DENSO *ROBOT*

Cartesian coordinate
XYC-4G SERIES
GENERAL INFORMATION ABOUT ROBOT

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 five.

Chapter 1 Packing List of the Robot

Lists the standard components contained in the product package and optional components.

Chapter 2 Configuration of the Robot System

Illustrates the configuration of the robot system and describes the component names of the robot unit and controller.

Chapter 3 Specifications of the Robot Unit

Describes the specifications, motion space, robot positioning time, air piping and signal wiring, and engineering-design notes for robot hands.

Chapter 4 Specifications of the Robot Controller

Lists the specifications of the robot controller and controller setting table (SETPRM LIST).

Chapter 5 Warranty

Describes the warranty period and coverage.

Contents

Chapter 1 Packing List of the Robot

1.1   Standard Components

The components listed below are contained in the product package.

Standard Components

No.	Item	Qty.
(1)	Robot unit	1
(2)	Robot controller	1
(3)	Power cable (5 m)	1
(4)	Motor & encoder cable set **(Note 1)** (Option)	1 set
(5)	Manuals ("Manual Pack CD" and "Safety Precautions")	1 set
(6)	WINCAPSIII Install CD (Trial version)	1
(7)	Spare fuses for robot controller	3
(8)	Pendantless connector (Dummy connector)	1
(9)	Connector set for hand control signals (for CN20 and CN21)	1 set
(10)	Direction indicator label **(Note 2)**	1
(11)	Warning label **(Note 3)**	1
(12)	Spare output IC for robot controller	1
(13)	Air regulator	1
(14)	Short sockets for robot controller	2

Note 1: Choose and order a motor & encoder cable set from the table below. The internal cable bending radius shall at least be 200 mm. Excessively bending will result in broken lead wires.

Item		Part No.
Standard cable set	4 m	410149-0960
Standard cable set	6 m	410149-0970

Note 2: After installation, attach the direction indicator label in a position on the robot unit that can be easily seen.

Note 3: Attach the warning label on the robot safety fence or other location where workers will easily notice it. If necessary, prepare a plate for attaching the seal.

1.1.1 Optional Components

The table below lists the optional components.

Optional Components (1)

Classification	No.	Item		Remarks		Part No.
I/O cables	1	Standard I/O cable set		(8 m) Incl. Nos. 1-1 and 1-2.		410149-0940
				(15 m) Incl. Nos. 1-1 and 1-2.		410149-0950
	1-1	I/O cable for "Mini I/O" (68 pins)		(8 m)		410141-2700
				(15 m)		410141-2710
	1-2	I/O cable for "HAND I/O" (20 pins)		(8 m)		410141-1740
				(15 m)		410141-1750
	2	I/O cable for "Parallel I/O board" (96 pins)		(8 m)		410141-3050
				(15 m)		410141-3060
	3	I/O cable for "SAFETY I/O" (36 pins) (Only for global type)		(8 m)		410141-3580
				(15 m)		410141-3590
Operation devices	4	Teach pendant		(4 m) With cable		410100-1572
				(8 m) With cable		410100-1582
				(12 m) With cable		410100-1592
	5	Mini-pendant kit (Incl. cable and WINCAPSIII Light)		(4 m)	Japanese indication	410109-0392
					English indication	410109-0402
				(8 m)	Japanese indication	410109-0412
					English indication	410109-0422
				(12 m)	Japanese indication	410109-0432
					English indication	410109-0442
	6	Pendant extension cable		(4 m)	For TP, MP	410141-3711
				(8 m)	For TP, MP	410141-3721
Programming support tool	7	WINCAPSIII		CD-ROM (common to the languages--Japanese, English, German, Korean, and Chinese)		410090-0980
Optional boards for the robot controller	8	Parallel I/O board	Shipped as installed on the controller	NPN		410010-3320
			Shipped as individual boards (supply part)	NPN		410010-3340
	9	DeviceNet board	Shipped as installed on the controller	For Slave station		410010-3370
				For Master station		410010-3380
				For Master & slave station		410010-3390
			Shipped as individual boards (supply part)	For Slave station		410010-3400
				For Master station		410010-3410
				For Master & slave station		410010-3480
	10	CC-Link board		Shipped as installed on the controller		410010-3430
				Shipped as individual boards (supply part)		410010-3440
	11	Conveyor tracking board		Shipped as installed on the controller		410010-3460
				Shipped as individual boards (supply part)		410010-3470

Optional Components (2)

Classification	No.	Item	Remarks	Part No.
Optional functions (For own optional board etc.)	12	Optional function for RS232C board Board manufacturer: CONTEC CO., LTD. Model: COM-2P(PCI)H	Shipped after integrated in the controller	410006-0260
			Added when the board is purchased as a spare part	410006-0270
	13	Optional function for S-LINK V board Board manufacturer: SUNX CO., LTD Model: SL-VPCI	Shipped after integrated in the controller	410006-0280
			Added when the board is purchased as a spare part	410006-0290
	14	Optional function for PROFIBUS-DP slave board Board manufacturer: Hilscher GmbH Model: CIF50-DPS\DENSO	Shipped after integrated in the controller	410006-0300
			Added when the board is purchased as a spare part	410006-0310
	15	EtherNet/IP function Board manufacturer: Hilscher GmbH Model: CIFX 50-RE\DENSO	Shipped after integrated in the controller	410006-0800
			Added when the board is purchased as a spare part	410006-0810
	16	Optional function for memory extension	Extension only upon controller shipment (3.25 MB to 5.5 MB)	410006-0320
Optional box	17	Controller protection box		410181-0091
	18	I/O conversion box	For interchangeability with RC5 type controller	410181-0100
CD Manuals	19	Manual Pack CD	Contained in the robot package.	410002-2661
Optional manuals (Printed materials, English edition)	20	Instruction manual for XYC-4G, full set	Incl. Nos. C and D.	410009-0430
	C	Instruction manual for XYC-4G, basic set	Incl. Nos. C-1 to C-3.	410009-0410
	C-1	GENERAL INFORMATION ABOUT ROBOT	For XYC-4G	410002-2770
	C-2	RC7M CONTROLLER MANUAL	For RC7M controller	410002-2430
	C-3	ERROR CODE TABLES		410002-3370
	D	Instruction manual for XYC-4G, extension set	Incl. Nos. D-1 to D-7.	410009-0390
	D-1	INSTALLATION & MAINTENANCE GUIDE	For XYC-4G	410002-2790
	D-2	STARTUP HANDBOOK		410002-2750
	D-3	SETTING-UP MANUAL		410002-3310
	D-4	PROGRAMMER'S MANUAL (I)		410002-3330
	D-5	PROGRAMMER'S MANUAL (II)		410002-3350
	D-6	Panel Designer USER'S MANUAL		410002-6480
	D-7	OPTIONS MANUAL	For RC7M controller	410002-2650

Chapter 2 Configuration of the Robot System

2.1   Configurators

The figure below shows configurators of the typical robot system.
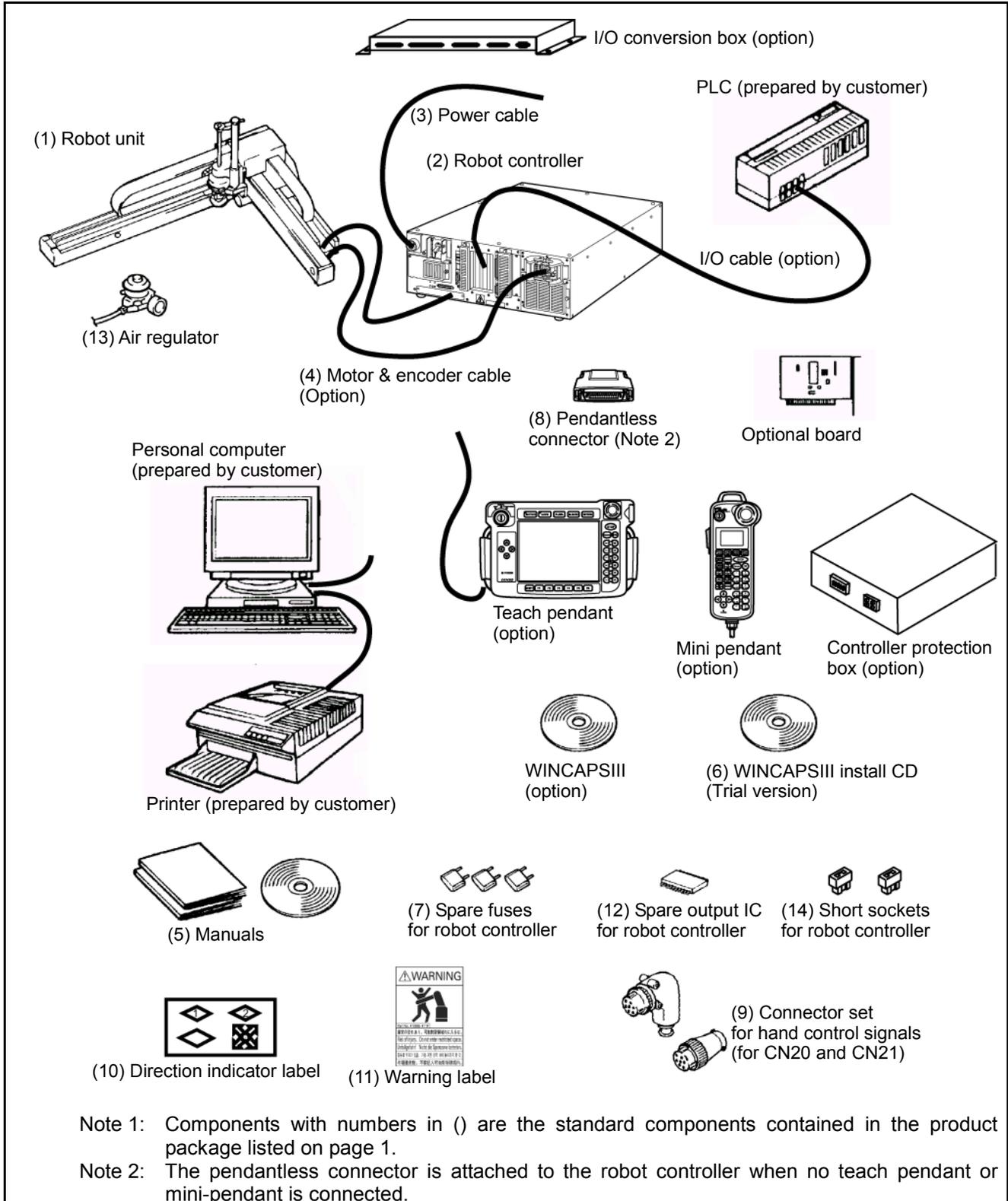
Configurators of the Robot System

Note 1:   Components with numbers in () are the standard components contained in the product package listed on page 1.

Note 2:   The pendantless connector is attached to the robot controller when no teach pendant or mini-pendant is connected.
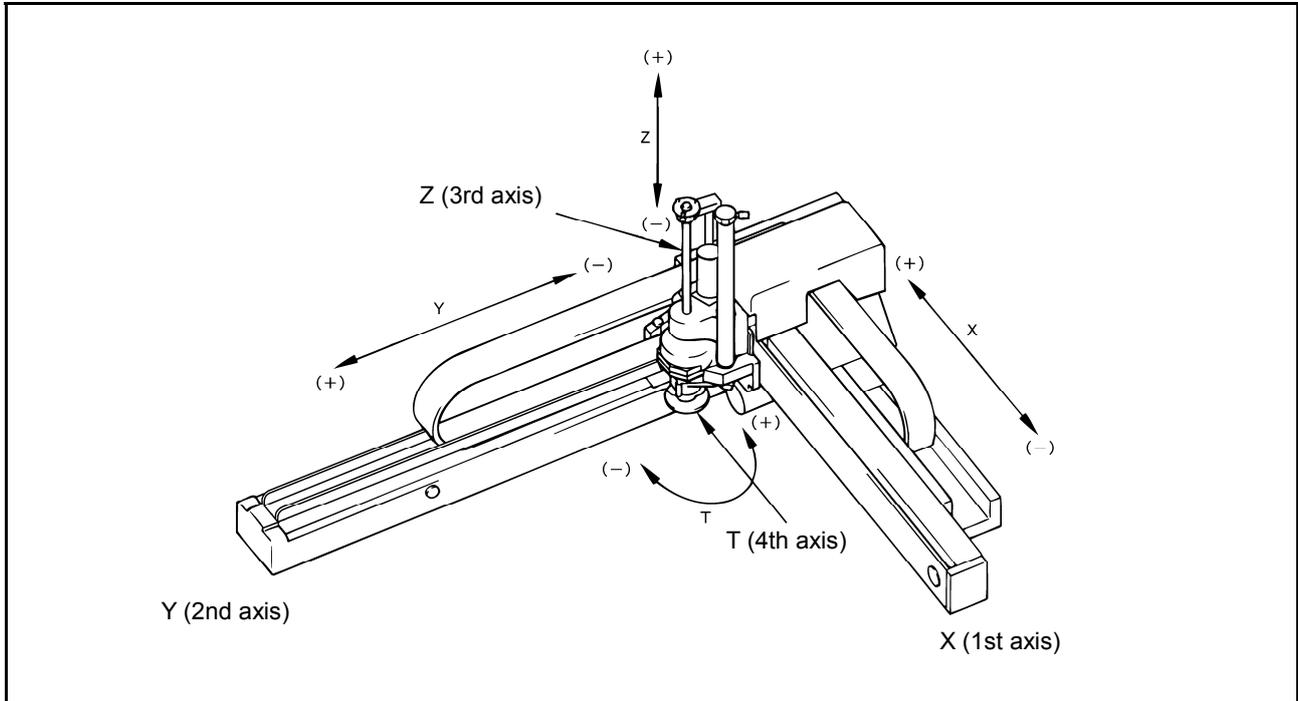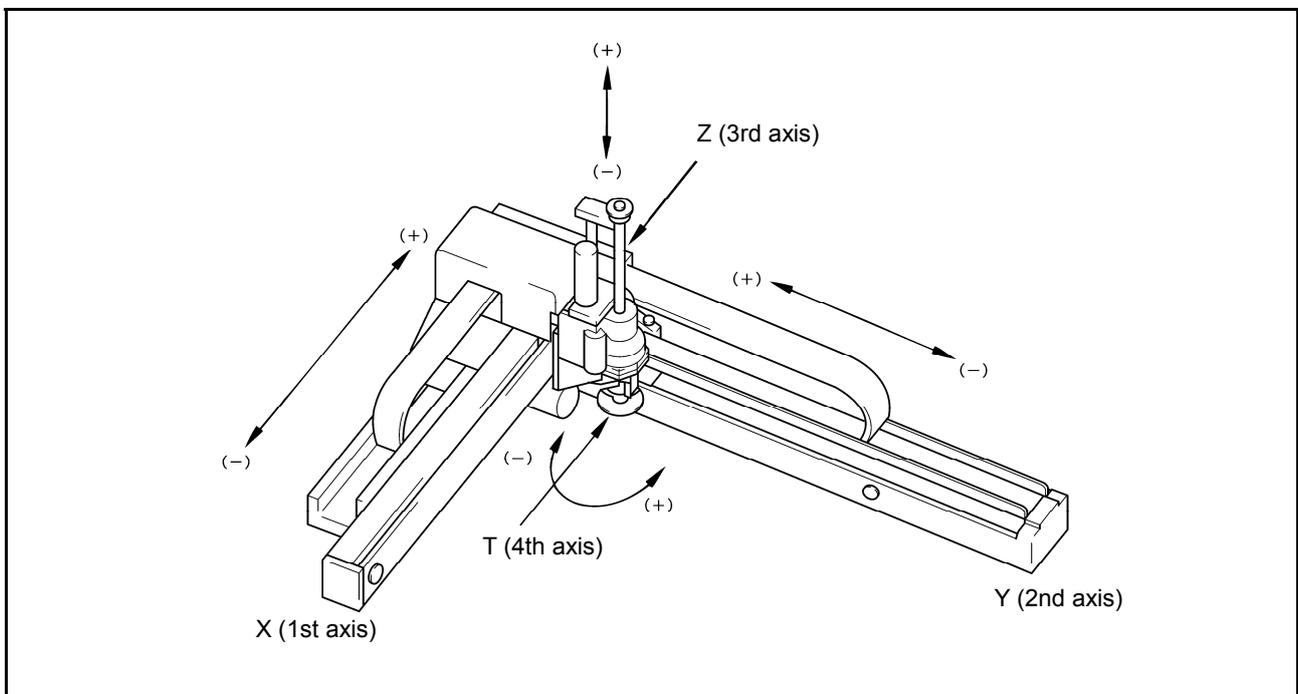
2.2 Names of Robot Unit Components and Motion Direction

2.2.1 Robot Unit Components and Motion Direction

The figure below shows the names of the components of the robot unit and the motion direction of each axis.

**Robot Unit Components and Motion Direction (XYC-4∗∗∗G-L)**

Robot Unit Components and Motion Direction (XYC-4∗∗∗G-R)
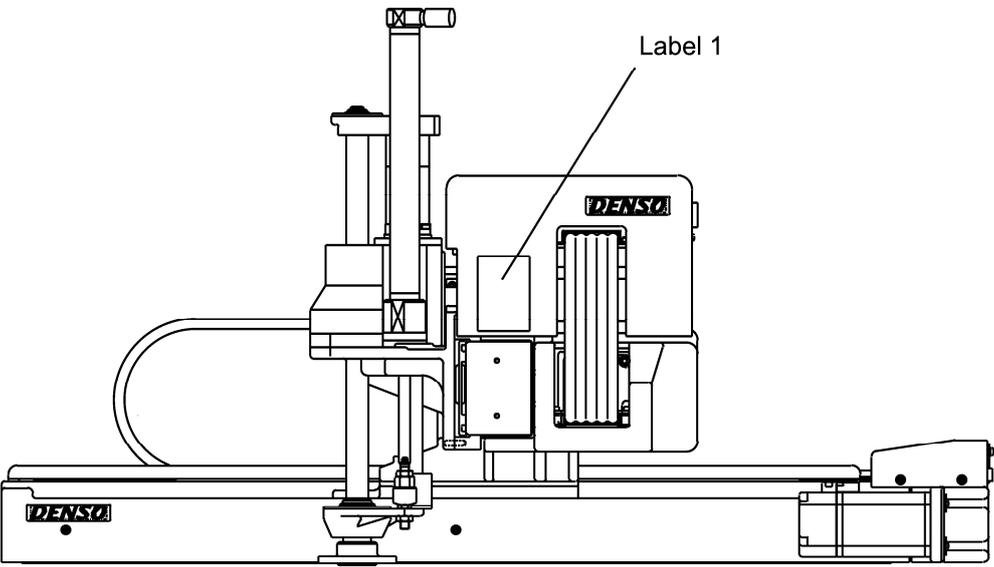
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2.2.2　Name Plate

The name plate is affixed in the base part, which includes serial number of the robot, robot model, and day of manufacturer, etc.
The serial number is the figure which identifies the robot of each customer and it is paired with the figure of the controller.
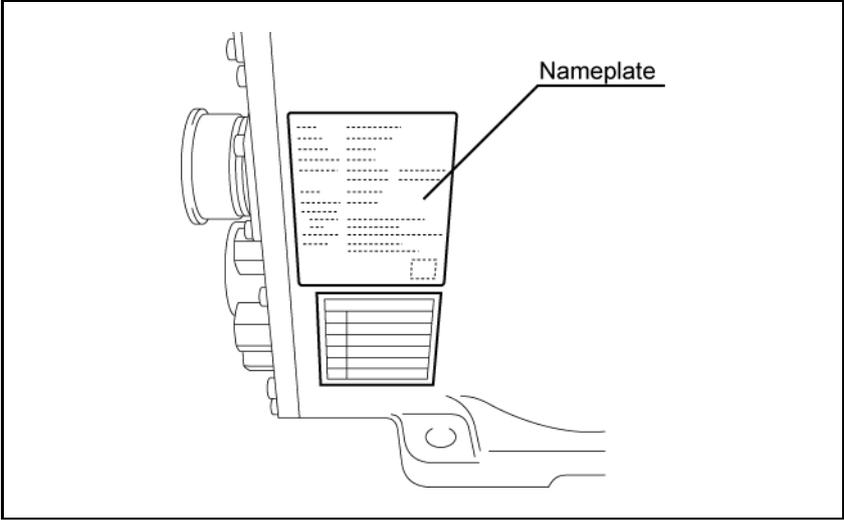
2.2.3   Warning and Caution Labels

The robot unit has warning and caution labels pasted as shown below. They alert the user to the dangers of the areas on which they are pasted. Be sure to observe the instructions printed on those labels.

Warning and Caution Labels on the Robot Unit

Location of labels

Label 1

Warning and caution labels on the robot unit	Additional description
Label 1 ⚠ WARNING Part No. 410985-411※ 衝突の恐れあり。可動制限領域内に入るな。 Risk of injury. Do not enter restricted space. Unfallgefahr! Nicht die Sperrzone betreten. 충돌의 우려가 있음. 가동 제한 영역 내에 들어가지 말 것. 有碰撞危险。不要进入可动限制领域内。	Contact with the robot unit which is in motion can cause serious injuries. Observe the following: (1) Never enter the robot's restricted space when the robot is in motion or the motor power is on. (2) When you need to enter the robot's restricted space for recovery from robot failures, be sure to cut the power to the robot motors by activating an emergency stop device or the like.

2.3 Names of the Robot Controller Components

The figure below shows the names of the robot controller components.

Note: For warning and caution labels pasted on the controller, refer to the RC7M CONTROLLER MANUAL.

SAFETY BOX
(Only for global type with safety box)

Rear panel (Air exhaust side)

Front panel

Air intake filters
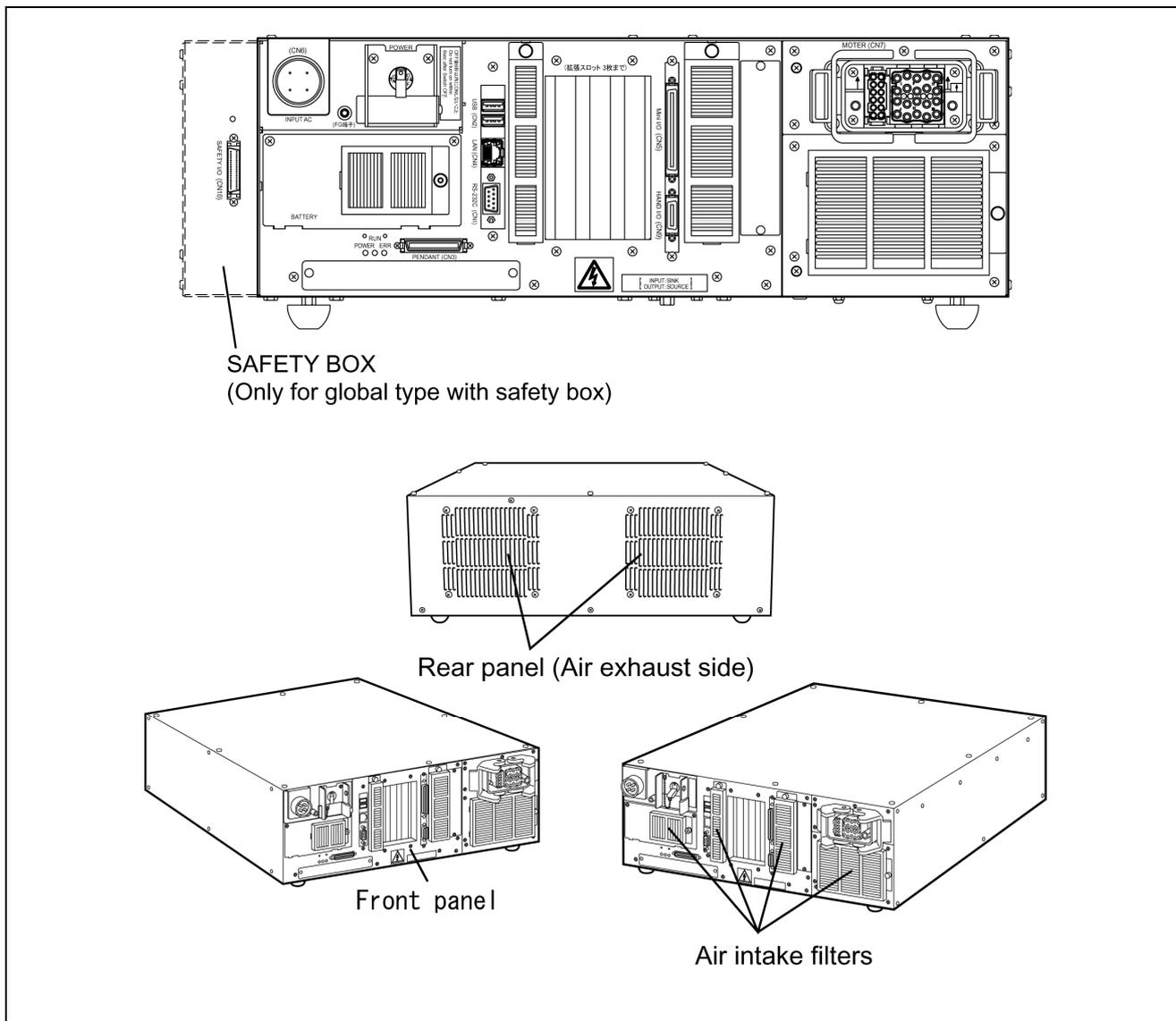
Connectors for the XYC-4G series (Encoders connected via bus)

Connector No.	Marking	Name
CN1	RS-232C	Serial interface connector
CN2	USB	USB connector (2 lines)
CN3	PENDANT	Teach pendant connector
CN4	LAN	Ethernet connector
CN5	Mini I/O	I/O connector
CN6	INPUT AC	Power supply connector
CN7	MOTOR	Motor connector
CN8	ENCODER	Encoder connector
CN9	HAND I/O	HAND I/O connector
CN10	SAFETY I/O	SAFETY I/O connector (Only for global type)

Chapter 3 Specifications of the Robot Unit

3.1   Robot Specifications

The table below lists the specifications of the XYC-4G series of robot units.

Robot Unit Specifications of the XYC-4G Series

Item		Specifications
Model name of robot system **(Note 1)**		XYC-40∗a∗b∗cG-L (R)
Model name of robot unit		XYC-40∗a∗b∗cGM-L (R)
X-axis stroke (∗a)		(∗a=) 2: 250 mm, 3: 350 mm, 4: 450 mm, 5: 550 mm
Y-axis stroke (∗b)		(∗b=) 3: 300 mm, 4: 400 mm, 5: 500 mm, 6: 600 mm, 7: 700 mm, 9: 900 mm
Vertical stroke (∗c)		(∗c=) 2: 200 mm, 3: 300 mm
Wrist rotation angle		$\pm270°$
Axis combination		X (1st axis) +Y (2nd axis) +Z (3rd axis) +T (4th axis)
Maximum payload		10 kg
Composite speed		X (1st axis) and Y (2nd axis): 1000 mm/s, Z (3rd axis): 2000 mm/s, +T (4th axis): 610°/s
Position repeatability **(Note 2)**		X (1st axis), Y (2nd axis) and Z (3rd axis): ±0.025 mm, +T (4th axis): $\pm0.02°$
Maximum force-fit		98N (one second or less)
Maximum allowable inertia moment around T axis		0.078 kgm^2
Position detection		Absolute encoder
Drive motor		AC servomotors for all axes + Gravity air balance cylinder, Z axis (3rd axis) equipped with brake
Air source	Operating pressure	0.05 to 0.35 MPa
	Maximum allowable pressure	0.59 MPa
Weight		Approx. 65 kg (143 lb) (in the case of the heaviest model, XYC-40593GM-L(R))

Note 1: The model name of robot system refers to the model of a complete set, including a robot unit and robot controller.
Note 2: Measured at the constant ambient temperature.

■ Rigidity of the X axis
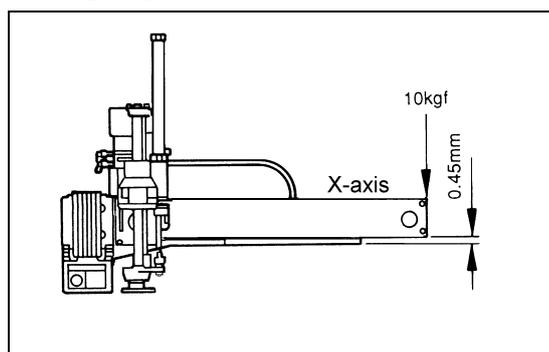
The X axis is cantilever-structured, so its rigidity is lower than that of other axes.

In the case of the XYC-40592GM-L(R), the deflection at the end of the X-axis frame is 0.45 mm when a 10 kg load is applied.

3.2 Outer Dimensions and Workable Space of the Robot Unit

The outer dimensions and workable space of the XYC-4G series are shown on this and the following pages.
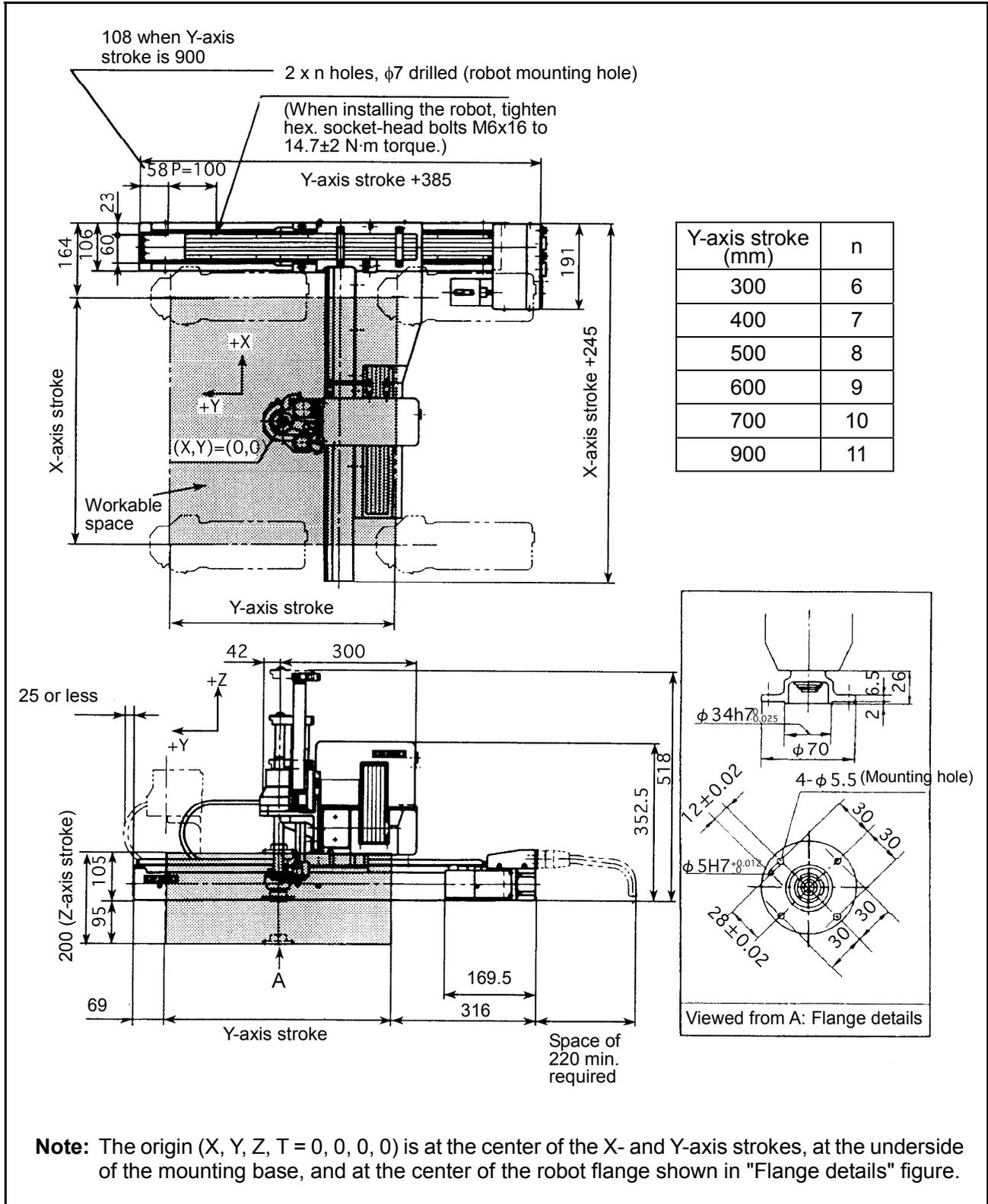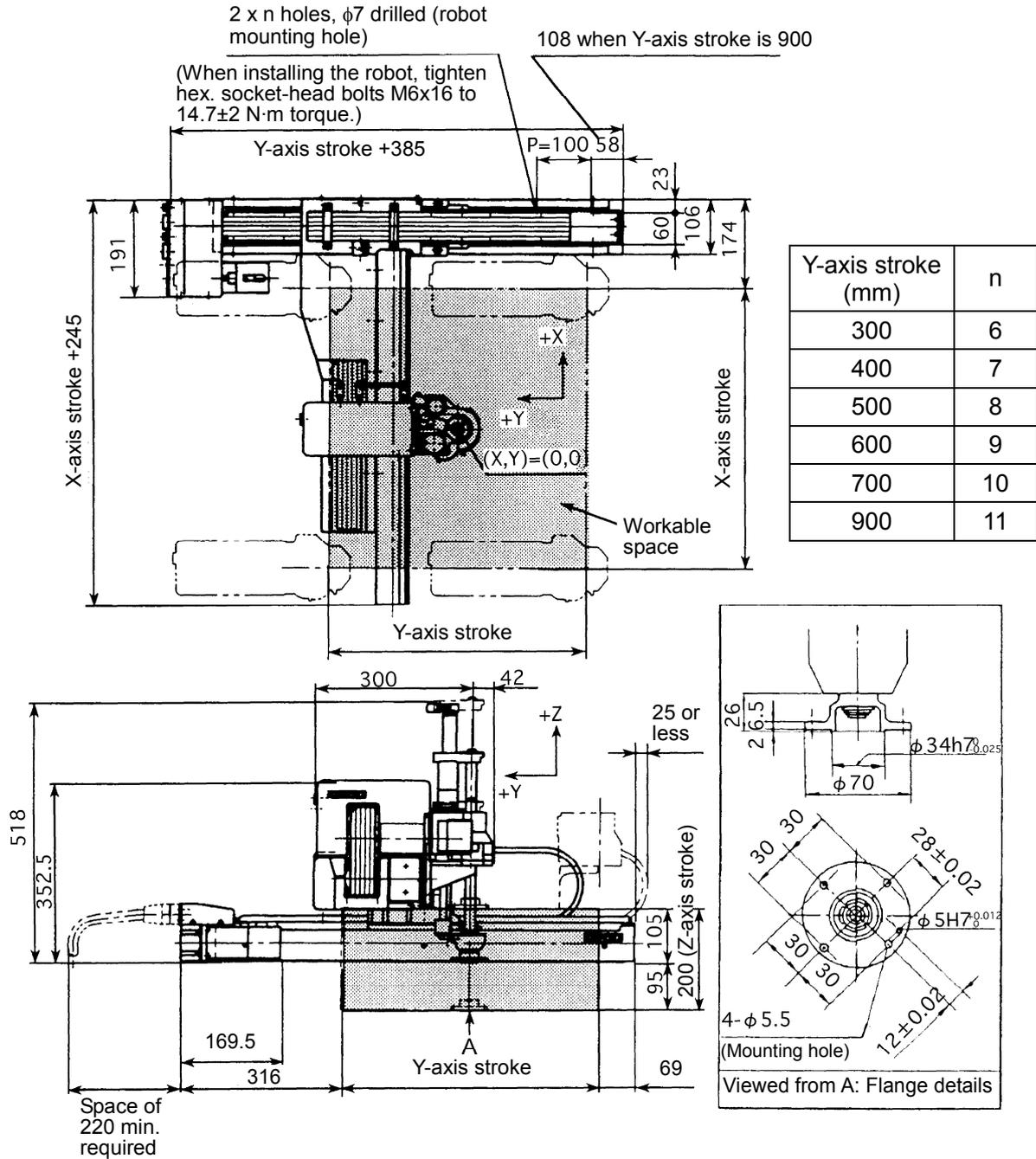
Y-axis stroke (mm)	n
300	6
400	7
500	8
600	9
700	10
900	11

Note: The origin (X, Y, Z, T = 0, 0, 0, 0) is at the center of the X- and Y-axis strokes, at the underside of the mounting base, and at the center of the robot flange shown in "Flange details" figure.

Outer Dimensions and Workable Space of the XYC-402G-L**

2 x n holes, φ7 drilled (robot mounting hole)

(When installing the robot, tighten hex. socket-head bolts M6x16 to 14.7±2 N·m torque.)

108 when Y-axis stroke is 900

Y-axis stroke +385

P=100 58

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

X-axis stroke +245

+X

+Y

(X,Y)=(0,0)

Workable space

X-axis stroke

Y-axis stroke

300   42

+Z

25 or less

+Y

518

352.5

φ34h7 $^{0}_{-0.025}$

φ70

105

200 (Z-axis stroke)

95

28±0.02

30 30

30 30

φ5H7 $^{+0.012}_{0}$

169.5

A
Y-axis stroke

316

69

4-φ5.5
(Mounting hole)

12±0.02

Viewed from A: Flange details
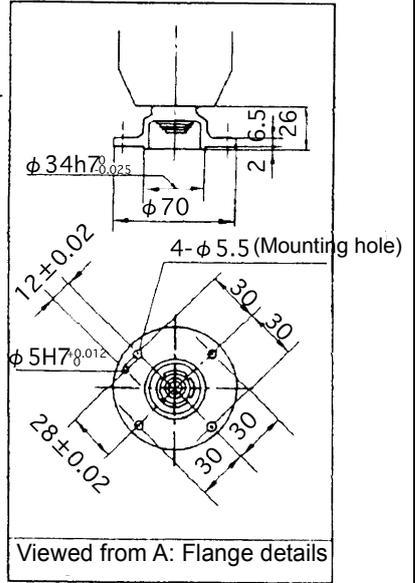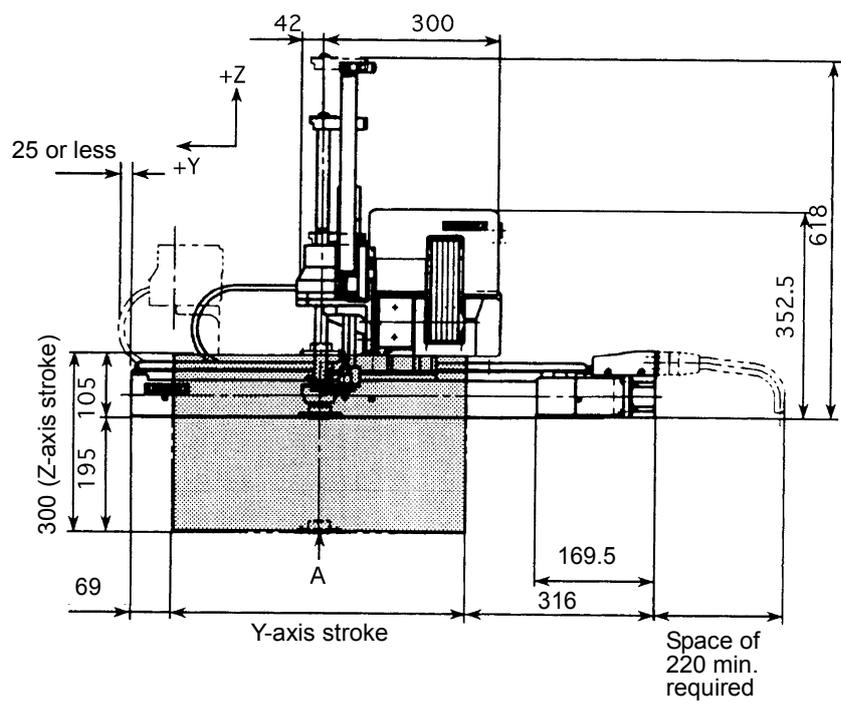
Space of 220 min. required

Note: The origin (X, Y, Z, T = 0, 0, 0, 0) is at the center of the X- and Y-axis strokes, at the underside of the mounting base, and at the center of the robot flange shown in "Flange details" figure.

Outer Dimensions and Workable Space of the XYC-402G-R**

108 when Y-axis stroke is 900

2 x n holes, φ7 drilled (robot mounting hole)

(When installing the robot, tighten hex. socket-head bolts M6x16 to 14.7±2 N·m torque.)

58 P=100

Y-axis stroke +385

23

164

106

60

191

+X

+Y

(X,Y)=(0,0)

X-axis stroke

X-axis stroke +245

Workable space

Y-axis stroke

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

42

300

+Z

25 or less

+Y

618

352.5

300 (Z-axis stroke)

105

195

69

A

Y-axis stroke

169.5

316

Space of 220 min. required

φ34h7 $_{-0.025}^{0}$

φ70

2

6.5

26

4-φ5.5 (Mounting hole)

12±0.02

φ5H7 $_{0}^{+0.012}$

28±0.02

30

30

30

30

Viewed from A: Flange details

Note: The origin (X, Y, Z, T = 0, 0, 0, 0) is at the center of the X- and Y-axis strokes, at the underside of the mounting base, and at the center of the robot flange shown in "Flange details" figure.
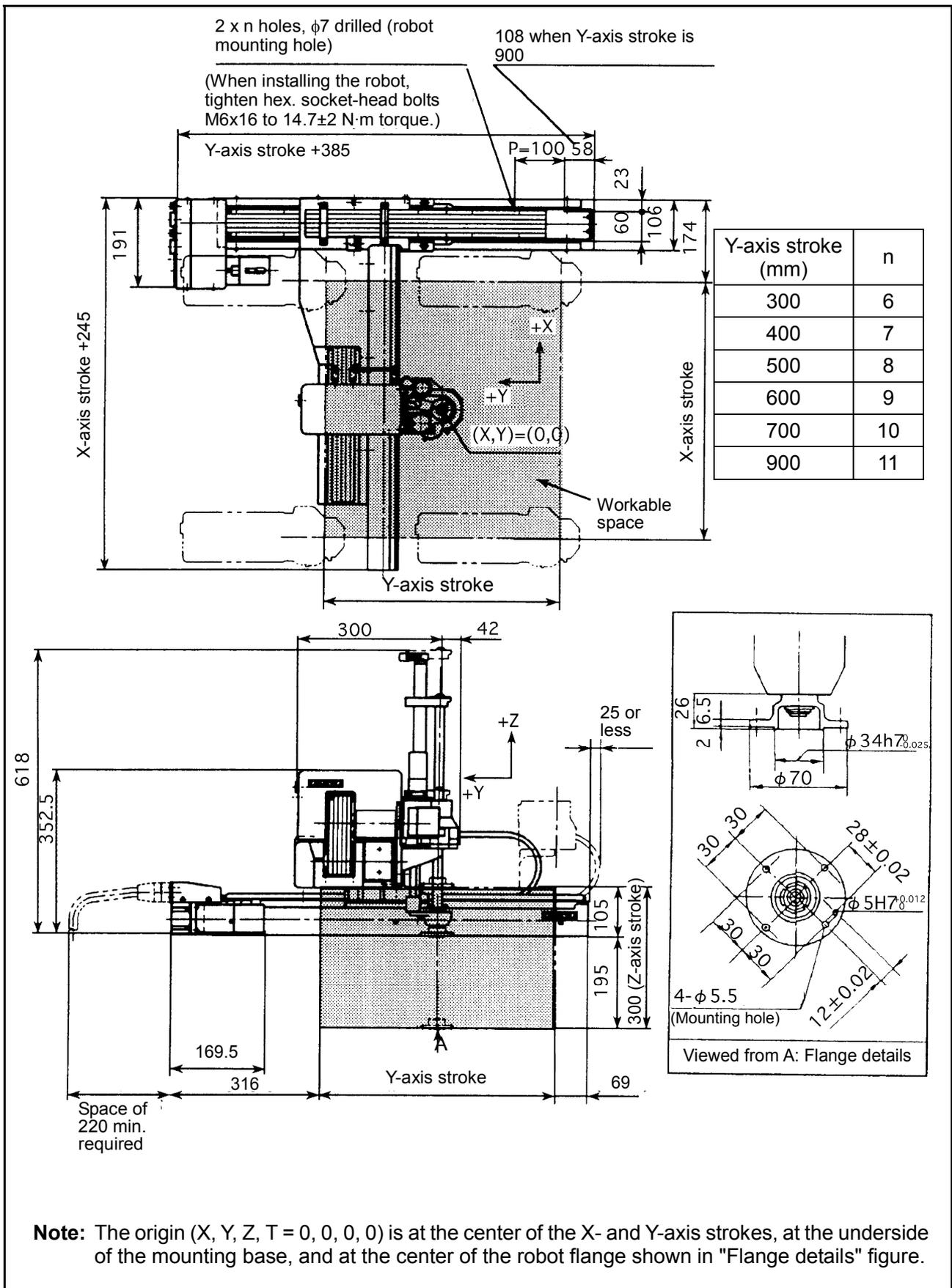
Outer Dimensions and Workable Space of the XYC-40∗∗3G-L

12

2 x n holes, φ7 drilled (robot mounting hole)

(When installing the robot, tighten hex. socket-head bolts M6x16 to 14.7±2 N·m torque.)

108 when Y-axis stroke is 900

Y-axis stroke +385

P=100 58

X-axis stroke +245

191

23

60

106

174

+X

+Y

(X,Y)=(0,0)

X-axis stroke

Workable space

Y-axis stroke

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

300

42

618

352.5

+Z

25 or less

+Y

169.5

316

Y-axis stroke

105

195

300 (Z-axis stroke)

69

Space of 220 min. required

26

6.5

2

φ34h7$_{-0.025}^{0}$

φ70

30 30

30 30

28±0.02

φ5H7$_{0}^{+0.012}$

12±0.02

4-φ5.5 (Mounting hole)

Viewed from A: Flange details

Note: The origin (X, Y, Z, T = 0, 0, 0, 0) is at the center of the X- and Y-axis strokes, at the underside of the mounting base, and at the center of the robot flange shown in "Flange details" figure.

Outer Dimensions and Workable Space of the XYC-40∗∗3G-R

13

3.3   Robot Positioning Time

Positioning time for the XYC-4G series

1. The graphs given on the following pages show the positioning times used to calculate the cycle time.

2. Positioning time refers to the time length required from the start of robot operation to the arrival at the target positioning point.

3. After the robot moves to and passes the target positioning point, vibration will be dampened and the robot will be positioned at the target positioning point as shown in the figure below. This vibration dampening time is not considered in those graphs.

Caution (1)   The vibration dampening time depends on factors such as the weight of the hand. If the robot is to be used in such a way that it overshoots or if the vibration damping time is of great concern, test the robot carefully beforehand.

(2)   If acceleration begins before residual vibration of the robot stops, an overcurrent error (code starts from ERROR6120; the first digit represents the axis number) may be displayed. In this case, take one of the following measures:
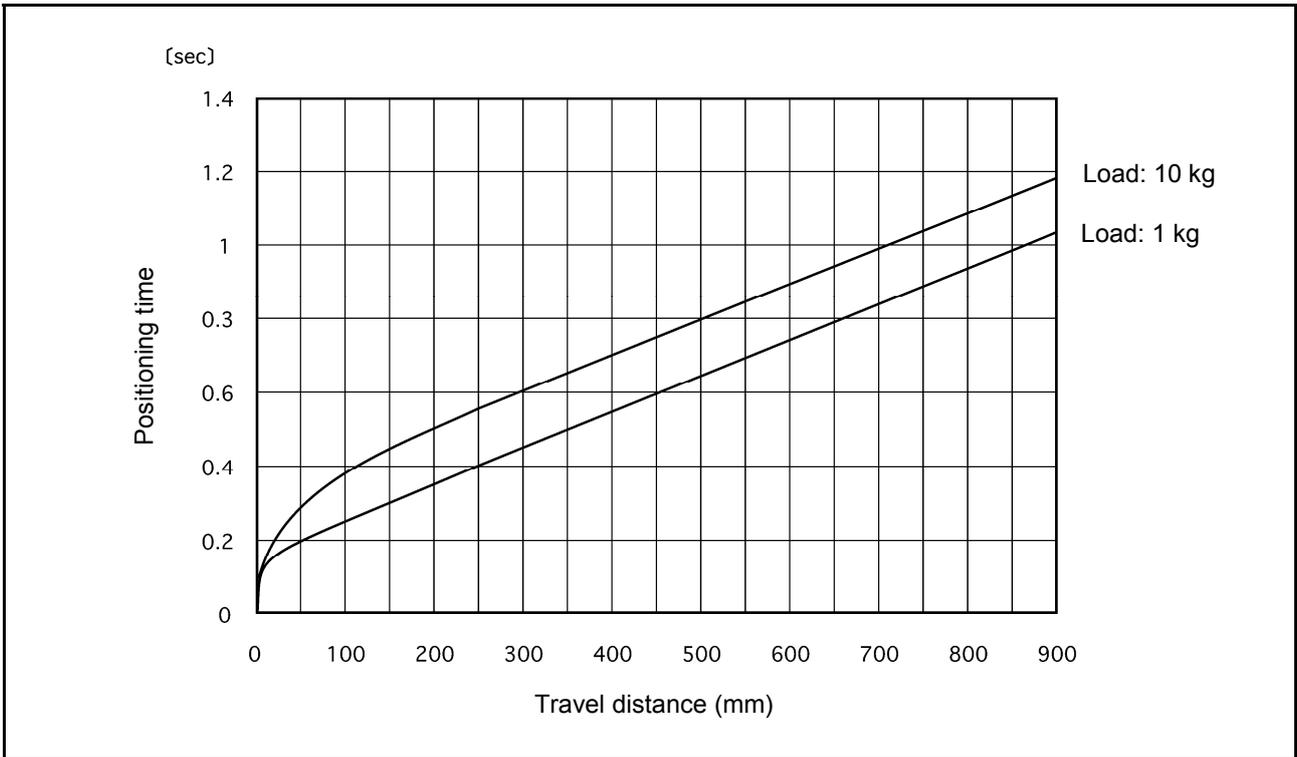
   • Lower the deceleration of the preceding operation with a DECEL command to reduce residual vibration.

   • Keep the robot on standby with a DELAY command until residual vibration stops.

   • Lower acceleration with an ACCEL command.

(3)   Operate the robot with the optimum payload setting in accordance with the hand weight and workpiece weight. If not, a robot failure may result.
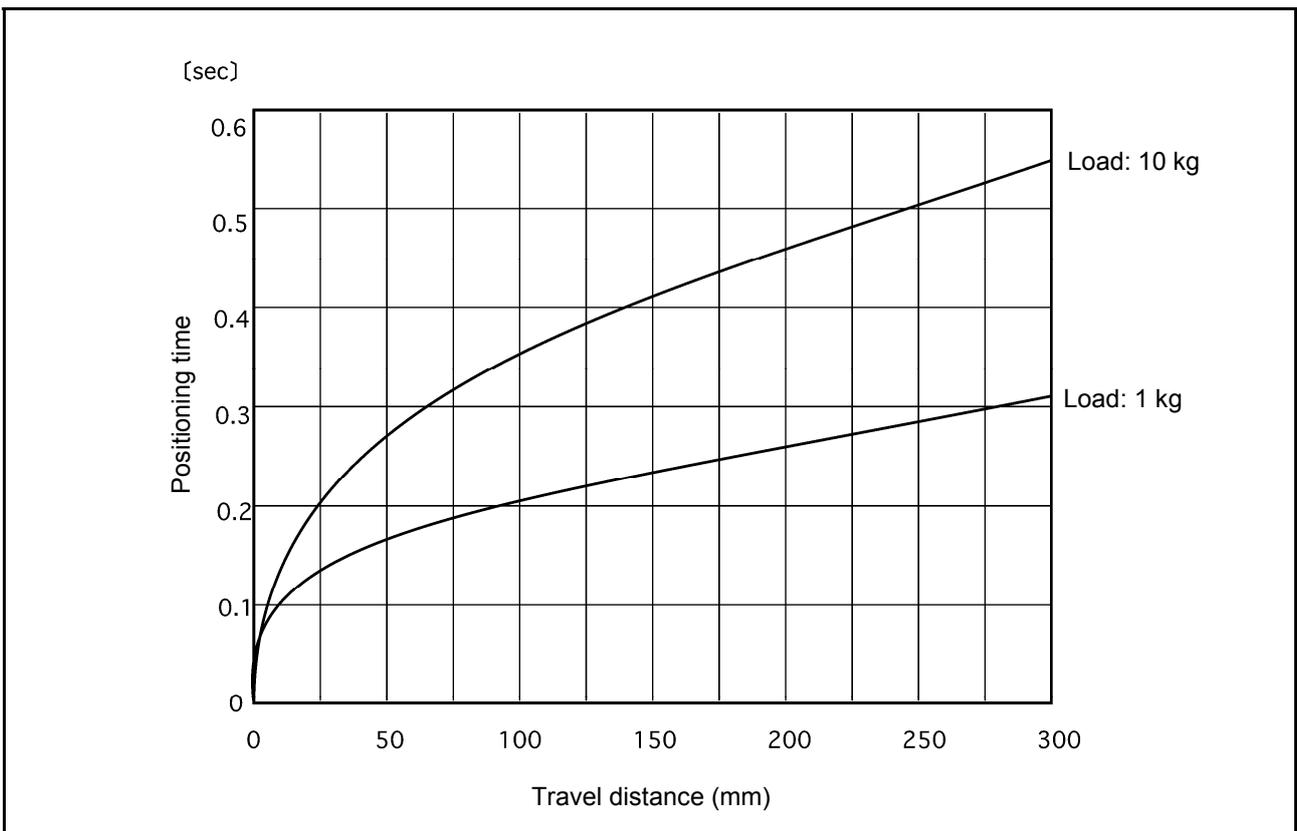
(4)   In the locating time graph, the Z-axis stroke of 300 mm is represented near the upper end. Near the lower end, the horizontal movement time along the J1/J2 axis increases.
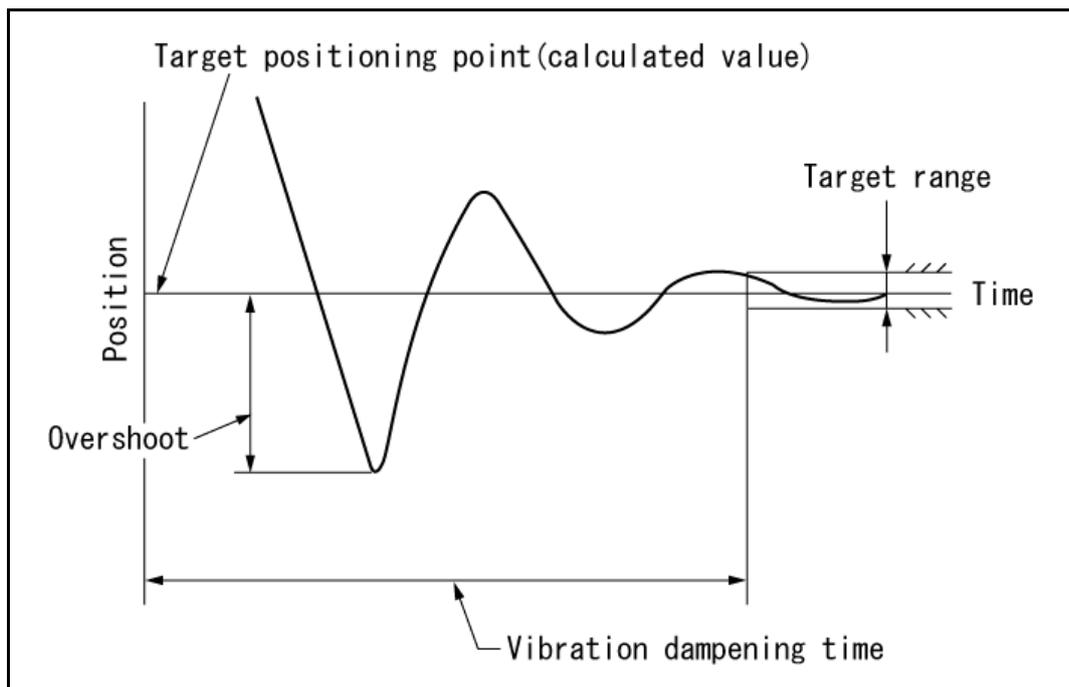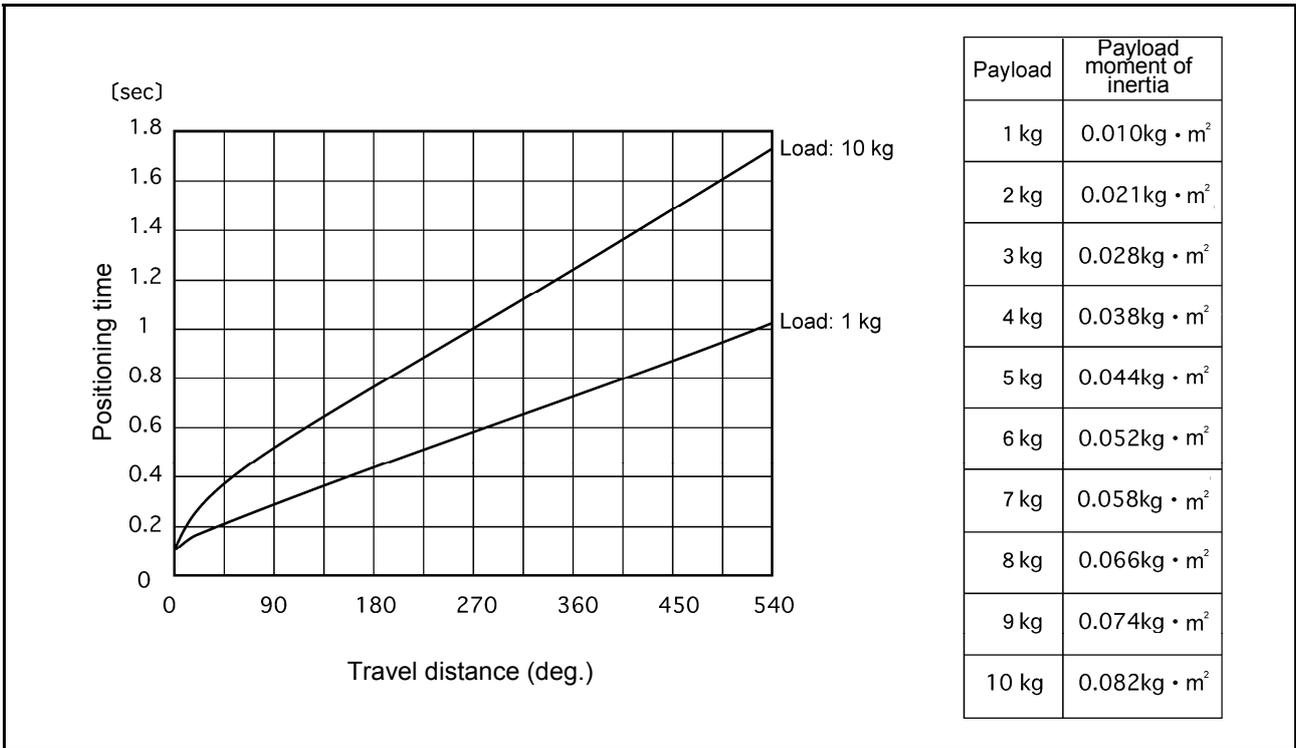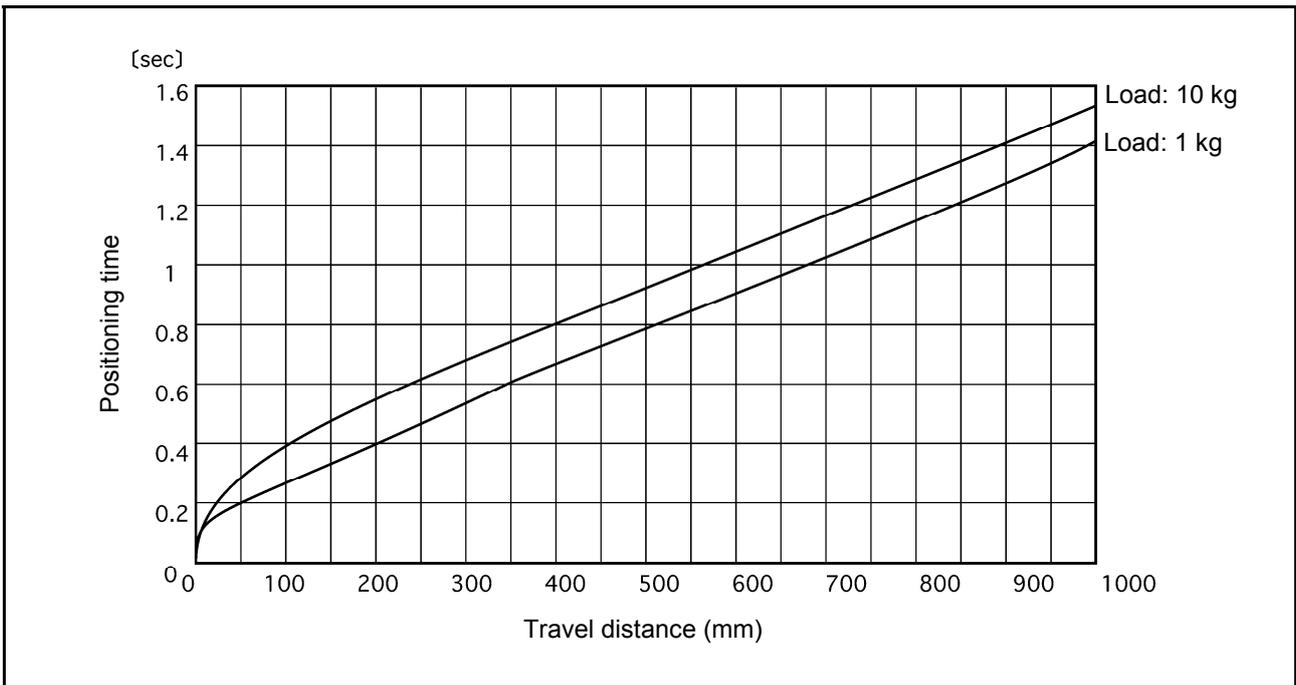

Vibration Dampening Time

〔sec〕

X-/Y-axis Positioning Time

〔sec〕

Z-axis Positioning Time

15

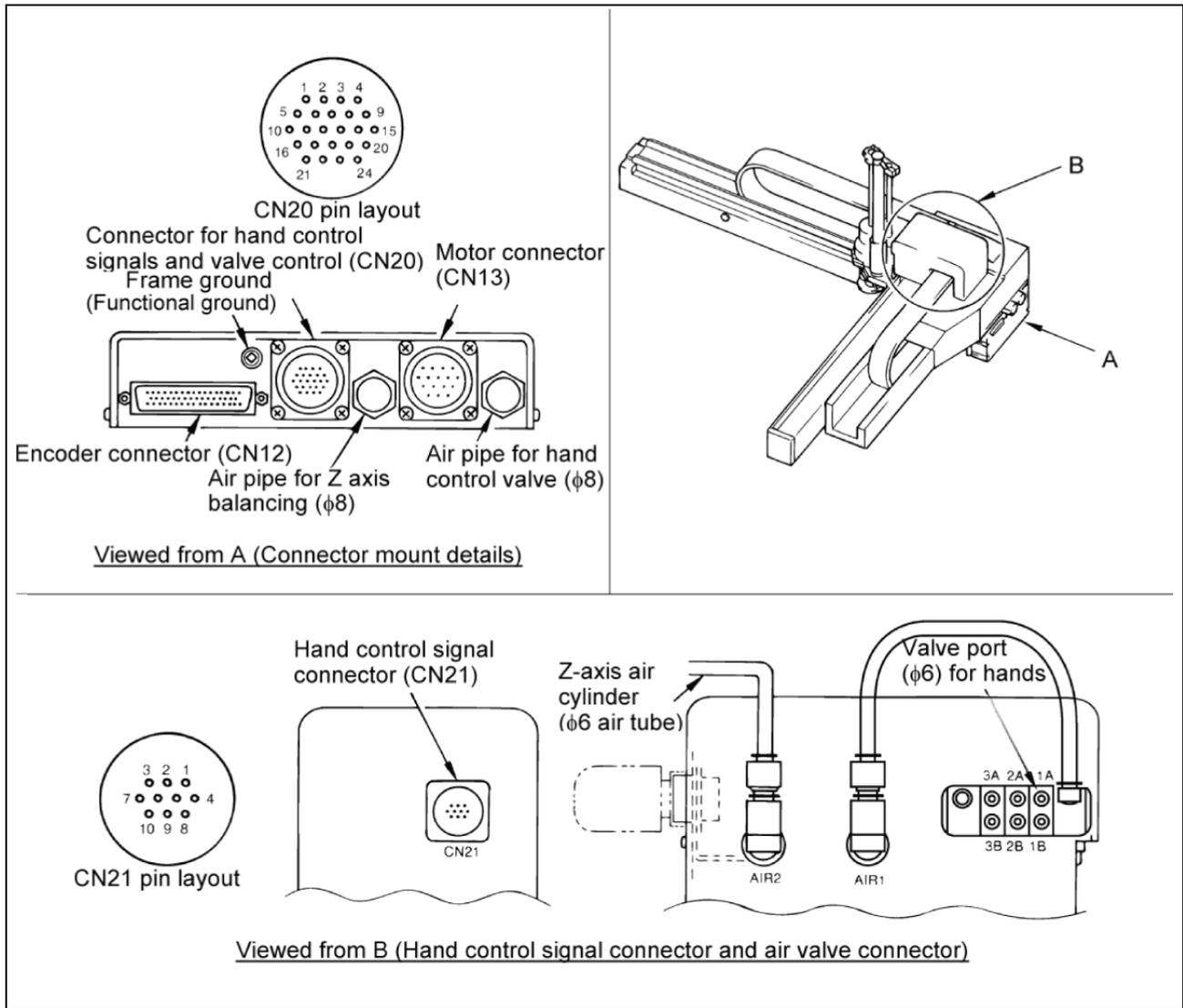| Payload	Payload moment of inertia
1 kg	0.010kg · m²
2 kg	0.021kg · m²
3 kg	0.028kg · m²
4 kg	0.038kg · m²
5 kg	0.044kg · m²
6 kg	0.052kg · m²
7 kg	0.058kg · m²
8 kg	0.066kg · m²
9 kg	0.074kg · m²
10 kg	0.082kg · m²

T-axis Positioning Time

Composite Positioning Time of All Axes (MV S motion)

16

3.4　Air piping and signal wiring

The XYC-4G series of robot units is equipped with 6 air pipes for air chuck, 10 signal lines, and 4 solenoid valves (incl. 3 for users) in it.

Those solenoid valves may be used by the robot controller if you connect pins 11 through 18 on CN20 with the valve output port on controller's CN4.

> ⚠**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.

CN20 pin layout

Connector for hand control signals and valve control (CN20)
Frame ground (Functional ground)
Motor connector (CN13)

Encoder connector (CN12)
Air pipe for Z axis balancing (φ8)
Air pipe for hand control valve (φ8)

Viewed from A (Connector mount details)

CN21 pin layout

Hand control signal connector (CN21)

Z-axis air cylinder (φ6 air tube)

Valve port (φ6) for hands

AIR2　AIR1

3A 2A 1A
3B 2B 1B

Viewed from B (Hand control signal connector and air valve connector)

Note: For hand control signal connectors CN20 and CN21, use the connector set that comes with the robot unit.

Parts No. of connector set	Part No.	Model and name	Illustration
410889-0030	410877-0170 (For CN20)	SRCN6A25-24S (Round connector) (Nippon Kohku Denshi)	
	410877-0180 (For CN21)	JMLP1610M (L-type plug connector) (Dai-ichi Electronic Industry)	

Air Piping and Signal Wiring

Solenoid Valve Specifications

	Item	Specifications
Valve	Switching system	2-position double
	Structural valve	Metal seal
	Applicable fluid	Air
	Operating pressure range	0.18 to 0.7 Mpa **(Note 1)**
	Guarantee pressure resistance	1.5 MPa
	Ambient temperature and fluid temperature	-10 to +50°C (If the temperature is low, use dry air. No dew condensation allowed.)
	Lubrication	Not required.
	Effective cross section (CV value)	4.5 mm^2 (0.25)
	Response time	12 ms or less
Power source	Coil rated voltage (Allowable voltage regulation) Power consumption (current value)	24 VDC (±10%) 1 W DC (42 mA)

Note 1: The air source connected to the robot unit must be used within the operating pressure range from 0.05 to 0.35 MPa (specified in Chapter 3 "Specifications of the Robot Unit").

CN20 Pin Layout

Pin No.	Name
12	+24V
13	Solenoid 1A (solenoid valve 1)
14	Solenoid 1B (solenoid valve 1)
15	Solenoid 2A (solenoid valve 2)
16	Solenoid 2B (solenoid valve 2)
17	Solenoid 3A (solenoid valve 3)
18	Solenoid 3B (solenoid valve 3)

Valve Symbols and Air Intake/Exhaust States

Air piping joint		Valve signal		
Air intake	Exhaust	Solenoid valve	Solenoid	
			A	B
1A	1B	1	ON	OFF
1B	1A	1	OFF	ON
2A	2B	2	ON	OFF
2B	2A	2	OFF	ON
3A	3B	3	ON	OFF
3B	3A	3	OFF	ON

NOTE: Pins 1 to 10 on CN21 are connected with pins 1 to 10 on CN20, respectively. The maximum rated current is 1A per line.

3.5   Engineering-design Notes for Robot Hands

Design a robot hand so that it will satisfy conditions (1) through (3) described below.

⚠**Caution**: Strictly observe these engineering-design notes. Otherwise, the clamped sections of the robot unit will become loose, rattle or be out of position. In the worst case, the mechanical parts of the robot unit and the robot controller may be damaged.
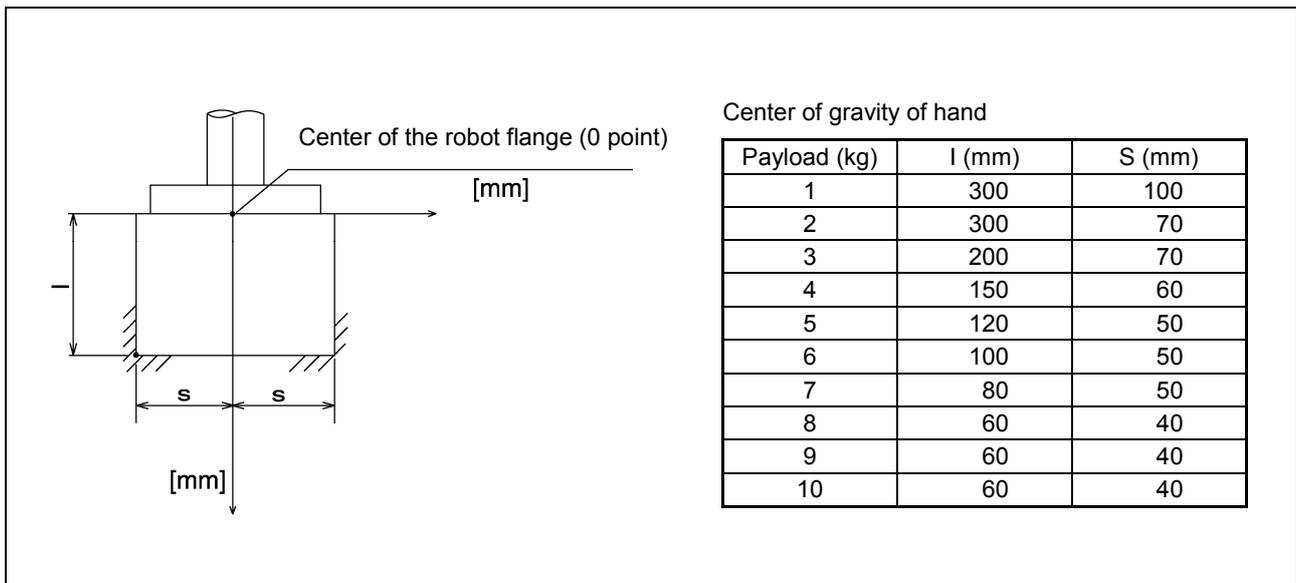
(1) Mass of hand

The total mass of a hand (including workpiece) should be less than the maximum allowable payload of the robot. Be sure to include the mass of wirings and piping used for hands.

Total mass of hand (incl. workpiece) ≤ Maximum allowable payload

NOTE: The maximum allowable payload refers to a mass of payload that you have preset.

(2) Center of gravity of hand

The center of gravity of a hand (including workpiece) should be located within the range specified in the figure below.
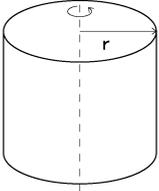
Center of gravity of hand

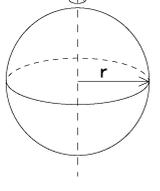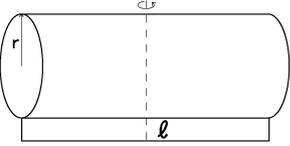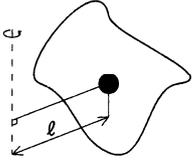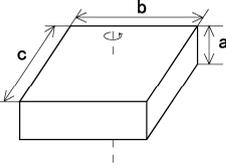| Payload (kg)	I (mm)	S (mm)
1	300	100
2	300	70
3	200	70
4	150	60
5	120	50
6	100	50
7	80	50
8	60	40
9	60	40
10	60	40

Position of Center of Gravity of Hand

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(3) Moment of inertia around the T-axis

The moment of inertia of a hand (including workpiece) around the T-axis should be less than the maximum allowable moment of inertia around the T-axis of the robot.

Moment of inertia of hand (incl. workpiece) around the T-axis ≤ Maximum allowable moment of inertia

Calculate the moment of inertia around the T-axis, referring to the table on the next page.

Moment-of-inertia Formulas

1. Cylinder (1)	4. Sphere
(Axis of rotation = Center axis) $I = \dfrac{mr^2}{2}$	(Axis of rotation = Center axis) $I = \dfrac{2mr^2}{5}$
2. Cylinder (2) (The axis of rotation passes through the center of gravity.) $I = \dfrac{m}{4}\left(r^2 + \dfrac{\ell^2}{3}\right)$	5. Center of gravity not on the axis of rotation. Ig: Moment of inertia around center of gravity 〔kgm²〕 $I = I_g + m\,\ell^2$
3. Rectangular parallelepiped (The axis of rotation passes through the center of gravity.) $I = \dfrac{m}{12}\left(b^2 + c^2\right)$	I: Moment of inertia (kgm²) m: Mass (kg) r: Radius (m) a, b, c, ℓ: Length (m)

Calculation example : When calculating the moment of inertia of a complicated shape, divide it into simple parts as much as possible for easier calculations.
As shown in the figure below, divide the hand into three parts ((1), (2), (3)).
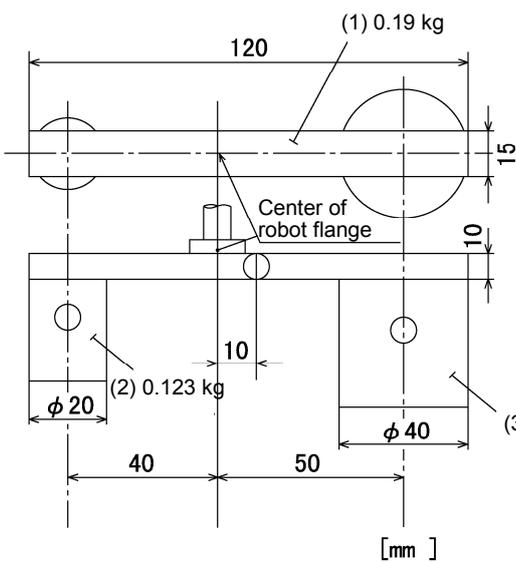
Moment of inertia around T-axis of (1): I_1 (from 3 and 5 in the above table)

$$I_1 = \frac{0.19}{12}\left(0.12^2 + 0.015^2\right) + 0.19 \times 0.01^2 = 2.51 \times 10^{-4} \;\; [\text{kgm}^2]$$

Moment of inertia around T-axis of (2): I_2 (from 1 and 5 in the above table)

$$I_2 = \frac{0.123 \times 0.01^2}{2} + 0.123 \times 0.04^2 = 2.03 \times 10^{-4} \;\; [\text{kgm}^2]$$

Moment of inertia around T-axis of (3): I_3 (from 1 and 5 in the above table)

$$I_3 = \frac{0.98 \times 0.02^2}{2} + 0.98 \times 0.05^2 = 2.65 \times 10^{-3} \;\; [\text{kgm}^2]$$

Moment of inertia of entire hand around T-axis: I

$$I = I_1 + I_2 + I_3 = 0.003 \;\; [\text{kgm}^2]$$

Calculation Example of Moment of Inertia of Hand Around the T-Axis

3.6 Stopping Time and Distance (Angle) at an Emergency Stop

Pressing the emergency stop button when the robot is in motion stops the robot. The stopping time required from activation of a stop signal and the distance (angle) for major three joints vary with the robot speed as shown in the graphs below. The measuring conditions are: Robot arm extended, 33%, 66% and 100% of the maximum payload.
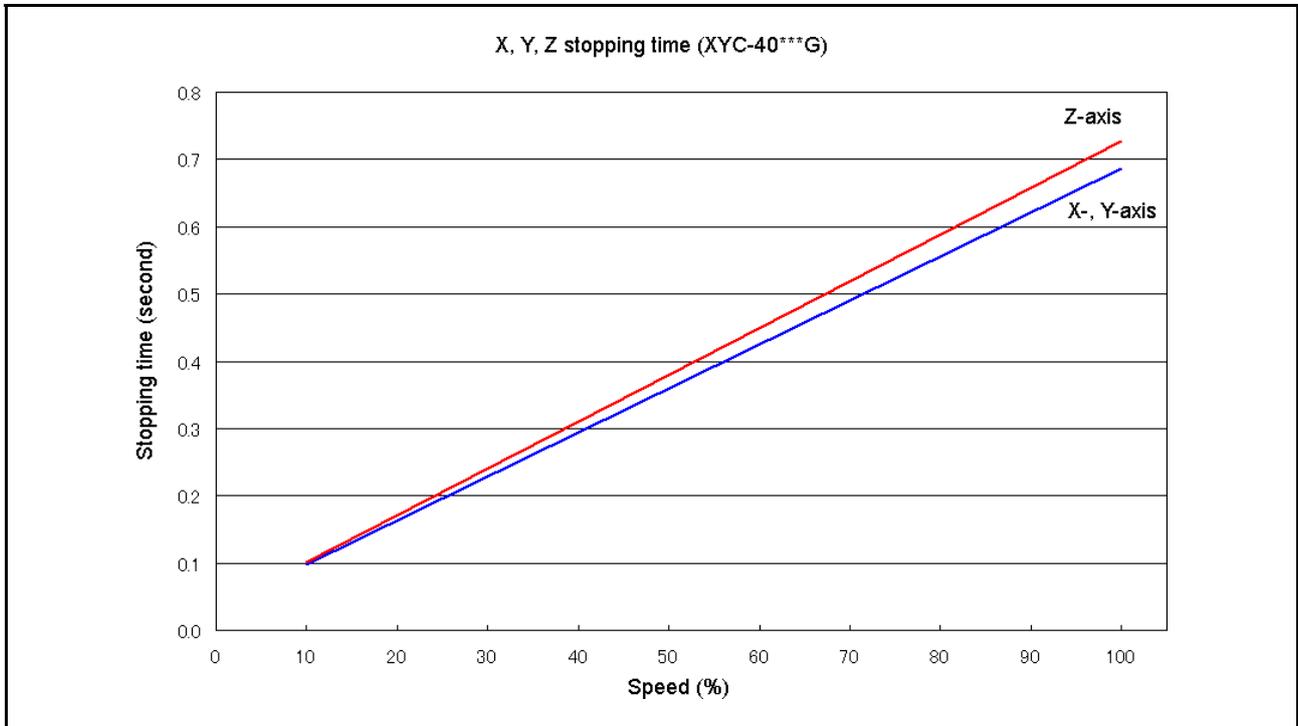
X, Y, Z stopping time vs. speed at an emergency stop (XYC-40***G series)
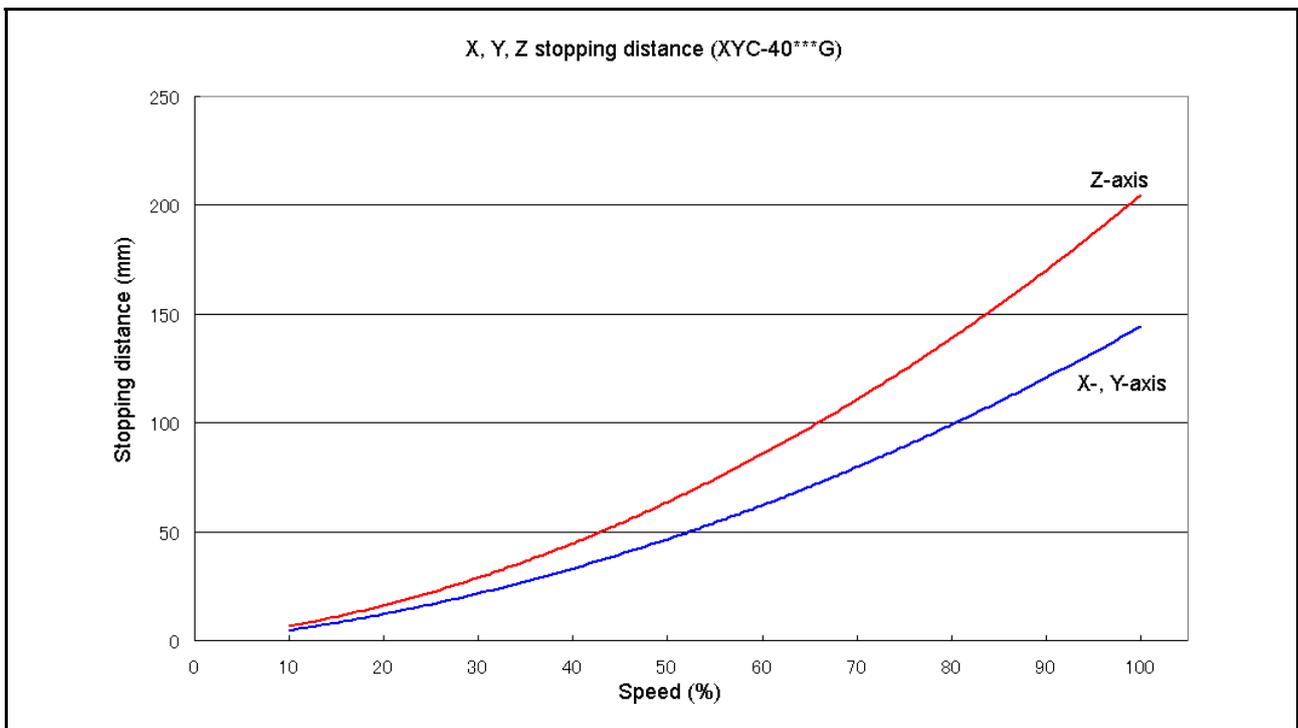
X, Y, Z stopping distance vs. speed at an emergency stop (XYC-40***G series)

Chapter 4 Robot Controller Specifications

4.1 Specifications

The table below lists the specifications of the XYC-4G series of robot controllers.

RC7M Controller Specifications (1) (XYC-4G series)

Item			Specifications
Applicable robot			Cartesian coordinate (XYC-4G)
Model			RC7M-XYCG 4 AA-**
Control system			PTP, CP 3-dimensional linear, 3-dimensional circular
No. of controllable axes			Up to four axes simultaneously
Drive system			All axes: all digital AC servo
Language used			DENSO robot language (conforming to SLIM)
Memory capacity			3.25 MB (equivalent to 10,000 steps, equivalent to 30,000 points)
Teaching system			1) Remote teaching 2) Numerical input (MDI)
External signals (I/O)	Standard I/O	Mini I/O	Input signals: 8 user open points + 11 fixed system points Output signals: 8 user open points + 14 fixed system points **Note:** In global type, some fixed system points are not used.
		HAND I/O	Input signals: 8 user open points Output signals: 8 user open points
	SAFETY I/O (Only for Global type)		Input signals: 6 fixed system points Output signals: 5 fixed system points
	Parallel I/O board (Option)	2 boards	Input signals: Additional 80 user open points Output signals: Additional 96 user open points
		1 board	Input signals: Additional 40 user open points Output signals: Additional 48 user open points
	DeviceNet board (Option)	Master & slave	Input signals: 1024 points (Master) + 256 points (Slave) Output signals: 1024 points (Master) + 256 points (Slave)
		Master	Input signals: 1024 points Output signals: 1024 points
		Slave	Input signals: 256 points Output signals: 256 points
	CC-Link board (option)	Slave	Input signals: 384 points Output signals: 384 points (including remote registers RWw and RWr)
External communication			RS-232C: 1 line Ethernet: 1 line USB: 2 lines (flash memory drive available)
Extension slot			3 (For an optional board)
Self-diagnosis function			Overrun, servo error, memory error, input error, etc.
Timer function			0.02 to 10 sec. (in units of 1/60 sec.)
Error display			Error codes will be issued to the external I/O. Error messages will be displayed in English on the teach pendant (option). Error codes will be displayed on the mini pendant (option).
Cables	Motor & encoder cable (option)		4 m, 6 m (Standard type)
	I/O cable (option)		8 m, 15 m (For Mini I/O, HAND I/O, Optional board for parallel I/O and SAFETY I/O)
	Power cable		5 m

RC7M Controller Specifications (2) (XYC-4G series)

Item		Specifications	
Environmental conditions (in operation)		Temperature: 0 to 40°C Humidity: 90% RH or less (no condensation allowed)	
Power source		3-phase, 200 VAC-15% to 230 VAC+10%, 50/60 Hz, 1.15 kVA Single-phase, 200 VAC-10% to 230 VAC+10%, 50/60 Hz, 1.15 kVA	
I/O power supply	Using external power supply	Supply 24 VDC±10% from external source	Note: Refer to the RC7M CONTROLLER MANUAL, Section 4.2.1 "Setting up Min I/O Power Supply."
	Using internal power supply	24 VDC±10% is supplied internally from the controller	
Safety category		Only robots with safety box conform to Safety category 4	
Degree of protection		IP20	
Weight		Standard type: Approx. 17 kg (38 lbs) Global type with safety box: Approx. 21 kg (46 lbs)	

Cautions for Use of the Robot Controller

⚠ **WARNING**

- **DO NOT touch fins. Their hot surfaces may cause severe burns.**
- **DO NOT insert fingers or foreign objects into openings. Doing so may cause bodily injury.**
- **Before opening the controller cover and accessing the inside of the controller for maintenance, be sure to turn off the power switch, disconnect the power cable, and wait 3 minutes or more. This is for protecting you from electric shock.**
- **DO NOT connect or disconnect connector to/from the controller when the AC power or 24 VDC for I/O is applied. Doing so may cause electric shock or controller failure.**

⚠ **CAUTION IN INSTALLATION**

- **This controller does not meet dust-proof, splash-proof or explosion-proof specifications.**
- **Read the owner's manuals before installation.**
- **Do not place anything on the controller or apply impact.**
- **Do not install the controller in an environment where excessive vibration is applied to the controller.**

⚠ **CAUTION**

The robot controller connectors are of a screw-lock type or ring-lock type. Lock the connectors securely. If even one of the connectors is not locked, weak contact may result thereby causing an error.

Be sure to turn the robot controller OFF before connecting/disconnecting the power connector or motor connector. Otherwise, the internal circuits of the robot controller may be damaged.

4.2   Outer Dimensions

Figure below shows the outer dimensions of the robot controller.

Outer Dimensions of RC7M Robot Controller

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4.3   Controller Setting Table

The controller setting table given in Figure below is attached to the controller. It shows the software version, the next replacement dates of the memory backup battery and encoder backup battery, etc.

コントローラ設定表／THE SETPRM LIST

①パラメータ／PARAMETER

ソフトウェアVer. SOFTWARE Ver.

電池交換日 DATE OF RENEWING BAT.

TYPE

②サブアッセンブリ／SUBASSEMBLY

IPM BOARD	SLOT5		SLOT6	
	SLOT3		SLOT4	
	SLOT1		SLOT2	

③その他変更点／OTHER MODIFICATIONS

Robot Controller

MODEL NO.   _____
PART NO.   _____
POWER

_____
CAPACITY   _____
TYP OUTPUT   _____
WEIGHT   _____
CONDITION   _____
SERIAL NO.   _____
YEAR OF PRODUCTION

DENSO WAVE INCORPORATED
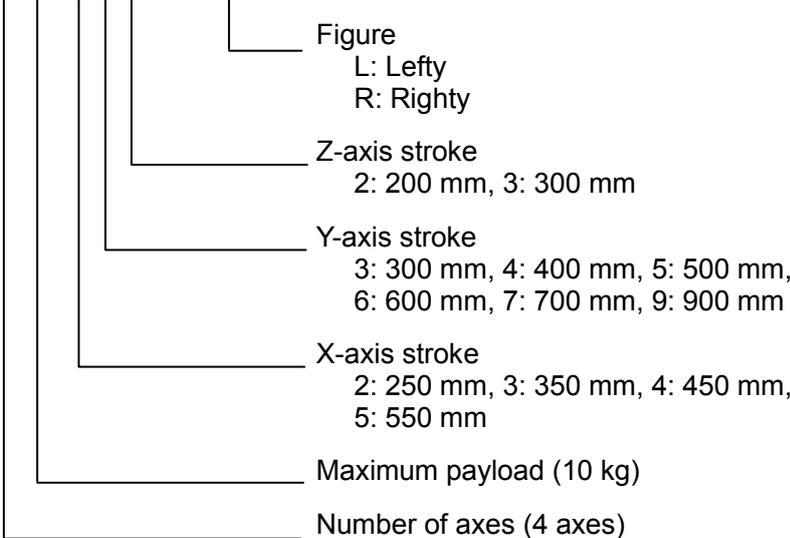1, Yoshiike, Kusagi, Agui-cho, Chita-gun, Aichi 470-2297, JAPAN

<Content THE SETPRM LIST>

SOFTWARE Ver.	The version of the main software for the controller is entered.
DATE OF RENEWING BAT.	The next replacement dates of the memory backup battery and encoder backup battery are entered.
TYPE	The model of the robot system is entered. The model name of the robot system is coded as shown on the next page.
SUBASSEMBLY	The type and position of the controller IPM board are described.

■ **Coding of the model name of robot system**

Cartesian coordinate type

XYC - 4 0 * * * G - *

Figure
L: Lefty
R: Righty

Z-axis stroke
2: 200 mm, 3: 300 mm

Y-axis stroke
3: 300 mm, 4: 400 mm, 5: 500 mm,
6: 600 mm, 7: 700 mm, 9: 900 mm

X-axis stroke
2: 250 mm, 3: 350 mm, 4: 450 mm,
5: 550 mm

Maximum payload (10 kg)

Number of axes (4 axes)

Chapter 5 Warranty

DENSO manufactures robots under strict quality control. In case of failure, we warrant the robot under the following conditions:

Warranty Period

The warranty shall be effective for one year from the date of purchase.

Warranty Coverage

DENSO shall repair the robot free of charge when a failure occurs and is attributable to the design, manufacture or material of the robot within the warranty period in spite of proper use.

Items Not Covered

Failures, which arise from one of the following, shall not be covered by the warranty even if the robot is under warranty:

(1) Failures caused by improper repair, modification, transfer or handling by you or a third party;

(2) Failures caused by the use of a part or oil/fat other than those specified by DENSO;

(3) Failures caused by a fire, salt damage, earthquake, storm/flood or other acts of God;

(4) Failures caused by the use of the robot in an environment other than the environment specified by DENSO, such as dust and water ingress;

(5) Failures caused by a worn-out consumable, such as a fan filter;

(6) Failures caused by improper performance or non-performance of lubrication, maintenance or inspections stated in this owner's manual; and

(7) Damages other than the robot repair costs.

Cartesian coordinate
XYC-4G SERIES

GENERAL INFORMATION ABOUT ROBOT