

# Preface: Must-knows before you start building

**Patience** and **Attention to Details** are the Keys!

## Rules of Thumb

1. **Sort and count** all hardware pieces, **placing them in separate compartments**. This will help ensure no screws are missing or extra ones are used. When you're finished, **check for any leftover parts**; it's a useful way to verify if your assembly is complete.
2. **Read the note** annotated with \* at each step before you start.
3. If a joint feels stuck, it's likely because the **screws are too long**. Double-check the screw length. **Avoid using excessive force**; loosen the screw slightly, then try again.
4. **Always refer to the manual** for specific details—don't rely solely on memory. If confused, watch the video before you proceed.
5. We recommend using electric screwdrivers for most tasks. When manual Allen keys are preferred, it will be specifically noted.
6. Use a screwdriver of the size **PH1** for all the Phillips head screws.
7. Some steps require soldering beforehand.
8. We highlight screws that threadlocker is recommended in **yellow**. This is not mandatory but will notably reduce the chance of loose screws. All the screws that need threadlocker add up to about 100. Please use Vibra-TITE VC-3 Threadlocker if possible. Here is a 2-min [tutorial](#) of how to use it.

## Dynamixel 101

1. Refer to the official website for installing the idler set [HN11-i101](#) and [HN12-i101](#).
2. Some additional details:

Standard screw holes

Self-tapping screw holes



Actuation side A, the opposite side is Idler side A

\*Use the standard screw holes unless specified otherwise

Actuation side B, the opposite side is Idler side B



These two need to align when you install the idler

**Hardware:**

- Bearing axk0414
- Bearing 684 (\*4)
- M2 nuts (\*7)
- M2 washers (\*12)
- M2x4 (\*8)
- M2x6 (\*12) + M2x6
- M2x8 (\*18)
- M2.5x10 (\*8)
- M3x8 studs (\*4)
- M3x10 studs (\*8)
- M4 nuts (\*3)
- M4x8 (\*2)
- M4x20 (\*2)

**Others:**

- 2XL430 (\*3)
- XC430 (\*1)
- HN11-I101 set (\*3)

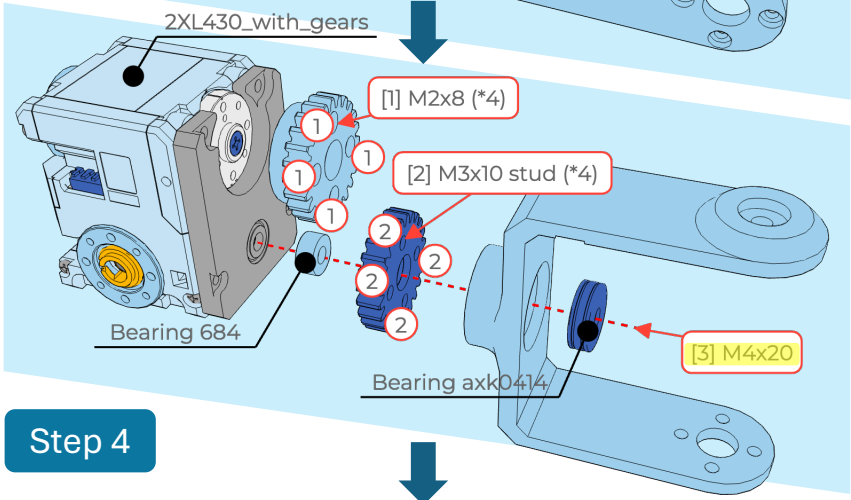
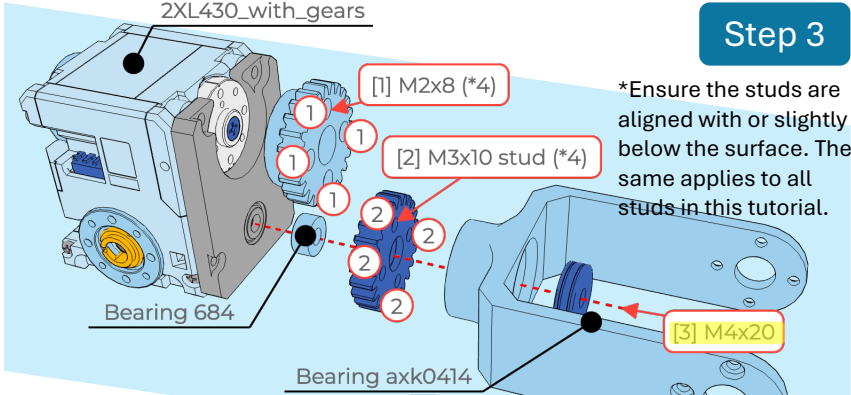
**3D-print:**

- Remove the support before you start

Threadlocker recommended for screws in **yellow**.

**Step 3**

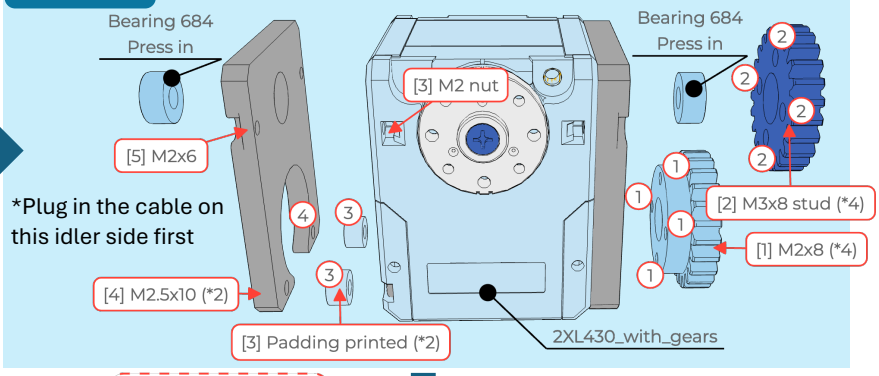
\*Ensure the studs are aligned with or slightly below the surface. The same applies to all studs in this tutorial.



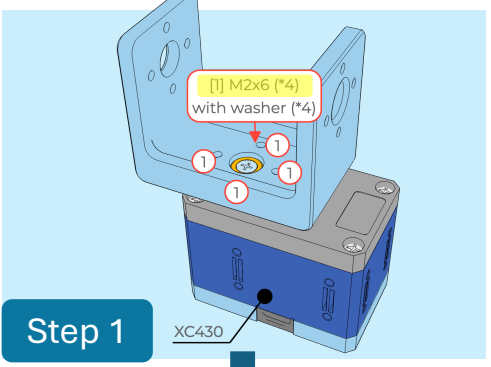
**Step 4**

**Step 5**

\*Watch how to assemble this gear in the video if confused

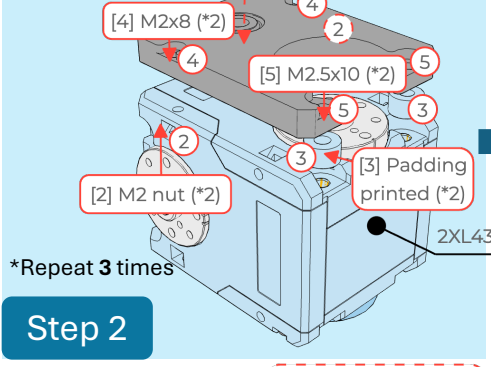


\*Plug in the cable on this idler side first



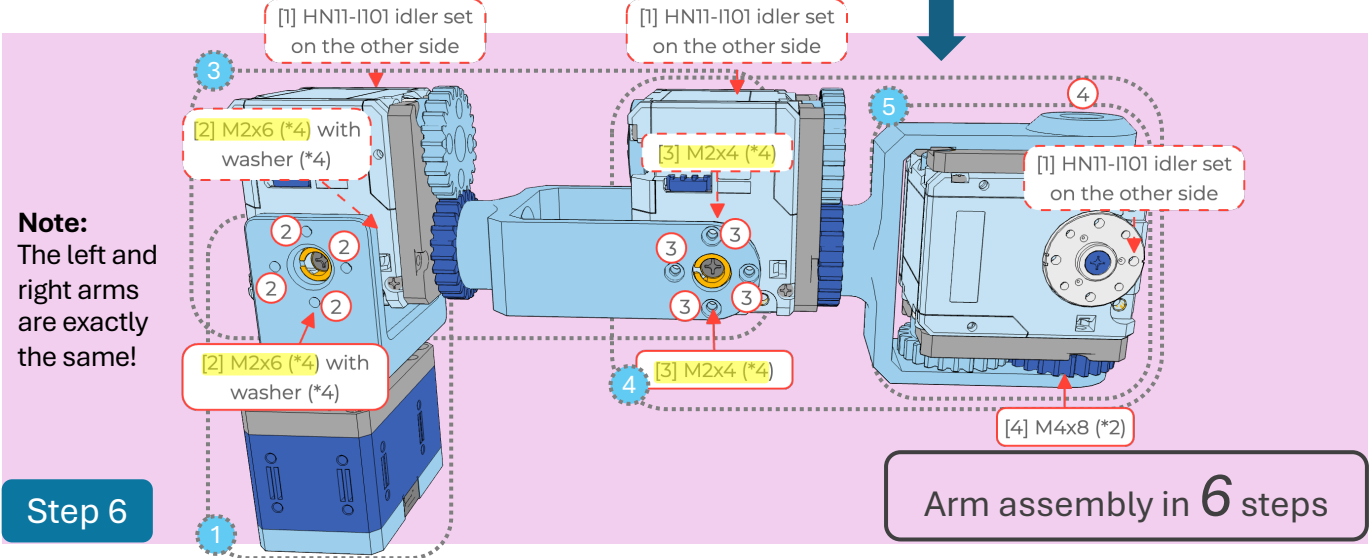
**Step 1**

\*Don't forget to put the M4 nut under the plate



**Step 2**

\*Repeat 3 times



**Note:** The left and right arms are exactly the same!

**Step 6**

**Arm assembly in 6 steps**

### Hardware:

- Bearing axk0414 (\*3)
- Bearing 683 (\*4)
- Bearing 684 (\*1)
- M2.5x4 from XM430 (\*14)
- M2x4 (\*4)
- M2x6 (\*20) + M2x6 (\*8)
- M2x10 (\*4)
- M2 washers (\*16)
- M2.5x5 self-tapping from XC430 (\*8)
- M3x6 (\*2)
- M3x8 (\*2)
- M3x10 (\*2)
- M3x10 studs (\*4)
- M3x12 flat head (\*3)
- M4x25 (\*1)
- M4x30 (\*1)
- M4 nut (\*2)
- M4 washer (\*1)

Threadlocker recommended for screws in **yellow**.

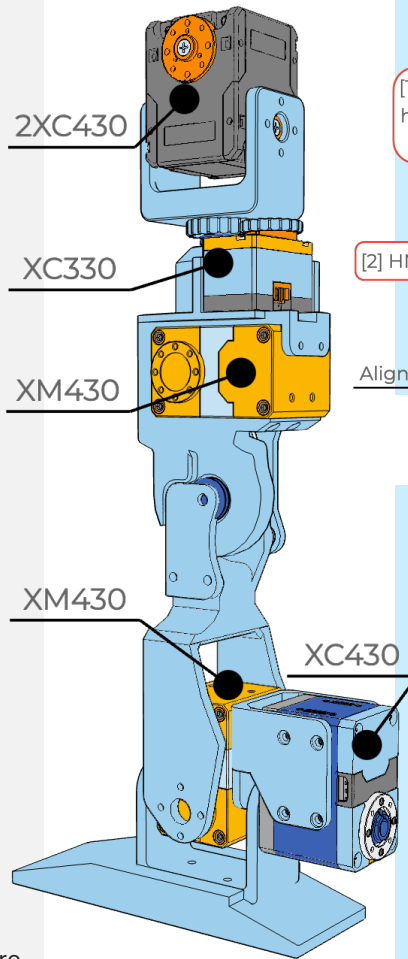
### Others:

- XM430 (\*2)
- XC430 (\*1)
- 2XC430 (\*1)
- XC330 (\*1)
- HN11-I101 set (\*2)
- HN12-I101 set (\*1)

### 3D-print:

- Remove the support before you start

## Leg Overview



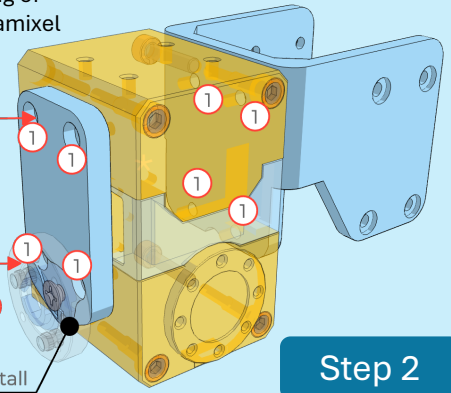
\*M2 and M2.5s are mixed in the bag of screws by dynamixel

\*Mirror for the right leg

[1] M2.5x4 socket head came with XM430 [\*8]

[2] HN11-I101 Idler (\*1)

Align the tip when install

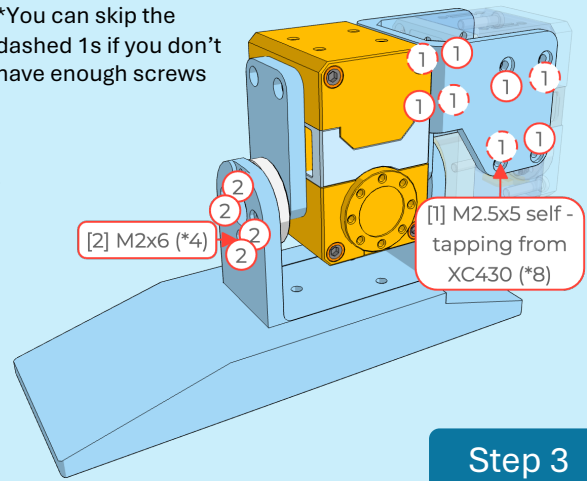


Step 2

\*You can skip the dashed 1s if you don't have enough screws

[2] M2x6 (\*4)

[1] M2.5x5 self-tapping from XC430 (\*8)



Step 3

## Leg assembly in 9 steps

More steps are on the next page...

### Note:

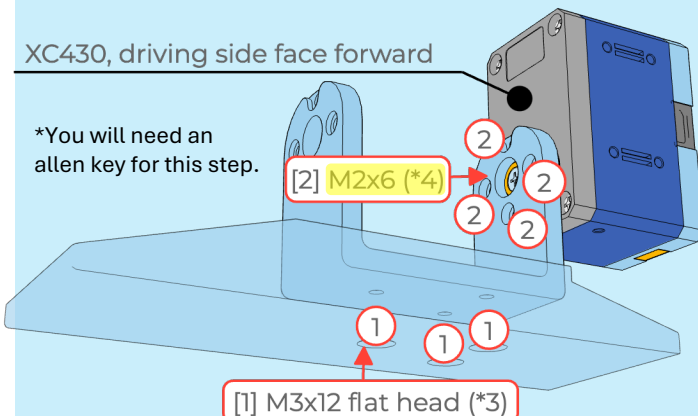
This is for the left leg, and the right leg is the mirror of the left.

XC430, driving side face forward

\*You will need an allen key for this step.

[2] M2x6 (\*4)

[1] M3x12 flat head (\*3)



Step 1

\*Mirror for the right leg

\*Idler includes both washer and plate

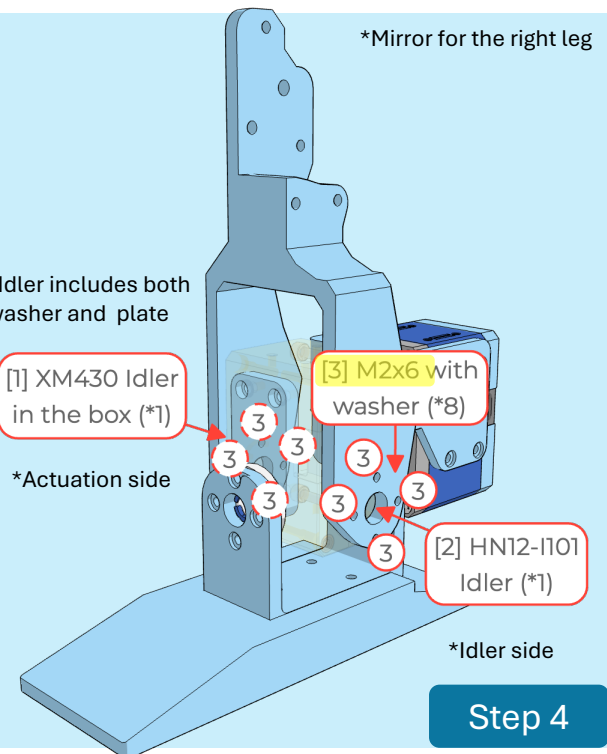
[1] XM430 Idler in the box (\*1)

[3] M2x6 with washer (\*8)

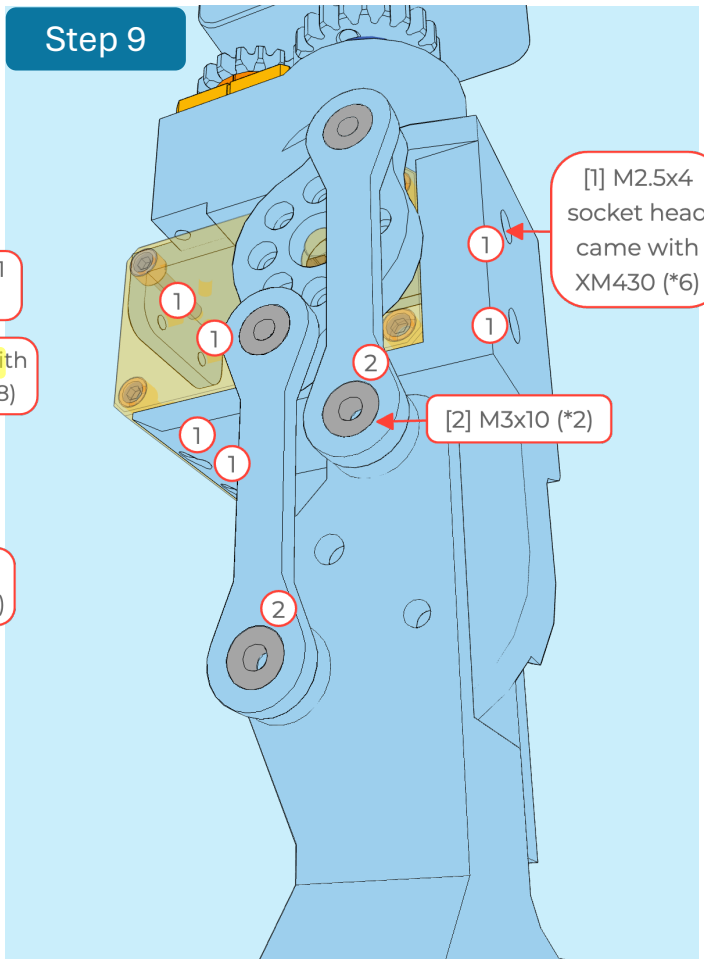
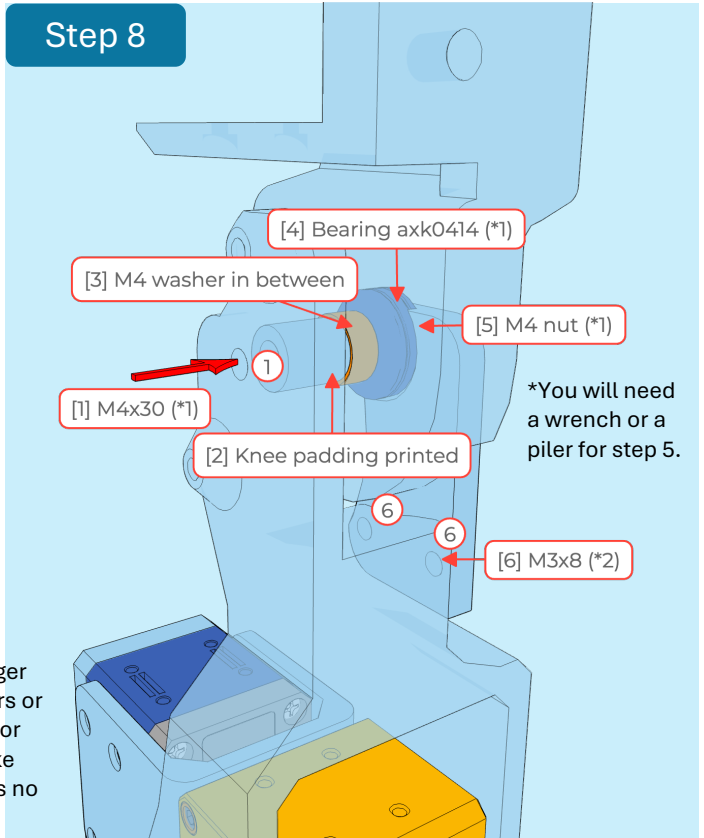
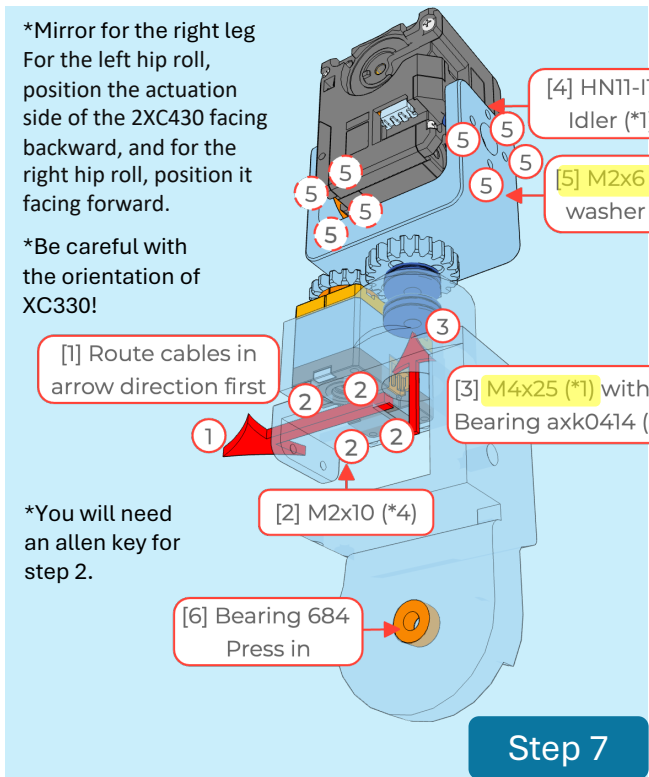
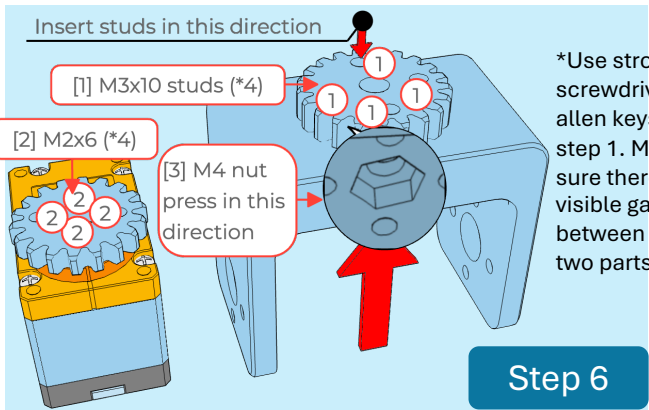
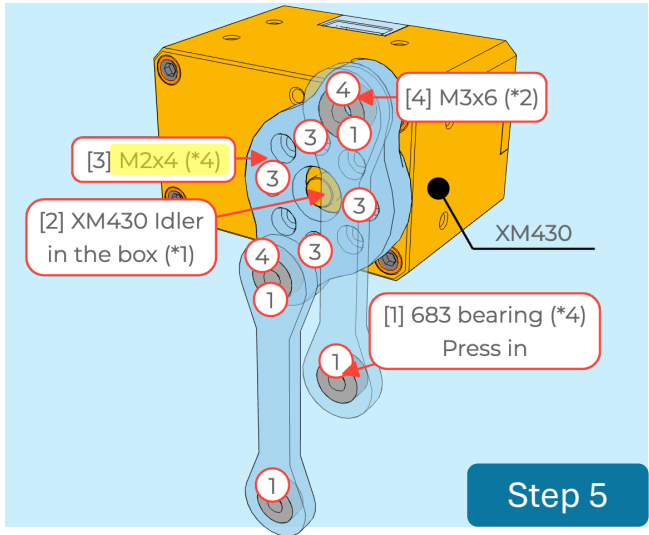
\*Actuation side

[2] HN12-I101 Idler (\*1)

\*Idler side



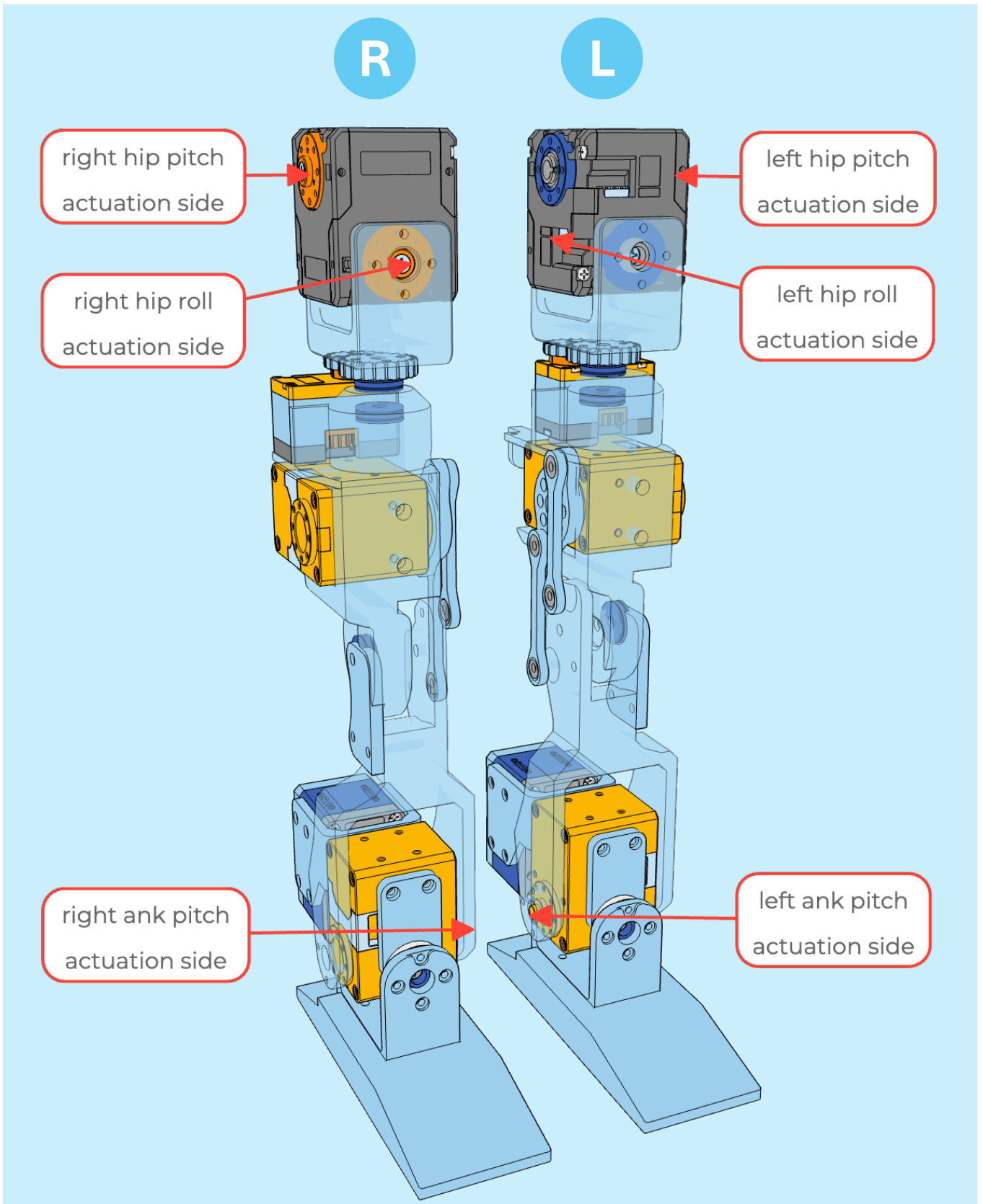
Step 4





**Note:**

The right leg is the exact mirror of the left leg. Refer to this figure for the orientations of all the motors.



### Hardware:

- Bearing 683 (\*4)
- Bearing 684 (\*1)
- M2x6 (\*4)
- M2x8 (\*4) self-tapping from XC330
- M2.5x6 (\*8)
- M3x4 (\*1)
- M3x6 (\*10)
- M3x10 (\*3)
- M3x10 stud (\*1)

### Others:

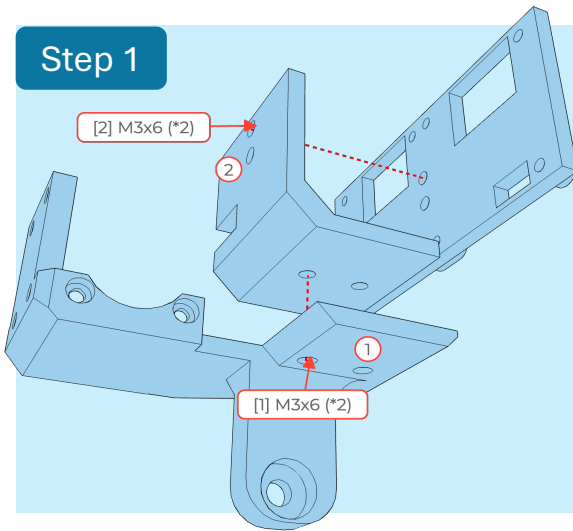
- Fisheye camera with cables (\*2)
- Speaker with 1.5-foot USB-A to micro USB cable (\*1)
- Double-sided tape
- XC330 (\*1)
- Dynamixel cables (\*2)

### 3D-print:

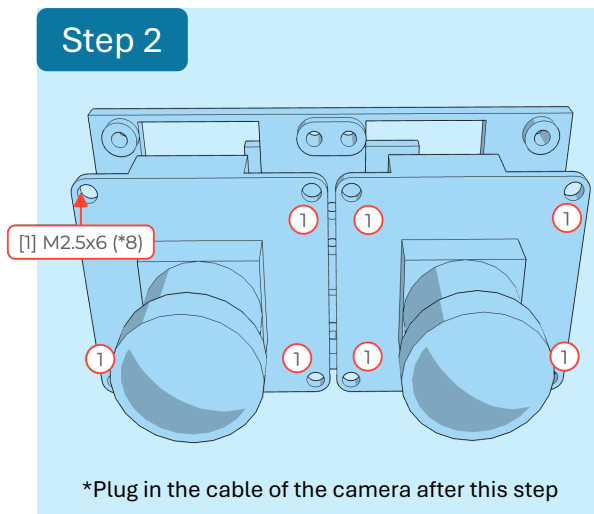
- Remove the support before you start

## Head Assembly in 5 steps

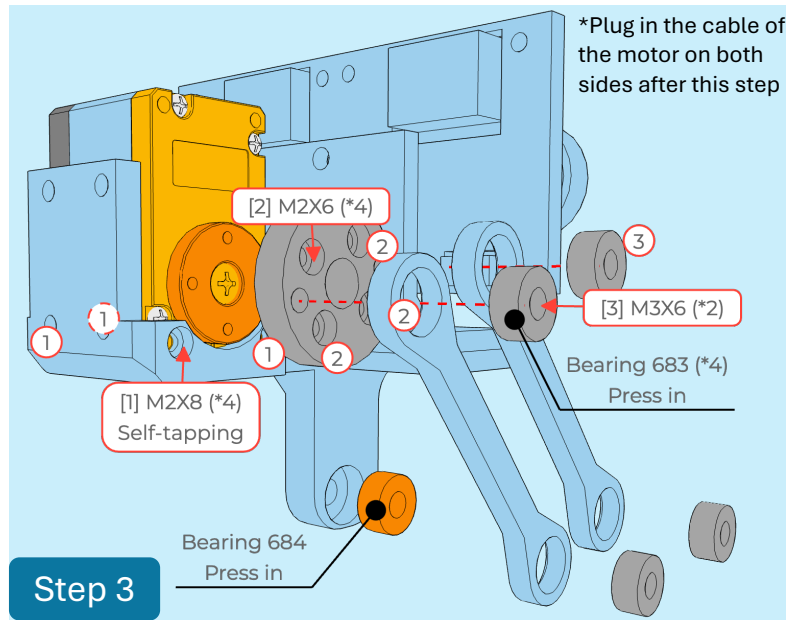
### Step 1



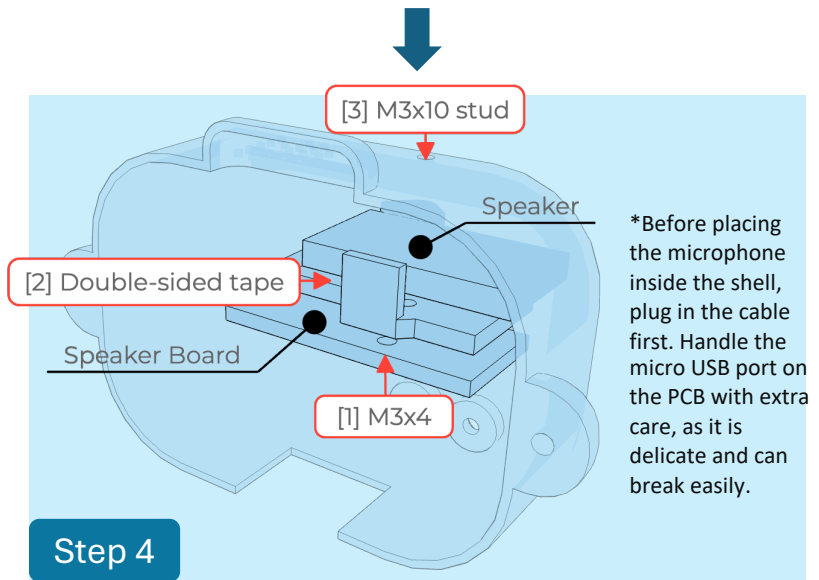
### Step 2



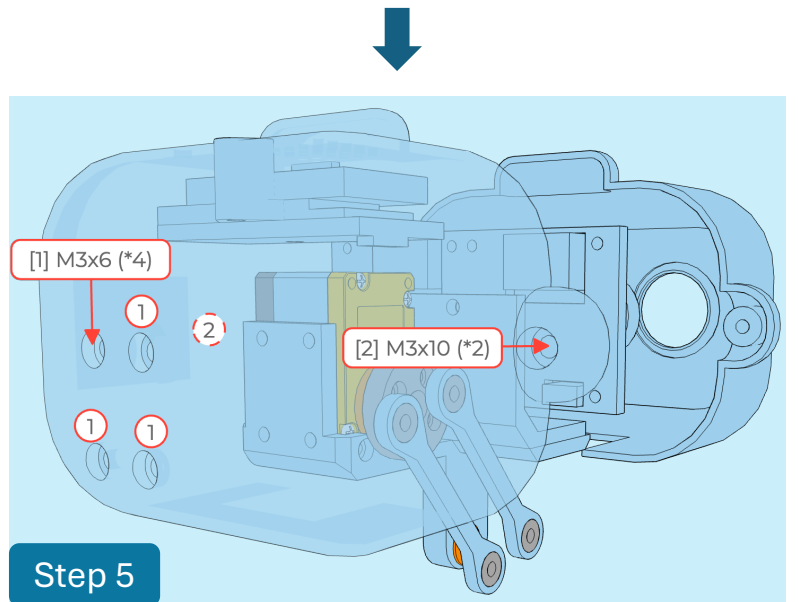
### Step 3



### Step 4



### Step 5



### Hardware:

- Bearing axk0414 (\*4)
- Bearing 684 (\*2)
- M2x6 (\*16)
- M2x10 (\*8)
- M2 washers (\*16)
- M4x55 (\*1)
- M4 nut (\*1)

Threadlocker recommended for screws in yellow.

### Others:

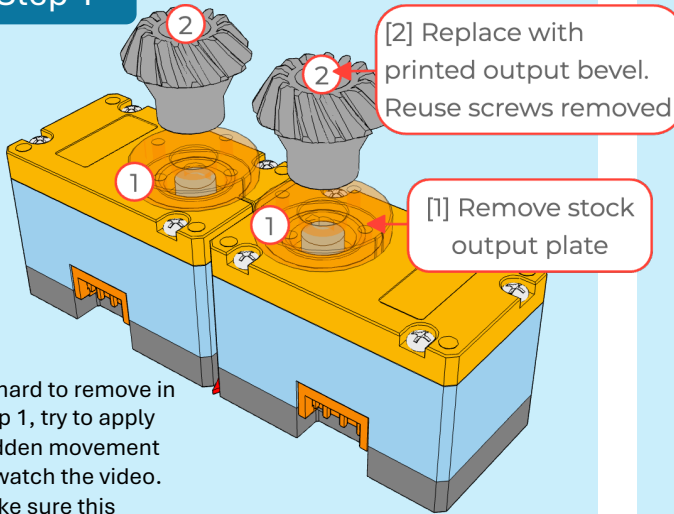
- XC330 (\*2)
- HN11-I101 set (\*2)

### 3D-print:

- Remove the support before you start
- You need 2 fully-assembled legs

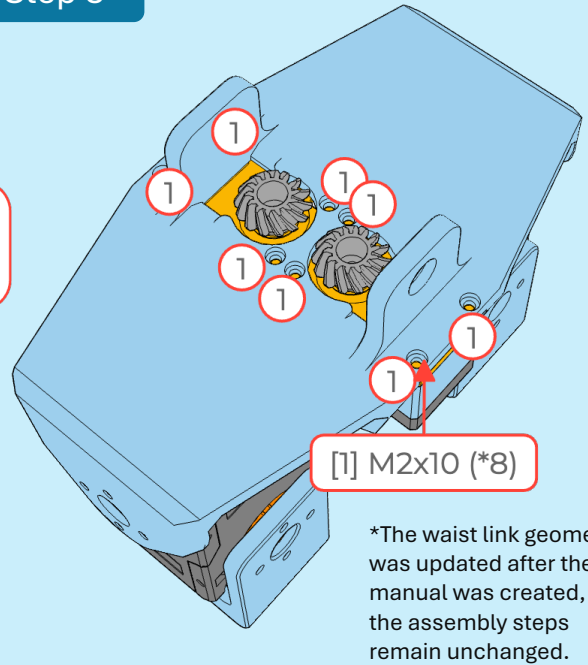
## Waist assembly in 4 steps

### Step 1

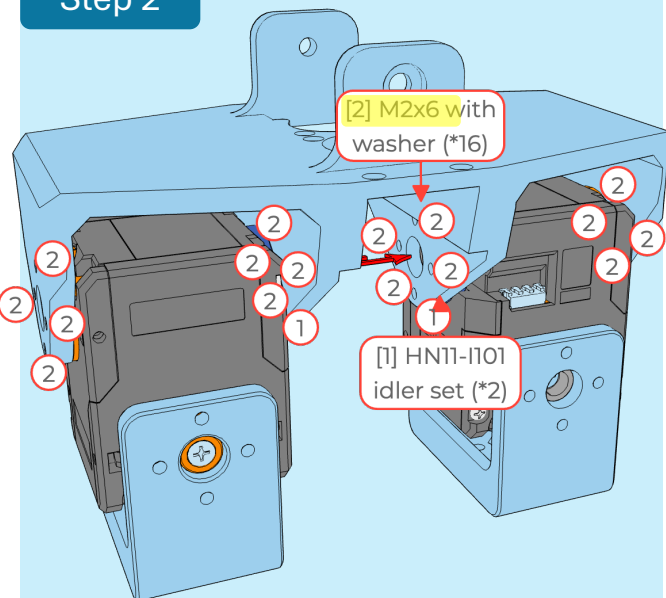


\*If hard to remove in step 1, try to apply sudden movement or watch the video. Make sure this screw is tight.

### Step 3



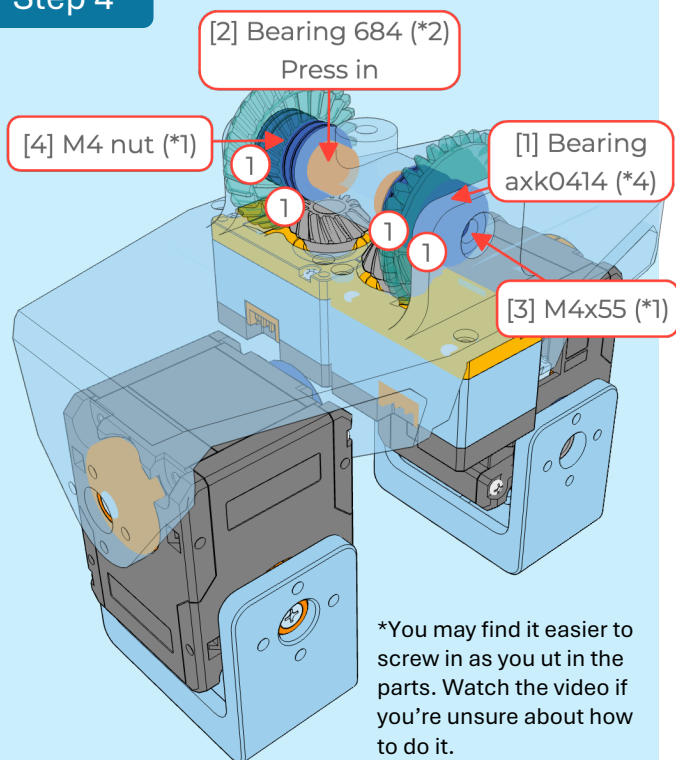
### Step 2



\*Make sure the motor orientation matches this figure. The flexibility of the waist link is required to insert the motors. Watch the video if unsure.

\*You will need an allen key for the 8 screws in the middle. They don't need to be super tight though.

### Step 4



\*You may find it easier to screw in as you do in the parts. Watch the video if you're unsure about how to do it.

### Hardware:

- Bearing axk0414 (\*4)
- M2x6 (\*4)
- M2x10 (\*4)
- M2.5x4 (\*4)
- M2.5x5 self-tapping from XC430 (\*8)
- M2.5x10 (\*3)
- M3x4 (\*4)
- M3x6 flat head (\*2)
- M3x8 flat head (\*5)
- M3x10 (\*2)
- M4x12 (\*1)
- M4x20 (\*2)

### Others

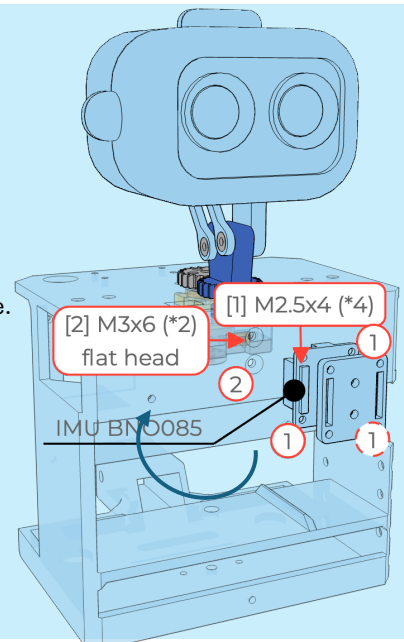
- XC330 (\*1)
- IMU BNO085
- Jumper wire
- Jetson Orin NX
- Dynamixel power hub
- Dynamixel U2D2
- Power cord

### 3D-print:

- Remove the support before you start

## Step 3

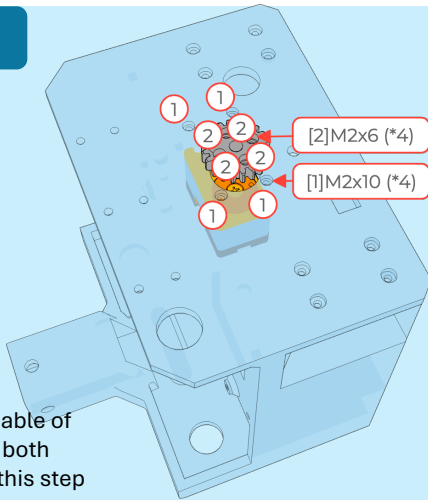
\*Plug in the cable of the IMU before this step. The cable is 4 jumper wires taped together. The pin mapping is shown below. Watch the video for an example.



## Torso assembly in 10 steps

More steps are on the next page...

## Step 1

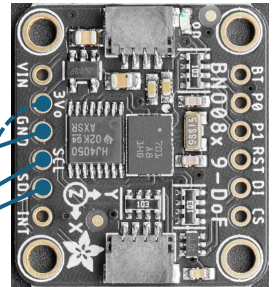
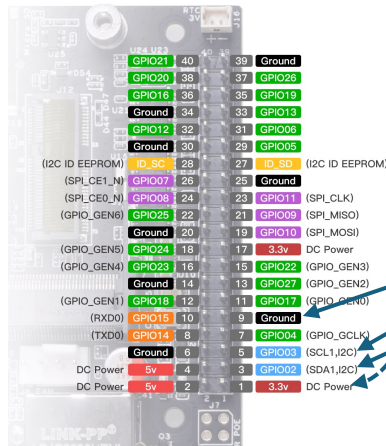


\*Plug in the cable of the motor on both sides before this step

5v 3.3v I2C GND UART SPI GPIO

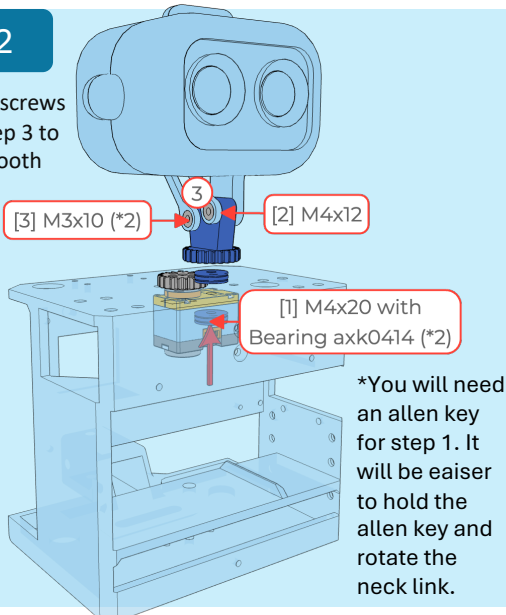
Credit:

<https://files.seeedstudio.com/wiki/re-Computer-Jetson-Nano/59.png>  
<https://learn.adafruit.com/adafruit-9-dof-orientation-imu-fusion-breakout-bno085/pinouts>



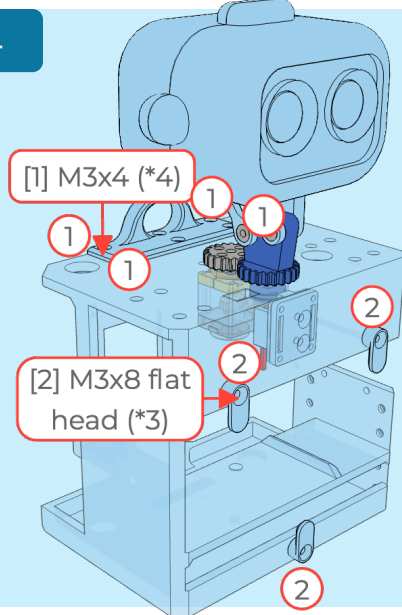
## Step 2

\*Loosen the screws slightly in step 3 to allow for smooth rotation.



\*You will need an allen key for step 1. It will be easier to hold the allen key and rotate the neck link.

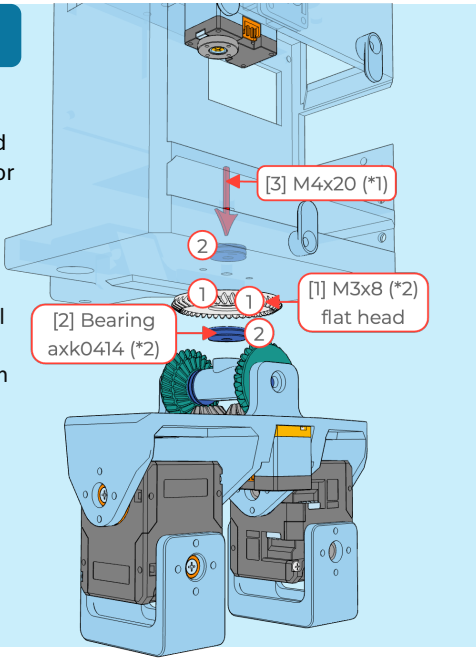
## Step 4





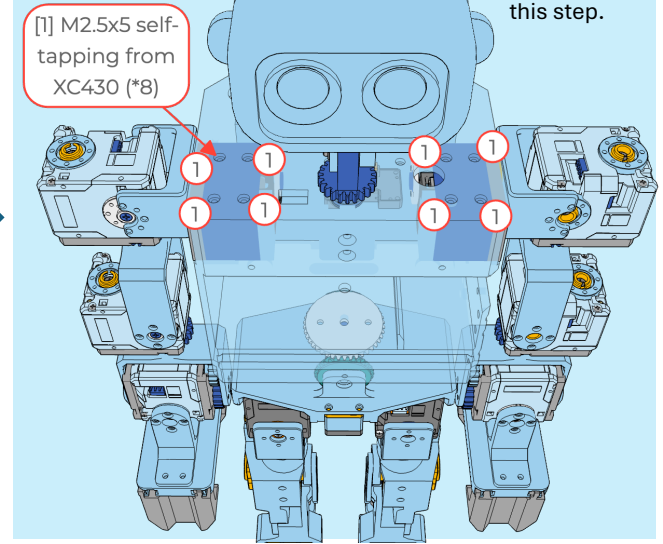
## Step 5

\*You will need an allen key for step 3. Ensure this screw is securely fastened, as it could very well be the most critical screw in the entire assembly.



## Step 6

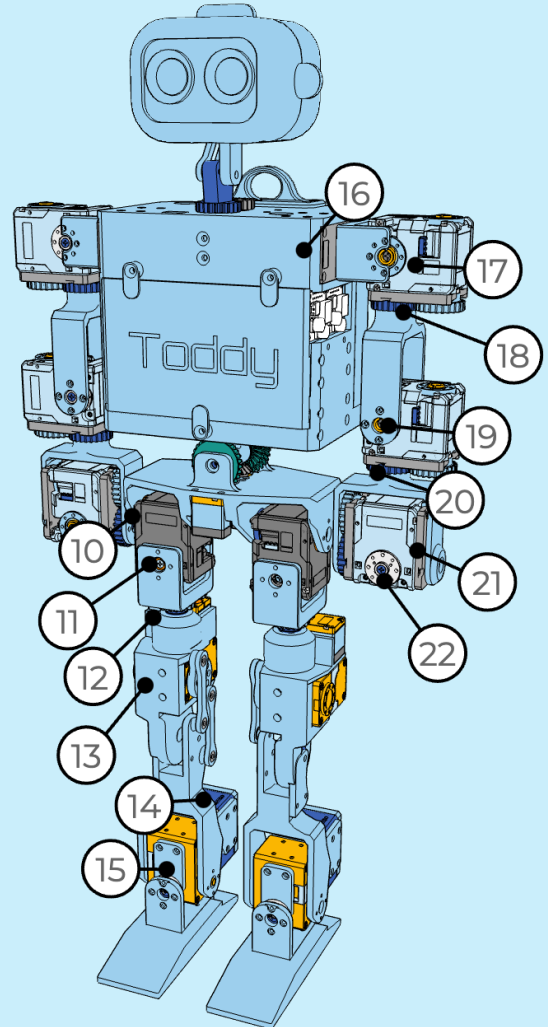
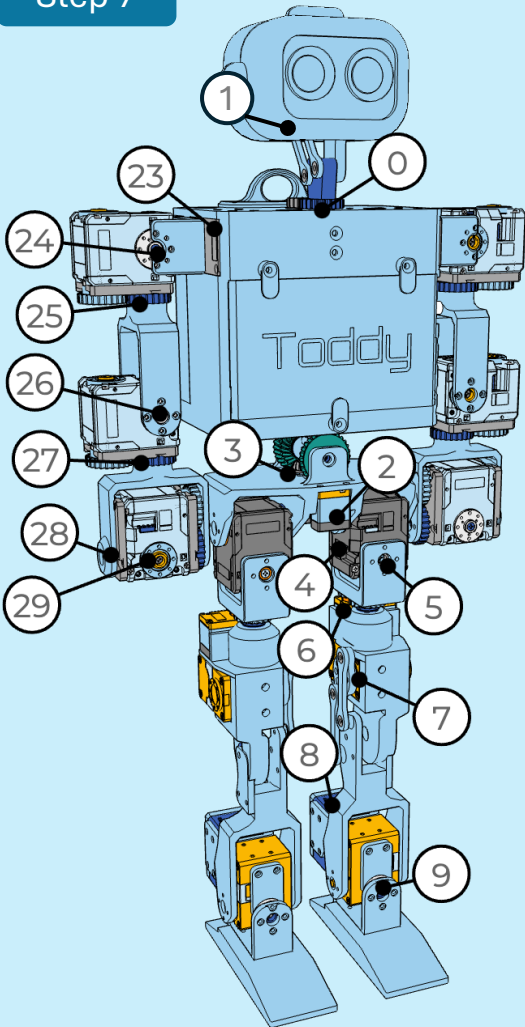
\*Plug in the cables of XC430 before this step.



## Step 7

\*ID the motors **one at a time**, otherwise the ID might conflict. Refer to the video for guidance. The ID of each motor is listed here. Set the baudrate to 2M. For the 2X motors, two IDs will appear. To distinguish between them, move the joint and observe which position reading changes.

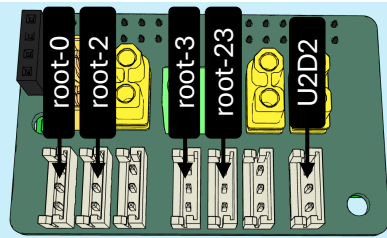
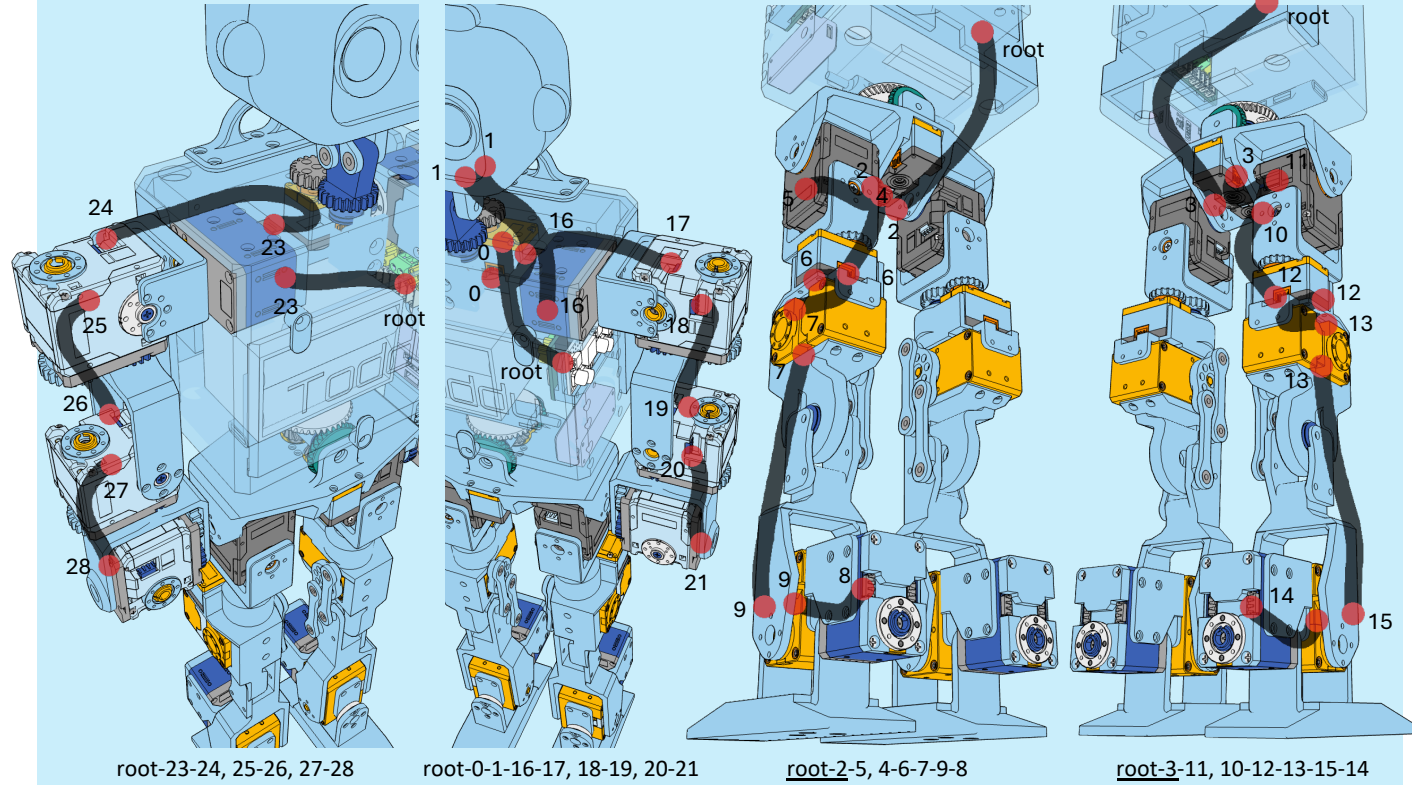
\*To proceed, you will need the Dynamixel power hub, U2D2, a 12V power adapter, and a computer with Dynamixel Wizard 2.0 installed. Ensure the power hub switch is turned on. The power hub's light serves as an indicator.





## Step 8

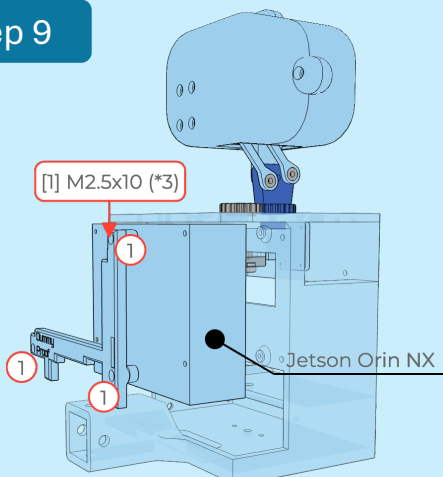
\*Watch the video for how to prepare the power board. Then chain all the motors to the communication board (root) with this diagram as a reference. For root-2 and root-3, use longer wires with JST EH pre-crimped cables and JST EH housing from the BOM. The wiring below is not the only solution but pay attention to how we organize the cables through holes on the torso. Ensure that motor can move without restriction. After this step, connect a leaf motor to the power hub and verify that all the motors are detected in Dynamixel Wizard.



\*When you connect wires to the power board, it's important to follow this slot allocation to balance current distribution to each step-down converter on the back.

**IMPORTANT:** Time for a break! Ensure Jetson is set up before proceeding by following the steps in our documentation.

## Step 9

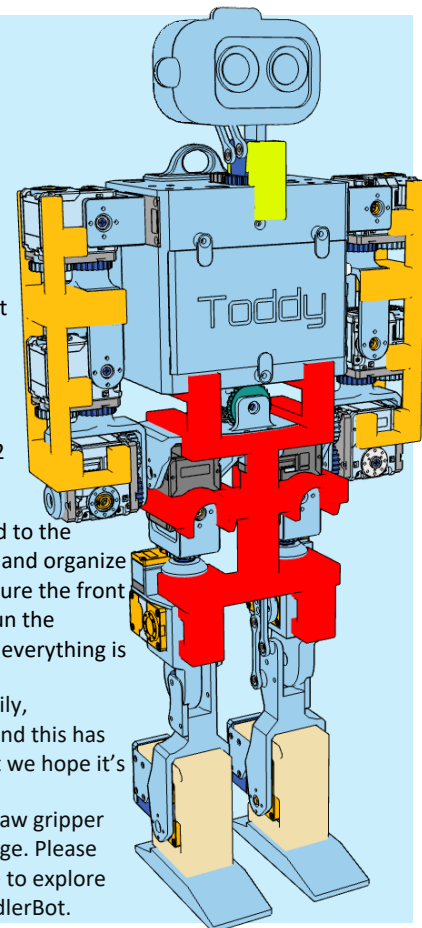


\*Connect the USB hub and the communication board to Jetson before proceeding with the Jetson installation.

## Step 10

\*Watch the video for a complete walkthrough. When installing the calibration devices, ensure cables are positioned properly to avoid interference. Run the calibration script to record the zero point. Connect the camera cables and the speaker cable to the USB hub, and the Dynamixel U2D2 to Jetson.

\*Attach the power board to the torso. Insert the battery and organize all the cables neatly. Secure the front cover in place. Finally, run the standing policy to test if everything is functioning correctly. If Toddy can stand steadily, congrats!!! We understand this has been a long journey, but we hope it's worthwhile. We include the parallel jaw gripper assembly on the next page. Please visit our tutorial website to explore more skills for your ToddlerBot.



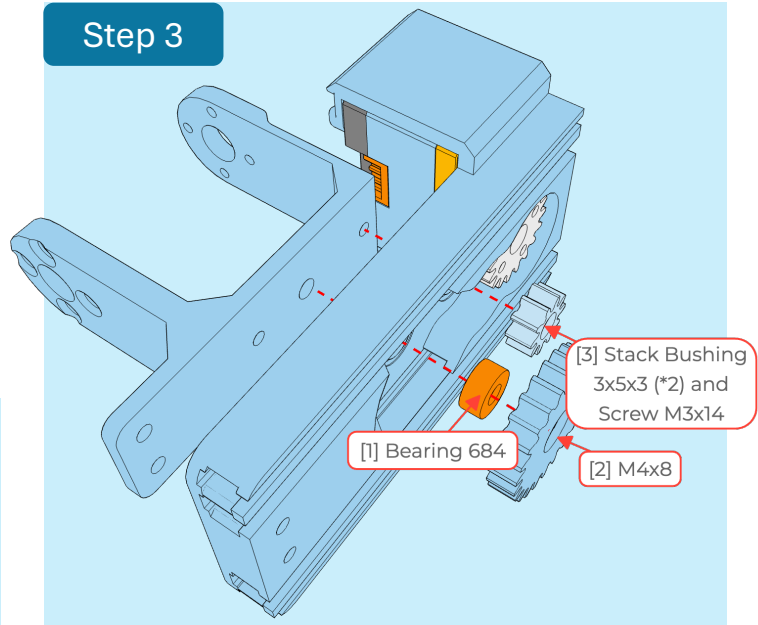
### Hardware:

- Bearing 684 (\*1)
- Bushing 3x5x3 (\*2)
- M2x8 (\*7)
- M3x10 (\*2)
- M3x12 (\*1)
- M4x8 (\*1)

### Others

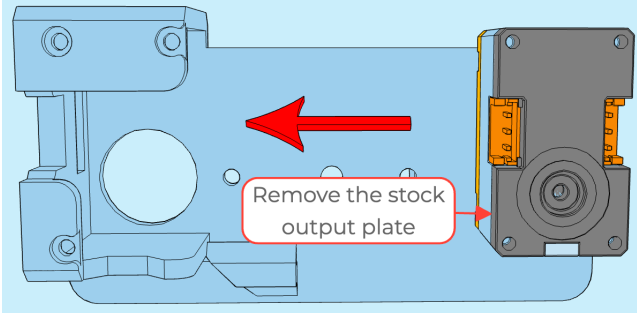
- XC330 (\*1)
- 3D-print:**
- Remove the support before you start

### Step 3

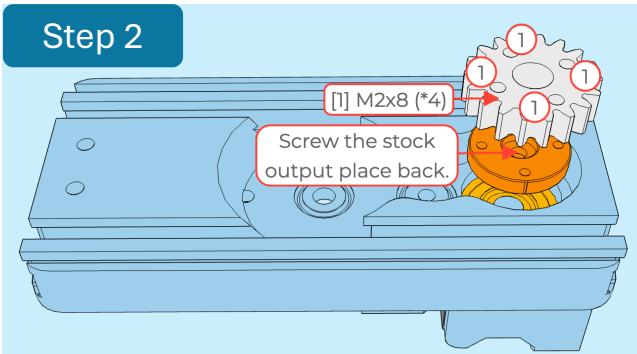


## Gripper assembly in 5 steps

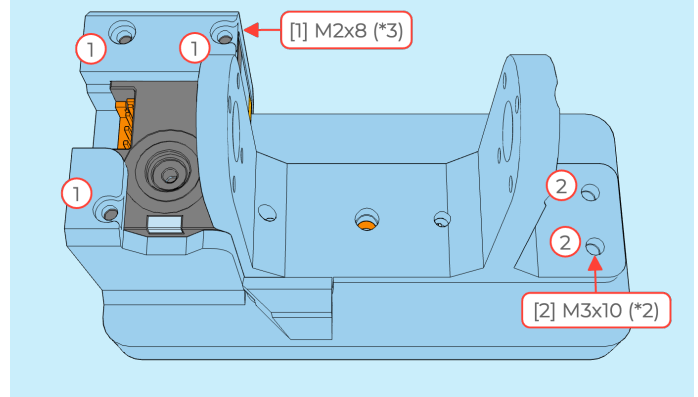
### Step 1



### Step 2



### Step 4



### Step 5

\*The zero point of the parallel jaw gripper is shown below. Manually move the fingers to this position before running the calibration script.

