DENSO ROBOT

Cartesian coordinate

XYC-4G SERIES

INSTALLATION & MAINTENANCE GUIDE

Preface

Thank you for purchasing this high-speed, high-accuracy assembly robot.

Before operating your robot, read this manual carefully to safely get the maximum benefit from your robot in your assembling operations.

Robot series and/or models covered by this manual

Series	Model
XYC-4G (Cartesian coordinate)	XYC-40***G-L XYC-40***G-R

NOTE 1: Model names listed above apply to the models of robot systems. The model names of robot units are followed by M. If the robot system model is XYC-40***G-L, for example, the robot unit model is XYC-40***GM-L.

NOTE 2: Asterisks (***) in model names denote numerals meaning the strokes of the X-, Y-, and Z-axes.

Important

To ensure operator safety, be sure to read the precautions and instructions given in "SAFETY PRECAUTIONS".

The robot does not comply with the CE Standard. If you need to declare CE conformity for the robot, facility-wide CE Declaration of Conformity is required.

NOTE:

Robots and controllers that will be exported to South Korea after March 1st 2013 need to have KCs mark for each equipment.

How this book is organized

This book is just one part of the robot documentation set. This book consists of SAFETY PRECAUTIONS and chapters one through three.

Chapter 1 Installing Robot Components
Provides information about physical site planning, installation procedures, and engineering-design notes for hands.

Chapter 2 Customizing Your Robot
Describes how to customize your robot--defining the software motion space and restricted space, CALSETing, and setting control set of motion optimization.

Chapter 3 Maintenance and Inspection
Describes the regular maintenance and inspections necessary for maintaining the performance and functions of your robot.

Contents

Chapter 1
Installing Robot Components

1.1 Preparing a Proper Environment for Installation

Before installing the robot unit and robot controller, confirm that the operating environment is in conformity with each item of the "SAFETY PRECAUTIONS, Installation Precautions,". Also, take proper measures to protect the components from vibration.

In an inappropriate environment, the robot will not operate to its full capacity or performance, components may not last long, and unexpected failure may result.

1.1.1 Ambient Temperature and Humidity

Keep the ambient temperature between 0°C and 40°C during operation.

Keep the ambient humidity at 90% or below to prevent dew condensation.

1.1.2 Vibration

Do not install the robot in an environment where it will be exposed to excessive vibration or impact.

1.1.3 Connecting the Robot Unit and Robot Controller

Before delivery, the robot unit and the robot controller are configured as a set. If you purchase two or more robot systems, take care not to mistake each set when connecting robot units and controllers.

> ⚠**Caution: Configured as a set, the robot unit and robot controller are given the same serial number.**

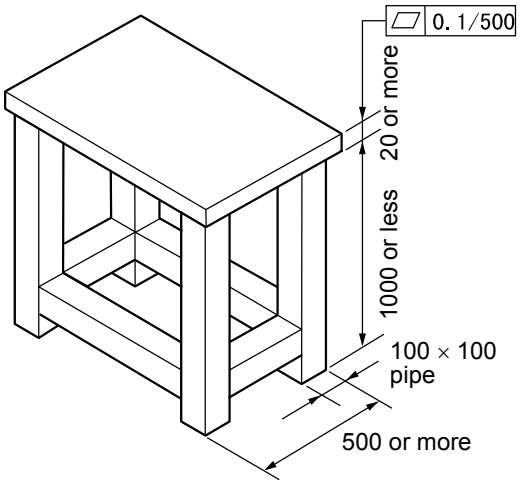
1.1.4 Installation Environment of the Robot Unit

The table below lists the installation requirements for the robot unit. Prepare a highly rigid mount as shown in the figure on the next page.

> ⚠**Caution: Do not electric-weld the equipment including the robot. A large current may flow through the motor encoder or robot controller resulting in a failure. If electric welding is required, remove the robot unit and the robot controller from the equipment beforehand.**

Installation Requirements for the Robot Unit

Item	Environments and Conditions
Flatness of the mount	0.1/500 mm (See the figure on the next page.)
Rigidity of the mount	Use steel materials. (See the figure on the next page.)
Installation type	Floor-mount
Ambient temperature	During operation : 0 to 40°C During storage and transportation : -10 to 60°C
Humidity	During operation : 90% or less (No dew condensation allowed.) During storage and transportation : 75% or less (No dew condensation allowed.)
Vibration	During operation : 4.9 m/s^2 (0.5G) or less During storage and transportation : 29.4 m/s^2 (3G) or less
Safe installation environment	Refer to the SAFETY PRECAUTIONS, **3.1 "Insuring the proper installation environment"**
Working space, etc.	• Sufficient service space must be available for inspection and disassembly. • Keep wiring space (230 mm or more) behind the robot, and fasten the wiring to the mounting face or beam so that the weight of the cables will not be directly applied to the connectors.
Grounding conditions	Functional ground See the figure on page 6.



⚠Caution (1) When the robot operates at high speed, the robot mount undergoes large reaction forces. The mount must be rigid enough so that it will not vibrate or be displaced due to reaction forces. It is also advisable to mechanically join the robot mount with heavy equipment.

(2) Some mounts may produce a resonance sound (howling). If this sound is loud, increase the rigidity of the mount or slightly modify the robot speed.

Robot Mount Sample for Floor-mount

1.2 Installing the Robot Unit

> ⚠**Caution: Before handling or installing the robot unit, be sure to read "SAFETY PRECAUTIONS, Installation Precautions."**

1.2.1 Transporting the Robot Unit

The transporting jobs should be handled by at least three persons. The XYC-4G series weights approximately 65 kg (143 lb) (in the case of the heaviest model, XYC-40593GM).

Workers should put on helmet, safety shoes, and globes.

Follow the transporting procedure given below.

(1) Remove the motor and encoder cables from the robot unit.

(2) Press the ZT-axis against the mechanical end by moving it in the direction of the arrows as shown at left below.

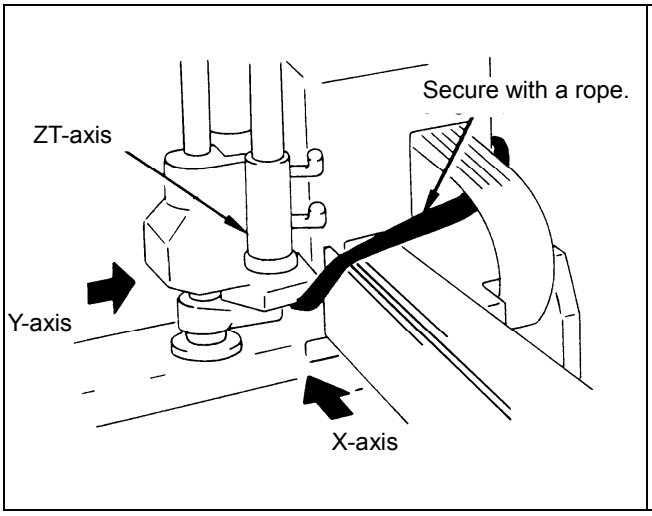
(3) Secure the ZT-axis with a rope or belt.

(4) While supporting the end of the X-axis to prevent the robot unit from overturning, remove the Y-axis mounting bolts to release the robot unit from the mount.

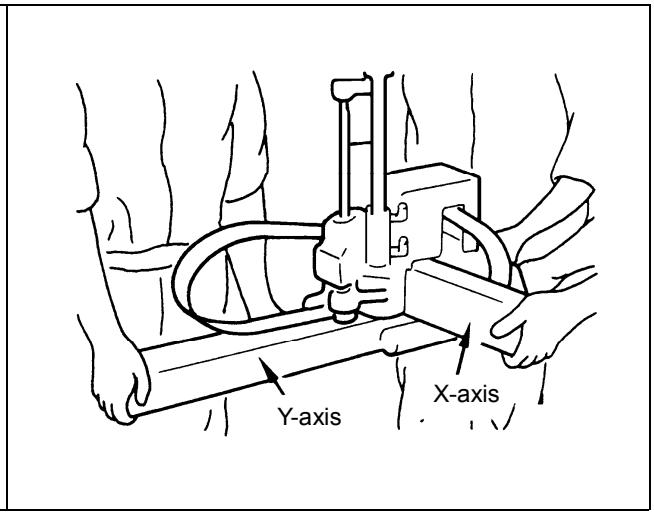
(5) Have at least three workers lift up the robot unit and transport it to the installation place.

The ZT-axis side of the X-axis and Y-axis is heavier, so keep the robot unit in balance for safe transport.

> ⚠**Caution (1) Do not hold the plastic covers by hand. They may be deformed or broken.**
> **(2) Make sure that the transport path is free of obstacles.**



Securing the ZT-Axis



Transporting the Robot Unit

(6) Lift the robot unit down onto the installation point; as soon as this is done, temporarily clamp the robot unit with the four bolts previously removed.

(7) Fix the robot unit properly, referring to the procedures given on the next page.

> **NOTE:** After temporary bolting, connect the motor cable and encoder cable previously detached.

1.2.2 Installing the Robot Unit

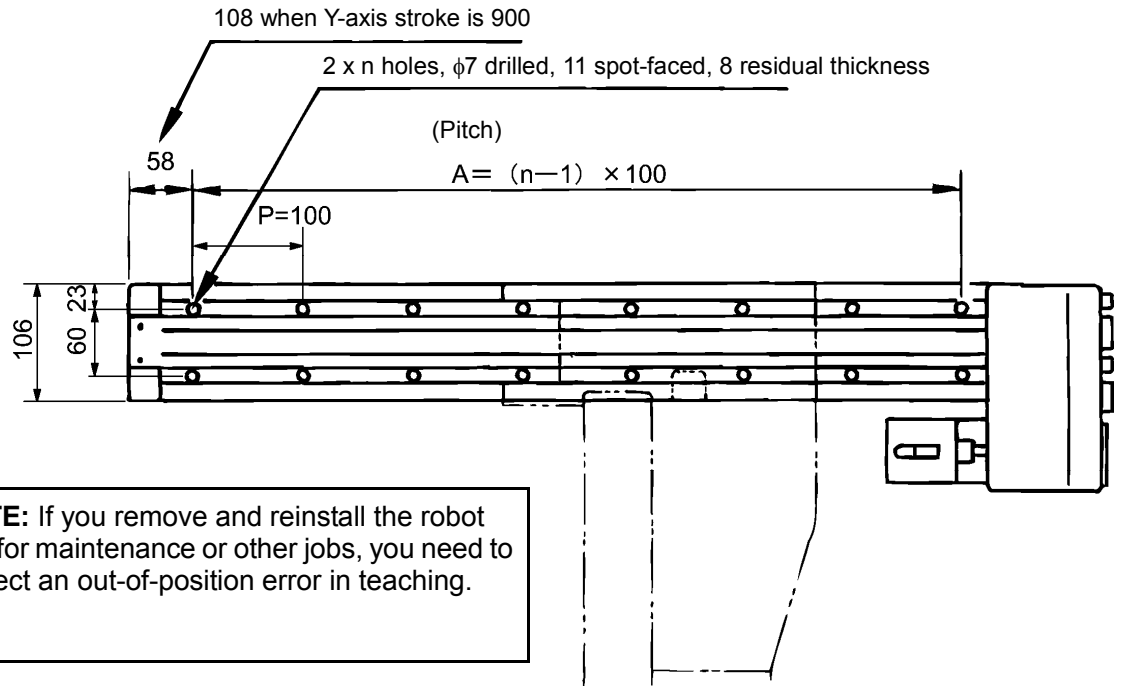
(1) Drill "2 x n" bolt holes (M6) in the robot mount where the robot unit is to be secured, according to the dimensions shown below.

(2) Put the robot unit on the robot mount, following the transport instructions given in "[1] Transporting the Robot Unit."

(3) Secure the robot unit to the mount with hex. socket-head bolts (M6x18). Tightening torque: 14.7±2 N·m

Caution: Be sure to tighten all of "2 x n" bolts firmly. If any one of those bolts is loose, the rigidity of Y-axis frame setting will decrease, resulting in vibration of the robot servo system. When designing the robot mount, take care not to cause trouble due to improper installation. Failures which arise from improper installation shall not be covered by the warranty.

Y-axis stroke (mm)	A (mm)	n
300	500	6
400	600	7
500	700	8
600	800	9
700	900	10
900	1000	11



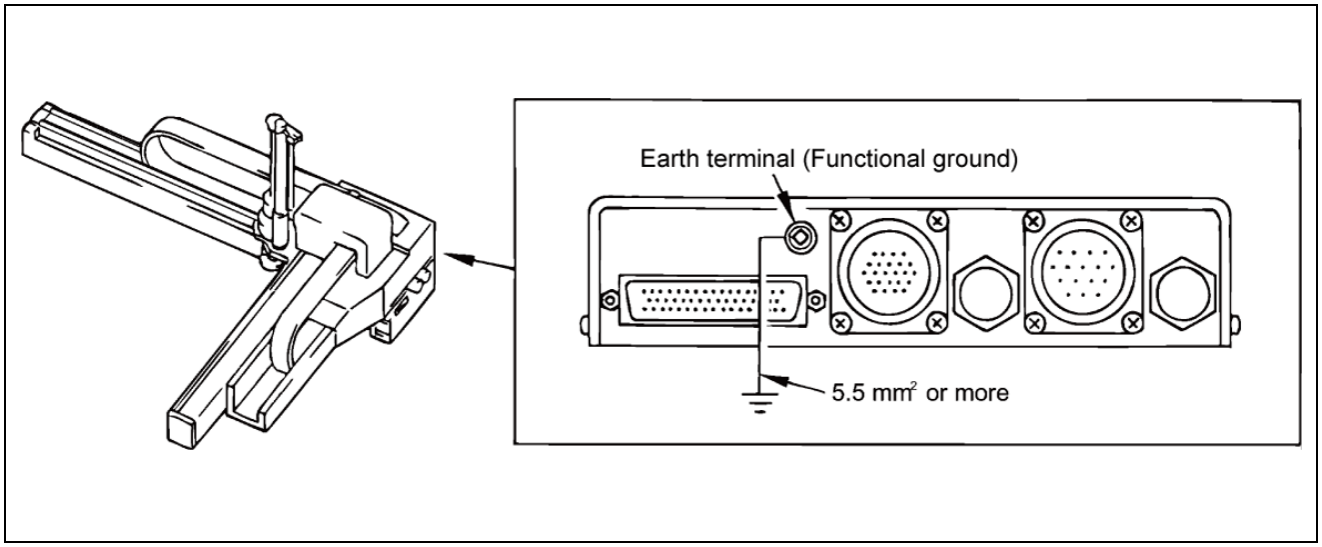
NOTE: If you remove and reinstall the robot unit for maintenance or other jobs, you need to correct an out-of-position error in teaching.

Bolt Positions for Securing the XYC-4G Series

1.2.3 Grounding the Robot Unit

Ground the earth terminal of the robot unit using a wire of 5.5 mm^2 or more.

NOTE: Use a dedicated grounding wire and grounding electrode. Do not share them with any other electric power or power equipment such as a welder.



Grounding the Robot Unit

1.3 Installing the Robot Controller

For the installing procedures of the robot controller, refer to the RC7M CONTROLLER MANUAL, Section 6.2 "Installing the Robot Controller."

1.4 Electrical Wiring and Air Piping of the Robot Unit

Make electrical wiring and air piping of the hand or tool to be attached to the arm end, referring to the example given below.

Use robot instrumentation cables (manufactured by Daikyo Denshi) or equivalent for electrical wiring.

NOTE: Maintenance and inspection of the robot unit sometimes requires removing and installing the covers. Mount the stays for wiring and piping so that they will not interfere with removal/installation of the covers.

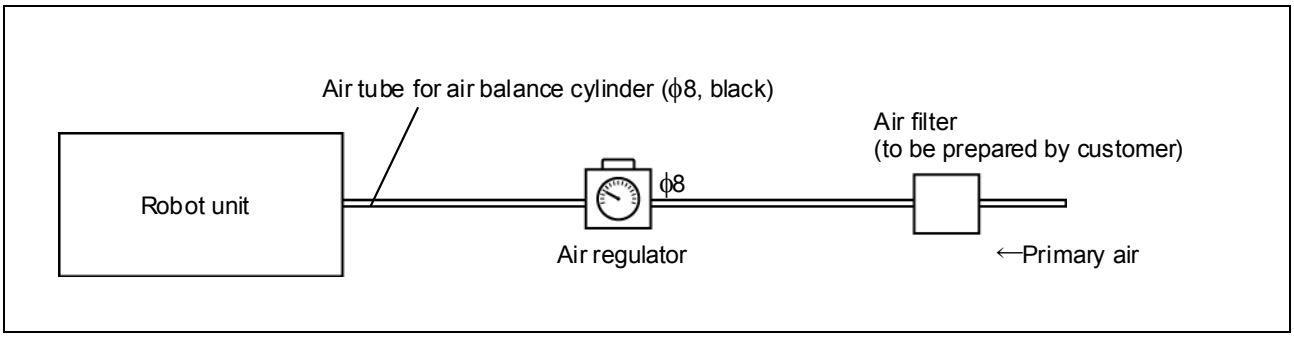
1.4.1 Piping for Air Balance Cylinder

Install piping for the air balance cylinder as shown in the figures below. The air source pressure should be within the range listed below.

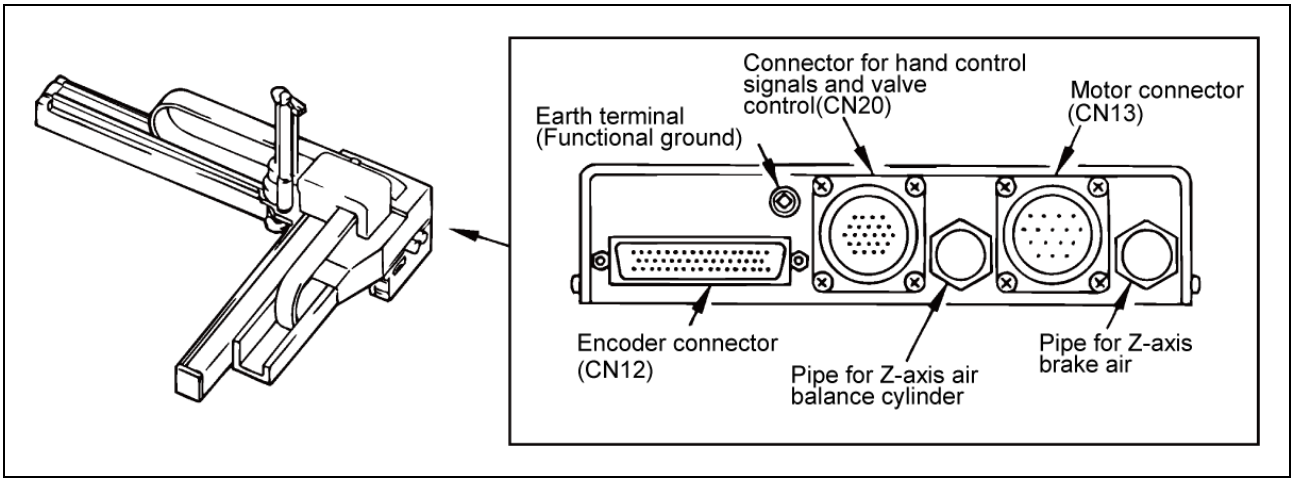
Air source pressure	0.35 to 0.59 MPa

Caution: - Supply dry air filtered through an air filter (Recommended filtration rating: 5 μm or below).
- Before piping, blow the air tube out with dry air to clean out the inside (flushing); otherwise, any chips, cutting oil, dust or dirt remaining in the air tube may result in a damaged valve.

Join air pipes to the robot unit at the connector sections shown at the bottom of this page.



Air Piping to the Robot Unit



Air Piping Joints at the Robot Unit

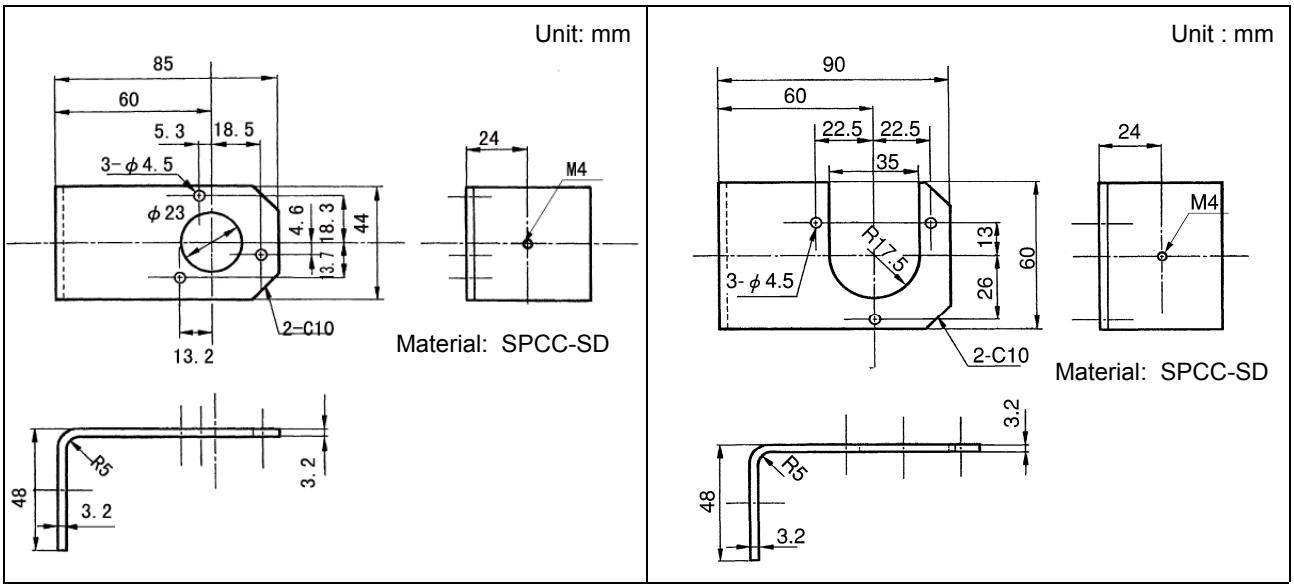
Also, observe the details below regarding the environment and conditions to install the air regulator.

- Avoid use in locations subjected to vibration and shock.
- Avoid use in locations subjected to ambient temperatures of 40℃ or higher.
- When there is a heat source in the surroundings, avoid use in locations subjected to radiant heat.
- Avoid use in atmospheres abundant in grit and dust, or atmospheres where corrosive gases or spatter are present.
- Avoid use in locations subjected to direct sunlight, the wind and rain, or water.
- Avoid repetition of drastic rise and fall in pressure or pressure pulsation, which can decrease the operating life of the pressure meter.
- Install as close to the robot as possible.

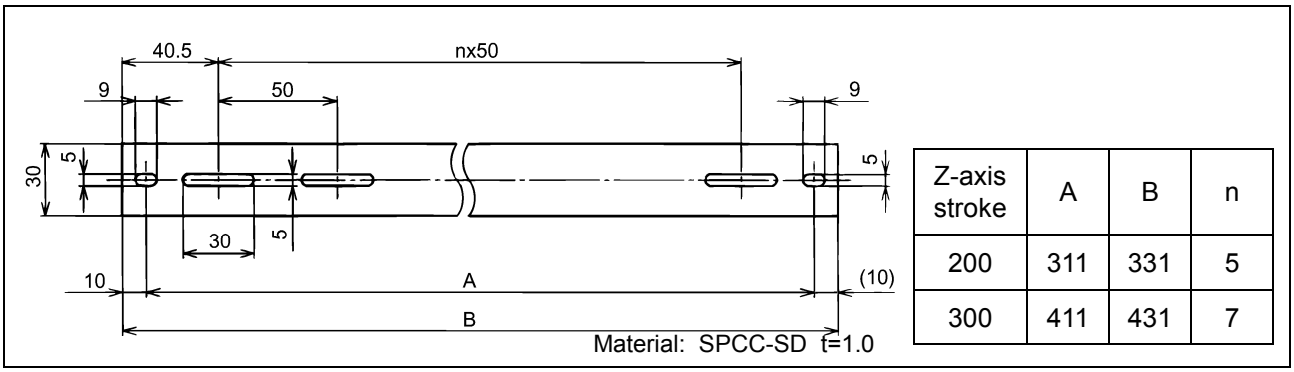
1.4.2 Making Stays for Wiring and Piping

You need to make stays for wiring and piping.

(1) Make stays. The figures below show the drawings of sample stays 1 to 3.



Stay 1 **Stay 2**



Z-axis stroke	A	B	n
200	311	331	5
300	411	431	7

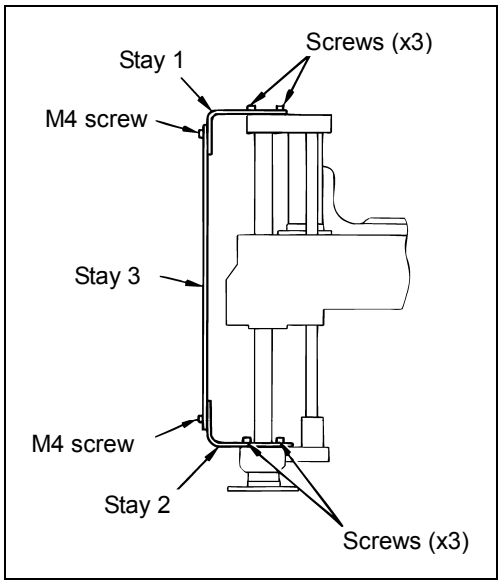
Stay 3

(2) Secure stays 1 and 2 to the top and bottom of the vertical axis arm together with the bearing covers, as shown at the right.

(3) Install stay 3 to stays 1 and 2 with M4 screws.

(4) Carry out wiring and piping jobs.

⚠Caution: The range of the motion angle of the 4th-axis is 540°, so the length of the wiring and piping should be enough to support the wide motion range.



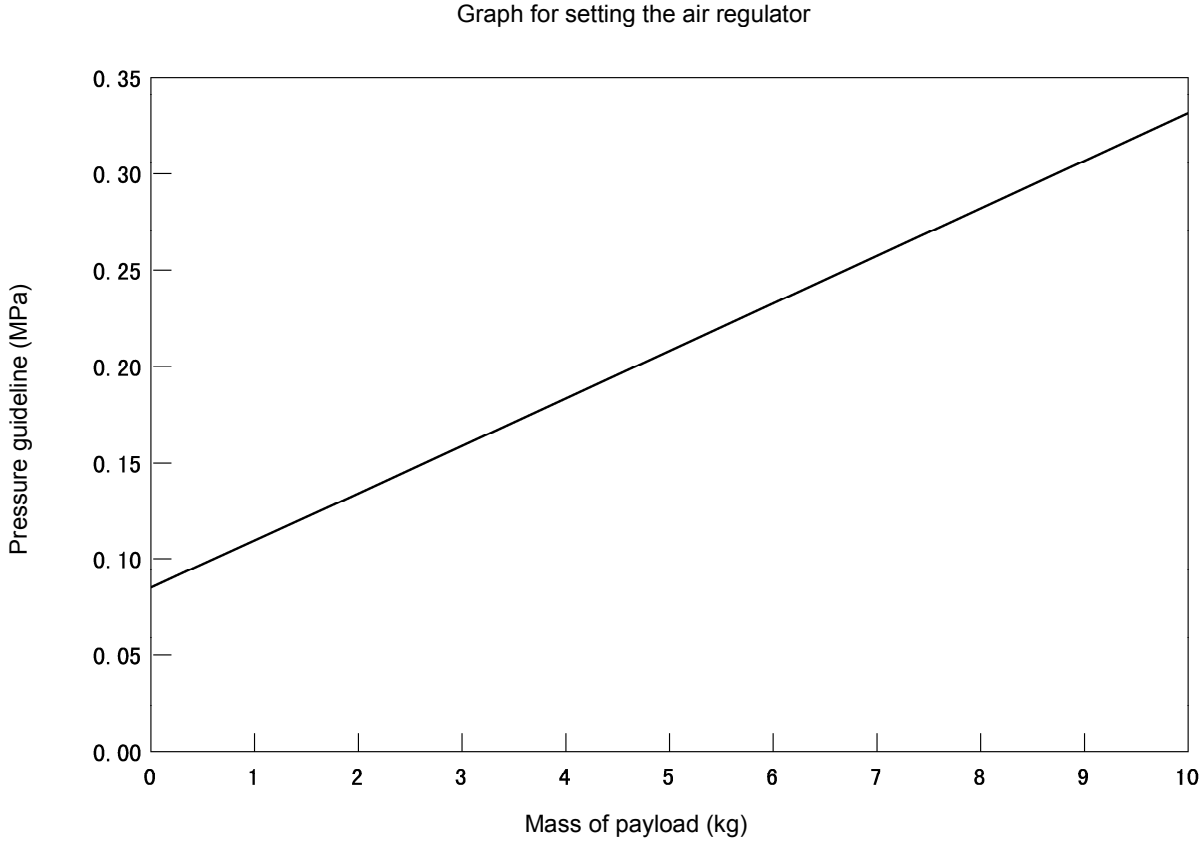
Securing stays

1.4.3 Adjusting the Air Balance

Adjust the air pressure by using the air regulator so that the robot hand plus payload chucked by the robot hand will balance with gravity.

For details, refer to the graph below and the SETTING-UP MANUAL, Section 5.3, "Adjusting the air pressure balance of the Z axis (for 4-axis robots), [F2 Arm]—[F12 Maint.]—[F4 Adj.Z.Bal]."

Air Pressure Guideline



Note: This graph shows only a guideline.

1.5 Engineering-design Notes for Robot Hands

Refer to the GENERAL INFORMATION ABOUT ROBOT for XYC-4G SERIES, Chapter 3, Section 3.5 "Engineering-design Notes for Robot Hands."

Chapter 2
Customizing Your Robot

2.1 What Is Customization?

You may customize your robot by modifying or setting the following:

- Software motion limits for defining motion space
- Mechanical ends for defining restricted space
- Control set of motion optimization
- Robot installation conditions

You are recommended to define new motion space and restricted space in order to prevent interference with other devices or entanglement of the robot hand wiring and piping.

WARNING:

Always set the software motion limits and mechanical ends so that the motion space will be within the restricted space. Otherwise, the robot will bump the mechanical stops, causing serious accidents.

2.2 Modifying Software Motion Limits to Define New Motion Space

2.2.1 What Is a Software Motion Limit?

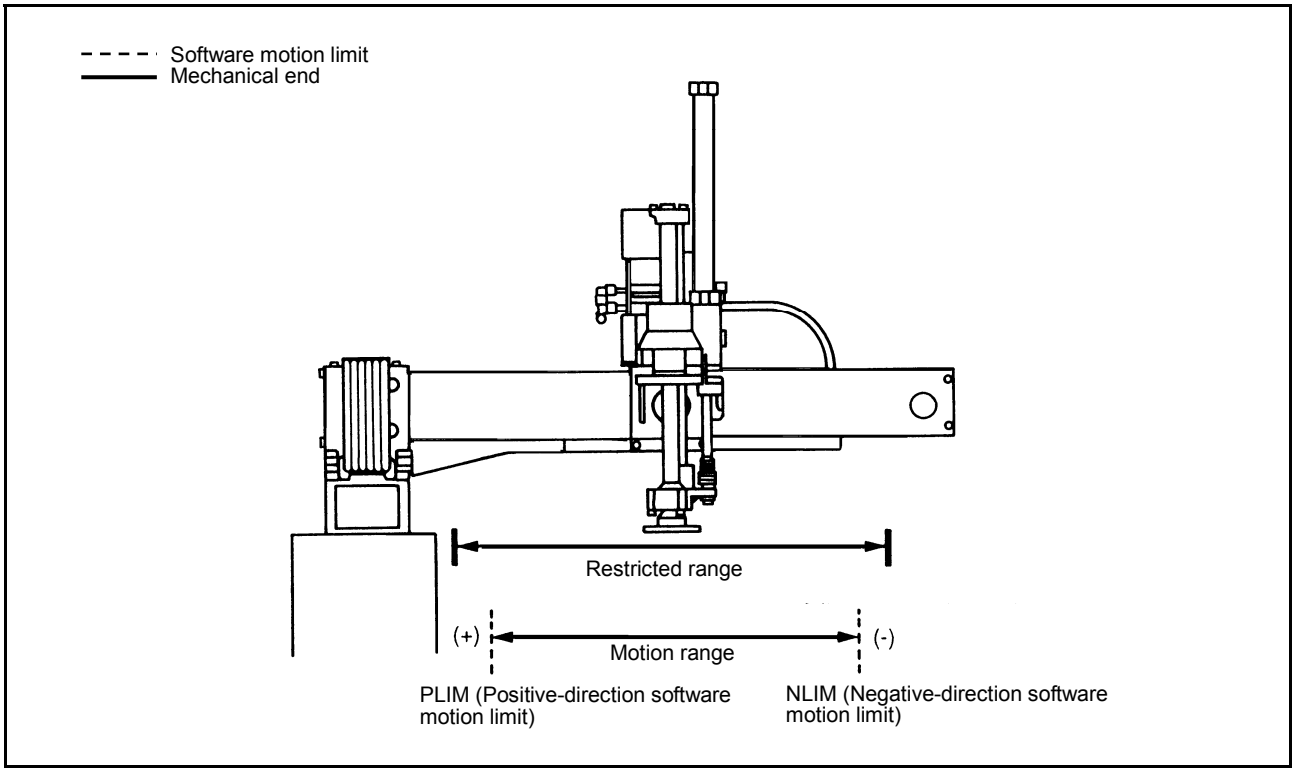
A limit to the operation range of the robot defined by the software is called a software motion limit. Software motion limits become valid after CAL of the robot has been completed and the robot has entered the range set by the limits.

A mechanical motion limit is called a mechanical end and set by a mechanical stop. To prevent the robot from striking against a mechanical stop, each software motion limit is set slightly in front of the mechanical end as shown below. Although there is no mechanical stop for the sixth axis, a software motion limit is set.

If the robot reaches a software motion limit during manual or automatic operation, an error message will be displayed (error code starting from 6070; the first digit represents the axis number) and the robot will come to a stop. The power to the motor is also turned OFF in such a case during automatic operation.

All axes are assigned a software motion limit in both the positive and negative direction of the operation range. The software motion limit in the positive direction is called the positive-direction software motion limit and that in the negative direction is called the negative-direction software motion limit.

⚠**Note:** Software motion limits are not functions in accordance with safety standards.



Software Motion Limits and Mechanical Ends

2.2.2 Software Motion Limits (Factory defaults)

The tables below list the software motion limits that are set at the time of delivery.

Software Motion Limits (Factory defaults)

1st axis (X axis) (Unit: mm)

1st-axis (X) stroke	250	350	450	550
Positive direction	125	175	225	275
Negative direction	-125	-175	-225	-275

2nd axis (Y axis) (Unit: mm)

2nd-axis (Y) stroke	300	400	500	600	700	900
Positive direction	150	200	250	300	350	450
Negative direction	-150	-200	-250	-300	-350	-450

3rd axis (Z axis) (Unit: mm)

3rd-axis (Z) stroke	200
Positive direction	105
Negative direction	-95

4th-axis (T axis) (Unit: degree)

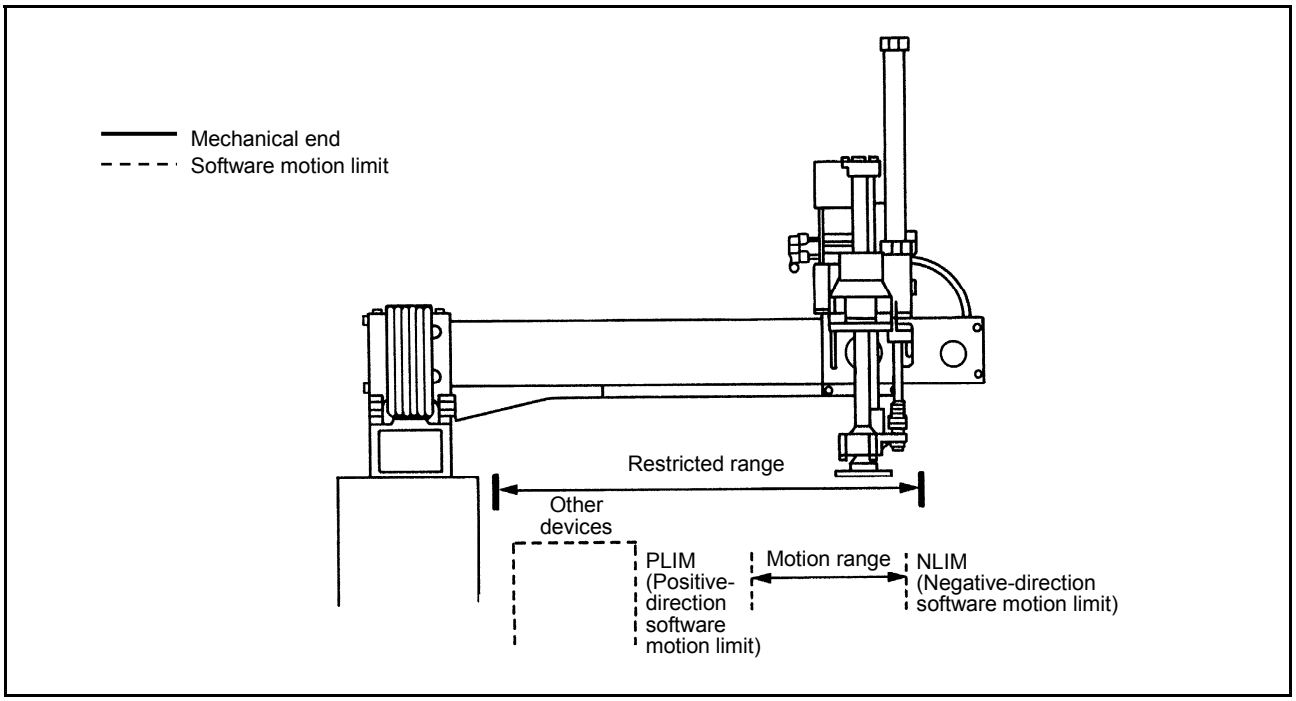
4th axis (T) stroke	540
Positive direction	270
Negative direction	-270

2.2.3 Changing Software Motion Limits

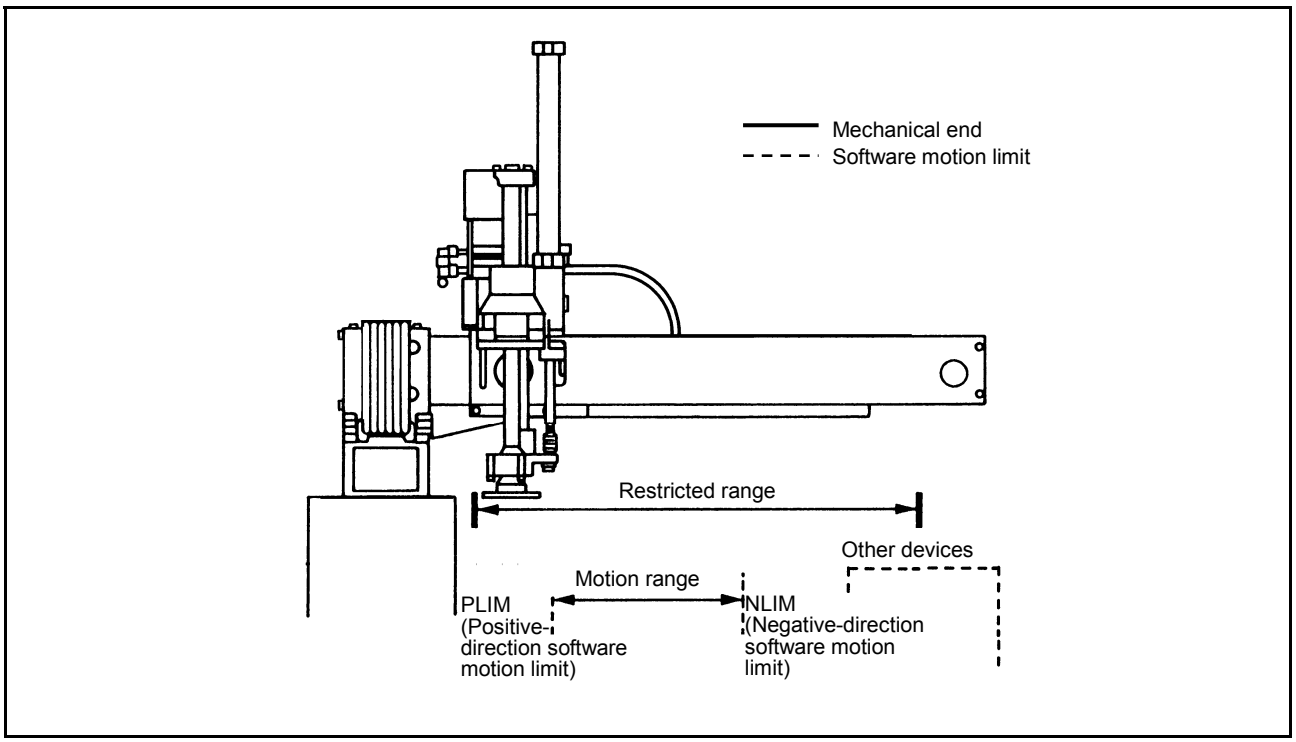
If the robot interferes with any other device, change the software motion limits to make the motion space smaller as shown below.

If the air piping and wiring of the robot hand become taut as the robot runs, then change the software motion limits to make the motion space smaller as shown below.

NOTE: When changing software motion limits, always make the new motion space smaller than the motion space defined by initial settings.



Changing Software Motion Limits (Example 1)



Changing Software Motion Limits (Example 2)

2.2.4 Precautions When Changing the Software Motion Limits

Confirm the operating space of the robot in the actual working environment. Set the software motion limits using the correct unit of measurement.

If the operating space is too small, the robot may seem to become inoperable.

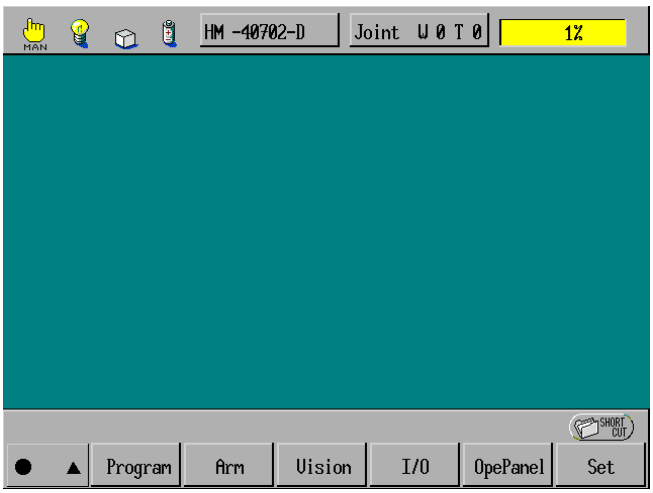
2.2.5 Procedure for Changing the Software Motion Limits

Described below is the procedure for changing the software motion limits.

Step 1 **Turn the power switch of the robot controller ON.**

Step 2 **Set the mode selector switch of the teach pendant to MANUAL.**

Step 3 **Press [F2 Arm] on the top screen of the teach pendant.**

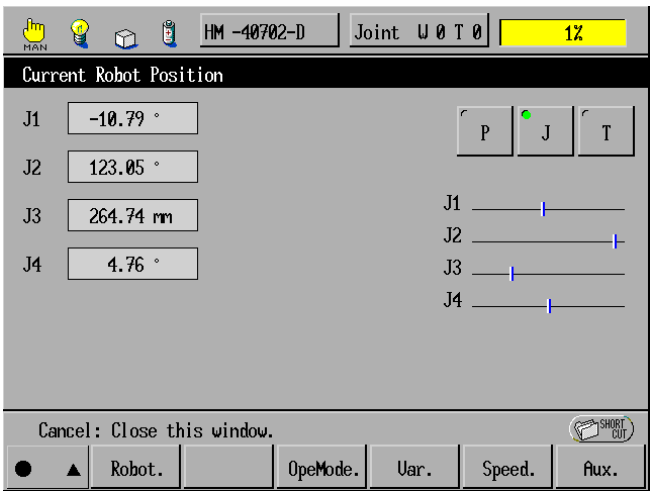


F2

The Current Robot Position window appears as shown in Step 4.

Step 4

Press the SHIFT key and then press [F12 Maint.].



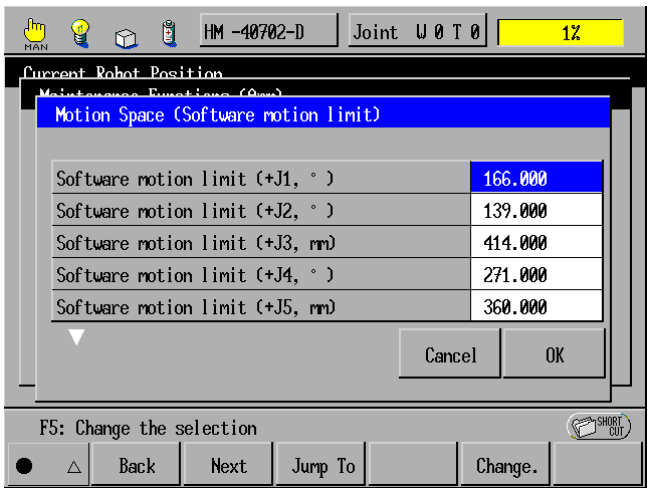
F12

The Maintenance Functions (Arm) window will appear.

Step 5

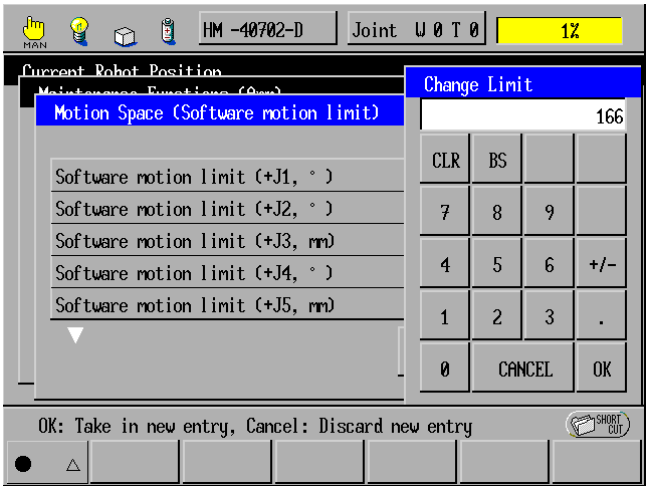
In the Maintenance Functions (Arm) window, press [F1 M Space].
The Motion Space window will appear as shown below.

Select the item to be modified, then press [F5 Change].



F5

Step 6 The numeric keypad will appear as shown below.
Enter a desired value using the numeric keys, then press OK.



Step 7 The new value will be set on the line of the item selected in the Motion Space window. If two or more items must be changed, repeat Steps 6 and 7.

Step 8 **Press OK in the Motion Space window.**

Step 9 **Turn the robot controller off.**

> **Caution:** Restarting the controller makes the new motion space settings (software motion limits) effective.

2.3 Changing Mechanical Ends to Define New Restricted Space

If it is necessary to limit the travel ranges of the X and Y axes due to restrictions on the equipment, mount poles or the like (to be prepared by the customer) on the equipment (e.g., robot mount) to define a new restricted space.

To limit the travel range of the Z axis, mount a stopper ring or the like (to be prepared by the customer) on the Z axis shaft.

> ⚠ **Caution: Once you have changed mechanical ends, be sure to change the software motion limits.**

2.4 CALSET

2.4.1 What Is CALSET?

Calibrating the relationship between position-related information recognized by the robot controller and the actual position of the robot unit is called CALSET.

CALSET must be performed when the motor is replaced or when the encoder backup battery goes dead and the position-related data retained in the encoder is lost as a result.

After CALSET is completed, the calibrated data of the robot unit will be stored in the robot controller. This data is called CALSET data which is different on each robot.

Back up the CALSET data periodically, referring to "Backing Up Projects."

2.4.2 CALSET Procedure

Record the positions of 1st to 4th axes by manually bringing them into contact with the mechanical ends.

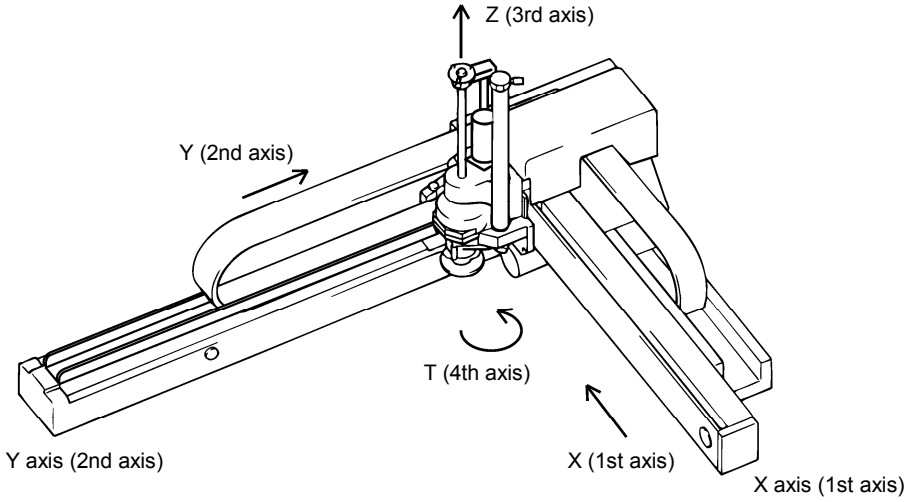
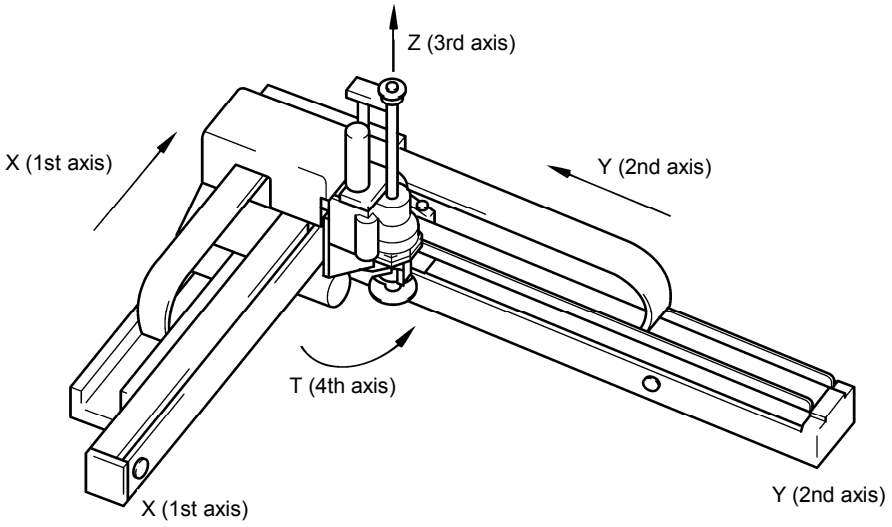
CALSET requires some space to do so.

Caution
(1) When CALSETing, move the axis to be CALSET in the vicinity of the mechanical stop, release the brake, and bring the axis into contact with the mechanical stop. When bringing the 3rd axis (Z-axis) into contact with the mechanical end, be careful not to let your fingers get caught in the geared part of the rack.
(2) After CALSET, confirm in the manual mode that each axis stops at the software motion limit before coming into contact with the mechanical end.
(3) In automatic operation, start to run the robot at low speed. Ensuring safety, gradually increase the speed. It makes adjustment easy.
(4) Position-related data in some programs made before CALSET may vary somewhat after CALSET.

What is CALSET position?

The limit position of an arm to be CALSET is called a CALSET position.

Each axis has a mechanical end in each of the positive and negative directions. The mechanical ends shown on the next page are the CALSET positions that are set by default.

Robot series		XYC-4G Series
Location	X axis (1st axis)	Linear movement end in the positive direction
	Y axis (2nd axis)	Left-hand version: Linear movement end in the negative direction Right-hand version: Linear movement end in the positive direction
	Z axis (3rd axis)	Upward movement end (in the positive direction)
	T axis (4th axis)	Turning end in the positive direction (clockwise end when viewed from the top)
Left-hand version (XYC-40***G-L)		
Right-hand version (XYC-40***G-R)		

CALSET Positions (by factory default)

2.4.3 CALSET Procedure

[1] CALSETing a Single Axis

CALSETing a specified single axis only is called single-axis CALSET.

Perform single-axis CALSET if the motor of an axis is replaced so that the axis must be CALSET, or if some axes cannot be moved to the CALSET positions (mechanical stop positions) at any given time because of interference between the robot unit and its surrounding facilities.

In the procedure below, releasing the brake is required only for the 3rd axis.

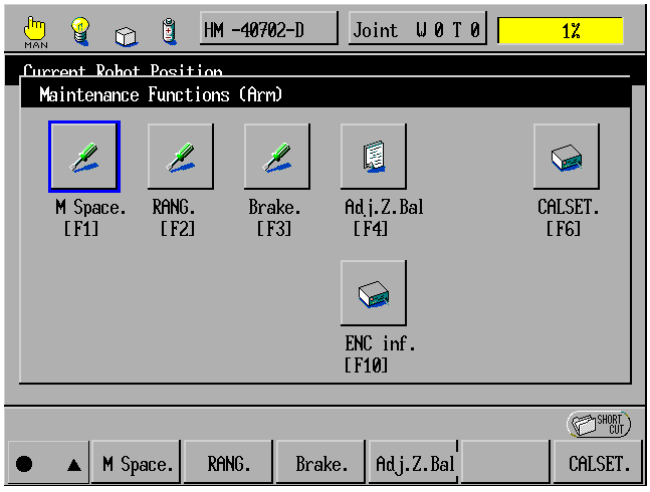
Step 1 **Move the axis to be CALSET to the mechanical stop position.**

Step 2 **On the top screen of the teach pendant, press [F2 Arm].**

Step 3 **Press the SHIFT key.**

Step 4 **Press [F12 Maint.].**

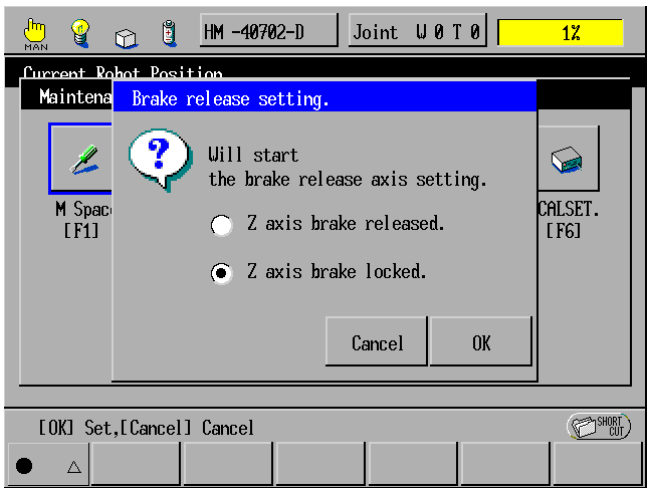
The Maintenance Functions (Arm) window appears as shown below.



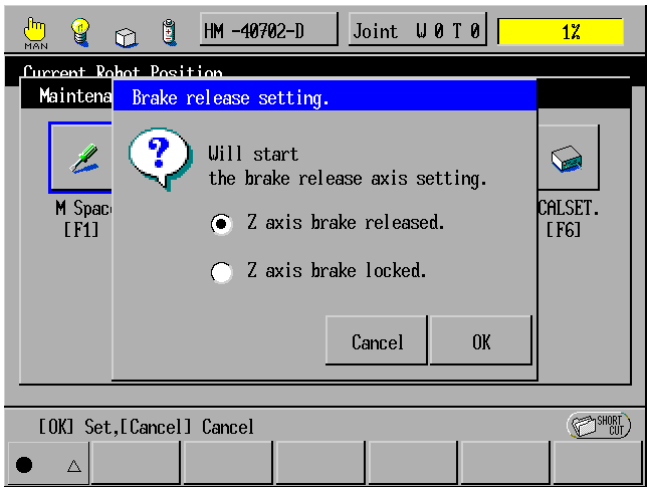
F3

Press [F3 Brake.].

Step 5 The Brake release setting window appears as shown below.



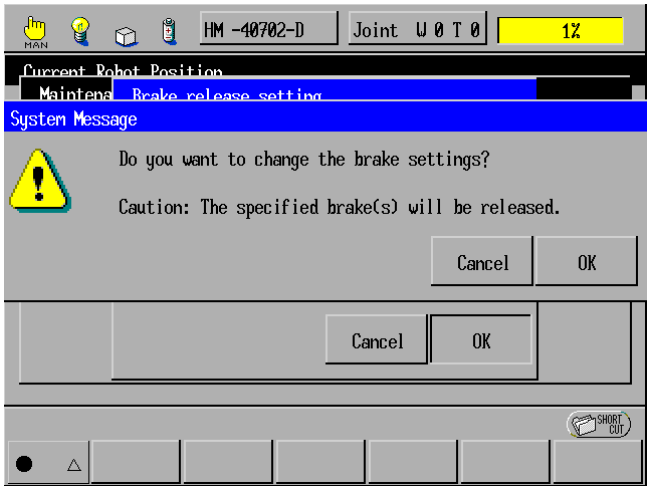
Step 6 **Select "Z axis brake released."**



Step 7 Confirm that there is no danger even if the arm falls as a result of the brake being released.

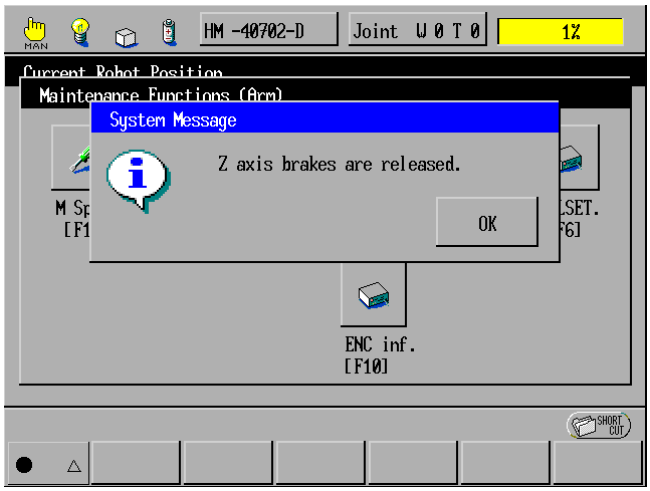
Then press OK.

Step 8 The system message appears asking you whether you want to change the brake settings.



Press OK.

Step 9 The system message appears as shown below.



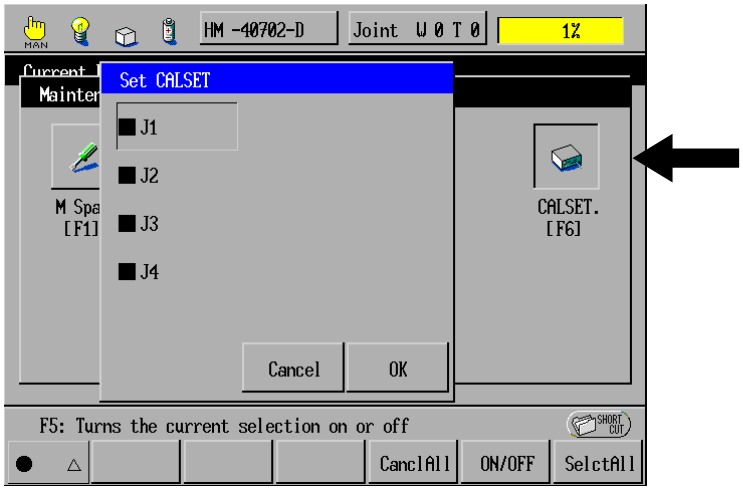
Press OK.

Step 10 **Press the axis to be CALSET against the mechanical stop by hand.**

> **Caution:** When bringing the 3rd axis (Z-axis) into contact with the mechanical end, be careful not to let your fingers get caught in the geared part of the rack.

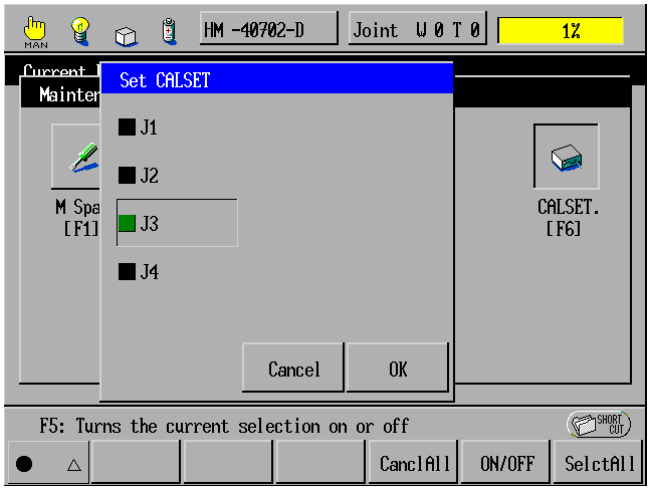
Step 11

Press [F6 CALSET.].
The Set CALSET window appears as shown below.



Step 12

Press the axis number to be CALSET to turn ON CALSET (green display). Turn OFF CALSET (black display) for the other axes that are not to be set.

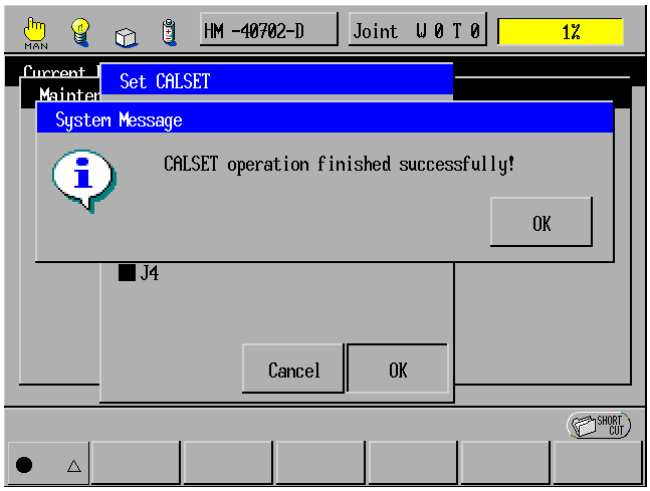


Press OK.

Step 13 The system message appears asking whether you want to carry out CALSET with a caution that the robot reference position will change.

Press OK.

Step 14 The system message appears informing that CALSET is completed.



Press OK.

Step 15 **Press the emergency stop button.**
The robot brake becomes activated.

Step 16 **Turn the emergency stop button to cancel emergency stop.**

Step 17 **Press the MOTOR key to turn the motor ON.**

> **Caution:** A "motor lock overload" error may occur just after the power to the motor is turned ON. In this case, try to turn ON the power to the motor several times, or release the brake, move the axis a little in the opposite direction of the mechanical end, and turn ON the power to the motor again.

Step 18 **Move the CALSETed axis in the opposite direction from the mechanical end by the manual operation of the teach pendant.**

Step 19 **The single-axis CALSET of the specified axis is completed.**

[2] CALSETing All Axes

The CALSET of all axes is called all-axis CALSET.

The procedure is the same as that for single-axis CALSET except that you should select all axes in Step 12. For details of the procedure, see "[1] CALSETing a Single Axis."

2.5 Setting Control Set of Motion Optimization

The optimum speed or acceleration will vary depending upon the payload and center of gravity of a robot hand or workpiece that is to be set at the end of the robot flange. Set the payload and center of gravity position of the robot hand or workpiece and the control set of motion optimization according to the payload and robot posture.

For further information, see the PROGRAMMER'S MANUAL, Section 4.7 "Setting the Master Control Parameters in User Preferences." For the setting procedure, refer to the SETTING-UP MANUAL, Section 2.8, "Setting the Master Control Parameters of the Payload, Center of Gravity, and Control Set of Motion Optimization."

Chapter 3
Maintenance and Inspection

3.1 Maintenance & Inspection Intervals and Purposes

The table below lists the intervals and purposes of maintenance & inspection required for your robot.

> ⚠**Caution: Maintenance and inspection must be carried out by a trained worker who possesses the ability to perform these tasks safely. Before performing maintenance and inspection jobs, read the SAFETY PRECAUTIONS, "4 Precautions while robot is running" and "5 Daily and periodical inspections."**

Maintenance & Inspection Intervals and Purposes

No.	Intervals		Purposes
1	Daily	Perform inspection jobs specified in Section 3.2 every day before starting operations.	To use your robot safely.
2	Quarterly	Perform inspection jobs specified in Section 3.3 every three months.	- To prevent the controller from failure due to heat. (Inspection of filters) - To check the rotary sections and slideways of the robot and its controller for wear, preventing seizure, breakage, and other serious failures that could result from wear. (Lubrication)
3	Biennial	Replace backup batteries as specified in Section 3.4 every two years.	To retain the robot-specific data (programs, parameters, etc.) stored in the internal memory of the robot controller and the position data stored in the electronic absolute encoder built in the robot unit.

3.2 Daily Inspections

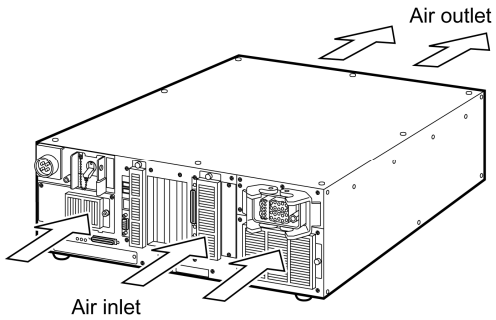
3.2.1 Check Items

Before starting operations, check the items listed below every day.

Daily Inspections Table

No.	Check:	Controller Power	How to check:	Criterion	What to do: (Note 1)
1	Connectors (CN1 to CN10 on the robot controller) and their mating parts	OFF	Visually	No looseness, disengagement or dirt.	Engage the parts properly and clean them.
2	Cables (connected to CN1 to CN10 on the robot controller) and robot's external cables	OFF	Visually	Free of damage or gouges.	Repair or replace.
3	LCD on the teach pendant	ON	Visually	Properly displayed	Repair or replace.
4	Pilot lamps on the robot controller	ON	Visually	Should light.	Repair or replace.
5	Cooling fan in the robot controller	ON	Visually **(Note 2)**	Should work properly.	Repair or replace.
6	Emergency stop button on the mini-pendant, or teach pendant	ON	Press the emergency stop button.	The robot should come to an emergency stop.	Repair or replace.
7	Safety door	ON	Operate the safety door switch and open the switch-wiring door.	The robot should come to an emergency stop.	Inspect and repair.

(Note 1) Some repair and replacement operations, shown in "What to do:" column, may involve special work. Contact the DENSO Robot Service Section.
(Note 2) The normal air flow of the cooling fan is as shown below.



Normal Air Flow of Cooling Fan

3.3 Quarterly Inspections

3.3.1 Check Items and Lubrication

Check the items and lubricate your robot as listed below every three months.

Quarterly Inspections Table

No.	Check:	Controller power	How to check:	Criterion	What to do:
1	Robot base mounting bolts	OFF	Measure the tightening torque with a torque wrench.	No looseness. Specified torque: 14.7 ±2 N•m	Tighten the bolts to the specified torque.
2	Rotary sections and slideways of the robot	OFF	Apply the specified lubricants to the specified points. (Refer to Section 3.3.3.)		
3	Cooling fan filters in the robot controller	OFF	Visually	No dust or dirt.	Clean the cooling fan filters. (Refer to Section 3.3.2.)

3.3.2 Cleaning the Cooling Fan Filters in the Robot Controller

For the cleaning procedures of the air intake filters, refer to the RC7M CONTROLLER MANUAL, Section 6.4 "Cleaning the Air Intake Filter."

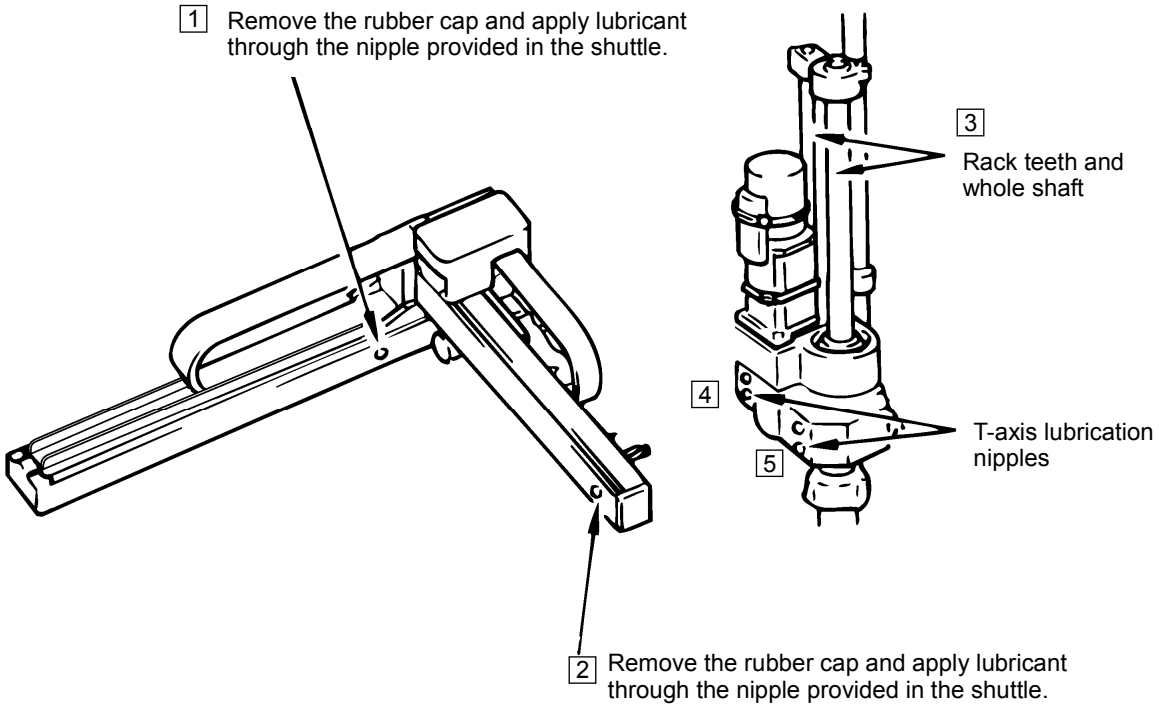
3.3.3 Lubrication Jobs

Apply the specified lubricants to the rotary sections and slideways of the robot unit as listed below every three months.

> **NOTE:** Use a recommended grease gun listed in Section 3.5. One push of the grease gun will discharge 1.4 cc of grease.

Lubrication Points and Lubricants

No.	Lubrication points	Lubricant type	Lubricant amount
1	Y-axis lubrication nipple	Epinoc AP1	2 to 3 cc
2	X-axis lubrication nipple	↑	2 to 3 cc
3	Z-axis rack teeth and whole shaft	↑	2 to 3 cc
4	T-axis lubrication nipple	↑	1.5 cc
5	T-axis lubrication nipple	↑	3 cc



NOTE: Move the X-axis and Y-axis and check to see nipples through holes, then apply lubricant through those nipples.

3.4 Biennial Inspections

3.4.1 Battery Replacement

Replace the two types of backup batteries listed below during biennial inspections.

> **⚠Caution (1) The battery used in this device may present a risk of fire or chemical burn if mistreated. Do not recharge, disassemble, heat above 100°C (212°F), or incinerate.**
> **(2) Dispose of used battery promptly. Keep away from children. Do not disassemble and do not dispose of in fire.**

Backup Battery Type

	Battery type	Used to:	Located:	Refer to:
1	Encoder backup battery	Back up the position data of the servomotor encoder.	In the robot unit	Section 3.4.2
2	Memory backup battery	Back up programs, parameters, and CAL data.	In the robot controller	Section 3.4.3

The position data of the encoder built in the servomotor is stored in the internal memory of the encoder.

Programs, parameters, CAL data, etc. are stored in the internal memory of the robot controller.

The backup battery for each memory retains the above data, while the power to the robot controller is turned OFF. However, these batteries have a limited lifetime and must, therefore, be replaced regularly.

NOTE: If two years elapse from replacement of either backup battery, the "Time to change controller backup battery" message will appear on the teach pendant.

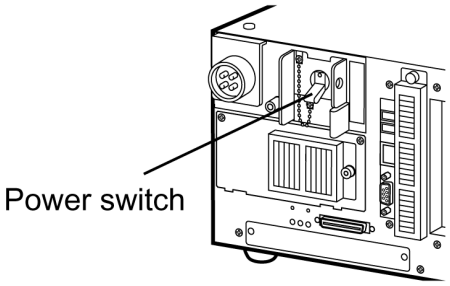
> **⚠Caution: Without replacing the backup batteries, important robot-specific data stored in each memory will be lost.**

3.4.2 Replacing the Encoder Backup Battery

Replace the encoder backup battery according to the procedure given below.

Step 1 Turn the controller power ON.

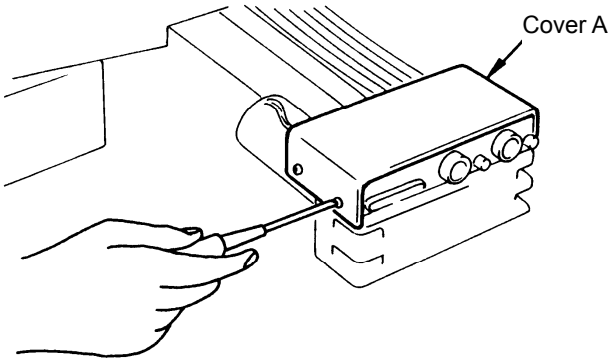
> ⚠**Caution: NEVER turn the motor power ON.**



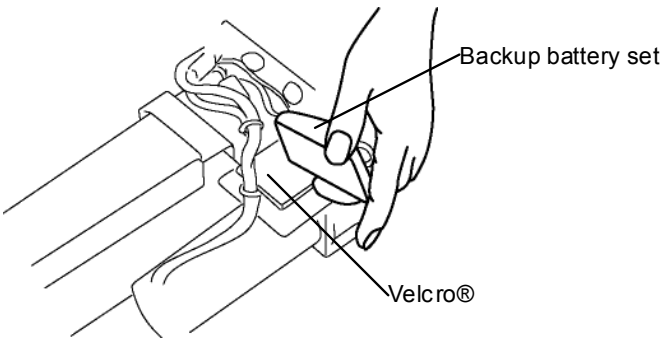
Step 2 Press the emergency stop button to lock the teach pendant or mini-pendant to prevent the motor power from getting turned on accidentally.

Note: To unlock the emergency stop button, slightly turn it clockwise.

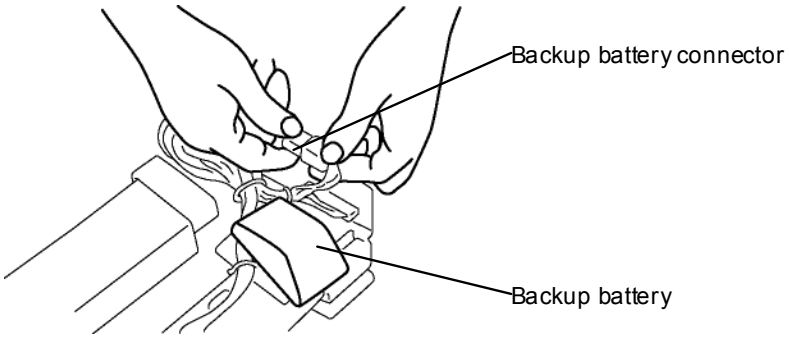
Step 3 Remove four screws from cover A and take it off from the robot unit.



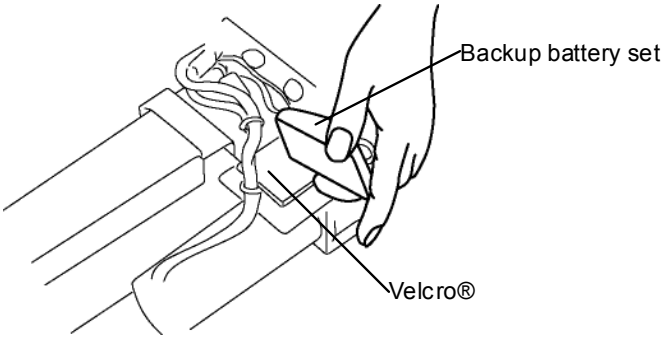
Step 4 Cut off cable ties (INSULOK) that secure the backup battery wires, and then remove the backup battery set that is secured with Velcro®.



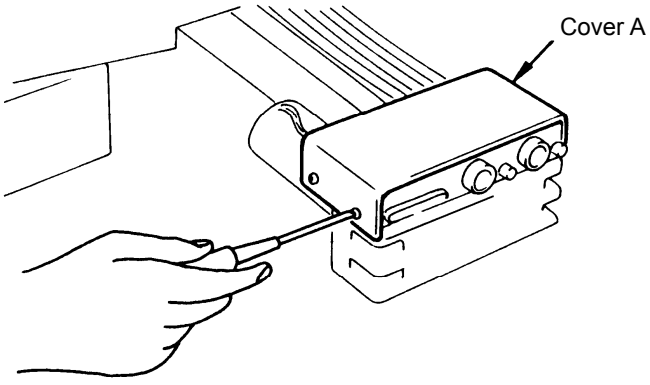
Step 5 Disconnect the backup battery connector and connect a new one.



Step 6 Set the new backup battery with Velcro®.
Secure the backup battery wires with cable ties (INSULOK).



Step 7 Fit cover A to the robot unit.
Tightening torque: 0.8 ±0.2 N•m



3.4.3 Replacing the Memory Backup Battery

Refer to the RC7M CONTROLLER MANUAL, Section 6.5 "Replacing the Memory Backup Battery."

3.4.4 Setting the Next Battery Replacement Date

After replacing the memory backup battery, set the next battery replacement date from the teach pendant, according to the following procedure.

NOTE: Check that the system clock of the robot controller shows the correct date beforehand. If it is incorrect, the next replacement date will also become incorrect.

Step 1

On the top screen of the teach pendant, press [F6 Set].

The Settings (Main) window appears.

Step 2

Press [F6 Maint.] in the Settings (Main) window.

The Maintenance menu appears.

Step 3

Press [F4 Battery] in the Maintenance menu.

The Next Battery Replacement Date window appears.

In the top of the window, the current setting is displayed.

TIP: The date entry areas show the default replacement date that is two years later the current data at which you open this window, assuming that the battery service life is two years.

Step 4

Press OK.

If you do not want to change the replacement date, press Cancel.
The message "Are you sure you want to set the next battery replacement date?" appears.

Step 5

Press OK.

The screen returns to the Settings (Main) window.

3.5 Supplies and Tools for Maintenance

The tables below list the supplies and robot components to be replaced regularly, and the recommended tools necessary for maintenance and inspection.

3.5.1 Supplies and Components Required

List of Supplies and Components

No	Name	Part No.	Remarks	
1	Grease	410971-0040	2.5 kg can	Epinoc AP-1
2	Grease	410971-0050	16 kg can	
3	Encoder backup battery	410076-0300	ER17/50B T-3 WK23 SC	
4	Air filter set	410053-0100	For standard type of controllers (FS-1705W)	
		410053-0110	For global type of controllers (FS-1705)	
5	Memory backup battery	410076-0261	Memory backup battery for RC7M controller	
6	Fuse (1.3A)	410054-0230	Fuse LM13 for controller I/O	
7	Fuse (3.2A)	410054-0270	Fuse LM32 for controller I/O	
8	IC for output (NPN)	410077-0010	IC (M54522P) for controller output	

3.5.2 Recommended Tools

List of Recommended Tools

No	Tool name	Recommended tool (manufacturer)	Application
1	Grease gun	(Yamada Corporation) ·Body: KH-32 ·Flexible attachment: SPK-3C	Force grease into nipple

3.6 Replacing Fuses and Output ICs

Refer to the RC7M CONTROLLER MANUAL, Section 6.6 "Replacing Fuses and Output ICs."

3.7 Resetting Encoders

In any of the following cases, you need to reset encoders and perform CALSET.

- Error 641* occurs due to the expired service life of backup batteries or
- Error 677* occurs due to an excessive impact applied to the robot when the controller power is off.

(* is any of 1 to 4 denoting the object axis.)

For the encoder resetting procedure, refer to the SETTING-UP MANUAL, Section 5.3 "[F2 Arm]—[F12 Maint.]—[M11 ENC rst]."

3.8 Checking the Odometer and Trip Meter

You may check the odometer and trip meter which count traversed distance of each axis in the Odometer window of the teach pendant.

The access to the Odometer window is [F6 Set]—[F6 Maint.]—[F5 Odometer].

The Odometer window shows the following items:

[Odometer]	Shows the total distance of each axis traversed after the robot leaves the factory. You cannot reset the odometer.
[Trip meter]	Shows the distance of each axis traversed after you reset the trip meter to zero. You can reset the trip meter by pressing [F5 Reset] in the Odometer window and following the guidance shown on the screen.

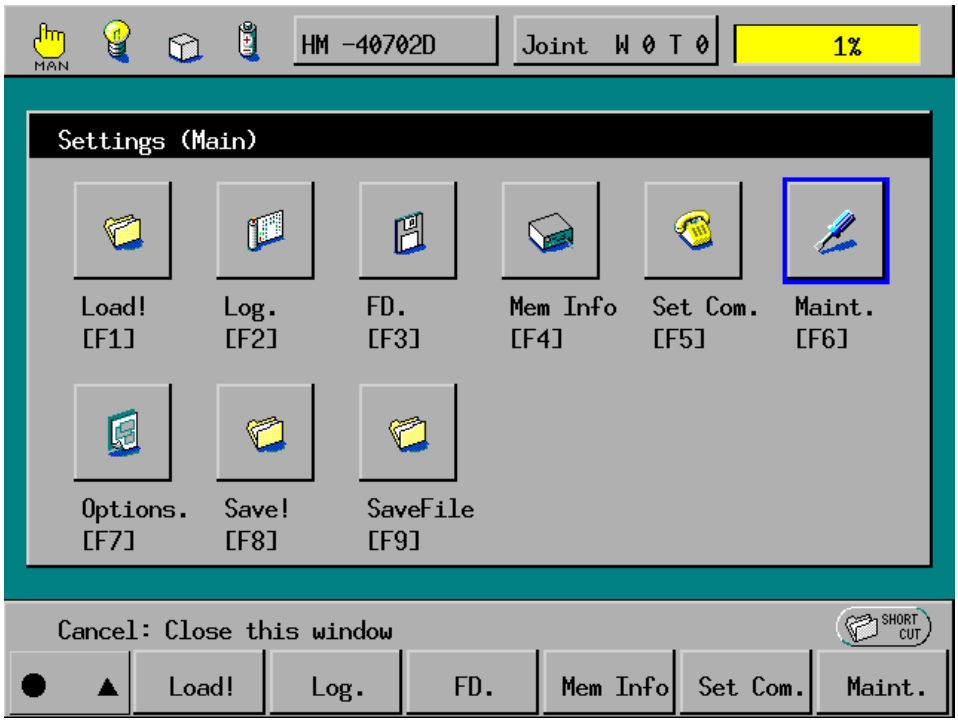
3.8.1 Displaying the Odometer and Trip Meter

Step 1 Turn the robot controller ON.

Step 2 On the teach pendant, set the mode switch to the MANUAL position.

Step 3 On the top screen, press [F6 Set].

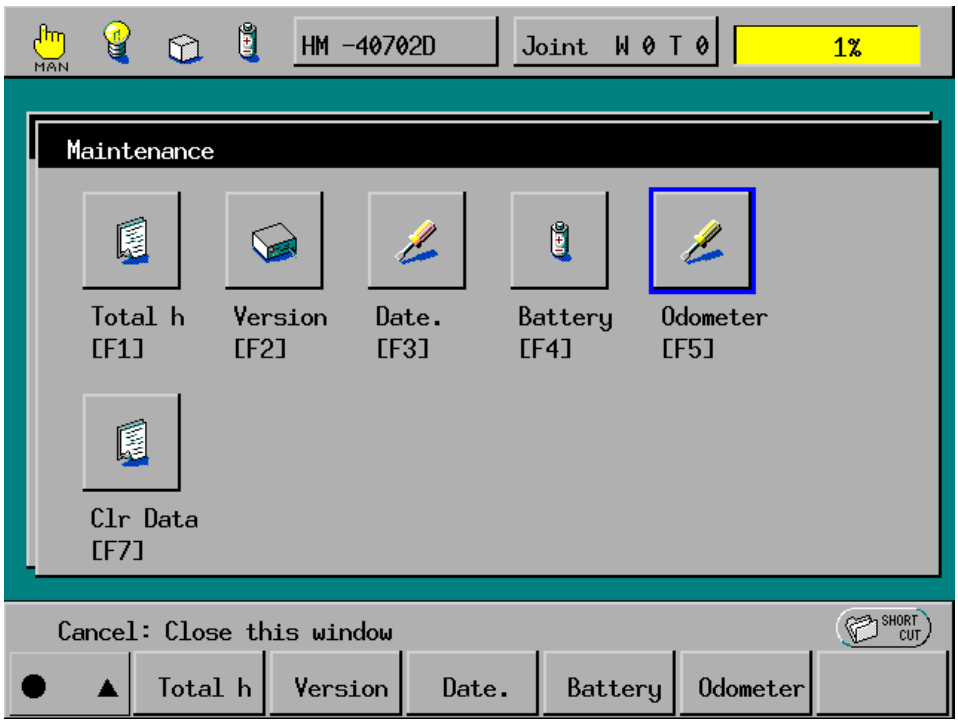
The Settings (Main) window appears as shown below.



F6

Press [F6 Maint.].

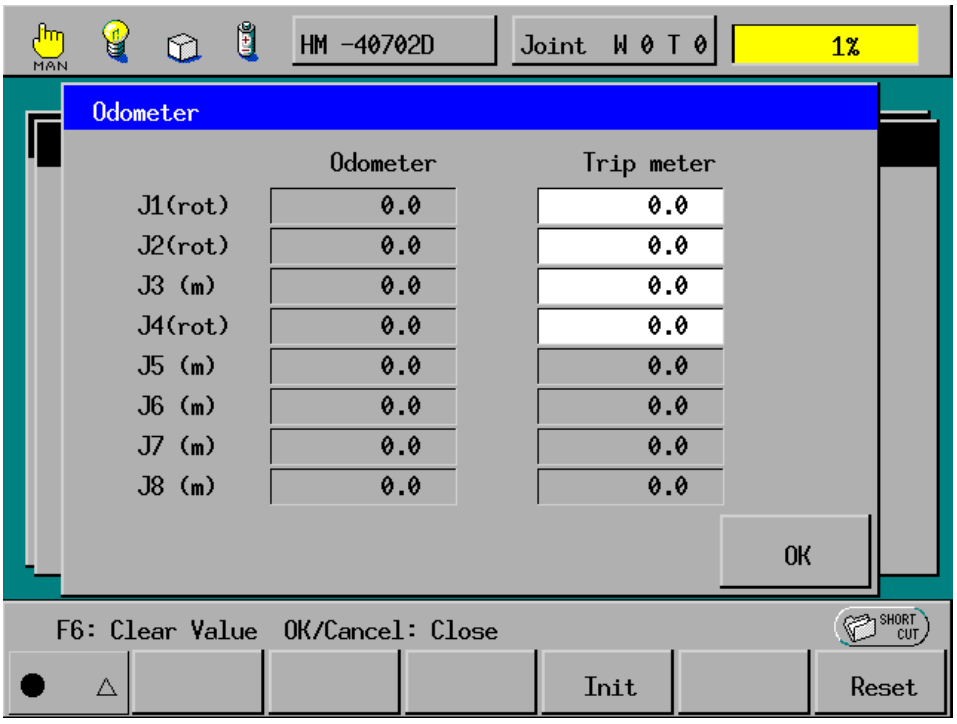
Step 4 The Maintenance menu appears as shown below.



F5

Press [F5 Odometer].

Step 5 The Odometer window appears as shown below.



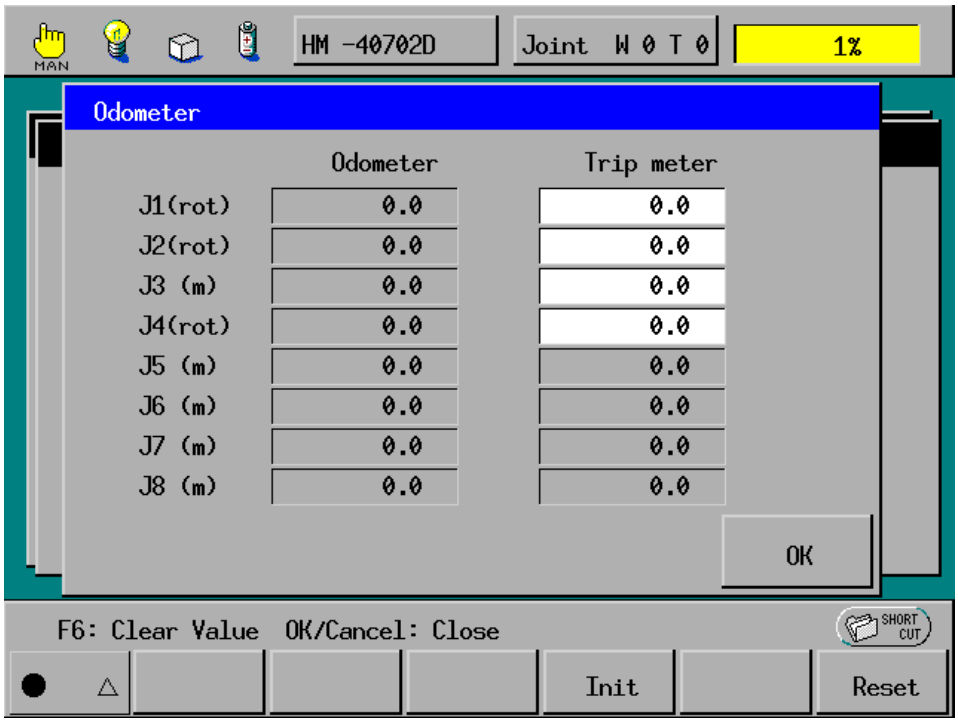
F6

3.8.2 Resetting the Trip Meter to Zero

Step 1

Display the Odometer window as shown below.

Access: [F6 Set]—[F6 Maint.]—[F5 Odometer] from the top screen.

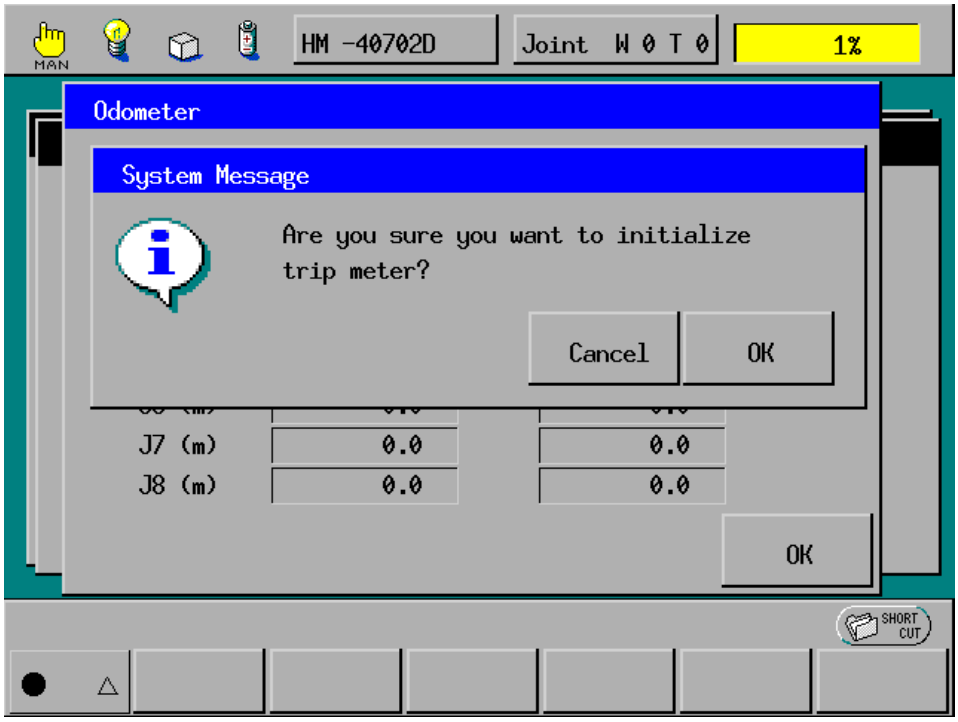


F6

Press [F6 Reset].

Step 2

The following system message appears.



Press the OK button.

The trip meter has been reset to zero.

3.9 Checking the Controller ON-Time and the Robot Running Time and Resetting Their User Counters

You may check the robot controller ON-time and the robot running time in the Total hours window of the teach pendant.

The Total hours window shows the following items:

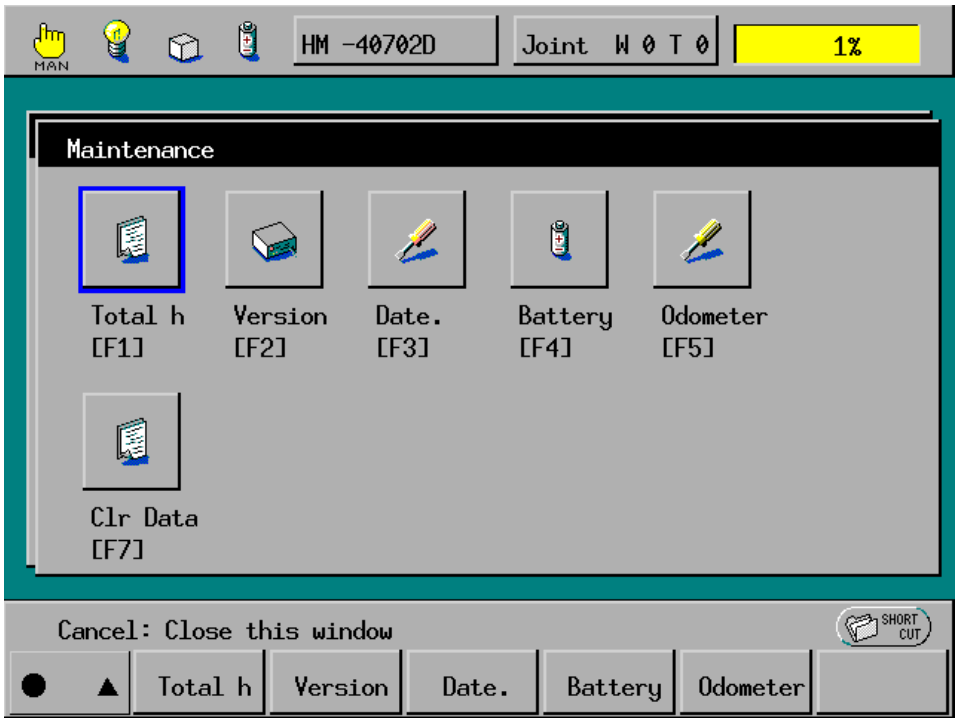
[Total operation]	Shows the grand total of the robot controller ON-time counted after the controller leaves the factory.
[Total running]	Shows the grand total of the robot running time counted after the robot leaves the factory.
[Cumu. operation]	Shows the total of the robot controller ON-time counted after you reset the user counter to zero.
[Cumu. running]	Shows the total of the robot running time counted after you reset the user counter to zero.
[Operation]	Shows the ON-time of the robot controller counted after it is turned ON this time.
[Running]	Shows the running time of the robot counted after the robot controller is turned ON this time.

3.9.1 Displaying the Controller ON-time and the Robot Running Time

Step 1

Display the Maintenance window as shown below.

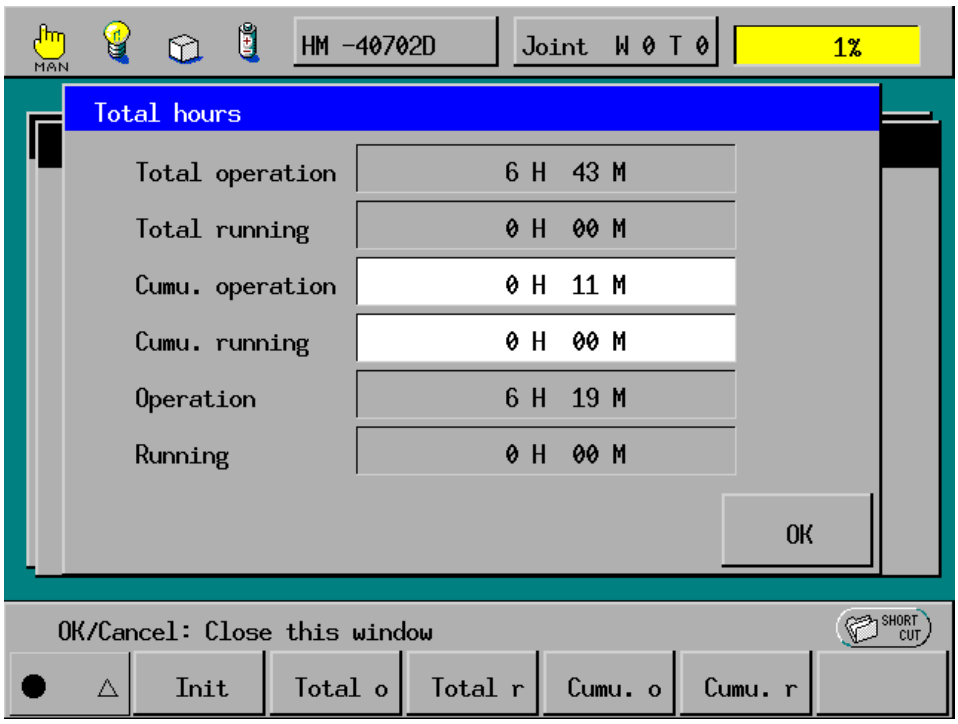
Access: [F6 Set]—[F6 Maint.] from the top screen



F1

Press [F1 Total h].

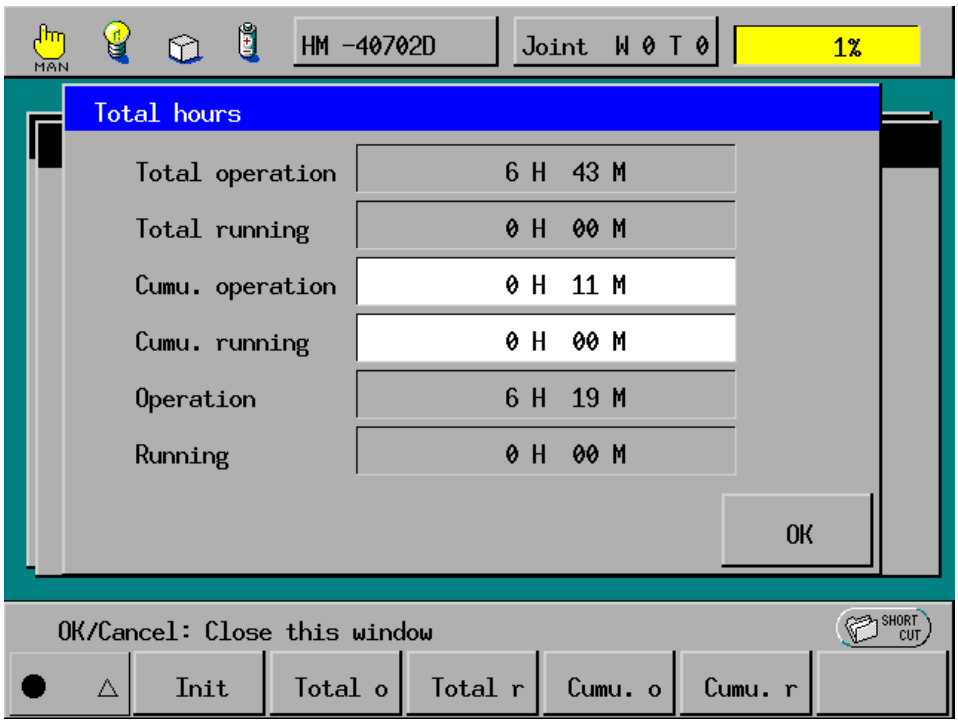
Step 2 The Total hours window appears as shown below.



3.9.2 Resetting the User Counters of the Controller ON-Time and the Robot Running Time

Step 1 Display the Total hours window as shown below.

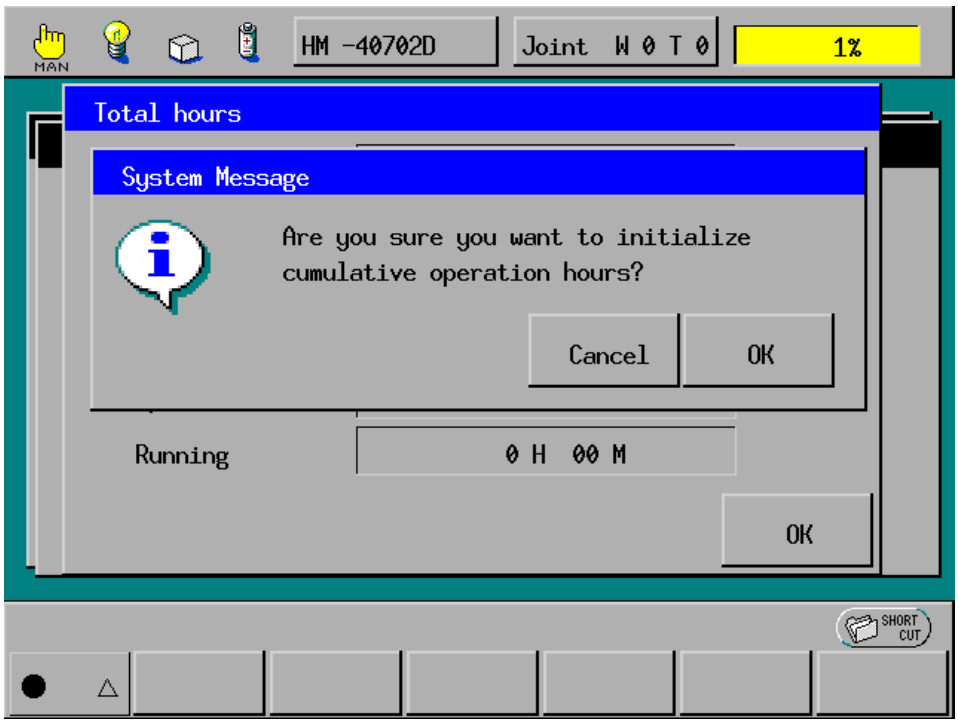
Access: [F6 Set]—[F6 Maint.]— [F1 Total h] from the top screen



F4

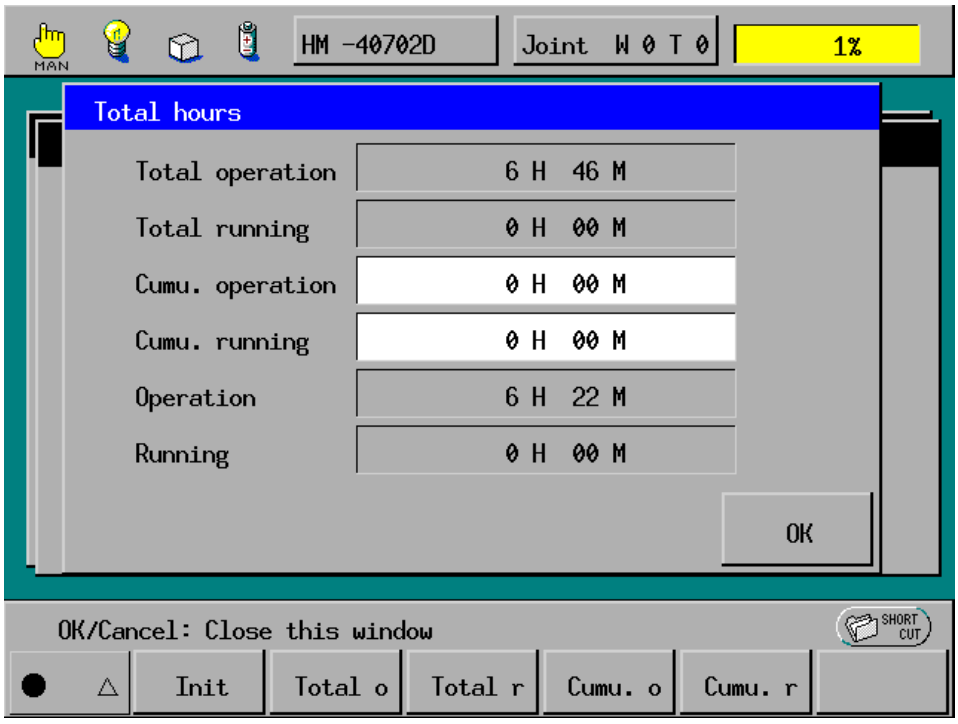
To reset the user counter of the controller ON-time to zero, press [F4 Cumu. o].

Step 2 The following system message appears.



Press the OK button.

Step 3 The user counter of the controller ON-time has been reset to zero.



3.10 Backing up Projects

You should back up project data periodically in WINCAPSIII in order to recover the robot controller smoothly after loss of project data due to unexpected accidents such as expired service life of memory backup batteries.

Be sure to back up project data and preserve it, in particular:

- at the time of purchase
- after performing CALSET
- after changing RANG values
- after replacement of a motor

DENSO preserves arm data configured at the time of shipment for 10 years. If your arm data is lost, contact your DENSO representative.

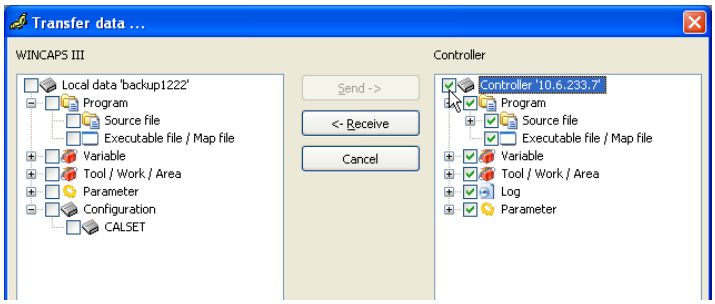
> **Note**: Arm data refers to CALSET and RANG values in project data, which is unique to individual robots and determines the position of each joint.

3.10.1 Back up project data

Use WINCAPSIII to back up project data.

When a project has been created in WINCAPSIII

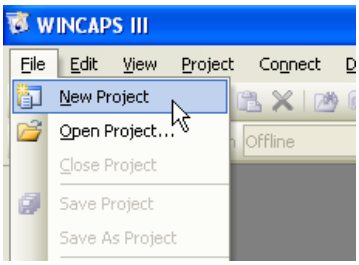
Receive all data from the controller and preserve it.



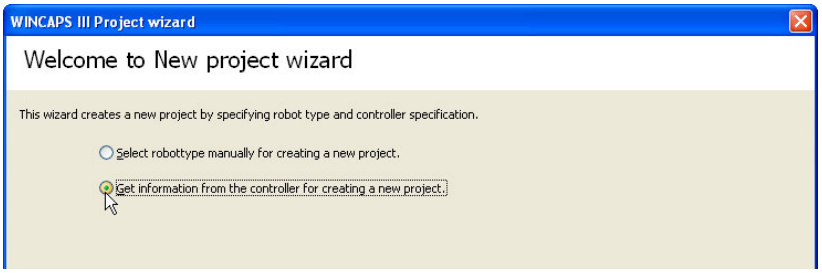
When creating a new project to preserve backup data

Follow the procedure given below.

Step 1 Create a new project in WINCAPSIII.

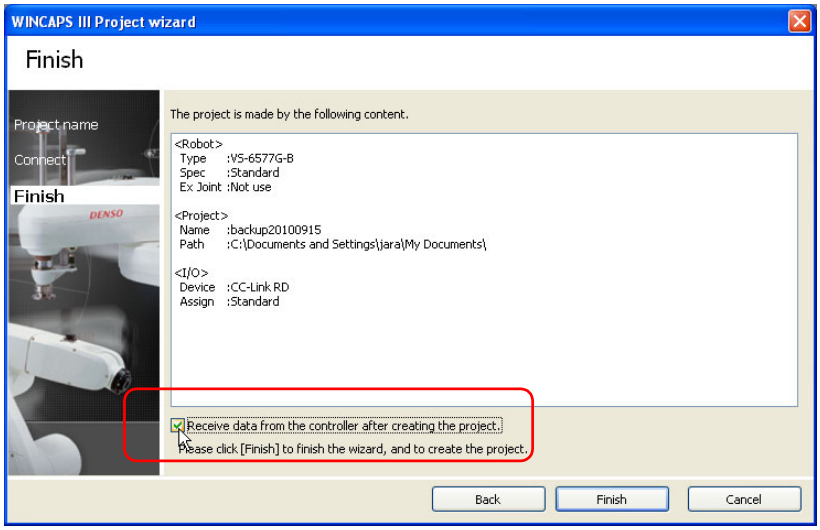


Step 2 Choose "Get information from the controller for creating a new project."



Step 3 Following the project wizard, enter the IP address and the desired backup file name.

Step 4 Select "Receive data from the controller after creating the project."



Step 5 Close the project.

3.10.2 Transfer arm data

When WINCAPSIII exchanges project data with the robot controller, arm data unique to individual robots can be transferred only from the robot controller to WINCAPSIII, but it cannot from WINCAPSIII to the robot controller. This is to protect arm data in the robot controller from being overwritten accidentally.

To transfer arm data from WINCAPSIII to the robot controller, use the following procedure.

Step 1

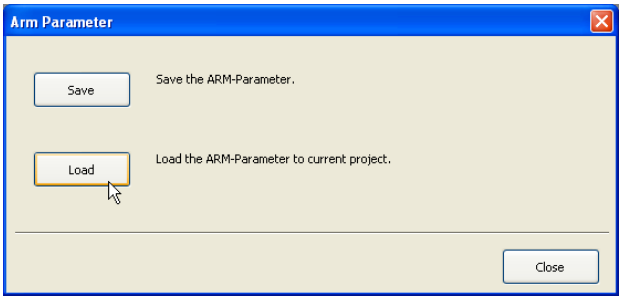
Loading the arm data (***.wam) into the WINCAPSIII project

This step is necessary when only arm data is supplied by DENSO. When project data has been backed up, open the project data in WINCAPSIII and proceed to STEP 2.

Start WINCAPSIII, log on as a Programmer, and create a project suitable for your robot model.

Choose Tool | Arm parameters to display the Arm Parameter window.

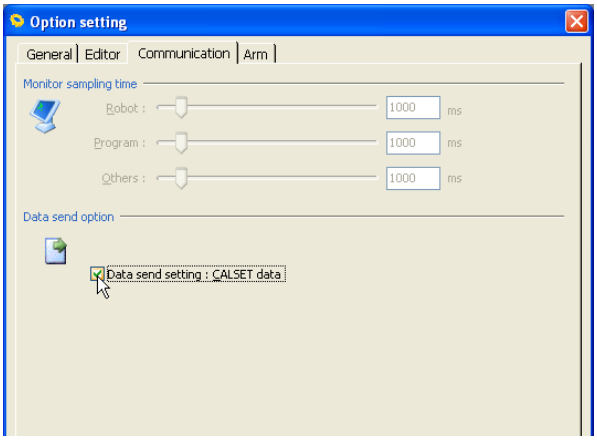
Press Load and select the arm data (***.wam) to load.



Step 2

Configuring communication options for transfer of arm data from WINCAPSIII to the robot controller

Choose Tool | Option | Communication tab. Select "Data send setting: CALSET data" and press OK.



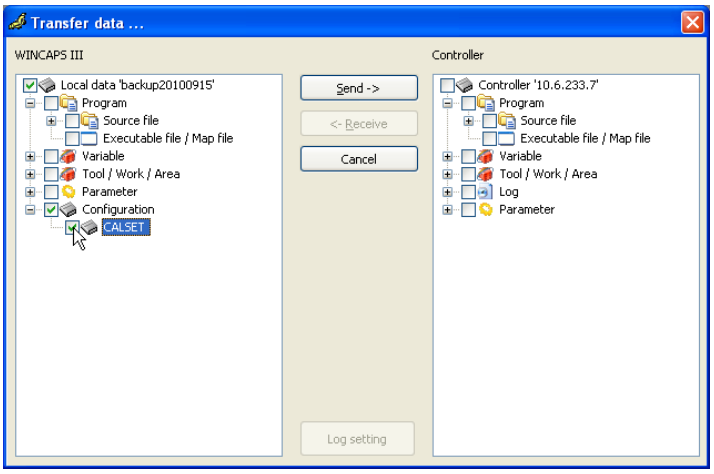
ATTENTION: During ordinary operations, the "Data send setting: CALSET data" should be deselected. If it is selected, creating a new project and transferring arm parameters overwrites the CALSET-related data in the robot controller with the transferred data, causing errors in teaching positions.

Step 3

Transferring arm data to the robot controller

Choose Connect | Transfer data to display the Transfer data window.

Select Parameters | Arm parameters and Configuration | CALSET, then press Send.



Upon completion of transfer of the CALSET-related arm data, restart the robot controller.

Cartesian coordinate
XYC-4G SERIES

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The purpose of this manual is to provide accurate information in the handling and operating of the robot. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.