correlation Matrix

Correlation analysis can be performed by reading a CSV file offline and creating a correlation matrix.
The following lists types of CSV files which can be used to create a correlation matrix.

Classification	Description
Create in Real-time Statistic Diagnosis Tool	CSV file created by clicking the [CSV for matrix] button on the following function screens: ☞ Page 164 Displaying Read Data ☞ Page 179 Displaying Read Data Statistics ☞ Page 182 Displaying Read Data Frequency ☞ Page 188 SPC ☞ Page 204 Multivariate Analysis (Single Central Value Format)
	CSV file created by extracting statistics and saving them in the CSV format in 'Editing Logics' ☞ Page 250 Editing Logics
	CSV file created by saving variable values in the CSV format in 'Editing Logics' ☞ Page 250 Editing Logics
CSV files created manually	CSV file created according to the standard format

A created correlation matrix can be used in the following sections.
☞ Page 238 Multiple Regression Analysis (LMR)
☞ Page 245 Maharanobis - Taguchi method (MT)

Point

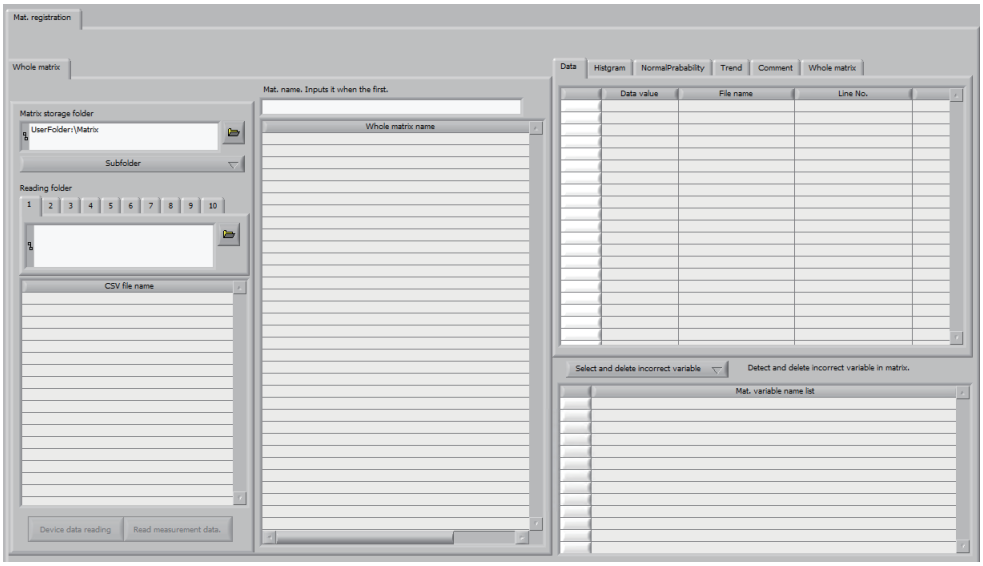
The CSV file must contain the column item title on the first line and data on the second and later lines. (No time stamp column is required.)

Operating procedure

1. Select [Advanced analysis] ⇨ [Create correlation matrix].
2. Create a whole matrix.
☞ Page 221 Creating whole matrix
3. Delete incorrect variables from the created whole matrix.
☞ Page 223 Deleting an incorrect variable
4. Add measurement data to the whole matrix.
☞ Page 224 Adding measurement data to a whole matrix
5. Create a partial matrix.
☞ Page 227 Creating partial matrix
6. Display and analyze the correlation graph.
☞ Page 231 Correlation analysis by using a correlation graph

Screen configuration

The following shows the screen configuration for creating a correlation matrix.



Item		Description
[Whole matrix] tab	—	Read a CSV file and create and operate the whole matrix.
	Matrix storage folder*1	Specify a folder path to save a matrix (up to 256 characters). If the file is saved in a folder other than 'Reader equipment data folder' and 'RSD dataset folder, the file needs to be moved manually to the migration destination when migrating the settings to Real-time Statistic Diagnosis Tool installed in another industrial PC. ☞ Page 120 Migrating settings to Real-time Statistic Diagnosis Tool in another industrial PC, Page 121 Project File Setting Utility
	[Subfolder] button	When creating a subfolder for each equipment in a matrix storage folder specified for "Matrix storage folder", select the subfolder.*1
	Reading folder*1	Specify the folder path in which a CSV file containing equipment data is stored (up to 256 characters). Up to ten folders can be registered or selected.
	CSV file name	Shows the name of the CSV file saved in the folder specified in "Reading folder".
	[Device data reading] button	Reads the highlighted CSV file(s) as the whole matrix.
	[Read measurement data.] button	Inserts measurement data into the created whole matrix.
	Please input Matrix name first.	Enter the name of a whole matrix to be displayed in "Whole matrix name" (up to 32 characters).
	Whole matrix name	Shows the existing whole matrices. Highlight a whole matrix name to display the tab for that whole matrix.
[Data] tab		Shows the data value of the matrix variable selected "Mat. variable name list".
[Histogram] tab		Shows the histogram of the matrix variable selected "Mat. variable name list".
[NormalPrabability] tab		Shows the normal probability chart of the matrix variable selected "Mat. variable name list". The vertical axis of the normal distribution chart shows the predicted accumulated probability (%) while the horizontal axis shows the observed accumulated probability (%).
[Trend] tab		Shows the trend chart of the matrix variable selected "Mat. variable name list".
[Comment] tab		Shows a comment automatically added when reading a file by clicking the [Device data reading] button.
[Whole matrix] tab		Shows the created whole matrices.

Item		Description
[Select and delete incorrect variable] button	—	Detects and deletes incorrect variables in the matrix.
	Delete highlight variable.	Deletes highlighted (selected) variables and creates a matrix. Columns of the matrix contain variable names and rows contain points (samples).
	Highlight the variable which the value doesn't change.	Highlights (selects) variables which have unchanging values. Variables with a constant value or no value are excluded from a correlation analysis. A constant value can be read if the variable is read as a string.
	Highlight the variable that the number of points doesn't come up to the number of variables.	Highlights (selects) variables which have the less number of points than the number of variables. When the number of points (sample number) is less than the number of variables, a correlation analysis can be performed, but Multiple regression analysis and Maharanobis-Taguchi method can not be performed.
	Retrieve variable in which matrix is empty	Searches for and highlights (selects) a variable which has data only in one of the same rows of two or more variables (i.e., an exclusive variable). An exclusive variable causes the matrix to become empty and a partial matrix cannot be created.
	Retrieve variable of minimum points	Highlights (selects) a variable which has the least number of points (sampling count). When any of variables has extremely few number of points, the number of points of the matrix is adjusted to that (extremely few) number of points.
Mat. variable name list		Shows the matrix variable names.

*1 Do not specify a folder with the encryption attribute enabled.

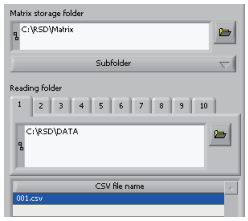
Creating whole matrix

A whole matrix to be a base of correlation analysis can be created by reading equipment data (data to be subjected to correlation analysis) in the CSV file format.

Operating procedure

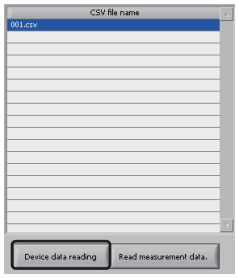
1. Specify a folder path to save a created whole matrix in "Matrix storage folder" and a folder path in which a CSV file used for creating a correlation matrix is stored in "Reading folder" (up to 256 characters).

Up to ten folders can be specified in the "Reading folder".



2. When a folder is specified in the "Reading folder", the names of the CSV files saved in the specified folder is listed in "CSV file name".

3. Select a CSV file(s) to create the whole matrix and click the [Device data reading] button.

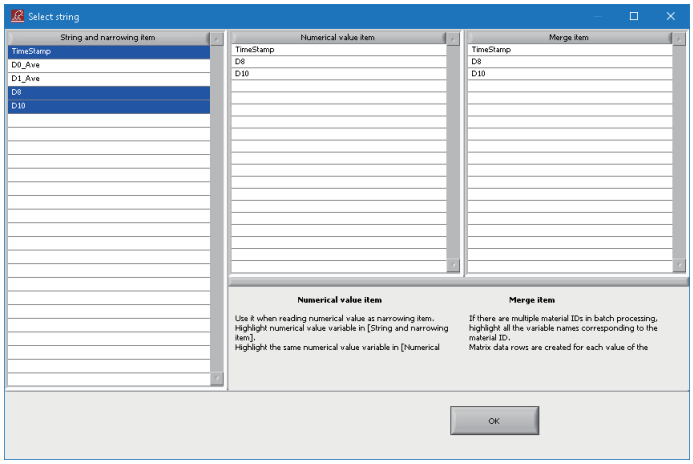


4. Enter the whole matrix name (up to 32 characters) and click the [OK] button.

5. Select a numeric value(s) or string variable(s) to filter the matrix from "String column and filtering item".

Select a corresponding variable in "Numerical value item" for a variable used as a numerical value among variables used for narrowing down.

To merge two or more variables into a single variable, select the merge target variables from "Merge item".



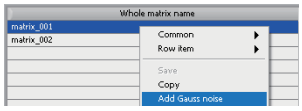
6. After selecting necessary items, click the [OK] button.

7. The whole matrix is created.

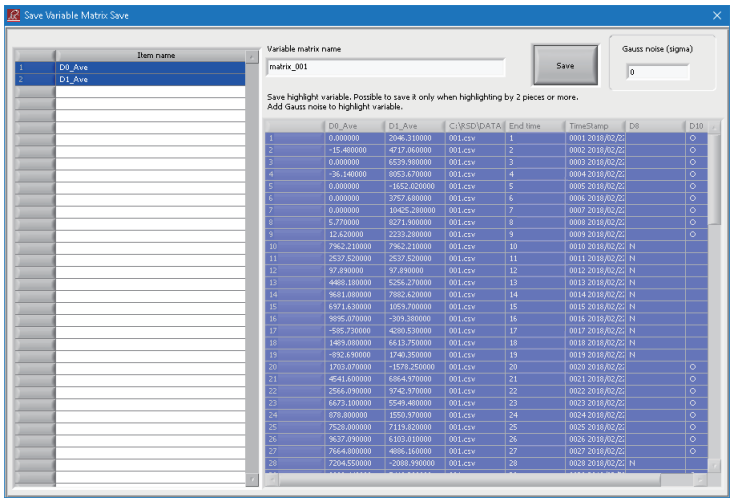
The whole matrix is saved in the folder specified in "Matrix storage folder" with the name '(input whole matrix name).csv'.
When a subfolder is specified, the whole matrix is saved in the subfolder selected by clicking the [Subfolder] button.

8. Apply Gauss noise to data of the created whole matrix to give variation.

Right-click the matrix name in "Whole matrix name" and select [Add Gauss noise].



9. Select the name of a variable to be added a Gauss noise and enter sigma (0.0000 to 100.0000) of a noise in "Gauss noise (sigma)" to add the noise.



10. After adding the Gauss noise, select all variables, enter a name (up to 32 characters) different from the original name of the whole matrix in "Variable matrix name", and click the [Save] button.

The whole matrix with the Gauss noise added is created.

Precautions

- Do not specify a folder with the encryption attribute enabled at the "Matrix storage folder", "Reading folder", and the subfolder selected by clicking the [Subfolder] button.
- When the size of a specified CSV file is too large, a memory overflow error occurs and the file may not be read. In this case, reduce the file size by reducing the number of variables or that of records in the file. (It is recommended to reduce the file size to 10 M bytes or less.)
- If the specified CSV file is too large, a memory overflow error occurs and the matrix may not be read or deleted. In this case, delete the following file or folder:
  Folder specified in "Matrix storage folder"*1\(matrix name).csv
  Folder specified in "Matrix storage folder"*1\Attribute folder/(matrix name folder)

*1 When a subfolder is specified, the subfolder selected by clicking the [Subfolder] button is used.

- If multiple CSV files are selected to create the whole matrix, they are not read unless all of the column item names (on the first row) are identical in all files.
- When setting a folder path in "Matrix storage folder," set the path so that the path length of a setting file to be created in the set folder does not exceed 259 characters. The maximum path length of a setting file is as follows:
  (Set folder)\ + 113 characters (if the whole matrix name and partial matrix name are 32 characters long each)
- When creating a whole matrix with the Gauss noise added, data for the number of sections more than the number of selected variables are required.
- When creating a whole matrix with the Gauss noise added, it cannot be saved as the same name of the original whole matrix (i.e., overwrite it).
- Variables not selected in "String column and filtering item" are regarded as numeric values.
- The variable values are merged as the value of the variable listed top. Same data is copied except for variables targeted for merge.

(1)

Value1	Value2	ID1	ID2	ID3
10	20	1	2	3
20	40	4	5	6
30	60	7	8	9

(2)

Value1	Value2	ID1
10	20	1
10	20	2
10	20	3
20	40	4
20	40	5
20	40	6
30	60	7
30	60	8
30	60	9

(1) Before merge
(2) After merge
(a) ID1, ID2, and ID3 are selected as merge items.

Deleting an incorrect variable

Delete an incorrect variable such as ones which are not required for a correlation analysis from a created whole matrix.

Operating procedure

1. Click the [Select and delete incorrect variable] button, and select an operation content.

For operations, refer to the following:

☞ Page 219 Screen configuration

Adding measurement data to a whole matrix

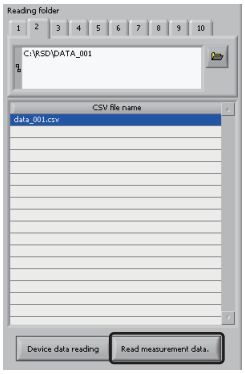
When CSV format measurement data such as quality evaluation data obtained by a product inspection after processing products exists, the data can be added to a created whole matrix.
By linking measurement data and equipment data, more detailed correlation analysis can be performed.
This operation is necessary when the measurement data has been saved in a different file from equipment data.

Operating procedure

1. Select the name of a whole matrix, to which measurement data will be added, in a list, then specify the folder, in which the measurement data has been stored, for "Reading folder".

If the measurement data and equipment data are stored in different folders, select and specify a tab different from that for the equipment data in "Reading folder".

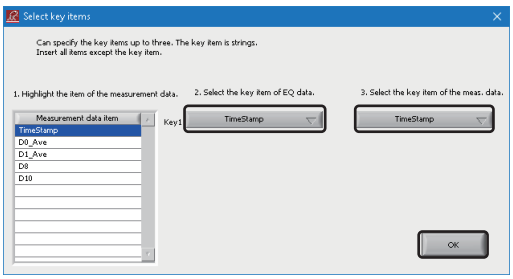
2. Select a CSV file of measurement data to be added (multiple selection available), and click the [Read measurement data.] button.



3. Click the [Yes.] button.

4. Match the equipment data and measurement data.

Select a string item(s) of the measurement data in "Measurement data item". Select the equipment data and measurement data items (up to three items) used for matching, and click the [OK] button.
For details of matching between the measurement data and equipment data, refer to the following:
☞ Page 225 Matching between equipment data and measurement data



5. The measurement data is added in "Mat. variable name list".

Point

A measurement data name is as follows. Equipment data and measurement data can be distinguished in "Mat. variable name list" based on a measurement data name. In addition, it can be identified which tab the measurement data is read from based on an added tab number.

- (Item name) + (read folder name) + (m) + (tab number in "Reading folder" (1, 2, 3))

Precautions

- Do not specify a folder with the encryption attribute enabled as the "Reading folder"
- When the size of a specified CSV file is too large, a memory overflow error occurs and the file may not be read. In this case, reduce the file size by reducing the number of variables or that of records in the file.
  (It is recommended to reduce the total size of the files specified for equipment data or measurement data to 10 M bytes or less.)

■ Matching between equipment data and measurement data

Matching is performed using the matching keys from the bottom row toward the top row of the equipment data whole matrix and measurement data matrix.

If the same matching key appears more than once, the equipment data and measurement data matching for the first time are only paired.

The following shows the matching process with the equipment data and measurement data listed below.

- Equipment data

Value1	Value2	ID1	ID2
10	20	AAA111	ZZZ111
20	40	AAA222	ZZZ222
30	60	AAA333	ZZZ333
40	80	AAA444	ZZZ444
50	100	AAA555	ZZZ555

- Measurement data

Value3	Value4	RecID	LotID
12	21	AAA111	ZZZ111
24	42	AAA223	ZZZ222
31	65	AAA333	ZZZ333
41	81	AAA555	ZZZ555
50	106	AAA555	ZZZ555

Operating procedure

1. Select "RecID" and "LotID" as the key items of the measurement data.

2. Select 'ID1' and 'ID2' as the key items of the equipment data.

3. Match "RecID" with "ID1" and "LotID" with "ID2".

4. The fifth row of the measurement data matches the fifth row of the equipment data, and they are merged.

(1)

Value1	Value2	ID1	ID2
10	20	AAA111	ZZZ111
20	40	AAA222	ZZZ222
30	60	AAA333	ZZZ333
40	80	AAA444	ZZZ444
50	100	AAA555	ZZZ555

(2)

Value3	Value4	RecID	LotID
12	21	AAA111	ZZZ111
24	42	AAA223	ZZZ222
31	65	AAA333	ZZZ333
41	81	AAA555	ZZZ555
50	106	AAA555	ZZZ555

(1) Equipment data
(2) Measurement data

5. The fourth row of the measurement data matches the fifth row of the equipment data. Since the fifth row of the device data has already been matched with the fifth row of the measurement data, the fourth row of the measurement data is discarded.

(1)

Value1	Value2	ID1	ID2
10	20	AAA111	ZZZ111
20	40	AAA222	ZZZ222
30	60	AAA333	ZZZ333
40	80	AAA444	ZZZ444
50	100	AAA555	ZZZ555

(2)

Value3	Value4	RecID	LotID
12	21	AAA111	ZZZ111
24	42	AAA223	ZZZ222
31	65	AAA333	ZZZ333
41	81	AAA555	ZZZ555
50	106	AAA555	ZZZ555

(1) Equipment data
(2) Measurement data

6. The third row of the measurement data matches the third row of the equipment data, and they are merged.

(1)

Value1	Value2	ID1	ID2
10	20	AAA111	ZZZ111
20	40	AAA222	ZZZ222
30	60	AAA333	ZZZ333
40	80	AAA444	ZZZ444
50	100	AAA555	ZZZ555

(2)

Value3	Value4	RecID	LotID
12	21	AAA111	ZZZ111
24	42	AAA223	ZZZ222
31	65	AAA333	ZZZ333
41	81	AAA555	ZZZ555
50	106	AAA555	ZZZ555

(1) Equipment data
(2) Measurement data

7. Since 'RecID' on the second row of the measurement does not match anything under 'ID1' of the equipment data, the second row of the measurement data is discarded.

(1)

Value1	Value2	ID1	ID2
10	20	AAA111	ZZZ111
20	40	AAA222	ZZZ222
30	60	AAA333	ZZZ333
40	80	AAA444	ZZZ444
50	100	AAA555	ZZZ555

(2)

Value3	Value4	RecID	LotID
12	21	AAA111	ZZZ111
24	42	AAA223	ZZZ222
31	65	AAA333	ZZZ333
41	81	AAA555	ZZZ555
50	106	AAA555	ZZZ555

(1) Equipment data
(2) Measurement data

8. The first row of the measurement data matches the first row of the equipment data, and they are merged.

(1)

Value1	Value2	ID1	ID2
10	20	AAA111	ZZZ111
20	40	AAA222	ZZZ222
30	60	AAA333	ZZZ333
40	80	AAA444	ZZZ444
50	100	AAA555	ZZZ555

(2)

Value3	Value4	RecID	LotID
12	21	AAA111	ZZZ111
24	42	AAA223	ZZZ222
31	65	AAA333	ZZZ333
41	81	AAA555	ZZZ555
50	106	AAA555	ZZZ555

(1) Equipment data
(2) Measurement data

9. Matching completes.

Value1	Value2	Value3	Value4	ID1	ID2
10	20	12	21	AAA111	ZZZ111
20	40			AAA222	ZZZ222
30	60	31	65	AAA333	ZZZ333
40	80			AAA444	ZZZ444
50	100	50	106	AAA555	ZZZ555

Point

- Up to three items can be selected for matching.
- If the same matching key appears more than once, the logic uses the newer key. To use this function, the equipment data and measurement data files must be arranged in the ascending order of the file names as well as the rows in each file must be arranged in the order of timestamps. CSV files created by 'Logic editing' automatically satisfy this requirement.

☞ Page 250 Editing Logics

Creating partial matrix

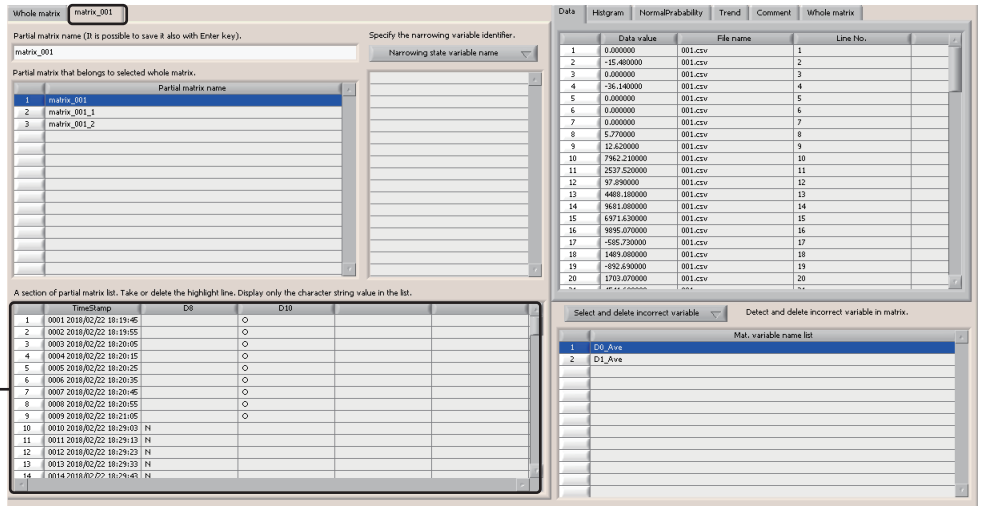
When a whole matrix is created, a partial matrix with the same name and contents as the whole matrix is created by default.
The created partial matrix is saved under the following folder path:

- (Folder specified for "Matrix storage folder")*1\Attribute\(whole matrix name folder)\(whole matrix name).csv

*1 When a subfolder is specified, the subfolder selected by clicking the [Subfolder] button is used.

Operating procedure

1. Click a tab of the created partial matrix.



(1)

Item	Description
Partial matrix name (It is possible to save it also with Enter key).	Set a name to create a partial matrix (up to 32 characters).
Partial matrix that belongs to selected whole matrix.	Displays the created partial matrix.
[Filtering state variable name] button	Specify a text variable when filtering data with a text variable value.
(1) Section list of partial matrices	The section list of partial matrices is displayed.

2. Edit a partial matrix using one of the following three methods:

- Filtering variables by text variable values (☞ Page 228 Creating partial matrix by filtering by text variable values)
- Deleting outliers or values other than outliers in the histogram (☞ Page 229 Creating partial matrix by deleting outliers or values other than outliers in the histogram)
- Deleting points in the trend chart (☞ Page 230 Creating partial matrix by deleting points in the trend chart)

Precautions

The partial matrix in the "Partial matrix name" list with the same name as the whole matrix is copied from the whole matrix and the partial matrix is created based on it. This copy of the whole matrix cannot be changed or overwritten.

■ Creating partial matrix by filtering by text variable values

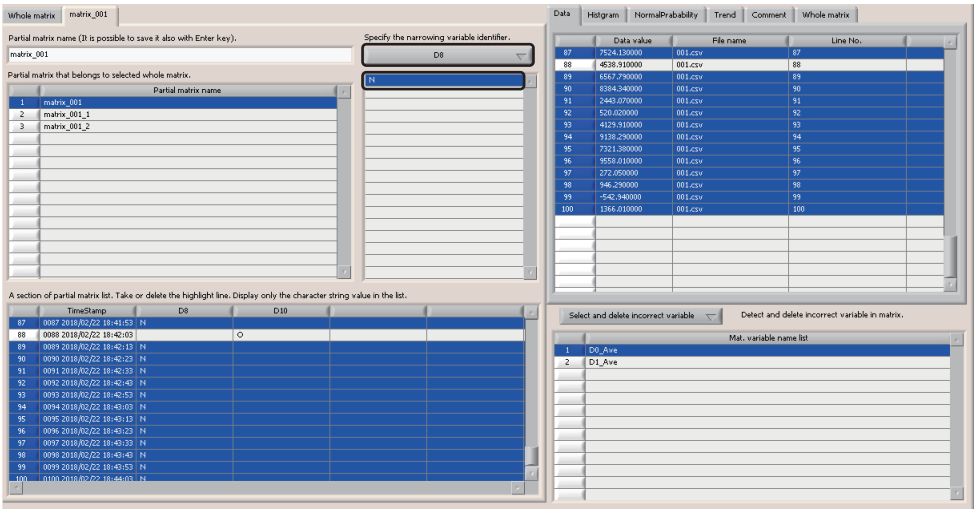
Operating procedure

1. Click the [Filtering state variable name] button to specify a text variable used to filter data.

Text variable values are displayed in a list.

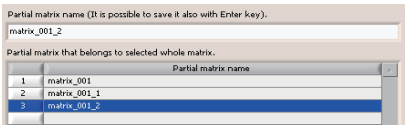
2. Select a text variable value in the text variable value list.

Rows corresponding to a selected text variable value are highlighted in the section list of partial matrices and the [Data] tab.



3. Set an arbitrary name for "Partial matrix name", and press the Enter.

The partial matrix with filtered rows is registered to the "Partial matrix name" list.



4. The partial matrix is saved under the following folder path:

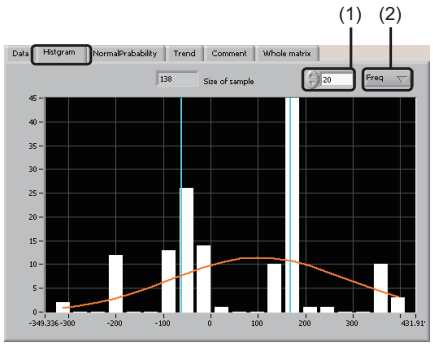
- (Folder specified for "Matrix storage folder")[*1]\Attribute\(whole matrix name folder)\(arbitrarily entered partial matrix name).csv

*1 When a subfolder is specified, the subfolder selected by clicking the [Subfolder] button is used.

■ Creating partial matrix by deleting outliers or values other than outliers in the histogram

Operating procedure

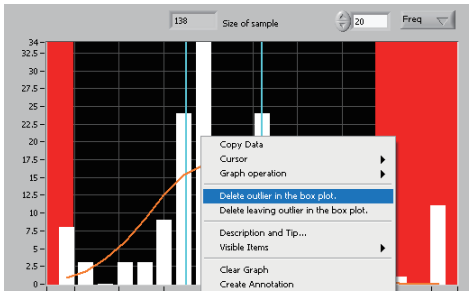
1. When the [Histogram] tab is selected, the variable histogram and sample size, quartile (vertical blue line), and a curve fitted to the Gauss distribution by the least squares method are shown.



Item	Description
(1) Number of bins	Specify the number of bins in a histogram (0 to 100).
(2) Display scale	Select the vertical axis unit of the histogram between "Freq" and "%".

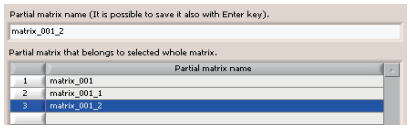
2. Sections beyond the whisker tip of the histogram are displayed with a red background. Right-click the histogram and select [Delete outlier in the box plot.] or [Delete leaving outlier in the box plot.].

Outliers or values other than outliers are deleted from the matrix.



3. Enter an arbitrary name for "Partial matrix name", and press the Enter.

The partial matrix with outliers or values other than outliers deleted in the histogram is registered in the list of "Partial matrix name".



4. The partial matrix is saved under the following folder path:

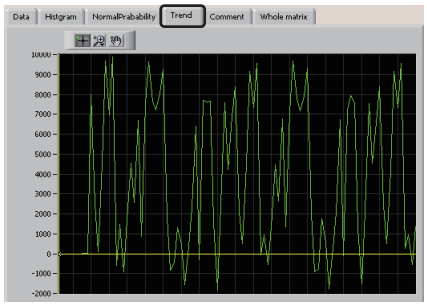
- (Folder specified for "Matrix storage folder")*1\Attribute\(whole matrix name folder)\(arbitrarily entered partial matrix name).csv

*1 When a subfolder is specified, the subfolder selected by clicking the [Subfolder] button is used.

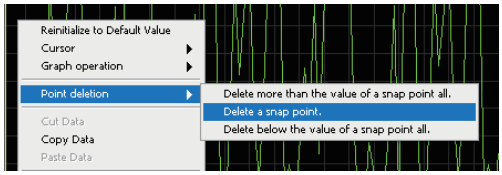
■ Creating partial matrix by deleting points in the trend chart

Operating procedure

1. Click the [Trend] tab to show the trend chart.

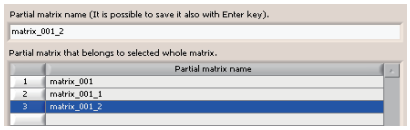


2. Snap the cursor to the trend chart, then right-click and select [Point deletion] ⇨ [Delete more than the value of a snap point all.], [Delete a snap point.], or [Delete below the value of a snap point all.].



3. Enter an arbitrary name for "Partial matrix name", and press the Enter.

The partial matrix with points deleted in the trend chart is registered to the "Partial matrix name" list.



4. The partial matrix is saved under the following folder path:

- (Folder specified for "Matrix storage folder")[*1]\Attribute\(whole matrix name folder)\(arbitrarily entered partial matrix name).csv

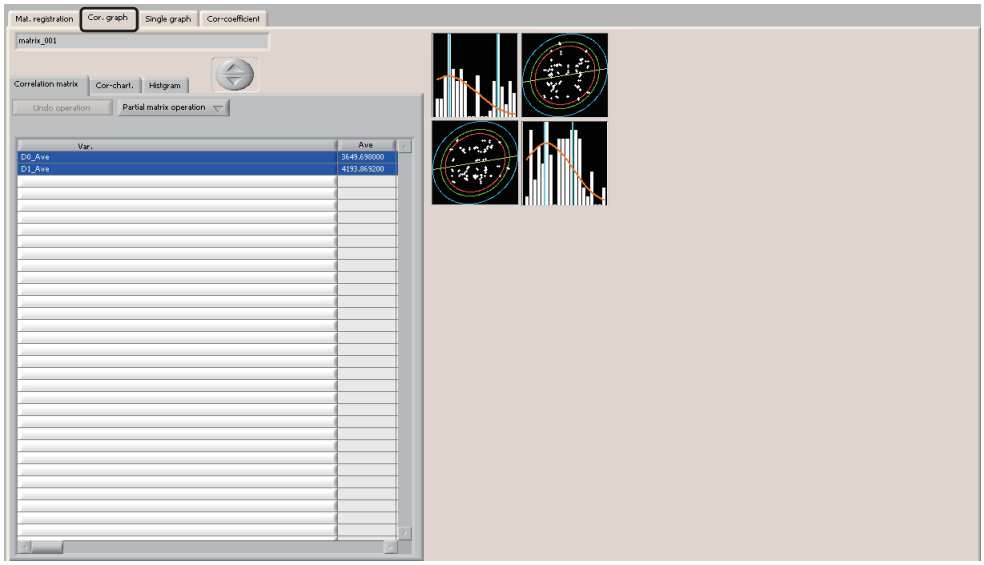
*1 When a subfolder is specified, the subfolder selected by clicking the [Subfolder] button is used.

Correlation analysis by using a correlation graph

Perform correlation analysis by displaying a correlation graph of a selected partial matrix.

Operating procedure

1. Select the [Cor. graph] tab.



2. Perform correlation analysis in one of the following four methods:

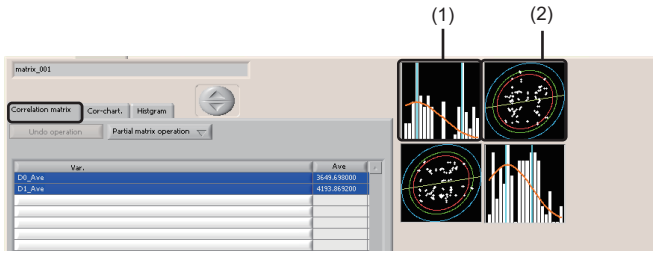
- Display a correlation matrix. (☞ Page 231 Correlation matrix display)
- Display a 2-variable scatter chart. (☞ Page 232 2-variable scatter chart display)
- Display a histogram. (☞ Page 234 Histogram display)
- Display a correlation chart. (☞ Page 235 Correlation chart display)

■ Correlation matrix display

Operating procedure

1. Select the [Correlation matrix] tab.

Select up to six variables in the "Var." list. A correlation chart (scatter chart) of two variables and the histogram of each variable are shown.



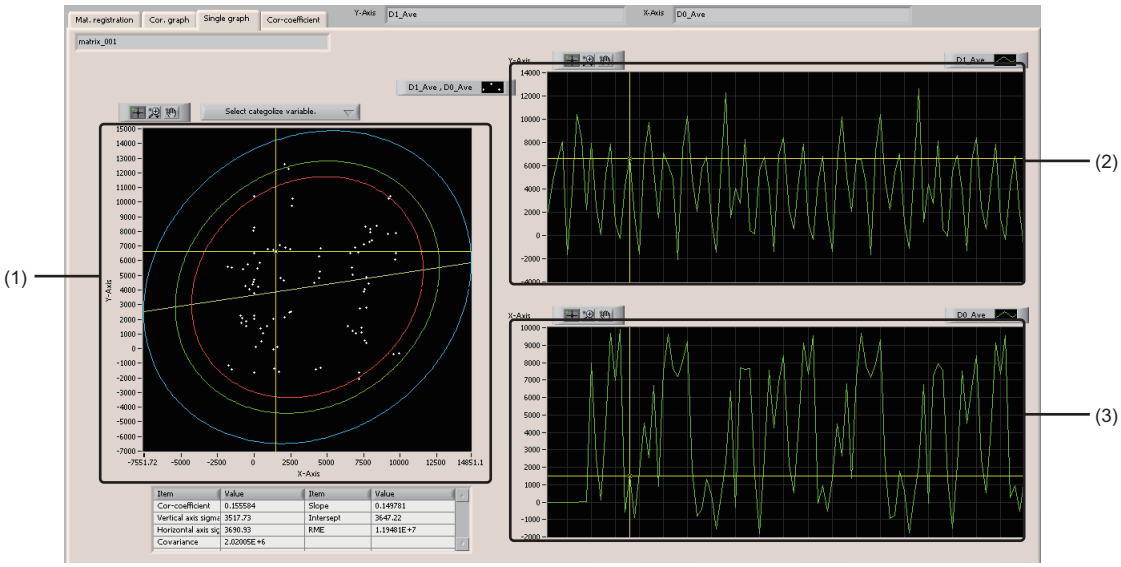
Item	Description
(1) Histogram	Display the histogram of each variable.
(2) Scatter chart	Displays a correlation chart (scatter chart) of two variables. The scatter chart shows probability ellipses for 90%, 95%, and 99% (from the inside to the outside).

■ 2-variable scatter chart display

Operating procedure

1. Click the scatter chart on the [Correlation matrix] tab.

A 2-variable scatter chart is shown on the [Single graph] tab.



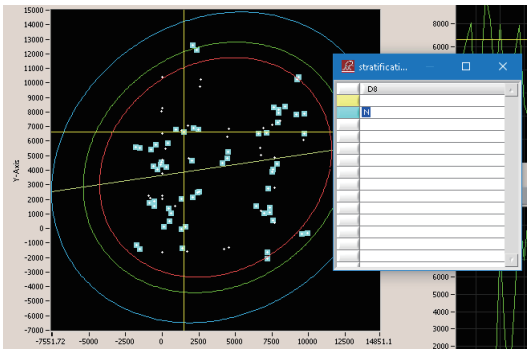
Item	Description
(1) Scatter chart display screen	Displays a 2-variable scatter chart. The scatter diagram shows probability ellipses for 90%, 95%, and 99%, and the regression line used to estimate the Y-axis value from the X-axis value.
(2) Vertical-axis variable chart display screen	Displays a chart for the vertical axis variable.
(3) Horizontal-axis variable chart display screen	Displays a chart for the horizontal axis variable.

Point

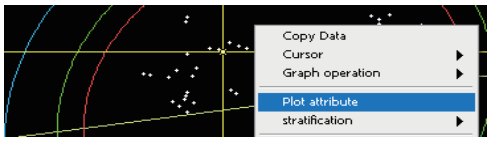
The regression line passes through the X minimum and maximum values, that is, the point of contact between a line drawn in parallel to the Y-axis and the probability ellipse. Therefore, the slope is slightly smaller than the long axis of the probability ellipse.

2. Click the [Select categolize variable.] button and select a text variable.

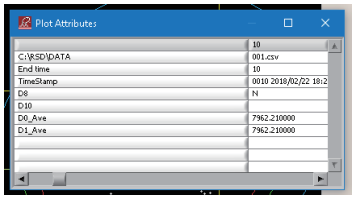
3. When a text variable is selected on the "stratification" screen, data linked with the selected text variable is indicated by the marker.



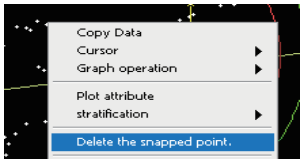
4. Right-click on the scatter chart display screen, and select [Plot attribute].



5. The attributes of the point snapped by the cursor are shown on the "Plot Attributes" screen. When an item is selected, plots with the same value are indicated by the marker.



6. Snap the plot with the cursor, right-click it and select [Delete the snapped point.].



7. The plot is deleted and the corresponding data is also deleted from the vertical- and horizontal-axis variable chart display screens.

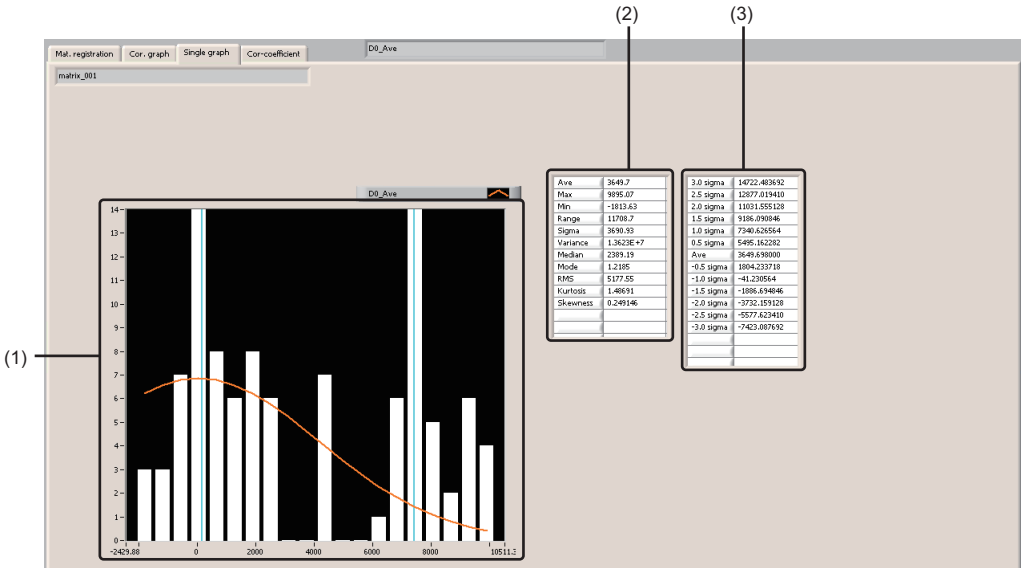
When the partial matrix is saved, a partial matrix with the target plot deleted is created.

■ Histogram display

Operating procedure

1. Click the histogram in the [Correlation matrix] tab.

The corresponding histogram is shown in the [Single graph] tab.



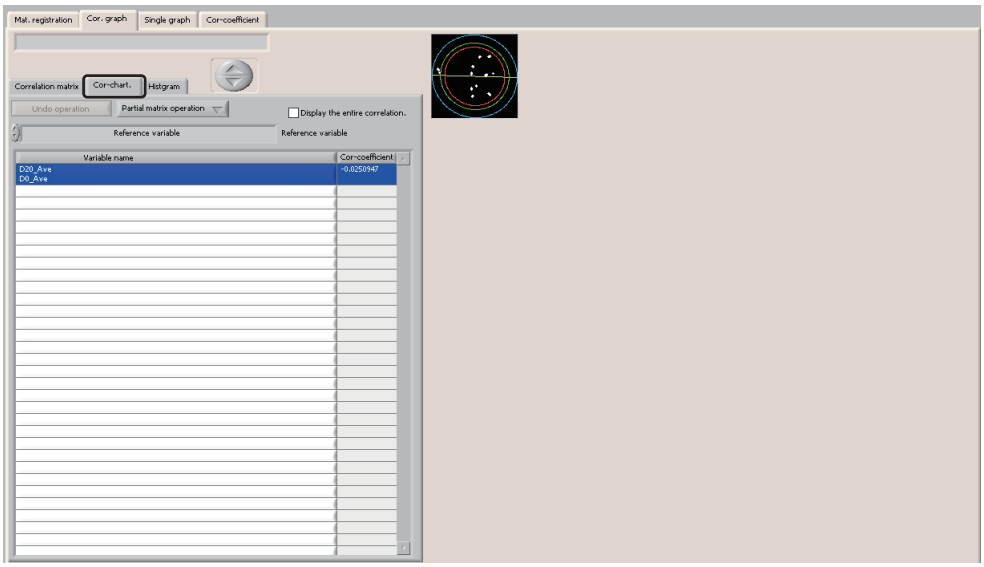
Item	Description
(1) Histogram display screen	Displays a histogram.
(2) Statistical quantity	Shows the statistics.
(3) Sigma value	Shows the sigma values.

■ Correlation chart display

Operating procedure

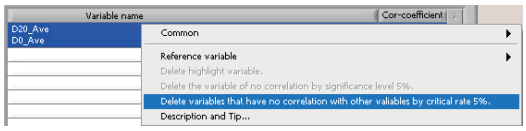
1. Select the [Cor-chart.] tab. Pairs of 2 variables are displayed on the chart from the one with the highest correlation coefficient first.

A chart with the hazard rate of 5% (Significance level of 5%) and correlation, the background is shown in blue.



2. Right-click on the "Variable name" list and select [Delete variables that have no correlation with other valiables by critical rate 5%.].

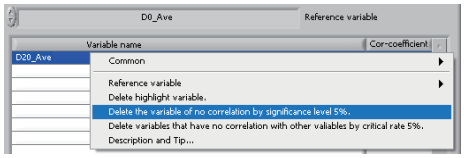
Variables satisfying the condition are deleted from the partial matrix.



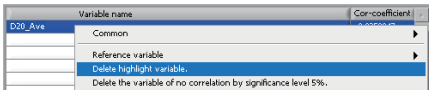
3. When a variable is specified in "Reference variable", the specified standard variable and variables are listed in the descending order of the positive correlation coefficients.

4. Right-click on the "Variable name" list and select [Delete the variable of no correlation by significance level 5%.].

Variables not correlated with the standard variable are deleted from the partial matrix.

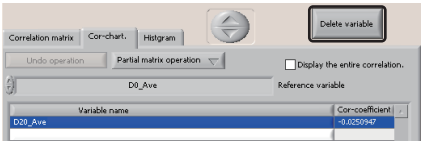


5. Selecting [Delete highlight variable.] deletes the highlighted variables from the partial matrix.



6. Clicking the [Undo operation] button cause the partial matrix to revert to the original state before deletion.

7. When variable are too many, click the [Delete variable] button while the variables are selected in the "Variable name" list. Clicking the scatter chart deletes the variables.



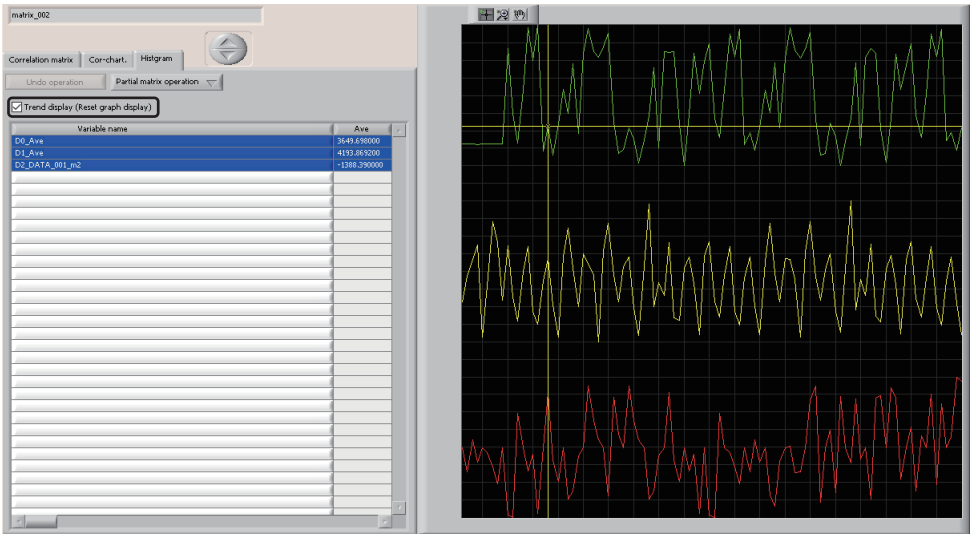
8. Click the [Partial matrix operation] button and select [Partial matrix [Saving]].
A partial matrix with the target variables deleted is created.

Point

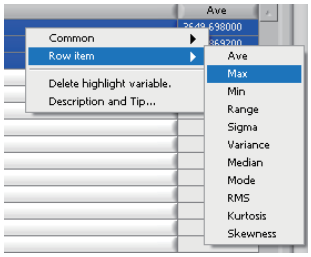
After operating on a partial matrix, click the [Partial matrix operation] button and select [Partial matrix [Saving]] to save the operated partial matrix.

9. When the [Histogram] tab is selected, the variable histogram is shown.

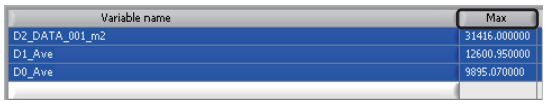
10. Selecting the checkbox of "Trend display (Reset graph display)" switches from the histogram display to trend display.



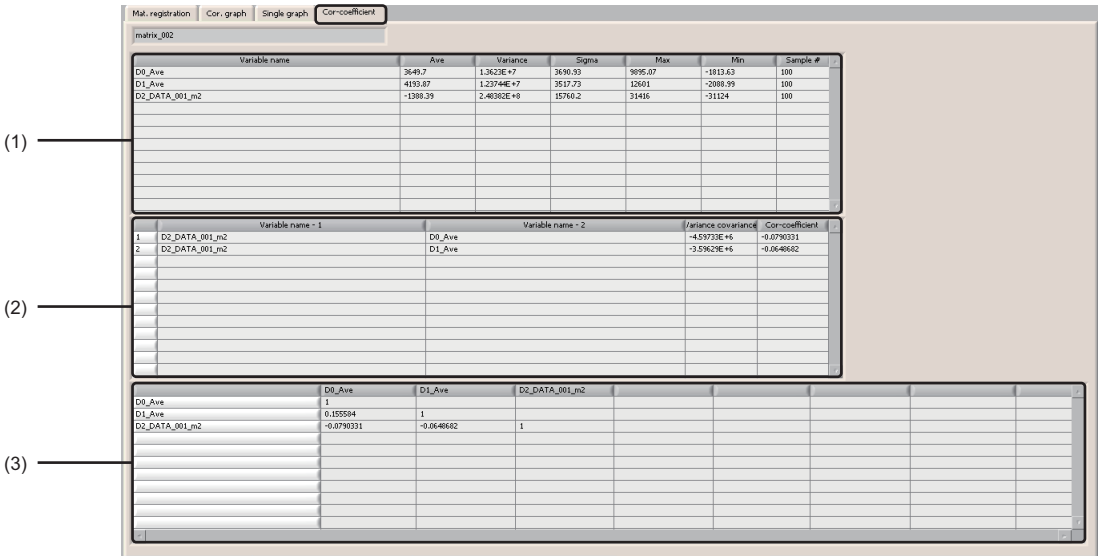
11. Right-click on the "Variable name" list and specify the statistics type from [Row item].



12. By clicking the title row, the statistics displayed in the row can be sorted in ascending or descending order.



13. When the [Cor-coefficient] tab is selected, the basic statistics of each variable, mutual correlation coefficient, and correlation matrix are shown.



Item	Description
(1) Basic statistics	Shows the basic statistics.
(2) Mutual correlation coefficient	Shows the mutual correlation coefficient. Up to 100 × 100 variables are shown.
(3) Correlation matrix	Display a correlation matrix.

Precautions

- By default, correlation between equipment data and equipment data, and correlation between measurement data and measurement data are not shown.
- By default, measurement data variables other than that is specified as the standard are not shown. Selecting the checkbox of "Display the entire correlation." in the [Cor-chart.] tab shows the whole correlation chart including the measurement data.

21.8 Multiple Regression Analysis (LMR)

Calculates correlation between multiple variables and estimate the variable value using the multiple regression equation.

Operating procedure

1. Select [Advanced analysis] ⇨ [Multiple regression analysis (MLR)].
2. Perform recurrence calculation.

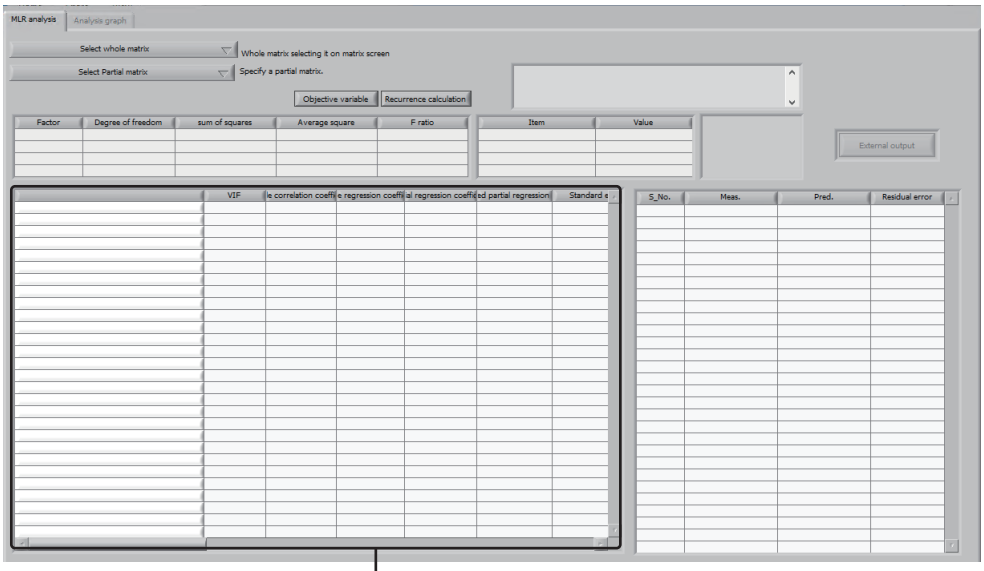
☞ Page 242 Recurrence calculation

3. Check the analysis chart.

☞ Page 243 Checking analysis chart

Screen configuration

The following shows the screen configuration for multiple regression analysis.



Displayed items

Item	Description
Whole matrix selecting it on matrix screen	Select a whole matrix. The whole matrix selected in 'Create correlation matrix' is shown by default. ☞ Page 218 Creating Correlation Matrix
Specify a partial matrix.	Select a partial matrix. A partial matrix of the selected whole matrix can be selected.
[Objective variable] button	Click this to set an objective variable and perform recurrence calculation.
[Recurrence calculation] button	Click this to perform recurrence calculation with a set objective variable.
[External output] button	This button is enabled after a recurrence calculation is performed (while the result of the recurrence calculation is displayed). Click this to output the unit space data of the criterion matrix, which is derived in the recurrence calculation process, in the format available in a programmable controller. ☞ Page 394 External output The default save file name is shown below. (It can be changed to any name within 255 characters including an extension.) LMR_method_param.PMR For the path of a file to be saved, up to 255 characters (two characters are used for a double-byte character) including the extension can be specified.
Factor*1	Shows the "Regression variance" or "residual sum of squares".
Degree of freedom*1	Shows the number of samples which can be gathered freely. • Regression variance: Number of explanatory variables • Residual sum of squares: n-p-1 p: Number of explanatory variables, n: Number of samples (number of section statistics)
Sum of squares*1	Shows the sum of squares of difference between data and its average value. • Regression variation: Variation which can be explained with a regression equation. $S_r = \Sigma_{i=1,n}(Y_i-Y_{bar})^2$ Y_i: Predicted value, Y_{bar}: Average of measured values • Residual sum of squares: Variation which cannot be explained with a regression equation. $S_e = \Sigma_{i=1,n}(y_i-Y_i)^2$ y_i: Measured value
Average square*1	Shows the value obtained by 'sum of squares' ÷ 'Degree of freedom'.
F ratio*1	Shows the value obtained by 'Average square of regression sum of squares' ÷ 'average square of residual sum of squares'.

Item		Description
Item[*1]		Shows the following items. • Multiple corr-coefficient: Correlation coefficient between a measured value and a predicted value. R = Square root of determination coefficient Ranges from 0 to 1, and a bigger value is better. • Coefficient of determination: Sum of squares of regression variation ÷ Sum of squares of total variation R^2 = "Sum of squares of regression variation (S_r) ÷ Sum of squares of total variation (S_r+S_e)" Ranges from 0 to 1, and a bigger value is better. • Coefficients of determination that have adjusted degree of freedom: Equation which replaces "Sum of squares of total variation (Sr+Se)" in the equation of the coefficient of determination (R^2) with mean square, introducing the degree of freedom. $R'=(n-1)(1-R^2)/(n-p-1)$ If the difference between n and p is small, R^2 becomes larger just by increasing the explanatory variable p with no correlation. As a result, R' does not increase simply just by increasing p. • AIC: $n\log(S_e)+2(p+1)$ Reference for selecting explanatory variables. If the number of explanatory variables is the same, select variables with the smaller AIC value. A smaller value is better. Since AIC is based on the calculation of the maximum log-likelihood that indicates the largest possibility in the future, it is assumed that the distribution of the estimated value and measured value follows the normal distribution. AIC is a kind of approximation and its accuracy decreases as the number of explanatory variables increases. Samples more than twice as many as the explanatory variables are necessary.
Value[*1]		Shows the value of each item.
(1) Regression variable list	VIF[*1]	Variance inflation factor. If VIF = $1/(1-R^2)$)>10, multicollinearity is suspected.
	Single correlation coefficient[*1]	Single correlation coefficient between an objective variable and explanatory variable.
	Single regression coefficient[*1]	Simple regression coefficient of a single regression equation (objective variable and one explanatory variable). The first row of the regression coefficient list does not have data.
	Partial regression coefficient[*1]	Regression coefficient of a multiple regression equation. The first row of the regression coefficient list is a constant term.
	Standardized partial regression coefficient[*1]	Regression coefficient with a standardized variable (average = 0, variance = 1). The constant term in the first row of the regression coefficient list is '0'. It can be used as reference for contribution to the objective variable. If correlation between explanatory variables is 0, the standard regression coefficient equals to the single correlation coefficient.
	Standard error[*1]	Standard deviation of the partial regression coefficient. Used to estimate sections for the partial regression coefficient. The first row of the regression coefficient list is a value which can be ignored.
	t value[*1]	Value of "partial regression coefficient ÷ standard error". Used for the t-test of the partial regression coefficient.
	P-value[*1]	Possibility of observing statistics more extreme than the t value obtained by the t-test.
	LL 95%[*1]	Section estimated value at the lower limit 95% of the partial regression coefficient.
	UL 95%[*1]	Section estimated value at the upper limit 95% of the partial regression coefficient.
	LL 90%[*1]	Section estimated value at the lower limit 90% of the partial regression coefficient.
	UL 90%[*1]	Section estimated value at the upper limit 90% of the partial regression coefficient.
	F value[*1]	Square of the t-value. Compared with the F-boundary value to test the partial regression coefficient.
	Both sides of P(F<=f)[*1]	Unused area.
	Both sides of F bound 95%[*1]	Boundary value for section estimate on both sides of F-distribution with a specified degree of freedom. If the F-value of the partial regression coefficient is greater than this value, "Hypothesis: Influence by partial regression coefficient is not present" can be rejected.
	Both sides of F bound 90%[*1]	Boundary value for section estimate on both sides of F-distribution with a specified degree of freedom. If the F-value of the partial regression coefficient is greater than this value, "Hypothesis: Influence by partial regression coefficient is not present" can be rejected.
	Variable mean value[*1]	Average value per variable.
	Var. Sigma[*1]	Standard deviation per variable.
S_No.[*1]		Sample number of the partial matrix
Meas.[*1]		Shows the measured value.
Pred.[*1]		Shows the predicted value.
Residual error[*1]		Shows the difference between the measured value and predicted value. Measured value - Predicted value

*1 By clicking the title of each item, the order can be changed in ascending or descending order. However, the objective variable in the first

row of 'Regression variable list' is excluded from the order change.

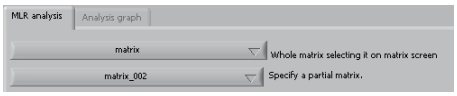
Recurrence calculation

Perform recurrence calculation.

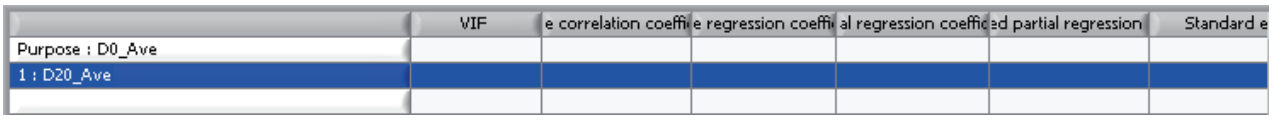
Operating procedure

1. Click the [MLR analysis] tab and select the whole matrix and partial matrix created in 'Create correlation matrix'.

☞ Page 218 Creating Correlation Matrix



2. Select a variable to set as an objective variable in 'Regression variable list'.



3. Click the [Objective variable] button.

When an objective variable is set, recurrence calculation is performed and the result is displayed.

The multiple regression equation is automatically saved in the corresponding partial matrix folder.

Point

- In another way to set objective variables and perform recurrence calculation, right-click in 'Regression variable list'.
- Recurrence calculation is also performed by selecting the objective variable and clicking the [Recurrence calculation] button or right-clicking and selecting the [Recurrence calculation] menu.
- When specifying a partial matrix for the primitive 'Regression operation', a recurrence calculation will be executed at the timing when the Reader reads a CSV file.

☞ Page 250 Editing Logics

- The multiple regression equation for recurrence calculation is as follows:
  Predicted value = Σ(Partial regression coefficient of variable n × Variable n) + Partial regression coefficient in the first row (= intercept)
- Only one multiple regression equation is created per partial matrix.
- If any of the following conditions is true, multicollinearity is suspected and the value shown in "VIF" is marked with "**".
  When the sign of the single correlation coefficient (or single regression coefficient) of the objective and explanatory variables is different from the sign of the partial regression coefficient in the multiple correlation equation
  When "VIF" value = $1/(1-R^2)>10$
- Multicollinearity occurs when the correlation coefficient is high between explanatory variables. In this case, recurrence cannot be calculated correctly.
- When multicollinearity is suspected for a variable, the value shown in "VIF" is marked with '**'. If necessary, delete variables from the partial matrix using 'Create correlation matrix' and perform recurrence calculation again.

☞ Page 218 Creating Correlation Matrix

Precautions

- It is necessary to delete unnecessary variables, variables of which values do not change, and outliers from the partial matrix.
- The number of units of data (number of sections) included in a partial matrix must be three times or more the number of variables. If it does not satisfy this condition, a recurrence calculation may fail.
- When multicollinearity is detected, an error is indicated. In this case, delete variables which may have high correlation coefficients from the partial matrix using 'Create correlation matrix' and perform recurrence calculation again.

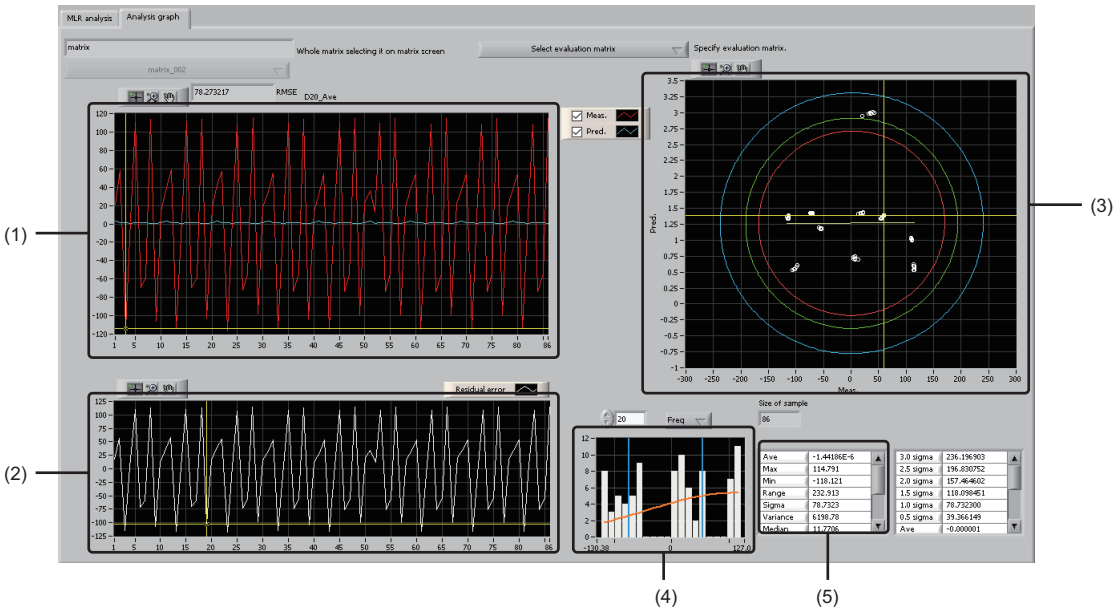
☞ Page 218 Creating Correlation Matrix

Checking analysis chart

Check the analysis chart.

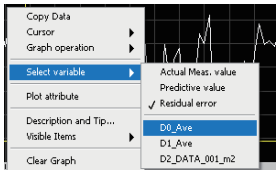
Operating procedure

1. Select the [Analysis graph] tab.



Item	Description
RMSE	Shows the root mean square of the errors.
(1) Predicted value/measured value display screen	Shows the predicted value/measured value.
(2) Residual display screen	Shows the residual.
(3) Scatter chart display screen	Displays a scatter chart.
(4) Histogram display screen	Displays a histogram.
(5) Statistical quantity	Shows the statistics of the variable.

2. Right-click on the residual display screen, and select a variable name from [Select variable]. The chart of the specified variable is shown.



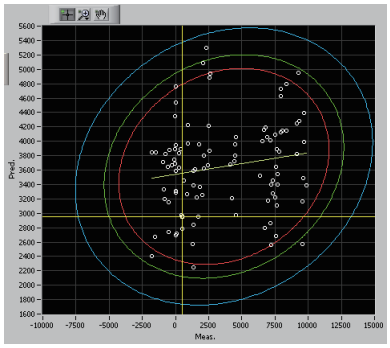
Point

The root mean square (RMSE) can be calculated with the following equation:

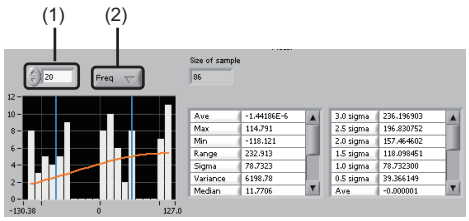
$$RMSE = \sqrt{(\Sigma_{i=1,n}(a_i-b_i)^2) \div n}$$

a: Measured Value, b: Predicted Value, n: Section count

3. The scatter chart display screen shows the scatter chart of the predicted and measured values as well as the probability ellipses (90%, 95%, and 99%).

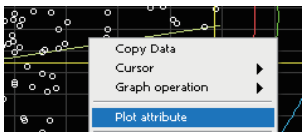


4. Statistics of specified variables are displayed in 'Statistics'. A histogram, a number of bins of the histogram, and a number of units of sampled data used for recurrence calculation (number of units of data included in a whole matrix (number of sections)) are displayed in 'Histogram display' screen.

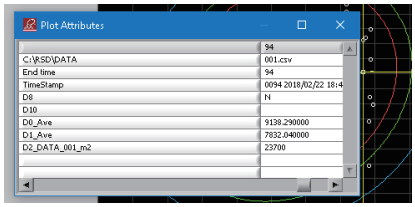


Item	Description
(1) Number of bins	Specify the number of bins in a histogram (0 to 100).
(2) Display scale	Select the vertical axis unit of the histogram between "Freq" and "%".

5. Right-click on the scatter chart display screen, and select [Plot attribute].



6. The "Plot Attributes" screen opens and shows the plot point attributes (state variable values). When an attribute is selected, plots with the same attribute are indicated by the marker.



Point

If another matrix is selected in "Specify evaluation matrix.", calculation using the multiple regression equation is performed and the result is shown.

21.9 Maharanobis - Taguchi method (MT)

Diagnose the variations based on the correlation of variations between multiple variables.

Operating procedure

1. Select [Advanced analysis] ⇨ [Maharanobis - Taguchi method (MT)].
2. Perform MT distance calculation.

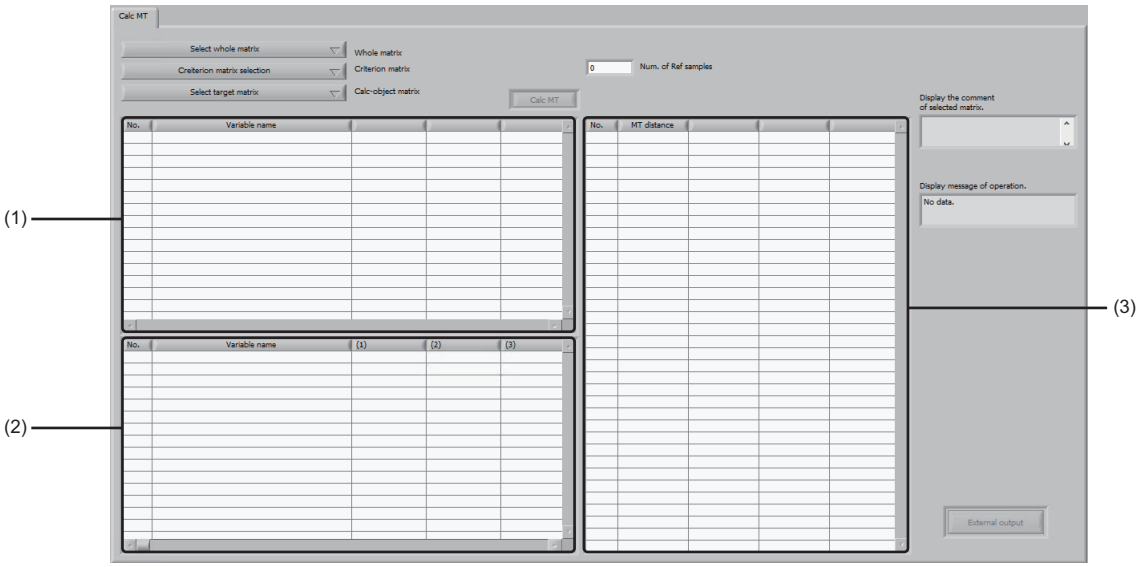
☞ Page 247 MT distance calculation

3. Check the chart.

☞ Page 248 Checking chart

Screen configuration

The following shows the screen configuration for analyzing by Mahalanobis-Taguchi method.



Displayed items

Item	Description
Whole matrix	Selects a whole matrix. The whole matrix selected in 'Create correlation matrix' is shown by default. ☞ Page 218 Creating Correlation Matrix
Criterion matrix	Selects a partial matrix used as the criterion. A partial matrix of the selected whole matrix can be selected.
Calc-object matrix	Selects a partial matrix for calculation. A partial matrix of the selected whole matrix can be selected.
[Calc MT] button	Performs MT distance calculation.
Num. of Ref samples	Shows the number of samples (number of units of data included in a whole matrix (number of sections)) based on MT distance calculation.
(1) Evaluation variable list	Shows the evaluation variable list.
(2) Criterion list	Shows the criterion list.
(3) MT distance calculation result	Shows the MT distance (Mahalanobis distance). When a multicollinearity error occurs, an error message appears or the result will be 'Nan'.
Display the comment of selected matrix.	Shows the history of CSV files read by the selected whole matrix.
Display message of operation.	Shows the message for the operation.
[External output] button	This button is enabled after performing MT calculation (state in which MT distance is calculated). Click this to output the unit space data of the criterion matrix, which is derived in the calculation process of MT distance (Mahalanobis distance), in the format available in a programmable controller. ☞ Page 401 External output The default save file name is shown below. (It can be changed to any name within 255 characters including an extension.) MT_method_param.PMT For the path of a file to be saved, up to 255 characters (two characters are used for a double-byte character) including the extension can be specified.

MT distance calculation

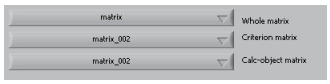
Perform MT distance calculation.

Operating procedure

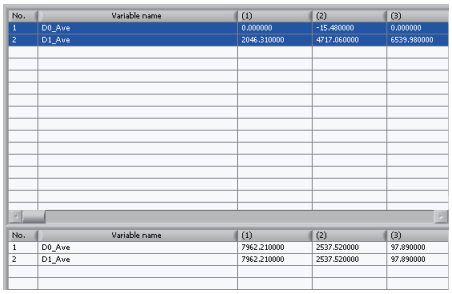
1. Click the [Calc MT] tab, and select the whole matrix, criterion matrix, and calculation target matrix created in 'Correlation matrix creating'.

☞ Page 218 Creating Correlation Matrix

For "Criterion matrix" and "Calc-object matrix", the partial matrices of the selected whole matrix are displayed, so select from among them.



2. When a dynamic characteristic variable is present, select the dynamic characteristic variable from the criterion list. Selecting a dynamic characteristic variable cancels its selection in the evaluation variable list.



Point

A dynamic characteristic variable is a variable which changes its value according to the input value.

3. Click the [Calc MT] button.

The calculation result of MT distance (Mahalanobis distance) is displayed in 'MT distance calculation result'.

Point

MT distance calculation can also be performed by right-clicking on the evaluation variable list and then selecting [Calc MT].

Precautions

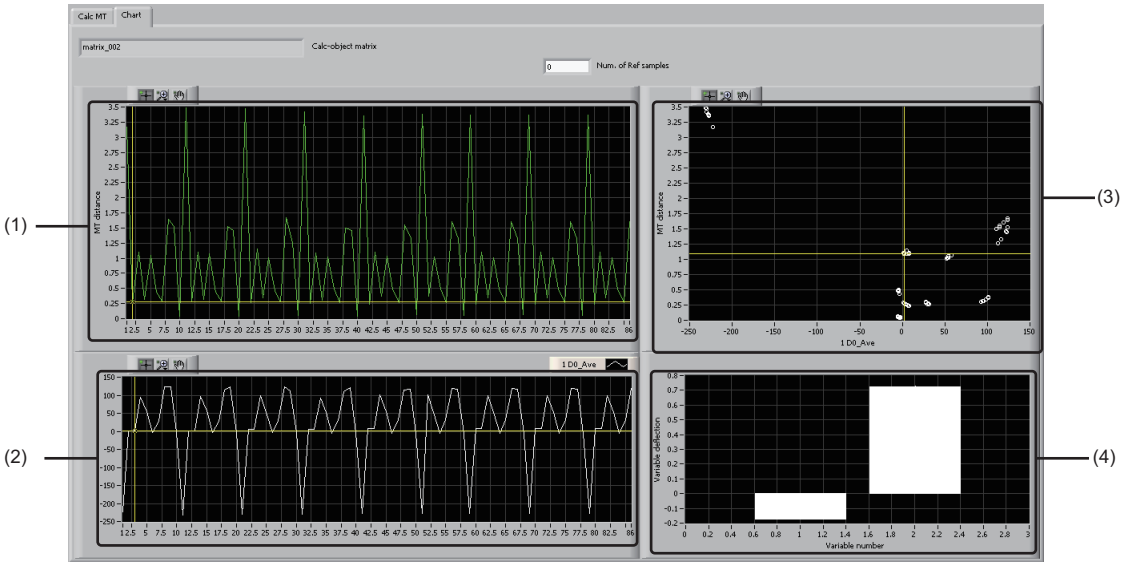
When an error occurs due to multicollinearity, the error message appears or the calculation result will be 'Nan'.

Checking chart

Check the chart.

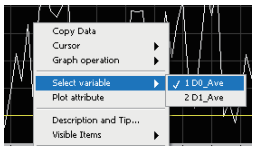
Operating procedure

1. Select the [Chart] tab.

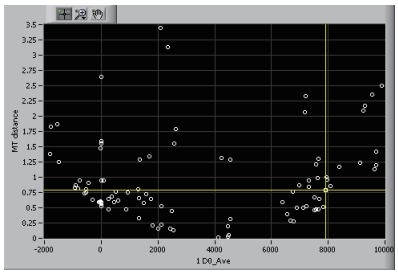


Item	Description
(1) MT distance (Mahalanobis distance) display screen	Shows the MT distance (Mahalanobis distance).
(2) Variable chart display screen	Displays a variable chart.
(3) Scatter chart display screen	Display a scatter chart.
(4) Variable deviation display screen	Shows the variable deviation of a section plotted by cursor.
Num. of Ref samples	Shows the number of samples (number of units of data of a whole matrix) based on MT distance calculation.

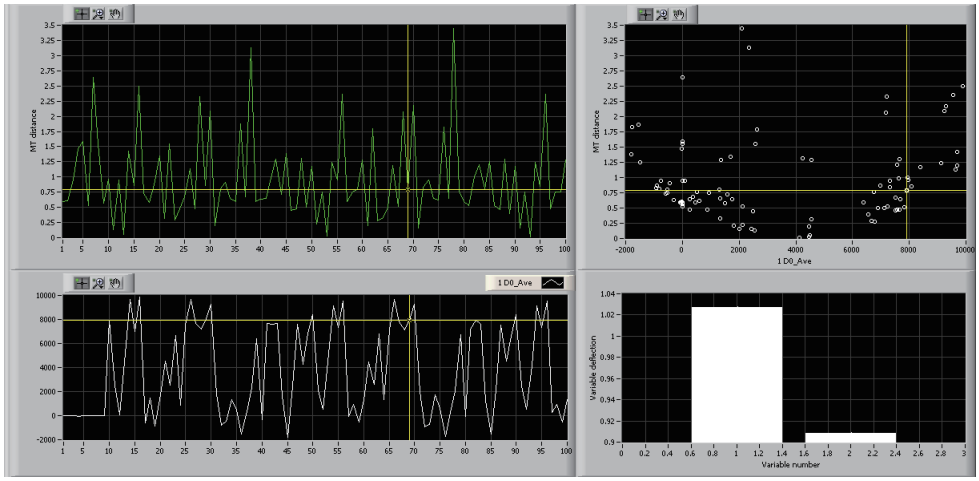
2. Right-click on the variable chart display screen, and select a variable name from [Select variable]. The chart of the selected variable is shown.



3. The scatter chart display screen shows a scatter chart with the vertical axis representing the MT distance (Mahalanobis distance) and the horizontal axis representing the variable value.

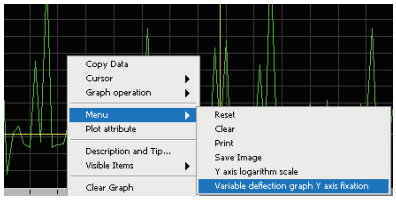


4. The variable deviation of the section plotted on the MT distance (Mahalanobis distance) display screen is shown on the variable deviation display screen.

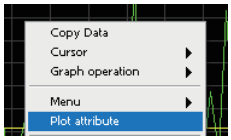


5. Right-click on the MT distance (Mahalanobis distance) display screen and choose [Menu] ⇨ [Variable deflection graph Y axis fixation].

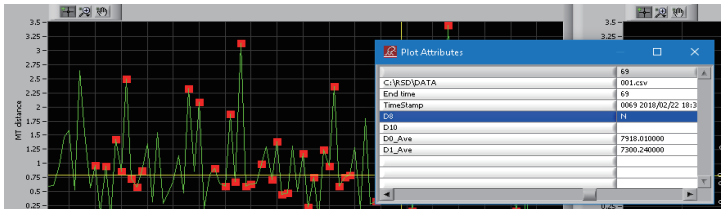
The vertical axis of the variable deviation display screen is fixed within the range between the maximum and minimum values.



6. Right-click on the MT distance (Mahalanobis distance) display screen or the variable chart display screen and choose [Plot attribute].

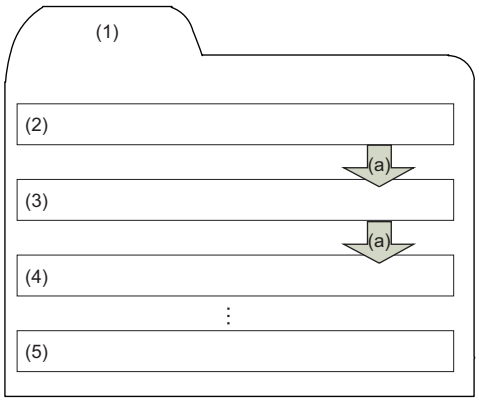


7. The "Plot Attributes" screen opens and shows the plot point attributes (state variable values). When an attribute is selected, plots with the same attribute are indicated by the marker.



21.10 Editing Logics

Create arbitrary analysis logic/diagnostic logic.
A logic is an execution unit of a sequence of processes to perform analysis or diagnosis in Real-time Statistic Diagnosis Tool, and consists of one or more processes (primitives).
Primitives are executed sequentially in logic units.
A primitive has input and output, similarly to general program functions, and output from an upper-level primitive can be used as input to a lower-level primitive.
In addition, a variable can be specified to enter a primitive. (☞ Page 250 Available variables for primitives)



(1) Logic
(2) Primitive 1
(3) Primitive 2
(4) Primitive 3
(5) Primitive n
(a) Output from upper-level primitive is used as input to lower-level primitive.

Operating procedure

1. Select [Analysis logic - diagnostic logic operation] ⇨ [Logic editing].
2. Create a logic.

☞ Page 253 Creating logic

3. Execute the logic.

☞ Page 349 Executing logic

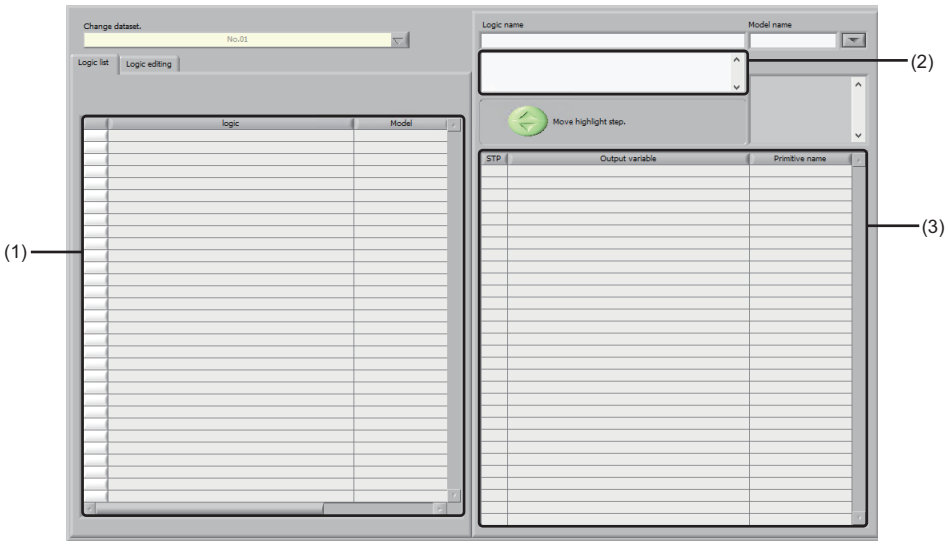
Available variables for primitives

The following table shows the variables available for entering primitives.

Variable type	Description	Remarks
Trace variable	Numerical value data which varies continuously	Variable in a CSV file read by Reader
Text variable	Text data which varies in each section	Output variable of a primitive or variable in a CSV file read by Reader
Step variable (state variable)	Data which does not vary continuously	Output variable of a primitive or variable in a CSV file read by Reader
Statistical variable (statistics)	Statistics of 'average value', 'maximum value', 'minimum value', 'range', 'standard deviation', 'dispersion', 'median value' and others.	Output variable of a primitive
Boolean variable (boolean)	Value (o or 1) indicates the result of a primitive.	Output variable of a primitive
Event variable (event)	Time stamp when an event occurs in Real-time Statistic Diagnosis Tool.	Output variable of a primitive or the start and end points of an extracted section by Reader.
Logic variable	Variable such as a numerical value, text, and conversion table.	Variable registered in 'Logic variable setting'. ☞ Page 351 Setting logic variable

Screen configuration

The following shows the screen configuration for editing a logic.



Displayed items

Item		Description
Change dataset.		Shows dataset selected in 'Management'. ☞ Page 378 Management The dataset can be changed by clicking it. ☞ Page 252 Changing dataset
[Logic list] tab	(1) Logic list	Shows the list of logics.
[Logic editing] tab	—	Edits a logic.
	Category	Select a category of the primitive to create.
	Primitive	Select a primitive to create.
Logic name		Enter a logic name (up to 32 characters).
(2) Logic comment		Enter a comment for a logic (up to 1000 characters). The comment entered here is shown in "Logic comment" in Monitor. ☞ Page 407 Monitor
Model name		Do not use this.
[Move highlight step.] button		When clicked, the step highlighted in the primitive in the primitive list moves. While executing the logic manually and the execution result screen is shown, it changes to the [Run highlight step.] button. ☞ Page 349 Manual execution
(3) Primitives list		Shows added primitives.

Changing dataset

Changes the contents of the dataset to display.

Operating procedure

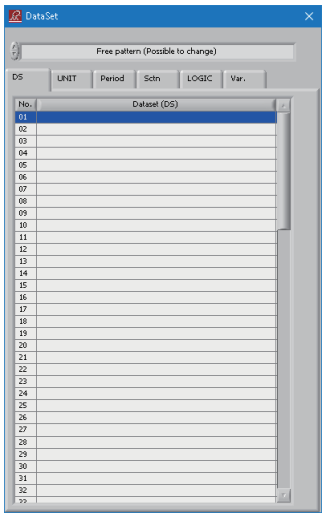
1. For 'Logic editing', click "Change dataset.".

For 'Data display after execution', click "Change dataset.".

The dataset set in 'Management' is shown.

☞ Page 378 Management

2. Set each item to edit the dataset.



Item		Description
[DS] tab	Dataset (DS)	Shows the list of dataset names. The dataset name is displayed in the format '(unit name)_UNIT'. The dataset selected in this item is shown on related screens.
[UNIT] tab	Unit	Shows all units registered in the specified folder.
[Period] tab	Period	When a unit is selected in "Unit", a data period registered in the unit is shown, one day per one line. Select the period shown on related screens.
[Sctn] tab	Sctn	Shows sections in the period selected in "Period". The section name indicates the start time extracted by Reader, or the start time of the text variable. When text variables are selected in "Text name" on the [FLT] tab on the "Management" screen, the text variable values are shown in order from the "1" column. ☞ Page 378 Management
[LOGIC] tab	Logic	Shows the logic executed during the period selected in "Period" and on the section selected in "Sctn". Selecting a logic shows the execution result of that logic. A logic can be executed for a selected period or section.
[Var.] tab	[Trace variable name] button	Shows variables contained in data registered in the unit. When a logic is selected in "logic", names of variables output by the logic are also shown.
	Statistics	When a logic is selected in "logic", names of variables output by the logic are also shown.

Creating logic

Create a logic.

Set and register primitives in an order to be performed.

Precautions

- Register a logic per unit in 'Dataset'. To register a logic, 'Dataset' must be configured in advance.

☞ Page 378 Management

- On the logic list, 'Monitor' is registered by default for all units. 'Monitor' is a logic which monitors the diagnosis results of 'SPC', 'multivariate analysis (single central value format)', and 'guard band'. If 'Monitor' is edited or deleted, the results cannot be detected in Monitor.

☞ Page 188 SPC, Page 204 Multivariate Analysis (Single Central Value Format), Page 211 Guard Band Diagnosis

- It may not work properly when entering a text directly in the text entry area in the primitive setting. In that case, copy the text with a text editor or others and paste it in the text entry area.

Operating procedure

1. Select a dataset to register the logic.

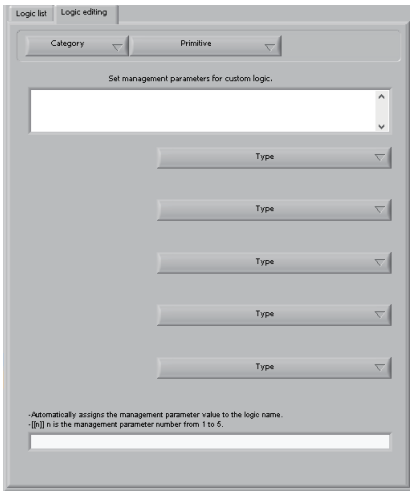
☞ Page 252 Changing dataset

2. Select a blank line on the logic list.

3. Select the [Logic editing] tab, and select a primitive or primitives to register by clicking the [Category] and [Primitive] buttons.

See below for the list of primitives.

☞ Page 256 Primitives

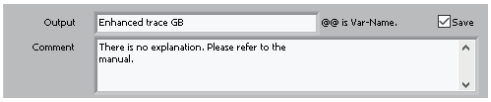


4. Set the parameters for each primitive.

See below for the details of the parameters.

☞ Page 263 Primitive parameters

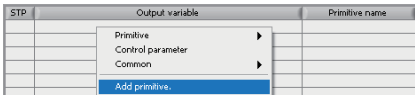
5. "Output" shows a primitive name by default. (A name can be changed as necessary (up to 32 characters).)
When selecting the checkbox of "Save", output from the primitive is added to the dataset variables at the logic execution and it can be referred in 'Data display after execution'.
☞ Page 359 Displaying Data after Running
Output from a primitive with "Save" checked but is inactive is always added to the variables when the logic is executed.
A comment for the primitive can be changed by changing the content in "Comment" (up to 1000 characters).



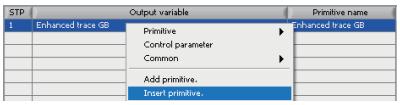
Point

When '@@' is specified in 'Output', adding, inserting, or updating a primitive automatically replaces it with a variable name selected by the primitive (if any).
(Example) When entering "EVENT_EXTRACTION-@@" as an output variable name, selecting the variable name 'ABC', and adding, inserting, or updating a primitive:
EVENT_EXTRACTION-ABC

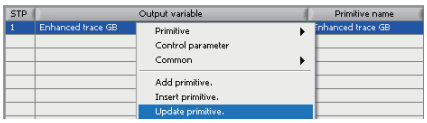
6. Right-click on the primitive list and select [Add primitive.] to add the primitive being edited to the end of the primitive list.
If a primitive with the same name already exists in the primitive list, a sequential number (e.g., 01, 02) is automatically appended to the variable name to avoid duplication of output variable names.



7. Right-click the primitive list while a primitive is selected. Select [Insert primitive.] to insert another primitive on the currently selected primitive.



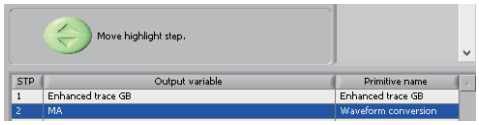
8. If a primitive is edited while it is selected, right-clicking it and selecting [Update primitive.] causes the primitive being edited to be updated with the current contents.



Point

- After editing a primitive, it must be updated, added, or inserted. If none of these operations is done, edited data will be lost.
- If a primitive is added, inserted, or updated while a period and section are selected in the dataset, the primitive is run for the selected period and section.

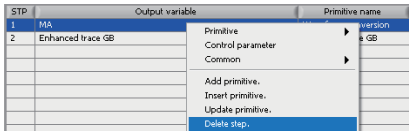
9. The order of primitive steps can be changed by clicking the [Move highlight step.] button while the step to move is selected.



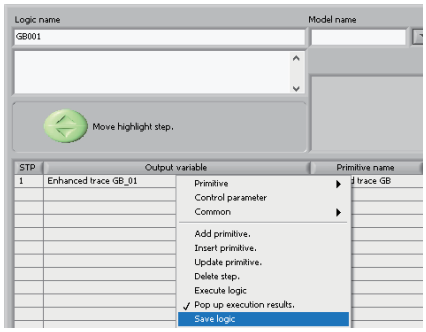
Point

A primitive is executed sequentially from the primitive of which "STP" is "1".

10. To delete a primitive step, right-click the step and select [Delete step.].



11. Enter a name in "Logic name" (up to 32 characters), and right-click on the primitives list and select [Save logic].



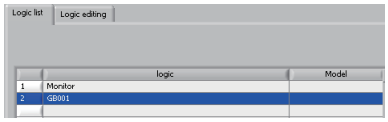
Point

- After editing a logic or primitive, the logic must be saved. If the logic is not saved, edited data will be lost.
- A logic can also be saved by pressing the Enter after setting a logic name for "Logic name".
- If a comment is entered in "Logic comment", the entered comment is shown in "Logic comment" for Monitor.

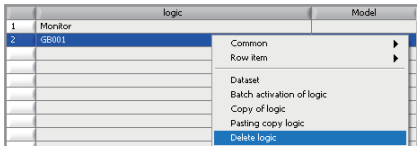
☞ Page 407 Monitor

12. The logic is saved.

To the logic again, select the logic in the logic list.



13. To delete a logic, select and right-click it in the logic list. Select [Delete logic] to delete the selected logic.



Primitives

The following shows primitives used to edit logics.Primitive [primitive]

Primitives are classified into the following categories:

Category	Description	Reference
Event operation	Used in the following cases: • When extracting events at the start time and end time of a subsection to extract a partial waveform from a waveform collected from the equipment • When extracting an event to extract time statistics • When extracting a particular event from multiple events An event is a time stamp recorded when an event occurs in Real-time Statistic Diagnosis Tool, and is used as a trigger to control primitives. For details of the section level, refer to the following: ☞ Page 262 Section level	Page 257 Event operation
Extract section	Used in the following cases: • When extracting a partial waveform to diagnose or analyze a trace variable • When extracting a calculation section to extract the statistics of an event • When extracting a subsection from step variable for each value • When outputting a subsection, the start and end events, and boolean variable (successful with = 0) • When deleting a section which is not required for diagnosis or analysis • When extracting a section for diagnosis or analysis • When extracting a section for a process for which a subsection is not available such as power spectrum calculation • When extracting a single L1 subsection with simple setting For details of the section level, refer to the following: ☞ Page 262 Section level	Page 257 Extract section
Constant and variable	Used in the following cases: • When setting the initial value of a variable necessary for logic execution • When extracting or generating text or step from a step variable, text variable, event, trace variable, statistics or conversion table (logic variable)	Page 258 Constant and variable
Waveform operation	Used in the following cases: • When analyzing data of a trace variable and converting into an applicable form for an error detection • When performing a curve fitting for data of a trace variable and extracting a fit waveform and the coefficient of a fit formula	Page 258 Waveform operation
Statistic extraction	Used in the following cases: • When extracting statistics from a trace variable in a specified section for diagnosis or analysis • When performing the limit pair diagnostics or an SPC by using the extracted statistics • When extracting event frequency and statistics of the section length enclosed by events • When extracting statistics from a step variable or file	Page 259 Statistic extraction
Statistic processing	Used for statistics extracted by a primitive in the statistics category to perform operation, save data, and/or change the section level. For details of the section level, refer to the following: ☞ Page 262 Section level	Page 259 Statistic processing
Waveform diagnostics	Used to diagnose a waveform using GB (guard band) and extract stabilization points (points where set upper or lower limit width was entered) from a waveform.	Page 260 Waveform diagnostics
Statistic diagnostics	Used to diagnosis by using statistics extracted in a primitive.	Page 260 Statistic diagnostics
Decision logic	Used to control step execution of primitives.	Page 260 Decision logic
Output	Used to report an error and output the error log to a file when the error is detected during logic execution.	Page 261 Output
Special usage	Used to define a primitive which is not usually used or does not require parameter setting.	Page 261 Special usage

■ Event operation

Primitives classified in this category are listed below.

Primitive	Description	Parameter settings
Event extraction	Extracts an event by specifying one of the following methods: • Text matching • Offset from section start time • Threshold of trace variable • Maximum/minimum value of trace variable	☞ Page 263 Event extraction
Step change event extraction	Detects change of a step variable and output the time of change as an event.	☞ Page 265 Step change event extraction
Variable threshold event extraction	Uses a threshold to detect events and peaks from trace variable.	☞ Page 266 Variable threshold event extraction
Event extraction at regular intervals	Extracts lower-level sections divided equally or at an even interval from a section.	☞ Page 267 Event extraction at regular intervals
Event consolidating & shift	Integrates several different events and converts them into a single event. Shifts the time of the converted event by a specified amount of time. The output variable name of this primitive is used as the name of the integrated event.	☞ Page 268 Event consolidating & shift
Order specified event extraction	Extracts an event from several events according to a specified order.	☞ Page 269 Order specified event extraction
Event filter	Filters events based on a specified variable value. Outputs events passing through the filter only.	☞ Page 270 Event filter
Text change event extraction	Detects change of text and output the time of change as an event.	☞ Page 271 Text change event extraction
Statistic event extraction	Divides a section into subsections of a specified length, and extracts specified statistic data per variable per subsection. If the statistics data does not update the maximum or minimum value of a subsection consecutively for the specified number of subsections, the start time event for the first subsection is extracted.	☞ Page 272 Statistic event extraction

■ Extract section

Primitives classified in this category are listed below.

Primitive	Description	Parameter settings
Extract subsection	Extracts subsections (L1, L2, and L3). Three configuration modes are available: simplified setting, detailed setting, and state variable. If the upper-level section is not extracted, the lower-level section cannot be extracted. The range of subsections is specified by an event or change of the state variable.	☞ Page 273 Extract subsection
Specified range extraction	Extracts a section defined by the start and end events. Or, deletes a section defined by the start and end events and outputs the rest.	☞ Page 277 Specified range extraction
L-1-Section extraction	Extracts a single L1 section as specified by the start and end conditions. When an L1 section has been already extracted, the succeeding sections are extracted.	☞ Page 278 L-1-Section extraction

■ Constant and variable

Primitives classified in this category are listed below.

Primitive	Description	Parameter settings
Constant generation	Sets a constant as the initial value.	☞ Page 281 Constant generation
Reading numeric LOGIC variable	Outputs a value set to numeric by a logic variable as statistics data.	☞ Page 283 Reading numeric LOGIC variable
Text variable connection	Connects multiple texts and outputs the result as a single text variable. The time to extract texts can be specified.	☞ Page 284 Text variable connection
Numeric variable extraction	Extracts the value at the time specified by an event as a step variable from a step variable, trace variable, and statistics. An offset (in seconds) can be set for an event. When the offset time is out of the specified section, no value is extracted.	☞ Page 285 Numeric variable extraction
Execution conversion	Outputs values matching the input condition using a conversion table registered by a logic variable.	☞ Page 286 Execution conversion
Step variable filter	Compares two state variables or a state variable and a numeric value and converts the time zone when they match into a value.	☞ Page 287 Step variable filter

■ Waveform operation

Primitives classified in this category are listed below.

Primitive	Description	Parameter settings
Waveform conversion	Perform one of the following: • Moving average (simple moving average, polynomial fit, median, smoothing by MAD) • Waveform differentiation (n-order differential) • Waveform integration (n-order integral) • Waveform difference (difference by shifting own waveform) • Auto-scaling (converts to average value = 0, standard deviation = 1) • Range-scaling (converts amplitude to ±1) • Centering (shifts Y value to make average value =0) • Wave statistic operation (calculation between waveforms or waveform and statistics) • Logarithmic conversion (common, natural, logarithmic conversion with base = 2)	☞ Page 288 Waveform conversion
Waveform interpolation	Interpolates trace variable and converts it into a short sampling interval.	☞ Page 292 Waveform interpolation
Shift in X axis	Shifts a variable in the time axis direction.	☞ Page 293 Shift in X axis
Max. Avg. Min. waveform ext.	Extracts the following from selected multiple waveforms: • Maximum value waveform extracted only the maximum value • Minimum value waveform extracted only the minimum value • Average value waveform extracted only the average value For the maximum or minimum value waveform, a text variable which indicates the trace variable name for the maximum or minimum values of the points on the waveform.	☞ Page 294 Max. Avg. Min. waveform ext.
Linear curve fit	Performs curve-fitting using a linear equation and outputs a waveform and coefficient.	☞ Page 295 Linear curve fit
Polynomial curve fit	Performs curve-fitting using a polynomial equation and outputs a waveform and coefficient.	☞ Page 296 Polynomial curve fit
Exponential curve fit	Performs curve-fitting using an exponential equation and outputs a waveform and coefficient.	☞ Page 297 Exponential curve fit

■ Statistic extraction

Primitives classified in this category are listed below.

Primitive	Description	Parameter settings
Individual trace statistic	Extracts specified statistics from trace variable.	☞ Page 298 Individual trace statistic
Event specified trace value ext.	Extracts the value at the time when an event occurs from multiple trace variable data.	☞ Page 299 Event specified trace value ext.
Multi trace statistic	Extracts multiple statistics data items from multiple trace variable data. The output statistics name is "output variable name" + "trace variable name" + "statistics type". To shorten the name, change the output name to "_" (underscore).	☞ Page 300 Multi trace statistic
Area statistic	Calculates time for which trace variable exists within a range defined by specified upper and lower limits.	☞ Page 302 Area statistic
Event statistic	Performs the following per specified section: • Event section: Extracts the section length as statistics. • Event frequency: Extracts the event occurrence frequency as statistics. • Event interval: Extracts the event occurrence interval as statistics.	☞ Page 303 Event statistic
Range specified event statistic	Extracts multiple sections defined by start and end events and calculates the statistics of the section length.	☞ Page 304 Range specified event statistic
Event specified variable value ext.	Extracts the Y value of the variable at the time when the specified event first occurred during the specified section.	☞ Page 305 Event specified variable value ext.

■ Statistic processing

Primitives classified in this category are listed below.

Primitive	Description	Parameter settings
Multi-section total	Calculates statistics from the current and past section data. To reference output from a primitive after the current step, run the primitive in the FD mode (error detection mode). It cannot be executed in the analysis mode. When [Reset at Zero Value] is checked, the aggregated value can be reset each time the value for the current section becomes "0".	☞ Page 306 Multi-section total
Subordinate section total	Performs a specified operation on the statistics of a lower-level section and outputs the result as the statistics of the upper-level section.	☞ Page 307 Subordinate section total
Multi-section calculation	Performs an operation on statistics of the past and current sections.	☞ Page 308 Multi-section calculation
Calculation in present section	Performs an operation on the current sections or extracts a central value. When a multi-operation form is set, a polynomial operation is performed on multiple variables concurrently.	☞ Page 309 Calculation in present section
Raises level to section statistic.	Upgrades statistics of a subsection to section statistics of a specified section number.	☞ Page 310 Raises level to section statistic.
Statistic level down	Downgrades statistics extracted on an upper level by one level so that it can be referenced on the lower level.	☞ Page 311 Statistic level down
Regression operation	Performs multiple regression analysis (LMR) calculation by specifying a partial matrix and outputs a predicted value.	☞ Page 312 Regression operation
MVA statistic	Outputs MT distance, Q statistic (SPE), and Euclidean distance (EU distance) by specifying a partial matrix. By specifying a text variable, calculation is performed for each text value in a partial matrix.	☞ Page 313 MVA statistic

■ Waveform diagnostics

Primitives classified in this category are listed below.

Primitive	Description	Parameter settings
Enhanced trace GB	Performs the guard band diagnosis of the waveform for each section or L1 subsection. The guard band is created from the reference waveform or registered directly. When a value exceeds the guard band consecutively for the number of excess points, 'Boolean variable = 1' is output. For details of the section level, refer to the following: ☞ Page 262 Section level	☞ Page 315 Enhanced trace GB
Stability deviating GB	Detects stabilization points and points deviating from stabilization consecutively. Outputs the event at the stabilization deviation time, time to stabilize, and stabilization time.	☞ Page 317 Stability deviating GB
Variable limit pair GB	Diagnoses the upper and lower limit values of a waveform. A value equal to the upper or lower limit is regarded to be excessive. For details of the section level, refer to the following: ☞ Page 262 Section level	☞ Page 319 Variable limit pair GB
Amplitude change detection	Sections the moving window horizontally at the specified point. Calculates the average amplitude of the waveform in each window. The average amplitude of the waveform in the first window is assumed to be 100%. When the average amplitude of the waveform in the second window becomes larger or smaller than that of the first window by the specified percentage, it is detected as an amplitude change point.	☞ Page 320 Amplitude change detection
Slope change detect.	Sections the moving window at the specified point. Performs liner fitting on the waveform in each window to calculate the slope. Detects the point where the slope increase or decreases as well as the ±peak. A repeated detection count can be specified.	☞ Page 322 Slope change detection

■ Statistic diagnostics

Primitives classified in this category are listed below.

Primitive	Description	Parameter settings
SPC diagnostics	Performs SPC diagnosis.	☞ Page 325 SPC diagnostics
Limit pair diagnostics	Diagnoses multiple statistics data pieces with the same upper and lower limits. When a conversion table is used, multiple statistics data pieces are diagnosed with the same upper and lower limits set by a logic variable, and the diagnosis result is inserted into the message template.	☞ Page 326 Limit pair diagnostics
Moving upper/lower limit diag.	Extracts statistics from specified moving sections. Diagnoses the extracts statistics.	☞ Page 328 Moving upper/lower limit diagnostics

■ Decision logic

Primitives classified in this category are listed below.

Primitive	Description	Parameter settings
Boolean operation	Performs a boolean operation on boolean variables. Detects the boolean variable and terminates a logic.	☞ Page 329 Boolean operation
Boolean level change	Upgrades a boolean value of a subsection of the specified subsection number to a section boolean value. For details of the section level, refer to the following: ☞ Page 262 Section level	☞ Page 330 Boolean level change
Judge by text	Determine the value of a text variable value and output a boolean variable. By selecting the checkbox of "Logic closing option", the logic will be ended depending on a boolean variable value.	☞ Page 331 Judge by text
Judge by step	Determine the value of a step variable value and output a boolean variable. By selecting the checkbox of "Logic closing option", the logic will be ended depending on a boolean variable value.	☞ Page 332 Judge by step
IF	When the boolean variable value is "1", the steps between IF and ELSE are executed.	☞ Page 333 IF
ELSE	Steps following the IF to ELSE section are executed when the boolean variable value is "0".	☞ Page 334 ELSE
ENDIF	Terminates the IF ELSE statement.	☞ Page 334 ENDIF
CASE	Executes the CASE statement. When the input variable value and comparison value match, the variable value of the specified type is output.	☞ Page 334 CASE

■ Output

Primitives classified in this category are listed below.

Primitive	Description	Parameter settings
Save CSV data	Saves the waveform and statistics in the CSV format. For the unit of one file, specify the unit of the period to store the file. For the write option, specify whether to overwrite the entire file for each saving or append new sections to the existing file. When [[EQ]], [[FLT]], [[SEQ]], [[START]], [[END]], and [[variable name]] are added to the file name, an appropriate value is inserted in each [[]]. This allows for saving CSV data from the same period in different files with different file names.	☞ Page 335 Save CSV data
Read & insert template	Reads the template and inserts the specified text.	☞ Page 337 Read & insert template
Write log and error notification	Displays a pop-up for an error. Writes log data to display in the operating screen of 'Diagnostic logic result display'. ☞ Page 376 Displaying a Diagnostic Logic Result A response data file can be output by using this in combination with a waveform diagnostic logic not having a function to display a pop-up window or a statistic diagnostic logic.	☞ Page 339 Write log and error notification
Write template	Outputs the template to the specified folder.	☞ Page 340 Write template

■ Special usage

Primitives classified in this category are listed below.

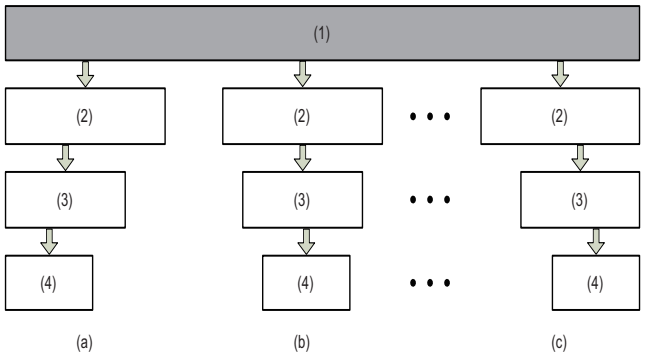
Primitive	Description	Parameter settings
Moving max min	Generates a moving maximum or minimum value waveform.	☞ Page 341 Moving max min
Parametrical conversion	Converts a single input value into multiple output values using the I/O conversion table. Interpolation is performed linearly.	☞ Page 342 Parametrical conversion
Step variable generation	When specifying an event, assigns a numeric value to the event and converts it to a state variable. When specifying time, specifies a numeric value and time to retain the value and creates a state variable.	☞ Page 343 Step variable generation
Boolean judgment statistic saving	Saves a specified value according to a boolean variable value. For the automatic specification value update SPC, a diagnosis value is saved when the result of SPC determination is normal and no value is saved when the result is not normal.	☞ Page 345 Boolean judgment statistic saving
Read measurement data.	Reads the measurement data. Reads a value which matches the key item value from a CSV file as statistics. Up to two key items are ANDed for judging whether they match each value. Reads CSV data from multiple sections of a single CSV file or from multiple CSV files.	☞ Page 346 Read measurement data
Simple diagnosis	Performs diagnosis registered on the operation screen of 'SPC', 'Multivariate analysis (single central value format)', or 'Guard band diagnosis'. ☞ Page 188 SPC ☞ Page 204 Multivariate Analysis (Single Central Value Format) ☞ Page 211 Guard Band Diagnosis This primitive is defined in the logic "Monitor" that is provided by default. This primitive cannot be added, changed, and/or deleted.	—
Frequency filter	Performs frequency filtering.	☞ Page 347 Frequency filter
Power spectrum	Calculates the power spectrum.	☞ Page 348 Power spectrum

■ Section level

Just as Reader extracts an expansion section from a unit section, a subsection can be extracted from a unit section or expansion section.

Subsections has levels of L1 (upper) to L3 (lower), and the subsection of L1 is defined as L2, and the subsection of L2 is defined as L3.

Multiple subsections can be extracted on the same level and are assigned ascending subsection numbers 1, 2, 3, ... chronologically from the oldest subsection.



(1) Unit section or expansion section
(2) L1 subsection (Numbers 1, 2, ... n are assigned to the 1st to the nth sections.)
(3) L2 subsection (Numbers 1, 2, ... n are assigned to the 1st to the nth sections.)
(4) L3 subsection (Numbers 1, 2, ... n are assigned to the 1st to the nth sections.)
(a) 1st section
(b) 2nd section
(c) nth section

Primitive parameters

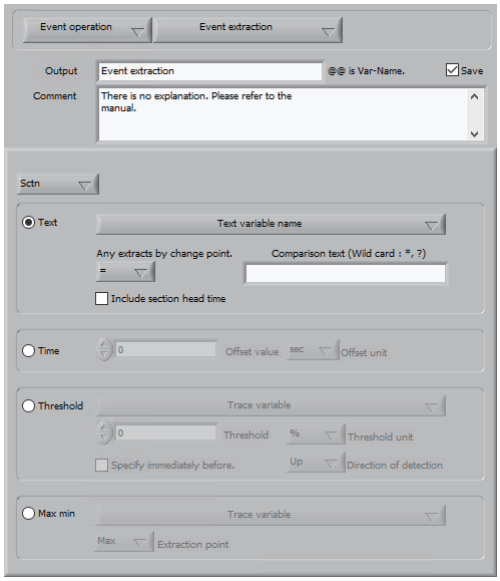
Setting items (parameters) for each primitive are explained below.

For details of the section level, refer to the following:

☞ Page 262 Section level

■ Event extraction

Extracts events according to the selected event type (text, time, threshold, maximum value, or minimum value).



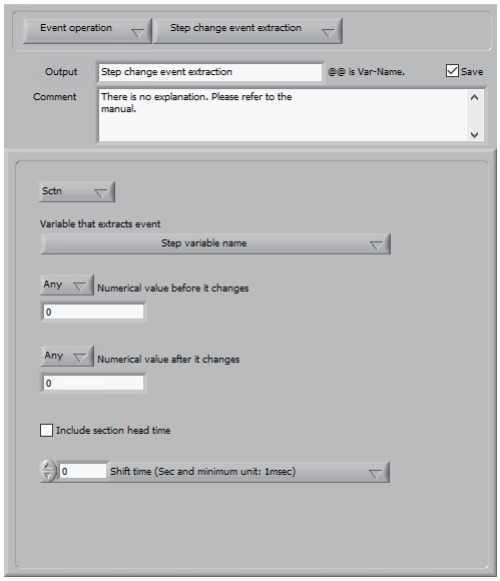
Item		Description	Output
Sctn		Specifies the level of sections to output.	—
Text	—	Extracts events of the time when the text variable changes to the specified value.	• Extracts all events satisfying the condition. • When the comparison operator is [Any], an event is extracted when ever text changes.
	[Text variable name] button*1	Selects a text variable used for comparison to extract events.	
	Operator*1	Select one of the following options: • =: Equal to • !=: Not equal to • Any: Value changed	
	Comparison text*1	When setting a comparison operator other than "Any", set a text to compare (up to 32 characters). A wild card ('*' for one or more characters and '?' for one character) can be set.	
	Include section head time*1	When checked, the value of the section or subsection start time is used for comparison.	
Time	—	Extracts events according to the offset from the section start time.	Extracts one event satisfying the condition.
	Offset value*2	Set an offset value (0.0000 to 2147483647.0000) from the start time of a section or subsection.	
	Offset unit*2	Select "sec" or "%". • "%" refers to a percentage of the upper-level section.	

Item		Description	Output
Threshold	—	Extracts events from trace variables using a fixed threshold.	Extracts all events at the times when the threshold is crossed.
	[Trace variable] button*3	Select a trace variable.	
	Threshold*3	Enter a threshold value (-2147483648.0000 to 2147483647.0000).	
	Threshold unit*3	Select "sec" or "%". • "%" represents the percentage of the threshold with the minimum value and maximum value of the trace variable within the section regarded as 0% and 100%, respectively.	
	Direction of detection*3	Select one of the following options: • Up: An event is extracted when a waveform rises. • Down: An event is extracted when a waveform falls.	
	Specify immediately before.*3	• By selecting this, the time of the former point is extracted as an event when crossing a threshold between two points. • By unselecting this, the time of the latter point is extracted as an event.	
Max min	—	Extracts an event at the time when the maximum or minimum value occurs.	Extracts an event at the time when the maximum or minimum value occurs.
	[Trace variable] button*4	Select a trace variable.	
	Extraction point*4	Select "Max" or "Min". • Max: An event is extracted at the time when the trace variable data becomes the maximum during the specified section. • Min: An event is extracted at the time when the trace variable data becomes the minimum during the specified section. When there are many points which take the maximum value or minimum value, the time of the first point is extracted as an event.	

*1 It can be set when "Text" is selected.
*2 It can be set when "Time" is selected.
*3 It can be set when "Threshold" is selected.
*4 It can be set when "Max min" is selected.

■ Step change event extraction

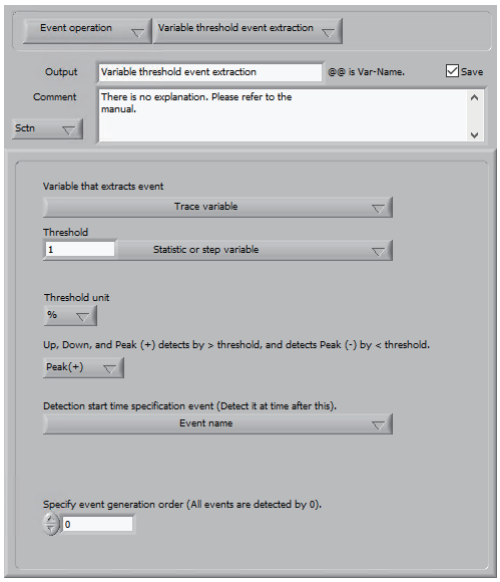
Extracts events of the time when values before and after the step variable changes to the specified value.



Setting item		Description	Output
Sctn		Specifies the level of sections to output.	All events on the time which matched to a specified condition are extracted by detecting the variation of a step variable.
Variable that extracts event		Select a step variable to extract events.	
Numerical value before it changes	—	Select one of the following options: • Any: Value changed • =: Equal to • >=: Equal to or greater than • <=: Equal to or less than • >: Greater than • <: Less than • !=: Not equal to When "Any" is selected, all change points are targeted regardless of values changed.	
	Comparison value	Specify a value unless "Any" is selected in "Numerical value before it changes". Enter a value (-2147483648.0000 to 2147483647.0000) or select a variable (step variable, statistics, or logic variable) from the menu.	
Numerical value after it changes	—	Select one of the following options: • Any: Value changed • =: Equal to • >=: Equal to or greater than • <=: Equal to or less than • >: Greater than • <: Less than • !=: Not equal to When "Any" is selected, all change points are targeted regardless of values changed.	
	Comparison value	Specify a value unless "Any" is selected in "Numerical value after it changes". Enter a value (-2147483648.0000 to 2147483647.0000) or select a variable (step variable, statistics, or logic variable) from the menu.	
Include section head time		When checked, the value of the section or subsection start time is used for comparison.	
Shift time		Shifts the output event forward or backward. Enter time (-2147483648.0000 to 2147483647.0000 seconds) or select a variable (statistic, logic variable, or step variable).	

■ Variable threshold event extraction

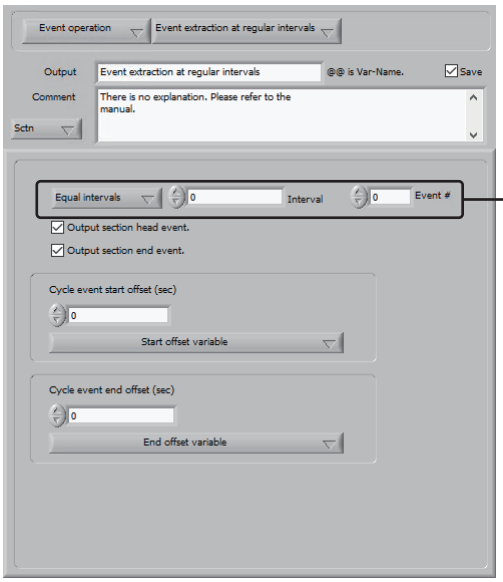
Extracts events by specifying a threshold or peak.



Setting item	Description	Output
Sctn	Specifies the level of sections to input and output.	All events on the time which matched to a specified condition are extracted
Variable that extracts event	Select a trace variable name to extract events.	
Threshold	Enter a value (-2147483648.0000 to 2147483647.0000) or select a variable (statistics, or logic variable). Extracts an event in a range exceeding a threshold. Threshold of the upper-level section can be referenced.	
Threshold unit	Select one of the following options: • Value: Uses the trace variable data as the threshold • %: Uses the percentage of trace variable amplitude within the specified section as the threshold, with the maximum amplitude regarded as 100%	
Detection type	Select one of the following options: • Up: An event is extracted when a value matches or exceeds a threshold at the timing of the rising of a waveform. • Down: An event is extracted when a value matches or falls below a threshold at the timing of the falling of a waveform. • Peak (+): An event is extracted when a peak in the positive direction exceeds a threshold is detected. • Peak (-): An event is extracted when a peak in the negative direction falls below a threshold is detected.	
Width of peak detection	Allows for detecting peaks without being affected by a noise. Specify the minimum value possible.	
Detection start time specification event	Specify the time to start detection. If not specified, detection starts at the lead time of the section level.	
Filter	Select from "All", "Max",or "Min". • Max: Detects the maximum peak Y value from multiple peaks. • Min: Detects the minimum peak Y value from multiple peaks.	
Specify event generation order	When "All" is selected for "Filtering" and multiple events occur, one of them is extracted according to the specified order (0 to 2147483647). If set to '0', all events are extracted.	

■ Event extraction at regular intervals

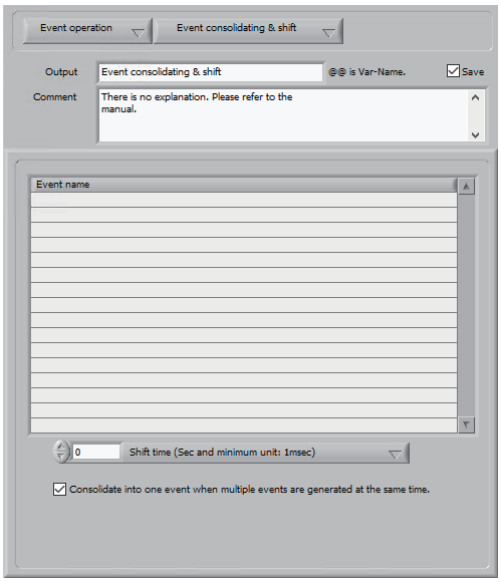
Extracts events at a constant interval.



Setting item	Description	Output
Sctn	Specifies the level of sections to input and output.	• Extracts events at a specified interval. • When "Equal intervals" is specified in "Extraction type", length of the last section is shorter than the specified time interval unless the entire section can be divided by the specified time interval.
(1) Extraction type	Select one of the following options: • Equal dividing: Extracts events which divide an section at a regular interval. In this case, specify the number of divisions (2 to 10000) and the number of events (0 to 10000). • Equal intervals: Extracts events at a specified interval. In this case, specify an interval (0.0000 to 2147483647.0000) and the number of events (0 to 10000). If the number of events is set to '0', all events are extracted.	
Output section head event.	If checked, the event at the section start time is also included in the extracted events.	
Output section end event.	If checked, the event at the section end time is also included in the extracted events.	
Cycle event start offset	Specify an offset from the time to start event extraction (start time of the specified section). A fixed value (0.0000 to 2147483647.0000) or variable can be specified as an offset. If both are specified, the variable is used.	
Cycle event end offset	Specify an offset (-2147483648.0000 to 0.0000) for the time to end an event extraction (end time of a specified section).	

■ Event consolidating & shift

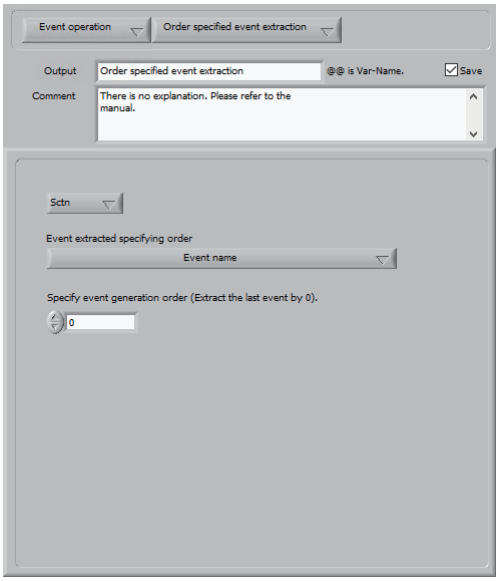
Integrates several different events and converts them into a single event.



Setting item	Description	Output
Event name	Selects events to aggregate.	• Integrates several events with different names and converts them into a single event. • Shifts the converted event forward or backward. Note that an event which was shifted out of the section is not output.
Shift time	Shifts the aggregated event. Enter time (-2147483648.0000 to 2147483647.0000 seconds) or select a variable (statistic, logic variable, or step variable). If only one event is selected, this event is shifted.	
Consolidate into one event when multiple events are generated at the same time.	Specify whether to aggregate multiple events into a single event or keep them all if they occur at the same time. When a subsection is extracted using multiple events occurring at the same time as the start and end events, a subsection of which length is "0" is extracted.	

■ Order specified event extraction

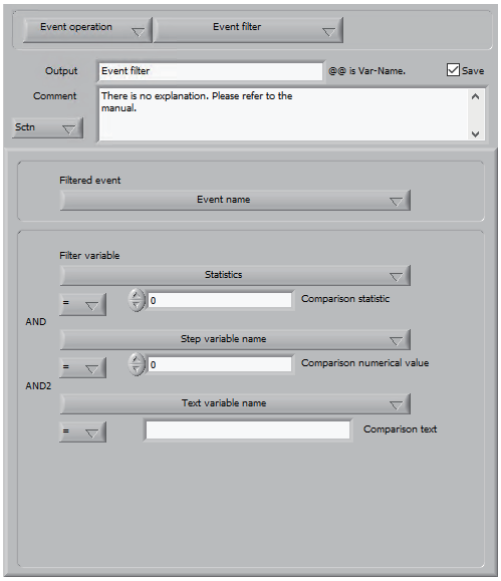
Extracts an event from several events with the same name according to a specified order.



Setting item	Description	Output
Sctn	Specifies the level of sections to output.	Extracts an event from several events according to a specified order.
Event extracted specifying order	Select an event to extract.	
Specify event generation order	Specify the occurrence order (0 to 2147483647) of events to be extracted from the start time of a specified section. If the order is set to "0" or a value larger than the number of events present in the section, the last event is selected. Overlapping events are counted individually.	

■ Event filter

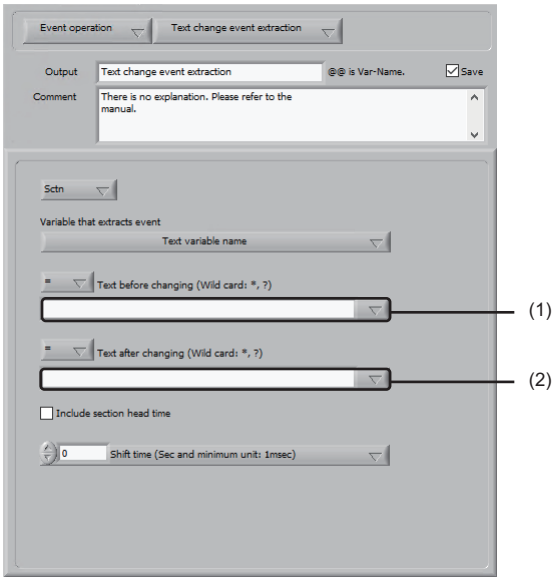
Filters events based on a specified variable value.



Setting item	Description	Output
Sctn	Specifies the level of sections to input and output.	Outputs all events satisfying the condition during the specified section.
Filtered event	Specify an even to be filtered.	
Filter variable (Statistics, Step variable name, and Text variable name)	Specify the statistical variable name, step variable name, and text variable name.	
Comparison value (Comparison statistic, Comparison numerical value, and Comparison text)	Enter the fixed statistics (-2147483648.0000 to 2147483647.0000), fixed numeric value (-2147483648.0000 to 2147483647.0000), and fixed text (up to 32 characters).	
AND/AND2	When two or more filter variables are specified, they are ANDed.	
Operator	For a numeric value, select from "=]", ">=", "<=", ">", "<", or "!=". For text, select "=" or "!=". • =: Equal to • >=: Equal to or greater than • <=: Equal to or less than • >: Greater than • <: Less than • !=: Not equal to	

■ Text change event extraction

Extracts events of the time when values before and after the text variable changes to the specified value.

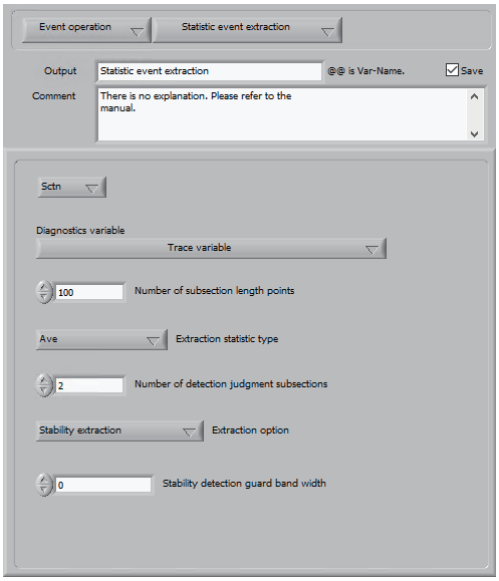


Setting item		Description	Output
Sctn		Specifies the level of sections to output.	All events on the time which matched to a specified condition are extracted by detecting the variation of a text variable.
Variable that extracts event		Specify the text variable to extract events.	
Text before changing	—	Select "Any", "=", or "!=" as the comparison operator. When "Any" is selected, all change points are targeted regardless of values changed. • Any: Value changed • =: Equal to • !=: Not equal to	
	(1) Comparison text	Specify a value unless "Any" is selected in "Text before changing". Enter a text (up to 32 characters) or select a variable (text variable or logic variable) from the menu. A wild card character ('*' represents one or more characters and '?' represents a single character) can be used.	
Text after changing	—	Select "Any", "=", or "!=" as the comparison operator. When "Any" is selected, all change points are targeted regardless of values changed. • Any: Value changed • =: Equal to • !=: Not equal to	
	(2) Comparison text	Specify a value unless "Any" is selected in "Text after changing". Enter a text (up to 32 characters) or select a variable (text variable or logic variable) from the menu. A wild card character ('*' represents one or more characters and '?' represents a single character) can be used.	
Include section head time		When checked, comparison starts from the section or subsection start time.	
Shift time		Shifts the output event forward or backward. Enter time (-2147483648.0000 to 2147483647.0000 seconds) or select a variable (statistic, logic variable, or step variable).	

■ Statistic event extraction

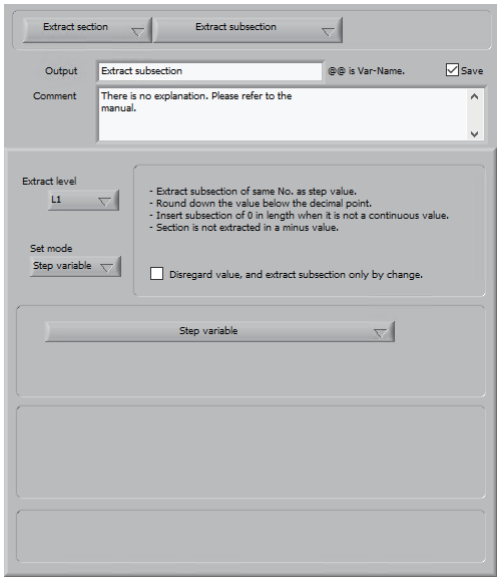
Divides a waveform into subsections and extracts the specified statistics.

If the specified statistics data does not update the maximum or minimum value consecutively for the specified number of subsections, the event for the first subsection is extracted.



Setting item	Description	Output
Sctn	Specify the level of a section to be output.	• Extracts an event at the subsection start time and the statistical value at that time. • When extracting, 'Boolean variable = 1' is output. When not extracting, 'Boolean variable = 0' is output.
Diagnostics variable	Specify the target waveform.	
Number of subsection length points	Specify the length of a subsection when dividing a section into subsections by using a number of points (1 to 2147483647).	
Extraction statistic type	Specify the statistics extracted from the waveform.	
Number of detection judgment subsections	Specify the number (2 to 2147483647) of subsections to detect the maximum value, minimum value, and stabilization (that is a state in which values are in a specified range).	
Extraction option	Select one of the following options: • Stability extraction: Events of the stabilization of statistics are extracted. • Minimum value extraction: When the minimum value in statistics is not updated consecutively for the specified number of subsections, extract the event at the start time of the subsection containing the minimum value. • Maximum value extraction: When the maximum value in statistics is not updated consecutively for the specified number of subsections, extract the event at the start time of the subsection containing the maximum value.	
Stability detection guard band width	Shown when "Stability extraction" is selected in "Extraction option". Enter the upper and lower limit widths (0.0000 to 2147483647.0000).	
Extract including equal	Shown when "Minimum value extraction" or "Maximum value extraction" is selected in "Extraction option". Extracts an event even if the statistics does not change.	

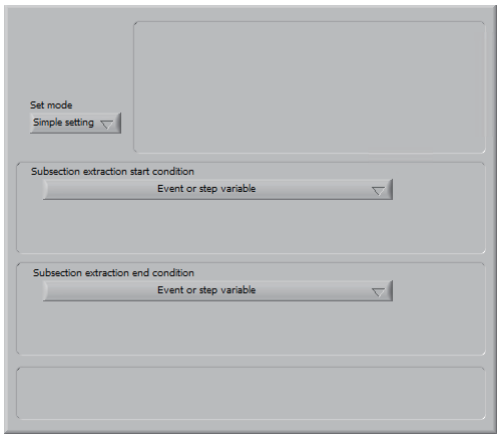
■ Extract subsection



Setting item	Description	Output
Set mod	Select from "Simple setting", "Advanced", or "Step variable".	—

• Setting items when selecting "Simple setting" for "Set mode"

Extracts a section enclosed by two successive events as a subsection.



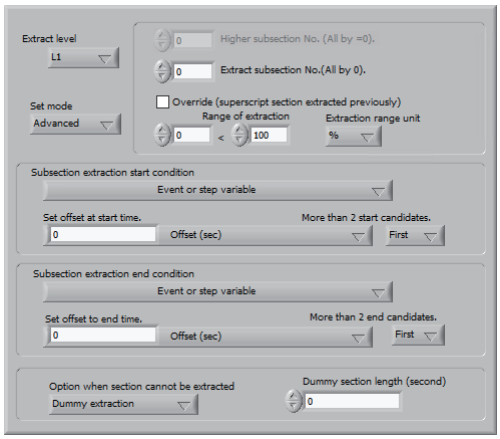
Setting item	Description	Output
Subsection extraction start condition	Select an event, step variable, or text variable.	• Extracts a section enclosed by the subsection extraction start and end conditions as an L1 section. • Step and text variables are used assuming that a change point is an event. • The following are output: Boolean variable (Successful: 0, failed: 1) Event (Start and end of subsection extractions) Statistics (Number of subsections extracted)
Subsection extraction end condition	Select an event, step variable, or text variable.	

Precautions

When setting "Simple setting" for "Set mode", if there is any item selected when setting "Advanced" for "Set mode", the selected contents are applied.

• Setting items when selecting "Advanced" for "Set mode"

Extracts a section enclosed by two events as a subsection by specifying a condition.



Setting item	Description	Output
Extract level	Specify the section level to extract events.	• When the same event is specified for both of the start and end events or a step variable is specified, consecutive sections are extracted. • Sections (L1, L2, and L3), boolean variable (successful = 0, failed = 1), and statistics (number of sections extracted in the same section level in a logic) are extracted. • When extracting a dummy section, 'Boolean variable = 1' is output.
Higher subsection No.	Specify the order of the upper-level subsection (0 to 65535) to extract subsections. When "0" is specified, all subsections are targeted for extraction. When a number greater than the maximum upper-level section number is specified, the last section is targeted for extraction.	
Extract subsection No.	Specify the order of subsections to be extracted (0 to 65535). When "0" is specified, subsections are extracted repeatedly (repeat extraction). When a number greater than the maximum upper-level section number is specified, the last section is extracted.	
Override	Check to overwrite already extracted sections at the same level. When a subsection is overwritten, data extracted for that subsection is deleted.	
Range of extraction	Specify the range of lengths of the subsection to extract. Subsections which are shorter or longer than the specified range are not extracted. • When "%" is set for "Extraction range unit", specify this in the range from 0.0000 to 100.0000. • When "sec" is set for "Extraction range unit", specify this in the range from -2147483648.0000 to 2147483647.0000.	

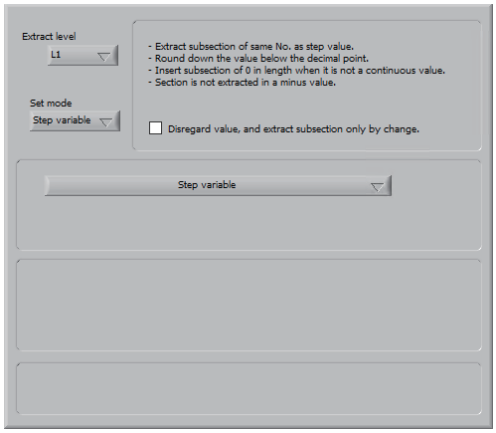
Setting item		Description	Output
Extraction range unit		Specify the unit of the extraction range (length) in "%" or "sec". • "%" refers to a percentage of the upper-level section.	• When the same event is specified for both of the start and end events or a step variable is specified, consecutive sections are extracted. • Sections (L1, L2, and L3), boolean variable (successful = 0, failed = 1), and statistics (number of sections extracted in the same section level in a logic) are extracted. • When extracting a dummy section, 'Boolean variable = 1' is output.
Subsection extraction start condition	—	Select an event, step variable, or text variable.	
	Set offset at start time.	Specify an offset (-2147483648.0000 to 2147483647.0000) from the start event to start a section. A logic variable can also be selected. When offsetting backward, specify a negative value. When offsetting forward, specify a positive value.	
	More than 2 start candidates.	Specify either "First" or "Last" to determine which one of multiple start events occurring consecutively should be used.	
Subsection extraction end condition	—	Select an event, step variable, or text variable.	
	Set offset to end time.	Specify an offset (-2147483648.0000 to 2147483647.0000) from the end event to end a section. A logic variable can also be selected. When offsetting backward, specify a negative value. When offsetting forward, specify a positive value.	
	More than 2 end candidates.	Specifies which one of multiple end events occurring consecutively should be used or whether the first or last end event should be used.	
Option when section cannot be extracted		When no section could be extracted, a dummy section is extracted. • No dummy extraction.: Nothing is performed. • Dummy extraction: A dummy section with the specified section length is generated from the end time of the previous section or from the section start time. • Quit the logic: The logic terminates.	
Dummy section length (second)		Specify the length of a dummy section (0.0000 to 2147483647.0000). When '0' is specified, a zero-length section is extracted.	

Point

If a subsection is not extracted at an expected location, the subsection number may differ from an expected number. A dummy section is a temporary section to prevent this situation (i.e., to align the subsection numbers.

• Setting items when selecting "Step variable" for "Set mode"

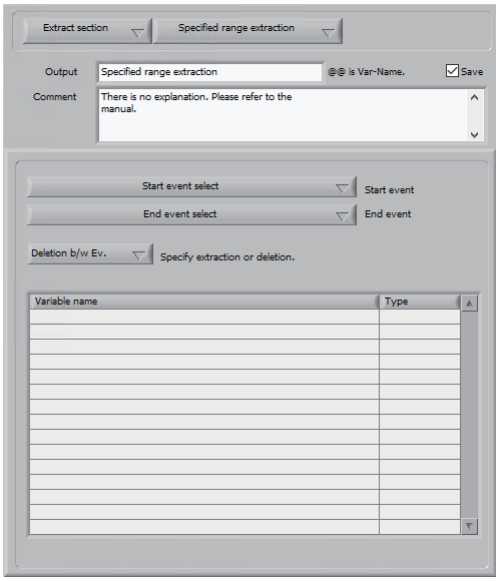
Extracts a subsection with the subsection number same as the variable value.



Setting item	Description	Output
Extract level	Specify the section level to extract events.	• As the step variable changes its value, a subsection with the subsection number that is the same as the variable value is extracted. • When the step variable values change from '1' to '3' and to '5', skipping '2' and '4', the length of the subsections No.2 and No.4 is zero. • When the step variable values change from '1' to '3' and then to '2', not in the ascending order, the subsections No.1 and No.3 are extracted. • The following are output: Boolean variable (Successful: 0, failed: 1) Event (Start and end of subsection extractions) Statistics (Number of subsections extracted)
Disregard value, and extract subsection only by change.	When checked, extracts subsections by connecting points where the step variable changes its value. Subsections are extracted regardless of the ascending or descending order as well as the ± direction.	
Step variable	Select a step variable.	

■ Specified range extraction

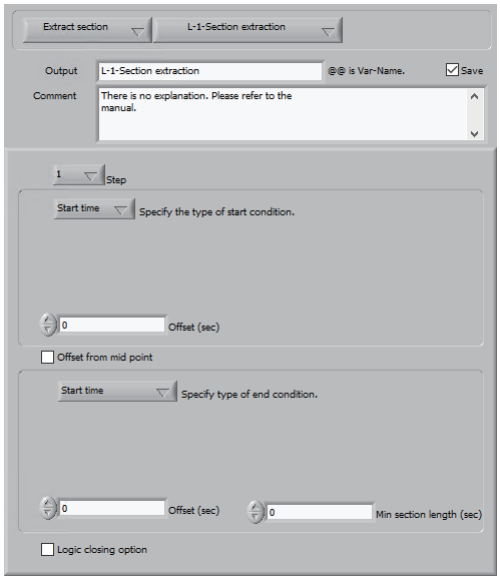
Delete a section between events of a specified variable or retain the section and extract the section data.



Setting item	Description	Output
Start event	Specifies the section start event.	• When "Deletion b/w Ev." is selected in "Specify extraction or deletion.", the specified section is deleted and section data is output. • When "Extraction b/w Ev." is selected in "Specify extraction or deletion.", the specified section is left and section data is output. • An extracted waveform is forward-aligned from the beginning of the original section. • When an extraction is successful, 'Boolean variable = 0' is output. When an extraction fails, 'Boolean variable = 1' is output.
End event	Specifies the section end event.	
Specify extraction or deletion.	Select "Deletion b/w Ev." or "Extraction b/w Ev.". • Deletion b/w Ev.: The specified sections between events is deleted and the section data is output • Extraction b/w Ev.: The section data is output with the specified sections between events left	
Variable name	Select a trace variable, event, or step variable.	

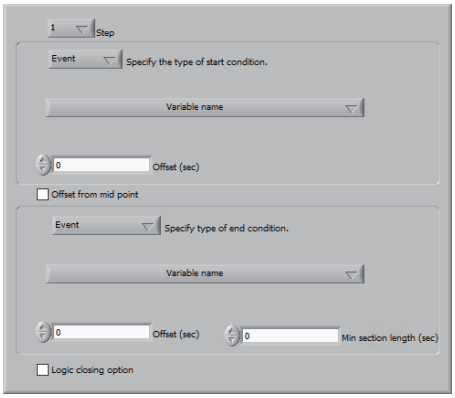
■ L-1-Section extraction

Specify the start and end conditions to extract the subsection of L1.



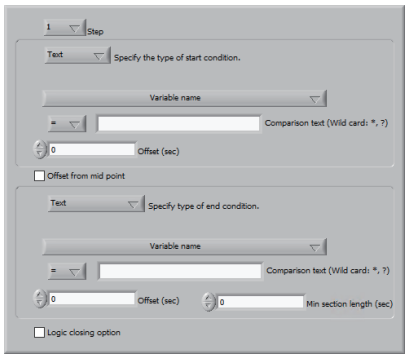
Setting item	Description	Output
Step	Do not use this. ("1" can only be selected.)	A subsection and an event of the start and end time are output. When an extraction is successful, 'Boolean variable = 0' is output. When an extraction fails, 'Boolean variable = 1' is output.
Specify the type of start condition.	Select from "Start time", "End time", "Event", "Text", "Step", or "Threshold".	
Offset (sec)	Specify an offset (-2147483648.0000 to 2147483647.0000) from the specified start condition. When offsetting backward, specify a negative value. When offsetting forward, specify a positive value.	
Offset from mid point	When selecting this, specify a value for "Offset (sec)" in case where the midpoint of a subsection to be extracted is set as 0. For "Offset (sec)", specify a negative value to offset backward from the midpoint or a positive value to offset forward from the midpoint. Extracts an L-1 section which spans from the middle point of the section by the forward and backward offset lengths.	
Specify type of end condition.	Select from "Start time", "End time", "Event", "Text", "Step", "Threshold", or "Start Subsection".	
Offset (sec)	Specify an offset (-2147483648.0000 to 2147483647.0000) from the specified end condition. When offsetting backward, specify a negative value. When offsetting forward, specify a positive value.	
Min section length (sec)	Specify the minimum section length (-2147483648.0000 to 2147483647.0000). Sections of which length is longer than the specified number of seconds are extracted.	
Logic closing option	Option used when executing the logic by creating temporary sections per CSV file. When checked, one of the following can be selected: • End with all subsections failure: When no subsection is extracted, the step in this primitive terminates the logic. • End it if there is a failure subsection: If any of subsections is not extracted, the step in this primitive terminates the logic. When sections are extracted and the logic finishes normally, the next temporary section is not generated and the logic is not executed. To use this function, "Execute logic by file unit before ending section" under 'Extended section definition' must be checked in Reader. ☞ Page 154 Defining an extended section	

• Setting items when selecting "Event" for "Starting condition type" or "End condition type"



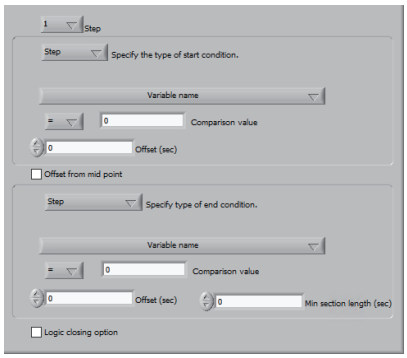
Setting item	Description	Output
Variable name	Select an event for the start condition or end condition.	• Outputs the subsection and events and the start and end times. • When the extraction of a subsection is successful, 'Boolean variable = 0' is output. When the extraction fails, 'Boolean variable = 1' is output.

• Setting items when selecting "Text" for "Starting condition type" or "End condition type"



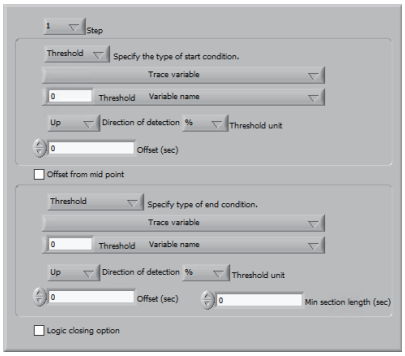
Setting item	Description	Output
Variable name	Select a text variable for the start condition or end condition.	• Outputs the subsection and events and the start and end times. • When the extraction of a subsection is successful, 'Boolean variable = 0' is output. When the extraction fails, 'Boolean variable = 1' is output.
Operator	Select "=" or "!=".	
Comparison text	Set a text to compare (up to 32 characters).	

• Setting items when selecting "Step" for "Starting condition type" or "End condition type"



Setting item	Description	Output
Variable name	Select a step variable for the start condition or end condition.	• Outputs the subsection and events and the start and end times. • When the extraction of a subsection is successful, 'Boolean variable = 0' is output. When the extraction fails, 'Boolean variable = 1' is output.
Operator	Select "=", "!=", "<", ">", "<=", or ">=".	
Comparison value	Enter a numerical value to compare (0.0000 to 2147483647.0000).	

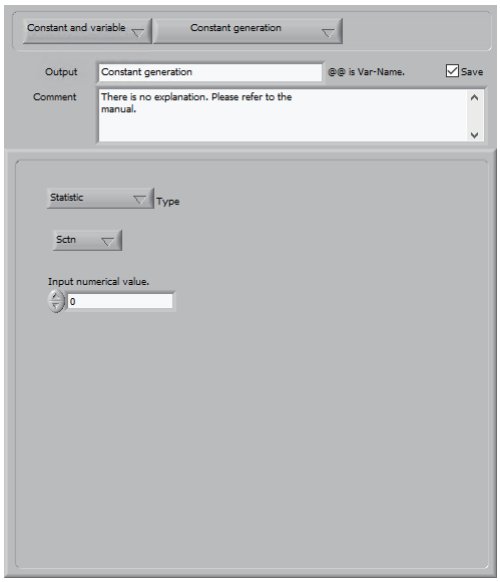
• Setting items when selecting "Threshold" for "Starting condition type" or "End condition type"



Setting item	Description	Output
[Trace variable] button	Select a trace variable for the start condition or end condition.	• Outputs the subsection and events and the start and end times. • When the extraction of a subsection is successful, 'Boolean variable = 0' is output. When the extraction fails, 'Boolean variable = 1' is output.
Threshold/Variable name	Enter a threshold value (-2147483648.0000 to 2147483648.0000) or select a step variable for the start condition or end condition.	
Direction of detection	Select one of the following options: • Up: A value exceeds a threshold. • Down: A value falls into a threshold. • =: A value becomes the same as a threshold.	
Threshold unit	Select "Value or "%" ('%' for the waveform amplitude).	

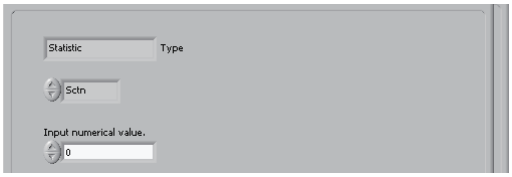
■ Constant generation

Sets numeric constants.



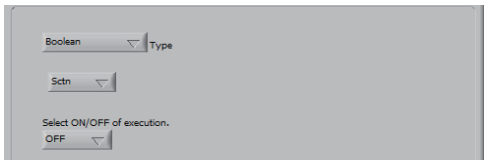
Setting item	Description	Output
Type	Select the output constant type from the following options: "Statistic", "Boolean", "Step variable", or "Text variable". • Statistic: Numeric value • Boolean: 1, 0 • Step variable: Numeric value • Text variable: Text	Outputs a constant of the specified type.

• Setting items when selecting "Statistic" for "Type"



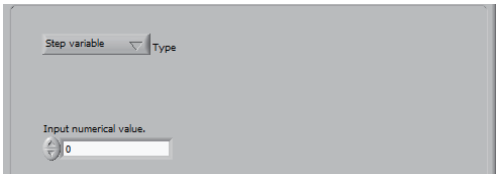
Setting item	Description	Output
Sctn	Select the section level.	Outputs a constant of the specified type.
Input numerical value.	Enter a numerical value (-2147483648.0000 to 2147483647.0000).	

• Setting items when selecting "Boolean" for "Type"



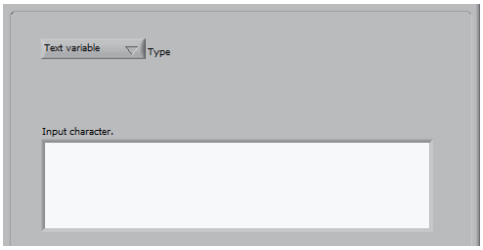
Setting item	Description	Output
Sctn	Select the section level.	Outputs a constant of the specified type.
Select ON/OFF of execution.	Select one of the following options: • ON: Output variable = 1 • OFF: Output variable = 0	

- Setting items when selecting "Step variable" for "Type"



Setting item	Description	Output
Input numerical value.	Enter a numerical value (-2147483648.0000 to 2147483647.0000).	Outputs a constant of the specified type.

- Setting items when selecting "Text variable" for "Type"

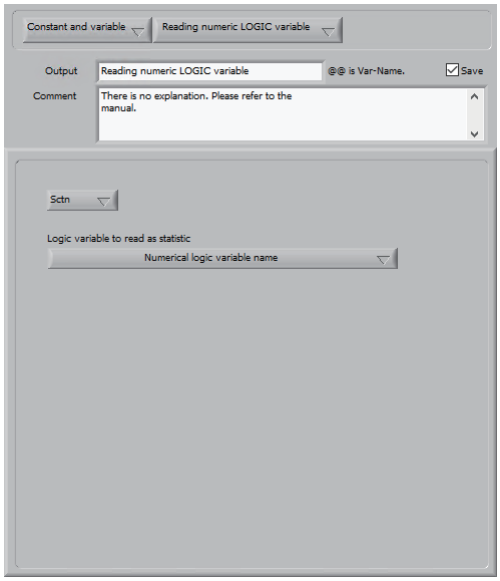


Setting item	Description	Output
Input character.	Enter a character string (up to 32 characters).	Outputs a constant of the specified type.

■ Reading numeric LOGIC variable

Reads the step variable set in 'Logic variable setting'.

☞ Page 351 Setting logic variable



Setting item	Description	Output
Sctn	Specifies the level of sections to output.	Reads the numeric logic variable set in the operation screen of 'Logic variable setting', and outputs a numeric value (statics type) at the specified section level. ☞ Page 351 Setting logic variable
Logic variable to read as statistic	Select a logic variable read as statistics.	

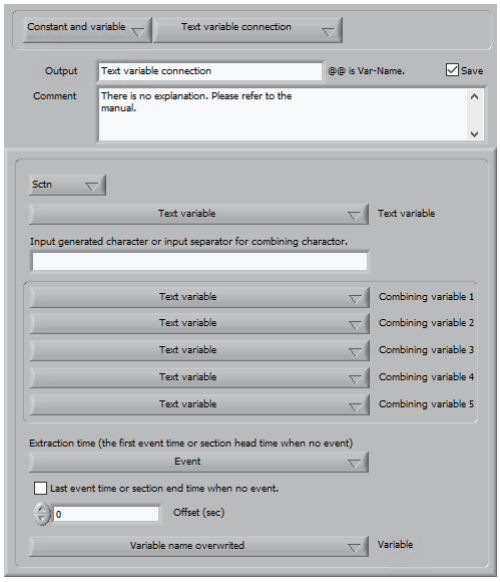
Point

Register a constant value which needs to be changed later as a logic variable, and the change can be applied to a logic by simply changing the value in the operation screen of 'Logic variable setting'.

☞ Page 351 Setting logic variable

■ Text variable connection

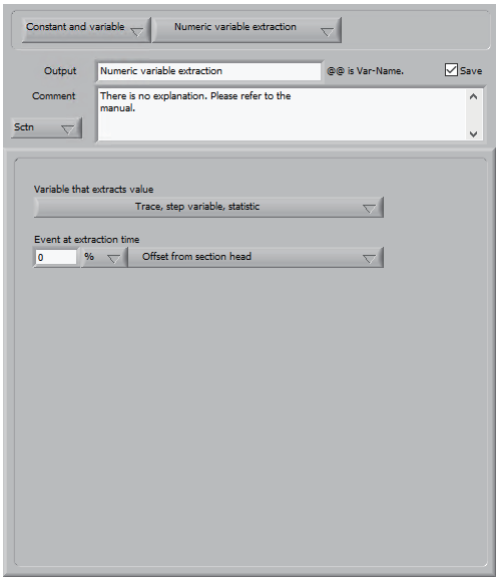
Generates fixed text or connects existing text variables to generate a connection variable.



Setting item	Description	Output
Sctn	Specifies the level of sections to output.	• Outputs a text variable or input text as a text variable. • Connects multiple texts and generates a single text variable. • A text variable which was output by a primitive of the previous step is overwritten with another text.
Text variable	Select a text variable.	
Input generated character or input separator for combining charactor.	Enter a text. If a text variable is not selected in "Text variable", a text entered for this item is output.	
Combining variable 1 to 5	Select up to five variables to connect with the first variable. Enter a separator for "Input generated character or input separator for combining charactor."	
Extraction time	Specify the time to fetch the text value by an event. When not specifying an event, specify the section start or end time.	
Last event time or section end time when no event.	Specify which event should be used.	
Offset (sec)	Specify an offset (-2147483648.0000 to 2147483647.0000) from the start and end of a section or the event time. When offsetting backward, specify a negative value. When offsetting forward, specify a positive value.	
Variable	Overwrites a text variable output from the previous primitive step with the specified text.	

■ Numeric variable extraction

Extracts the value at the time specified by an event as a step variable from a step variable, trace variable, and statistics.

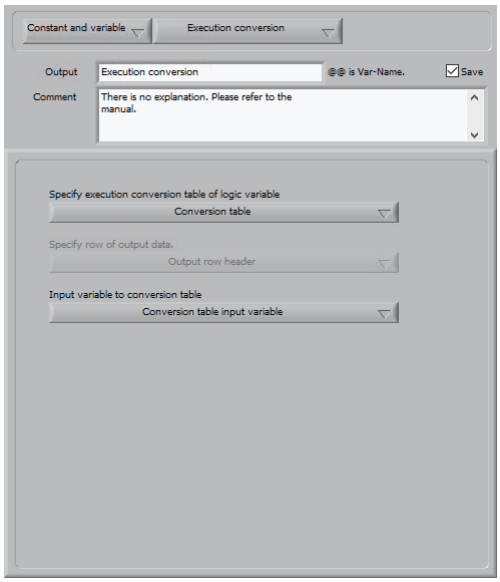


Setting item	Description	Output
Sctn	Specifies the level of sections to input and output.	• Extracts the step variable at the time offset from the start of a section or subsection start time. • When the number of seconds exceeding the section length is specified, the section or subsection end time is extracted as a step variable. • When an event is specified, the value of the time when the first event is found is extracted as step variable. • When multiple events exist, the second and later events are ignored.
Variable that extracts value	Select a step variable, trace variable, and statistics.	
Event at extraction time	Specify the time of an offset from the start of a section by using a value (-2147483648.0000 to 2147483647.0000), or select an event. To specify the offset using a value, enter a numeric value and unit ("%" or "sec").	

■ Execution conversion

Outputs a value converted using the execution conversion table or edit conversion table registered in 'Logic variable setting' based on a value obtained during logic execution.

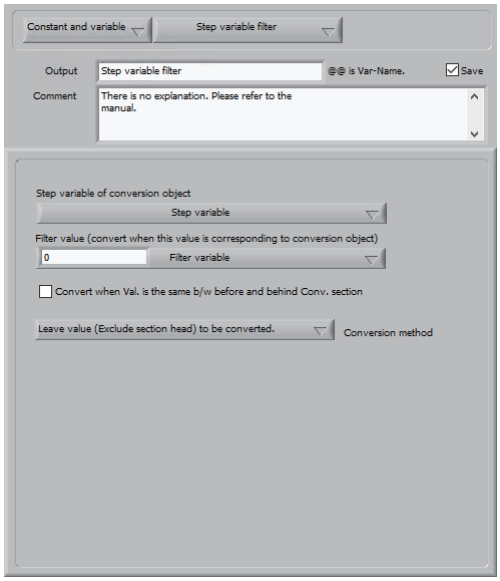
☞ Page 351 Setting logic variable



Setting item	Description	Output
Specify execution conversion table of logic variable	Select the execution or edit conversion table defined in 'Logic variable setting'.	• For the execution conversion table, input variables for each row are verified with the input condition and the data of the cell in the specified column header of the row satisfied the condition first is output. • For the edit conversion table, text corresponding to the matched ID is output.
Specify row of output data.	Effective when the execution conversion table is selected in "Specify execution conversion table of logic variable". Select the header name of a row to which the execution conversion table is output.	
Input variable to conversion table	For the execution conversion table, select a variable to enter a value specified for each row. For the edit conversion table, select a variable to enter a value specified in ID column of the table.	

■ Step variable filter

Compare step variables or step variable and a numerical value and convert the value of a step variable value of the time matched into the specified value.

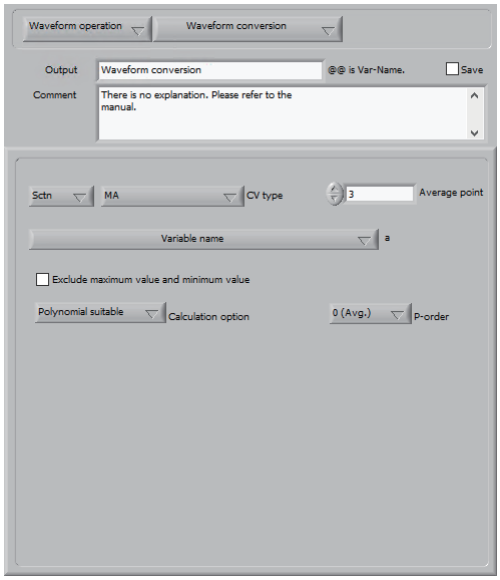


Setting item	Description	Output
Step variable of conversion object	Select a step variable to convert.	A step variable and a filter value is compared and the matched values are converted according to the contents set in "Conversion method".
Filter value	Converts the portion that matches the filter value. If the filter value is a subsection, performs filtering process on that subsection. Enter a fixed value (-2147483648.0000 to 2147483647.0000) of select a step variable.	
Convert when Val. is the same b/w before and behind Conv. section	If checked, conversion is performed only when the value remains the same before and after the filter section. (For smoothing unevenness.)	
Conversion method	Select one of the following options: • Replace it by a specified value.: Replace the values of a part to be converted by filtering with a value specified for "Replaced specified value". • Leave value (Exclude section head) to be converted.: Replace the values with the value just before a part to be converted by filtering. When a conversion is started from the start point of a section, values are not replaced.	
Replaced specified value	Shown when "Replace it by a specified value." is selected in "Conversion method". Replace the values of a part to be converted with a value (-2147483648.0000 to 2147483647.0000).	

Point

When extracting a subsection depending on the change of a step variable, it cannot be extracted unless the value changes in ascending order. This primitive converts the values in a range where step variable values decrease into the same value as the one immediately before or a fixed value, and changes the order in ascending.

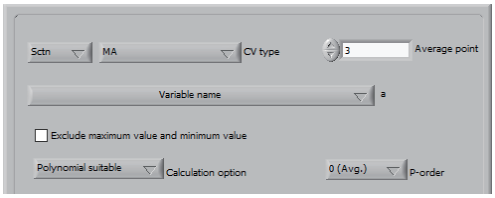
■ Waveform conversion



Setting item	Description	Output
Sctn	Specifies the level of sections to output.	—
Conversion type	Select one of the following options: "MA", "Waveform differentiation", "Waveform integration", "Waveform difference", "Auto-scaling", "Range-scaling", "Centering", "Wave statistic operation", or "Logarithmic conversion".	

• Setting items when selecting "MA" for "Conversion type"

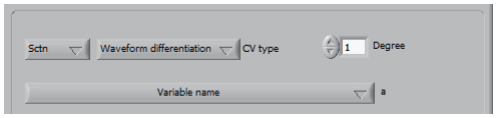
Outputs the moving average trace variable.



Setting item	Description	Output
Average point	Enter the number of moving averages by using an odd number (3 to 2147483647).	A smoothed waveform (trace variable) is output.
a	Select a trace variable.	
Exclude maximum value and minimum value	Select this to output the moving average excluding the maximum and minimum values.	
Calculation option	Select "Polynomial suitable", "Median", or "MAD". • Polynomial suitable: Performs smoothing using values fit by a polynomial of the order specified in "P-order". • MAD: Calculates the moving average after filtering values the using the median absolute deviation filter and removing the outliers.	
P-order	Shown when "Polynomial suitable" is selected for "Calculation option". Select an order. '0', '2', '4', '6', and '8' can be specified for the order. Order = 0 is equivalent to the simple moving average.	

• Setting items when selecting "Waveform differentiation" for "Conversion type"

Outputs the differential waveform of the trace variable.



Setting item	Description	Output
Degree	Enter the degree of differentiation (1 to 5).	A differential waveform (trace variable) is output.
a	Select a trace variable.	

Point

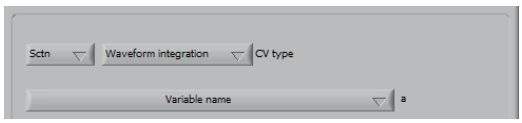
n-degree differential with the specified degree "n" is performed.

- Primary differential calculates the slope between two adjacent points.
- Secondary differential further performs primary differential on the result of the primary differential.
- Tertiary differential further performs primary differential on the waveform obtained from the secondary differential.
- n-order differential further performs primary differential on the waveform obtained from the "n-1"-order differential.

• Setting items when selecting "Waveform integration" for "Conversion type"

Outputs a waveform obtained from time integral of trace variable data (i.e., area enclosed by the horizontal axis and waveform).

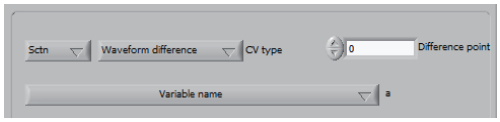
A negative integral value is obtained where the vertical axis is formed within the negative region.



Setting item	Description	Output
a	Select a trace variable.	An integral waveform (trace variable) is output.

• Setting items when selecting "Waveform difference" for "Conversion type"

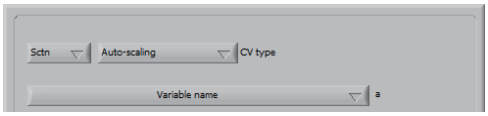
Extracts chronological changes of trace variable.



Setting item	Description	Output
Difference point	Enter the number (0 to 2147483647) of points to shift a waveform in X axis direction in order to calculate a difference.	• The difference between a value in Y axis of a waveform shifted for the number of points set for "Difference point" and a value in Y axis of a waveform not shifted is output as a trace variable. • The original waveform is displayed for the differential number of points from the lead of the section.
a	Select a trace variable.	

• Setting items when selecting "Auto-scaling" is selected in "Conversion type"

Standardizes the Y value of trace variable.



Setting item	Description	Output
a	Select a trace variable.	The Y value of a section waveform is output as a trace variable by converting the value 'Average value = 0' and 'Variance = 1'.

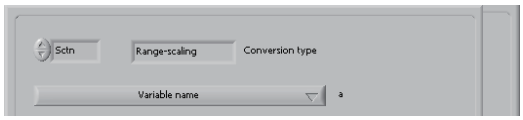
Point

With the average of "n" Y-axis values before conversion included in the conversion target section as "Y_{ave}" and variance as "σ_Y", the converted value Y_i' at the "i"th measurement point Y_i can be expressed by the following equation:

$Y_i' = (Y_i - Y_{ave})/\sigma_Y$

• Setting items when selecting "Range-scaling" for "Conversion type"

Normalizes the Y value of trace variable.



Setting item	Description	Output
a	Select a trace variable.	The Y value of a section waveform is output as a trace variable by converting it into a waveform of which the maximum value is '1' and the minimum value is '-1'.

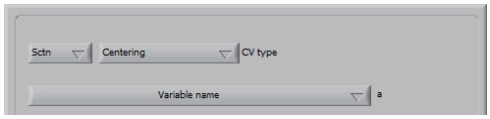
Point

With the maximum value of "n" Y-axis values before conversion included in the conversion target section as "Y_{max}" and the minimum value as "Y_{min}", the converted value Y_i' at the "i"th measurement point Y_i can be expressed by the following equation:

$Y_i' = (Y_i - Y_{min})/\{(Y_{max} - Y_{min})/2\} - 1$

• Setting items when selecting "Centering" for "Conversion type"

Converts data into a waveform where the average value of Y values of trace variable data is '0'.



Setting item	Description	Output
a	Select a trace variable.	The Y value of a section waveform is converted into a waveform (trace variable) on which the average is '0'.

Point

With the average of "n" Y-axis values before conversion included in the conversion target section as "Y_{ave}", the converted value Y_i' at the "i"th measurement point Yi can be expressed by the following equation:

$Y_i' = Y_i - Y_{ave}$

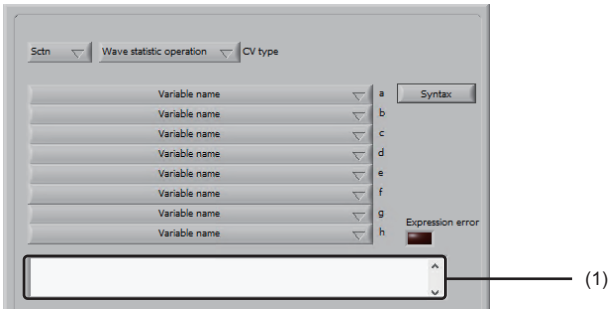
• Setting items when selecting "Wave statistic operation" for "Conversion type"

Perform calculation between trace variable and trace variable, or trace variable and statistics.

Precautions

The following precautions apply when "Wave statistic operation" is selected for "Conversion type":

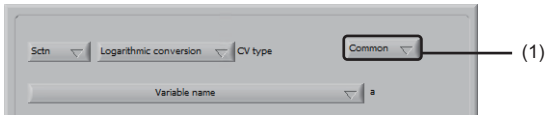
- Variables specified in "a" to "h" must be used in 'Expression'. If not used, an expression error occurs.
- The function 'rand()' that can be used in 'Expression' must take an argument (e.g., rand(a)). Otherwise, a syntax error occurs. Note that the specified argument is not used within the function.



Setting item	Description	Output
a to h	Select one or more trace variables. And then select trace variable, statistics, or step variable.	A waveform (trace variable) of the operation result is output. If there is an operation which cannot be performed, '0' will be output as the result.
[Syntax] button	Shows explanation of the expression syntax in a pop-up window.	
(1) Expression	Enter exponentiation, multiplication, division, addition, subtraction, and functions to describe an operation expression (up to 256 characters). When describing an expression, use trace variables specified by "a" to "h", statistics, and step variables. Refer to the pop-up window displayed by clicking the [Syntax] button for the available functions.	
Expression error	It is lighted in red if the entered operation expression is incorrect.	

• Setting items when selecting "Logarithmic conversion" for "Conversion type"

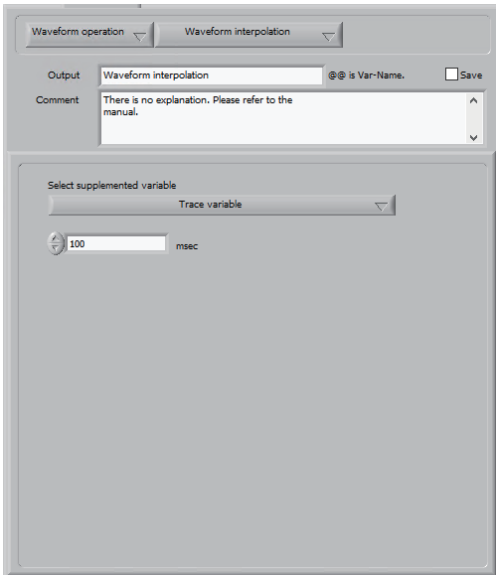
Performs logarithmic conversion on trace variable.



Setting item	Description	Output
(1) Logarithm type	Select "Common", "Natural", or "Base=2".	A waveform which is converted in a logarithmic conversion for "Common", "Natural", or "Base =2" is output.
a	Select a trace variable.	

■ Waveform interpolation

Interpolates the sampling interval of trace variable to the minimum of 10 msec.



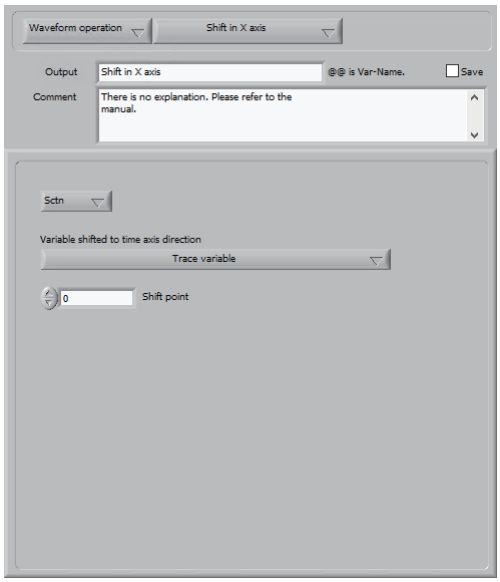
Setting item	Description	Output
Select supplemented variable	Select a trace variable.	• A selected trace variable is converted into a waveform with a specified sample interval, then it is output as a trace variable. • Assign the most recent original sampling value to the sample to generate for interpolation.
msec	Enter a sampling interval (10.0000 to 2147483647.0000 after conversion. Enter a value smaller than the original interval before conversion. (10 ms or longer)	

Point

When analyzing trace variables of which the sampling intervals are different by overlapping them, they are is converted into the waveform with a finer granularity.

■ Shift in X axis

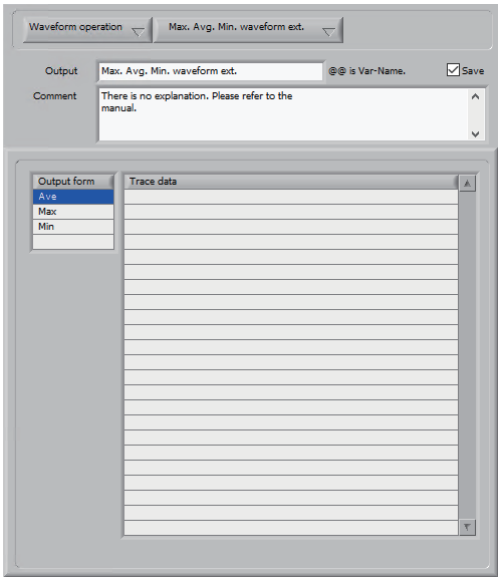
Shift the X (time) axis of trace variable forward or backward.



Setting item	Description	Output
Sctn	Specifies the level of sections to output.	A variable is output as a trace variable by shifting X (time) axis of the data of the trace variable forward or backward.
Variable shifted to time axis direction	Select a trace variable.	
Shift point	Enter the number (-2147483647 to 2147483647) of points to shift a variable in X axis direction. A waveform is shifted right by entering a positive number and shifted left by entering a negative value.	

■ Max. Avg. Min. waveform ext.

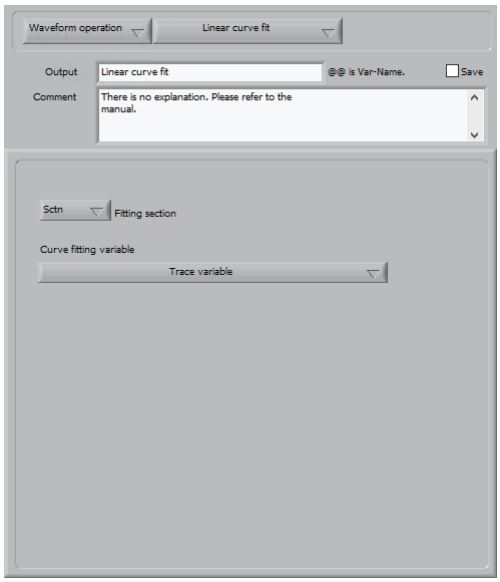
Extracts a waveform connecting the average, maximum, and minimum values of each point from waveforms of multiple trace variables.



Setting item	Description	Output
Output form	Select one or more types of waveform to output from "Ave", "Max", and "Min". • Ave: Average value • Max: Maximum value • Min: Minimum value	A waveform (trace variable) connecting the average values, maximum values, or minimum values of each point is output. The output variable name is as follows: • Ave: Output variable name_Average • Max: Output variable name_Max • Min: Output variable name_Min
Trace data	Specify multiple trace variables to extract waveforms.	

■ Linear curve fit

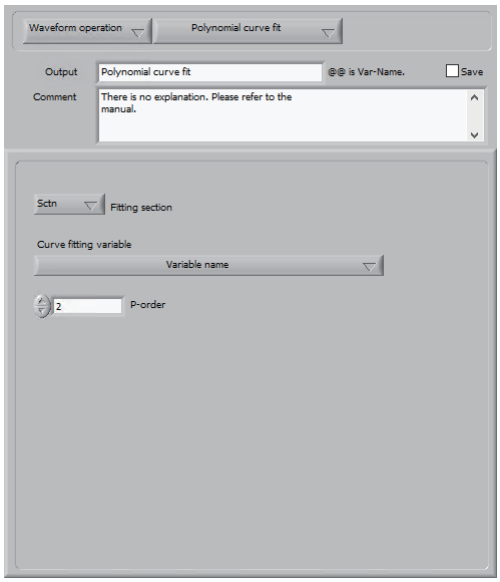
Performs a linear fit and extracts curve fit parameters.



Setting item	Description	Output
Fitting section	Specify two sections to perform a liner fit.	A linear fit (least-squares method) is performed and a fit waveform (trace variable), slope (statistics), intercept (statistics), and MSE (Mean Square Error) (statistics) are output.
Curve fitting variable	Select a trace variable.	

■ Polynomial curve fit

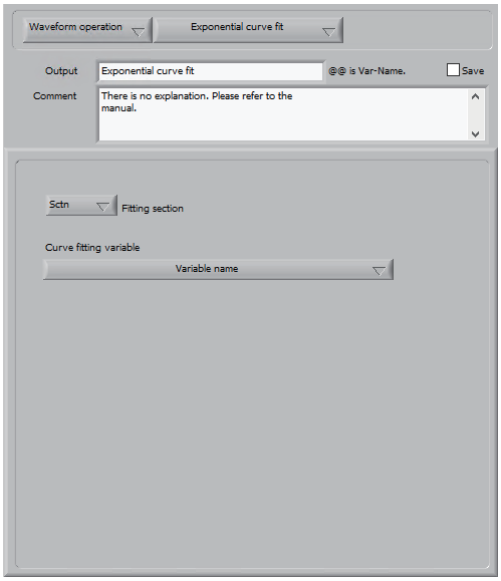
Performs a polynomial fit and extracts curve fit parameters.



Setting item	Description	Output
Fitting section	Specify two sections to perform a polynomial curve fit.	A polynomial fit is performed and a fit waveform (trace waveform), coefficient (statistics), and MSE (Mean Squared Error) (statistics) are output. The intercept of a coefficient is 1. Coefficients are output in an order where orders are few.
Curve fitting variable	Select a trace variable.	
P-order	Specify the order of the polynomial (0 to 2147483647).	

■ Exponential curve fit

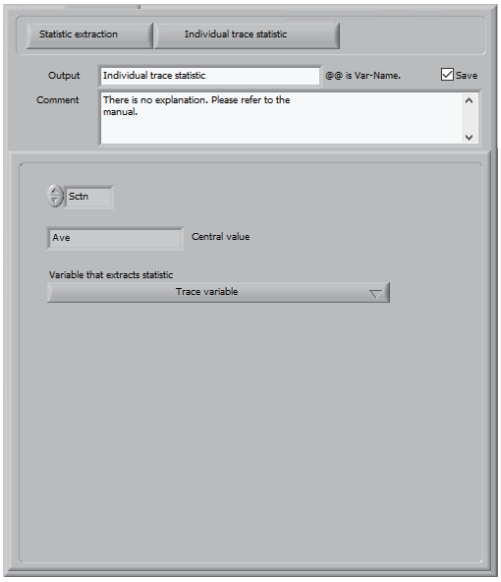
Perform an exponential fit and extracts curve fit parameters.



Setting item	Description	Output
Fitting section	Specify two sections to perform exponential curve-fitting.	An index fit is performed and a fit waveform (trace variable), amplitude (statistics), dumping (statistics), and MSE (Mean Squared Error) (statistics) are output.
Curve fitting variable	Select a trace variable.	

■ Individual trace statistic

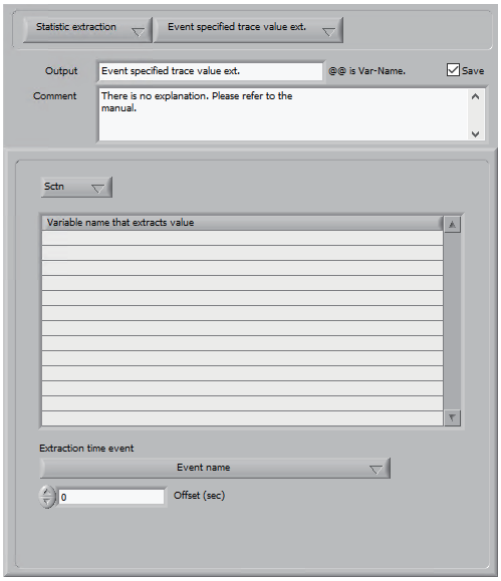
Extract a statistic in a section or subsection from a trace variable.



Setting item	Description	Output
Sctn	Specifies the level of sections to output.	Outputs the following according to option settings for the section level output. • Outputs at the subsection level.: Statistics of all subsections at the selected section levels (L1, L2, and L3). • Subsection number: Statistics of the specified subsection number to statistics at the upper-level section level. • Ave/Max/Min/Range/Sigma: Central statistics value (one of the average, maximum, minimum, range, or sigma) at the selected section levels (L1, L2, and L3) to statistics at the upper-level section level.
Central value	Select one of the following options: • Ave: Average value • Max: Maximum value • Min: Minimum value • Range: Range • Sigma: Standard deviation • Variance: Variance • Median: Median • Mode: Mode • RMS: Root mean square • Kurtosis: Kurtosis • Skewness: Skewness • Int-val.: Integral value • Interval1: Time from the minimum value to the next maximum value (sec) • Interval2: Time from the maximum value to the next minimum value (sec) • Interval3: Time between the maximum value and minimum value (sec) • Start value: Start value of section • End value: End value of section • Corr-range.: Difference between the maximum and minimum residual values • Intermediate: Intermediate value of section	
Variable that extracts statistic	Select a trace variable.	
Section level output option	Shown when "L1", "L2", or "L3" is selected in "Sctn". Select one of the following options: "Outputs at the subsection level.", "Subsection number", "Ave", "Max", "Min", "Range", or "Sigma".	
Subsection No.	Shown when "Subsection number" is selected in the option for the section level output. Specify the subsection number (1 to 2147483647).	

■ Event specified trace value ext.

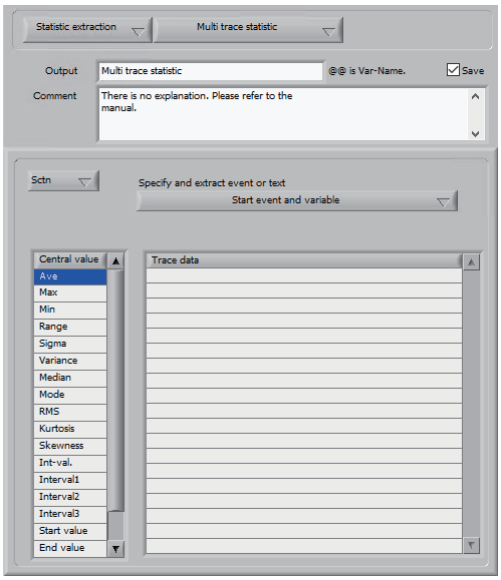
Extracts the value at the time when an event occurs from multiple trace variable data.



Setting item	Description	Output
Sctn	Specifies the level of sections to output.	• The value of the occurrence time when the first event is found in a specified section in the data of multiple trace variables is extracted as the statistic. • If no event is specified, the time value obtained by adding the offset time to the start time of a specified section is output as the statistics.
Variable name that extracts value	Select one or more trace variables.	
Extraction time event	Select an event name. If an event is not found, the value at the head of section is extracted.	
Offset (sec)	Specify the offset time (-2147483648.0000 to 2147483647.0000) from the time of an event occurrence or the start time of a section. When specifying a negative value, a value of the time before the event occurrence is extracted. If it is before the start time of a section as a result of an offset, the value of the start time of the section is extracted. A negative offset when no event is specified is reset to "0" when the primitive is added or updated.	

■ Multi trace statistic

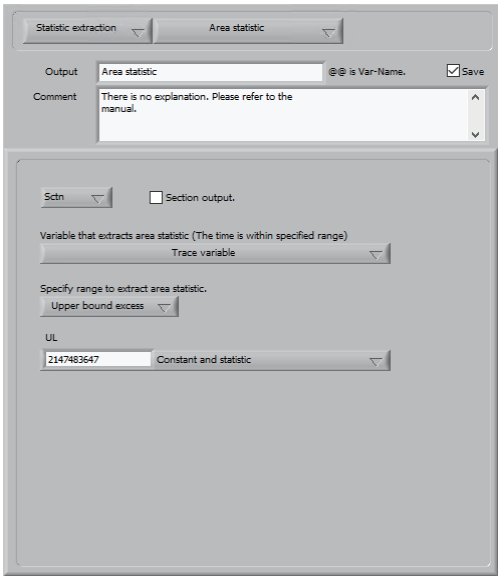
Extracts statistics from multiple trace variable data by specifying the extraction range.



Setting item	Description	Output
Sctn	Specifies the level of sections to output.	• Extracts statistics with the name 'primitive output name' + 'trace variable name' + 'statistic' from a trace variable within the specified range. • The length of the section from which statistics were extracted is output as statistics.
Specify and extract event or text	• When specifying the range by events, select the start and end events. • When specifying the range by text and step variables, specify a variable name, comparison operator, and comparison value (up to 32 characters). If multiple ranges exist, statistics is output for the first range. If the specified range is not found, nothing is output. If this item is not specified, statistics for the start and end of the section is output.	
Section level output option	Shown when a subsection ("L1", "L2", or "L3") is selected in "Sctn". Select one of the following options: "Outputs at the subsection level.", "Subsection number", "Ave", "Max", "Min", "Range", "Sigma", or "All up to specified sub-sec No.". Outputs the following according to the setting. • Outputs at the subsection level.: Outputs statistics of all subsections at the selected levels (L1, L2, and L3) at the subsection level. • Subsection number: Outputs statistics of the specified subsection number only as the statistics at the section level. • Ave/Max/Min/Range/Sigma: Outputs the central value (one of the average, maximum, minimum, range, or sigma) of the statistics at the selected levels (L1, L2, and L3) as statistics at the section level. • All up to specified sub-sec No.: Outputs all statistics of subsections from the first subsection to the specified subsection at the section level.	
Subsection No.	Shown when "Subsection number" is selected in the option for the section level output. Specify a subsection number (1 to 10000).	
Central value	Select one or more central values to extract from the following: • Ave: Average value • Max: Maximum value • Min: Minimum value • Range: Range • Sigma: Standard deviation • Variance: Variance • Median: Median • Mode: Mode • RMS: Root mean square • Kurtosis: Kurtosis • Skewness: Skewness • Int-val.: Integral value • Interval1: Time from the minimum value to the next maximum value (sec) • Interval2: Time from the maximum value to the next minimum value (sec) • Interval3: Time between the maximum value and minimum value (sec) • Start value: Start value of section • End value: End value of section • Corr-range.: Difference between the maximum and minimum residual values • Intermediate: Intermediate value of section	
Trace data	Select one or more trace variables.	

■ Area statistic

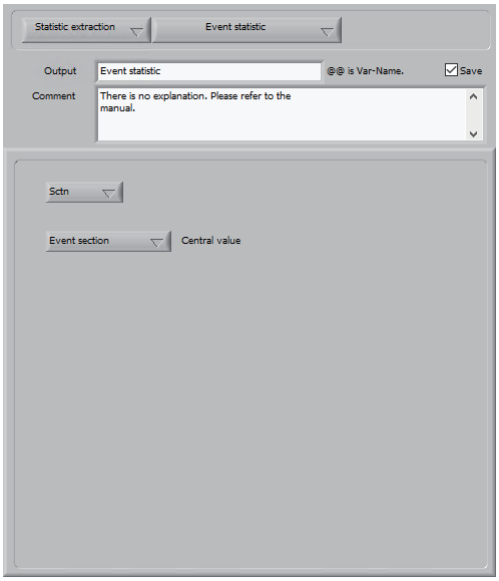
Calculates time during which the trace variable remains within the specified Y value range.



Setting item	Description	Output
Sctn	Specifies the level of sections to output.	The time of a trace variable within the specified range and the % value within the specified section are output as statistics.
Section output.	Outputs area statistics extracted in the first deepest subsection (L1, L2, or L3) at the section level.	
Variable that extracts area statistic	Select a trace variable.	
Specify range to extract area statistic.	Select "Upper limit excess," "Less than Lower limit," or "Range of limit pair." • Upper limit excess: Exceeded the upper limit. • Less than Lower limit: Falls below the lower limit. • Range of limit pair: Stays within the range between the upper and lower limits.	
Upper limit	Shown when "Upper limit excess" or "Range of limit pair" is selected in "Specify range to extract area statistic." Enter an upper limit value (-2147483648.0000 to 2147483647.0000) or select a variable. When entering the upper limit value, it should be greater than the lower limit (upper limit > lower limit).	
Lower limit	Shown when "Less than Lower limit" or "Range of limit pair" is selected in "Specify range to extract area statistic." Enter a lower limit value (-2147483648.0000 to 2147483647.0000) or select a variable. When entering the upper limit value, it should be greater than the lower limit (upper limit > lower limit).	

■ Event statistic

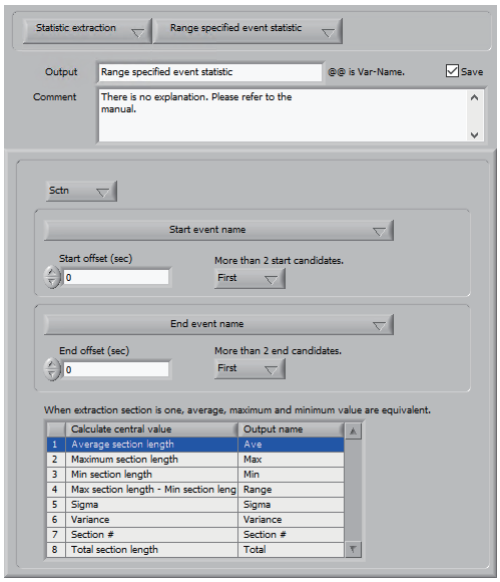
Extracts the section length, frequency, and interval as statistics.



Setting item	Description	Output
Sctn	Specifies the level of sections to output.	The following are output as statistics according to the setting in "Central value". • Event section: Outputs the specified section length. • Event frequency: Extracts the number of event occurrences within the section. Also counts events overlapping the section start and end times. • Event interval: Calculates the event occurrence interval by dividing the section length by 'number of events which occurred + 1'. If no event exists within the section, the section length is regarded as the event interval. Also counts events overlapping the section start and end times.
Central value	Select "Event section", "Event frequency", or "Event interval".	
Event that extracts statistic	When "Event frequency" or "Event interval" was selected in "Central value", select the event to extract the statistics.	

■ Range specified event statistic

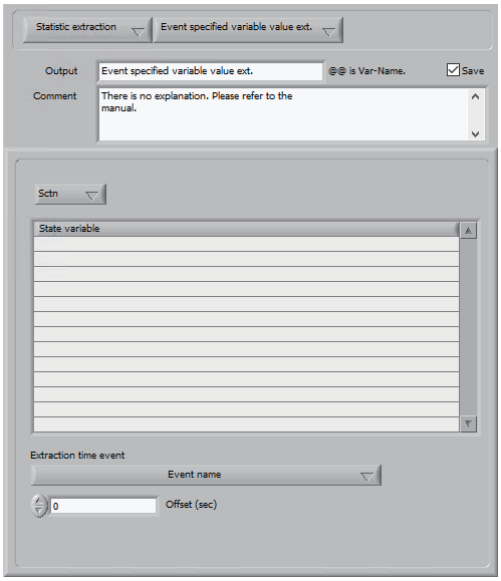
Extracts multiple sections defined by start and end events and calculates the statistics of the section length.



Setting item	Description	Output
Sctn	Specifies the level of sections to output.	• Extracts the start-to-end section from the specified event and outputs the statistics for the section length. • Include the events overlapping the section start and end times. • When it is successful, 'Boolean variable = 0' is output. When it fails, 'Boolean variable = 1' is output.
[Start event name] button	Select the start event of the section to extract the statistics.	
Start offset (sec)	Specify an offset (-2147483648.0000 to 2147483647.0000) from the start event. When offsetting backward, specify a negative value. When offsetting forward, specify a positive value.	
More than 2 start candidates.	Select the event to use between "First" and "Last" if multiple events satisfying the specified condition exist.	
[End event name] button	Select the end event of the section to extract the statistics.	
End offset (sec)	Specify an offset (-2147483648.0000 to 2147483647.0000) from the end event. When offsetting backward, specify a negative value. When offsetting forward, specify a positive value.	
More than 2 end candidates.	Select the event to use between "First" and "Last" if multiple events satisfying the specified condition exist.	
Calculate central value	Select statistics type to output from the following: (Multiple items can be selected.) • Average section length: Average section length • Maximum section length: Maximum section length • Min section length: Minimum section length • Max section length - Min section length: Range • Sigma: Standard deviation • Variance: Variance • Section #: Number of sections • Total section length: Total section length	

■ Event specified variable value ext.

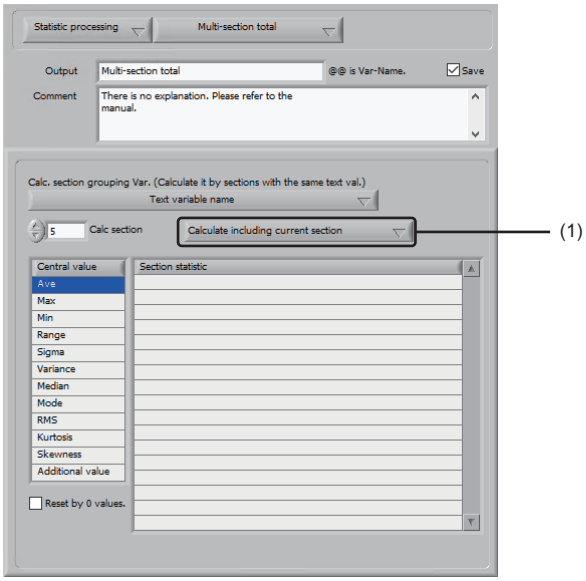
Extracts the value at the time when an event occurs from multiple step variables.



Setting item	Description	Output
Sctn	Specifies the level of sections to output.	• The value of the occurrence time when the first event is found in a specified section in the data of multiple step variables is extracted as the statistic. • If no event is specified, the time value obtained by adding the offset time to the start time of a specified section is extracted as the statistics.
State variable	Select a step variable (state variable) to extract a value.	
Extraction time event	Specify the extraction time by an event. If an event not found, the value of the head in a section is returned.	
Offset (sec)	Specify an offset from the event occurrence time (-2147483648.0000 to 2147483647.0000). If the event is not specified, the specified value is regarded as an offset from the start time of the specified section. A negative offset when no event is specified is reset to '0'. If the offset time comes after the end of the section, the section end time is returned.	

■ Multi-section total

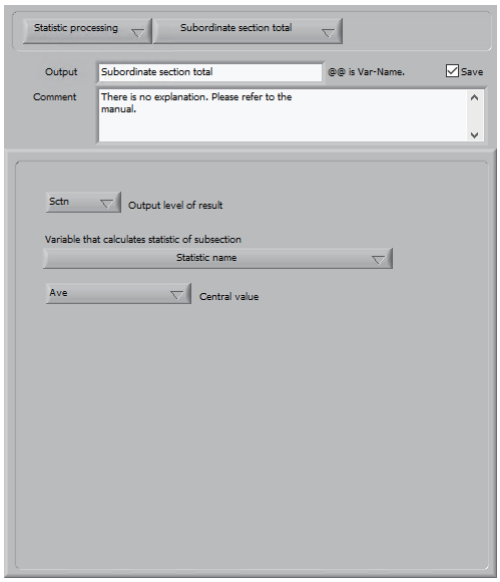
Calculates single statistics from multiple statistics for the current and past section data.



Setting item	Description	Output
Calc. section grouping Var.	Select this when grouping sections by the same text variable value.	• Calculates the specified statistics for the specified calculation section and outputs the result. • When outputting, 'Boolean variable = 1' is output. When not outputting, 'Boolean variable = 0' is output.
Calc section	Specify the number (1 to 10000) of sections in which a calculation is performed.	
(1) Calculation type	Select one of the following options: • [Calculate with Past Sections Only]: Uses values of the past sections (those before the currently running section) for calculation. • [Include Current Section in Calculation]: Include the current section value in addition to the past section values for calculation.	
Central value	Select statistics from the following: (Multiple items can be selected.) • Ave: Average value • Max: Maximum value • Min: Minimum value • Range: Range • Sigma: Standard deviation • Variance: Variance • Median: Median • Mode: Mode • RMS: Root mean square • Kurtosis: Kurtosis • Skewness: Skewness • Additional value: Additional value (integral value)	
Section statistic	Select from calculation target from the statistics variables and execution result (boolean variables) extracted by the logic in the previous primitive step.	
Reset by 0 values.	If checked, when statistics has a value of '0' in the current section, the calculation result is reset to '0' at that section, and calculation resumes with the next section. Output from that section is '0'.	

■ Subordinate section total

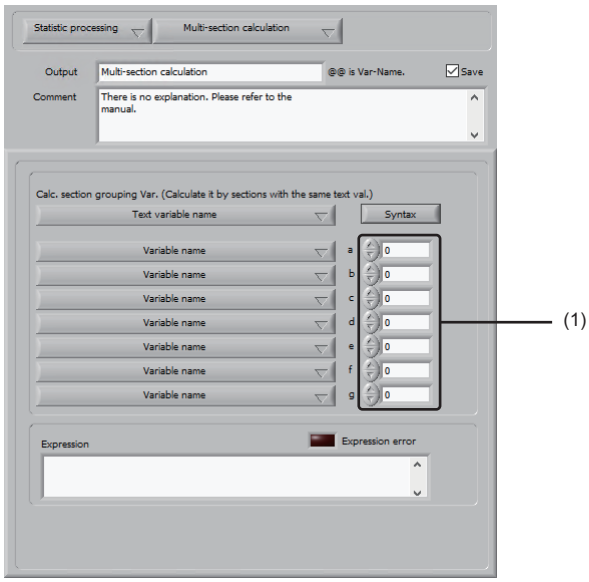
Summarizes the current subsection statistics and outputs the result as the statistics of the upper-level section.



Setting item	Description	Output
Output level of result	Specify the level of sections to output the calculation result.	• Calculates the subsection statistics at the lower level and outputs the result as the statistics of the upper-level section. • When "Additional value(sum)" is selected in "Central value", all the statistics of the lower level sections are aggregated and the result is output as the statistics of the upper-level section.
Variable that calculates statistic of subsection	Select a statistic in a level lower than a section to be output or a boolean variable.	
Central value	Select the central values to aggregate from the following: • Ave: Average value • Max: Maximum value • Min: Minimum value • Range: Range • Sigma: Standard deviation • Variance: Variance • Median: Median • Mode: Mode • Number of effective data: Number of subsections with values calculated • Additional value(sum): Statistics or total of boolean variables	

■ Multi-section calculation

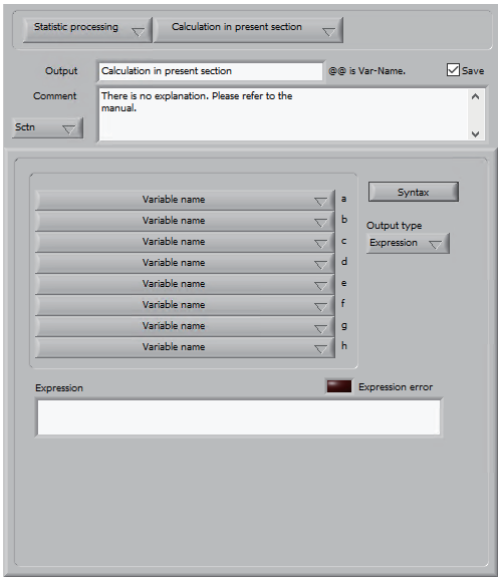
Performs an operation on statistics of the past and current sections.



Setting item	Description	Output
Calc. section grouping Var.	Select this when grouping sections by the same text variable value.	• Performs an arbitrary operation between the statistics of the 'n'th last section and that of the current section. • When there is past data in a section which was specified for all variables, 'Boolean variable = 0' is output. • When there is no past section data which was specified for one or more variables, 'Boolean variable = 1' is output. • Past sections without statistics are skipped. • If the output from this primitive itself does not exist, '0' is used instead. • If the past statistics does not exist for any of "a" to "g", the operation result is output as null. • If there is an operation which cannot be performed in an operation expression, 'null' will be output as the result.
a to g	Selects a statistics name. By selecting "Forward of n section", output from this primitive for the 'n'th last section can be referenced.	
(1) Reading section (Input fields for 'a' to 'g')	Enter a number (0 to 100) for a reading section. '0' refers to the current section and a number 'n' refers to the 'n'th last section.	
[Syntax] button	Shows the expression syntax.	
Expression	Enter exponentiation, multiplication, division, addition, subtraction, and functions to describe an operation expression (up to 256 characters). When describing an expression, use statistics specified by "a" to "g". Refer to the pop-up window displayed by clicking the [Syntax] button for the available functions.	
Expression error	It is lighted in red if the entered operation expression is incorrect.	

■ Calculation in present section

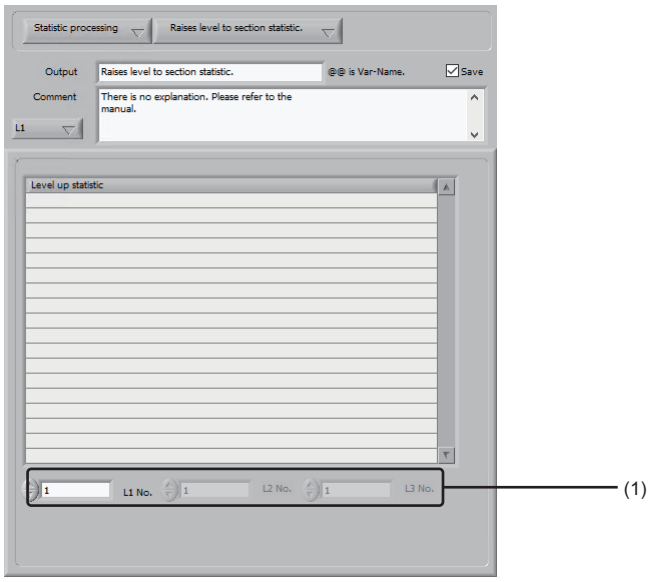
Perform an operation between statistics in the current section.



Setting item	Description	Output
Sctn	Specifies the level of sections to input and output.	• The calculation result acquired from a statistic according to the specified output type is output as a statistic. • If there is an operation which cannot be performed in an operation expression, 'null' will be output as the result.
a to h	Selects statistics.	
Output type	Select the type of statistic to be output. • By specifying "Expression", the input field for an operation expression is displayed. The calculation result of the operation will be output. • By selecting "Ave", "Max", "Min", "Range", or "Total", the selected type of statistic is calculated from a variable selected from "a" to "h". Then, the calculation result will be output.	
[Syntax] button	Shows the expression syntax.	
Expression	Enter exponentiation, multiplication, division, addition, subtraction, and functions to describe an operation expression (up to 256 characters). When describing an operation expression, use statistics specified for "a" to "h". Refer to the pop-up window displayed by clicking the [Syntax] button for the available functions.	
Expression error	It is lighted in red if the entered operation expression is incorrect.	

■ Raises level to section statistic.

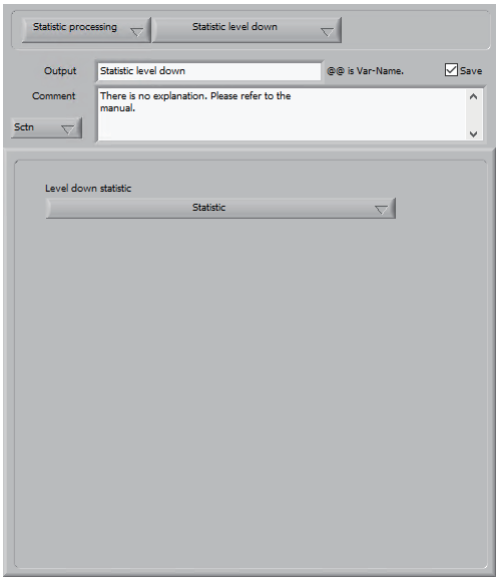
Upgrades the level subsection statistics to section statistics.



Setting item	Description	Output
Sctn	Specify the subsection of the subsection statistics which are upgraded to section statistics.	• Outputs the specified statistics as the statistics at the section level. • The output statistics name is 'output variable name_statistics name'.
Level up statistic	Select a statistics name at L1 or lower level.	
(1) Subsection No.	For the L3 statistics, specify the L1, L2, and L3 section numbers (1 to 2147483647). For the L2 statistics, specify the L1 and L2 section numbers (1 to 2147483647). For the L1 statistics, specify the L1 section number (1 to 2147483647).	

■ Statistic level down

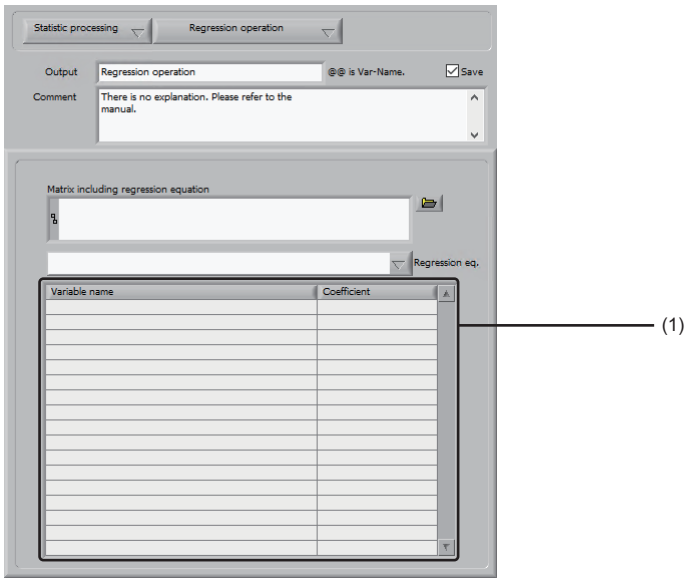
Downgrades the level subsection statistics to a lower level.



Setting item	Description	Output
Sctn	Specifies the level of sections to input and output.	Outputs the specified statistics as the statistics at a lower section level with a different name.
Level down statistic	Select a statistics name to downgrade.	

■ Regression operation

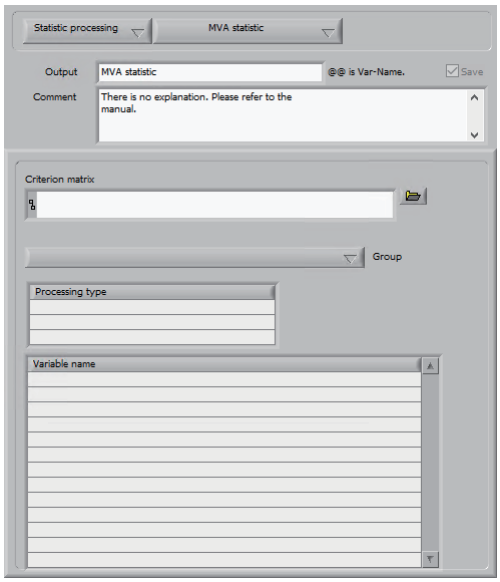
Run a regression equation created by a partial matrix.



Setting item	Description	Output
Matrix including regression equation	Specify the file path (up to 256 characters) of a partial matrix in which 'Recurrence calculation' was performed in 'Multiple regression analysis (LMR)'. ☞ Page 218 Creating Correlation Matrix ☞ Page 238 Multiple Regression Analysis (LMR) The partial matrix is stored at the following location under the name '(partial matrix name).csv': (Matrix storage folder)\Attribute\(Whole matrix name)	A predicted value calculated based on the regression expression is output as statistics.
Regression eq.	Select a regression equation for Multiple Regression Analysis (LMR).	
(1) Regression equation list	List of statistics names and partial regression coefficients of regression equations is shown. If it does not match the statistics name extracted in the primitive step before the logic, it is grayed out. In this case, the equation is run in an incomplete format.	

■ MVA statistic

Performs MT distance calculation based on the partial matrix.



Setting item	Description	Output
Criterion matrix	Specify the file path (up to 256 characters) of a partial matrix in which 'MT distance calculation' is performed in 'Maharanobis-Taguchi method' and the validity of the Mahalanobis distance is checked. ☞ Page 218 Creating Correlation Matrix ☞ Page 245 Maharanobis - Taguchi method (MT) The partial matrix is stored at the following location under the name '(partial matrix name).csv': (Matrix storage folder)\Attribute\(Whole matrix name)	• Mahalanobis distance, Q statistic (SPE), and Euclidean distance (EU distance are output as statistics. • EU distance is the Euclid distance of the diagnosis section for the criterion matrix, and used when there is no correlation between the variables.
Group	Text variables in the matrix can be selected. Specify it when calculating the distance by filtering the criterion matrix to the same text value as that of the diagnosis section.	
Processing type	Select "MT distance".	
Variable name	Shows the statistics included in the partial matrix selected in "Criterion matrix". Select two or more statistics used for diagnosis. Statistics not extracted from the preceding primitive steps are not shown.	

Point

The following gives an example of using the primitive 'MVA statistic':

❶ Create a logic and add primitives 'Multi trace statistic' and 'Save CSV data' to that logic.

☞ Page 300 Multi trace statistic, Page 335 Save CSV data

❷ Use the primitive 'Multi trace statistic' to select a variable to apply to diagnosis by 'Mahalanobis-Taguchi method'.

❸ Calculate the statistics of the variable selected in ❷ and save the result in a CSV file.

❹ Create a partial matrix from the CSV file created in ❸ in 'Create correlation matrix'.

☞ Page 218 Creating Correlation Matrix

❺ To avoid multicollinearity, perform the following operations to create a criterion matrix which is an appropriate Mahalanobis distance.

- Delete one of high correlation coefficient variables (statistics) in combination.
- Manipulate variables (statistics) with missing or abnormal values appropriately.

❻ Perform 'MT distance calculation' using the 'Mahalanobis-Taguchi method' to check the validity.

☞ Page 245 Maharanobis - Taguchi method (MT)

❼ Repeat ❷❸❹❺❻ until a criterion matrix with a valid Mahalanobis distance is created.

❽ Delete the primitive 'Save CSV data' from the logic defined in ❶ and define and add the primitive 'MVA statistic' to the logic.

❾ In the definition of the primitive 'MVA statistic', specify the partial matrix created in ❼ in "Criterion matrix".

❿Following the primitive 'MVA statistic' in ❽, define the primitive 'Limit pair diagnostics' or 'SPC diagnostics' and diagnose the output variable of the primitive 'MVA statistic'.

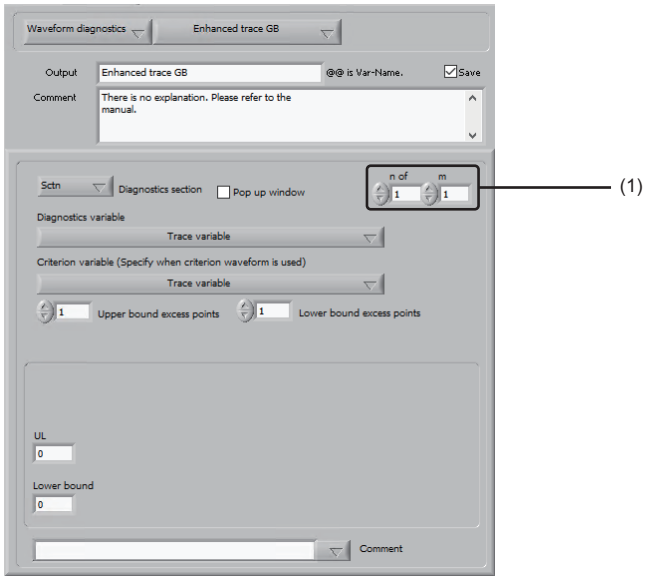
☞ Page 319 Variable limit pair GB, Page 325 SPC diagnostics

■ Enhanced trace GB

Diagnoses the waveform using GB (guard band).

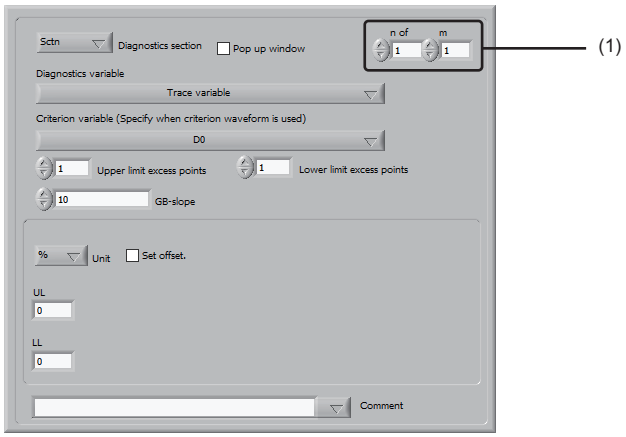
The enhanced trace GB can be created by entering upper and lower limits or from a reference waveform.

- Creating guard band by entering upper and lower limits



Setting item	Description	Output
Diagnostics section	Specify "Sctn" or "L1". For L1, up to ten sections can be diagnosed.	• Outputs an event at the time when the upper or lower limit GB was exceeded at the specified section level. • For the GB error, 'Boolean variable = 1' is output. For the normal state, 'Boolean variable = 0' is output. • The following items are also output. Boolean variable ('1' for a section and '0' for L1 to L3 sections) Trace variable (upper and lower limit values)
Pop up window	If checked, opens a pop-up window upon detection of guard band deviation. A response data file can be output by displaying the pop-up window.	
(1) n of m (number of sections for consecutive deviation)	Specify a section (1 to 1000) among the number of specified sections. It is determined as an error when the guard band is exceeded in the specified section. When specifying '3' for "n of" and '5' for "m", an error occurs if the guard band is deviated in the third section within five sections.	
Diagnostics variable	Select a trace variable to diagnose.	
Reference variable	Not selected.	
Upper limit excess points	Specify the number of point (1 to 100) to define the timing of an error determination. It is determined as an error when the upper limit of the guard band is exceeded continuously by the specified number of point in a single section.	
Lower limit excess points	Specify the number of point (1 to 100) to define the timing of an error determination. It is determined as an error when the lower limit of the guard band is exceeded continuously by the specified number of point in a single section.	
Upper limit	Specify the upper limit value (-2147483648.0000 to 2147483647.0000) of a guard band. When the diagnosis section is L1, up to 10 sections can be specified for each section number of the L1 section. When specifying '0', GB diagnosis for the upper limit is not performed. When specifying a value other than '0', the upper limit should be greater than the lower limit (upper limit > lower limit).	
Lower limit	Specify the lower limit value (-2147483648.0000 to 2147483647.0000) of a guard band. When the diagnosis section is L1, up to 10 sections can be specified for each section number of the L1 section. When specifying '0', GB diagnosis for the lower limit is not performed. When specifying a value other than '0', the upper limit should be greater than the lower limit (upper limit > lower limit).	
Comment	Specify a text (up to 100 characters) shown in the comment column of the pop-up window.	

• Creating guard band from reference waveform

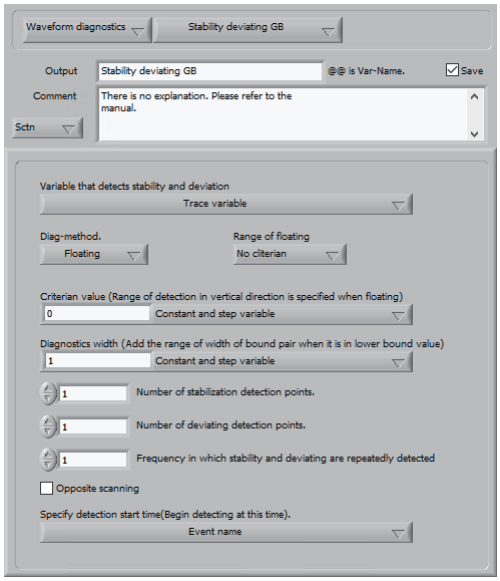


Setting item	Description	Output
Diagnostics section	Specify "Sctn" or "L1". For L1, up to ten sections can be diagnosed.	• Outputs an event at the time when the upper or lower limit GB was exceeded at the specified section level. • For the GB error, 'Boolean variable = 1' is output. For the normal state, 'Boolean variable = 0' is output. • The following items are also output. Boolean variable ('1' for a section and '0' for L1 to L3 sections) Trace variable (upper and lower limit waveforms)
Pop up window	Opens a pop-up window upon detection of guard band deviation. A response data file can be output by displaying the pop-up window.	
(1) n of m (number of sections for consecutive deviation)	Specify a section (1 to 1000) among the number of specified sections. It is determined as an error when the guard band is exceeded in the specified section. When specifying '3' for "n of" and '5' for "m", a GB error occurs if a deviation occurs in the third section within five sections.	
Diagnostics variable	Select a trace variable to diagnose.	
Reference variable	Select a trace variable used as the standard for the guard band.	
Upper limit excess points	Specify the number of point (1 to 100) to define the timing of an error determination. It is determined as an error when the upper limit of the guard band is exceeded continuously by the specified number of point in a single section.	
Lower limit excess points	Specify the number of point (1 to 100) to define the timing of an error determination. It is determined as an error when the lower limit of the guard band is exceeded continuously by the specified number of point in a single section.	
GB-slope	Specify the slope (Vertical axis (Y value change) ÷ Horizontal value (Number of Points)) applied when the upper-limit guard band descends or the lower-limit guard band ascends. When '0' is specified, this setting will be disabled.	
Unit	Specify the upper/lower-limit width by "Value" or "%" of the waveform amplitude.	
Set offset.	Check it to specify the pre- and post-offsets.	
Pre-offset	Enter a backward offset for the waveform of a standard variable as the number of plots (1 to 2147483647).	
Post-offset	Enter a forward offset for the waveform of a standard variable as the number of plots (1 to 2147483647).	
Upper limit	Enter the upward width (value or percentage of amplitude) for the waveform of the standard variable. When the diagnosis section is L1, up to 10 sections can be specified for each section number of the L1 section. The default value is '0'. When specifying '0', GB diagnosis for the lower limit is not performed.	
Lower limit	Enter the downward width (value or percentage of amplitude) for the waveform of the standard variable. When the diagnosis section is L1, up to 10 sections can be specified for each section number of the L1 section. The default value is '0'. When specifying '0', GB diagnosis for the lower limit is not performed.	
Comment	Specify a text (up to 100 characters) shown in the comment column of the pop-up window.	

■ Stability deviating GB

Detect the point to which a value is input in the set range and the point which a deviation occurs.

After executing this primitive, response data file can be output by executing the primitive 'Write log and error notification'.

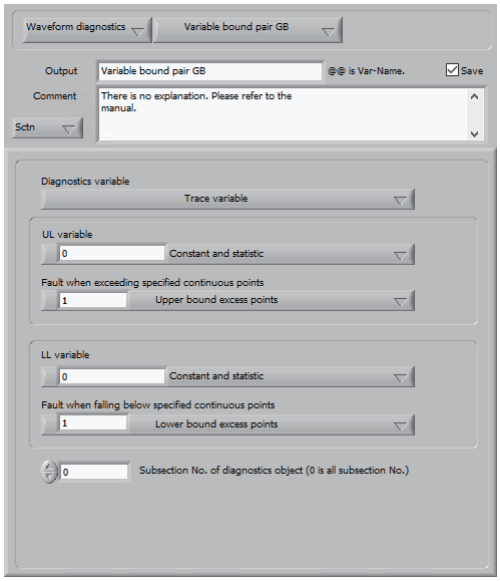


Setting item	Description	Output
Sctn	Specifies the level of sections to input and output.	• In the specified section level, if trace variable values consecutively for the number of points within the continuous range are included in a diagnosis amplitude from the time when the stabilization is detected, the start point is output as an stabile point. • When "Floating" is set for "Diag-method.", set the upper and lower limit range by referencing the point when the stable event is detected as the starting point. When it is deviated in the upper and lower limit range consecutively for the number of times set in "Number of deviating detection points", the start point is output as a deviation event. • When deviations occur between two points, the time of the deviation time will be the time of the former point. • Time from the first stabilization detection start time to the stabilization point as well as time from the stabilization point to the deviation point are output. Time is not output for the second and later stabilization points. When the stabilization point is detected, the upper/lower-limit GB value is output. The above process is repeated for the specified repeat count. • A boolean variable (One or more is detected: 0, Nothing is detected: 1), statistics (last deviation value, or last value of a section if nothing is detected), event (all detected time for stabilization and deviation time) are output. • The following items are also output. Statistics (Number of stability, number of deviations, diagnosis upper value, diagnosis lower value, time for stabilization, stability time)
Variable that detects stability and deviation	Select a trace variable.	
Diag-method.	Select one of the following options: • Floating: Set the diagnosis width by centering the value of the start point of stabilization (that is a state in which values are in a specified range) to perform a diagnosis. • Targeted value: Set the diagnosis width by centering the standard value to perform a diagnosis. • Lower limit: Set the lower limit of the diagnosis width as the standard value to perform a diagnosis.	
Range of floating	When "Floating" is set for "Diag-method.", select "No cliterian", "Over base", or "Below base".	
Criterian value	When "Floating" is set for "Diag-method." set the threshold of an area to detect a stable deviation according to the contents set in "Range of floating" as follows: • Below base: Set the upper limit value (-2147483648.0000 to 2147483647.0000). • Over base: Set the lower limit value (-2147483648.0000 to 2147483647.0000). When setting "No criterion" for "Range of floating", the value set for this item will not be used. For "Targeted value" or "Lower limit", set a value to be referenced. Sets the standard value from statistics, logic variable, or constant. When a step variable is set as the standard value, the value of the first step variable at the section level is used.	
Diagnostics width	Specify the width between the upper limit value and lower limit value to be diagnosed (0.0000 to 2147483647.0000). Set a statistic, a logic variable, and a constant to a diagnosis width. When a step variable is set as the diagnosis width, the value of the first step variable at the section level is used.	
Number of stabilization detection points.	Specify the number (1 to 2147483647) to detect the stabilization (a state in which values are in a specified range). It is detected when values are stored continuously by the specified number of point stored in the diagnosis width.	
Number of deviating detection points.	Specify a number to detect the deviation (1 to 2147483647). When a value deviates from the diagnosis width for the specified value, the deviation is detected.	
Frequency in which stability and deviating are repeatedly detected	Specify the number of times (1 to 2147483647) to detect stabilization within one section.	
Opposite scanning	Check this to perform scanning in the backward direction.	
Specify detection start time	Specifies the detection start event.	

■ Variable limit pair GB

Performs a limit pair value diagnostics of the trace variable using a variable.

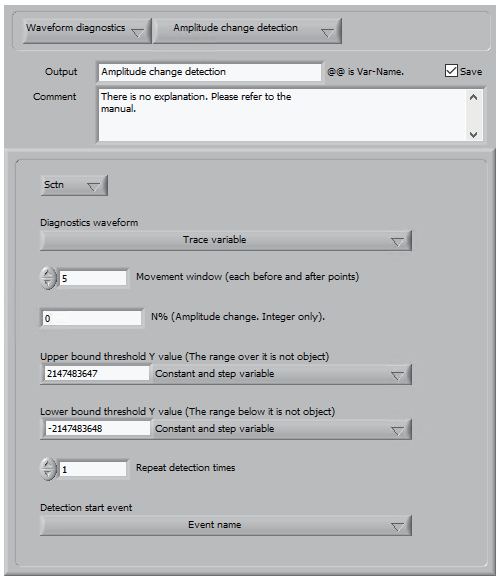
After executing this primitive, response data file can be output by executing the primitive 'Write log and error notification'.



Setting item	Description	Output
Sctn	Specifies the level of sections to input and output.	• Whether a waveform in a specified section deviates the upper or lower limit value is checked. • A boolean variable (Within a range: 0, Outside of a range: 1), statistics (a value when a deviation is detected outside of a range or last value when it is detected within a range), event (time when a deviation is detected) are output. • The following items are also output. Statistics (UCL and LCL) Trace variable (UCL and LCL)
Diagnostics variable	Select a trace variable to diagnose.	
UL variable	Enter a fixed integer value (-2147483648.0000 to 2147483647.0000), or specify a statistic or a logic variable (integer). When entering a fixed integer value, the upper limit variable should be greater than the lower limit variable (upper limit variable > lower limit variable).	
Fault when exceeding specified continuous points	Specify the number of point (1 to 2147483647) to define the timing of an error determination. It is determined as an error when the upper limit value is exceeded continuously by the specified number of point.	
LL variable	Enter a fixed integer value (-2147483648.0000 to 2147483647.0000), or specify a statistic or a logic variable (integer). When entering a fixed integer value, the upper limit variable should be greater than the lower limit variable (upper limit variable > lower limit variable).	
Fault when falling below specified continuous points	Specify the number of point (1 to 2147483647) to define the timing of an error determination. It is determined as an error when the lower limit value is exceeded continuously by the specified number of point.	
Subsection No. of diagnostics object	Enter the number (0 to 2147483647) of the L1 subsection to be diagnosed. Diagnoses the L1 subsection only even when L2 and L3 sections exist. When '0' is specified, all subsections are diagnosed.	

■ Amplitude change detection

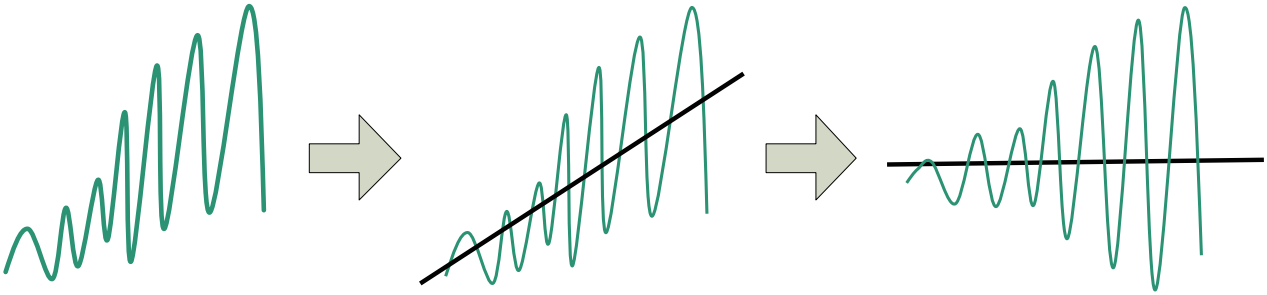
Detect an event at the change point of the waveform amplitude and a trace waveform of the amplitude change rate by using the movement window (one window in the first half and the last half).



Setting item	Description	Output
Sctn	Specifies the level of sections to extract.	• An event at the change point of the amplitude and a trace waveform of the amplitude change rate are output. • When the checkbox of "Save" is selected, output can be referenced in 'Data display after logic execution'. ☞ Page 359 Displaying Data after Running • The following item is also output. Statistics (Number of detection)
Diagnostics waveform	Specify a trace variable to extract an amplitude change.	
Movement window	Specify the width of the former half and the latter half of a point which is focused as the change point of amplitude by using a number of points (5 to 2147483647). Width is the same for the former and latter parts.	
N%	Specify the average amplitude (0.0000 to 2147483647.0000) of the latter window when a percentage of the average amplitude for the former window is 100%. Specify a value less than or more than '100'. ('100' cannot be specified.)	
Upper limit threshold Y value	Specify the upper limit (-2147483648.0000 to 2147483647.0000) of a threshold (Y value) so as not to detect the amplitude change of a waveform. An amplitude change exceeding a specified value are not detected. When entering a threshold, the upper limit threshold Y value should be greater than the lower limit threshold Y value (upper limit threshold Y value > lower limit threshold Y value).	
Lower limit threshold Y value	Specify the lower limit (-2147483648.0000 to 2147483647.0000) of a threshold (Y value) so as not to detect the amplitude change of a waveform. An amplitude change falling below a specified value are not detected. When entering a threshold, the upper limit threshold Y value should be greater than the lower limit threshold Y value (upper limit threshold Y value > lower limit threshold Y value).	
Repeat detection times	Specify the number of times (1 to 2147483647) to detect an amplitude change within one section.	
Detection start event	Specifies the detection start event.	

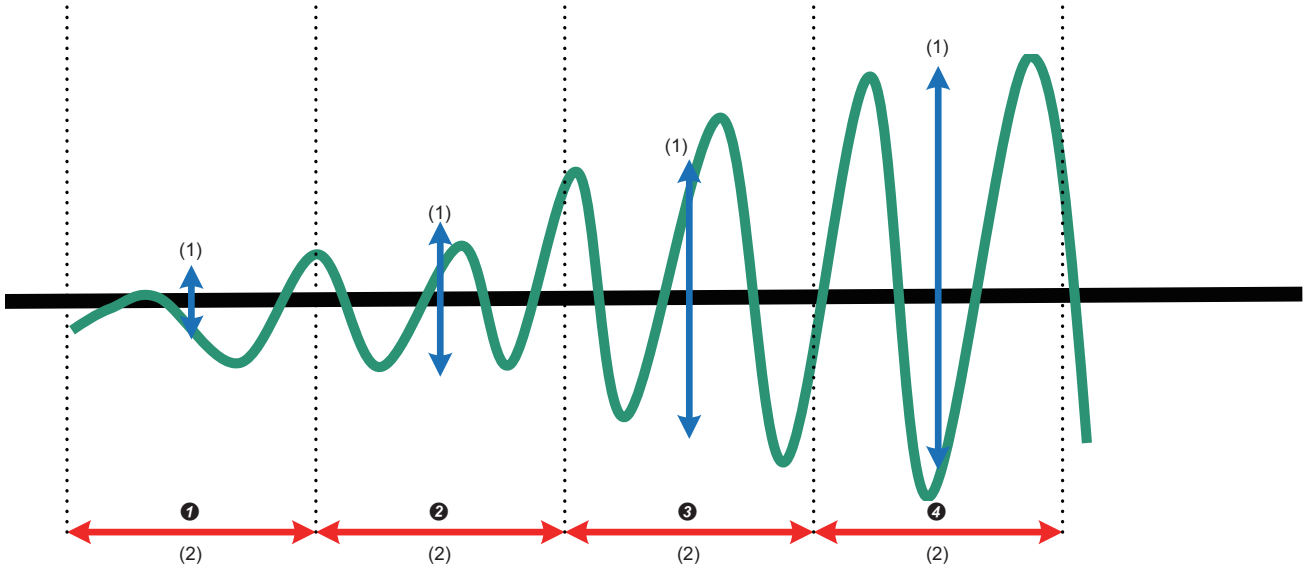
• Operation flow to detect change in amplitude

1. A linear fit is performed to make a waveform horizontal.



2. By regarding ❶ and ❷ as a former window and a latter half window respectively and setting the average amplitude of the former window is 100%, the average amplitude of the latter window is calculated and the amplitude change is determined.

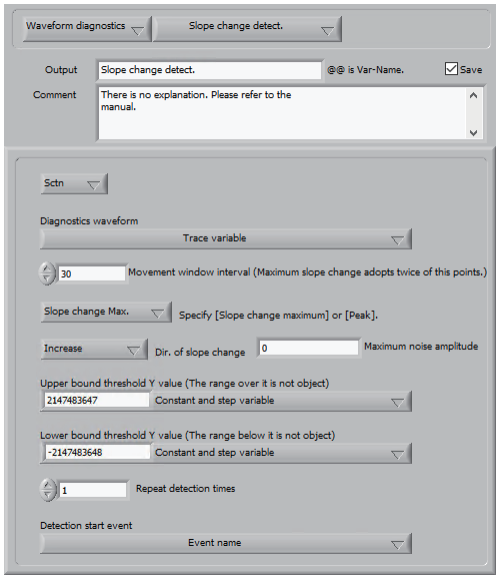
3. In succession, by regarding ❷ and ❸ as a former window and a latter window respectively, and change in a slope is determined in a same way.



(1) Average amplitude
(2) Movement window interval

■ Slope change detection

Detect an event at the change point of the waveform slope and a trace waveform of the slope change by using the movement window (two windows in the first half and the last half).



Setting item	Description	Output
Sctn	Specifies the level of sections to extract.	• An event at the change point of the waveform slope and a trace waveform of the slope change are output. • When the checkbox of "Save" is selected, output can be referenced in 'Data display after execution'. ☞ Page 359 Displaying Data after Running • When "Slope change Max." is specified, the difference trace waveform of the slope change is output. • When "+- peak" is specified, the trace waveform of the slope change is output. • The following item is also output. Statistics (number of detection)
Diagnostics waveform	Specify a trace variable to extract an amplitude change.	
Movement window interval	Specify the width of the former half and the latter half of a point which is focused as the change point of slope by using a number of points (5 to 2147483647). Width is the same for the former and latter parts.	
Specify [Slope change maximum] or [Peak].	Select "Slope change Max." or "+- peak".	
Dir. of slope change	Specifies increase or decrease. '+ peak' indicates decrease and '- peak' indicates increase.	
Maximum noise amplitude	Specify the Y value (0.0000 to 2147483647.0000) of a waveform that is regarded as a noise and be ignored.	
Upper limit threshold Y value	Specify the upper limit (-2147483648.0000 to 2147483647.0000) of a threshold (Y value) so as not to detect the slope change of a waveform. Values exceeding the threshold are not detected. When entering a threshold, the upper limit threshold Y value should be greater than the lower limit threshold Y value (upper limit threshold Y value > lower limit threshold Y value).	
Lower limit threshold Y value	Specify the lower limit (-2147483648.0000 to 2147483647.0000) of a threshold (Y value) so as not to detect the slope change of a waveform. Values falling below the threshold are not detected. When entering a threshold, the upper limit threshold Y value should be greater than the lower limit threshold Y value (upper limit threshold Y value > lower limit threshold Y value).	
Repeat detection times	Specify the number of times (1 to 2147483647) to detect a slope change within one section.	
Detection start event	Specifies the detection start event.	

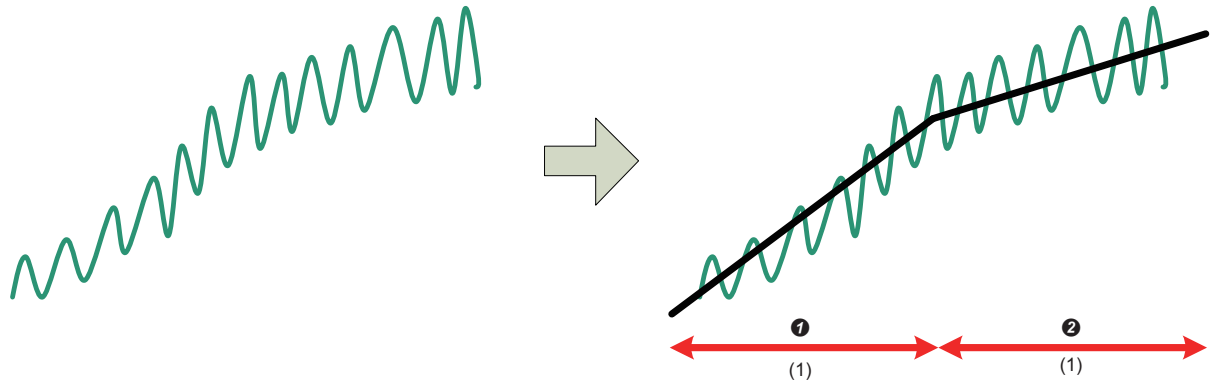
Precautions

A waveform including noise should be smoothed by moving average in the step of the previous primitive. In addition, an appropriate width should be specified for the movement window to capture the slope change of a waveform.

• Operation flow to detect change in a slope

When change in a slope is maximum

1. A linear fit is performed for each former window and latter window.

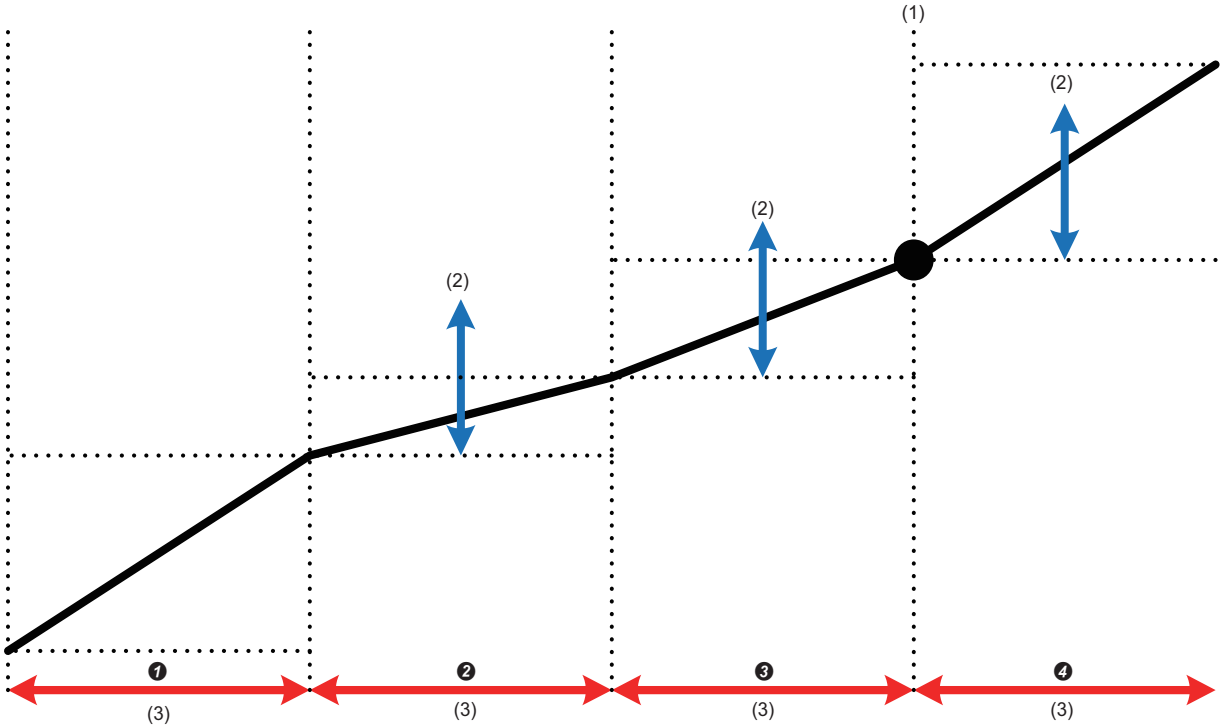


(1) Movement window interval

2. By regarding ❶ and ❷ as a former window and a latter half window respectively, change in a slope of a line to which a linear fit is performed is determined.

3. The point where the slope decreases or increases is defined as the detection point. (When the slope does not exceed 'Maximum noise amplitude', it is regarded as noise and the change in slope is not detected.)

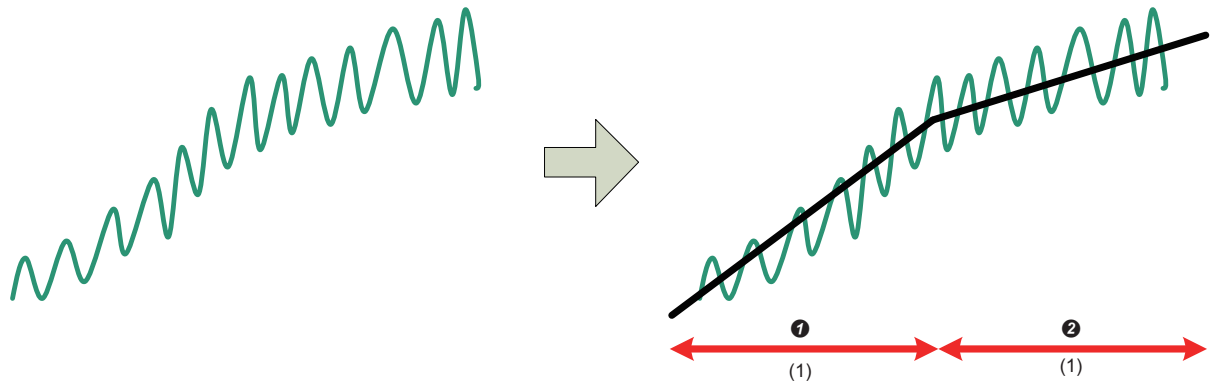
4. In succession, by regarding ❷ and ❸ as a former window and a latter window respectively, and change in a slope is determined in a same way.



(1) Change detection point
(2) Maximum noise amplitude
(3) Movement window interval

For +- peak

1. A linear fit is performed for each former window and latter window.

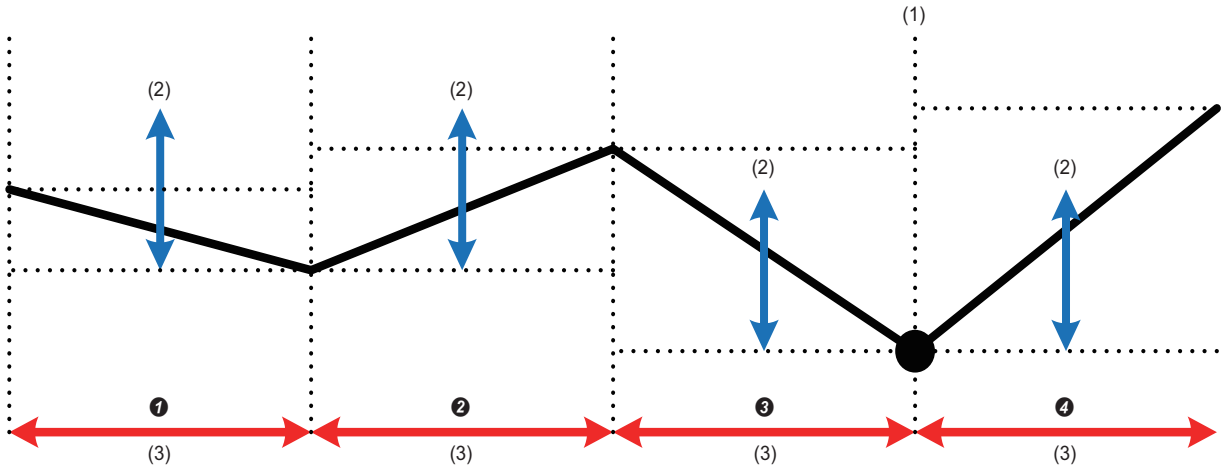


(1) Movement window interval

2. By regarding ❶ and ❷ as a former window and a latter half window respectively, change in a slope of a line to which a linear fit is performed is determined.

3. The point where the slope goes up from the bottom right to top right is defined as the detection point of the minus peak. And, the point where the slope goes down from the top right to bottom right is defined as the detection point of the plus peak. (When both the slopes of lines in a former and latter windows do not exceed 'Maximum noise amplitude', it is regarded as noise and the change in slope is not detected.)

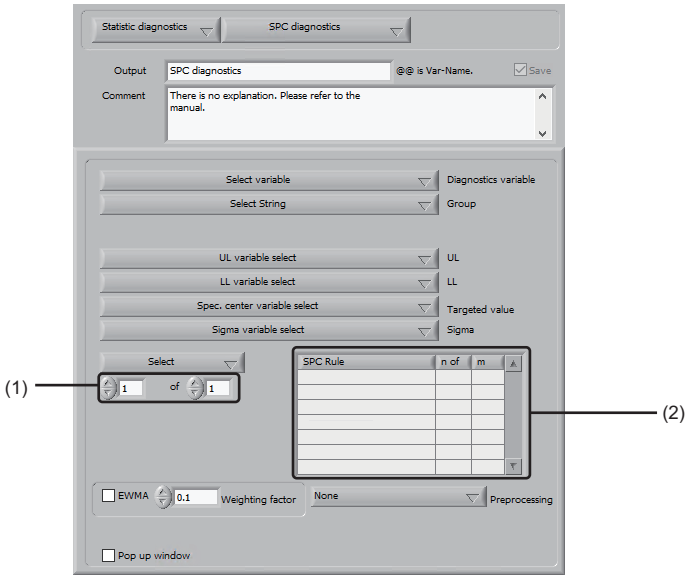
4. In succession, by regarding ❷ and ❸ as a former window and a latter window respectively, and change in a slope is determined in a same way.



(1) Change detection point
(2) Maximum noise amplitude
(3) Movement window interval

■ SPC diagnostics

Performs SPC diagnosis by specifying the SPC rule.



Setting item	Description	Output
Diagnostics variable	Select statistics to diagnose.	• If the statistics to diagnose has a less number of samples than specified, the SPC diagnosis is not performed. • A detection is started from the top of the list in "SPC Rule" and ended at the timing when an error is detected. • The output variable name_value, upper-limit value (UCL), lower-limit value (LCL), target value (Target), σ(σ), judgment result boolean value (SPC judgment normal = 0, error = 1), execution result boolean value (executed = 0, not executed = 1), judgment rule text variable (detected SPC rule name) are output.
Group	Select this when grouping sections by a text variable value.	
Upper limit	Select a statistic that indicates the upper management limit.	
Lower limit	Select a statistic that indicates the lower management limit.	
Target value	Select a statistic that indicates the center line.	
Sigma	Select a statistic that indicates a sigma.	
[Select] button	Select, delete, or update an SPC rule. The same rule can be set for multiple times. The selected list is shown in the "SPC Rule" list. To perform a deletion or update, select a row in the "SPC Rule" list and select "Delete" or "Update" from the pull-down list.	
(1) Number of diagnostics sections	Specify the diagnostics points for the SPC rule as 'n of m'. Specify a section (1 to 20) among the number of specified sections. It is determined as an error when the 'SPC Rule' is satisfied in the specified section. When specifying '3' to the left side of input area and '5' to the right side of input area, an error occurs if the SPC Rule is satisfied in the third section within five sections. Note that a section (n) should be equal or less than the number of specified sections (m) (Section (n) ≤ Number of specified sections (m))	
EWMA	Check this to run the SPC diagnosis on the exponential weighted moving average.	
Weighting factor	Sets a weighting factor (0.1000 to 1.0000). Enter a factor to multiply the current section statistics.	
(2) List	• "SPC Rule" shows the name of the SPC rule selected by the [Select] button. • "n of" shows 'n' for 'number of diagnostics sections'. • "m" shows 'm' for 'number of diagnostics sections'.	
Preprocessing	Select "None" or "Common logarithm conversion". • None: No preprocessing • Common logarithm conversion: Performs a common logarithm conversion to the statistics in the current section and an SPC diagnosis.	
Pop up window	When checked, shows the SPC screen as a pop-up window upon SPC error (SPC judgment boolean =1). ☞ Page 188 SPC A response data file can be output by displaying the pop-up window.	
Mail sending level	Do not use this.	

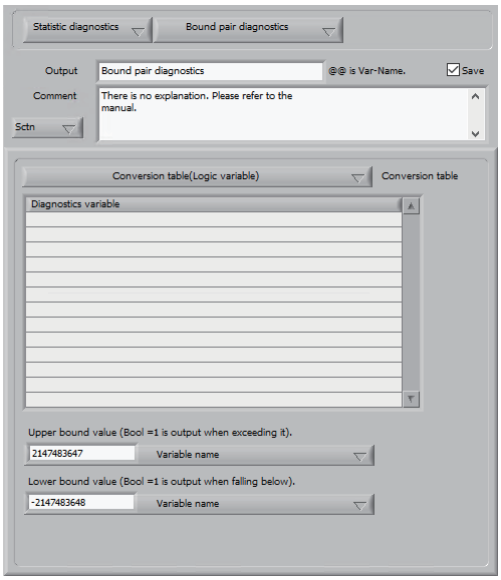
■ Limit pair diagnostics

Diagnoses the upper/lower-limit value of statistics.

After executing this primitive, response data file can be output by executing the primitive 'Write log and error notification'.

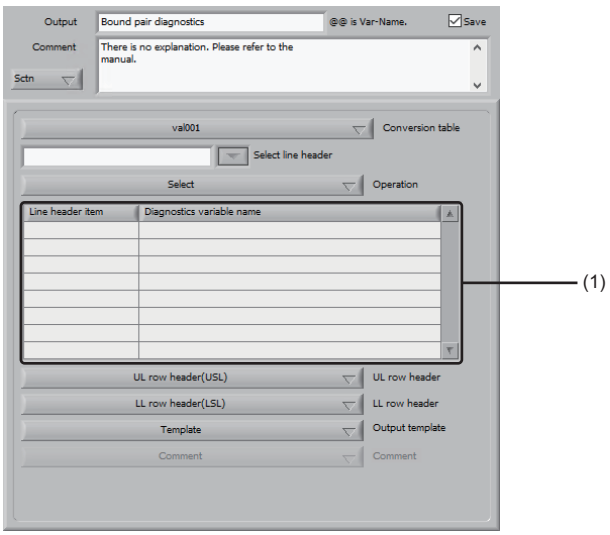
Two methods are available for the limit pair diagnostics; 'diagnosing multiple statistics with same upper and lower limits' and 'diagnosing multiple statistics with same upper and lower limits set by logic variable'.

- Diagnosing multiple statistics with same upper and lower limits



Setting item	Description	Output
Sctn	Specifies the level of sections to input and output.	• It is diagnosed whether a value of statistics to be diagnosed deviates from the upper and lower limit values in a specified section. • A boolean variable is output for each diagnostics variable (Normal = 0, Not normal = 1). • One boolean variable is output with OR condition between all selected diagnostics variables (Normal = 0, Not normal = 1).
Conversion table	Not specified.	
Diagnostics variable	Select the diagnosis target statistics name or names.	
Upper limit	Enter a numerical value (-2147483648.0000 to 2147483647.0000), or select a variable name used as the upper limit. When entering a numerical value, it should be greater than the lower limit (upper limit > lower limit).	
Lower limit	Enter a numerical value (-2147483648.0000 to 2147483647.0000), or select a variable name used as the lower limit. When entering a numerical value, it should be greater than the lower limit (upper limit > lower limit).	

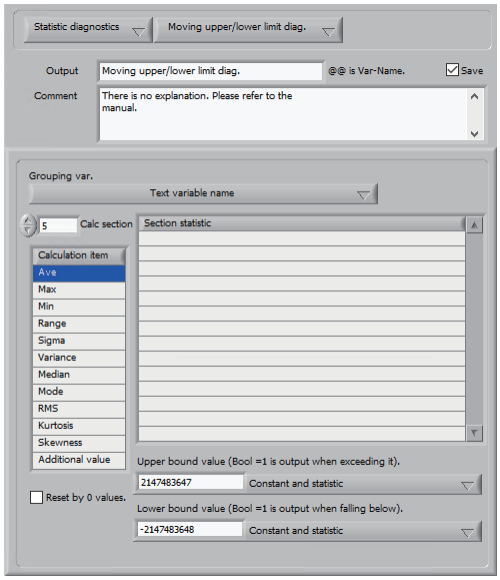
• Diagnosing multiple statistics with upper and lower limit values set for a logic variable



Setting item	Description	Output
Sctn	Specifies the level of sections to input and output.	• Reads the execution conversion table and assign the upper/lower-limit value to the diagnostics variable. • The limit pair diagnostics are performed for each variable at the timing of logic execution and the information on a diagnostics variable deviating from the upper and lower limit values is written to a template and output. • The following values are output: individual diagnostics variable, whole boolean variable, '0' for normal and '1' for abnormal (AND of individual diagnostic variable), upper limit value, and lower limit value.
Conversion table	Select the execution conversion table defined in 'Logic variable setting'. ☞ Page 351 Setting logic variable	
Select line header	Select the row header of an execution conversion table (up to 256 characters).	
Operation	Select a statistics name of the diagnosis target corresponding to the row header, or delete the diagnostics variable selected in the "Diagnostics variable" list.	
(1) Diagnostics variable list	Shows the row header of the selected diagnostics variable and the diagnostics variable name.	
UL row header	Select a column header corresponding to the upper limit value of the execution conversion table.	
LL row header	Select a column header corresponding to the lower limit value of the execution conversion table.	
Output template	Select the template to write the diagnosis result. To select the template, 'Read & insert template' must be defined in a step prior to this primitive in the same logic. ☞ Page 337 Read & insert template	
Comment	Select a column header corresponding to the comment column of the execution conversion table.	

■ Moving upper/lower limit diagnostics

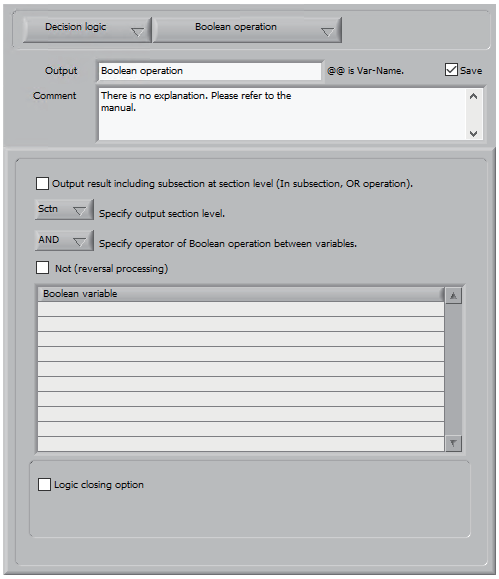
Extracts statistics from moving sections and performs the limit pair diagnostics with common upper/lower-limit values.
After executing this primitive, response data file can be output by executing the primitive 'Write log and error notification'.



Setting item	Description	Output
Grouping var.	Select this when grouping sections by the same text variable value.	• Saves the specified statistics for the specified number of sections. • Reads saved the past statistics and calculates the statistics for multiple sections. • When Reader runs when it reads the CSV file, the saved statistics is deleted upon start of the logic. • When the logic is executed offline, the statistics is saved for the specified range from the beginning each time. • If the past data for the specified section is present for all variables (i.e., normally calculated), boolean = 0 is output. If the past data for the specified section is missing for at least one variable, boolean = 1 is output. • If there is no past section, null is output. • In a specified calculation section, whether a value of statistics deviates from the upper and lower limit values is checked and a boolean variable for each variable (normal = 0, abnormal = 1). When multiple variables are selected, one boolean variable is output with OR condition between all selected variables (Normal = 0, Not normal = 1).
Calc section	Specify the number of sections to be calculated (1 to 10000).	
Calculation Item	Select statistics from the following (multiple items can be selected): • Ave: Average value • Max: Maximum value • Min: Minimum value • Range: Range • Sigma: Standard deviation • Variance: Variance • Median: Median • Mode: Mode • RMS: Root mean square • Kurtosis: Kurtosis • Skewness: Skewness • Additional value: Additional value	
Section statistic	Specify the statistics name targeted for calculation.	
Reset by 0 values.	When statistics has a value of '0' in the calculation section, the calculation result is reset to '0' at that section, and calculation resumes with the next section. Output from that section is '0'.	
Upper limit	Enter a numerical value (-2147483648.0000 to 2147483647.0000), or select a variable name used as the upper limit. When entering a numerical value, it should be greater than the lower limit (upper limit > lower limit).	
Lower limit	Enter a numerical value (-2147483648.0000 to 2147483647.0000), or select a variable name used as the lower limit. When entering a numerical value, it should be greater than the lower limit (upper limit > lower limit).	

■ Boolean operation

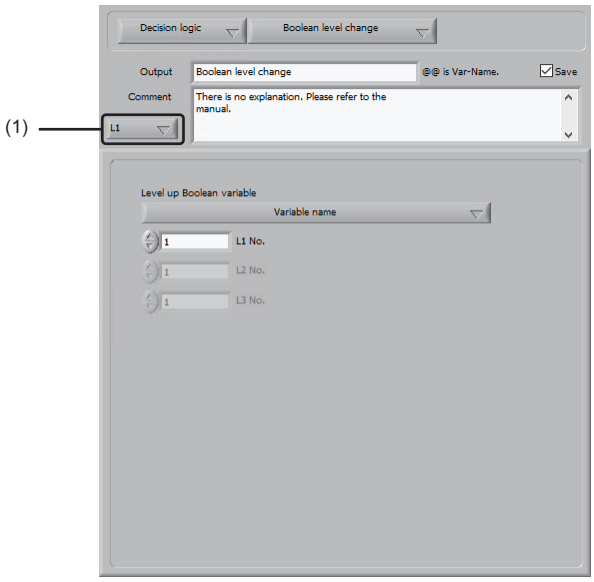
Performs a boolean operation on boolean variables. Detects the boolean variable and terminates a logic.



Setting item	Description	Output
Output result including subsection at section level	If checked, the boolean variables at all levels are shown in the list. The subsection boolean variable is the result of ORing the subsections.	An AND/OR operation is performed between boolean variables and the boolean variable (0, 1) is output.
Specify output section level.	Boolean variables at the level specified here are shown in the list. The input level becomes the output level.	
Specify operator of Boolean operation between variables.	Select "AND", "OR", or "XOR". Performs an operation on boolean variables. • AND: AND operation • OR: OR operation • XOR: XOR operation	
Not (reversal processing)	Select this to reverse boolean variable values in the output result.	
Boolean variable	Shows the boolean variable at the level specified in "Specify output section level.".	
Logic closing option	By selecting the checkbox, a logic is ended according to a boolean variable value in the output result. Not shown when the output level is subsection.	

■ Boolean level change

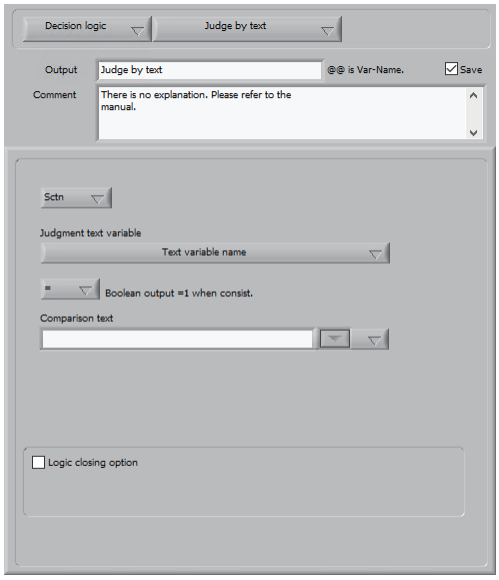
Changes the boolean variable level.



Setting item	Description	Output
(1) Section	Specify the boolean variable subsection to upgrade.	Converts the specified boolean variable to a section boolean variable and output it.
Level up Boolean variable	Select a boolean variable name.	
L1 No.	Specify the L1 section number to be upgraded (1 to 2147483647).	
L2 No.	Specify the L2 section number to be upgraded (1 to 2147483647).	
L3 No.	Specify the L3 section number to be upgraded (1 to 2147483647).	

■ Judge by text

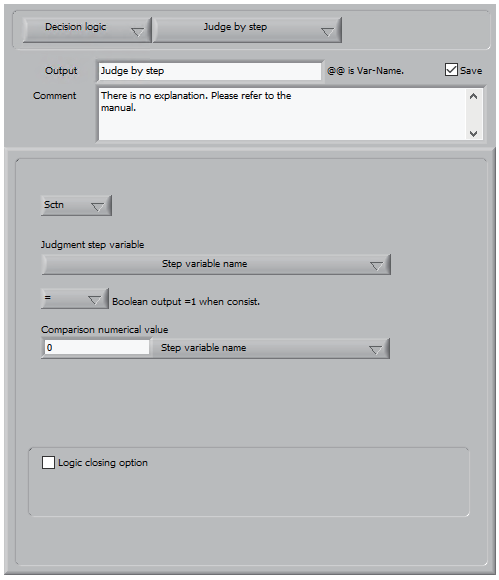
Determine a text and output the result by using a boolean variable.



Setting item	Description	Output
Sctn	Specifies the level of sections to output.	• Checks whether the text variables at the start time of the specified section match. • When the specified condition is satisfied, 'Boolean variable = 1' is output. • When either one of the text variables is 'null', 'Boolean variable = 0' is output. • When both text variables are 'null', 'Boolean variable = 1' is output.
Judgment text variable	Select a text variable to judge.	
Boolean output =1 when consist.	Select the comparison operator from the following: • =: Equal to • !=: Not equal to	
Comparison text	Select a variable name or enter a text (up to 256 characters). Also, values in the selected dataset for the variable selected in "Judgment text variable" are shown, and a value can be selected from this list.	
Logic closing option	By selecting the checkbox, a logic is ended according to a boolean variable value in the output result.	

■ Judge by step

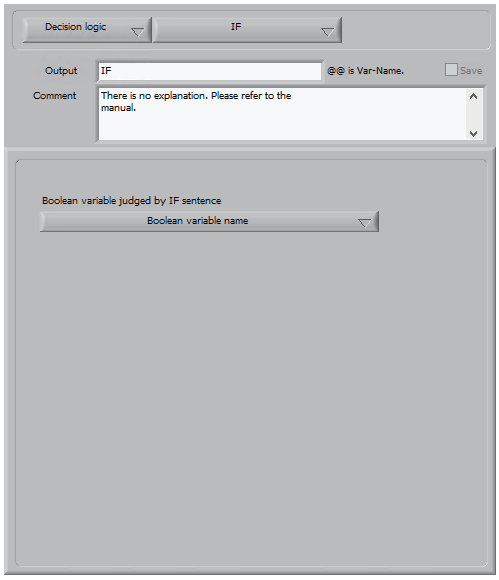
Determine a step value and output the result by using a boolean variable.



Setting item	Description	Output
Sctn	Specifies the level of sections to output.	• Judges a step variable at the section start time at the specified section level. • When the specified condition is satisfied, 'Boolean variable = 1' is output. • When either one or both step variables is/are 'null', 'Boolean variable = 0' is output.
Judgment step variable	A step variable (statistics or logic variable) to compare.	
Boolean output =1 when consist.	Select the comparison operator from the following: • =: Equal to • !=: Not equal to • >: Greater than • >=: Equal to or greater than • <: Less than • <=: Equal to or less than	
Comparison numerical value	Select a variable (step variable, statistics, or logic variable) or enter a value (-2147483648.0000 to 2147483647.0000).	
Logic closing option	By selecting the checkbox, a logic is ended according to a boolean variable value in the output result.	

■ IF

Inserted between steps of a logic to control execution of primitives.



Setting item	Description	Output
Boolean variable judged by IF sentence	Selects a boolean variable.	• The steps of a primitive between IF and ELSE is performed when a boolean variable is '1'. • The steps of a primitive between ELSE and ENDIF is performed when a boolean variable is '0'.

Precautions

In this specification, reversing a boolean variable value by using an ELSE statement is only available. Note that it is different from general control statements.

Nested control statements at the same section level (e.g., IF -> IF -> ELSE -> ELSE) are not allowed.

Since each output variable name must be unique within a logic, a syntax using control statements to change the value of the same variable name (e.g, IF -> variable A output -> ELSE -> variable A output -> ENDIF) is not allowed.

■ ELSE

Inserted between steps of a logic to control execution of primitives.

No setting item is available.

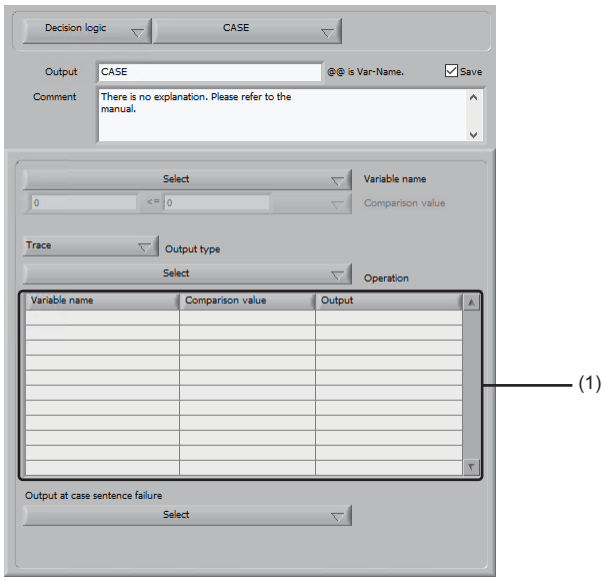
■ ENDIF

Inserted between steps of a logic to control execution of primitives.

No setting item is available.

■ CASE

Executes the Case statement and outputs a variable.



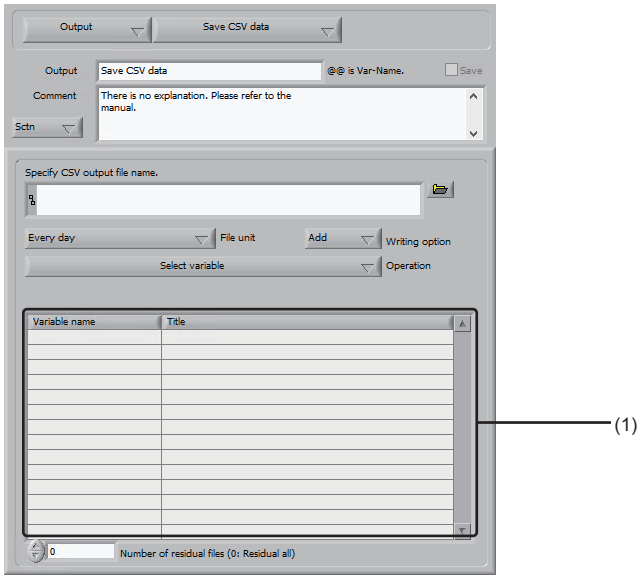
Setting item	Description	Output
Variable name	Select the variable name used for judgment of the Case statement.	• The text value at the section start time is compared. • If the comparison source variable matches the comparison value, the CASE statement is satisfied. • CASE statements in the list are checked sequentially from the top, and the variable value of the CASE statement satisfied first is output. • When multiple events are compared, the CASE statement is satisfied if any one of them matches. • According to the setting of "Output type", trace variable, event, numeric value, text, or statistics (L1, L2, or L3) is output.
Comparison value	Enter a value (-2147483648.0000 to 2147483647.0000) or a character string (up to 32 characters) to compare with a variable name. When specifying a numeric value or text in "Variable name", the value or text can be entered directly.	
Output type	Select the output variable type from the following options: "Trace", "Event", "Text variable", "Step variable", "Statistic (section)", "Statistic (L1)", "Statistics (L2)", or "Statistics (L3)".	
Operation	Select the output variable name from the variable name list displayed according to the "Output type" setting. Or, specify addition, insertion, or deletion of the list rows.	
(1) List	Shows a list of CASE comparison conditions. • "Variable name" shows the variable name selected in "Variable name". • "Comparison value" shows the variable name selected in "Comparison value" or entered value. • "Output" shows the variable name selected in "Operation".	
Output at case sentence failure	Select a variable to output when CASE judgment is not satisfied.	

Point

When directly entering a value in "Comparison value", "Operation", or "Output at case sentence failure", a wild card character (* or ?) can be used. * Wild card character of '*' represents one or more arbitrary characters and '?' represent one arbitrary character.

■ Save CSV data

Saves the waveform, statistics data, and text data in the CSV format.



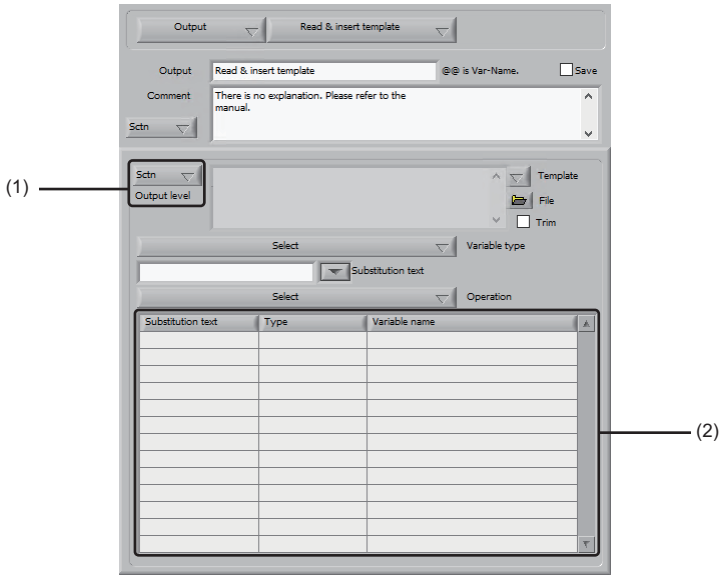
Setting item	Description	Output
Sctn	Specifies the level of sections to input and output.	• Saves the waveform, statistics, and text variable data at the specified section level in a CSV file. • When "Logic execution unit" is selected in "File unit", the section data selected in the dataset is saved for each of the specified section levels. • When a section is specified, all row data of the entire section is output. • When a subsection is specified, row data of the entire section × entire subsection is output. (Example) When the number of sections is 30 and the number of subsection is 10 each, data of a total of 300 rows is output. • Data from different section levels cannot be output simultaneously. • The output file name specified in "Specify CSV output file name." is appended with "_YYmmdd".
Specify CSV output file name.	Enter the file path (up to 256 characters) of a CSV file for an output. The following macros can be used in the file name: When a macro is added to the file name, an appropriate value is inserted in each [[]]. • [[EQ]]: Fixed string 'UNIT' • [[FLT]]: Unit name • [[SEQ]]: Logic name • [[START]]: Section start time • [[END]]: Section end time • [[Variable Name]]: Variable name Do not specify a folder with the encryption attribute enabled as the file destination.	
File unit	Select the period to write to a single file from the following: • Logic execution unit: Sections which executed a single logic are saved in a single file. • Every day: Sections are grouped and saved in a single file for each day. • Every month: Sections are grouped and saved in a single file for each month. • Unit of section: A single file is created per section. • Replace the Mat. in each section.: A single file is created per section by swapping rows and columns (i.e., columns are arranged in the row direction). • Not add the date to the file name.: Select this when [[]] is used. The date is not added to the file name. If the variable value within [[]] is the same, the file is overwritten.	
Writing option	Select "Overwrite" or "Add" (to add new sections only). Select "Add" when executing logics per day or month.	
Operation	Adds the selected variable to the list. • By selecting "Delete selection line.", the variable selected in the list is deleted. • By selecting "Select statistic", "Select text", or "Select waveform", all of the corresponding variables are added to the list.	
(1) List	• "Variable name" shows the variable name output to the CSV file. • "Title" shows the variable name by default. The string in "Title" can be changed by clicking the "Title" item while the row is selected and entering an arbitrary text.	
Number of residual files	Specify the maximum number of files retained in the output destination of a CSV file (0 to 2147483647). Up to the specified number of files are retained and extra files are deleted.	

Precautions

Do not change the string in the "Variable name" column in the list. Otherwise, the system may not function normally.

■ Read & insert template

Reads the template and inserts the specified text.



Setting item	Description	Output
Sctn	Specifies the level of sections to input and output.	• Checks for the replacement string from the top of the template and writes the variable value at the first matching location. • When the same replacement string appears multiple times, the second and later strings are not replaced. • The template inserted for each section specified by the output level is output. • If no template has been inserted, the output template is read.
(1) Output level	Specifies the level of sections to output templates. If a subsection is selected, templates are output for the number of subsections.	
Trim	If checked, trims blank characters in the template.	
Template	Selects a text variable registered in 'Logic variable setting'. ☞ Page 351 Setting logic variable When the menu is returned to "Select", the contents of the text variable are shown.	

File	When using a file defining the message template, select the file.
	Define the temperate using a text file as follows:
	`Sample message template.`
	`·Process: [[Process name]]`
	`·Unit: [[Unit name]]`
	`·Logic: [[Logic name]]`
	`·RecipeID: [[Recipe ID]]`
	Do not specify a folder with the encryption attribute enabled.	

Variable type	Select one of the following options: "Variable name", "Text variable", "Fixed text", "Logic variable" (variable type = text), "Equipment", "Numeric variable", "Statistic", "Unit name", "Logic name", "Time stamp (start)", "Time stamp (end)", "BOOL", or a logic variable (edit conversion table). • When selecting "Time stamp (start)" or "Time stamp (end)", specify the time stamp form such as '%Y%m'. %Y: Year %m: Month %d: Day %H: Hour %M: Minute %S: Second • When selecting "BOOL", specify characters to be inserted separated by a comma when a boolean variable is '0' and '1'.	
Substitution text	Specify a substitution text on the template to write variables (up to 256 characters). A character string enclosed in brackets '[[ ]]' on the template is a substitution text. The replacement string is read from the template and shown on the menu.	
After the decimal point	Enter this value when "Statistic" is selected in "Variable type". A value is rounded off to the specified number of digits (0 to 2147483647).	
Operation	Select the output variable name from the variable name list displayed according to the "Variable type" setting. Or, specify addition, insertion, or deletion of the list rows.	
(2) List	• "Substitution text" shows the character specified in "Substitution text". • "Type" shows the variable type selected in "Variable type". • "Variable name" shows the variable name selected in "Operation". Nothing is displayed in the "Variable name" column, when "Equipment", "Unit name", "Logic name", "Time stamp (start)", or "Time stamp (end)" is selected for "Variable type".	

Point

- The text variable contents must be defined as follows:
  Arbitrary text [[Replacement character 1]]
- The replacement character enclosed in [[ ]] is converted into the specified value and then output. Characters outside [[ ]] are output without conversion.
- Specifying [[replacement character%.3]] inserts the first three characters only.
- [[replacement character%5.3]] inserts two blank spaces and then three characters.

■ Write log and error notification

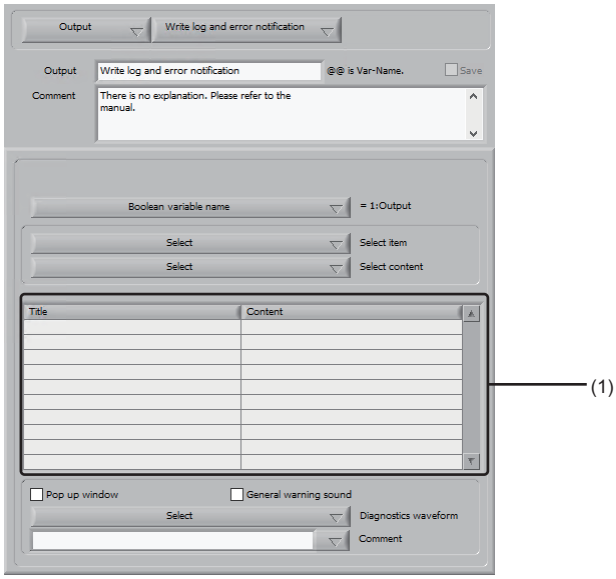
Writes log data displayed in 'Diagnostic logic result display'.

☞ Page 376 Displaying a Diagnostic Logic Result

By adding this primitive after a waveform diagnostic logic not having a function to display a pop-up window or a statistic diagnostic logic as a setting to display a pop-up window, an error occurred in the logic can be detected in Monitor and the response data file can be output.

☞ Page 315 Enhanced trace GB

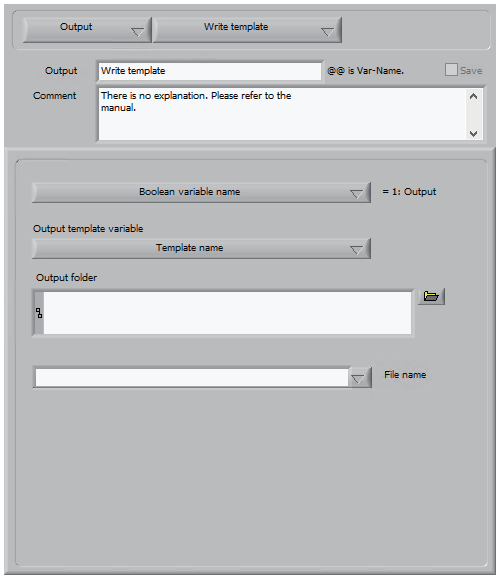
☞ Page 325 SPC diagnostics



Setting item	Description	Output
= 1:Output	Specify a boolean variable. If not checked, logs are always output.	A pop-up is displayed when a boolean variable is '1' and a log which can be referenced in 'Diagnostic logic result display' is saved. ☞ Page 376 Displaying a Diagnostic Logic Result
Select item	Select the variable type written to the log list. Select one of the following options: "Statistic", "Boolean variable" (True=0, False=1), "Numeric variable", "Text variable", "Trace variable", "Event", or an edit conversion table (logic variable).	
Select content	Shows a variable corresponding to each of the selected items. For the edit conversion table, select the conversion table name in "Select item" and ID defined in the conversion table in "Select content".	
(1) List	• "Title" shows the variable item name written to the log. • "Content" shows the variable name written to the log. By selecting an item and single-clicking it, its contents can be changed.	
Pop up window	Select this to display the pop-up window when a boolean variable is '1'. A waveform is displayed on a graph and a text on the list in the pop-up window. A response data file can be output by displaying the pop-up window.	
General warning sound	If checked, gives the general warning sound of Windows.	
Diagnostics waveform	Select a waveform to diagnose. A selected waveform is displayed in the pop-up window.	
Comment	Specify a text (up to 100 characters) to display on the comment column of the pop-up window displayed in 'Diagnostic logic result display'.	

■ Write template

Writes the output template to a specified file.

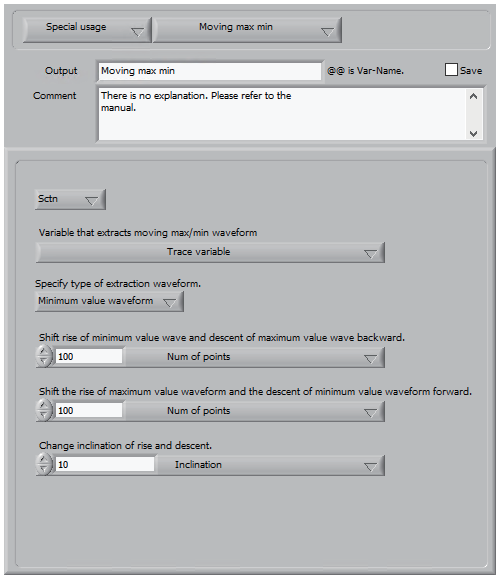


Setting item	Description	Output
= 1:Output	Specify a boolean variable. Always output if not checked.	The template is written in a file per section or subsection.
Output template variable	Select a template to save. The template is created by using 'Read & insert template' in the preceding step. ☞ Page 337 Read & insert template	
Output folder*1	Specify a folder path to write a template (up to 256 characters). However, do not specify a folder with the encryption attribute enabled.	
File name*1	Enter an output file name (up to 256 characters), or select a logic variable (text) or a template created n 'Read & insert template'. ☞ Page 337 Read & insert template	

*1 Set it so that the path length of a file to be output does not exceed 259 characters.

■ Moving max min

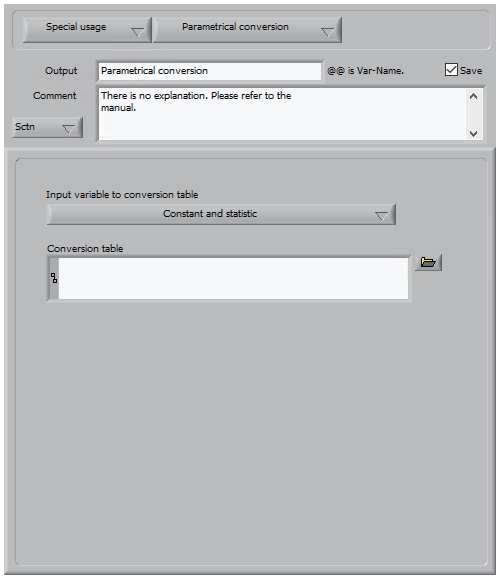
Create a guard band while executing a logic.



Setting item	Description	Output
Sctn	Specifies the level of sections to output.	• When "Maximum value waveform" is selected in "Specify type of extraction waveform.", the waveform with the larger value is output. • When "Minimum value waveform" is selected in "Specify type of extraction waveform.", the waveform with the smaller value is output.
Variable that extracts moving max/min waveform	Specify a waveform to extract the moving maximum/minimum.	
Specify type of extraction waveform.	Select "Maximum value waveform" or "Minimum value waveform".	
Shift rise of minimum value wave and descent of maximum value wave backward.	Enter an offset to the positive X axis direction by using the number of points (1 to 2147483647). When the minimum value waveform is selected, the rising of the waveform is sifted forward for the set number of points. When the maximum value waveform is selected, the falling of the waveform is sifted forward for the set number of points.	
Shift the rise of maximum value waveform and the descent of minimum value waveform forward.	Enter an offset to the negative X axis direction by using the number of points (1 to 2147483647). When the minimum value waveform is selected, the falling of the waveform is sifted backward for the set number of points. When the maximum value waveform is selected, the rising of the waveform is sifted backward for the set points.	
Change inclination of rise and descent.	Enter a value to change the slope (0.0000 to 2147483647.0000). A larger value causes a steeper slope.	

■ Parametrical conversion

Converts I/O data conversion using the conversion table.



Setting item	Description	Output
Sctn	Specifies the level of sections to input and output.	• Performs linear transformation from an input variable to an output variable by referencing the conversion table. • Outputs a (statistics type) numeric value with the column header of the conversion table as the variable name. • Outputs '0' for an input value exceeding the range defined for the conversion table.
Input variable to conversion table	Specify the statistics.	
Conversion table	Specify a file path (up to 256 characters) of the conversion table in the CSV format. A conversion table is a matrix of input values and output values, and the 1st column contains an input value and 2nd and later columns contain output values. The following shows the example of a conversion table. Output1, Output2, Output3, Output4 1, 1000, 3, 0.001 10, 2, 100, 3, 0.005 100, 3, 10, 3, 0.01 1000, 4, 0, 3, 0.1 10000, 5, −10, 3, 1 100000, 6, −100, 3, 10	

Precautions

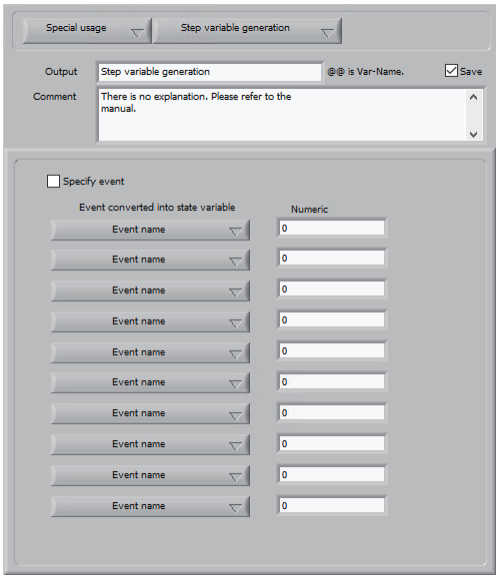
When the conversion table has been updated, this primitive must be updated.

■ Step variable generation

Converts an event or value and time to a step variable.

Two methods are available to generate a step variable; converting multiple events to step variable and generating step variable from value and time.

- Converting multiple events to step variable



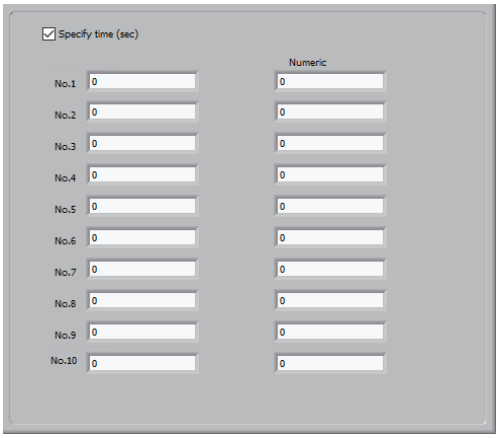
Setting item	Description	Output
Specify event	Not checked.	Assign input numeric values to the specified event through the next event.
Event converted into state variable	Select an event to convert to a step variable. Up to ten events can be specified.	
Numeric	Enter a numeric value assigned to each event (-2147483648.0000 to 2147483647.0000).	

Precautions

The following precautions apply when converting multiple events into a step variable:

- If a section start event is specified as the first event, input numeric values are assigned to the section start time through the next event. If the first event is not a section start event, the numeric value of the last event of the preceding section is retained from the section start to that event.

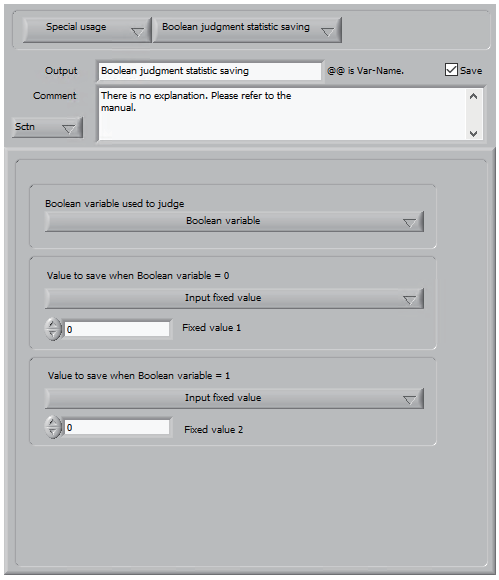
• Generating step variable from value and time



Setting item	Description	Output
Specify time (sec)	Changes to "Specify Time (Sec)" if the checkbox of "Specify event" is selected.	Creates a step variable from the specified numeric value and time to retain the value.
No.1 to No.10	Enter time to retain each numeric value (-2147483648.0000 to 2147483647.0000 seconds). Up to ten values can be entered.	
Numeric	Enter a step variable value (-2147483648.0000 to 2147483647.0000). Up to ten values can be entered.	

■ Boolean judgment statistic saving

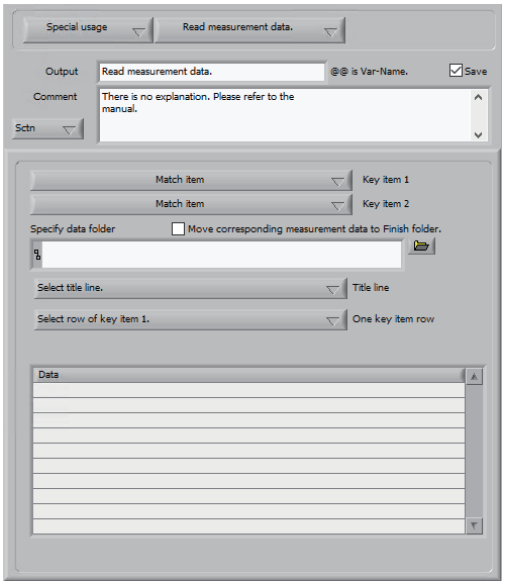
Save a value specified according to a boolean variable value as the statistics.



Setting item	Description	Output
Sctn	Specifies the level of sections to input and output.	• Save a statistic specified according to a boolean variable value. • The saved statistics name is the output variable name of this primitive.
Boolean variable used to judge	Selects a boolean variable.	
Value to save when Boolean variable = 0	Select a variable name. • When selecting "Input fixed value", enter a numeric value in "Fixed value 1" (-2147483648.0000 to 2147483647.0000). If both a variable name and fixed value are input, the variable is used. • If "Not save anything." is selected, null is saved. • For null, nothing is shown on the chart and the variable is also excluded from statistics calculation.	
Value to save when Boolean variable = 1	Select a variable name. • When selecting "Input fixed value", enter a numeric value in "Fixed value 2" (-2147483648.0000 to 2147483647.0000). If both a variable name and fixed value are input, the variable is used. • If "Not save anything." is selected, null is saved. • For null, nothing is shown on the chart and the variable is also excluded from statistics calculation.	

■ Read measurement data

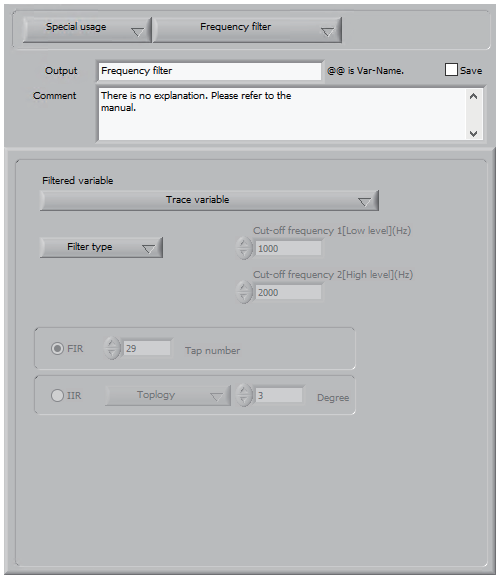
Save a value specified according to a boolean variable value as the statistics.



Setting item	Description	Output
Sctn	Specifies the level of sections to input and output.	• Compares the key item of CSV data and the text variable at the start time of the section, and outputs the corresponding CSV data as statistics when they match. • If a string variable is set for "Key item 2", it is ANDed with "Key item 1" for comparison.
Key item 1	Select a string variable to compare.	
Key item 2	Select a string variable to AND with "Key item 1". This item is optional.	
Specify data folder	Select the folder path in which CSV data (measurement data) is saved (up to 256 characters). However, do not specify a folder with the encryption attribute enabled.	
Move corresponding measurement data to Finish folder.	Check to create a subfolder named 'Finish' under the measurement data folder and moves matching measurement data to that folder.	
Title line	Shows data for 20 rows from the first file in the selected folder. A row corresponding to the variable name is selected from them.	
One key item row	Selects a column containing the key item 1.	
Two key item rows	Selects a column containing the key item 2.	
Data	Shows the variable name in the title row. Selects all variable names to read from them.	

■ Frequency filter

Apply the frequency filter to the trace variable waveform.



Setting item		Description	Output
Filtered variable		Select a trace variable.	Outputs the filtered trace variable.
Filter type		Select one of the following: "Low pass", "High pass", "Band pass", or "Band stop". • Low pass: Low pass filter • High pass: High pass filter • Band pass: Band pass filter • Band stop: Band stop filter	
Cut-off frequency 1[Low level]		Specify the low-pass cut-off frequency (0.0000 to 100000.0000).	
Cut-off frequency 2[High level]		• When "Band pass" or "Band stop" is selected for "Filter type", specify the high-pass cut-off frequency (0.0000 to 100000.0000). • Not required if the filter type is "Low pass" or "High pass". (Ignored if specified.)	
FIR	—	Select this to use the FIR (Finite Impulse Response) filter.	
	Tap number	Specify the number of taps (0 to 1000).	
IIR	—	Select this to use the IIR (Infinite Impulse Response) filter.	
	Topology	Specify the topology.	
	Degree	Specify a degree (0 to 100).	

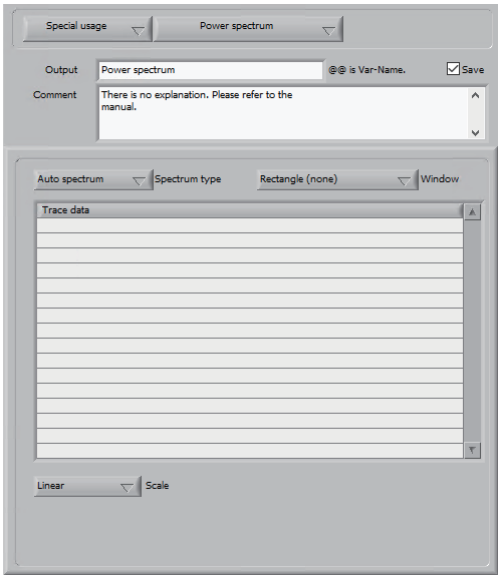
Precautions

Enter values in "Cut-off frequency 1[Low level]" and "Cut-off frequency 2[High level]" so that the values maintain the following relationship:

- Cut-off frequency 1[Low level] < Cut-off frequency 2[High level]

■ Power spectrum

Calculates the power spectrum of the trace variable waveform.



Setting item	Description	Output
Spectrum type	Select "Auto spectrum" or "Cross spectrum". • Auto spectrum: Auto power spectrum • Cross spectrum: Cross spectrum	Calculates the power spectrum and outputs the result as the spectrum waveform.
Window	Enter the window information used to calculate STFT. If "Rectangle (none)" is selected, windowing is not performed.	
Trace data	When "Cross spectrum" is selected in "Spectrum type", select two variables.	
Scale	Select the output result unit between "Linear" or "dB".	

Executing logic

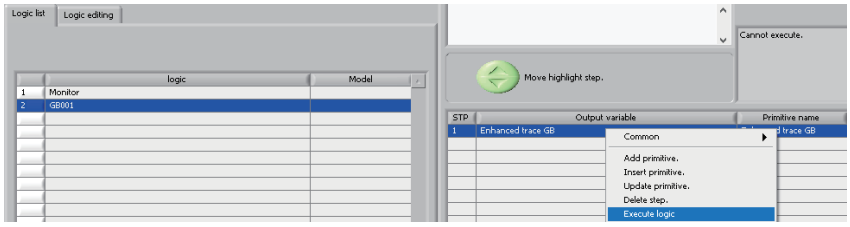
There are two methods to execute a logic: 'manual execution' and 'cooperative execution with Reader and Monitor'.
The execution result of a logic is saved per unit.

■ Manual execution

Manually execute all primitives within the logic for the period and section of the selected dataset.
☞ Page 378 Management

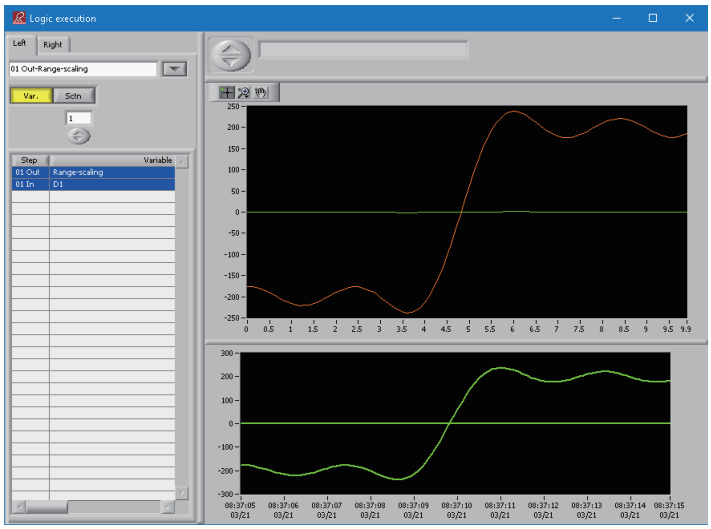
Operating procedure

1. Right-click on the primitive list and choose [Execute logic].



2. If the checkbox of [Display definition pop up.], which is on the right-click menu, is selected, the execution result screen appears after logic execution.

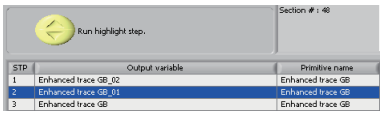
A variable with 'In' shown in "Step" is an input variable of the primitive.
A variable with 'Out' shown in "Step" is an output variable of the primitive.



Point

When more than one input or output variables have the same name, only one of them is shown on the execution result screen. In addition, variables other than boolean variables are highlighted.

3. When the execution result screen appears, the [Move highlight step.] button changes to the [Run highlight step.] button. Clicking [Run highlight step.] button to run from the primitive of which "STP" is "1" through the primitive selected when this button is clicked.
In the following example, primitives of which "STP" is "1" and "2" are executed.



Precautions

If a period and section are not selected in the dataset, nothing happens when [Execute logic] is selected.

Point

If the up button of the [Run highlight step.] button is clicked while no primitive is selected, no step is selected and the logic is not executed. Clicking the down button selects the primitive of which "STP" is "1" and this primitive is only executed.

■ Cooperative execution with Reader and Monitor

When Reader reads a CSV file, all primitives in the logic are executed for the data (sections) in the read CSV file.
However, the following condition must be satisfied to execute the primitives:

- The created logic is shown in "logic" in the logic information list of Monitor and "State" shows "Diagnosing".

For details on the setting, refer to the following:
☞ Page 407 Monitor

21.11 Setting logic variable

Set variables of which values are referenced by primitives in a logic.
When a logic variable is updated, the update is immediately reflected on logic execution.
Use a logic variable when the same value is used by multiple logics or the value referenced by the logic is frequently changed after registering the logic.

Precautions

A logic variable referenced by a logic cannot be deleted.

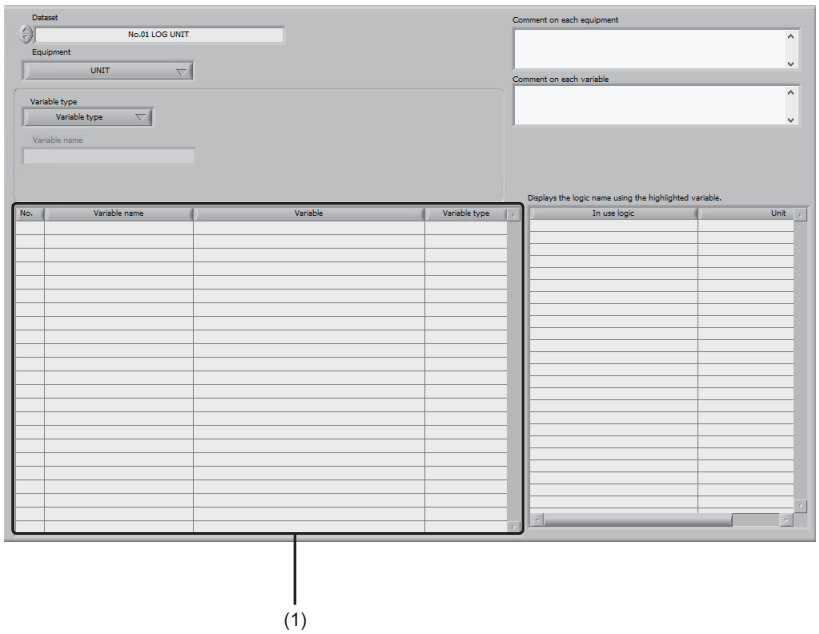
Operating procedure

1. Select [Analysis logic - diagnostic logic operation] ⇨ [Logic variable setting].
2. Select the type of the logic variable to add and configure it.

☞ Page 353 Selecting and setting variable type

Screen configuration

The following shows the screen configuration for setting a logic variable.



Displayed items

Item		Description
Dataset		Shows a list of dataset names. When a dataset is selected, the equipment name associated with the selected dataset is shown in "Equipment". To show a dataset name, the dataset must be registered in advance. ☞ Page 378 Management
Equipment		Select the equipment name 'UNIT' to register the logic variable.
Variable type	—	Select the type of the logic variable to add. ☞ Page 353 Selecting and setting variable type
	Numeric (fix)	Numeric variable. Set a single value for the variable name. A logic primitive specifies a variable name and reads and uses its value.
	Text (fix)	Text variable. Set a single value for the variable name. A logic primitive specifies a variable name and reads and uses its value.
	Integer (fix)	Integer variable. Set a single value for the variable name. A logic primitive specifies a variable name and reads and uses its value.
	Exe. Conv. table (exe.)	Sets up a variable value list for a variable name, and selects a value to use from the list when registering a primitive.
	Edit Conv. table (edit)	Sets up an I/O conversion table of which values are dynamically taken and used during logic execution.
Variable name		Set a variable name (up to 32 characters).
Input variable value		Enter a variable value (for a numerical value: -2147483648.0000 to 2147483647.0000, for a character string: up to 1000 characters).
(1) List of variables	—	Shows information related to the registered logic variable.
	Variable name	Shows the variable name.
	Variable	Shows the variable value.
	Variable type	Shows the variable type.
Comment on each equipment		A comment can be entered for the logic variable setting itself (up to 1000 characters). Enter a comment, right-click on the variable list, and select [Save].
Comment on each variable		A comment can be entered for each variable (up to 1000 characters). Enter a comment, right-click on the variable list, and select [Add&update (highlight line)].

Selecting and setting variable type

Select the type of the logic variable to add and configure it.

The following types of logic variables are available and the setting method differs for each of them.

Item	Description	Reference
Numeric (fix)	Numeric variable. Set a single value for the variable name. A logic primitive specifies a variable name and reads and uses its value.	Page 353 Setting numeric value/text/integer
Text (fix)	Text variable. Set a single value for the variable name. A logic primitive specifies a variable name and reads and uses its value.	
Integer (fix)	Integer variable. Set a single value for the variable name. A logic primitive specifies a variable name and reads and uses its value.	
Exe. Conv. table (exe.)	Sets up a variable value list for a variable name, and selects a value to use from the list when registering a primitive.	Page 354 Setting up execution conversion table
Edit Conv. table (edit)	Sets up an I/O conversion table of which values are dynamically taken and used during logic execution.	Page 357 Setting up edit conversion table

Precautions

- After setting completes, right-click the variable list and select [Save]. Otherwise, the setting will not be applied.
- Restarting Monitor is required after adding or changing a logic variable.

■ Setting numeric value/text/integer

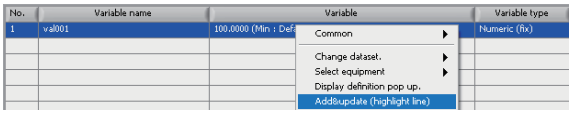
Operating procedure

1. Select "Numeric (fix)", "Text (fix)", or "Integer (fix)" for the variable type.

Enter a character string in "Variable name" (up to 32 characters), and click the [OK] button.

2. To change a variable value, enter a character string in the "Input variable value" field (up to 1000 characters) or a value (-2147483648.0000 to 2147483647.0000).

3. Right-click the variable list while a variable is selected, and select [Add&update (highlight line)].



4. Click the [OK] button.

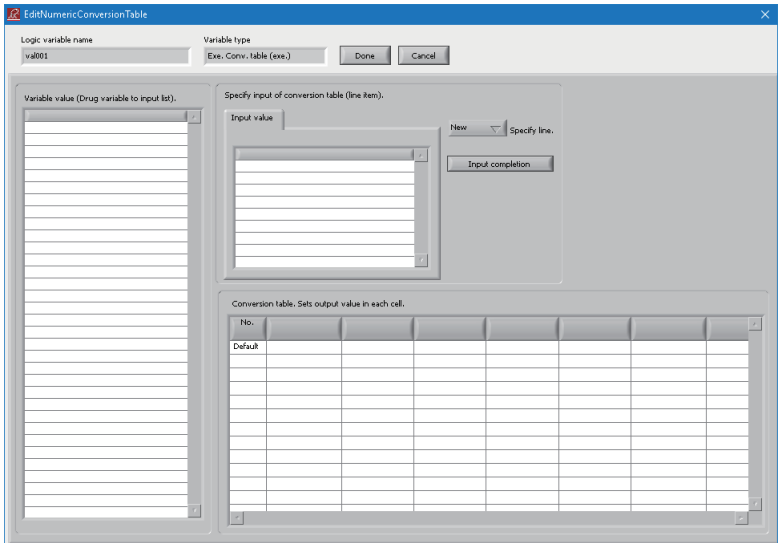
■ Setting up execution conversion table

Operating procedure

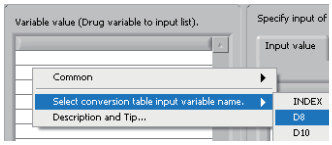
1. Select "Exe. Conv. table (exe.)" for the variable type.

Enter a character string in "Variable name" (up to 32 characters), and click the [OK] button.

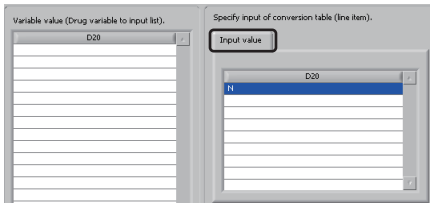
2. Shows the definition screen.



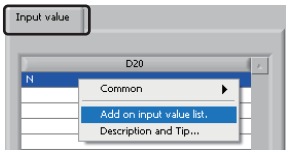
3. To specify a text variable value and output data from the conversion table when an input value matches this value, right-click on "Variable value (Drug variable to input list)." and select a text variable from [Select conversion table input variable name.].



4. When the variable value is displayed, drag it into the list on the [Input value] tab.

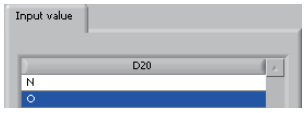


5. When using a value not shown in "Variable value (Drug variable to input list).", right-click on the list on the [Input value] tab and select [Add on input value list.].



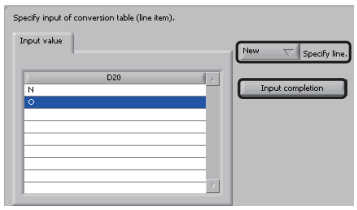
6. Enter an arbitrary value and click the [OK] button.

7. The entered value is shown on the list on the [Input value] tab.

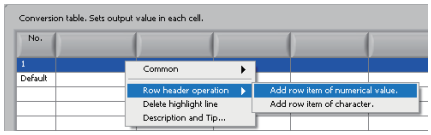


8. After setting the text variable value, select "New" for "Specify line." and click the [Input completion] button.

A row is added to the conversion table.



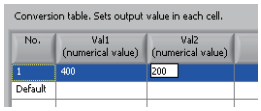
9. Right-click on the header row of the conversion table, then select [Row header operation] ⇨ [Add row item of numerical value.] or [Add row item of character.].



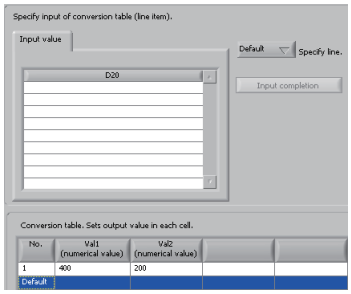
10. Enter a column item name for the conversion table and click the [OK] button.

- The range of numeric values available in column items is '-2147483648.0000' to '2147483647.0000'.
- The range of character strings available in column items is 32.

11. Select a row to define a value, click the cell to define the value, and set the value directly.



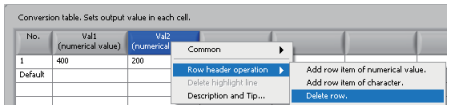
12. In the "Default" row, define a value which is used when the entered value is not matched to the contents set in all rows (list in the [Input value] tab).



Point

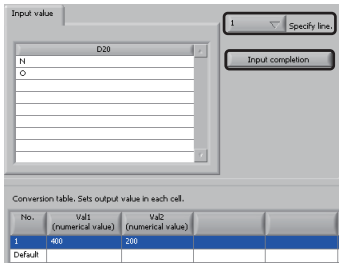
While the "Default" row is selected, the [Input value] tab is not editable.

13. To delete a row, right-click the row and select [Row header operation] ⇨ [Delete row.].



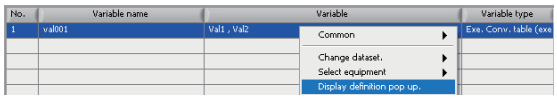
14. To edit setting contents of an added row (list in [Input value] tab), select the row directly on the conversion table, or enter the row number in [Specify line.] to select the row, and edit the contents.

After editing, click the [Input completion] button.



15. After setting is complete, click the [Done] button to register the conversion table.

16. To edit the conversion table again, right-click the variable list while a variable is selected, and select [Display definition pop up.].



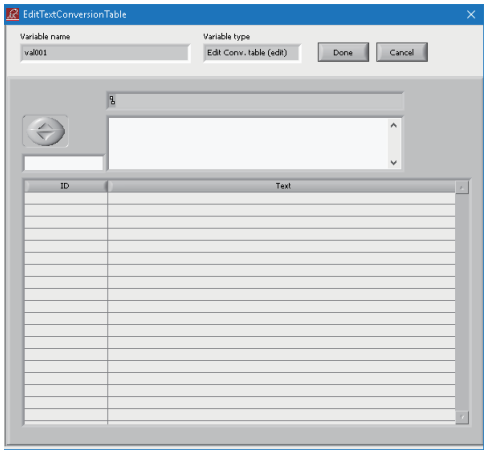
■ Setting up edit conversion table

Operating procedure

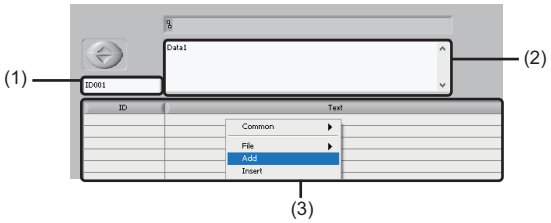
1. Select "Edit Conv. table (edit)" for the variable type.

Enter a character string in "Variable name" (up to 32 characters), and click the [OK] button.

2. Shows the definition screen.

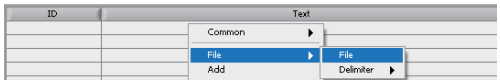


3. Enter an ID (up to 32 characters) and a text (up to 1000 characters), right-click on the ID list, then select [Add] or [Insert].



(1) ID entry area
(2) Text entry area
(3) ID list

4. To read a CSV file for setting, right-click on the ID list and select [File] ⇨ [File] to select the CSV file.

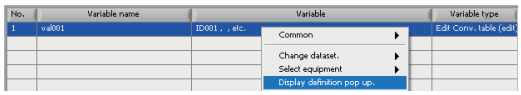


5. "ID" and "Text" are displayed in the ID list.

Point

An added or inserted item can be deleted by selecting it in the ID list, right-clicking it, and then choosing [Delete].

6. After setting is complete, click the [Done] button to register the conversion table.
7. To edit the conversion table again, right-click the variable list while an item is selected, and select [Display definition pop up.].



Point

CSV file must be formatted as follows:
1st column: ID (character string)
2nd column: Text (character string)
No title row

Precautions

When reading a CSV file for setting, do not specify a CSV file in a folder with the encryption attribute enabled as the file source or destination.

21.12 Displaying Data after Running

Shows data read by Reader as well as data registered to a dataset as a result of executing an analysis or diagnostic logic in various forms within a single window.

To use this function, a dataset needs to be configured in advance.

☞ Page 378 Management

Operating procedure

1. Select [Data display after logic execution] ⇨ [Data display after execution (single)].

2. The dataset set in 'Management' is shown in 'Select dataset'.

To change dataset selection, click 'Select Dataset'.

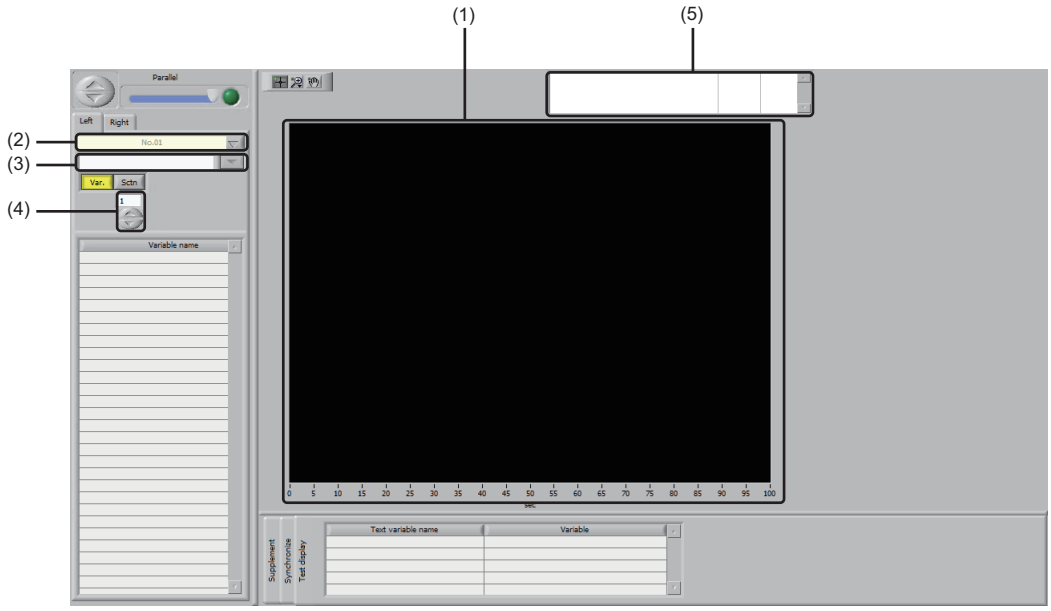
☞ Page 252 Changing dataset

3. Display the data as follows:

- Waveform display (single section) (☞ Page 362 Waveform display (single section))
- Waveform display (single variable) (☞ Page 363 Waveform display (single variable))
- Waveform display (complex) (☞ Page 364 Waveform display (complex))
- Text display (☞ Page 365 Text display)
- Synchronous display (☞ Page 366 Synchronous display)
- Supplemental data display (☞ Page 367 Displaying supplemental data)

Screen configuration

The following shows the screen configuration for displaying data after execution.



Displayed items

Item		Description
(1) Trend graph (waveform) display screen		Shows the waveform. • The vertical axis shows the value of the selected variable. • The horizontal axis shows the number of seconds after the start point. The display status of the waveform currently snapped (grabbed) by the cursor can be switched to hide. ☞ Page 367 Hiding a waveform
[Parallel] button 		Clicking the [Parallel] button arranges multiple variables vertically. This button turns to yellow in the parallel display. Clicking it again cancels the parallel display.
[Left] tab/[Right] tab	—	Specify the variable or section to display the waveform.
	(2) Select dataset	Shows dataset selected in 'Management'. ☞ Page 378 Management The dataset can be changed by clicking it. ☞ Page 252 Changing dataset
	(3) Select variable	 Clicking it allows for selecting a variable.
	[Var.] button	Click this button to display the waveform of a specified variable.
	Variable name*1	Shows the variable name.
	(4) Section	Click  to switch sections (0 to 2147483647).
	[Sctn] button	Click this button to display the waveform of a specified section.
	Start time*2	Shows the start time of the section.
	End time*2	Shows the end time of the section.
[Test display] tab	—	Shows information of the text variable at the cursor position.
	Text variable name	Shows the text variable name.
	Variable	Shows the text variable value.

Item		Description
[Synchronize] tab	—	When the rising or falling time of the waveform is misaligned with that of another waveform, synchronize them. In addition, waveforms can be overlapped by resolving misalignment for each step.
	Sync state variable name	When synchronizing waveforms by specifying a variable name and value, select a step variable.
	Sync state variable value	When synchronizing waveforms by specifying a variable name and value, specify a step variable value.
	Order for the same variable value	When the same step variable value occurs repeatedly within a section, specify which one to use (1 to 2147483647).
	[Synchronizes with cursor snap point.] button	Click this button to synchronize waveforms at the point specified by the cursor. The cursor must be visible in the trend graph (waveform) display screen. Waveforms are synchronized at the point in the X-axis direction where each waveform first crosses the Y value specified by the cursor.
	[Sync. by val.] button	Click this to perform synchronization by using entered value (-2147483648.0000 to 2147483647.0000). While this button is clicked (shown in yellow), waveforms are synchronized automatically even when waveforms or sections are switched. However, synchronization at the point specified by the cursor is disabled. Clicking this button cancels its selection. Waveforms are synchronized at the point in the X-axis direction where each waveform first crosses the entered Y value.
[Supplement] tab	—	Shows information on a single point or between two points on a waveform snapped to the cursor.
	V-differ	Shows the difference between the first and second cursors (absolute value) in the Y axis. The value changes only when two cursors are shown.
	H-differ	Shows the difference between the first and second cursors (absolute value) in the X axis. The value changes only when two cursors are shown.
	Y coordinates -1	Shows the value in the Y axis for the first cursor.
	Y coordinates -2	Shows the value in the Y axis for the second cursor. This item is shown only when two cursors are shown.
	Left EQ	Shows the fixed string "UNIT".
	Right EQ	Shows the fixed string "UNIT".
	Left alias	Unused area.
	Right alias	Unused area.
	Cursor snap time	Shows the time of the point snapped by the cursor. • Upper display area: Time of the point snapped by the first cursor • Lower display area: Time of the point snapped by the second cursor
(5) Cursor legend		The legend of the waveform currently snapped (grabbed) by the cursor can be displayed. Effective while the cursor is shown on the chart. For showing or hiding the cursor, refer to the following: ☞ Page 177 Show and Hide Cursor

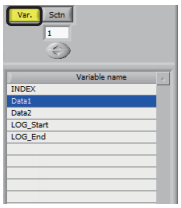
*1 Shown when the [Var.] button is clicked.
*2 Shown when the [Sctn] button is clicked.

Waveform display (single section)

Shows the waveform for a single section of a selected variable.

Operating procedure

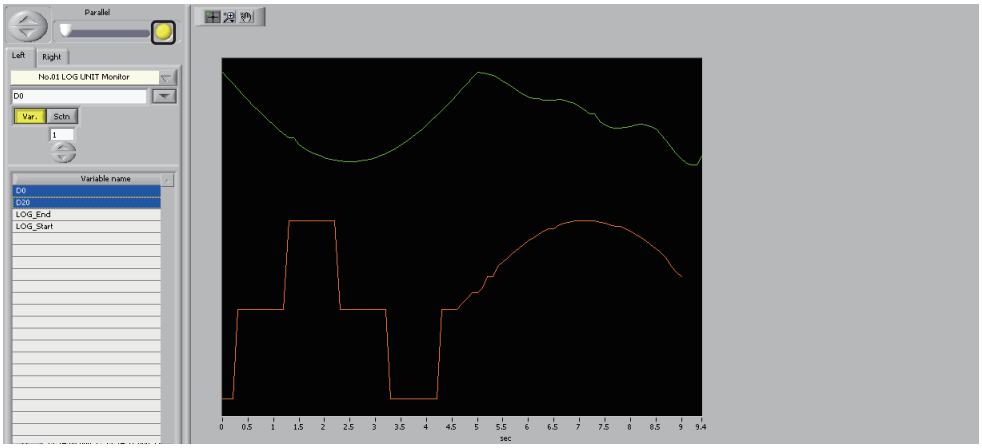
1. Click the [Var.] button and select a variable from the variable name list. (Multiple selections allowed.)



2. Click to change a section to be displayed (0 to 2147483647).

3. By clicking the [Parallel] button while multiple variables are selected, the variables are displayed vertically.*1

*1 Values in Y axis (left axis) and cursor will not be displayed.



By operating the slider of parallel display, the position of displayed waveforms can be shifted.

- Slider is positioned at the center: Waveforms before applying the parallel display are displayed.
- Slider is positioned a location other than the center: Waveforms displayed in parallel are shifted vertically.

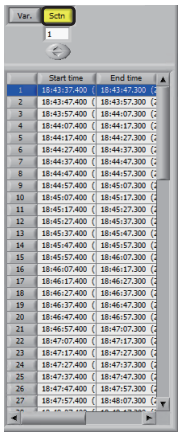
When the slider is positioned at the leftmost or rightmost, the up and down of waveforms displayed in parallel are reversed.

Waveform display (single variable)

The waveform of a single variable in the selected section is shown.

Operating procedure

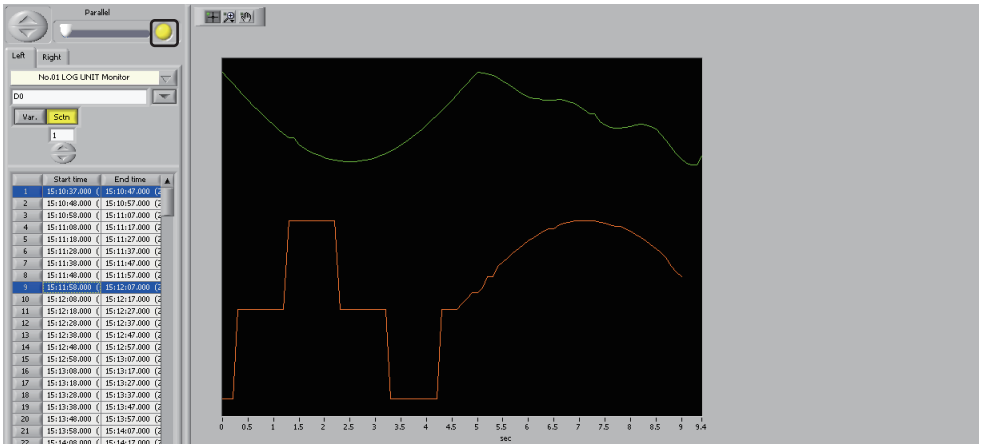
1. Click the [Sctn] button and select a section. (Multiple selections allowed.)



2. Click [▼] to change variable to be displayed.

3. By clicking the [Parallel] button while multiple variables are selected, the variables are displayed vertically.*1

*1 Values in Y axis (left axis) and cursor will not be displayed.



By operating the slider of parallel display, the position of displayed waveforms can be shifted.

- Slider is positioned at the center: Waveforms before applying the parallel display are displayed.
- Slider is positioned a location other than the center: Waveforms displayed in parallel are shifted vertically.

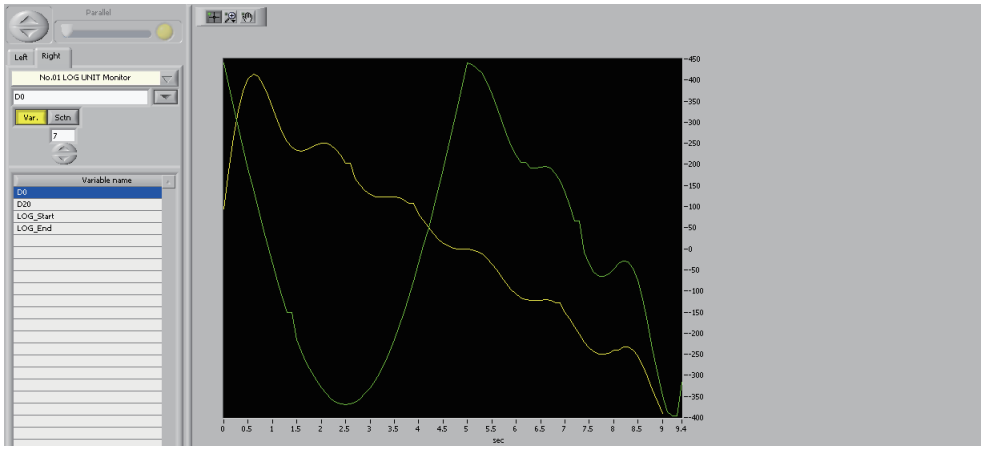
When the slider is positioned at the leftmost or rightmost, the up and down of waveforms displayed in parallel are reversed.

Waveform display (complex)

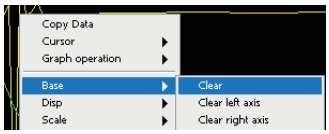
Shows two waveforms by overlapping them.

Operating procedure

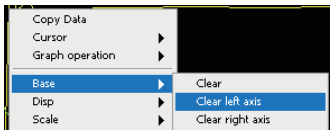
1. Select the [Right] tab and configure settings similarly to those on the [Left] tab to display waveforms overlapped.



2. By right-clicking the trend graph (waveform) display screen and selecting [Base] ⇨ [Clear], the selection of variables in the [Right] and [Left] tab will be canceled.



3. By selecting [Base] ⇨ [Clear right axis], the selection of variables in the [Right] tab will be canceled. By selecting [Base] ⇨ [Clear left axis], the selection of variables in the [Left] tab will be canceled.



Point

Settings on the [Left Axis] and [Right Axis] tab are reflected on the left and right sides of the Y-axis, respectively, in the trend graph (waveform) display screen.

Text display

Shows information of the text variable at the cursor position.

Operating procedure

1. Display the cursor in the trend graph (waveform) display screen.

For showing the cursor, refer to the following:

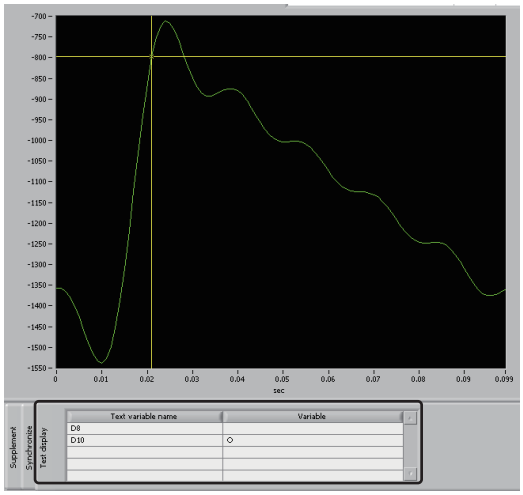
☞ Page 177 Show and Hide Cursor

2. Click in the trend graph (waveform) display screen.

The cursor moves to the point where the clicked point intersects with the waveform. Information of the text variable at that point is shown in the [Test display] tab.

For the display contents, refer to the following:

☞ Page 360 Screen configuration



3. By right-clicking on the trend graph (waveform) display screen and selecting [Cursor] ⇨ [Delete], all cursors in a graph will be deleted.

Synchronous display

A synchronization is performed between different variables selected in the [Left] tab or between the same variables in different sections of variables selected in the [Left] tab.
When the rising or falling time of the waveform is misaligned with that of another waveform, they can be synchronized.
In addition, waveforms can be overlapped by resolving misalignment for each step.
The following synchronization methods are available:

- Synchronize by a variable name and value
- Synchronizes at cursor snap point
- Synchronize by value

Operating procedure

1. Set items in the [Synchronize] tab.

For details on setting items, refer to the following:

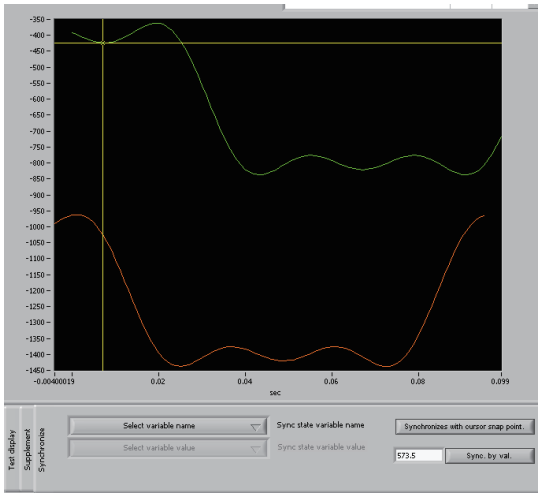
☞ Page 360 Screen configuration

Items to set differs depending on the synchronization method.

- Synchronizing by a variable name and value: Set the settings for "Sync state variable name", "Sync state variable value", or "Order for the same variable value".
- Synchronizes with cursor snap point.: Click the [Synchronizes with cursor snap point.] button while snapping a waveform with the cursor.
- Sync. by val.: Enter a value (-2147483648.0000 to 2147483647.0000) and click the [Sync. by val.] button.

2. Waveforms are overlapped according to the specified method.

When waveforms are synchronized by a variable name and value, they are shifted in the X-axis direction to align the step change times.
When waveforms are synchronized by a point specified by the cursor or by a value, they are shifted in the X-axis direction so that they pass the same Y value.



Displaying supplemental data

Shows information at the point or between two points on the waveform snapped to the cursor in the [Supplement] tab.

Operating procedure

1. Display the cursor in the trend graph (waveform) display screen.

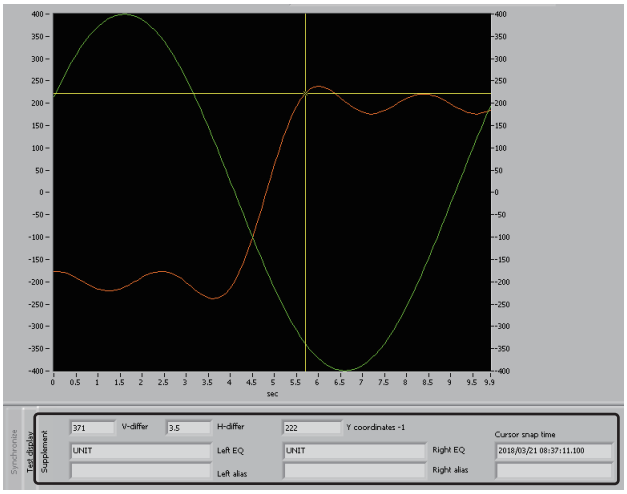
For showing the cursor, refer to the following:

☞ Page 177 Show and Hide Cursor

2. Information is shown on the [Supplement] tab.

For the display contents, refer to the following:

☞ Page 360 Screen configuration



Hiding a waveform

The display status of the waveform snapped (grabbed) by the cursor can be switched to hide.

Operating procedure

1. Right-click on the display screen and select [Clear snapped waveform].

Point

When redisplaying a waveform, perform the following operations:

- When the [Var.] button has been clicked:
  Select the variable corresponding to the hidden waveform. (When hiding a waveform, the corresponding section will be unselected in the section list.)
- When the [Sctn] button has been clicked:
  Select the section corresponding to the hidden waveform. (When hiding a waveform, the corresponding section will be unselected in the section list.)

21.13 Displaying a Result of Simple diagnosis

The diagnosis results of 'SPC', 'multivariate analysis (single central value format)', or 'guard band' in process are displayed.
☞ Page 188 SPC, Page 204 Multivariate Analysis (Single Central Value Format), Page 211 Guard Band Diagnosis

Operating procedure

1. Select [Diagnostics result display] ⇨ [Simple diagnosis result display].
2. Display the diagnosis result by clicking one of the following buttons:

- [Trend] button (☞ Page 371 Displaying trend chart)
- [Beep] button (☞ Page 372 Beep)
- [Total] button (☞ Page 374 Displaying aggregated data)
- [Log] button (☞ Page 375 Viewing log)

Screen configuration

The following shows the screen configuration for displaying the result of simple diagnosis.

For the screen configuration when clicking the [Trend] button, [Beep] button, [Total] button, or [Log] button, refer to:

☞ Page 371 Displaying trend chart
☞ Page 372 Beep
☞ Page 374 Displaying aggregated data
☞ Page 375 Viewing log

Displayed items

Item	Description
Diag-name	Shows the name of the simplified diagnosis currently in progress. For a diagnosis for which a filtering text has been specified, a diagnosis name can be displayed by specifying a filtering text and its name. Shows error information related to the selected diagnosis name. When nothing is selected, error information for all displayed diagnosis name is displayed.
[Trend] button	Shows a trend chart. ☞ Page 371 Displaying trend chart
[Beep] button	If an error is detected in diagnosis started with simple diagnosis, a log will be displayed and the pop-up window will be displayed. ☞ Page 372 Beep
[Total] button	Selects aggregated data for the selected equipment, unit, or period. ☞ Page 374 Displaying aggregated data
[Log] button	Shows the log. ☞ Page 375 Viewing log
[ALL] button*1	Shows the results of all simple diagnoses.
[GB] button*1	Shows the result of simple diagnosis related to a guard band.
[SPC] button*1	Shows the result of simple diagnosis related to SPC.
[MVA] button*1	Shows the result of simple diagnosis related to multivariate analysis (single central value format).
[Log CSV] button	Output a determination result for a section in which the one or more number of diagnoses is displayed in the log screen and the detailed information to a CSV file. ☞ Page 375 Viewing log For the path of a file to be output, up to 255 characters (two characters are used for a double-byte character) including the extension can be specified.

*1 It cannot be selected while the [Beep] button is clicked.

The other items are the same as those described in the following section.

☞ Page 165 Screen configuration

Note that the following items are not included.

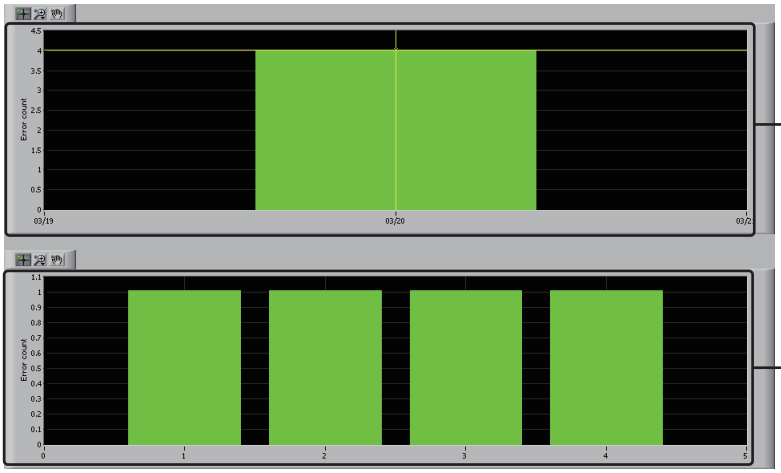
- [Save] button
- [Read] button
- [Multi] button
- [Overlay] button
- [CV] button
- [FLT] button
- [3D] button
- [CSV for matrix] button
- [Lock] button
- [Scl-fit.] button
- [Max] button
- [Min] button
- [Ave] button
- [Range] button
- [Center] button
- [Sigma] button
- [Parallel] button
- Histogram
- [Var.] tab
- [EQ Def] tab
- Up/Down/Left/Right button

Displaying trend chart

Shows a trend chart.

Operating procedure

1. Click the [Trend] button.
2. A trend chart is shown.



Item	Description
(1) Error count display screen (per day)	Shows the number of error occurrences per day as a trend chart. Snap the cursor to a day to show the trend chart of error occurrences per section of that day in the error count display screen (per section on that day).
(2) Error count display screen (per section on that day)	Shows the number of error occurrences on the selected day as a trend chart.

3. Snap the cursor to a section to show the text information related to that section.

Point

While the text information for the section is displayed, click the [Sctn] button to show the section list with the section selected.

☞ Page 171 Selecting section list

4. Clicking the [Update] button updates the display contents to the data of the latest time.

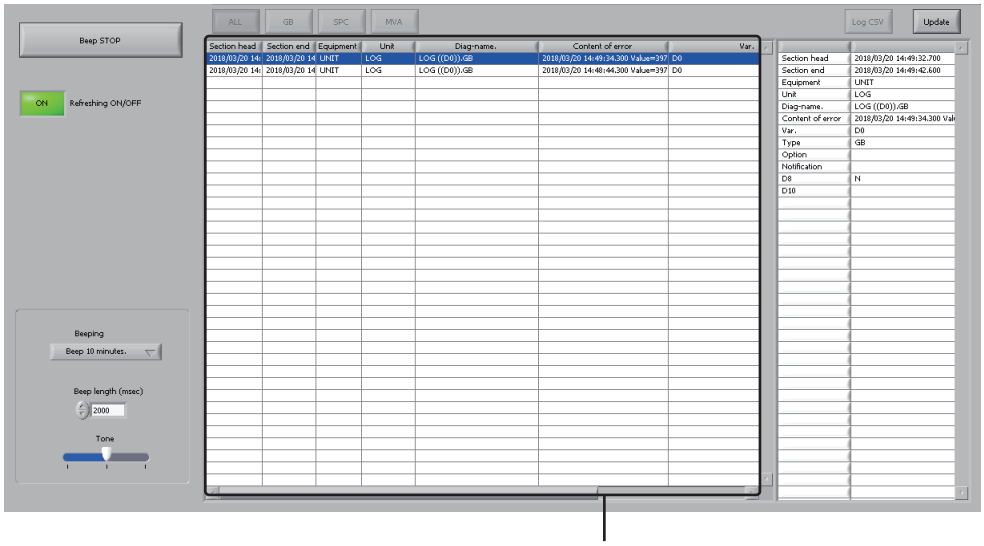
Beep

If an error is detected in diagnosis started with simple diagnosis (SPC, multivariate analysis (single central value format), or guard band), a log is displayed and a beep sounds. The pop-up window is also displayed.

Operating procedure

1. Click the [Beep] button.
2. When an error is detected during the simplified diagnosis, a log is shown at the top of the log list. (When "Refreshing ON/OFF" is set to "ON")

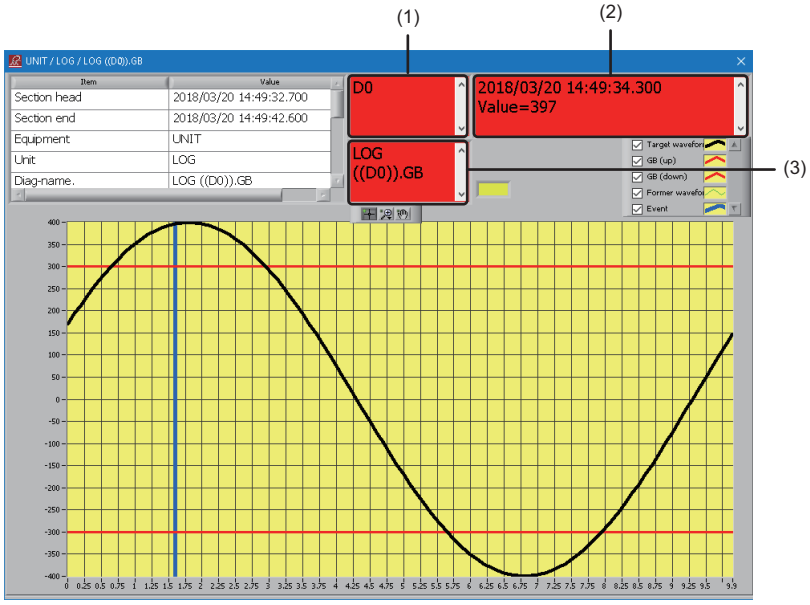
In addition, the beep sound is generated according to the setting of "Beeping".



Item	Description
(1) Log list	Shows the log related to the error.
Beep STOP	Stops the beep sound.
Refreshing ON/OFF	Switches ON and OFF of refresh. When switching to "OFF", updating the list stops and a beep sound stops. In addition, the pop-up window display stops. (Diagnosis itself continues.)
Beeping	Specify the time to sound the beep tone. The beep tone sounds once when the setting has been changed.
Beep length (msec)	Specify the length of the beep sound (1 to 10000 milliseconds).
Tone	Specify the tone of the beep.

3. Clicking the [Update] button updates the display contents to the data of the latest time.

4. The pop-up window appears at the same time when a log is displayed on the top in the log list.



(1) Shows the variable name.
(2) Shows error occurrence time and error value
(3) Shows the diagnosis name.

Point

- Up to 2000 lines are shown for a single log. Starting Analyzer clears the log.
- The pop-up window also appears when a log is selected in the log list.

Precautions

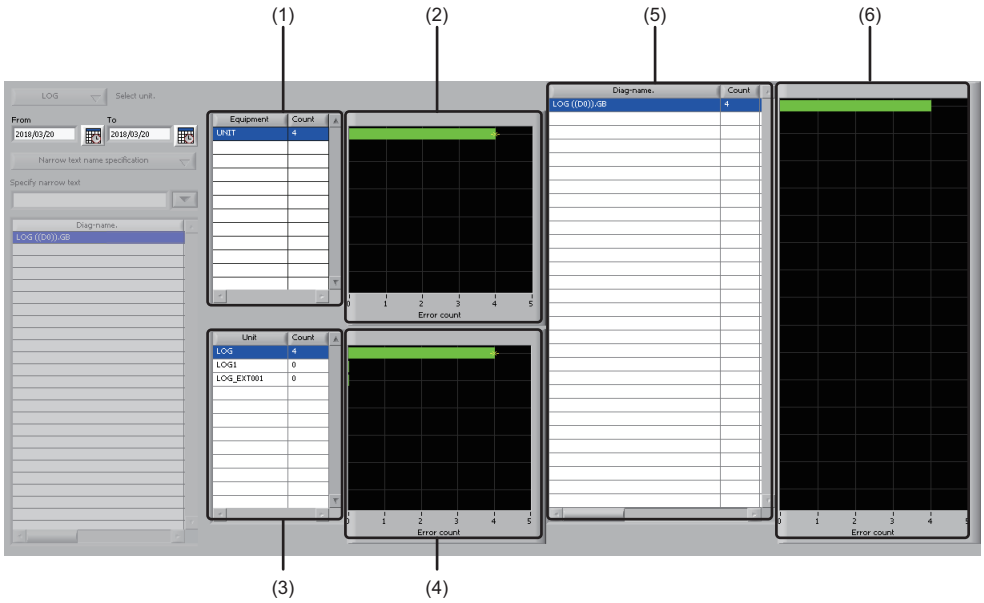
- Error information detected while "Refreshing ON/OFF" is set to "OFF" is not reflected on the log list even when the [Update] button is clicked.
- If an error is detected during data reading on a first section since an SPC or a multivariate analysis (single central value format) has been started, a waveform to be diagnosed will not be displayed in the pop-up window (because the waveform to be displayed is only one).

Displaying aggregated data

Displays aggregated data of the equipment, unit, and diagnosis name for a period specified for "From" and "To".

Operating procedure

1. Click the [Total] button.
2. Aggregated data of the equipment, unit, and diagnosis name is shown.



Item	Description
(1) Equipment list	Displays the equipment list.
(2) Error occurrences display area (per equipment)	Shows error occurrences per equipment.
(3) Unit list	When a device is selected in the equipment list, the unit defined for that device is shown.
(4) Error count display area (per unit)	Shows the number of error occurrences per unit.
(5) Diagnosis name list	When a unit is selected from the unit list, the name of diagnosis currently performed on the unit is shown.
(6) Error count display area (per diagnosis name)	Shows the number of error occurrences per diagnosis name.

3. Clicking the [Update] button updates the display contents to the data of the latest time.

Point

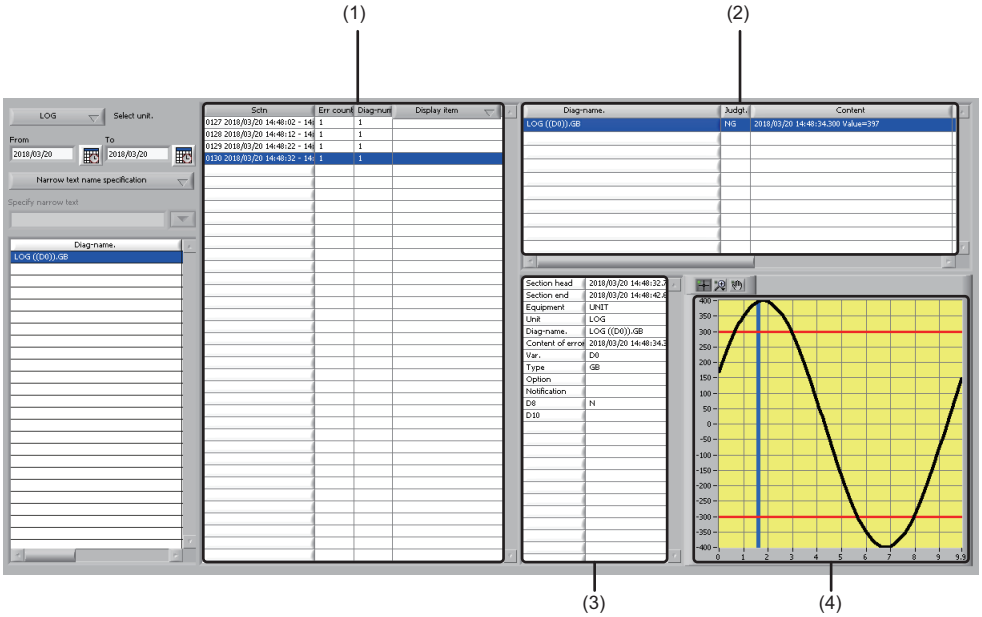
When diagnosis is stopped, the diagnosis name disappears. When the [Update] button is clicked in this state, the count shown for each diagnosis name disappears and the equipment and unit counts are rest to '0'.

Viewing log

Shows the log.

Operating procedure

1. Click the [Log] button.
2. The log is displayed.



Item	Description
(1) Log list	Logs are displayed.
(2) Diagnosis contents	The list of diagnoses performed in a section selected in the log list is displayed.
(3) Detailed information	Detailed information is displayed when selecting a row that "NG" is selected for "Judgt." in the diagnosis contents.
(4) Waveform when an error occurs	A waveform when an error occurs is displayed when selecting a row that "NG" is selected for "Judgt." in the diagnosis contents. For a guard band, the horizontal axis of a waveform represents the section length. For multivariate analysis (single central value format) and SPC, it represents past sections (up to 30 sections).

3. Clicking the [Update] button updates the display contents to the data of the latest time.

Point

When diagnosis is stopped, "Error Count" and "Diag-num." on the error information row in the log list changes to '0'. When diagnosis is resumed, data before it was stopped is shown again.

Precautions

If an error is detected during data reading on a first section since a multivariate analysis (single central value format) and SPC have been started, a waveform to be diagnosed will not be displayed in 'Waveform when an error occurs' (because the waveform to be displayed is only one).

21.14 Displaying a Diagnostic Logic Result

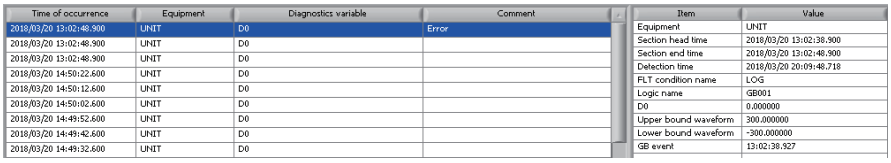
Shows the log written by the logics listed below.

Logic	Description	Reference
Enhanced trace GB	Log when a guard band error was detected.	Page 315 Enhanced trace GB
SPC diagnostics	Log when an error was detected with the SPC rule.	Page 325 SPC diagnostics
Write log and error notification	Output contents configured by the 'Write log and error notification' logic.	Page 339 Write log and error notification

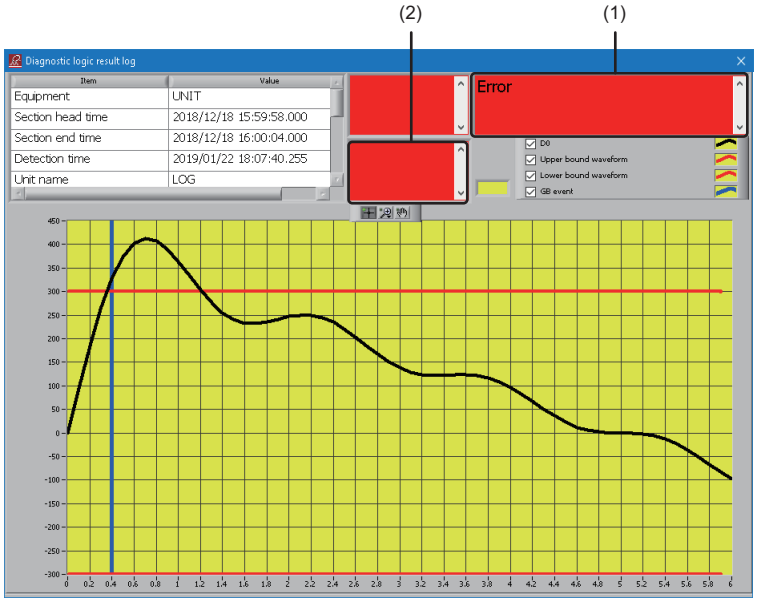
Operating procedure

1. Select [Diagnostics result display] ⇨ [Diagnostic logic result display].

Logs are shown in the log list.



2. The log is updated at an interval set for "Refreshing cycle (sec)", and the latest pop-up window appears at the same time.



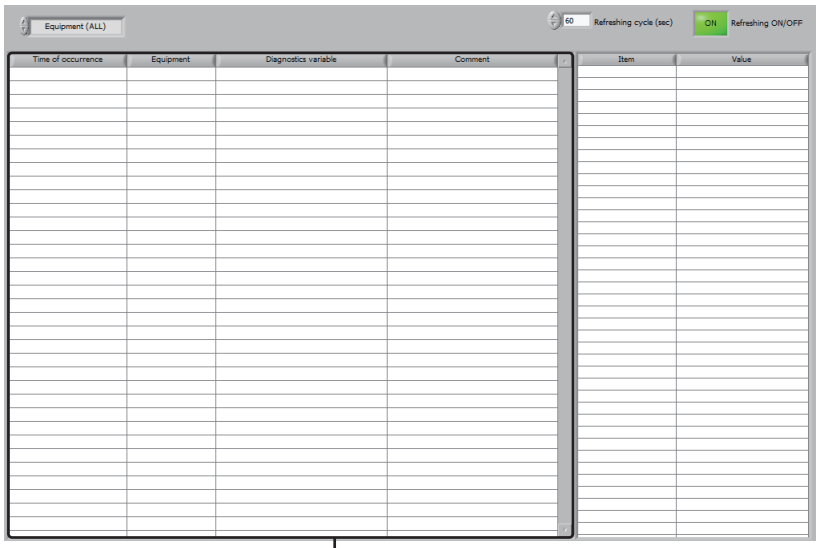
(1) Shows a comment entered in the configuration item "Comment" of the primitive 'Enhanced trace GB' or 'Write log and error notification'. For the primitive 'SPC diagnostics', the SPC rule that detected an error first among the SPC rules on the list is shown.
(2) Shows the logic comment entered in "Logic comment" of 'Logic editing'.

Point

- Up to 1000 logs are displayed.
- The pop-up window is also displayed when selecting a log in the log list.
- The contents displayed in "Item" excluding a text variable and a diagnosis name and "Value" corresponding to "Item" in the pop-up window are displayed in "Item" and "Value" in the screen of 'Diagnostic logic result display'.

Screen configuration

The following shows the screen configuration for displaying the diagnostic logic result.



Displayed items

Item		Description
(1) Log list	—	An output log is displayed.
	Time of occurrence	Shows the time when the log occurred.
	Equipment	Shows the "UNIT".
	Diagnostics variable	Shows the diagnosis target variable name.
	Comment	For the primitive 'Enhanced trace GB' or 'Write Log and Notify Error', text entered in the setting item "Comment" is shown. For the primitive 'SPC diagnostics', the SPC rule among the SPC rules on the list that detected an error first is shown.
Item		The contents displayed in "Item" in the pop-up window excluding a text variable and a diagnosis name are displayed.
Value		The contents displayed in "Value" corresponding to "Item" in the pop-up window excluding a text variable and a diagnosis name are displayed.
Refreshing cycle (sec)		Set the interval to update a log to the latest one (10 to 3600 seconds). It is set to 60 seconds by default.
Refreshing ON/OFF		Switches ON and OFF of refresh. The default is "ON". When set to "OFF", the log list is not automatically updated at the interval specified in "Refreshing ON/OFF".

21.15 Management

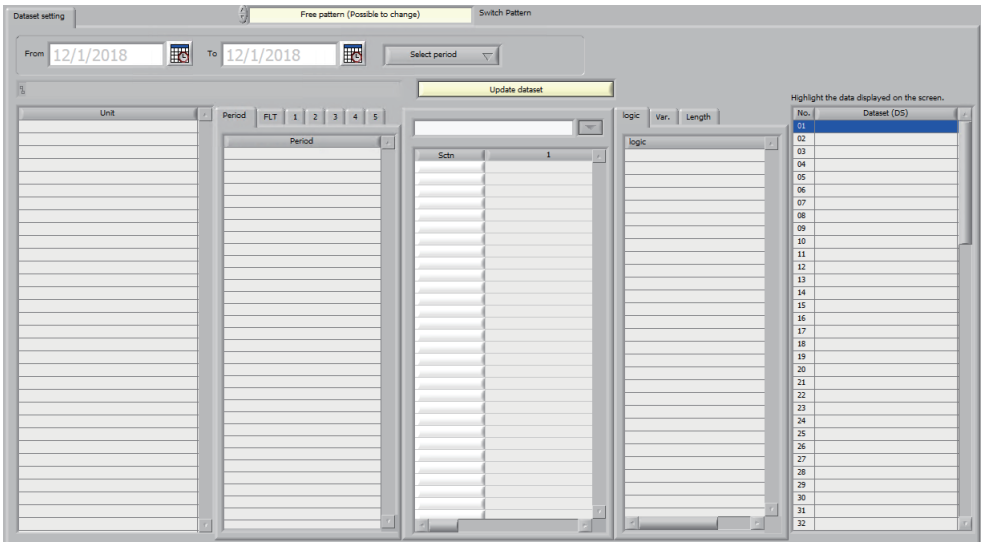
Configures dataset settings.
When analyzing data read by Reader or data waveforms after logic execution in detail in 'Data display after execution' or cooperating with Monitor, dataset settings must be configured in advance.
☞ Page 359 Displaying Data after Running

Operating procedure

1. Select [Management] ⇨ [Dataset].
2. Register the dataset.
☞ Page 380 Registering dataset
3. Set a period and section according to the screen configuration.
☞ Page 379 Screen configuration
4. Data which is no longer necessary can be deleted from the dataset setting.
☞ Page 381 Deleting data from dataset
5. A dataset which was registered by mistake or is no longer necessary can be canceled.
☞ Page 382 Canceling dataset

Screen configuration

The following shows the screen configuration for setting a dataset.



Displayed items

Item		Description
From/To		Specify the period for data to display. To display data for the period set by this item, click the [Select period] button and select "Specify date".
[Select period] button		Select the period for data to display from the following: • 10 days recently • 20 days recently • 30 days recently • Specify date • Release specification When the period is specified, the background of "From" and "To" becomes blue. When the period is not specified or "Release specification" is selected, the background of "From" and "To" becomes white and the entire period is shown.
[Update dataset] button		If the up-to-date data read by Reader is not shown, click to update display.
Unit		Shows all units registered in the specified folder.
[Period] tab	Period	When a unit is selected in "Unit", a data period registered in the unit is shown, one day per one line. Select the period shown on related screens.
[FLT] tab	—	Filters the section shown using a text variable value. Sections filtered by the text variable values selected in "Text" on the [1] to [5] tabs are shown in "Sctn".
	Filtering type	Select "AND" or "OR". • AND: Filters sections into those which satisfy all of the text variable values selected in "Text" on the [1] to [5] tabs. • OR: Filters sections into those which satisfy any one of the text variable values selected in "Text" on the [1] to [5] tabs.
	Text name	Select (up to five) text variable names used to filter sections.
[1] to [5] tabs	—	Text variable values selected in "Text name" on the [FLT] tab are shown in order from the [1] to [5] tabs.
	Text	Shows the text variable value.
	#	Shows the number of items for each text variable value.
Sctn		Shows sections in the period selected in "Period". The section name indicates the start time extracted by Reader, or the start time of the text variable. When text variables are selected in "Text name" on the [FLT] tab, the text variable values are shown in order from the "1" column.
[logic] tab	logic	Shows the logic run during the period selected in "Period" and on the section selected in "Sctn". Selecting a logic shows the execution result of that logic. A logic can be executed for a selected period or section.

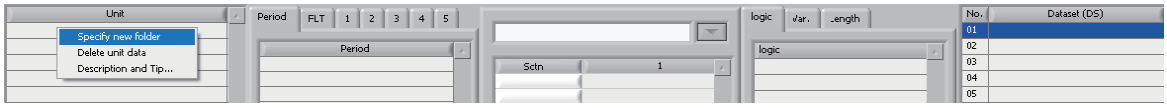
Item		Description
[Var.] tab	Variable name	Shows variable information (variable name, data type, description, and ID) included in data registered to the unit. When a logic is selected in "logic", names of variables output by the logic are also shown.
[Length] tab	Start time	Shows the start time of each section registered to the unit.
	Length	Shows the section length (in seconds) in the section data registered to the unit.
	Interval	An interval (second) from the end time of the previous section to that of this section is displayed.
Switch Pattern		Switches to a dataset pattern registered in advance. The upper-level folder name of a folder set for 'RSD dataset folder' in Reader is automatically registered as a pattern name when restarting Analyzer. By selecting this pattern name in this item, a dataset with all units included in 'RSD dataset folder' are expanded is displayed A pattern can be registered by selecting items for "Unit", "Period", and "Sctn" and right-clicking on the display area of "Dataset (DS)" and selecting [Register pattern].
Dataset (DS)		Shows the list of dataset names. The dataset name is shown in the format 'unit name_UNIT'. The dataset selected in this item is shown on related screens.

Registering dataset

Register a dataset.

Operating procedure

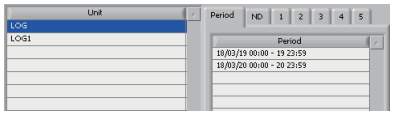
1. Select a blank line in "Dataset (DS)".
2. Right-click in "Unit" and select [Specify new folder].



3. Specify the 'UNIT' folder specified in 'RSD dataset folder' in Reader.

☞ Page 128 Folder Definition

4. The dataset of the unit read by Reader is registered.



Deleting data from dataset

Delete data from the dataset settings.

The following data can be deleted.

- Unit data (☞ Page 381 Deleting unit data)
- Unit data within a section (☞ Page 381 Deleting unit data within period)
- Data generated by a logic (☞ Page 381 Deleting data generated by logic)

To delete data, selecting the checkbox of "Enable data deletion from the data set screen." in 'Data management setting' is required in advance.

☞ Page 383 Data Management Setting

Point

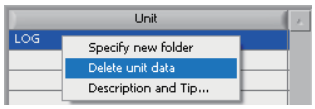
- A unit and a logic itself are not deleted.
- Data is deleted per period. Deletion per section is not available.

■ Deleting unit data

Operating procedure

1. Right-click a unit in "Unit", then select [Delete unit data].

Data of the selected unit is deleted.

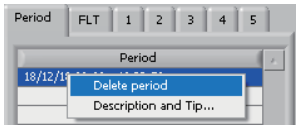


■ Deleting unit data within period

Operating procedure

1. Right-click a data period in "Period" and select [Delete period].

Data of the unit within the selected period is deleted.

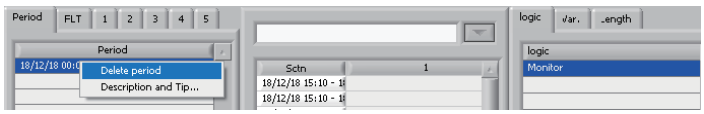


■ Deleting data generated by logic

Operating procedure

1. Select a logic in "Logic", then right-click in "Period" and select [Delete period].

Output data of the selected logic is deleted. Collected data is not deleted.



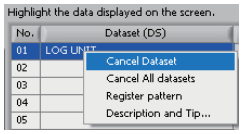
Canceling dataset

Cancel a dataset which was registered by mistake or is no longer necessary.

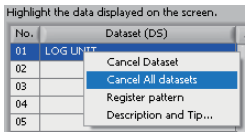
Operating procedure

1. Right-click a dataset in "Dataset (DS)" and select [Cancel Dataset].

The selected dataset is canceled.



2. To cancel all datasets in batch, right-click a dataset in "Dataset (DS)" and select [Cancel All datasets].



Point

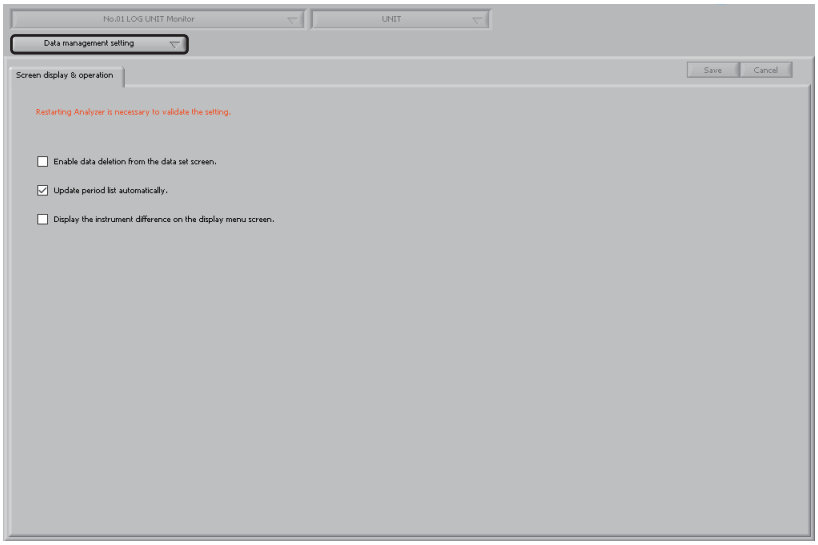
[Cancel Dataset] or [Cancel All datasets] does not delete the data itself but just deletes dataset definition(s).

21.16 Data Management Setting

Configures settings related to data management.

Operating procedure

1. Select [Option] ⇨ [Setting].
2. Select "Data management setting".
3. Set each item and click the [Save] button.



Item	Description
Enable data deletion from the data set screen.	A unit and its data selected for "Unit" in the operation screen of 'Management', or data of a period selected for "Period" can be deleted. ☞ Page 378 Management
Update period list automatically.	It must be selected.
Display the instrument difference on the display menu screen.	By selecting this checkbox, shows the [EQ Def] tab is displayed in the operating screens of 'Read data display' or 'Read data statistics display' and the data of different units can be displayed simultaneously. ☞ Page 164 Displaying Read Data ☞ Page 179 Displaying Read Data Statistics

Precautions

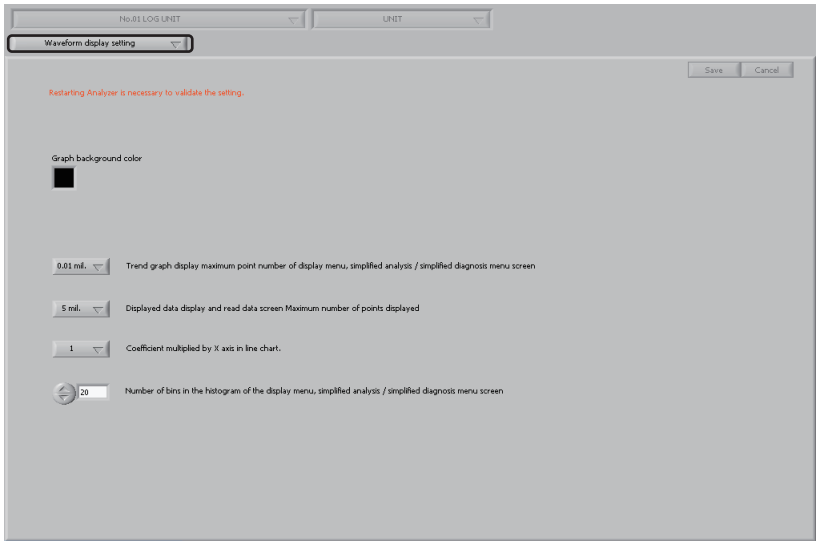
Analyzer must be restarted to reflect the changes in 'Data management setting'.

21.17 Waveform Display Setting

Configures settings related to waveform display.

Operating procedure

1. Select [Option] ⇨ [Setting].
2. Select "Waveform display setting".
3. Set each item and click the [Save] button.



Item	Description
Graph background color	Sets the background color of a graph displayed in the screen.
Trend graph display maximum point number of display menu, simplified analysis / simplified diagnosis menu screen	Sets the upper limit of the number of points in a trend graph displayed in the operation screen for the [Disp] menu ('Read data', 'Read data statistics', and 'Read data frequency') and the [Simple analysis - Simple diagnosis] menu ('SPC', 'MVA (Single central value format)', and 'Guard band'). ☞ Page 164 Displaying Read Data ☞ Page 179 Displaying Read Data Statistics ☞ Page 182 Displaying Read Data Frequency ☞ Page 188 SPC ☞ Page 204 Multivariate Analysis (Single Central Value Format) ☞ Page 211 Guard Band Diagnosis
Displayed data display and read data screen Maximum number of points displayed	Sets the upper limit of the number of points displayed in the operating screen of 'Data display after logic execution' and 'Read data display'. ☞ Page 359 Displaying Data after Running ☞ Page 164 Displaying Read Data
Coefficient multiplied by X axis in line chart.	Specifies how much the time axis of the original data should be multiplied in the operation screen of 'Data display after logic execution'. ☞ Page 359 Displaying Data after Running
Number of bins in the histogram of the display menu, simplified analysis / simplified diagnosis menu screen	Sets the number of histogram bins (10 to 100) in the operation screen for the [Disp] menu ('Read data', 'Read data statistics', and 'Read data frequency') and the [Simple analysis - Simple diagnosis] menu ('SPC', 'MVA (Single central value format)', and 'Guard band'). ☞ Page 164 Displaying Read Data ☞ Page 179 Displaying Read Data Statistics ☞ Page 182 Displaying Read Data Frequency ☞ Page 188 SPC ☞ Page 204 Multivariate Analysis (Single Central Value Format) ☞ Page 211 Guard Band Diagnosis

Precautions

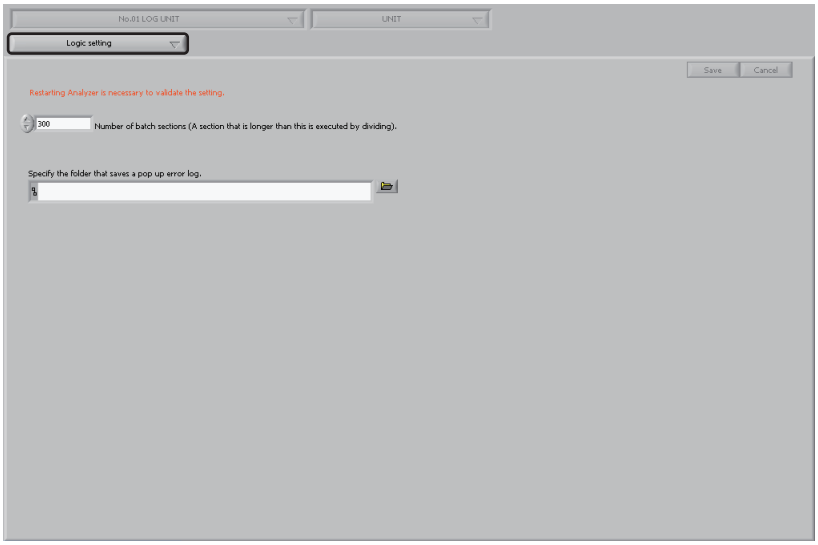
- Analyzer must be restarted to reflect the changes to the waveform display settings.
- When the upper limit of the number of display points is exceeded, an error is output and chart display is interrupted.

21.18 Logic Setting

Configures settings related to logic.

Operating procedure

1. Select [Option] ⇨ [Setting].
2. Select "Logic setting".
3. Set each item and click the [Save] button.



Item	Description
Number of batch sections	Do not use this.
Specify the folder that saves a pop up error log.*1*2	Sets save destination (up to 256 characters) for a log when the pop-up window appears by performing a logic manually in 'Logic editing'. ☞ Page 250 Editing Logics

*1 Do not specify a folder with the encryption attribute enabled.

*2 Set it so that the path length of a file to be saved does not exceed 259 characters. The maximum path length of a pop up error log is as follows:
(Set folder)\ + 49 characters (if the logic name is 32 characters long)

Precautions

Analyzer must be restarted to reflect the changes to the logic settings.

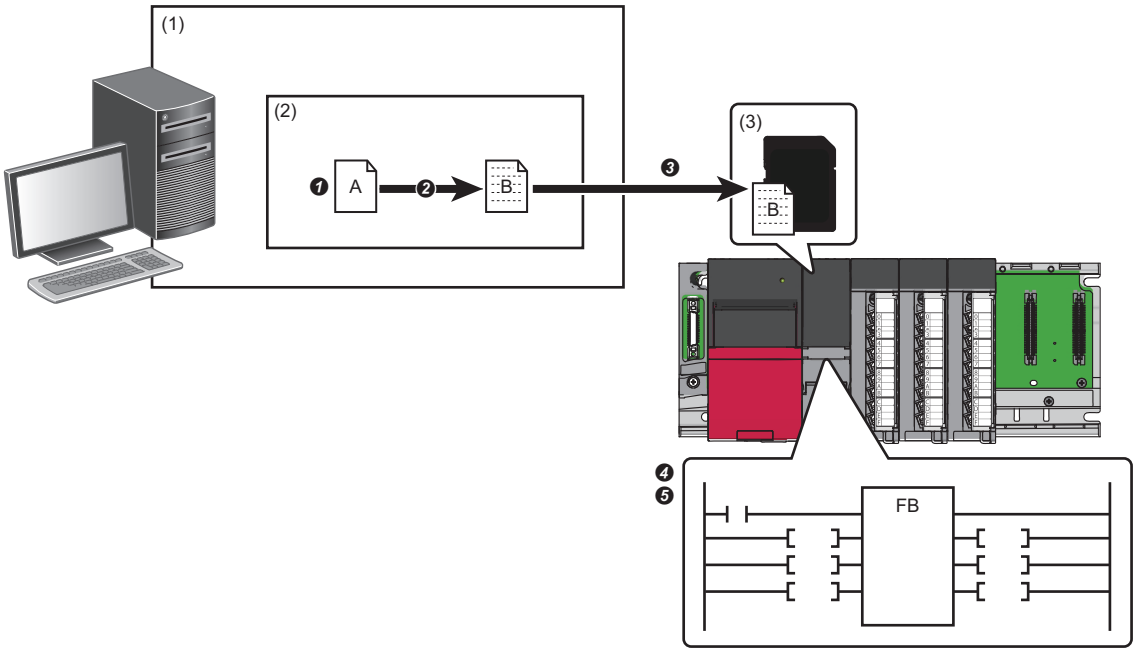
21.19 Programmable Controller CPU Cooperation Function

This function is for diagnosing data on a programmable controller CPU in real time using the result of offline analysis created in Real-time Statistic Diagnosis Tool.

☞ Page 211 Guard Band Diagnosis, Page 238 Multiple Regression Analysis (LMR), Page 245 Maharanobis - Taguchi method (MT)

Guard band diagnosis

To use the result of offline analysis created in a guard band diagnosis in a programmable controller CPU, follow the procedure below.



(1) Industrial PC
(2) Real-time Data Analyzer
(3) SD memory card
A: Guard band
B: Guard band file (.PGB)

❶ Create a guard band. (☞ Page 216 Creating guard band)

❷ Save the guard band in the programmable controller format (.PGB). (☞ Page 217 Saving the guard band)

❸ Write the guard band file (.PGB) to an SD memory card. (☞ Page 388 Writing to an SD memory card)

❹ Execute the Real-time Data Analyzer data linkage FB. (☞ Page 389 Execution of Real-time Data Analyzer data linkage FB)

❺ Execute the data analysis FB (guard band diagnosis FB). (☞ Page 391 Executing the data analysis FB (guard band diagnosis FB))

Precautions

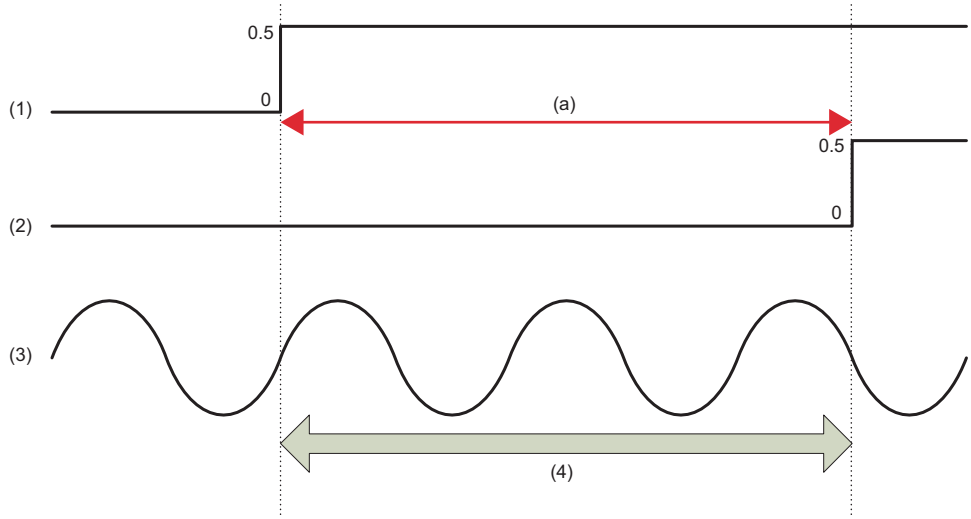
- For the temporary license, a guard band cannot be saved in the programmable controller format.
- To save a guard band in the programmable controller format, the data interval and length (number of units of data) of the guard band need to be the same as that of the waveform to be diagnosed by an FB. In that case, perform the following operations.

❶Set the sampling interval of a CSV file to be read in Reader to the same as the collection interval of the waveform data to be diagnosed by an FB, and write it to a file register (ZR).

❷Configure the settings for sections or extended sections in Reader so that the length of each section becomes constant, and then set the length (number of units of data) of a guard band to be created to the same as the data length (number of units of data) of the waveform to be diagnosed by the FB.

(Example) Prepare variables to detect the start and end of a section as the collection targets, and extract sections so that the length of each section between its start and end becomes constant.

To prepare the following variables A and B for detecting the start and end of a section, configure the section start and end conditions by setting "Numeric" in "Starting condition type"/"End condition type", "UP(Less than TO greater than or equal)" in "Operator", and "0.5" in "Comparison value". (☞ Page 136 Section start conditions, Page 139 Section end conditions)



(1) Variable A (for section start detection)
(2) Variable B (for section end detection)
(3) Extraction target variable
(4) Extraction section
(a) Set conditions so that the time between the rises of variables A and B becomes constant.

❸Use data whose sampling intervals are constant and which have no data missing (data with no need for interpolation) for the data of the CSV file to be read in Reader.

- A guard band can be saved in the programmable controller format when the following conditions are satisfied. When ❶ is not satisfied, the value of 25th digit will be rounded off. When neither ❶ nor ❷ is satisfied, an error will occur.

❶ The number of digits (including signs ('+' or '-') and a decimal separator) is less than 24.

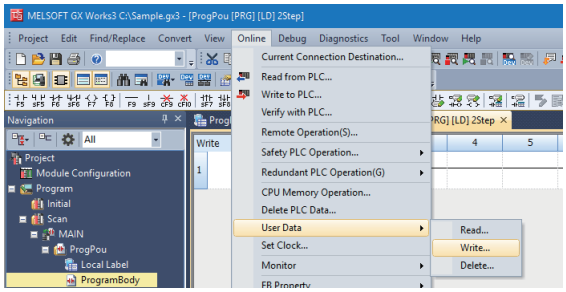
❷ The number of digits for the integer part of a single-precision real number data is less than 16.

Writing to an SD memory card

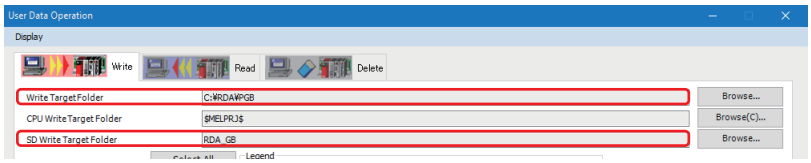
Write a guard band file (.PGB) saved in the programmable controller format to an SD memory card.
The following shows the writing method using GX Works3.

Operating procedure

1. Insert an SD memory card into a programmable controller CPU.
2. Start GX Works3, and create a project.
3. Select [Online] ⇨ [User Data] ⇨ [Write].

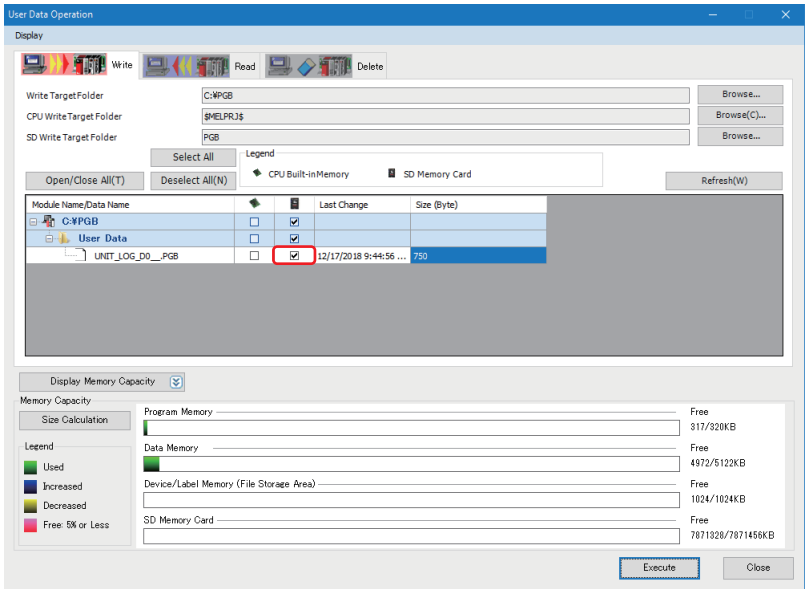


4. Specify "Write TargetFolder" and "SD Write TargetFolder."



- Write TargetFolder: Specify the folder where a guard band file (.PGB) is stored.
- SD Write TargetFolder: Specify the folder to write the guard band file (.PGB).

5. Select the checkbox of a guard band file (.PGB) to be written, and click the [Execute] button.



Execution of Real-time Data Analyzer data linkage FB

Store data of the guard band file (.PGB), which is in an SD memory card, in a file register (ZR) of a programmable controller CPU by the Real-time Data Analyzer data linkage FB (M+RDAData_ImportGB_R).

For details on the Real-time Data Analyzer data linkage FB, refer to the following:

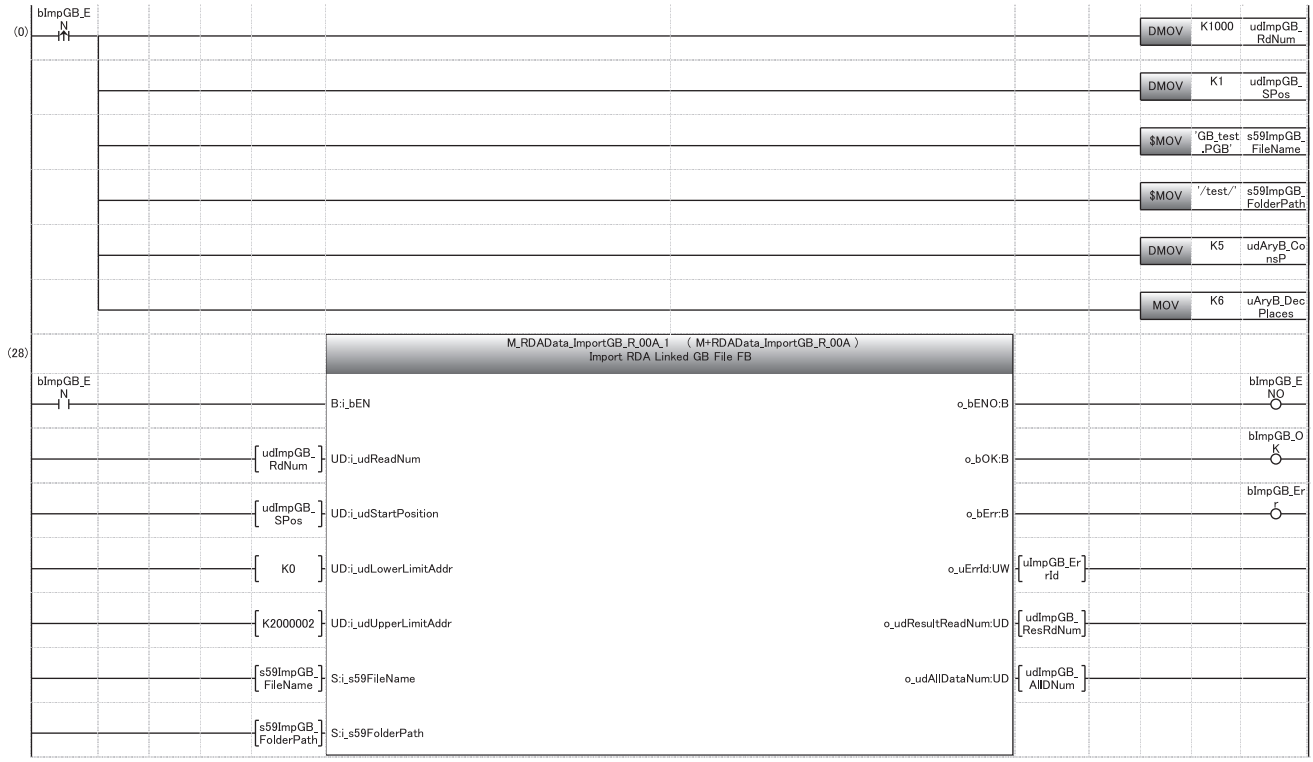
MELSEC iQ-R Real-time Data Analyzer Data Linkage Function Block Library Reference

Point

To acquire the Real-time Data Analyzer data linkage FB (M+RDAData_ImportGB_R), please contact your local Mitsubishi Electric sales office or representative.

■ Program example

The following shows a program example to execute the Real-time Data Analyzer data linkage FB (M+RDAData_ImportGB_R).



■ Settings of the Real-time Data Analyzer data linkage FB

The following shows the settings of Real-time Data Analyzer data linkage FB (M+RDAData_ImportGB_R) used in the program example.

Variable name	Name	Setting value	Description
i_udReadNum	Number of reading points	K1000	Specify the number of points to be used from the waveforms output to the guard band file. To check the number of guard band points, refer to the following: ☞ Page 216 Creating guard band
i_udStartPosition	Start position of reading	K1	Specify the start point of data to be used from data of the waveforms output in a guard band file. (When using data of the start and succeeding points, specify '1'.)
i_udLowerLimitAddr	Check value (lower limit value) address	K0	Specify the start address of a file register (ZR) to store the check value (lower limit value).
i_udUpperLimitAddr	Check value (upper limit value) address	K2000002	Specify the start address of a file register (ZR) to store the check value (upper limit value).
i_s59FileName	File name	'GB_test.PGB'	Specify the file name of a guard band file.
i_s59FolderPath	Folder Path	'/test/'	Specify the folder path on an SD memory card where a guard band file is stored. (Use '\' or '/' for a delimiter of the path.)

■ Labels

The following shows the labels used in the program example.

• External input

Label name	Description
bImpGB_EN	Execution command for the Real-time Data Analyzer data linkage FB

• External output

Label name	Description
bImpGB_ENO	Execution status of the Real-time Data Analyzer data linkage FB
bImpGB_OK	Normal completion of the Real-time Data Analyzer data linkage FB
bImpGB_Err	Error completion of the Real-time Data Analyzer data linkage FB
uImpGB_ErrId	Error code when the Real-time Data Analyzer data linkage FB is completed with an error
udImpGB_ResRdNum	Number of data points read when the Real-time Data Analyzer data linkage FB is normally completed
udImpGB_AllDNum	Number of all data points for a guard band file

Precautions

Insert the SD memory card where the guard band file (.PGB) output in Real-time Data Analyzer is stored into a programmable controller CPU.

Executing the data analysis FB (guard band diagnosis FB)

Execute the data analysis FB (M+DataAnalysisPro_AryBoundCompareTest_R).

For details on the data analysis FB, refer to the following:

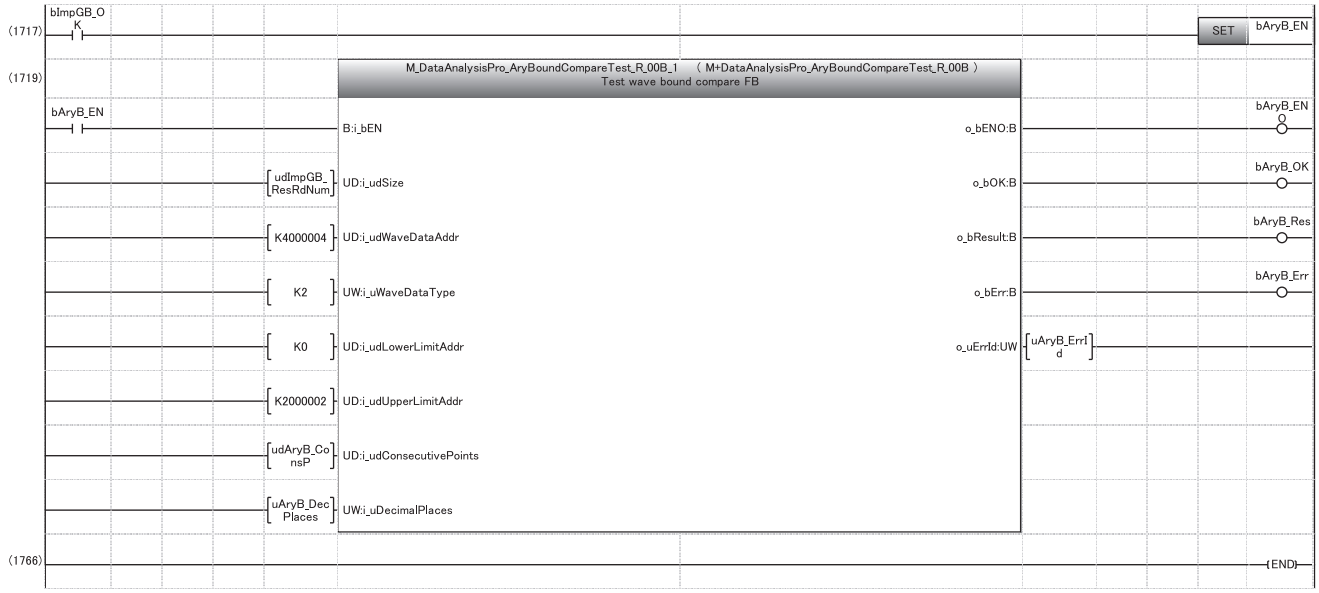
MELSEC iQ-R Data Analysis Function Block Library Reference (Application)

Point

To acquire the data analysis FB (M+DataAnalysisPro_AryBoundCompareTest_R), please contact your local Mitsubishi Electric sales office or representative.

■ Program example

The following shows a program example to execute the data analysis FB (M+DataAnalysisPro_AryBoundCompareTest_R).



■ Settings of the data analysis FB

The following shows the settings of data analysis FB (M+DataAnalysisPro_AryBoundCompareTest_R) used in the program example.

Variable name	Name	Setting value	Description
i_udSize	Number of data points	udImpGB_RdNum*1	Specify the number of data points for waveforms to be diagnosed.
i_udWaveDataAddr	Waveform data start address	K4000004	Specify the start address of the file register (ZR) where the waveform data to be diagnosed is stored.
i_uWaveDataType	Waveform data type selection	K2*2	Specify the data type of waveform data.
i_udLowerLimitAddr	Check value (lower limit value) address	K0*3	Specify the address of the file register (ZR) where the check value (lower limit value) is stored.
i_udUpperLimitAddr	Check value (upper limit value) address	K2000002*4	Specify the address of the file register (ZR) where the check value (upper limit value) is stored.
i_udConsecutivePoints	Number of consecutive excess points	K5	Specify the number of points to define the timing of an NG determination. It is determined as NG when the range between the lower and upper limit values is exceeded continuously by the specified number of points.
i_uDecimalPlaces	Number of significant decimal places	K6	Specify the number of significant digits after the decimal point.

*1 Specify the same value as 'o_udResultReadNum' of M+RDAData_ImportGB_R.
*2 Specify '2' (single-precision real number) for the data type.
*3 Specify the same value as 'i_udLowerLimitAddr' of M+RDAData_ImportGB_R.
*4 Specify the same value as 'i_udUpperLimitAddr' of M+RDAData_ImportGB_R.

■ Labels

The following shows the labels used in the program example.

• External input

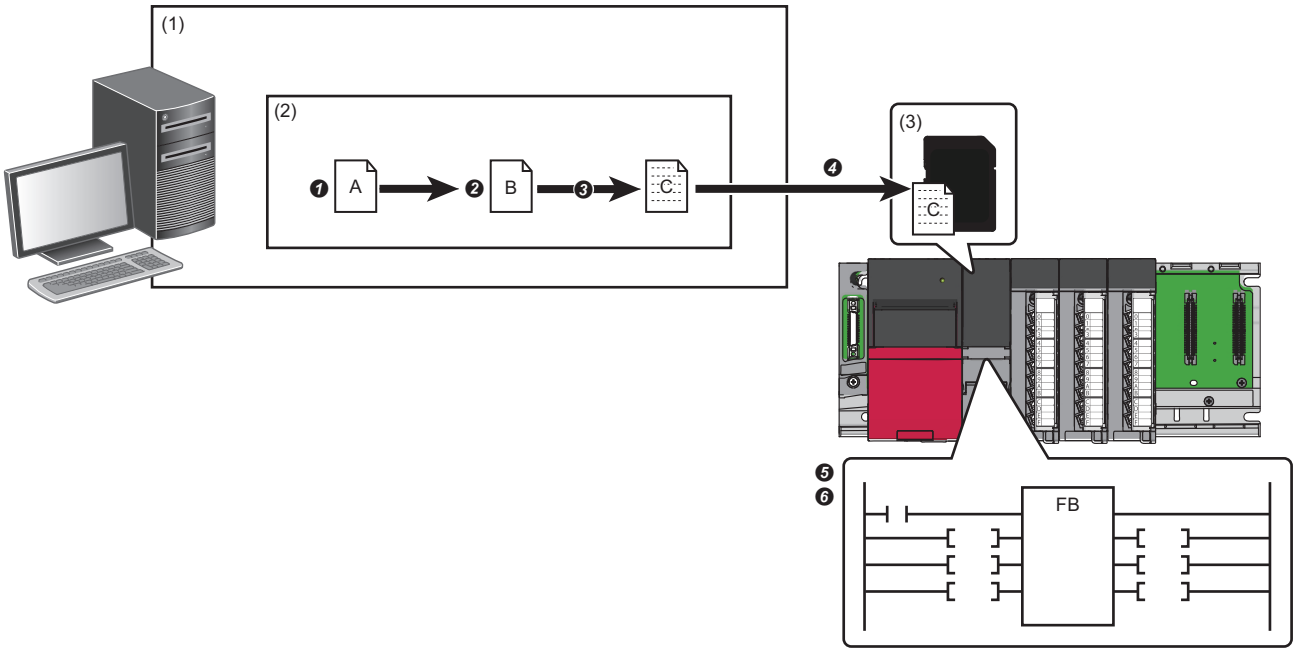
Label name	Description
bAryB_EN	Execution command for the data analysis FB

• External output

Label name	Description
bAryB_ENO	Execution status of the data analysis FB
bAryB_OK	Normal completion of the data analysis FB
bAryB_Res	Check result of the data analysis FB
bAryB_Err	Error completion of the data analysis FB
uAryB_ErrId	Error code when the data analysis FB is completed with an error

Multiple regression analysis

To use the result of offline analysis created in a multiple regression analysis to a programmable controller CPU, follow the procedure below.



(1) Industrial PC
(2) Real-time Data Analyzer
(3) SD memory card
A: Correlation analysis result
B: Unit space data
C: Multiple regression analysis file (.PMR)

❶ Perform correlation analysis. (☞ Page 231 Correlation analysis by using a correlation graph)
❷ Perform recurrence calculation. (☞ Page 242 Recurrence calculation)
❸ Output the unit space data of the criterion matrix in the programmable controller format (.PMR). (☞ Page 394 External output)
❹ Write a multiple regression analysis file (.PMR) to an SD memory card.(☞ Page 395 Writing to an SD memory card)
❺ Execute the Real-time Data Analyzer data linkage FB. (☞ Page 396 Execution of Real-time Data Analyzer data linkage FB)
❻ Execute the multiple regression analysis FB. (☞ Page 398 Execution of multiple regression analysis FB)

External output

Output the unit space data of the criterion matrix in the format available in a programmable controller.

The unit space data includes the following:

Item name	Data type	Number of units of data	Corresponding item of the FB
Number of target variables for recurrence calculation	Word [unsigned]	1	Number of signal data items
Coefficient	Single-precision real number	Value of 'Number of target variables for recurrence calculation'	Coefficient
Constant	Single-precision real number	1	Constant

Operating procedure

Click the [External output] button in the screen shown in the following section.

☞ Page 239 Screen configuration

The unit space data is output.

■ Output format

The following table shows the format for outputting the unit space data.

Format (extension)	Description
Programmable controller format (.PMR)	This format is available in a programmable controller.

Point

When the extension not corresponding to the selected format is specified, the correct extension is automatically added and the data is saved.

Precautions

- For the temporary license, the [External output] button cannot be clicked.
- Unit space data of the criterion matrix that is output when clicking the [External output] button may not be the same value as the data output by the FB (M+DataStatisticsPro_LinMultRg_ED_R) which generates unit space data.
- The available data type in a programmable controller is the single-precision real number type. When saving in the programmable controller format and if the value of unit space data of criterion matrix falls below the range that can be represented in single-precision real numbers, the value will be rounded so as to fall within the range[*1] and saved. In addition, when the range that can be represented in single precision real numbers is exceeded, an error will occur.

*1 It will be rounded off.

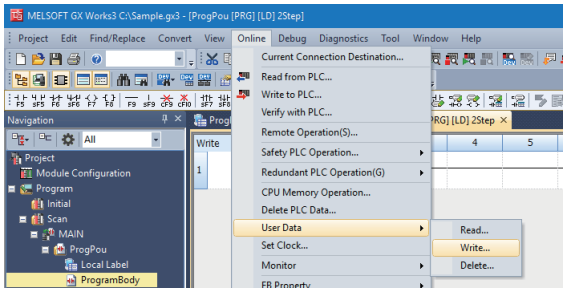
- The maximum number of units of unit space data for the criterion matrix is 64 excluding objective variables. An error occurs if there are more than 64 units.
- The value of a target variable for recurrence calculation in a correlation matrix (partial matrix) needs to be set within the range that can be represented in single-precision real numbers.
- The maximum number of target variables for recurrence calculation in a correlation matrix (partial matrix) is 64 excluding objective variables.

Writing to an SD memory card

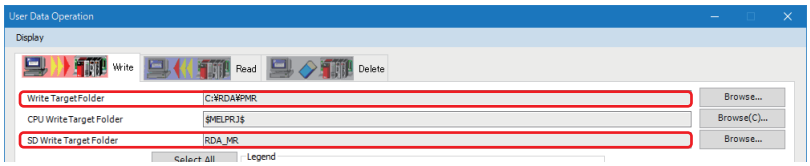
Write a multiple regression analysis file (.PMR) saved in the programmable controller format to an SD memory card.
The following shows the writing method using GX Works3.

Operating procedure

1. Insert an SD memory card into a programmable controller CPU.
2. Start GX Works3, and create a project.
3. Select [Online] ⇨ [User Data] ⇨ [Write].

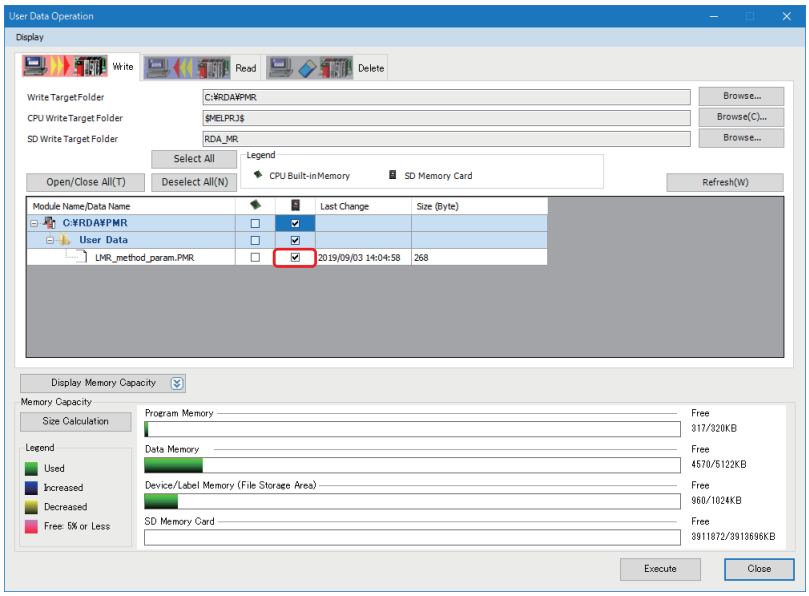


4. Specify "Write TargetFolder" and "SD Write TargetFolder."



- Write TargetFolder: Specify the folder where a multiple regression analysis file (.PMR) is stored.
- SD Write TargetFolder: Specify the folder to write the multiple regression analysis file (.PMR).

5. Select the checkbox of a multiple regression analysis file (.PMR) to be written, and click the [Execute] button.



Execution of Real-time Data Analyzer data linkage FB

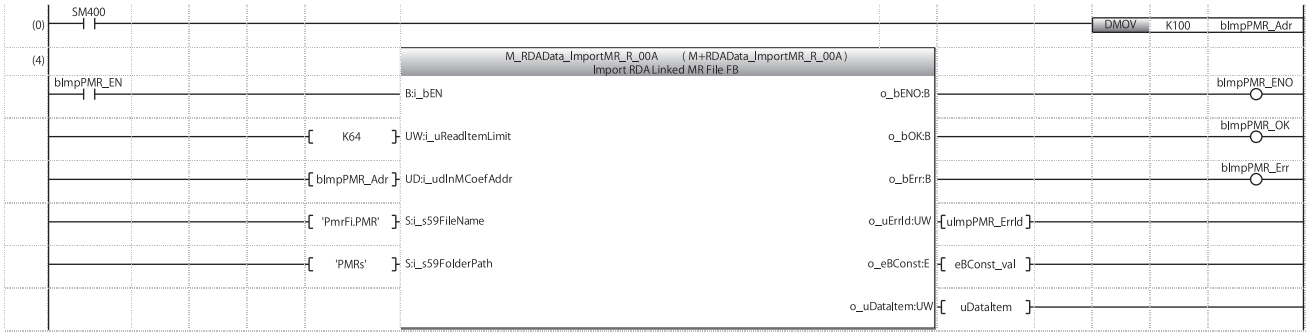
Store data of a multiple regression analysis file (.PMR), which is in an SD memory card, in a file register (ZR) of a programmable controller CPU by the Real-time Data Analyzer data linkage FB (M+RDAData_ImportMR_R).
For details on the Real-time Data Analyzer data linkage FB, refer to the following:
MELSEC iQ-R Real-time Data Analyzer Data Linkage Function Block Library Reference

Point

To acquire the Real-time Data Analyzer data linkage FB (M+RDAData_ImportMR_R), please contact your local Mitsubishi Electric sales office or representative.

■ Program example

The following shows a program example to execute the Real-time Data Analyzer data linkage FB (M+RDAData_ImportMR_R).



■ Settings of the Real-time Data Analyzer data linkage FB

The following shows the settings of Real-time Data Analyzer data linkage FB (M+RDAData_ImportMR_R) used in the program example.

Variable name	Name	Setting value	Description
i_uReadItemLimit	Maximum number of items to read	K64	Specify a value equal to or larger than the number of target variables for 'recurrence calculation' when creating a multiple regression analysis file.
i_udInMCoefAddr	Coefficient m area start address	K100	Specify the start address of the file register (ZR) to store the coefficient m. (The data is output in the single-precision real number type.)
i_s59FileName	File name	'PmrFi.PMR'	Specify the file name of the multiple regression analysis file.
i_s59FolderPath	Folder Path	'PMRs'	Specify the folder path on an SD memory card where a multiple regression analysis file is stored. (Use '\' or '/' for a delimiter of the path.)

■ Labels

The following shows the labels used in the program example.

• External input

Label name	Description
bImpPMR_EN	Execution command for the Real-time Data Analyzer data linkage FB

• External output

Label name	Description
bImpPMR_ENO	Execution status of the Real-time Data Analyzer data linkage FB
bImpPMR_OK	Normal completion of the Real-time Data Analyzer data linkage FB
bImpPMR_Err	Error completion of the Real-time Data Analyzer data linkage FB
uImpPMR_ErrId	Error code when the Real-time Data Analyzer data linkage FB is completed with an error
eBConst_val	Constant stored in the multiple regression analysis file
uDataItem	Number of target variables for 'recurrence calculation' when creating the multiple regression analysis file

Precautions

Insert the SD memory card where the multiple regression analysis file (.PMR) output in Real-time Data Analyzer is stored into a programmable controller CPU.

Execution of multiple regression analysis FB

Execute the multiple regression analysis FB (M+DataStatisticsPro_LinMultRgCalc_E_R).

For details on the multiple regression analysis FB, refer to the following:

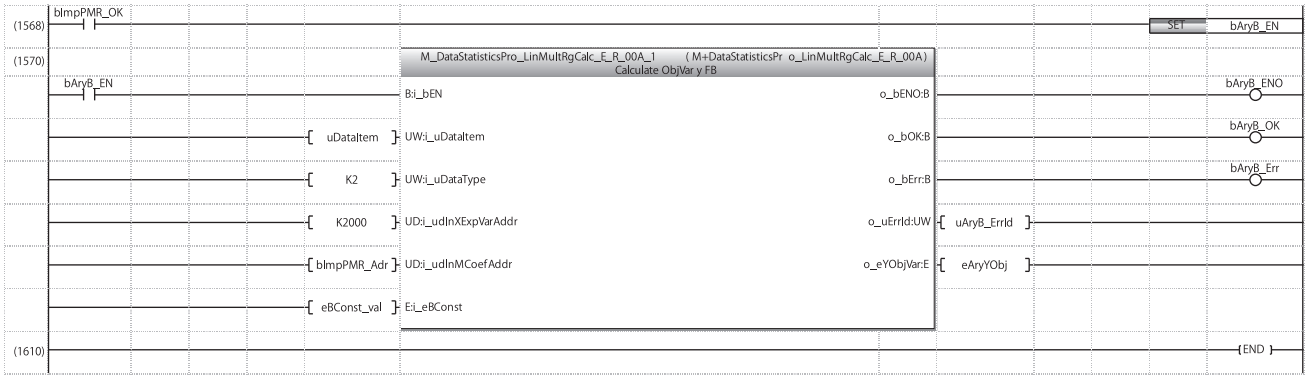
MELSEC iQ-R Statistical Analysis Function Block Library Reference (Application)

Point

To acquire the multiple regression analysis FB (M+DataStatisticsPro_LinMultRgCalc_E_R), please contact your local Mitsubishi Electric sales office or representative.

■ Program example

The following shows a program example to execute the multiple regression analysis FB (M+DataStatisticsPro_LinMultRgCalc_E_R).



■ Settings of the multiple regression analysis FB

The following shows the settings of multiple regression analysis FB (M+DataStatisticsPro_LinMultRgCalc_E_R) used in the program example.

Variable name	Name	Setting value	Description
i_uDataItem	Number of signal data items	uDataItem*1	Specify the number of explanatory variable x. (Example) If the explanatory variable x to be calculated (X) equals X0, X1, ..., and Xn-1, specify 'n.'
i_uDataType	Data type selection	K2*2	Specify the data type of waveform data.
i_udInXExpVarAddr	Start address of predictor variable x storage destination	K2000	Specify the start address of the file register (ZR) where the explanatory variable x is stored. Data for the 'number of signal data items' is stored in the file register (ZR). The data is stored in the data type same as the one selected for the 'number of signal data items.' For the explanatory variable, store the statistics calculated with the same method as the one used for generating unit space data.
i_udInMCoefAddr	Start address of coefficient m storage location	bImpPMR_Adr*3	Specify the start address of the file register (ZR) where the coefficient m is stored. Data for the 'number of signal data items' is stored in the file register (ZR). The data is stored in the single-precision real number type.
i_eBConst	Constant b	eBConst_val*4	Specify the constant b.

*1 Specify the same value as 'o_uDataItem' of M+RDAData_ImportMR_R.
*2 Specify '2' (single-precision real number) for the data type.
*3 Specify the same value as 'i_udInMCoefAddr' of M+RDAData_ImportMR_R.
*4 Specify the same value as 'o_eBConst' of M+RDAData_ImportMR_R.

■ Labels

The following shows the labels used in the program example.

• External input

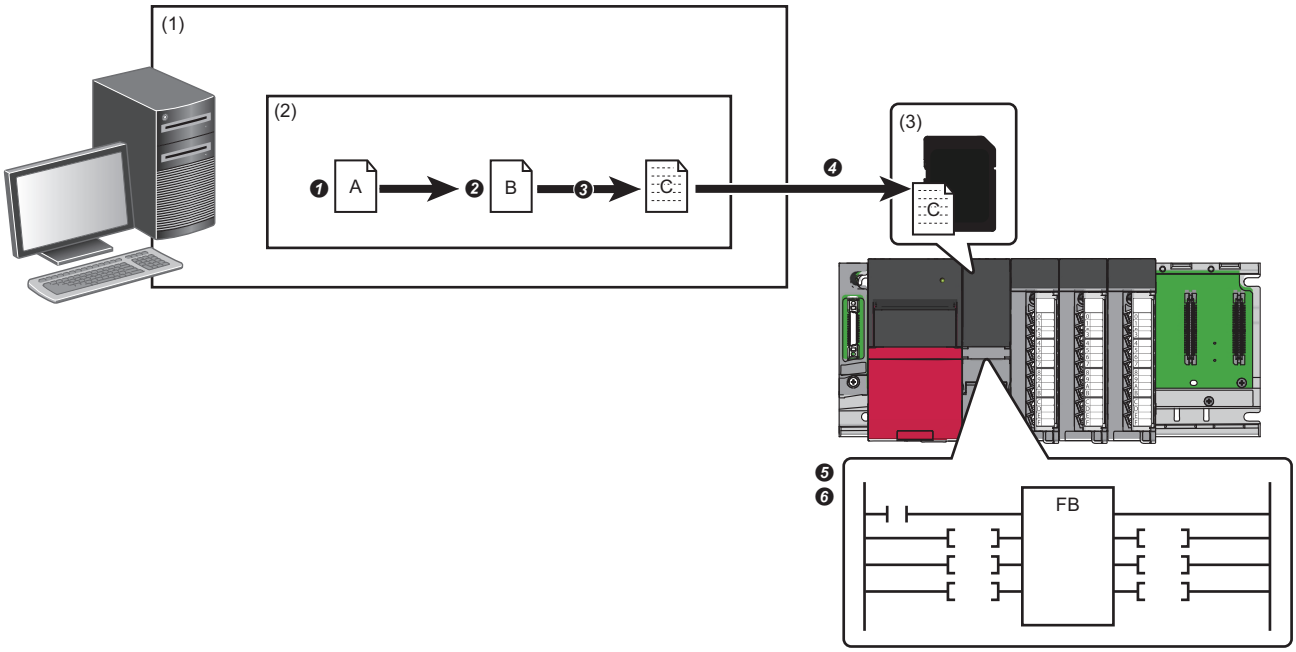
Label name	Description
bAryB_EN	Execution command for the multiple regression analysis FB

• External output

Label name	Description
bAryB_ENO	Execution status of the multiple regression analysis FB
bAryB_OK	Normal completion of the multiple regression analysis FB
bAryB_Err	Error completion of the multiple regression analysis FB
uAryB_ErrId	Error code when the multiple regression analysis FB is completed with an error
eAryYObj	Response variable y

Maharanobis-Taguchi method

To use the result of offline analysis created by Mahalanobis-Taguchi method in a programmable controller CPU, following the procedure below.



(1) Industrial PC
(2) Real-time Data Analyzer
(3) SD memory card
A: Correlation analysis result
B: Unit space data
C: MT method file (.PMT)

❶ Perform correlation analysis. (☞ Page 231 Correlation analysis by using a correlation graph)
❷ Calculate MT distance. (☞ Page 247 MT distance calculation)
❸ Output the unit space data of the criterion matrix in the programmable controller format (.PMT). (☞ Page 401 External output)
❹ Write an MT method file (.PMT) to an SD memory card.(☞ Page 402 Writing to an SD memory card)
❺ Execute the Real-time Data Analyzer data linkage FB. (☞ Page 403 Execution of Real-time Data Analyzer data linkage FB)
❻ Execute the statistical analysis FB (MT method FB). (☞ Page 405 Execution of statistical analysis FB (MT method FB))

External output

Output the unit space data of the criterion matrix in the format available in a programmable controller.

The unit space data includes the following:

Item name	Data type	Number of units of data	Corresponding item of the FB
Number of target variables for MT distance calculation	Word [unsigned]	1	Number of signal data items
Inverse matrix of correlation matrix	Single-precision real number	Value of 'Number of target variables for MT distance calculation' × 2	Inverse matrix
Average value per item	Single-precision real number	Value of 'Number of target variables for MT distance calculation'	Average value
Standard deviation per item	Single-precision real number	Value of 'Number of target variables for MT distance calculation'	Standard deviation

Operating procedure

Click the [External output] button in the screen shown in the following section.

☞ Page 246 Screen configuration

The unit space data is output.

■ Output format

The following table shows the format for outputting the unit space data.

Format (extension)	Description
Programmable controller format (.PMT)	This format is available in a programmable controller.

Point

When the extension not corresponding to the selected format is specified, the correct extension is automatically added and the data is saved.

Precautions

- For the temporary license, the [External output] button cannot be clicked.
- Unit space data of the criterion matrix that is output when clicking the [External output] button may not be the same value as the data output by the FB (M+DataStatisticsPro_MTUnit_R) which generates unit space data.
- The available data type in a programmable controller is the single-precision real number type. When saving in the programmable controller format and if the value of unit space data of criterion matrix falls below the range that can be represented in single-precision real numbers, the value will be rounded so as to fall within the range*1 and saved. In addition, when the range that can be represented in single precision real numbers is exceeded, an error will occur.

*1 It will be rounded off.

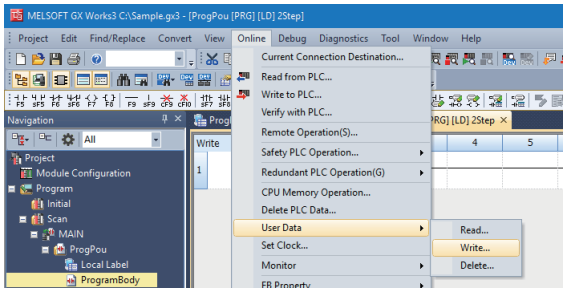
- When outputting data in the programmable controller format, set the value of a target variable for MT distance calculation in a correlation matrix (partial matrix) within the range that can be represented in single-precision real numbers.

Writing to an SD memory card

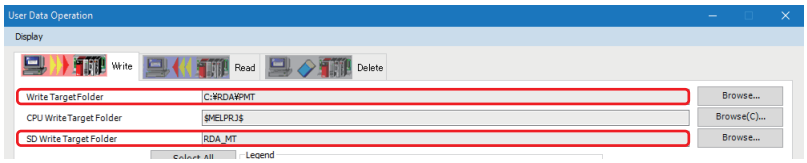
Write an MT method file (.PMT) saved in the programmable controller format to an SD memory card.
The following shows the writing method using GX Works3.

Operating procedure

1. Insert an SD memory card into a programmable controller CPU.
2. Start GX Works3, and create a project.
3. Select [Online] ⇨ [User Data] ⇨ [Write].

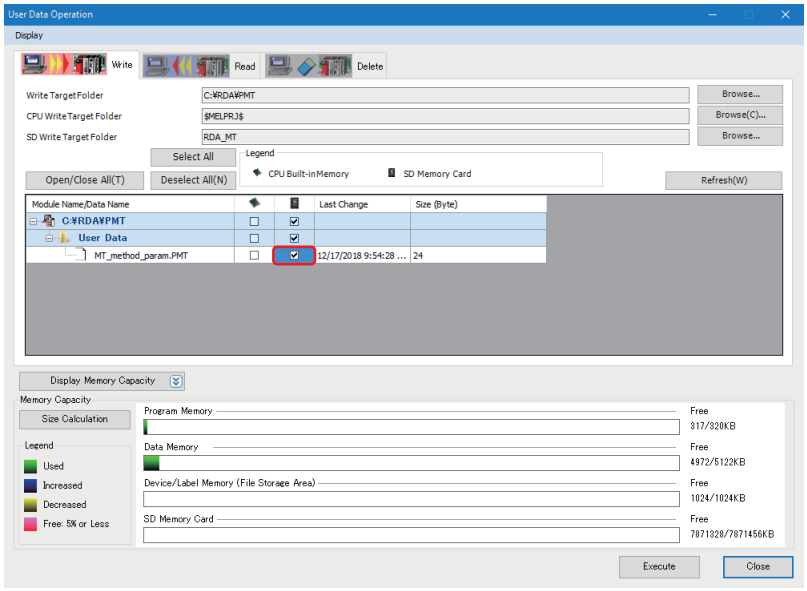


4. Specify "Write TargetFolder" and "SD Write TargetFolder."



- Write TargetFolder: Specify the folder where an MT method file (.PMT) is stored.
- SD Write TargetFolder: Specify the folder to write the MT method file (.PMT).

5. Select the checkbox of an MT method file (.PMT) to be written, and click the [Execute] button.



Execution of Real-time Data Analyzer data linkage FB

Store data of an MT method file (.PMT), which in an SD memory card, in a file register (ZR) of a programmable controller CPU by the Real-time Data Analyzer data linkage FB (M+RDAData_ImportMT_R).

For details on the Real-time Data Analyzer data linkage FB, refer to the following:

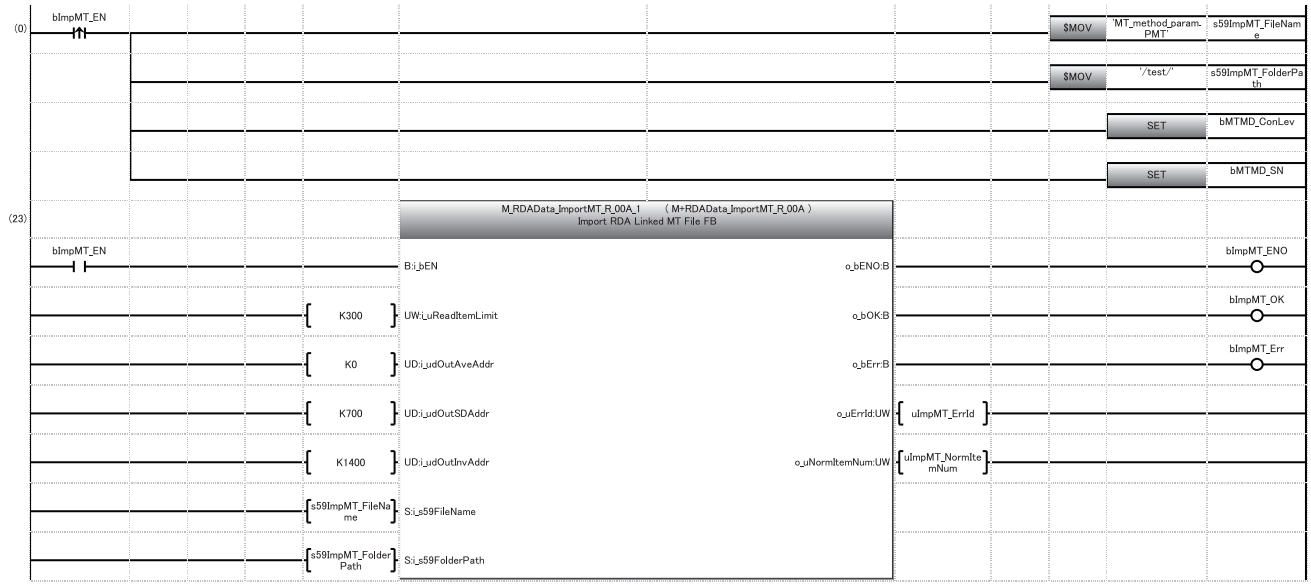
MELSEC iQ-R Real-time Data Analyzer Data Linkage Function Block Library Reference

Point

To acquire the Real-time Data Analyzer data linkage FB (M+RDAData_ImportMT_R), please contact your local Mitsubishi Electric sales office or representative.

■ Program example

The following shows a program example to execute the Real-time Data Analyzer data linkage FB (M+RDAData_ImportMT_R).



■ Settings of the Real-time Data Analyzer data linkage FB

The following shows the settings of Real-time Data Analyzer data linkage FB (M+RDAData_ImportMT_R) used in the program example.

Variable Name	Name	Setting value	Description
i_uReadItemLimit	Maximum number of items to read	K300	Specify the value equal to or larger than the number of target variables for 'MT distance calculation' when creating the MT method file.
i_udOutAveAddr	Output average start address	K0	Specify the start address of a file register (ZR) to store the average value. (The data is output in the single-precision real number type.)
i_udOutSDAddr	Output SD start address	K700	Specify the start address of a file register (ZR) to store the standard deviation. (The data is output in the single-precision real number type.)
i_udOutInvAddr	Output invmatrix start address	K1400	Specify the start address of a file register (ZR) to store the inverse matrix. (The data is output in the single-precision real number type.)
i_s59FileName	File name	'MT_method_param.PMT'	Specify the file name of an MT method file.
i_s59FolderPath	Folder path	'/test/'	Specify the folder path on a SD memory card where an MT method file is stored. (Use '\' or '/' for a delimiter of the path.)

■ Labels

The following shows the labels used in the program example.

• External input

Label name	Description
bImpMT_EN	Execution command for the Real-time Data Analyzer data linkage FB

• External output

Label name	Description
bImpMT_ENO	Execution status of the Real-time Data Analyzer data linkage FB
bImpMT_OK	Normal completion of the Real-time Data Analyzer data linkage FB
bImpMT_Err	Error completion of the Real-time Data Analyzer data linkage FB
uImpMT_ErrId	Error code when the Real-time Data Analyzer data linkage FB is completed with an error
uImpMT_NormItemNum	Number of target variables for 'MT distance calculation' when creating the MT method file

Precautions

Insert the SD memory card where the MT method file (.PMT) output in Real-time Data Analyzer is stored into a programmable controller CPU.

Execution of statistical analysis FB (MT method FB)

Execute the statistical analysis FB (M+DataStatisticsPro_MTMD_R).

For details on the statistical analysis FB, refer to the following:

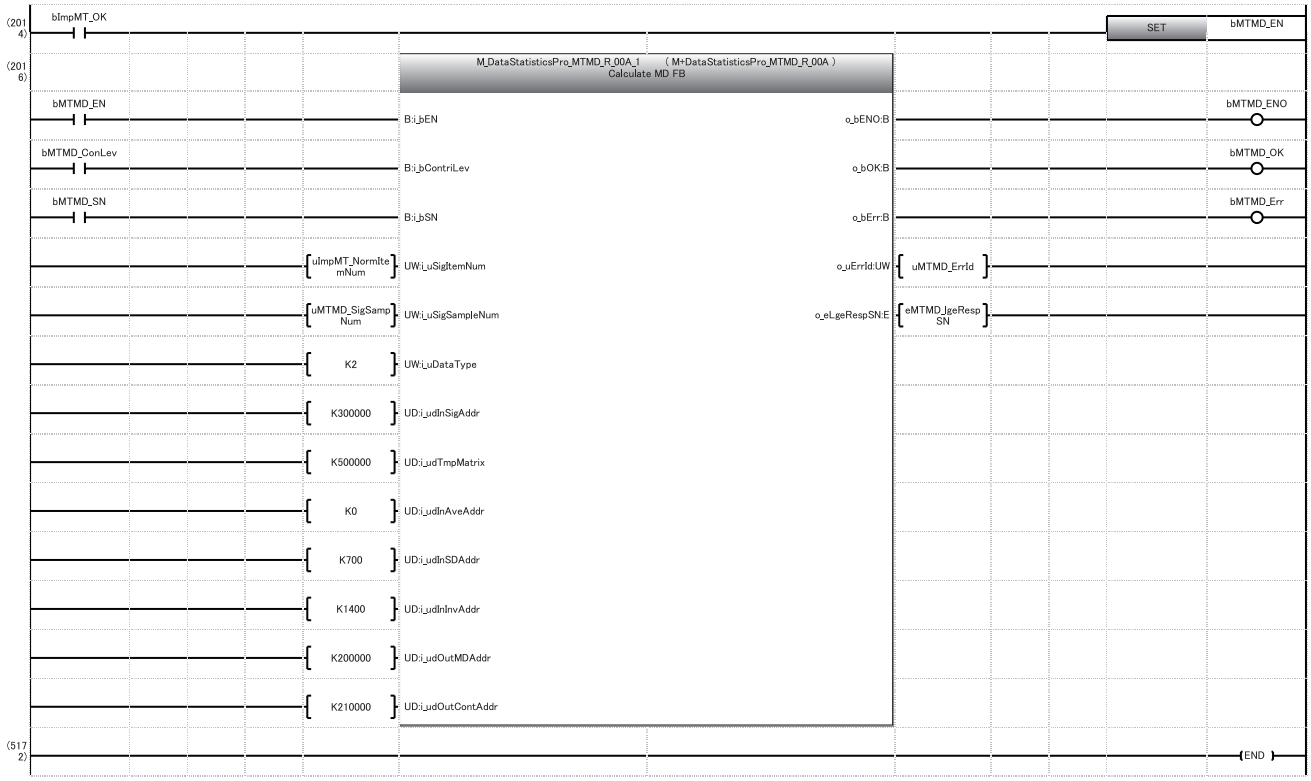
MELSEC iQ-R Statistical Analysis Function Block Library Reference (Application)

Point

To acquire the statistical analysis FB (M+DataStatisticsPro_MTMD_R), please contact your local Mitsubishi Electric sales office or representative.

■ Program example

The following shows a program example to execute the statistical analysis FB (M+DataStatisticsPro_MTMD_R).



■ Settings of the statistical analysis FB

The following shows the settings of statistical analysis FB (M+DataStatisticsPro_MTMD_R) used in the program example.

Variable Name	Name	Setting value	Description
i_uSigItemNum	Number of signal data items	uImpMT_NormItemNum*1	Specify the number of target variables for 'MT distance calculation' when creating the MT method file.
i_uSigSampleNum	Number of signal data samples	K100	Specify the number of signal data samples.
i_uDataType	Data type selection	K2*2	Specify the data type of signal data.
i_udInSigAddr	Start address of signal data storage destination	K300000	Specify the start address of the file register (ZR) where the signal data for calculating the Mahalanobis distance is stored. To the file register (ZR), store the data for 'Number of signal data items' × 'Number of signal data samples' in the single-precision real number type. For the signal data, store the statistics calculated with the same method as the one used for generating unit space data.
i_udTmpMatrix	Start address of an area for matrix operation	K500000	Specify the start address of a file register (ZR) in the area for matrix operation.
i_udInAveAddr	Start address of average value storage destination	K0*3	Specify the start address of the file register (ZR) where the average value of normal data is stored.
i_udInSDAddr	Start address of standard deviation storage destination	K700*4	Specify the start address of the file register (ZR) where the standard deviation of normal data is stored.
i_udInInvAddr	Start address of inverse matrix storage destination	K1400*5	Specify the start address of the file register (ZR) where the inverse matrix of the correlation matrix of a unit space is stored.
i_udOutMDAddr	Start address of signal data MD output destination	K200000	Specify the start address of a file register (ZR) to store an output result (Mahalanobis distance of signal data). To the file register (ZR), the data for 'Number of signal data samples' is stored in the single-precision real number type.
i_udOutContAddr	Start address of contribution level output destination	K210000	Specify the start address of a file register (ZR) to store an output result (contribution level). The contribution level is stored to the file register when 'Contribution level output enable/disable of the statistical analysis FB' is ON. To the file register (ZR), the data for 'Number of signal data items' × 'Number of signal data samples' is stored in the single-precision real number type.

*1 Specify the same value as 'o_uNormItemNum' of M+RDAData_ImportMT_R.
*2 Specify '2' (single-precision real number) for the data type.
*3 Specify the same value as 'i_udOutAveAddr' of M+RDAData_ImportMT_R.
*4 Specify the same value as 'i_udOutSDAddr' of M+RDAData_ImportMT_R.
*5 Specify the same value as 'i_udOutInvAddr' of M+RDAData_ImportMT_R.

■ Labels

The following shows the labels used in the program example.

• External input

Label name	Description
bMTMD_EN	Execution command for the statistical analysis FB
bMTMD_ConLev	Contribution level output enable/disable of the statistical analysis FB
bMTMD_SN	SN ratio (larger-is-better characteristic) output enable/disable of signal data MD of the statistical analysis FB

• External output

Label name	Description
bMTMD_ENO	Execution status of the statistical analysis FB
bMTMD_OK	Normal completion of the statistical analysis FB
bMTMD_Err	Error completion of the statistical analysis FB
uMTMD_ErrId	Error code when the statistical analysis FB is completed with an error
eMTMD_lgeRespSN	SN ratio (larger-is-better characteristic) of signal data MD*1

*1 It is stored when 'SN ratio (larger-is-better characteristic) output enable/disable of signal data MD' is ON.

22 Monitor

This software displays the diagnosis status and a diagnosis result, and outputs a response data file when an error occurs in diagnosis.
For the content output in a response data file, refer to the following:
☞ Page 16 Real-time Statistic Diagnosis Tool
In addition, the following operations can be performed in this software:

- Outputting a log when a diagnosis is performed
- Outputting a diagnosis result detail information file when an error occurs in a simple diagnosis

For the content output in a diagnosis result detail information file, refer to the following:
☞ Page 16 Real-time Statistic Diagnosis Tool
The following shows the procedure to operate Monitor.

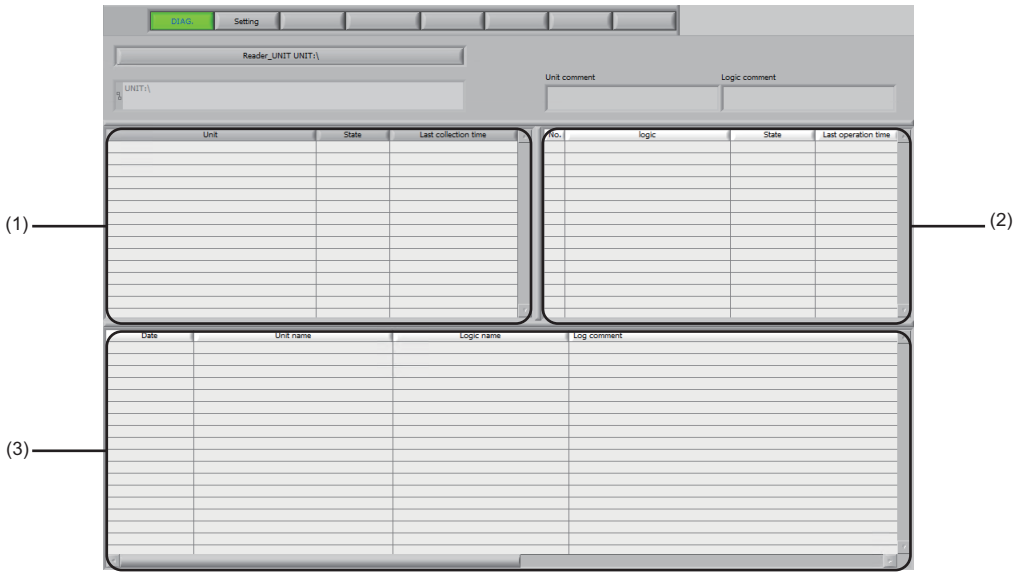
Operating procedure

1. Set the settings for cooperating with an external tool such as Edgecross Basic Software.
☞ Page 410 Monitor Setting

2. Perform operations for cooperating with Edgecross Basic Software.
☞ Page 412 Starting Monitor

22.1 Screen Configuration

The following shows the screen configuration of Monitor.



Displayed items

Item		Description
[DIAG.] button		Click this to perform a diagnosis in Monitor.
[Setting] button		Click this to set the settings for Monitor.
Unit comment		Unused area.
Logic comment		A logic comment set for 'logic editing' in Analyzer is displayed. ☞ Page 250 Editing Logics
(1) Unit information list	—	Information on a unit defined in Reader is displayed.
	Unit	A unit name defined in Reader is displayed.
	State	"Diagnosing" is displayed.
	Last collection time	The latest time when a CSV file of a selected unit is read in Reader is displayed.
(2) Logic information list	—	Information on a logic of a unit selected in the unit information list is displayed.
	logic	A logic name defined in a unit selected in the unit information list is displayed. A logic indicated as "Monitor" is regarded as simple diagnosis (SPC, multivariate analysis (single central value format) and guard band) in Analyzer. ☞ Page 188 SPC, Page 204 Multivariate Analysis (Single Central Value Format), Page 211 Guard Band Diagnosis
	State	"Diagnosing" is displayed.
	Last operation time	The latest time when a logic is executed is displayed.
(3) Logic list	—	Information on logic execution is displayed.
	Date	The date and time when a log is output is displayed.
	Unit name	A unit name to be logged is displayed.
	Logic name	The name of a logic to be logged is displayed.
	Log comment	Logs related to data collection and logic execution are displayed. For the displayed contents, refer to the following section. ☞ Page 409 Log comment list

Log comment list

The following table lists the log comments.

Item	Description
Logic registration*1	This log is output when a logic is started by Monitor.
Logic diagnostic start*1	This log is output when a logic is started by Monitor.
Unit data acquisition n (msec) m section	This log is output when Reader generates section data and then Monitor read that section. n: Reference for time required m: Number of sections read together
Logic execution ended n (msec) logics remaining (m)	This log is output when a logic execution ends. n: Reference for execution time m: Number of outstanding logics
Logic deletion	This log is output when a logic is terminated by Monitor.
Logic execution error	This log is output when an incomplete and unexecutable logic is executed (e.g., variable data was deleted by Reader after the logic was created or the logic was deleted in 'Logic editing' in Analyzer). This error does not occur after terminating the logic.

*1 It is also output when the logic 'Monitor' was deleted in the logic information list and then 'Switch to CSV reading mode' was performed in Reader.

Precautions

When a logic remaining value in the 'logic execution ended' log continues to increase, it indicates that the load limit is exceeded. In this case, the number of logics to execute must be reduced.

22.2 Monitor Setting

This section shows the settings for cooperating with an external tool such as Edgecross Basic Software.

Operating procedure

1. Click the [Setting] button.
2. Select [Logic setting] from the pull-down menu displayed in the upper portion of the screen.

☞ Page 410 Logic setting

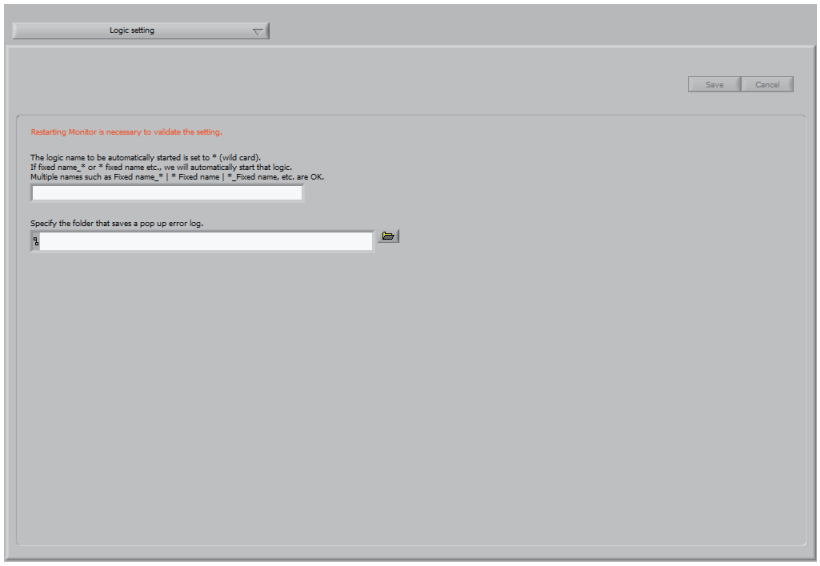
3. Set each item and click the [Save] button.
4. Select [Diagnosis result detail information file setting] from the pull-down menu displayed in the upper portion of the screen.

☞ Page 411 Diagnosis result detail information file setting

5. Set each item and click the [Save] button.

■ Logic setting

Window



Displayed items

Item	Description
The logic name to be automatically started is set to * (wild card).*1*2	Set a logic name (up to 256 characters) to automatically be added or started as a logic to be diagnosed when starting Monitor.
Specify the folder that saves a pop up error log.*3*4*5	Set a save destination (up to 256 characters) of a log if the pop-up window appears when executing a logic.

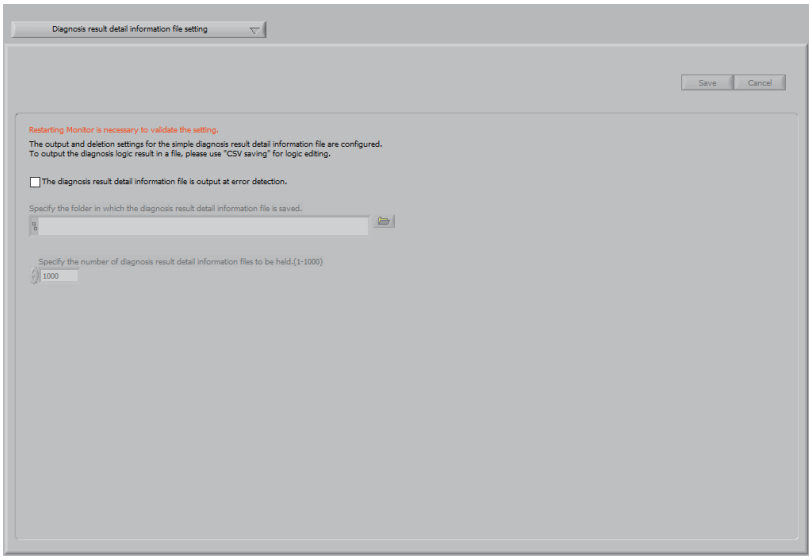
1 A wild car character (*) can be used. "" represents one or more arbitrary characters.
*2 '|' can be used as a separator when specifying multiple logic names.
*3 Except for a case where logics are manually run from 'Logic editing' of Analyzer. ☞ Page 349 Manual execution
*4 Do not specify a folder with the encryption attribute enabled.
*5 Set it so that the path length of a file to be saved does not exceed 259 characters. The maximum path length of a pop up error log is as follows:
(Set folder)\ + 49 characters (if the logic name is 32 characters long)

Precautions

Monitor must be restarted to apply changes to the settings.

■ Diagnosis result detail information file setting

Window



Displayed items

Item	Description
The diagnosis result detail information file is output at error detection.	Select the checkbox to output a diagnosis result detail information file when an error is detected.
Specify the folder in which the diagnosis result detail information file is saved.*1*2	Set the save destination (up to 256 characters) of a diagnosis result detail information file.
Specify the number of diagnosis result detail information files to be held.(1-1000)*3*4*5	Set the number of files to be retained. If the number of output diagnosis result detail information files exceeds a specified number, files are deleted in chronological order.

*1 Disabled if the checkbox of "The diagnosis result detail information file is output at error detection." is unselected. (The set value will be cleared.)

*2 Set it so that the path length of a file to be saved does not exceed 259 characters. For the name of a diagnosis result detail information file, refer to the following:
☞ Page 16 Real-time Statistic Diagnosis Tool

*3 Disabled if the checkbox of "The diagnosis result detail information file is output at error detection." is unselected. (The set value will be changed to '1000.')

*4 Only files that can be deleted are counted.

*5 An error does not occur even if an file that cannot be deleted exists.

Precautions

- Monitor must be restarted to apply changes to the settings.
- A diagnosis result detail information file is not output if an output destination drive does not have space sufficient to output the file. It will be output when the insufficiency is resolved. (Each file has approximately 300 B; therefore, to save 1000 files which is the maximum, approximately 300 KB are required.)

22.3 Starting Monitor

This section shows the operations for cooperating with Edgecross Basic Software.

Operating procedure

1. Click the [DIAG.] button.
2. Check that "Reader_UNIT" is displayed.

Point

"Reader_UNIT" is displayed when all of the following conditions are satisfied.

❶ Folders are defined in Reader.

☞ Page 128 Folder Definition

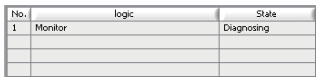
❷ The operation for switching the operation mode of Reader to the CSV file reading mode has been performed after the operations in ❶ is completed.

☞ Page 161 Switching the Operation Mode to CSV File Reading Mode

❸ Monitor is restarted after the operation in ❷ is completed.

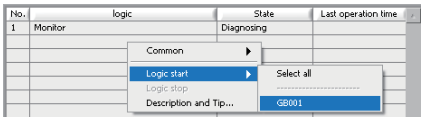
3. Logics are shown in the logic information list.

When "Diagnosing" is displayed in "State", cooperation with Edgecross Basic Software is available.
A logic indicated as "Monitor" in the "Logic" column is regarded as simple diagnosis (SPC, multivariate analysis (single central value format) and guard band) in Analyzer.

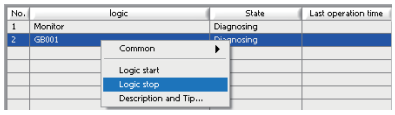


4. When the required logic is not shown, right-click the logic information list and select the logic from [Logic start].

When Reader has read a CSV file, logics shown in the logic information list are diagnosed.



5. To stop the logic, right-click the logic and select [Logic stop].



Precautions

- The screen must remain in this state to keep Monitor running during diagnosis.
- When a logic set in an automatic start setting is stopped, it automatically restarts and its state shows "Diagnosing". To stop the logic completely, perform either of the following operations:
  - Stop the logic after deleting its logic name from an automatic start setting (☞ Page 410 Monitor Setting)
  - Delete the target logic in Analyzer (☞ Page 250 Editing Logics)

23 TROUBLESHOOTING BY SYMPTOM

If a function of Real-time Statistic Diagnosis Tool does not perform properly, check the applicable items in the following and troubleshoot the error.

Symptom	Check item	Corrective action
Unable to save, export, read, or import of a file or a setting.	Does the path exceed 259 characters?	Set the path for save, export, reading, or import within 259 characters including an extension.
	Is the path of the access target an external folder such as a shared folder?	• Check whether it is accessible to the external folder. • Check the following when cooperating with Real-time Flow Manager installed in another industrial PC: Is a cooperation destination folder accessible? Is a communication cable connected? Is a communication destination industrial PC running? Is an external media recognized? Are an access destination drive and media formatted in NTFS format?
	Is there enough free space in a disk specified as the save destination?	Secure free space in the disk.
When Reader reads a CSV file, the following log is output and the file cannot be read. • "Because the time stamp that overlapped with existing data existed, data was not updated."	Does the CSV file[*1] contain data with a time stamp older than or same as that of the latest data which is already read?	Store data with a time stamp newer than that of the latest data which is already read to the CSV input folder.
	Is the time stamp of data set to a future date when reading the data to perform a diagnosis or to create a correlation matrix?	Set the time stamp to a past date when reading the data to perform a diagnosis or to create a correlation matrix. For details, refer to the precautions described in the following: ☞ Page 161 Switching the Operation Mode to CSV File Reading Mode
Unable to close Analyzer or Monitor.	Is the [×] button displayed on the upper right of the screen in Analyzer or Monitor?	• Right-click the icon of Analyzer or Monitor on the taskbar, and select [Close window]. • Perform the following procedure. ❶ Press the Alt + Tab keys, or the Windows key + Tab key to display the application list. ❷ Click the [×] button on the upper right of the screen in Analyzer or Monitor displayed in the list.
Unable to read a CSV file which is stored in the specified folder.	Is Reader in the CSV file reading mode?	Switch the operation mode of Reader to the CSV file reading mode.
	Is Monitor running? (Can an operation be performed in the screen of Monitor?)	• Start Real-time Statistic Diagnosis Tool. • Wait until the screen of Monitor is ready for operation.
A file is recognized as 'undefined' and cannot be read even though its unit definition exists.	Is a string of 13 characters set for "Prefix of file name"?	Set a string from 1 to 12 characters or that of 14 or more characters for "Prefix of file name."
An error (error code: 5812H) occurs in a data diagnosis flow of Real-time Flow Manager that cooperates with Real-time Statistic Diagnosis Tool.	Does the diagnosis name have more than 16 characters?	Set the diagnosis name to output to Real-time Flow Manager in the screen for starting the diagnosis.
A dialog displayed in Analyzer is hidden behind an inactive screen and cannot be operated. A screen becomes inactive in Analyzer and cannot be operated.	Is a dialog with the icon of Analyzer in the application list that is displayed by pressing the Alt + Tab keys or the Windows key + Tab key?	Perform the following procedure. ❶ Press the Alt + Tab keys, or the Windows key + Tab key to display the application list. ❷ Click the [×] button on the upper right of the dialog in Analyzer displayed in the list. ❸ Close the inactive screens other than Analyzer, or move the screens so that they do not overlap with the dialog.
Contents in the screen are not displayed properly.	Is a value other than 100% set for "Change the size of text, apps, and other items" in Windows?	• Change the value to 100% for "Change the size of text, apps, and other items". • For Windows 10 (version 1703 or later)[*2], the display of a screen can be enlarged with high DPI scaling by using a Windows 10 function[*3]. ❶ Select the execution file[*4,*5], then select [Properties] on the right-click menu. ❷ Select the checkbox of "Override high DPI scaling behavior. Scaling performed by:" in the [Compatibility] tab, then select "System" from the pull-down list. ❸ Click the [OK] button.

Symptom	Check item	Corrective action
Read data is not displayed though external media is set for 'Reader equipment data folder' and 'RSD dataset folder'.	Is the external media formatted in other than NTSF format? For the checking method, refer to the following: ☞ Page 128 Folder Definition	Format the external media in NTFS format.

*1 The CSV file is stored in a folder under the "Reader equipment data folder".
Reader_UNIT\YYMMDD\Original\Invalid
('YYMMDD' indicates the current date.)

*2 The Windows version can be checked by the following procedure.
❶ Press Windows key + R, or select "Run" from "Windows System" in Windows Start.
❷ Enter 'winver' in the "Run" screen.
❸ Check the version in the displayed screen.

*3 The display will be blurred by enlarging.
The following lists the setting values for "Change the size of text, apps, and other items" and the recommended display resolution for each setting value in Windows 10.
Setting value: 100%, display resolution: 1280 × 800 dots or more
Setting value: 125%, display resolution: 2048 × 1536 dots or more
Setting value: 150%, display resolution: 2048 × 1536 dots or more
Setting value: 175%, display resolution: 2880 × 1620 dots or more
Setting value: 200%, display resolution: 2880 × 1620 dots or more
Setting value: 225%, display resolution: 3840 × 2160 dots or more
Setting value: 250%, display resolution: 3840 × 2160 dots or more

*4 The execution file is stored in the folder in which Real-time Data Analyzer is installed.
The following are examples of storage locations.
(Example) When the installation destination folder is set as the default:
Screen of Reader (setting edit mode): C:\Mitsubishi Electric Edgecross Software\RDA\RSD\en\Reader\Reader.exe
Screen of Reader (CSV file reading mode): C:\Mitsubishi Electric Edgecross Software\RDA\RSD\en\Reader\Reader_UNIT.exe
Screen of Analyzer: C:\Mitsubishi Electric Edgecross Software\RDA\RSD\en\Analyzer\Analyzer.exe
Screen of Monitor: C:\Mitsubishi Electric Edgecross Software\RDA\RSD\en\Monitor\Monitor.exe

*5 The following are examples of storage locations for the execution file selected when enlarging the display of a screen of License Manager and the utility for switching language.
(Example) When the installation destination folder is set as the default:
License Manager: C:\Mitsubishi Electric Edgecross Software\License Manager\License Manager.exe
Utility for switching language: C:\Mitsubishi Electric Edgecross Software\RDA\LanguageSwitchingUtility\RDA_LanguageSwitchingUtility.exe

APPENDIX

Appendix 1 Processing Performance and Processing Time

This section shows the processing performance and processing time of Real-time Data Analyzer.

Similar Waveform Recognition Tool

The following shows the processing performance and processing time of Similar Waveform Recognition Tool.

Measurement conditions

The following industrial PCs are used for measurement.

■ Industrial PC (operation-guaranteed environment)

Item		Description
CPU		Intel® Core i3 (1.90GHz Quad Core)
RAM		8 GB
Operating system (64-bit version)		Windows® 10 IoT Enterprise 2016 LTSB
Ethernet network I/F	Interface	1000BASE-T
	Communication method	Full-duplex
	Communication speed	1000Mbps (1000BASE-T)

■ Industrial PC (MELIPC MI5122-VW)

Item		Description
CPU		Intel Core i7 (2.6GHz Quad Core)
RAM		12 GB
Operating system (64-bit version)		Windows 10 IoT Enterprise 2016 LTSB
Ethernet network I/F	Interface	1000BASE-T
	Communication method	Full-duplex
	Communication speed	1000Mbps (1000BASE-T)

For MELIPC MI5122-VW, refer to the following manual.

MELIPC MI5000 Series User's Manual (Startup)

■ Industrial PC (MELIPC MI1002-W)

Item		Description
CPU		Intel Atom E3826 (1.46GHz Dual Core)
RAM		4GB
Operating system (64-bit version)		Windows 10 IoT Enterprise 2016 LTSB
Ethernet network I/F	Interface	1000BASE-T
	Communication method	Full-duplex
	Communication speed	1000Mbps (1000BASE-T)

These industrial PC are used as installation destinations for Real-time Flow Manager when cooperating with the Real-time Flow Manager installed in another industrial PC.

For MELIPC MI1002-W, refer to the following:

MI1002-W User's Manual

Processing performance (waveform learning)

The following shows the processing time that takes to learn a waveform.

Point

- The time taken for Similar Waveform Recognition Tool to learn a waveform is greatly affected not only by the number of samples or the unit waveform width but also by the waveform properties such as cycle stability, S/N ratio, instability. The performance value will be the average of the measurement time when five types of waveforms with different properties are processed.
  The processing time may significantly be longer when processing a waveform that is not recommended as a reference waveform because the cycle is unclear.
- Waveform learning processing can be performed for up to three days, and the operation is not guaranteed for learning exceeding three days.
- The processing time mentioned above indicates a time per learning. When performing it two or more times, the above processing time is repeated for the number of learning settings. (Learning can be performed up to 64 times in one setting in Similar Waveform Recognition Tool.)

■ Industrial PC (operation-guaranteed environment)

×: Not applicable because the calculation time exceeds three days.

—: Not applicable because the number of samples of a reference waveform exceeds the maximum number of samples of learning (1000000).

(Unit: minute)

Length of a reference waveform*1	Unit waveform width (record)				
	200	400	600	800	1000
Unit waveform width × 200	3	28	101	299	734
Unit waveform width × 400	14	117	382	985	3977
Unit waveform width × 600	33	239	1023	3281	×
Unit waveform width × 800	60	354	1855	×	×
Unit waveform width × 1000	92	719	2944	×	×
Unit waveform width × 2000	249	3020	—	—	—
Unit waveform width × 3000	942	—	—	—	—
Unit waveform width × 4000	1708	—	—	—	—
Unit waveform width × 5000	2711	—	—	—	—

*1 If the length of the reference waveform is 'unit waveform width × 800', the number of samples of the reference waveform is 160000 when the unit waveform width is 200.

■ Industrial PC (MELIPC MI5122-VW)

×: Not applicable because the calculation time exceeds three days.

—: Not applicable because the number of samples of a reference waveform exceeds the maximum number of samples of learning (1000000).

(Unit: minute)

Length of a reference waveform*1	Unit waveform width (record)				
	200	400	600	800	1000
Unit waveform width × 200	2	13	47	145	357
Unit waveform width × 400	7	56	178	469	1092
Unit waveform width × 600	16	114	376	1697	×
Unit waveform width × 800	30	169	960	×	×
Unit waveform width × 1000	46	261	1523	×	×
Unit waveform width × 2000	129	1562	—	—	—
Unit waveform width × 3000	271	—	—	—	—
Unit waveform width × 4000	884	—	—	—	—
Unit waveform width × 5000	1402	—	—	—	—

*1 If the length of the reference waveform is 'unit waveform width × 800', the number of samples of the reference waveform is 160000 when the unit waveform width is 200.

Processing performance (similarity diagnosis)

The following shows the maximum number of diagnoses that can be set and the CPU usage rate.

Point

- The numbers in the above tables are the number of diagnoses that can be set when the number of data diagnosis flow of Real-time Flow Manager is '1'. When setting similarity diagnoses for two or more data diagnosis flows separately, the number of diagnoses exceeding the upper limit of the numbers in the above tables can be set.
- Reference waveform learning data created when performing waveform learning with the length of the reference waveform set to 'unit waveform width × 200' is used.
- The set diagnosis cycle is '5'.
- CPU usage rate when the upper limit is set depends on the number of CPU cores and the number of data diagnosis flows. The maximum CPU usage rate of Similar Waveform Recognition Tool is approximately as follows:
  100/number of CPU cores × number of diagnosis flows
- A value of the CPU usage rate is the average value of the CPU usage rate for 10 minutes after the diagnosis status turns into the 'similar' state or 'different' state from the 'preparing for diagnosis' state.

■ Using one industrial PC

• Industrial PC (operation-guaranteed environment)

Collection cycle (ms)	Data collector to use	Collection method	Measurement target	Unit waveform width (record)				
				200	400	600	800	1000
100	SLMP Data Collector (MELSEC connection)	—	Number of diagnoses	64	16	8	2	2
			CPU usage rate (%)	49	51	55	48	58

• Industrial PC (MELIPC MI5122-VW)

×: The data collector is not available under the given conditions.

—: No description since the data collector is unavailable under the given conditions.

Collection cycle (ms)	Data collector to use	Collection method	Measurement target	Unit waveform width (record)				
				200	400	600	800	1000
0.5	CC-Link IE TSN Data Collector	Cycle setting	Number of diagnoses	4	×	×	×	×
			CPU usage rate (%)	60	—	—	—	—
1	CC-Link IE Field Network Data Collector	Each link scan	Number of diagnoses	4	×	×	×	×
			CPU usage rate (%)	36	—	—	—	—
2	CC-Link IE Field Network Data Collector	Each link scan	Number of diagnoses	4	×	×	×	×
			CPU usage rate (%)	88	—	—	—	—
5	CC-Link IE Field Network Data Collector	Cycle specification	Number of diagnoses	8	1	×	×	×
			CPU usage rate (%)	71	53	—	—	—
10	CC-Link IE Field Network Data Collector	Cycle specification	Number of diagnoses	16	4	1	×	×
			CPU usage rate (%)	96	59	43	—	—
50	CC-Link IE Field Network Data Collector	Cycle specification	Number of diagnoses	64	16	4	2	2
			CPU usage rate (%)	86	54	26	19	28
100	SLMP Data Collector (MELSEC connection)	—	Number of diagnoses	64	16	8	4	4
			CPU usage rate (%)	27	96	62	39	37

For details on a data collector to use, refer to the following manuals.

📖SLMP Data Collector User's Manual

📖CC-Link IE Field Network Data Collector (MELIPC MI5122-VW) User's Manual

■ Using two separate industrial PCs

- Installation destination for Similar Waveform Recognition Tool: ☞ Page 415 Industrial PC (operation-guaranteed environment)
  Installation destination for Real-time Flow Manager: ☞ Page 415 Industrial PC (MELIPC MI1002-W)

Collection cycle (ms)	Data collector to use	Collection method	Measurement target	Unit waveform width (record)				
				200	400	600	800	1000
100	SLMP Data Collector (MELSEC connection)	—	Number of diagnoses	64	16	8	2	2
			CPU usage rate (%)	17	16	16	15	16

- Installation destination for Similar Waveform Recognition Tool: ☞ Page 415 Industrial PC (operation-guaranteed environment)
  Installation destination for Real-time Flow Manager: ☞ Page 415 Industrial PC (operation-guaranteed environment)

Collection cycle (ms)	Data collector to use	Collection method	Measurement target	Unit waveform width (record)				
				200	400	600	800	1000
100	SLMP Data Collector (MELSEC connection)	—	Number of diagnoses	64	16	8	2	2
			CPU usage rate (%)	20	14	10	10	11

- Installation destination for Similar Waveform Recognition Tool: ☞ Page 415 Industrial PC (operation-guaranteed environment)
  Installation destination for Real-time Flow Manager: ☞ Page 415 Industrial PC (MELIPC MI5122-VW)

Collection cycle (ms)	Data collector to use	Collection method	Measurement target	Unit waveform width (record)				
				200	400	600	800	1000
100	SLMP Data Collector (MELSEC connection)	—	Number of diagnoses	64	16	8	2	2
			CPU usage rate (%)	25	13	10	18	10

- Installation destination for Similar Waveform Recognition Tool: ☞ Page 415 Industrial PC (MELIPC MI5122-VW)
  Installation destination for Real-time Flow Manager: ☞ Page 415 Industrial PC (MELIPC MI1002-W)

Collection cycle (ms)	Data collector to use	Collection method	Measurement target	Unit waveform width (record)				
				200	400	600	800	1000
100	SLMP Data Collector (MELSEC connection)	—	Number of diagnoses	64	16	8	2	2
			CPU usage rate (%)	25	17	15	12	13

- Installation destination for Similar Waveform Recognition Tool: ☞ Page 415 Industrial PC (MELIPC MI5122-VW)
  Installation destination for Real-time Flow Manager: ☞ Page 415 Industrial PC (operation-guaranteed environment)

Collection cycle (ms)	Data collector to use	Collection method	Measurement target	Unit waveform width (record)				
				200	400	600	800	1000
100	SLMP Data Collector (MELSEC connection)	—	Number of diagnoses	64	16	8	2	2
			CPU usage rate (%)	25	50	28	16	21

• Installation destination for Similar Waveform Recognition Tool: ☞ Page 415 Industrial PC (MELIPC MI5122-VW)
Installation destination for Real-time Flow Manager: ☞ Page 415 Industrial PC (MELIPC MI5122-VW)

×: The data collector is not available under the given conditions.

—: No description since the data collector is unavailable under the given conditions.

Collection cycle (ms)	Data collector to use	Collection method	Measurement target	Unit waveform width (record)				
				200	400	600	800	1000
1	CC-Link IE Field Network Data Collector	Each link scan	Number of diagnoses	4	×	×	×	×
			CPU usage rate (%)	20	—	—	—	—
2	CC-Link IE Field Network Data Collector	Each link scan	Number of diagnoses	4	×	×	×	×
			CPU usage rate (%)	13	—	—	—	—
5	CC-Link IE Field Network Data Collector	Cycle specification	Number of diagnoses	8	1	×	×	×
			CPU usage rate (%)	13	10	—	—	—
10	CC-Link IE Field Network Data Collector	Cycle specification	Number of diagnoses	16	4	1	×	×
			CPU usage rate (%)	25	10	10	—	—
50	CC-Link IE Field Network Data Collector	Cycle specification	Number of diagnoses	64	16	4	2	2
			CPU usage rate (%)	40	18	13	10	10
100	SLMP Data Collector (MELSEC connection)	—	Number of diagnoses	64	16	8	4	4
			CPU usage rate (%)	18	10	18	13	13

For details on a data collector to use, refer to the following manuals.

📖SLMP Data Collector User's Manual

📖CC-Link IE Field Network Data Collector (MELIPC MI5122-VW) User's Manual

CPU usage rate

It is recommended to limit the CPU usage rate of the whole industrial PC to average 60% so that Similar Waveform Recognition Tool can be operated stably. If the CPU average usage rate exceeds 60%, review the settings and system configuration by referring this measurement result to reduce the load on the industrial PC.

■ Example for reducing the load on an industrial PC by modifying the settings

• Before modification

Installation destination for Similar Waveform Recognition Tool	Installation destination for Real-time Flow Manager	Unit waveform width (record)	Number of diagnoses	Collection cycle (ms)
☞ Page 415 Industrial PC (MELIPC MI5122-VW)	Same industrial PC as the installation destination for Similar Waveform Recognition Tool	400	16	100 (SLMP Data Collector (MELSEC connection))

• After modification (changing the unit waveform width and the number of diagnoses)

Installation destination for Similar Waveform Recognition Tool	Installation destination for Real-time Flow Manager	Unit waveform width (record)	Number of diagnoses	Collection cycle (ms)
☞ Page 415 Industrial PC (MELIPC MI5122-VW)	Same industrial PC as the installation destination for Similar Waveform Recognition Tool	600	8	100 (SLMP Data Collector (MELSEC connection))

■ Example for reducing the load on an industrial PC by modifying the system configuration

• Before modification

Installation destination for Similar Waveform Recognition Tool	Installation destination for Real-time Flow Manager	Unit waveform width (record)	Number of diagnoses	Collection cycle (ms)
☞ Page 415 Industrial PC (MELIPC MI5122-VW)	Same industrial PC as the installation destination for Similar Waveform Recognition Tool	400	16	100 (SLMP Data Collector (MELSEC connection))

• After modification (changing the installation destination for Real-time Flow Manager)

Installation destination for Similar Waveform Recognition Tool	Installation destination for Real-time Flow Manager	Unit waveform width (record)	Number of diagnoses	Collection cycle (ms)
☞ Page 415 Industrial PC (MELIPC MI5122-VW)	☞ Page 415 Industrial PC (MELIPC MI1002-W)	400	16	100 (SLMP Data Collector (MELSEC connection))

Real-time Statistic Diagnosis Tool

The following shows the processing performance and processing time of Real-time Statistic Diagnosis Tool.

Measurement conditions

■ Industrial PC

Refer to the following section.

☞ Page 415 Industrial PC (MELIPC MI5122-VW)

■ Parameter setting value

Setting item		Setting content
CSV file	Collection cycle	1000 ms
	Number of rows	10 to 36000 rows
	Number of variables	6 (excluding the time stamp column)
	Variable type	Numeric
Diagnosis contents		The following logics to diagnose MT distance: ❶ Multi trace statistic (statistic:range) ❷ MVA statistic (processing type: MT distance, target: 6 variables) ❸ Limit pair diagnostics (target: MT distance calculated in ❷) ❹ Write log and error notification

Processing performance

■ Diagnosis processing (per diagnosis)

(Unit: second)

Number of rows in a CSV file	Performance value
10	5.0
100	5.0
1000	5.0
10000	5.0
30000	5.0
36000	5.0

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Appendix 2 Available Characters

This section shows the characters available in Real-Time Data Analyzer.

Similar Waveform Recognition Tool

The following table shows the characters available in Similar Waveform Recognition Tool.

Screen	Item		Available/invalid character	Reference
Edgecross Link Setting	Port number		■Available characters • Single-byte characters (decimal)	Page 35 Edgecross Link Setting
	User name		■Available characters • Printable ASCII characters (0x20 to 0x7E)	
	Password		■Available characters • Printable ASCII characters (0x20 to 0x7E)	
Reference Waveform Learning Data File Creation setting	Folder to save the Reference Waveform File		■Available characters • Characters available for file paths in Windows	Page 63 Reference Waveform Learning Data File Creation Setting Screen
	Reference waveform		■Available characters • Single-byte characters (decimal)	
	Reference waveform learning data output file path	Output folder	■Available characters • Characters available for file paths in Windows	
		File Name	■Available characters • Characters available for file paths in Windows However, the reserved words described in the following section cannot be used. ☞ Page 426 Reserved words that cannot be used	
	Setting of reference waveform learning data creation	Learning period	■Available characters • Single-byte characters (decimal)	
		Unit waveform width	■Available characters • Single-byte characters (decimal)	
Publishing Data Setting	Setting name		■Available characters • Characters available for file names in Windows	Page 66 Publishing Data Setting Screen
	Diagnosis execution cycle		■Available characters • Single-byte characters (decimal)	

Screen	Item		Available/invalid character	Reference
Operation Settings	Setting name		■Invalid characters • Space • ASCII control code (U+0000 to U+001F), DEL(U+007F)	Page 69 Operation Setting Screen
	Reference waveform learning data file		■Available characters • Characters available for file names in Windows However, the reserved words described in the following section cannot be used. ☞ Page 426 Reserved words that cannot be used	
	I/O setting	Response Data Name	■Invalid characters • , (comma), space • ASCII control code (U+0000 to U+001F), DEL(U+007F) • Unicode (U+00A0, U+00AD, U+2028, U+2029)	
	Diagnosis operation setting	Detection sensitivity setting (when entering a value directly)	■Available characters • Single-byte characters (decimal) • . (period)	
	Diagnosis result file saving setting	Number of digits after decimal point	■Available characters • Single-byte characters (decimal)	
		Switched when the following number of rows (records) is exceeded.	■Available characters • Single-byte characters (decimal)	
		Switching cycle setting	■Available characters • Single-byte characters (decimal)	
		Max. number of save files (when exceeded, the oldest file is deleted.)	■Available characters • Single-byte characters (decimal)	
		Save destination folder	■Available characters • Characters available for file names in Windows	
		Prefix of file name	■Available characters • Characters available for file names in Windows However, the reserved words described in the following section cannot be used. ☞ Page 426 Reserved words that cannot be used	
Diagnosis stop condition setting	Constant value	For the following data types: • INT • UINT • DINT • UDINT	■Available characters • Numerals (decimal) • +, -	Page 74 Diagnosis Stop Condition Setting Screen
		For the following data types: • REAL • LREAL	■Available characters • Numerals (decimal) • e, E • +, - • . (period)	
		For the STRING type	■Available characters Printable ASCII characters (0x20 to 0x7E)	
		For the WSTRING type	■Invalid characters Unicode(U+0000 to U+001F, U+007F to U+00A0, U+00AD, U+2028, U+2029)	

Reserved words that cannot be used

Reserved word
CON
AUX
COM0
COM1
COM2
COM3
COM4
COM5
COM6
COM7
COM8
COM9
LPT0
LPT1
LPT2
LPT3
LPT4
LPT5
LPT6
LPT7
LPT8
LPT9
PRN
NUL

Real-time Statistic Diagnosis Tool

The following table shows the characters available in Real-time Statistic Diagnosis Tool.
For the characters that can be entered when setting parameters of each primitive for logic editing, refer to the following section.

☞ Page 429 Primitive parameters

Operation		Item	Available/invalid character	Reference
Folder definition		Reader equipment data folder	■Invalid characters • ", *, /, <, >, ?, |	Page 128 Folder Definition
		CSV input folder		
		RSD dataset folder		
Adding a unit definition		Sample CSV file	■Invalid characters • ", *, /, <, >, ?, |	Page 130 Adding a Unit Definition
		Reading target CSV file name	■Invalid characters • ", /, :, <, >, ?, \, |	
		Unit name	■Invalid characters • Space • Single-byte katakana • Double-byte character • !, ", #, $, %, &, ', (,), *, +, , (comma), ., /, :, ;, <, =, >, ?, @, [, \,], ^, _, `, {, |, }, ~ However, the reserved words described in the following section cannot be used. ☞ Page 430 Reserved words that cannot be entered	
Editing settings	Adding variables	Sample CSV file	■Invalid characters • ", *, /, <, >, ?, |	Page 147 Adding variables
		Reading target CSV file name	■Invalid characters • ", /, :, <, >, ?, \, |	
	Defining an extended section	Extended section name	■Invalid characters • Space • Single-byte katakana • Double-byte character • !, ", #, $, %, &, ', (,), *, +, , (comma), ., /, :, ;, <, =, >, ?, @, [, \,], ^, _, `, {, |, }, ~ However, the reserved words described in the following section cannot be used. ☞ Page 430 Reserved words that cannot be entered	Page 154 Defining an extended section
Editing an SPC specification value		Upper limit	■Available characters • Numerals (decimal) • e, E • +, - • . (period)	Page 197 Editing an SPC specification value
		Target		
		Lower limit		
		Sigma		
Creating a correlation matrix (creating a whole matrix)		Matrix storage folder	■Invalid characters • ", *, /, <, >, ?, | However, the reserved words described in the following section cannot be used. ☞ Page 430 Reserved words that cannot be entered	Page 221 Creating whole matrix
		Reading folder	■Invalid characters • ", *, /, <, >, ?, |	
		Please input Matrix name first.	■Invalid characters • ", *, /, :, <, >, ?, \, | However, the reserved words described in the following section cannot be used. ☞ Page 430 Reserved words that cannot be entered	
		Variable matrix name		

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Operation		Item	Available/invalid character	Reference
Creating a correlation matrix (creating a partial matrix)		Partial matrix name (It is possible to save it also with Enter key).	■Invalid characters • ", *, /, :, <, >, ?, \, | However, the reserved words described in the following section cannot be used. ☞ Page 430 Reserved words that cannot be entered	Page 227 Creating partial matrix
Logic editing (creating a logic)		Logic name	■Invalid characters*1 • ", *, /, :, <, >, ?, \, | However, the reserved words described in the following section cannot be used. ☞ Page 430 Reserved words that cannot be entered	Page 253 Creating logic
		Output	■Invalid characters*1 • ", *, /, :, <, >, ?, \, |	
Logic variable setting		Variable name	■Invalid characters*1 • ", *, /, :, <, >, ?, \, |	Page 352 Screen configuration
Logic variable setting (selecting and setting a variable type)	—	Variable name	■Invalid characters*1 • ", *, /, :, <, >, ?, \, |	Page 353 Selecting and setting variable type
	When setting an execution conversion table	Upper limit	■Available characters • -, . (period) • 0 to 9	Page 354 Setting up execution conversion table
		Lower limit	■Available characters • -, . (period) • 0 to 9	
Logic setting		Specify the folder that saves a pop up error log.	■Invalid characters • ", *, /, <, >, ?, | However, the reserved words described in the following section cannot be used. ☞ Page 430 Reserved words that cannot be entered	Page 385 Logic Setting
Monitor setting	Logic setting	Specify the folder that saves a pop up error log.	■Invalid characters • ", *, /, <, >, ?, | However, the reserved words described in the following section cannot be used. ☞ Page 430 Reserved words that cannot be entered	Page 410 Logic setting
		The logic name to be automatically started is set to * (wild card).	■Invalid characters • ", /, :, <, >, ?, \	
	Diagnosis result detail information file setting	Specify the folder in which the diagnosis result detail information file is saved.	■Invalid characters • ", *, /, <, >, ?, | However, the reserved words described in the following section cannot be used. ☞ Page 430 Reserved words that cannot be entered	Page 411 Diagnosis result detail information file setting

*1 The following symbols cannot be entered.
", *, /, :, <, >, ?, \, |

Primitive parameters

The following table shows the characters that can be entered when setting parameters of each primitive for logic editing.

Primitive	Item	Available/invalid character	Reference
Waveform conversion (when selecting "Wave statistic operation" for "Conversion type")	Expression	■Invalid characters • Single-byte alphabetical characters (upper-case characters) • Single-byte katakana • Double-byte character • !, ", #, $, %, &, ', , (comma), ., :, ;, <, =, >, ?, @, [, \,], _, `, {, |, }, ~	Setting items when selecting "Wave statistic operation" for "Conversion type"
Multi-section calculation	Expression	■Invalid characters • Single-byte alphabetical characters (upper-case characters) • Single-byte katakana • Double-byte character • !, ", #, $, %, &, ', , (comma), ., :, ;, <, =, >, ?, @, [, \,], _, `, {, |, }, ~	Page 308 Multi-section calculation
Calculation in present section	Expression	■Invalid characters • Single-byte alphabetical characters (upper-case characters) • Single-byte katakana • Double-byte character • !, ", #, $, %, &, ', , (comma), ., :, ;, <, =, >, ?, @, [, \,], _, `, {, |, }, ~	Page 309 Calculation in present section
Regression operation	Matrix including regression equation	■Invalid characters • ", *, /, <, >, ?, |	Page 312 Regression operation
MVA statistic	Criterion matrix	■Invalid characters • ", *, /, <, >, ?, |	Page 313 MVA statistic
Save CSV data	Specify CSV output file name.	■Invalid characters • ", *, /, <, >, ?, |	Page 335 Save CSV data
Write template	Output folder	■Invalid characters • ", *, /, <, >, ?, |	Page 340 Write template
	File name	■Invalid characters • ", *, /, :, <, >, ?, \, |	
Parametrical conversion	Conversion table	■Invalid characters • ", *, /, <, >, ?, |	Page 342 Parametrical conversion
Read measurement data.	Specify data folder	■Invalid characters • ", *, /, <, >, ?, |	Page 346 Read measurement data

Reserved words that cannot be entered

Reserved word
CON
AUX
COM0
COM1
COM2
COM3
COM4
COM5
COM6
COM7
COM8
COM9
LPT0
LPT1
LPT2
LPT3
LPT4
LPT5
LPT6
LPT7
LPT8
LPT9
PRN
NUL

Appendix 3 Environment Settings for an Industrial PC where Real-time Data Analyzer Runs

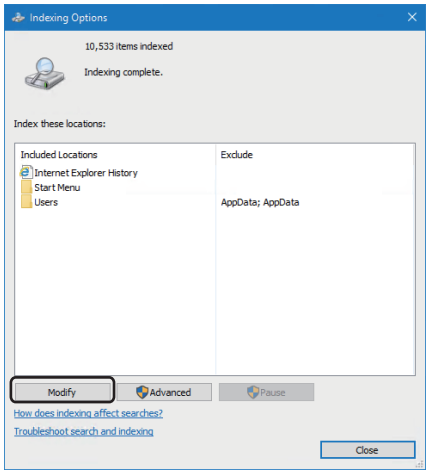
This section shows the environment settings for an industrial PC where Real-time Data Analyzer runs.

Settings for indexes created for Windows Search

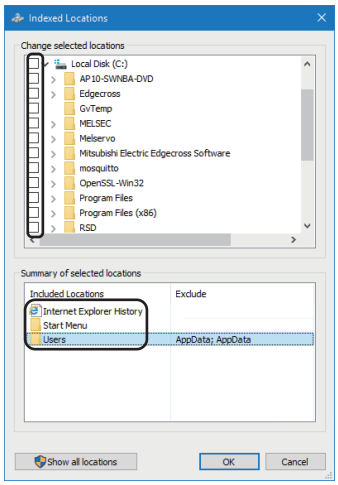
The load due to indexes created for Windows Search which is one of the standard features of Windows 10 may affect operations of Real-time Data Analyzer, therefore, change the setting as necessary.

Operating procedure

1. Open the control panel and change the setting of "View by" to "Small Icons".
2. Select "Indexing Options".
3. Click the [Modify] button.



4. Select a location in "Summary of selected locations", and unselect the checkbox of a folder where index does not need to be created in "Change selected locations".
5. Repeat step 4 for all locations displayed in "Summary of selected locations".



6. Click the [OK] button.

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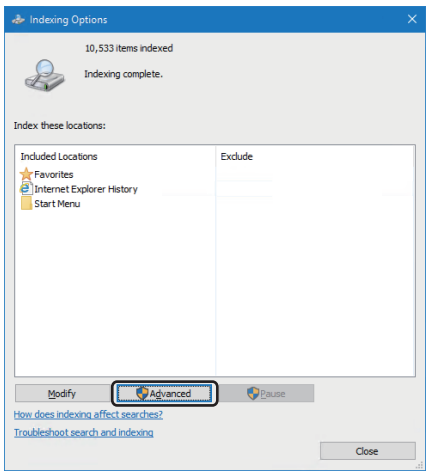
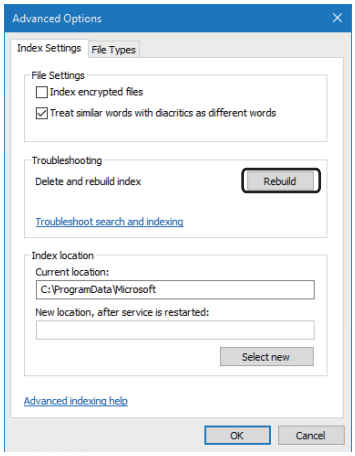
7. Click the [Advanced] button.

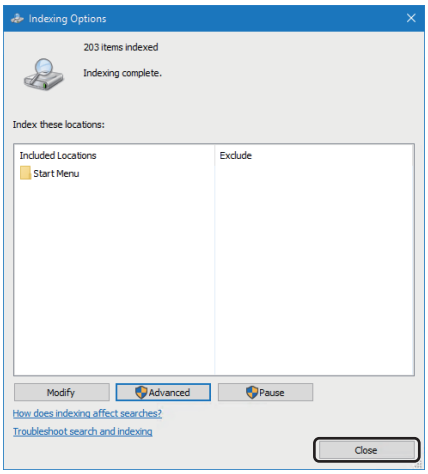


8. Click the [Rebuild] button.



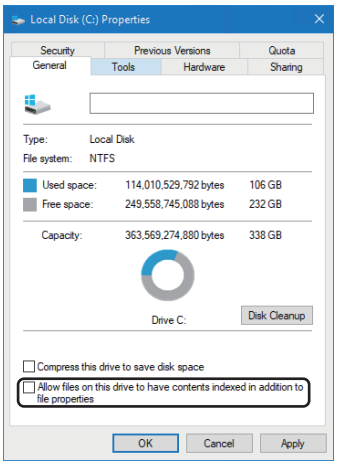
9. Click the [OK] button in the "Rebuild Index" screen.

10. Click the [Close] button.



11. To exclude the contents of a file from a search, right-click the C drive in Windows Explorer and select [Properties].

12. Unselect the checkbox of "Allow files on this drive to have contents indexed in addition to file properties", and click the [OK] button.



13. Click the [OK] button in the "Confirm Attribute Changes" screen.

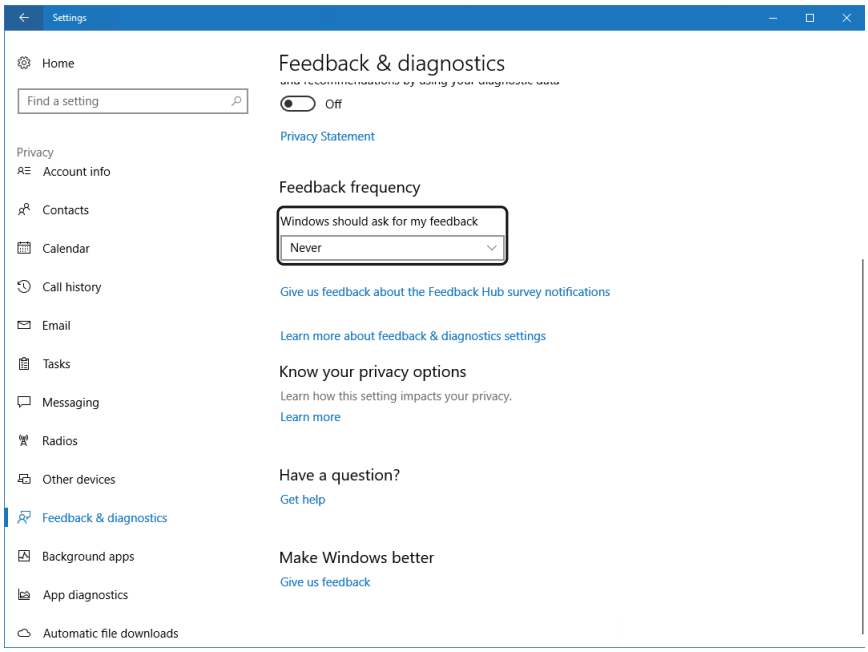
Settings for the Customer Experience Improvement Program

The Customer Experience Improvement Program which is one of the standard features of Windows 10 may affect operations of Real-time Data Analyzer, therefore, disable the setting as necessary.

Operating procedure

1. Change the setting of "Windows should ask for my feedback" to "Never".

Select [Privacy] ⇨ [Feedback & diagnostics] in Windows settings.



2. Restart the industrial PC.

Appendix 4 System Configuration and Application Settings for Operation of Real-time Data Analyzer

When operating Real-time Data Analyzer with other Edge applications, the load on an industrial PC may increase depending on the settings; an error or data corruption may occur in each application.
It is recommended to set each application to limit the CPU and memory usage rate of the whole industrial PC to average 60%[*1] so that each application can be operated stably.
This section shows the examples of system configurations and application settings to stabilize operation.

*1 If the usage rate exceeds 60%, it is recommended to cooperate with Real-time Flow Manager that is installed in another industrial PC.

System configuration

Diagnose and monitor the operation status of one production line that consists of ten devices simultaneously in a MELIPC.

Item	Content
Industrial PC	MELIPC MI5122-VW
Access target device	QCPU×10 (via QJ71E71-100)
Data collector	SLMP Data Collector
Edge application	Real-time Data Analyzer
	MC Works64 EdgeComputing Edition

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Application settings

Purpose	Application	Description		
Diagnostic	• Real-time Data Analyzer • Edgecross Basic Software (Data diagnosis flow) • GX LogViewer	■Data diagnosis flow setting No.1		
		Collection interval	500 milliseconds	
		Number of collection points	100	
		Diagnostic method	Real-time Statistic Diagnosis Tool (MT method)	
			Setting or not setting for an extended section	Not set
			Reading target variable	100 variables
			Statistic extraction	Multi trace statistic (Calculate from 6 variables in each section)
			Criterion matrix size	6 columns×105 rows
		Number of pieces of feedback	1	
		■Data diagnosis flow setting No.2		
		Collection interval	500 milliseconds	
		Number of collection points	100	
		Diagnostic method	Similar Waveform Recognition Tool	
			Data type of diagnosis target data	REAL
			Number of diagnoses	1
		Monitoring or not monitoring the result of a similar waveform recognition in GX LogViewer	Not set	
		Number of pieces of feedback	1	
Monitor	• MC Works64 EdgeComputing Edition • Edgecross Basic Software (Management Shell)	Number of monitoring items	1400	
			Details	
			Data display (GraphWorX)	200
			Alarm monitoring (AlarmWorX Server)	300
			Logging (MC Historian)	900 (Data collection rate: 1 second)
		Number of display screens	1	
			Screen display and setting content	
			Data display (Process Point)	200
			Alarm list display (AlarmWorX64 Viewer)	Real Time Alarm display
				Animation Speed (1000 milliseconds)
			Graph display (TrendWorX64 Viewer)	four line graphs (using logging data)
				Trend Range and Period: 5 minutes
				Animation Speed: 1 second
				History Read Rate: 5 seconds
				Screen Update Interval (Scan Rate) 1000 milliseconds
			3D View	Not set
Data storing	• Edgecross Basic Software (data logging flow)	■Data logging flow setting No.1 to No.2		
		Collection interval	500 milliseconds	
		Number of collection points	100	
		Data storing format	File	

Corrective actions for high load on an industrial PC

When the load on an industrial PC is high, perform the following operations:

- Refer to 'The load on an industrial PC is high.' described in the following section, and take the corrective action.
  (☞ Page 98 TROUBLESHOOTING BY SYMPTOM)
- Refer to 'TROUBLESHOOTING' in the following manual, and reduce the load.
  (📖MC Works64 Version 4 Startup Manual)

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❸ mosquitto (☞ Page 440 mosquitto)
❹ LabVIEW Runtime, LabWindows/CVI Runtime (☞ Page 444 LabVIEW Runtime, LabWindows/CVI Runtime)
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Appendix 6 Supported Edgecross Basic Software Version

This section shows the version of Edgecross Basic Software supported by Real-time Data Analyzer.

Similar Waveform Recognition Tool

The following table shows the version of Edgecross Basic Software supported by Similar Waveform Recognition Tool.

Similar Waveform Recognition Tool version*1	Edgecross Basic Software version*2
1.00A or later	1.00 or later

*1 It can be checked by selecting [Help] ⇨ [Version Information] in the screen shown in the following section:
☞ Page 33 Home screen

*2 For the checking method, refer to the following:
📖Edgecross Basic Software for Windows User's Manual

Real-time Statistic Diagnosis Tool

The following table shows the version of Edgecross Basic Software supported by Real-time Statistic Diagnosis Tool.

Real-time Statistic Diagnosis Tool version*1	Edgecross Basic Software version*2
1.00A or later	1.00 or later

*1 It can be checked by selecting [Help] ⇨ [Version Information] in the screen shown in the following section:
☞ Page 111 Analyzer

*2 For the checking method, refer to the following:
📖Edgecross Basic Software for Windows User's Manual

Appendix 7 Added and Changed Functions

This section shows the added and changed functions of Real-time Data Analyzer.

Added/changed contents	Version	Reference
■Similar Waveform Recognition Tool • Data in nanoseconds can be used.	1.02C	Page 62 CREATING REFERENCE WAVEFORM LEARNING DATA
■Real-time Statistic Diagnosis Tool • The programmable controller CPU cooperation function is supported.	1.03D	Page 386 Programmable Controller CPU Cooperation Function
Cooperation with Real-time Flow Manager installed in another industrial PC is supported.	1.05F	Page 44 PROCEDURE TO USE Similar Waveform Recognition Tool Page 113 PROCEDURE TO USE Real-time Statistic Diagnosis Tool
■Similar Waveform Recognition Tool • A similarity diagnosis can be paused.		Page 43 Pause of Similarity Diagnosis Page 74 Diagnosis Stop Condition Setting Screen
■Real-time Statistic Diagnosis Tool • Programmable controller CPU cooperation function: A multiple regression analysis is supported.		Page 393 Multiple regression analysis
■Real-time Statistic Diagnosis Tool • The project file setting utility is supported.		Page 121 Project File Setting Utility
■Real-time Statistic Diagnosis Tool • Read data and analysis result data can be output to an external media.		Page 128 Folder Definition
■Real-time Statistic Diagnosis Tool • Multiple regression analysis: P-values can be output.		Page 239 Screen configuration
■Similar Waveform Recognition Tool • Diagnosis information (inspection waveform and diagnosis result) can be constantly output to a file.	1.08J	Page 69 Operation Setting Screen Page 81 When "Fixed cycle output" is selected for "Output Settings"
■Similar Waveform Recognition Tool • Response data: Diagnosis results can be output.		Page 14 Similar Waveform Recognition Tool Page 75 RESPONSE DATA SETTING
■Similar Waveform Recognition Tool • "Operation Settings" screen: The similarity score threshold that corresponds to the detection sensitivity can be displayed.		Page 69 Operation Setting Screen
■Real-time Statistic Diagnosis Tool • Variables can be added to the set unit definition.		Page 147 Adding variables
■Real-time Statistic Diagnosis Tool • A function that edits the SPC specification values is supported.		Page 197 Editing an SPC specification value
■Real-time Statistic Diagnosis Tool • If an error is detected during a simple diagnosis, detailed information when the error occurred can be output to a file		Page 16 Real-time Statistic Diagnosis Tool Page 411 Diagnosis result detail information file setting

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REVISIONS

*The manual number is given on the bottom left of the back cover.

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May 2018	SH(NA)-081873ENG-A	First edition
May 2018	SH(NA)-081873ENG-B	Partial correction
September 2018	SH(NA)-081873ENG-C	■Added or modified parts Section 16, Section 19.4, Appendix 2, Appendix 3, Appendix 5
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