

# **Robotinno**


## **16-DOF Humanoid Robot**

### **Instruction Manual**

Ver. 1.3



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## Error correction

We hope that this assembly manual is useful to the user. We spend a lot of time and effort developing a comprehensive manual to accurately convey what we want the user to understand. However, it is unavoidable that there may be some errors. To provide the latest and most comprehensive information, we will continuously improve the manual contents. If you find any error in this manual, you are welcome to contact us via our email address: [service@innovati.com.tw](mailto:service@innovati.com.tw). Any information update will be posted on our website. To obtain the latest information, please visit our website: <http://www.innovati.com.tw>.

## Notes


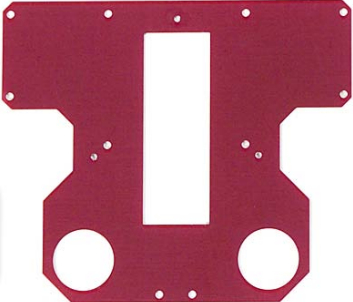
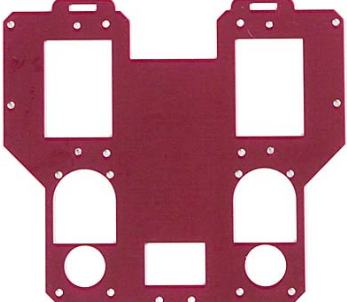




-  This package contains a Servo Commander16 module with the instructions for how to use it. Refer to the instructions for the best performance of the item.
-  When you install the Servo Commander 16, make sure **the input voltage is between 6 and 12V** to avoid damage to the module.
-  For the voltage input to Servo Commander 16, the corresponding voltage should be provided based on the servo connected. For the **servo provided in this package, use an input voltage between 10.8 and 12V**. Higher or lower voltage will result in unexpected actions, or may even burn the servo. Make sure the value of the voltage provided is appropriate prior to connection to the power source.
-  There are 16 servos in this package. A larger power source must be provided when all of them operate simultaneously. Make sure the power supply or battery connected to Servo Commander 16 is capable of providing **a current of more than 2A** for normal operation. When the current provided is insufficient, an unexpected action may occur, causing damage to the package.
-  If a battery serves as the power source for the module, its voltage will decrease after it operates for a period of time, which may cause abnormal operation of the module. Remove the battery at this time and charge it for another use. If you want to use the module for an extended period of time, it is recommended to use a power supply for consistent performance.









Before you install the package, install InnoBASIC™ Workshop first according to instructions described on CD and make sure the PC can be connected to BASIC Commander® via USB cable to finish the assembly properly.





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# Parts List






Item	Illustration	Qt'y	Specifications and instructions
Assembly Kit Parts			
Frame bracket A01		1	Made of aluminum alloy for the mounting of the neck.
Frame bracket A02		1	The front plate made of aluminum alloy.
Frame bracket A03		1	The back plate made of aluminum alloy.
Frame bracket A04		2	Made of aluminum alloy for the mounting of the hands.
Frame bracket A05		2	Made of aluminum alloy for the mounting of the hands.
Frame bracket A06		1	Made of aluminum alloy.
Hand bracket B01		1	The left palm made of aluminum alloy.

Hand bracket B02		1	The right palm made of aluminum alloy.
Leg bracket C01		1	The left knee made of aluminum alloy.
Leg bracket C02		1	The right knee made of aluminum alloy.
Leg bracket C03		2	Made of aluminum alloy to reinforce of the inner part of the knee joint.
Leg bracket C04		2	Made of aluminum alloy to reinforce the outer part of the knee joint.
Leg bracket C05		2	The ankle joint made of aluminum alloy.
Leg bracket C06		2	The foot sole made of aluminum alloy.
Servo bracket		6	The limb bracket made of aluminum alloy for mounting of the servo.

Joint bracket		12	The limb bracket made of aluminum alloy for the connection of each joint.
Shoulder bracket		2	The shoulder bracket made of aluminum alloy for the connection of body and arms. The thickness is 1.5 mm
Polycarbonate chest plate		1	Made of polycarbonate material and mounted in front of the chest to prevent impact and to keep the battery from falling out.
Module mounting plate		1	Made of polycarbonate material and mounted in the back to connect Servo Commander 16
Servo		16	Voltage: 12V; torque: 12Kgf-cm; speed: 0.15sec/60°; control angle: 180°; weight: 58g; and external dimension (L×W×H):A-43×21×49mm; B-54×21×49mm

Servo horn A		17	Mounted in front of the servo for auxiliary rotation.
Servo horn B		14	Mounted in back of the servo for auxiliary rotation.
Servo cable A		13	For communication between the servo and control board. 32cm
Servo cable B		4	For communication between the servo and control board. 42cm
Screw A		140	2*3mm
Screw B		42	2*4mm
Screw C		31	3*6mm
Screw D		2	2*9mm
Screw E		4	3*6mm
<b>Modules &amp; Components</b>			



<p>Servo Commander 16</p>		<p>1</p>	<p>BASIC Commander® BC1 + Servo Runner A 2-in-1 module.</p>
<p>Charger</p>		<p>1</p>	<p>Red light: Charging Green light: Slow charging after charging is finished. At this time, the battery capacity is approx. more than 85%. 5-10 nickel-metal hydride batteries are suitable for the purpose.</p>
<p>Power adapter</p>		<p>1</p>	<p>Provides power for development and testing. Do not use for battery charging.</p>
<p>Nickel-metal hydride battery</p>		<p>1</p>	<p>10.8V/800mAH(9 cells)</p>
<p>USB cable</p>		<p>1</p>	<p>Connecting BC1 to PC, which allows the PC program to be downloaded to BC1 and communication in Debug mode.</p>

Cable tie		30	Secures any type of cable, which prevents cables from tangling and influence due to shaking of cables when the servo is operating.
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## Tools

- Slotted screwdrivers (2 mm and 3 mm specifications required)
- Nose pliers
- Screw grab (optionally used for the joint between the nut and aluminum plate to mitigate screw loosening)

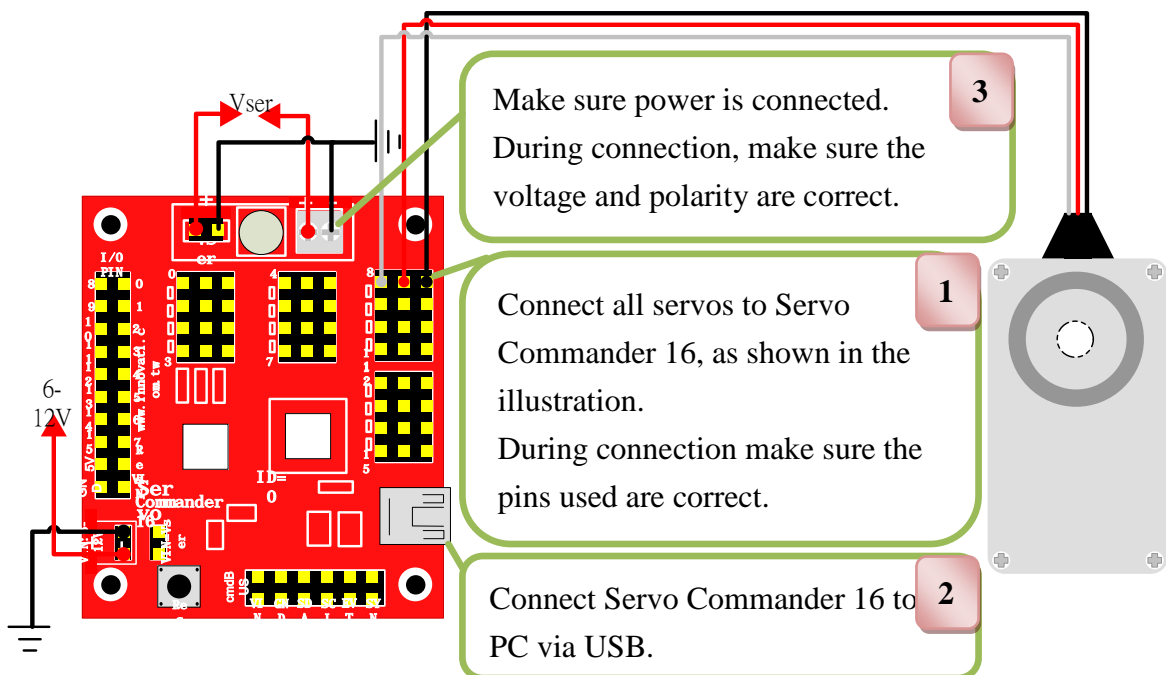
# Assembly Procedure

## (I) Calibrating Servos

Prior to installation, make sure the servo wheel in the proper position. Confirm this according to the following procedures and adjust if necessary:

1 : Perform wiring for the servo as shown in the illustration below.

ServoCommander16 & power.



- Ⓢ When Servo Commander 16 is connected to power, the voltage for this package should be between 10.8V and 12V. It is recommended to use a voltage regulator to ensure that the voltage falls within the safe range.

2 : Use a USB cable to connect the PC and Servo Commander 16.

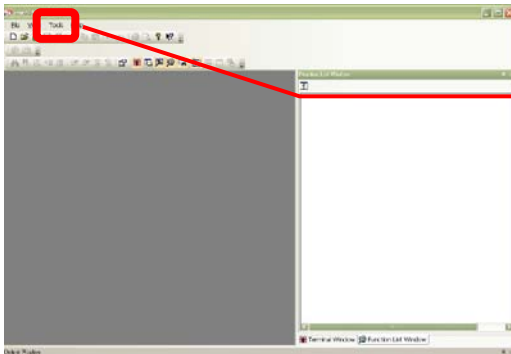
- Ⓢ When the power cord of the servo is connected to the power source, make sure the values of the voltage and current from the power source fall within the range required by the servo. When the power source is connected, the servo will temporarily operate when a surge happens. This is normal. During power-on, your hands should not be put in a position where the servo may move across them to prevent pinching.

### 3 : Open innoBASIC™ Workshop



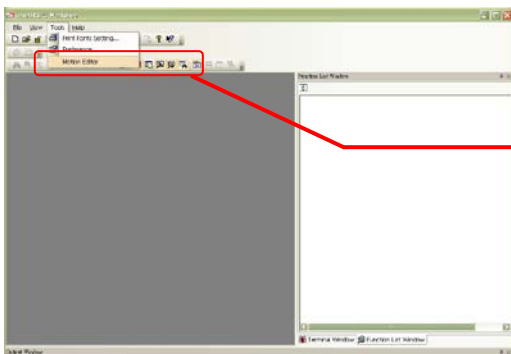
Click the run program of innoBASIC™ Workshop to start it

### 4 : Click the “Tool” option in the toolbar in the top.

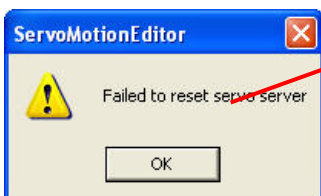


Many features are shown when you click each option. Now click the “Tool” option first.

### 5 : Click “Motion Editor” in the drop-down menu (If a warning window appears when doing so, it means that BASIC Commander® is not properly connected. Check if the USB cable is connected, or disconnect and re-connect the cable. After you make sure the connection is correct, exit the Motion Editor and press this button.)

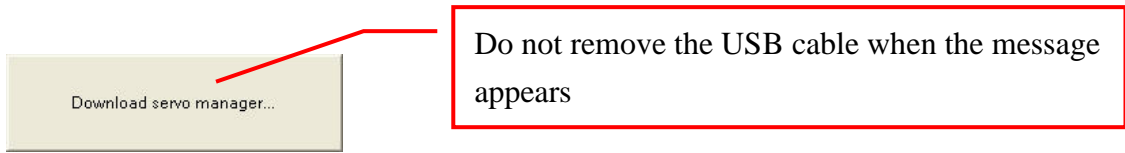


Click Motion Editor to start it

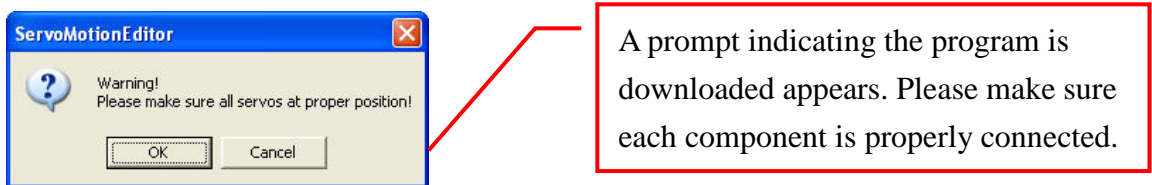


If this message appears, it means the USB cable is not properly connected

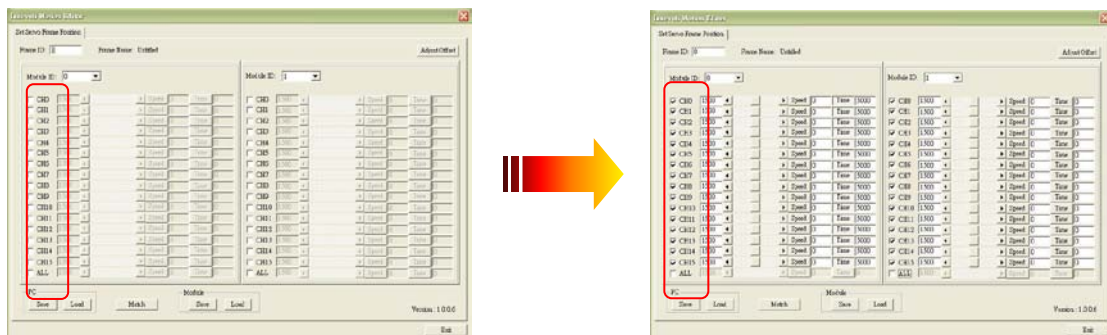
**6 : If connection is correct, a message “Download servo manager” appears on the PC screen, indicating the program is downloading. Please turn the dip switch on the Command Board to 1 and wait for a while.**



**7 : After downloading is complete, make sure each servo is properly connected. If all are connected, press “OK.” (Press "Cancel" to exit the Motion Editor. If any component is disconnected, press "Cancel" to exit.)**



**8 : Do not put your hands in a position where the servo may move across them to prevent pinching. Select the box at the far left to move all servos to the middle point. The figure next to the box should be 1500. If it is not 1500, click it, type 1500, and press Enter**



**Ⓢ During assembly, hold the wheel at a proper angle before the wheel is locked. If the wheel is turned, repeat these steps for adjustment to avoid unexpected actions that may cause damage to parts.**

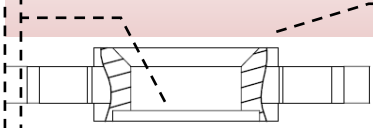
## (II) Assembling Servos and Mechanisms

### A : Assembling body mechanisms

#### Notes on installation:

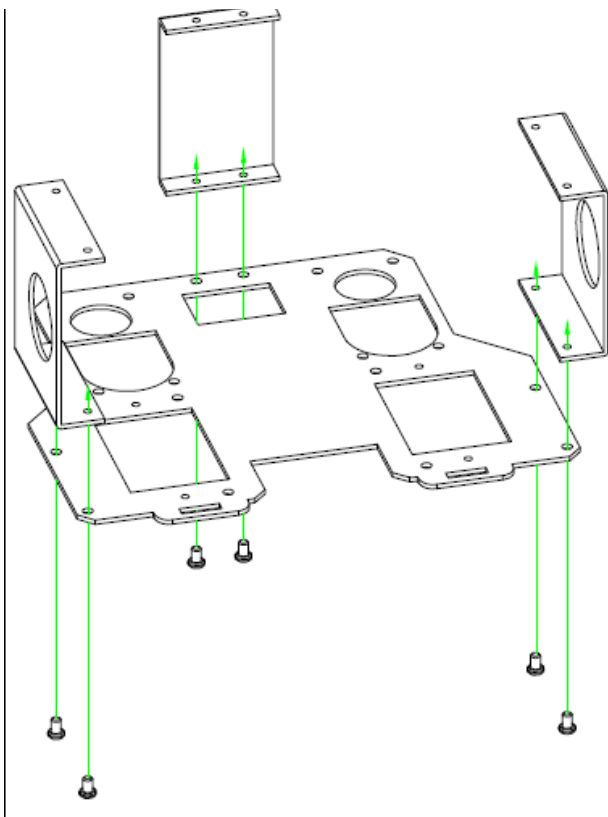
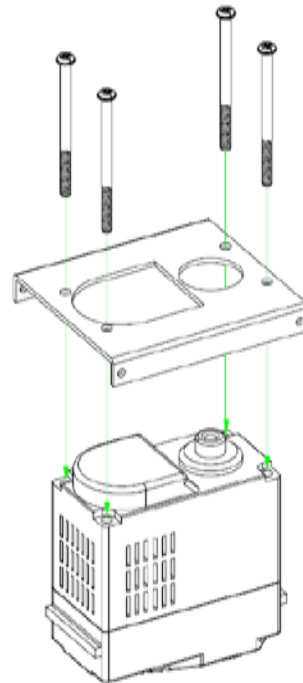
- When the screw A is used, do not exert excessive force to avoid thread failure.
- When the horn B is used, note that the slant groove in the center is in contact with the servo.

The right-angle groove is in contact with the screw.

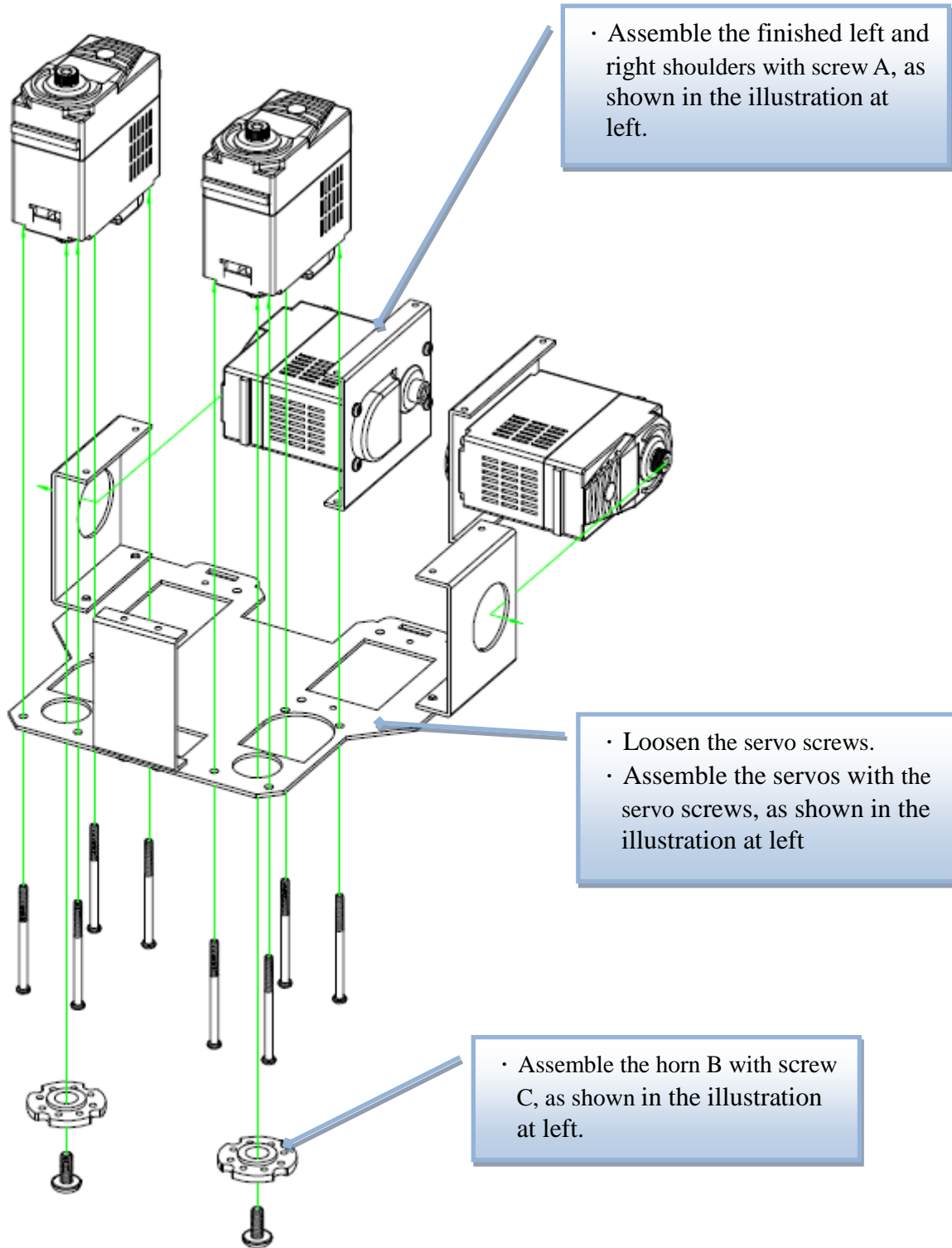


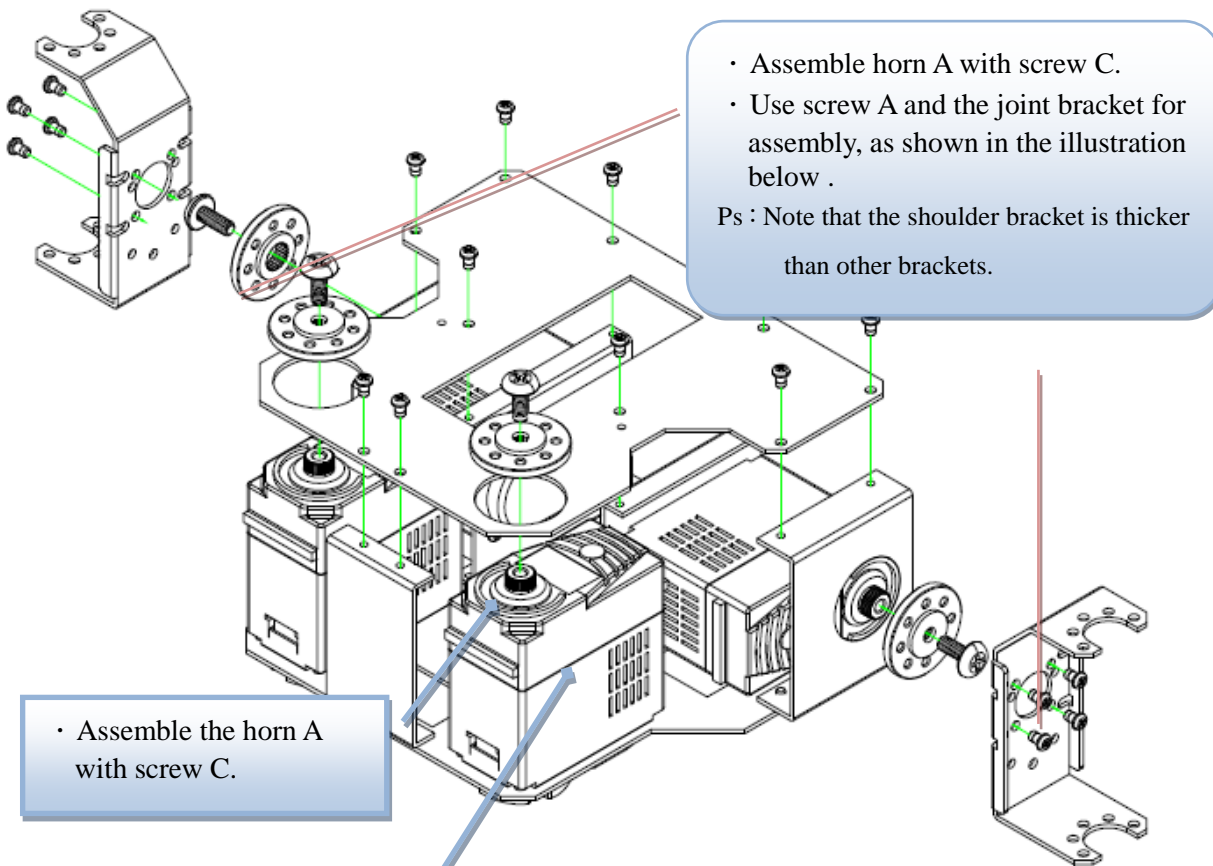
The slant groove is in contact with the servo.

- Loosen the servo screws.
- Assemble the servo and the frame bracket A05 with the servo screws, as shown in the illustration at left.
- Repeat this step to finish the assembly of the left and right shoulders.



- Assemble the frame bracket A04, frame bracket A06, and frame bracket A03 with screw A, as shown in the illustration at left.





- Assemble horn A with screw C.
- Use screw A and the joint bracket for assembly, as shown in the illustration below .

Ps : Note that the shoulder bracket is thicker than other brackets.

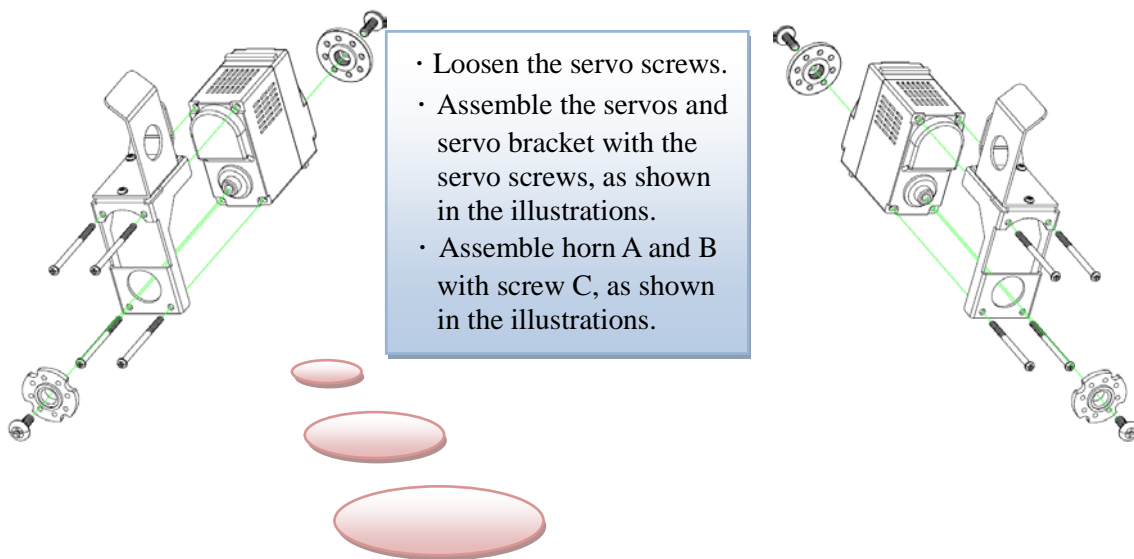
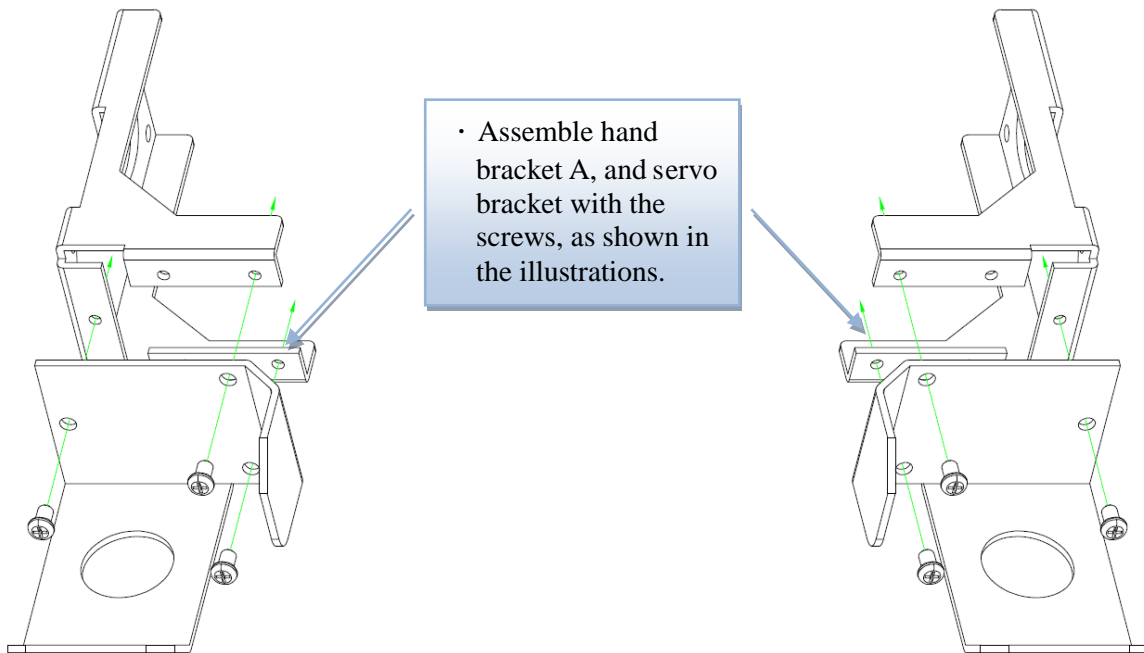
- Assemble the horn A with screw C.

- Assemble the frame bracket 02 with screw A, as shown in the illustration.

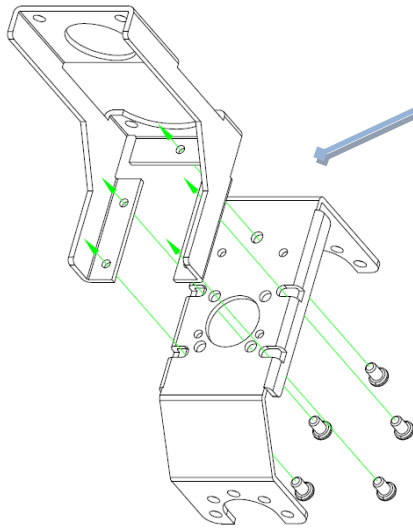
- When you assemble the horn A, note that the hole of the horn should be perpendicular to the servo.
- If the servo spindle moves during the installation, perform “servo calibration” again to make sure the servo is in the proper position.



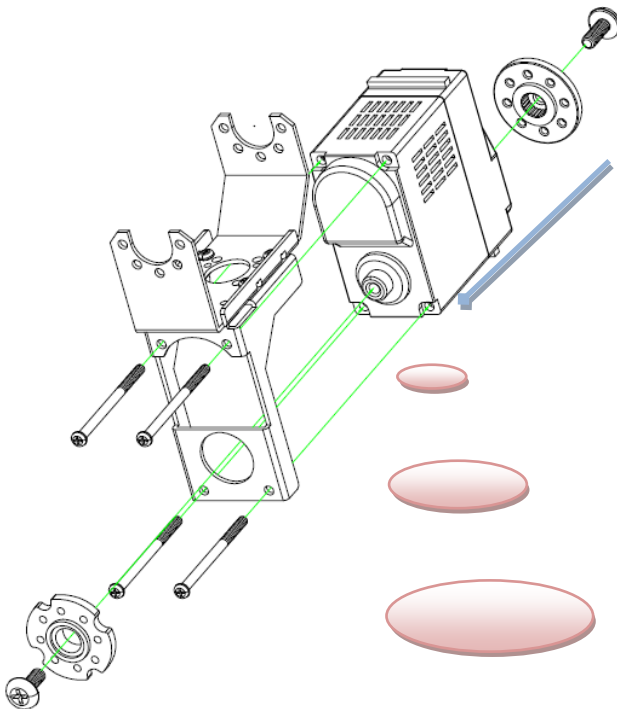
## B : Assembling hand mechanisms



- When you assemble horn A, note that the hole of the horn should be perpendicular to the servo.
- If the servo spindle moves during the installation, perform “servo calibration” again to make sure the servo is in the proper position.
- When you assemble horn B, note that the slant groove in the center is in contact with the servo.



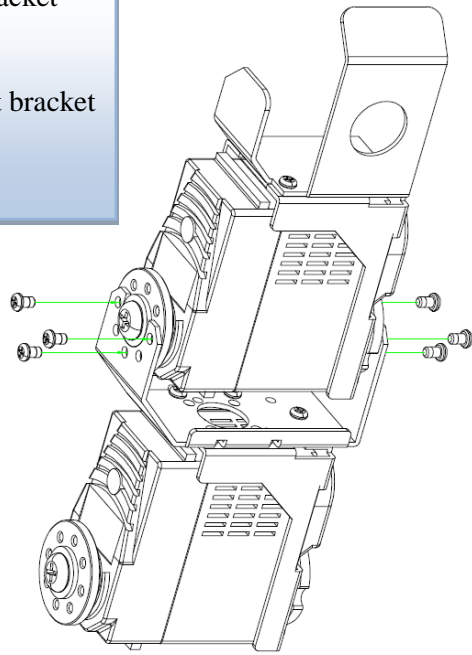
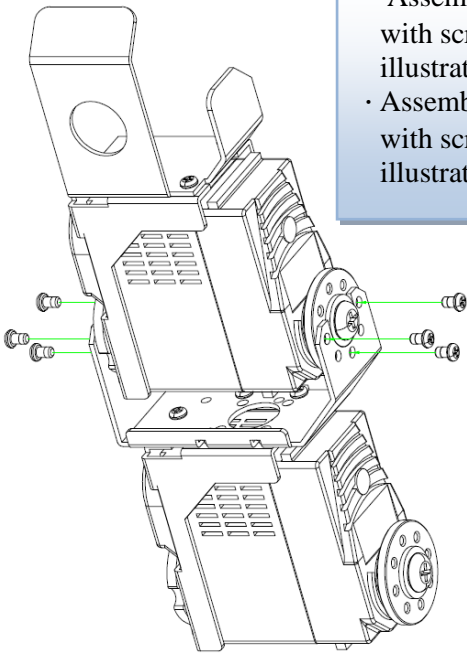
- Assemble the servo bracket and joint bracket with screw A, as shown in the illustration at left.
- Repeat the step above to finish the assembly of the left and right hand brackets.



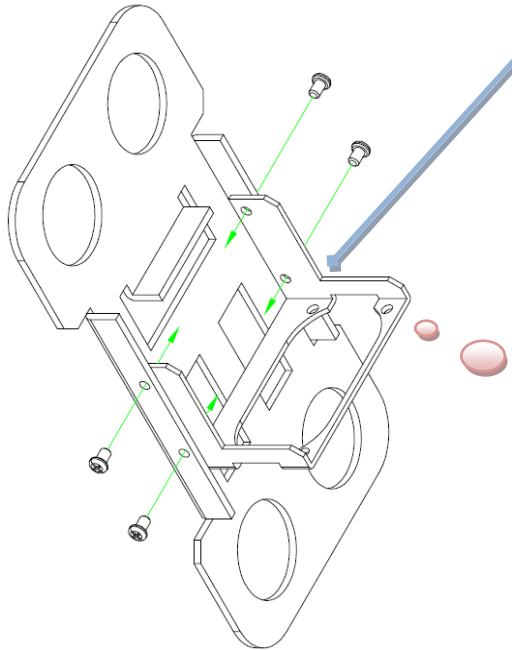
- Loosen the servo screws.
- Assemble the servos and servo brackets with the servo screws, as shown in the illustrations.
- Repeat the step above to finish the assembly of the left and right hand parts.
- Assemble horn A and B with screw C, as shown in the illustration at left.

- When you assemble the horn A, note that the hole of the horn should be perpendicular to the servo.
- If the servo spindle moves during the installation, perform “servo calibration” again to make sure the servo is in the proper position.
- When you assemble horn B, note that the slant groove in the center is in contact with the servo.

- Assemble horn A and joint bracket with screw A, as shown in the illustrations.
- Assemble the horn B and joint bracket with screw B, as shown in the illustrations.

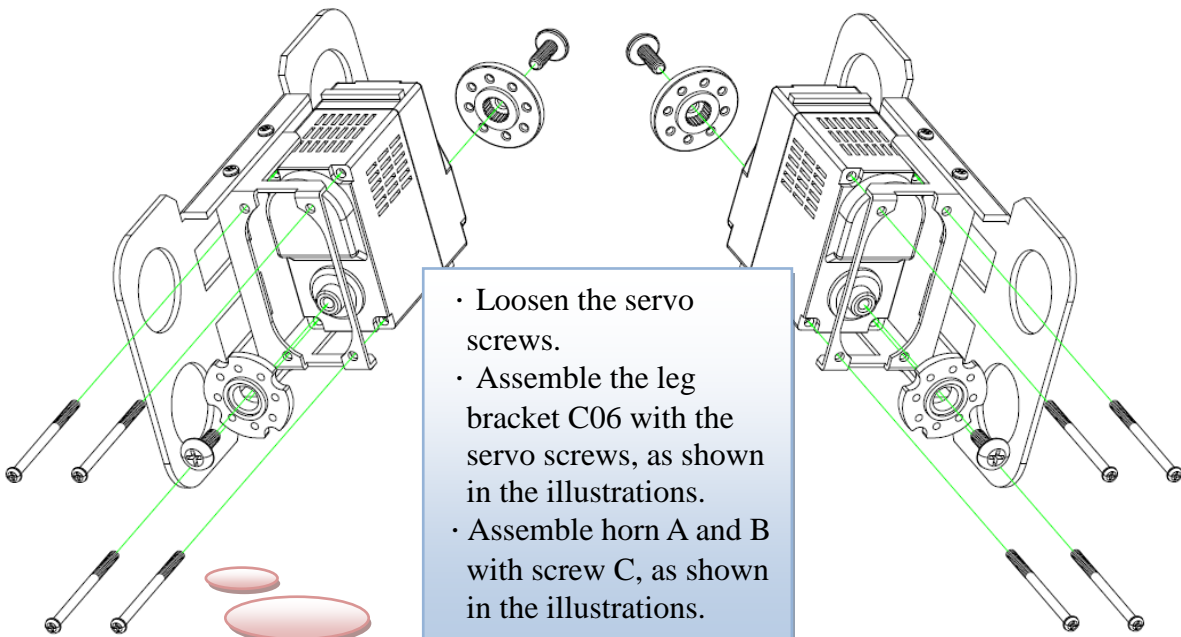


## C : Assembling leg mechanisms



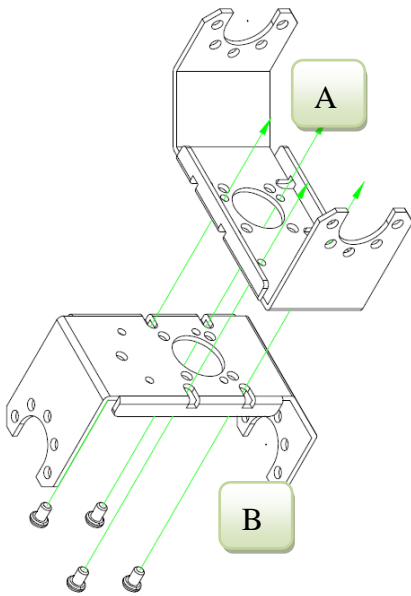
- Assemble the leg bracket C05 and leg bracket C06 with screw A, as shown in the illustration at left.
- Repeat the step above to finish the assembly of the left and right foot sole parts.

When screw A is used, do not exert excessive force to avoid thread failure.

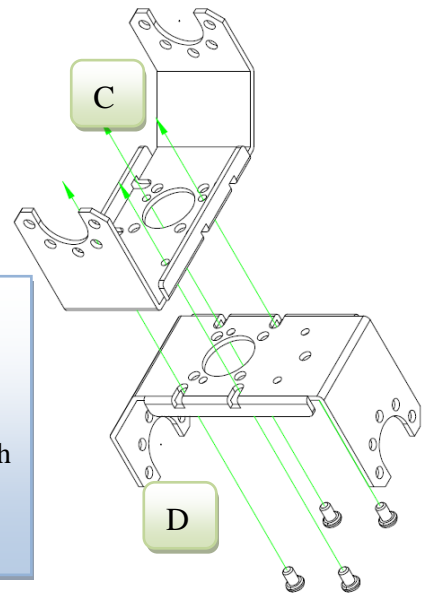


- Loosen the servo screws.
- Assemble the leg bracket C06 with the servo screws, as shown in the illustrations.
- Assemble horn A and B with screw C, as shown in the illustrations.

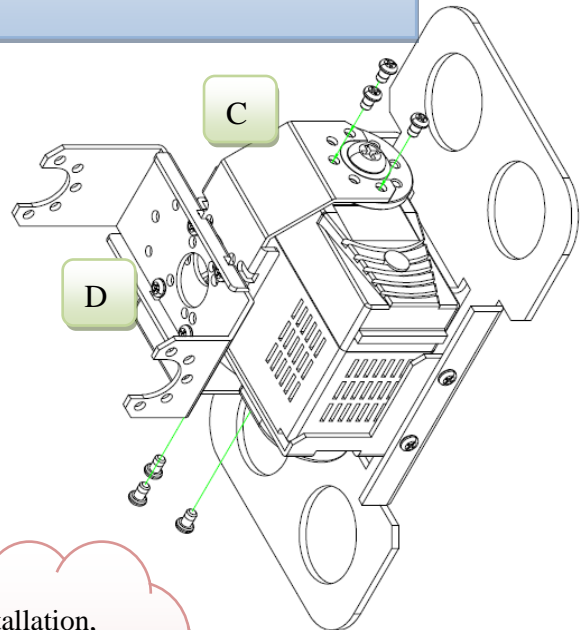
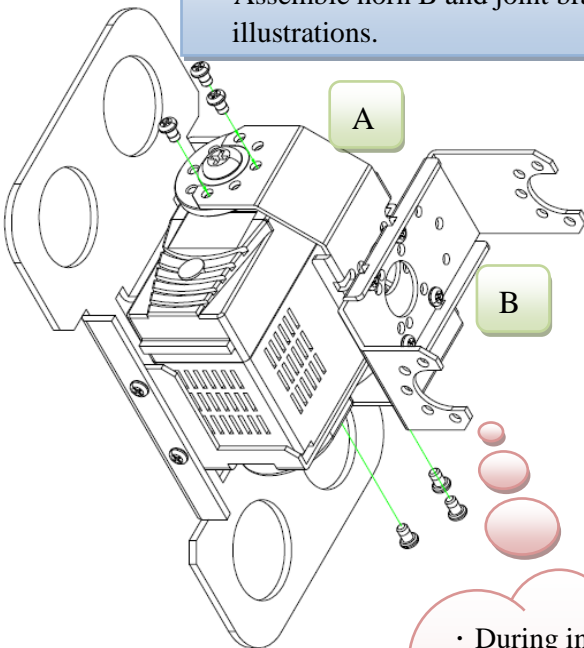
- When you assemble horn A, note that the hole of the horn should be perpendicular to the servo.
- If the servo spindle moves during the installation, perform “servo calibration” again to make sure the servo is in the proper position.
- When you assemble the horn B, note that the slant groove in the center is in contact with the servo.



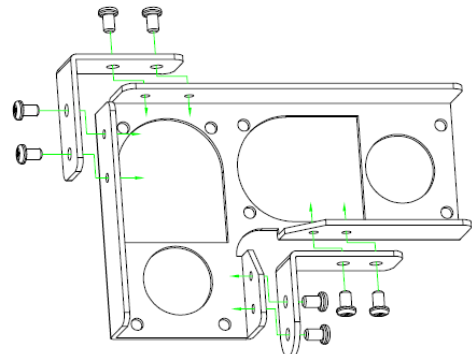
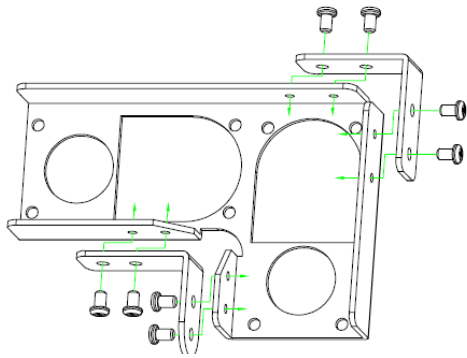
- Assemble the two joint brackets with screw A, as shown in the illustrations.
- Repeat this step to finish the assembly of the left and right leg joint parts.



- Assemble horn A and joint bracket with screw A, as shown in the illustrations.
- Assemble horn B and joint bracket with screw B, as shown in the illustrations.

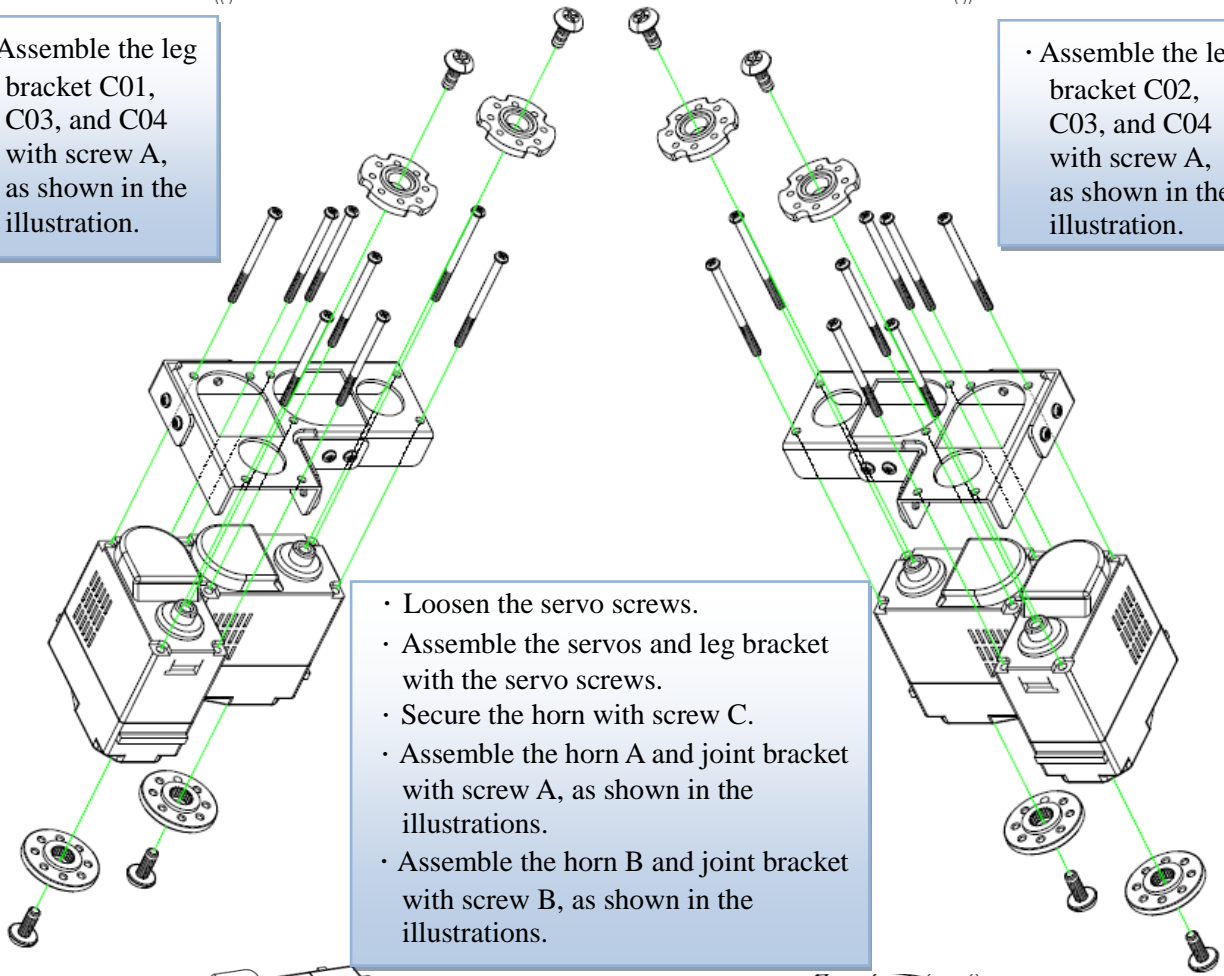


• During installation, note the positions corresponding to points from A to D, as shown in the illustrations.

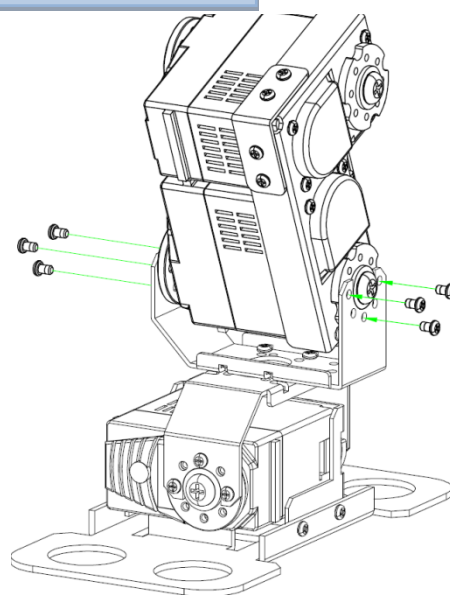
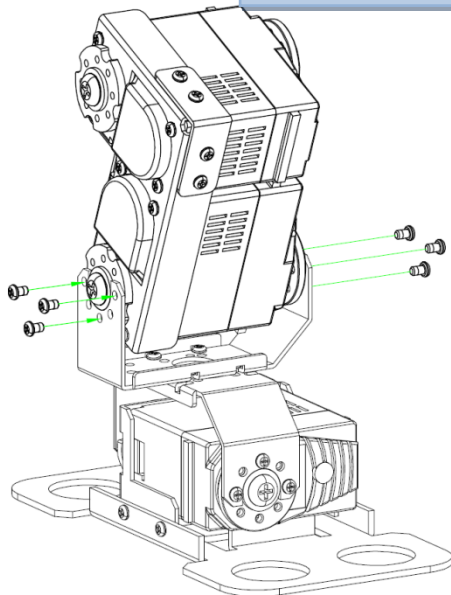


• Assemble the leg bracket C01, C03, and C04 with screw A, as shown in the illustration.

• Assemble the leg bracket C02, C03, and C04 with screw A, as shown in the illustration.



- Loosen the servo screws.
- Assemble the servos and leg bracket with the servo screws.
- Secure the horn with screw C.
- Assemble the horn A and joint bracket with screw A, as shown in the illustrations.
- Assemble the horn B and joint bracket with screw B, as shown in the illustrations.

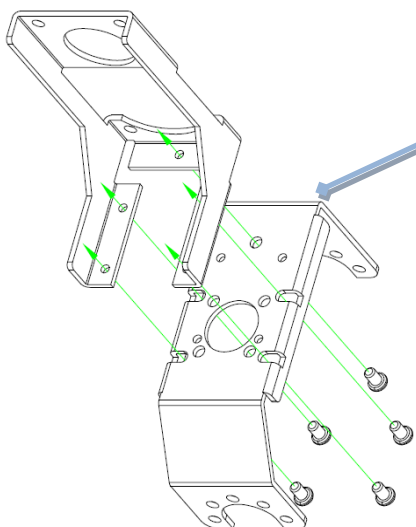
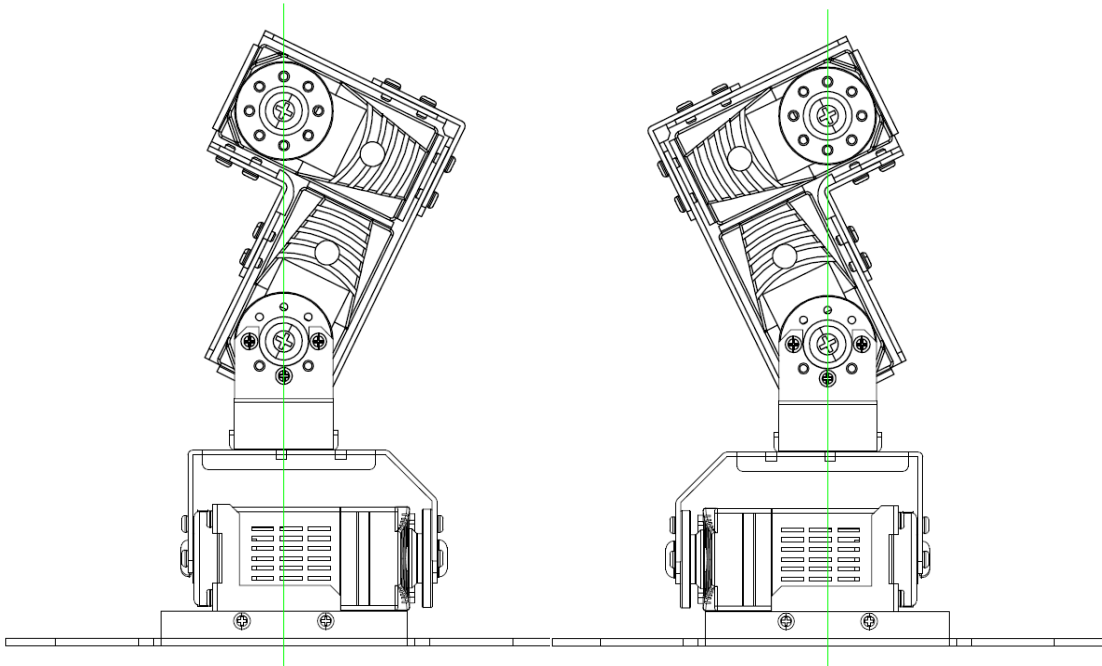




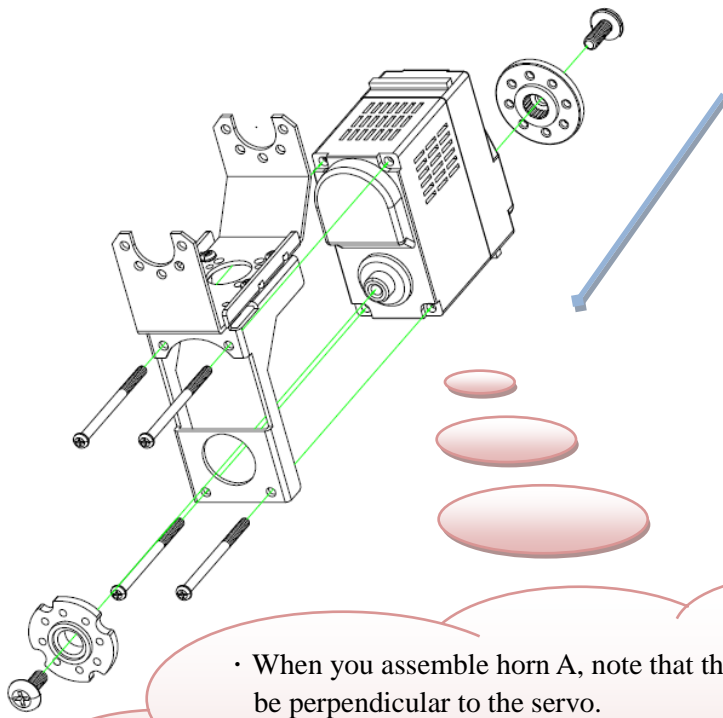
**Notes :**

**For the knee joint parts, horn A has a special installation, as shown in the illustrations. Please note this.**

**The holes of the two horn gear splines are in the same line.**

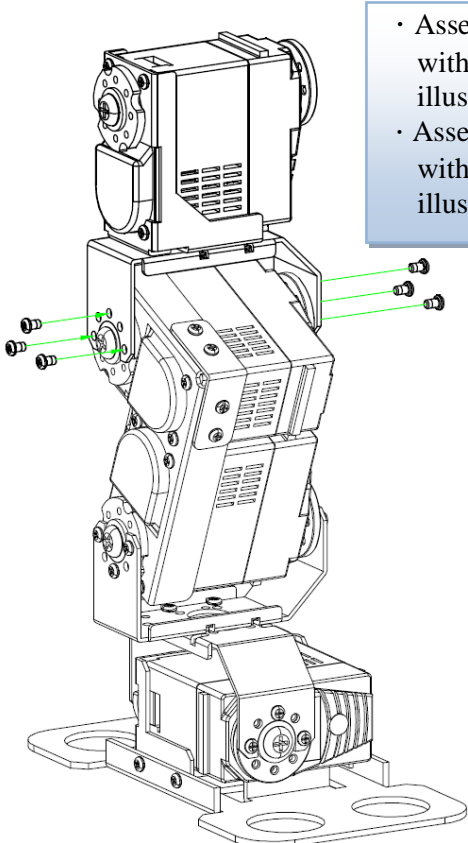


- Assemble the servo bracket and joint bracket with screw A, as shown in the illustrations.
- Repeat this step to finish the assembly of the left and right leg brackets.

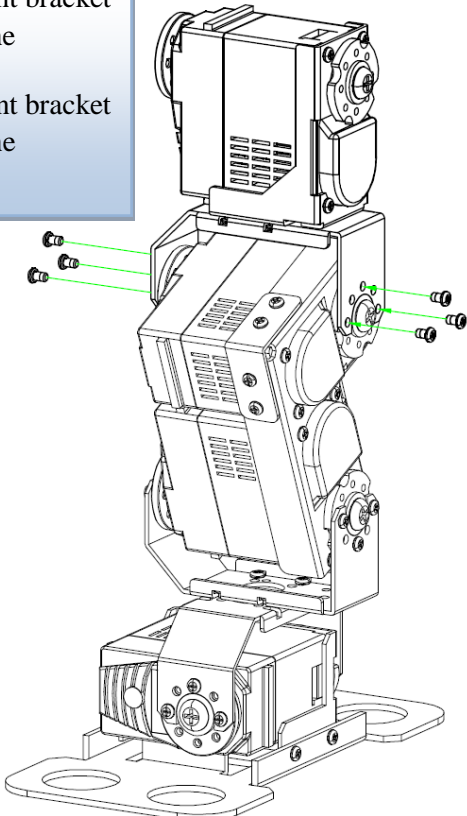


- Loosen the servo screws.
- Assemble the servo and servo bracket with the servo screws, as shown in the left illustration.
- Repeat this step to finish the assembly of the left and right leg parts.
- Assemble the horn A and B with screw C, as shown in the illustration at left.

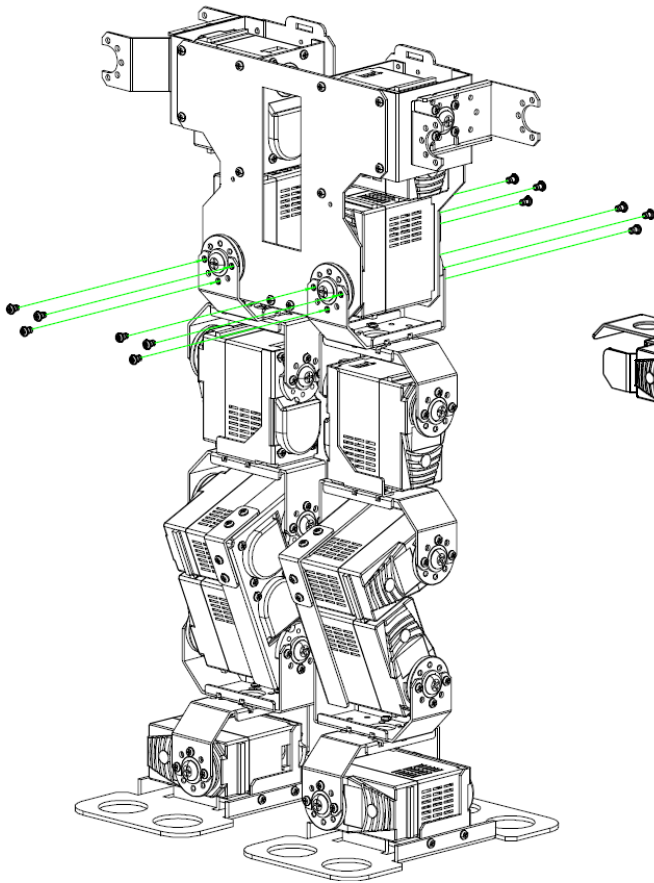
- When you assemble horn A, note that the hole of the horn should be perpendicular to the servo.
- If the servo spindle moves during the installation, perform “servo calibration” again to make sure the servo is in the proper position.
- When you assemble the horn B, note that the slant groove in the center is in contact with the servo.



- Assemble the horn A and joint bracket with screw A, as shown in the illustrations.
- Assemble the horn B and joint bracket with screw B, as shown in the illustrations.

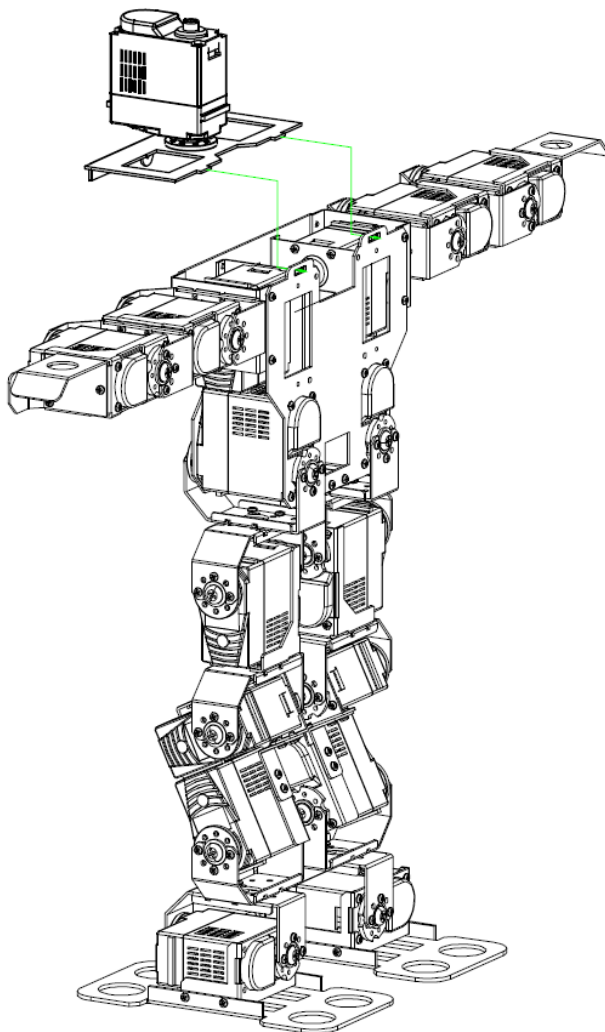
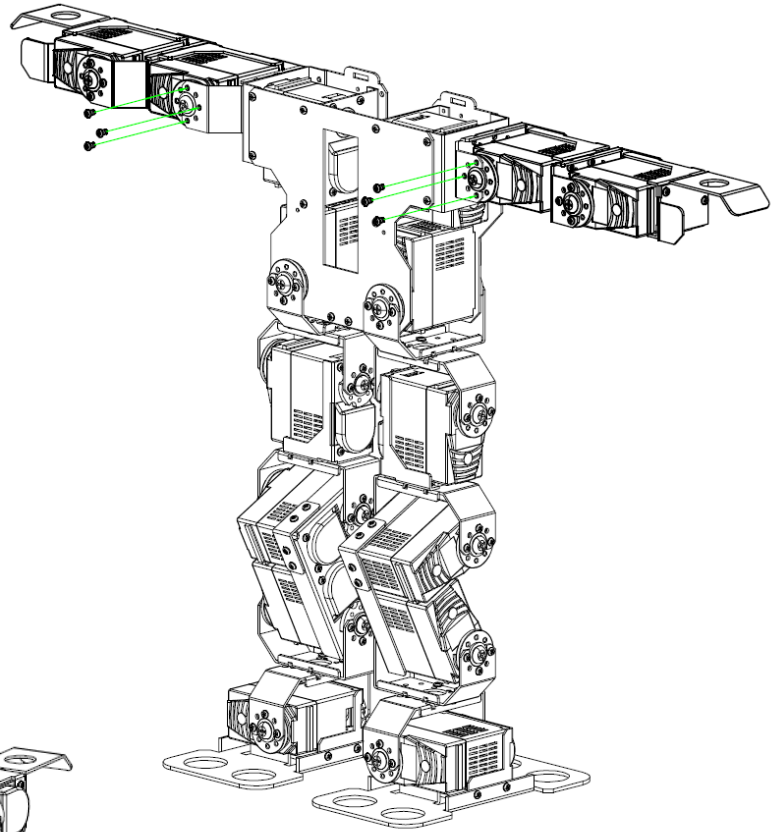




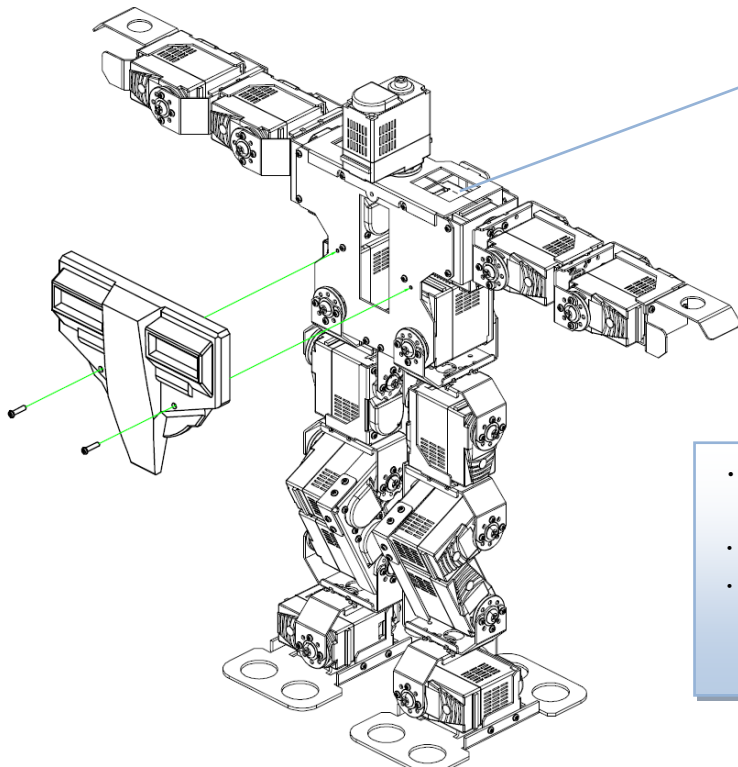


Assemble the horn A and joint bracket with screw A, as shown in the illustrations.

- Assemble the horn B and joint bracket with screw B, as shown in the illustrations.

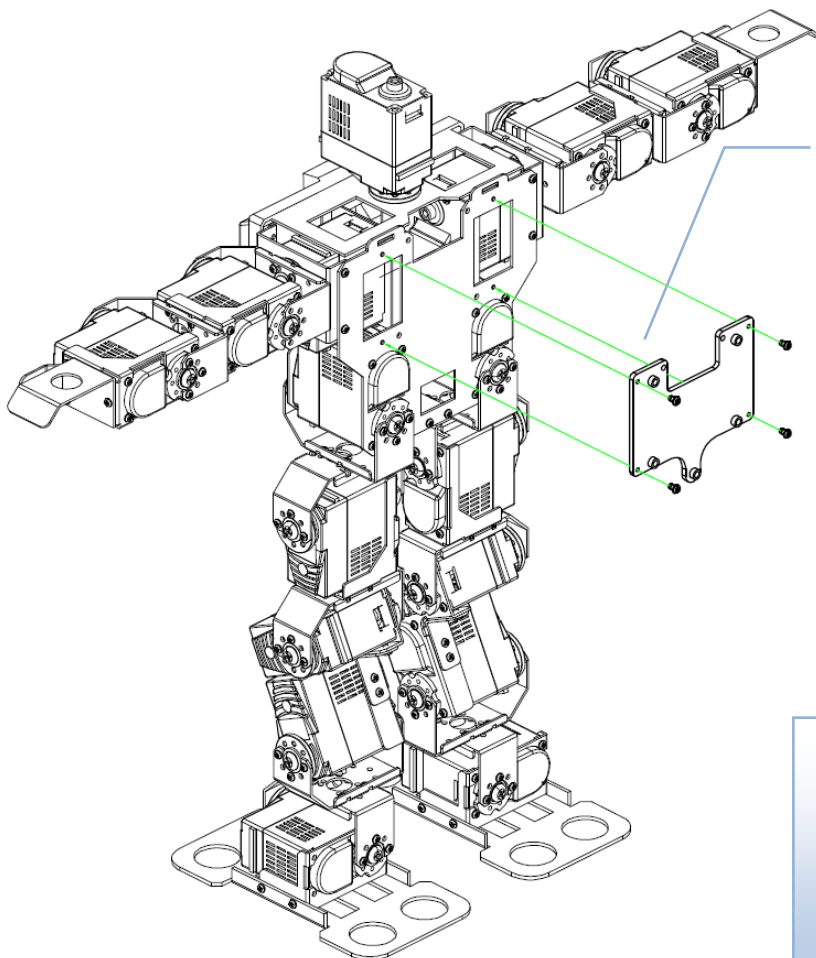


- Secure the frame bracket A01 with screw A and B, as shown in the illustration at left.

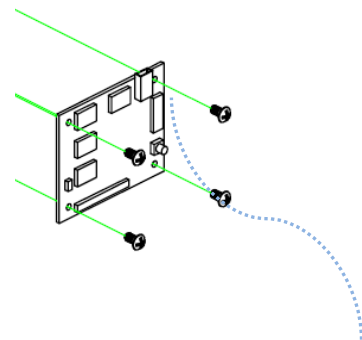


- Secure the frame bracket A01 with screw A.

- Secure the polycarbonate chest plate with screw D.
- The battery is placed inside the body.
- When screw D is used, do not exert excessive force to avoid thread failure.



- Mount the module mounting plate to the back with screw A.



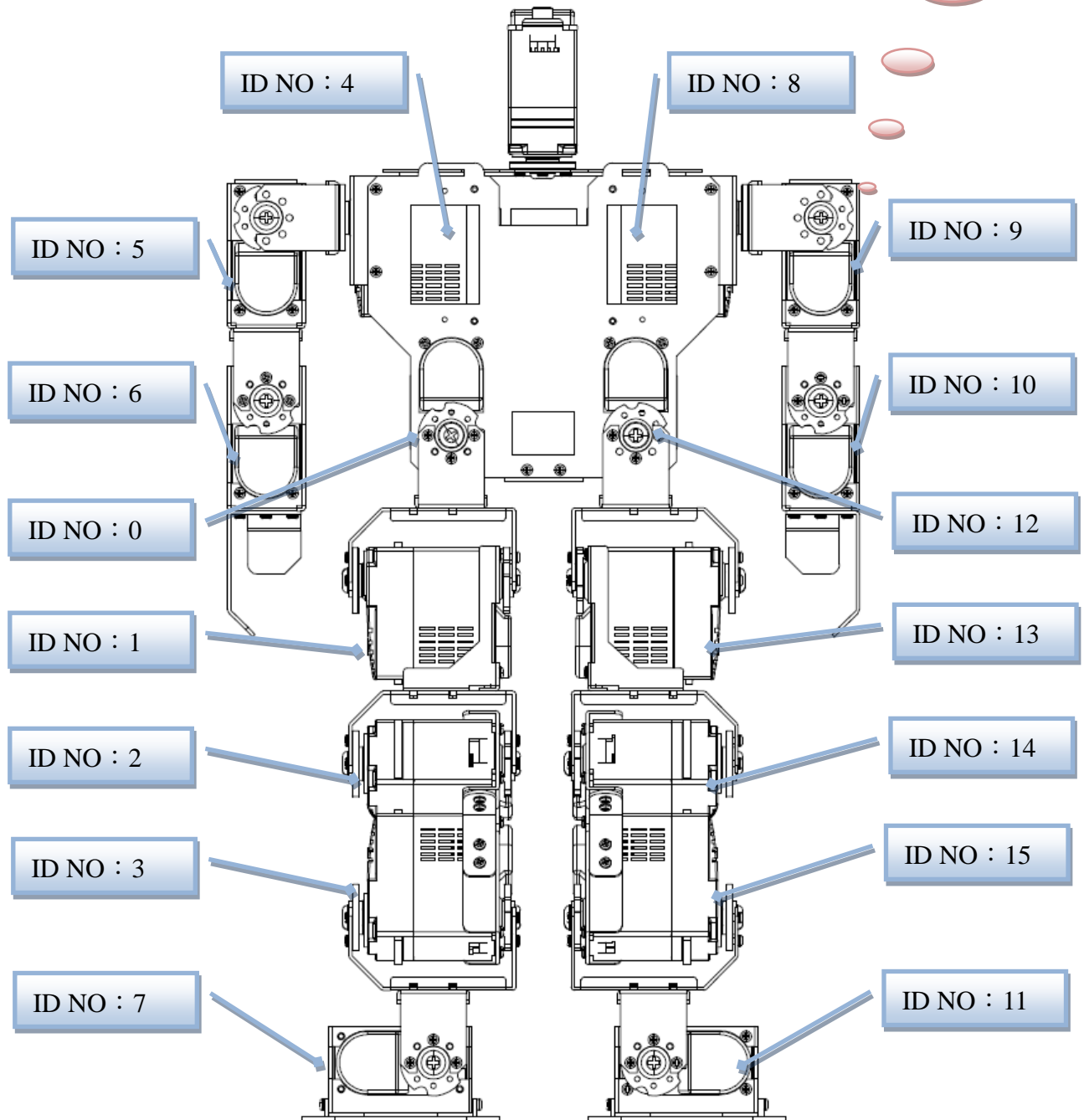
- Mount ServoCommander16 to the module mounting plate with screw E.
- Pay attention to the orientation when mounting. As shown in the illustration, the USB connector faces upward.

### (III) Connecting Modules and Wiring

Perform wiring for Servo Commander 16 based on the illustration.

Note that this is the backside.

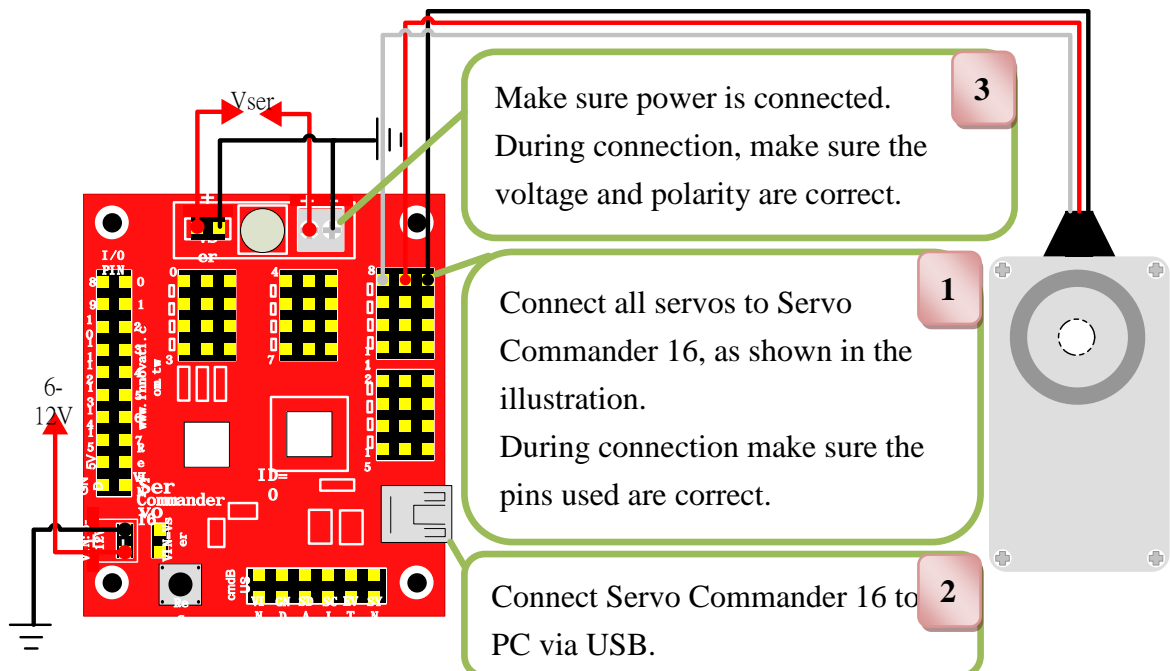
Pay attention to the polarity when mounting.



# Fine-Tuning Initial value of Servo

While the servos are adjusted to the proper position before assembly, positioning difference may occur with each servo. It may result from the offset occurring during mounting or mechanical errors. Software should be used to obtain the offset values before operation to ensure correct positioning in future operations.

- Ⓢ *When software tuning is performed, make sure all wheel screws are tightened and each servo has a value within the allowable error range.*



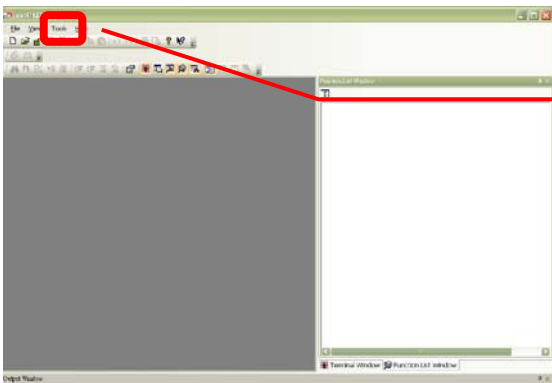
**When the power cord of the servo is connected to the power source, make sure the values of the voltage and current from the power source fall within the range required by the servo. When the power source is connected, the servo will temporarily operate when a surge happens. This is normal. During power-on, your hands should not be put in a position where the servo may move across them to prevent pinching.**

**1 : Open innoBASIC™ Workshop**



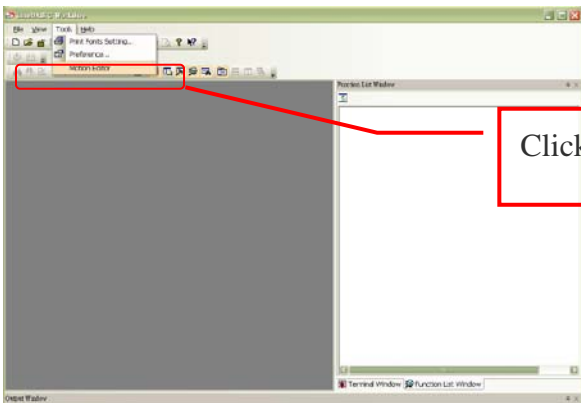
Click the run program of innoBASIC™ Workshop to start it.

**2 : Click the “Tool” option in the toolbar in the top.**

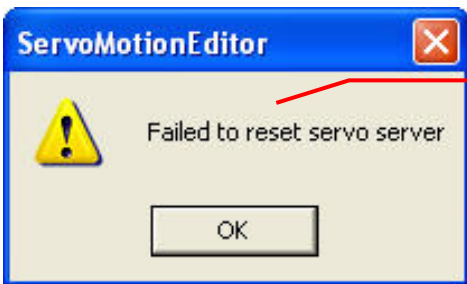


Many features are shown when you click each option. Now click the “Tool” option first.

**3 : Click “Motion Editor” in the drop-down menu (If a warning window appears when doing so, it means that BASIC Commander® is not properly connected. Check if the USB cable is connected, or disconnect and re-connect the cable. After you make sure connection is correct, exit the Motion Editor and press this button.)**



Click Motion Editor to start it



If this message appears, it means the USB cable is not properly connected

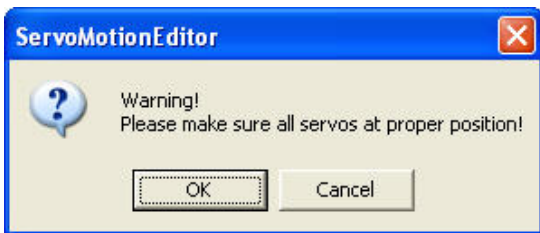


**4 : If connection is correct, a message “Download servo manager” appears on the PC screen, indicating the program is downloading.**



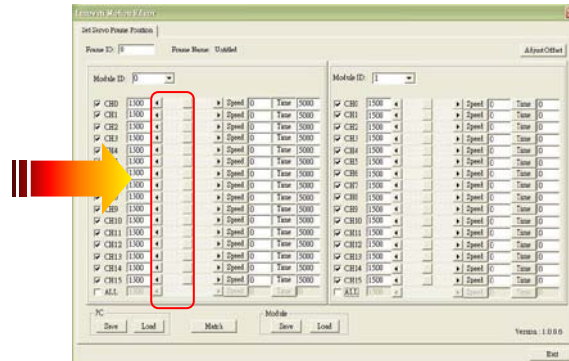
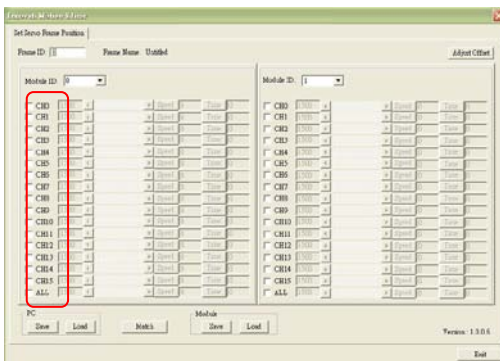
Do not remove the USB cable when the message appears

**5 : After downloading is complete, make sure each servo is properly connected. If all are connected, press “OK.” (Press "Cancel" to exit the Motion Editor. If any component is found to be disconnected, press "Cancel" to exit.)**

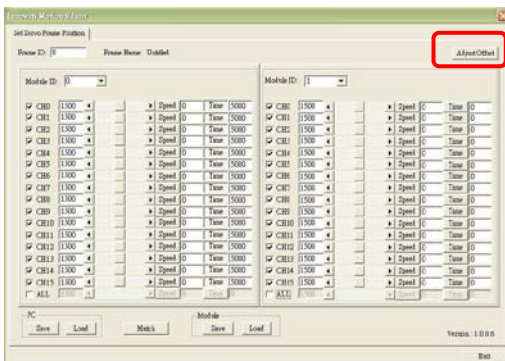


A prompt indicating the program is downloaded appears. Please make sure each component is properly connected.

**6 : Do not put your hands in a position where the servo may move across them to prevent pinching. Select the box at the far left to move all servos to the middle point. The figure next to the box should be 1500. If it is not 1500, click it, type 1500, and press Enter.**



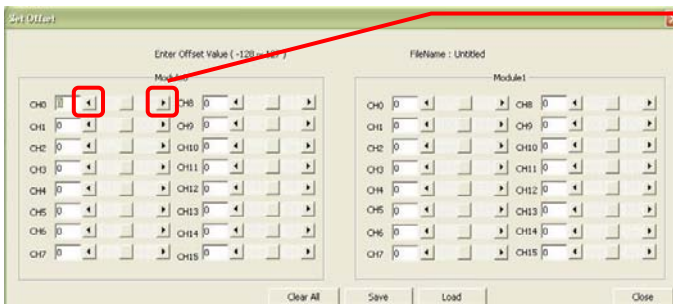
**7 : Press the "Adjust Offset" button in the top right corner.**



**8 : Before the offset value is saved, the file name appears as "Untitled." You can enter your desired name when saving a file.**

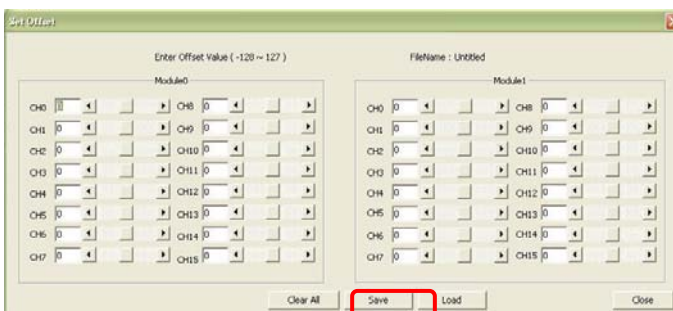


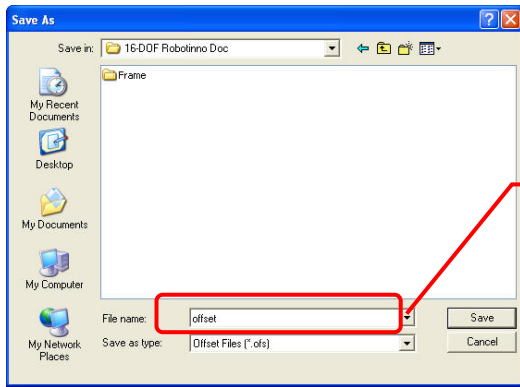
**9 : Observe the servo requiring adjustment. Press the corresponding arrow button and the servo will rotate in the selected direction. Please make sure the rotational direction is correct. If it rotates in the opposite direction, click the other arrow button to adjust each servo to the middle position in sequence.**



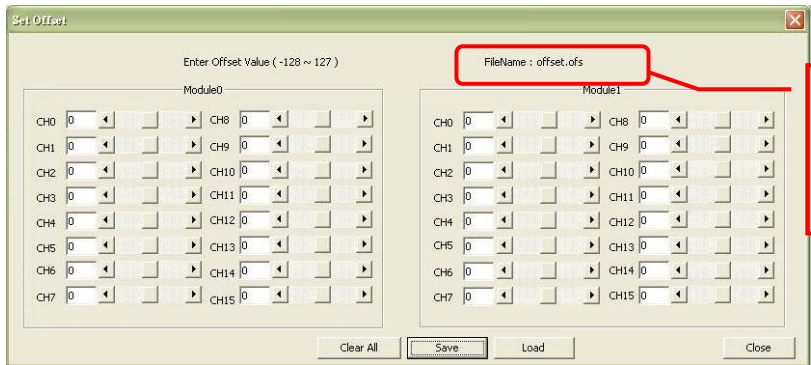
The left and right arrows are designed to make the servo rotate clockwise or counter-clockwise. After you observe that the servo rotates to the required middle position, adjust the next servo.

**10 : Record the adjustment values and press "Save" to select the location where the file is to be stored. Press OK after entering your desired name to save the file. Press "Read File" when you want to make a query or download a file.**



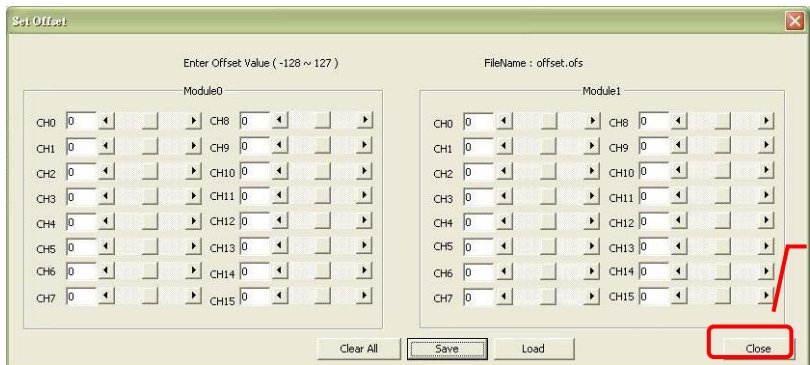


Enter your desired name and press "Save."



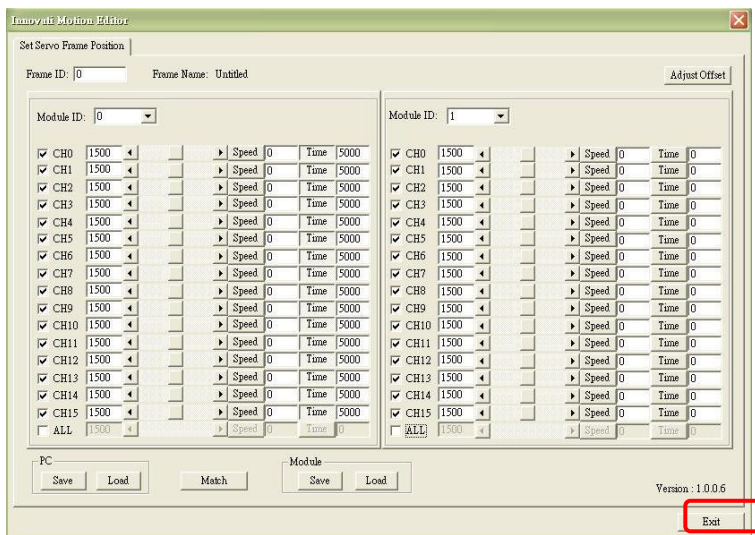
After saving, the last saved name will be shown in the Filename field

**11 : Press the "Close" button to close the window**



Press the "Close" button to close the window

**12 : After returning to the "Motion Editor" window, press "Exit" in the bottom right corner to exit the Motion Editor and to finish adjustment**

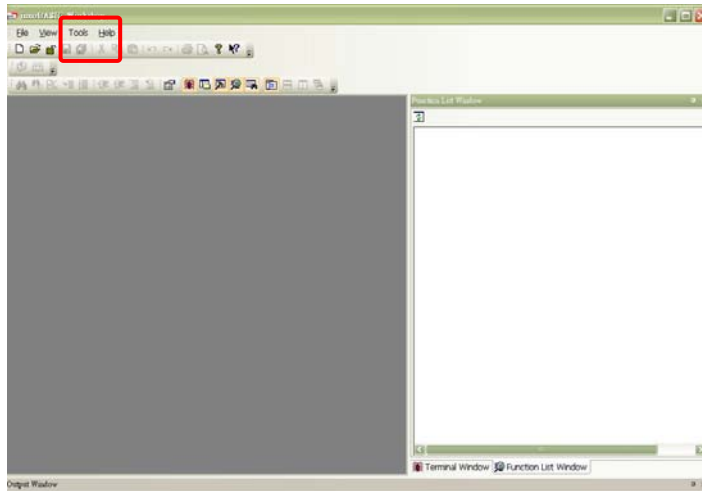


Press the "Exit" button to exit the Motion Editor

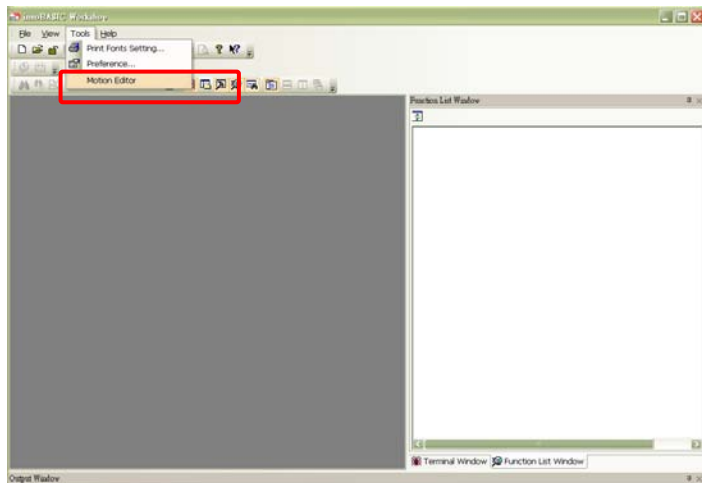


# Perform Demonstrative Motions

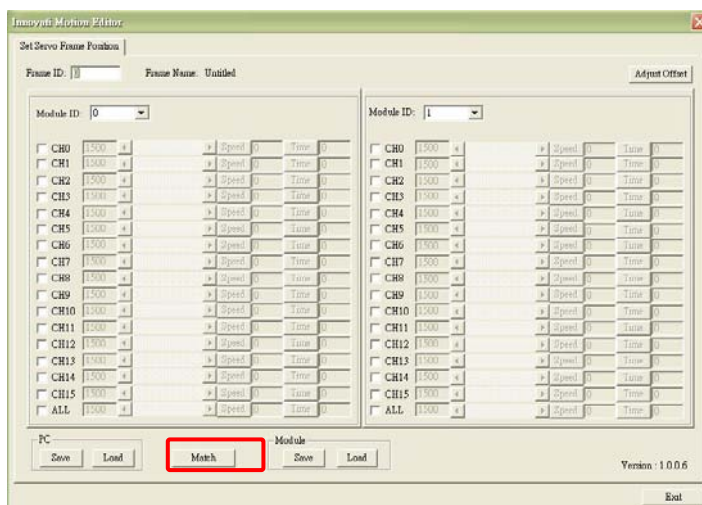
- 1 : Copy the "16-DOF Robotinno Doc" folder on CD to PC.
- 2 : From innoBASIC™ Workshop, click the “Tool” option in the toolbar in the top.



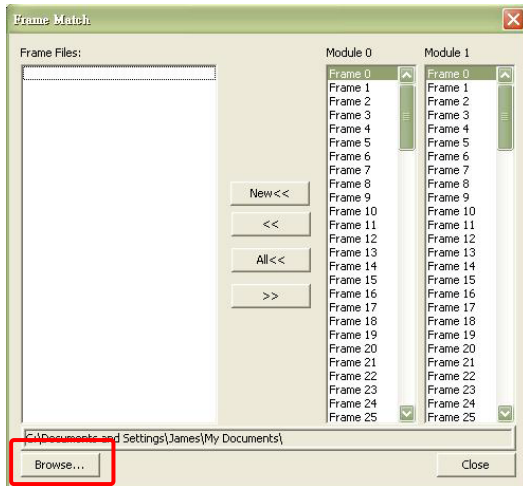
- 3 : Click “Motion Editor” in the drop-down menu.



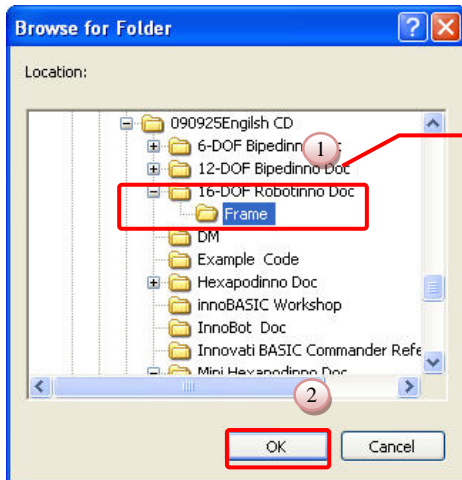
- 4 : Press the “Match” button in the bottom in the Motion Editor.



5 : Click the “Browse” button in the bottom left corner.

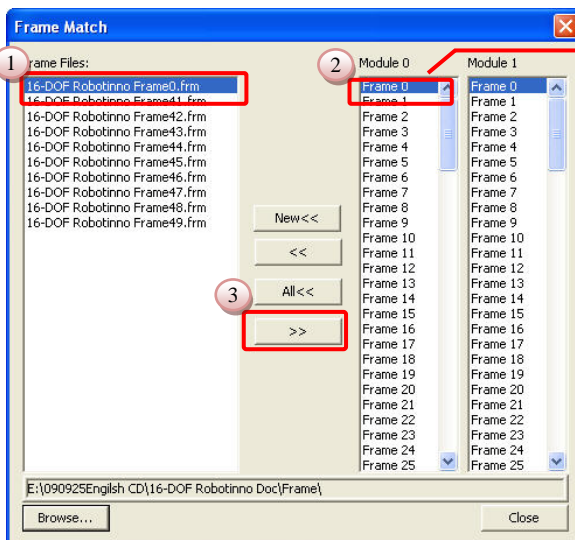


6 : Set the browse folder to “Frame” under the "16-DOF Robotinno Doc" folder and press the “OK” button.



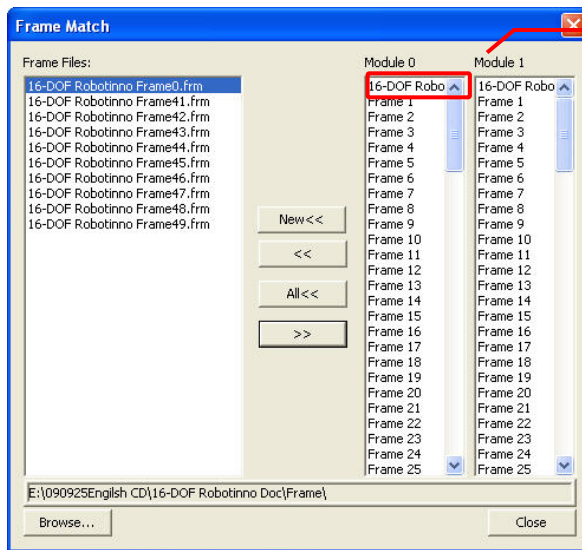
The selected folder will be highlighted. Make sure the selected folder is “Frame.”

7 : Click the "16-DOF Robotinno Frame0.frm" under Frame Files to the left, click "Frame0" under Module 0, and press the ">>" button.



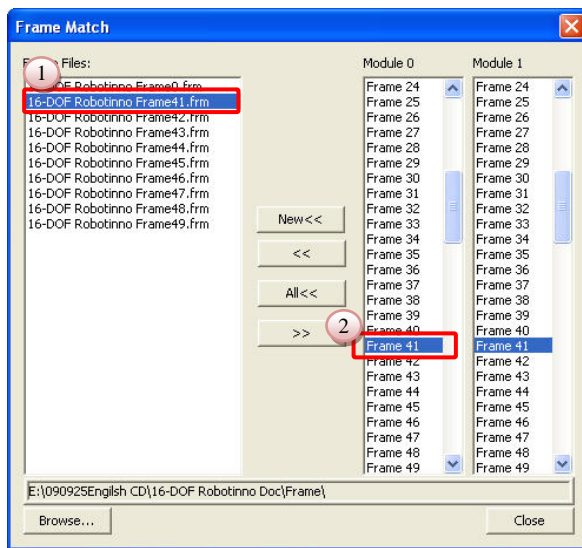
Before pressing ">>" to download a frame file to the module, make sure "Frame0" under Module 0 is selected and highlighted.

**8 : Make sure the "frame0" under Module 0 becomes "16-DOF Robotinno Frame0.frm."**

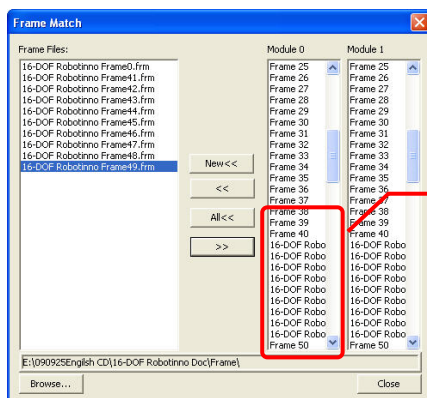


On downloading, you can see "frame0" turns into "16-DOF Robotinno Frame0.frm"

**9 : Click the "16-DOF Robotinno Frame41.frm" under Frame Files and click "Frame41." Repeat the above two steps to download 0 and 41~49 to the corresponding Frames.**

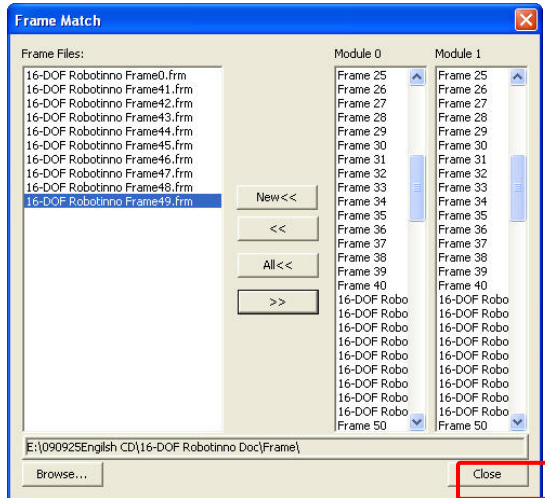


**10 : When all frame files are downloaded, you can see all Frames are changed into corresponding motions.**

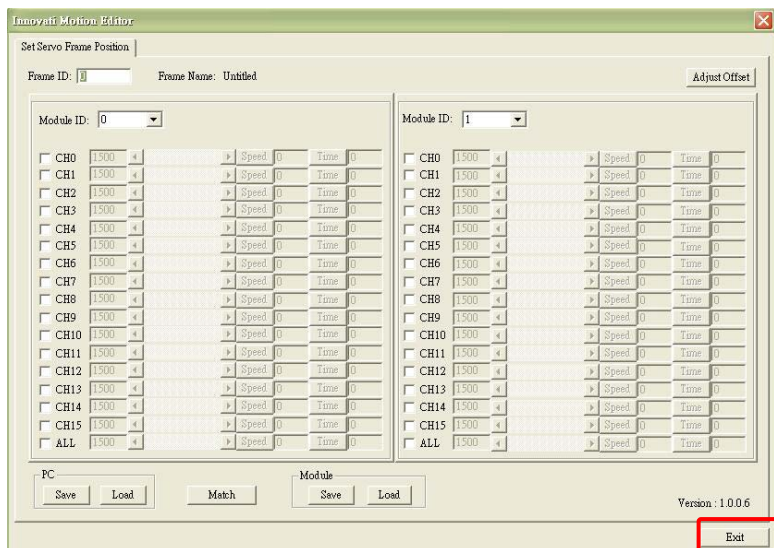


Make sure all of ten Frames are downloaded.

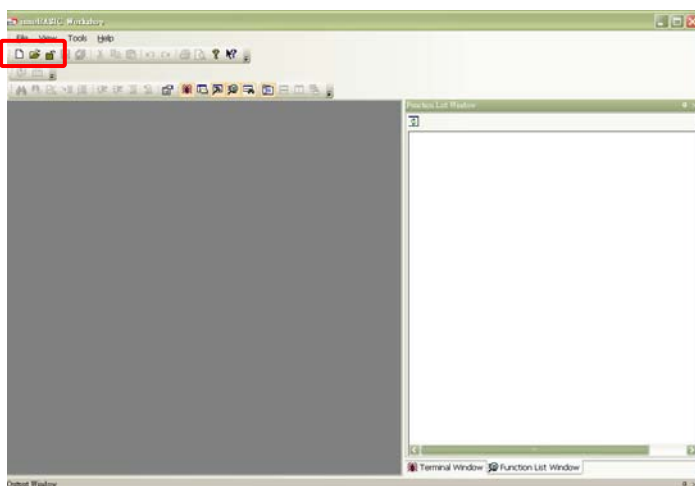
**11 : After you make sure all frames are correct, press the “Close” button in the bottom right to finish frame matching.**

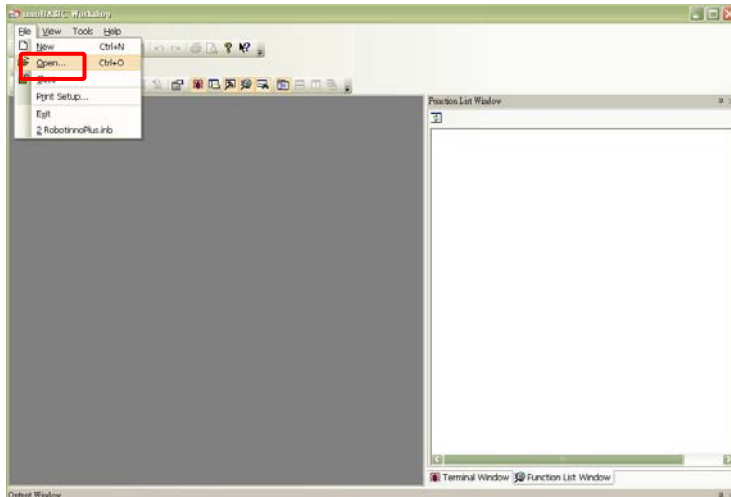


**12 : In the Motion Editor window, press the “Exit” button in the bottom right to exit the Motion Editor.**

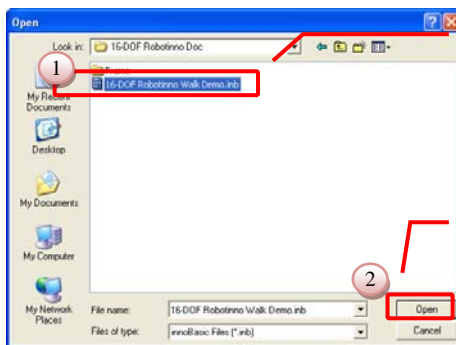


**13 : Press the “File” option in the toolbar and click “Open.”**





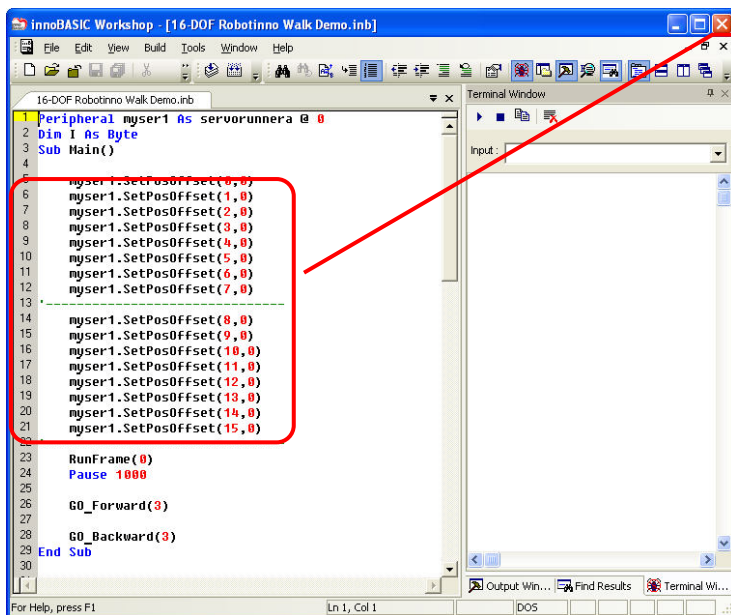
**14 : Select “16-DOF Rootinno Walk Demo.inb” in the folder and press “Open.”**



The selected folder will be highlighted.  
Make sure the selected folder is “**16-DOF Rootinno Walk Demo.inb**”

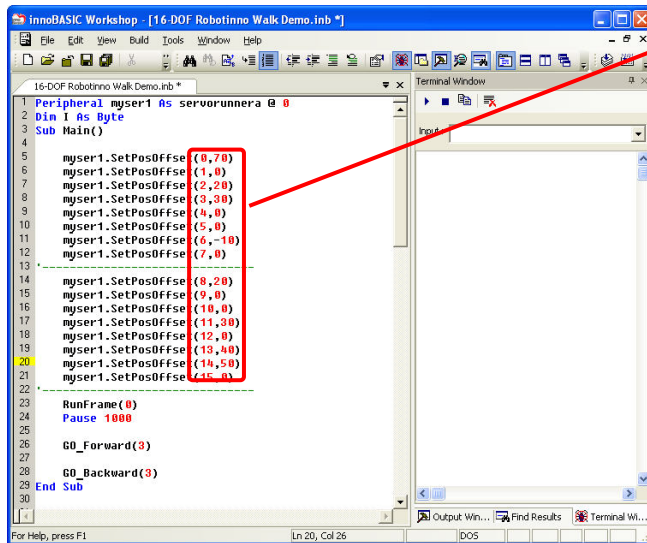
Press “Open” to download the program to innoBASIC Workshop for editing or creation.

**15 : Go to line 6 to see the initial adjustment values.**



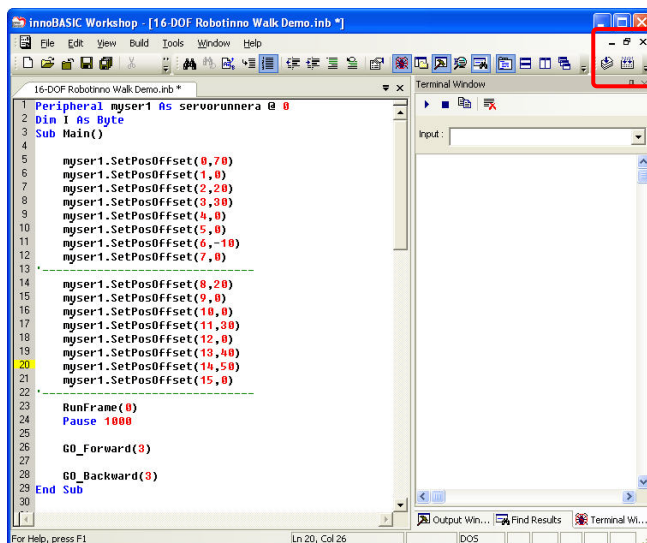
The figure to the left represents the line no. and lines 6~22 are designed to write the adjustment values into the modules. Always execute setting of the adjustment values for each motion control program.

**16 : During software adjustment, record the adjustment values and perform updating of the program to replace the original zero value.**



The command SetPosOffset has two parameters. The first is Servo No. and the second is Adjustment Value. Fill in the adjustment value of each servo recorded. The figures shown in the illustration are examples and do not fill in them.

**17 : Press the “Create” button on the screen and wait until downloading is complete.**

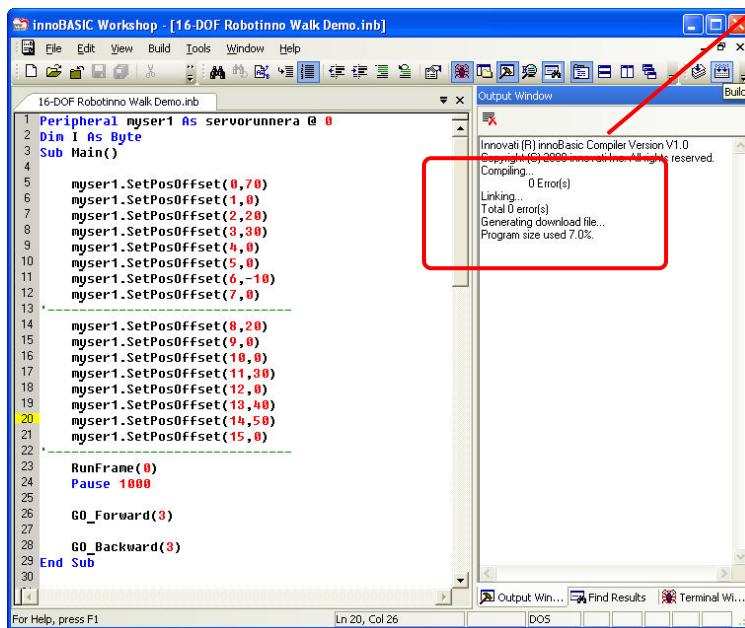


If you are not sure what a button can do, move the cursor on the icon for several seconds and a Chinese button name appears automatically. After you press Create, the program will be downloaded into BASIC Commander® and saved automatically.

The position of the "Create" button may vary depending on the arrangement.







After downloading, the memory amount used is shown in the Output Window. Any error will be shown in this Window. Make sure there is no error shown in the Output Window

**18 : Remove the USB cable connected to the Robot and place it in the place where it will act.**

**19 : Connect power and the Robot will act based on the demonstration program.**