



**MITSUBISHI
ELECTRIC**









Mitsubishi Electric Industrial Robot

CR800-D/R/Q series controller

Preventive Maintenance Function User's Manual

Safety Precautions

Always read the following precautions and the separate "Safety Manual" before starting use of the robot to learn the required measures to be taken.

-  **CAUTION** All teaching work must be carried out by an operator who has received special training. (This also applies to maintenance work with the power source turned ON.)
Enforcement of safety training
-  **CAUTION** For teaching work, prepare a work plan related to the methods and procedures of operating the robot, and to the measures to be taken when an error occurs or when restarting. Carry out work following this plan. (This also applies to maintenance work with the power source turned ON.)
Preparation of work plan
-  **WARNING** Prepare a device that allows operation to be stopped immediately during teaching work. (This also applies to maintenance work with the power source turned ON.)
Setting of emergency stop switch
-  **CAUTION** During teaching work, place a sign indicating that teaching work is in progress on the start switch, etc. (This also applies to maintenance work with the power source turned ON.)
Indication of teaching work in progress
-  **DANGER** Provide a fence or enclosure during operation to prevent contact of the operator and robot.
Installation of safety fence
-  **CAUTION** Establish a set signaling method to the related operators for starting work, and follow this method.
Signaling of operation start
-  **CAUTION** As a principle turn the power OFF during maintenance work. Place a sign indicating that maintenance work is in progress on the start switch, etc.
Indication of maintenance work in progress.
-  **CAUTION** Before starting work, inspect the robot, emergency stop switch and other related devices, etc., and confirm that there are no errors.
Inspection before starting work

The points of the precautions given in the separate "Safety Manual" are given below.
Refer to the actual "Safety Manual" for details.

**DANGER**

When automatic operation of the robot is performed using multiple control devices (GOT, programmable controller, push-button switch), the interlocking of operation rights of the devices, etc. must be designed by the customer.

**CAUTION**

Use the robot within the environment given in the specifications. Failure to do so could lead to a drop or reliability or faults. (Temperature, humidity, atmosphere, noise environment, etc.)

**CAUTION**

Transport the robot with the designated transportation posture. Transporting the robot in a non-designated posture could lead to personal injuries or faults from dropping.

**CAUTION**

Always use the robot installed on a secure table. Use in an instable posture could lead to positional deviation and vibration.

**CAUTION**

Wire the cable as far away from noise sources as possible. If placed near a noise source, positional deviation or malfunction could occur.

**CAUTION**

Do not apply excessive force on the connector or excessively bend the cable. Failure to observe this could lead to contact defects or wire breakage.

**CAUTION**

Set work masses, including hands, so as not to exceed the rated load or permitted torque.

Exceeding either of these can cause an alarm or breakdown.

**WARNING**

Securely install the hand and tool, and securely grasp the workpiece. Failure to observe this could lead to personal injuries or damage if the object comes off or flies off during operation.

**WARNING**

Securely ground the robot and controller. Failure to observe this could lead to malfunctioning by noise or to electric shock accidents.

**CAUTION**

Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.

**WARNING**

When carrying out teaching work in the robot's movement range, always secure the priority right for the robot control. Failure to observe this could lead to personal injuries or damage if the robot is started with external commands.

**CAUTION**

Keep the jog speed as low as possible, and always watch the robot. Failure to do so could lead to interference with the workpiece or peripheral devices.

**CAUTION**

After editing the program, always confirm the operation with step operation before starting automatic operation. Failure to do so could lead to interference with peripheral devices because of programming mistakes, etc.

**CAUTION**

Make sure that if the safety fence entrance door is opened during automatic operation, the door is locked or that the robot will automatically stop. Failure to do so could lead to personal injuries.

**CAUTION**

Never carry out modifications based on personal judgments, or use non-designated maintenance parts.

Failure to observe this could lead to faults or failures.

**WARNING**

When the robot arm has to be moved by hand from an external area, do not place hands or fingers in the openings. Failure to observe this could lead to hands or fingers catching depending on the posture.

**CAUTION**

Do not stop the robot or apply emergency stop by turning the robot controller's main power OFF. If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected. Moreover, it may interfere with the peripheral device by drop or move by inertia of the arm.

**CAUTION**

Do not turn off the main power to the robot controller while rewriting the internal information of the robot controller such as the program or parameters. If the main power to the robot controller is turned off while in automatic operation or rewriting the program or parameters, the internal information of the robot controller may be damaged.

**DANGER**

Do not connect the Handy GOT when using the GOT direct connection function of this product. Failure to observe this may result in property damage or bodily injury because the Handy GOT can automatically operate the robot regardless of whether the operation rights are enabled or not.

**DANGER**

Do not connect the Handy GOT to a programmable controller when using an iQ Platform compatible product with the CR800-R/CR800-Q controller. Failure to observe this may result in property damage or bodily injury because the Handy GOT can automatically operate the robot regardless of whether the operation rights are enabled or not.

**DANGER**

Do not remove the SSCNET III cable while power is supplied to the multiple CPU system or the servo amplifier. Do not look directly at light emitted from the tip of SSCNET III connectors or SSCNET III cables of the Motion CPU or the servo amplifier. Eye discomfort may be felt if exposed to the light.

(Reference: SSCNET III employs a Class 1 or equivalent light source as specified in JIS C 6802 and IEC60825-1 (domestic standards in Japan).)

**DANGER**

Do not remove the SSCNET III cable while power is supplied to the controller.

Do not look directly at light emitted from the tip of SSCNET III connectors or SSCNET III cables. Eye discomfort may be felt if exposed to the light.

(Reference: SSCNET III employs a Class 1 or equivalent light source as specified in JIS C 6802 and IEC60825-1 (domestic standards in Japan).)

**DANGER**

Attach the cap to the SSCNET III connector after disconnecting the SSCNET III cable. If the cap is not attached, dirt or dust may adhere to the connector pins, resulting in deterioration connector properties, and leading to malfunction.

**CAUTION**

Make sure there are no mistakes in the wiring. Connecting differently to the way specified in the manual can result in errors, such as the emergency stop not being released. In order to prevent errors occurring, please be sure to check that all functions (such as the teaching box emergency stop, customer emergency stop, and door switch) are working properly after the wiring setup is completed.

**CAUTION**

Use the network equipments (personal computer, USB hub, LAN hub, etc) confirmed by manufacturer. The thing unsuitable for the FA environment (related with conformity, temperature or noise) exists in the equipments connected to USB. When using network equipment, measures against the noise, such as measures against EMI and the addition of the ferrite core, may be necessary. Please fully confirm the operation by customer. Guarantee and maintenance of the equipment on the market (usual office automation equipment) cannot be performed.

**CAUTION**

To maintain the safety of the robot system against unauthorized access from external devices via the network, take appropriate measures. To maintain the safety against unauthorized access via the Internet, take measures such as installing a firewall.

■ Revisions

Revision Date	Instruction Manual No.	Revision Details
2018-09-13	BFP-A3625	<ul style="list-style-type: none"> • First print
2019-04-25	BFP-A3625-A	<ul style="list-style-type: none"> • Save buttons were added. (Total Score,Consumptiondegree calculation function, Maintenance simulation) • “Tact time” and “Axis Load Lebel” were added. (Maintenance simulation “1 Cycle” operation). • Parameter “PMVER” was added.

■ Introduction

Thank you for purchasing the Mitsubishi industrial robot "MELFA Smart Plus Card/Card Pack Option".

This instruction manual explains the "Preventive Maintenance Function" that can be used with the MELFA Smart Plus Card/Card Pack Option.

This product provides features that support maintenance and inspection so that the robot can be used for a long time without trouble.

Efficient maintenance is supported through notification of the time of maintenance parts replacement or overhaul based on the actual operating status of the robot.

Furthermore, due to the feature of estimating the parts replacement time or the recommended maintenance time, this function can be used for decision making on the maintenance cycle.

To ensure correct usage of the product, always read through this manual before starting to use "Preventive maintenance function".

For details of basic robot operation, refer to the separate "Instruction Manual / Detailed Explanations of Functions and Operations".

■ Notation method in this document



Danger

This indicates an item for which incorrect handling could present imminent danger of death or serious injury.



Warning

This indicates an item for which incorrect handling could present a danger of death or serious injury.



Caution

This indicates an item for which incorrect handling could present a danger of injury. It could also present a danger of just physical damage.

- No part of this manual may be reproduced by any means or in any form, without prior consent from Mitsubishi.
- The details of this manual are subject to change without notice.
- The specification value is based on our standard test method.
- An effort has been made to make full descriptions in this manual. However, if any discrepancies or unclear points are found, please contact your dealer.
- This specifications is original.
- Company names and product names described in this document are trademarks or registered trademarks of each company.
- ® and TM are omitted in the text of this guide.

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1. Before starting use

1.1 Contents of the instruction manual

This function can be used with the RT ToolBox3 Preventive Maintenance screen, parameters, status variables, and dedicated input/output signals.

In this manual, the following structure is used to explain how the preventive maintenance function using examples of the RT ToolBox3 Preventive Maintenance screens.

For functions and operation methods provided in the standard robot controller, refer to the "Instruction Manual" supplied for the robot controller.

Chapter	Title	Description
1	Before starting use	Explains the structure of this manual, products compatible with this function, related manuals, and maintenance/inspection.
2	Basic specifications	Explains the specification of the preventive maintenance function.
3	Startup and initial settings	Explains how to start the preventive maintenance function and the initial setting method.
4	Basic screen structure	Each preventive maintenance function is explained using examples of the RT ToolBox3 Preventive Maintenance screens.
5	Total score	
6	Consumption degree calculation function	
7	Operating information	
8	Maintenance simulation	
9	When consumption occurred	Explains actions to take when consumption is detected.
10	Maintenance	Explains pause of warning occurrence related to this function and operation at the time of maintenance using examples of the RT ToolBox3 Preventive Maintenance screens.
11	Batch management of maintenance information	Explains how to collectively manage maintenance information of the entire production line with the host system.
12	Robot (system) status variables	Explains robot (system) status variables, parameters, and dedicated input/output signals related to the preventive maintenance function.
13	Parameter	
14	Dedicated input/output signals	
15	Troubleshooting	Explains error details related to the preventive maintenance function and actions to take.

1.2 Compatible products

The following products are compatible with this function.

	Item	Description		Remarks
1)	Robot arm	Vertical multi-joint type RV-FR series	RV-2FR series, RV-4FR series, RV-7FR series, RV-13FR series, RV-20FR series	Standard model 6-axis robot only
		Horizontal multi-joint type RH-FR series	RH-3FRH series, RH-6FRH series, RH-12FRH series, RH-20FRH series, RH-3FRHR series	Standard model only
2)	Robot controller	CR800-D	Ver.A3 or later	
		CR800-R	Ver.A3 or later	
		CR800-Q	Ver.A3 or later	
3)	Robot total engineering support software (Note 1)	RT ToolBox3	Ver.1.30G or later	Robot program language: MELFA-BASIC VI
		RT ToolBox3 mini (Note 2)	Ver.1.30G or later	
		RT ToolBox3 Pro	Ver.1.30G or later	
4)	Function expansion card	MELFA Smart Plus Card Pack (Note 3)	A type (2F-DQ510) AB type (2F-DQ520) (Note 4)	Either one
		MELFA Smart Plus Card (Note 3)	A type (2F-DQ511)	

Note 1) Must be purchased separately.

Note 2) When RT ToolBox3 mini is used, simulation on RT ToolBox3 cannot be used.

Note 3) In this instruction manual, "MELFA Smart Plus card" may be used as the general term for MELFA Smart Plus card pack and MELFA Smart Plus card.

Note 4) When using a CR800 series robot controller Ver.A4 or later, this function is "Predictive maintenance function", instead of "Preventive maintenance function". For details on "Predictive maintenance function", refer to "Instruction Manual/Preventive maintenance function".

1) Robot arm



Vertical multi-joint type



Horizontal multi-joint type

2) Robot controller



CR800 series

3) Robot total engineering support software



RT ToolBox3

4) Function expansion card



1.3 Related manuals

The following manuals are related to the preventive maintenance function.

Manual name	Description
Robot Arm Setup & Maintenance	Explains the procedures required to operate the robot arm (unpacking, transportation, installation, confirmation of operation), and the maintenance and inspection procedures.
Detailed explanations of functions and operations	Explains details on the functions and operations such as each function and operation, commands used in the program, connection with the external input/output device, and parameters, etc.
CR800 Series Controller Instruction Manual Troubleshooting	Explains the causes and remedies to be taken when an error occurs. Explanations are given for each error No.
RT ToolBox3 / RT ToolBox3 mini User's Manual	The operation manuals for the robot total engineering support software "RT ToolBox3", "RT ToolBox3 mini", "RT ToolBox3 Pro" (Option).
MELFA Smart Plus User's Manual	Describes the installation method and setting method of MELFA Smart Plus card (Option).
Communication Middleware Manual (MelfaRXM.ocx)	The operation manual for ActiveX controller "MelfaRXM.ocx" that communicates with the robot controller.
Ethernet Function Instruction Manual	The operation manual for the Ethernet function that enables Ethernet communication with PCs using the TCP/IP protocol. Also, explains the SLMP connection.

1.4 Maintaining the robot

This function supports maintenance and inspection so that the robot can be used for a long time without trouble.

Efficient maintenance is supported through notification of the time of maintenance parts replacement or overhaul based on the actual operating status of the robot. However, in order to prevent failure beforehand and ensure prolonged service life and safety of the robot, we strongly recommend periodic maintenance and inspection be carried out.

This chapter explains maintenance and inspection of parts that are subject to this function.

For details on robot inspection items, implementation time of periodic inspection, calculation of operating time, and maintenance and inspection procedures, refer to "5. Maintenance and Inspection" in the separate volume "Instruction Manual/Robot Arm Setup & Maintenance".

1.4.1 Type of maintenance and inspection

There are two types of maintenance and inspection, daily inspection and periodic inspection. The following table shows the type of maintenance and inspection.

■Type of maintenance and inspection

No.	Type of inspection and maintenance works		Description	Operating time (Note1)
1	Daily inspection		Inspection works to be performed every day before starting operation for the safe use of the robot.	
2	Periodic inspection	Monthly inspection	Inspection and maintenance works to be performed every month.	Every 300 hr
3		6-month inspection	Inspection and maintenance works to be performed every 6 months.	Every 1,800 hr
4		2-year inspection	Inspection and maintenance works to be performed every 2 years.	Every 7,200 hr
5		Battery replacement	Replacement of the backup battery of the robot. Replace the battery every year regardless of the operating hours.	
6		Lubrication	Lubrication of each axis of the robot. Refer to "1.4.3 Lubrication" for the lubrication schedule.	

Note 1) Robot operating hours are based on 15 hours/day, 20 days/month. If the robot operates 8 hours/day, the operation hours per month are about half the above condition. Therefore, monthly inspection shall be performed once every two months.

1.4.2 Inspecting/replacing timing belt

This robot uses a timing belt for the drive conveyance system.

Compared to gears and chains, the timing belt does not require lubrication and has a low noise. However, if the belt usage method and tension adjustment are inadequate, the life could drop and noise could be generated. depending on the robot working conditions, elongation will occur gradually over a long time. The tension must be confirmed during the periodic inspection.

The inspection/replacement method of the timing belt differs depending on the model. Perform inspection/replacement by referring to "5. Maintenance and Inspection" in the separate volume "Instruction Manual/Robot Arm Setup & Maintenance".

■Timing belt replacement period

The timing belt life is greatly affected by the robot working conditions, so a set time cannot be given. However, if the following symptoms occur, replace the belt.

- 1) The belt tension value becomes less than the guideline value.
- 2) Position mismatch or gear teeth skipping occurs.
- 3) Cracks or wear occurs on the belt.
- 4) The tooth bottom of the belt is worn out and the core is exposed.



Caution

The timing belt can be replaced by customers; however, if adjustment is not appropriate, it could lead to failure of related parts. When the timing belt needs to be replaced, we recommend that you contact our Mitsubishi Service Department to request replacement.



Caution

If you need to remove the timing belt for repair and others, measure the tension before removing the belt.

When installing the belt, make sure to install with the same degree of tension as before removal.

Failure to do so could shorten the service life of the belt and related parts.

1.4.3 Lubrication

Grease is used for the reduction gears of the robot. Grease has various roles, such as suppressing of wear of reduction gears, removal of frictional heat, and prevention of burn-in.

If you use a robot for a long period of time, the grease will deteriorate due to loads during operation (operating speed, operation frequency, heat generation condition, and others.). Degraded grease loses initial performance and adversely affects machine service life.

Therefore, periodic replacement of grease is essential.

Lubrication intervals, lubrication locations, lubrication specifications and lubrication methods for grease are different for each model.

Lubricate the robot before the lubrication interval shown in the following table elapses.

In addition, before the servo ON time reaches the specified hours (24,000 hours), overhaul work to replace the grease inside the robot is necessary.

If it is unavoidable that overhaul cannot be performed at the specified interval, lubricate at the lubrication intervals shown in the following table.

For details on overhaul, refer to "1.4.5About Overhaul".

Refer to "5. Maintenance and Inspection" in the separate volume "Instruction manual/Robot Arm Setup & Maintenance" for lubrication locations, lubrication specifications, and lubrication methods.

■Lubrication interval

Robot type	Lubrication interval
RV-2FR / RV-2FRL	All axes: 6,000 hr
RV-4FR / RV-4FRL RV-7FR / RV-7FRL	All axes: 24,000 hr
RV-7FRLL RV-13FR / RV-13FRL RV-20FR	J1 axis to J3 axis: 20,000 hr J4 axis to J6 axis: 24,000 hr
RH-3FRH series RH-6FRH series RH-12FRH series RH-20FRH series	J1 axis to J2 axis: 24,000 hr Shaft part (ball screw / spline): 2,000 km/travel
RH-3FRHR series	J1 axis to J2 axis: 6,000 hr Shaft part: 2,000 km/travel



Caution

- The lubrication intervals are the cumulative value of operation at maximum speed. In case of intermittent operation or slow specified speed, the lubrication interval can be extended accordingly.
- Since the lubrication interval changes depending on the operation status of the robot, make decisions as necessary so that grease will not run out.
- Avoid excessive lubrication as it could cause grease leakage. Also, lubrication shall be performed a maximum of three times. For maintenance after that, overhaul work is required to replace the grease inside.

1.4.4 Replacing the battery

An absolute encoder is used for the position detector, so while power of controller is turned off the position must be saved by the backup battery. These batteries are installed when the robot is shipped from the factory, but as these are consumable parts, they must be replaced periodically by the customer. The guideline for replacing the battery is one year, but this will differ according to the robot's usage state. When a battery-related error occurred, replace the battery of the robot arm.

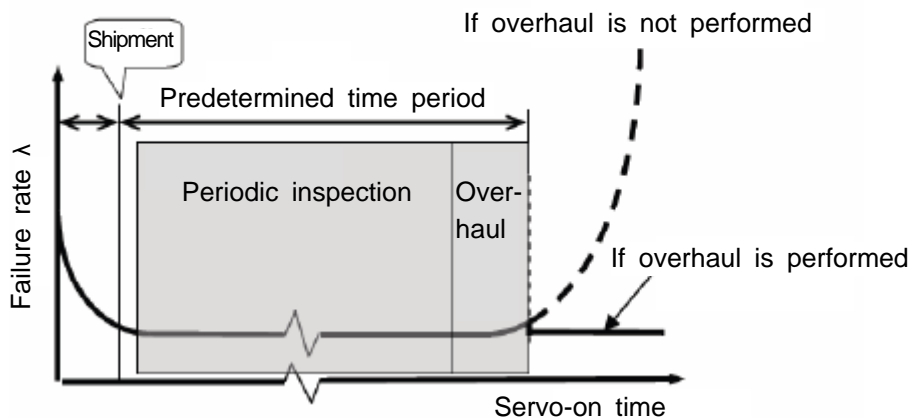
The robot arm battery replacement method differs depending on the model. Refer to "5. Maintenance and Inspection" in the separate volume "Instruction Manual/Robot Arm Setup & Maintenance".

1.4.5 About Overhaul

Robots which have been in operation for an extended period of time can suffer from wear and other forms of deterioration. In regard to such robots, we define overhaul as an operation to replace parts running out of specified service life or other parts which have been damaged, so that the robots may be put back in shape for continued use.

As a rule of thumb, it is recommended that overhaul be carried out before the total amount of servo-on time reaches the specified time (24,000 hours for the robot arm and 36,000 hours for the controller). (Refer to the figure below.)

However, the degree of the equipment's wear and deterioration presumably varies depending on their operating conditions. Especially for operation with high load and frequency, the maintenance cycle may be shorter.



2. Basic specifications

2.1 Overview of basic specification of the preventive maintenance function

The preventive maintenance function roughly consists of the following two functions.

The maintenance simulation can be checked on the preventive maintenance function screen of RT ToolBox3.

Information on preventive maintenance by the consumption degree calculation function can be checked on the Preventive Maintenance screen, status variables, and parameters of RT ToolBox3. The following features are also available.

- Allows preventive maintenance information to be output to the host system of your production line and collectively managed.
(Compatible with MelfaR XM.ocx and SLMP)
- If you are using a CR800 series Ver.A3 or later robot controller, by enabling this function using the MELFA Smart Plus card, this function can be used by taking over the previous consumption degree even during operation of the robot. (For compatible cards, refer to "1.2 Compatible products , 4) Function extension card".)

	Function	Overview
1	Maintenance simulation	Using the real machine or simulations on RT ToolBox3, this function estimates the parts replacement time or the recommended maintenance time when specific motion patterns are repeated. This can be used for pre-study of maintenance cycles or parts-friendly operation verification of robots. (Refer to "8 Maintenance simulation".)
2	Consumption degree calculation function	This function calculates the consumption degree [%] of robot components based on the actual operating status (motor speed, load status, and others), and displays/notifies the period up to maintenance/inspection or overhaul. This supports efficient maintenance through notification of maintenance timing and deciding the maintenance priority order. <Target parts> Maintenance parts : Grease, timing belt Overhaul parts : Reduction gear, bearing, ball screw, ball spline (Refer to "6 Consumption degree calculation function ".)

Caution

When using this function by upgrading from a non-compatible controller software version to a compatible controller software version, the consumption degree during the period of the non-compatible software version is not added up, thus the result of consumption degree calculation function cannot be the correct value.

The consumption degree of the robot arm is saved in the robot controller, thus it is necessary to use the correct combination of the robot arm and robot controller.

To replace the robot arm or robot controller only, perform backup/restore of preventive maintenance information to migrate the preventive maintenance information.

(For backup/restore, refer to "10.3 Backup and restore".)

2.1.1 Maintenance simulation

Using the real machine (online) or simulations on RT ToolBox3, this function estimates the parts replacement time or the recommended maintenance time when specific motion patterns (robot programs) are repeated.

Maintenance simulation estimates the following items.

- 1) Number of years up to the time of replenishing grease
- 2) Number of years up to the time of timing belt replacement
- 3) Recommended number of years up to the maintenance time for overhauling parts
(Of reduction gear, bearing, ball screw, and ball spline, the part for which there is the shortest number of years of maintenance)

There are two types of estimation methods, "Program operation" and "1 Cycle operation".

For the real machine (online), estimation is possible using "Program operation", and for simulation, in addition to "Program operation", "1 Cycle operation" can also be used.

- 1 Cycle operation: Specify the start line and end line of the robot program to estimate the parts replacement/ the recommended maintenance time based on its 1 cycle operation pattern.
Because 1 cycle can be accurately specified on a robot program, it is possible to more accurately estimate the number of years when 1 cycle operation is repeated than when using Program operation.
The estimation result of the number of years is from the brand new robot state.
- Program operation: While running a robot program automatically, the parts replacement/ the parts replacement/ the recommended maintenance time is estimated based on the operation pattern from when the start button is pressed to when the end button is pressed.
Accurate 1 cycle (start line and end line) cannot be specified but Program operation is used when it is difficult to specify 1 cycle on the program, such as when the program uses external signals.
The estimation result for a real machine (online) is the number of years from the current consumption degree of the robot.
The estimation result for simulation is the number of years from the brand new robot state.

Output data	
Number of years up to the time of replenishing grease (for each joint axis)	
Number of years up to the time of timing belt replacement (for each joint axis)	
Number of years up to the recommended maintenance time for overhaul parts (for each joint axis) (Of reduction gear, bearing, ball screw, and ball spline, the part for which there is the shortest number of years of maintenance)	

Estimation method		
	Real machine (online)	· Program operation · Estimates the number of years from the current consumption degree of the robot.
	Simulation	· 1 Cycle operation, Program operation · Estimates the number of years from the brand new robot state.
Usage		
	Usage	RT ToolBox3 Preventive Maintenance screen (Refer to 8.Maintenance simulation)
	Setting item	· Operation hours per day, operation days per month

* For models and joint axes subject to this function, refer to "2.1.3 Target models/target axes".



Caution

When RT ToolBox3 mini is used, simulation on RT ToolBox3 cannot be used.

The recommended number of years up to the replacement/maintenance time output by this function is the value calculated when the specified operation is repeated. Also, the result may vary depending on the performance of the personal computer used and the load status. The actual time changes depending on the actual operating status or load status of the robot.

Use as reference values for planning of maintenance and inspection.

Correctly set hand work conditions (weight, center of gravity, shape) actually used. If the settings differ from the actual robot settings, the consumption degree cannot be calculated correctly.

Use parameters HNDDAT* and WRKDAT* to set hand work conditions and use Loadset commands to specify hand work conditions.

For details of hand work condition setting, refer to the separate "Instruction Manual/Detailed Explanations of Functions and Operations".

Do not use M_TIMER(8) while programming. This function uses M_TIMER(8) for the estimation of parts replacement time and maintenance time. If M_TIMER(8) is used while programming, the number of years of replacement and maintenance cannot be estimated accurately.

After changing to M_TIMER(1) to M_TIMER(7), perform the maintenance simulation.

Note on 1 Cycle operation

(1) For command line that waits for signals to be input or robot status changes, use a comment to set the stop time.

For a program waiting for input of signal from outside or change of the robot status variable, comment out that portion and instead set a stop time (assumed) and specify the start line and end line including that line.

(2) Use a program with no infinite loop.

A program that executes an infinite loop does not give the correct calculation result. Check that the program is not an infinite loop in a FOR or GOTO statement.

(3) Include all instructions required for 1 cycle in the line selection range.

When selecting the start line and end line of a program, specify line numbers in such a way that all instructions such as jump destinations of Gosub or hand word settings required for the robot to perform 1 cycle operation are included in the range.

When sending/receiving external signals, set the stop time as a substitute for the signal sending/receiving time and specify the line numbers including that line.

(4) About robot program "ESTPROG.prg"

When executing 1 cycle operation, "ESTPROG" is displayed as the robot program on the operating panel.

This is a program that is automatically generated when 1 cycle operation is executed. After 1 cycle operation, you can delete this program if it is unnecessary.

2.1.2 Consumption degree calculation function

This function calculates the consumption degree [%] of robot components based on the actual operating status (motor speed, load status, and others), and calculates the period up to maintenance/inspection or overhaul.

Consumption Degree [%] is calculated based on the recommended maintenance time of each part as 100 [%].

Beside consumption degree [%] of each robot component, the Total Score (Consumption Degree [%] and Up to Maintenance) of maintenance parts (grease, timing belt), and the Total Score (Consumption Degree [%]) of overhaul parts (reduction gear, bearing, ball screw, ball spline) are calculated, respectively and are displayed on the comprehensive evaluation screen.

	Target parts	Output data
Maintenance parts	Grease	Grease consumption degree [%] (for each joint axis)
	Timing belt	Timing Belt consumption degree [%] (for each joint axis)
		Total Score (Consumption Degree [%], Up to Maintenance [h]) ^{*1}
Overhaul parts	Reduction gear	Gear consumption degree [%] (for each joint axis)
	Bearing	Bearing consumption degree [%] (for each joint axis)
	Ball screw/ball spline	Ball Screw/Ball Spline consumption degree [%] (for each joint axis)
		Total Score (Consumption Degree [%]) ^{*2}
Operating Information	-	Servo ON Time [h], Operation Time [h], Actual Operation Time [h], Power ON Time [h], Servo ON Count [times], Motor Cumulative Rotation Count [rotation] (for each joint axis)

*1: Of the maintenance parts (grease, timing belt), the Consumption Degree [%] and Up to Maintenance [h] of the part (joint axis) having the least remaining time are used.

*2: Of the overhaul parts (reduction gear, bearing, ball screw, ball spline), the Consumption Degree [%] of the part (joint axis) having the least up to maintenance time is used.

Information confirmation		
	Information	<ul style="list-style-type: none"> Consumption Degree: See above Up to Maintenance: See above (Total Score Maintenance Parts) Operating Information: See above [Consumption Status]: Existence of wear in each target part Maintenance Log: Log data under Maintenance Reset (date & time, parts, joint axes)
	Check method	RT ToolBox3 Preventive Maintenance screen (Refer to 5. Total score, 6 Consumption degree calculation function) [Parameters] (Refer to 13.2 Consumption degree calculation function 13.2.2 Data acquisition parameter.) [Status Variable] (Refer to 12.Robot (system) status variables 12.2 Consumption degree calculation function)
Setting/operation		
	Setting item	<ul style="list-style-type: none"> Notification Day setting: Warning Remaining Number of Days, Operation Time of a Day, Notification Interval How to Notify setting (maintenance parts): Warning Occurrence, Signal Output How to Notify setting (overhaul parts): Warning Occurrence, Signal Output ["I/O Signals assignment"]
	Setting method	RT ToolBox3 Preventive Maintenance screen (Refer to 3.2.1.Setting how to notify) [Parameters] (Refer to 13.2 Consumption degree calculation function 13.2.1 Setting parameters.)
	Operation item	<ul style="list-style-type: none"> Maintenance Reset (reset of consumption degree) [Notification Pause]

	Operation method	RT ToolBox3 Preventive Maintenance screen (Refer to 10.1 Warning Pause, 10.2 Maintenance Reset) [Parameters] (Refer to 13.2 Consumption degree calculation function 13.2.3 Operation parameters.) [I/O Signal]* ¹ (Refer to 14 Dedicated input/output signals 14.1 Consumption degree calculation function.)
Notification		
	Notification content	<ul style="list-style-type: none"> · [Consumption Status] (maintenance parts): Output for each part, for each joint axis · [Consumption Status] (overhaul parts): Output for each part, for each joint axis · Servo ON Time*²
	Notification method	RT ToolBox3 Preventive Maintenance screen* ³ (3.2.1.Setting how to notify) Warning Occurrence* ¹ (Refer to 3.2.1.Setting how to notify) Signal Output* ¹ (Refer to 3.2.2 Setting signals.)

*1 Setting is required.

*2 Notification of overhaul intervals by servo ON time follows "How to notify the consumption degree of overhaul parts".

*3 A maintenance message is displayed.

* For models and joint axes subject to this function, refer to "2.1.3 Target models/target axes".





Caution [About calculation of the consumption degree]


- The consumption degree of each part is calculated on the assumption that the robot is used in the environment (ambient temperature, humidity) within the specification scope described in the instruction manual (standard specifications).
- The consumption degree of each part is used as a reference value for supporting the maintenance and inspection schedule calculated based on the robot operating status. It does not guarantee the service life of the robot.
- Irrespective of the consumption degree, carry out daily inspection and periodic maintenance and inspection described in the instruction manual (Standard Specifications Manual, Robot Arm Setup & Maintenance).
- When the servo ON time exceeds the specified time (24,000 hours) or the consumption degree exceeds the warning remaining number of days, we recommend you perform overhaul of the robot arm.
- Reset operation of the consumption degree of each part must not be executed except during maintenance or part replacement.
- For the total score of maintenance parts and overhaul parts, the value of the part among all joint axes having the least remaining time (Up to Maintenance) to the recommended maintenance time is output, respectively. For that reason, the consumption degree of the total score could be smaller than the maximum consumption degree value of each part.
- The remaining time is a reference value calculated based on the operating status of the robot from the previous maintenance time. Also, the remaining time is when you use the robot in the same way as before.
Therefore, if operation is changed, the remaining time may increase or decrease.
- For the axis with multiple parts of one type, the part that wears the fastest in terms of design is the subject for the calculation. It is recommended to perform maintenance on the peripheral parts at the same time as the part replacement.

Caution [About the robot controller]

- When using this function by upgrading from a non-compatible controller software version to a compatible controller software version, the consumption degree during the period of the non-compatible software version is not added up, thus the result of consumption degree calculation function cannot be the correct value.
- The consumption degree of the robot arm is saved in the robot controller, thus it is necessary to use the correct combination of the robot arm and robot controller. To replace the robot arm or robot controller only, perform backup/restore of preventive maintenance information to migrate the preventive maintenance information.
(For backup/restore, refer to "10.3 Backup and restore".)

 **Caution** Depending on the operating status at startup, correct results may not be obtained at the beginning due to fluctuations until sufficient data is accumulated.

 **Caution** Correctly set hand work conditions (weight, center of gravity, shape) actually used. If the settings differ from the actual robot settings, the consumption degree cannot be calculated correctly.
Use parameters HNDDAT* and WRKDAT* to set hand work conditions and use Loadset commands to specify hand work conditions.
For details of hand work condition setting, refer to the separate "Instruction Manual/Detailed Explanations of Functions and Operations".

 **Caution** When the preventive maintenance function is valid, the maintenance forecast is not displayed and warning signals of maintenance forecast are not output. When the information is reset by the preventive maintenance function or maintenance forecast, the information in the other function is reset as well.

<< MEMO >>

2.1.3 Target models/target axes

(1) Consumption degree calculation function/maintenance simulation

The table below shows the joint axes for which target parts of the consumption degree calculation function of each robot type are used.

(Compatible robots are the standard models only.)

(●: Uses target parts, -: Not use target parts)

(1) RV-2FR / RV-2FRL

Joint axis		J1 axis	J2 axis	J3 axis	J4 axis	J5 axis	J6 axis
Maintenance parts	Grease	●	●	●	●	●	●
	Timing belt	●	●	●	●	●	●
Overhaul parts	Reduction gear	●	●	●	●	●	●
	Bearing	●	●	●	●	●	●
	Ball screw	-	-	-	-	-	-
	Ball spline	-	-	-	-	-	-

(2) RV-4FR / RV-4FRL / RV-7FR / RV-7FRL

Joint axis		J1 axis	J2 axis	J3 axis	J4 axis	J5 axis	J6 axis
Maintenance parts	Grease	●	●	●	●	●	●
	Timing belt	●	-	●	●	●	●
Overhaul parts	Reduction gear	●	●	●	●	●	●
	Bearing	●	-	●	●	●	●
	Ball screw	-	-	-	-	-	-
	Ball spline	-	-	-	-	-	-

(3) RV-13FR / RV-13FRL / RV-20FR / RV-7FRL

Joint axis		J1 axis	J2 axis	J3 axis	J4 axis	J5 axis	J6 axis
Maintenance parts	Grease	●	●	●	●	●	●
	Timing belt	-	-	-	●	●	●
Overhaul parts	Reduction gear	●	●	●	●	●	●
	Bearing	-	-	-	●	●	●
	Ball screw	-	-	-	-	-	-
	Ball spline	-	-	-	-	-	-

(4) RH-3FRH / RH-6FRH / RH-12FRH / RH-20FRH

Joint axis		J1 axis	J2 axis	J3 axis	J4 axis
Maintenance parts	Grease	●	●	●	-
	Timing belt	-	-	●	●
Overhaul parts	Reduction gear	●	●	-	-
	Bearing	-	-	● ^{*1}	●
	Ball screw	-	-	● ^{*2}	-
	Ball spline	-	-	-	● ^{*2}

*1: For RH-3FRH, J3 axis does not use a bearing, shown as (-).

*2: RH-3FRH uses a ball screw/spline but this function assumes that the J3 axis uses a ball screw and the J4 axis uses a ball spline.

(5) RH-3FRHR

Joint axis		J1axis	J2 axis	J3 axis	J4 axis
Maintenance parts	Grease	●	●	●	-
	Timing belt	●	●	●	●
Overhaul parts	Reduction gear	●	●	-	-
	Bearing	●	●	-	●
	Ball screw	-	-	●*3	-
	Ball spline	-	-	-	●*3

*3: The RH-3FRHR series uses a ball screw/spline but this function assumes that the J3 axis uses a ball screw and the J4 axis uses a ball spline.

2.2 How to utilize the preventive maintenance function

The preventive maintenance function assumes the following usages.

(1) At system startup

It is possible to estimate the replacement time of maintenance parts or the recommended maintenance time of overhaul parts when an operation pattern of the robot is repeated using "Maintenance Simulation".

This function can be used for planning a maintenance schedule when starting up a system.

(For details, refer to "8 Maintenance simulation".)

(2) System operation time (at periodic inspection)

You can check the consumption degree using the "Consumption degree calculation function".

Because the consumption degree calculation function calculates the consumption degree based on the actual robot operation status (motor speed, loads, and others), you can check the current robot consumption degree and remaining time to replacement/maintenance.

This function is useful for reviewing or planning a maintenance schedule.

(For function details, refer to "6 Consumption degree calculation function".)

(3) System operation time (when a part is consumed)

As a result of the remaining time to replacement/maintenance calculated by the consumption degree calculation function, if the set remaining time is reached, that effect is notified by the method you set. Check detailed information and arrange or carry out maintenance.

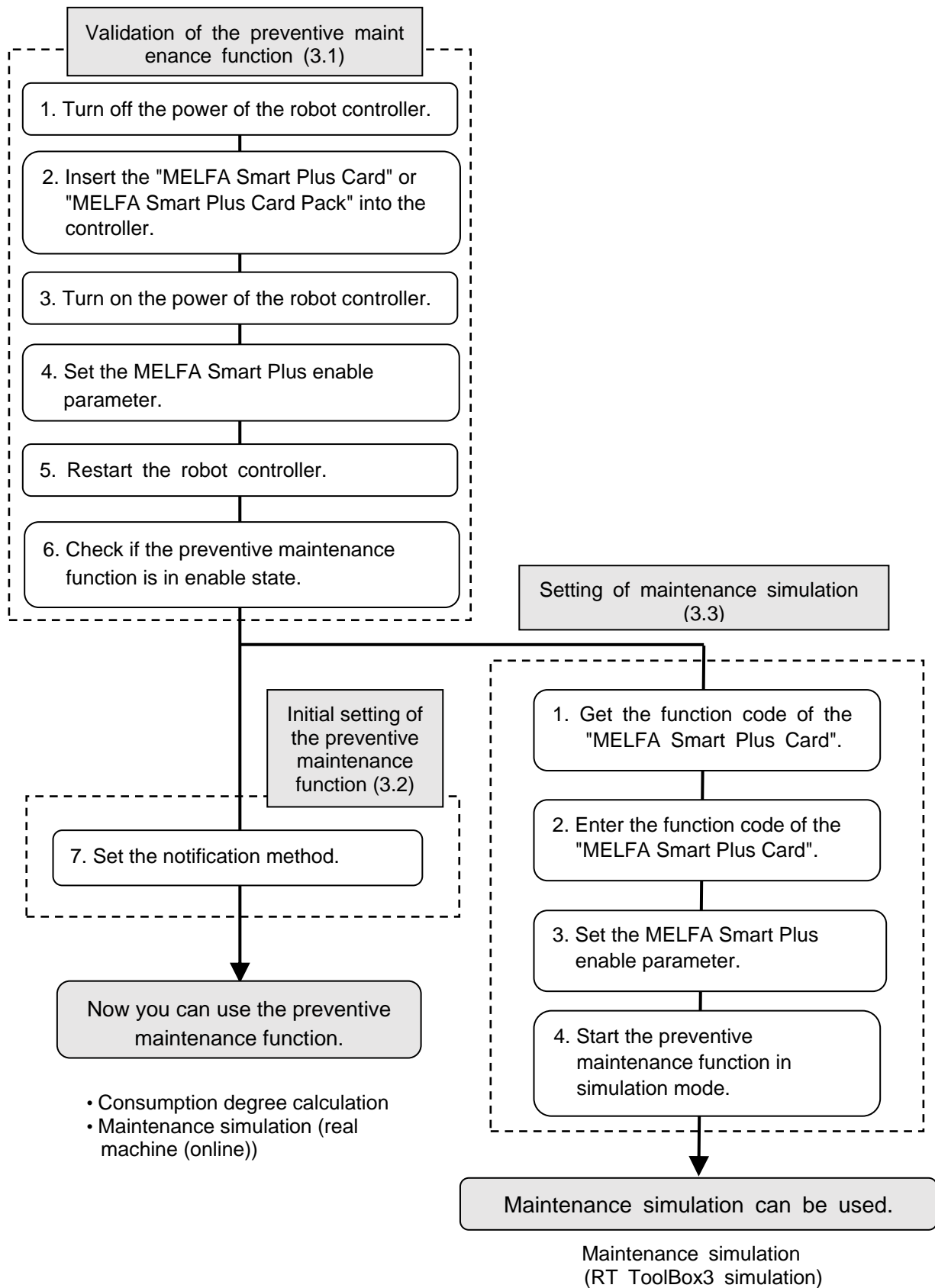
By carrying out appropriate maintenance, it is possible to prevent the production line from stopping due to a sudden failure of the robot and reduce down time.

(For function details, refer to "6 Consumption degree calculation function".)

<< MEMO >>

3. Startup and initial settings

This section describes the procedure to start the preventive maintenance function.



3.1 Enabling the preventive maintenance function

Insert the "MELFA Smart Plus Card" into the robot controller and set parameters.

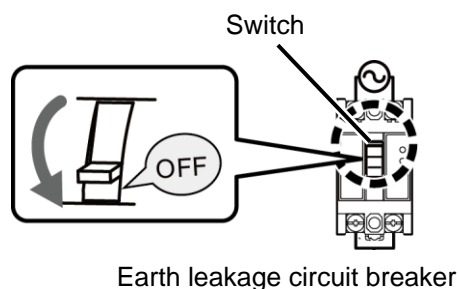
1 Turn off the power of the robot controller.

CR800-D type

- 1) Turn off the switch of the earth leakage circuit breaker.

CR800-R/Q type

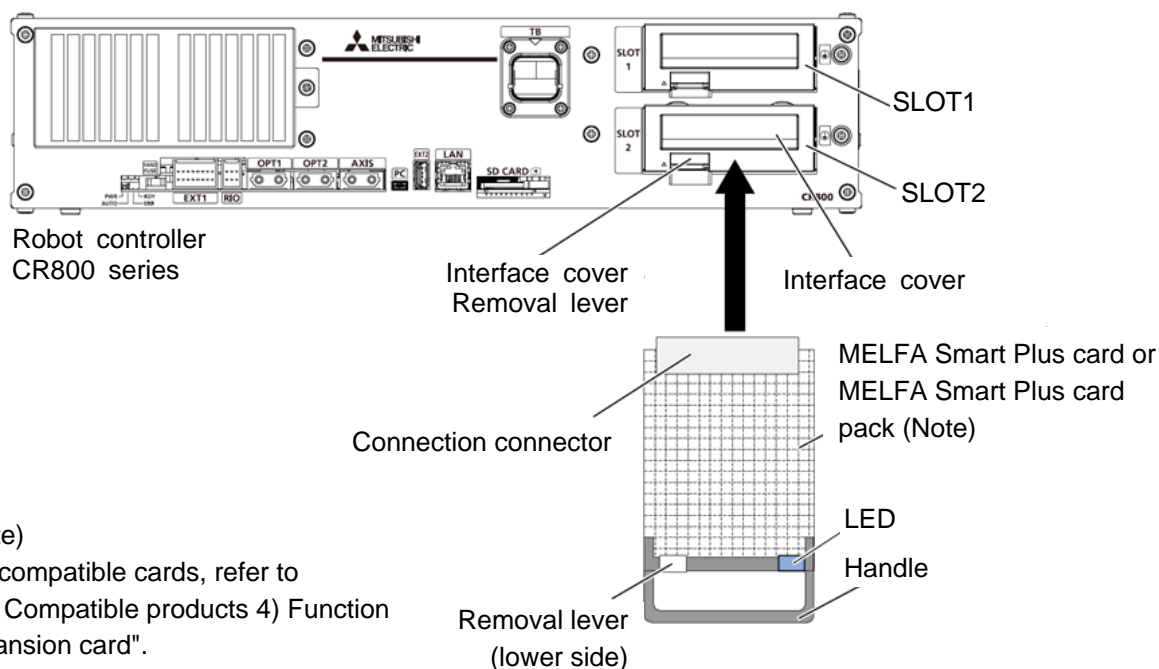
- 1) Turns off the power of the robot CPU system.
- 2) Turn off the switch of the earth leakage circuit breaker.



2 Insert the MELFA Smart Plus card into the robot controller.

Insert the "MELFA Smart Plus Card" or the "MELFA Smart Plus Card Pack" in an available slot on the robot controller. (Note: For compatible cards, refer to "1.2 Compatible products 4) Function extension card".)

- 1) Lightly hold the interface cover removal lever to pull out the interface cover.
- 2) Hold the handle of the MELFA Smart Plus card and insert it into SLOT1 or SLOT2.
At that time, insert in such a way that both ends of the card fit into the groove of the slot (SLOT1 or SLOT2 in the illustration).
- 3) Insert the connection connector all the way to the end until the removal lever clicks into place to be locked.



(Note)
For compatible cards, refer to
"1.2 Compatible products 4) Function
expansion card".



Caution

Install only one MELFA Smart Plus card.

If multiple MELFA Smart Plus cards have been installed, the LED will not flash and an error (L3782) will occur. For error details, refer to "15.1.3 MELFA Smart Plus card".

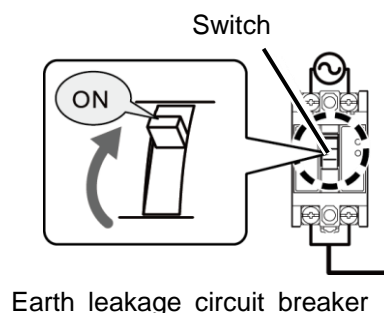
3 Turn on the power of the robot controller.

CR800-D type

- 1) Turn on the switch of the earth leakage circuit breaker.
- 2) The POWER lamp of the robot controller lights.

CR800-R/Q type

- 1) Turn on the switch of the earth leakage circuit breaker.
- 2) The POWER lamp of the robot controller lights.
- 3) Next, turn on the power of the robot CPU system.



* When the robot controller starts up, the LED of the MELFA Smart Plus card flashes.

- MELFA Smart Plus Card ... Flashes in red.
- MELFA Smart Plus Card Pack ... Flashes in blue.

4 Selecting the MELFA Smart Plus function and setting the preventive maintenance function enable parameters.

With a robot controller where the "MELFA Smart Plus Card" has been inserted, set the MELFA Smart Plus function selection parameter "SMART+1" and the preventive maintenance function enable parameter "PMENA".

For this operation, use the teaching pendant or RT ToolBox3.

[When using the MELFA Smart Plus card]

- 1) Change the parameter "SMART+1" value to [4].
- 2) Change the parameter "PMENA" value to [1].

[When using the MELFA Smart Plus card pack]

- 1) Change the parameter "PMENA" value to [1].

5 Restart the robot controller.

CR800-D type

- 1) Turn off the switch of the earth leakage circuit breaker.
- 2) Turn on the switch of the earth leakage circuit breaker.

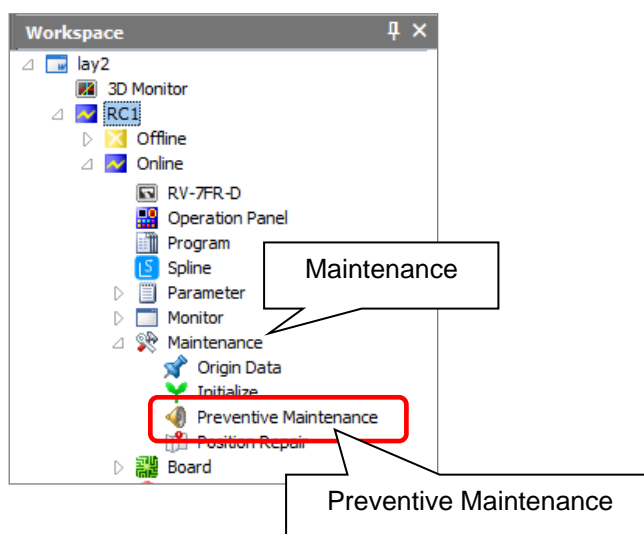
CR800-R/Q type

- 1) Turns off the power of the robot CPU system.
- 2) Turn off the switch of the earth leakage circuit breaker.
- 3) Turn on the switch of the earth leakage circuit breaker.
- 4) After the POWER lamp of the robot controller lights, turn on the power of the robot CPU system.

6 Check that the preventive maintenance function is enabled.

- 1) When the MELFA Smart Plus card is used, the LED of the MELFA Smart Plus card flashes green.
When the MELFA Smart Plus card pack is used, the LED flashes blue.
- 2) Check that the preventive maintenance function has been enabled.
 - For the teaching pendant
Check that the "MSPPMENA" parameter is set to [1].
 - For RT ToolBox3
Connect RT ToolBox3 to the robot controller and start a project from "Online"
Click [Online] - [Maintenance] to expand the project tree and check that "Preventive Maintenance" is displayed.

RT ToolBox3 project tree



3.2 Initial setting of the preventive maintenance function

Set how to notify when consumption of parts is detected.

Specify the notification method (presence of warning/signal output, notification day) when the warnings occur.

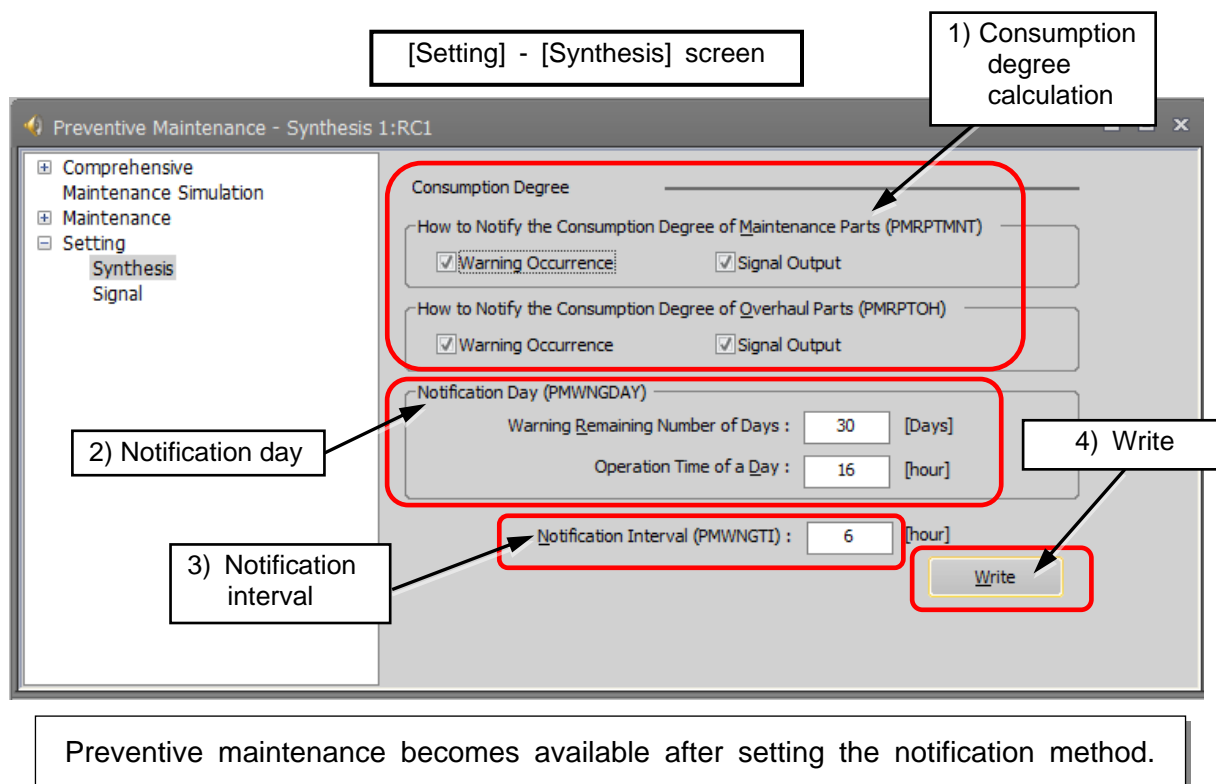
If you have not set the notification method, upon starting the preventive maintenance function, the [Setting] - [Synthesis] screen appears.

[Note] In the default setting, notification is disabled. Make sure to set according to your environment.

3.2.1 Setting how to notify

7 Set the notification method.

- 1) From the RT ToolBox3 project tree, double-click [Online] - [Maintenance] - [Preventive Maintenance].
 - 2) From the preventive maintenance tree, click [Setting] - [Synthesis].
- * If you have not set the notification method, upon clicking [Preventive Maintenance], the [Setting] - [Synthesis] screen appears.



1) Consumption degree notification method:

Set how to notify consumption of maintenance parts and overhaul parts. You can select Warning Occurrence or Signal Output, or both.

Warning Occurrence ... A warning occurs and the error number and error message are displayed according to the situation.

Signal Output ... The status can be checked with dedicated output signals.

(Setting of signal numbers are required. Refer to "3.2.2 Setting signals".)

2) Consumption degree notification day:

Warning Remaining Number of Days: Set the number of remaining days for warning to occur.

Operation Time of a Day: Set the number of hours of operation of the robot per day.

3) Consumption degree notification interval: Set the interval of notification of warning.

4) Write: Writes setting items on the robot controller.

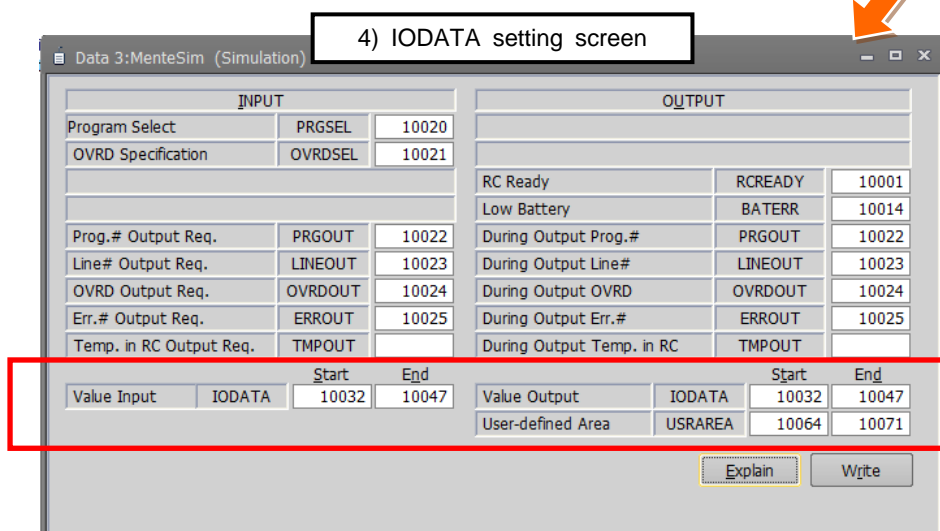
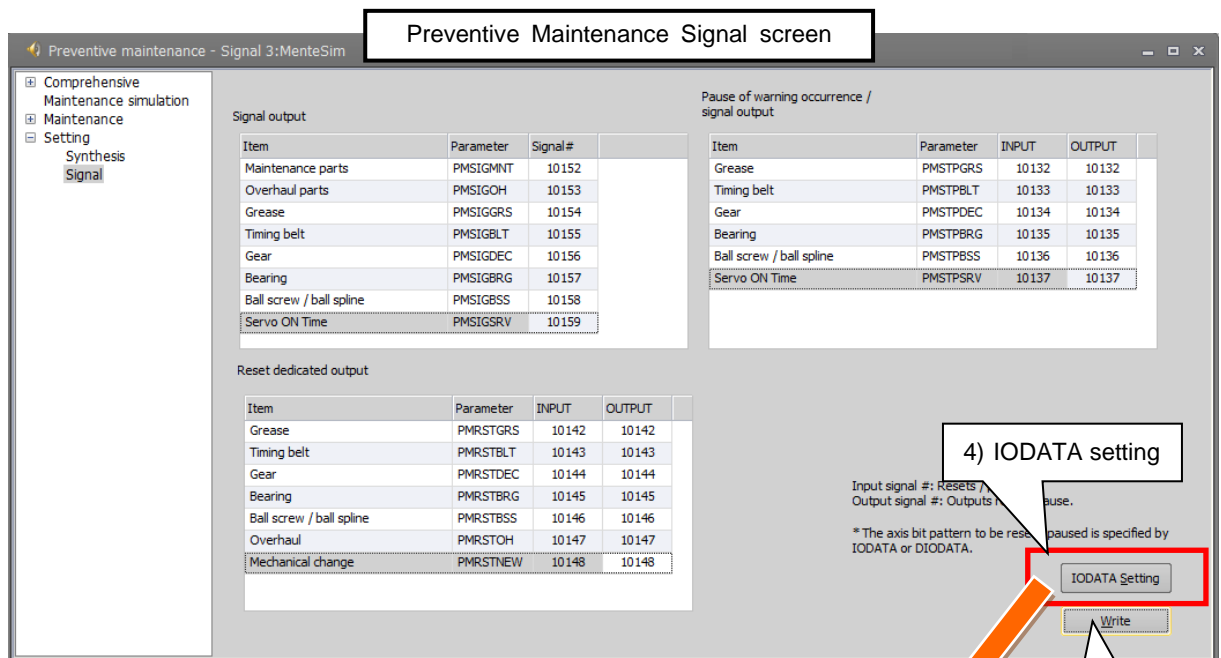
3.2.2 Setting signals

Set signal numbers when you wish to use signal input/output to implement notification when consumption or parts is detected, reset the consumption degree, or pause warning occurrence/signal output.

For dedicated input/output signals of the preventive maintenance function, refer to "14 Dedicated input/output signals".

- 1) From the RT ToolBox3 project tree, double-click [Online] - [Maintenance] - [Preventive Maintenance].
- 2) From the Preventive Maintenance tree, click [Setting] - [Signal].
- 3) Enter the signal number for the item to be set. (Note 1)
- 4) When setting an axis bit pattern for reset/pause, click "IODATA Setting". When IODATA Setting screen appears, set necessary information and click "Write".
- 5) After changing the parameter values, click the Write button to write them to the robot controller.

Note 1) Set the signal numbers according to the system to be used. The range of values that can be set in the parameters are 0 to 255, 2000 to 5071, 6000 to 8047, and 10000 to 18191.



3.3 Setting of maintenance simulation

In order to use "Maintenance Simulation" for the simulation of RT ToolBox3, the function code and parameter of the MELFA Smart Plus card need to be set to RT ToolBox3.

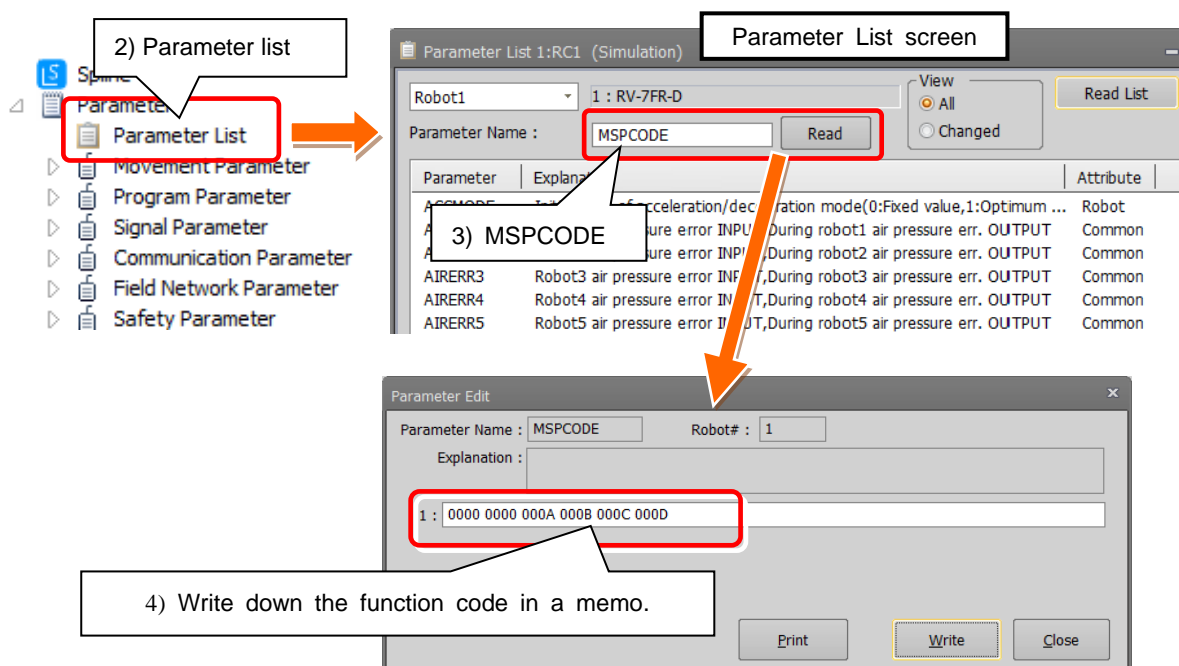
This section explains the procedure for setting the function code of the MELFA Smart Plus card to RT Toolbox3, which is not connected to the robot controller where the MELFA Smart Plus card has been installed.

(For maintenance simulation, refer to "8.Maintenance simulation".)

1 Get the function code of the MELFA Smart Plus card.

First, get the function code from the robot controller where the MELFA Smart Plus card and preventive maintenance function have been enabled ("3.1 Enabling the preventive maintenance function" is completed).

- 1) Use the RT ToolBox3 connected to the robot controller where the MELFA Smart Plus card and preventive maintenance function have been enabled.
- 2) From the RT ToolBox3 project tree, select [Parameter List].
- 3) Enter "MSPCODE" for the parameter name on the Parameter List screen.
- 4) The function code (24 alphanumeric characters) of the "MELFA Smart Plus Card" is displayed; write it down in a memo.



*It is possible to read the "MSPCODE" parameter with the teaching pendant.

[When using the maintenance simulation on a personal computer connected to the real machine]

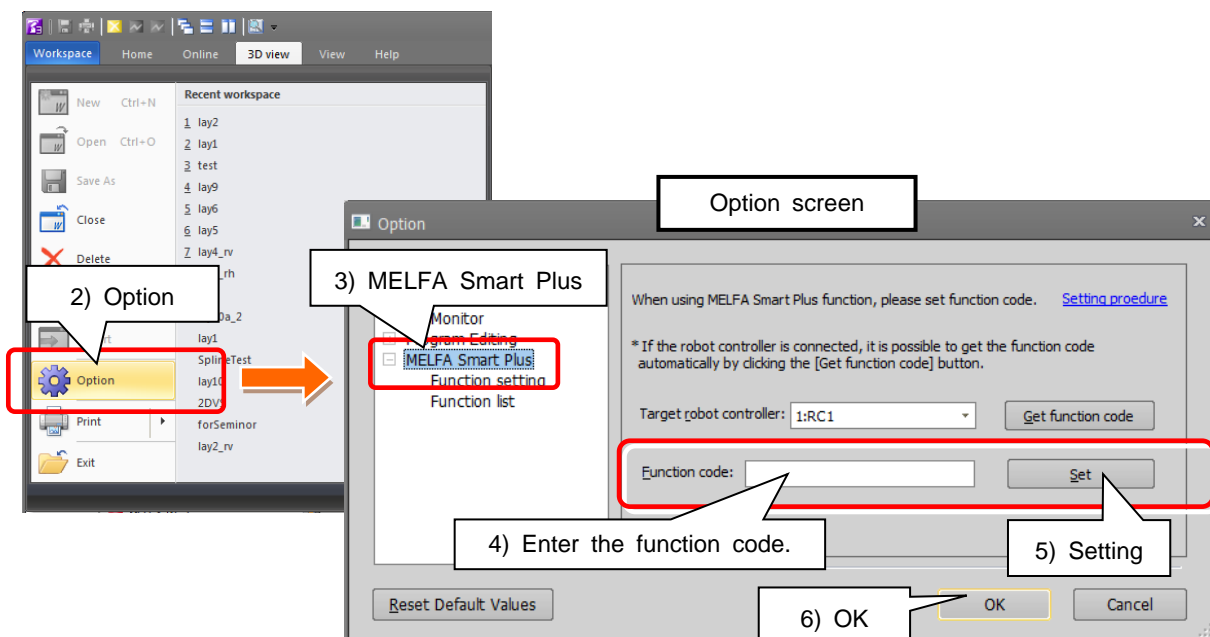
- 1) Select [Option] from the [Workspace] tab of RT ToolBox3.
- 2) From the left tree on the Option screen, select MELFA Smart Plus.
- 3) When you click the "Get function code" button, the function code of the "MELFA Smart Plus Card" is displayed in the "Function code" field. (See the screen on the next page.)

* Now you can use the maintenance simulation with a personal computer connected to the real machine.

2 Set the function code of the MELFA Smart Plus card.

Next, enter the function code obtained in Step 1 to the RT ToolBox3 that performs the maintenance simulation.

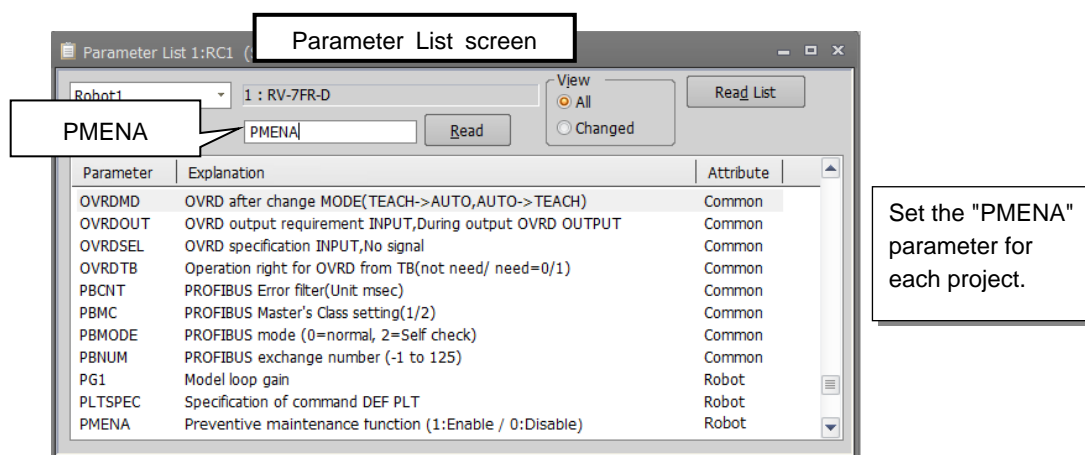
- 1) Start RT ToolBox3 that performs the maintenance simulation. At that time, click the right button of the mouse on the desktop icon of RT ToolBox3 and select "Implement as administrator" from the displayed menu.
- 2) Select [Option] from the [Workspace] tab of RT ToolBox3.
- 3) From the left tree on the Option screen, select MELFA Smart Plus.
- 4) Enter the MELFA Smart Plus card function code obtained in Step 1 to the "Function code" field.
- 5) Press the Set button.
- 6) Press the OK button and restart RT ToolBox3.



3 Set the preventive maintenance function enable parameter.

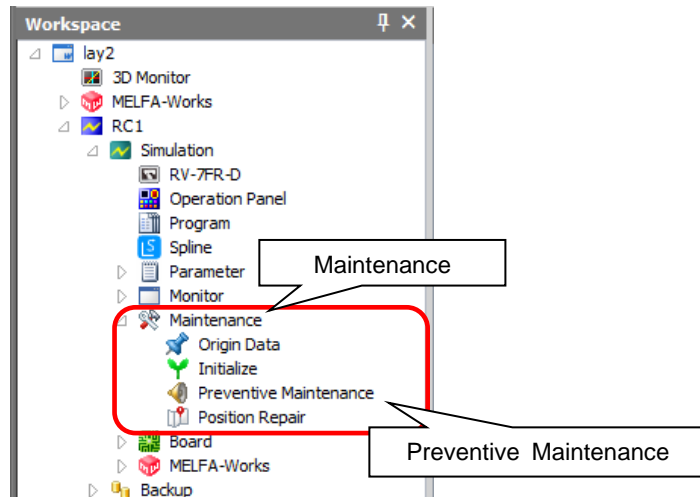
Set the parameter to enable preventive maintenance.

- 1) Open the workspace that performs the maintenance simulation. Open the project.
- 2) Open the parameter list of the project that performs the maintenance simulation.
- 3) Set the "PMENA" preventive maintenance function parameter to [1: Enable].



4 Check that the preventive maintenance function is enabled.

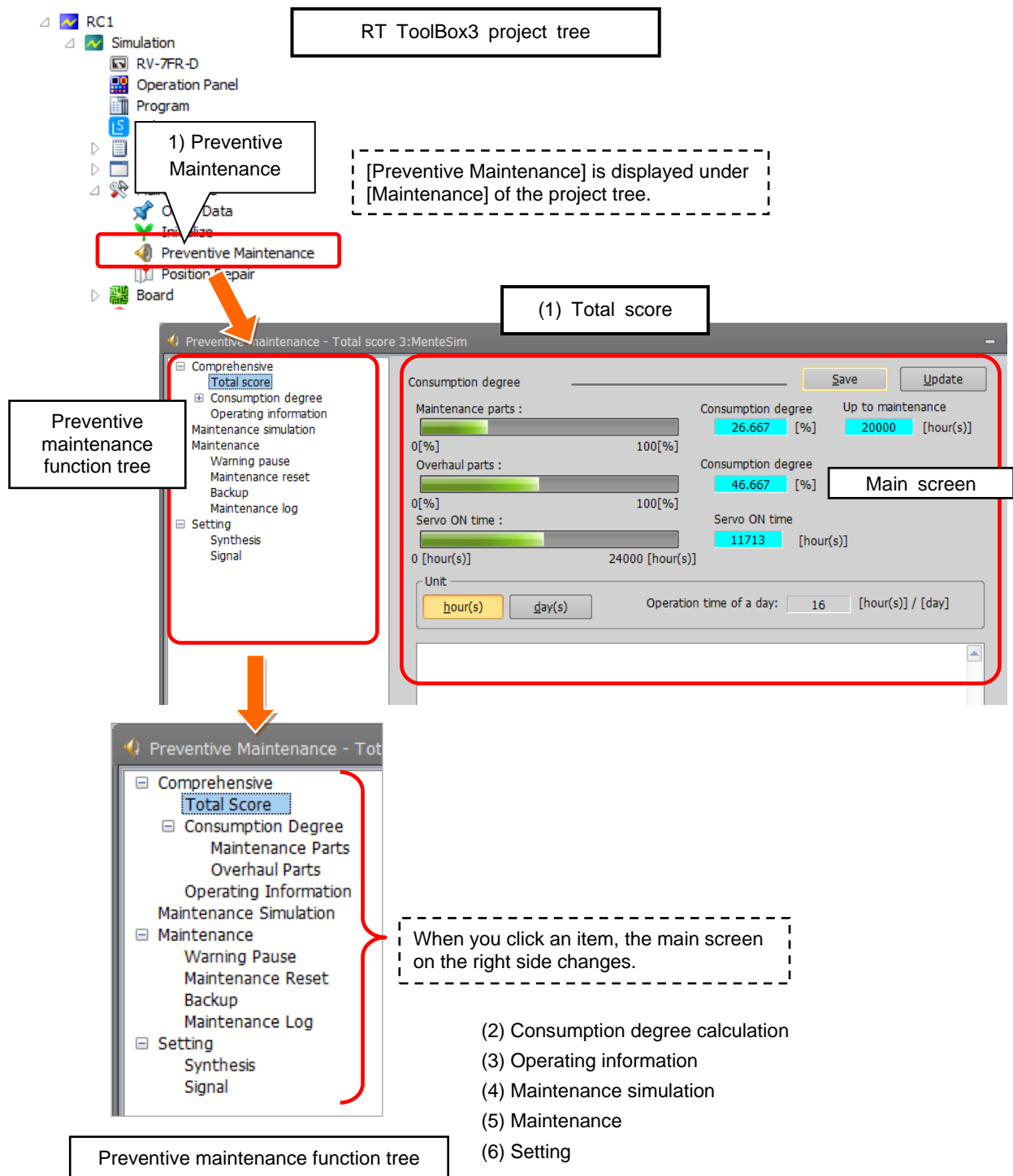
- 1) Change the operation mode to <Simulation>.
If parameter setting in Step 3 is performed using <Simulation>, start up Simulation once again.
(The "PMENA" parameter requires rebooting.)
- 2) From the project tree, expand [Maintenance] and check that [Preventive Maintenance] is displayed.



<< MEMO >>

4. Basic screen structure

This screen displays the total evaluation result of the consumption degree calculation function.



- 1) From the RT ToolBox3 project tree, when you double-click [Maintenance] - [Preventive Maintenance], the preventive maintenance function starts and the Total Score screen appears.
- 2) In the Total Score screen, the preventive maintenance function tree is displayed on the left side and the main screen on the right side.
- 3) When you click the + mark in the preventive maintenance function tree, menus of the preventive maintenance function appear.
- 4) When you click an item on the preventive maintenance function tree, the main screen on the right changes.

(1) Total score

The screen that is displayed first when starting the preventive maintenance function.

This screen displays the total evaluation result of the consumption degree calculation function, and maintenance messages.

For details, refer to "5 Total score".

(2) Consumption degree calculation

The screen indicates the consumption degree of each part and each joint axis of maintenance parts and overhaul parts calculated by the consumption degree calculation function.

For details, refer to "6 Consumption degree calculation function".

(3) Operating information

The screen that displays the integration time and accumulation count from the time when the previous overhaul was carried out.

- Integration Time [hours]: Power ON Time, Servo ON Time, Operation Time, Actual Operation Time

- Accumulation Count [times] : Servo ON Count, Motor Cumulative Rotation Count

For details, refer to "7 Operating information".

(4) Maintenance simulation

Using the real machine (online) or simulations on RT ToolBox3, this function estimates the parts replacement time or the recommended maintenance time when specific motion patterns (robot programs) are repeated.

For details, refer to "8 Maintenance simulation".

(5) Maintenance

This menu is used to specify pause of warning occurrence/signal output, and reset the consumption degree of maintenance parts and overhaul parts, backup, restore, and checking of the maintenance log.

For details, refer to "10 Maintenance".

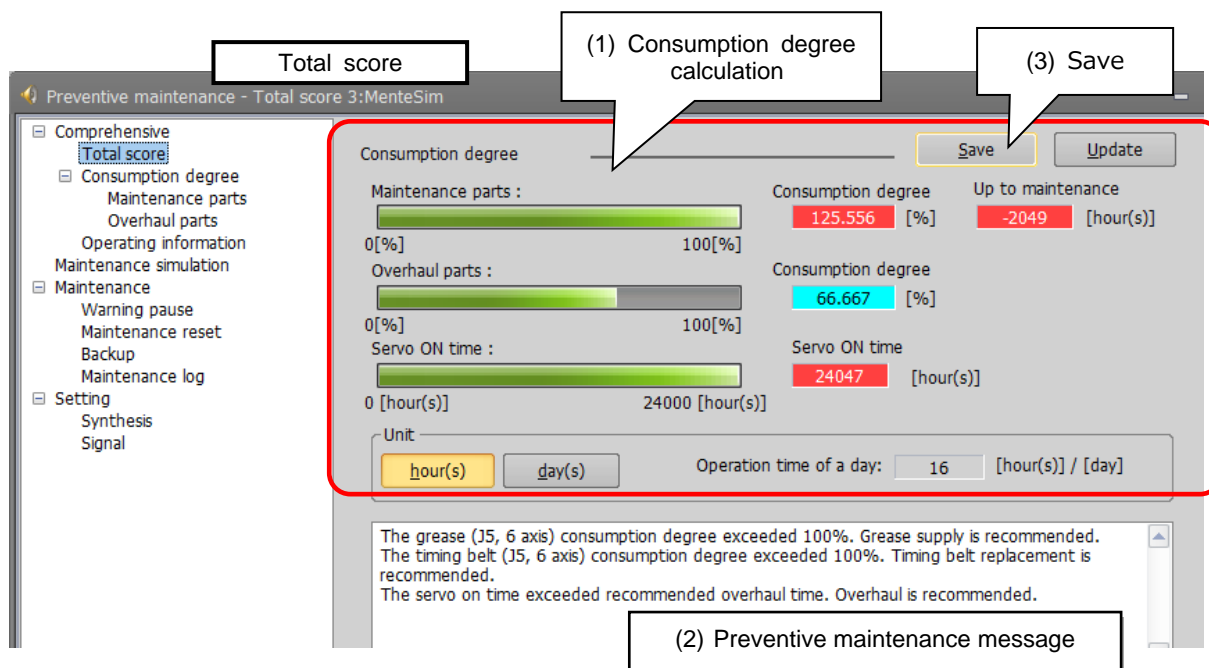
(6) Setting

This menu is used to set the preventive maintenance function including the presence of warning occurrence, signal output and its occurrence intervals, and set dedicated input/output signals.

For details, refer to "3.2.1 Setting how to notifySetting how to notify".

5. Total score

This screen displays the total evaluation result of the consumption degree calculation function.



(1) Consumption degree calculation

The Consumption Degree area indicates the total score (Consumption Degree [%] and Up to Maintenance) of maintenance parts (grease, timing belt), and the total score (Consumption Degree [%] of overhaul parts (reduction gear, bearing, ball screw, ball spline), and the accumulated servo ON time since the previous overhaul time.

Consumption degree [%] is displayed based on the recommended maintenance time of each part as 100 [%].

You can check details of each part and joint axis on the Consumption Degree screen.

(Refer to "6 Consumption degree calculation function".)

■Maintenance parts and overhaul parts

Classification	Target parts	Display description
Maintenance parts	Grease, timing belt	Consumption degree [%], remaining time up to the recommended maintenance time The remaining time of each joint axis of maintenance parts is calculated and Consumption Degree [%] and Up to Maintenance [h] of the part (joint axis) having the least remaining time to the recommended maintenance time is displayed.
Overhaul parts	Reduction gear, bearing, ball screw/ball spline	Consumption degree [%] The remaining time of each joint axis is individually calculated and the consumption degree [%] of the part (joint axis) having the least remaining time is used.

When the consumption status comes close to or exceeds the notification day you specified, check the content of the preventive maintenance message displayed at the bottom of the screen and details of each part/each joint axis on the Consumption Degree screen and take measures.

For preventive maintenance message and measures, refer to "9 When consumption occurred".

(2) Preventive maintenance message

When the consumption status of the target part exceeds the notification day you specified, the preventive maintenance message according to the status is displayed; check the message content and take measures.

For preventive maintenance messages and measures, refer to "9 When consumption occurred".

(3) Save

"Save" button in the total score window exports all preventive maintenance data as a CSV file.

(Applicable version: RT Toolbox3 version 1.50C or later.)

The log data of the score calculated by the operation data are included.

Storage destination : [Folder for workspace]¥[Project name]¥Maintenance¥PMLog

File name : [TotalDataYYYYMMDD-HHMMSS].csv

(The storage destination and the folder name can be changed.)

6. Consumption degree calculation function

This function calculates the consumption degree [%] of robot components based on the actual operating status (motor speed, load status, and others), and calculates the period up to maintenance/inspection or overhaul.

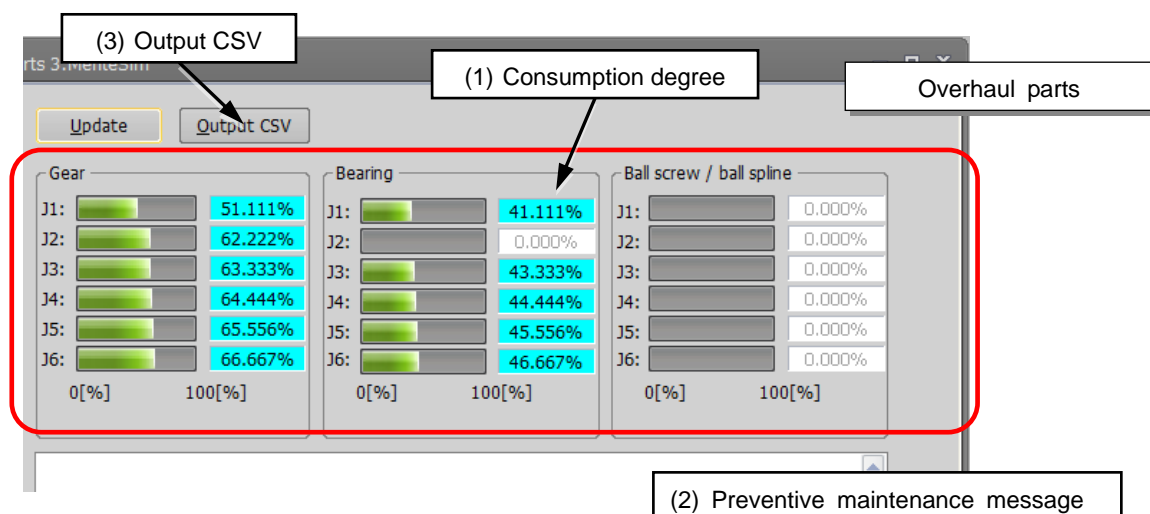
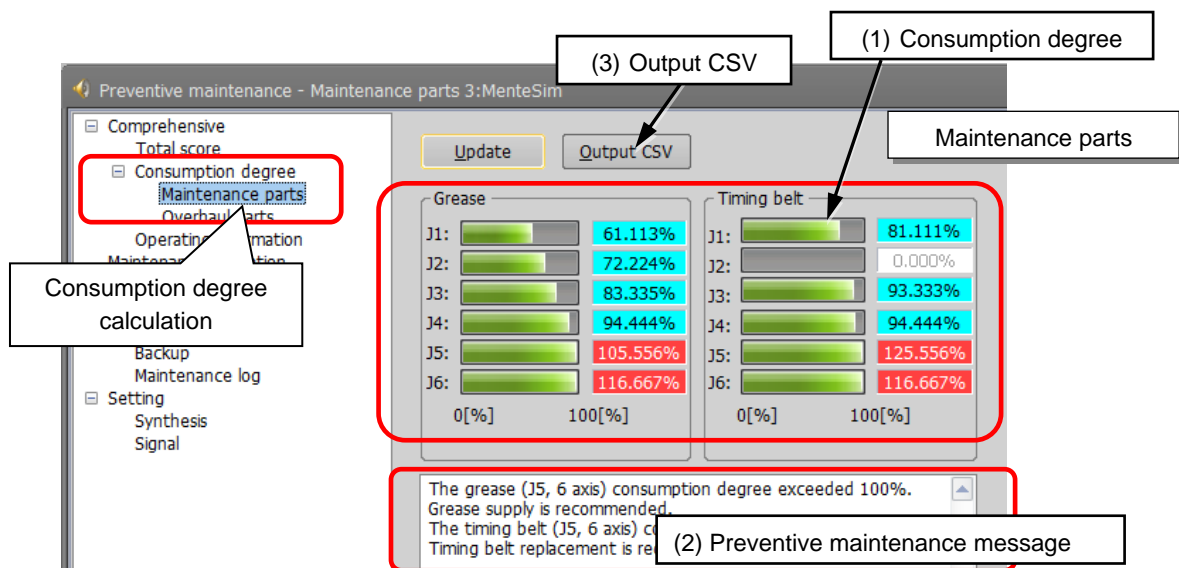
The screen indicates the consumption degree of each joint axis of maintenance parts and overhaul parts calculated by the consumption degree calculation function.

The current status of maintenance parts (grease, timing belt) and overhaul parts (reduction gear, bearing, ball screw/ball spline) is displayed, separately in two screens. Also, the current status is displayed as the preventive maintenance message.

■ Maintenance parts and overhaul parts

Maintenance parts	Grease, timing belt
Overhaul parts	Reduction gear, bearing, ball screw/ball spline

- 1) Start preventive maintenance.
- 2) Click [Total Score] - [Consumption Degree] to expend the menu.
- 3) When you select "Maintenance Parts" or "Overhaul Parts", the consumption degree of each part of the target axis and each joint axis is displayed.



(1) Consumption degree

This area of the screen indicates the consumption degree of each part of the target axis and each joint axis in a graph and numeric value [%].

(For target axis, refer to "2.1.3 Target models/target axes ".)

(2) Preventive maintenance message

This field displays preventive maintenance messages according to the part status.

When the remaining time exceeds the notification day, an appropriate preventive maintenance message is displayed; check the message content and take measures. For preventive maintenance message and measures, refer to "9.When consumption occurred".

(3) Output CSV

Exports data of the consumption degree displayed in the window as a CSV file.

(Applicable version: RT Toolbox3 version 1.50C or later.)

Storage destination and the file name of the CSV file

Storage destination : [Folder for workspace]¥[Project name]¥Maintenance¥PMLog

File name : [ConsumptionDataYYYYMMDD-HHMMSS].csv

(The storage destination and the folder name can be changed.)



Caution

[About calculation of the consumption degree]

- The consumption degree of each part is calculated on the assumption that the robot is used in the environment (ambient temperature, humidity) within the specification scope described in the instruction manual (standard specifications).
- The consumption degree of each part is used as a reference value for supporting the maintenance and inspection schedule calculated based on the robot operating status. It does not guarantee the service life of the robot.
- Irrespective of the consumption degree, carry out daily inspection and periodic maintenance and inspection described in the instruction manual (Standard Specifications Manual, Robot Arm Setup & Maintenance).
- When the servo ON time exceeds the specified time (24,000 hours) or the consumption degree exceeds the warning remaining number of days, we recommend you perform overhaul of the robot arm.
- Reset operation of the consumption degree of each part must not be executed except during maintenance or part replacement.
- For the total score of maintenance parts and overhaul parts, the value of the part among all joint axes having the least remaining time (Up to Maintenance) to the recommended maintenance time is output, respectively. For that reason, the consumption degree of the total score could be smaller than the maximum consumption degree value of each part.
- The remaining time is a reference value calculated based on the operating status of the robot from the previous maintenance time. Also, the remaining time is when you use the robot in the same way as before.
Therefore, if operation is changed, the remaining time may increase or decrease.
- For the axis with multiple parts of one type, the part that wears the fastest in terms of design is the subject for the calculation. It is recommended to perform maintenance on the peripheral parts at the same time as the part replacement.

Caution

[About the robot controller]

- When using this function by upgrading from a non-compatible controller software version to a compatible controller software version, the consumption degree during the period of the non-compatible software version is not added up, thus the result of consumption degree calculation function cannot be the correct value
- The consumption degree of the robot arm is saved in the robot controller, thus it is necessary to use the correct combination of the robot arm and robot controller. To replace the robot arm or robot controller only, perform backup/restore of preventive maintenance information to migrate the preventive maintenance information.

(For backup/restore, refer to "10.3 Backup and restore".)

Caution

Depending on the operating status at startup, correct results may not be obtained at the beginning due to fluctuations until sufficient data is accumulated.

Caution

Correctly set hand work conditions (weight, center of gravity, shape) actually used. If the settings differ from the actual robot settings, the consumption degree cannot be calculated correctly.

Use parameters HNDDAT* and WRKDAT* to set hand work conditions and use Loadset commands to specify hand work conditions.

For details of hand work condition setting, refer to the separate "Instruction Manual/Detailed Explanations of Functions and Operations".

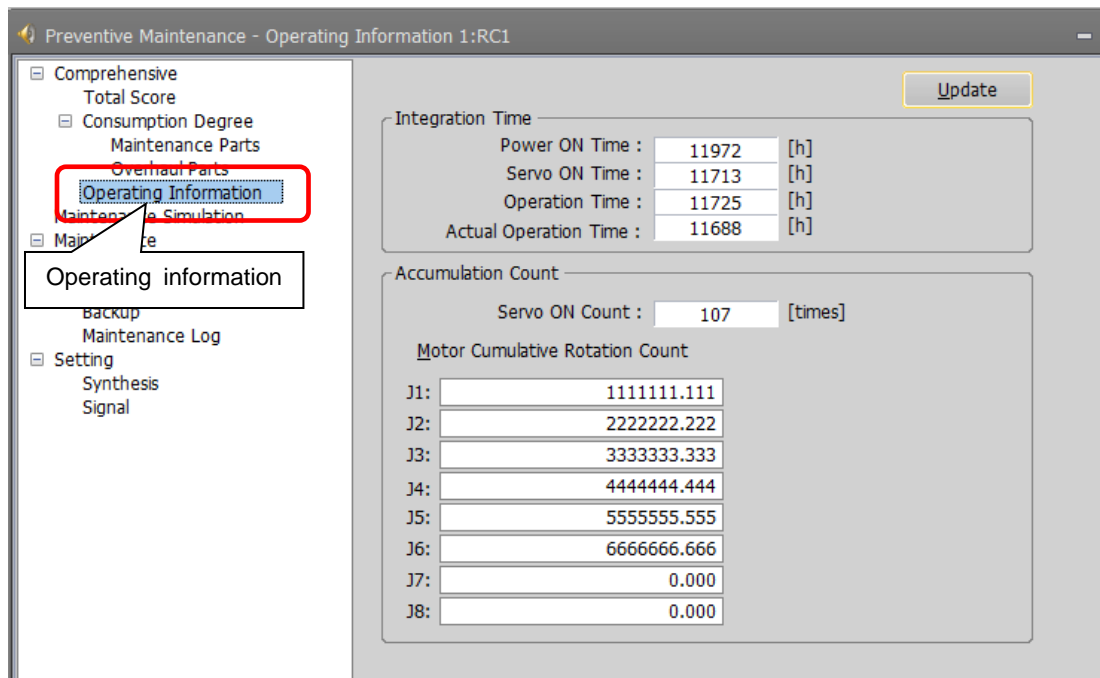
Caution

When the preventive maintenance function is valid, the maintenance forecast is not displayed and warning signals of maintenance forecast are not output. When the information is reset by the preventive maintenance function or maintenance forecast, the information in the other function is reset as well.

7. Operating information

The Operating Information screen is used to manage and display the integration time and accumulation count from the time when the previous overhaul was carried out.
The integration time and accumulation count data are reset when "Reset operation at overhaul implementation" is performed.

- 1) Start preventive maintenance.
- 2) Click [Total Score] to expand the menu.
- 3) When you select [Operating Information], the integration time and accumulation count are indicated on the main screen.



■Data that can be monitored

Classification	Data	Unit
Integration Time	Power ON Time (duration of robot controller power ON)	[h] hours
	Servo ON Time (duration of servo ON)	[h] hours
	Operation Time (duration of robot program execution)	[h] hours
	Actual Operation Time (duration of actual robot arm operation)	[h] hours
Accumulation Count	Servo ON Count (robot)	[times]
	Motor Cumulative Rotation Count (for robot, each joint axis)	[r] (rotation)

8. Maintenance simulation

This function estimates the parts replacement time or the recommended maintenance time when a specific motion pattern (robot program) is repeated using a real machine (online) or simulations on RT ToolBox3.

Maintenance simulation estimates the following items.

- 1) Number of years up to the time of replenishing grease
- 2) Number of years up to the time of timing belt replacement
- 3) Recommended number of years up to the recommended maintenance time for overhauling parts
(Of reduction gear, bearing, ball screw, and ball spline, the part for which there is the shortest number of years of maintenance)

There are two types of estimation methods, "Program operation" and "1 Cycle operation".

For the real machine (online), estimation is possible using "Program operation", and for simulation, in addition to "Program operation", "1 Cycle operation" can also be used.

- 1 Cycle operation: Specify the start line and end line of the robot program to estimate the parts replacement/ the recommended maintenance time based on its 1 cycle operation pattern.
Because 1 cycle can be accurately specified on a robot program, it is possible to more accurately estimate the number of years when 1 cycle operation is repeated than when using Program operation.
The estimation result of the number of years is from the brand new robot state.
- Program operation: While running a robot program automatically, the parts replacement/the recommended time is estimated based on the operation pattern from when the start button is pressed to when the end button is pressed.
Accurate 1 cycle (start line and end line) cannot be specified but Program operation is used when it is difficult to specify 1 cycle on the program, such as when the program uses external signals.
The estimation result for a real machine (online) is the number of years from the current consumption degree of the robot. The estimation result for simulation is the number of years from the brand new robot state.

Operation mode	Estimation method	Number of years estimated
Real machine (online)	Program operation	The number of years from the current consumption degree of the robot.
Simulation	1 Cycle operation, Program operation	The number of years from the brand new robot state.

[Note] In order to use Maintenance Simulation in the simulation mode of RT ToolBox3, the function code and parameter of the MELFA Smart Plus card need to be set.
For the setting method, refer to "3.3 Setting of maintenance simulation".



When RT ToolBox3 mini is used, simulation on RT ToolBox3 cannot be used.

The recommended number of years up to the replacement/maintenance time output by this function is the value calculated when the specified operation is repeated. Also, the result may vary depending on the performance of the personal computer used and the load status. The actual time changes depending on the actual operating status or load status of the robot.

Use as reference values for planning of maintenance and inspection.

Correctly set hand work conditions (weight, center of gravity, shape) actually used. If the settings differ from the actual robot settings, the consumption degree cannot be calculated correctly.

Use parameters HNDDAT* and WRKDAT* to set hand work conditions and use Loadset commands to specify hand work conditions. For details of hand work condition setting, refer to the separate "Instruction Manual/Detailed Explanations of Functions and Operations".

Do not use M_TIMER(8) while programming. This function uses M_TIMER(8) for the estimation of parts replacement time and maintenance time. If M_TIMER(8) is used while programming, the number of years of replacement and maintenance cannot be estimated accurately.

After changing to M_TIMER(1) to M_TIMER(7), perform the maintenance simulation.

8.1 "1 Cycle" operation

This operation is performed in the simulation mode of the RT ToolBox3.

Specify the start line and end line of the robot program to estimate the parts replacement/ the recommended maintenance time based on its 1 Cycle operation pattern.

[Note] When an actual machine is connected, the "1 Cycle" button and "Program" button are not displayed.

Note on 1 Cycle operation

(1) For command line that waits for signals to be input or robot status changes, use a comment to set the stop time.

For a program waiting for input of signal from outside or change of the robot status variable, comment out that portion and instead set a stop time (assumed) and specify the start line and end line including that line.

(2) Use a program with no infinite loop.

A program that executes an infinite loop does not give the correct calculation result.

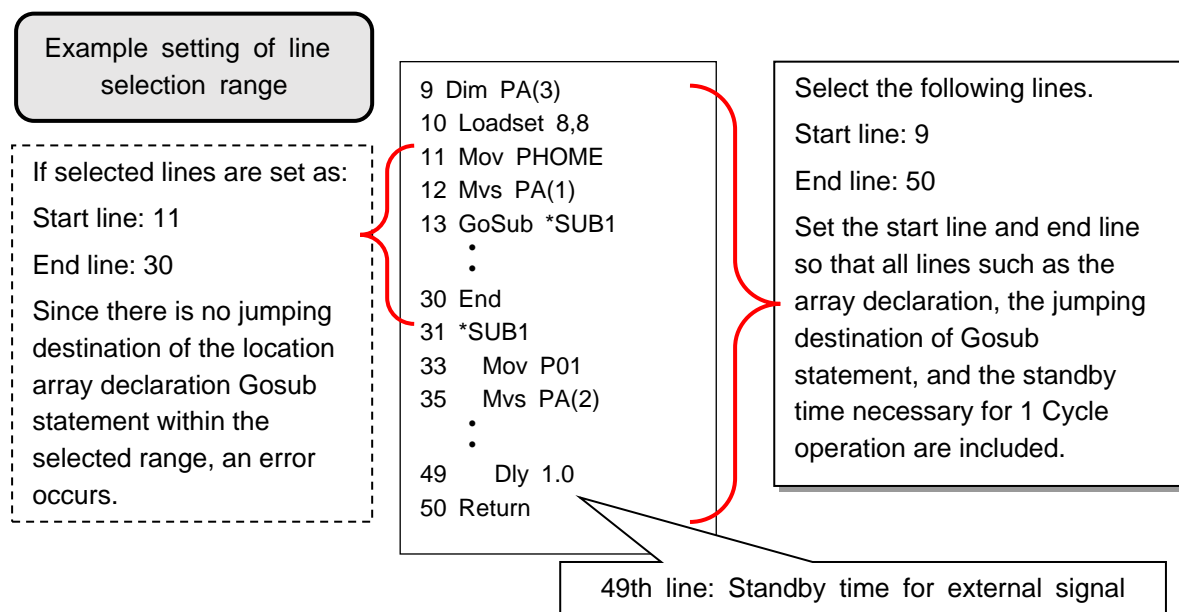
Check that the program is not an infinite loop in a FOR or GOTO statement.

(3) Include all instructions required for 1 cycle in the line selection range.

When selecting the start line and end line of a program, specify line numbers in such a way that all instructions such as jump destinations of Gosub or hand word settings required for the robot to perform 1 cycle operation are included in the range.

When sending/receiving external signals, temporarily set the stop time as a substitute for the signal sending/receiving time and specify the line numbers including that line.

Example) If there is no jumping destination of a sub routine within the selected range, an error (jumping destination does not exist) occurs and the maintenance simulation cannot be executed.



(4) About robot program "ESTPROG.prg"

When executing 1 cycle operation, "ESTPROG" is displayed as the robot program on the operating panel.

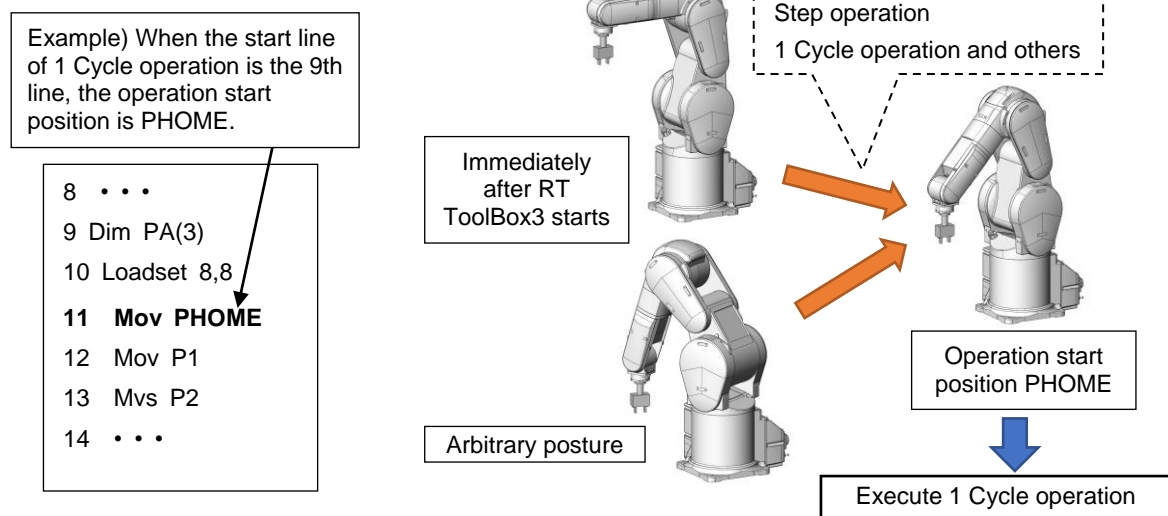
This is a program that is automatically generated when 1 cycle operation is executed. After 1 cycle operation, you can delete this program if it is unnecessary.

1 Move the current position of the robot to the robot operation start position of 1 Cycle operation.

If the current position of the robot is not at the start position of 1 Cycle operation, if 1 Cycle operation starts, the robot moves to the operation start position first. Since that operation is included in the calculation by the maintenance simulation, calculation cannot give the correct 1 Cycle operation result.

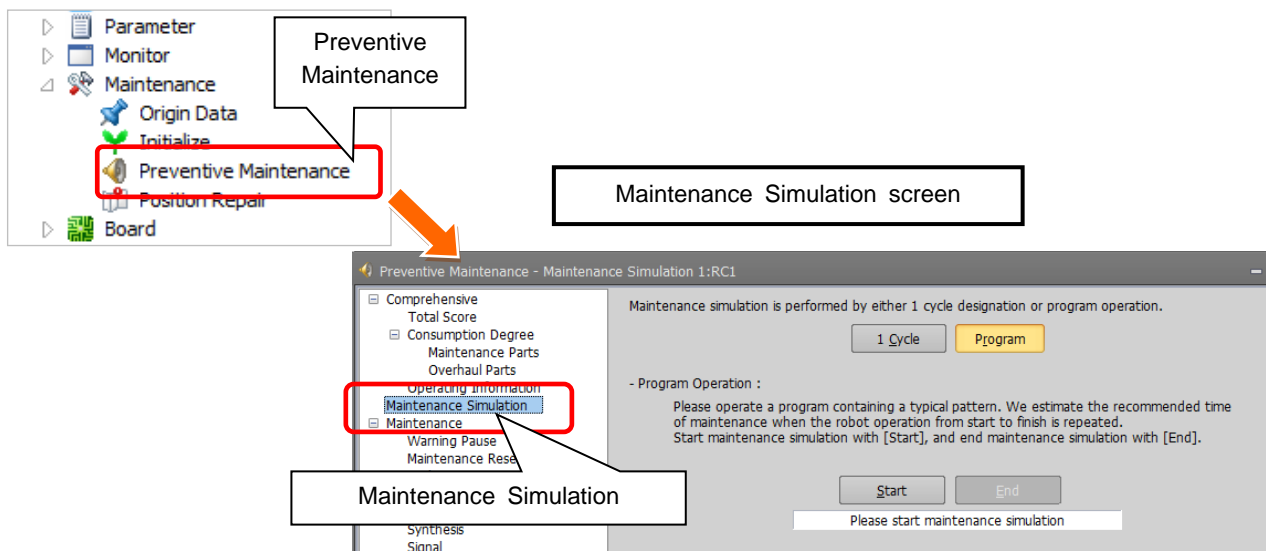
Immediately after starting RT ToolBox3, when performing 1 Cycle operation after the robot is changed to an arbitrary posture using the JOG operation or the program is paused while running, move the current position of the robot to the start position of 1 Cycle operation. Example moving methods of the current position of the robot are described below.

- Use direct execution to move the robot to the operation start position.
- Use step operation to execute up to the start line of 1 Cycle operation.
- Execute 1 Cycle operation once (Step 2 to Step 7) and use the maintenance simulation results of the second and subsequent time.



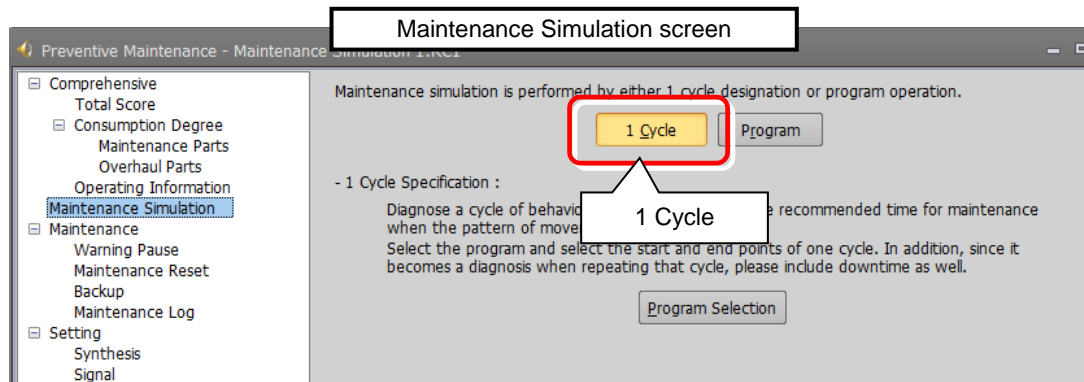
2 Open the Maintenance Simulation screen.

- 1) Start RT ToolBox3 where the MELFA Smart Plus card function code is set.
- 2) Open the RT ToolBox3 project using <Simulation>.
- 3) From the RT ToolBox3 project tree, click [Maintenance] - [Preventive Maintenance].
- 4) From the preventive maintenance tree, select [Maintenance Simulation].



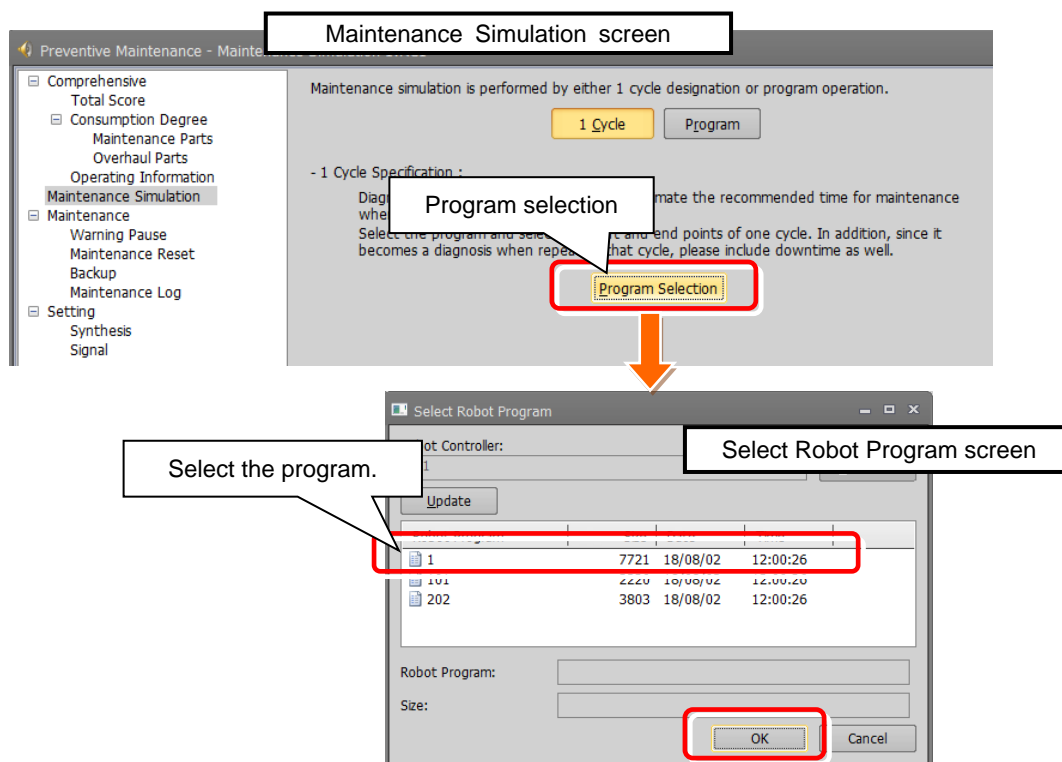
3 Select "1 Cycle".

- 1) Select "1 Cycle" on the Maintenance Simulation screen.

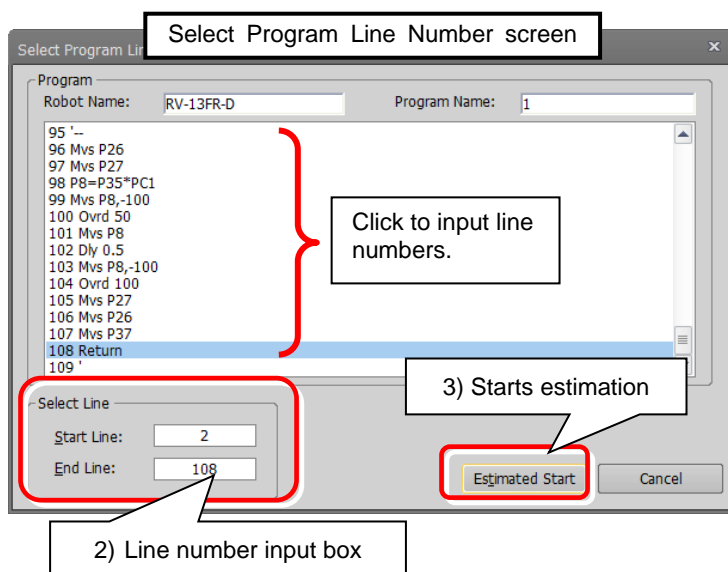


4 Select the execution program.

- 1) Click [Program Selection] on the Maintenance Simulation screen.
- 2) The "Select Robot Program" screen opens; select the program to run the simulation and click the "OK" button.



5 Select the start line and end line of the program.



- 1) The Select Program Line Number screen appears.
- 2) Select the start line and end line.

<Selection method>

Enter the line number in the input box at the right side of Start Line and End Line.

Also, when you click a program line, that line number is entered in the input box.

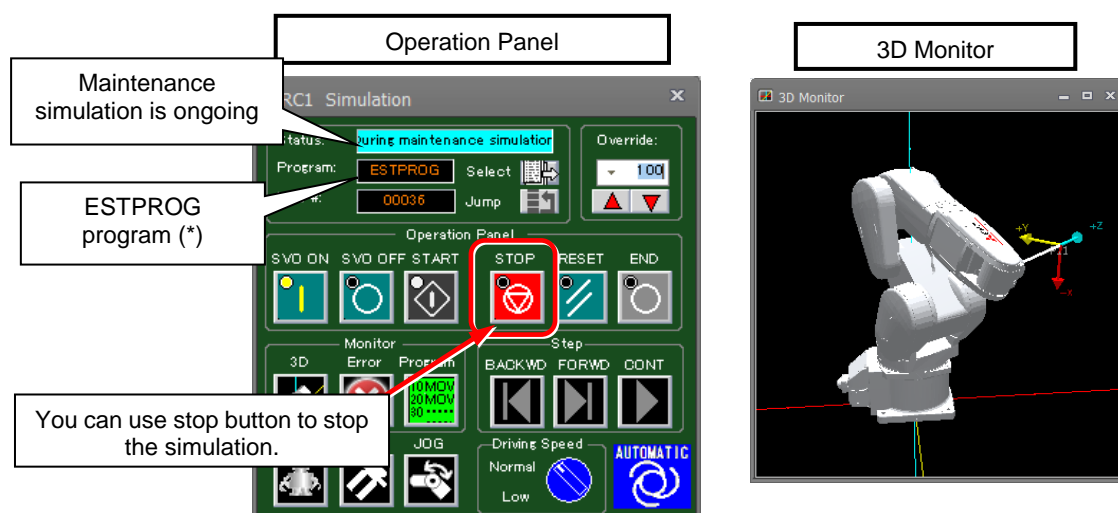
- 3) Clicking the "Estimated Start" button starts the maintenance simulation.

- (*1) If the start line number is greater than the end line number, an error message is displayed.
- (*2) If an error occurred while the maintenance simulation is running, an error message is displayed. After resetting the error, execute Step 1 to adjust the robot posture to the start posture and then execute again from Step 3.

Caution Include all instructions required for 1 Cycle operation in the line selection range.
(Refer to "Note on 1 Cycle operation".)

6 Robot program is executed.

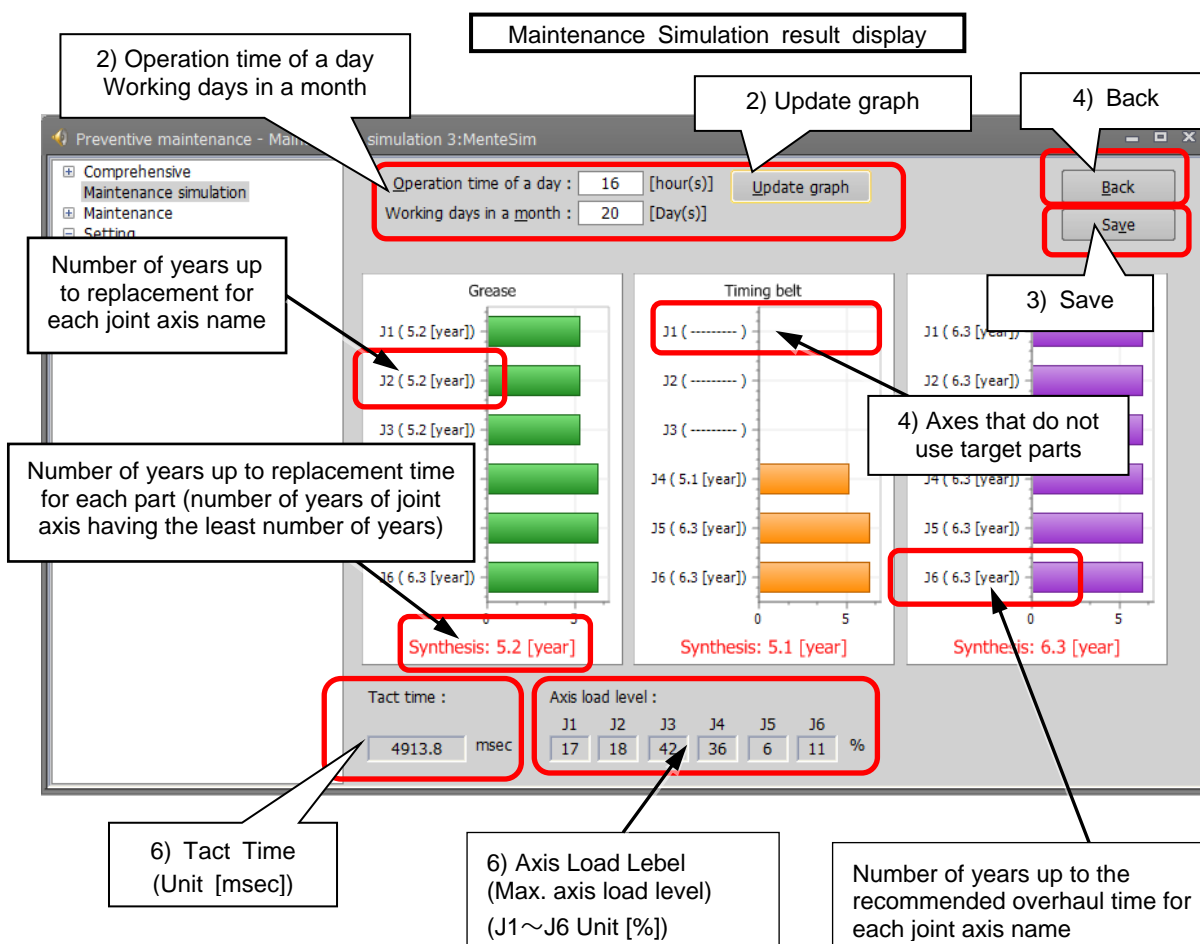
- 1) The status of the operating panel indicates "During maintenance simulation", and the robot program is indicated as "ESTPROG(*)", and 1 cycle from the start line and end line specified on the Select Program Line Number screen is executed. You can check operation of the robot on the 3D monitor.
 - 2) To stop the maintenance simulation halfway through, press the "STOP" button on the operating panel. The running program stops and the maintenance simulation is stopped.
- (*) The program that is automatically generated when 1 Cycle operation is executed. After 1 cycle operation, you can delete this program if it is unnecessary.



7 The simulation results are displayed.

The simulation results are displayed when operation from the start line to end line specified in Step 5 is repeated.

- 1) When program operation ends, the maintenance simulation results are displayed.
The displayed results are estimated results based on the value of "Operation Time of a Day" and "Working Days in a Month".
- 2) After changing the value of "Operation Time of a Day" and "Working Days in a Month", click the "Update Graph" button. The simulation results recalculated by the changed conditions are displayed.
- 3) When you click the "Save" button, output maintenance simulation results in the CSV format.
(Applicable version: RT Toolbox3 version 1.50C or later.)
*Storage destination and file name of the CSV file
Storage destination: [Folder for workspace]¥[Project name]¥Maintenance¥PMLog
File name: [SimulationDataYYYYMMD-HHMMSS].csv
- 4) Click the "Back" button to return to the initial screen of maintenance simulation.
- 5) The graph and the number of years are not displayed for joint axes that do not use the target parts.
- 6) The operation time (unit: msec) of "1 Cycle operation" and the axis load level (unit: %) are displayed. (Applicable version: RT Toolbox3 version 1.50C or later.)



The number of years up to the replacement time of grease and the timing belt are displayed. Also, for overhaul parts, of the reduction gear, bearing, ball screw/ball spline, the number of years of the part having the least years are displayed for each joint axis.

Caution

[Tact time calculation]

- The calculated tact time varies with the performance and load status of the computer used and will not completely match the actual robot operating time (tact time).
- Use this function as a rough yardstick for tact time study.
Under correct conditions, the results of tact time calculation with this software have an error of about $\pm 3\%$ compared to the actual robot operating time (tact time).

Caution

[Axis load level calculation]

- The axis load level numerically expresses the motor load.
- The robot will generate an overload error and stops protecting the motor when the axis load level exceeds 100%. The calculated axis load level assumes multiple iterations of the same operation.
However, be aware that stop will not occur in simulation even if the load level exceeds 100%.
- There is a possibility that continuous operation will not be possible in an actual robot when the calculated axis load level is high. You should lower the operation frequency with the Dly command, and lower operation speed and the acceleration with the Accel and the Ovrd commands, etc. Changing the operation point may lower the operation point.
- Complete agreement with the calculated axis load level cannot be guaranteed because the axis load level of an actual robot is influenced in robot individual differences, the ambient temperature, the condition of the robot, etc. Use this function as a rough yardstick for studying robot movement.

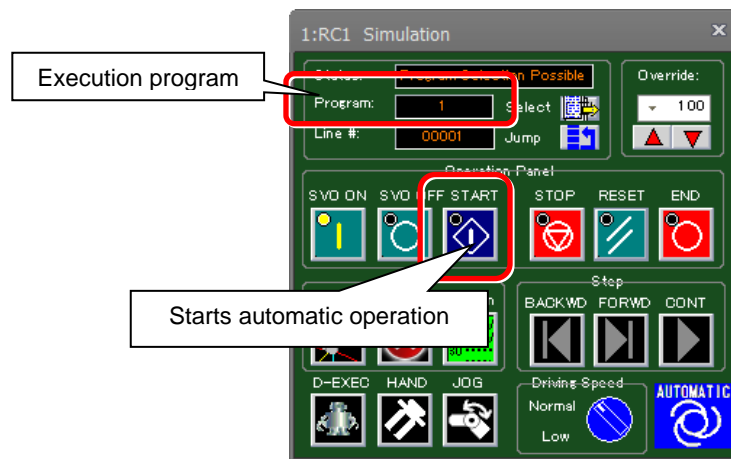
8.2 Program operation

Run a program online or in the simulation mode of RT ToolBox3.

While running a robot program automatically, the parts replacement/ the recommended maintenance time is estimated for operation from when the start button is pressed to when the end button is pressed is repeated.

1 Perform automatic operation for the program.

- 1) Automatically run the program that performs maintenance simulation.

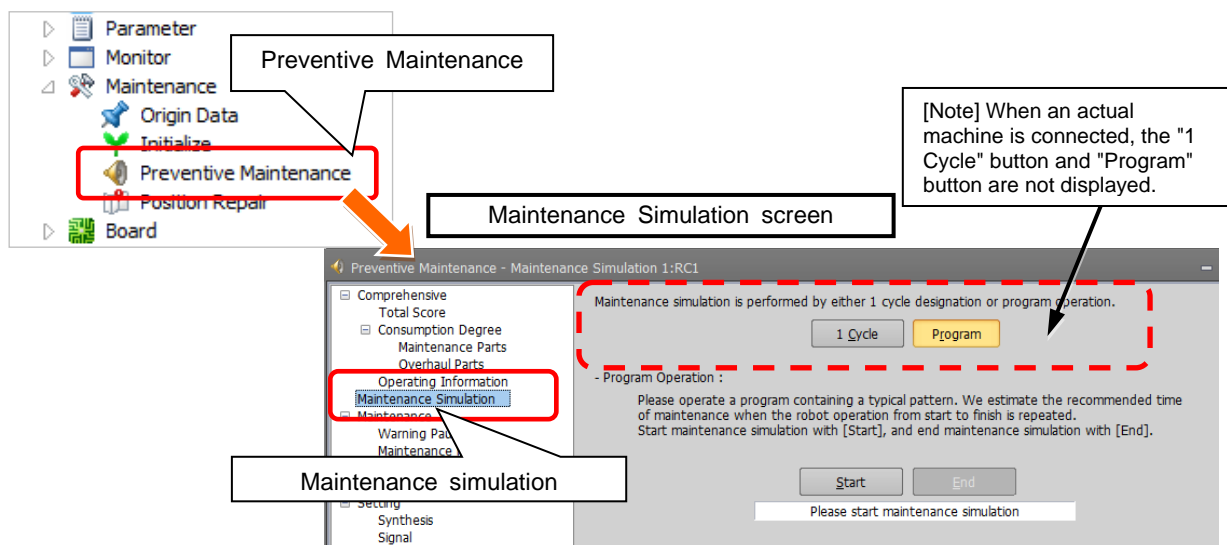


2 Open the Maintenance Simulation screen.

- 1) While automatically running the program that performs maintenance simulation, from the RT ToolBox3 project tree, click [Maintenance] - [Preventive Maintenance] to start.

- 2) From the preventive maintenance tree, select [Maintenance Simulation].

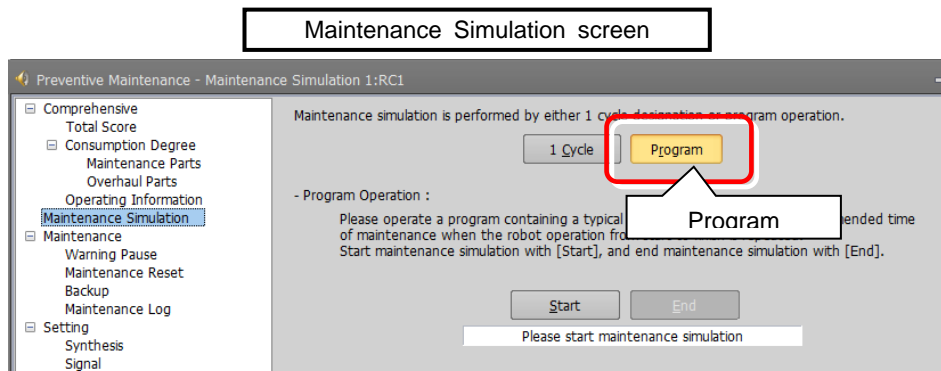
[Note] When an actual machine is connected, the "1 Cycle" button and "Program" button are not displayed.



3 Select the "Program" for the estimation method. (Simulation only)

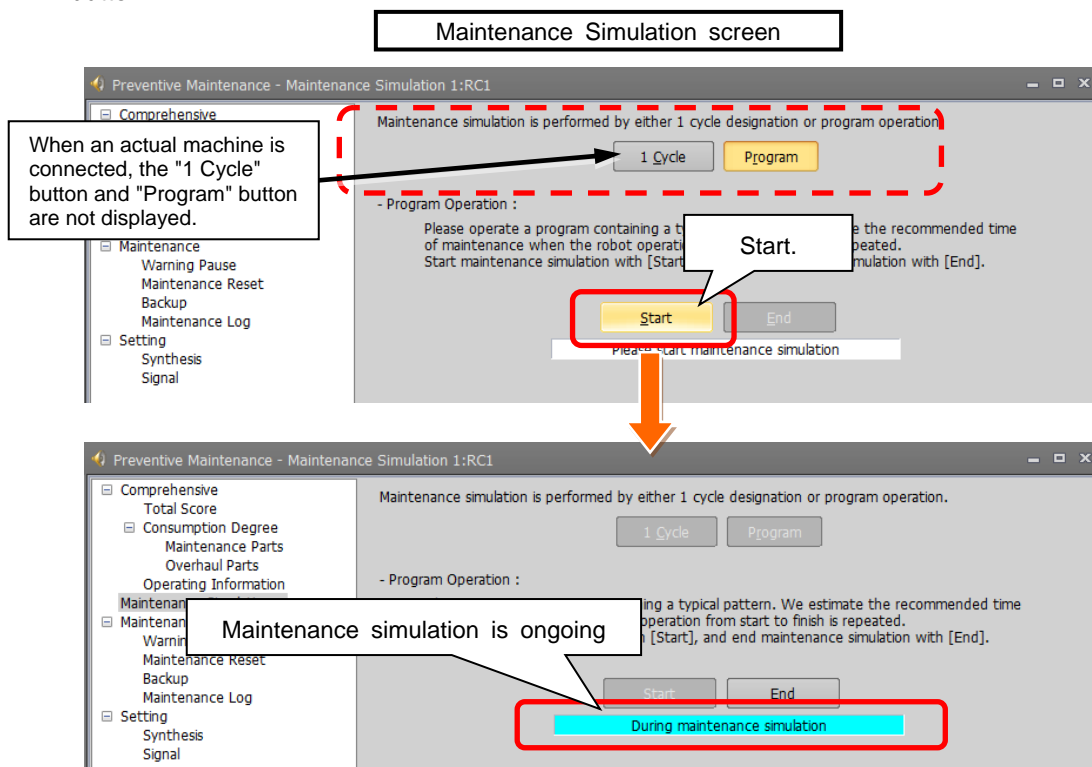
- 1) When running a program in simulation mode, select "Program" on the Maintenance Simulation screen.

[Note] When an actual machine is connected, the "1 Cycle" button and "Program" button are not displayed.



4 Start maintenance simulation.

- 1) Clicking the "Start" button on the Maintenance Simulation screen starts maintenance simulation. During simulation, a "During maintenance simulation" message is displayed under the Start button.



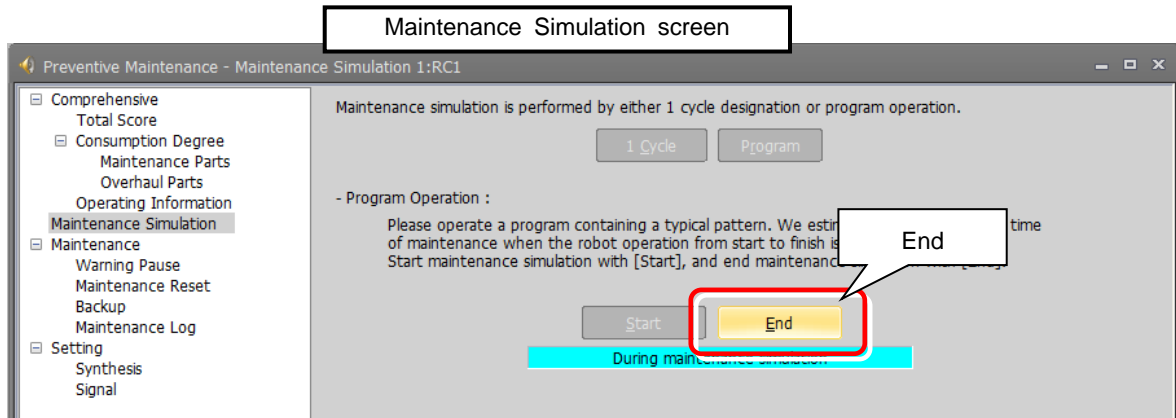
On the operation panel, "Operating" is displayed for Status and the currently running program name is displayed for Program.

In case of simulation mode, robot motion can be checked on the 3D monitor.

5 End the maintenance simulation.

- 1) When a series of operations for performing maintenance simulation have been executed, click the "End" button on the Maintenance Simulation screen.

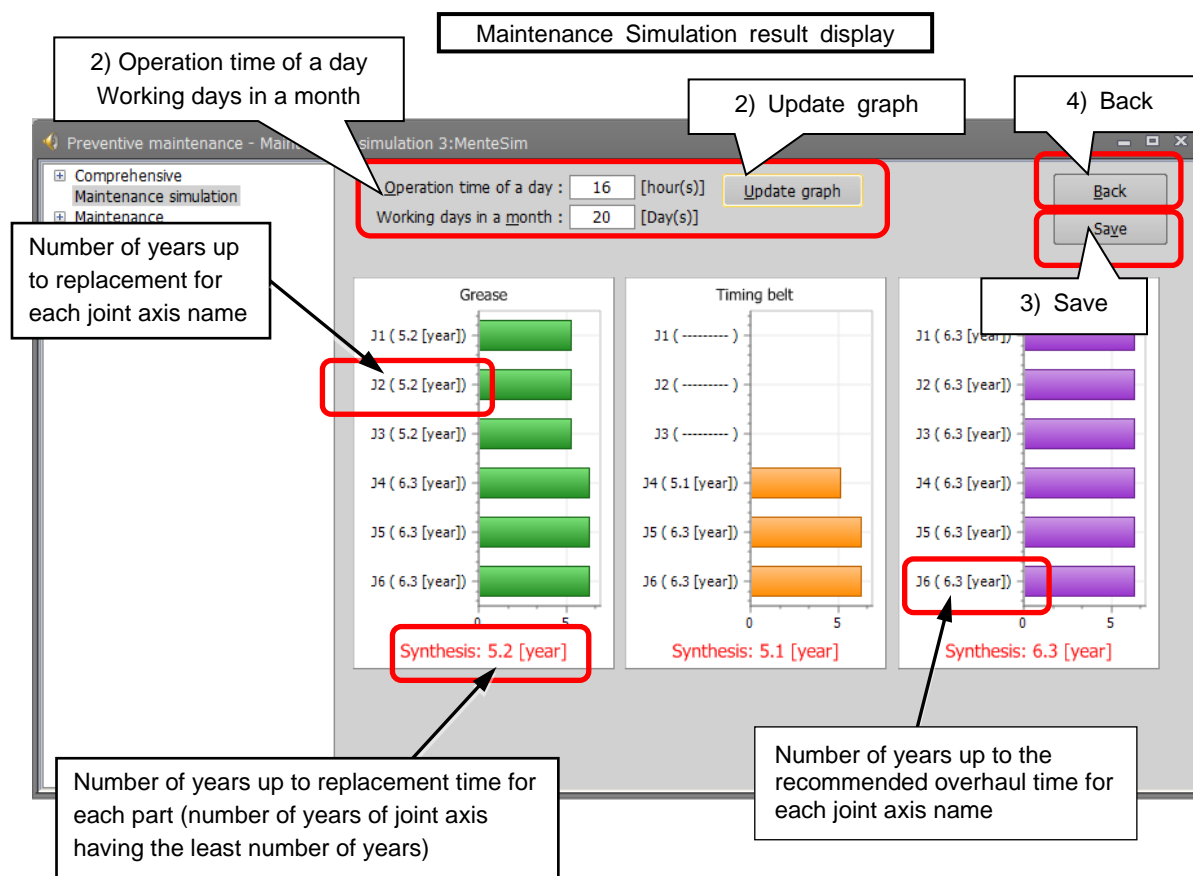
The maintenance simulation ends and the Maintenance Simulation result screen appears.
(Even though the "End" button is clicked, the robot continues operation.)



6 The simulation results are displayed.

The maintenance simulation result displayed is when the operation from clicking the "Start" button in Step 4 to clicking the "End" button in Step 5 is repeated.

- 1) When program operation ends, the maintenance simulation results are displayed.
The displayed results are estimated results based on the value of "Operation Time of a Day" and "Working Days in a Month".
- 2) After changing the value of "Operation Time of a Day" and "Working Days in a Month", click the "Update Graph" button. The simulation results recalculated by the changed conditions are displayed.
- 3) When you click the "Save" button, output maintenance simulation results in the CSV format.
(Applicable version: RT Toolbox3 version 1.50C or later.)
*Storage destination and file name of the CSV file
Storage destination: [Folder for workspace]¥[Project name]¥Maintenance¥PMLog
File name: [SimulationDataYYYYMMDD-HHMMSS].csv
- 4) Click the "Back" button to return to the initial screen of maintenance simulation.
- 5) The graph and the number of years are not displayed for joint axes that do not use the target parts.



The number of years up to the replacement time of grease and the timing belt are displayed. Also, for overhaul parts, of the reduction gear, bearing, ball screw/ball spline, the number of years of the part having the least years are displayed for each joint axis.

9. When consumption occurred

When the consumption status of the target part exceeded the notification day you specified, an error number and error message corresponding to the status are displayed. Preventive maintenance message is also displayed in the maintenance message field on the RT ToolBox3 Preventive Maintenance screen.

This section explains the content and measures corresponding to each error number and preventive maintenance message; take measures corresponding to the error number and preventive maintenance message given.

For other error numbers, refer to "15 Troubleshooting" and the separate "Troubleshooting in CR800 Series Controller Instruction Manual".

[CAUTION]

For a warning that occurred due to parts consumption, even though the warning signal output is reset, the RT ToolBox3 preventive maintenance message continues to be displayed if the consumption status is unchanged.

9.1 Consumption Degree

9.1.1 Maintenance parts

(1) Grease

(* n in the table indicates the axis numbers (1 to 6).)

Error number	C.712n
Error message	Grease replenishment period
RT ToolBox3 preventive maintenance message	The grease (Jn axis) consumption degree exceeded the warning number of days remaining. Please check the details and prepare for grease supply.
Measures	Replenish grease. After that, reset the consumption degree. For details of the grease and replenishing procedure, refer to "5. Maintenance and Inspection" in the separate volume, "Instruction Manual/Robot Arm Setup & Maintenance". For reset method, refer to "10.2 Maintenance Reset".

Error number	C.712n
Error message	Grease replenishment period
RT ToolBox3 preventive maintenance message	The grease (Jn axis) consumption degree exceeded 100%. Grease supply is recommended.
Measures	Replenish grease. After that, reset the consumption degree. For details of the grease and replenishing procedure, refer to "5. Maintenance and Inspection" in the separate volume, "Instruction Manual/Robot Arm Setup & Maintenance". For reset method, refer to "10.2 Maintenance Reset".

(2) Timing belt

Error number	C.713n
Error message	Timing belt replacement period
RT ToolBox3 preventive maintenance message	The timing belt (Jn axis) consumption degree exceeded the warning number of days remaining. Please check the details and prepare for timing belt replacement.
Measures	<p>Replace the timing belt. After that, reset the consumption degree.</p> <p>For details of the timing belt and replacement procedure, refer to "5. Maintenance and Inspection" in the separate volume, "Instruction Manual/Robot Arm Setup & Maintenance".</p> <p>For reset method, refer to "10.2 Maintenance Reset".</p>

Error number	C.713n
Error message	Timing belt replacement period
RT ToolBox3 preventive maintenance message	<p>The timing belt (Jn axis) consumption degree exceeded 100%.</p> <p>Timing belt replacement is recommended.</p>
Measures	<p>Replace the timing belt. After that, reset the consumption degree.</p> <p>For details of the timing belt and replacement procedure, refer to "5. Maintenance and Inspection" in the separate volume, "Instruction Manual/Robot Arm Setup & Maintenance".</p> <p>For reset method, refer to "10.2 Maintenance Reset".</p>

9.1.2 Overhaul parts

(1) Reduction gear

(* n in the table indicates the axis numbers (1 to 6).)

Error number	C.714n
Error message	Overhaul period (decelerator)
RT ToolBox3 preventive maintenance message	The gear (Jn axis) consumption degree exceeded the warning number of days remaining. Please check the details and prepare for overhaul.
Measures	<p>Perform overhaul of the robot body.</p> <p>For selection of replacement parts and overhaul implementation timing, consult with our service affiliated company.</p> <p>When overhaul is performed, perform reset.</p> <p>For reset method, refer to "10.2 Maintenance Reset".</p>

Error number	C.714n
Error message	Overhaul period (decelerator)
RT ToolBox3 preventive maintenance message	<p>The gear (Jn axis) consumption degree exceeded 100%.</p> <p>Overhaul is recommended.</p>
Measures	<p>Perform overhaul of the robot body.</p> <p>For selection of replacement parts and overhaul implementation timing, consult with our service affiliated company.</p> <p>After overhaul, perform reset.</p> <p>For reset method, refer to "10.2 Maintenance Reset".</p>

(2) Bearing

Error number	C.715n
Error message	Overhaul period (bearing)
RT ToolBox3 preventive maintenance message	The bearing (Jn axis) consumption degree exceeded the warning number of days remaining. Please check the details and prepare for overhaul.
Measures	<p>Perform overhaul of the robot body.</p> <p>For selection of replacement parts and overhaul implementation timing, consult with our service affiliated company.</p> <p>When overhaul is performed, perform reset.</p> <p>For reset method, refer to "10.2 Maintenance Reset".</p>

Error number	C.715n
Error message	Overhaul period (bearing)
RT ToolBox3 preventive maintenance message	<p>The bearing (Jn axis) consumption degree exceeded 100%.</p> <p>Overhaul is recommended.</p>
Measures	<p>Perform overhaul of the robot body.</p> <p>For selection of replacement parts and overhaul implementation timing, consult with our service affiliated company.</p> <p>After overhaul, perform reset.</p> <p>For reset method, refer to "10.2 Maintenance Reset".</p>

(3) Ball screw

Error number	C.716n
Error message	Overhaul period (ball screw)
RT ToolBox3 preventive maintenance message	The ball screw (Jn axis) consumption degree exceeded the warning number of days remaining. Please check the details and prepare for overhaul.
Measures	<p>Perform overhaul of the robot body.</p> <p>For selection of replacement parts and overhaul implementation timing, consult with our service affiliated company.</p> <p>After overhaul, reset the consumption degree.</p> <p>For reset method, refer to "10.2 Maintenance Reset".</p>

Error number	C.716n
Error message	Overhaul period (ball screw)
RT ToolBox3 preventive maintenance message	<p>The ball screw (Jn axis) consumption degree exceeded 100%.</p> <p>Overhaul is recommended.</p>
Measures	<p>Perform overhaul of the robot body.</p> <p>For selection of replacement parts and overhaul implementation timing, consult with our service affiliated company.</p> <p>After overhaul, reset the consumption degree.</p> <p>For reset method, refer to "10.2 Maintenance Reset".</p>

9.1.3 Servo ON time

(* n in the table indicates the axis numbers (1 to 6)).

Error number	C.7110
Error message	Overhaul period (servo on time)
RT ToolBox3 preventive maintenance message	The servo on time exceeded the warning number of days remaining. Please check the details and prepare for overhaul.
Measures	Perform overhaul of the robot body. For selection of replacement parts and overhaul implementation timing, consult with our service affiliated company. After overhaul, perform reset. For reset method, refer to "10.2 Maintenance Reset".

Error number	C.7110
Error message	Overhaul period (servo on time)
RT ToolBox3 preventive maintenance message	The servo on time exceeded recommended overhaul time. Overhaul is recommended.
Measures	Perform overhaul of the robot body. For selection of replacement parts and overhaul implementation timing, consult with our service affiliated company. After overhaul, perform reset. For reset method, refer to "10.2 Maintenance Reset".



Caution

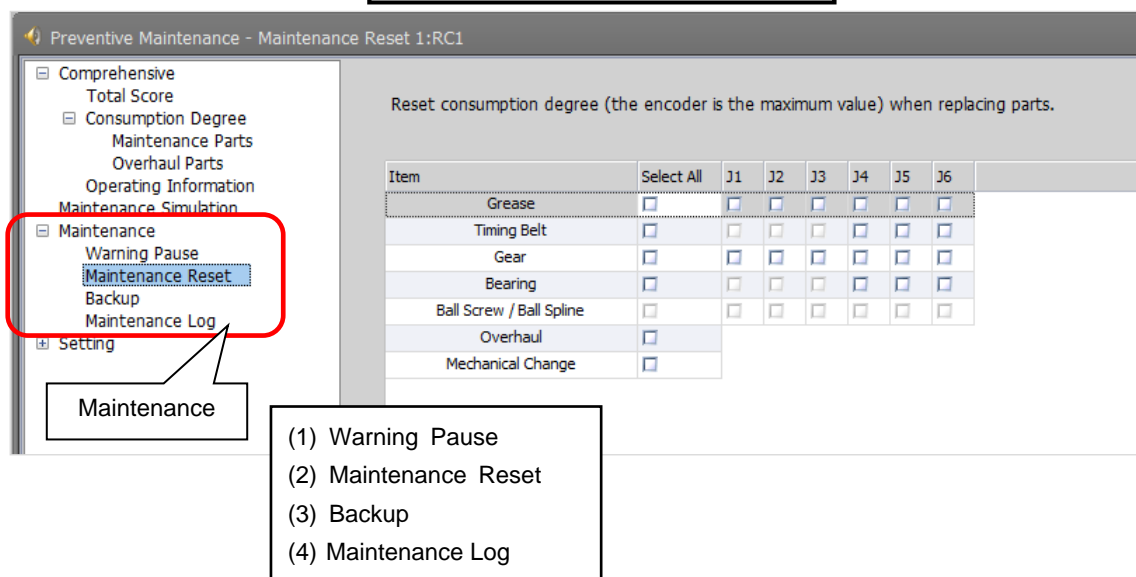
When the servo ON time exceeds the specified time (24,000 hours) or the consumption degree exceeds the warning remaining number of days, we recommend you perform overhaul of the robot arm.

10. Maintenance

On the maintenance screen, you can reset the consumption degree, or can specify backup/restore and pausing of warning occurrence/warning signal output during maintenance. In addition, you can check the maintenance log.

- 1) Start preventive maintenance.
- 2) Click [Maintenance] to expand the menu; the maintenance functions are displayed.
- 3) Click [Warning Pause], [Maintenance Reset], [Backup], or [Maintenance Log], to switch the main screen.

Example: Maintenance Reset screen



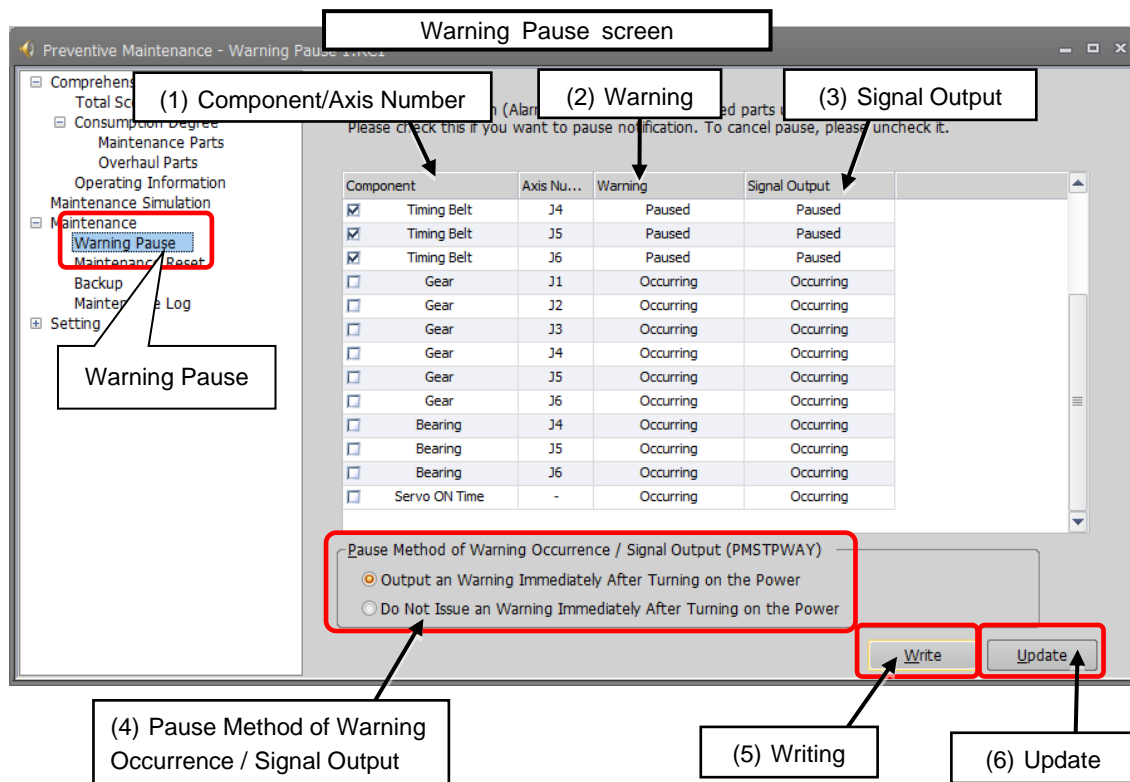
- 1) Warning Pause : Displays the warning occurred/list of warning signals being output. Specify pausing of notifications (alarm, dedicated output signal).
- 2) Maintenance Reset : Resets (clears) the accumulation data related to consumption degree.
- 3) Backup : Performs backup/restore when migrating the preventive maintenance data to a different controller.
- 4) Maintenance Log : Displays the maintenance log recorded during executing maintenance reset.

10.1 Warning Pause

Displays the list of warning and warning signals that are occurring or paused.

Usually, the alarm of consumption degree calculation is notified at the intervals you set.

If you desire to stop notification (alarm, dedicated output signal), you can temporarily disable at this stage.



1) Component/Axis Number:

Indicates the parts and axes currently under warning.

2) Warning:

Indicates either occurring or pause.

Select this check box to pause. Deselect this check box to cancel pause.

3) Signal Output:

Indicates either occurring or pause.

Select this check box to pause. Deselect this check box to cancel pause.

4) Pause Method of Warning Occurrence / Signal Output:

Set the pause method of warning occurrence.

5) Writing:

Writes the content of the selected item.

You can temporarily disable notification related to consumption degree calculation until part replacement (reset of consumption degree).

6) Update:

Updates the screen display.



Caution

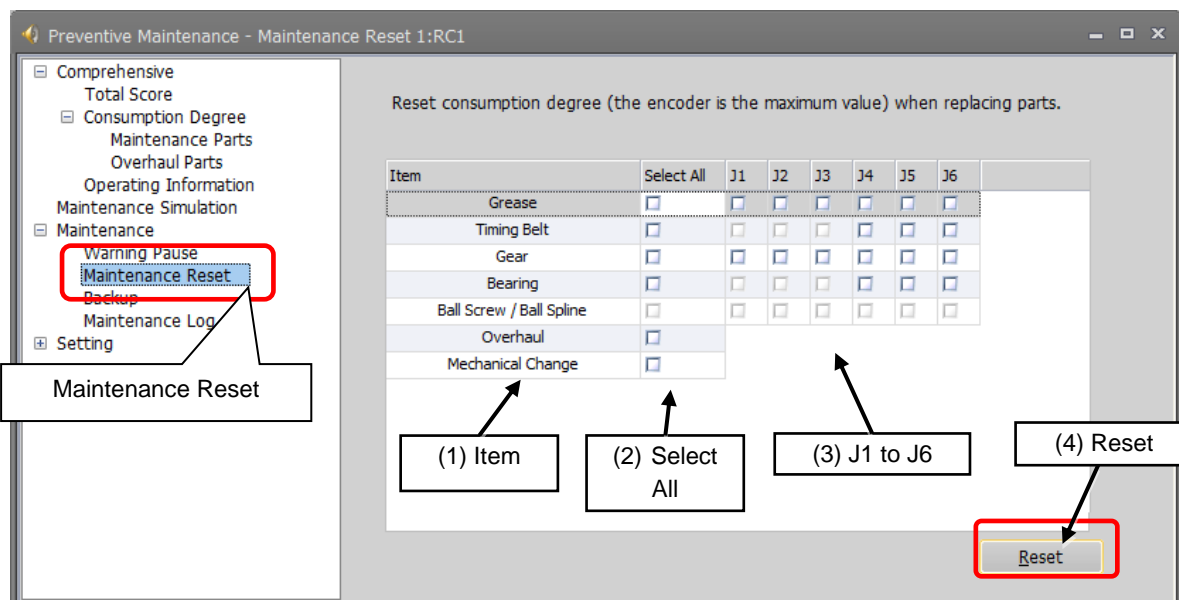
Even though you set pause of warning occurrence or signal output, already occurred warnings and warning signals are not reset.

Use the error reset operation from the teaching pendant or inputting error reset signal (ERRRESET) to reset those warnings and signals.

10.2 Maintenance Reset

When part replacement, grease replenishing, or overhaul was performed, the information of the axes for which maintenance was performed accumulated in the controller needs to be reset.

On the Maintenance Reset screen, you can reset the information held by the controller such as the consumption degrees calculated by the consumption degree calculation function.



- 1) Item: Displays parts subject to reset.
- 2) Select All: Selecting this check box selects all [J1] to [J6] check boxes on the right field.
- 3) J1 to J6: Depending on the robot type, non-target axes are not selected.
- 4) Reset: Resets the consumption degree of the items you have selected.

Item	Implementation timing	Reset target
Grease	At grease replenishing	Accumulated data for consumption degree calculation of the specified joint axis.
Timing belt	At part replacement	
Reduction gear		
Bearing		
Ball screw/ball spline		
Overhaul	At overhaul	• Accumulated data of all parts, operating information (integration time and accumulation count)
Mechanism replacement	At replacement of robot body	

Caution

- Once maintenance reset is executed, the accumulated data before that cannot be restored.
- Perform maintenance reset only when maintenance such as part replacement, grease replenishing, overhaul was carried out.

10.3 Backup and restore

You can back up or restore preventive maintenance information held in the controller.

To replace the robot body or robot controller only, you need to perform backup/restore of the preventive maintenance information to migrate the preventive maintenance information.

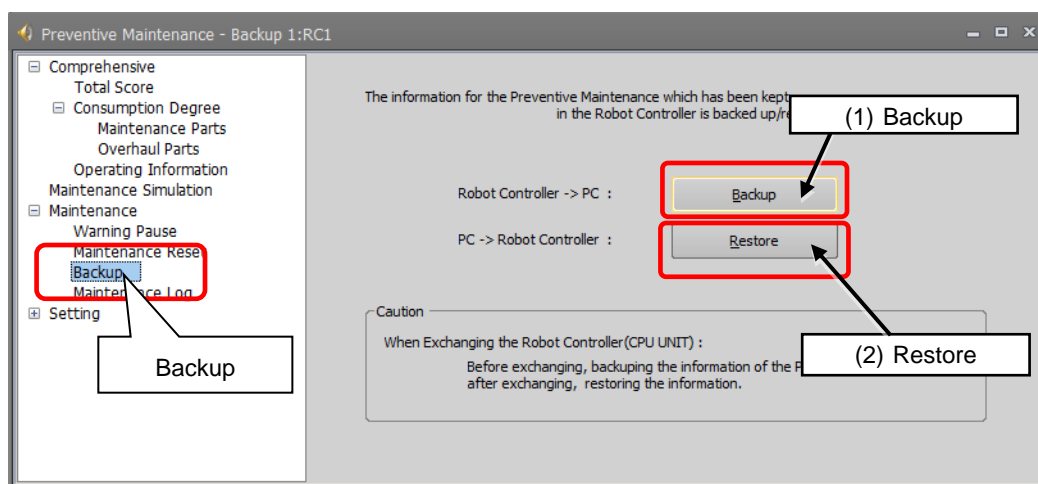
For backup/restore of the preventive maintenance information, click [Maintenance] - [Backup] of the preventive maintenance function.

- Replacing the robot controller

When replacing the controller, back up the preventive maintenance information from the previous controller and restore it in the new controller.

- Exchanging the combination of robot controller and mechanism (between the same models)

When exchanging the combination of controller and mechanism between the same models, before implementation, back up the preventive maintenance information of the respective controllers and after implementation restore the information to the replaced controllers.



1) Backup: Save the preventive maintenance information in the robot controller to a file on a personal computer.

2) Restore: Transfer the information backed up on the personal computer to the robot controller.

Caution

- The preventive maintenance information of the robot body is saved in the robot controller; it is necessary to use the correct combination of the robot body and robot controller.
To replace the robot body or robot controller only, perform backup/restore of preventive maintenance information to migrate the preventive maintenance information.
- In order to prevent writing backup data to a different robot, an error (H.7101) occurs when the serial number of the robot is different from the backup data value when restoring.
- When the serial number of the connected robot was changed, an error (H.7100) is output upon power on to notify that effect in order to prevent the occurrence of unmatched preventive maintenance information when exchanging robot.
- When there is no backup data, all consumption degrees can be reset by performing mechanism replacement of maintenance reset. However, in that case, the consumption degree calculation result cannot be the correct value. (Refer to "10.2 Maintenance Reset".)
- After replacing the robot controller, if you did not restore the preventive maintenance information or if you restored it a long time after backup was performed, the consumption degree calculation result cannot be the correct value.

10.3.1 Backup (robot → personal computer)

Save the preventive maintenance information in the robot controller to a file on a personal computer.

When clicking the [Backup] button, a time stamp folder (folder name: "YYmmdd-HHMMSS") is automatically created in the [Maintenance] - [PMBackup] folder directly under the project and the backup data is saved in that folder.

The following describes how to back up preventive maintenance information.

1 Create a backup file for preventive maintenance information.

- 1) Start preventive maintenance.
- 2) Click [Maintenance] - [Backup].
- 3) When you click Backup on the main screen, the "Select Backup Folder" screen opens, and click the "OK" button.

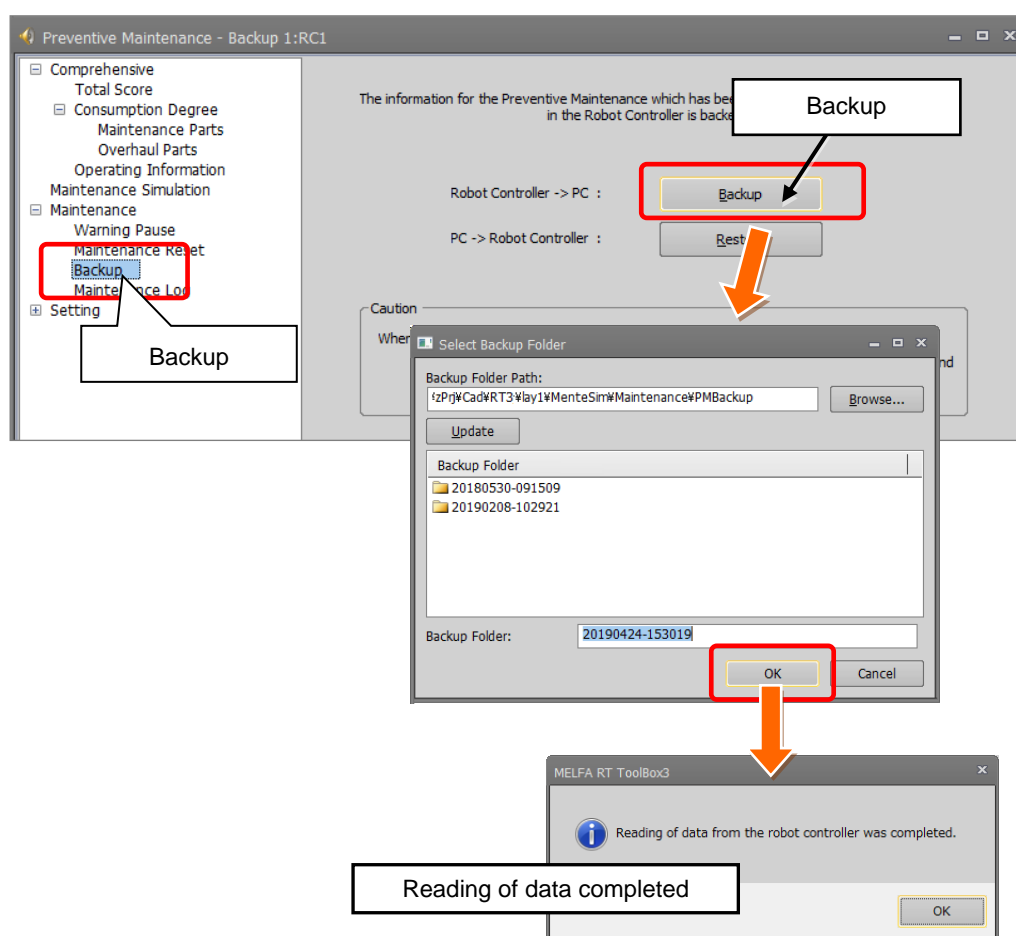
Storage destination and the folder name of the backup data

Storage destination: [Folder for workspace]¥[Project name]¥Maintenance¥PMLog

Folder name: [YYYYMMDD-HHMMSS]

(The storage destination and the folder name can be changed.)

- 4) After a while, a message indicating the end of data read is displayed.



10.3.2 Restore (personal computer → robot)

Transfer the information backed up on the personal computer to the robot controller.

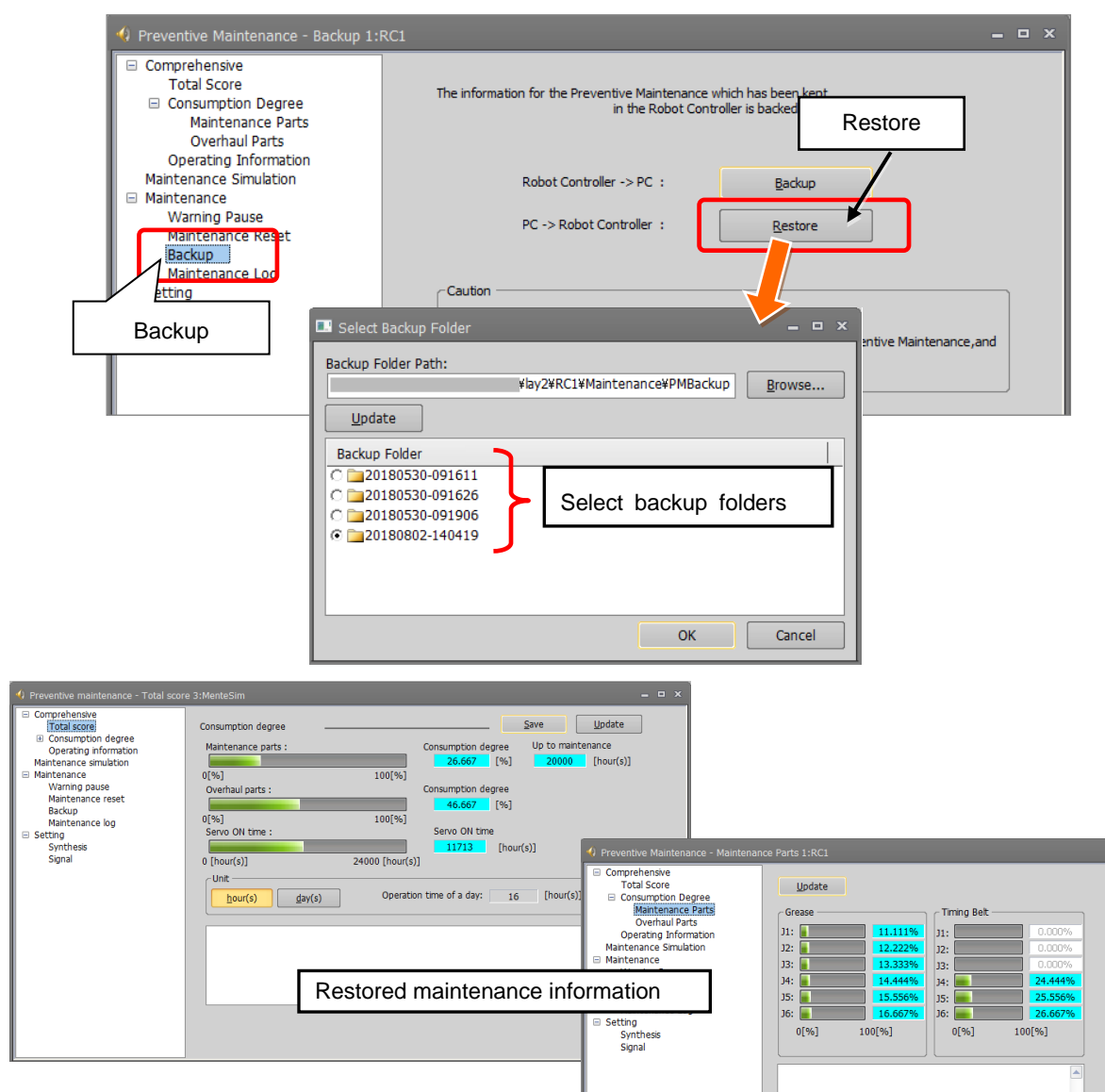
To restore preventive maintenance information, from the folder selection dialog box, select the folder you wish to restore.

If there is missing backup data, an error message is displayed and restore is interrupted.

The following describes how to restore preventive maintenance information.

1 Restore preventive maintenance information.

- 1) Start preventive maintenance.
- 2) Click [Maintenance] - [Backup].
- 3) When "Restore" is clicked on the main screen, the "Select Backup Folder" appears.
- 4) Use the "Browse" button to specify the location of the backup folder.
- 5) The backup folder is displayed on the screen; select the folders you wish to restore and then press the [OK] button.
- 6) From the tree on the left side, when you select Total Score, Consumption Degree, or other preventive maintenance functions, the restored information is displayed on the main screen.



10.4 Maintenance Log

Display the recorded maintenance log.

10.4.1 Maintenance Log screen

The preventive maintenance function stores 10 maintenance log items of the past.

Upon executing maintenance reset, item, date & time, consumption degree [%] and accumulation count are recorded.

On the Maintenance Log screen, the recorded log is displayed.

Log targets: Grease, timing belt, reduction gear, bearing, ball screw, overhaul

The screenshot shows the 'Preventive Maintenance - Maintenance Log 1:RC1' window. On the left is a tree view with 'Maintenance Log' highlighted. On the right is a table with columns: Component, Axis Nu..., Date, and Consumption Degree. A dropdown menu 'Select Parts : All' is at the top of the table. Annotations with arrows point to: (1) Select Parts (dropdown), (2) Component (table column), (3) Axis Number (table column), (4) Date (table column), and (5) Consumption degree (table column).

Component	Axis Nu...	Date	Consumption Degree
Grease	6	18-08-20 19:23:34	106.667
Timing Belt	4	18-08-20 19:23:34	0.000
Timing Belt	4	18-08-20 19:23:32	114.444
Timing Belt	5	18-08-20 19:23:34	0.000
Timing Belt	5	18-08-20 19:23:32	115.556
Timing Belt	6	18-08-20 19:23:34	116.667
Gear	1	18-08-20 19:23:34	0.000
Gear	1	18-08-20 19:23:32	121.111
Gear	2	18-08-20 19:23:34	0.000
Gear	2	18-08-20 19:23:34	122.222
Gear	3	18-08-20 19:23:34	123.333
Gear	4	18-08-20 19:23:34	124.444
Gear	5	18-08-20 19:23:34	125.556
Gear	6	18-08-20 19:23:34	126.667
Bearing	4	18-08-20 19:23:34	134.444
Bearing	5	18-08-20 19:23:34	0.000
Bearing	5	18-08-20 19:23:34	135.556
Bearing	6	18-08-20 19:23:34	0.000
Bearing	6	18-08-20 19:23:34	136.667
Overhaul	-	18-08-20 19:23:34	

1) Select Parts

Select items for which a log is displayed.

(All, Grease, Timing Belt, Gear, Bearing, Ball Screw, Overhaul)

2) Component

Items selected in the Select Parts field are displayed. A maximum of 10 log items are displayed for each axis.

3) Axis Number

Displays the target axes. Displays "-" for overhaul.

4) Date

Displays the reset date & time.

5) Consumption degree

Displays consumption degree [%] at the time of reset.

10.4.2 Data to be recorded in the maintenance log

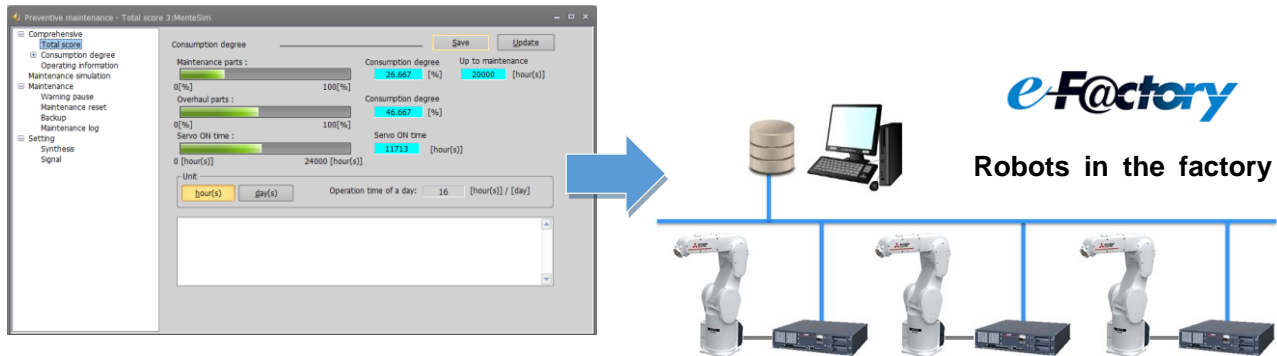
After performing grease replenishing, timing belt replacement, or robot overhaul, upon resetting the consumption degree of each part, the reset date & time, consumption degree [%] at the time of reset, and reset count are recorded in the maintenance log.

Log type	Record target	Log save count	Type of data log to be recorded
Grease	For each joint axis	For 10 times	Reset date & time, consumption degree [%] at the time of reset
Timing belt			
Reduction gear			
Bearing			
Ball screw Ball spline			
Overhaul	Robot		Reset date & time, servo ON time [h] at the time of reset
Reset (implementation) count	For each joint axis	–	Grease, timing belt, reduction gear, bearing, ball screw/ball spline, overhaul

- The maintenance log of each part and the implementation log of overhaul are recorded.
- When the log save count is exceeded, the old log data is deleted first.
- In case the preventive maintenance function is disabled, a log is also recorded when reset is performed with the maintenance forecast.

11. Batch management of maintenance information

Explains how to collectively manage maintenance information of the entire production line with the host system.



11.1 Functional overview

Maintenance information used in the preventive maintenance function is compatible with the data output in communication protocol MelfaRXM.ocx, SLMP.

By using this function to collectively manage the maintenance information of the entire production line in a host system, it is easier to plan maintenance schedules and carry out maintenance activities for the entire production line.

Use the following means to output preventive maintenance data so the maintenance information of each robot in your factory can be collectively managed. (For data to be output, refer to "11.2 Output data".)

Communication protocol	Details	Data acquisition method
MelfaRXM.ocx	<p>This is ActiveX control that communicates with the robot controller used when you create application software to communicate with the robot controller.</p> <p>The instruction manual is included in the following folder in the CD-ROM of RT ToolBox3 (Standard Version/Pro Version).</p> <p>Communication Middleware (MelfaRXM.ocx) Manual: [Utility\MelfaRXM\Doc\MelfaRxMJ.pdf]</p>	Specify by the dedicated request ID using the RequestService function.
SLMP	<p>This is a common protocol for inter-application communication. Reading/writing of robot controller devices can be performed from a compatible programmable controller, personal computer or HMI (Human Machine Interface), and other devices via Ethernet.</p> <p>For details, refer to the following instruction manual. Separate volume, "Instruction Manual Ethernet Function".</p>	Allocate status variables to D device (parameters DDEVVL01 to DDEVVL32)

11.2 Output data

Output data	Target	Unit	Robot status variable	Parameter
Basic data	Robot body serial number	Character string	C_RBSerial	RBSERIAL
	Power ON time	h (hours)	M_PowOnTime	TIMPOWON
	Servo ON time	h (hours)	M_SrvOnTime	TIMSRVON
	Operation time	h (hours)	M_PrgTime	TIMPRG
	Actual operation time	h (hours)	M_MovTime	TIMMOV
	Servo ON count	Times	M_SrvOnNum	NUMSRVON
	Motor cumulative rotation count	Rotation	M_MtRotNum	NUMMTROT
Consumption degree	Mechanism total (maintenance parts)	%	M_PMCsmMnt	CSMPMMNT
	Mechanism total (overhaul parts)	%	M_PMCsmOH	CSMPMOH
	Grease	%	M_PMCsmGrs	CSMPMGRS
	Timing belt	%	M_PMCsmBlt	CSMPMBLT
	Reduction gear	%	M_PMCsmDec	CSMPMDEC
	Bearing	%	M_PMCsmBrg	CSMPMBRG
	Ball screw Ball spline	%	M_PMCsmBss	CSMPMBSS
Remaining time	Mechanism total (maintenance parts)	h (hours)	M_PMRmnMnt	RMNPMMNNT
	Servo ON time (At overhaul implementation)	h (hours)	M_PMRmnSrv	RMNPMSRV
Consumption status	Mechanism total (maintenance parts)	–	M_PMStsMnt	STSPMMNT
	Mechanism total (overhaul parts)	–	M_PMStsOH	STSPMOH
	Grease	–	M_PMStsGrs	STSPMGRS
	Timing belt	–	M_PMStsBlt	STSPMBLT
	Reduction gear	–	M_PMStsDec	STSPMDEC
	Bearing	–	M_PMStsBrg	STSPMBRG
	Ball screw Ball spline	–	M_PMStsBss	STSPMBSS
	Servo ON time (At overhaul implementation)	–	M_PMStsSrv	STSPMSRV
Notification pause status	Grease	–	M_PMRptGrs	RPTPMGRS
	Timing belt	–	M_PMRptBlt	RPTPMBLT
	Reduction gear	–	M_PMRptDec	RPTPMDEC
	Bearing	–	M_PMRptBrg	RPTPMBRG
	Ball screw Ball spline	–	M_PMRptBss	RPTPMBSS
	Servo ON time (At overhaul implementation)	–	M_PMRptSrv	RPTPMSRV

Output data	Target	Unit	Robot status variable	Parameter
Maintenance Log	Specify data to get	–	–	LOGPMNO
	Grease	Piece	M_PMLogGrs	–
		Character string	C_PMLogGrs	LOGPMGRS
	Timing belt	Piece	M_PMLogBlt	–
		Character string	C_PMLogBlt	LOGPMBLT
	Reduction gear	Piece	M_PMLogDec	–
		Character string	C_PMLogDec	LOGPMDEC
	Bearing	Piece	M_PMLogBrg	–
		Character string	C_PMLogBrg	LOGPMBRG
	Ball screw Ball spline	Piece	M_PMLogBss	–
		Character string	C_PMLogBss	LOGPMBSS
	Overhaul	Piece	M_PMLogOH	–
		Character string	C_PMLogOH	LOGPMOH

11.3 Request ID (MelfaRXM.ocx) specified by RequestService

You can get robot status variables and parameter values related to the preventive maintenance function using the existing request ID.

ID value	Function name
212	Get variable value
301	Get parameter value (consider open level)
302	Write parameter value

<< MEMO >>

12. Robot (system) status variables

12.1 Robot (system) status variable list

12.1.1 Consumption degree calculation function

*1) Attributes in the table, R: Read only

*2) Mechanism No.1 to 3, Specifies a mechanism number corresponding to the multitask processing function

<Serial number>

Variable name	Array designation	Details	Attribute *1)	Data type, Unit	Page
C_RBSerial	Mechanism No. (1 to 3) *2)	Robot body serial number	R	Character string type	69
C_RCSerial	None	Controller serial number	R	Character string type	70

<Operating information>

Variable name	Array designation	Details	Attribute *1)	Data type, Unit	Page
M_PowOnTime	None	Power ON time	R	Integer type, Time	71
M_SrvOnTime	None	Servo ON time	R	Integer type, Time	72
M_PrgTime	None	Operation time	R	Integer type, Time	73
M_MovTime	None	Actual operation time	R	Integer type, Time	74
M_SrvOnNum	None	Servo ON count	R	Integer type	75
M_MtRotNum	Axis No.(1 to 8)	Motor cumulative rotation count	R	Double-precision real number type	76

<Maintenance log>

Variable name	Array designation	Details	Attribute *1)	Data type, Unit	Page
M_PMLogGrs	Axis No.(1 to 8)	Maintenance count (grease)	R	Integer type	77
M_PMLogBlt	Axis No.(1 to 8)	Maintenance count (timing belt)	R	Integer type	78
M_PMLogDec	Axis No.(1 to 8)	Maintenance count (reduction gear)	R	Integer type	79
M_PMLogBrg	Axis No.(1 to 8)	Maintenance count (bearing)	R	Integer type	80
M_PMLogBss	Axis No.(1 to 8)	Maintenance count (ball screw/ball spline)	R	Integer type	81
M_PMLogOH	None	Maintenance count (overhaul (servo ON time))	R	Integer type	82
C_PMLogGrs	Axis No.(1 to 8) Log No.(1 to 10)	Maintenance log (grease)	R	Character string type	83
C_PMLogBlt	Axis No.(1 to 8) Log No.(1 to 10)	Maintenance log (timing belt)	R	Character string type	84
C_PMLogDec	Axis No.(1 to 8) Log No.(1 to 10)	Maintenance log (reduction gear)	R	Character string type	85
C_PMLogBrg	Axis No.(1 to 8) Log No.(1 to 10)	Maintenance log (bearing)	R	Character string type	86
C_PMLogBss	Axis No.(1 to 8) Log No.(1 to 10)	Maintenance log (ball screw/ball spline)	R	Character string type	87
C_PMLogOH	Log No.(1 to 10)	Maintenance log (overhaul (servo ON time))	R	Character string type	88

<Consumption degree>

Variable name	Array designation	Details	Attribute *1)	Data type, Unit	Page
M_PMCsmMnt	None	Consumption degree (mechanism total (maintenance parts))	R	Single-precision real number type, %	89
M_PMCsmOH	None	Consumption degree (mechanism total (overhaul parts))	R	Single-precision real number type, %	90
M_PMCsmGrs	Axis No.(1 to 8)	Consumption degree (grease)	R	Single-precision real number type, %	91
M_PMCsmBlit	Axis No.(1 to 8)	Consumption degree (timing belt)	R	Single-precision real number type, %	92
M_PMCsmDec	Axis No.(1 to 8)	Consumption degree (reduction gear)	R	Single-precision real number type, %	93
M_PMCsmBrg	Axis No.(1 to 8)	Consumption degree (bearing)	R	Single-precision real number type, %	94
M_PMCsmBss	Axis No.(1 to 8)	Consumption degree (ball screw/ball spline)	R	Single-precision real number type, %	95
M_PMRmnMnt	None	Remaining time (mechanism total (maintenance parts))	R	Integer type,Time	96
M_PMRmnSrv	None	Remaining time (servo ON time)	R	Integer type,Time	97

<Consumption status>

Variable name	Array designation	Details	Attribute *1)	Data type, Unit	Page
M_PMStsMnt	None	Consumption status (mechanism total (maintenance parts))	R	Integer type	98
M_PMStsOH	None	Consumption status (mechanism total (overhaul parts))	R	Integer type	99
M_PMStsGrs	Axis No.(1 to 8)	Consumption status (grease)	R	Integer type	100
M_PMStsBlit	Axis No.(1 to 8)	Consumption status (timing belt)	R	Integer type	101
M_PMStsDec	Axis No.(1 to 8)	Consumption status (reduction gear)	R	Integer type	102
M_PMStsBrg	Axis No.(1 to 8)	Consumption status (bearing)	R	Integer type	103
M_PMStsBss	Axis No.(1 to 8)	Consumption status (ball screw/ball spline)	R	Integer type	104
M_PMStsSrv	None	Consumption status (servo ON time)	R	Integer type	105

<Notification>

Variable name	Array designation	Details	Attribute *1)	Data type, Unit	Page
M_PMRptGrs	Axis No.(1 to 8)	Notification pause status (grease)	R	Integer type	106
M_PMRptBlit	Axis No.(1 to 8)	Notification pause status (timing belt)	R	Integer type	107
M_PMRptDec	Axis No.(1 to 8)	Notification pause status (reduction gear)	R	Integer type	108
M_PMRptBrg	Axis No.(1 to 8)	Notification pause status (bearing)	R	Integer type	109
M_PMRptBss	Axis No.(1 to 8)	Notification pause status (ball screw/ball spline)	R	Integer type	110
M_PMRptSrv	None	Notification pause status (servo ON time)	R	Integer type	111

12.1.2 MELFA Smart Plus

<MELFA Smart Plus card>

Variable name	Array designation	Details	Attribute *1)	Data type, Unit	Page
M_SmartPlus*2)	1	MELFA Smart Plus function usage status	R	Integer type	—
C_SmartPlus*2)	1	MELFA Smart Plus function name	R	Character string type	—

*1) Attributes in the table, R: Read only

*2) For the Robot (system) status variable of MELFA Smart Plus card, refer to the separate volume, "Instruction Manual/MELFA Smart Plus".

12.2 Consumption degree calculation function

12.2.1 Serial number

C_RBSerial: Robot body serial number

[Function]

Returns the serial number of the robot body.

[Format]

Example) <String variable> = C_RBSerial(<Mechanism number>)

[Terminology]

<String variable>	Specify the string variable to assign.
<Mechanism number>	Set the mechanism number. (1 to 3) When omitted, 1 is used.

[Sample]

1 C1\$ = C_RBSerial(1) 'The serial number of the robot body (mechanism 1) is set in C1\$.

[Explanation]

- (1) Returns the serial number of the robot body registered in the "RBSerial" parameter.
- (2) This variable is read only.

[Related system status variables]

C_RCSerial

C_RCSerial: Controller serial number

[Function]

Returns the serial number of the robot controller.

[Format]

Example) <String variable> = C_RCSerial

[Terminology]

<String variable> Specify the string variable to assign.

[Sample]

1 C1\$ = C_RCSerial 'The serial number of the robot controller is set in C1\$.

[Explanation]

- (1) Returns the serial number of the robot controller.
- (2) This variable is read only.

[Related system status variables]

C_RBSerial

12.2.2 Operating information

M_PowOnTime: Power ON time

[Function]

Returns the cumulative time of power supply ON of robot controller from a last overhaul. [hour]

[Format]

Example) <Numeric variable> = M_PowOnTime

[Terminology]

<Numeric variable> Specify the numeric variable to assign.

[Sample]

1 M1 = M_PowOnTime 'The cumulative time of power ON of the robot controller is set in M1.

[Explanation]

- (1) Returns the cumulative time of power ON of the robot controller.
The cumulative time is the time from when the previous overhaul was carried out.
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.

M_SrvOnTime: Servo ON time

[Function]

Returns the cumulative time of servo ON of the robot body from a last overhaul. [hour]

[Format]

Example) <Numeric variable> = M_SrvOnTime

[Terminology]

<Numeric variable> Specify the numeric variable to assign.

[Sample]

1 M1 = M_SrvOnTime 'The cumulative servo ON time of the robot body (mechanism 1) is set in M1.

[Explanation]

- (1) Returns the cumulative time of servo ON of the robot body (mechanism 1).
The cumulative time is the time from when the previous overhaul was carried out.
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.

M_PrgTime: Operation time

[Function]

Returns the cumulative time of the operating time of the robot controller from a last overhaul. [hour]

[Format]

Example) <Numeric variable> = M_PrgTime

[Terminology]

<Numeric variable> Specify the numeric variable to assign.

[Sample]

1 M1 = M_PrgTime 'The operation time of the robot controller is set in M1.

[Explanation]

- (1) Returns the operation time of the robot controller.
The operation time is the time from when the previous overhaul was carried out.
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.

M_MovTime: Actual operation time

[Function]

Returns the cumulative time of the moving time of the robot body from a last overhaul. [hour]

[Format]

Example) <Numeric variable> = M_MovTime

[Terminology]

<Numeric variable> Specify the numeric variable to assign.

[Sample]

1 M1 = M_MovTime 'The actual operation time of the robot body (mechanism 1) is set in M1.

[Explanation]

- (1) Returns the actual operation time of the robot body (mechanism 1).
The actual operation time is the time from when the previous overhaul was carried out.
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.

M_SrvOnNum: Servo ON count

[Function]

Returns the cumulative count of the servo ON of the robot body from a last overhaul.

[Format]

Example) <Numeric variable> = M_SrvOnNum
--

[Terminology]

<Numeric variable> Specify the joint type variable to assign.

[Sample]

1 M1 = M_SrvOnNum 'The servo ON count of the robot body (mechanism 1) is set in M1.

[Explanation]

- (1) Returns the servo ON count of the robot body (mechanism 1).
The count is the accumulation count from when the previous overhaul was carried out.
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.

M_MtRotNum: Motor cumulative rotation count

[Function]

Returns the cumulative number of rotations of the motor of the robot body from a last overhaul of the specified axis.

[Format]

Example) <Numeric variable> = M_MtRotNum(<Axis number>)

[Terminology]

- <Numeric variable> Specify the joint type variable to assign.
- <Axis number> Specify the joint axis to get the cumulative rotation count. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_MtRotNum(1) The motor cumulative rotation count of the J1 axis is set in M1.

[Explanation]

- (1) Returns the motor cumulative rotation count of the robot body (mechanism 1).
The rotation count is the accumulation count from when the previous overhaul was carried out.
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when a nonexistent axis is specified in <Axis number>.

12.2.3 Maintenance Log

M_PMLogGrs: Maintenance count (grease)

[Function]

Returns the maintenance count (reset count) of the grease of the specified axis.

[Format]

Example) <Numeric variable> = M_PMLogGrs(<Axis number>)

[Terminology]

- <Numeric variable> Specify the numeric variable to assign.
- <Axis number> Specify the joint axis for which to get a log. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_PMLogGrs(1) The maintenance count of the grease for the J1 axis is set in M1.

[Explanation]

- (1) Returns the maintenance count (reset count) of the grease for the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when a nonexistent axis is specified in <Axis number>.

[Related system status variables]

C_PMLogGrs

M_PMLogBlt: Maintenance count (timing belt)

[Function]

Returns the maintenance count (reset count) of the timing belt of the specified axis.

[Format]

Example) <Numeric variable> = M_PMLogBlt(<Axis number>)

[Terminology]

- <Numeric variable> Specify the numeric variable to assign.
- <Axis number> Specify the joint axis for which to get a log. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_PMLogBlt(1) 'The maintenance count of timing belt for the J1 axis is set in M1.

[Explanation]

- (1) Returns the maintenance count (reset count) of timing belt of the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when a nonexistent axis is specified in <Axis number>.

[Related system status variables]

C_PMLogBlt

M_PMLogDec: Maintenance count (reduction gear)

[Function]

Returns the maintenance count (reset count) of the decelerator of the specified axis.

[Format]

Example) <Numeric variable> = M_PMLogDec(<Axis number>)

[Terminology]

- <Numeric variable> Specify the numeric variable to assign.
- <Axis number> Specify the joint axis for which to get a log. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_PMLogDec(1) 'The maintenance count of the reduction gear for the J1 axis is set in M1.

[Explanation]

- (1) Returns the maintenance count (reset count) of the reduction gear of the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when a nonexistent axis is specified in <Axis number>.

[Related system status variables]

C_PMLogDec

M_PMLogBrg: Maintenance count (bearing)

[Function]

Returns the maintenance count (reset count) of the bearing of the specified axis.

[Format]

Example) <Numeric variable> = M_PMLogBrg(<Axis number>)

[Terminology]

- <Numeric variable> Specify the numeric variable to assign.
- <Axis number> Specify the joint axis for which to get a log. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_PMLogBrg(1) The maintenance count of the bearing of the J1 axis is set in M1.

[Explanation]

- (1) Returns the maintenance count (reset count) of the bearing of the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when a nonexistent axis is specified in <Axis number>.

[Related system status variables]

C_PMLogBrg

M_PMLogBss: Maintenance count (ball screw/ball spline)

[Function]

Returns the maintenance count (reset count) of the ball screw / ball spline of the specified axis.

[Format]

Example) <Numeric variable> = M_PMLogBss(<Axis number>)

[Terminology]

- <Numeric variable> Specify the numeric variable to assign.
- <Axis number> Specify the joint axis for which to get a log. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_PMLogBss(3) The maintenance count of the ball screw of the J3 axis is set in 'M1.

[Explanation]

- (1) Returns the maintenance count (reset count) of the ball screw/ball spline of the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when a nonexistent axis is specified in <Axis number>.

[Related system status variables]

C_PMLogBss

M_PMLogOH: Maintenance count (overhaul (servo ON time))

[Function]

Returns the maintenance count (reset count) of the overhaul.

[Format]

Example) <Numeric variable> = M_PMLogOH

[Terminology]

<Numeric variable> Specify the numeric variable to assign.

[Sample]

1 M1 = M_PMLogOH 'The maintenance count of overhaul is set in M1.

[Explanation]

- (1) Returns the maintenance count (reset count) of overhaul for the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.

[Related system status variables]

C_PMLogOH

C_PMLogGrs: Maintenance log (grease)

[Function]

Returns the maintenance log data (the reset date and time, the consumption degree when resetting) of the grease.

[Format]

Example) <String variable> = C_PMLogGrs(<Log number>, <Axis number>)

[Terminology]

- <String variable> Specify the string variable to assign.
- <Log number> Specify the log number to get. (1 to 10)
The greater the number, the older the log data.
To get the last reset date & time, specify "1".
- <Axis number> Specify the joint axis for which to get a log. (1 to 6)

[Sample]

1 C1\$ = C_PMLogGrs(1,1) 'The maintenance log of the grease is set in C1\$.

[Explanation]

- (1) Returns the maintenance log data (reset date & time, consumption degree at the time of reset) of the grease for the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1.000" when the preventive maintenance function is disabled.
- (4) Returns "<Date>, <Time>, <Consumption degree [%] at the time of reset>" when the preventive maintenance function is enabled.
<Date> is output in "YYYY/MM/DD" format, and <Time> in "hh:mm:ss" format.
Example : "2018/02/01,12:00:00,80.000"
- (5) Returns "----/--/--,--:--:--,0.000" when there is no log data specified by <Log number>.
- (6) Returns "----/--/--,--:--:--,0.000" when a nonexistence axis is specified in <Axis number>.

[Related system status variables]

M_PMLogGrs

C_PMLogBlt: Maintenance log (timing belt)

[Function]

Returns the maintenance log data (the reset date and time, the consumption degree when resetting) of the timing belt.

[Format]

Example) <String variable> = C_PMLogBlt(<Log number>, <Axis number>)
--

[Terminology]

- <String variable> Specify the string variable to assign.
- <Log number> Specify the log number to get. (1 to 10)
The greater the number, the older the log data.
To get the last reset date & time, specify "1".
- <Axis number> Specify the joint axis for which to get a log. (1 to 6)

[Sample]

1 C1\$ = C_PMLogBlt(1,1) 'The maintenance log of the timing belt is set in C1\$.

[Explanation]

- (1) Returns the maintenance log data (reset date & time, consumption degree at the time of reset) of the timing belt of the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1.000" when the preventive maintenance function is disabled.
- (4) Returns "<Date>, <Time>, <Consumption degree [%] at the time of reset>" when the preventive maintenance function is enabled.
<Date> is output in "YYYY/MM/DD" format, and <Time> in "hh:mm:ss" format.
Example : "2018/02/01,12:00:00,80.000"
- (5) Returns "----/--/--,--:--:--,0.000" when there is no log data specified by <Log number>.
- (6) Returns "----/--/--,--:--:--,0.000" when a nonexistence axis is specified in <Axis number>.

[Related system status variables]

M_PMLogBlt

C_PMLogDec: Maintenance log (reduction gear)

[Function]

Returns the maintenance log data (the reset date and time, the consumption degree when resetting) of the decelerator.

[Format]

Example) <String variable> = C_PMLogDec(<Log number>, <Axis number>)
--

[Terminology]

<String variable> Specify the string variable to assign.

<Log number> Specify the log number to get. (1 to 10)
The greater the number, the older the log data.
To get the last reset date & time, specify "1".

<Axis number> Specify the joint axis for which to get a log. (1 to 6)

[Sample]

1 C1\$ = C_PMLogDec(1,1) 'The maintenance log of the reduction gear is set in C1\$.

[Explanation]

- (1) Returns the maintenance log data (reset date & time, consumption degree at the time of reset) of the reduction gear for the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1.000" when the preventive maintenance function is disabled.
- (4) Returns "<Date>, <Time>, <Consumption degree [%] at the time of reset>" when the preventive maintenance function is enabled.
<Date> is output in "YYYY/MM/DD" format, and <Time> in "hh:mm:ss" format.
Example : "2018/02/01,12:00:00,80.000"
- (5) Returns "----/--/--,--:--:--,0.000" when there is no log data specified by <Log number>.
- (6) Returns "----/--/--,--:--:--,0.000" when a nonexistence axis is specified in <Axis number>.

[Related system status variables]

M_PMLogDec

C_PMLogBrg: Maintenance log (bearing)

[Function]

Returns the maintenance log data (the reset date and time, the consumption degree when resetting) of the bearing.

[Format]

Example) <String variable> = C_PMLogBrg(<Log number>, <Axis number>)
--

[Terminology]

<String variable> Specify the string variable to assign.

<Log number> Specify the log number to get. (1 to 10)

The greater the number, the older the log data.

To get the last reset date & time, specify "1".

<Axis number> Specify the joint axis for which to get a log. (1 to 6)

[Sample]

1 C1\$ = C_PMLogBrg(1,1) 'The maintenance log of the bearing is set in C1\$.

[Explanation]

- (1) Returns the maintenance log data (reset date & time, consumption degree at the time of reset) of the bearing of the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1.000" when the preventive maintenance function is disabled.
- (4) Returns "<Date>, <Time>, <Consumption degree [%] at the time of reset>" when the preventive maintenance function is enabled.
<Date> is output in "YYYY/MM/DD" format, and <Time> in "hh:mm:ss" format.
Example : "2018/02/01,12:00:00,80.000"
- (5) Returns "----/--/--,--:--:--,0.000" when there is no log data specified by <Log number>.
- (6) Returns "----/--/--,--:--:--,0.000" when a nonexistence axis is specified in <Axis number>.

[Related system status variables]

M_PMLogBrg

C_PMLogBss: Maintenance log (ball screw/ball spline)

[Function]

Returns the maintenance log data (the reset date and time, the consumption degree when resetting) of the ball screw / ball spline.

[Format]

Example) <String variable> = C_PMLogBss(<Log number>, <Axis number>)
--

[Terminology]

<String variable> Specify the string variable to assign.

<Log number> Specify the log number to get. (1 to 10)

The greater the number, the older the log data.

To get the last reset date & time, specify "1".

<Axis number> Specify the joint axis for which to get a log. (1 to 6)

[Sample]

1 C1\$ = C_PMLogBss(1,3) 'The maintenance log of the ball screw of the J3 axis is set in C1\$.

[Explanation]

- (1) Returns the maintenance log data (reset date & time, consumption degree at the time of reset) of the ball screw/ball spline of the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1.000" when the preventive maintenance function is disabled.
- (4) Returns "<Date>, <Time>, <Consumption degree [%] at the time of reset>" when the preventive maintenance function is enabled.
<Date> is output in "YYYY/MM/DD" format, and <Time> in "hh:mm:ss" format.
Example : "2018/02/01,12:00:00,80.000"
- (5) Returns "----/--/--,--:--:--,0.000" when there is no log data specified by <Log number>.
- (6) Returns "----/--/--,--:--:--,0.000" when a nonexistence axis is specified in <Axis number>.

[Related system status variables]

M_PMLogBss

C_PMLogOH: Maintenance log (overhaul (servo ON time))

[Function]

Returns the maintenance log data (the reset date and time, the cumulative time of servo ON when resetting) of the overhaul.

[Format]

Example) <String variable> = C_PMLogOH(<Log number>)
--

[Terminology]

<String variable> Specify the string variable to assign.

<Log number> Specify the log number to get. (1 to 10)

The greater the number, the older the log data.

To get the last reset date & time, specify "1".

When omitted, 1 is used.

[Sample]

1 C1\$ = C_PMLogOH(1) 'The maintenance log of overhaul is set in C1\$.

[Explanation]

- (1) Returns the maintenance log data (reset date & time, servo ON time at the time of reset) of overhaul for the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "<Date>, <Time>, <Servo ON time [h] at the time of reset>" when the preventive maintenance function is enabled.
<Date> is output in "YYYY/MM/DD" format, and <Time> in "hh:mm:ss" format.
Example : "2018/02/01,12:00:00,24000"
- (5) Returns "----/--/--,--:--:--,0" when there is no log data specified by <Log number>.

[Related system status variables]

M_PMLogOH

12.2.4 Consumption degree

M_PMCsmMnt: Consumption degree (mechanism total (maintenance parts))

[Function]

Returns the overall consumption degree of the maintenance part (grease and timing belt). [%]

[Format]

Example) <Numeric variable> = M_PMCsmMnt
--

[Terminology]

<Numeric variable> Specify the numeric variable to assign.

[Sample]

1 M1 = M_PMCsmMnt 'The overall consumption degree of the maintenance parts is set in M1.

[Explanation]

- (1) Returns the overall consumption degree of the maintenance parts (grease, timing belt) of the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.

[Related system status variables]

M_PMCsmGrs / M_PMCsmBlt

M_PMCsmOH: Consumption degree (mechanism total (overhaul parts))

[Function]

Returns the overall consumption degree of the overhaul part (decelerator, bearing and ball screw / ball spline). [%]

[Format]

Example) <Numeric variable> = M_PMCsmOH

[Terminology]

<Numeric variable> Specify the numeric variable to assign.

[Sample]

1 M1 = M_PMCsmOH 'The overall consumption degree of the overhaul parts is set in M1.

[Explanation]

- (1) Returns the overall consumption degree of the parts (reduction gear, bearing, ball screw, ball spline) requiring overhaul of the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.

[Related system status variables]

M_PMCsmDec / M_PMCsmBrg / M_PMCsmBss

M_PMCsmGrs: Consumption degree (grease)

[Function]

Returns the consumption degree of the grease of the specified axis. [%]

[Format]

Example) <Numeric variable> = M_PMCsmGrs(<Axis number>)

[Terminology]

<Numeric variable> Specify the numeric variable to assign.

<Axis number> Specify the joint axis to get the cumulative rotation count. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_PMCsmGrs(1) 'The consumption degree of the grease for the J1 axis is set in M1.

[Explanation]

- (1) Returns the consumption degree (unit: %) of the grease of each joint axis of the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when a nonexistent axis is specified in <Axis number>.
- (5) Returns "0" for joint axes that do not require grease replenishing.

M_PMCsmBlT: Consumption degree (timing belt)

[Function]

Returns the consumption degree of the timing belt of the specified axis. [%]

[Format]

Example) <Numeric variable> = M_PMCsmBlT(<Axis number>)

[Terminology]

<Numeric variable> Specify the numeric variable to assign.

<Axis number> Specify the joint axis to get the cumulative rotation count. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_PMCsmBlT(1) The consumption degree of the timing belt of the J1 axis is set in M1.

[Explanation]

- (1) Returns the consumption degree (unit: %) of the timing belt of each joint axis of the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when a nonexistent axis is specified in <Axis number>.
- (5) Returns "0" when the joint axis does not have the target parts.

M_PMCsmDec: Consumption degree (reduction gear)

[Function]

Returns the consumption degree of the decelerator of the specified axis. [%]

[Format]

Example) <Numeric variable> = M_PMCsmDec(<Axis number>)

[Terminology]

- <Numeric variable> Specify the numeric variable to assign.
- <Axis number> Specify the joint axis to get the cumulative rotation count. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_PMCsmDec(1) 'The consumption degree of the reduction gear of the J1 axis is set in M1.

[Explanation]

- (1) Returns the consumption degree (unit: %) of the reduction gear of each joint axis of the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when a nonexistent axis is specified in <Axis number>.
- (5) Returns "0" when the joint axis does not have the target parts.

M_PMCsmBrg: Consumption degree (bearing)

[Function]

Returns the consumption degree of the bearing of the specified axis. [%]

[Format]

Example) <Numeric variable> = M_PMCsmBrg(<Axis number>)

[Terminology]

<Numeric variable> Specify the numeric variable to assign.

<Axis number> Specify the joint axis to get the cumulative rotation count. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_PMCsmBrg(1) 'The consumption degree of the bearing of the J1 axis is set in M1.

[Explanation]

- (1) Returns the consumption degree (unit: %) of the bearing of each joint axis of the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when a nonexistent axis is specified in <Axis number>.
- (5) Returns "0" when the joint axis does not have the target parts.

M_PMCsmBss: Consumption degree (ball screw/ball spline)

[Function]

Returns the consumption degree of the ball screw / ball spline of the specified axis. [%]

[Format]

Example) <Numeric variable> = M_PMCsmBss(<Axis number>)

[Terminology]

<Numeric variable> Specify the numeric variable to assign.

<Axis number> Specify the joint axis to get the cumulative rotation count. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_PMCsmBss(3) 'The consumption degree of the ball screw of the J3 axis is set in M1.

[Explanation]

- (1) Returns the consumption degree (unit: %) of the ball screw/ball spline of each joint axis of the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when a nonexistent axis is specified in <Axis number>.
- (5) Returns "0" when the joint axis does not have the target parts.

M_PMRmnMnt: Remaining time (mechanism total (maintenance parts))

[Function]

Returns the remaining time until maintenance of the maintenance part (grease and timing belt). [hour]

[Format]

Example) <Numeric variable> = M_PMRmnMnt
--

[Terminology]

<Numeric variable> Specify the numeric variable to assign.

[Sample]

1 M1 = M_PMRmnMnt 'The remaining time up to the maintenance of the maintenance part is set in M1.

[Explanation]

- (1) Returns the remaining time up to the maintenance of the maintenance parts (grease, timing belt) of the robot body (mechanism 1).
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.

M_PMRmnSrv: Remaining time (servo ON time)

[Function]

Returns the remaining time until specified time of an overhaul of the cumulative time of servo ON. [hour]

[Format]

Example) <Numeric variable> = M_PMRmnSrv
--

[Terminology]

<Numeric variable> Specify the numeric variable to assign.

[Sample]

1 M1 = M_PMRmnSrv 'The remaining time up to overhaul of the overhaul part is set in M1.

[Explanation]

- (1) Returns the remaining time of the cumulative servo ON time to reach the specified overhaul time.
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.

12.2.5 Consumption status

M_PMStsMnt: Consumption status (mechanism total (maintenance parts))

[Function]

Returns the consumption status of the maintenance part (grease and timing belt).

[Format]

Example) <Numeric variable> = M_PMStsMnt
--

[Terminology]

<Numeric variable> Specify the numeric variable to assign.

[Sample]

1 M1 = M_PMCsmMnt 'The overall consumption degree of the maintenance parts is set in M1.

[Explanation]

- (1) Returns the consumption status of the maintenance part (grease, timing belt) of the robot body (mechanism 1).
0 : The remaining time exceeded the warning occurrence remaining time.
1 : The remaining time is less than the warning occurrence remaining time, exceeded 0 [h].
2 : The remaining time is 0 [h] or less.
- (2) Specify the warning occurrence remaining time using the "PMWNGDAY" parameter.
- (3) This variable is read only.
- (4) Returns "-1" when the preventive maintenance function is disabled.

[Related system status variables]

M_PMCsmGrs / M_PMCsmBlit

M_PMStsOH: Consumption status (mechanism total (overhaul parts))

[Function]

Returns the consumption status of the overhaul part (decelerator, bearing and ball screw / ball spline).

[Format]

Example) <Numeric variable> = M_PMStsOH

[Terminology]

<Numeric variable> Specify the numeric variable to assign.

[Sample]

1 M1 = M_PMStsOH 'The consumption status of the overhaul part is set in M1.

[Explanation]

- (1) Returns the consumption status of the maintenance part (grease, timing belt) requiring overhaul of the robot body (mechanism 1).
0 : The remaining time exceeded the warning occurrence remaining time.
1 : The remaining time is less than the warning occurrence remaining time, exceeded 0 [h].
2 : The remaining time is 0 [h] or less.
- (2) Specify the warning occurrence remaining time using the "PMWRGDAY" parameter.
- (3) This variable is read only.
- (4) Returns "-1" when the preventive maintenance function is disabled.

M_PMStsGrs: Consumption status (grease)

[Function]

Returns the consumption status of grease of the specified axis.

[Format]

Example) <Numeric variable> = M_PMStsGrs(<Axis number>)

[Terminology]

- <Numeric variable> Specify the numeric variable to assign.
- <Axis number> Specify the joint axis to get the cumulative rotation count. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_PMStsGrs(1) 'The consumption status of the grease for the J1 axis is set in M1.

[Explanation]

- (1) Returns the consumption status of the grease of each joint axis of the robot body (mechanism 1).
0 : The remaining time exceeded the warning occurrence remaining time.
1 : The remaining time is less than the warning occurrence remaining time, exceeded 0 [h].
2 : The remaining time is 0 [h] or less.
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when a nonexistent axis is specified in <Axis number>.
- (5) Returns "0" for joint axes that do not require grease replenishing.

M_PMStsBlT: Consumption status (timing belt)

[Function]

Returns the consumption status of timing belt of the specified axis.

[Format]

Example) <Numeric variable> = M_PMStsBlT(<Axis number>)

[Terminology]

- <Numeric variable> Specify the numeric variable to assign.
- <Axis number> Specify the joint axis to get the cumulative rotation count. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_PMStsBlT(1) 'The consumption status of the timing belt of the J1 axis is set in M1.

[Explanation]

- (1) Returns the consumption status of the timing belt of each joint axis of the robot body (mechanism 1).
0 : The remaining time exceeded the warning occurrence remaining time.
1 : The remaining time is less than the warning occurrence remaining time, exceeded 0 [h].
2 : The remaining time is 0 [h] or less.
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when a nonexistent axis is specified in <Axis number>.
- (5) Returns "0" when the joint axis does not have the target parts.

M_PMStsDec: Consumption status (reduction gear)

[Function]

Returns the consumption status of decelerator of the specified axis.

[Format]

Example) <Numeric variable> = M_PMStsDec(<Axis number>)

[Terminology]

- <Numeric variable> Specify the numeric variable to assign.
- <Axis number> Specify the joint axis to get the cumulative rotation count. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_PMStsDec(1) The consumption status of the reduction gear of the J1 axis is set in M1.

[Explanation]

- (1) Returns the consumption status of the reduction gear of each joint axis of the robot body (mechanism 1).
0 : The remaining time exceeded the warning occurrence remaining time.
1 : The remaining time is less than the warning occurrence remaining time, exceeded 0 [h].
2 : The remaining time is 0 [h] or less.
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when a nonexistent axis is specified in <Axis number>.
- (5) Returns "0" when the joint axis does not have the target parts.

M_PMStsBrg: Consumption status (bearing)

[Function]

Returns the consumption status of bearing of the specified axis.

[Format]

Example) <Numeric variable> = M_PMStsBrg(<Axis number>)

[Terminology]

<Numeric variable> Specify the numeric variable to assign.

<Axis number> Specify the joint axis to get the cumulative rotation count. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_PMStsBrg(1) The consumption status of the bearing of the J1 axis is set in M1.

[Explanation]

- (1) Returns the consumption status of the bearing of each joint axis of the robot body (mechanism 1).
0 : The remaining time exceeded the warning occurrence remaining time.
1 : The remaining time is less than the warning occurrence remaining time, exceeded 0 [h].
2 : The remaining time is 0 [h] or less.
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when a nonexistent axis is specified in <Axis number>.
- (5) Returns "0" when the joint axis does not have the target parts.

M_PMStsBss: Consumption status (ball screw/ball spline)

[Function]

Returns the consumption status of ball screw / ball spline of the specified axis.

[Format]

Example) <Numeric variable> = M_PMStsBss(<Axis number>)

[Terminology]

- <Numeric variable> Specify the numeric variable to assign.
- <Axis number> Specify the joint axis to get the cumulative rotation count. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_PMStsBss(3) The consumption status of the ball screw of the J3 axis is set in M1.

[Explanation]

- (1) Returns the consumption status of the ball screw/ball spline of each joint axis of the robot body (mechanism 1).
0 : The remaining time exceeded the warning occurrence remaining time.
1 : The remaining time is less than the warning occurrence remaining time, exceeded 0 [h].
2 : The remaining time is 0 [h] or less.
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when a nonexistent axis is specified in <Axis number>.
- (5) Returns "0" when the joint axis does not have the target parts.

M_PMStsSrv: Consumption status (servo ON time)

[Function]

Returns the arrival status to the specified time of an overhaul of the cumulative time of servo ON.

[Format]

Example) <Numeric variable> = M_PMStsSrv
--

[Terminology]

<Numeric variable> Specify the numeric variable to assign.

[Sample]

1 M1 = M_PMStsSrv 'The arrival status to the specified overhaul time is set in M1.

[Explanation]

- (1) Returns the arrival status of the cumulative servo ON time to the specified overhaul time for the robot body (mechanism 1).
0 : The remaining time exceeded the warning occurrence remaining time.
1 : The remaining time is less than the warning occurrence remaining time, exceeded 0 [h].
2 : The remaining time is 0 [h] or less.
- (2) This variable is read only.
- (3) Returns "-1" for all axes when the preventive maintenance function is disabled.

12.2.6 Notification

M_PMRptGrs: Notification pause status (grease)

[Function]

Returns the stop status of warning / signal output, of grease consumption of the specified axis.

[Format]

Example) <Numeric variable> = M_PMRptGrs<Axis number>

[Terminology]

- <Numeric variable> Specify the numeric variable to assign.
- <Axis number> Specify the joint axis for which to get a log. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_PMRptGrs(1) The notification method of the grease consumption of the J1 axis is set in M1.

[Explanation]

- (1) Returns the pause status of warning occurrence/warning signal output, which occurs due to grease consumption of the joint axis specified in <Axis number> of the robot body (mechanism 1). (1/0 = Enable/Disable)
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when the joint axis does not exist.
- (5) Returns "0" for joint axes that do not require grease replenishing.

M_PMRptBlt: Notification pause status (timing belt)

[Function]

Returns the stop status of warning / signal output, of timing belt consumption of the specified axis.

[Format]

Example) <Numeric variable> = M_PMRptBlt<Axis number>

[Terminology]

<Numeric variable>	Specify the numeric variable to assign.
<Axis number>	Specify the joint axis for which to get a log. (1 to 6) When omitted, 1 is used.

[Sample]

1 M1 = M_PMRptBlt(1)	'The notification method of the timing belt consumption of the J1 axis is set in M1.
----------------------	--

[Explanation]

- (1) Returns the pause status of warning occurrence/warning signal output, which occurs due to timing belt consumption of the joint axis specified in <Axis number> of the robot body (mechanism 1). (1/0 = Enable/Disable)
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when the joint axis does not exist.
- (5) Returns "0" when the joint axis does not have the target parts.

M_PMRptDec: Notification pause status (reduction gear)

[Function]

Returns the stop status of warning / signal output, of decelerator consumption of the specified axis.

[Format]

Example) <Numeric variable> = M_PMRptDec<Axis number>

[Terminology]

- | | |
|--------------------|---|
| <Numeric variable> | Specify the numeric variable to assign. |
| <Axis number> | Specify the joint axis for which to get a log. (1 to 6)
When omitted, 1 is used. |

[Sample]

1 M1 = M_PMRptDec(1)	'The notification method of the reduction gear consumption of the J1 axis is set in M1.
----------------------	---

[Explanation]

- (1) Returns the pause status of warning occurrence/warning signal output, which occurs due to reduction gear consumption of the joint axis specified in <Axis number> of the robot body (mechanism 1). (1/0 = Enable/Disable)
- (2) This variable is read only.
- (3) Returns "0" when the preventive maintenance function is disabled.
- (4) Returns "0" when the joint axis does not exist.
- (5) Returns "0" when the joint axis does not have the target parts.

M_PMRptBrg: Notification pause status (bearing)

[Function]

Returns the stop status of warning / signal output, of bearing consumption of the specified axis.

[Format]

Example) <Numeric variable> = M_PMRptBrg<Axis number>

[Terminology]

- <Numeric variable> Specify the numeric variable to assign.
- <Axis number> Specify the joint axis for which to get a log. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_PMRptBrg(1) 'The notification method of bearing consumption of the J1 axis is set in M1.

[Explanation]

- (1) Returns the pause status of warning occurrence/warning signal output, which occurs due to bearing consumption of the joint axis specified in <Axis number> of the robot body (mechanism 1). (1/0 = Enable/Disable)
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when the joint axis does not exist.
- (5) Returns "0" when the joint axis does not have the target parts.

M_PMRptBss: Consumption status (ball screw/ball spline)

[Function]

Returns the stop status of warning / signal output, of ball screw / ball spline consumption of the specified axis.

[Format]

Example) <Numeric variable> = M_PMRptBss<Axis number>

[Terminology]

- <Numeric variable> Specify the numeric variable to assign.
- <Axis number> Specify the joint axis for which to get a log. (1 to 6)
When omitted, 1 is used.

[Sample]

1 M1 = M_PMRptBss(3) 'The notification method of ball screw consumption of the J3 axis is set in M1.

[Explanation]

- (1) Returns the pause status of warning occurrence/warning signal output, which occurs due to ball screw/ball spline consumption of the joint axis specified in <Axis number> of the robot body (mechanism 1). (1/0 = Enable/Disable)
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.
- (4) Returns "0" when the joint axis does not exist.
- (5) Returns "0" when the joint axis does not have the target parts.

M_PMRptSrv: Notification pause status (servo ON time)

[Function]

Returns the stop status of warning / signal output, of arrival status to the specified time of an overhaul of the cumulative time of servo ON.

[Format]

Example) <Numeric variable> = M_PMRptSrv
--

[Terminology]

<Numeric variable> Specify the numeric variable to assign.

[Sample]

1 M1 = M_PMRptSrv 'The arrival notification method to the specified overhaul time is set in M1.

[Explanation]

- (1) Returns the pause status of warning occurrence/warning signal output, of arrival status to the specified time of an overhaul of the cumulative time of servo ON of the robot body (mechanism 1). (1/0 = Enable/Disable)
- (2) This variable is read only.
- (3) Returns "-1" when the preventive maintenance function is disabled.

13. Parameter

13.1 Common to preventive maintenance functions

(*1 Attributes in the table, R: Read only, W: Write only, R/W: Read/write)

Parameter	Parameter name	Number of elements	Details explanation	Factory setting	Attribute *1)
Pause method of warning occurrence	PMSTPWAY	Integer 1	<p>Specify the pause method of warning occurrence or warning signal output of the preventive maintenance function.</p> <p>Specify the behavior of the preventive maintenance function when warning occurrence or warning signal output is paused.</p> <p>1: Pause until maintenance (occurs only once when power is input).</p> <p>(Warning occurs or a warning signal is output once immediately after power input and pause continues after reset.)</p> <p>2: Pause until maintenance (stops as well when power is input)</p>	1	R/W
Preventive maintenance function enable/disable switching	PMENA	Integer 1	<p>Specify enable/disable of the preventive maintenance function.</p> <p>This parameter is used when a customer who uses the "MELFA Smart Plus Card Pack" disables the preventive maintenance function in order to continue using the maintenance forecast.</p>	0	R/W
Preventive maintenance function enable/disable status	MSPPMENA	Integer 1	<p>You can check whether or not the preventive maintenance function is enabled. (Read only)</p> <p>1: Enable 0: Disable</p>		R
Version management of preventive maintenance function	PMVER	Character string	<p>Manages the version of the predictive/preventive maintenance function.</p> <p>(Applicable version:the CR800 series controller software version A4 or later.)</p>		R

13.2 Consumption degree calculation function

13.2.1 Setting parameters

(*1 Attributes in the table, R: Read only, W: Write only, R/W: Read/write)

Parameter	Parameter name	Number of elements	Details explanation	Factory setting	Attribute *1)
Warning remaining number of days and operation time of a day	PMWNGDAY	Integer 2	<p>Specify the warning remaining number of days and operation time of a day of the preventive maintenance function.</p> <p>■Element 1</p> <p>Specify the remaining number of days (remaining recommended maintenance time) to issue a warning by the preventive maintenance function.</p> <p>Unit: [day] Setting range: 0 or higher</p> <p>■Element 2</p> <p>Specify the operation time of a day used by the preventive maintenance function.</p> <p>Unit: [h] (time) Setting range: 1 to 24</p> <p>* The warning remaining number of days is calculated by Element 1 x Element 2.</p>	(30, 16)	R/W
Notification interval of part consumption	PMWNGTI	Integer 1	<p>Specify the notification interval of part consumption of the preventive maintenance function. Specify the interval (hours) to issue a warning by the preventive maintenance function.</p> <p>After warning/signal output is reset, warning does not occur until the specified hours elapses.</p> <p>Unit: [h] (time) Setting range: 1 to 24</p>	6	R/W
Notification method of maintenance part consumption	PMRPTMNT	Integer 2	<p>Specify the notification method of the preventive maintenance function. (Maintenance part consumption)</p> <p>Specify the behavior when the warning occurrence detection level by the preventive maintenance function exceeded the remaining time (remaining recommended maintenance time) of the maintenance parts.</p> <p>Element 1: Issues warning/does not issue warning (1/0)</p> <p>Element 2: Outputs/does not output dedicated signals (1/0)</p>	0, 0	R/W

Parameter	Parameter name	Number of elements	Details explanation	Factory setting	Attribute *1)
Notification method of overhaul part consumption	PMRPTOH	Integer 2	<p>Specify the notification method of the preventive maintenance function. (Overhaul part consumption)</p> <p>Specify the behavior when the warning occurrence detection level by the preventive maintenance function exceeded the remaining time (remaining recommended maintenance time) of the part requiring overhaul.</p> <p>Element 1: Issues warning/does not issue warning (1/0)</p> <p>Element 2: Outputs/does not output dedicated signals (1/0)</p>	0, 0	R/W

13.2.2 Data acquisition parameter

The following operations are possible using the data acquisition parameters of the consumption degree calculation function.

Get the integration time and accumulation count from the previous overhaul. (Total)

Get the consumption degree [%] of the target part. (Total/for each joint axis)

Get the remaining time [h] to the recommended maintenance time of the target part. (Total/for each joint axis)

(*1 Attributes in the table, R: Read only, W: Write only, R/W: Read/write)

<Integration time>

Parameter	Parameter name	Number of elements	Details explanation	Attribute *1)
Power ON time from the previous overhaul	TIMPOWON	Integer 1	Power ON time from the previous overhaul * "-1" when the preventive maintenance function is disabled.	R
Servo ON time from the previous overhaul	TIMSRVON	Integer 1	Servo ON time from the previous overhaul * "-1" when the preventive maintenance function is disabled.	R
Operation time from the previous overhaul	TIMPRG	Integer 1	Operation time from the previous overhaul * "-1" when the preventive maintenance function is disabled.	R
Actual operation time from the previous overhaul	TIMMOV	Integer 1	Actual operation time from the previous overhaul * "-1" when the preventive maintenance function is disabled.	R

<Accumulation count>

Parameter	Parameter name	Number of elements	Details explanation	Attribute *1)
Servo ON count from the previous overhaul	NUMSRVON	Integer 1	Servo ON count from the previous overhaul * "-1" when the preventive maintenance function is disabled.	R
Servo ON time from the previous overhaul	NUMMTROT	Real number 8	Motor cumulative rotation count from the previous overhaul (up to three decimal places) * "-1" when the preventive maintenance function is disabled, and "0" when the axis does not exist.	R

<Getting consumption degree>

Parameter	Parameter name	Number of elements	Details explanation	Attribute *1)
Consumption degree of the preventive maintenance function (mechanism total (maintenance parts))	CSMPMMNT	Real number 1	Consumption degree of the preventive maintenance function (mechanism total (maintenance parts)) (Up to three decimal places) * "-1" when the preventive maintenance function is disabled.	R
Consumption degree of the preventive maintenance function (mechanism total (overhaul parts))	CSMPMOH	Real number 1	Consumption degree of the preventive maintenance function (mechanism total (overhaul parts)) (Up to three decimal places) * "-1" when the preventive maintenance function is disabled.	R

Parameter	Parameter name	Number of elements	Details explanation	Attribute *1)
Consumption degree of the preventive maintenance function (grease)	CSMPMGRS	Real number 8	Consumption degree of the preventive maintenance function (grease) (Up to three decimal places) * "-1" when the preventive maintenance function is disabled, and "0" when the axis does not exist.	R
Consumption degree of the preventive maintenance function (timing belt)	CSMPMBLT	Real number 8	Consumption degree of the preventive maintenance function (timing belt) (Up to three decimal places) * "-1" when the preventive maintenance function is disabled, and "0" when the axis does not exist.	R
Consumption degree of the preventive maintenance function (reduction gear)	CSMPMDEC	Real number 8	Consumption degree of the preventive maintenance function (reduction gear) (Up to three decimal places) * "-1" when the preventive maintenance function is disabled, and "0" when the axis does not exist.	R
Consumption degree of the preventive maintenance function (bearing)	CSMPMBRG	Real number 8	Consumption degree of the preventive maintenance function (bearing) (Up to three decimal places) * "-1" when the preventive maintenance function is disabled, and "0" when the axis does not exist.	R
Consumption degree of the preventive maintenance function (ball screw/ball spline)	CSMPMBSS	Real number 8	Consumption degree of the preventive maintenance function (ball screw/ball spline) (Up to three decimal places) * "-1" when the preventive maintenance function is disabled, and "0" when the axis does not exist.	R

<Getting remaining time>

Parameter	Parameter name	Number of elements	Details explanation	Attribute *1)
Remaining time of the preventive maintenance function (mechanism total (maintenance parts))	RMNPMMNNT	Integer 1	Remaining time of the preventive maintenance function (mechanism total (maintenance parts)) * "-1" when the preventive maintenance function is disabled.	R
Remaining time of the preventive maintenance function (servo ON time (at overhaul implementation))	RMNPMSRV	Integer 1	Remaining time of the preventive maintenance function (servo ON time (at overhaul implementation)) * "-1" when the preventive maintenance function is disabled.	R

<Getting consumption status>

Parameter	Parameter name	Number of elements	Details explanation	Attribute *1)
Consumption status of the preventive maintenance function (mechanism total (maintenance parts))	STSPMMNT	Integer 1	Consumption status of the preventive maintenance function (mechanism total (maintenance parts)) -1: The preventive maintenance function is disabled 0: The remaining time exceeded the warning occurrence remaining time. 1: The remaining time is less than the warning occurrence remaining time, exceeded 0 [h]. 2: The remaining time is 0 [h] or less.	R
Consumption status of the preventive maintenance function (mechanism total (overhaul parts))	STSPMOH	Integer 1	Consumption status of the preventive maintenance function (mechanism total (overhaul parts)) The meaning of the value is the same as that of the mechanism total (maintenance parts) (STSPMMNT).	R
Consumption status of the preventive maintenance function (grease)	STSPMGRS	Integer 8	Consumption status of the preventive maintenance function (grease) The meaning of the value is the same as that of the mechanism total (maintenance parts) (STSPMMNT). * "0" when the axis does not exist.	R
Consumption status of the preventive maintenance function (timing belt)	STSPMBLT	Integer 8	Consumption status of the preventive maintenance function (timing belt) The meaning of the value is the same as that of the mechanism total (maintenance parts) (STSPMMNT). * "0" when the axis does not exist.	R
Consumption status of the preventive maintenance function (reduction gear)	STSPMDEC	Integer 8	Consumption status of the preventive maintenance function (reduction gear) The meaning of the value is the same as that of the mechanism total (maintenance parts) (STSPMMNT). * "0" when the axis does not exist.	R
Consumption status of the preventive maintenance function (bearing)	STSPMBRG	Integer 8	Consumption status of the preventive maintenance function (bearing) The meaning of the value is the same as that of the mechanism total (maintenance parts) (STSPMMNT). * "0" when the axis does not exist.	R
Consumption status of the preventive maintenance function (ball screw/ball spline)	STSPMBSS	Integer 8	Consumption status of the preventive maintenance function (ball screw/ball spline) The meaning of the value is the same as that of the mechanism total (maintenance parts) (STSPMMNT). * "0" when the axis does not exist.	R

Parameter	Parameter name	Number of elements	Details explanation	Attribute *1)
Consumption status of the preventive maintenance function (servo ON time (at overhaul implementation))	STSPMSRV	Integer 1	Consumption status of the preventive maintenance function (servo ON time (at overhaul implementation)) The meaning of the value is the same as that of the mechanism total (maintenance parts) (STSPMMNT).	R

13.2.3 Operation parameters

The following operations are possible using the parameters for operation of the consumption degree calculation function.

Reset consumption degree reset of the target part. (For each joint axis)

Pause occurrence of warnings until consumption degree reset of the target part. (For each joint axis)

Get the consumption degree warning occurrence status or pause status of the target part. (For each joint axis)

Get the maintenance log data of the target part. (For each joint axis)

(*1 Attributes in the table, R: Read only, W: Write only, R/W: Read/write)

<Consumption degree reset>

Parameter	Parameter name	Number of elements	Details explanation	Attribute *1)												
Consumption degree (grease) accumulated data reset	RSTPMGRS	Integer 1	<div>Resets accumulated data related to the consumption degree (grease) of the preventive maintenance function. (When the specified axis is under pause of warning occurrence, the pause status is canceled at the same time.) In order to prevent mis-operation, the value upon reading is [-1] (out of setting range).</div> <table><tr><th>Value</th><th>Read</th><th>Writing</th></tr><tr><td>0</td><td>—</td><td>Resets all axes</td></tr><tr><td>1 to 6</td><td>—</td><td>Resets the specified axis number only</td></tr><tr><td>Other</td><td>—</td><td>C.7081(04000) : Out of range C.7081(03000) : Other than numeric value</td></tr></table>	Value	Read	Writing	0	—	Resets all axes	1 to 6	—	Resets the specified axis number only	Other	—	C.7081(04000) : Out of range C.7081(03000) : Other than numeric value	W
Value	Read	Writing														
0	—	Resets all axes														
1 to 6	—	Resets the specified axis number only														
Other	—	C.7081(04000) : Out of range C.7081(03000) : Other than numeric value														
Consumption degree (timing belt) accumulated data reset	RSTPMBLT	Integer 1	<div>Resets accumulated data related to the consumption degree (timing belt) of the preventive maintenance function.</div> <div>* The meaning of reading and writing is the same as that of grease (RSTPMGRS).</div>	W												
Consumption degree (reduction gear) accumulated data reset	RSTPMDEC	Integer 1	<div>Resets accumulated data related to the consumption degree (reduction gear) of the preventive maintenance function.</div> <div>* The meaning of reading and writing is the same as that of grease (RSTPMGRS).</div>	W												
Consumption degree (bearing) accumulated data reset	RSTPMBRG	Integer 1	<div>Resets accumulated data related to the consumption degree (bearing) of the preventive maintenance function.</div> <div>* The meaning of reading and writing is the same as that of grease (RSTPMGRS).</div>	W												
Consumption degree (ball screw/ball spline) accumulated data reset	RSTPMBSS	Integer 1	<div>Resets accumulated data related to the consumption degree (ball screw/ball spline) of the preventive maintenance function.</div> <div>* The meaning of reading and writing is the same as that of grease (RSTPMGRS).</div>	W												

Parameter	Parameter name	Number of elements	Details explanation	Attribute *1)									
Operating information (integration time, accumulation count) total accumulated data reset	RSTPMOH	Integer 1	Resets total accumulated data related to the operating information (integration time, accumulation count) of the preventive maintenance function. (Used at the time of overhaul.)	W									
			In order to prevent mis-operation, the value upon reading is [-1] (out of setting range).										
			<table><tr><td>Value</td><td>Read</td><td>Writing</td></tr><tr><td>1</td><td>-</td><td>Reset</td></tr><tr><td>Other</td><td>-</td><td>C.7081(04000) : Out of range C.7081(03000) : Other than numeric value</td></tr></table>		Value	Read	Writing	1	-	Reset	Other	-	C.7081(04000) : Out of range C.7081(03000) : Other than numeric value
			Value		Read	Writing							
1	-	Reset											
Other	-	C.7081(04000) : Out of range C.7081(03000) : Other than numeric value											
Consumption degree, operating information (integration time, accumulation count) total accumulated data reset	RSTPMNEW	Integer 1	<p>Resets total accumulated data related to the consumption degree and operating information (integration time, accumulation count) of the preventive maintenance function. (Used at the time of mechanism replacement.)</p> <p>* The meaning of reading and writing is the same as that of overhaul (RSTPMOH).</p>	W									

<Pausing warning occurrence/signal output>

Parameter	Parameter name	Number of elements	Details explanation	Attribute *1)															
Consumption degree (grease) of each joint axis Specifying pause of warning occurrence/warning signal output	RPTPMGRS	Integer 8	<div>Specifies pause of warning occurrence/warning signal output of the consumption degree (grease) of each joint axis.</div> <table><tr><th>Value</th><th>Read</th><th>Writing</th></tr><tr><td>-1</td><td>The preventive maintenance function is disabled</td><td>C.7081(04000) : Out of range</td></tr><tr><td>0</td><td>Pause disabled</td><td>Pause disabled</td></tr><tr><td>1</td><td>Pause enabled</td><td>Pause enabled</td></tr><tr><td>Other</td><td>-</td><td>C.7081(04000) : Out of range C.7081(03000) : Other than numeric value</td></tr></table>	Value	Read	Writing	-1	The preventive maintenance function is disabled	C.7081(04000) : Out of range	0	Pause disabled	Pause disabled	1	Pause enabled	Pause enabled	Other	-	C.7081(04000) : Out of range C.7081(03000) : Other than numeric value	R/W
Value	Read	Writing																	
-1	The preventive maintenance function is disabled	C.7081(04000) : Out of range																	
0	Pause disabled	Pause disabled																	
1	Pause enabled	Pause enabled																	
Other	-	C.7081(04000) : Out of range C.7081(03000) : Other than numeric value																	
Consumption degree (timing belt) Specifying pause of warning occurrence/warning signal output	RPTPMBLT	Integer 8	<div>Specifies pause of warning occurrence/warning signal output of the consumption degree (timing belt) of each joint axis.</div> <div>* The meaning of reading and writing is the same as that of grease (RPTPMGRS).</div>	R/W															

Parameter	Parameter name	Number of elements	Details explanation	Attribute *1)
Consumption degree (reduction gear) Specifying pause of warning occurrence/warning signal output	RPTPMDEC	Integer 8	Specifies pause of warning occurrence/warning signal output of the consumption degree (reduction gear) of each joint axis. * The meaning of reading and writing is the same as that of grease (RPTPMGRS).	R/W
Consumption degree (bearing) Specifying pause of warning occurrence/warning signal output	RPTPMBRG	Integer 8	Specifies pause of warning occurrence/warning signal output of the consumption degree (bearing) of each joint axis. * The meaning of reading and writing is the same as that of grease (RPTPMGRS).	R/W
Consumption degree (ball screw/ball spline) Specifying pause of warning occurrence/warning signal output	RPTPMBSS	Integer 8	Specifies pause of warning occurrence/warning signal output of the consumption degree (ball screw/ball spline) of each joint axis. * The meaning of reading and writing is the same as that of grease (RPTPMGRS).	R/W
Servo ON time (at overhaul implementation) Specifying pause of warning occurrence/warning signal output	RPTPMSRV	Integer 1	Specifies pause of warning occurrence/warning signal output of the servo ON time (at overhaul implementation). * The meaning of reading and writing is the same as that of grease (RPTPMGRS).	R/W

<Maintenance log>

Parameter	Parameter name	Number of elements	Details explanation	Attribute *1)
Specifying data to get maintenance log	LOGPMNO	Integer 2	<p>Specifies the data to get the maintenance log of the preventive maintenance function. It is possible to get specified data (log number, joint axis number) for each part using the following virtual parameters.</p> <p>Element 1: Log number of maintenance log (1 to 10)</p> <p>* The log number of the last reset date & time is "1".</p> <p>Element 2: Joint axis number of maintenance log (1 to 6)</p> <p>* When an out of range value is specified, "C.7081(04000): value is out of range", when a value other than numeric is specified, "C.7081(03000): value is out of range" is used.</p>	R/W
Getting maintenance log data (grease)	LOGPMGRS	Character string 6	<p>Gets maintenance log data (grease).</p> <p>Element 1: Log number (1 to 10)</p> <p>Element 2: Joint axis number (1 to 6)</p> <p>Element 3: Reset date (YYYY/MM/DD)</p> <p>Element 4: Reset time (hh: mm: ss)</p> <p>Element 5: Consumption degree [%] at reset (up to three decimal places)</p> <p>Element 6: Reset count [times]</p> <p>* If a log number with which there is no recorded data or nonexistent joint axis number is specified, the output becomes as follows:</p> <p>Element 3: "----/--/--"</p> <p>Element 4: "--:--:--"</p> <p>Element 5: 0.000</p> <p>* If the preventive maintenance function is disabled, the output becomes as follows:</p> <p>Element 3: ""</p> <p>Element 4: ""</p> <p>Element 5: -1.000</p> <p>Element 6: -1</p>	R
Getting maintenance log (timing belt) data	LOGPMBLT	Character string 6	<p>Gets maintenance log (timing belt) data.</p> <p>* The meaning of data is the same as that of the grease (LOGPMGRS).</p>	R
Getting maintenance log (reduction gear) data	LOGPMDEC	Character string 6	<p>Gets maintenance log (reduction gear) data.</p> <p>* The meaning of data is the same as that of the grease (LOGPMGRS).</p>	R
Getting maintenance log (bearing) data	LOGPMBRG	Character string 6	<p>Gets maintenance log (bearing) data.</p> <p>* The meaning of data is the same as that of the grease (LOGPMGRS).</p>	R
Getting maintenance log (ball screw/ball spline) data	LOGPMBSS	Character string 6	<p>Gets maintenance log (ball screw/ball spline) data.</p> <p>* The meaning of data is the same as that of the grease (LOGPMGRS).</p>	R

Parameter	Parameter name	Number of elements	Details explanation	Attribute *1)
Getting maintenance log (overhaul) data	LOGPMOH	Character string 6	<p>Gets maintenance log (overhaul) data. Element 5: Servo ON time [h] at reset (integer)</p> <p>* If a log number with which there is no recorded data or nonexistent joint axis number is specified, the output becomes as follows:</p> <p>Element 5: 0</p> <p>* If the preventive maintenance function is disabled, the output becomes as follows:</p> <p>Element 5: -1</p> <p>* The meaning of data is the same as that of the grease (LOGPMGRS).</p>	R

14. Dedicated input/output signals

This section describes dedicated input/output signals related to the preventive maintenance function.

To use those signals, from the Preventive Maintenance screen, click the [Setting] - [Signal] screen and assign a signal number to the respective parameter. ^(Note 1)

For the setting procedure for signal numbers, refer to "3. Startup and initial settings, 3.2.2 Setting signals".

For details on dedicated input/output signals, refer to the separate volume, "CR800 Series Controller INSTRUCTION MANUAL Detailed explanations of functions and operations".

Note 1) Set the signal numbers according to the system to be used. The range of values that can be set in the parameters are 0 to 255, 2000 to 5071, 6000 to 8047, and 10000 to 18191.

14.1 Consumption degree calculation function

It is possible to check the status with dedicated output signals in case the remaining time up to the recommended replacement/maintenance time of each part or the remaining time up to the specified overhaul time exceeded the warning occurrence detection level specified by the "PMWNGDAY" parameter. Also, you can reset the consumption degree [%] of the preventive maintenance function using a dedicated input signal.



Caution

- If the preventive maintenance function is disabled, the output is always OFF.
- For parts for each joint axis, if even one of the axes exceeds the warning occurrence detection level, the signal becomes ON.
- In case of maintenance part (grease, timing belt), the signal is output only when the PMRPTMNT parameter's Element 2 is ON (output), and if the preventive maintenance function is disabled, the signal is always OFF.
- In case of an overhaul part (reduction gear, bearing, ball screw, ball spline) and servo ON time, the signal is output only when the PMRPTOH parameter's Element 2 is ON (output), and if the preventive maintenance function is disabled, the signal is always OFF.

<Dedicated warning output>

Parameter name	Category	Function	Signal level	Signal number at factory default	
				CR800-R/Q	CR800-D
PMSIGMNT	Input	—	—	-1 (No meaning),	-1 (No meaning),
	Output	Maintenance warning of preventive maintenance (maintenance part) Outputs the effect that the remaining time (remaining recommended maintenance time) of the mechanism total (maintenance parts) exceeded the warning occurrence detection level.	—	-1	-1
PMSIGOH	Input	—	—	-1 (No meaning),	-1 (No meaning),
	Output	Maintenance warning of preventive maintenance (overhaul part) Outputs the effect that the remaining time (remaining recommended maintenance time) of the mechanism total (overhaul parts) exceeded the warning occurrence detection level.	—	-1	-1

Parameter name	Category	Function	Signal level	Signal number at factory default	
				CR800-R/Q	CR800-D
PMSIGGRS	Input	–	–	-1 (No meaning),	-1 (No meaning),
	Output	Maintenance warning of preventive maintenance (grease) Outputs the effect that the remaining time (remaining recommended maintenance time) of the grease exceeded the warning occurrence detection level.	–	-1	-1
PMSIGBLT	Input	–	–	-1 (No meaning),	-1 (No meaning),
	Output	Maintenance warning of preventive maintenance (timing belt) Outputs the effect that the remaining time (remaining recommended maintenance time) of the timing belt exceeded the warning occurrence detection level.	–	-1	-1
PMSIGDEC	Input	–	–	-1 (No meaning),	-1 (No meaning),
	Output	Maintenance warning of preventive maintenance (decelerator) Outputs the effect that the remaining time (remaining recommended maintenance time) of the reduction gear exceeded the warning occurrence detection level.	–	-1	-1
PMSIGBRG	Input	–	–	-1 (No meaning),	-1 (No meaning),
	Output	Maintenance warning of preventive maintenance (bearing) Outputs the effect that the remaining time (remaining recommended maintenance time) of the bearing exceeded the warning occurrence detection level.	–	-1	-1
PMSIGBSS	Input	–	–	-1 (No meaning),	-1 (No meaning),
	Output	Maintenance warning of preventive maintenance (ball screw/ball spline) Outputs the effect that the remaining time (remaining recommended maintenance time) of the ball screw/ball spline exceeded the warning occurrence detection level.	–	-1	-1
PMSIGSRV	Input	–	–	-1 (No meaning),	-1 (No meaning),
	Output	Maintenance warning of preventive maintenance (servo on time) Outputs that the servo ON time reached the overhaul implementation time.	–	-1	-1

<Consumption degree reset>

Parameter name	Category	Function	Signal level	Signal number at factory default	
				CR800-R/Q	CR800-D
PMRSTGRS	Input	Consumption degree reset of preventive maintenance (grease) Resets the grease consumption degree information. * The reset target axis is specified in IODATA or DIODATA using the axis bit pattern.	–	-1,	-1,
	Output	Outputs the reset completion.	–	-1	-1
PMRSTBLT	Input	Consumption degree reset of preventive maintenance (timing belt) Resets the timing belt consumption degree information. * The reset target axis is specified in IODATA or DIODATA using the axis bit pattern.	–	-1,	-1,
	Output	Outputs the reset completion.	–	-1	-1
PMRSTDEC	Input	Consumption degree reset of preventive maintenance (decelerator) Resets the reduction gear consumption degree information. * The reset target axis is specified in IODATA or DIODATA using the axis bit pattern.	–	-1,	-1,
	Output	Outputs the reset completion.	–	-1	-1
PMRSTBRG	Input	Consumption degree reset of preventive maintenance (bearing) Resets the bearing consumption degree information. * The reset target axis is specified in IODATA or DIODATA using the axis bit pattern.	–	-1,	-1,
	Output	Outputs the reset completion.	–	-1	-1
PMRSTBSS	Input	Consumption degree reset of preventive maintenance (ball screw/ball spline) Resets the ball screw/ball spline consumption degree information. * The reset target axis is specified in IODATA or DIODATA using the axis bit pattern.	–	-1,	-1,
	Output	Outputs the reset completion.	–	-1	-1
PMRSTOH	Input	Consumption degree reset of preventive maintenance (overhaul) Resets the consumption degree information and operating information (integration time/accumulation count) of all parts. * The reset target axis is all axes.	–	-1,	-1,
	Output	Outputs the reset completion.	–	-1	-1
PMRSTNEW	Input	Consumption degree reset of preventive maintenance (replace to new robot) Resets the consumption degree information and operating information (integration time/accumulation count) of all parts. * The reset target axis is all axes.	–	-1,	-1,
	Output	Outputs the reset completion.	–	-1	-1

<Pausing warning occurrence/signal output>

Parameter name	Category	Function	Signal level	Signal number at factory default	
				CR800-R/Q	CR800-D
PMSTPGRS	Input	Pause of warning and warning signal output (grease) * The pause target axis is specified in IODATA or DIODATA using the axis bit pattern. Pause of unspecified axes is canceled.	–	-1,	-1,
	Output	Outputs the completion of pause specification change.	–	-1	-1
PMSTPBLT	Input	Pause of warning and warning signal output (timing belt) * The pause target axis is specified in IODATA or DIODATA using the axis bit pattern. Pause of unspecified axes is canceled.	–	-1,	-1,
	Output	Outputs the completion of pause specification change.	–	-1	-1
PMSTPDEC	Input	Pause of warning and warning signal output (decelerator) * The pause target axis is specified in IODATA or DIODATA using the axis bit pattern. Pause of unspecified axes is canceled.	–	-1,	-1,
	Output	Outputs the completion of pause specification change.	–	-1	-1
PMSTPBRG	Input	Pause of warning and warning signal output (bearing) * The pause target axis is specified in IODATA or DIODATA using the axis bit pattern. Pause of unspecified axes is canceled.	–	-1,	-1,
	Output	Outputs the completion of pause specification change.	–	-1	-1
PMSTPBSS	Input	Pause of warning and warning signal output (ball screw/ball spline) * The pause target axis is specified in IODATA or DIODATA using the axis bit pattern. Pause of unspecified axes is canceled.	–	-1,	-1,
	Output	Outputs the completion of pause specification change.	–	-1	-1
PMSTPSRV	Input	Pause of warning and warning signal output (servo on time) * Enable/disable of pause is specified by bit0 of IODATA or DIODATA.	–	-1,	-1,
	Output	Outputs the completion of pause specification change.	–	-1	-1

15. Troubleshooting

15.1 Error number list

This section describes the cause and countermeasure to take for the error numbers when errors related to the preventive maintenance function occurs. In event of an error, refer to this chapter and take appropriate action.

For other error numbers described in this chapter, refer to the separate volume, "Troubleshooting in CR800 Series Controller Instruction Manual".

When an error occurs, the ERROR LED in front of the robot controller lights up or flashes.

ERROR LED status	Description
On	Low-level error, or warning occurred.
Flashing	High-level error occurred.
Off	Normal operation.

The meaning of the error numbers is explained below.

□ 0000 *

- Errors marked with an * are those required for power reset.
Take action according to the countermeasures given.
- The error type is indicated by a four-digit number.
- There are 3 types of errors.
H: High-level error.....Servo turns off.
L: Low-level error.....Operation stops.
C: Warning.....Operation continues.

- "n" indicated in the last one digit of the error number is the robot axis number.
Example) Motor overcurrent error of H0931J1 axis.

15.1.1 Common to preventive maintenance functions

Functions such as consumption degree calculation of the preventive maintenance function assume that the same controller and the same mechanism are used.

When the serial number of the connected robot was changed, the error (H.7100) is output to notify that effect upon power ON in order to prevent reliability of the preventive maintenance function from decreasing after exchanging the robot or robot controller.

Also, in order to prevent writing backup data to a different robot, the error (H.7101) occurs when attempting restoration if the serial number of the robot body is different from the backup data value, and restoration cannot be performed.

Also, in case the backed up data format has been changed as a result of version upgrade of the robot controller and it is attempted to write the old format data, error H.7102 is output to notify that effect.

Error number		Causes of the error and its countermeasures	
Upper four digits	Lower five digits		
H.7100	00000	Error message	Robot arm serial number mismatch
		Cause	Robot arm that connection was replaced
		Measures	Execute restoration of preventive maintenance data, or reset
H.7101	00000	Error message	Backup serial number mismatch
		Cause	Robot arm and backup data are the different serial number
		Measures	Please use the backup data matching robot arm
H.7102	00n00 (n is the mechanism number)	Error message	Backup file version is different
		Cause	Preventive maintenance function backup file version mismatch
		Measures	Please select the backup file of the corresponding version

15.1.2 Consumption degree calculation function

In case the remaining time up to the recommended replacement/maintenance time of each part or the remaining time up to the specified overhaul time exceeded the remaining time of warning occurrence specified by the "PMWNGDAY" parameter, or the setting of the dedicated output signal is incorrect, the following warnings will occur.

However, warning occurrence is limited to those permitted by the "PMRPTMNT" parameter for maintenance parts (grease, timing belt) and to those permitted by the "PMRPTOH" parameter for overhaul parts (reduction gear, bearing, ball screw, ball splicer).

* For details of countermeasures when error number C.7110, C.712n, C.713n, C.714n, C.715n, or C.716n occurs, refer to "9 When consumption occurred".

Error number		Causes of the error and its countermeasures	
Upper four digits	Lower five digits		
C.7110	00X00 X = Mechanism number	Error message	Overhaul period (servo on time)
		Cause	The servo on time has entered the overhaul recommendation period
		Measures	Execution of an overhaul of a robot arm is recommended
C.712n (n indicates the axis numbers (1 to 6).)	00X00 X = Mechanism number	Error message	Grease replenishment period
		Cause	Grease consumption degree exceeded the warning level
		Measures	Please replenish grease and reset consumption degree
C.713n (n indicates the axis numbers (1 to 6).)	00X00 X = Mechanism number	Error message	Timing belt replacement period
		Cause	Timing belt consumption degree exceeded the warning level
		Measures	Please replace timing belt and reset consumption degree
C.714n (n indicates the axis numbers (1 to 6).)	00X00 X = Mechanism number	Error message	Overhaul period (decelerator)
		Cause	Decelerator consumption degree exceeded the warning level
		Measures	Execution of an overhaul of a robot arm is recommended
C.715n (n indicates the axis numbers (1 to 6).)	00X00 X = Mechanism number	Error message	Overhaul period (bearing)
		Cause	Bearing consumption degree exceeded the warning level
		Measures	Execution of an overhaul of a robot arm is recommended
C.716n (n indicates the axis numbers (1 to 6).)	00X00 X = Mechanism number	Error message	Overhaul period (ball screw)
		Cause	Ball screw consumption degree exceeded the warning level
		Measures	Execution of an overhaul of a robot arm is recommended
H.6640	99000	Error message	Illegal parameter (PMSIGMNT)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter
		Error message	Illegal parameter (PMSIGOH)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter

Error number		Causes of the error and its countermeasures	
Upper four digits	Lower five digits		
H.6640	99000	Error message	Illegal parameter (PMSIGGRS)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter
		Error message	Illegal parameter (PMSIGBLT)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter
		Error message	Illegal parameter (PMSIGDEC)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter
		Error message	Illegal parameter (PMSIGBRG)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter
		Error message	Illegal parameter (PMSIGBSS)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter
		Error message	Illegal parameter (PMSIGSRV)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter
		Error message	Illegal parameter (PMRSTGRS)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter
		Error message	Illegal parameter (PMRSTBLT)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter
		Error message	Illegal parameter (PMRSTDEC)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter
		Error message	Illegal parameter (PMRSTBRG)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter
		Error message	Illegal parameter (PMRSTBSS)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter
		Error message	Illegal parameter (PMRSTOH)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter

Error number		Causes of the error and its countermeasures	
Upper four digits	Lower five digits		
H.6640	99000	Error message	Illegal parameter (PMRSTNEW)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter
		Error message	Illegal parameter (PMSTPGRS)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter
		Error message	Illegal parameter (PMSTPBLT)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter
		Error message	Illegal parameter (PMSTPDEC)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter
		Error message	Illegal parameter (PMSTPBRG)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter
		Error message	Illegal parameter (PMSTPBSS)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter
		Error message	Illegal parameter (PMSTPSRV)
		Cause	The parameter setting is illegal
		Measures	Correct the parameter

15.1.3 MELFA Smart Plus card

Indicates the error number related to the MELFA Smart Plus card.

Error number	Error cause and measures	
L3780	Error message	Cannot use the MELFA Smart Plus.
	Cause	Invalid MELFA Smart Plus.
	Measures	Check the MELFA Smart Plus card or parameter.
L3781	Error message	Cannot use the MELFA Smart Plus.
	Cause	Invalid MELFA Smart Plus.
	Measures	Check the MELFA Smart Plus card or parameter.
L3782	Error message	There're MELFA Smart Plus Cards.
	Cause	Multiple MELFA Smart Plus cards are installed.
	Measures	Turn off controller and pull unnecessary MELFA Smart Plus card.

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