





Mitsubishi Industrial Robot

**CR750-D/CR751-D series controller
CRnD-700 series controller**

GOT Direct Connection Extended Function Instruction 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** Make sure that the workpiece weight, including the hand, does not exceed the rated load or tolerable torque. Exceeding these values could lead to alarms or faults.
- ⚠ 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 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.

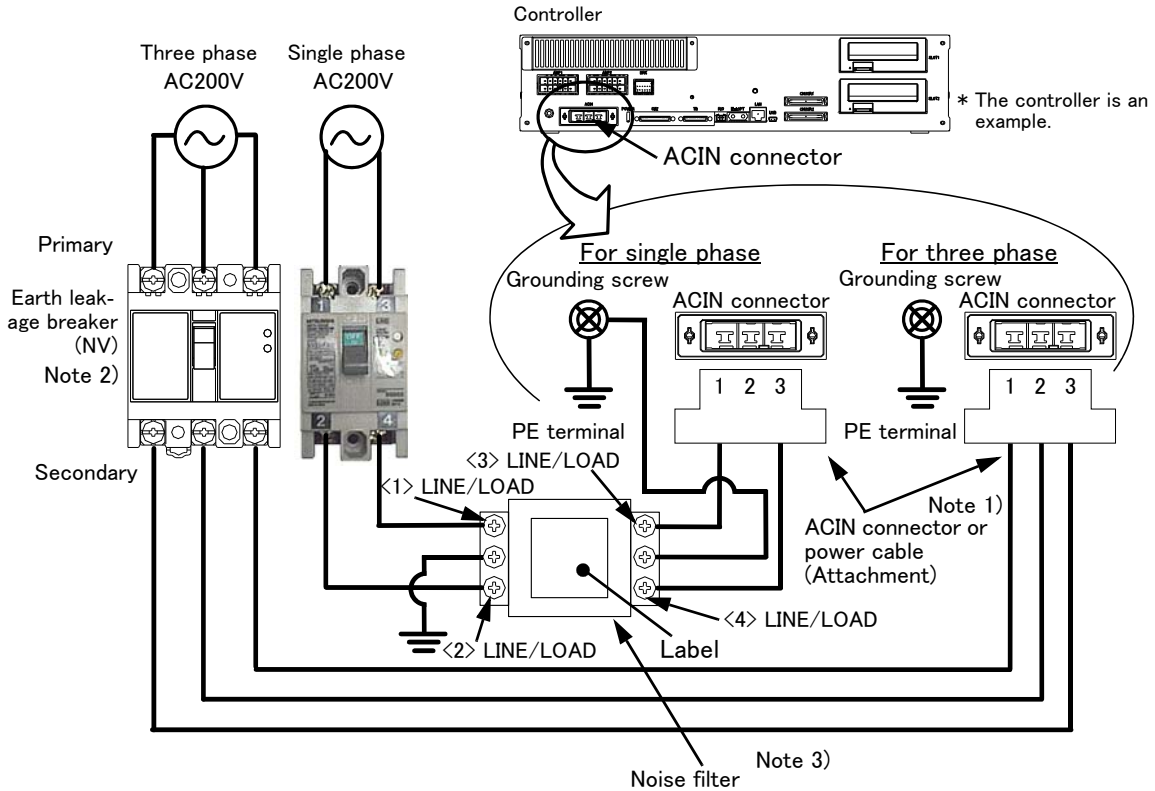
*CR751-D or CR751-Q controller

Notes of the basic component are shown.



CAUTION

Please install the earth leakage breaker in the primary side supply power supply of the controller of CR751-D or CR751-Q because of leakage protection.



Note 1) Crimping swage is recommended for connecting the attachment ACIN connector (soldering is also possible)
Recommendation compression tools: 234171-1(Tyco Electronics)

Note 2) The earth leakage breaker is the customer preparation. Always use the cover below.

Recommendation: For single primary power supply NV30FAU-2P-10A-AC100-240V-30mA, (Cover: TCS-05FA2)

For three primary power supply NV30FAU-3P-10A-AC100-240V-30mA, (Cover: TCS-05FA3)

Note 3) If necessary, as shown in the figure, connects the noise filter between ACIN terminal blocks and primary power supply.
(Recommended noise filter: SUP-EL20-ER6 *OKAYA ELECTRIC INDUSTRIES)

- 1) Please prepare the following: Leakage current breaker (with the terminal cover), cable for connecting the primary power supply (AWG #14 (2mm² or above), cables to ground the primary power supply (AWG #12 (3.5mm² or above).
The secondary power cable (with the ACIN connector) for single phase or three phase power is supplied with the product to match the specifications. When you build a cable suitable for your environment using the ACIN connector and the ACIN terminal supplied, prepare a secondary power cable (AWG #14 (2mm² or above).
- 2) Confirm that the primary power matches the specifications.
- 3) Confirm that the primary power is OFF and that the earth leakage breaker power switch is OFF.
- 4) Connect the secondary power cable.
 - a) When using the supplied power cable with the ACIN connector
Refer to the figure above and connect the cable from the secondary side of the earth leakage breaker.
 - b) When building a power cable using the ACIN connector and the ACIN terminals supplied
Connect the ACIN terminals with the secondary power cable (prepared by customers), and insert the ACIN terminals to the ACIN connector pins with the following numbers. Crimping caulking is recommended to connect the ACIN terminals.
For single phase: 1 and 3
For three phase: 1, 2, and 3
Refer to the figure above and connect the cable from the secondary side of the earth leakage breaker.
- 5) Connect this ACIN connector to the ACIN connector on the front of the controller.
- 6) Connect the grounding cable to the PE terminal. (M4 screw)
- 7) Connect the primary power cable to the primary side terminal of the earth leakage breaker.

Revision history

| Date of print | Specifications No. | Details of revisions |
|---------------|--------------------|---|
| 2011-07-01 | BFP-A8849 | • First edition created |
| 2012-03-07 | BFP-A8849-A | • CR750-D/CR751-D series controller were added. |
| 2012-12-05 | BFP-A8849-B | • The statement about trademark registration was added. |
| 2014-08-06 | BFP-A8849-C | • The cover and corporate logo mark of this manual was changed. • The statement about trademark registration was modified. |
| 2014-12-11 | BFP-A8849-D | • The corporate logo mark of illustrations in this manual was changed. |
| 2015-03-10 | BFP-A8849-E | • The new function of software version S3p was added. Long-precision integer number and single-precision real number can be used for reading/writing of numeric value variables. |
| | | |

*Introduction

Thank you for buying the industrial robot MELFA manufactured by Mitsubishi Electric. This manual explains the expanded function and operation when connecting the robot controller and the GOT directly in SD series robot controller (CR750-D/CR751-D series, CRnD-700 series). Monitoring of the robot information and the setup of the data are possible through the shared memory.

Please carefully read and fully understand this document before making use of the extended functions.

Target controller of this document

This document supports the robot controller below:

- CR750-D/CR751-D series controller: ... Ver. S3 or later
- CRnD-700 series controller: Ver. S2g or later
Robot language MELFA BASIC V or later

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Contents

| | Page |
|--|------|
| 1 Overview | 1-1 |
| 1.1 Function List | 1-1 |
| 1.2 Features | 1-2 |
| 1.3 Shared Memory Configuration | 1-3 |
| 1.3.1 Memory Configuration for Valid/Invalid Extended Function | 1-3 |
| 1.3.2 Memory Map of Extended Function Area | 1-4 |
| 2 Preparation for Using Extended Function | 2-5 |
| 2.1 Operation flow | 2-5 |
| 2.1.1 Set up Parameter for Selecting Shared Memory Extended Function | 2-5 |
| 2.1.2 Check Robot Language Setting | 2-6 |
| 3 Monitor Robot Information | 3-7 |
| 3.1 Operation Flow | 3-8 |
| 3.1.1 Select Monitoring Items | 3-9 |
| 3.1.2 Select Target Mecha | 3-9 |
| 3.1.3 Timing Chart | 3-10 |
| 3.2 Monitoring Item | 3-11 |
| 3.2.1 Monitor Operation Control Setting Values | 3-11 |
| 3.2.2 Monitor Activities | 3-13 |
| 3.2.3 Monitor Current and Aimed Positions | 3-14 |
| 3.2.4 Monitor Position and Joint Information | 3-16 |
| (1) Select Position and Joint Data | 3-16 |
| (2) Position and Joint Data | 3-18 |
| 3.2.5 Monitor Maintenance Information | 3-21 |
| 4 Reads/Writes Robot's Variables | 4-22 |
| 4.1 Function Description | 4-22 |
| 4.2 Operation Flow | 4-22 |
| 4.3 How to Operate Variables | 4-23 |
| 4.3.1 Data List | 4-23 |
| (1) GOT output data | 4-23 |
| (2) Robot output data | 4-24 |
| (3) Completion status | 4-25 |
| (4) Data description | 4-25 |
| 4.3.2 Timing Chart | 4-27 |
| 5 Read Current Line of Robot Program | 5-28 |
| 5.1 Function Description | 5-28 |
| 5.2 Operation flow | 5-28 |
| 5.3 How to Operate Program | 5-29 |
| 5.3.1 Data List | 5-29 |
| 5.3.2 Timing Chart | 5-33 |
| 6 Set up Robot's Maintenance | 6-34 |
| 6.1 Function Description | 6-34 |
| 6.2 Operation flow | 6-34 |
| 6.3 How to Operate Maintenance | 6-35 |
| 6.3.1 Data List | 6-35 |
| 6.3.2 Timing Chart | 6-37 |
| 7 Read Robot Information | 7-38 |
| 7.1 Function Description | 7-38 |
| 7.2 Operation flow | 7-38 |
| 7.3 How to Operate Robot Information | 7-39 |

Contents

| | Page |
|---|------|
| 7.3.1 Data List | 7-39 |
| 7.3.2 Timing Chart | 7-42 |
| 8 Function Relevant Parameter | 8-43 |
| 8.1 Function Definition Parameter | 8-43 |
| 9 Extended Function Relevant Error List | 9-44 |

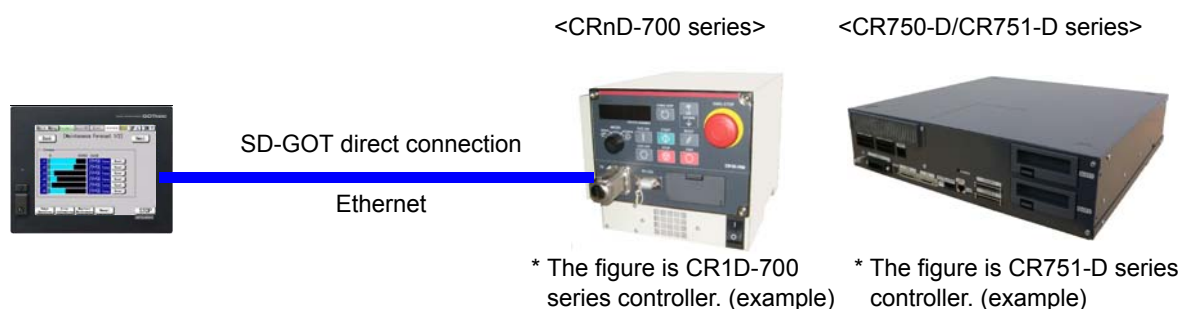
1 Overview

This manual explains the expanded function and operation when connecting the robot controller and the GOT directly in CR750-D/CR751-D series and CRnD-700 series robot controller.

Monitoring of the robot information and the setup of the data are possible through the shared memory. (The shared memory is extended.)

Note: These shared memory extended functions only support MELFA-BASIC V or later. They do not support MELFA-BASIC IV.

(For more information, refer to [Page 6, "2.1.2 Check Robot Language Setting"](#))



1.1 Function List

These shared memory extended functions are largely classified into monitoring and operation functions. Monitoring function periodically updates and outputs the data in shared memory on the robot. Operation function outputs a request from the GOT to the robot as needed and exchanges the data.

| No | Item | Description | I/F btwn Robots | Update Cycle |
|----|---------------------|--|---|--|
| 1 | Monitoring function | Monitor operation control setting values | Motoring output (Robot side periodically updates the data in shared memory) | 7.1msec |
| 2 | | Monitor activities | | 7.1msec |
| 3 | | Monitor current and aimed positions | | 7.1msec |
| 4 | | Monitor general position and joint information | | It may differ according to each item. Refer to Page 16, "3.2.4 Monitor Position and Joint Information" . |
| 5 | | Monitor maintenance information | | Depending on the parameter MFINTVL |
| 6 | Operation function | Read/write variables | Request reply method (The robot side answers by the output request of the GOT, and delivers the data on the shared memory) | Responds within 1s (It may vary according to the load status of robot control) |
| 7 | | Read program's current line | | |
| 8 | | Set up maintenance | | |
| 9 | | Read error information | | |
| 10 | | Read product information | | |

1.2 Features

(1) Fulfilling functions to monitor and operate robot from GOT. Advances T/B and PC-less solution.

→ Various functions can be performed by reading/ writing the data in shared memory from GOT.

- Allows you to check activities, position information, and setting values of operation control command and thereby analyze the operation in case of debugging or problem. (Monitoring current and aimed positions, activities, and operation control setting values)
- Allows you to read and write the contents of program and variables and thereby change the robot's operation in case of debugging or problem.
- Allows you to check and set up maintenance status.
- Allows you to check error's detailed content. (Reading error information)
- Allows you to display and check various information in the robot (product, servo information, etc.)

1.3 Shared Memory Configuration

Here, describes the shared memory configuration among the GOT.

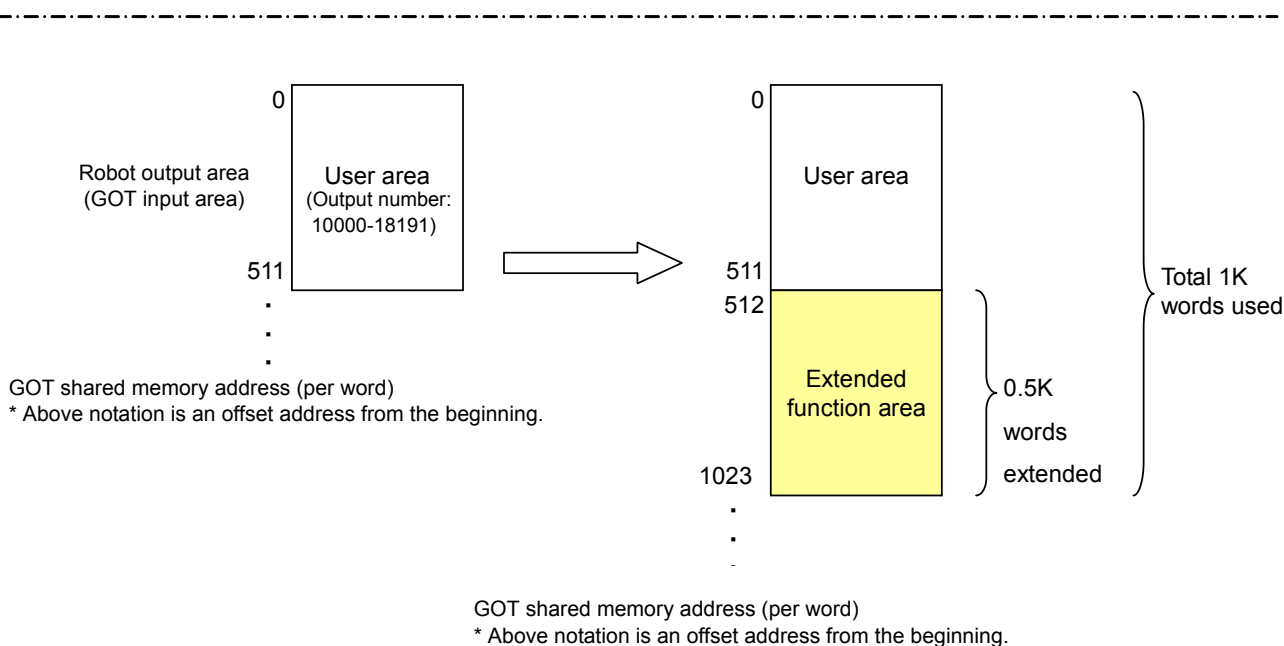
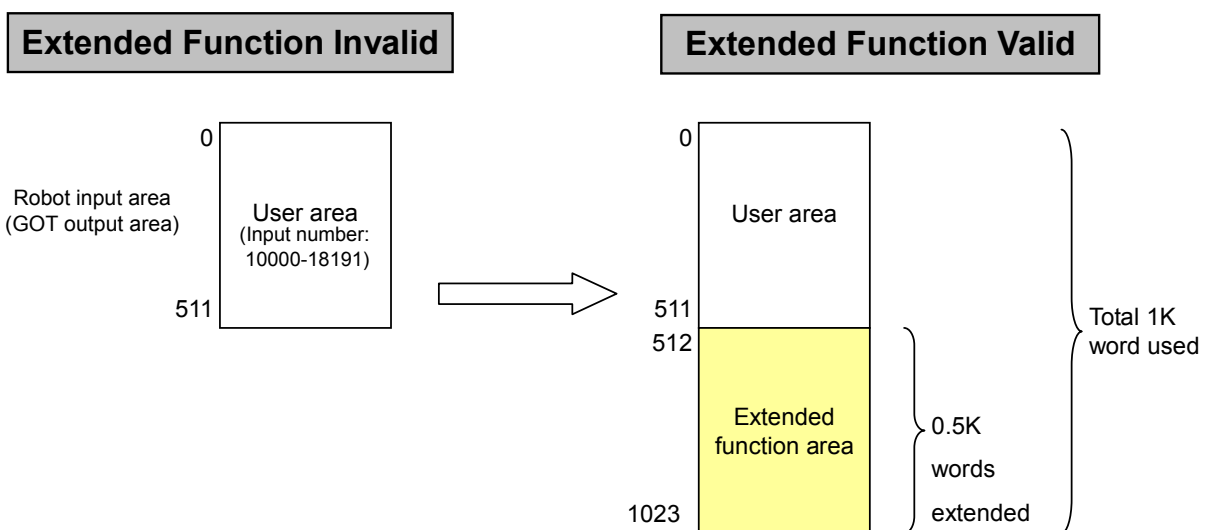
1.3.1 Memory Configuration for Valid/Invalid Extended Function

To use the shared memory extended functions, enable the shared memory extended functions with the parameter "IQMEM".

After enabling the shared memory extended functions, the shared memory is used by extending the robot I/O area by 0.5 K word.

[Supplement]

In this manual, the shared memory address is written by offset. The top address outputted to the robot from the GOT is "U3E0\G10000", and this data is the robot's input signal 10000. And the data of the robot's output signal 10000 can be read by input top address "U3E1\G10000" of the GOT.



Note) Only the user area can be referred to by robot program, signal monitor, and dedicated I/O signal allocation. They cannot refer to the extended function area.

1.3.2 Memory Map of Extended Function Area

The table below lists the memory map of extended function area in the shared memory among the GOT.

* The GOT address is described in the offset address from start address.

* When not otherwise specified, the values are stored in binary format.

(1) Robot input (GOT output) area

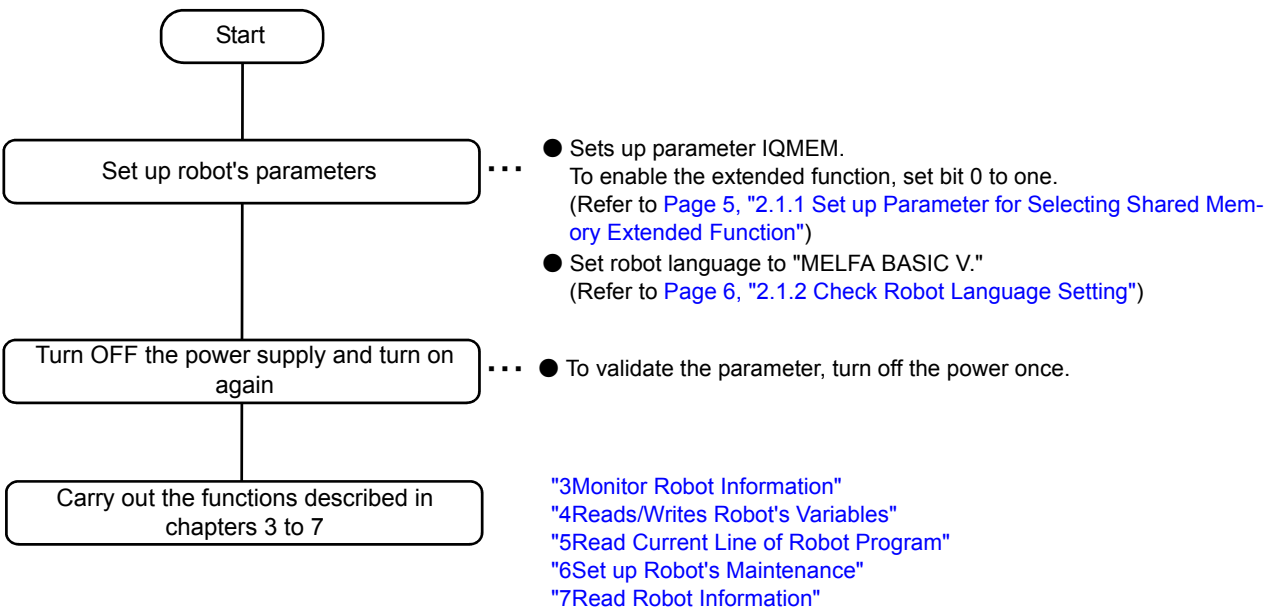
| Shared Memory Addr GOT Addr | Description |
|--------------------------------|---|
| 512 | Common setting area of extended function (Reserved: Future extended area) |
| 600 | |
| 700 | Common area of operation function Reading/ writing/ teaching area of variables Reading area of program's current line |
| 800 | Reset area of servo monitor information Reading area of error and product information Common area of monitoring function Monitoring area of general position and joint information (Reserved: Future extended area) |
| 900 | |
| 1000 | |
| 1023 | |
| 1024 | |

(2) Robot output (GOT input) area

| Shared Memory Addr GOT Addr | Description |
|--------------------------------|---|
| 512 | Common setting area of extended function (Reserved: Future extended area) |
| | Common area of operation function Read/write variables |
| | Reading area of program's current line |
| 600 | |
| | Reset area of servo monitor information Reading area of information |
| 700 | |
| | Common area of monitoring function Monitoring area of operation control setting values |
| 800 | |
| | Monitoring area of activities Monitoring area of current and aimed positions |
| 900 | |
| | Monitoring area of general position and joint information |
| | Monitoring area of maintenance information |
| 1000 | |
| | (Reserved) |
| 1023 | |
| 1024 | |

2 Preparation for Using Extended Function

2.1 Operation flow



2.1.1 Set up Parameter for Selecting Shared Memory Extended Function

The parameter "IQMEM" for selecting the shared memory extended function is 16bit data. Set the bit 0 to one to use the extended functions.
For information on how to set up a parameter, refer to Supplement volume "Instruction Manual, Detailed Description of Functions and Operations."

| Parameter | Parameter Name | Array Qty Character Qty | Description | Factory Default |
|--|----------------|----------------------------|---|------------------|
| Select shared memory extended function | IQMEM | 1 digit integer | Set validity (1)/ invalidity (0) for the function. Sets each bit by allocating a function to each bit. 0000000000000000 bit1-15: Not used +- bit0: Use the shared memory extended function | 0000000000000000 |

2.1.2 Check Robot Language Setting

The shared memory extended functions can be carried out only when the robot language is set to MELFA-BASIC V.

Check the value of robot language setting parameter "RLNG".

To use the shared memory extended function, set the parameter "RLNG" to 2.

For information on how to set up a parameter, refer to Supplement volume "Instruction Manual, Detailed Description of Functions and Operations."

| Parameter | Parameter Name | Array Qty Character Qty | Description | Factory Default |
|----------------|----------------|----------------------------|--|-----------------|
| Robot language | RLNG | 1 digit integer | Select the robot language to be used: 2: MELFA-BASIC V 1: MELFA-BASIC IV | 2 |

The robot controller's factory default is MELFA-BASIC V. But, when you have selected MELFA-BASIC IV, an error "L3994" occurs on controller startup.



CAUTION

When the robot language setting is changed from MELFA-BASIC V to MELFA-BASIC IV, the extended variable area is cleared. Consequently, be aware that the teaching and setting data for shared memory extended function will disappear.

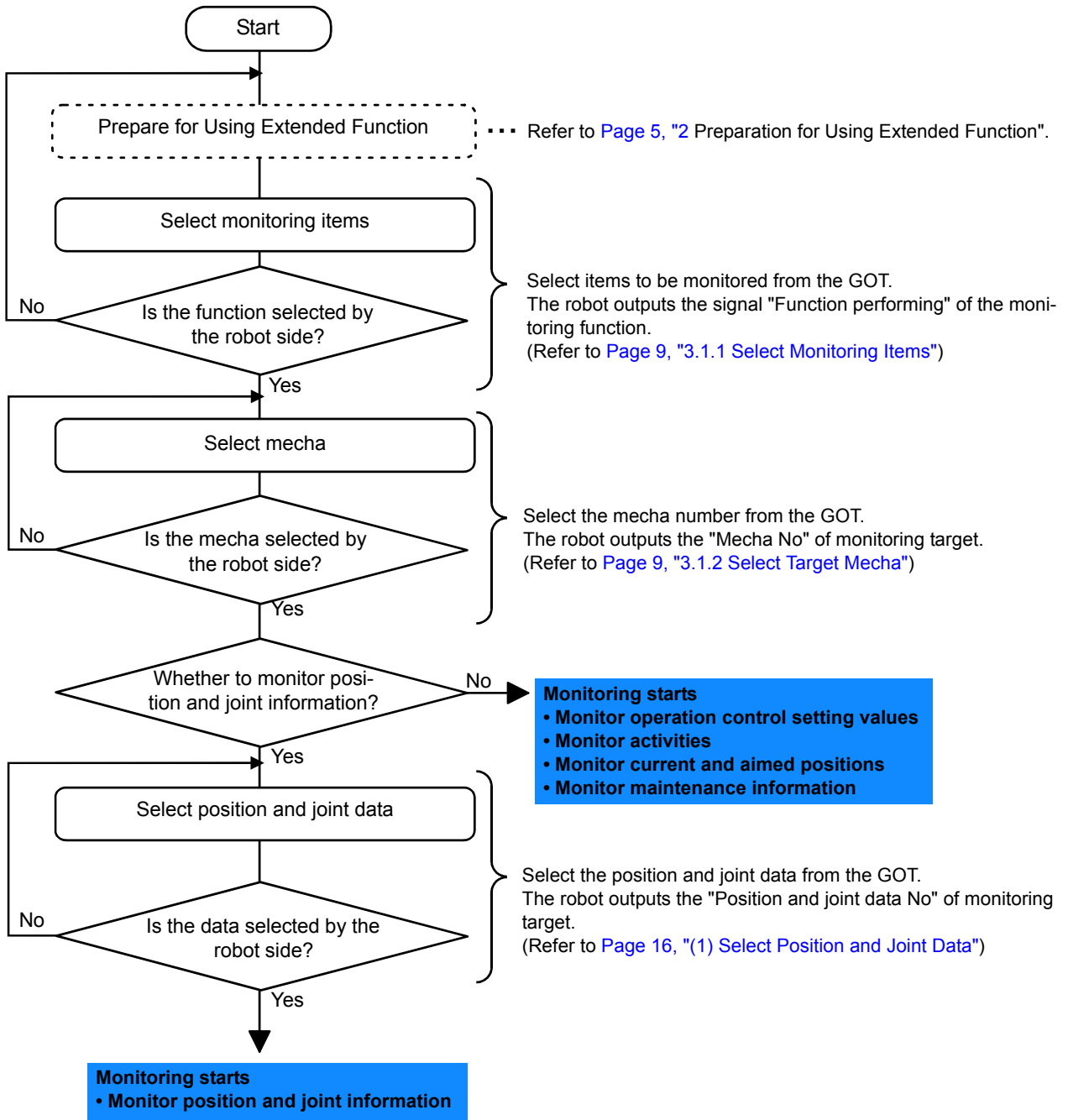
3 Monitor Robot Information

The [Table 3-1](#) lists the robot information monitored from GOT.

Table 3-1:Monitoring item list

| No | Item | Description | I/F betw Robots | Update Cycle | Mecha No Setting | Section No |
|----|--|---|--|------------------------------------|------------------|------------|
| 1 | Monitor operation control setting values | Monitors the setting values relating to operation control command and operation control | Monitoring output (Robot side periodically updates the data in shared memory) | 7.1msec | ○ (necessary) | "3.2.1" |
| 2 | Monitor activities | Monitors the robot's activities (current speed, arrival factor to the aimed position, etc.) | | 7.1msec | ○ | "3.2.2" |
| 3 | Monitor current and aimed positions | Monitors current and aimed positions of robot | | 7.1msec | ○ | "3.2.3" |
| 4 | Monitor position and joint information | Monitors various position type data (orientation at collision, etc.) and joint type data (current value, load factor, etc.) | | Differ according to items | ○ | "3.2.4" |
| 5 | Monitor maintenance information | Monitors the maintenance information (battery and grease remaining times) | | Depending on the parameter MFINTVL | ○ | "3.2.5" |

3.1 Operation Flow



3.1.1 Select Monitoring Items

Here, selects the monitoring functions output by the robot from the GOT.

Only the data specified by items (set to "1") selected with each bit can be monitored. For more information on each monitoring data, refer to [Page 11, "3.2 Monitoring Item"](#) and after.

(1) GOT output data

a) Word data

| GOT Addr (offset) | Description | Remarks |
|-------------------|---|---------|
| 512 | Function selection [Allocated to each bit, 0: invalid, 1: valid] bit15 0 0000000000000000 +---bit0: (Reserved) +---bit1: (Reserved) +----bit2: Monitor operation control settings +----bit3: Monitor activities +-----bit4: Monitor current and aimed positions +-----bit5: Monitor position and joint information +-----bit6: Monitor maintenance information +-----bit7: (Reserved) | |

(2) Robot output data

a) Word data

| GOT Addr (offset) | Description | Remarks |
|-------------------|--|---------|
| 512 | Function performing [allocated to each bit, 0: invalid, 1: valid] bit15 0 0000000000000000 +---bit0: (Reserved) +---bit1: (Reserved) +----bit2: Monitor operation control settings +----bit3: Monitor activities +-----bit4: Monitor current and aimed positions +-----bit5: Monitor position and joint information +-----bit6: Monitor maintenance information +-----bit7: (Reserved) | |

3.1.2 Select Target Mecha

Here, selects the target mecha number of monitoring data output by the robot from the GOT.

The robot outputs the data with selected mecha number. The number (1 to 3) is selectable for mecha numbers. When the number other than 1 - 3 is specified, the data is initialized (zeros are put in the whole target area)

(1) GOT output data

a) Word data

| GOT Addr (offset) | Description | Remarks |
|-------------------|--------------------------------|---------|
| 841 | Specify a mecha number [1 - 3] | |

(2) Robot output data

a) Word data

| GOT Addr (offset) | Description | Remarks |
|-------------------|----------------------|---------|
| 731 | Mecha number [1 - 3] | |

3.1.3 Timing Chart

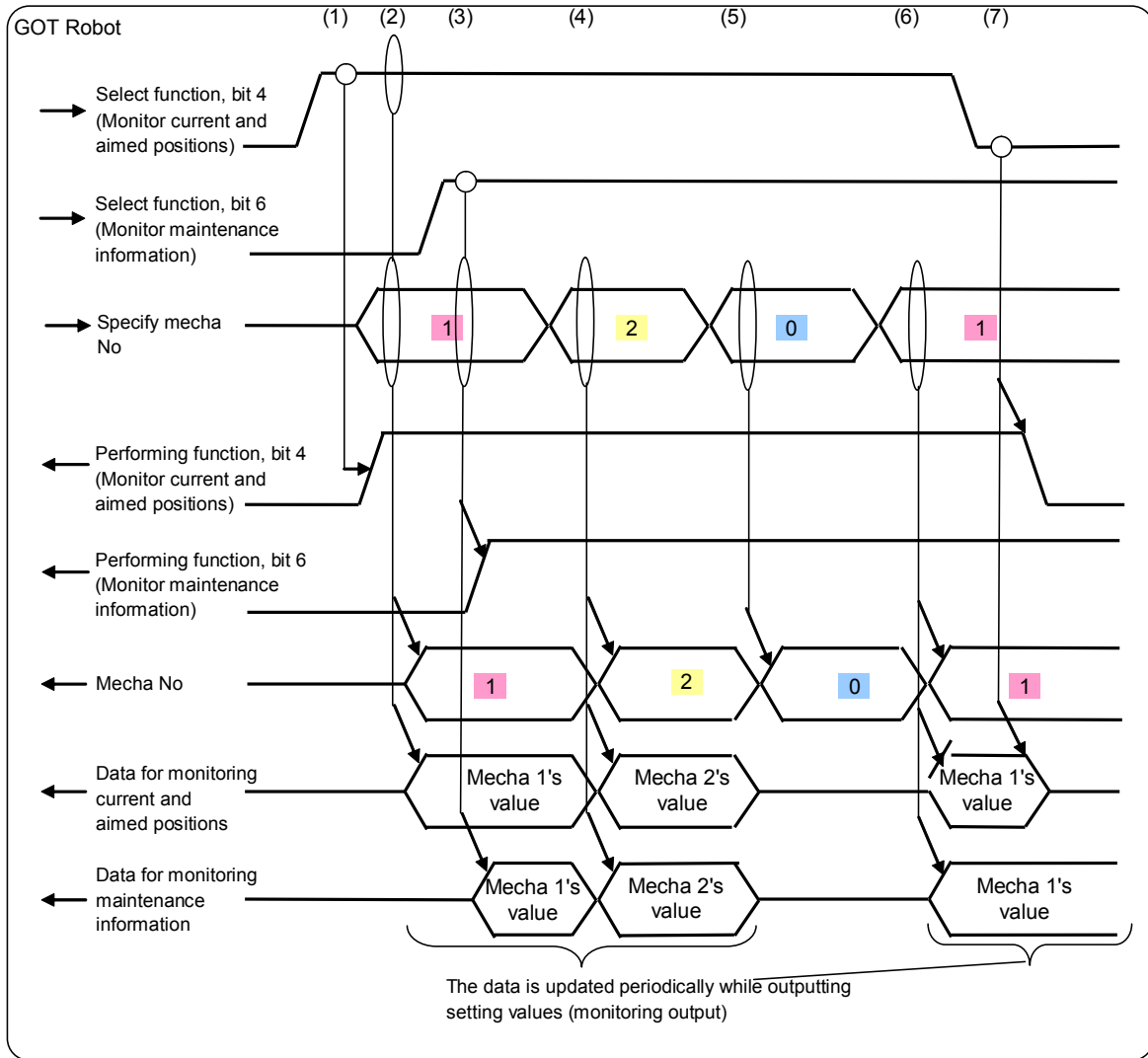


Fig.3-1:Timing chart for selecting monitoring items and target mecha

- (1) When the GOT sets the target bit of "Select function" to "ON", the robot sets the target bit of "Performing function" to "ON" to start the monitoring output of target item. Here, when "Specify mecha number" is other than 1 - 3, the robot waits to update the data.
- (2) When the GOT sets "Specify mecha number" to one, the robot starts to update mecha 1's data.
- (3) When the target bit of "Select function" is set to "ON" while the GOT sets "Specify mecha number", the robot starts to update the data of target item while at the same time the robot sets the target bit of "Performing function" to "ON".
- (4) When the GOT changes "Specify mecha number", the robot outputs the data of specified mecha.
- (5) When the GOT sets "Mecha number" to other than 1 - 3, the robot clears the output data.
- (6) When the GOT re-sets "Mecha number", the robot outputs the data of target mecha.
- (7) When the GOT sets the target bit of "Select function" to "OFF", the robot sets the target bit of "Performing function" to "OFF" to initialize the output data.

CAUTION

The synchronization of data in shared memory is guaranteed on a per 32bit (2 word) basis. But, the synchronization in the unit more than this bit cannot be guaranteed. Therefore, be aware that the position type and joint type data is guaranteed for each axis, the data is not guaranteed as a whole.

3.2 Monitoring Item

3.2.1 Monitor Operation Control Setting Values

Here, periodically outputs the robot's operation control commands and the setting values for operation control to the shared memory.

(1) Monitoring data list

| GOT Addr (Offset) | Description | Supported State Variable | Update Cycle |
|-------------------|---|--------------------------|--------------|
| 777 | ColChk setting value | | 7.1msec |
| 778 | ColLvl setting value | | |
| 779 | | | |
| 780 | | | |
| 781 | | | |
| 782 | | | |
| 783 | | | |
| 784 | | | |
| 785 | | | |
| 794 | CMP Pos/Tool/Jnt setting values | | |
| 795 | Compliance coordinate type [0: Invalid/ 1: Perpendicular/ 2: Tool/ 3: Joint] Specify a compliance coordinate type [Specify target axis with bit] [Setting values to specify compliance axis of CMP Pos/Tool/Jnt setting values] The values below are set by setting up bit: bit7 0 00000000 +---bit0:J1/X axis +---bit1:J2/Y axis +---bit2:J3/Z axis +----bit3:J4/A axis +-----bit4:J5/B axis +-----bit5:J6/C axis +-----bit6: (Reserved) +-----bit7: (Reserved) | | |
| 796 | CmpG setting value | | |
| 797 | | | |
| 798 | | | |
| 799 | | | |
| 800 | | | |
| 801 | | | |
| 802 | | | |
| 803 | | | |
| 804 | MvTune/Prec setting values | | |

<Precautions>

- When the target mecha does not exist, outputs the data zero.
- The value below is output as ColChk:
 - When multiple mechas are in use or when the element 1 of parameter COL is zero (collision detection unavailable),
 - zero is output
 - Otherwise (collision detection available):
 - When being in operation (including step feed, position jump operation),
 - the initial value is the value of element 2 of parameter COL, and then the output value is the value changed by ColChk command.
 - When not being in operation (including suspension and jog operation),
 - it is set to the value of element 3 of parameter COL.
- The value below is output as Collvl:
 - When multiple mechas are in use or when the element 1 of parameter COL is zero (collision detection unavailable) and being in operation,
 - the initial value is the value of parameter COLLVL, and then the output value is the value changed by Collvl command.
 - When not being in operation,
 - it is the value during automatic operation is held when being in suspension, and it is the value of parameter COLLVL when being stopped.
 - Otherwise (collision detection available),
 - When being in operation,
 - the initial value is the value of parameter COLLVL, and then the output value is the value changed by Collvl command.
 - When not being in operation,
 - it is the value of parameter COLLVLJG.
- CMP Pos/Tool/Jnt setting values are set to zero when mechas 2, 3 are selected during using multiple mechas.
(User mecha cannot use compliance)

3.2.2 Monitor Activities

Here, periodically outputs the robot's activities (current speed, arrival factor to the aimed position, etc.) to the shared memory.

(1) Monitoring data list

| GOT Addr (offset) | Description | Supported State Variable | Update Cycle |
|-------------------|---|--------------------------|--------------|
| 810 | Current instruction speed [10^{-4} mm/s] | M_RSpd | 7.1msec |
| 811 | | | |
| 812 | Current distance remained [10^{-4} mm] | M_RDst | |
| 813 | | | |
| 814 | Distance between instructed and feedback positions [10^{-4} mm] | M_Fbd | |
| 815 | | | |
| 816 | Arrival factor [%] to the current aimed position | M_Ratio | |
| 817 | Current acceleration and deceleration state [0: Stopped/ 1: Accelerated/ 2: Constant speed/ 3: Decelerated] | M_AclSts | |
| 818 | Collision detection [1: Collided/ 0: Otherwise] ^{Note1)} | M_ColSts | |
| 819 | Going over the limit during performing compliance [1: Almost go over the limit/ 0: Does not go over the limit] | M_CmpLmt | |
| 820 | Deviance amount between instructed and actual positions during performing compliance [10^{-4} mm] | M_CmpDst | |
| 821 | | | |

Note1) Robot state variable (M_ColSts) is "1" for about 7.1ms between collision detection and servo OFF. But, the data "1" is output to the shared memory for 1sec after the collision is detected.

<Precautions>

- When the target mecha does not exist, outputs the data zero.
- When the data is dependent on a slot and the slot does not exist which has the control of target mecha, outputs the data zero. The data dependent on a slot is as follows:
 - Current distance remained (M_RDst)
 - Arrival factor to the current aimed position (M_Ratio)
 - Current acceleration and deceleration state (M_ActSts)

3.2.3 Monitor Current and Aimed Positions

Here, periodically outputs robot's current and aimed positions to the shared memory.

(1) Monitoring data list

| GOT Addr (offset) | Description | Update Cycle | |
|-------------------|--|--------------|--|
| 830 | Current position (perpendicular) | 7.1msec | |
| 831 | | | X coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 832 | | | Y coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 833 | | | Z coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 834 | | | A coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 835 | | | B coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 836 | | | C coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 837 | | | L1 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 838 | | | L2 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 839 | | | Structure flag |
| 840 | | | Multi-turn data |
| 841 | | | X coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 842 | | | Y coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 843 | | | Z coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 844 | | | A coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 845 | | | B coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 846 | | | C coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 847 | L1 coordinate value [10^{-4} mm/ 10^{-4} deg] | | |
| 848 | L2 coordinate value [10^{-4} mm/ 10^{-4} deg] | | |
| 849 | Structure flag | | |
| 850 | Aimed position (perpendicular) | 7.1msec | |
| 851 | | | X coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 852 | | | Y coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 853 | | | Z coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 854 | | | A coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 855 | | | B coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 856 | | | C coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 857 | | | L1 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 858 | | | L2 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 859 | | | Structure flag |
| 860 | | | Multi-turn data |
| 861 | | | X coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 862 | | | Y coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 863 | | | Z coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 864 | | | A coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 865 | | | B coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 866 | | | C coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 867 | L1 coordinate value [10^{-4} mm/ 10^{-4} deg] | | |
| 868 | L2 coordinate value [10^{-4} mm/ 10^{-4} deg] | | |
| 869 | Structure flag | | |

| GOT Addr (offset) | Description | Update Cycle | |
|-------------------|---|--------------|---|
| 870 | Current position (joint) | | |
| 871 | | | J1 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 872 | | | J2 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 873 | | | J3 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 874 | | | J4 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 875 | | | J5 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 876 | | | J6 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 877 | | | J7 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 878 | | | J8 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 879 | | | J9 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 880 | | | J10 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 881 | | | J11 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 882 | | | J12 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 883 | | | J13 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 884 | J14 coordinate value [10^{-4} mm/ 10^{-4} deg] | | |
| 885 | J15 coordinate value [10^{-4} mm/ 10^{-4} deg] | | |
| 886 | Aimed position (joint) | | |
| 887 | | | J1 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 888 | | | J2 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 889 | | | J3 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 890 | | | J4 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 891 | | | J5 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 892 | | | J6 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 893 | | | J7 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 894 | | | J8 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 895 | | | J9 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 896 | | | J10 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 897 | | | J11 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 898 | | | J12 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 899 | | | J13 coordinate value [10^{-4} mm/ 10^{-4} deg] |
| 900 | J14 coordinate value [10^{-4} mm/ 10^{-4} deg] | | |
| 901 | J15 coordinate value [10^{-4} mm/ 10^{-4} deg] | | |

<Precautions>

- When the target mecha and axis do not exist, outputs the data zero.
- When the origin is not established, outputs zero for the both perpendicular and joint components of current position.

(2) Data description

[Perpendicular data]

- The unit is 10^{-4} mm or 10^{-4} deg.
- Only lower one word is used for the structure flag. Upper one word is a reserved area.

[Joint data]

- The unit is 10^{-4} mm or 10^{-4} deg.

3.2.4 Monitor Position and Joint Information

Here, periodically outputs the robot's various position type and joint type data to the shared memory. The GOT selects the data output by the robot. The area exists for one pieces of position type data and three pieces of joint type data and the data output for monitoring can be individually set by the GOT.

(1) Select Position and Joint Data

In the GOT, set up the number for position and joint data output by the robot. The robot outputs the monitoring data corresponding to the selected data number. The area exists for one pieces of position type data and three pieces of joint type data and the data can be individually set. When the GOT specifies the data with the number which is out of range, the robot sets all monitoring data to zero.

- (1) Data list
 - a) GOT output

| GOT Addr (offset) | Description |
|----------------------|---|
| 850 | Position data selection [1 - 4] 1: (Reserved) 2: (Reserved) 3: (Reserved) 4: Direction at the time of collision |
| 851 | Joint data selection-1 [1 - 13] 1: (Reserved) 2: (Reserved) 3: Difference between estimated and actual torques when detecting a collision 4: (Reserved) 5: Current instruction 6: Maximum current instruction 1 7: Maximum current instruction 2 8: Current feedback 9: Allowable current instruction, minus side 10: Allowable current instruction, plus side 11: Effective current 12: Axis load level 13: Maximum axis load level |
| 852 | Joint data selection-2 [1 - 13] For setting values, refer to 851 above. |
| 853 | Joint data selection-3 [1 - 13] For setting values, refer to 851 above. |

- b) Robot output

| GOT Addr (offset) | Description |
|----------------------|------------------------------|
| 906 | Position data number [1 - 4] |
| 907 | Joint data number-1 [1 - 13] |
| 908 | Joint data number-2 [1 - 13] |
| 909 | Joint data number-3 [1 - 13] |

(2) Timing chart

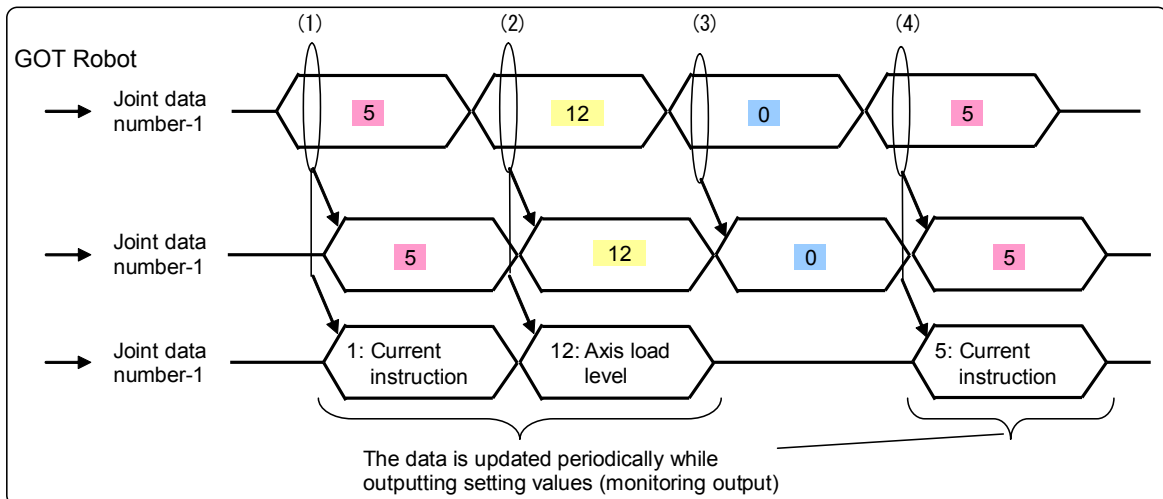


Fig.3-2:Joint data output, Timing chart

- (1) When the GOT selects "Joint data selection-1," the robot outputs the target data to "Joint data-1" area.
- (2) When the GOT changes "Joint data selection-1," the robot outputs the changed target data to "Joint data-1" area.
- (3) When the GOT selects the data out of valid range for "Joint data selection-1," the robot clears "Joint data-1" (set all components to zero) and outputs zero for "Joint number-1."
- (4) When the GOT reselects "Joint data selection-1", the robot outputs the target data to "Joint data-1" area.

* The same applies to Joint data-2, 3 and position data.

(2) Position and Joint Data

(1) Data list

b) Robot output

| GOT Addr (offset) | Description | |
|-------------------|---|---------------------|
| 910 | Position data [1 - 4] 1: (Reserved) 2: (Reserved) 3: (Reserved) 4: Direction at the time of collision | X coordinate value |
| 911 | | |
| 912 | | Y coordinate value |
| 913 | | |
| 914 | | Z coordinate value |
| 915 | | |
| 916 | | A coordinate value |
| 917 | | |
| 918 | | |
| 919 | | |
| 920 | | |
| 921 | | |
| 922 | | L1 coordinate value |
| 923 | | |
| 924 | | L2 coordinate value |
| 925 | | |
| 926 | | Structure flag |
| 927 | | |
| 928 | | Multi-turn data |
| 929 | | |
| 930 | Joint data-1 [1 - 13] 1: (Reserved) 2: (Reserved) 3: Difference between estimated and actual torques when detecting a collision 4: (Reserved) 5: Current instruction 6: Maximum current instruction 1 7: Maximum current instruction 2 8: Current feedback 9: Allowable current instruction, minus side 10: Allowable current instruction, plus side 11: Effective current 12: Axis load level 13: Maximum axis load level | J1 coordinate value |
| 931 | | |
| 932 | | |
| 933 | | |
| 934 | | |
| 935 | | |
| 936 | | |
| 937 | | |
| 938 | | |
| 939 | | |
| 940 | | |
| 941 | | |
| 942 | | |
| 943 | | |
| 944 | | |
| 945 | | |
| 946 | Joint data-2 [1 - 13] * The data is similar to Joint data-1. | J1 coordinate value |
| 947 | | |
| 948 | | |
| 949 | | |
| 950 | | |
| 951 | | |
| 952 | | |
| 953 | | |
| 954 | | |
| 955 | | |
| 956 | | |
| 957 | | |
| 958 | | |
| 959 | | |
| 960 | | |
| 961 | | |

| GOT Addr (offset) | Description | |
|----------------------|--|---------------------|
| 962 | Joint data-3 [1 - 13] * The data is similar to Joint data-1 | J1 coordinate value |
| 963 | | |
| 964 | | J2 coordinate value |
| 965 | | |
| 966 | | J3 coordinate value |
| 967 | | |
| 968 | | J4 coordinate value |
| 969 | | |
| 970 | | J5 coordinate value |
| 971 | | |
| 972 | | J6 coordinate value |
| 973 | | |
| 974 | | J7 coordinate value |
| 975 | | |
| 976 | J8 coordinate value | |
| 977 | | |

<Precautions>

- When the target mecha and axis do not exist, outputs the data zero.

(2) Data description

The table below lists the content of each data item.

| Item | | Description | Setting Value (unit) | Supported State Variable | Update cycle |
|---------------|---|---|--|--------------------------|--------------|
| Position data | 4: Direction at the time of collision ^{Note1)} | Robot's direction when the collision is detected | Divides the direction at the time of collision to components X, Y, Z. Specify the value with the proportion when the | P_ColDir | 7.1msec |
| | 3: Difference between estimated and actual torques when detecting a collision ^{Note1)} | Maximum difference value between estimated and actual torques when detecting a collision is valid | [10 ⁻³ %] | J_Colmxi | 7.1msec |
| Joint data | 5: Current instruction | Outputs the current instruction value. | [10 ⁻³ Arms] | | 57msec |
| | 6: Maximum current instruction 1 | Outputs the maximum current instruction value after power-up. Reset when the robot power supply is shut off. | [10 ⁻³ Arms] | | 1.8sec |
| | 7: Maximum current instruction 2 | Outputs the maximum current instruction value for past 2sec. | [10 ⁻³ Arms] | | 1.8sec |
| | 8: Current feedback | Outputs the current value generated in the servo motor. | [10 ⁻³ Arms] | | 7.1msec |
| | 9: Allowable current instruction, minus side | Outputs the maximum allowable value (minus side) of the current generated in the servo motor. * The value may vary according to jog and automatic operations. | [10 ⁻³ Arms] | | 7.1msec |
| | 10: Allowable current instruction, plus side | Outputs the maximum allowable value (plus side) of the current generated in the servo motor. * The value may vary according to jog and automatic operations. | [10 ⁻³ Arms] | | 7.1msec |
| | 11: Effective current | Outputs the effective value of current feedback. | [10 ⁻³ Arms] | | 57msec |
| | 12: Axis load level | Outputs the motor's load level. The bigger this value, the heavier the load on the motor. Roughly it should be 80% or less. * It takes a few minutes until the value will stable. | [10 ⁻³ %] | | 1.8sec |
| | 13: Maximum axis load level | Outputs the maximum value of axis load level after power-up. Reset when the power supply is shut off. | [10 ⁻³ %] | | 1.8sec |

Note1) Because the collision detection function is unavailable during using multiple mechas, outputs zero.

3.2.5 Monitor Maintenance Information

Here, periodically outputs the robot's scheduled maintenance data (battery, grease, and belt remaining times) to the shared memory.

(1) Monitoring data list

| GOT Addr (offset) | Description | Update Cycle |
|-------------------|--------------------------------------|---|
| 980 | Battery remaining time [Hr] | Updated at scheduled interval set up in the second element of parameter "MFINTVL" |
| 981 | | |
| 982 | Grease remaining time - J1 axis [Hr] | |
| 983 | | |
| 984 | Grease remaining time - J2 axis [Hr] | |
| 985 | | |
| 986 | Grease remaining time - J3 axis [Hr] | |
| 987 | | |
| 988 | Grease remaining time - J4 axis [Hr] | |
| 989 | | |
| 990 | Grease remaining time - J5 axis [Hr] | |
| 991 | | |
| 992 | Grease remaining time - J6 axis [Hr] | |
| 993 | | |
| 994 | Grease remaining time - J7 axis [Hr] | |
| 995 | | |
| 996 | Grease remaining time - J8 axis [Hr] | |
| 997 | | |
| 998 | Belt remaining time - J1 axis [Hr] | |
| 999 | | |
| 1000 | Belt remaining time - J2 axis [Hr] | |
| 1001 | | |
| 1002 | Belt remaining time - J3 axis [Hr] | |
| 1003 | | |
| 1004 | Belt remaining time - J4 axis [Hr] | |
| 1005 | | |
| 1006 | Belt remaining time - J5 axis [Hr] | |
| 1007 | | |
| 1008 | Belt remaining time - J6 axis [Hr] | |
| 1009 | | |
| 1010 | Belt remaining time - J7 axis [Hr] | |
| 1011 | | |
| 1012 | Belt remaining time - J8 axis [Hr] | |
| 1013 | | |

<Precautions>

- When the target mecha does not exist, outputs all the data with zero.
- When the target mecha exists but the maintenance schedule is not supported, outputs all the data with "-1".
- When the target axis is not updated by the maintenance schedule, outputs the data "-1".

(2) Data description

[Battery remaining time]: Outputs the remaining time until the battery exchange.

[Grease remaining time]: Outputs the remaining time until the grease-up of each axis.

[Belt remaining time]: Outputs the remaining time until the belt exchange of each axis.

4 Reads/Writes Robot's Variables

4.1 Function Description

(1) Function list

The table below lists the variable operations performed from the GOT:

Table 4-1:Variable operation function list

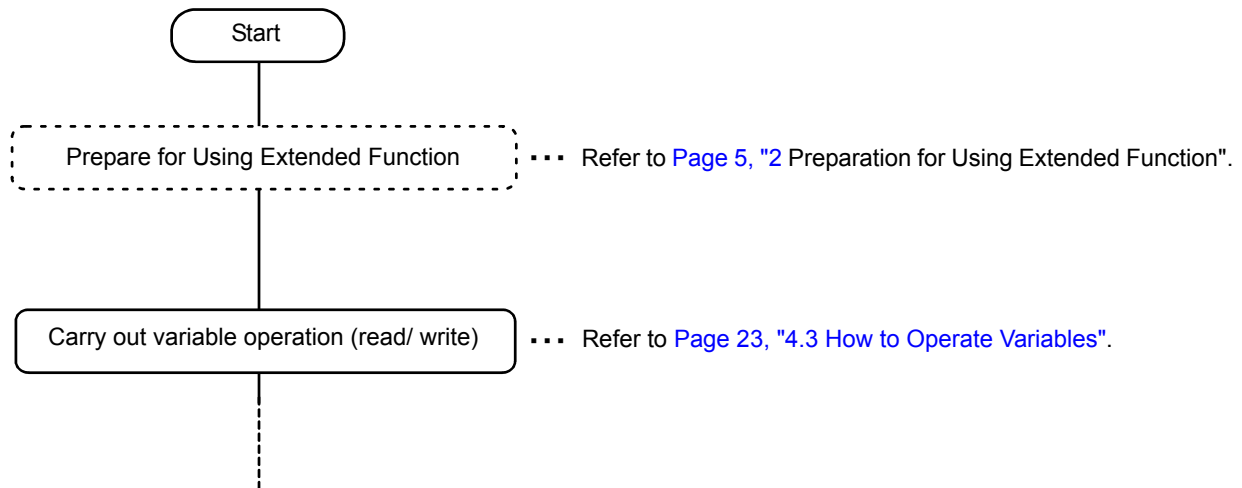
| No | Item | Description | Robot's response time |
|----|-------------------------|---|--|
| 1 | Read numeric variable | Reads variable content by specifying slot number and variable name. | Answered within 1sec (it may vary according to the robot control's load state) |
| 2 | Write numeric variable | Rewrites variable content by specifying slot number, variable name, and variable content. | |
| 3 | Read position variable | Reads variable content by specifying slot number and variable name. | |
| 4 | Write position variable | Rewrites variable content by specifying slot number, variable name, and variable content. | |
| 5 | Read joint variable | Reads variable content by specifying slot number and variable name. | |
| 6 | Write joint variable | Rewrites variable content by specifying slot number, variable name, and variable content. | |

(2) Functional requirements

Always available when a program is selected for robot's target slot and the target variable exists. When the target is external variable, the variable operation is possible by specifying zero for a slot number, even when a program is not selected.

⚠ CAUTION Be careful fully to change variable value.
 The robot's location and behavior may be changed by changing the variable value, thereby interfering with surrounding devices. Because it is especially dangerous when the robot is in operation, sufficiently check the value to be changed.

4.2 Operation Flow



4.3 How to Operate Variables

Here, in the GOT, operates the robot's variables (read/ write variables) by specifying function number, slot number, variable name, and variable data.

Function number setting allows you to select work type (read/ write variable) and variable type (numeric/ position/ joint variables) and specify a variable name (designation of ASCII character).

* Long-precision integer number and single-precision real number can be used for reading/writing of numeric value variables since software version S3p.

4.3.1 Data List

(1) GOT output data

1) Word data

Setting values when specifying ASCII character for variable and program names

| GOT Addr (offset) | Item | Setting Value for Specifying ASCII Character | | | | | | | | | | |
|-------------------|-------------------------|--|---------------------|--------------|------------|---------------------|------------|--|------------|---|------------|------------------------------------|
| | | Numeric Var (Integer) | | Position Var | | Joint Var | | Numeric Var (Long-precision integer number ^{Note1)}) | | Numeric Var (Single-precision real number ^{Note1)}) | | |
| | | Read | Write | Read | Write | Read | Write | Read | Write | Read | Write | |
| 701 | (Reserved) | (Reserved) | | | | | | | | | | |
| 702 | Function No | 101 | 102 | 104 | 105 | 107 | 108 | 111 | 112 | 121 | 122 | |
| 703 | Slot No | Slot number [0, 1 to the value of parameter TASKMAX] | | | | | | | | | | |
| 704 | Program name (Not used) | (Not used) | | | | | | | | | | |
| 705 | | | | | | | | | | | | |
| 706 | | | | | | | | | | | | |
| 707 | | | | | | | | | | | | |
| 708 | | | | | | | | | | | | |
| 709 | | | | | | | | | | | | |
| 710 | Variable name | Variable name [ASCII data, up to 16 characters] | | | | | | | | | | |
| 711 | | | | | | | | | | | | |
| 712 | | | | | | | | | | | | |
| 713 | | | | | | | | | | | | |
| 714 | | | | | | | | | | | | |
| 715 | | | | | | | | | | | | |
| 716 | | | | | | | | | | | | |
| 717 | | | | | | | | | | | | |
| 718 | Variable data | (Not used) | Integer | (Not used) | (Not used) | X coordinate value | (Not used) | J1 coordinate value | (Not used) | Long-precision integer number value | (Not used) | Single-precision real number value |
| 719 | | | | | | | | | | | | |
| 720 | | | Y coordinate value | | | J2 coordinate value | | | | | | |
| 721 | | | Z coordinate value | | | J3 coordinate value | | | | | | |
| 722 | | | A coordinate value | | | J4 coordinate value | | | | | | |
| 723 | | | B coordinate value | | | J5 coordinate value | | | | | | |
| 724 | | | C coordinate value | | | J6 coordinate value | | | | | | |
| 725 | | | L1 coordinate value | | | J7 coordinate value | | | | | | |
| 726 | | | L2 coordinate value | | | J8 coordinate value | | | | | | |
| 727 | | | Structure flag | | | (Not used) | | | | | | |
| 728 | | | Multi-turn data | | | (Not used) | | | | | | |
| 729 | | | | | | | | | | | | |
| 730 | | | | | | | | | | | | |
| 731 | | | | | | | | | | | | |
| 732 | | | | | | | | | | | | |
| 733 | | | | | | | | | | | | |
| 734 | | | | | | | | | | | | |
| 735 | | | | | | | | | | | | |
| 736 | | | | | | | | | | | | |
| 737 | | | | | | | | | | | | |

Note1) This number can be used since software version S3p.

2) Bit signal

| GOT Address | | Description |
|---------------|--------------|--------------------------------|
| Addr (offset) | Bit position | |
| 700 | 0 | Request for variable operation |

(2) Robot output data

1) Word data

Setting values when specifying ASCII character for variable and program names

| GOT Addr (offset) | Item | Setting Value for Specifying ASCII Character | | | | | | | | | |
|-------------------|-------------------|--|------------|---------------------|-------|---------------------|------------|--|------------|---|------------|
| | | Numeric Var (Integer) | | Position Var | | Joint Var | | Numeric Var (Long-precision integer number ^{Note1)}) | | Numeric Var (Single-precision real number ^{Note1)}) | |
| | | Read | Write | Read | Write | Read | Write | Read | Write | Read | Write |
| 551 | Completion status | Completion status [1: OK/ other than 1: NG] | | | | | | | | | |
| 552 | Function No | 101 | 102 | 104 | 105 | 107 | 108 | 111 | 112 | 121 | 122 |
| 553 | Slot No | Slot number [0, 1 to the value of parameter TASKMAX] | | | | | | | | | |
| 554 | Program name | Program name, ASCII data, up to 12 characters] | | | | | | | | | |
| 555 | | | | | | | | | | | |
| 556 | | | | | | | | | | | |
| 557 | | | | | | | | | | | |
| 558 | | | | | | | | | | | |
| 559 | Variable name | Variable name [ASCII data, up to 16 characters] | | | | | | | | | |
| 560 | | | | | | | | | | | |
| 561 | | | | | | | | | | | |
| 562 | | | | | | | | | | | |
| 563 | | | | | | | | | | | |
| 564 | | | | | | | | | | | |
| 565 | | | | | | | | | | | |
| 566 | | | | | | | | | | | |
| 567 | Variable data | Integer | | X coordinate value | | J1 coordinate value | | Long-precision integer number value | | Single-precision real number value | |
| 568 | | (Not used) | (Not used) | Y coordinate value | | J2 coordinate value | | (Not used) | (Not used) | (Not used) | (Not used) |
| 569 | | | | Z coordinate value | | J3 coordinate value | | | | | |
| 570 | | | | A coordinate value | | J4 coordinate value | | | | | |
| 571 | | | | B coordinate value | | J5 coordinate value | | | | | |
| 572 | | | | C coordinate value | | J6 coordinate value | | | | | |
| 573 | | | | L1 coordinate value | | J7 coordinate value | | | | | |
| 574 | | | | L2 coordinate value | | J8 coordinate value | | | | | |
| 575 | | | | Structure flag | | (Not used) | (Not used) | | | | |
| 576 | | | | Multi-turn data | | (Not used) | (Not used) | | | | |
| 577 | | | | | | | | | | | |
| 578 | | | | | | | | | | | |
| 579 | | | | | | | | | | | |
| 580 | | | | | | | | | | | |
| 581 | | | | | | | | | | | |
| 582 | | | | | | | | | | | |
| 583 | | | | | | | | | | | |
| 584 | | | | | | | | | | | |
| 585 | | | | | | | | | | | |
| 586 | | | | | | | | | | | |
| 587 | | | | | | | | | | | |

Note1) This number can be used since software version S3p.

2) Bit signal

| GOT Address | | Description |
|---------------|--------------|------------------------------|
| Addr (offset) | Bit position | |
| 550 | 0 | Variable operation completed |

(3) Completion status

The values below are established as completion status:

| Setting Value | Description |
|---------------|---|
| 1 | Successfully completed |
| 2 | Specified data (function number, slot number, variable number, element number, or external variable specification) out of range |
| 3 | Program not selected for the target slot |
| 4 | Target variable does not exist |
| 5 | (Reserved) |
| 6 | Not the formal variable data (at the time of writing variable) |
| 7 | Target variable not writable (at the time of writing variable) |
| 8 | Target variable value out of range at the time of reading variable: Not in the range between -32768 and 32767 (at the time of reading numeric variable) |
| 10 | NG because of a factor other than 2 to 8 |

(4) Data description

[Function No]

Select the target function.

Function number setting allows you to select work type (read/ write variable) and variable type (numeric/ position/ joint variables) and specify a variable name (designation of ASCII character).

[Slot number]

Select the target slot.

In general, specify a value between 1 and the value of parameter TASKMAX (factory default: 8). In case of external variable, "0" can be specified.

[Program name]

Program name is displayed in ASCII character.

● Specifying ASCII character

- Specify ASCII program name in 6 words area (12 characters).
- To specify ASCII characters, specify all 12 characters or string data including terminating code. However, leading and ending blank characters (space) are ignored.
- When target is an external variable and zero is specified for slot number, the program name becomes NULL.

[Variable name]

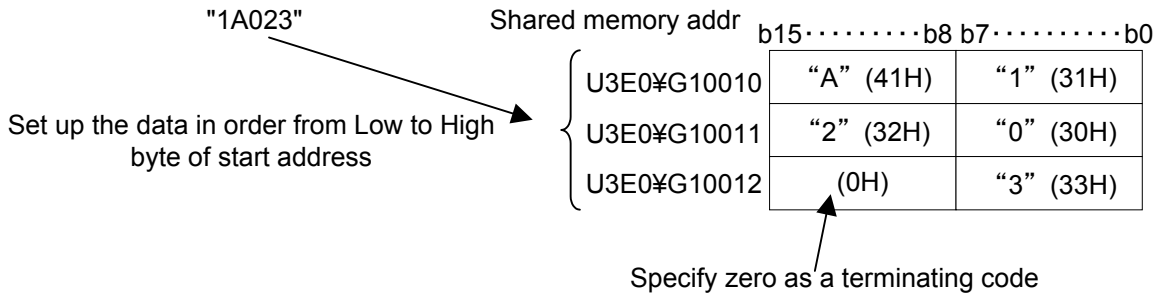
To specify a variable name, specify ASCII characters.

● Specifying ASCII character

- Specify the variable name (including leading character) in the 8 words area (16 characters, robot specification).
- To specify ASCII characters, specify all 16 characters or string data including terminating code. However, leading and ending whitespace characters (space) are ignored.
- The character underscore (_) used in array and external variable is also available, and array or external variable can be specified.

<ASCII data setting example>

- Set up the data in order from low to high byte of start address.
- Specify zero as a terminating code.
(Be compliant with the character input specification of the GOT)



<Available character>

Available characters are compliant with robot specification. (Refer to the table below.)

| Category | Available Characters | Program Name | Variable Name |
|----------------------|--|--------------|---------------|
| Alphabetic character | A B C D E F G H I J K L M N O P Q R S T U V W X Y Z | ○ | ○ |
| | a b c d e f g h i j k l m n o p q r s t u v w x y z | × | ○ |
| Figure | 0 1 2 3 4 5 6 7 8 9 | ○ | △ Note1) |
| Symbol | " ' & () * + - . , / : ; = < > ? [\] ^ { } ~ ! # \$ % | × | × |
| | '_' (underscore) | × | △ Note3) |
| White space | Whitespace character | × | × |

Note1) Only the alphabetic characters are available at the beginning of variable name. A figure is available for second and after characters.

Note2) Parentheses "(")" for specifying an array are available.

Note3) Available for second and after characters. The variable whose second character is underscore '_' is an external variable.

[Variable data: numeric variable (Integer)]

- One word is prepared for a numeric variable and only an integer can be specified.
- Therefore, its range is between -32768 and 32767, and digits after decimal point are discarded.

[Variable data: numeric variable (Long-precision integer number)]

- Two words are prepared for a numeric variable and only an integer can be specified.
- Therefore, its range is between -2147483648 and 2147483647, and digits after decimal point are discarded.

[Variable data: position, joint, and numeric (Single-precision real number) variables]

- The unit is 10⁻⁴mm or 10⁻⁴deg.
However, the number of significant figures for position and joint variable data output from the robot is dependent on the parameter PRGDPNTM (digits after decimal point: factory default is 2 or 3 digits (it may vary according to the robot model)), and the portion less than the significant figures is rounded off. For example, when PRGDPNTM is two, to round off 1.2345 gives 12300 and to round off 6.7890 gives 67900.
- Only lower one word is used for the structure flag of position variable, and upper one word is a reserved area.
- When a variable in undefined state (a variable exists but its data is empty) is read, zero is set to the undefined portion of data.
- Because each component value is handled as a single-precision floating type real number in the robot, the number of significant figures is about 7 digits.
(The value which can be expressed with 24bit when expressed in binary number is about 7 digits when expressed in decimal number).

- When the data is successfully written into a variable, the variable data in the robot after the writing is read again and sent.

Therefore, even when writing into a position or joint variable is successfully ended, the data specified by the GOT may be different from the data to be sent by the robot. The robot's posture data or the number of significant figures of data's digits after decimal point may differ.

4.3.2 Timing Chart

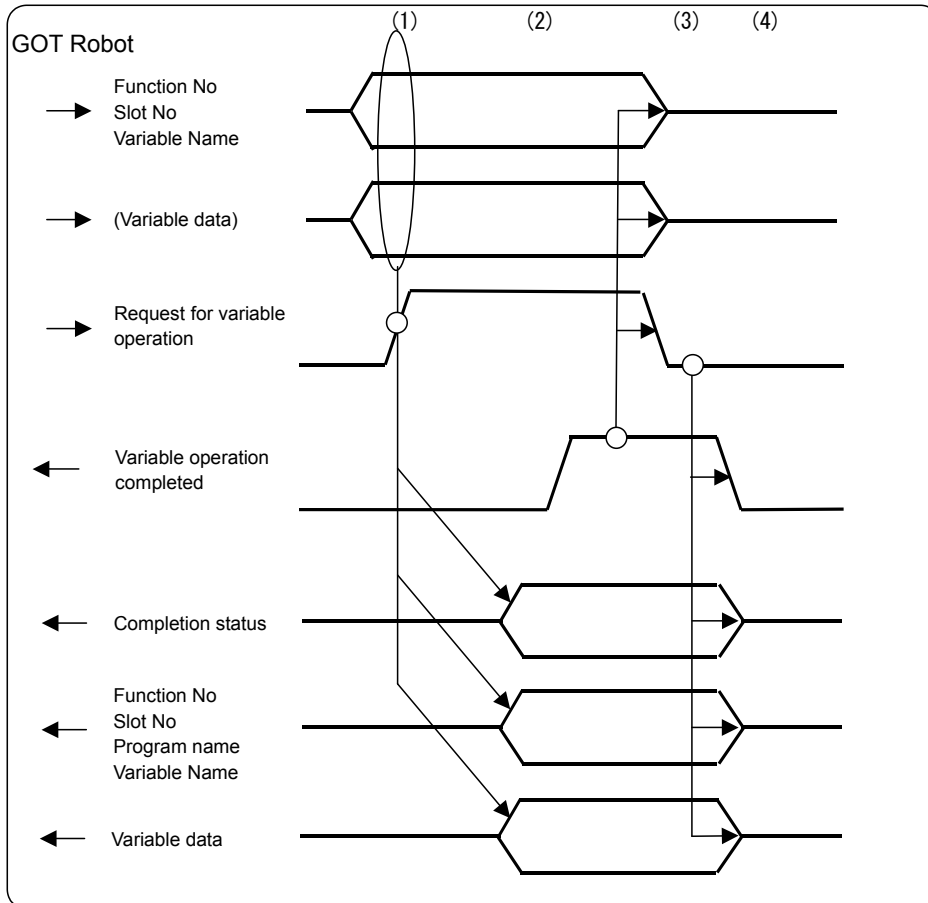


Fig.4-1:Variable operation timing chart

- (1) The GOT sets up "Function number", "Slot number", "Variable name", and "Variable data" (only for writing variable) and turns ON "Request for variable operation".
- (2) When the robot receives "Request for variable operation ON", the robot operates the variable based on received data. When "Function number", "Slot number", "Variable name", "Variable data", and "Completion status" are specified after the operation, the robot turns ON "Variable operation completed".
When the operation cannot be carried out, the robot specifies a number indicating NG and turns ON "Variable operation completed".
- (3) When "Variable operation completed ON" is received, the GOT turns OFF "Request for variable operation".
- (4) When received "Request for variable operation OFF", the robot turns OFF "Variable operation completed" and clears the data.

5 Read Current Line of Robot Program

5.1 Function Description

(1) Function list

The [Table 5-1](#) lists the program operations performed from the GOT.

Table 5-1: Program operation function list

| No | Item | Description | Robot's Response Time |
|----|-----------------------------|--|--|
| 1 | Read program's current line | <ul style="list-style-type: none"> ● Reads currently performing robot program (one line, 128 characters) by specifying a slot number. ● Practicable when a program is selected for robot's slot. | Responds within 1s (it may vary according to the robot control's load state) |

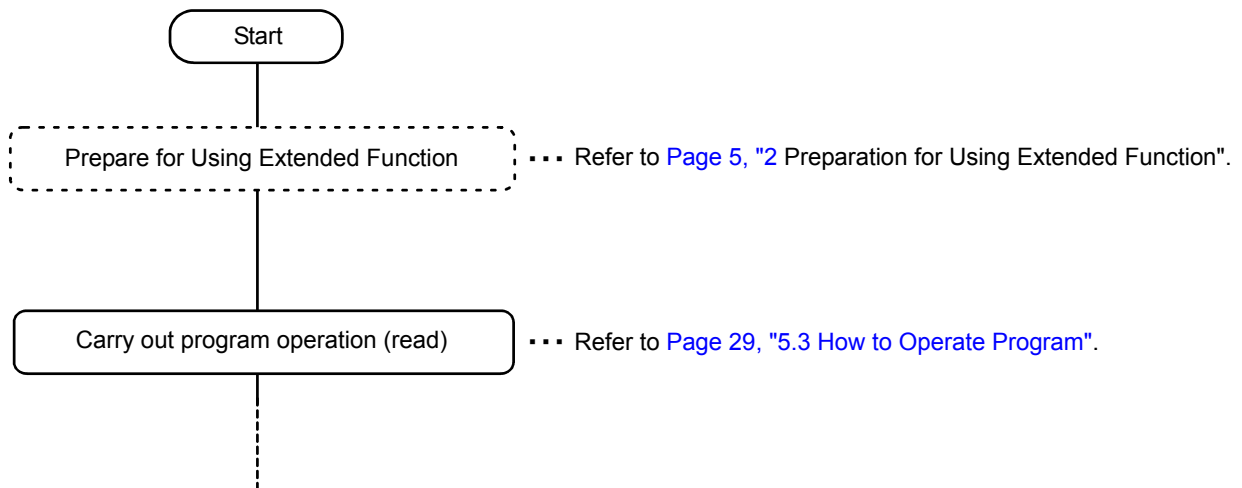
(2) Program data

The program data is as follows:

- The data is one line of program (up to 128 characters) in ASCII.
- When the data is less than 128 characters, terminating code 0 (NULL) is added at the end of string.
- Shift JIS codes are used for kanji character (similar to GOT specification).

⚠ CAUTION When a program line can be longer than 128 characters, the data after 128th character cannot be read. Consequently, when the program whose line is longer than 128 characters is read and the data is written as-is into the robot, be careful that the data which exceeds 128 characters will be deleted.

5.2 Operation flow



5.3 How to Operate Program

Here, in the GOT, operates the robot program by specifying function number, slot number, program name, and program data.

Setting function number to '103' allows you to select a work type (read current line) and specify a program name (designation of ASCII character).

5.3.1 Data List

(1) GOT output data

1) Word data

| GOT Addr (offset) | Item | Setting Value for Specifying ASCII Character |
|----------------------|--------------|--|
| | | Program |
| | | Read current line |
| 740 | (Reserved) | (Reserved) |
| 741 | Function No | 103 |
| 742 | Slot No | Slot number [1 to the value of parameter TASKMAX] |
| 743 | Program name | (Not used) |
| 744 | | |
| 745 | | |
| 746 | | |
| 747 | | |
| 748 | | |
| 749 | Line No | (Not used) |
| 750 | (Reserved) | (Reserved) |
| 751 | Program data | (Not used) |
| 752 | | |
| . | | |
| . | | |
| . | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| 813 | | |
| 814 | | |

2) Bit signal

| GOT Address | | Description |
|---------------|--------------|-------------------------------|
| Addr (offset) | Bit position | |
| 700 | 1 | Request for program operation |

(2) Robot output data

1) Word data

| GOT Addr (offset) | Item | Setting Value for Specifying ASCII Character |
|----------------------|-----------------------------------|--|
| | | Program |
| | | Read current line |
| 590 | Completion status | Completion status [1: OK/ other than 1: NG] |
| 591 | Function No | 103 |
| 592 | Slot No | Slot number [1 to the value of parameter TASKMAX] |
| 593 | Program name | Program name, ASCII data, up to 12 characters |
| 594 | | |
| 595 | | |
| 596 | | |
| 597 | | |
| 598 | | |
| 599 | Line No | Line No [1 - 32767] |
| 600 | Number of pro- gram characters | Number of program characters |
| 601 | Program data | Program to be read [ASCII data, up to 128 characters] * Shift JIS code for kanji |
| 602 | | |
| . | | |
| . | | |
| . | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| 663 | | |
| 664 | | |

2) Bit signal

| GOT Address | | Description |
|---------------|--------------|-----------------------------|
| Addr (offset) | Bit position | |
| 550 | 1 | Program operation completed |

(3) Completion status

The values below are established as completion status:

| Setting Value | Description |
|---------------|--|
| 1 | Successfully completed |
| 2 | Specified data (function number, slot number, program number) out of range |
| 3 | Program not selected for the target slot |
| 4 | (Reserved) |
| 5 | (Reserved) |
| 6 | (Reserved) |
| 7 | (Reserved) |
| 10 | NG because of a factor other than 2 to 7 |

(4) Data description

[Function No]

Selects the target function.

Function number setting allows you to select a work type (read current line) and specify a program name (designation of ASCII character).

[Slot number]

Select the target slot. Specify a value (factory default: 8) in the range between 1 and the value of parameter TASKMAX.

[Program name]

ASCII characters of the output program name.

- Specifying ASCII character
- Specify ASCII program name in 6 words area (12 characters).
- To specify ASCII characters, specify all 12 characters or string data including terminating code. However, leading and ending whitespace characters (space) are ignored.

For information about ASCII data, available characters, refer to [Page 25, "\(4\) Data description"](#).

[Line No]

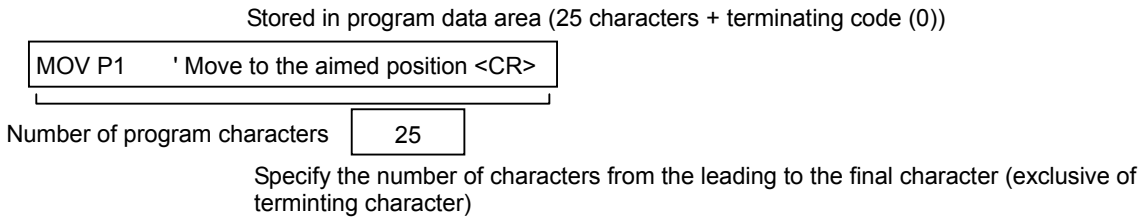
The line number of the read line is output.

When a program is selected but program is in abeyance (program is not running), the line number of first line is output.

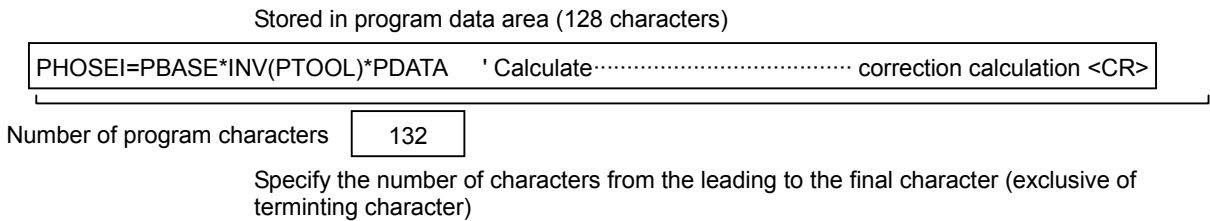
[Number of program characters]

Outputs the number of characters of target line in the target program.
Count and specify the number of characters from the leading to final character (exclusive of line feed/ terminating characters) including comment line (exclusive of line number).
When the target line is longer than 128 characters, up to 128 characters are read as a program data, but the number of counted characters is set as-is as the number of program characters.
When writing into a program, the number of characters of written line is set.

Example 1: A line is less than 128 characters:



Example 2: A line is more than 128 characters:



[Program data]

- The data is in ASCII format and up to 128 characters of program content are stored.
- Shift JIS codes are used for kanji.
- Line number is excluded from the program data.

5.3.2 Timing Chart

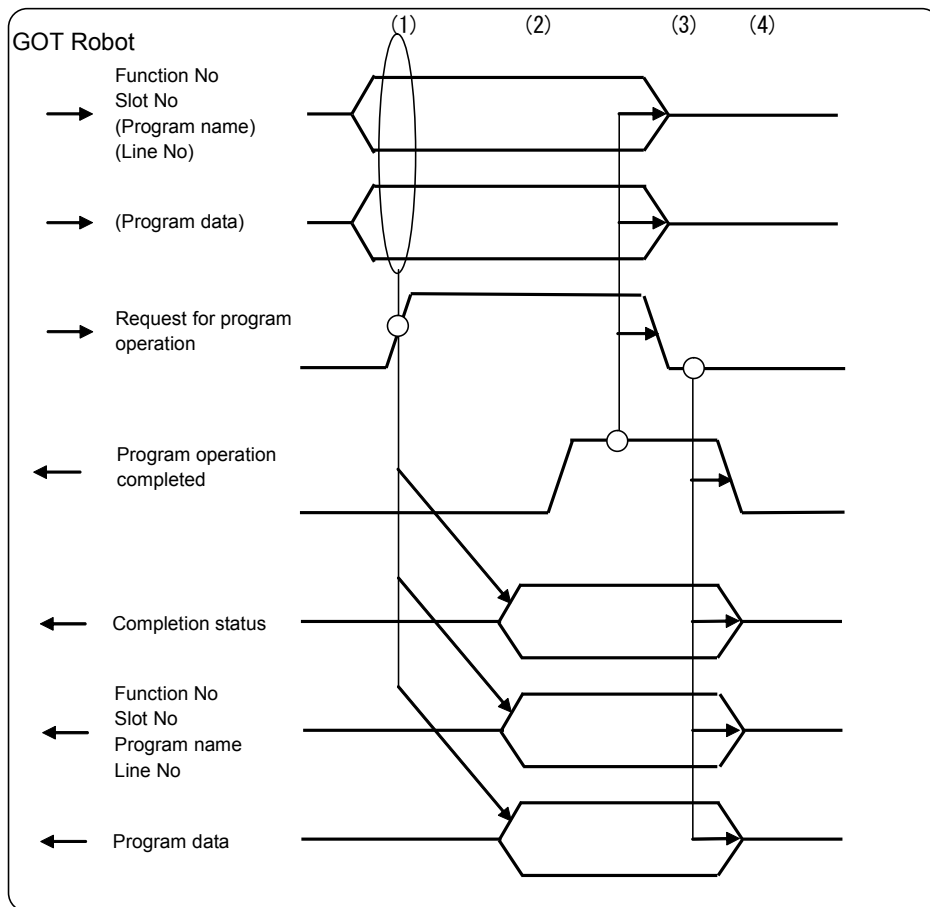


Fig.5-1:Program operation timing chart

- (1) The GOT sets up necessary data of "Function number", "Slot number", "Program name", "Line number", and "Program data" and turns ON "Request for program operation".
- (2) When the robot receives "Request for program operation ON", the robot operates the program based on received data. When "Function number", "Slot number", "Program name", "Program data", and "Completion status" are specified after the operation, the robot turns ON "Program operation completed".
When the operation cannot be carried out, the robot specifies a number indicating NG and turns ON "Program operation completed".
- (3) When "Program operation completed ON" is received, the GOT turns OFF "Request for program operation".
- (4) When received "Request for program operation OFF", the robot turns OFF "Program operation completed" and clears the data.

6 Set up Robot's Maintenance

6.1 Function Description

(1) Function list

The [Table 6-1](#) lists the maintenance setting performed from the GOT.

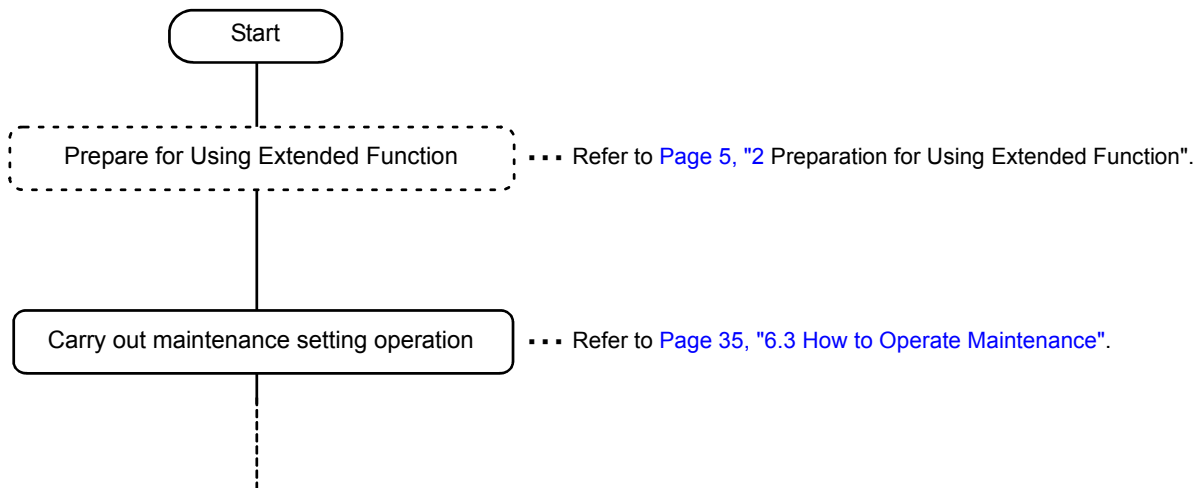
Table 6-1: Maintenance setting function list

| No | Item | Description | Robot's Response Time |
|----|--------------------------------|---|--|
| 1 | Reset maximum servomotor value | Resets the servo monitor's maximum values (current value, load factor, etc.) stored by robot to zero. | Responds within 1s (it may vary according to the robot control's load state) |

(2) Functional requirements

Always practicable.

6.2 Operation flow



6.3 How to Operate Maintenance

Here, in the GOT, operates the maintenance setting by specifying function number and setting data corresponding to the function.

Function number setting allows you to select function items.

6.3.1 Data List

(1) GOT output data

1) Word data

| GOT Addr (offset) | Item | Setting Value |
|----------------------|-------------|--|
| | | Reset Servo Monitor's Maximum/Minimum Values |
| 820 | (Reserved) | (Reserved) |
| 821 | Function No | 6 |
| 822 | Mecha No | Mecha No[1-3] |
| 823 | Mecha No | (Not used) |
| 824 | | |
| 825 | | |
| 826 | | |
| 827 | | |
| 828 | | |

2) Bit signal

| GOT Address | | Description |
|---------------|---------------|---------------------------------|
| Addr (offset) | Addr (offset) | |
| 700 | 2 | Request for maintenance setting |

(2) Robot output data

1) Word data

| GOT Addr (offset) | Item | Setting Value |
|----------------------|-------------------|--|
| | | Reset Servo Monitor's Maximum/Minimum Values |
| 670 | Completion status | Completion status [1: OK/ other than 1: NG] |
| 671 | Function No | 6 |
| 672 | Mecha No | Mecha No[1-3] |
| 673 | Mecha No | (Not used) |
| 674 | | |
| 675 | | |
| 676 | | |
| 677 | | |
| 678 | | |

2) Bit signal

| GOT Address | | Description |
|---------------|---------------|-------------------------------|
| Addr (offset) | Addr (offset) | |
| 550 | 2 | Maintenance setting completed |

(3) Completion status

The values below are established as completion status:

| Setting Value | Description |
|---------------|--|
| 1 | Successfully completed |
| 2 | Specified "Function number" and "Mecha number" are out of range (including the case that the target mecha does not exist). |
| 3 | (Not used) |
| 4 | No target function (the function specified by target mecha does not exist) |
| 10 | NG because of a factor other than 2 to 4 |

(4) Data description

[Function No]

Selects the target function.

[Mecha No]

Select the target mecha. Specify a mecha in the range of mechas 1 - 3.

6.3.2 Timing Chart

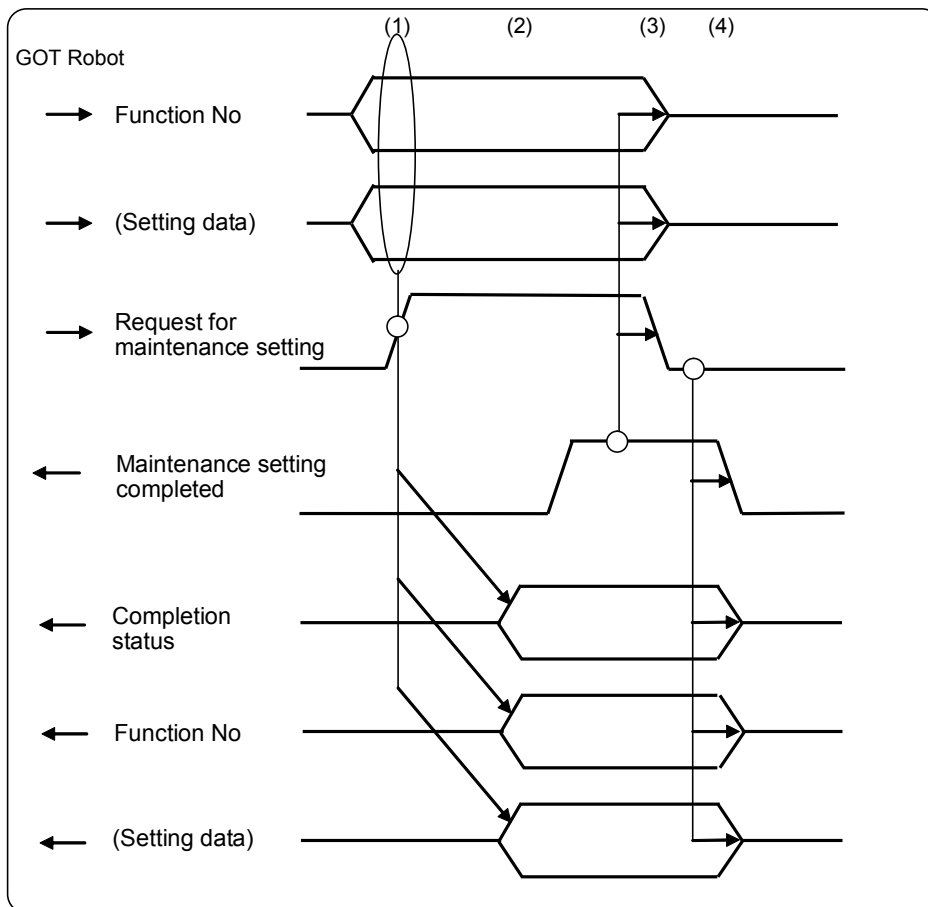


Fig.6-1: Maintenance function timing chart

- (1) The GOT sets up necessary data of "Function number" and "Setting data" and turns ON "Request for maintenance setting."
- (2) When the robot received "Request for maintenance setting ON," the robot operates the maintenance setting based on received data. When "Function number", "Setting data", and "Completion status" are specified after the operation, the robot turns ON "Maintenance setting completed." When the operation cannot be carried out, the robot specifies a number indicating NG and turns ON "Maintenance setting completed."
- (3) When "Maintenance setting completed ON" is received, the GOT turns OFF "Request for maintenance setting."
- (4) When "Request for maintenance setting OFF" is received, the robot turns OFF "Maintenance setting completed" and clears the data.

7 Read Robot Information

7.1 Function Description

(1) Function list

The [Table 7-1](#) lists the robot information reading performed from the GOT.

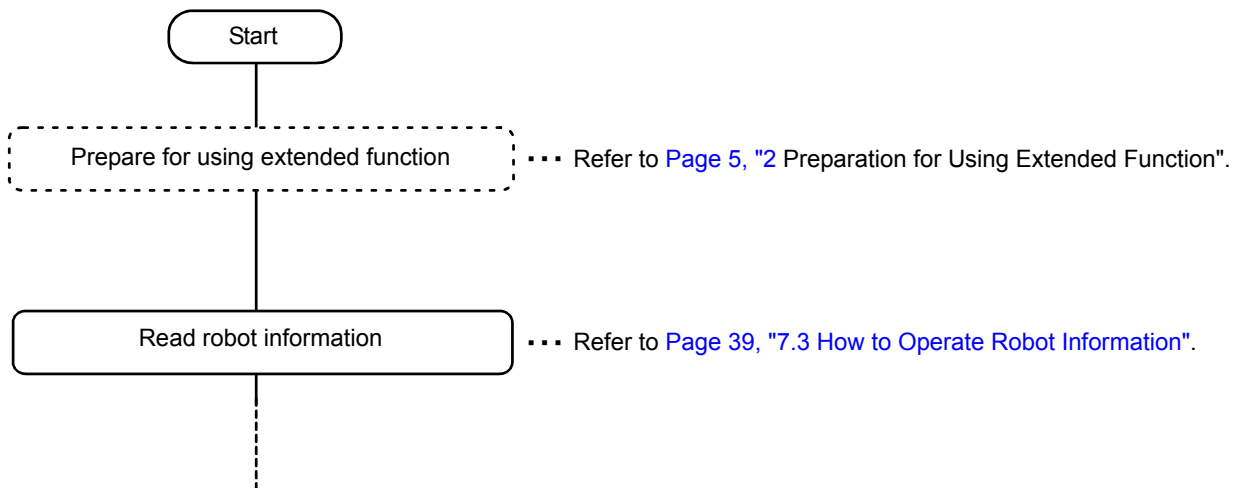
Table 7-1:Robot information reading function list

| No | Item | Description | Robot's Response Time |
|----|--------------------------|---|--|
| 1 | Read error information | Reads the detailed error information generated in the robot. When multiple errors occur, three information can be read at the same time, and the information to be read can be changed by specifying the start number. | Responds within 1s (it may vary according to the robot control's load state) |
| 2 | Read product information | Read the robot's product information. | |

(2) Functional requirements

Always practicable.

7.2 Operation flow



7.3 How to Operate Robot Information

Here, reads the robot information from the GOT by specifying function number and setting data. Function number allows you to select the robot information to be read.

7.3.1 Data List

(1) GOT output data

1) Word data

| GOT Addr (offset) | Item | Setting Value | |
|----------------------|-------------|---------------------------|-----------------------------|
| | | Read Error Information | Read Product Information |
| 830 | (Reserved) | (Reserved) | |
| 831 | Function No | 3 | 4 |
| 832 | Setting No | Start number [1 -] | (Not used) |

2) Bit signal

| GOT Address | | Description |
|---------------|---------------|---------------------------------|
| Addr (offset) | Addr (offset) | |
| 700 | 3 | Request for reading information |

(2) Robot output data

1) Word data

| GOT Addr (offset) | Item | Setting Value | | |
|----------------------|---|---|--|---|
| | | Read Error Information | Read Product Information | |
| 680 | Completion status | Completion status [1: OK/ other than 1: NG] | | |
| 681 | Function No | 3 | 4 | |
| 682 | Read data | Start number [1 -] | (Not used) | |
| 683 | | Number of errors occurred | Robot type name [ASCII data, up to 20 characters] | |
| 684 | | Information 1 (error No) | | |
| 685 | | Information 1 (error occurred program name) [ASCII data, up to 12 characters] | | |
| 686 | | | | |
| 687 | | | | |
| 688 | | | | |
| 689 | | Information 1 (occurred line No) | | |
| 690 | | | | |
| 691 | | Information 1 (detailed error No) | | |
| 692 | | | | |
| 693 | | Information 1 (occurred slot No) | | Controller version [ASCII data, up to 6 characters] |
| 694 | | | | |
| 695 | | (Reserved) | | |
| 696 | | | | |
| 697 | | Information 2 (error No) | Controller serial No [ASCII data, up to 16 characters] | |
| 698 | | | | |
| 699 | | Information 2 (error occurred program name) [ASCII data, up to 12 characters] | | |
| 700 | | | | |
| 701 | | | | |
| 702 | | | | |
| 703 | | Information 2 (occurred line No) | Robot serial No [ASCII data, up to 16 characters] | |
| 704 | | | | |
| 705 | | Information 2 (detailed error No) | | |
| 706 | | | | |
| 707 | Information 2 (occurred slot No) | | | |
| 708 | | | | |
| 709 | (Reserved) | | | |
| 710 | | | | |
| 711 | Information 3 (error No) | (Not used) | | |
| 712 | | | | |
| 713 | Information 3 (error occurred program name) [ASCII data, up to 12 characters] | | | |
| 714 | | | | |
| 715 | | | | |
| 716 | | | | |
| 717 | Information 3 (occurred line No) | | | |
| 718 | | | | |
| 719 | Information 3 (detailed error No) | | | |
| 720 | | | | |
| 721 | Information 3 (occurred slot No) | | | |
| 722 | | | | |
| 723 | (Reserved) | | | |
| 724 | | | | |
| 725 | | | | |

2) Bit signal

| GOT Address | | Description |
|---------------|---------------|-------------------------------|
| Addr (offset) | Addr (offset) | |
| 550 | 3 | Reading information completed |

(3) Completion status

The values below are established as completion status:

| Setting Value | Description |
|---------------|---|
| 1 | Successfully completed |
| 2 | Specified "Function number" out of range |
| 3 | Specified "Setting data" out of range |
| 10 | NG because of a factor other than 2 and 3 |

(4) Data description

[Function No]

Selects the target function.

[Start No of read data]

Specify the information's start number to be read.

The robot reads and stores three pieces of information from the specified number in the shared memory.

Specify 1: Reads first to third pieces of registered information.

Specify 2: Reads second to fourth pieces of registered information.

Specify 3: Reads third to fifth pieces of registered information.

Of information 1 - 3, the information with small number is a new error.

When the target information with the specified number does not exist, the robot sets all read data to zero.

7.3.2 Timing Chart

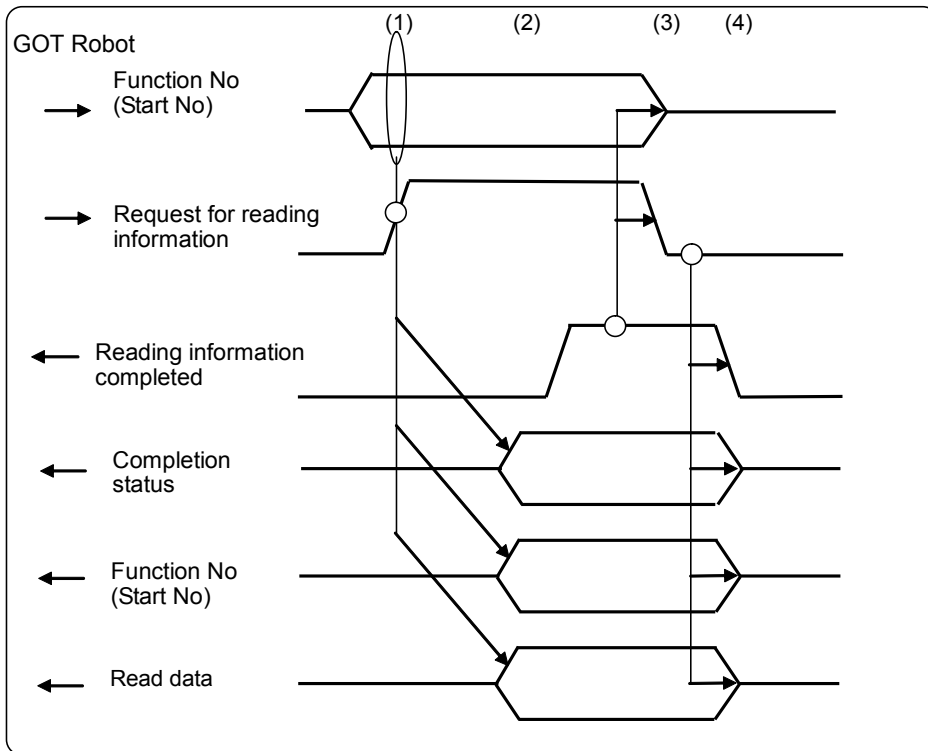


Fig.7-1:Information reading timing chart

- (1) The GOT sets up necessary data of "Function number" and "Start number" and turns ON "Request for reading information."
- (2) When "Request for reading information ON" is received, the robot specifies requested "Read data" and "Completion status" and turns ON "Reading information completed."
When the operation cannot be carried out, the robot specifies a number indicating NG and turns ON "Reading information completed."
- (3) When "Reading information completed" is received, the GOT turns OFF "Request for reading information."
- (4) When "Request for reading information OFF" is received, the GOT turns OFF "Reading information completed."

8 Function Relevant Parameter

8.1 Function Definition Parameter

| Parameter | Parameter Name | Array Qty Character Qty | Description | Factory Default |
|-----------------|----------------|-------------------------------|---|------------------|
| Define function | IQSPEC | 1 digit integer | Set up function for robots. Set each function allocated by each bit. 0000000000000000 bit1-15: Not used +--- bit0: Direction to write into shared memory 0: Reads/writes in order from first to last address 1: Reads in order from first to last address, writes in order from last to first address (communication specification among robot CPU of GOT) | 0000000000000001 |

The access sequence of the shared memory of the robot controller is direction to the final address from the top address for both of reading and writing. However, the GOT's communication specification among robot controllers is direction from last to start address for writing. Thus, when a system is designed according to the shared memory map specification, the interlock of dataset may be impossible. (For more information, refer to the [Fig. 8-1](#).)

Therefore, when utilizing shared memory expanded function, it is necessary to make the shared memory access order the same as the specification of the GOT. We provide the parameter (IQSPEC) to solve it. The initial value is set to the same specification as the GOT, so its change by customer is not necessary at all. If the access sequence of the shared memory direction to the final address from the top address for both of reading and writing is necessary, it can specify with this parameter.

Prevention of separation of data over 32 bits

When user's free area is used

The program reads in order from start of user's free area. In write command, the transmission data is written in order from last to start address of user's free area.

Consequently, the interlock device at the start of data for communication can prevent separation of data for communication

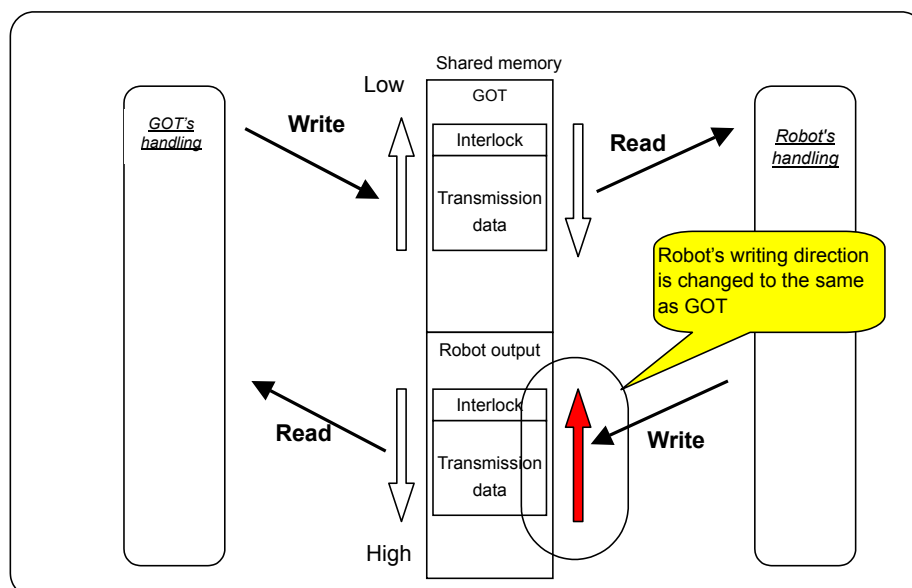


Fig.8-1:Change the writing order of shared memory data

9 Extended Function Relevant Error List

(1) Error occurred when MELFA-BASIC IV is selected while shared memory extended function is valid

| Error No | Error Cause and Measure | |
|----------|-------------------------|--|
| L3994 | Error message | Shared memory extended function unavailable (MB4) |
| | Cause | Shared memory extended function is unavailable in MELFA-BASIC IV. The parameter RLNG=1 (MELFA-BASIC IV) is selected while shared memory extended function is valid. Make sure to set the parameter RLNG to 2 (MELFA-BASIC V). |
| | Measure | Set the parameter RLNG to 2 (MELFA-BASIC V). |

MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE: TOKYO BUILDING, 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
NAGOYA WORKS: 5-1-14, YADA-MINAMI, HIGASHI-KU NAGOYA 461-8670, JAPAN

Authorised representative:

MITSUBISHI ELECTRIC EUROPE B.V. GERMANY
Gothaer Str. 8, 40880 Ratingen / P.O. Box 1548, 40835 Ratingen, Germany

| HEADQUARTERS | | EUROPEAN REPRESENTATIVES | | EUROPEAN REPRESENTATIVES | | MIDDLE EAST REPRESENTATIVE | |
|---|--------------------|---|-------------------------------|--|--------------------|--|---------------|
| Mitsubishi Electric Europe B.V. Gothaer Straße 8 D-40880 Ratingen Phone: +49 (0)2102 / 486-0 Fax: +49 (0)2102 / 486-1120 | EUROPE | GEVA Wiener Straße 89 A-2500 Baden Phone: +43 (0)2252 / 85 55 20 Fax: +43 (0)2252 / 488 60 | AUSTRIA | AXICONT Automatika Kft. (Robot Center) Rokolya utca 1-13 HU-1131 Budapest Phone: +36 (0)1 / 412-0882 Fax: +36 (0)1 / 412-0883 | HUNGARY | ILAN & GAVISH Ltd. 24 Shenkar St., Kiryat Ariet IL-49001 Petah-Tikva Phone: +972 (0)3 / 922 18 24 Fax: +972 (0)3 / 924 0761 | ISRAEL |
| Mitsubishi Electric Europe B.V. Radlická 751/113e Avenir Business Park CZ-158 00 Praha 5 Phone: +420 251 551 470 Fax: +420 251 551 471 | CZECH REP. | 000 TECHNIKON Prospect Nezavisimosti 177-9 BY-220125 Minsk Phone: +375 (0)17 / 393 1177 Fax: +375 (0)17 / 393 0081 | BELARUS | ALFATRADE Ltd. 99, Paola Hill Malta-Paola PLA 1702 Phone: +356 (0)21 / 697 816 Fax: +356 (0)21 / 697 817 | MALTA | | |
| Mitsubishi Electric Europe B.V. 25, Boulevard des Bouvets F-92741 Nanterre Cedex Phone: +33 (0)1 / 55 68 55 68 Fax: +33 (0)1 / 55 68 57 57 | FRANCE | ESCO DRIVES Culliganlaan 3 BE-1831 Diegem Phone: +32 (0)2 / 717 64 60 Fax: +32 (0)2 / 717 64 61 | BELGIUM | HIFLEX AUTOM. B.V. Wolweverstraat 22 NL-2984 CD Ridderkerk Phone: +31 (0)180 / 46 60 04 Fax: +31 (0)180 / 44 23 55 | NETHERLANDS | | |
| Mitsubishi Electric Europe B.V. Westgate Business Park, Ballymount IRL-Dublin 24 Phone: +353 (0)1 4198800 Fax: +353 (0)1 4198890 | IRELAND | KONING & HARTMAN B.V. Woluwelaan 31 BE-1800 Vilvoorde Phone: +32 (0)2 / 257 02 40 Fax: +32 (0)2 / 257 02 49 | BELGIUM | KONING & HARTMAN B.V. Energieweg 1 NL-2627 AP Delft Phone: +31 (0)15 260 99 06 Fax: +31 (0)15 261 9194 | NETHERLANDS | | |
| Mitsubishi Electric Europe B.V. Viale Colleoni 7 Palazzo Sirio I-20864 Agrate Brianza (MB) Phone: +39 039 / 60 53 1 Fax: +39 039 / 60 53 312 | ITALY | INEA RBT d.o.o. Stegne 11 SI-1000 Ljubljana Phone: +386 (0)1 / 513 8116 Fax: +386 (0)1 / 513 8170 | BOSNIA AND HERZEGOVINA | Beijer Electronics AS Postboks 487 NO-3002 Drammen Phone: +47 (0)32 / 24 30 00 Fax: +47 (0)32 / 84 85 77 | NORWAY | | |
| Mitsubishi Electric Europe B.V. Nijverheidsweg 23a NL-3641RP Mijdrecht Phone: +31 (0) 297250350 | NETHERLANDS | AKHNATON 4, Andrei Ljapchev Blvd., PO Box 21 BG-1756 Sofia Phone: +359 (0)2 / 817 6000 Fax: +359 (0)2 / 97 44 06 1 | BULGARIA | Fonseca S.A. R. João Francisco do Casal 87/89 PT-3801-997 Aveiro, Esqueira Phone: +351 (0)234 / 303 900 Fax: +351 (0)234 / 303 910 | PORTUGAL | | |
| Mitsubishi Electric Europe B.V. ul. Krakowska 50 PL-32-083 Balice Phone: +48 (0) 12 347 65 00 Fax: +48 (0) 12 347 65 01 | POLAND | INEA CR Losinjska 4 a HR-10000 Zagreb Phone: +385 (0)1 / 36 940 - 01/ -02/ -03 Fax: +385 (0)1 / 36 940 - 03 | CROATIA | SIRIUS TRADING & SERVICES SRL Aleea Lacul Morii Nr. 3 RO-060841 Bucuresti, Sector 6 Phone: +40 (0)21 / 430 40 06 Fax: +40 (0)21 / 430 40 02 | ROMANIA | | |
| Mitsubishi Electric (Russia) LLC 52, bld. 1 Kosmodamianskaya emb. RU-115054 Moscow Phone: +7 495 / 721 2070 Fax: +7 495 / 721 2071 | RUSSIA | AutoCont C. S. S.R.O. Kačkova 1853/3 CZ-702 00 Ostrava 2 Phone: +420 595 691 150 Fax: +420 595 691 199 | CZECH REPUBLIC | INEA SR d.o.o. Ul. Karadjordjeva 12/1217 SER-11300 Smederevo Phone: +386 (0)26 / 461 54 01 | SERBIA | | |
| Mitsubishi Electric Europe B.V. Carretera de Rubi 76-80 Apdo. 420 E-08190 Sant Cugat del Vallés (Barcelona) Phone: +34 (0) 93 / 5653131 Fax: +34 (0) 93 / 5891579 | SPAIN | Beijer Electronics A/S Lykkegardsvej 17 DK-4000 Roskilde Phone: +45 (0)46 / 75 76 66 Fax: +45 (0)46 / 75 56 26 | DENMARK | SIMAP SK (Západné Slovensko) Jána Derku 1671 SK-911 01 Trenčín Phone: +421 (0)32 743 04 72 Fax: +421 (0)32 743 75 20 | SLOVAKIA | | |
| Mitsubishi Electric Europe B.V. (Scandinavia) Fjellievägen 8 SE-22736 Lund Phone: +46 (0) 8 625 10 00 Fax: +46 (0) 46 39 70 18 | SWEDEN | HANS FÖLSGAARD A/S Theilgaardstr. Torv 1 DK-4600 Køge Phone: +45 4320 8600 Fax: +45 4396 8855 | DENMARK | INEA RBT d.o.o. Stegne 11 SI-1000 Ljubljana Phone: +386 (0)1 / 513 8116 Fax: +386 (0)1 / 513 8170 | SLOVENIA | | |
| Mitsubishi Electric Turkey Elektrik Ürünleri A.Ş. Fabrika Otomasyonu Merkezi Şerifali Mahallesi Nutuk Sokak No.5 TR-34775 Ümraniye-İSTANBUL Phone: +90 (0)216 / 526 39 90 Fax: +90 (0)216 / 526 39 95 | TURKEY | Beijer Electronics OY Vanha Nurmijärventie 62 FIN-01670 Vantaa Phone: +358 (0)207 / 463 500 Fax: +358 (0)207 / 463 501 | FINLAND | Beijer Electronics Automation AB Box 426 SE-20124 Malmö Phone: +46 (0)40 / 35 86 00 Fax: +46 (0)40 / 93 23 01 | SWEDEN | | |
| Mitsubishi Electric Europe B.V. Travellers Lane UK-Hatfield, Herts. AL10 8XB Phone: +44 (0)1707 / 28 87 80 Fax: +44 (0)1707 / 27 86 95 | UK | PROVENDOR OY Teljänkatu 8 A3 FIN-28130 Pori Phone: +358 (0) 2 / 522 3300 Fax: +358 (0) 2 / 522 3322 | FINLAND | 000 "CSC-AUTOMATION" 4-B, M. Raskovoyi St. UA-02660 Kiev Phone: +380 (0)44 / 494 33 44 Fax: +380 (0)44 / 494-33-66 | UKRAINE | | |
| Mitsubishi Electric Europe B.V. Dubai Silicon Oasis United Arab Emirates - Dubai Phone: +971 4 3724716 Fax: +971 4 3724721 | UAE | UTECO A.B.E.E. 5, Mavrogenous Str. GR-18542 Piraeus Phone: +30 (0)211 / 1206-900 Fax: +30 (0)211 / 1206-999 | GREECE | | | | |
| Mitsubishi Electric Corporation Tokyo Building 2-7-3 Marunouchi, Chiyoda-ku Tokyo 100-8310 Phone: +81 (3) 3218-2111 Fax: +81 (3) 3218-2185 | JAPAN | | | | | | |
| Mitsubishi Electric Automation, Inc. 500 Corporate Woods Parkway Vernon Hills, IL 60061 Phone: +1 (847) 478-2100 Fax: +1 (847) 478-0328 | USA | | | | | | |