OMRON

Data Mining Software

AI Controller Data Mining Software

Operation Manual

SYSMAC-AICSTENGE☐☐L
SYSMAC-AICMSENGE☐☐L

sysmac
always in control

W612-E1-04

Introduction

Thank you for purchasing the AI Controller Data Mining Software.
This manual contains information that is necessary to use the AI Controller Data Mining Software.
Please read this manual and make sure you fully understand the functionality and performance before you attempt to use it in a control system.
Keep this manual in a safe place where it will be available for reference during operation.

Intended Audience

This manual is intended for the following personnel, who must also have knowledge of electrical systems (an electrical engineer or the equivalent).
• Personnel in charge of introducing FA systems.
• Personnel in charge of designing FA systems.
• Personnel in charge of installing and maintaining FA systems.
• Personnel in charge of managing FA systems and facilities.

For programming, this manual is intended for personnel who understand the programming language specifications in international standard IEC 61131-3 or Japanese standard JIS B 3503, and who have knowledge about artificial intelligence.

Notice

This manual contains information that is necessary to use the AI Controller Data Mining Software. Please read and understand this manual before using the software. Keep this manual in a safe place where it will be available for reference during operation.

Manual Structure

Page Structure and Symbols

The following page structure is used in this manual.
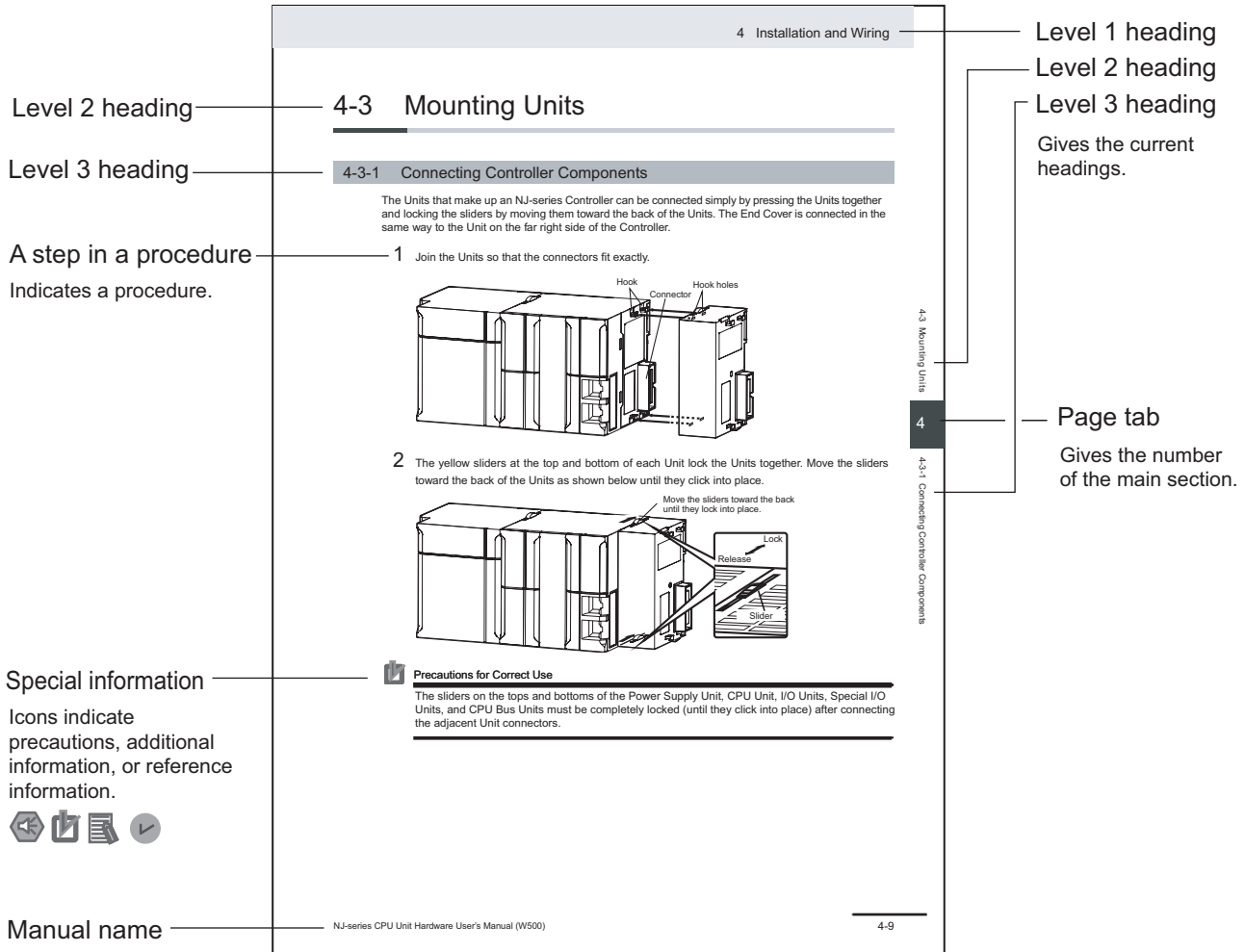
This illustration is provided only as a sample. It may not literally appear in this manual.

Special Information

Special information in this manual is classified as follows:

Precautions for Safe Use

Precautions on what to do and what not to do to ensure safe usage of the product.

Precautions for Correct Use

Precautions on what to do and what not to do to ensure proper operation and performance.

Additional Information

Additional information to read as required.

This information is provided to increase understanding or make operation easier.

Version Information

Information on differences in specifications and functionality for Controller with different unit versions and for different versions of the Sysmac Studio is given.

Precaution on Terminology

- In this manual, the functions of a specific model of the NX-series CPU Units/Controllers may be described with its model specified, such as "NX701 CPU Unit/Controller".
- In this manual, the Controller functions that are integrated in the NY-series Industrial PC may be referred to as an "NY-series Controller".
- The AI Controller Data Mining Software supports the NX/NY-series Controllers. Unless another Controller series is specified, the operating procedures and screen captures used in the manual are examples of the NY-series AI Controllers.

Terminology

For descriptions of the Controller terms that are used in this manual, refer to information on terminology in the manuals that are listed in *Related Manuals* on page 17.

Sections in this Manual

1	Overview of the AI Controller Data Mining Software
2	Basic Operation of the AI Controller Data Mining Software
3	Functions of the AI Easy Modeler
4	Functions of the AI Easy Modeler for Model Setting
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Section 2   Basic Operation of the AI Controller Data Mining Software

Section 3 Functions of the AI Easy Modeler

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Terms and Conditions Agreement

WARRANTY

- The warranty period for the Software is one year from the date of purchase, unless otherwise specifically agreed.
- If the User discovers defect of the Software (substantial non-conformity with the manual), and return it to OMRON within the above warranty period, OMRON will replace the Software without charge by offering media or download from OMRON's website. And if the User discovers defect of media which is attributable to OMRON and return it to OMRON within the above warranty period, OMRON will replace defective media without charge. If OMRON is unable to replace defective media or correct the Software, the liability of OMRON and the User's remedy shall be limited to the refund of the license fee paid to OMRON for the Software.

LIMITATION OF LIABILITY

- THE ABOVE WARRANTY SHALL CONSTITUTE THE USER'S SOLE AND EXCLUSIVE REMEDIES AGAINST OMRON AND THERE ARE NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE. IN NO EVENT, OMRON WILL BE LIABLE FOR ANY LOST PROFITS OR OTHER INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF USE OF THE SOFTWARE.
- OMRON SHALL HAVE NO LIABILITY FOR DEFECT OF THE SOFTWARE BASED ON MODIFICATION OR ALTERNATION TO THE SOFTWARE BY THE USER OR ANY THIRD PARTY. OMRON SHALL NOT BE RESPONSIBLE AND/OR LIABLE FOR ANY LOSS, DAMAGE, OR EXPENSES DIRECTLY OR INDIRECTLY RESULTING FROM THE INFECTION OF OMRON PRODUCTS, ANY SOFTWARE INSTALLED THEREON OR ANY COMPUTER EQUIPMENT, COMPUTER PROGRAMS, NETWORKS, DATABASES OR OTHER PROPRIETARY MATERIAL CONNECTED THERETO BY DISTRIBUTED DENIAL OF SERVICE ATTACK, COMPUTER VIRUSES, OTHER TECHNOLOGICALLY HARMFUL MATERIAL AND/OR UNAUTHORIZED ACCESS.
- OMRON SHALL HAVE NO LIABILITY FOR SOFTWARE DEVELOPED BY THE USER OR ANY THIRD PARTY BASED ON THE SOFTWARE OR ANY CONSEQUENCE THEREOF.

APPLICABLE CONDITIONS

USER SHALL NOT USE THE SOFTWARE FOR THE PURPOSE THAT IS NOT PROVIDED IN THE ATTACHED USER MANUAL.

CHANGE IN SPECIFICATION

The software specifications and accessories may be changed at any time based on improvements and other reasons.

ERRORS AND OMISSIONS

The information in this manual has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.

Safety Precautions

Definition of Precautionary Information

The following notation is used in this manual to provide precautions required to ensure safe usage of the AI Controller Mining Software and the Artificial Intelligence Machine Automation Controller.
The safety precautions that are provided are extremely important to safety. Always read and heed the information provided in all safety precautions.
The following notation is used.

⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. Additionally, there may be severe property damage.
⚠ CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

Precautions for Safe Use

Indicates precautions on what to do and what not to do to ensure safe usage of the product.

Precautions for Correct Use

Indicates precautions on what to do and what not to do to ensure proper operation and performance.

Symbols

🚫	The ⊘ symbol indicates operations that you must not do. The specific operation is shown in the ⊘ symbol and explained in text. This example indicates prohibiting disassembly.
⚡	The △ symbol indicates precautions (including warnings). The specific operation is shown in the △ symbol and explained in text. This example indicates a precaution for electric shock.
⚠	The △ symbol indicates precautions (including warnings). The specific operation is shown in the △ symbol and explained in text. This example indicates a general precaution.
❗	The ● symbol indicates operations that you must do. The specific operation is shown in the ● symbol and explained in text. This example shows a general precaution for something that you must do.

WARNINGS

⚠ WARNING

| To prevent computer viruses, install antivirus software on a computer where you use this software. Make sure to keep the antivirus software updated. | ❗ |

| Keep your computer's OS updated to avoid security risks caused by a vulnerability in the OS. | ❗ |

| Always use the highest version of this software to add new features, increase operability, and enhance security. | ❗ |

| Manage usernames and passwords for this software carefully to protect them from unauthorized uses. | ❗ |

| Set up a firewall (E.g., disabling unused communication ports, limiting communication hosts, etc.) on a network for a control system and devices to separate them from other IT networks. Make sure to connect to the control system inside the firewall. | ❗ |

| Use a virtual private network (VPN) for remote access to a control system and devices from this software. | ❗ |

Precautions for Safe Use

Operation

- Confirm that the controlled system will not be adversely affected before you perform any of the following operations.
  - a) Changing the operating mode of the CPU Unit (including changing the Startup Mode)
  - b) Change the settings
- Before you use the system for the actual operation, make sure to verify that errors can be correctly detected by using the results analyzed by this tool. Upon verification, set the machine learning engine to start reading learning data and parameters. Inappropriate settings will result in misjudging errors.
- Before you start the operation, make sure to transfer parameters and data necessary for resuming the operation to the replaced CPU Unit.
- When you restore only part of the data that was backed up, confirm that no problems will occur if you do not restore all of the backup data. Otherwise, malfunction of the device may occur.

Unit Replacement

- The performance may be different if the hardware revisions are different. Before you transfer the user program, data, and parameter settings to the CPU Units with the different hardware revisions, check them for proper execution and then use them for actual operation.

Precautions for Correct Use

Observe the following precautions before you start the AI Controller Data Mining Software or any of the Support Software that is provided with it.

- Exit all applications that are not necessary to use the AI Controller Data Mining Software. For virus checker or other software that could affect the startup and operations of the AI Controller Data Mining Software, take measures such as to remove the AI Controller Data Mining Software from the scope of virus checking.
- If any hard disks or printers that are connected to the computer are shared with other computers on a network, isolate them so that they are no longer shared.
- With some notebook computers, the default settings do not supply power to the USB port or Ethernet port to save energy. There are energy-saving settings in Windows, and also sometimes disable all energy-saving features. Refer to the user documentation for your computer and disable all energy-saving features.

Regulations and Standards

Software Licenses and Copyrights

This product incorporates certain third party software. The license and copyright information associated with this software is available at ThirdPartyLicenses.txt in DVD media.

Versions

Hardware revisions and unit versions are used to manage the hardware and software in NX/NY-series Units and EtherCAT slaves. The hardware revision or unit version is updated each time there is a change in hardware or software specifications. Even when two Units or EtherCAT slaves have the same model number, they will have functional or performance differences if they have different hardware revisions or unit versions.

Checking Versions

You can check versions on the ID information indications or with the Sysmac Studio.

Checking Unit Versions on ID Information Indications

The unit version is given on the ID information indication on the side of the product.

● **Checking the Unit Version of an NX-series CPU Unit**

The ID information on an NX-series NX701-Z□□□ CPU Unit is shown below.

ID information indication

Lot number   Serial number   Unit version

LOT No.   DDMYY □   xxxx   Ver.1.□□

AI Controller version → AIC Ver.1.□□   HW Rev.□

PORT1 : □□□□□□□□□□□□
PORT2 : □□□□□□□□□□□□

MAC address   Hardware revision
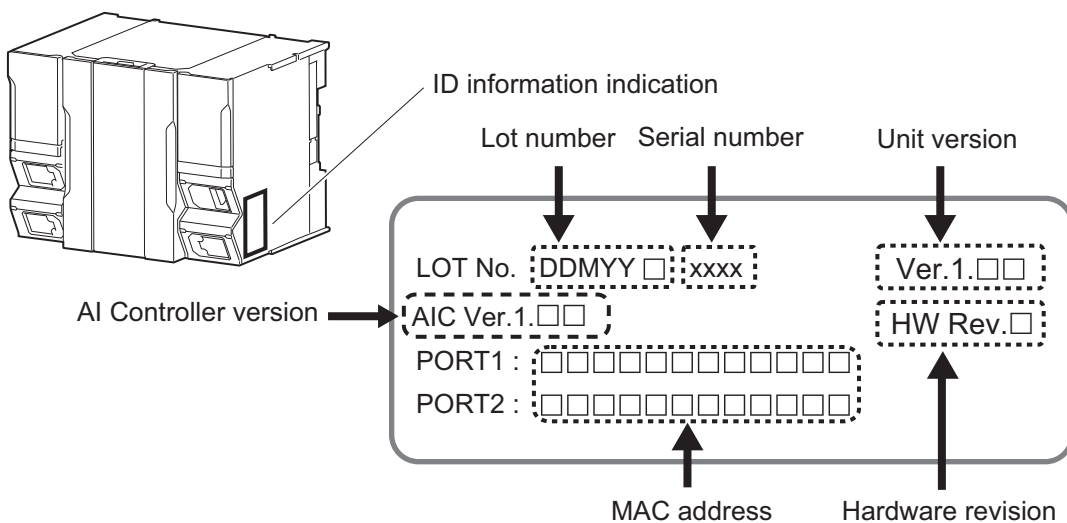
● **Checking the Unit Version of an NY-series Controller**

The ID information on an NY-series NY5□2-Z□□□ Controller is shown below.

ID information indication

Unit version   AI Controller version

LOT No.   DDMYY□ <<<<   Ver. X.XX   AIC Ver.1.□□

Serial number
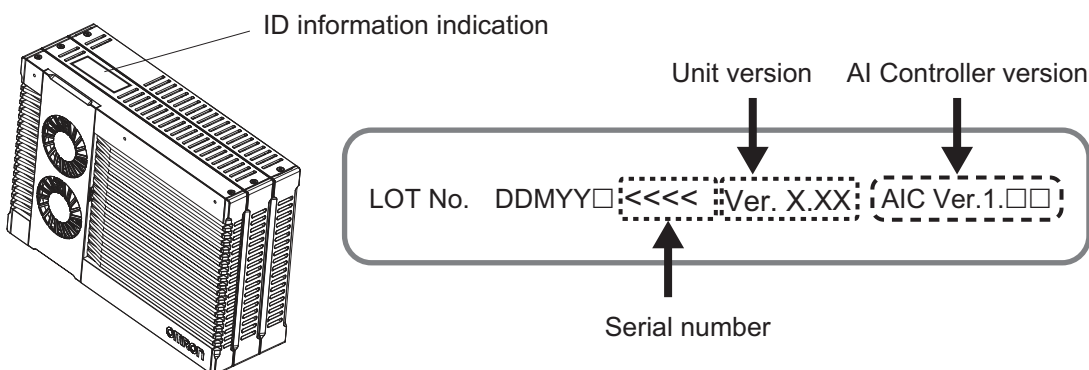
Checking Unit Versions with the Sysmac Studio

You can use the Sysmac Studio to check unit versions. The procedure is different for Units and for EtherCAT slaves.

● Checking the Unit Version of an NX-series CPU Unit

You can use the **Production Information** while the Sysmac Studio is online to check the unit version of a Unit. You can do this for the following Unit.

Model	Unit for which version can be checked
NX701-□□□□	CPU Unit

1 Right-click **CPU Rack** under **Configurations and Setup** - **CPU/Expansion Racks** in the Multi-view Explorer and select **Display Production Information**.
The **Production Information** Dialog Box is displayed.

● Checking the Unit Version of an NY-series Controller

You can use the **Production Information** while the Sysmac Studio is online to check the unit version of a Unit. You can only do this for the Controller.

1 Right-click **CPU Rack** under **Configurations and Setup** - **CPU/Expansion Racks** in the Multi-view Explorer and select **Display Production Information**.
The **Production Information** Dialog Box is displayed.

● Changing Information Displayed in Production Information Dialog Box

1 Click the **Show Outline** or **Show Detail** Button at the lower right of the **Production Information** Dialog Box.
The view will change between the **Production Information** details and outline.
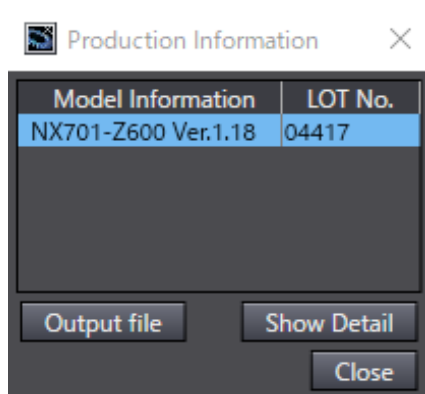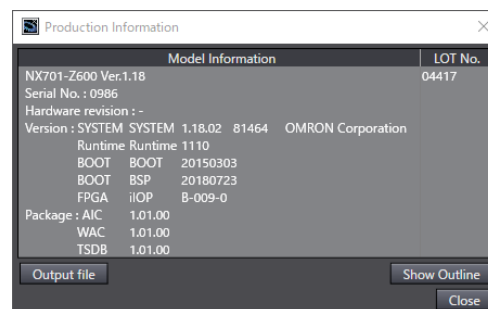
Outline View   Detail View

The information displayed is different for the Outline View and the Detail View. The Detail View displays both the unit version and the AI Controller version. The Outline View displays only the unit versions.

Note The hardware revision is separated by "/" and is displayed on the right of the hardware version. The hardware revision is not displayed for the Unit that the hardware revision is in blank.

Related Manuals

The following manuals are related. Use these manuals for reference.

Manual name	Cat. No.	Model numbers	Application	Description
NJ/NX-series CPU Unit Software User's Manual	W501	NX701-☐☐☐☐ NX102-☐☐☐☐ NX1P2-☐☐☐☐ NJ501-☐☐☐☐ NJ301-☐☐☐☐ NJ101-☐☐☐☐	Learning how to program and set up an NJ/NX-series CPU Unit. Mainly software information is provided.	The following information is provided on a Controller built with an NJ/NX-series CPU Unit. • CPU Unit operation • CPU Unit features • Initial settings • Programming based on IEC 61131-3 language specifications
Sysmac Studio Version 1 Operation Manual	W504	SYSMAC-SE2☐☐☐	Learning about the operating procedures and functions of the Sysmac Studio.	Describes the operating procedures of the Sysmac Studio.
Sysmac Library AI Predictive Maintenance Library User's Manual	W610	SYSMAC-ZPA00☐000W	Learning about the specifications of the AI Predictive Maintenance Libraries and function blocks	Information necessary to use AI predictive maintenance library is provided.
AI Controller Standard Software Operation Manual	W611	SYSMAC-AICST☐☐☐L	Learning about the overview of the AI Controller Standard Software and how to use it	This manual describes the overview of the AI Controller Standard Software (AI Operator, AI Viewer), how to install the software, basic operations, connections, and how to use the main functions.
NX/NY-series Artificial Intelligence Machine Automation Controller User's Manual	W594	NX701-Z☐☐☐ NY532-Z☐☐☐ NY512-Z☐☐☐	Learning about the NX/NY-series Artificial Intelligence Machine Automation Controllers	This manual describes the overview of the NX/NY-series Artificial Intelligence Machine Automation Controllers, the specifications of the AI functions, how to start the system, and maintenance and error details.
NY-series IPC Machine Controller Industrial Panel PC / Industrial Box PC Software User's Manual	W558	NY532-☐☐☐☐ NY512-☐☐☐☐	Learning how to program and set up the Controller functions of an NY-series Industrial PC.	The following information is provided on the NY-series Controller functions. • Controller operation • Controller features • Controller settings • Programming based on IEC 61131-3 language specifications

Revision History

A manual revision code appears as a suffix to the catalog number on the front and back covers of the manual.

Cat. No. **W612-E1-04**

↑ Revision code

Revision code	Date	Revised content
01	October 2018	Original production
02	April 2021	Revisions for an upgrade to AI Controller Data Mining Software version 1.01.
03	April 2022	Revisions for an upgrade to AI Controller Data Mining Software version 1.02.
04	October 2022	Revisions for adding safety precautions regarding security.

Overview of the AI Controller Data Mining Software

This section provides an overview and lists the specifications of the AI Controller Data Mining Software and describes its features and components.

1-1 The AI Controller Data Mining Software

The AI Controller Data Mining Software is designed for the Artificial Intelligence Machine Automation Controller (abbreviation: AI Controller) to perform predictive maintenance on the system and is used in the data analysis phase.
Refer to the *NX/NY-series Artificial Intelligence Machine Automation Controller USER'S MANUAL (Cat. No. W594)* for AI Controller system configuration.

Main Features

● Making Data Analysis Easier

The AI Controller Data Mining Software consists of the AI Easy Modeler and AI Easy Modeler for Model Setting. The AI Easy Modeler and AI Easy Modeler for Model Setting are the tools designed to generate necessary AI machine learning models for the AI Controller's AI functions. It works on Windows

If a user wants to do an own data analysis without using the AI Predictive Maintenance Library, the user can use AI Easy Modeler, which enables data analysis, threshold setting, and AI machine learning model generation.
AI Easy Modeler for Model Setting is used for a data analysis with the AI Predictive Maintenance Library. It can perform threshold settings and model generations for multiple equipment events at once.

● Easy Operation

The AI Easy Modeler and AI Easy Modeler for Model Setting make a data analysis easier for users with limited controller programming experiences and knowledge on statistics.

1-2 Specifications

Product Model Numbers

The product AI Controller Data Mining Software consists of a DVD media and a license, each of which is given a model number.
If you are purchasing the AI Controller Data Mining Software for the first time, purchase both a DVD and one or more licenses. The media is the same for all of the licenses. If you are purchasing the product for additional licenses, you can purchase only the licenses. You can also purchase the DVD separately.
The DVD is not included with the licenses.

● DVD

Product	Media
AI Controller Data Mining Software Ver.1.□□	DVD

● Licenses

Product	Number of licenses	Model number
AI ControllerDataMining Software Ver.1.□□	1 license	SYSMAC-AICSTENGE01L
	10 licenses	SYSMAC-AICSTENGE10L
	30 licenses	SYSMAC-AICSTENGE30L
	50 licenses	SYSMAC-AICSTENGE50L
AI Controller Data Mining Software Model Setting Edition Ver.1.□□	1 license	SYSMAC-AICMSENGE01L
	10 licenses	SYSMAC-AICMSENGE10L
	30 licenses	SYSMAC-AICMSENGE30L
	50 licenses	SYSMAC-AICMSENGE50L

The Model Setting Edition allows only AI Easy Modeler for Model Setting.

Support Software That You Can Install from the DVD media of AI Controller Data Mining Software and Enclosed Data

The following table lists the Support Software that you can install from the DVD media of AI Controller Data Mining Software and the data that is included in the DVD media.

Installable Software	Application	Version
AI Easy Modeler	If a user wants to do an own data analysis without using the AI Predictive Maintenance Library, the user can use AI Easy Modeler, which enables data analysis, threshold setting, and AI machine learning model generation.	Ver.1.□

Installable Software	Application	Version
AI Easy Modeler for Model Setting	AI Easy Modeler for Model Setting is used for a data analysis with the AI Predictive Maintenance Library. It can perform threshold settings and model generations for multiple equipment events at once.	Ver.1.□

Supported Languages

The AI Controller Data Mining Software supports the following languages.
Japanese, English

Applicable Models

The models that you can select when you create a project on the AI Controller Data Mining Software are given in the following tables.

Controllers

Model numbers	Unit version
NX701-Z□00	Ver.1.18 or later
NY5□2-Z□00	Ver.1.18 or later

Applicable Computers

The AI Controller Data Mining Software is a Microsoft Windows-based software.
The supported operating systems are listed below.
• Windows 7 (32-bit or 64-bit edition)
• Windows 10 (32-bit or 64-bit edition)
Apply the latest updates to the OS installed on your computer to ensure that it is always up-to-date.

Installation of the following applications is a system requirement for the AI Controller Data Mining Software.
• .NET Framework3.5
• .NET Framework4.6.1
It is installed automatically if it is not already installed on the computer when the AI Controller Data Mining Software is installed.

● System Requirements

The system requirements for the AI Controller Data Mining Software are given in the following table.

1

OS		CPU	RAM	Display
Windows 7 (32-bit or 64-bit edition) Windows 10 (32-bit or 64-bit edition)	Re-quired	IBM AT or compatible with Intel® Celeron® processor 540 (1.8 GHz)	2 GB	XGA 1024 x 768 16 million colors
	Recom-mended	IBM AT or compatible with Intel® Core™ i5 M520 processor (2.4 GHz) or the equivalent	4 GB or more	WXGA 1280 x 800 16 million colors

In addition, the following are also required.

System requirement	Specification
Free HDD space required for software installation	4.6 GB or more
Optical drive type	DVD-ROM drive
Communications port	Ethernet

2

Basic Operation of the AI Controller Data Mining Software

2-1 Installation and Uninstallation

2-1-1 What to Check to Install

Check the following before installing the software.
- Log in to Windows as Administrator or user who has the Administrator right to install. A user without the Administrator right is not allowed to write in some folders, and an access error will occur.
- Update your OS applying the latest OS updating.
- Quit all applications before you install the software.
- AI Controller Data Mining Software cannot be installed via a network drive such as shared DVD drive or hard disk on the network. Make sure to use a device supplied to the PC to which you are installing the software, e.g. a DVD drive.
- Restoring a corrupted compressed drive is rather difficult. Therefore, do not install the software on the compressed drive.
- Do not interrupt a setup. Copied files may remain under the installation directory.
- Do not turn off or reset your PC during an installation. It may corrupt the data in the PC.
- After installation, you may asked to restart Windows. Restart Windows following the installation wizard, if necessary.

2-1-2 How to Install

1 Start Windows, and then insert an installation disk into the DVD-ROM drive.
The setup program runs automatically, then the **Select Setup Language** dialog appears.

> **Additional Information**
>
> - If .NET Framework is not installed on your PC, the .NET Framework installation dialog will be displayed. Install .NET Framework following the dialog.
> - After installation, a dialog that confirms to restart your PC. Be sure to press the **Yes** button to restart. The setup wizard automatically continues to the next step after the PC restarts.

2 Proceed the installation following the wizard.

2-1-3 How to Uninstall

1 Open Windows Control Panel[1], then select **Add/Remove Programs**.

2 Select **AI Controller Data Mining Software** to uninstall.

*1. The method of starting Control Panel differs depending on the OS.
   For Windows7: Select Control Panel from the Start menu.
   For Windows10: Right-click the Start button, and then select Control Panel.
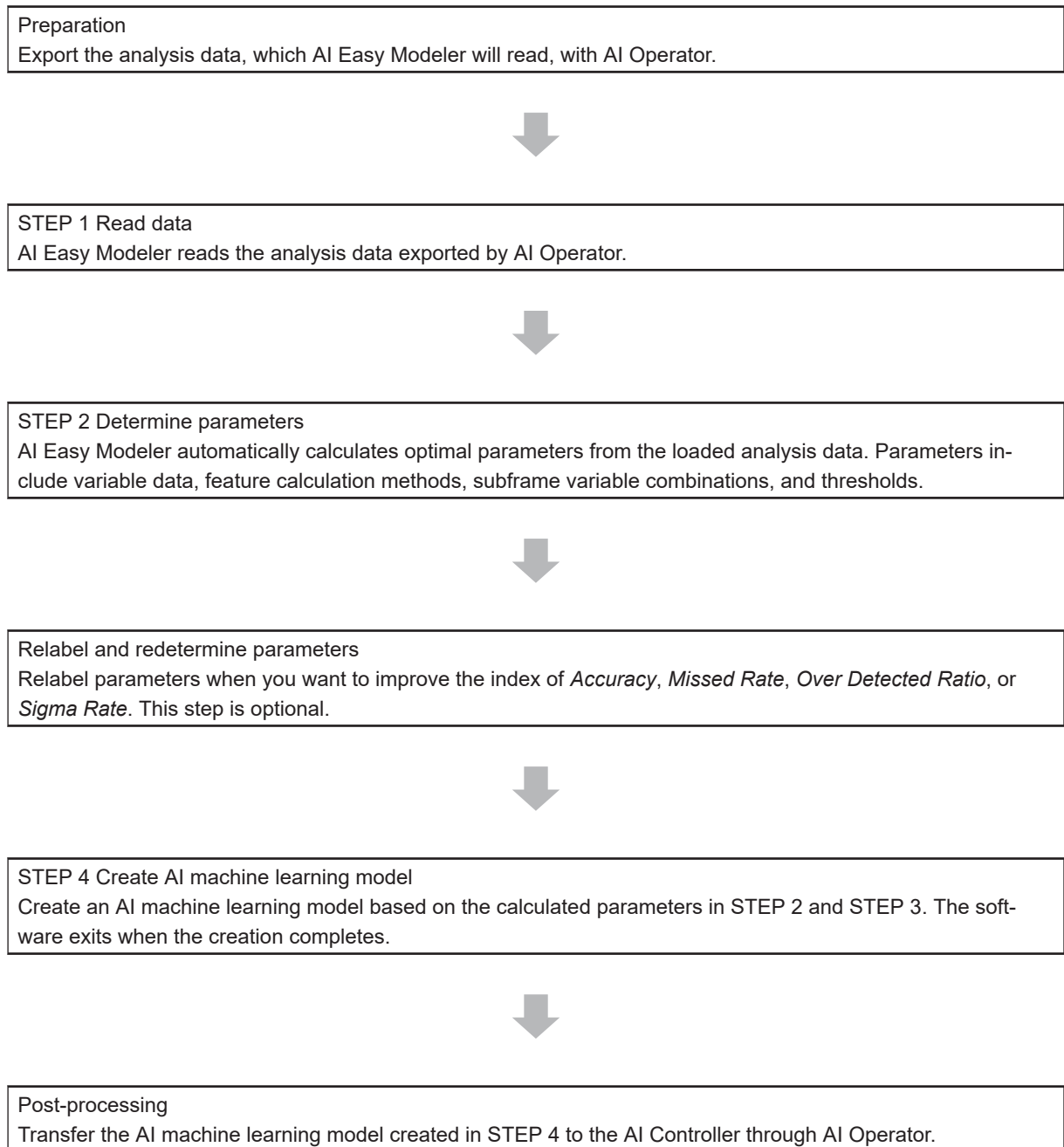
2-2   Basic Operation Flow

2-2-1   AI Easy Modeler

If you want to analyze the data not using AI Predictive Maintenance Library but by yourself, use AI Easy Modeler.

Refer to *2-2-2 AI Easy Modeler for Model Setting* on page 2-5 to use AI Predictive Maintenance Library.

AI Easy Modeler allows you to analyze the data, generate a model, and set thresholds. The basic operation flow of AI Easy Modeler is shown below.

Preparation
Export the analysis data, which AI Easy Modeler will read, with AI Operator.

STEP 1 Read data
AI Easy Modeler reads the analysis data exported by AI Operator.

STEP 2 Determine parameters
AI Easy Modeler automatically calculates optimal parameters from the loaded analysis data. Parameters include variable data, feature calculation methods, subframe variable combinations, and thresholds.

Relabel and redetermine parameters
Relabel parameters when you want to improve the index of *Accuracy*, *Missed Rate*, *Over Detected Ratio*, or *Sigma Rate*. This step is optional.

STEP 4 Create AI machine learning model
Create an AI machine learning model based on the calculated parameters in STEP 2 and STEP 3. The software exits when the creation completes.

Post-processing
Transfer the AI machine learning model created in STEP 4 to the AI Controller through AI Operator.

● **Preparation**

Export the analysis data (ANL_DATA), which AI Easy Modeler will read, with AI Operator.
Press the **Export** button on the *AI Machine Learning Model* pane of AI Operator to export.
Refer to AI machine learning section in *AI Controller Standard Software Operation Manual (Cat. No. W611)* for details.

● **STEP 1 Read Data**

Load the analysis data (ANL_DATA) exported by AI Operator to AI Easy Modeler.
A dialog to specify a folder appears when AI Easy Modeler starts. Specify the export destination folder used in the Preparation step. The data that AI Easy Modeler creates in the following steps will be exported to the folder you specify in this step.

● **STEP 2 Determine Parameters**

AI Easy Modeler calculates features from inputs of the analysis data by all combinations of variable data, feature calculation methods, and subframe variables.
Then AI Easy Modeler automatically picks up an optimal feature set for monitoring an equipment event. You can also select any desirable set containing up to 16 features.
Then the machine learning algorithm automatically calculates thresholds. The thresholds are shown on the screen.
Refer to *3-4-5 Determine Parameters and AI Machine Learning Model* on page 3-9 for details.

● **STEP 3 Relabel and Redetermine Parameters**

Relabeling is possible once the parameters have been determined. If you relabel, the parameters will be recalculated. Refer to *3-4-1 Labeling by Using the Feature Value* on page 3-6 and *3-4-4 Labeling by Using the Feature Graph* on page 3-8 for more information.

● **STEP4 Create AI Machine Learning Model**

Pressing the **MDL Creation** button generates an AI machine learning model. This software will exit after the AI machine learning model has been created. Refer to *3-4-5 Determine Parameters and AI Machine Learning Model* on page 3-9 for more information.

● **Post-processing**

Using AI Operator, transfer the AI machine learning model created in STEP 4 to the AI Controller.
In the **AL Machine Learning Model** pane, press the **Import** button to import the AI machine learning model and the **Transfer to Controller** button to transfer the AI machine learning model to the AI Controller.
Refer to the section about AI machine learning models in *AI Controller Standard Software Operation Manual (Cat. No. W611)* for more information.

2-2-2   AI Easy Modeler for Model Setting

AI Easy Modeler for Model Setting is used for a data analysis with the AI Predictive Maintenance Library.

If you want to do an own data analysis without using the AI Predictive Maintenance Library, see *2-2-1 AI Easy Modeler* on page 2-3.

AI Easy Modeler for Model Setting can perform threshold settings and model generations for multiple equipment events at once.

The basic operation flow is shown below.

> **Preparation**
> Export the feature data, which AI Easy Modeler for Model Setting will read, with AI Operator.

⬇

> **STEP1 Read data**
> AI Easy Modeler for Model Setting reads the feature data exported by AI Operator.

⬇

> **STEP2 Label and set thresholds**
> AI Easy Modeler for Model Setting automatically calculates thresholds.
> The thresholds will be displayed on the screen. Label and set thresholds when you want to improve the index of *Accuracy*, *Missed Rate*, *Over Detected Ratio*, or *Sigma Rate*.

⬇

> **STEP3 Create AI machine learning model**
> Create an AI machine learning model based on the parameters set in STEP 2.

⬇

> **Post-processing**
> Transfer the AI machine learning model created in STEP 3 to the AI Controller through AI Operator.

● **Preparation**

Export the feature data (FTR_DATA), which AI Easy Modeler for Model Setting will read, with AI Operator.
Press the **Batch Export** button on the *AI Machine Learning Model* pane of AI Operator to export. Refer to AI machine learning section in *AI Controller Standard Software Operation Manual (Cat. No. W611)* for details.

● **STEP1 Read Data**

Load the feature data (FTR_DATA) exported by AI Operator to AI Easy Modeler for Model Setting. A dialog to specify a folder appears when AI Easy Modeler for Model Setting starts. Specify the export destination folder used in the Preparation step. The data that AI Easy Modeler for Model Setting creates in the following steps will be exported to the folder you specify in this step.

● **STEP2 Label and Set Thresholds**

AI Easy Modeler for Model Setting calculates thresholds automatically with machine learning algorithm and shows on the screen. You can label the parameters and set thresholds when you want to improve the index of *Accuracy*, *Missed Rate*, *Over Detected Ratio*, or *Sigma Rate*.
Refer to *4-4-2 Labeling by Using the Feature Graph* on page 4-7 for more information.

● **STEP3 Create AI Machine Learning Model**

Pressing the **MDL Creation** button generates an AI machine learning model. Refer to *4-4-3 Determine Parameters and Create AI Machine Learning Model* on page 4-8 for more information.

● **Post-processing**

Using AI Operator, transfer the AI machine learning model created in STEP 3 to the AI Controller. In the **AL Machine Learning Model** pane, press the **Batch Import** button to import the AI machine learning model and the **Transfer to Controller** button to transfer the AI machine learning model to the AI Controller.
Refer to the section about AI machine learning models in *AI Controller Standard Software Operation Manual (Cat. No. W611)* for more information.

3

Functions of the AI Easy Modeler

3

3-1   Start and Exit the AI Easy Modeler

Starting AI Controller Data Mining Software

From Windows Start Menu, select **OMRON** - **AI Controller Data Mining Software** and boot up AI Easy Modeler.

Precautions for Correct Use
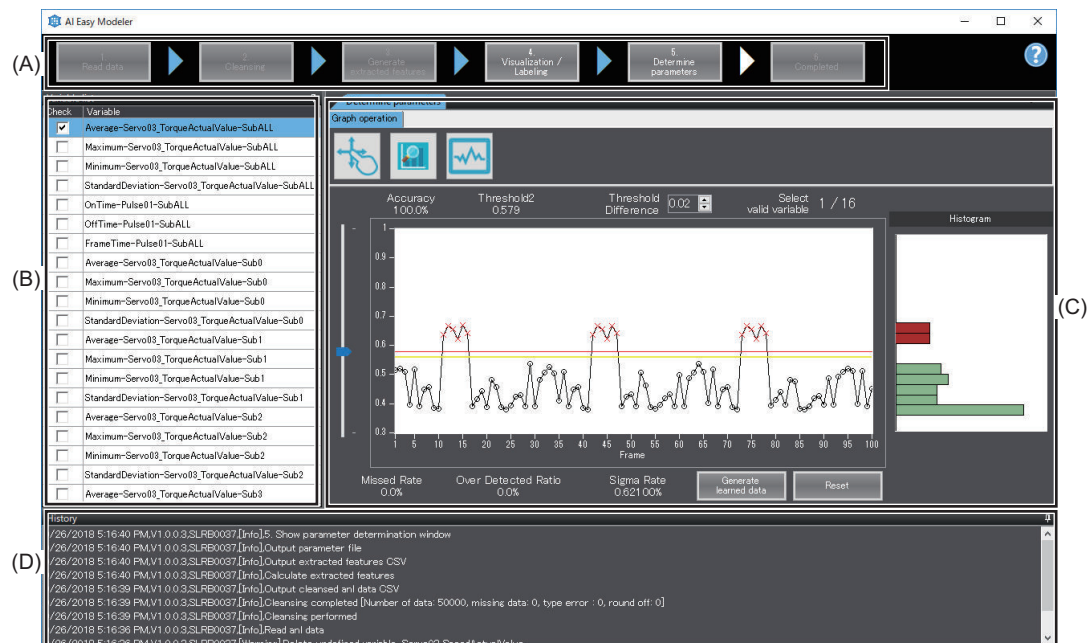
This software can not be activated in duplicate.

Exiting AI Controller Data Mining Software

The software closes in the following cases:
- The × button in the upper-right corner of a window is clicked.
- The AI machine learning model has been generated.

3-2   Window Configuration

This screen consists of State Transition Menus, Variable List Window that lists combinations of variable data, feature calculation method, and subframe variables selected by the software, Main Window that shows equipment event monitoring score as the result of data mining, and Log Window. The overview of the functions on each window is described below.

Symbol	Area name	Outline of function
(A)	State Transition Menu	Displays the current status of the data mining processes. The status is available in the following six processes: 1. Read data 2. Cleansing 3. Feature value generation 4. Visualization/Labeling 5. Determine parameters 6. Completed The steps (1) through (3) are automatically completed when the software starts up.
(B)	Variable List Window	It is a list of combinations consisting of variable data, a feature calculation method, and subframe variables, which are used for calculating equipment event monitoring scores based on the machine learning algorithm (Isolation Forest). The optimum combination for detecting anomaly will be selected automatically. • Users can select a combination. • The available feature calculation method depends on the controller's version. See the following table for details.

Symbol	Area name	Outline of function
(C)	Main Window	Displays the data mining result. Data mining is performed by using a combination of variable data selected on the Variable List Window, a feature calculation method, and subframe variables. The following will appear: • Equipment event monitoring score and threshold • Feature value • Variable data in the interval where feature values are calculated
(D)	Log Window	Displays the processing history.

The following are available calculation methods of features for LREAL type variables, and the methods depend on the controller version set on AI Operator.

Controller Model	Version	Function
NY5□2-Z□00	V1.18 or higher	Average, standard deviation, skewness, kurtosis, maximum value, and minimum value
	V1.26 (AIC 1.02) or higher	Average, standard deviation, skewness, kurtosis, maximum value, minimum value, amplitude, median, and effective value
NX701-Z□00	V1.18 or higher	Average, standard deviation, skewness, kurtosis, maximum value, and minimum value
	V1.28 or higher	Average, standard deviation, skewness, kurtosis, maximum value, minimum value, amplitude, median, and effective value

• Skewness and kurtosis are not available in default. Refer to *A-3 Changing Feature Calculation Method of AI Easy Modeler* on page A-5.
• Median is unavailable if the analysis data (ANL data) contains a frame with more than 1024 data sets. The Log Window shows the message saying, *Calculating median feature was disabled by exceeding 1024 variables in one frame.*

Precautions for Correct Use

In the state transition menu, the options users can use are *(4) Visualization/Labeling* and *(5) Determine parameters* only.

3-3   Reading Analysis Data

This section describes the procedure to read analysis data into the AI Easy Modeler.

When you start the AI Easy Modeler, the file selection window shown below appears.

On the file selection window, select a file used for reading analysis data in the procedure described below.

File selection button
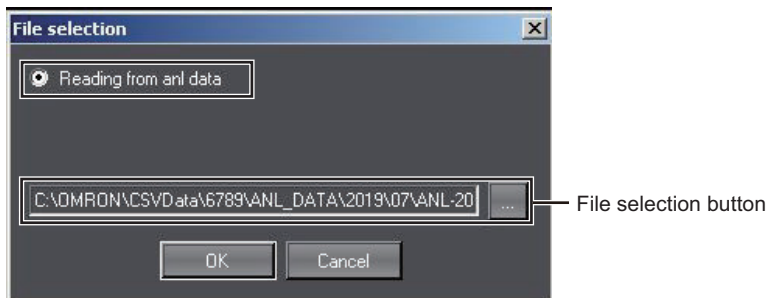
_1_   Select a file to read.

Area name	Outline of function
Reading from ANLI data	Select this option when you read new analysis data without using the AI Predictive Maintenance Library.

_2_   Click the File selection button and read data you want to analyze.

_3_   Click the **OK** button.

> **Additional Information**
>
> To create analysis data, open the **AI Machine Learning Model Creation** screen on the AI Operator and follow the steps described below.
> 1. Select an equipment event that will be used to generate analysis data.
> 2. Press the Reference button and select an CSV file.
>   When you use data from other than the AI Predictive Maintenance Libraries, select analysis data (ANL-****.csv).
> 3. Press the Export button and select a folder to save the data. A new folder for the equipment event ID is created in the specified folder.
>
> This folder contains analysis data. You will read this folder into the AI Easy Modeler.

3-4 Visualization and Labeling

3-4-1 Labeling by Using the Feature Value

Use the following procedure to assign labels (normal, anomaly, delete) to frame.

1 Click **4. Visualization/Labeling** in the state transition menu.

2 In the table of extracted features, right-click on a frame you want to assign a label.

3 Select Normal (○), Anomaly (×), or Delete (■).
The labeling completes.
Click **5. Determine parameters** in the status transition menu. The parameters are recalculated.

Additional Information

- The frame with the Delete (■) option selected are removed from the analysis target. The accuracy of the machine learning improves by eliminating data containing noise or that of unstable behavior.
- Labeling can be also specified from the feature data graph. Refer to *3-4-4 Labeling by Using the Feature Graph* on page 3-8 for details.

3-4-2 Displaying the Feature Graph

When you select the **Feature value** button in the variable list, you can display a time-series graph for the feature value.

1 Click **4. Visualization/Labeling** in the state transition menu.

2 Press any **Feature value** 📊 button from the Variable List Window.

The time-series graph of the feature value you selected appears.

3 Press the **Graph Operation** button.
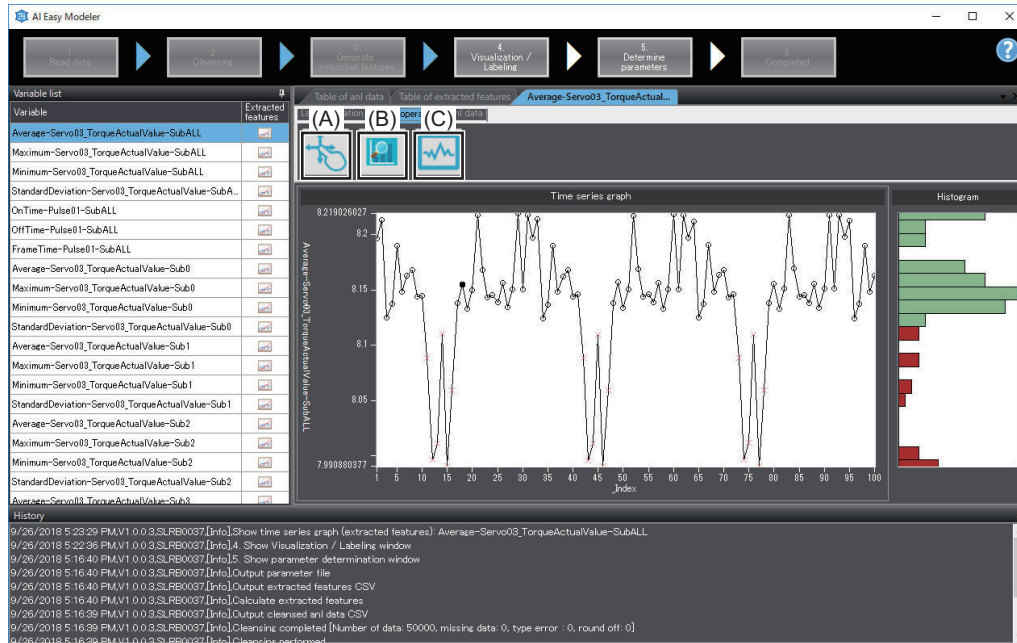
By clicking the following icons, you can move or zoom the graph.

Symbol	Item name	Description
(A)	**Move** button	Allows you to move the graph.
(B)	**Zoom** button	Allows you to zoom the graph. To zoom, drag the area you want to zoom.
(C)	**Full-screen** button	Restores the initial view mode (full screen mode) of the graph.

3-4-3 Displaying Variable Data

You can display variable data for a frame that is used for calculating feature values.

1 Follow the steps described in *3-4-2 Displaying the Feature Graph* on page 3-6 and display the time-series graph of feature values.

2 Press the **Anl data** tab.
On the time-series graph, select data for a frame you want to confirm.

3 Press the **Variable data** button.
The variable data of the selected frame appears.

Symbol	Item name	Description
(A)	**Variable data** button	Displays the variable data graph for the specified variable data.

3-4-4 Labeling by Using the Feature Graph

Use the following procedure to assign labels (normal, anomaly, delete) to feature data on the Visualization/Labeling window.

1 Follow the steps described in *3-4-2 Displaying the Feature Graph* on page 3-6 and display the time-series graph of feature values.

2 Press the **Label operation** tab.
On the time-series graph, select data for a frame you want to confirm.

3 Click the **Normal**, **Anomaly** or **Delete** button to assign the label.
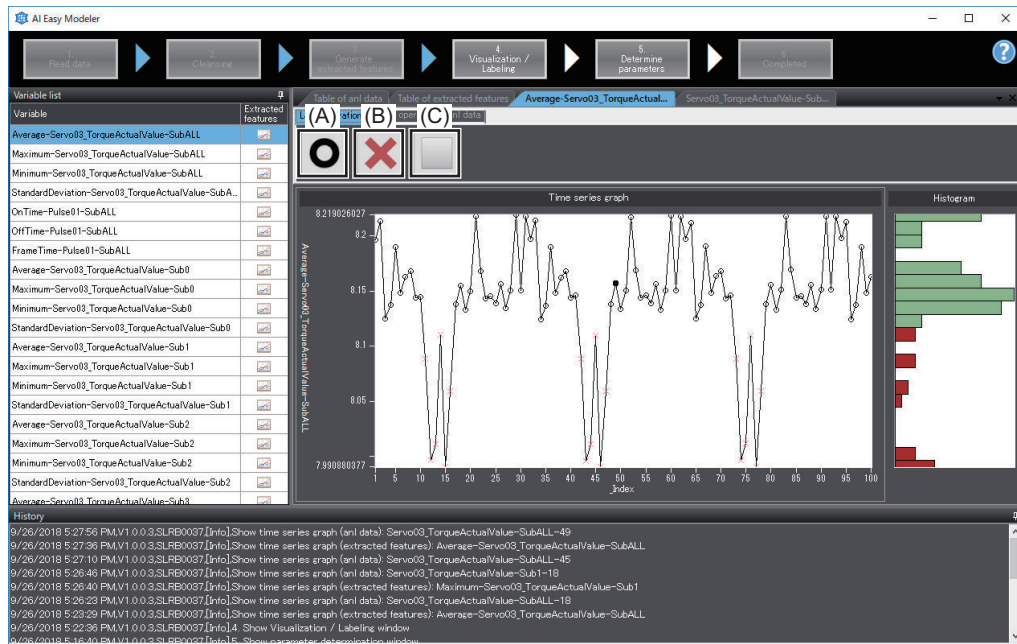
Symbol	Item name	Description
(A)	**Normal** button	Assigns label information of Normal to the data for a frame selected by a user.
(B)	**Anomaly** button	Assigns label information of Anomaly to the data for a frame selected by a user.
(C)	**Delete** button	Assigns label information of Delete to the data for a frame selected by a user. Deleted frames are not used for mining.

3-4-5   Determine Parameters and AI Machine Learning Model

The equipment event monitoring score is calculated based on the label information specified in *3-4-1 Labeling by Using the Feature Value* on page 3-6 and *3-4-4 Labeling by Using the Feature Graph* on page 3-8.

1 Perform the steps described in *3-4-1 Labeling by Using the Feature Value* on page 3-6 or *3-4-4 Labeling by Using the Feature Graph* on page 3-8.

2 Click **5. Determine parameters** in the status transition menu.

3 Check the parameters of a selected combination of variable data, feature calculation method, and subframe variable, as well as Threshold 1 and 2 values.
If you need to adjust the parameters, go back to the steps described in *3-4-1 Labeling by Using the Feature Value* on page 3-6 or *3-4-4 Labeling by Using the Feature Graph* on page 3-8 to assign labels.

4 If necessary, you can adjust the threshold by using the **Threshold 2** slide bar and specifying a difference between Threshold 1 and Threshold 2.

5 On the Variable List Window, select another combination of variable data, a feature calculation method and subframe variables as needed.

6 If there is no problem with the parameter values, click the **Generate learned data** button. This outputs the AI machine learning model and causes this software to exit.

The following table provides description of the figure. Refer to *A-1 Definition of Terms* on page A-2 for details on the terms appearing in the table.

Symbol	Item name	Description
(A)	**Check** item	This software adds a check automatically. Users can also select it manually. When the selection is modified, the equipment event monitoring score is recalculated.
(B)	Accuracy	Display the rate of normal labeled data that was judged as Alrt Lv1 or normal , and anomaly labeled data that was judged as Alrt Lv2. It is modified after each recalculation.
(C)	Threshold 2	Threshold 2 is displayed. It is modified after each recalculation.
(D)	Warning difference	Displays the difference between Threshold 1 and Threshold 2. Users can change this value.
(E)	Select valid variable	Displays the number of values selected on the Variable List Window.
(F)	**Threshold 2** slide bar	Allows users to adjust Threshold 2. The accuracy, missed rate, over detected ratio, and sigma rate will be recalculated every time you adjust this value.
(G)	**Monitoring index** graph	Displays the graph of the equipment event monitoring scores. Red indicates Threshold 2 and yellow indicates Threshold 1.
(H)	Missed Rate	Displays the rate of anomaly labeled data that was judged as Alrt Lv1 or normal.
(I)	Over Detected Ratio	Displays the rate of normal labeled data that was judged as Alrt Lv2.
(J)	Sigma Rate	Displays the rate of data judged as Alrt Lv2. It is calculated based on the standard deviation in the statistical quality control. (e.g. 3σ)
(K)	**Generate learned data** button	Extracts only the normal labels from the selected feature values and generates the AI machine learning model.
(L)	**Reset** button	Restores the parameters to the state right after **5. Determine parameters** was pressed.

Precautions for Correct Use

The feature data variables cannot be changed for the AI predictive maintenance library.

4

Functions of the AI Easy Modeler for Model Setting

4-1   Start and Exit the AI Easy Modeler for Model Setting

Starting AI Easy Modeler for Model Setting

From Windows Start Menu, select **OMRON** - **AI Controller Data Mining Software**. Then start AI Easy Modeler for Model Setting.

📝 **Precautions for Correct Use**

This software cannot be activated in duplicate.

Exiting AI Easy Modeler for Model Setting

This software closes in either of the following cases:

* The × button at the upper-right corner of a window is clicked.
* *All End* is selected from the **File** menu.

4-2   Window Configuration

This screen consists of the following windows:

- Event List Window

  Equipment events you want to monitor are listed in this window

- Main Window

  Equipment event monitoring scores as data mining results are displayed

- Log Window

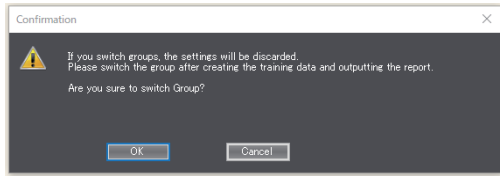The overview of the functions on each window is described below.

Symbol	Area name	Outline of function
(A)	Event List	Equipment events you want to monitor are listed. A graph of the selected equipment event group is shown in the Main Window.
(B)	Main Window	Displays a graph of the equipment events in group. The following is shown: • Equipment event monitoring scores and the thresholds • Feature values
(C)	Log Window	Displays the processing history.
(D)	**Generate learned data** button	Generates AI machine learning models on equipment events for the groups shown in the Main Window.
(E)	**Generate report** button	Outputs the following information on equipment events in the Excel format for a group: event name, score graph, feature graph, threshold 1, threshold 2, accuracy, missed rate, over detected ratio, and sigma rate. Excel is required to output the report.

Selecting an equipment event in another group shows the message in the following screen shot.

When you configured options such as thresholds in the Main Window, generate learning data and report before switching groups.

The number of equipment events in a group affects the group switching duration, and it may take time.

Confirmation

⚠ If you switch groups, the settings will be discarded.
Please switch the group after creating the training data and outputting the report.

Are you sure to switch Group?

[OK]   [Cancel]

4-3 Reading Feature Data

This section describes how to load the feature data to AI Easy Modeler for Model Setting.

1 Load the data exported by AI Operator
The Browse For Folder dialog will appear as AI Easy Modeler for Model Setting starts. Select the data folder that AI Operator has exported the data. Up to 50 equipment events can be loaded.
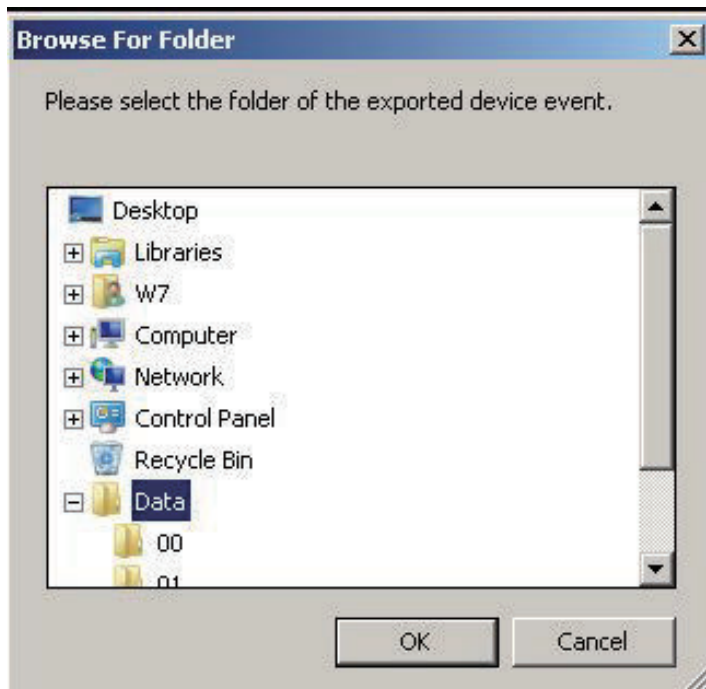
2 Specify the folder where the feature data gathered through the AI Controller stored
Subsequently the dialog shown below appears. Specify the folder where the feature data gathered through the AI Controller stored. The initial value displayed is the path of the feature data (FTR_DATA) specified to export from AI Operator.
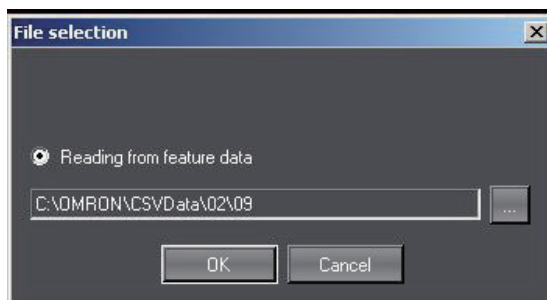
> **Additional Information**
>
> To create the feature data to load to AI Easy Modeler for Model Setting, open the **AI Machine Learning Model Creation** pane on the AI Operator and follow the steps described below.
> 1. Press the Batch Export button to display a dialog.
> 2. Select an equipment event to generate a machine learning model.
> 3. Press the reference button to select the folder where FTR_DATA stored.
> 4. Press the Export button to select a folder in which to save the data. This folder will be loaded to AI Easy Modeler for Model Setting.

4-4   Labeling and Setting Thresholds

4-4-1   Displaying the Feature Graph

Select the **Extracted Features** tab in the Main Window to show feature values on a time-series graph.
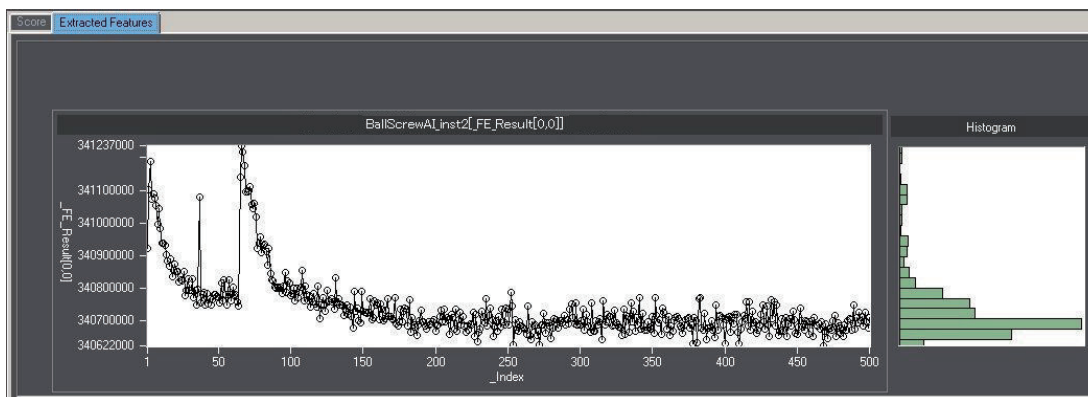

4-4-2   Labeling by Using the Feature Graph

You can label the data and set thresholds when you want to improve the index of *Accuracy*, *Missed Rate*, *Over Detected Ratio*, or *Sigma Rate*.
Label the frames as Normal, Error, or Delete through the following procedure.

1   Select the **Extracted Features** tab in the Main Window. Then specify an area to label by dragging the mouse over the graph.
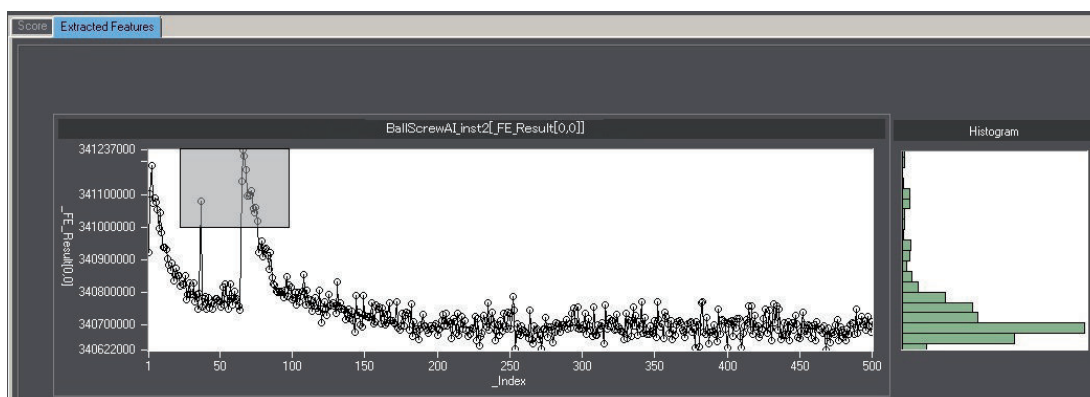
2   Select either of Normal (○), Error (×), or Delete (■) from a right-click menu.
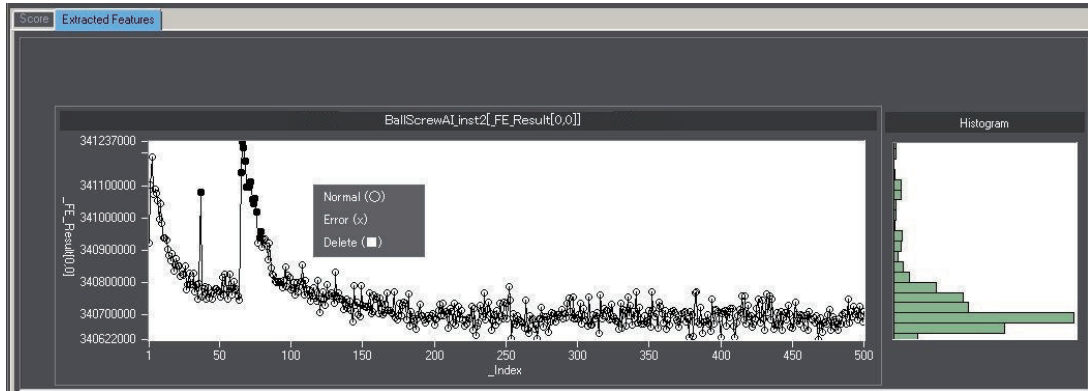
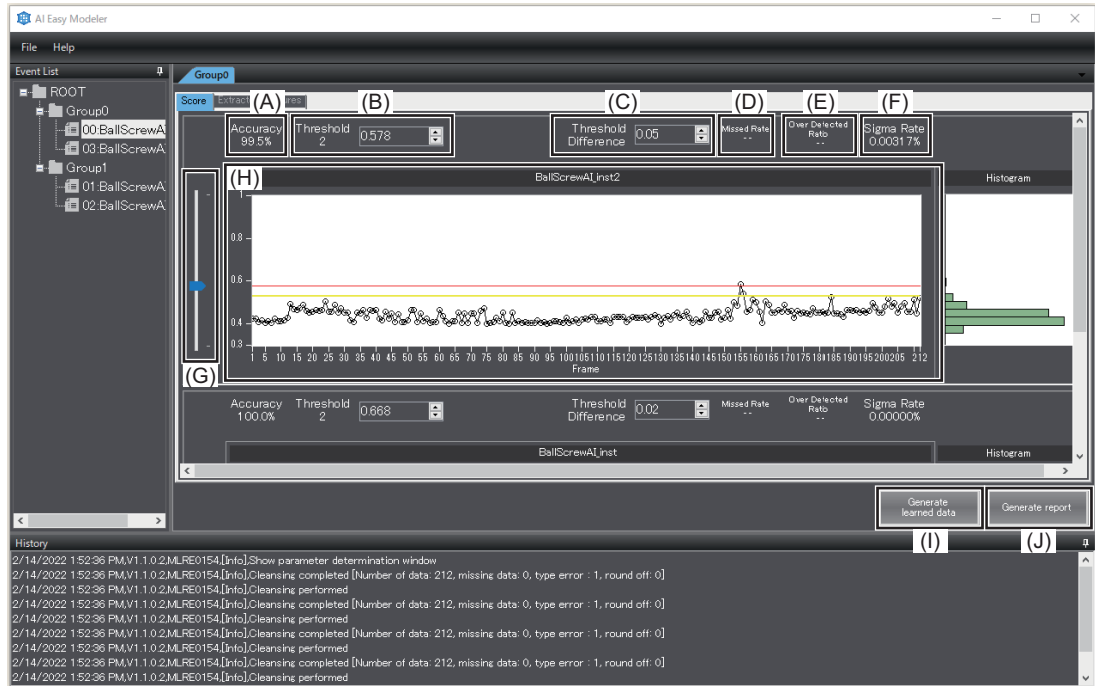| Label	Description
Normal (○)	Label a selected data as Normal for mining.
Error (×)	Label a selected data as Error for mining.
Delete (■)	Label a selected data as Delete. A deleted frame is not used for mining.

Additional Information

A frame labeled as Delete (■) is removed from an analysis. Removing the data containing a noise or behaving unstably increases the machine learning accuracy.

4-4-3   Determine Parameters and Create AI Machine Learning Model

Calculate an equipment event monitoring score using the label information you have set in *4-4-2 Labeling by Using the Feature Graph* on page 4-7. Conduct the following procedure for each group to determine parameters and create AI machine learning models.

1 Perform labeling according to descriptions in *4-4-2 Labeling by Using the Feature Graph* on page 4-7.

2 Show a score graph.
    If the graph needs an adjustment, re-label the data following the procedure in *4-4-2 Labeling by Using the Feature Graph* on page 4-7.

3 Arrange the **Threshold 2** slider and Threshold Difference to adjust thresholds, if necessary.

4 Press the **Generate learned data** button.
    An AI machine learning model will be created.

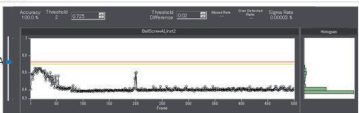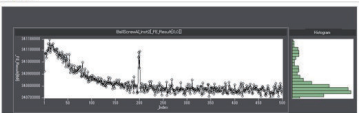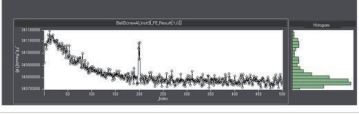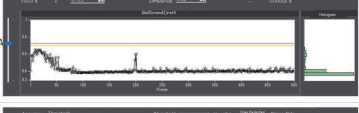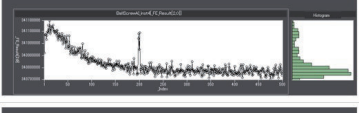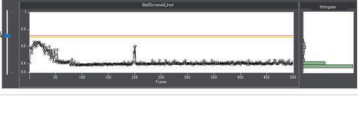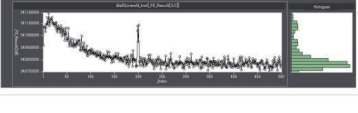| Symbol	Item	Description
(A)	Accuracy	Displays the percentage of Normal labeled data judged as Alrt Lv1 or normal, or Error labeled data judged as Alrt Lv2. The value will be updated in every recalculation.
(B)	Threshold 2	Displays a value of Threshold 2. The value will be updated in every recalculation.
(C)	Threshold Difference	Input a difference between Threshold 1 and 2 with increment/decrement buttons.
(D)	Missed Rate	Displays the percentage of Error labeled data judged as Alrt Lv1 or normal.
(E)	Over Detected Ratio	Displays the percentage of Normal labeled data judged as Alrt Lv2.
(F)	Sigma Rate	Displays the percentage of the data judged as Alrt Lv2. It is calculated based on a standard deviation for statistical quality control (e.g. 3σ).
(G)	**Threshold 2** slider	Adjust the value of Threshold 2. The values of Accuracy, Missed Rate, Over Detected Ratio, and Sigma Rate will be recalculated in every adjustment.
(H)	**Monitoring index** graph	Displays a graph of equipment event monitoring score. Red indicates Threshold 2 and yellow indicates Threshold 1.
(I)	**Generate learned data** button	Generates AI machine learning models on equipment events for the groups shown in the Main Window.
(J)	**Generate report** button	Outputs the following information on equipment events in the Excel format for a group: event name, score graph, feature graph, threshold 1, threshold 2, accuracy, missed rate, over detected ratio, and sigma rate. Excel is required to output the report.

Precautions for Correct Use

The feature calculation method cannot be changed in AI Predictive Maintenance Library.

4-4-4   Generating a Report

You can generate a report based on the information set in *4-4-3 Determine Parameters and Create AI Machine Learning Model* on page 4-8.
This function is available on a PC with Microsoft Excel.

1 Perform the works provided in *4-4-3 Determine Parameters and Create AI Machine Learning Model* on page 4-8.

2 Press the **Generate report** button.

3 An Excel file containing the data of event name, score graph, feature graph, thresholds, Accuracy, Missed Rate, Over Detected Ratio, Sigma Rate, and comment will be generated in the export destination folder.

A

Appendices

A

A-1   Definition of Terms

The following table summarizes the description of terms that are related to the values displayed in *3-4-5 Determine Parameters and AI Machine Learning Model* on page 3-9.

Term	Description
Missed Rate	The rate of anomaly labeled data that was judged as Alrt Lv1 or normal. (Formula: FN/(TP + FN))
Over Detected Ratio	The rate of normal labeled data that was judged as Alrt Lv2. (Formula: FP/(FP + TN))
Accuracy	The rate of normal labeled data that was judged as Alrt Lv1 or normal, and anomaly labeled data that was judged as Alrt Lv2 out of the entire data. Formula: (TP + TN)/Number of data counts
Sigma Rate	The distribution of the area assumed to be Alrt Lv2 (= area equal to or greater than Threshold 2) out of the entire data distribution
True positive (TP: True Positive)	Number of anomaly labeled data judged as Alrt Lv 2.
True negative (TN: True Negative)	Number of normal labeled data judged as Alrt Lv1 or normal.
False positive (FP: False Positive)	Number of normal labeled data judged as Alrt Lv2
False negative (FN: False Negative)	Number of anomaly labeled data judged as Alrt Lv1 or normal

A-2   Error Messages

A-2-1   Error Messages and Corrections

The following table summarizes details of the error messages for this software along with the trouble-shooting methods.

Error message	Cause	Correction
No file is selected. Exit the application.	File not selected	Select a file.
Failed to load the event setting file. Please check if the file exists in the selected folder. Exit the application.	You have specified a folder that does not contain the equipment event file.	During *3-3 Reading Analysis Data* on page 3-5, specify a folder containing the equipment event file (Event.xml).
Feature amount calculation process failed. Please retrieve the data again. Exit the application.	Feature value calculation failed due to invalid data input.	Try retrieving the data again.
Cleansing process failed. Please retrieve the data again. Exit the application.	Failed in checking input data due to invalid data input.	Try retrieving the data again.
The parameter determination process failed. Please retrieve the data again. Exit the application.	Parameter definition failed due to invalid data input.	Try retrieving the data again.
Frame is not specified in Event.xml. Please specify the Frame variable. Exit the application.	No Frame variable specified in equipment event file.	Specify Frame variable using the AI Controller Standard Software.
EntryVariables is not specified in Event.xml. Please specify EntryVariables. Exit the application.	No EntryVariables specified in equipment event file.	Specify EntryVariables variable using the AI Controller Standard Software.
The variables of the feature quantity data exceeds the valid variables (16). Please do not exceed effective variable. Exit the application.	The number of feature values exceeded the value specified in the application setting file.	Check the settings in the application setting file.
Failed to read ANL data. Check the ANL data. Exit the application.	Cannot read ANL data.	Check whether another application does not open the ANL data, and confirm the ANL data has collected through the AL Controller.
Failed to read feature data. Check the feature quantity data. Exit the application.	Cannot read feature data.	Check whether another application does not open the feature quantity data, and confirm the feature quantity data has collected through the AL Controller.
Data of extracted features necessary to determine parameters does not exist. Please check the labeling.	Labeling information is invalid.	Check labeling.
Variable specified in ANL data does not exist. Make sure that the variable is correctly specified. Exit the application.	Variable not specified in ANL data.	Properly set variable to be analyzed using the AI Controller Standard Software.
There is no variable specified in the feature data. Make sure that the variable is correctly specified. Exit the application.	No variable is specified in feature data.	Properly set variable to be analyzed using the AI Controller Standard Software.

Error message	Cause	Correction
Can not write to the following files. Please close it if it is open. <file_name>	<file name> is opened by another application.	Close the application where <file name> is open.
Learning data could not be written. Please close the application that opened the writing destination folder.	Cannot access a folder to write to.	Close the application that opened the writing destination folder
You can not write to the selected folder. Please select another folder.	Cannot access a folder to write to.	Close the application that opened the writing destination folder.
The following file / folder does not exist in the project path. Quit the application. <file name>	File or folder does not exist in project path.	Check to see that file or folder exists.
Specify the exported equipment event folder. Exit the application.	The equipment event folder is not specified.	Specify the equipment event folder.
It is illegal input data. Because processing can not continue, quit the application. Error code: *****	The error occurred due to the following causes: 1. Invalid input data was read. 2. The AI machine learning model cannot be created because invalid data was used in the feature value calculation, such as zero division or infinite divergence.	Cause 1. Correct the user program and try retrieving data again. Detailed causes are described below. • The header is not specified for the input data. • The data has not collected through the AI Controller. Cause 2. It could be due to problems with the data retrieval environment. Check the system environment and try retrieving data again.
Multiple applications cannot run.	This application is already running.	Exit the application that is already running.
An unexpected error occurred. Please re-install the application.	File necessary for application does not exist.	Reinstall the application.
Event counts exceeded the limit of 50. Quit the application.	Event counts exceeded 50, the limit allowed to this tool.	Reduce the events and try again.
Microsoft Excel was not installed.	Excel is mandatory for a report.	To generate a report with this tool, install Microsoft Excel.
Unsupported version. Exit the application.	Application with the previous version is installed.	Upgrade your AI Controller Mining Software to the latest version.
Contains data that AI Easy Modeler For Model Setting does not support. Get the latest AI Easy Modeler For Model Setting.	Application with the previous version is installed.	Upgrade your AI Controller Mining Software to the latest version.

A-3   Changing Feature Calculation Method of AI Easy Modeler

The *Kurtosis and Skewness* option for AI Easy Modeler's feature calculation method is disabled in default setting.
The *Kurtosis and Skewness* option can be changed by using the Feature Switching Tool.

1   Select **OMRON** - **AI Controller Data Mining Software** - **Tools** - **Feature Switching Tool** from the Windows Start Menu.
The Feature Switching Tool runs.

2   Select the *Enable*/*Disable* option for *Kurtosis and Skewness*, then click the **Set** button.
This option will be applied to the feature calculation method at next AI Easy Modeler boot time.

Precautions for Correct Use

When the Kurtosis and Skewness option is enabled, a calculation may fail due to dividing by zero (i.e., features become ∞) under the condition that a variable value is constant.

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Authorized Distributor: