

smorphi²
transforming learning with
transformer robots

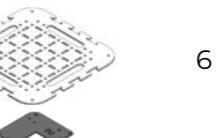
assembly & info

(contents)

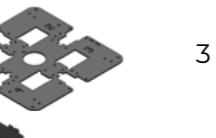
PART LIST	-----	(02)
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SMORPHI ASSEMBLY		
 MECHANICAL	-----	(05)
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(part list)

8 x Acrylic Base Plate



4 x Aluminium Base Plate



8 x Base Skirt Panel A



8 x Base Skirt Panel B



8 x Mecanum Wheel (Right)



8 x Mecanum Wheel (Left)



16 x Mecanum Motor



16 x Motor Shaft Sleeve



16 x Motor Mount



6 x Solenoid



6 x Solenoid Latch Mount



6 x Solenoid Latch Guide



6 x Solenoid Catch



All colors of parts are represented accurately here.
In the assembly steps, colors of some parts will be changed for diagram clarity.

6 x Hinge Mount



28 x Hex F-F M3 Nylon 10mm



3 x Hinge Mechanism



200 x Cap Screw M3x5



1 x Battery



50 x Cap Screw M3x25



2 x Battery bracket



15 x Countersunk Screw M4x8



1 x Masterboard (ESP32)



2 x Wing Screw M3x5



4 x Slaveboard



1 x USB-C Cable



1 x Sound Sensor



9 x 4-pin Connector



1 x Temperature Sensor



4 x 8-pin Connector



3 x IR Sensor



1 x Battery Charger



1 x Pixy2 Camera



1 x Ceramic Screwdriver CD-25



1 x Pixy2 Mount



1 x HEX Key 1.5mm



10 x Sensor Lock



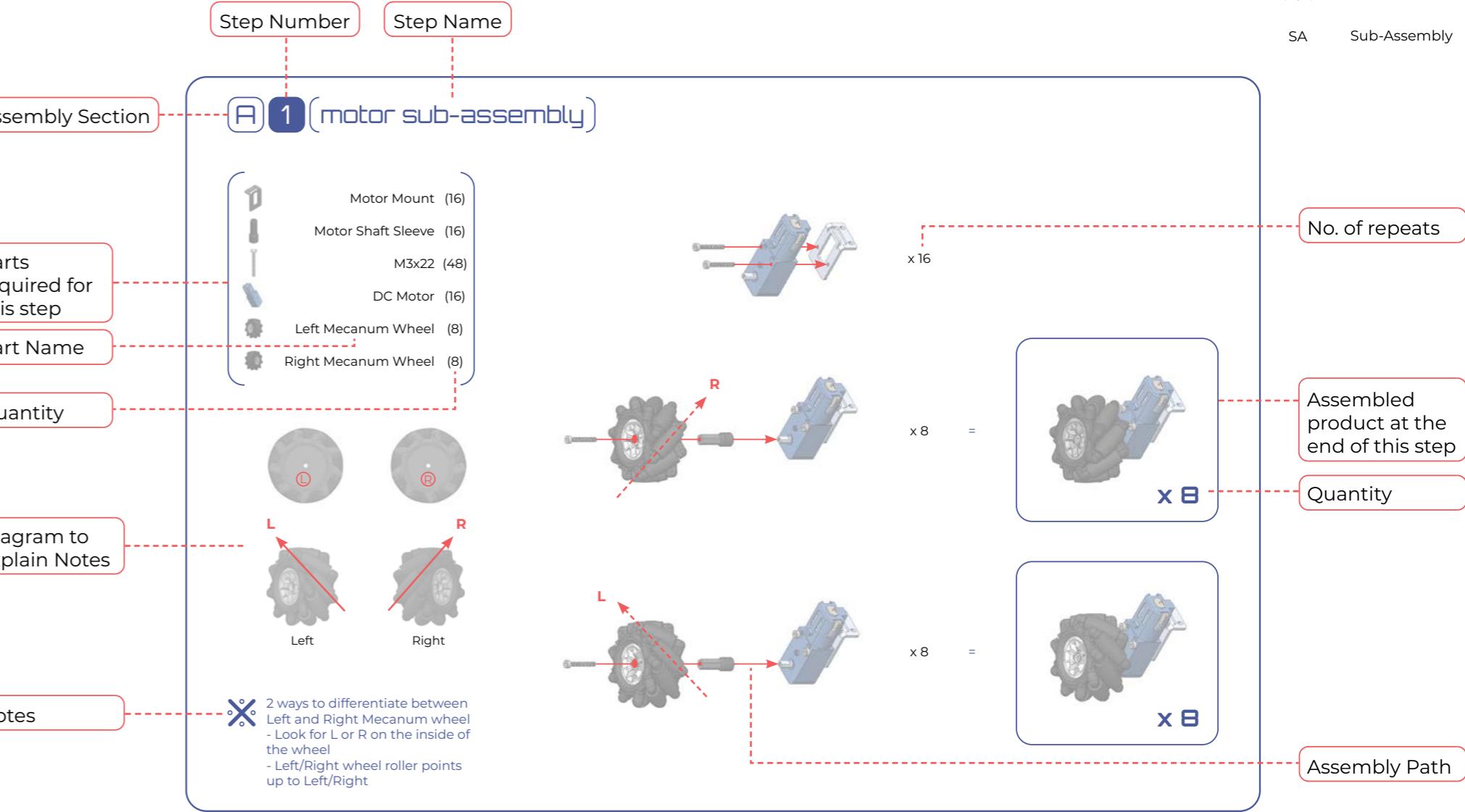
1 x Ribbon cable (included in pixycam package)



32 x Hex M-F M3 Nylon 45mm

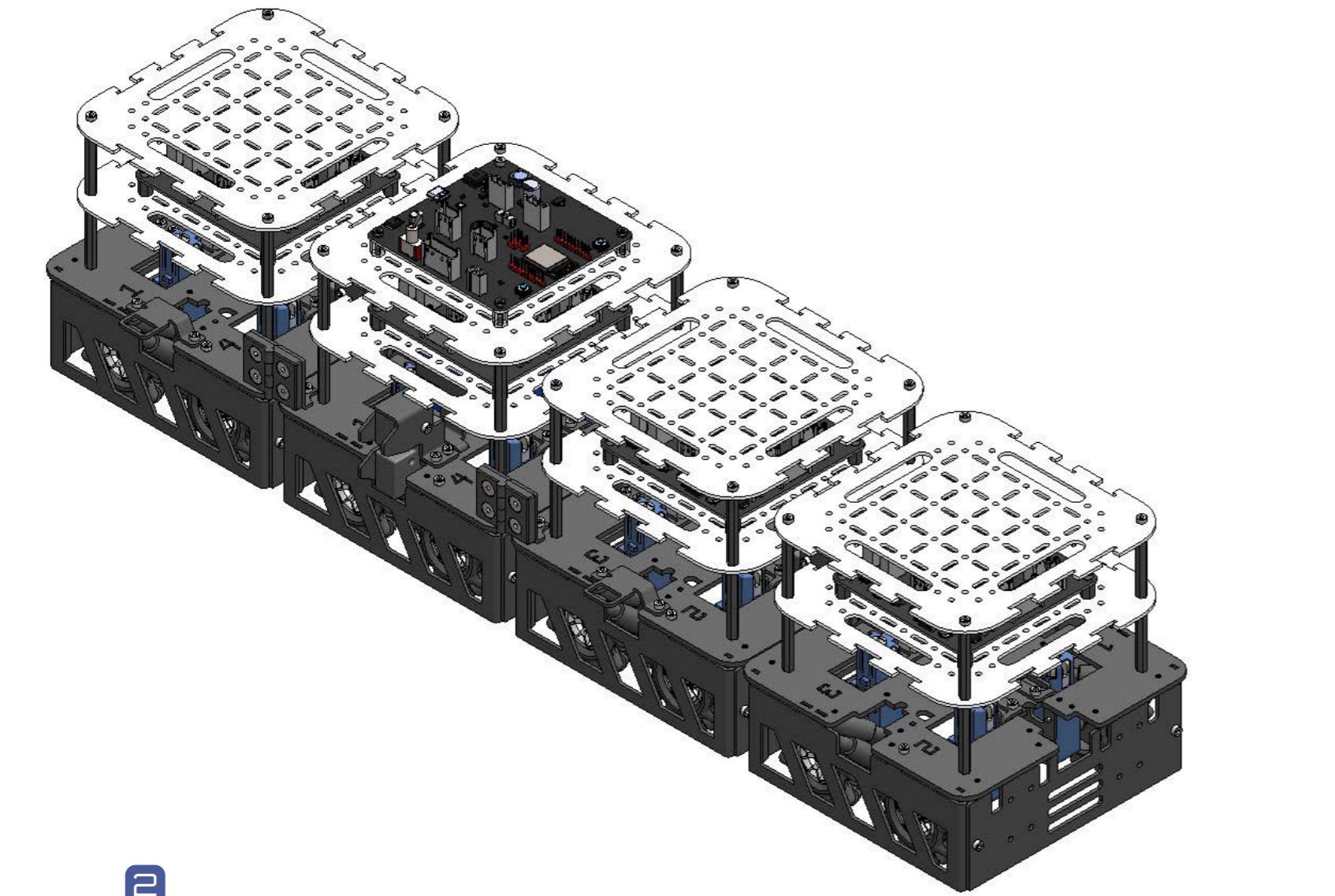


(basic assembly tips)



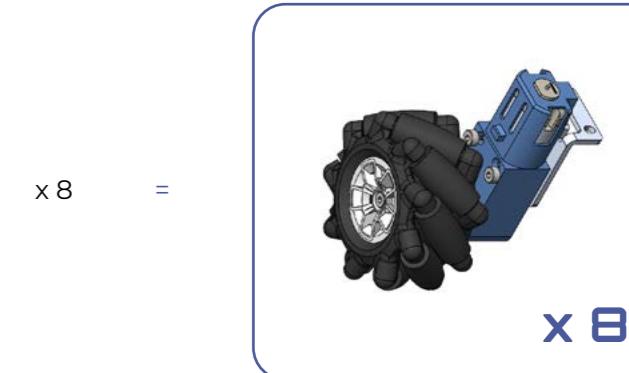
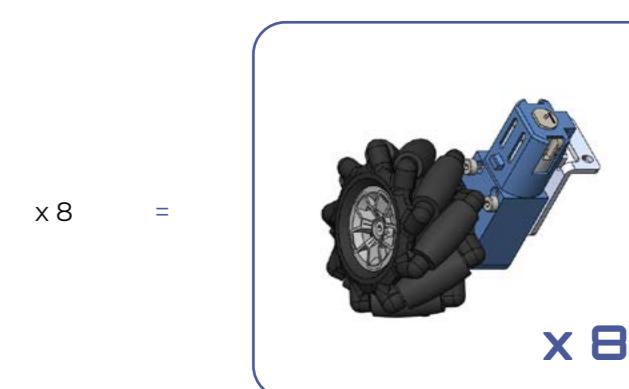
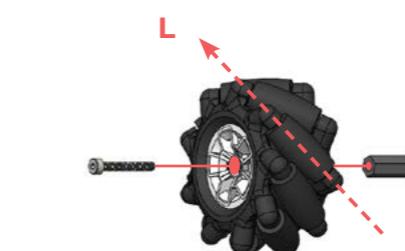
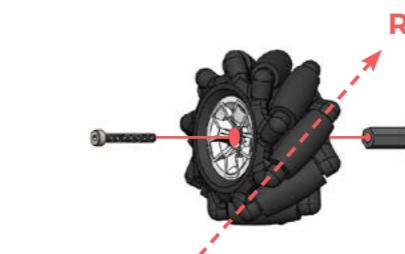
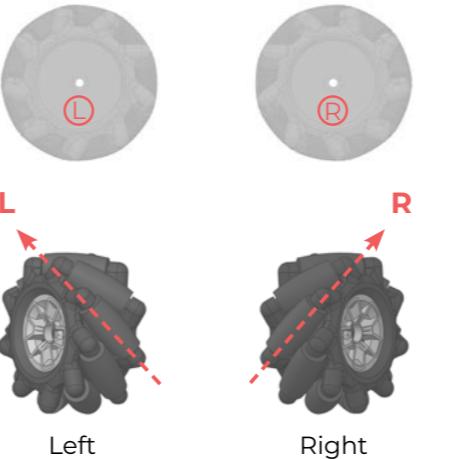
Symbols Used

	Rotate Part
	Assembly Path
	Important Note
SA	Sub-Assembly



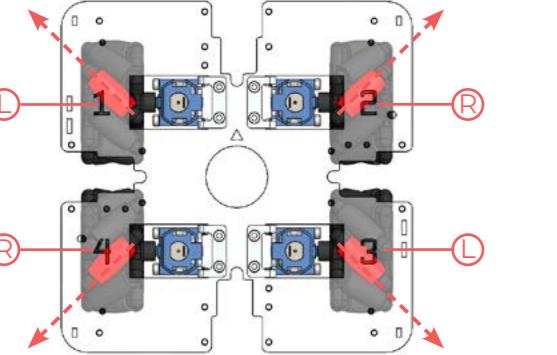
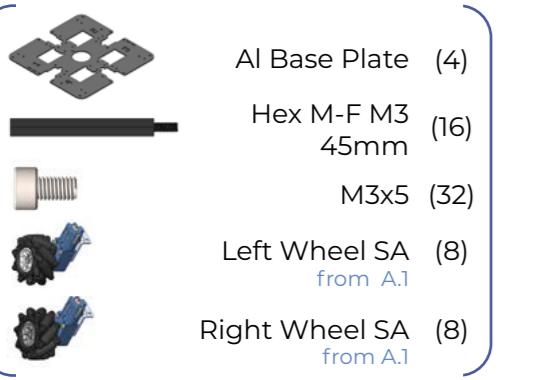
A 1 (motor sub-assembly)

- Motor Mount (16)
- Motor Shaft Sleeve (16)
- M3x22 (48)
- DC Motor (16)
- Left Mecanum Wheel (8)
- Right Mecanum Wheel (8)



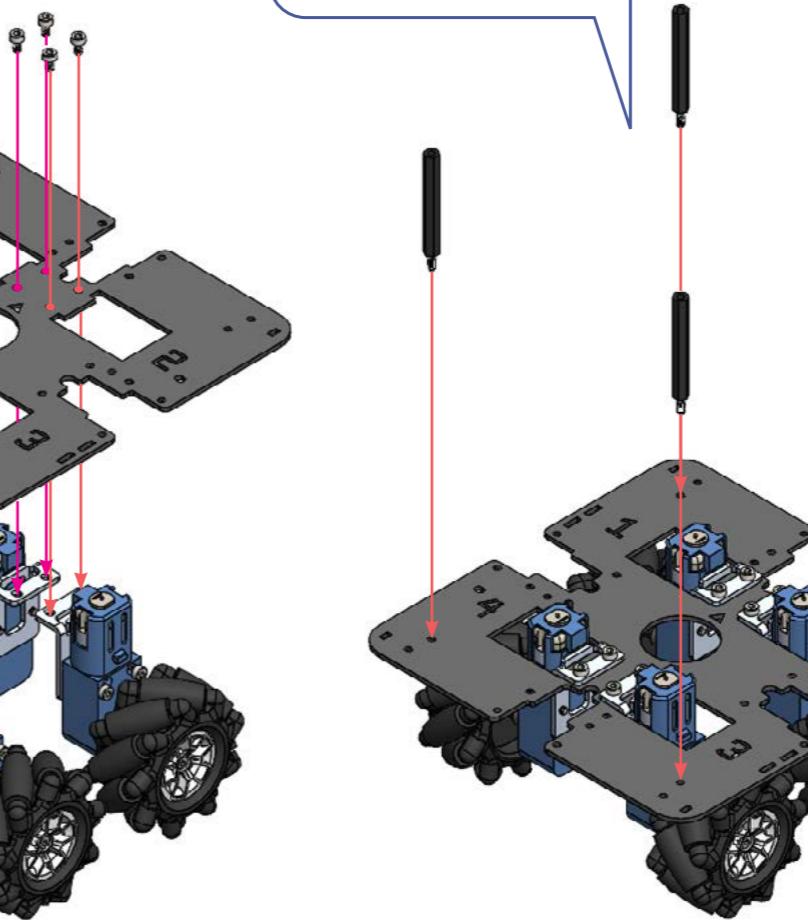
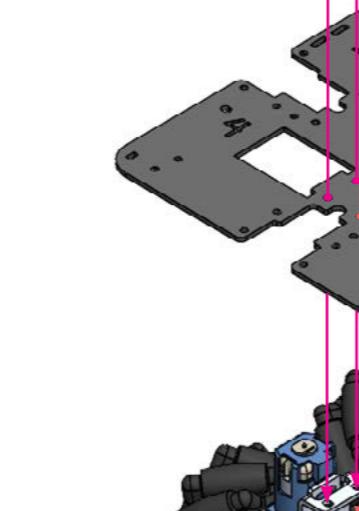
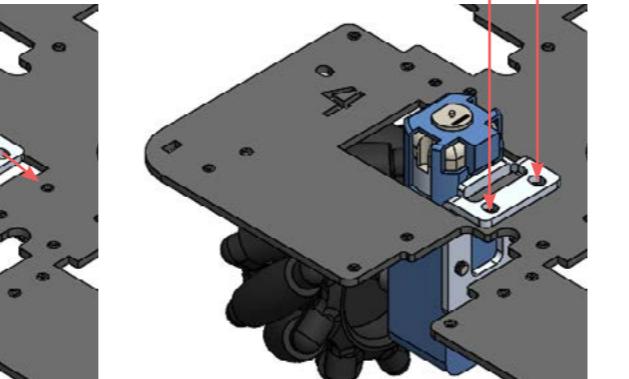
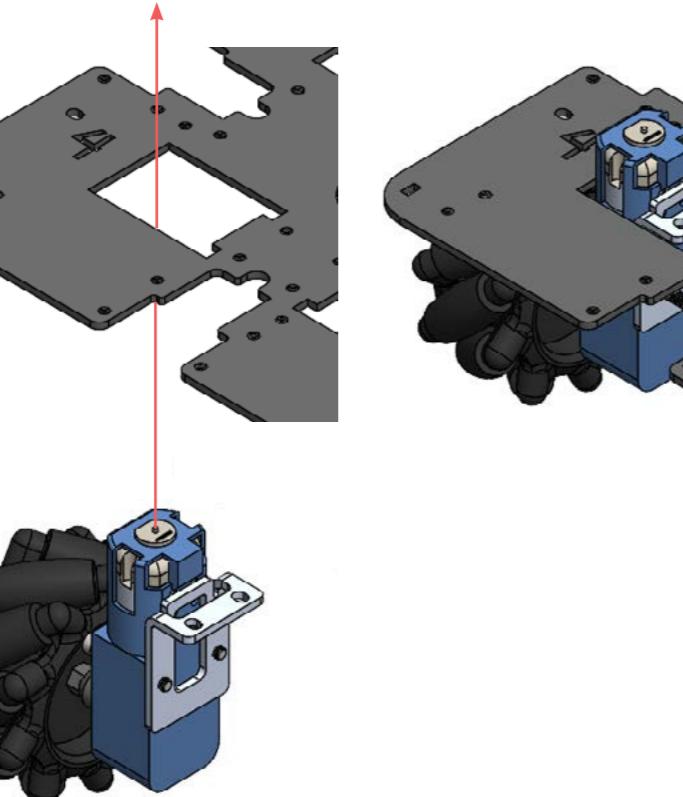
2 ways to differentiate between Left and Right Mecanum wheel
 - Look for L or R on the inside of the wheel
 - Left/Right wheel roller points up to Left/Right

A2 (base module sub-assembly)



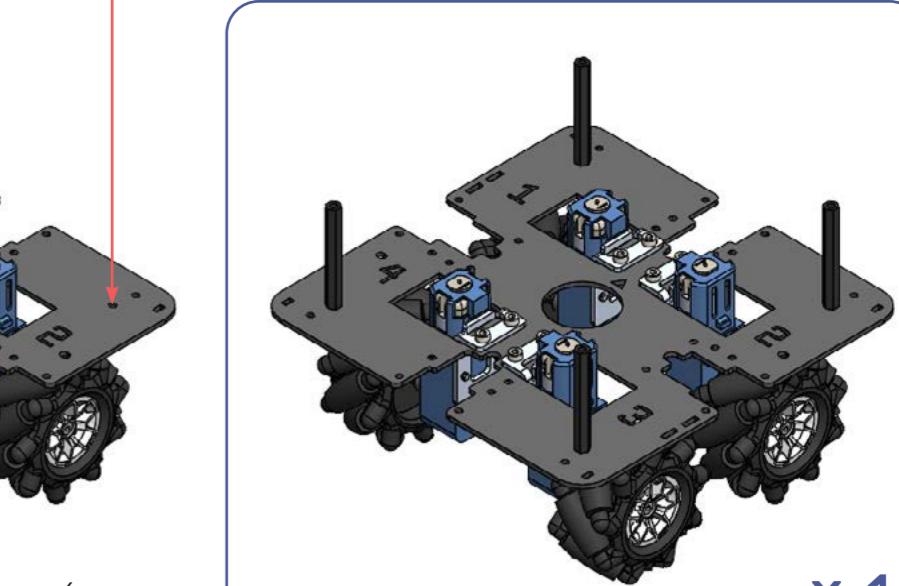
✖ Make sure that the numbers are facing the right way up as shown in the plan view above.

✖ Before attaching each wheel, check that the wheel is of the correct orientation for each numbered slot.



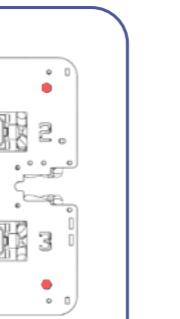
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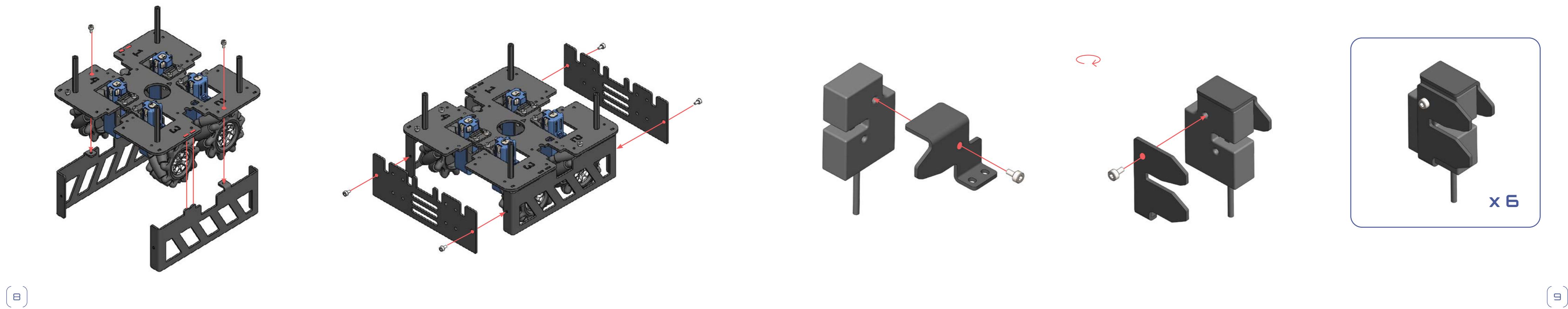
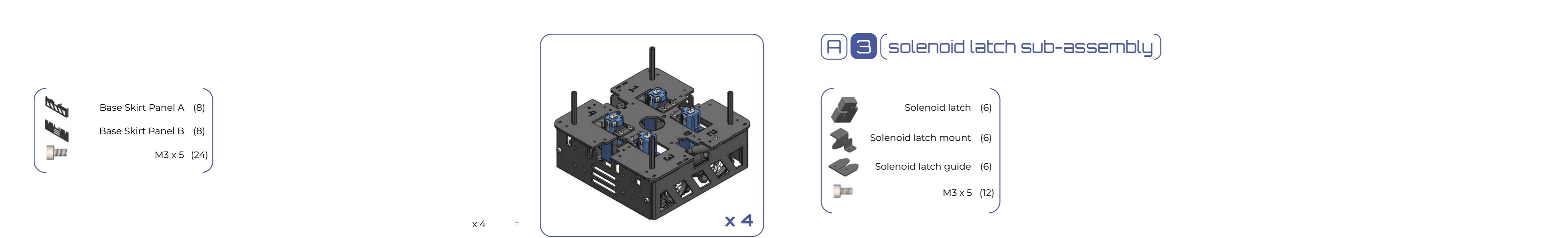
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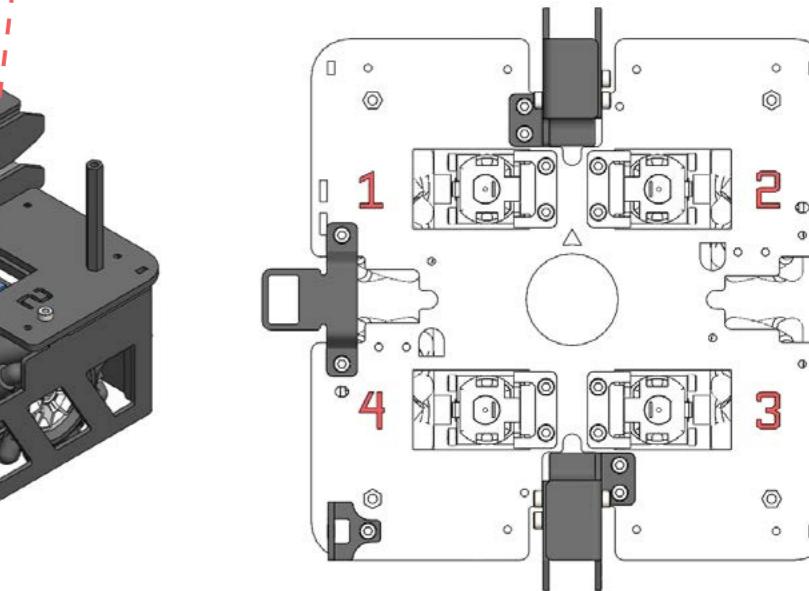
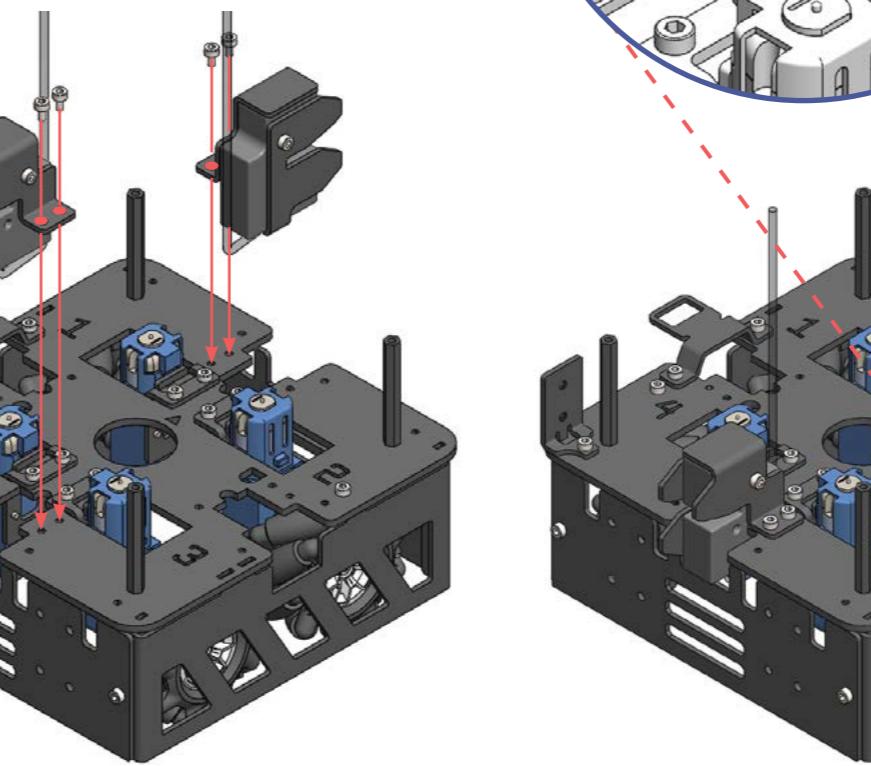
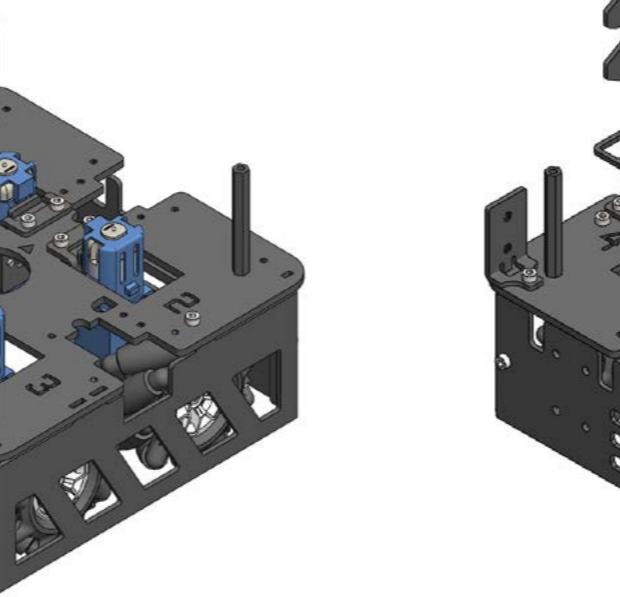
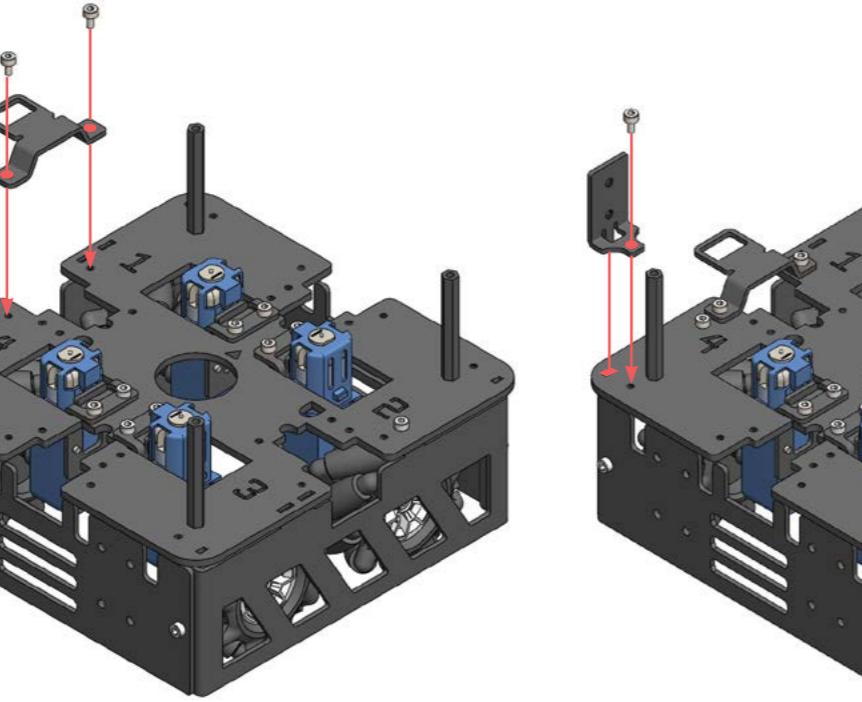
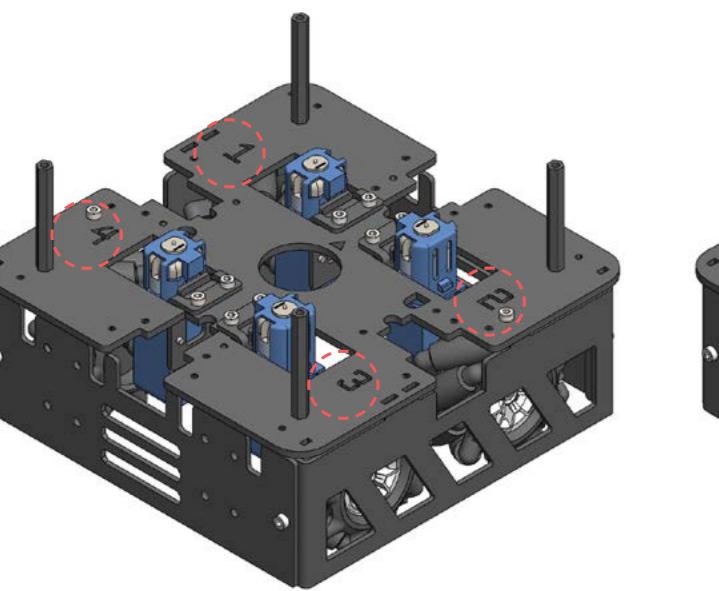
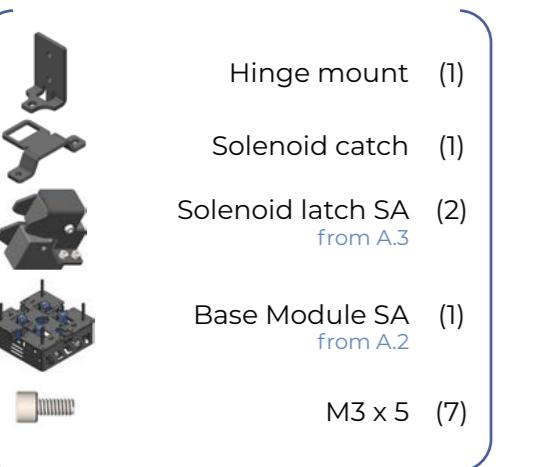
x 4

plan view





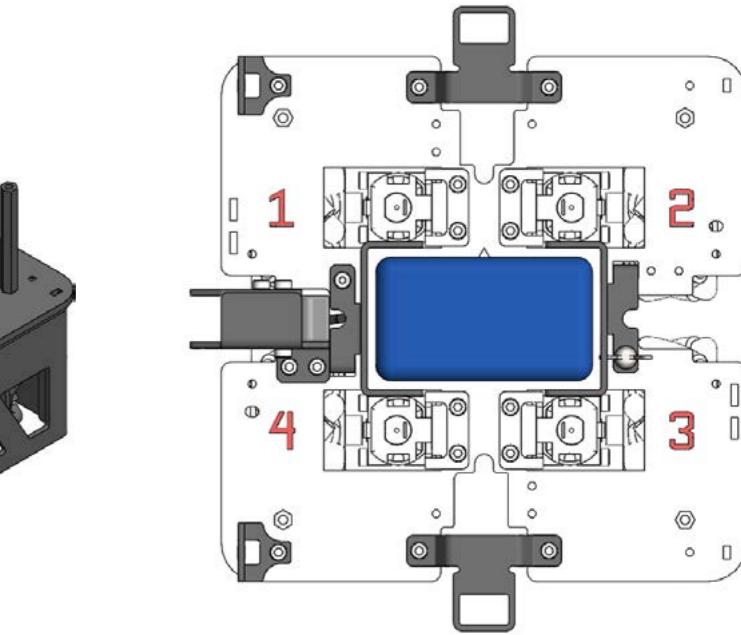
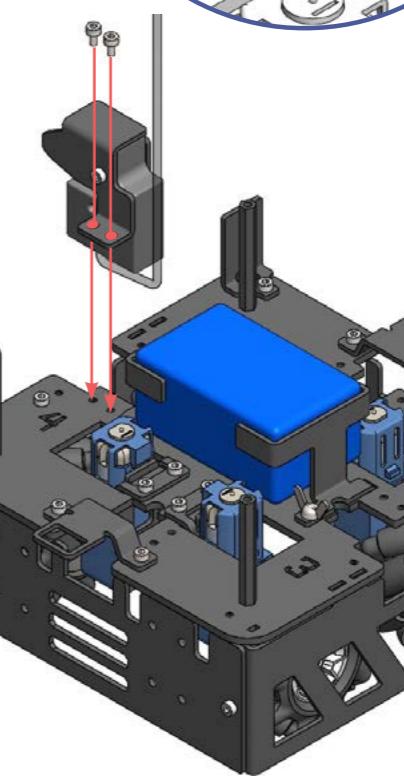
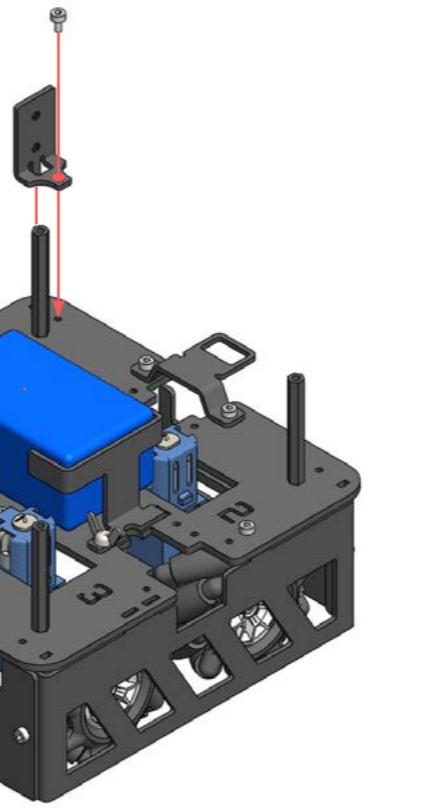
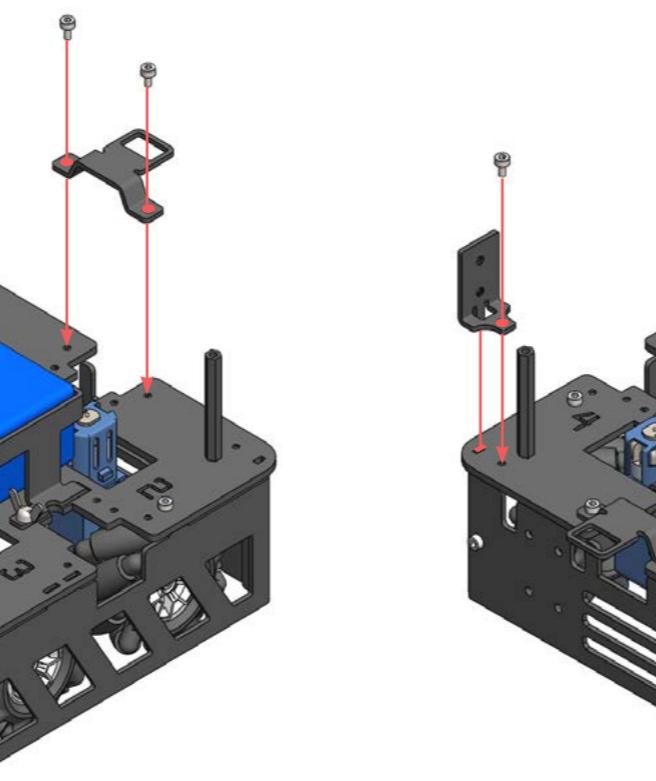
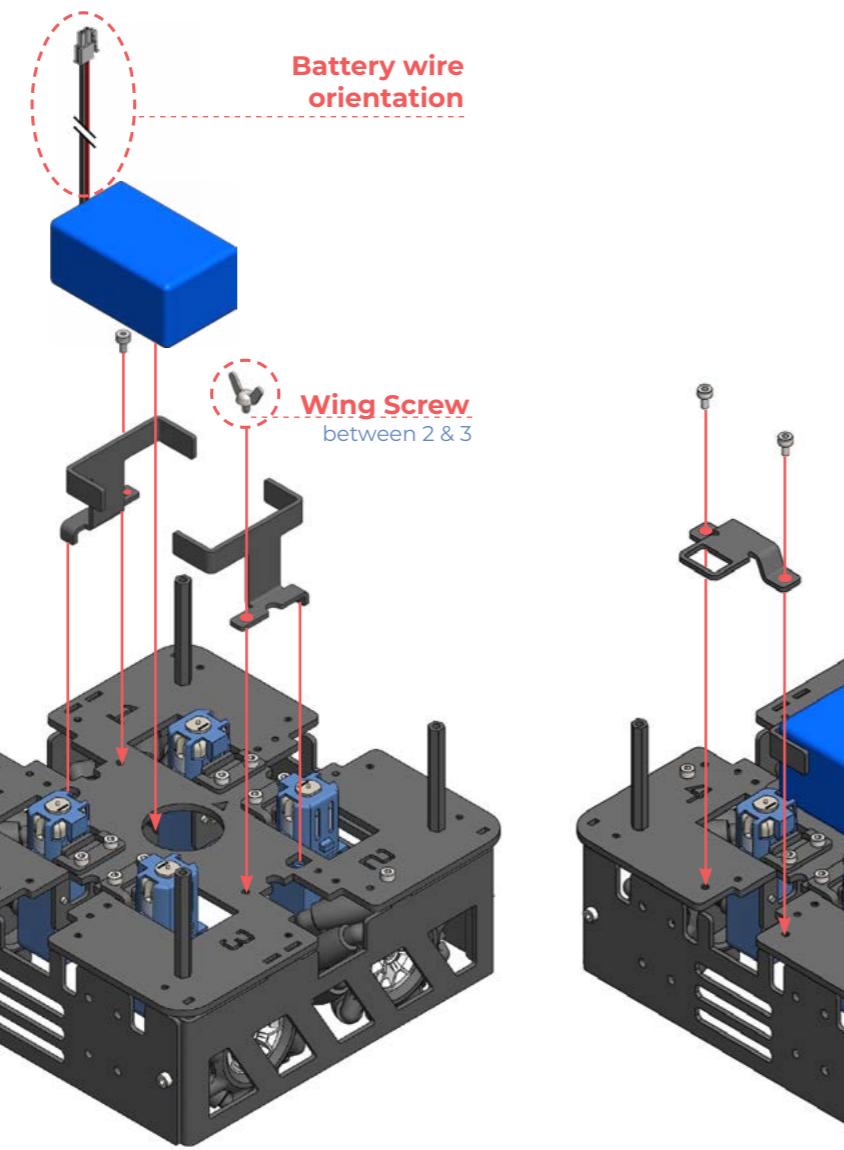
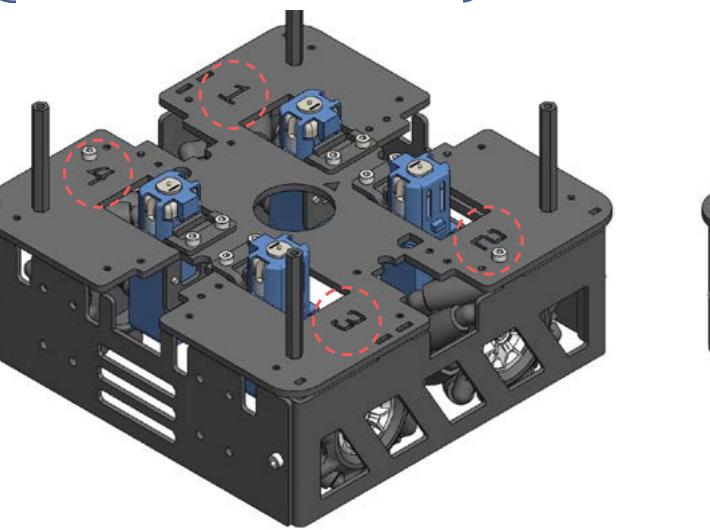
A 4 (module 1 mechanical sub-assembly)



✗ Pay attention to the numbers and their positions in relation to the parts being attached.

✗ Check that the parts have been attached in the right location, in relation to the numbers.

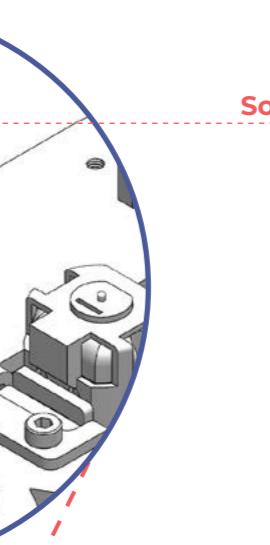
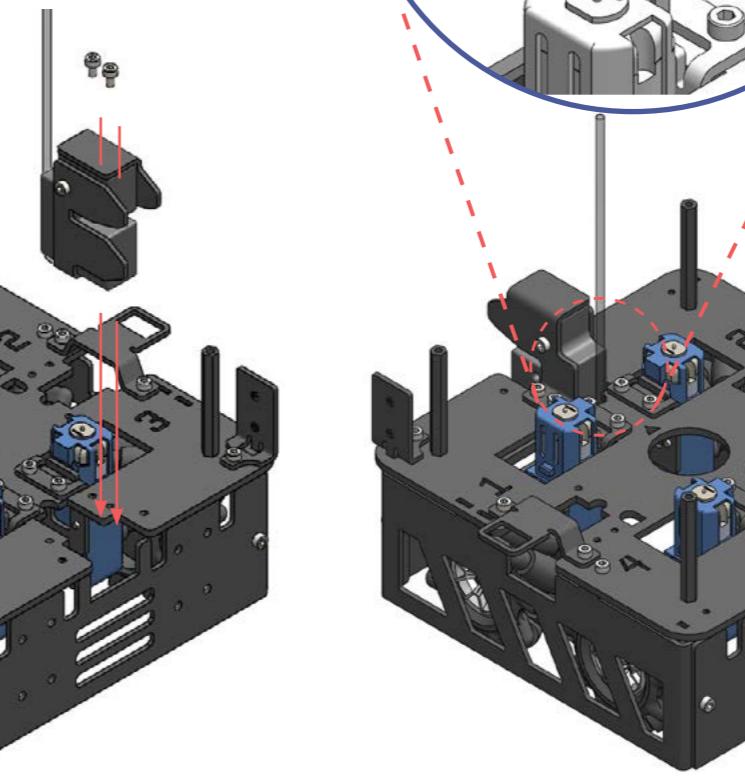
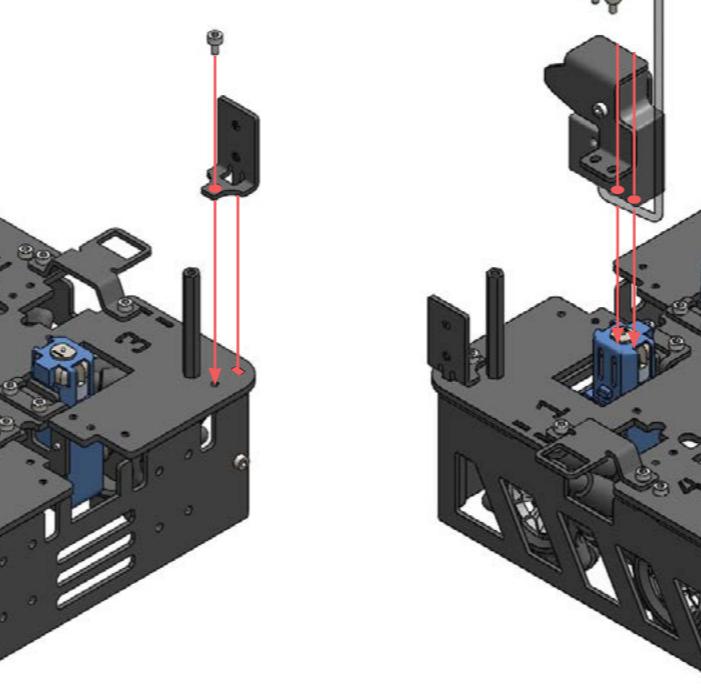
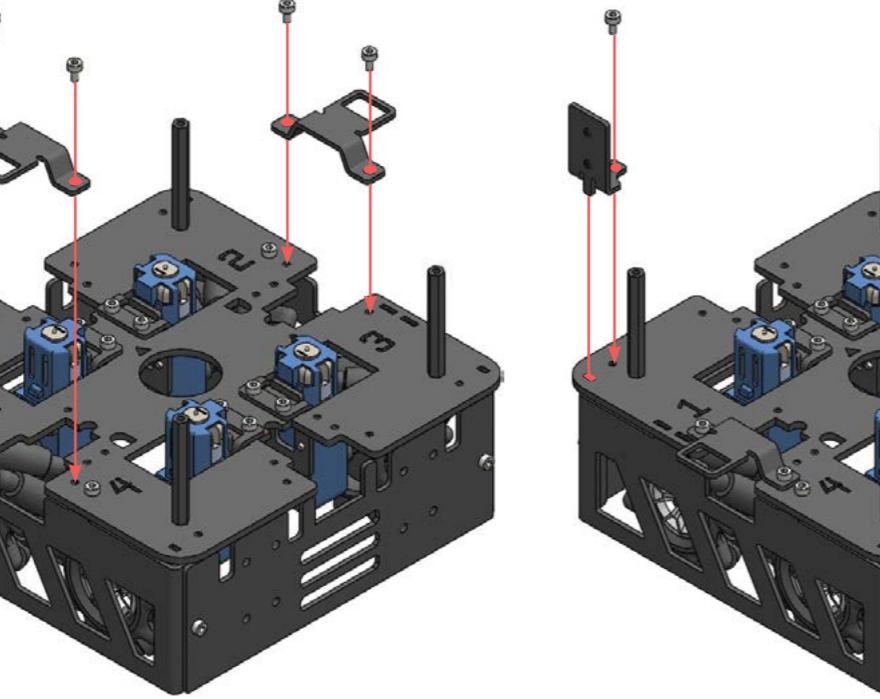
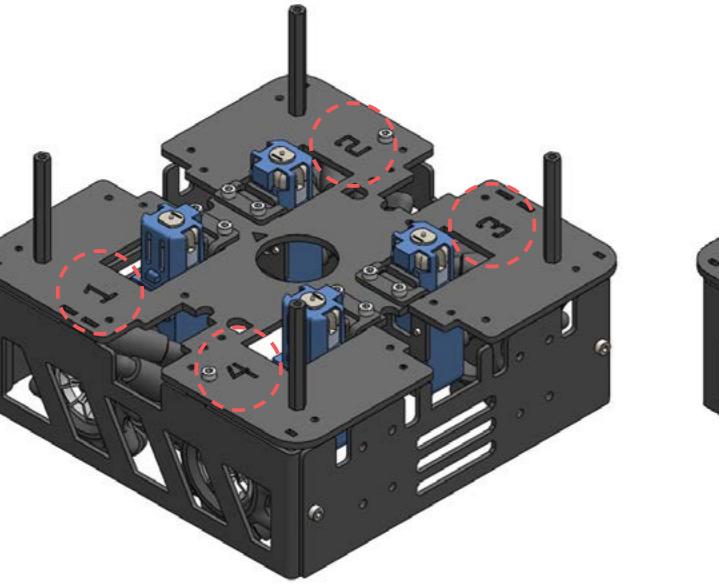
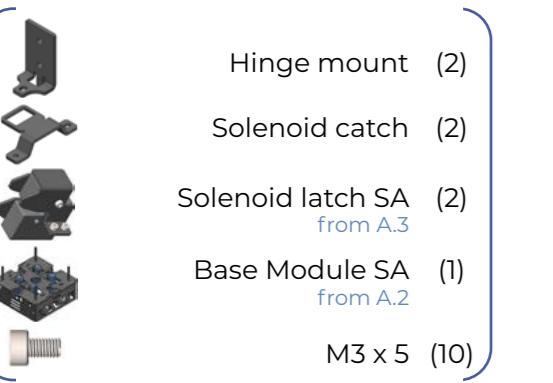
A5 (module 2 mechanical sub-assembly)



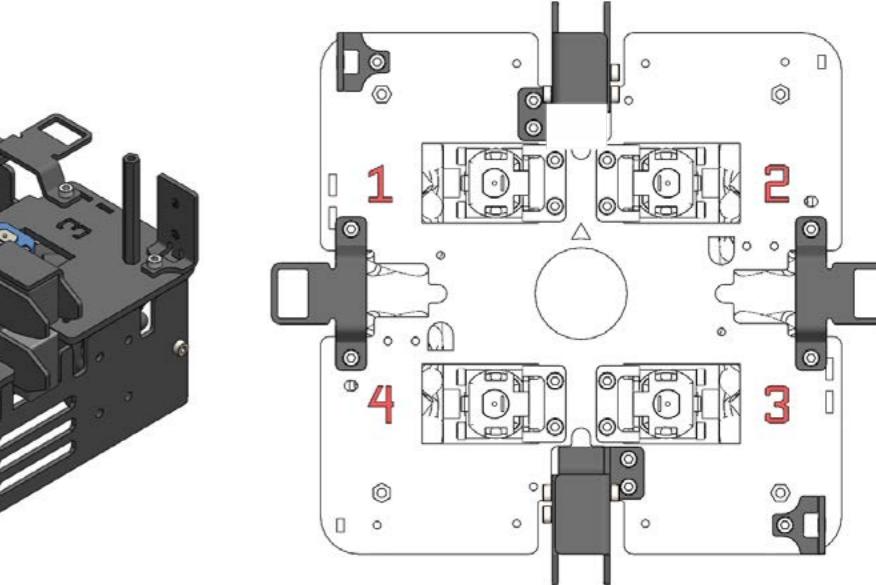
Pay attention to the numbers and their positions in relation to the parts being attached.

Check that the parts have been attached in the right location.

A6 [module 3 mechanical sub-assembly]

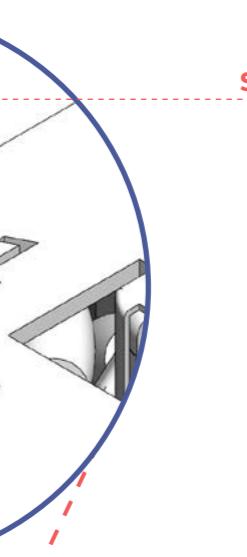
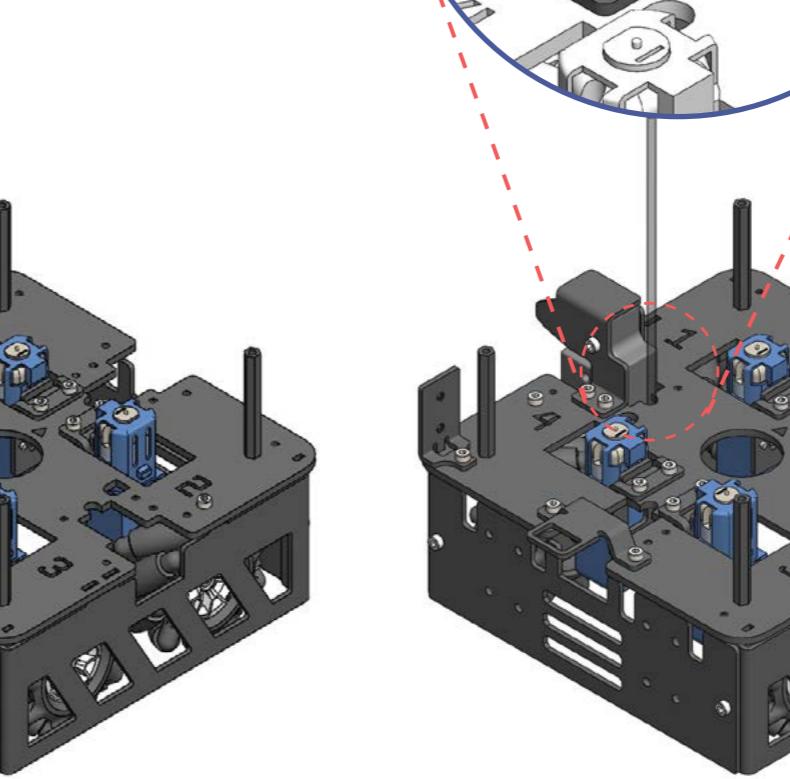
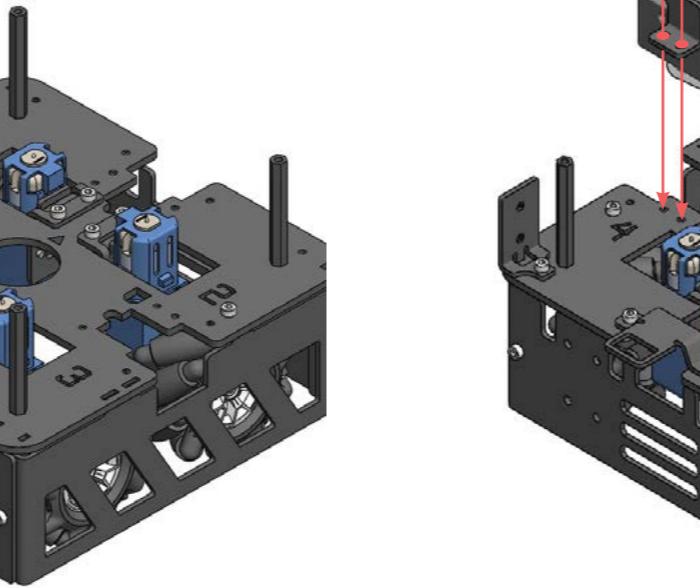
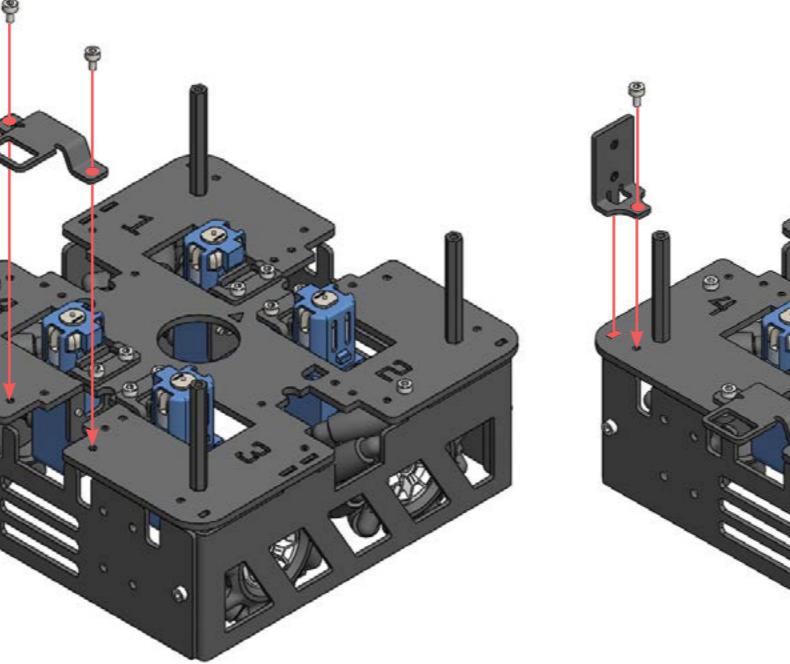
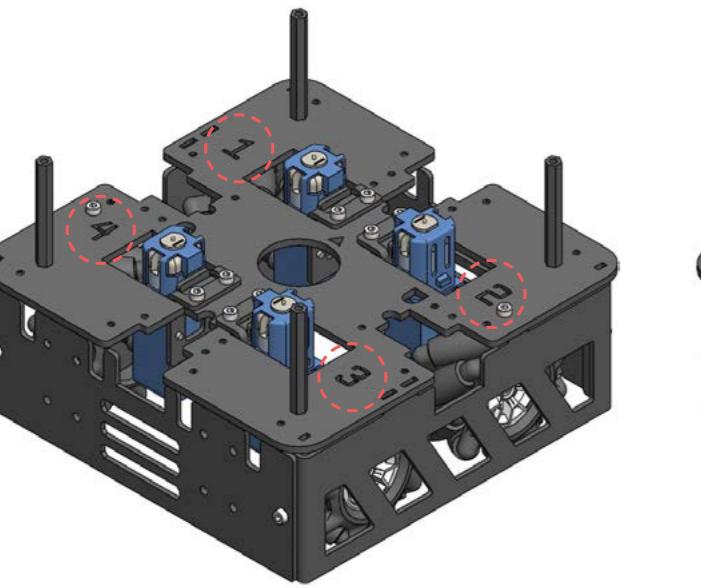
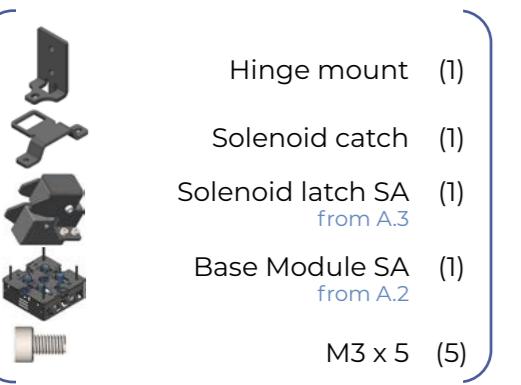


Solenoid Wire

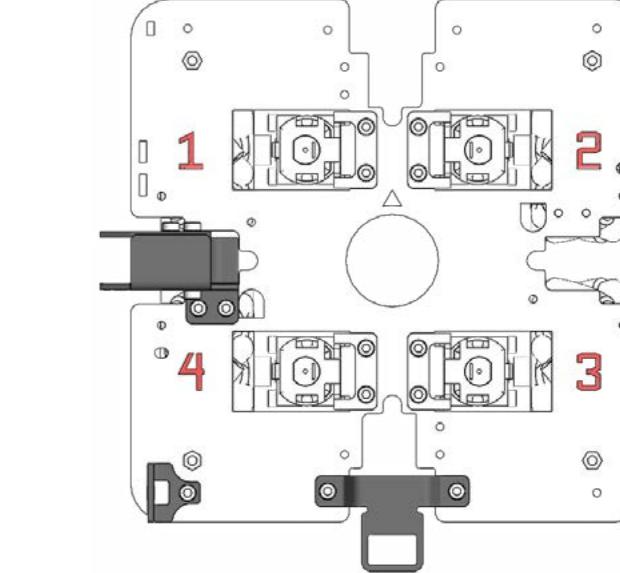


Check that the parts have been attached in the right location, in relation to the numbers.

A7 (module 4 mechanical sub-assembly)



Solenoid Wire



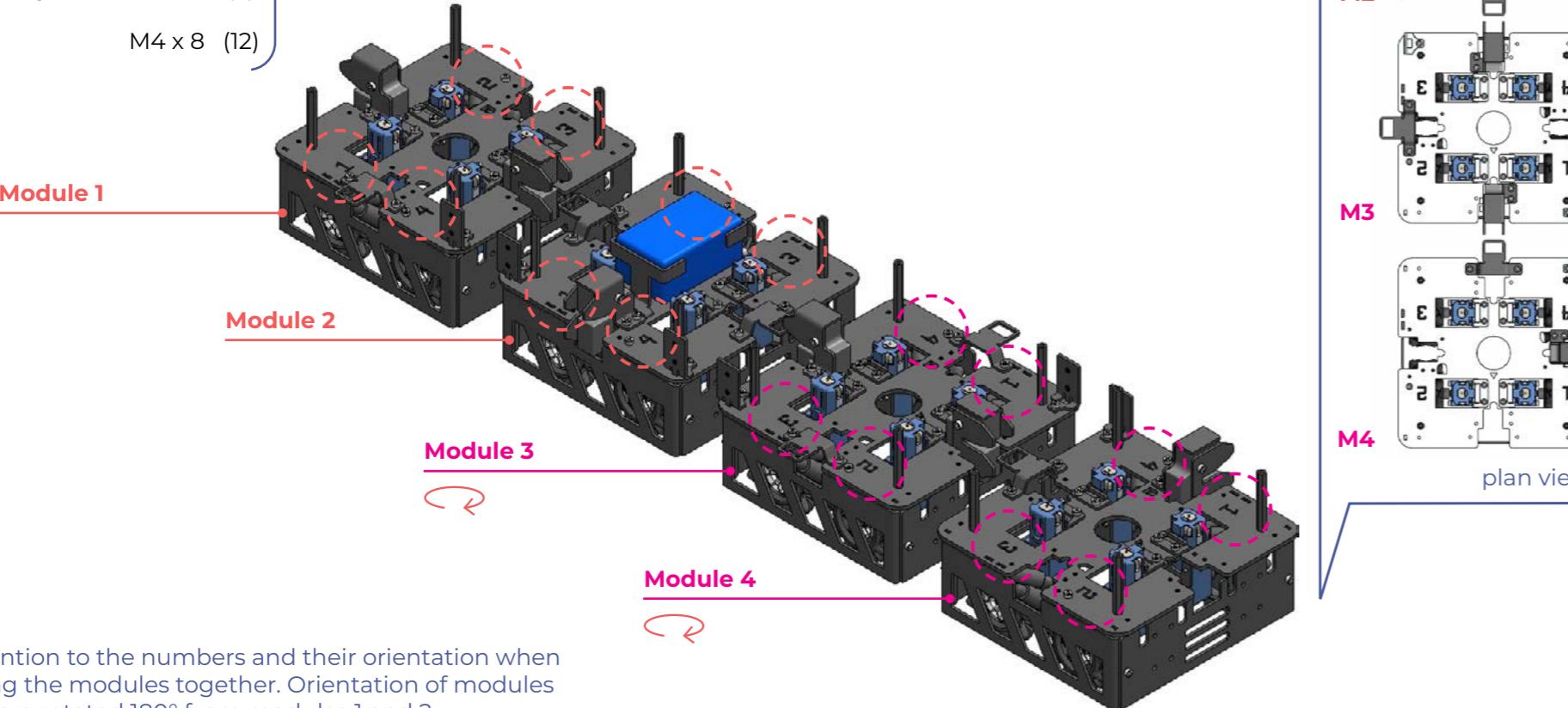
✗ Pay attention to the numbers and their positions in relation to the parts being attached.

✗ Check that the parts have been attached in the right location.

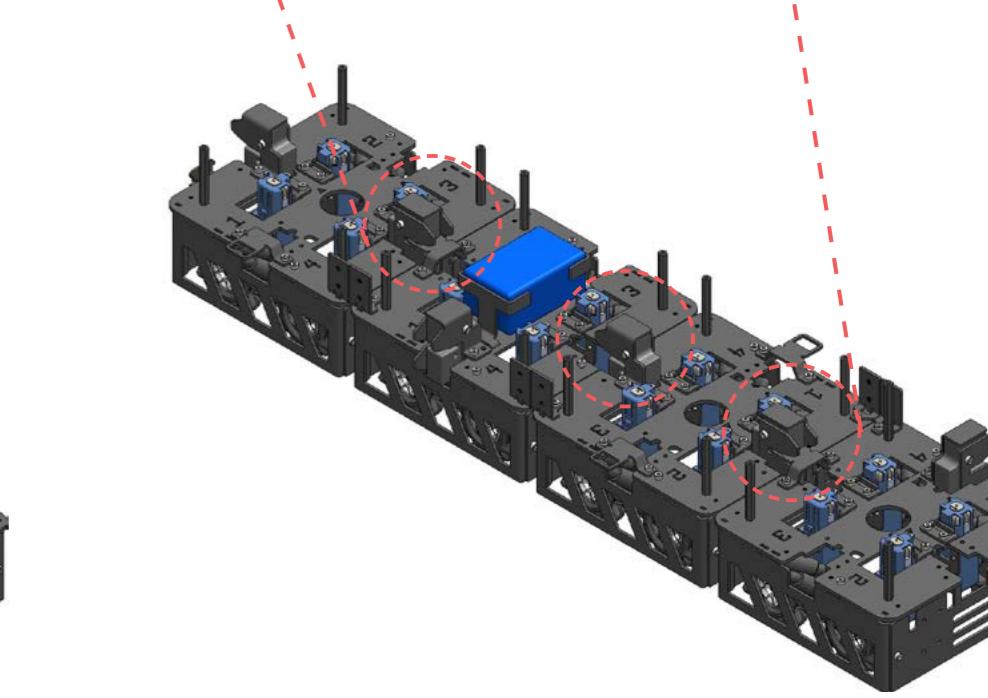
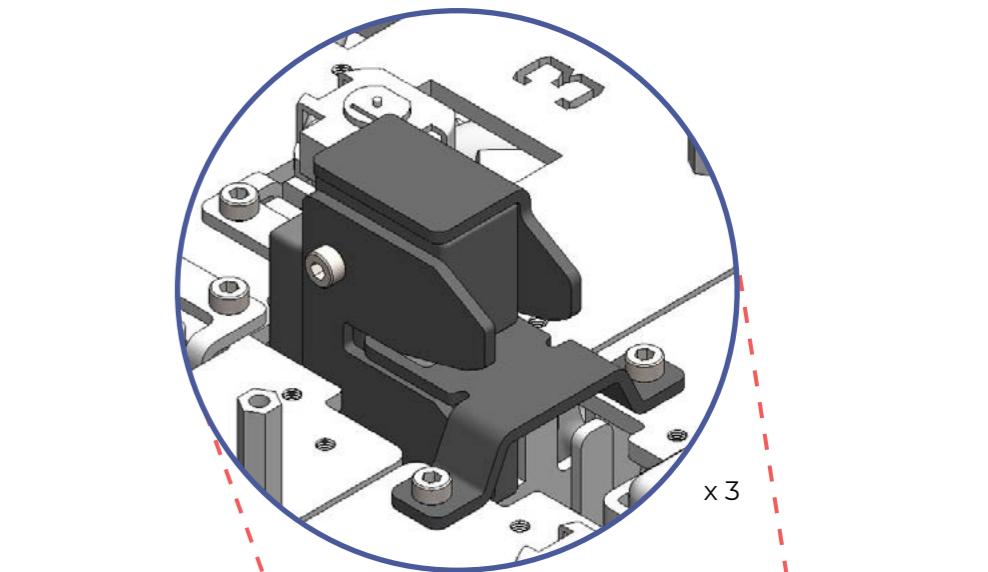
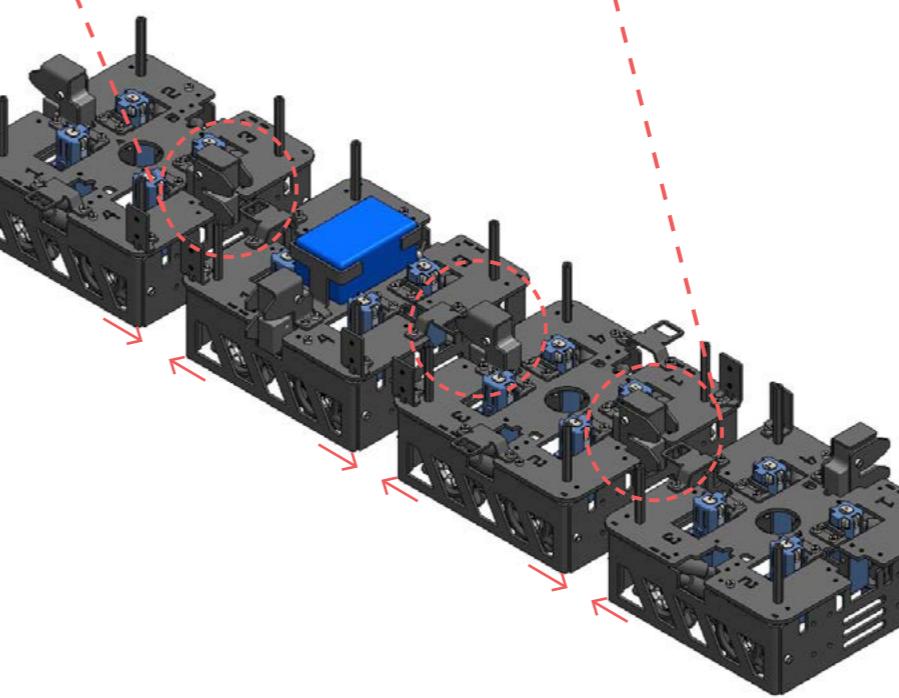
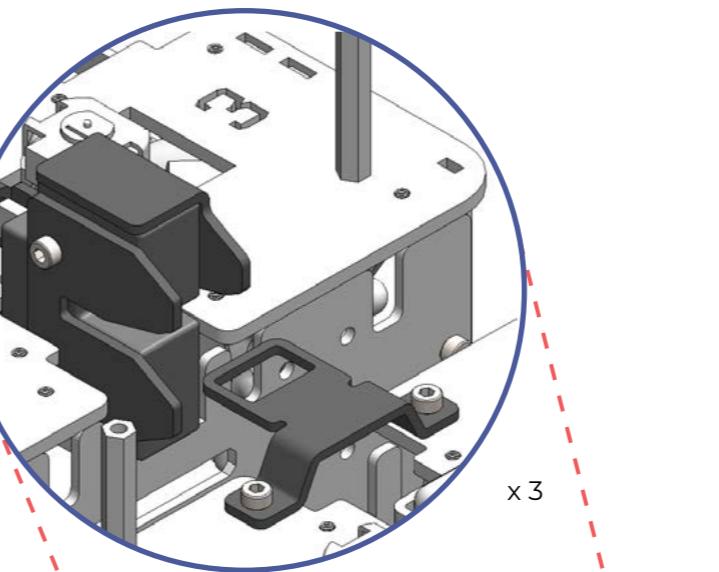
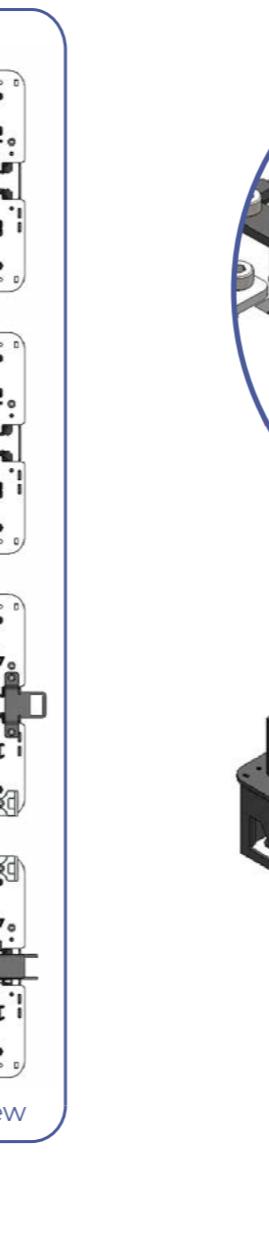
A8 (full mechanical assembly)

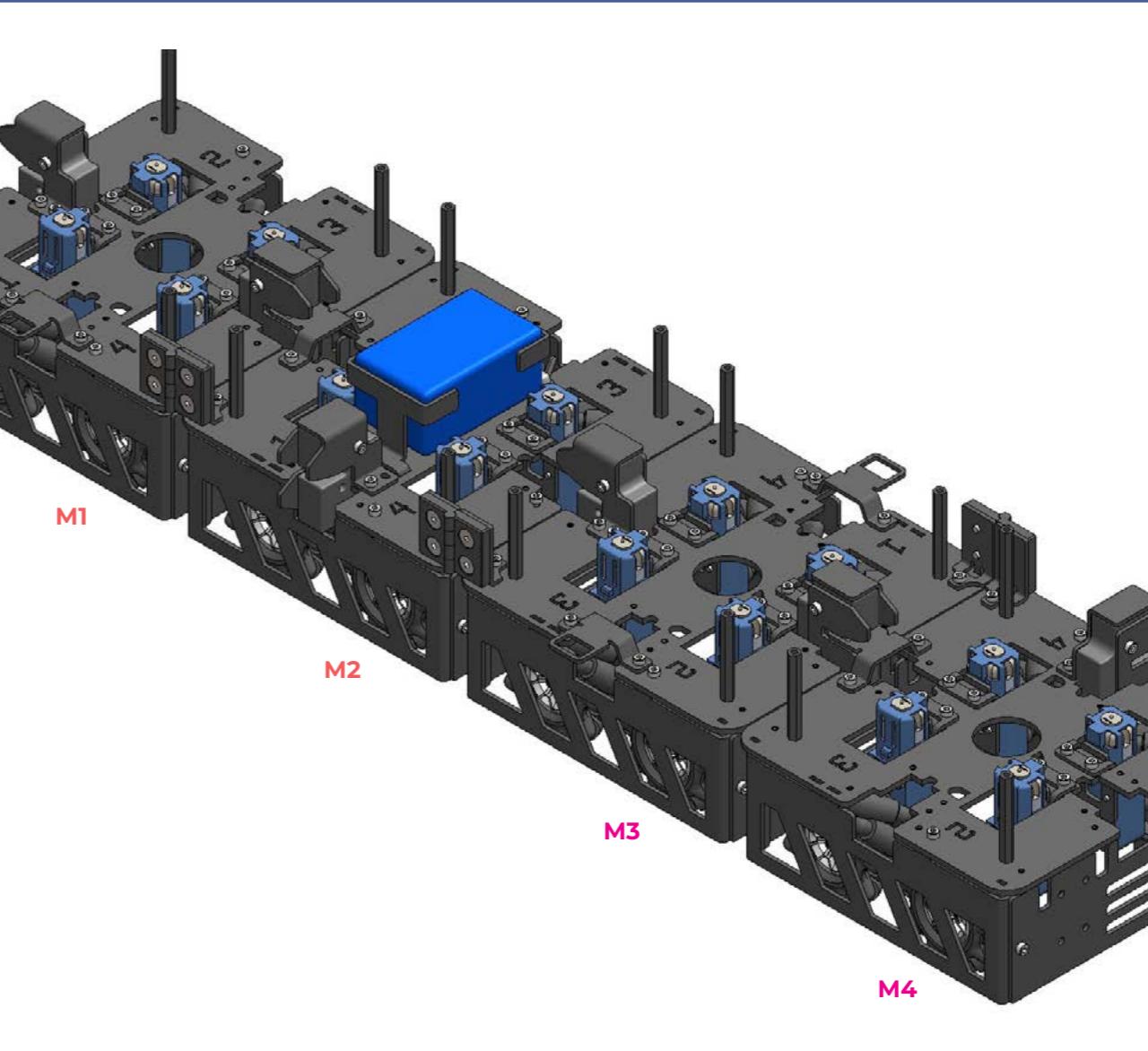
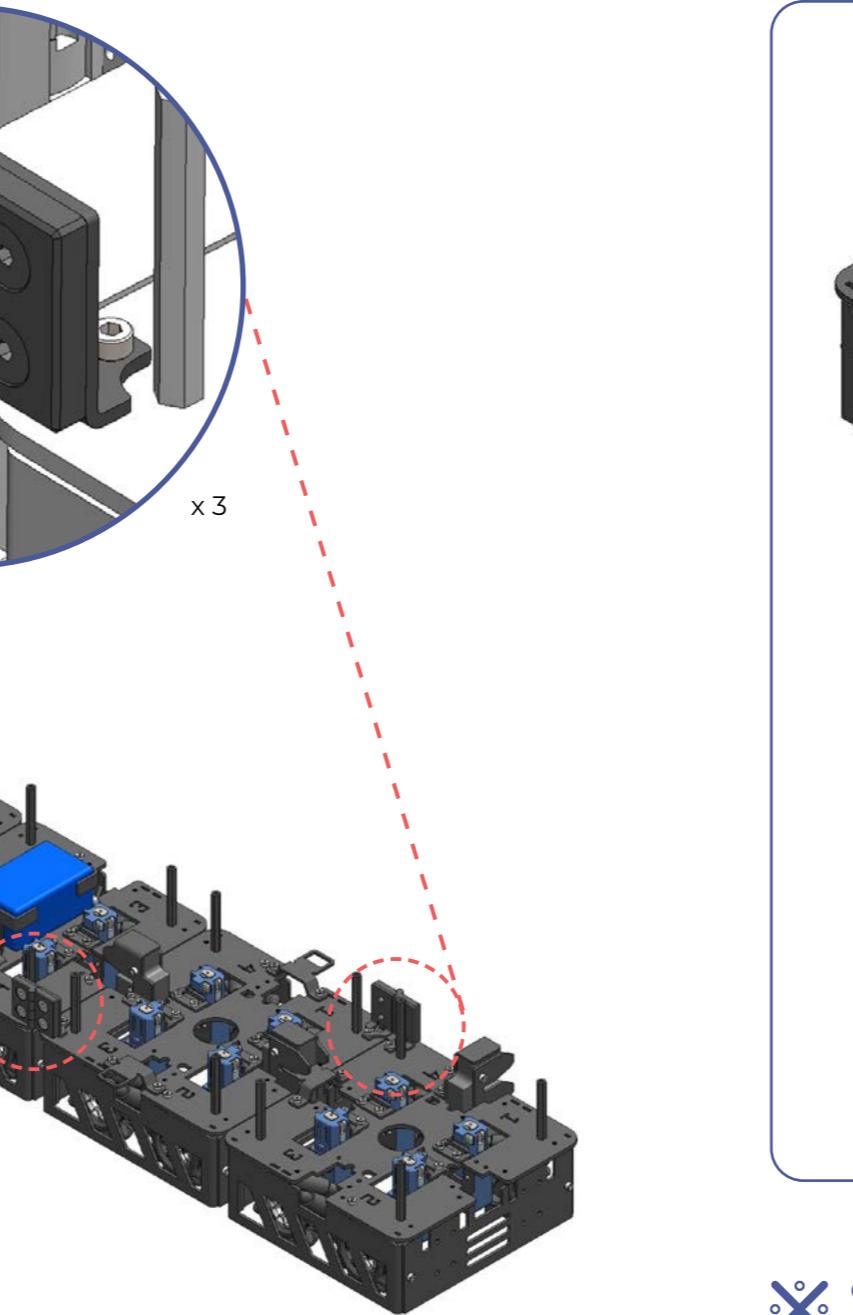
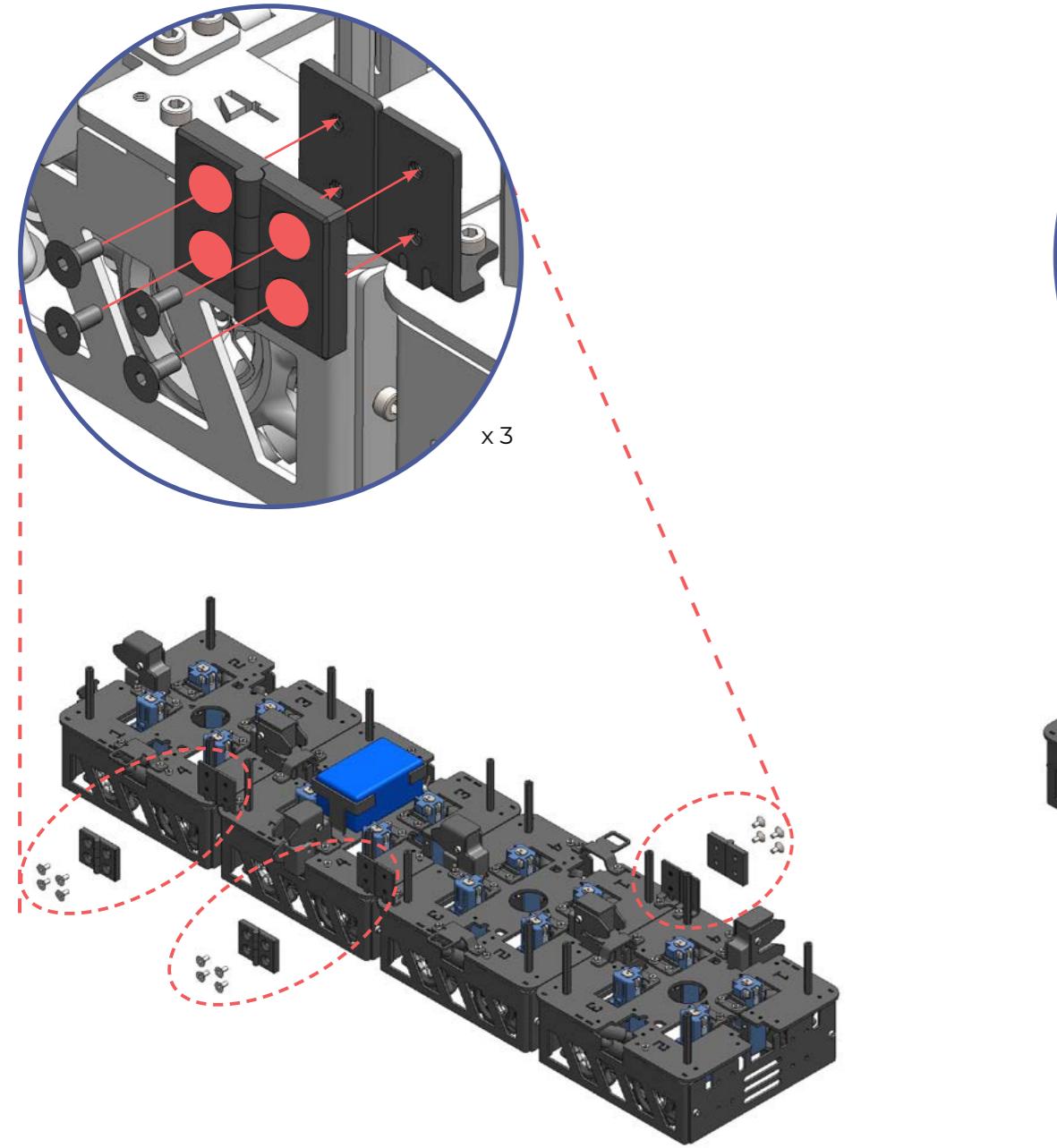


Module 1 (1)
Module 2 (1)
Module 3 (1)
Module 4 (1)
Hinge mechanism (3)
M4 x 8 (12)



Pay attention to the numbers and their orientation when attaching the modules together. Orientation of modules 3 and 4 are rotated 180° from modules 1 and 2.

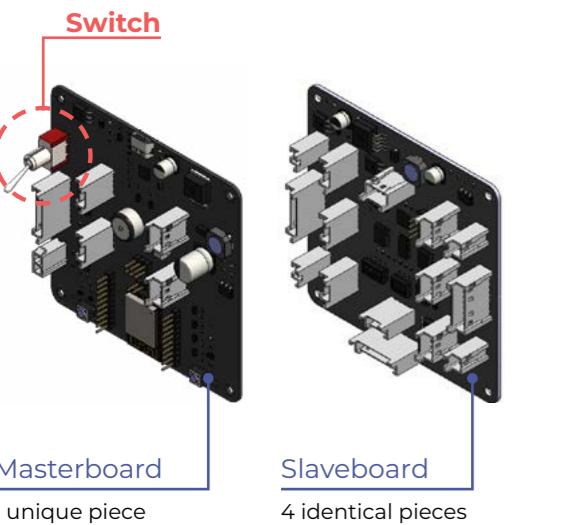




✖ Check all the positions of solenoids,
solenoid catches, hinge mounts before
proceeding to section B.

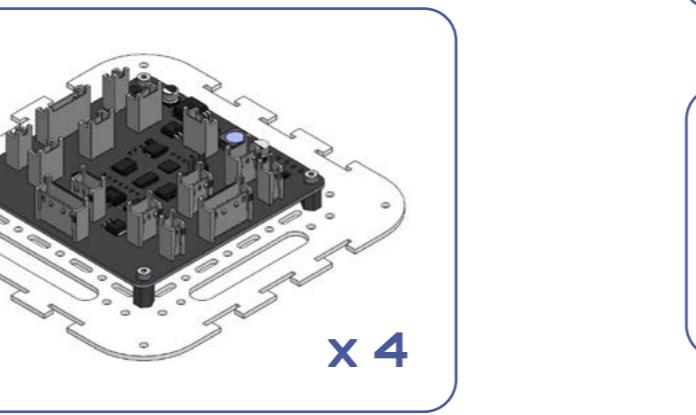
A mechanical assembly completed

B 1 (e-tray sub-assembly)

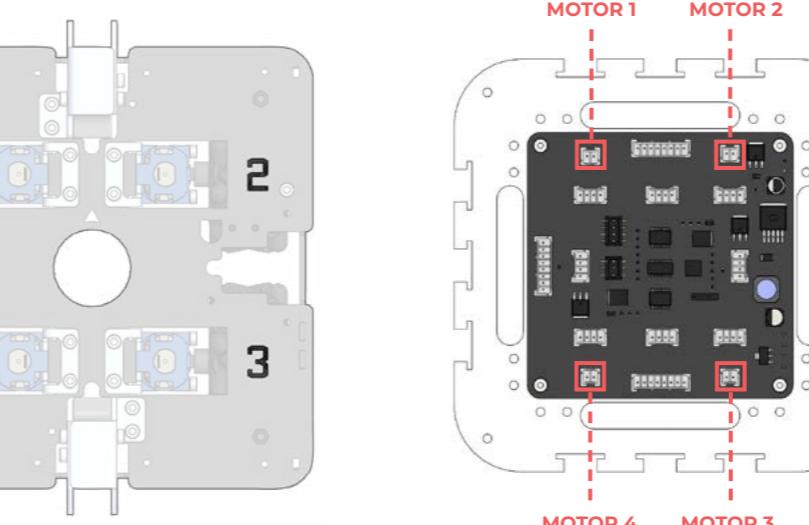
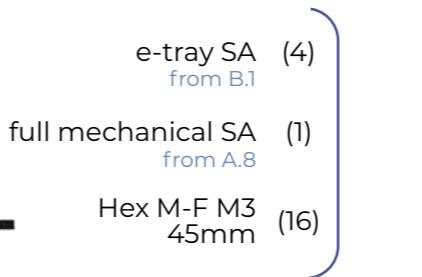


✗ Make sure that you are attaching the slaveboards and not the masterboard.

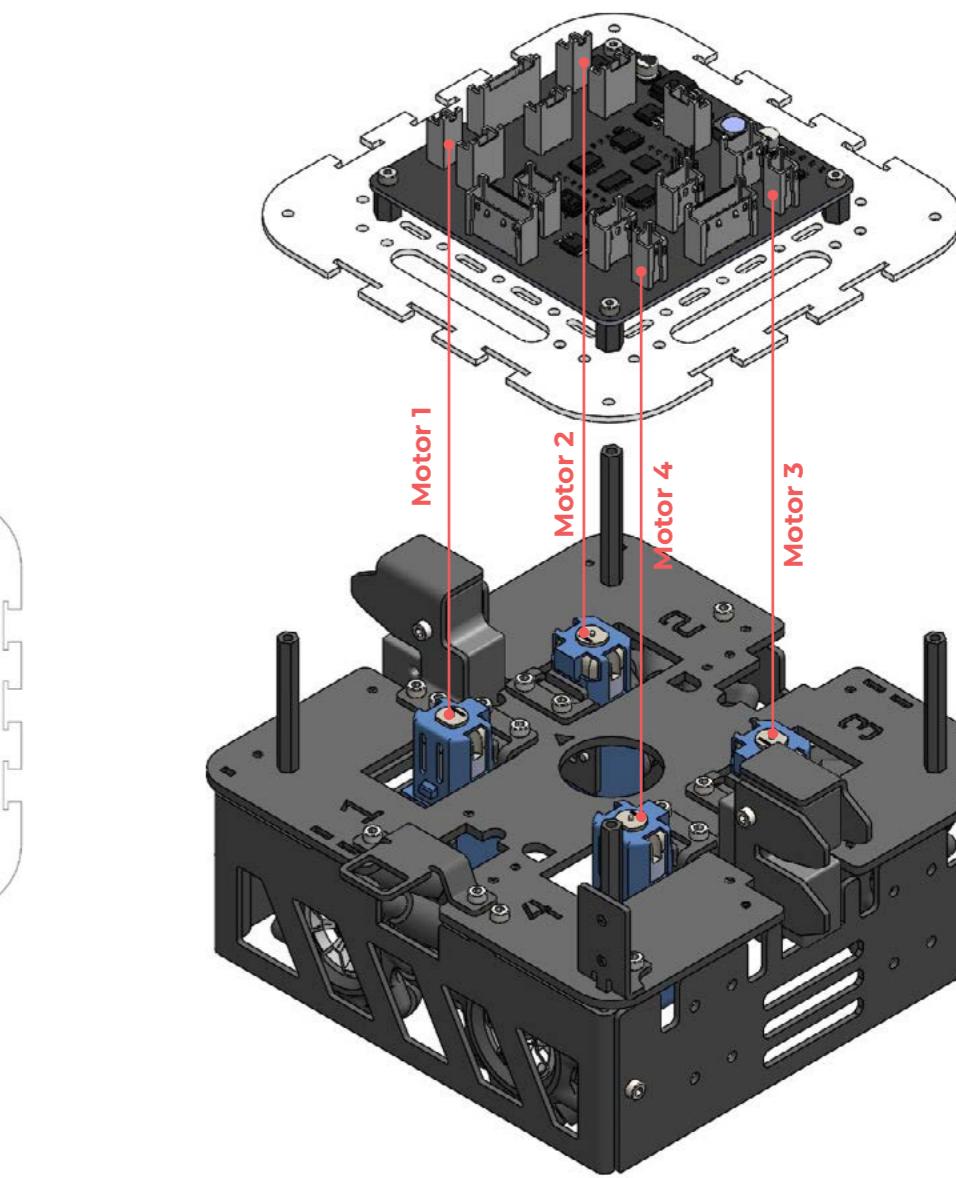
✗ How to differentiate between masterboard and slaveboards:
- Masterboard has a special switch

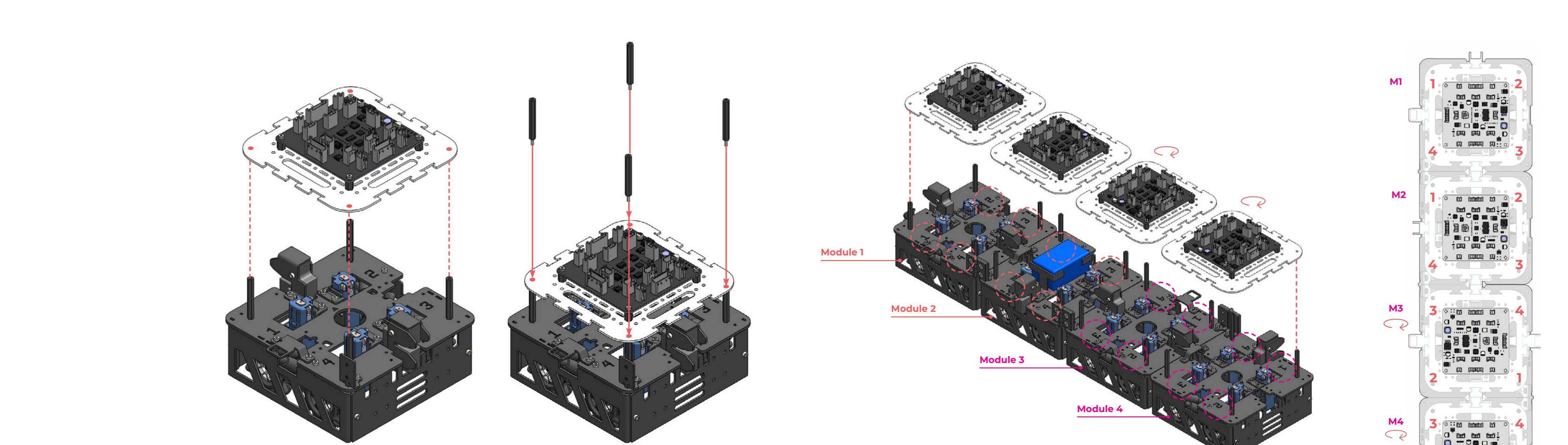


B 2 (e-tray onto mechanical assembly)



✗ Orientate e-tray SA and base module as shown on the right.
Motor 1 connector on e-tray should be on top of Motor 1 of base module.
Same goes for Motor 2, 3 and 4.

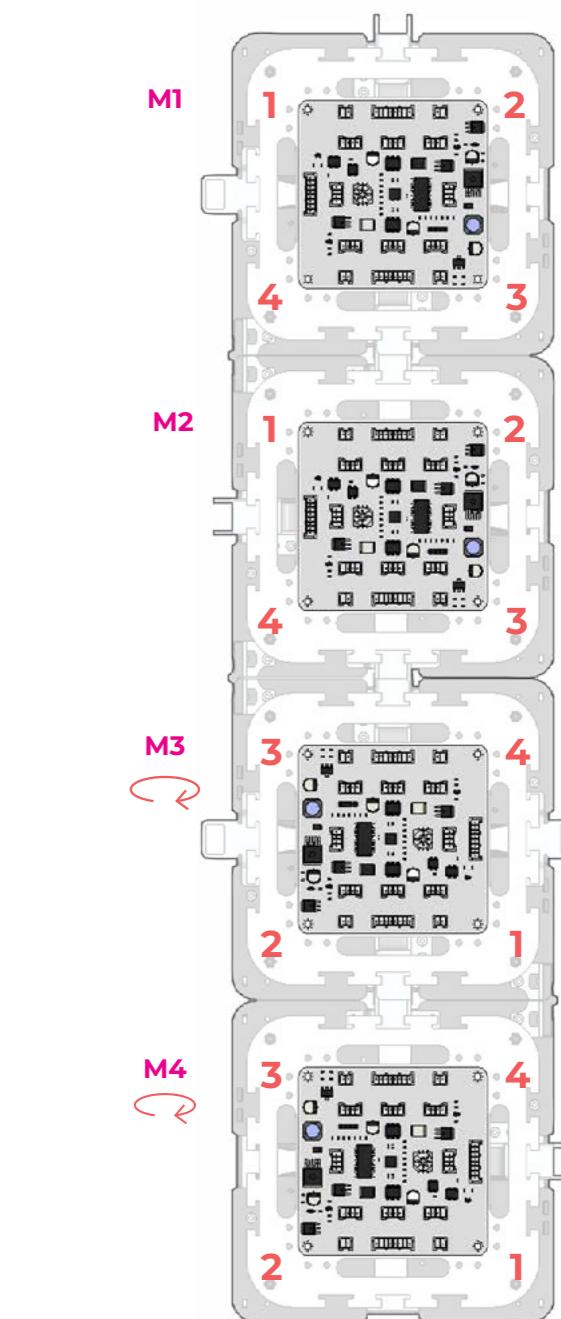




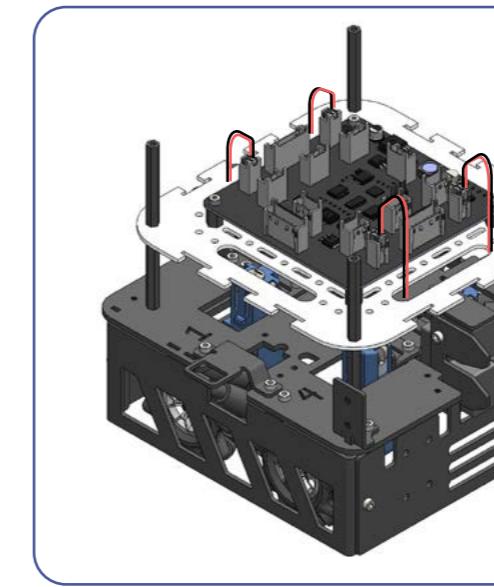
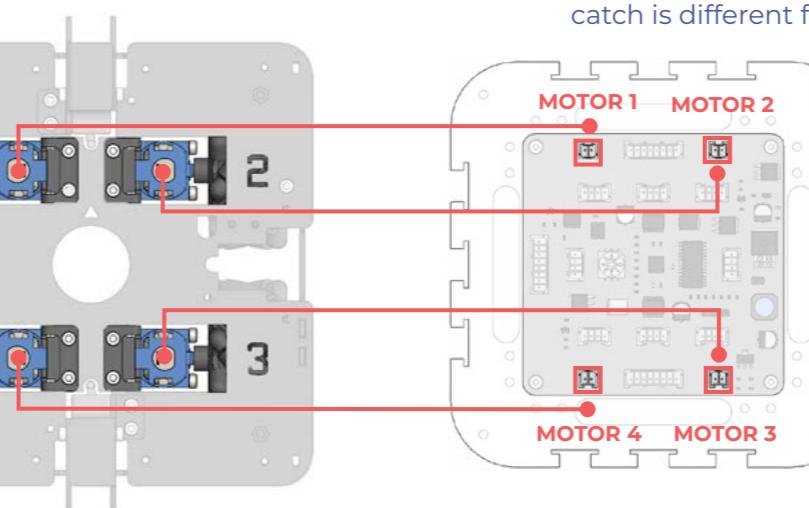
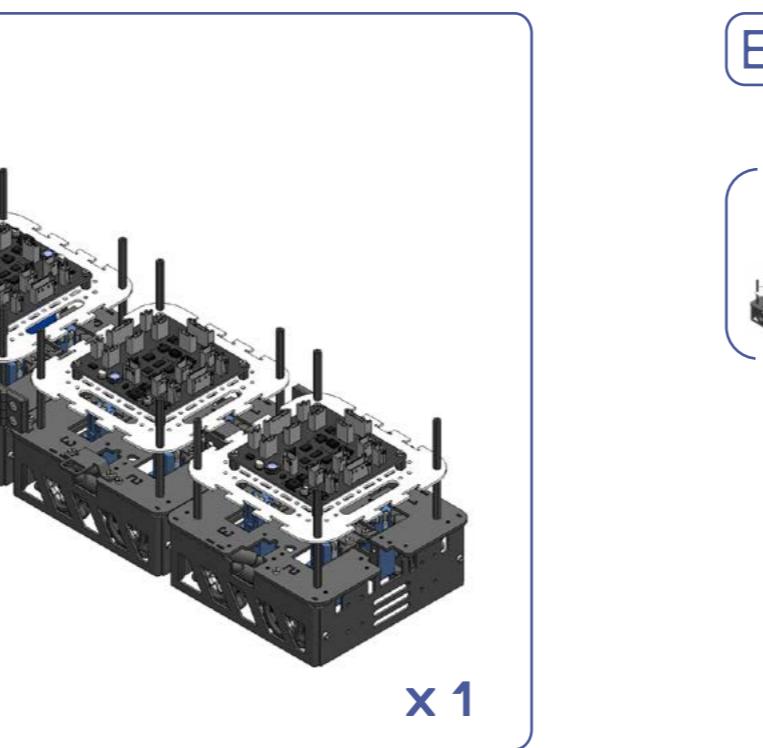
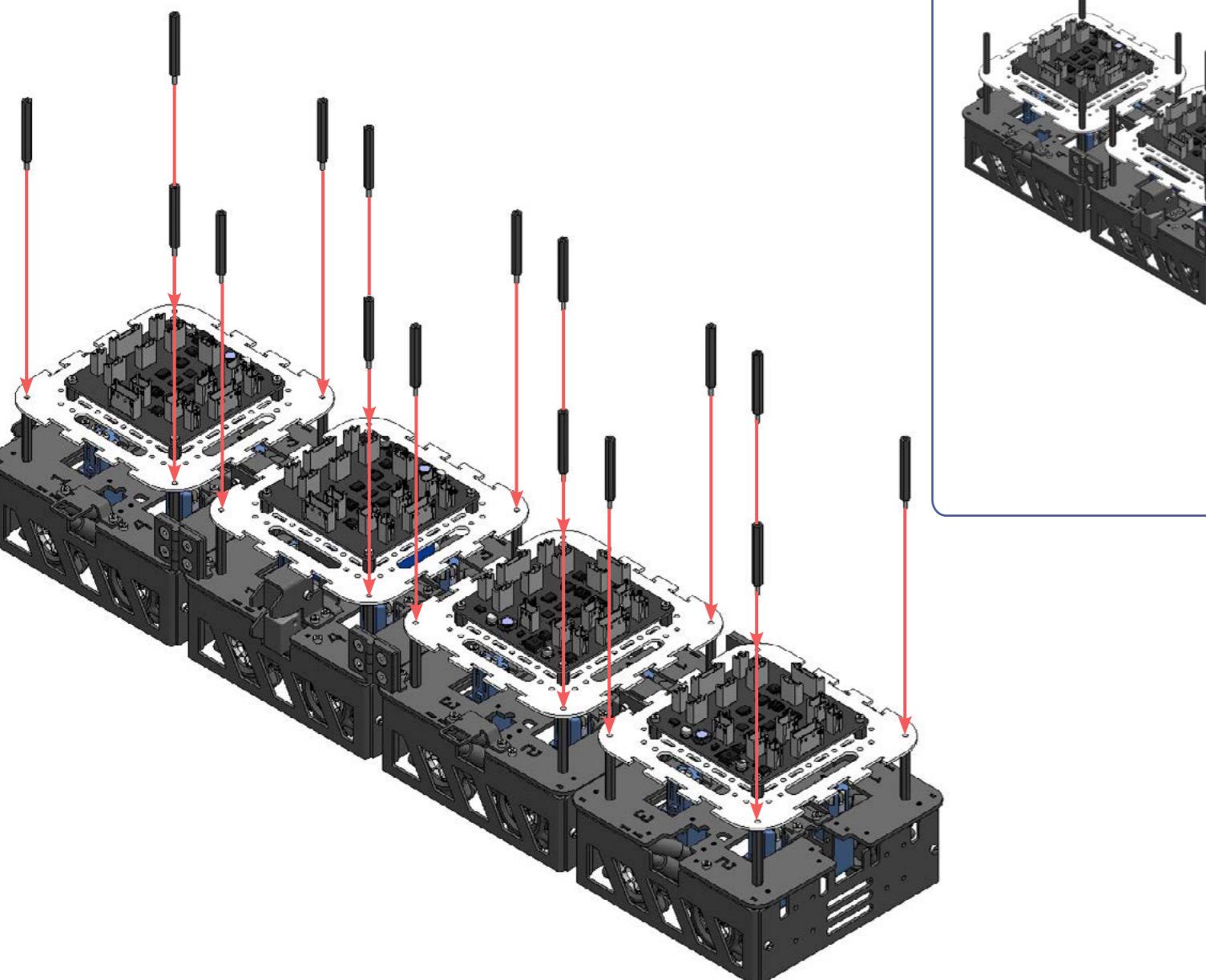
Before attaching the e-tray SA, please flip all the cables and connectors for motors and solenoids (not shown in diagram for clarity) out, for easy attachment later on.



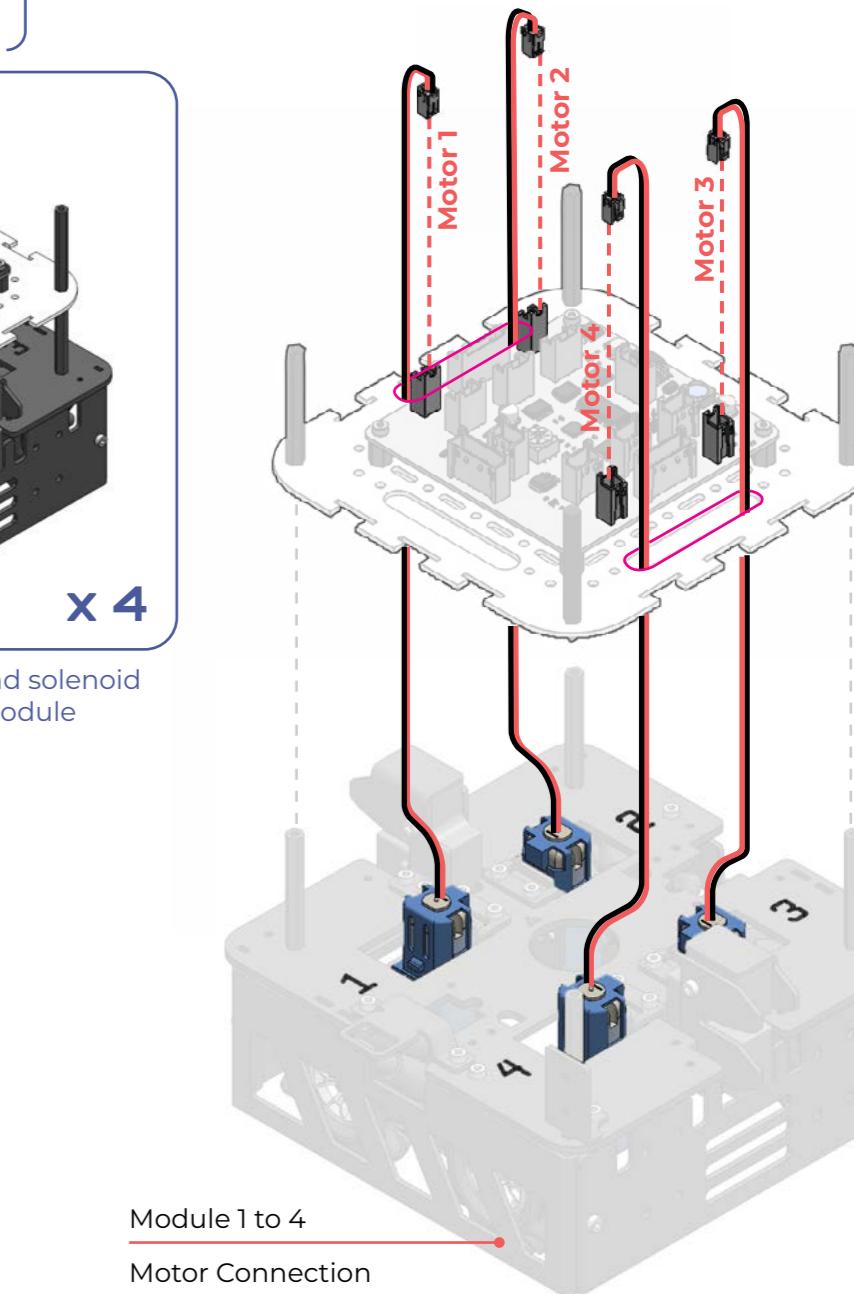
Orientation of modules 3 and 4 are rotated 180° from modules 1 and 2. Therefore, make sure that the e-tray SAs for module 3 and 4 are also rotated 180° to correspond to the motor orientation as numbered.



B3 [all module motor cable connection]



Note: Position of solenoid latch and solenoid catch is different for each module



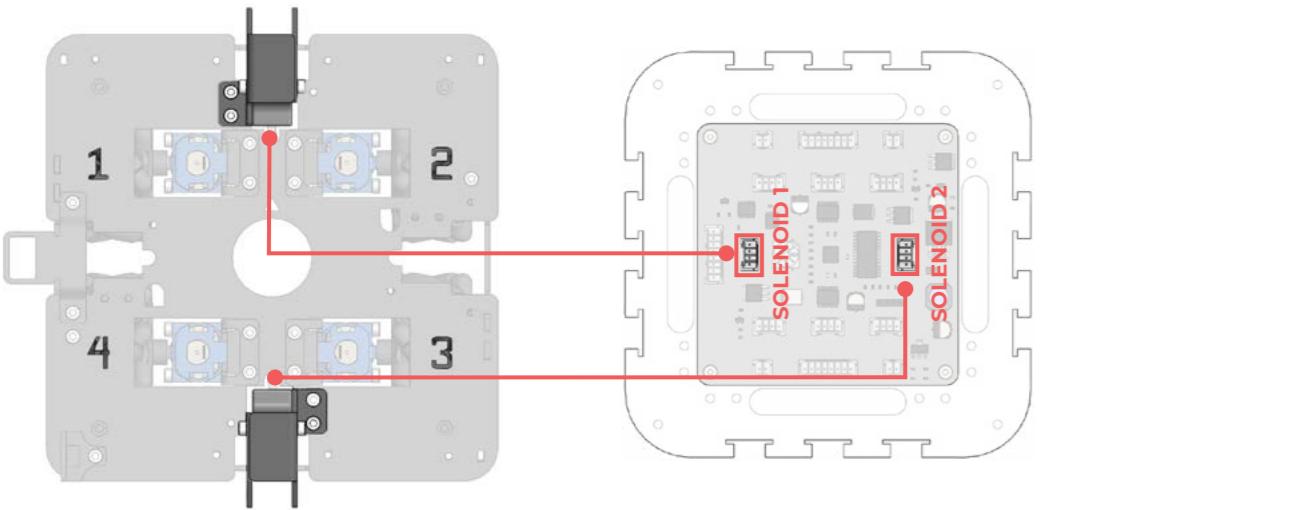
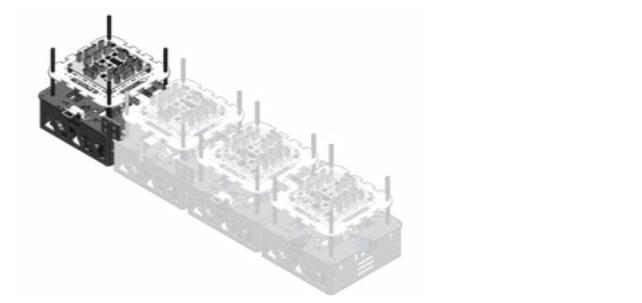
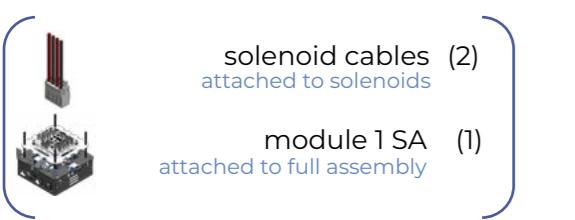
Make sure that Motor 1 is connected to Motor 1 connector on Slaveboard; the same goes for Motor 2, 3 and 4.

Motor cable connection is the same for all 4 modules

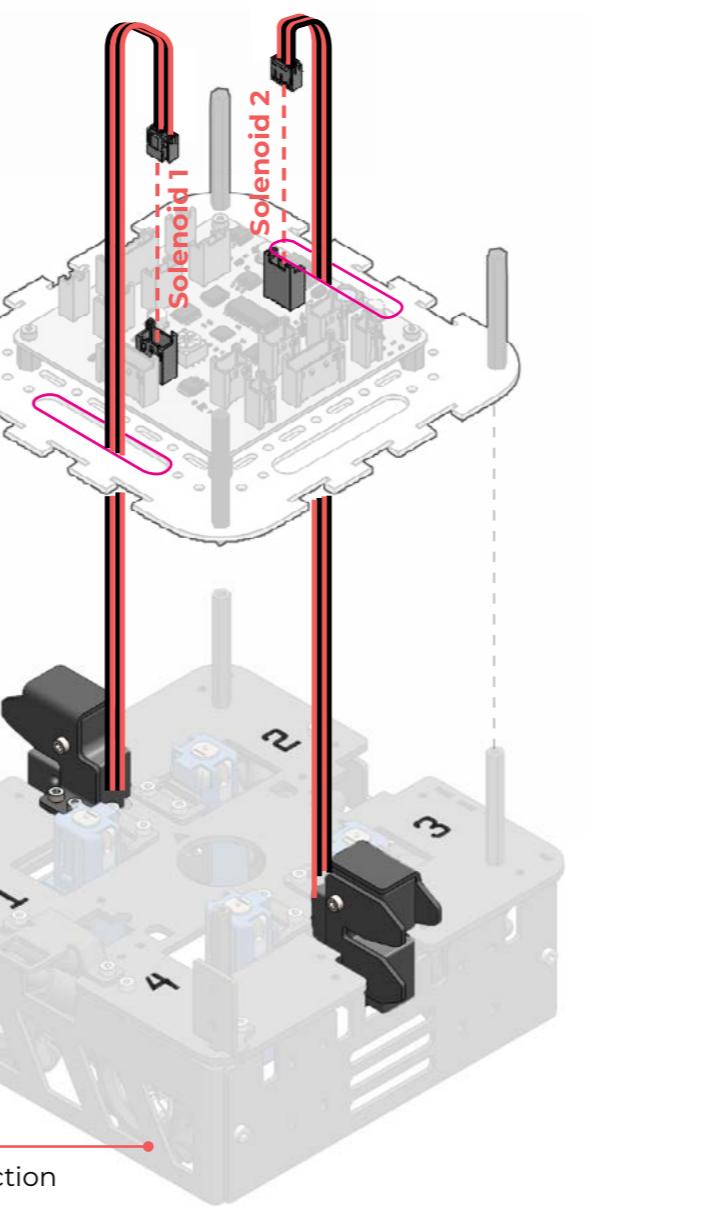
Module 1 to 4
Motor Connection

Opening to pass wire through

B 4 (module 1 solenoid cable connection)



⚠ Make sure to connect the solenoid to the labelled solenoid connector exactly as in the diagram below.

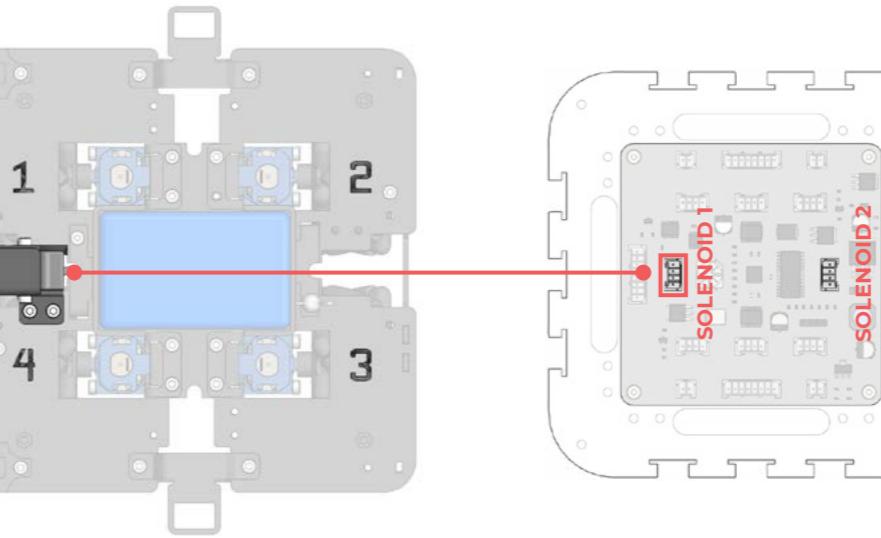
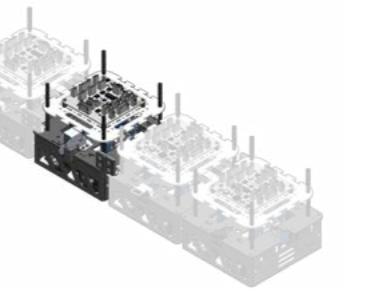
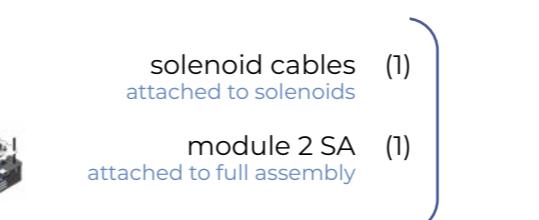


Module 1

Solenoid Connection

Opening to pass wire through

B 5 (module 2 solenoid cable connection)

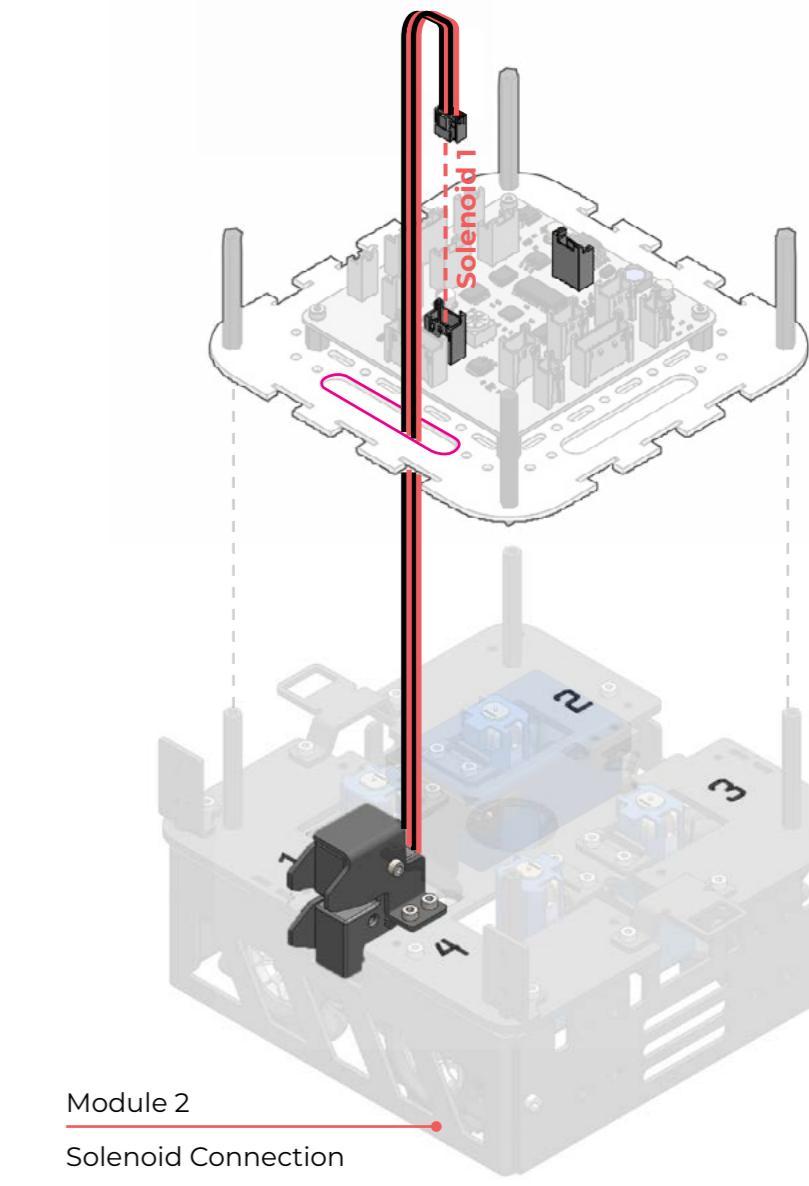


⚠ Make sure to connect the solenoid to the labelled solenoid connector exactly as in the diagram below.

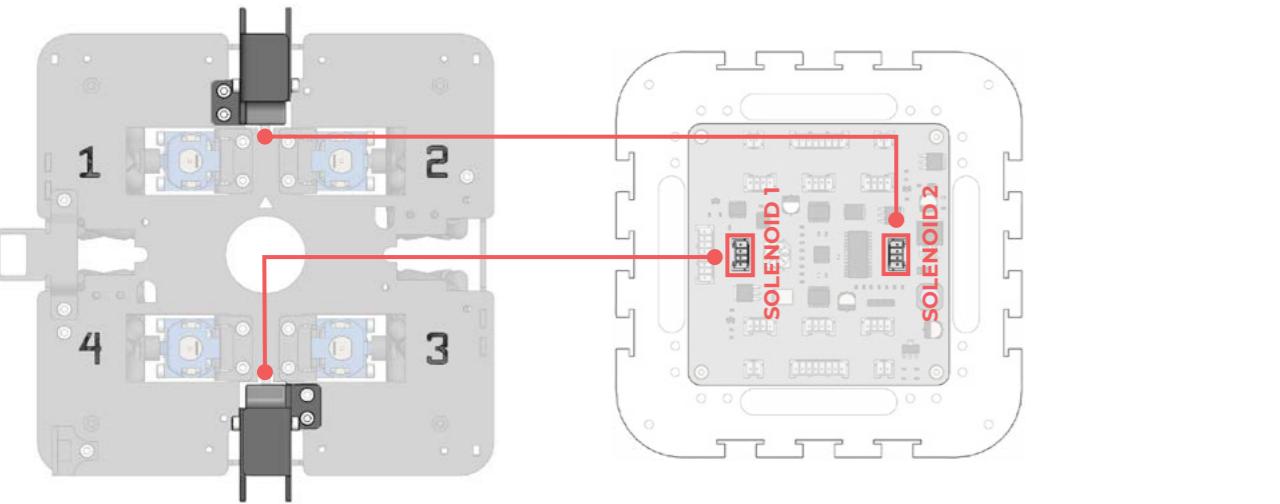
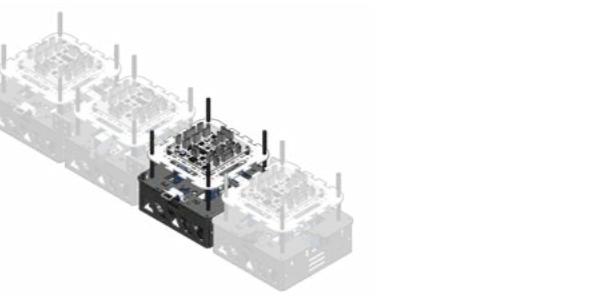
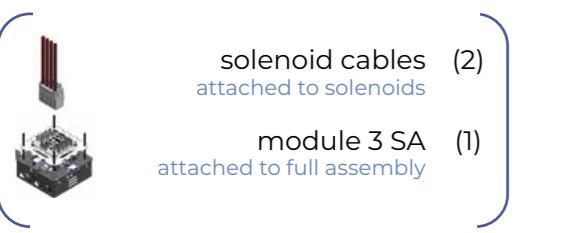
Module 2

Solenoid Connection

Opening to pass wire through



B6 (module 3 solenoid cable connection)

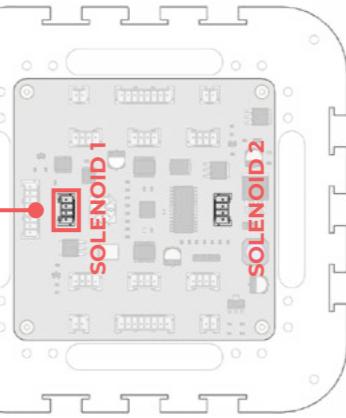
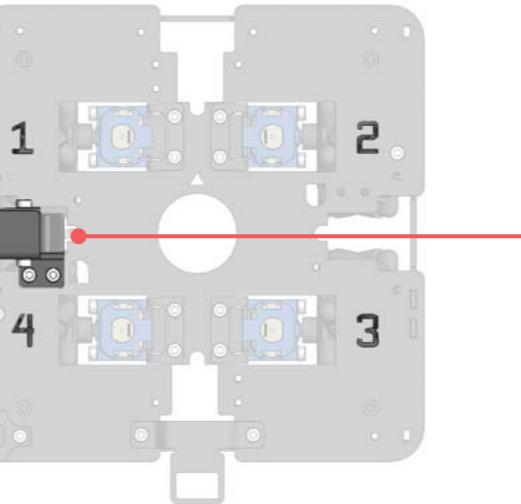
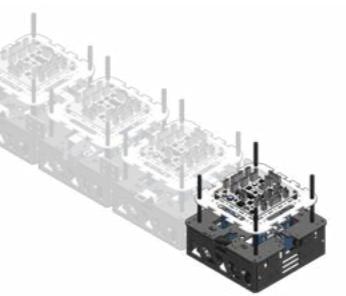
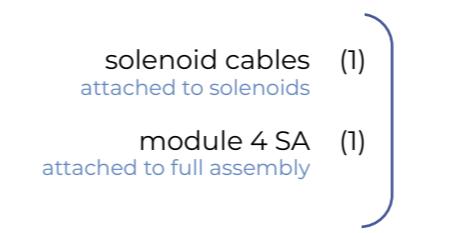


Module 3
Solenoid Connection

Opening to pass wire through

Make sure to connect the solenoid to the labelled solenoid connector exactly as in the diagram below.

B7 (module 4 solenoid cable connection)

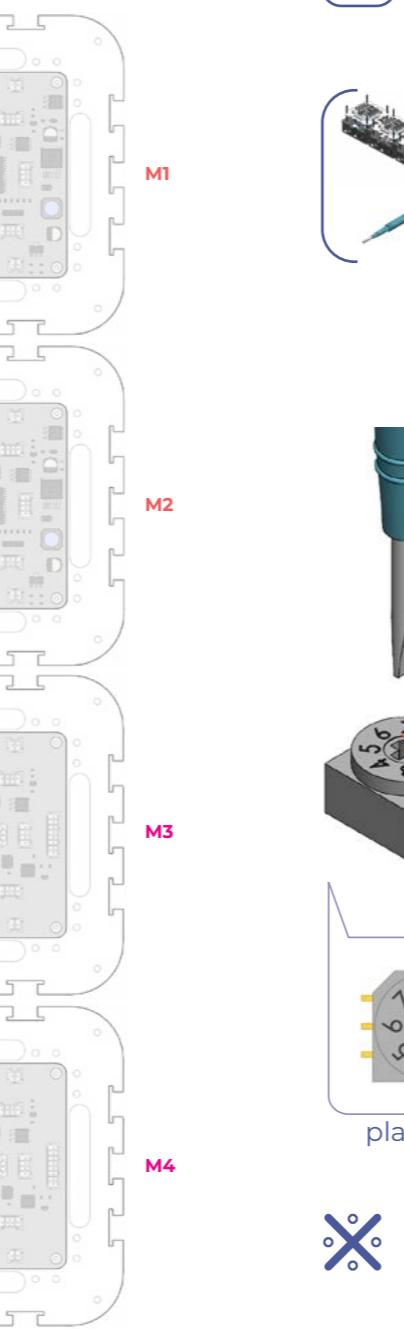
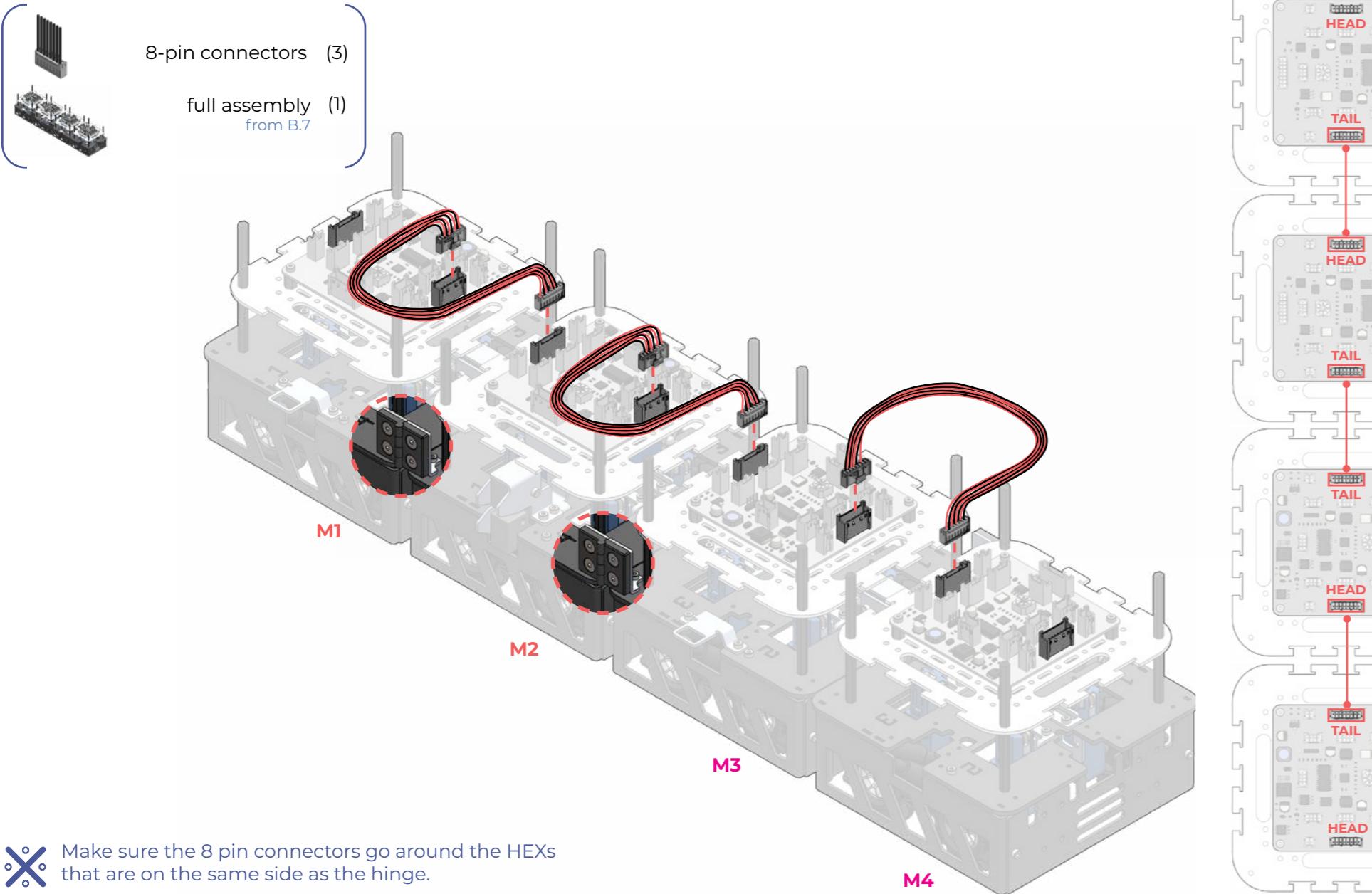


Module 4
Solenoid Connection

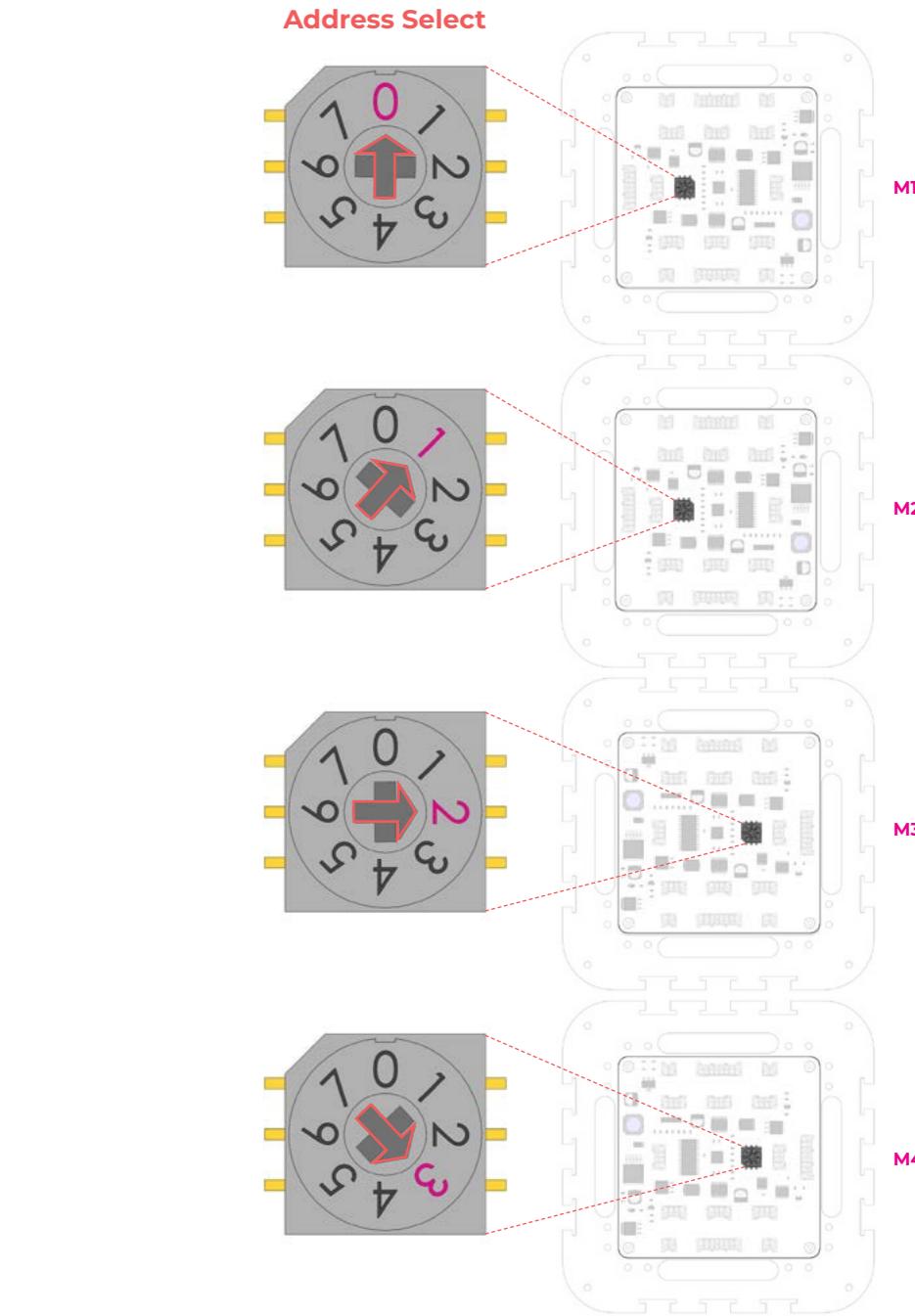
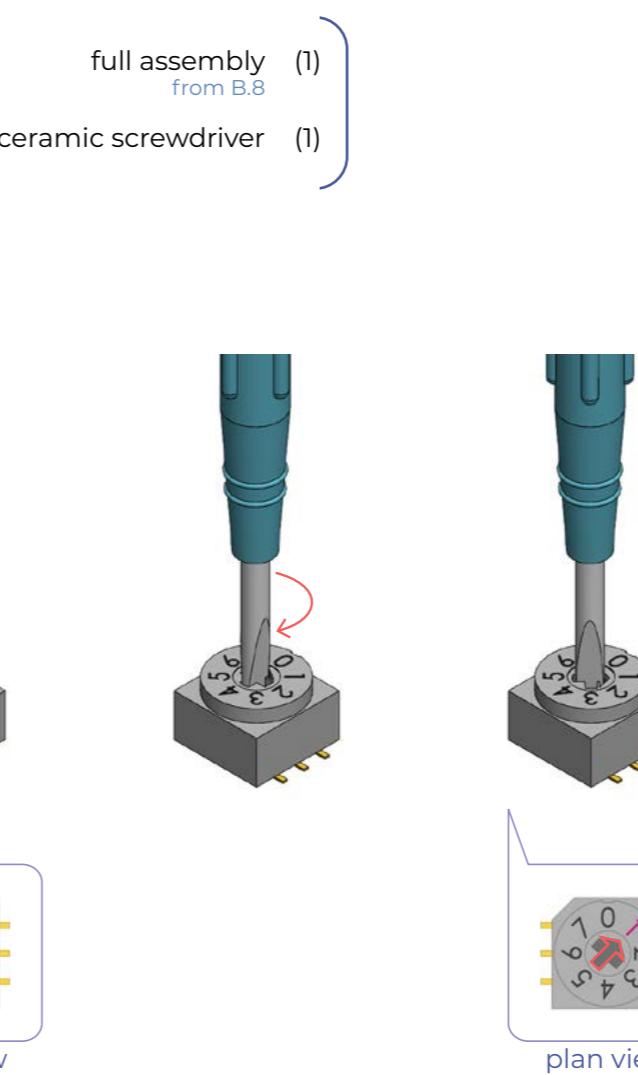
Opening to pass wire through

Make sure to connect the solenoid to the labelled solenoid connector exactly as in the diagram below.

B8 (inter-module cable connection)

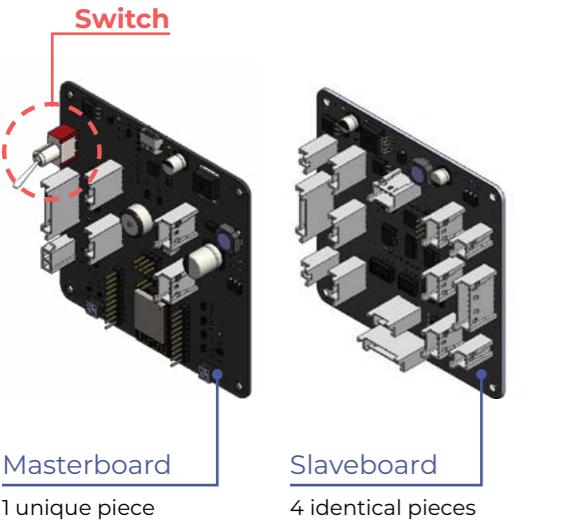


B9 (address selection)



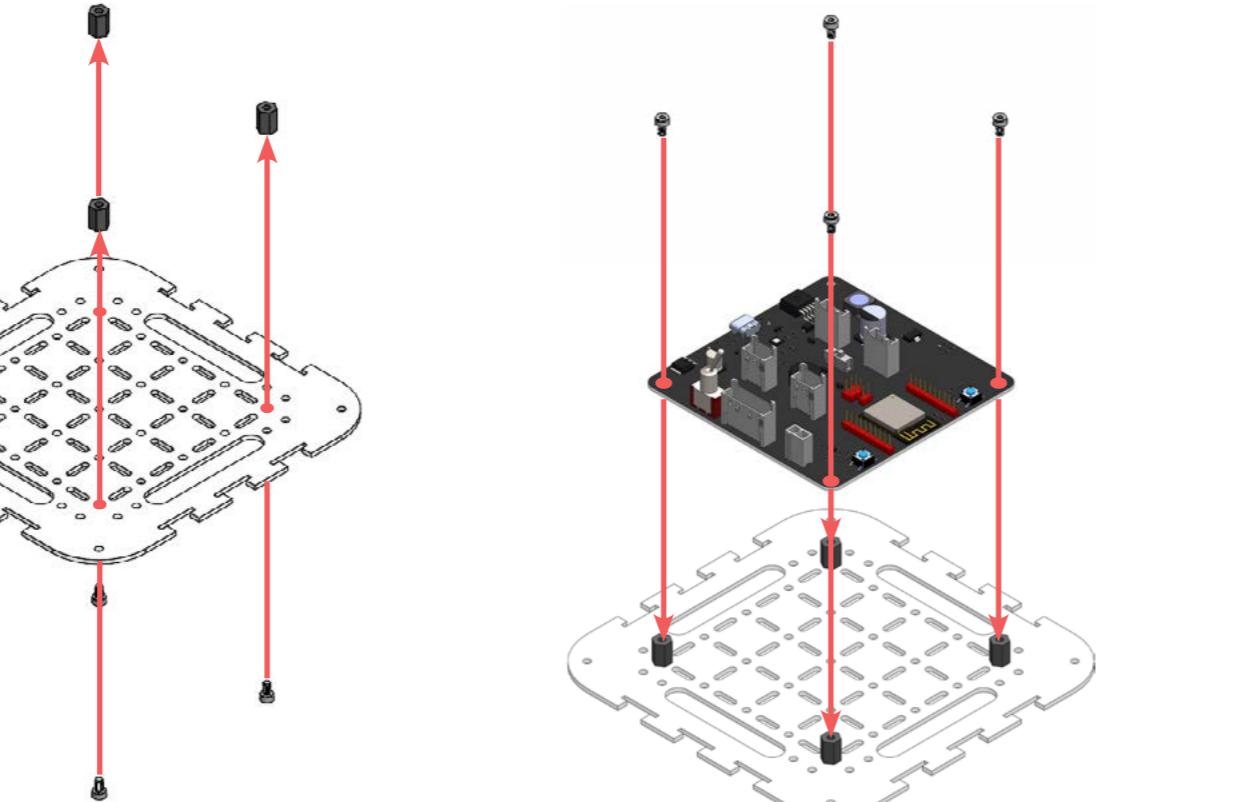
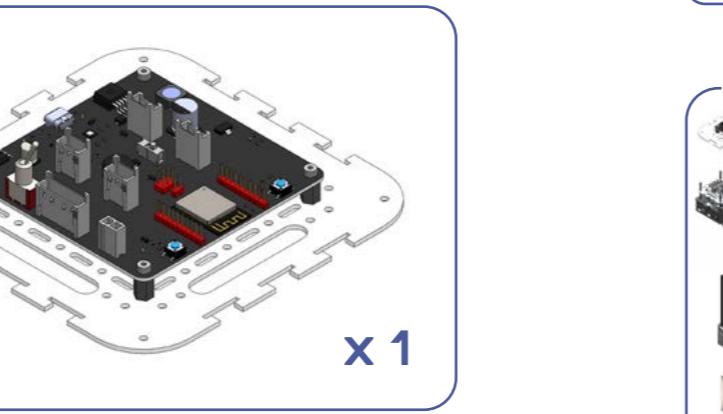
Use the ceramic screwdriver to adjust the rotary switch and select the address for all 4 modules.
Module 1: Address 0, Module 2: Address 1,
Module 3: Address 2, Module 4: Address 3

B 10 (masterboard e-tray sub-assembly)

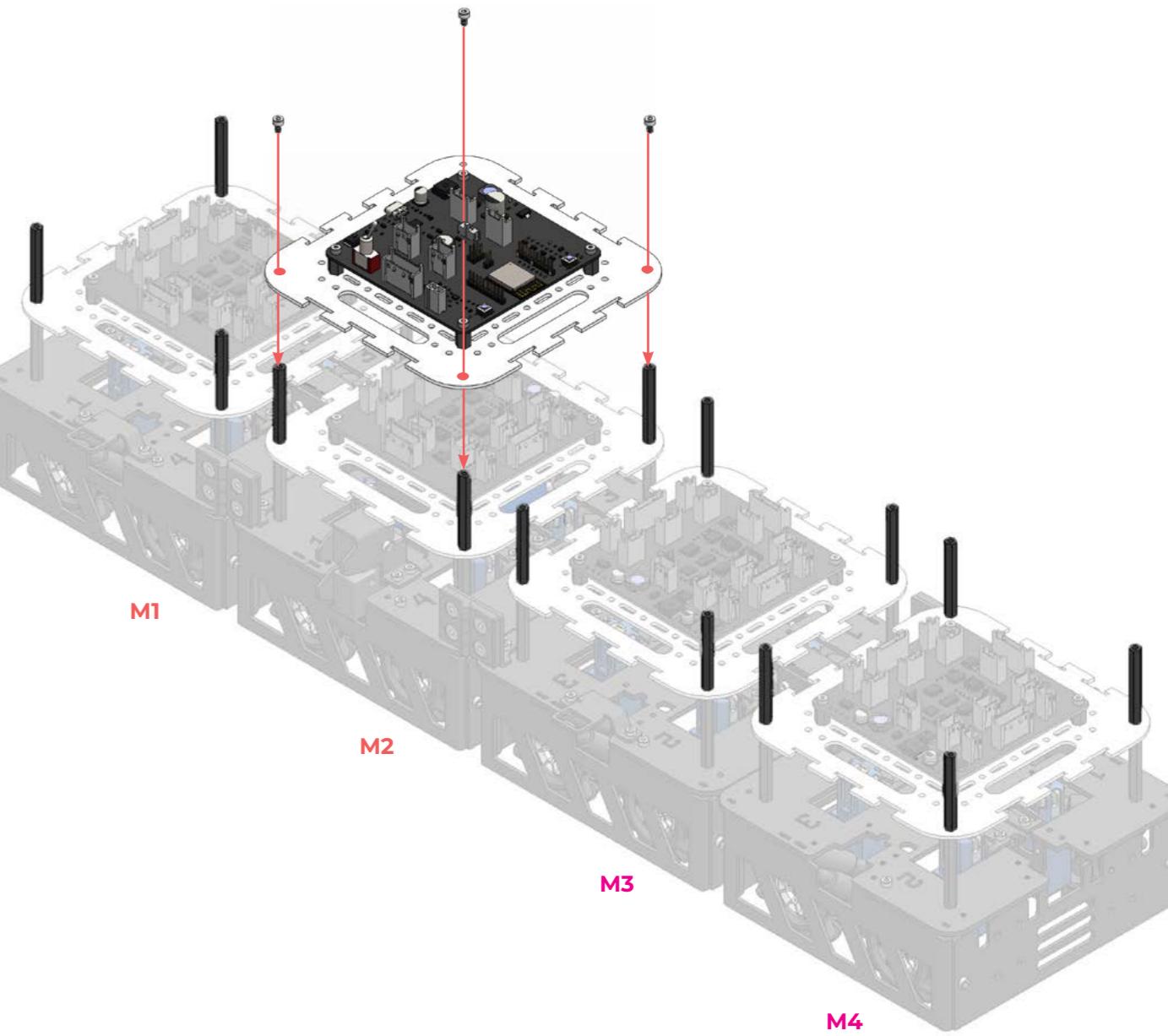
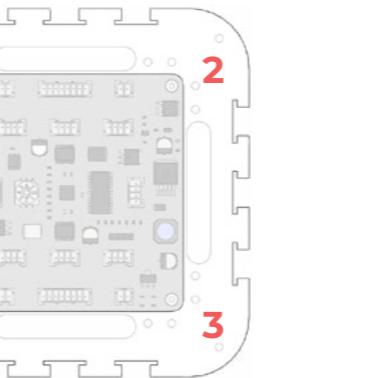
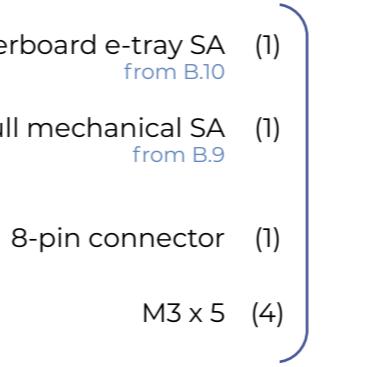


✗ Make sure that you are attaching the masterboard and not the slaveboards.

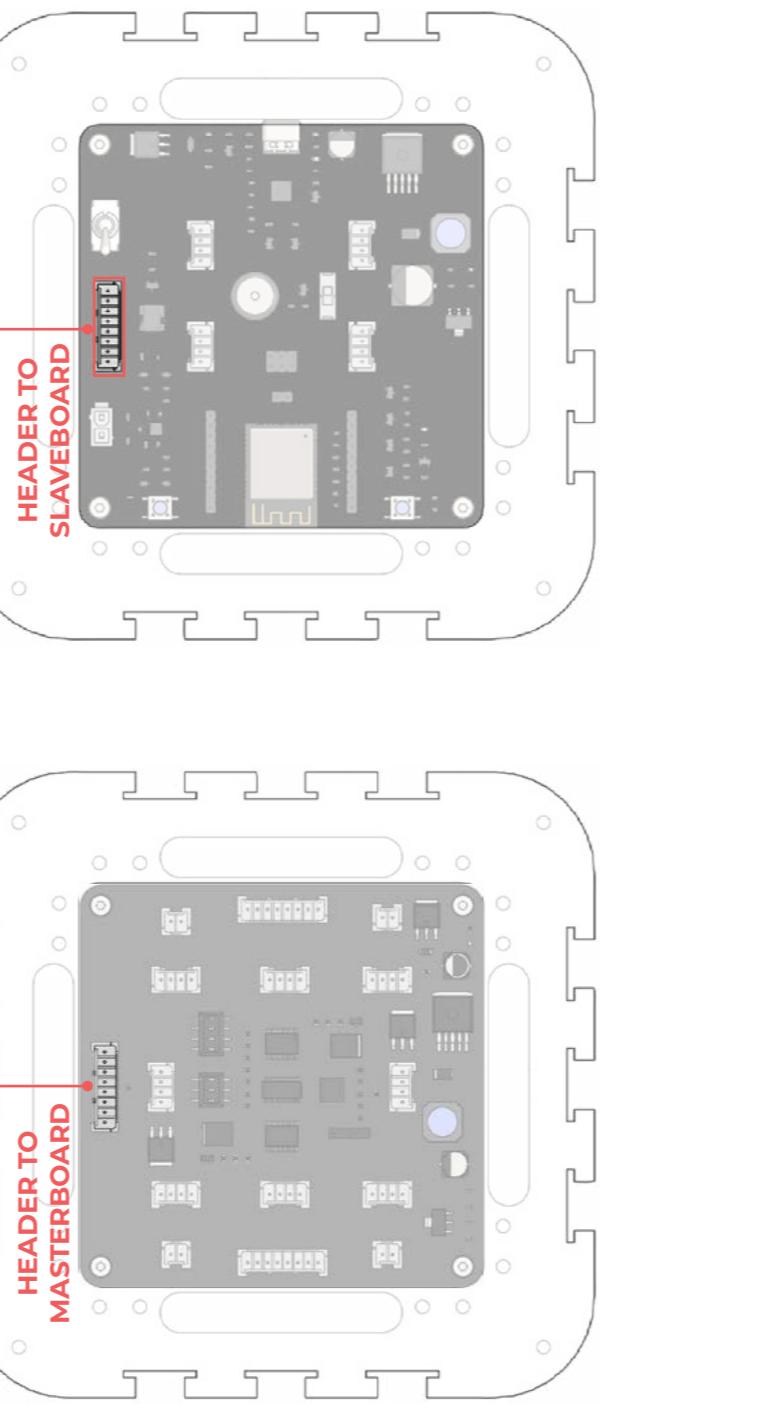
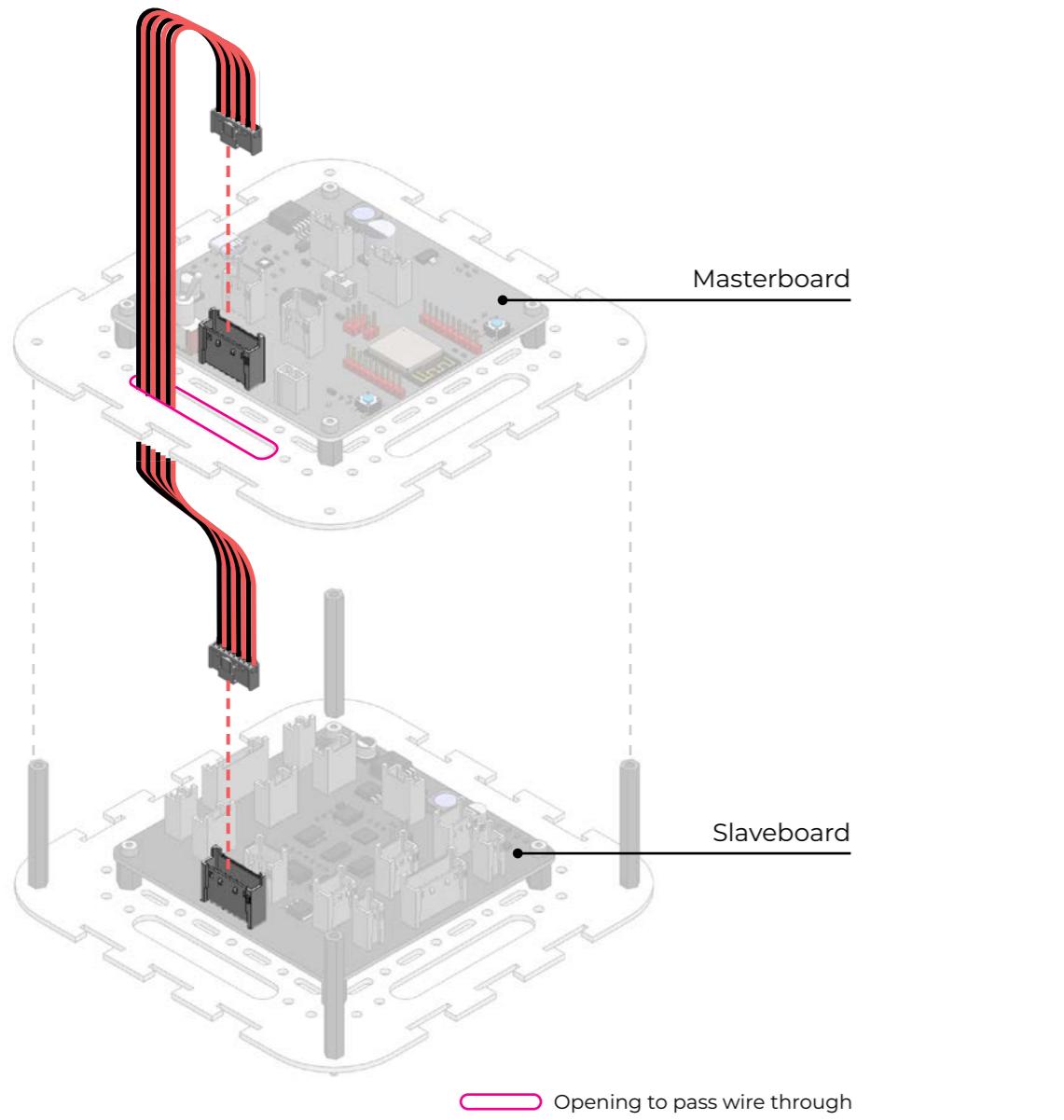
✗ How to differentiate between masterboard and slaveboards:
- Masterboard has a special switch



B 11 (masterboard e-tray onto main assembly)

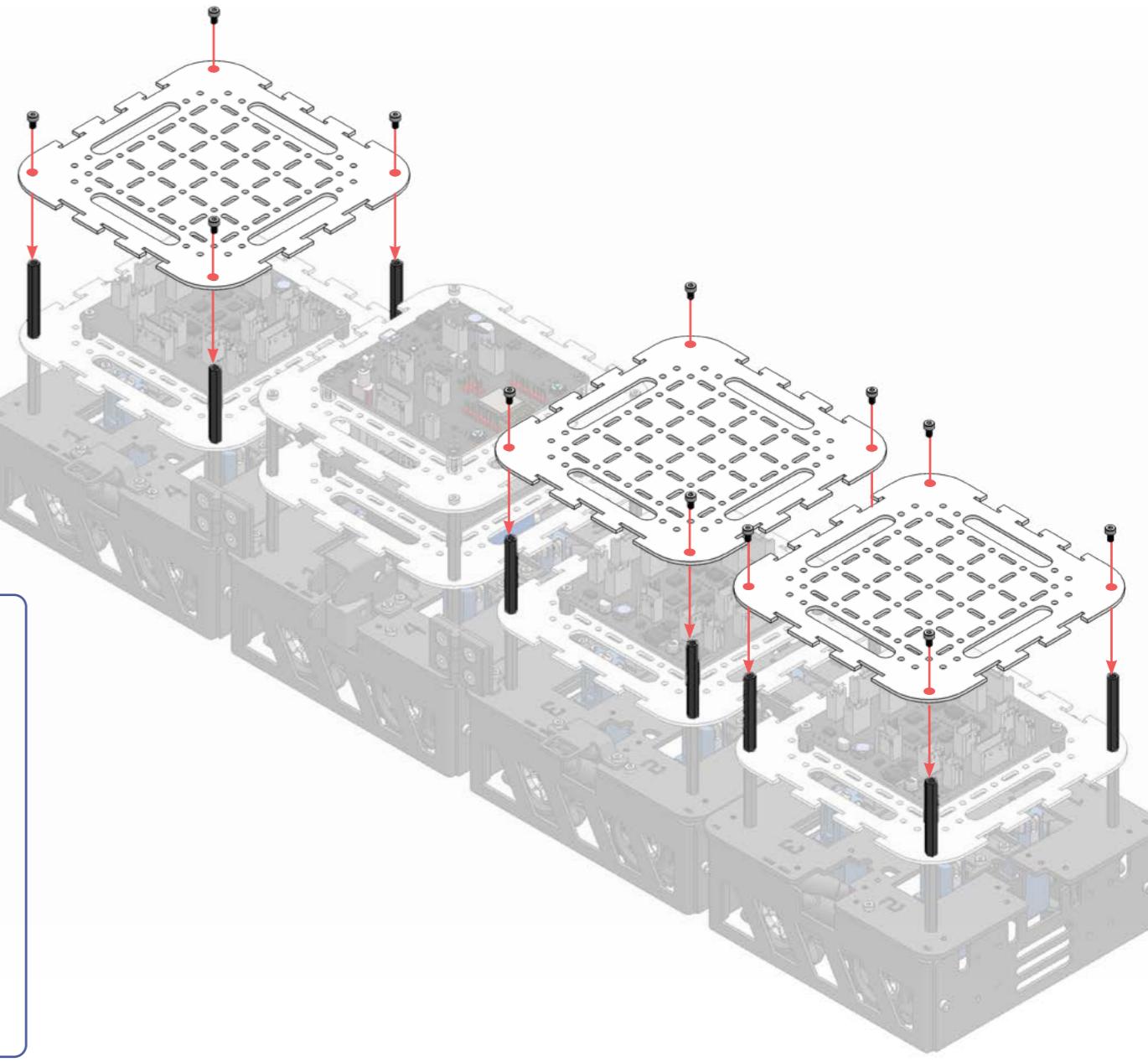
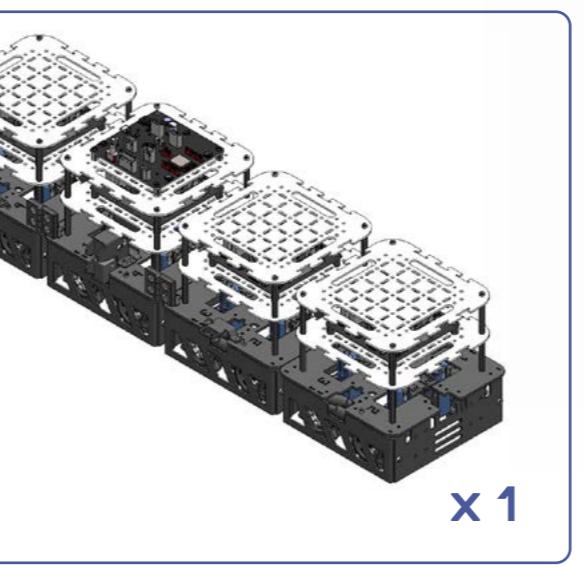


✗ Align the header to slaveboard connector on the masterboard to face the side connecting Motor 1 and 4.

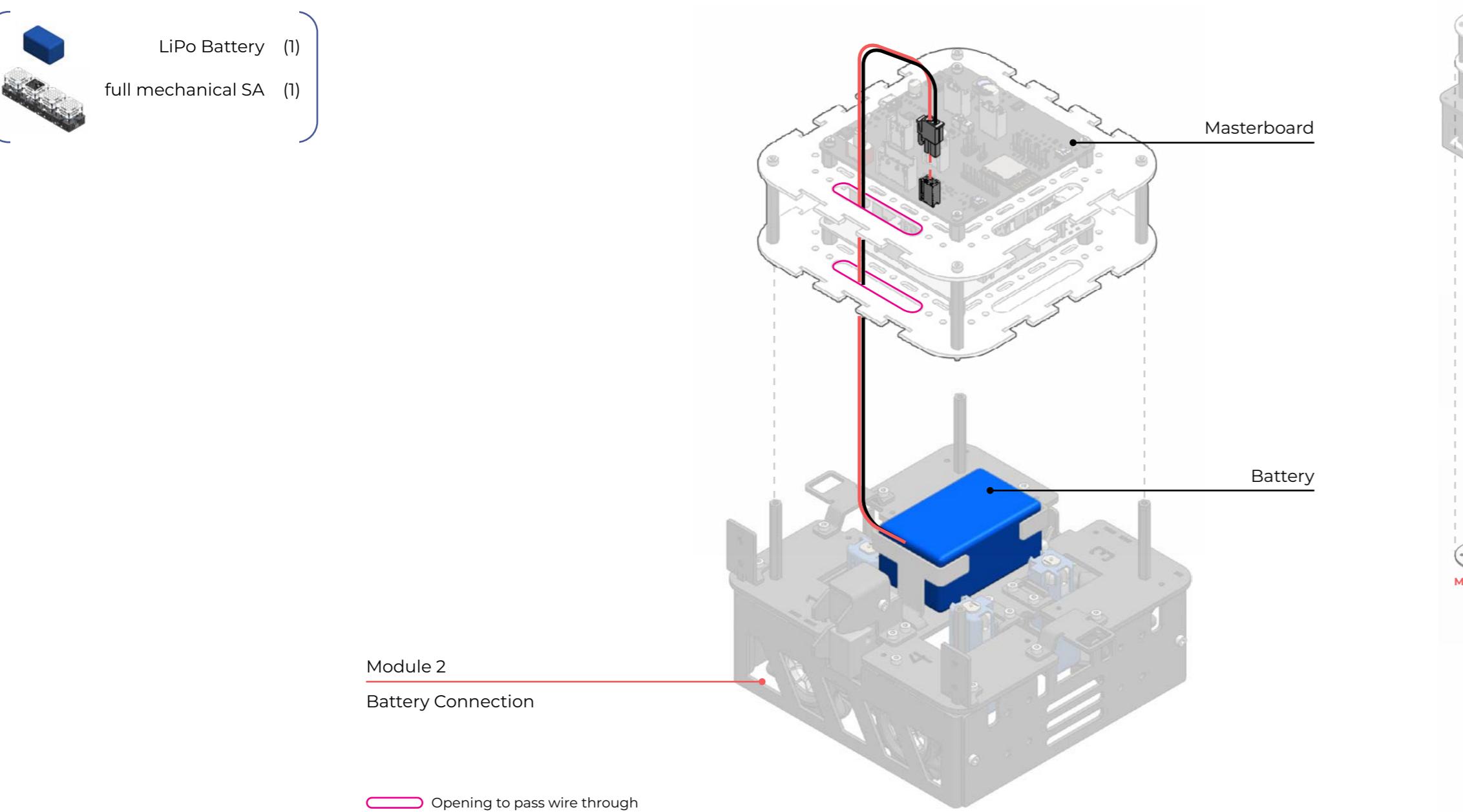


B12 (attach acrylic covers)

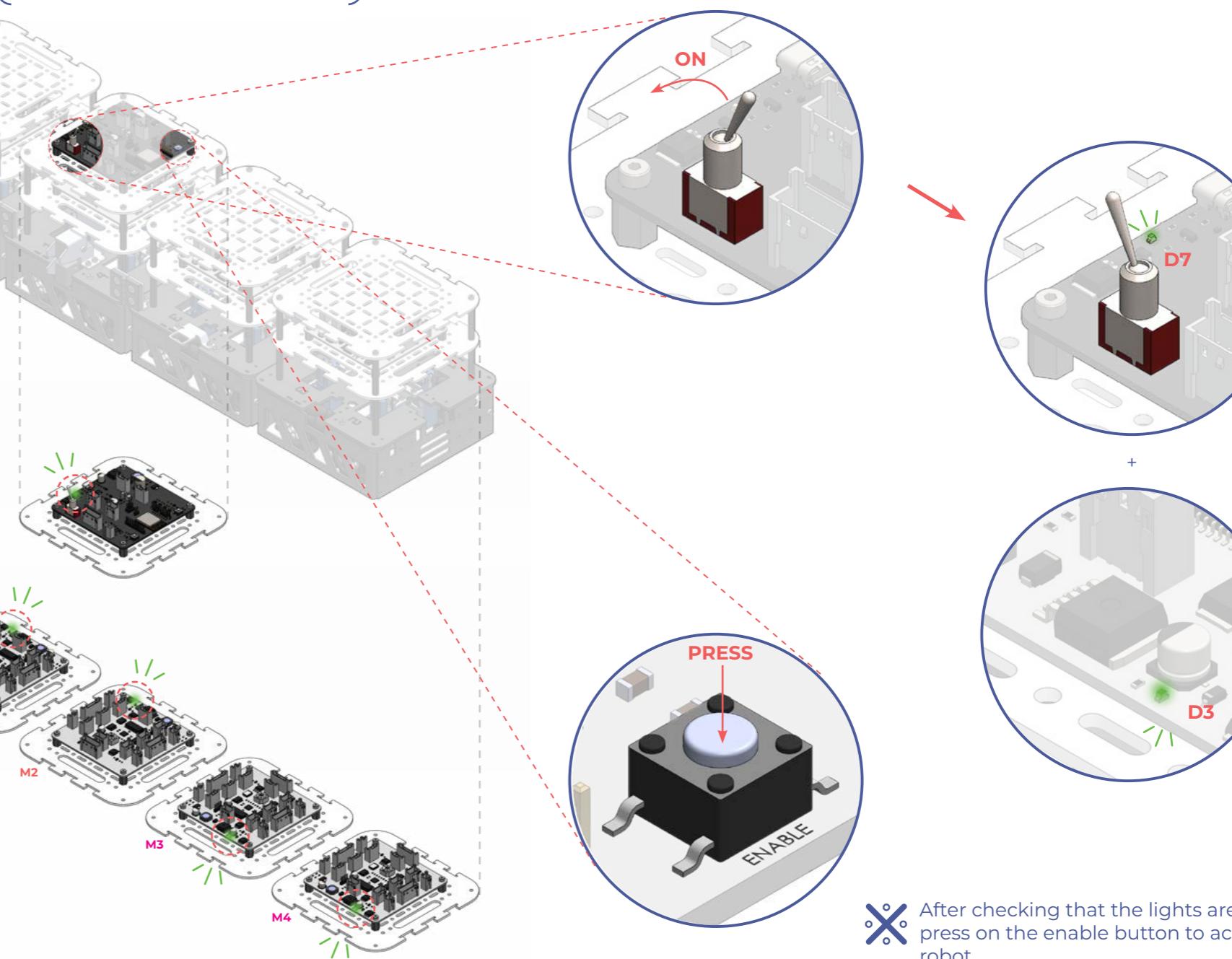
Acrylic base plate (3)
full mechanical SA (1) from B.11
M3 x 5 (12)

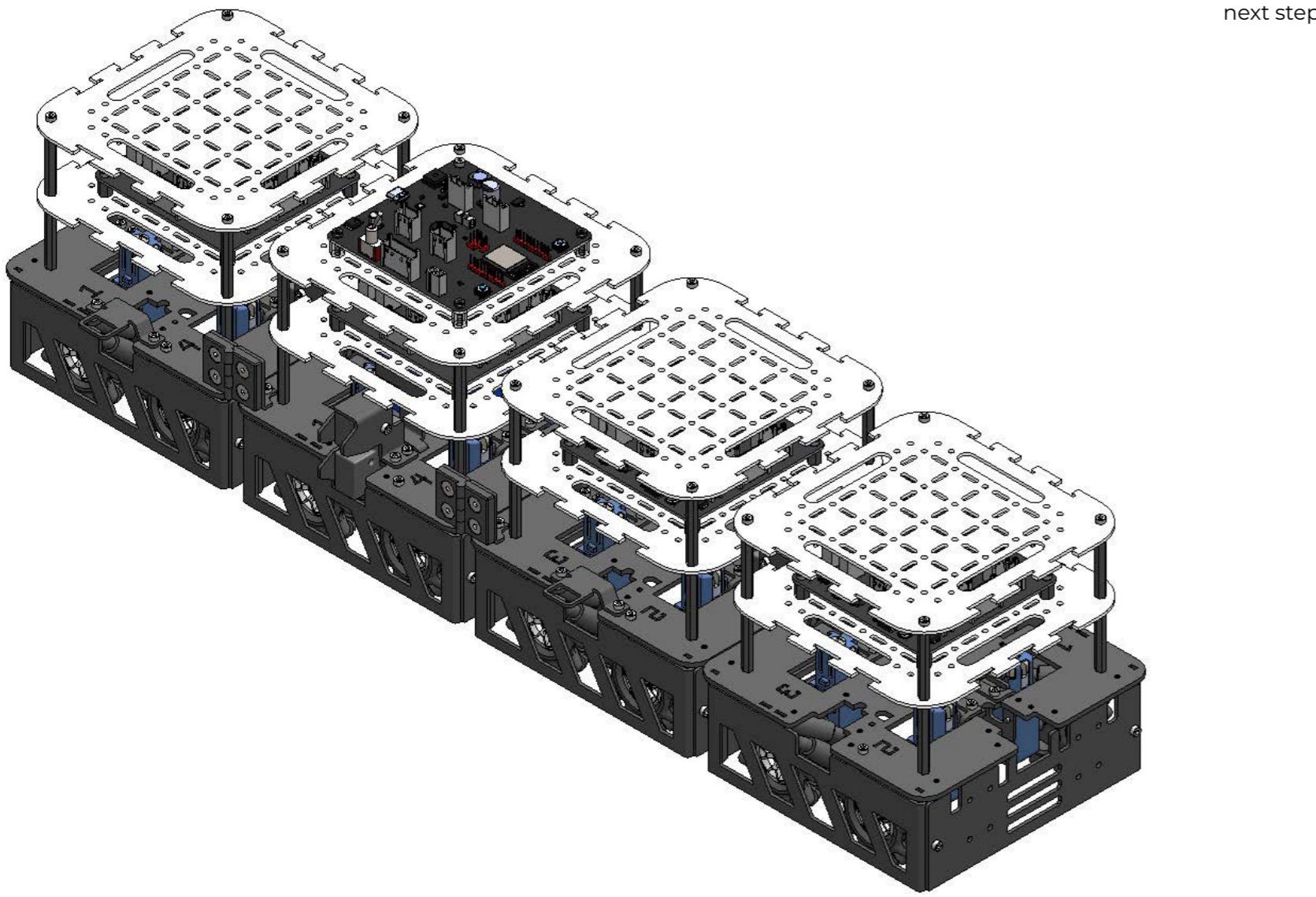


B13 (connect battery to masterboard)



B14 (check connection)





B electronic assembly completed

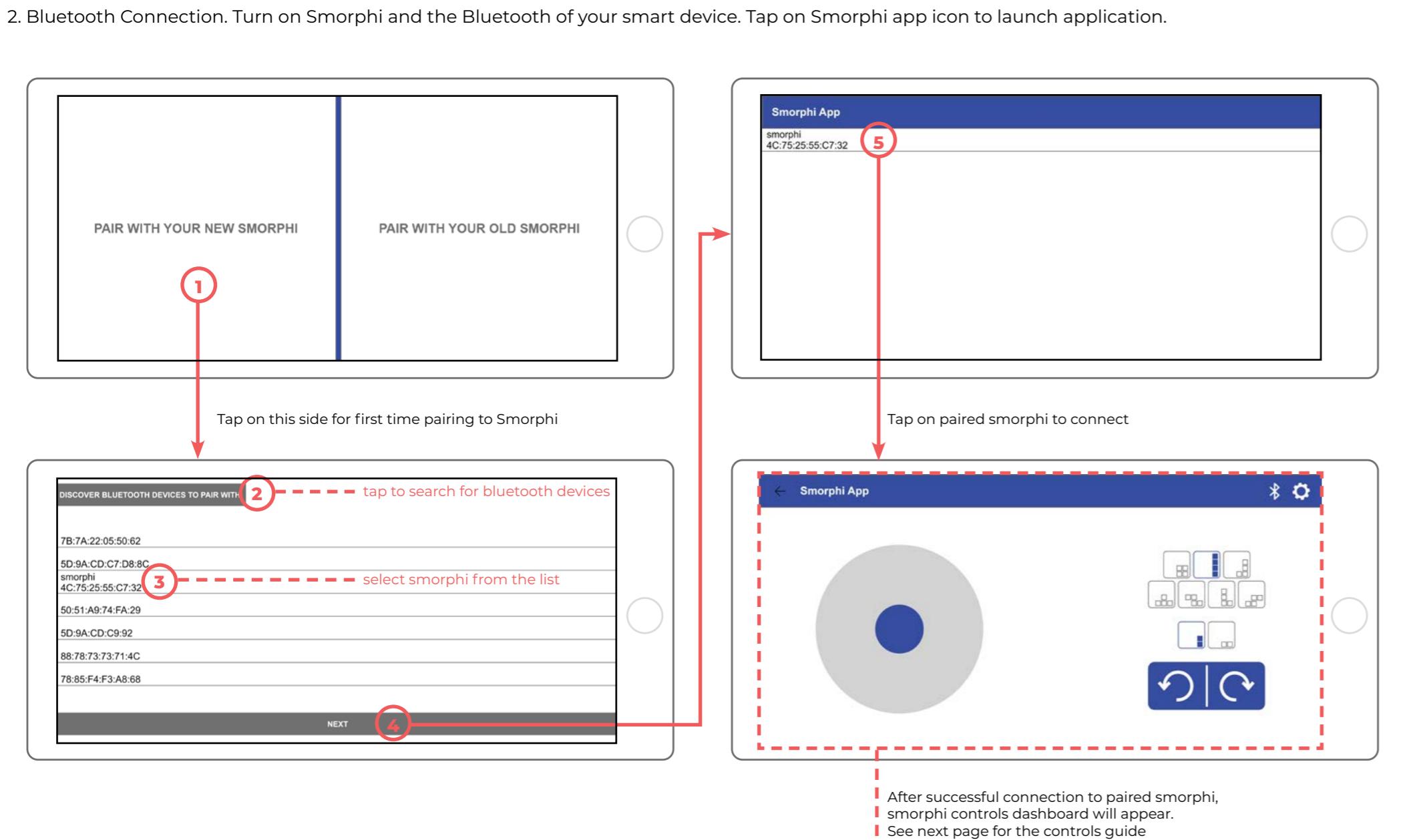
smorphi is ready!
next step: connect with app

(app)

1. App Download.

✗ Not all devices are compatible now.
See the table below to check if your device is compatible with the Smorphi app.

Smorphi App Information	
Available Platforms	(Android)
Download from	(Google Play)
App Icon & Name	
	 smorphi
System Requirements	
OS Requirements	{ Android 6+ Bluetooth 4.0+ }



3. Smorphi controls dashboard guide.

Direction & Speed Joystick Control

Direction Control

Move Joystick in intended direction
Smorphi will move in the direction that the user intend

Speed Control

Speed of smorphi is controlled by how much the user push the joystick from centre

Shape Transformation Control (Smorphi Mini)

Current Shape

Highlighted Shape on Highlighted Button

Shape Transformation

Click on the button to transform Smorphi into the intended shape

Shape Transformation Control (Smorphi Square)

Note:

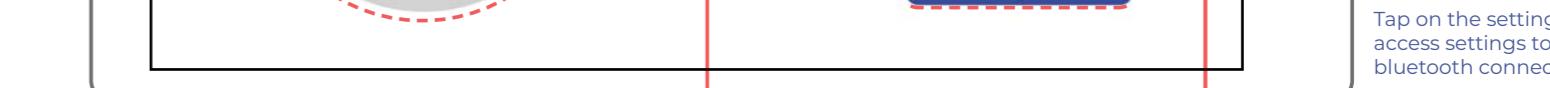
Wait for Smorphi to finish transforming before attempting another shape transformation

Bluetooth

After pairing the robot, you can click on the bluetooth button to reconnect the robot to the app.

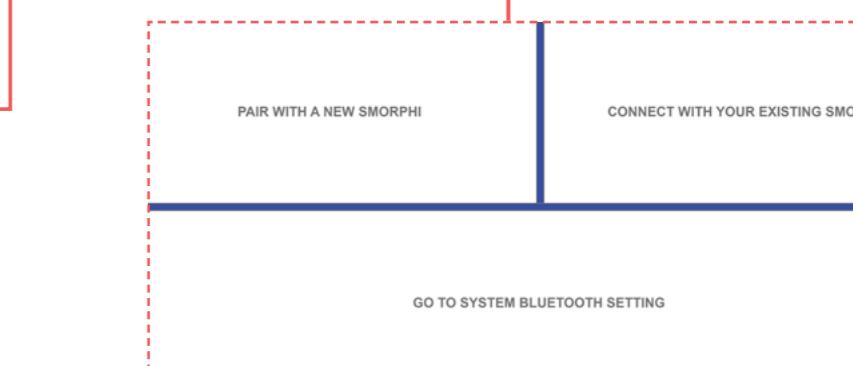
Setting

Tap on the setting button to access settings to the robot-device bluetooth connection



Pivot Turning

Press and hold to pivot the robot around centre



For tutorial to Smorphi activites and exercises, please refer to the online class exercises by following the link below:
<https://github.com/WefaaRobotics/Smorphi/wiki/>

(sensors)



sound sensor (x2)

Sound sensor measures volume of sound. Onboard potentiometer* can be used to tune the range of sensing. Possible applications: sound-triggered shape transformation or sound-triggered locomotion.



temperature sensor (x1)

Temperature sensor measures surrounding temperature, with a range of -55°C to 125°C.



IR sensor (x4)

IR sensors comes with 2 different modes, toggled by the switch onboard the sensor itself. One IR is front-facing and can be used to detect obstacles ahead. The other IR faces the ground and can be used for path tracking.



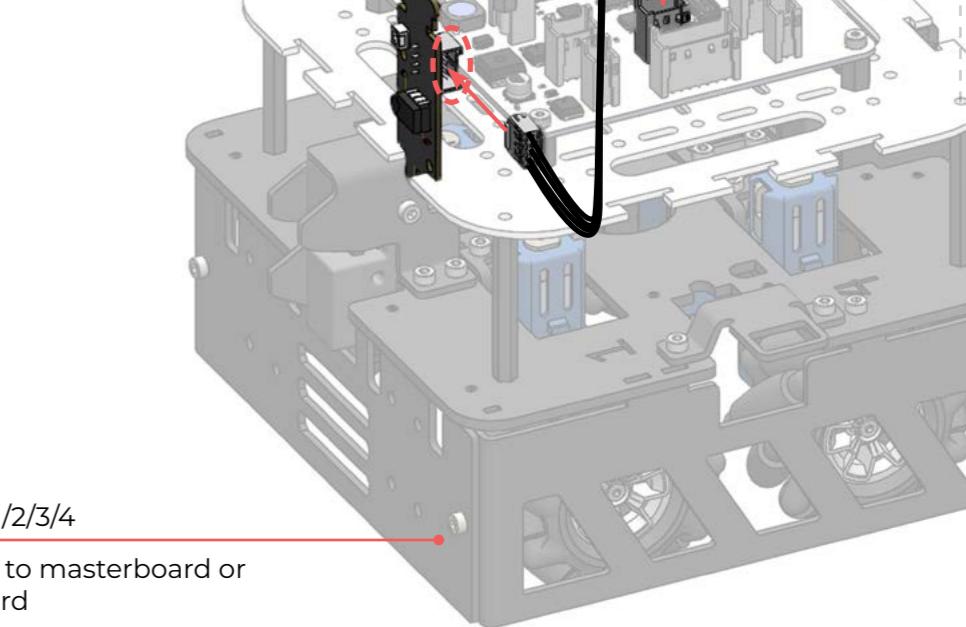
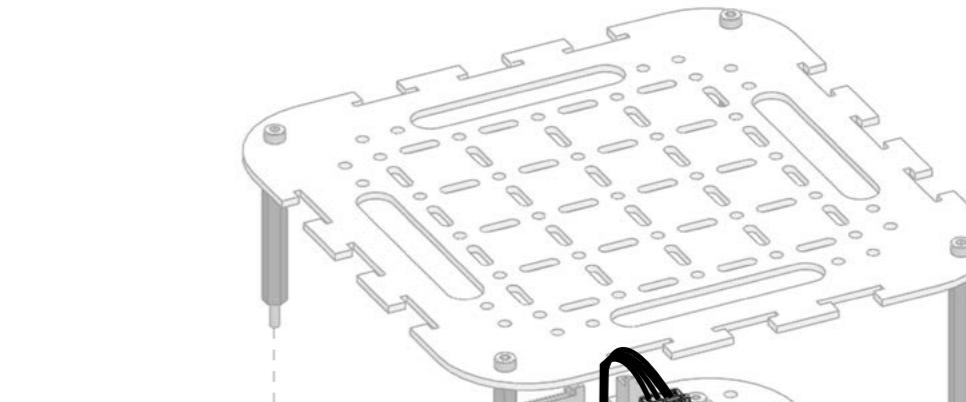
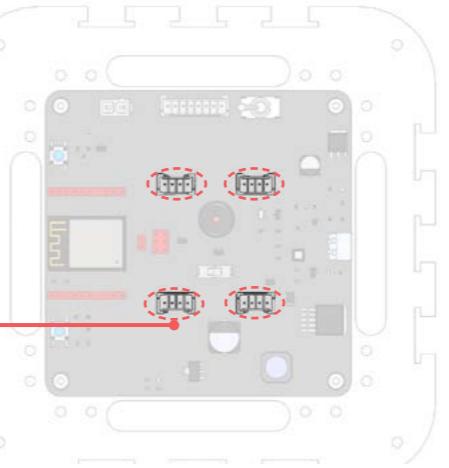
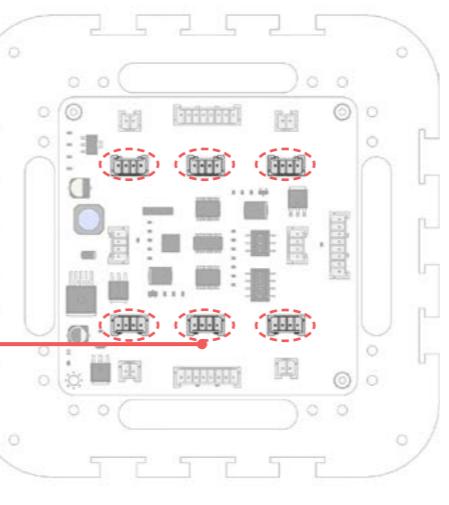
Pixy2 camera (x1)

Pixy2 Camera is able to colour code, detect and track lines and intersections, and learn to detect objects taught to it.

✖ For sensor related activities and implementation, please refer to the online class exercises by following the link below:
<https://github.com/WefaaRobotics/Smorphi/wiki/Robot-Exercises>

✳ Tutorial on how to operate the potentiometer can be found by following the link below:
<https://github.com/WefaaRobotics/Smorphi/wiki/Exercise-6>

(sound/IR sensor wiring)

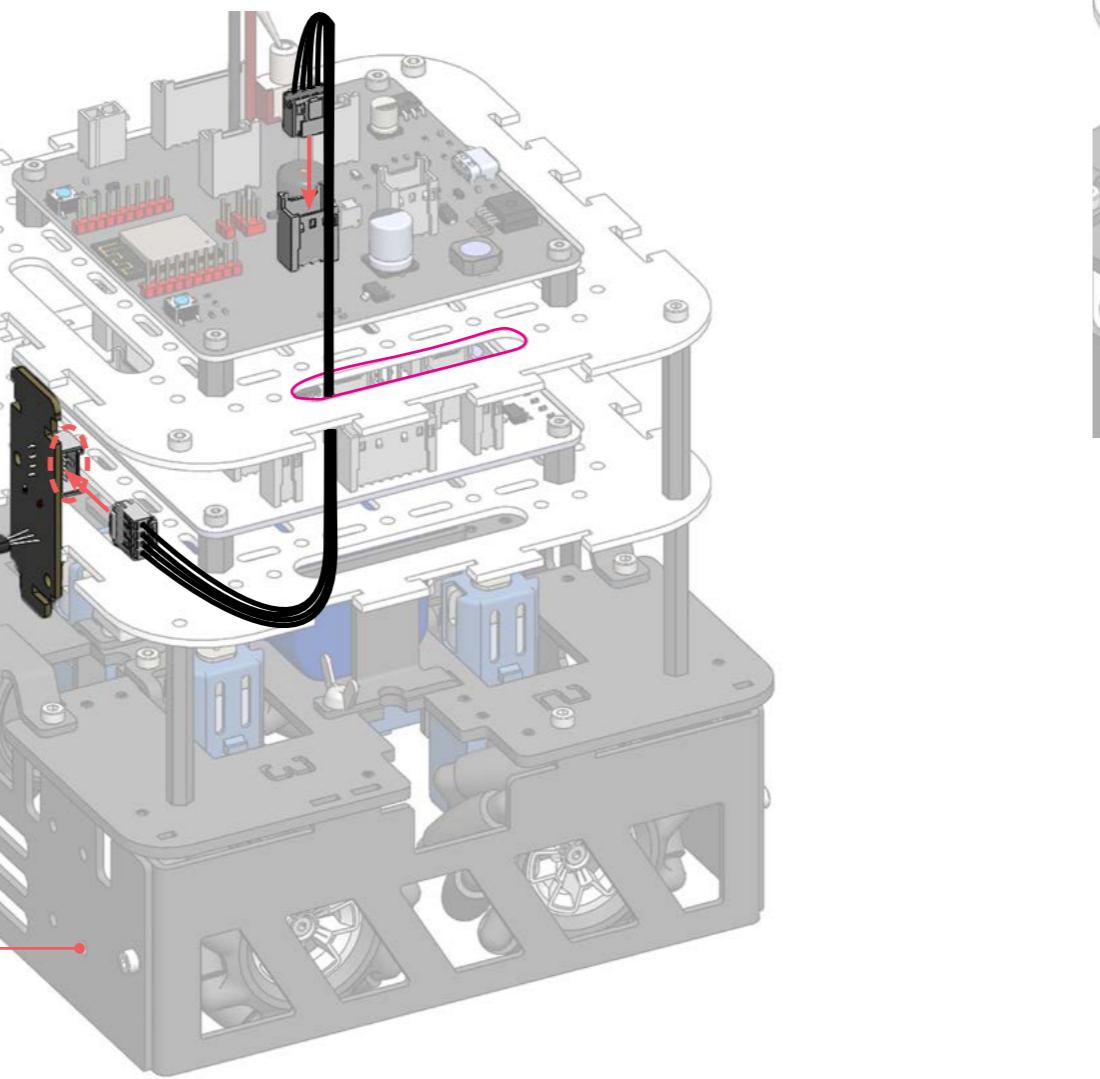
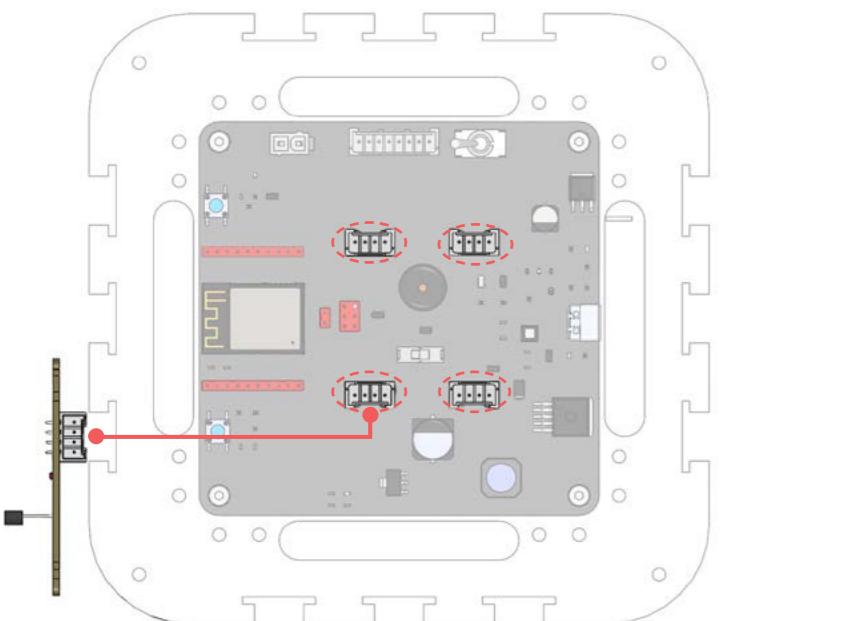


Module 1/2/3/4

Connect to masterboard or slaveboard

✖ Sound/IR sensor can be connected to any of the 6 sensor ports on the slaveboard (top) or any of the 4 sensor ports on the masterboard (bottom).

(temperature sensor wiring)



Module 2

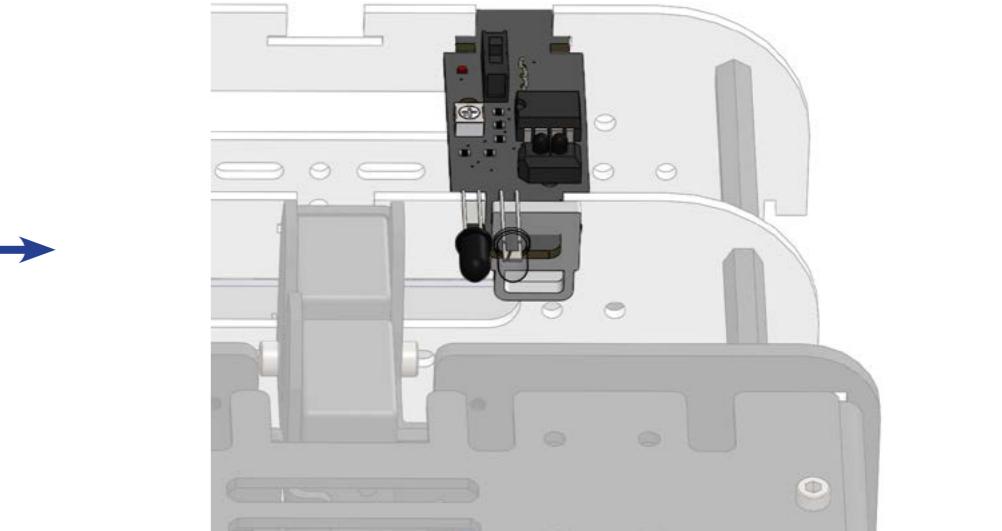
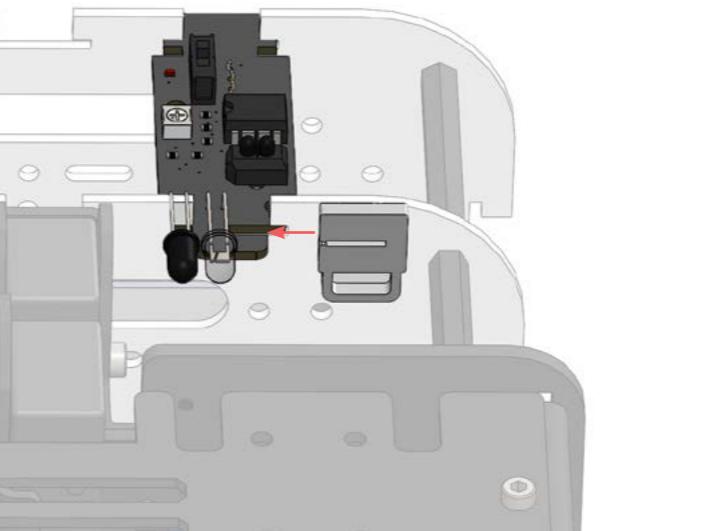
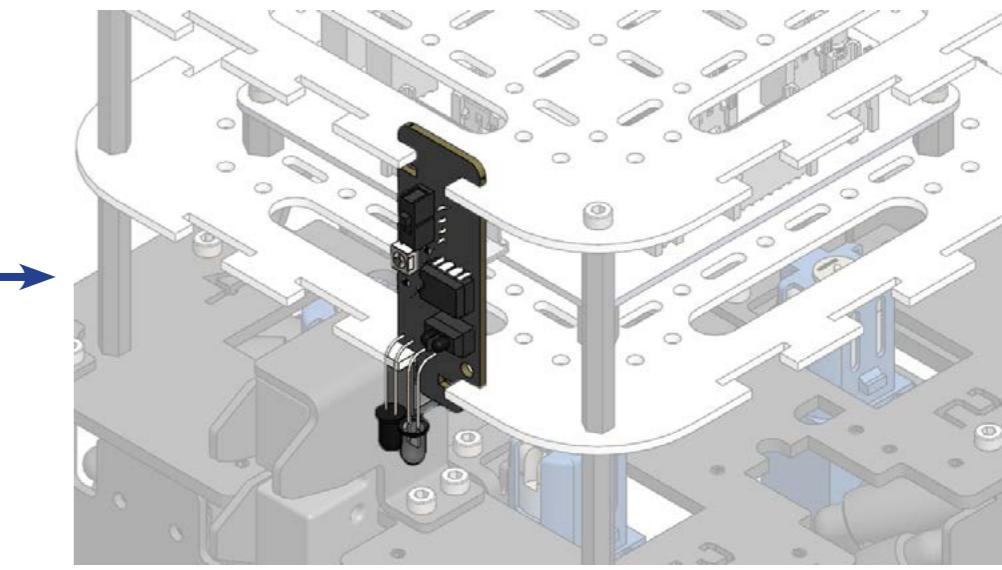
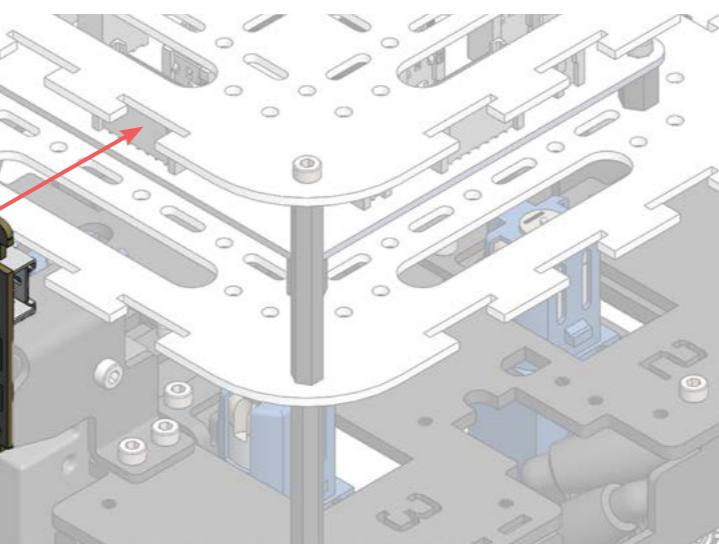
Only connect to masterboard



Temperature sensors can only be connected to any of the 4 sensor ports on the masterboard.

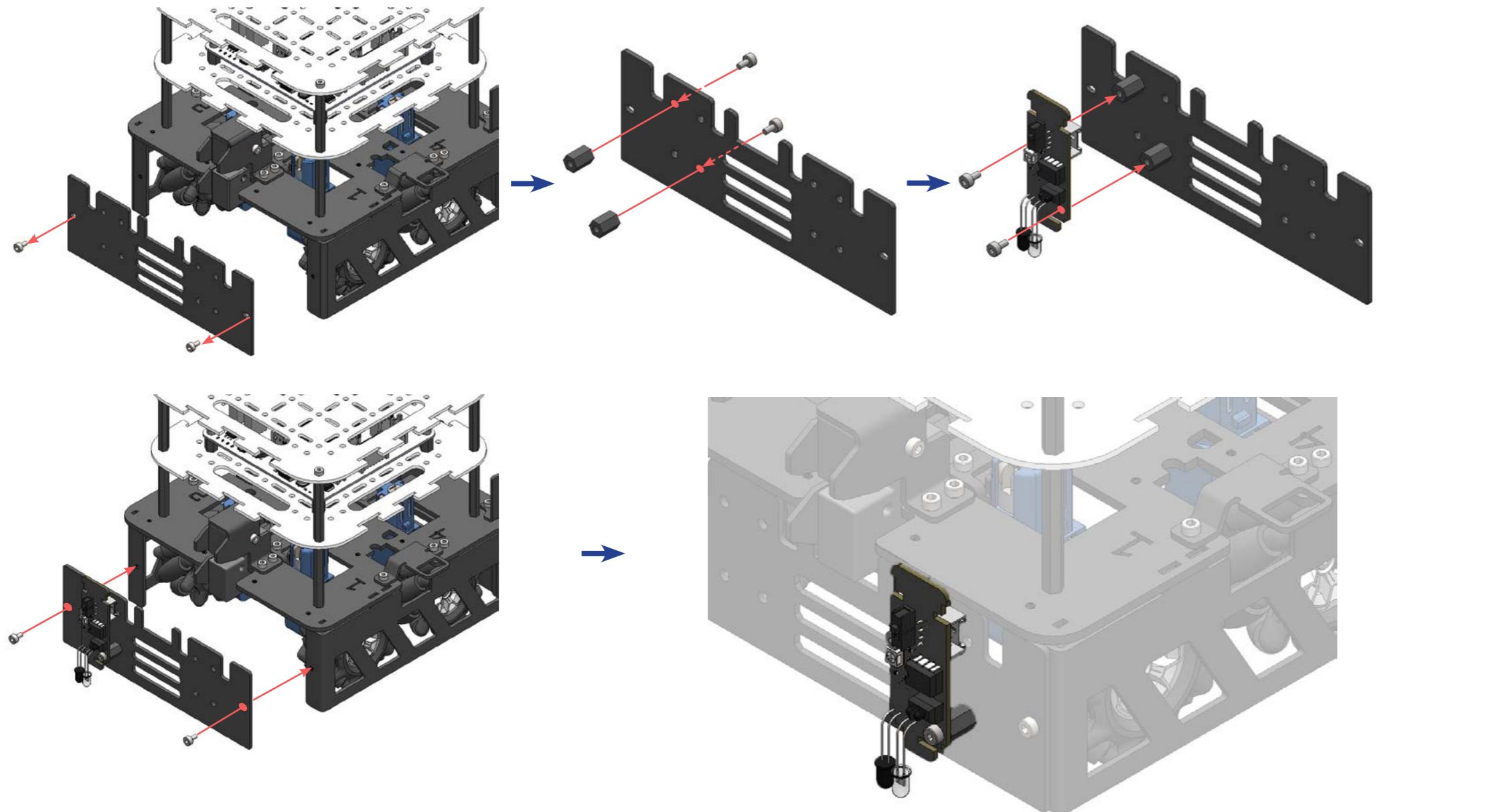
Opening to pass wire through

(sensor position 1)



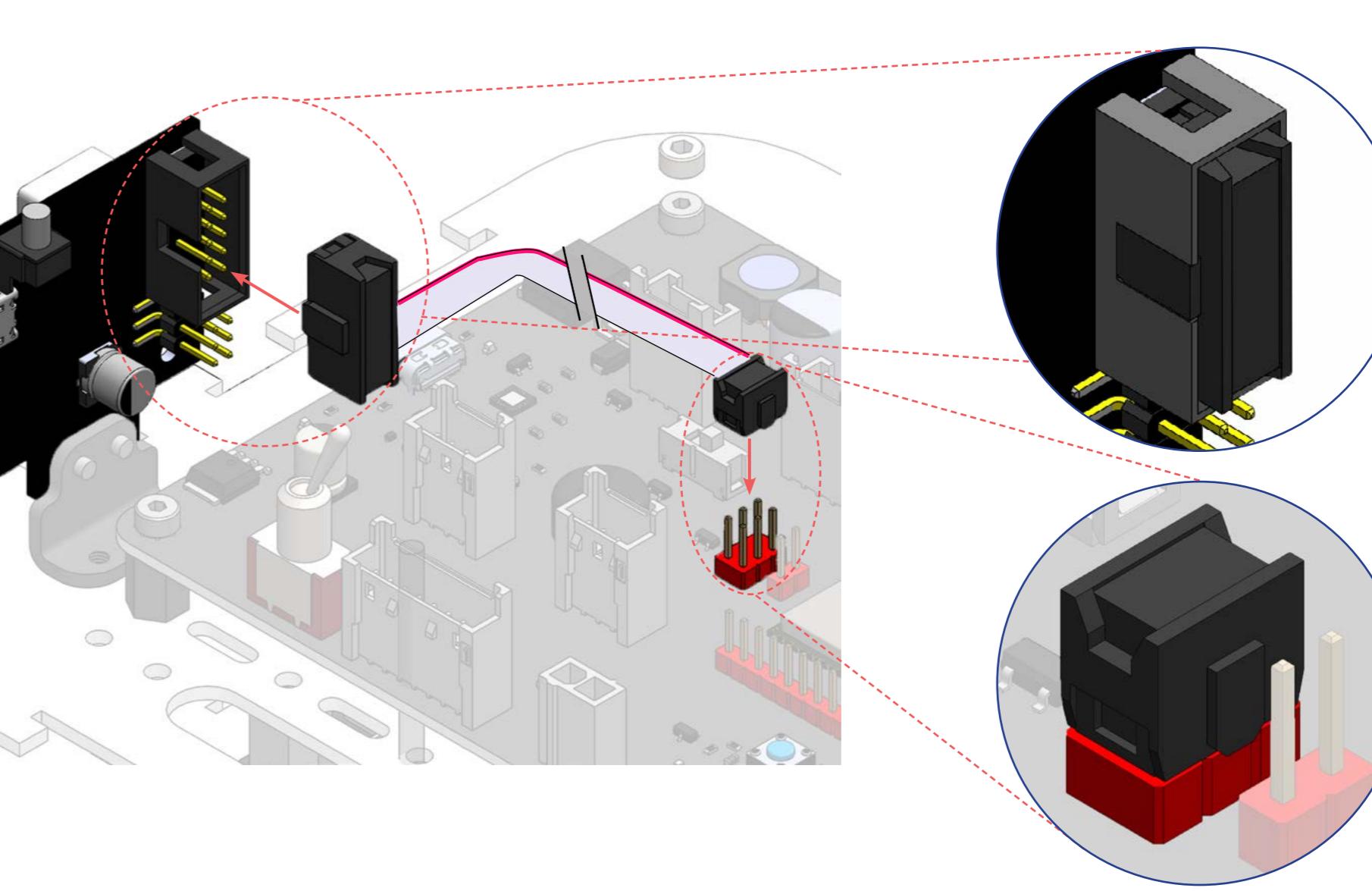
Sensors can be secured to the robot using the sensor lock provided.

(sensor position 2)



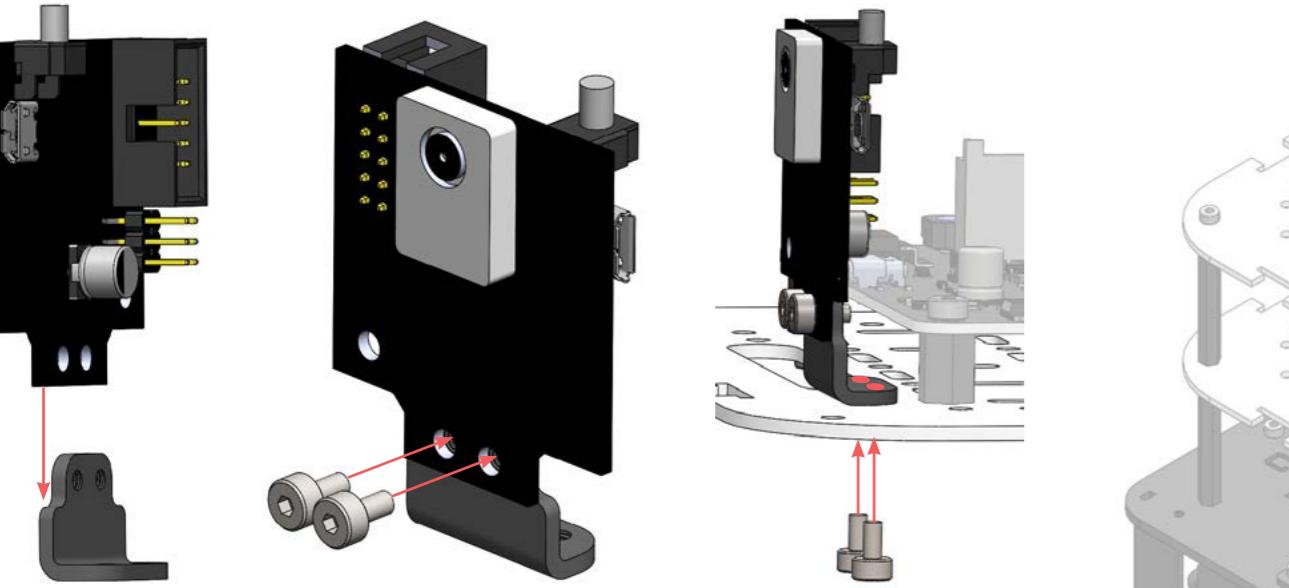
 Sensors can also be attached at the skirt panel of the robot.

(pixycam wiring)



 Use the flat ribbon cable to connect the pixycam to the masterboard
6 pin side to the masterboard
10 pin side to the pixycam

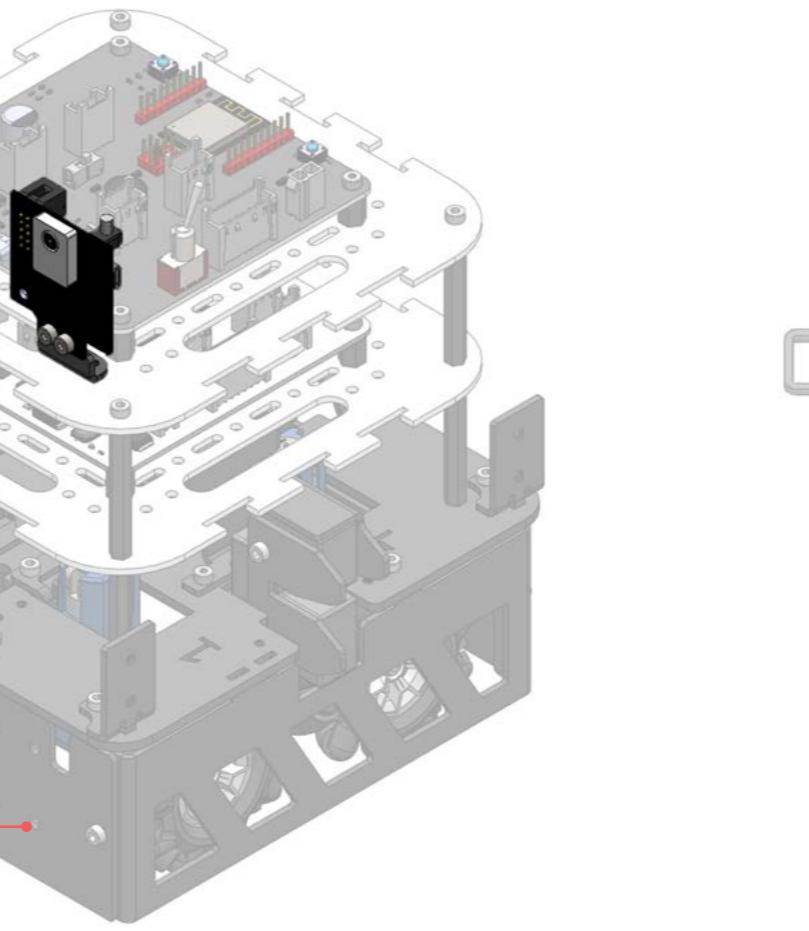
(mounting the pixycam)



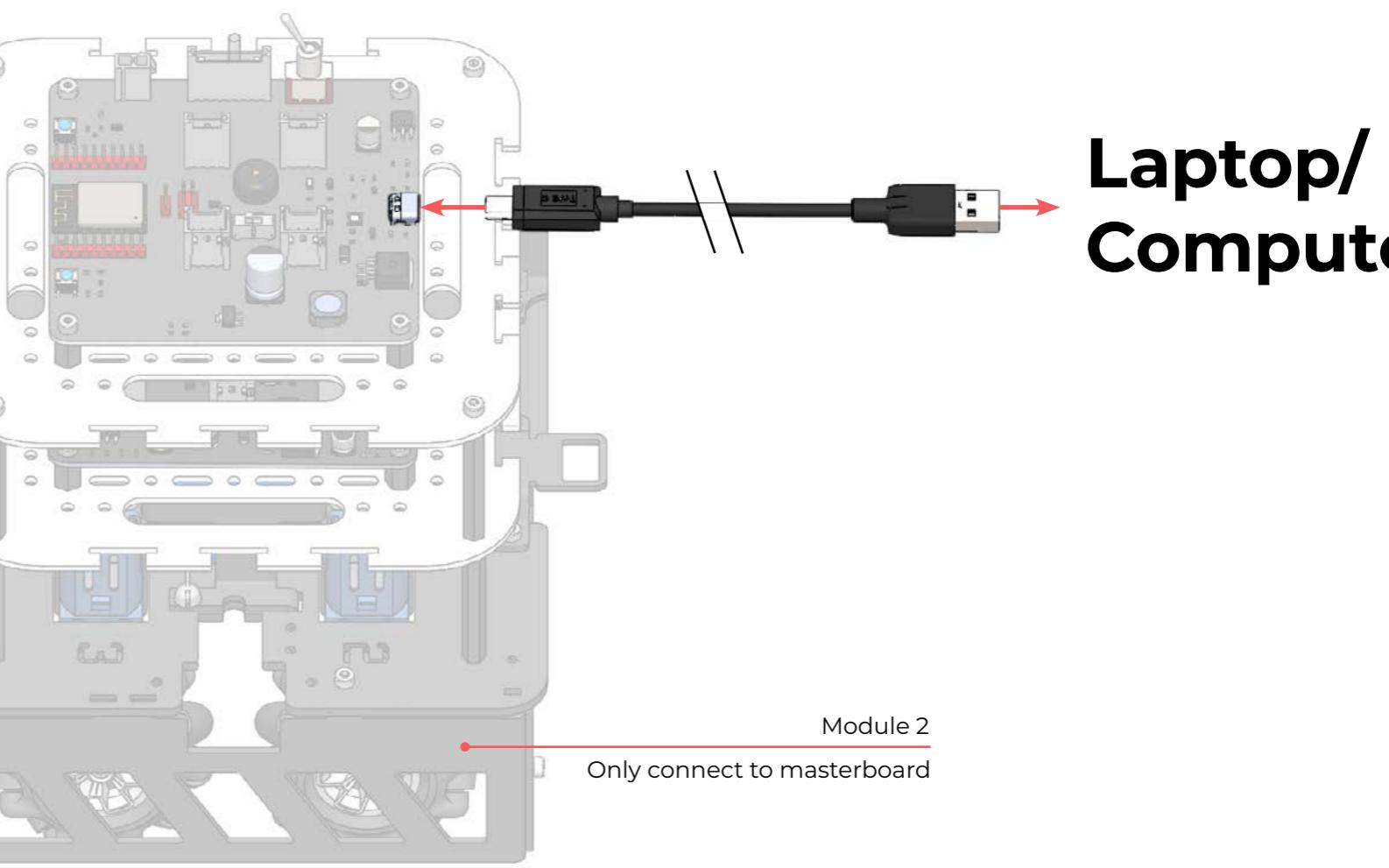
Module 2

Only connect to masterboard

 Pixycam can be mounted on anywhere on the acrylic board.

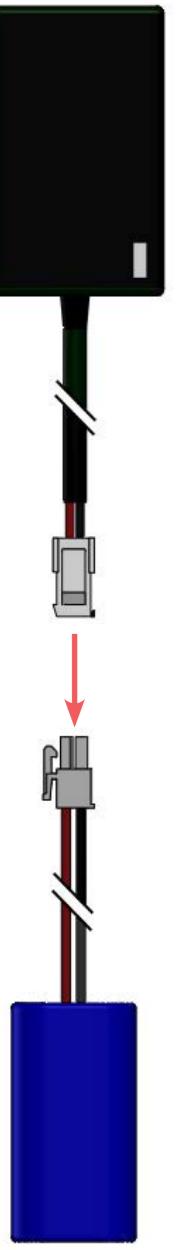


(connect to laptop)

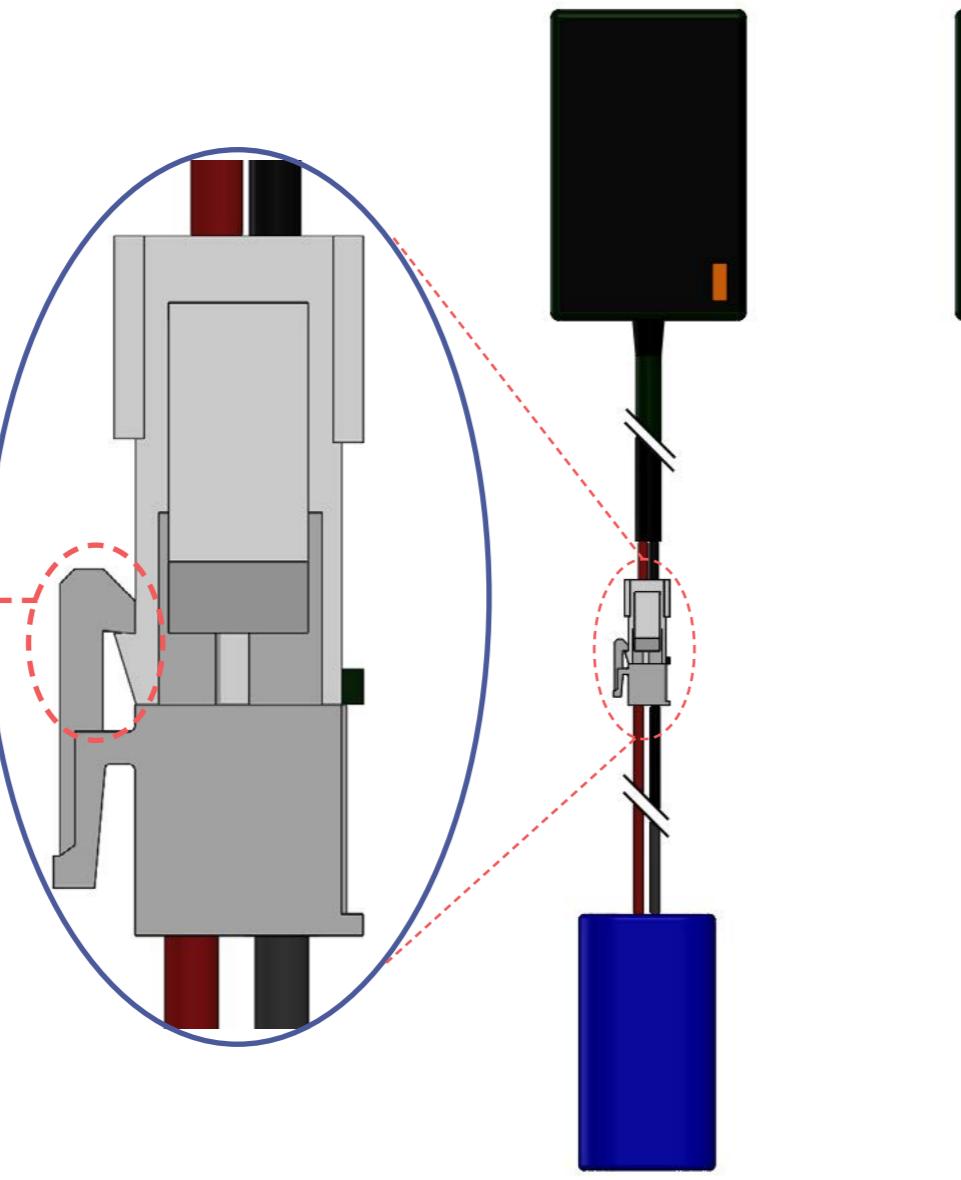


 Plug in the USB-C cable as shown above to connect the masterboard to the computer.
It allows us to upload our code from our computer onto the masterboard.

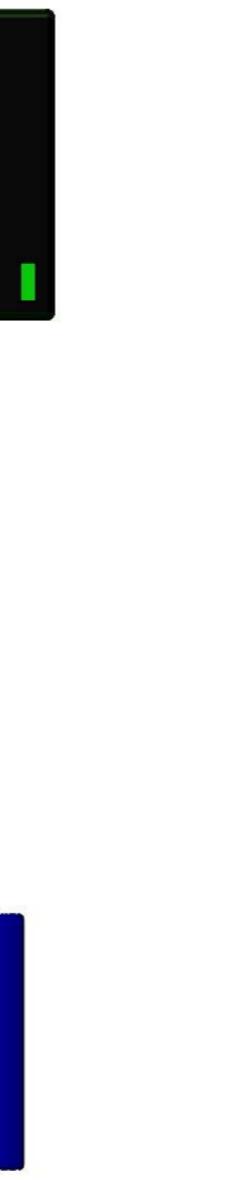
(charging)



Make sure the both connector is connected by the latch



✖ When battery is charging, an orange light will be shown on the charger. Once battery is fully charged, a green light will be shown



(unplug cable)

