DENSO ROBOT

Vertical articulated

VP-G 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
Mini-sized, vertical articulated VP-G (Models configured with RC7M controller)	VP-6242G (6-axis type) VP-5243G (5-axis type)

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 VP-6242G, for example, the robot unit model is VP-6242E/GM.

Important

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

> **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, chapters one through five, and appendix.

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.

Appendix How to Use the Manual Pack CD

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	Q'ty
(1)	Robot unit	1
(2)	Robot controller	1
(3)	Power cable (5 m)	1
(4)	Motor & encoder cable **(Note 1)** **(Option)**	1
(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)	Dowel pins (internally threaded positioning pin and diamond-shaped pin)	1 set
(14)	Short sockets for robot controller	2

Note 1: Choose a motor & encoder cable from the table below. The 20-m motor & encoder cable (standard/splash-proof) is not available for controllers equipped with extended-joint options or UL-Listed robot units. The internal cable bending radius shall at least be 200 mm. Excessively bending will result in broken lead wires.

Item		Part No.
Standard cable	2 m	410141-4400
Standard cable	4 m	410141-3611
Standard cable	6 m	410141-3621
Standard cable	12 m	410141-3631
Standard cable	20 m	410141-4440

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.

1.2 Optional Components

The table below lists the optional components.

Optional Components

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" (68pins)		(8 m)		410141-2700
				(15 m)		410141-2710
	1-2	I/O cable for "HAND I/O"		(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
				PNP		410010-3330
			Shipped as individual boards (supply part)	NPN		410010-3340
				PNP		410010-3350
	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

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 (3.25MB to 5.5MB)	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 VP-G, full set	Includes No. C and No. D	410009-0320
	C	Instruction manual for VP-G, basic set	Includes No. C-1 to No. C-3	410009-0220
	C-1	GENERAL INFORMATION ABOUT ROBOT	For VP-G	410002-2530
	C-2	RC7M CONTROLLER MANUAL	For RC7M controller	410002-2430
	C-3	ERROR CODE TABLES		410002-3370
	D	Instruction manual for VP-G, extension set	Includes No. D-1 to No. D-7	410009-0100
	D-1	INSTALLATION & MAINTENANCE GUIDE	For VP-G	410002-2550
	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.

(1) Robot unit

I/O conversion box (option)

PLC (prepared by customer)

(3) Power cable

(2) Robot controller

I/O cable (option)

(4) Motor & encoder cable
(Option)

(8) Pendantless
connector (Note 2)

Optional board

Personal computer
(prepared by customer)

Teach pendant (option)

Mini pendant
(option)

Controller protection
box (option)

WINCAPSIII
(option)

(6) WINCAPSIII install CD
(Trial version)

Printer (prepared by customer)

(7) Spare fuses
for robot controller

(12) Spare output IC
for robot controller

(14) Short sockets
for robot controller

(5) Manuals

⚠WARNING

(9) Connector set
for hand control signals
(for CN20 and CN21)

(13) Dowel pins

(10) Direction
indicator label

(11) Warning label

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

Note 2: The pendantless connector should be attached to the robot controller when no teach pendant or mini-pendant is connected.

Configurators of the Robot System (VP-G series)

2.2   Names of Robot Unit Components

2.2.1   Robot Unit Components and Rotation Direction

The figure below shows the names of the components of the robot unit and the rotation direction of each axis.
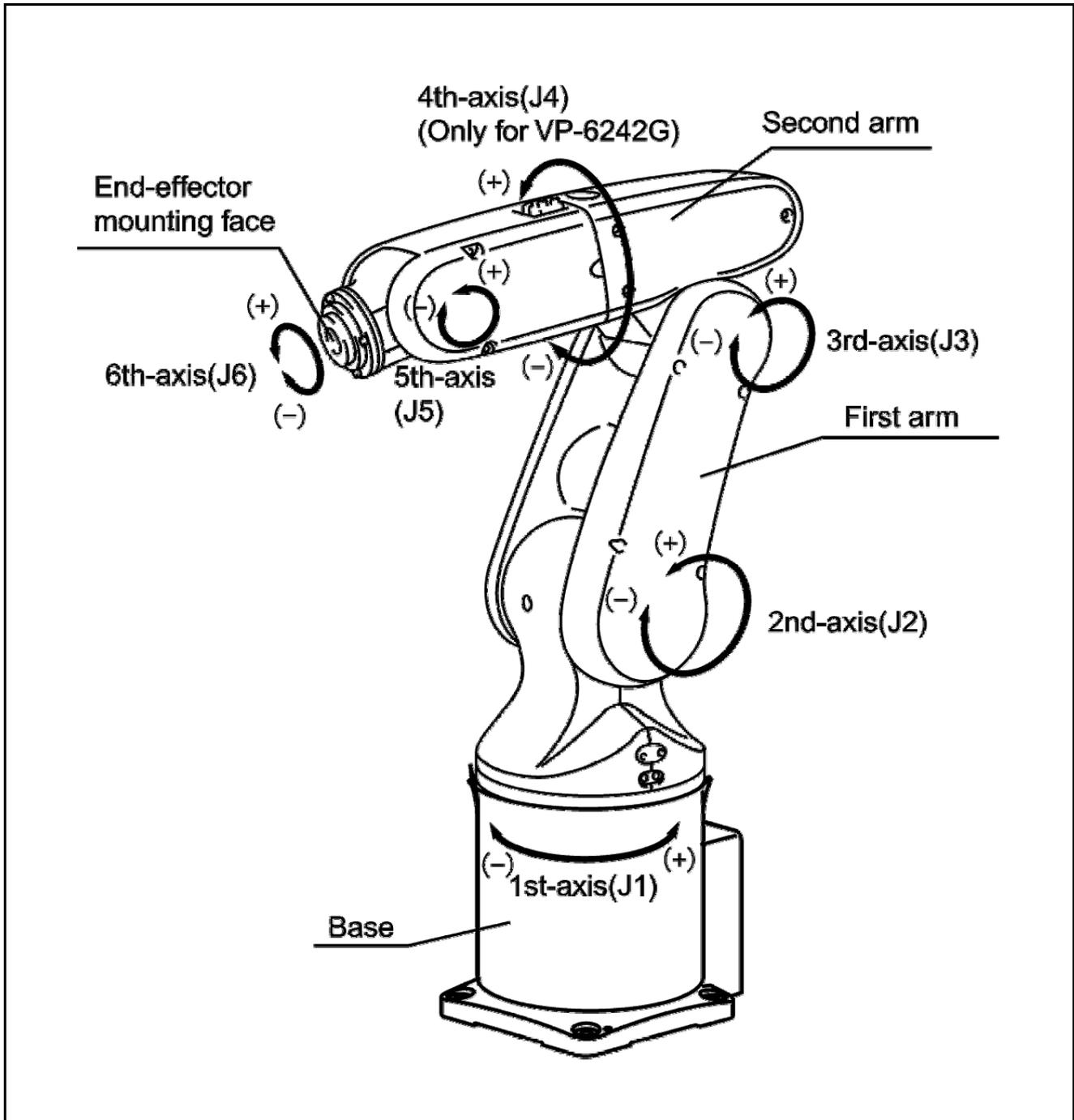
Names of Components (VP-G series)

NOTE: The flange (tool mounting face) of the robot unit may be coated with rust preventive oil which does not affect the robot function. If spattering of the oil could be a problem when the robot is in use, wipe it off before use.
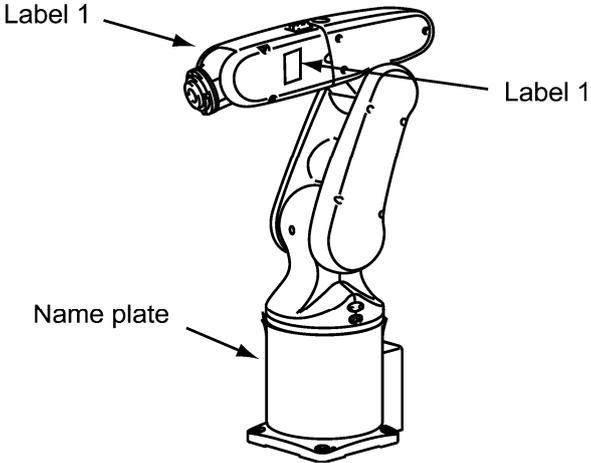
2.2.2 Name Plate

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

Warning and caution labels on the robot unit	Additional description
Label 1	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.

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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)

SAFETY BOARD
(Only for global type with safety board)

Rear panel (Air exhaust side)

Front panel

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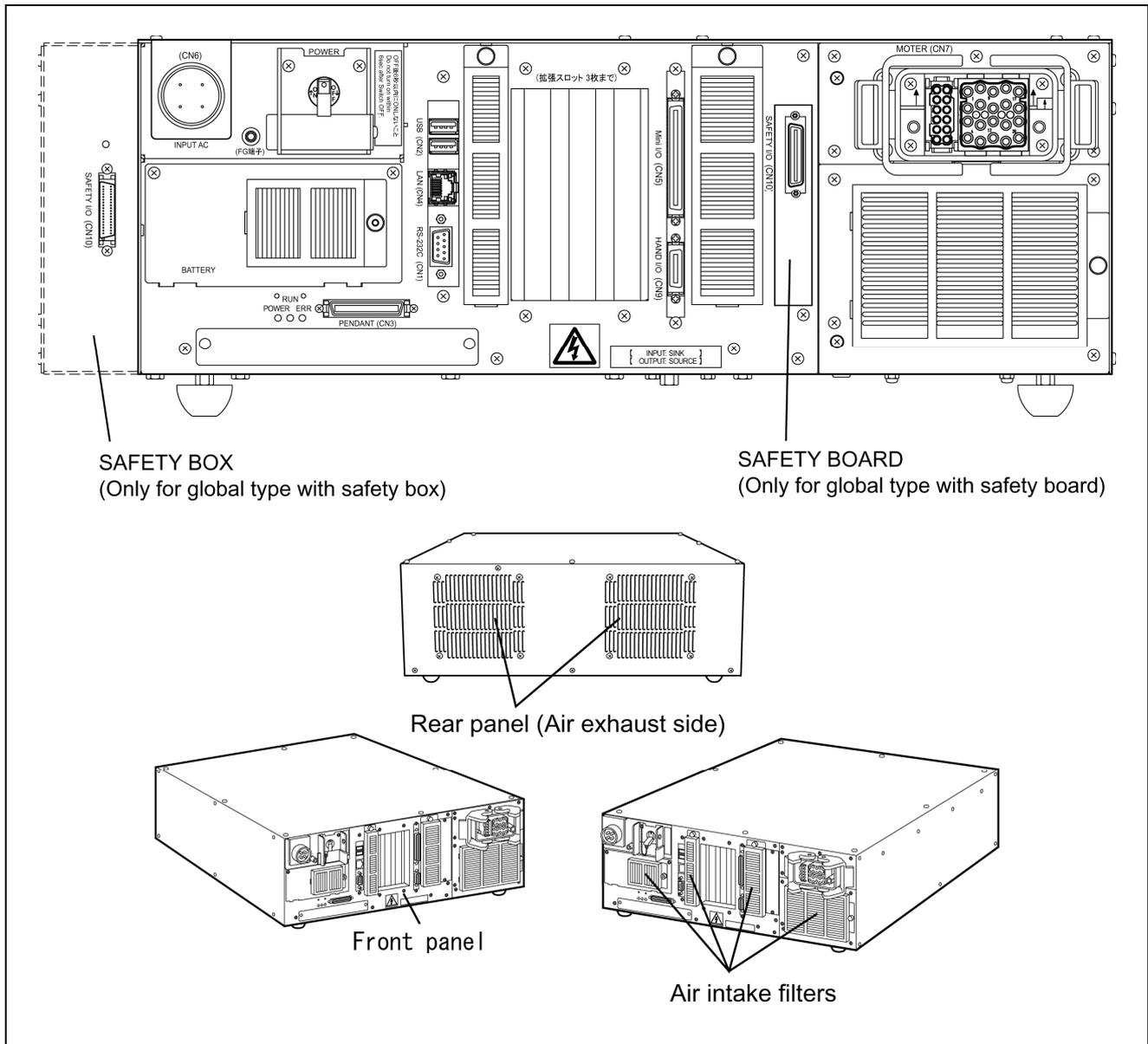
Connectors for the VP-G series (Encoders connected via bus)

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/encoder connector
CN9	HAND I/O	HAND I/O connector
CN10	SAFETY I/O	SAFETY I/O connector (Only for global type)

Names of Robot Controller Components

Chapter 3 Specifications of the Robot Unit

3.1 Robot Specifications

Following table list the robot unit specifications of the VP-G series.

VP-G Series Specifications

Item		Specifications	
		6-axis type	5-axis type **(Note 1)**
Model name of robot set **(Note 2)**		VP-6242G	VP-5243G
Model name of robot unit		VP-6242E/GM	VP-5243E/GM
Overall arm length		210 (first arm) + 210 (second arm) = 420 mm	210 (first arm) + 220 (second arm) = 430 mm
Arm offset		J3 (front arm): 75 mm	-
Maximum motion area		R = 502 mm (end-effector mounting face) R = 432 mm (Point P: J4, J5, J6 center)	R = 500 mm (end-effector mounting face) R = 430 mm (Point P: J5, J6 center)
Motion range		J1 : ±160° J2 : ±120° J3 : +160°, +19° J4 : ±160° J5 : ±120° J6 : ±360°	J1 : ±160° J2 : ±120° J3 : +136°, -128° J4 : none J5 : ±120° J6 : ±360°
Maximum payload		2 kg (2.5 kg at wrist direction downward)	2.5 kg (3 kg at wrist direction downward)
Maximum composite speed		3900 mm/s (at the center of an end-effector mounting face)	
Position repeatability **(Note 3)**		In each of X, Y and Z directions: ±0.02 mm	
Maximum allowable inertia moment		Around J4 and J5: 0.030 kgm^2 Around J6: 0.007 kgm^2	Around J5: 0.040 kgm^2 Around J6: 0.010 kgm^2
Position detection		Absolute encoder	
Drive motor and brake		AC servomotors for all joints, Brakes for all joints	
User air piping		4 systems (ϕ4x4)	
User signal line		9 (for proximity sensor signals, etc.)	
Air source	Operating pressure	0.10MPa to 0.39MPa	
	Maximum allowable pressure	0.49MPa	
Degree of protection		IP30	
Airborne noise (A-weighted equivalent continuous sound pressure level)		80 dB or less	
Weight		Approx. 15 kg (32 lbs)	Approx. 13 kg (29 lbs)

Note 1: **The 5-axis type robot has not the 4th axis (J4).**

Note 2: **The model name of robot set refers to the model name of a complete set including a robot unit and robot controller.**

Note 3: **Position repeatability is the value at constant ambient temperature.**

3.2 Outer Dimensions and Workable Space of the Robot Unit

The outer dimensions and workable space of the VP-G series are shown on the following pages.
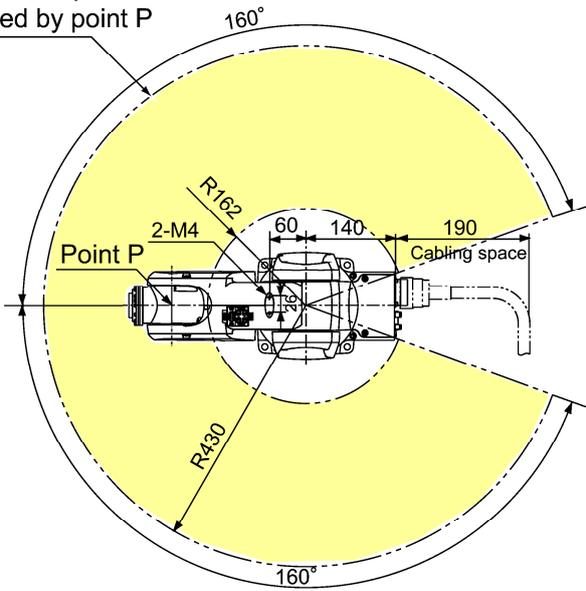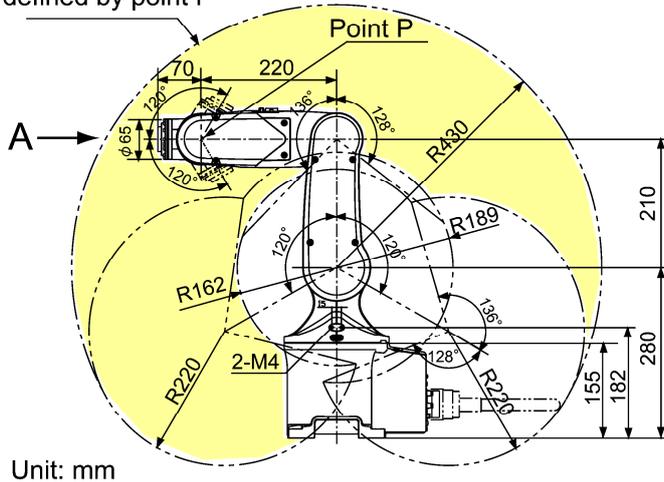
(1) VP-6242G (6-axis type)

Detailed drawing of end-effector mounting face (View A)

$\phi 40\,h\,8\,^{0}_{-0.039}$

4-M5, Depth 8 (P. C. D. 31.5)

$\phi 20H7\,^{+0.021}_{0}$, Depth 6

$\phi 5H7\,^{+0.012}_{0}$, Depth 7

Detailed drawing of base mounting face (Top view)

$2\text{-}\phi 6H7\,^{+0.012}_{0}$ (Reference hole)

49 ± 0.05

$4\text{-}\phi 10$

144 ± 0.05

R10
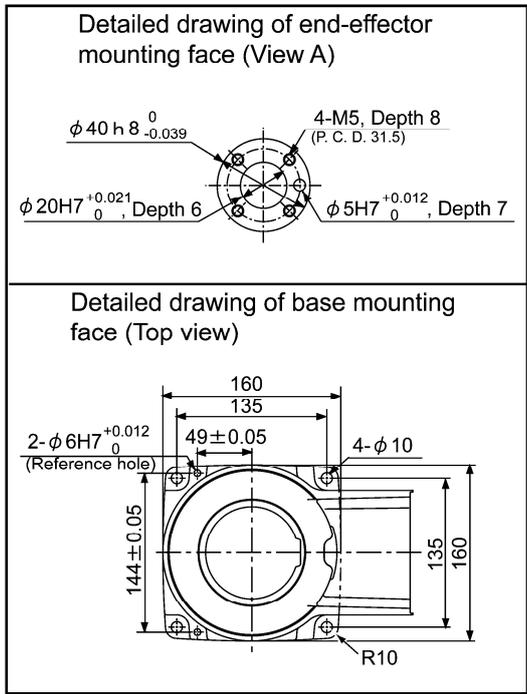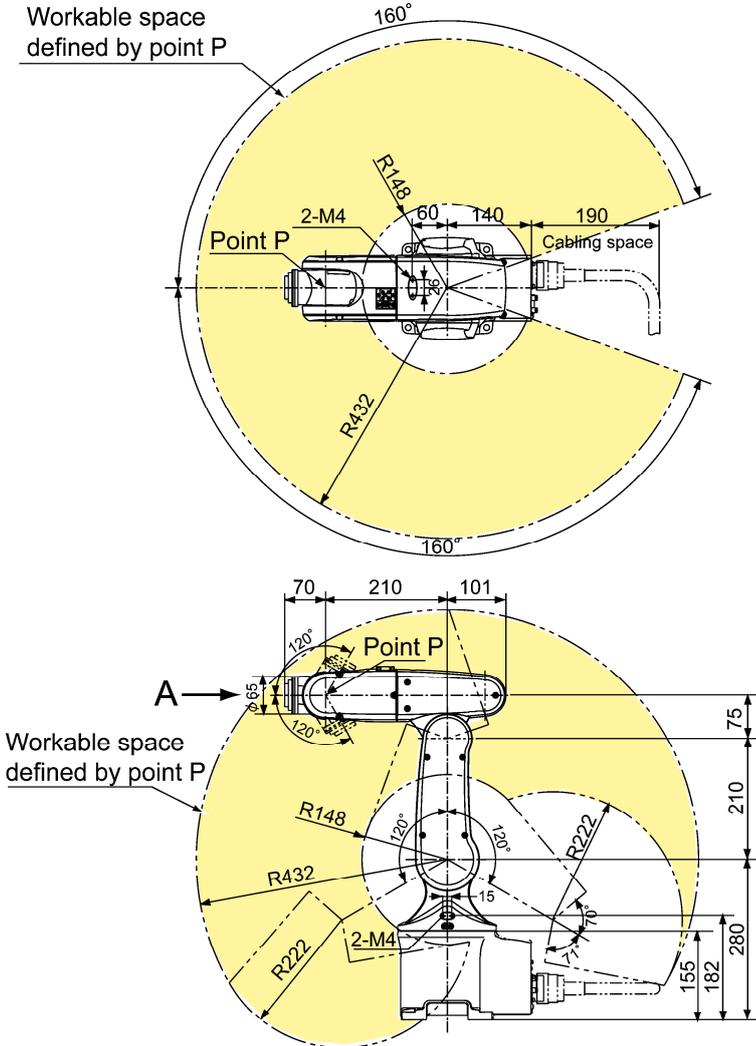
Unit: mm

Outer Dimensions and Workable Space [VP-6242G]

(2) VP-5243G (5-axis type)

Workable space defined by point P

Detailed drawing of end-effector mounting face (View A)

ϕ40 h 8 $^{0}_{-0.039}$

4-M5, Depth 8 (P. C. D. 31.5)

ϕ20H7 $^{+0.021}_{0}$, Depth 6

ϕ5H7 $^{+0.012}_{0}$, Depth 7

Detailed drawing of base mounting face (Top view)

160
135
2-ϕ6H7 $^{+0.012}_{0}$ (Reference hole)
49±0.05
4-ϕ10
144±0.05
135
160
R10

Workable space defined by point P

Unit: mm
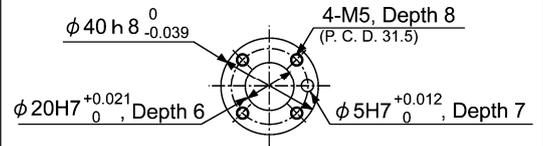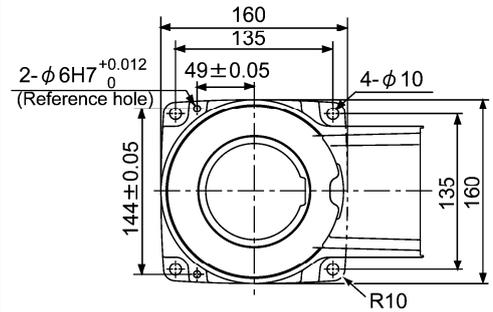
Outer Dimensions and Workable Space [VP-5243G]

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3.3   Robot Positioning Time

1. Positioning time means the time from the start of robot operation to the arrival at the target positioning point.

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

Caution (1) **The vibration dampening time depends on factors such as the weight of the end-effector. 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 in stand-by with a DELAY command until residual vibration stops.
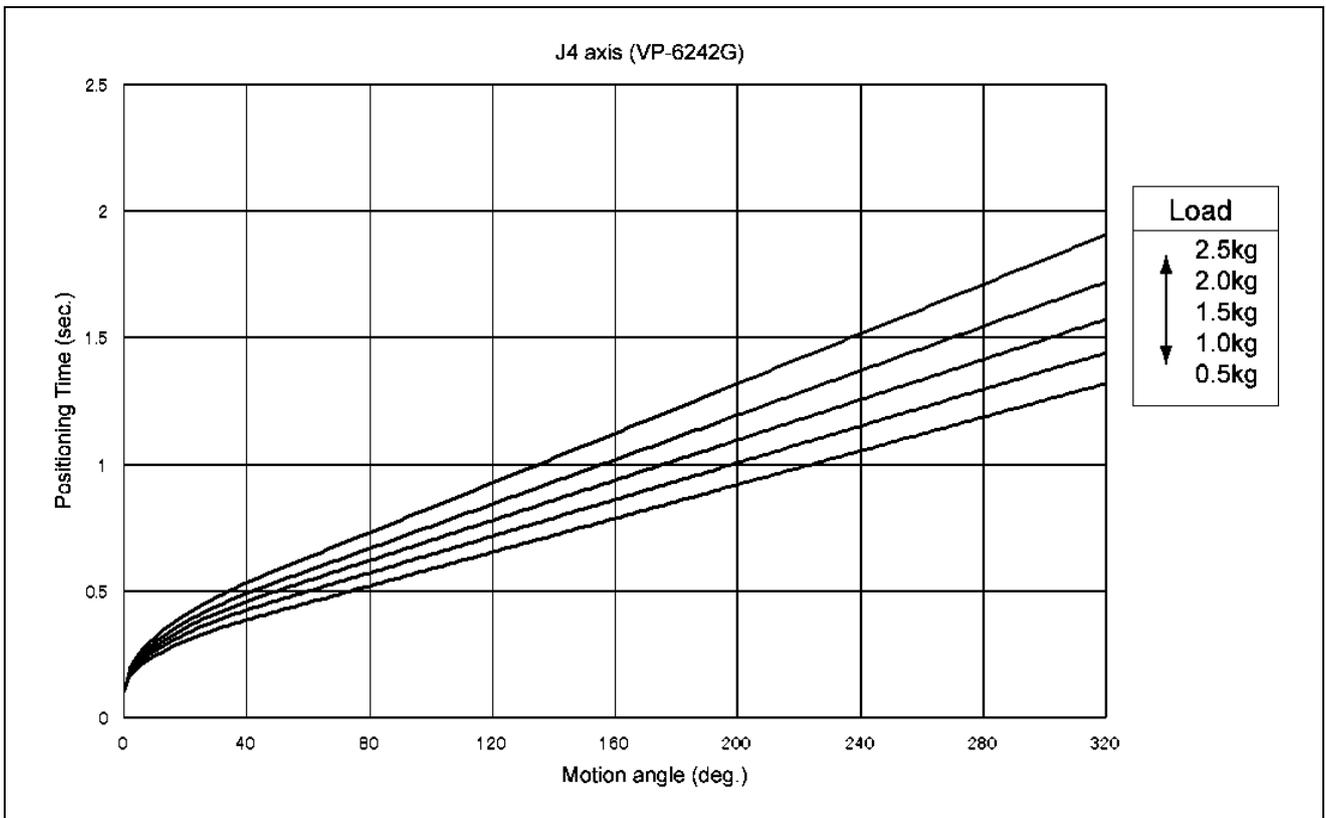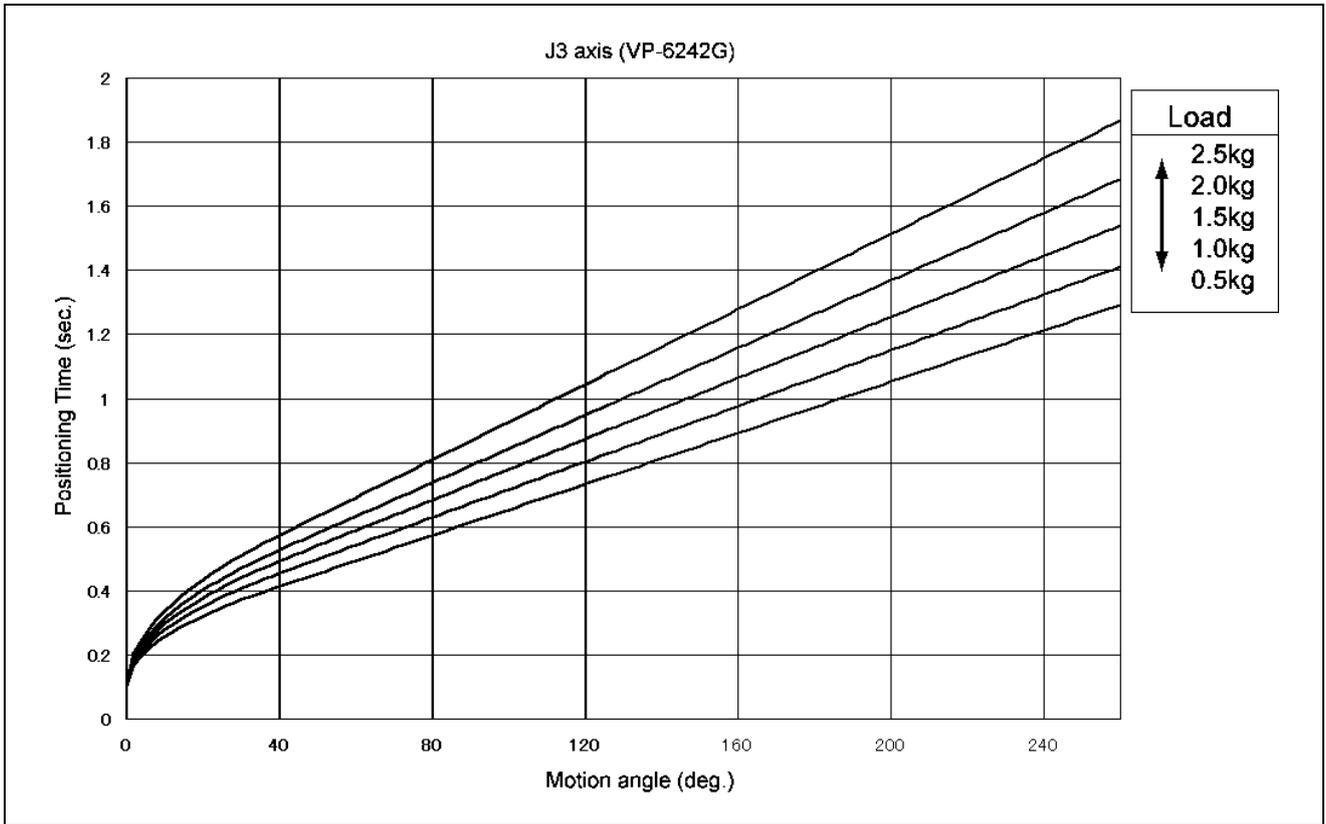   **· Lower acceleration with an ACCEL command.**

(3) **Operate the robot with the optimum load setting in accordance with the end-effector weight and workpiece weight. If not, a robot failure may result.**
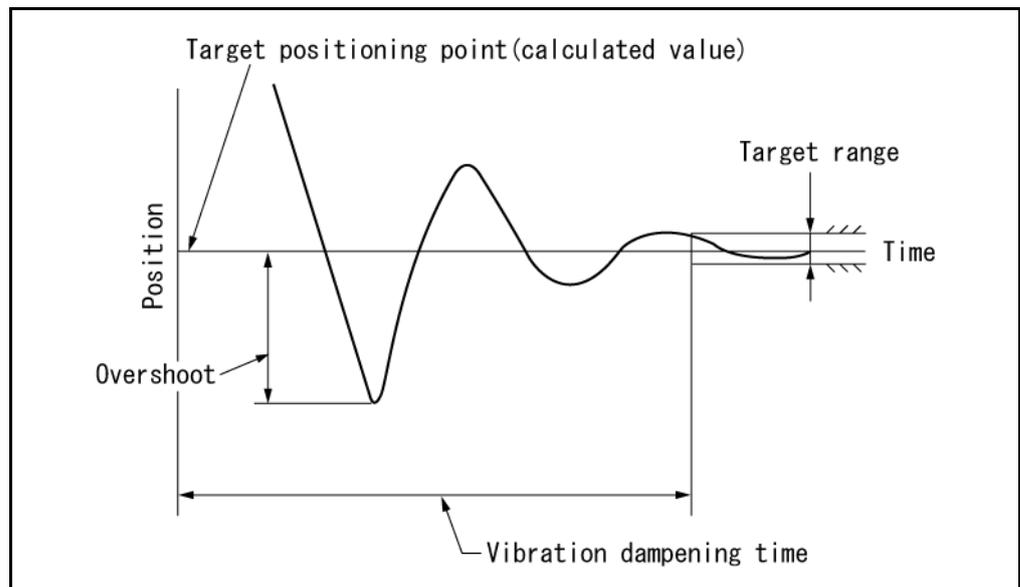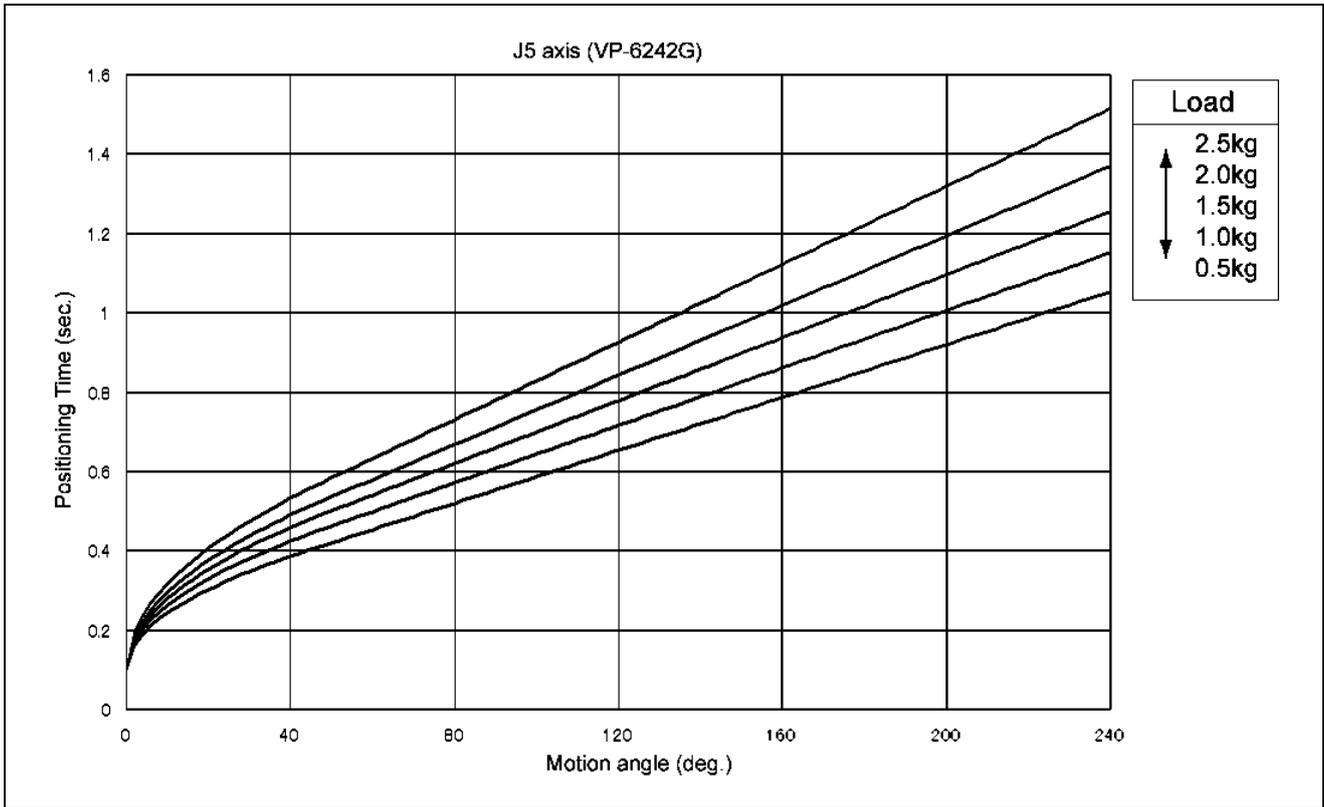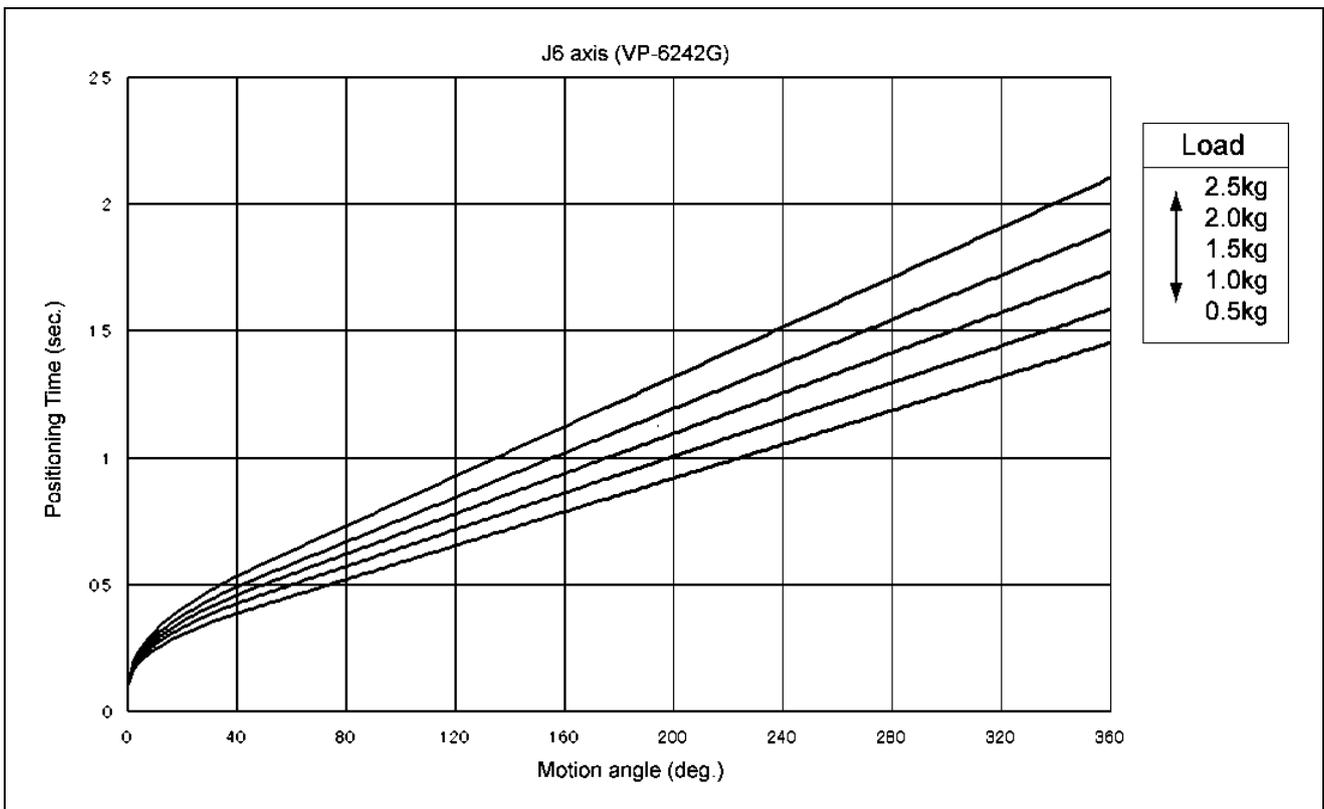

Vibration Dampening Time

3.3.1   VP-6242G robot positioning time

J1 Axis [VP-6242G]

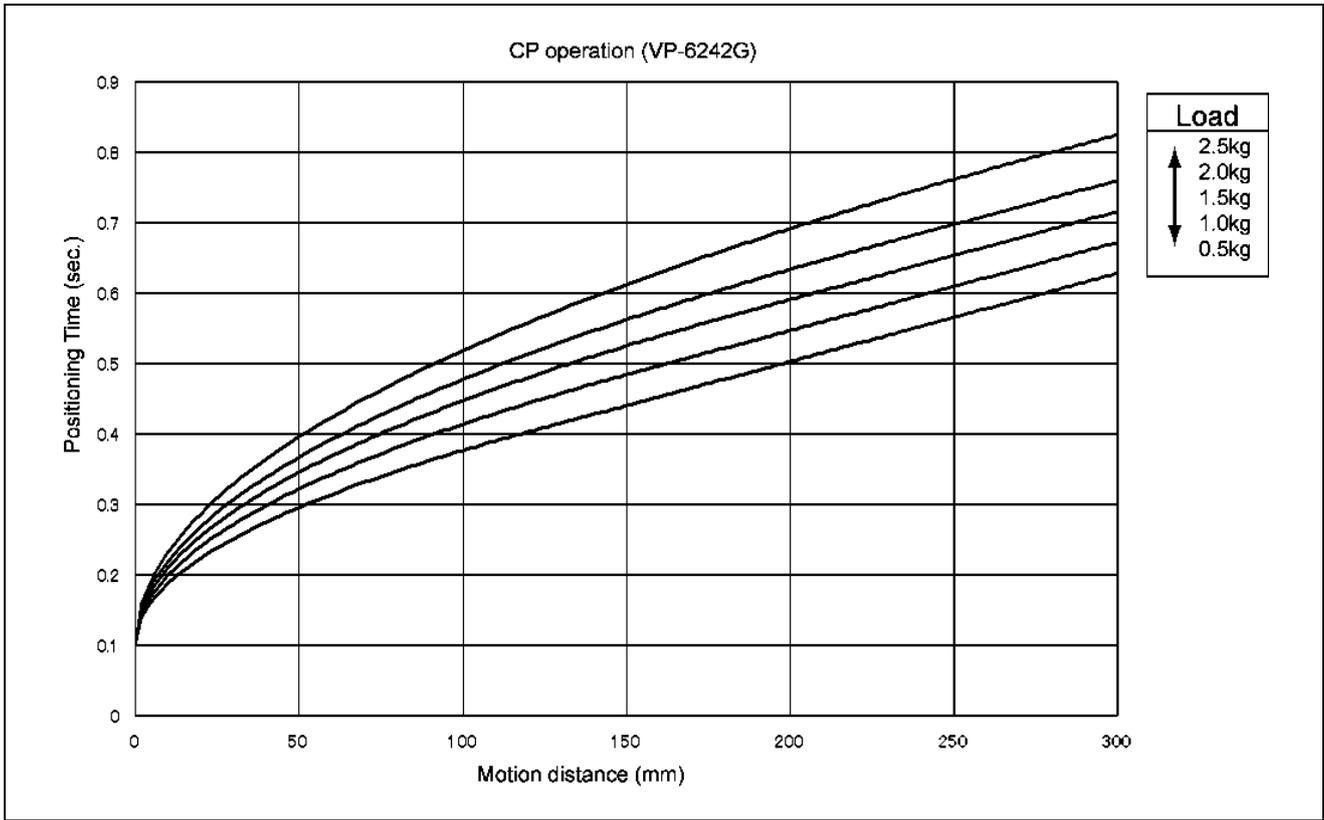J2 Axis [VP-6242G]

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J3 Axis [VP-6242G]
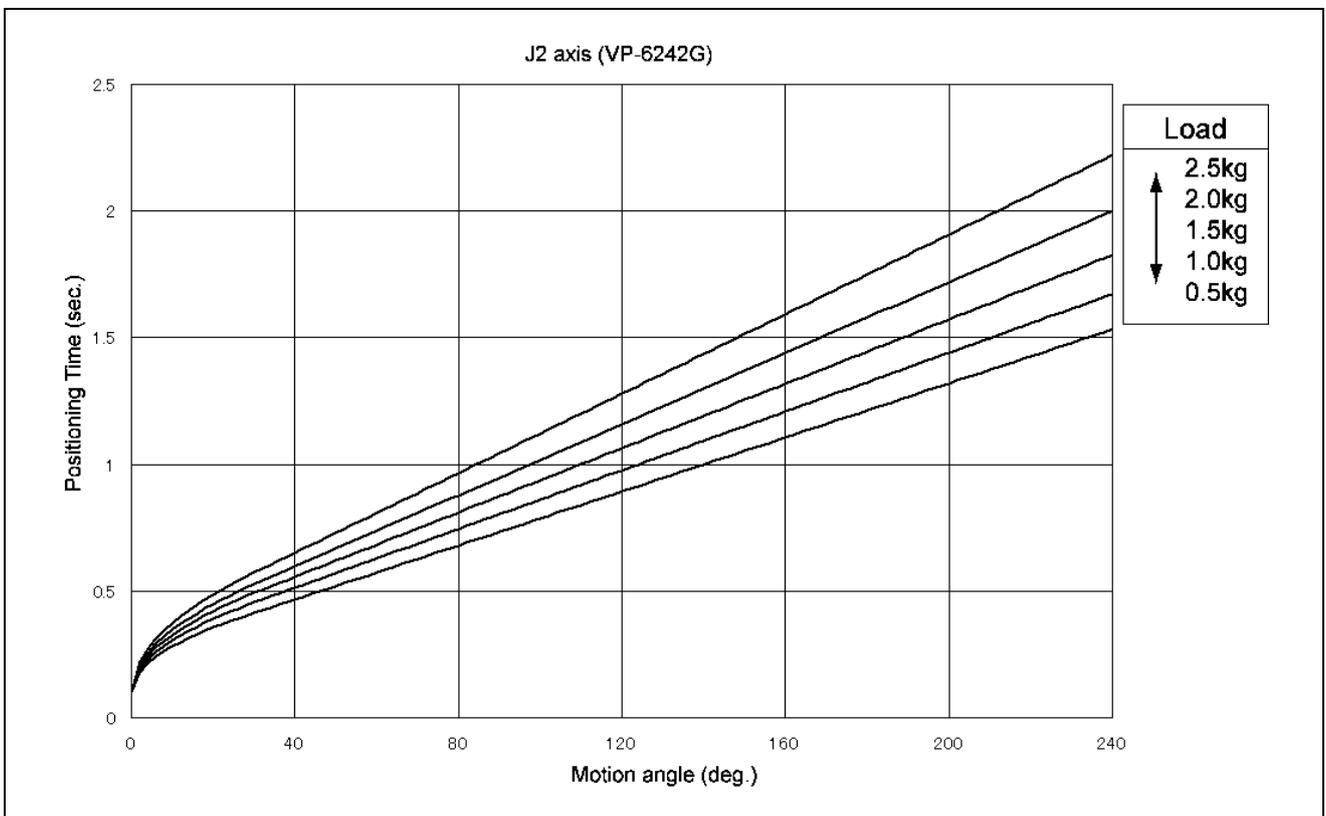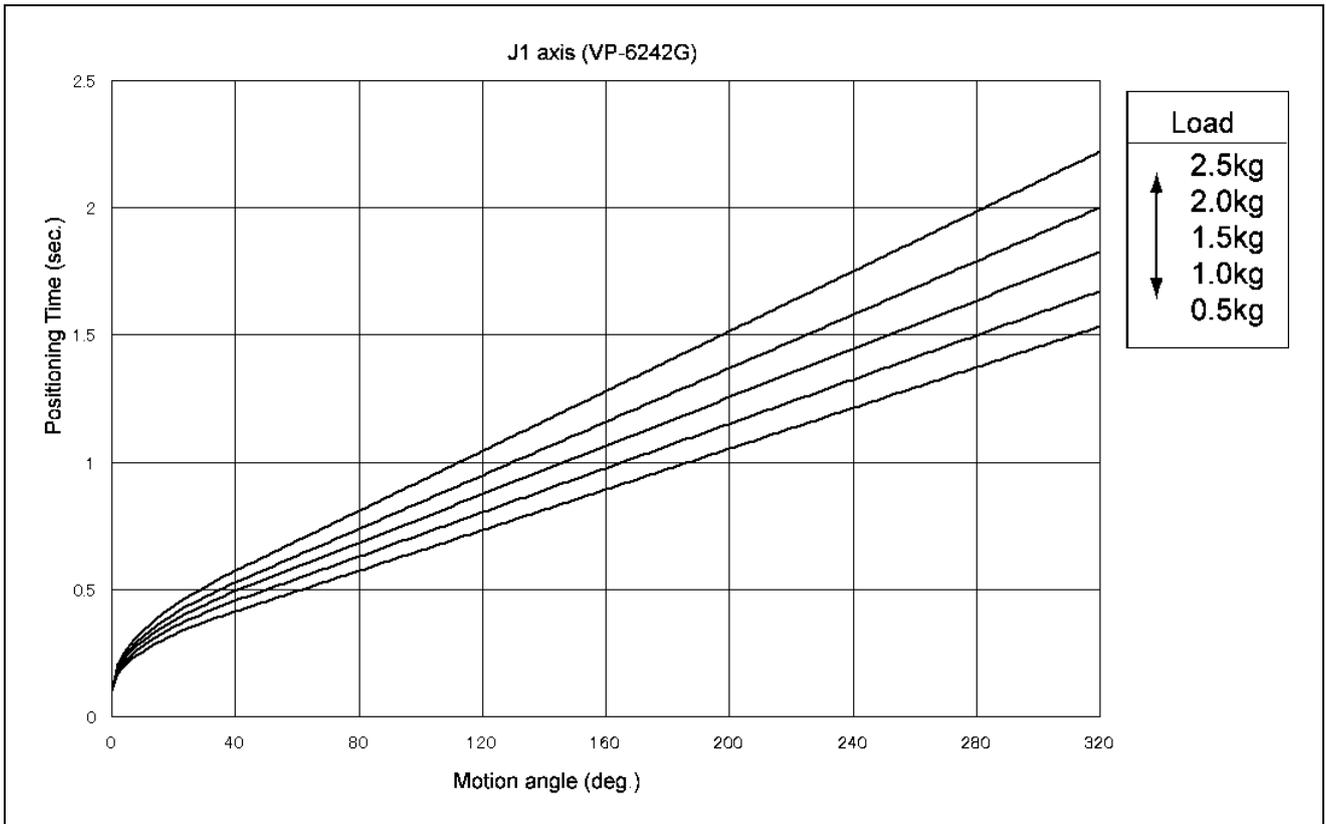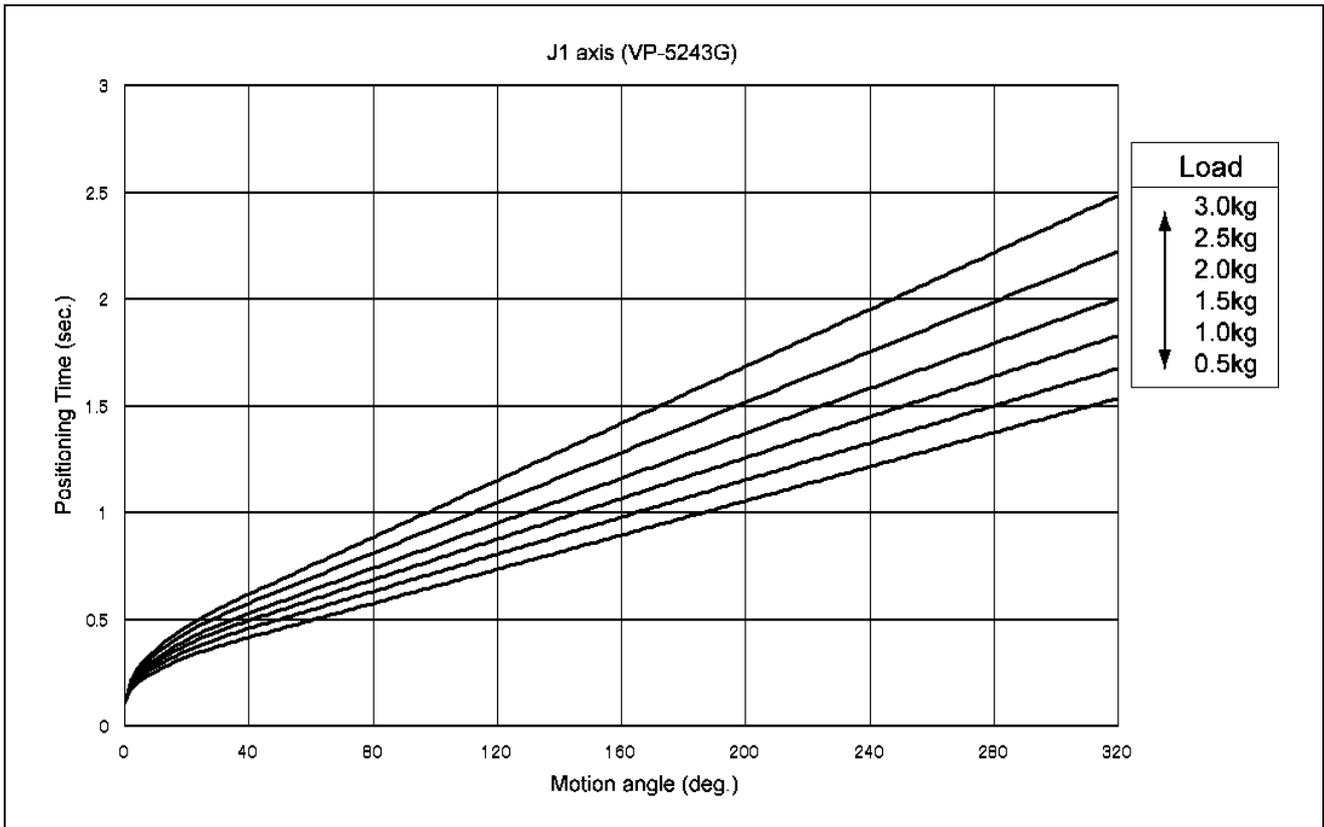

J4 Axis [VP-6242G]

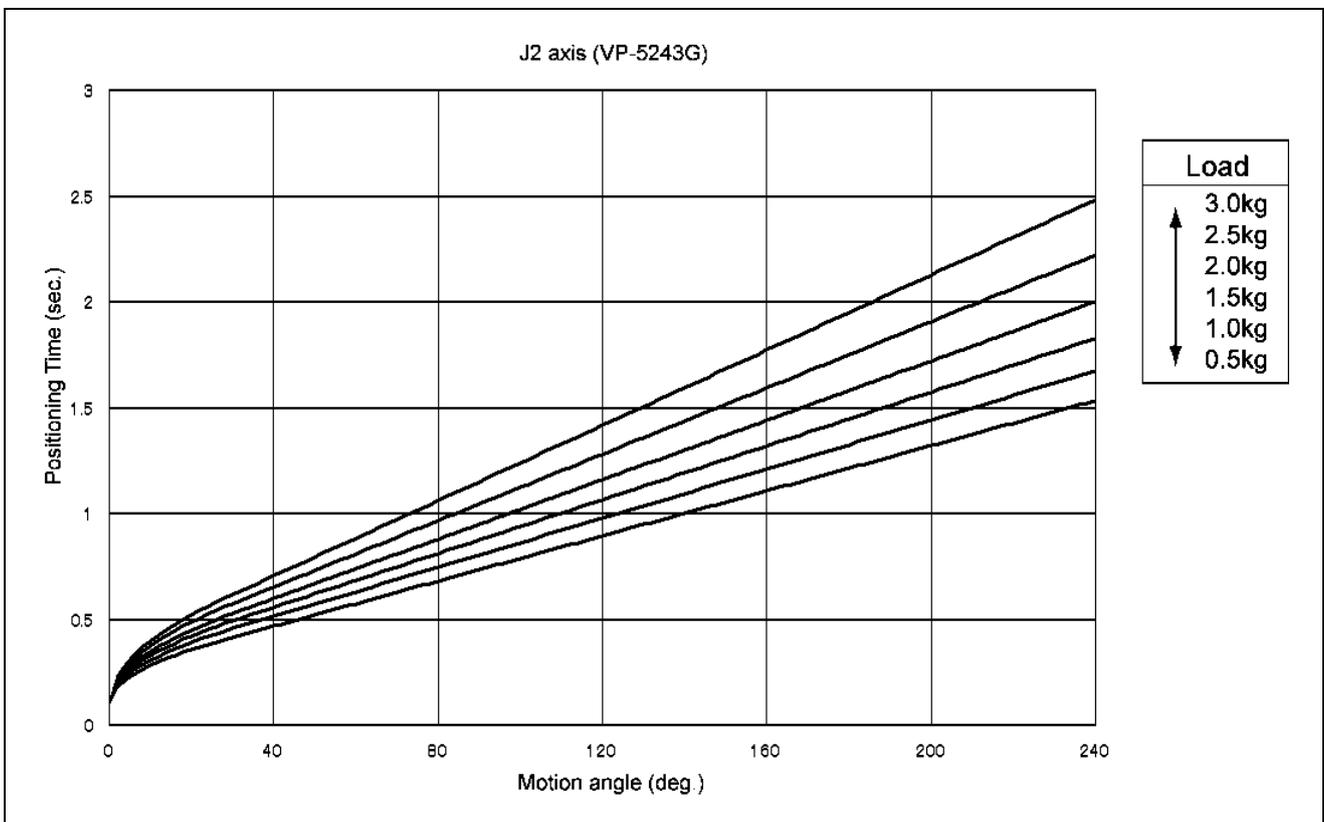J5 Axis [VP-6242G]

J6 Axis [VP-6242G]
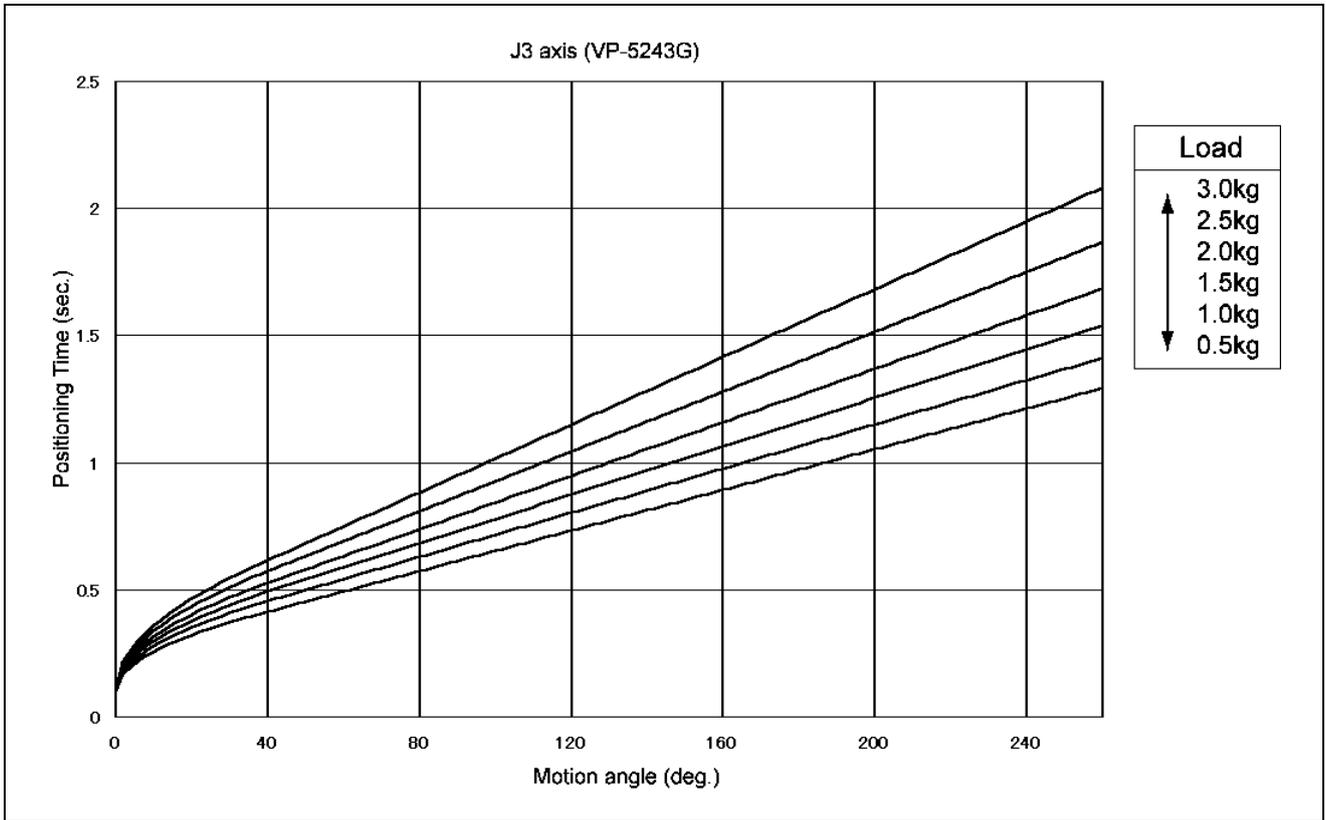
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CP Operation [VP-6242G]

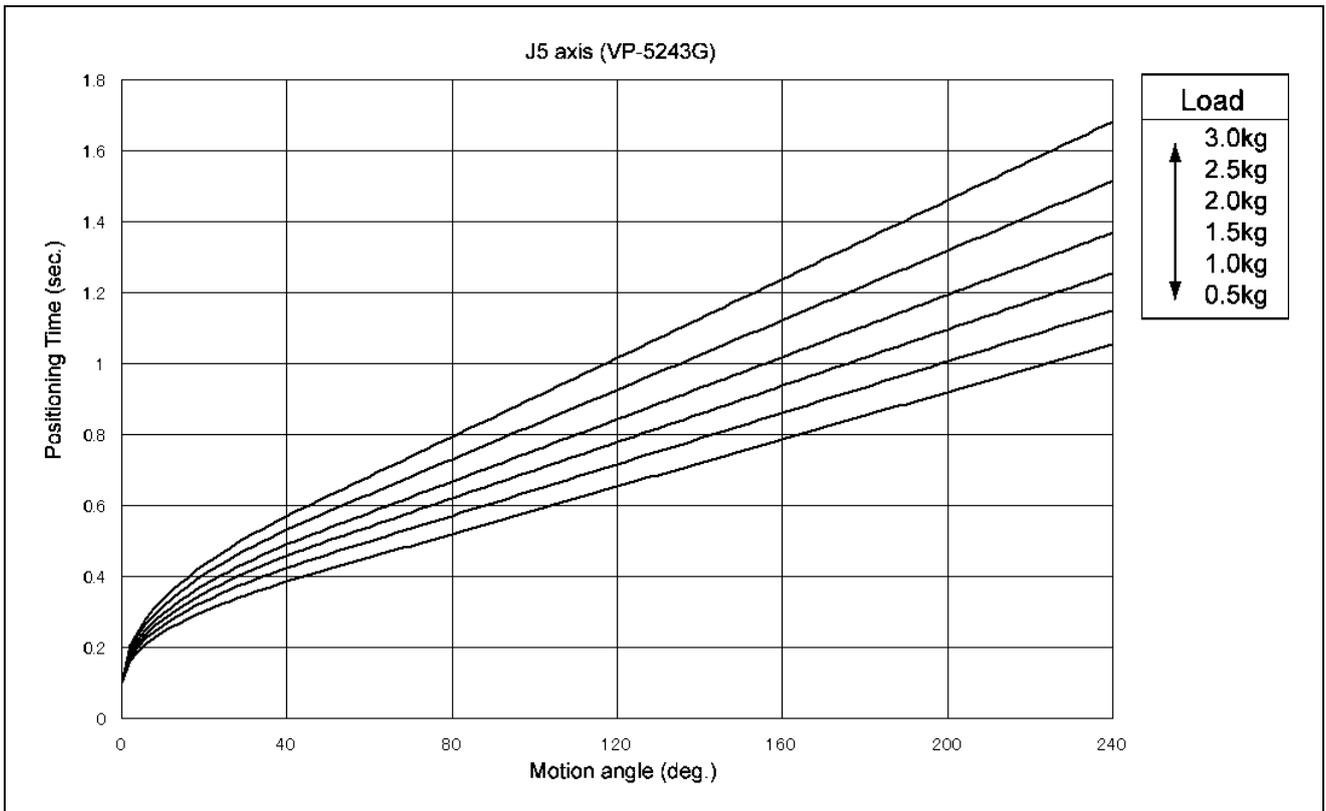## 3.3.2 VP-5243G robot positioning time

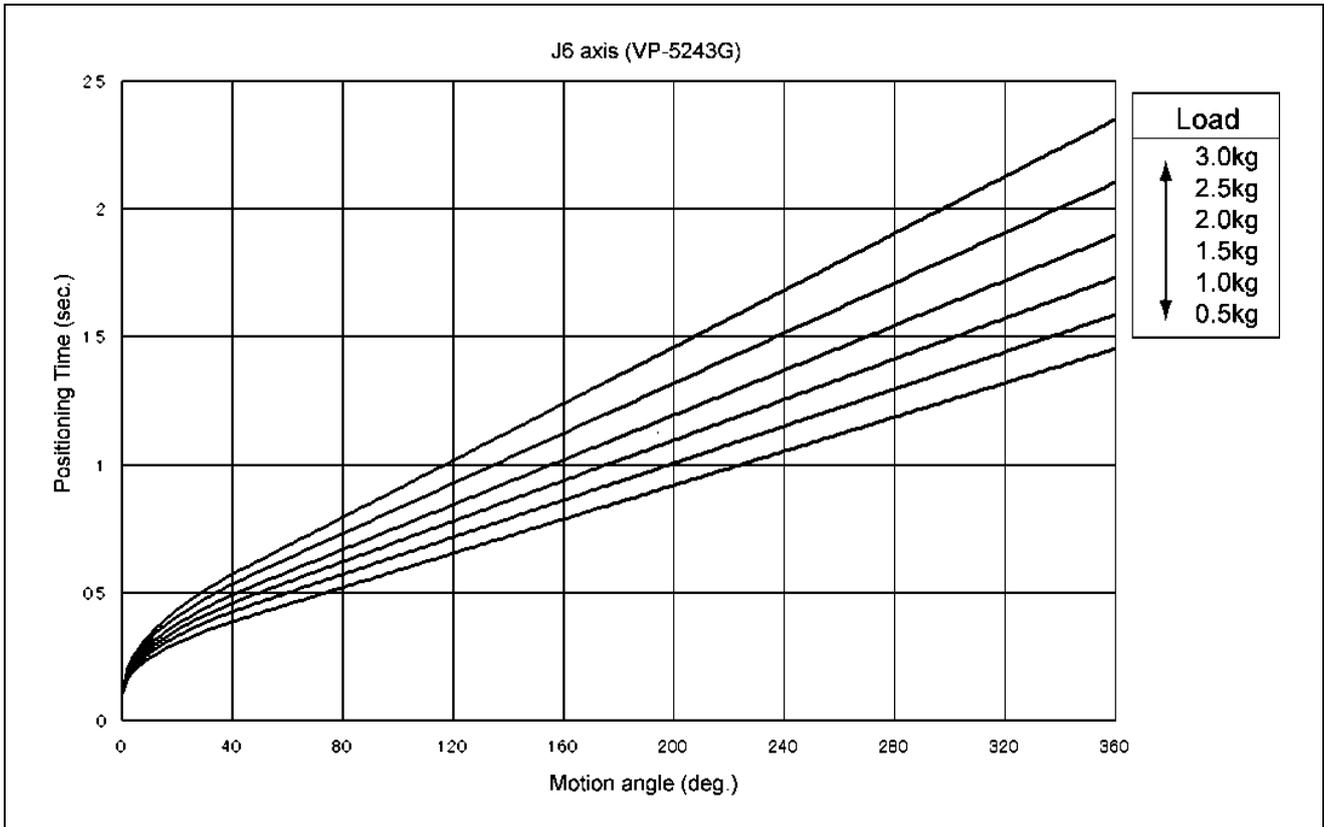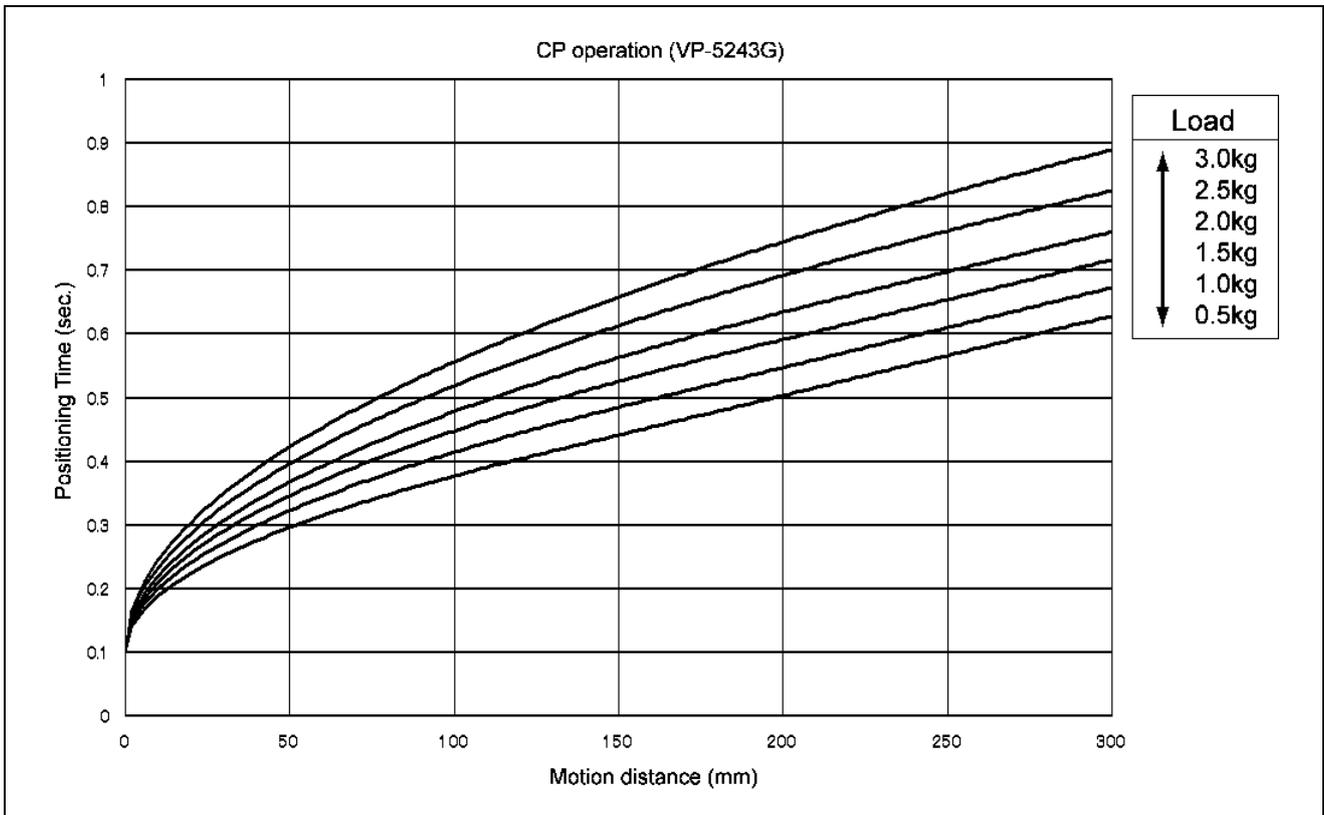J1 Axis [VP-5243G]

J2 Axis [VP-5243G]

J3 Axis [VP-5243G]

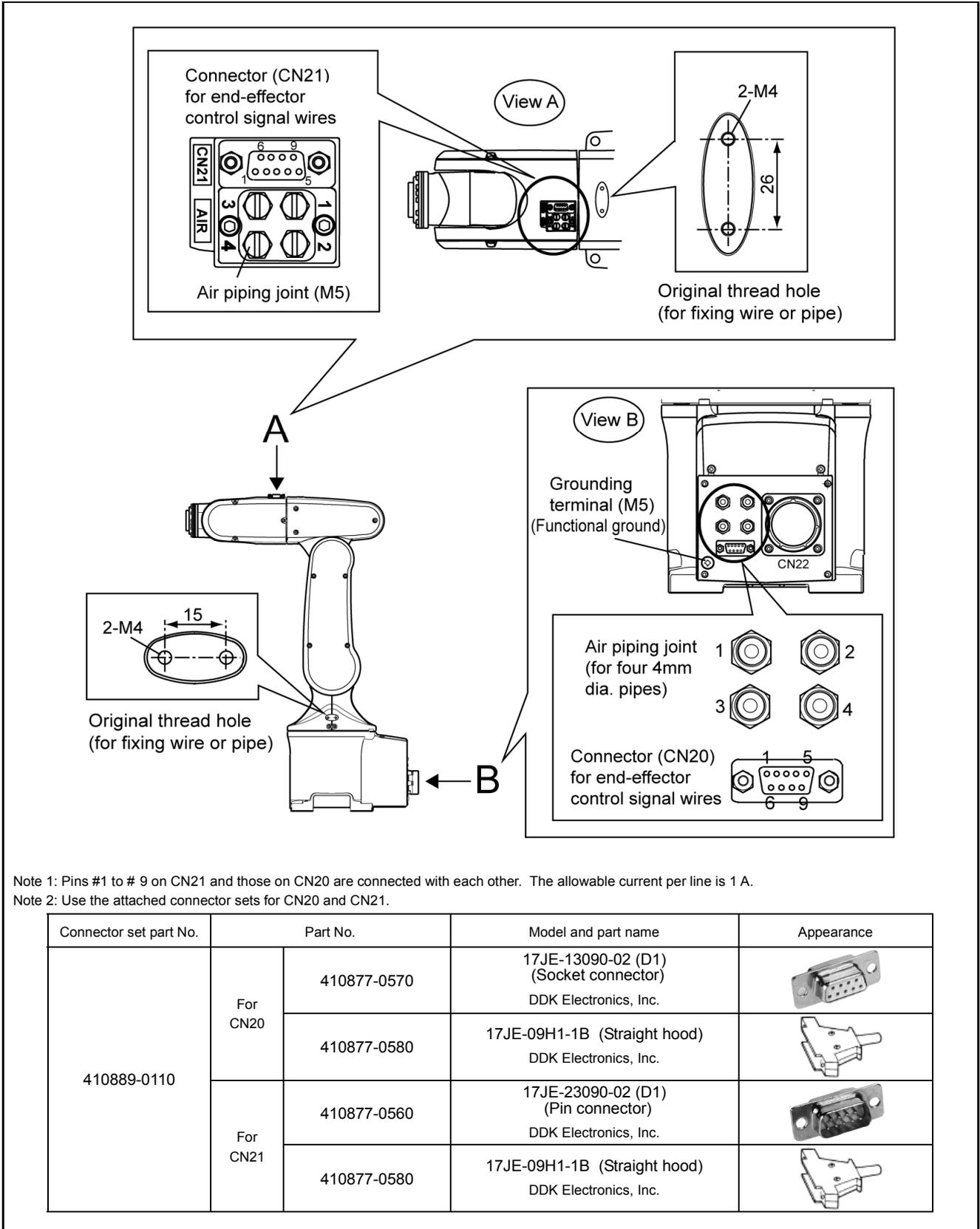

J5 Axis [VP-5243G]

J6 Axis [VP-5243G]

CP Operation [VP-5243G]

3.4 Air Piping and Signal Wiring

The VP-G series is equipped with 4 air pipes for air chuck and 9 signal lines. The air piping and signal wiring of the VP-G series are shown in the figure below.

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.

Note 1: Pins #1 to # 9 on CN21 and those on CN20 are connected with each other. The allowable current per line is 1 A.
Note 2: Use the attached connector sets for CN20 and CN21.

Connector set part No.		Part No.	Model and part name	Appearance
410889-0110	For CN20	410877-0570	17JE-13090-02 (D1) (Socket connector) DDK Electronics, Inc.	
		410877-0580	17JE-09H1-1B (Straight hood) DDK Electronics, Inc.	
	For CN21	410877-0560	17JE-23090-02 (D1) (Pin connector) DDK Electronics, Inc.	
		410877-0580	17JE-09H1-1B (Straight hood) DDK Electronics, Inc.	

Air Piping and Signal Wiring [VP-G series]

3.5   Precautions When Designing the End-effectors

Design an end-effector such that it is in compliance with items (1) to (3) described below.

| ⚠ CAUTION	If the end-effector design precautions are not observed, the clamped parts of the robot unit may become loose, rattle or be out of position. In the worst case, the mechanical parts of the robot and robot controller may become damaged.

(1) Mass of end-effector

Design the end-effector so that the total mass of the end-effector (including workpiece) will be lighter than the maximum payload capacity of the robot. The total mass includes the wiring, piping, etc.

Max. total mass of end-effector (inc. workpiece) ≤ Max. payload capacity

(2) Center of gravity position of end-effector

Design an end-effector so that the center of gravity position of the end-effector (including workpiece) is within the specified range.

VP-6242G	VP-5243G
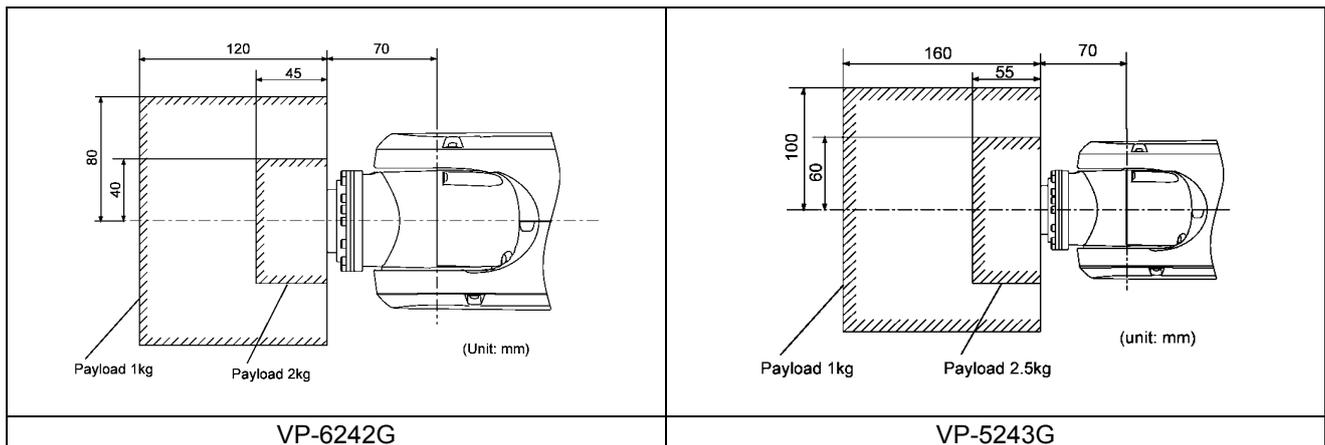
Allowable Range of Center of Gravity Position of End-effector

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(3) Moment of inertia around J4, J5 and J6

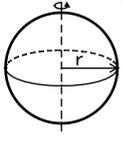Design an end-effector so that its moments of inertia around J4, J5 and J6 (including workpiece) do not exceed the maximum allowable moment of inertia of the robot.

Moment of inertia around J4, J5 and J6 of end-effector (incl. mass of workpiece) ≤ Max. allowable moment of inertia

Robot model	Around axis	Maximum allowable moment
VP-6242G	Around J4 or J5	0.030kgm^2
	Around J6	0.007kgm^2
VP-5243G	Around J5	0.040kgm^2
	Around J6	0.010kgm^2

When calculating the moment of inertia around J4, J5 and J6 of the end-effector, use the formulas given in Following Table and Figure.

Moment-of-Inertia Formulas

1. Cylinder (1)

(Axis of rotation = Center axis)

$$I = \frac{mr^2}{2}$$

2. Cylinder (2)

(The axis of rotation passes through the center of gravity.)

$$I = \frac{m}{4}\left(r^2 + \frac{\ell^2}{3}\right)$$

3. Rectangular parallelepiped

(The axis of rotation passes through the center of gravity.)

$$I = \frac{m}{12}(b^2 + c^2)$$

4. Sphere

(Axis of rotation = Center axis)

$$I = \frac{2mr^2}{5}$$
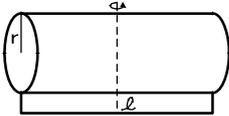
5. Center of gravity not on the axis of rotation
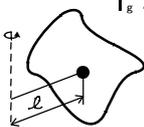
I_g : Inertia moment around center of gravity $[\text{kgm}^2]$
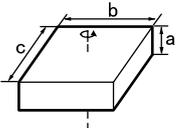
$$I = I_g + m\ell^2$$

I:	Moment of inertia	kgm^2
m:	Mass	kg
r:	Radius	m
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 end-effector into three parts (①, ②, ③).

(1) Moment of inertia around J6
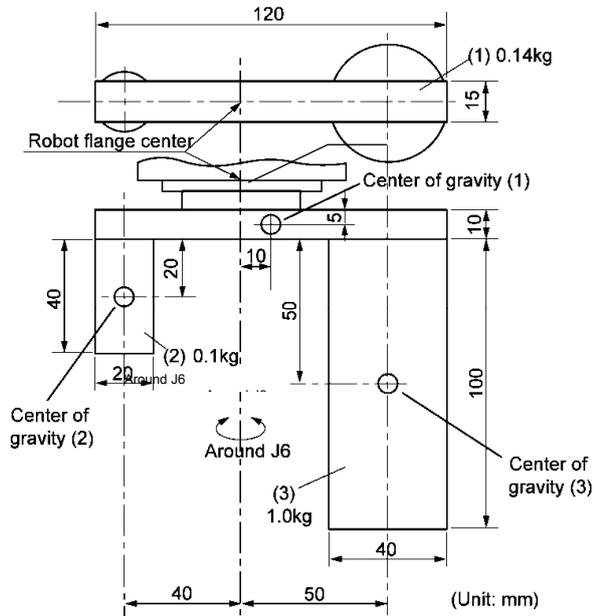
Moment of inertia around J6 of (1): I_1 (from 3 and 5 in the above table)

$$I_1 = \frac{0.14}{12}(0.12^2 + 0.015^2) + 0.14 \times 0.01^2 = 1.85 \times 10^{-4} \ [kgm^2]$$

Moment of inertia around J6 of (2): I_2 (from 1 and 5 in the above table)

$$I_2 = \frac{0.1 \times 0.01^2}{2} + 0.1 \times 0.04^2 = 1.65 \times 10^{-4} \qquad [kgm^2]$$

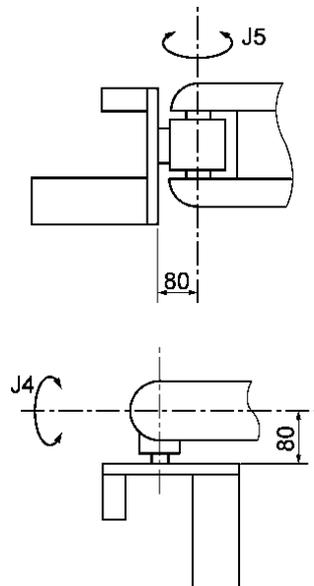Moment of inertia around J6 of (3): I_3 (from 1 and 5 in the above table)

$$I_3 = \frac{1.0 \times 0.02^2}{2} + 1.0 \times 0.05^2 = 2.7 \times 10^{-3} \qquad [kgm^2]$$

Moment of inertia around J6 of entire hand: I_{J6}

$$I_{J6} = I_1 + I_2 + I_3 = 0.003 \qquad [kgm^2]$$

(2) Moment of inertia around J4 and J5

For the end-effector shown below, the moment of inertia around J4 and J5 can be calculated according to the same formula.

Moment of inertia around J4 and J5 of (1): I_1 (from 3 and 5 in the above table)

$$I_1 = \frac{0.14}{12}(0.015^2 + 0.01^2) + 0.14 \times (0.08 + 0.005)^2 = 1.02 \times 10^{-3} \qquad [kgm^2]$$

Moment of inertia around J4 and J5 of (2): I_2 (from 2 and 5 in the above table)

$$I_2 = \frac{0.1}{4}(0.01^2 + \frac{0.04^2}{3}) + 0.1 \times (0.08 + 0.01 + 0.02)^2 = 1.23 \times 10^{-3} \ [kgm^2]$$

Moment of inertia around J4 and J5 of (3): I_3 (from 2 and 5 in the above table)

$$I_3 = \frac{1.0}{4}(0.02^2 + \frac{0.1^2}{3}) + 1.0 \times (0.08 + 0.01 + 0.05)^2 = 2.0 \times 10^{-2} \ [kgm^2]$$

Moment of inertia around J4 and J5 of entire end-effector: I_{J4}, I_{J5}

$$I_{J4} = I_{J5} = I_1 + I_2 + I_3 = 2.22 \times 10^{-2} \qquad [kgm^2]$$

End-effector Moment of Inertia Calculation Example

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.

(1) VP-6242G series
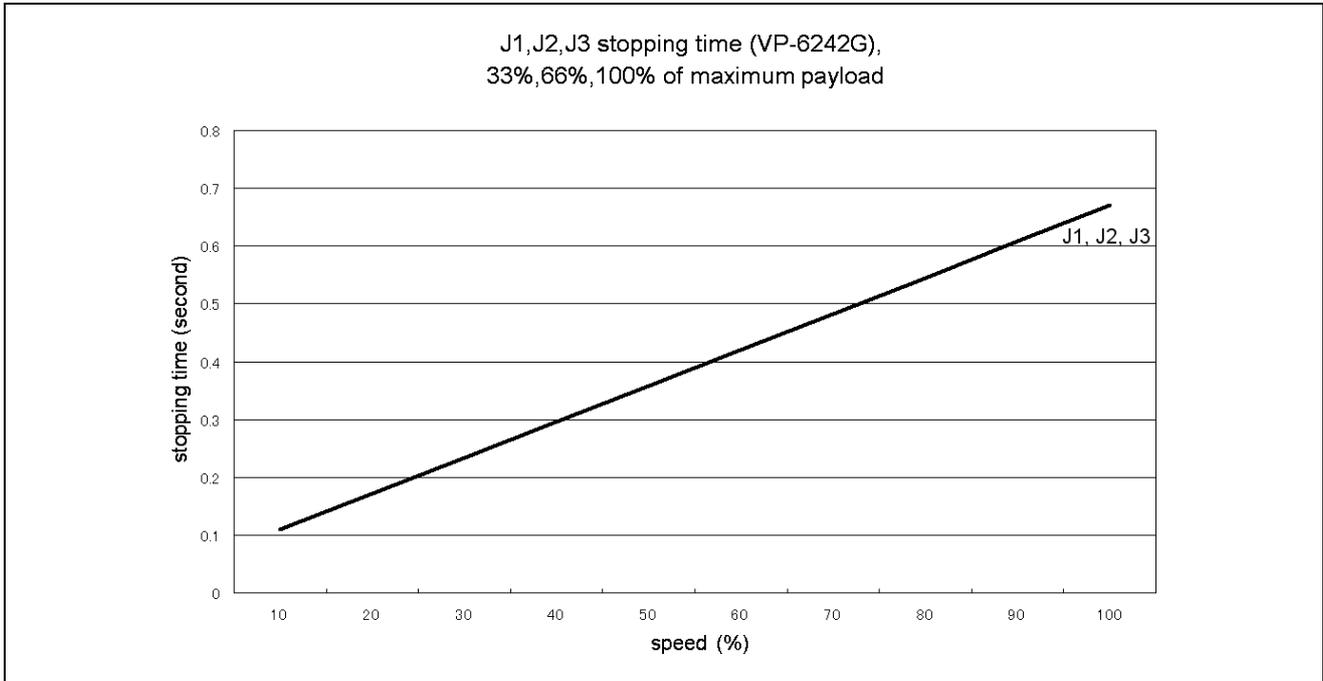
J1, J2, J3 stopping time vs. speed at an emergency stop (VP-6242G series)
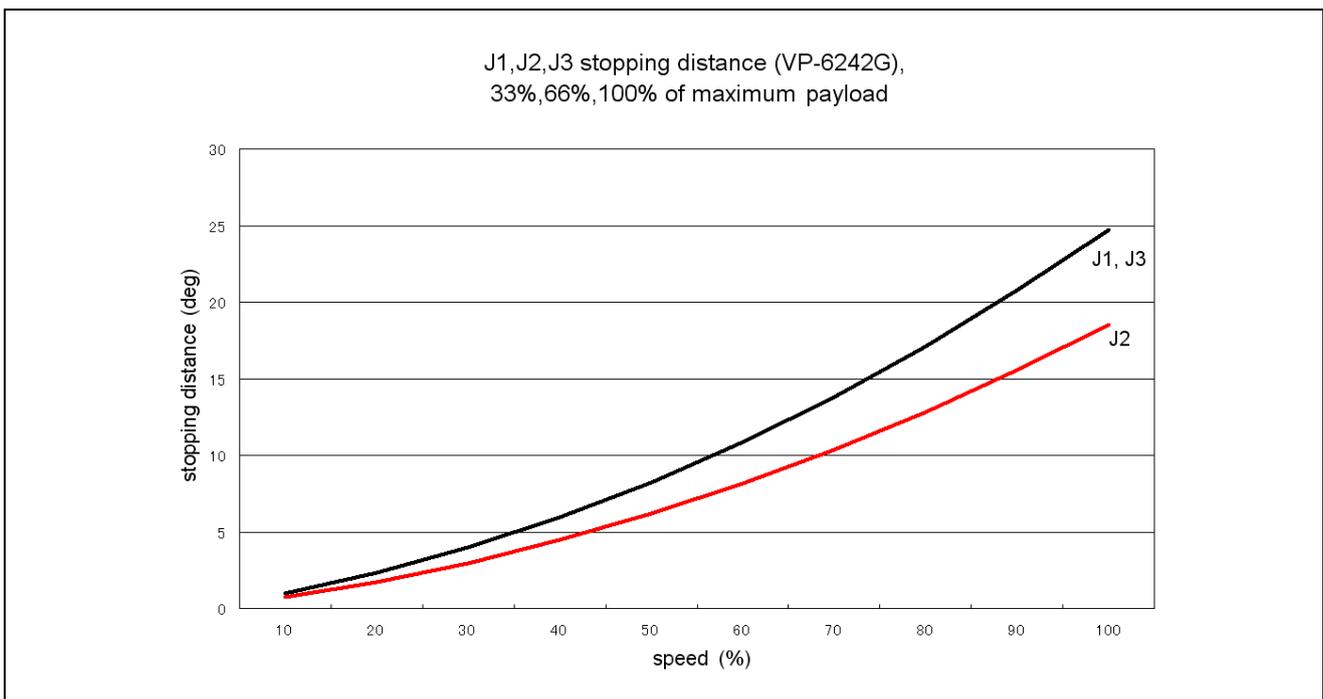
J1, J2, J3 stopping distance vs. speed at an emergency stop (VP-6242G series)

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(2) VP-5243G series

J1, J2, J3 stopping time vs. speed at an emergency stop (VP-5243G)

J1, J2, J3 stopping distance vs. speed at an emergency stop (VP-5243G)

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Chapter 4
Specifications of the Robot Controller

4.1   Specifications

Table below lists the robot controller specifications.

RC7M Controller Specifications (1) (VP-G series)

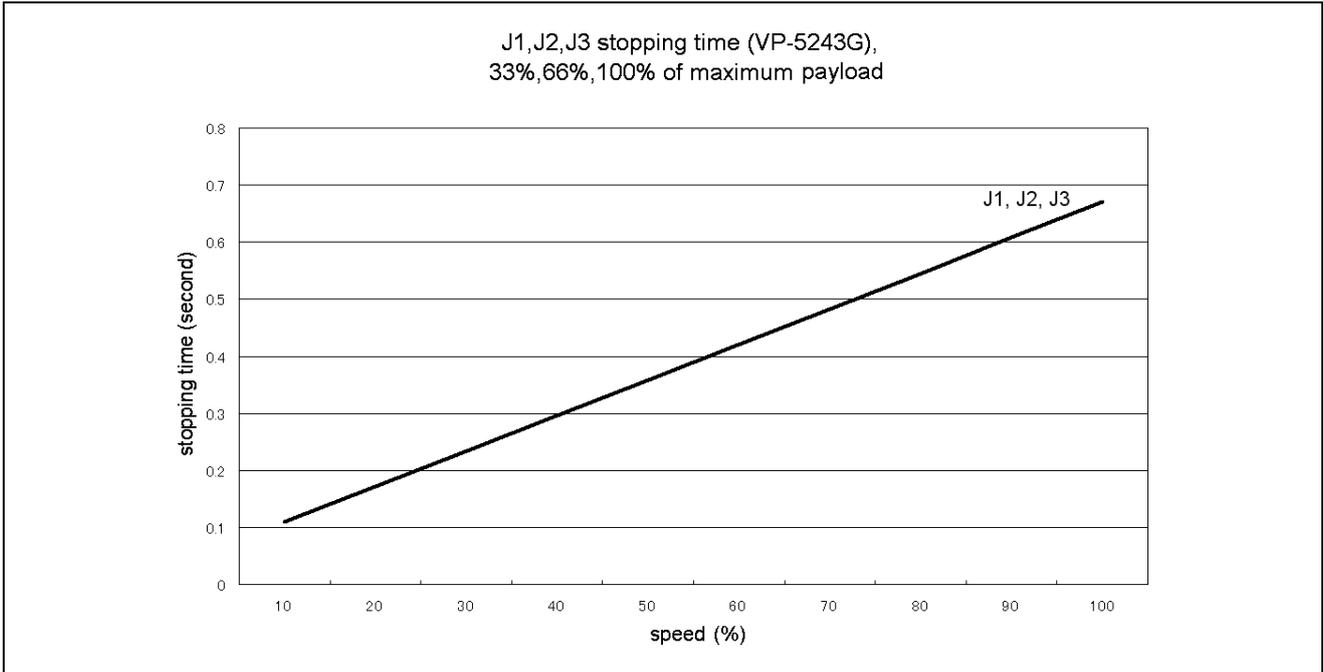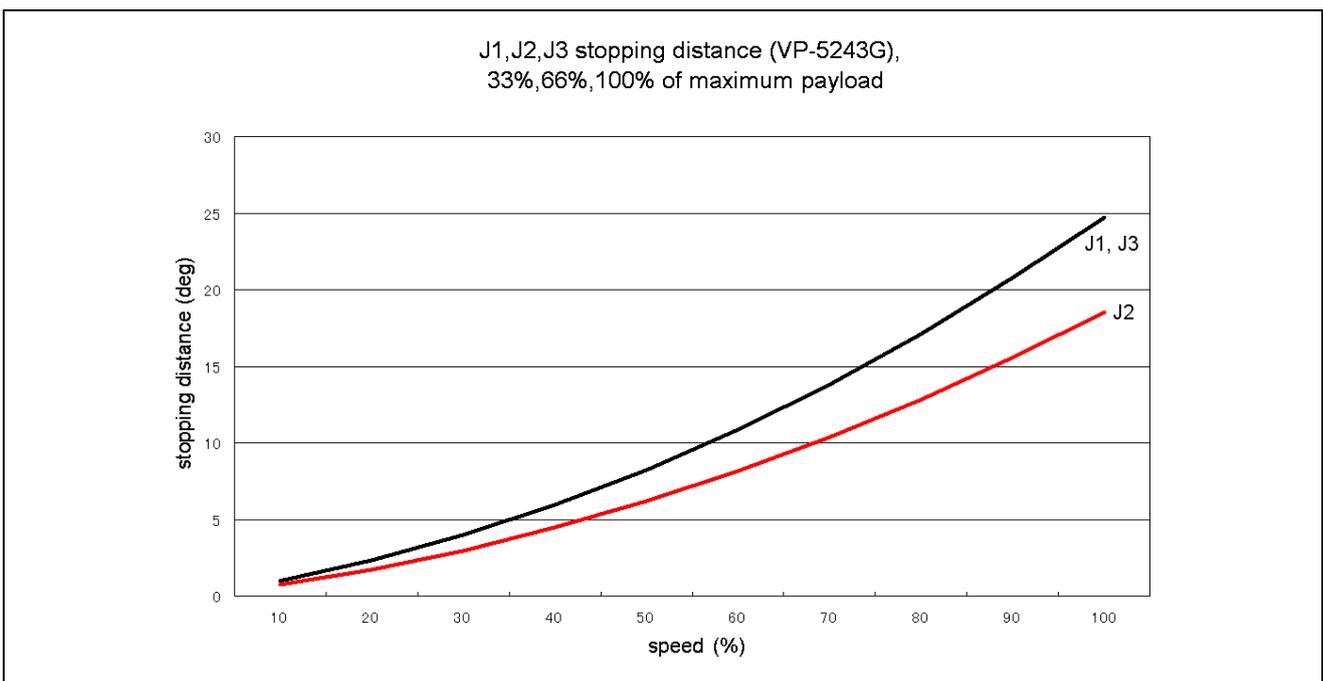| Item			Specifications	
Applicable robot			Mini-sized, vertical articulated type VP-6242G (6-axis type)	Mini-sized, vertical articulated type VP-5243G (5-axis type)
Controller model			RC7M-VPG5/6CA*-**	RC7M-VPG5/6CA*-**
No. of controllable axes			Six axes	Five axes
Control system			PTP, CP 3-dimensional linear, 3-dimensional circular	
Drive system			All axes: Full-digital AC servo	
Language used			DENSO robot language (conforming to SLIM)	
Memory capacity			3.25 MB (equivalent to 10,000 steps, 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	
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 outputted on 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)		2 m, 4 m, 6 m, 12 m, 20 m (Standard)	
	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) (VP-G series)

Item	Specifications
Environmental conditions (in operation)	Temperature: 0 to 40°C Humidity: 90% RH or less (no condensation allowed)
Power source	200 VAC type: 　Three-phase, 200 VAC-15% to 230 VAC+10%, 50/60 Hz, 1 kVA 　Single-phase, 230 VAC-10% to 230 VAC+10%, 50/60 Hz, 1 kVA -- 100 VAC type: 　Single-phase, 100 VAC-10% to 110 VAC+10%, 50/60 Hz, 1 kVA
Degree of protection	IP20
Weight	Standard type:　　　　　　　　Approx. 18 kg (40 lbs) Global type with safety board:　Approx. 19 kg (42 lbs) Global type with safety box:　　Approx. 22 kg (49 lbs)

⚠**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 while the power switch is on. Doing so may cause electric shock or controller failure.**

⚠ **CAUTION IN INSTALLATION**

· **This controller is not designed to be dust-proof, splash-proof, or explosion-proof.**

· **Read operation-manuals before installation.**

· **Do not place anything on the controller.**

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4.2   Outer Dimensions

Figure below shows the outer dimensions of the robot controller.

Outer Dimensions of Robot Controller (VP-G series)

Safety board
(Only for global type with safety board)

Safety box
(Only for global type with safety box)

(Unit：mm)

Outer Dimensions of RC7M Robot Controller

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
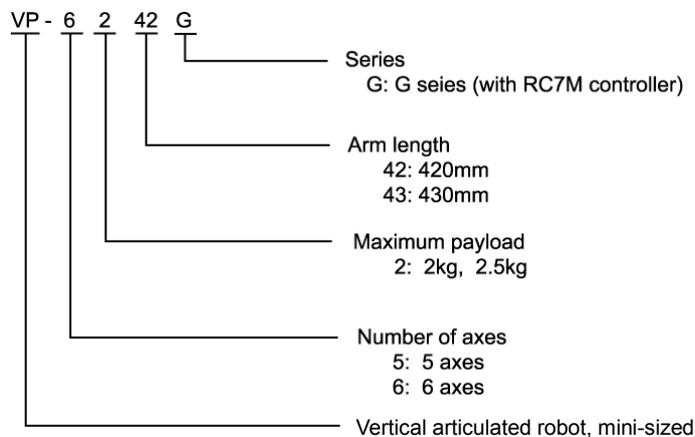

Robot Controller

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 coding of the set model is described below:
SUBASSEMBLY	The type and position of the controller IPM board are described.

The coding of the set model (VP-G series)

VP - 6 2 42 G

Series
   G: G seies (with RC7M controller)

Arm length
   42: 420mm
   43: 430mm

Maximum payload
   2: 2kg, 2.5kg

Number of axes
   5: 5 axes
   6: 6 axes

Vertical articulated robot, mini-sized

Chapter 5 Warranty

DENSO robots are manufactured under strict quality control. In case of failure, we warranty the robot under the following conditions:

Warranty Period

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

Warranty Coverage

DENSO WAVE 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 in the related manuals;

(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 in the related manuals, 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.

Chapter 6 Appendix

6.1 Conformity with Standards by Robot Model

For information on conformity with standards,contact your DENSO representative.

Vertical Articulated Robot
VP-G SERIES

GENERAL INFORMATION ABOUT ROBOT

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.