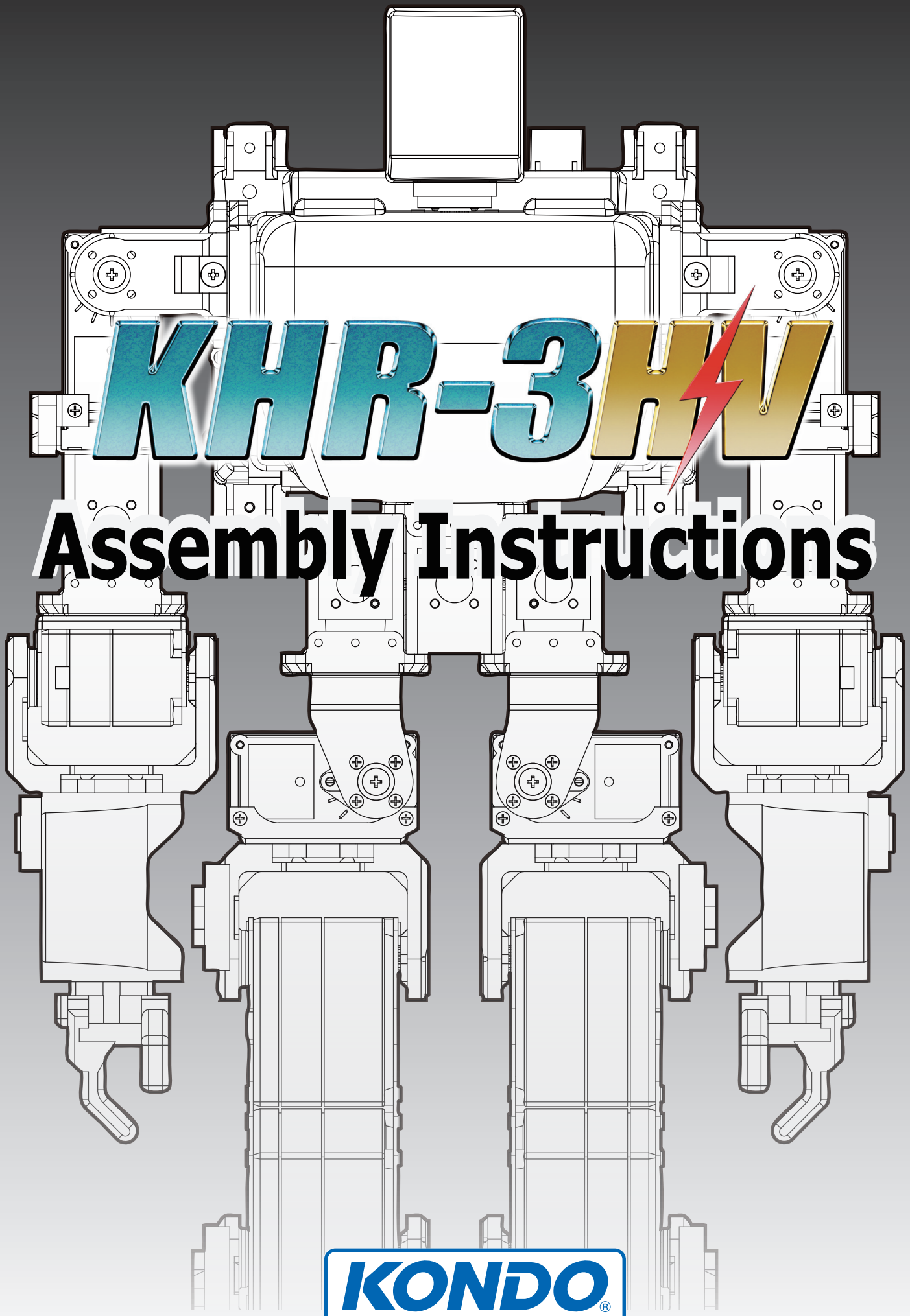


KHR-3HV

Assembly Instructions

KONDO
KONDO KAGAKU CO., LTD.

Ver1.0 2009-12-10

Safety Precautions

Users: Due to the nature of this product as an assembly kit, consequences resulting from the use of this product is of your responsibility.

In order to prevent damages to the user and the people and properties surrounding the user, safety precautions are listed as follows:

■The following signs are used with each description to indicate the level of harm and interference caused by ignoring the precautions.

⚠危険	This sign indicates that there is imminent danger of death or severe injury.
⚠警告	This sign indicates that the action may possibly result in death or severe injury.
⚠注意	This sign indicates that the action may possibly result in injury or material damage.

■The following pictorial indications are used with description according to the type of precaution.
(The following are only part of the pictorial indications used.)

	This pictorial indication signifies that the action is prohibited.
	This pictorial indication signifies that the action is mandatory.

⚠ Danger

Work with sufficient space in a physically and emotionally healthy state.

There is danger of death or serious injury by unpredictable accident.

⚠ WARNING

Keep all parts away from small children.

Parts such as aluminum frame bar can cause injury.

Pull out the connector of the HV battery immediately if abnormalities occur.

・Damage in main body. Foreign object in main body. Smoke. Odd smell. Abnormal heat generation.
Continued use under such conditions can result in fire or electric shock.

●Should any abnormalities be observed, stop use of product immediately and contact our service section.

Do not break charger and cable.

Do not damage, convert, bring in close contact with thermal appliances or use under forced pressure.
Continuous use under such conditions can result in fire or electric shock.

●For repair of cords and cables, please contact our service section.

Disconnect plug from outlet when charger is not used.

When plugged to an outlet, a small amount of electricity flows into the charger.

Clean the plug regularly to avoid dust from accumulating.

Do not disassemble or convert the servo and board of the finished product.

Prohibition

Disassembly and repair other than those stated in this Instruction is prohibited.

Mistaken disassembly or assembly can cause malfunction, fire and electric shock.

In case of malfunction, please contact our service section.

Do not wet or use under high humidity and conditions at which dew condensation occurs.

Prohibition

Such conditions may result in malfunction as this product is composed of precision electronic parts.

Such conditions can also result in electric shock and fire by short out.

Should you wet the product, please consult our service section.

During operation, exercise caution and be prepared for unforeseen accidents.

Please be reminded that due to the nature of this product as an assembly kit, safety is not guaranteed for the movements resulting from the operation of the product. Please take extra precaution as injury of the fingertips and fracture of bones may result when movements of the product greatly differ from what you expect.

Recognize the possibility that components can short circuit.

Short circuit can easily occur as terminals are bare on the control board. Short circuit causes ignition of battery and wiring materials. Incorrect wiring can also result in equal danger.

⚠ CAUTION

For overseas use, approval or license may be needed. Please check.

In certain areas or countries, legal procedures may be necessary.

Our support does not apply to the use of this product outside of Japan.

When detaching the connectors of the charger and battery, hold the connectors.

Detachment by holding the cord may cause breaking of wire and short circuit, which can result in electric shock or fire.

Do not operate at an unstable place.

Prohibition

The product can lose balance and collapse or fall off and cause injury.

Ni-MH

The HV battery of this product is a nickel-metal hydride battery. In order to protect valuable resources, used batteries should be recycled instead of disposed.

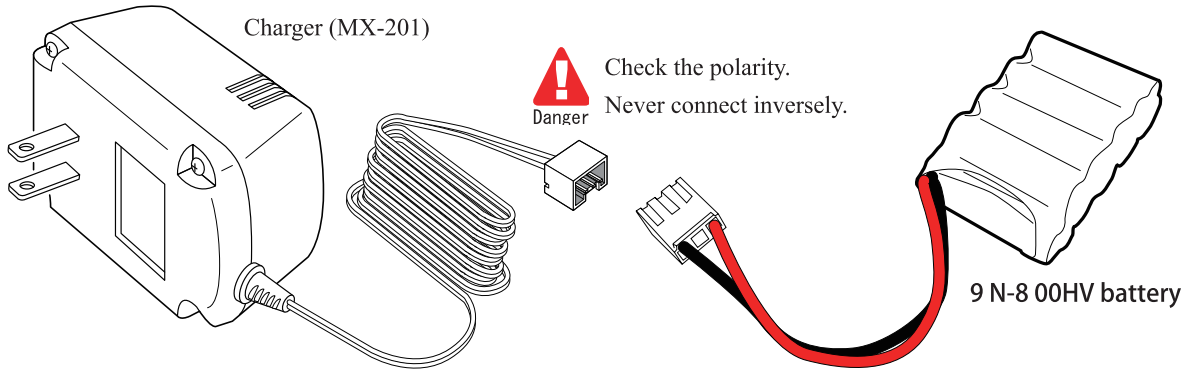
Handling HV Battery

In this kit, HV battery (nickel-metal hydride battery) is used as a power source for operation. Although nickel-metal hydride battery is a secondary battery that can be charged and reused, misuse can result in serious accidents. This Instruction should be read carefully before use.

How to charge

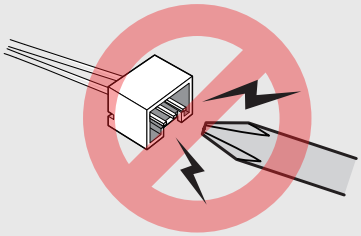
1 Plug the charger (MX-201) to an outlet.

Do not attach battery before plugging to outlet, as this can cause malfunction.



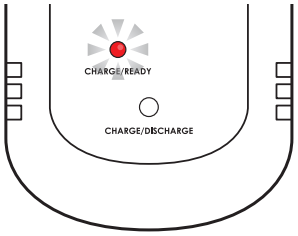
The charger is exclusively for AC 100 V, and is used by plugging to a household AC outlet.

Warning Electrical current runs through the cord to the terminal pin when connected to the charger. Do not short circuit the pin with a conductive material.



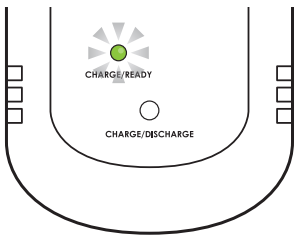
2 Insert the HV battery connector to the charger connector. The LED on the charger turns red and charging starts automatically.

Plug in firmly to avoid disconnection while charging.



Warning Beware of the state of the nickel-metal hydride battery while charging. Should you detect any abnormal heat generation, noise or smell, remove the nickel-metal hydride battery immediately.

3 LED turns green when charging is completed. Disconnect the charger connector and the battery connector. Unplug charger from outlet if next battery is not charged successively.



Charge time depends on the amount of nickel-metal hydride remaining, and is approximately 12 hours when empty.

Handling HV Battery

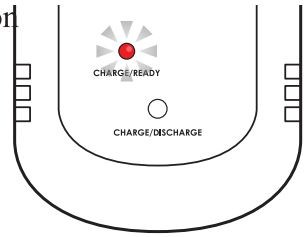
How to charge after discharge

1 Plug the charger (MX-201) to an outlet.

Do not attach battery before plugging to outlet, as this can cause malfunction.

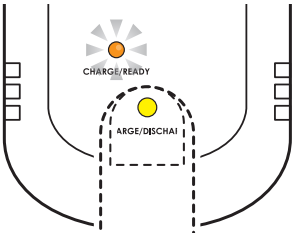
2 Insert the HV battery connector to the charger connector. The LED on the charger turns red.

Plug in firmly to avoid disconnection while charging.



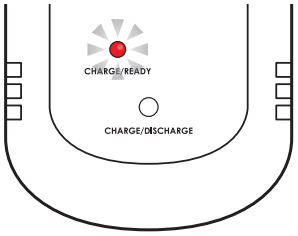
3 Press down on the yellow button for a while. The LED on the charger turns from red to orange and discharge begins.

In order to forcibly begin charging, press down on the yellow button for a while. The LED changes from Orange to Red and charging begins.



4 Charging immediately begins when discharge is completed. The LED on the charger will turn from orange to red.

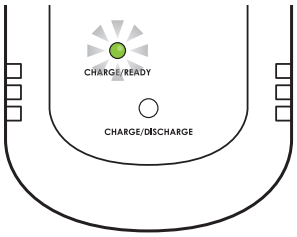
The LED (lamp) darkens as charging proceeds, but will not disappear completely.



Warning

Beware of the state of the nickel-metal hydride battery while charging.
Should you detect any abnormal heat generation, noise or smell, remove the nickel-metal hydride battery immediately.

5 LED turns green when charging is completed. Disconnect the charger connector and the battery connector. Unplug the charger from the outlet if next battery is not charged successively.



Precautions

⚠DANGER

Prohibition

The following actions are dangerous and are thus prohibited.

Removal of the connector and conversion such as changing of cords.
Do not short circuit the battery.

Short circuiting a battery can result in explosion, ignition and fluid leakage, which could cause injury and loss of eyesight. Short circuit can occur at the pin even with the connector attached. Attention is always required during use.

Do not place the battery alongside other objects during transportation and storage.

Short circuit caused by damage of the connector, wire and wrapping of the nickel-metal hydride battery can result in ignition and fluid leakage. Please place battery apart from other objects during transportation and storage. There have been reports of ignition caused by short circuiting with coins and car/house keys.

⚠Warning

Should the following circumstances occur, take necessary measures.

In case of fluid leakage, any liquid adhered to the hands must be washed away immediately. Should you get any fluid in your eyes, wash thoroughly and seek medical attention.

The substance inside the battery is harmful and will affect the human body, as well as damage furniture and residence. Immediate attention is required as blindness can be caused when fluid gets in the eye.

Unplug the battery connector from the board and charger when battery is not in us or when battery is left unattended for a length of time.

To take necessary measures in case of unexpected circumstances, keep the battery within eyeshot.
Do not leave the connector plugged for a long period of time as it may result in fire.

⚠Caution

In order to protect valuable resources, please take any used batteries to the store for recycling instead of disposing them.

Property of Nickel-Metal Hydride Battery

Compared to dry-cell battery, nickel-metal hydride battery is advantageous in that it has very low internal resistance and can produce large currents. On the other hand, if charging is repeated before it is fully consumed, a condition called memory effect occurs, causing its life span to become very short. In order to prevent such memory effect, nickel-metal hydride battery should be charged only after it is fully consumed.

Preface

Thank you for purchasing the robot assembly kit "KHR-3HV".
This product is a low-priced assembly kit that enables the assembly of a bipedal robot that can be operated to various motions. For its assembly, please read this Instruction as well as the attached Operation Manual carefully. In addition, we recommend that the instructions be printed out, as necessary.

Caution

1 Please be reminded that due to the nature of this product as an assembly kit, the motion of the assembled product can not be guaranteed. Further, due to the fact that the movements of the assembled product largely depends on the method by which it was assembled, we may not be able to provide precise answers to your questions regarding operations.

2 This product is constructed for people of all ages to enjoy a bipedal robot. However, this product is not a toy, and contains parts and tasks that would be difficult for young children to understand or perform. For such parts and tasks, parents or teachers should provide assistance.

3 For the assembly and the operation of this product, a personal computer (on which Windows XP(SP2) or Vista operates and has a USB port) is used. Thus, in this Instruction and the attached Operation Manual, all instructions are written under the presumption that the user has basic computer skills. Further, please be informed that we can not provide answers to any questions and inquiries regarding computers or Windows.

The contents of this Instruction and product are subject to changes without notice for improvement or other reasons.

Preparations

For the assembly and operation of this product, in addition to the assembly kit, the following items are needed.

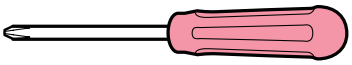
Personal computer

Processor (CPU) : Pentium4 2GHz or above
Microsoft Windows XP (SP2 or later) or Vista must operate
Hard Disk : 32 MByte or larger (not including data file)
Memory : 256MByte or larger
Drive : CD-ROM drive (for installation)
USB : 1 or more USB 2.0 port(s)
Software : Microsoft. NET Frame work 2.0 is necessary

Tools

*0 and #1 screwdriver

One with a thick handle and a magnetic tip is convenient.



*cutter knife
*nipper・・・for cutting parts and board cover
*sandpaper or metallic file
*(4mm) box wrench (or spanner)・・・for tightening M2 nut
*screw locking adhesive (of moderate strength)・・・convenient for preventing screws and nuts from loosening.

Accessories

KRS-2552HV

Servo motor KRS-2552HV used in this kit is a FET servo exclusively for serial signal. Since half-duplex serial transmitting and receiving method has been adopted, by wiring cables according to the multi-drop method, the number of connecting cords from the control board is decreased, allowing a simple wiring layout.

* Various servo properties can be installed by using the ICS USB adapter HS.
* Configuration items are expanded by the use of ICS 3.0, thus allowing ultra-high speed communication.
* As a servo exclusively for robots, fixation by double axial support is possible.
* Output torque is larger although size is about the same as that of KRS-788HV servo motor.
* By adopting ultrasonic motor, operation with smaller amount of electricity, compared to former products, is made possible.
* Detects temperature and current values and for safety.

Major specifications

External size ---------- 41 x 21 x 35.5 (mm)
* Not including projections

Weight ---------- 41.5 g
* Not including cable and servo horn

Maximum operating angle --------- 270degree
Maximum Torque ---------- 14kgcm (at 11.1 V/ at rest)
Maximum Speed ---------- 0.14s/60degree (at 11.1 V/ unloaded)
Proper voltage ---------- Direct current 9-12V (our specified HV power source is recommended)

RCB-4HV

* A computer software is needed for its use.

RCB-4HV control board used in this kit contains eight SIO ports for two systems of ICS3.0 compliant device, and can connect up to thirty-six ICS3.0 devices.
With ten AD ports, multiple analog sensors can now be used. Further, AD input for power management is available separately. Ten PIO ports have been newly mounted. LED may easily be lit up. The COM ports and SIO ports enable a maximum speed of 1.25 Mbps. EEPROM, known for its high-speed and high capacity has been adopted.

Major specifications

Size ---------- 45×35(mm) About equal to RCB-3
Weight ---------- 12 g
Interface ---------- SIO port, COM port, AD port, PIO port
Proper voltage --------- Direct current 9-12V (our specified

After-sales service

Inquiries regarding this product and accessories may be taken to our service section.

Inquiry by email is welcomed at the following email address; however, replies may require some time.

support @ kondo-robot.com

Notices and updates regarding this product are posted on our website.

http://www.kondo-robot.com

Instruction Manuals

There are five manuals in total for this product.

1, Kit Guidance

The only printed manual.
Provides overall description of the kit and how to view the other manuals.

2, Assembly Instruction Manual for KHR-3HV

This Instruction. Mainly describes how to assemble the kit.

3, HTH4 Users' Manual

Provided as PDF file. Describes RCB-4HV and "HeartToHeart4".

4, KONDO USB Driver Installation Manual

Provided as PDF file. Describes the installation of driver for serial USB adapter HS.

5, IDW Utility Manual

Provided as PDF file. Describes how to use manager to rewrite servo motor ID.

Construction of this Instruction and Outline of Assembly

This Instruction consists of a step by step description of the assembly method.

- Charge HV Battery Before Assembly
- Setting Origin of Servo
- 1 Assembly of Hip Unit
- 2 Assembly of Chest Unit
- 3 Assembly of Arm Unit
- 4 Assembly of Leg Unit
- 5 Assembly of Sole Unit
- 6 Attaching Each Unit
- 7 Entirety and Wiring Assembly
- 8 Assembly of Backpack
- 9 Overall Assembly
- 10 Setting Home Position

In this kit, most assembly steps can be completed just by tightening screws. However, for the first origin setting of servo and the steps subsequent to step 6 shown in the left scheme, the work must be done by connecting the servo motor to the control board, and verifying the stop position of the initial condition (origin setting).

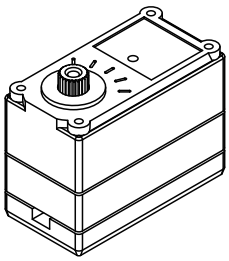
Caution: If the units are assembled without setting the origin, the range of movement could differ resulting in abnormal movements or malfunction.

Therefore, before starting assembly, please charge the HV battery.

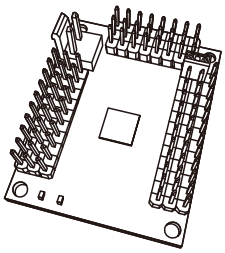
When tightening multiple screws, all screws should be temporarily screwed in and then tightened further. If each screw is tightened from the beginning, the screws that follow may not fit into the holes.

Component List

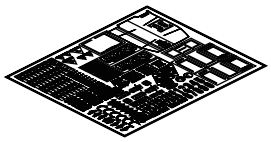
* Before beginning assembly, make sure that all parts are intact.
* Some parts are similar in shape. Please check with reference to the Instruction.



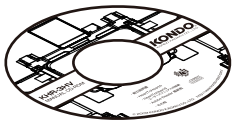
KRS-2552HV (17)



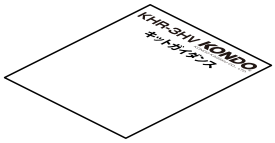
RCB-4HV (1)



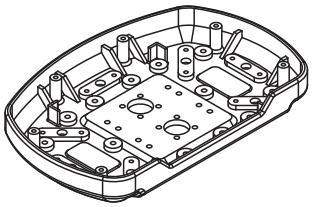
Decal (1)



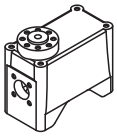
CD-ROM (1)



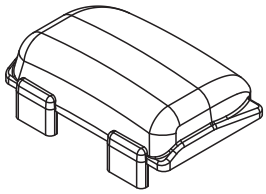
Kit Guidance (1)



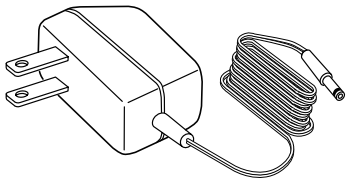
YHR-B1
Sole S-02 (2)



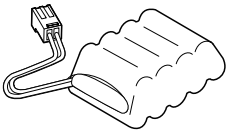
YHR-C2
Dummy Servo 2500A (7))



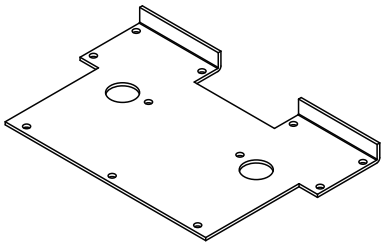
YHR-F1-2
Front Cowl (SD1) (1)



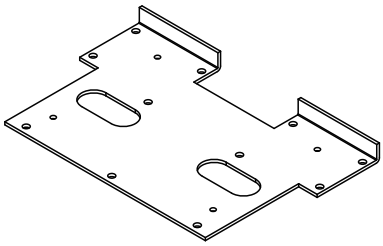
HV Charger
MX-201 (1)



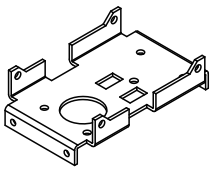
HV Battery
9N 800mAh (1)



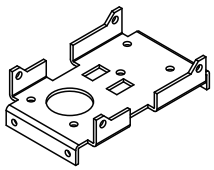
YHR-001 Body Frame F (1)



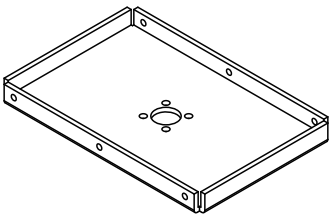
YHR-002 Body Frame B (1)



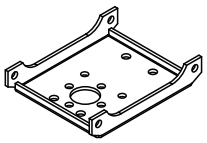
YHR-003 Shoulder Frame L (1)



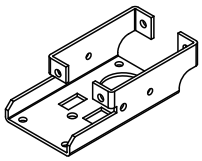
YHR-004 Shoulder Frame R (1)



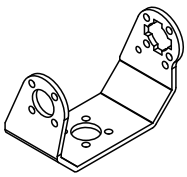
YHR-005 Body Base (1)



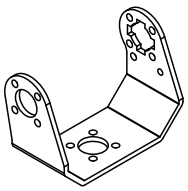
YHR-006 Servo Bracket A (6)



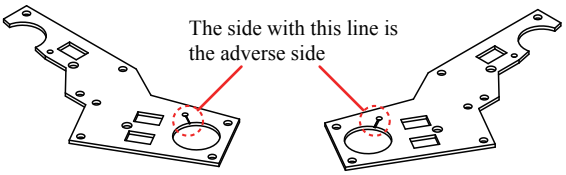
YHR-007 Elbow Joint A (2)



YHR-008 Offset Arm La (1)

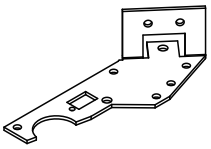


YHR-009 Offset Arm Ra (1)

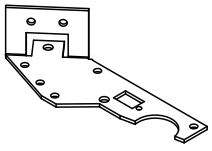


YHR-010 Side Joint L (2)

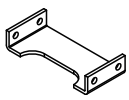
YHR-011 Side Joint R (2)



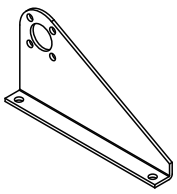
YHR-012 Leg Joint L (2)



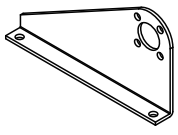
YHR-013 Leg Joint R (2)



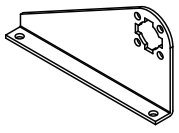
YHR-014 Leg Joint B (2)



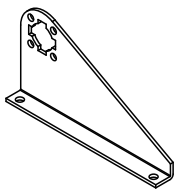
YHR-015 Foot Angle A-L (1)



YHR-016 Foot Angle A-R (1)



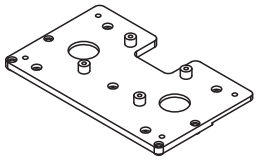
YHR-017 Foot Angle B-L (1)



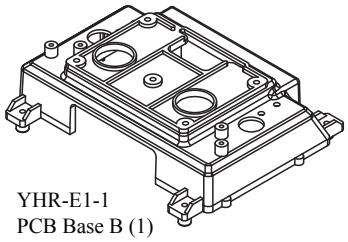
YHR-018 Foot Angle B-R (1)

Component List

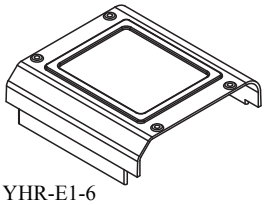
PARTSBAG A



YHR-F1-1
Base Plate A (1)

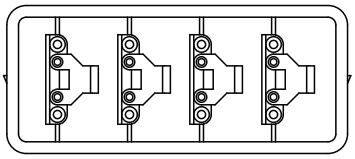


YHR-E1-1
PCB Base B (1)



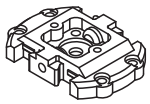
YHR-E1-6
Board Cover (SD1) (1)

PARTSBAG B



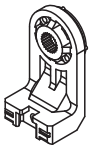
Cable Guide (2)

PARTSBAG C



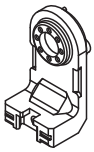
YHR-A1-1
Joint Base 2500A (10)

PARTSBAG D



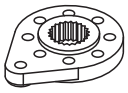
YHR-A1-2
Upper Arm 2500A (10)

PARTSBAG E



YHR-A1-3
Bottom Arm 2500A (10)

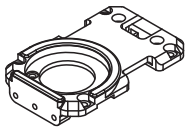
PARTSBAG F



YHR-A1-4
Small Diameter Horn (Offset 0) (12)

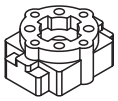
YHR-A1-5
Free Horn 2500B (4)

PARTSBAG G

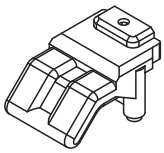


YHR-C1
Arm Supporter 2500A (7)

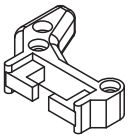
PARTSBAG H



YHR-D1-1
Hand Base B (2)

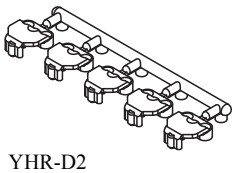


YHR-D1-2
Knuckle B (2)



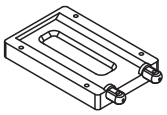
YHR-D1-3
Thumb B (2)

PARTSBAG I

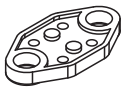


YHR-D2
Cable Guide (small) (2)

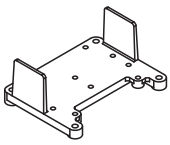
PARTSBAG J



YHR-G1-1
Battery Holder A (2)

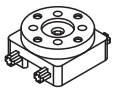


YHR-G1-2
Retainer B (2)

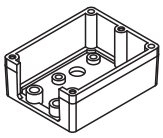


YHR-G1-3
Parts Mount A (2)

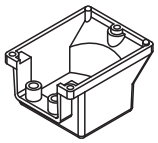
PARTSBAG K



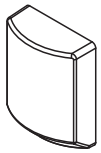
YHR-F2-1
Head Base A (1)



YHR-F2-2
Face (SD1) (1)

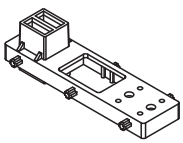


YHR-F2-3
Helmet (SD1) (1)

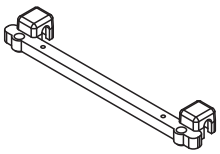


YHR-F2-4
Visor (SD1) (1)

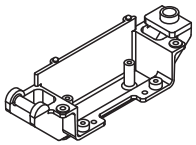
PARTSBAG L



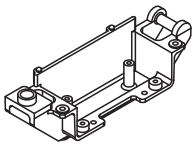
YHR-E1-2
Top Base B (1)



YHR-E1-3
Top Cover B (1)

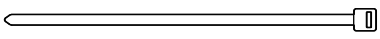


YHR-E1-4
Wing B-L (1)



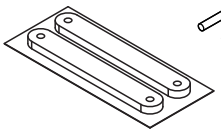
YHR-E1-5
Wing B-R (1)

PARTSBAG M

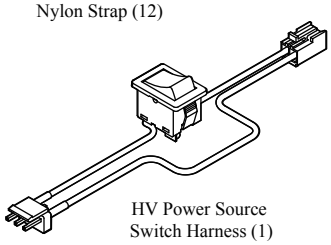


Nylon Strap (12)

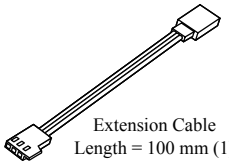
Body Pin (6)



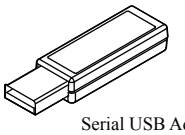
Battery-holding Sponge (1)



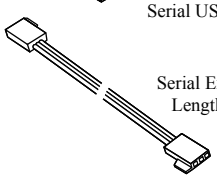
HV Power Source Switch Harness (1)



Extension Cable Length = 100 mm (1)



Serial USB Adapter HS (1)



Serial Extension Cable Length = 1.5 m (1)

Component List

PARTSBAG N

2.3-6BH Tapping Screw (16)

PARTSBAG O

2.6-10BH Tapping Screw (24)

PARTSBAG P

2.6-6 Flat Head Screw (18)

PARTSBAG Q

M3-8 Low Head Horn Screw (24)

PARTSBAG R

2-5 Low Head Tapping Screw (200)

PARTSBAG S

2-8 Low Head Tapping Screw (10)

PARTSBAG T

M2-4 Low Head Screw (38)

PARTSBAG U

M2-6BH Screw (26)

PARTSBAG V

M2 Nut (10)

PARTSBAG W

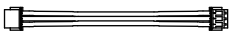
2-6 Flat Head Tapping Screw (10)

PARTSBAG X

3-6 Flat Head Screw (7)

Connecting Cords

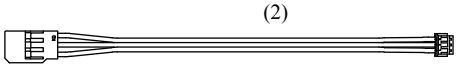
ZH Connecting Cable A (ZH⇔ZH Connector) 50 mm (3)



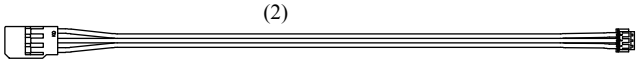
ZH Connecting Cable A (ZH⇔ZH Connector) 100 mm (8)

ZH Connecting Cable A (ZH⇔ZH Connector) 200 mm (2)

ZH Connecting Cable B (ZH⇔Servo Connector) 100 mm (2)



ZH Connecting Cable B (ZH⇔Servo Connector) 200 mm (2)



ZH Connecting Cable B (ZH⇔Servo Connector) 300 mm (2)

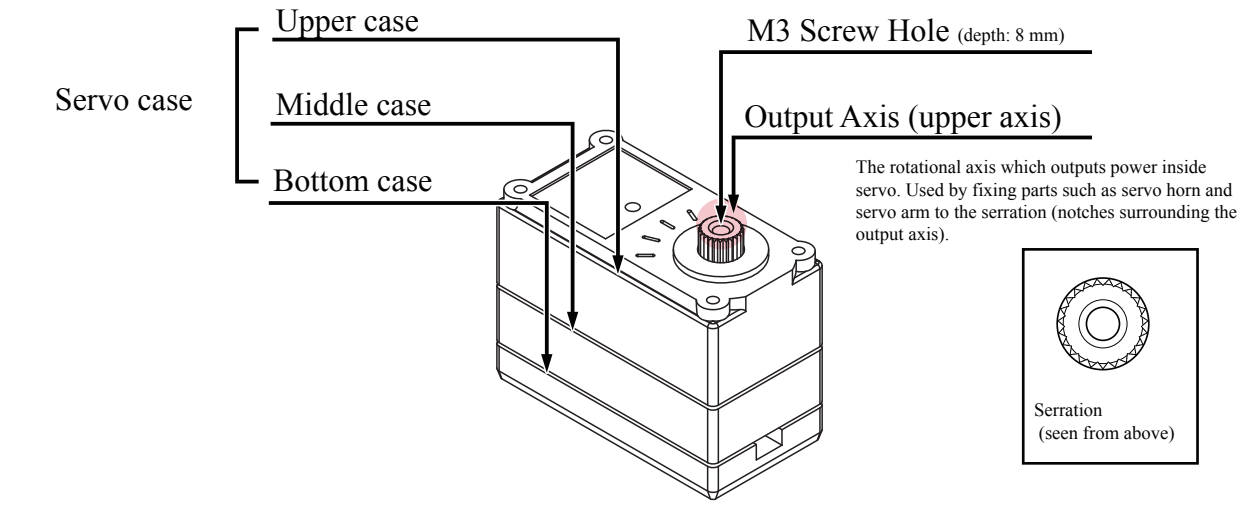
ZH Connecting Cable B (ZH⇔Servo Connector) 450 mm (2)

Table of Contents

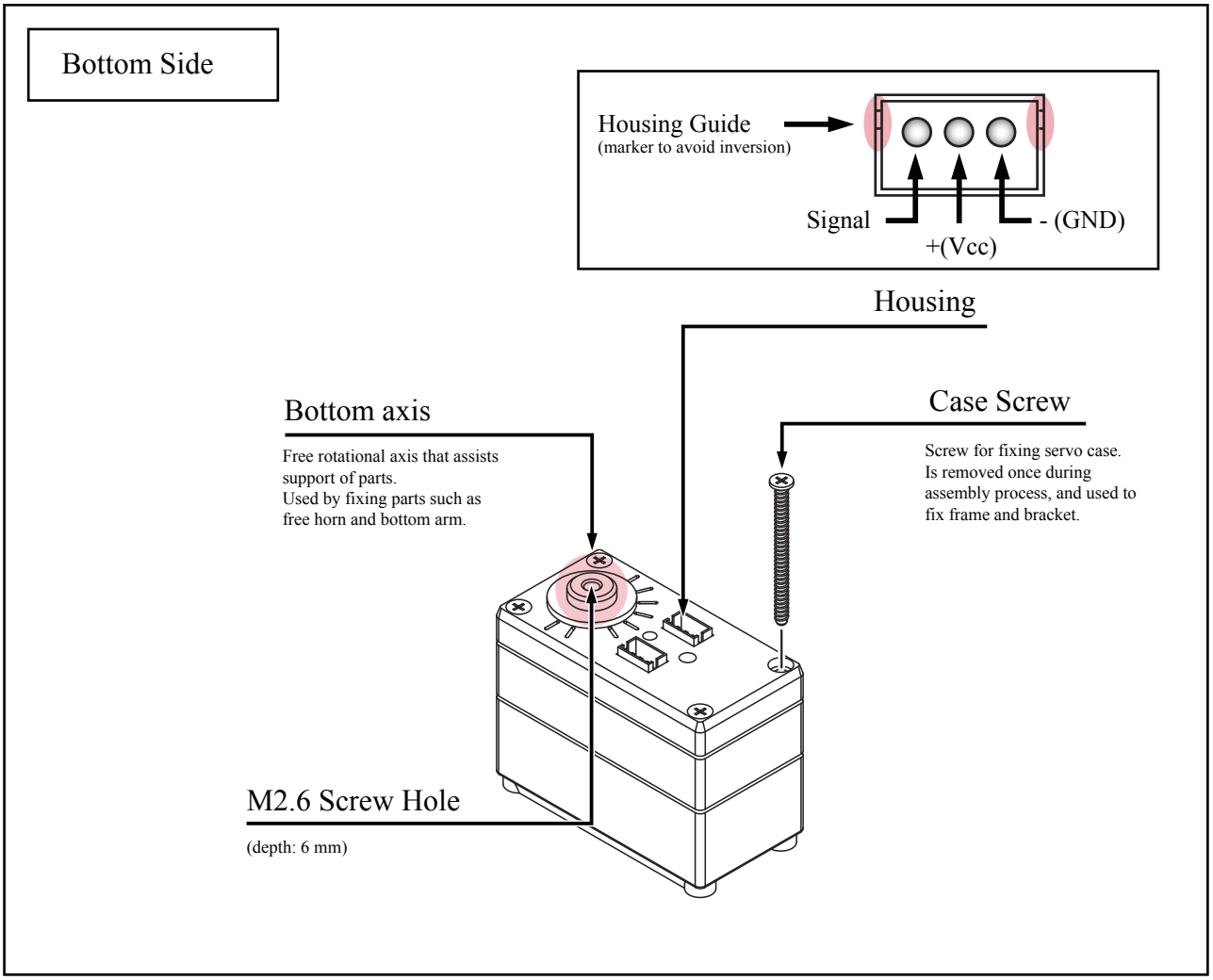
Table of Contents

Names of Servo Motor (KRS-2552HV) Parts

Upper Side



Bottom Side

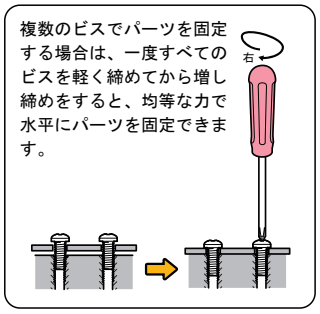


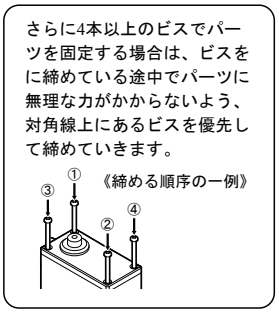
Types of screws and how to handle them

Screw (coarse metric screw)

* Characteristics
In this kit, this screw is mostly used for fixing aluminum parts together. (The “M” inscribed in the name of the screw indicates that it is a metric screw of JIS standard.) This type of screw fits only in tapped hole. (You can see indentations matching the screw inside the hole.) This type of screw can be used repeatedly unless it wears out or deforms.

* Tightening Suggestions
Be careful not to break the screw head with a screwdriver. (Using a screwdriver of ill-fitted point size, and over-tightening can destroy the cross recessed head.)
Change the screw with a new one when its head is destroyed, as it will become impossible to remove with a screwdriver. When the screw stops tightening, check that the screw is not bent. Continued use of a bent screw can cause deformation of the tapped hole, and will become impossible to tighten even new screws.

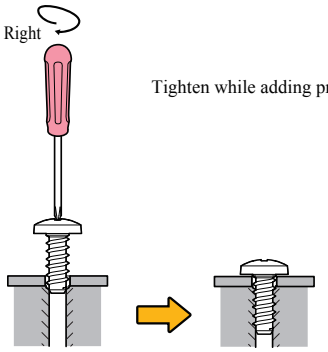




* Maintenance
Vibration causes screws to eventually loosen, even if the screws are tightened securely. Check regularly that the screws are not loosened even after assembly is completed. If you find that the screws loosen or fall off frequently with motion, screw locking adhesives (such as lock-tight and screw-lock) may be effective.
*When using locking adhesive, follow instructions attached to the adhesive.
Fixing screws with instantaneous adhesive can cause the screws to be permanently locked or the holes to be clogged.

Tapping screw

* Characteristics
This type of screw is used to fix resin parts and some aluminum parts. The thread of the tapping screws is tapered and drill-shaped, and can fix parts by tapping holes that have diameters smaller than the screw. (The action of cutting a spiral groove for the screw ridge to fit in a hole is called “tapping”.) Because the screws are tapped into the parts, they can be fastened more tightly than normal screws (metric screws), but will require more force to tighten them in the beginning. If the tapping screws are tightened and taken off repeatedly, the holes become larger and may easily loosen.
* Tightening Instructions
(1) Confirmation of screw holes
Before tightening tapping screws, see if their positions and shapes are as shown in this Instruction.
* If tapping screws are screwed into normal screw holes or holes of ill-fitted sizes, the screw holes can deform, making it impossible to screw in the correct ones.
(2) Tapping
Tighten the tapping screw by pushing its head with a screwdriver so that the screw stands vertical.
* If screws are tightened too hard into resin parts, the head may become embedded and deform. Tighten with care.



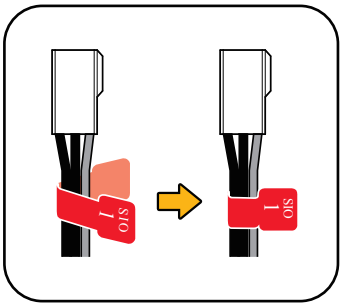
* Retightening a screw after taking it off
If a tapping screw is taken off after tightening, grooves are already formed in the hole. Thus, retightening should be done as follows:
(1) Lock screw vertically
Rotate the screw conversely before tightening to see if it is locked vertically.
(2) Screw in without pushing
Tighten it as with normal screws (metric screws).
* If you push the screw, the holes will be damaged and it will become impossible to fix the screw.

Distinction of servo and channel

How to fix decal for servo lead

Cutting the decal with a cutter or scissors beforehand makes it easier to handle.

Cut decal as you like with reference to the left drawing.



For fixing channel number, refer to the “Process of Assembly” section or the “List of Channels” shown bellow.

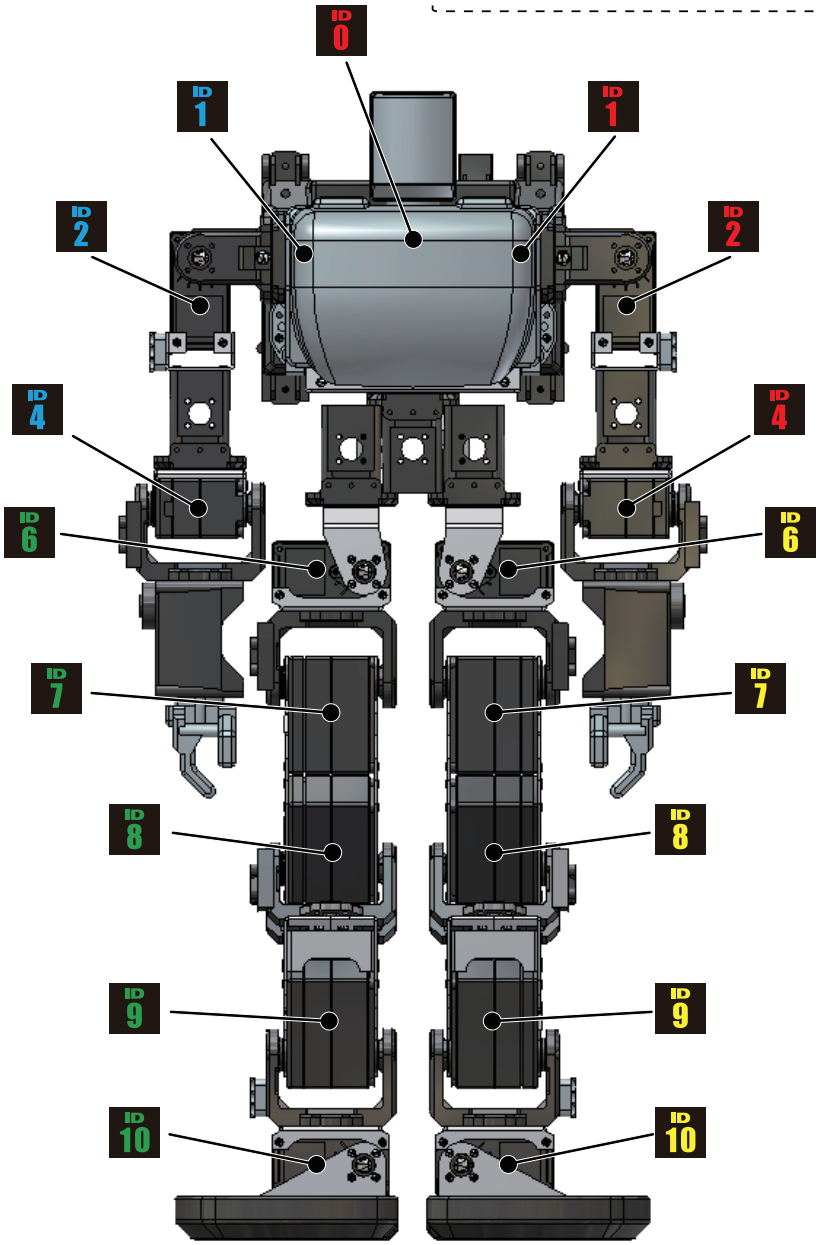
List of IDs for KHR-3HV

For the assembly of this kit, each servo with fixed IDs are used as shown in the following layout figure.

This is a frontal view.

ID 3 ID 5 ID 0 ID 3 ID 5

Can be expanded from 17 axis to 22 axis using KHR-3HV expansion 5 set.



1. Charging Battery

Battery should be charged beforehand.
See p 4-6 for charging methods.

In this kit, HV battery (Nickel-metal hydride battery) is used as a power source for operation. Charging takes about one hour. The following sections refer to processes that use battery. While charging, install the exclusive software "HeartToHeart4" and the driver for serial USB adapter HS, as well as read all instructions.

Further, process 4 (Assembly of Chest Unit) and processes succeeding 16 can be done ahead under your own judgment and responsibility.

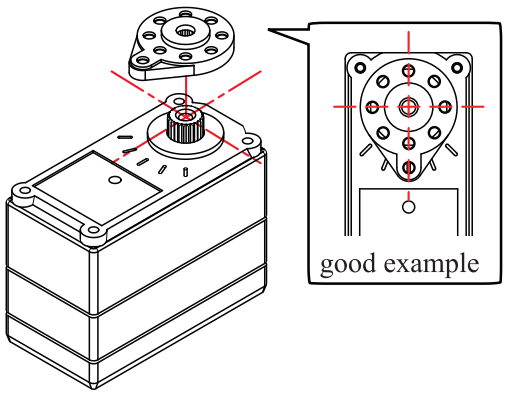
* Be attentive and prepared for any abnormalities while charging battery.

** Stop all use if abnormal heat generation and odd odor is noticed.

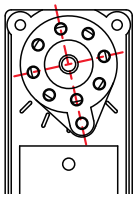
2. Setting Origin of Servo

- Fixing parts to servo output axis and precautions -

Mounting Small Diameter Horn

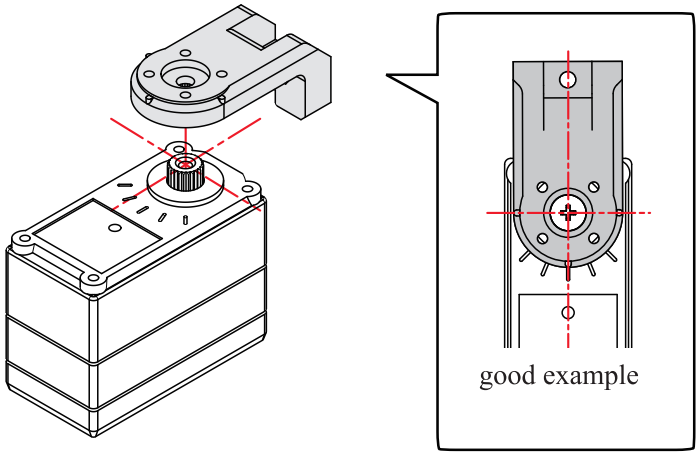


Origin Setting is an important process that decides the reference point of the servo rotation angle. Accurate setting will lead to high reproducibility of sample motions.



bad example

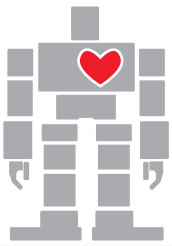
Mounting Servo Arm

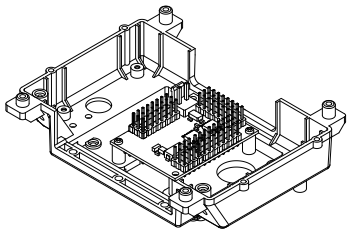


There is only one mounting direction for the servo arm, so if it does not match the figure, stir to either the right or left. For instance, when setting the origin of servos in both shoulders, the more gap there is between the left and right shoulders, the more uneven the arms of the robot becomes. Try to assemble by carefully finding the proper position.

- Assembly of Control Unit -

Process Completion Image



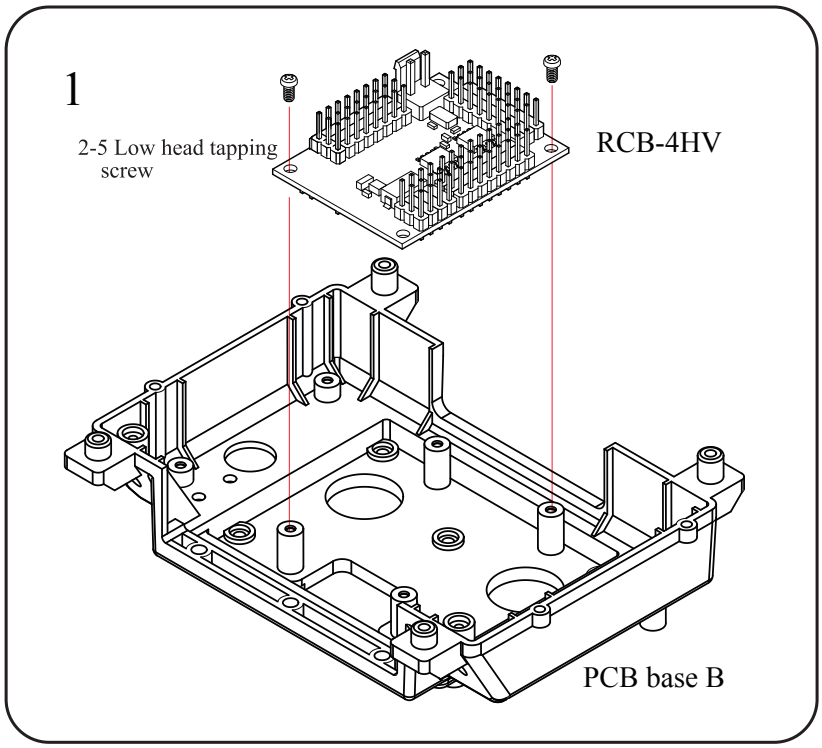


Parts to Prepare

RCB-4HV	x 1
PCB base B	x 1
2-5 Low head tapping screw	x 2
Power switch harness	x 1

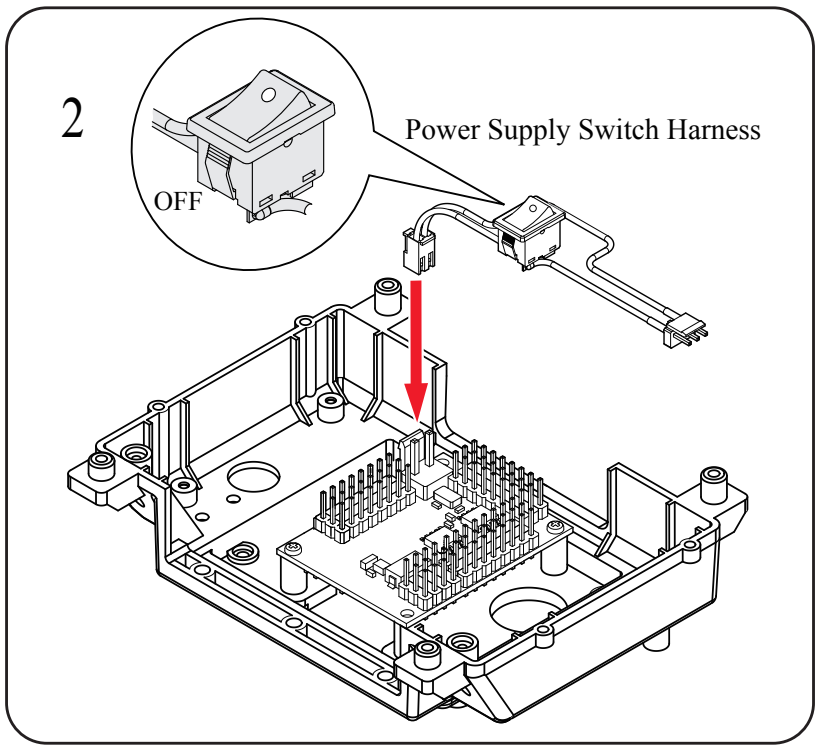
Description of Icons — Points — Tips — Caution of Breaking — Confirm

Procedure



(1) Temporarily Fix RCB-4HV to PCB base B using two 2-5 low head tapping screw.

The screw is taken off in a later process.
2-5 low head tapping screw should be screwed on temporarily.



(2) Plug the Power Source Switch Harness to the power terminal of RCB-4HV.

Danger

The power switch on the Power Source Switch Harness must be turned OFF at all times unless directed otherwise. If the switch is turned ON, the robot may unexpectedly move and fall off, break, or cause injury when connected to a power source.

The connector is shaped so as to avoid inverse connection. Do not forcibly plug in incorrectly, as this may result in the connector breaking.

Setting Origin of Servos

Servo-motor KRS-2552HV used in this product has a maximum operation angle of approximately 270 degrees. Therefore, like human joints, it does not turn limitlessly and is restricted in its angle of motion. For the robot to operate properly, it must be assembled taking into consideration its mechanical restrictions and actual operations.

Setting the origin of the servo is important in this respect.

If the origin is not correct, it might not operate properly when performing sample motions. Therefore, know the method and proceed carefully.

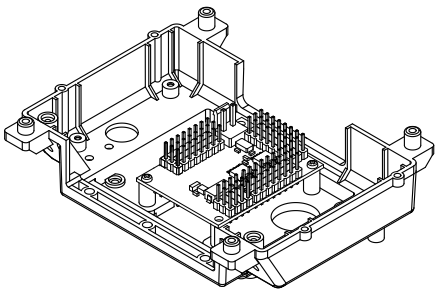
The origin must be set each time a servo arm is mounted on a servo.

Hereinafter, when origin setting is called for, the following process must be performed.

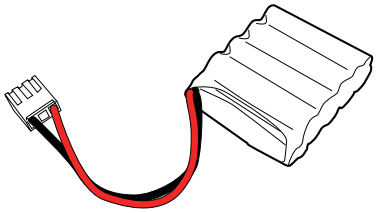
1 Things to prepare

Control Board RCB-4HV mounted on PCB base B in the preceding process is used.
The accompanying "HV battery 9N-800mAh" is used as a power source for RCB-4HV. Please charge beforehand.
Furthermore, the motion creating software "HeartToHeart4" must be installed in a personal computer.
Connect RCB-4HV to a personal computer using the attached Serial USB Adapter HS and the Serial Extension Cable. Drivers should be installed in advance.

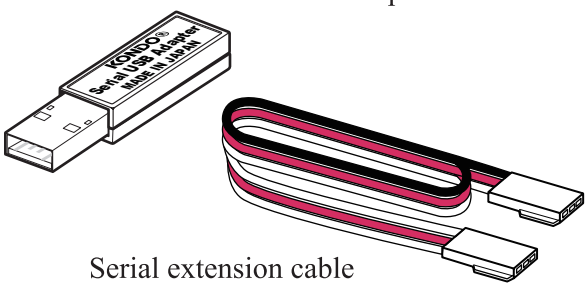
Control unit



HV battery
9N-800mAh



Serial USB adapter HS

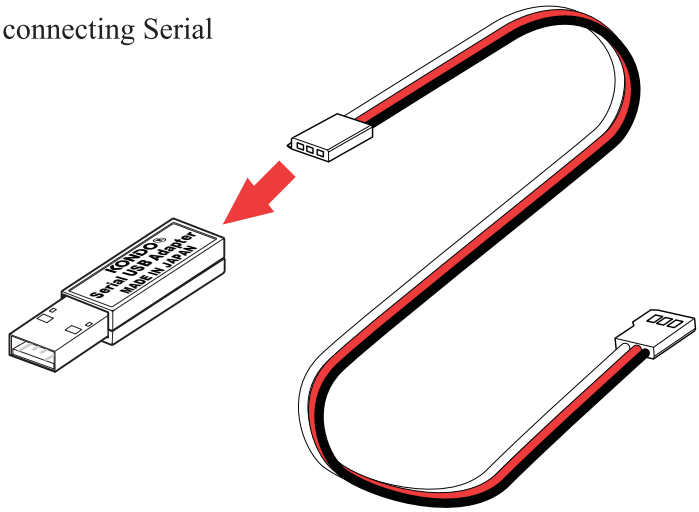


Serial extension cable

For detailed description on the use of RCB-4HV, software and Serial USB Adapter HS, see "HTH4 user's manual".

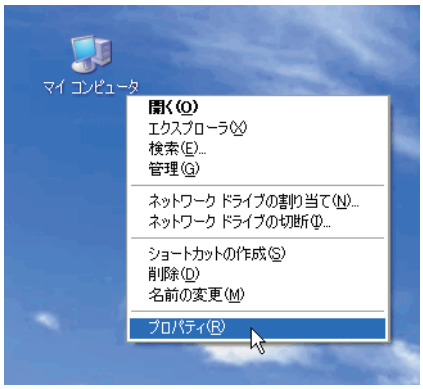
Prepare a computer loaded with Microsoft Windows XP or Vista.

1, Plug to the USB port on your computer after connecting Serial Extension Cable to serial USB adapter HS.



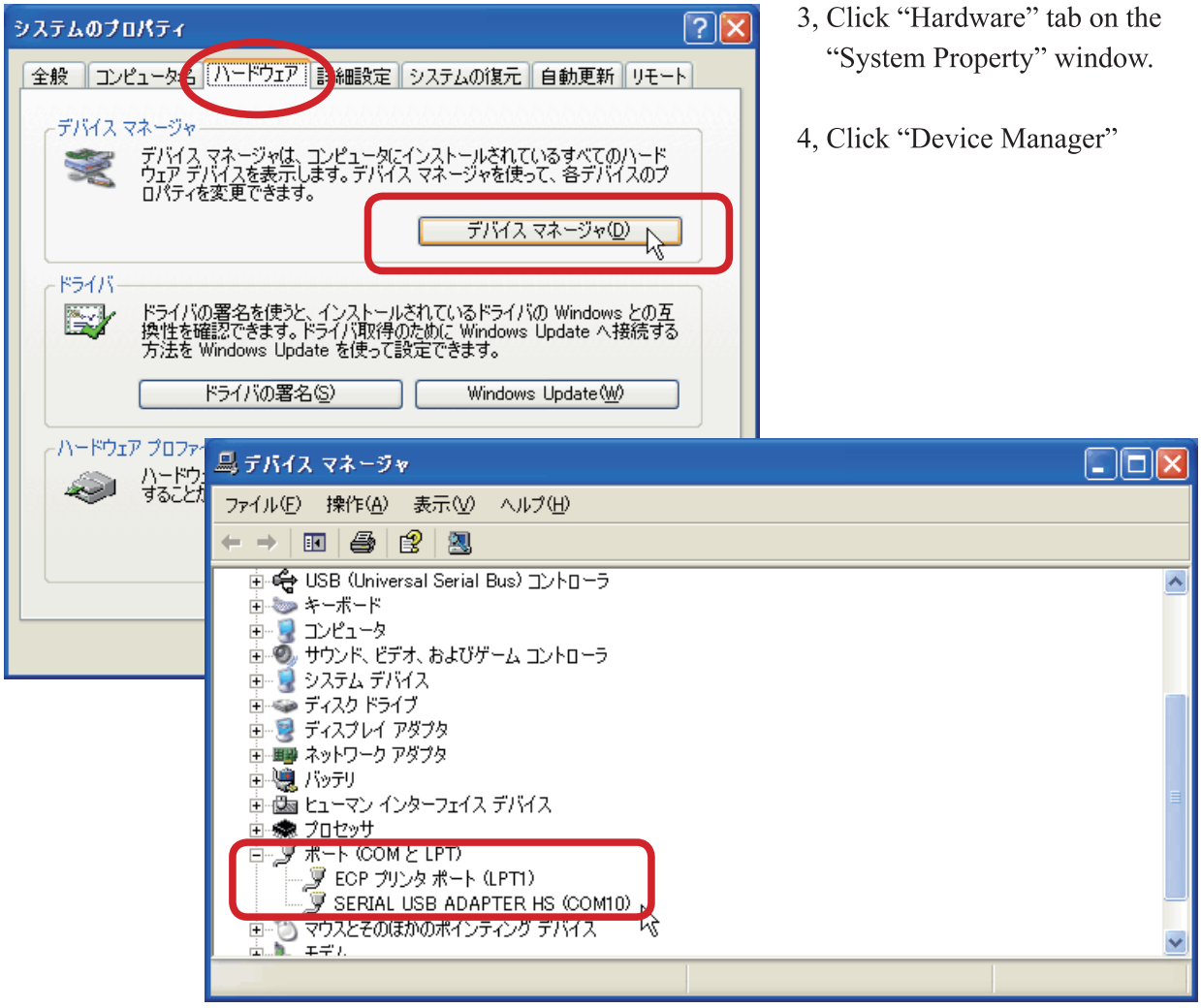
2 Confirm COM port for Serial USB adapter HS.

Connect serial USB adapter HS to the USB port on your computer.
* When connecting for the first time, “Add New Hardware Wizard” runs.
Complete setup according to the KONDO USB Driver Installation Manual.



When installation of the driver for Serial USB adapter HS is completed, confirm the “COM Port Number”.
This number becomes important when using the software, so write it down.

1, Right click on MY COMPUTER.
2, Select PROPERTY.
* This description is based on Windows XP.



3, Click “Hardware” tab on the “System Property” window.

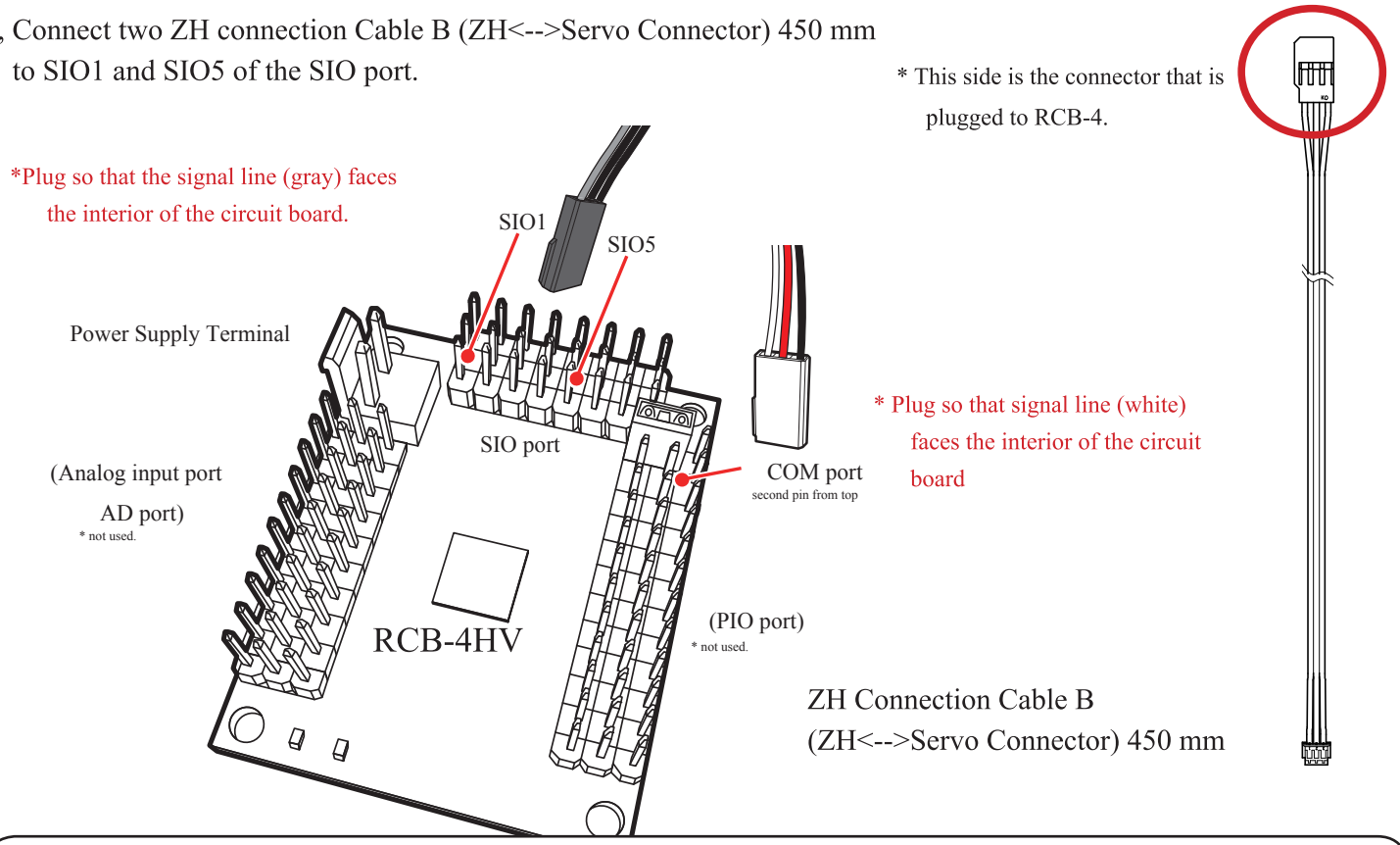
4, Click “Device Manager”

5, Click “+” for “Port (COM and LPT)” in Device Manager and check that SERIAL USB ADAPTER HS is displayed. Confirm the COM number that appears in the ( ).
* If SERIAL USB ADAPTER HS does not appear, either the driver is not installed properly or the Serial USB Adapter is not connected to the computer.

3 Connection

1, Connect cable from Serial USB Adapter HS to COM terminal (port) of RCB-4HV.

2, Connect two ZH connection Cable B (ZH<-->Servo Connector) 450 mm to SIO1 and SIO5 of the SIO port.



Important Issues on Origin Setting

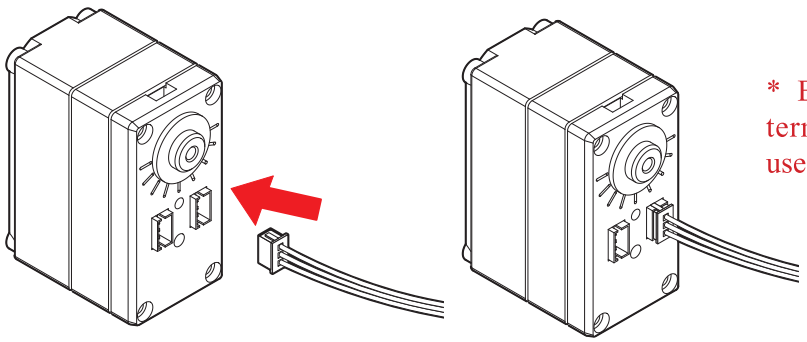
RRCB-4 contains two systems as serial ports for servo driving: SIO1-4 and SIO5-8.

SIO1-SIO4 outputs the same signal and servo motor operates the same way when connected to one of them. The same cab be said about SIO5-SIO8.

In KHR-3HV, SIO1-SIO4 are used for the left side, and SIO5-SIO8 are used for the right side.

Therefore, servo motors with red and yellow ID decals are operated by connecting the cable from SIO1, and servo motors with blue and green ID decals are operated by connecting the cable from SIO5.

4 Connecting cable to servo motor for origin setting

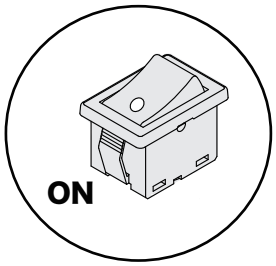


* Either one of the connection terminal on the servo motor can be used.

5 Activate the software

Activate the motion creating software “HeartToHeart4” and prepare for origin setting.
If you have not finished installing ‘HeartToHeart4’, do so by using the attached CD-ROM.

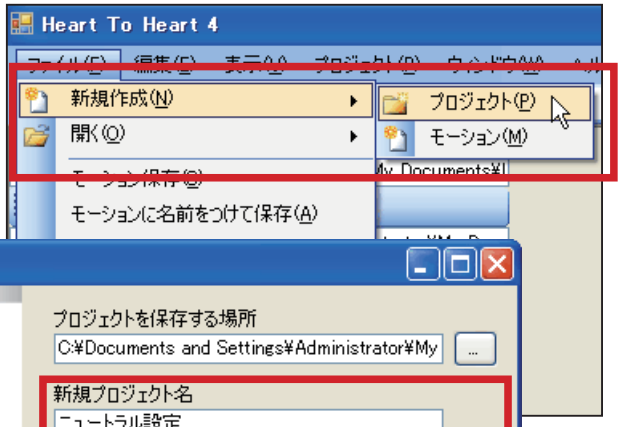
* When first activating the software ‘HeartToHeart4’, a ‘HeartToHeart4’ folder is created automatically in the My Documents folder on your computer. Project files created must be saved in the “Project” folder in here.



1, Switch ON the Power Switch for RCB-4.

When motion creation software ‘HeartToHeart4’ is activated, create a "neutral setting" project in the ‘HeartToHeart4’ folder.

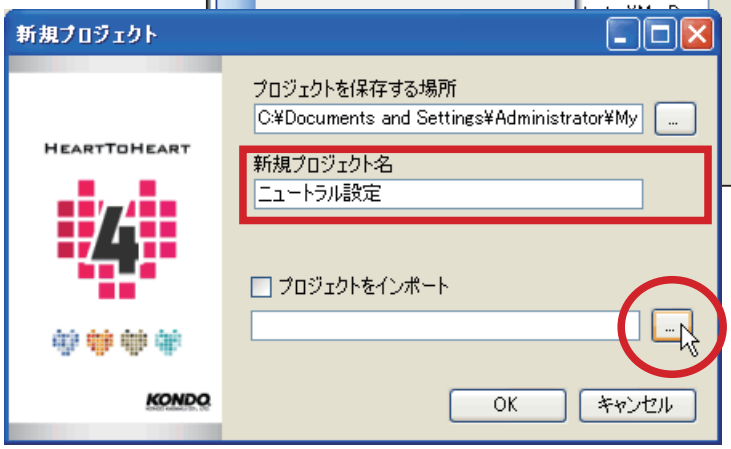
2, Click “File” -> “New Document” -> “Project”



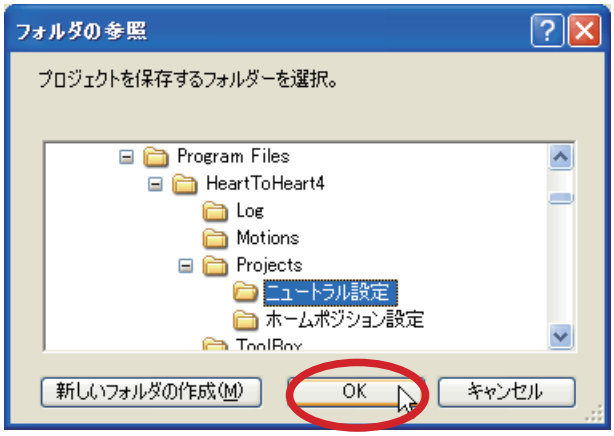
3, In the New Project Window, name the new project “Neutral Setting”.

* New projects may be named arbitrarily. Do not change the location for saving files unless necessary. Files are normally saved in the ‘HeartToHeart4’ folder in “My Documents”.

3, Click the Import project button.



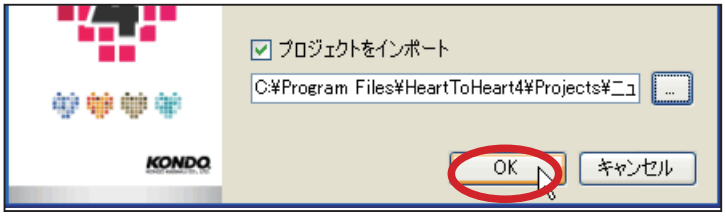
4, Select “Neutral Setting” in “Projects” folder in ‘HeartToHeart4’ folder created in “Program Files”.



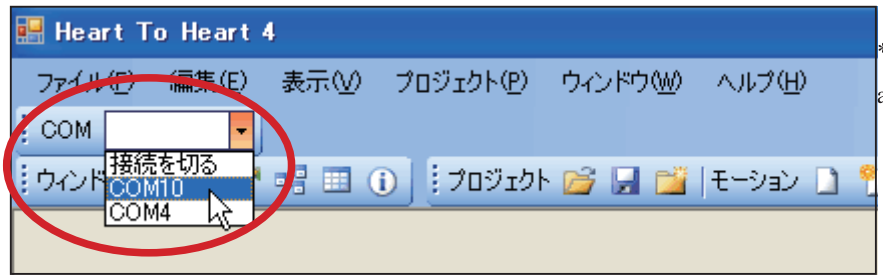
* Unless changed after installation of software, the ‘HeartToHeart4’ folder is under “C:/Program Files”.

* When ‘HeartToHeart4’ software is installed, a sample project is saved inside “Program Files”. The project for Neutral Setting is inside this sample project, so the Neutral Setting Project must be loaded from the sample project according to the above instructions, and imported to the New Project specified above.

5, Go back to the New Project Window and Click OK.

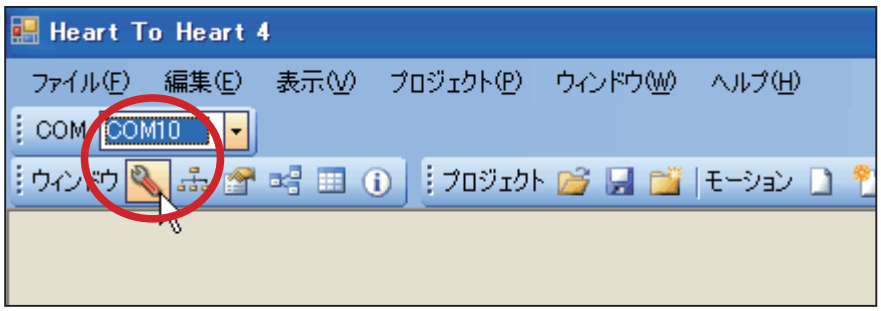


6, Select the previously-checked number of the communication port (COM).

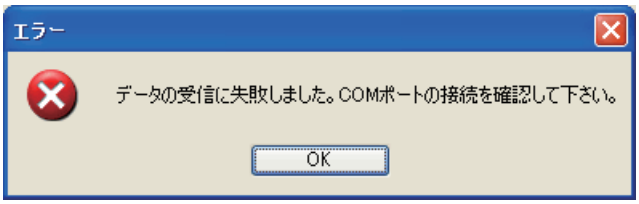


* Here, COM10 is selected as an example.

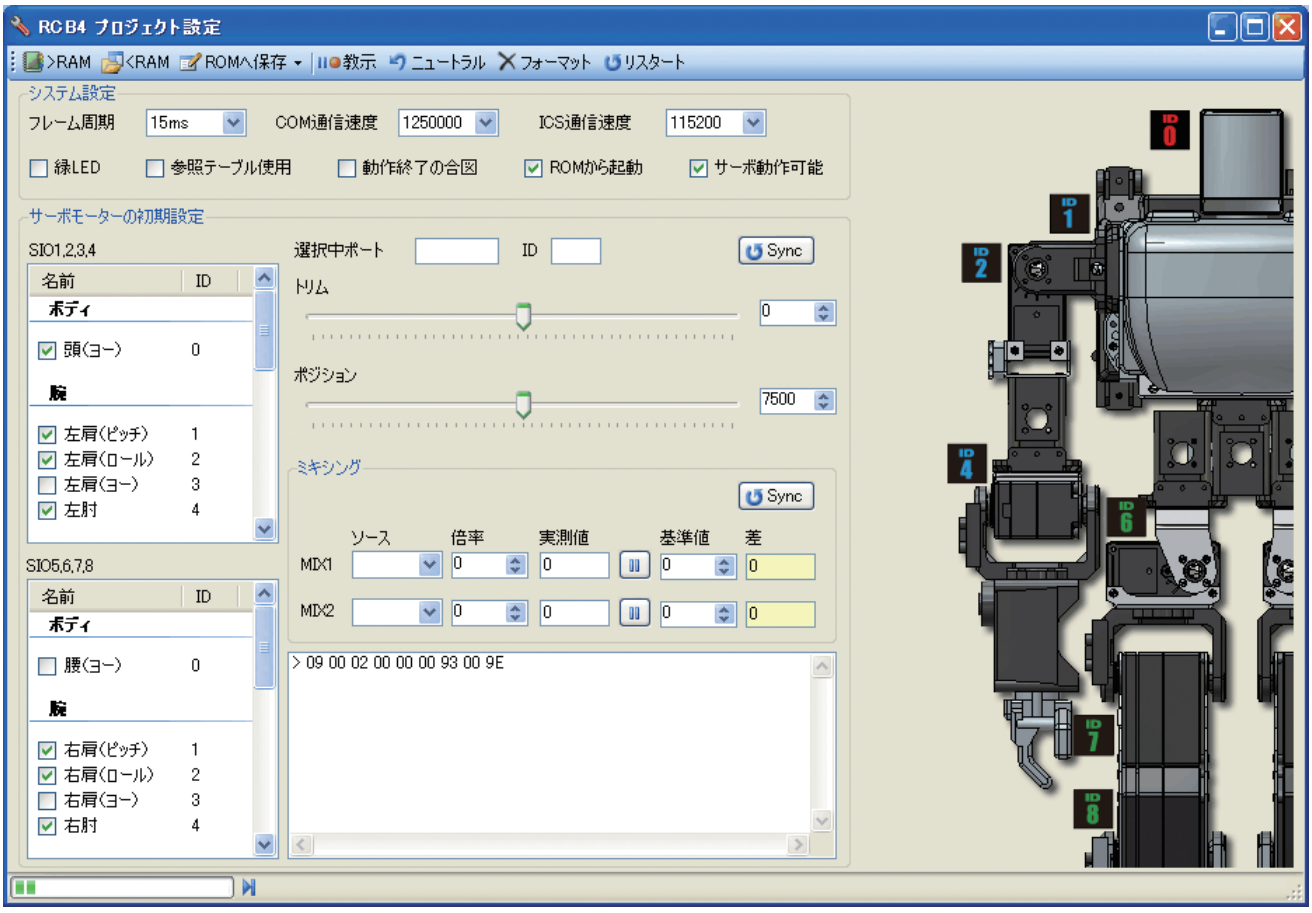
7, Select “Project Setting”



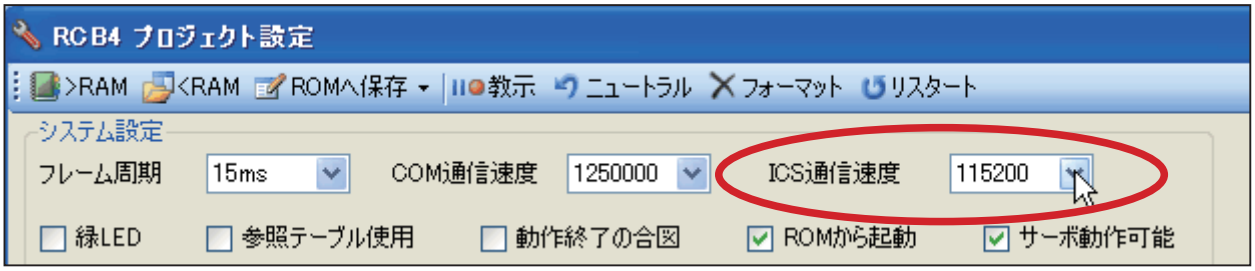
* An error message as shown in the right appears when communication problems occur for reasons such as robot not being switched ON.



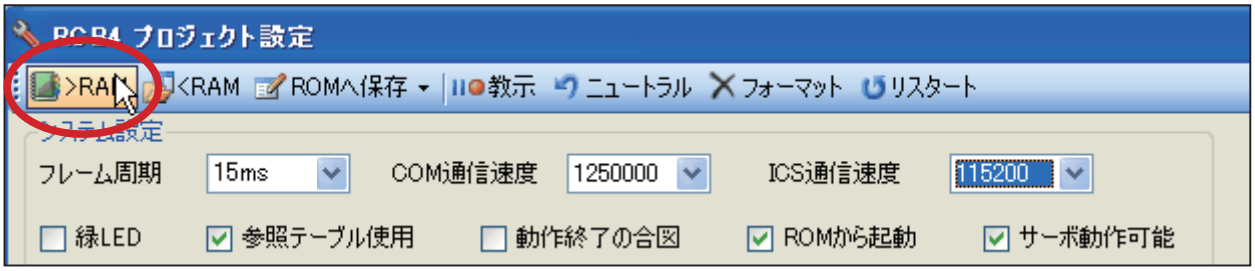
When normal connection is made, the following window appears.



8, Set ICS communication speed to 115200.

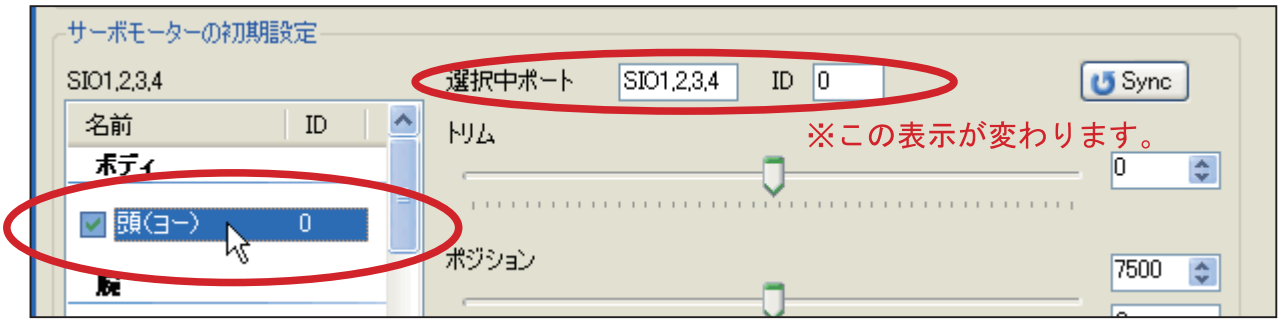


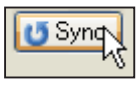
9, When “RAM” button is clicked, the project standard values are sent to RCB-4 and servo becomes operable.



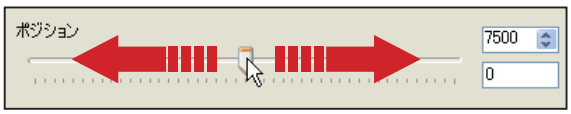
10, Select the servo motor which needs to be adjusted in “Servo Motor Initial Setting”.

In the following example, the origin for servo “ID 0” (red) connected to the SIO1 channel is set.



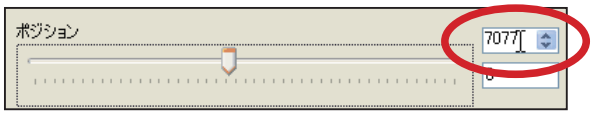
11, Press “Sync” 

button and check operation using the position slide bar.



Servo moves with slide bar

12, When operation is confirmed, return position to "7500 (origin)".



Double clicking the value next to the slide bar automatically changes it to “7500”.

13, Turn off RCB-4, plug in another servo that needs origin setting, and repeat steps 9-13.

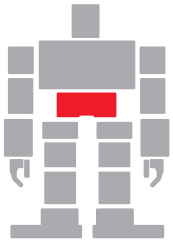
The above are the process for origin setting. The origin should be set for all servos based on these steps.

14, When all procedures are completed, turn off RCB-4 and close the "RCB4 project setup" window.

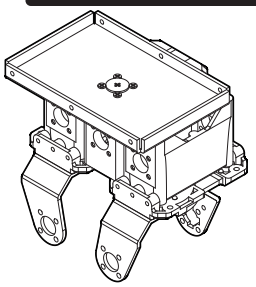
3. Assembly of Hip Unit

Parts to Prepare

Dummy Servo 2500A	3	
Arm supporter 2500A	3	
YHR-005_Body Base	1	
YHR-008_Offset Arm La	1	
YHR-009_Offset Arm Ra	1	
2-5 Low Head Tapping Screw		32
3-6 Flat Head Screw	3	



Process Completion Image



Description of Icons　Points　Tips　Caution of Breaking　Confirm

Procedure

(1) Mount Arm Supporter 2500A to Dummy Supporter 2500A using four 2-5 Low Head Tapping Screws.

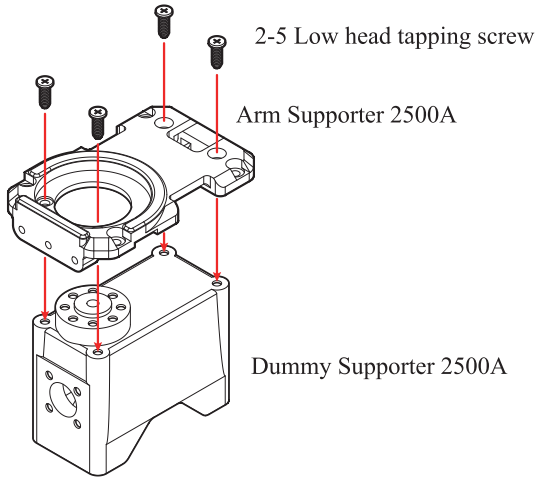
Prepare 3 sets of the same unit.

(2) Connect the three units prepared in step (1) using four 2-5 Low Head Tapping Screws, as shown in the figure.

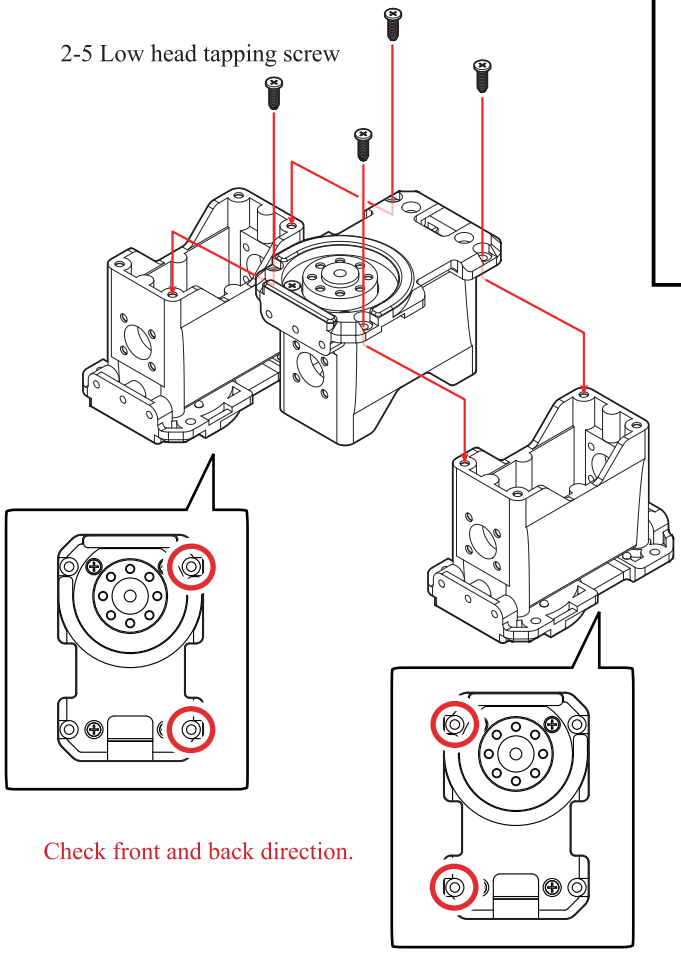
Make sure the front and back sides are correct.

(3) Use four 2-5 Low Head Tapping Screws to fix the back side of the unit assembled in step (2).

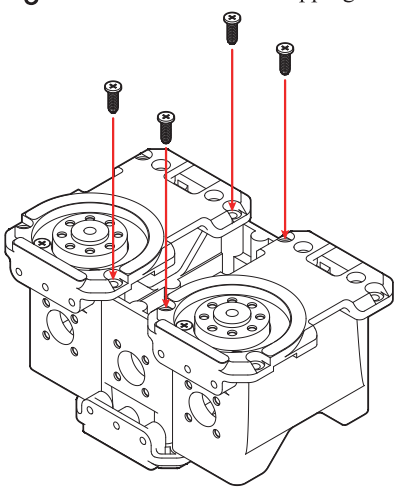
1



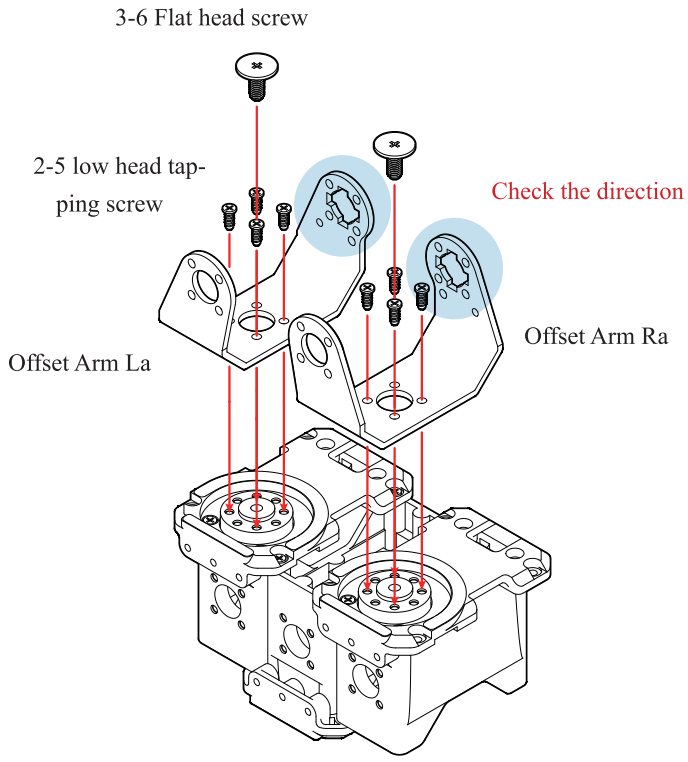
2



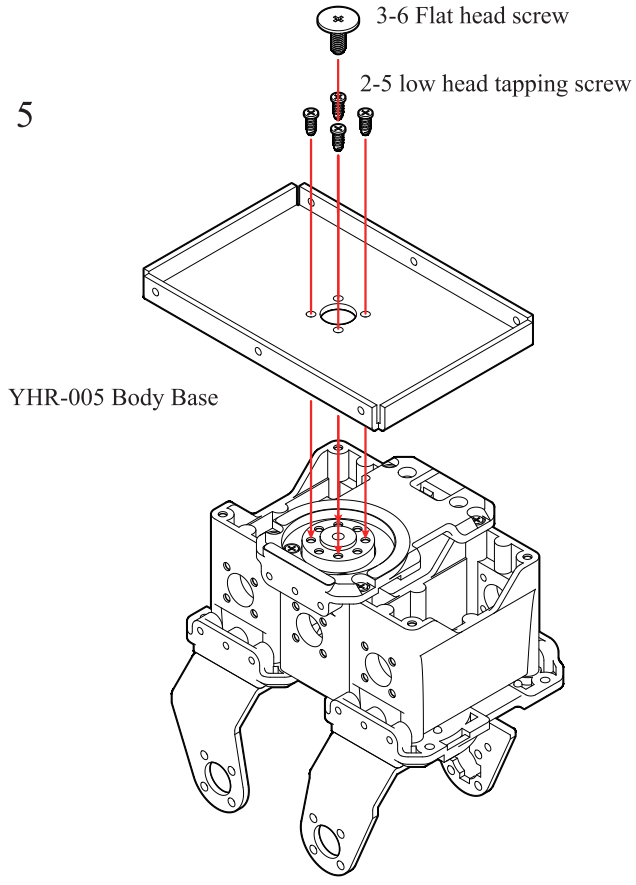
3



4



5

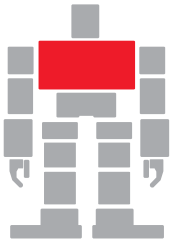


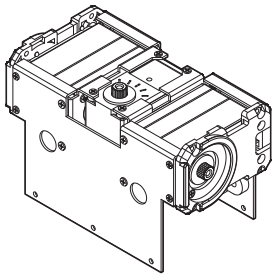
(4) Using eight 2-5 Low Head Tapping Screws, mount YHR-008_Offset Arm La and YHR-009_Offset Arm Ra as shown in the figure. Use two 3-6 Flat Head Screws to fix the center.

(5) Mount YHR-005_Body Base using four 2-5 Low Head Tapping Screws and one 3-6 Flat Head Screw as shown in the figure.

4. Assembly of Chest Unit

Process Completion Image

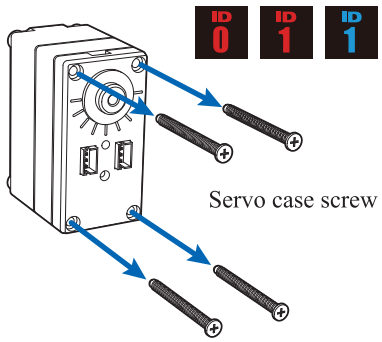




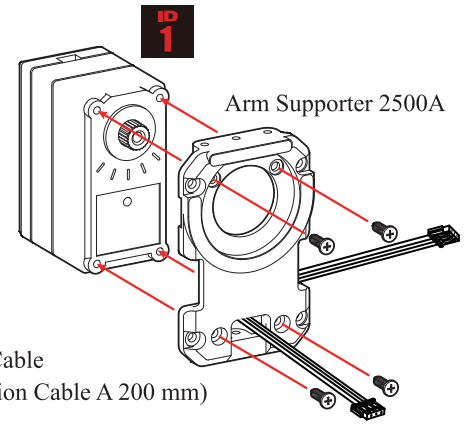
Parts to Prepare

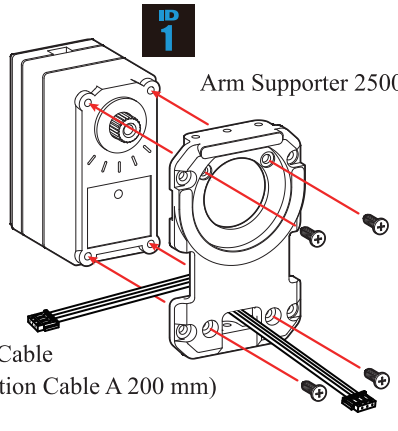
Servo Motor KRS-2552 [ID 0]	1
Servo Motor KRS-2552 [ID 1]	2
YHR-001_Body Frame F	1
YHR-002_Body Frame B	1
YHR-003_Shoulder Frame L	1
YHR-004_Shoulder Frame R	1
Arm Supporter 2500A	2
Battery-Holding Sponge	1
2-5 Low Head Tapping Screw	20
M2-4 Low Head Screw	8
ZH Connection Cable A 200 mm	2
ZH Connection Cable A 50 mm	1
ZH Connection Cable B 100 mm	2

1



2





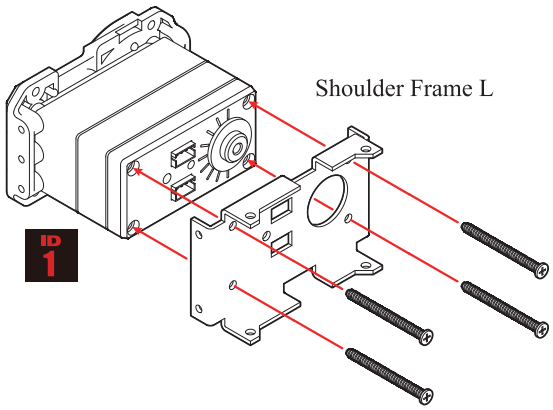
Procedure

(1) Take out Servo Motors of [ID 0] (red), [ID 1] (red) and [ID 1] (blue), and remove all Servo Case screws (4 each).

(2) Put Connection Cable (ZH Connection Cable A 200 mm) through Arm Supporter, and fix Arm Supporter 2500 A to Servo Motors [ID 1] (red) and [ID1] (blue), using four 2-5 Low Head Tapping Screw for each.

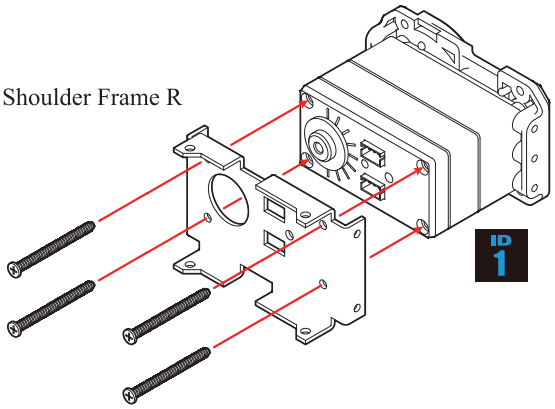
* The direction of the cables differ between the two servos. Check the ID numbers in the figure.

Danger Do not tighten case screw too much



3

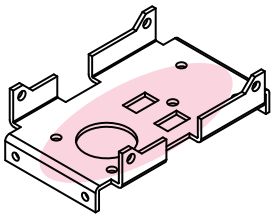
Servo Case Screw



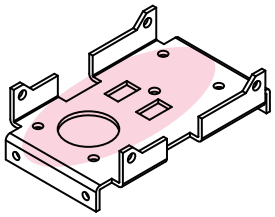
Servo Case Screw

(3) Using the Servo Screw taken off in step (1), mount YHR-003_Shoulder Frame L to Servo Motor [ID1] (red), and YHR-004_Shoulder Frame R to Servo Motor [ID1] (blue). Make sure the direction of the frames are correct.

The Shoulder Frames have different shapes on the left and right. Distinguish by carefully checking the position of the holes.

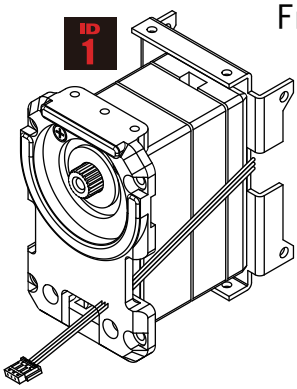


YHR-003 Shoulder Frame L

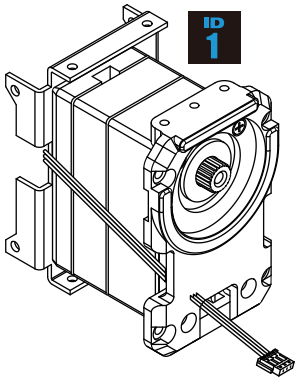


YHR-004 Shoulder Frame R

Frontal View

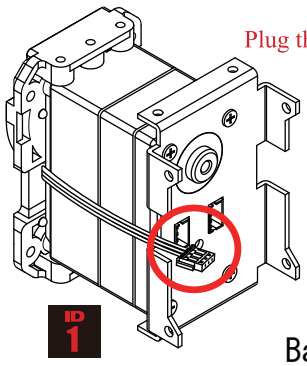


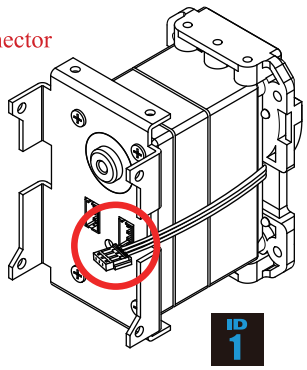
Shoulder Unit L



Shoulder Unit R

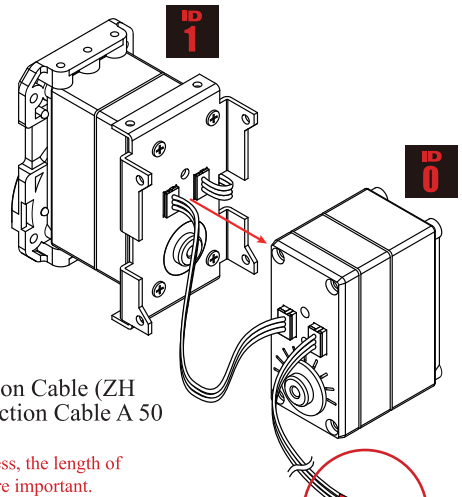
Plug the Cable to the Connector





Backside View

4



Connection Cable (ZH Connection Cable A 50 mm)

In this process, the length of the cables are important. Please check thoroughly.

Connection Cable (ZH Connection Cable B 100 mm)

(4) Connect Servo Motor [ID 0] (red) with [ID 1] (red) using Connection Cable (ZH Connection Cable A 50 mm), then connect Connection Cable (ZH Connection Cable B 100 mm) to [ID 0] (red).

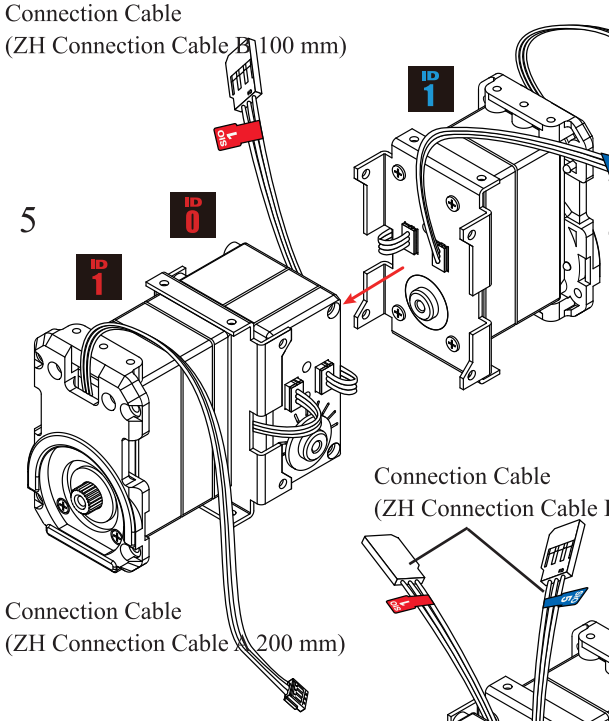
(5) Connect Connection Cable (ZH Connection Cable B 100 mm) to [ID 1] (blue). Make sure the cables are strung as shown is Figure [A].

(6) Use four 2-5 Low Head Tapping Screws on the Servo Output Axis side and four Servo Case Screws taken off in step (1) on the bottom side.

Stick a decal for servo lead on to ZH Connection Cable B 100 mm

Connection Cable (ZH Connection Cable B 100 mm)

5



Connection Cable (ZH Connection Cable A 200 mm)

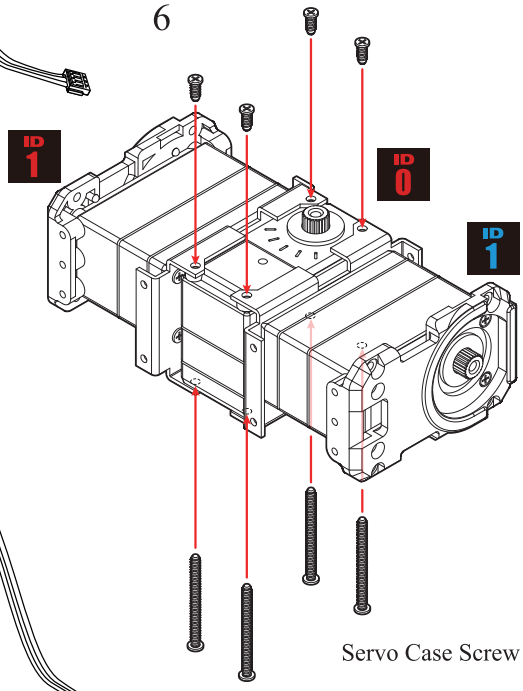
Connection Cable (ZH Connection Cable B 100 mm)

Connection Cable (ZH Connection Cable B 100 mm)

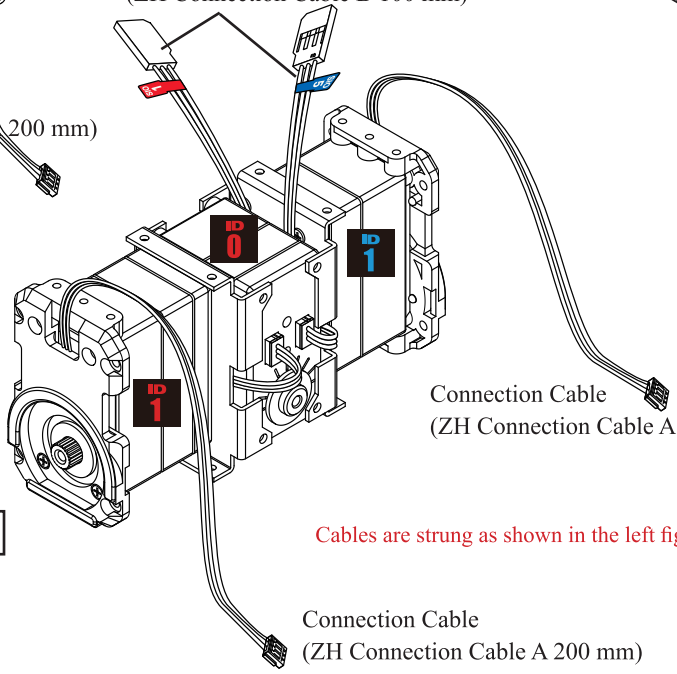
Connection Cable (ZH Connection Cable A 200 mm)

6

2-5 Low Head Tapping Screw



Servo Case Screw



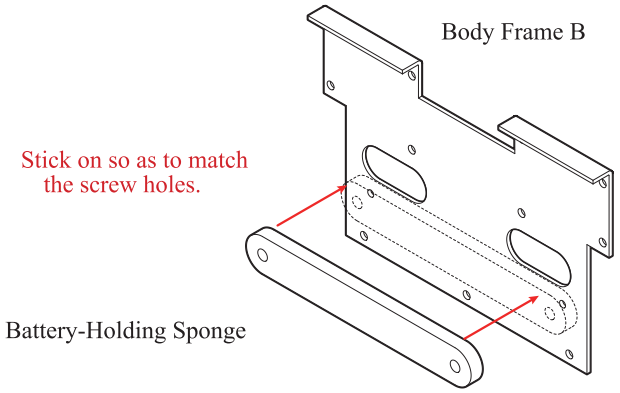
A

Connection Cable (ZH Connection Cable A 200 mm)

Cables are strung as shown in the left figure

Connection Cable (ZH Connection Cable A 200 mm)

7



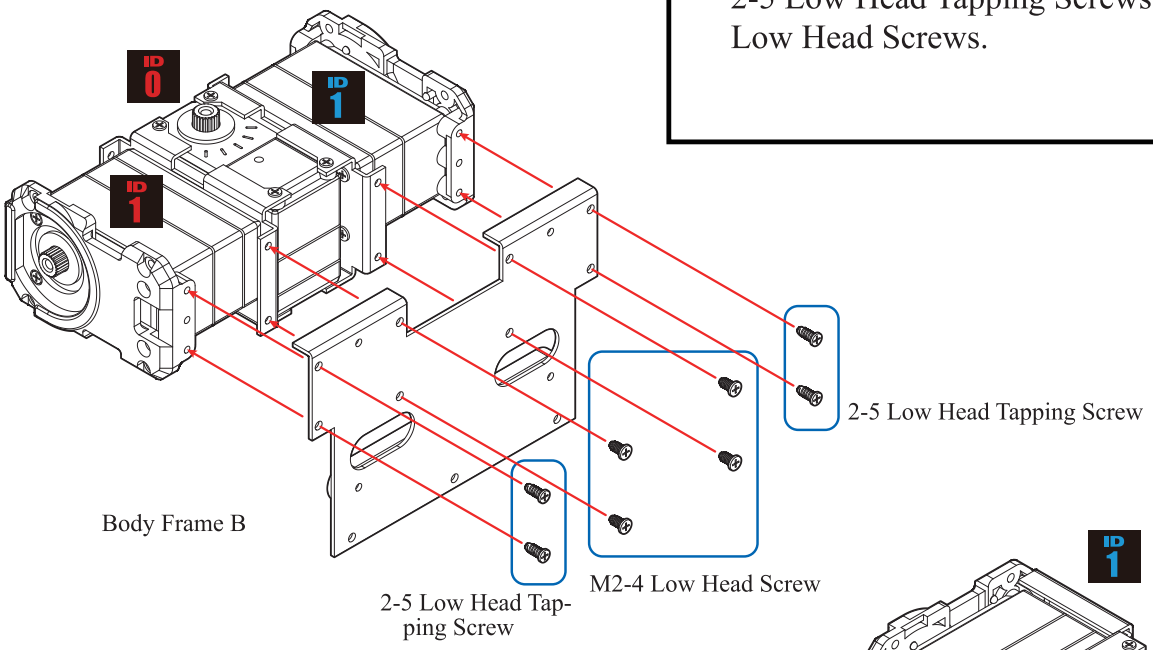
(7) Stick Battery Holding Sponge to YHR-002_ Body Frame B.

(8) Using four 2-5 Low Head Tapping Screws and four M2-4 Low Head Screws, mount YHR-002_Body Frame B with Sponge attached to the unit assembled in step (6).

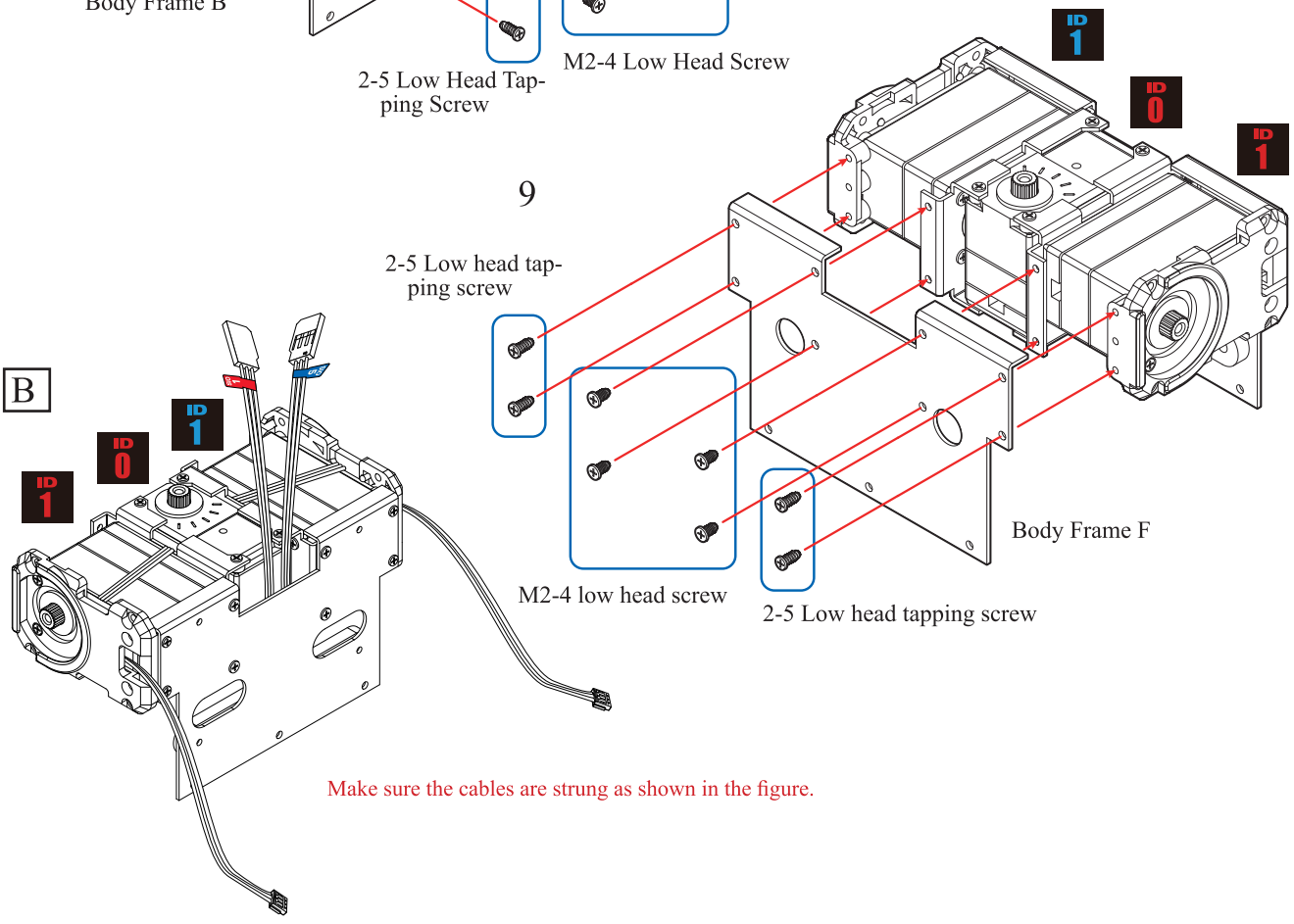
Make sure the cables are strung as shown in Figure [B]

(9) Mount YHR-001_Body Frame F using four 2-5 Low Head Tapping Screws and four M2-4 Low Head Screws.

8



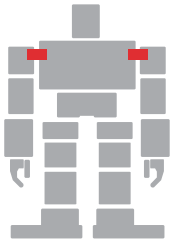
9

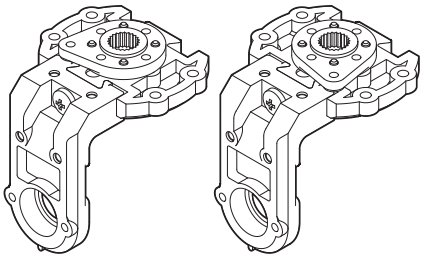


Make sure the cables are strung as shown in the figure.

5. Assembly of Servo Arm (Shoulder)

Process Completion Image



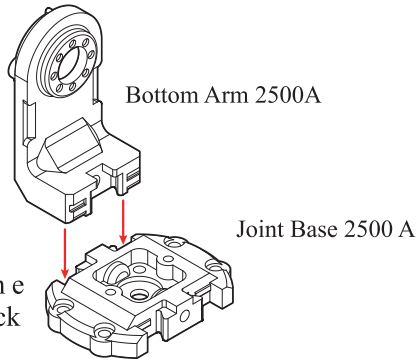


Parts to Prepare

Joint Base 2500A	2
Bottom Arm 2500A	2
Small Diameter Horn	2
2.6-10BH Tapping Screw	2
M2-6BH Screw	8

Description of Icons　Points　Tips　Caution of Breaking　Confirm

1



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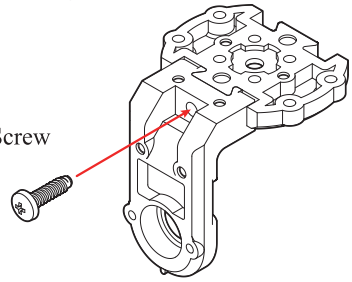

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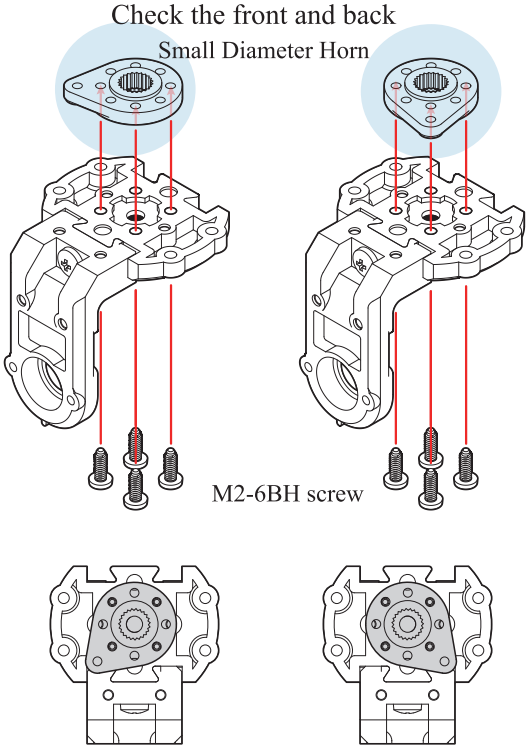


Procedure

(1) Insert Bottom Arm 2500A into Joint Base 2500A.

Check the direction (front / back) of the Joint Base.

Prepare two sets of the same unit.

(2) Fix the connection using one 2.6-10BH Tapping Screw each.

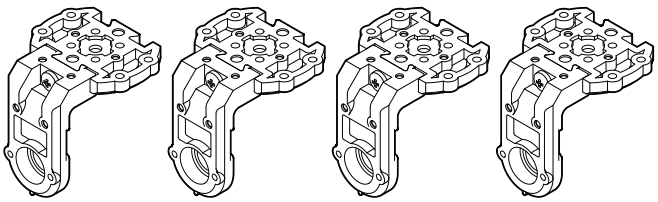
Prepare two sets of the same unit.

(3) Mount Small Diameter Horn as indicated in the figure and fix using four M2-6BH screws.

Caution: The position of the Small Diameter Horn differ 90 degree for each arm.

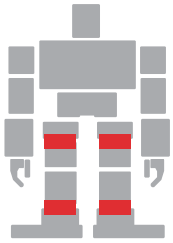
6. Assembly of Servo Arm (Ankle - Thigh)

Process Completion Image



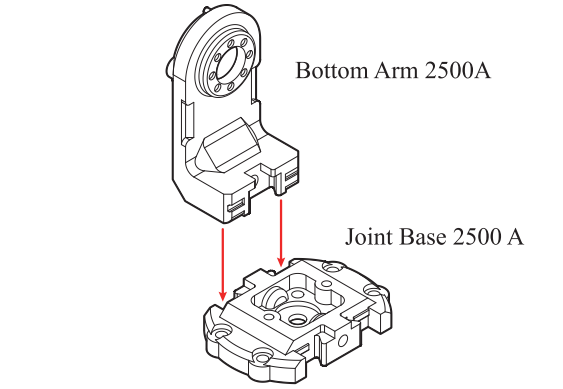
Parts to Prepare

Joint Base 2500A	4
Bottom Arm 2500A	4
2.6-10BH Tapping Screw	2



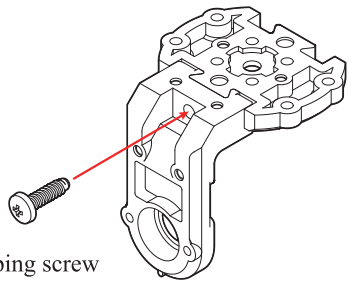
Description of Icons — Points — Tips — Caution of Breaking — Confirm

1



Check the direction (front / back)

2



Procedure

(1) Insert Bottom Arm 2500A into Joint Base 2500A.
Check the direction (front / back) of the Joint Base.

Prepare four sets of the same unit.

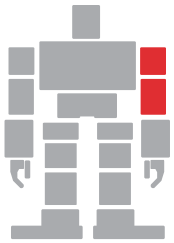
(2) Fix the connection using one 2.6-10BH Tapping Screw.

Prepare four sets of the same unit

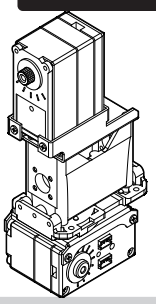
7. Assembly of Elbow Unit L

Parts to Prepare

Servo Motor KRS-2552 [ID2]	1
Servo Motor KRS-2552 [ID 4]	1
YHR-006_Servo Bracket A	1
YHR-007_Elbow Joint A	1
Dummy Servo 2500A	1
Arm Supporter 2500A	1
2-5 Low Head Tapping Screw	16
3-6 Flat Head Screw	1



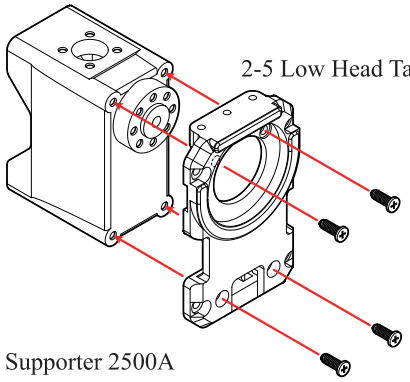
Process Completion Image



Description of Icons　Points　Tips　Caution of Breaking　Confirm

1

Dummy Servo 2500A



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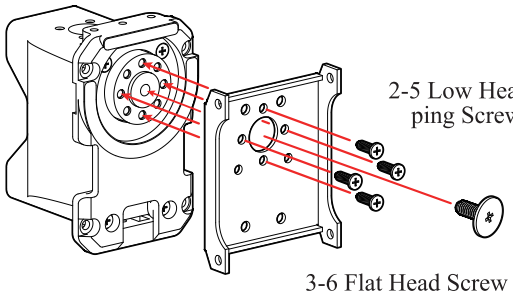

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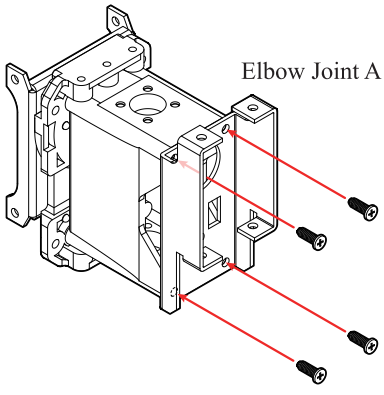


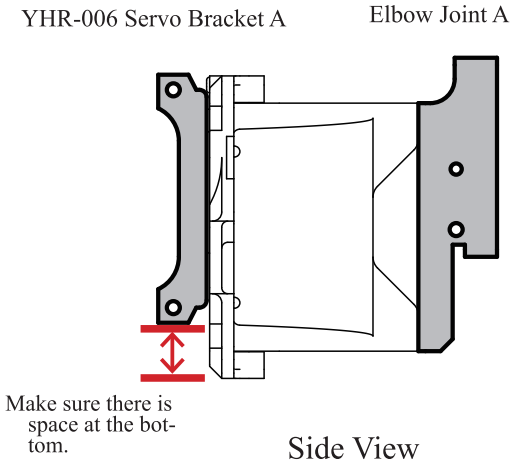
Procedure

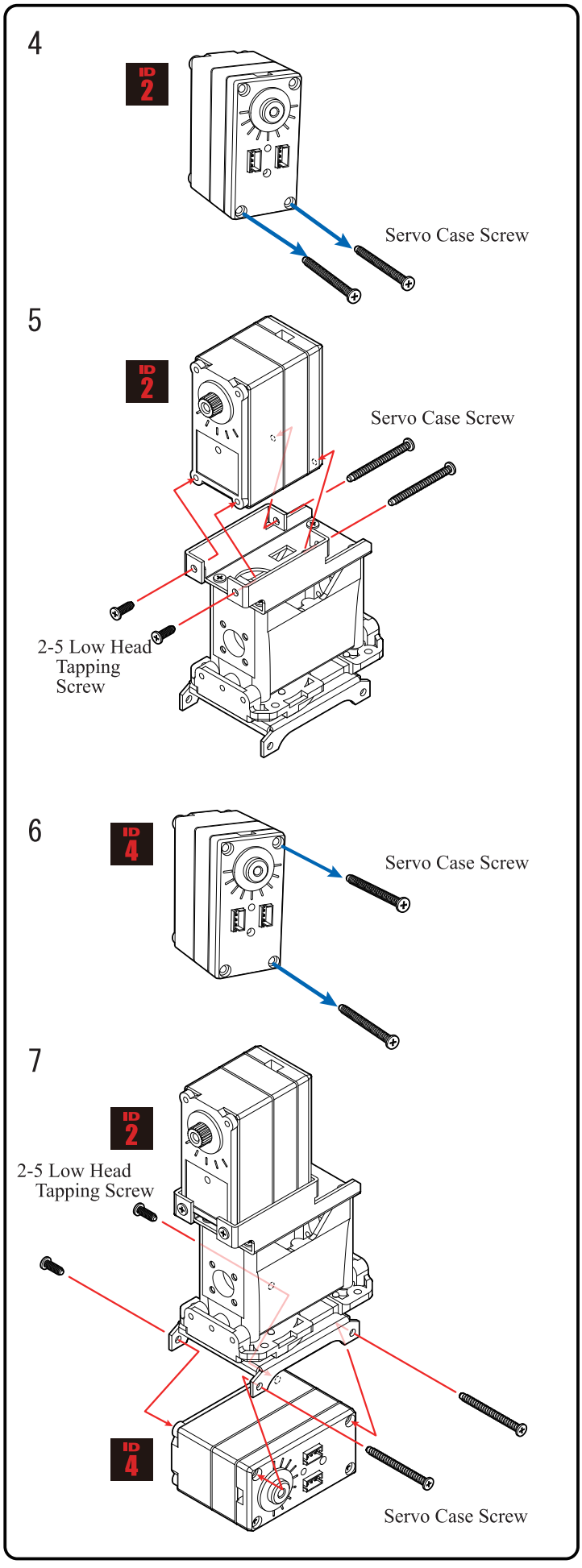
(1) Mount Arm Supporter 2500A on Dummy Servo 2500A using four 2-5 Low Head Tapping Screws.

(2) Mount YHR-006 Servo Bracket A using four 2-5 Low Head Tapping Screws and one 3-6 Flat Head Screw.

(3) Mount YHR-007_Elbow Joint A using four 2-5 Low Head Tapping Screws.

* Elbow Joints can be mounted on the top or bottom. Check the following figure carefully and mount accordingly.





4) Unscrew the two case screws on the bottom from Servo Motor [ID 2] (red).

(5) Mount Servo Motor [ID2] (red) to the unit prepared in step (3). Use two 2-5 Low Head Tapping Screw on the servo output axis side, and the two Servo Case Screws taken off in step (4) on the bottom side.

(6) Take two of the Case Screws on the right side (looked at from the bottom side) of Servo motor [ID 4] (red).

(7) Mount Servo Motor [ID 4] (red) on the parts prepared in step 5. Use two 2-5 Low Head Tapping Screws on the Servo Output Axis side, and two Servo Case Screws taken off in step (6) on the bottom side.

Danger Be careful not to tighten case screw too hard.

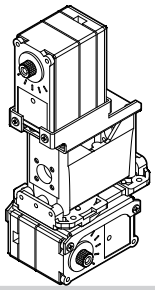
* Check direction carefully when mounting Servo Motor.

8. Assembly of Elbow Unit R

Parts to Prepare

Servo Motor KRS-2552 [ID2]	1
Servo Motor KRS-2552 [ID 4]	1
YHR-006_Servo Bracket A	1
YHR-007_Elbow joint A	1
Dummy Servo 2500A	1
Arm Supporter 2500A	1
2-5 Low Head Tapping Screw	16
3-6 Flat Head Screw	1

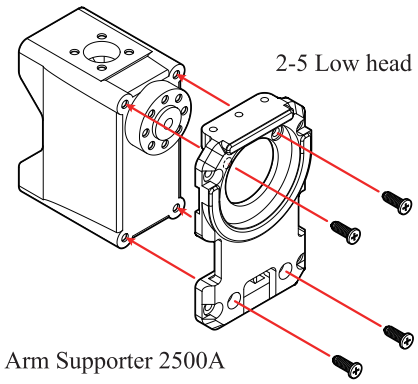
Process Completion Image



Description of Icons　Points　Tips　Caution of Breaking　Confirm

1

Dummy Servo 2500A



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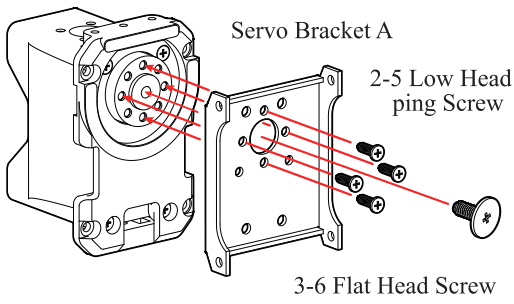

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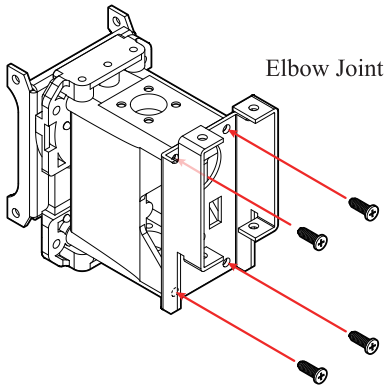


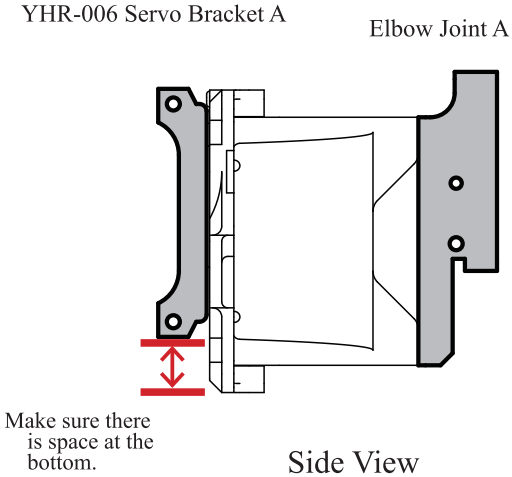
Procedure

(1) Mount Arm Supporter 2500A on Dummy Servo 2500A using four 2-5 Low Head Tapping Screws.

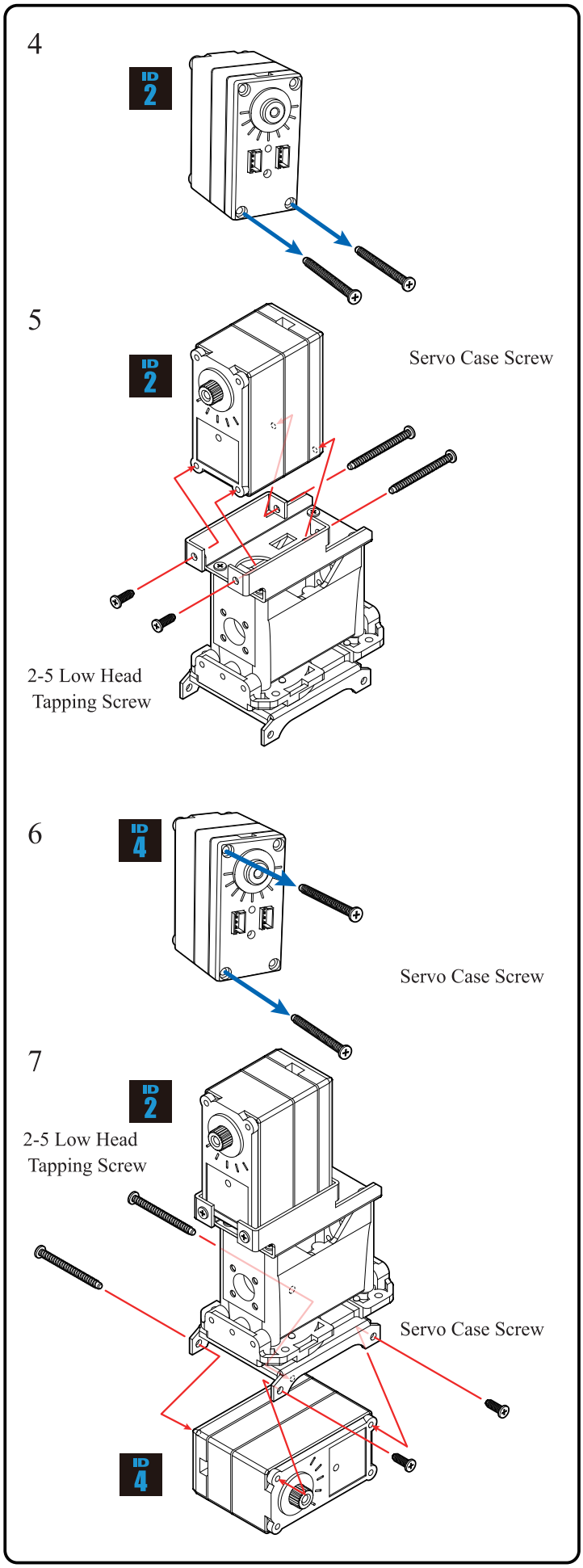
(2) Mount YHR-006_Servo Bracket A using four 2-5 Low Head Tapping Screws and one 3-6 Flat Head Screw.

(3) Mount YHR-007_Elbow Joint using four 2-5 low head tapping screws.

* Elbow Joints can be mounted on the top or bottom. Check the following figure carefully and mount accordingly.



Side View



(4) Unscrew the two Case Screws on the bottom from Servo Motor [ID 2] (blue).

(5) Mount Servo Motor [ID 2] (blue) to the parts prepared in step (3). Use two 2-5 Low Head Tapping Screw on the Servo Output Axis side, and two Servo Case Screws taken off in step (4) on the bottom side.

(6) Take two of the case screws on the right side (looked at from the bottom side) of Servo motor [ID 4] (blue) .

(7) Mount Servo Motor [ID 4] (red) on the parts prepared in step (5). Use two 2-5 Low Head Tapping Screws on the Servo Output Axis side, and two Servo Case Screws taken off in step (6) on the bottom side.

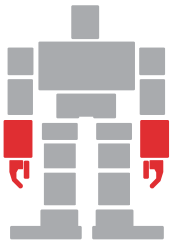
Danger Be careful not to tighten case screw too hard.

* Check direction carefully when mounting Servo Motor.

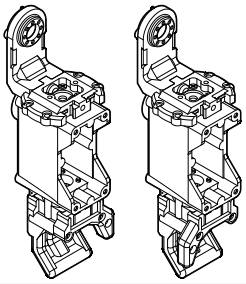
9. Assembly of Arm Unit

Parts to Prepare

Hand Base B	2	Knuckle B	2
Dummy Servo 2500A	2	Thumb B	2
Joint Base 2500A	2		
Bottom Arm 2500A	2		
Joint Base 2500A	2		
Bottom Arm 2500A	2		
2-8 Low Head Tapping Screw	20		
2.6-10BH Tapping Screw	2		

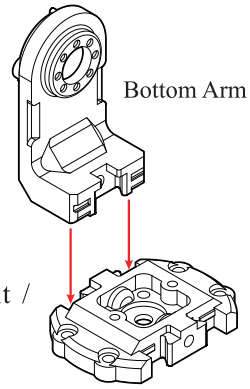


Process Completion Image

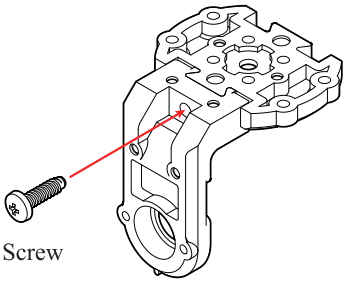


Description of Icons　Points　Tips　Caution of Breaking　Confirm

1



2



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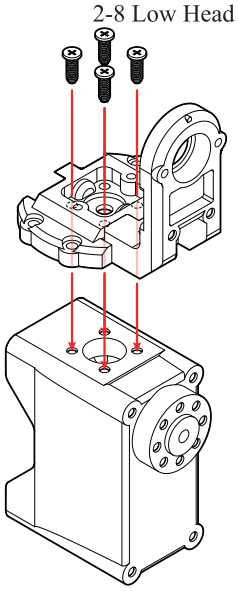


Procedure

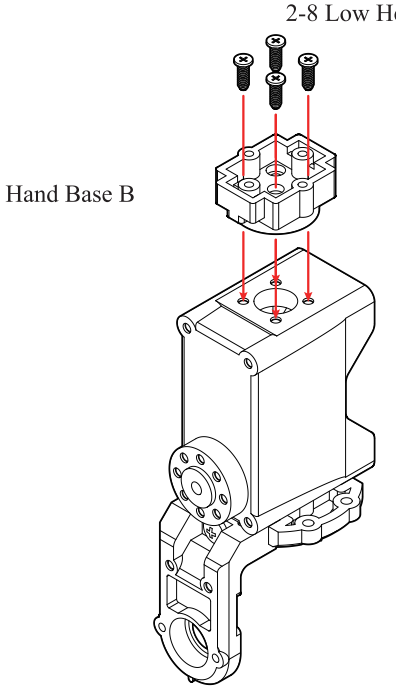
(1) As in the previous process “Assembly of Shoulder Servo Arm”, insert Bottom Arm 2500A to Joint Base 2500A.
* Make sure to check the direction (front / back) of the Joint Base.

(2) Fix the Arm connection using one 2.6-10BH Tapping Screw.

(3) Mount Dummy Servo 2500A as shown in the figure and fix using four 2-8 Low Head Tapping Screws. Make sure that the horn on Dummy Servo 2500A is on the same side as Bottom Arm 2500A.

Prepare two sets of the same.

4



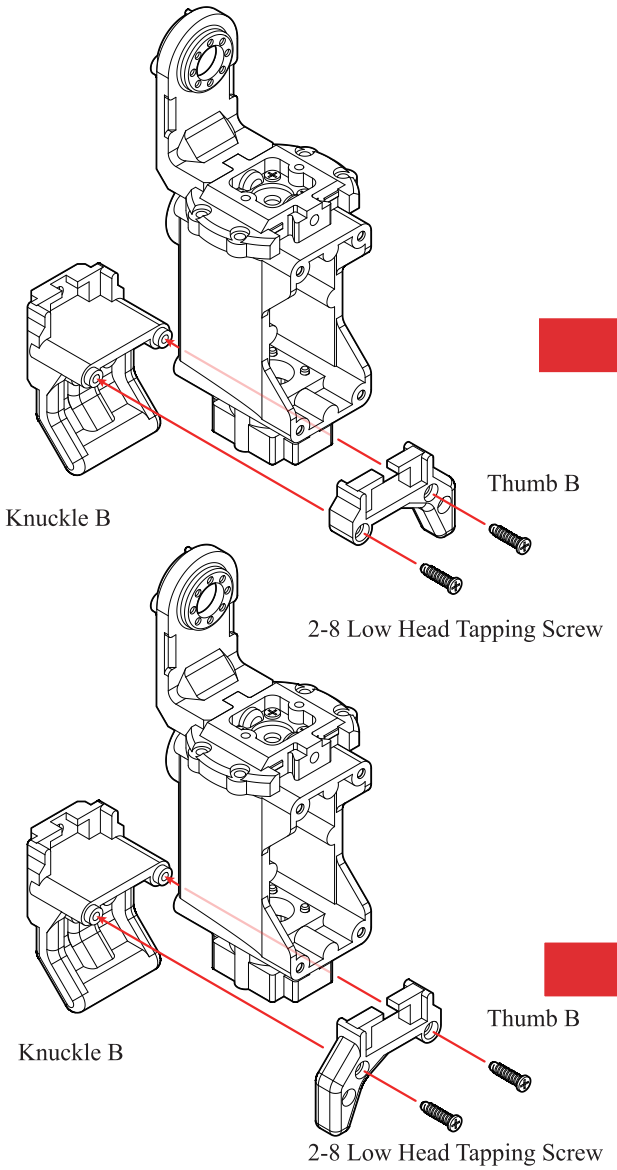
(4) Mount Hand Base B using four each of 2-8 Low Head Tapping Screw.

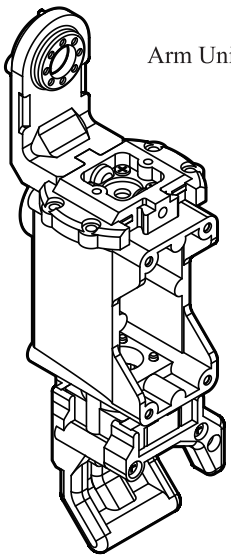
Prepare two sets of the same.

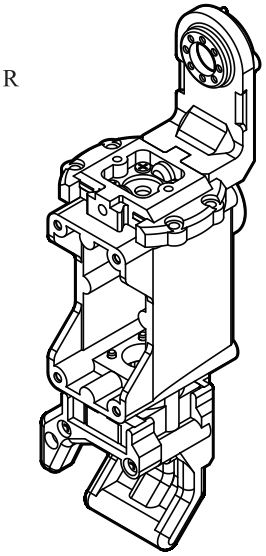
(5) Insert Knuckle B and Thumb B into Hand Base B and fix using two each of 2-8 Low Head Tapping Screw.

* Take precaution as the direction of Thumb B differ between the left and right arms.

5



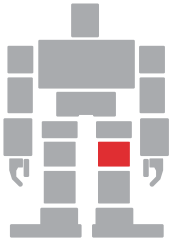




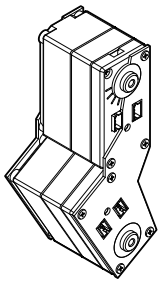
10. Assembly of Thigh Unit L

Parts to Prepare

YHR-010_Thigh Joint L	1
YHR-011_Thigh Joint R	1
Servo Motor KRS-2552 [ID 7]	1
Servo Motor KRS-2552 [ID 8]	1
2-5 Low Head Tapping Screw	7



Process Completion Image



Description of Icons　Points　Tips　Caution of Breaking　Confirm

Procedure

(1) Unscrew three of the Case Screws from Servo Motor [ID7] (yellow), as shown in the figure.

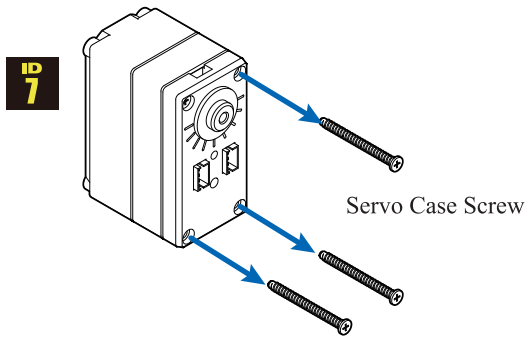
(2) Unscrew all four of the Case Screws from Servo Motor [ID8] (yellow).

(3) Mount YHR-010_Thigh Joint L to the bottom side of Servo using the seven Servo Case Screws taken off in the preceding steps.

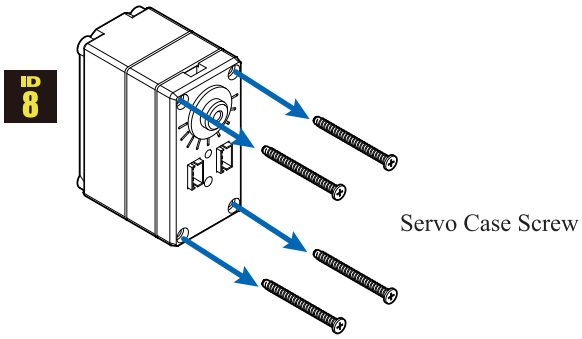
* Check servo ID carefully.

(4) Mount YHR-011_Thigh Joint R to the Output Axis side of Servo using seven 2-5 Low Head Tapping Screws.

1



2



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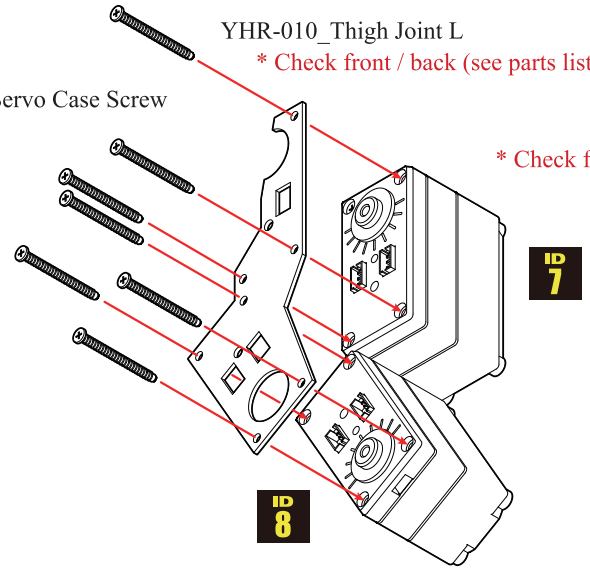

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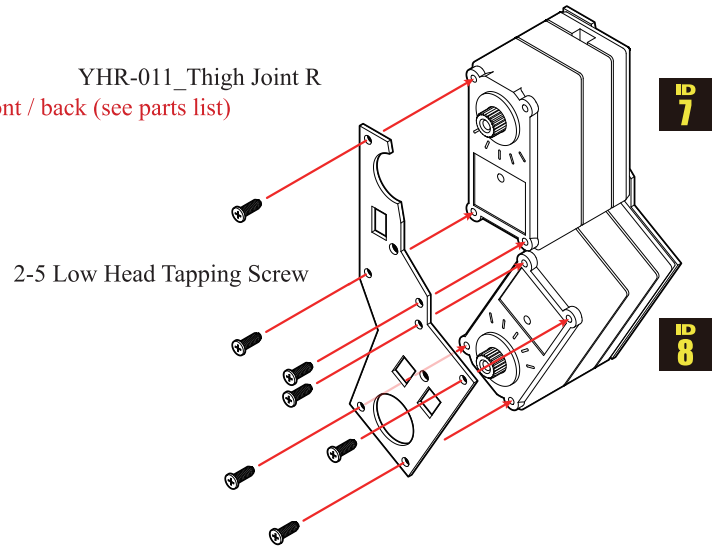
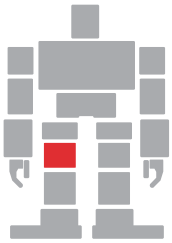


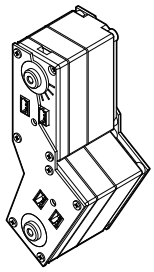
11. Assembly of Thigh Unit R

Parts to Prepare

YHR-010_Thigh Joint L	1
YHR-011_Thigh Joint R	1
Servo Motor KRS-2552 [ID 7]	1
Servo Motor KRS-2552 [ID 8]	1
2-5 Low Head Tapping Screw	7

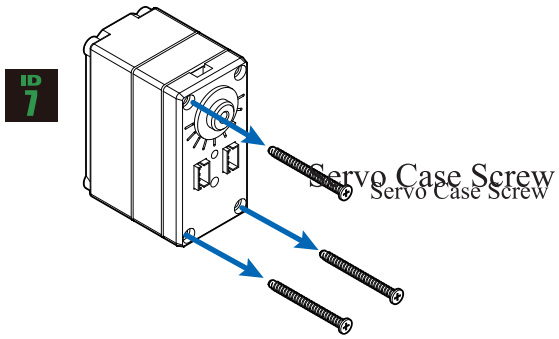


Process Completion Image



Description of Icons — Points — Tips — Caution of Breaking — Confirm

1



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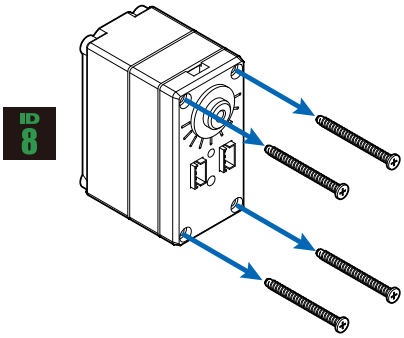


Procedure

(1) Unscrew three of the Case Screws from Servo Motor [ID7] (green), as shown in the figure.

(2) Unscrew all four of the Case Screws from Servo Motor [ID8] (green).

(3) Mount YHR-011_Thigh Joint R to the bottom side of Servo using the seven Servo Case Screws taken off in the preceding steps.

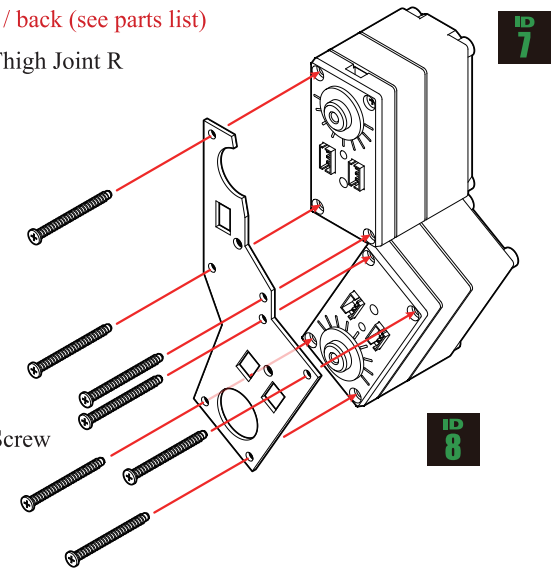
* Check servo ID carefully.

(4) Mount YHR-010_Thigh Joint L to the Output Axis side of Servo using seven 2-5 Low Head Tapping Screws.

3

* Check front / back (see parts list)

YHR-011_Thigh Joint R



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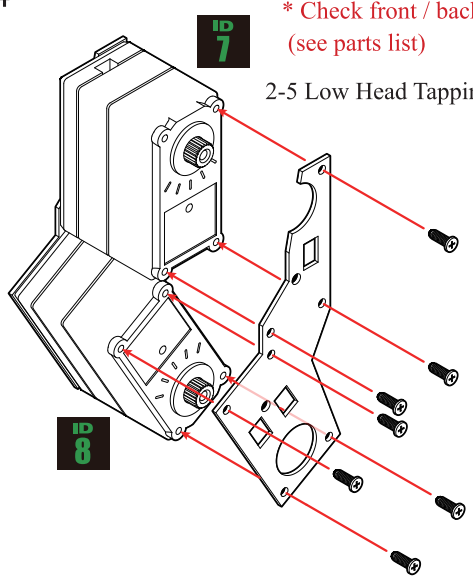
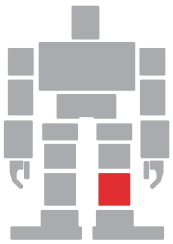


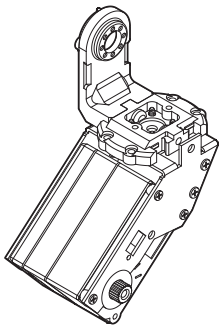
12. Assembly of Leg Unit L

Parts to Prepare

Servo Motor KRS-2552 [ID 9]	1
YHR-012_Leg Joint L	1
YHR-013_Leg Joint R	1
YHR-014_Leg Joint B	1
Joint Base 2500A	1
Bottom Arm 2500A	1
2.3-6BH Tapping Screw	4
2.6-10 Tapping Screw	1
M2-4 Low Head Screw	4
2-5 Low Head Tapping Screw	3



Process Completion Image



Procedure

(1) As in the previous process “Assembly of Shoulder Servo Arm”, insert Bottom Arm 2500A to Joint Base 2500A.

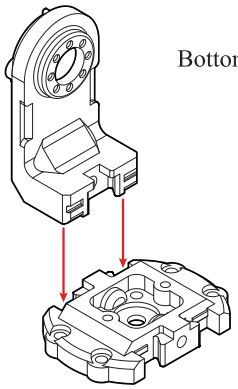
* Make sure to check the direction (front / back) of the Joint Base.

(2) Mount the Arm assembled in step (1) to YHR-012_Leg Joint L using two 2.3-6BH Tapping Screws.

(3) Mount YHR-013_Leg Joint R using two 2.3-6BH Tapping Screws.

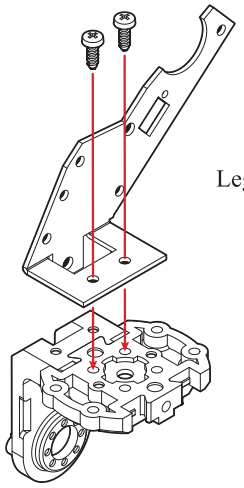
(4) Fix using one 2.6-10 Tapping Screw.

1



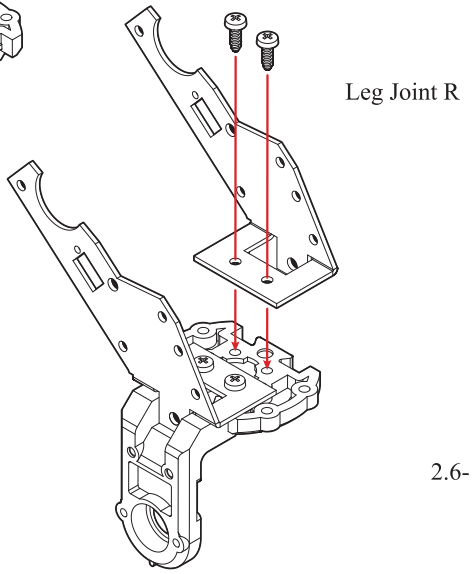
2

2.3-6BH Tapping Screw



2.3-6BH Tapping Screw

3



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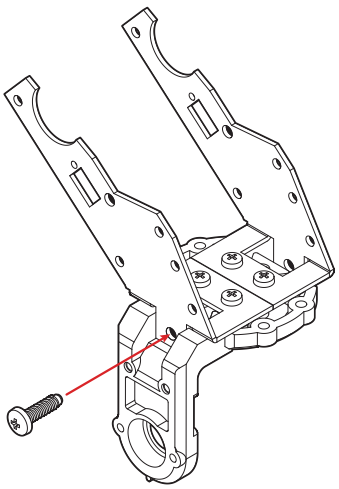

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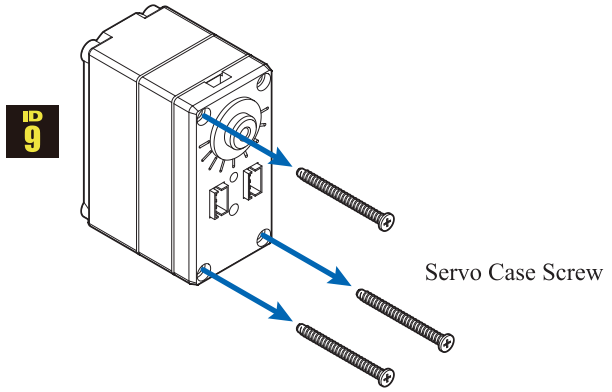

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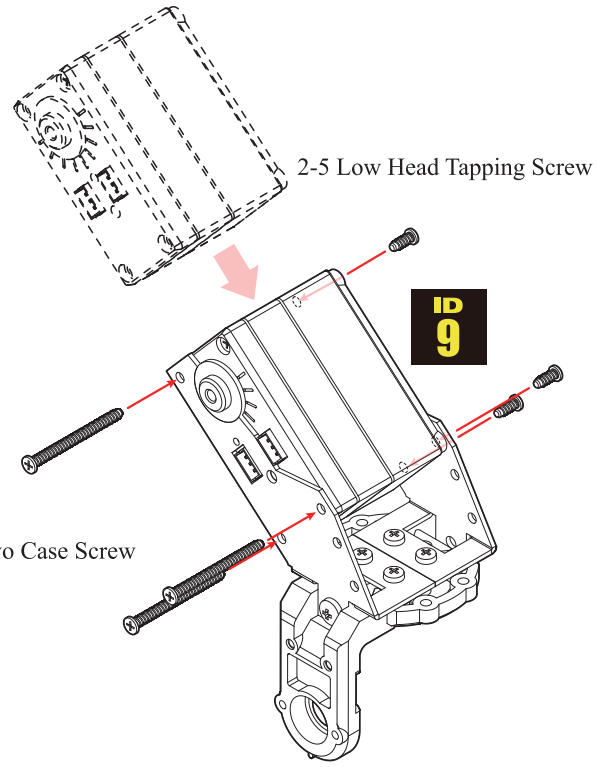

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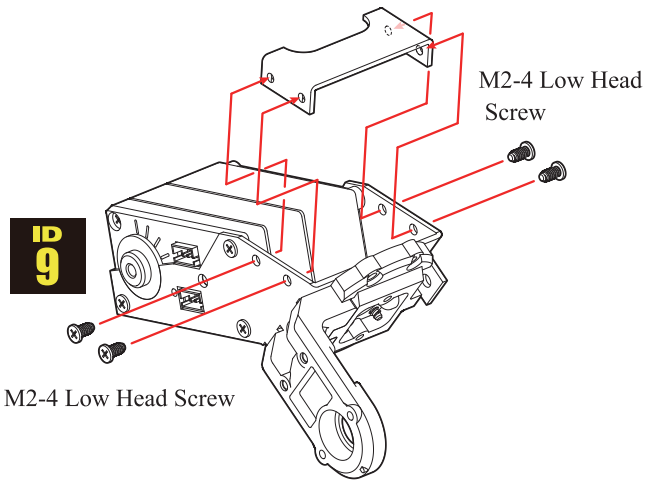


(5) Unscrew three of the case screws from Servo Motor [ID 9] (yellow), as shown in the figure.

(6) Insert servo so that YHR-012_Leg Joint L is on the bottom side of the servo and YHR-013_Leg Joint R is on the Output Axis side of the servo. Fix using the three Servo Case Screws taken off on the bottom side, and three 2-5 Low Head Tapping Screw on the output axis side.

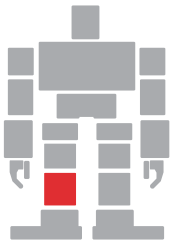
(7) Fix YHR-014 Leg Joint B using four M2-4 Low Head Screws.

* When you find it difficult to mount Leg Joint B, loosen the three 2-5 Low Head Screws tightened beforehand, and then retighten.

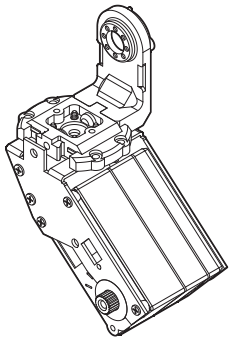
13. Assembly of Leg Unit R

Parts to Prepare

Servo Motor KRS-2552 [ID 9]	1
YHR-012_Leg Joint L	1
YHR-013_Leg Joint R	1
YHR-014_Leg Joint B	1
Joint Base 2500A	1
Bottom Arm 2500A	1
2.3-6BH Tapping Screw	4
2.6-10 Tapping Screw	1
M2-4 Low Head Screw	4
2-5 Low Head Tapping Screw	3



Process Completion Image



Procedure

(1) As in the previous process “Assembly of Shoulder Servo Arm”, insert Bottom Arm 2500A to Joint Base 2500A.

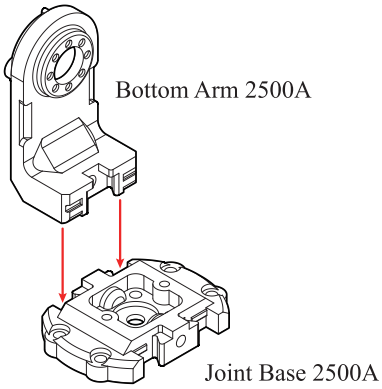
* Make sure to check the direction (front / back) of the Joint Base.

(2) Mount the Arm assembled in step (1) to YHR-013_Leg Joint R using two 2.3-6BH Tapping screws.

(3) Mount YHR-012_Leg Joint L using two 2.3-6BH Tapping screws.

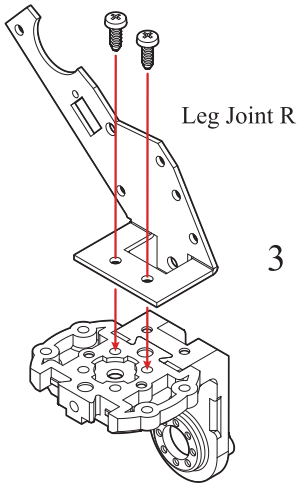
(4) Fix using one 2.6-10 Tapping screw.

1



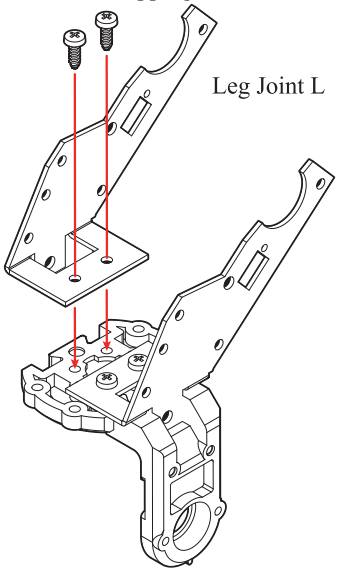
2

2.3-6BH Tapping Screw



3

2.3-6BH Tapping Screw



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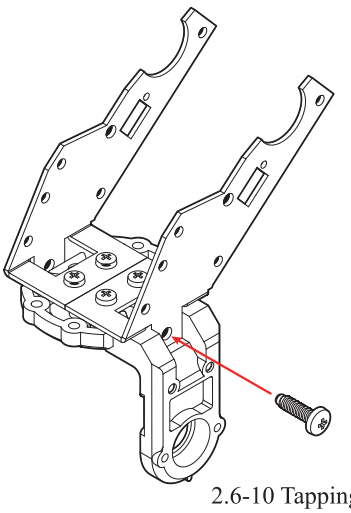

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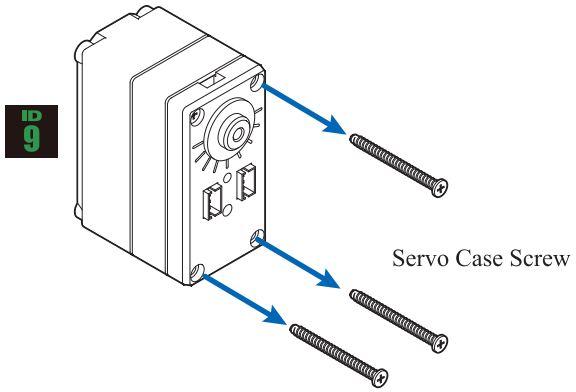

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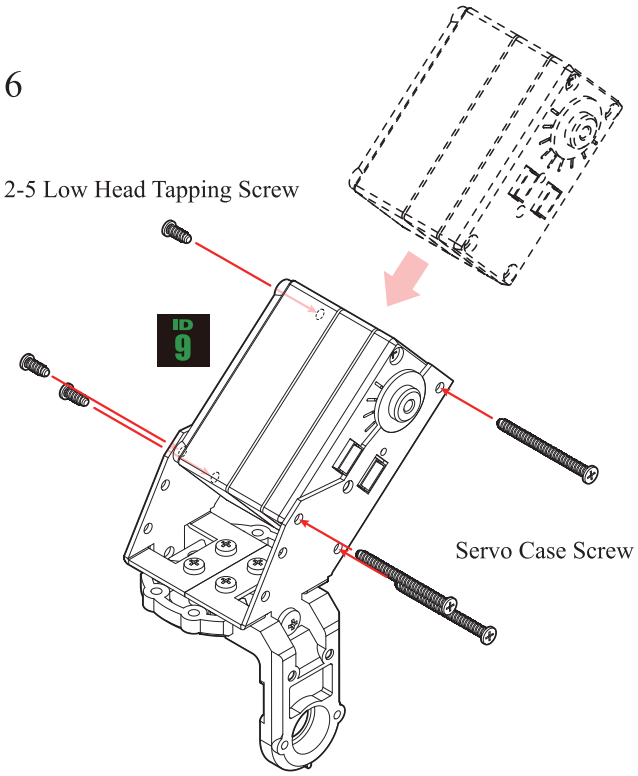

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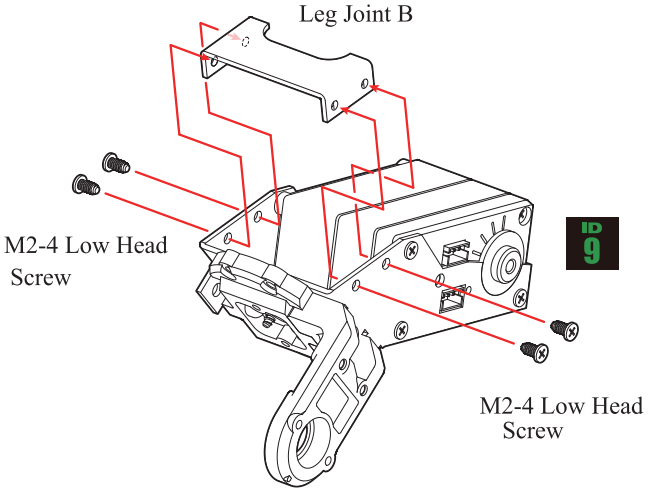


(5) Unscrew three of the case screws from Servo Motor [ID 9] (green), as shown in the figure.

(6) Insert Servo so that YHR-012_Leg Joint L is on the Output Axis side of the Servo and YHR-013_Leg Joint R is on the bottom side of the servo. Fix using the three servo case screws taken off on the bottom side, and three 2-5 Low Head Tapping Screws on the Output Axis side.

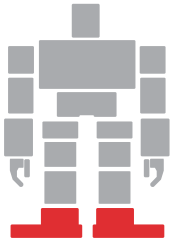
(7) Fix YHR-014_Leg Joint B using four M2-4 Low Head Screws.

* When you find it difficult to mount Leg Joint B, loosen the three 2-5 Low Head Screws tightened beforehand, and then retighten.

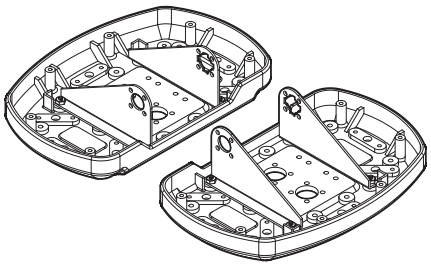
14. Assembly of Sole

Parts to Prepare

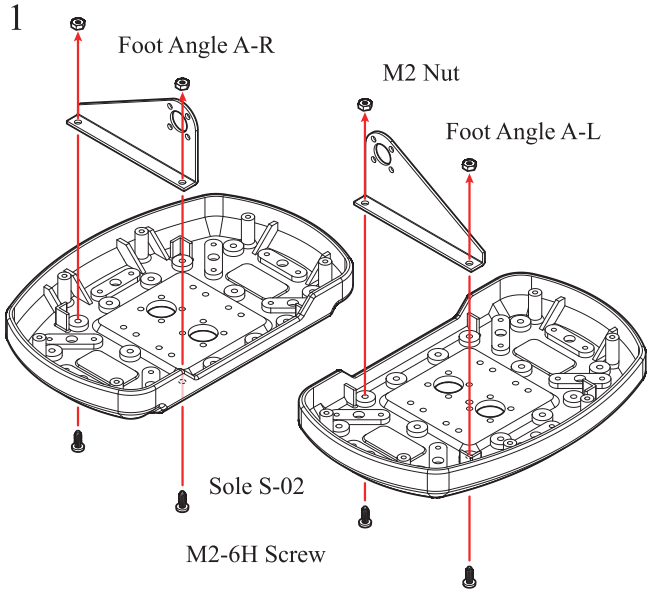
Sole S-02	2
YHR-015_Foot Angle A-L	1
YHR-016_Foot Angle A-R	1
YHR-017_Foot Angle B-L	1
YHR-018_Foot Angle B-R	1
M2-6BH Screw	8
M2 Nut	8

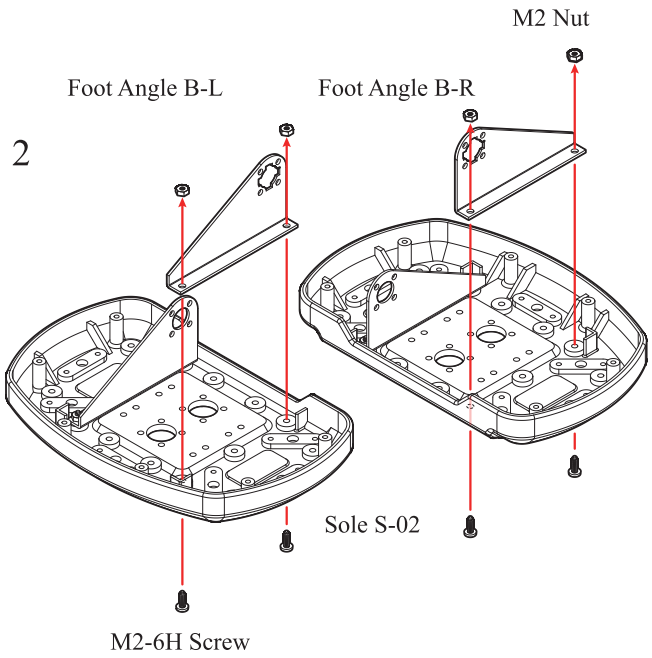


Process Completion Image



Description of Icons　Points　Tips　Caution of Breaking　Confirm





Procedure

(1) Mount YHR-015_Foot Angle A-L and YHR-016_Foot Angle A-R to two separate 5-1924_Sole S-02s using two M2-6BH screws and two M2 nuts each.

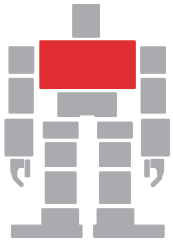
(2) Accordingly, mount YHR-015_Foot Angle B-L and YHR-016_Foot Angle B-R using two M2-6BH screws and two M2 nuts each.

* Use of screw locking adhesive is recommended if nut loosens.

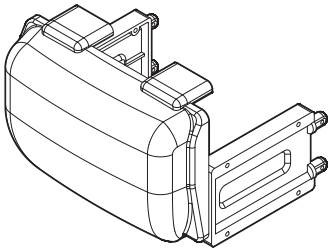
15. Assembly of Front Cowl

Parts to Prepare

Base Plate A	1
Front Cowl (SD1)	1
Battery Holder A	2
2-8 Low Head Tapping Screw	4
2-5 Low Head Tapping Screw	4

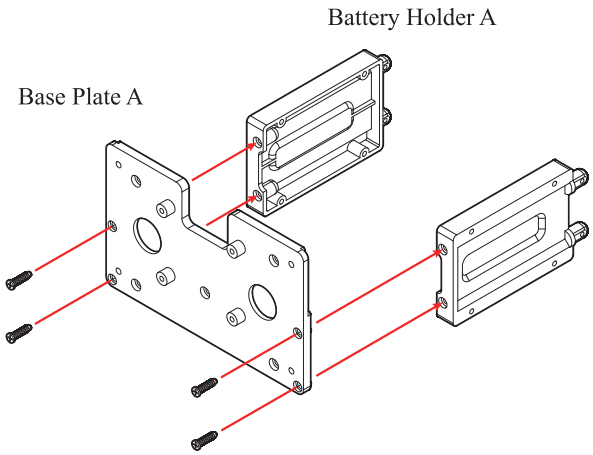


Process Completion Image



Description of Icons　Points　Tips　Caution of Breaking　Confirm

1



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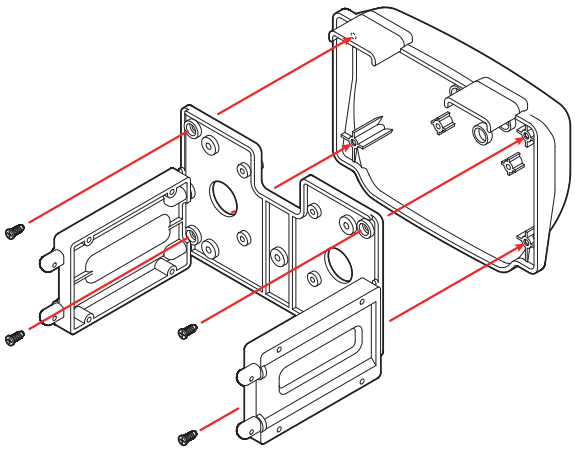


Procedure

(1) Fix two Battery Holders on Base Plate A using four 2-8 Low Head Tapping Screws.

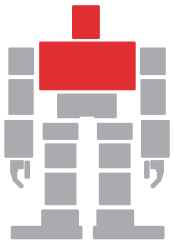
* The concaved side of the base plate should face inward.

(2) Fix Front Cowl (SD1) to the unit assembled in step (1) using four 2-5 Low Head Tapping Screws.

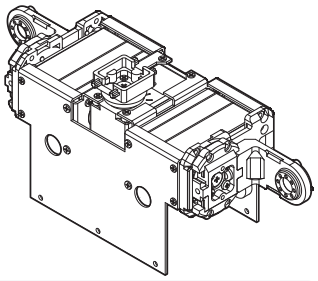
16. Installation of Units (Head - Torso)

Parts to Prepare

Chest Unit [Process 4] 1
Shoulder Servo Arm [Process 5] left, right 1
Small Diameter Horn 1
Head Base A 1
2-5 Low Head Tapping Screw 4
M3-8 Low Head Horn Fixing Screw 3



Process Completion Image



Description of Icons　Points　Tips　Caution of Breaking　Confirm

Procedure

The processes hereinafter require servo motors with origin setting completed. If Origin Setting hase not been completed, go back to [Process 2] “Origin Setting”.

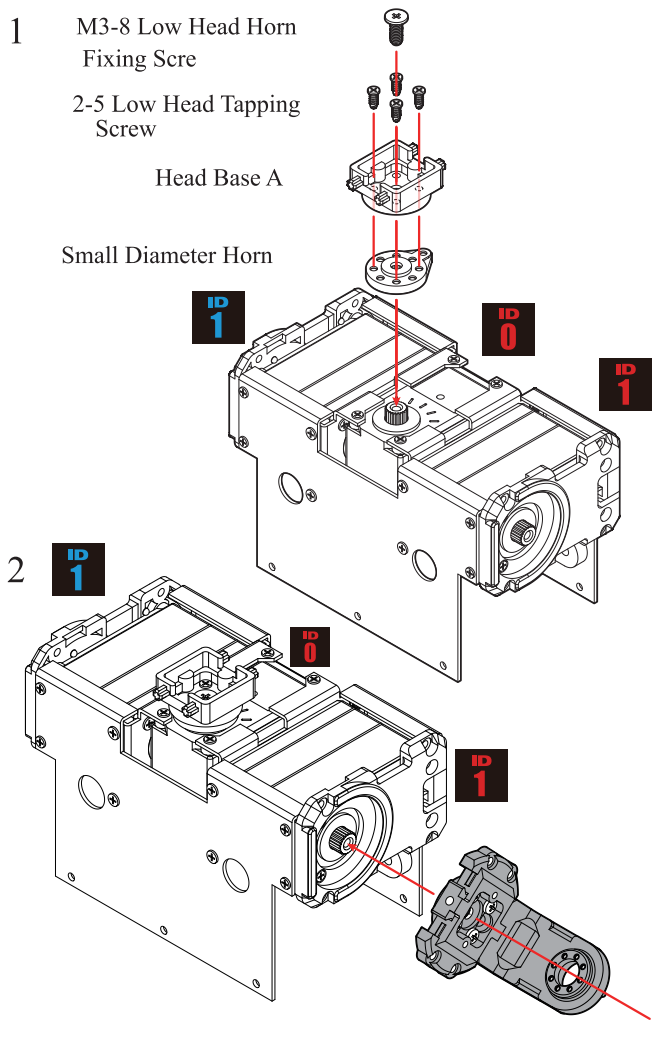
(1) Insert Small Diameter Horn as indicated in the figure and fix Head Base A over it using four 2-5 Low Head Tapping Screws.

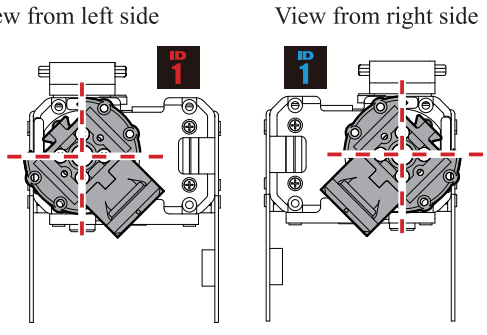
(You may fix the Small Diameter Horn and Head Base A with 2-5 Low Head Tapping Screws beforehand.)

Fix one M3-8 Low Head Horn Fixing Screw at the center of Head Base A.

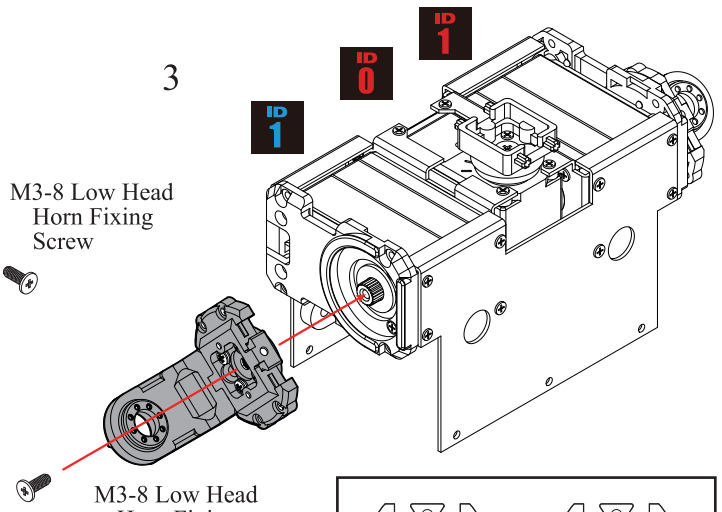
(2) Insert the Left Shoulder Servo Arm assembled in process 5 to Servo Motor [ID 1] (red), and fix using one M3-8 Low Head Horn Fixing Screw.

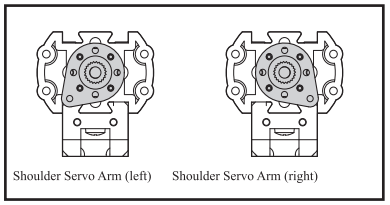
(3) Insert the Right Shoulder Servo Arm assembled in process 5 to Servo Motor [ID 1] (blue), and fix using one M3-8 Low Head Horn Fixing Screw.





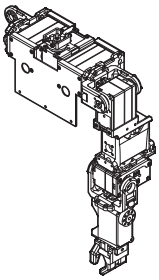
* Mount so that the screws on the servo base form a cross.





17. Installation of Units (Left Arm)

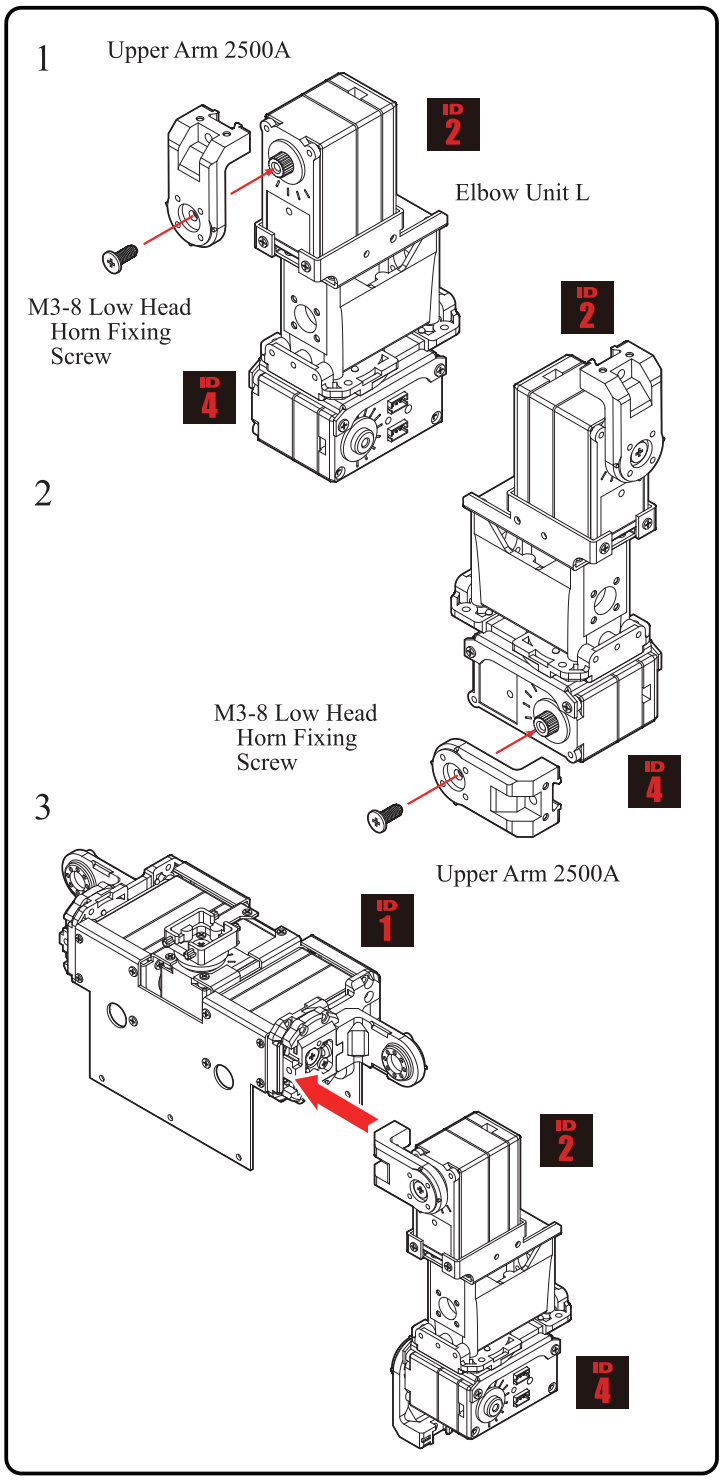
Process Completion Image



Parts to Prepare

Chest Unit [Process 16] 1
Elbow Unit L [Process 7] 1
Arm Unit L [Process 9] 1
Upper Arm 2500A 2
M3-8 Low Head Horn Fixing Screw 2
2.6-10BH Tapping Screw 2
2.6-6 Flat Head Screw 2

Description of Icons　Points　Tips　Caution of Breaking　Confirm



Procedure

(1) Insert Upper Arm 2500A into Servo Motor [ID 4] (red) and fix using one M3-8 Low Head Horn Fixing Screw.

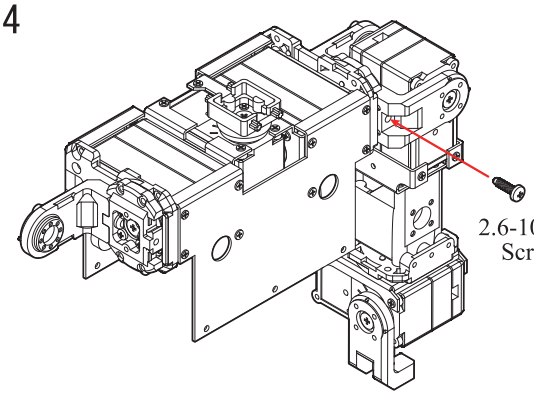
* Upper Arm 2500A must be fixed straight in relation to the servo motor.

(2) Insert Upper Arm 2500A into Servo Motor [ID 4] (red) and fix using one M3-8 Low Head Horn Fixing Screw.

* Upper Arm 2500A must be fixed straight in relation to the servo motor.

(3) Insert the left arm part of the Chest Unit assembled in Process 16 to the Joint Base part. Here, the parts will Click to fit if the connective part of the upper arm is first inserted to the base and then lifted towards to servo bottom.

4



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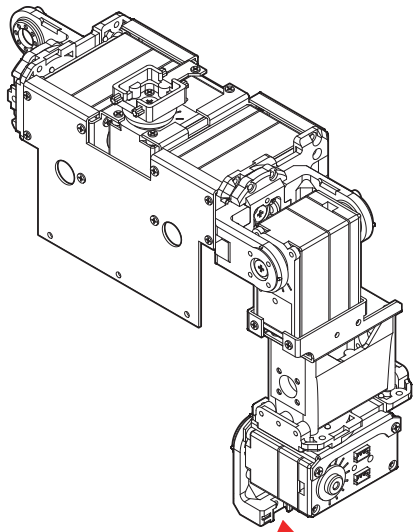
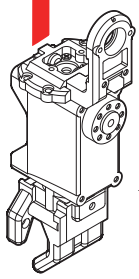
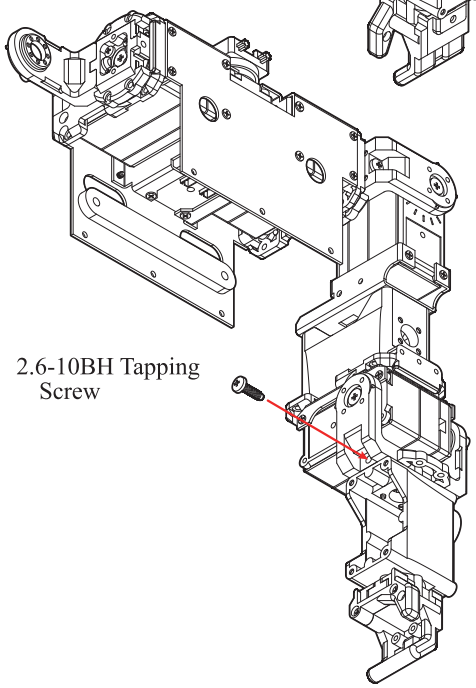
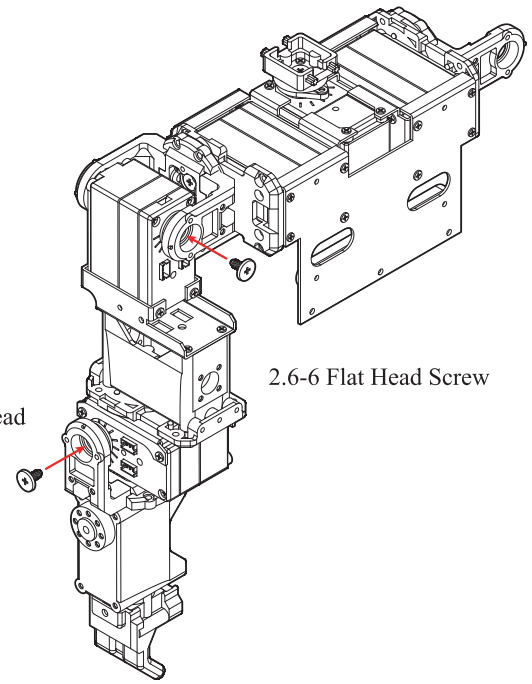


6







(4) Fix the connective part of the arm using one 2.6-10BH Tapping Screw.

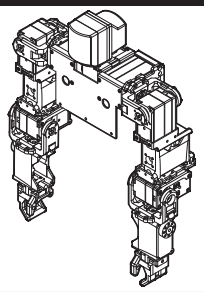
(5) Insert the left arm part of the Arm Unit assembled in Process 9 to the Joint Base part.

(6) Fix the connective part of the arm using one 2.6-10BH Tapping Screw.

(7) Fix using two 2.6-6 Flat Head Screws on the bottom side.

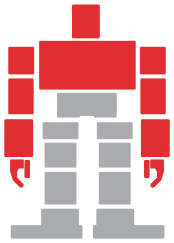
18. Installation of Units (Right Arm)

Process Completion Image

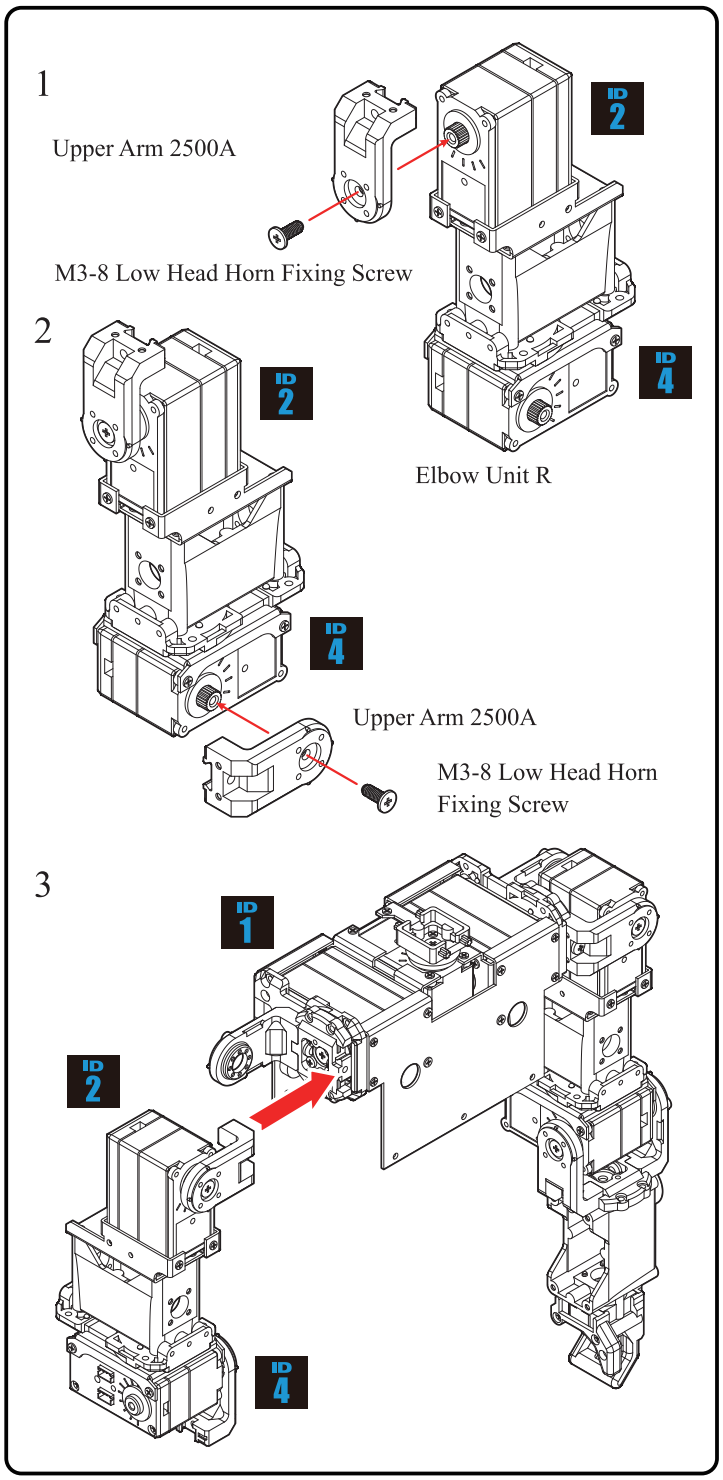


Parts to Prepare

Chest Unit [Process 17]	1
Elbow Unit R [Process 8]	1
Arm Unit R [Process 9]	1
Upper Arm 2500A	2
Face (SD1)	1
Visor (SC1)	1
Helmet (SD1)	1
M3-8 Low Head Horn Fixing Screw	2
2.6-10BH Tapping Screw	2
2.6-6 Flat Head Screw	2
2-8 Low Head Tapping Screw	5



Description of Icons　Points　Tips　Caution of Breaking　Confirm



Procedure

(1) Insert Upper Arm 2500A into Servo Motor [ID 2] (blue) and fix using one M3-8 Low Head Horn Fixing Screw.

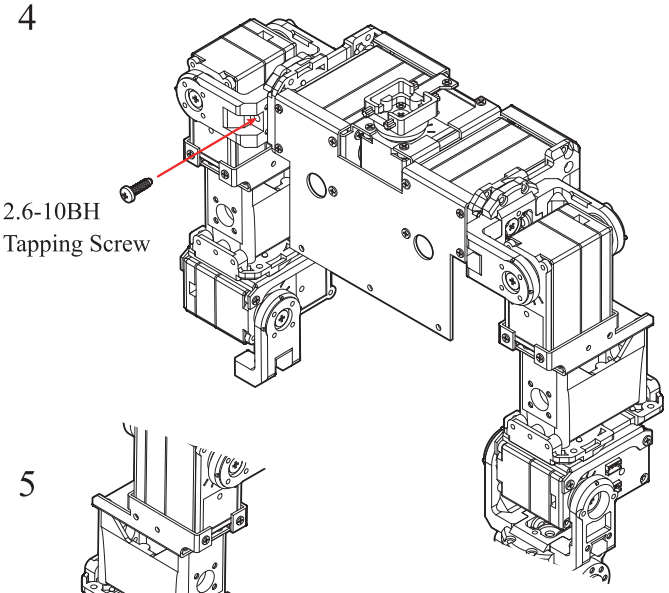
* Upper Arm 2500A must be fixed straight in relation to the servo motor.

(2) Insert Upper Arm 2500A into Servo Motor [ID 4] (blue) and fix using one M3-8 Low Head Horn Fixing Screw.

* Upper Arm 2500A must be fixed straight in relation to the servo motor.

(3) Insert the right arm part of the Chest Unit assembled in the previous process to the Joint Base part.

4



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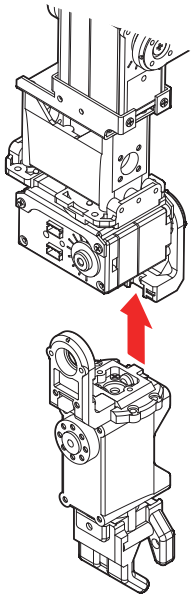

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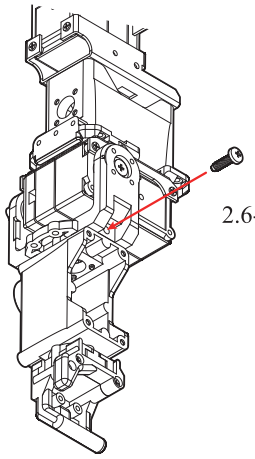

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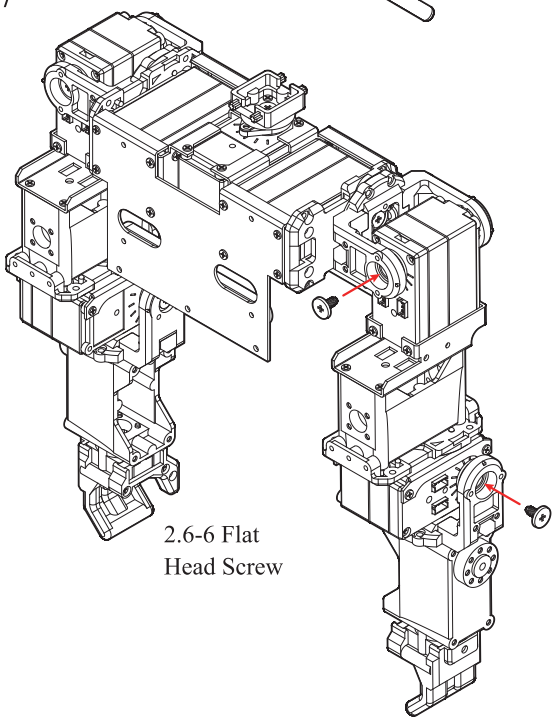


(4) Fix the connective part of the arm using one 2.6-10BH Tapping Screw.

(5) Insert the right arm part of the Arm Unit assembled in Process 9 to the Joint Base part.

(6) Fix the connective part of the arm using one 2.6-10BH Tapping Screw.

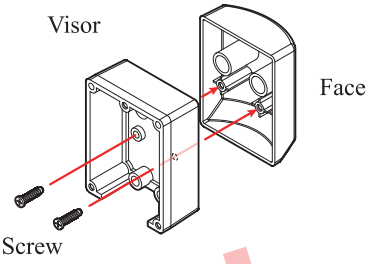
(7) Fix using two 2.6-6 Flat Head Screws on the bottom side.

(8) Mount Visor (SD1) to Face (SD1) using two 2-8 Low Head Tapping Screws.

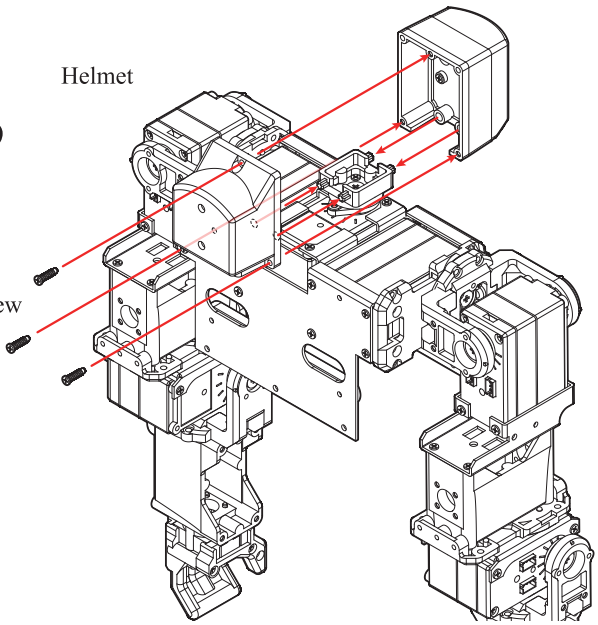
(9) Sandwich the Head Base with Face and Helmet (SD1) and fix using three 2-8 Low Head Tapping Screws.

* The protrusion on the Head Base fit the Face and Helmet.

8



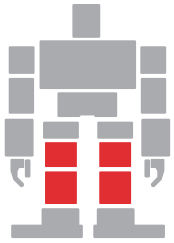
9



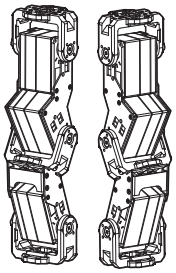
19. Installation of Units (Leg 1)

Parts to Prepare

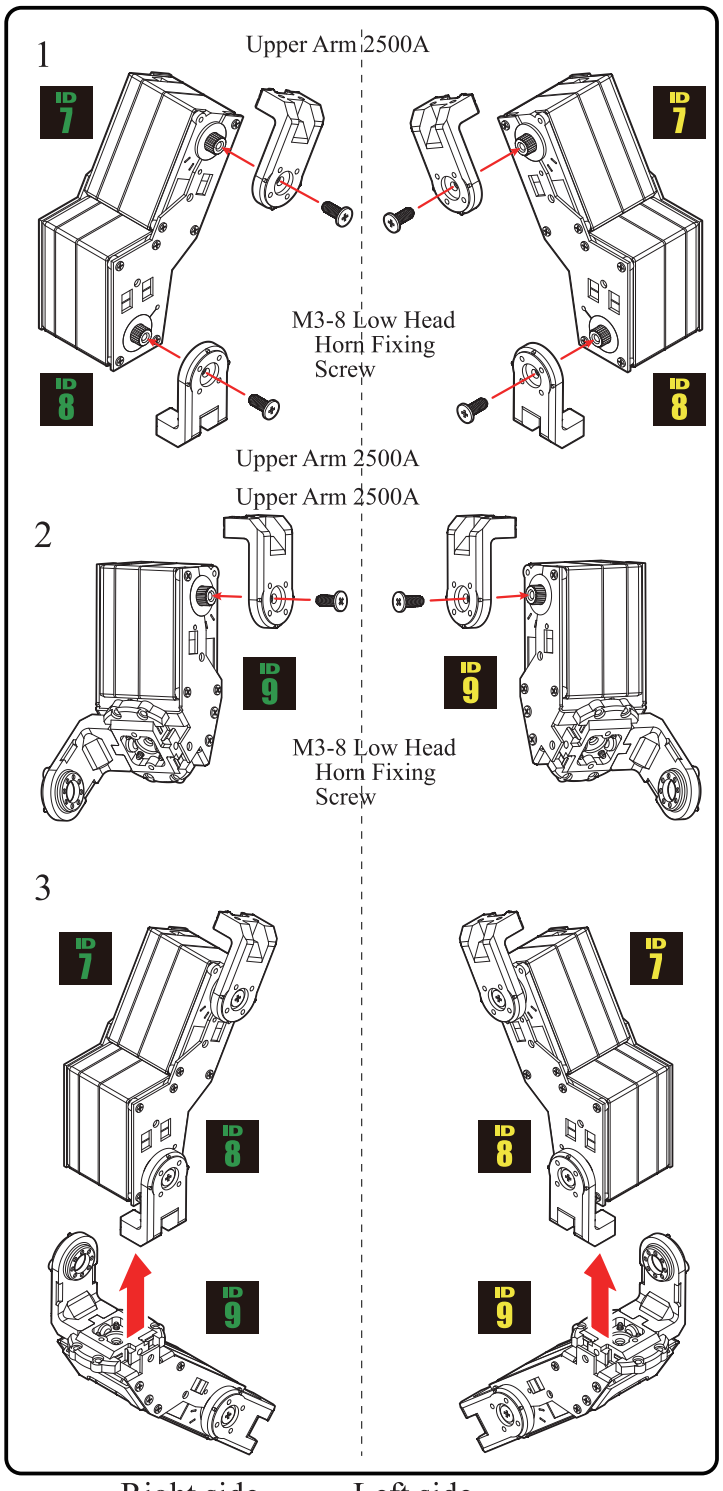
Servo Arm [Process 6]	4
Thigh Unit L [Process 10]	1
Thigh Unit R [Process 11]	1
Leg Unit L [Process 12]	1
Leg Unit R [Process 13]	1
Upper Arm 2500A	6
M3-8 Low Head Horn Fixing Screw	6
2.6-10BH Tapping Screw	6
2.6-6 Flat Head Screw	6



Process Completion Image



Description of Icons　Points　Tips　Caution of Breaking　Confirm



Right side　　Left side

Procedure

(1) Mount Upper Arm 2500A onto Thigh Unit L and Thigh Unit R and fix using one M3-8 Low Head Horn Fixing Screw each.

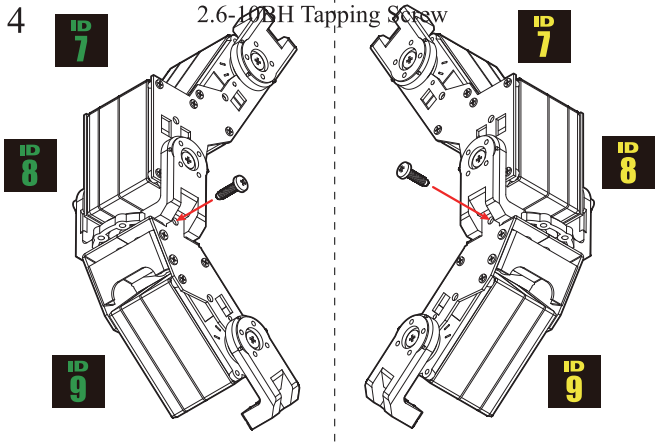
(2) Mount Upper Arm 2500A onto Leg Unit L and Leg Unit R and fix using one M3-8 Low Head Horn Fixing Screw each.

(3) Attach Leg Unit L to Thigh Unit L, and Leg Unit R to Thigh Unit R.

Right side Left side

4

2.6-10BH Tapping Screw



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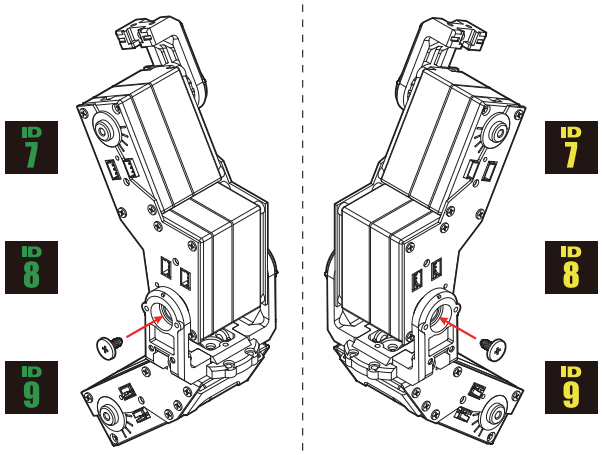
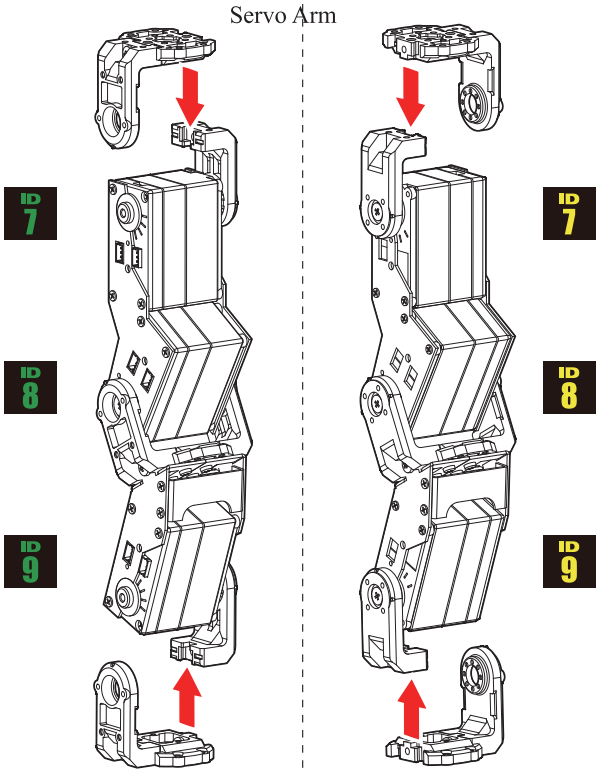


2.6-6 Flat Head Screw

6

Servo Arm



Servo Arm

Right side Left side

(4) Fix the connective parts using one 2.6-10BH Tapping Screw each.

(5) Fix one 2.6-6 Flat Head Screw on each Bottom Arm 2500A.

(6) Attach Servo Arm to Upper Arm.

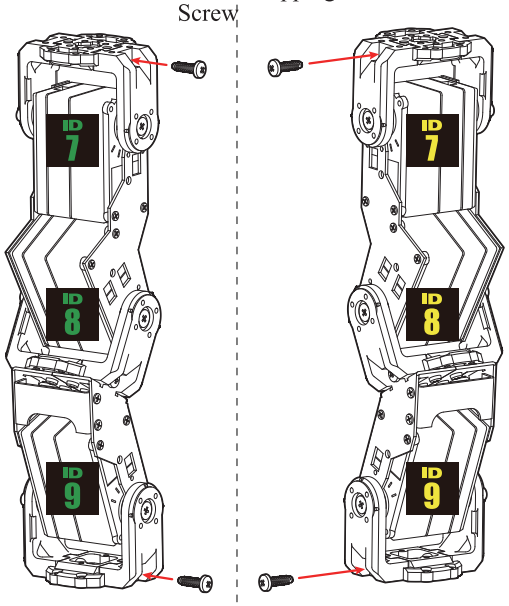
(7) Fix the connective parts using one 2.6-10BH Tapping Screw each.

(8) Fix one 2.6-6 Flat Head Screw on each Bottom Arm 2500A.

Right side Left side

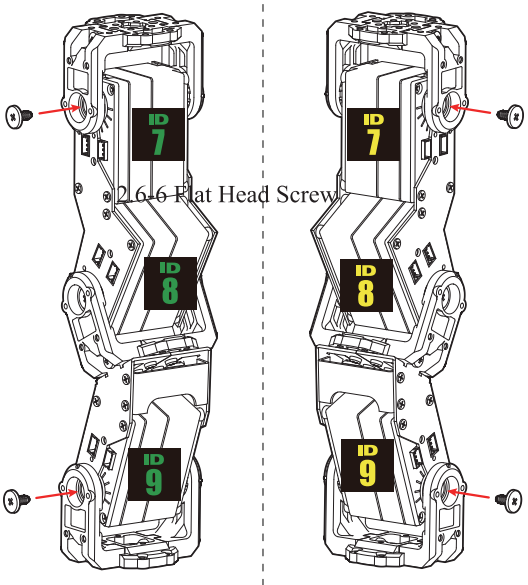
7

2.6-10BH Tapping Screw



2.6-10BH Tapping Screw

8



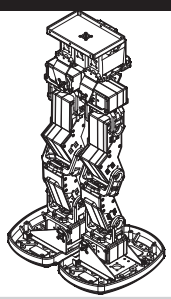
2.6-6 Flat Head Screw

2.6-6 Flat Head Screw

Right side Left side Right side Left side

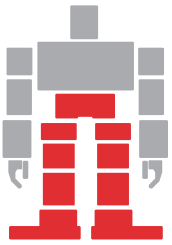
20. Installation of Units (Leg 2)

Process Completion Image

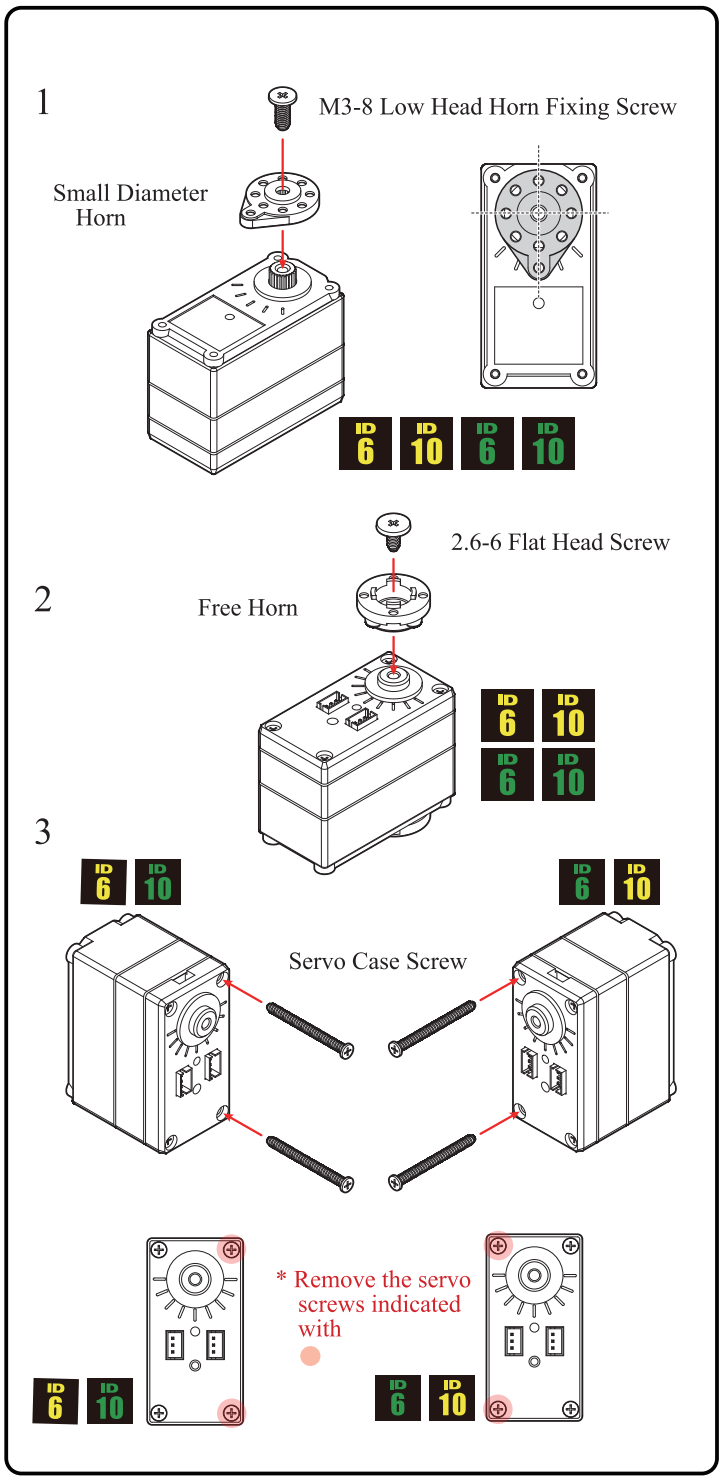


Parts to Prepare

Foot Unit L [Process 19]	1	Small Diameter Horn	4
Foot Unit R [Process 19]	1	Free Horn	4
Sole L [Process 14]	1	M3-8 Low Head Horn Fixing Screw	4
Sole R [Process 14]	1	2.6-6 Flat Head Screw	4
Servo Motor KRS-2552 [ID 6]	2	2-5 Low Head Tapping Screw	56
Servo Motor KRS-2552 [ID 10]	2	M2-4 Low Head Screw	8
YHR-006 Servo Bracket A	4		



Description of Icons　Points　Tips　Caution of Breaking　Confirm



Procedure

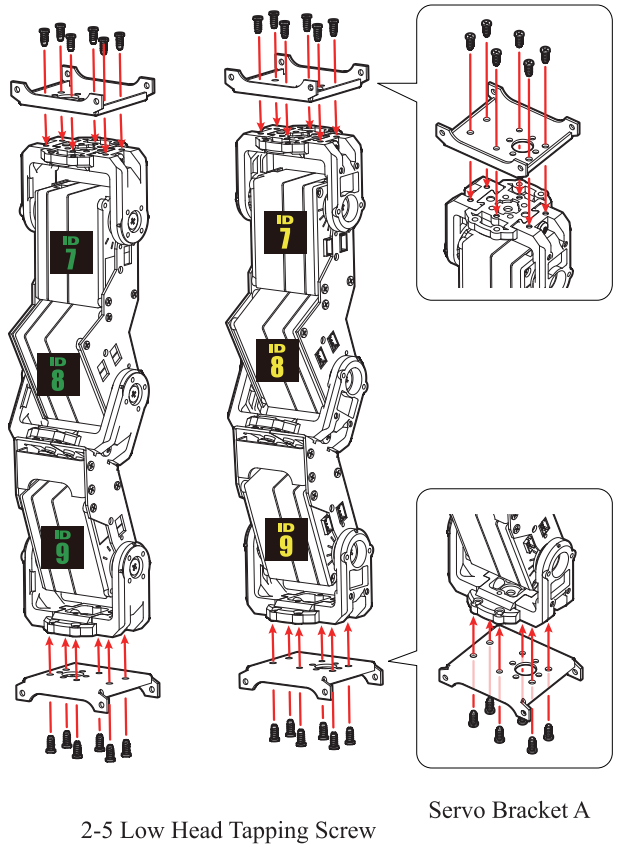
(1) Mount one Small Diameter Horn each on Servo Motors [ID 6] (yellow), [ID10] (yellow), [ID 6] (green) and [ID10] (yellow), and fix using one M3-8 Low Head Horn Fixing Screw for each.

(2) Mount one Free Horn each on the bottom side of all four servo motors and fix using one 2.6-6 Flat Head Screw for each.

(3) Remove two Servo Screws each as indicated in the figure.

Right side Left side

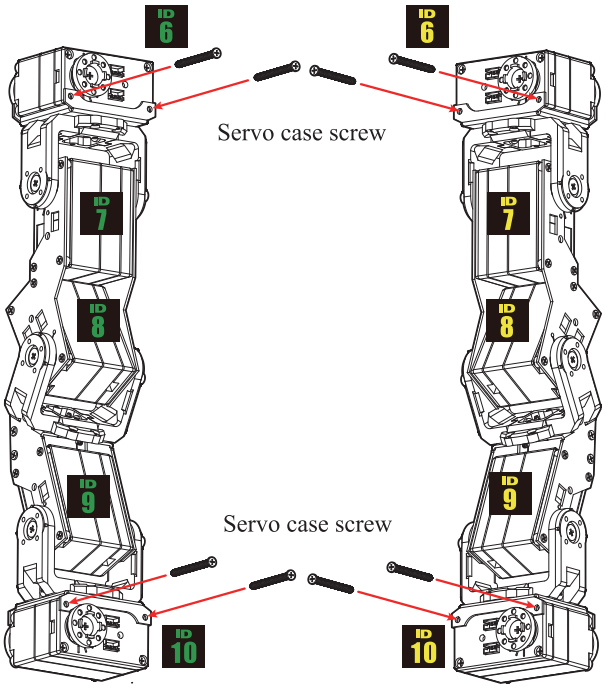
4



(4) Fix four Servo Bracket A to Servo Base 2500A using six 2-5 Low Head Tapping Screws for each. Be careful of the direction.

(5) Fix each Servo Motor to Servo Bracket A using each of the four Servo Screws removed and four 2-5 Low Head Tapping Screws for each.

Right side Left side



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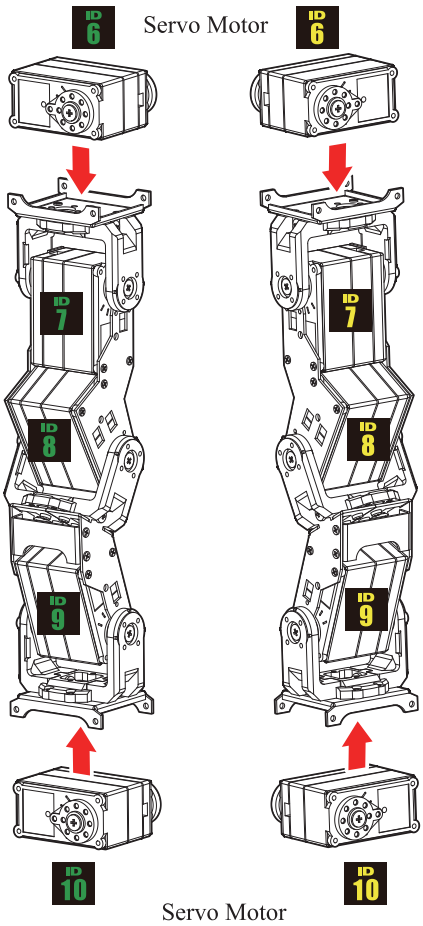
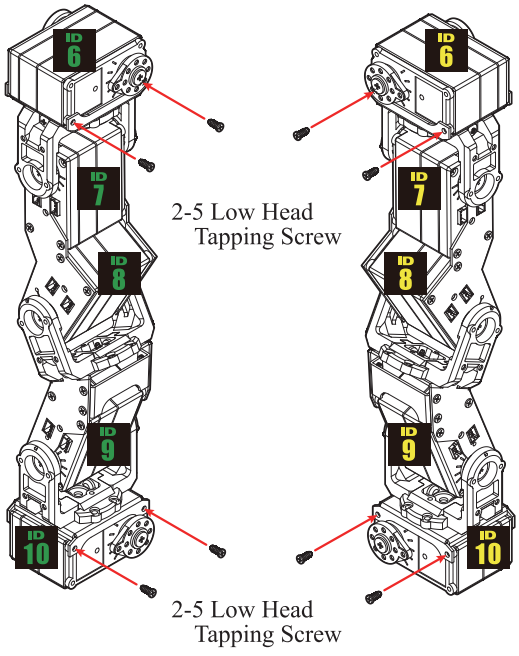


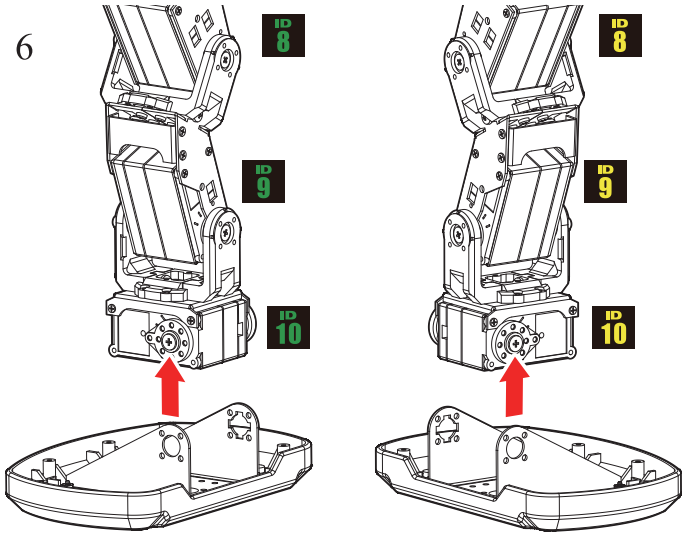


Right side Left side

Right side Left side

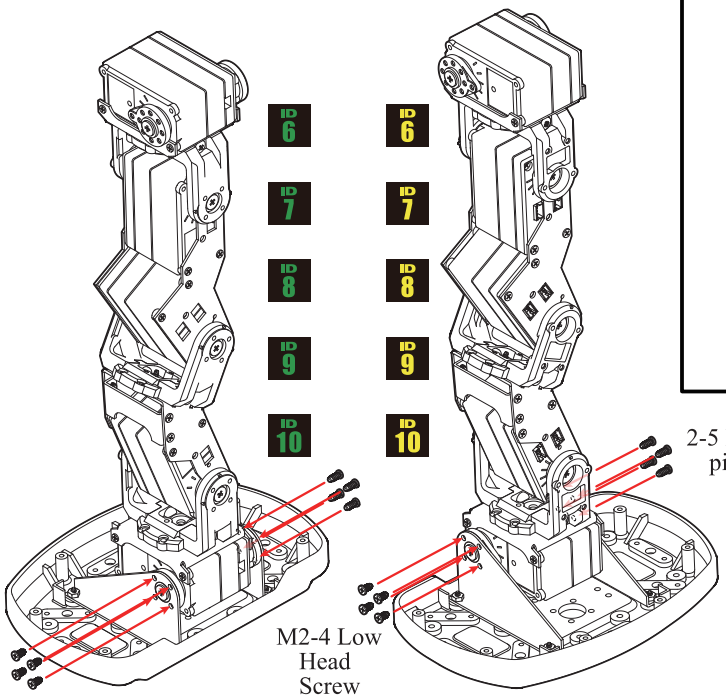
Right side Left side

6



(6) Mount each sole. Fix Small Diameter Horn using four M2-4 Low Head Screws each and Free Horn using four 2-5 Low Head Tapping Screws. Here, check the direction of the protrusion on the Small Diameter Horn. If the protrusion is not as shown in the figure, turn the Small Diameter Horn by hand to match the figure.

(7) Mount both legs on the Hip Unit. Both Small Diameter Horn and Free Horn should be fixed using 2-5 Low Head Tapping Screws each.



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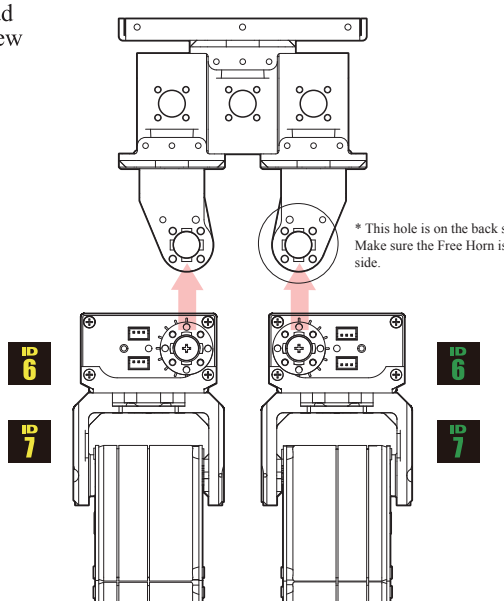
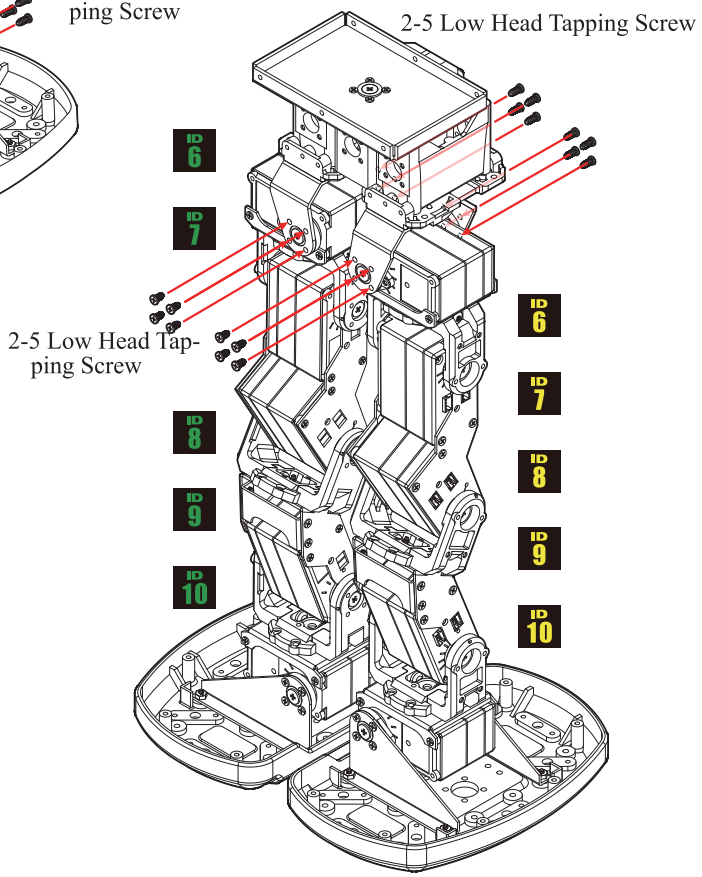




Left side Right side

21. Wiring and Binding of Wiring

Parts to Prepare

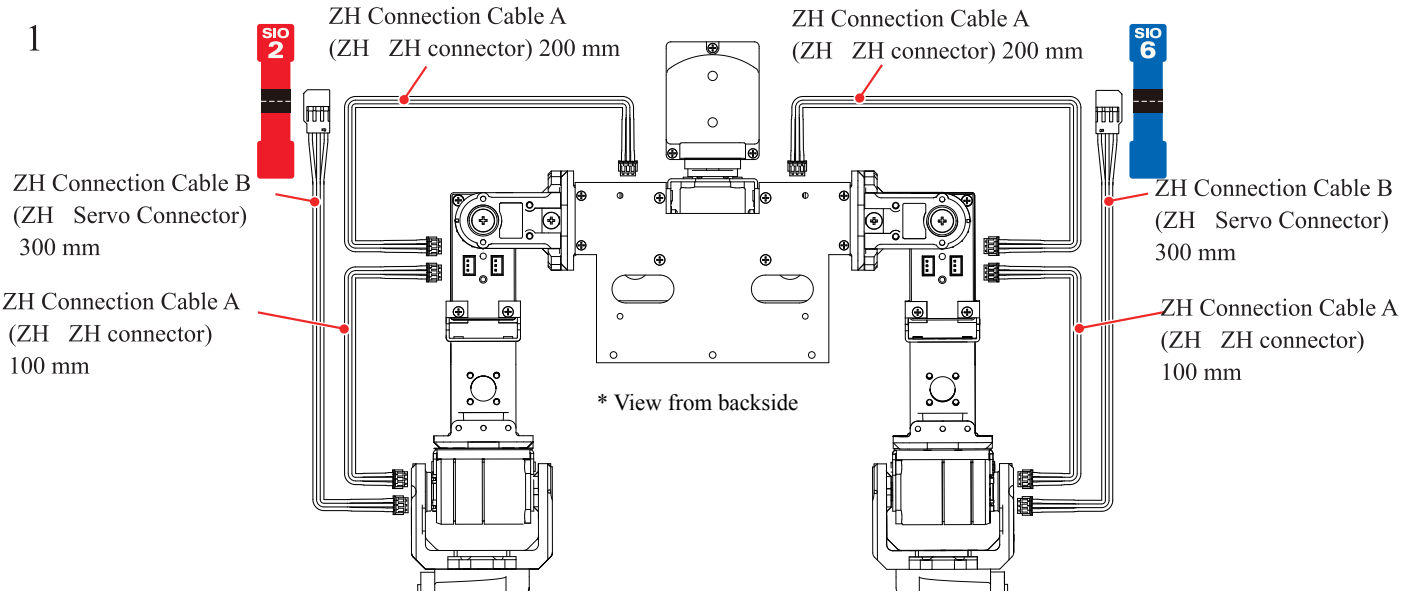
Cable Guide	8
Cable Guide (small)	4
M2-4 Low Head Screw	4
2-5 Low Head Tapping Screw	4
2-6 Flat Head Tapping Screw	8

Procedure

(1) Wire the Arms in accordance with the wiring diagram.

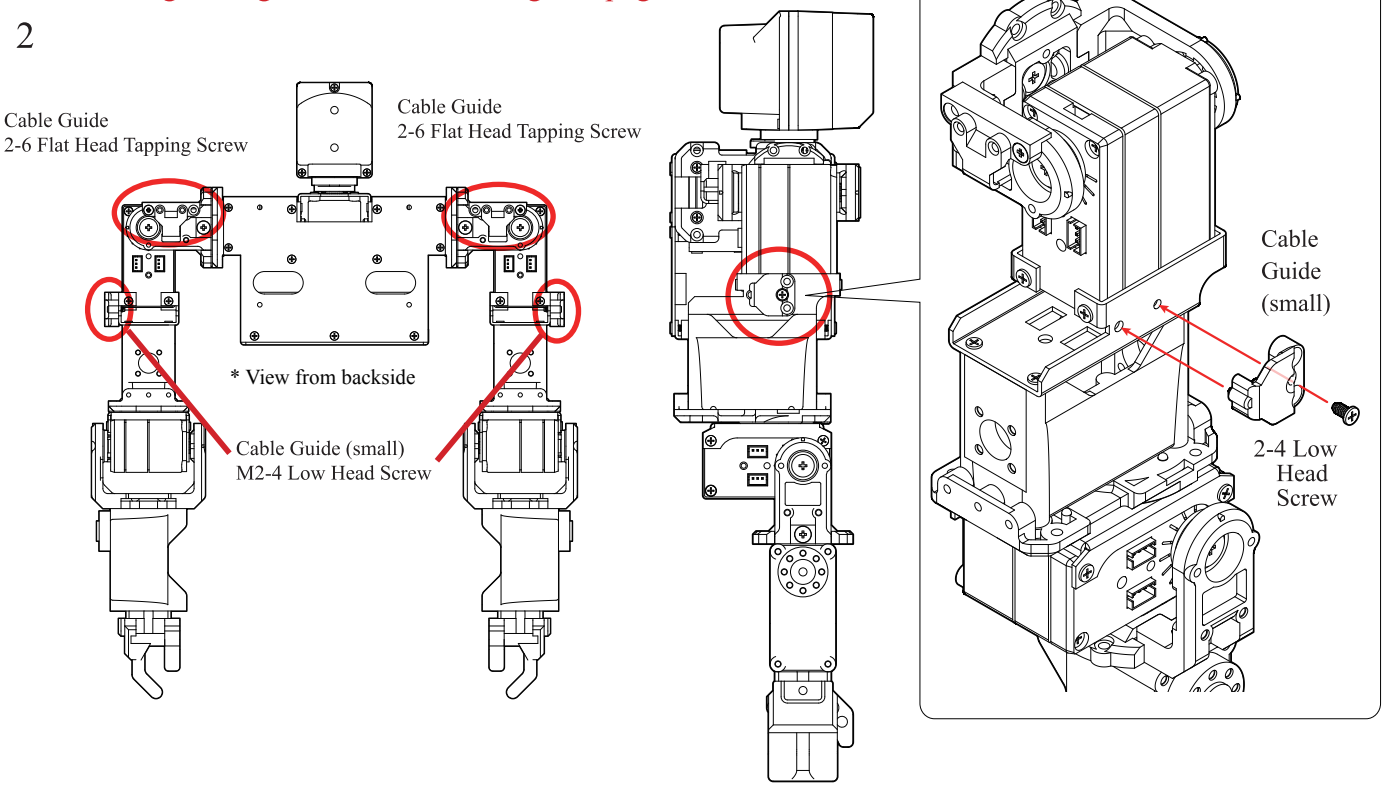
(2) Organize the cables using Cable Guide and Cable Guide (small), in accordance to the figure.

1



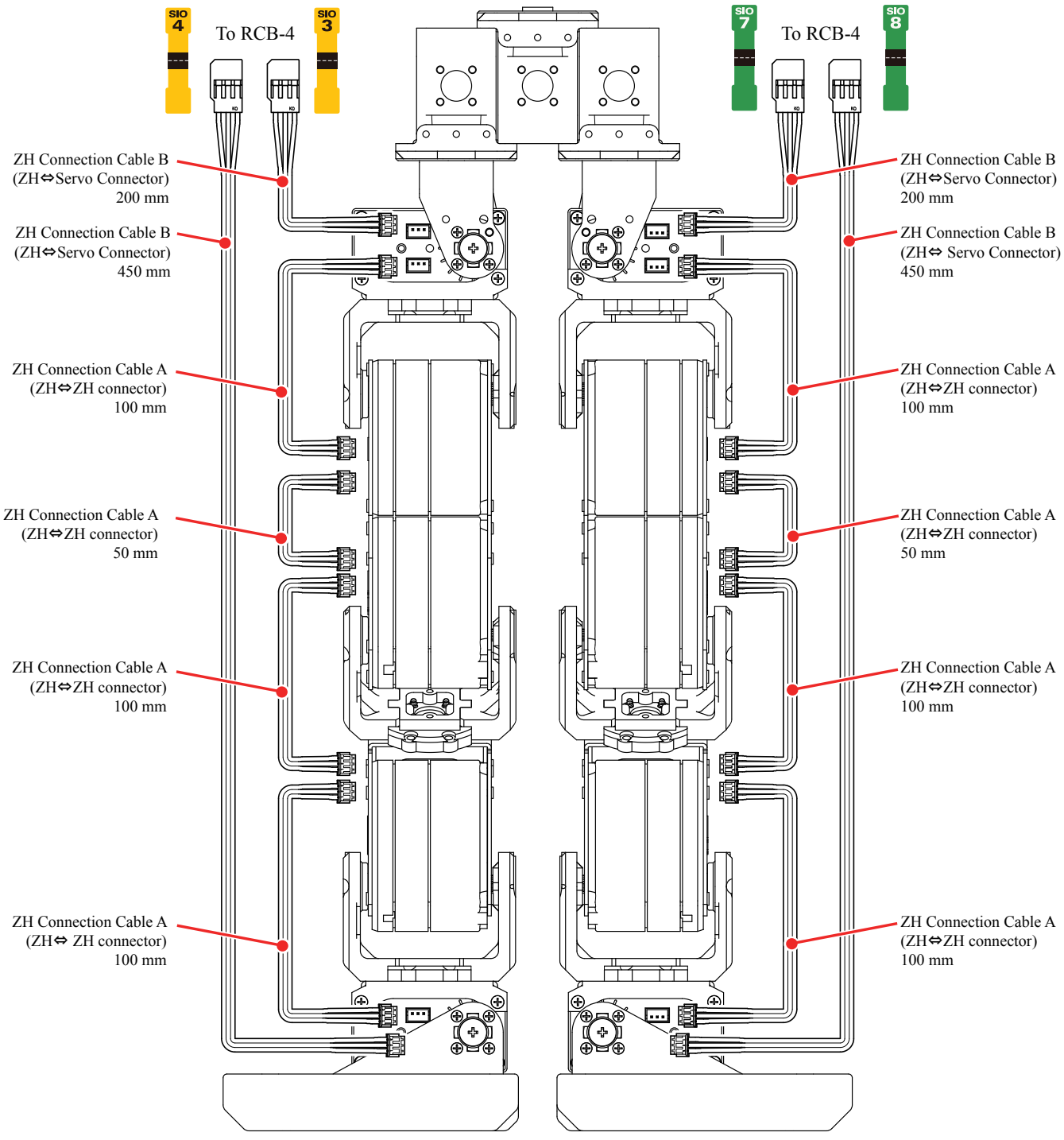
When organizing cables, refer to image on page 62.

2



3 Leg Wiring Diagram

(3) Wire the Legs in accordance with the wiring diagram.



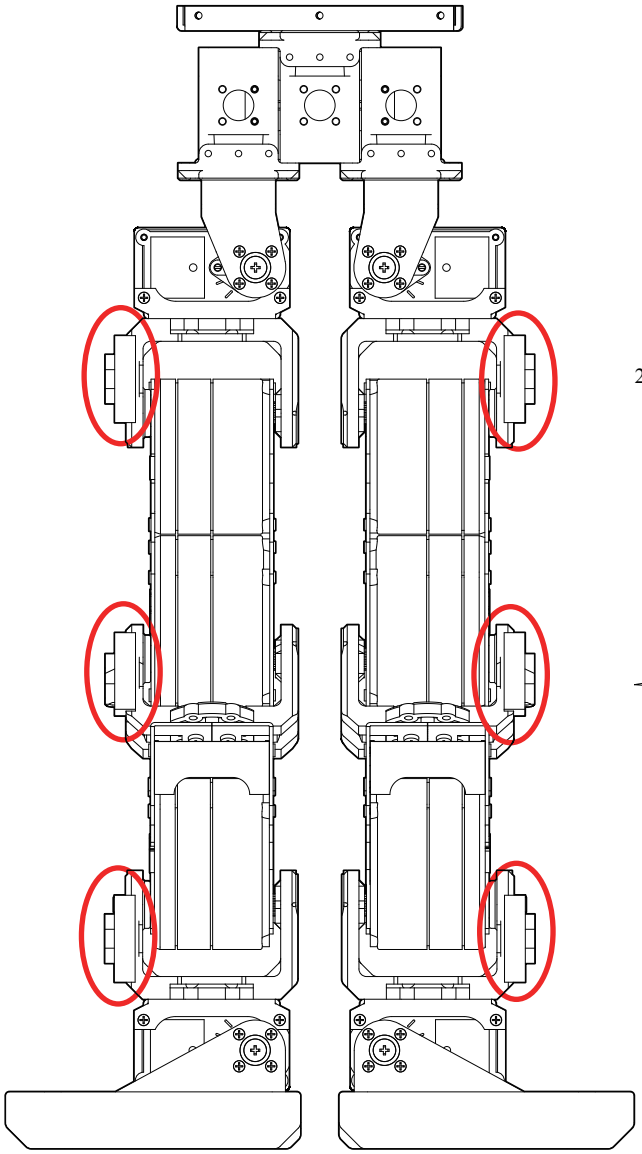
* View from backside

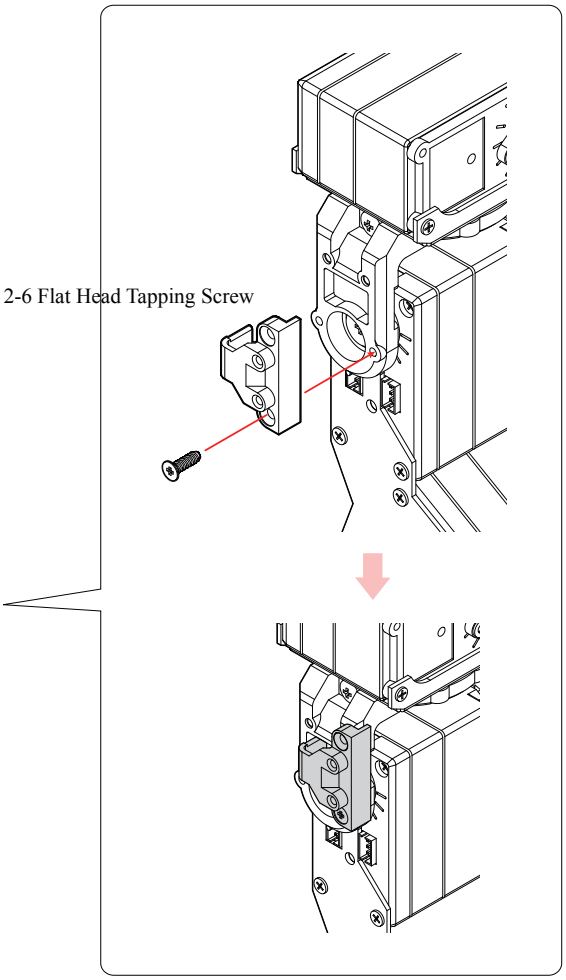
4

Mounting Cable Guide (6)

(4) Mount Cable Guide in accordance with the figure.

* Frontal View



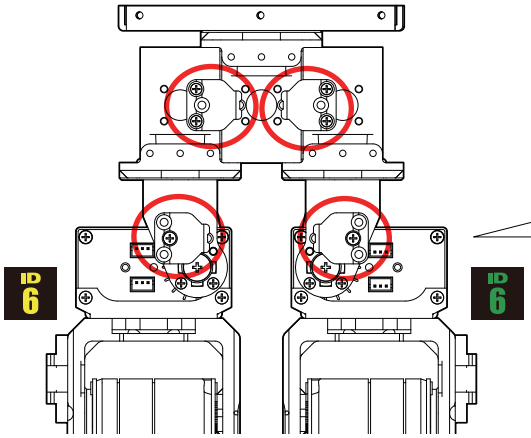


When organizing cables, refer to image on page 62.

5

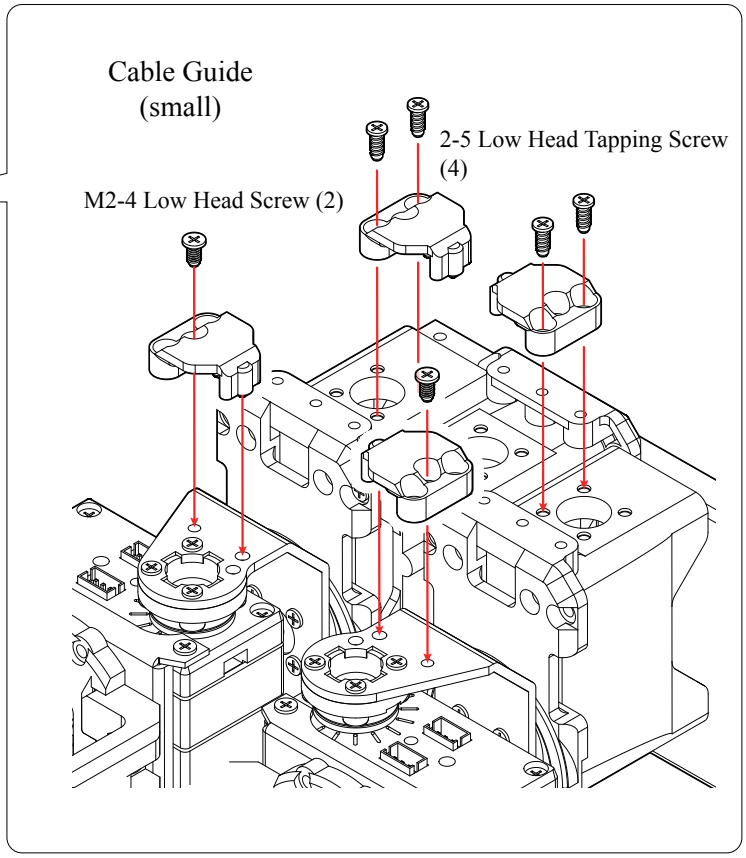
Mounting Cable Guide (small) (4)

* Backside View



(5) Mount Cable Guide (small) in accordance with the diagram.

(6) Bundle cables using Nylon Strap.



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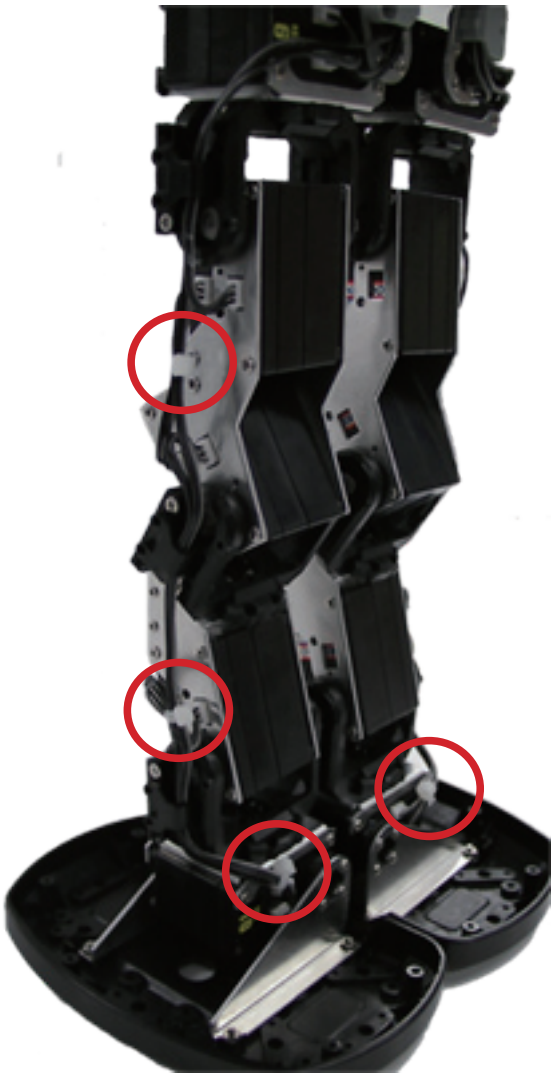
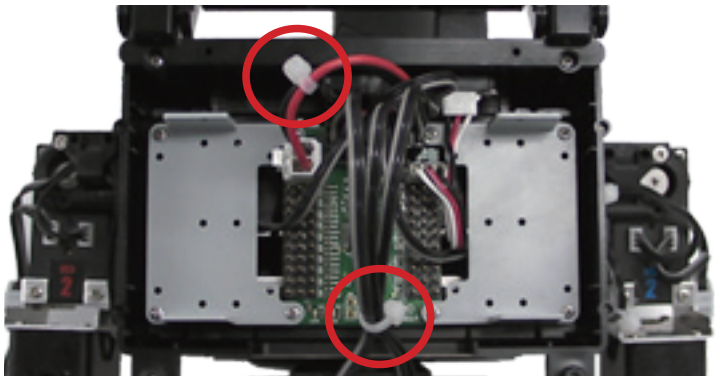




Organization of Arm Wirings

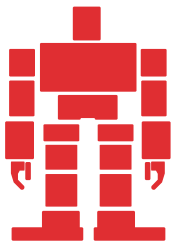
Organization of Leg Wirings

Organization of Hip Wirings

22. Overall Assembly

Parts to Prepare

M2-4 Low Head Screw　6



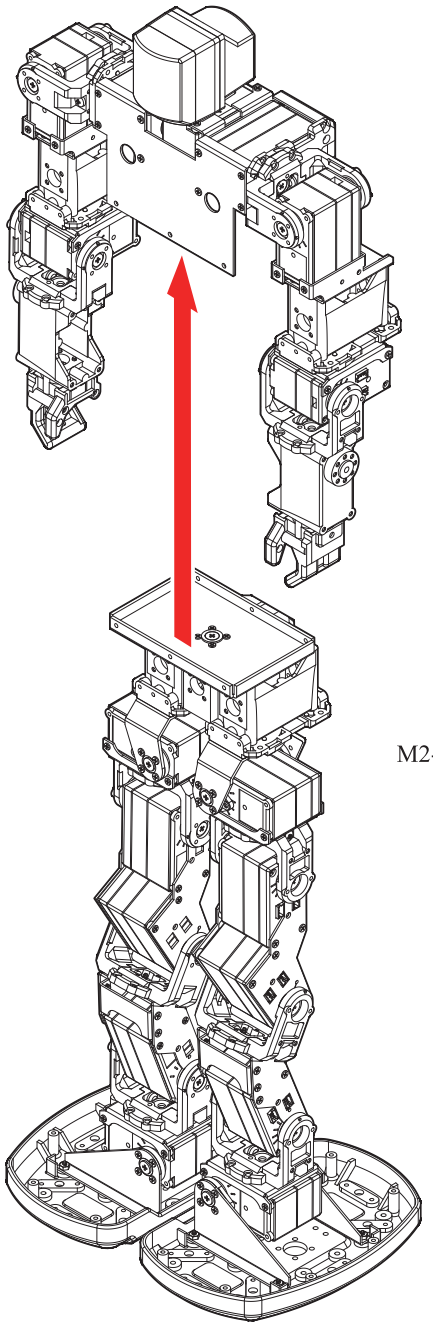
Description of Icons　Points　Tips　Caution of Breaking　Confirm

Procedure

(1) Insert Leg Part to Torso Part.

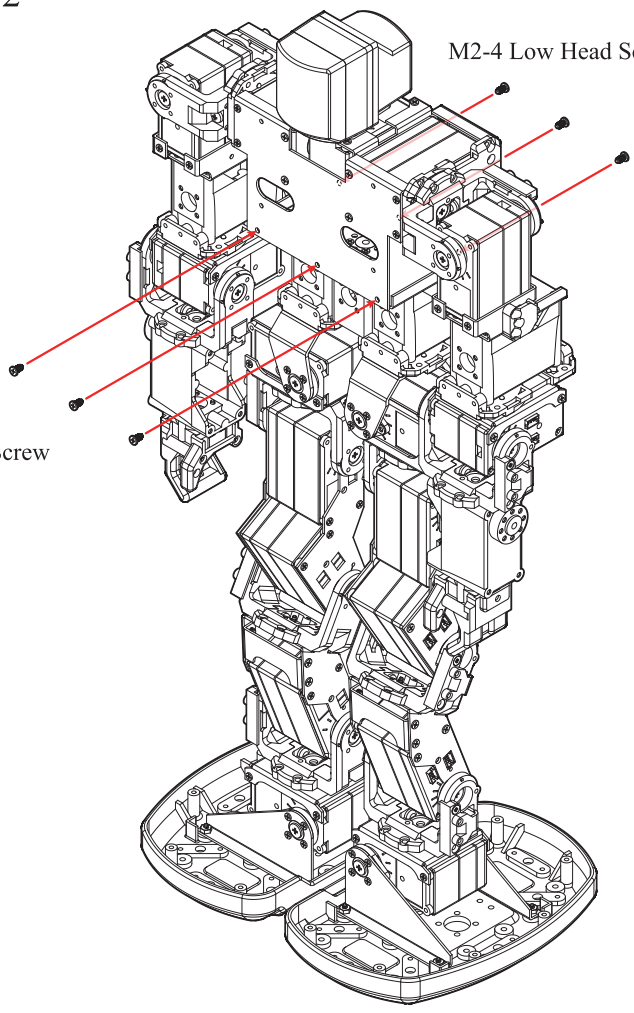
(2) Fix using six M2-4 Low Head Screws.

1



M2-4 Low Head Screw

2



M2-4 Low Head Screw

23. Attachment of Back Pack

Parts to Prepare

Retainer B	2	Servo Extension Cord	1
PCB Base B	1	2-5 Low Head Tapping Screw	4
Top Panel B	1	M2-6BH Screw	6
Top Cover B	1	M2-8 Low Head Tapping Screw	2
Wing B-L	1		
Wing B-R	1		
HV Power Switch Harness	1		

Description of Icons　Points　Tips　Caution of Breaking　Confirm

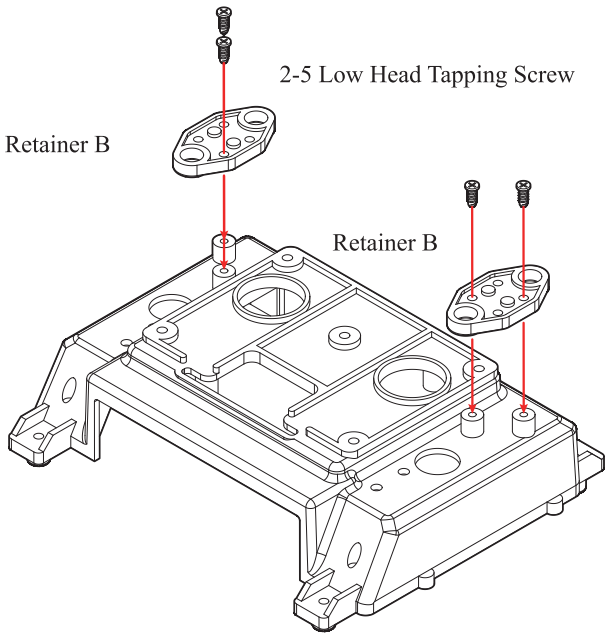
Procedure

(1) Unplug RCB-4HV, Power Switch and Extension Cord used for Origin Setting.

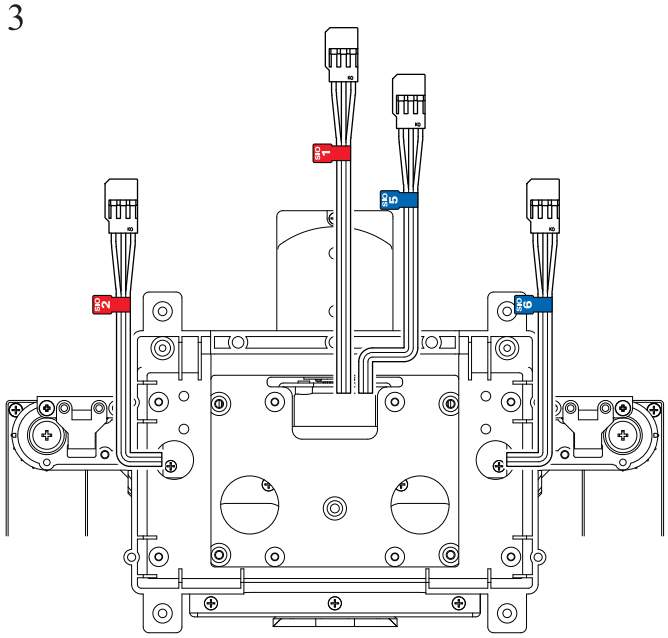
(2) Mount two Retainer B using two 2-5 Low Head Tapping Screws for each.

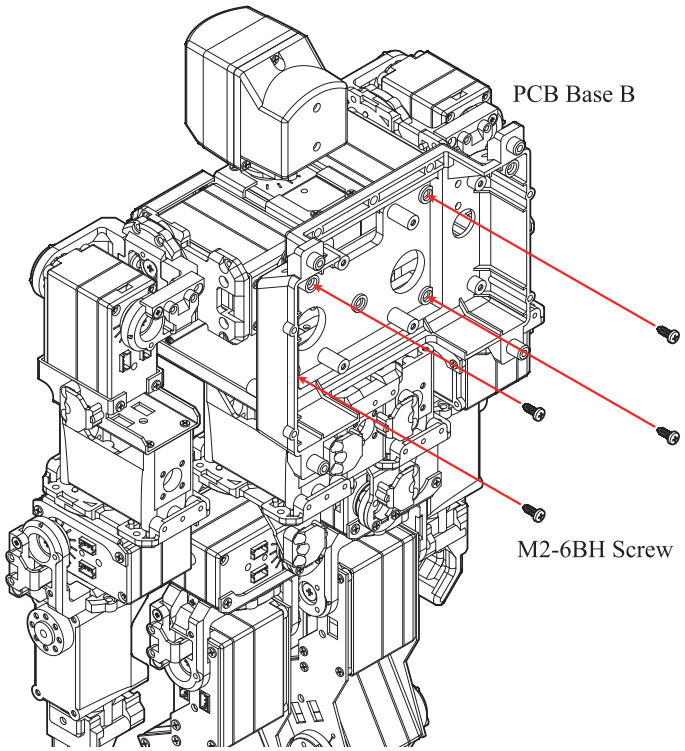
(3) Thread cables as shown in the figure and mount PCB Base B to the back of the body using four M2-6BH screws.

2

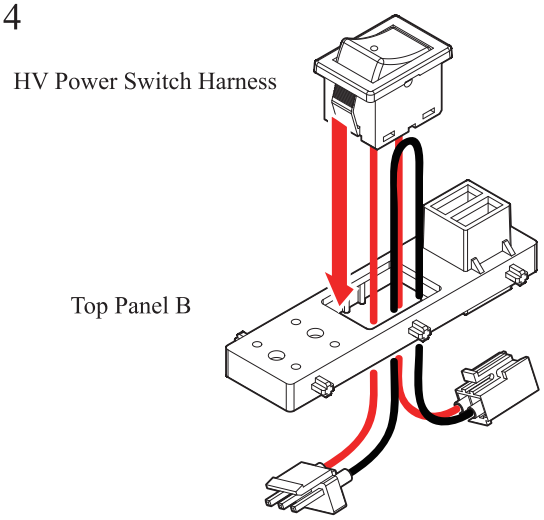


3





4



(4) Plug the Power Switch to Top Panel B until it clicks in.

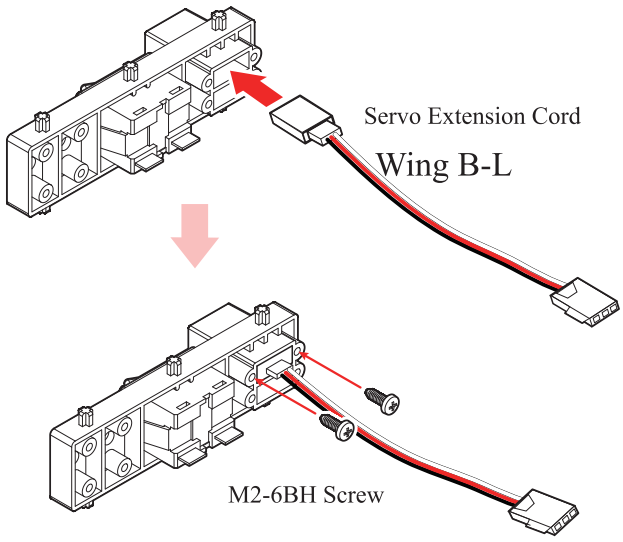
(5) Plug the Extension Cord to the entrance of the Port and fix using two M2-6BH screws.

(6) Insert Top Panel B to the top of PCB Base B.

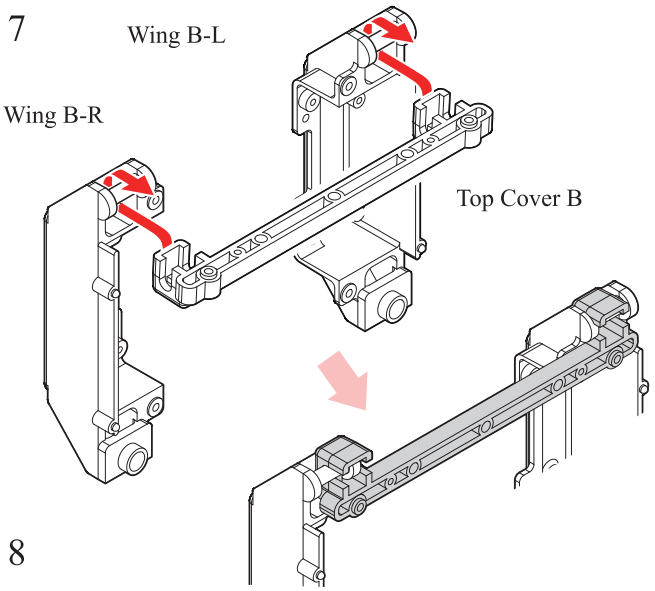
(7) Hook Wing B-L and Wing B-R onto Top Cover B and insert to the top of PCB Base B.

(8) Fix using two 2-8 Low Head Tapping Screw.

5

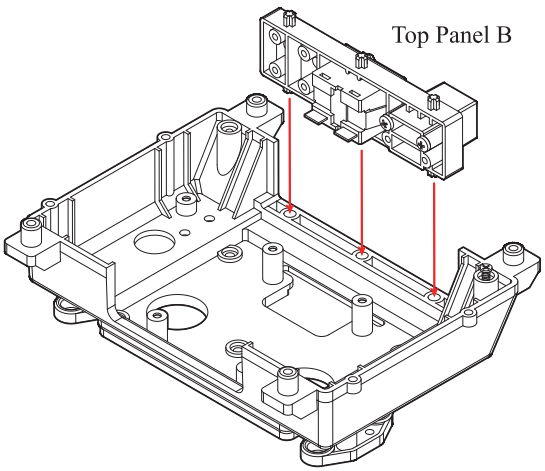


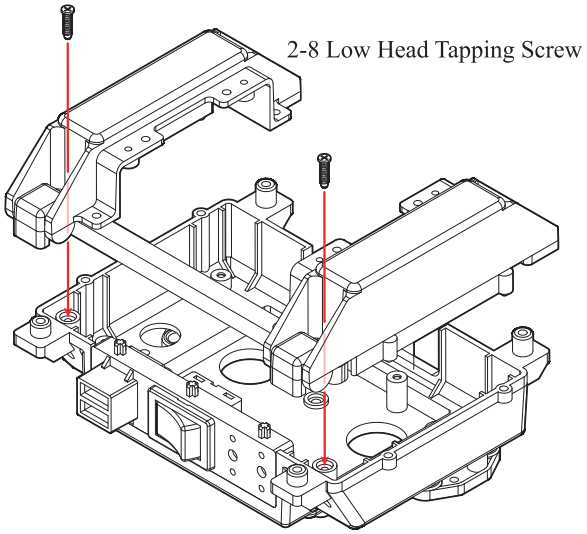
7



8

6

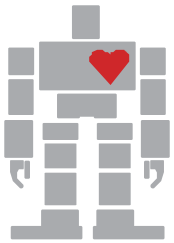




24. Mounting Control Board

Parts to Prepare

Parts Mount A	2
RCB-4HV	1
2-8 Low Head Tapping Screw	8
2.6-6 Flat Head Screw	2



Description of Icons　Points　Tips　Caution of Breaking　Confirm

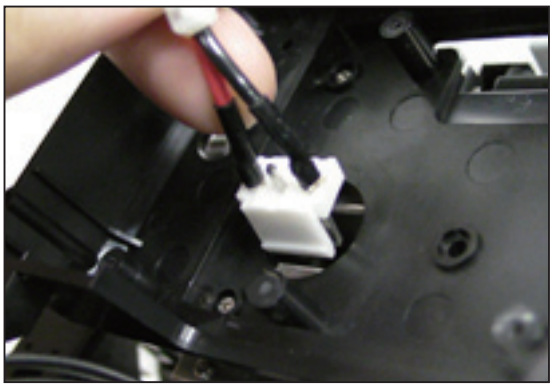
Procedure

(1) Put the HV Connector inside the body as shown in the picture.

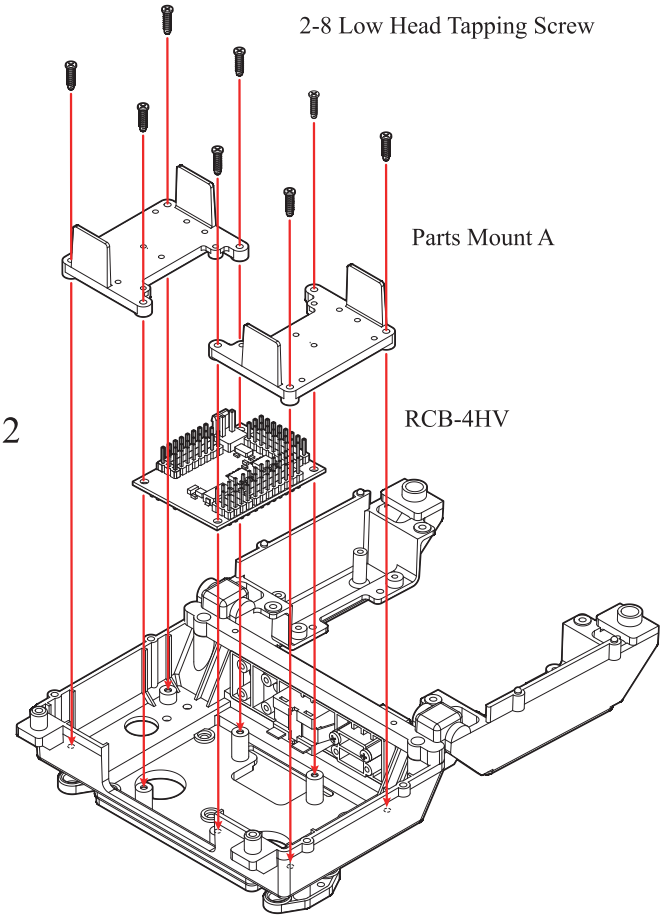
(2) Open the Wing and mount RCB-4HV using eight 2-8 Low Head Tapping Screws so that it comes between PCB Base B and Parts Mount A.

(3) Close both wings and fix using two 2.6-6 Flat Head Screw.

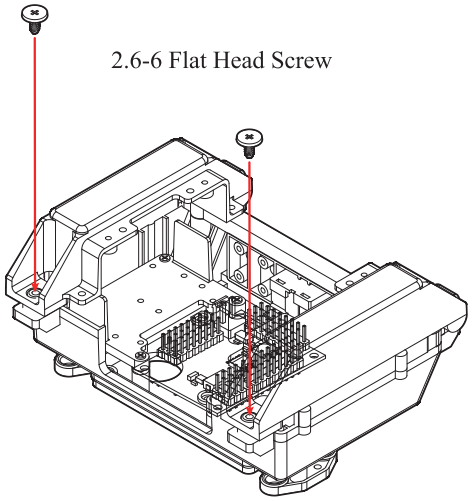
1



2



3

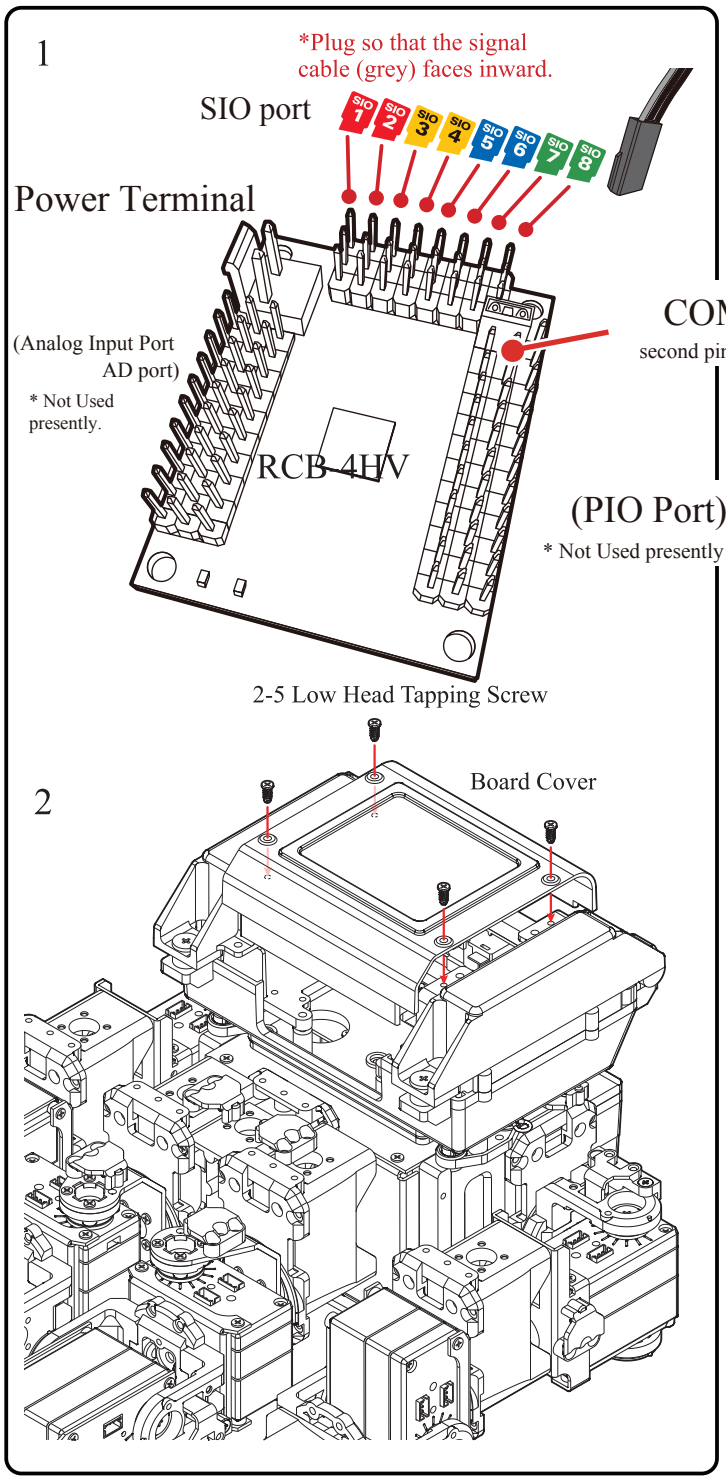


25. Wiring to Control Board

Parts to Prepare

2-5 Low Head Tapping Screw　4
Board Cover　1

Description of Icons　Points　Tips　Caution of Breaking　Confirm



Procedure

(1) Plug in Servo Connector, Power Connector and Extension Cord to each port according to the wiring diagram.

(2) Fix Board Cover using four 2-5 Low Head Tapping Screw.

* Hereinafter, when cover is opened, these screws or the two 2.6-6 Flat Head Screws on the Wing are unscrewed.

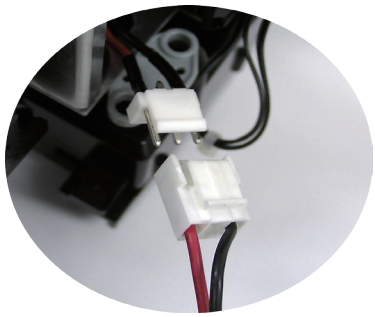
26. Mounting of Battery

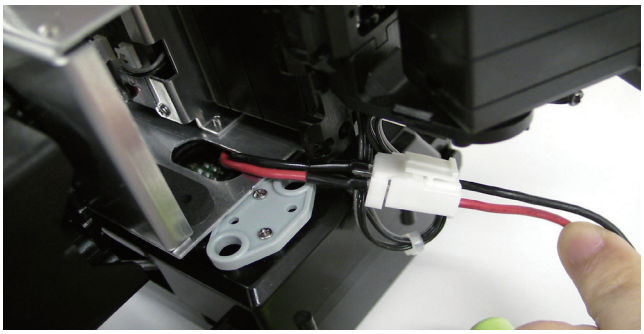
Parts to Prepare

Charged HV Battery

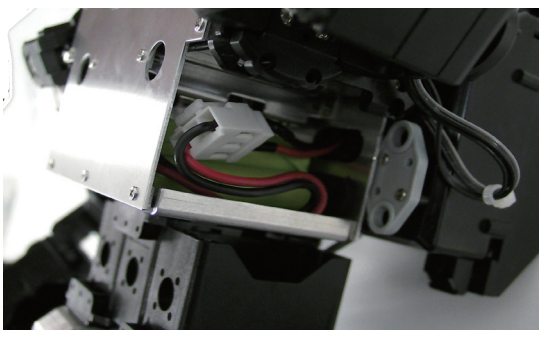
Description of Icons　Points　Tips　Caution of Breaking　Confirm

1





2



Procedure

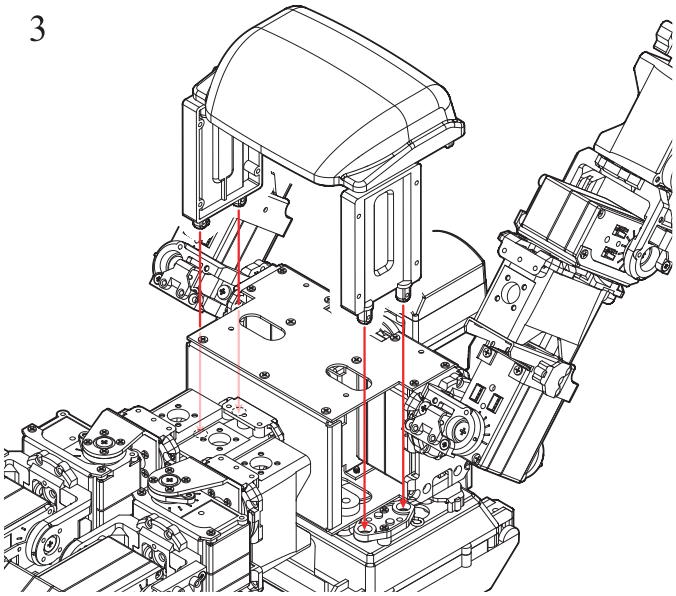
(1) Plug in HV Connector for Power.

(2) Insert Battery. Stirring the connector upward makes it easier to insert.

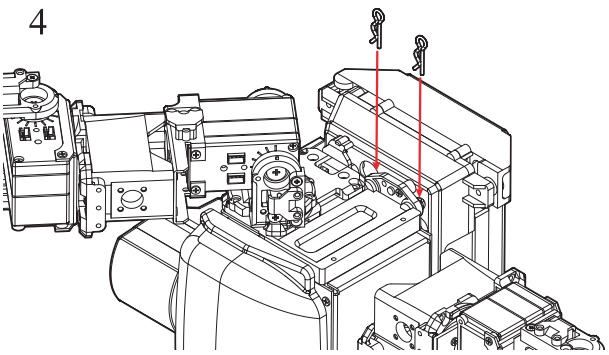
(3) Fit in Front Cowl by sliding it in.

(4) Fasten four Body Pins as shown in the diagram.

3



4



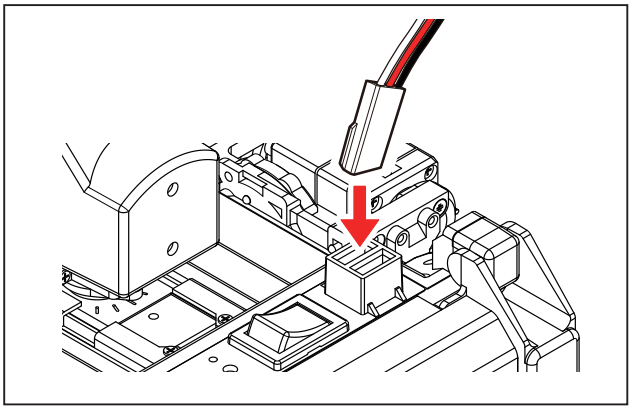
Confirmation of Trim Position

What is Trim Position?

Up to this point, for the assembly of all units, servo horns and servo arms were assembled at their origin (neutral position). This process is for confirming that the origin is accurately read out and that the horns and arms are mounted normally.
If the Trim Position is set normally, proceed to set Home Position by the following steps.
"Trim Position" and "Home Position" are confusing concepts, but are very important for robots. "Trim Position" refers to the state where trim data is "0" and position data is "7500", and servo motor is at its origin. On the other hand, "Home Position" refers to the Robot's original posture (position) for the "Sample Motion" of this product to operate normally.
To operate the sample motion fully and to heighten its reproducibility, this "Home Position" becomes extremely important.

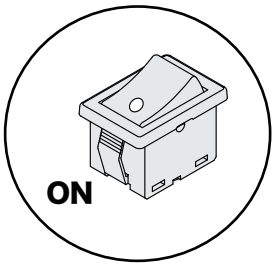
1 Connect Serial USB Adapter HS Cable.

Connect the Serial USB Adapter HS Cable plugged to the computer to the port entrance at the top of the Back Pack.



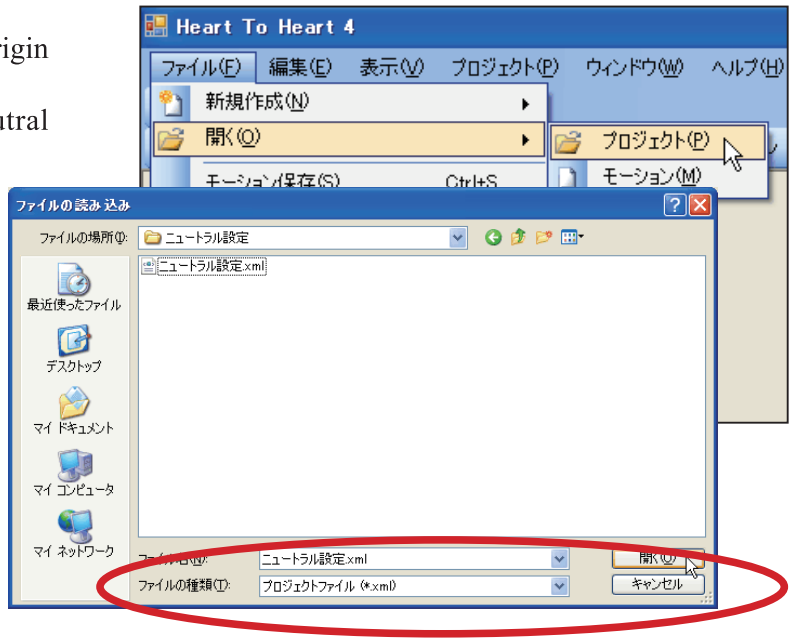
2 Activate software 'HearToHeart4'.

3 Turn power switch for KHR-3HV ON.



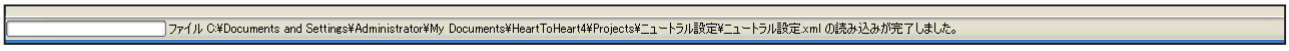
4 Open "Neutral Setting" project.

The "Neutral Setting" project created during Origin Setting is used.
Select "File" -> "Open" -> "Project" -> "Neutral Setting" -> "Neutral Setting .xml"

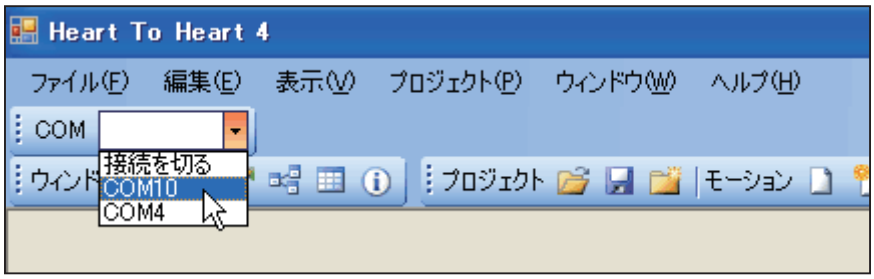


* Under standard conditions, HeartToHeart4 folder is created in My Documents.

If project is opened normally, will appear as shown in the figure at the bottom of the software window.

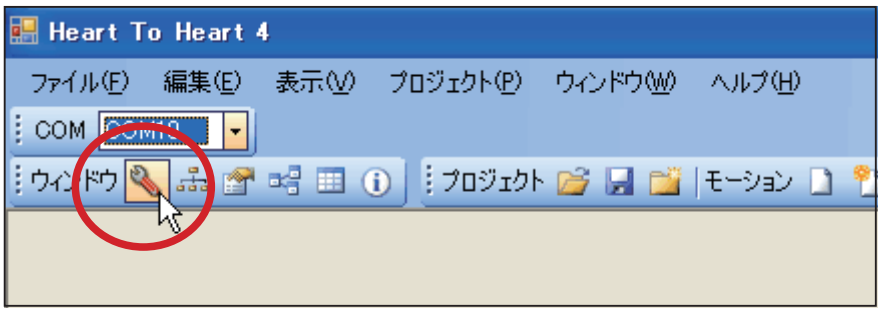


5 Assigning Communication Port (COM) Number

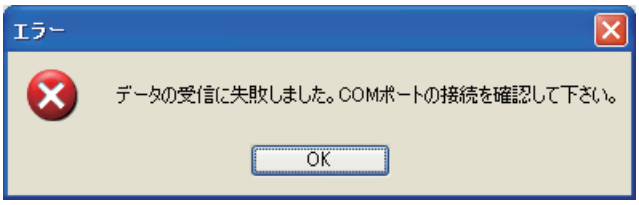


* Here, COM10 is selected as an example.

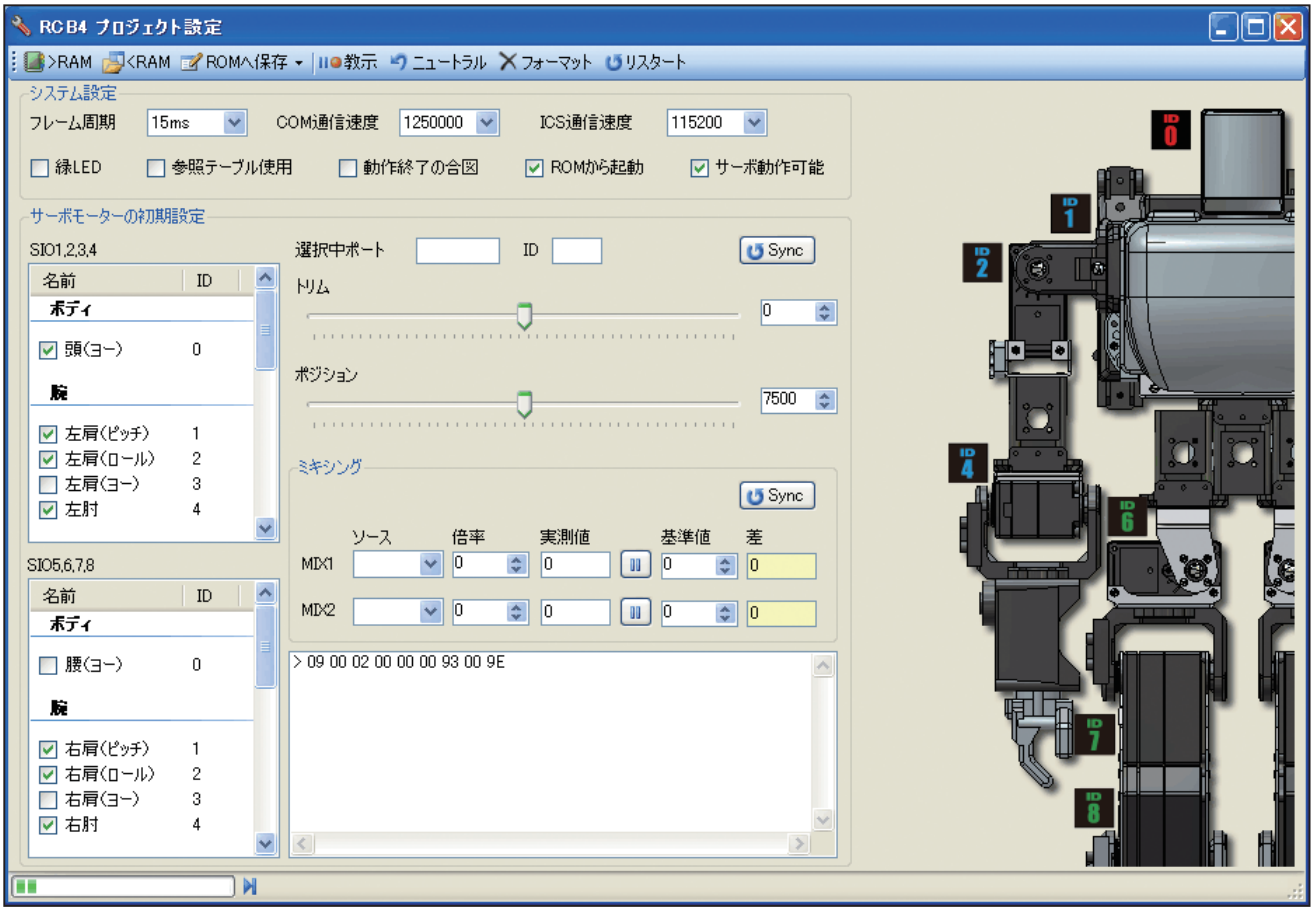
6 Select “Project Setting”



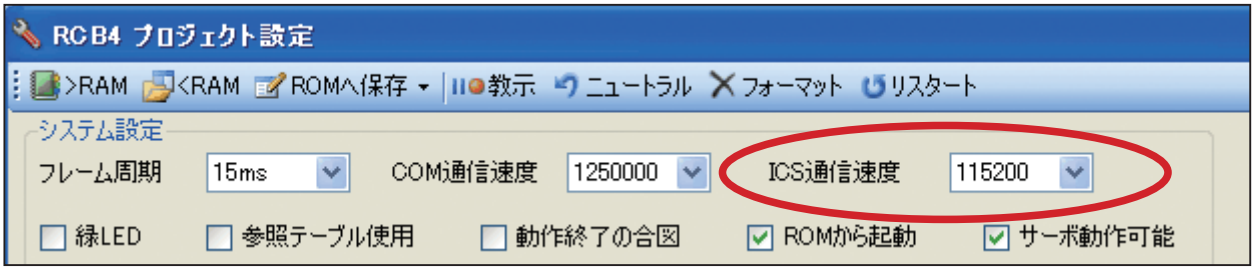
* An error message as shown in the left figure appears when there is no communication for reasons such as robot not turned on.



The following window appears when normal communication is made.

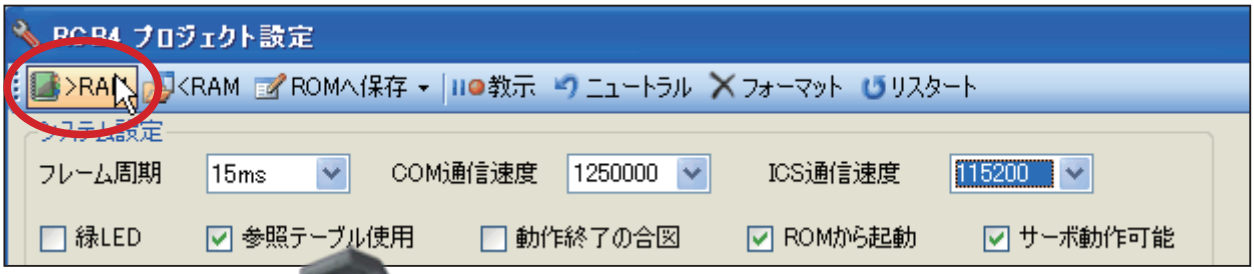


7 Set ICS communication rate to “115200”



8 Click “RAM” button.

Robot will slowly move to its trim position.



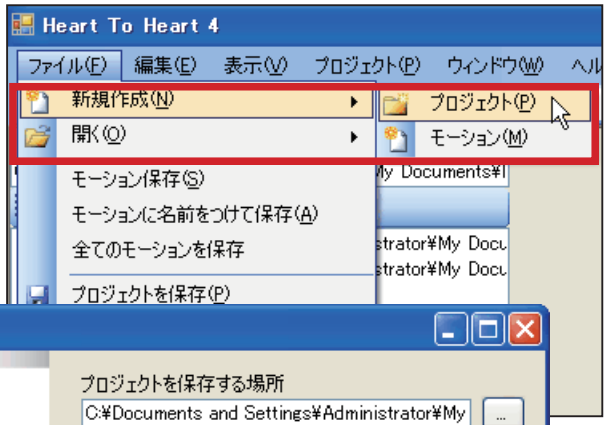
Danger

When the RAM button is clicked, the robot will assume the following posture. If this is not the pose held, the origin setting is wrong, so retrace the origin setting steps for the part that is off track. Proceeding to set Home Position without confirming this posture can cause damage to the servo motor. Make sure this posture is assumed before continuing on.

Setting Home Position

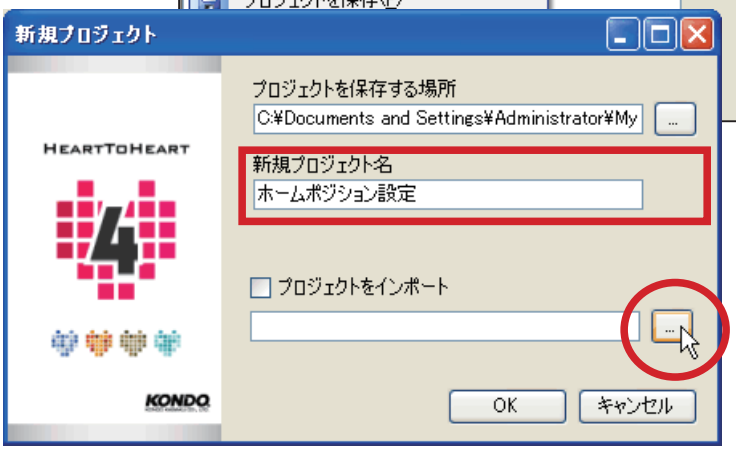
As in the preceding steps, the Home Position is set using a personal computer. All assembly is completed when this setting is over.

1 Click “File” -> “New Document” -> “Project” in order.



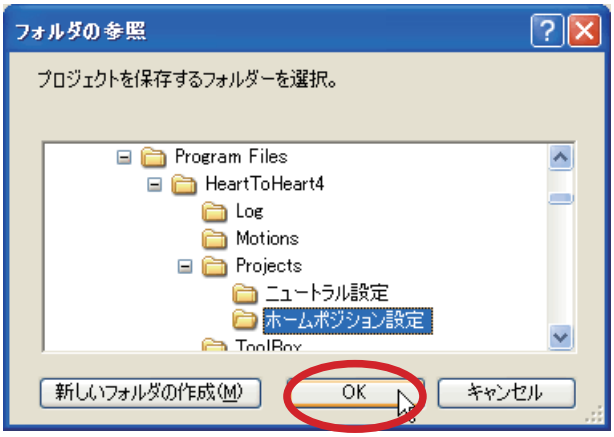
2 In the new project window, name the new project “Home Position Setting” and click project import button.

*New Project may be named arbitrarily. Do not change location of file unless necessary.
As a standard, projects are saved in HeartToHeart4 folder in My Documents.

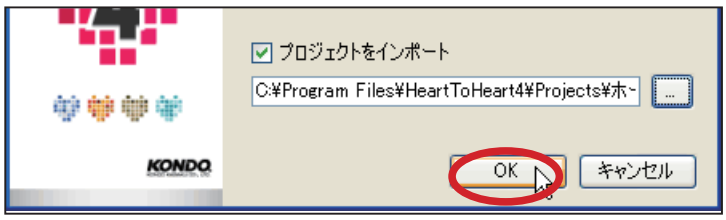


3 Select “Home Position Setting” in “Projects” from the “HeartToHeart4” folder created in “Program Files”, and click “OK”.

* Unless changed after installation of software, “HeartToHeart4” folder should be in “C:/Program Files”.

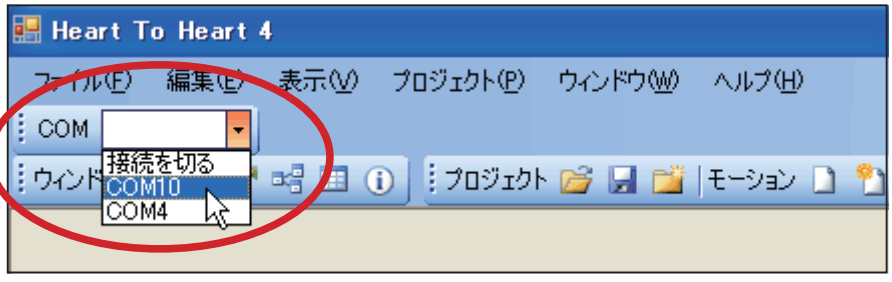


4 Return to project window and click “OK”.



5 Assign a Communication Port number (COM) in the main window.

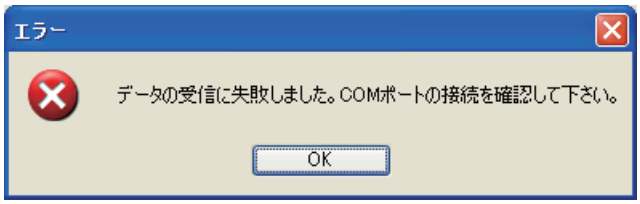
* This step is unnecessary if it has already been set.



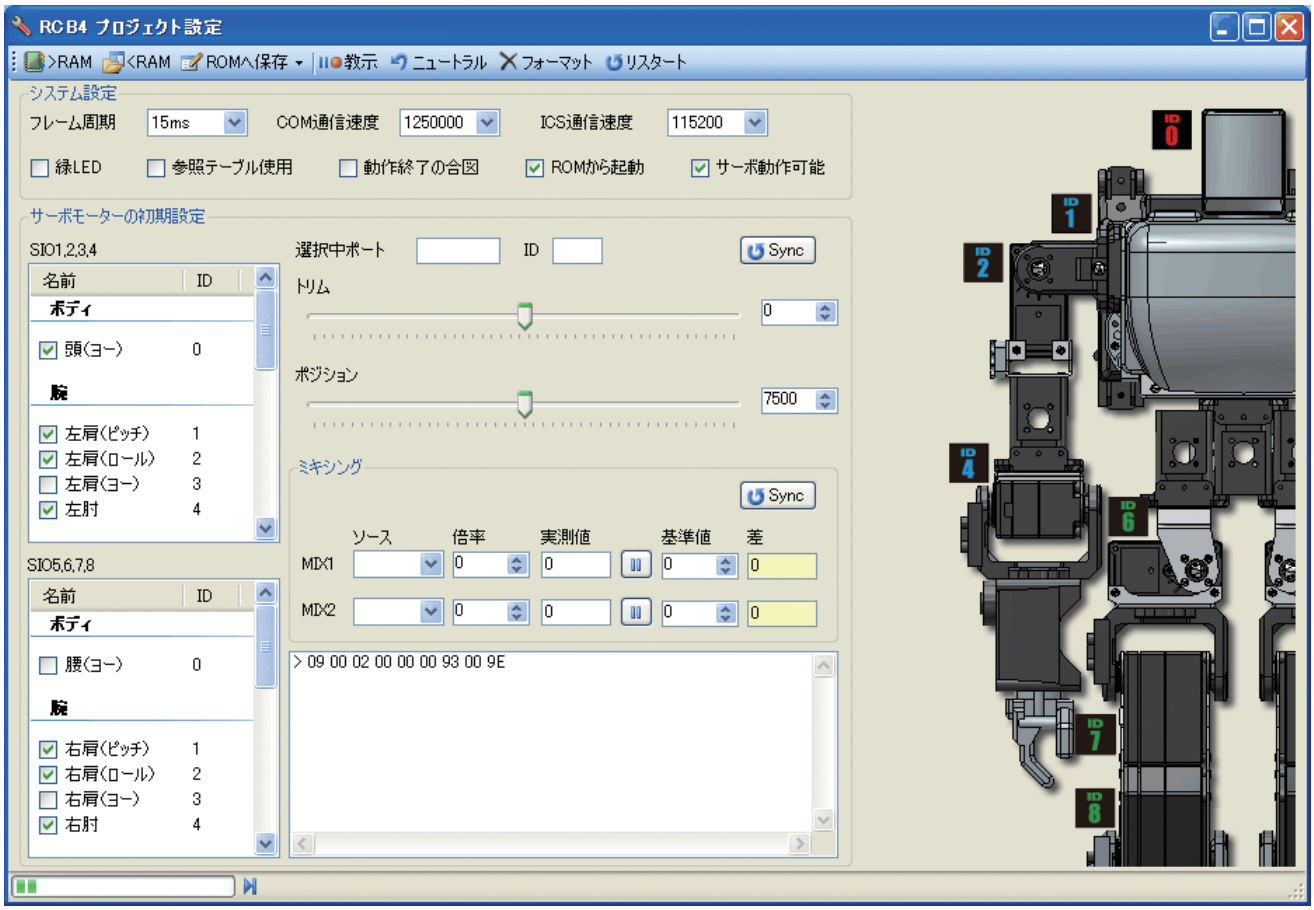
* Here, COM10 is selected as an example.

6 Select “Project Settings”.

* An error message as shown in the left figure appears when there is no communication for reasons such as robot not turned on.

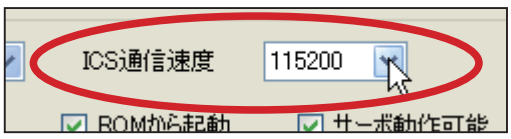


The following window appears when normal communication is made.



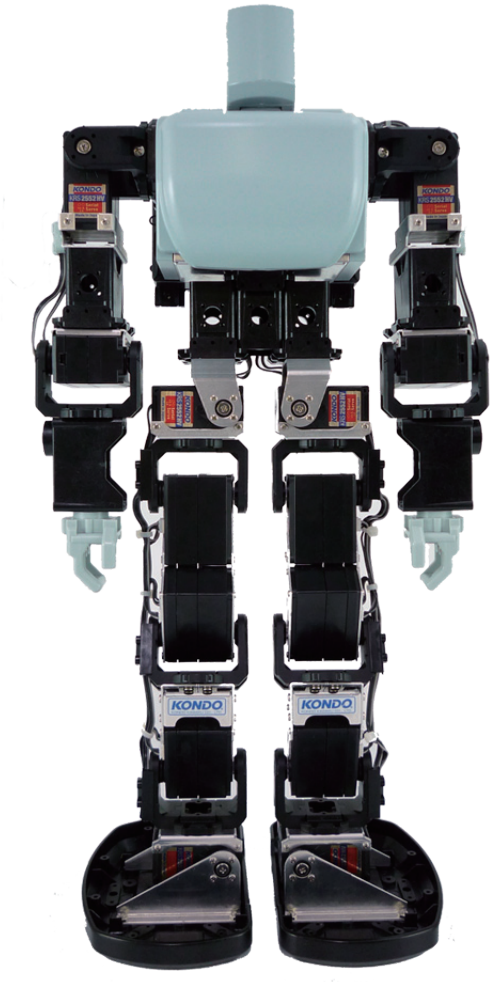
7 Set ICS communication rate to “115200”.

* This step is unnecessary if it has already been set.



8 When “RAM” button is clicked, the project standard values are sent to RCB-4 and servo will operate.

Robot will start moving to Home Position.



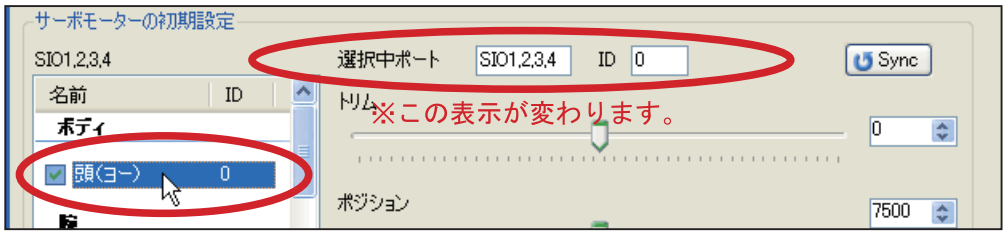
When the RAM button is clicked, the robot will assume the posture indicated in this picture.
This Home Position is a rough approximation and differs depending on the method of assembly. (* It is not necessarily accurate.)

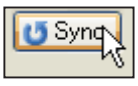
The shear is adjusted by the steps indicated in the following section.

If the position assumed is not as shown in the graphics (an upright position), there may have been a mistake in, for example, servo mounting, during the assembly process. Check servo IDs with reference to p. 18 “List of KHR-3HV IDs” thoroughly.

9 Choose the servo motor you wish to adjust in the “Servo Motor Initial Setting” section.

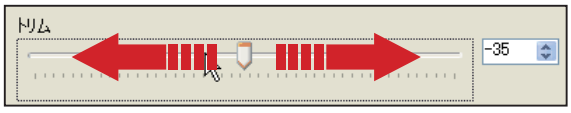
Here, servo motor [ID 0] (red) connected to SIO1 channel is used as an example.



10 Press “Sync” button 

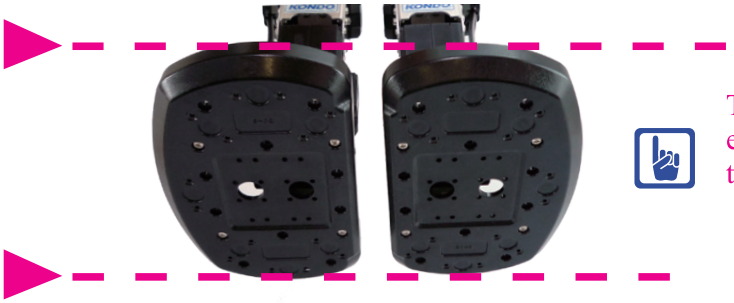
and adjust using “Trim” slide bar.

* Servo will move with slide bar.



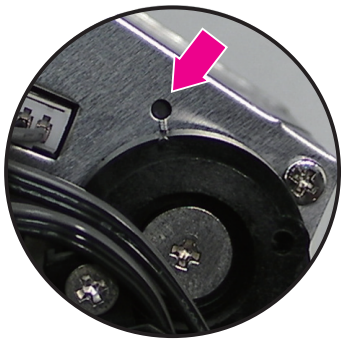
11 Adjust other servos by the same steps.

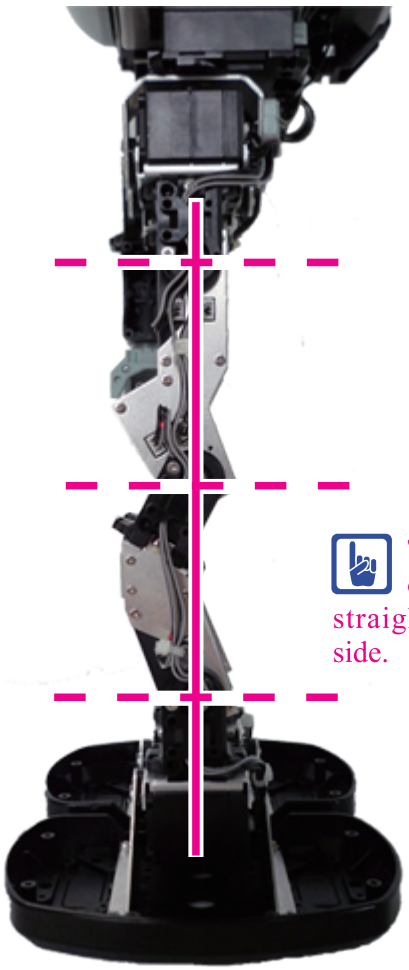
Adjust position of each servo in the adjustment window and adjust the Home Position.
Home Position is designated as the upright position.
Home Position is an important position in performing motion.
In particular, the left and right feet must be aligned accurately or else sample motions such as walking may not proceed well.
Align accurately by referring to the following picture.



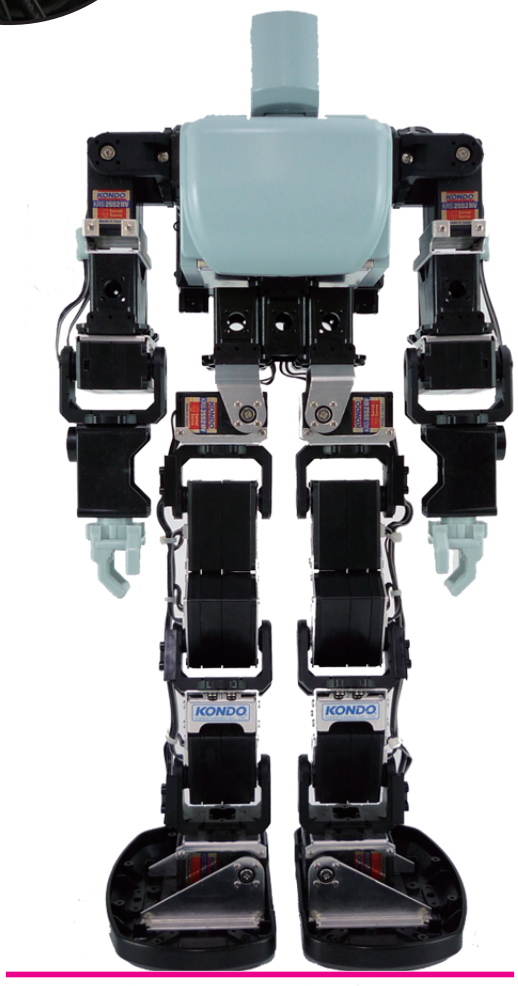
The position of the back side of the feet are especially important. Stability can not be obtained unless both feet are aligned.

There are marks (hole) called Neutral Gauge on each frame. Aligning this mark and the protrusion on the arm can be used as an indicator for the Neutral Position.

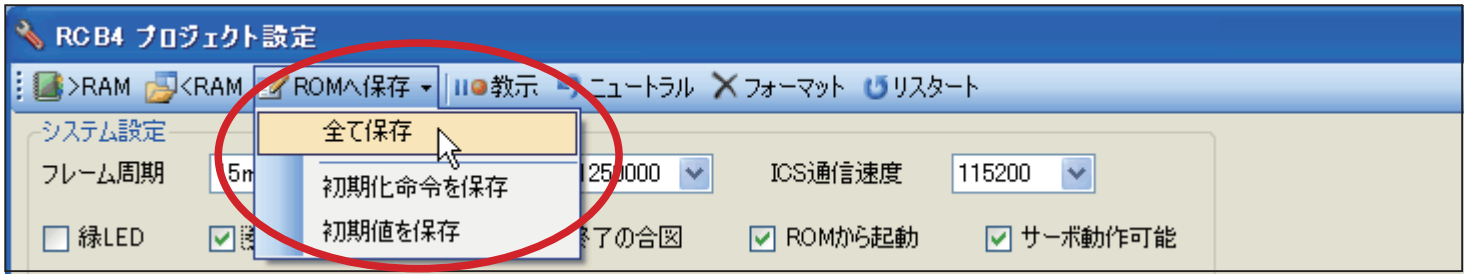




The output axis of each servo on the leg should form a straight line when seen from the side.

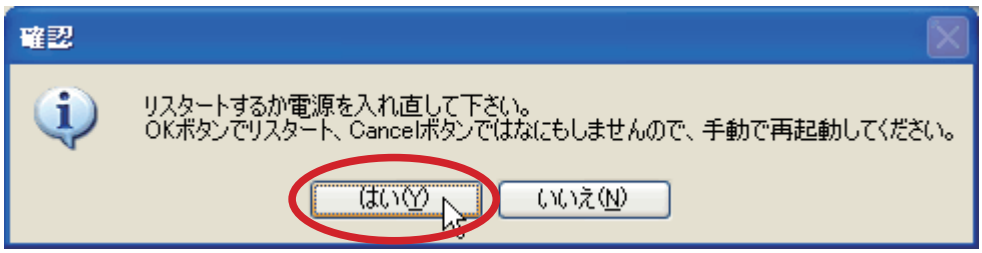


12 After setting each servo, select “Save All” in “Save to ROM”.

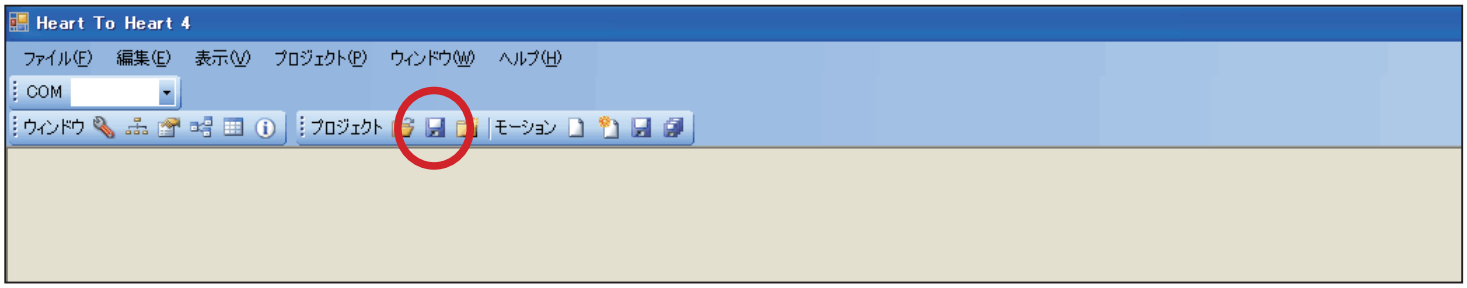


* clicking this button sends data to the robot and Home Position is recorded.

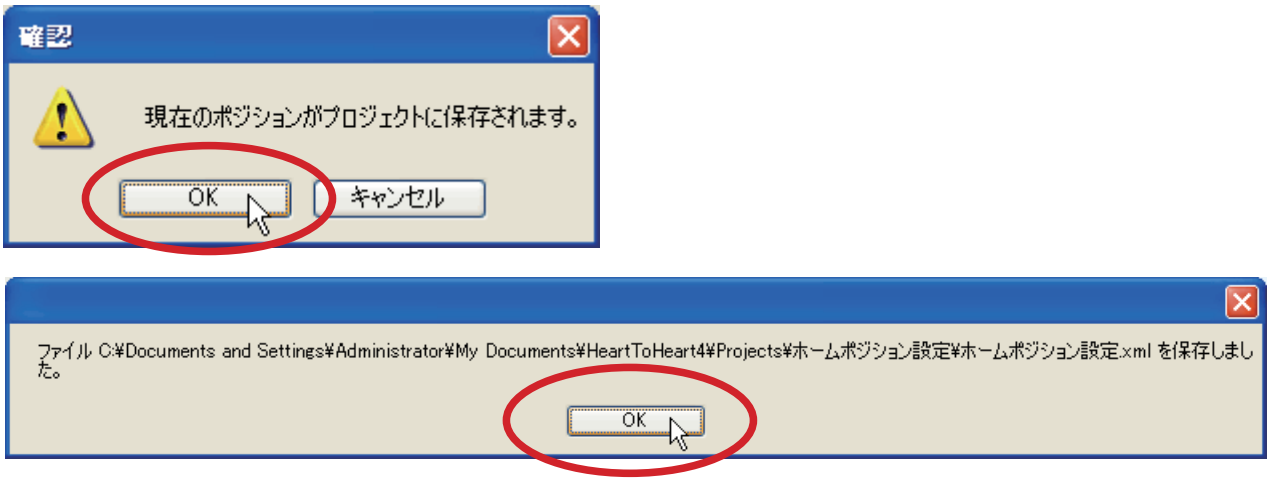
13 A confirmation screen appears. Press “YES”.



14 Return to Main Window and press “Save Project”.



* clicking this button saves data in the computer, making it possible to read this data next time.



15 As a means for confirmation, turn OFF the robot and turn it ON once again. If the robot slowly moves to the set position, Home Position setting is successfully completed.

This is it for the instructions on assembly. For software operation instructions such as reproduction of motion, refer to “HeartToHeart4 User’s Manual”.

KHR-3HV