

DENSO ROBOT

Vertical articulated

VM-G SERIES

GENERAL INFORMATION ABOUT ROBOT

Copyright © DENSO WAVE INCORPORATED, 2005-2013

All rights reserved. No part of this publication may be reproduced in any form or by any means without permission in writing from the publisher.

Specifications are subject to change without prior notice.

All products and company names mentioned are trademarks or registered trademarks of their respective holders.

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		Remarks (Max. reach nickname)
	Floor-mount	Overhead-mount	
VM-G (Medium-sized, vertical articulated)	VM-6083G VM-60B1G	Same as left. Same as left.	(VM1000) (VM1300)

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 VM-6083G, for example, the robot unit model is VM-6083D/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
1.1 Standard Components	1
1.2 Optional Components.....	2
Chapter 2 Configuration of the Robot System	4
2.1 Configurators	4
2.2 Names of Robot Unit Components	5
2.2.1 Robot Unit Components and Rotation Direction	5
2.2.2 Name Plate.....	6
2.2.3 Warning and Caution Labels.....	7
2.3 Names of the Robot Controller Components	8
Chapter 3 Specifications of the Robot Unit	9
3.1 Robot Specifications	9
3.2 Outer Dimensions and Workable Space of the Robot Unit	13
3.3 Robot Positioning Time.....	19
3.4 Air Piping, Signal Wiring, and Solenoid Valve Specifications	26
3.4.1 Air Piping and Signal Wiring.....	26
3.4.2 Instructions for Using Splash-proof Connector Sets.....	29
3.4.3 Solenoid Valve Specifications (VM-G series)	30
3.4.4 Original Thread Holes for Wiring and Piping (VM-G series).....	30
3.5 Precautions When Designing the End-effectors.....	31
3.6 Stopping Time and Distance (Angle) at an Emergency Stop	34
Chapter 4 Specifications of the Robot Controller	36
4.1 Specifications	36
4.2 Outer Dimensions.....	38
4.3 Controller Setting Table	39
Chapter 5 Warranty	40
Chapter 6 Appendix	41
6.1 Conformity with Standards by Robot Model	41

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)	Short sockets for robot controller	2

Note 1: Choose and order 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 2 m	410141-3611
Standard cable 6 m	410141-3621
Standard cable 12 m	410141-3631
Standard cable 20 m	410141-4440
Splash-proof cable 2 m	410141-4420
Splash-proof cable 4 m	410141-3681
Splash-proof cable 6 m	410141-3691
Splash-proof cable 12 m	410141-3701
Splash-proof cable 20 m	410141-4460

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 (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"	(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	

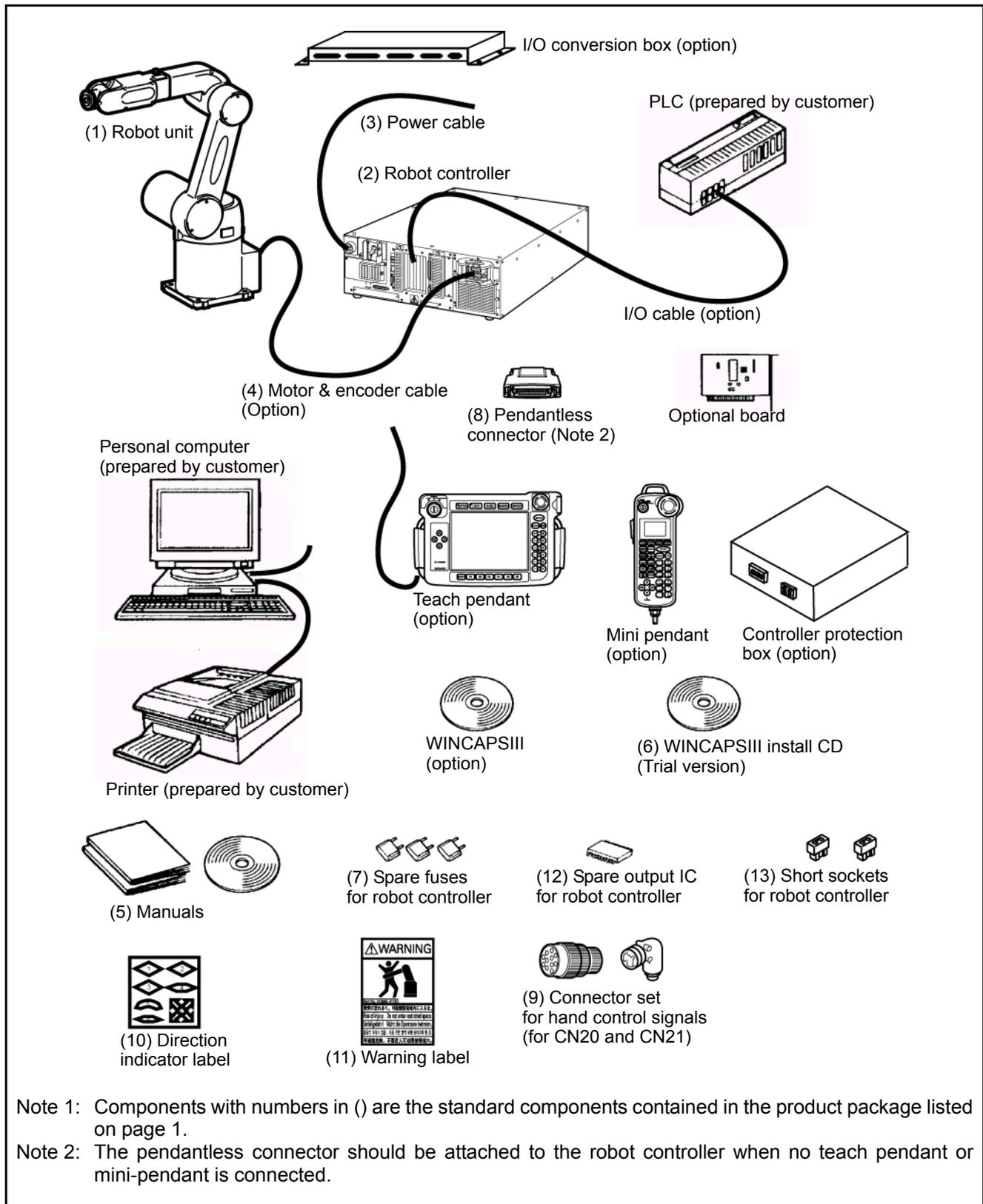
Optional Components (2)

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 VM-G, full set	Includes No. C and No. D	410009-0280	
	C	Instruction manual for VM-G, basic set	Includes No. C-1 to No. C-3	410009-0180	
	C-1	GENERAL INFORMATION ABOUT ROBOT	For VM-G	410002-2450	
	C-2	RC7M CONTROLLER MANUAL	For RC7M controller	410002-2430	
	C-3	ERROR CODE TABLES		410002-3370	
	D	Instruction manual for VM-G, extension set	Includes No. D-1 to No. D-7	410009-0060	
	D-1	INSTALLATION & MAINTENANCE GUIDE	For VM-G	410002-2470	
	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.



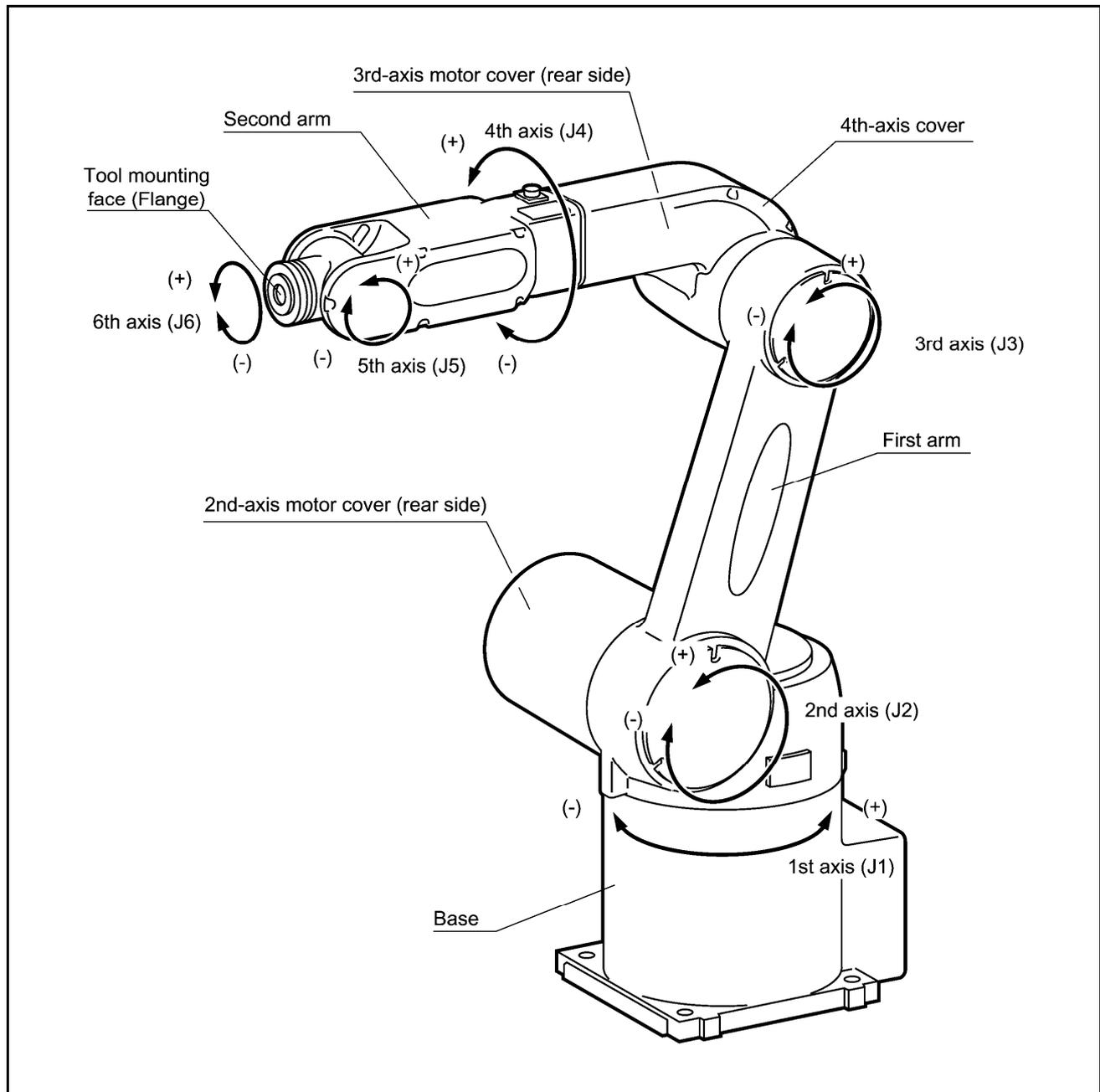
Configurators of the Robot System (VM-G series)

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.

[VM-6083G/VM-60B1G]



Robot Unit Components and Rotation Direction [VM-6083G/VM-60B1G]

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

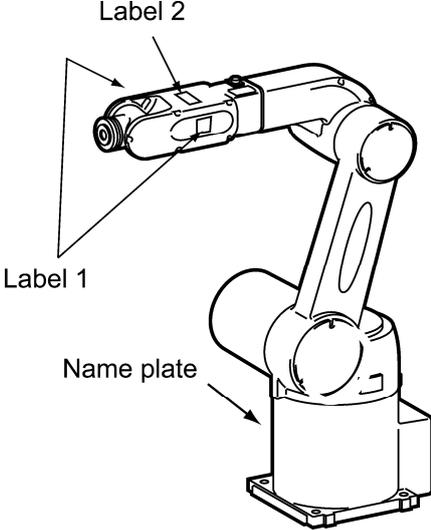
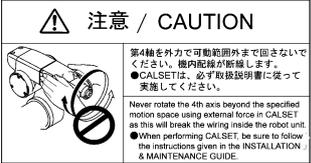
The name plate is affixed in the base part, which includes serial number of the robot, robot model, and day of manufacturer, etc.

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.

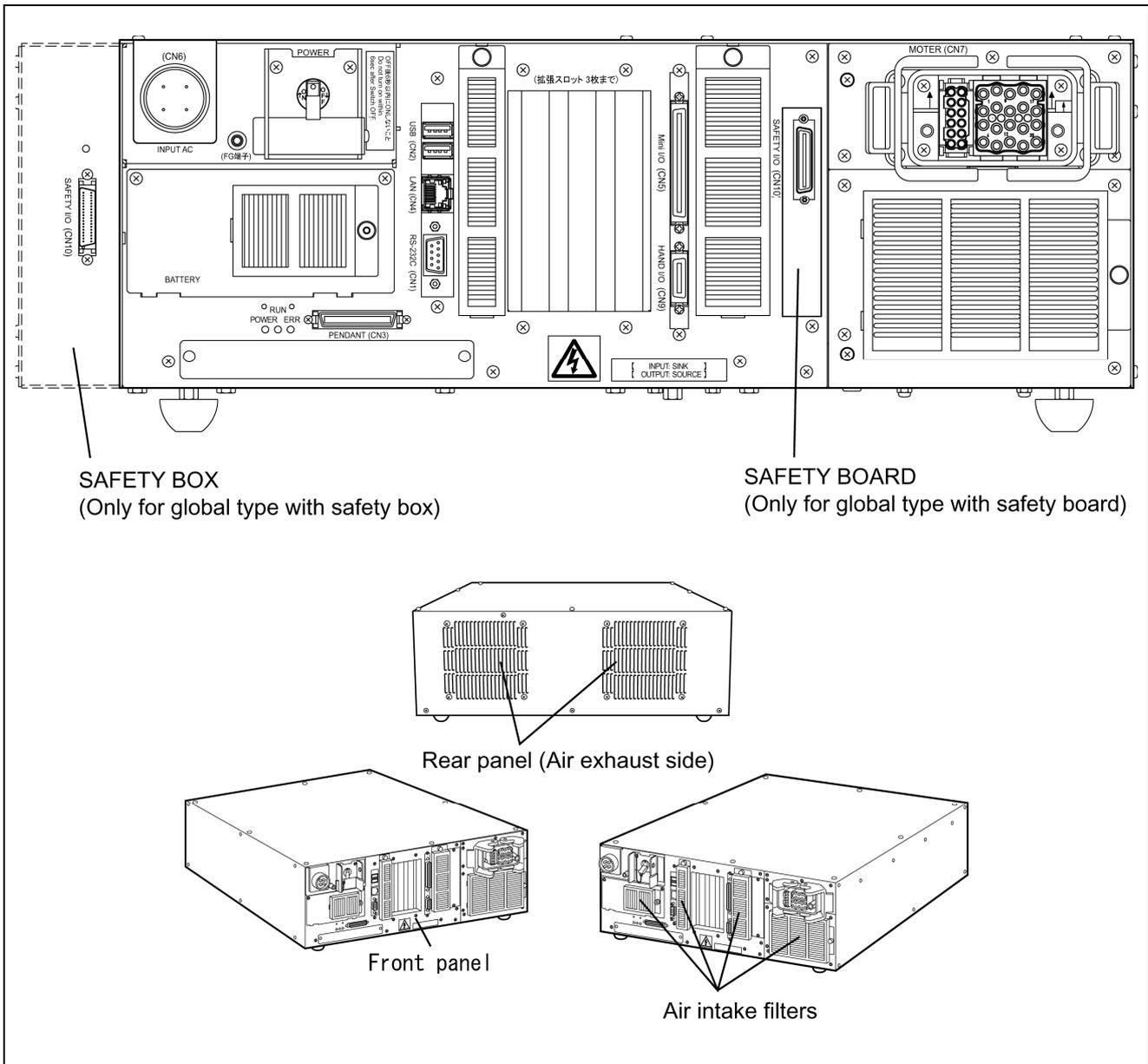
Warning and Caution Labels on the Robot Unit

Location of labels	
	
Warning and caution labels on the robot unit	Additional description
<p>Label 1</p> 	<p>Contact with the robot unit which is in motion can cause serious injuries. Observe the following:</p> <ol style="list-style-type: none"> (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.
<p>Label 2</p> 	<p>Cautions when performing CALSET. For details, refer to the INSTALLATION & MAINTENANCE GUIDE.</p>

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 VM-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 (VM-G series)

Chapter 3 Specifications of the Robot Unit

3.1 Robot Specifications

The tables below list the specifications of the VM-G series of robot units.

(1) VM-6083G (Nickname: VM1000)

VM-6083G Specifications

Item	Specifications	
	Standard type (VM)	Dust- & splash-proof type (VM-W)
Model name of robot set (Note 1)	VM-6083G	VM-6083G-W
Model name of robot unit	VM-6083D/GM	VM-6083D/GM-W
Overall arm length	385 (first arm) + 445 (second arm) = 830 mm	
Arm offset	J1 (swing): 180 mm, J3 (front arm): 100 mm	
Maximum workable space	R = 1,111 mm (end-effector mounting face) R = 1,021 mm (Point P: J4, J5, J6 center)	
Motion range	J1: $\pm 170^\circ$, J2: $+135^\circ, -90^\circ$, J3: $+165^\circ, -80^\circ$ J4: $\pm 185^\circ$, J5: $\pm 120^\circ$, J6: $\pm 360^\circ$	
Maximum payload	13 kg (Note 4)	
Maximum composite speed	8300 mm/s (at the center of an end-effector mounting face)	
Position repeatability (Note 2)	In each of X, Y and Z directions: ± 0.05 mm (at the center of an end-effector mounting face)	
Maximum allowable inertia moment	Around J4 and J5: 0.36 kgm^2 Around J6: 0.064 kgm^2	
Position detection	Absolute encoder	
Drive motor and brake	AC servomotors for all joints, Brakes for joints J2 to J6	
User air piping (Note 3)	7 systems ($\phi 4 \times 6$, $\phi 6 \times 1$), 3 solenoid valves (2-position, double solenoid) contained.	
User signal line	10 (for proximity sensor signals, etc.)	
Air source	Operating pressure	0.10~0.39MPa
	Maximum allowable pressure	0.49MPa
Airborne noise (A-weighted equivalent continuous sound pressure level)	80 dB or less	
Degree of protection	IP40	IP54 (Wrist: IP65)
Weight	Approx. 82 kg (180 lbs)	Approx. 86 kg (189 lbs)
<p>Note 1: The model name of robot set refers to the model name of a complete set including a robot unit and robot controller.</p> <p>Note 2: Position repeatability is the value at constant ambient temperature.</p> <p>Note 3: Only the $\phi 4 \times 6$ air piping system may be controlled by built-in solenoid valves.</p> <p>Note 4: If the payload exceeds 11 kg, the robot unit must be used with the flange facing down at ± 10 degrees from vertical. Also, the maximum payload is 10 kg if the robot controller version is older than Ver.3.32.</p>		

(2) VM-60B1G (Nickname: VM1300)**VM-60B1G Specifications**

Item	Specifications	
	Standard type (VM)	Dust- & splash-proof type (VM-W)
Model name of robot set (Note 1)	VM-60B1G	VM-60B1G-W
Model name of robot unit	VM-60B1D/GM	VM-60B1D/GM-W
Overall arm length	520 (first arm) + 590 (second arm) = 1,110 mm	
Arm offset	J1 (swing): 180 mm, J3 (front arm): 100 mm	
Maximum workable space	R = 1,388 mm (end-effector mounting face) R = 1,298 mm (Point P: J4, J5, J6 center)	
Motion range	J1: $\pm 170^\circ$, J2: $+135^\circ, -90^\circ$, J3: $+165^\circ, -80^\circ$ J4: $\pm 185^\circ$, J5: $\pm 120^\circ$, J6: $\pm 360^\circ$	
Maximum payload	13 kg (Note 4)	
Maximum composite speed	8300 mm/s (at the center of an end-effector mounting face)	
Position repeatability (Note 2)	In each of X, Y and Z directions: ± 0.07 mm (at the center of an end-effector mounting face)	
Maximum allowable inertia moment	Around J4 and J5: 0.36 kgm^2 Around J6: 0.064 kgm^2	
Position detection	Absolute encoder	
Drive motor and brake	AC servomotors for all joints, Brakes for joints J2 to J6	
User air piping (Note 3)	7 systems ($\phi 4 \times 6$, $\phi 6 \times 1$), 3 solenoid valves (2-position, double solenoid) contained.	
User signal line	10 (for proximity sensor signals, etc.)	
Air source	Operating pressure	0.10~0.39MPa
	Maximum allowable pressure	0.49MPa
Airborne noise (A-weighted equivalent continuous sound pressure level)	80 dB or less	
Degree of protection	IP40	IP54 (Wrist: IP65)
Weight	Approx. 82 kg (180 lbs)	Approx. 88 kg (193 lbs)
<p>Note 1: The model name of robot set refers to the model name of a complete set including a robot unit and robot controller.</p> <p>Note 2: Position repeatability is the value at constant ambient temperature.</p> <p>Note 3: Only the $\phi 4 \times 6$ air piping system may be controlled by built-in solenoid valves.</p> <p>Note 4: If the payload exceeds 11 kg, the robot unit must be used with the flange facing down at ± 10 degrees from vertical. Also, the maximum payload is 10 kg if the robot controller version is older than Ver.3.32.</p>		

(3) VM-6083G-P100

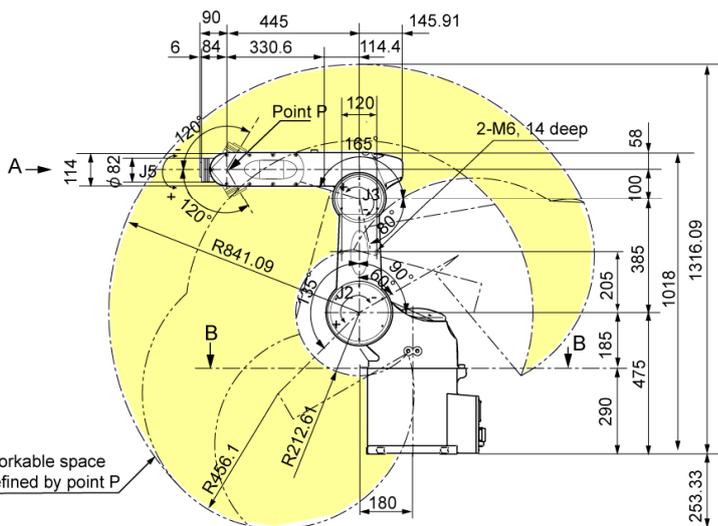
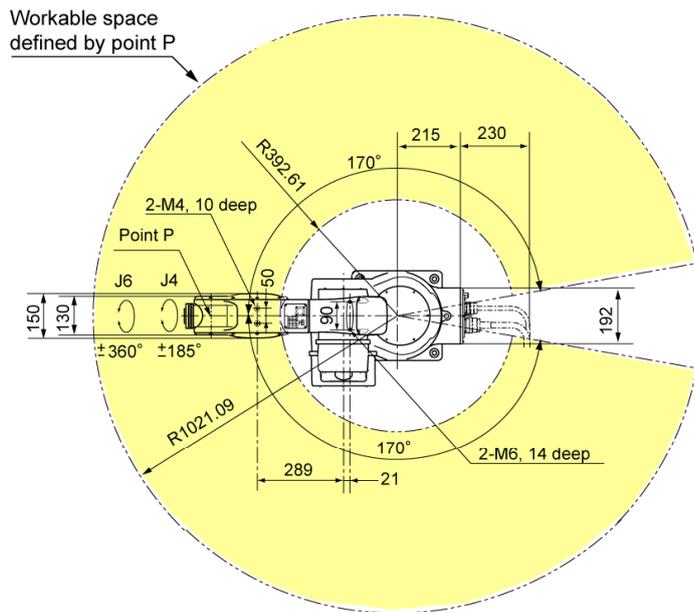
VM-6083D/G-P100, specifications

Item	Specifications	
Model name of robot set (Note 1)	VM-6083G-P100	
Model name of robot unit	VM-6083GM-P100	
Overall arm length	385 (first arm) + 445 (second arm) = 830 mm	
Arm offset	J1 (swing): 180 mm, J3 (front arm): 100 mm	
Maximum motion area	R = 1111 mm (end-effector mounting face) R = 1021 mm (Point P: J4, J5, J6 center)	
Motion range	J1 : $\pm 170^\circ$, J2 : $+135^\circ, -90^\circ$, J3 : $+165^\circ, -80^\circ$ J4 : $\pm 185^\circ$, J5 : $\pm 120^\circ$, J6 : $\pm 360^\circ$	
Maximum payload	13 kg (Note 3)	
Maximum composite speed	8300 mm/s (at the center of an end-effector mounting face)	
Position repeatability (Note 2)	In each of X, Y and Z directions: ± 0.05 mm	
Maximum allowable inertia moment	Around J4 and J5: 0.36 kgm^2 Around J6: 0.064 kgm^2	
Position detection	Absolute encoder	
Drive motor and brake	AC servomotors for all joints, Brakes for joints J2 to J6	
User air piping (Note 3)	6 systems ($\phi 4 \times 6$), 3 solenoid valves (2-position, double solenoid) contained.	
User signal line	10 (for proximity sensor signals, etc.)	
Air source	Operating pressure	$1.0 \times 10^5 \text{ Pa}$ to $3.9 \times 10^5 \text{ Pa}$
	Maximum allowable pressure	$4.9 \times 10^5 \text{ Pa}$
Weight	Approx. 86 kg (189 lbs) (See the name plate on each model.)	
Clean class for cleanroom type (FED-STD-209D)	Class 100 (0.3μ) at point-of-use	
<p>Note 1: The model name of robot set refers to the model name of a complete set including a robot unit and robot controller.</p> <p>Note 2: Position repeatability is the value at constant ambient temperature.</p> <p>Note 3: If the payload exceeds 11 kg, the robot unit must be used with the flange facing down at ± 10 degrees from vertical. Also, the maximum payload is 10 kg if the robot controller version is older than Ver.3.32.</p>		

(4) VM-60B1G-P100**VM-60B1D/G-P100, specifications**

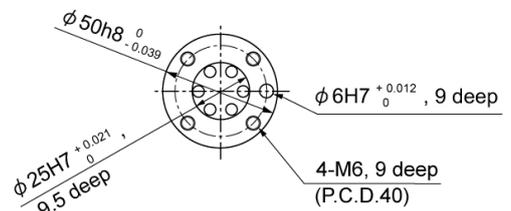
Item	Specifications	
Model name of robot set (Note 1)	VM-60B1G-P100	
Model name of robot unit	VM-60B1GM-P100	
Overall arm length	520 (first arm) + 590 (second arm) = 1110 mm	
Arm offset	J1 (swing): 180 mm, J3 (front arm): 100 mm	
Maximum motion area	R = 1388 mm (end-effector mounting face) R = 1298 mm (Point P: J4, J5, J6 center)	
Motion range	J1 : ±170°, J2 : +135°, -90°, J3 : +168°, -80° J4 : ±185°, J5 : ±120°, J6 : ±360°	
Maximum payload	13 kg (Note 3)	
Maximum composite speed	8300 mm/s (at the center of an end-effector mounting face)	
Position repeatability (Note 2)	In each of X, Y and Z directions: ±0.07 mm	
Maximum allowable inertia moment	Around J4 and J5: 0.36 kgm ² Around J6: 0.064 kgm ²	
Position detection	Absolute encoder	
Drive motor and brake	AC servomotors for all joints, Brakes for joints J2 to J6	
User air piping (Note 3)	6 systems (φ4x6), 3 solenoid valves (2-position, double solenoid) contained.	
User signal line	10 (for proximity sensor signals, etc.)	
Air source	Operating pressure	1.0 × 10 ⁵ Pa to 3.9 × 10 ⁵ Pa
	Maximum allowable pressure	4.9 × 10 ⁵ Pa
Weight	Approx. 88 kg (193 lbs) (See the name plate on each model.)	
Clean class for cleanroom type (FED-STD-209D)	Class 100 (0.3 μ) at point-of-use	
<p>Note 1: The model name of robot set refers to the model name of a complete set including a robot unit and robot controller.</p> <p>Note 2: Position repeatability is the value at constant ambient temperature.</p> <p>Note 3: If the payload exceeds 11 kg, the robot unit must be used with the flange facing down at +/-10 degrees from vertical. Also, the maximum payload is 10 kg if the robot controller version is older than Ver.3.32.</p>		

(2) VM-6083G-W (Dust- & splash-proof type)

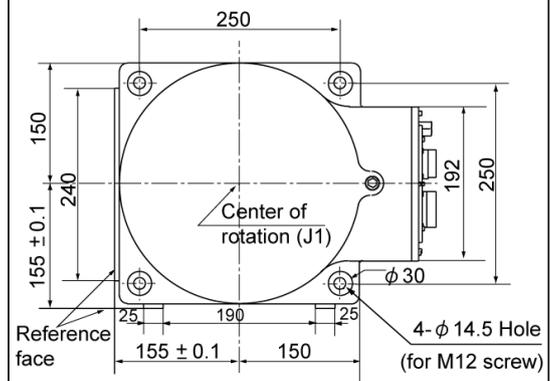


(Unit: mm)

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



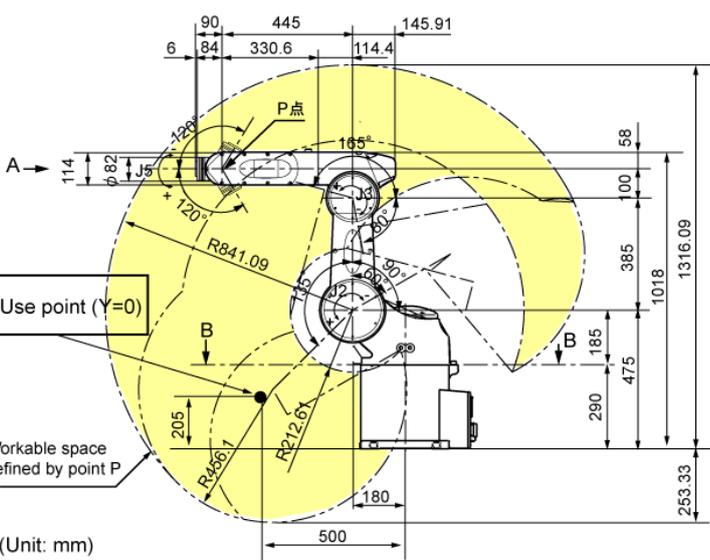
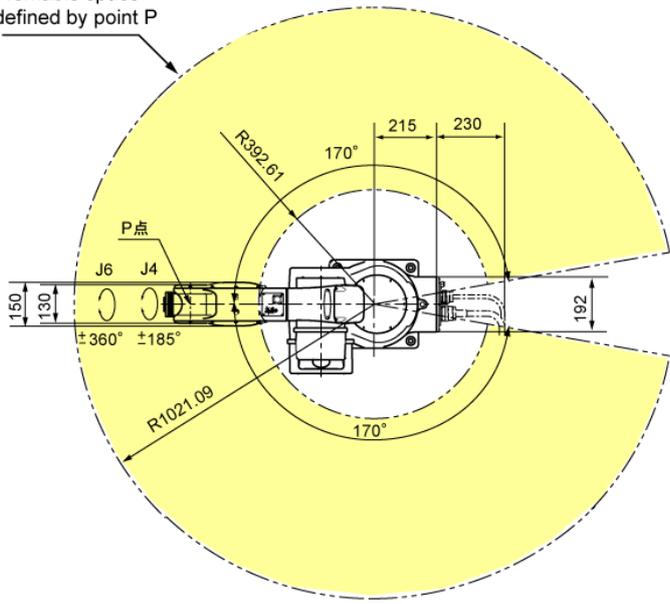
Detailed drawing of base mounting face (View: B-B)



Outer Dimensions and Workable Space [VM-6083G-W]

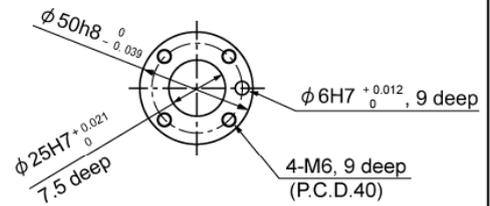
(3) VM-6083G-P100

Workable space defined by point P

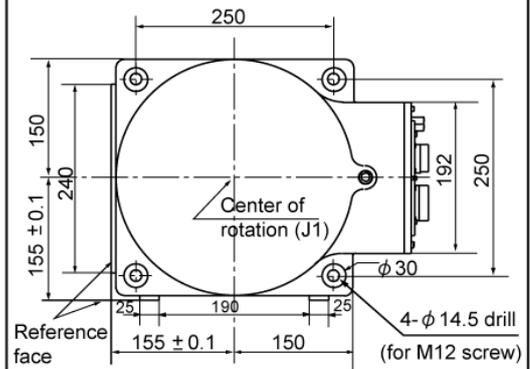


(Unit: mm)

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

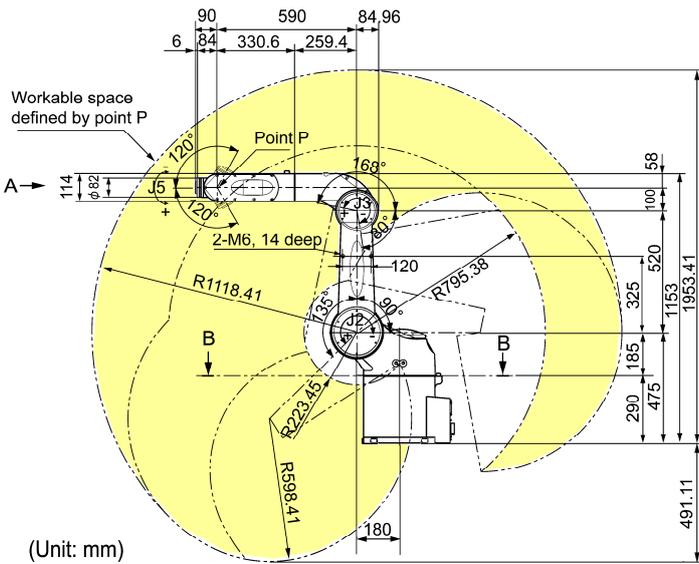
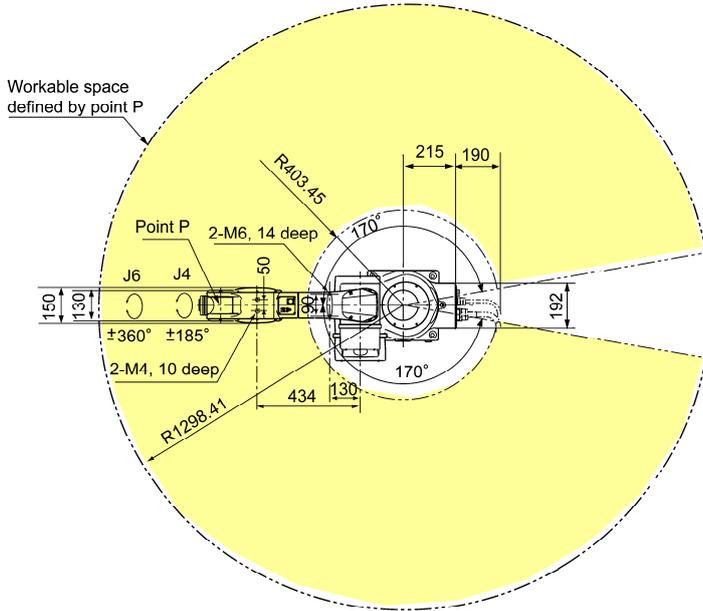


Detailed drawing of base mounting face (View: B-B)

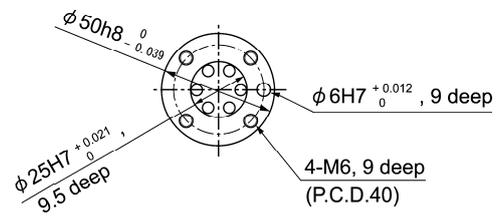


Outer dimensions and workable space (VM-6083G-P100)

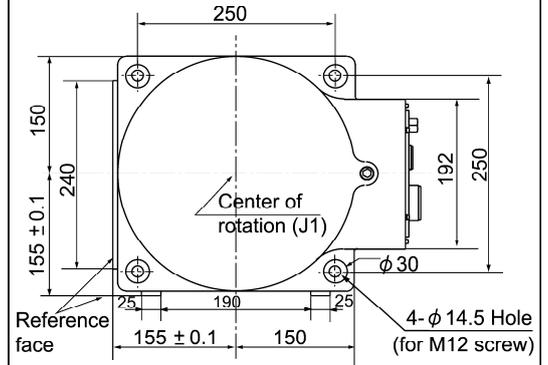
(4) VM-60B1G (Standard type)



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

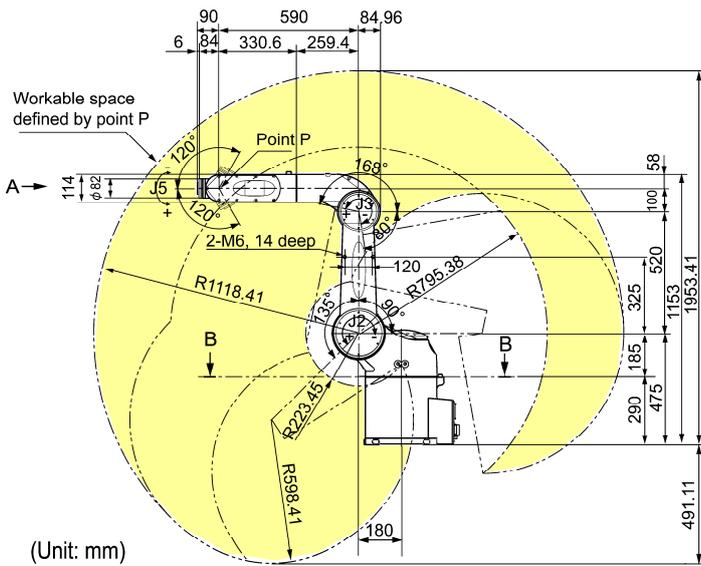
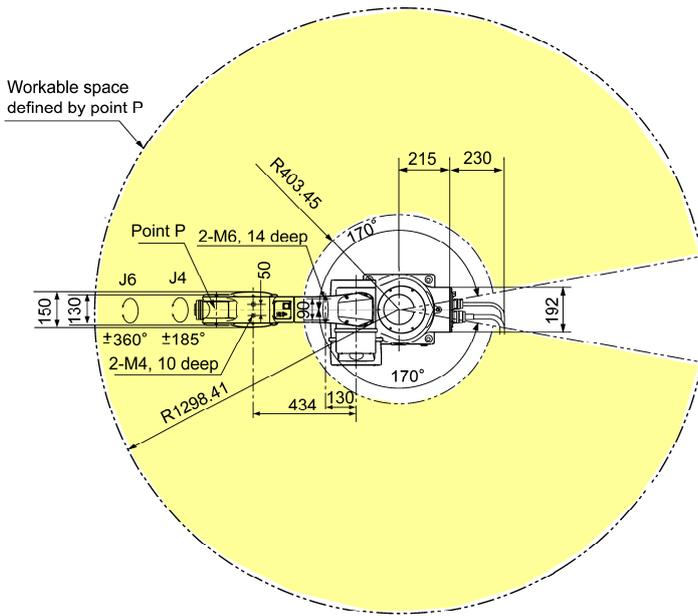


Detailed drawing of base mounting face (View: B-B)

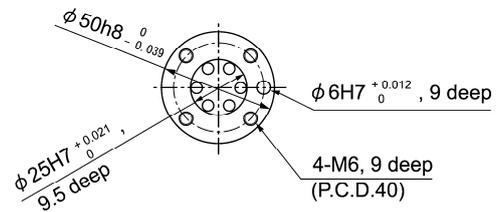


Outer Dimensions and Workable Space [VM-60B1G]

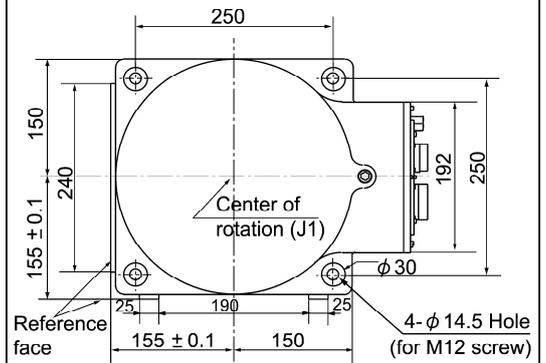
(5) VM-60B1G-W (Dust- & splash-proof type)



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

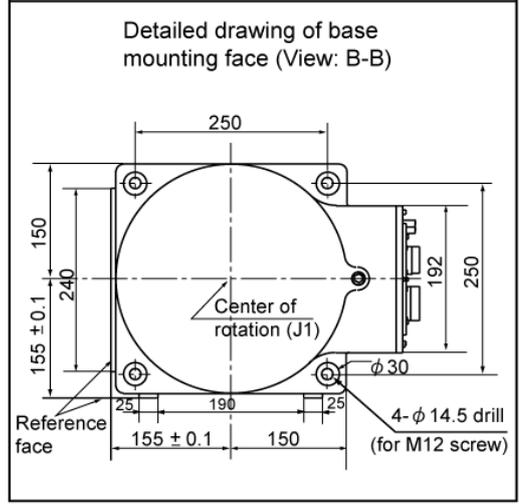
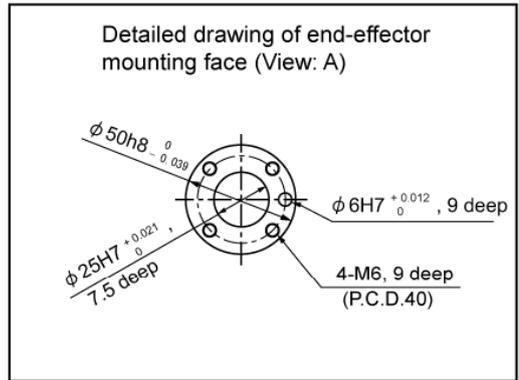
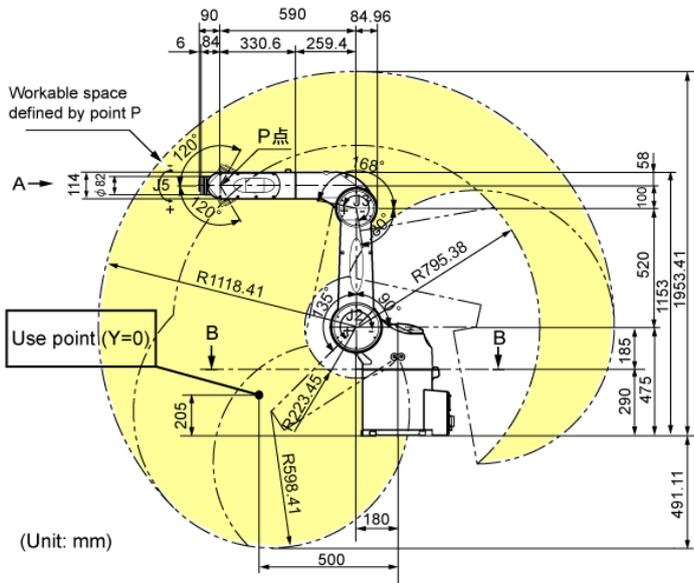
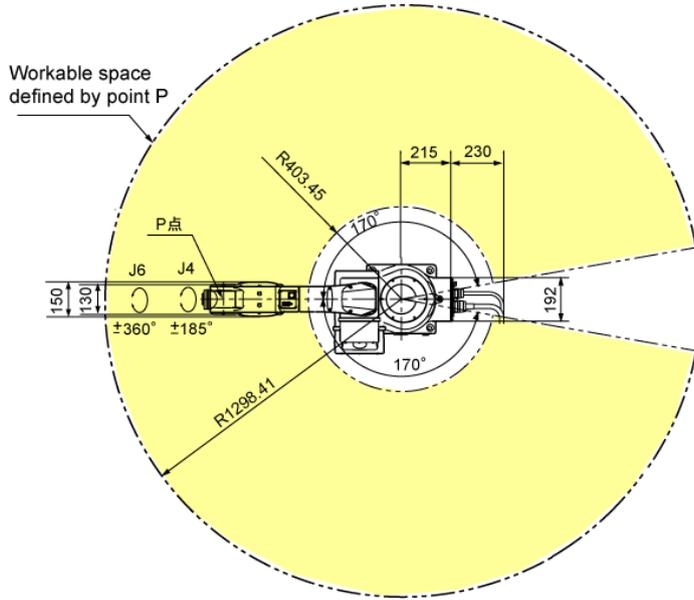


Detailed drawing of base mounting face (View: B-B)



Outer Dimensions and Workable Space [VM-60B1G-W]

(6) VM-60B1G-P100



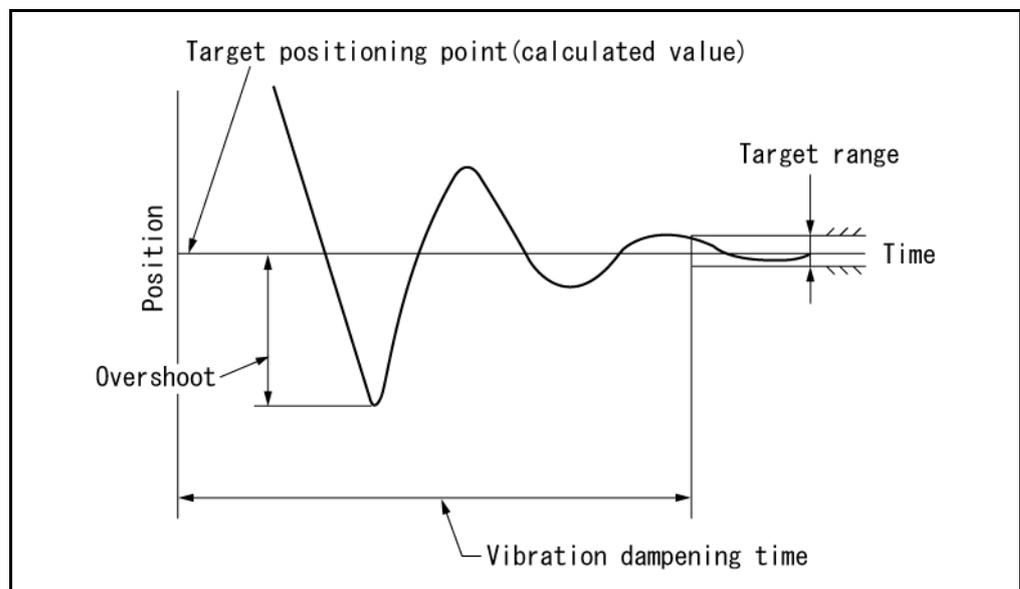
Outer dimensions and workable space (VM-60B1G-P100)

3.3 Robot Positioning Time

VM-G series robot positioning time

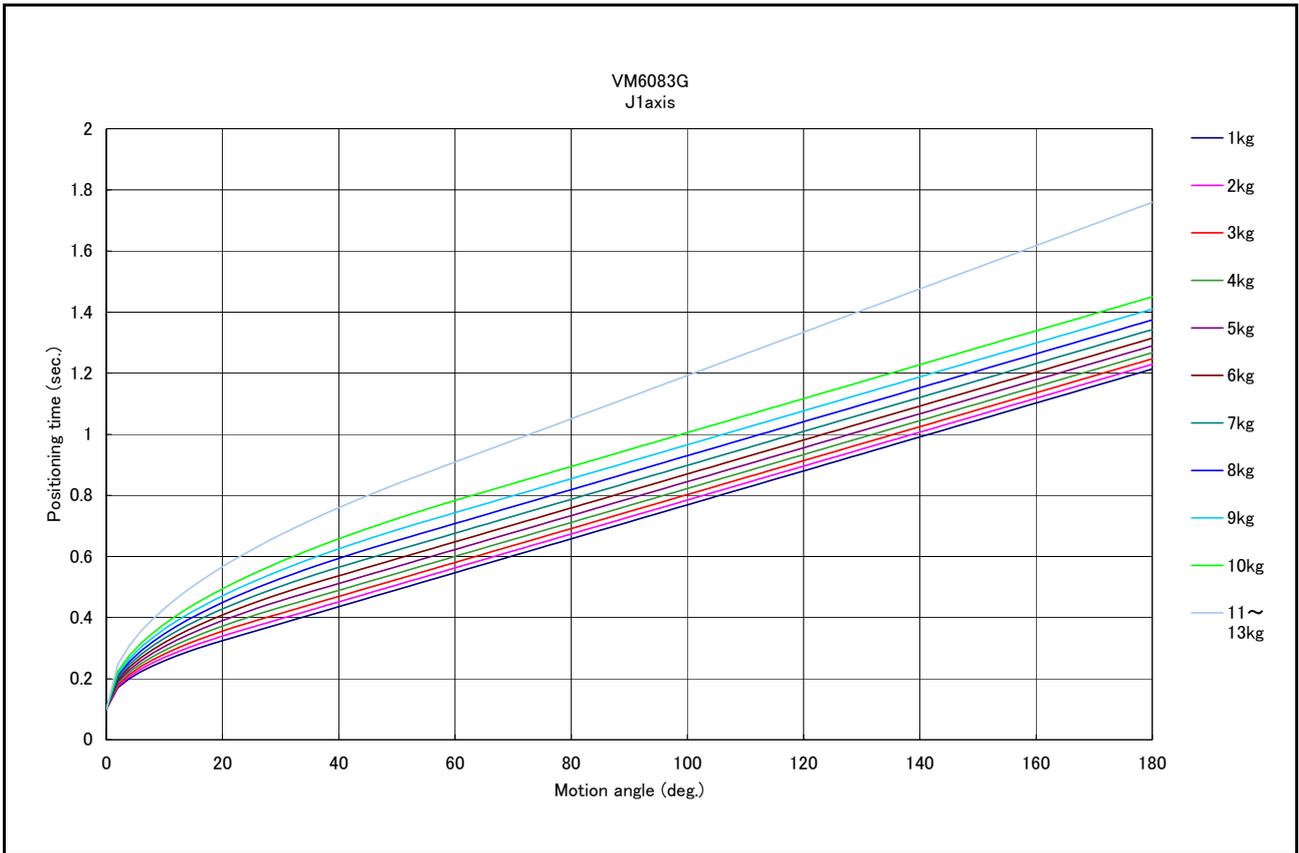
1. Following figures show the positioning times used to calculate the cycle time.
2. Positioning time means the time from the start of robot operation to the arrival at the target positioning point.
3. After the robot moves to and passes the target positioning point, vibration will be dampened and the robot 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 dampening 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.

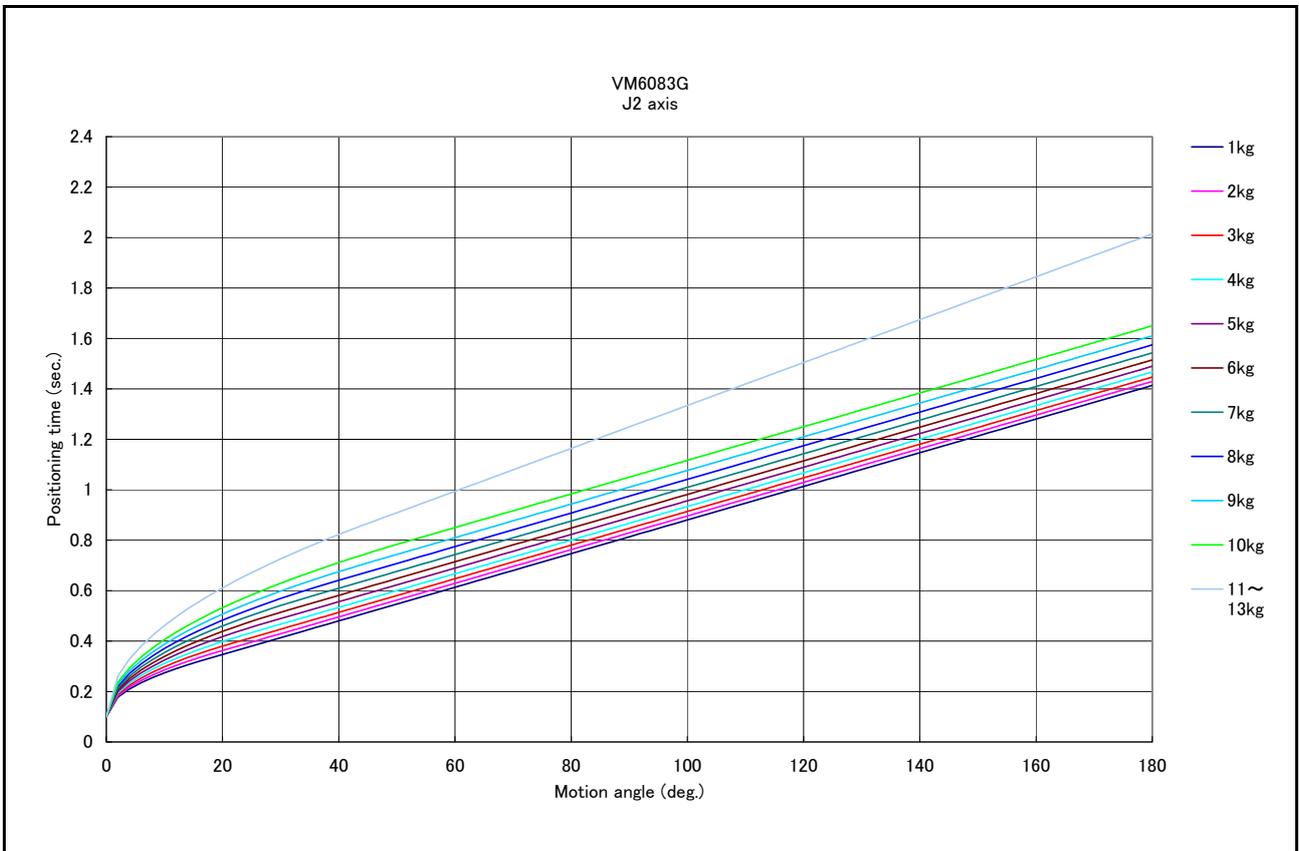


Vibration Dampening Time

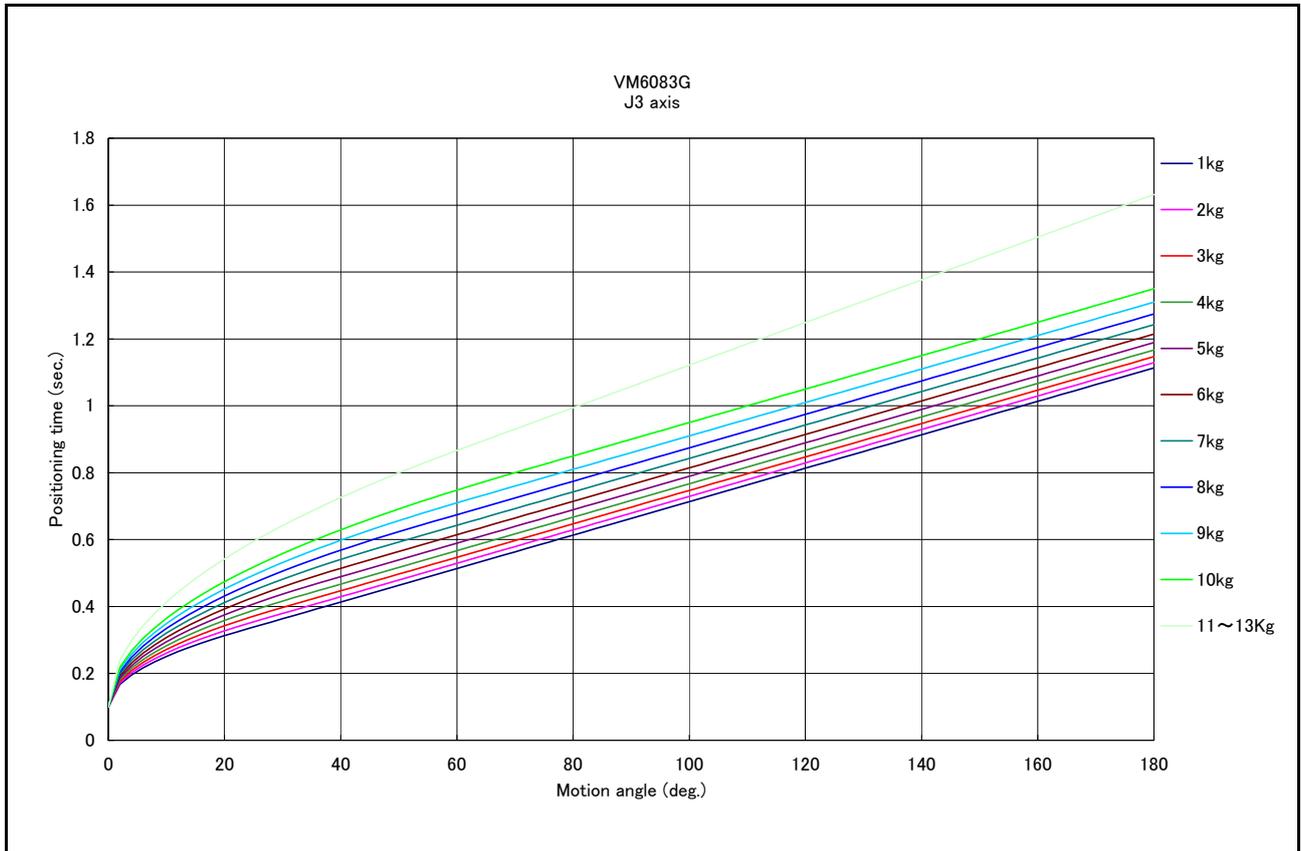
(1) VM-6083G robot positioning time



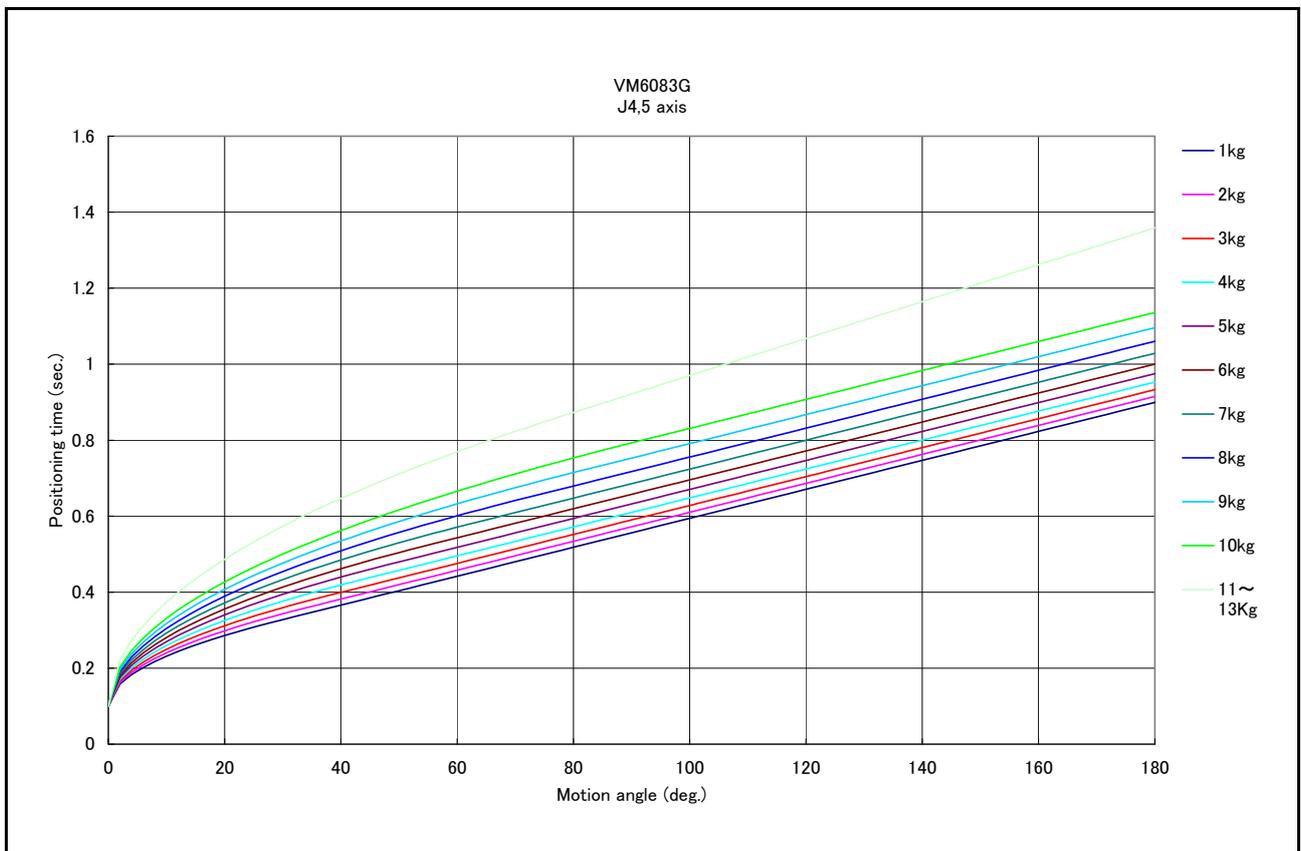
J1 Axis [VM-6083G]



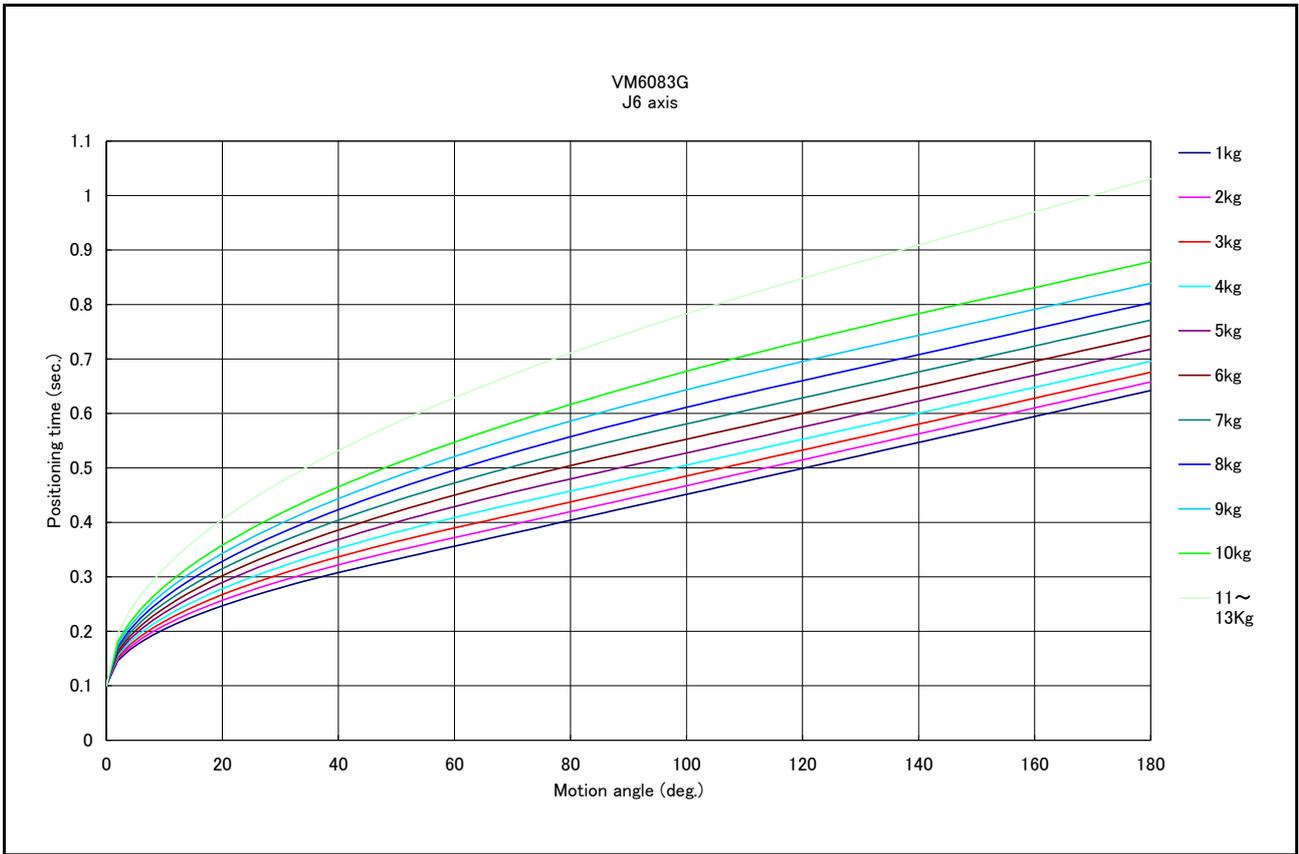
J2 Axis [VM-6083G]



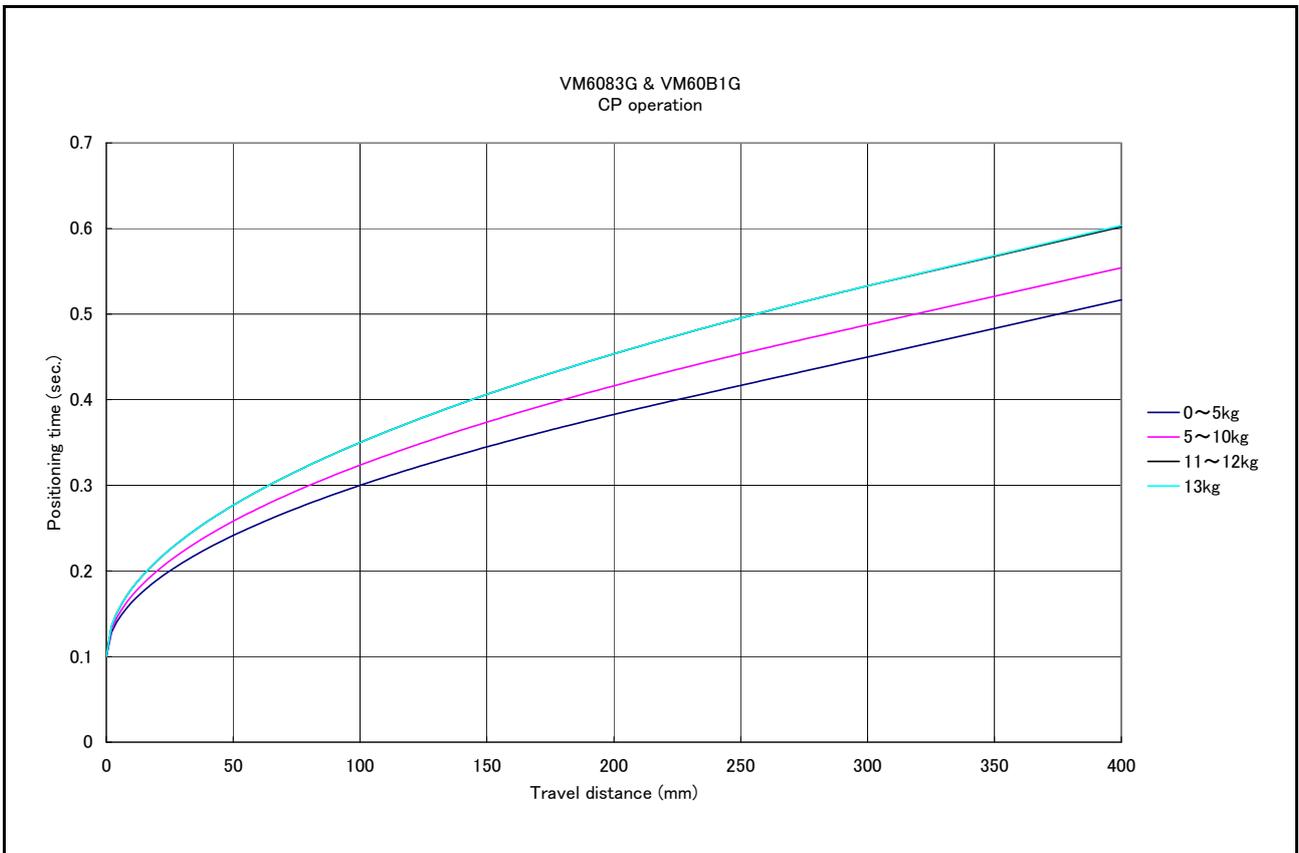
J3 Axis [VM-6083G]



J4/J5 Axis [VM-6083G]

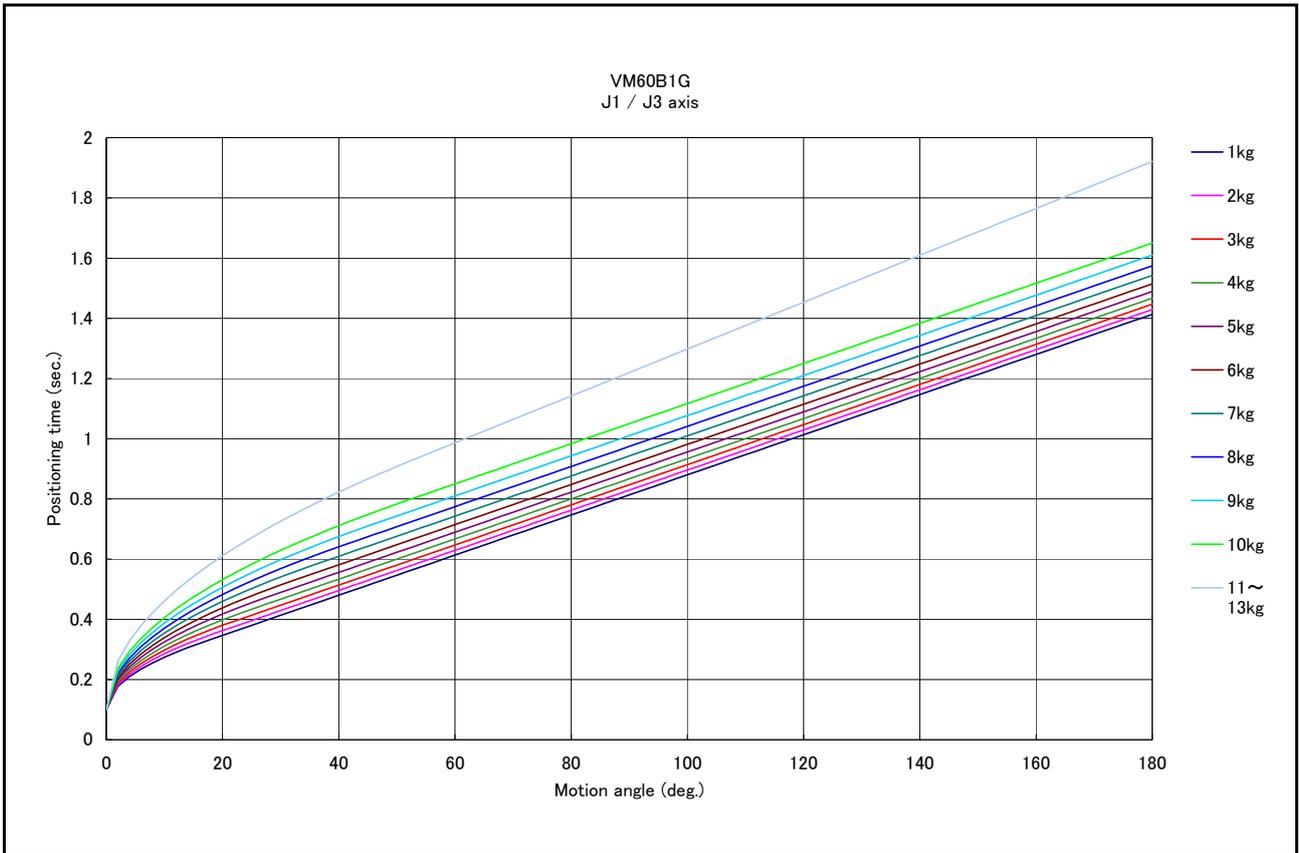


J6 Axis [VM-6083G]

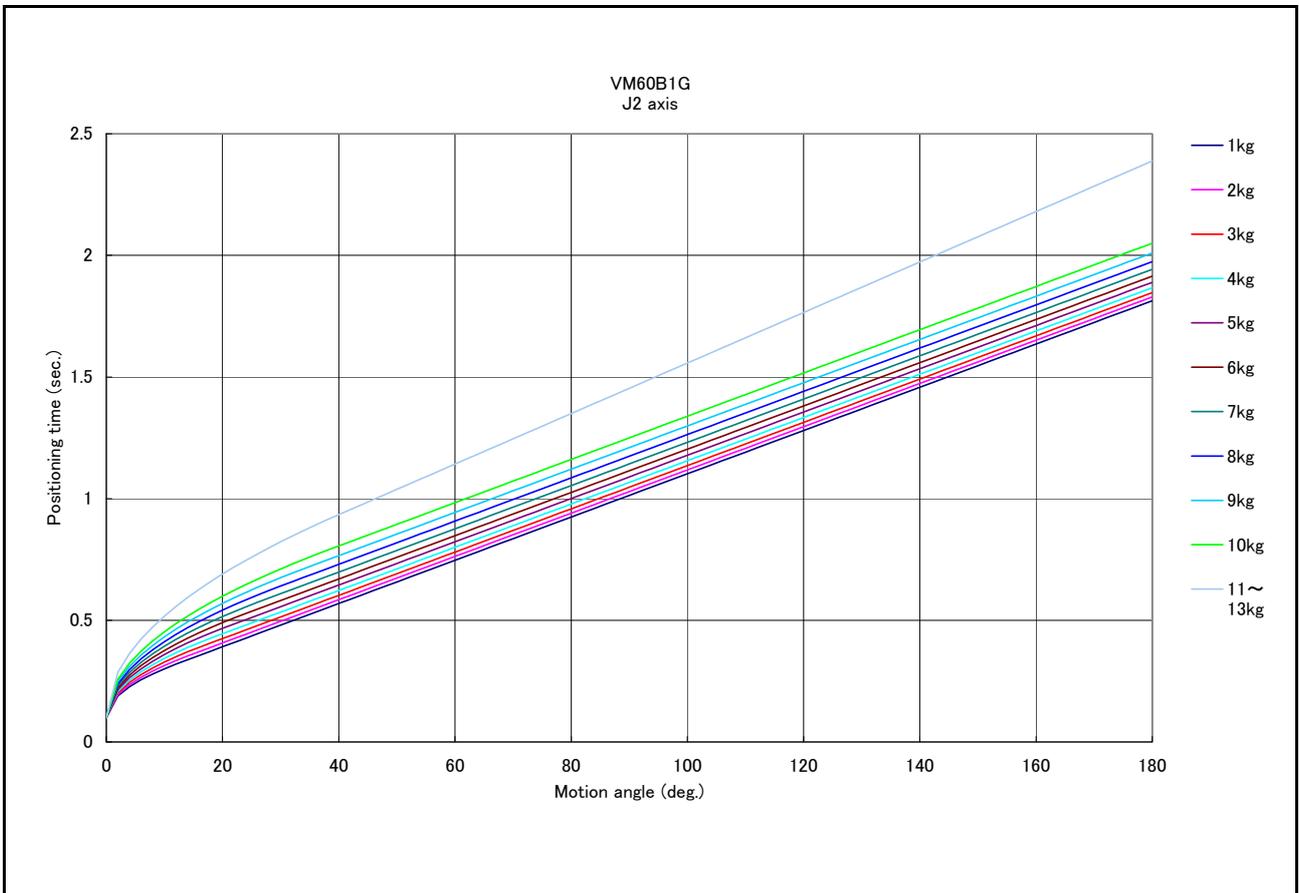


CP Operation [VM-6083G]

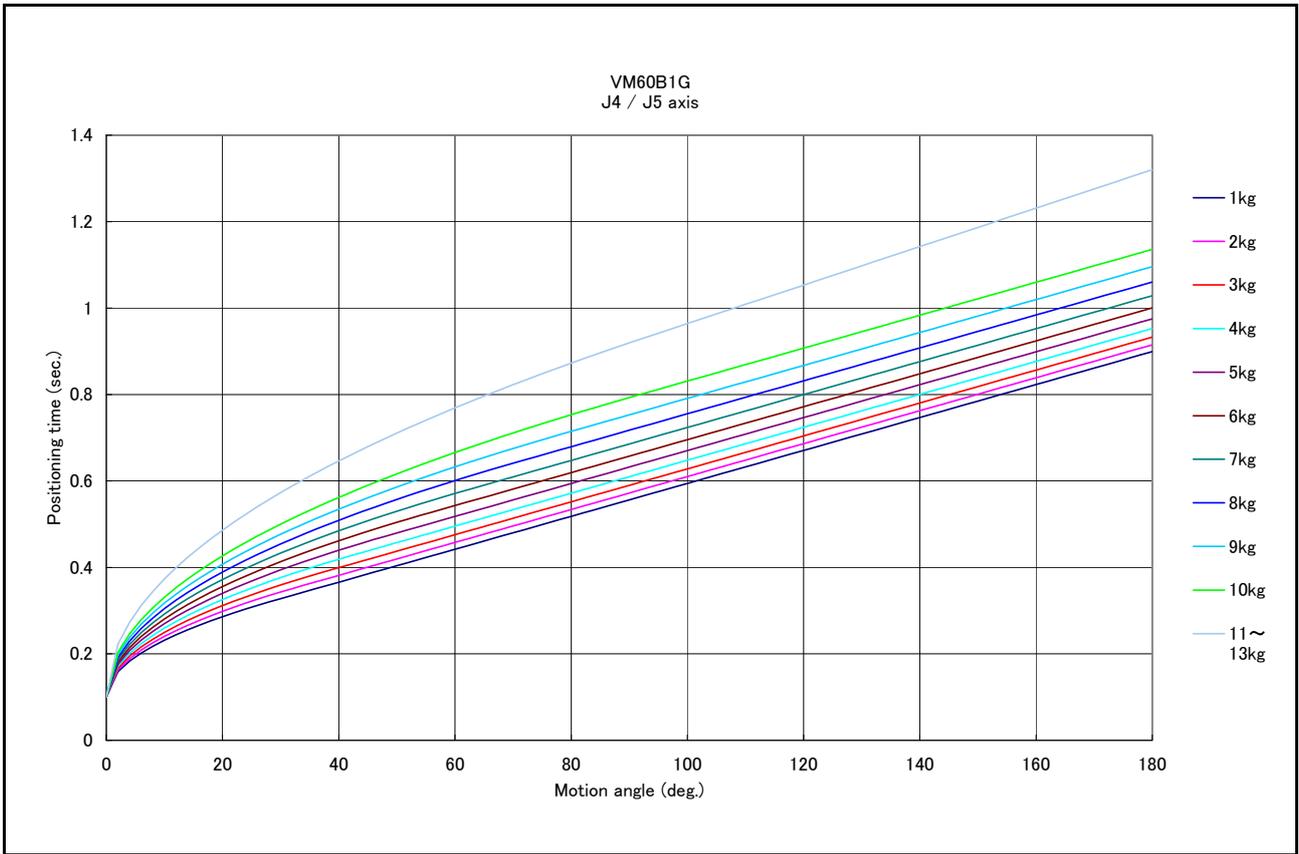
(2) VM-60B1G robot positioning time



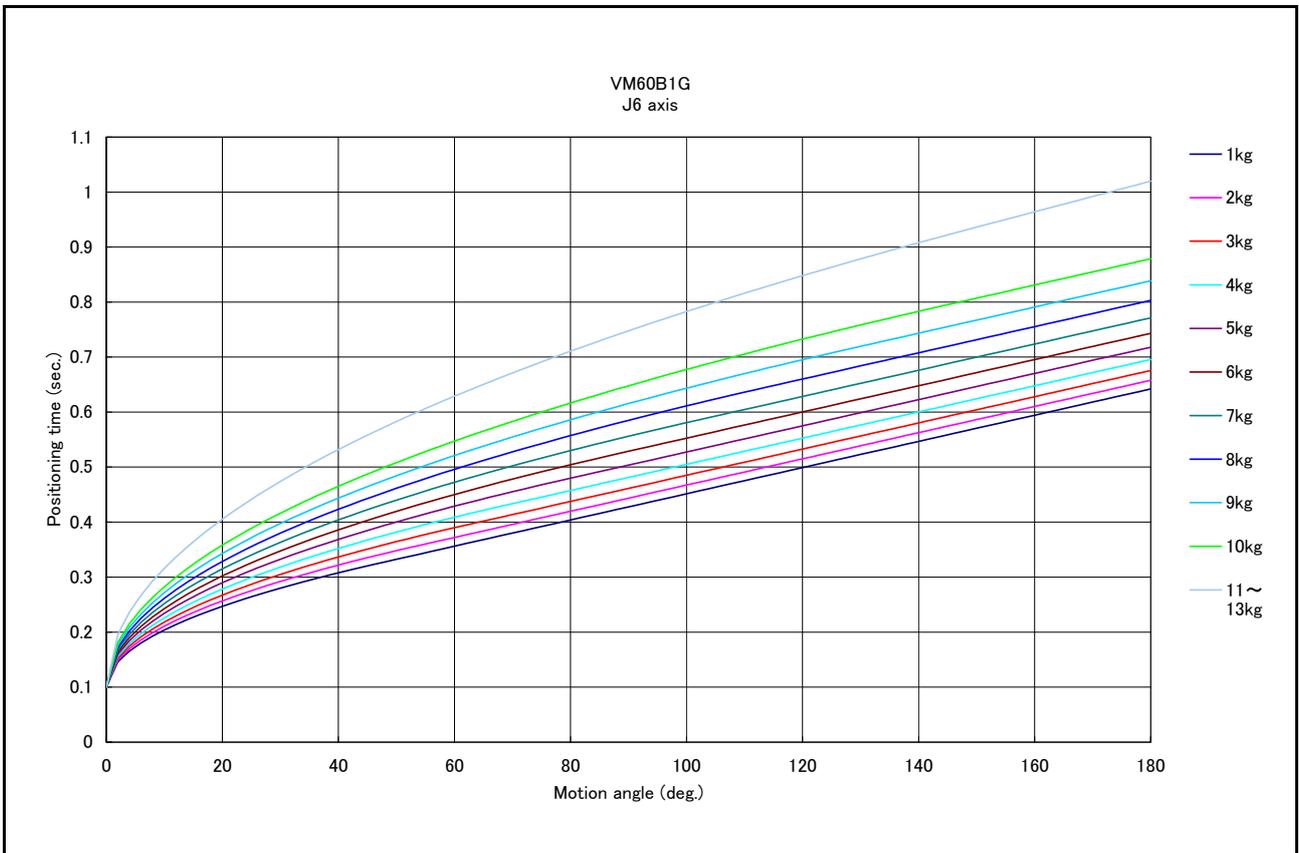
J1/J3 Axis [VM-60B1G]



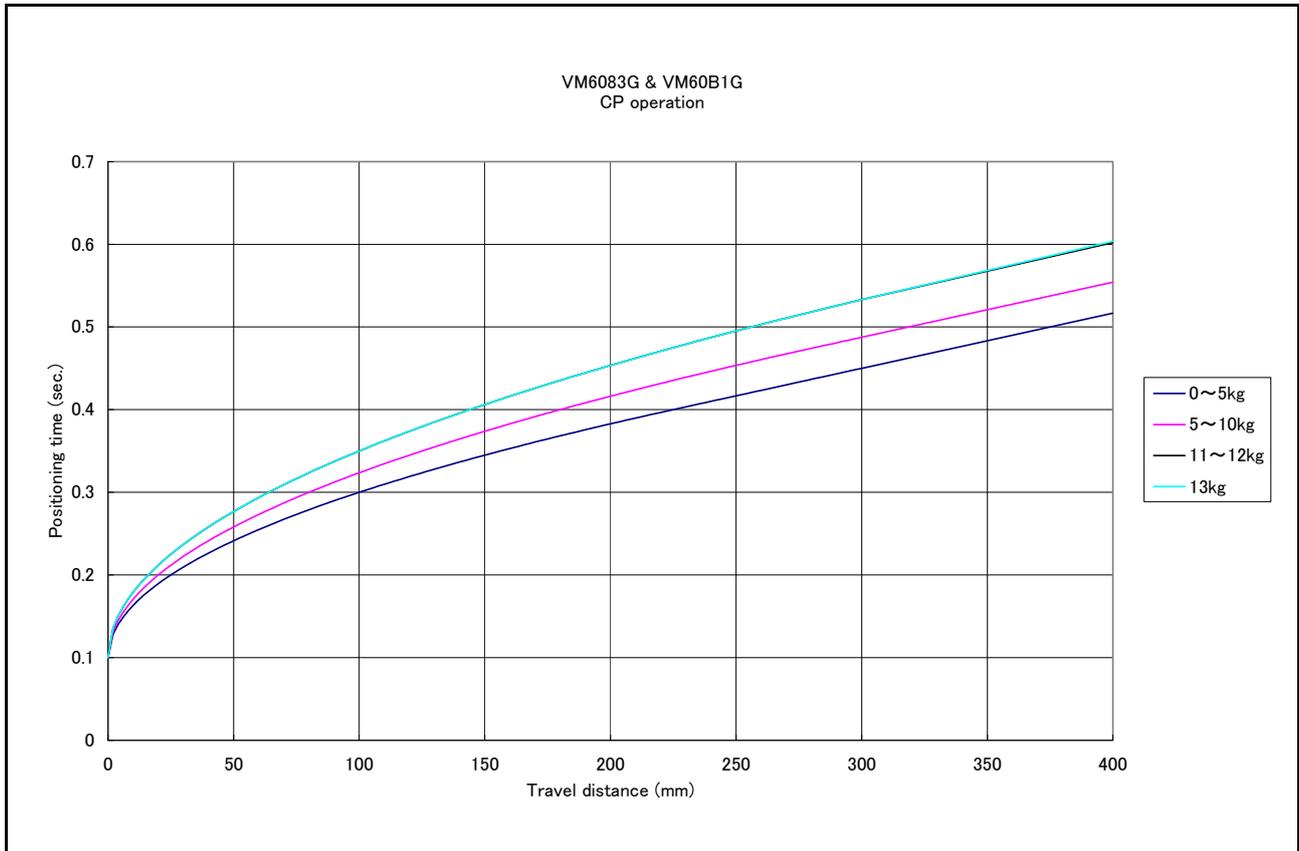
J2 Axis [VM-60B1G]



J4/J5 Axis [VM-60B1G]



J6 Axis [VM-60B1G]



CP Operation [VM-60B1G]

3.4 Air Piping, Signal Wiring, and Solenoid Valve Specifications

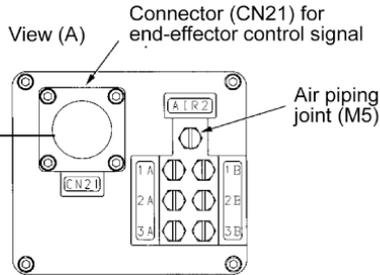
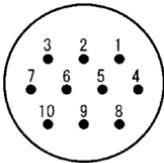
The VM-G series is equipped with seven air pipes for air chuck, 10 signal lines, and 3 solenoid valves in it. The air piping and signal wiring of the VM-G series are shown on this and the following figures.

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.

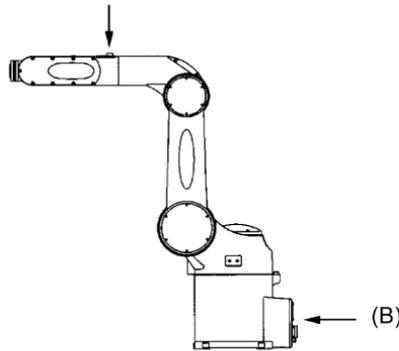
3.4.1 Air Piping and Signal Wiring

(1) VM-6083G/VM-60B1G

CN21 pin layout

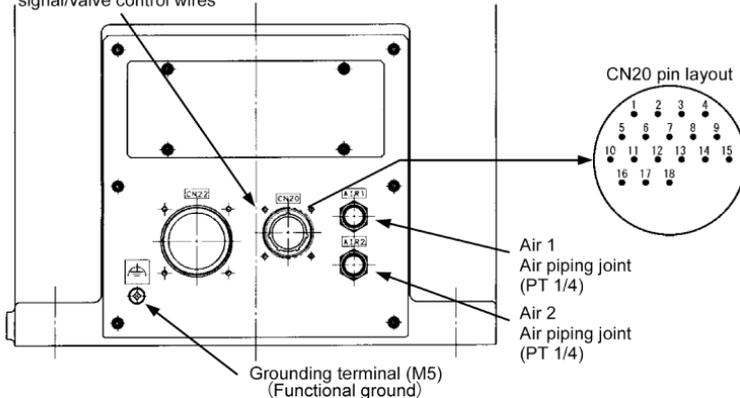


(A)

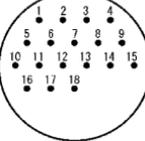


View (B)

Connector (CN20) for end-effector signal/valve control wires



CN20 pin layout



Valve Symbols and Air Intake and Exhaust States (1A and 1B are piping joint symbols.)

	Air piping joint		Valve signal		
	Air intake	Exhaust	Solenoid valve	Solenoid	
AIR1	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
AIR2					

CN20 Pin Assignment

For controller I/O unit, NPN type (source IN, sink OUT)

CN20 pin No.	Used for:
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)

For controller I/O unit, PNP type (sink IN, source OUT)

CN20 pin No.	Used for:
12	0V
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)

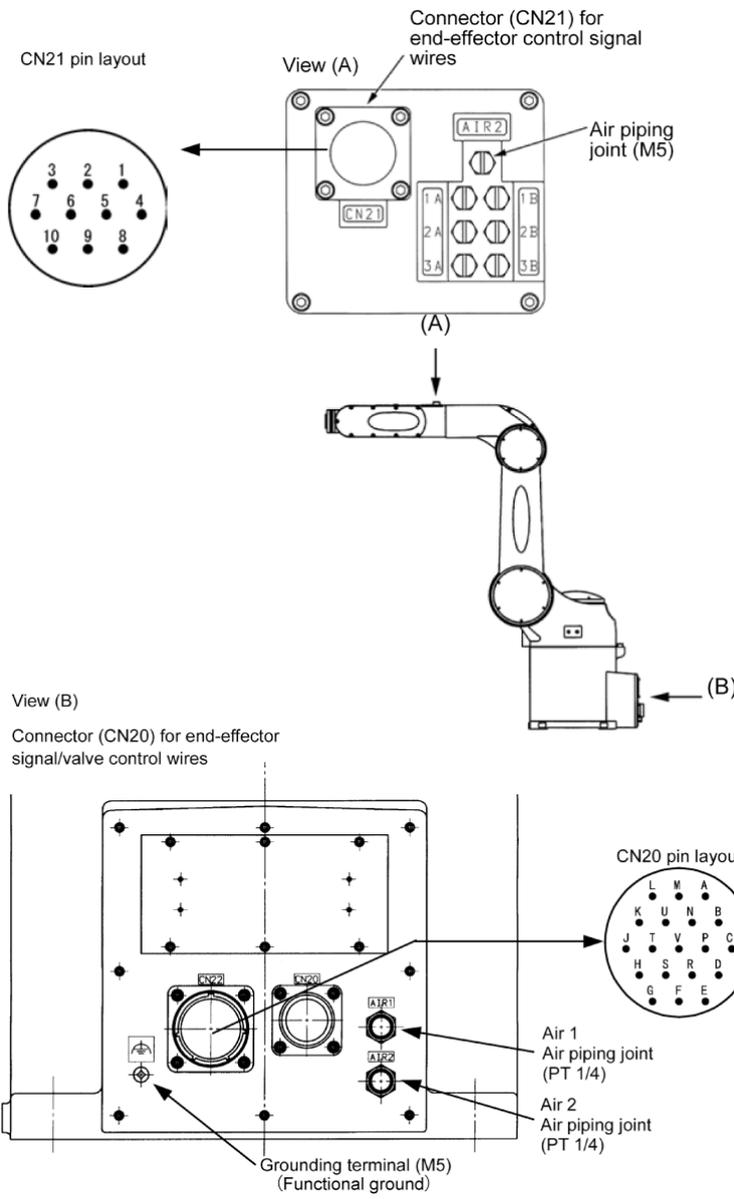
Note 1: Pin #1 to #10 on CN21 and those on CN20 are connected with each other. The allowable current per line is 1 A.

Note 2: Use the attached connector sets for CN20 and CN21.

Connector set part No.	Part No.	Model and part name	Appearance
410889-0030	410877-0170 (for CN20)	SRCN6A25-24S (round type connector) (Japan Aviation Electronics Industry Ltd)	
	410877-0180 (for CN21)	JMLP1610M (L type plug connector) DDK Electronics, Inc.	

Air Piping and Signal Wiring [VM-6083G/VM-60B1G]

(2) VM-6083G-W/VM-60B1G-W



Valve Symbols and Air Intake and Exhaust States (1A and 1B are piping joint symbols.)

AIR1	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
AIR2				

CN20 Pin Assignment
For controller I/O unit, NPN type (source IN, sink OUT)

CN20 pin No.	Used for:
M	+24V
N	Solenoid 1A (solenoid valve 1)
P	Solenoid 1B (solenoid valve 1)
R	Solenoid 2A (solenoid valve 2)
S	Solenoid 2B (solenoid valve 2)
T	Solenoid 3A (solenoid valve 3)
U	Solenoid 3B (solenoid valve 3)

For controller I/O unit, PNP type (sink IN, source OUT)

CN20 pin No.	Used for:
M	0V
N	Solenoid 1A (solenoid valve 1)
P	Solenoid 1B (solenoid valve 1)
R	Solenoid 2A (solenoid valve 2)
S	Solenoid 2B (solenoid valve 2)
T	Solenoid 3A (solenoid valve 3)
U	Solenoid 3B (solenoid valve 3)

Note 1: Pins A to K on CN21 and pins #1 to #10 on CN20 are connected with each other as shown below. The allowable current per line is 1 A.

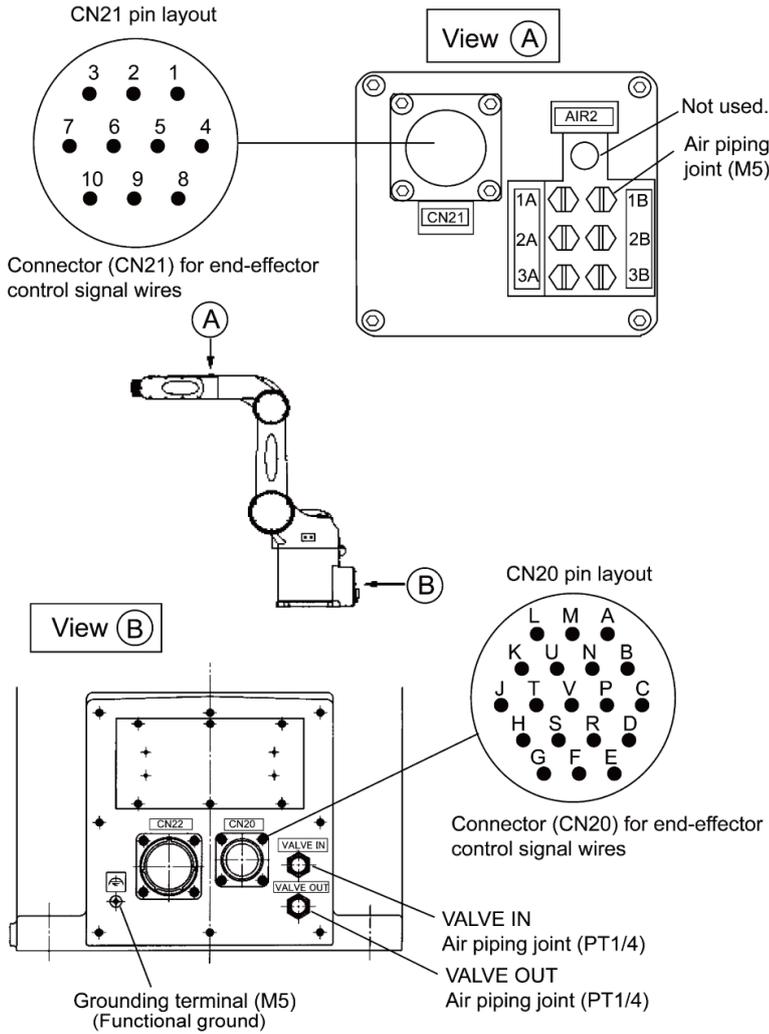
CN20	A	B	C	D	E	F	G	H	J	K
CN21	1	2	3	4	5	6	7	8	9	10

Note 2: Use the attached connector sets for CN20 and CN21.

Connector set part No.	Part No.	Model and part name	Appearance
410889-0010	410877-0120 (for CN20)	H/M3106A22-14S (straight plug) HIROSE ELECTRIC CO., LTD.	
	410877-0130 (for CN20)	H/MS3057-12A (cord clamp) HIROSE ELECTRIC CO., LTD.	Applicable wire dia. φ11.4-15.9
	410877-0140 (for CN20)	H/MS3057-12A1 (cord clamp) HIROSE ELECTRIC CO., LTD.	Applicable wire dia. φ8-11.6
	410877-0070 (for CN21)	EBLP1610M (L type plug connector) DDK Electronics, Inc.	

Air Piping and Signal Wiring [VM-6083G-W/VM-60B1G-W]

(3) VM-6083G-P100, VM-60B1G-P100



Valve Symbols Air Intake/Exhaust States
(1A and 1B are piping joint symbols.)

	Air piping joint		Valve signal		
	Air intake	Exhaust	Solenoid valve	Solenoid	
AIR 1	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

AIR 2: Not used for cleanroom type

CN20 Pin Assignment

For controller I/O unit, NPN type (source IN, sink OUT)

CN20 pin No.	Used for:
M	+24V
N	Solenoid 1A (solenoid valve 1)
P	Solenoid 1B (solenoid valve 1)
R	Solenoid 2A (solenoid valve 2)
S	Solenoid 2B (solenoid valve 2)
T	Solenoid 3A (solenoid valve 3)
U	Solenoid 3B (solenoid valve 3)

For controller I/O unit, PNP type (sink IN, source OUT)

CN20 pin No.	Used for:
M	0V
N	Solenoid 1A (solenoid valve 1)
P	Solenoid 1B (solenoid valve 1)
R	Solenoid 2A (solenoid valve 2)
S	Solenoid 2B (solenoid valve 2)
T	Solenoid 3A (solenoid valve 3)
U	Solenoid 3B (solenoid valve 3)

Note 1 : Pins A to K on CN20 and pins #1 to #10 on CN21 are connected with each other as shown below. The allowable current per line is 1 A.

CN20	A	B	C	D	E	F	G	H	J	K
CN21	1	2	3	4	5	6	7	8	9	10

Note 2 : Use the attached connector sets for CN20 and CN21.

Connector set part No.	Part No.	Model and part name	Appearance
410889-0010	410877-0120 (for CN20)	H/M3106A22-14S (straight plug) (HIROSE ELECTRIC CO., LTD.)	
	410877-0130 (for CN20)	H/MS3057-12A (cord clamp) (HIROSE ELECTRIC CO., LTD.)	Applicable wire diameter φ11.4 to 15.9
	410877-0140 (for CN20)	H/MS3057-12A1 (cord clamp) (HIROSE ELECTRIC CO., LTD.)	
	410877-0070 (for CN21)	EBLP1610M (L type plug connector) (DDK Electronics, Inc.)	

Air Piping and Signal Wiring [VM-6083G-P100 & VM-60B1G-P100]

3.4.2 Instructions for Using Splash-proof Connector Sets

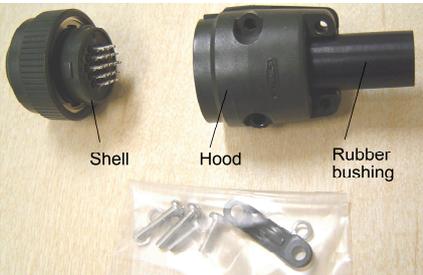
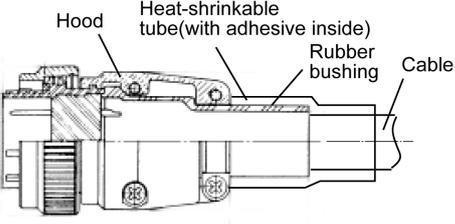
The splash-proof connector sets for CN20 and CN21 assure the splash-proofness as long as they are properly assembled and connected.

When using those connector sets, be sure to observe the following notes.

- (1) The degree of protection of the splash-proof robot unit, which is specified in Section 3.1 "Robot Specifications," is assured as long as the splash-proof connectors are joined with connectors CN20 and CN21 on the robot unit. If there is no connection on CN20 and CN21, the splash-proof rating is not assured.
- (2) Use a sheathed cable for a splash-proof connector. Using an unsheathed cable cannot assure the splash-proof rating.
- (3) Each connector set contains two types of cord clamps for CN20. Use the one that matches the cable diameter.
- (4) Each connector set should be assembled according to the instructions specified by the connector manufacturer.

The table below shows an assembly procedure example of a connector set for CN20, 21. The actual assembly procedure should be in accordance with the instructions specified by the connector manufacturer.

Overview of assembly procedure example of connector set for CN20, 21

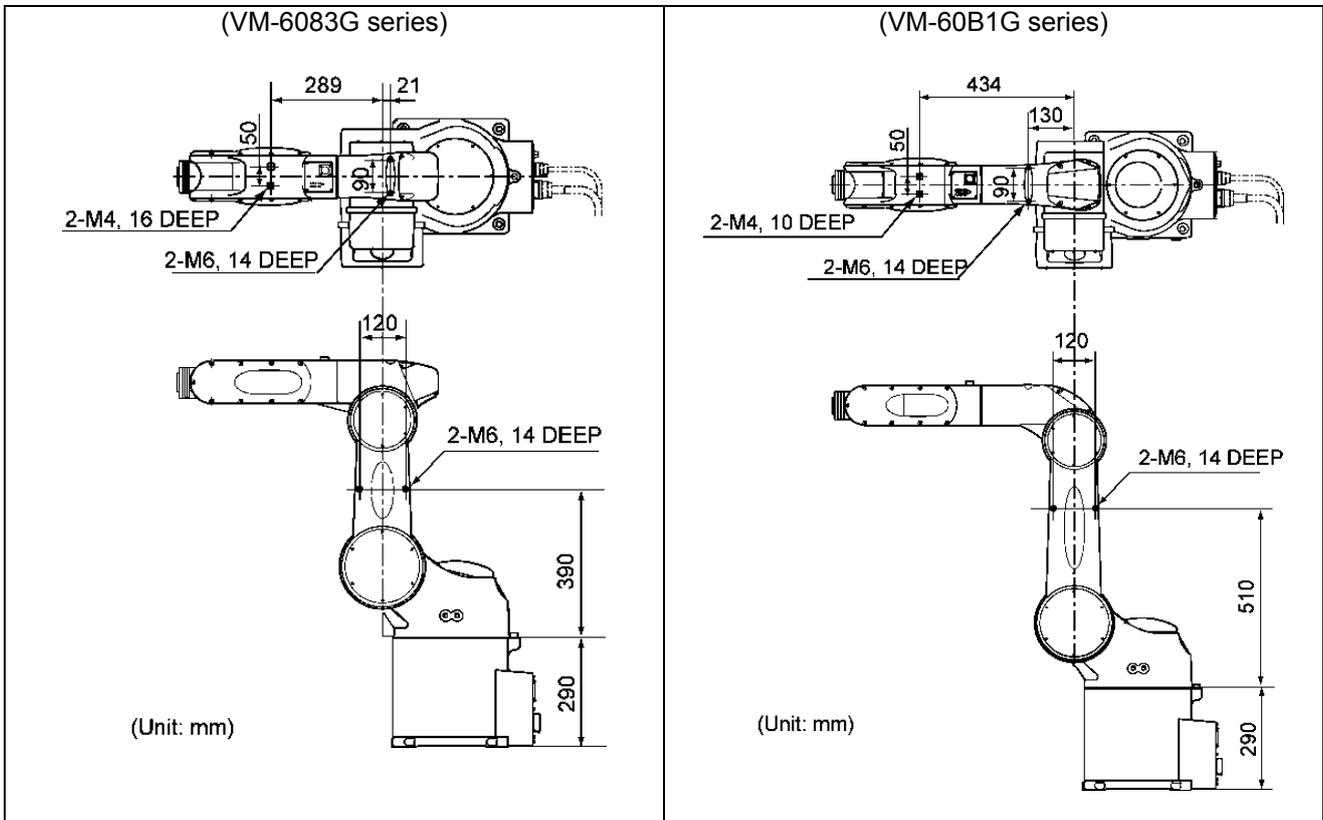
Components of connector set for CN20, 21	Assembly procedure example
 <p>(For straight plug)</p>  <p>(For L type plug)</p>	<ol style="list-style-type: none"> (1) Treatment of wire ends: Strip the wire ends of the cable (prepared by the customer). The cable diameter and the lengths "A" and "B" should be in accordance with the instructions given by the connector manufacturer.  <ol style="list-style-type: none"> (2) Tinning: Tin both the core wires and the connector contacts. (3) Pass the cable through the heat-shrinkable tube for splash-proof purpose (with adhesive inside, prepared by the customer) and the rubber bushing. (4) Solder the core wires onto the connector contacts to connect them each other. (5) Press the rubber bushing against the shell to fit the hood. Then cover the rubber bushing with the heat-shrinkable tube and apply heat to shrink the tube.  

3.4.3 Solenoid Valve Specifications (VM-G series)

Note: Do not cover the valve exhaust port behind the second arm.

	Item	Specifications
Valve	Switching system	2-position double
	Applicable fluid	Air
	Operating system	Pilot type
	Effective cross section (Cv value)	P→A/B : 1.98mm ² (0.11) A/B→R : 1.80mm ² (0.10)
	Lubrication	Oilless
	Operating pressure range	0.1 to 0.7 MPa (Note 1)
	Response time	10 ms or less (at 0.5 MPa)
	Maximum operating frequency	10 Hz
	Ambient temperature	-5 to 50°C (No dew condensation allowed. When dry air is used)
Solenoid	Operating voltage	24 V ±10%
	Power consumption (current)	0.65 W (27 mA)
	Surge voltage protection circuit	Diode
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").		

3.4.4 Original Thread Holes for Wiring and Piping (VM-G series)



Existing Internal Threads for Wiring and Piping (VM-G series)

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.

3.5 Precautions When Designing the End-effectors

■ VM-G Series

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

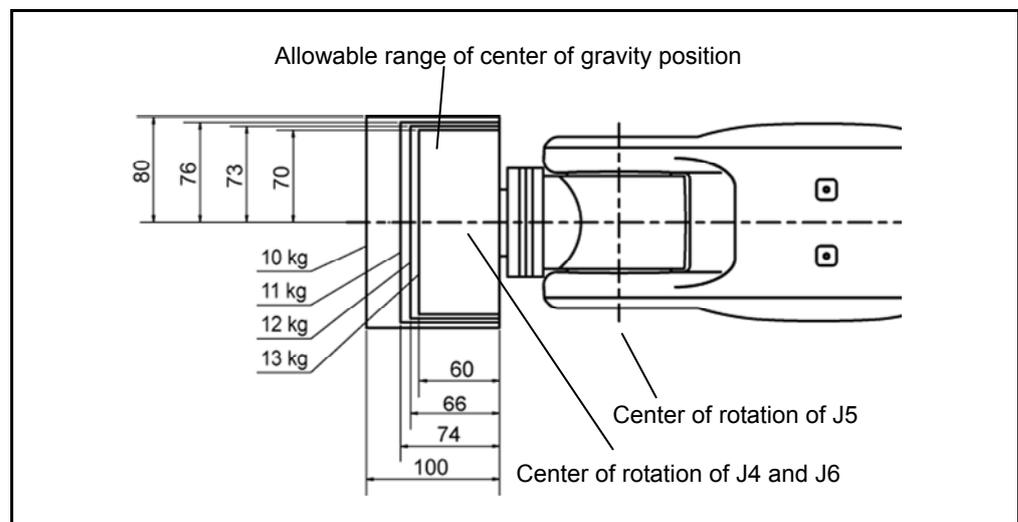
Design the end-effector so that the total mass of the end-effector (including workpiece) will be less than the maximum payload capacity of the robot. The total mass includes the wiring, piping, etc.

Maximum total mass of end-effector (including workpiece) \leq Maximum payload capacity (13 kg) *

- * If the payload exceeds 11 kg, the robot unit must be used with the flange facing down at +/-10 degrees from vertical. Also, the maximum payload is 10 kg if the robot controller version is older than Ver.3.32.

(2) Center of gravity position of end-effector

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



**Allowable Range of Center of Gravity Position
[VM-6083G/VM-60B1G]**

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

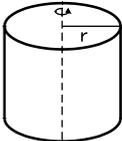
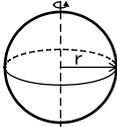
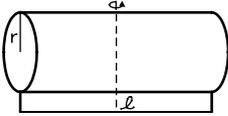
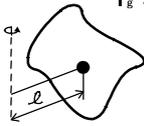
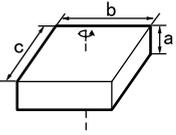
Design an end-effector so that its moments of inertia around J4, J5 and J6 (including workpiece) do not exceed the maximum allowable moment of inertia of the robot.

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

Mass of payload (kg)	Max allowable moment of inertia (kgm ²)	
	Around J4 & J5	Around J6
~1	0.04	0.006
~2	0.07	0.013
~3	0.11	0.019
~4	0.14	0.026
~5	0.18	0.032
~6	0.22	0.038
~7	0.25	0.045
~8	0.29	0.051
~9	0.32	0.058
~13	0.36	0.064

When calculating the moment of inertia around J4, J5 and J6 of the end-effector, use the formulas given in following table and figure.

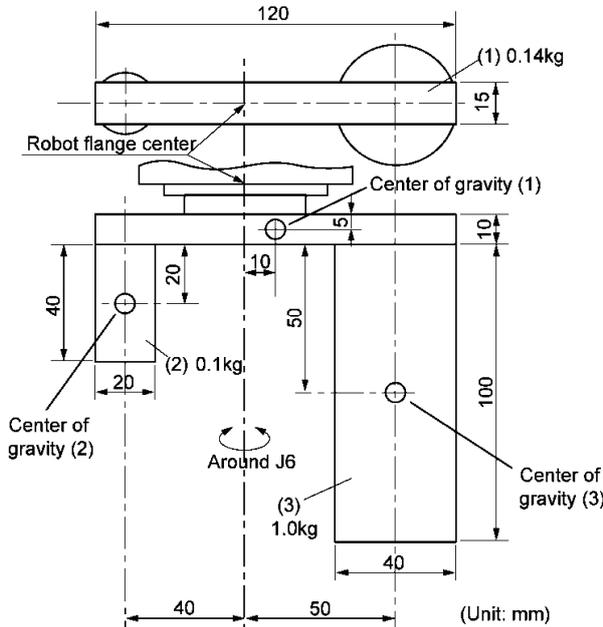
Moment-of-Inertia Formulas (VM-G series)

<p>1. Cylinder (1) (Axis of rotation = Center axis)</p>  $I = \frac{mr^2}{2}$	<p>4. Sphere (Axis of rotation = Center axis)</p>  $I = \frac{2mr^2}{5}$
<p>2. Cylinder (2) (The axis of rotation passes through the center of gravity.)</p>  $I = \frac{m}{4} \left(r^2 + \frac{l^2}{3} \right)$	<p>5. Center of gravity not on the axis of rotation</p>  <p>I_g : Inertia moment around center of gravity [kgm²]</p> $I = I_g + m\ell^2$
<p>3. Rectangular parallelepiped (The axis of rotation passes through the center of gravity.)</p>  $I = \frac{m}{12} (b^2 + c^2)$	<p> I: Moment of inertia kgm² m: Mass kg r: Radius m b, c, ℓ: Length m </p>

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)

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

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

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

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

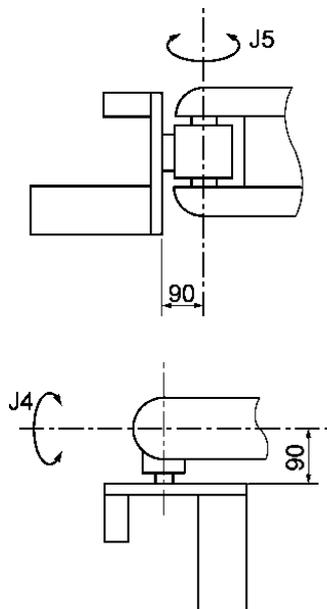
$$I_3 = \frac{1.0 \times 0.02^2}{2} + 1.0 \times 0.05^2 = 2.7 \times 10^{-3} \text{ [kgm}^2\text{]}$$

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

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

(2) Moment of inertia around J4 and J5

For the following figure, 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)

$$I_1 = \frac{0.14}{12} (0.015^2 + 0.01^2) + 0.14 \times (0.09 + 0.005)^2 = 1.3 \times 10^{-3} \text{ [kgm}^2\text{]}$$

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

$$I_2 = \frac{0.1}{4} (0.01^2 + \frac{0.04^2}{3}) + 0.1 \times (0.09 + 0.01 + 0.02)^2 = 1.46 \times 10^{-3} \text{ [kgm}^2\text{]}$$

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

$$I_3 = \frac{1.0}{4} (0.02^2 + \frac{0.1^2}{3}) + 1.0 \times (0.09 + 0.01 + 0.02)^2 = 2.3 \times 10^{-2} \text{ [kgm}^2\text{]}$$

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

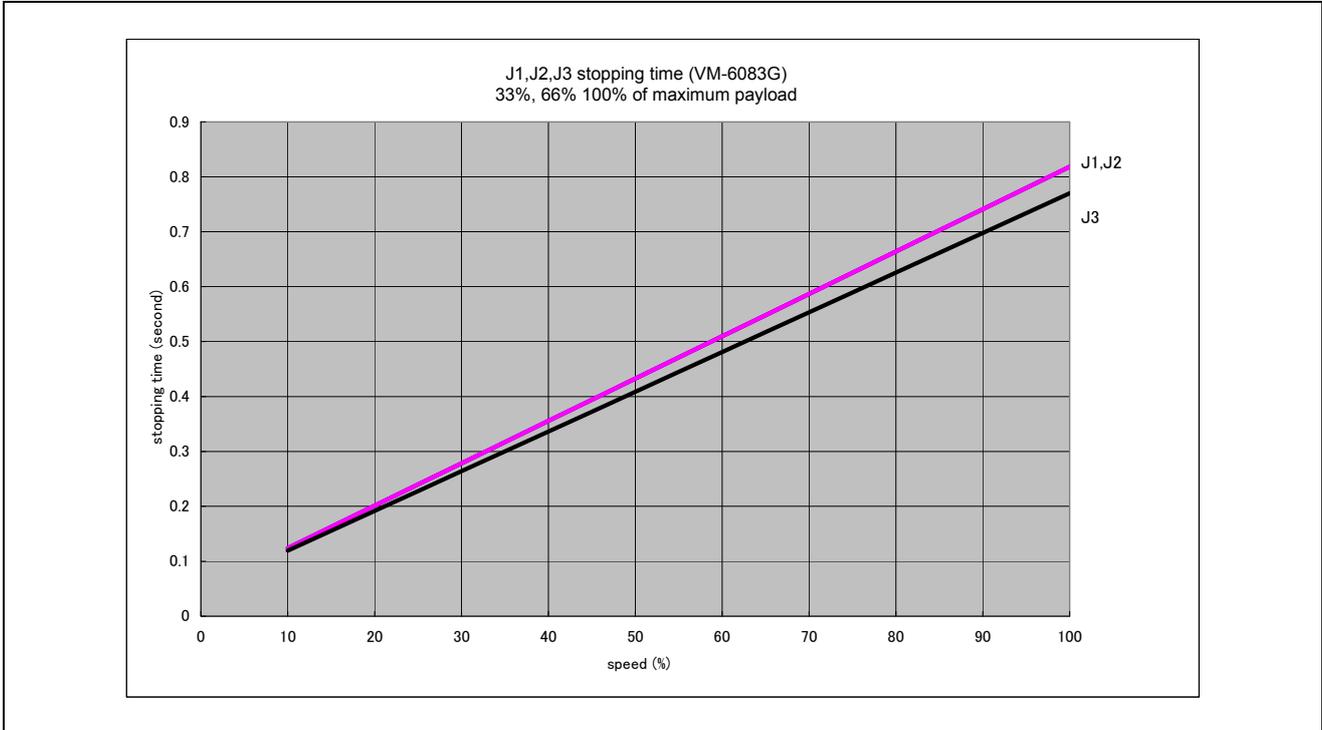
$$I_{J4} = I_{J5} = I_1 + I_2 + I_3 = 2.6 \times 10^{-2} \text{ [kgm}^2\text{]}$$

End-effector Moment of Inertia Calculation Example (VM-G series)

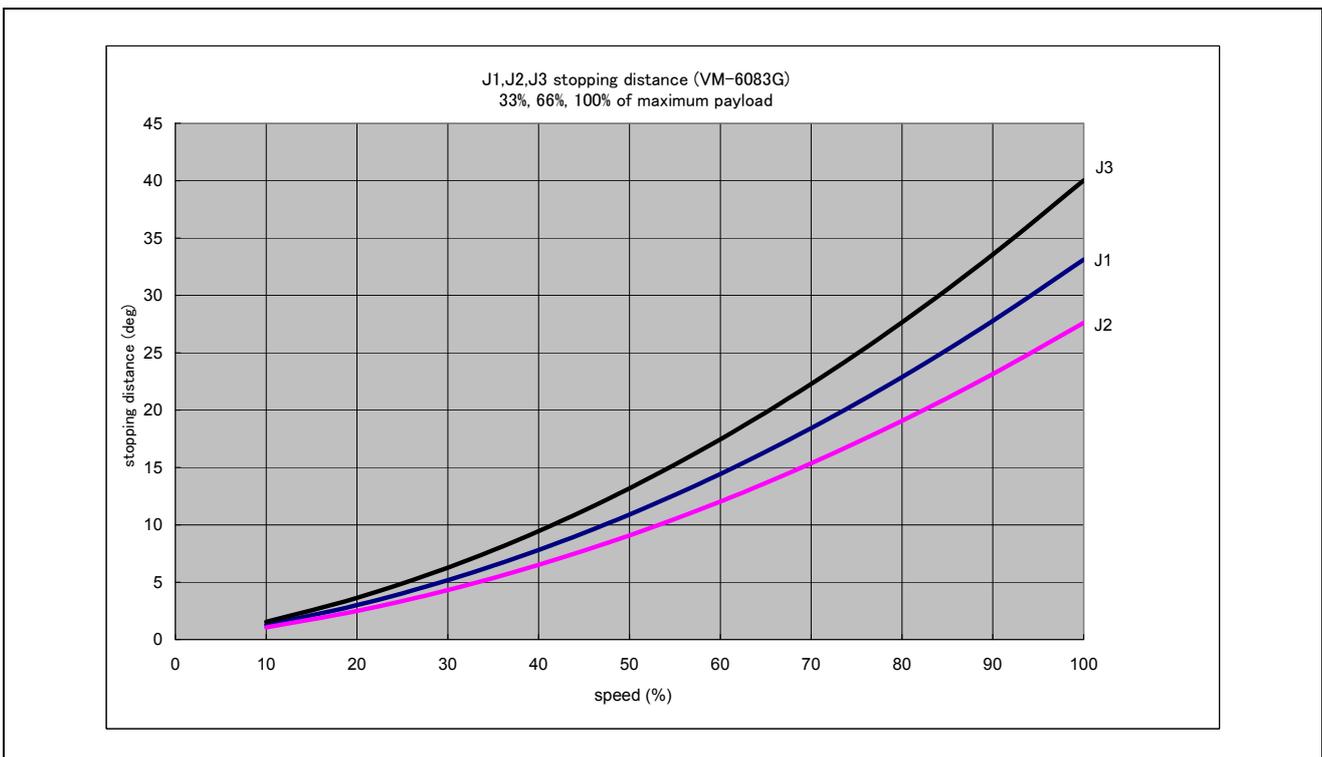
3.6 Stopping Time and Distance (Angle) at an Emergency Stop

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) VM-6083G series (VM-6083G / VM-6083G-W, VM-6083G-P100)

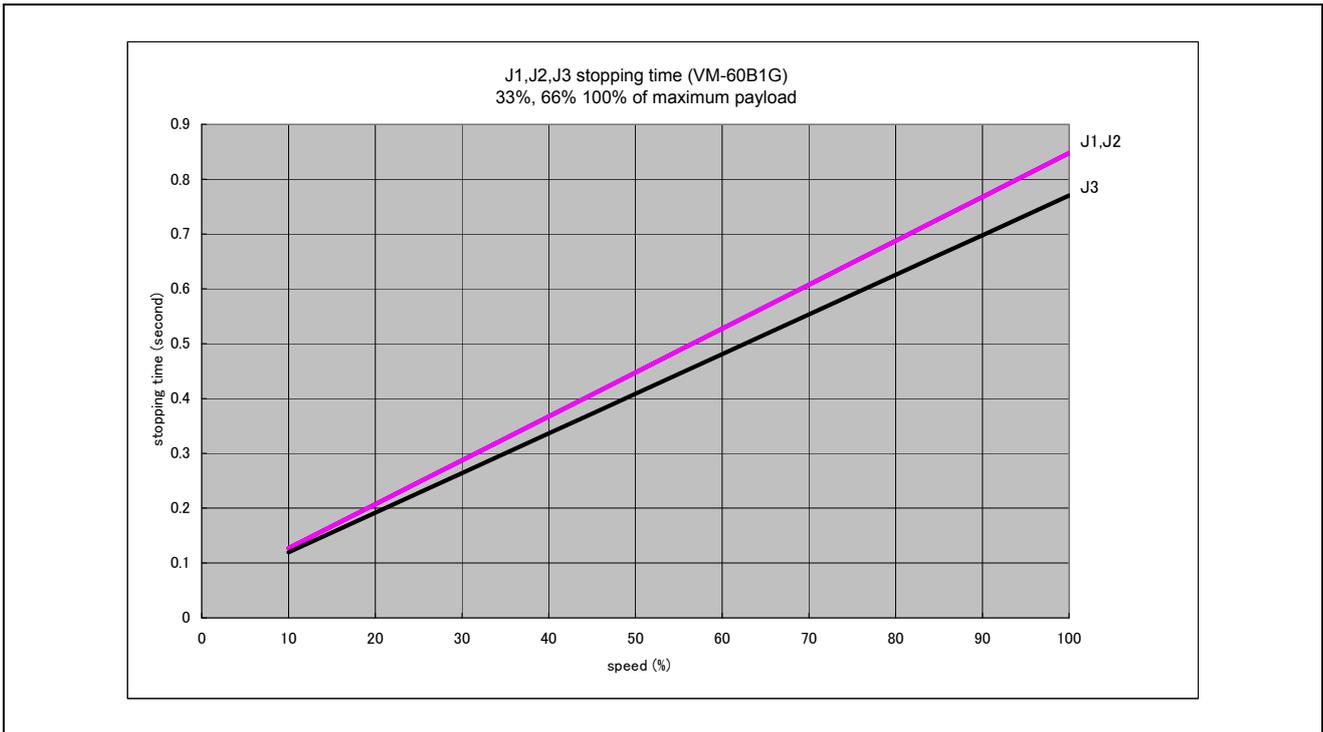


J1, J2, J3 stopping time vs. speed at an emergency stop (VM-6083G series)

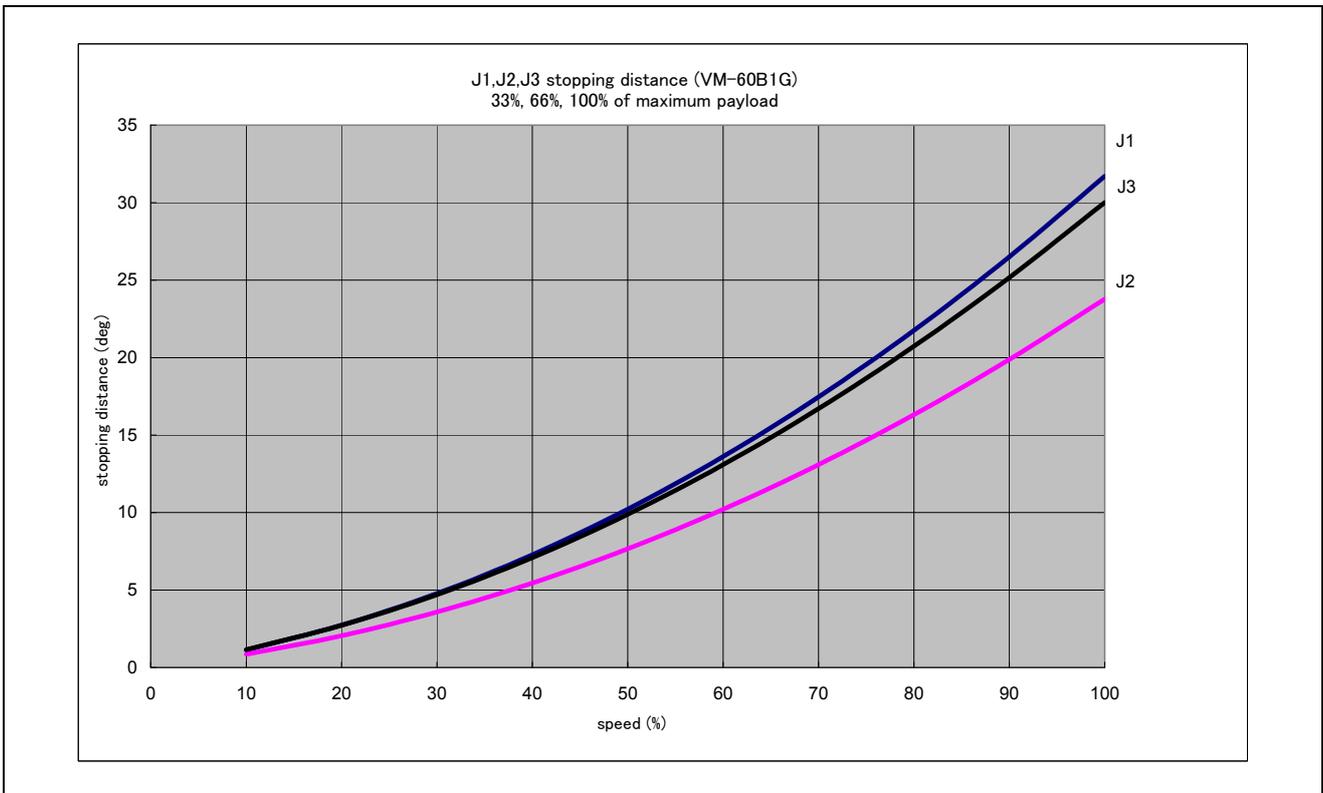


J1, J2, J3 stopping distance vs. speed at an emergency stop (VM-6083G series)

(2) VM-60B1G series (VM-60B1G / VM-60B1G-W, VM-60B1G-P100)



J1, J2, J3 stopping time vs. speed at an emergency stop (VM-60B1G series)



J1, J2, J3 stopping distance vs. speed at an emergency stop (VM-60B1G series)

Chapter 4

Specifications of the Robot Controller

4.1 Specifications

The table below lists the specifications of the robot controller.

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

Item			Specifications
Applicable robot			Medium-sized, vertical articulated type (VM-G series)
model			RC7M-VMG6BA-**
Control system			PTP, CP 3-dimensional linear, 3-dimensional circular
No. of controllable axes			Up to six axes simultaneously
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).	

RC7M Controller Specifications (2) (VM-G series)

Item		Specifications
Cables	Motor & encoder cable (option)	2 m, 4 m, 6 m, 12 m, 20 m (Standard / Splash-proof)
	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
Environmental conditions (in operation)		Temperature: 0 to 40°C Humidity: 90% RH or less (no condensation allowed)
Power source		Three-phase, 200 VAC-15% to 230 VAC + 10%, 50/60 Hz, 3.3 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

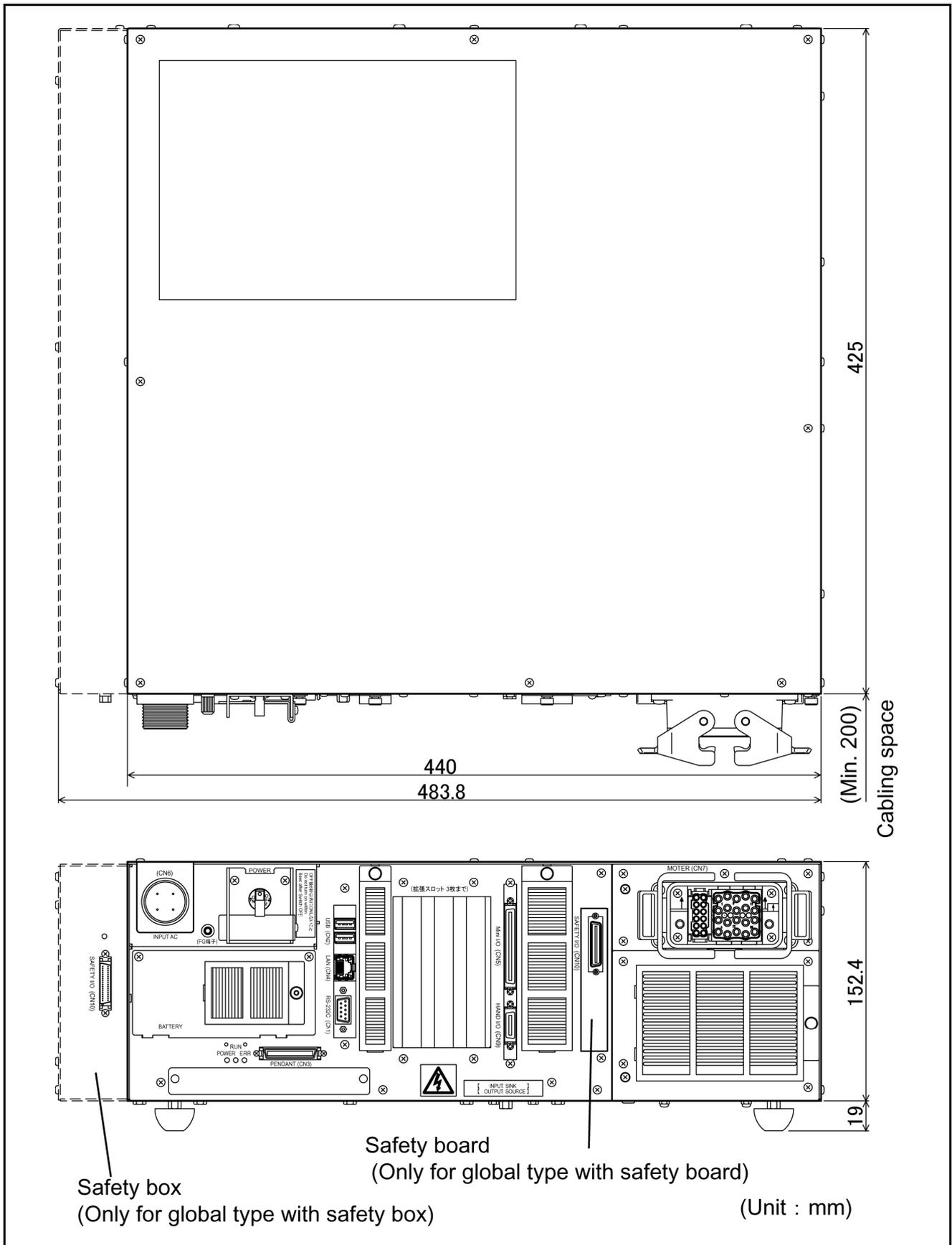
- **DO NOT touch fins. Their hot surfaces may cause severe burns.**
- **DO NOT insert fingers or foreign objects into openings. Doing so may cause bodily injury.**
- **Before opening the controller cover and accessing the inside of the controller for maintenance, be sure to turn off the power switch, 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.**

4.2 Outer Dimensions

Figure below shows the outer dimensions of the robot controller.



Outer Dimensions of Robot Controller (VM-G series)

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サブアセンブリ／SUBASSEMBLY

IPM	SLOT5	SLOT6	
BOARD	SLOT3	SLOT4	
	SLOT1	SLOT2	

③その他変更点／OTHER MODIFICATIONS

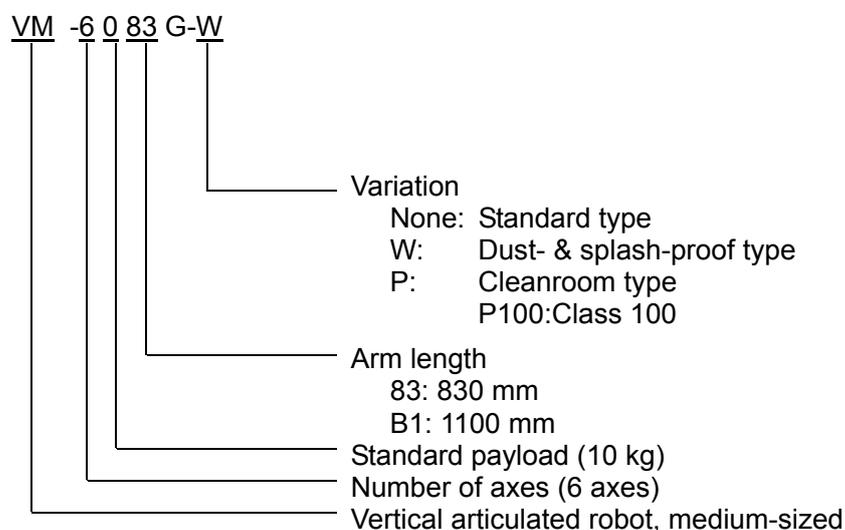
--

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.

Medium-sized, vertical articulated type (VM-G series)



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, refer to "Conformity with Standards by Robot Model" in the Additional Information section of the RC7M controller manual pack CD SUPPLEMENT.

Vertical Articulated Robot VM-G SERIES

GENERAL INFORMATION ABOUT ROBOT

First Edition July 2005
Twelfth Edition January 2012
Thirteenth Edition February 2013

DENSO WAVE INCORPORATED

2Q**C

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.

In no event will DENSO WAVE INCORPORATED be liable for any direct or indirect damages resulting from the application of the information in this manual.

