Simple and friendly

Kawasaki Robot Controller
E Series

Operation Manual

Robot

Kawasaki Heavy Industries, Ltd.

90203－1104DED

PREFACE

This manual describes operating instructions for the Kawasaki Robot Controller E series. This manual should be read with careful review of the related manuals listed below. Once the contents of all the manuals are thoroughly read and understood, the robot can be used.

1. Safety Manual
2. Installation and Connection Manual for Arm
3. Installation and Connection Manual for Controller
4. External I/O Manual (for connecting with peripheral devices)
5. Inspection and Maintenance Manual

The contents of this manual are described on condition that installation and connection of the robot are done in accordance with the above listed manuals.

This manual provides as much detailed information as possible on the standard operating methods for the Kawasaki robot. However, not every possible operation, condition or situation that should be avoided can be described in full. Therefore, should any unexplained questions or problems arise during robot operation, please contact Kawasaki. Refer to the contact information listed on the rear cover of this manual for the nearest Kawasaki office.

The explanations in this manual include information on optional functions, but depending on the specification of each unit, not every optional function detailed here may be included with the robot. Also, note that figures given here may differ partially from actual screens.

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1. This manual does not constitute a guarantee of the systems in which the robot is utilized. Accordingly, Kawasaki is not responsible for any accidents, damage, and/or problems relating to industrial property rights as a result of using the system.
2. It is recommended that all personnel assigned for activation of operation, teaching, maintenance or inspection of the robot attend the necessary education/training course(s) prepared by Kawasaki, before assuming their responsibilities.
3. Kawasaki reserves the right to change, revise, or update this manual without prior notice.
4. This manual may not, in whole or in part, be reprinted or copied without the prior written consent of Kawasaki.
5. Store this manual with care and keep it available for use at any time. If the robot is reinstalled or moved to a different side or sold off to a different use, attach this manual to the robot without fail. In the event the manual is lost or damaged severely, contact Kawasaki.

SYMBOLS

The items that require special attention in this manual are designated with the following symbols.

Ensure proper and safe operation of the robot and prevent physical injury or property damage by complying with the safety matters given in the boxes with these symbols.

DANGER

Failure to comply with indicated matters can result in imminent injury or death.

WARNING

Failure to comply with indicated matters may possibly lead to injury or death.

CAUTION

Failure to comply with indicated matters may lead to physical injury and/or mechanical damage.

[**NOTE**]

Denotes precautions regarding robot specification, handling, teaching, operation and maintenance.

WARNING

1. **The accuracy and effectiveness of the diagrams, procedures, and detail explanations given in this manual cannot be confirmed with absolute certainty. Should any unexplained questions or problems arise, please contact Kawasaki.**
2. **Safety related contents described in this manual apply to each individual work and not to all robot work. In order to perform every work in safety, read and fully understand the safety manual, all pertinent laws, regulations and related materials as well as all the safety explanations described in each chapter, and prepare safety measures suitable for actual work.**

INTRODUCTORY NOTES

1. HARDWARE KEYS AND SWITCHES (BUTTON)

E series controller provides hardware keys and switches on the operation panel and the teach pendant for various kinds of operations.　In this manual the names of the hardware keys and switches are enclosed with a square as follows.　The terms “key” or “switch” which should follow the relevant names are sometimes omitted for simpler expression.　When pressing two or more keys at the same time, the keys are indicated by “+” as shown in the example below.

EXAMPLES

ENTER: expresses the hardware key “ENTER”.
TEACH/REPEAT: indicates the mode switch “TEACH/REPEAT” on the operation panel.
A+MENU: indicates pressing and holding down A then pressing MENU.

2. SOFTWARE KEYS AND SWITCHES

E series controller provides software keys and switches which appear on the screen of the teach pendant for various kinds of operations depending on specifications and situations.　In this manual, the names of software keys and switches are enclosed by “< >” parentheses.　The terms “key” or “switch” which should follow the relevant names are sometimes omitted for simpler expression.

EXAMPLES

<ENTER>: expresses an “ENTER” key that appears on the teach pendant screen.
<NEXT PAGE>: expresses a “NEXT PAGE” key on the teach pendant screen.

3. SELECTION ITEMS

Very often an item must be selected from a menu or pull-down menu on the teach pendant screen. In this manual the names of these menu items are enclosed in brackets [XXX].

EXAMPLES

[Auxiliary Function]: Expresses the item “Auxiliary Function” in a menu.　To select it, move the cursor to the relevant item by the arrow keys, and press the ↵ key.　For detailed description, this procedure should be described every time, but “select [XXX] item” will be used instead for simpler expression.

CONTENTS

1.0 GENERAL

The E series controller is equipped with the latest electronic devices, computers and software to make possible a wide variety of sophisticated robot control functions. All controllers have basic control functions for positioning, speed, acceleration and I/O built in as standard specification. Also, additional axes and control functions are available as options for specific applications.

1.1 MODELS OF E SERIES CONTROLLERS

E series controller (standard spec.) is provided depending on the region where the controller is used and arm models to be connected.

1. Japan spec. controller (E10, E12, E13, E14, E20, E22, E23, E24, E73, E74, E94)
2. North America spec. controller (E30, E32, E33, E34, E76, E77, E97)
3. Europe spec. controller (E40, E42, E43, E44, E70, E71, E91)

For arm models to be connected, refer to Chapter 1.4.

1.2 APPLICABLE STANDARDS

North America and Europe specification robots comply with the following standards.

1. North America spec. robot

ANSI/RIA R15.06	Industrial Robots and Robot Systems - Safety Requirements
ANSI/RIA/ISO 10218-1	Robots for Industrial Environment - Safety Requirements - Part 1 - Robot
ANSI/UL 1740	Standard for Robots and Robotic Equipment, Third Edition
NFPA 79	Electrical Standard for Industrial Machinery
NFPA 70	National Electrical Code
CSA Z434-03	Industrial Robots and Robot Systems - General Safety Requirements

2. Europe spec. robot

EN ISO 10218-1 Robots for industrial environments -
Safety requirements - Part 1: Robot

EN ISO 13849-1 Safety of machinery - Safety related parts of
control systems - Part 1: General principles for design

EN 60204-1 Electrical equipment of industrial machines
General requirements

EN 61000-6-4 Electromagnetic compatibility (EMC) - Part 6-4:
Generic standards - Emission standard for industrial environments

EN 61000-6-2 Electromagnetic compatibility (EMC) - Part 6-2:
Generic standards - Immunity for industrial environments

1.3 SPECIFICATIONS OF E SERIES CONTROLLERS

Main specifications of E series controllers are as follows.

1. Controller for Japan spec.

1. Model	E10/E12/E13/E14	
2. Construction	Self-sustaining fully closed, indirect cooling system	
3. Dimensions	Refer to Installation and Connection Manual.	
4. Number of controlled axes	6 axes for E10/E12/E14, 5 axes for E13 (depends on number of axes of arm) option)	
5. Drive system	Full Digital Servo System	
6. Type of control	Teach mode	Joint, Base, Tool, Fixed Tool (option) operation mode
	Repeat mode	Joint, Linear, Circular (option) interpolation
7. Teaching method	Teaching or AS language programming	
8. Memory capacity	8 MB	
9. External operation signal	External Motor Power Off, External Hold, etc.	
10. General purpose signals	Input signals	32 channels (Includes dedicated signals)
	Output signals	32 channels (Includes dedicated signals)
11. Operation panel	Teach/Repeat SW, Emergency Stop SW, Control power lamp	
12. Cable length	Power/Signal cable	5 m
	Teach Pendant cable	5 m
13. Mass	Refer to Installation and Connection Manual.	
14. Power requirement	AC200 V - AC220 V±10%, 50/60 Hz, 3 phases, Max 5.6 kVA (E10), Max 10 kVA (E12/E13/E14)	
15. Ground	Less than 100 Ω (robot dedicated ground) Leakage current: max. 100 mA	
16. Ambient temperature	0 - 45 °C	
17. Relative humidity	35 - 85 % (non-condensation)	
18. Color	Munsell: 10GY9/1 equivalent	
19. Teach Pendant	TFT color display (6.4 inch LCD) with touch panel Emergency Stop,Teach Lock and Deadman Switches	
20. Options		
General purpose signals	Input signals	64/96/128 channels
	Output signals	64/96/128 channels
I/O connector	D-SUB 37pin (male,female) with cover	
Operation panel	Motor Power ON, Cycle start, RUN/HOLD, Error reset, Error lamp	
Power/Signal cable	10m, 15m	
Teach Pendant cable	10m, 15m	
Auxiliary storage	USB memory	
Brake release	Brake release switch	
AC Outlet	AC100V Outlet	
PC cable	1.5 m, 3 m	
Teach Pendant option	Teach Pendant Stand, Cable hook, connector for TP less	
Others	Cooler, LED Light, Field BUS, Software PLC, Analog input/output, Conveyor Synchronization, Vision and so on	
21. Others	Consult Kawasaki about maintenance parts and spare parts.	

1. Model		E10/E12/E13/E14 (with Insulating Transformer)	
2. Construction		Self-sustaining fully closed, indirect cooling system	
3. Dimensions		Refer to Installation and Connection Manual.	
4. Number of controlled axes		6 axes for E10/E12/E14, 5 axes for E13 (depends on number of axes of arm) option)	
5. Drive system		Full Digital Servo System	
6. Type of control		Teach mode	Joint, Base, Tool, Fixed Tool (option) operation mode
		Repeat mode	Joint, Linear, Circular (option) interpolation
7. Teaching method		Teaching or AS language programming	
8. Memory capacity		8 MB	
9. External operation signal		External Motor Power Off, External Hold, etc.	
10. General purpose signals		Input signals	32 channels (Includes dedicated signals)
		Output signals	32 channels (Includes dedicated signals)
11. Operation panel		Teach/Repeat SW, Emergency Stop SW, Control power lamp	
12. Cable length		Power/Signal cable	5 m
		Teach Pendant cable	5 m
13. Mass		Refer to Installation and Connection Manual.	
14. Power requirement		AC400 / 440 V±10%, 50/60 Hz, 3 phases, Max 10 kVA	
15. Ground		Less than 100 Ω (robot dedicated ground) Leakage current: max. 10 mA	
16. Ambient temperature		0 - 45 °C	
17. Relative humidity		35 - 85 % (non-condensation)	
18. Color		Munsell: 10GY9/1 equivalent	
19. Teach Pendant		TFT color display (6.4 inch LCD) with touch panel Emergency Stop,Teach Lock and Deadman Switches	
20. Options			
	General purpose signals	Input signals	64/96/128 channels
		Output signals	64/96/128 channels
	I/O connector	D-SUB 37pin (male,female) with cover	
	Operation panel	Motor Power ON, Cycle start, RUN/HOLD, Error reset, Error lamp	
	Power/Signal cable	10m, 15m	
	Teach Pendant cable	10m, 15m	
	Power requirement	AC200 - 220 V±10%, 50/60 Hz, 3 phases, Max 10 kVA	
	Earth Leakage Breaker	Leakage current trip level: 30mA	
	Auxiliary storage	USB memory	
	Brake release	Brake release switch	
	AC Outlet	AC100V Outlet	
	PC cable	1.5 m, 3 m	
	Teach Pendant option	Teach Pendant Stand, Cable hook, connector for TP less	
	Others	Cooler, LED Light, Field BUS, Software PLC, Analog input/output, Conveyor Synchronization, Vision and so on	
21. Others		Consult Kawasaki about maintenance parts and spare parts.	

1. Model	E20/E22/E23/E24	
2. Construction	Self-sustaining fully closed, indirect cooling system	
3. Dimensions	Refer to Installation and Connection Manual.	
4. Number of controlled axes	6 axes for E20/E22/E24, 5 axes for E23 (depends on number of axes of arm) option)	
5. Drive system	Full Digital Servo System	
6. Type of control	Teach mode	Joint, Base, Tool, Fixed Tool (option) operation mode
	Repeat mode	Joint, Linear, Circular (option) interpolation
7. Teaching method	Teaching or AS language programming	
8. Memory capacity	8 MB	
9. External operation signal	External Motor Power Off, External Hold, etc.	
10. General purpose signals	Input signals	32 channels (Includes dedicated signals)
	Output signals	32 channels (Includes dedicated signals)
11. Operation panel	Teach/Repeat SW, Emergency Stop SW, Control power lamp	
12. Cable length	Power/Signal cable	5 m
	Teach Pendant cable	5 m
13. Mass	Refer to Installation and Connection Manual.	
14. Power requirement	AC200 V - AC220 V±10%, 50/60 Hz, 3 phases, Max 5.6 kVA(E20), Max 10 kVA(E22/E23/E24)	
15. Ground	Less than 100 Ω (robot dedicated ground) Leakage current: max. 100 mA	
16. Ambient temperature	0 - 45 °C	
17. Relative humidity	35 - 85 % (non-condensation)	
18. Color	Munsell: 10GY9/1 equivalent	
19. Teach Pendant	TFT color display (6.4 inch LCD) with touch panel Emergency Stop,Teach Lock and Deadman Switches	
20. Options		
General purpose signals	Input signals	64/96/128 channels
	Output signals	64/96/128 channels
I/O connector	D-SUB 37pin(male,female) with cover	
Operation panel	Motor Power ON, Cycle start, RUN/HOLD, Error reset, Error lamp	
Power/Signal cable	10m, 15m	
Teach Pendant cable	10m, 15m	
Auxiliary storage	USB memory	
Brake release	Brake release switch	
AC Outlet	AC100V Outlet	
PC cable	1.5 m, 3 m	
Teach Pendant option	Teach Pendant Stand, Cable hook, connector for TP less	
Others	Cooler, LED Light, Field BUS, Software PLC, Analog input/output, Conveyor Synchronization, Vision and so on	
21. Others	Consult Kawasaki about maintenance parts and spare parts.	

1. Model	E73/E74	
2. Construction	Self-sustaining fully closed, indirect cooling system	
3. Dimensions	Refer to Installation and Connection Manual.	
4. Number of controlled axes	6 axes 8 (max.) axes (two built-in amp. addition, option)	
5. Drive system	Full Digital Servo System	
6. Type of control	Teach mode	Joint, Base, Tool, Fixed Tool (option) operation mode
	Repeat mode	Joint, Linear, Circular (option) interpolation
7. Teaching method	Teaching or AS language programming	
8. Memory capacity	8 MB	
9. External operation signal	External Motor Power Off, External Hold, etc.	
10. General purpose signals	Input signals	32 channels (Includes dedicated signals)
	Output signals	32 channels (Includes dedicated signals)
11. Operation panel	Teach/Repeat SW, Emergency Stop SW, Control power lamp	
12. Cable length	Power/Signal cable	5 m
	Teach Pendant cable	5 m
13. Mass	Refer to Installation and Connection Manual.	
14. Power requirement	AC200 V - AC240 V±10%, 50/60 Hz, 1 phases, Max 1.5 kVA(E73), Max 3 kVA(E74)	
15. Ground	Less than 100 Ω (robot dedicated ground) Leakage current: max. 100 mA	
16. Ambient temperature	0 - 45 ℃ (Holizontal mount), 0 - 40℃ (Vertical mount)	
17. Relative humidity	35 - 85 % (non-condensation)	
18. Surface Treatment	Zinc Plating, Trivalent chromate finish	
19. Teach Pendant	TFT color display (6.4 inch LCD) with touch panel Emergency Stop,Teach Lock and Deadman Switches(3 position)	
20. Options		
General purpose signals	Input signals	64/96 channels
	Output signals	64/96 channels
I/O connector	D-SUB 37pin (male,female) with cover	
Operation panel	Motor Power ON, Cycle start, RUN/HOLD, Error reset, Error lamp	
Power/Signal cable	10m, 15m	
Teach Pendant cable	10m, 15m	
Motor brake release	Manual brake release switch BOX	
Auxiliary storage	USB memory	
PC cable	1.5 m, 3 m	
Teach Pendant option	Connector for TP less, Small TP	
Others	Field BUS, Software PLC, Analog input/output, Conveyor Synchronization, Vision and so on	
21. Others	Consult Kawasaki about maintenance parts and spare parts.	

1. Model	E94	
2. Enclosure	Open construction *	
3. Dimensions	Refer to Installation and Connection Manual	
4. Number of controlled axes	Max.6 axes	
5. Servo control and drive system	Full Digital Servo System	
6. Type of control	Teach mode	Joint, Base, Tool, Fixed Tool (option) operation mode
	Repeat mode	PTP, CP control mode Joint, Linear, Circular (option) interpolation
7. Teaching method	Teaching or AS language programming	
8. Memory capacity	8 MB	
9. External operation signals	External Motor Power Off, External Hold, etc.	
10. General purpose signals	Input signals	32 channels (Includes dedicated signals)
	Output signals	32 channels (Includes dedicated signals)
11. Operation panel	Teach/Repeat SW, Emergency Stop SW, Control power lamp	
12. Cable length	Power/Signal cable	5 m
	Teach Pendant cable	5 m
13. Mass	Refer to Installation and Connection Manual	
14. Power requirement	AC200 V - AC230 V±10%, 50/60 Hz, 1 phases, Max 4 kVA	
15. Ground	Less than 100 Ω (robot dedicated ground) Leakage current: max. 100 mA	
16. Ambient temperature	0 - 45 °C	
17. Relative humidity	35 - 85 % (non-condensation)	
18. Color	Munsell: 10GY9/1 equivalent	
19. Teach Pendant	TFT color display (6.4 inch LCD) with touch panel Emergency Stop,Teach Lock and Deadman Switches(3 position)	
20. Options		
General purpose signals	Input signals	64/96 channels
	Output signals	64/96 channels
I/O connector	D-SUB 37pin(male,female) with cover	
Operation panel	Motor Power ON, Cycle start, RUN/HOLD, Error reset, Error lamp	
Power/Signal cable	10m, 15m	
Teach Pendant cable	10m, 15m	
Enclosure	Enclosed indirect cooling system (Ambient temperature 0 - 40 °C)	
Auxiliary storage	USB memory	
Brake release	Brake release switch	
PC cable	1.5 m, 3 m	
Teach Pendant option	Connector for TP less	
Others	Field BUS, Software PLC, Analog input/output, Conveyor Synchronization, Vision and so on	
21. Others	Consult Kawasaki about maintenance parts and spare parts.	

NOTE* Cooling of the electronic components in this open construction E9x controller is achieved by circulation of ambient air. The enclosure is designed so that it protects personnel from contact with hazardous parts inside the controller but it cannot protect invasion of conductive dust like metal dust, non-conductive dust which becomes conductive due to condensation or moisture and water. In this case please select the optional “Enclosed indirect cooling system”.

2. Controller for North America spec.

1. Model	E30/E32/E33/E34	
2. Construction	Self-sustaining fully closed, indirect cooling system	
3. Dimensions	Refer to Installation and Connection Manual.	
4. Number of controlled axes	6 axes for E30/E32/E34, 5 axes for E33 (depends on number of axes of arm) option)	
5. Drive system	Full Digital Servo System	
6. Type of control	Teach mode	Joint, Base, Tool, Fixed Tool (option) operation mode
	Repeat mode	Joint, Linear, Circular (option) interpolation
7. Teaching method	Teaching in block (block teaching) or AS language programming	
8. Memory capacity	8 MB	
9. External operation signal	External Motor Power Off, External Hold, etc.	
10. General purpose signals	Input signals	32 channels (Includes dedicated signals)
	Output signals	32 channels (Includes dedicated signals)
11. Operation panel	Teach/Repeat SW, Emergency Stop SW, Control power lamp	
12. Cable length	Power/Signal cable	10 m
	Teach Pendant cable	10 m
13. Mass	Refer to Installation and Connection Manual.	
14. Power requirement	AC440 V - AC480 V±10%, 50/60 Hz, 3 phases, Max 4.9 kVA(E30), Max 9.9 kVA(E32/E33/E34)	
15. Ground	Less than 100 Ω (robot dedicated ground) Leakage current: max. 10 mA	
16. Ambient temperature	0 - 45 °C	
17. Relative humidity	35 - 85 % (non-condensation)	
18. Color	Munsell: 10GY9/1 equivalent	
19. Teach Pendant	TFT color display (6.4 inch LCD) with touch panel Emergency Stop,Teach Lock and Deadman switches	
20. Motor brake release	Manual brake release switch	
21. Options		
General purpose signals	Input signals	64/96/128 channels
	Output signals	64/96/128 channels
I/O connector	D-SUB 37pin(male,female) with cover	
Power/Signal cable	5m, 7m, 15m	
Teach Pendant cable	5m, 15m	
Power requirement	AC200-220 V, AC380-415 V, AC440-480 V, AC515 V, AC575 V±10% 50/60 Hz, 3 phases, Max 9.9 kVA(E32/E33/E34)	
Auxiliary storage	USB memory	
PC cable	1.5 m, 3 m	
AC outlet	AC-110-120 V Outlet (depends on supply power voltage)	
Teach Pendant option	Teach Pendant Stand, Cable hook, connector for nonuse	
Others	Cooler, LED Light, Field BUS, Software PLC, Analog input/output, Conveyor synchronization, Vision and so on	
22. Others	Consult Kawasaki about maintenance parts and spare parts.	

1. Model	E76/E77	
2. Construction	Self-sustaining fully closed, indirect cooling system	
3. Dimensions	Refer to Installation and Connection Manual.	
4. Number of controlled axes	6 axes 8 (max.) axes (two built-in amp. addition, option)	
5. Drive system	Full Digital Servo System	
6. Type of control	Teach mode	Joint, Base, Tool, Fixed Tool (option) operation mode
	Repeat mode	Joint, Linear, Circular (option) interpolation
7. Teaching method	Teaching or AS language programming	
8. Memory capacity	8 MB	
9. External operation signal	External Motor Power Off, External Hold, etc.	
10. General purpose signals	Input signals	32 channels (Includes dedicated signals)
	Output signals	32 channels (Includes dedicated signals)
11. Operation panel	Teach/Repeat SW, Emergency Stop SW, Control power lamp	
12. Cable length	Power/Signal cable	10 m
	Teach Pendant cable	10 m
13. Mass	Refer to Installation and Connection Manual.	
14. Power requirement	AC200 V - AC240 V±10%, 50/60 Hz, 1 phases, Max 1.5 kVA (E76), Max 3 kVA (E77)	
15. Ground	Less than 100 Ω (robot dedicated ground) Leakage current: max. 100 mA	
16. Ambient temperature	0 - 45 ℃ (Holizontal mount), 0 - 40℃ (Vertical mount)	
17. Relative humidity	35 - 85 % (non-condensation)	
18. Surface Treatment	Zinc Plating, Trivalent chromate finish	
19. Teach Pendant	TFT color display (6.4 inch LCD) with touch panel Emergency Stop,Teach Lock and Deadman Switches (3 position)	
20. Options		
General purpose signals	Input signals	64/96 channels
	Output signals	64/96 channels
I/O connector	D-SUB 37pin (male,female) with cover	
Operation panel	Motor Power ON, Cycle start, RUN/HOLD, Error reset, Error lamp	
Power/Signal cable	5m, 15m	
Teach Pendant cable	5m, 15m	
Motor brake release	Manual brake release switch BOX	
Auxiliary storage	USB memory	
PC cable	1.5 m, 3 m	
Teach Pendant option	Connector for TP less	
Others	Field BUS, Software PLC, Analog input/output, Conveyor Synchronization, Vision and so on	
21. Others	Consult Kawasaki about maintenance parts and spare parts.	

1. Model	E97	
2. Enclosure	Open construction *	
3. Dimensions	Refer to Installation and Connection Manual	
4. Number of controlled axes	Max.6 axes	
5. Servo control and drive system	Full Digital Servo System	
6. Type of control	Teach mode	Joint, Base, Tool, Fixed Tool (option) operation mode
	Repeat mode	PTP, CP control mode Joint, Linear, Circular (option) interpolation
7. Teaching method	Teaching or AS language programming	
8. Memory capacity	8 MB	
9. External operation signals	External Motor Power Off, External Hold, etc.	
10. General purpose signals	Input signals	32 channels (Includes dedicated signals)
	Output signals	32 channels (Includes dedicated signals)
11. Operation panel	Teach/Repeat SW, Emergency Stop SW, Control power lamp	
12. Cable length	Power/Signal cable	10 m
	Teach Pendant cable	10 m
13. Mass	Refer to Installation and Connection Manual	
14. Power requirement	AC200 V - AC230 V±10%, 50/60 Hz, 1 phases, Max 4 kVA	
15. Ground	Less than 100 Ω (robot dedicated ground) Leakage current: max. 100 mA	
16. Ambient temperature	0 - 45 °C	
17. Relative humidity	35 - 85 % (non-condensation)	
18. Color	Munsell: 10GY9/1 equivalent	
19. Teach Pendant	TFT color display (6.4 inch LCD) with touch panel Emergency Stop,Teach Lock and Deadman Switches(3 position)	
20. Options		
General purpose signals	Input signals	64/96 channels
	Output signals	64/96 channels
I/O connector	D-SUB 37pin(male,female) with cover	
Operation panel	Motor Power ON, Cycle start, RUN/HOLD, Error reset, Error lamp	
Power/Signal cable	5m, 15m	
Teach Pendant cable	5m, 15m	
Enclosure	Enclosed indirect cooling system (Ambient temperature 0 - 40 °C)	
Auxiliary storage	USB memory	
Brake release	Brake release switch	
PC cable	1.5 m, 3 m	
Teach Pendant option	Connector for TP less	
Others	Field BUS, Software PLC, Analog input/output, Conveyor Synchronization, Vision and so on	
21. Others	Consult Kawasaki about maintenance parts and spare parts.	

NOTE* Cooling of the electronic components in this open construction E9x controller is achieved by circulation of ambient air. The enclosure is designed so that it protects personnel from contact with hazardous parts inside the controller but it cannot protect invasion of conductive dust like metal dust, non-conductive dust which becomes conductive due to condensation or moisture and water. In this case please select the optional “Enclosed indirect cooling system”.

3. Controller for Europe spec.

1. Model	E40/E42/E43/E44	
2. Construction	Self-sustaining fully closed, indirect cooling system	
3. Dimensions	Refer to Instruction Manual.	
4. Number of controlled axes	6 axes for E40/E42/E44, 5 axes for E43 (depends on number of axes of arm) option)	
5. Drive system	Full Digital Servo System	
6. Type of control	Teach mode	Joint, Base, Tool, Fixed Tool (option) operation mode
	Repeat mode	Joint, Linear, Circular (option) interpolation
7. Teaching method	Teaching or AS language programming	
8. Memory capacity	8 MB	
9. External operation signal	External Motor Power Off, External Hold, etc.	
10. General purpose signals	Input signals	32 channels (Includes dedicated signals)
	Output signals	32 channels (Includes dedicated signals)
11. Operation panel	Fast Check/Teach/Repeat SW, Emergency Stop SW, Control power lamp	
12. Cable length	Power/Signal cable	10 m
	Teach Pendant cable	10 m
13. Mass	Refer to Instruction Manual.	
14. Power requirement	AC380 V - AC415 V±10%, 50/60 Hz, 3 phases, Max 4.9 kVA(E40), Max 9.9 kVA(E42/E43/E44)	
15. Ground	Less than 100 Ω (robot dedicated ground) Leakage current: max. 10 mA	
16. Ambient temperature	0 - 45 °C	
17. Relative humidity	35 - 85 % (non-condensation)	
18. Color	Munsell: 10GY9/1 equivalent	
19. Teach Pendant	TFT color display (6.4 inch LCD) with touch panel Emergency Stop,Teach Lock and Deadman Switches	
20. Safety Circuit	Category: 3, Performance Level: d (EN ISO13849-1: 2008) *	
21. AC Outlet	AC220 - 240V Outlet (depends on Primary input voltage)	
22. Motor brake release	Manual brake release switch	
23. Options		
General purpose signals	Input signals	64/96/128 channels
	Output signals	64/96/128 channels
I/O connector	D-SUB 37pin (male,female) with cover	
Operation panel	Motor Power ON, Cycle start, RUN/HOLD, Error reset, Error lamp	
Power/Signal cable	5m, 15m	
Teach Pendant cable	5m, 15m	
Auxiliary storage	USB memory	
PC cable	1.5 m, 3 m	
Teach Pendant option	Teach Pendant Stand, Cable hook, connector for TP less	
Others	Cooler, LED Light, Field BUS, Software PLC, Analog input/output, Conveyor Synchronization, Vision and so on	
24. Others	Consult Kawasaki about maintenance parts and spare parts.	

NOTE* Category and Performance level (PL) are determined by the whole system and conditions. The safety circuit of this controller is available in the system of category: up to 3, PL: up to d.

1. Model	E70/E71	
2. Construction	Self-sustaining fully closed, indirect cooling system	
3. Dimensions	Refer to Instruction Manual.	
4. Number of controlled axes	6 axes 8 (max.) axes (two built-in amp. addition, option)	
5. Drive system	Full Digital Servo System	
6. Type of control	Teach mode	Joint, Base, Tool, Fixed Tool (option) operation mode
	Repeat mode	Joint, Linear, Circular (option) interpolation
7. Teaching method	Teaching or AS language programming	
8. Memory capacity	8 MB	
9. External operation signal	External Motor Power Off, External Hold, etc.	
10. General purpose signals	Input signals	32 channels (Includes dedicated signals)
	Output signals	32 channels (Includes dedicated signals)
11. Operation panel	Fast Check/Teach/Repeat SW, Emergency Stop SW, Control power lamp	
12. Cable length	Power/Signal cable	10 m
	Teach Pendant cable	10 m
13. Mass	Refer to Instruction Manual.	
14. Power requirement	AC200 V - AC240 V±10%, 50/60 Hz, 1 phases, Max 1.5 kVA (E70), Max 3 kVA (E71)	
15. Ground	Less than 100 Ω (robot dedicated ground) Leakage current: max. 100 mA	
16. Ambient temperature	0 - 45 ℃ (Holizontal mount), 0 - 40℃ (Vertical mount)	
17. Relative humidity	35 - 85 % (non-condensation)	
18. Surface Treatment	Zinc Plating, Trivalent chromate finish	
19. Teach Pendant	TFT color display (6.4 inch LCD) with touch panel Emergency Stop,Teach Lock and Deadman Switches (3 position)	
20. Safety Circuit	Category: 3, Performance Level: d (EN ISO13849-1: 2008) *	
21. Options		
General purpose signals	Input signals	64/96 channels
	Output signals	64/96 channels
I/O connector	D-SUB 37pin (male,female) with cover	
Operation panel	Motor Power ON, Cycle start, RUN/HOLD, Error reset, Error lamp	
Power/Signal cable	5m, 15m	
Teach Pendant cable	5m, 15m	
Motor brake release	Manual brake release switch BOX	
Auxiliary storage	USB memory	
PC cable	1.5 m, 3 m	
Teach Pendant option	Connector for TP less	
Others	Cooler, LED Light, Field BUS, Software PLC, Analog input/output, Conveyor Synchronization, Vision and so on	
24. Others	Consult Kawasaki about maintenance parts and spare parts.	

NOTE* Category and Performance level (PL) are determined by the whole system and conditions. The safety circuit of this controller is available in the system of category: up to 3, PL: up to d.

1. Model	E91	
2. Enclosure	Enclosed, indirect cooling type	
3. Dimensions	Refer to Installation and Connection Manual	
4. Number of controlled axes	Max.6 axes	
5. Servo control and drive system	Full Digital Servo System	
6. Type of control	Teach mode	Joint, Base, Tool, Fixed Tool (option) operation mode
	Repeat mode	PTP, CP control mode Joint, Linear, Circular (option) interpolation
7. Teaching method	Teaching or AS language programming	
8. Memory capacity	8 MB	
9. External operation signals	External Motor Power Off, External Hold, etc.	
10. General purpose signals	Input signals	32 channels (Includes dedicated signals)
	Output signals	32 channels (Includes dedicated signals)
11. Operation panel	FastCheck/Teach/Repeat SW, Emergency Stop SW, Control power lamp	
12. Cable length	Power/Signal cable	10 m
	Teach Pendant cable	10 m
13. Mass	Refer to Installation and Connection Manual	
14. Power requirement	AC200 V - AC230 V±10%, 50/60 Hz, 1 phase, Max. 4 kVA	
15. Ground	Less than 100 Ω (robot dedicated ground) Leakage current: max. 100 mA	
16. Ambient temperature	0 - 40℃	
17. Relative humidity	35 - 85 % (non-condensation)	
18. Surface Treatment	Munsell: 10GY9/1	
19. Teach Pendant	TFT color display (6.4 inch LCD) with touch panel Emergency Stop,Teach Lock and Deadman Switches(3 position)	
20. Safety Circuit	Category: 3, Performance Level: d (EN ISO13849-1: 2008) *	
21. Options		
General purpose signals	Input signals	64/96 channels
	Output signals	64/96 channels
I/O connector	D-SUB 37pin(male,female) with cover	
Power/Signal cable	5m, 15m	
Teach Pendant cable	5m, 15m	
Motor brake release	Manual brake release switch BOX	
Auxiliary storage	USB memory	
PC cable	1.5 m, 3 m	
Teach Pendant option	Connector for TP less	
Others	Field BUS, Software PLC, Analog input/output, Conveyor Synchronization, Vision and so on	
22. Others	Consult Kawasaki about maintenance parts and spare parts.	

NOTE* Category and Performance level (PL) are determined by the whole system and conditions. The safety circuit of this controller is available in the system of category: up to 3, PL: up to d.

1.4 ROBOT ARMS TO BE CONNECTED

Robot arms from small to large-size can be connected to the E series controllers.　The table below shows rough arm-controller combinations.　For further information, please refer to our catalogues and standard specifications.

	E70/73/76	E71/74/77	E91/E94/ E97	E10/20/ 30/40	E12/22/ 32/42	E13/23/ 33/43	E14/24/ 34/44
Extra small robot	R series: 03N						
Small robot		R series: 05N/05L/ 06L/10N	Y series R series: 10L/20N	Y series R series: 05-20			
Medium/Large robot					R series: 30-80 B series Z series MT series	ZD series	
Extra large robot							MX series MD series

1.5 RELEVANT OPERATION MANUALS

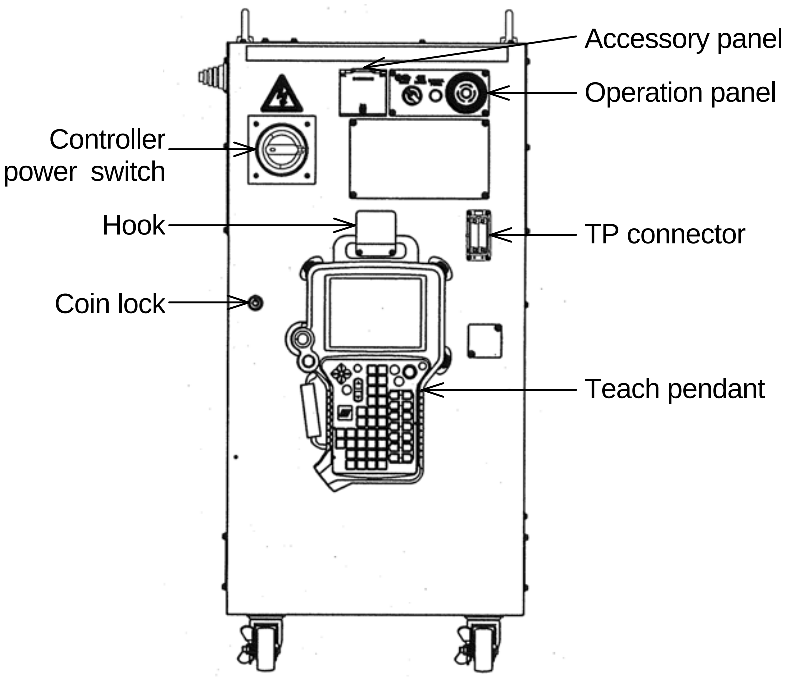
This manual explains the standard functions common to all E series controller models (standard spec.) and some of the additional functions available as options.　For optional functions not described in this manual, see the separate-volume option manuals.

2.0 SWITCHES, KEYS AND DISPLAYS

This chapter describes overview of the controller, the various kinds of switches which are equipped with this controller, and the hardware keys and the displays on the teach pendant (hereinafter called TP).

2.1 OVERVIEW OF CONTROLLER

The figure below shows the external front view of this controller. A controller power switch, an accessory panel, an operation panel, etc. are equipped on the front side of the controller. Use the TP by connecting the cable to the connector on the front side of the controller, and place it on the hook of the controller when not in use.



	Description
Controller power switch	Power ON/OFF switch for this controller
Teach pendant	Provides the keys necessary for robot teaching and data editing, and a screen for displaying and operating various kinds of data.
Accessory panel	USB port for external storage device and RS-232C port for PC connection are provided inside.
Operation panel	Provides various kinds of switches necessary for operating the robot.
TP connector	Connector to connect the TP
Hook	Hook to hang TP cable on
Coin lock	Lock for locking the controller door

DANGER

If TP cable is removed and replaced by short circuit connector, and then later reinserted into the connector, be sure to confirm operation of the E-STOP switch on the TP without fail before using the robot.

2.2 SWITCHES ON THE CONTROLLER

This section describes switches and lamps equipped on the operation panel and optional operation panel of the controller.

	No.	Switch and Lamp	Function
Operation panel	1	TEACH/REPEAT (Teach/Repeat switch)	Switches the mode to Teach[*] or Repeat[**]. (Japan spec. and North America spec.: standard)
		100%/TEACH/REPEAT (100%/Teach/Repeat switch)	Switches the mode to Fast check, Teach[*] or Repeat[**]. (Japan spec.: optional, North America spec.: unavailable, Europe spec.: standard)
	2	CONTROL POWER (Controller power lamp)	Lights when the controller power is ON.
	3	Emergency stop button	Intercepts motor power and stops the robot when this button is pressed in an emergency. At the same time, the <MOTOR> lamp and <CYCLE> lamp on TP are turned OFF. However, the controller power is not cut OFF.
Optional operation panel	4	CYCLE START (Cycle start button with lamp)	When pressed in repeat mode, repeat operation[***] starts and this lamp lights.
	5	MOTOR POWER (Motor power button with lamp)	Turns motor power ON when pressed. The lamp lights for successful powering up.
	6	HOLD/RUN (Hold/Run switch)	Allows robot to move (RUN) or stops the robot temporarily (HOLD). HOLD/RUN is also provided on the TP. However, when using the optional operation panel, robot cannot be activated unless both switches are set to RUN. For example, when this switch is set to HOLD, robot remains in HOLD even if A+RUN on TP is pressed.
	7	ERROR RESET (Error reset button)	Turns OFF error lamp when pressed to release the error. If errors continue to occur, the errors cannot be released.
	8	ERROR (Error lamp)	Lights when errors occur.

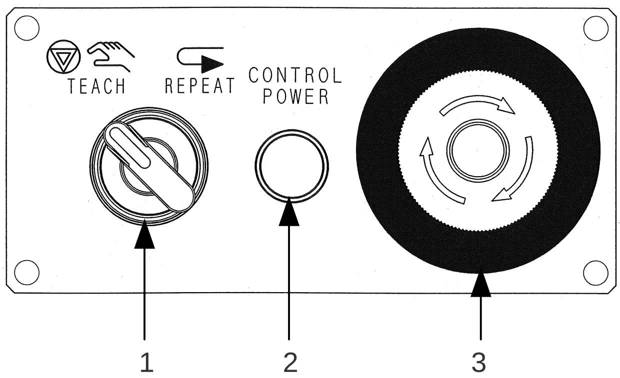
NOTE[*] Selected when teaching an instruction or its parameter to a robot or when operating a robot manually using the operation box called TP. Repeat operation is not possible while in teach mode though check operation is possible.

NOTE** The mode for repeat operation

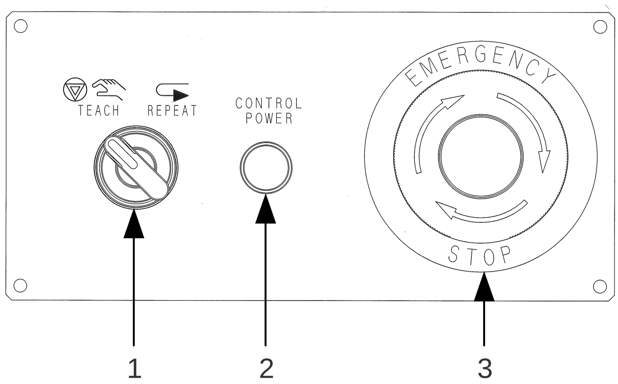
NOTE*** Condition in which the robot automatically works and executes a memorized program continuously.

Operation panel

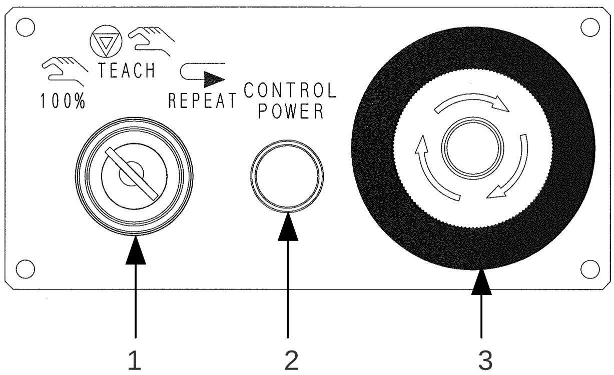
Japan spec. (Standard)



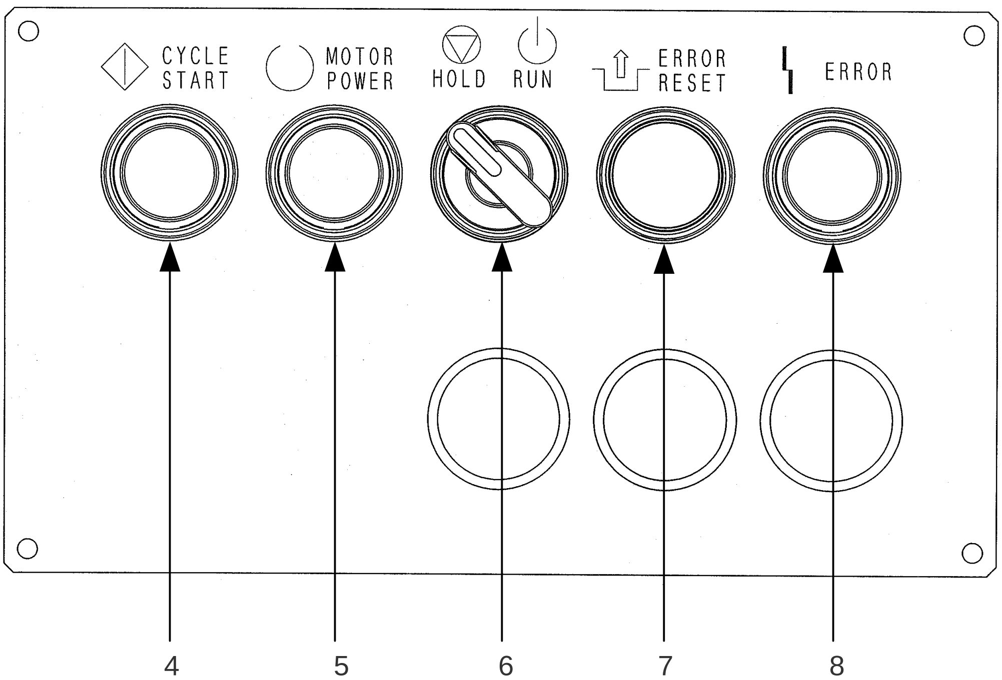
North America spec. (Standard)



Europe spec. (Standard)

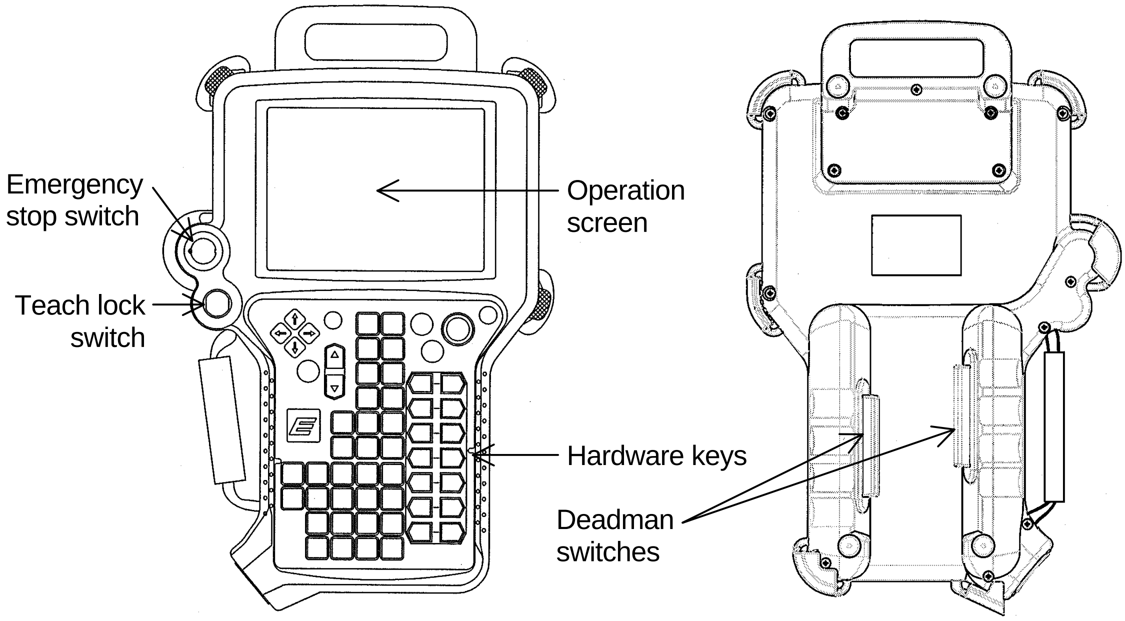


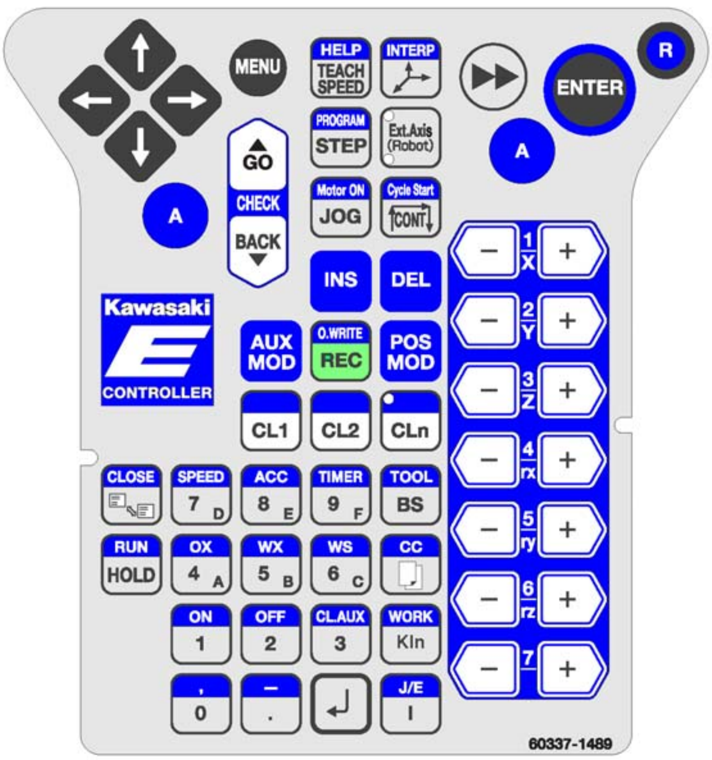
Optional operation panel



2.3 OVERVIEW OF TEACH PENDANT

Figures below (top) show the overview of TP. TP provides hardware keys and switches which are necessary for manual operation of robot and data editing, and a screen for editing/displaying various kinds of data. Figure (bottom) shows the arrangement of the hardware keys.

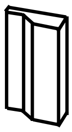


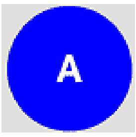
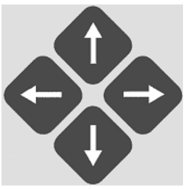
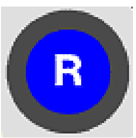


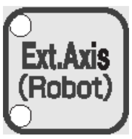
This teach pendant is compatible with most robot models and applications, except explosion-proof painting applications. For arc welding applications, the hard key layout sheet differs from that shown above.

2.4 SWITCHES ON TEACH PENDANT AND FUNCTIONS OF HARDWARE KEYS

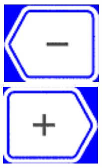
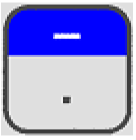
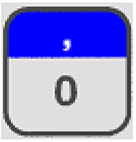
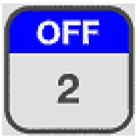
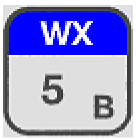
The function of each switch and hardware key on the TP is as follows.

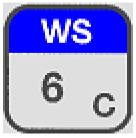
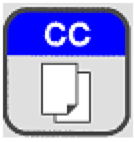
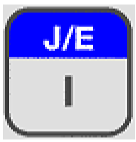
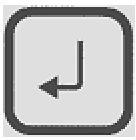
Switches	Function
 Emergency stop	Cut OFF the motor power and stops the robot. To release emergency stop, turn this button to the right until the button returns to its original position.
 Teach lock	Turning ON this switch (in teach mode) enables manual and check motions. Turning OFF this switch (in repeat mode) enables repeat operations. **Note:** Make sure this switch is turned ON before starting teaching operation to prevent robot from being operated in repeat mode erroneously.
 Deadman	This is the enable switch. Robot axes cannot operate manually without pressing this switch. Motor power cuts OFF and robot stops if switch is fully depressed to its third deadman position, or if it is released completely.

Keys	Function	Functions when pressing [A] key
	Used with other key. The function on the upper part of the key is enabled when it is pressed with this [A] key.	
	Displays a pull-down menu of an active area.	
	Moves the cursor. Used to move the cursor between items and screens, or to change the step.	[A] + [↑]: Moves to a previous step in teaching or editing. [A] + [↓]: Moves to a next step in teaching or editing.
	Functions in same manner as [↵] key, except that this key does not register data input by keyboard screen.	
	Erases data in the input box, calls R code input box, returns to the previous screen, etc. The R codes list appears when pressing [A]+[HELP] with the R code input box displayed.	Captures a displayed screen image and save it in USB memory as a graphics file (PNG).

Keys	Function	Functions when pressing A key
	When the Fast Check function is enabled, pressing CHECK + this key conducts check operations at fast speed.　Called Fast Check key hereinafter. (E2x: optional, E3x: unavailable, E4x: standard)	
	Advances a step in check mode.　Used as a step forward key for a single step operation in repeat mode.	Advances a step when [Continuous Step Mode] in Aux. 0807 is set to [Disable] and the check mode is set to [Check Once].
	Moves back a step in check mode.	Moves back a step when [Continuous Step Mode] in Aux. 0807 is set to [Disable] and the check mode is set to [Check Once].
	Sets speed level for manual and check operations. 1 → 2 → 3 → 4 → 5 → 1 **Note:** Default is slow speed (speed 2). (Not 1 for inching)	Pressing this key after pressing KIn, R, etc., displays help information. While in teach screen or interface panel, press A + this key to display customer-created help screen. While in auxiliary function, press A + this key to display help information for that auxiliary function.　See Chapter 2.12 for details.
	Selects the coordinate system for manual operation.　Press this key to switch among operation modes. Joint → Base → Tool → Joint This key is called COORD(INATES) key hereinafter. **Note:** Default is Joint coordinate system.	Selects the type of interpolation instruction.　Press A + this key to switch among interpolated motion modes: Joint→Linear→Lin(ear)2→ Cir(cular)1→Cir(cular)2→ F Lin(ear)→F Cir(cular)1→ F Cir(cular)2→X Lin(ear)→Joint.
	Displays the step selection menu.	Displays the program selection menu.
	Switches illumination of upper (/lower) LED to enable AXIS to operate external axis groups: JT15-JT18 (/JT8-JT14).	

Keys	Function	Functions when pressing $\boxed{\text{A}}$ key
Motor ON JOG	Increases robot motion speed in teach or check mode. **Note:** Effective only while being pressed.	Turns ON the motor power when the motor power is OFF.　Conversely, turns OFF the motor power when the motor power is ON. **Note:** Motor power cannot be turned OFF during robot motion.
Cycle Start CONT	Sets how program is repeated in check mode.　Toggles between Once and Continuous. **Note:** Turning OFF controller power switches to Check Once mode.	Starts cycle operation in repeat mode.
INS	Inserts new steps to a program.	
DEL	Deletes recorded program steps.	
AUX MOD	Edits auxiliary data.	
O.WRITE REC	Adds a new step following the current step.	Overwrites the new step onto the current step.
POS MOD	Modifies pose data.	
CL1	Switches the signal data for clamp 1 instruction: ON→OFF→ON.	Switches both the signal data for clamp 1 instruction and the actual clamp 1 signal.: ON→OFF→ON.
CL2	Switches the signal data for clamp 2 instruction: ON→OFF→ON.	Switches both the signal data for clamp 2 instruction and the actual clamp 2 signal.: ON→OFF→ON.

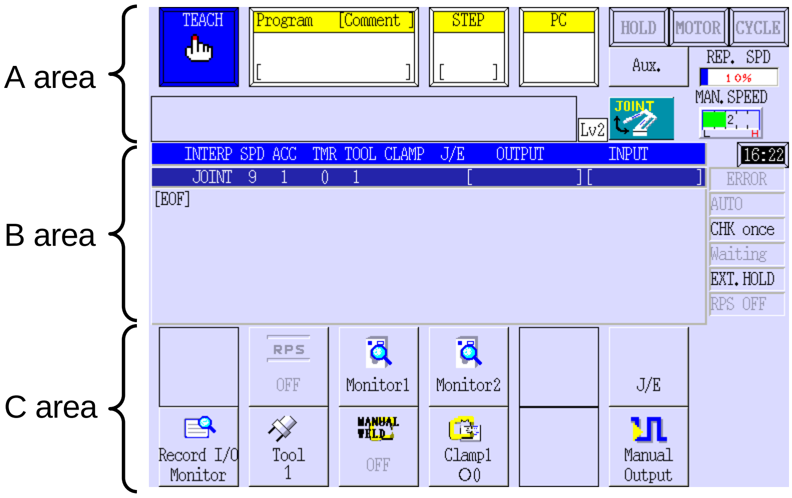
Keys	Function	Functions when pressing A key
	Switches clamp-n signal ON or OFF. When pressed, LED on key turns ON(red)/ OFF.　CLn + NUMBER (1～8) switches the signal data for the specified clamp-n instruction.: ON→OFF→ON.　LED turns red when clamp-n signal is ON.	A + CLn + NUMBER (1～8) switches both the signal data for clamp instruction and the actual clamp signal of the specified clamp no.: ON→OFF→ON.
	Moves each axis from JT1 to JT7.　Called AXIS keys hereinafter.	
	“.”.	“-”.
	Inputs “0”.	Inputs “,”.
	Inputs “1”.	Turns ON the specified actual clamp signal forcibly.
	Inputs “2”.	Turns OFF the specified actual clamp signal forcibly.
	Inputs “3”.	Calls up input screen for the clamp auxiliary (OC) instruction data during block teaching.
	Inputs “4”.	Calls up input screen for the output (OX) instruction data during block teaching.　Inputs “A” for non-block teaching.
	Inputs “5”.	Calls up input screen for the input (WX) instruction data during block teaching.　Inputs “B” for non-block teaching.

Keys	Function	Functions when pressing A key
	Inputs "6".	Calls up input screen for the WS instruction data during block teaching. Inputs "C" for non-block teaching.
	Inputs "7".	Calls up input screen for the speed instruction data during block teaching. Inputs "D" for non-block teaching.
	Inputs "8".	Calls up input screen for the accuracy instruction data during block teaching. Inputs "E" for non-block teaching.
	Inputs "9".	Calls up input screen for the timer instruction data during block teaching. Inputs "F" for non-block teaching.
	Deletes data before the cursor.	Calls up input screen for the tool instruction data during block teaching.
	Shows/hides the interface panel screen. Other screens are not displayed when pressing this key. Called I/F Screen Change key hereinafter.	Calls up input screen for the CC instruction data during block teaching.
	Specifies KI-instruction number directly.	Calls up input screen for the workpiece instruction data during block teaching.
	Activates program editing function. (Selects screens other than block teaching screen, such as: AS language teaching, pose teaching, program editing screens.)	Switches the setting of J/E (Jump / End) instruction.
	Registers input data	
	Changes the active screen each time it is pressed. Called Screen Change hereinafter.	Closes the currently activated monitor screen.

Keys	Function	Functions when pressing A key
	Puts the robot into hold (stop) state.	Puts the robot into run (active) state.

2.5 TEACH PENDANT DISPLAY SCREEN

A liquid crystal display is provided on the TP. The screen is divided into 3 areas: A, B and C.



B and C areas have active and inactive states, and the functions inside active areas are operable. The procedures below describe how to distinguish between active and inactive states and to switch between the two states.

2.5.1 ACTIVE/INACTIVE

To distinguish which area is active or currently selected, windows and characters in the B and C areas have different colors in teach and repeat modes. Refer to the table below.

	B area		C area	
	Teach mode	Repeat mode	Teach mode	Repeat mode
Active	Blue	Green	Blue	
Inactive	Gray			

2.5.2 SWITCHING ACTIVE AREAS

Pressing Screen Change makes either the B or C area active.　Pressing B area directly also activates the B area.

[NOTE]

1. Switching of active areas or screens is not possible when error messages, warnings and confirmation boxes are on screen.
2. The screens cannot be switched by an external signal.

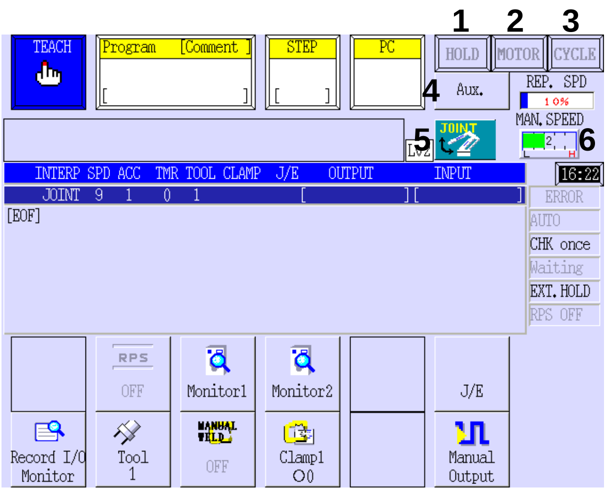
2.6 OPERATION KEYS ON TEACH PENDANT SCREEN

TP screen consists of several operation keys and display areas.

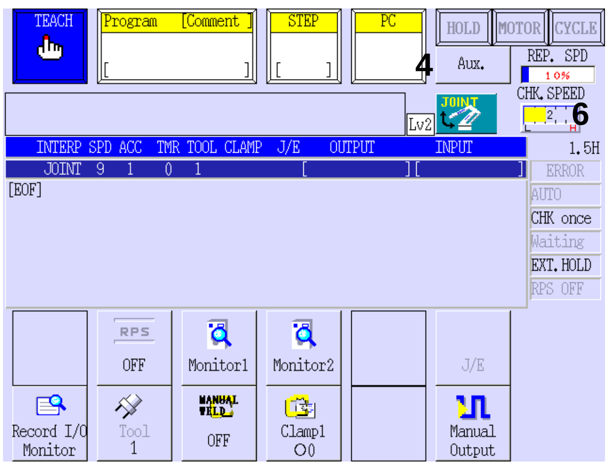
This section describes the function of the operation keys, including:
F (function) keys, operation keys other than the F keys, and operation keys displayed only on repeat mode screen.　Appearance of TP screen differs slightly depending on robot application.　The screen for spot welding and handling applications is shown below.

2.6.1 OPERATION KEYS OTHER THAN F (FUNCTION) KEYS

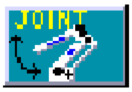
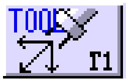
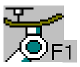
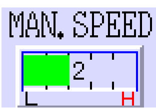
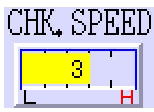
This section describes operation keys 1-6 shown below.　When pressing A, keys 4 and 6 change as shown below right.



When pressing A

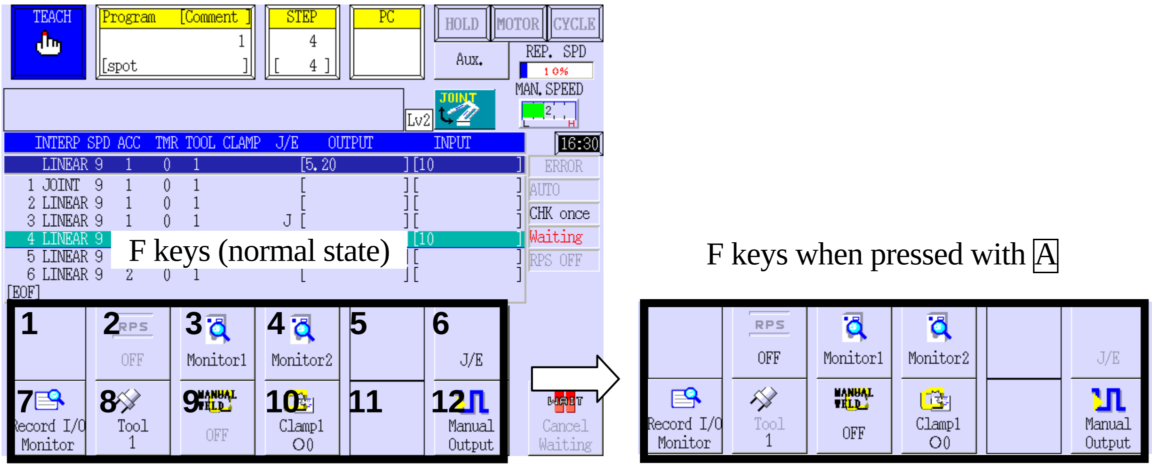


No.	Operation key	Functions	When pressed with $\boxed{\text{A}}$	
			Operation key	Function
1		Unavailable	HOLD RUN	Activates/stops a robot. When robot is stopped, "HOLD" is displayed. When robot is activated, "RUN" is displayed as shown on the left.
2		Unavailable	MOTOR MOTOR	Turns ON/OFF motor power. When motor power turns ON, the key lights up as shown on the left.
3		Unavailable	CYCLE CYCLE	Turns ON the cycle operation. The key lights up as shown on the left while cycle operation is ON.
4	Aux.	Displays the Auxiliary Function screen when this key is pressed.	Aux. CONDITION	For standard spec., displays the Auxiliary Function screen when this key is pressed. For servo welding gun/sealing spec., displays the screen for setting the data of spot welding/sealing operation.

No.	Operation key	Functions	When pressed with A	
			Operation key	Function
5		<Coord(inates)> key. Sets the coordinate system for manual operation in teach mode. Key changes as follows each time it is pressed: Joint (coordinates) → Base (coordinates) → Tool (coordinates) → Joint (coordinates)		
		This icon is displayed during QTOOL ON, and the tool number is displayed on lower right of icon. Toggles among T1 → T2 → …→ T9.		
		Fixed tool number displays on lower right of icon when robot system is specified as Fixed Tool Mode (option). Toggles among: F1 → F2 → F3…→ F9.		
6		Selects the speed level for manual operation. Pressing the key switches between levels (1 to 5, 1 for inching) **Note:** Pressing JOG in teach (manual) speed 1 or 2 moves robot in teach speed 3.		Selects the speed level for the check speed. Pressing the key switches between levels (1 to 5).

2.6.2 F KEYS (FUNCTION KEYS)

The table below describes the function of the F keys (1-12) on teach mode screen for handling/ spot welding specification.　When $\boxed{A}$ is pressed, F keys change as shown on the right.　Note that different F keys appear on repeat mode screen.　For more details, refer to Chapter 2.6.3. The F keys for sealing specification, refer to Chapter 16.

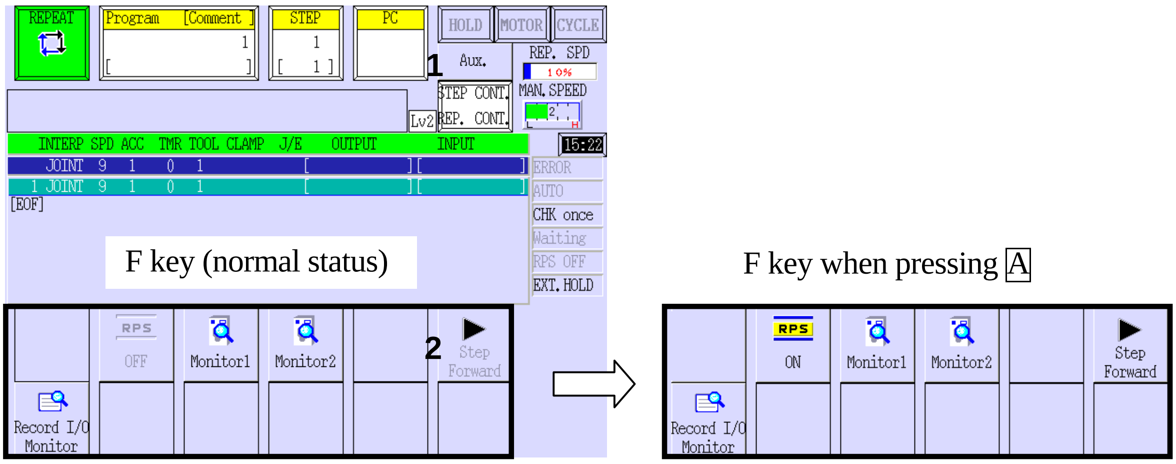


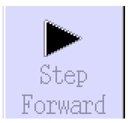
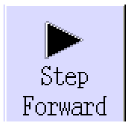
No.	Operation key	Functions	When pressed with $\boxed{A}$ key	
			Operation	Functions
1		Unavailable		Unavailable
2	RPS ON	(Unavailable when the icon is shown shaded.)	RPS ON	Selects whether or not to enable RPS.　The current status is indicated on the F key.　When RPS is enabled, “RPS” is displayed in the status area on the right part of the teach screen.　Press this key to switch between RPS ON and RPS OFF.
3	Monitor1	Displays indicated items of Monitor 1.(e.g., axis data)..	Monitor1	Displays indicated items of Monitor 1.(e.g., axis data).
4	Monitor2	Displays indicated items of Monitor 2. (e.g., axis data).	Monitor2	Displays indicated items of Monitor 2. (e.g., axis data).

No.	Operation key	Functions	When pressed with $\boxed{A}$ key	
			Operation	Functions
5		Unavailable		Unavailable
6	J/E	Records jump and end instructions.　Toggles between jump and end instructions: OFF → J → E → OFF	J/E	(Unavailable when the icon is shown shaded.)
7	Record I/O Monitor	Displays name of IO signal taught in current step.　Nothing displays if signal not taught in selected step.	Record I/O Monitor	Displays name of IO signal taught in current step.　Nothing displays if signal not taught in selected step.
8	Tool 2	Sets the tool number as the parameter value for the tool instruction.　Number shown on key is currently selected tool number.	Tool 2	(Unavailable when the icon is shown shaded.)
9	MANUAL WELD OFF	(Unavailable when the icon is shown shaded.)	MANUAL WELD OFF	Turns ON/OFF manual welding.　Red sparks are shown when welding is ON.
10	Clamp1 O0	Turns ON/OFF the clamp instruction for spot welding by using pneumatic gun,.　Set data (O/C) of OC instruction and set number (0-9) of CC instruction are displayed at the bottom of the icon.　For details, see Chapter 5.　For servo weld gun, see the optional manual “Servo Weld Gun Instruction Manual”.	Clamp1 O0	Unavailable for pneumatic gun.　For servo weld gun, see the optional manual “Servo Weld Gun Instruction Manual”.
11		Unavailable		Unavailable
12	Manual Output	Sends output signal manually.　Also resets all the signals when setting the signal number to 0.	Manual Output	Sends output signal manually.　Also resets all the signals when setting the signal number to 0.

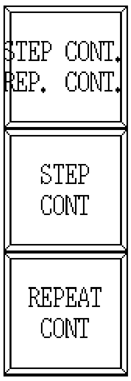
2.6.3 OPERATION KEYS ON REPEAT MODE SCREEN

This section describes functions of operation keys displayed on repeat mode screen (labeled 1 and 2 in screen below).　When A is pressed, key 2 changes as shown on the right.



No.	Operation key	Functions	When pressed with A	
			Operation key	Functions
1		Sets repeat conditions*. Current setting is displayed on the key.		Unavailable
2		(Unavailable when the icon is shown shaded.)		Used to execute steps one by one when [Step Once] is selected.

NOTE* There are four (4) repeat conditions as shown in the table below.　Pressing this key displays keys for selecting Step Once/Continuous and Repeat Continuous/Once as shown below.　Press the key and set repeat conditions.　The repeat conditions can also be set by the method shown in Chapter 2.7.1.3.

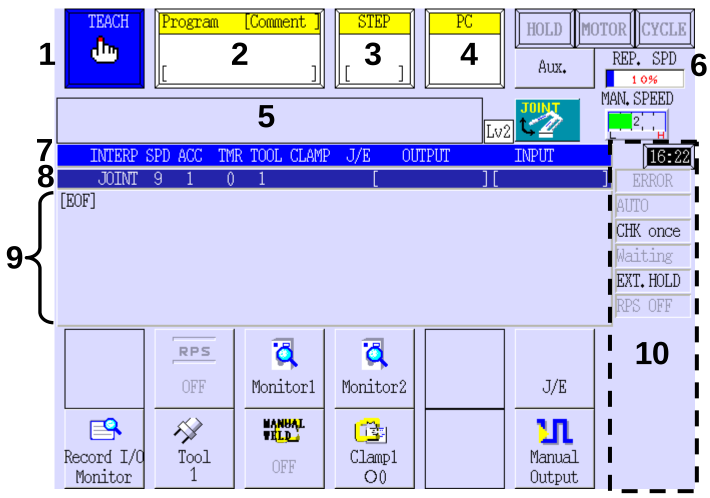


		Step	
		ONCE	CONTINUOUS
Repeat	ONCE	Executes one step and then stops. (Cycle operation stays ON.) Pressing $\boxed{A}$ + <Step Forward> executes the next step. Program execution stops at the last step*.	The steps are executed continuously. Program execution stops when the last step* is reached.
	CONTINUOUS	Steps are executed one by one as above. (Cycle operation stays ON.) Pressing $\boxed{A}$ + <Step Forward> executes the next step. When the last step* is reached, program repeats from the first step. When RPS is ON, execution program is changed by program selection signal at the step with END instruction.	The steps are executed continuously, and when the last step* is reached, program repeats from the first step. When RPS is ON, execution program is changed by program selection signal at the step with END instruction. This is the setting for normal repeat operations.

NOTE* The step with either largest step number or END instruction

2.7 DETAILS OF DISPLAY AREAS OF THE TEACH PENDANT

A and B areas of the TP screen are divided into nine areas (1-10) as shown below.　This section describes their names and their functions.　Icons on the upper right screen change according to the robot status.



No.	Areas	Description
1	Teach/Repeat Area	Displays the information on Teach/Repeat mode.　The color of the window changes to blue in Teach mode and to green in Repeat mode.
2	Program/Comment Area	Top row displays the current program number. Second row displays the program comment.　Pressing this area displays a pull-down menu.　For details, see Chapter 2.7.1.
3	Step Area	Top row displays the current step number. Second row displays the axis coincidence comment. Pressing this area displays a pull-down menu.　For details, see Chapter 2.7.1.
4	PC Program Area	Displays information about the currently executing PC program.　Max. five programs can be run, and three programs run first are displayed here.　The PC program which is being executed has a * on its left.
5	Message Area	Displays error messages and various information.
6	Repeat Speed Area	Displays the monitor speed when operating robot in repeat mode.　Pressing this area displays a pull-down menu. For details, see Chapter 2.7.1.
7	Element Instructions Setting Area (Element instructions row)	Displays the element instructions that are included in a compound instruction.
8	Parameter Values Setting Area (Parameter row)	Displays parameter values, including auxiliary data and excluding pose data, for element instructions in currently displayed step.
9	Program Area (Auxiliary data row)	Displays the content of the taught program.　Pressing this area displays the pull-down menu.　For details, see Chapter 2.7.1.
10	Status Area (Area enclosed with a dotted line)	Displays the current robot status. 1. Items that are always displayed in fixed places: Error, AUTO, CHK cont/CHK once, Waiting 2. Items that are displayed in various places as they occur: (Some are not displayed depending on the spec.) External hold, Emergency stop, Gun No., Dry run, etc. 3. Items that are displayed in fixed places when necessary: Wait cancel

2.7.1 PULL-DOWN MENU FUNCTIONS

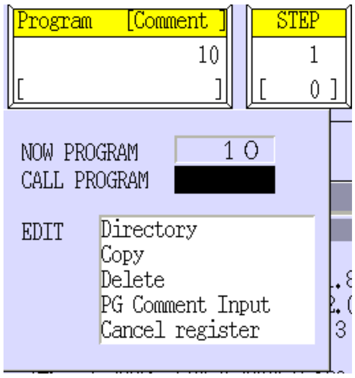
Pull-down menus are provided in the areas indicated by 2, 3, 6 and 9 in Chapter 2.7. The pull-down menu functions of each area are explained below.

2.7.1.1 PROGRAM/COMMENT AREA

The pull-down menu in this area has seven functions. Refer to the figure below.

CAUTION

The TP display is pressure sensitive and items on screen can be selected by fingers, pens, pointers, etc. However, use caution not to soil or damage the screen's liquid crystal during operations.



[NOTE]

1. The cursor is on [CALL PROGRAM] when the pull-down menu is displayed.
2. The pull-down menu closes when switching active areas or screens while the menu is displayed.

1. [NOW PROGRAM]

Displays the name of the current program. When teaching a new program, nothing is displayed.

2. [CALL PROGRAM]

The desired program can be created or an existing program can be selected by inputting its number if the program name consists of "pg" and a number. (Only the program number without "pg" is displayed.) Display the pull-down menu, and specify it by the following method.

(1) Press NUMBER (0-9). (Specifies the program name.)

(2) Pressing ↵ displays the specified program name in the [NOW PROGRAM] and the program/comment area.

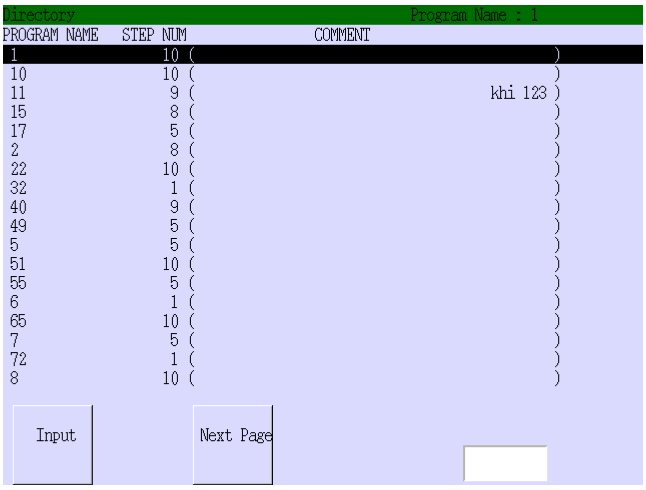
[NOTE]

1. When inputting a wrong number, press R and re-enter.
2. This operation is possible only when the program name consists of “pg” and numbers.　Programs can have a max. of five digits in its name.

3. [Directory]

Displays a list of registered programs, and the desired program can be chosen from the list. After displaying the pull-down menu, choose it by the following method.

(1) Move the cursor to [Directory] and press ↵ to display the program selection screen as shown below.　When the screen has more than one page, press <Next Page> or <Prev. Page>.



(2) Move cursor to a desired program and press ↵.　Or, move cursor to <Input> and press ↵ to display the keyboard screen, input the program name, and press ↵ or <ENTER> on the keyboard screen*.

NOTE* Refer to Chapter 2.8 for more information about the keyboard screen.

(3) The selected program name is displayed in the program/comment area.

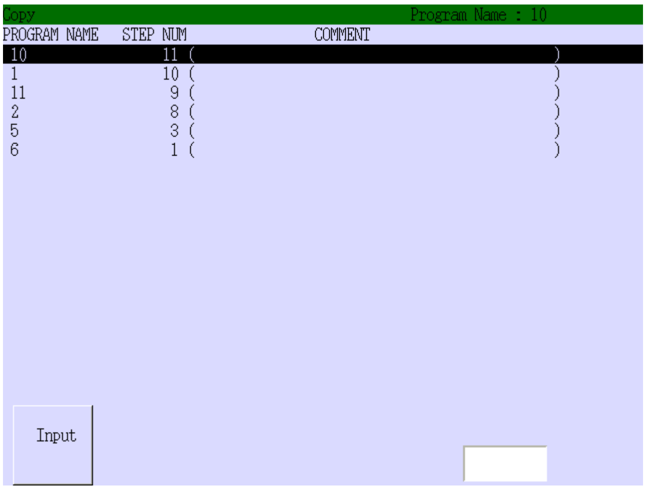
[NOTE]

1. When inputting a wrong program number in step (2), press BS and re-enter.
2. Close this function by pressing R at the program selection screen.

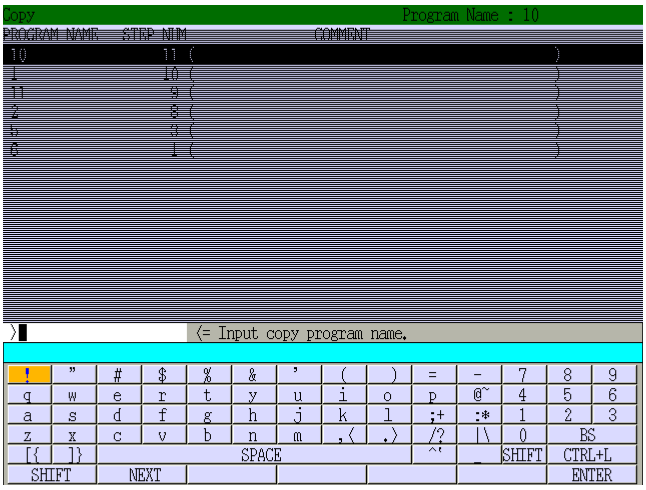
4. [Copy]

Copies the content of the selected program. After displaying the pull-down menu, copy it by the following method.

(1) Move the cursor to [Copy] and press ↵ to display the program copy screen as shown below.



(2) Select the program to copy and press ↵ to display the keyboard screen as shown below. Input the program name for the copy destination and press <ENTER> on the keyboard screen. (An error occurs when an existing program name is input.)



(3) Teach screen is redisplayed after copying the selected program.

[NOTE]

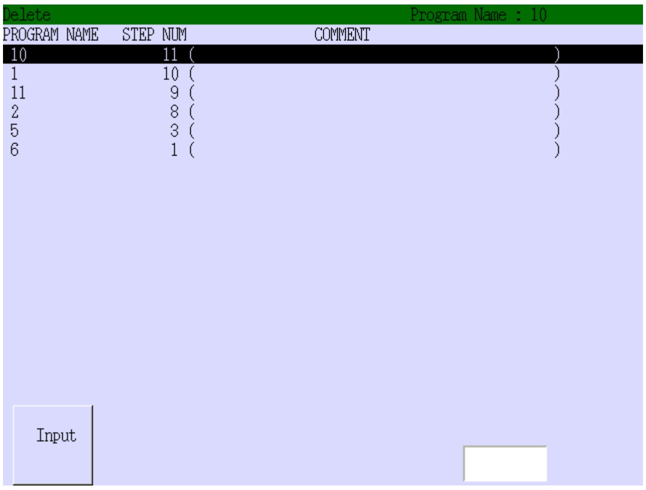
Close the copy function by pressing R at the program selection screen.

5. [Delete]

Deletes a selected program. After displaying the pull-down menu, delete it by the following method.

(1) Move the cursor to [Delete] and press ↵ to display the delete screen as shown below. Select the program to delete and press ↵. Or, move cursor to <Input> and press ↵ to display the keyboard screen, input the program name, and press ↵ or <ENTER> on the keyboard screen*.

NOTE* Refer to Chapter 2.8 for more information about the keyboard screen.



(2) The confirmation box is displayed as shown below.

(3) Selecting [Yes] deletes the selected program and redisplays the teach screen.

(4) Selecting [No] redisplays the teach screen without deleting the selected program.

[NOTE]

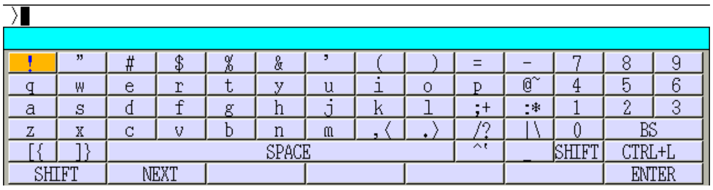
1. [No] is selected by default when confirmation dialog is displayed.
2. Close the delete function by pressing R at the program selection screen.

6. [PG Comment Input]

Inserts comments in the comment area of the selected program.　After displaying the pull-down menu, input by the following method.

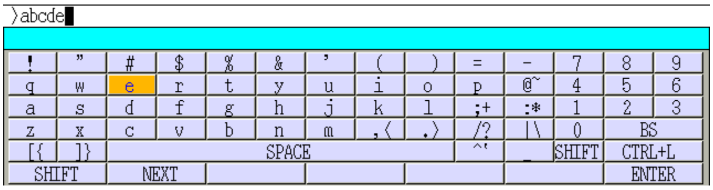
(1) Select the program to input a comment into.　For the procedure for the program selection, see “2. CALL PROGRAM” or “3. Directory”.

(2) Redisplay the pull-down menu, move cursor to [PG Comment Input] and press ↵ to display the comment input screen as shown below

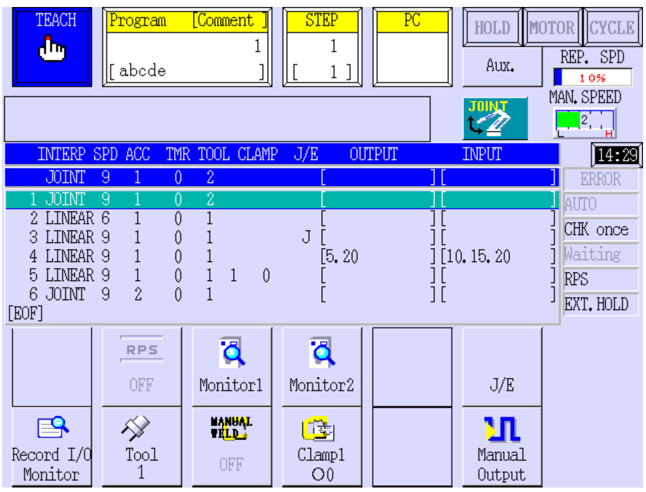


(3) Input a comment in the keyboard screen and press <ENTER> on the keyboard*.

NOTE* Refer to Chapter 2.8 for more information about the keyboard screen.



(4) Teach screen is redisplayed, and the input comment (up to 18 one-byte characters) is now displayed for the selected program.



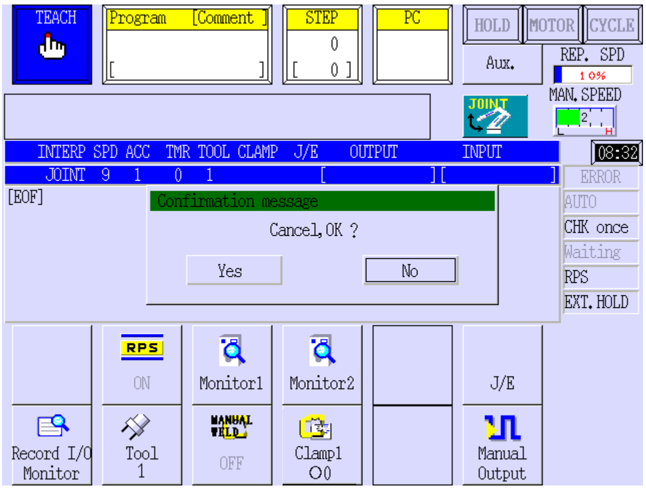
[NOTE]

Close this function by pressing R at the comment input screen.

7. [Cancel register]

Clears the program from the program/comment area. After displaying the pull-down menu, cancel the program by the following procedure.

(1) Move the cursor to [Cancel register] and press ↵ to display the confirmation box as shown below.



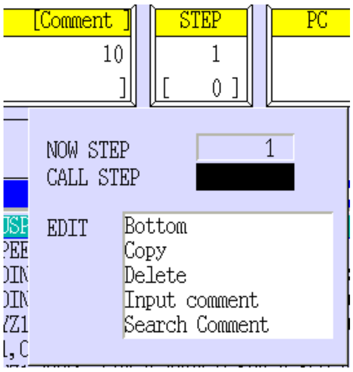
(2) Selecting [Yes] cancels the program registration. Program and comment area become blank. Selecting [No] keeps the program.

[NOTE]

[No] is selected when the confirmation box is displayed.

2.7.1.2 STEP AREA

The pull-down menu in this area has the following functions.



> **[NOTE]**
> The cursor is on [CALL STEP] when the pull-down menu is displayed.

1. [NOW STEP]

Displays the currently selected step number. When teaching a new program, nothing is displayed.

2. [CALL STEP]

Selects a desired step by input of the step number. Display the pull-down menu, and specify it by the following method.

(1) Press [NUMBER] (0-9). (Specifies the step number.)

(2) Pressing [↵] displays the specified program step in the [NOW STEP] and the step area.

> **[NOTE]**
> Displays the last step automatically when the input number is larger than the last step number in the program.

3. [Bottom]

Selects the last step in the program. After displaying the pull-down menu, select the last step by the following:

(1) Move cursor to [Bottom].

(2) Press [↵] to display the last step of the program in the [NOW STEP] and the step area.

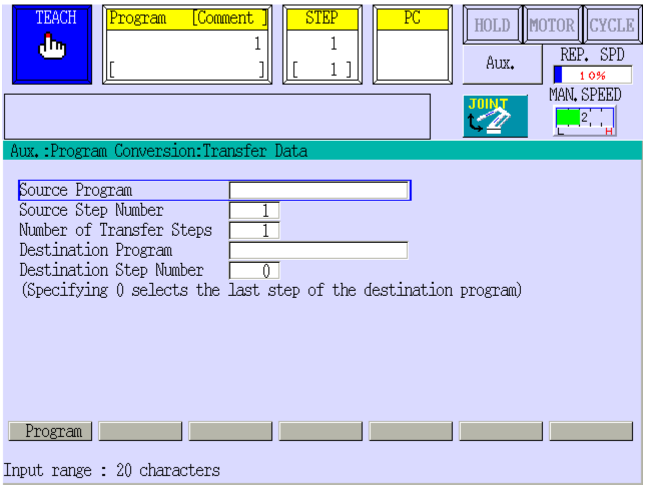
DANGER

The robot starts to move to the selected step from its stopped pose if the cycle operation is started after the step has been changed. Ensure all safety measures are in effect so that the robot, workpiece(s) and tool (s) do not crash into or interfere with peripheral equipment and that all personnel are clear of the work cell.

4. [Copy]

Copies the content of selected steps. After displaying the pull-down menu, copy it by the following method.

(1) Move the cursor to [Copy] and press ↵ to display the Transfer Data screen as shown below.

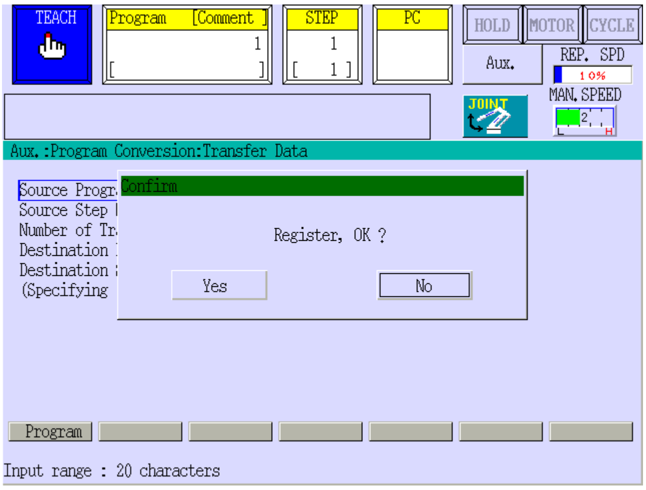


(2) Move the cursor to a desired item referring the table below, and input data.

Item	Description
[Source Program]	Specifies the program to transfer.
[Source Step Number]	Specifies the first program step to transfer.
[Number of Transfer Steps]	Specifies the number of steps to transfer.
[Destination Program]	Specifies the destination program to which the specified steps are transferred.
[Destination Step Number]	Specifies the first program step to receive the transferred steps data from. Specifying 0 transfers the steps after the last step of the destination program.

(3) Input required data, and press ↵.

(4) Confirmation box is displayed. If it is OK, select [Yes].

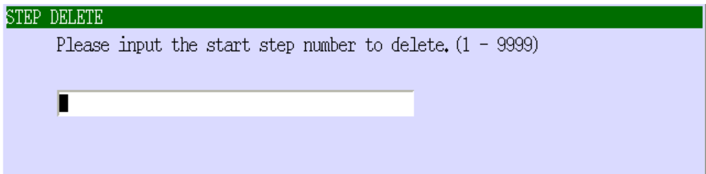


(5) The specified steps will be copied and placed as consecutive steps from the step specified as the destination step number.

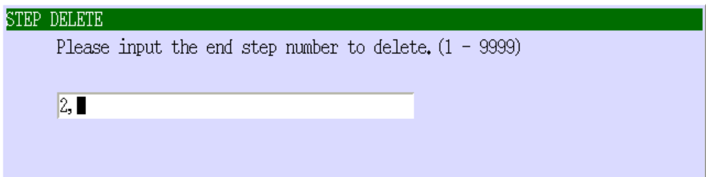
5. [Delete]

Deletes selected step(s). After displaying the pull-down menu, delete by the following method.

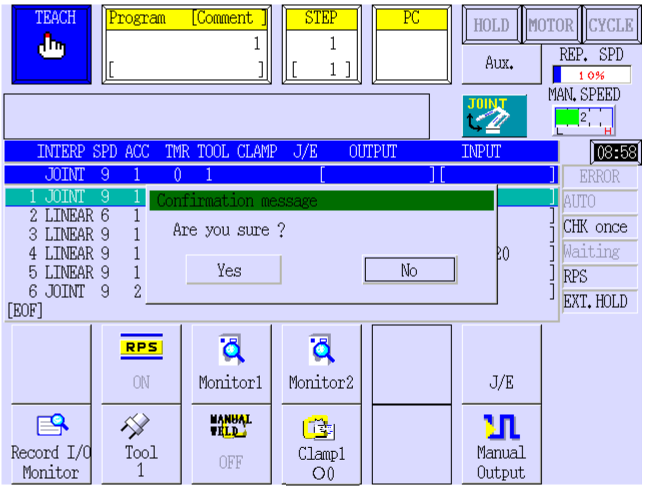
(1) Move the cursor to [Delete] and press ↵ to display the step delete screen as shown below.



(2) Input the start step number to delete and press ↵. Then, input the end step number to delete and press ↵.



(3) The confirmation box is displayed as shown below.



(4) Selecting [Yes] deletes the selected steps and returns to the teach screen.

(5) Selecting [No] returns to the teach screen without deleting the selected steps.

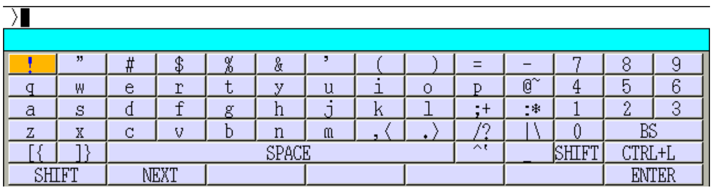
[NOTE]

1. [No] is selected by default when confirmation dialog is displayed.
2. Close the delete function by pressing R at the step delete screen.

6. [Input Comment]

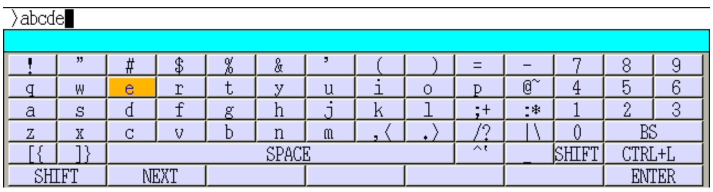
Input comments in the comment area for the selected step. After displaying the pull-down menu, input comment following the procedure below.

(1) Move cursor to [Input comment] and press ↵ to display the comment input screen as shown below.



(2) Input a comment in the keyboard screen*.

NOTE* Refer to Chapter 2.8 for more information about the keyboard screen.



(3) Pressing <ENTER> on the keyboard registers the comment input in step 2 (up to 30 one-byte characters) and returns to the teach screen. Press ←/→ to display the comment.

[NOTE]

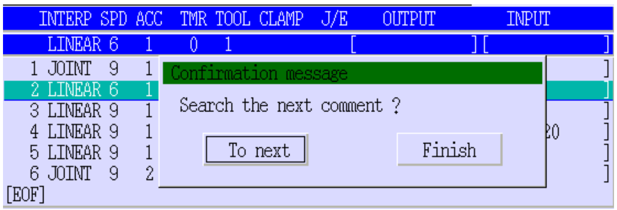
Close this function by pressing R at the comment input screen.

7. [Search Comment]

Searches the step where the comment data is registered. After displaying the pull-down menu, execute search following the procedure below.

(1) Display the pull-down menu, move cursor to [Search Comment] and press ↵ to start searching.

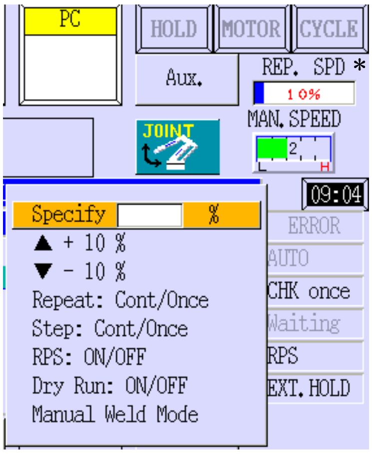
(2) The retrieved step number is displayed in the step area. When there are two or more comments, the screen below is displayed. Select <To next> to continue or <Finish> to end searching.



(3) The teach screen is redisplayed after the search is complete.

2.7.1.3 REPEAT SPEED DISPLAY AREA

The pull-down menu, which is displayed by pressing this area, contains eight functions.　See the figure below.



NOTE* The numbers are red and the background is blue in repeat speeds 1 % to 99 %.
At 100 %, numbers are white and the background is red.

[NOTE]

1. Pressing Repeat Speed Display Area again or R closes the pull-down menu. Displaying another pull-down menu will also close this menu.
2. Except when data is changed by [▲+10 %] or [▼-10 %], the pull-down menu is closed after the setting.
3. The cursor is on [Specify] when pull-down menu is displayed.

1. [Specify]

Sets the repeat speed as a percentage of the maximum speed.　Display the pull-down menu and select by the following method.

(1) Press NUMBER (0-9) to set the desired speed.

(2) Press ↵ to set the repeat speed to the value input above.

[NOTE]

1. Standard input values are 1-100.
2. Speed setting of over 100 is acceptable as option.

2. ▲+10 %

Increases repeat speed in 10 % increments from the current value. Display the pull-down menu and set by the following method.

(1) Move cursor to [▲+10 %].

(2) Current repeat speed increases by 10 % every time [▲+10 %] or ↵ is pressed. However, take note that pressing [▲+10 %] or ↵ the first time raises the speed to a 10 % unit. For example, pressing [▲+10 %] or ↵ at 72 % setting changes the speed to 80 %. After this, the speed increases by 10 %.

(3) Press R at the desired value.

[**NOTE**]

1. Highest possible setting is 100 % in this operation.
2. The numbers and the background turn white and red respectively only at 100 % or more setting, and turn red and blue respectively below 100 %.

3. ▼-10 %

Decreases the repeat speed in 10 % increments from the current value. Display the pull-down menu and set by the following method.

(1) Move cursor to [▼-10 %].

(2) Current repeat speed decreases by 10 % every time [▼-10 %] or ↵ is pressed. However, take note that pressing [▼-10 %] or ↵ the first time reduces the speed to a 10 % unit. For example, pressing [▼-10 %] or ↵ at the 38 % setting changes the speed to 30 %. After this, the speed decreases by 10 %.

(3) Press R at the desired value.

[**NOTE**]

Lowest possible setting is 10 % in this operation.

4. [Repeat: Cont/Once]

Sets how to run the program, repeatedly or only once. Display the pull-down menu and select by the following method.

(1) Move cursor to [Repeat: Cont/Once].

(2) Pressing ↵ toggles between: Repeat Cont → Repeat Once → Repeat Cont.

5. [Step: Cont/Once]

Sets how to execute the program steps, continuously or in one step increments. Display the pull-down menu and select by the following method.

(1) Move cursor to [Step: Cont/Once].

(2) Pressing ↵ toggles between: Step Cont → Step Once → Step Cont.

[**NOTE**]

When set to Step Once, robot does not move to the next step even if CHECK GO is pressed.

6. [RPS: ON/OFF]

Enables or disables the RPS function during repeat mode. RPS allows switching to the program specified by external signals. Display the pull-down menu and select by the following method.

(1) Move cursor to [RPS: ON/OFF].

(2) Pressing ↵ toggles between: RPS ON → RPS OFF → RPS ON. "RPS" is displayed in the status area when it is enabled.

[**NOTE**]

Set RPS conditions in Aux. 0502.

7. [Dry Run]

To check the program contents or input/output signal condition without moving the robot, select Dry Run ON.　Display the pull-down menu and select by the following method.

(1) Move cursor to [Dry Run: ON/OFF].

(2) Pressing ↵ toggles between: Dry Run ON → Dry Run OFF → Dry Run ON.　“Dry RUN” is displayed in the status area when it is enabled.

Follow the procedure in Chapter 6.2 to perform operations after setting.

CAUTION

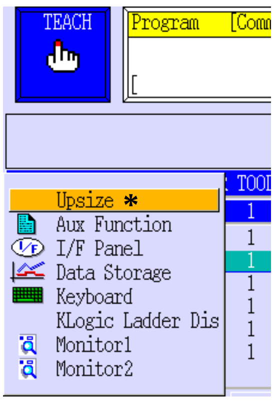
Setting Dry Run OFF allows the robot to move during repeat operation.　Be aware when setting Dry Run ON and OFF.

8. [Manual Weld Mode]

Used in servo weld gun application.　For more details, refer to the optional manual, a separate volume.

2.7.1.4 PROGRAM AREA (B AREA)

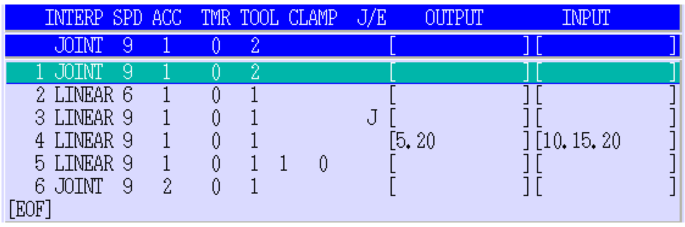
This area contains a pull-down menu and displays the following eight screens as shown below. To display the pull-down menu, activate B area and press MENU, or press the B area window directly.

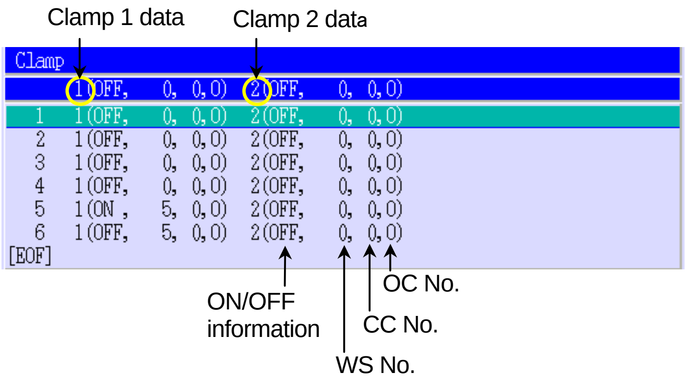


NOTE* [Upsize]/[Down size] is displayed on the pull-down menu when the teach screen is displayed on B area.　[Teach screen] is displayed on the pull-down menu when screens other than the teach screen (Auxiliary function, I/F panel etc.) are displayed on B area.

1.-(1) [Teach screen]

Displays the teach screen by default in the B area. Use this screen to teach or edit a robot program. Clamp instructions data is displayed on the next page and subsequent pages, as shown in lower screen below. Pressing $\boxed{A}$ + $\boxed{\leftarrow}$/$\boxed{\rightarrow}$ changes pages. See Chapter 5 for more details on this screen.



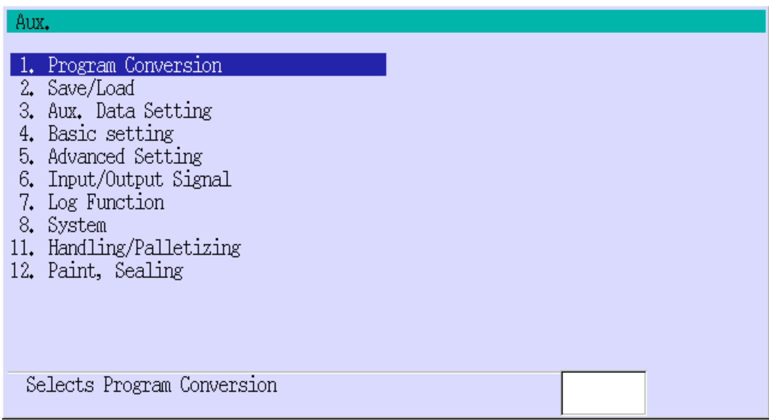


1.-(2) [Upsize]/[Down size]

Selecting [Upsize] enlarges and displays the contents of B area in the combined area of B and C areas. To restore the window size, select [Down size].

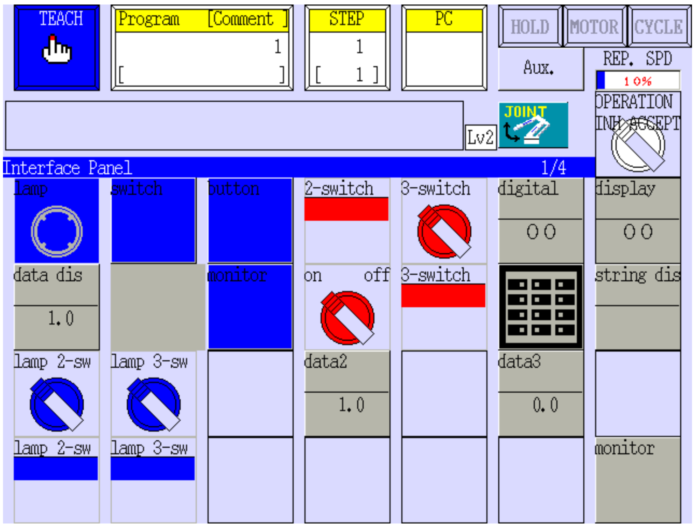
2. [Auxiliary function]

Displays the auxiliary function screen. Use this screen to set various kinds of robot data. Refer to Chapter 8 for more details on this screen.



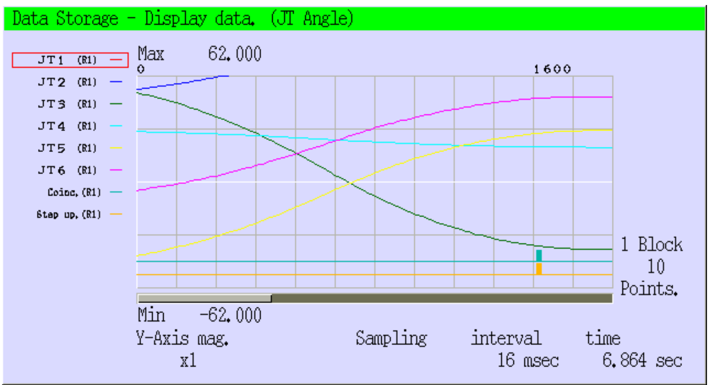
3. [I/F panel]

Displays the I/F(Interface) panel screen. This screen provides the switches, lamps and functions necessary for operating robots and peripheral equipment. The screen below is an example. See Chapter 9 for more details on this screen.



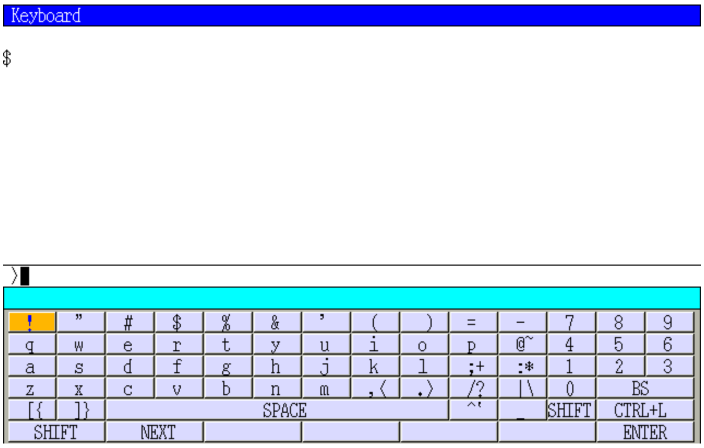
4. [Data storage]

Displays the data storage screen. This screen displays data such as joint angle, speed, deviation, I/O, etc. in graph form. The screen below is an example. Refer to a separate option manual for more details on this screen.



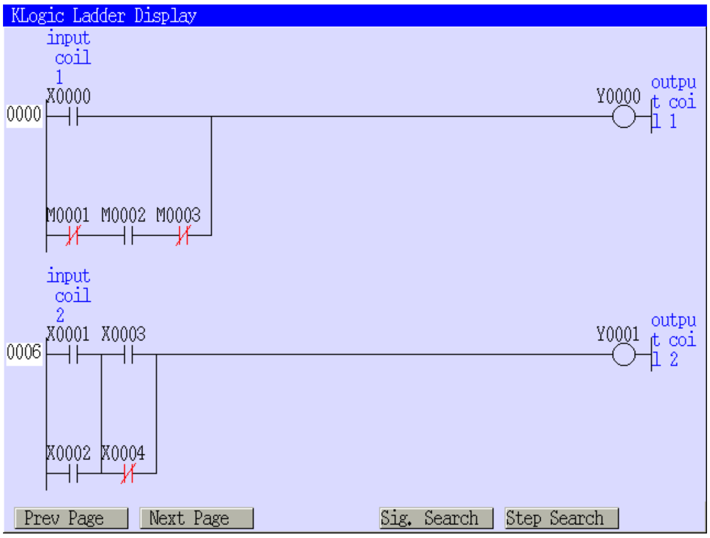
5. [Keyboard]

Displays the keyboard screen. Use this screen to input characters such as a program name, the comments, etc. See Chapter 2.8 for more details on this screen.



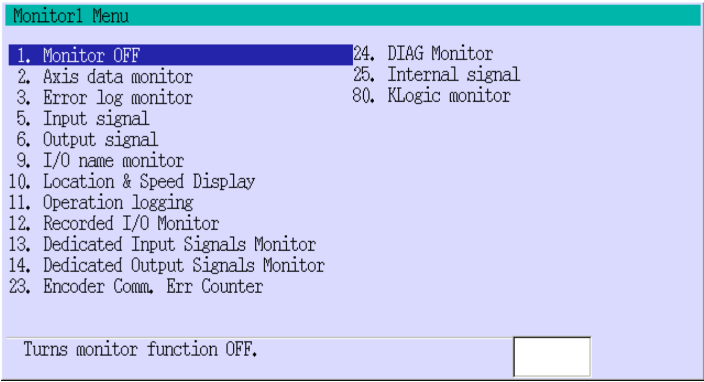
6. [KLogic ladder display]

Displays the KLogic ladder screen. The screen below is an example. Refer to a separate option manual for more details on this screen.



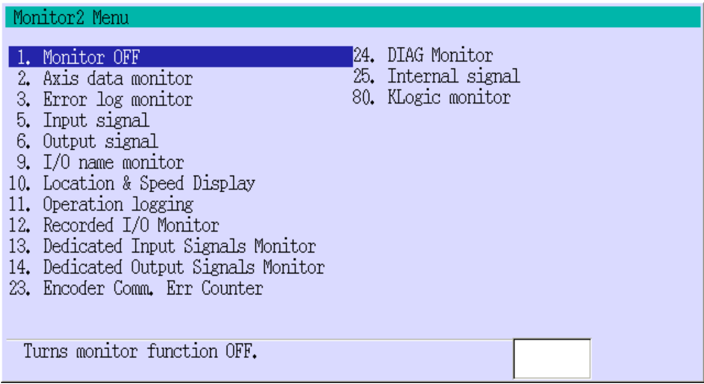
7. [Monitor 1]

Displays the Monitor 1 menu screen. Select the information to be monitored by this screen. C area displays the monitor screen with the selected information. See Chapter 2.9 for more details on this screen.



8. [Monitor 2]

Displays the Monitor 2 menu screen. Select the information to be monitored by this screen. C area displays the monitor screen with the selected information. When selecting both Monitor 1 and Monitor 2, both monitor screens are displayed side by side.

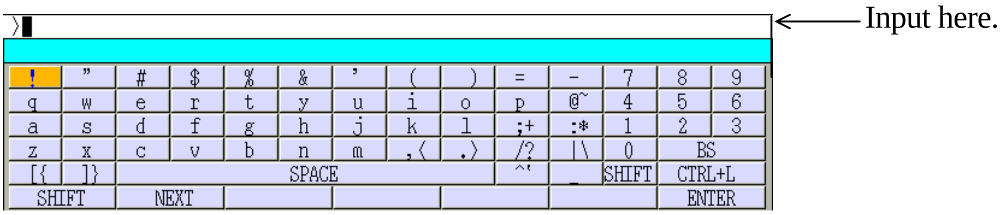


2.8 KEYBOARD SCREEN

The keyboard screen display covers 78 columns and 15 rows. The section below describes how to input characters.

2.8.1 KEYBOARD OPERATION

Keyboard is shown below. Operation procedure is as follows.



1. Method for moving the cursor

Pressing →: Moves the cursor to the right key.
Pressing ←: Moves the cursor to the left key.
Pressing ↓: Moves the cursor to the upper key.
Pressing ↑: Moves the cursor to the lower key.

2. Methods for selecting characters

There are two methods to select a character.

- Press the character on the keyboard directly.
- Move the cursor to the character to be input, and press ↵.

3. Using <SHIFT> - dual character keys

Characters shown on left side of key are input by default.　Pressing <SHIFT> allows input of characters on the right side.　Pressing <SHIFT> again returns keys to their defaults.

4. Using <SHIFT> - upper case and lower case letters

Lower case letters are input by default.　Pressing <SHIFT> allows inputting upper case letters (capitals).　Pressing <SHIFT> again returns the keys to lower case.

5. Operation of other keys

(1) When the information is too large to fit on one screen, the display scrolls and stops when the screen is full.　To continue viewing the information, press <NEXT>.

(2) BS deletes characters one by one.　Pressing ←/→ moves the cursor in the input area.

(3) Pressing <CTRL+L> recalls the last character string that was input.　Up to nine previous strings (lines) can be recalled.　Pressing <SHIFT> + <CTRL+N> recalls the next string (line).　For example, after pressing <CTRL+L> six times, pressing <SHIFT> + <CTRL+N> three times recalls the third previous character string that was entered (string two previous to the last one.)

[NOTE]

Cursor is on <!> and key input is set to lower case when the keyboard is displayed initially.

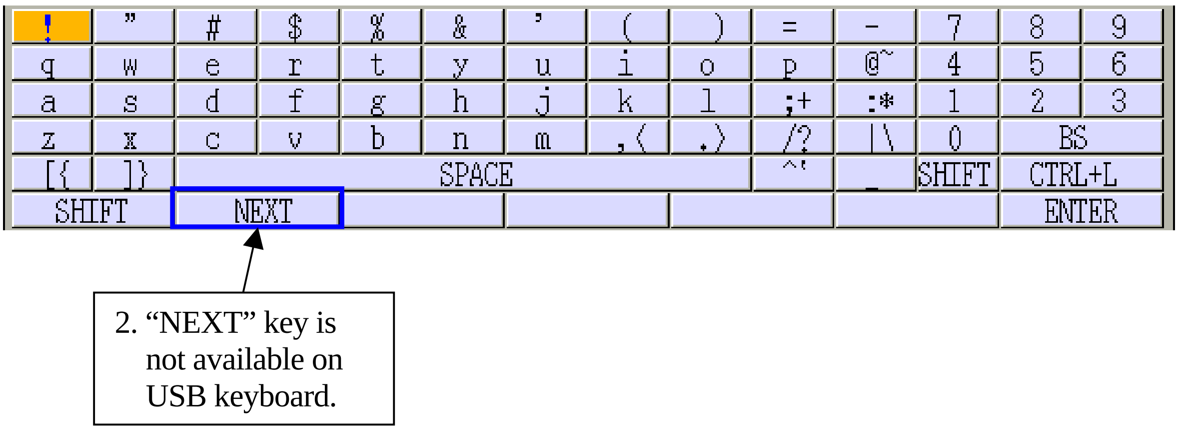
2.8.2 USB KEYBOARD

For E series controller, USB keyboard is available while the keyboard screen is displayed on the TP operation screen. To use the USB keyboard, connect it to the USB port inside the accessory panel on the front side of the controller.

101 keyboard is usable as USB keyboard and has the following conditions of use.

1. Usable keys on USB keyboard are ones that are on the TP keyboard screen.

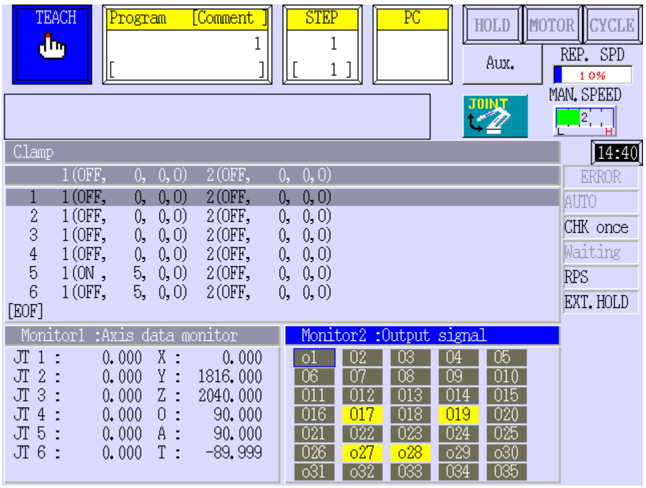
2. There is no “NEXT” key on USB keyboard. “NEXT” key is only available on the touch panel.



For setting procedures of USB keyboard, refer to Aux.0818.

2.9 MONITOR SCREEN

Up to two monitor screens (Monitor 1 and Monitor 2) can be displayed on the TP. Each of the monitor displays accessed from this menu is updated in real time as the robot moves, as program is executed, etc. Monitor screens are displayed in C area as shown on next page (or in center of screen in other applications.). In the screen below, Axis data monitor and Output signal monitor are displayed as Monitor 1 and Monitor 2, respectively. Some monitors can be displayed in the combined area of both B and C areas.

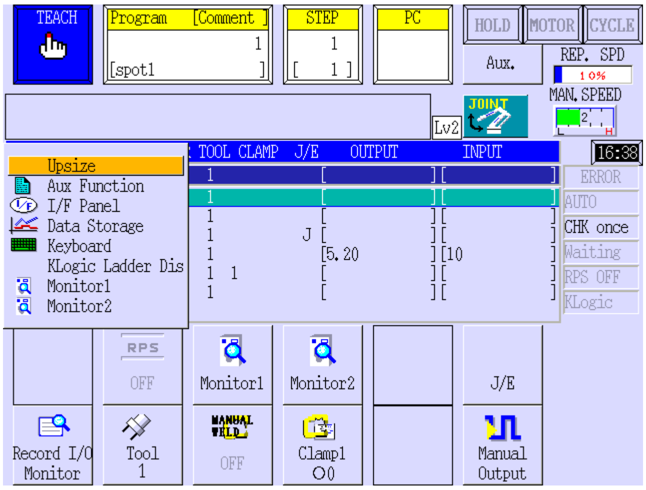


2.9.1 DISPLAYING MONITOR SCREEN

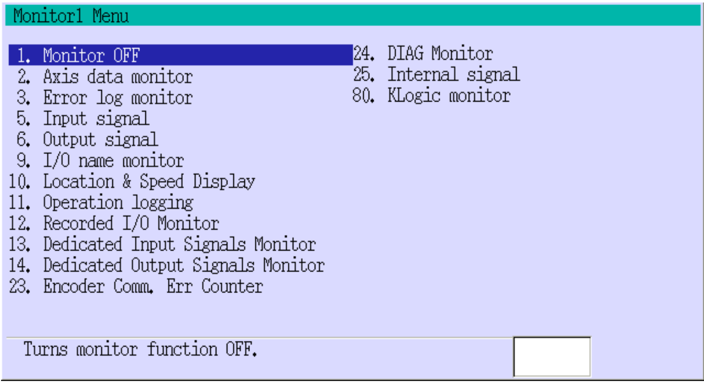
This section describes how to display monitor screens.

1. Selecting from the pull-down menu

   Press B area directly or MENU as shown in the screen below, and select [Monitor 1] or [Monitor 2] from the pull-down menu.



The list of available monitor screens displays as shown below. Selecting an item from the list displays the monitor information for that item.



2. Selecting by pressing the function key

   Press <Monitor 1> or <Monitor 2> on the bottom part of the screen. The list of monitor screens is displayed as shown above. Select the monitor information to display.

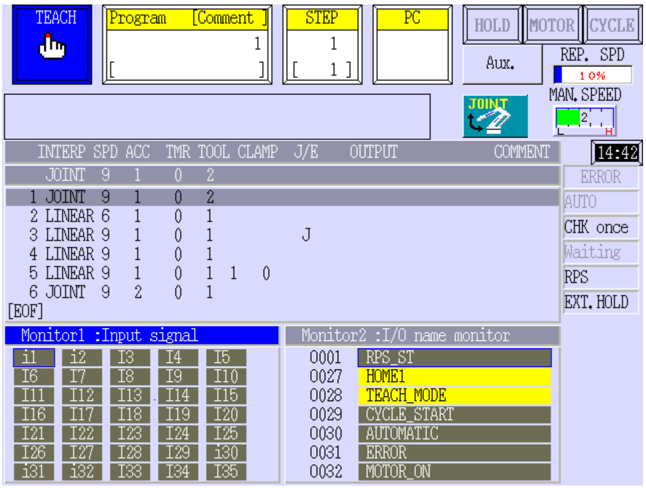
2.9.2 ENLARGING MONITOR SCREEN AREA

The screens of the following monitor information can be enlarged and displayed in the combined area of both B and C areas.

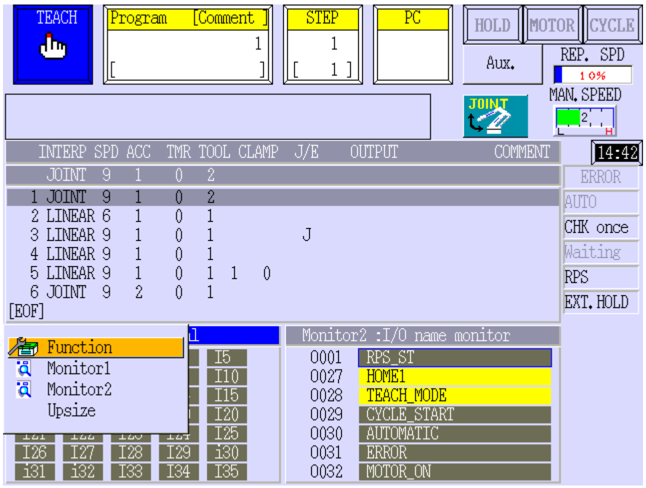
5. Input signal
6. Output signal
9. I/O name monitor
13. Dedicated input signal monitor
14. Dedicated output signal monitor
25. Internal signal monitor

Follow the procedure below to enlarge and restore the monitor screens.

1. Display the monitor screen following the procedure in Chapter 2.9.1. The C area of this screen displays Input signal monitor and the I/O name monitor as Monitor 1 and Monitor 2, respectively.

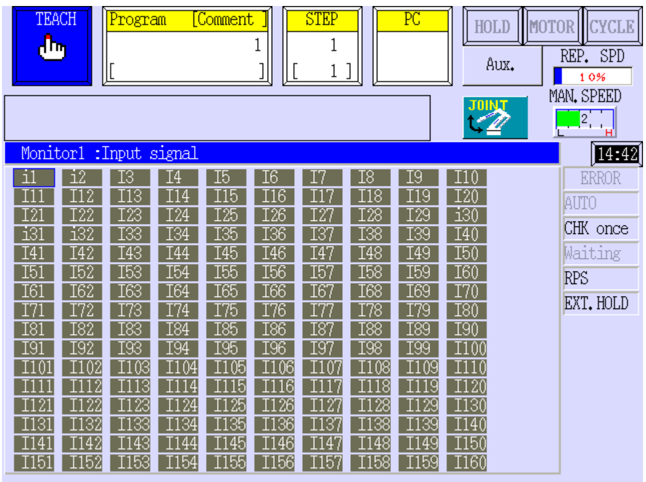


2. Activate the monitor screen to enlarge. Display the pull-down menu by pressing the monitor screen directly or pressing MENU.

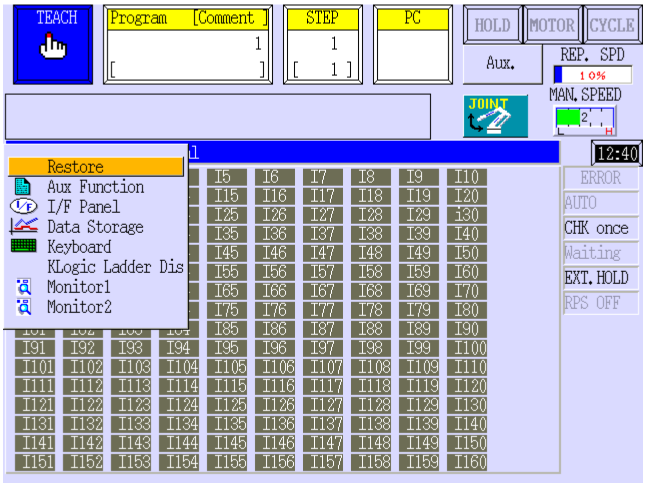


3. Selecting [Upsize]* enlarges the monitor screen to B area. The other monitor screen closes.

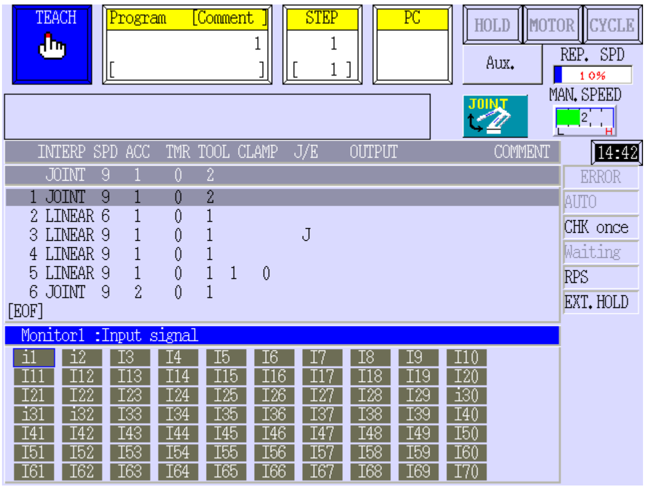
NOTE* [Upsize] is not effective for the monitors which cannot be enlarged.



4. To restore the screen, press B area directly or MENU, and display the pull-down menu.



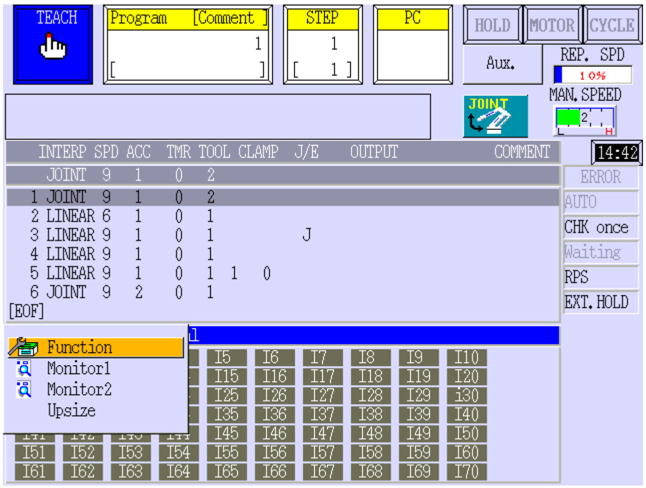
5. Selecting [Restore] restores the monitor screen.



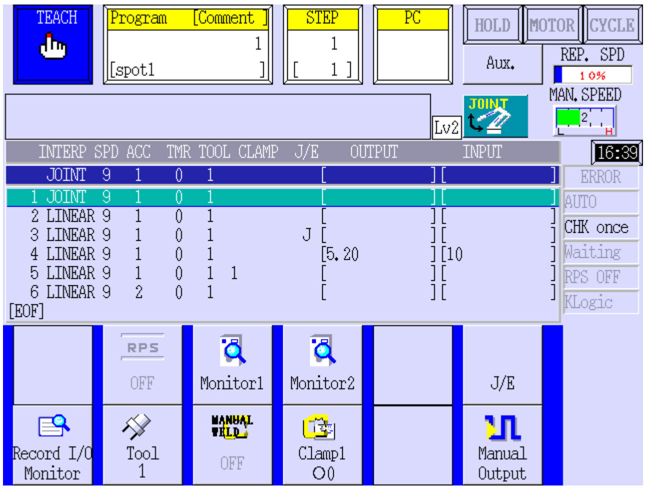
2.9.3 SWITCHING BETWEEN MONITOR SCREEN AND FUNCTION KEY SCREEN

F keys cannot be used when a monitor screen is displayed. Follow the procedure below to display the F keys on the front screen.

1. Press MENU with the monitor screen displayed. The pull-down menu is displayed.

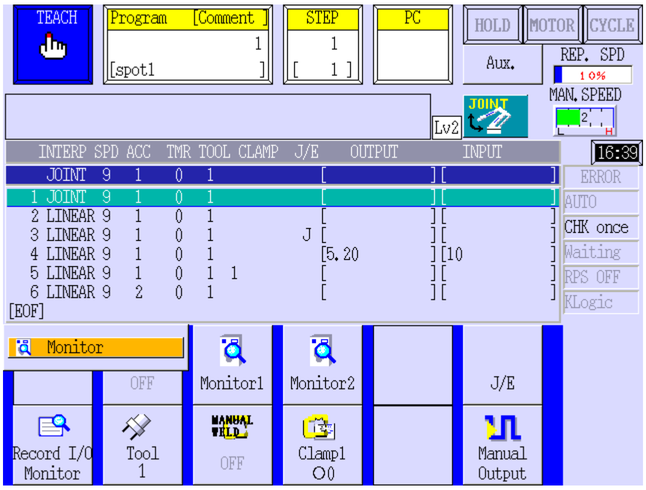


2. Selecting [Function] from the pull-down menu displays the F keys on the front screen. The monitor screen is now behind the F key screen.

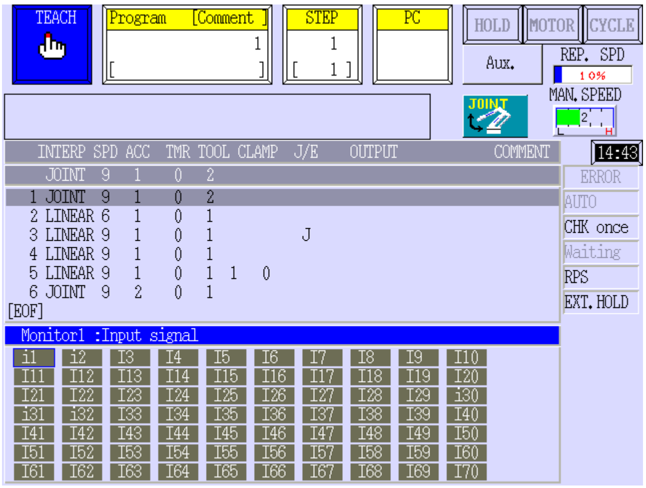


3. Press MENU to display the pull-down menu* on the screen.

NOTE* When a monitor screen is not behind, the pull-down menu will not be displayed even if MENU is pressed.



4. Selecting [Monitor] from the pull-down menu displays the monitor, which was behind the F key screen, on the front screen.

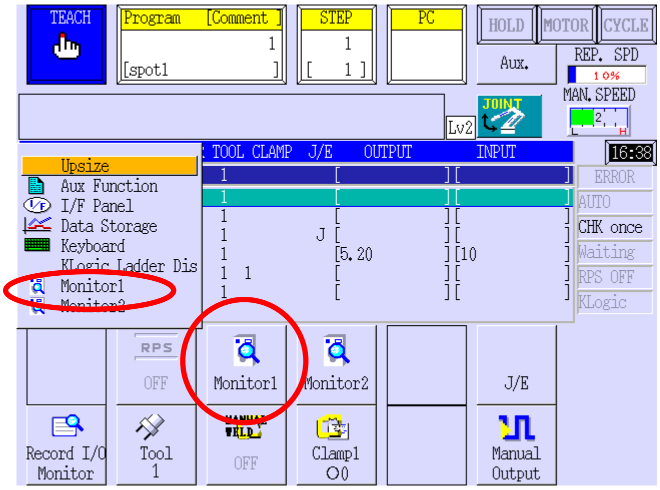


2.9.4 EXAMPLE OF MONITOR FUNCTIONS

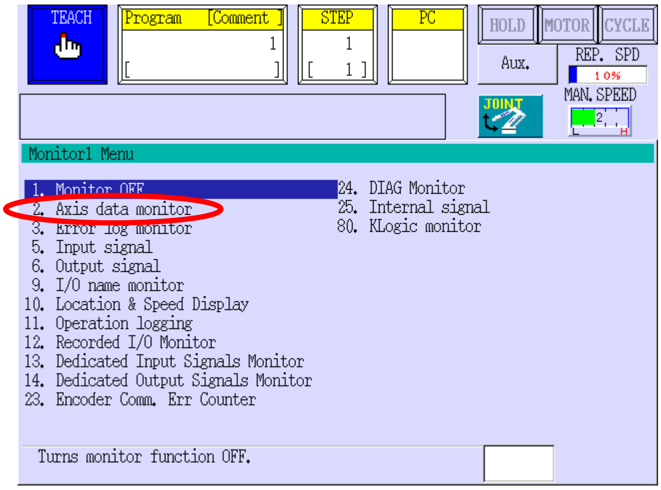
This section describes how to display monitor screens, using an example.

1. Displaying Axis data monitor on Monitor 1

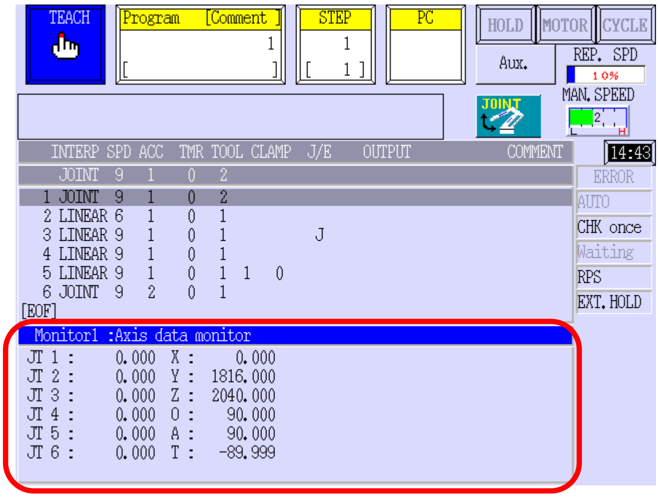
(1) Select [Monitor 1] from the pull-down menu or press F key, <Monitor 1>, to display the Monitor 1 menu.



(2) Select [2. Axis data monitor] from the Monitor 1 menu.

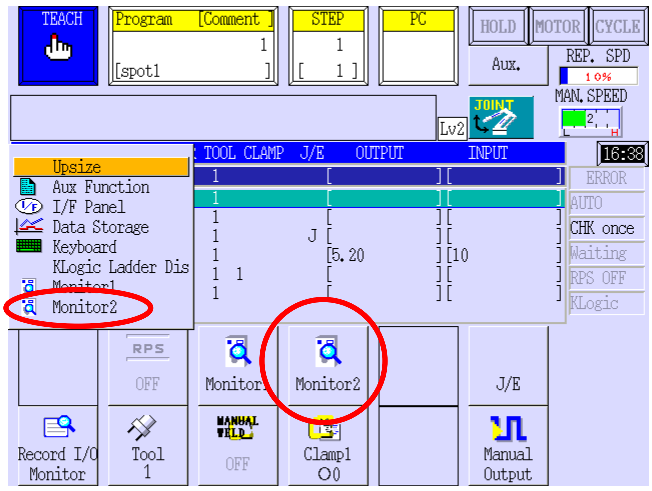


(3) Axis data monitor screen is displayed on Monitor 1.

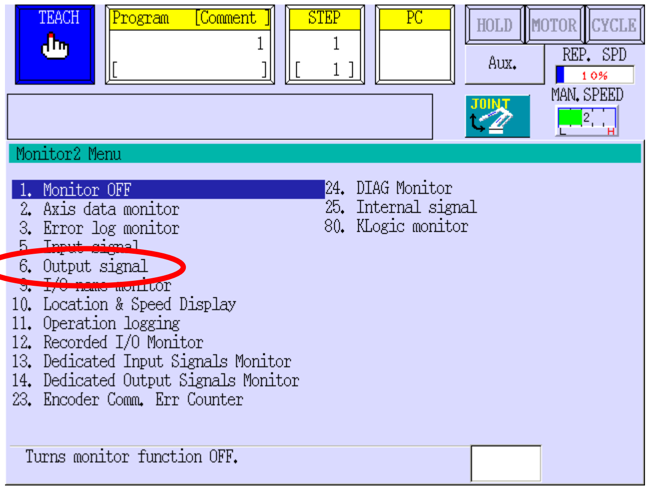


2. Displaying Output signal monitor on Monitor 2

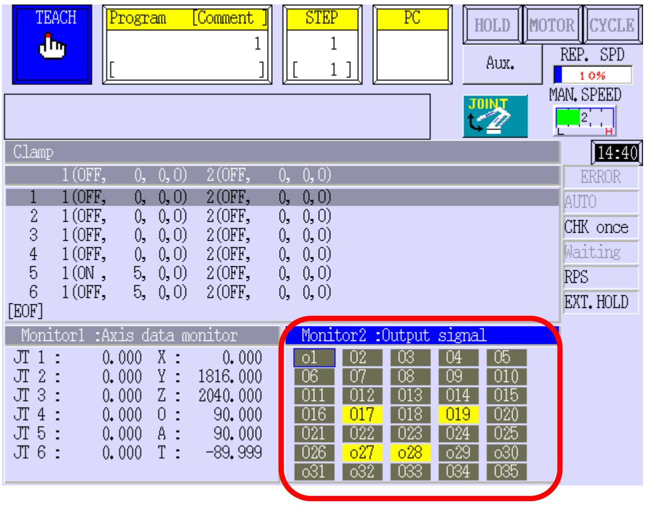
(1) Select [Monitor 2] from the pull-down menu or press F key, <Monitor 2>, to display the Monitor 2 menu.



(2) Select [6. Output signal] from the Monitor 2 menu.

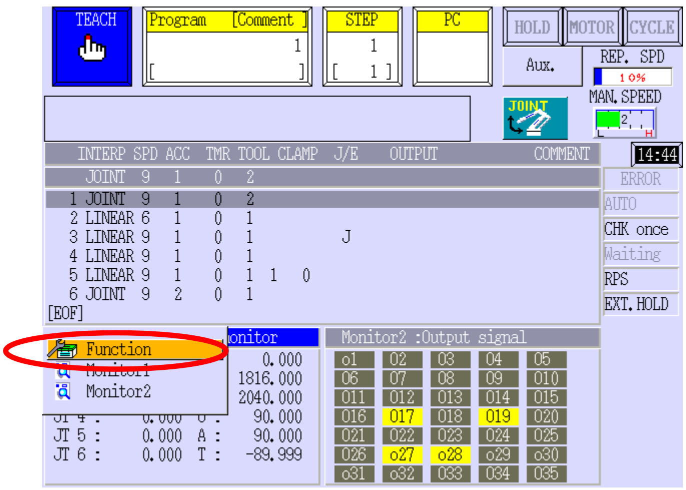


(3) Output signal monitor is displayed on Monitor 2.

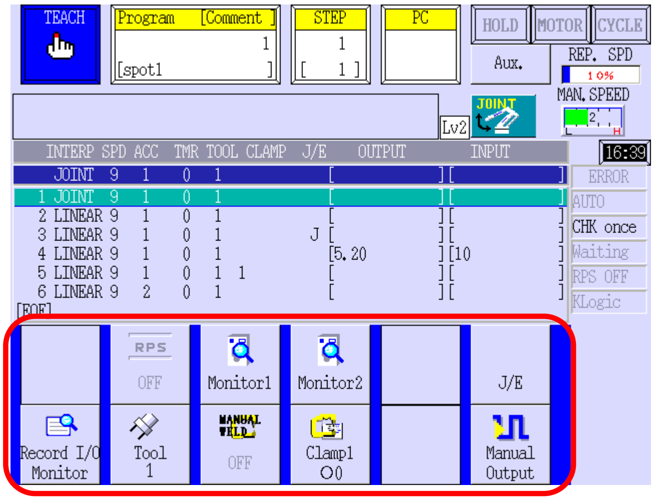


3. Hiding the monitor screen and displaying the F keys

(1) Select [Function] from the pull-down menu of Monitor.

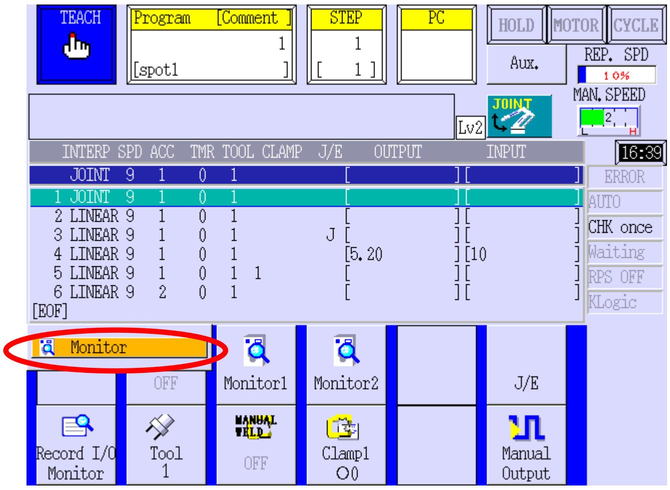


(2) F keys are displayed.

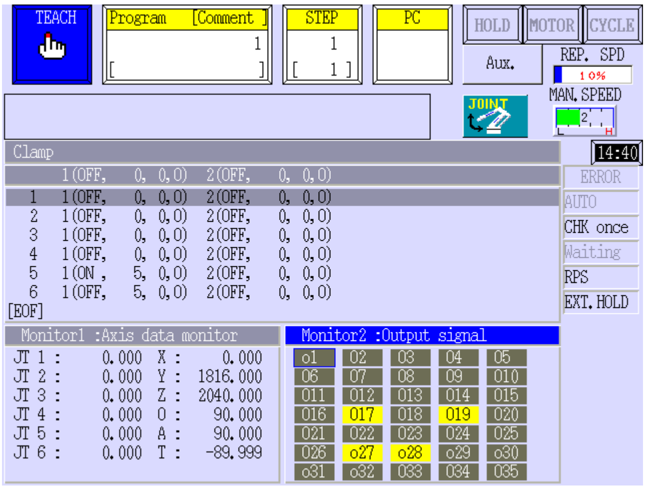


4. Hiding the F keys and displaying the monitor screen

(1) Select [Monitor] from the pull-down menu on the F key screen.

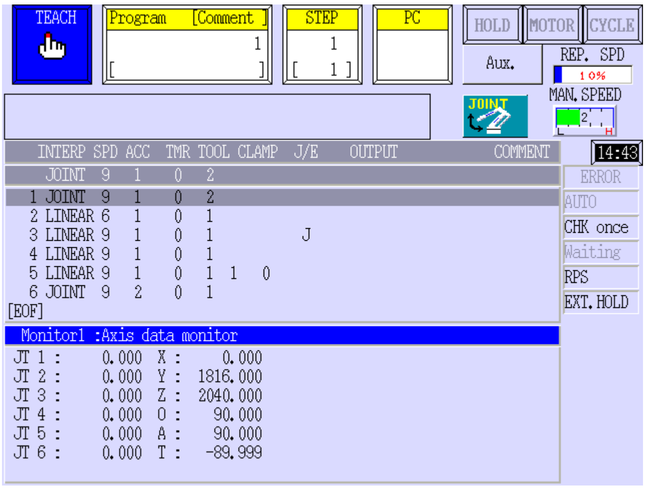


(2) Monitor screens are displayed.



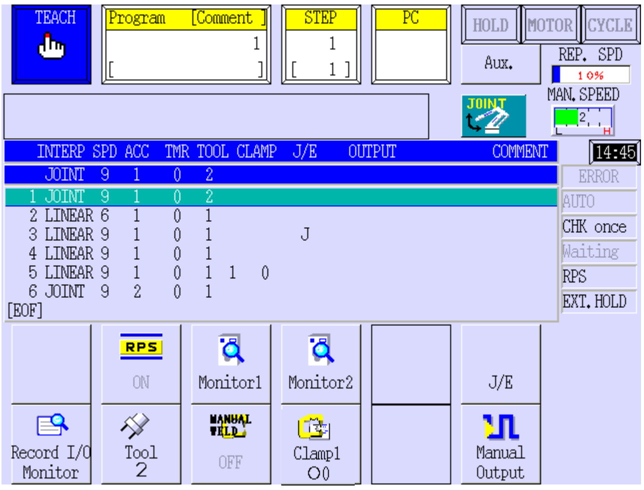
5. Closing Monitor 2

Activate Monitor 2 by pressing Screen Change, and press A + Close. Or, select [1. Monitor OFF] from the Monitor 2 menu.



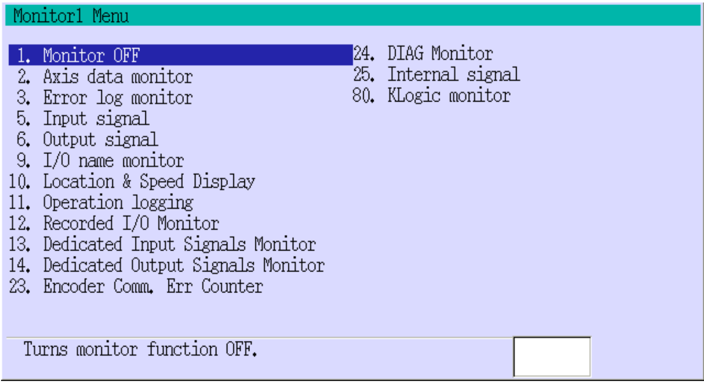
6. Closing Monitor 1

Activate Monitor 1 by pressing Screen Change, and press A + Close. Or, select [1. Monitor OFF] from the Monitor 1 menu.



2.9.5 EXPLANATION OF EACH MONITOR

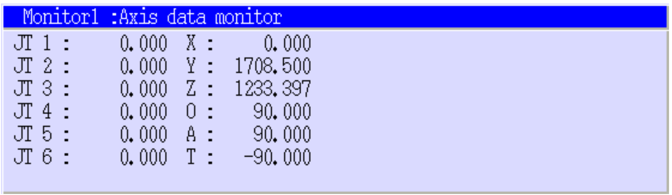
This section describes each monitor. Each of the monitor displays accessed from this menu is updated in real time as the robot moves, program is executed, etc.



1. [Monitor OFF]

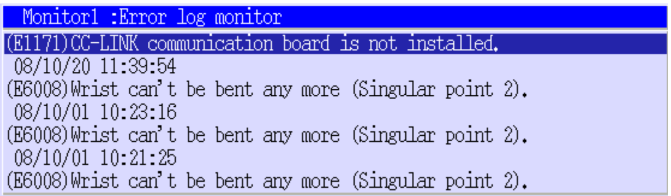
   Monitor screen closes and function keys appear on C area.

2. [Axis data monitor]



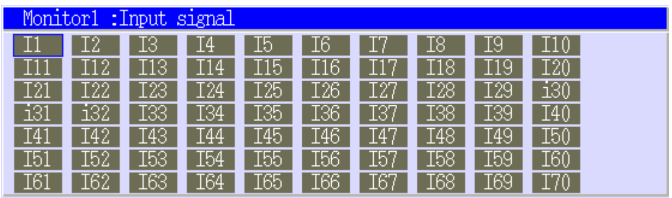
Displays current pose information (position and posture) by joint displacement values and transformation values, X, Y, Z, O, A and T.

3. [Error log monitor]



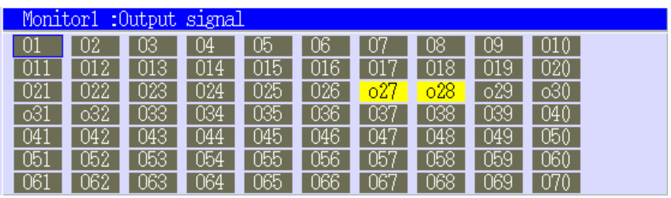
Displays the error log.

5. [Input signal]



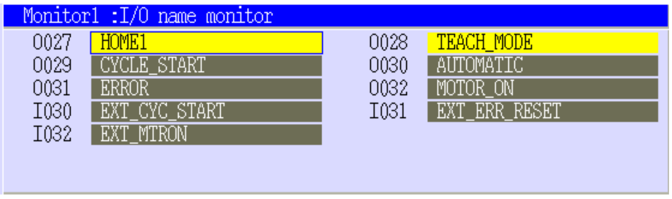
Displays the input signal status.
ON-signals are highlighted in yellow.

6. [Output signal]



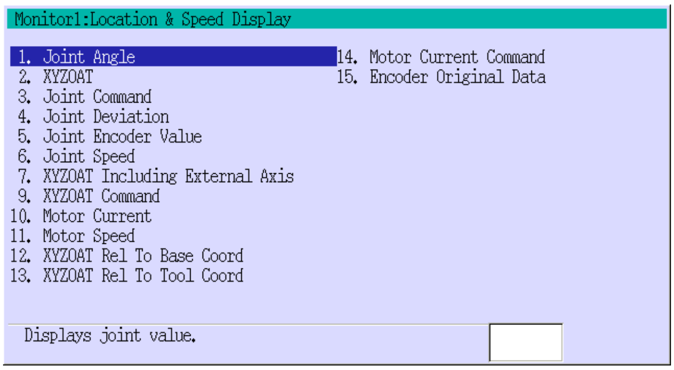
Displays output signal status.
ON-signals are highlighted in yellow.
Signals can be forced to output using this screen.

9. [I/O name monitor]



Displays the list of names set to each signal and signal status. ON-signals are highlighted in yellow. Signals without a name are not displayed.

10. [Location & speed display]



Data selected from this menu is displayed in real time.

10.1 [Joint angle]

Displays the current axis values (joint angles).

10.2 [XYZOAT]

Displays the transformation values of the tool coordinates relative to the base coordinates.

10.3 [Joint command]

Displays axis command values.

10.4 [Joint deviation]

Displays axis deviation.

10.5 [Joint encoder value]

Displays current encoder values for each axis.

10.6 [Joint speed]

Displays axis speeds.

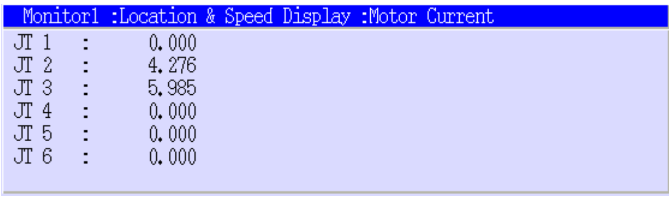
10.7 [XYZOAT including external axis]

Displays the transformation values of tool coordinates relative to the world coordinates, incorporating the motion of the external axis.

10.9 [XYZOAT command]

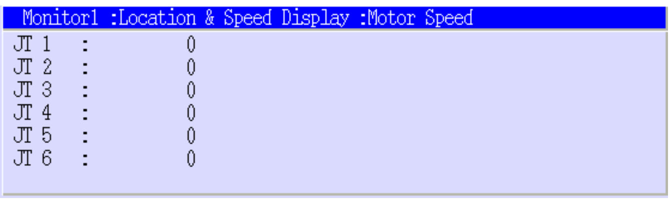
Displays the pose command values for tool coordinates relative to the base coordinates.

10.10 [Motor current]



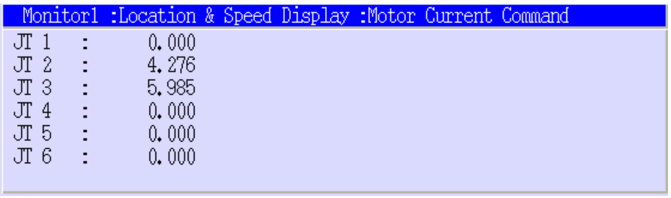
Displays motor current to axis as the current value of the q-coordinate axis.

10.11 [Motor speed]



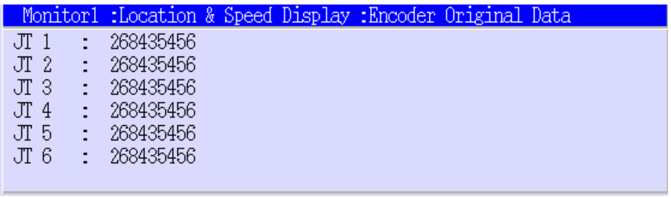
Displays motor speeds of each axis.

10.14 [Motor current command]



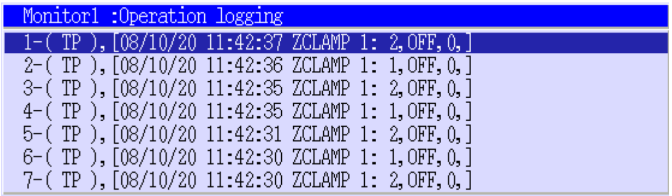
Displays motor current command values of the q-coordinate axis to each axis motor.

10.15 [Encoder original data]



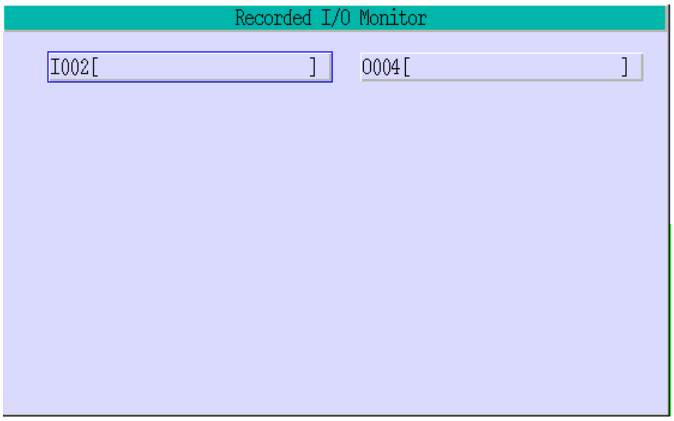
Displays encoder original data of each axis.

11. [Operation logging]



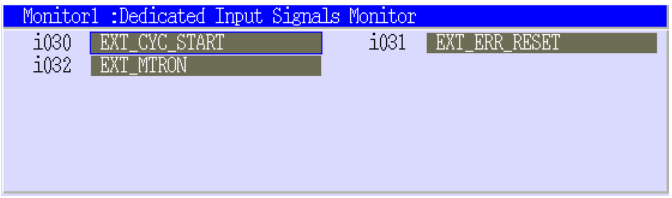
Displays the operation log.

12. [Recorded I/O monitor]



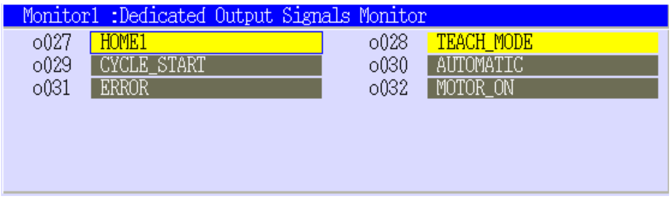
Displays the numbers and names of the I/O signals taught in the selected steps.

13. [Dedicated input signals monitor]



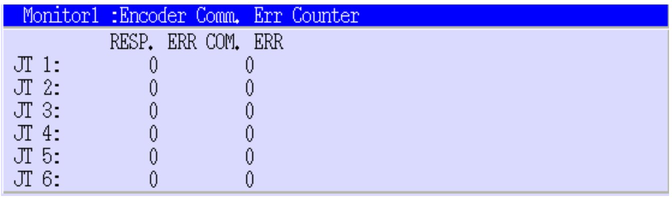
Displays the dedicated input signals currently set.　ON-signals are highlighted in yellow.

14. [Dedicated output signals monitor]



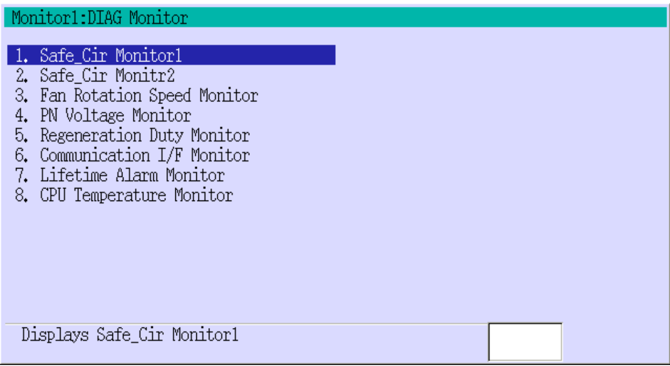
Displays the dedicated output signals currently set. ON-signals are highlighted in yellow.

23. [Encoder Comm. Err Counter]



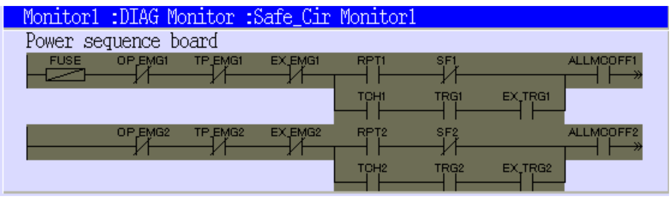
Displays the number of communication errors that have occurred in each axis encoder.

24. [DIAG monitor]



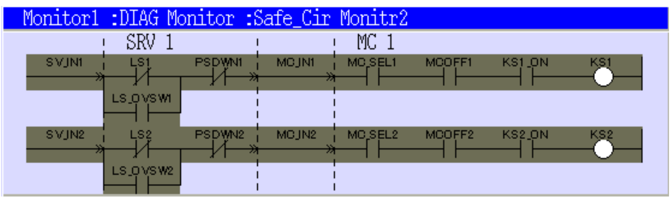
Displays information for the hardware selected from this menu.

24.1 [Safe_cir monitor 1]



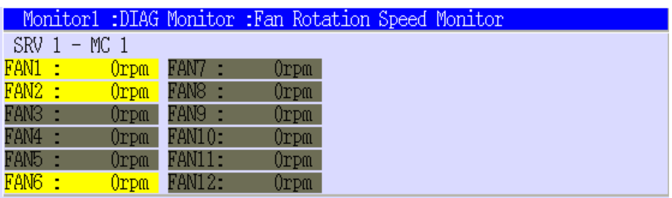
Monitors the safety circuit status on the power sequence board.

24.2 [Safe_cir monitor 2]



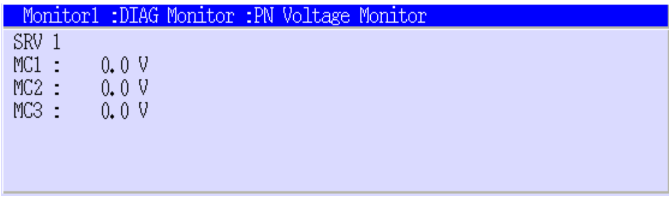
Monitors the safety circuit status of the servo board and the MC unit.

24.3 [Fan rotation speed monitor]



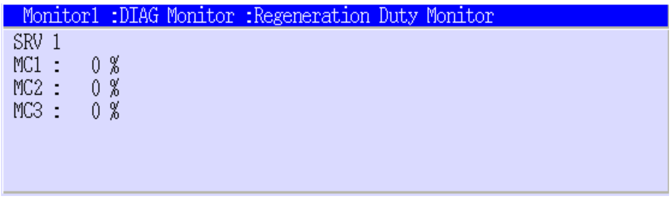
Displays rotation speeds of the fans provided on each MC unit.

24.4 [PN voltage monitor]



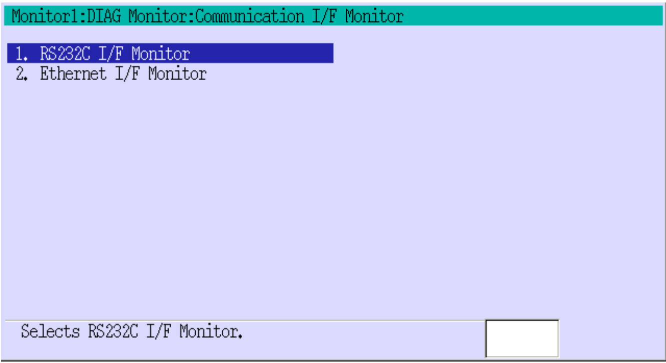
Displays the PN voltages of each MC unit.

24.5 [Regeneration duty monitor]



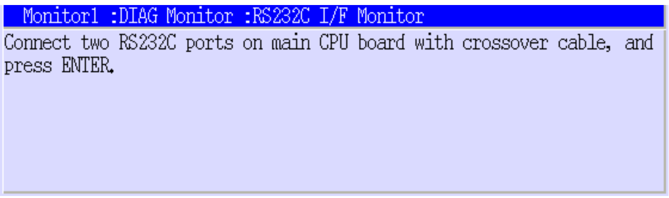
Displays duty ratios of each MC unit.

24.6 [Communication I/F monitor]



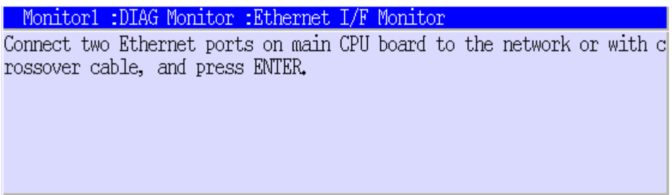
Displays the monitor screens for communication interfaces.

24.6-1 [RS232C I/F monitor]



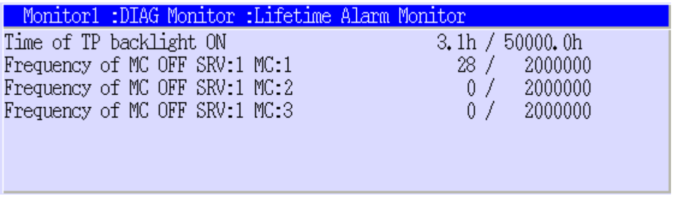
Conducts the RS232C I/F monitor function test.　When no error is detected, displays “RS232C interface works normally”.　When error is detected, displays “(D4000) [DIAG] Error is detected in RS232C. (Code: xx)”.

24.6-2 [Ethernet I/F monitor]



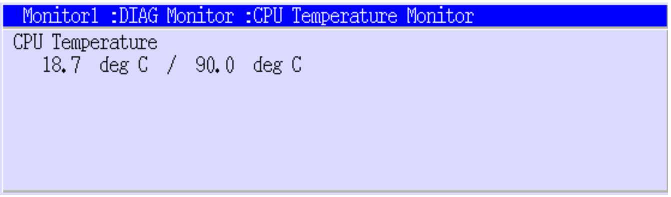
Conducts the Ethernet port I/F monitor function test.　When no error is detected, displays “Ethernet interface works normally”.　When an error is detected, displays “(D4001) [DIAG] Error is detected in Ethernet. (Code: xx)”.

24.7 [Lifetime alarm monitor]



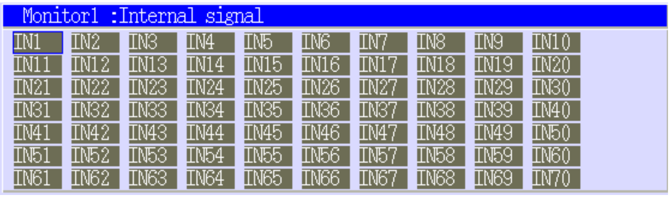
Displays the lifetime of the MC unit and TP backlight.

24.8 [CPU temperature monitor]



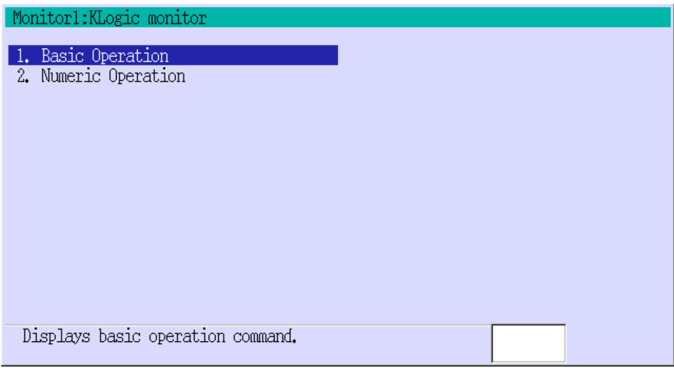
Displays the current temperature of the CPU on the main CPU board (1TA board). The displayed values indicate: “current temperature”/“the temperature at which error occurs”.

25. [Internal signal]



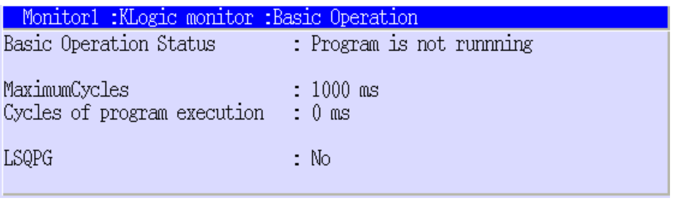
Displays internal signals of the I/O signal monitor (signals 2000-2999 for AS). ON-signals are highlighted in yellow.

80. [KLogic monitor]



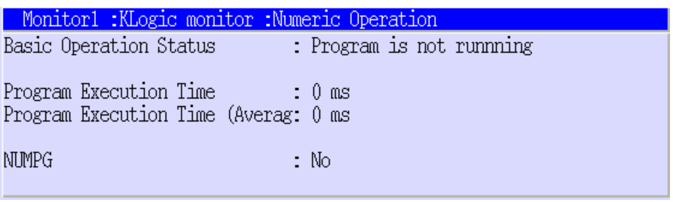
Displays menu to select either of Klogic monitor items.

80.1 [Basic operation]



Displays KLogic information on basic operations.

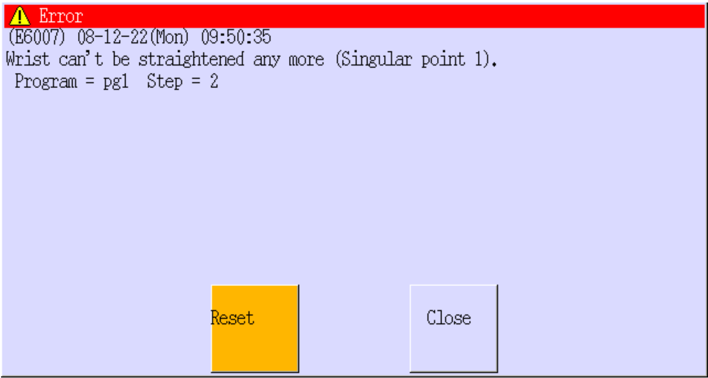
80.2 [Numeric operation]



Displays KLogic information on numeric operations.

2.10 ERROR SCREEN

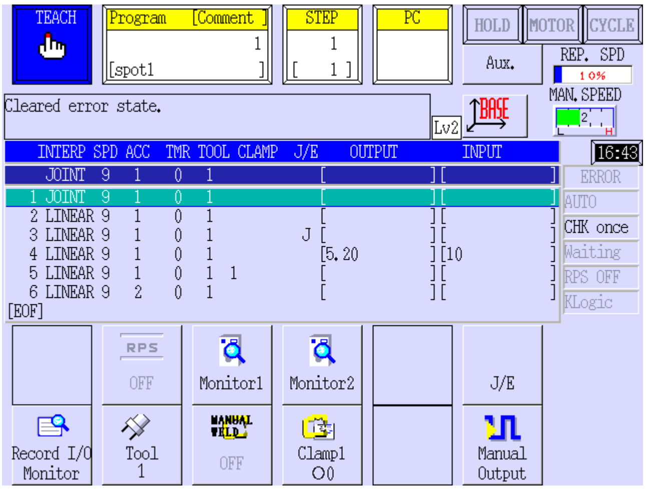
When an error occurs during operation of the robot, an error screen is displayed as shown below.



There are two ways to reset an error.

1. Procedure for error reset - 1

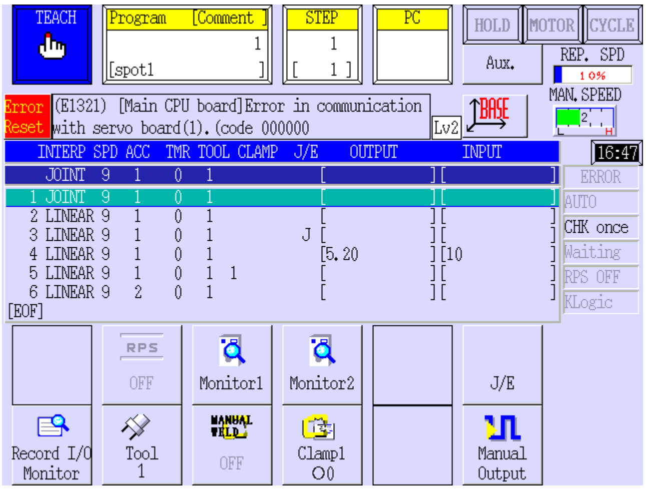
Move the cursor to <RESET> and press ↵ to close the error screen, and the message "Cleared error state." appears in the system message area.



2. Procedure for error reset - 2

(1) Move the cursor to <CLOSE> and press ↵ to close the error screen.　This displays the content of the error and <Error Reset> in the system message area.

(2) Press <Error Reset> to reset the error.



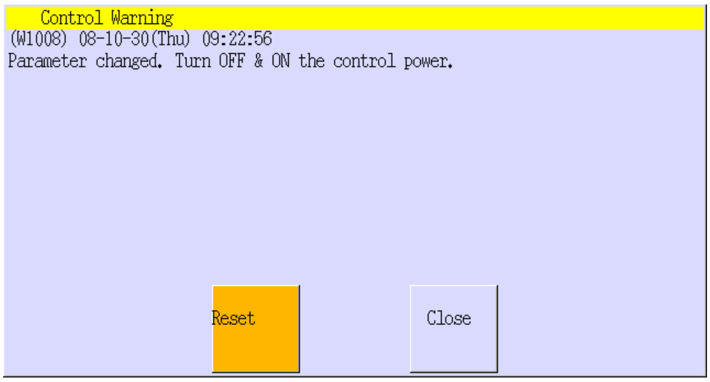
[NOTE]

1. The latest error is displayed.　When several errors occur simultaneously, a maximum of five errors can be displayed.
2. To redisplay the previous error screen, press the system message area without pressing <Error Reset >.
3. Switching to other screens is not possible while the error screen is displayed.
4. If error state does not release even after pressing <Error Reset>, then the content of the second error will be displayed.

2.11 WARNING SCREEN

This section describes the procedures for responding to a warning state.

When a warning state occurs, a screen is displayed as shown below.



There are two ways in which to respond to a warning state.

1. To reset,

(1) Move the cursor to <RESET> and press ↵.

(2) The warning screen closes and “Cleared error state.” appears in the system message area.

2. To close the screen,

(1) Move the cursor to <Close> and press ↵.

(2) The warning screen closes and the content of the warning and <Error Reset> appears in the system message area.

(3) Press <Error Reset> to reset the warning. To redisplay the warning screen, press the system message area without pressing <Error Reset>.

[NOTE]

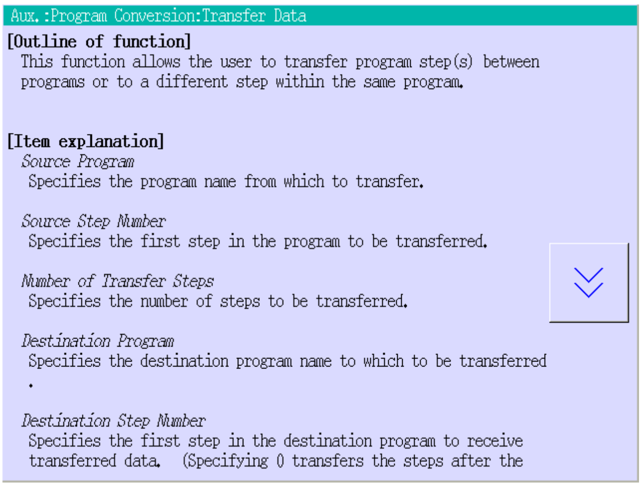
Switching to other screens is not possible while warning screen is displayed.

2.12 HELP SCREEN

This section describes how to display the help screen.

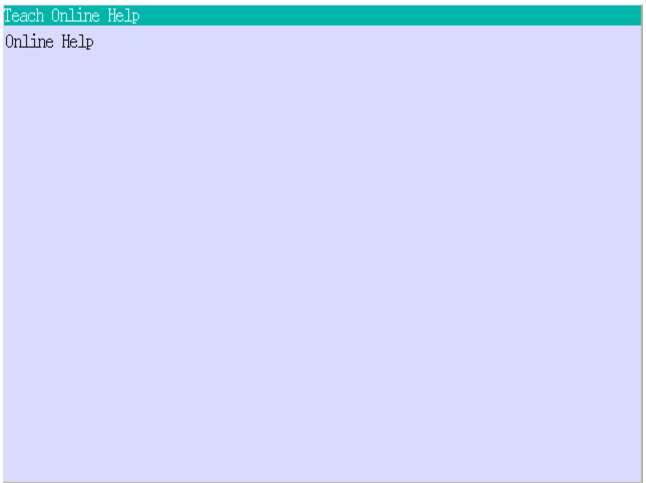
1. Help screen on auxiliary functions

When the auxiliary function screen is displayed, pressing A+HELP displays the help screen on auxiliary functions. When more than one page is available, scroll the screen by pressing <⩓>/<⩔>.



2. Help screen created by customers

When either the teach screen or interface panel screen is displayed, pressing A+HELP displays the text files created by customers as a help screen.



A help file can be created as follows.

(1) Create the help in a text file. Decorated characters such as boldface and italic face can be displayed by adding the following tags at the head of the string. Several tags can be added.

Tag	Function
<b>	Displays the line with the tag in bold.
<i>	Displays the line with the tag in italic.
<title>	Displays the line in title format. (The line cannot be displayed in either bold or italic.)
<number>	Indents by the specified number of spaces. (Range: 1-99)

(2) Save the text file with the following name.

Teach screen: Teach0J.txt *

Interface panel screen: Ifpnl10J.txt **

NOTE* 1. The number indicates the created file number.
2. The final alpha character indicates the language. (J: Japanese, E: English)

NOTE** 1. The first number indicates the page number, which corresponds to the page number of the interface panel screen.
2. The second number indicates the created file number.
3. The final alpha character indicates the language. (J: Japanese, E: English)

(3) Save the file to a USB memory.

(4) Insert the USB memory into the USB port on the main CPU board, and open Aux. 0203.

(5) Copy the file to robot memory (CF) from the USB memory. See Aux. 0203 in Chapter 8 for details.

3.0 PROCEDURES FOR POWER ON/OFF AND STOPPING THE ROBOT

This chapter describes the power ON/OFF procedures for the robot controller and methods for stopping the robot.

[**NOTE**]

This manual explains operation procedures assuming that the optional operation panel is not used. When using the optional operation panel, both switches on the TP and the optional operation panel can be used for turning ON/OFF motor power and cycle operation start. However, for the robot activation (RUN), robot will not activate unless both settings of the TP and optional operation panel are RUN. That is, if the setting of the optional operation panel is HOLD, robot cannot be activated even if A+RUN on the TP is pressed.

3.1 POWER ON PROCEDURE

Ensure that all personnel are clear of the work cell, and that all safety devices are in place and operational. Follow the steps below to turn ON the controller power first, and then the motor power.

WARNING

When turning ON the controller power and motor power of the robot controller, thorough attention should be taken to prevent personnel from entering the motion range of the robot and the peripheral equipment controlled by the robot controller. The robot may move or operate accidentally when turning ON the motor power, if the robot servo system is damaged.

3.1.1 CONTROLLER POWER ON PROCEDURE

1. Confirm that the external power is supplied to the controller.

2. Press the CONTROLLER POWER on the upper left portion of the controller front.

3.1.2 MOTOR POWER ON PROCEDURE

1. Ensure that all personal are clear of the work cell, and that all safety devices are in place and operational. (e.g.: door on safety fence is closed and safety plug is inserted, etc.)

2. Press A + MOTOR ON on the TP to turn ON. The motor power turns ON and the <MOTOR> lamp on the top right of the TP screen illuminates at this time.*

NOTE* If motor power does not turn ON, read the contents displayed in the error screen and system message area and restore the system accordingly, and then press A + MOTOR ON again.

DANGER

Before turning ON the controller power and the motor power, ensure that all personnel are clear of the work cell and that no interfering objects are around the robot(s).

3.2 POWER OFF PROCEDURE

Stop the robot and shut down the controller in the reverse order in which it was turned ON. However, in the case of emergency, press the EMERGENCY STOP immediately to cut OFF the motor power. Refer to Chapter 3.3 for more details about emergency stop.

1. Confirm the robot has completely stopped. Refer to Chapter 3.3 for more details.

2. Press HOLD or A+<RUN> on the TP.

3. Press the EMERGENCY STOP on the controller or the TP to cut OFF the motor power.*

   NOTE* In repeat mode, turning the TEACH/REPEAT on the controller to TEACH also cuts OFF the motor power.

4. After the <MOTOR> lamp on the TP screen turns OFF, shut OFF the power by turning OFF the CONTROLLER POWER on the upper left portion of the controller front.

WARNING

1. **Refer to the "External I/O Manual", a separate volume, for power OFF methods using external signals.**
2. **When shutting down the controller power, press the EMERGENCY STOP to cut OFF the motor power first, then turn OFF the CONTROLLER POWER.**

3.3 METHOD FOR STOPPING THE ROBOT

The methods for stopping the robot are different in teach mode and repeat mode.

1. In teach mode,

   (1) Release the DEADMAN on the TP.

   (2) Confirm that the robot has come to a complete stop, and press HOLD or A+<RUN> on the TP.

2. In repeat mode,

   (1) Set the [Step] to [Step Once], or repeat condition to [Repeat Once]. Refer to Chapter 2.7.1.3 for more details.

   (2) Confirm that the robot has come to a complete stop, and press HOLD or A+<RUN> on the TP.

CAUTION

1. **After robot has stopped, cut OFF power to the motors to disable any further motion by pressing EMERGENCY STOP.**
2. **Once motor power has been cut OFF, take measures to prevent personnel from accidentally turning ON the power supply (tag and lock out power switches, etc.).**

3. In emergency stop,

When the robot works abnormally and there is a possibility of danger such as injury, press immediately any EMERGENCY STOP wherever they are located, on the controller front, TP, safety fence etc. to cut off the motor power.

Applying emergency stop may cause the error screen to pop up. To restart the robot from this condition, reset errors before turning ON the motor power. Refer to Chapter 6.4 for more details.

DANGER

Before moving the robot, ensure that all EMERGENCY STOP on the TP, controller and external emergency stop switches, etc. are working correctly.

4.0 MANUAL OPERATION OF ROBOT

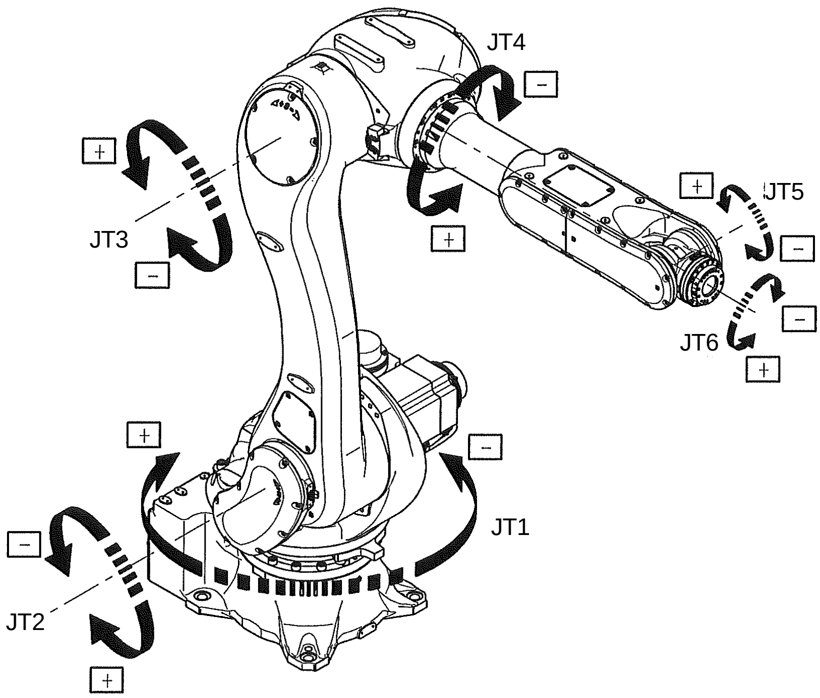
This chapter describes methods for operating the robot manally, the names of operation axes, the movement mode, etc.

4.1 METHOD FOR BASIC OPERATION

This section describes the standard methods for operating the robot manually.

4.1.1 NAMES OF EACH AXIS

A robot is normally equipped with six axes as shown in figure below. These axes are called JT1, …JT6 in order of axis construction.



4.1.2 PROCEDURE FOR MANUAL OPERATION OF THE 6 AXES

To move a robot, follow the procedure described below.

1. Turn ON the CONTROLLER POWER and confirm that the controller power lamp illuminates.

2. On the operation panel of the controller, turn the TEACH/REPEAT to the TEACH position, and press HOLD or A+<RUN> to put the robot into HOLD state.

3. Turn ON the TEACH LOCK on the TP.

> **[NOTE]**
>
> Cycle operation cannot be executed if TEACH LOCK is OFF, even though TEACH/REPEAT is set to TEACH.

4. Press COORD or <Coord> to set the manual operation mode: Joint, Base or Tool.

5. Set the manual speed by pressing TEACH SPEED or <MAN. SPEED>. To move only a very small, specified distance, select speed 1 for inching.

6. When steps 1 to 5 are complete, turn ON the motor power by pressing A + MOTOR ON on the TP.

7. Press A+RUN or A+<HOLD> on the TP.

8. While depressing DEADMAN on back of TP, move robot by pressing the AXIS (marked 1 - 6). The robot will continue to move as long as the keys are pressed.

9. Releasing the AXIS or the DEADMAN on the TP stops the robot.

> **⚠ WARNING**
>
> **Whenever the robot is operated manually inside the safety fence, position yourself so that you can press the EMERGENCY STOP to stop the robot at any time in emergency.**

10. Finish the manual operation.

4.1.3 PROCEDURE FOR MANUAL OPERATION OF THE 7TH AXIS (OPTION)

The seventh axis (option) is an additional axis such as traverse axis, servo weld gun driving axis, etc. Manual operation method is the same as when operating the standard six axes. While depressing DEADMAN switch on TP, move axis by pressing the AXIS (marked 7).

4.1.4 MANUAL OPERATION OF AXES 8 TO 18 (OPTION)

This controller can control a maximum of 18 axes. Manual operation of these axes is the same as that for the seventh axis. To operate, first select either group JT8 to JT14 or JT15 to JT18 by pressing Ext. Axis(Robot).

Press Ext. Axis(Robot) once to illuminate LED on bottom of this key. Then, operate JT8 to JT14 by AXIS, the same as when operating axes JT1 to JT7.

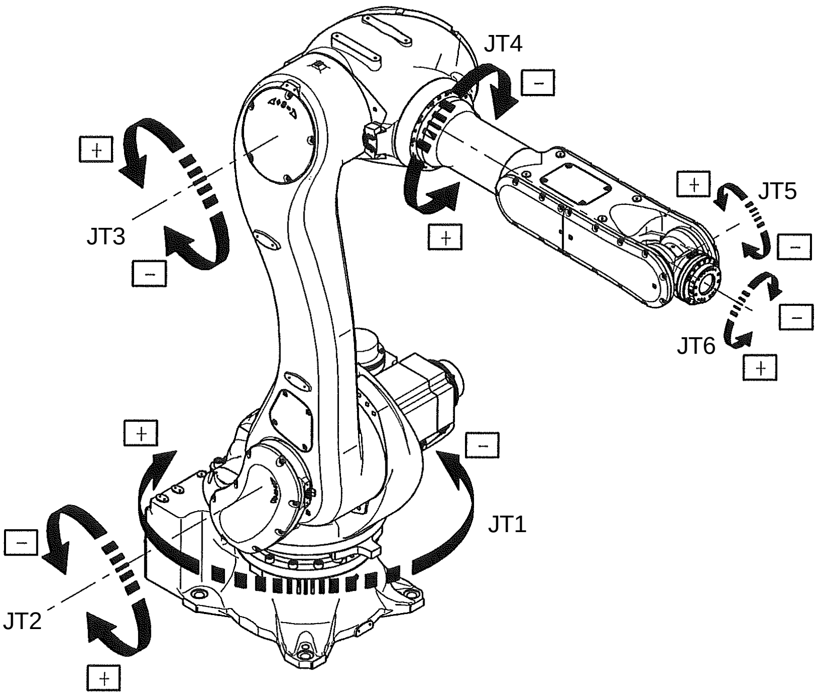
Press Ext. Axis(Robot) twice to illuminate LED on top of this key. Then, operate JT15 to JT18 by AXIS, the same as when operating axes JT1 to JT4.

4.2 MANUAL OPERATION MODE OF ROBOT

This section describes the manual operation mode.

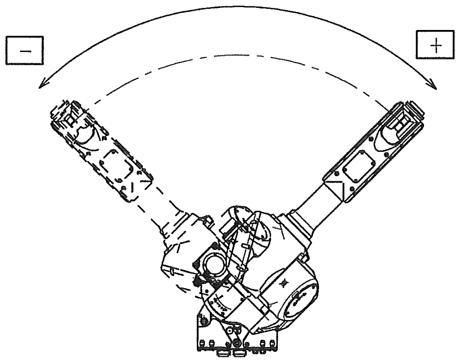
4.2.1 MANUAL OPERATION MODE BASED ON JOINT COORDINATES

Press COORD or <Coord> to change the mode display to manual operation based on joint coordinates. When this mode is selected, the robot axes can be moved individually as shown in the figure below. When pressing several AXIS at the same time, the robot axes can be moved simultaneously in combination.

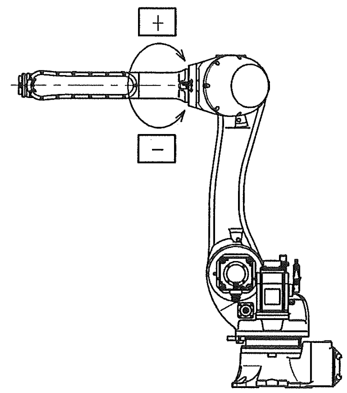


Each axis movement based on joint coordinates

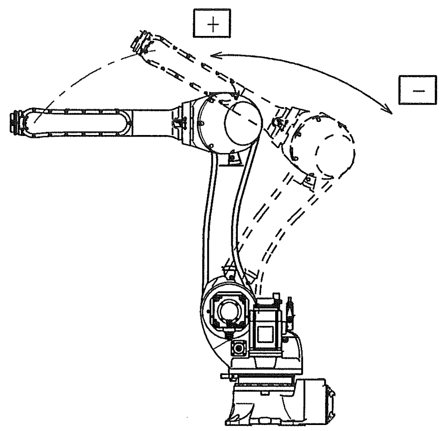
JT1: Left and right rotation of arm



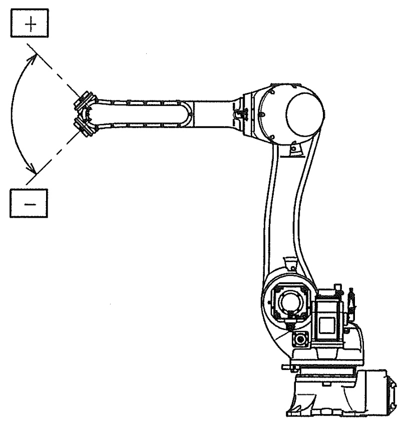
JT4: Rotation of wrist axis (1)



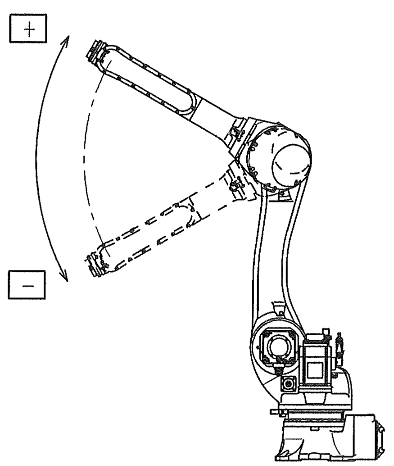
JT2: Back and forth motion of arm



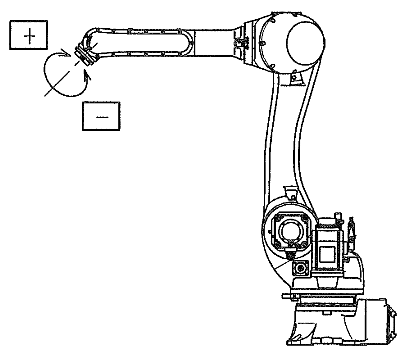
JT5: Rotation of wrist axis (2)



JT3: Up and down motion of arm



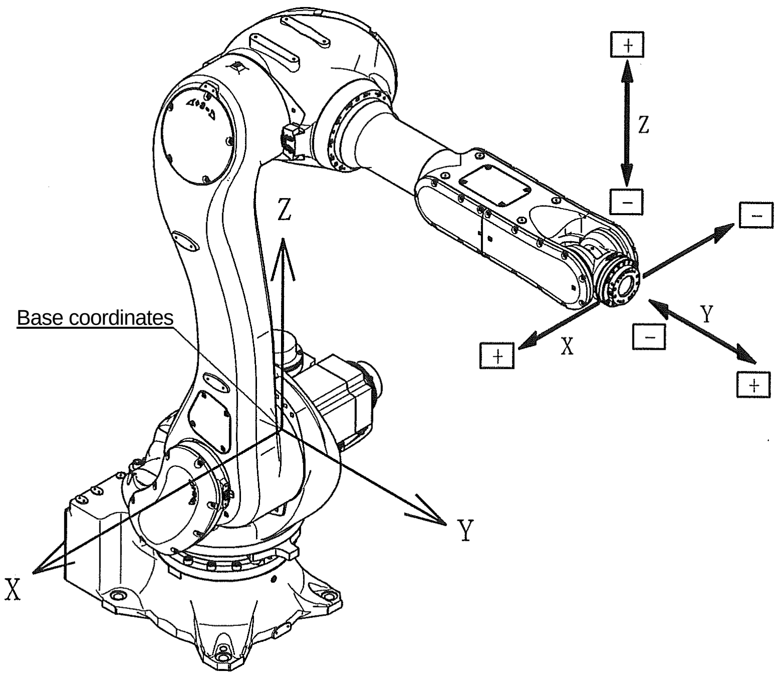
JT6: Rotation of wrist axis (3)



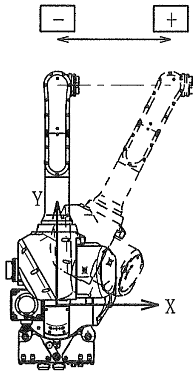
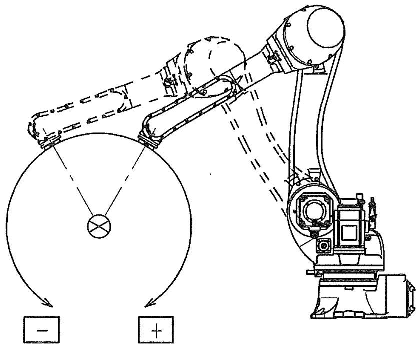
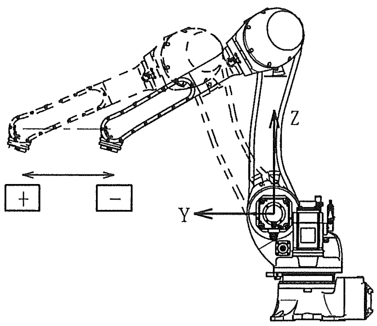
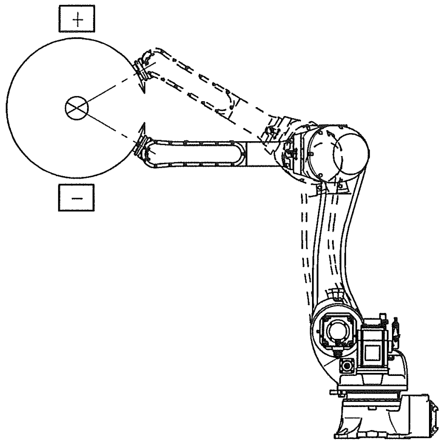
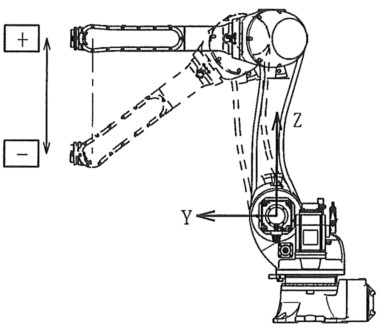
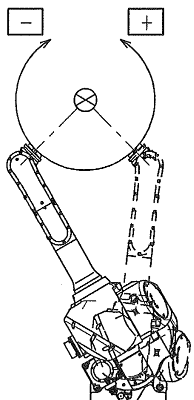
4.2.2 MANUAL OPERATION BASED ON BASE COORDINATES

Press COORD or <Coord> to change the mode display to manual operation based on the base coordinates. When this mode is selected, the robot axes can be moved based on the base coordinate system. When pressing several AXIS at the same time, the robot axes can be moved in combination.

Base coordinate operation will differ in motion direction depending on the coordinates transformation to the null-base coordinates. Figure below is based on the null-base coordinates.



Compound movement based on the base coordinates.　When looking in the positive direction of each base coordinate, clockwise rotation is positive.

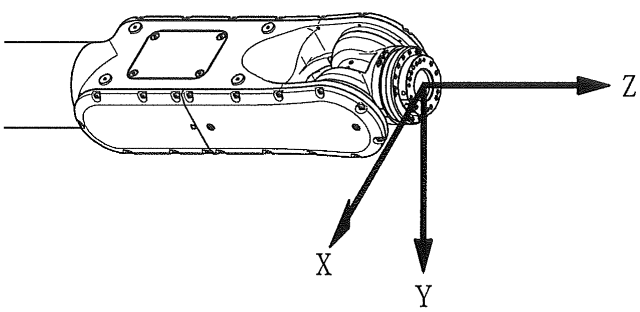
<table>
<tr>
<td>X: Motion of arm parallel to base X coordinate (Wrist orientation is constant.)

</td>
<td>RX Rotation around base X coordinate (- dir. toward viewer) (Tool center point (TCP) does not move.)

</td>
</tr>
<tr>
<td>Y: Motion of arm parallel to base Y coordinate (Wrist orientation is constant.)

</td>
<td>RY Rotation around base Y coordinate (+ is JT2 forward dir.) (TCP does not move.)

</td>
</tr>
<tr>
<td>Z: Motion of arm parallel to base Z coordinate (Wrist orientation is constant.)

</td>
<td>RZ Rotation around base Z coordinate (+ dir. toward viewer) (TCP does not move.)

</td>
</tr>
</table>

4.2.3 MANUAL OPERATION BASED ON TOOL COORDINATES

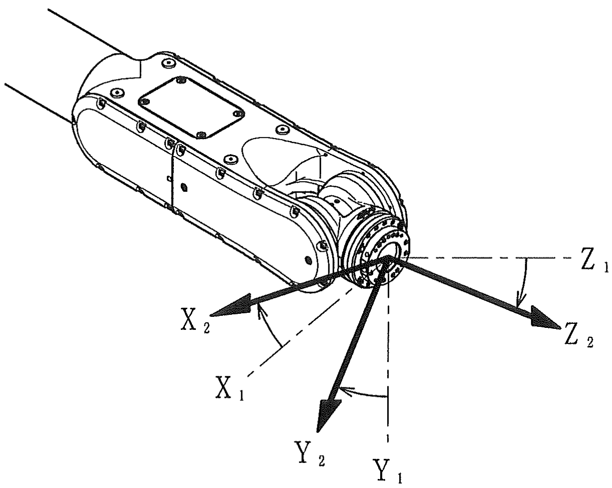
Press COORD or <Coord> to change the mode display to manual operation based on the tool coordinates. When this mode is selected, the robot axes can be moved based on the tool coordinate system.

Tool coordinate system is defined on the tool which is installed on JT6. The tool coordinates change whenever the pose of the robot changes. Operations based on this tool coordinate system will differ in motion direction depending on the coordinates transformation to the null-tool coordinates. Tool coordinates also change when wrist orientation changes as shown in figures below, even though only the forearm moves without moving wrist axes.

When forearm is horizontal.

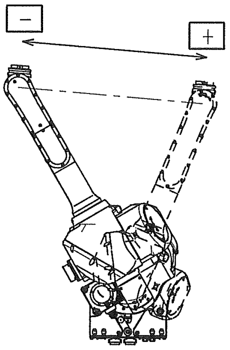
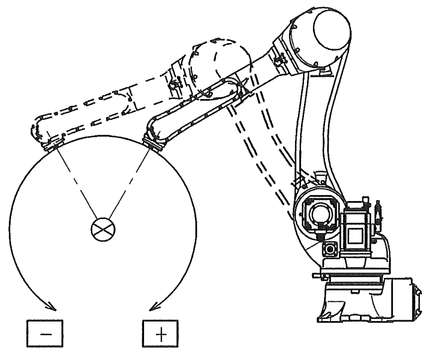
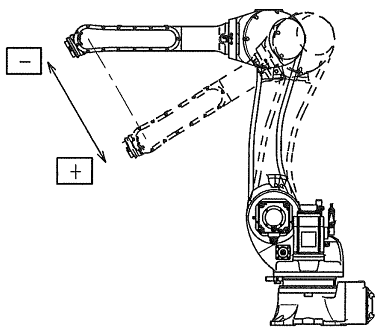
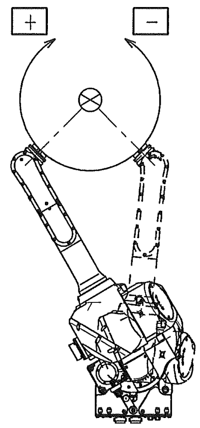
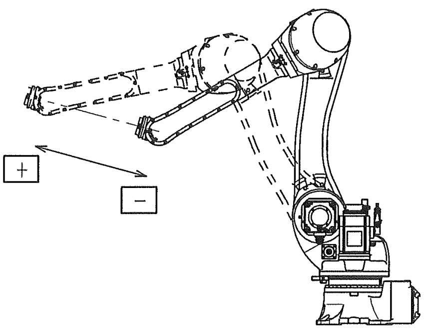
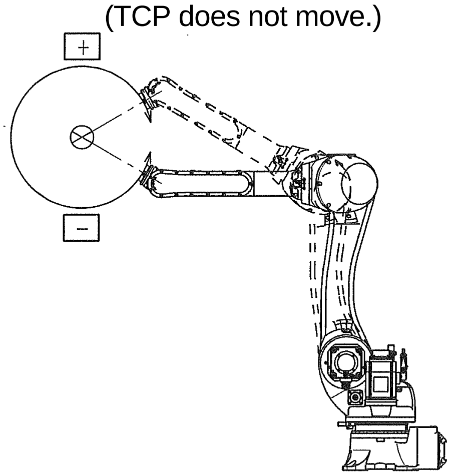


When forearm faces downward.



Compound movement based on the tool coordinates

When looking in the positive direction of each tool coordinate, clockwise rotation is positive.

x: Motion of arm parallel to tool X coordinate (Wrist orientation is constant.) 	rx: Rotation around tool X coordinate (- dir. toward viewer) (TCP does not move.) 
y: Motion of arm parallel to tool Y coordinate (Wrist orientation is constant.) 	ry: Rotation around tool Y coordinate (- dir. toward viewer) (TCP does not move.) 
z Motion of arm parallel to tool Z coordinate (Wrist orientation is constant.) 	rz: Rotation around tool Z coordinate (+ is JT2 forward dir.) (TCP does not move.) 

5.0 TEACHING

Teaching is defined as programming the robot to do the required tasks. E series controller enables you to create programs by various methods in the combination of following three classification items.

1. Robot to use:	Actual on-line robot (On-line teaching)
	Virtual robot or actual off-line robot (Off-line teaching)
	Combination use of two kinds of robots
2. Teaching apparatus to use:	TP
	PC
	combination use of both apparatuses
3. Instructions to use:	compound (package) instruction
	mono-function instruction (AS instruction, KI instruction)
	combination use of two kinds of instructions

In teaching in block (hereinafter simply called block teaching), a program is created by using compound instructions, each of which is composed of element instructions (interpolation, speed, accuracy, timer, I/O signals, etc.) which are necessary for each application field of robot (spot weld, arc weld, sealing … application). Parameter values for each element instruction (alphanumeric characters indicating quantity, condition and items to be selected) are recorded all at once to each step of the program. The recorded data consists of position and orientation data (called "pose" hereinafter) and auxiliary data or "step status" called in the sense that they indicate the "status" of the parameters to be recorded to each step. To make data modification easier, some auxiliary data of element instructions such as speed, accuracy, and timer are recorded indirectly using numbers which represent the levels of the parameter values of the corresponding element instructions. The actual amounts corresponding to each number are set by auxiliary functions. For pose data, pressing REC automatically records the current robot pose as a parameter value for the interpolation instruction at the step.

Auxiliary data to be recorded differs depending on the application field of the robot. The following types of data are recorded as auxiliary data: robot motion conditions, input/output control conditions, tool operation conditions when controlling operation of tools by the robot controller (servo spot weld gun, servo torch for arc welding, etc.), and other special conditions. Parameter values are selected and set via the TP using hardware keys and on-screen keys and buttons. When an application such as spot welding requires a large number of auxiliary data, and data setting is difficult using the hardware keys, the TP provides special setting screens.

When pose data is taught off-line, data transformation is necessary to compensate the difference of the robot-to-workpiece poses between in off-line and online teaching.

On the other hand, AS language programming is usually done by teaching AS instructions and their parameter values are directly specified to each program step via the keyboard. AS language programming can teach mono-function instructions not included in ordinary block instructions. AS language may create and edit a program for new applications, but the programming by block teaching may need to add new element instructions for new applications. For AS language instructions, refer to the "AS Language Reference Manual".

This manual explains how to create a program in block teaching using an actual robot and TP.

5.1 PREPARATION FOR TEACHING

To ensure safety during teaching, follow the items below before starting operations.

1. Ensure that all EMERGENCY STOP are working correctly.
2. Display signs stating clearly "TEACHING IN PROGRESS" in places where personnel can see them.
3. Turn ON the TEACH LOCK on the TP.

⚠ WARNING

For teaching or teaching monitoring duties, qualify only persons who have completed the Kawasaki approved training course(s).

⚠ CAUTION

Backup all data taught during teaching operations for any contingency, to ensure the latest condition can be restored.

5.1.1 CONFIRMING OPERATION OF EMERGENCY STOP BUTTONS

Emergency stop buttons are used for stopping a moving robot immediately when there is a possibility of danger such as injury. Before operating a robot, ensure the following items for all emergency stop buttons: on the controller, the TP, and any other equipment.

1. Press the EMERGENCY STOP on the operation panel, the TP, the interface panel, etc. Confirm that the motor power cuts off and the <MOTOR> lamp turns OFF when each of the buttons is pressed.

2. After EMERGENCY STOP is pressed, reset the error and confirm that the motor power can be turned ON.

DANGER

Ensure that all EMERGENCY STOP are working correctly before moving a robot.

CAUTION

When EMERGENCY STOP is pressed, brakes are applied immediately to the robot and motion stops. Any sudden stop places excessive stress on the mechanical parts of the robot arm. Therefore, avoid using EMERGENCY STOP except in emergency.

[**NOTE**]

1. Emergency stop is possible at any time in either teach or repeat modes.
2. After EMERGENCY STOP is pressed, error messages are displayed on the TP.
3. Motor power ON is not possible in error state. Release the error(s) by error reset, etc. before attempting to restart the robot.

5.1.2 DISPLAY DURING TEACHING

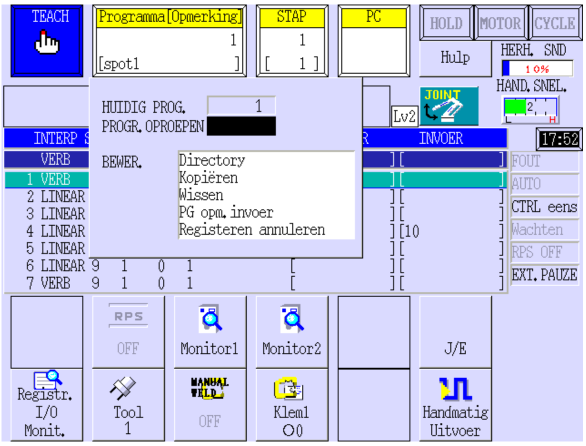
Display signs around the work area/cell indicating “TEACHING IN PROGRESS” to prevent accidents caused by unauthorized personnel.

5.1.3 SETTING OF TEACH LOCK

Turn ON the TEACH LOCK on the TP. The robot will not move once this switch is set to ON, even if TEACH/REPEAT is carelessly set to repeat mode. Conversely, when the TEACH LOCK is OFF, the robot cannot be operated manually in teach mode.

5.2 SELECTING PROGRAM AND STEP NUMBER

Specify the desired program and step numbers before starting teaching operation.



1. Press <PROGRAM> or A + PROGRAM on TP to display pull-down menu.

2. Input the desired program number in [CALL PROGRAM] using NUMBER.

3. Press ↵ to set the specified program number.

If a new program number is specified, “0” is displayed in the step area. The data is recorded to the first step for a new program, or to the next to the last step in an existing program. To add new step(s) to existing program, select the last step in the program by pressing <STEP>/ STEP.

[NOTE]

When selecting an existing program, maximum of 7 lines starting from step 1 are displayed in program display area.

5.3 ELEMENT INSTRUCTION AND THEIR PARAMETERS

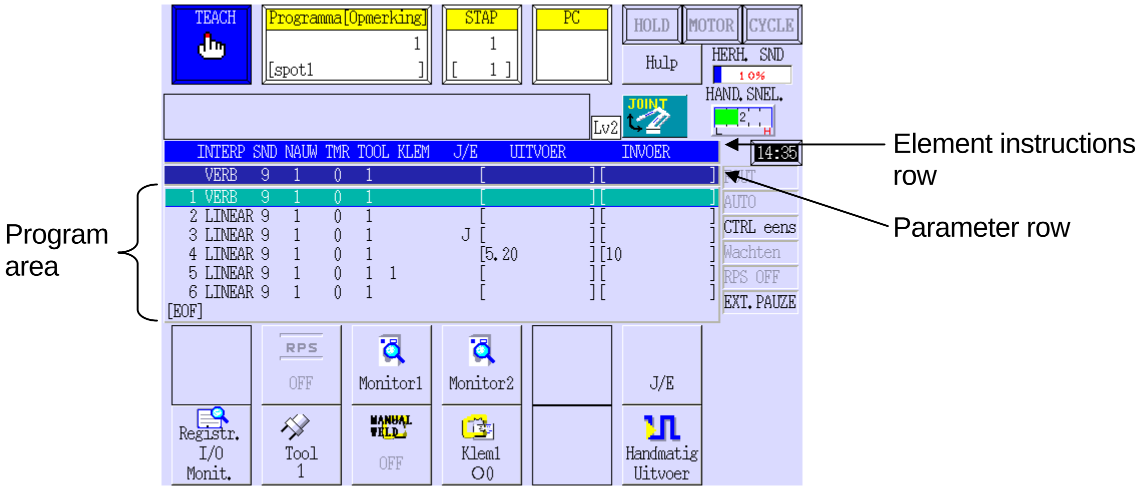
This section explains the element instructions and how to set their parameter values (auxiliary data). Element instructions necessary for the robot in doing given work are preset and displayed on the element instructions row, as shown in the following screen. Under each element instruction, the parameter value for that instruction is displayed.

Some element instructions are not displayed on the element instructions row due to limited space, although their parameters are displayed on the parameter row. For example, in spot weld application with servo weld gun, gun status instruction is not displayed on element instructions row, but the set parameter values for the instruction are displayed on the parameter row.
Also, some element instructions, such as comment instructions, etc., are not displayed even on the

parameter row, and these instructions require extra procedures to view/edit their contents.

The parameter values are selected/set using operation keys and F keys (function key).

Element instructions, and their related parameter values and keys used for setting, are summarized in the table below for each application.　The element instructions are shown in the order they are displayed.　Shaded element instructions are unique to that application.



Handling specification

Element intruc-tion	Interpolation	Speed	Accu-racy	Timer	Tool	Clamp	WK (Work)*	J/E (jump /End)	Output	Input
Parameter values	JOINT/LINEAR/LIN2/ CIR1/CIR2/FLinear/ FCIR1/FCIR2/XLIN	0-9	0-4	0-9	1-9	No disp., 1-2	No disp., C	J, E	1-64 or 1-96	1-64 or 1-96
Keys	A + INTERP	A + SPD	A + ACC	A + TMR	A + TOOL or <Tool>	CL 1 / CL 2	A + Work	A + J/E or <J/E>	A + OX	A + WX

NOTE* This instruction is optional.

Pneumatic gun spot welding specification*

Element intruc-tion	Interpo-lation	Speed	Accu-racy	Timer	Tool	Clamp	J/E (jump /End)	Output	Input	Spot weld			
Paramet er val.	JOINT/LINEAR/LIN2/ CIR1/CIR2/FLinear/ FCIR1/FCIR2/XLIN	0-9	0-4	0-9	1-9	No display, 1-2	J, E	1-64 or 1-96	1-64 or 1-96	ON/ OFF	1-15 (WS)	0-9 (CC)	O/C (OC)
Keys	A + INTERP	A + SPD	A + ACC	A + TMR	A + TOOL or <Tool>	CL1/ CL2	A + J/E or <J/E>	A + OX	A + WX	CL1/ CL2/ CLn	A + WS	A + CC	A + CL.AUX

NOTE* For servo welding gun, refer to the relevant optional manual, a separate volume.

The next sections explain the element instructions.

5.3.1 INTERPOLATION INSTRUCTION

To set the interpolation mode (e.g. linear or joint) for the motion from the previous step to the current step where this instruction is taught, press A + INTERP.

The display toggles: Joint→Linear→Lin(ear)2→Cir(cular)1→Cir(cular)2→F Lin(ear)→F Cir(cular)1→F Cir(cular)2→X Lin(ear)→Joint, every time keys are pressed (except in painting/sealing specification).

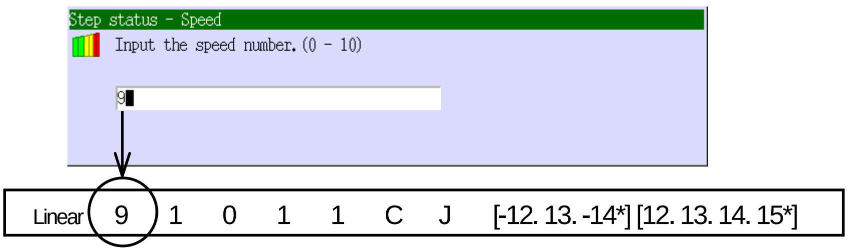
```
Linear  9  1  0  1  1  C  J  [-12. 13. -14*] [12. 13. 14. 15*]
```

Mode	Description
Joint	Robot moves to the target point so that the difference of each axis value between the two taught points decreases at the same proportion in all axes. Select this mode when priority is given to the time it takes to move between the two points, rather than the path the robot takes.
Linear	TCP moves to the target point along linear path between the two taught points, while decreasing the difference in orientation of the tool coordinates (OAT) between the two points at the same proportion as the distance to the target point.
Linear2	TCP moves to the target point along linear path between the two taught points, while decreasing the difference of wrist axes (JT4, JT5, JT6) values between the two points at the same proportion in all wrist axes.
Circular1	Select this mode to specify a robot pose at the middle point between two points (start and end points), when TCP moves along a circular path specified by these 3 points. TCP moves along circular path, while robot moves changing the orientation of the tool coordinates (OAT) in the same way as in linear interpolation mode.
Circular2	Select this mode to specify the pose robot takes at the end point, when TCP moves along circular path specified by the 3 points. TCP moves along circular path while the robot moves changing the orientation of the tool coordinates (OAT) in the same way as in linear interpolation mode.
F Linear/ F Circular1/ F Circular2	Select these modes to move a workpiece based on the fixed tool coordinates.
X Linear	Robot stops when sensing signal input during motion to the target point in linear interpolation mode. Select this mode to use sensing function.

5.3.2 SPEED INSTRUCTION

Pressing A + SPEED displays the screen below.　Press NUMBER keys and enter the speed number (0-9).　Press ↵ to confirm the input number.　This sets the motion speed level from the previous step to the current step.

The actual speed represented by the speed number is set in <Aux.>/[Auxiliary Function]-[3.Aux. Data Setting]–[1.Speed].

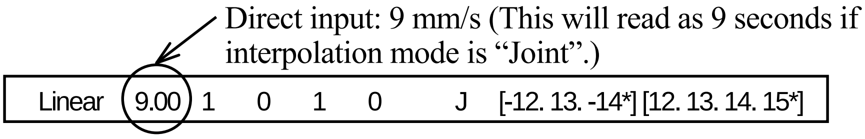


An absolute velocity/ traveling (moving) time can also be input, as shown below.

Direct speed setting:
(Setting range is 0 –10, when optional direct speed setting is enabled.)

Input 10 as the speed number and press ↵.　An input box appears to enable entry of the motion speed in unit of second or unit of mm/s using NUMBER keys.　Press ↵ to confirm.　The unit of speed differs according to the interpolation mode being set.

For joint interpolation mode: motion speed between two taught points, in unit of second
For linear interpolation mode: speed of linear motion between taught points, in unit of mm/s



[NOTE]

This function is enabled/ disabled by option setting according to the specification.

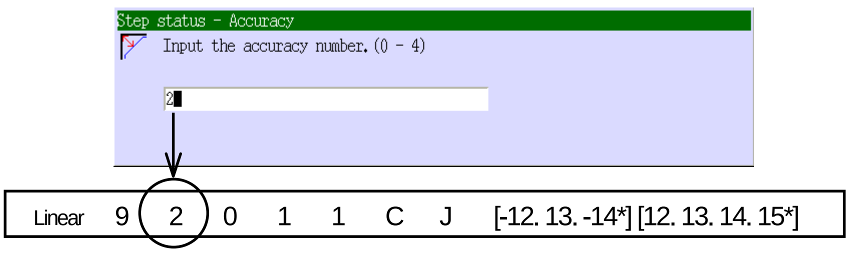
5.3.3 ACCURACY INSTRUCTION

Pressing A + ACC displays the screen below. Input the desired accuracy number (0-4) via the NUMBER keys. Press ↵ to confirm the input number. This sets the level of accuracy needed for axis coincidence with the taught point in the current step.

The actual accuracy represented by the accuracy number is set in <Aux.>/[Auxiliary Function]-[3.Aux. Data Setting]−[2.Accuracy]. The accuracy is set as the approaching distance to the target point. When the command value to TCP enters the set accuracy range, it is processed as “axis coincidence”. When 0 is set, robot moves so that the current TCP coincides with the target point regardless of the values set in Aux. 0302.

[NOTE]

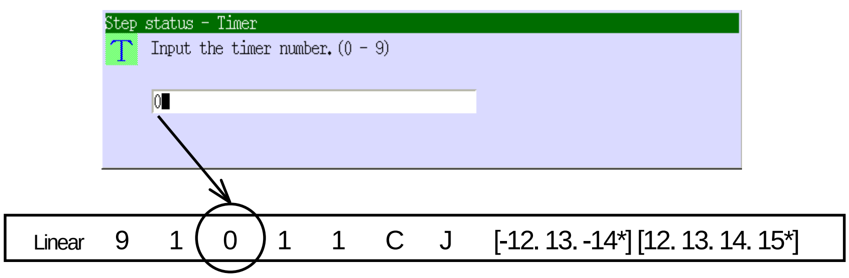
For E controller, the axis coincidence is acknowledged when the command values coincides with the target values for setting the accuracy level to 1. For the controller before E, the axis coincidence is acknowledged when the current values coincides with the target values for setting the accuracy level to 1 (1 mm) by default.



5.3.4 TIMER INSTRUCTION

Pressing A + TMR displays the screen below. Input the desired timer number (0-9) via the NUMBER keys. Press ↵ to confirm the input number. This sets the time to wait after axis coincidence with the taught point in the current step.

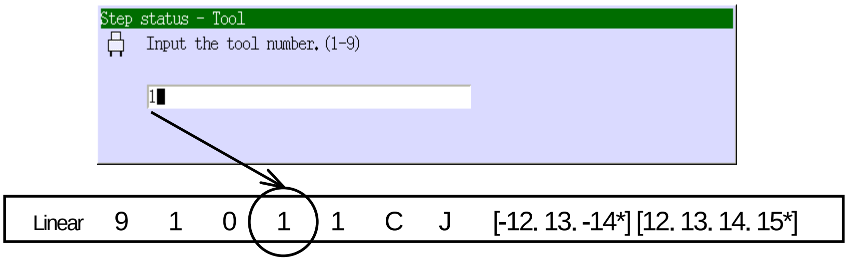
The actual waiting time represented by the timer number is set in <Aux.>/[Auxiliary Function]-[3.Aux. Data Setting]－[3.Timer].



5.3.5 TOOL INSTRUCTION

Pressing <Tool> or A + TOOL displays the screen below. Input the desired tool number (1-9) via the NUMBER keys. Press ↵ to confirm the input number. This sets the tool used when moving to the taught point.

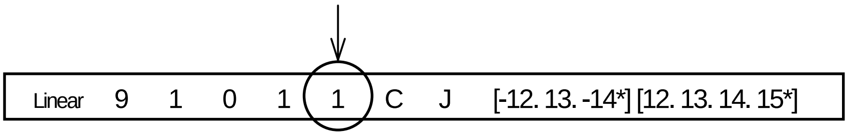
The tool data represented by the tool number is set in <Aux.>/[Auxiliary Function]-[3.Aux. Data Setting]－[4.Tool Coord].



5.3.6 CLAMP1/ CLAMP 2/ CLAMP-N INSTRUCTION

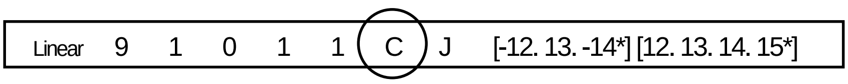
Set the clamp instruction to be executed after axes coincidence in the taught step by specifying ON/OFF as the parameter value. To select the parameter value (ON/ OFF) for clamp 1 or clamp 2, press CL1 or CL2. The parameter value switches ON→OFF→ON every time key(s) is pressed. The display on parameter row changes: clamp instruction number (1 or 2)→no display →clamp instruction number. For clamp 3 or higher (clamp-n), select ON/ OFF by CLn + NUMBER. The parameter value (ON/ OFF) for clamp-n instruction is displayed on the page for clamp-n data. When teach screen is displayed, pressing A + ←/→ displays the page for clamp-n data.

When CLAMP 1 with ON is selected



5.3.7 WORK INSTRUCTION (OPTION)

Pressing A + WORK toggles the parameter value: no compensation→work compensation→no compensation, and the display changes: no display→C→no display. When the taught point is a point for 3D sensor compensation function (Option), select Work C. If not, select 0 (no display).



5.3.8 JUMP / END (J/E) INSTRUCTION

Pressing <J/E> or A + J/E toggles the parameter value: not set→JUMP instruction→END instruction→not set, and the display changes: no display→J→E→no display. These instructions determine how the program steps are executed after executing the step where these instructions are taught. The instructions are processed as follows:

Not set: Executes steps in order. Continues currently executed program.
J: JUMP instruction. Jumps to a different program (selected program).
E: END instruction. Ends program execution.

```
Linear  9  1  0  1  1  C  J  [-12. 13. -14*] [12. 13. 14. 15*]
```

JUMP (J) instruction: Processing differs depending on whether RPS is disabled or enabled.

1. When RPS is disabled, JUMP instruction is ignored and the next step is executed.

2. When RPS is enabled, the program is executed as shown in the table below:

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="2">JUMPOFF signal</th></tr>
<tr><th>ON</th><th>OFF</th></tr>
<tr><td rowspan="2">JUMPON signal</td><td>ON</td><td colspan="2">1. JUMP ON signal has precedence over JUMP OFF signal.
2. When JUMP ON signal is input, program selection signal is read and program execution jumps to the designated program.
3. Acceptable range for destination program number: 0 – 999.
4. When a non-existing program is selected, error occurs and program execution stops. Motor power turns OFF at the same time.</td></tr>
<tr><td>OFF</td><td>1. Executes the next step.</td><td>1. Pauses at the step and waits for one of the signals to turn ON.</td></tr>
</table>

END (E) instruction : Processing differs depending on whether RPS is disabled or enabled.

1. When RPS is disabled,

(1) Ignores END instruction and returns to the first step in program.

(2) Steps following the END instruction are also ignored.

2. When RPS is enabled,

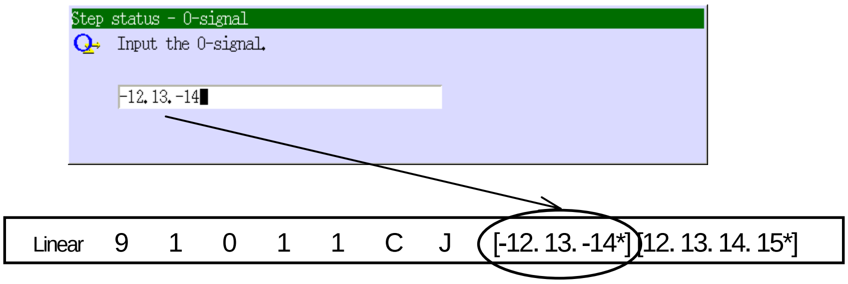
(1) When RPS ON signal is input, reads program selection signal and jumps to the program specified by the signal.

(2) Acceptable range for designation program number: 0 – 999.

(3) When a non-existing program is selected, error occurs and program execution stops.　Motor power turns OFF at the same time.

5.3.9 OUTPUT (O) INSTRUCTION

Pressing OX displays the screen for setting output signals.　Enter the output signal number via NUMBER keys and press ↵.　This sets which signal to output after axis coincidence with the taught point.



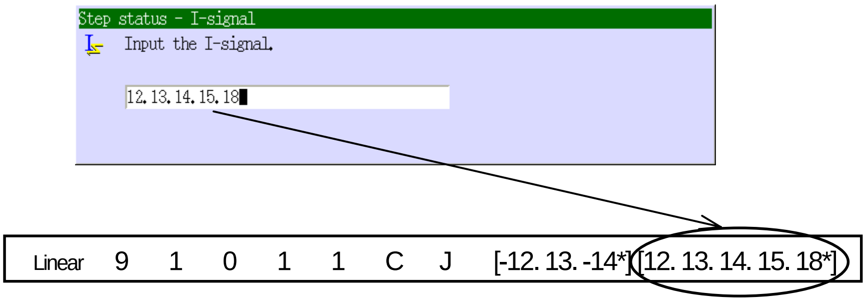
[NOTE]

1.　Signal numbers set randomly are displayed in ascending order by their absolute value the next time they are displayed.　2.　When setting more than one signal, place a period between the signal numbers.
3.　To delete a signal number displayed on the dialog box, move the cursor to the right of the signal number and press BS.
4.　* are displayed on the parameter row for signals unable to be displayed due to limited space.　All signals set are output at program execution. (To check all signals, open Recorded I/O Monitor screen.)
5.　To specify the order of outputting the signals, record the signals in separate steps.
6.　When OX.PREOUT is ON, the signal is output immediately after the robot starts its motion to the taught step. When OX.PREOUT is OFF, the signal is output immediately after axis coincidence with the taught step.
7.　For the instruction that explicitly turns the specified signal OFF (with minus (-) sign), use Multi function OXWX (option).

To name the output signal, open the Auxiliary function screen.　Select [6.Input/Output Signal]－[6.Signal name]-[1.OX(Output)].　Pressing <Input> displays the character input screen. Follow the procedures in Chapter 2.8 and input the desired name.

5.3.10 INPUT (I) INSTRUCTION

Pressing WX displays the screen for setting input signals.　Enter the input signal number via NUMBER keys and press ↵.　This sets the input signal that the robot will wait for, after axis coincidence with the taught point.



[NOTE]

1. Signal numbers set randomly are displayed in ascending order by their absolute value the next time they are displayed.
2. There is no function to wait for input signal to turn OFF.
3. When setting more than one signal, place a period between the signal numbers.
4. To delete a signal number displayed on the dialog box, move the cursor to the right of the signal number and press BS.5. Robot can begin to detect input signals only after axis coincidence with taught step.
6. When switching output signal to ON or OFF in the same step, input signal is detected after the execution of output signal.
7. In a step where more than one signal is recorded, all signals are detected under AND condition. Detection cannot be done under OR condition or combination of both.
8. When more than one signal is set, robot waits for all taught signal conditions are satisfied.
9. To specify the order in which the signals are input, record the signals in separate steps.
10. For the instruction that waits until the signal explicitly turns OFF (with minus (-) sign), use Multi function OXWX (option).

To name the input signal, open the Auxiliary function screen.　Select [6.Input/Output Signal]－[6.Signal Name]－[2.WX(Input)].　Pressing <Input> displays the character input screen. Follow the procedures in Chapter 2.8 and input the desired name.

5.3.11 SPOT WELD INSTRUCTIONS

In teaching for spot welding, set the following four kinds of auxiliary data for each spot weld instruction. : ON/OFF (Weld gun), WS (Weld Schedule) number, CC (Clamp Condition) number, and O/C (retract/ extend) for 2 stroke retractable gun.　To teach these data, follow the procedure below.

1. ON/OFF of clamp instruction

To set clamp instruction ON / OFF, follow the procedure described below.

(1) Pressing CL1 (CL2) switches the teaching data for clamp1 (clamp2): ON → OFF → ON.

(2) Pressing A + CL1 (CL2) switches the teaching data and the actual output signal* for clamp1 (clamp2): ON → OFF → ON.

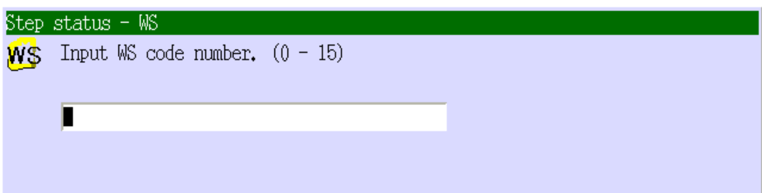
(3) Pressing CLn + NUMBER (1-8) switches the teaching data for clamp-n: ON → OFF → ON.
Example: Pressing CLn + 3 teaches ON/OFF for CL3 instruction.

(4) Pressing A + CLn + NUMBER (1-8) switches the teaching data and the actual output signal* for clamp-n: ON → OFF → ON.

NOTE* A + CL operation activates actual devices connected with clamp signals.　Be careful when turning a clamp signal from ON to OFF or OFF to ON during teaching with a workpiece grasped in handling specification, the hand will open and the workpiece may fall.

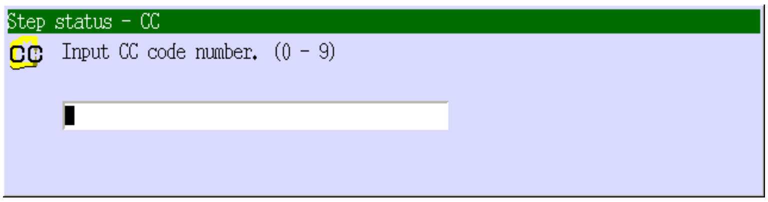
2. WS number of WS (Weld Schedule) instruction

Pressing A + WS displays the screen below.　Enter the WS number via NUMBER keys and press ↵.



3. CC number of Clamp Condition instruction

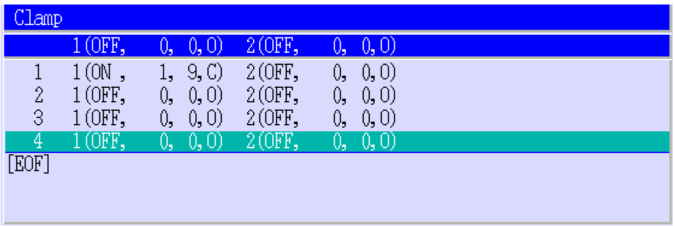
Pressing A + CC displays the screen below.　Enter the CC number via NUMBER keys and press ↵.



4. O/C of OC instruction

Pressing A + CL.AUX switches the parameter values between O and C.

Parameter values for the four instructions above are displayed on the same page per clamp instruction, as shown in example screen below.　In this screen, the four kinds of auxiliary data for CL1 instruction are set as follows in step 1: Clamp is ON, WS is 1, CC is 9 and O/C is C.



Setting ranges for the four parameter types:
Clamp: ON or OFF
WS: 0 – 15
CC: 0 – 9
O/C: O or C

Refer to Chapter 13 for more details about spot welding specifications.

5.4 RECORDING POSE AND AUXILIARY DATA TO A STEP

This section explains how to record pose and auxiliary data to a step, following the procedures in earlier sections.

5.4.1 NORMAL RECORDING PROCEDURE

Pressing REC records the data to the step after the last step currently displayed in program.

Repeat the data setting procedures until program is complete.　Step number increments by one every time REC is pressed.

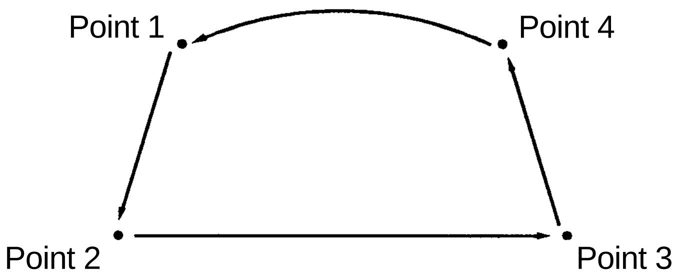
Move robot → Set parameters for element instructions → Record data to the step

[NOTE]

Error occurs when the setting procedures explained in this chapter are performed in program steps other than the last step of the program.

5.5 TEACHING PROCEDURES

This section describes how to create a program in block teaching.　This example teaches the four points shown in the figure below.



Pose data at each point and basic auxiliary data are basically taught in block teaching.　This example does not cover the teaching of signals that are transmitted/received between the controller and the peripheral devices.

CAUTION

Tool coordinates data must be registered before program teaching in Aux.0304.　These values define the pose (position and orientation) of the tool mounted on the robot.　If a program is taught without registering the tool coordinates data and they are registered after program teaching, the robot will not operate as taught.　To register them, refer to Chapter 8.

5.5.1 OPERATING SWITCHES

Confirm the EMERGENCY STOP condition and set the other switches and keys before actual teaching.

1. Checking EMERGENCY STOP
   Confirm that the EMERGENCY STOP operates properly before entering the safety fence.

   (1) Press the EMERGENCY STOP on the TP and the controller, and confirm that motor power is shut off and <MOTOR> lamp turns OFF.

   (2) Reset the error and confirm that the motor power can be turned ON.

2. Setting switches

   (1) Turn ON the CONTROLLER POWER on the controller. The CONTROL POWER lamp illuminates.

   (2) Set the TEACH/REPEAT on the controller to TEACH.

   (3) Press the A + Motor ON on the TP. The <MOTOR> lamp illuminates.

   (4) Press HOLD on the TP to set to HOLD.

   (5) Press the TEACH LOCK on the TP to turn ON.

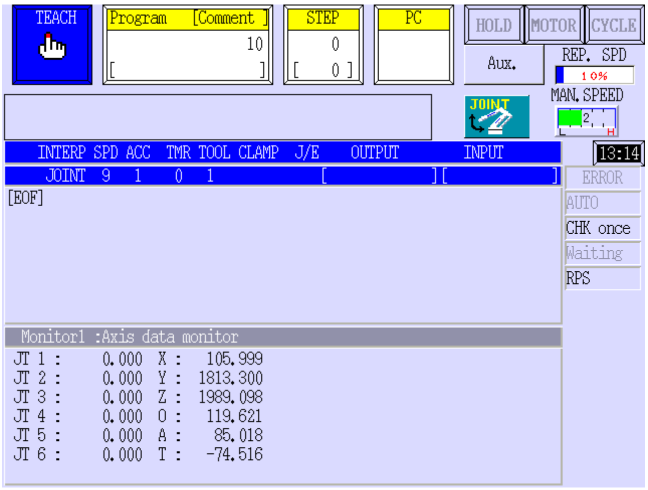
5.5.2 TEACHING PROCEDURE

The following is a brief description of teaching procedures. Refer to Chapter 5.2 and the following sections for more details.

WARNING

The following operations are performed inside the safety fence. Therefore, teaching must be conducted by two people, one who conducts teaching operation and a supervisor, both of whom have completed special education for teaching operation.

1. Select a program on the TP. Refer to Chapter 5.2 for the setting procedure. In this example, program No. 10 is selected. The teach screen is as follows.



2. The following instructions and their parameter values are taught in this example.

Step	Motion points (teaching points)	Teaching contents	Element instruction and parameter values				
			Interp	Speed	Accuracy	Timer	Tool
1	1	Teach pose at the point where robot starts operation.	Joint	9	4	0	1
2	2	Robot moves from point 1 to point 2 at speed level 7 and positioning accuracy level 3 by linear interpolation, and waits per timer instruction.	Linear	7	3	1	1
3	3	Robot moves from point 2 to point 3 at speed level 5 by linear interpolation, and changes tools from tool 1 to tool 2.	Linear	5	3	0	2
4	4	Robot moves from point 3 to point 4 at speed level 6 by linear interpolation, and changes tools from tool 2 to tool 1.	Linear	6	3	0	1
5	1	Robots moves from point 4 to point 1 at speed level 7 by joint interpolation.	Joint	7	3	0	1

3. Move robot to point 1 by AXIS for step 1.

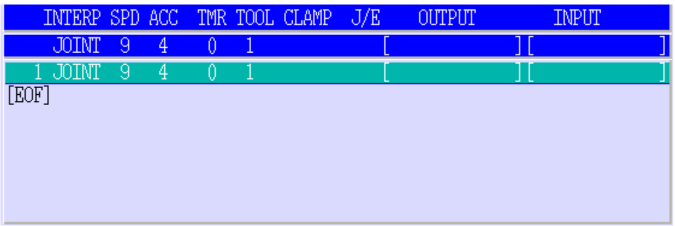
4. Set the parameter values of speed instruction* and accuracy instruction** to 9 and 4 respectively.

   NOTE* To set a parameter value of the speed instruction:
   Input speed number as parameter value by NUMBER on the screen displayed by pressing A + SPEED and press ↵.

   NOTE** To set a parameter value of the accuracy instruction:
   Input accuracy number as parameter value by NUMBER on the screen displayed by pressing A + ACC and press ↵.

5. Set the other parameter values by the same method described above.

6. Press REC to store all data taught to step 1, including pose and auxiliary data. The teach screen appears as shown below.



7. Move robot to point 2 by AXIS for step 2.

8. Set the parameter values of interpolation instruction* to Linear, speed instruction to 7, accuracy instruction to 3 and timer instruction** to 1. To set parameter values of the speed and accuracy instructions, refer to the procedures described above.

   NOTE* To set a parameter value of the interpolation instruction
   Pressing A + INTERP changes the display on parameter row as follows:
   Joint→Linear→Lin(ear)2→Cir(cular)1→Cir(cular)2→F Lin(ear)→F Cir(cular)1 →F Cir(cular)2→X Lin(ear)→Joint.
   When the desired interpolation mode appears, then the setting is complete.

   NOTE** To set a parameter value of the timer instruction:
   Input timer number as parameter value by NUMBER on the screen displayed by pressing A + TIMER and press ↵.

9. Press REC to store all data taught to step 2, including pose and auxiliary data. The teach screen appears as shown below.

	INTERP	SPD	ACC	TMR	TOOL	CLAMP	J/E	OUTPUT	INPUT
	LINEAR	7	3	1	1			[ ]	[ ]
1	JOINT	9	4	0	1			[ ]	[ ]
2	LINEAR	7	3	1	1			[ ]	[ ]
[EOF]									

10. Move robot to point 3 by AXIS for step 3.

11. Set the parameter values of interpolation instruction to Linear, speed instruction to 5, accuracy instruction to 3 and tool instruction* to 2. To set parameter values of the speed, accuracy and interpolation instructions, refer to the procedures described above.

NOTE* To set a parameter value of the tool instruction:
Input tool number as parameter value by NUMBER on the screen displayed by pressing <Tool> or A + TOOL and press ↵.

12. Press REC to store all data taught to step 3, including pose and auxiliary data. The teach screen appears as shown below.

	INTERP	SPD	ACC	TMR	TOOL	CLAMP	J/E	OUTPUT	INPUT
	LINEAR	5	3	0	2			[ ]	[ ]
1	JOINT	9	4	0	1			[ ]	[ ]
2	LINEAR	7	3	1	1			[ ]	[ ]
3	LINEAR	5	3	0	2			[ ]	[ ]
[EOF]									

13. Move robot to point 4 by AXIS for step 4.

14. Set the parameter values of interpolation instruction to Linear, speed instruction to 6 and accuracy instruction to 3. To set parameter values, refer to the procedures described above.

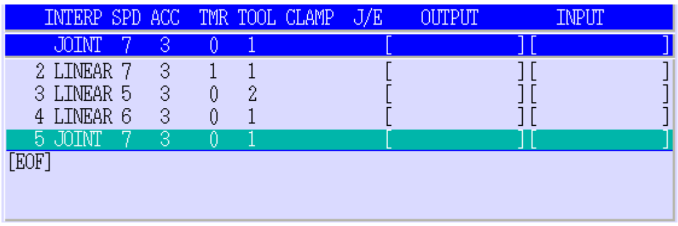
15. Press REC to store all data taught to step 4, including pose and auxiliary data. The teach screen appears as shown below.

	INTERP	SPD	ACC	TMR	TOOL	CLAMP	J/E	OUTPUT	INPUT
	LINEAR	6	3	0	1			[ ]	[ ]
1	JOINT	9	4	0	1			[ ]	[ ]
2	LINEAR	7	3	1	1			[ ]	[ ]
3	LINEAR	5	3	0	2			[ ]	[ ]
4	LINEAR	6	3	0	1			[ ]	[ ]
[EOF]									

16. Move robot to point 1 by AXIS for step 5.

17. Set the parameter values of interpolation instruction to joint and speed instruction to 7.
    To set parameter values, refer to the procedures described above.

18. Press REC to store all data taught to step 5, including pose and auxiliary data. The teach screen appears as shown below.



	INTERP	SPD	ACC	TMR	TOOL	CLAMP	J/E	OUTPUT	INPUT
	JOINT	7	3	0	1			[ ]	[ ]
2	LINEAR	7	3	1	1			[ ]	[ ]
3	LINEAR	5	3	0	2			[ ]	[ ]
4	LINEAR	6	3	0	1			[ ]	[ ]
5	JOINT	7	3	0	1			[ ]	[ ]

[EOF]

Teaching operations for pg10 are complete.

CAUTION

1. **As precaution, save always latest data to external memory devices such as USB memory, etc. after creating program.**
2. **To avoid deletion of saved data, be sure to store USB memory securely.**

5.6 PROCEDURE FOR OPERATING AS LANGUAGE TEACHING SCREEN

This section describes how to create a new program or edit via specialized AS language, etc., on the TP. For details on creating more complicated programs via PC, refer to the “AS Language Reference Manual”, a separate volume.

5.6.1 CREATING A NEW PROGRAM

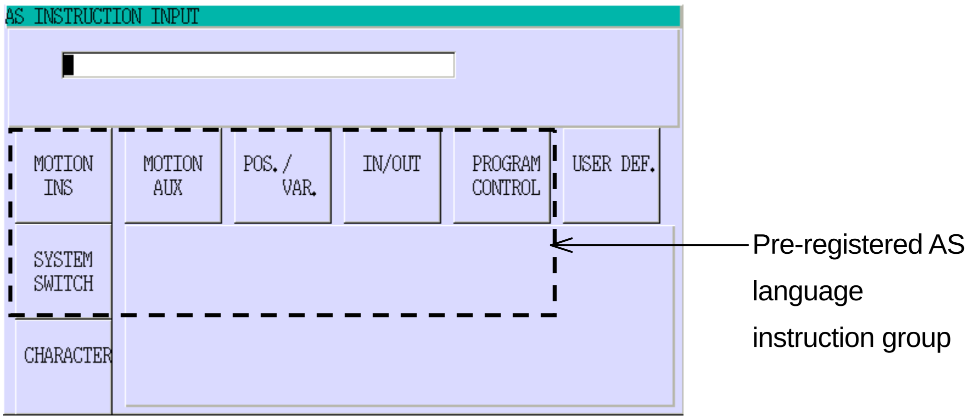
1. Programming by using pre-registered instructions

AS language instructions for E series controller are divided into six categories according to their functions, and registered as shown on the following pages. Refer to a separate manual, “AS Language Reference Manual” for the meaning of each instruction and how to use.

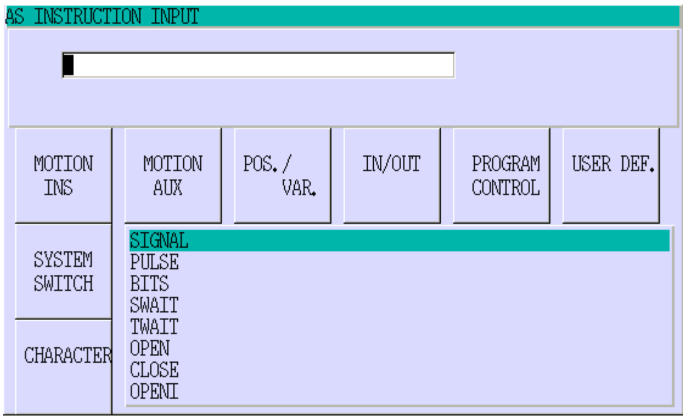
(1) Select a program to create on the teach screen. For selecting a program, refer to Chapter 2.7.1.1.

(2) Press ▯ to display the screen below, and select [AS Language Teach] from the pull-down menu.

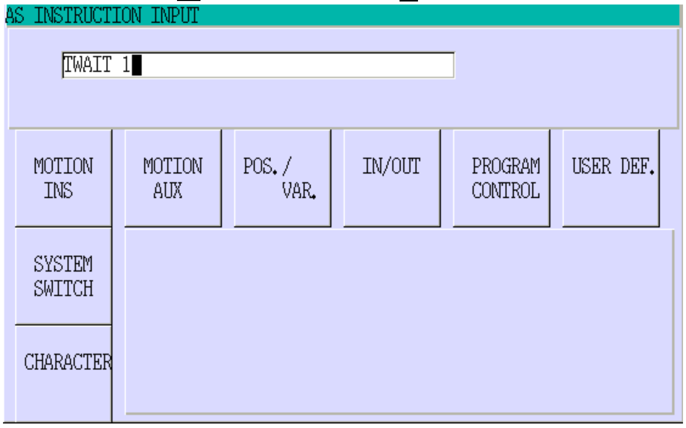
(3) As an example, teach TWAIT 1 in the first step. Press <IN/OUT> on the screen below.



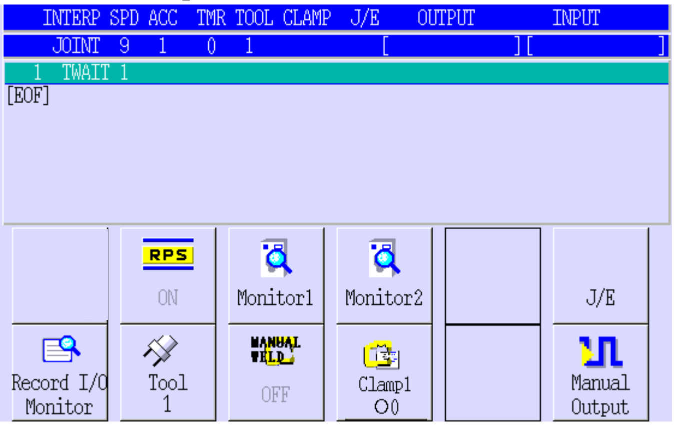
(4) The screen below is displayed.



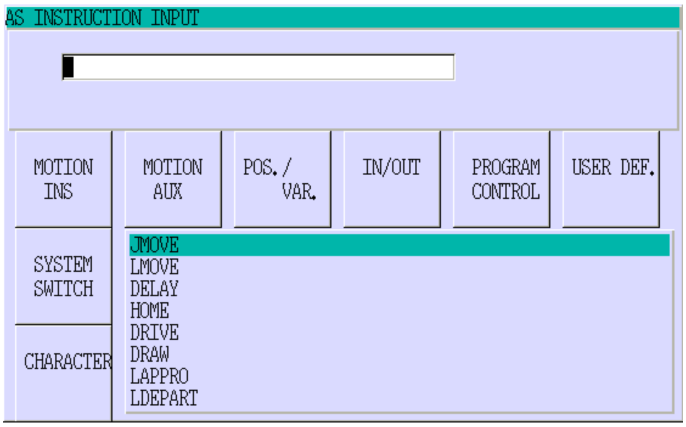
(5) Move cursor to TWAIT, press ↵, and then press 1 to input as shown below.



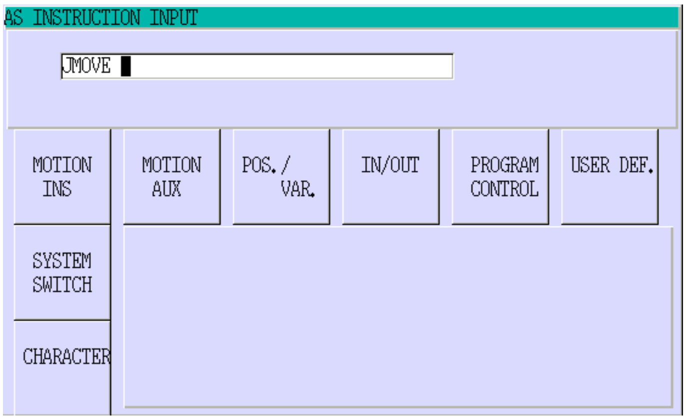
(6) Pressing ↵, records the first step as shown in screen below.



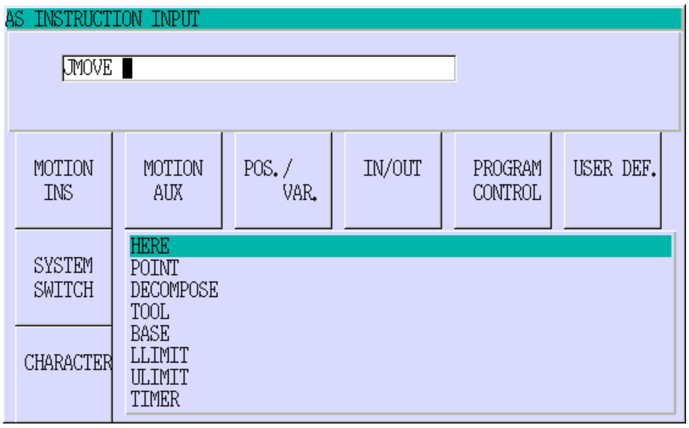
(7) Teach JMOVE #POINT1 in the second step.　As described in (3) above, display the screen and press <MOTION INS> to display the screen below.



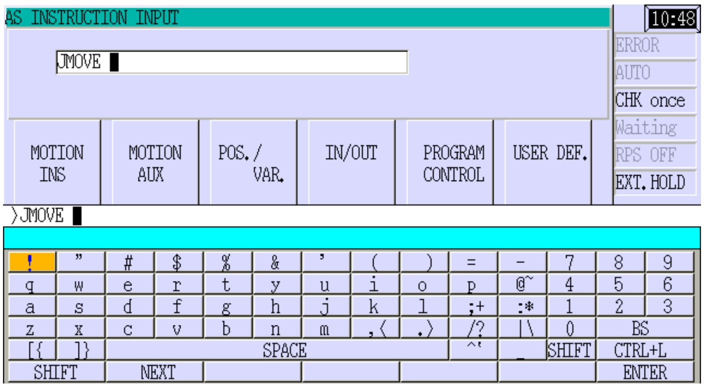
(8) Move cursor to JMOVE and then press ↵ to input as in screen below.



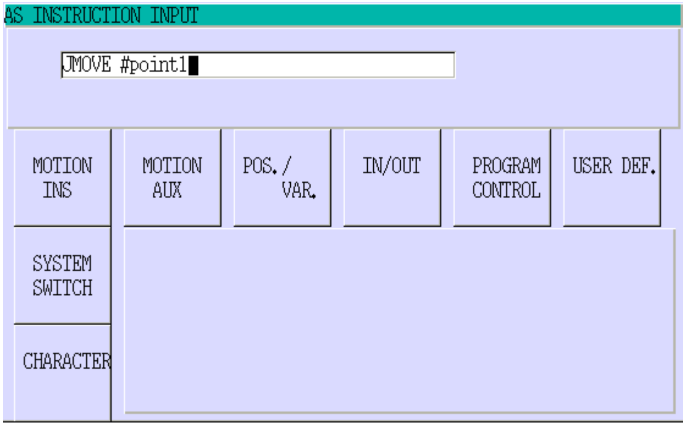
(9) Press <POS./VAR.> to display the list of registered pose variables. In the screen below, as #POINT1 has not been entered yet, select <CHARACTER>.



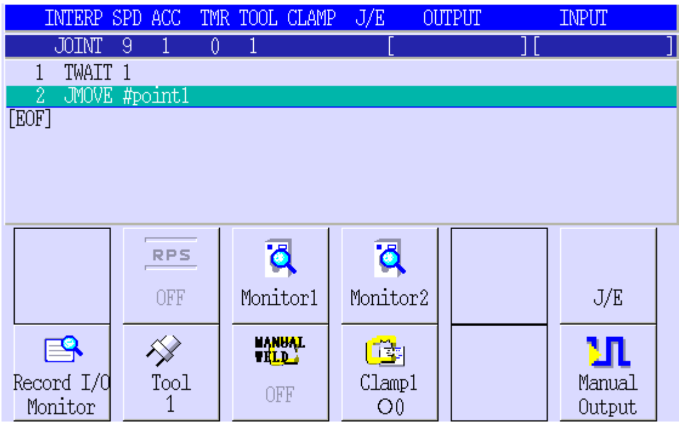
(10) The keyboard screen is displayed as shown below. Input #POINT1 here.



(11) Pressing <ENTER> or ↵ displays the screen as shown below.



(12) Pressing ↵ records the instruction as the second step.

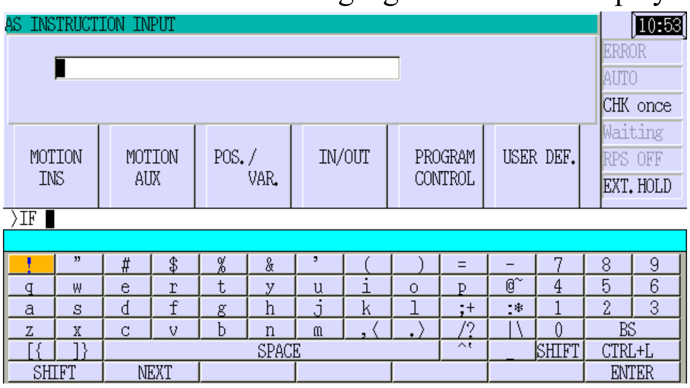


In the same way, input each step by selecting the AS language and/or registered variables to create a new program.

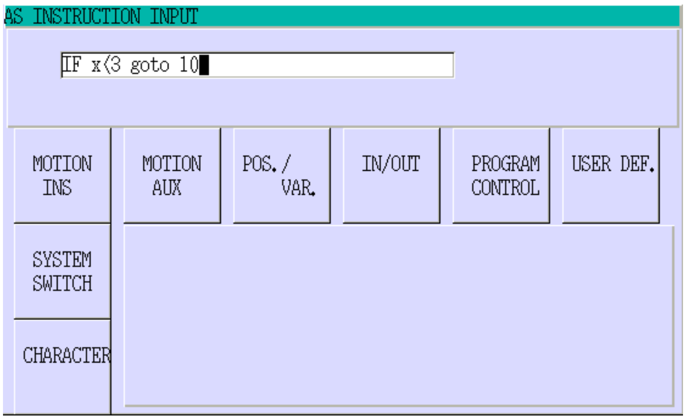
2. Free programming

Input instructions and variables freely by the keyboard screen as follows. The example procedure below demonstrates how to create a step which includes IF x<3 GOTO 10.

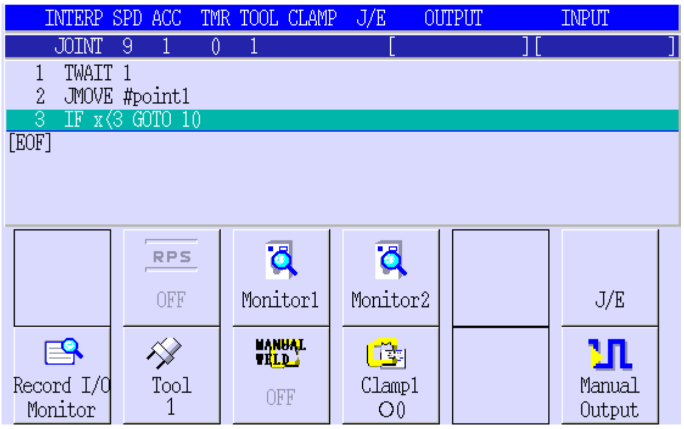
(1) Pressing <CHARACTER> on the AS language teach screen displays the screen below.



(2) Input x<3 goto 10 after IF via keyboard and press <ENTER> or ↵ to display the screen below.



(3) Press ↵ to record the instruction IF x<3 GOTO 10 to Step 3.



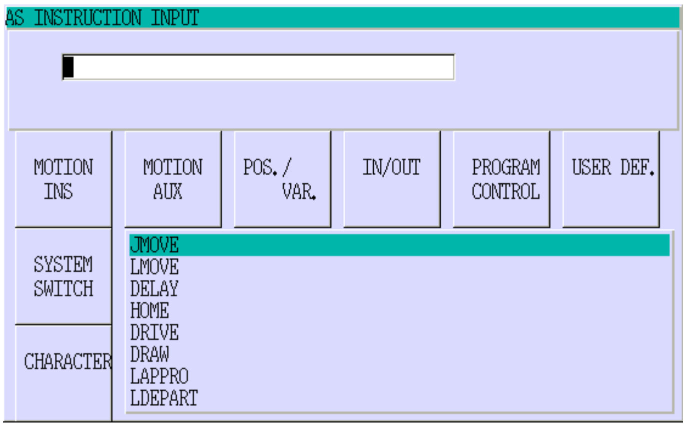
5.6.2 ADDING A STEP TO PROGRAM

This section describes how to add a new step to a program. As an example, add the LMOVE #t4 instruction after the last step 3.

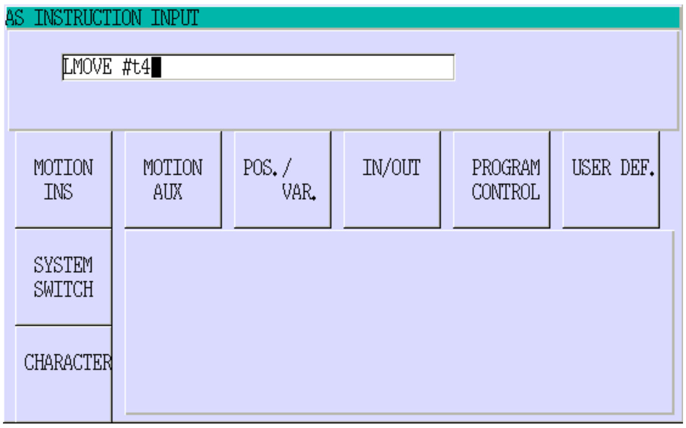
1. Select the last step. For details on selecting a last step, refer to Chapter 2.7.1.2.

2. Display AS language instruction teaching screen by following step 1-(1) and (2) in Chapter 5.6.1.

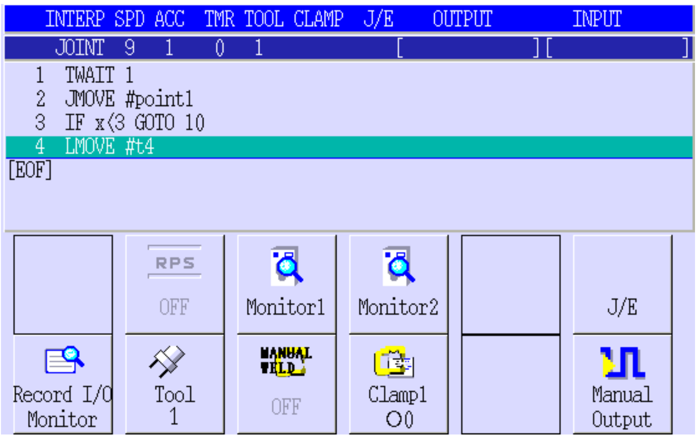
3. Press <MOTION INS> in the screen below.



4. Move cursor to LMOVE and press ↵. Input pose variable #t4 as shown in screen below by following steps 1-(9) to (11) in Chapter 5.6.1.



5. Pressing ↵ adds instruction LMOVE #t4 as the last step 4 in the screen below.



5.6.3 OVERWRITING A STEP IN A PROGRAM

This procedure is basically the same as Chapter 5.6.2 except for the following items.

1. In step 2. of the procedure, select the step to overwrite. For details on selecting steps, refer to Chapter 2.7.1.2.

2. In step 5. of the procedure, pressing A+O.WRITE overwrites the selected step with the new contents.

5.6.4 INSERTING/DELETING A STEP TO/FROM PROGRAM

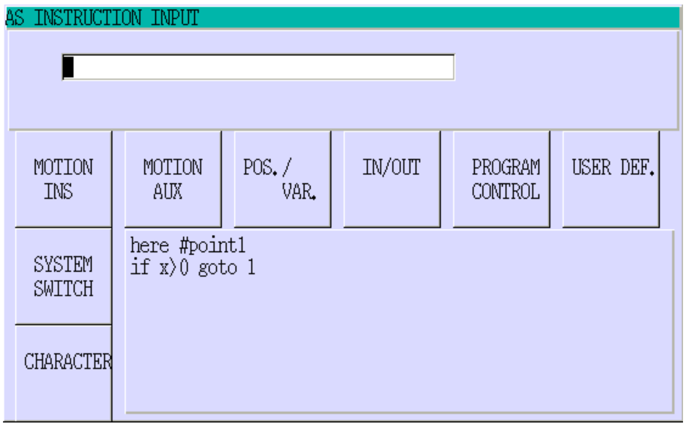
To insert a step into a program, use I command. To delete, use DELETE command. For details about these commands, refer to the “AS Language Reference Manual”, a separate volume.

5.6.5 OTHER FUNCTIONS

This section describes special functions of the AS language teaching screen.

1. Registration of AS language

Instructions which are frequently or occasionally used can be registered by Aux. 0307. (Up to 15) For more details, refer to Aux. 0307 in 8. Auxiliary Functions. To display the registered AS items, select <USER DEF.> in the screen below.



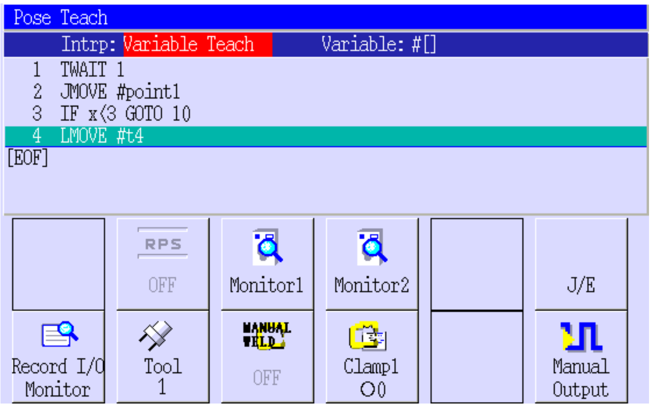
To select the registered instructions and to input data, refer to Chapter 5.6.1 and follow the same procedure as when selecting another instruction group.

5.7 PROCEDURE FOR OPERATING POSE TEACHING SCREEN

This section describes how to teach pose information.

1. Select teach screen, and then select a desired program. To select teach screen, refer to Chapter 2.7.1.4, for programs, to Chapter 2.7.1.1.

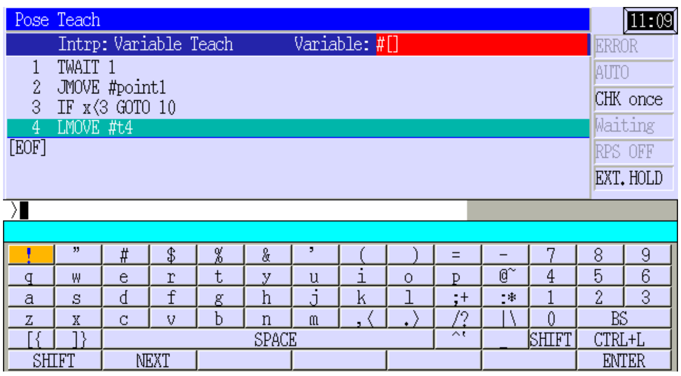
2. Press I and select [Pose Teach] from the pull-down menu to display the screen below.



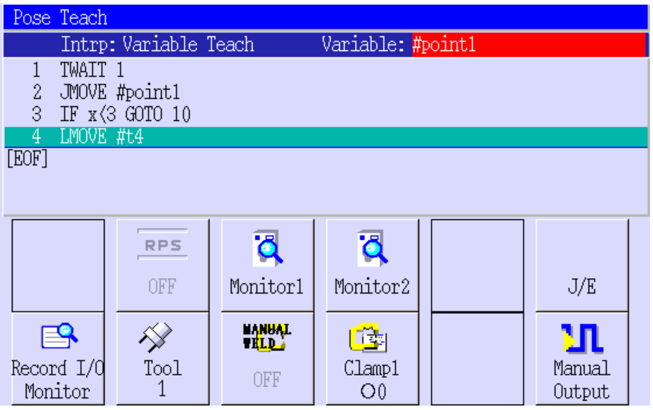
3. Select an interpolation mode. Pressing ↓ toggles as follows. (Pressing ↑ toggles in reverse order.)
   Variable Teach → (Continuous) Variables Teach → JMOVE → LMOVE → C1MOVE* → C2MOVE* → FJMOVE* →FLMOVE* → FC1MOVE* → FC2MOVE* → HMOVE* → Variable Teach
   NOTE* These interpolation modes are optional specifications.

When selecting [Variable Teach] for [Interp(olation)]

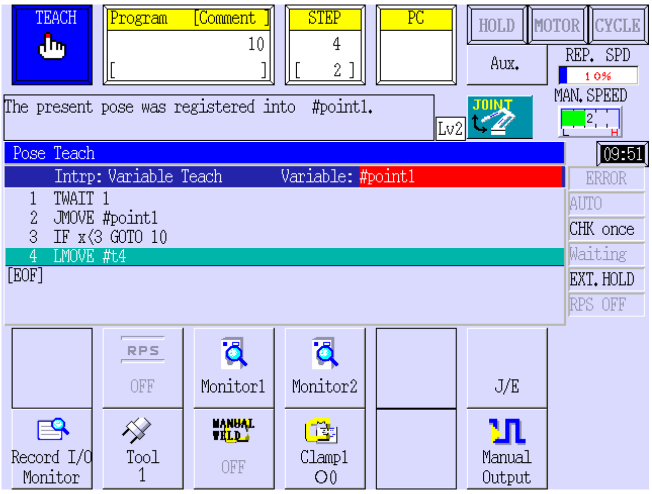
4. Input the variable name of the pose to be taught. Move cursor to [Variable] by → and press ↵ to display the screen below.



5. Input variable name “#point1” via keyboard and press <ENTER> or ↵ to display the screen below.



6. Move robot to the desired pose and press REC to record the pose to variable #point1.
A confirmation is displayed in the system message area as shown below.



When selecting [(Continuous) Variables Teach] for [Interp(olation)]

Basically, the teaching procedure is the same as in a variable teach, except that consecutive variable names count up automatically every time REC is pressed.　For example, if the variable name is #point, the number of the variable name increments with each recording.

#point1 → #point2 → #point3 → #point4……

When specifying a motion instruction for [Interp(olation)]

A motion instruction and a pose variable are taught all at once. For example, to add motion instruction JMOVE and pose variable name #t1 to the last step, follow below:

1. Execute steps 1. to 5. of Chapter 5.7. In step 1. of the procedure, select the last step. In step 3. of the procedure, select the motion instruction JMOVE. In step 5., input #t1.

2. Move robot to the desired pose and press REC to add JMOVE #t1 to the last step.

When overwriting

1. Select teach screen, and then select a desired program. To select teach screen, refer to Chapter 2.7.1.4, and to select a program, Chapter 2.7.1.1.

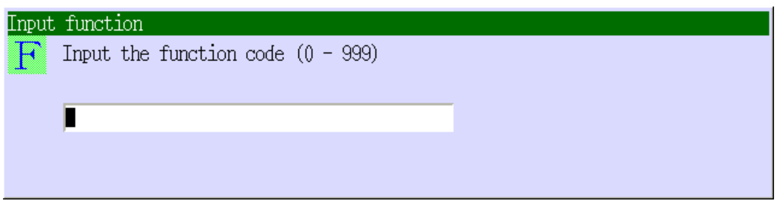
2. Select the step to overwrite. For details on selecting a step, refer to Chapter 2.7.1.2.

3. Execute steps 2. to 5. of Chapter 5.7. In step 3. of the procedure, select JMOVE. In step 5. of the procedure, input #t1.

4. Move robot to the desired pose and press A + O.WRITE to overwrite the specified step with JMOVE #t1.

5.8 KI INSTRUCTION (OPTION)

Pressing KIn displays the screen below. Enter the KI instruction number via NUMBER and press ↵. Parameter values setting dialog box appears for the selected KI instruction. Input the desired parameter values and press ↵. Note that the KI instructions are not displayed in element instructions row.



5.9 SELECTING PARAMETER COLUMN OF EACH ELEMENT INSTRUCTION ON TEACH SCREEN (OPTION)

When the optional function of "Teaching by Cursor Key" is set effective, the cursor key ←/→ is available to select the parameter column of each element instruction composing of the compound instruction as follows.

1. Select the parameter column of the desired element instruction by ←/→. The background color of the currently selected parameter column turns red.

INTERP	SPD	ACC	TMR	TOOL	CLAMP	J/E	OUTPUT	INPUT
JOINT	9	1	0	1			[ ]	[ ]
2 JOINT	9	1	0	1			[ ]	[ ]
3 JOINT	9	1	0	1			[ ]	[ ]
4 JOINT	9	1	0	1			[ ]	[ ]
5 JOINT	9	1	0	1			[ ]	[ ]
6 JOINT	9	1	0	1			[ ]	[ ]
7 JOINT	9	1	0	1			[ ]	[ ]
8 JOINT	9	1	0	1			[ ]	[ ]

2. Set the parameter value (auxiliary data) for each element instruction as follows. For element instructions and their parameters, refer to 5.3.

(1) For interpolation instruction

Each time pressing ↵, parameter value changes as follows: Joint → Linear → Circular 1 → ….

INTERP	SPD	ACC	TMR	TOOL	CLAMP	J/E	OUTPUT	INPUT
LINEAR	9	1	0	1			[ ]	[ ]
2 JOINT	9	1	0	1			[ ]	[ ]
3 JOINT	9	1	0	1			[ ]	[ ]
4 JOINT	9	1	0	1			[ ]	[ ]
5 JOINT	9	1	0	1			[ ]	[ ]
6 JOINT	9	1	0	1			[ ]	[ ]
7 JOINT	9	1	0	1			[ ]	[ ]
8 JOINT	9	1	0	1			[ ]	[ ]

(2) For speed , accuracy, timer, tool instructions

Press NUMBER and enter the desired number.

INTERP	SPD	ACC	TMR	TOOL	CLAMP	J/E	OUTPUT	INPUT
LINEAR	9	4	0	1			[ ]	[ ]
2 JOINT	9	1	0	1			[ ]	[ ]
3 JOINT	9	1	0	1			[ ]	[ ]
4 JOINT	9	1	0	1			[ ]	[ ]
5 JOINT	9	1	0	1			[ ]	[ ]
6 JOINT	9	1	0	1			[ ]	[ ]
7 JOINT	9	1	0	1			[ ]	[ ]
8 JOINT	9	1	0	1			[ ]	[ ]

(3) For clamp-n instruction

Specifying the desired clamp instruction number using NUMBER switches the parameter value (ON/ OFF) of the specified clamp instruction.

Example:

1) Input 1 via NUMBER.

	INTERP	SPD	ACC	TMR	TOOL	CLAMP	J/E	OUTPUT	INPUT
	LINEAR	9	4	0	1			[ ]	[ ]
2	JOINT	9	1	0	1			[ ]	[ ]
3	JOINT	9	1	0	1			[ ]	[ ]
4	JOINT	9	1	0	1			[ ]	[ ]
5	JOINT	9	1	0	1			[ ]	[ ]
6	JOINT	9	1	0	1			[ ]	[ ]
7	JOINT	9	1	0	1			[ ]	[ ]
8	JOINT	9	1	0	1			[ ]	[ ]

2) The parameter value for clamp 1 instruction (Clamp 1 signal) turns ON and "1" is displayed on the parameter column of CLAMP.

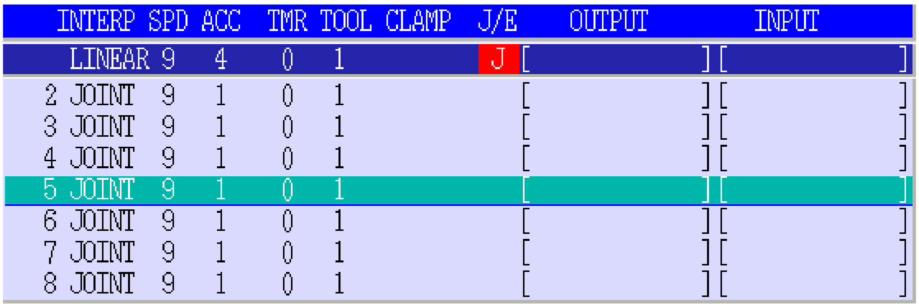
	INTERP	SPD	ACC	TMR	TOOL	CLAMP	J/E	OUTPUT	INPUT
	LINEAR	9	4	0	1	1		[ ]	[ ]
2	JOINT	9	1	0	1			[ ]	[ ]
3	JOINT	9	1	0	1			[ ]	[ ]
4	JOINT	9	1	0	1			[ ]	[ ]
5	JOINT	9	1	0	1			[ ]	[ ]
6	JOINT	9	1	0	1			[ ]	[ ]
7	JOINT	9	1	0	1			[ ]	[ ]
8	JOINT	9	1	0	1			[ ]	[ ]

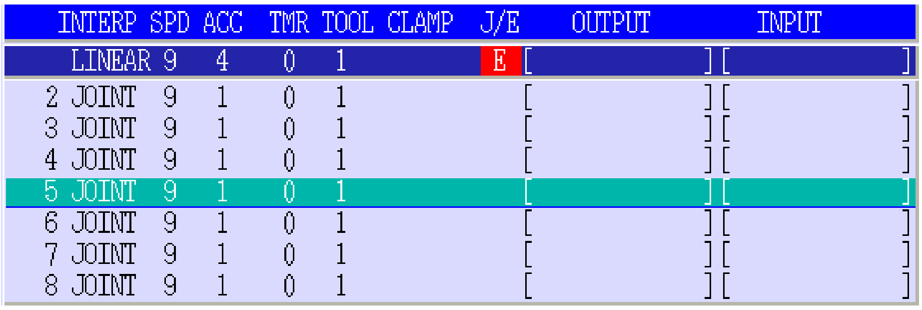
3) Inputting 1 via NUMBER at the state of step 2) above turns the parameter value for clamp 1 instruction to OFF and "1" on the parameter column of CLAMP disappears.

	INTERP	SPD	ACC	TMR	TOOL	CLAMP	J/E	OUTPUT	INPUT
	LINEAR	9	4	0	1			[ ]	[ ]
2	JOINT	9	1	0	1			[ ]	[ ]
3	JOINT	9	1	0	1			[ ]	[ ]
4	JOINT	9	1	0	1			[ ]	[ ]
5	JOINT	9	1	0	1			[ ]	[ ]
6	JOINT	9	1	0	1			[ ]	[ ]
7	JOINT	9	1	0	1			[ ]	[ ]
8	JOINT	9	1	0	1			[ ]	[ ]

4) For JUMP / END (J/E) instruction

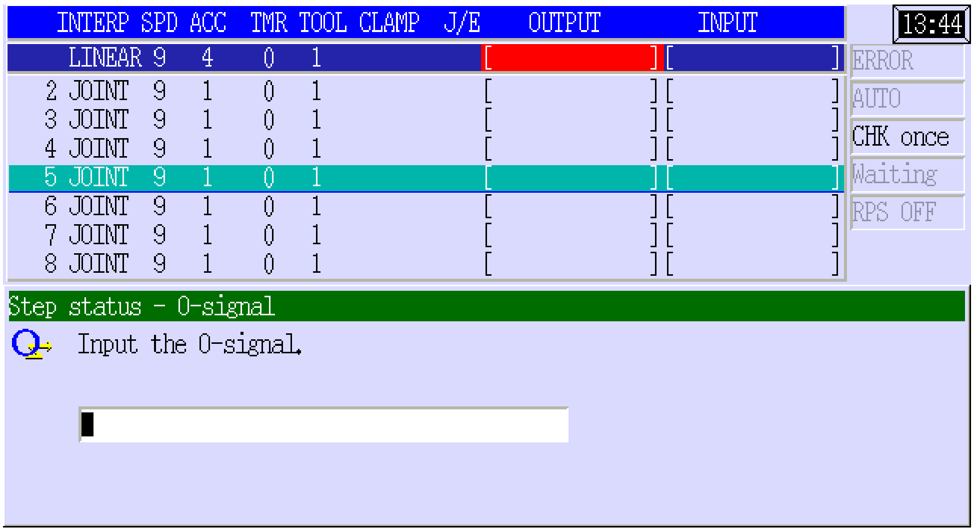
Each time pressing ↵, parameter value changes as follows: not set→JUMP instruction →END instruction→not set.





5) For OUTPUT (O)/ INPUT (I) instruction

Selecting the parameter column of OUTPUT (O) or INPUT (I) instruction and pressing ↵ displays the input screen below.　For the setting procedure, refer to 5.3.9 and 5.3.10.



6.0 REPEAT OPERATION

Repeat operation plays back the contents of a program that was taught to the robot. This chapter describes how to run the robot in repeat operation.

6.1 PREPARING FOR REPEAT OPERATION

Because the robot often moves at high speed during repeat operation, strictly observe the precautions below before starting in repeat mode.

⚠ WARNING

1. **Ensure that all personal are outside the safety fence and clear of the robot/system operating area.**
2. **Confirm that all EMERGENCY STOP work correctly.**
3. **Confirm that there are no abnormalities with the robot installation, installed tools, and peripheral equipment such as controller, etc.**
4. **Confirm that the robot does not interfere with safety fences and peripheral equipment.**
5. **Ensure that the robot is located at the home pose.**

6.2 EXECUTION OF REPEAT OPERATION

This section explains the basic method for starting the robot in repeat mode using the controller operation panel and the TP. Refer to the "External I/O Manual", a separate volume, for procedures on starting repeat operation using external signals.

Repeat Operation Procedure

1. Turn ON the CONTROLLER POWER located on the controller front, and confirm that the controller power lamp illuminates.

2. Press HOLD or A+<RUN> and confirm that the HOLD lamp illuminates on upper right of TP screen. Turn the TEACH/REPEAT on the operation panel to REPEAT.

3. Select the program/steps to be run. Refer to Chapter 2.7.1.1 and Chapter 2.7.1.2 for more details.

4. Set the repeat conditions. Refer to Chapter 2.7.1.3 for more details. Table below outlines the actual repeat conditions that can be set.

No.	Setting Items	Setting Contents
1	Repeat Speed	Sets the repeat operation speed as a percentage of the max. speed.
2	Repeat Cont/Once	Sets the program to be run either continuously or only once.
3	Step Cont/Once	Sets the program's steps to be run either in one step increments or continuously.
4	RPS Mode	Enables/disables switching to a specified program by external signal.
5	Dry Run OFF/ON	To check taught contents, Dry Run ON enables running a program without robot motion.
6	Manual Weld Mode	Used for the servo weld gun application. For more details, refer to the relevant operation manual, a separate volume.

5. Turn OFF the TEACH LOCK on the TP.

6. Press A+MOTOR ON, and confirm that the <MOTOR> lamp illuminates on the upper right screen of the TP.

7. Press the A+CYCLE START, and confirm that the <CYCLE> lamp on the upper right screen of the TP illuminates.

8. Press A+RUN or A+<HOLD>. Robot starts a repeat operation. Confirm that the <CYCLE> operation lamp illuminates on upper right of TP screen.

[NOTE]

1. While the TEACH LOCK is ON, repeat operation is not possible.
2. Pressing A+CYCLE START starts from the step displayed on the TP, and the robot moves to the next step in the program sequence after completing that step. If the program needs to be started from a different step than the one currently displayed, the step select function can be used to place the program at the desired step.

DANGER

1. **This operation starts the robot repeat operation. Reconfirm all safety precautions and that personnel are outside the safety fence, etc.**
2. **Prepare the area so that EMERGENCY STOP can be pressed at anytime in case of emergency.**

6.3 METHODS FOR STOPPING REPEAT OPERATION

There are two ways to stop a robot during repeat operation, aborting the program or ending the execution of the program.

WARNING

When an abnormal state arises on the robot during repeat operation, immediately press HOLD or A+<RUN>, or press any EMERGENCY STOP.

[**NOTE**]

During cycle operation, it is possible to change the repeat speed, repeat Cont/Once, or the step Cont/Once settings, but changing a program or step is not possible.

[**NOTE**]

The EMERGENCY STOP (located on the TP, etc.) should be pressed anytime an operator needs to stop robot motion immediately. However, this is not recommended as a routine method for stopping robot motion. When EMERGENCY STOP is pressed, power to the motors turns OFF immediately and brakes are applied. However, normal deceleration of the robot does not occur in an emergency stop, and the mechanical unit may be subjected to severe dynamic shock loads. Accordingly, avoid using EMERGENCY STOP except in an emergency.

6.3.1 ABORTING THE PROGRAM

1. Press HOLD or A+<RUN>, or set repeat condition to [Step Once]. Refer to Chapter 2.7.1.3 for more details.

2. When the robot has come to a complete stop, press one of the EMERGENCY STOP to cut off the motor power. Or, turning the TEACH/REPEAT on the controller from REPEAT to TEACH will also cut off the motor power.

6.3.2 ENDING EXECUTION OF THE PROGRAM

1. Set repeat condition to [Repeat Once]. Refer to Chapter 2.7.1.3 for more details.

2. When the robot has come to a complete stop, press one of the EMERGENCY STOP to cut off the motor power. Or, turning the TEACH/REPEAT on the controller from REPEAT to TEACH also will cut off the motor power.

6.4 METHODS FOR RESTARTING REPEAT OPERATION

The procedure for restarting the repeat operation will be different depending on how the program was stopped. Select the appropriate procedure from the subsections below.

6.4.1 RESTARTING AFTER ABORTING PROGRAM

If the CYCLE lamp on the TP is turned OFF, confirm that the tasks described in steps 2 to 5 in Chapter 6.2 have been done correctly, and start from step 6. If the <CYCLE> lamp illuminates, press A+RUN or A+<HOLD>. Robot restarts repeat operation.

DANGER

1. **This operation starts the robot repeat operation. Reconfirm all safety precautions and that personnel are outside the safety fence, etc.**
2. **Prepare the area so that EMERGENCY STOP can be pressed at anytime, in case of emergency.**

6.4.2 RESTARTIGN AFTER ENDING EXECUTION OF PROGRAM

Restart by following the instructions from step 2 in Chapter 6.2.

6.4.3 RESTARTING AFTER STOPPING BY EMERGENCY STOP

When the EMERGENCY STOP has been pressed during automatic operation, follow the procedure below to restart the repeat operation.

1. Release the emergency stop state/button.

2. If the error message is displayed, reset error(s).

3. Press HOLD or A+<RUN>.

4. Turn ON the motor power.

5. Press A+CYCLE START or A+<CYCLE>.

6. Press A+RUN or A+<HOLD>. Robot restarts repeat operation.

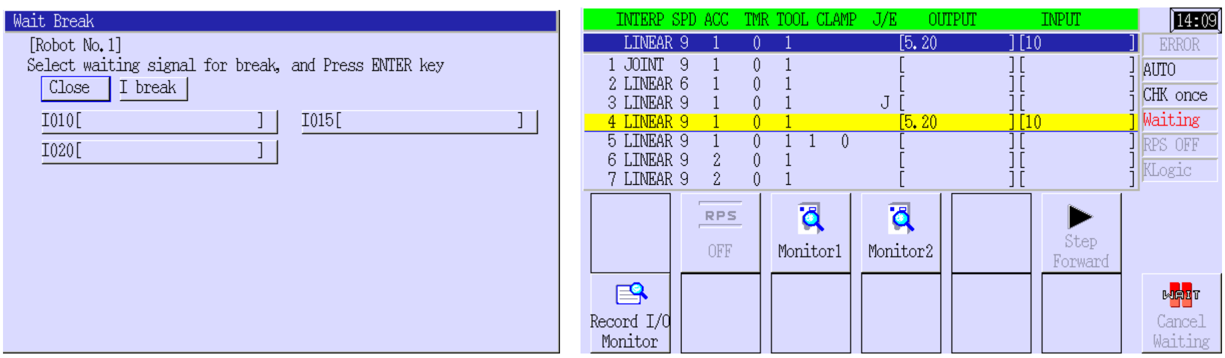
DANGER

1. **This operation starts the robot repeat operation. Reconfirm all safety precautions and that personnel are outside the safety fence, etc.**
2. **Prepare the area so that EMERGENCY STOP can be pressed at anytime, in case of emergency.**

6.5 WAIT CANCEL

The waiting state shows that the robot is stopped and is waiting for receipt of the input signal taught to that step before moving to the next step.

When a waiting state occurs, the waiting cancel screen below left appears automatically depending on setting condition in Aux. 0502, or “Waiting” is displayed in the status area (screen below right). When all of the waiting conditions are cancelled, the robot moves to the next step.



DANGER

When all of the waiting conditions are cancelled, the robot moves to the next step automatically. Be aware of how and when the robot will move.

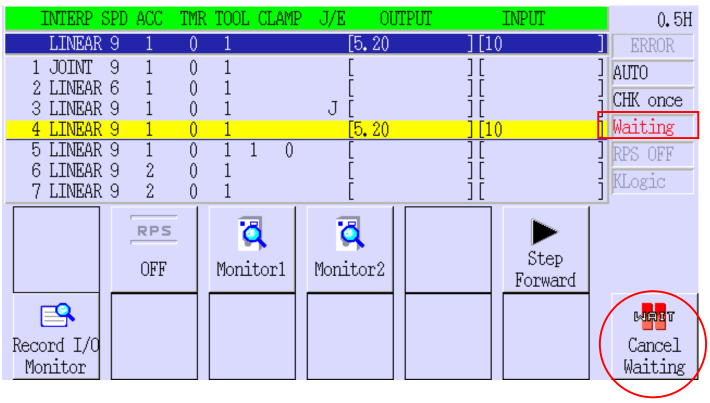
[NOTE]

1. If cycle start is stopped by an interruption (error, switching to teach mode, etc.) while the waiting cancel screen is displayed, then the screen closes automatically and the previous screen is displayed.
2. The waiting cancel screen can be displayed even in check mode if a step contains a waiting condition. However, the waiting cancel screen will close automatically when releasing the CHECK GO or CHECK BACK on the TP.

This procedure explains how to cancel a waiting state.

1. Displaying waiting cancel screen

The waiting cancel screen appears automatically when system switch WAITREL_AUTO is set to effective (ON) in Aux. 0502. When set to ineffective (OFF), [Waiting] and <Cancel Waiting> are displayed in the screen without displaying the waiting cancel screen. In this case, press A + <Cancel Waiting> as shown in screen below to display the cancel screen.

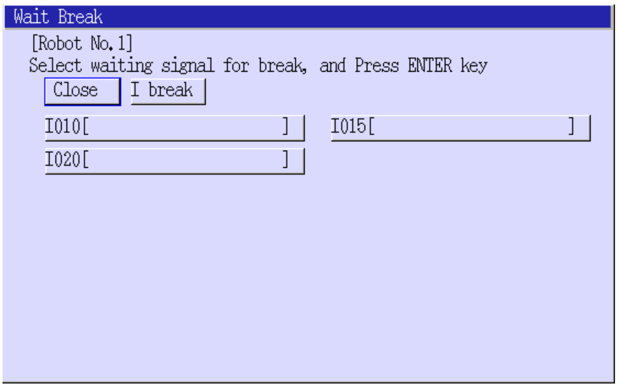


2. Cancel method

The waiting conditions can be cancelled in two ways depending on whether the wait signal is taught by compound instruction in block teaching or by AS language instruction.

(1) Canceling wait signals taught in block teaching

The waiting signals are displayed on the waiting cancel screen upon entering a waiting state. In the screen below, I10, I15, and I20 must be input to cancel the waiting state. Cancel signals individually or all at once as described below. Selecting [Close] returns to the teach screen without canceling the waiting state. Refer to 1. Displaying waiting cancel screen to redisplay the waiting cancel screen.

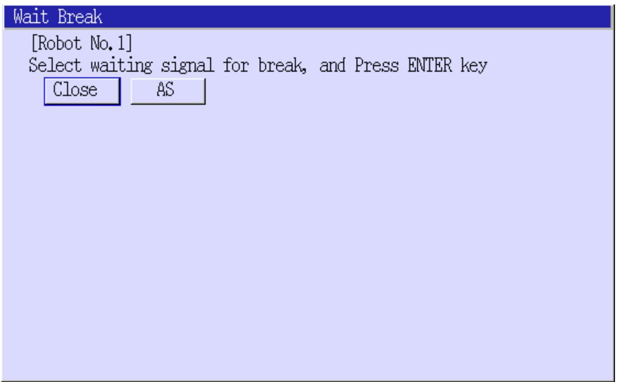


To cancel waiting conditions all at once:
Selecting [I break] cancels all of the waiting conditions and closes the waiting cancel screen.

To cancel waiting conditions individually:
Selecting the desired signal number cancels the waiting condition. The cancelled condition is displayed in red. The waiting cancel screen closes automatically when all of the remaining conditions are cancelled by the above procedure.

(2) Canceling wait signals taught by the AS language

The screen below is displayed upon entering a waiting state. Selecting [AS] cancels all of the waiting conditions and closes the waiting cancel screen. Selecting [Close] returns to the teach screen without canceling the waiting state. Refer to 1. Displaying waiting cancel screen to redisplay the waiting cancel screen.



DANGER

When all of the waiting conditions are cancelled, the robot moves to the next step automatically. Be aware of how and when the robot will move.

[**NOTE**]

When using the following functions during the display of the waiting cancel screen, the waiting screen closes and the selected function activates.

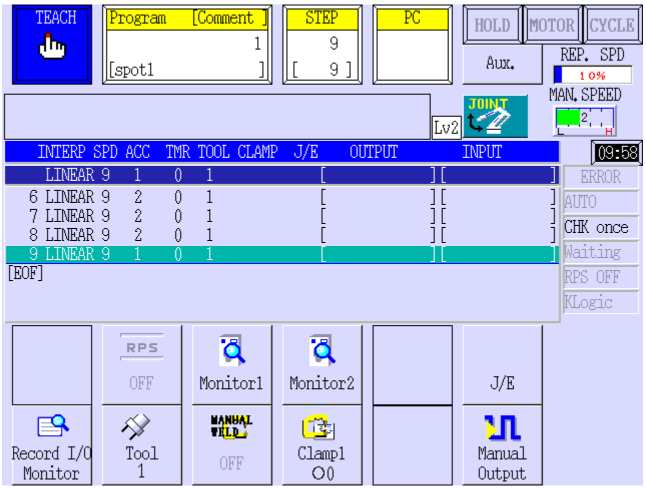
(1) Program selection
(2) Step selection
(3) Menu selection
(4) $\boxed{\text{I}}$ selection
(5) Repeat condition setting
(6) Switch to the auxiliary function screen
(7) Switch to the interface panel

7.0 CHECKING AND MODIFYING PROGRAMS

This section describes the procedure for checking and modifying a taught program. Before checking robot movement in check mode, check the contents of taught program as shown below.

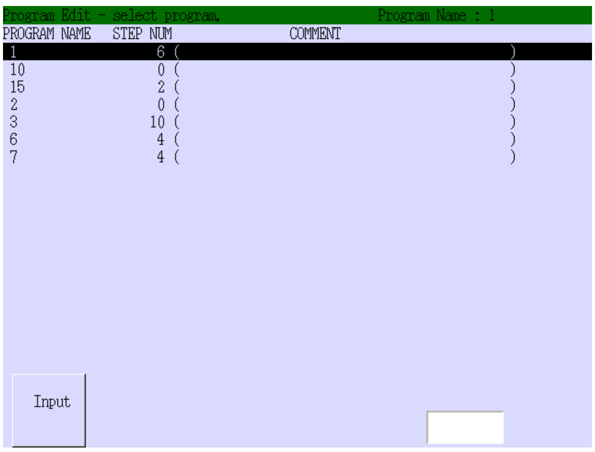
1. Check by teach screen

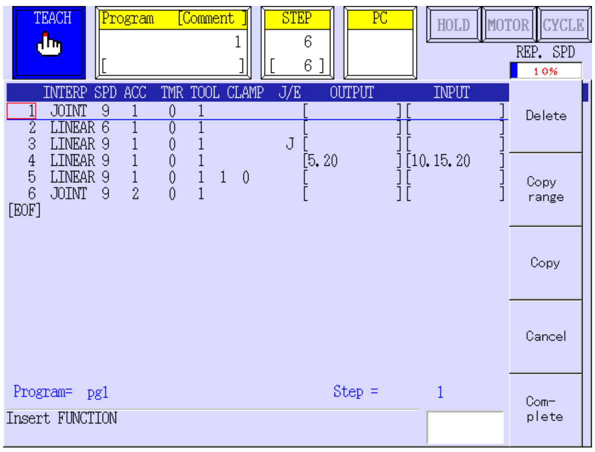
   Check the taught auxiliary data. In the teach screen, pressing A + ↓/↑ displays the taught auxiliary data, etc., for all the steps.



2. Check by edit screen

   Press I and select [Program Edit] from the pull-down menu to display the screen below left. Select the desired program and press ↵ to display the screen below right. In this screen, the taught pose data and the other data can be checked. Press A + ←/→ to display spot weld clamp and pose data. For details about program edit screen, refer to Chapter 7.3.





3. Check by monitor screens

   To check the taught data, such as I/O signals, use the monitor screens. For details, refer to Chapter 2.9.

7.1 CHECK GO, CHECK BACK

This section describes how to check a taught program in check mode by operating the robot. Press <MAN. SPEED >/ TEACH SPEED to change the check speed level (1-5). The actual speed corresponding to each check speed level (1-5) is set in <AUX>/ [Auxiliary Function] - [4. Basic Setting] − [1. Teach/Check Speed]. First, the procedure for checking the movement of a robot arm is described.

1. Press <Program>/ A + PROGRAM, and select the desired program number. Then, press ↵.

2. Press <Step>/ STEP, and select the desired step number. Then, press ↵. If the specified step does not exist, the last taught step of the program is displayed. If there are no recorded steps, step 0 is selected.

3. Pressing DEADMAN＋CHECK GO/CHECK BACK executes Check Go/Back in check mode.* Check Once and Check Continue can be switched by pressing CONT.
   In Check Once setting, robot proceeds to the next/previous step each time CHECK GO/ CHECK BACK is pressed. In Check Continue setting, pressing and holding CHECK GO/ CHECK BACK makes the robot execute steps continuously in forward or reverse order, respectively.**

NOTE* Turn ON motor power and release HOLD, etc. beforehand so that the robot can move.

NOTE** Verify the mode as “CHK once” or “CHK cont”, displayed in the status area on right side of TP screen.

[NOTE]

1. Check Back checks the program backwards. After checking the selected step, the check procedure goes on to the step before the selected step. Check is executed in the same manner at whichever step is chosen.
2. Check Back can be executed continuously but robot reaches the taught point regardless of accuracy setting, and then proceeds to the step before. Thus, at steps with rough accuracy setting, the path taken by the robot differs between Check Go and Check Back.
3. When checking a weld point, welding is executed at “Weld ON”, per the weld condition taught to the step. There is a system switch to select weld ON/OFF.
4. Wear measurement by clamping without workpiece or Reference plate is executed with Check Back. However, the data calculated from these measurements are not reflected in the current wear data.

7.2 STEP DATA MODIFICATION

This section describes how to edit a recorded program data. Program data can be modified on the program edit screen. For details, refer to Chapter 7.3.

7.2.1 MODIFYING POSE DATA

Use the procedure below when modifying only the pose data without changing the auxiliary data.

1. Press <Program>/ A + PROGRAM, and select the desired program number. Then, press ↵.
2. Press <Step>/ STEP, and select the desired step number. Then, press ↵.
3. Select the manual operation speed level by pressing <MAN. SPEED>/ TEACH SPEED.
4. Select the operation mode by pressing <Coord>/ COORD.
5. Move the robot to a desired pose by pressing DEADMAN + AXIS.*
   NOTE* Turn ON motor power and release HOLD, etc. beforehand so that the robot can move.
6. Press A + POS MOD.
7. Confirmation message appears. If it is OK to modify the selected step, select [Yes] using the arrow key and press ↵.
8. The pose data is modified.

[**NOTE**]

The same step is selected before and after this operation.
(The next step is not selected automatically.)

7.2.2 MODIFYING AUXILIARY DATA

Use the procedure below when modifying only the auxiliary data without changing the pose data.

1. Press <Program>/ A + PROGRAM, and select the desired program number. Then, press ↵.

2. Press <Step>/ STEP, and select the desired step number. Then, press ↵.

3. Change the auxiliary data to the desired value(s). Refer to Chapter 5 for setting each auxiliary data.

4. Press A + AUX MOD.

5. Confirmation message appears. If it is OK to overwrite the selected step, select [Yes] using the arrow key and press ↵.

6. Auxiliary data is modified (overwritten).

[NOTE]

The same step is selected before and after this operation.
(The next step is not selected automatically.)

7.2.3 MODIFYING BOTH POSE AND AUXILIARY DATA - OVERWRITING THE STEP

This section describes how to edit both pose and auxiliary data simultaneously.

1. Press <Program>/ A + PROGRAM, and select the desired program number. Then, press ↵.

2. Press <Step>/ STEP, and select the desired step number. Then, press ↵.

3. Select the manual operation speed level by pressing <MAN. SPEED>/ TEACH SPEED.

4. Select the operation mode by pressing <Coord>/ COORD.

5. Move the robot to a desired pose by pressing DEADMAN + AXIS.*
   NOTE* Turn ON motor power and release HOLD, etc. beforehand so that the robot can move.

6. Change the auxiliary data to the desired value(s). Refer to Chapter 5 for setting each auxiliary data.

7. Press A + O.WRITE.

8. Confirmation message appears. If it is OK to overwrite the selected step, select [Yes] using the arrow key and press ↵.

9. Both pose and auxiliary data are modified (overwritten) simultaneously.

[NOTE]

The same step is selected before and after this operation.
(The next step is not selected automatically.)

7.2.4 DELETING STEP

This section describes how to delete a specific step in a program.

1. Press <Program>/ A + PROGRAM, and select the desired program number. Then, press ↵.

2. Press <Step>/ STEP, and select the desired step number. Then, press ↵.

3. Press A + DEL.

4. Confirmation message is displayed. If it is OK to delete, select [Yes] and press ↵.

5. Specified step is deleted.

[NOTE]

A step can also be deleted in the program edit screen. For details, refer to Chapter 7.3.3.

7.2.5 INSERTING STEP

This section describes how to insert a program step in the taught program.

1. Press <Program>/ A + PROGRAM, and select the desired program number. Then, press ↵.

2. Press <Step>/ STEP, and select the desired step number. Then, press ↵.

3. Move the robot to a desired pose by pressing [DEADMAN] + [AXIS].*
   NOTE* Turn ON motor power and release HOLD, etc. beforehand so that the robot can move.

4. Change the auxiliary data to the desired value(s). Refer to Chapter 5 for setting each auxiliary data.

5. Press [A] + [INS] to insert the step.

[NOTE]

1. The step is inserted before the specified step.
2. The same step is displayed before and after the insertion.
3. When inserting several steps consecutively, for each step set the desired conditions then insert the step. Perform operations in this order.

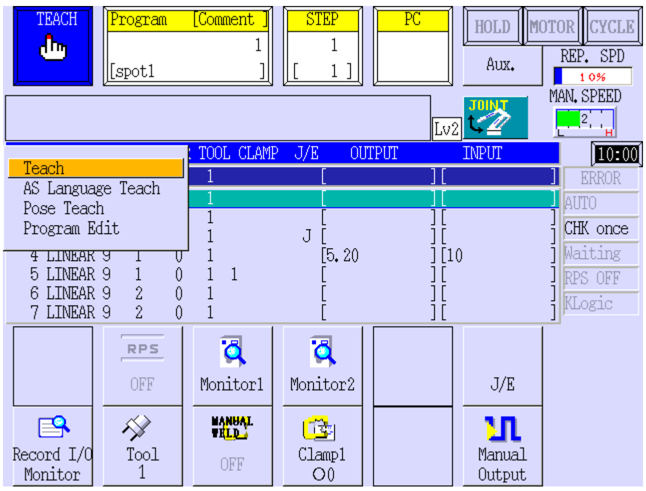
7.3 EDIT ON THE PROGRAM EDIT SCREEN

The program edit screen can also be used to edit a taught program. The program edit screen has copy and paste functions enabling easy edit and modification of the program. In addition, programs currently in repeat operation can also be edited. This section explains these functions.

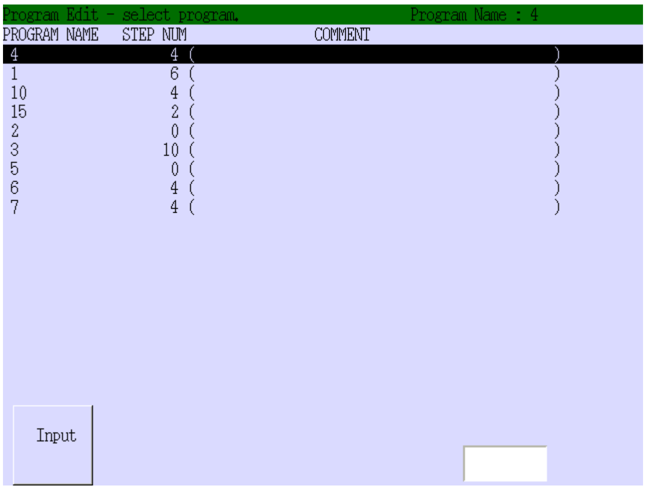
7.3.1 HOW TO SWITCH TO THE PROGRAM EDIT SCREEN

Switch to the program edit screen as follows.

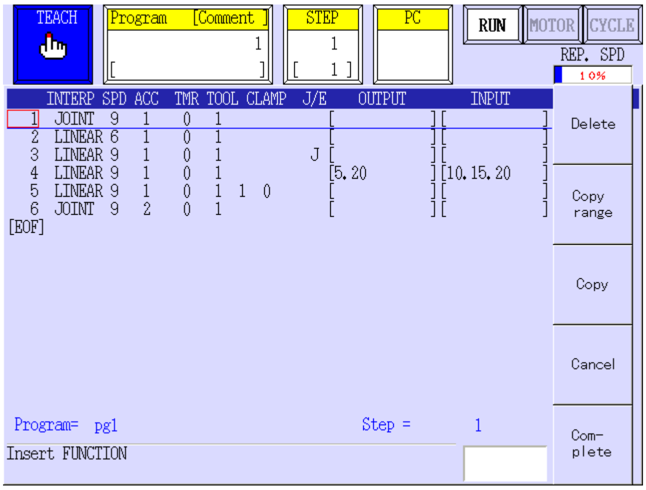
1. Select [Program Edit] from the pull-down menu displayed by pressing [I].



2. Program selection screen is displayed as shown below. Move the cursor to a desired program and press ↵. Or input a program name with a keyboard screen displayed by pressing <Input>, and press <ENTER>.



3. Selecting a program displays the program edit screen as shown below.



[NOTE]

When following screens are displayed, pressing I is invalid.

1. Data setting screen of auxiliary functions
2. Error/warning/confirmation/inquiry screen
3. OX/WX signal setting screen

7.3.2 KEYS ON THE PROGRAM EDIT SCREEN

Pressing keys on the right of the program edit screen directly functions the pressed keys. Details of keys are explained below.

1. Delete

(1) Select a step to delete by pressing ↑/↓ and press <Delete>. In addition select the last step to delete by pressing ↑/↓ when deleting several steps.

(2) Pressing ↵ deletes selected steps. Press <Complete> to determine the edit.

[NOTE]

A confirmation message will be displayed if screen is closed without pressing <Complete>. Select <Yes> to overwrite the data. Select <No> to redisplay the previous screen without overwriting the data.

2. Copy range

(1) Select a start step to copy by pressing ↑/↓ and press <Copy range>. Select the last step to copy by pressing ↑/↓.

(2) Pressing ↵ copies the content of selected steps temporarily.

3. Copy

Move cursor to the step where the steps will be inserted by pressing ↑/↓ and press <Copy>. Contents stored by <Copy range> will be copied as the consecutive steps from the specified step. Press <Complete> to determine the edit.

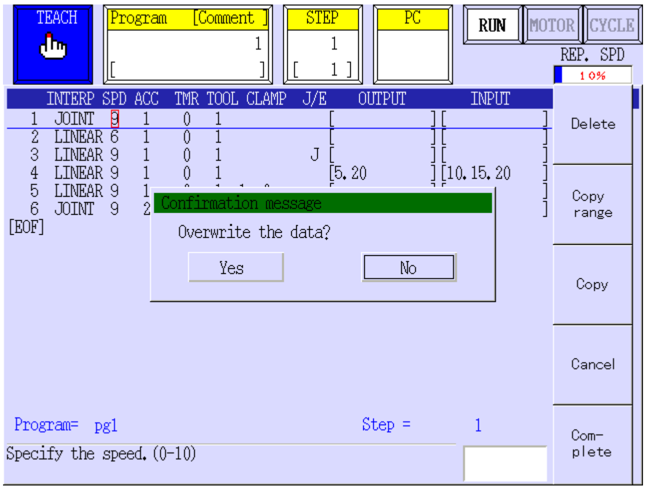
[NOTE]

A confirmation message will be displayed if screen is closed without pressing <Complete>. Select <Yes> to overwrite the data. Select <No> to redisplay the previous screen without overwriting the data.

4. Cancel

(1) Pressing <Cancel> ends the program edit without saving the edit.

(2) When the step is changed, a confirmation screen appears as shown below. Selecting [Yes] saves the change and ends the program edit. Selecting [No] ends the program edit without saving the change.



5. Complete

Pressing <Complete> saves and ends the program edit.

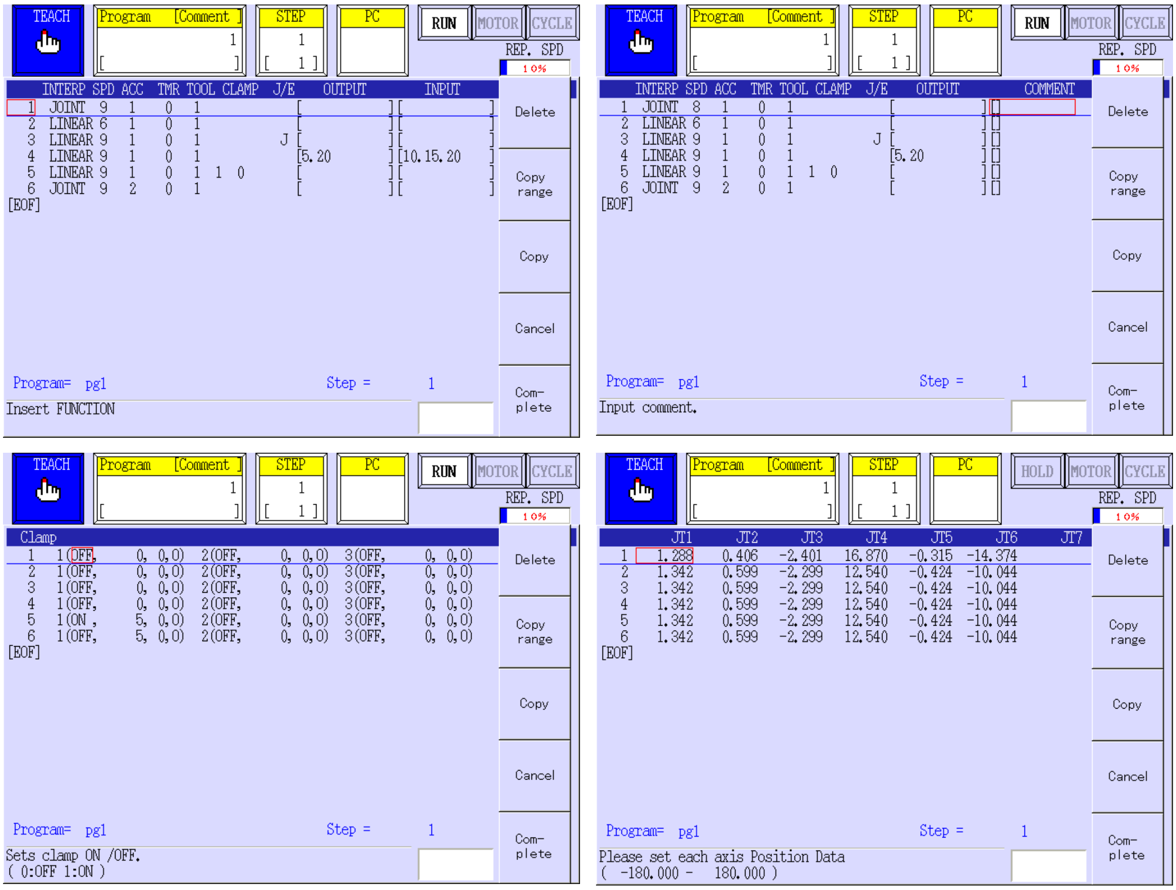
7.3.3 STEP DATA MODIFICATION ON EDIT SCREEN

This section describes how to edit a recorded step.

7.3.3.1 MODIFYING BOTH POSE AND AUXILIARY DATA

This section describes how to edit taught data (auxiliary and pose data) on the Edit screen.

1. Scroll pages by pressing A + ←/→ to display the screens below.



2. Select a desired item (parameter) by cursor.

3. Modify data by NUMBER. Methods of modifying data vary depending on the type of parameter. See (1) and (2) below.

(1) Modifying data other than Output (O), Input (I) and Comment data.

1) Move the cursor to the taught data to modify .

2) Input desired values according to the following descriptions.

Taught data	Description
Interpolation	Specify interpolation mode: 0: Joint, 1: Linear, 2: Linear2, 3: Circular1, 4: Circular2, 5: F Linear, 6: F Circular1, 7: F Circular2, 8: X Linear 9: NOP
Speed	Specify speed level: 0-9
Accuracy	Specify accuracy level: 1-4
Timer	Specify timer number: 0-9
Tool	Specify tool number: 1-9
	For the arc weld spec., this setting cannot be changed.
Clamp	Specify clamp status: 0: No clamp, 1: ON Specify auxiliary data for each spot weld instruction. See Chapter 5 for details.
J/E	Specify J/E instruction: 0: No Jump/End, 1: J, 2: E
Pose data	Specify pose data.

3) Press ↵ and <Complete> after modification.

(2) Modifying Output (O), Input (I) and Comment data.

1) Move cursor to a desired item and press ↵.

2) Setting screen for the item is displayed. Modify the values or comments. See Chapter 5 for details.

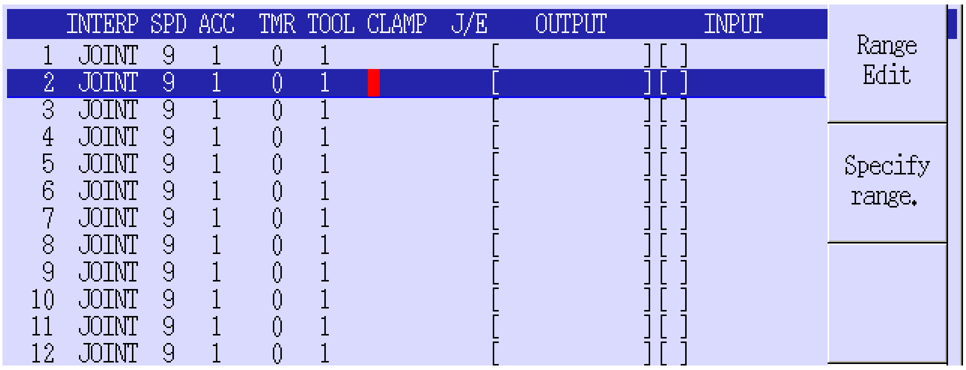
Item	Description
Output (O)	Currently recorded status is displayed. Specify and modify this numerically.
Input (I)	Currently recorded status is displayed. Specify and modify this numerically.
Comment	Pressing ↵ displays the comment input screen.

3) Press ↵ and <Complete> after modification.

7.3.4 BATCH MODIFICATION OF TAUGHT DATA OF SEVERAL STEPS

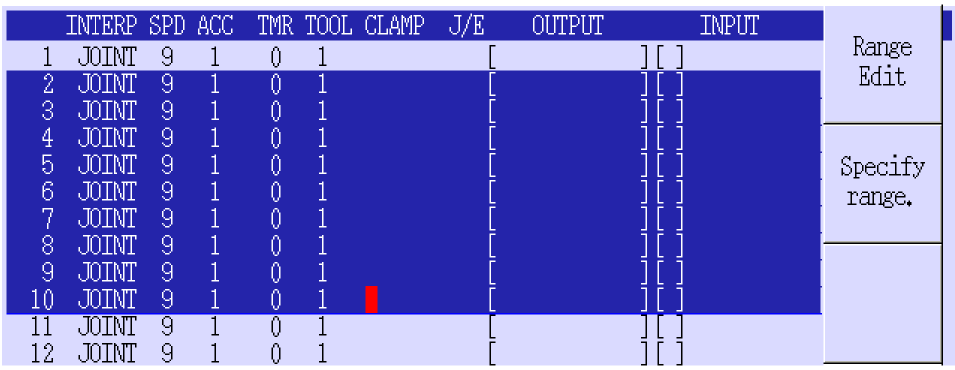
This section describes how to edit taught data in the several steps at the same time on the Edit screen.

1. Press A to display the <Specify range.> on the right side of the screen.　Press <Specify range.> to select range specification mode.　In range specification mode, the background color of the selected steps changes as shown below.



	INTERP	SPD	ACC	TMR	TOOL	CLAMP	J/E	OUTPUT	INPUT
1	JOINT	9	1	0	1			[ ]	[ ]
2	JOINT	9	1	0	1			[ ]	[ ]
3	JOINT	9	1	0	1			[ ]	[ ]
4	JOINT	9	1	0	1			[ ]	[ ]
5	JOINT	9	1	0	1			[ ]	[ ]
6	JOINT	9	1	0	1			[ ]	[ ]
7	JOINT	9	1	0	1			[ ]	[ ]
8	JOINT	9	1	0	1			[ ]	[ ]
9	JOINT	9	1	0	1			[ ]	[ ]
10	JOINT	9	1	0	1			[ ]	[ ]
11	JOINT	9	1	0	1			[ ]	[ ]
12	JOINT	9	1	0	1			[ ]	[ ]

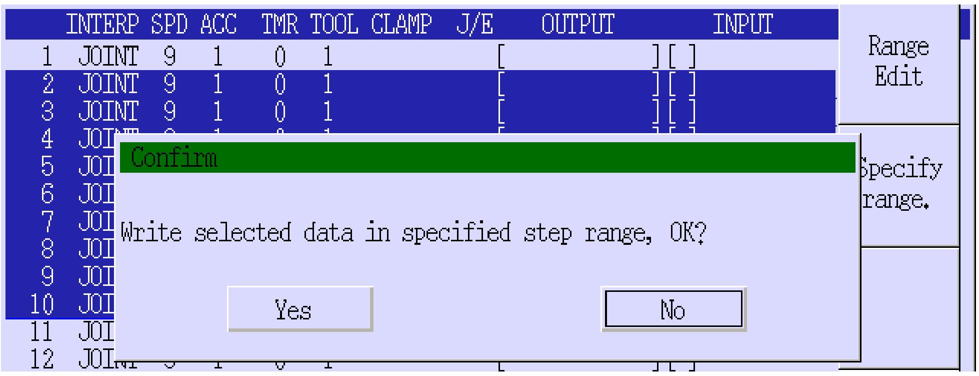
2. Select all the desired steps to modify using ↑/↓.



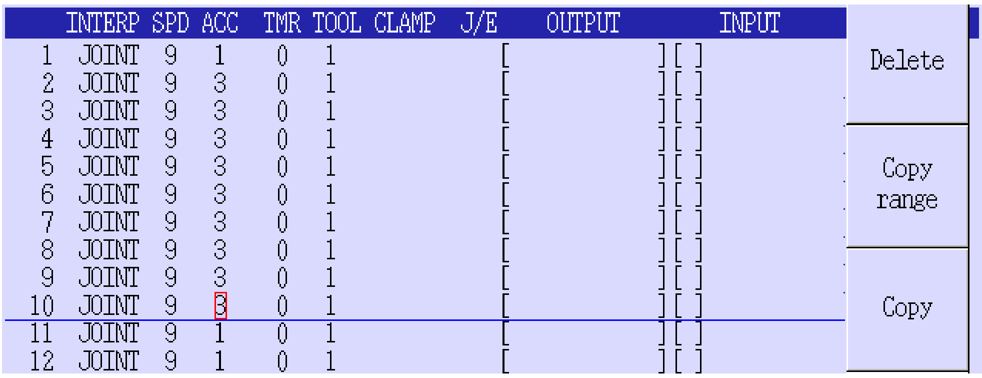
	INTERP	SPD	ACC	TMR	TOOL	CLAMP	J/E	OUTPUT	INPUT
1	JOINT	9	1	0	1			[ ]	[ ]
2	JOINT	9	1	0	1			[ ]	[ ]
3	JOINT	9	1	0	1			[ ]	[ ]
4	JOINT	9	1	0	1			[ ]	[ ]
5	JOINT	9	1	0	1			[ ]	[ ]
6	JOINT	9	1	0	1			[ ]	[ ]
7	JOINT	9	1	0	1			[ ]	[ ]
8	JOINT	9	1	0	1			[ ]	[ ]
9	JOINT	9	1	0	1			[ ]	[ ]
10	JOINT	9	1	0	1			[ ]	[ ]
11	JOINT	9	1	0	1			[ ]	[ ]
12	JOINT	9	1	0	1			[ ]	[ ]

3. Select a desired column using ←/→ and modify auxiliary data or comments.　Modifying procedure is the same in 7.3.3.

4. Pressing <Range Edit> displays the confirmation screen as shown below.　Select <Yes> to apply the modification in procedure 3 to all the other selected steps.



5. The data in the selected steps are chaged all together.



7.4 ONLINE EDIT FUNCTION

While in repeat mode, this function enables a limited degree of program editing. However, not all editing functions are available during repeat mode.

7.4.1 ONLINE EDIT SCREEN

Online editing is available for:

1. Registered programs
2. Programs registered as subroutines of the main program

7.4.2 FUNCTIONS ON ONLINE EDIT SCREEN

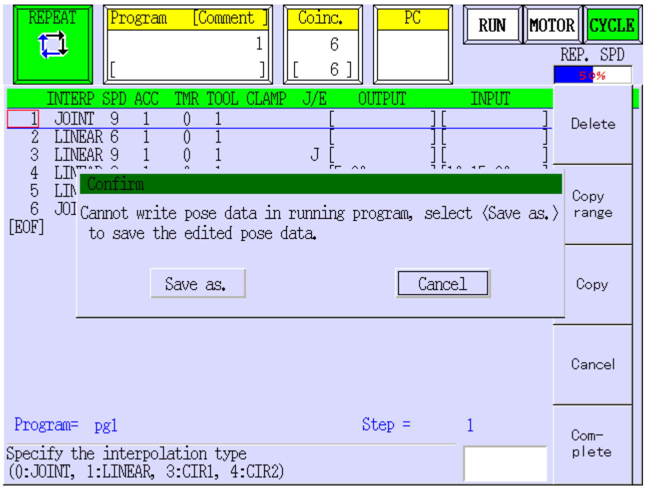
1. How to edit

This screen has basically the same functions as those described in Chapter 7.3. However, some data in a program undergoing online edit can not be overwritten. For details, refer to 2. Save As below.

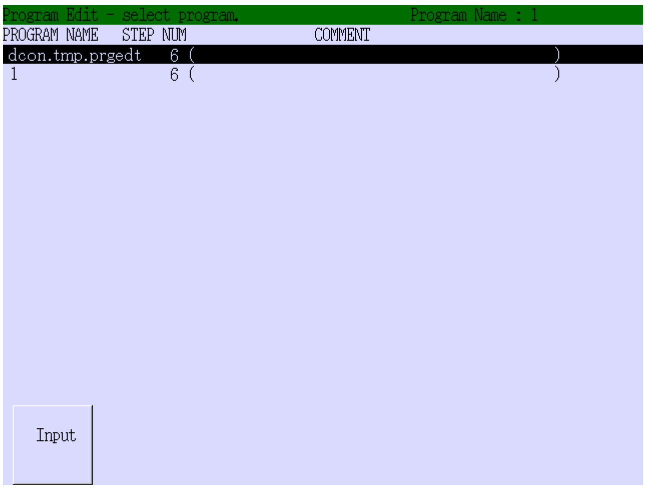
2. Save As

To save changes made to the data in auxiliary, pose, comment, and clamp (only for servo weld gun spec.) instructions, follow the procedures below to save the program under a new file name.

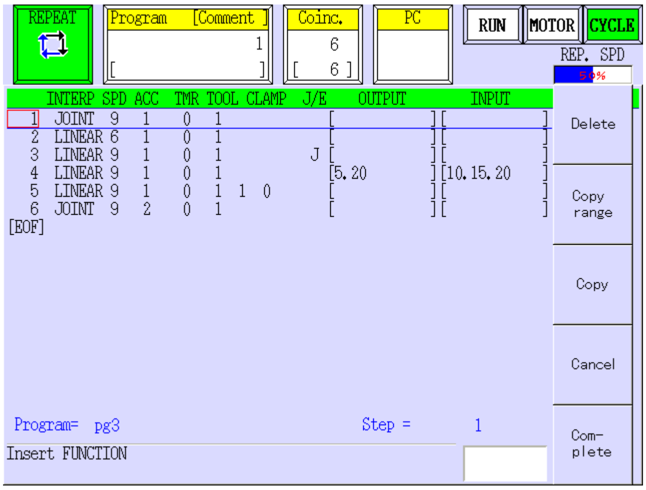
(1) After editing the data, press <Complete> to display the confirmation screen shown below.



(2) Select [Save as.] to display the program list as shown in the screen below.　Press <Input> and input a new program name.　The changes to the data are saved in the new program.



(3) The edit screen for the new program is displayed.　The screen below is for the program named “pg3”.



8.0 AUXILIARY FUNCTIONS

This chapter describes how the auxiliary functions are used for displaying information about robot operations and for setting the required data for those operations.

WARNING

Auxiliary functions are a kind of teaching. Their usage is limited to personnel who have completed special training and are qualified for teaching or supervising robot operation.

CAUTION

In this chapter, optional functions are also described. Be advised that some specifications may not include every function described here.

8.1 OVERVIEW OF AUXILIARY FUNCTIONS

Auxiliary functions are hierarchically divided as shown in the screen in Chapter 8.3, and used for the following purposes.

1. To display the main data that is used when operating the robot or editing a program:
   Pose and speed information, Memory available, Dedicated input/output signals, etc.

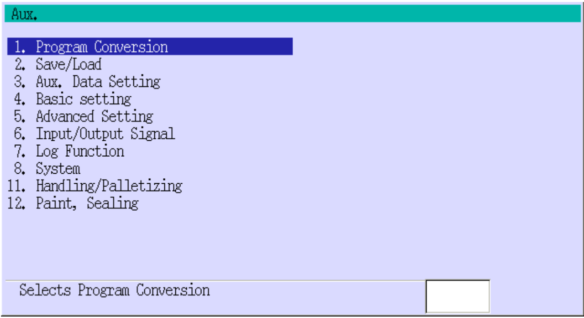
2. To set the data for robot motion and operations;
   Base coordinates, Tool coordinates, Motion limit, etc.

3. To perform maintenance operation such as adjusting the robot or troubleshooting:
   Zeroing, Zeroing data set/ display, etc.

In addition, auxiliary functions are divided into 4 hierarchies as shown in the list in 8.3. Auxiliary functions are usually represented by a four-digit combination number for large and middle classifications, such as Aux.XXXX, or by a six-digit number for small classifications.

8.2 HOW TO USE AUXILIARY FUNCTIONS

1. Press <Aux.> on operation screen to display the large classification screen.　Or, activate B area and press MENU to display the pull-down menu, and select [Auxiliary functions].



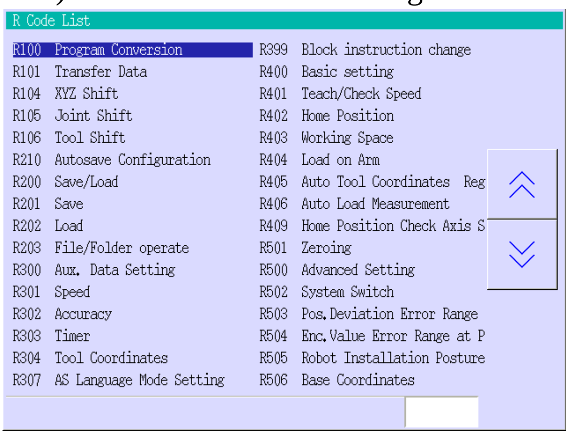
2. Refer to the list on next page and input the desired auxiliary function number (max. six-digit number including small classification no.), then press ↵.　The first 0 of the large classification no. can be omitted.　Or, move cursor to the desired group by ↑/↓, and press ↵ to open the function list screen for that group.　Then, select the desired auxiliary function.　Moving cursor to any on-screen item displays an explanation for that item on the bottom of the screen.

3. Input data.　Input range is displayed on the bottom of the screen when moving cursor to the desired item.　Finally, press ↵ and setting is complete.

4. Press R to return to the previous page of the data setting screen.　Press R several times or select another screen from the pull-down menu on B area to close auxiliary function screen.

In addition to the procedure above, using an R code can also open the auxiliary function screen by method 1 or 2 below.

1. Open teach screen and press R to display the R code input box, and input the desired R code number.　(R code number and auxiliary function number are the same.)
2. Open R code input box and press A＋HELP to display the R code list screen as shown in the screen below.　(Press <⩓>/<⩔> to scroll pages.)　Select the desired R code, or input the R code number (without “R”) into the box in the lower right corner.



8.3 AUXILIARY FUNCTIONS LIST

Large Class. No.	Function Name	Middle Class. No.	Function Name	Small Class. No.	Function Name	Branch No.	Function Name
01	Program Conversion	01	Transfer Data				
		02	Mirror Image				
		03	Transform Data	01	Start Data Transformation		
				02	Register Tool Coordinates		
				03	Measure Tool Coordinates		
				04	Compensate for Gravity		
		04	XYZ Shift				
		05	Joint Shift				
		06	Tool Shift				
		08	Inverse Program Copy				
		10	4 Ref. Points Based Trans.	01	4 Ref. Points Based Trans. Start		
				02	Measure Tool Coordinates		
				03	Gravity/Ind. Diff. Comp.		
		13	C/V Position Value Shift				
02	Saveload	01	Save				
		02	Load				
		03	File/Folder Operate				
		10	Autosave Configuration	01	Save Data 1		
				02	Save Data 2		
				03	Save Data 3		
				04	Display of Autosave Log		
03	Aux. Data Setting	01	Speed				
		02	Accuracy				
		03	Timer				
		04	Tool Coordinates				
		05	Fixed Tool Coordinates				
		07	As Language Mode Setting				
		99	Block Instruction Change				
04	Basic Setting	01	Teach/Check Speed				
		02	Home Position				
		03	Working Space				
		04	Load on Arm				
		05	Auto Tool Coordinates Register				
		06	Auto Load Measurement				

		07	Rotation for Spin Axis Set		
		09	Home Position Check Axis Set		
05	Advanced Setting	01	Zeroing	01	Zeroing
				02	Zeroing Data Set/Display
				03	Encoder Rotation Counter Reset
		02	System Switch		
		03	Pos. Deviation Error Range at E-Stop		
		04	Encoder Value Error Range at Power-ON		
		05	Robot Installation Posture		
		06	Base Coordinates		
		07	Motion Limit		
		08	Slow Repeat		
		09	Interface Panel		
		10	Collision Detection Function	01	Set Threshold for Teach Mode
				02	Set Threshold for Repeat Mode
				03	Register Threshold
				04	Auto Calibration
				05	Property
		12	Deviation Limit For Continuing		
		15	Variable Acce/Decel Spec		
		18	Moving Area XYZ Limits		
06	Input/Output Signal	01	Dedicated Input Signals		
		02	Dedicated Output Signals		
		03	Dedicated Input/Output Signal Display		
		04	OX Specification Setting		
		05	Clamp Specification	01	Application Field
				02	Clamp Condition
				10	Spot Weld Clamp Definition
				11	Spot Weld Control Definition
				12	Spot Weld Gun Definition
				20	Handling Clamp Signal Definition
		05	Gun Specifications	01	Application Field
				02	Gun Condition
				30	Painting Sealing Signal Definition
		06	Signal Name	01	OX (Output)
				02	WX (Input)
				03	INT (Internal)

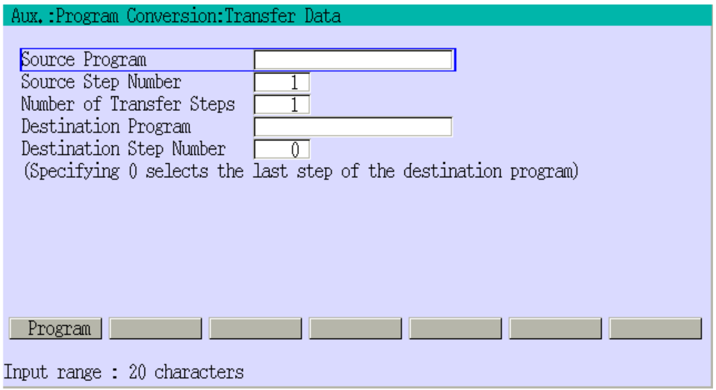
		07	Signal Setting of Arm ID Board				
		08	Signal Allocation				
		10	Input/Output Signals in Robot Arm				
		11	Number of I/O Signals				
		20	Klogic Control	01	Klogic Ladder Display		
07	Log Function	02	Error Logging Display	01	All		
				02	Operation Error (P)		
				03	Mechanical/Control Warning (W)		
				04	Error (E)		
				05	Fatal Error (D)		
				06	Property of Logging		
		03	Operation Logging Display	01	All		
				02	Operation Logging		
				03	Command Logging		
				05	Property of Logging		
		04	Maintenance Log	01	Maintenance Log Registration		
				02	Maintenance Log Display		
				03	Maintenance Log Deletion		
		06	Operating Data Display				
		07	Maintenance Support	01	Maintenance Support Aux.		
				02	Error List		
		08	Command Storage	01	Setting	01	JT Angle
						02	XYZOAT
						03	JT Command
						04	JT Deviation
						05	JT Speed
						06	Motor Cur. Value
						07	Motor Speed
						08	Motor Cur. Command
						09	Tool Speed
						10	I/O Signal
						11	Combination
		09	Motor Torque Information	01	Peak Current		
				02	Duty		
				03	Failure Prediction Setting		
				04	Base Data		

		17	Encoder Check Function	01	Logging Data Display		
				02	Counter Reset		
				03	Alarm Function		
		19	Diag (Diagnostic) Function				
		24	Executed Program Logging				
08	System	01	Memory Available				
		02	Inhibit Record				
		03	Reset Check Sum Error				
		04	Software Version				
		05	Initialize System				
		07	Check Specification				
		08	Environment Data				
		09	Time/Date				
		10	PC Program Run/Stop	01	Selects Start (PCEXECUTE)		
				02	Selects Abort (PCABORT)		
				03	Selects Stop (PCEND)		
				04	Select Continue (PCCONTINUE)		
				05	Kill PC Prg. (PCKILL)		
				06	Selects Status (PCSTATUS)		
		11	Choose Language	01	Choose Language		
				02	Language Allocation Function		
		12	Network Setting				
		14	Fast Check				
		18	USB Keyboard				
		19	Operation Panelless Setting				
		97	Selects Auxiliary Function				
		98	Change Operation Level				
11	Handling/ Palletizing	01	Palletizing Data Set	01	Pattern Set		
				02	Shift Frame Registration		
				03	Shift Frame Measurement		
				04	Shift Measurement		
		02	Conveyor Synchro	02	Data Set		
				03	Environment Data Set		
				04	Simulation		
				06	Start Delay	01	Common Delay Distance
						02	Individual Delay Distance

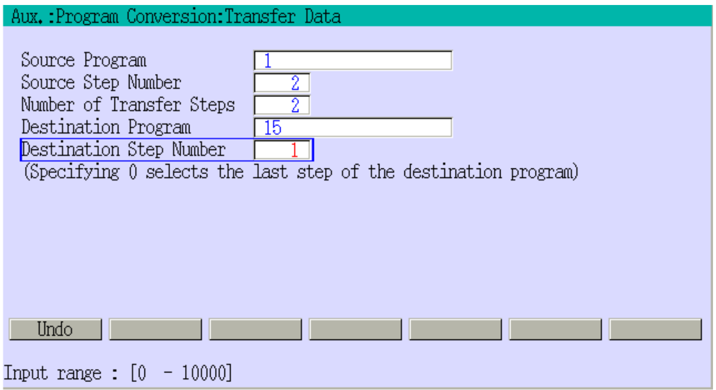
						03	Multi Start Daly	1. Display 2. Change 3. Delete
		03	Sensing					
		23	Program Queue	01	Display/Change			
				02	Environment Set			
12	Paint, Sealing	01	Flowrate Control					
		02	Speed Output	01	Linearization Table			
				02	Environment Set			
		03	Spray Enable/Disable					
		04	Output Ref Flowrate	01	Flowrate Calibration Table			
				02	Pressure/Voltage Table			
				03	Flowrate Magnification Table			
				04	Applying Pressure Table			
				05	Set Primary Line Pressure			
				06	Set Press. and Temp. Limits			
				08	Environment set			
				10	Set Material Circulation Data			
				11	A/D D/A Monitor			
				12	Data Monitor			
				13	Clogging Pressure			
				14	Temperature/Voltage Table			
				15	Disconnect Pump Motor			
				17	Accel/Decel Setting for Pump Axis			
		05	3D-Sensor Compensation	01	Reference Points Registration			
				02	Master/Slave			
				03	Allowable Deviation Range			
				04	XYZ Display			
				05	Offline Conversion			

AUX. 0101 TRANSFER DATA

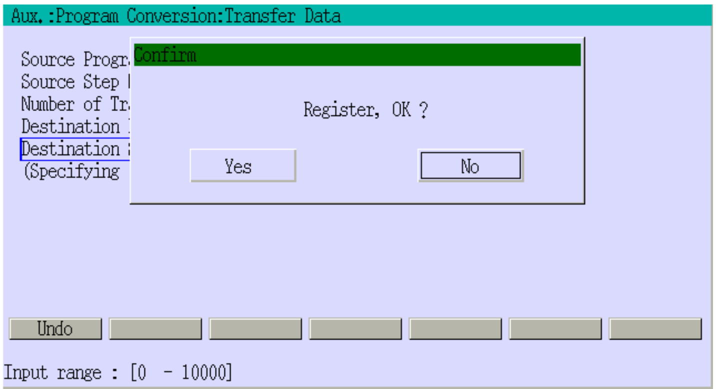
This function transfers program step(s) between different programs or to a specified step within the same program.



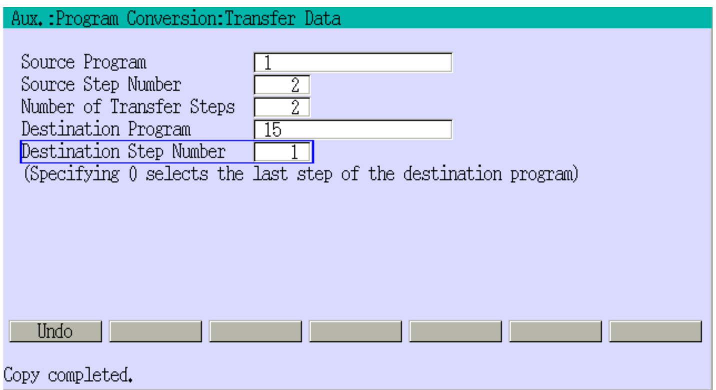
1. Press <Program> and select the program name, then press ↵. Refer to Chapter 2.7.1.1 for details about selecting a program name.



2. Input data and press ↵.



3. Confirmation box is displayed. Select [Yes] to execute or select [No] to cancel.



4. The data has been transferred when “Copy completed.” is displayed.

[NOTE]

Designation of step No.:

When the number of transfer steps is set to 0, input error is returned.

When 0 is set for source step number, input error is returned.

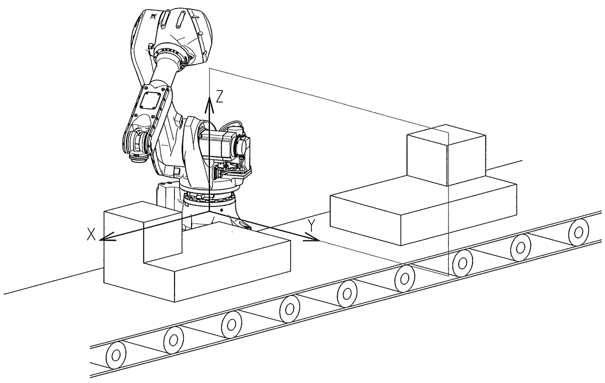
When specified number of transfer steps is greater than that of the specified program, up to the last step is transferred.

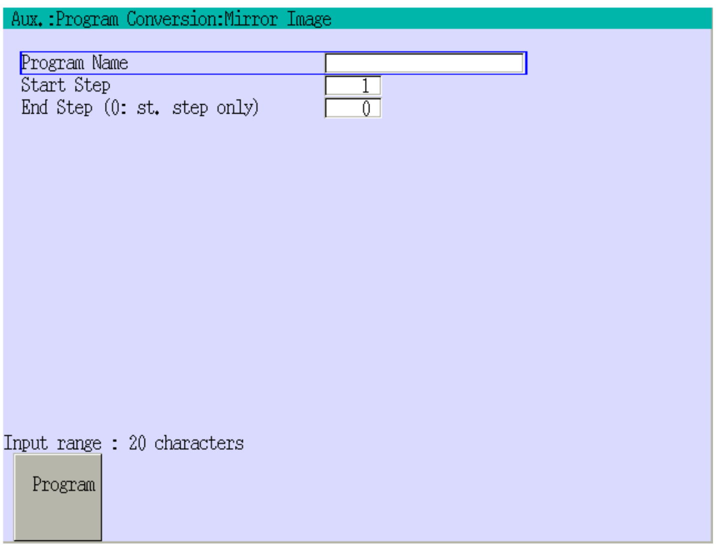
EXAMPLE INPUT

Start step No.	0	0	1	3
End step No.	0	5	0	1
	↓	↓	↓	↓
	Error	Error	Error	Only step 3 is transferred.

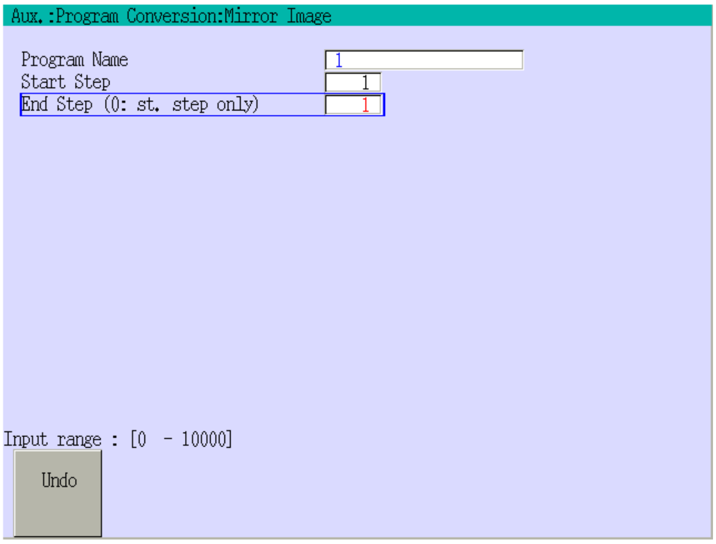
AUX. 0102 MIRROR IMAGE (OPTION)

This function transforms the taught data (pose data in the step) into a mirror symmetry data with respect to the robot’s YZ plane. It is possible to make symmetric data without actual operation of the robot, if the shape of the workpiece is mirror-symmetry with respect to the YZ plane.

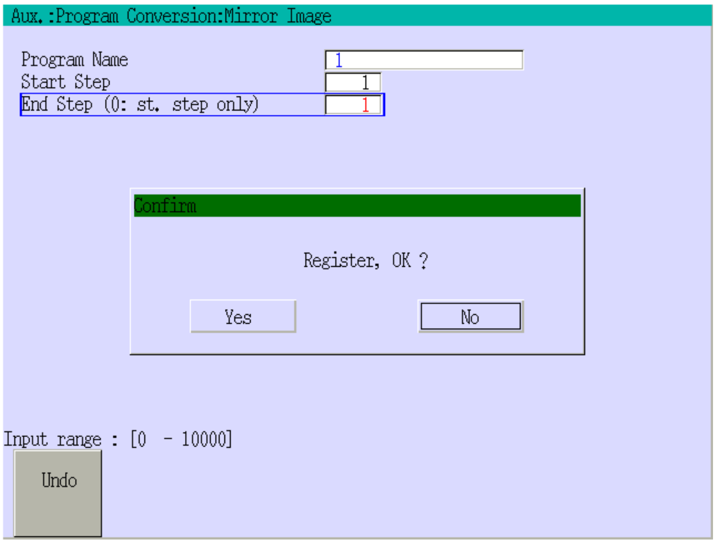




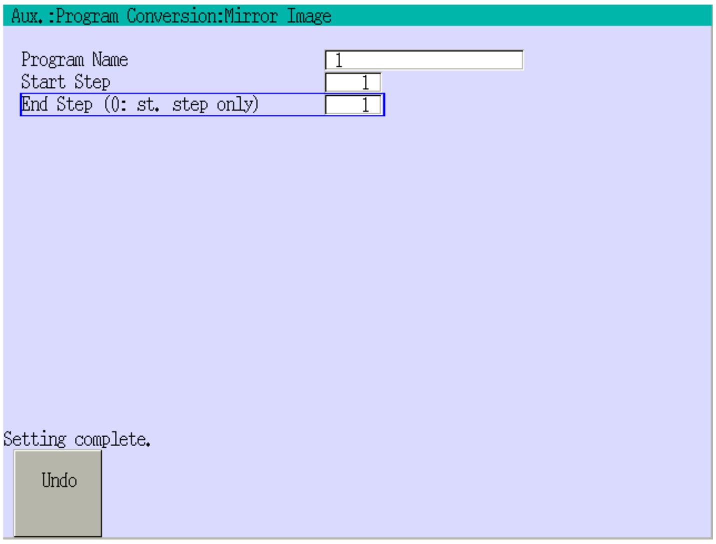
1. Press <Program> and select the program name, then press ↵. Refer to Chapter 2.7.1.1 for details about selecting a program name.



2. Input data and press ↵.



3. Confirmation box is displayed. Select [Yes] to execute or select [No] to cancel.



4. The transformation is stored when “Setting complete.” is displayed.

[NOTE]

Designation of step No.;

When the end step number is set to 0, only start step is transformed.

When 0 is set for start step number , input error is returned.

When specified end step number is greater than the last step number of the specified program, up to the last step is transformed.

Example of input:

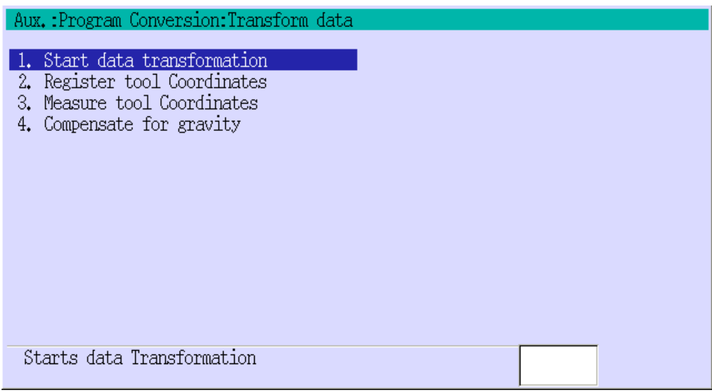
Start step No.	0	0	1	3
End step No.	0	5	0	1
	↓	↓	↓	↓
	Error	Error	Only step1/3 is transformed	

CAUTION

This function is valid only for pose data taught by block teaching. The pose data taught by AS program instruction cannot be transformed. This function transforms based on the YZ plane of robot's null base coordinates, not on the base coordinates after base coordinates transformation. The YZ plane is fixed as a reference plane for transformation and cannot be changed.

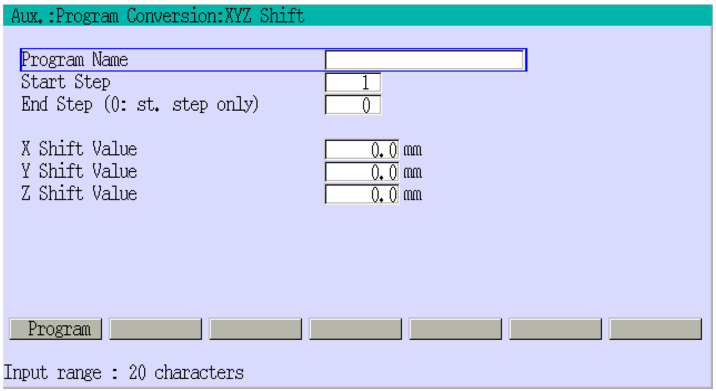
AUX. 0103 TRANSFORM DATA (OPTION)

This function creates the data necessary for on-line robots, based on the data taught by off-line robot or CAD (ROSET). In this function, reference points data is required to fix the pose relationship between workpiece and robot. For more details about this function, refer to Chapter 15.



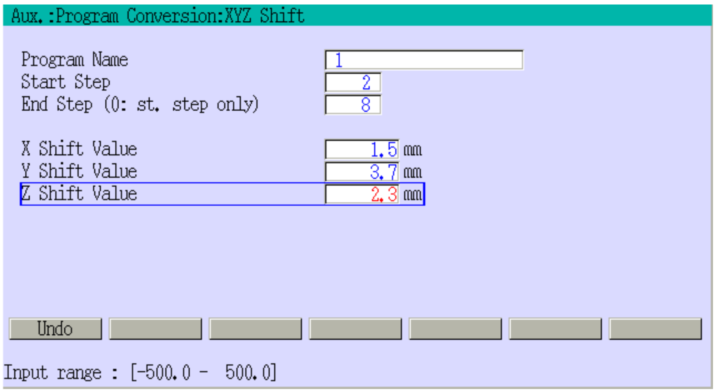
AUX. 0104 XYZ SHIFT

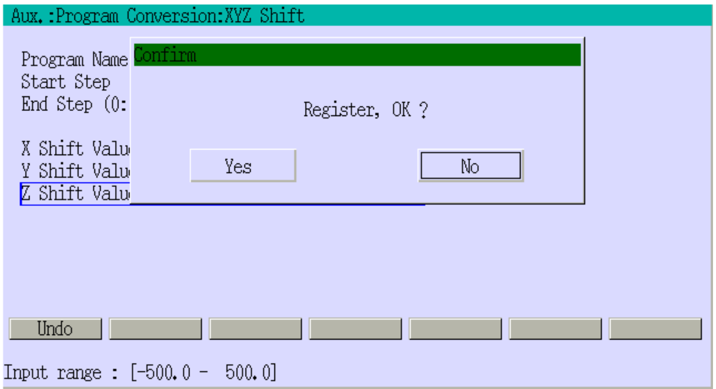
This function shifts the pose data taught by block teaching along the X, Y and Z axes of the robot base coordinates.



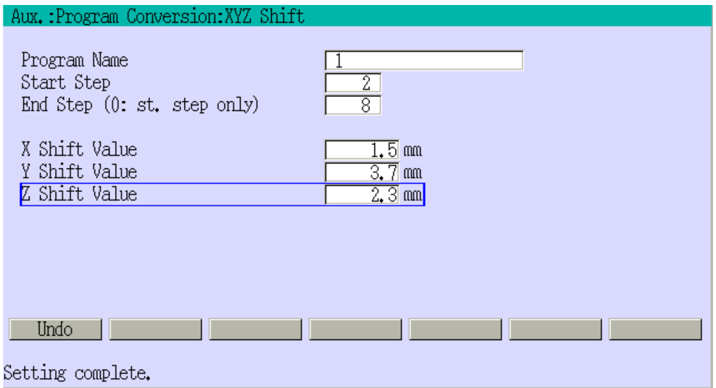
1. Press <Program> and select the program name, then press ↵. Refer to Chapter 2.7.1.1 for details about selecting a program name.

2. Input the required data and press↵.





3. Confirmation box is displayed. Select [Yes] to execute or select [No] to cancel.



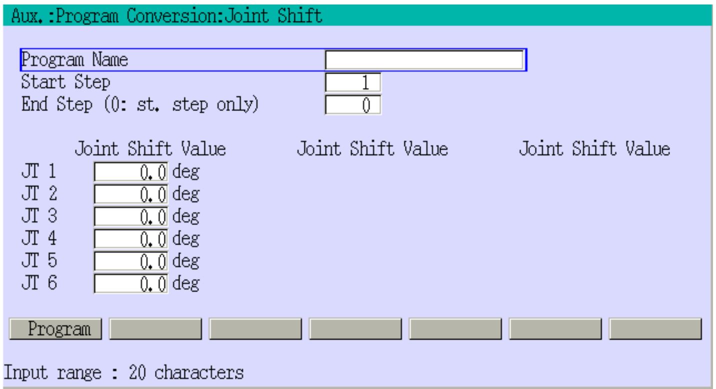
4. The transformation is stored when "Setting complete." is displayed.

See the NOTE in Aux. 0102 for specifying the start and end step numbers.

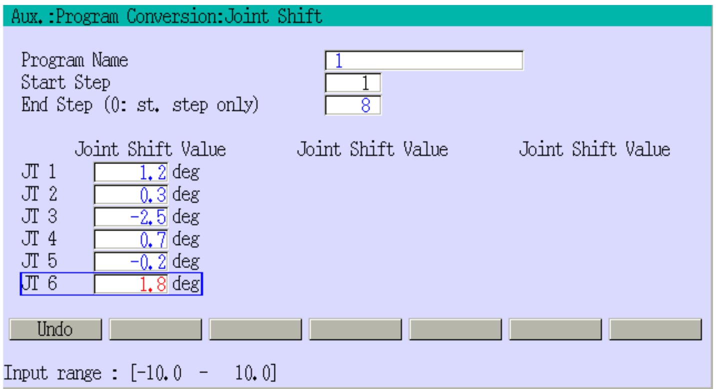
> **⚠ CAUTION**
>
> **Execution of this function changes the taught data on the memory. Save the current data on to USB memory before execution to prevent inadvertent deletion.**

AUX. 0105 JOINT SHIFT

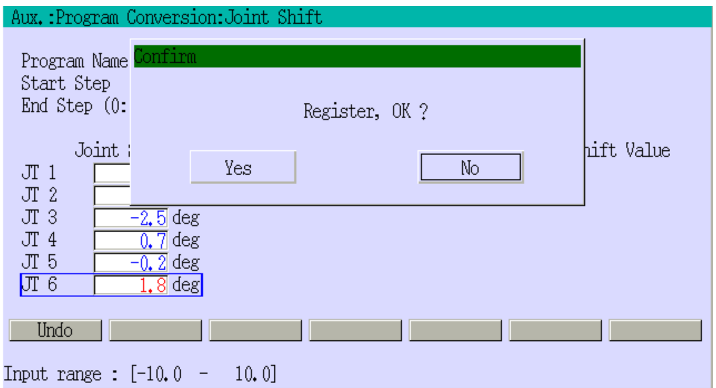
This function shifts each axis data taught by block teaching.



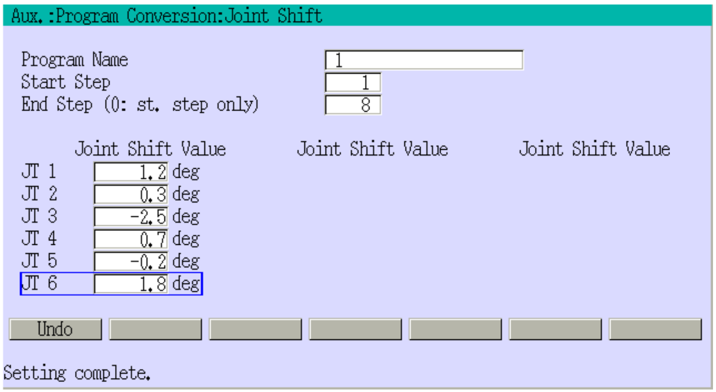
1. Press <Program> and select the program name, then press ↵. Refer to Chapter 2.7.1.1 for details about selecting a program name.



2. Input data and press ↵.



3. Confirmation box is displayed. Select [Yes] to execute or select [No] to cancel.



4. The transformation is stored when "Setting complete." is displayed.

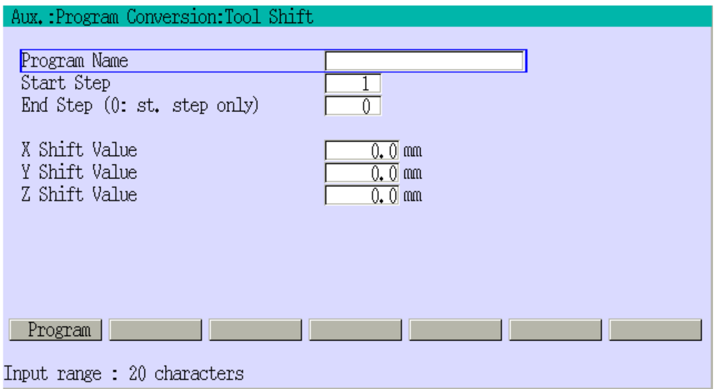
See the NOTE in Aux. 0102 regarding specifying the start and end step numbers.

CAUTION

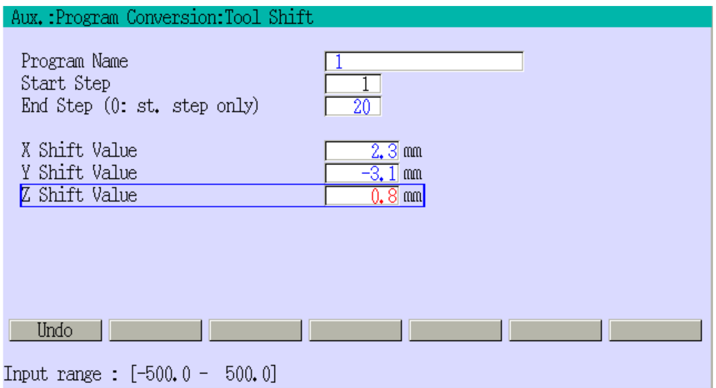
Execution of this function changes the taught data on the memory. Save current data on to USB memory before execution to prevent inadvertent deletion.

AUX. 0106 TOOL SHIFT

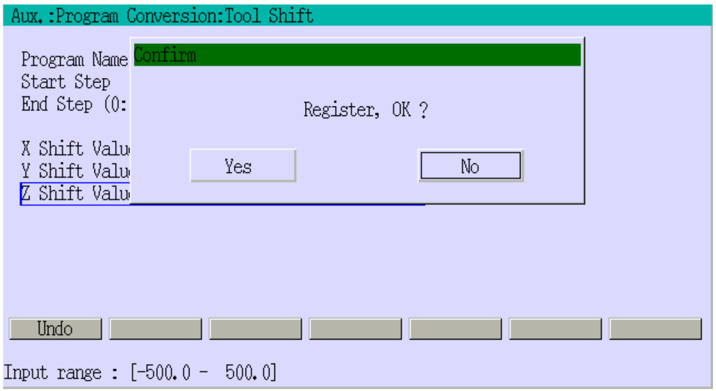
This function shifts the pose data taught by block teaching along the X, Y and Z axes of the robot tool coordinates.



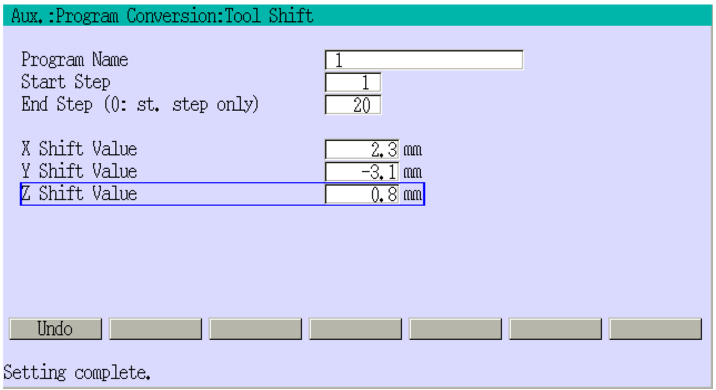
1. Press <Program> and select the program name, then press ↵. Refer to Chapter 2.7.1.1 for details about selecting a program name.



2. Input data and press ↵.



3. Confirmation box is displayed. Select [Yes] to execute or select [No] to cancel.



4. The transformation is stored when “Setting complete.” is displayed.

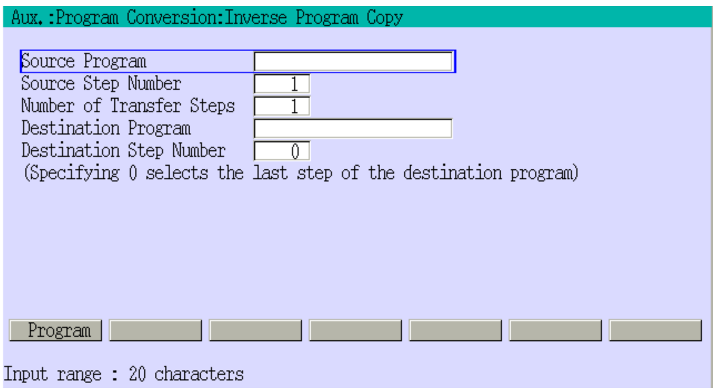
See the NOTE in Aux. 0102 regarding specifying the start and end step numbers.

CAUTION

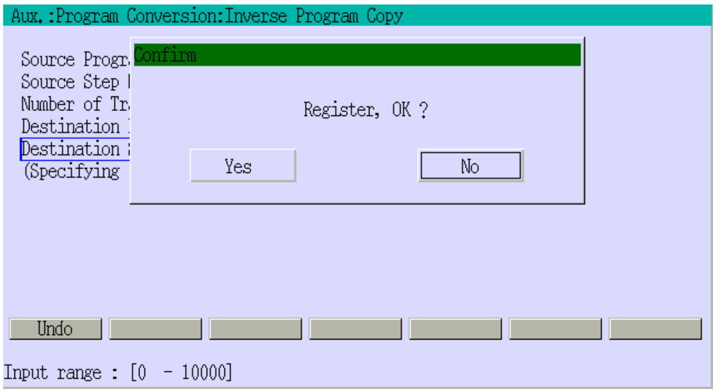
Execution of this function changes the taught data on the memory. Save current data on to USB memory before execution to prevent inadvertent deletion.

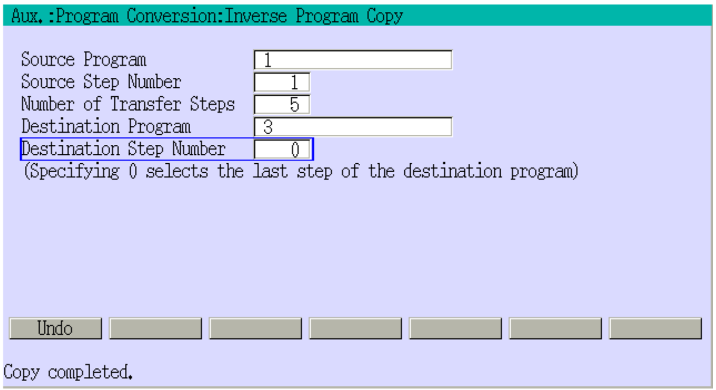
AUX. 0108 INVERSE PROGRAM COPY (OPTION)

This function transfers the specified steps in [Source Program] to the specified range in [Destination Program] in reverse order. This function works in the same manner as Aux. 0101 except program steps are copied in reverse order.



1. Press <Program> and select the program name, then press ↵. Refer to Chapter 2.7.1.1 for details about selecting a program name.





2. Input the first step number to be transferred in [Source Step Number] and the number of steps to be transferred in [Number of Transfer Steps].

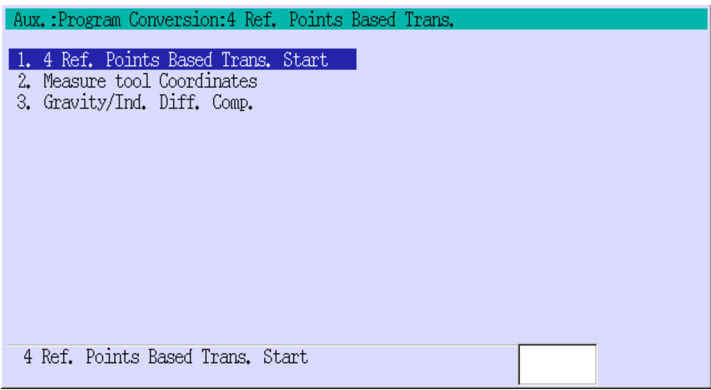
3. Input the destination step number in [Destination Step Number]. (Inputting 0 copies the step after the last step in the destination program.)

4. Confirmation box is displayed. Select [Yes] to execute or select [No] to cancel.

5. Copy is successful when “Copy completed.” is displayed.

AUX. 0110 4 REF. POINTS BASED TRANS. (OPTION)

This function basically works in the same manner as Aux. 0103. This function is effective when higher accuracy is required. This function contains the following three sub functions. For more details, refer to the optional manual “Four Reference Points Based Transformation Manual”, a separate volume.



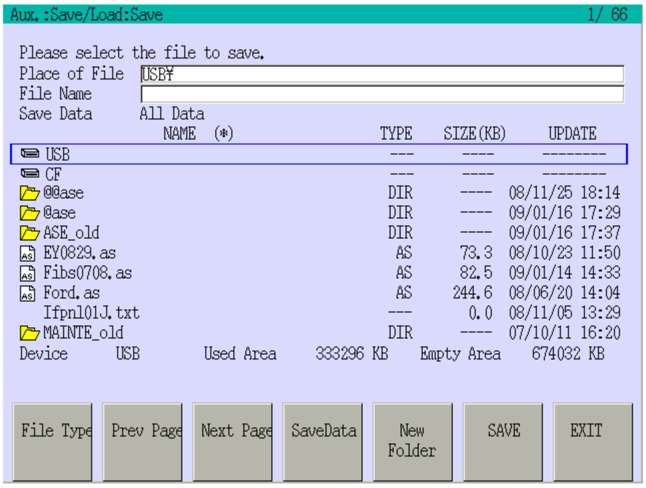
AUX. 0113 C/V POSITION VALUE SHIFT (OPTION)

This function uniformly shifts the conveyor position by the specified distance.

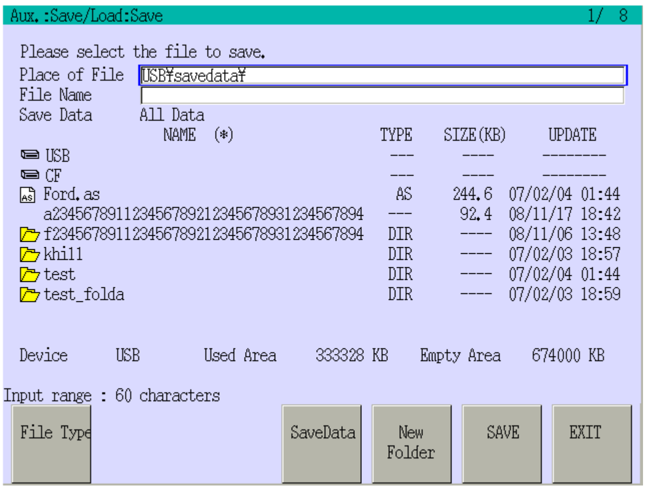
Example:
If the conveyor origin shifts 1000 mm downstream after teaching current conveyor position of 1000 mm, the conveyor position can be shifted 1000 mm upstream by this function to compensate for the conveyor origin shift and the conveyor position recorded in move instruction of the program is overwritten as 2000 mm.

AUX. 0201 SAVE

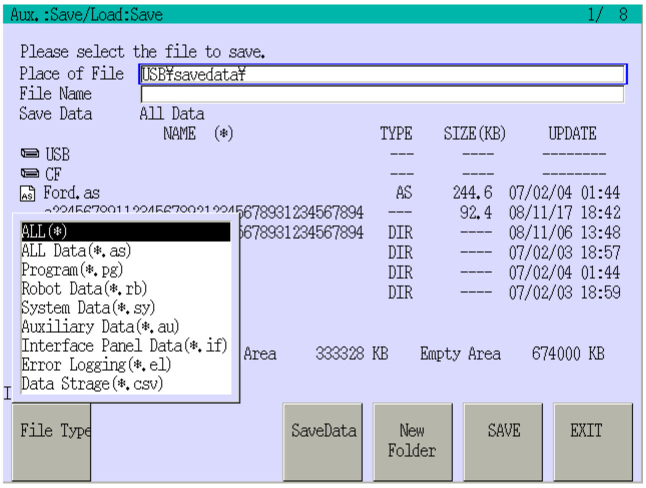
This function saves programs and other data in the controller memory to USB memory or compact flash card (hereinafter called CF) in file unit. USB memory is inserted into the USB port inside the accessory panel on the controller. CF is built in the controller and has capacity of about 20 MB.



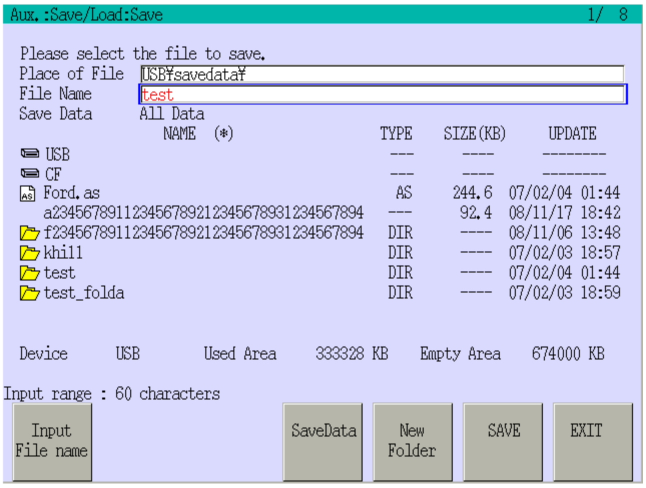
1. Select the desired device. Move cursor to [USB] and press to select USB memory, or to [CF] and press to select CF. USB memory is selected by default when screen opens.



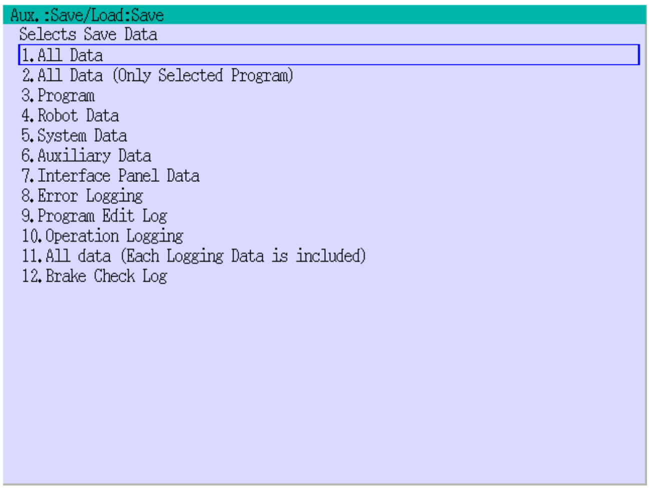
2. Select the desired folder to save the data to. Move cursor to desired folder with and press to open the folder. Confirm the specified folder name is displayed in [Place of File]. Pressing $\boxed{R}$ moves back to the parent folder.



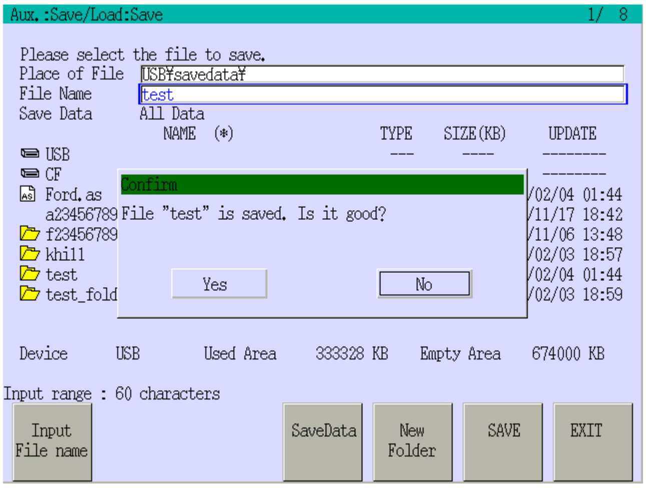
3. Move cursor to [Place of File], and press <File Type> in lower left portion of screen. Select the desired file type from the pull-down menu and press ↵.



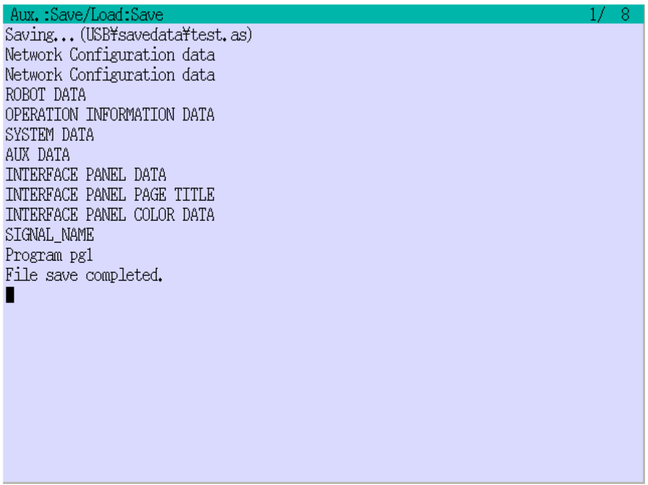
4. Select the desired file name from the list of file names. Or, move cursor to [File Name] and press <Input File name> in lower left portion of screen. Input file name via the keyboard screen, and press <ENTER>.



5. Screen at left appears by pressing <SaveData>. Select the desired file type.



6. If setting is correct, press <SAVE>. Confirmation box is displayed. Select [Yes] to execute or select [No] to cancel.



7. Saving finishes when “File save completed.” is displayed.

Selectable file types are below.

All Data

Saves all programs and other data in controller memory to the USB/CF memory.

All Data (Only selected program) (*.as)

Saves all data of the specified program with the specified file name* to USB/CF memory.

Program (*.pg)

Saves the specified program data to the file with the specified name* to USB/CF memory.　If the saved program calls other programs (subroutines), the called programs are also saved.

Robot Data (*.rb)

Saves system data such as dedicated signal setting data and zeroing data, etc. to the file with the specified name* to USB/CF memory.

System Data (*.sy)
Saves system data with the specified file name* to USB/CF memory.

Auxiliary Data (*.au)
Saves parameter values of element instructions (auxiliary data) such as speed, accuracy, timer, tool, etc., taught by block teaching with the specified file name* to USB/CF memory.

Interface Panel (*.if)
Saves data of devices set on the interface panel screen with the specified file name* to USB/CF memory.

Error Logging (*.el)
Saves the error history of the last 1000 entries in memory, including error code, message, date, time, under the specified file name* to USB/CF memory.

Data Storage (*.csv)
Saves the data storage data with the specified file name* to USB/CF memory.

Program Edit Logging (*.edl)
Saves the program edit histories stored in memory, including date and time, under the specified file name* to USB/CF memory.

Operation Logging (*.ol)
Saves the operation histories stored in memory, including date and time, under the specified file name* to USB/CF memory.

Brake Check Logging (*.bl) (option)
Saves the brake check histories stored in memory, including date and time, under the specified file name* to USB/CF memory.

NOTE* A file name (number) must be specified when storing data to USB/CF memory. Enter a name (number) for file identification, but a file extension, such as AS, PG, AU, RB is automatically added to the file name (number) according to the selected file type. (The file extension does not need to be input.)

If a file is identified with the same file number, or name, as an existing file, a backup file is automatically created. “B” is added to the extension of the original file name indicating a backup file. (i.e..BAS) Only one backup file is created, if additional files of the same name are specified, the backup file data is overwritten.

The settings for reading data from USB memory to the PC vary depending on PC. Be sure your PC is installed with the appropriate USB memory-compatible driver.

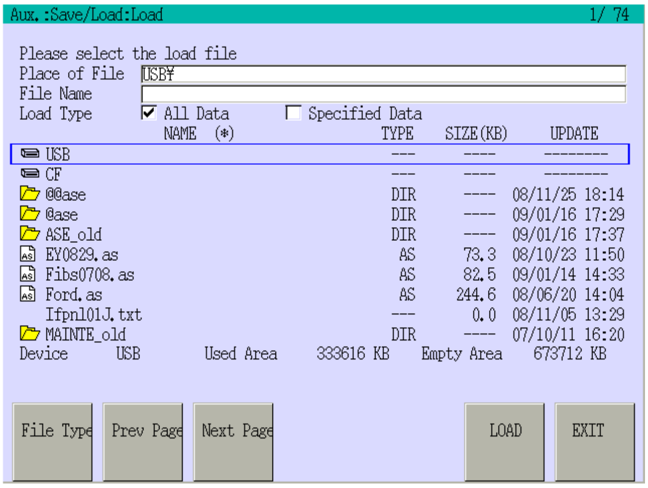
[**NOTE**]

The error message below may appear when an error occurs while writing data to a file, for example when USB memory is full.

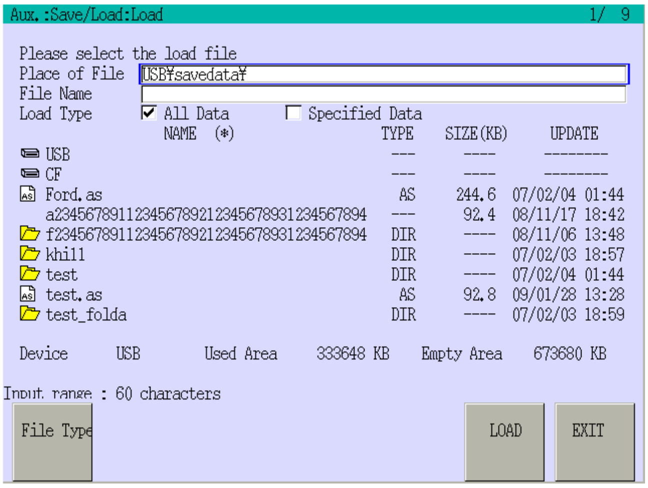
Data write error. (USB/CF)

AUX. 0202 LOAD

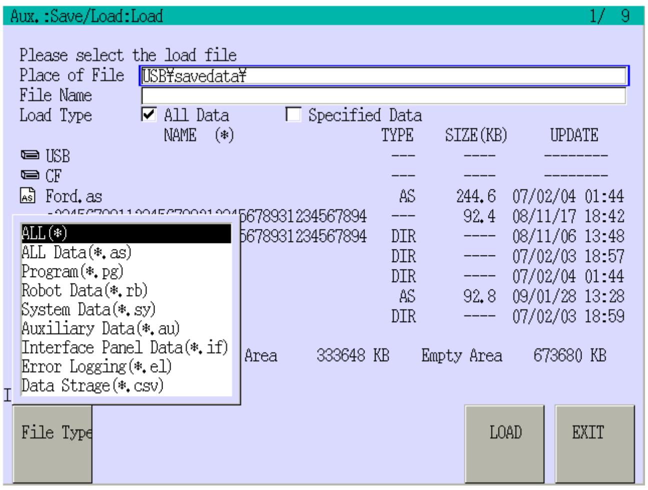
This function loads the data saved as files in the external memory device to the controller memory. Use either a USB memory device or the CF as external memory device.
USB memory is inserted into USB port inside the accessory panel on controller. CF is built in the controller and has capacity of about 20 MB.



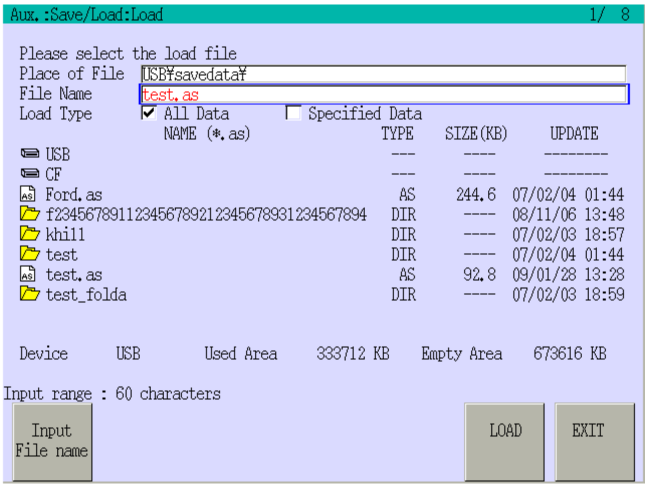
1. Select the desired device. Move cursor to [USB] and press ↵ to select USB memory, or to [CF] and press ↵. USB memory is selected by default when screen is displayed.



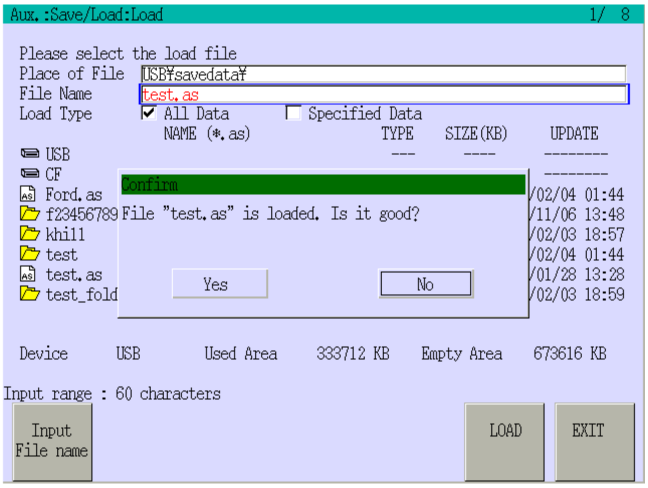
2. Select the folder that includes the file to be loaded. Move cursor to desired folder with and press ↵ to open the folder. Confirm the specified folder name is displayed in [Place of File]. Pressing R moves back to the parent folder.



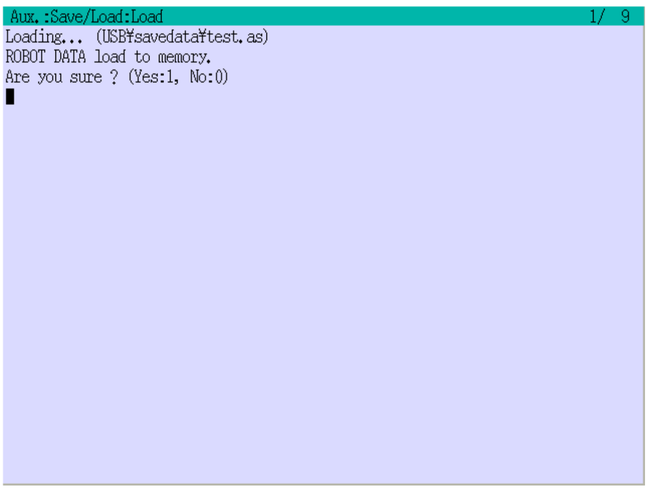
3. Move cursor to [Place of File], and press <File Type> in lower left portion of screen. Select the desired file type from the pull-down menu and press ↵.



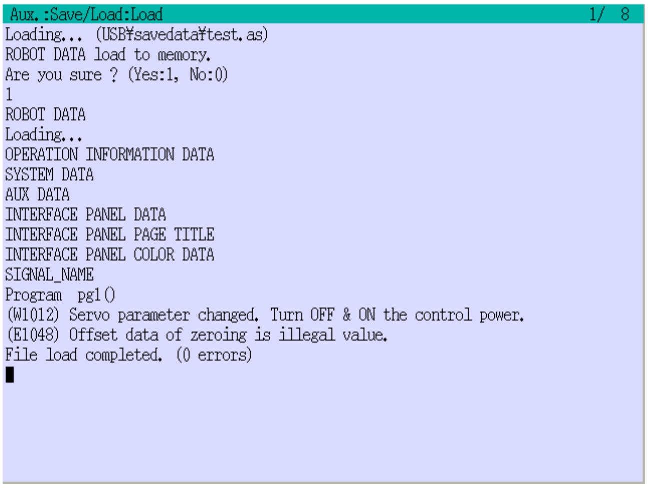
4. Select the desired file to be loaded from the list. Or, move cursor to [File Name] and press <Input File name> in lower left portion of screen. Input file name via keyboard screen and press <ENTER>.



5. If the setting is correct, press <LOAD>. Confirmation box is displayed. Select [Yes] to execute or select [No] to cancel.



6. Confirmation message is displayed. Input 0 (No) to cancel loading of the robot data. Input 1 (Yes) to load the robot data.



7. Loading finishes when “File load completed.” is displayed.

Selectable file types are below.

All

Loads all programs and other data in the memory to the controller memory.

All Data (Only selected program) (*.as)

Loads all data of the specified program with the specified file name* to the controller memory.

Program (*.pg)

Loads the specified program data to the file with the specified name* to controller memory. If the program calls other programs (subroutines), the called programs are also loaded.

Robot Data (*.rb)

Loads the system data such as dedicated signal setting data and zeroing data, etc. to the file with the specified name* to the controller memory.

System Data (*.sy)

Loads system data with the specified file name* to controller memory.

Auxiliary Data (*.au)

Loads parameter values of element instructions (auxiliary data) such as speed, accuracy, timer, tool, etc., taught by block teaching with the specified file name*to the controller memory.

Interface Panel (*.if)

Loads data of devices set on the interface panel screen with the specified file name* to the controller memory.

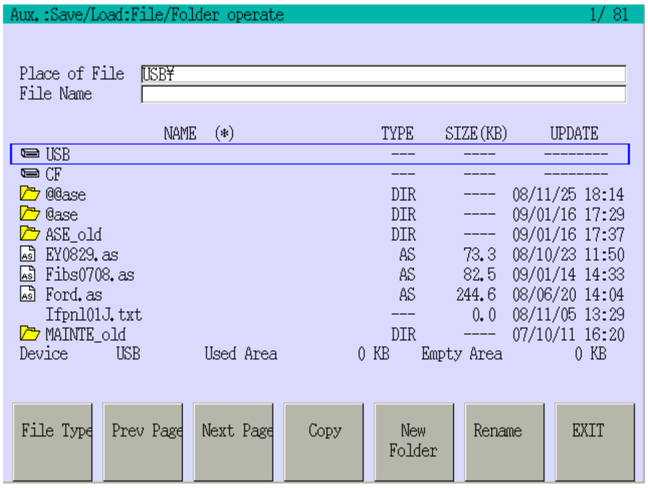
Data Storage (*.csv)

Loads the data storage data with the specified file name* to controller memory.

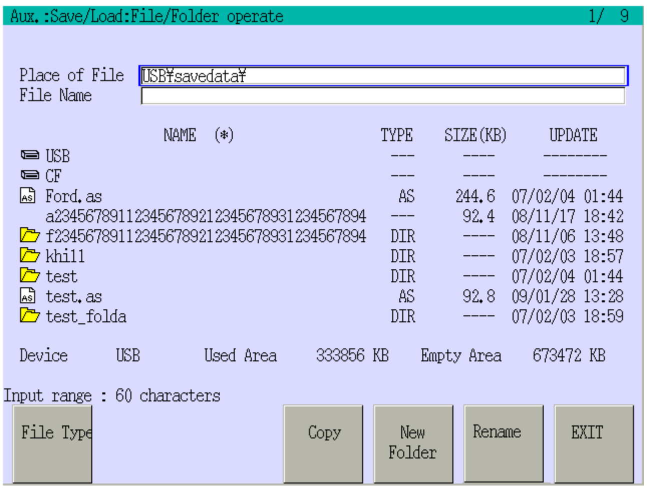
NOTE* A file name (number) must be specified when loading data to controller memory. Enter a name (number) for file identification, but a file extension, such as AS, PG, AU, RB is automatically added to the file name (number) according to the selected file type. (The file extension does not need to be input.)

AUX. 0203 FILE/FOLDER OPERATE

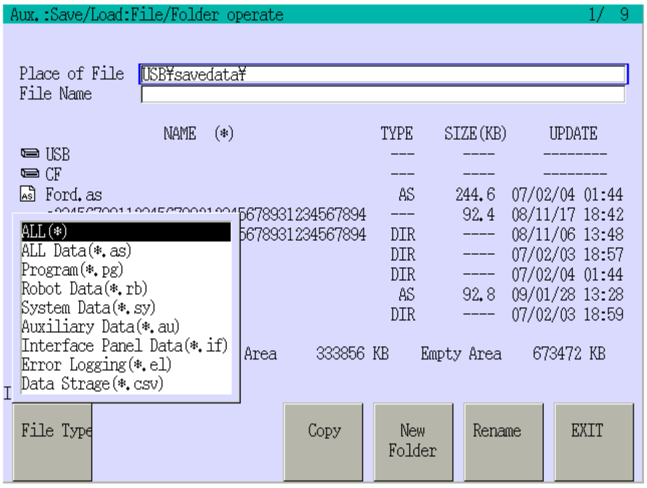
This function executes copy, deletion, and renaming of the file or folder in the external memory device.　Use either a USB memory device or the CF as external memory device.　USB memory is inserted into USB port inside the accessory panel on controller.　CF is built into the controller and is approximately 20 MB.



1. Select the desired device.　Move cursor to [USB] and press to select USB memory, or to [CF] and press .　USB memory is selected by default when screen is displayed.

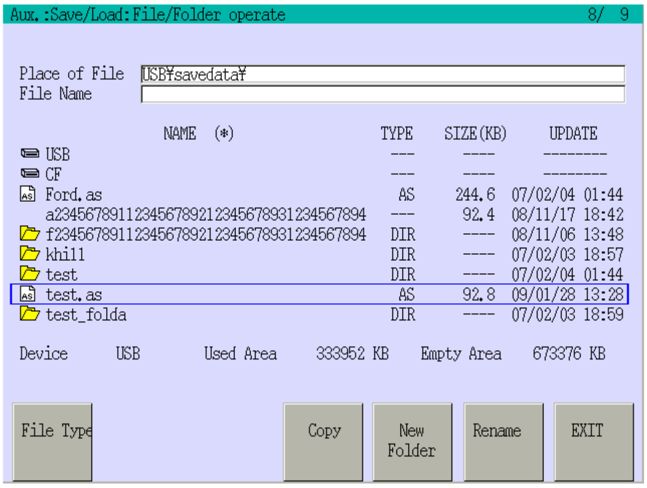


2. Select the folder that includes the desired file.　Move cursor to desired folder with and press to open the folder.　Confirm the specified folder name is displayed in [Place of File].　Pressing R moves back to the previous folder.

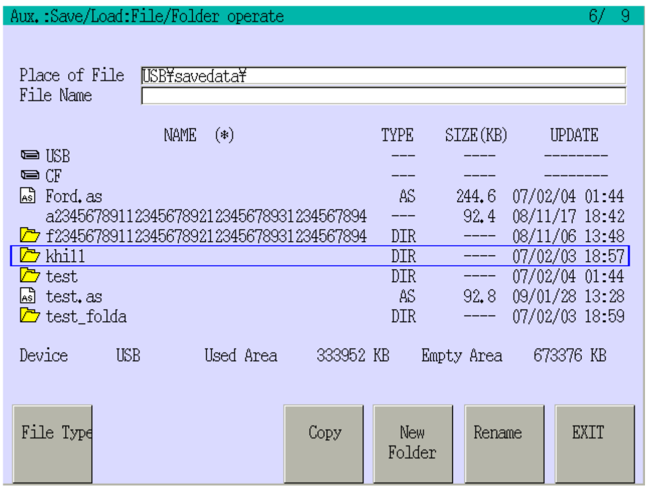


3. Move cursor to [Place of File], and press <File Type> in lower left portion of screen. Select the desired file type from the pull-down menu and press ↵.

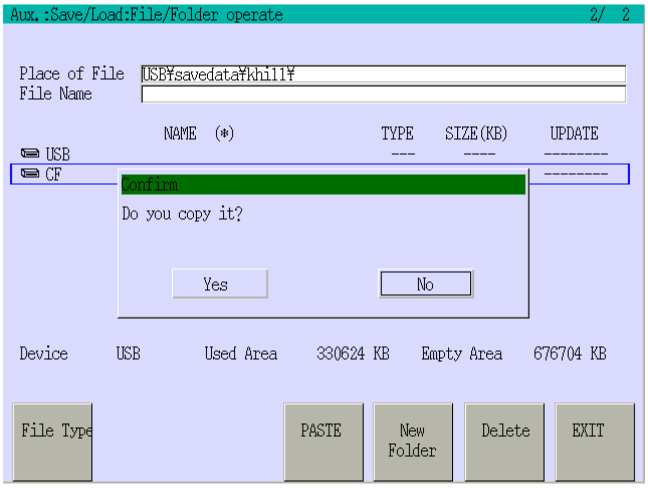
Copy



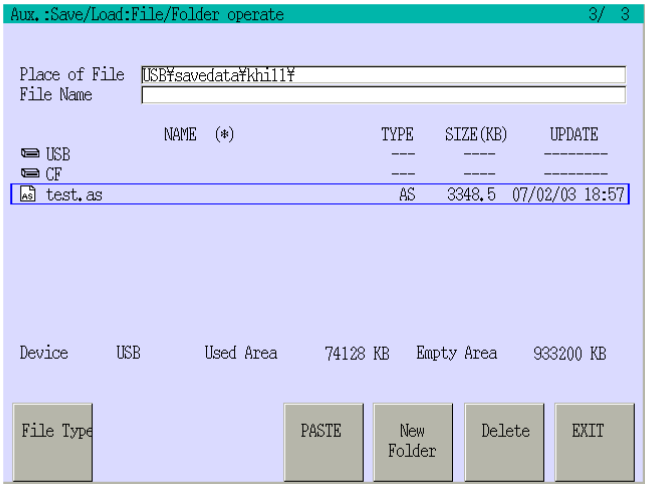
1. Move cursor to the desired file or folder name and press <Copy>.



2. Move cursor to the desired destination folder name and press ↵.

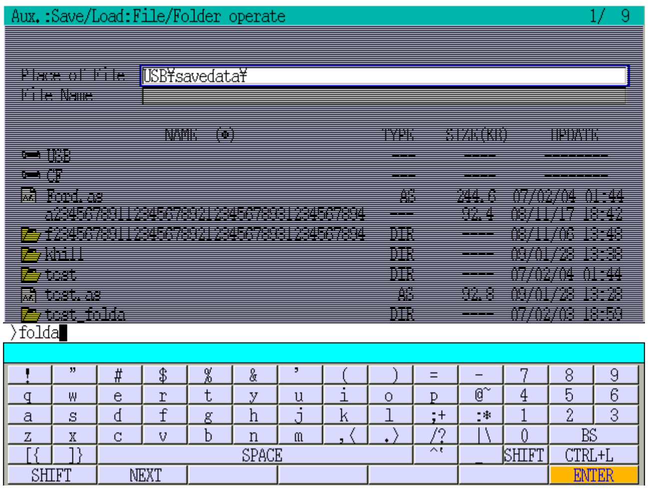


3. Pressing $\boxed{A}$ + <PASTE> displays confirmation box . Select [Yes] to execute.



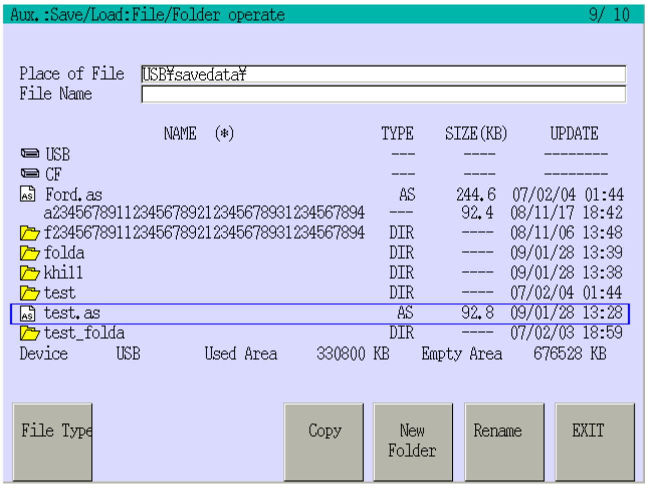
4. The file or folder is copied into the specified folder.

New Folder

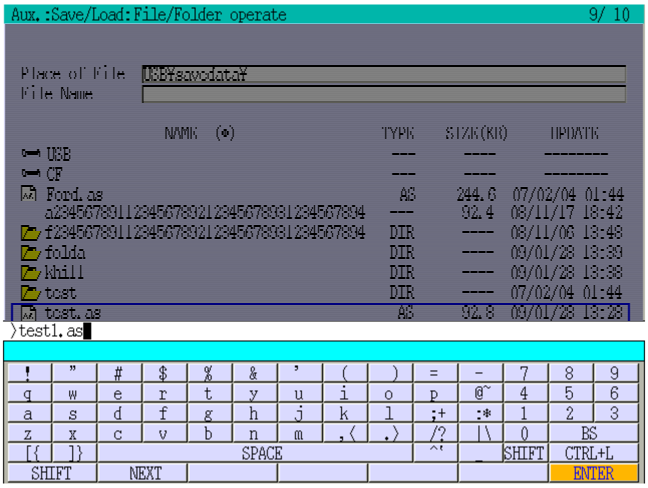


Input a folder name and press <ENTER>.

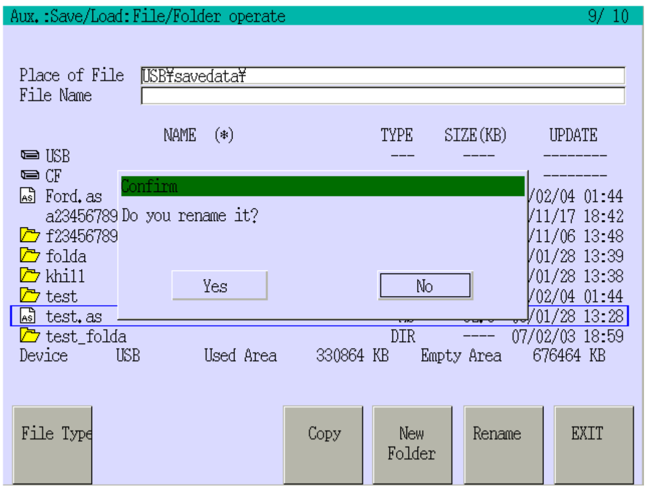
Rename



1. Move cursor to the desired file or folder and press <Rename>.

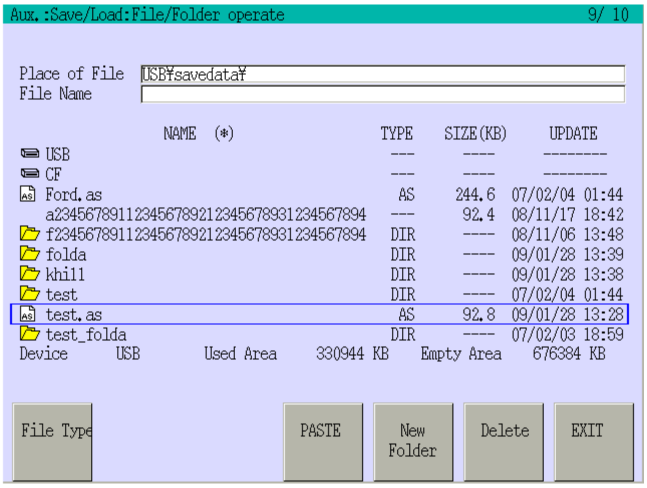


2. The keyboard screen is displayed. Input a new name and press <ENTER>.

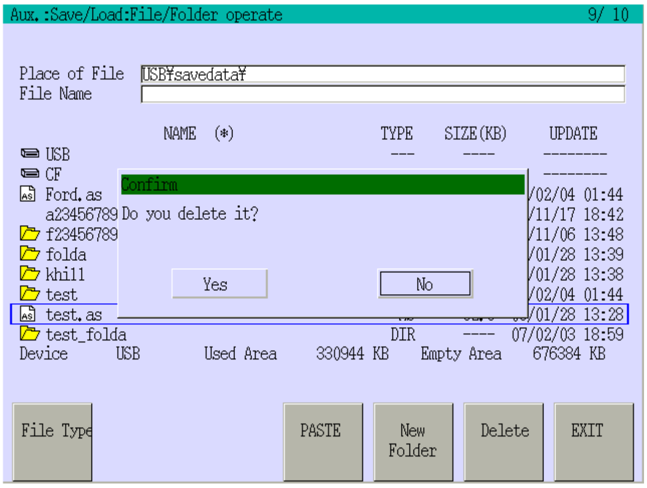


3. Confirmation box is displayed. Select [Yes] to execute.

Delete



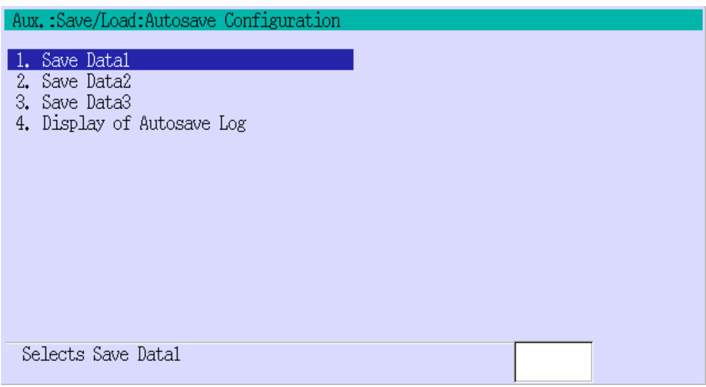
1. Move cursor to the desired file or folder and press $\boxed{A}$ + <Delete>.



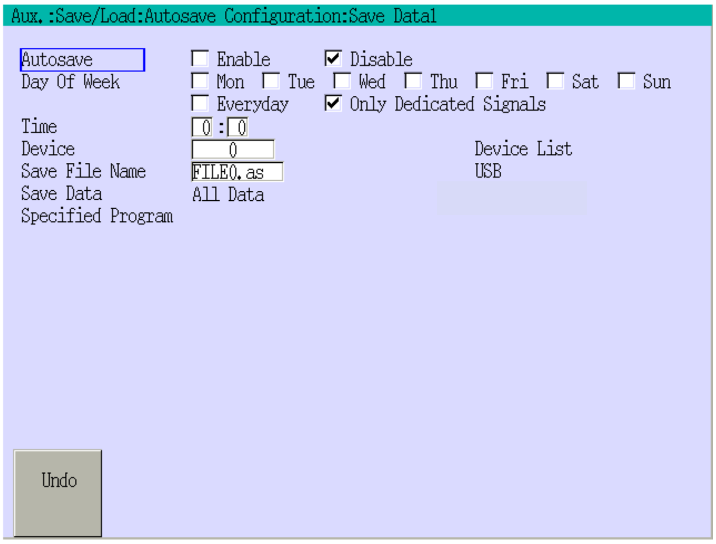
2. Confirmation box is displayed. Select [Yes] to execute.

AUX. 0210 AUTOSAVE CONFIGURATION

This function automatically saves data stored in the controller to the specified device at the specified timing. Three kinds of saving conditions are available. Also displays the autosave log.



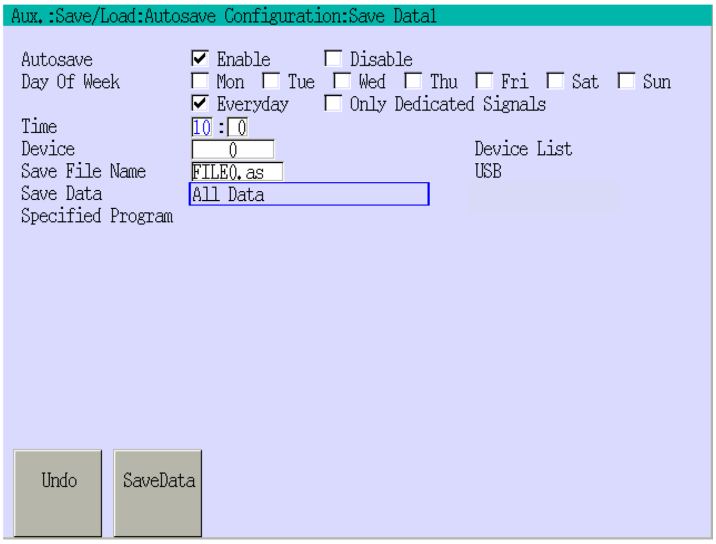
1. Select the desired setting screen, from [Save Data1] to [Save Data3].



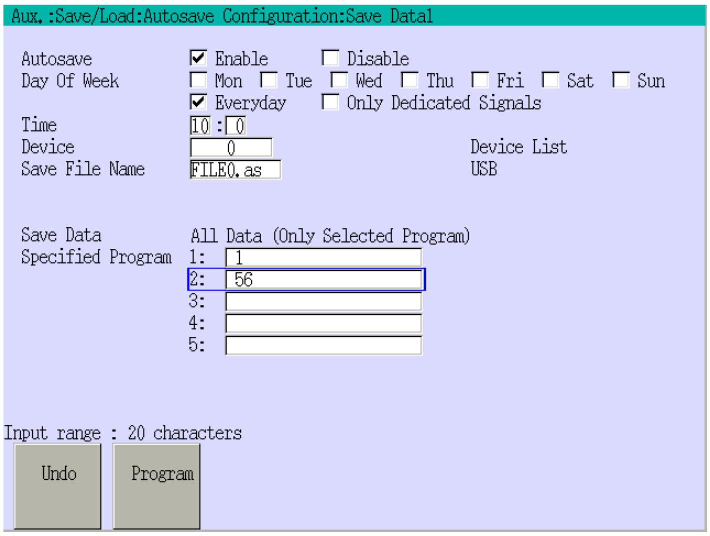
2. Screen at left is displayed when [Save Data1] is selected. Set [Autosave] to [Enable] by A + ←/→.

3. Set [Day Of Week], [Time], [Device]. Input 0 (USB) for [Device].

4. Move cursor to [Save File Name] and press <Input>. Input file name via the keyboard screen that appears, and press <ENTER>.



5. Move cursor to the file type displayed next to [Save Data]. [All Data] is shown at left. Press <Save Data> to select the desired file type, then press ↵.



6. Screen at left is displayed when selecting [All Data (Only Selected Program)] in step 5. Specify the program name and press ↵. (For details on specifying programs, refer to Chapter 2.7.1.1.) No need to specify program, if program already selected in step 5 and its file type is other than [All Data (Only Selected Program)].

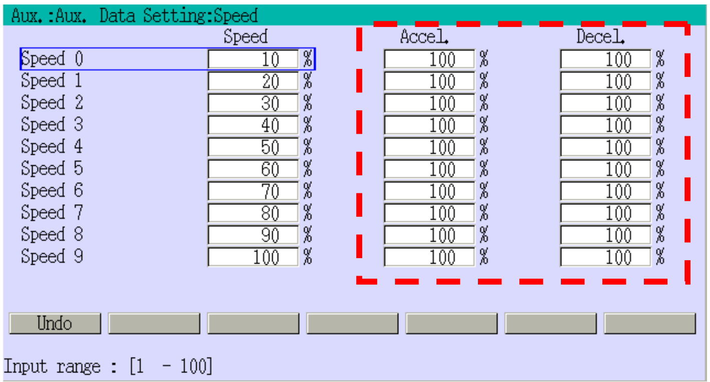
7. Settings are stored when "Setting complete." is displayed.

AUX. 0301 SPEED

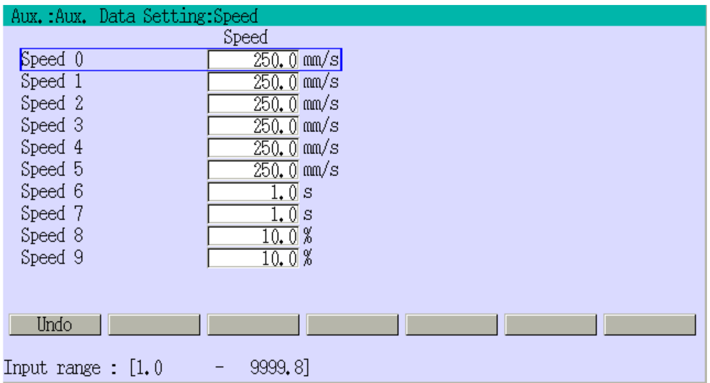
This function sets the speed data for auxiliary data [Speed0] - [Speed9], for SPEED instructions in block teaching.

All speed data are normally set as a percentage (%) of the maximum speed.
For joint interpolation: Percentage of the maximum speed for each axis
For linear/circular interpolation: Percentage of the maximum speed in interpolation motion

For the maximum speed of each axis and interpolation, refer to Installation and Connection Manual for the robot arm, a separate volume.



Input percentage (%) for each speed level. If the setting is correct, press ↵. The screen enclosed by is displayed when [ACCEL. AND DECEL.] is set to [Enable] in Aux. 0399. See below for the setting of acceleration and deceleration.



The speed setting screen is normally dispayed as shown above. If the multifunction speed option is set to ON, the left screen is displayed to enable three kinds of settings: absolute speed (mm/s), motion time (s) and percentage of max. speed.

When [ACCEL. AND DECEL.] is set to [Enable] in Aux. 0399, acceleration and deceleration can be set. This function is useful for suppressing induced vibration on the tip of robot arm or to make the tip move more smoothly by decreasing acceleration and deceleration.
All acceleration data are set as a percentage (%) of the max. acceleration.
All deceleration data are set as a percentage (%) of the max. deceleration.

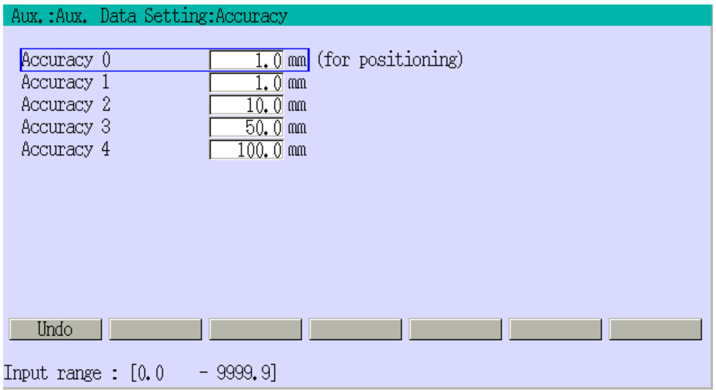
When [ACCEL. AND DECEL.] is set to [Enable] in Aux. 0399, the AS language ACCEL or DECEL instructions cannot affect the motion to points taught in block teaching.

[NOTE]

When [ACCEL. AND DECEL.] is set to [Disable] in Aux. 0399, the acceleration/deceleration is equivalent to a 100 % setting when [ACCEL. AND DECEL.] is set to [Enable].

AUX. 0302 ACCURACY

This function sets the accuracy values for auxiliary data [Accuracy 0] - [Accuracy 4] of ACCURACY instruction in block teaching.



Input the accuracy values for each accuracy level. If the setting is correct, press ↵.

[NOTE]

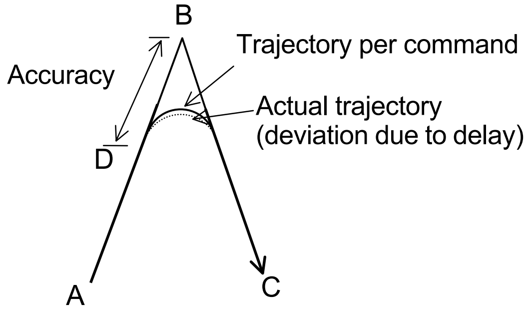
1. Robot may stop due to axis uncoincidence error if the accuracy value is set too small. Set a value larger than the repeatability. However, an axis uncoincidence error may still occur even if the value is taught larger than the repeatability, because the accuracy value set here is the deviation between teach and repeat points, which will change depending on particular robot motion and load conditions.
2. If wait conditions (timer, WS, etc.) are taught at point B (see next page) and the wait release conditions are not satisfied, the robot moves up to point B even if accuracy value is set larger (500 mm, for example).

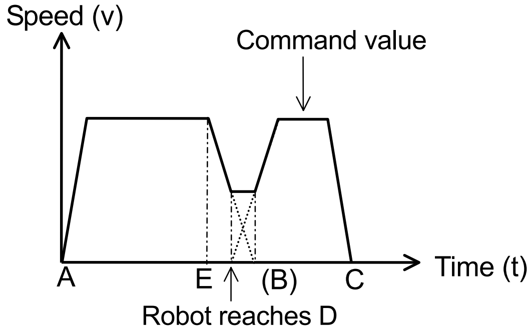
Accuracy and trajectory

Motion type 1

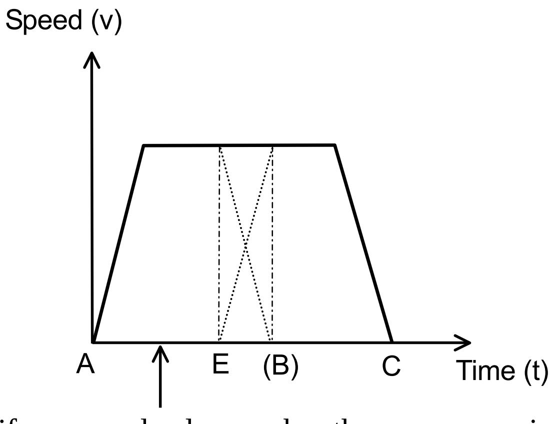
For example the robot takes the motions below (A →B →C).

As soon as the current pose values for the robot enters the accuracy value range specified by accuracy instruction (i.e. robot reaches point D), superposing of the command values for the current and next motion paths begins. The robot will shift movement continuously toward the next path according to these superposed command values. (see diagrams below.)



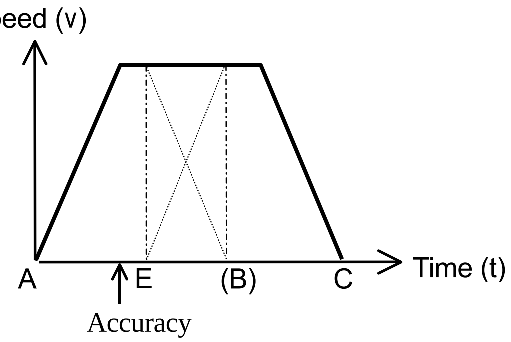


The greater the range specified by ACCURACY, the superposing will begin earlier. However, acceleration on next path does not begin before the point where the robot starts to decelerate (point E), therefore it can be said that the effect of ACCURACY instruction is saturated at a certain value, i.e. there is no effect in setting the accuracy value greater than the distance between point B and point E. (see the diagram below.)

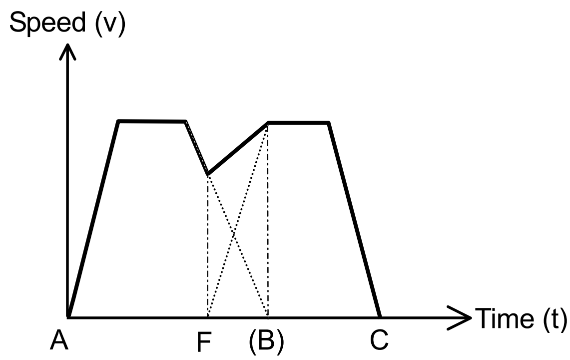


Even if command value reaches the accuracy point at this time, acceleration for next path will not start until deceleration begins at point E.

If the acceleration and the deceleration values for motion from/to the point B are set smaller, the superposing begins earlier and the robot will move in a trajectory with larger radius, but the total time it takes to reach C does not differ significantly.



Even if only the deceleration for the current path is decreased, the compound speed will not exceed the specified maximum speed, since the superposing does not begin until the robot reaches point F (the point where acceleration starts). In other words, the completion time of deceleration and acceleration is the same (point B).



Motion type 2

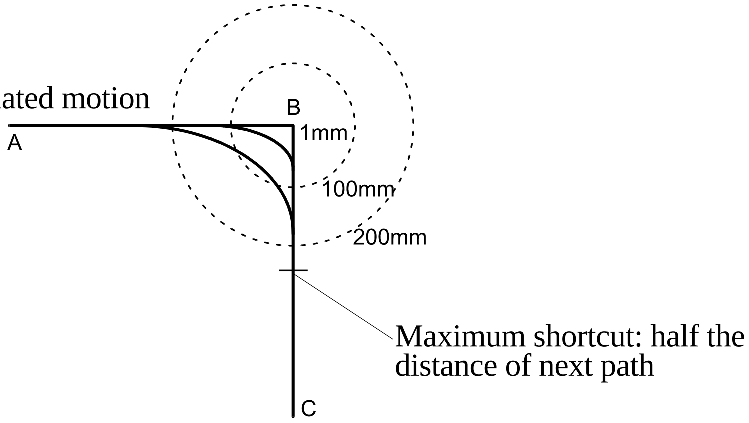
In Motion type 2, the concept of accuracy and velocity in linear, circular motion is different from that of Motion type 1. Motion type 1 and Motion type 2 can use the same programs without modifications, but the actual motion path and motion speed will change.

(1) Accuracy setting

1) Accuracy in joint interpolated motion

The motion path of the robot corresponding to the set accuracy value is shown in the figure below. In this example the accuracy values at point B are 1 mm, 100 mm, and 200 mm. In the same way as Motion type 1, the robot starts to shortcut before reaching point B, but does not necessarily turn at the point where it enters the range of the set accuracy value. How close the robot approaches point B before turning is determined by the value of each axis calculated proportionally to the set accuracy value. If setting an accuracy value that is larger than the half distance of the next path, the robot starts to shortcut when the remaining distance of the current path becomes half the distance of the next path from B to C.

Joint interpolated motion



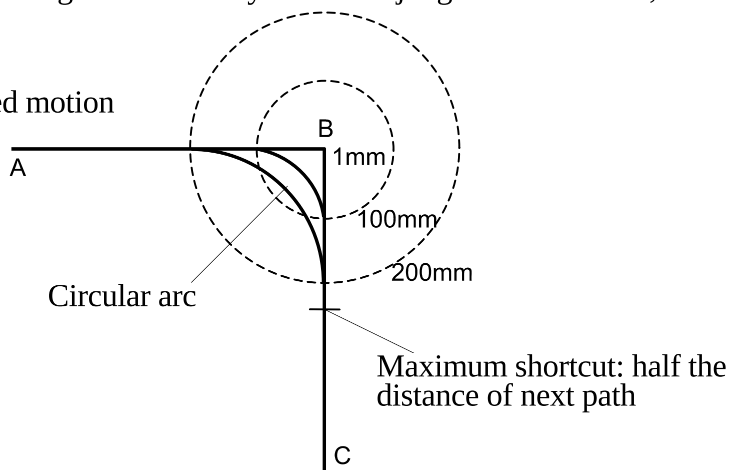
2) Accuracy in linear and circular interpolated motion

The motion trajectory of the robot corresponding to the set accuracy value is as shown in the figure below.　In this example the accuracy values at point B are 1 mm, 100 mm, and 200 mm.　The robot starts turning at the point where it enters the range of the set accuracy value.　The robot follows a circular trajectory within the circle of the set accuracy value.　If setting an accuracy value that is larger than half the distance of the next path, the robot starts to shortcut when the remaining distance of the current path becomes half the distance of the next path from B to C.　The accuracy value can be effectively set up to the value equal to half the distance of the second path.

By shortcutting, the cycle time can be shortened.　However, when the following conditions are set, the processing of the ACCURACY instruction will be the same as in Motion type 1.

- When a waiting instruction (TWAIT, SWAIT, etc.) is executed at point B
- When a workpiece/tool is changed at point B
- When the interpolation mode for the next point is changed to joint interpolation
- When the motion mode is changed at taught taught point (ordinary mode ↔ motion based on the fixed tool coordinates)
- When the processing is branched by condition judgment such as IF, etc.

Linear Interpolated motion



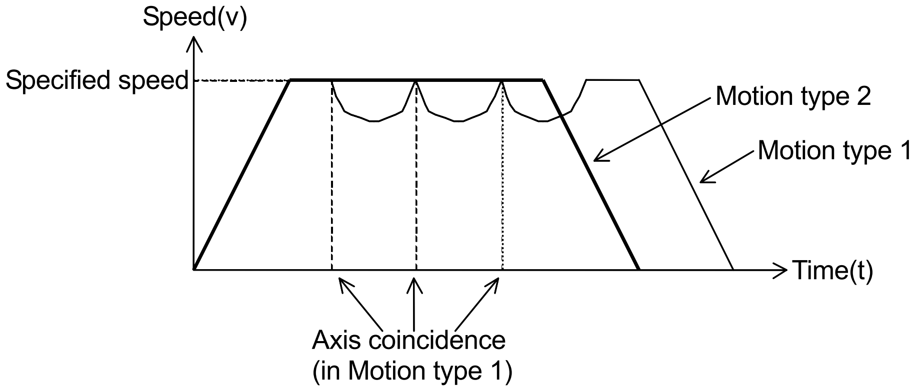
(2) Speed characteristics

1) Speed in joint interpolated motion

The same as in Motion type 1

2) Speed in linear and circular interpolated motion

In Motion type 2, if the accuracy value is set larger and the configuration of the robot does not change between two defined poses, the specified speed is attained even if the distance between the two poses is small.



However, when the following conditions are set, the speed characteristics will be the same as in Motion type 1:

· When a waiting instruction (TWAIT, SWAIT, etc.) is executed at taught point
· When a workpiece/tool is changed at taught point
· When the interpolation mode for the next point is changed to joint interpolation
· When the motion mode is changed at taught point from ordinary mode (workpiece is fixed and tool moves) to fixed tool dimensions

[NOTE]

When attempting to execute a program where the robot orientation changes greatly within a short distance, the time it takes to change the orientation will exceed the time it takes to move that distance at the specified speed. In this case, the joint movements are given priority, thus the linear motion will not reach the specified speed.

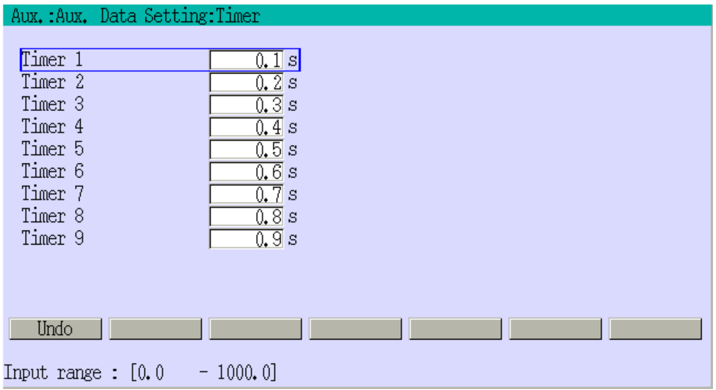
3. Speed in circular interpolation

In Motion type 2 the maximum speed is automatically set according to the robot's capacity to carry out proper circular interpolated motion.

In Motion type 2, the robot follows a circular trajectory within the circle of the set accuracy value. The maximum speed of this trajectory is also set by the robot's capacity.

AUX. 0303 TIMER

This function sets the actual waiting time in auxiliary data [Timer 1] – [Timer 9], for TIMER instructions in block teaching.



Input waiting time for each timer. If the setting is correct, press ↵.

AUX. 0304 TOOL COORDINATES

This function records data specific to auxiliary data [Tool 1] - [Tool 9], for TOOL instructions in block teaching.

The set data includes:
1. X, Y, Z coordinate values of the tool coordinates origin measured, based on the wrist flange coordinates (null tool coordinates), and rotation amount of tool coordinates, 2. Mass of tool, center of gravity, moment of inertia, and 3. Tool shape.

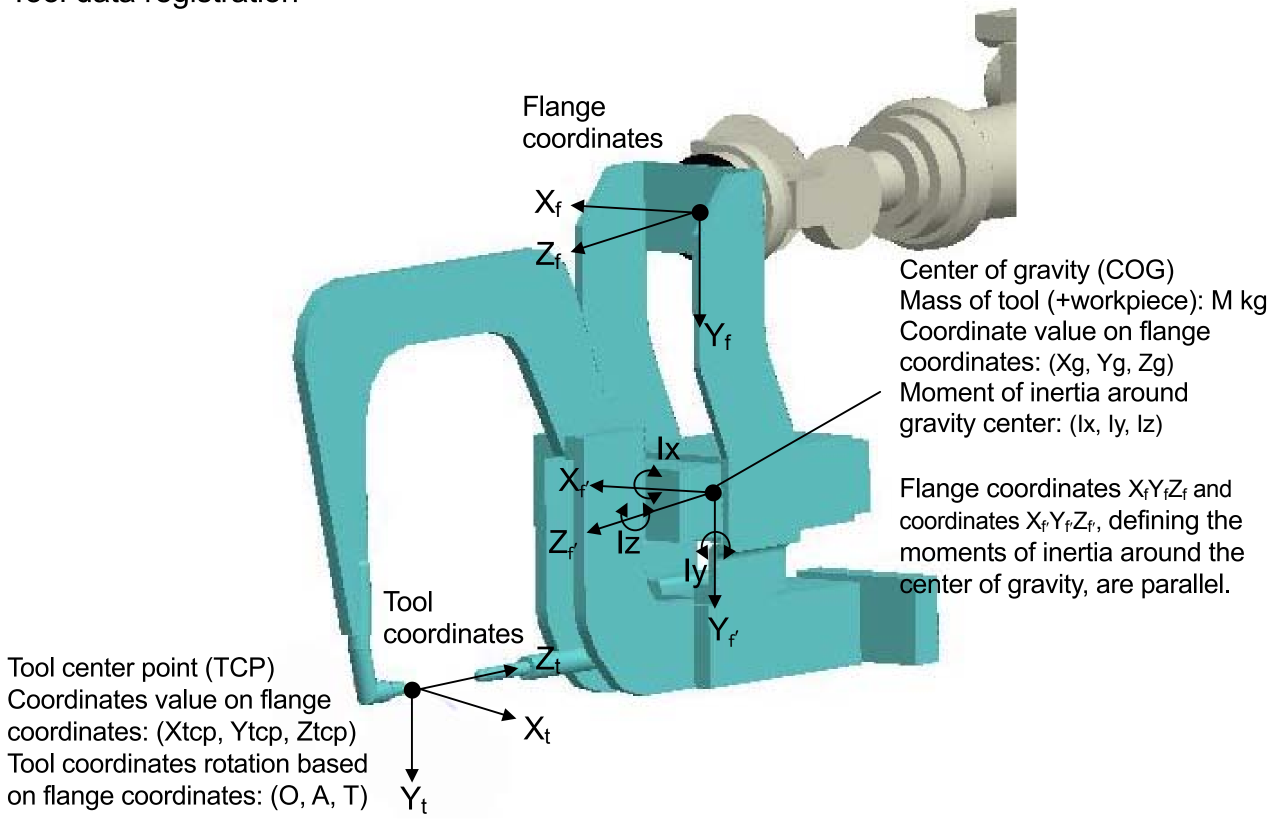
1. Defines a reference point for positioning/trajectory control, and the moving direction of the tool based on the tool coordinates.

2. Used for controlling motion through a variety of functions – acceleration/deceleration control, vibration control, collision detection, etc.

3. Used for controlling teach/check speed based on the position of the edge point of the tool. This function is effective when the edge points of the tool are farther than the TCP from the flange surface, or when considering the tool shape including the workpiece on the tool end.

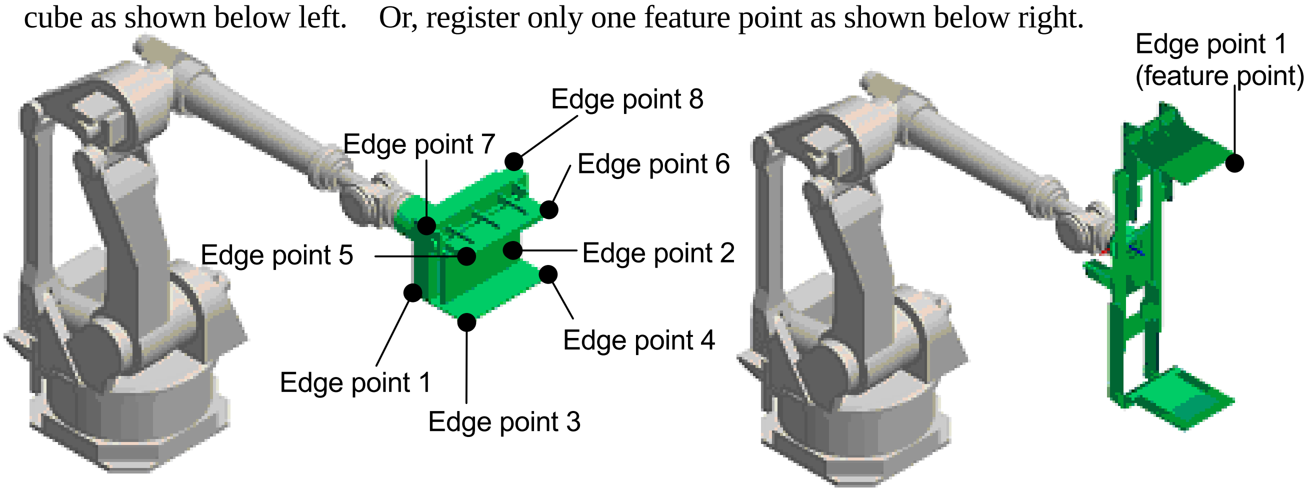
To take full advantage of robot performance, these data must be set properly.

Tool data registration



Tool shape setting

Approximate the shape of the tool as a cube, etc., and register the edge points (max. 8 points) of the cube as shown below left. Or, register only one feature point as shown below right.



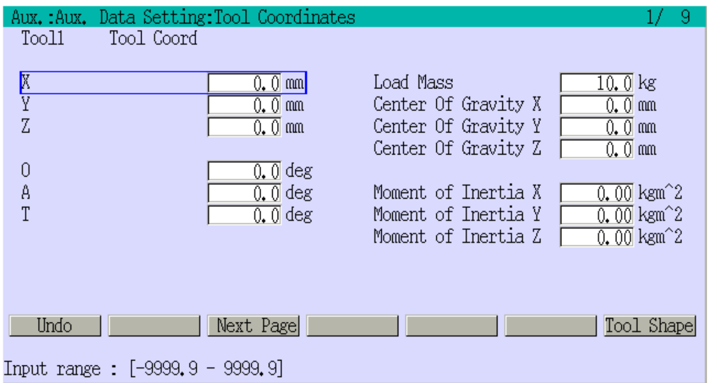
CAUTION

Be sure to register the correct mass, center of gravity and moment of inertia. Registering the wrong values may decrease the life service of component parts, cause motor overload or deviation errors.

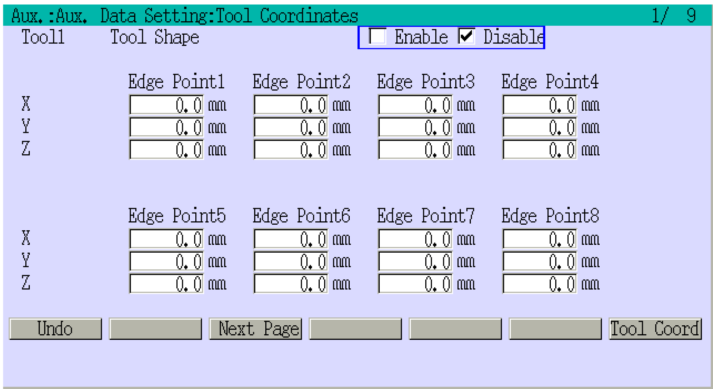
[NOTE]

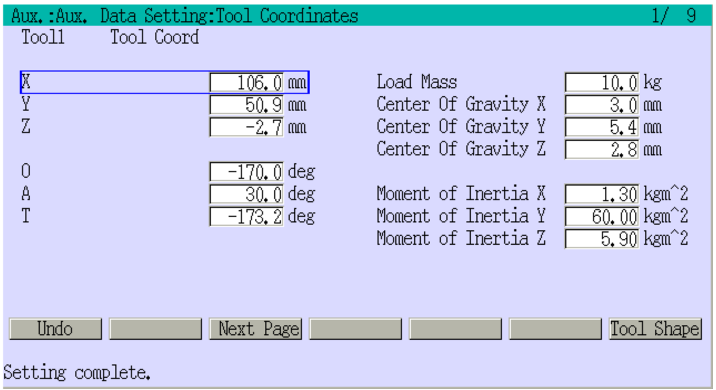
1. Data defining the load mass, position of center of gravity and moments of inertia about the center of gravity are used in robot motion controls for vibration suppression, acceleration/deceleration and collision detection. Setting values for these data, even approximately, is important for optimizing robot performance.
2. Approximate values for load mass and position of center of gravity can be obtained by Aux. 0406.
3. If load mass is set to 0, calculations assume robot carries its rated load (both mass and torque).
4. If all center of gravity positions (Xg, Yg, Zg) are set to 0, calculations assume robot carries its rated load (both mass and torque).
5. If all moments of inertia (Ix, Iy, Iz) around center of gravity are set to 0, robot operates at the max. allowed load of moment of inertia noted in specification sheet.
6. For safety, set 0 for the moments of inertia if Ix, Iy, Iz are unknown. In this case, acceleration/deceleration is controlled at the max. allowed load of moment of inertia.
7. If load at end of robot arm is small enough to be considered a point mass, register a small value for the moments of inertia, approx. 0.01. If setting 0, robot operates at the max. allowed load of moments of inertia noted in specifications, and acceleration/ deceleration is constrained. In this case, setting a small value enables cycle time to be shortened.

For more details about load condition registration, refer to Chapter 11.



1. Input data for each item. When using several tools, press <Next Page> to move to the next page and input the tool data.





2. Press <Tool Shape> in previous screen to display screen at left. Set [Tool Shape] to [Enable] to control teach/check speed based on edge point(s) of the tool. Then, input the position data of the edge points (max. 8 points). When using several tools, press <Next Page> to move to next page and input the tool data. Pressing <Tool Coord> displays Tool Coordinates screen.

3. After inputting all the data, press ↵. Values are stored when “Setting complete.” is displayed. (Press ↵ to set data in Tool Coordinates screen or Tool Shapes screen.)

X/Y/Z

XYZ coordinate values (Xtcp, Ytcp, Ztcp) of the tool coordinates origin viewed from the flange coordinates.

O rotation

Rotation amount of tool coordinates (around Z axis) (O).

A rotation

Rotation amount of tool coordinates (around Y axis after the above rotation) (A).

T rotation

Rotation amount of tool coordinates (around Z axis after the above rotation) (T).

Load Mass

Mass of tool to be mounted, including mass of workpiece grasped in handling applications.

Center Of Gravity X/Y/Z

XYZ coordinate values (Xg, Yg, Zg) of COG of the tool viewed from the flange coordinates.

Moment of Inertia about X/Y/Z axis

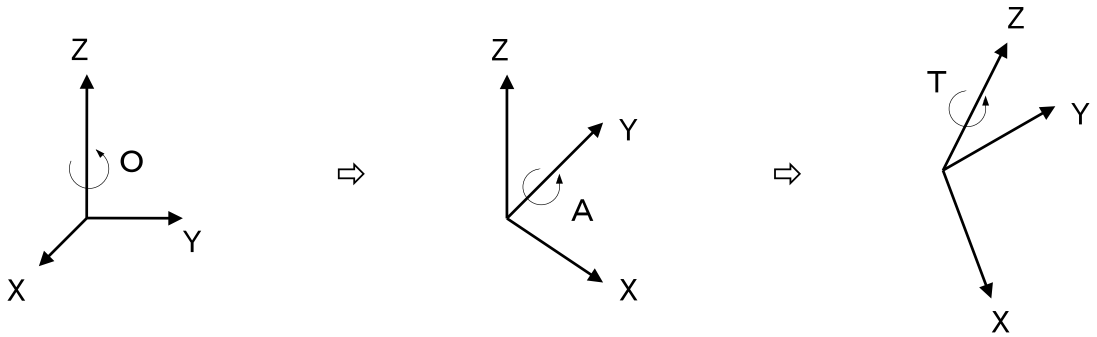
Moment of inertia values (Ix, Iy, Iz) around center of gravity $X_{f'}/Y_{f'}/Z_{f'}$ axis.

Tool Shape Enable/Disable

To control teach/check speed based on the edge points of the tool, set [Tool Shape] to [Enable] after setting data for Tool Shape.　Set at least one edge point to use this function.　Otherwise, error “E1356 The tool shape is not set.” occurs.

X/Y/Z Edge Point 1 - 8

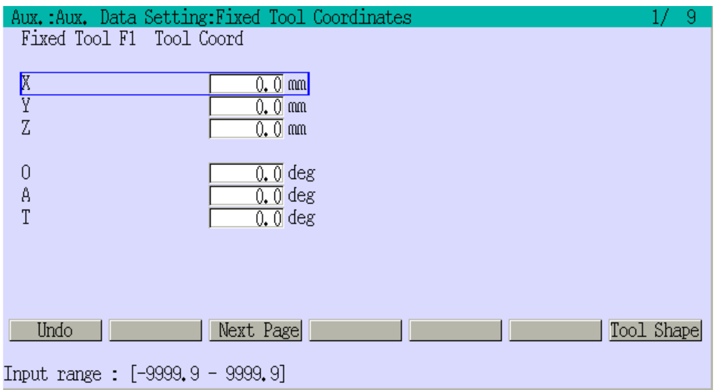
XYZ coordinate values of the edge point of the tool viewed from the flange coordinates.



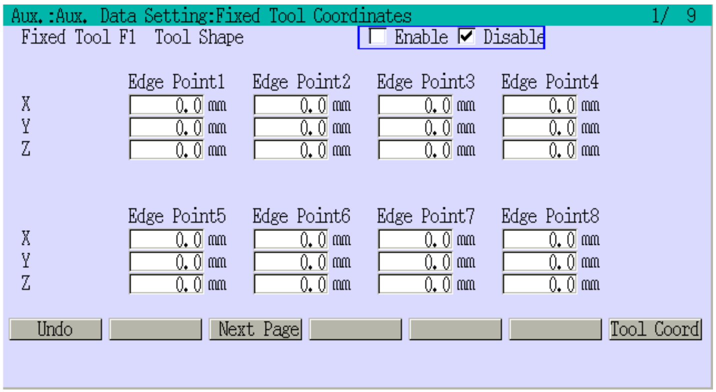
AUX. 0305 FIXED TOOL COORDINATES (OPTION)

This function specifies transformation values of the fixed tool coordinates when the tool is not mounted at robot wrist but is fixed in space and the robot holds the workpiece and moves based on the fixed tool.　Up to nine fixed tool coordinates can be set.

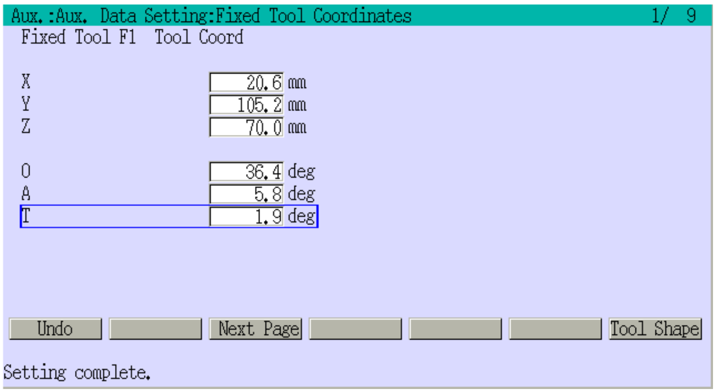
Fixed tool coordinates are set by transformation values that express the pose of the fixed tool coordinates viewed from the base coordinate system.



1. Move cursor to each item and input data.　When using several tools, press <Next Page> to move to the next page and input the tool data.



2. Pressing <Tool Shape> displays the left screen.　For details on setting Tool Shape, refer to Aux. 0304.



3. Press ↵ after inputting all the fixed tool data.　Values are stored when “Setting complete.” is displayed.

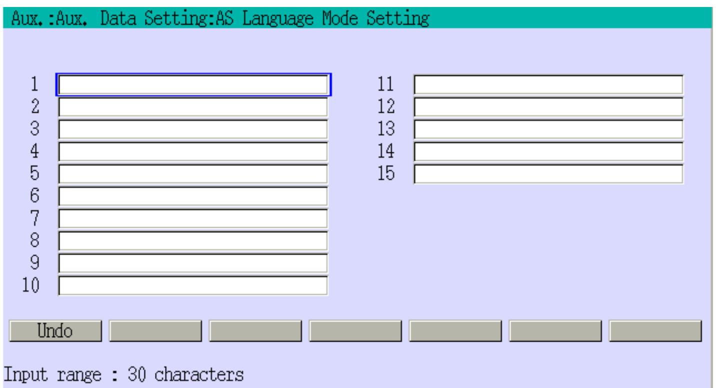
[NOTE]

1. The setting covers 9 pages.　All data in these pages are recorded together.
2. If only X, Y, and Z values are set and 0 is set for O, A, and T, the fixed tool coordinates will have the same orientation and face in the same direction as the base coordinates.

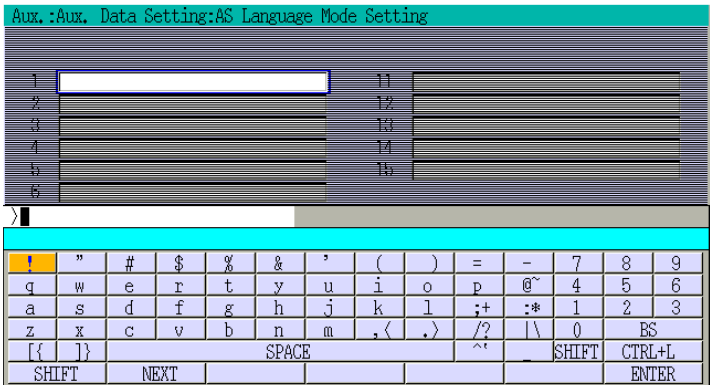
For more details, refer to the optional manual “Motion Based on Fixed Tool Manual”, a separate volume.

AUX. 0307 AS LANGUAGE MODE SETTING

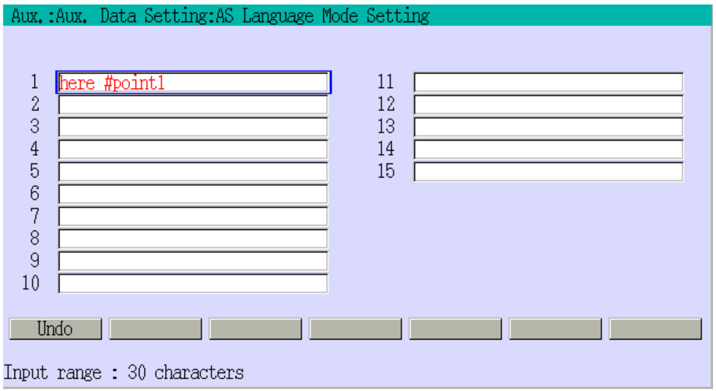
Frequently-used AS instructions or statements can be registered by this function.　Max. 15 of AS language items can be registered.



1. Move cursor to [1] and press ↵.



2. On the keyboard screen, input the desired AS instructions and press <ENTER>.



3. Check the entry as shown on the screen in step 1. If the setting is correct, press ↵.

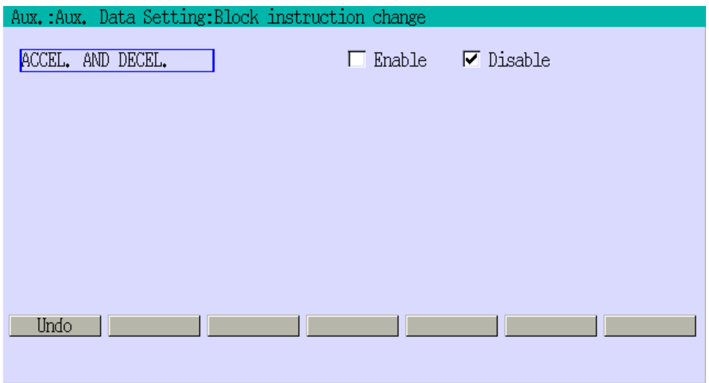
4. Repeat steps 1 to 3.

[NOTE]

1. Instructions are registered from No.1 in entry order.
2. To move the registered instruction into other number box, select the desired number box and input again by following the procedures above. Drag and drop functions, etc. are not available.

AUX. 0399 BLOCK INSTRUCTION CHANGE

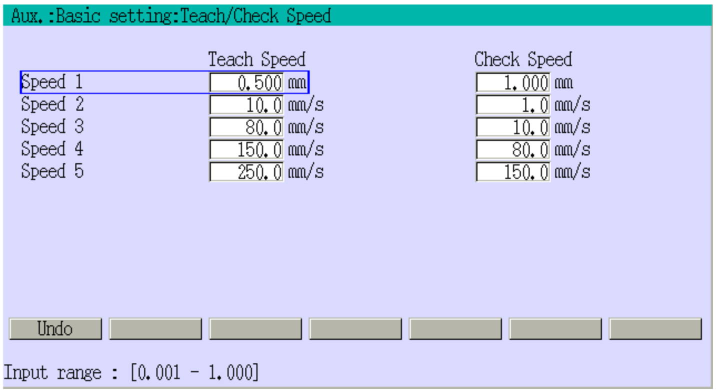
This function sets whether the acceleration/deceleration instruction is included in the compound instructions used in block teaching. Setting [ACCEL. AND DECEL.] to [Enable] makes the robot accelerate/decelerate at the values set to each block teaching speed (0 - 9) in Aux. 0301. Setting [Disable] enables the acceleration/deceleration to be controlled by AS instructions of ACCEL and DECEL. This function is also disabled when specifying the speeds directly.



Select either [Enable] or [Disable] for [ACCEL. AND DECEL.] by A + ←/→. If the setting is correct, press ↵. Selection is stored when "Setting complete." is displayed.

AUX. 0401 TEACH/CHECK SPEED

This function sets the speeds corresponding to the speed levels [Speed 1] to [Speed 5] for teach/check motion.　[Speed 1] sets the inching increment.

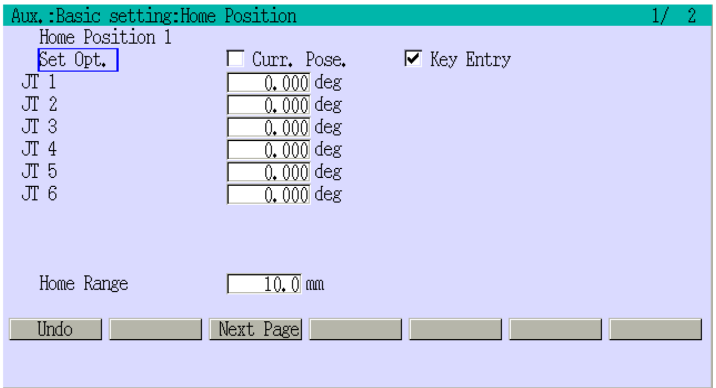


Move cursor to each item and input data.　If the setting is correct, press ↵.　Values are stored when “Setting complete.” is displayed.

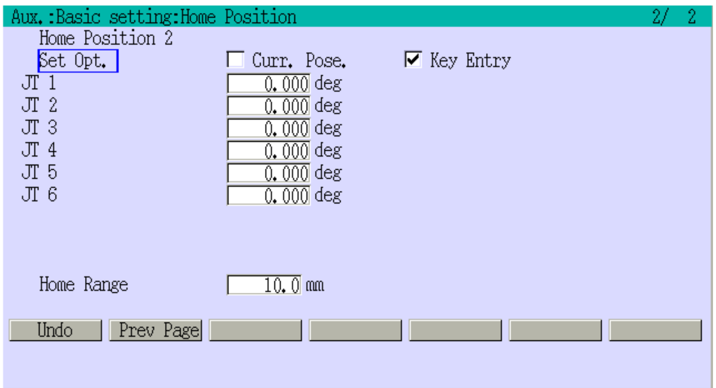
AUX. 0402 HOME POSITION (EQUIV. TO SETHOME, SET2HOME IN AS LANGUAGE)

This function sets two home poses (Home Position 1 and 2) for robot operation.　These poses are useful when:

1. Returning the robot to a pre-set home pose, using HOME instruction of AS language.
2. Externally outputting a signal to indicate that the robot has reached the set home pose.



1. Move cursor to each [JT] and input the Home Position 1 data. To store the current pose as the home pose, press ↵.



2. To set Home Position 2, press <Next Page> and input data.　If setting is correct, press ↵.

[NOTE]

> Home Range should be set between 5 mm and 10 mm to ensure that the home pose output signal is generated.

Curr. Pose.

Sets (records) the current robot pose as the home pose.

Key Entry

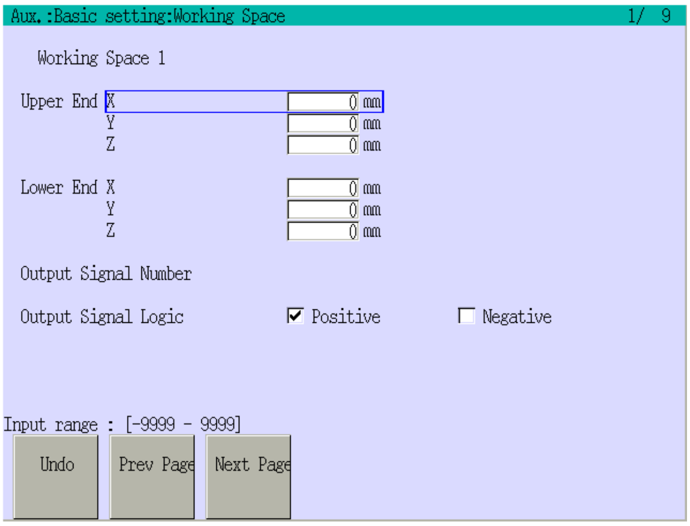
Set the home pose by entering numeric values for each axis.

Home Range

A home pose signal is output when the robot stays within the range of a circle whose center is Home Position 1(2) and radius is Home Range.

AUX. 0403 WORKING SPACE

The working space of the robot is parallel to the base coordinates and defined by setting upper and lower corner positions located diagonally from each other in a rectangular solid. Nine working spaces (1-9) can be set. Set the X, Y, Z values of the tool coordinates origin (TCP) based on the robot base coordinates.



Move cursor to each item and input the Working Space 1 data. For defining several working spaces, press <Next Page> to move to the next page and input the working space data. If the setting is correct, press ↵. Settings and Values are stored when “Setting complete.” is displayed.

Positive

Signal turns ON when robot enters the working space and turns OFF when robot departs the working space.

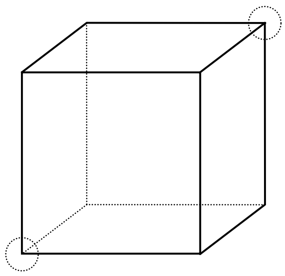
Negative

Signal turns OFF when the robot enters the working space and turns ON when the robot departs the working space.

[NOTE]

1. The setting covers 9 pages.　All the data in these pages are recorded together.
2. [Output Signal Number] is displayed on this screen, but its setting must be made in Aux. 0602.　When the signal is not dedicated, 0 appears in the signal number column.
3. Whether or not the TCP is in the working space is determined based on the command values of the robot.

Upper corner position

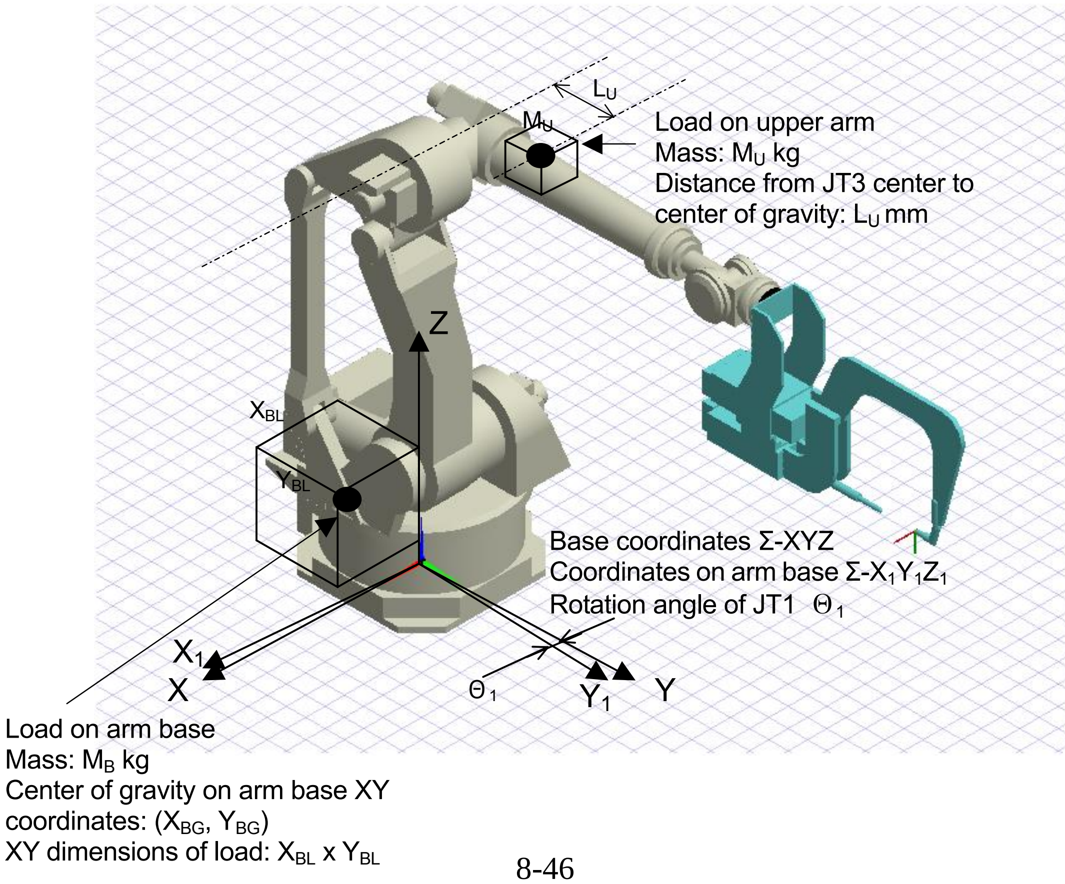


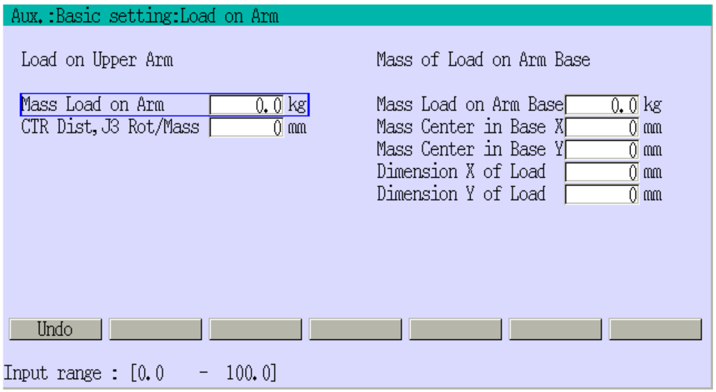
Using AXIS on teach pendant, move the TCP to the upper and lower corner positions, then set XYZ data of the transformation values.

Lower corner position

AUX. 0404 LOAD ON ARM

This function sets the load on the upper arm or on the arm base of the robot to optimally adjust acceleration/deceleration, vibration characteristics, etc.





Move cursor to each item and input data. If the setting is correct, press ↵.

Mass Load on Arm

Load mass on robot upper arm (M_U)

CTR Dist, JT3 Rot/Mass

Distance from rotation center of JT3 to load mass gravity center on upper arm (L_U)

Mass of Load on Arm Base

Weight of load on arm base (M_B)

Mass Center in Base X/Y

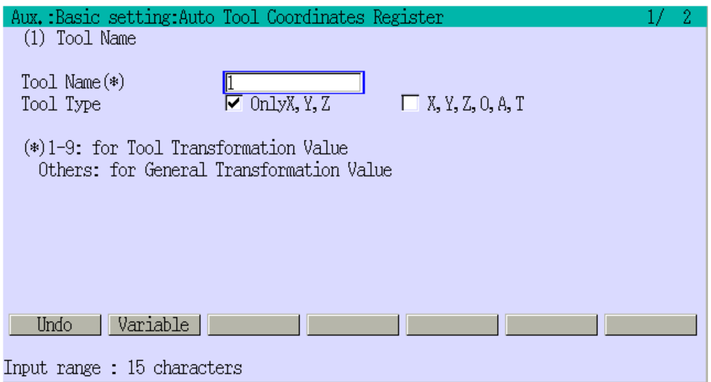
X/Y value of load mass center on the arm base coordinates (X_{BG}, Y_{BG})

Dimension X/Y of Load

X/Y dimension (length) of the load installed on arm base ($X_{BL} \times Y_{BL}$)

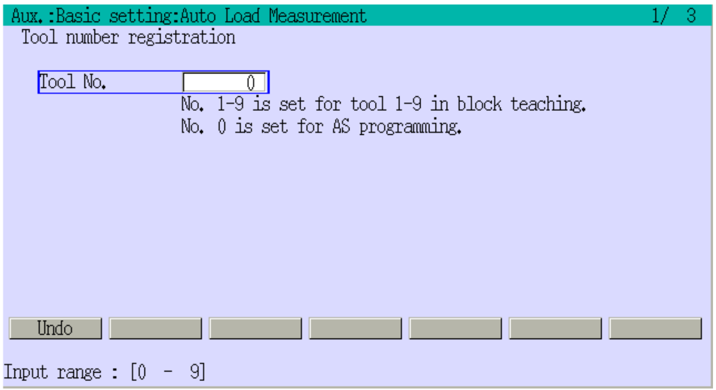
AUX. 0405 AUTO TOOL COORDINATES REGISTER

This function calculates the tool coordinates data and automatically registers its data based on 4 taught poses of the robot that meet the given conditions. Tool must be attached to the robot arm before registration. Set tool number and what kind of data to be calculated for that tool. For more details, refer to Chapter 10.



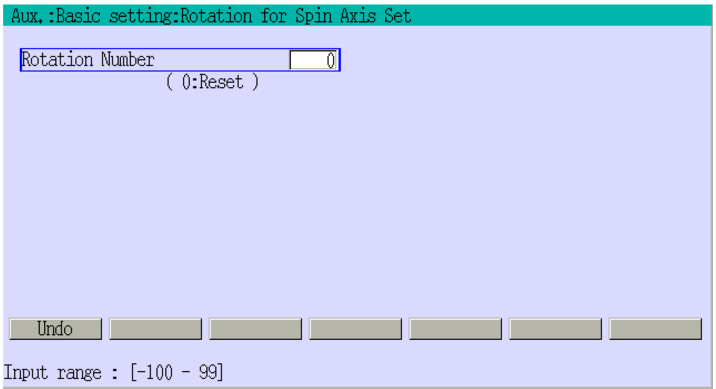
AUX. 0406 AUTO LOAD MEASUREMENT

This function calculates the load mass and center of gravity for the tool.　Calculation is based on results obtained after the program for load measurement is executed with the tool mounted at end of robot.　For more details, refer to Chapter 12.



AUX. 0407 ROTATION FOR SPIN AXIS SET (OPTION)

This function changes the number of rotations for JT6 in memory from the current value to the value set within the input range, without moving JT6.　This is available in robots installed with spin control function where the motion range of JT6 is not limited.

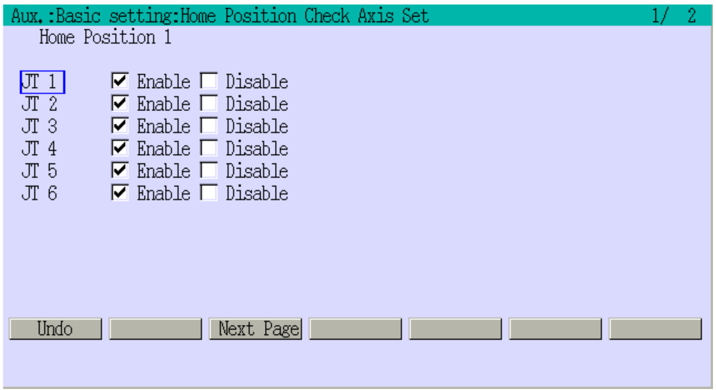


Input data in [Rotation Number].　If the setting is correct, press ↵. Value is stored when “Setting complete.” is displayed.

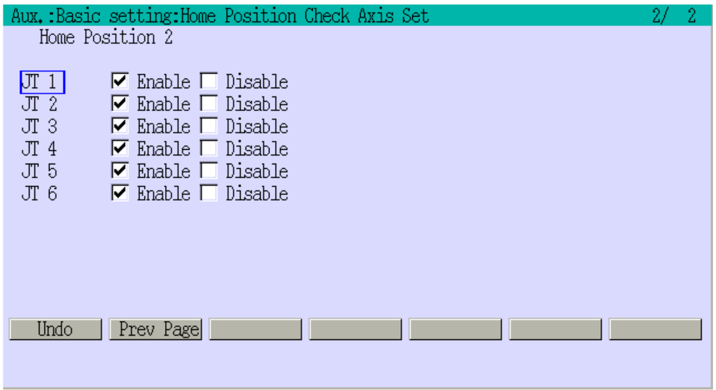
For more details, refer to the optional manual “Spin Control Function Manual”, a separate volume.

AUX. 0409 HOME POSITION CHECK AXIS SET

This function sets whether or not to check if axis stays within the Home Range for each axis registered in Aux. 0402.　Set [Enable] or [Disable] for each axis.　Setting [Enable] executes the check on that axis.　For details regarding Home Range, refer to Aux. 0402.



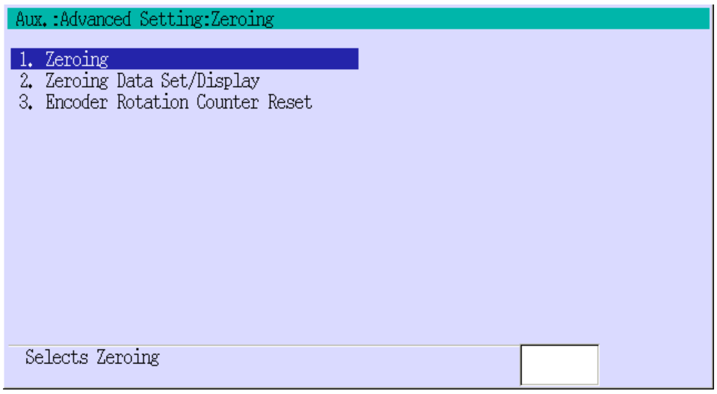
1. Select [Enable] or [Disable] by A + ←/→.　If the setting is correct, press ↵.



2. Press <Next page> to use Home Position 2, input the data for Home Position 2.　If the setting is correct, press ↵.　Settings are stored when “Setting complete.” is displayed.

AUX. 0501 ZEROING

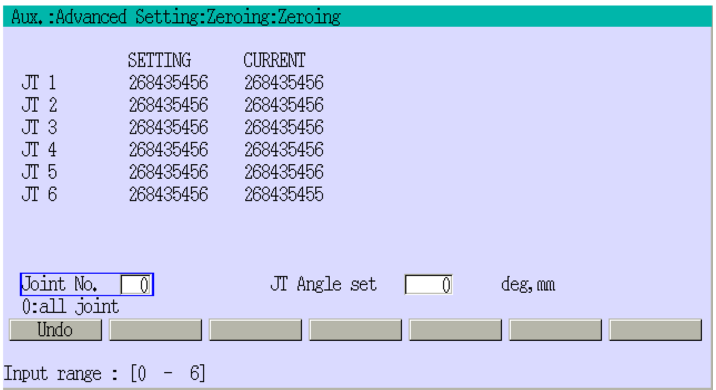
Zeroing registers the encoder value at the zero displacement position (reference zero position, typically when axis scribe marks align = 0 °/0 mm).　Joints can also be zeroed even if unaligned with their scribe marks by specifying [JT Angle set].　However, the values in [SETTING] stored in the controller will be used as the encoder values that correspond to the zero displacement position.　To zero, it is necessary to consider the number of encoder rotations (see Aux. 050103) and the position angle within one rotation (see Aux. 050102).



WARNING

Avoid using this function in normal operations. Zeroing is a maintenance function for fixing the mechanical origin of an axis whenever its motor is replaced. Only Kawasaki service staff or those who have completed the Kawasaki maintenance course can perform zeroing.

AUX. 050101 ZEROING



To perform zeroing to all joints, inputting 0 to [Joint No.] and pressing ↵ registers the current encoder value as the set value. To perform zeroing to a specified joint, move the axis to the set position first, and then input the joint number to [Joint No.] and the zeroing angle to [JT Angle set].

[NOTE]

1. After replacing encoders or motors, do not fail to reset the rotation counter for the encoder using function Aux. 050103, and then move robot in the joint mode.
2. After step 1, set the axes to their zero scribe marks and reset the rotation counter again.
3. Before replacing the main CPU board, note the zeroing and offset values currently set in Aux. 050102. After replacement, input these values and check whether zeroing pose is correct.

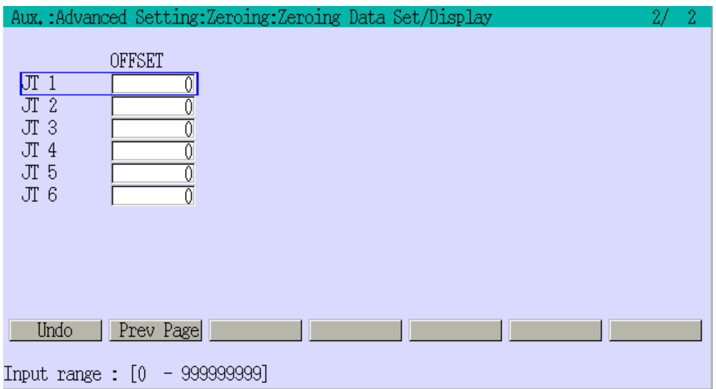
AUX. 050102 ZEROING DATA SET/ DISPLAY

This function displays current setting values. Inputting setting values for each joint directly is also possible on this screen.

WARNING

Avoid using this function in normal operation. Because this function is for the maintenance purpose of fixing the mechanical origin of each axis, perform this function only in the cases below:
1. To verify if the zeroing data has changed when the robot arm position is not proper.
2. To enter the correct value if changed.
Use caution when changing the setting values in ZEROING DATA SET as the values for the current detected robot position also change. Accordingly, any changes will alter the robot movement points and trajectory when playing back a program in repeat mode.

1. Move cursor to [JT1] – [JT6] and input the data.



2. Pressing <Next Page> displays OFFSET input screen as shown on the left. Avoid making any changes in this screen. If the setting is correct, press ↵. Values are stored when “Setting complete.” is displayed.

[NOTE]

1. After replacing encoders or motors, do not fail to reset the rotation counter for the encoder using function Aux. 050103, and then move robot in the joint mode.
2. After step 1, set the axes to their zero scribe marks and reset the rotation counter again.
3. Before replacing the main CPU board, note the zeroing and offset values currently set in Aux. 050102. After replacement, input these values and check whether zeroing pose is correct.

AUX. 050103 ENCODER ROTATION COUNTER RESET

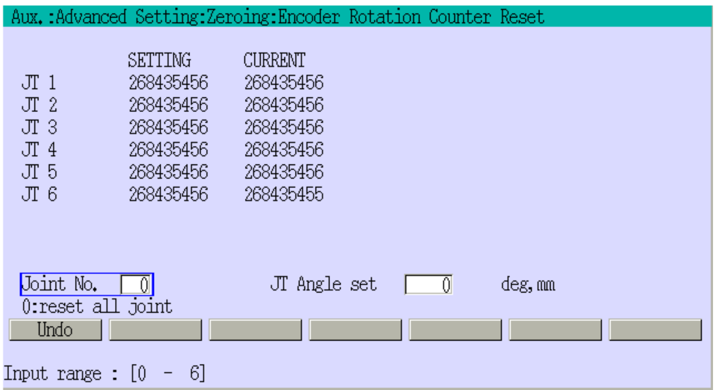
This function resets the counters used for storing the encoder rotation amount.

WARNING

This function calibrates the robot's mechanical origin with the encoder origin. An encoder is coupled to each axis and recalibration is required when the encoder or any related parts are replaced (main CPU board). If this function is not set properly, the origins will not match and the programmed positions may deviate. Therefore, qualify only persons who have completed Kawasaki's maintenance course to operate this function.

[NOTE]

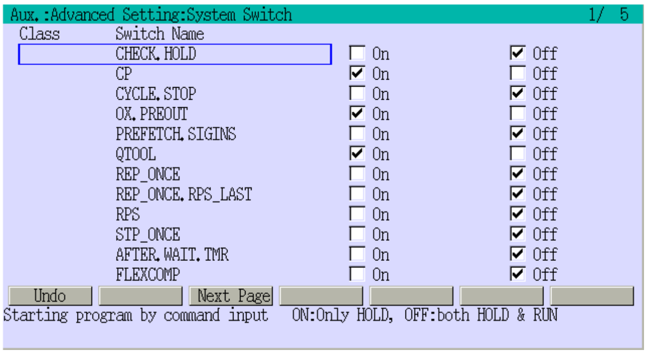
1. After replacing encoders or motors, do not fail to reset the rotation counter for the encoder using function Aux. 050103, and then move robot in the joint mode.
2. After step 1, set the axes to their zero scribe marks and reset the rotation counter again.
3. Before replacing the main CPU board, note the zeroing and offset values currently set in Aux. 050102. After replacement, input these values and check whether zeroing pose is correct.

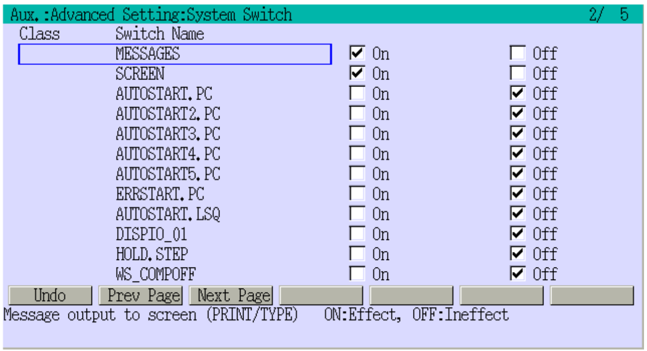


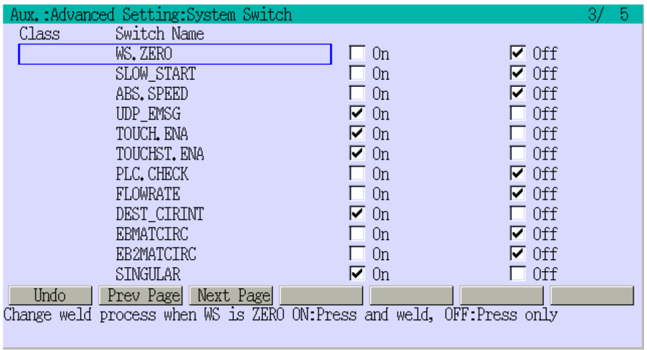
To reset rotation counters for all joints, input 0 to [Joint No.] and zeroing angle value to [JT Angle set], and press ↵. (Offset value on reset is displayed in Aux. 050102.) To reset rotation counter of a specified joint, input the joint number to [Joint No.] and register the zeroing angle value.

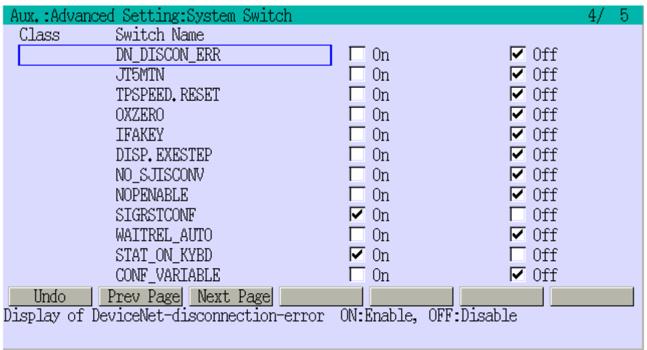
AUX. 0502 SYSTEM SWITCH (EQUIV. TO SWITCH INSTRUCTION OF AS LANGUAGE)

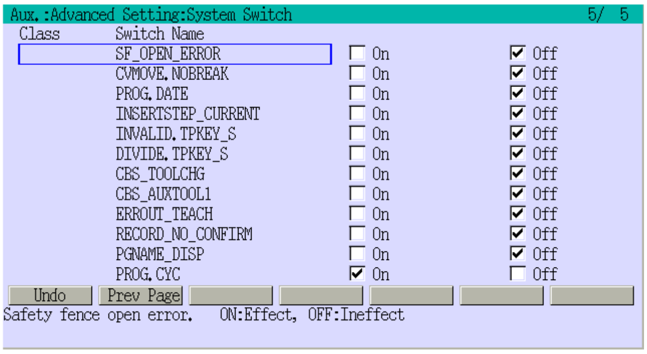
This function defines ON/OFF or effective/ineffective for system switches which set fundamental system specifications. The system switches that are available vary depending on application or software version. The following screens show typical system switches.











The system switches set to ON or effective appear with a "✓". To change status, move cursor to the desired switch and select ON/OFF by A + ←/→. If the setting is correct, press ↵. Moving cursor to a switch displays an explanation for that switch at the bottom of the screen.

CHECK.HOLD	ON	Starting program is acceptable only in HOLD condition.
	OFF	Starting program is acceptable in RUN condition, too.
CP	ON	Enables continuous path control operation.
	OFF	Disables continuous path control operation.
CYCLE.STOP	ON	Enables cycle stop by input of external hold signal. (<CYCLE> lamp turns OFF).
	OFF	Disables cycle stop by input of external hold signal. (system becomes hold state only.)
OX.PREOUT	ON	Sets the OX signal taught for a point in block teaching to be output immediately after a step change (memory change) to the taught point.
	OFF	Sets the OX signal taught for a point in block teaching to be output after reaching the taught point.
PREFETCH. SIGINS	ON	Enables execution of signal input/output instructions before a point is reached when using AS language instructions.
	OFF	Disables execution of signal input/output instructions before a point is reached when using AS language instructions.
QTOOL	ON	Updates tool coodinates data automatically based on auxiliary data registered to the tool number in block teaching.
	OFF	Performs transformation only at these times: when TOOL command or TOOL instruction are executed, or when the compound instruction is executed in block teaching programs.
REP__ONCE	ON	Repeats a program once.
	OFF	Repeats a program continuously.

REP_ONCE.RPS_ LAST	ON	Ends program execution at the step where END instruction is taught when repeat condition is set to once.
	OFF	Ends program execution at the first step of the following program after executing the step where END instruction is taught when repeat condition is set to once.
RPS	ON	Executes external program selection automatically to switch to the specified program when a JUMP/END or EXTCALL instruction is executed in block teaching.
	OFF	External program selection cannot be executed.
STP__ONCE	ON	Executes steps one by one.
	OFF	Executes steps continuously.
AFTER.WAIT. TMR	ON	Activates the taught timer countdown in block teaching when axis coincidence completes and after all other waiting conditions, such as WX, WAIT, and RPS_ON, are satisfied.
	OFF	Activates the taught timer countdown in block teaching as soon as axis coincidence completes.
FLEXCOMP	ON	Enables deflection compensation option.
	OFF	Disables deflection compensation option.
MESSAGES	ON	Enables on-screen display of the information from PRINT and TYPE instructions.
	OFF	Disables on-screen display of the information from PRINT and TYPE instructions.
SCREEN	ON	Enables scrolling through screens 1 page at a time when using LIST command.
	OFF	Screens are displayed continuously when using LIST command.
AUTOSTART.PC	ON	Executes a PC program automatically when turning controller power ON.
	OFF	Does not execute a PC program automatically when turning the controller power ON.
AUTOSTART2.PC AUTOSTART3.PC AUTOSTART4.PC AUTOSTART5.PC	ON	Executes PC program 2 (3, 4, 5) automatically when turning the controller power ON.
	OFF	Does not execute PC program 2 (3, 4, 5) automatically when turning the controller power ON.
ERRSTART.PC	ON	Executes a program automatically when errors occur.
	OFF	Does not execute a program when errors occur.

AUTOSTART.LSQ	ON	Executes KLOGIC automatically when turning the controller power ON.
	OFF	Does not execute KLOGIC automatically when turning the controller power ON.
DISPIO_01	ON	Sets I/O command display for the signal status: 1 for ON, 0 for OFF.
	OFF	Sets I/O command display for the signal status: x for ON, o for OFF. Alphabetic lower case letters show general purpose signals and upper case letters, dedicated signals.
HOLD.STEP	ON	Displays the step currently being executed.
	OFF	Displays the last motion step executed.
WS__COMPOFF	ON	Outputs weld conditions (WS) signals from the time of step change until the weld completion signal is input.
	OFF	Outputs weld conditions (WS) signals from a step change to the next step change.
WS.ZERO	ON	Enables welding process even when WS=0 (pressurizing and welding processes).
	OFF	Disables welding process when WS=0 (pressurizing only).
SLOW__START	ON	Enables slow start function.
	OFF	Disables slow start function.
ABS. SPEED	ON	Specifies the speed by absolute speed.
	OFF	Specifies the speed by percentage.
UDP_EMSG	ON	Displays communication error when UDP communication instruction is executed.
	OFF	Disables displaying communication error when UDP communication instruction is executed.
TOUCH.ENA	ON	Enables setting repeat conditions with touch panel.
	OFF	Disables setting repeat conditions with touch panel.
TOUCHST.ENA	ON	Enables operation of <MOTOR>, <HOLD/RUN >, <CYCLE> on TP screen.
	OFF	Disables operation of <MOTOR>, <HOLD/RUN >, <CYCLE> on TP screen.
PLC. CHECK	ON	Enables PLC check.
	OFF	Disables PLC check.
FLOWRATE	ON	Enables flow rate control mode.
	OFF	Enables speed output mode.

DEST_CIRINT	ON	The position that the DEST function returns becomes the strat point of cornering motion in motion type 2.
	OFF	The position that the DEST function returns becomes the target point on the program.
EBMATCTRC	ON	Enables material circulation by pump1.
	OFF	Disables material circulation by pump1.
EB2MATCTRC	ON	Enables material circulation by pump2.
	OFF	Disables material circulation by pump2.
SINGULAR	ON	Enables function of singularity check function.
	OFF	Disables function of singularity check function.
DN_DISCON_ ERR	ON	Displays device net disconnection error.
	OFF	Does not display device net disconnection error.
JT5MTN	ON	Enables movement of 5th axis. Effective only for the robot keeping the constant wrist direction, such as MD seriese.
	OFF	Disables movement of 5th axis. Effective only for the robot keeping the constant wrist direction, such as MD seriese.
TPSPEED.RESET	ON	Enables automatic switching of slow teach/check speed.
	OFF	Disables automatic switching of slow teach/check speed.
OXZERO	ON	Enables collectively resetting OX (output signal).
	OFF	Disables collectively resetting OX (output signal).
IFAKEY	ON	Enables operating I/F panel while pressing A key.
	OFF	Enables operating I/F panel at all times.
DISP.EXESTEP	ON	Displays the step currently being executed.
	OFF	Displays the step where the robot is in motion.
NO_SJISCONV	ON	Does not convert character codes between SJIS and EUC when executing save/load.
	OFF	Converts character codes between SJIS and EUC when executing save/load.
NOPENABLE	ON	Enables NOP instruction.
	OFF	Disables NOP instruction.
SIGRSTCONF	ON	Resets the set signals if 0 is specified at the time of manual outputting of signals.
	OFF	Resets the set signals available for block teaching if 0 is specified at the time of manual outputting of signals.
WAITREL_AUTO	ON	Calls up the Wait Break (wait override) automatically.
	OFF	Does not call up the Wait Break (wait override) automatically.

STAT_ON_KYBD	ON	Displays status information on keyboard screen.
	OFF	Does not display status information on keyboard screen.
CONF_ VARIABLE	ON	Enables configuration change of the 5-axis robot in linear interpolation motion.
	OFF	Disables configuration change of the 5-axis robot in linear interpolation motion.
SF_OPEN_ERROR	ON	Error occurs when the safety fence is open.
	OFF	Error does not occur when the safety fence is open.
CVMOVE.NOBREAK	ON	Robot moves smoothly without BREAK movement when switching the mode between conveyor synchronization and non-synchronization.
	OFF	Robot moves with BREAK movement when switching the mode between conveyor synchronization and non-synchronization.
PROG.DATE	ON	Adds the edit date to program when saving data.
	OFF	Does not add the edit date to program when saving data.
INSERTSTEP_CURRENT	ON	After a step insertion, step number of the selected step before insertion is displayed on the TP.
	OFF	After a step insertion, step number of the newly inserted step is displayed on the TP.
INVALID.TPKEY_S	ON	Turns TPKEY_S switch OFF while A is pressed.
	OFF	Turns TPKEY_S switch ON while A is pressed.
DIVIDE.TPKEY_S	ON	Allocates the left A to TPKEY_S switch and the right A to TPKEY_A switch.
	OFF	Turns both of TPKEY_S and PKEY_A swicthes ON when either the right or the left A is pressed.
CBS_TOOLCHG	ON	Enables Cubic-S tool switching function.
	OFF	Disables Cubic-S tool switching function.
CBS_AUXTOOL1	ON	Set the data of tool no. 1 - 9 in Aux. 0304 as the data of tool no. 1 – 9 of Cubic-S.
	OFF	Set the data of tool no. 1 - 9 in Aux. 0304 as the data of tool no. 11 – 19 of Cubic-S.
ERROUT_TEACH	ON	Outputs the dedicated signal “External error output” in teach mode.
	OFF	Does not output the dedicated signal “External error output” in teach mode.

RECORD_NO_CONFIRM	ON	Does not display confirmation screen when editing steps, such as overwriting or modifying.
	OFF	Displays confirmation screen when editing steps, such as overwriting or modifying.
PGNAME_DISP	ON	Does not omit the program name (other than its number) to display on TP screen when the program has the name and the number such as “pg xx”.
	OFF	Displays only the program number on TP screen when the program has the name and the number such as “pg xx”.
PROG.CYC	ON	Adds the number of playing program to saving data.
	OFF	Does not add the number of playing program to saving data.

The names of system switches and the default settings vary depending on specification.
indicates default settings.

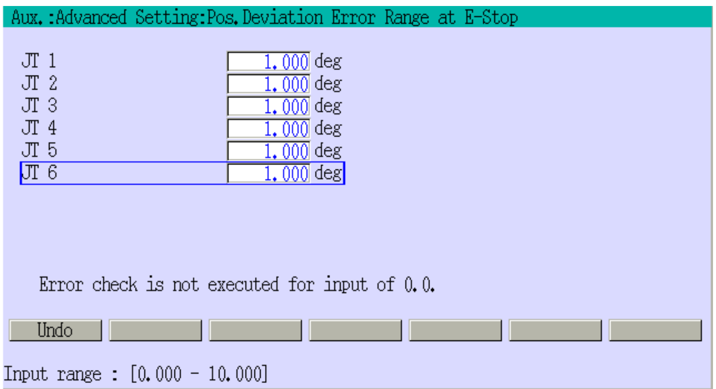
AUX. 0503 POS. DEVIATION ERROR RANGE AT E-STOP

This function sets an allowable position deviation range for each axis to check for position errors when motor power is reapplied after emergency stop.

Position deviation = | (current joint value at restart) – (joint value at the last E-stop) |

If 0.000 is entered, this error check is not performed. Take note that setting too small a value causes an error even under normal conditions when restarting after Emergency stop.

The purpose of this function is to prevent the robot from interfering with peripheral equipment (jigs, workpiece, etc.) when restarting after E-Stop.



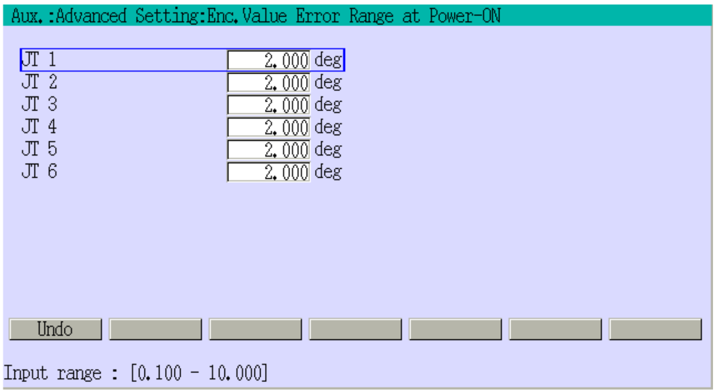
Move cursor to JT1 - JT6 and input the data. If the setting is correct, press ↵. Values are stored when “Setting complete.” is displayed.

AUX. 0504 ENCODER VALUE ERROR RANGE AT POWER-ON

This function sets an encoder value difference to be treated as a deviation error when encoder values at controller power ON and OFF are compared.

Encoder value difference = | (joint value when turning controller power ON) – (joint value when the last time controller power was turned OFF) |

Take notice that setting too small a value causes an error even in normal conditions when the system is operating within design performance specifications.

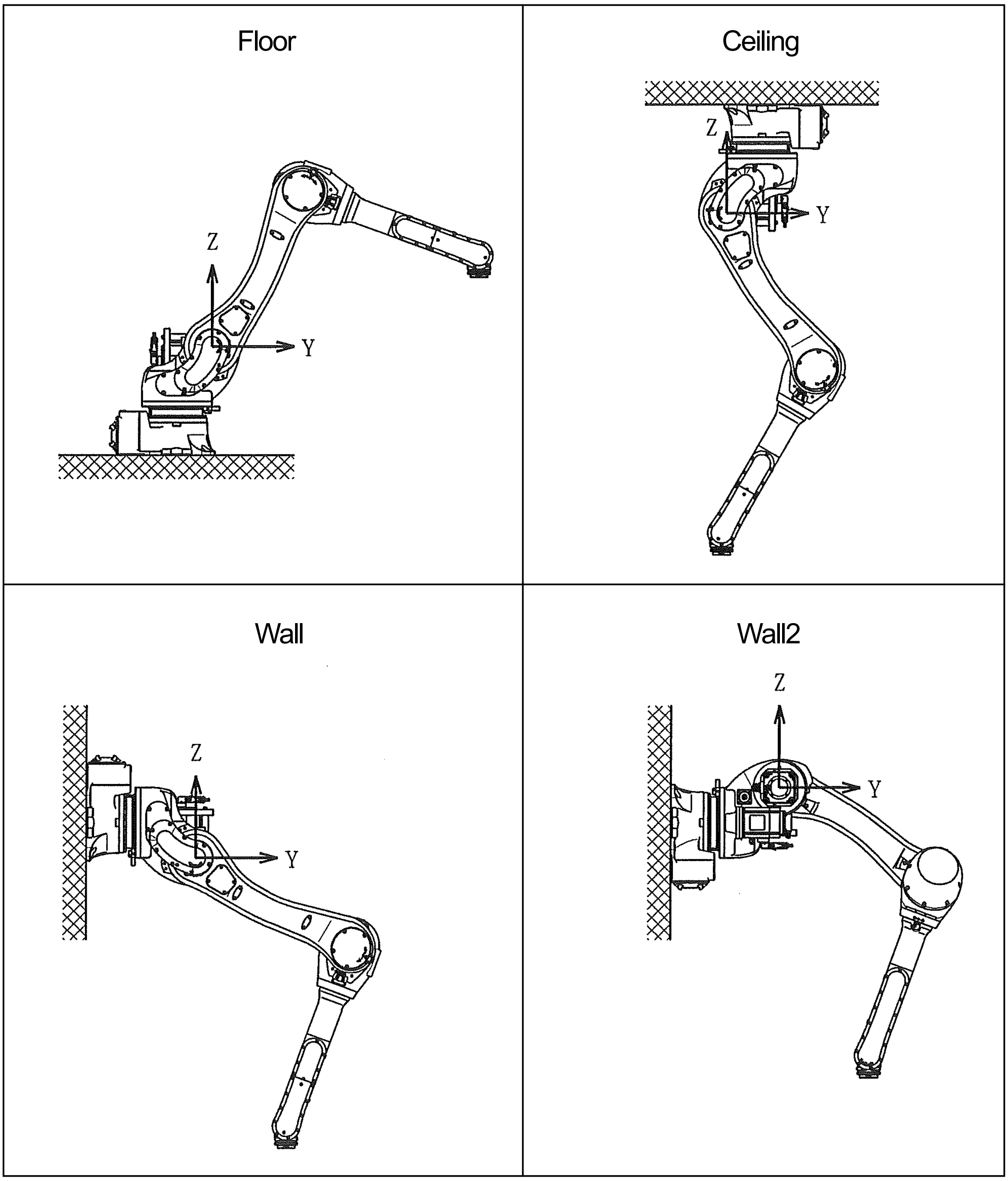


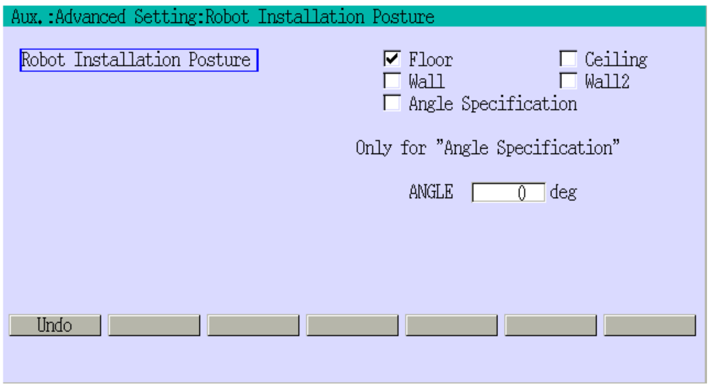
Move cursor to JT1 - JT6 and input the data. If the setting is correct, press ↵. Values are stored when "Setting complete." is displayed.

AUX. 0505 ROBOT INSTALLATION POSTURE

The +Z direction of the base coordinate motion can be set perpendicular upwards during teaching, once the actual installation posture is made to match the posture set in the controller.

The direction of robot's base coordinates is set as shown in the figure below. However, the value of the base coordinates must have O, A, and T set to 0 (zero) in Aux. 0506.

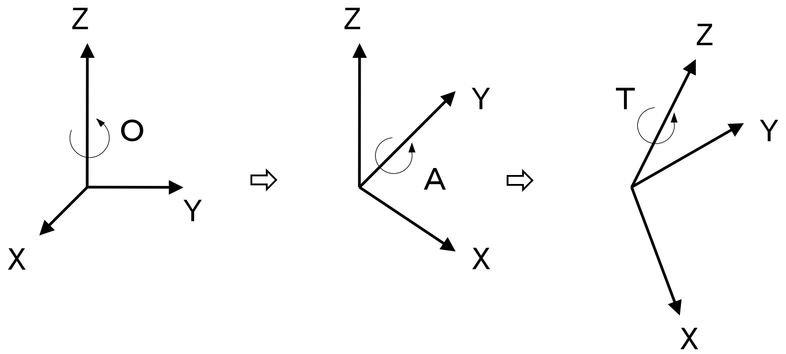


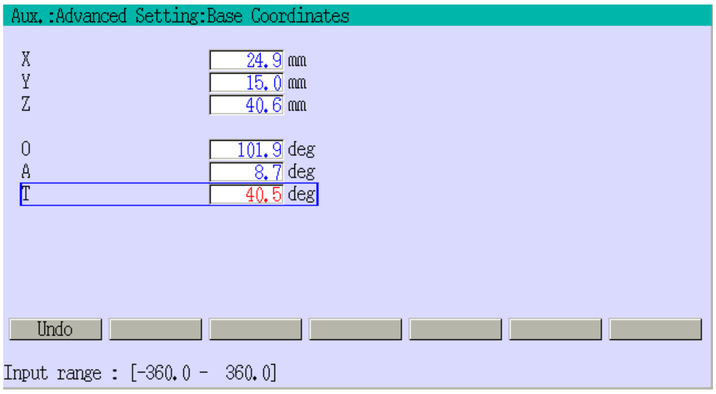


Select the desired setting posture by A + ←/→. Input an angle value to make an angle around X axis. If the setting is correct, press ↵. All settings are stored when “Setting complete.” is displayed.

AUX. 0506 BASE COORDINATES (EQUIV. TO BASE INSTRUCTION OF AS LANGUAGE)

Sets new base coordinates of the robot. Specify the pose of the new base coordinates with respect to the null base coordinates by inputting the origin position (X,Y,Z) and the orientation (O,A,T) values of the new base coordinates.





Move cursor to each item and input the data. If the setting is correct, press ↵. Values are stored when “Setting complete.” is displayed.

AUX. 0507 MOTION LIMITS (EQUIV. TO ULIMIT, LLIMIT COMMAND OF AS LANGUAGE)

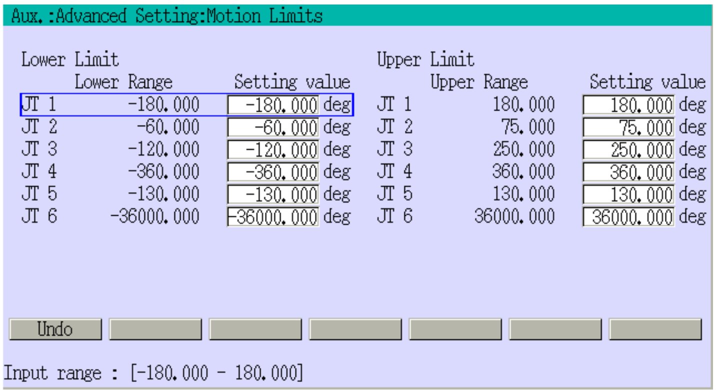
This function sets the upper and lower limits of robot motion range for all the axes, on the software.

WARNING

This motion range limit is effective only on the software.　Safety cannot be ensured if only the software limits are used for restricting motion.

[NOTE]

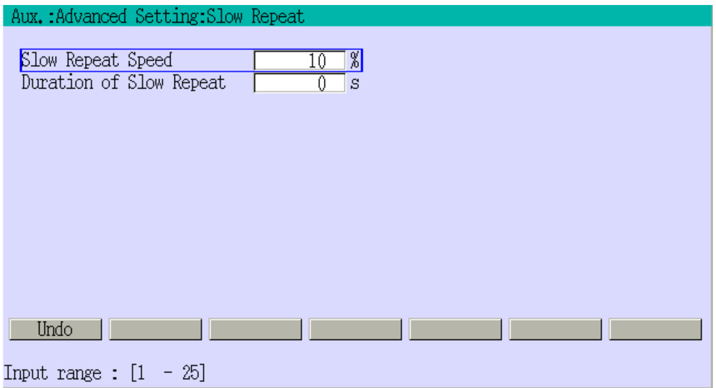
These values are set to the maximum range for the robot at factory shipment, if not specified beforehand.



Move cursor to Lower Limit/Upper Limit for each JT and input data.　If the setting is correct, press ↵. Values are stored when “Setting complete.” is displayed.

AUX. 0508 SLOW REPEAT

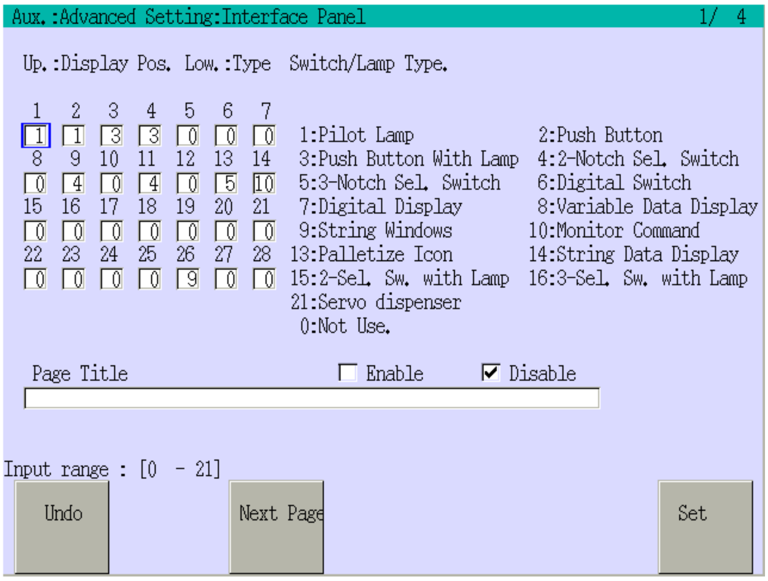
Sets slow repeat speed as a percentage of the maximum repeat speed of the robot.　[Duration of Slow Repeat] sets duration of slow repeat from the time of restart in seconds.　This setting is effective only when system switch SLOW_START is ON and the mode is set to repeat mode or Fast check (option).



Input data for each item.　If 0 is set in [Duration of Slow Repeat], slow repeat is effective only for current step.　If the setting is correct, press ↵.　Values are stored when “Setting complete.” is displayed.

AUX. 0509 INTERFACE PANEL

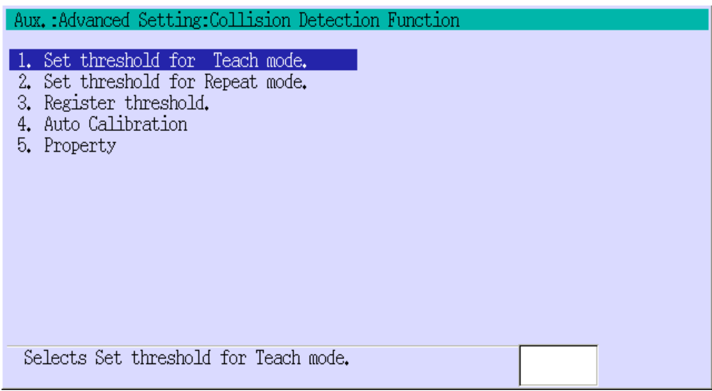
This function enables the setting of devices, such as switches, lamps and so on for use on the interface panel of the teach pendant screen.　The types of devices and their positions for display can be set by this function.　For more details, refer to Chapter 9.



AUX. 0510 COLLISION DETECTION FUNCTION (OPTION)

This function detects the crash or interference of the robot arm/tool with peripheral equipment including workpiece, jig, etc. via software without using sensors.　Upon reaching the set threshold, Emergency Stop is applied.

This function consists of the following five sub functions.　Data settings should be different for teach and repeat modes.　For more details, refer to the optional manual “Collision Detection Manual”, a separate volume.

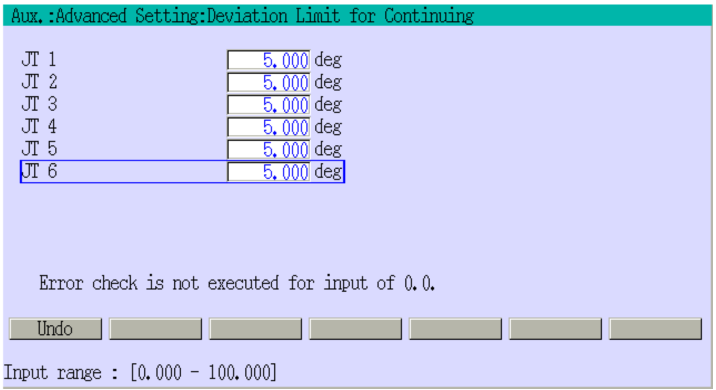


AUX. 0512 DEVIATION LIMIT FOR CONTINUING

This function sets the deviation limit from restart position for each axis when continuing programmed operation.

Axis deviation at restart position = |(Current axis value at restart) – (Axis value at the last stop by cycle-start OFF)|

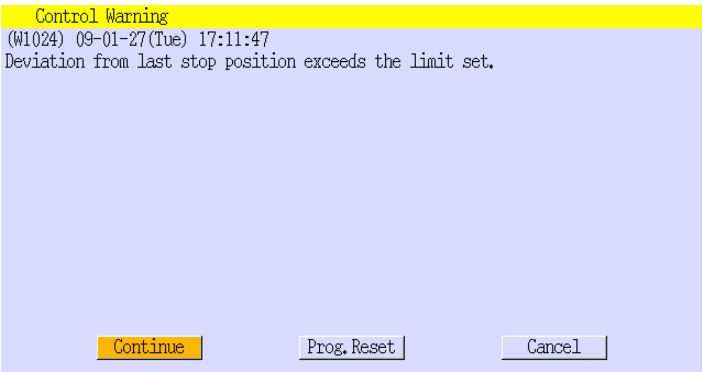
The purpose of this warning detection is to prevent a robot from interfering with peripheral objects such as jigs and workpiece when returning the robot to the last stop pose.



Input allowable deviation range for each axis, and press ↵. When setting the limit value to “0.000”, no error check is executed at the time of restart. Values are stored when “Setting complete.” is displayed.

[NOTE]

Setting too small values may cause an error at restart even under normal operating conditions.



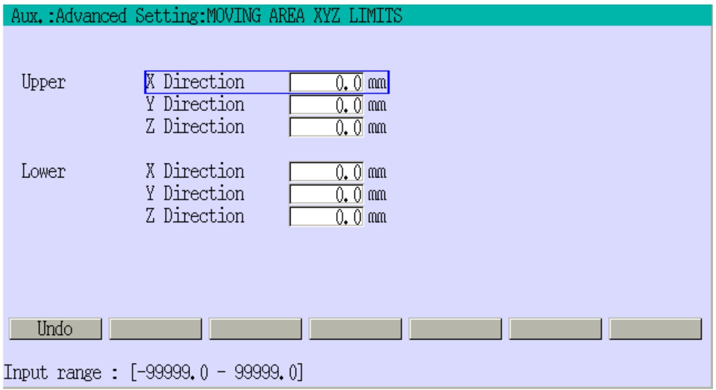
The screen on the left appears when deviation exceeds the set limit at the time of restart. Press <Continue> to continue operation after returning to the last stopped pose at slow repeat speed in joint interpolation mode.

[NOTE]

The deviation from the last stop position is not checked when restarting a robot by external signals.

AUX. 0518 MOVING AREA XYZ LIMITS

This function sets the upper and lower limits within the XYZ area of world coordinates, including traverse axis, to control the robot motion based on the TCP. This function is valid only for motion in repeat, check and teach modes. (The check is not executed when teaching and changing/ registering pose data.) Moving from out of range to within the range is allowed.



Move cursor to each item and input the upper/lower limits. If the setting is correct, press ↵. Values are stored when "Setting complete." is displayed.

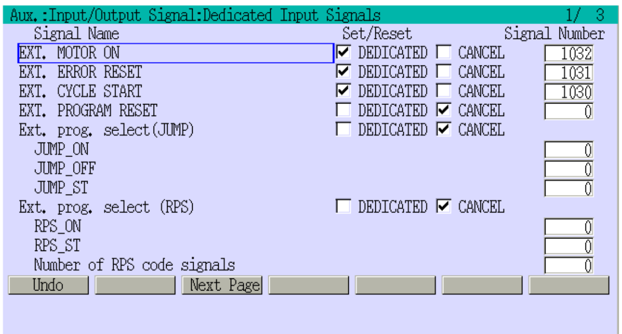
[NOTE]

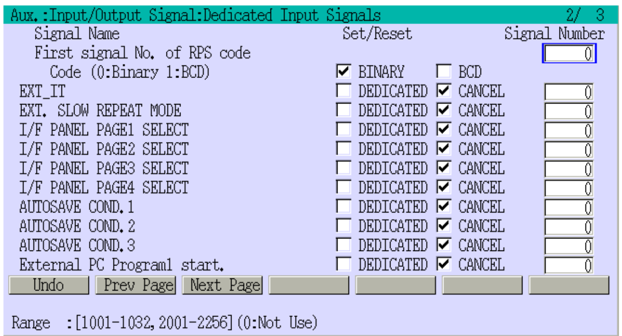
1. If the same values are set for the upper and lower limits, the motion range check is not executed.
2. The area of XYZ including traverse axis is checked. (Only in systems where robot cooperates with traverse axis.)
3. If the lower limit exceeds the upper limit, error occurs.

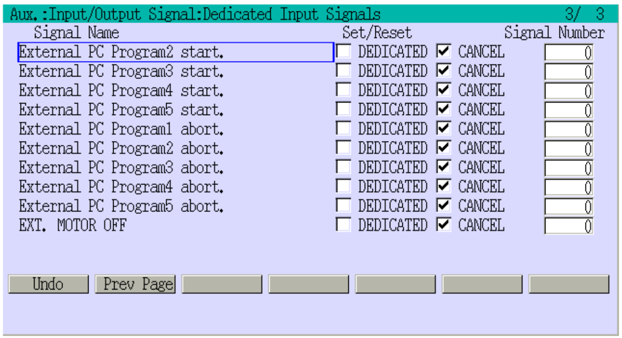
AUX. 0601 DEDICATED INPUT SIGNALS (EQUIV. TO DEFSIG INPUT OF AS LANG.)

This function sets the dedicated input signals. Refer to the External I/O Manual, a separate volume, for the function of each signal. The signals displayed on the screen vary depending on software version and application.

Display example







Move cursor to the desired signal, and select [DEDICATED] or [CANCEL] by A + ←/→. Then, input a signal number (channel number) to be allocated to the signal. If the setting is correct, press ↵.

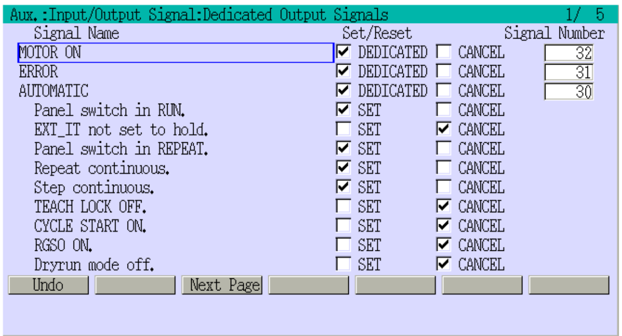
[NOTE]

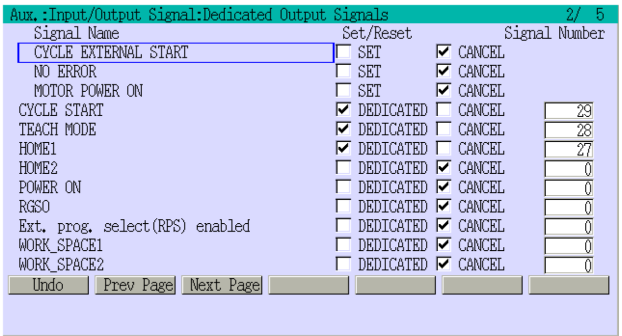
Although JUMP_ST and RPS_ST are output signals, their settings are done here.

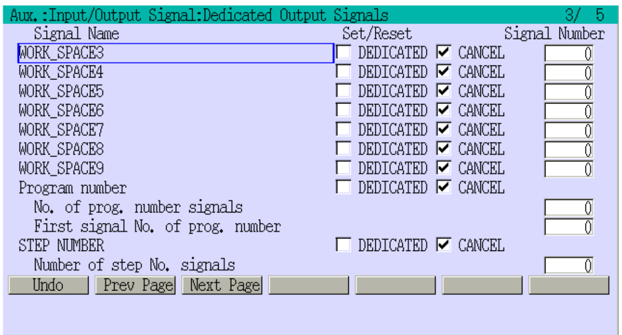
AUX. 0602 DEDICATED OUTPUT SIGNALS (EQUIV. TO DEFSIG OUTPUT OF AS LANG.)

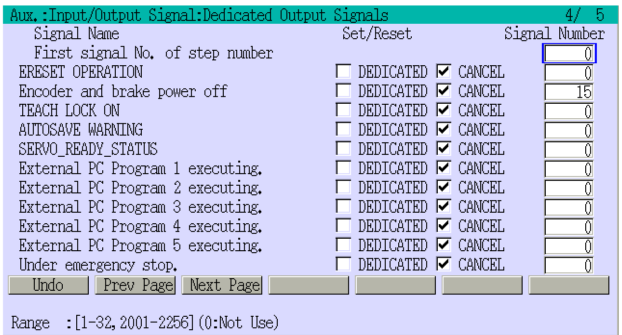
This function sets the dedicated output signals. For the function of each signal, refer to the External I/O Manual, a separate volume. The signals displayed on the screen vary depending on software version and application.

Display example







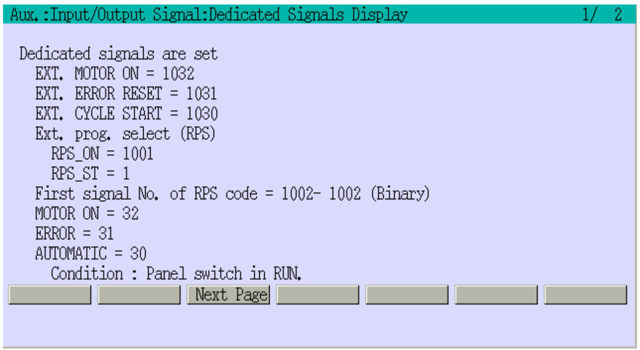


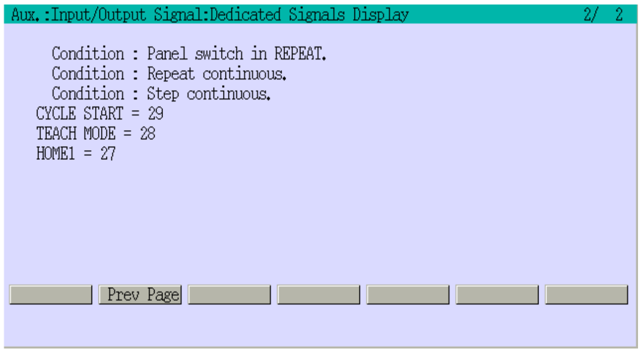
Move cursor to the desired signal, and select [DEDICATED] or [CANCEL] by A + ←/→. Then, input a signal number (channel number) to be allocated to the signal. If the setting is correct, press ↵.

AUX. 0603 DEDICATED INPUT/OUTPUT SIGNALS DISPLAY

This function displays the dedicated input and output signals that are currently set. The setting is configured in Aux. 0601 and Aux. 0602.

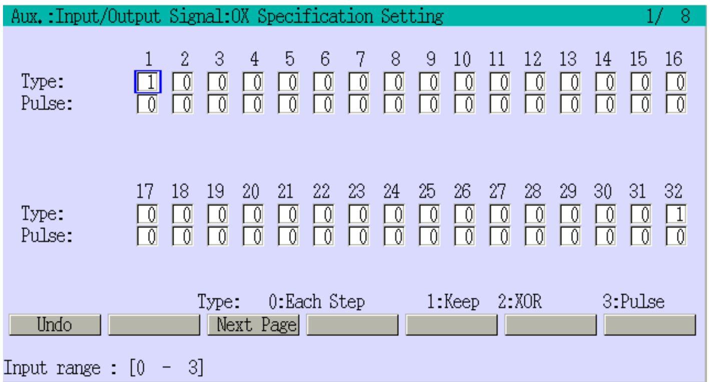
Display example



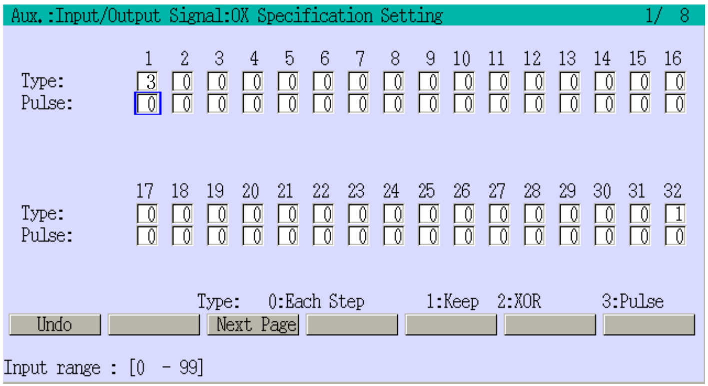


AUX. 0604 OX SPECIFICATION SETTING (OPTION)

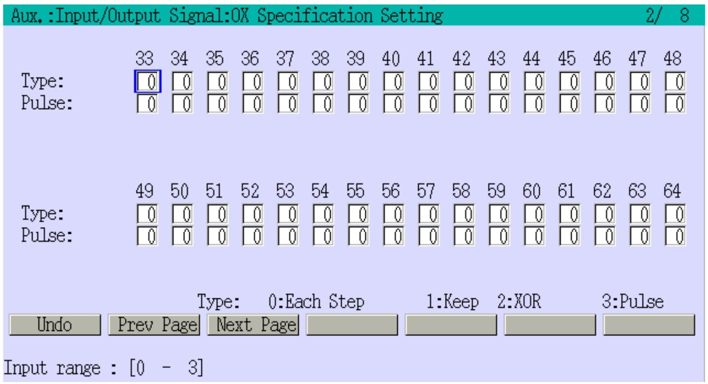
Output types can be set for each OX signal using teach pendant. Set the length of pulse when selecting [Pulse] as its [Type]. For more details, refer to Chapter 14.



1. Move cursor to [Type] for the desired OX signal number. To specify the signal type, input 0, 1, 2, or 3, corresponding to Each Step, Keep, Double (XOR), and Pulse. Default setting for all signals is 0 (Each Step).



2. Move cursor to [Pulse] as shown in screen on the left, and input the numeric data.

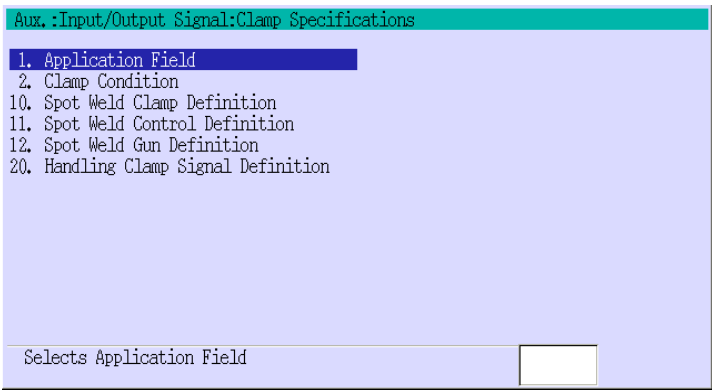


3. For signals OX33 to OX64, press <Next Page> and set as done above. If the setting is correct, press ↵. Settings are stored when "Setting complete." is displayed.

AUX. 0605 CLAMP SPECIFICATIONS

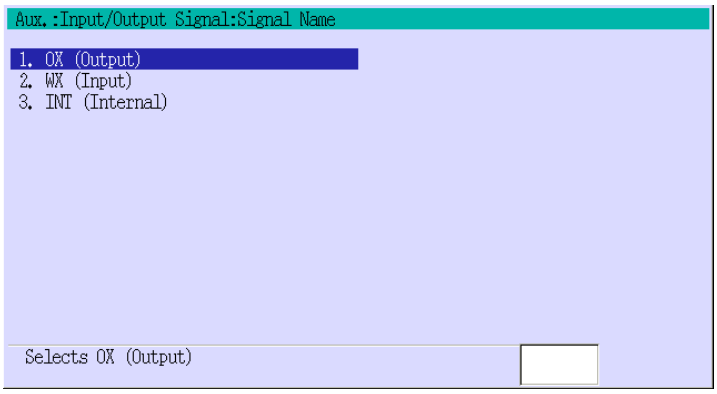
This function varies depending on application field. The screen below is for spot welding and handling operations. For sealing specification, refer to Chapter 16.

This function consists of the following six sub-functions to set the specifications of the clamp signals. For more details, refer to Chapter 13.

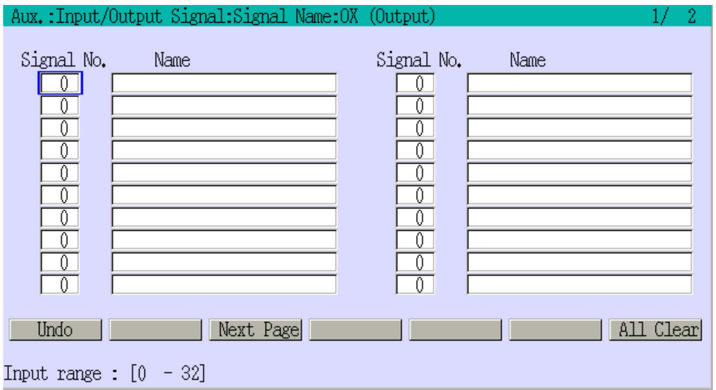


AUX. 0606 SIGNAL NAME

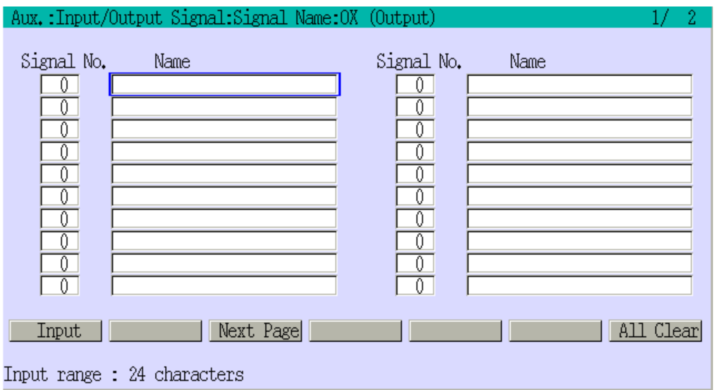
This function enables naming input/output signals and internal signals to indicate their functions. The maximum number of signals for naming is 64 for each signal type. When the signal number is set to 0 or no name is input, nothing is registered.



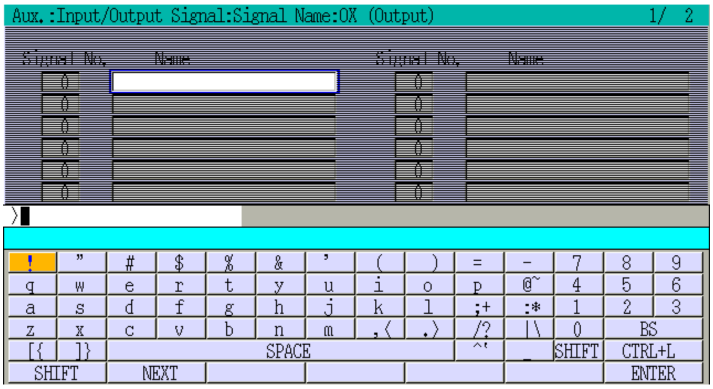
1. Select the desired type of signals.



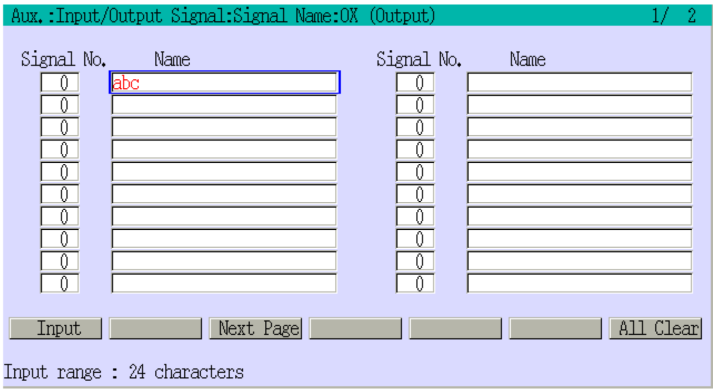
2. Move cursor to [Signal No.] and input the signal number.



3. Move cursor to the [Name] of the desired signal.



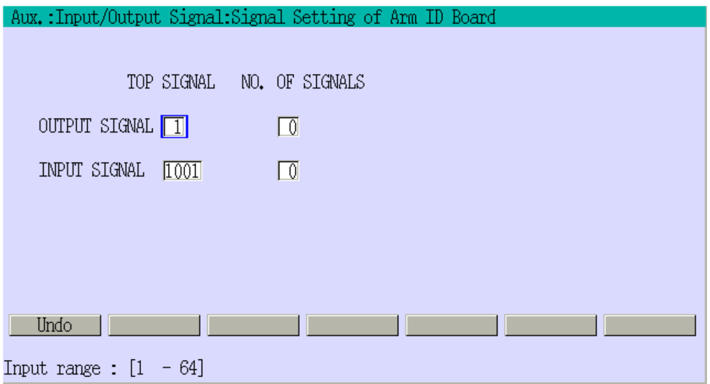
4. Pressing <Input> displays the keyboard screen. Input the name and press <ENTER>.



5. Set the other signal names in the same way. After setting all desired signals, press ↵. Names are stored when "Setting complete." is displayed. To cancel any names input thus far, press <All Clear> before pressing ↵. The set names are displayed with the signal number on the I/O name monitor screen of monitor1/2.

AUX. 0607 SIGNAL SETTING OF ARM ID BOARD

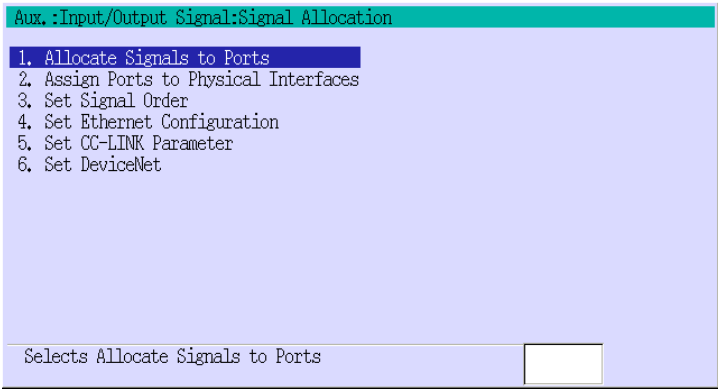
This function allocates signals for giving and receiving I/O signals through the arm ID board with daughter board. For more details, refer to the optional manual "Arm ID Board Instruction Manual", a separate volume.



AUX. 0608 SIGNAL ALLOCATION (OPTION)

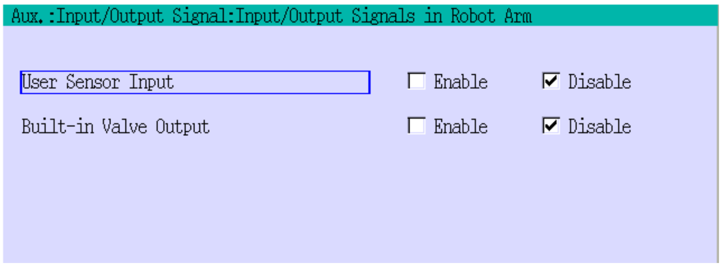
A field network can be constructed by connecting the robot controller with components within the FA system via various types of Fieldbus. To build this network, assign communication recipients and the signal numbers to be used via this function.

This function consists of the six sub functions below. For more details, refer to the optional manual “General Fieldbus I/O Usage Manual”, a separate volume.



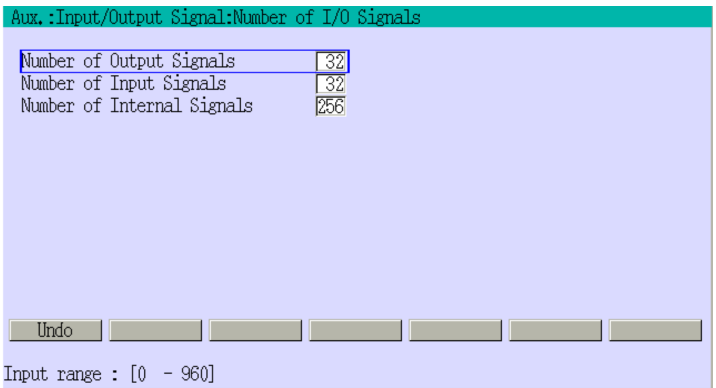
AUX. 0610 INPUT/OUTPUT SIGNALS IN ROBOT ARM

Only for RS03 robot, this function specifies whether to enable user sensor input and built-in valve output functions. For more details, refer to “Internal I/O Signal for RS03” in the “External I/O Manual”, a separate volume. For robots other than RS03 robot, set to [Disable].



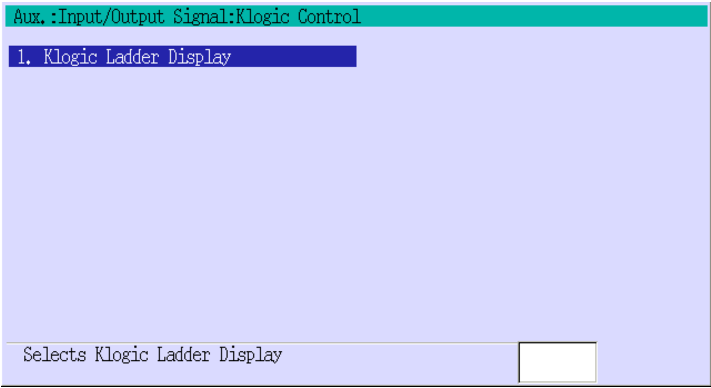
AUX. 0611 NUMBER OF I/O SIGNALS

This function sets the number of output signals, input signals, and internal signals used in Fieldbus. For more details, refer to the optional manual “General Fieldbus I/O Usage Manual”, a separate volume.



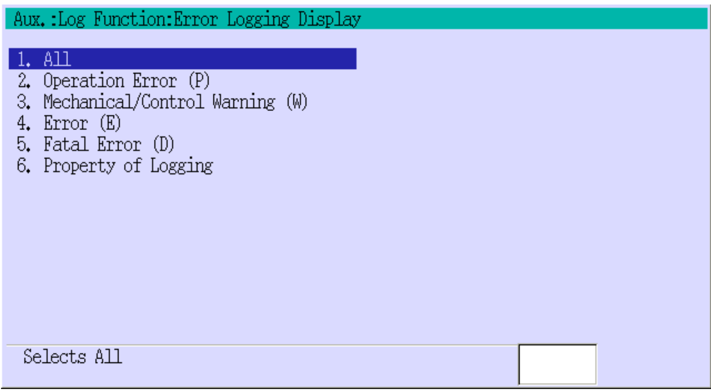
AUX. 0620 KLOGIC CONTROL (OPTION)

This function controls the sequence of tasks for the robot system via KLogic software built into the controller. This requires no external control panel or installation of printed circuit boards for that purpose. Selecting [1. KLogic Ladder Display] displays the ladder screen of the last or currently executing KLogic basic operation part program (lsqpg). For more details, refer to the optional manual “KLogic / KLadder Operation Manual”, a separate volume.

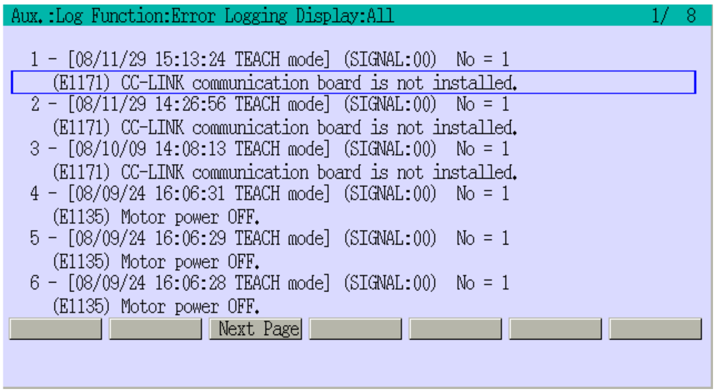


AUX. 0702 ERROR LOGGING DISPLAY (EQUIVALENT TO ERRLOG OF AS LANGUAGE)

This function displays a history of the errors in chronological order with the most recent entry first. These logs include data such as time of occurrence, the error code and the message. The following six kinds of error logs are available.



AUX. 070201 ALL



Displays every item recorded in the log.

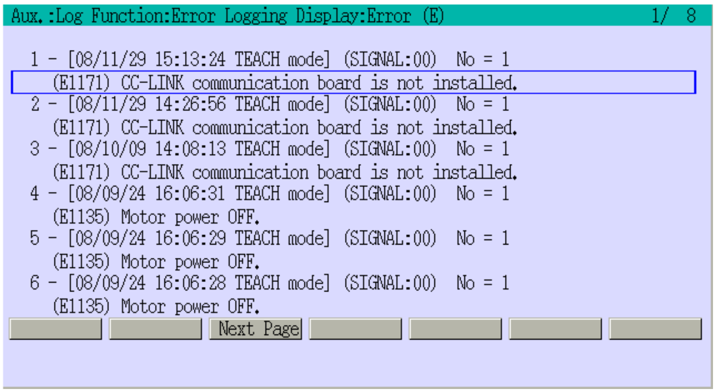
AUX. 070202 OPERATION ERROR (P)

Displays a history of the operation errors. To display this log, set [Logging Operation Error And Warning] to [Enable] in Aux. 070206.

AUX. 070203 MECHANICAL/CONTROL WARNING (W)

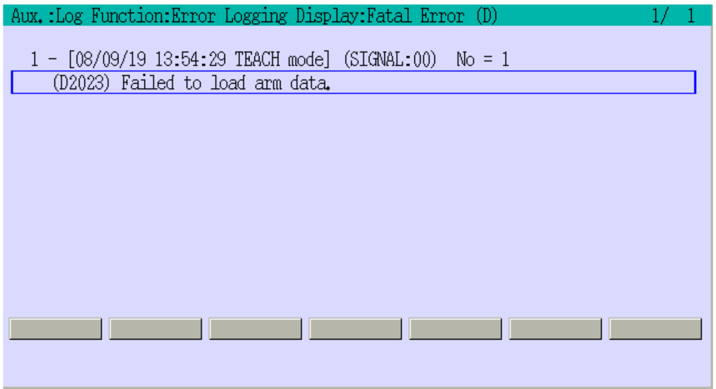
Displays a history of warnings output from the controller. To display this log, set [Logging Operation Error And Warning] to [Enable] in Aux. 070206.

AUX. 070204 ERROR (E)



Displays the error log contents.

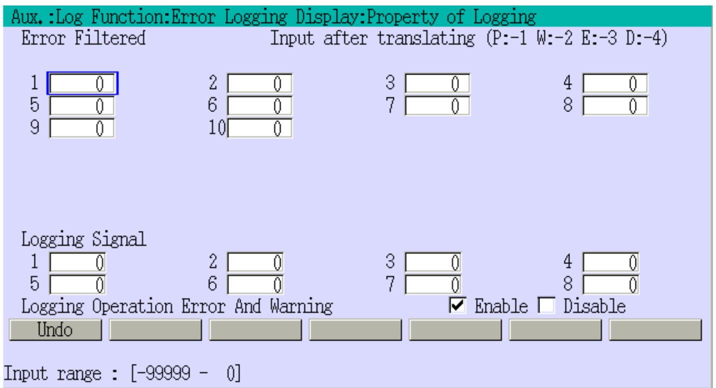
AUX. 070205 FATAL ERROR (D)



Displays a history of fatal errors output from the controller.

AUX. 070206 PROPERTY OF LOGGING

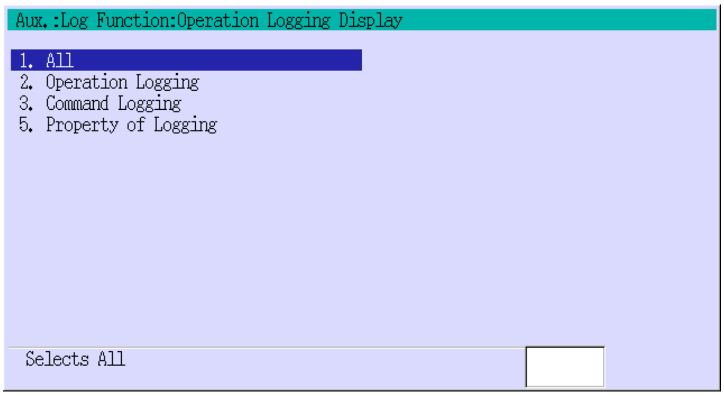
This function specifies which errors are omitted from the log. Also, it is possible to specify I/O signals so that their ON/OFF statuses are stored in the log at time of error occurrence.



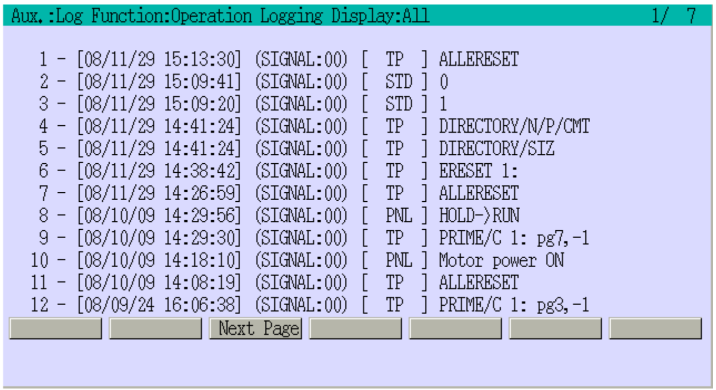
To specify an error, input its code as shown in the error messages list, replacing its first P,W,E,D character with -1, -2, -3, -4 respectively. Input data for each item. To log operation errors and warnings, set [Logging Operation Error And Warning] to [Enable]. If setting is correct, press ↵. Signal numbers are stored when “Setting complete.” is displayed.

AUX. 0703 OPERATION LOGGING DISPLAY (EQUIV. TO OPLOG INSTRUCTION OF AS LANGUAGE)

This function displays a history of operations in order of most recent entry first.

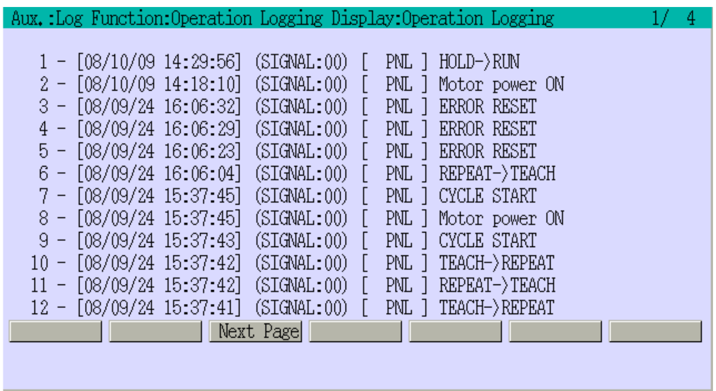


AUX. 070301 ALL



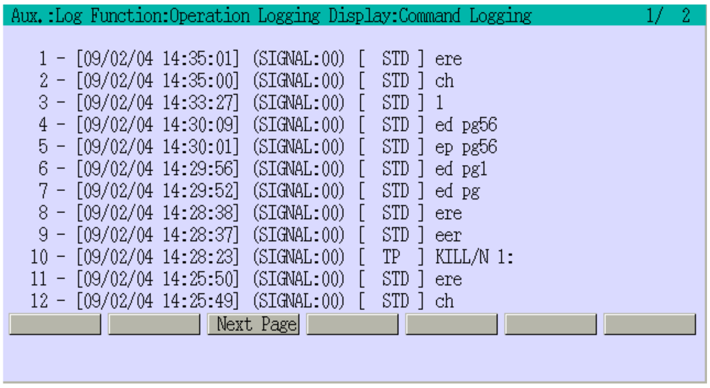
Displays all operations stored in the log.

AUX. 070302 OPERATION LOGGING



Displays a history of operations.

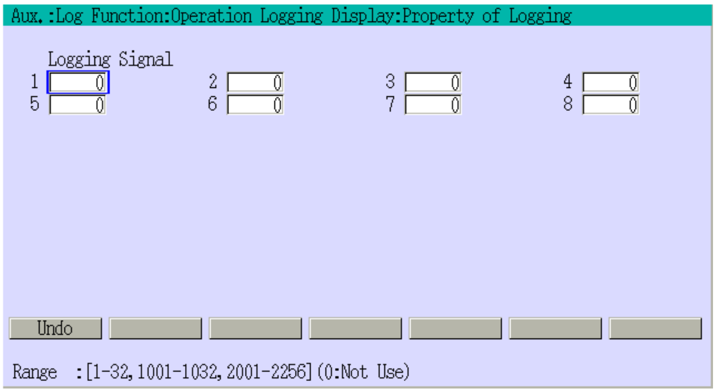
AUX. 070303 COMMAND LOGGING



Displays a history of commands stored in the operation log.

AUX. 070305 PROPERTY OF LOGGING

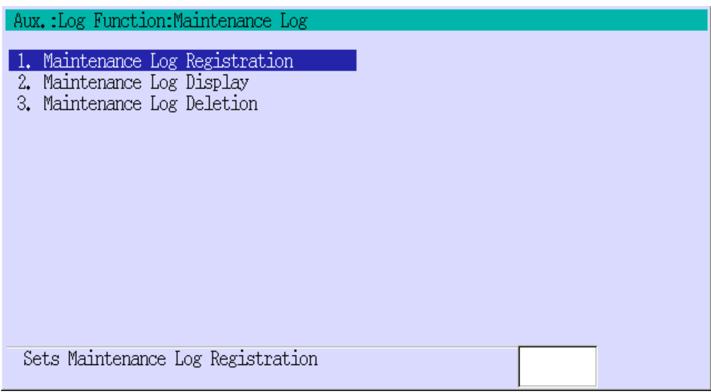
This function specifies the I/O signals whose ON/OFF status are to be stored in the log with the operation history.



Specifies I/O signals numbers to be logged. If the setting is correct, press ↵. Signal numbers are stored when “Setting complete.” is displayed.

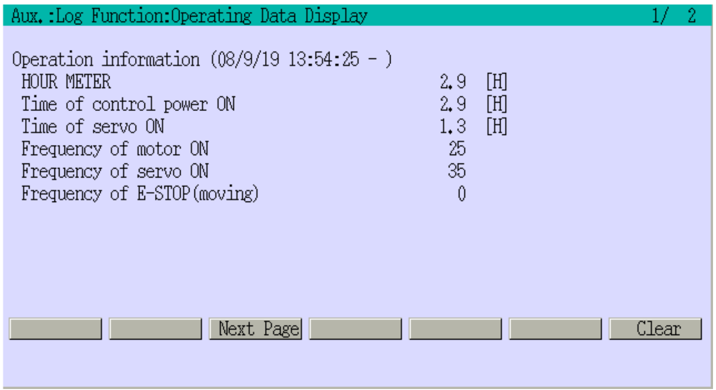
AUX. 0704 MAINTENANCE LOG

This function executes the registration/ display/ deletion of maintenance logs on the arm ID board. For more details, refer to the optional manual “Arm ID Board Instruction Manual”, a separate volume.

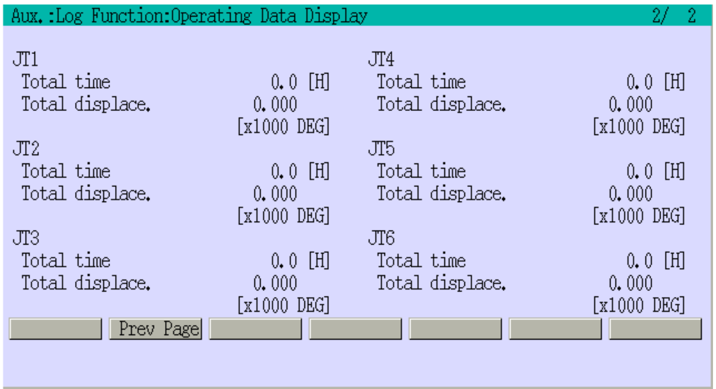


AUX. 0706 OPERATING DATA DISPLAY

This function displays robot operation information: hour meter operation time, controller power ON time, servo ON time, and the number of times of motor power ON, servoing ON and E-Stop. Also, the total accumulated operation time and displacement for each axis is also logged.



1. Operation information, from [HOUR METER] to [Frequency of E-STOP] are displayed.

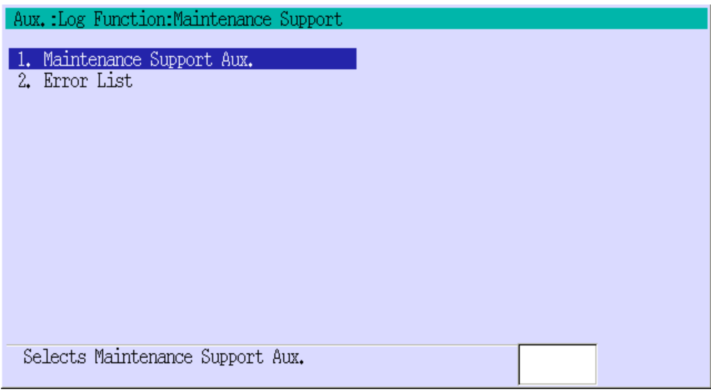


2. Pressing <Next Page> displays the operation information logged for each axis.

AUX. 0707 MAINTENANCE SUPPORT (OPTION)

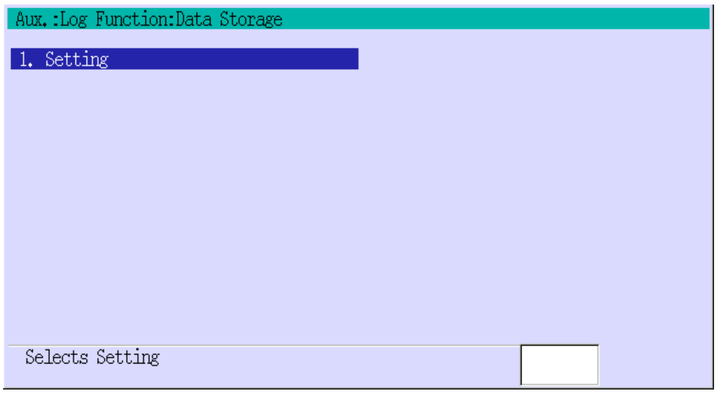
This function displays the information necessary for robot maintenance.

This function contains the following two sub functions. For more details, refer to the optional manual “Maintenance Support Manual”, a separate volume.

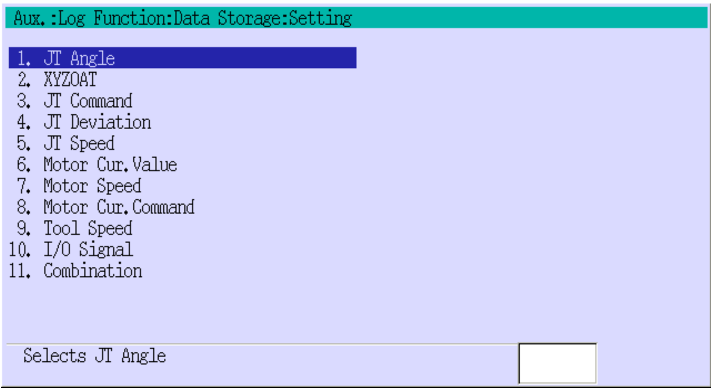


AUX. 0708 DATA STORAGE (OPTION)

This function sets the data to be displayed by Data Storage function.



1. Select [1. Setting].

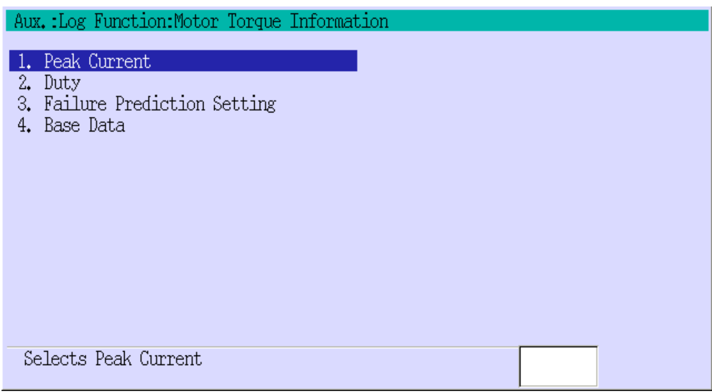


2. Select the desired data to be displayed in graph form. Input data for conditions in the following screen.

For more details, refer to the optional manual “Data Storage Function Manual”, a separate volume.

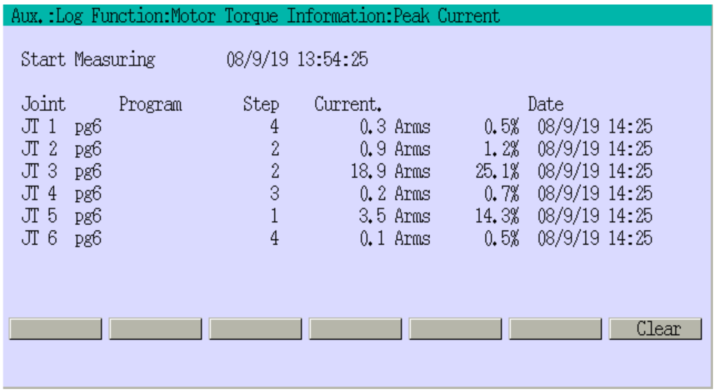
AUX. 0709 MOTOR TORQUE INFORMATION (OPTION)

This function displays the peak current value to each axis motor of the robot. This screen displays an additional sub-menu for the Reduction Gear Failure Prediction Function, if the function is enabled. For more details, refer to the optional manual, “Failure Prediction Function for Reduction Gear”, a separate volume.



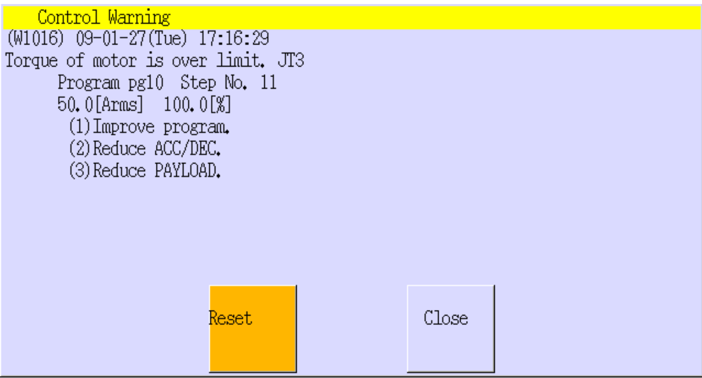
AUX. 070901 PEAK CURRENT

This function displays program, step, peak current value, percentage of peak current value to motor current limit, and the occurrence date/time of the peak current.　Information is for each axis is displayed.



Pressing <Clear> clears all data.

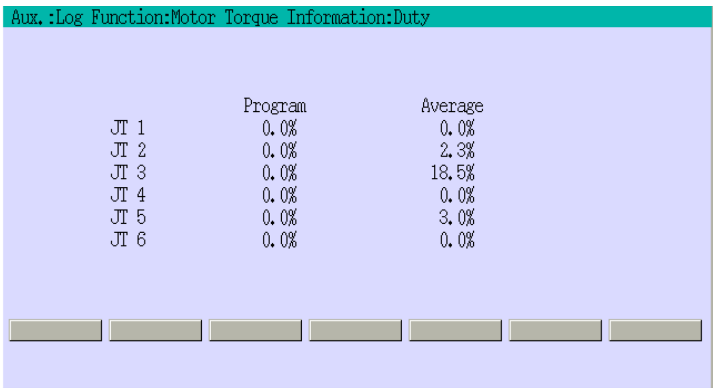
If the percentage of peak current value to motor current limit reaches 100.0 (%), the warning screen is displayed. (Robot will not stop.)　The date, the axis number, the step, peak current value, and countermeasure are displayed as shown in the following screen.



Selecting [Reset] resets the warning and closes the warning screen.　Selecting [Close] closes the warning screen without resetting the warning.

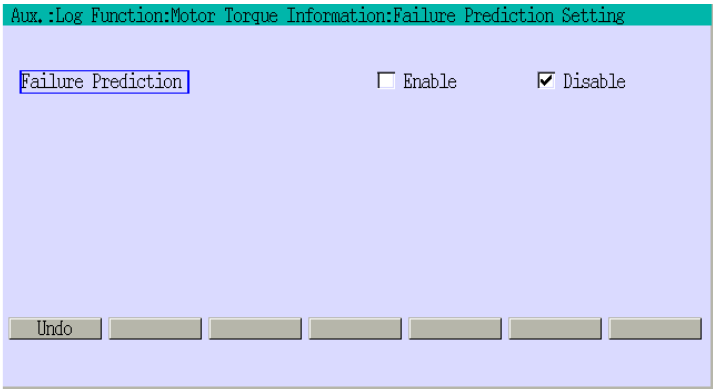
AUX. 070902 DUTY

This function displays motor duty.　[Average] displays the average motor duty for the last several tens of seconds.　[Program] displays the motor duty for the section of the program specified by the I2PG command.



AUX. 070903 FAILURE PREDICTION SETTING

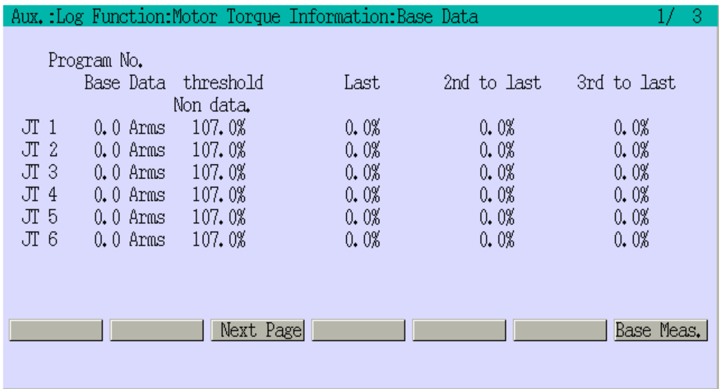
This function enables or disables the failure prediction function. This function automatically monitors the load on the drive system of the robot, and detects possible failure of the reduction unit before motor current becomes too high. When failure prediction function is enabled, motor current values are automatically measured five times during the program execution. An average of these values is stored as the standard value for detecting warnings at every program execution thereafter. This standard value is called base data.



Select [Enable] or [Disable] by A + ←/→. If the setting is correct, press ↵. Selection is stored when “Setting complete.” is displayed.

AUX. 070904 BASE DATA

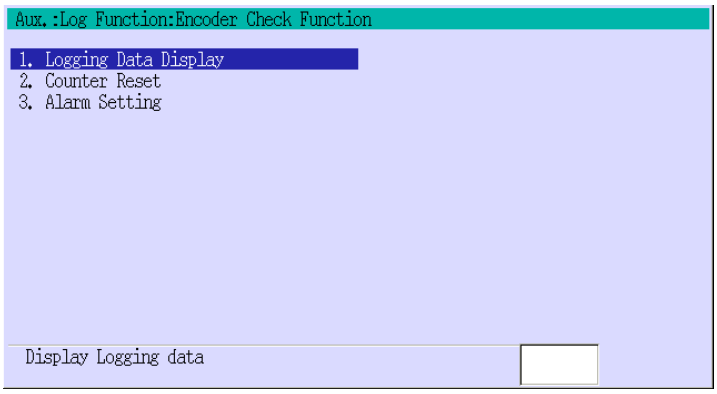
This function displays the result after completing the motor current measurement as shown in the screen below.



Pressing <Next page> displays the information of other programs.

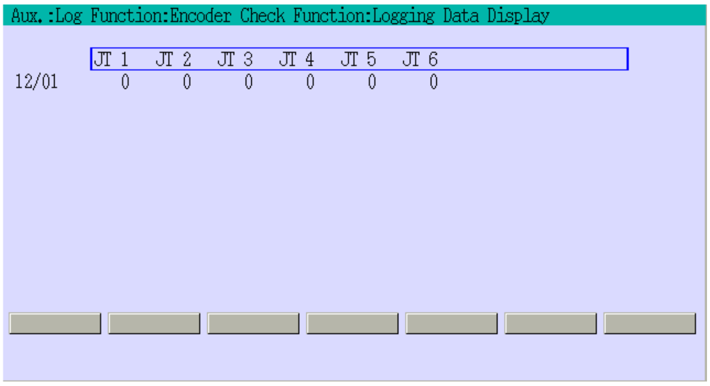
AUX. 0717 ENCODER CHECK FUNCTION

This function contains the following three sub-functions.



AUX. 071701 LOGGING DATA DISPLAY

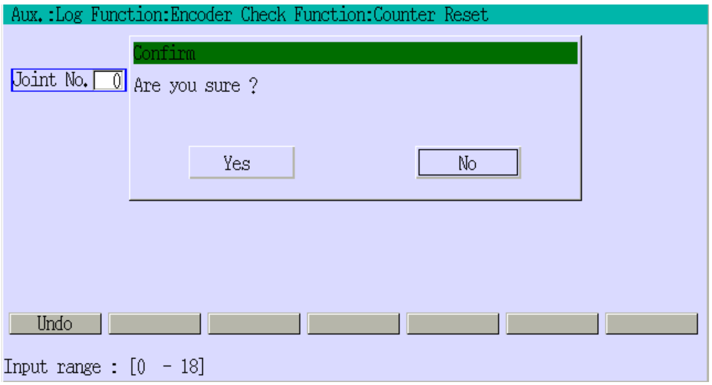
Displays encoder values for each axis.



AUX. 071702 COUNTER RESET

This function specifies the axis on which to reset the encoder rotation counter values.

1. Input the desired axis and press ↵.

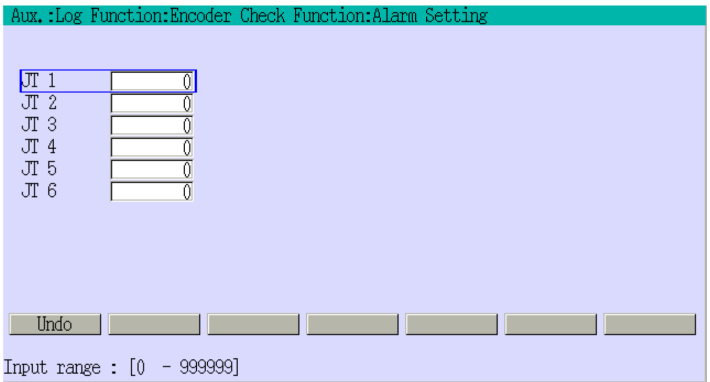


2. Confirmation box is displayed. Select [Yes] to execute, or select [No] to cancel.

3. Joint number is selected when "Setting complete." is displayed.

AUX. 071703 ALARM FUNCTION

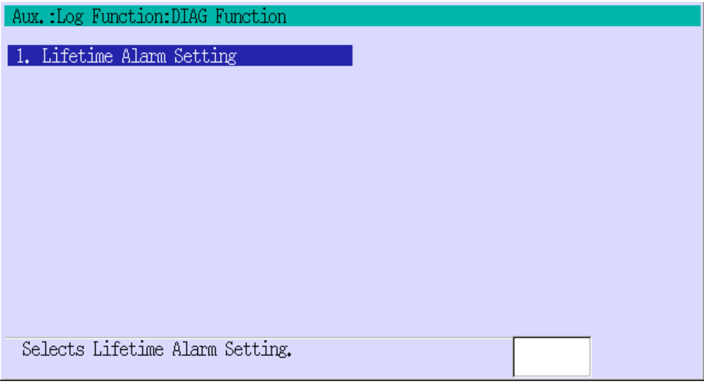
The alarm is displayed if the encoder rotation counter values exceed the values set in this function.



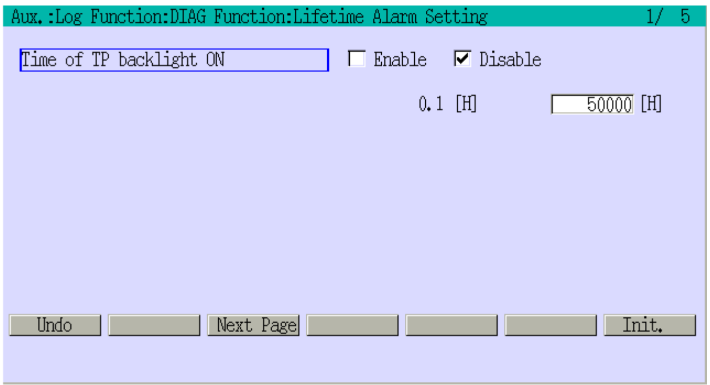
Input the rotation counter values. If the setting is correct, press ↵. Values are stored when "Setting complete." is displayed.

AUX. 0719 DIAG (DIAGNOSTIC) FUNCTION

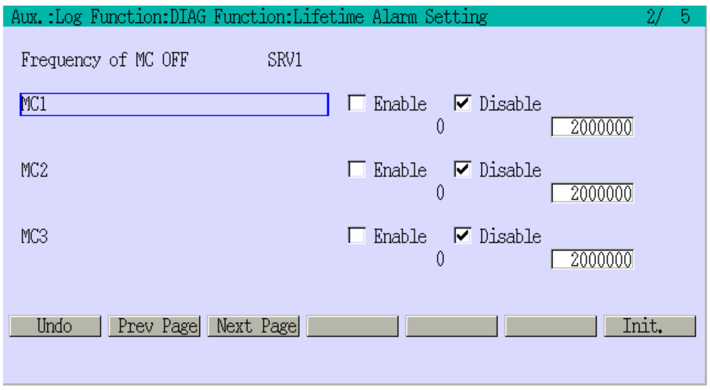
The alarm is displayed if current status exceeds any of the values set in the Lifetime Alarm Setting screen.



1. Select [1.Lifetime Alarm Setting].

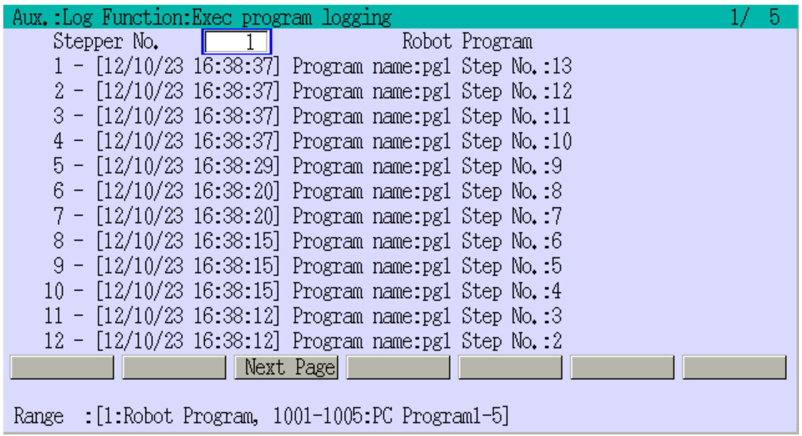


2. Select [Enable] or [Disable] to set whether or not to display alarm. When selecting [Enable], input hours or the number of times for alarm notification.　If the setting is correct, press ↵.　Settings and Values are stored when “Setting complete.” is displayed.

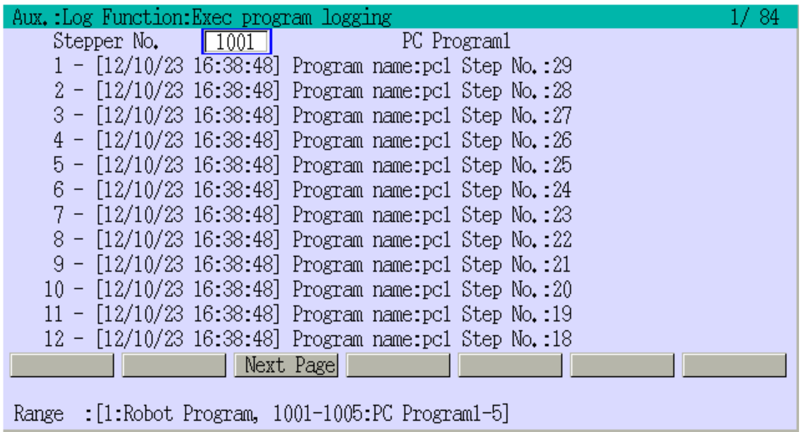


AUX. 0724 EXECUTED PROGRAM LOGGING

This function displays date and time of step execution in the program in reverse chronological order. Each step is classified and displayed according to robot program, PC program 1 - 5 as follws.



Input 1 in [Stepper No.] to display the execution date and time of steps in robot program.



Input 1001 - 1005 in [Stepper No.] to display the execution date and time of steps in PC program 1 - 5.

AUX. 0801 MEMORY AVAILABLE (EQUIV. TO FREE INSTRUCTION OF AS LANGUAGE)

This function displays memory available for programming or recording variables. Available memory is displayed in both bytes and percentage.

[NOTE]

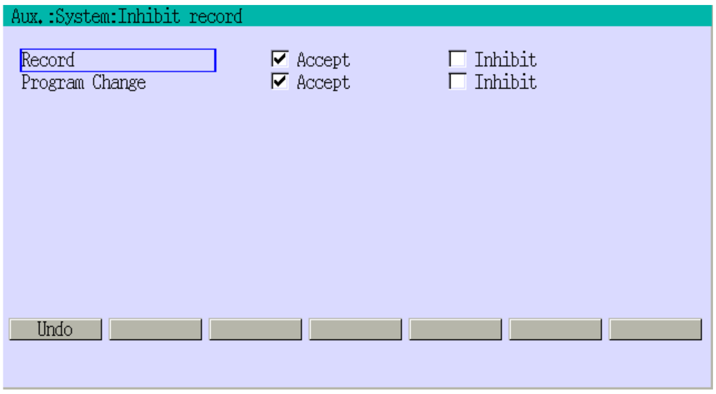
A portion of the memory mounted in the robot controller is dedicated for fundamental robot operations. You can use the amount of bytes displayed on screen. Value in parentheses shows percentage of max. available amount.

AUX. 0802 INHIBIT RECORD

This function prevents the taught program from being rewritten or changed by mistake.

Setting [Record] to [Inhibit] prohibits any attempt to teach and change the following: pose data, parameters values for instructions, or data in auxiliary functions.

Setting [Program Change] to [Inhibit] prohibits inputs from these commands: EDIT, TEACH, COPY, XFER, and LOAD. If [Program Change] is set to [Inhibit] during EDIT mode, the setting takes effect after exiting EDIT mode.



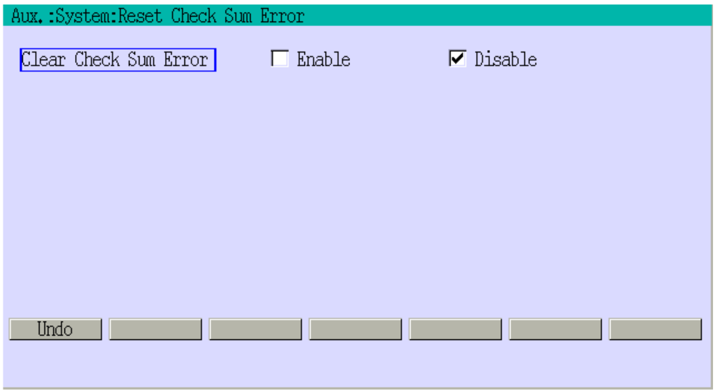
Move cursor to each item and select [Accept] or [Inhibit] by [A]+[←]/[→]. If the setting is correct, press [↵]. Selections are stored when “Setting complete.” is displayed.

AUX. 0803 RESET CHECK SUM ERROR

This function allows the user to clear sum check error (E0903) if set to [Enable], when a sum check error occurs on the system data.　While this function is enabled, if any sum check errors remain in the data, the error cannot be cleared.　In such case, instructions are displayed for changing the data that includes the sum check error.

[NOTE]

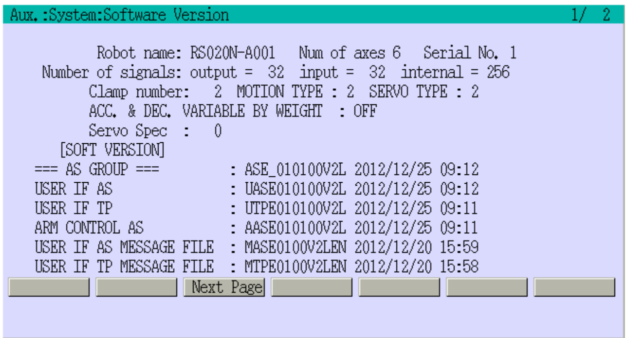
This setting is automatically set to Disable when turning the controller power OFF, then ON.

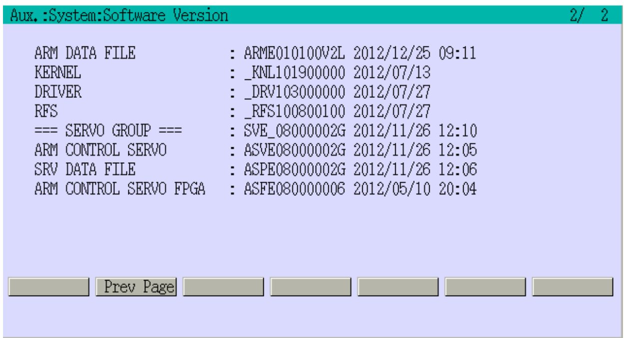


Select [Enable] or [Disable] by A + ←/→.　If the setting is correct, press ↵.　Selection is stored when “Setting complete.” is displayed.

AUX. 0804 SOFTWARE VERSION

This function displays the following information:
software version installed in robot controller and the teach pendant, robot model, robot serial number, the number of input/output signals, etc.



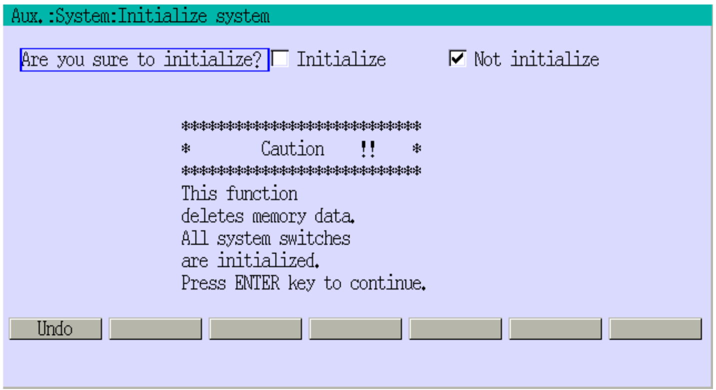


AUX. 0805 INITIALIZE SYSTEM

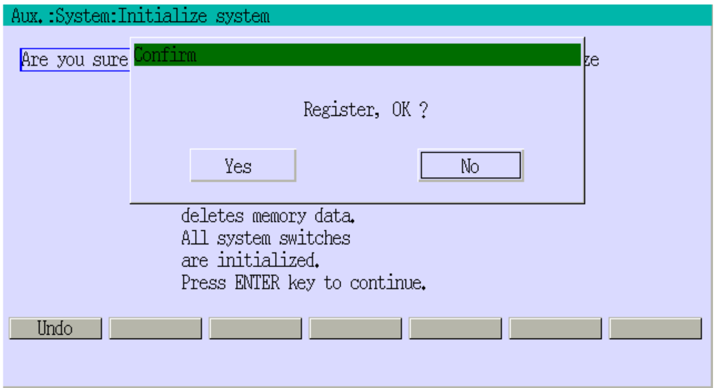
This function initializes the controller memory.

CAUTION

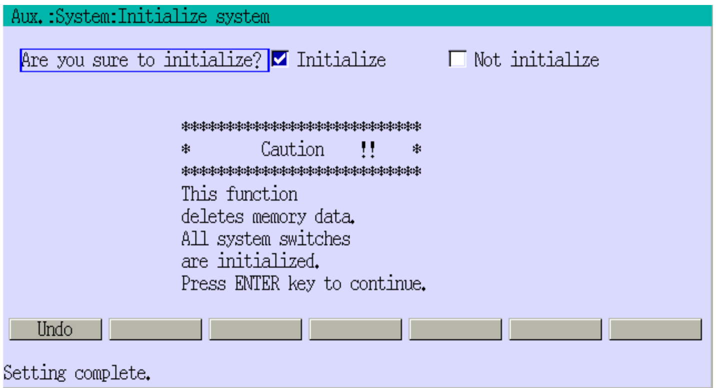
Initializing the system erases all the programs and variables data from the memory.



1. Select [Initialize] and press ↵.



2. Confirmation box is displayed. Select [Yes] to execute or select [No] to cancel.



3. Initialization is finished when "Setting complete." is displayed.

System initialization will:

(1) Delete all programs,
(2) Delete all variables,
(3) Initialize system switches settings, and
(4) Initialize parameters values registered as auxiliary data in compound instructions (block teaching instructions)

The only information not affected by the initialization process is:

(1) Zeroing data, and
(2) Settings for user dedicated signals.

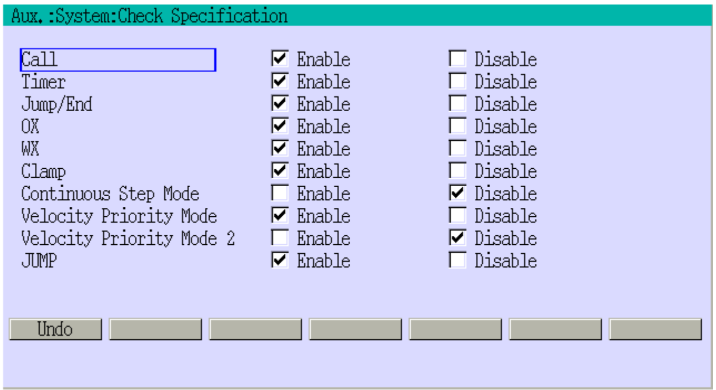
AUX. 0807 CHECK SPECIFICATION

This function sets whether or not to execute CALL, TIMER, JUMP/END, OX (output signal), WX (input signal), clamp instructions, etc., when executing taught programs in check mode.

CALL function	Enable	Executes CALL instruction in check mode.
	Disable	Ignores CALL instruction in check mode.
TIMER	Enable	Enables timer waiting in taught steps.
	Disable	Disables timer waiting in taught steps.
JUMP/END	Enable	Performs jump/end processing.
	Disable	Does not perform jump/end processing.
OX	Enable	Outputs signals externally from the robot.
	Disable	Does not output signals externally from the robot.
WX	Enable	Does not ignore external input signals.
	Disable	Ignores external input signals.
CLAMP	Enable	Enables clamp signal processing.
	Disable	Disables clamp signal processing.
STEP CONTINUOUS	Enable	While CHECK ONCE is selected, it is possible to go to the next or previous step by $\boxed{\text{CHECK GO}}$ or $\boxed{\text{CHECK BACK}}$.
	Disable	While CHECK ONCE is selected, it is possible to go to the next or previous step by $\boxed{\text{A}}$＋$\boxed{\text{CHECK GO}}$ or $\boxed{\text{CHECK BACK}}$.
VELOCITY PRIORITY	Enable	Robot operates at max. speed of 250 mm/s regardless of the taught speed. Valid only in CHECK ONCE mode.
	Disable	The lower the speed is taught, the quicker the robot accelerates/decelerates.
VELOCITY PRIORITY2	Enable	Only when VELOCITY PRIORITY is set effective, robot operates with priority on speed (250 mm/s), regardless if the mode is set to CHECK ONCE or CHECK CONT.
	Disable	Follows the setting for VELOCITY PRIORITY.
JUMP instruction	Enable	Executes JUMP instruction in check mode.
	Disable	Ignores JUMP instruction in check mode.

The difference between check forward and check backward in terms of motion is as follows. However, some software versions are not equipped with these functions.

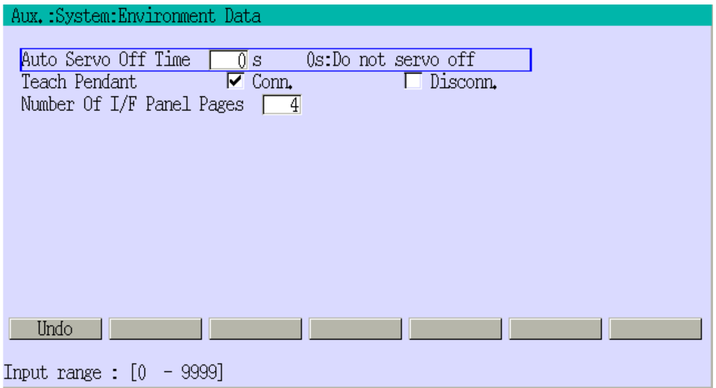
	CHECK GO	CHECK BACK
CALL function	Depends on setting	Always ineffective
TIMER	Depends on setting	Always ineffective
JUMP/END	Depends on setting	Always ineffective
OX	Depends on setting	Depends on setting
WX	Depends on setting	Always ineffective
CLAMP	Depends on setting	Depends on setting



Select [Enable] or [Disable] by A + ←/→. If the setting is correct, press ↵. Selections are stored when “Setting complete.” is displayed.

AUX. 0808 ENVIRONMENT DATA

In automatic operation, servoing turns OFF automatically after the period of time set in this function elapses, when robot is waiting for a WX signal.



1. Input data for each item. Inputting 0 sets AUTO SERVO OFF ineffective.
2. Set [Teach Pendant] to [Disconn.] to execute automatic operation without TP connected.
3. Input the number of pages in [Number of I/F Panel Pages] to change the number of I/F panel pages.
4. If the setting is correct, press ↵. Settings and values are stored when “Setting complete.” is displayed.

Teach Pendant Disconnection

Normally the robot operates with TP connected. Automatic operation is possible without TP connected using the following procedures.
Procedures to set [Teach Pendant] to [Disconn.]:

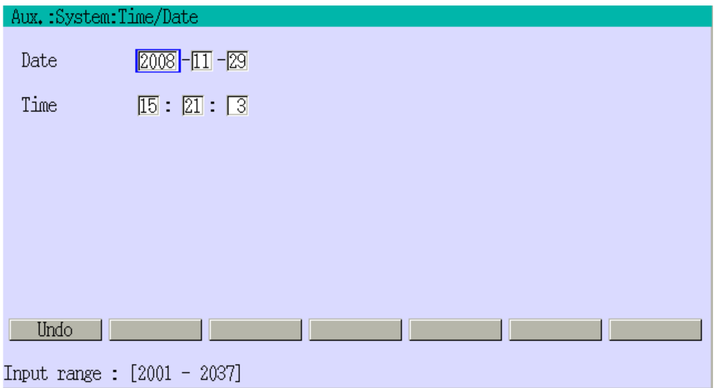
(1) Set TEACH/REPEAT on the operation panel to REPEAT.
(2) Set [Teach Pendant] to [Disconn.] and press ↵.
(3) Turn OFF the controller power.
(4) Unfasten the teach pendant connector and remove the TP.
(5) Insert the short-circuit plug.
(6) Turn ON the controller power.

[NOTE]

Set the TEACH/REPEAT to REPEAT without fail before setting to Disconn. (disconnect). In teach mode, the setting automatically returns to Conn. (connect) when TP is connected.

AUX. 0809 TIME/DATE (EQUIVALENT TO TIME INSTRUCTION OF AS LANGUAGE)

This function sets the current year, month, day and time for the clock built into the controller. This time setting is used for the current time shown on the teach pendant and in the error log.



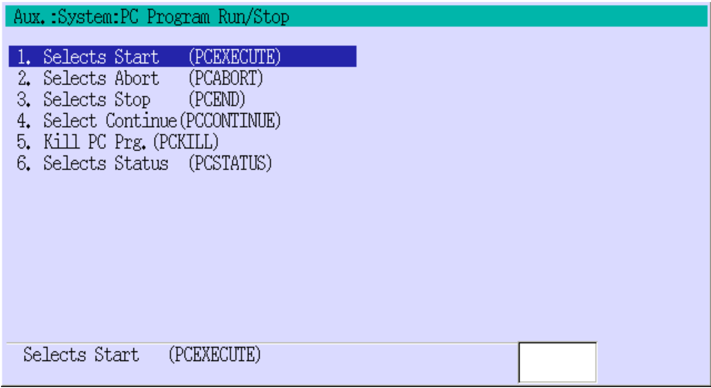
Input data in each item of [Date]. To input [Time], take into consideration the time lost for pressing ↵. After inputting data, press ↵ quickly.

[NOTE]

The moment this function is selected will be the time displayed on the screen. Therefore, if ↵ is pressed without updating the setting, delayed time will be shown instead of the actual current time. Be sure to press R if not changing the setting.

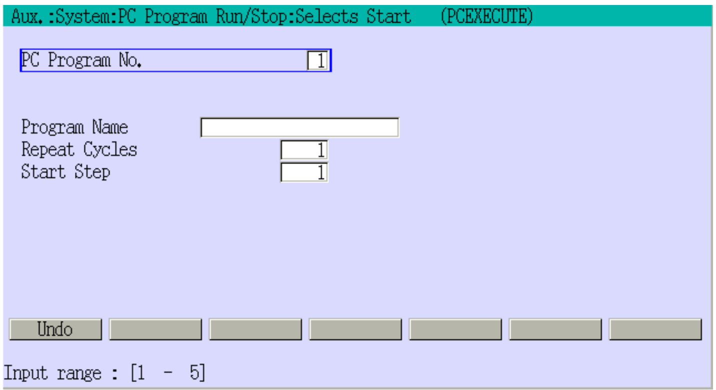
AUX. 0810 PC PROGRAM RUN/STOP

This function contains the following six sub-functions and enables PC programs to be run or held (stopped).

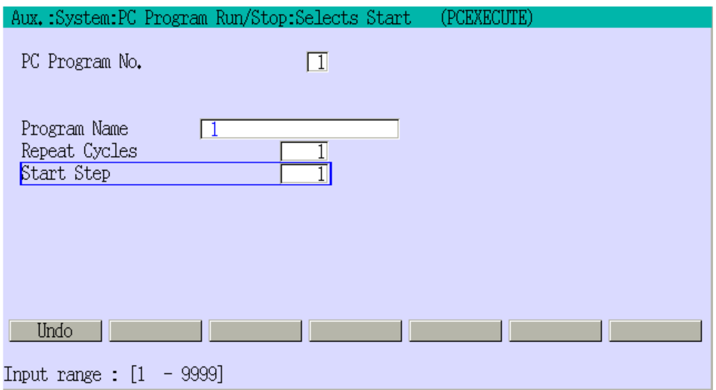


AUX. 081001 SELECTS START (PCEXECUTE)

This function executes the designated PC program. The program number and starting step can be selected.



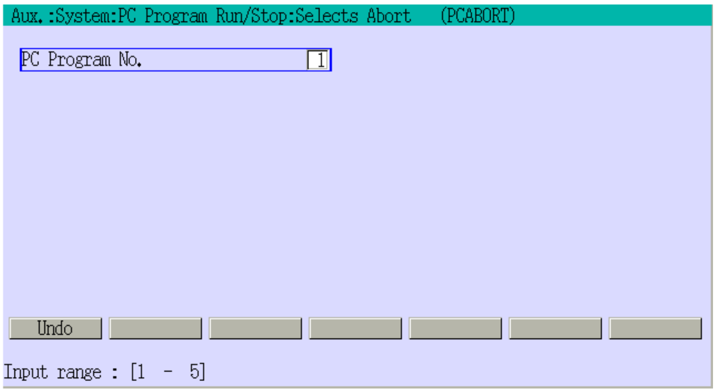
1. Input the desired number in [PC Program No.]. Or, move cursor to [Program Name] and press ↵ to display the program list. Select the desired program from the list.



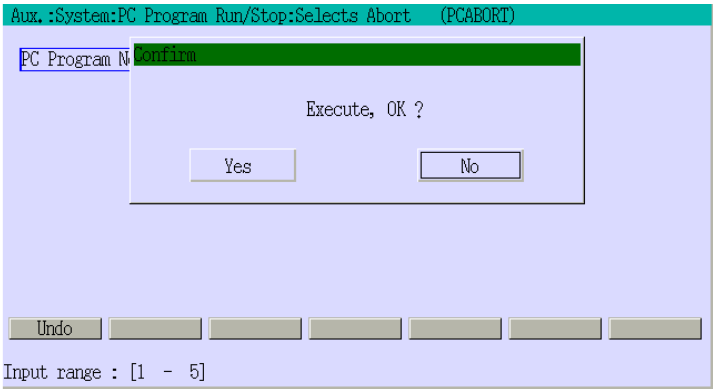
2. Input the desired numbers in [Repeat Cycles], [Start Step] and press ↵. If setting is correct, robot starts to execute the program.

AUX. 081002 SELECTS ABORT (PCABORT)

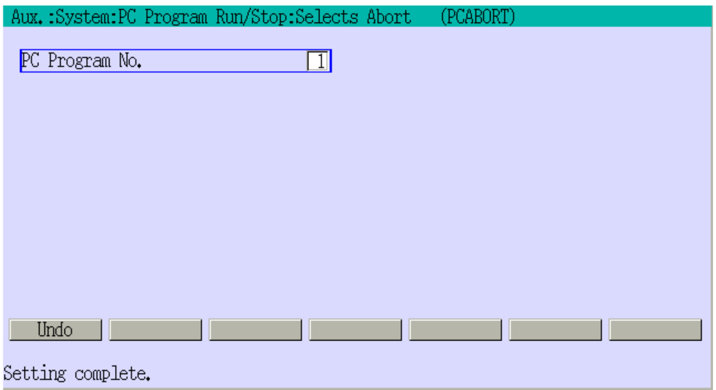
This function interrupts the currently executing PC program.



1. Input the desired program number and press ↵.



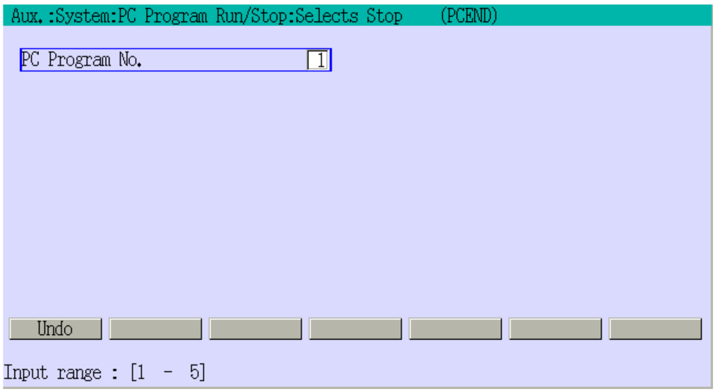
2. Confirmation box is displayed. Select [Yes] to execute or select [No] to cancel.



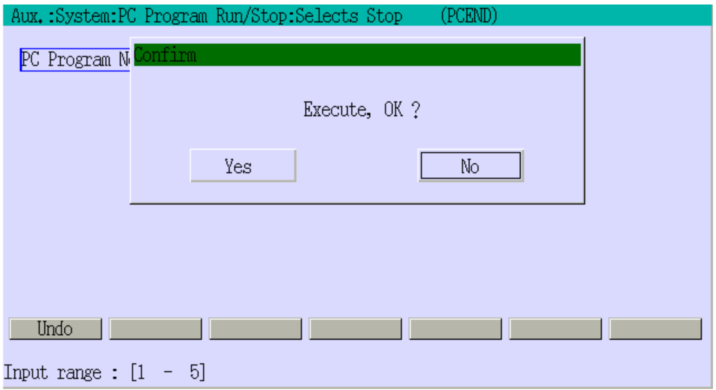
3. PC Program number is selected when “Setting complete.” is displayed.

AUX. 081003 SELECTS STOP (PCEND)

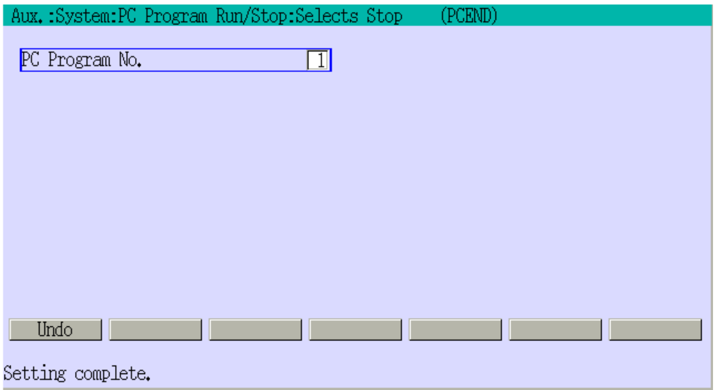
This function stops the currently running PC program after execution of the STOP instruction, or when the final step of the program has been executed.



1. Input the desired program number.



2. Pressing ↵ displays the confirmation box. Select [Yes] to execute or select [No] to cancel.



3. The PC Program is selected when “Setting complete.” is displayed.

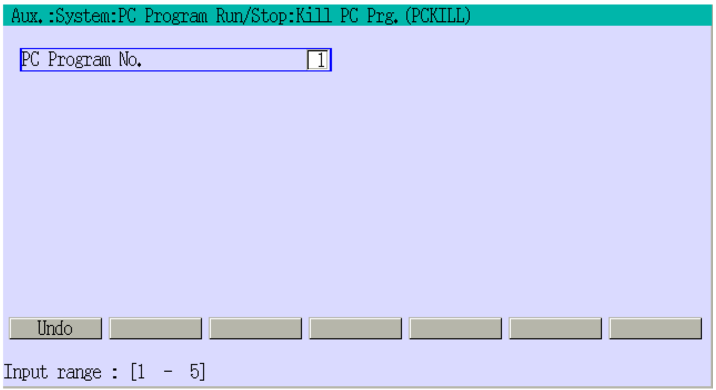
AUX. 081004 SELECT CONTINUE (PCCONTINUE)

This function restarts the PC program that is currently interrupted by PCABORT or PCEND.

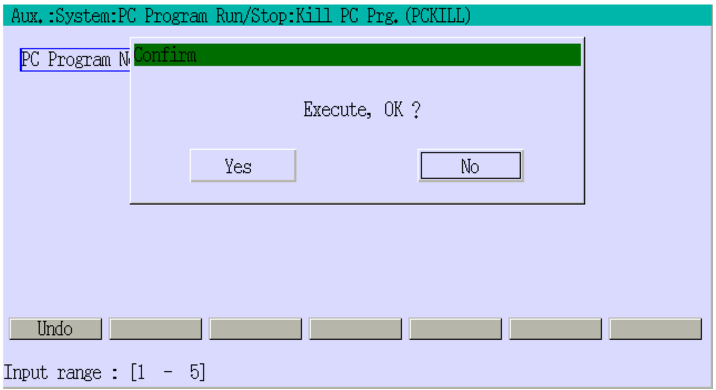
Input the desired program number and press ↵.

AUX. 081005 KILL PC PRG. (PCKILL)

This function cancels the currently selected PC program, and the stack becomes empty.



1. Input the desired program number and press ↵.

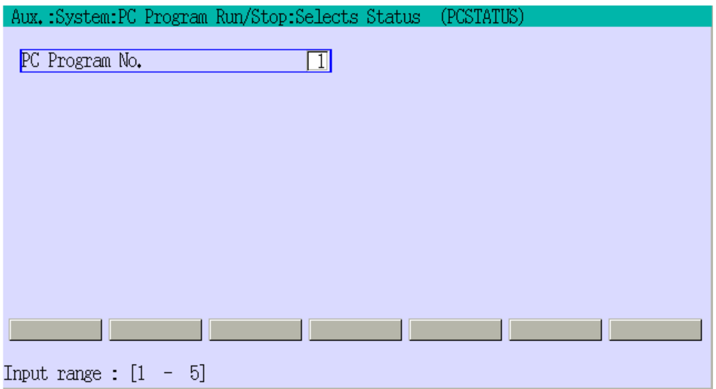


2. Confirmation box is displayed. Select [Yes] to execute or select [No] to cancel.

3. The PC Program number is stored when “Setting complete.” is displayed.

AUX. 081006 SELECTS STATUS (PCSTATUS)

This function displays status information for the currently executing PC program.

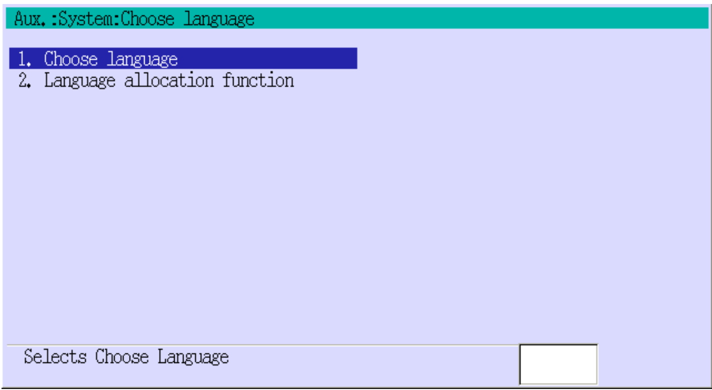


1. Input the desired PC program number.

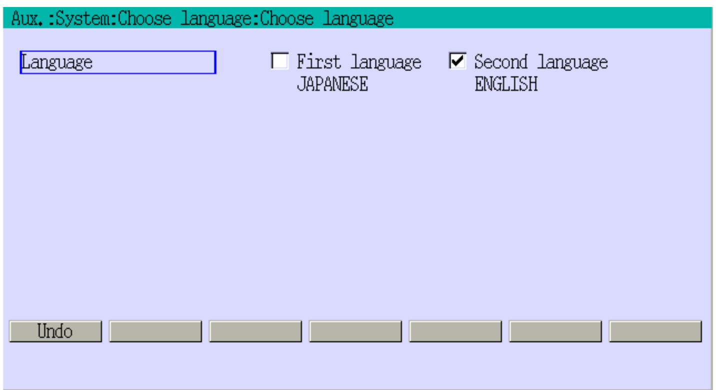
2. Pressing ↵ displays the status.

AUX. 0811 CHOOSE LANGUAGE

This function sets the language displayed on TP screen.　The selectable languages vary depending on the shipping destination of the robot.　Although the display language can be changed, not every language or combination of languages can be chosen.



AUX. 081101 CHOOSE LANGUAGE



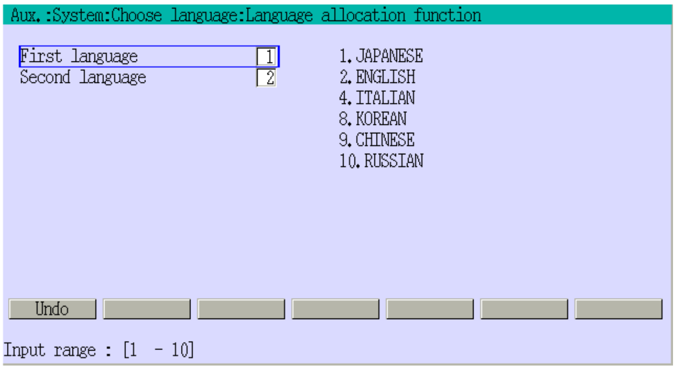
Select the desired language by A+←/→.　If the setting is correct, press ↵.　Selection is stored when “Setting complete.” is displayed.

The first and second language for the TP is set in Aux. 081102.

⚠ CAUTION

After registering the change of the display language, the previous screen is shown again.　At this time, the screen is refreshed so that all menus and on-screen items can be redisplayed in the new language.　Also, some message displays, for errors, etc., may not display correctly.　However, the display will only show the selected language after exiting from the current screen.

AUX. 081102 LANGUAGE ALLOCATION FUNCTION



Refer to the list of languages and input the desired number into [First language] and [Second language] as shown here.
If the setting is correct, press ↵.
Selections are stored when “Setting complete.” is displayed.

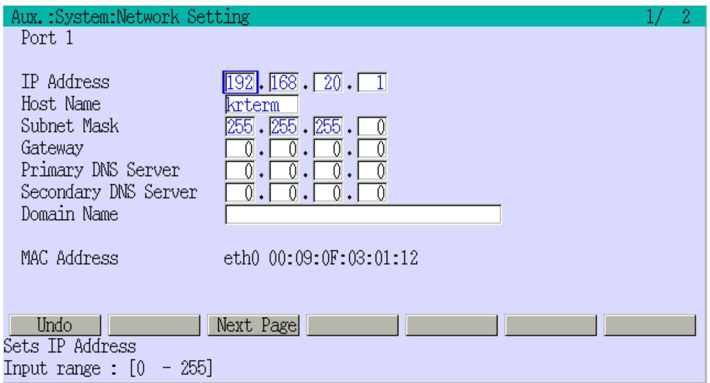
[NOTE]

Turn the contorller power OFF and then ON after changing the setting to make the new setting effective.

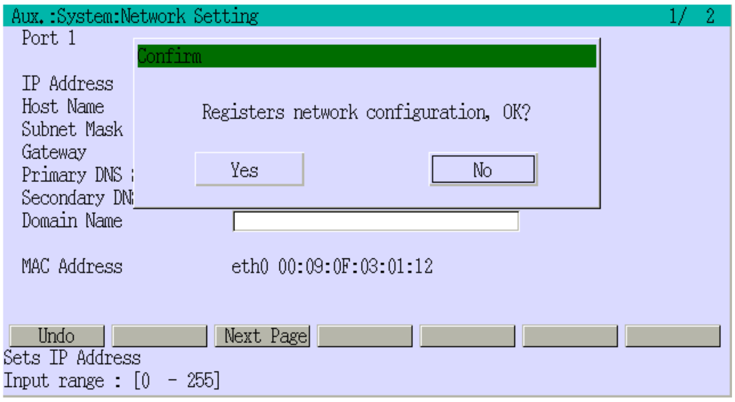
AUX. 0812 NETWORK SETTING

It is possible to treat the robot as a node on the information network when controller is connected to Ethernet using the ethernet port on main CPU board.　This function sets the necessary IP address, host name, subnet mask, gateway IP address, DNS server IP address, and domain name. Net work address is determined by bitwise AND of IP address and Subnet mask.

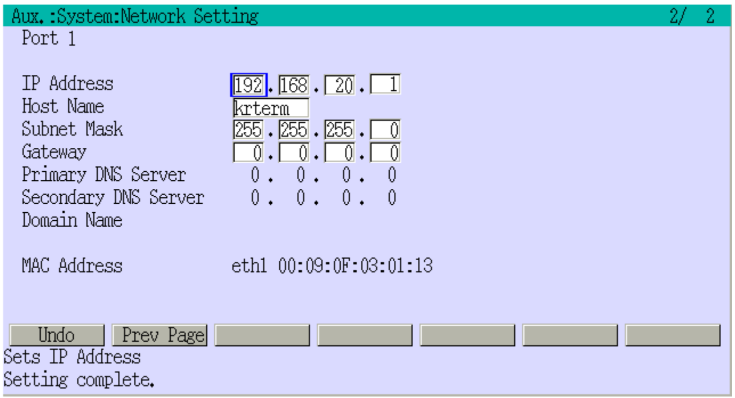
There are two ethernet ports on main CPU board.　The upper ethernet port is Port 1 and the lower one is Port 2.　Both ports data can be set by this function.



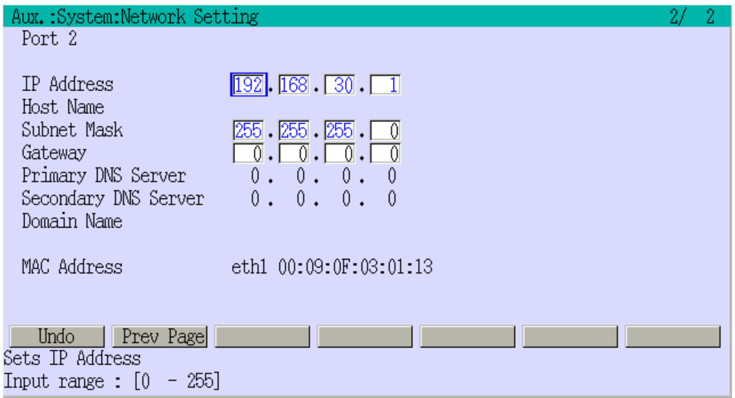
1. To set data for Port 1, input data for each item.　For [Hostname] and [Domain Name], move cursor to each item and press ↵ to display the keyboard screen, and then input the name.　If the setting is correct, press ↵.



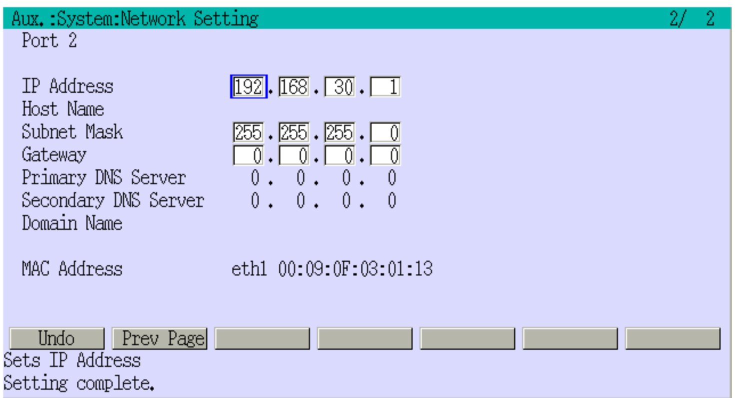
2. Confirmation box is displayed. Select [Yes] to execute or select [No] to cancel.



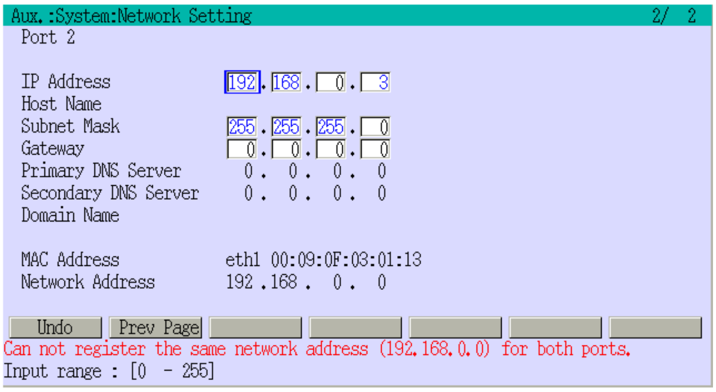
3. Set data are stored when “Setting complete.” is displayed.



4. To set data for Port 2, press <Next Page> to move to the settings page for Port 2.



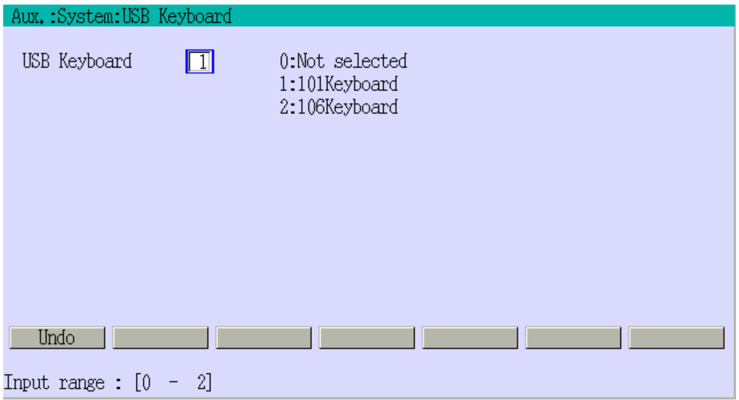
5. Set data for Port 2 in the same way as Port 1.　Don’t set the same network address to Port1 and Port2.　The same setting will result in abnormal communication.



6. The same network address can not be set to both Port1 and Port2.

AUX. 0818 USB KEYBOARD

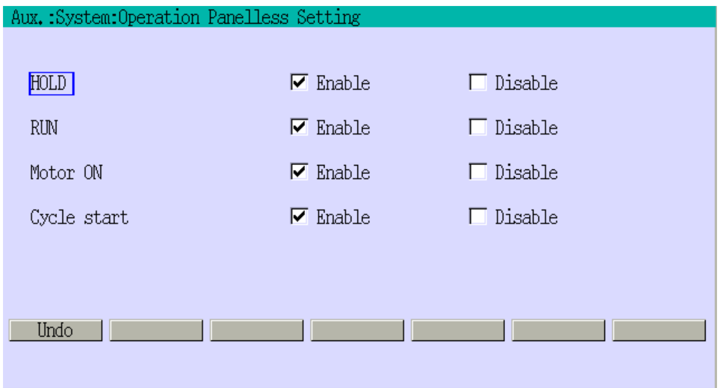
101 and 106 keyboards are available as USB keyboard.　This function specifies the type of USB keyboard to be used.　Specifying [0:Not selected] automatically selects a keyboard depending on the display language.　106 keyboard is selected for Japanese and 101 keyboard is for the other languages.



Input the type number of keyboard. If the setting is correct, press ↵. Selection result is stored when “Setting complete.” is displayed.

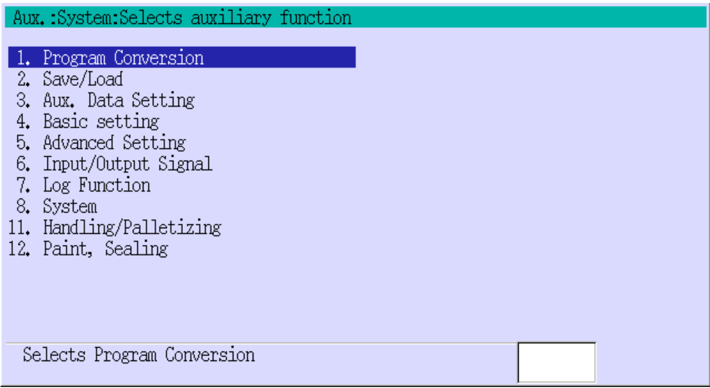
AUX. 0819　OPERATION PANELLESS SETTING

This fuction enables or disables HOLD/RUN, CYCLE START, MOTOR POWER switches on TP.　These switches become inoperative when they are set to Disable.　The setting on this function is effective to the switches only on the TP, not effective to those on the optional operation panel.

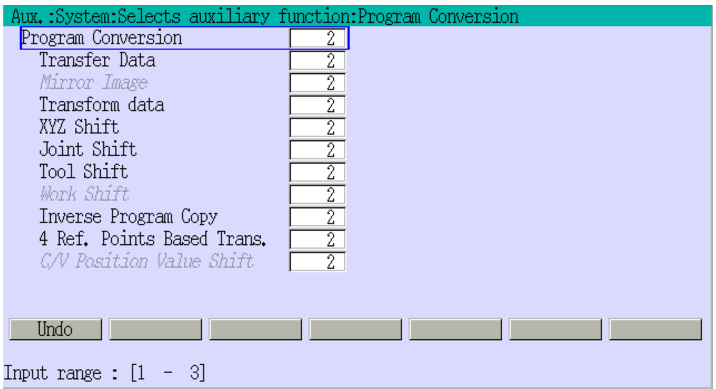


AUX. 0897 SELECTS AUXILIARY FUNCTION

This function sets a skill level and restricts access to individual auxiliary functions.　Levels 1 to 3 are available.　Setting a higher level indicates more skill is required for that function.　To define the skill level at which the auxiliary functions may be executed, specify in Aux. 0898. Setting skill level 3 does not display the specified auxiliary functions.　Setting skill levels 1 or 2 redisplays the specified functions.



1. Move cursor to the desired auxiliary function group item and press ↵.

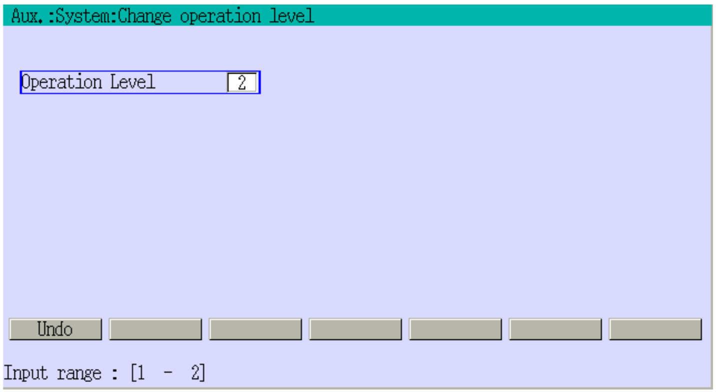


2. This displays the auxiliary functions for that group.　Specify and input a required skill level for each function.　Screen at left lists the aux. functions for the [1. Program Conversion] group.　If settings are correct, press ↵. Skill levels are stored when “Setting complete.” is displayed.

AUX. 0898 CHANGE OPERATION LEVEL

This function specifies the operation level which allows/prohibits executable aux. functions, based on the skill level set to each aux. function in Aux. 0897.

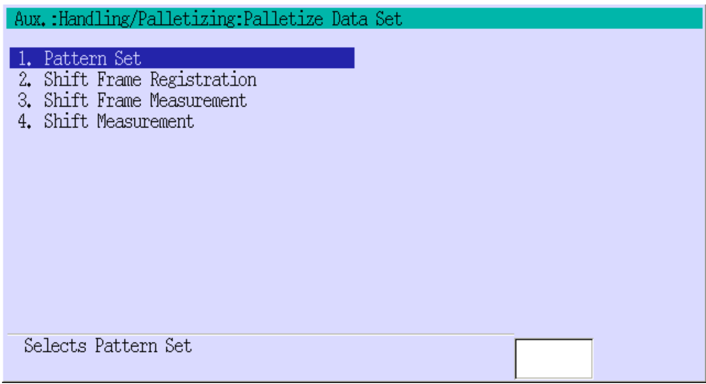
For example, specifying operation level 2 allows the execution of all auxiliary functions set to skill level 1 and 2 in Aux. 0897. (Specifying operation level 1 enables executing only auxiliary functions set to skill level 1 in Aux. 0897.)



Input 1 or 2 for [Operation Level]. If the setting is correct, press, ↵. Selection is stored when “Setting complete.” is displayed.

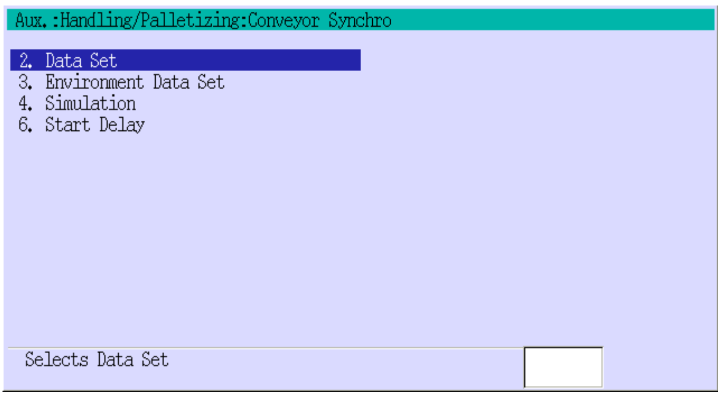
AUX.1101 HANDLING/PALLETIZING (OPTION)

This function contains the following four sub-functions and sets data for the simple palletizing function. For more details, refer to the optional manual “Simple Palletizing Function Manual”, a separate volume.



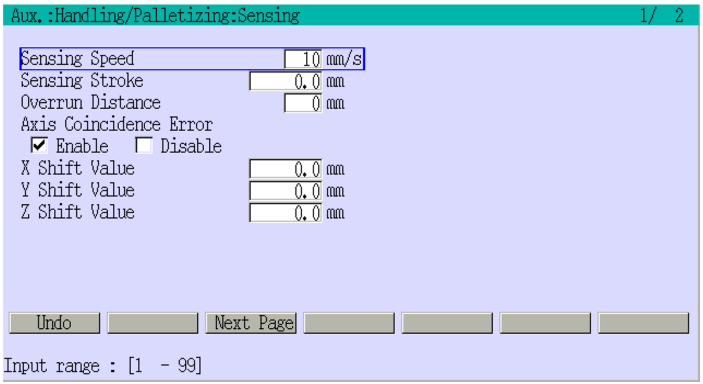
AUX.1102 CONVEYOR SYNCHRONIZATION (OPTION)

This function contains the following four sub-functions and sets data for conveyor synchronous operation. For more details, refer to the optional manual “Conveyor Synchronous Operation Manual”, a separate volume.



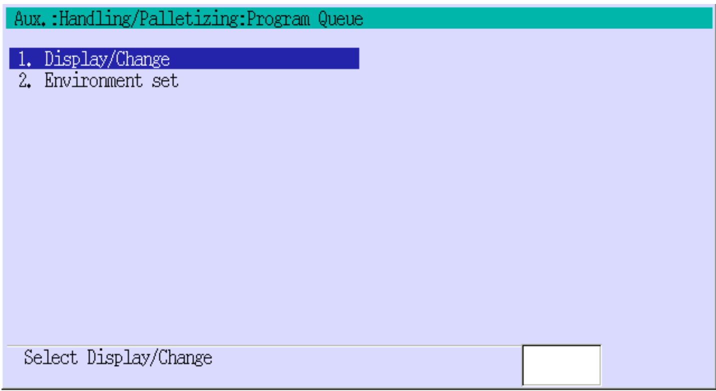
AUX.1103 SENSING (OPTION)

This function sets data for the sensing function so that the workpiece can be detected by the sensor on the robot. For more details, refer to the optional manual “Sensing Function Manual”, a separate volume.



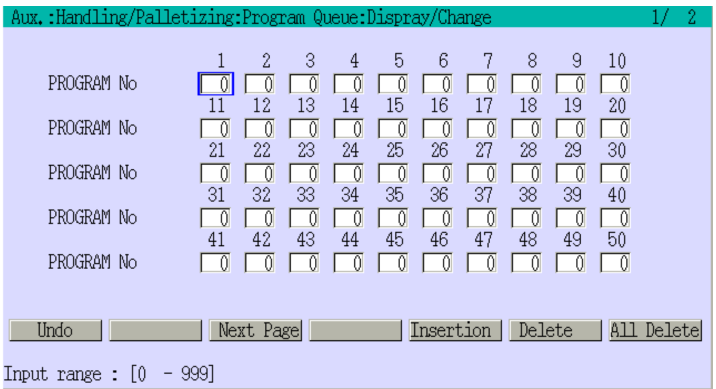
AUX.1123 PROGRAM QUEUE (OPTION)

This function edits data and sets environment of program queue.



AUX.112301 DISPLAY/CHANGE

This function executes display, insertion and deletion of the data in program queue.



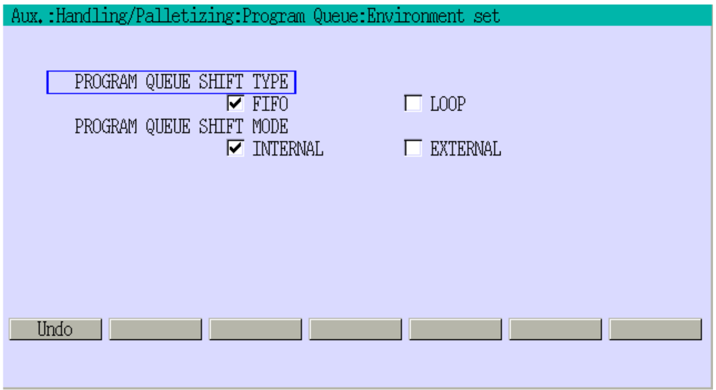
Input program number for each address and press <Insertion> to insert the program. Move cursor to the desired program number and press <Delete> to delete the program. Press <All Delete> to delete all the programs registered in the program queue.

[NOTE]

1. 100 programs can be registered in program queue.
2. Unfinished programs can be registered with numbers in program queue.
3. The same program number can be registered a number of times.
4. The program in a program queue is playbacked in the order of address number.

AUX.112302 ENVIRONMENT SET

Sets the environment of program queue.



Select [PROGRAM QUEUE SHIFT TYPE] and [PROGRAM QUEUE SHIFT MODE] by A + ←/→. If the setting is correct, press ↵. Selections are stored when “Setting complete.” is displayed.

Program queue shift type

Select the type of shift to apply to the queue table, when program queue is updated.

FIFO (First In First Out)	When program is switched, programs are shifted to forward addresses as shown below. When the last program in the queue is executed, all the programs disappear. Example Address 1 2 3 4 5 6 Program 10 11 3 5 6 0 ↓ Program switch Address 1 2 3 4 5 6 Program 11 3 5 6 0 0
LOOP	When program is switched, the executed program is registered again at the last address of the queue and looped. Example Address 1 2 3 4 5 6 Program 10 11 3 5 6 0 ↓ Program switch Address 1 2 3 4 5 6 Program 11 3 5 6 10 0

Program queue shift mode

This sets the program shift in the queue to be executed automatically or by external signals when program is switched.

Internal shift: Programs are shifted automatically when the program is switched.

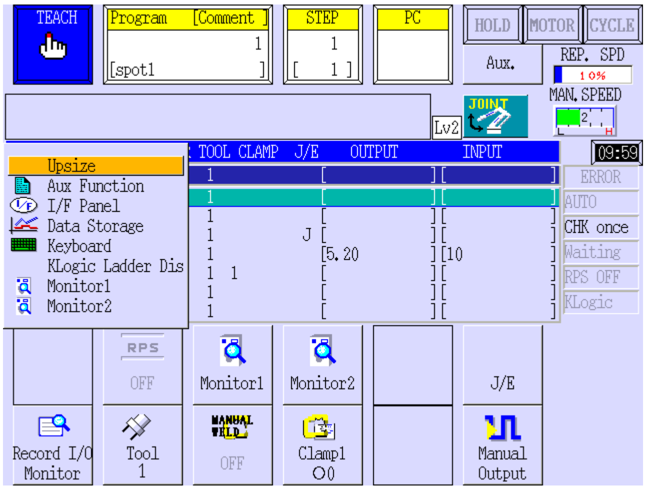
External shift: Programs are shifted by external signals.

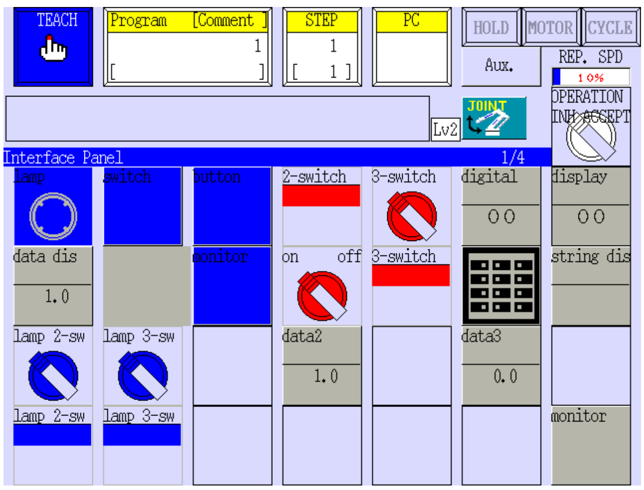
9.0 INTERFACE PANEL

Typically, a operation panel, known as interlock panel, is required to operate the robot and peripheral equipment together through a variety of hard switches and lamps. This controller provides an interface panel screen on the TP and enables the setting of the switches and lamps, changing arrangement of them etc. on the screen. This chapter describes this interface panel screen.

9.1 METHOD FOR SWITCHING TO INTERFACE PANEL SCREEN

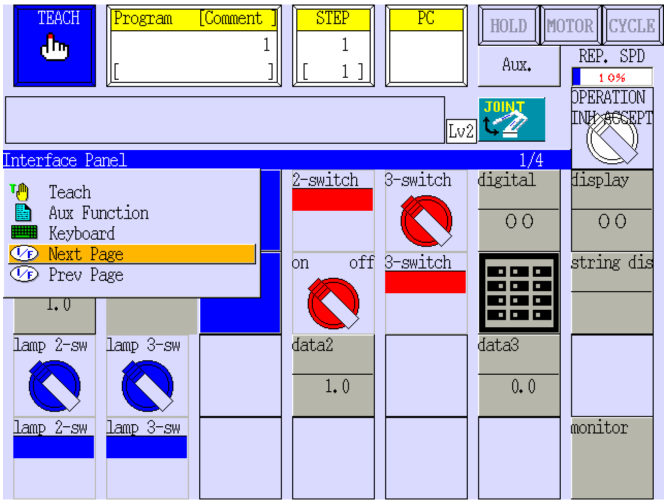
[I/F Panel] can be displayed on the pull-down menu in B area as shown in the screen below (top). Moving cursor to [I/F Panel] and pressing ↵ switches the B and C areas to the interface panel as shown in the screen below (bottom). Or, activate the B area, and press I/F Screen Change on the TP. I/F Screen Change switches between teach screen ↔ interface panel screen each time the key is pressed.





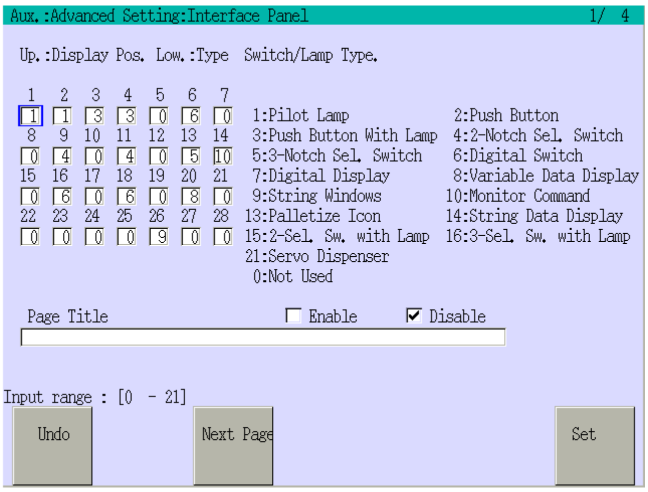
9.2 SETTING METHOD FOR INTERFACE PANEL SCREEN

Interface panel consists of several pages. Switch between interface panels by pressing [Next Page] and [Prev Page] on the B area pull-down menu as shown in the screen below. The number of pages of the interface panels can be set in Aux. 0808.



Each screen can have up to 28 devices (switches, lamps, etc.). Only devices that can be set in Aux. 0509 are available for the I/F Panel.

Selecting Aux. 0509 displays the screen shown below. This screen also consists of the pages set in Aux. 0808 with the page number displayed on the above right of the screen. Pressing <Next Page> switches to the next screen.



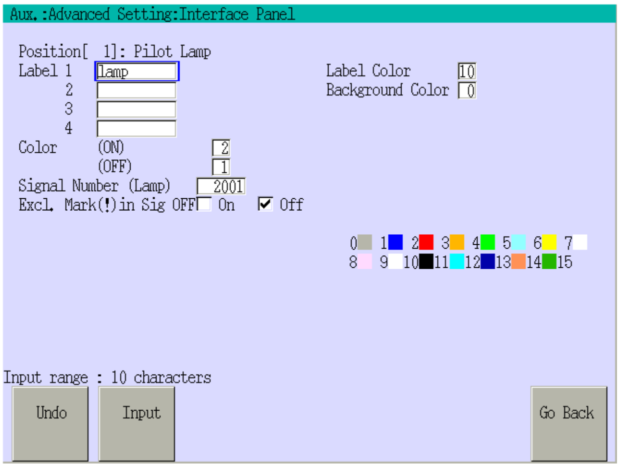
Inputting a device type number 1 to 10, 13-16 or 21 under the device position number sets the type of the device. Inputting 0 makes the device position blank on the interface panel. Once a device type number is input, pressing <Set> displays the device setting screen corresponding to its type.

9.3 SETTING METHOD FOR DEVICES

This section describes the function and procedure for setting devices provided in this controller.

9.3.1 PILOT LAMP

Inputting 1 in desired device position in the screen in Chapter 9.2, and pressing <Set> displays the setting screen shown in the screen below. Figures on the next page show the lamps set in the screen below.



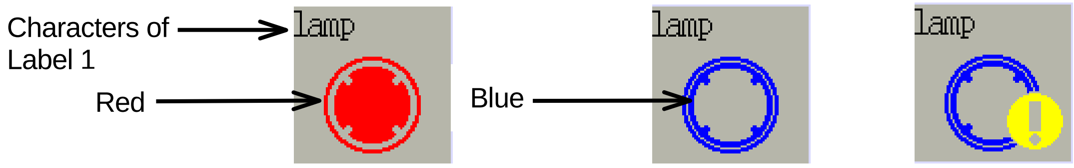
Set each data field as follows.

A max. of ten characters can be input in each row of [Label 1 to 4]. Moving cursor to [Label 1 to 4] and pressing <Input> displays the keyboard screen to input the label name. The characters “lamp” input in [Label 1] in the above screen are displayed on the top row as shown in the figure on the next page. The characters input in [Label 2 to 4] are displayed on the second to fourth rows under the [Label 1] characters.

Set the color of the characters in [Label Color], and the background color of the lamp in [Background Color]. Via the above setting, the characters are black and the background is gray. Refer to Chapter 9.3.16 for more details.

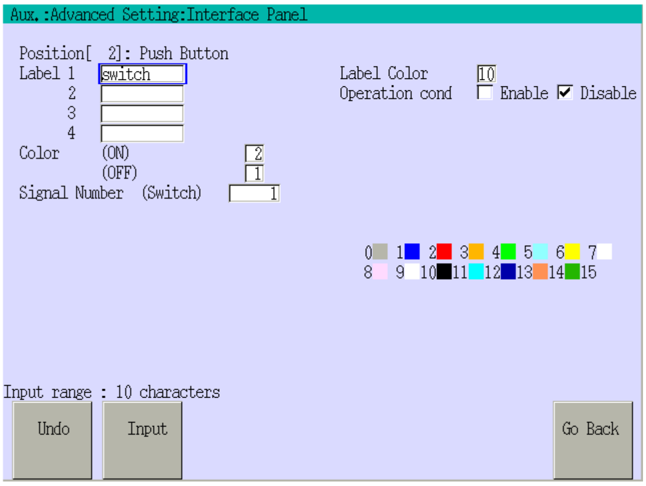
[Color (ON)/(OFF)] sets the lamp color when the signal set in [Signal Number (Lamp)] is ON and OFF respectively.

The setting of the above screen turns the lamp red as shown in the figure on the next page (left) when signal 2001 is ON, or blue as shown in the figure (middle) when signal 2001 is OFF. Or, if setting [On] in the [Excl. Mark (1) in Sig OFF], an exclamation mark is displayed as shown in the figure (right) when signal 2001 is OFF.



9.3.2 PUSH BUTTON

Inputting 2 in desired device position in the screen in Chapter 9.2, and pressing <Set> displays the setting screen shown below. Figures shown on the next page show the push buttons, set in the screen below.



Set each data field as follows.

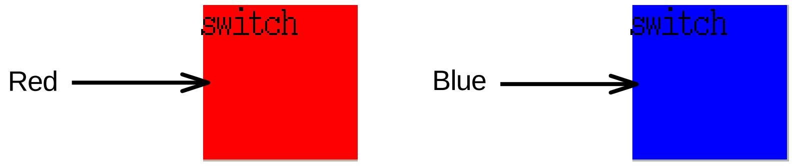
A max. of ten characters can be input in each row of [Label 1 to 4]. Moving cursor to [Label 1 to 4] and pressing <Input> displays the keyboard screen to input the label name. The characters “switch” input in [Label 1] in the above screen are displayed on the top row as shown in the figures on the next page. The characters input in [Label 2 to 4] are displayed on the second to fourth rows under the [Label 1] characters.

Set the color of the characters in [Label Color]. Via the above setting, the characters are black. Refer to Chapter 9.3.16 for more details.

[Color (ON)/(OFF)] sets the color when this switch is pressed and released respectively. Pressing this switch turns ON the signal set in [Signal Number (Switch)]. When the same signal as the set signal on the switch is ON, it automatically turns OFF if;

1. Interface panel screen is displayed or switched to the other screen.
2. Interface panel screen in the current page is switched to that of the other page.

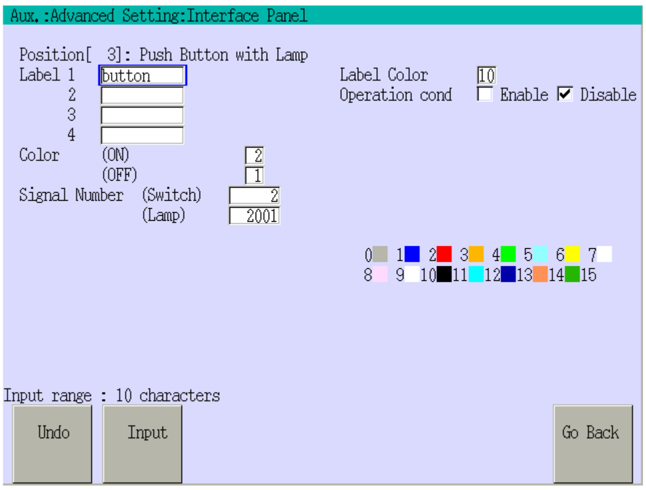
The setting in the above screen turns the switch red as shown in the figure below (left) when the switch is pressed and signal 1 turns ON, or blue as shown in the figure (right) when the switch is released and signal 1 turns OFF.



Setting [Operation cond] to [Enable] disables operation of this switch on the interface panel. To make it operable, turn the <INH/ACCEPT> switch displayed on the upper right of the screen in Chapter 9.2 to the ACCEPT position.

9.3.3 PUSH BUTTON WITH LAMP

Inputting 3 in desired device position in the screen in Chapter 9.2, and pressing <Set> displays the setting screen shown below. Figures shown on the next page show the push button with lamp, set in the screen below.



Set each data field as follows.

A max. of ten characters can be input in each row of [Label 1 to 4]. Moving cursor to [Label 1 to 4] and pressing <Input> displays the keyboard screen to input the label name. The characters “button” input in [Label 1] in the above screen are displayed on the top row as shown in the figures on the next page. The characters input in [Label 2 to 4] are displayed on the second to fourth rows under the [Label 1] characters.

Set the color of the characters in [Label Color]. Via the above setting, the characters are black. Refer to Chapter 9.3.16 for more details.

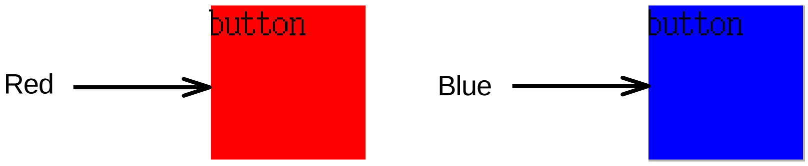
[Color (ON)/(OFF)] sets the color when this switch is pressed and released respectively. Pressing this switch turns ON the signal set in [Signal Number (Switch)].

When the signal set in [Signal Number (Lamp)] is ON, the switch is colored according to [Color (ON)] regardless of the ON/OFF status of the switch. When the same signal as the set signal on the switch is ON, it automatically turns OFF if;

1. Interface panel screen is displayed or is switched to the other screen.
2. Interface panel screen in the current page is switched to that of the other page.

When signal 2001 is OFF, the setting in the above screen turns the switch red as shown in the figure below (left) when the switch is pressed and signal 2 turns ON, or blue as shown in the figure (right) when the switch is released and signal 2 turns OFF.

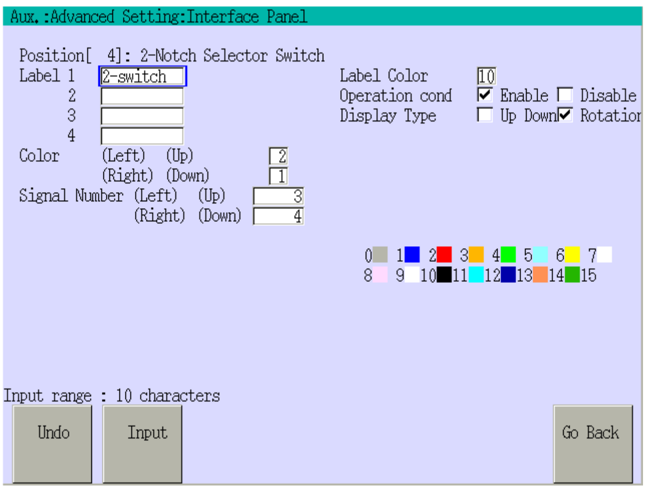
When signal 2001 is ON, the switch is turned red as shown in the figure below (left) regardless of whether or not the switch is pressed or released.



Setting [Operation cond] to [Enable] disables operation of this switch on the interface panel. To make it operable, turn the <INH/ACCEPT> switch displayed on the upper right of the screen in Chapter 9.2 to the ACCEPT position.

9.3.4 2-NOTCH SELECTOR SWITCH

Inputting 4 in desired device position in the screen in Chapter 9.2, and pressing <Set> displays the setting screen shown below. The figures shown on the next page show the 2-notch selector switch, set in the screen below.



Set each data field as follows.

A max. of ten characters can be input in each row of [Label 1 to 4]. Moving cursor to [Label 1 to 4] and pressing <Input> displays the keyboard screen to input the label name. The characters "2-switch" input in [Label 1] in the screen on the previous page are displayed on the top row as shown in the figures below. The characters input in [Label 2 to 4] are displayed on the second to fourth rows under the [Label 1] characters.

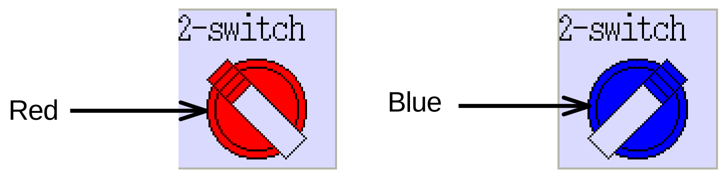
Set the color of the characters in [Label Color]. Via the setting on the previous page, the characters are black. Refer to Chapter 9.3.16 for more details.

Two types of switching are available for 2-notch switch. Select either [Up Down] or [Rotation] in [Display Type].

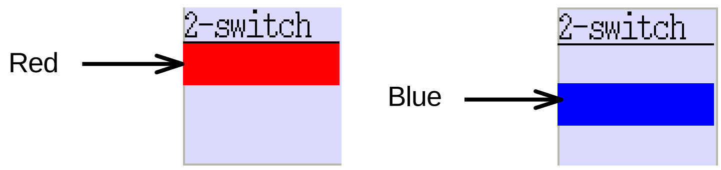
[Color] sets the color of the switch when the switch is turned (Left) and (Right) or (Up) and (Down).

When turned (Left) and (Right) or (Up) and (Down), the signal set in [Signal Number (Left), (Right) or (Up), (Down)] turns ON.

For [Rotation] type, the setting in the screen on the previous page turns the switch red as shown in the figure below (left) when the switch is turned (Left) and signal 3 turns ON, or blue as shown in the figure (right) when the switch is turned (Right) and signal 4 turns ON.



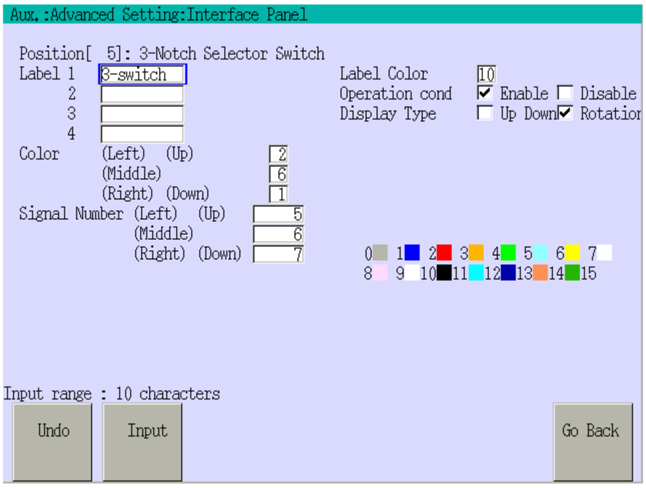
For [Up Down] type, the switch turns red as shown in the figure below (left) when pressed to the (Up) position and signal 3 turns ON, or blue as shown in the figure (right) when pressed to (Down) position and signal 4 turns ON.



Setting [Operation cond] to [Enable] disables operation of this switch on the interface panel. To make it operable, turn the <INH/ACCEPT> switch displayed on the upper right of the screen in Chapter 9.2 to the ACCEPT position.

9.3.5 3-NOTCH SELECTOR SWITCH

Inputting 5 in desired device position in the screen in Chapter 9.2, and pressing <Set> displays the setting screen shown below. Figures shown on the next page show the 3-notch selector switch, set in the screen below.



Set each data field as follows.

A max. of ten characters can be input in each row of [Label 1 to 4]. Moving cursor to [Label 1 to 4] and pressing <Input> displays the keyboard screen to input the label name. The characters "3-switch" input in [Label 1] in the above screen are displayed on the top row as shown in the figures on the next page. The characters input in [Label 2 to 4] are displayed on the second to fourth rows under the [Label 1] characters.

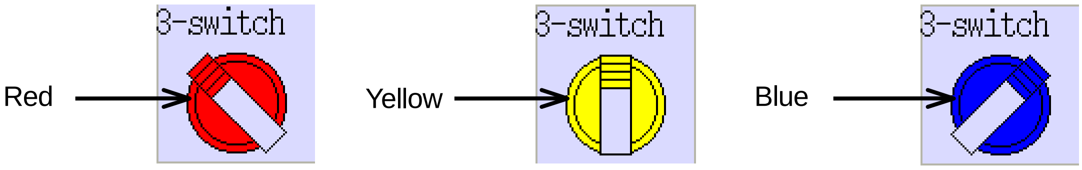
Set the color of the characters in [Label Color]. Via the above setting the characters are black. Refer to Chapter 9.3.16 for more details.

Two types of switching are available for 3-notch switch. Select either [Up Down] or [Rotation] in [Display Type].

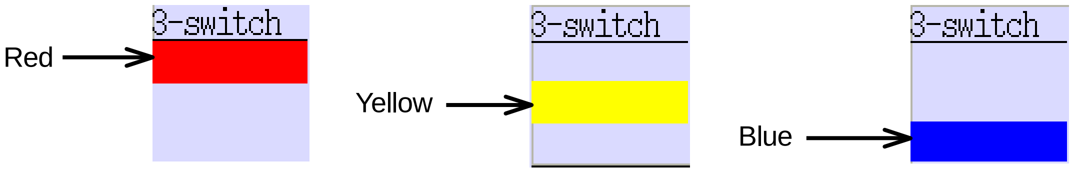
[Color] sets the color of the switch when the switch is turned (Left), (Middle), and (Right) or (Up), (Middle), and (Down).

When turned (Left), (Middle) and (Right) or (Up), (Middle) and (Down), the signal set in [Signal Number (Left), (Middle), (Right) or (UP), (Middle), (Down)] turns ON.

For [Rotation] type, the setting in the above screen turns the switch red as shown in the figure below (left) when the switch is turned (Left) and signal 5 turns ON, or yellow as shown in the figure below (middle) when the switch is turned (Middle) and signal 6 turns ON, or blue as shown in the figure (right) when switch is turned (Right) and signal 7 turns ON.



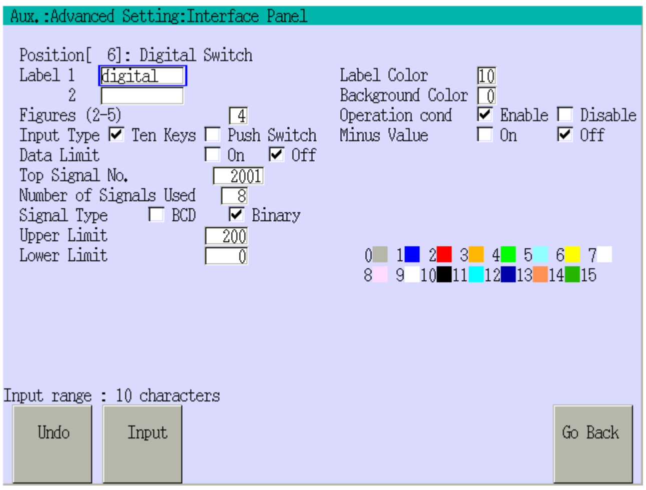
For [Up Down] type, the switch turns red as shown in the figure below (left) when set to the (Up) position and signal 5 turns ON, or yellow as shown in the figure (middle) when set to (Middle) and signal 6 turns ON, or blue as shown in the figure (right) when set to (Down) and signal 7 turns ON.



Setting [Operation cond] to [Enable] disables operation for this switch on the interface panel.　To make it operable, turn the <INH/ACCEPT> switch displayed on the upper right of the screen in Chapter 9.2 to the ACCEPT position.

9.3.6 DIGITAL SWITCH

Inputting 6 in desired device position in the screen in Chapter 9.2, and pressing <Set> displays the setting screen shown below.　The figure on the next page shows the digital switch, set in the screen below.



Set each data field as follows.

A max. of ten characters can be input in each row of [Label 1 or 2].　Moving cursor to [Label 1 or 2] and pressing <Input> displays the keyboard screen to input the label name.　The characters “digital” input in [Label 1] in the screen on the previous page are displayed on the top row as shown below.　The characters input in [Label 2] are displayed on the second row.

Set the color of the characters in [Label Color], and the background color of the switch in [Background Color].　Via the setting on the previous page, the characters are black and the background is gray.　Refer to Chapter 9.3.16 for more details.

[Figures (2-5)] sets how many digits can be displayed on the digital switch.

[Input Type] sets how to input numbers on the digital switch, by ten key or by pushing the switch. When selecting [Ten Keys], pressing the switch displays the Digital SW Input screen, then input NUMBER (0-9).　When selecting [Push Switch], the number only increases by pressing the switch.

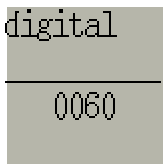
[Data Limit] sets a restriction on the range of allowable input data.　If the limit is set ON, it is necessary to specify both upper limit and lower limit.

The number set in [Top Signal No.] becomes the first channel of the signal output from the digital switch.　[Number of Signals Used] corresponds to the bit number of the output data.

[Signal Type] sets how the input number is output either by BCD or binary.

In [Minus Value], set [On] if there are two types of input data, using plus or minus signs.

The screen on the previous page sets [Top Signal No.] 2001, [Number of Signals Used] 8, [Signal Type] [Binary], and [Minus Value] [Off].　Therefore, setting 60 in the digital switch in the figure below outputs as follows.



⇩

Signal	2008	2007	2006	2005	2004	2003	2002	2001
Output State	OFF	OFF	ON	ON	ON	ON	OFF	OFF

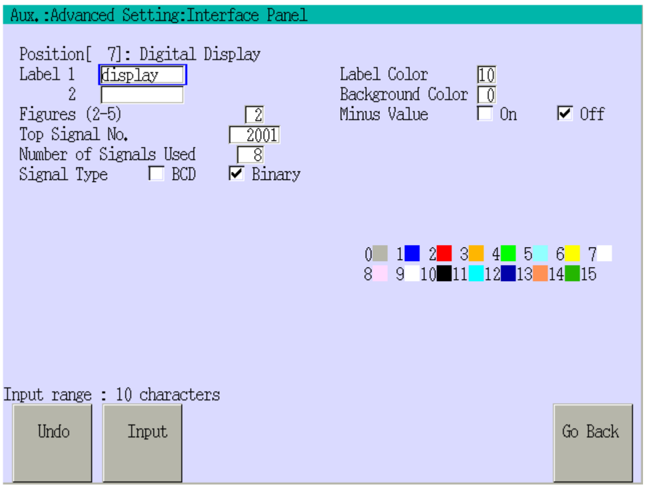
When setting [Signal Type] [BCD] in the screen on the previous page, setting 60 in the digital switch in the above figure outputs as follows.

Signal	2008	2007	2006	2005	2004	2003	2002	2001
Output State	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF

Setting [Operation cond] to [Enable] disables operation of this switch on the interface panel. To make it operable, turn the <INH/ACCEPT> switch displayed on the upper right of the screen in Chapter 9.2 to the ACCEPT position.

9.3.7 DIGITAL DISPLAY

Inputting 7 in desired device position in the screen in Chapter 9.2, and pressing <Set> displays the setting screen shown in the screen below. The figure on the next page shows the digital display, set in the screen below.



Set each data field as follows.

A max. of ten characters can be input in each row of [Label 1 or 2]. Moving cursor to [Label 1 or 2] and pressing <Input> displays the keyboard screen to input the label name. The characters "display" input in [Label 1] in the above screen are displayed on the top row as shown in the figure on the next page. The characters input in [Label 2] are displayed on the second row.

Set the color of the characters in [Label Color], and the background color of the display in [Background Color]. Via the above setting, the characters are black and the background is gray. Refer to Chapter 9.3.16 for more details.

[Figures (2-5)] sets how many digits can be displayed on the digital display.

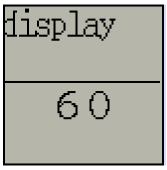
The number in [Top Signal No.] sets which input signal becomes the least significant bit.
[Number of Signals Used] corresponds to the bit number of the input data.
[Signal Type] sets how the input number is displayed either by BCD or binary.

In [Minus Value], set [On] if there are two types of input data, using plus or minus signs.

The screen on the previous page sets [Top Signal No.] 2001, [Number of Signals Used] 8, [Signal Type] [Binary], and [Minus Value] [Off]. Therefore, when input signal is as follows, the digital display displays as in the figure below.

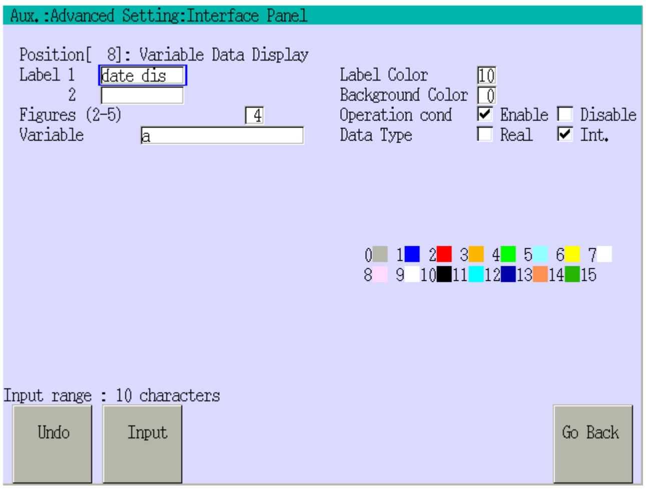
Signal	2008	2007	2006	2005	2004	2003	2002	2001
Input State	OFF	OFF	ON	ON	ON	ON	OFF	OFF

⇩



9.3.8 VARIABLE DATA DISPLAY

Inputting 8 in desired device position in the screen in Chapter 9.2, and pressing <Set> displays the setting screen shown below. The figure on the next page shows the data display, set in the screen below.



Set each data field as follows.

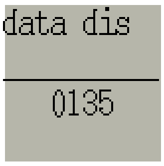
A max. of ten characters can be input in each row of [Label 1 or 2]. Moving cursor to [Label 1 or 2] and pressing <Input> displays the keyboard screen to input the label name. The characters “data dis” input in [Label 1] in the above screen are displayed on the top row as shown in the figure below. The characters input in [Label 2] are displayed on the second row.
Set the color of the characters in [Label Color], and the background color of the display in [Background Color]. Via the setting on the previous page, the characters are black and the background is gray. Refer to Chapter 9.3.16 for more details.

[Figures (2-5)] sets how many digits can be displayed on the variable data display.

In [Variable], input the variable name for the data to be displayed.

In [Data Type], set how to display the data, by real numbers or integers.

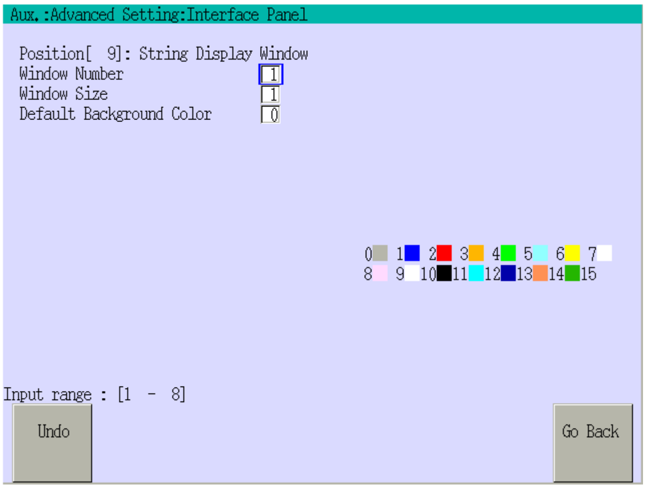
The screen on the previous page sets [Figures (2-5)] 4, [Variable] a, and [Data Type] [Int.]. Therefore, the data displayed when a=135 is as in the figure below.



Setting [Operation cond] to [Enable] disables display of data on this indicator on the interface panel. To change the data, turn the <INH/ACCEPT> switch displayed in upper right of screen in Chapter 9.2 to the ACCEPT position.

9.3.9 STRING DISPLAY WINDOW

Inputting 9 in desired device position in the screen in Chapter 9.2, and pressing <Set> displays the setting screen shown below.



Set each data field as follows.

In [Window Number], input a number (1-8).　Up to eight string display windows can be set per interface panel.

Inputting 1 in [Window Size] specifies the window to have the standard width, inputting 2 doubles the width, and inputting 3 triples the width.

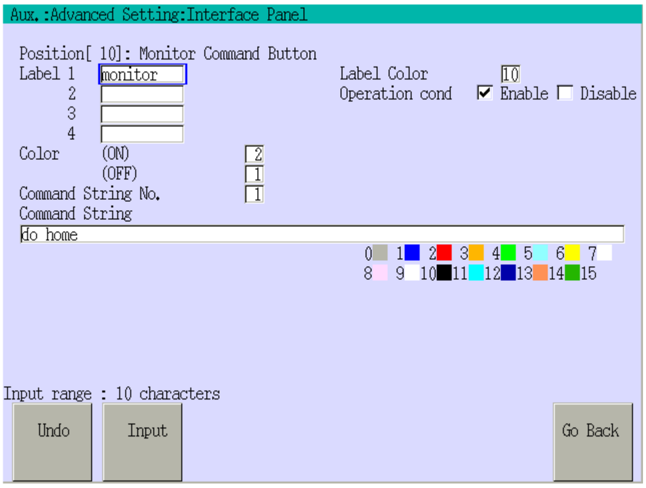
Set the color of the window display in [Default Background Color].　Via the setting on the previous page, the color of the window display is gray.　Refer to Chapter 9.3.16 for more details.

Inputting IFPWPRINT 1,1,1,0,10=”kawasaki” on the keyboard screen displays the figure below*.

NOTE* For the procedure for inputting the string, refer to the IFPWPRINT instruction in “5. Monitor Commands” of “AS Language Reference Manual”, a separate volume.

9.3.10 MONITOR COMMAND BUTTON

Inputting 10 in desired device position in the screen in Chapter 9.2, and pressing <Set> displays the setting screen shown below. The figures below show the monitor command button set in the screen below.



Set each data field as follows.

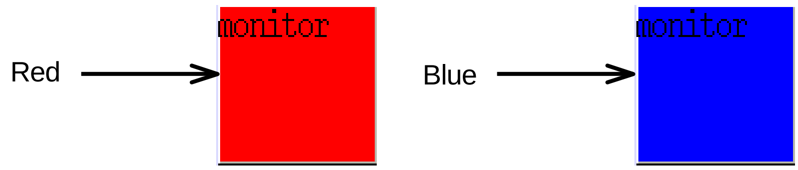
A max. of ten characters can be input in each row of [Label 1 to 4]. Moving cursor to [Label 1 to 4] and pressing <Input> displays the keyboard screen to input the label name. The characters “monitor” input in [Label 1] in the above screen are displayed on the top row as shown in the figures below. The characters input in [Label 2 to 4] are displayed on the second to fourth rows under the [Label 1] characters.

Set the color of the characters in [Label Color]. Via the setting on the previous page, the characters are black. Refer to Chapter 9.3.16 for more details.

[Color (ON)/(OFF)] sets the color when this switch is pressed and released respectively.

In [Command String No.] and [Command String], input the command to be executed. First, allocate the command string number to [Command String No.]. The same number can not be specified to the buttons of different commands. Then, input the command to be executed in [Command String]. Moving cursor to [Command String] and pressing <Input> displays the keyboard to input the string. Up to 75 characters can be input.

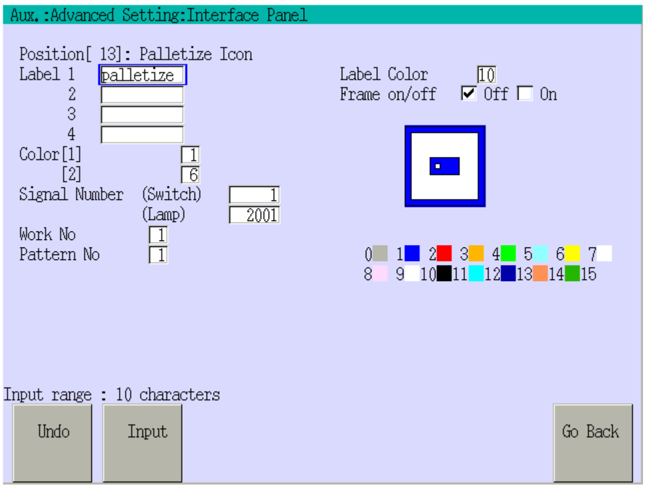
The setting of the above screen turns the switch red as shown in the figure below (left) and executes “do home”, i.e. the robot returns to the home pose, when this switch is pressed, or blue as shown in the figure (right) when the switch is released.



Setting [Operation cond] to [Enable] disables operation of this switch on the interface panel.　To make it operable, turn the <INH/ACCEPT> switch displayed on the upper right of the screen in Chapter 9.2 to the ACCEPT position.

9.3.11 PALLETIZE ICON

Inputting 13 in desired device position in the screen in Chapter 9.2, and pressing <Set> displays the setting screen shown below.　Figures shown on the next page show the palletize icon, set in the screen below.



Set each data field as follows.

A max. of ten characters can be input in each row of [Label 1 to 4].　Moving cursor to [Label 1 to 4] and pressing <Input> displays the keyboard screen to input the label name.　The characters "palletize" input in [Label 1] in the above screen are displayed on the top row as shown in the figures on the next page.　The characters input in [Label 2 to 4] are displayed on the second to fourth rows under the [Label 1] characters.

Set the color of the characters in [Label Color].　Via the above setting, the characters are black. Refer to Chapter 9.3.16 for more details.

[Color [1]/[2]] sets the color of the palletize icon.　The color in [1] sets the blue parts of the icon, shown on right half of the setting screen, and the color in [2] sets the white part of the icon.

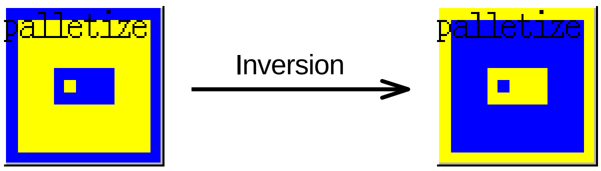
Pressing this switch turns ON the signal set in [Signal Number (Switch)].

Twelve kinds of [Work No.] can be specified by inputting a number (1 to 12). For [Pattern No.], several patterns, which correspond to the work No., are available for the icon. Setting both [Work No.] and [Pattern No.] displays a sample icon on the right side of the screen.

To display a frame around the icon, set [On] for [Frame on/off].

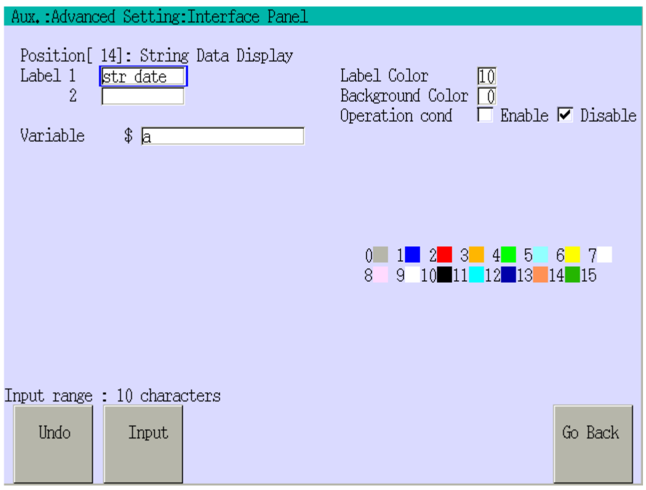
When signal 2001 is OFF, the settings in the above screen display the icon as shown in the figure below (left). When signal 2001 is ON, the colors [1] and [2] of the switch invert as shown in the figure below (right).

Pressing the palletize icon turns ON signal 1 and releasing the icon turns OFF the signal 1. The color of the icon does not change regardless of whether or not the switch is pressed or released.



9.3.12 STRING DATA DISPLAY

Inputting 14 in desired device position in the screen in Chapter 9.2, and pressing <Set> displays the setting screen shown below. The figure shown on the next page shows the string data display, set in the screen below.



Set each data field as follows.

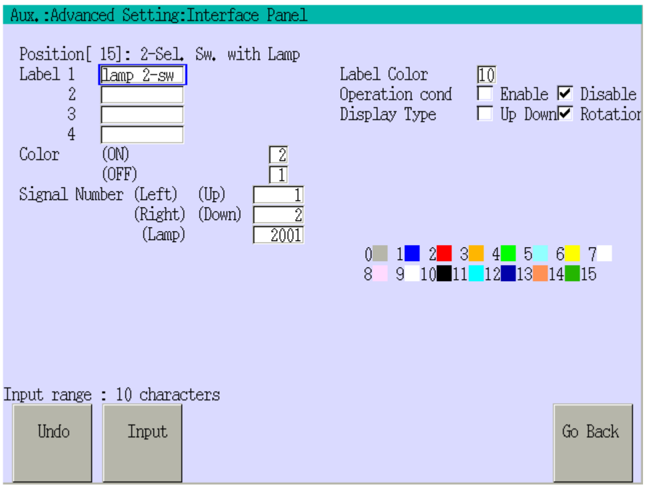
A max. of ten characters can be input in each row of [Label 1 or 2]. Moving cursor to [Label 1 or 2] and pressing <Input> displays the keyboard screen to input the label name. The characters “str data” input in [Label 1] in the above screen are displayed on the top row as shown on the next page. The characters input in [Label 2] are displayed on the second row.

Set the color of the characters in [Label Color], and the background color of the device in [Background Color]. Via the above setting, the characters are black and the background is gray. Refer to Chapter 9.3.16 for more details.
In [Variable], input the string data to display. In this setting, $a is set in [Variable]. Therefore, the figure below will be displayed if $a is ”kawasaki”.

Setting [Operation cond] to [Enable] disables display of this icon on the interface panel. To enable display of this icon, turn the <INH/ACCEPT> switch displayed on upper right of screen in Chapter 9.2 to the ACCEPT position.

9.3.13 2-SELECTOR SWITCH WITH LAMP

Inputting 15 in desired device position in the screen in Chapter 9.2, and pressing <Set> displays the setting screen shown below. The figures shown on the next page show the 2-selector switch with lamp, set in the screen below.



Set each data field as follows.

A max. of ten characters can be input in each row of [Label 1 to 4]. Moving cursor to [Label 1 to 4] and pressing <Input> displays the keyboard screen to input the label name. The characters “lamp 2-sw” input in [Label 1] in the above screen are displayed on the top row as shown in the figures on the next page. The characters input in [Label 2 to 4] are displayed on the second to fourth rows under the [Label 1] characters.

Set the color of the characters in [Label Color]. Via the above setting, the characters are black. Refer to Chapter 9.3.16 for more details.

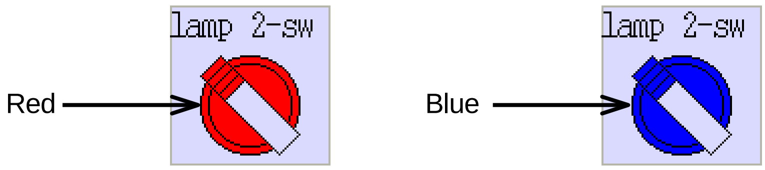
Two types of switching are available for 2-selector switch. Select either [Up Down] or [Rotation] in [Display Type].

[Color (ON)/(OFF)] sets the colors of the lamp when the signal set in [Signal Number (Lamp)] is ON and OFF respectively.

When the switch is turned (Left) and (Right) or (Up) and (Down), the signal set in [Signal Number (Left), (Right) or (Up), (Down)] turns ON.

The setting of the screen on the previous page turns the switch red when signal 2001 is ON or blue when the signal 2001 is OFF as shown below.

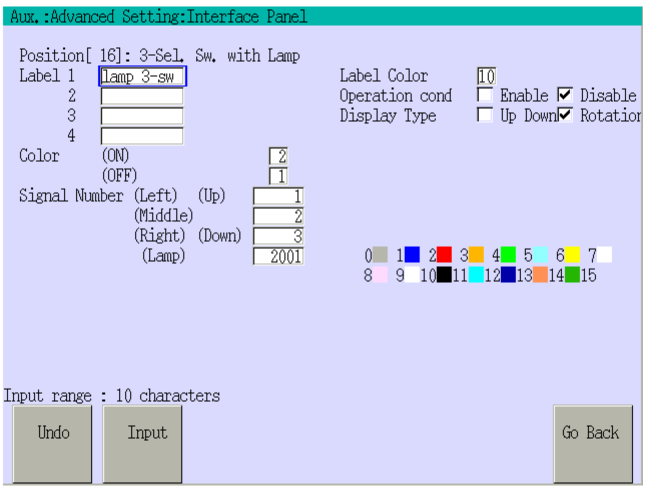
Signal 1 turns ON when the switch is turned (Left), and signal 2 turns ON when it is turned (Right). The color of the switch does not change even if the switch is turned (Left)/(Right).



Setting [Operation cond] to [Enable] disables operation of this switch on the interface panel. To make it operable, turn the <INH/ACCEPT> switch displayed on the upper right of the screen in Chapter 9.2 to the ACCEPT position.

9.3.14 3-SELECTOR SWITCH WITH LAMP

Inputting 16 in desired device position in the screen in Chapter 9.2, and pressing <Set> displays the setting screen shown below. Figures shown on the next page show the 3-selector switch, set in the screen below.



Set each data field as follows.

A max. of ten characters can be input in each row of [Label 1 to 4].　Moving cursor to [Label 1 to 4] and pressing <Input> displays the keyboard screen to input the label name.　The characters “lamp 3-sw” input in [Label 1] in the screen on the previous page are displayed on the top row as shown in the figures below.　The characters input in [Label 2 to 4] are displayed on the second to fourth rows under the [Label 1] characters.

Set the color of the characters in [Label Color].　Via the setting on the previous page, the characters are black.　Refer to Chapter 9.3.16 for more details.

Two types of switching are available for 3-selector switch.　Select either [Up Down] or [Rotation] in [Display Type].

[Color (ON)/(OFF)] sets the colors of the lamp when the signal set in [Signal Number (Lamp)] is ON and OFF respectively.

When the switch is turned (Left), (Middle) and (Right) or (Up), (Middle) and (Down), the signal set in [Signal Number (Left), (Middle), (Right) or (Up), (Middle), (Down)] turns ON.

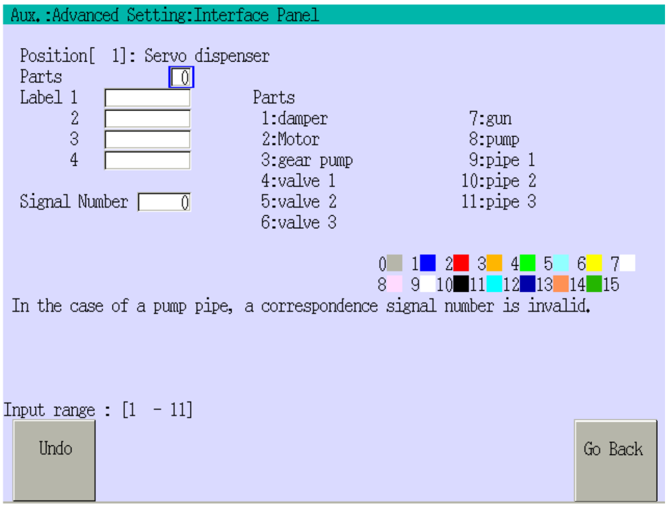
The setting of the screen on the previous page turns the switch red when signal 2001 is ON or blue when signal 2001 is OFF as shown below.

Signal 1 turns ON when the switch is turned (Left), signal 2 turns ON when it is turned (Middle), and signal 3 turns On when it is turned (Right).　The color of the switch does not change even if the switch is turned (Left)/(Middle)/(Right).

Setting [Operation cond] to [Enable] disables operation of this switch on the interface panel.　To make it operable, turn the <INH/ACCEPT> switch displayed on the upper right of the screen in Chapter 9.2 to the ACCEPT position.

9.3.15 SERVO DISPENSER

Inputting 21 in desired device position in the screen in Chapter 9.2, and pressing <Set> displays the setting screen shown below. The figures on the next page show the servo dispenser, set in the screen below.



Set each data field as follows.

In [Parts], specify one of the parts shown in the right half of the screen with a number (1-11). The part corresponding to the number will be displayed.

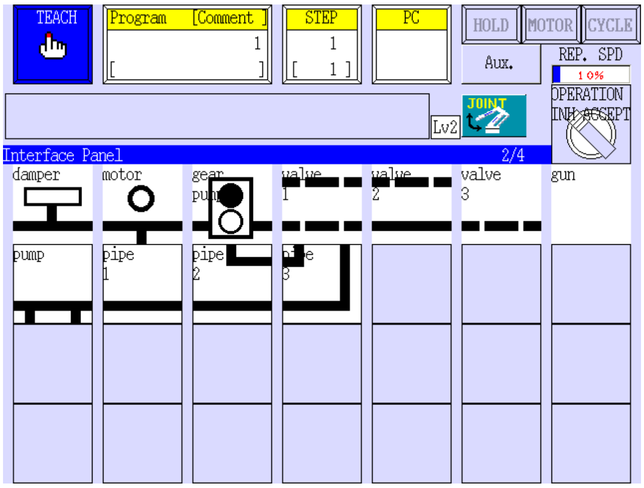
A max. of ten characters can be input in each row of [Label 1 to 4]. Moving cursor to [Label 1 to 4] and pressing <Input> displays the keyboard screen to input the label name. The characters “damper” input in [Label 1] in the above screen are displayed on the top row as shown in the screen on the next page. The characters input in [Label 2 to 4] are displayed on the second to fourth rows under the [Label 1] characters.

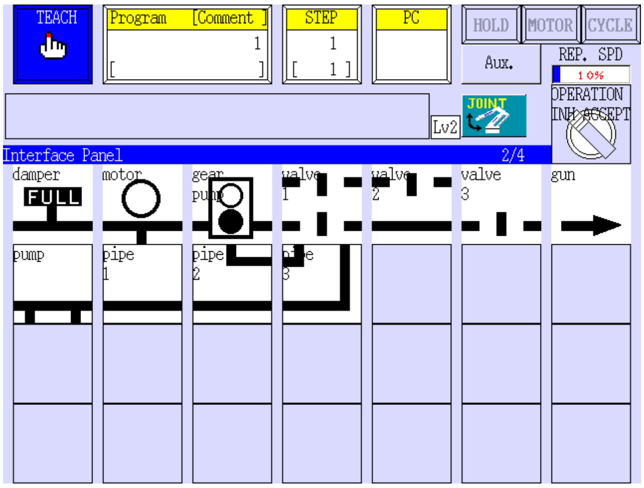
The servo dispenser icon changes when the signal set in [Signal Number] switches between ON and OFF. However, the pump and pipe icons do not change even if the signal set in [Signal Number] switches ON or OFF.

The setting of the above screen displays the damper as shown in the screen on the next page (top) when signal 2001 is ON. The damper shown in screen on next page (bottom) is displayed when signal 2001 is OFF.

Each part in the screen corresponds to the table below.

Damper	Motor	Gear pump	Valve 1	Valve 2	Valve 3	Gun
Pump	Pipe 1	Pipe 2	Pipe 3			





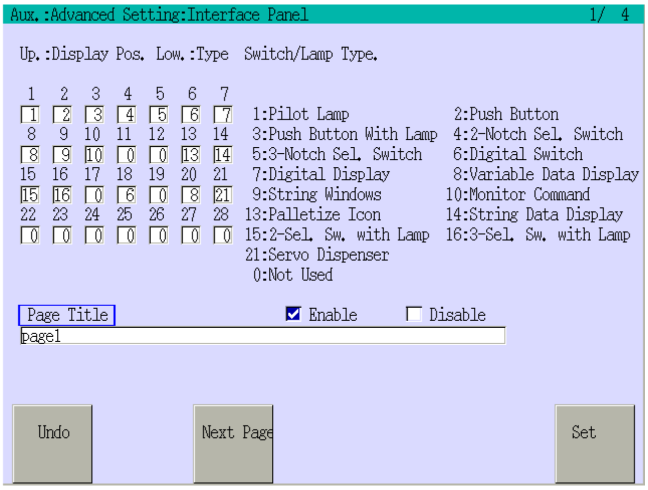
9.3.16 LABEL COLORS

The following 15 colors are available. Specify the color by the number 0 to 15.

No.	Color	No.	Color	No.	Color	No.	Color
0	Gray	4	Green	8	Pink	12	Navy
1	Blue	5	Pale Blue	9	White	13	Reddish Brown
2	Red	6	Yellow	10	Black	14	Dark Green
3	Orange	7	White	11	Cyan	15	Lavender

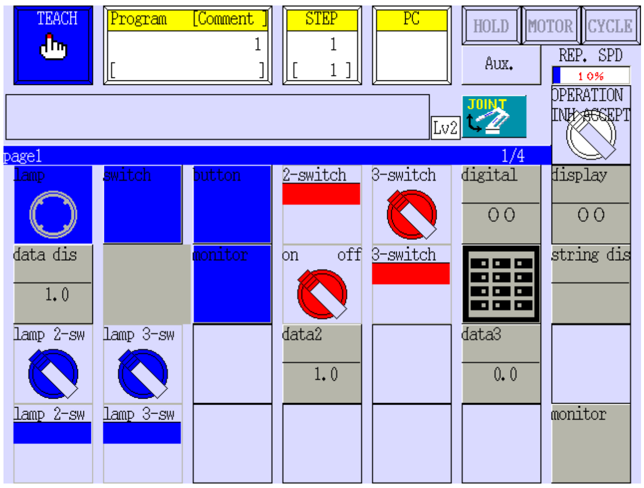
9.4 PAGE TITLE

On the interface panel screen, it is possible to set a title for each screen. To set the title, set [Page Title] to [Enable] in the screen in Chapter 9.2 and press <Input>. For example, inputting the title as shown below displays the screen on the bottom of this page.



When [Page Title] is set to [Disable] or when a title is not input, “Interface Panel”, the default title, will be displayed even if [Page Title] is set to [Enable].

A max. of 60 characters can be input in [Page Title]. Moving cursor to [Page Title] and pressing <Input> displays the keyboard screen to input the title.



10.0 AUTOMATIC TOOL (COORDINATES DATA) REGISTRATION

This chapter describes operation procedures for automatic registration of tool coordinates values by using the TP.

> **WARNING**
>
> **Automatic tool registration is a kind of teaching.　Its usage is limited to personnel who have completed special training and are qualified for teaching or supervising robot operations.**

10.1 OVERVIEW OF AUTOMATIC TOOL REGISTRATION FUNCTION

A variety of tools of different shapes (gun, hand, etc.) can be mounted on the wrist flange at the end of the arm when operating the robot.　If the tool data is not measured correctly at this time, the robot motion trajectory may deviate from the taught path and any errors or malfunctions may enlarge through the off-line data transformation.

In other words, the tool data is essential for operating the robot correctly.　In general, the tool data are input by numeric values and registered, but measurement of the position and orientation of the tool coordinates may not be accurate, or require a long time.

This function makes it possible to automatically register the tool transformation values by teaching several points in space without having to enter tool data values by numeric keys.

10.2 REQUIRED DATA FOR AUTOMATIC TOOL COORDINATES REGISTRATION

When using the automatic tool registration function, the following set of pose data is stored according to the condition of the tool data.　The pose data measurement is taken by aiming at one teaching point from 4 or 6 different tool poses, as described below.

Tool coordinates data

- When registering only tool coordinates (origin) position (X, Y, Z only)

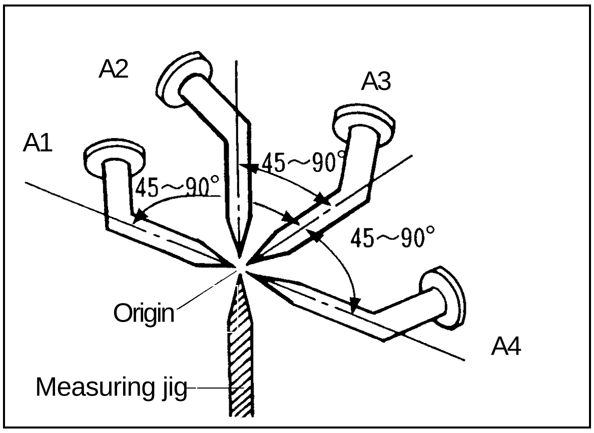
  Teaching pose consists of four base poses, A1, A2, A3, A4.

- When registering tool coordinates position (X, Y, Z) and orientation of the tool coordinates (angle values for O, A, T).

  Teaching pose consists of six base poses, A1, A2, A3, A4, B and C.

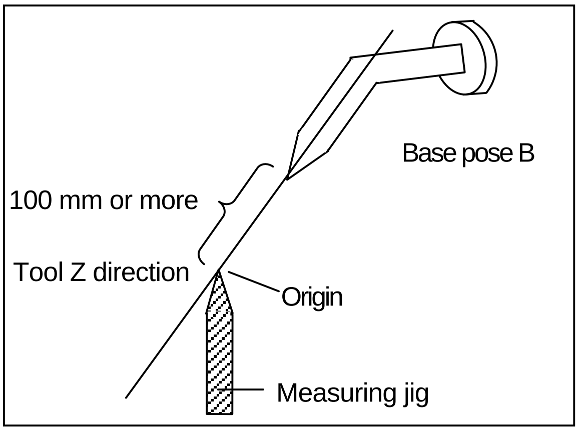
10.2.1 TEACHING THE FOUR BASE POSES

As shown in figure below, teach the 4 Base Poses (A1, A2, A3, A4) with the same position data but with different orientation data, aiming at the same tip point on a measuring jig. Ensure that the angles between each orientation are within the range 45° - 90°. The wrist flange face should have a different plane for each base orientation. Teach each base pose so that the tool coordinates and measuring jig origins are in contact with each other.



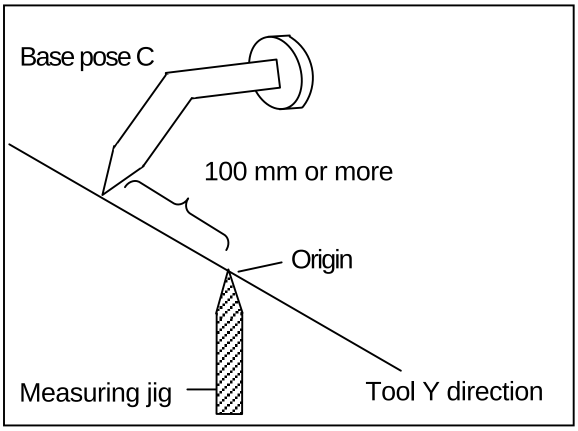
10.2.2 TEACHING THE TOOL Z DIRECTION DESIGNATION

For Base Pose B, teach so that contact is made between the Measuring Jig's Origin and a position 100 mm or more away from the TCP (tool center point) in the desired -Z direction of the tool as shown below.



10.2.3 TEACHING THE TOOL Y DIRECTION DESIGNATION

For Base Pose C, teach so that contact is made between the Measuring Jig's Origin and a position 100 mm or more away from the TCP in the desired +Y direction of the tool as shown below.



10.3 CAUTIONS FOR TEACHING BASE POSES

The purpose of the automatic tool registration function is to automate registration of the tool coordinates data by using the robot. Pay attention to the items below when using this function during teaching. Failure to do so may enlarge errors/deviations in the tool coordinates data.

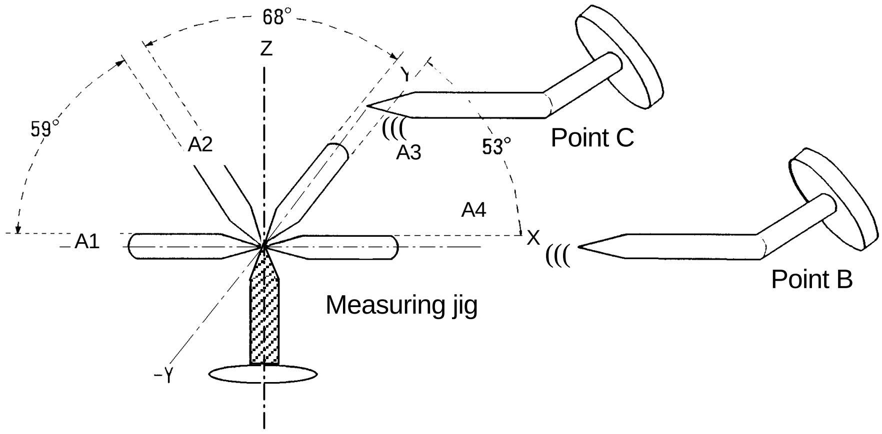
1. The angle between tool Z axes at Base Poses A1, A2, A3, and A4 should be within the range of 45°-90° as shown in the figure in Chapter 10.2.1.

2. The distance between the jig origin and tool coordinates origin at Base Poses B and C should be 100 mm or more as shown in the figure in Chapter 10.2.2 and Chapter 10.2.3.

3. Base Poses B and C should not be set at the same position as the jig origin. (Doing so results in error.)

4. When teaching Base Poses A1, A2, A3, A4, B, C, take note that if the position data for 2 or more poses is the same, an error may occur.

As an example, the figure below shows one method for teaching poses B and C.



Teach pose A4 so that the tool Z axis runs parallel with the base coordinates X axis.

⇩ ⇩

Teaching Pose B
Teach Pose B by moving tool 100 mm or more away from the origin along the base coordinates +X direction (tool –Z direction), keeping the same orientation as A4.

Teaching Pose C
Teach Pose C by moving tool 100 mm or more away from the origin along the base coordinate +Y direction (tool +Y direction), keeping the same orientation as A4.

10.4 OPERATION METHOD FOR AUTOMATIC TOOL REGISTRATION

10.4.1 PREPARATIONS FOR AUTOMATIC TOOL REGISTRATION

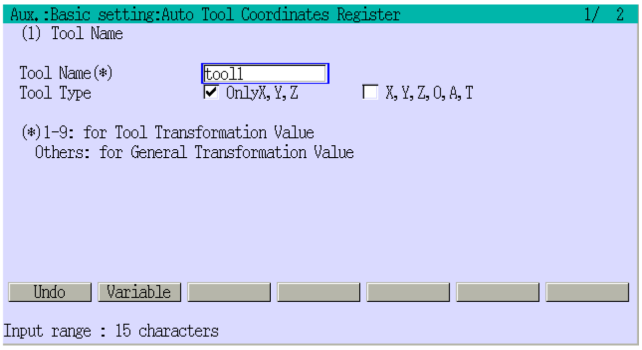
Follow the procedure described below.

1. Select [Aux. Function] from pull-down menu in B area to display the auxiliary function screen.

2. Select Aux. 0405.

3. Input [Tool Name] and [Tool Type] in the screen on the next page.

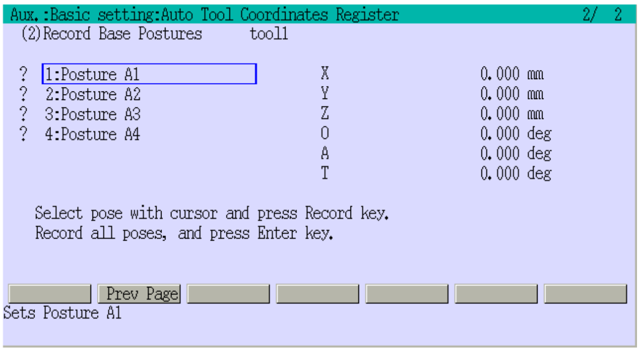
   Selecting the tool names 1 to 9 corresponds to tools 1 to 9 in Aux. 0304. Also, optional names may be entered for the tools by <Variable> and registered as variable names or system data. For [Tool Type], select either [Only X, Y, Z] or [X, Y, Z, O, A, T].



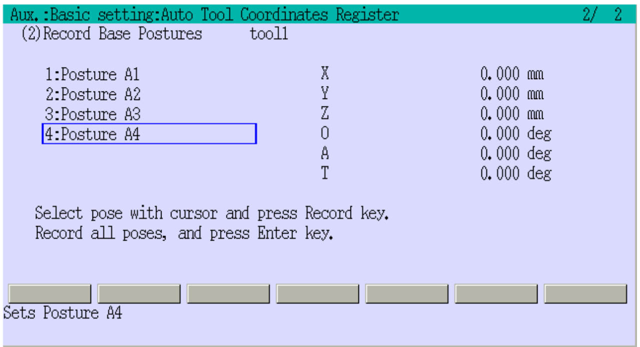
4. When the setting is complete, press ↵.

10.4.2 REGISTERING BASE POSES DATA

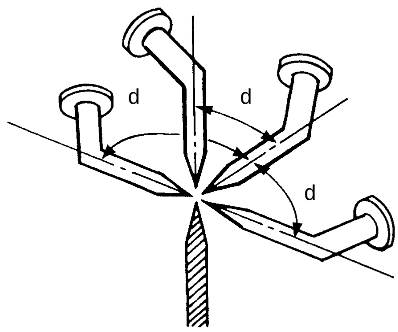
Register the base poses data in the Record Base Postures screen.



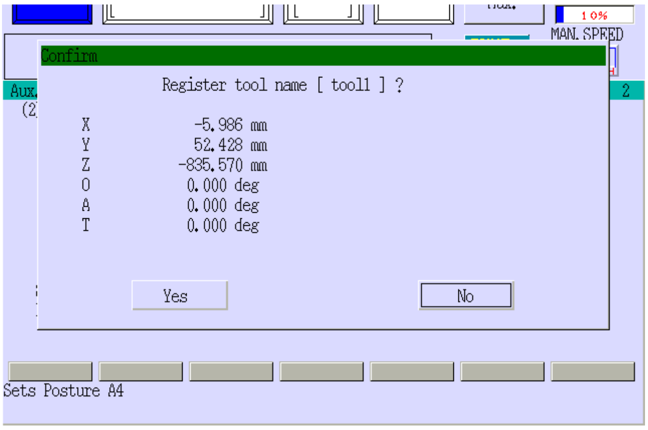
1. Move robot to the A1 pose of the four base poses. Move cursor to [A1] as shown in the screen on the left and press REC. Register [A2] to [A4] (B and C) in the same way.



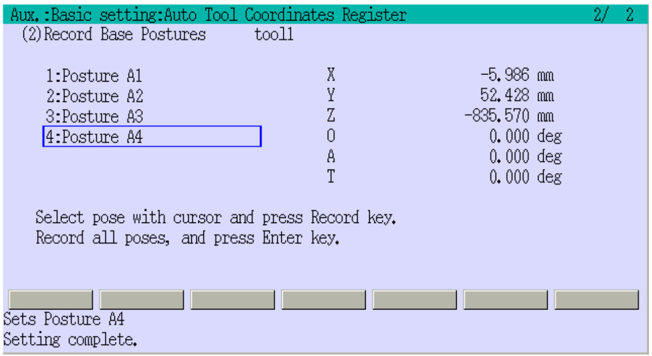
2. When the base poses data is registered, the "?" mark disappears in the margin of the item. Register all the base poses data, and press ↵.

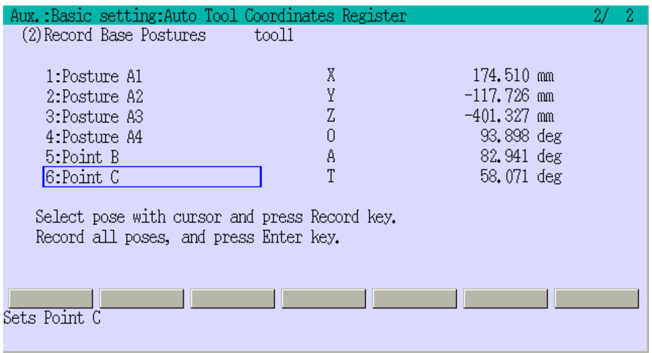


In teaching the 4 base poses (A1-A4), set each angle for d within the range of 45°-90°.



3. If warning is displayed in the screen as shown on the left, select [No] and register the tool coordinates data again. If no warning is displayed, select [Yes].





4. When registration completes, tool coordinates data calculated from the registered data are displayed and registered in the memory. For tool names 1 to 9, the data are registered in their corresponding tool numbers. 1 to 9 in Aux. 0304. For tool names with other characters (abc, tool1, etc.), the data are registered as variable names with transformation values.

When selecting [Only X, Y, Z] as [Tool Type], data for A1 to A4 are registered and X, Y and Z are displayed as coordinates data.

When selecting [X, Y, Z, O, A, T], data for A1 to A4, B and C are registered and X, Y, Z, O, A and T values are displayed as tool coordinates data as in the figure on the left.

11.0 ROBOT MOTION PARAMETER VALUES SETTINGS

In the E series controller, the moment of inertia and gravity load are calculated per axis, and robot motion is controlled based on these calculation results to elicit optimal performance for cycle time, trajectory accuracy, etc.　Therefore, parameters such as tool mass, torque and robot installation posture must be set properly.

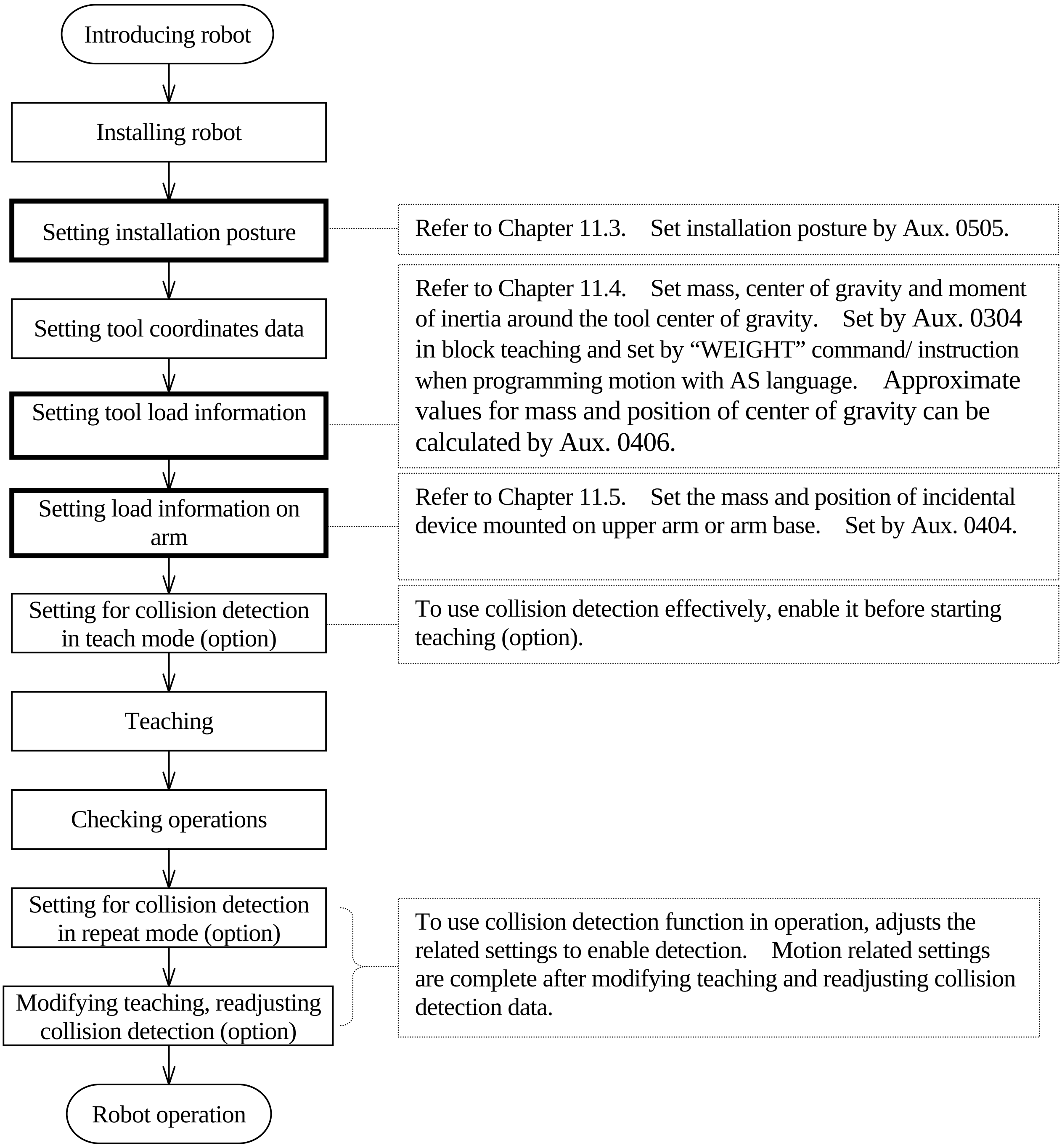
Follow the procedures described in this section to set tool mass/torque and robot installation posture, these settings are essential to elicit high motion performance.

WARNING

Setting of parameter values is a kind of teaching.　Usage of these functions is limited to personnel who have completed special training and are qualified for teaching or supervising robot operations.

11.1 ROBOT MOTION PARAMETER VALUES SETTING FLOWCHART

The flowchart below shows an overview of the steps required for optimizing robot motion from robot introduction to start of robot operations.



NOTE: For the above settings, refer to the following manuals.

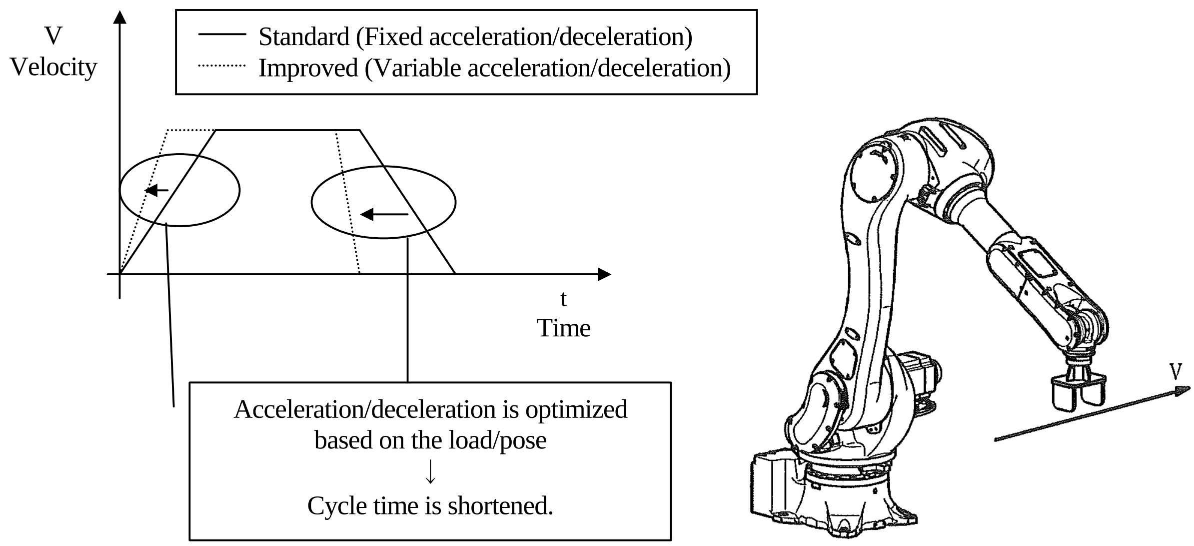
1. E Series Controller AS Language Reference Manual
2. Collision Detection Function (Option)

11.2 FUNCTIONS AFFECTED BY ROBOT MOTION PARAMETERS

The moment of inertia and gravity load are calculated per axis, and robot motion is controlled based on these calculation results to achieve a shorter cycle time, accurate trajectory, etc. To make the robot run at maximum capability, follow the procedures below to properly set the parameter values for tool mass, torque and robot installation posture. Functions affected by robot motion parameters are described below.

11.2.1 VARIABLE ACCELERATION/DECELERATION FUNCTION

This function automatically sets the most suitable acceleration/deceleration according to the robot arm pose and load mass. This function effectively shortens robot cycle time (Not available in some robot models.).



This function controls motions based on the dynamic condition of the robot. Therefore, all of the following affect motion control: Installation posture, Load data of the tool (mass, center of gravity, moment of inertia around center of gravity), Load on Arm (mass and mounting position). To optimize robot cycle time, each of these parameter values must be set properly.

> **CAUTION**
>
> 1. **Be sure to register the correct mass, center of gravity and moments of inertia. Registering the wrong value may decrease the service life of component parts, causing motor overload or deviation errors.**
> 2. **Be sure to register the correct installation posture. Registering the wrong posture may decrease the service life of the component parts, causing motor overload or deviation errors.**

11.2.2 VIBRATION INHIBITORY CONTROL

The E series controller constantly calculates and controls real-time changes in the moment of inertia, rigidity and gravity load of each axis to prevent vibration on the tip of robot arm. In order to minimize robot vibration and achieve maximum motion performance, the tool load information, installation posture, etc. must be set properly.

11.2.3 COLLISION DETECTION FUNCTION (OPTION)

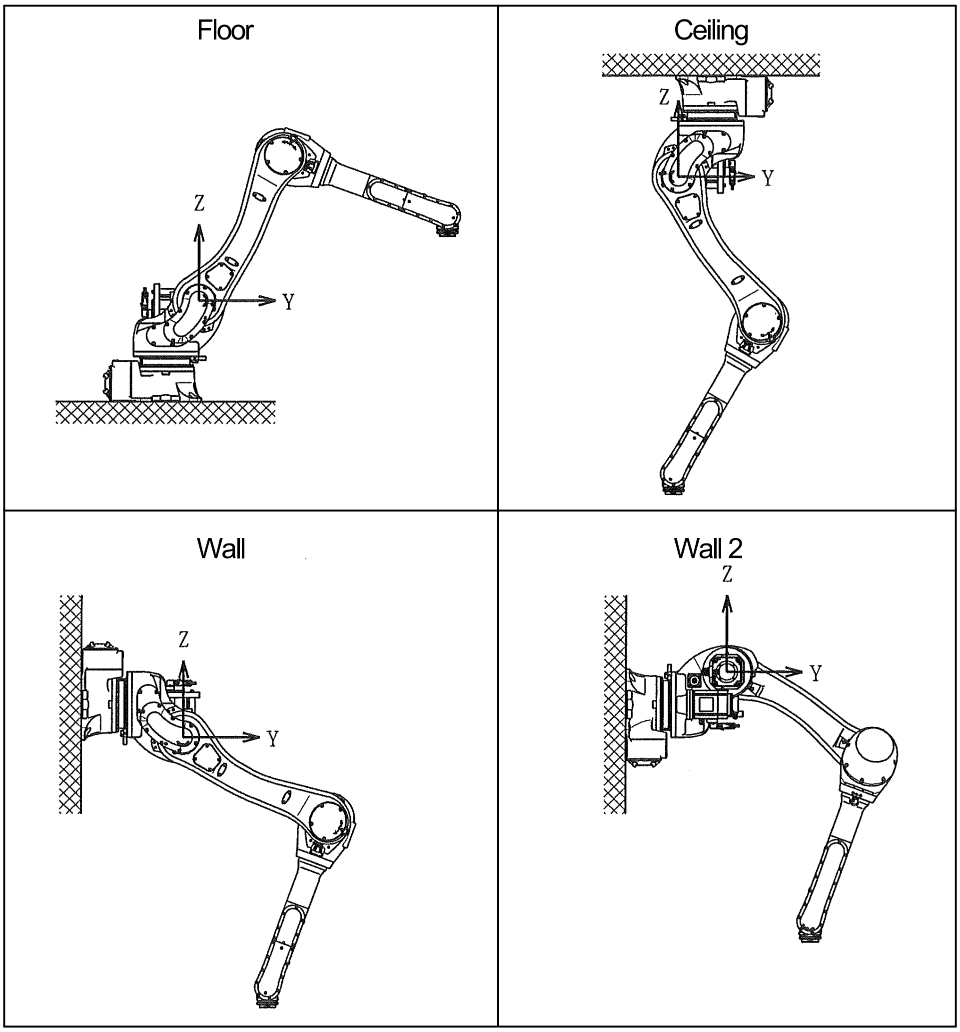
This function compares the torque and installation posture data registered as the standard operating conditions for the robot with the data detected during actual motion. To maximize performance of the collision detection function, ensure tool load information, installation posture, etc. are set correctly.

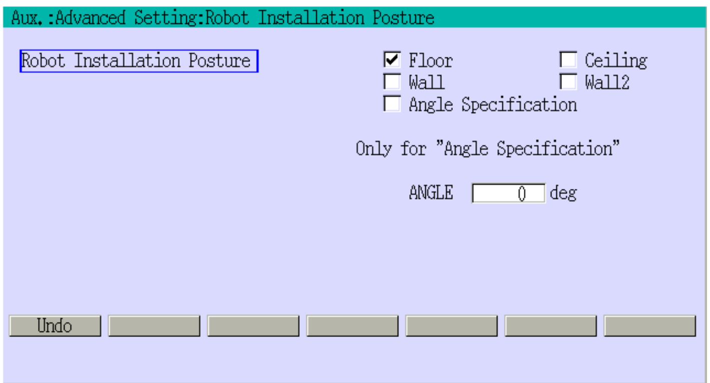
CAUTION

1. **Be sure to register the correct mass, center of gravity and moments of inertia. Registering the wrong value may decrease the service life of component parts, causing motor overload or deviation errors.**
2. **Be sure to register the correct installation posture. Registering the wrong posture may decrease the service life of component parts, causing motor overload or deviation errors.**

11.3 SETTING ROBOT INSTALLATION POSTURE

Install each robot referring to the Installation and Connection Manual. Register the installation posture that matches the actual installation posture. This setting fixes the gravity direction so that acceleration/deceleration is properly controlled and so robot can be taught with the +Z base coordinate vertically up, as shown below. Note when setting base coordinates via Aux. 0506, the values for O, A, T must be set 0 (zero). Robot installation posture is set in Aux. 0505.

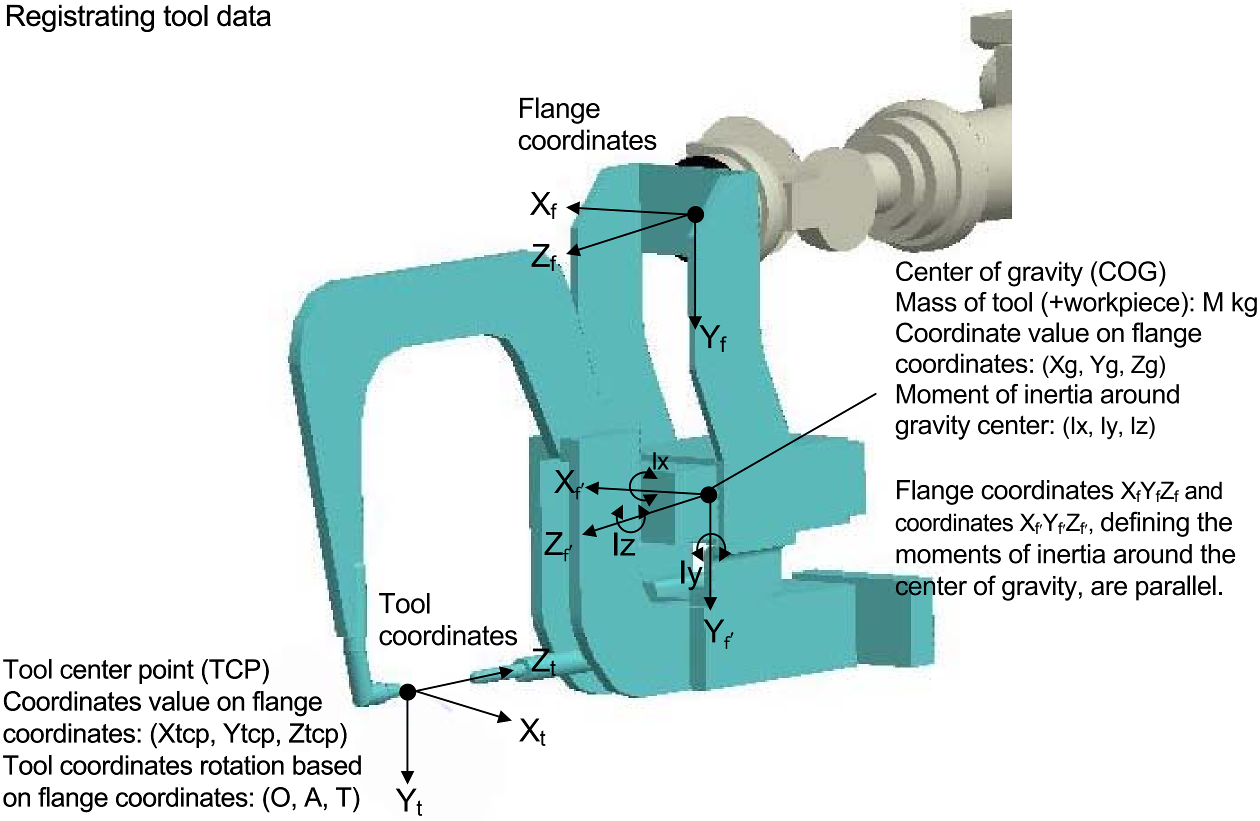




11.4 SETTING TOOL LOAD INFORMATION

Tool load information consists of mass, center of gravity and the moment of inertia around the center of gravity of the tool fixed on the wrist flange. This information is set by Aux. 0304 or by the AS language "WEIGHT" instruction/command. To optimize robot performance in terms of cycle time and service life, tool load information must be set properly.

Registrating tool data



CAUTION

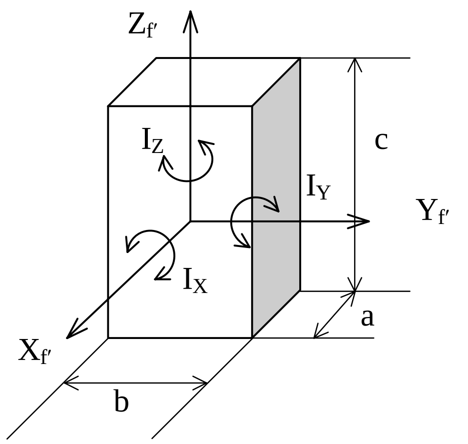
Be sure to register the correct mass, center of gravity and moment of inertia. Registering the wrong value may decrease the life service of component parts, cause motor overload or deviation errors.

Item	Description	Setting range
[Load Mass]	M: Mass of tool to be mounted, including mass of workpiece grasped in handling applications. Approx. value is acceptable, use only highest estimate.	0 − Rated load kg
[Center of Gravity X]	Xg: X coordinate value of COG of the tool based on the flange (=null tool) coordinates. Approx. value is acceptable if precise center of gravity is unobtainable.	-9999.9 - 9999.9 mm
[Center of Gravity Y]	Yg: Y coordinate value of COG of the tool based on the flange (=null tool) coordinates. Approx. value is acceptable if precise center of gravity is unobtainable.	-9999.9 - 9999.9 mm
[Center of Gravity Z]	Zg: Z coordinate value of COG of the tool based on the flange (=null tool) coordinates. Approx. value is acceptable if precise center of gravity is unobtainable.	-9999.9 - 9999.9 mm
[Moment of Inertia about $X_{f'}$ axis]	Ix: Value of moment of inertia about center of gravity $X_{f'}$ axis Approx. value is acceptable if precise moment of inertia is unobtainable. To calculate approximate value, see explanation below.	0 - 999.99 kgm^2
[Moment of Inertia about $Y_{f'}$ axis]	Iy: Value of moment of inertia about center of gravity $Y_{f'}$ axis Approx. value is acceptable if precise moment of inertia is unobtainable. To calculate approximate value, see explanation below.	0 - 999.99 kgm^2
[Moment of Inertia about $Z_{f'}$ axis]	Iz: Value of moment of inertia about center of gravity $Z_{f'}$ axis Approx. value is acceptable if precise moment of inertia is unobtainable. To calculate approximate value, see explanation below.	0 - 999.99 kgm^2

11.4.1 HOW TO APPROXIMATE MOMENTS OF INERTIA AROUND TOOL CENTER OF GRAVITY

Moment of inertia about the tool center of gravity should be calculated precisely. However, for practical use, approximate values are acceptable. Moments of inertia can be approximated in two ways: by judging the general shape of the tool as either a rectangular solid or as a cylinder. Moreover, if tool outside dimensions are small enough, it is possible to approximate as a point mass.

<Example 1> To approximate as a rectangular solid:
Moments of inertia of a rectangular solid whose center occupies the same point as the tool center of gravity are calculated by these formulas.

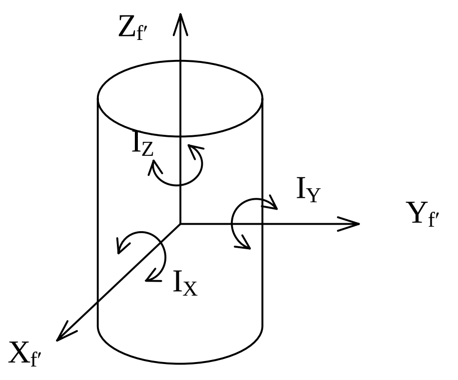


$$=\frac{M}{12}(b^2+c^2)$$

$$Iy=\frac{M}{12}(c^2+a^2)$$

$$Iz=\frac{M}{12}(a^2+b^2)$$

<Example 2> To approximate as a cylinder (Diameter: a, Height: h):



$$Ix=Iy=\frac{M}{12}(3a^2+h^2)$$

$$Iz=\frac{M}{2}a^2$$

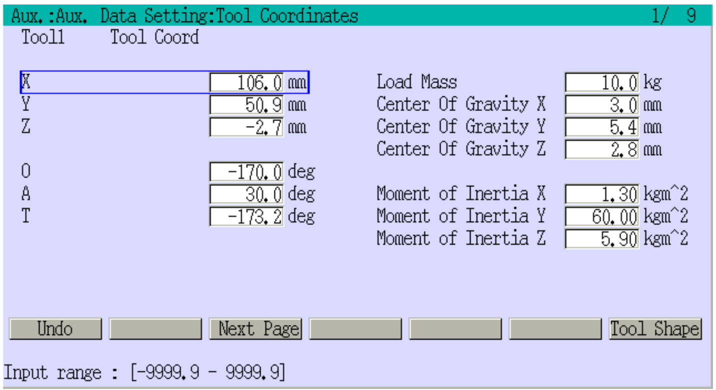
<Example 3> To approximate as a point mass:
If the tool outermost dimensions are small enough (i.e., smaller than the distance between flange and tool center of gravity), the tool can be considered as a point mass. In that case, input 0.01 for I_X, I_Y, I_Z instead of 0. Inputting 0 sets the moment of inertia to the max. allowable moment of inertia (spec.) and restricts acceleration/deceleration.

11.4.2 HOW TO SET TOOL LOAD INFORMATION

Tool load information is set in Aux. 0304 or by AS language “WEIGHT” command/instruction. For the [Load Mass] and [Center Of Gravity], approximate values can be obtained by Aux. 0406.

<Example 1> Aux.0304 Tool Coordinates

In block teaching, make load settings by this auxiliary function.　For details, refer to Chapter 8.



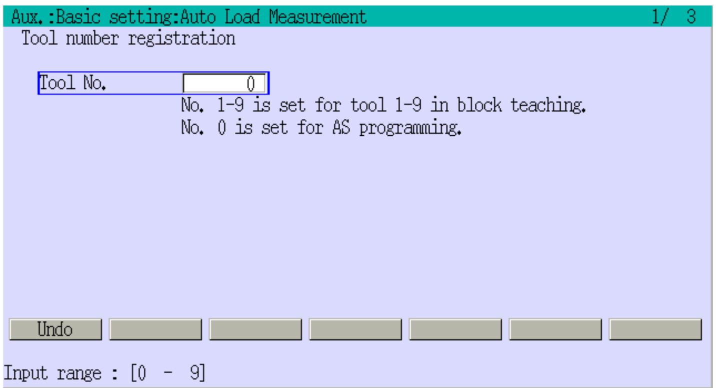
<Example 2> WEIGHT instruction/command

For steps taught by AS language, set the tool load data by this command/instruction.　If the step taught by compound instruction is executed in the program, be aware tool load information set in Aux.0304 takes precedence for that step.　Execute WEIGHT command in the program where needed.

WEIGHT 120,300,250,100,10,10,10	Mass 120 kg, Center of gravity Xg, Yg, Zg (300,250,100), Moments of inertia Ix, Iy, Iz (10,10,10) If collision detection option is disabled, setting of moment of inertia is not required.

<Example 3> Aux.0406 Auto Load Measurement

This function calculates approximate values of the mass and center of gravity.　For details, see Chapter 12.

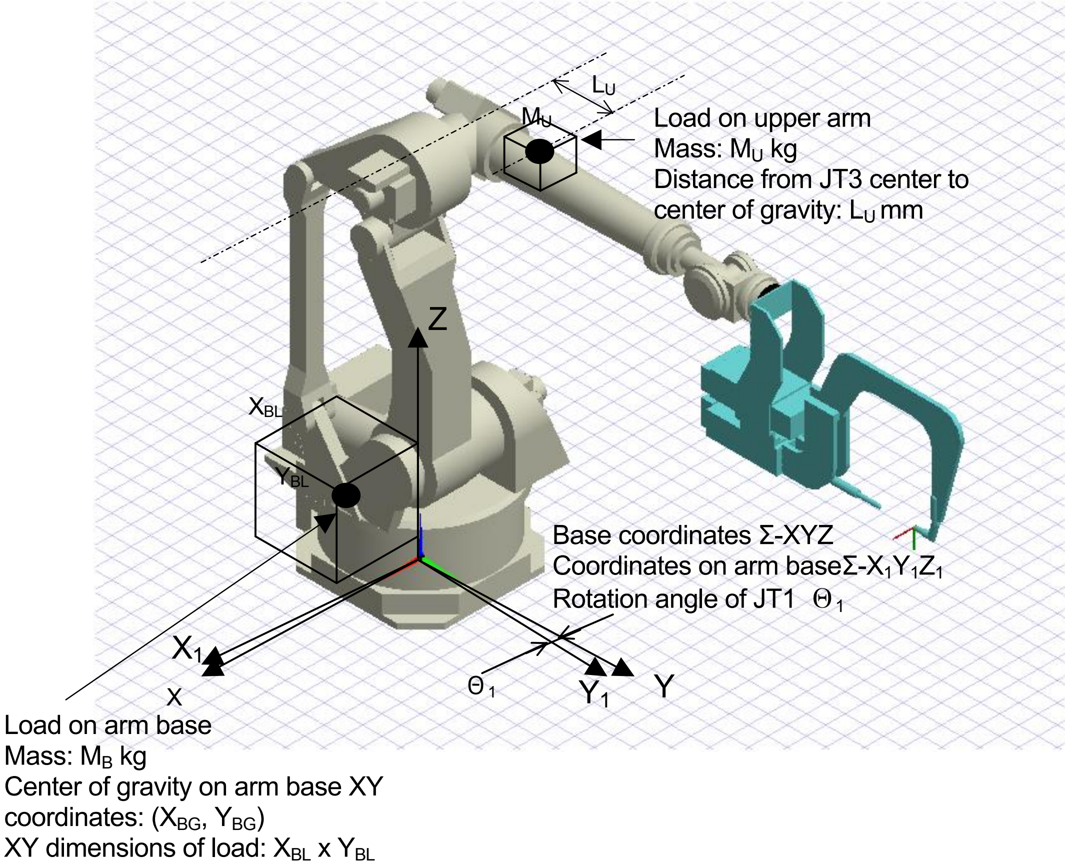


[**NOTE**]

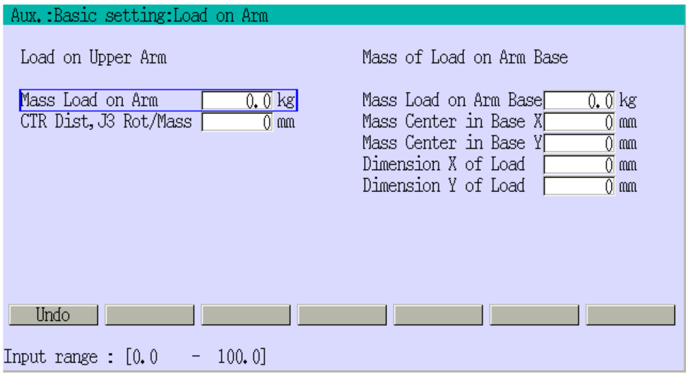
1. Data defining the load mass, position of center of gravity and moments of inertia around the center of gravity are used in robot motions for controlling vibration, acceleration/deceleration and collision detection. Setting values for these data, even approximately, is important for optimizing robot performance.
2. Approximate values for load mass and position of center of gravity can be obtained by Aux.0406.
3. If load mass is set 0, calculations assume robot is carrying its rated load (both mass and torque).
4. If all center of gravity positions (Xg, Yg, Zg) are set 0, calculations assume robot is carrying its rated load (both mass and torque).
5. If all moments of inertia (Ix, Iy, Iz) around center of gravity are set 0, robot operates at the max. allowed load moment of inertia noted in specification sheet.
6. For safety, set 0 for the moments of inertia if Ix, Iy, Iz are unknown. In this case, acceleration/deceleration is controlled at the max. allowed load of moment of inertia.
7. If load at end of robot arm is small enough to be considered a point mass, register a small value for the moments of inertia, approx. 0.01. If set 0, robot operates at the max. allowed load of moments of inertia noted in specifications, and acceleration/deceleration is constrained. In this case, setting a small value enables cycle time to be shortened.

11.5 SETTING LOAD ON ARM

For larger robots such as ZX series, if mounting device on the upper arm or the arm base, set appropriate values for the mass and center of gravity for that device in Aux. 0404. This enables the robot to optimize control of its motion, acceleration, deceleration, etc.



Item	Description	Setting range
[Mass Load on Arm]	M_U: Load mass on robot upper arm	0.0 - max. payload kg
[CTR Dist, J3 Rot/Mass]	L_U: Distance from JT3 axis center to gravity center	0 - 9999 mm
Mass Load on Arm Base	M_B: Weight of load on arm base	0.0 - max. payload kg
Mass Center in Base X	X_{BG}: X value of load mass center on the arm base coordinates	-9999.9 − 9999.9 mm
Mass Center in Base Y	Y_{BG}: Y value of load mass center on the arm base coordinates	-9999.9 − 9999.9 mm
Dimension X of Load	X_{BG}: X dimension (length) of the load installed on arm base	0 − 9999.9 mm
Dimension Y of Load	Y_{BG}: Y dimension (length) of the load installed on arm base	0 − 9999.9 mm



See Chapter 8 for details on operating this screen.

12.0 AUTO LOAD MEASUREMENT

This chapter describes the operation procedures for the auto load measurement function.

12.1 OVERVIEW OF AUTO LOAD MEASUREMENT FUNCTION

This function is used to automatically measure and calculate the mass, center of gravity, and the load moment with the actual load (tool + workpiece) mounted at end of robot arm by moving axes JT3, 4, 5, and 6.

12.2 EXECUTION PROCEDURES

The following flowchart describes the procedures for measuring the load automatically by using this function.

12.2.1 Positioning for Auto Load Measurement

↓

12.2.2 Displaying Auto Load Measurement Screen

↓

12.2.3 Registering Tool Number for Auto Load Measurement

↓

12.2.4 Setting Operational Area for Auto Load Measurement

↓

12.2.5 Confirming Operational Area for Auto Load Measurement

↓

12.2.6 Executing Auto Load Measurement

↓

12.2.7 Registering Results after Auto Load Measurement

See the following sections for a description of each procedure.

12.2.1 POSITIONING FOR AUTO LOAD MEASUREMENT

This section describes the positioning procedure for auto load measurement.

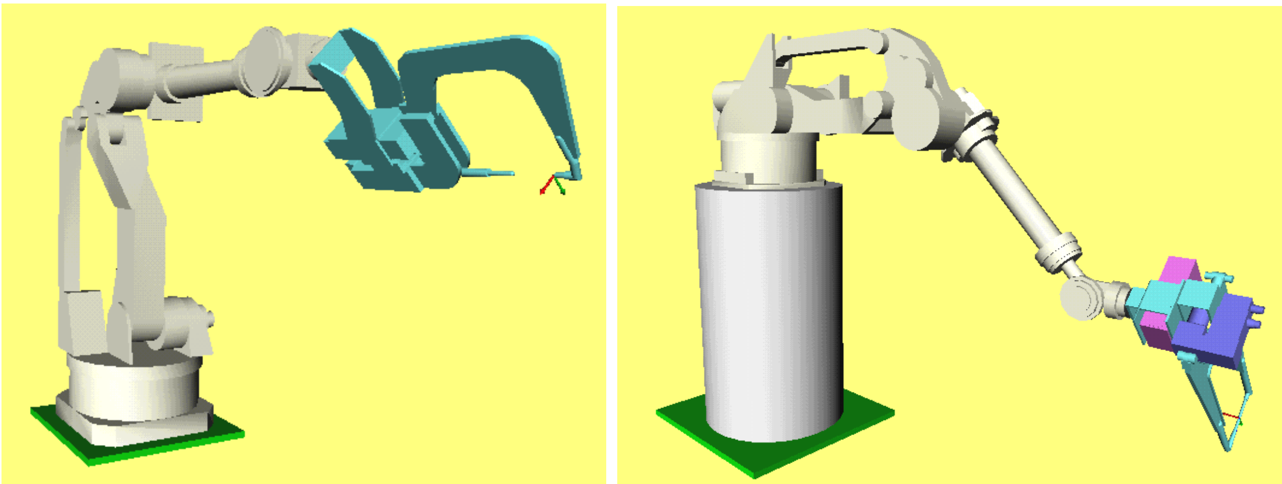
1. Make sure that the tool is mounted on the robot flange firmly.

2. As shown in figure below, guide the robot to a pose that provides enough clearance for the arm to move without interfering with surrounding objects (devices, etc.) and sufficient gravitational torque to each axis of the arm.

3. Press HOLD*, and A+Motor ON to turn the motor power OFF**. Then, set TEACH/REPEAT to REPEAT.

NOTE* For controller with option operation panel, turn HOLD/RUN on the option operation panel to HOLD.

NOTE** For controller with option operation panel, press MOTOR POWER on the option operation panel to turn OFF.



CAUTION

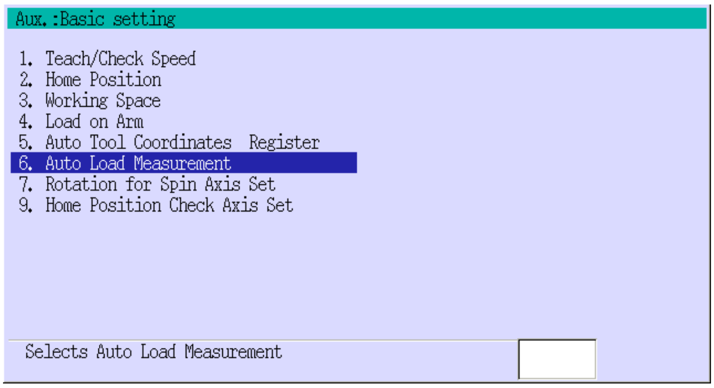
Do not fail to fix the equipment firmly for safety and for acquiring accurate measurement.

12.2.2 DISPLAYING AUTO LOAD MEASUREMENT SCREEN

This section describes how to display the screen for auto load measurement.

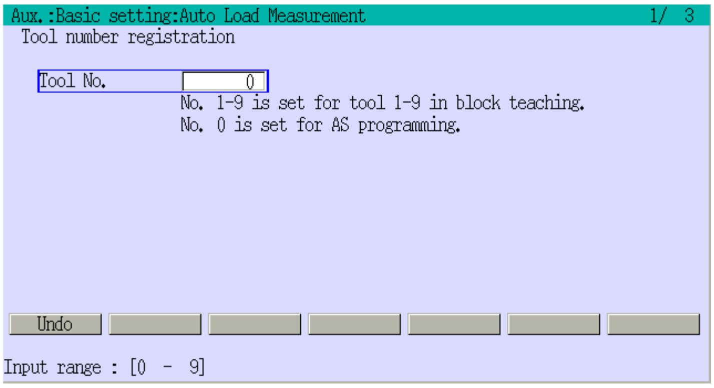
1. Call up Auxiliary Function screen and select [4. Basic setting]. For more details about selecting auxiliary functions, refer to Chapter 8.2.

2. Selecting [6. Auto Load Measurement] displays the screen as shown in Chapter 12.2.3.



12.2.3 REGISTERING TOOL NUMBER FOR AUTO LOAD MEASUREMENT

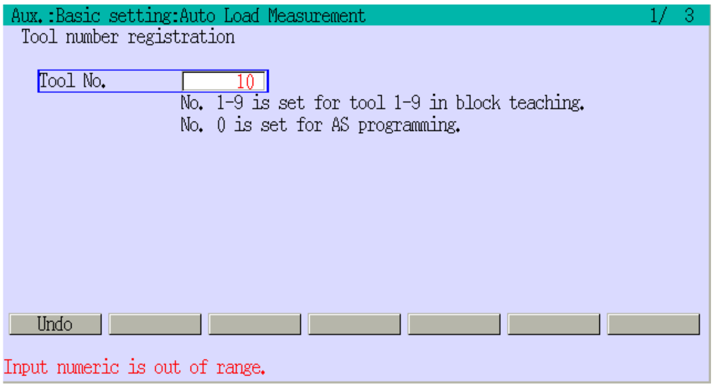
In this section, set the tool number to be measured and registered. This tool number corresponds to the tool number in Aux. 0304.



Input the number of the tool whose load is to be measured, and press ↵. (Setting range 0 - 9) Press R to return to the previous page.

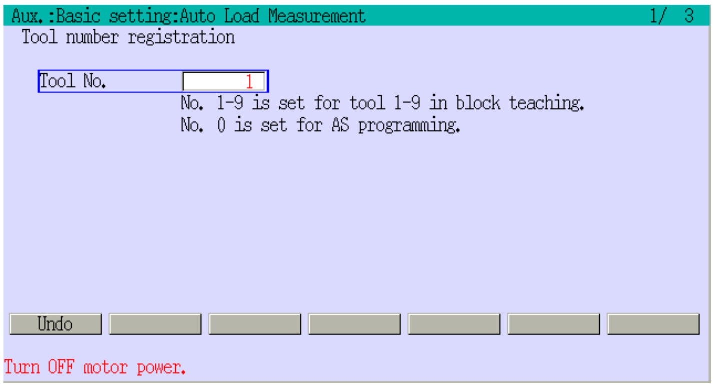
[NOTE]

If the setting is incorrect, a message is displayed as shown in the following screen. In this case, try registering again.



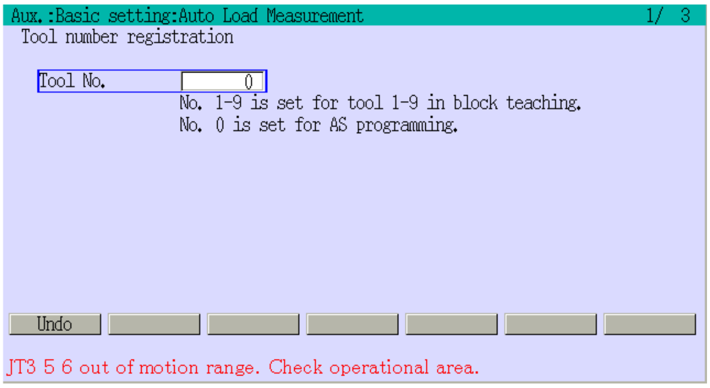
[NOTE]

In order to set the necessary data for this auto measurement function, robot motion must be stopped before proceeding to next step. When message as shown below is displayed at bottom of screen, follow the instructions.



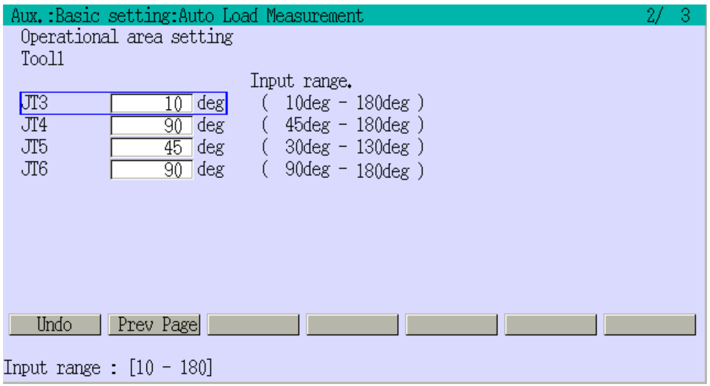
[NOTE]

1. If message shown below is displayed at bottom of screen, robot cannot move inside the operational area set in Chapter 12.2.4 for auto load measurement. Check the current robot pose and the data settings for the operational area.
2. Upper limit of input range displayed on screen in Chapter 12.2.4 is the value registered in Aux. 0507. Lower limit is determined by the conditions of the minimum motion range required for measurement. If after the operational area is set and the motion range is reset to smaller value than the operational area in Aux. 0507, the message in the following screen is displayed. In this case, correct the set values.



12.2.4 SETTING OPERATIONAL AREA FOR AUTO LOAD MEASUREMENT

In this section, set the operational area for auto load measurement. During measurement, JT3 to JT6 moves within the operational area set here only in the plus direction from the current pose and not to minus direction. Set the data making sure that robot does not interfere with the peripheral equipment.



1. Set the operational area for [JT3] to [JT6] by NUMBER. Pressing R returns to the last step in Chapter 12.2.3.

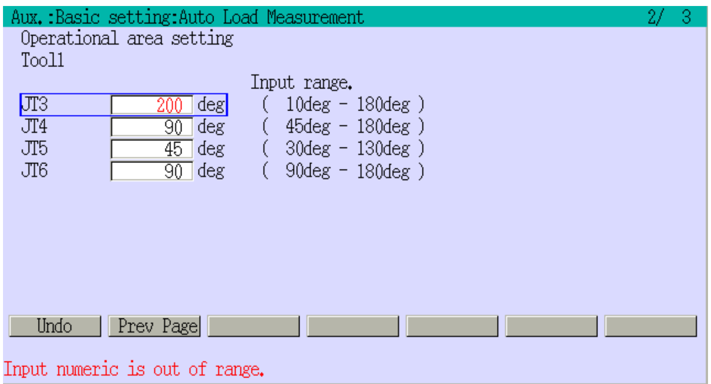
2. Set the operation panel and TP as follows:

   (1) TEACH LOCK ⇒ OFF
   (2) TEACH/REPEAT ⇒ REPEAT
   (3) A + Motor ON ⇒ <MOTOR> lamp ON
   (4) A + RUN ⇒ <RUN> lamp ON

3. If the setting is correct, press ↵.

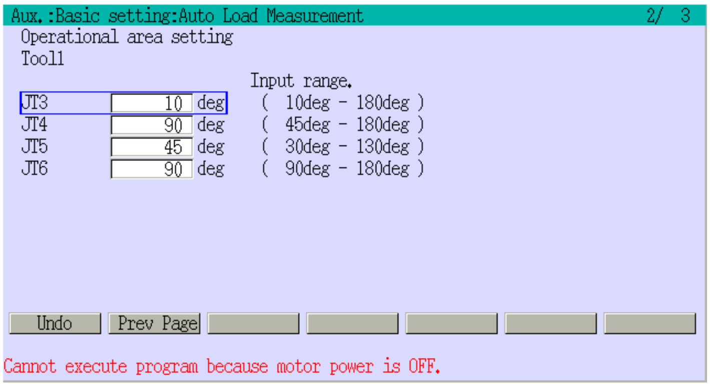
[NOTE]

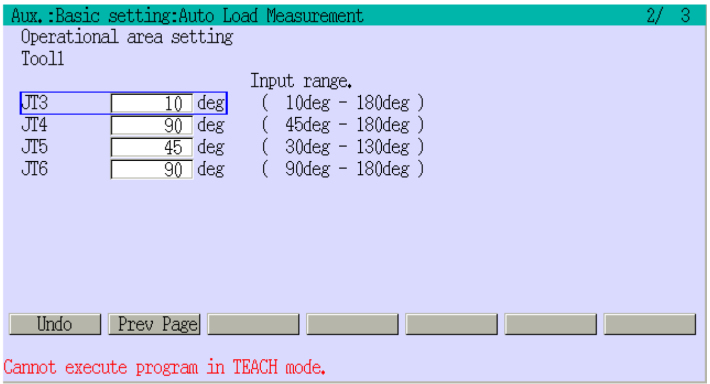
Message “Input numeric is out of range.” is displayed at bottom of screen as shown below when attempting to set a value outside the range. See the screen below. Check the setting and correct it.

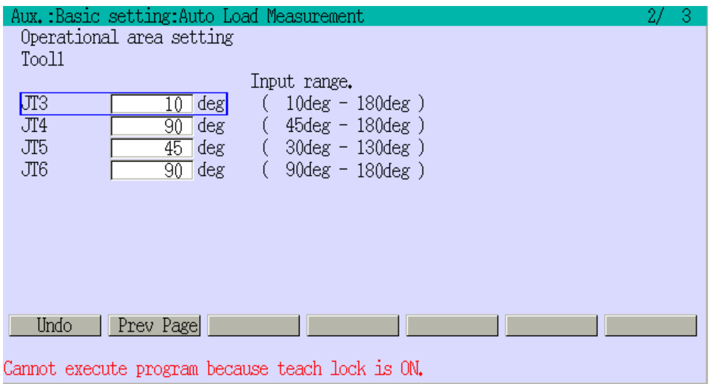


[NOTE]

1. If any settings other than the operational area settings are incorrect, the reason is displayed. Refer to the following screens.
2. Even if all conditions are correct, proceeding to the next step is not possible if robot is currently running.
3. If all settings are correct, proceed to Chapter 12.2.5.

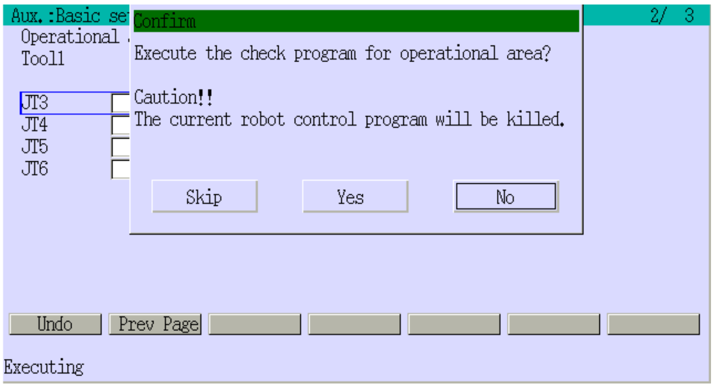




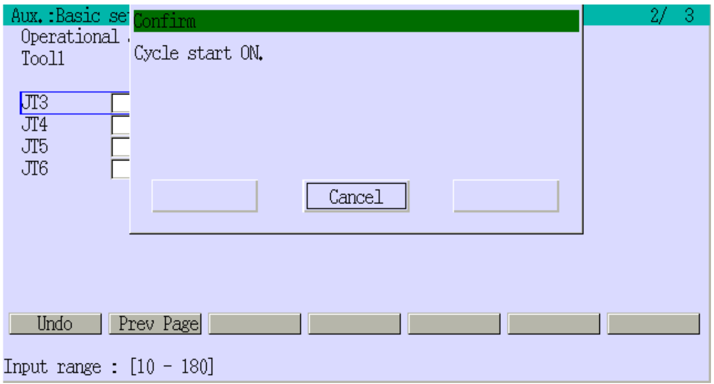


12.2.5 CONFIRMING OPERATIONAL AREA FOR AUTO LOAD MEASUREMENT

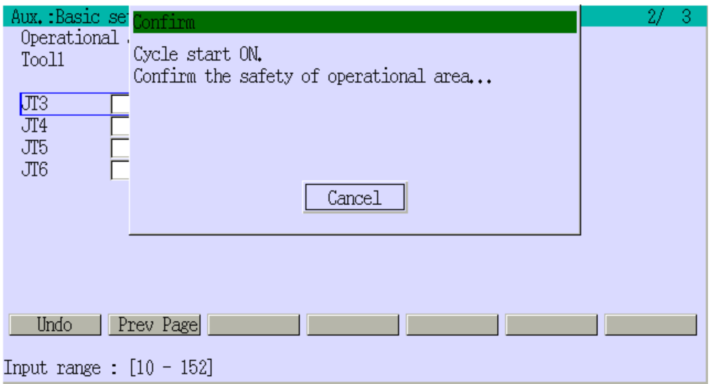
This section describes how to check the operational area for auto load measurement in low speed.



1. When the operational area is set correctly, the left screen is displayed. Selecting [Skip] skips the contents in this section and proceeds to Chapter 12.2.6. Selecting [Yes] sets the check program. Selecting [No] returns to the last step, Chapter 12.2.4.



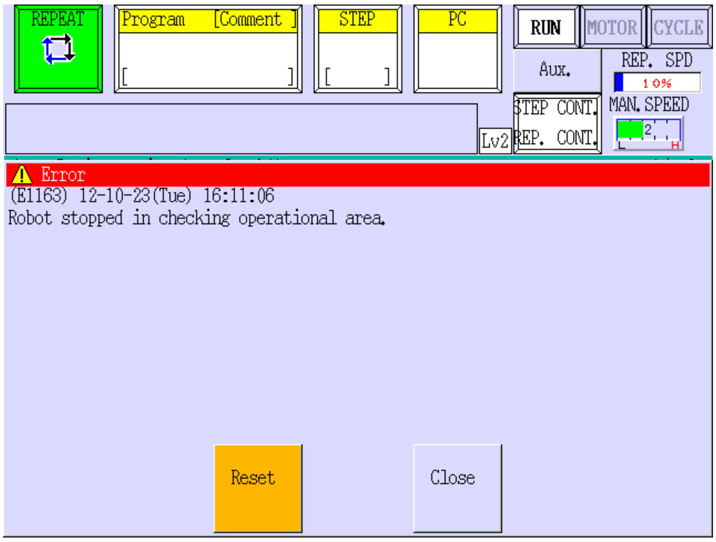
2. Selecting [Yes] in step 1 displays screen requesting “Cycle Start ON”. Now press A + Cycle Start. Pressing <Cancel> before cycle start returns to the last step in Chapter 12.2.4.

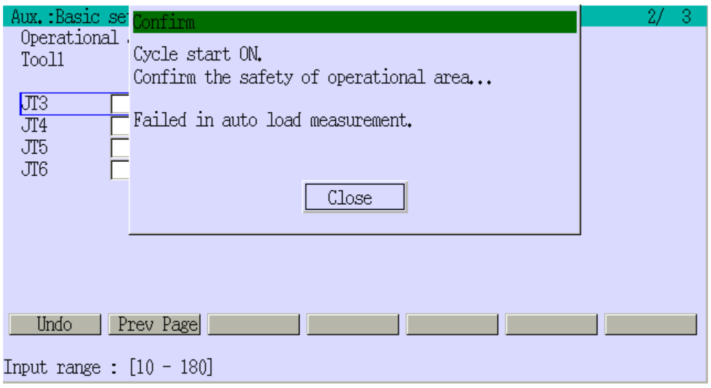


3. While operational area is checked, “Confirm the safety of operational area…” is displayed. Once completed, proceed to next step in Chapter 12.2.6.

[NOTE]

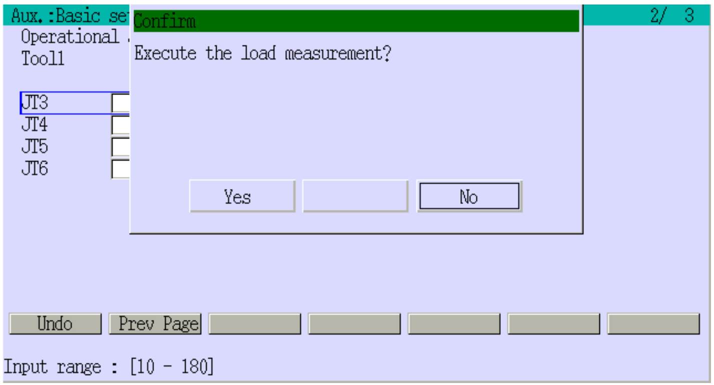
1. If robot stops for some reason while checking the operational area, the error message “Robot stopped. Checking operational area stopped.” is displayed at bottom of screen as shown below.
2. Selecting [Reset] in screen below displays confirmation screen indicating “Failed in auto load measurement.” shown in the screen below. Select [Close] and retry after removing the cause of error.
3. Selecting [Close] in screen below displays confirmation screen indicating “Failed in auto load measurement.” without resetting the error. Reset error and retry after removing the cause of error. For details about error reset after selecting [Close], refer to 2. Procedure for error reset-2 in Chapter 2.10.



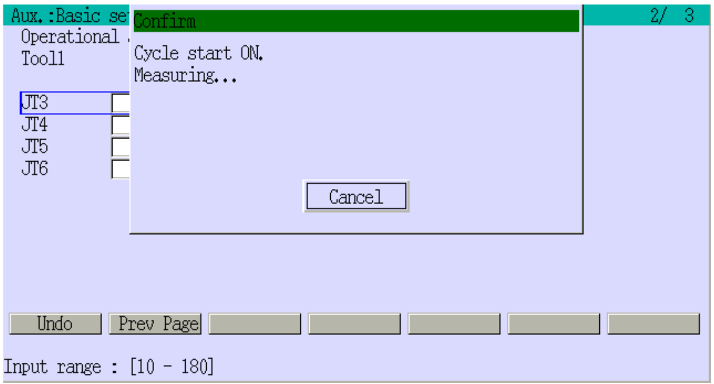


12.2.6 EXECUTING AUTO LOAD MEASUREMENT

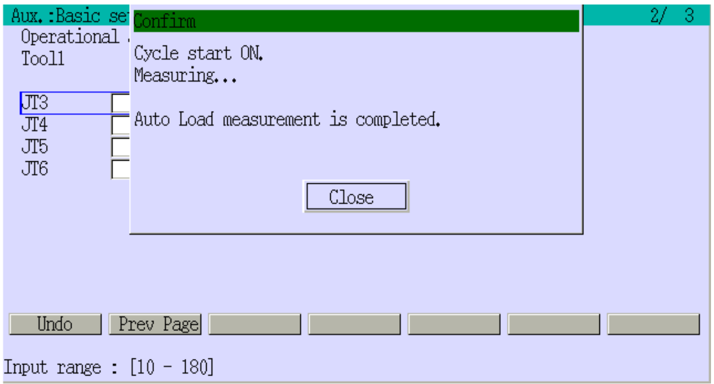
After confirming the safety of the operational area for auto load measurement and no problem is found, execute auto load measurement.



1. Selecting [Yes] sets the measurement program. Selecting [No] returns to Chapter 12.2.3.



2. Selecting [Yes] in step 1 displays the screen to request "Cycle Start ON" as shown at left. Press A + Cycle Start. During auto load measurement, "Measuring…" is displayed.



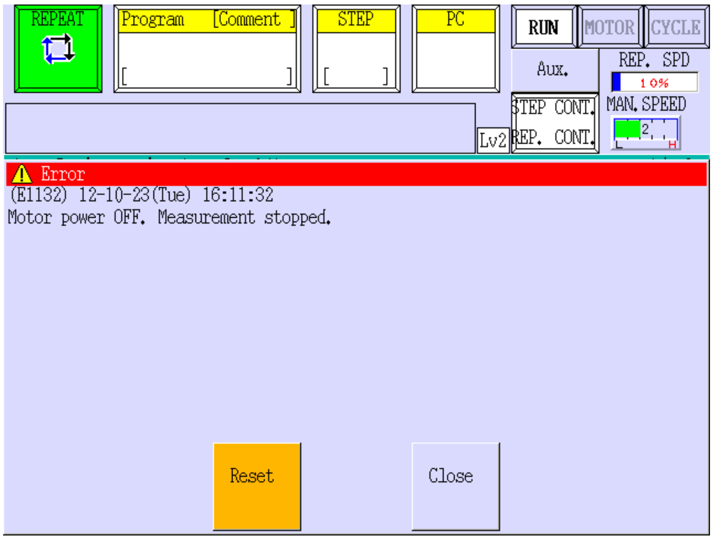
3. "Auto Load measurement is completed." is displayed when process is finished. Then, press <Close>.

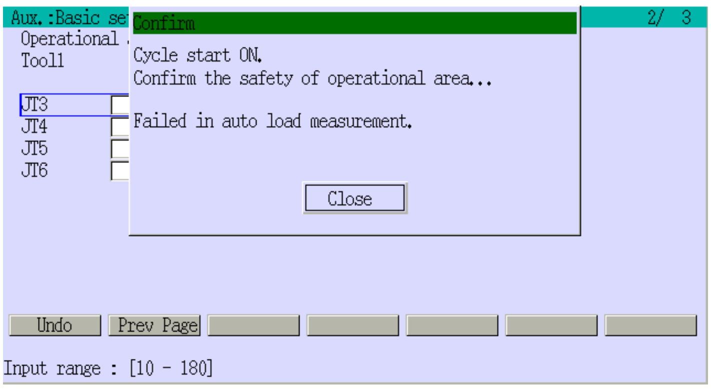
[NOTE]

Pressing <Cancel> before cycle start in step 2 above displays the confirmation screen. Pressing <Close> returns to the last step in Chapter 12.2.5.

[**NOTE**]

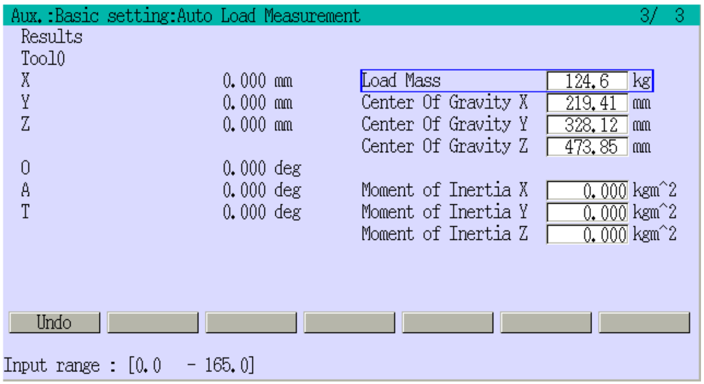
1. If robot stops for some reason while measuring, the error message “Motor power OFF.　Measurement stopped.” is displayed as shown in top screen below.
2. Selecting [Reset] in top figure below displays confirmation screen indicating “Failed in auto load measurement.” shown in bottom screen below.　Press <Close> and retry after removing the cause of error.
3. Selecting [Close] in top screen below displays confirmation screen indicating “Failed in auto load measurement.” without resetting the error.　Reset error and retry after removing the cause of error.　For details about error reset after selecting [Close], refer to 2. Procedure for error reset-2 in Chapter 2.10.



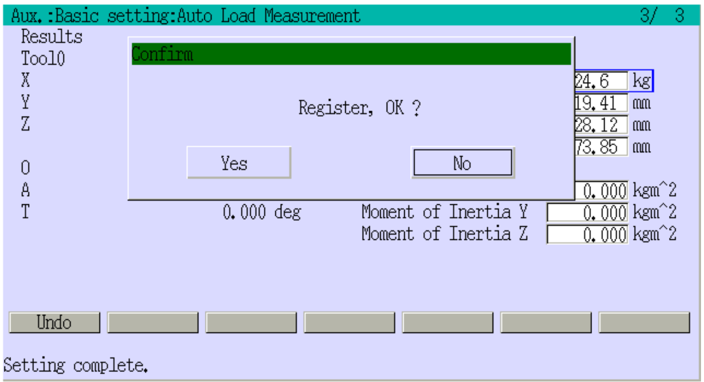


12.2.7 REGISTERING RESULTS AFTER AUTO LOAD MEASUREMENT

When measurement process completes with no problem, the results are displayed. Results can be edited at this time by inputting numbers directly.



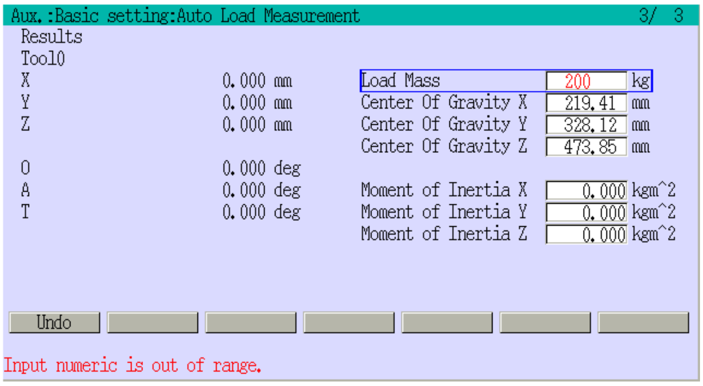
1. The results are displayed.

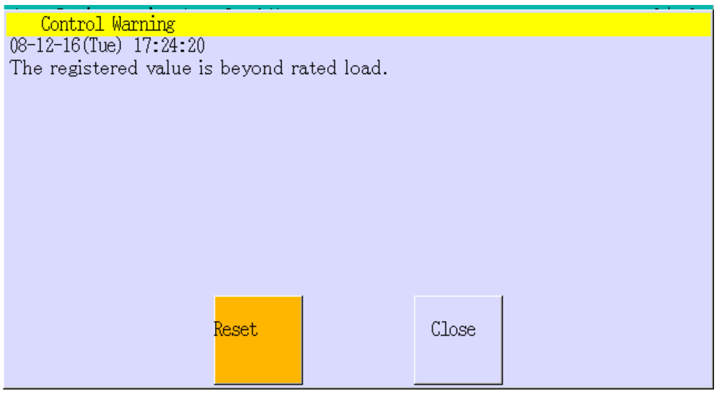


2. Pressing ↵ displays the confirmation screen. Selecting [Yes] registers the displayed data as the load of the tool set in Chapter 12.2.3. Selecting [No] does not register them.

[NOTE]

1. This screen remains regardless of whether [Yes] or [No] is selected.
2. Pressing R either before or after registration returns to Chapter 12.2.3.
3. The result cannot be registered if the load mass value is beyond mass capacity as shown in screen below.
4. For load moment, note that the result can still be registered even if it exceeds the max. allowed moment, only a warning is displayed as shown in screen below.


Aux.:Basic setting:Auto Load Measurement 3/ 3
Results
Tool0
X 0.000 mm
Y 0.000 mm
Z 0.000 mm
O 0.000 deg
A 0.000 deg
T 0.000 deg
Load Mass 200 kg
Center Of Gravity X 219.41 mm
Center Of Gravity Y 328.12 mm
Center Of Gravity Z 473.85 mm
Moment of Inertia X 0.000 kgm^2
Moment of Inertia Y 0.000 kgm^2
Moment of Inertia Z 0.000 kgm^2
Undo
Input numeric is out of range.


Control Warning
08-12-16(Tue) 17:24:20
The registered value is beyond rated load.
Reset
Close

13.0 DEDICATED INSTRUCTIONS FOR SPECIFIC FIELDS OF ROBOT APPLICATIONS

When using a robot in a specific field, it is necessary to specialize clamp instructions according to the application and to use dedicated instructions for that application. This chapter describes how to specialize the clamp instruction and the dedicated instructions used in spot welding* and handling operations.

NOTE* This manual describes pneumatic spot weld guns. For details about servo spot weld guns, refer to the optional manual for Servo Weld Gun, a separate volume.

13.1 SETTING DATA FOR CLAMP INSTRUCTIONS

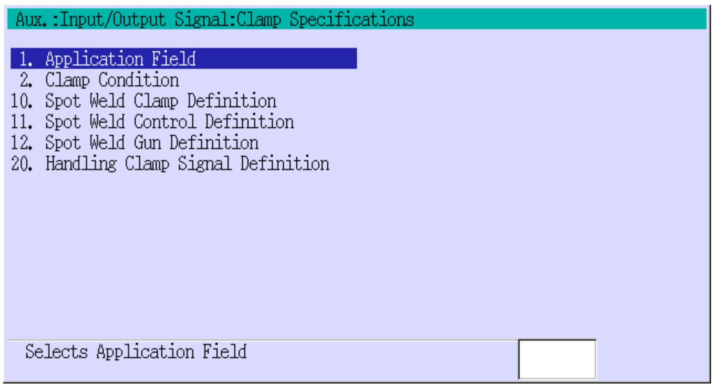
As shown in table below, the required setting items and contents of clamp instructions vary depending on the application field of the robot. A max. of eight clamp instructions (Clamp 1 − 8) can be used. Follow the sections below to set the data of clamp instructions for spot welding or handling operation.

Application number	Description
0: Not Used	The clamp instruction is not used.
1: Spot Welding operation	Used to start up a welding sequence in spot welding operation.
2: Handling Operation	Used to open/ close a hand in handling operation

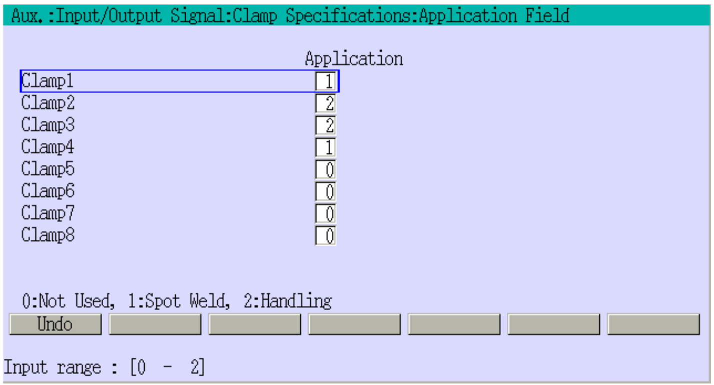
Setting procedure

1. Display Aux. 0605 screen. For details on calling up the screen, refer to Chapter 8.2.

2. The screen below is displayed. Select [1. Application Field].



3. Input the application field for each clamp instruction. Set 0 to the instructions that will not be used. Screen below sets Clamp 1 to spot welding, clamp 2 to handling, Clamp 3 – 8 to not used.

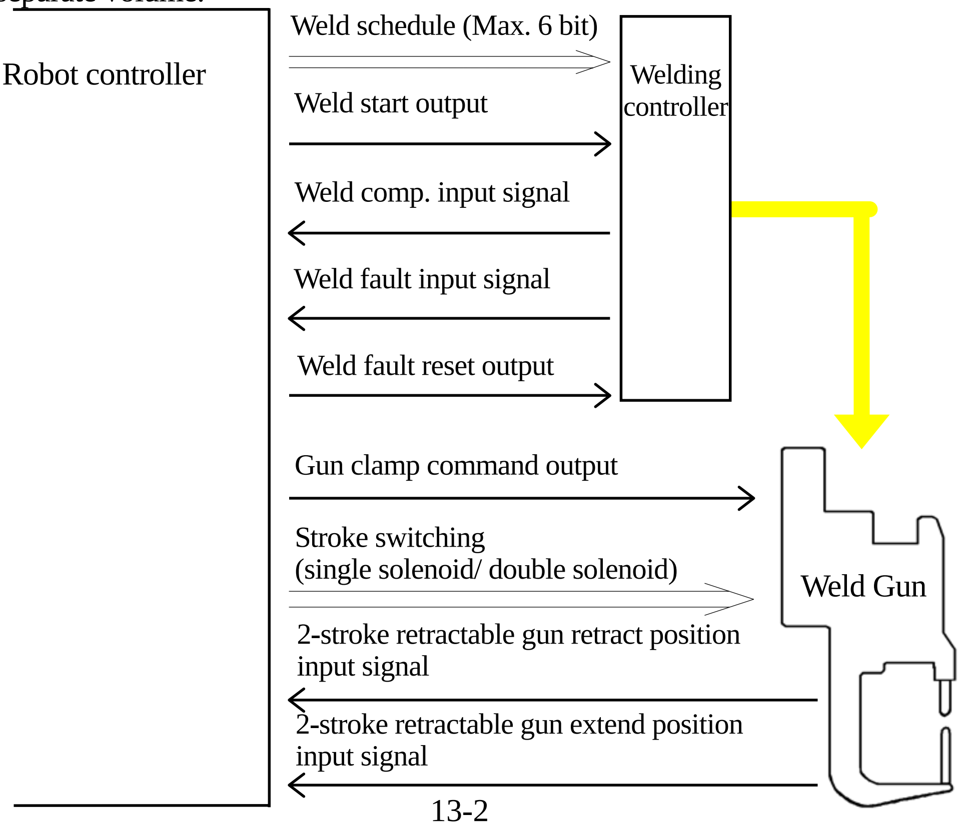


4. If the setting is correct, press ↵.

13.2 SPOT WELDING DEDICATED SIGNAL

When executing spot welding operation, first set 1 to [Application] to specify spot welding as the application field in Aux. 060501.

Furthermore, dedicated signals for spot welding are used in addition to the regular I/O signals. Figure below outlines these signals. The following subsections describe how to set the dedicated signals for spot welding. For more details about I/O signals, see the External I/O Manual, a separate volume.



13.3 TEACHING SPOT WELD DEDICATED INSTRUCTIONS

For spot welding operation, WS, CC and OC instructions and their parameter values are required to be taught in addition to clamp instructions.

13.3.1 CLAMP INSTRUCTION

A max. of eight clamp instructions can be used. Record ON (close)/ OFF (open) of the gun as the parameter value in steps where the clamp instruction for spot welding is taught. For details about teaching ON/OFF, refer to Chapter 5.3.11.

13.3.2 WELD SCHEDULE (WS) INSTRUCTION

Specify weld schedule number as the parameter value. For details about teaching weld schedules, refer to Chapter 5.3.11. Weld schedule is effective only when the gun is set to ON (close).

13.3.3 CLAMP CONDITION (CC) INSTRUCTION

Specify clamp condition number as the parameter value. The data for the clamp condition numbers are set in Aux. 060502. For setting procedure, refer to Chapter 13.4.1. For teaching clamp condition instructions, refer to Chapter 5.3.11.

Setting a clamp condition to 0 at the step where the gun is set to ON (close) executes a subroutine.

13.3.4 GUN RETRACT/ EXTEND (OC) INSTRUCTION

To use a 2-stroke retractable gun, set O or C as the parameter value to specify whether the gun should be retracted (O) or extended (C) in the taught step. For details about teaching OC instructions, refer to Chapter 5.3.11.

This setting is ignored by assuming as a single stroke gun in steps where the clamp condition is set to 0.

13.4 SETTING OF EACH DATA

This section describes how to set parameter values for the dedicated instructions in Chapter 13.3 and the other data used for spot welding operations.

13.4.1 SETTING DATA PER CLAMP CONDITION NUMBER

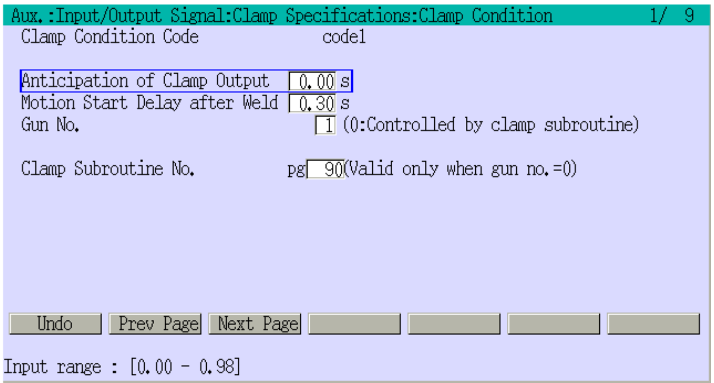
Set each data corresponding to the clamp condition (CC) number in the taught data.*

NOTE* This setting is effective only when spot welding or handling is specified in 060501.

Setting procedure

1. Call up Aux. 0605 screen.　For details on calling up the screen, refer to Chapter 8.2.

2. Selecting [2. Clamp Condition] displays the screen below. (Default settings are shown below.)



3. Set data for the items below for each CC number by pressing <Prev page>/<Next Page>.

Item	Contents
Anticipation of Clamp Output	Sets how early the gun clamp signal is output to the weld gun before robot reaches a taught point.　Corresponds to T1 in Figure in Chapter 13.5. (Default is 0 sec.)
Motion Start Delay after Weld	Sets how long robot waits before moving to the next taught step after it has received weld completion signal from welding controller.　Corresponds to T2 and T6 in Figure in Chapter 13.5. (Default is 0.3 sec.)
Gun No.	Sets eight kinds of guns available for spot welding.　Set the data corresponding to each gun No. in Chapter 13.4.4.　Setting 0 disables the gun data settings and executes preset clamp subroutine.

4. If the setting is correct, press ↵.

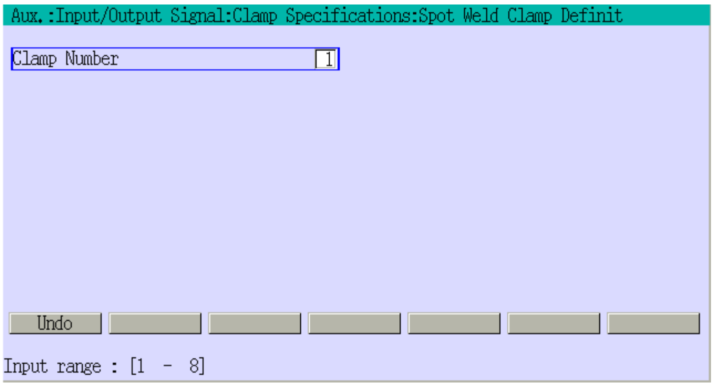
13.4.2 SETTING OF SPOT WELDING CLAMP DATA

Sets data for I/O signals or 2-stroke retractable guns to clamp Nos. 1 to 8 used for spot welding operation.

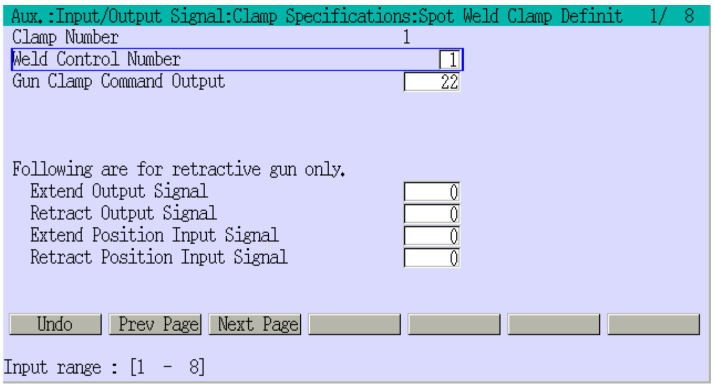
Setting procedure

1. Call up Aux. 0605 screen. For details on calling up the screen, refer to Chapter 8.2.

2. Selecting [10. Spot Weld Clamp Definition] displays the screen below.



3. Inputting clamp number and pressing ↵ displays the screen below. The screen below shows the settings for Clamp 1. (The setting below is default.)



4. Set data for these items in each clamp instruction. Table below describes each item.

Item	Contents
Weld Control Number	Sets welding controller numbers (1-8) which are used for spot welding.
Gun Clamp Command Output	Sets the Gun Clamp Command Output number to be used. Setting 0 does not output this signal.
Extend Output Signal*	Sets the Extend Output Signal number that makes 2-stroke retractable gun extended. Setting 0 does not output this signal.
Retract Output Signal*	Sets the Retract Output Signal number that makes 2-stroke retractable gun retracted. Setting 0 does not output this signal.
Extend Position Input Signal*	Sets input signal number confirming 2-stroke retractable gun is extended. When this signal is set, robot will not move after pressurizing and reaching its extend position until this signal is input. Setting 0 does not detect extending.
Retract Position Input Signal*	Sets input signal number confirming 2-stroke retractable gun is retracted. When this signal is set, robot will not move after pressurizing and reaching its retract position until this signal is input. Setting 0 does not detect retracting.

NOTE* Set when using a 2-stroke retractable gun.

Regarding extend position input signal and retract position input signal, also refer to extend monitor and retract monitor in Chapter 13.4.4.

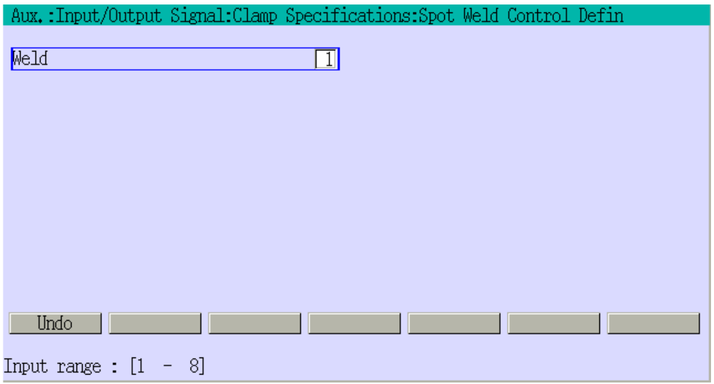
5. If the setting is correct, press ↵.

13.4.3 SETTING OF SPOT WELDING CONTROLLER

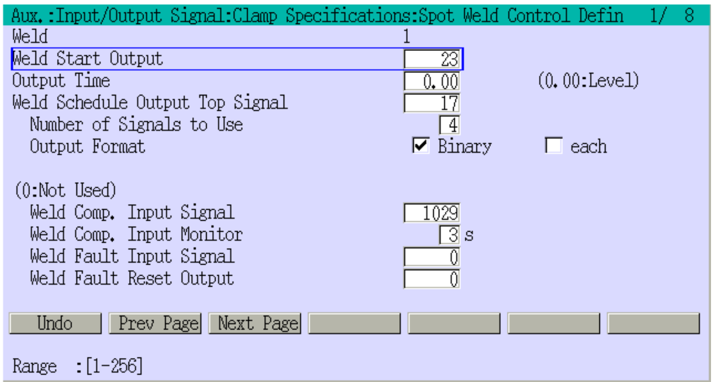
Sets I/O signal specifications for the spot welding controller that is specified in Chapter 13.4.2. This setting is effective only when 1 is set to [Application] in Aux. 060501.

1. Call up Aux. 0605 screen. For details on calling up the screen, refer to Chapter 8.2.

2. Selecting [11. Spot Weld Gun Definition] displays the screen below.



3. Inputting spot welding controller number and pressing ↵ displays the screen below. The screen below displays the settings for weld control 1. (Default settings are shown below.)



4. Set data for each item. Table below describes each item.

5. If the setting is correct, press ↵.

Items to be set for each spot welding controller.

Item	Contents
Weld Start Output	Sets the number of the Weld Start Output signal sent to welding controller.
Output Time	Sets output duration time for Weld Start Output. This signal is level output.
Weld Schedule Output Top Signal*	Sets the first signal number that is output to welding controller.
Number of Signals to Use*	Sets the number of signals to use for weld schedule output signals.
Output Format*	Sets how the Weld Schedule Output Top Signal and the signals set in [Number of Signals to Use] are output, Binary or individual (each).
Weld Comp. Input Signal**	Sets the number of the Weld Comp. (completion) Input Signal sent from spot welding controller to the robot.
Weld Comp. Input Monitor	When Weld Comp. Input Signal is not received within time set here, an error occurs and robot stops after Weld Start Output has been sent. (Default is 3 sec.) Setting 0 disables error detection.
Weld Fault Input Signal	Sets number of the Weld Fault Input Signal sent from spot welding controller to the robot. Setting 0 disables weld fault detection.
Weld Fault Reset Output	Sets the number of the Weld Fault Reset Output signal sent to welding controller. When this signal is set and an abnormality occurs in the welding controller, the Weld Fault Reset Output signal is sent to spot welding controller. (Signal generated by pressing <Reset> on the screen.) When setting is 0, this signal is not output.

NOTE* As shown on screen on previous page, when [Weld Schedule Output Top Signal] is set to 17, [Number of Signals to Use] to 4, [Output Format] to [Binary], the output signals 17, 18, 19, 20 are used as weld schedule output signals, as shown below.

If the taught data of WS instruction is 3, the ON/OFF States for weld schedule output signals will be as shown below because [Output Format] is set to [Binary].

Output signal	20	19	18	17
WS=3	OFF	OFF	ON	ON

When [Output Format] is set to [each], the third weld schedule output signal will be ON as shown below.

Output signal	20	19	18	17
WS=3	OFF	ON	OFF	OFF

NOTE** When setting 0, the program executes the next step without waiting for input of weld completion. Except in special cases, do not fail to set a number for the Weld Comp. Input Signal.

13.4.4 SETTING OF SPOT WELD GUN

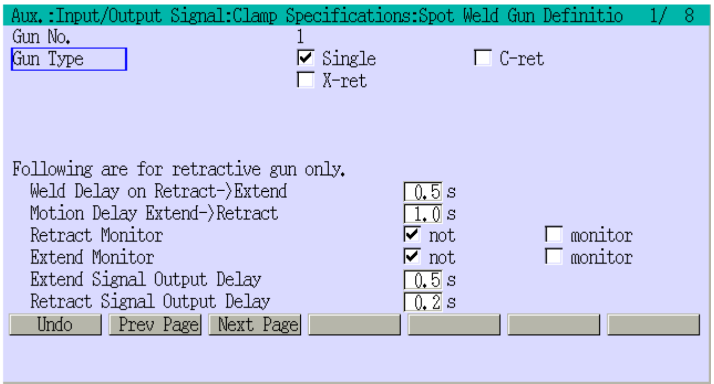
Sets the gun type and specifications for the 2-stroke retractable spot welding gun. The gun number here corresponds to [Gun No.] (1 – 8) in Aux. 060502. (See Chapter 13.4.1)

Setting procedure

1. Call up Aux. 0605 screen. For details on calling up the screen, refer to Chapter 8.2.

2. Selecting [12. Spot Weld Gun Definition] displays the screen below.

3. Inputting gun number and pressing ↵ displays the screen below. In the screen below, the setting is for Gun No. 1. (Default settings are shown below.)



4. Set data for each item. Table below describes each item.

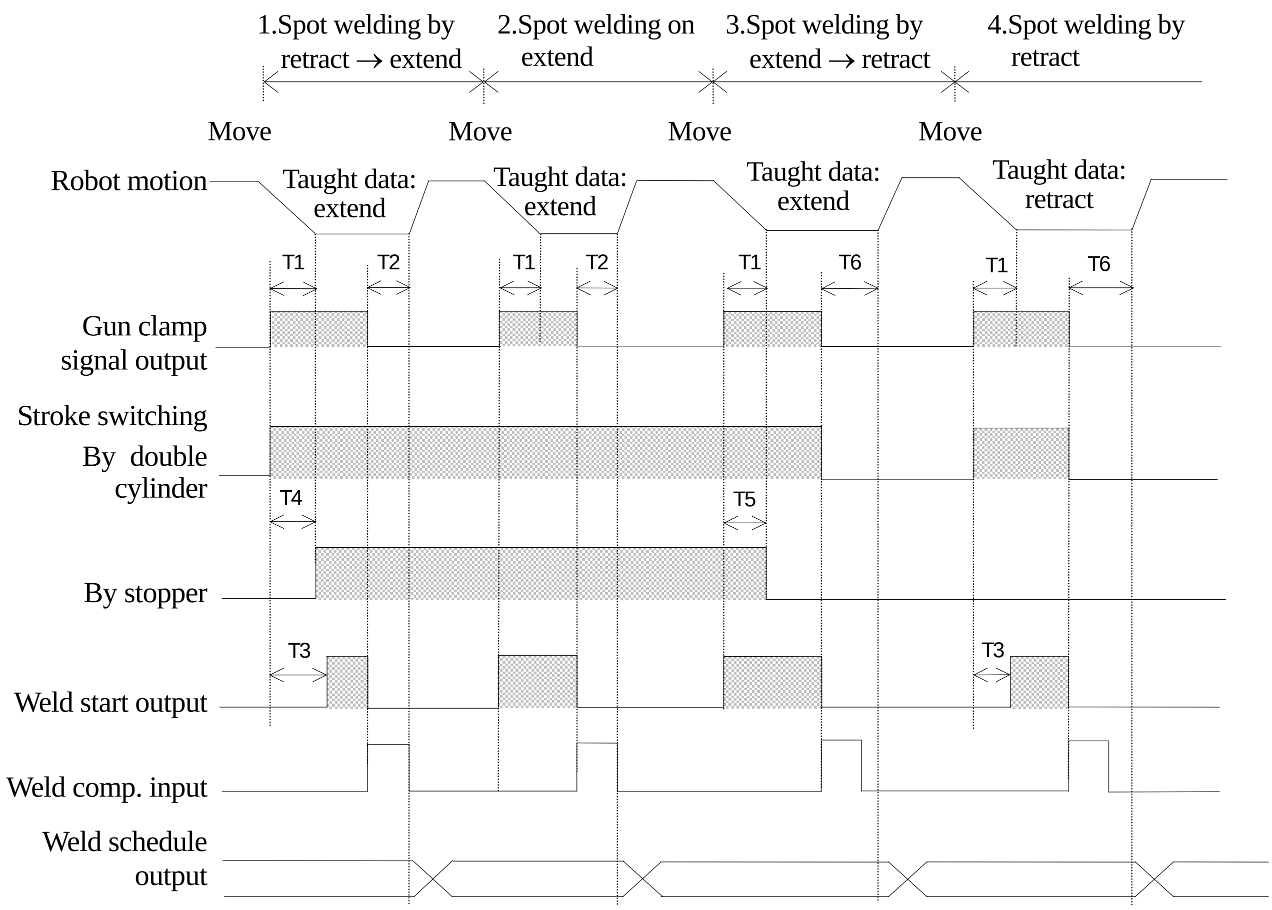
5. If the setting is correct, press ↵.

Items to be set for spot welding gun

Item	Contents
Gun Type	Sets type of gun to use. Single: single gun X-ret: 2-stroke retractable X gun C-ret: 2-stroke retractable C gun
Weld Delay on Retract → Extend	Sets time required for switching 2-stroke gun from retracted position to extended position and delays outputting Weld Start Output signal by the set time. Corresponds to T3 in Chapter 13.3.3. (Default is 0.5 sec.)
Motion Delay Extend → Retract	Sets time required for returning the 2-stroke gun from extended position to retracted position after welding and before moving to the next taught point. (Default is 1.0 sec.)
Retract Monitor	Selecting [monitor] enables continuous checking of the Retract Position Input Signal during robot motion. If this signal is not input in retracted state, error occurs and robot stops. Selecting [not] stops monitoring of the input signal.
Extend Monitor	Selecting [monitor] enables continuous checking of the Extend Position Input Signal during robot motion with the gun at extended position. If this signal is not input in extended state, error occurs and robot stops. Selecting [not] stops monitoring of the input signal.
Extend Signal Output Delay	Delays outputting the Extend Output Signal by the set time, for switching the stopper type of 2-stroke retractable gun from retracted position to extended position. Corresponds to T4 in Chapter 13.5. (Default is 0.5 sec.)
Retract Signal Output Delay	Delays outputting the Retract Output Signal by the set time, for switching the stopper type of 2-stroke retractable gun from extended position to retracted position. Corresponds to T5 in Chapter 13.5. (Default is 0.2 sec.)

13.5 TIME CHART FOR INPUT/OUTPUT SIGNALS

The figure below is a sample of the timing for each I/O signal in spot welding operation.



areas can be either enabled or disabled.

T1-T6 in the time chart shows:

T1: Early output of Clamp signal

Outputs Clamp signal T1 seconds in advance, before robot reaches the taught point.

T2: Motion Start Delay after Weld

Robot starts motion to the next taught point T2 seconds later after receiving weld completion signal. When the next taught data is for extended state, gun will remain extended.

T3: Weld Delay in change from Retract to Extend

Delays outputting Weld Start signal by the set time for switching from retracted position to extended position in the case of a 2-stroke retractable gun.

T4: Extending Signal Output Delay

Delays outputting Extending signal by the set time for switching the stopper type of 2-stroke retractable gun from retracted position to extended position.

T5: Retracting Signal Output Delay

Delays outputting Retracting signal by the set time for switching the stopper type of 2-stroke retractable gun from extended position to retracted position.

T6: Motion Start Delay after Weld

Robot starts motion to the next taught point with delay time of T2 after receiving weld completion signal. When the next taught data is for retracted state, gun will switch from extended position to retracted position.

13.6 CLAMP INSTRUCTION IN HANDLING OPERATION

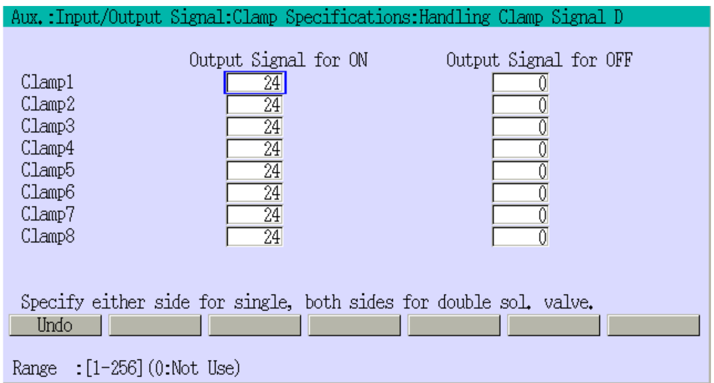
When using this instruction to open/close the hand(s), set 2 to [Application] in Aux. 060501. For the setting procedure, refer to Chapter 13.1.

Furthermore, in order to set more detailed conditions for the handling application, it is necessary to set the properties of the handling clamp signal.

Refer to the External I/O Manual, a separate volume, for more details about input/output signals.

13.6.1 SETTING OF HANDLING CLAMP DATA

Set output signals corresponding to each Clamp instruction that controls the valves that open/close the hand(s), etc. Selecting [20. Handling Clamp Signal Definition] in Aux. 0605 displays the screen below.



1. For single solenoid valves

Consider actual wiring and hand mechanism, and define the clamp signal output either for ON or OFF. A specified clamp signal for ON is output when the clamp instruction becomes ON. Conversely, a specified clamp signal for OFF is output when clamp instruction becomes OFF.

For example, if signal number 10 is set to [Output Signal for ON] in [Clamp 1], system outputs OX10 when clamp1 instruction is ON, and the electric potential of OX10 becomes high.

If signal number 11 is set to [Output Signal for OFF] in [Clamp 1], system outputs OX11 when clamp1 instruction is OFF, and the electric potential of OX11 becomes high.

2. For double solenoid valves:

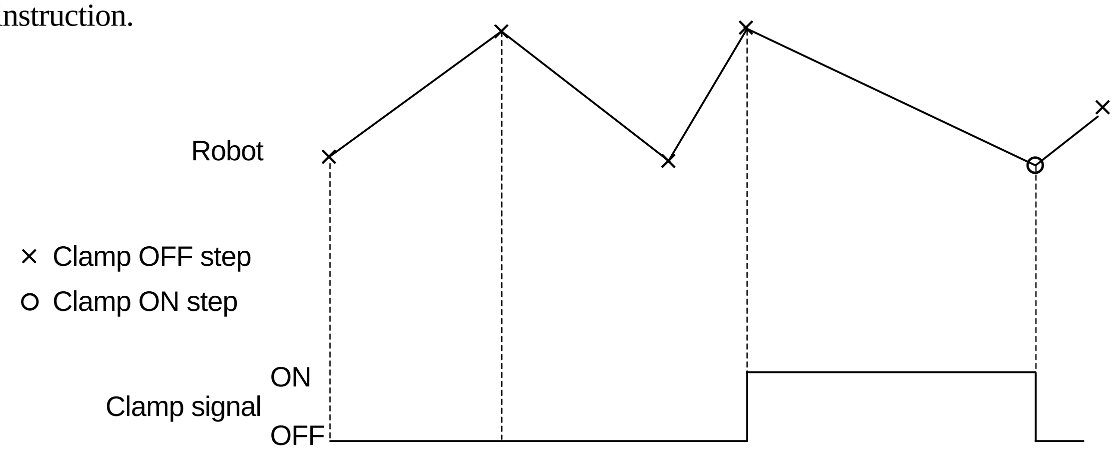
Unlike single solenoid valves, define two signal numbers for each clamp instruction.

For example, if setting signal number 20 to [Output Signal for ON] in [Clamp 2], system outputs OX20 when clamp2 instruction is ON, and the electric potential of OX20 becomes high.

System outputs OX21 when clamp2 instruction is OFF and the electric potential of OX21 becomes high.

13.6.2 TIME CHART FOR HANDLING SIGNALS

The figure below is a time chart for a clamp signal taught for handling specification. At the time of memory change to a step taught with ON for a clamp instruction, the clamp signal turns ON and remains ON until the memory change to a step taught with OFF for the clamp instruction.



14.0 MULTI FUNCTION OX/WX SPECIFICATIONS (OPTION)

This chapter describes optional specifications for OX and WX signals.

14.1 OX SIGNAL SPECIFICATIONS

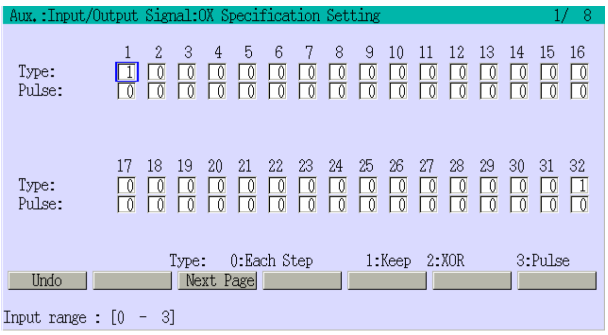
The following four types of OX signals can be set by Aux. 0604 (option) .

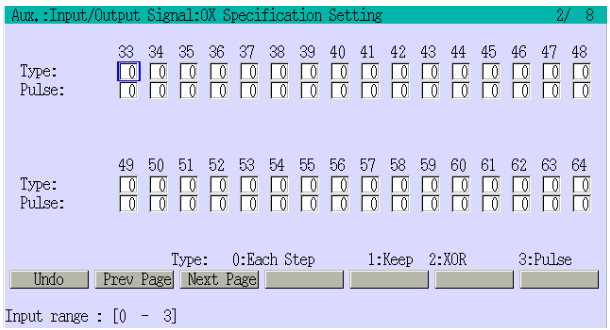
1. Step Type (Standard Type)
2. Keep Type
3. Double Type (XOR)
4. Pulse Type

The specifications for each are described below.　For output timing of each signal, refer to Chapter 14.3.

14.1.1 STEP TYPE

This is the standard type, teaching this OX instruction outputs a signal in step increments.　After robot reaches axis coincidence at a step, the memory changes, movement begins toward the next step where OX is taught, and the OX signal turns ON.　When the memory changes to a step where OX is not taught, the signal turns OFF.　To use Step Type, input 0 to [Type] in Aux. 0604 (option).





14.1.2 KEEP TYPE

The timing for turning ON the signal is the same as Step type, but Keep type signals remain ON until the signals are turned OFF at an OFF taught step.　To use Keep Type, input 1 to [Type] in Aux. 0604 (option).

14.1.3 DOUBLE TYPE (XOR)

A pair of signals of this type turns one signal ON and the other OFF, or vice versa. To use Double Type, input 2 to [Type] in Aux. 0604 (option).

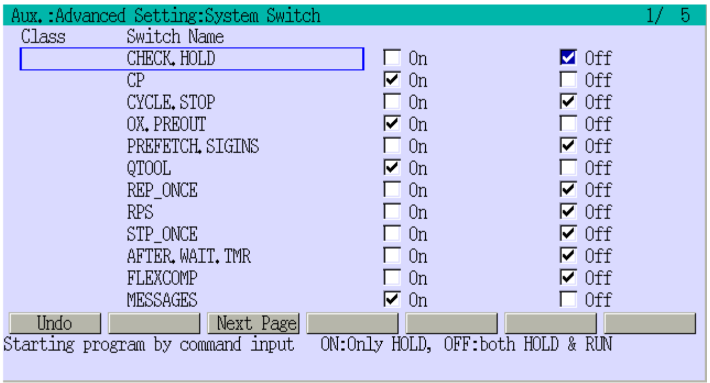
For Double Type (XOR), it should be noted that the combination of signals is restricted. The combination of OX1 and OX2, or OX3 and OX4 are possible, but combinations of OX2 and OX3, or OX4 and OX5 are not allowed.

14.1.4 PULSE TYPE

This type of signal remains ON for the specified length of the pulse after the robot reaches axis coincidence. To use Pulse Type, input 3 to [Type] and the length of pulse to [Pulse] in Aux. 0604 (option). Pulse length can be 0 to 9.9 sec, set in 0.1 sec increments. Even if setting 0, 0.4 seconds of pulse is output.

In Step Type and Keep Type OX signals, it is possible to change the output timing to output after axis coincidence. Set OFF in [OX.PREOUT] in Aux. 0502 as shown below.

Double Type (XOR) and Pulse Type output after axis coincidence regardless of this setting.

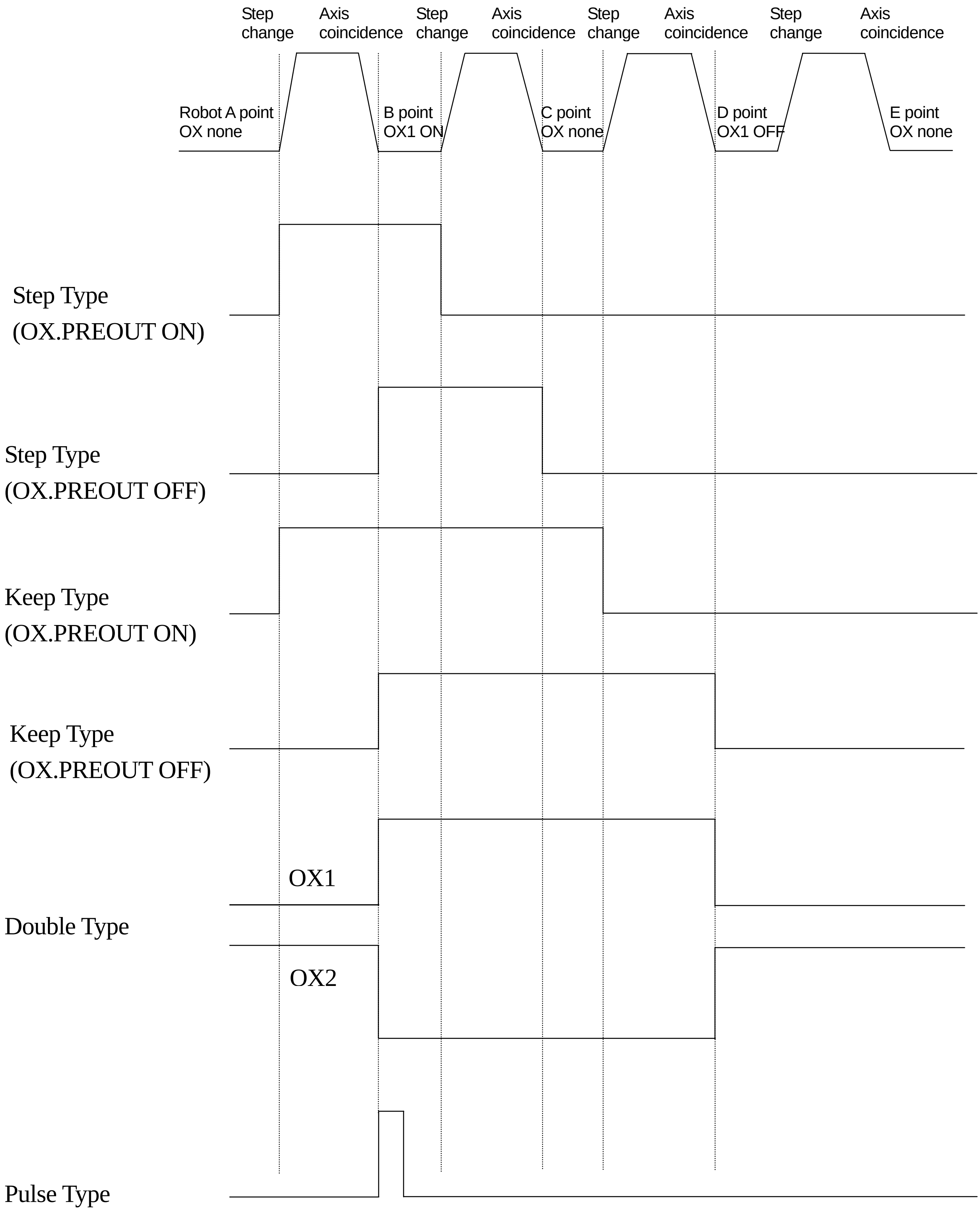


14.2 WX SIGNAL SPECIFICATIONS

There are two ways of detecting WX signals, when the signal turns OFF → ON, or ON → OFF. In teaching, a signal number with minus (-) sign in front indicates detection at ON → OFF, otherwise signal is detected at OFF → ON.

14.3 OUTPUT TIMING

Output timing of each type is illustrated in the figure below. As stated above, the memory change occurs at every step change. (See also Chapter 14.1.1.)



15.0 DATA TRANSFORMATION (OPTION)

This chapter describes procedures for transforming the pose data created in offline teaching into data which online robots can use.

WARNING

Data transformation is a kind of teaching.　Its usage is limited to personnel who have completed special training and are qualified for teaching or supervising robot operations.

15.1 OVERVIEW OF DATA TRANSFORMATION FUNCTION

There are two ways of teaching work contents to the robot: online and offline teaching. Because online teaching uses a robot installed on the production line (online robot), motion programs can be taught only when the line is not operating.

Offline teaching, on the other hand, does not use a robot on the production line, but instead uses an offline robot or CAD (Robot simulator) system.　Therefore, teaching is possible regardless of the state of the production line.

Data transformation is a function that transforms the pose data taught with an offline robot or CAD system into data that can be used by an online robot in actual operation.

In this function, the position data of four reference (base) points located on the workpiece is essential for fixing the pose relation between workpiece and robot.

The time needed to teach motion programs in the actual production system takes far longer time than the time for this data transformation operation.　Therefore, this function can raise the operating rate of the robot.

15.2 OFFLINE TEACHING DATA

CAUTION

When performing gravity compensation* and data transformation, the original data (offline teaching data) is deleted and the transformed data is written in the memory of the controller.　Therefore, save any data that should not be deleted in USB memory beforehand.

NOTE* For gravity compensation function, see Chapters 15.5.5.1, 15.5.7, 15.5.9.5.

When Aux. 0802 is set to [Inhibit], the original teaching data is not rewritten by the gravity compensation and data transformation functions.　Set it to [Accept] to rewrite.

During execution of data transformation function, teaching data cannot be input nor output from/to external device. (USB memory operation is not necessary.)

The following data is necessary before execution of data transformation function:

1. Offline	Data for four reference points	These data need to be prepared with offline robot beforehand.
2. Offline	Teaching data	
3. Offline	Data for measuring tool coordinates	
4. Online	Data for four reference points	For procedures on creating data, see Chapter 15.5.3.
5. Online	Data for measuring tool coordinates	

If any of the above data was saved to a USB memory, load the data from the USB memory.
Refer to Aux. 0202 for more details.

15.3 TOOL COORDINATES DATA

CAUTION

1. **The tool coordinates data which is measured by the automatic tool measuring function is valid only during the data transformation. The values set by Aux. 0304 in the robot controller are not changed.**
2. **Data of tool coordinates registered in this function are also valid only during the data transformation. The data return to the values set by Aux. 0304 after termination of the data transformation function.**
3. **The most recent position and pose data of tool coordinates (X, Y, Z, O, A, T) which were used for data transformation are shown on screen.**

Six kinds of tools can be used in data transformation function (each tool is specified with a number 1- 6.)

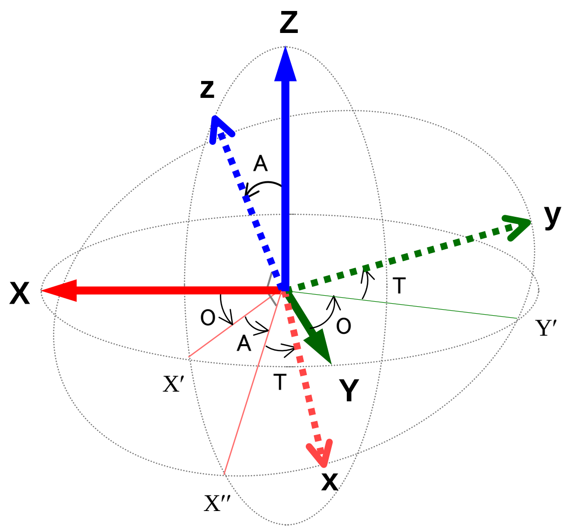
For Tools 1 to 3, the position (X, Y, Z) and orientation (O, A, T) of the tool coordinates, with respect to the null tool coordinates, must be set in Aux. 0304 before executing the data transformation function.

For tools 4 to 6, the position (X, Y, Z) and orientation (O, A, T) of the tool coordinates, with respect to the null tool coordinates, can be set using the data registered in this function on the display. The initial values are set in Aux. 0304.

For Tools 1 to 6, each tool coordinates position data, with respect to the null tool coordinates, can also be set automatically by the automatic tool measuring function in this data transformation function.

15.4 DEFINITION OF TOOL POSTURE

Both the translation amount (mm) of the tool coordinates with respect to the null tool coordinates, and the rotation angles (°) O, A, T, are registered as tool coordinates data. The figure below shows the relations between the orientation of the tool coordinates (x,y,z) with respect to the null tool coordinates (X,Y,Z) and Euler's OAT angles.



As shown in the figure above, the three angles can be defined as follows.

O: The angle between Zz plane and XZ plane
A: The angle between z axis and Z axis
T: The angle between x axis and X″ *axis

NOTE* Refer to the order of rotation on next page.

[NOTE]

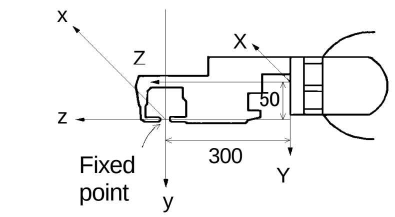
Sets O, A, and T as values from −180 to +180 deg. The value of rotation is expressed as shown below depending on the direction:

Right : Positive value
Left : Negative value

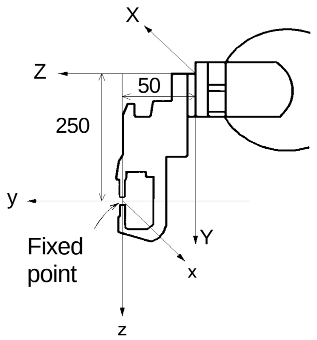
The null tool coordinates (X, Y, Z) coincides with the tool coordinates (x, y, z) when it rotates in the following order, according to the definition above.

1. O : rotation of the null tool coordinates ΣXYZ around Z axis. (This moves ΣXYZ to ΣX′Y′Z.)
2. A : rotation of ΣX′Y′Z around Y′ axis. (This moves ΣX′Y′Z to ΣX″Y′z.)
3. T : rotation of ΣX″Y′z around z axis. (This moves ΣX″Y′z to Σxyz.)

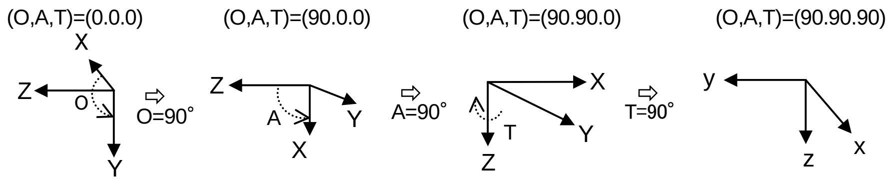
The setting procedures for X, Y, Z, O, A, T according to the actual gun shapes are as follows:



When registering the gun shown in the left figure as tool 1:
X, Y, Z, O, A, T ＝ 0, 50, 300, 0, 0, 0
(X axis faces down, vertical against this plane.)



When registering the gun shown in the left figure as tool 2:
X, Y, Z, O, A, T ＝ 0, 250, 50, 90, 90, 90
(X axis faces down, vertical against this plane.)



CAUTION

O, A, and T are displayed as values from –180° to 180°.
For example, inputting , , , 90, 150, 220 is expressed as:

O; 90.000
A; 150.000
T; -140.000

15.5 OPERATING PROCEDURES FOR DATA TRANSFORMATION FUNCTION

15.5.1 OPERATION FLOW

Operate as follows to execute the data transformation function:

Preparing data for transformation

1. Mounting tool
2. Setting workpiece
3. Loading an offline program for data transformation
4. Creating data for automatic measurement of tool coordinates for online robot
5. Measuring four reference points data by online robot

⇩

Executing online automatic tool measurement

1. Gravity compensation* for tool measuring data
2. Automatic measurement of tool coordinates for online robot
3. Displaying and recording tool coordinates data for online robot

⇩

Registering data of tool coordinates for online robot

1. Inputting tool coodinates data obtained by automatic measurement

⇩

Gravity compensation for four online reference points

1. Gravity compensation*

⇩

Registering data of tool coordinates for offline robot

1. Registering offline tool coordinates data

⇩

Executing data transformation

1. Verifying the data of tool coordinates for the online robot
2. Verifying the data of tool coordinates for the offline robot
3. Setting the four base points and tool numbers
4. Displaying distances and errors between the four base points
5. Executing data transformation
6. Gravity compensation*

⇩

Confirming the transformed data after data transformation

1. In check mode, run program that includes transformed data

If online tool coord. data is not correct:

If offline tool coord. data is not correct:

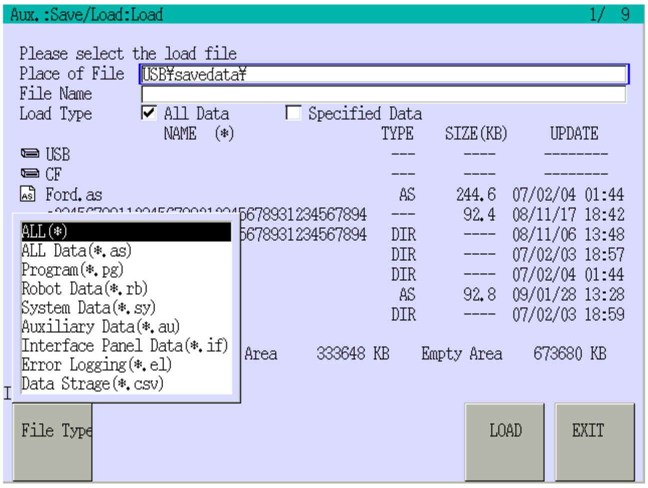
If error exceeds allowable range:

If data transformation error is large:

NOTE* Gravity compensation is necessary only when the offline teaching data is created by CAD.

15.5.2 PREPARING DATA FOR TRANSFORMATION

Finish mounting tools and workpieces before executing data transformation function.　Then, load the program for data transformation.　For more details, refer to Aux. 0202.



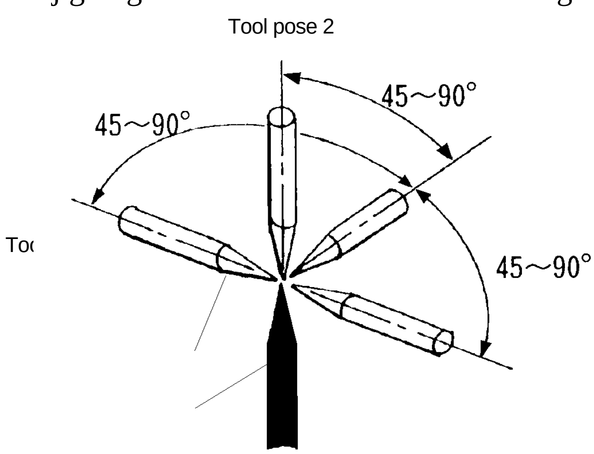
1. Select [Aux. 0202 Load].
2. Connect the USB memory.
3. Select [All Data] or [Program] from the pull down menu displayed by pressing <File Type>.
4. Select the file name.
5. Pressing <Load> starts loading the file.

15.5.3 CREATING DATA FOR AUTOMATIC MEASUREMENT OF ONLINE TOOL COORDINATES

Set up the measuring jig for the tool, and teach the robot’s pose data corresponding to four tool poses for automatic tool measurement.

The angle between each pose should be within 45°- 90° as shown in the figure below.　Follow this guideline when recording, poses out of this range will enlarge errors during data transformation.

In creating teaching data, move the robot by using $\boxed{\text{AXIS}}$, and position the distance between tool coordinates origin and the jig origin within 1 mm as shown in the figure below.

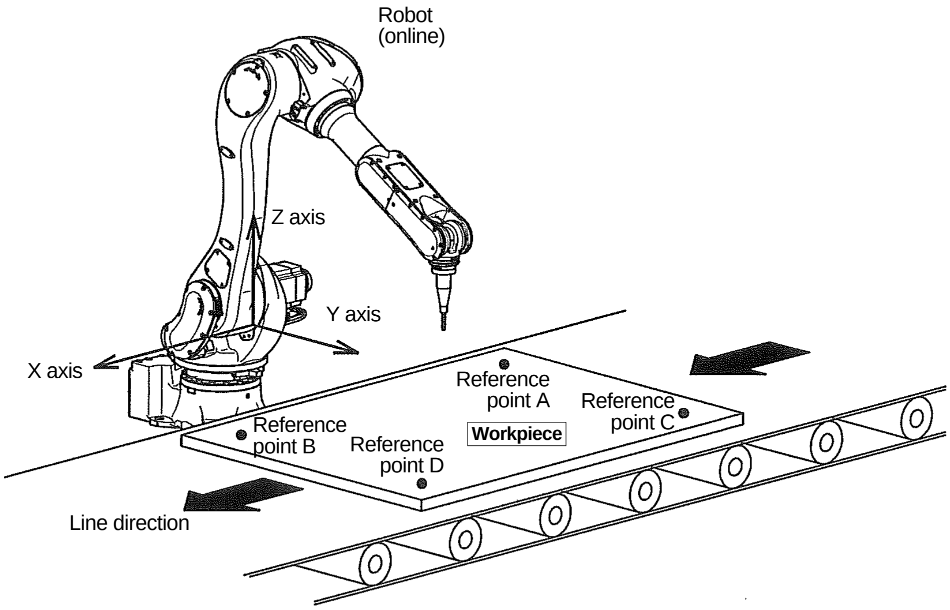


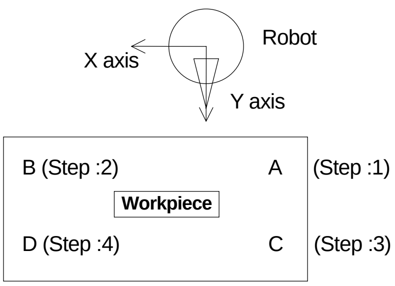
Refer to Chapter 10 for more details about how to create the teaching data for automatic tool measurement.

15.5.4 TEACHING FOUR REFERENCE POINTS BY ONLINE ROBOT

Teach the position data for four reference points on the workpiece using the online robot. Set these points close to each corner so that all the teaching points in the program can be inside the area that they define.

The position data of the four reference points are necessary for fixing the pose relation between the workpiece and the online (or offline) robot. Select four points (A, B, C, and D) on workpiece, teach them with online (or offline) robot, and record their step numbers corresponding to point A, B, C, and D.





As an example, take a pose relation between the robot and workpiece as shown in the left figure. Recording two or more points at the same position results in error.

The closer the angle ∠BAC is to 90 °, the more accurate the data transformation is. If the angle is less than 45°, transformation error becomes large.

The procedure for teaching the four reference points for online data is as follows. Create data in point order, A → B → C → D.

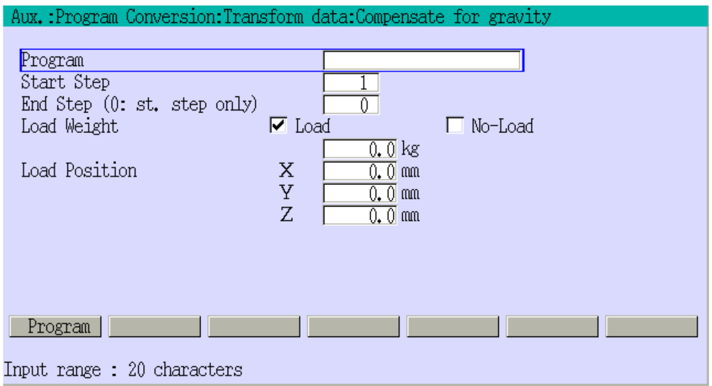
1. Select the program name. Refer to Chapter 2.7.1.1 for more details about selecting a program name.

2. Move the robot to the four reference points by pressing AXIS, and press REC at each point to record the pose information.

15.5.5 EXECUTING AUTOMATIC TOOL MEASUREMENT

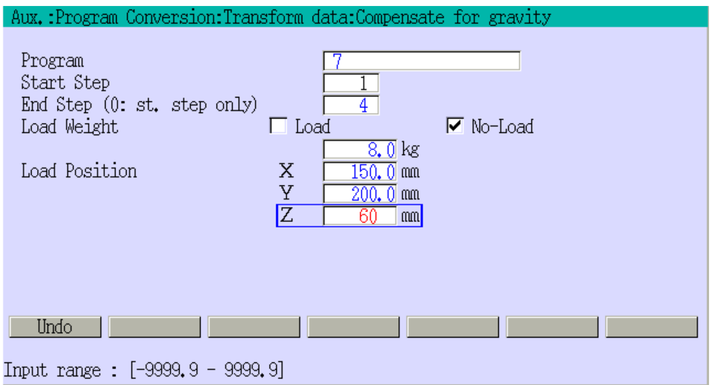
15.5.5.1 GRAVITY COMPENSATION

This function performs gravity compensation on the teaching data obtained by automatic measurement, for the position (X,Y,Z) of the tool coordinates origin. This compensation is necessary only when the offline data was created with CAD.



1. Select [Aux. 010304 Compensate for gravity].

2. Press <Program> and select the desired program. Refer to Chapter 2.7.1.1 for details about selecting a program name.



3. Input data for each item. Set [Load Weight] to [No-Load]. Press BS to clear the input data. If the setting is correct, press ↵.

[NOTE]

When specifying step numbers:

Only the first step number is executed when the end step is set to 0.

Setting 0 for the first step number results in an input error.

If the end step number is set larger than the last step, all the program steps are executed.

Example of input:

Start step number	0	0	1	3
End step number	0	5	0	3
	↓	↓	↓	↓
	Error	Error	Executes only step1	Executes only step3

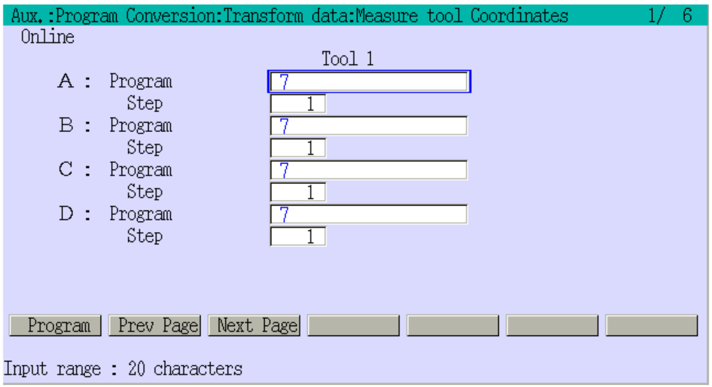
4. Confirmation box is displayed. Select [Yes] to execute the gravity compensation. Registration is finished when "Setting complete." is displayed.

[NOTE]

1. For [Load Position](X,Y,Z), input the center of gravity of the load in coordinate values on null tool coordinate system.
2. When load mass value is negative, data with a load is transformed into data without load. (This transformation is necessary when measuring robot data is used.) When load mass value is positive, data without a load is transformed into data for robots with a load. (This transformation is necessary when CAD data is used.)
3. If the load mass is set to 0 kg, the data created by CAD is transformed into data for robots without load. If -1 kg is set, the data set for the robot with a load is transformed into one for CAD.

15.5.5.2 AUTOMATIC MEASUREMENT OF TOOL COORDINATES FOR ONLINE ROBOT

This procedure automatically calculates tool coordinates data for online robot. This operation can be repeated any number of times. The last calculation result is valid.

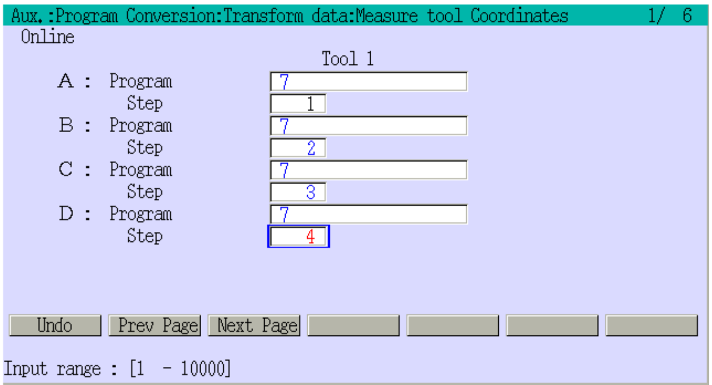


1. Select [Aux. 010303 Measure Tool Coordinates].

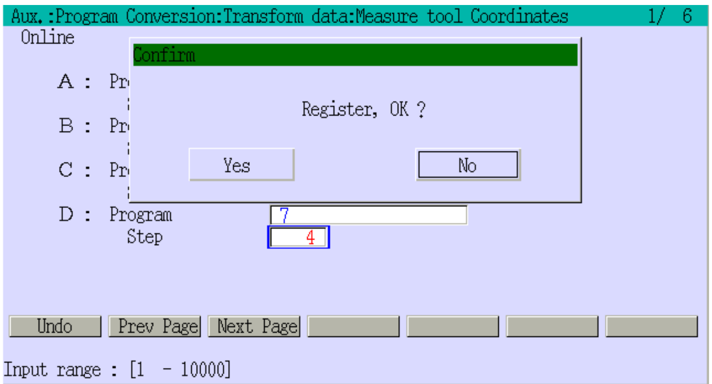
2. Select the appropriate tool number (1 - 6) by pressing <Prev Page>/<Next Page>.

3. Press <Program> and select the desired program* with the 4 reference points position data. Refer to Chapter 2.7.1.1 for details about selecting a program name.

NOTE* Inputting a program name in [A] copies the same program name into [B] to [D].
Inputting a program name in [B] to [D] does not copy the name to other fields.



4. Input step numbers in [Step] for each reference point (A - D). If the setting is correct, press ↵.



5. The confirmation box is displayed. Select [Yes] to register the data. Tool coordinates position data is overwritten by the values calculated from the teaching data of each step. Registration is finished when "Setting complete." is displayed.

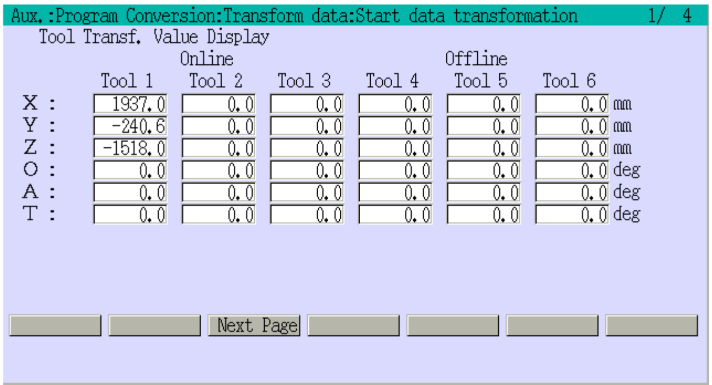
[NOTE]

1. When the four step numbers are all set to 0, position data of this tool is not calculated nor overwritten.
2. Position data for several tools can be calculated and overwritten at the same time.

15.5.5.3 DISPLAYING AND RECORDING TOOL COORDINATES DATA FOR ONLINE ROBOT

After verifying the tool coordinates data that is obtained from automatic measurement with online robot, be sure to note down the X, Y, and Z values.* The values will be input and registered in the following steps.

NOTE* The tool coordinates data obtained in Chapter 15.5.5.2 is deleted after completion of data transformation. Be sure to note the X, Y, and Z values for tool 1.



Select Aux. 010301 and confirm the displayed data.

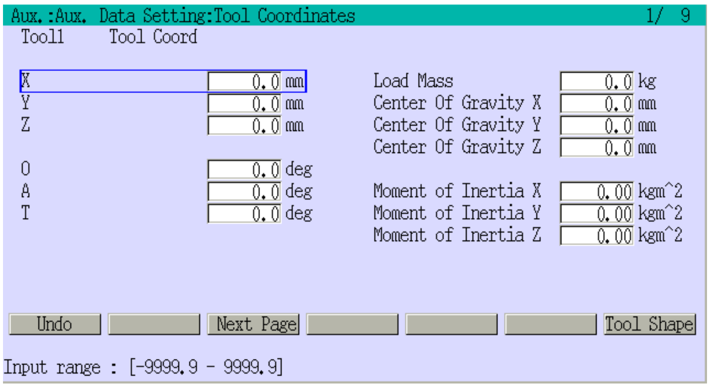
[NOTE]

1. When the tool coordinates data is automatically measured, the tool coordinates position is obtained as a calculated result.
2. When the tool data is not automatically measured, the tool data indicates the set values (for Tool 1- 3) in Aux. 0304 and values (for Tool 4- 6) registered in Aux. 010302.

15.5.6 TOOL COORDINATES DATA REGISTRATION FOR ONLINE ROBOT

This function registers the tool coordinates data that is obtained in automatic tool measurement.

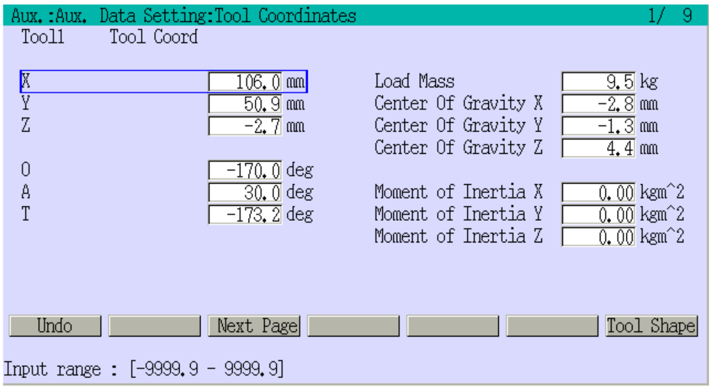
Take note that because only X, Y, and Z can be calculated by automatic tool measurement, input the values for O, A, and T by NUMBER.



1. Select [Aux. 0304 Tool Coord].

2. Select the appropriate tool number by pressing <Next Page>.

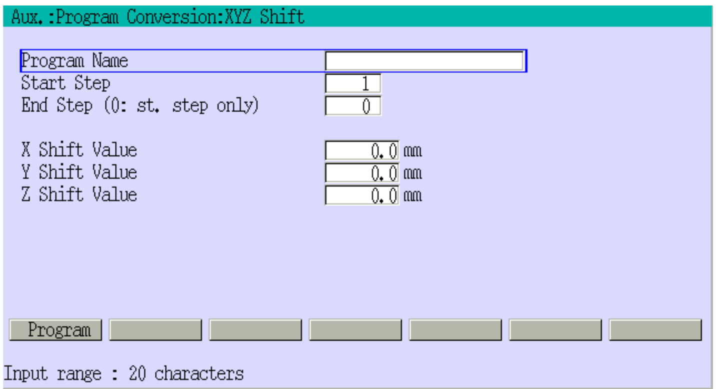
3. Input the tool data that was obtained in Chapter 15.5.5.2.



4. If the setting is correct, press ↵. The tool coordinates are registered when "Setting complete." is displayed.

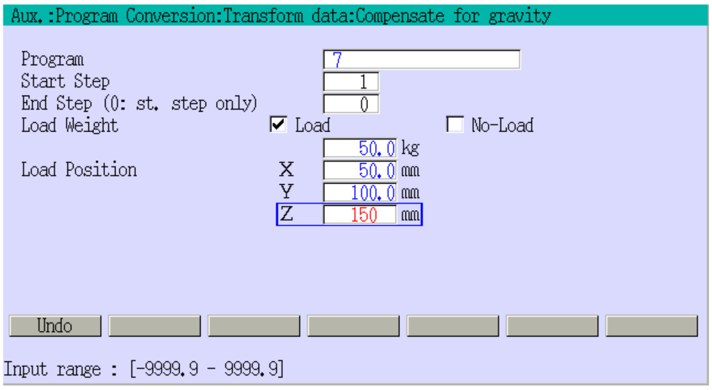
15.5.7 GRAVITY COMPENSATION FOR FOUR ONLINE REFERENCE POINTS

This function performs gravity compensation on the four reference points data measured by online robot. This compensation is only necessary when offline teaching data is created by CAD.

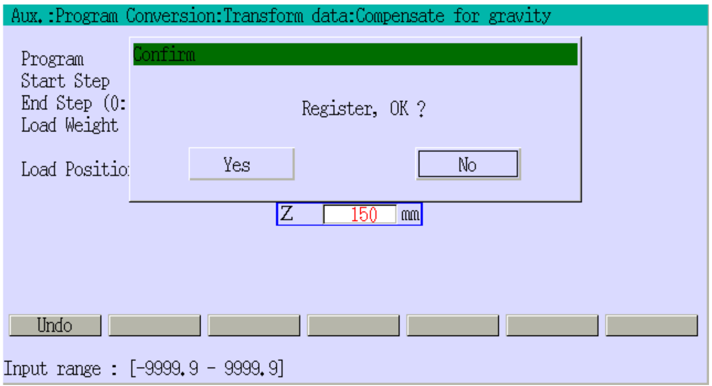


1. Select [Aux. 010304 Compensate for Gravity].

2. Press <Program> and select the desired program. Refer to Chapter 2.7.1.1 for details about selecting a program name.



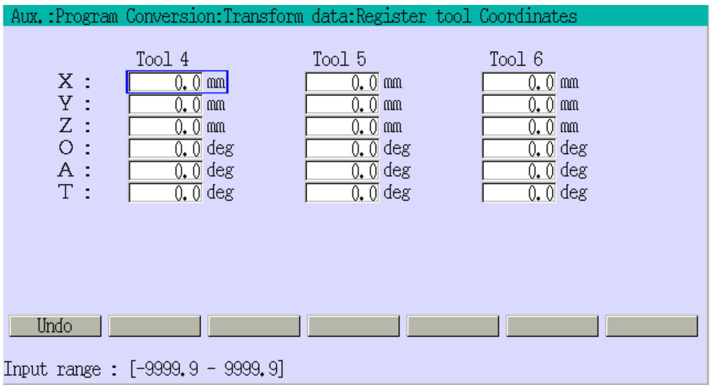
3. Input data for each item. Set [Load Weight] to [No-Load]. To clear the input data, press BS. If the setting is correct, press ↵.



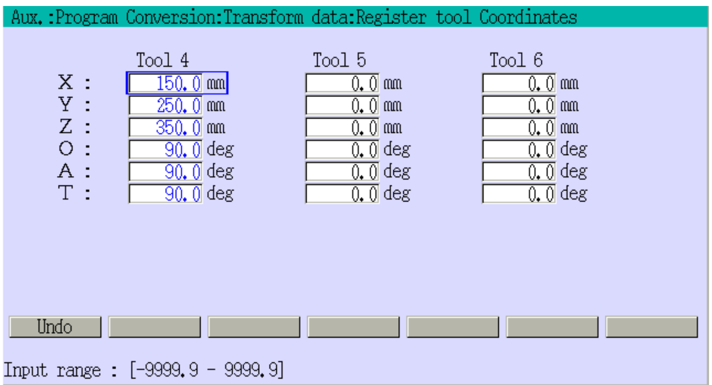
4. The confirmation box is displayed. Select [Yes] to execute the gravity compensation. Gravity compensation settings are stored when “Setting complete.” is displayed.

15.5.8 TOOL DATA REGISTRATION FOR OFFLINE ROBOT

This function sets the position (X, Y, Z) and orientation (O, A, T) of each tool coordinates for tool numbers 4 to 6 on the offline robot.



1. Select [Aux. 010302.Register Tool Coordinates].



2. Input data for each item. To clear the input data, press BS. If the setting is correct, press ↵. The input data is now stored in the memory.

CAUTION

1. When the data registration for tool 4 is complete, do not terminate data transformation.

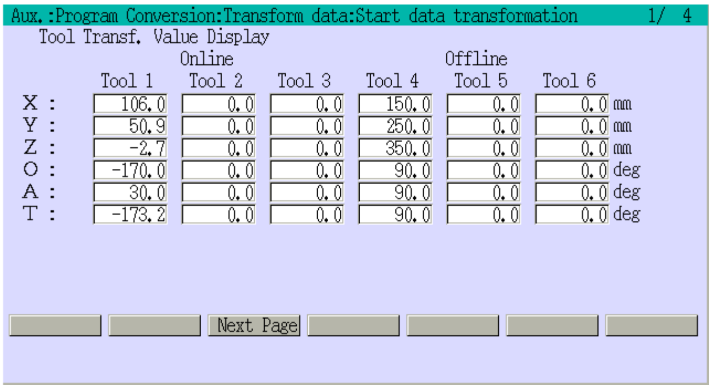
2. The tool data registered in this function is valid only during the data transformation.

3. When data transformation mode is accidentally terminated, the tool data will need to be set once again.

15.5.9 EXECUTING DATA TRANSFORMATION

15.5.9.1 VERIFYING THE TOOL DATA FOR THE ONLINE AND OFFLINE

Verify if tool data for the online and offline robot is the same as the values set in Aux. 0304.

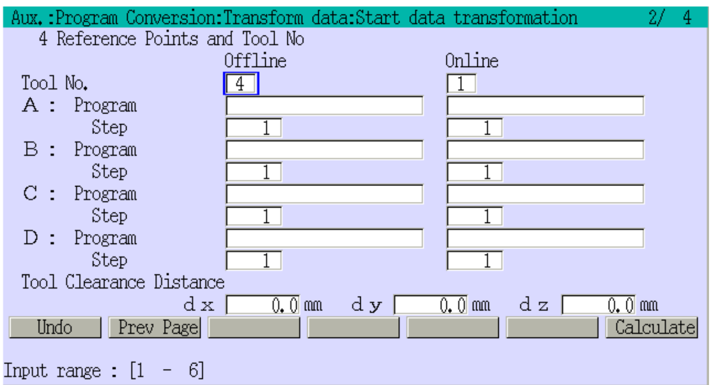


1. Select [Aux. 010301 Start Data Transformation].

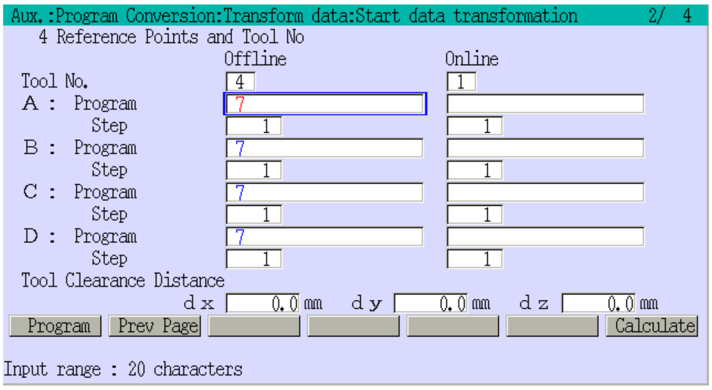
2. Screen at left appears. Verify if the data for each tool are the same as the values set in Aux. 0304.

15.5.9.2 SETTING THE FOUR REFERENCE POINTS AND TOOL NUMBERS

Set the tool number of the tool which is used when teaching the four reference points by using offline and online robots, and the program and the step numbers where the four base reference points are taught.



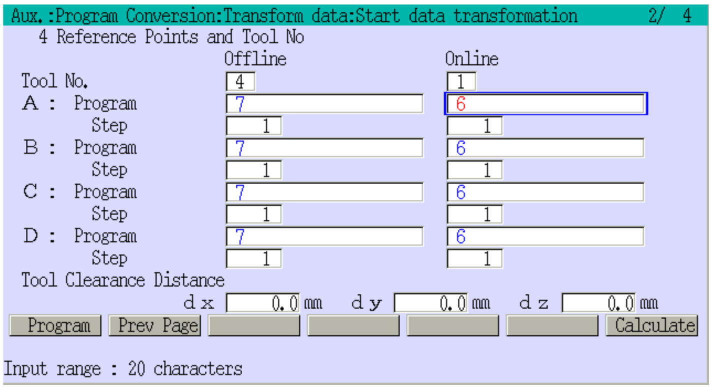
1. Press <Next Page> in Aux. 010301 screen.

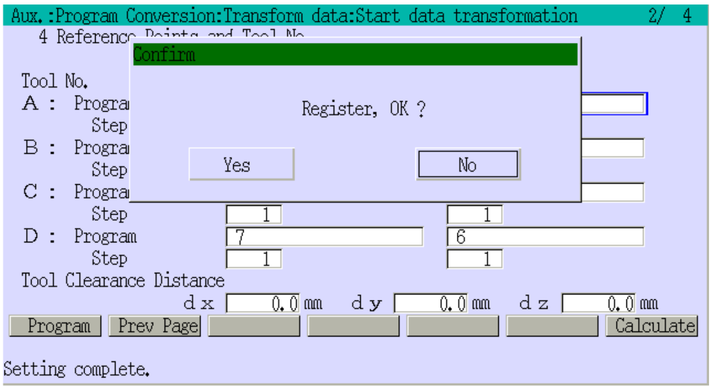


2. Press <Program> and select the desired program. Refer to Chapter 2.7.1.1 for details about selecting a program name.

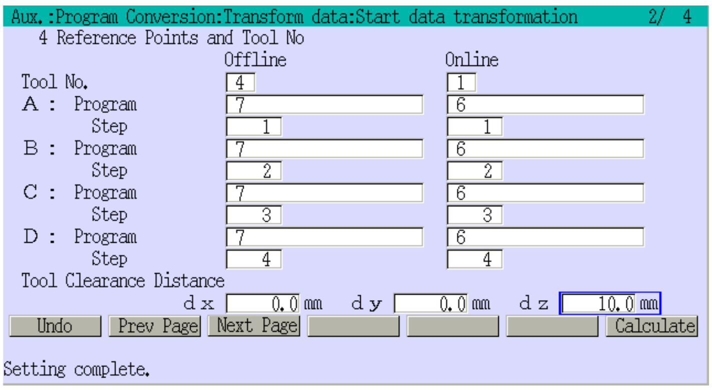
3. Input offline data.

4. Input online data. Set [Tool Clearance Distance] if necessary. To clear the input data, press BS. If the setting is correct, press ↵.





5. Pressing <Calculate> displays the confirmation box. Select [Yes] to start calculating the data transformation.



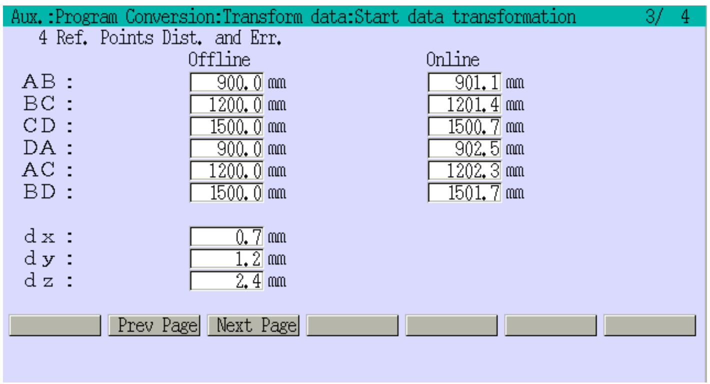
6. Transformation is finished when “Setting complete.” is displayed. Press <Next Page> to move to the next screen.

[NOTE]

1. [Tool clearance distance] shifts the data in each axis direction of the base coordinates by a set amount, after transformation based on four reference points data for online robot.　In this example, the data is transformed to a position 10 mm above the workpiece (distance from tool-tip to taught-point= dz= 10).
2. Set this data to move the tool away from the workpiece during the first repeat operation to reduce risk of interference, etc.　Set 0 in normal operation.

15.5.9.3 DISPLAYING DISTANCES AND ERRORS BETWEEN THE FOUR REFERENCE POINTS

Next screen displays the deviation between the transformation position of point D obtained by the calculation in Chapter 15.5.9.2 and the point D position measured by online robot.　Deviations are displayed as dx, dy, and dz distances.



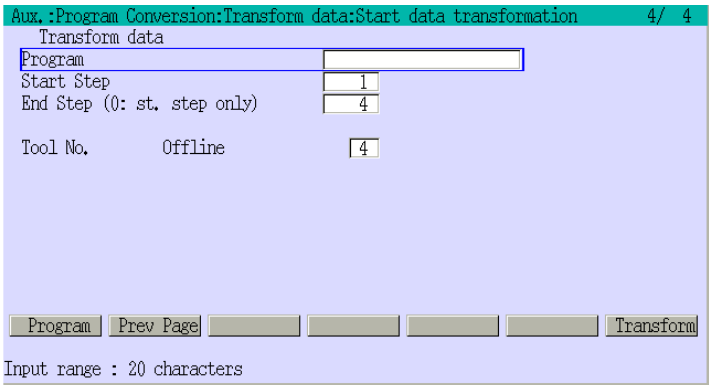
Pressing <Next Page> in the screen described in step 6 in Chapter 15.5.9.2 displays the screen on the left.　Here, verify the distance between four reference points for [Offline]/[Online] and the values of deviation in [dx], [dy], [dz].

CAUTION

If values dx, dy, and dz are not within the range of ±3.0 mm, the procedures up to this point can be thought as causing the error. Remove the error causes and execute once again.

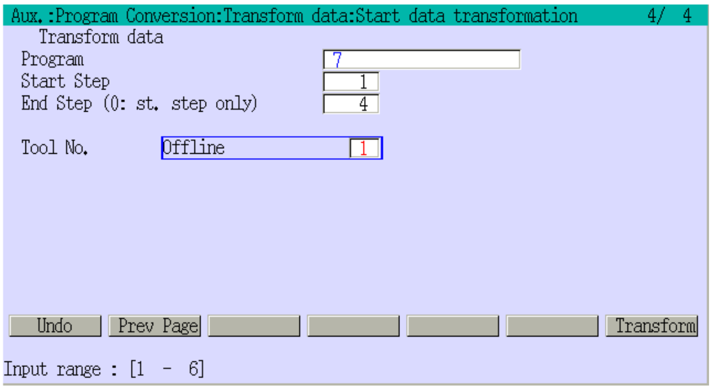
15.5.9.4 EXECUTING DATA TRANSFORMATION

This function performs data transformation based on offline data (program: pg7, for example).

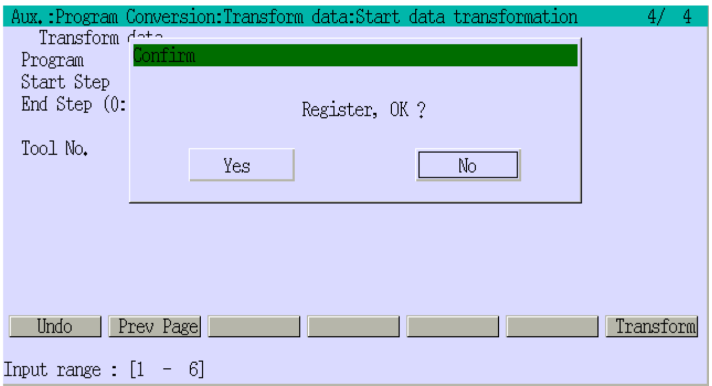


1. Pressing <Next Page> on the screen in Chapter 15.5.9.3 displays the screen on the left.

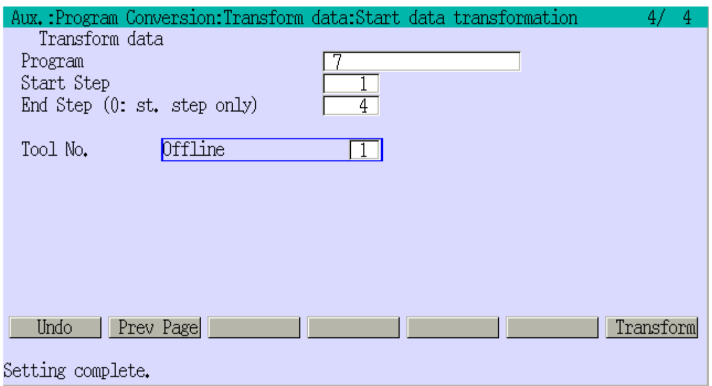
2. Press <Program> and select the desired program. Refer to Chapter 2.7.1.1 for details about selecting a program name.



3. Tool numbers input in Chapter 15.5.9.2 are displayed. Specify the first and last steps of the program for data transformation, and the tool number of the offline robot. If the setting is correct, press <Transform>.



4. Confirmation box is displayed. Select [Yes] to register the data.

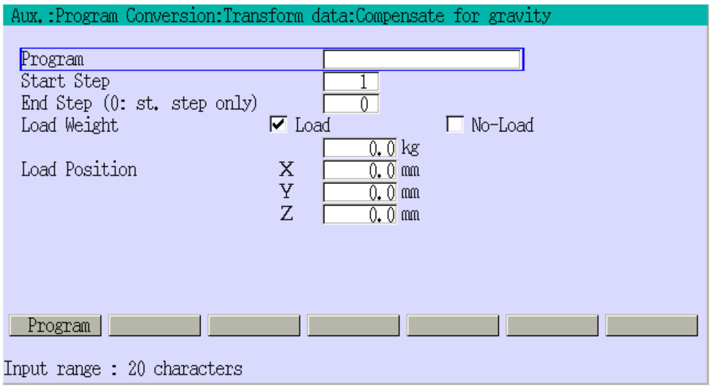


5. If data transformation performs properly, the teaching data in the step is rewritten and “Setting complete.” is displayed.

15.5.9.5 GRAVITY COMPENSATION FOR OFFLINE DATA

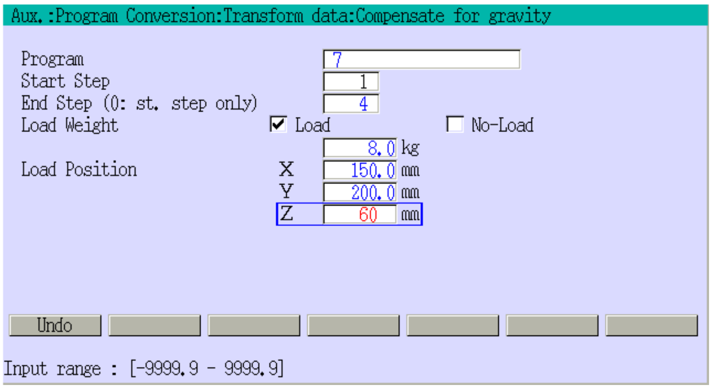
Performs gravity compensation on the data to be used online (program pg7 for example).

This compensation is valid only when the offline teaching data is created by CAD.　When offline teaching data was created with an actual online robot, do not perform gravity compensation.

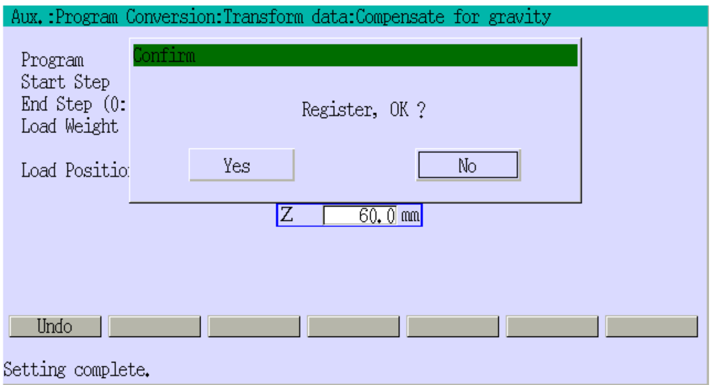


1. Select [Aux. 010304 Compensate for Gravity].

2. Press <Program> and select the desired program.　Refer to Chapter 2.7.1.1 for details about selecting a program name.



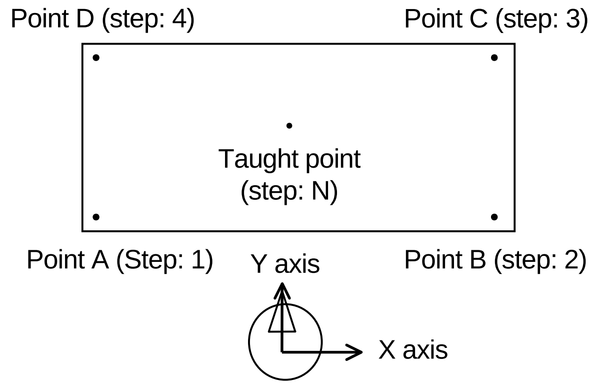
3. Input data for each item.　Set [Load Weight] to [Load].　To clear the input data, BS.　If the setting is correct, press ↵.



4. Confirmation box is displayed. Select [Yes] to register the set data.　Gravity compensation settings are stored when “Setting complete.” is displayed.

15.5.10 CONFIRMING TEACHING DATA AFTER DATA TRANSFORMATION

Execute a program (pg6, for example) which contains data transformed from offline data to confirm if the data transformation has been performed correctly.



The procedure is as follows:

1. Select the desired program. Refer to Chapter 2.7.1.1 for more details about selecting a program name.

2. Confirm that the first step is selected. Refer to Chapter 2.7.1.1 for more details about selecting a program name.

3. Set check motion to Step Once by CONT on the TP.

4. Press A + Motor ON on the TP to turn the motor power ON. Then, press A + RUN or A + <HOLD> to enable the robot to move.

5. Press CHECK GO with DEADMAN engaged. The robot executes the first step and then stops.

6. Repeat this operation to confirm each teaching point, and re-teach points with large deviation.

7. Check the operation for all steps.

This completes the series of operations for data transformation.

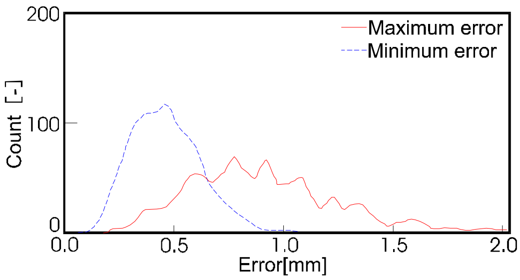
15.6 TRANSFORMATION ERRORS DURING DATA TRANSFORMATION

When online operations are not performed correctly, transformation of the data for the online robot will not be executed accurately, even though the offline teaching data is correct.

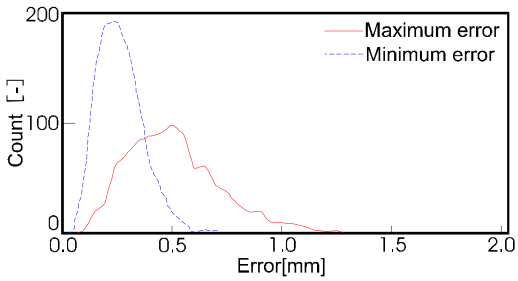
Causes for transformation errors during online operation

Tool orientation when teaching four reference points

Data transformation errors caused by tool orientation difference do not occur if there is no error in the tool data that is used when processing the offline and online data. However, errors inevitably exist within the tool data, and data transformation error will occur and will be affected by differences in the tool orientations for the four online reference points (A, B, C, and D) and for actual teaching points. When setting tool orientation for the four online reference points, the four offline reference points (A, B, C, and D), and those of the actual teaching points to be the same, the error becomes relatively smaller. When tool orientations for the four online reference points (A, B, C, and D), or those at the actual teaching points do not match, the error becomes relatively larger. Aspects of this error are described with actual examples below:



Graph A: Postures are not limited



Graph B: Postures limited to 1/4 of the postures in Graph A

Above graph describes transformation error with an error of ±0.5 mm against reference points X, Y, Z.

Remarks at operation

Note the following in order to make data transformation error smaller:

1. As much as possible, teach each of the four reference points for online robot to have almost the same orientation, and teach so that their orientations also match those of the actual teaching points for repeat operation.
2. When tool orientations at repeat mode differ dramatically at each point, group similar orientations, teach four reference points for each group, and perform data transformation. This makes data transformation errors smaller.

15.7 ERROR HANDLING

An error message may appear when some defect occurs during data transformation. In this case, normally taught data is not rewritten, however, be advised that it may be rewritten for specific errors. The following is a list of error messages.

Error messages	Causes ⇨ Countermeasures
Step No. (XX) movement range over. (Press <CONTINUE> for rewrite.)	Calculated result exceeds joint motion range. ⇩ Selecting [CONTINUE] on the confirmation box rewrites the teaching data to be within motion range and continues the processing.
Step No. (XX) interference range over. (Press <CONTINUE> for rewrite.)	Calculated result exceeds joint interference range. ⇩ Selecting [CONTINUE] on the confirmation box rewrites the teaching data and continues the processing.
Step No. (XX) JT. 4, 5, 6 has changed over 45 deg. (Press <CONTINUE> for rewrite.)	Axis value difference between before and after transformation is more than 45° in any axis of wrist. (Normally there is no problem if this error occurs.) ⇩ Selecting [CONTINUE] on the confirmation box rewrites the teaching data and continues the processing.
Auto measuring error.	Calculation of tool data did not complete properly. ⇩ Check the settings of the four reference poses for auto tool measurement and set the appropriate data again.
Numerical operation error.	An error occurred in process of numeric calculation. ⇩ Check the set data and set the appropriate data again.
Data is incorrect.	1. Tool coordinates position (X, Y, Z) is set out of the range of ±9999.9 mm in Aux. 010302 2. Tool coordinates orientation (O, A, T) is set out of the range of ±360.0 ° . ⇩ Set tool coordinates transformation values (X, Y, Z, O, A, T) within the limit.

Message	Detail
Normally Completed.	Appears when calculation, etc. finishes properly.
Executing….	Appears while transformation matrix for data transformation is being calculated in the setting screen for four reference points and tool numbers in Aux. 010301.

16.0 SEALING SPECIFICATION (OPTION)

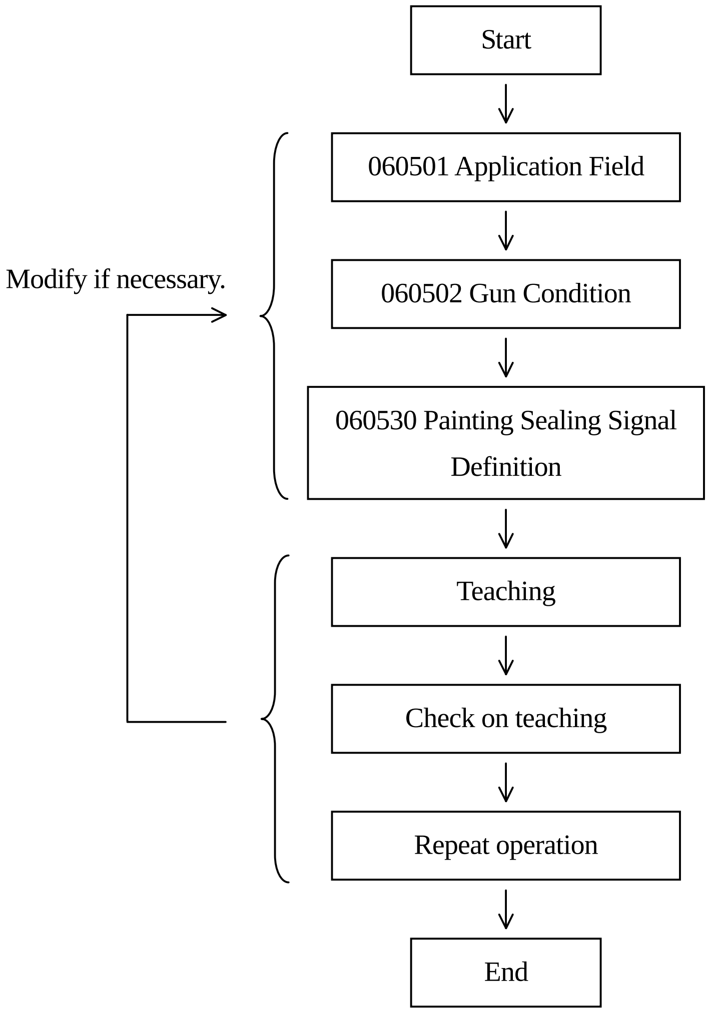
Sealing spec. robots have various control function necessary for sealing operations.　This chapter describes how to set the data for sealing control.

WARNING

Setting of the sealing specification is a kind of teaching. Usage of these functions is limited to only those who have completed special training and are qualified for teaching or supervising robot operations.

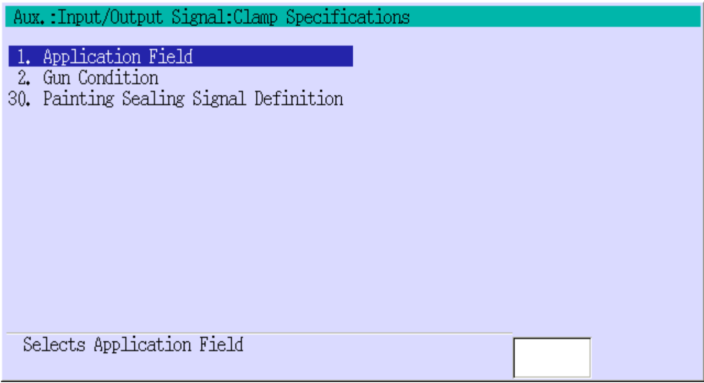
16.1 FLOWCHART FOR SEALING OPERATION

The flowchart below shows the sealing procedure for sealing spec. robots.　Make the necessary settings for sealing control on the screens in auxiliary function 060501 - 060530.　Teaching and the subsequent operations are the same as those in workpiece handling, etc.



16.2 SETTING OF NECESSARY ITEMS BY AUXILIARY FUNCTION

To display the pull-down menu, activate B area on TP screen and press MENU, or press the B area directly. Select [Aux Function] and input the auxiliary function number (605) directly with NUMBER. Then, press ↵ to display the setting screen below.



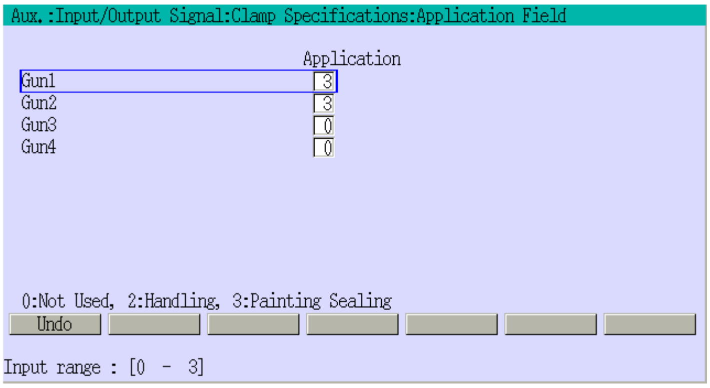
To display each setting screen, move the cursor or input the function number directly and press ↵.

1 Application Field	Selects the application field for the gun.
2 Gun Condition	Specifies operation conditions for each code of gun condition (CC)* that is auxiliary data of gun instruction.
30 Painting Sealing Signal Definition	Sets the signal numbers for painting/sealing gun ON/OFF.

NOTE* Refer to Chapter 16.2.2 for the gun condition setting procedure.

16.2.1 SETTING OF APPLICATION FIELD

Sealing spec. robots can use up to 4 guns. The application field of [Gun1] to [Gun4] are specified here.



Select a gun from [GUN1] to [GUN4] using ↑/↓, and press ↵ after setting either 0, 2 or 3 for each gun.

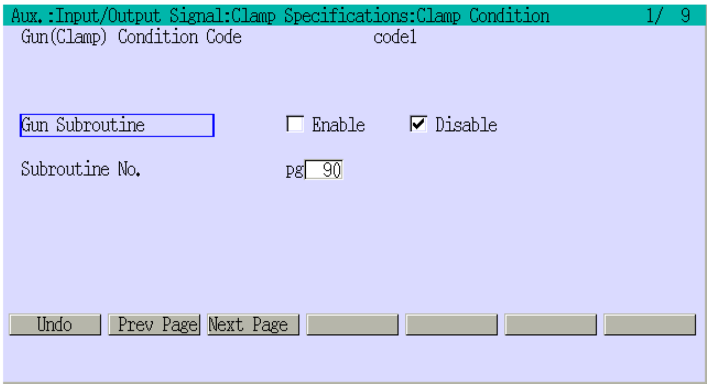
[NOTE]

1. For guns set to either [2: Handling] or [3: Painting Sealing], the gun number will appear as the auxiliary data of the gun instruction on the block teaching screen if it is taught ON. Nothing is displayed when it is taught OFF.
2. For guns set to [3: Painting Sealing], the data specified in Aux. 060502 and Aux. 060530 becomes effective.
3. For guns set to [2: Handling], the data specified in Aux. 060502 becomes effective.

0: Not used	Gun is not used.
2: Handling	Gun is used for handling specification.
3: Painting Sealing	Gun is used for sealing specification.

16.2.2 SETTING OF GUN CONDITION FOR EACH CC NUMBER

Specify items shown in the screen below for each code of gun condition (CC) that is one of auxiliary data of gun instruction.　By setting [Gun Subroutine] to [Enable], the robot automatically executes the set subroutine program after the gun ON/OFF signal has been output, and then returns to the current step after the subroutine completes.
Range of setting: pg0 to pg999



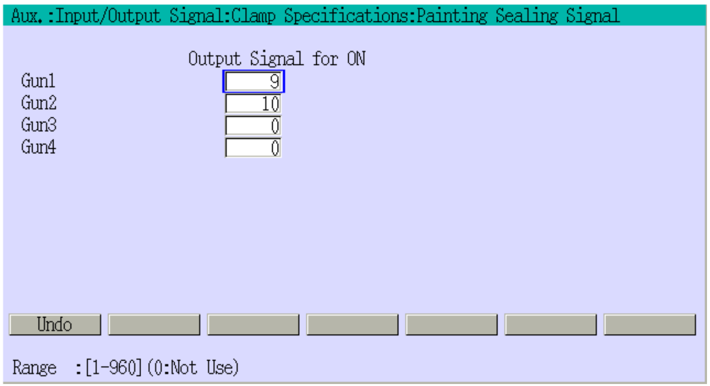
Move cursor to each item using ↑/↓, and make necessary settings by ←/→ and NUMBER.

Pressing <Next Page> displays the data for codes 2 to 9 and to enable setting for these codes.

Pressing ↵ registers the data set for codes 1 to 9 at the same time.

16.2.3 DEFINING SIGNALS FOR PAINTING/SEALING

Sets the number of the output signal to be used to turn ON the gun (GUN1 - 4). This takes effects only if that gun type number 3 (Painting Sealing) was specified for [Application] in Aux. 060501.

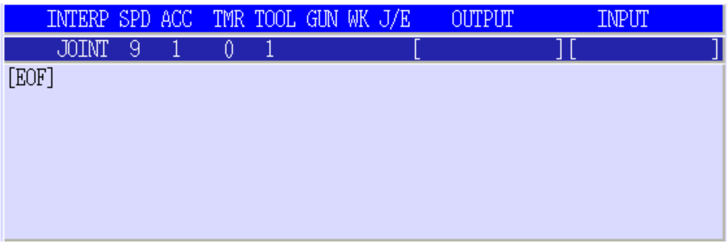


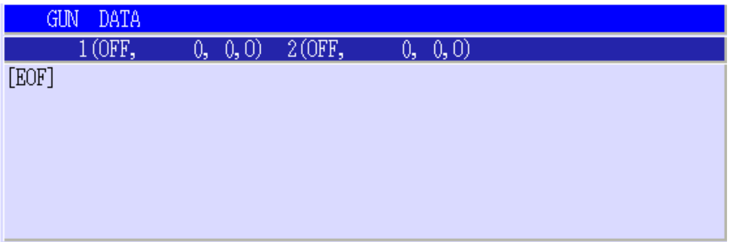
[NOTE]

1. In teach and check modes, pressing $\boxed{\text{A}}$+$\boxed{\text{CL}}$ outputs the signal that turns the Gun ON.
2. GS – Gun Schedule value which controls Gun Spray ON/OFF timing is enabled for the output signals assigned here.
3. These signals are output in the same timing as OX signals if the GS value is set to 0.

16.3 TEACHING SCREEN FOR SEALING SPECIFICATION

To switch to the gun instruction dedicated screen (Lower screen below), move the cursor to the right of the Comment position by pressing A+→ or by → on the teach screen. Refer to 2.7.1.4 to display the teach screen.





Except for the auxiliary data of gun instruction, the configuration of the block teaching screen and the auxiliary data of each instruction are the same as those displayed for handling specification. Please refer to Chapter 5.3 for details.

On the gun instruction dedicated screen, three kinds of auxiliary data are set for each gun, from left to right in the following order: ON/OFF, GS value, CC number (The fourth item is fixed to 0 in sealing applications.).

16.4 HOW TO TEACH AUXILIARY DATA OF GUN INSTRUCTION

To teach/edit auxiliary data of gun instruction, turn ON TEACH LOCK and input numerical data directly via NUMBER. Teach/edit the following auxiliary data for each gun (max. four guns).

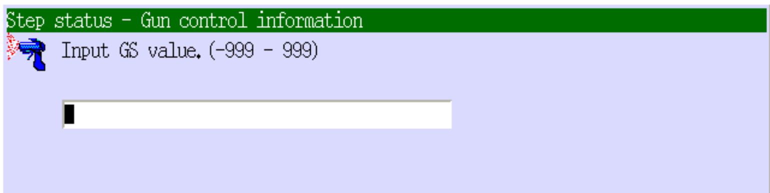
1. Setting of Gun ON/OFF

   Display the gun instruction dedicated screen. The data of the selected gun changes “ON→OFF→ON” each time CL1 (CL2) is pressed.
   The signal also changes “ON→OFF→ON” by pressing CLn+NUMBER (0-8).

Example: Pressing CLn+3 sets ON/ OFF for Gun3.
The gun numbers appear for ON setting in the parameter values display are for gun instruction on the block teaching screen, gun numbers set do not appear for OFF setting.

2. Setting of GS values

Pressing the F key of the desired gun number (<Gun1> or <Gun2>) displays the setting screen for GS values. See the screens below.

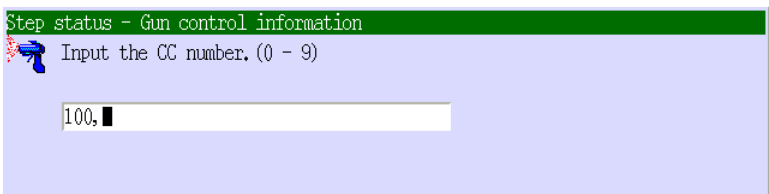


Pressing ↵ after inputting the GS value (-999 to 999) prompts the setting of CC number (0-9).

3. Setting of CC number

Input CC number and press ↵. When 3 or more guns are used, pressing A + → changes <Gun1>/<Gun2> to <Gun3>/<Gun4>.

To set the auxiliary data of the instructions other than gun instruction on block teaching screen, refer to Chapter 5.3.



16.5 GS VALUE

The GS value sets the time for turning ON/OFF gun signals based on the taught value.

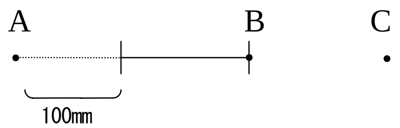
To advance ON/OFF timing: negative value (unit: mm)

To delay ON/OFF timing: positive value (unit: mm)

Specifying the GS value enables fine control of the ON/OFF timing.

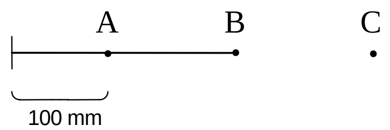
The followings are examples for Gun1.

(Example 1)



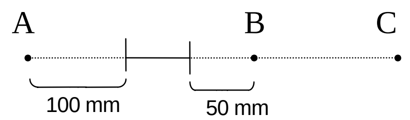
When “GS100” and “Gun1ON” are taught at point B, the gun signal is output 100 mm after point A.

(Example 2)



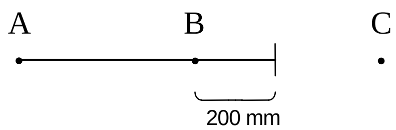
When “GS-100” and “Gun1ON” are taught at point B, the gun signal is output 100 mm before point A.

(Example 3)



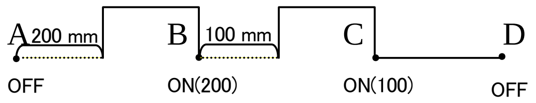
To delay outputting the gun ON signal by 100 mm and advance output of the gun OFF signal by 50 mm as shown above, teach “GS100” and “Gun1ON” at point B, and “GS-50” and “Gun1OFF” at point C.

(Example 4)



To delay outputting the gun OFF signal by 200 mm as shown above, teach “GS200” and “Gun1OFF” at point C.

(Example 5)



The above figure shows the output when Gun1 is taught as shown below and GunON is taught to a series of points B, C.

“GS0” and “Gun1OFF” at point A
“GS200” and “Gun1ON” at point B
“GS100” and “Gun1ON” at point C
“GS0” and “Gun1OFF” at point D

[**NOTE**]

The gun can be kept ON continuously if negative distances are taught to a series of points.

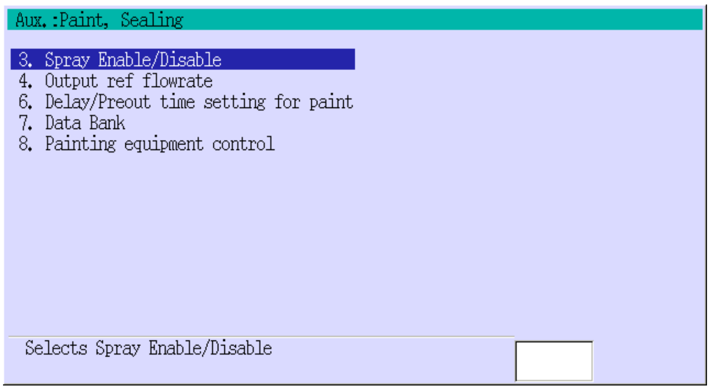
[**NOTE**]

1. Pressing ↵ after inputting a GS value sets the value and redisplays the gun instruction dedicated screen.
2. Pressing R before/after inputting the GS value displays the gun instruction dedicated screen without setting the value.

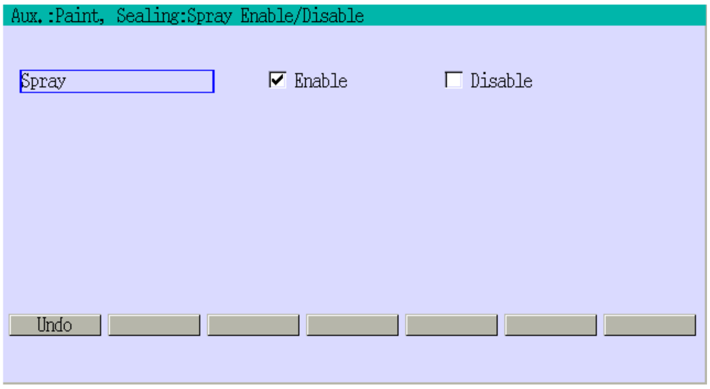
16.6 SPRAY ENABLE/DISABLE

This selection is effective both in teach and repeat modes. When selecting [Enable], material cannot be applied in teach mode unless gun ON signal is output manually. When selecting [Disable], in repeat mode, robot motion can be checked without spraying from gun.

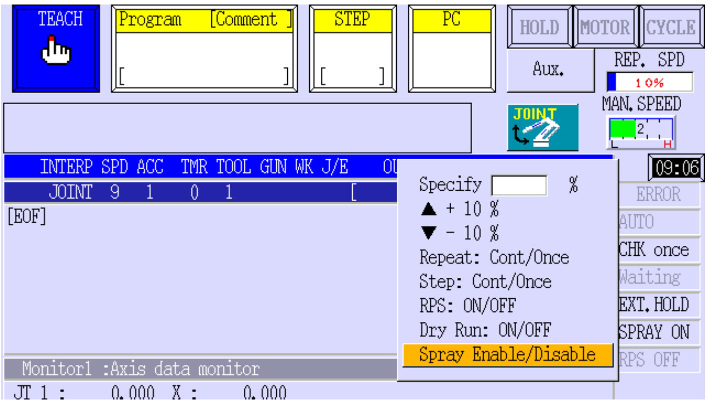
To select Spray Enable/Disable, activate B area and press MENU, or press the B area directly, and display the pull-down menu. Select [Aux Function] and input the auxiliary function number (12) directly with NUMBER. Then, press ↵ to display the screen below.



The screen below is displayed by pressing ↵. Select either [Enable] or [Disable] and press ↵ to register it.



Spray Enable/Disable can be selected via the pull-down menu in repeat speed display area, too. To display the pull-down menu, press A + MENU, or press the repeat speed display area directly.



Move cursor to [Spray Enable/Disable]. Pressing ↵ toggles between: Enable → Disable → Enable. SPRAY ON is displayed in status area when selecting [Enable].

16.7 MANUAL OUTPUT OF GUN ON SIGNALS

The gun signal can be output manually by pressing A+CL in teach mode.

When GunON is displayed	Gun signal is ON while A+CL are pressed. Timing of the gun signal ON is dependent on the auxiliary data of gun instruction, such as GS and CC, currently displayed in Teach Pendant.
When GunOFF is displayed	Gun signal does not change even when A+CL are pressed.

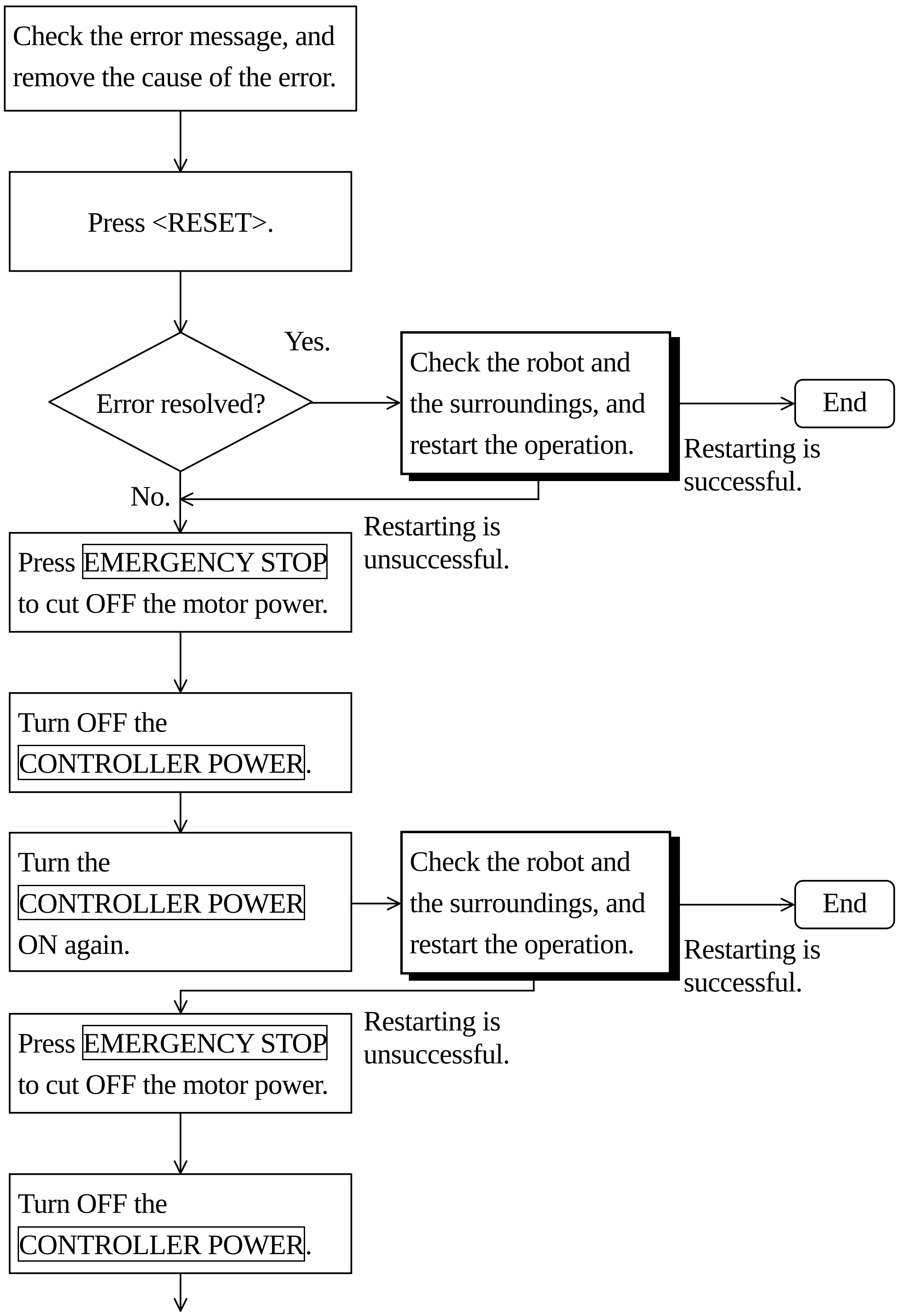
If selecting [Disable], the gun ON signal cannot be output manually even if GunON is displayed.

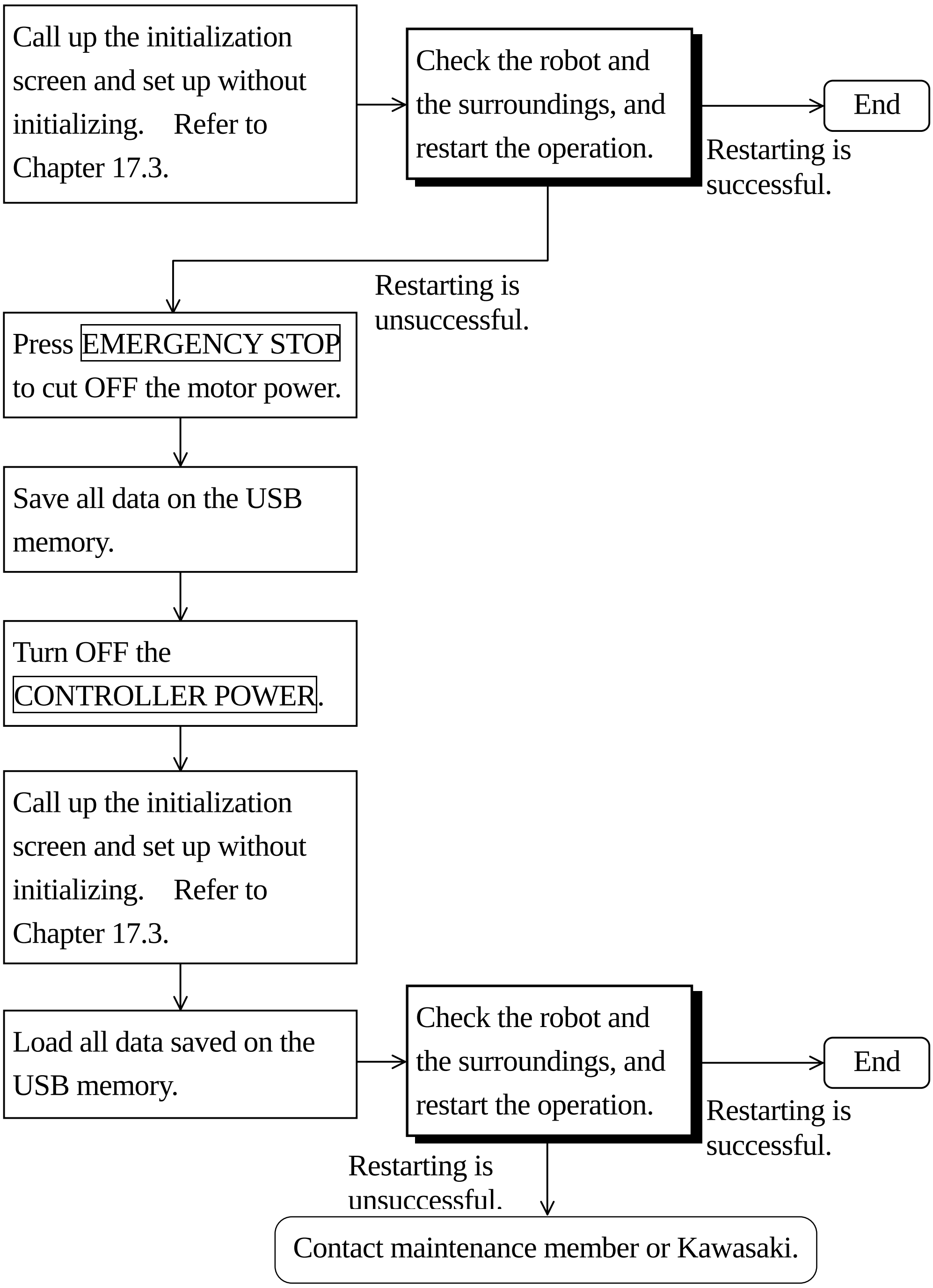
17.0 TROUBLESHOOTING

This chapter describes the basic procedures for troubleshooting.

17.1 BASIC PROCEDURE FOR TROUBLESHOOTING

Follow the procedure described below when an abnormal condition arises.





[NOTE]

When contacting maintenance member or Kawasaki, please provide all details, information, and operating conditions at the time the error occurred.

17.2 CALLING UP THE INITIALIZATION SCREEN

Follow the procedure below to call up the initialization screen.

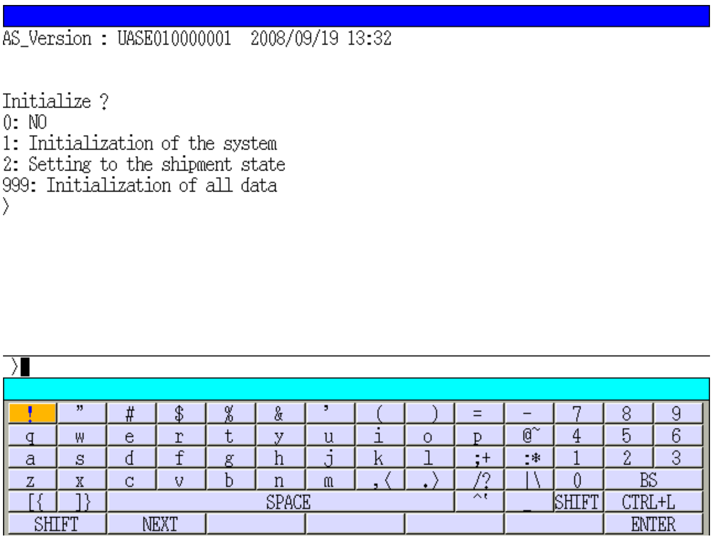
1. Turn OFF the CONTROLLER POWER.

2-1. Connect the PC.　Turn ON the power and activate the AS monitor software.

2-2. Or, connect the TP.

3. Set dip switch No.8 of main CPU board to ON side.

4. Turning ON the CONTROLLER POWER displays the screen below.



17.3 SYSTEM INITIALIZATION

> **⚠ WARNING**
>
> **Avoid using this function in normal state.　Take note that performing this function deletes all programs and variables in memory.**

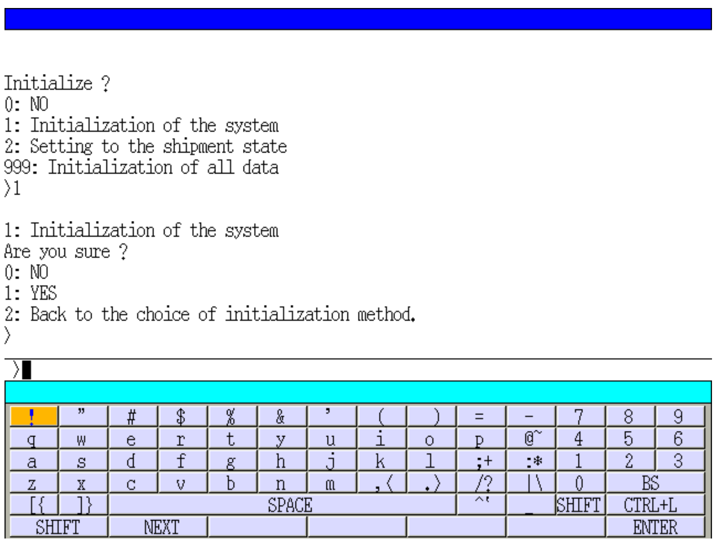
Normally, input 0 in the screen in Chapter 17.2.

1. Selecting 1: Initialization of the system

Initialization resets system data and auxiliary data, including system switch settings, to their default settings, but not to the factory setting*.　Also, note that user programs and variables data are cleared, but data inherent to the robot are not affected.　Execute following the procedure below.

(1) When the screen in Chapter 17.2 is displayed, input 1 by keyboard screen on PC or TP.

(2) Confirmation message is displayed as shown below.　Inputting 1 (Yes) executes the initialization of the system.



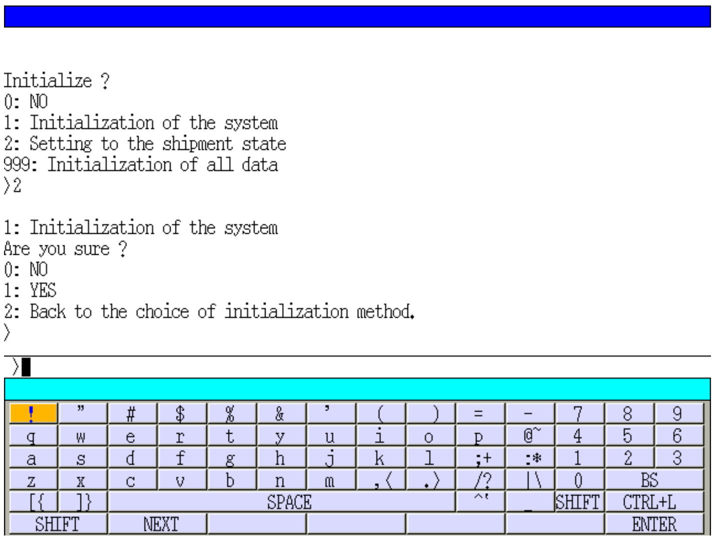
NOTE* To return system data or auxiliary data to the factory setting, save the data in external device before initialization, and after initialization load the data or input the data on the E controller setting list included with the robot at time of factory shipment.

2. Selecting 2: Setting to the shipment state*

Returns system data and auxiliary data, including data inherent to the robot and system switch settings data, to their factory settings. But, user programs and variables data are cleared. Execute following the procedure below.

(1) When the screen in Chapter 17.2 is displayed, input 2 by keyboard screen on PC or TP.

(2) Confirmation message is displayed as shown below. Inputting 1 (Yes) executes the resetting to the factory shipment state.



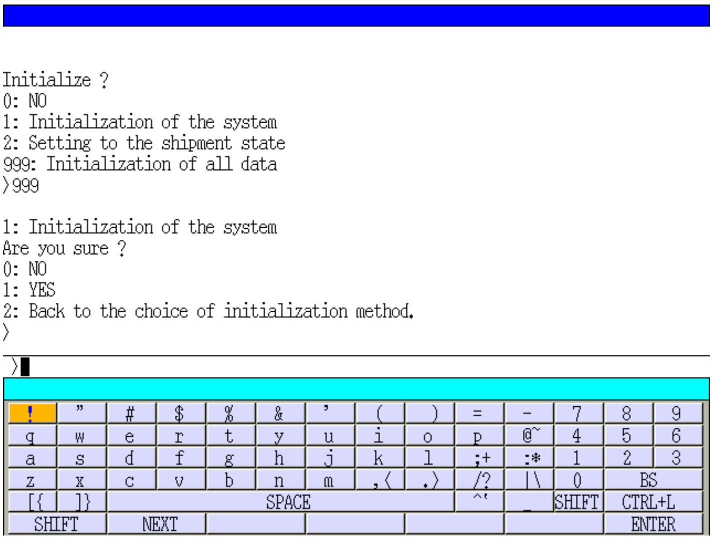
NOTE* This operation is possible only when a file with the factory setting data has been set and stored at time of factory setting. This file is typically stored when robot is shipped from the factory per customer order and specification.

3. Selecting 999: Initialization of all data

Resets the system data and auxiliary data, including data inherent to the robot and system switch settings data, to their default settings. Also, user programs and variables data are cleared. Follow the procedure below for the execution.

(1) When the screen in Chapter 17.2 is displayed, input 999 by keyboard screen on PC or TP.

(2) Confirmation message is displayed as shown below.　Inputting 1 (Yes) executes the initialization of all the data.



Once initialized, all data must be reset, including robot model setting.　In addition, incompatibility error between the software and hardware/ robot arm may occur after initialization. Therefore, to prevent inadvertent loss of data, save all data before executing initialization, and then reload this data forcibly after initialization.　After completion, turn the controller power OFF then ON again.

APPENDIX ERROR MESSAGE LIST

Code	Error Message
P0100	Illegal input data.
P0101	Too many arguments.
P0102	Input data is too big.
P0103	Illegal PC number.
P0104	Illegal Robot number.
P0105	Illegal program.
P0106	Illegal priority.
P0107	Invalid coordinate value.
P0108	Syntax error.
P0109	Invalid statement.
P0110	Specify full spelling of command.
P0111	Cannot use this command/instruction in current mode.
P0112	Cannot execute with DO command.
P0113	Not a program instruction.
P0114	Illegal expression.
P0115	Illegal function.
P0116	Illegal argument of function.
P0117	Invalid variable (or program) name.
P0118	Illegal variable type.
P0119	Incorrect array suffix.
P0120	Incongruent num. of parenthesis.
P0121	Expected to be a binary operator.
P0122	Illegal constant.
P0123	Illegal qualifier.
P0124	Invalid label.
P0125	Missing expected character.
P0126	Illegal switch name.
P0127	Specified switch name needs full spelling.
P0128	Illegal format specifier.
P0129	Duplicate statement label.
P0130	Cannot define as array.
P0131	No. of dimensions in array exceeds 3.
P0132	Array variable already exists.
P0133	Non array variable exists.

Code	Error Message
P0134	Array variable expected.
P0135	Local variable expected.
P0136	Unexpected suffix.
P0137	Mismatch of arguments at subroutine call.
P0138	Mismatch of argument type at subroutine call.
P0139	Illegal control structure.
P0140	Step:XX Wrong END statement.
P0141	Step:XX Extra END statement.
P0142	Step:XX Cannot terminate DO with END.
P0143	Step:XX No VALUE statement after CASE.
P0144	Step:XX Preceding IF missing.
P0145	Step:XX Preceding CASE missing.
P0146	Step:XX Preceding DO missing.
P0147	Step:XX Cannot find END of XX.
P0148	Step:XX Too many control structures.
P0149	Variable (or program) already exists.
P0150	Variable of different type already exists.
P0151	Internal buffer over due to complicated expression.
P0152	Undefined variable (or program).
P0153	Illegal clock value.
P0154	Missing '='.
P0155	Missing ')'.
P0156	Missing ']'.
P0157	Missing "TO".
P0158	Missing "BY".
P0159	Missing ':'.
P0160	Specify "ON" or "OFF".
P0161	Robot Num. must be specified.
P0162	Cannot modify position data in this instruction.
P0163	Name of program, variable, file, etc. misspecified.
P0164	Illegal Robot network ID.
P0165	Step:XX No SVALUE statement after SCASE.
P0166	Step:XX Preceding SCASE missing.
P1000	Cannot execute program because motor power is OFF.
P1001	Cannot execute program in TEACH mode.
P1002	Cannot execute program because teach lock is ON.

Code	Error Message
P1003	Cannot execute program because of EXT. HOLD input.
P1004	Cannot execute program being reset.
P1005	Cannot execute program because of EXT. START ENABLE.
P1006	Cannot execute program because of EXT. START DISABLE.
P1007	Start signal was not input at a RPS_END step.
P1008	Cannot execute program, HOLD sw. engaged.
P1009	Program is already running.
P1010	Robot control program is already running.
P1011	Cannot continue this program. Use EXECUTE.
P1012	Robot is moving now.
P1013	Cannot execute because in error now. Reset error.
P1014	Cannot execute because program already in use.
P1015	Cannot delete, in use by another command.
P1016	Cannot delete, used in program.
P1017	Cannot delete a program in Editor.
P1018	KILL or PCKILL to delete program.
P1019	PC program is running.
P1020	Cannot operate, teach pendant in operation.
P1021	Cannot execute with DO command.
P1022	Cannot execute with MC instruction.
P1023	Cannot execute in Robot program.
P1024	Statement cannot be executed.
P1025	Cannot be executed, function not set.
P1026	Cannot KILL program that is running.
P1027	Cannot edit program, teach lock is ON.
P1028	Cannot paste.
P1029	Program name not specified.
P1030	Program interlocked by other procedure.
P1031	No free memory.
P1032	No program step.
P1033	Program name already exists.
P1034	This program is not editable.
P1035	Record inhibited. Set [Record Accept] and operate again.
P1036	Program change inhibited. Set [Accept] and operate again.
P1037	Program name cannot be called "calib_load_".
P1038	Program does not exist.

Code	Error Message
P1039	Teach pendant is not connected.
P1040	Cannot execute this command in I/F panel.
P1041	Auto monitor command failure.
P1042	NUM program is running.
P1043	Cannot execute in REPEAT mode.
P1044	Cannot execute on because motor power is ON.
P1045	Set TEACH mode and teach lock ON.
P1046	Turn on trigger switch.
P1047	The disconnected robot cannot select the program/step.
P1048	Cannot operate during execution of brake check.
P1049	Program is locked.
P1050	Exist protected program.
P1051	Cannot unlock protection while program running.
P1052	Because the memory was full, could not copy the program.
P1053	Because the memory was full, the copy of program was suspended.
P1054	Turn off trigger switch.
P1055	Teach the axis lock instruction at the step of clamp ON.
P1056	Teach the axis unlocking instruction at the step of clamp ON.
P2000	Turn OFF motor power.
P2001	Turn HOLD/RUN sw. to HOLD.
P2002	There is no external axis.
P2003	Illegal positioner type.
P2004	Cannot change, user data already exists.
P2005	Graphic area error.
P2006	Option is OFF.
P2007	Cannot execute because executed by other device.
P2008	Device is not ready.
P2009	Illegal file name.
P2010	Disk is not ready.
P2011	Invalid disk format.
P2012	Disk is write-protected.
P2013	Disk full.
P2014	Too many files.
P2015	Cannot write on read-only file.
P2016	Cannot open the file.
P2017	Cannot close the file.

Code	Error Message
P2018	Storage data logging now.
P2019	ADC function already in use.
P2020	Illegal device number.
P2021	Cannot execute on this terminal.
P2022	Cannot use DOUBLE OX.
P2023	In cooperative mode.
P2024	Invalid coordinate value X.
P2025	Invalid coordinate value Y.
P2026	Invalid coordinate value Z.
P2027	Cannot use signal, already used in I/F panel.
P2028	Arm ID board is busy.
P2029	Axis setting data is incorrect.
P2030	Unknown Aux. function number.
P2031	Deleted step was destination step of Jump, Call instruction.
P2032	Incorrect number input as WHERE parameter.
P2033	Logging is running.
P2034	Undefined memory.
P2035	Non data.
P2036	Memory verify error.
P2037	Real time path modulation is already running.
P2038	Matrix calculation error.
P2039	Cannot start cycle from FN instruction.
P2040	Card is not ready.
P2041	Wrong card loaded.
P2042	Card is write-protected.
P2043	Card battery is low voltage.
P2044	Card is not formatted.
P2045	Cannot format this card.
P2046	Card initialization error.
P2047	File is already open.
P2048	File does not exist in card.
P2049	Attempted to open too many files.
P2050	Unexpected error during card access.
P2051	Illegal sequence numbers for file I/O data.
P2052	[LSEQ]Program includes unavailable instruction.
P2053	[LSEQ]Too many steps exist.

Code	Error Message
P2054	[LSEQ]Invalid type of signal variable.
P2055	[LSEQ]Program is already running.
P2056	[LSEQ]No.of signal is outside specifiable range.
P2057	[SerialFlash]Cannot open file.
P2058	[SerialFlash]Data read error.
P2059	[SerialFlash]Data write error.
P2060	[SerialFlash]File or directory doesn't exist.
P2061	File does not exist in floppy.
P2062	[FDD/PC_CARD]Failure in writing data per verify function.
P2063	[FDD/PC_CARD]Faulty response from verify function.
P2064	[FDD]No space available.
P2065	[Multi Disks]Invalid disk was loaded.
P2066	Boot flash state is write-disenable.
P2067	[Serial Flash]File directory error.
P2068	Cannot execute program being edited now.
P2069	[FDD/PC_CARD]Device already in use.
P2070	No more data can be registered.
P2071	C/S switch set to disable.
P2072	[LSEQ]Maximum cycles of execution.
P2073	[LSEQ]Other program is waiting execution.
P2074	Floppy disk is broken.
P2075	Channel number for JtXX is incorrect.
P2076	SAVE/LOAD in progress.
P2077	[Serial Flash]Access error occurred.
P2078	[Serial Flash]Upload or Download was aborted.
P2079	Card full.
P2080	Can not execute because of the channel assigned joint No.
P2083	User log is not created.
P2084	The number of registration of a user log was changed.
P2085	Cannot register user log, no free memory.
P2086	User log data is not registered.
P2087	The kind of user log data and specified data is different.
P2088	Cannot load the improper compensation parameter.
P2090	No servo data of the servo spec.
P2091	[Serial Flash]The file or directory already exists.
P2092	[Serial Flash]The directory is not yet empty.

Code	Error Message
P2093	[Serial Flash]There is no space to write.
P2094	[Serial Flash]Cannot access the file for read only.
P2095	No response from option CPU board.
P2096	Cannot execute cycle start after palletizing motion aborted.
P2097	Cannot change steps during palletizing motion.
P2098	The axis is not for endless rotation.
P2099	Cannot change palletizing state into ON.
P2100	Macro error.
P2101	Nesting is too deep in include file.
P2102	File or folder is missing.
P2103	USB memory is not inserted.
P2104	Failed to download softwares.
P2105	Available USB memory is low.
P2106	Available compact flash memory is low.
P2107	System is now downloading the software.
P2108	There is no software in the USB memory.
P2109	Cannot execute program because of simultaneously operation sig. inputting.
P2110	[USB/CF]File write error.
P2111	Please return spin-axis to the original position.
P2112	File name is too long.
P2113	Cannot start cycle from KI instruction.
P4500	FIELD-BUS)Interface not enabled.
P4501	DEVNET)Node XX not in the scanlist.
P4502	DEVNET)Already in that mode.
P4503	Duplicate signal number.
P4504	FIELD-BUS)signals limit over.(max. XX)
P4505	CC-LINK)Version mismatch.
P4506	EN/IP-M)Already in specified mode.
P4507	FIELD-BUS)Cannot execute with old ANYBUS card firmware.
P4508	FIELD-BUS)Cannot communicate with interface card.
P4509	FIELD-BUS)Wrong interface card type error.
P4510	FIELD-BUS)Initialization of the card is not complete.
P5000	Waiting weld completion.
P5001	Waiting retract or extend pos. input signal.
P5002	Spot sequence is running.
P5003	External-axis type and Gun type data mismatch.

Code	Error Message
P6000	Shifted location of STEPXX is out of range.
P6001	STEPXX in source program is out of motion range.
P6002	Specified painting data bank does not exist.
P6003	Cannot execute program because of suspend playback.
P6004	Cannot execute because of the Air Purge sequence.
P6005	Cannot execute because robot is disconnected.
P6006	Cannot specify circular move to end point of spraying path.
P6007	Number of taught points for spraying path exceeds the limit.
P6008	Number of instructions between points exceeds the limit.
P6009	Shortage in number of taught points for spraying path.
P6010	Selected program other than pgxxx.
P6011	Cannot move, change to joint interpolation or add points.
P6012	Cannot edit program, TEACH LOCK is OFF.
P6500	Cannot generate working line direction.
P6501	Illegal tool posture.
P6502	No weld database.
P6503	Cannot change weld condition.
P6504	Step:XX Preceding L.START missing.
P6505	The axis type is not set as the servo torch.
P6506	Shift function can not be used in CIR interp.
P7000	Cannot program reset, because not at home position 1.
P7001	In force meas. mode, only NOP Interp. avail.
P7002	Cannot change stroke because clamp on now.
P7003	Servo parameter file is not found.
P7500	Turn motor power on.
P7501	Because of repeat mode,wait to teach mode.
P7502	Over the number which can be registered in interruption.
P7503	Cannot execute program in error masking.
P7504	ONC/ONCI channel has already received.
P7505	Cannot execute in saving.
P7506	Cannot accept a record because robot is moving.
P7507	Amount of the data change is too large in repeat operation.
P8400	Cannot execute program because of CLAMP MODE sig. inputting.
P8800	The controller number is duplicated.
P8801	The IL robot number is duplicated.
P8802	The IL server is processing.

Code	Error Message
P8803	The connection with the IL server is disabled.
P8804	IL server IP address is not yet set.
P8805	Set the mode to Teach.
P8806	Turn off servo.
P8807	ILL)Communication time out error.
P8808	ILL)Time out error for PC server processing.
P8809	ILL)PC server processing demand completion waiting is time out error.
P8810	ILL)Error in auto interlock setting system.
P8811	ILL)Could not release operation lock for slave controller.
P8812	ILL)Could not communicate with the PC server.
P8813	The IL robot number is unregistered.
P9000	Unacceptable control-direction.
P9001	Unacceptable control-distance.
P9002	Same data are specified for some reference points.
P9003	Reference points1,2,3 are on a straight line.
P9004	Reference point 4 is out of allowed range.
P9005	Cannot manipulate because teach lock is ON.
W1000	Cannot move along straight line JtXX in this configuration.
W1001	Over maximum joint speed in check. Set low speed.
W1002	Operation log information was cleared.
W1003	Calibration failed. Retry after changing posture.
W1004	JtXX out of motion range. Check operational area.
W1005	Illegal center of gravity, default parameter is set.
W1006	Incorrect load moment. Default parameter is set.
W1007	Application setting changed. Turn OFF & ON the control power.
W1008	Parameter changed. Turn OFF & ON the control power.
W1009	Position envelope error of JtXX at last E-stop.
W1010	RAM battery low voltage.
W1011	PLC alarm. (XX)
W1012	Servo parameter changed. Turn OFF & ON the control power.
W1013	Encoder battery low voltage. [Servo(XX)]
W1014	Number of axes changed. Reinitialize.
W1015	Possibility of failure.
W1016	Torque of motor is over limit. JtXX
W1017	Encoder battery low voltage.[External axis(XX)]
W1018	Network parameter is changed. Turn OFF & ON the control power.

Code	Error Message
W1019	The registered value is beyond rated load.
W1020	Error sector was found.
W1021	The optimal posture can't be found at present location.
W1022	Not execute ZRPAADSET command.
W1023	Teach Plug Position wrong or P-N low voltage.[XX]
W1024	Deviation from last stop position exceeds the limit set.
W1025	(SSCNET)Excessive regenerative warning of JtXX.(CodeXX)
W1026	(SSCNET)Motor overload warning of JtXX.(CodeXX)
W1027	While lifter is locked, it cannot move.
W1028	The center of gravity for payload is over limit. Reduction gears could be broken.
W1029	The center of gravity for payload is over limit. Use the Jt5 at zero degree only.
W1030	Braking torque of JtXX has decreased.
W1031	Cannot move along straight line unless JtXX value is 0 degree.
W1032	Cannot move straight - the flange faces direction of upper sphere.
W1033	Cannot change orientation.
W1034	Encoder power voltage is low. JtXX
W1035	Encoder battery voltage is low. Check zeroing. JtXX
W1036	Step data is different.
W1037	The axis is not for endless rotation.
W1048	No. of encoder errors exceeded limit JtXX.
W1053	(FANXX-XX)Rotational speed of fan is below the limit. (ServoBoardXX)
W1054	AVR reaches the expected lifetime soon.
W1055	Vision cycle timer over.
W1056	[Main CPU board]CPU temperature exceeded the limit. (XX 1/1000 deg C)
W1057	Cannot move along straight line tool in this configuration.
W1058	Link3 interferes in ground.
W1059	Link5 interferes in base.
W1060	Link6 interferes in base.
W1061	TP changed. Confirm current pose, and operate the robot.
W1062	The TP backlight lighting time exceeded the limit.
W1063	The number of ON/OFF operations of MC relay exceeded the limit.(SrvB'dXX)(MCXX)
W1064	Exceeded the limit.(Parts:XX)
W1072	Deviation of JtXX is too large.
W2901	SLOGIC ERROR MESSAGE #1
W2902	SLOGIC ERROR MESSAGE #2

Code	Error Message
W2903	SLOGIC ERROR MESSAGE #3
W2904	SLOGIC ERROR MESSAGE #4
W2905	SLOGIC ERROR MESSAGE #5
W2906	SLOGIC ERROR MESSAGE #6
W2907	SLOGIC ERROR MESSAGE #7
W2908	SLOGIC ERROR MESSAGE #8
W2909	SLOGIC ERROR MESSAGE #9
W2910	SLOGIC ERROR MESSAGE #10
W2911	SLOGIC ERROR MESSAGE #11
W2912	SLOGIC ERROR MESSAGE #12
W2913	SLOGIC ERROR MESSAGE #13
W2914	SLOGIC ERROR MESSAGE #14
W2915	SLOGIC ERROR MESSAGE #15
W2916	SLOGIC ERROR MESSAGE #16
W2917	SLOGIC ERROR MESSAGE #17
W2918	SLOGIC ERROR MESSAGE #18
W2919	SLOGIC ERROR MESSAGE #19
W2920	SLOGIC ERROR MESSAGE #20
W2921	SLOGIC ERROR MESSAGE #21
W2922	SLOGIC ERROR MESSAGE #22
W2923	SLOGIC ERROR MESSAGE #23
W2924	SLOGIC ERROR MESSAGE #24
W2925	SLOGIC ERROR MESSAGE #25
W2926	SLOGIC ERROR MESSAGE #26
W2927	SLOGIC ERROR MESSAGE #27
W2928	SLOGIC ERROR MESSAGE #28
W2929	SLOGIC ERROR MESSAGE #29
W2930	SLOGIC ERROR MESSAGE #30
W2931	SLOGIC ERROR MESSAGE #31
W2932	SLOGIC ERROR MESSAGE #32
W2933	SLOGIC ERROR MESSAGE #33
W2934	SLOGIC ERROR MESSAGE #34
W2935	SLOGIC ERROR MESSAGE #35
W2936	SLOGIC ERROR MESSAGE #36
W2937	SLOGIC ERROR MESSAGE #37
W2938	SLOGIC ERROR MESSAGE #38

Code	Error Message
W2939	SLOGIC ERROR MESSAGE #39
W2940	SLOGIC ERROR MESSAGE #40
W2941	SLOGIC ERROR MESSAGE #41
W2942	SLOGIC ERROR MESSAGE #42
W2943	SLOGIC ERROR MESSAGE #43
W2944	SLOGIC ERROR MESSAGE #44
W2945	SLOGIC ERROR MESSAGE #45
W2946	SLOGIC ERROR MESSAGE #46
W2947	SLOGIC ERROR MESSAGE #47
W2948	SLOGIC ERROR MESSAGE #48
W2949	SLOGIC ERROR MESSAGE #49
W2950	SLOGIC ERROR MESSAGE #50
W2951	SLOGIC ERROR MESSAGE #51
W2952	SLOGIC ERROR MESSAGE #52
W2953	SLOGIC ERROR MESSAGE #53
W2954	SLOGIC ERROR MESSAGE #54
W2955	SLOGIC ERROR MESSAGE #55
W2956	SLOGIC ERROR MESSAGE #56
W2957	SLOGIC ERROR MESSAGE #57
W2958	SLOGIC ERROR MESSAGE #58
W2959	SLOGIC ERROR MESSAGE #59
W2960	SLOGIC ERROR MESSAGE #60
W2961	SLOGIC ERROR MESSAGE #61
W2962	SLOGIC ERROR MESSAGE #62
W2963	SLOGIC ERROR MESSAGE #63
W2964	SLOGIC ERROR MESSAGE #64
W2965	The max load is XX of a permissible torque.
W2966	Load exceeded permissible torque.
W2967	Load exceeded max torque.
W2968	Please set a group number as XX.
W3801	Because the brake has been released, it is not possible to move.
W3802	Maint. period elapsed, maint. is required.
W3803	Total power ON time exceeded limit, maint. is required.
W3804	Total robot connection time exceeded limit, maint. is required.
W3805	Total servo ON time exceeded limit, maint. is required.
W3806	Total JtXX the total travel dist. exceeded limit, maint. is required.

Code	Error Message
W3807	Total times of MC ON exceeded limit, maint. is required.
W3808	Total times of servo ON exceeded limit, maint. is required.
W3809	Total times of E-stop exceeded limit, maint. is required.
W3810	JtXX total (curr)^3-motion dist. exceeded limit, maint. is required.
W3811	JtXX RMS value of current exceeded limit, maint. is required.
W3812	Power supply(1) for input to NO.XX I/O board is abnormal.
W3813	Power supply(2) for input to NO.XX I/O board is abnormal.
W3814	Power for output from NO.XX I/O board is abnormal or Fuse blown.
W4000	No response from PLC to Break down info writing.
W4001	Break down info cannot write on PLC[EC = XX].
W4002	Break down info writing cannot receive correct answer.
W4500	FIELD-BUS)Slave port OFFLINE.
W4501	FIELD-BUS)Master port OFFLINE.
W4502	CC-LINK)Data link error on Master board. XX
W5000	Release wait cond., in force measurement mode.
W5001	PLC communication error.
W5002	Weld controller XX not connected.
W5003	Weld controller XX no response.
W5004	Weld controller XX response error.
W5005	(Spot welding)No response from RWC XX.
W5006	(Spot welding)RWC response error XX.
W5007	(Spot welding)Weld fault XX.
W5008	(Spot welding)Cable disconnection error XX.
W5009	(Spot welding)Internal leak XX.
W5010	(Spot welding)Main cable exchange alarm XX.
W5011	(Spot welding)No connection with RWC XX.
W5012	Cannot achieve set force.
W5013	Tip wear over the limit. (MOVING SIDE)
W5014	Tip wear over the limit. (FIXED SIDE)
W5015	(Spot welding) Welding current has decreased.
W5016	Weld warning has arisen. (CodeXX)
W6000	Grease reduction gears and motor bearings.
W6001	Replace the robot main cable.
W6002	Replace the cooling fans in the controller.
W6003	Replace the DC power supply in the controller.
W6004	Replace the servo power unit.

Code	Error Message
W6005	Replace the power amplifier for the robot arm.
W6006	Replace the power amplifier for the robot wrist.
W6007	Replace the power amplifier for the traveller.
W6008	Exp interlock is disabled by jumper wiring.
W6009	Not selected Internal pressure Explosion-proof.
W6010	Disable Gun Relative Distance Check (ID:XX).
W6011	Shutter release signal variable logging error.
W7000	Cannot operate excluding the servo welding gun axis. Because the pressure measurement mode.
W7001	Detected board gap quantity error.
W7002	Detected board gap quantity error.
W7003	The foreign body was detected in the Tip Dress.
W7004	Value of auto collect exceeds work abnormality level.
W7500	Can't continue check motion because separated from last pos.
W7501	Cannot execute a program because of LOW voltage.
W8400	Cannot achieve set force of JtXX.
W8800	Command value almost exceeds virtual safety fence.(SphereXX, LineXX)
W8801	Command value almost exceeds virtual safety fence.(SphereXX, ZUpper)
W8802	Command value almost exceeds virtual safety fence.(SphereXX, ZLower)
W8803	Command value almost invades restricted space.(SphereXX, Part.XX LineXX)
W8804	Command value almost invades restricted space.(SphereXX, Part.XX ZUpper)
W8805	Command value almost invades restricted space.(SphereXX, Part.XX ZLower)
W8806	Command value almost exceeds virtual safety fence.(ToolBox, LineXX)
W8807	Command value almost exceeds virtual safety fence.(ToolBox, ZUpper)
W8808	Command value almost exceeds virtual safety fence.(ToolBox, ZUpper)
W8809	Command value almost invades restricted space.(ToolBox, Part.XX)
W8810	Command value almost exceeds virtual safety fence.(LinkXX, LineXX)
W8811	Command value almost exceeds virtual safety fence.(LinkXX, ZUpper)
W8812	Command value almost exceeds virtual safety fence.(LinkXX, ZLower)
W8813	Command value almost invades restricted space.(LinkXX, Part.XX LineXX)
W8814	Command value almost invades restricted space.(LinkXX, Part.XX ZUpper)
W8815	Command value almost invades restricted space.(LinkXX, Part.XX ZLower)
W8851	Detected area interference.
W8852	Detected arm interference.(XX, XX)
W8853	ILL)Detected arm interference.(XX, XX)
W8854	ILL)Communication time out error.

Code	Error Message
W8855	ILL)Sequence processing demand completion waiting is time out error.
W8856	ILL)Sequence processing completion waiting is time out error.
W8857	ILL)Sequence processing system error.
W8858	ILL)Create/Set processing completion waiting is time out error.
W8859	ILL)Inter lock less function system error.
W8860	[ARM CONTROL b'd]Data received from IL server is invalid.
W8900	Can not operate because motion limitation signal was input.
E0001	Unknown error.
E0002	[Servo boardXX]CPU BUS error.
E0100	Abnormal comment statement exists.
E0101	Nonexistent label.
E0102	Variable is not defined.
E0103	Location data is not defined.
E0104	String variable is not defined.
E0105	Program or label is not defined.
E0106	Value is out of range.
E0107	No array suffix.
E0108	Divided by zero.
E0109	Floating point overflow.
E0110	String too long.
E0111	Attempted operation with neg. exponent.
E0112	Too complicated expression.
E0113	No expressions to evaluate.
E0114	SQRT parameter is negative.
E0115	Array suffix value outside range.
E0116	Faulty or missing argument value.
E0117	Incorrect joint number.
E0118	Too many subroutine calls.
E0119	Nonexistent subroutine.
E0120	No destination program.
E0121	Cannot specify the jump source program as jump destination.
E0900	Block step instruction check sum error.
E0901	Step data is broken.
E0902	Expression data is broken.
E0903	Check sum error of system data.
E1000	ADC channel error.

Code	Error Message
E1001	ADC input range error.
E1002	PLC interface error.
E1003	Built-in PLC is not installed.
E1004	INTER-bus board is not ready.
E1005	Spin axis encoder difference error.
E1006	Touch panel switch is short-circuited.
E1007	Power sequence board is not installed.
E1008	Second Power sequence board is not installed.
E1009	No.XX I/O board is not installed.
E1010	Power sequence detects error.
E1011	Built-in sequence board is not installed.
E1012	RI/O board or C-NET board is not installed.
E1013	INTER-BUS board is not installed.
E1014	Dual port memory for communication is not installed.
E1015	Amp Interface board is not installed.(Code=XX)
E1016	No.XX CC-LINK board is not installed.
E1017	PLC error.Error code is Hex.XX.
E1018	INTER-BUS status error.
E1019	Power sequence board for safety unit is not installed.
E1020	External equipment is abnormal.
E1021	Arm ID board error. (CodeXX)
E1022	Power sequence board error. (CodeXX)
E1023	Communication error in robot network.
E1024	EXT.AXIS release sequence error.(CodeXX)
E1025	EXT.AXIS connect sequence error.(CodeXX)
E1026	Main CPU ID mismatch.
E1027	Safety circuit was cut OFF.
E1028	JtXX motor overloaded.
E1029	Encoder rotation data is abnormal.(JtXX)
E1030	Encoder data is abnormal.(JtXX)
E1031	Miscount of encoder data.(JtXX)
E1032	Mismatch ABS and INC encoder data(JtXX).
E1033	Encoder line error of (JtXX).
E1034	Encoder initialize error (JtXX).
E1035	Encoder response error(JtXX).
E1036	Encoder communication error.(JtXX)

Code	Error Message
E1037	Encoder data conversion error.(JtXX)
E1038	Encoder ABS-track error.(JtXX)
E1039	Encoder INC-pulse error.(JtXX)
E1040	Encoder MR-sensor error. (JtXX)
E1041	Limit switch (JtXX) is ON.
E1044	Destination position is out of the specified area.
E1045	(Spot welding)Gun-clamp mismatch.
E1046	Too short distance between start point and end point.
E1047	Axis number is not for conveyor follow mode.
E1048	Offset data of zeroing is illegal value.
E1049	Current position is out of the specified area.
E1050	Encoder and brake power off signal not dedicated.
E1051	Incorrect double OX output.
E1052	Work sensing signal is not dedicated.
E1053	Work sensing signal already input.
E1054	Cannot execute motion instruction.
E1055	Start point position error for circle.
E1056	MASTER robot already exists.
E1057	Check to which robot MASTER/ALONE were instructed.
E1058	SLAVE robot already exists.
E1059	Not an instruction for cooperative motion.
E1060	Cannot execute in check back mode.
E1061	Cannot execute in ONE program.
E1062	Jt2 and Jt3 interfere during motion to start pose.
E1063	Jt2 and Jt3 interfere during motion to end pose.
E1064	Illegal pallet number.
E1065	Illegal work number.
E1066	Illegal pattern number.
E1067	Illegal pattern type.
E1068	Illegal work data.
E1069	Illegal pallet data.
E1070	ON/ONI signal is already input.
E1071	XMOVE signal is already input.
E1072	Home position data is not defined.
E1073	Illegal timer number.
E1074	Over maximum signal number.

Code	Error Message
E1075	Illegal clamp number.
E1076	Cannot use negative time value.
E1077	No value set.
E1078	Illegal signal number.
E1079	Cannot use dedicated signal.
E1080	Not RPS mode.
E1081	Cannot use negative value.
E1082	Out of absolute lower motion range limit.
E1083	Out of absolute upper motion range limit.
E1084	Out of set lower motion range limit.
E1085	Out of set upper motion range limit.
E1086	Start point for JtXX beyond motion range.
E1087	End point for JtXX beyond motion range.
E1088	Destination is out of motion range.
E1089	Cannot do linear motion in current configuration.
E1090	External modulation data is not input.
E1091	External modulation data is abnormal.
E1092	Modulation data is over limit.
E1093	Incorrect motion instruction to execute modulate motion.
E1094	Illegal joint number.
E1095	Cannot execute motion instruction in PC program.
E1096	Incorrect auxiliary data settings.
E1097	Missing C1MOVE or C2MOVE instruction.
E1098	C1MOVE(CIR1)instruction required before C2MOVE.
E1099	Unable to create arc path, check positions of the 3 points.
E1100	Cannot execute in sealing specification.
E1101	Can only execute in sealing specification.
E1102	Option is not set, cannot execute.
E1103	Over conveyer position.
E1104	Too many SPINMOVE instructions.
E1105	Start/Destination point is in protected space.
E1106	Cannot execute in this robot.
E1107	Cannot use SEPARATE CONTROL.
E1108	Duplicate robot network IDs.
E1109	Conveyor I/F board is not installed.
E1110	GROUP is not primed.

Code	Error Message
E1111	Due to motion restriction, JtXX cannot move.
E1113	Work sensing signal is not detected.
E1114	Interruption in cooperative control.
E1115	Forced termination of cooperative control.
E1116	Spin axis is not stopped on every 360 degrees.
E1117	Process time over.
E1118	Command value for JtXX suddenly changed.
E1119	Command value for JtXX beyond motion range.
E1120	Current command causes interference betw Jt2 and Jt3.
E1121	Other robot is already in the interference area.
E1122	Unexpected motor power OFF.
E1123	Speed error JtXX.
E1124	Deviation error of JtXX.
E1125	Velocity envelope error JtXX.
E1126	Command speed error of JtXX.
E1127	Command acceleration error of JtXX.
E1128	Uncoincidence error betw destination and current JtXX pos.
E1129	External axis JtXX moved while holding them.
E1130	JtXX collision was detected.
E1131	JtXX unexpected shock is detected.
E1132	Motor power OFF. Measurement stopped.
E1133	Conveyor has reached max. value position.
E1134	Abnormal work transfer pitch of conveyor.
E1135	Motor power OFF.
E1136	Standard terminal is not connected.
E1137	Cannot input/output to teach pendant.
E1138	Aux. terminal is not connected.
E1139	DA board is not installed.
E1140	No conveyor axis.
E1141	Conveyor transfers beyond sync. zone.
E1142	No traverse axis.
E1143	Conveyor axis number is not set.
E1144	No Arm control board.
E1145	Cannot use specified channel, already in use.
E1146	[LSEQ]Aborted by processing time over.
E1147	Cannot open setting file, so cannot set to shipment state.

Code	Error Message
E1148	Cannot read setting file, so cannot set to shipment state.
E1149	Cannot open setting data, so cannot set to shipment state.
E1150	Cannot read setting data, so cannot set to shipment state.
E1151	Too much data for setting to the shipment state.
E1152	Name of setting data for shipment state is too long.
E1153	Power sequence board detected error.(Code=XX)
E1154	Option SIO port not installed.
E1155	A/D converter is not installed.
E1156	[ARM CONTROL BOARD]Processing time over.
E1157	Arm ID I/F board error. (CodeXX)
E1158	(SSCNET)Servo error in JtXX.
E1159	(SSCNET)Error code for servo is (XX).
E1160	(SSCNET)Servo error and monitor setting error of JtXX.
E1161	Automatic Tool Registration not supported by robot model.
E1162	Buffer overflow occurred in the gravity comp. value channel XX.
E1163	Robot stopped in checking operational area.
E1164	[LSEQ]Program execution error at control power ON.(CodeXX)
E1165	Unable to download ext. axis parameter.(Jt-A)
E1166	Num. not assigned to specified channel.(Jt-A)
E1167	Unable to download ext. axis parameter.(Jt-B)
E1168	Num. not assigned to specified channel.(Jt-B)
E1169	Error in servo parameter change sequence.(CodeXX)
E1170	Slave is not ready.
E1171	CC-LINK communication board is not installed.
E1172	Weld communication board is not installed.
E1173	Servo communication error JtXX.
E1174	AD board No.0 is not installed.
E1175	Offset data of zeroing is illegal value.(RobotXX)
E1176	(SSCNET)Download error of external axis parameter.
E1177	(SSCNET)Joint number is not assigned to the channel.
E1179	The current under bending compensation is too large.(JtXX)
E1180	Download error of external axis parameter.(JtXX)
E1181	Encoder battery low voltage.[Servo(XX)]
E1182	Encoder battery low voltage.[External axis(XX)]
E1183	Because Jt5 is not zero degree, cannot move along straight line.
E1184	Illegal configuration for motion.

Code	Error Message
E1185	Jt1 and Jt2 is interfered at start location.
E1186	Jt1 and Jt2 is interfered at end location.
E1187	Current command between Jt1 and Jt2 is interfered.
E1188	(SSCNET)Error in servo parameter change sequence.(CodeXX)
E1189	(SSCNET)Regenerative error of JtXX.(CodeXX)
E1190	(SSCNET)Speed error of JtXX.(CodeXX)
E1191	(SSCNET)Motor overload of JtXX.(CodeXX)
E1192	(SSCNET)Deviation error of JtXX.(CodeXX)
E1193	(SSCNET)Encoder battery of JtXX is low voltage.(CodeXX)
E1194	(SSCNET)Parameter warning of JtXX.(CodeXX)
E1195	(Dual servo)Deviation error between master joint and slave joint.
E1196	While lifter is locked, it cannot move.
E1197	Compensation LS signal is not dedicated.
E1198	Brake check sequence error.
E1199	Brake check function is not supported by servo software ver.
E1200	(Dual servo)Cannot compensate current error (deviation XX).
E1201	Interference check board is not installed.
E1202	Voice recorder cannot stop.
E1203	LS location is not registered.
E1204	Current stretch over the limit.
E1205	Total stretch over the limit.
E1207	The type of I/O board on arm ID board is wrong.
E1208	Download error of servo parameter.(JtXX)
E1209	Upload error of servo parameter.(JtXX)
E1210	Cannot execute program because unprotected.
E1211	Because the memory was full, could not copy the program.
E1212	Because the memory was full, the copy of program was suspended.
E1213	Jt4 and robot arm interfere during motion to start pose.
E1214	Jt4 and robot arm interfere during motion to end pose.
E1215	Current command causes interference between Jt4 and robot arm.
E1216	Jt5 and Jt6 interfere during motion to start pose.
E1217	Jt5 and Jt6 interfere during motion to end pose.
E1218	Current command causes interference between Jt5 and Jt6.
E1219	Exceeds allowable No. of output instructions for the path.
E1220	Signal output point is out of the path.
E1221	Too many signal numbers are specified.

Code	Error Message
E1222	Motion instruction to start/end point of path not set.
E1223	No pose data in last/next motion instruction.
E1224	Several signal output points detected at the same point.
E1225	Correction end instruction is missing.
E1228	Jt4 value in the start point is not 0 degree.
E1229	Jt4 value in the target point is not 0 degree.
E1230	Flange faces direction of upper sphere in start point.
E1231	Flange faces direction of upper sphere in target point.
E1232	Option CPU board is not installed.
E1233	IJoint/ILinear signal not specified.
E1234	IJoint/ILinear signal not detected.
E1235	Separate control I/O board is not installed.
E1236	Distance is too long to correct.
E1237	Vision recognition error.
E1238	Vision communication error.
E1239	Cannot use this instruction in frame correction mode.
E1240	BASE FRAME is not sent from vision unit.
E1241	Improper parameter for FN481.
E1242	Cannot create more than 99 BASE FRAME.
E1243	Cannot execute because cameraXX is disconnected.
E1244	Jt1 and Jt2 and floor interfere during motion to start pose.
E1245	Jt1 and Jt2 and floor interfere during motion to end pose.
E1246	Current command causes interference between Jt1, Jt2 and floor.
E1247	Calculation of encoder absolute data is not completed.(JtXX)
E1248	EEPROM access flag in encoder is busy.(JtXX)
E1249	Temperature in encoder is over the limit.(JtXX)
E1250	Rotation speed of encoder is over the limit.(JtXX)
E1251	EEPROM access error occurred in encoder.(JtXX)
E1252	Encoder rotation data (internal) is abnormal.(JtXX)
E1253	Uncoincidence error between request and response in encoder. (JtXX)
E1254	Cannot operate because a MC of a group XX is off.
E1255	The motor power of unchosen robot was turned on.
E1256	Internal valve , sensor and error reset I/F board missing.
E1257	MC of groupXX turned off during individual repeat operation.
E1258	MC turned off during operation.
E1259	Invalid Structure of palletizing instruction.

Code	Error Message
E1260	Cannot execute instruction during palletizing motion.
E1261	Palletising motion aborted.
E1262	Encoder rotation speed exceeded limit. (JtXX)
E1263	Encoder temperature exceeded limit. (JtXX)
E1264	Velocity envelope error in endless rotation axis.(JtXX)
E1267	The initial setting of Encoder is abnormal. (JtXX)
E1268	Breakage in the encoder line or faulty setting of encoder baud rate. (JtXX)
E1269	The program is for other robot.
E1270	The pose variable is for other robot.
E1271	Interference between arm and floor at start pose.
E1272	Interference between arm and floor at end pose.
E1273	Command causes interference between arm and floor.
E1274	JtXX Over speed in heavy load mode.
E1275	JtXX Beyond the motion range in heavy load mode.
E1276	Start point JtXX is beyond the motion range in heavy load mode.
E1277	End point JtXX is beyond the motion range in heavy load mode.
E1278	Can't slant wrist any more.
E1279	Wrist does not face vertically down at start point.
E1280	Wrist does not face vertically down at end point.
E1281	Command to Jt4 over limit.
E1282	Cannot operate because a MC of a groupXX(JtXX) is off.
E1283	analysis)The E1035 error occurs frequently.JtXX
E1284	analysis)The E1035 and E1029 error occur at the same time.JtXX
E1285	analysis)The E1035 and E1036 error occur at the same time.JtXX
E1286	analysis)The E1035 and E1032 error occur at the same time.JtXX
E1287	Power module error JtXX (UPPER).
E1288	Power module error JtXX (LOWER).
E1289	[Servo boardXX]Synchronous error.(Servo FPGA)
E1290	JtXX Voltage of the current sensor exceeded the upper limit.
E1291	JtXX Current sensor is disconnected or out of order.(U)
E1292	[Servo boardXX]Abnormal signal input from MCXX.
E1293	[Servo boardXX]Current feedback gain is abnormal.
E1294	[Servo boardXX]I/O 24V is low.
E1295	[Servo boardXX]24V for internal valve is low.
E1296	[Servo boardXX]Mismatch in safety circuit LS conditions.
E1297	[Servo boardXX]Mismatch in jumper wiring for detecting internal pressure.

Code	Error Message
E1298	[Servo boardXX]Mismatch in contact condition of LS override switches.
E1299	[Servo boardXX]Jumper wiring for detecting internal pressure is disconnected.
E1300	[Servo boardXX]DC 24V is abnormal.
E1301	[Servo b’dXX]Encoder type mismatch between software and servo board.
E1302	[MCXX]OFF check is abnormal.(Servo boardXX)
E1303	[MCXX]OFF check of safety relay is abnormal.(Servo boardXX)
E1304	[MCXX]Incorrect operation of K1.(Servo boardXX)
E1305	[MCXX]Incorrect operation of K2.(Servo boardXX)
E1306	[MCXX]Incorrect operation of inrush current control relay.(Servo boardXX)
E1307	[MCXX]Incorrect operation of safety relay KS1.(Servo boardXX)
E1308	[MCXX]Incorrect operation of safety relay KS2.(Servo boardXX)
E1309	[MCXX]Incorrect operation of safety relay KS3.(Servo boardXX)
E1310	[MCXX]Incorrect operation of motor ON relay.(Servo boardXX)
E1311	[MCXX]Incorrect operation of safety circuit motor OFF relay.(Servo boardXX)
E1312	[MCXX]Mismatch in safety circuit motor OFF relay.(Servo boardXX)
E1313	[MCXX]Mismatch in individual MC control of safety circuit.(Servo boardXX)
E1314	[MCXX]Thyristor Thermal is abnormal.(Servo boardXX)
E1315	Watchdog error in NoXX I/O board.
E1316	[I/O board(No.XX)]Access Error.[Address:XX][Code:XX]
E1317	[Servo Board(NoXX)]Response from monitor is abnormal. [Code:XX]
E1318	[MCXX]DC 20V is abnormal.(Servo boardXX)
E1319	Internal valve, sensor and error reset I/F board No.2 is not installed.
E1321	[Main CPU board]Servo board(XX) communication error. (CodeXX)
E1322	Setting num. of safety circuits differs betw. powerseq.b'd and MCXX. (Servo b'dXX)
E1323	Setting num. of safety circuits differs betw. servo b'dXX and MCXX.
E1324	Safe circuit disconnected between power sequence board and servo boardXX.
E1325	Safe circuit disconnected between servo boardXX and MCXX.
E1326	Safety fence is open.
E1327	[Power sequence board]Miscompare in motor off relay condition on safety circuit.
E1328	[Power sequence board]Error of motor off relay on safety circuit.
E1329	[Power sequence board]Error in TEACH/REPEAT switch on safety circuit.
E1330	[Power sequence board]IO 24V is low.
E1331	[Power sequence board]Thermal error.
E1332	[Power sequence board]Power error signal was input from servo boardXX.

Code	Error Message
E1333	Motor power ON signal has turned off.(Servo boardXX)(MCXX)
E1334	TEACH/REPEAT switch is abnormal.(Mode differs betw. safety circuit and monitor.)
E1335	Unexpected motor powerOFF.(Servo boardXX)(MCXX)
E1336	[Servo boardXX]Communication error with Main CPU board.
E1337	[MCXX]Brake power is abnormal.(Servo boardXX)
E1338	[MCXX]P-N low voltage.(Servo boardXX)
E1339	[MCXX]P-N high voltage.(Servo boardXX)
E1340	[MCXX]Regenerative time over.(Servo boardXX)
E1341	[MCXX]Regenerative resistor overheat.(Servo boardXX)
E1342	Motor harness disconnected or robot temperature exceeded limit.(MCXX)
E1343	Mismatch betw connected place of brake harness and software setting. (JtXX)
E1344	JtXX Current sendor is disconnected or out of order.(V)
E1345	[Servo boardXX]Limit switch signal line is disconnected.
E1346	JtXX Failed to get encoder full data.
E1347	[MCXX]Destination spec is incorrect.(Servo boardXX)
E1348	[MCXX]Robot arm spec/separate control spec is incorrect. (Servo boardXX)
E1349	[MCXX]Explosion proof setting is mismatch.(Servo boardXX)
E1350	[MCXX]MC specification error.[CodeXX](Servo boardXX)
E1351	[MCXX]MC OFF delay specification is incorrect.(Servo boardXX)
E1352	JtXX Codes set in software and power block do not match.
E1353	[Main CPU board]CPU temperature is abnormal.
E1355	Error in servo I/F command communication.(Code:XX)
E1356	The tool shape is not set.
E1357	Failed to download ext. axis parameter data.(Jt-C)
E1358	Axis No. is not assigned to the specified channel.(Jt-C)
E1359	JtXX axis U phase overcurrent.
E1360	JtXX axis V phase overcurrent.
E1361	JtXX axis W phase overcurrent.
E1362	[Servo boardXX]Speed of tool center point exceeded safety speed.
E1363	[Servo boardXX]Speed of flange center point exceeded safety speed.
E1365	TEACH KEY SWITCH is ON in two or more places.
E1366	Watchdog error in NoXX ANYBUS interface board.
E1367	Improper parameter for KI481.
E1377	[Main CPU board] Speed of tool center point exceeded safety speed.
E1378	[Main CPU board] Speed of flange center point exceeded safety speed.

Code	Error Message
E1379	[Main CPU board] Deviation error of JtXX.
E1382	[Servo boardXX] Internal valve/sensor interface board is not installed.
E1392	Servo software does not support deviation alarm function.
E1409	[MCXX]Error of gate power output in MC control board[Diagnostic pulse](Servo board XX)(CodeXX)
E1411	[MCXX]Error of gate power output in MC control board[mismatch between output and feedback](Servo board XX)(CodeXX)
E1412	[MCXX]Error of brake power output in MC control board[Diagnostic pulse](Servo board XX)(CodeXX)
E1414	[MCXX]Brake release switch was pushed during motor power ON, or error of break power output(Servo board XX)(CodeXX)
E1415	[MCXX]Error of motor ON output in MC control board[Diagnostic pulse](Servo board XX)(CodeXX)
E1416	[MCXX]Error of motor ON output in MC control board[mismatch between outputs](Servo board XX)(CodeXX)
E1417	[MCXX]Error of motor ON output in MC control board[mismatch between output and feedback](Servo board XX)(CodeXX)
E1418	[MCXX]Error of MC shutoff output in MC control board[Diagnostic pulse](Servo board XX)(CodeXX)
E1419	[MCXX]Error of MC shutoff output in MC control board[mismatch between outputs](Servo board XX)(CodeXX)
E1420	[MCXX]Error of MC shutoff output in MC control board[mismatch between output and feedback](Servo board XX)(CodeXX)
E1421	[MCXX]Mismatch in safety circuit inputs (Servo board XX)(CodeXX)
E1422	[MCXX]Short circuit in safety circuit inputs or 24V power drop (Servo board XX)(CodeXX)
E1423	[MCXX]MC control board error[Diagnostic pulse of safety circuit input](Servo board XX)(CodeXX)
E1424	[MCXX]Mismatch in MC shutoff inputs (Servo board XX)(CodeXX)
E1425	[MCXX]Short circuit in MC shutoff inputs or 12V power drop (Servo board XX)(CodeXX)
E1426	[MCXX]MC control board error[Diagnostic pulse of MC shutoff input](Servo board XX)(CodeXX)
E1427	[MCXX]Relay connected to motor ON output is welded or error of weld diagnostic circuit(Servo board XX)(CodeXX)
E1428	[MCXX]MC connected to MC shutoff output is welded　or error of weld diagnostic circuit(Servo board XX)(CodeXX)

Code	Error Message
E1429	[MCXX]Failure of MC in MC unit (Servo board XX)(CodeXX)
E1430	[MCXX]Error of PFC board(Servo board XX)
E1431	[MCXX]Voltage drop of power for power module in MC power board(Servo board XX)
E1432	[MCXX]Communication error for PN voltage sensor(Servo board XX)
E1433	[MCXX]Mismatch between software setting and Off-delay DIP-SW setting on MC control board (Servo board XX)
E1434	[MCXX]MC power board is wrong(Servo board XX)
E1436	[MCXX]P-N low voltage.(Servo boardXX)（CodeXX)
E1437	[MCXX]Mismatch in state of ind, shutoff contacts of safety circuits.(SrvB'dXX)(CodeXX)
E1438	[MCXX] PFC board does not working.(Servo board XX)(PN voltage = XXV)
E3808	Motor power OFF (EXT_EMG).
E3809	Brake release signal error.
E3810	Power sequence ready off.
E3811	JtXX axis amp command value suddenly changed.
E3900	Mismatch moving tool data and selected tool data.
E4000	Data communication error.
E4001	Data reading error.
E4002	Data write error.
E4003	Unexpected error in file access.
E4004	Communication retry error.
E4005	Communication process was stopped.
E4006	Receive no data after request.
E4007	Receiving data is too long(MAX=255 characters).
E4008	Abnormal data (EOT) received in communication.
E4009	Communication time out error.
E4010	Terminal already in use.
E4011	Communication port already in use.
E4012	Waiting for input of PROMPT. Connect input device.
E4013	TELNET)SEND error. Code=XX
E4014	TELNET)RECV error. Code=XX
E4015	TELNET)IAC receive error. Code=XX
E4016	TELNET)Close failure. Code=XX
E4017	TELNET)Main socket close failure. Code=XX
E4018	TELNET)System error. Code=XX

Code	Error Message
E4019	TCPIP)Socket open failure. Code=XX Dst.IP=XX.XX.XX.XX
E4020	TCPIP)Socket close failure. Code=XX Dst.IP=XX.XX.XX.XX
E4021	TCPIP)Communication Error. Code=XX Dst.IP=XX.XX.XX.XX
E4022	TCPIP)Message is too long.
E4023	TCPIP)Cannot reach the Host.
E4024	TCPIP)Communication Time Out. Dst.IP=XX.XX.XX.XX
E4025	TCPIP)Connection aborted.
E4026	TCPIP)No Buffer Space.
E4027	TCPIP)Bad Socket.
E4028	FTP)Data receive error.(Code=XX)
E4029	FTP)Data send error.(Code=XX)
E4030	FTP)Server does not recognize command.(Code=XX)
E4031	FTP)Failed to disconnect with FTP server.(Code=XX)
E4032	FTP)Unregistered OS detected.
E4033	FTP)Failed to connect with server.(Code=XX)
E4034	FTP)Failed to receive HOST OS information.(Code=XX)
E4035	FTP)TCP/IP not initialized.
E4036	FTP)FTP service busy now.
E4037	FTP)Failed AUTO-SAVing.
E4053	Channel error.
E4054	TCPIP)Cannot execute because Ethernet board not installed.
E4055	TCP)Cannot create a socket.
E4056	TCP)This port is not in LISTEN (SOCK).
E4057	TCP)Illegal Socket ID.
E4059	ASCYCLE communication receive error.(Code:XX)
E4060	[ARM CONTROL BOARD]ASCYCLE communication receive error.(Code:XX)
E4061	Received gauge hole data exceeds allowable range.
E4062	Master/slave data is not registered.
E4063	Reference point data is not registered.
E4064	3D calibration/measurement modes are both ON.
E4065	Unregistered variable specified to receive data.
E4066	Variable specified to receive data is broken.
E4067	Received data is broken.
E4068	Start code is not correct.
E4069	End code is not correct.

Code	Error Message
E4070	3D camera group No. not specified.
E4071	Incorrect 3D camera group No.
E4072	Communication beginning wait time out error.
E4073	No servo off signal from ARM I/F board.
E4074	[Servo boardXX]No response from MCXX.(Code:XX)
E4075	[Servo boardXX]Error in communication with MCXX.(Code:XX)
E4076	[MCXX]Servo boardXX communication error.(Code:XX)
E4077	[Servo boardXX]Error in communication with main CPU board.(Code:XX)
E4078	[Servo boardXX]Error in command communication with the main CPU board.(Code:XX)
E4500	ANYBUS)IN-AREA request timeout.XX
E4501	ANYBUS)OUT/FB.CTRL release timeout.XX
E4510	DN)Master status.XX
E4511	DN)Node status.XX
E4512	ABM-DN)Mailbox error.
E4520	ABMA-PDP)Status STOP.XX
E4521	ABMA-PDP)Status OFFLINE. XX
E4522	ABMA-PDP)I/O data Communication error.XX
E4523	ABMA-PDP)Sending of timed out I/O data.XX
E4524	ABMA-PDP)Timeout of receiving I/O data.XX
E4525	ABMA-PDP)Timeout of sending message.XX
E4526	ABMA-PDP)Timeout of receiving message.XX
E4527	ABMA-PDP)Check configuration data.XX
E4528	PROFIBUS)Slave Diag-error response detected.XX
E4529	PROFIBUS)Statistic counter-error response detected.XX
E4530	DN)DeviceNet cable is disconnected.
E4531	CC-LINK)Communication has been disconnected. XX
E4532	CC-LINK)Initial condition setting is incorrect.
E4533	CC-LINK)Watch dog timeout error.
E4534	CC-LINK)Parameter setting error. XX
E4535	CC-LINK)Time out on setting parameter.
E4536	CC-LINK)Master board is abnormal. XX
E4537	CC-LINK)Initialization error on master board . XX
E4538	CANopen)Network is disconnected.
E5000	Connected permission signal has not been turned ON.
E5001	RWC type is not process control type.

Code	Error Message
E5002	1GS board is not process control type.
E5003	Illegal extend (retract) output signal.
E5004	Weld completion signal already input.
E5005	(Spot weld)Weld schedule setting data is abnormal.
E5006	CLAMP SPEC is not set as PULSE.
E5007	Servo weld gun not connected or wrong gun connected.
E5008	Tip wear measurement (STAGE1) was not executed.
E5009	Work sensing signal(gun_tip touch signal) is not set.
E5010	Servo weld gun mechanical parameter is not set.
E5011	This clamp number already set for servo weld gun axis.
E5012	Cannot change the gun because offset data is abnormal.
E5013	Cannot change multiple guns at the same step.
E5014	Cannot execute, gun connected to another joint.
E5015	Gun status data disagrees with clamp condition.
E5016	Data of SRVPRESS is wrong.
E5017	Wear base data is not registered.
E5018	Weld completion signal has not been detected.
E5019	Weld fault signal is detected.
E5020	Retract pos. monitor error.
E5021	Extend pos. monitor error.
E5022	Current gun retract position differs from a destination.
E5023	Wear is abnormal, cannot take measurement.
E5024	Pressurization comp. signal has not been detected.
E5025	Gun opening comp. signal has not been detected.
E5026	(Spot welding)RWC error. XX
E5027	Robot stopped in welding.
E5028	Cannot achieve set force.
E5029	Gun tip stuck.
E5030	Copper plate wear exceeds limit. step=XX
E5031	Weld completion signal is not turned OFF.
E5032	Calibration did not end normally.
E5033	Cannot weld because of abnormal thickness.
E5034	Tip wear exceeds limit. (MOVING SIDE)
E5035	Tip wear exceeds limit. (FIXED SIDE)
E5036	Incorrect gun status data.
E5037	Tip wear exceeds limit. XX

Code	Error Message
E5038	Arc detection signal did not turn OFF.
E5039	No response from RWC communication I/F board.
E5040	Cannot connect gun because gun is already connected.
E5041	Cannot disconnect gun because gun is already disconnected.
E5042	Gun No is not defined or Gun type is not servo gun.
E5043	Communication error in welder. (CodeXX)
E5044	Failed to get weld data. (timer XX)
E5045	Failed to change weld data. (timer XX)
E5046	Weld error has arisen.
E5047	Receiving weld items now, wait till completion.
E5048	Weld controller is unconnected or weld items are not received. (timer XX)
E5049	Serial number signal error.
E5050	This welder is without Traceability.
E5051	Cannot calibrate because tool change axis is disconnected.
E5052	The pressurizing power measurement value is abnormal.
E5053	The pressurizing power sensor is disconnected or it breaks down.
E5054	The selector switch on TP is set to manual operation.
E5055	The selector switch on TP is set to automatic operation.
E5056	No Initialization Weld board.
E5057	Initialization failure in Initialization Weld board.
E5058	Welder(DENGEN COMPANY) not connected. (welder XX)
E5059	Welder(DENGEN COMPANY) response error. (welder XX)
E5060	Initialization Weld board protected. (welder XX)
E5061	Welder(DENGEN COMPANY) data process not execute. (welder XX)
E5062	Welder(DENGEN COMPANY) data process error.(welder XX)
E5063	Weld error has arisen. (CodeXX)
E5064	Welder(DENGEN COMPANY) of weld was aborted. (welder XX)
E5065	Welder(DENGEN COMPANY) error has arisen. (welder XX)
E5066	Waiting weld completion time out.(welder XX)
E5067	Magnet control is abnormal.(welder XX)
E5500	Vision board is not installed.
E5501	(Vision)Camera not connected.
E5502	(Vision)Incorrect parameter.
E5503	(Vision)Incorrect Symbol.
E5504	(Vision)Incorrect name.
E5505	(Vision)Incorrect image memory.

Code	Error Message
E5506	(Vision)Incorrect histogram data.
E5507	(Vision)Incorrect mode.
E5508	(Vision)Incorrect density(/color).
E5509	(Vision)Incorrect camera input assignment.
E5510	(Vision)Incorrect camera ch.number.
E5511	(Vision)Incorrect Window No.
E5512	(Vision)Incorrect coordinates data.
E5513	(Vision)Incorrect number.
E5514	(Vision)Incorrect image code(binary/multi).
E5515	(Vision)Incorrect threshold.
E5516	(Vision)PROTO(/TEMPLATE) not registered or already exists.
E5517	(Vision)Cal. data not registered.
E5518	(Vision)Graphic cursor is not initialized.
E5519	(Vision)Too many samples from PROTO object.
E5520	(Vision)Too many targets detected.
E5521	(Vision)Vision command not initiated.
E5522	(Vision)System registered with abnormal data.
E5523	(Vision)Error in processing image(s).
E5524	(Vision)Sound port assigned another function.
E5525	(Vision)Lack of data storage area.
E5526	(Vision)Incorrect synch. mode.
E5527	(Vision)Vision processing now.
E5528	(Vision)Image capture error.
E5529	(Vision)Time out or Buffer overflow.
E5530	(Vision)Failed to write on flash memory.
E5531	(Vision)Proto data abnormal, so initialized.
E5532	(Vision)Work detection failure.
E5533	(Vision)Initialization error. Code = XX
E5534	(Vision)Vision system error.
E5535	(Vision)Specified motion mode is incorrect.
E5536	(Vision)Inappropriate camera/projector parameters.
E5537	(Vision)Incorrect camera switch assignment.
E5538	(Vision)This plane is assigned to another camera.
E5539	(Vision)Edge was not found.
E5540	(Vision)Inappropriate HSI data.
E5541	(Vision)H data range width is over 128.

Code	Error Message
E5542	(Vision)Distance image input unit not set for camera.
E5543	(Vision)Cannot calculate the set edge points.
E5544	(Vision)Check color conversion table type in set config.
E5545	(Vision)Incorrect area size.
E5546	(Vision)Slit image does not exist.
E5547	(Vision)Incorrect no. of correlation vectors.
E5548	(Vision)Inappropriate vector data.
E5549	(Vision)X-Fit environment was not set.
E5550	(Vision)Mouse is not initialized.
E5551	(Vision)Camera switcher board is not installed.
E6000	Explosion proof teach pendant is not connected.
E6001	Step after XD(2)START must be LMOVE or HMOVE.
E6002	Signal condition already input.
E6003	Door open detect signal is not dedicated.
E6004	Location data was not detected.
E6005	Incorrect setting of barrier unit.
E6006	Signal not detected.
E6007	Wrist can't be straightened any more (Singular point 1).
E6008	Wrist can't be bent any more (Singular point 2).
E6009	Purge air flow is insufficient.
E6010	Out of XYZ MOVING AREA LIMIT.
E6011	Pressure within enclosure is low.
E6012	Relative distance between guns is too near (ID:XX).
E6013	No free memory in program queue.
E6014	No free memory in delayed start queue.
E6015	Special signal is not specialized.
E6016	Robot arm stretching out (Singular Point 3).
E6017	Out of mechanical XYZ motion limits.
E6018	Painting equipment control board error. (CodeXX)
E6019	Painting equipment control board is not installed.
E6020	Monitoring Robot ID is duplicate.
E6021	(Mutual-Wait)There is no response from the other party robot.
E6022	Duplicate Mutual-Wait IDs.
E6023	(Mutual-Wait)Communication error in Mutual-Wait.
E6024	Wrist can't bend any further left/right (Singular Point 1).
E6025	(Conveyer synchronous communications)It is a conveyer position reception

Code	Error Message
	error.
E6026	Guns are too near in X direction. (ID:XX)
E6027	Guns are too near in Y direction. (ID:XX)
E6028	Guns are too near in Z direction. (ID:XX)
E6029	[Servo boardXX]Mismatch in internal pressure in safety circuit.
E6030	[Servo boardXX]Pressure within enclosure is low.
E6031	Monitoring Robot ID is invalid.
E6032	[Purge control board]Pressure within enclosure is low.
E6033	Painting equipment control process error. (CodeXX)
E6034	Cartridge table rotate command is abnormal.
E6500	No welding Interface board.
E6501	No.2 welding Interface board not found.
E6502	Arc failure.
E6503	Wire stuck.
E6504	Arc start failure.
E6505	Arc weld insulation defect.
E6506	Torch interference.
E6507	Illegal interpolation data.
E6508	No D/A board for polarity ratio control.
E6509	No work detected.
E6510	Undefined sensing direction.
E6511	Insufficient num. of sensing points.
E6512	Undefined mother or daughter work.
E6513	Too many sensing points.
E6514	Work specification incorrect.
E6515	Incorrect sensing point specified.
E6516	Wire check failure.
E6517	Incorrect weld condition number.
E6518	No weld condition data set.
E6519	Weld condition data is out of range.
E6520	Laser sensor tracking value exceeded.
E6521	Beyond Laser sensor tracking ability.
E6522	Laser sensor cannot detect welding joint.
E6523	Calibration data between torch and camera is not ready.
E6524	Error in data calculated using Laser sensor.
E6525	Cannot detect weld joint, Laser sensor tracking set already.

Code	Error Message
E6526	No response from Laser sensor controller.
E6527	Laser sensor communication error. Code is XX.
E6528	Start point not found by Laser sensor.
E6529	Finish point not found by Laser sensor.
E6530	Cannot use circular interp. with Laser sensor function.
E6531	Cannot turn Laser ON because motor power is OFF.
E6532	No communication board to Laser sensor.
E6533	No RTPM board.
E6534	Too many taught points for RTPM.
E6535	RTPM arc sensor error.
E6536	RTPM current deviation error.
E6537	RTPM tracking value is out of range.
E6538	Beyond RTPM tracking ability.
E6539	AVC tracking value is out of range.
E6540	Beyond AVC tracking ability.
E6541	No AVC board.
E6542	AVC voltage deviation error.
E6543	Too many taught points for AVC.
E6544	Hyper Arc tracking value is out of range.
E6545	Beyond Hyper Arc tracking ability.
E6546	Bead end is not found.
E6547	Finish end is not found.
E6548	Hyper Arc revolution beyond normal deviation.
E6549	Hyper Arc torch calibration error.
E6550	Hyper Arc Z phase index error.
E6551	No Hyper Arc board.
E6552	Hyper Arc board error. Code is XX.
E6553	Hyper Arc current sensor error.
E6554	Hyper Arc voltage sensor error.
E6555	Hyper Arc current deviation error.
E6556	Hyper Arc amplifier error. Code is XX.
E6557	No Wire feeding Control board.
E6558	Wire feeding control error, code is XX.
E6559	Wire feeding speed deviation error.
E6560	Cannot re-calibrate weld in progress.
E6561	Cannot weld, re-calibration in progress.

Code	Error Message
E6562	Electric pole stuck.
E6563	KHITS tracking system error. (Code = XX)
E6564	The arc weld instruction sequence is incorrect.
E6565	Arc welding Interface board(1LN) is not installed.(robot XX)
E6566	FN instructions not executed in the correct order.
E6567	KLS tracking system error.(Code=XX)
E6568	Failed in executing command to tracking system.(cmd=XX)
E6569	Taught data exceeds inclination limit for compensation.
E6570	Cannot execute because welding now.
E6571	Cannot execute because wire inching/retracting now.
E6572	Teach point for circular motion is missing.
E6573	The welding machine is abnormal.(Code=XX)
E6574	Sensing of groove: cannot detect edge.
E6575	Sensing of groove: gap error.
E6576	Welder is not ready for operation. (Code=XX)
E6577	Deviation is too large. Reset allows non-correction movement.
E6578	Sensing was interrupted due to power OFF. Restore step and retry.
E6579	KI instructions not executed in the correct order.
E7000	Servo weld gun disconnected.
E7001	Location data includes released gun status data.
E7002	Destination is far from target point.
E7003	The clearance distance of gunXX is set to 0mm.
E7004	Gun tip wear change over the limit. (MOVING SIDE)
E7005	Gun tip wear change over the limit. (FIXED SIDE)
E7006	Clamp number or gun number is not servo weld gun.
E7007	Cannot change tip base data in 1 Stg. because tip wear rate is not set.
E7008	Independent Gun control is not completed.
E7009	Current limit for servo welding gun is abnormal.
E7500	JtXX Collision is detected.
E7501	JtXX Unexpected shock is detected.
E7502	AC Fail Process Error = XX
E7503	POWER SEQUENCE setting data incorrect.
E7504	Angle between JtXX is out of range at start location.
E7505	Angle between JtXX is out of range at end location.
E7506	Angle between JtXX is out of range.
E7507	SC1MOVE or SC2MOVE instruction is required after SC1MOVE.

Code	Error Message
E7508	SC1MOVE instruction is required before SC2MOVE.
E7509	Cannot execute, interpolation conditions are not fulfilled.
E7510	Cannot move with current posture.
E7511	Brake control bit number is duplicated.
E7512	L3C1MOVE or L3C2MOVE instruction is required after L3C1MOVE.
E7513	L3C1MOVE instruction is required before L3C2MOVE.
E7514	Specified parameter is not consistent.
E8200	Not in cooperative mode.
E8201	Unmatch the total of motion instruction in cooperative mode.
E8202	Unmatch step of motion instruction in cooperative mode.
E8203	Cannot use this instruction in cooperative mode.
E8204	Invalid cooperative group No.
E8205	No JMASTER robot.
E8206	TouchSensing in Cooperative mode is no supported.
E8207	JMASTER robot already exists.
E8208	WSLAVE robot already exists.
E8209	Fixed Point Motion in Cooperative mode is no supported.
E8210	No WSLAVE robot.
E8211	Out of sync.
E8212	Cannot continue non-cooperative instruction in cooperative mode.
E8213	No MASTER robot.
E8214	No SLAVE robot.
E8400	Servohand opened in clamp ON step.(CLAMP=XX)
E8401	Clamping position of servo Hand is error.(CLAMP=XX)
E8402	Cannot achieve set force of JtXX.
E8403	NC Joints lock signal not off.
E8404	Interpolation other than joint int. is unavailable.
E8405	It tries to move the Matehan axis with the axis locked.
E8600	（FSJ)Processing condition error.XX
E8601	Gap was over the lower pos. limit.
E8602	Reached the Penetration depth within min.processing time.
E8603	It could not reach the set Penetration depth within the appointed period.
E8604	Pressure cable disconnected.
E8605	Please input two set pressure or more.
E8606	Please input data in ascending order.
E8607	FSJ COUNTER ALARM.XX

Code	Error Message
E8608	(FSJ)FSJ schedule setting data is abnormal.
E8609	Setting tip force is over limit.
E8610	Setting rotation speed is over limit.
E8611	FSW Logging buffer is full.
E8800	Command value almost exceeds virtual safety fence.(SphereXX, LineXX)
E8801	Command value almost exceeds virtual safety fence.(SphereXX, ZUpper)
E8802	Command value almost exceeds virtual safety fence.(SphereXX, ZLower)
E8803	Command value almost invades restricted space.(SphereXX, Part.XX LineXX)
E8804	Command value almost invades restricted space.(SphereXX, Part.XX ZUpper)
E8805	Command value almost invades restricted space.(SphereXX, Part.XX ZLower)
E8806	Command value almost exceeds virtual safety fence.(ToolBox, LineXX)
E8807	Command value almost exceeds virtual safety fence.(ToolBox, ZUpper)
E8808	Command value almost exceeds virtual safety fence.(ToolBox, ZUpper)
E8809	Command value almost invades restricted space.(ToolBox, Part.XX)
E8810	Command value almost exceeds virtual safety fence.(LinkXX, LineXX)
E8811	Command value almost exceeds virtual safety fence.(LinkXX, ZUpper)
E8812	Command value almost exceeds virtual safety fence.(LinkXX, ZLower)
E8813	Command value almost invades restricted space.(LinkXX, Part.XX LineXX)
E8814	Command value almost invades restricted space.(LinkXX, Part.XX ZUpper)
E8815	Command value almost invades restricted space.(LinkXX, Part.XX ZLower)
E8820	Current value exceeded virtual safety fence.(SphereXX, LineXX)
E8821	Current value exceeded virtual safety fence.(SphereXX, ZUpper)
E8822	Current value exceeded virtual safety fence.(SphereXX, ZLower)
E8823	Current value invaded restricted space.(SphereXX, Part.XX LineXX)
E8824	Current value invaded restricted space.(SphereXX, Part.XX ZUpper)
E8825	Current value invaded restricted space.(SphereXX, Part.XX ZLower)
E8826	Current value exceeded virtual safety fence.(ToolBox, LineXX)
E8827	Current value exceeded virtual safety fence.(ToolBox, ZUpper)
E8828	Current value exceeded virtual safety fence.(ToolBox, ZLower)
E8829	Current value invaded restricted space.(ToolBox, Part.XX)
E8830	Current value exceeded virtual safety fence.(LinkXX, LineXX)
E8831	Current value exceeded virtual safety fence.(LinkXX, ZUpper)
E8832	Current value exceeded virtual safety fence.(LinkXX, ZLower)
E8833	Current value invaded restricted space.(LinkXX, Part.XX LineXX)
E8834	Current value invaded restricted space.(LinkXX, Part.XX ZUpper)
E8835	Current value invaded restricted space.(LinkXX, Part.XX ZLower)

Code	Error Message
E8850	Disabled robot motion.
E8851	Detected area interference.
E8852	Detected arm interference.(XX, XX)
E8853	Failed to predict trajectory.
E8854	Detected near miss.(XX, XX)
E8855	No response from interference check board.
E8856	Communication error between interference check board and ARM CONTROL board.
E8857	The number of robots is too many.
E8860	[ARM CTRL BOARD]Cannot receive data from INTERFERENCE CHECK BOARD.
E8861	Communication error between IL server and ARM CONTROL board.
E8862	Cable disconnected between IL server and ARM CONTROL board.
E8900	Detected torque for load presence is abnormal.
E8901	Detected torque for load absence is abnormal.
E8902	Stopped because motion limitation signal was input.
E9300	Cannot rotate JtXX. Because disconnected axis.
E9301	Cannot rotate JtXX. Because invalid axis.
E9302	Rotation speed setting for JtXX is abnormal.
D0001	CPU error.(PC=XX)
D0002	Main CPU BUS error.(PC=XX)
D0007	[Servo boardXX]CPU error. (CodeXX)
D0008	[Servo boardXX]Floating point exception. (CodeXX)
D0009	[Servo boardXX]CPU exception. (PC=XX)
D0900	Teach data is broken.
D0901	AS Flash memory sum check error.
D0902	Servo Flash memory sum check error.
D0903	IP board memory error. (XX)
D0904	Memory is locked due to AC_FAIL.
D1003	Init. error of servo control software.
D1011	As or servo software is not compatible with the robot model.
D1012	Servo type mismatch. Check the settings.
D1014	Servo system error.(Code=XX)
D1015	The servo data file does not exist.
D1016	Data applicable to the robot model not in servo data file.
D1017	Error of download of servo data.

Code	Error Message
D1018	Servo software version mismatch.
D1020	[ARM CONTROL BOARD]Synchronous error between CPUs.
D1021	Servo FPGA configuration data not found.
D1022	Configuration error in servo FPGA.(CodeXX)
D1023	Current mismatch betw. m-plexer&software. JtXX
D1025	[Servo boardXX]Detected Watch dog error.(Servo FPGA)
D1026	[Servo boardXX]Abnormal signal input from power sequence board.
D1027	[MCXX]Detected Watch dog error.
D1028	[Servo boardXX]DC power is abnormal.(Servo FPGA)
D1029	[Servo boardXX]AC primary power is abnormal.(Servo FPGA)
D1030	Cannot start communication with the servo boardXX.
D1031	Read error of servo software.
D1032	[Servo boardXX]Download error of servo software.(CodeXX)
D1033	Connection Port No(XX) and Servo board No(XX) mismatch.
D1034	The servo data file is missing or not acceptable.(CodeXX)
D1035	[Servo boardXX]Init. error of servo software.(CodeXX)
D1036	[Servo boardXX]Download error of servo data.(CodeXX)
D1037	[Servo boardXX]Configuration error in servo FPGA.(CodeXX)
D1038	[Servo boardXX]Upload error of servo software initial data.(CodeXX)
D1039	[Servo boardXX]Download error of servo software initial data.(CodeXX)
D1040	[Servo boardXX]Device check error. (CodeXX)
D1041	JtXX axis brake release circuit is abnormal.
D1044	[MCXX] Detected Watch dog error.(Servo board XX)(codeXX)
D1500	Encoder misread error. JtXX
D1501	Defective gun changer connection or encoder comm. error.
D1502	Amp overcurrent. JtXX
D1504	Abn. curr feedback JtXX. (Amp fail, pwr harness disconnect)
D1507	AC primary power OFF.
D1512	Brake line error for JtXX.
D1516	Mismatch betw hard/software settings for HOLD backup time.
D1517	Blown fuse on safety circuit emergency line.
D1518	Mismatch in the Emer. Stop condition on safety circuit.
D1520	Mismatch in safety circuit TEACH/REPEAT condition.
D1521	Mismatch in safety circuit safety-fence condition.
D1522	Mismatch in cond. of safety circuit enabling device.
D1523	Mismatch in cond. of safety circuit ext.enabling device.

Code	Error Message
D1528	Controller temperature is out of range.
D1529	Signal harness disconnected or encoder power error.
D1530	Abnormal current limit of JtXX.
D1532	(SSCNET)EnCoder communication error.(JtXX)(CodeXX)
D1533	(SSCNET)Absolute position of JtXX is erased.(CodeXX)
D1534	(SSCNET)Parameter error of JtXX.(CodeXX)
D1535	(SSCNET)Alarm of JtXX.(CodeXX)
D1536	JtXX does not move normally.
D1539	Power supply circuit for PWM signal output malfunctioned.
D1541	Encoder type set in software and arm control board mismatch.
D1542	No Rotation data from multidrop encoder at initialize.
D1543	[Servo boardXX]DC 5V is abnormal.
D1544	[Servo boardXX]DC 3.3V is abnormal.
D1545	[Servo boardXX]DC 12V is abnormal.
D1546	[Servo boardXX]DC 2.5V is abnormal.
D1547	[Servo boardXX]DC 1.2V is abnormal.
D1548	[Servo boardXX]DC 1.0V is abnormal.
D1549	[Servo boardXX]Primary power source is too low.
D1550	[Servo boardXX]Primary power source is too high.
D1551	[Servo boardXX]AC primary power OFF.
D1552	[MCXX]DC 3.3V is abnormal.
D1553	[MCXX]DC 5V is abnormal.
D1557	[Power sequence board]DC 3.3V is abnormal.
D1558	[Power sequence board]DC 5V is abnormal.
D1559	[Power sequence board]DC 12V is abnormal.
D1560	[Power sequence board]DC 24V is abnormal.
D1561	[Power sequence board]AC primary power OFF.
D1562	[Power sequence board]AC primary power voltage is too high.
D1563	[Power sequence board]AC primary power voltage is too low.
D1564	[Power sequence board]Remote power off signal was detected.
D1565	Cannot access power sequence board.(CodeXX)
D1566	P-N capacitor has not discharged.(Servo board XX)(MCXX)
D1567	[Servo boardXX]Primary Power source is error.
D1568	[Servo boardXX]Power supply circuit for PWM signal output malfunctioned.
D1572	[MCXX]MC control board error[clock](Servo board XX)(CodeXX)
D1573	[MCXX]MC control board error[reset IC] (Servo board XX)(CodeXX)

Code	Error Message
D1575	[MCXX]Setting error of Dip-SW for Off-delay setting(Servo board XX)(CodeXX)
D1576	[MCXX]Error reset for MC control board is input over the fixed time(Servo board XX)(CodeXX)
D1577	[MCXX]Error of gate power output in MC control board[detected ON during OFF condition](Servo board XX)(CodeXX)
D1578	[MCXX]Error of brake power output in MC control board[detected ON during OFF condition](Servo board XX)(CodeXX)
D1579	[MCXX]P-N Capacitor is not connected.(Servo board XX)
D2000	No response from Comm. board for Laser sensor.
D2001	RI/O or C-NET board initialize error.
D2002	No response from the Arm ID board.
D2003	No data in the Arm ID board.
D2004	Mismatch data in the Arm ID board.
D2005	CC-LINK software version mismatch.
D2006	Watch dog error on communication board for Explosion proof TP.
D2007	No response from the built-in sequence board.
D2008	Magnet is Contactor of groupXX is stuck.
D2009	Sensor for detecting pressure in enclosure is abnormal.
D2010	Sync. error between User I/F and Arm control board.
D2011	Parameter download error betw User I/F & Arm control boards.
D2012	Soft Absorber error. Turn OFF & ON the control power.
D2013	Change gain error. Turn OFF & ON the control power.
D2014	Robot network initialize error.
D2016	No response from the Arm control board.
D2021	Arm data file is not found.
D2022	Arm data is not found.
D2023	Failed to load arm data.
D2024	[ARM CTRL BOARD]Robot type setting failed.
D2025	Robot codes set in software and Arm ctrl board do not match.
D2026	Codes set in software & curr. sensor I/F b'd do not match.
D2027	Codes set in software and power block do not match.
D2028	(SSCNET) Initialization error. (CodeXX)
D2035	Program execution error.
D2036	(SSCNET)System error occurred in 1LP I/F board. (CodeXX)
D2037	Safety unit circuit is abnormal.

Code	Error Message
D2038	(SSCNET)Interface board is not installed.
D2039	(SSCNET)Communication error of JtXX on initialization.
D2040	(SSCNET)Initialization error of JtXX.(CodeXX)
D2041	Connection of the signal harness is wrong.
D2042	Servo amp and robot arm are mismatched.
D2043	Arm I/F board detects AC-Fail.
D2044	[ARM CONTROL BOARD]No response from Servo FPGA software.
D2045	[ARM CONTROL BOARD]Device check error. (CodeXX)
D2046	Relay error on purge control board. (relay XX)
D2047	Jumper setting error or Safety relay failure on Servo CPU board.
D2048	DC 12V Voltage source error on purge control board.
D2049	Over current error in interlock relay drive circuit(1) for purge control board.
D2050	Over current error in interlock relay drive circuit(2) for purge control board.
D2051	Communication error on purge control board.
D2052	Hardware setting for the external axis amplifier has discrepancy. robot=n
D2053	(FANXX-XX)Rotational speed of fan is abnormal.(Servo boardXX)
D2054	Codes set in software and power block do not match.(Code:XX)
D2055	[Power sequence board]Watchdog error was detected.
D2056	[I/O board(No.XX)]Several boards have same ID address.
D2057	[Servo boardXX]No response from Servo FPGA device.
D2058	[Main CPU board]DC power supply is abnormal.(XX mV)
D2064	[Purge control board]Pressure within enclosure is low.(during purging)
D2065	Safety relay is abnormal which cut off brake power when inner pressure is low.
D2066	[Purge control board]DC is abnormal.(12V)
D2067	[Main CPU board]Communication with purge control board is abnormal.
D2068	[IO board No. XX]Device check failure.(CodeXX)
D2069	[ANYBUS interface board(No.XX)]Several boards have the same ID address.
D3800	Communication board memory error. (XX)
D3822	Motor parameter is not consistent with controller. JtXX
D3823	FAN NO. XX in Controller is out of order.
D3824	Fuse NO.XX on IO board NO.1 is open.
D3825	Fuse NO.XX on IO board NO.2 is open.
D3826	Robot DC voltage error.
D3828	Controller type error.
D4000	[DIAG]Error is detected in RS232C.(Code:XX)
D4001	[DIAG]Error is detected in Ethernet.(Code:XX)

Code	Error Message
D4500	Fieldbus interface board is not detected.
D4501	ABMA-PDP)I/F module error. XX
D4502	FIELD-BUS-INIT)Error reply. XX
D4503	FIELD-BUS-INIT)Reply timeout. XX
D4504	ANYBUS)OUT/FB.CTRL request timeout. XX
D6000	Over temperature error in Barrier unit.
D6001	Mutual-Wait initialize error.

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