

smorphi²
transforming learning with
transformer robots

assembly & info

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SMORPHI ASSEMBLY		
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(part list)

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

8 x Acrylic Base Plate



6 x Hinge Mount



28 x Hex F-F M3 Nylon 10mm



4 x Aluminium Base Plate



3 x Hinge Mechanism



200 x Cap Screw M3x5



8 x Base Skirt Panel A



1 x Battery



50 x Cap Screw M3x25



8 x Base Skirt Panel B



2 x Battery bracket



15 x Countersunk Screw M4x8



8 x Mecanum Wheel (Right)



1 x Masterboard (ESP32)



2 x Wing Screw M3x5



8 x Mecanum Wheel (Left)



4 x Slaveboard



1 x USB-C Cable



16 x Mecanum Motor



2 x Sound Sensor



9 x 4-pin Connector



16 x Motor Shaft Sleeve



1 x Temperature Sensor



4 x 8-pin Connector



16 x Motor Mount



4 x IR Sensor



1 x Battery Charger



6 x Solenoid



1 x Pixy2 Camera



1 x Ceramic Screwdriver CD-25



6 x Solenoid Latch Mount



1 x Pixy2 Mount



1 x HEX Key 1.5mm



6 x Solenoid Latch Guide



10 x Sensor Lock



1 x Ribbon cable
(included in pixycam package)

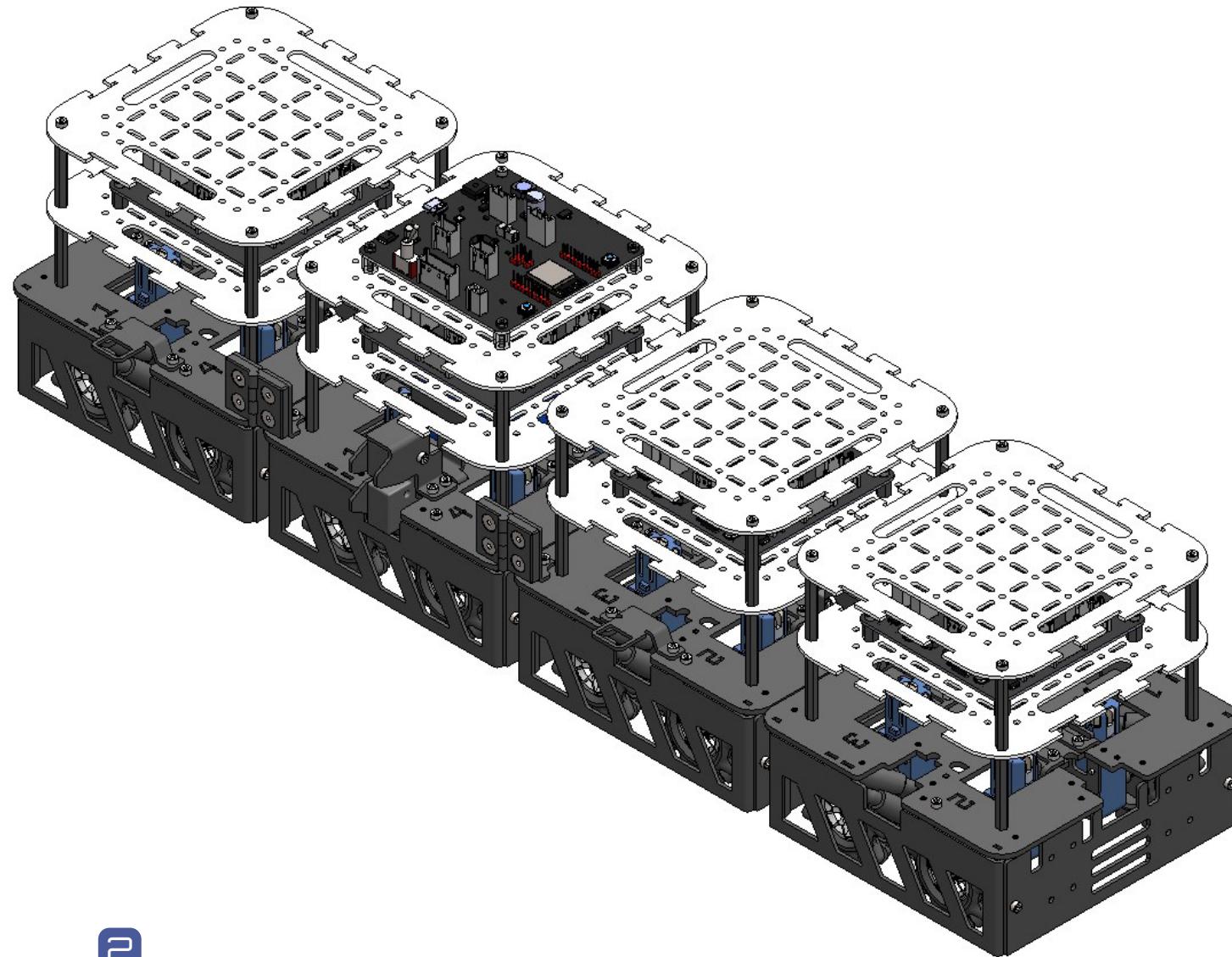


6 x Solenoid Catch



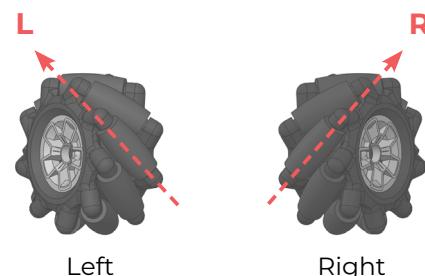
32 x Hex M-F M3 Nylon 45mm



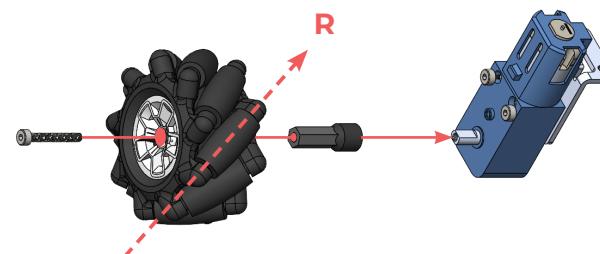
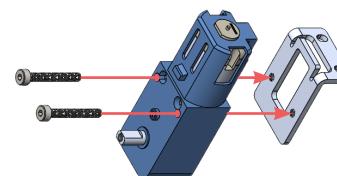


smorphi^e
assembly start

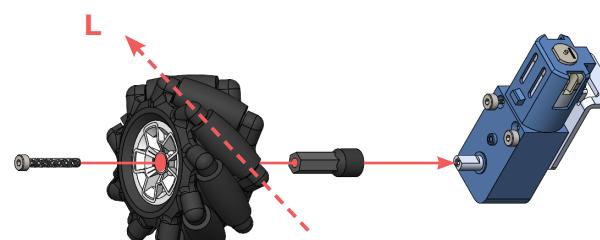
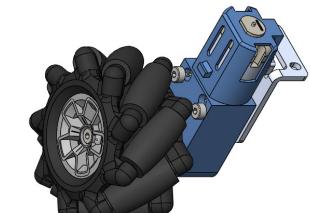
A 1 (motor sub-assembly)



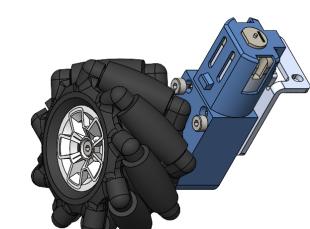
2 ways to differentiate between Left and Right Mecanum wheel
 - Look for L or R on the inside of the wheel
 - Left/Right wheel roller points up to Left/Right



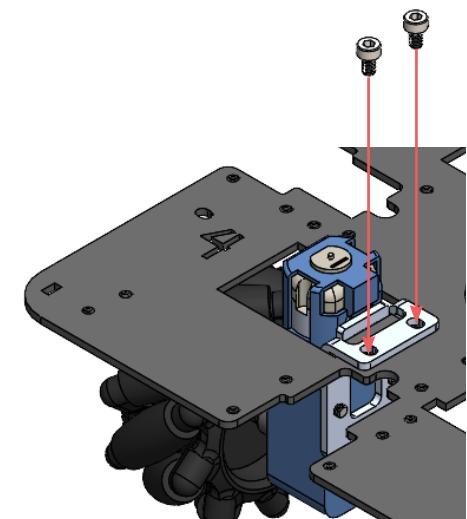
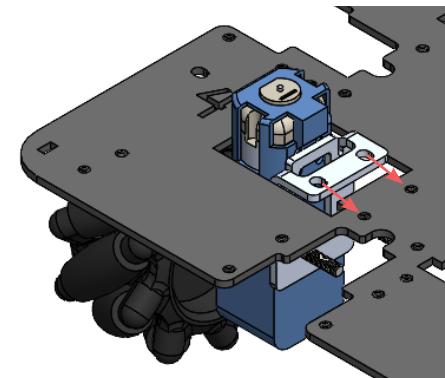
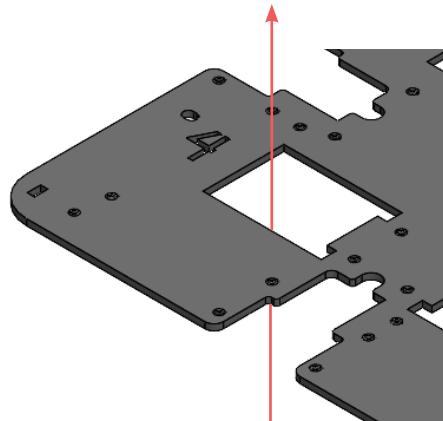
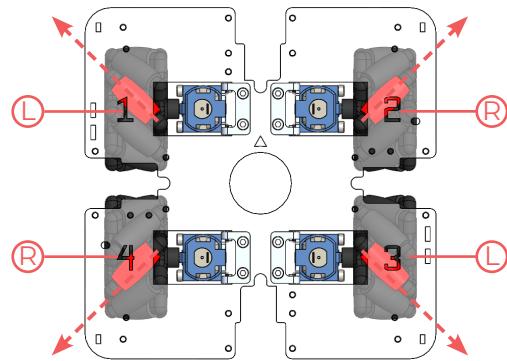
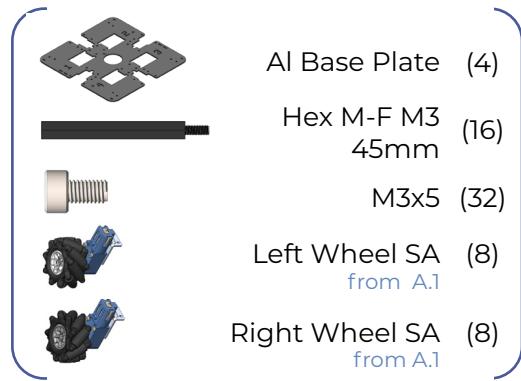
x 8 =



x 8 =

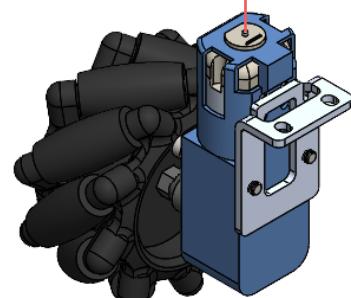


A2 (base module sub-assembly)

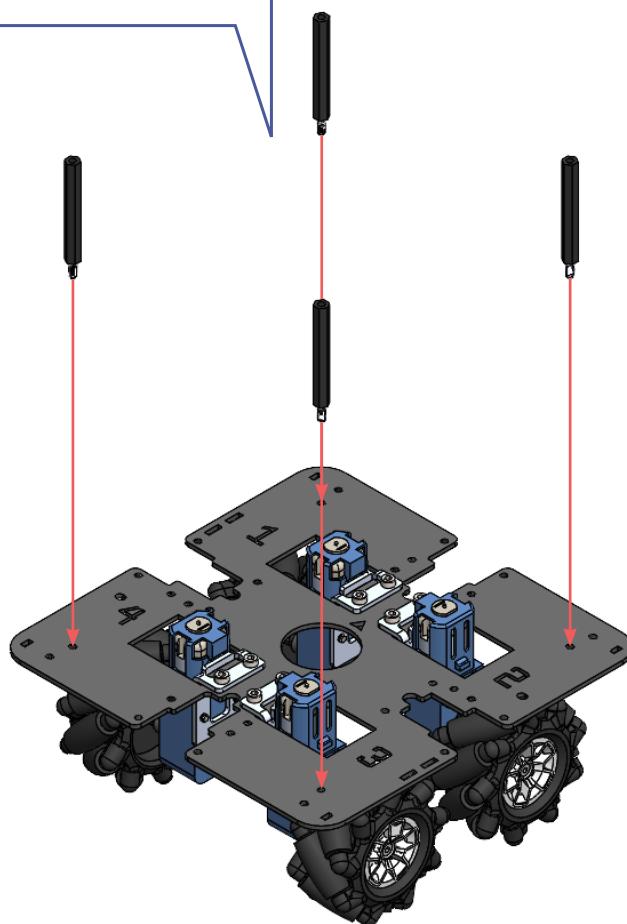
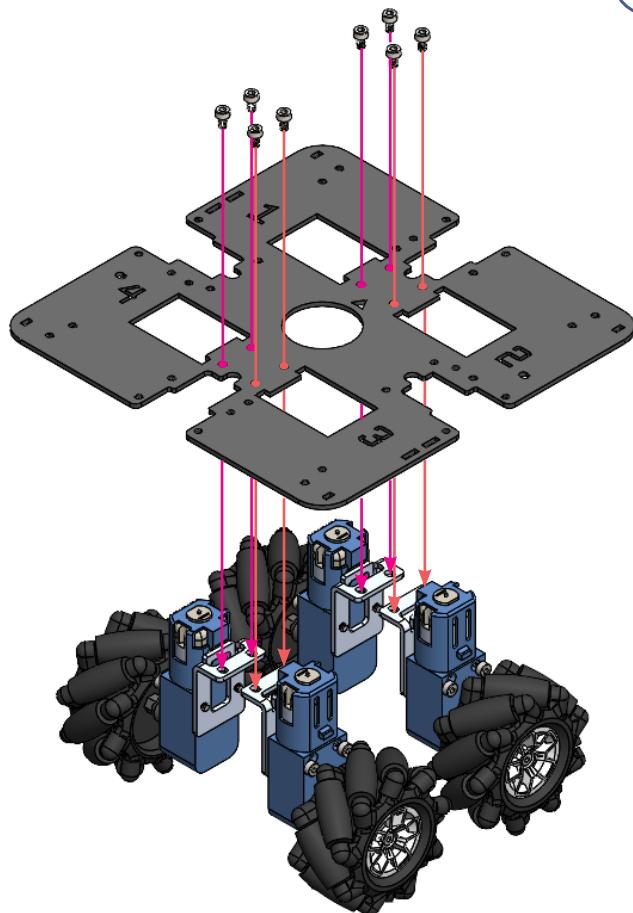
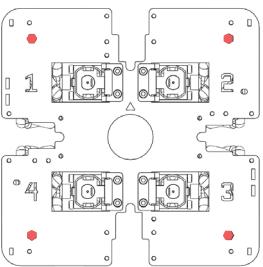


✖ Make sure that the numbers are facing the right way up as shown in the plan view above.

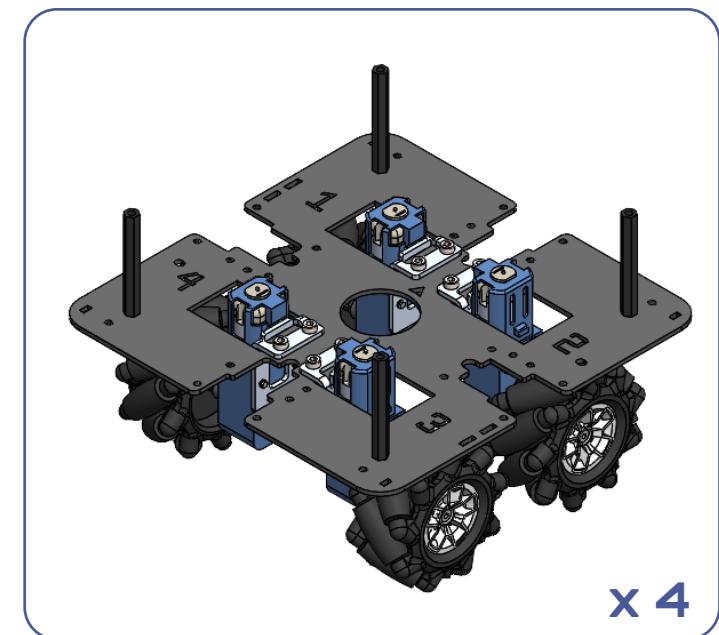
✖ Before attaching each wheel, check that the wheel is of the correct orientation for each numbered slot.

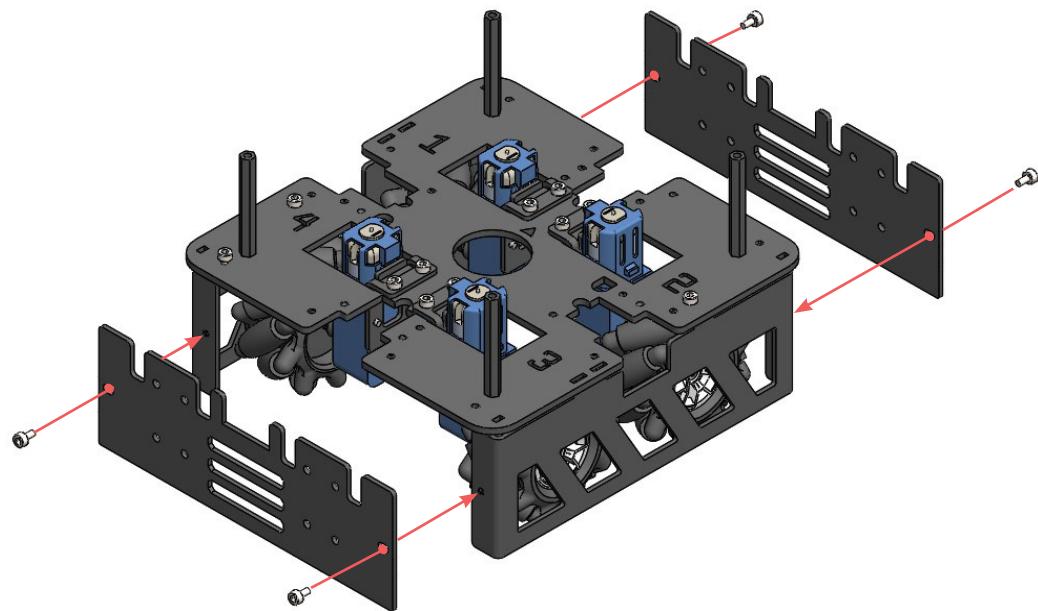
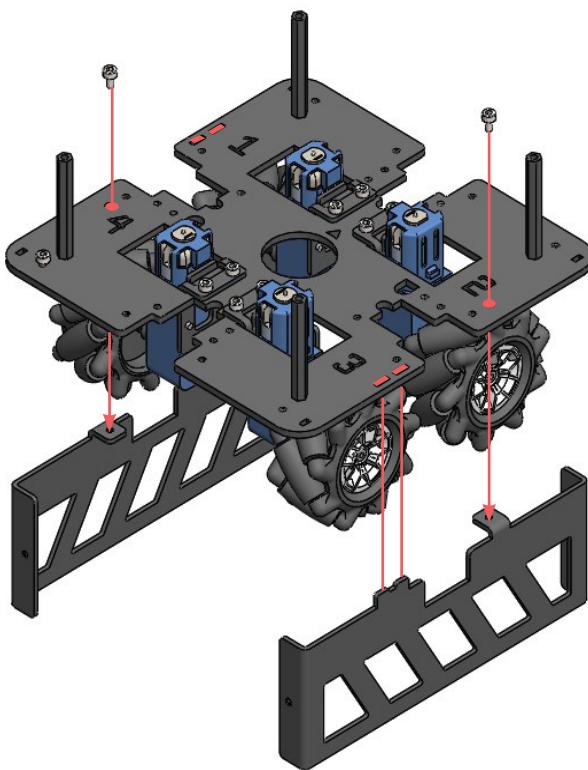
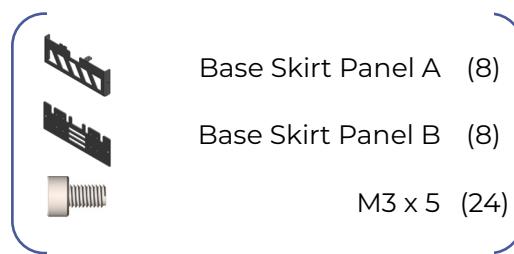


plan view

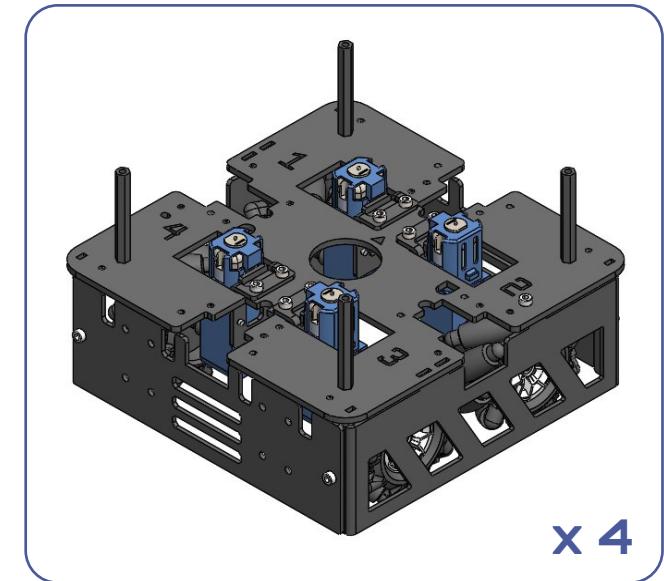


x 4 =

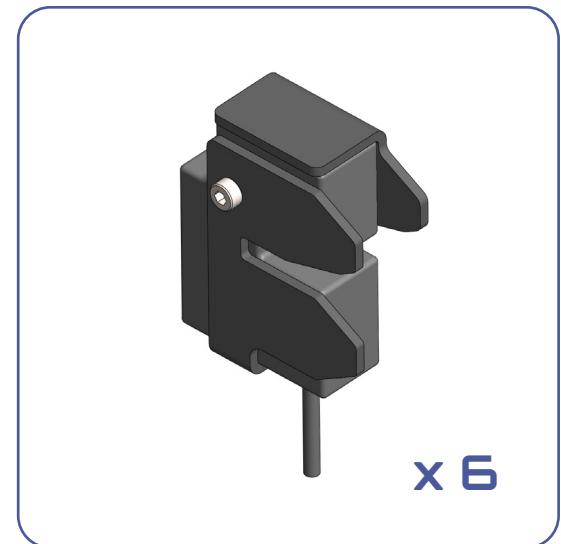
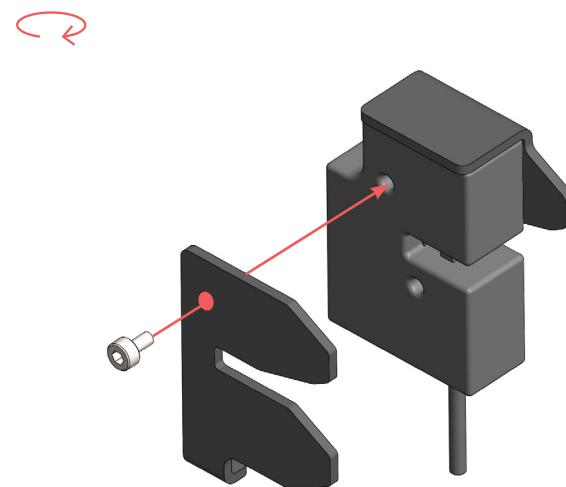
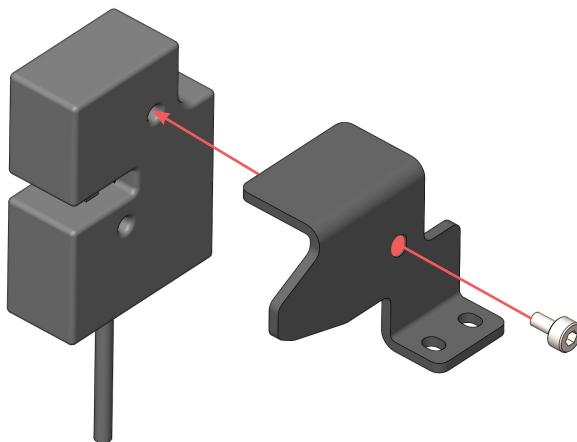




x 4 =

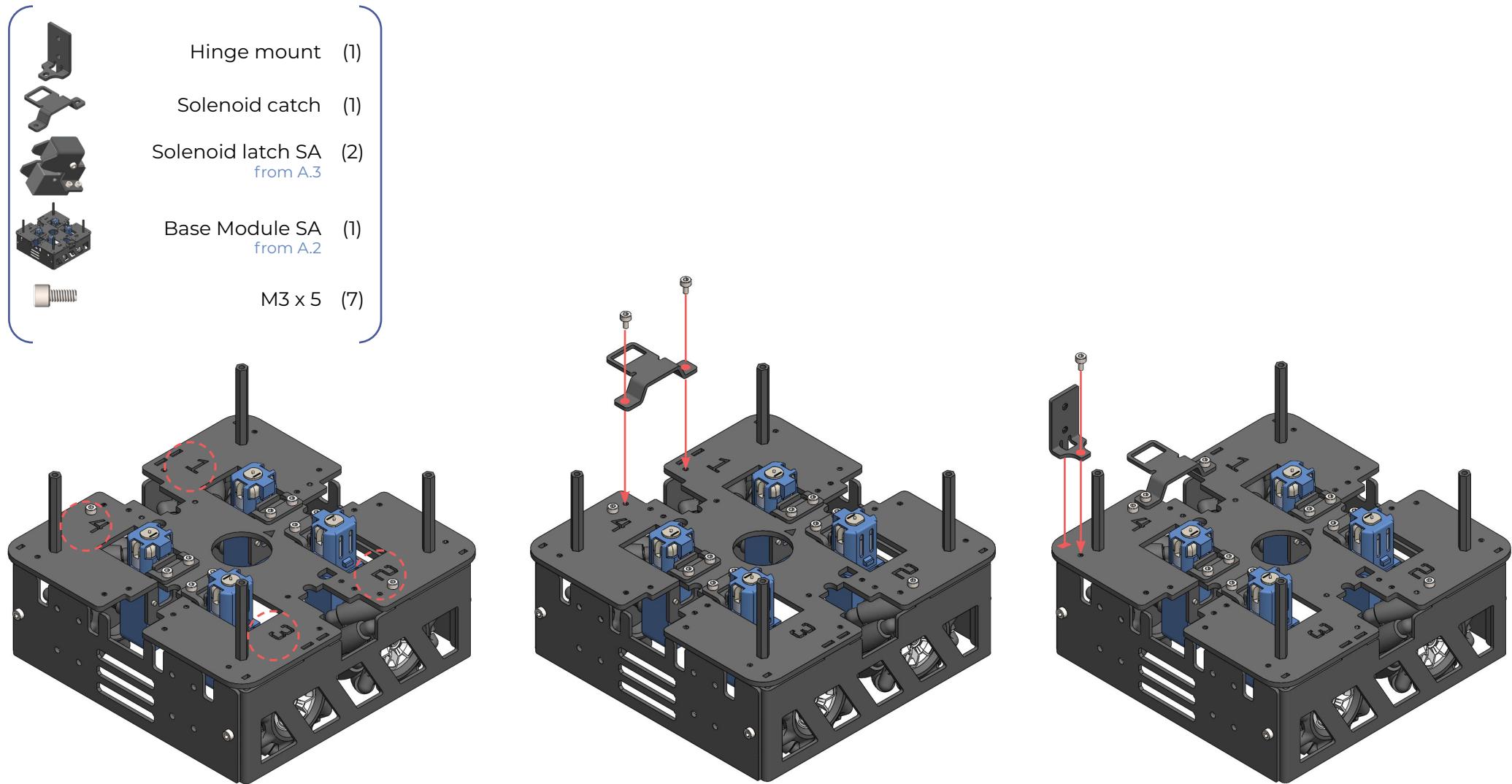


A3 (solenoid latch sub-assembly)

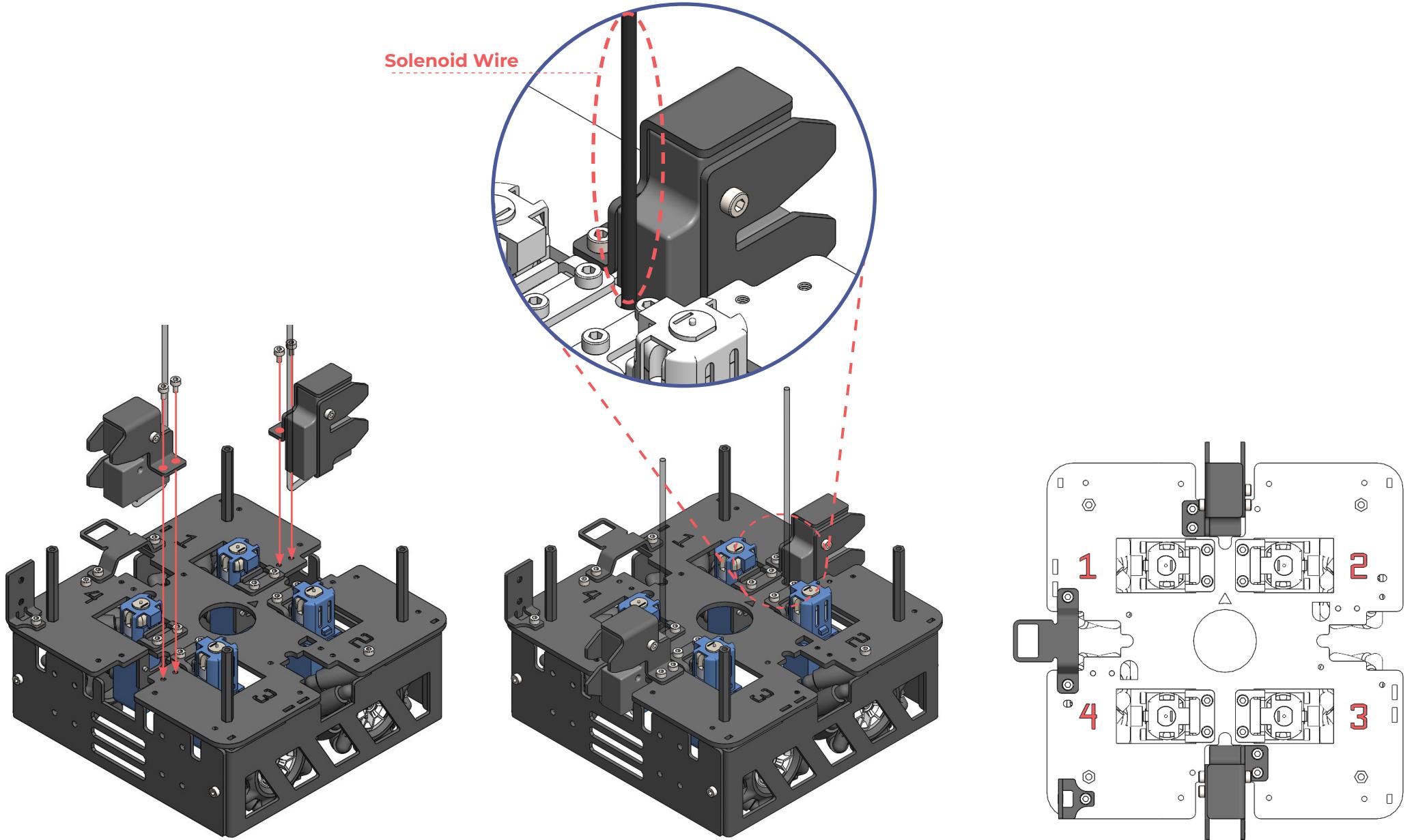


x 6

A 4 (module 1 mechanical sub-assembly)



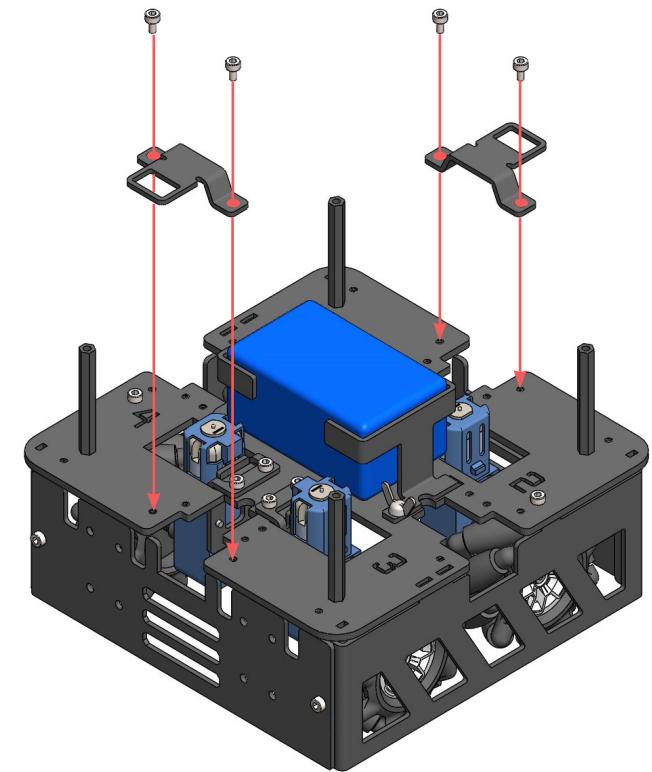
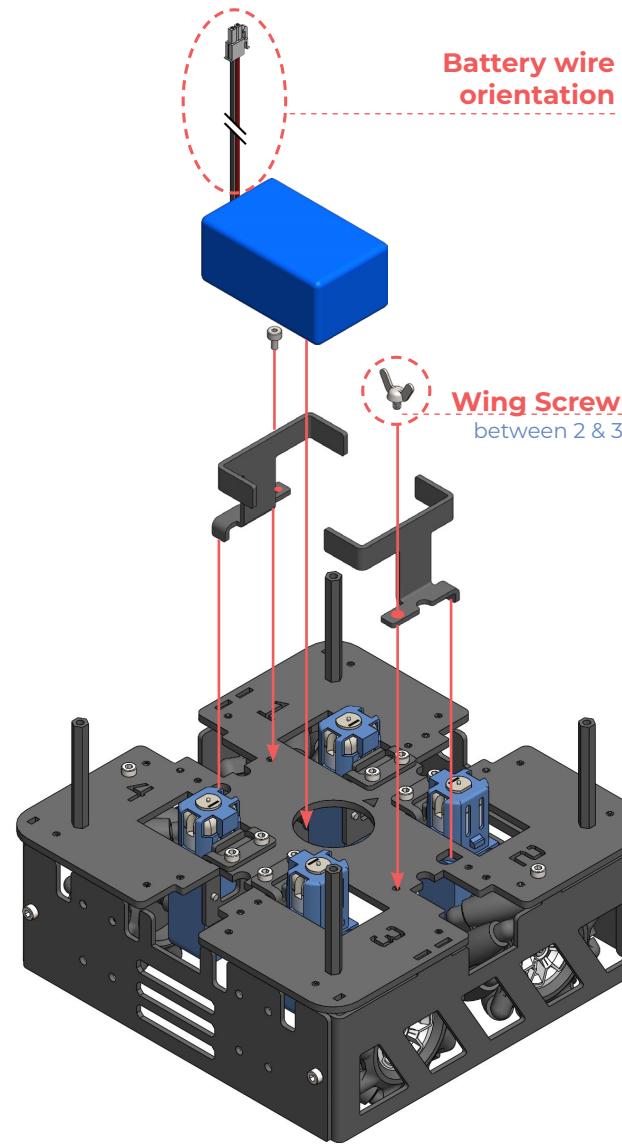
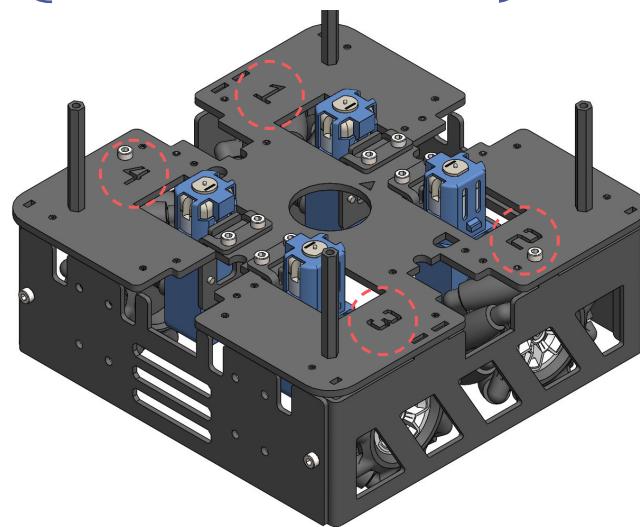
Pay attention to the numbers and their positions in relation to the parts being attached.



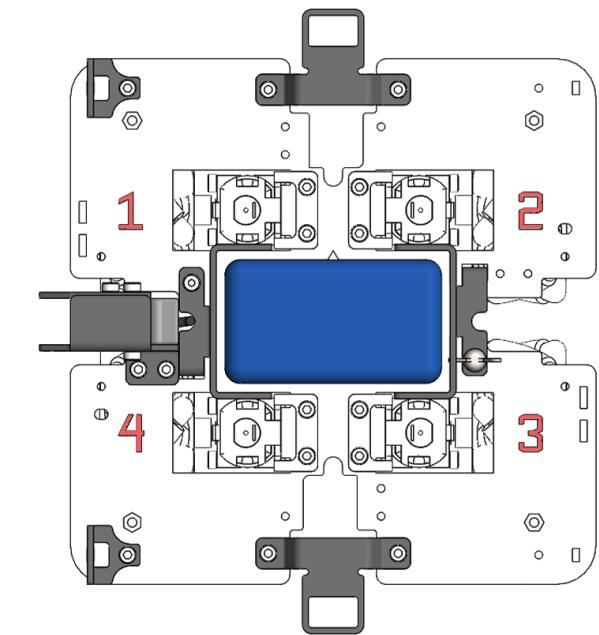
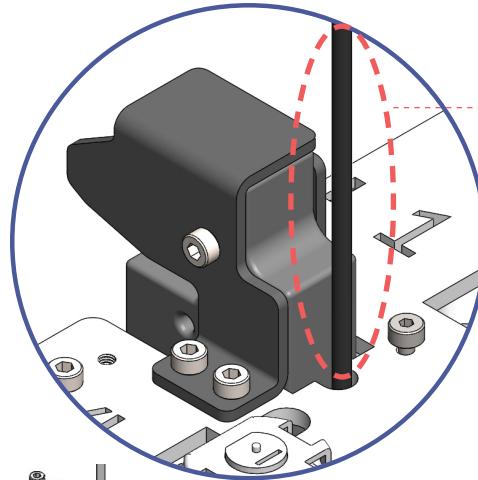
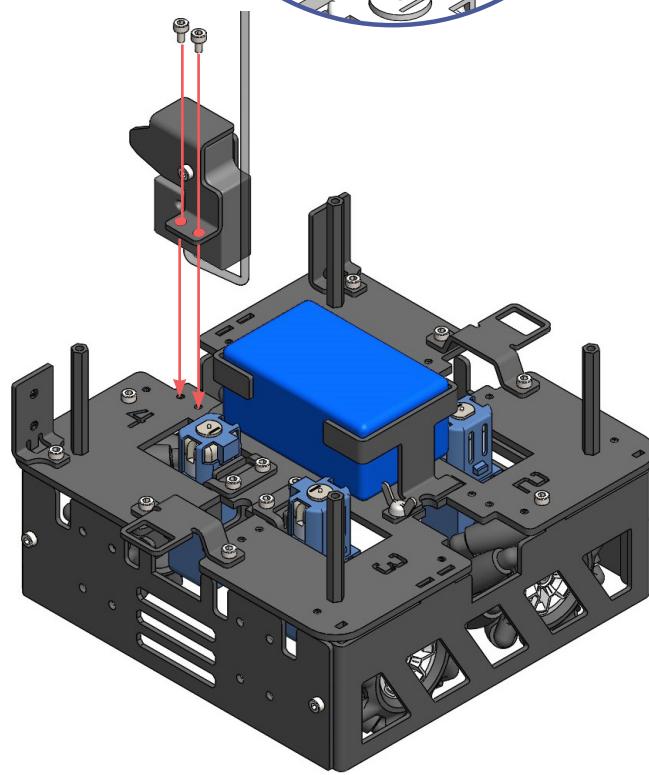
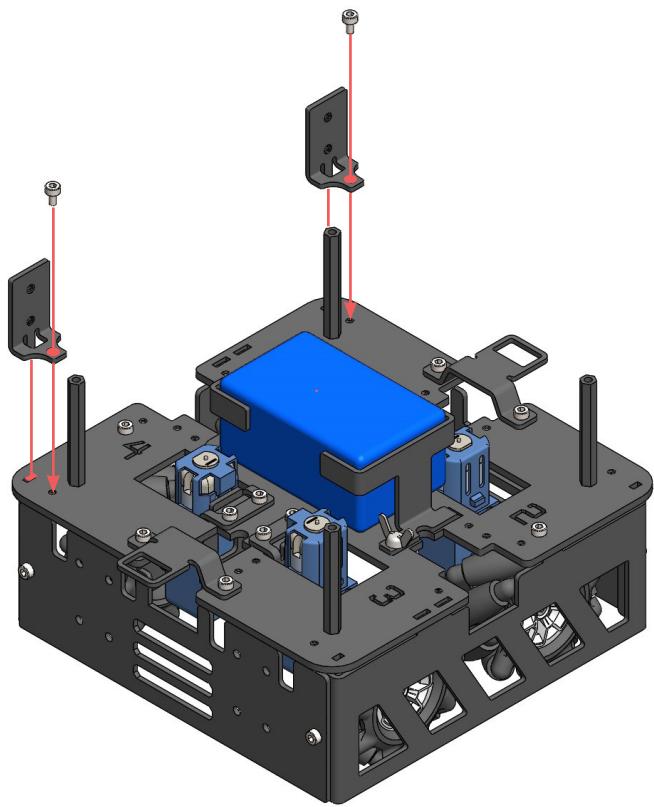
Check that the parts have been attached in the right location, in relation to the numbers.

A5 (module 2 mechanical sub-assembly)

Hinge mount (2)
Solenoid catch (2)
Solenoid latch SA from A.3 (1)
Battery bracket (2)
LiPo Battery (1)
Base Module SA from A.2 (1)
M3 x 5 (9)
Wing Screw M3 x 5 (1)

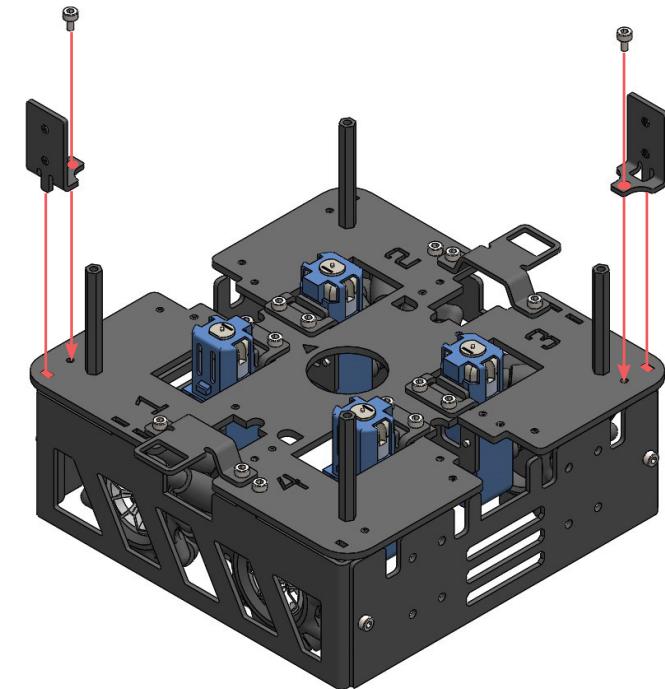
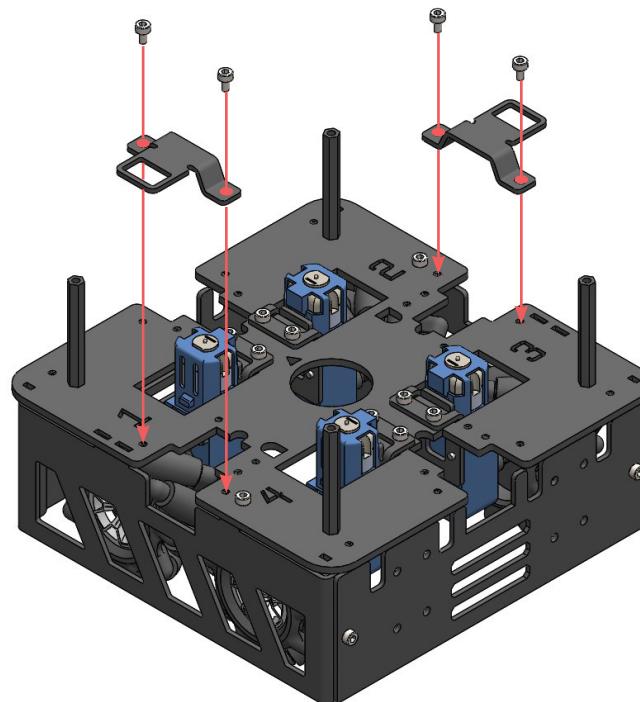
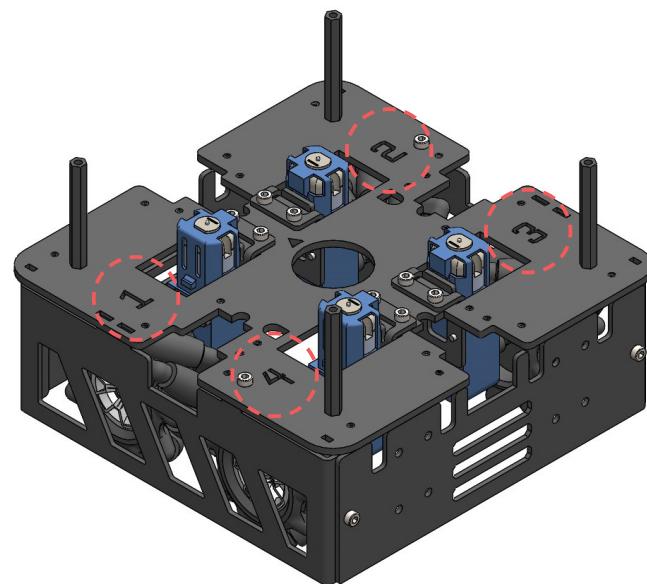


Pay attention to the numbers and their positions in relation to the parts being attached.

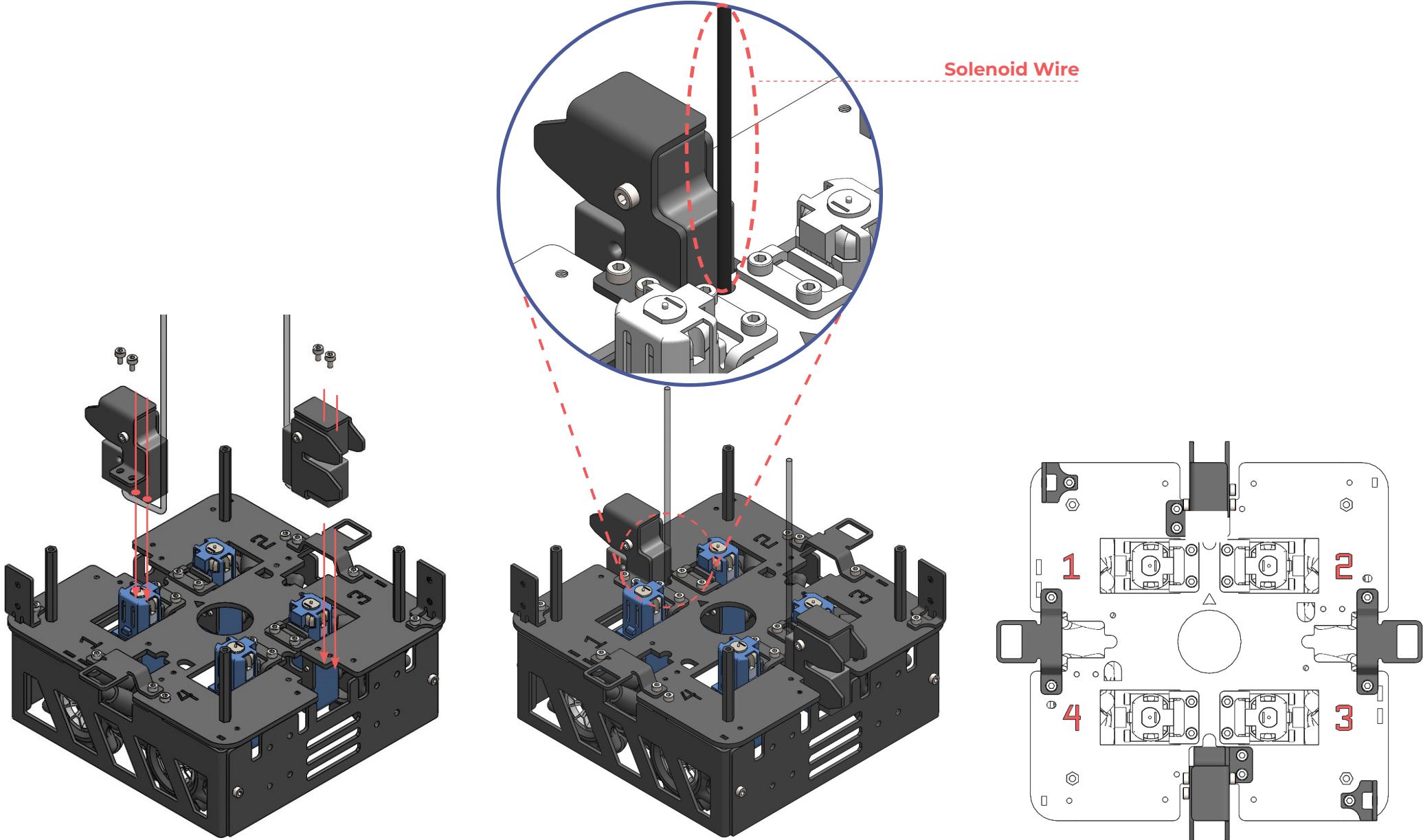


Check that the parts have been attached in the right location.

A6 (module 3 mechanical sub-assembly)

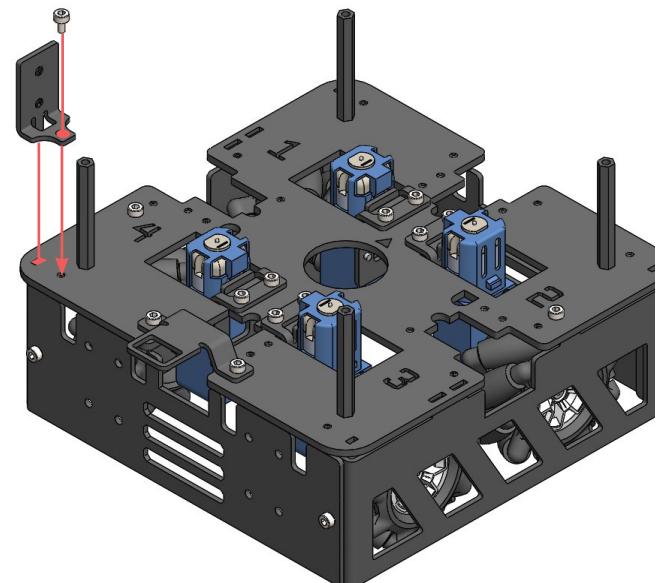
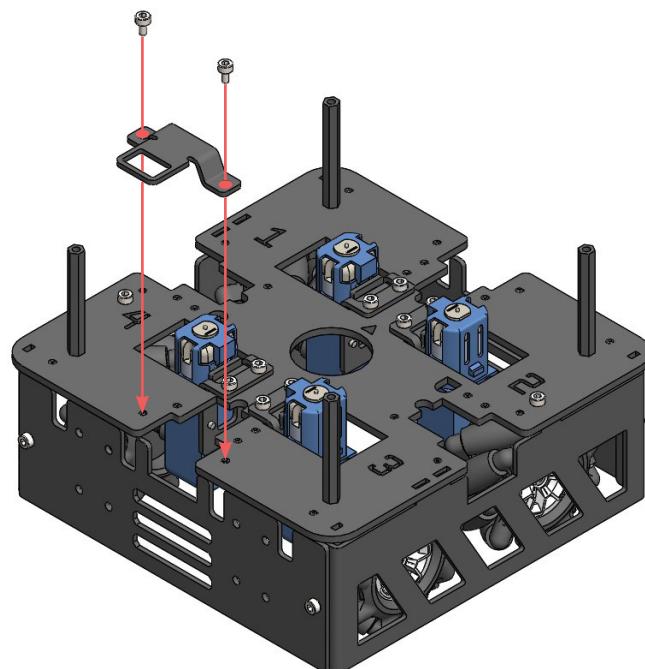
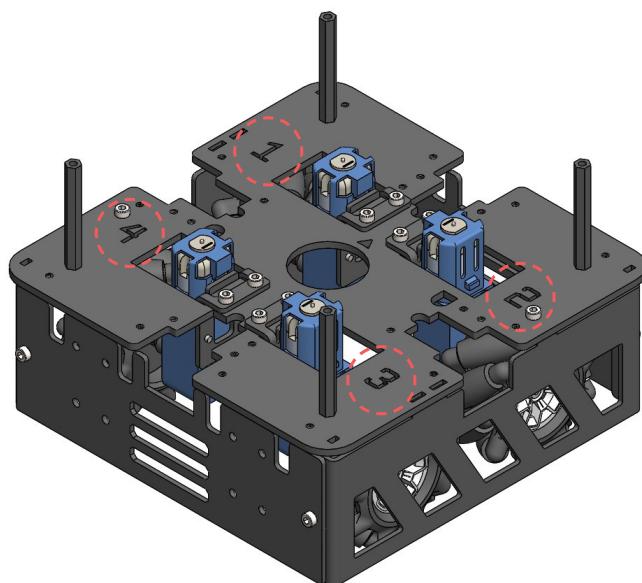


Pay attention to the numbers
and their positions in relation to
the parts being attached.

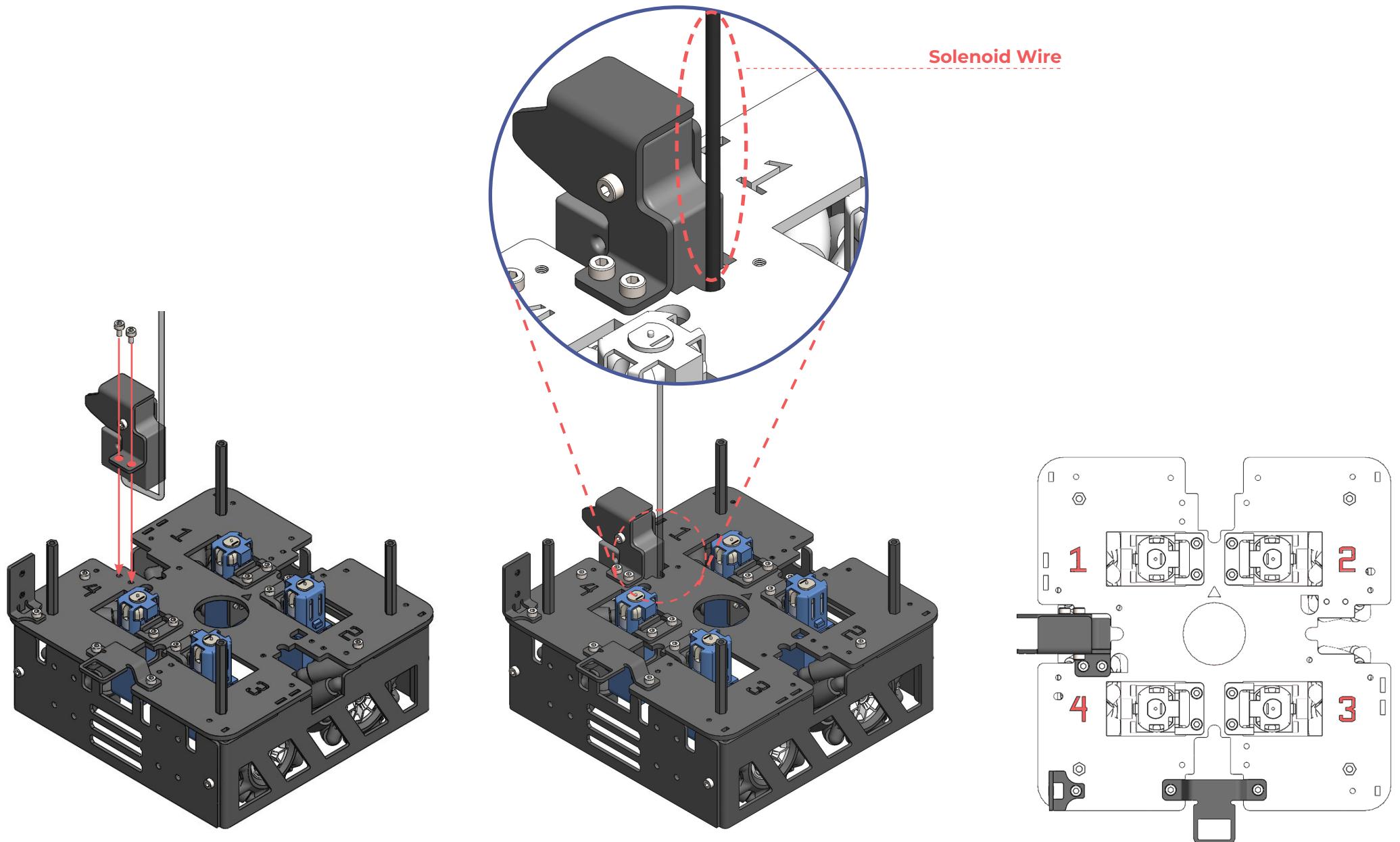


 Check that the parts have been attached in the right location, in relation to the numbers.

A1 (module 4 mechanical sub-assembly)

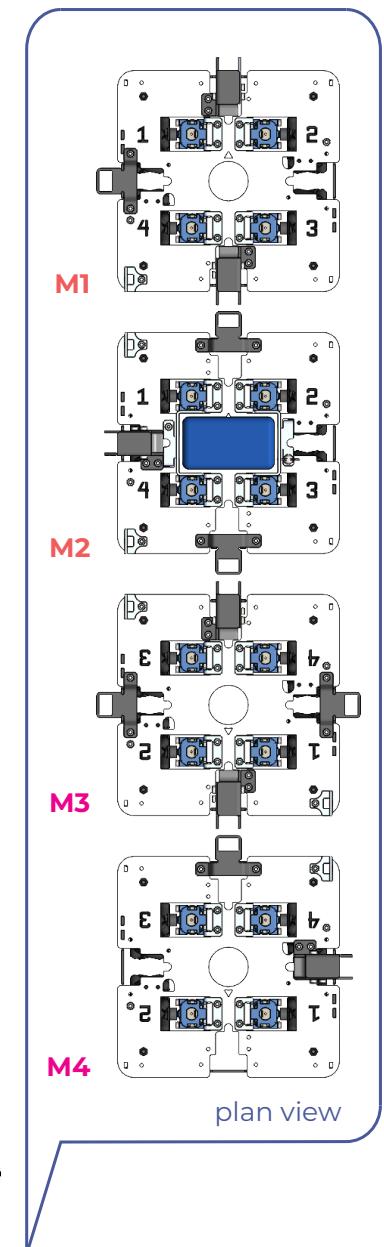
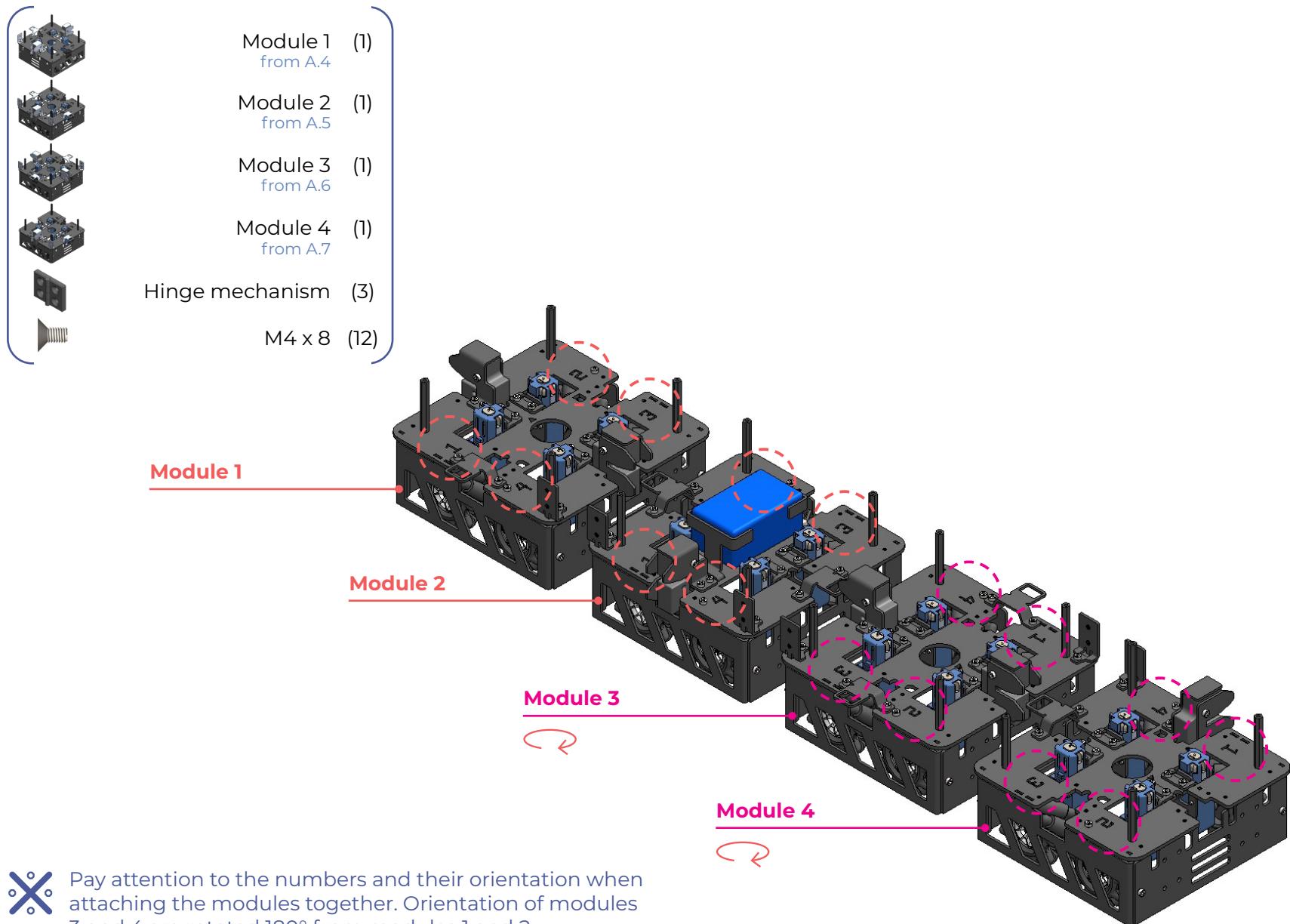


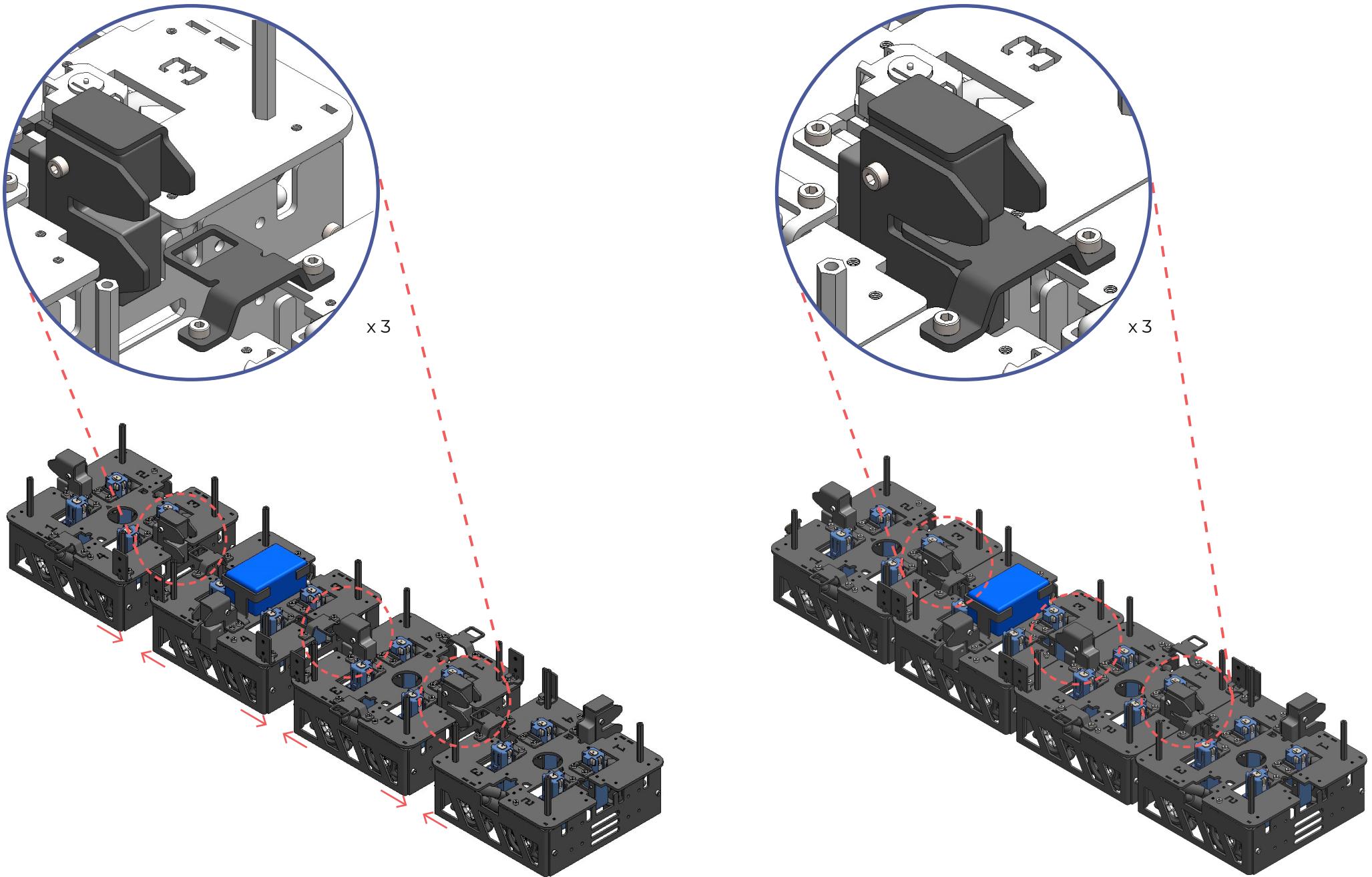
Pay attention to the numbers and their positions in relation to the parts being attached.

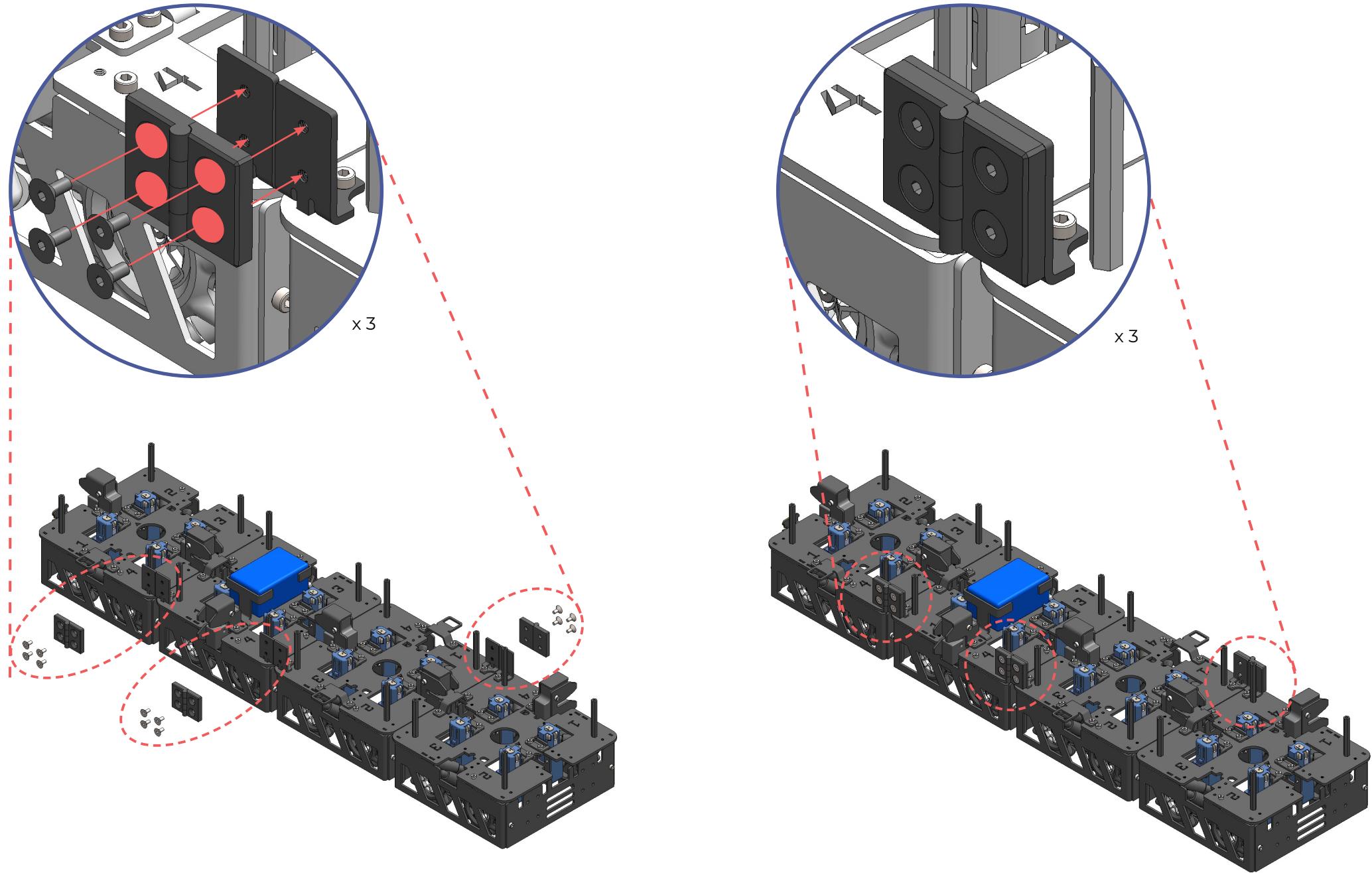


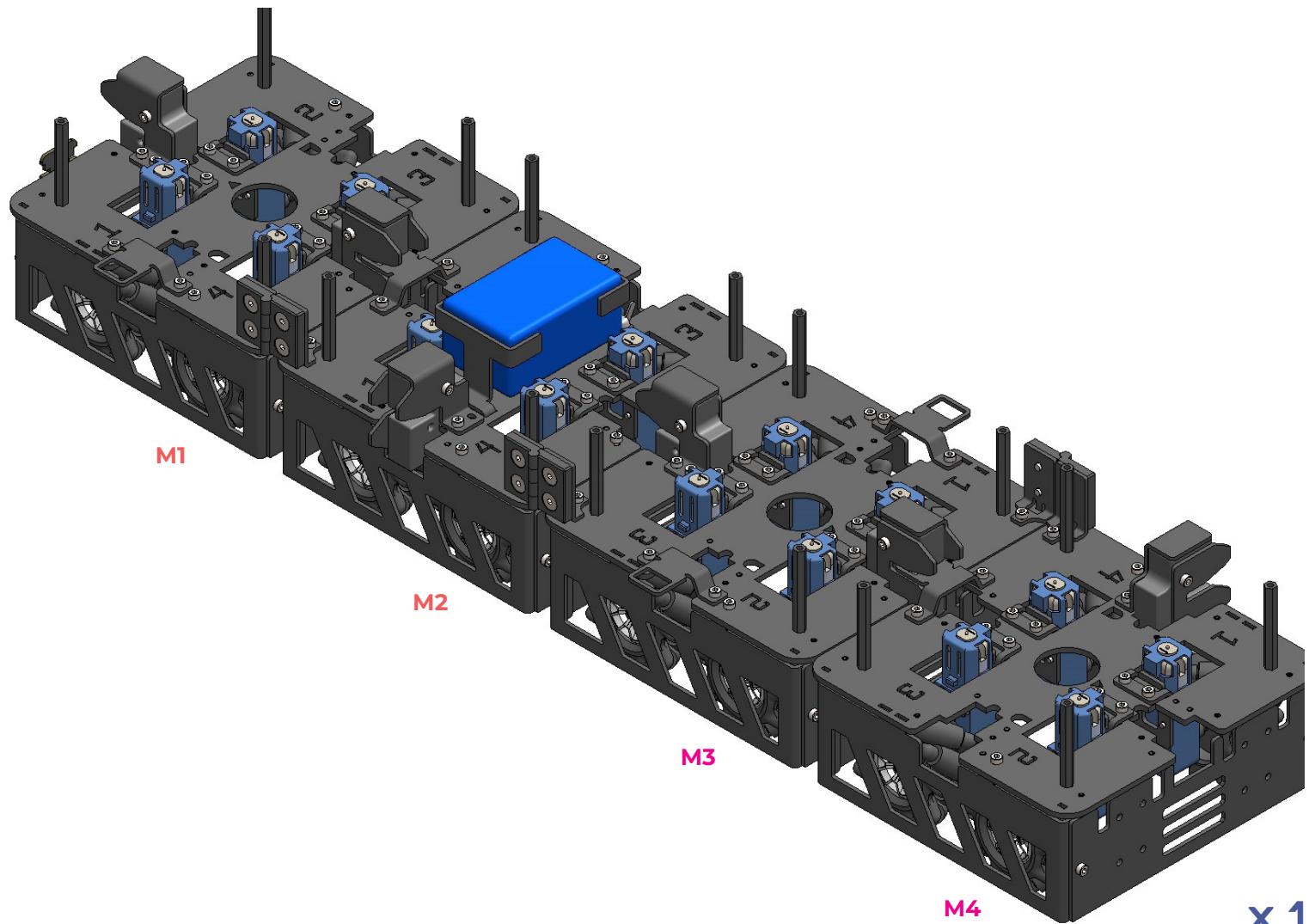
✖ Check that the parts have been attached in the right location.

A8 (full mechanical assembly)







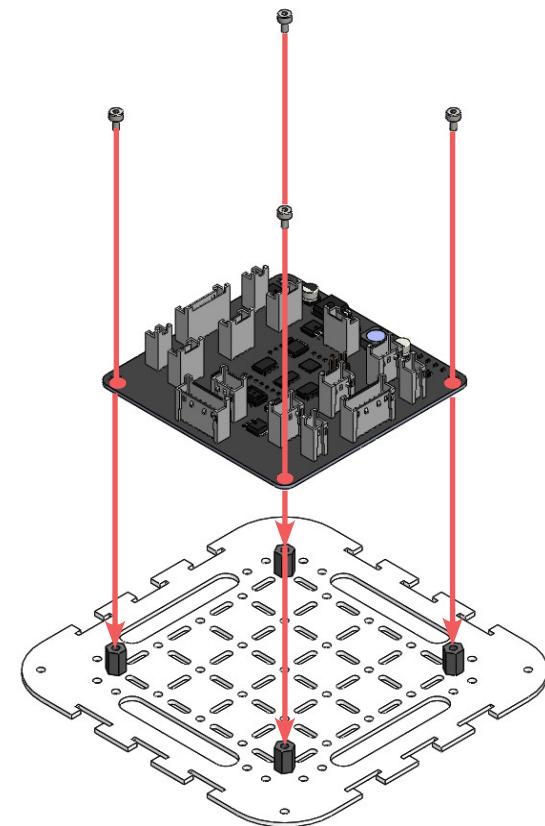
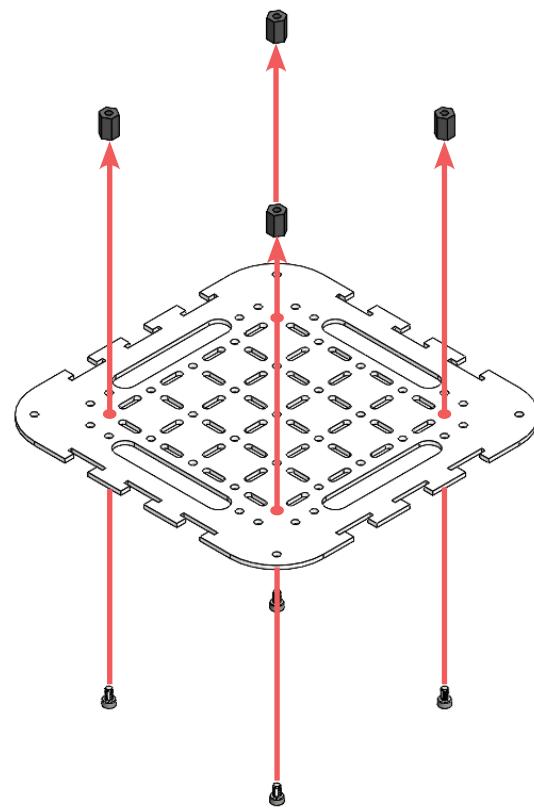
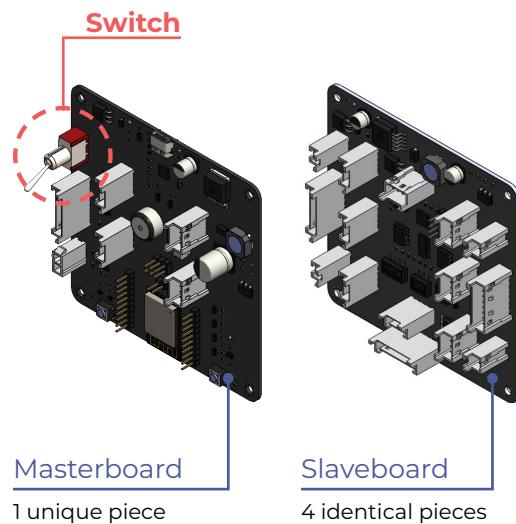
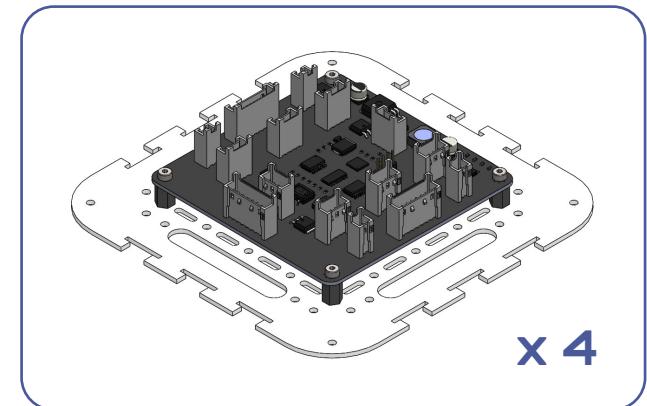


Check all the positions of solenoids, solenoid catches, hinge mounts before proceeding to section B.



mechanical assembly completed

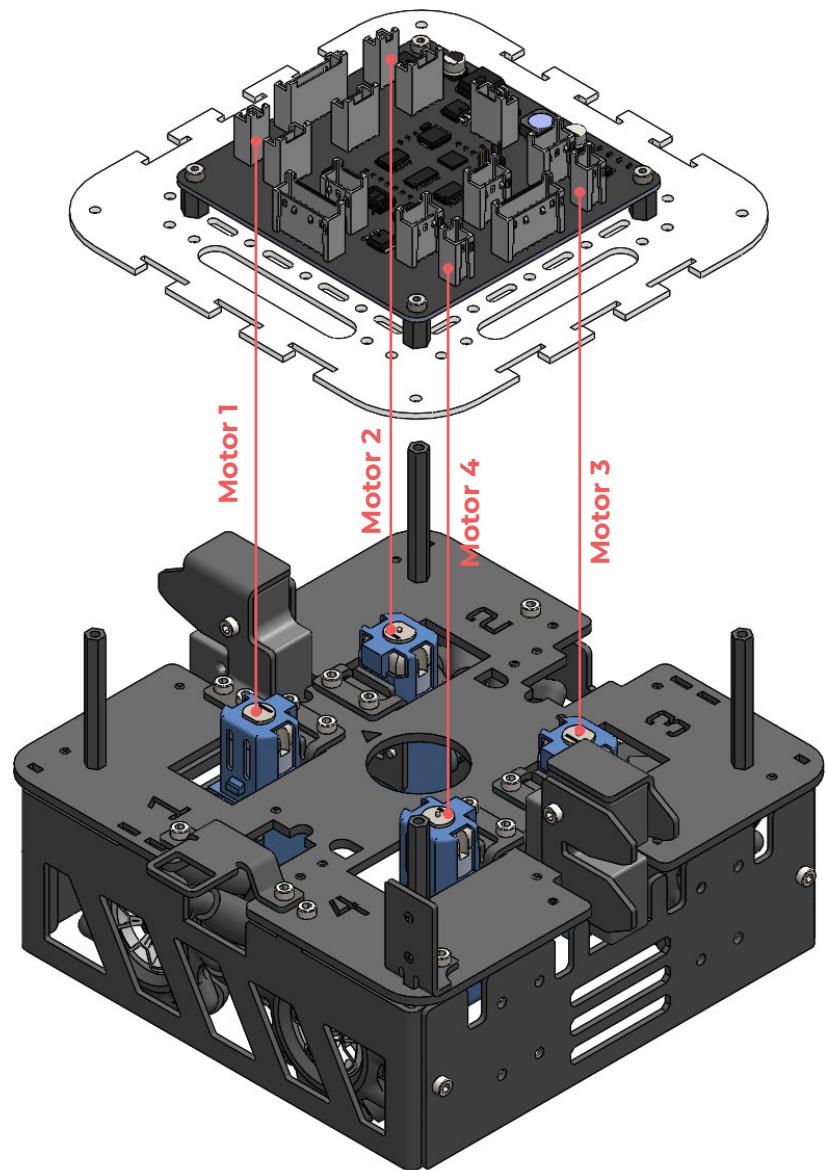
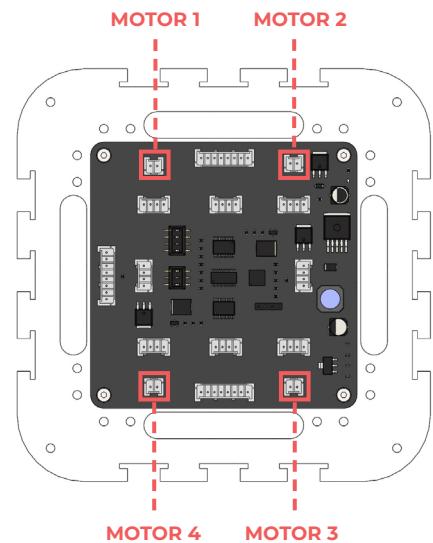
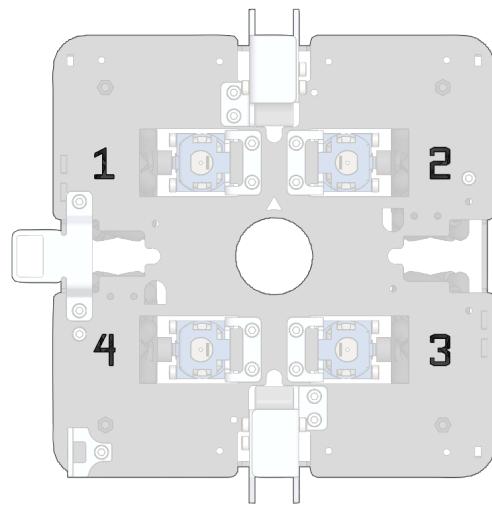
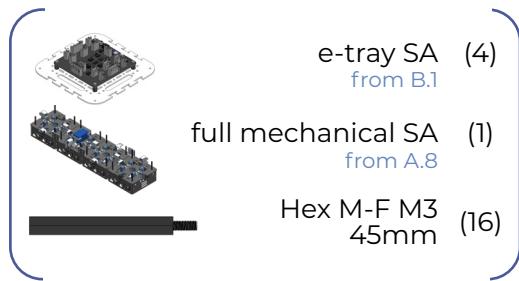
B 1 (e-tray sub-assembly)



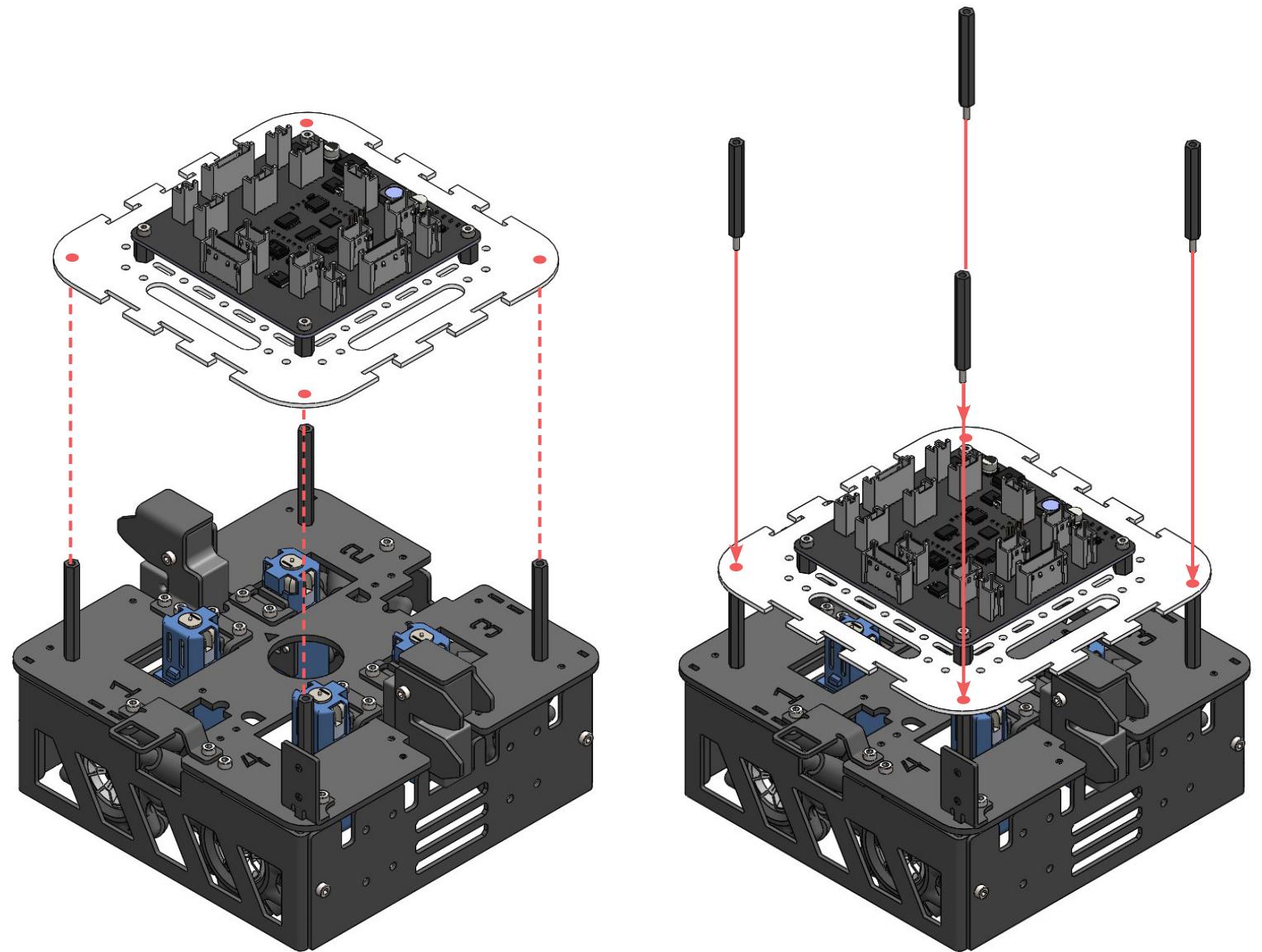
✖ Make sure that you are attaching the slaveboards and not the masterboard.

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

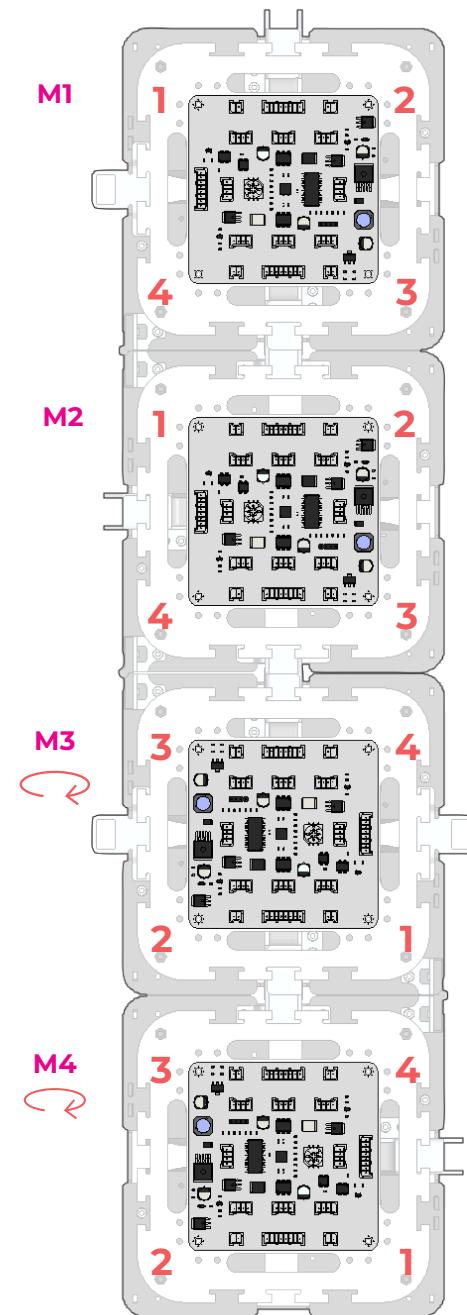
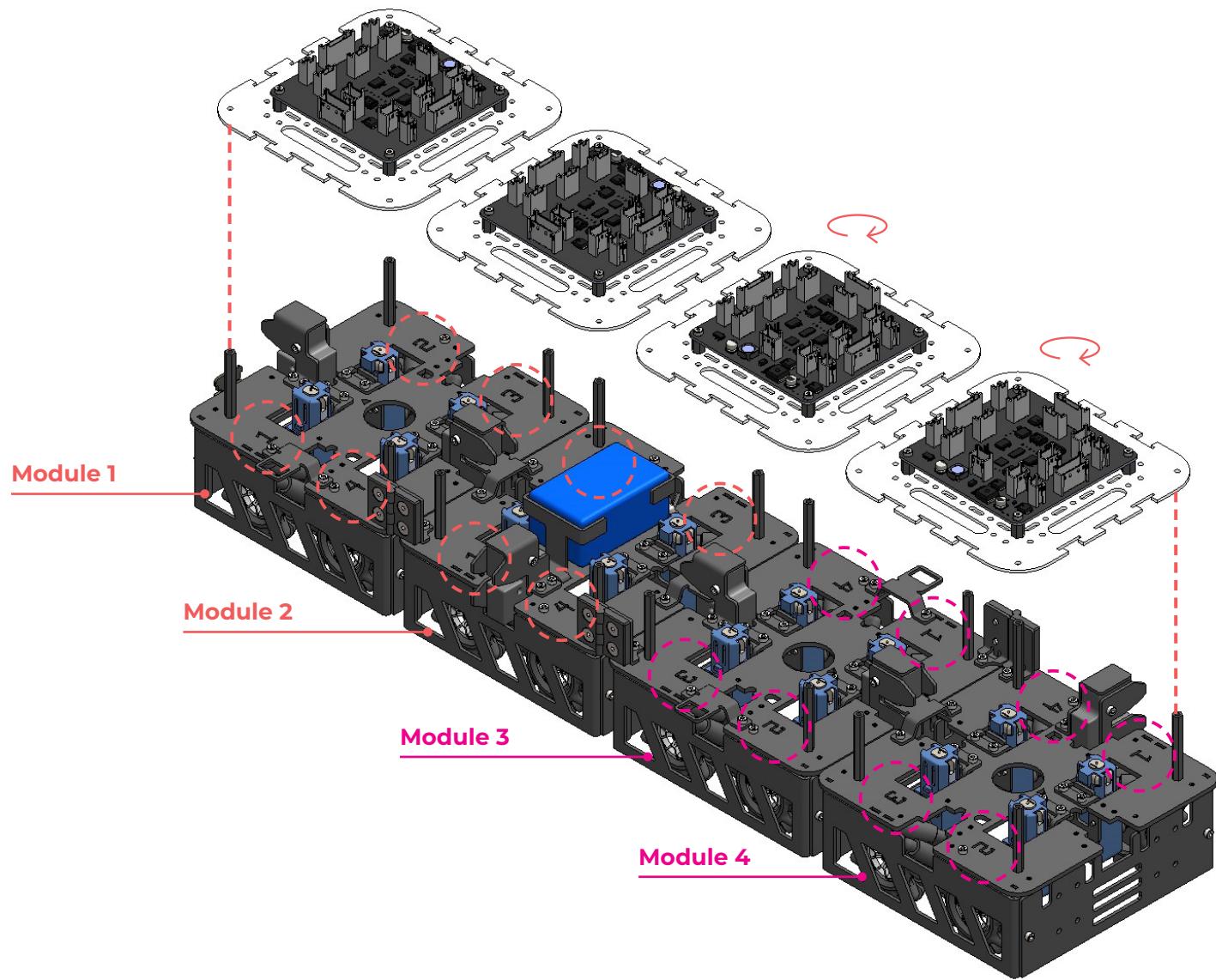
B2 (e-tray onto mechanical assembly)



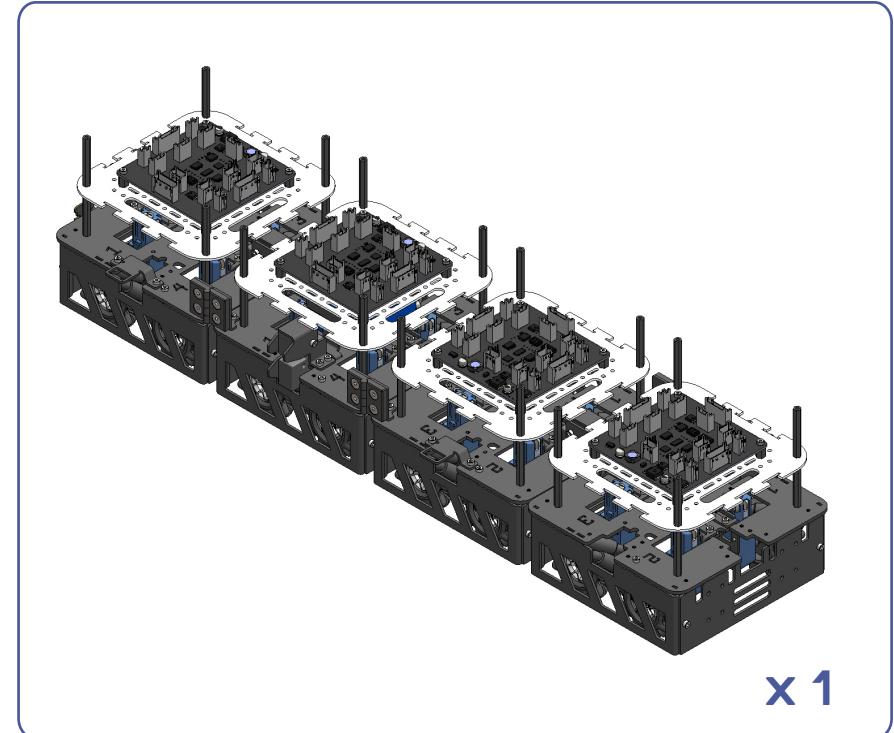
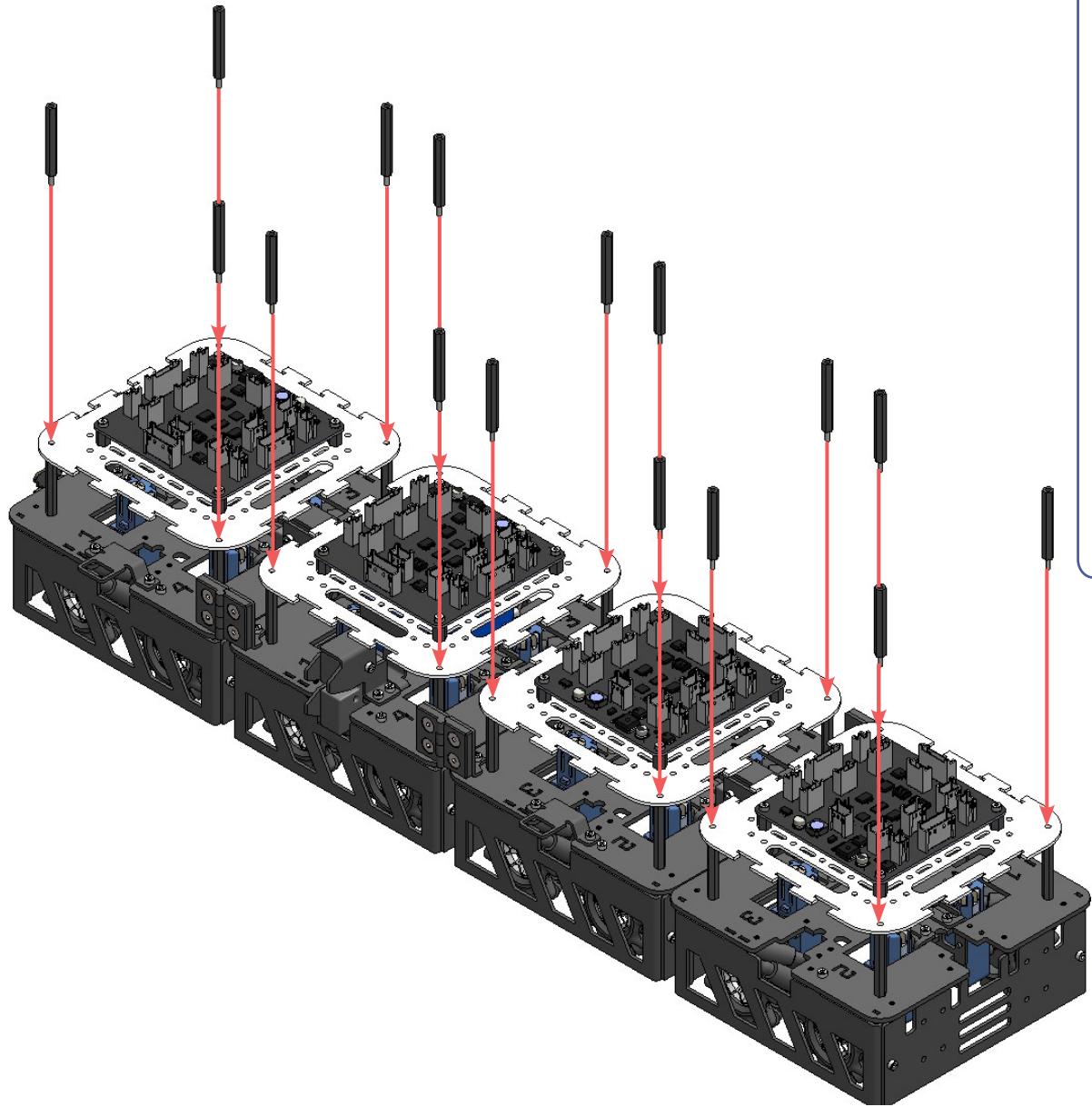
Orientate e-tray SA and base module as shown on the right.
Motor 1 connector on e-tray should be on top of Motor 1 of base module.
Same goes for Motor 2, 3 and 4.



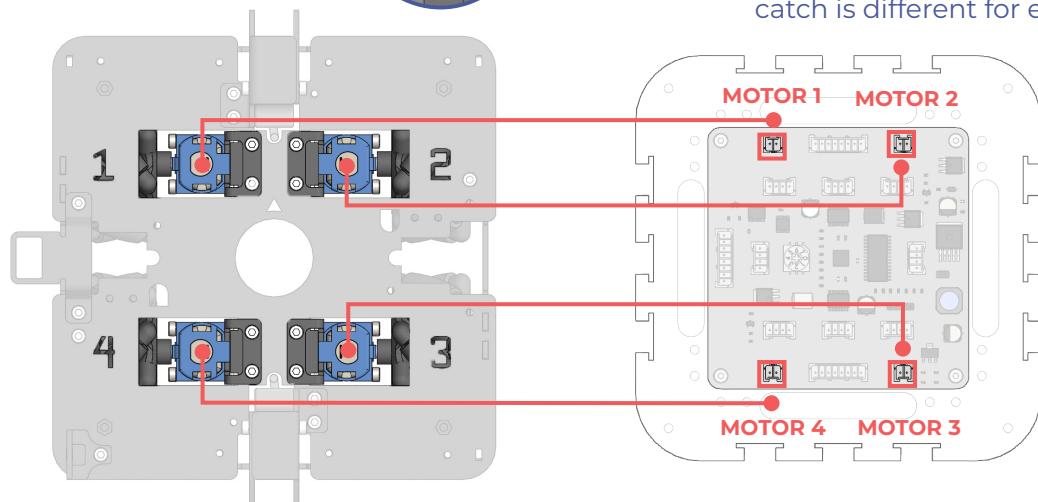
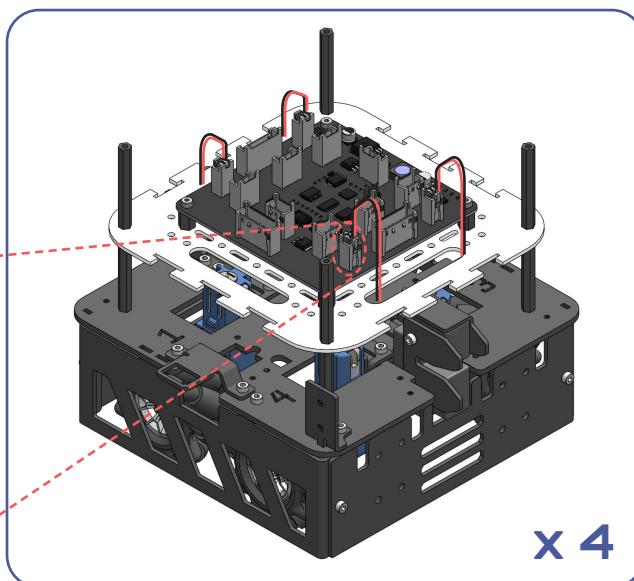
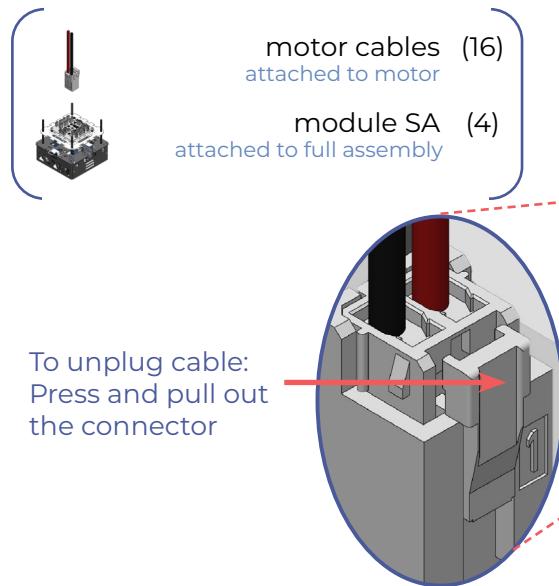
Before attaching the e-tray SA, please flip all the cables and connectors for motors and solenoids (not shown in diagram for clarity) out, for easy attachment later on.



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.

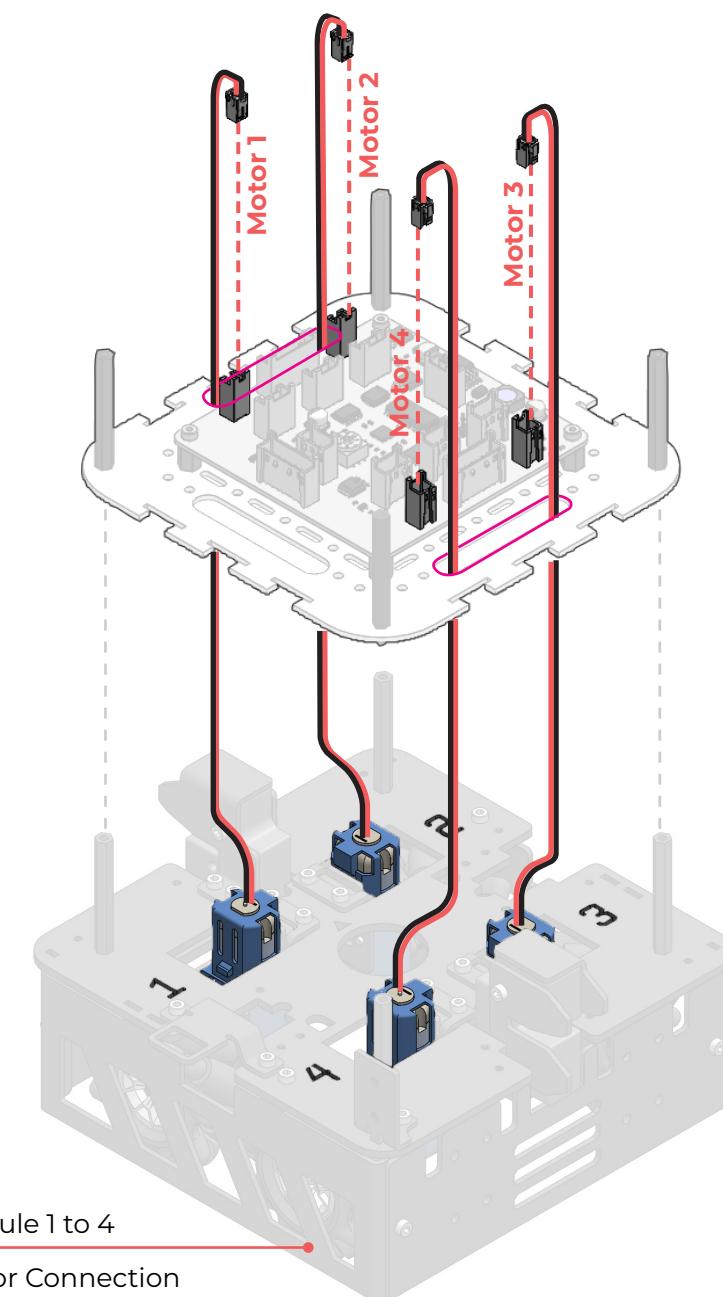


B3 (all module motor cable connection)

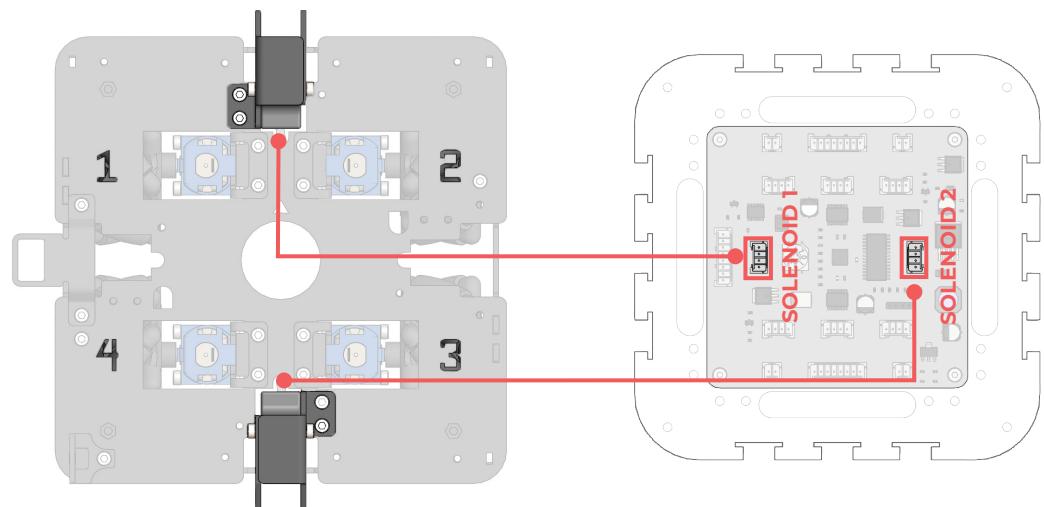
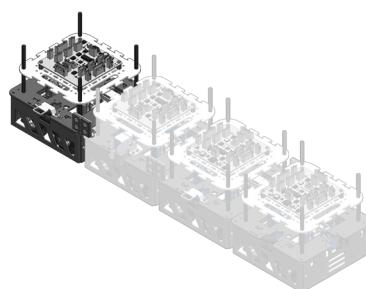
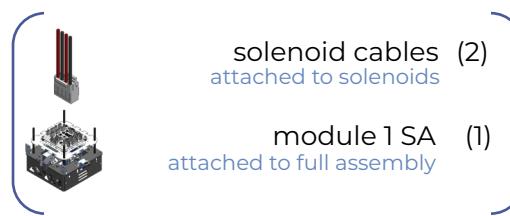


Make sure that Motor 1 is connected to Motor 1 connector on Slaveboard; the same goes for Motor 2, 3 and 4.

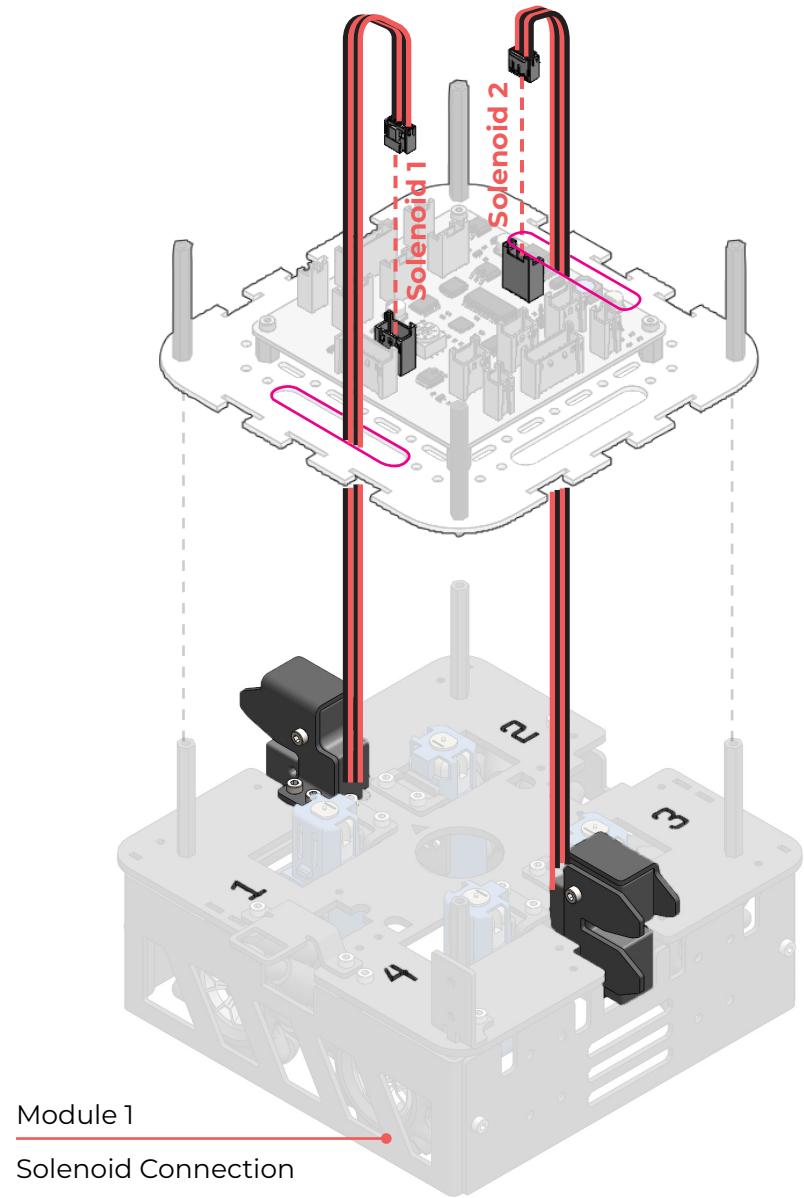
Motor cable connection is the same for all 4 modules



B 4 (module 1 solenoid cable connection)

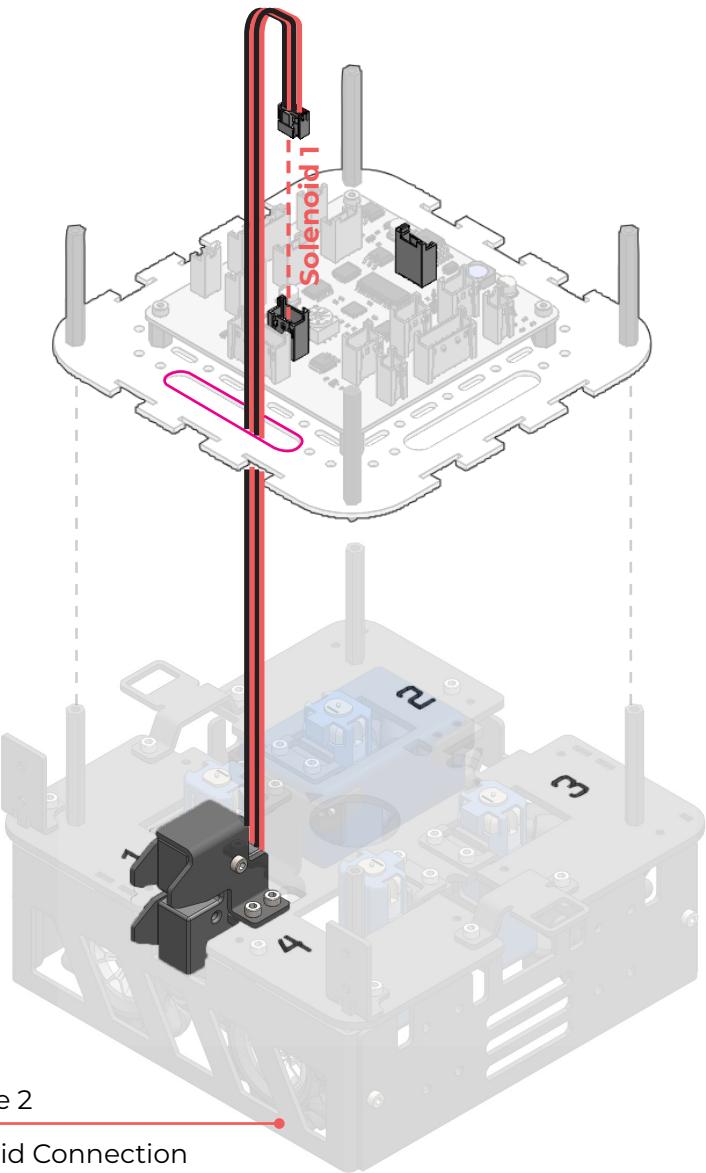
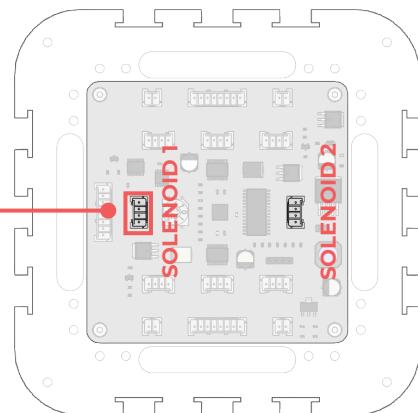
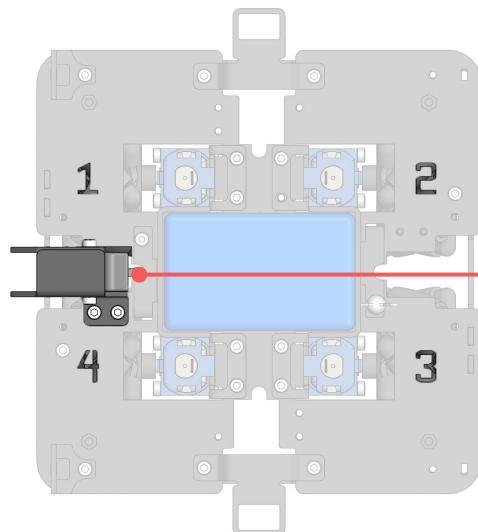
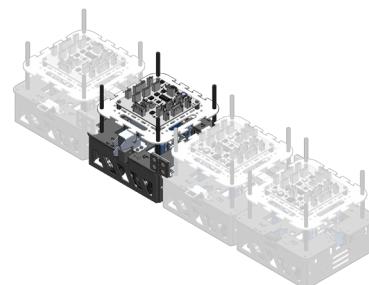
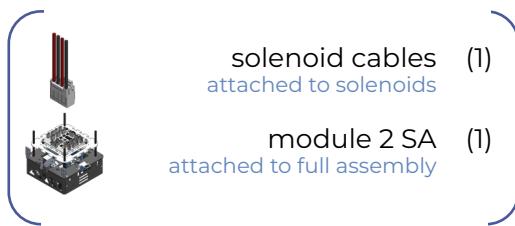


 Make sure to connect the solenoid to the labelled solenoid connector exactly as in the diagram below.



 Opening to pass wire through

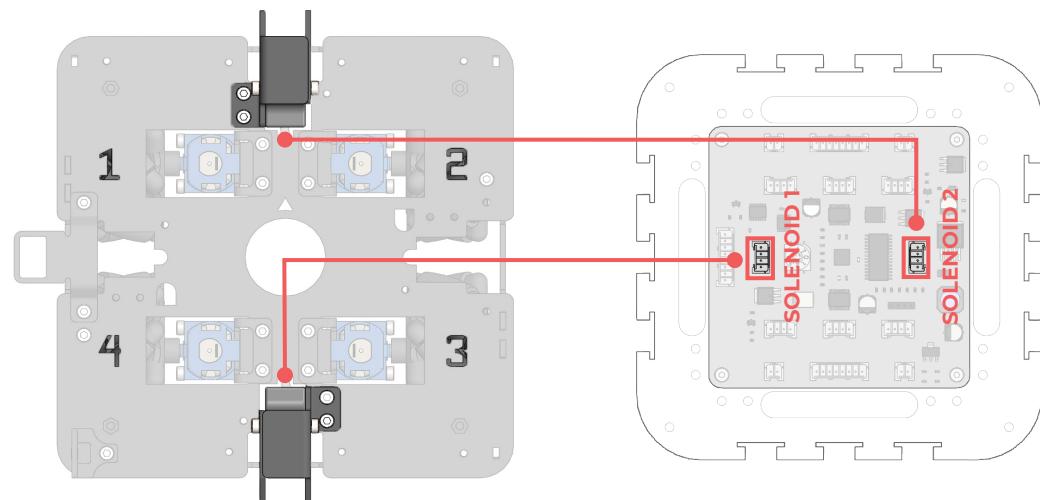
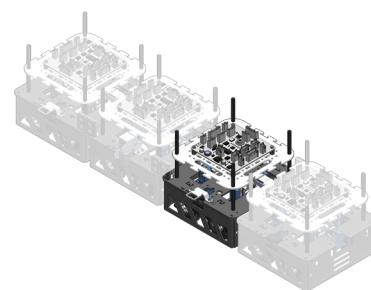
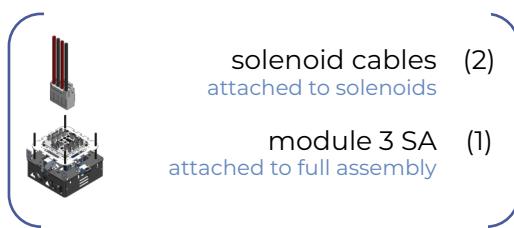
B5 (module 2 solenoid cable connection)



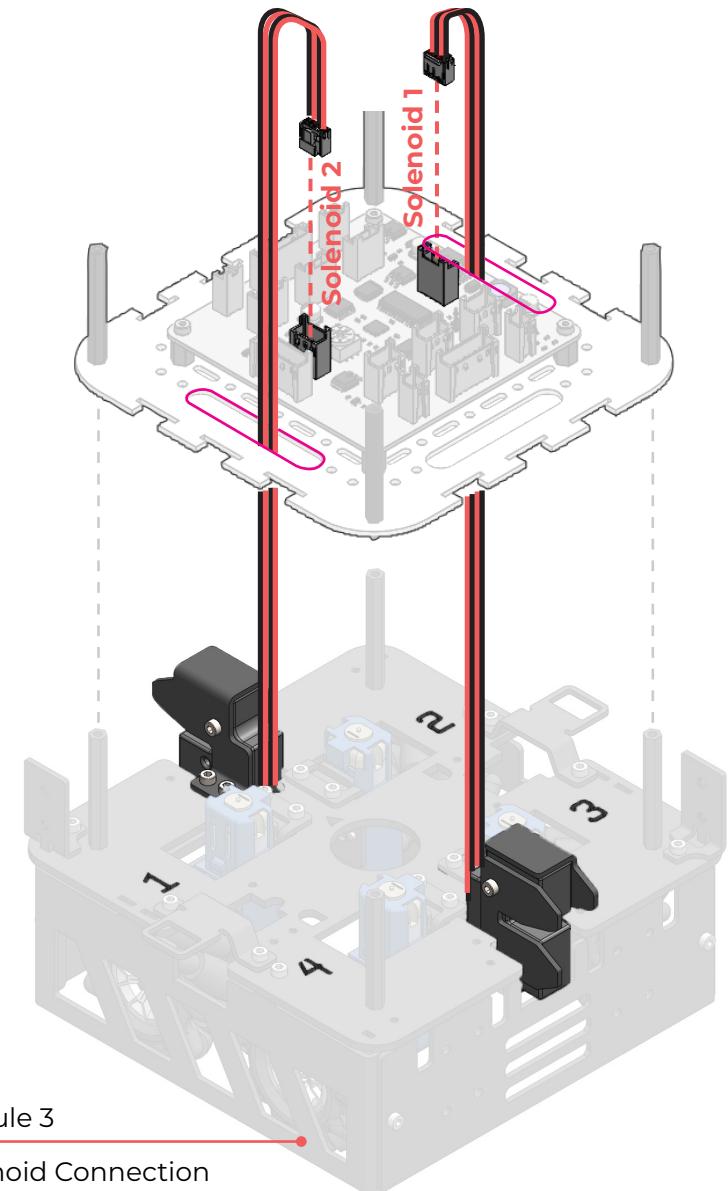
 Make sure to connect the solenoid to the labelled solenoid connector exactly as in the diagram below.

 Opening to pass wire through

B6 (module 3 solenoid cable connection)



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

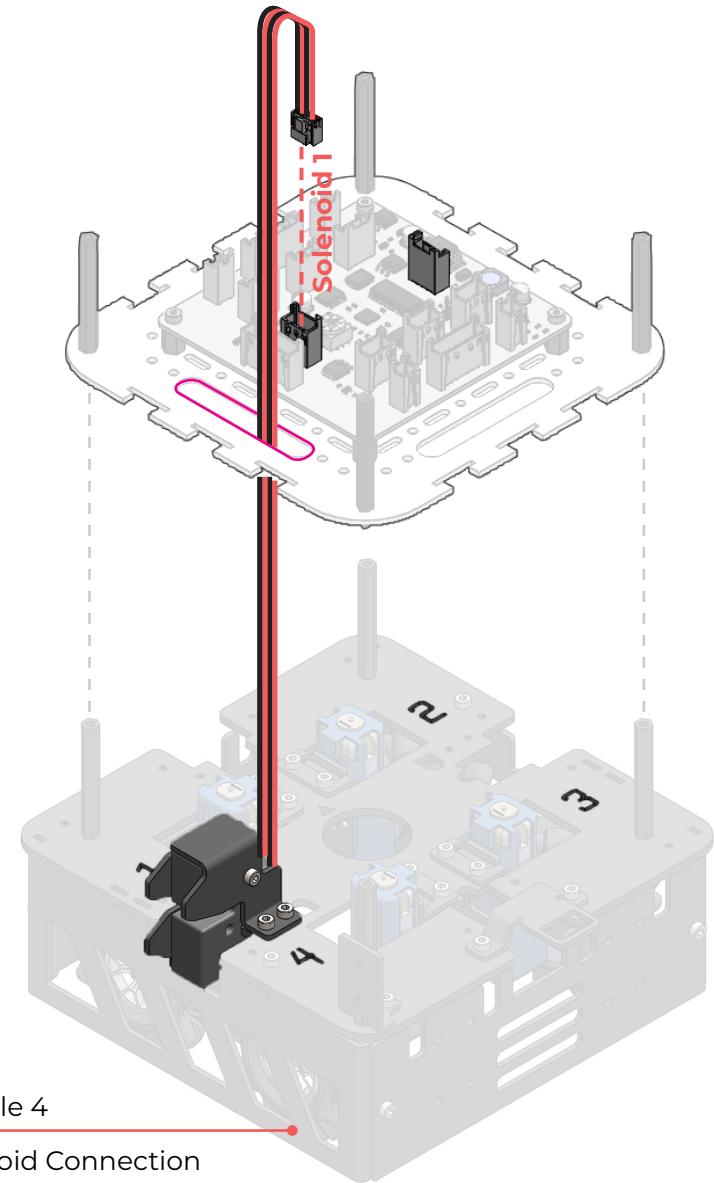
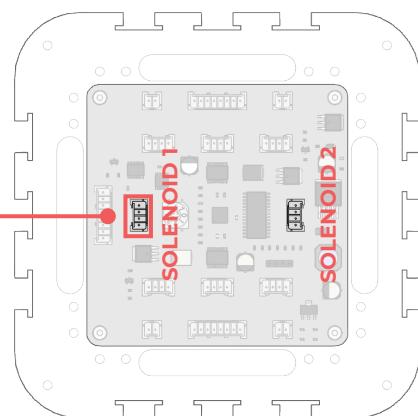
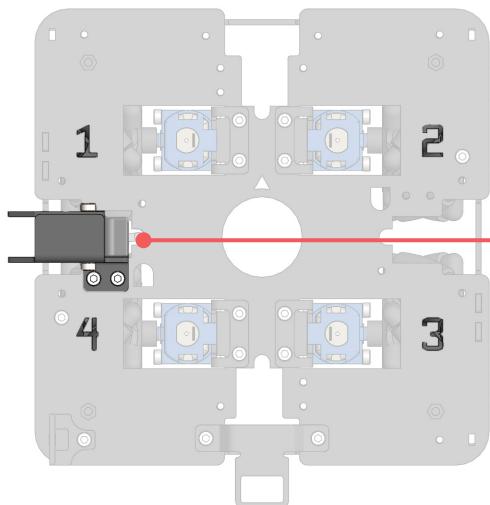
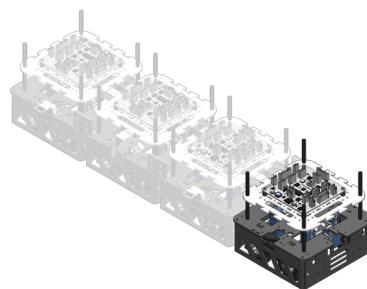
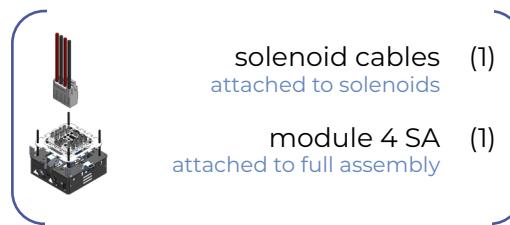


Module 3

Solenoid Connection

Opening to pass wire through

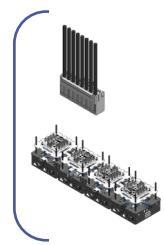
87 (module 4 solenoid cable connection)



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

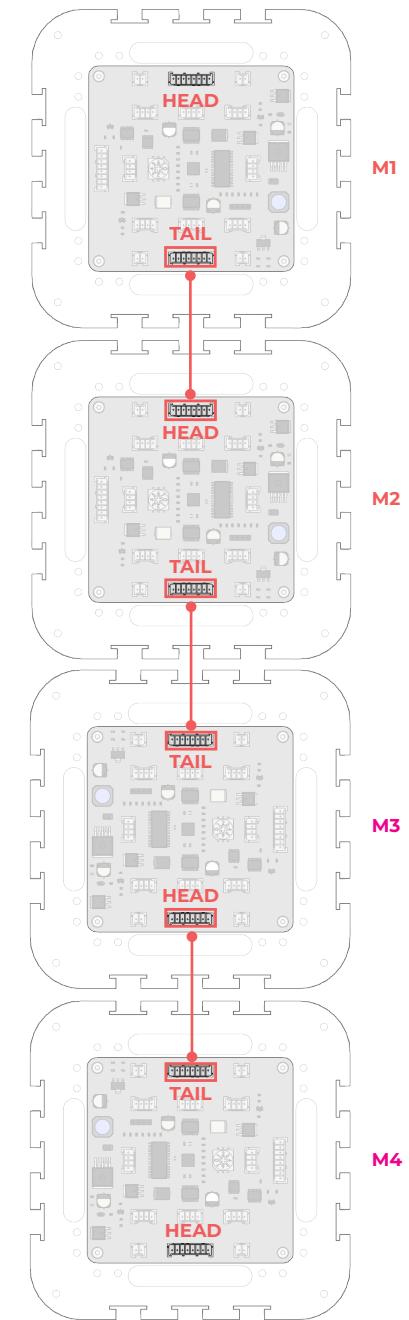
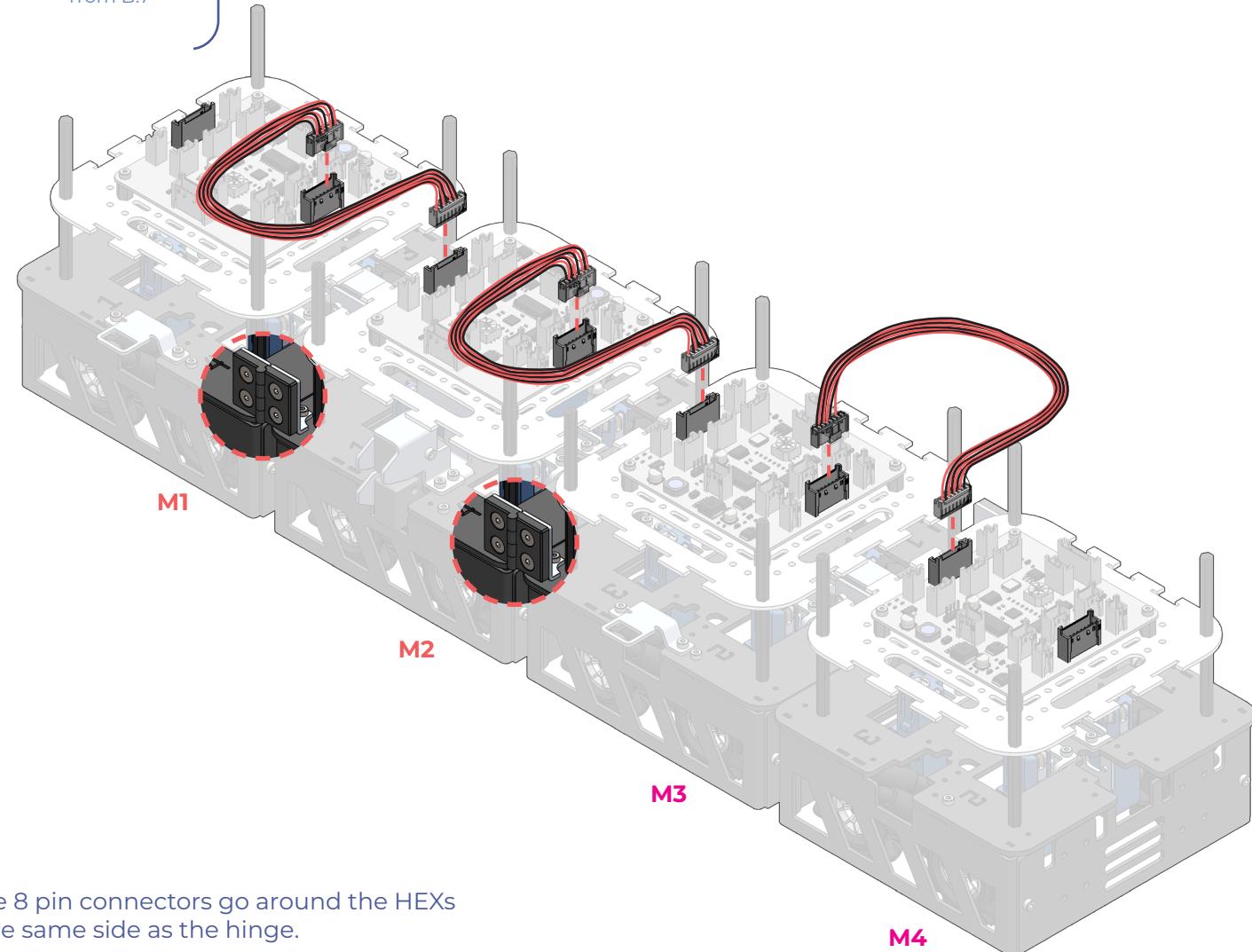
 Opening to pass wire through

B8 (inter-module cable connection)



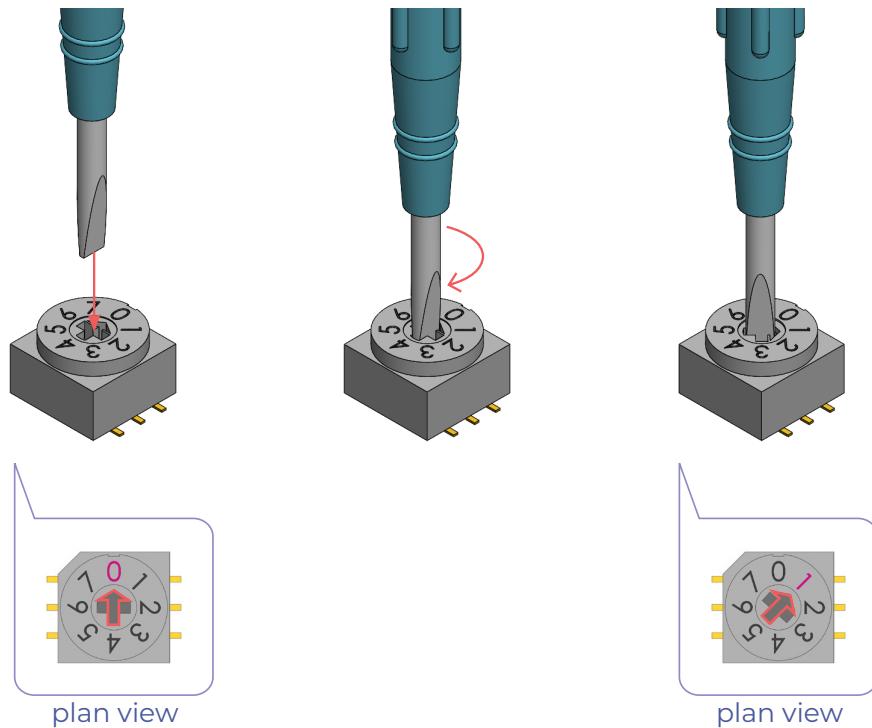
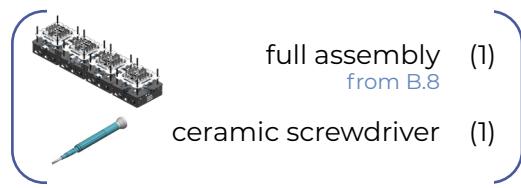
8-pin connectors (3)

full assembly (1)
from B.7



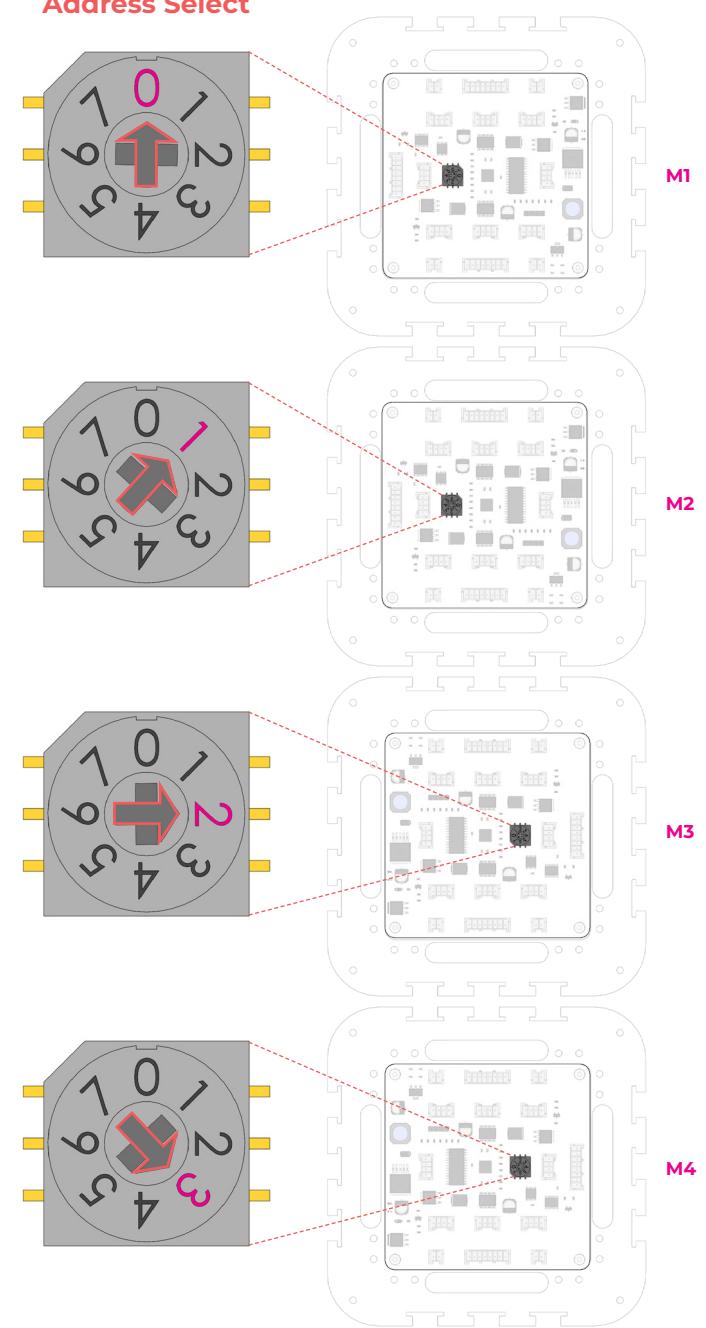
Make sure the 8 pin connectors go around the HEXs
that are on the same side as the hinge.

B9 (address selection)

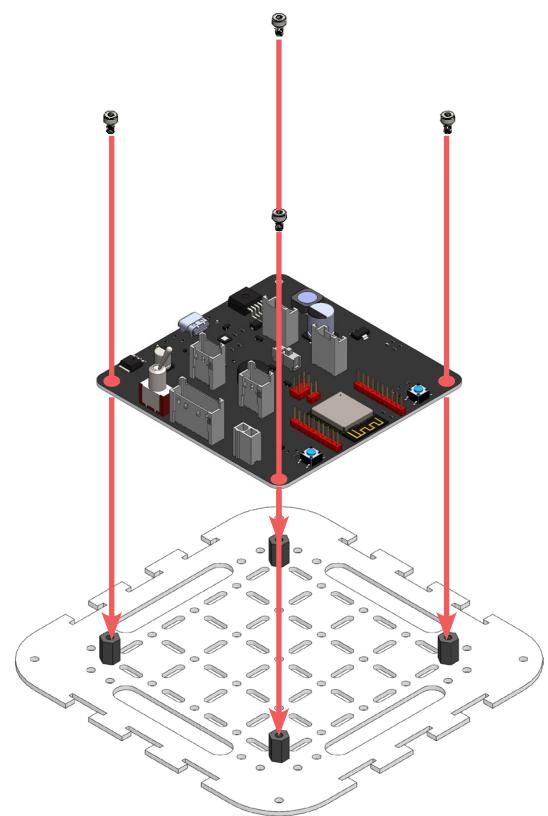
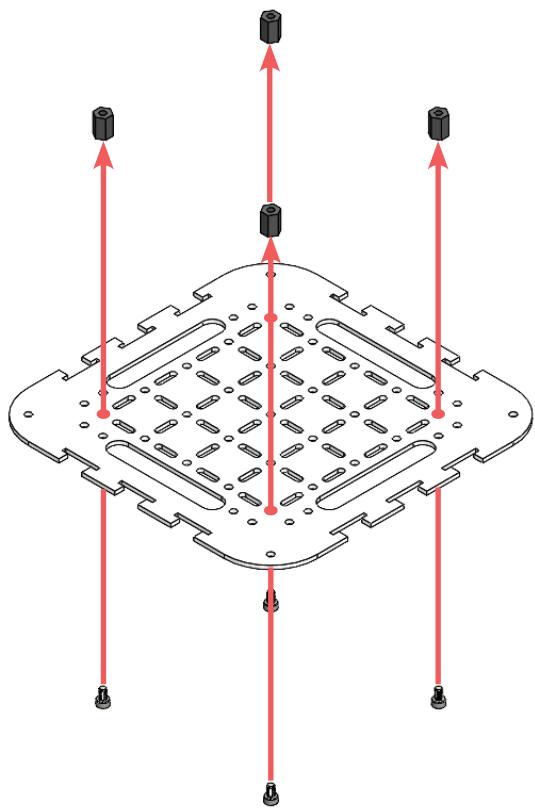
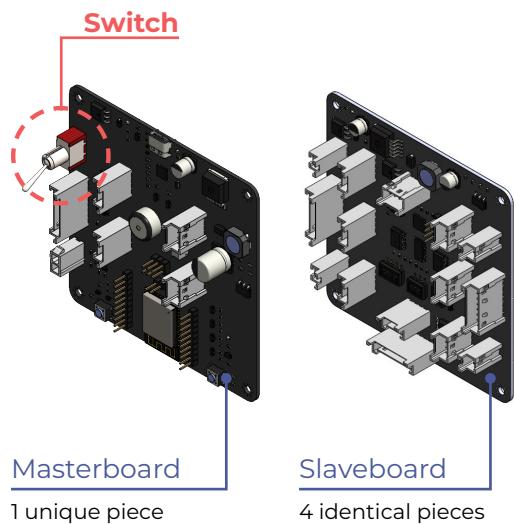
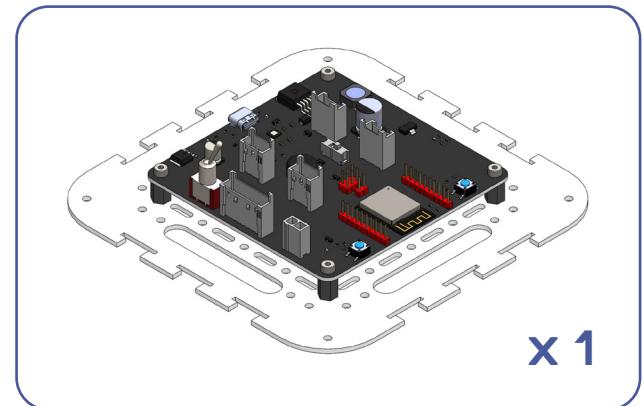


Use the ceramic screwdriver to adjust the rotary switch and select the address for all 4 modules.
Module 1: Address 0, Module 2: Address 1,
Module 3: Address 2, Module 4: Address 3

Address Select



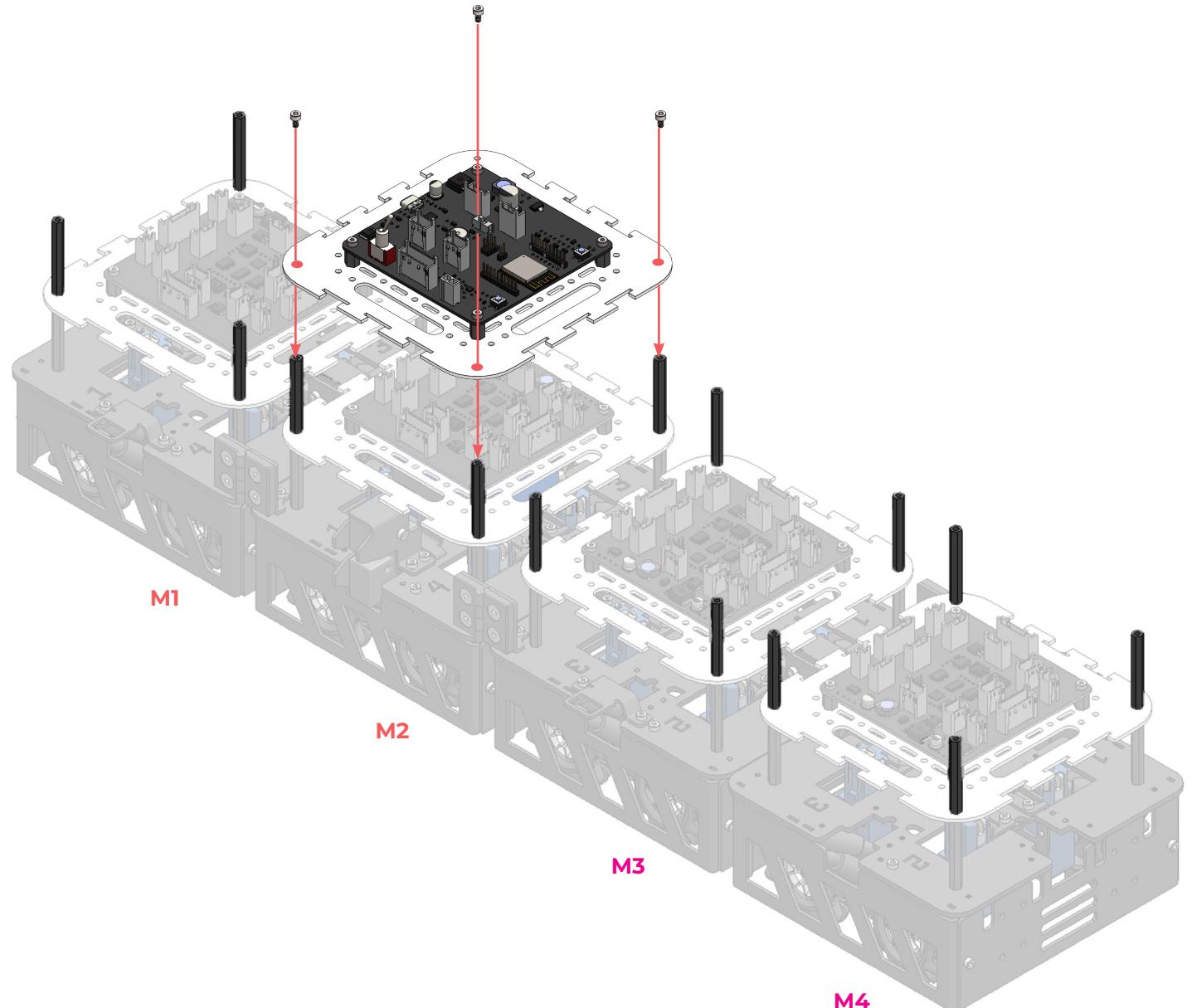
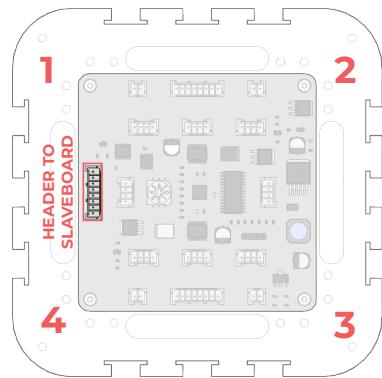
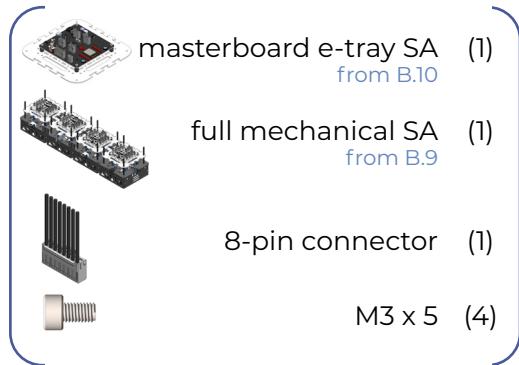
B10 (masterboard e-tray sub-assembly)



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

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

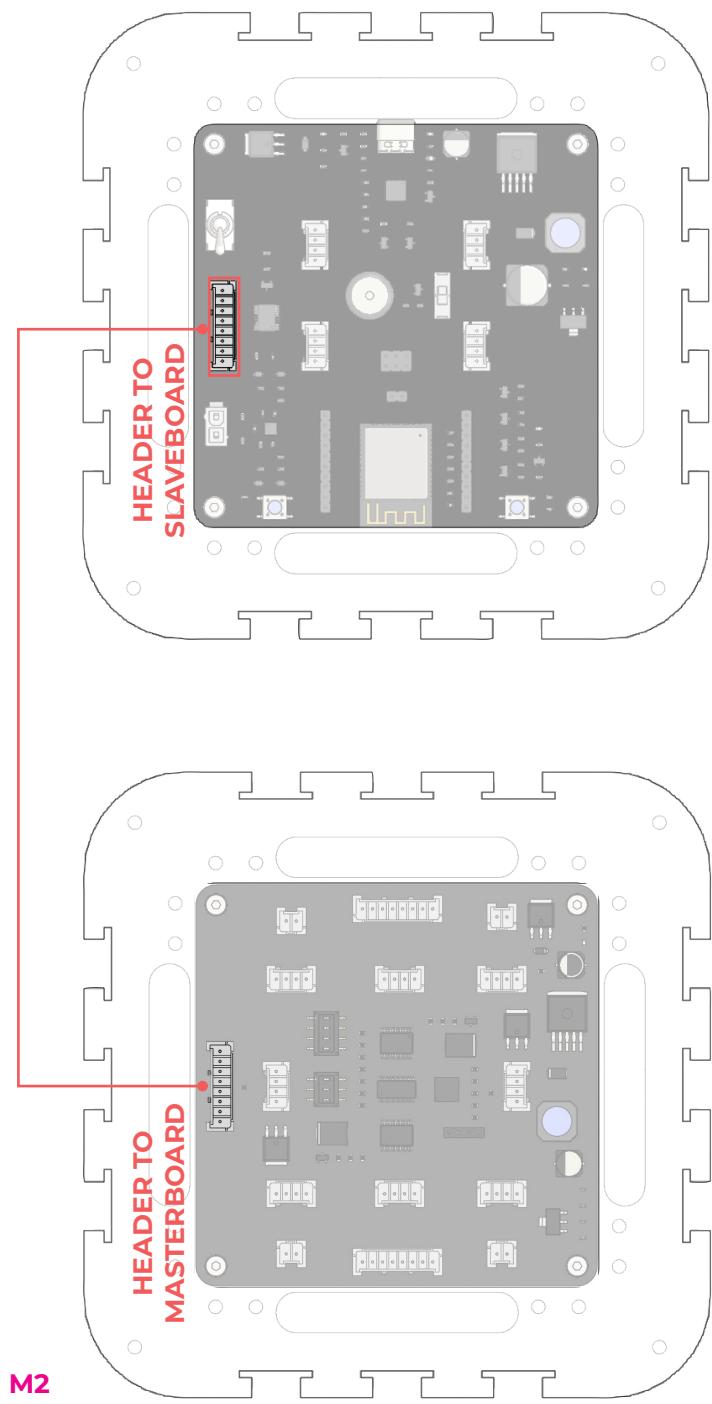
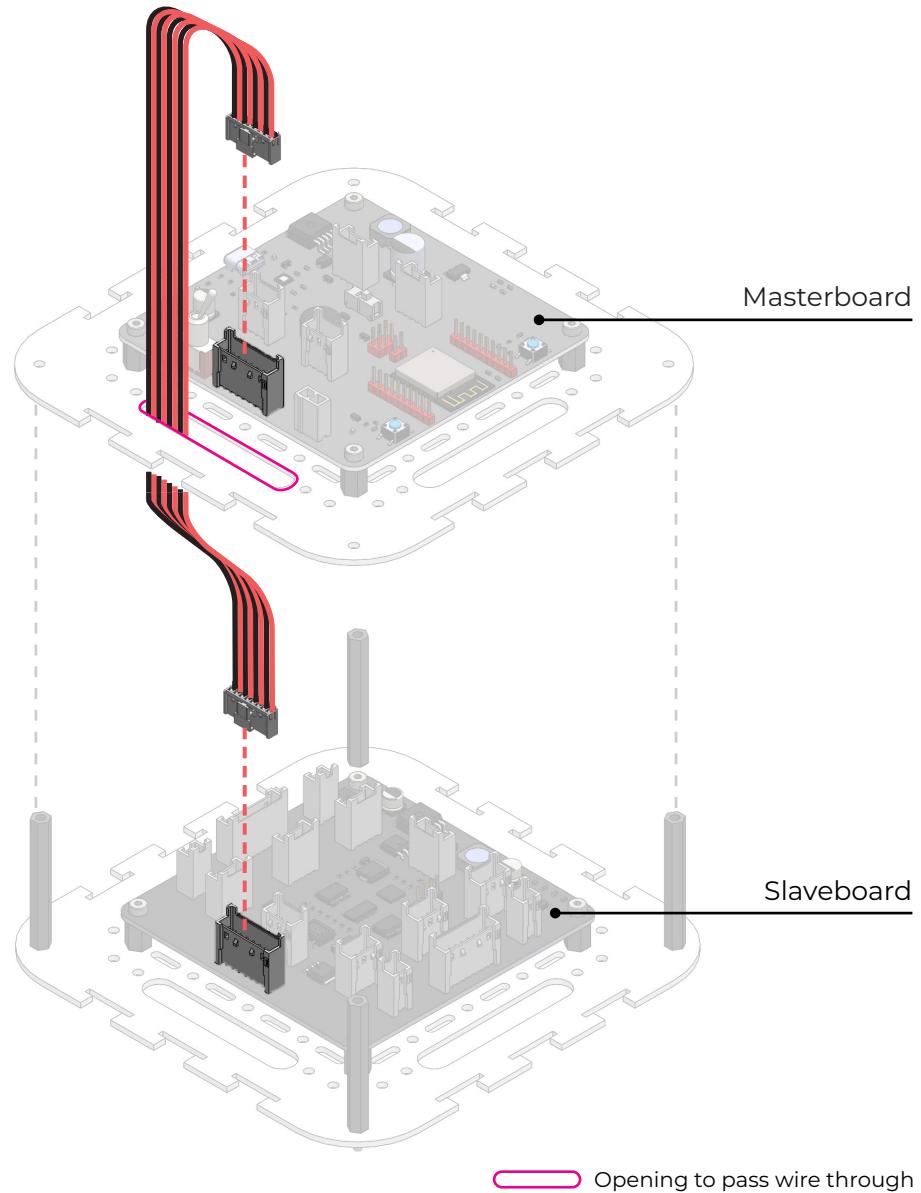
B 11 (masterboard e-tray onto main assembly)



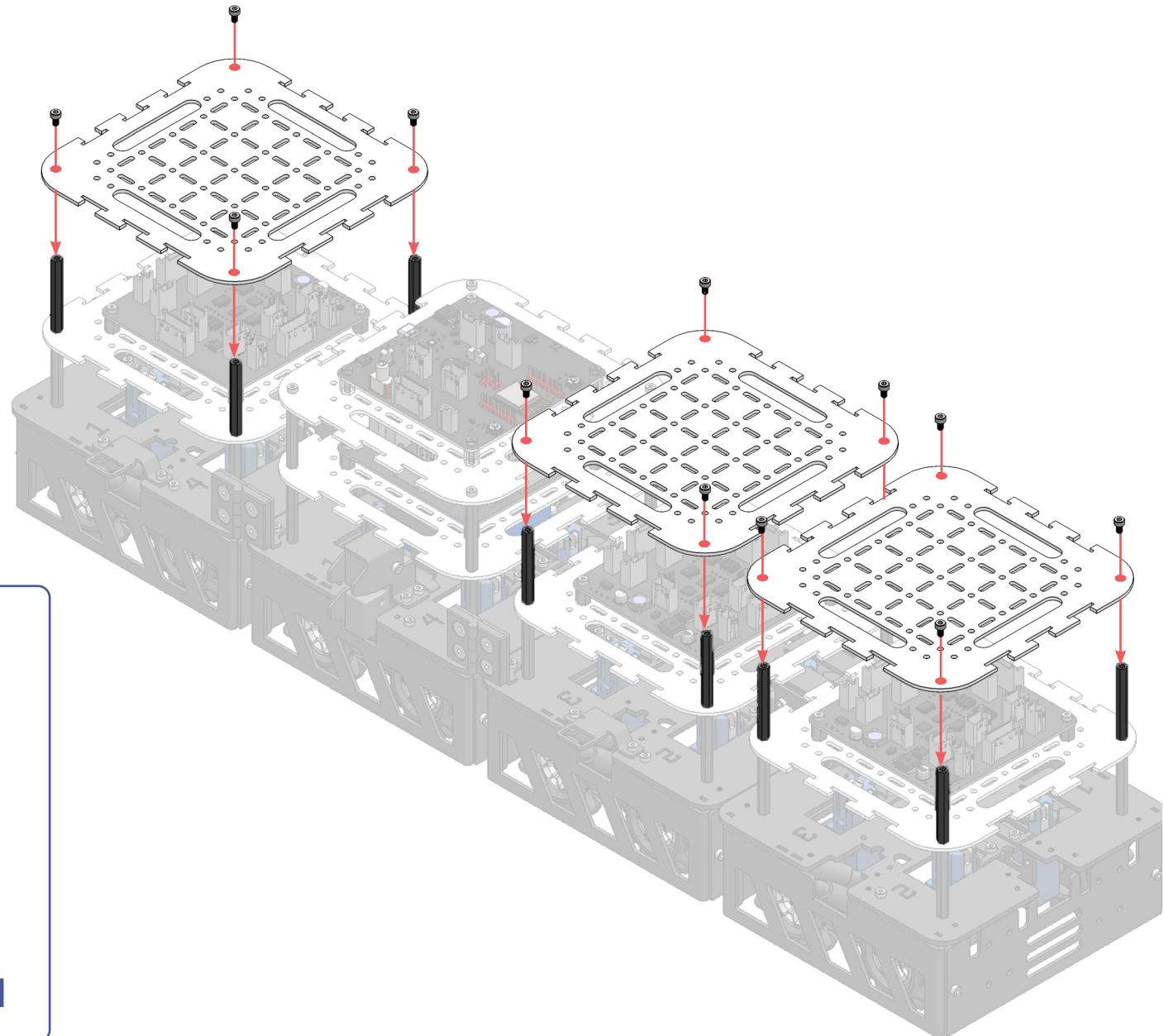
Align the header to slaveboard connector on the masterboard to face the side connecting Motor 1 and 4.



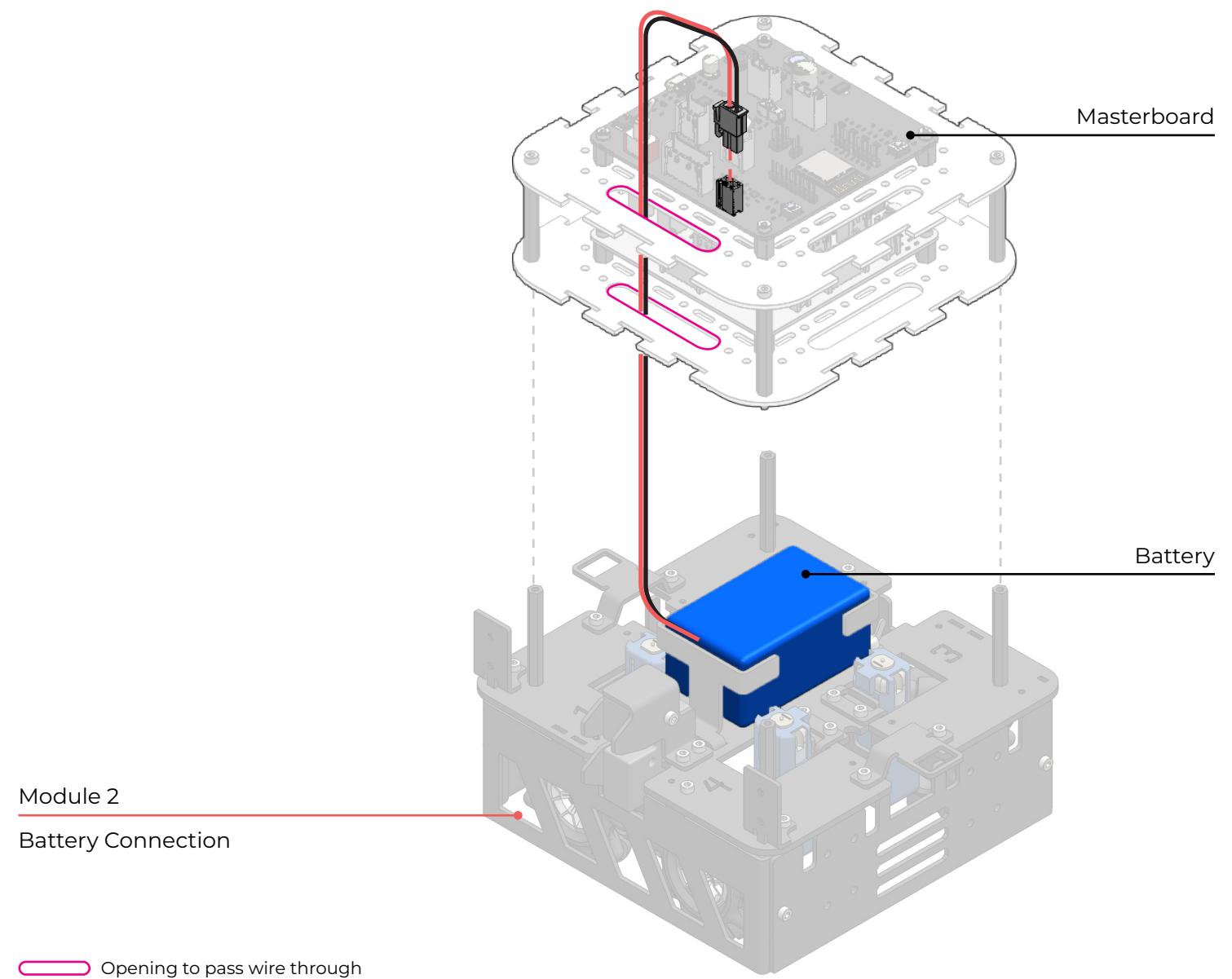
"DO NOT PLUG-IN / UNPLUG THE CONNECTOR CABLES WHILE THE POWER SUPPLY IS ACTIVELY PROVIDED
PROVIDED
(EITHER THROUGH BATTERY/ USB)"



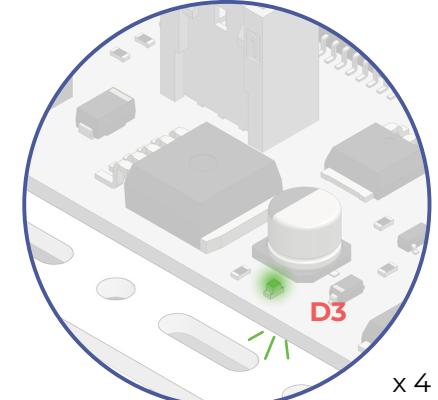
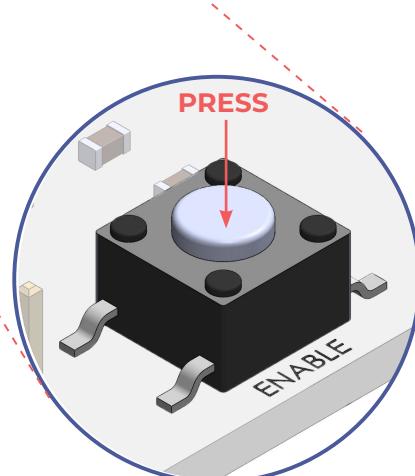
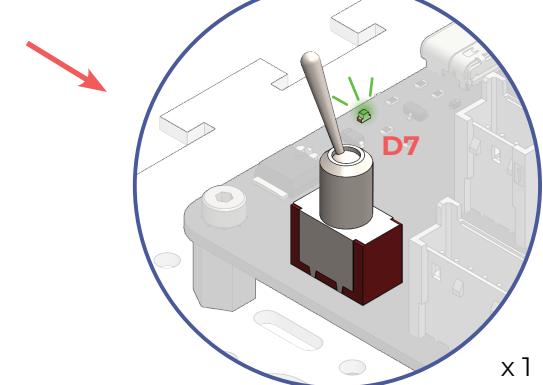
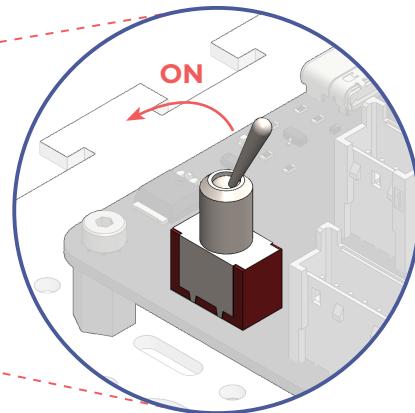
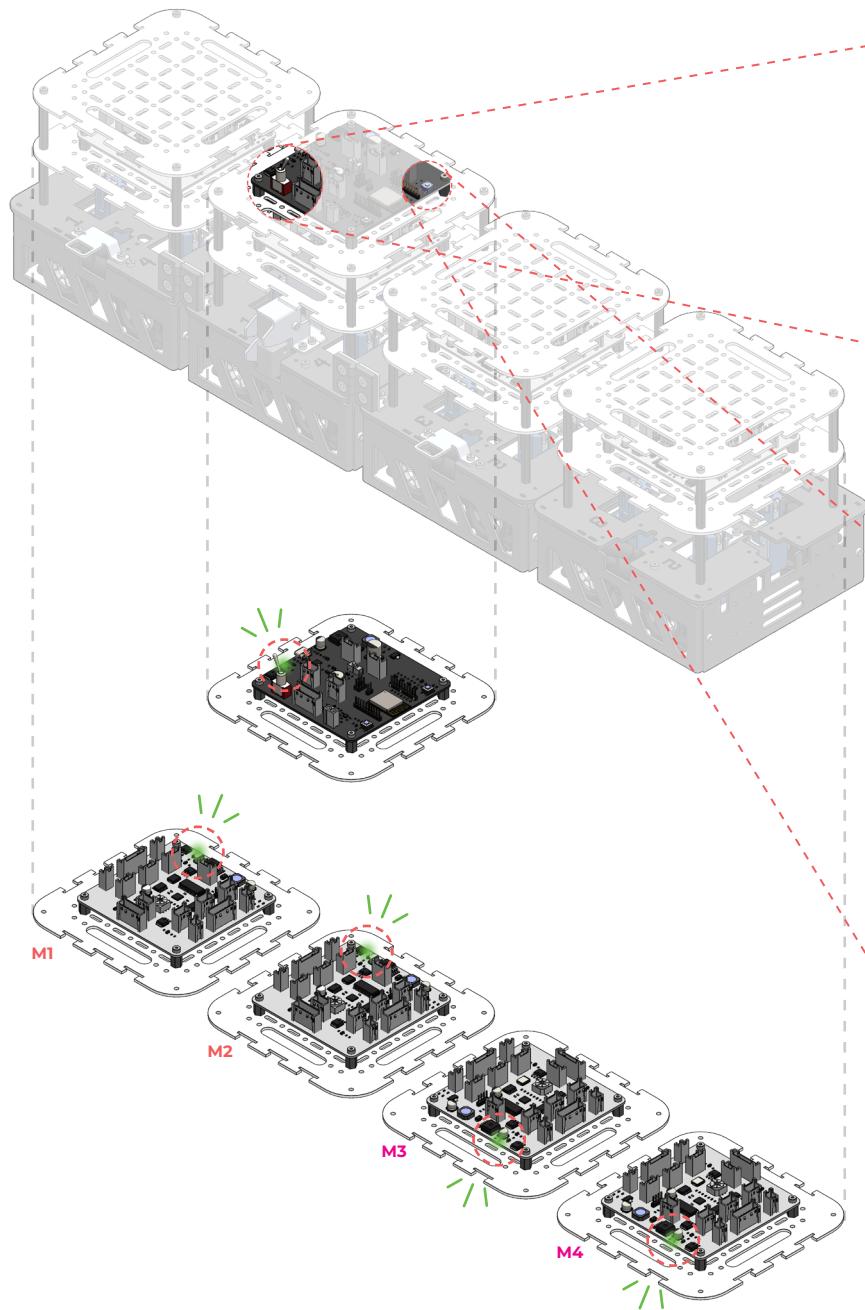
B12 (attach acrylic covers)



B13 (connect battery to masterboard)



B14 (check connection)



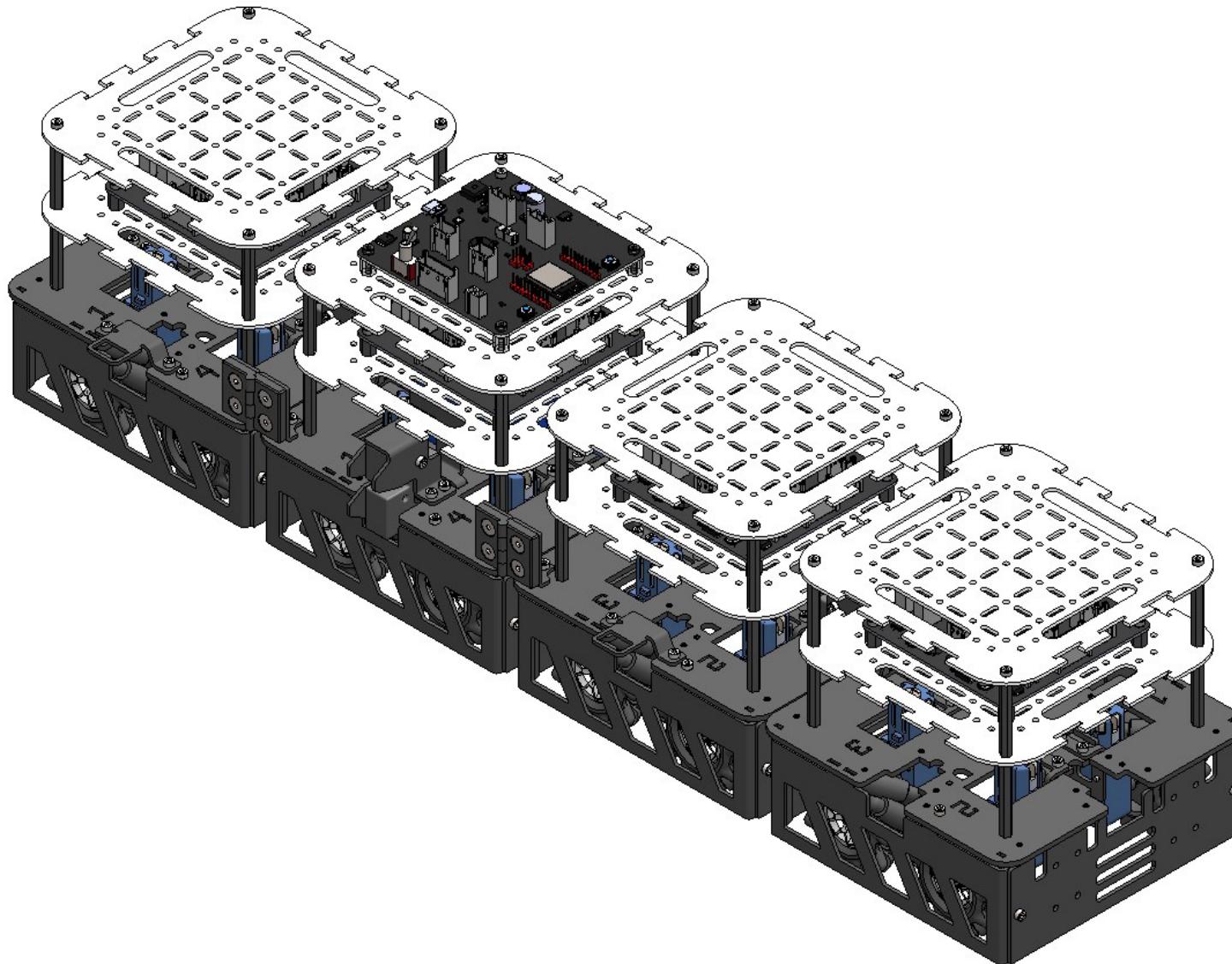
After checking that the lights are turned on, press on the enable button to activate the robot.



electronic assembly completed

smorphi is ready!

next step: connect with app



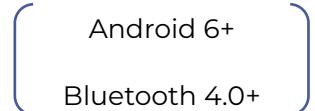


1. App Download.

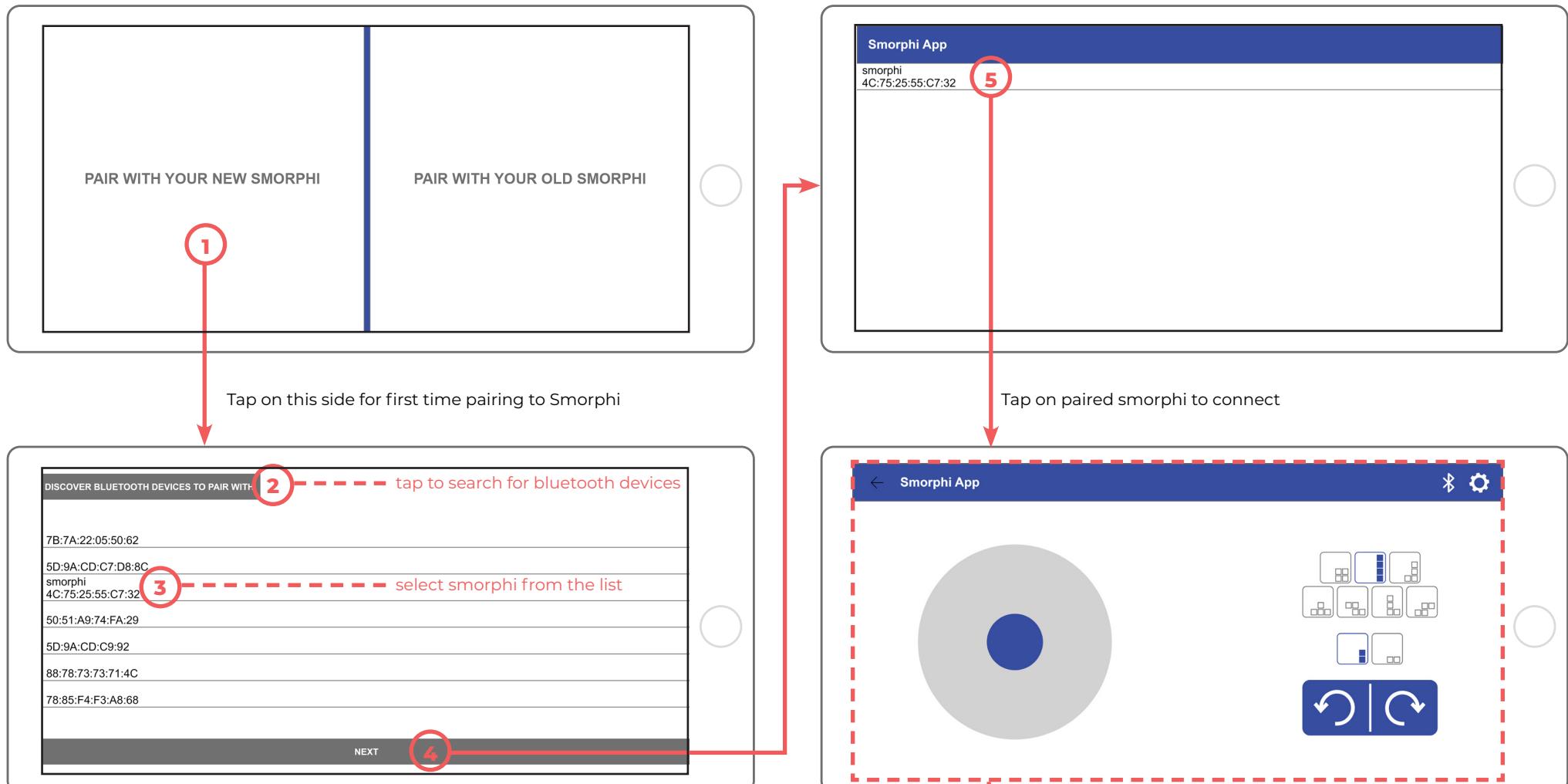


Not all devices are compatible now.

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+

2. Bluetooth Connection. Turn on Smorphi and the Bluetooth of your smart device. Tap on Smorphi app icon to launch application.



3. Smorphi controls dashboard guide.

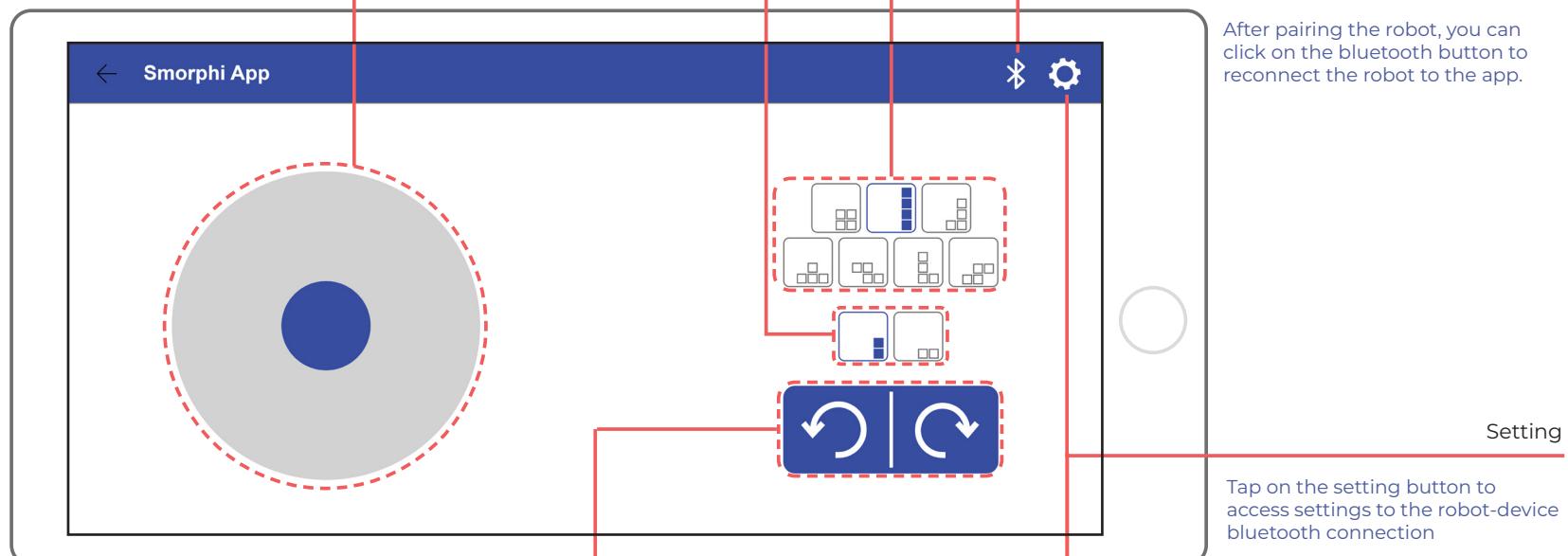
Direction & Speed Joystick Control

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



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/>

Shape Transformation Control (Smorphi Mini)

Shape Transformation Control (Smorphi Square)

Current Shape | Highlighted Shape on Highlighted Button

Shape Transformation

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

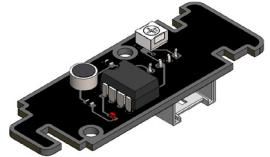
Tap on the setting button to access settings to the robot-device bluetooth connection

PAIR WITH A NEW SMORPHI

CONNECT WITH YOUR EXISTING SMORPHI

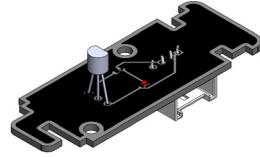
GO TO SYSTEM BLUETOOTH SETTING

(sensors)



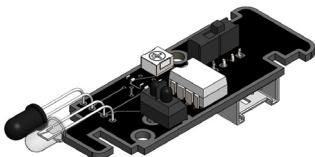
sound sensor (x2)

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.



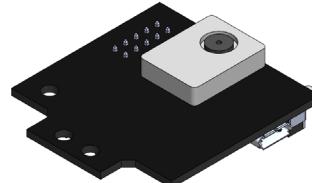
temperature sensor (x1)

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



IR sensor (x4)

IR sensors come 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.

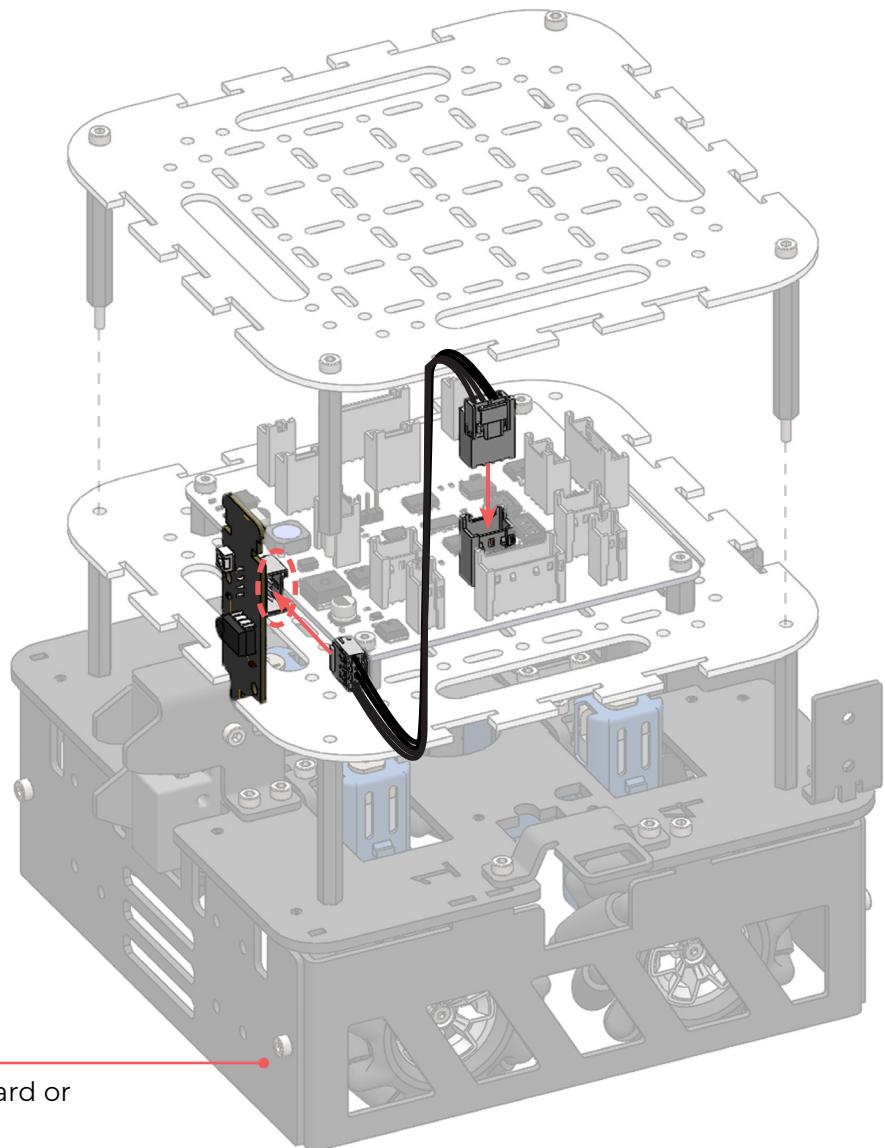
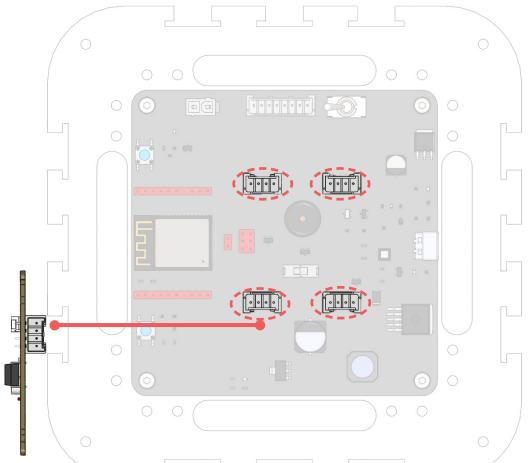
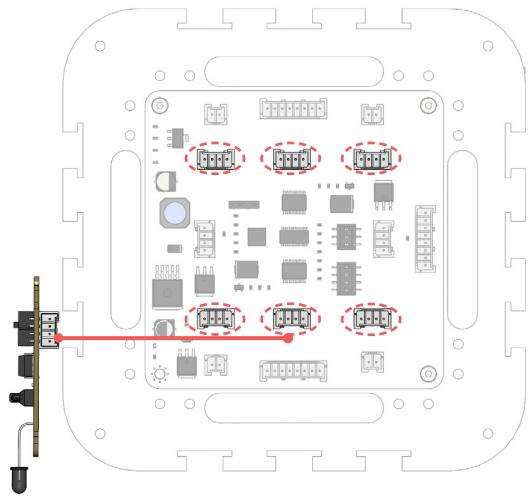


For sensor related activities and implementation, please refer to the online class exercises by following the link below:
<https://github.com/WefaaRobotics/Smorphi/wiki/Robot-Exercises>



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)



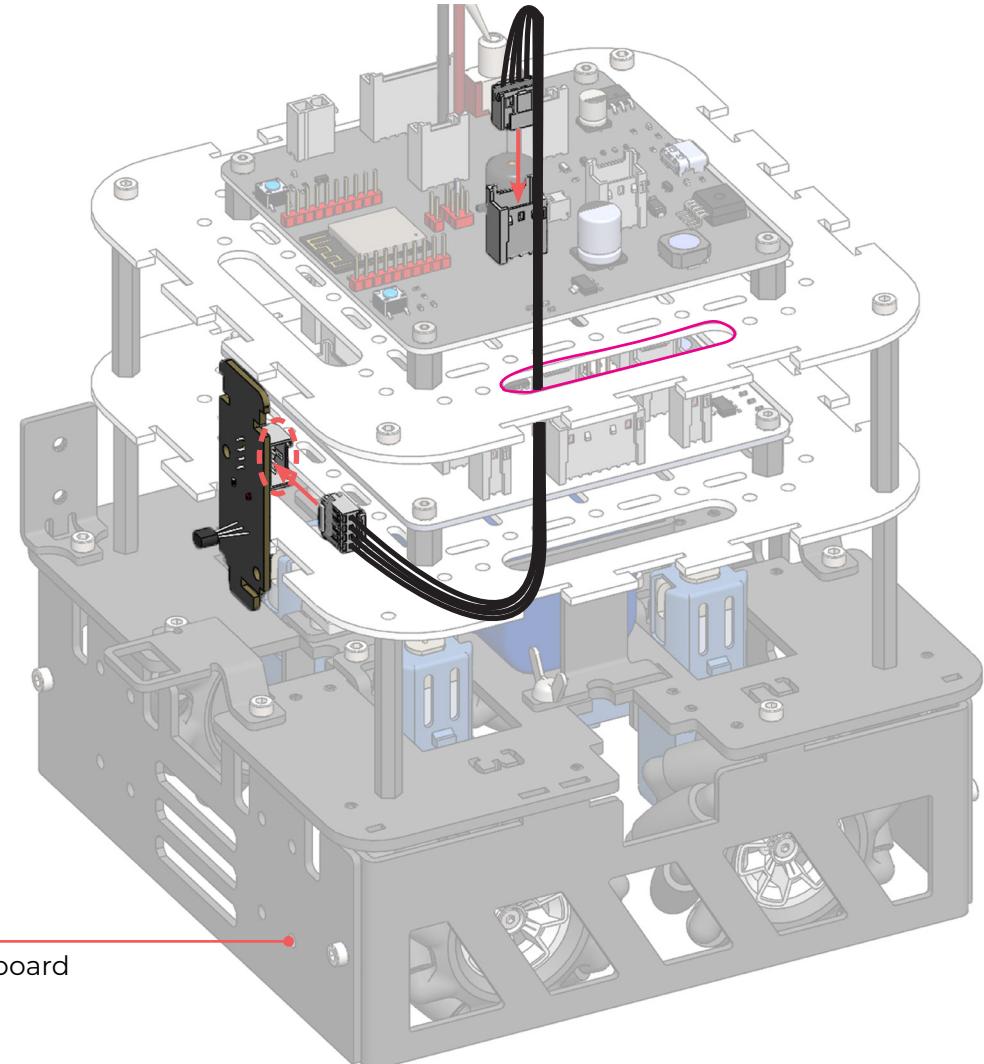
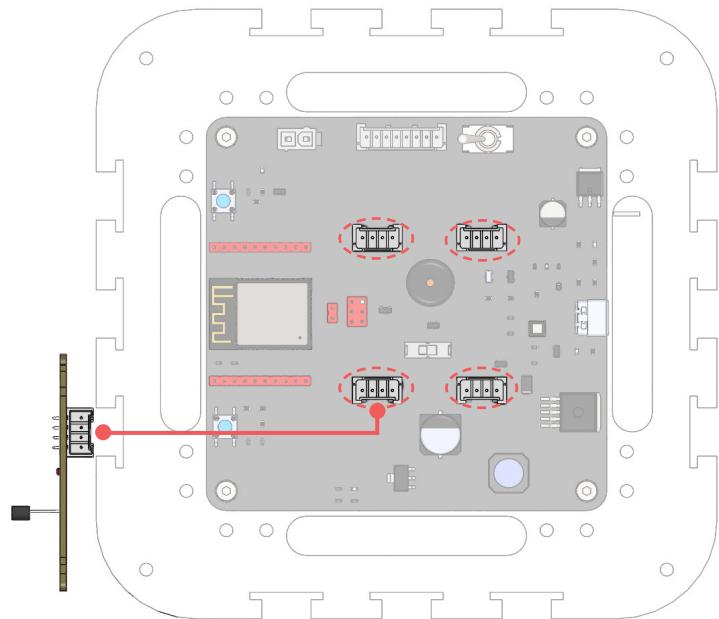
Module 1/2/3/4

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

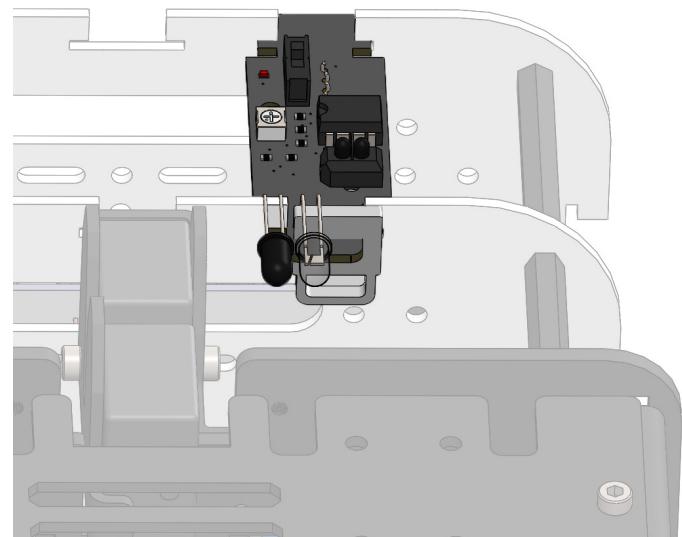
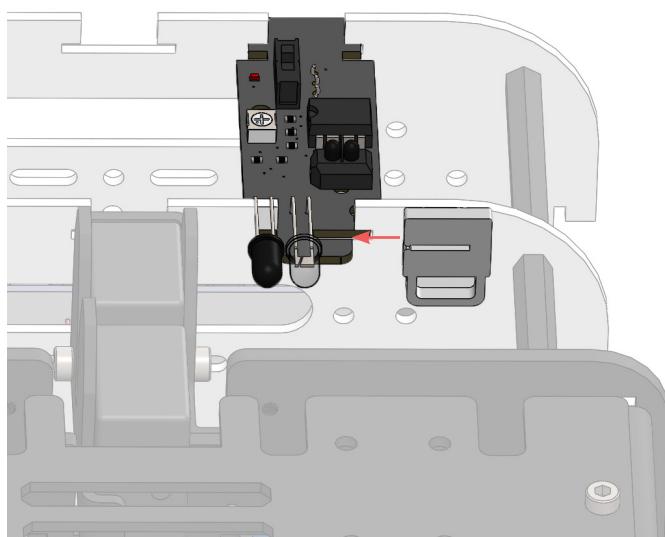
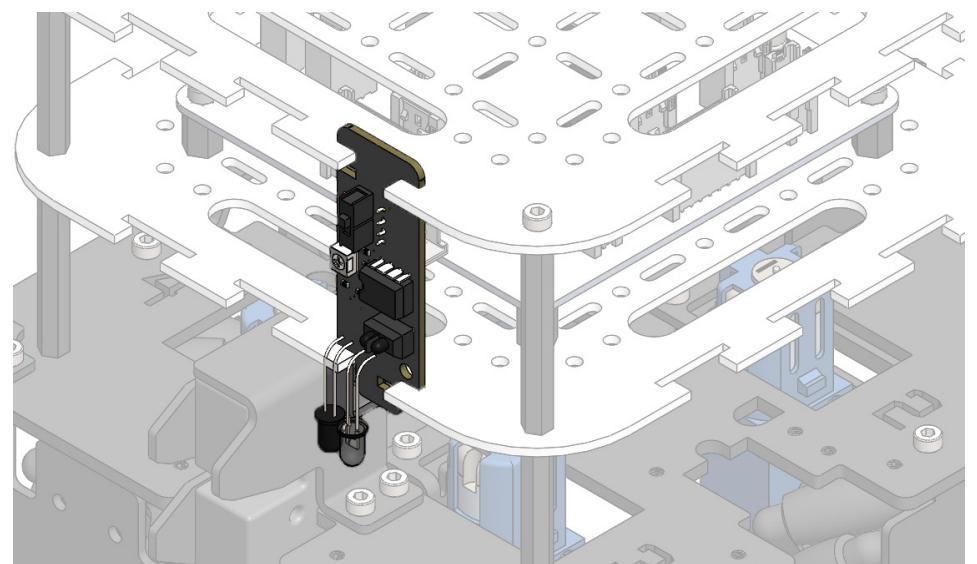
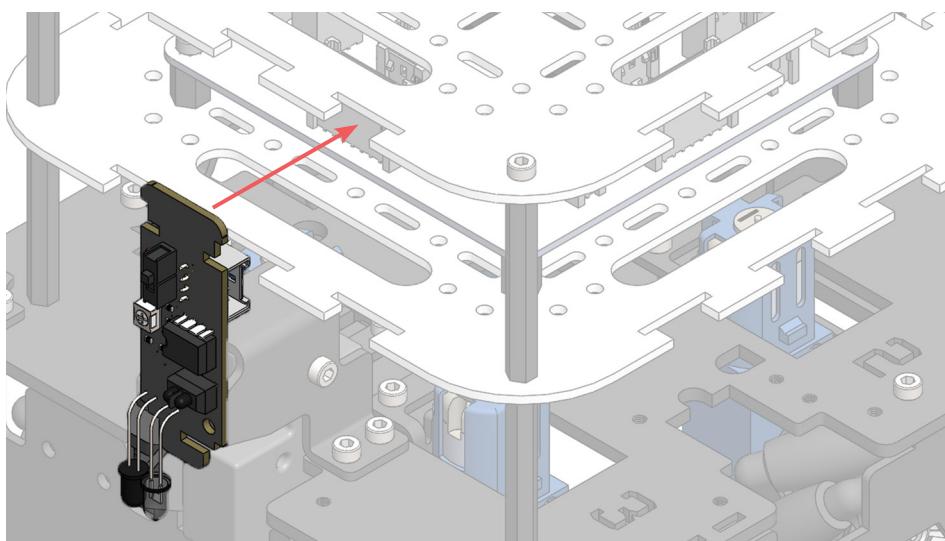
Only connect to masterboard



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

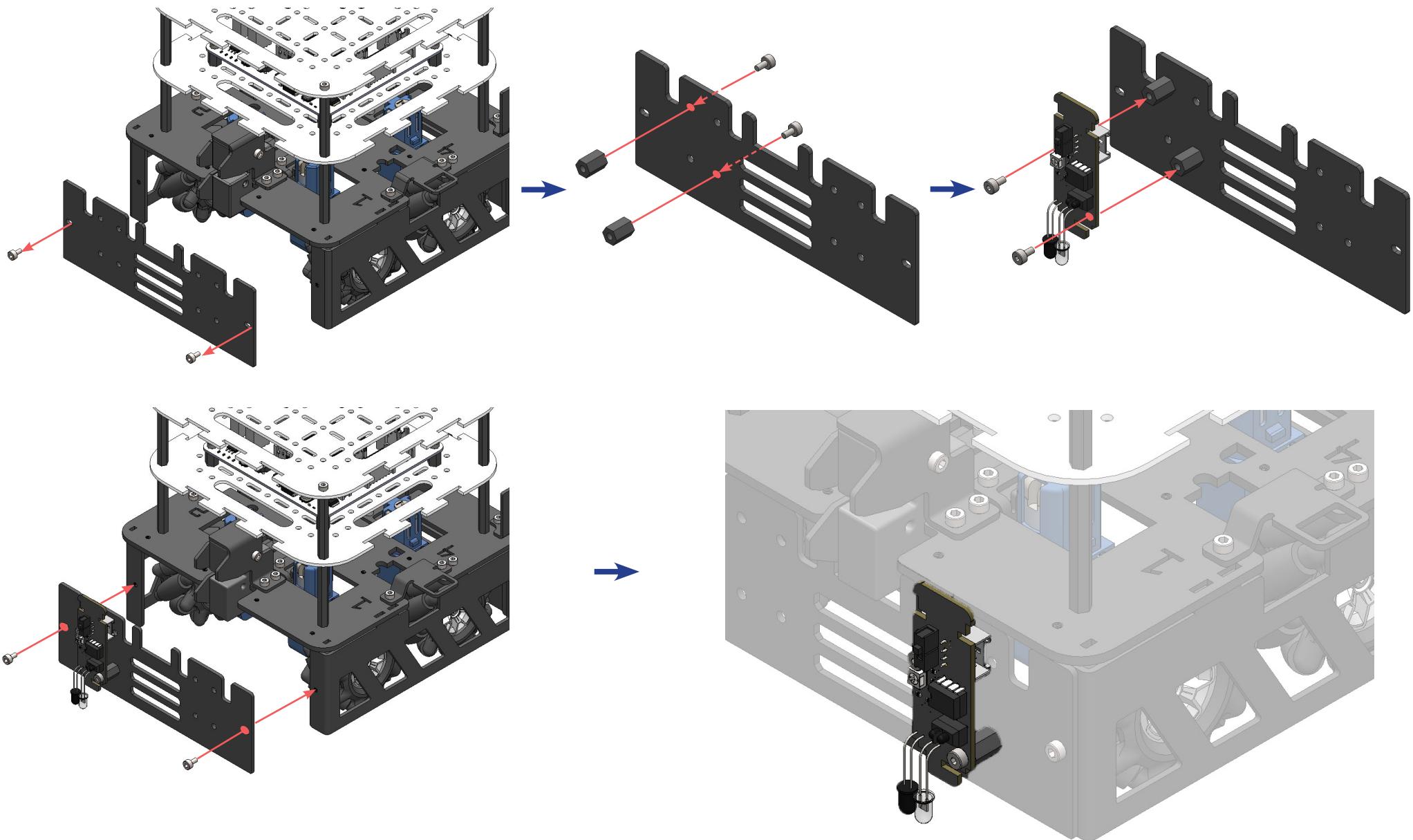
Opening to pass wire through

(sensor position 1)



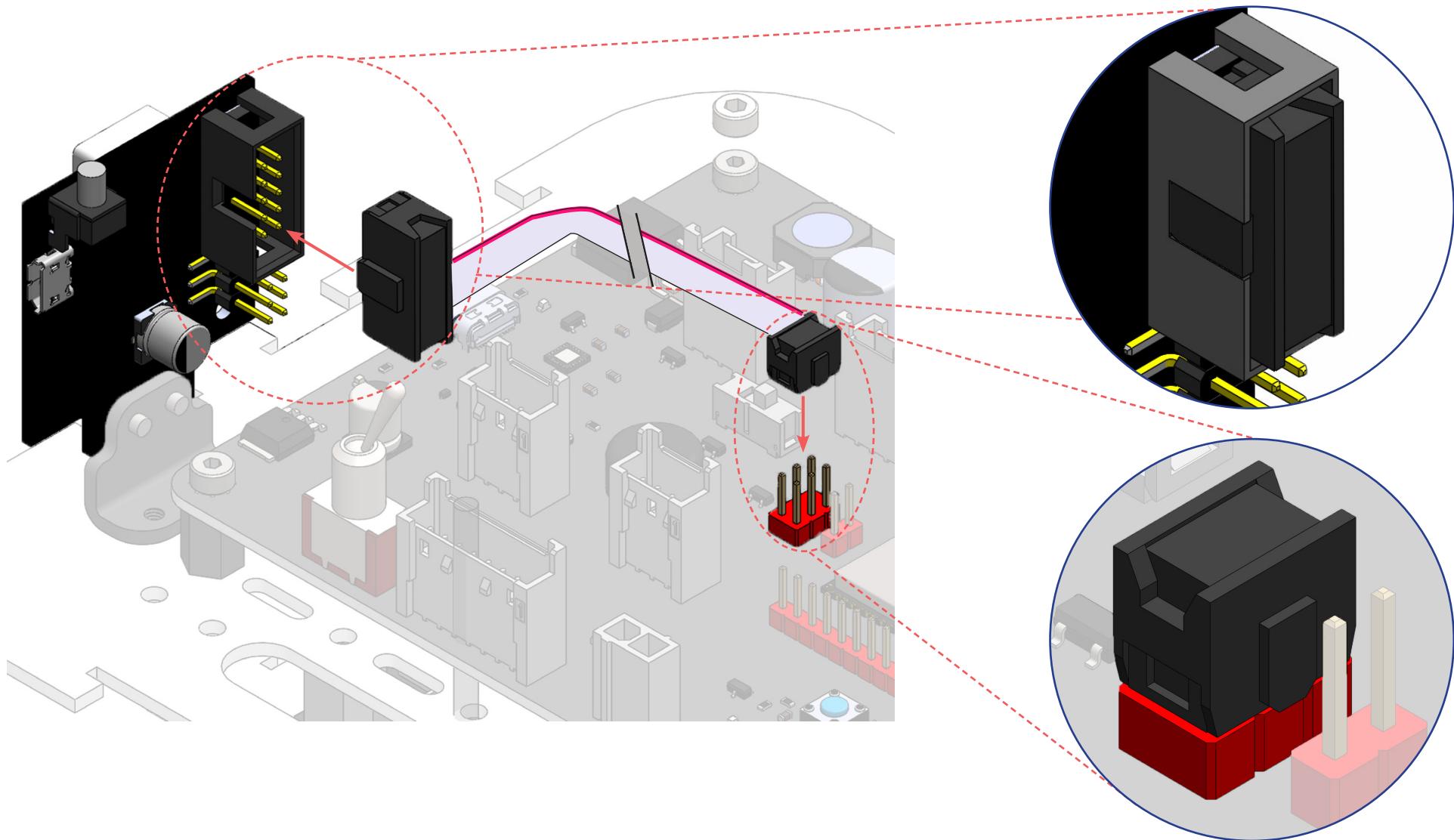
Sensors can be secured to the robot using the sensor lock provided.

(sensor position 2)



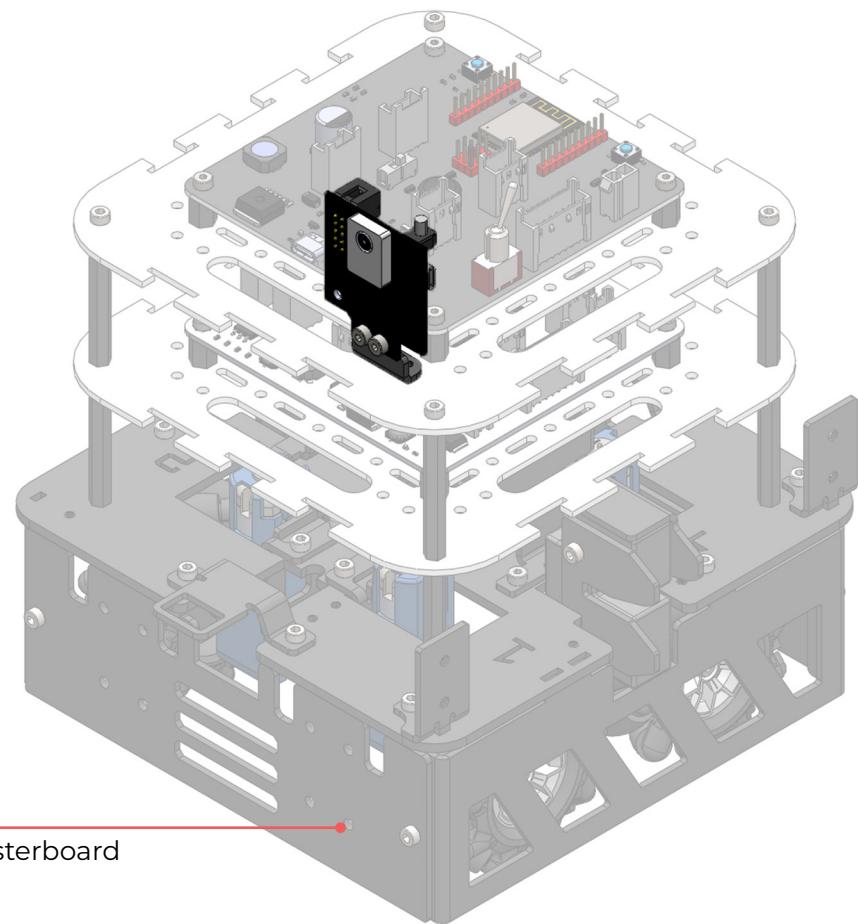
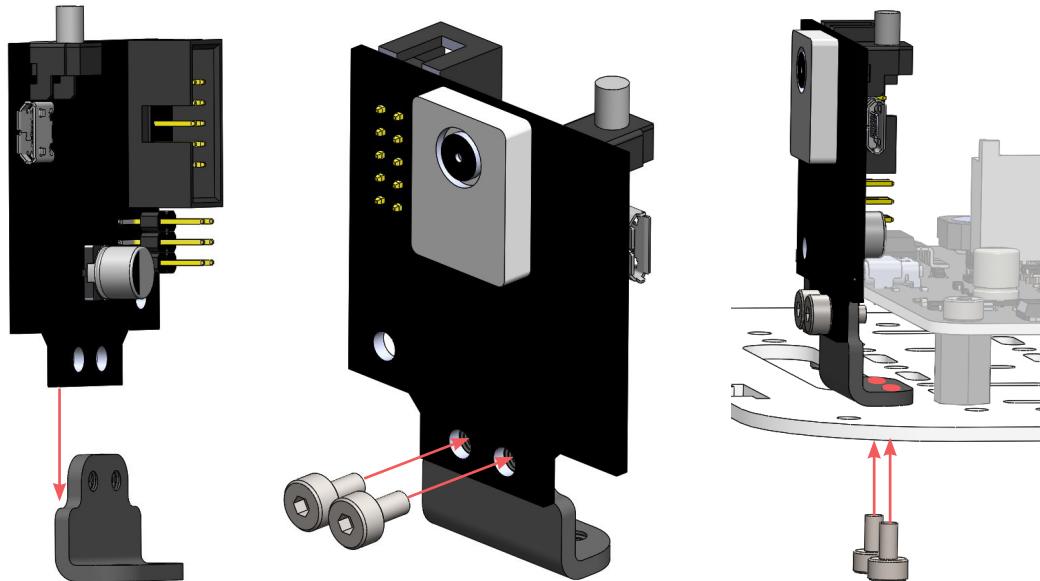
Sensors can also be attached at the skirt panel of the robot.

(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

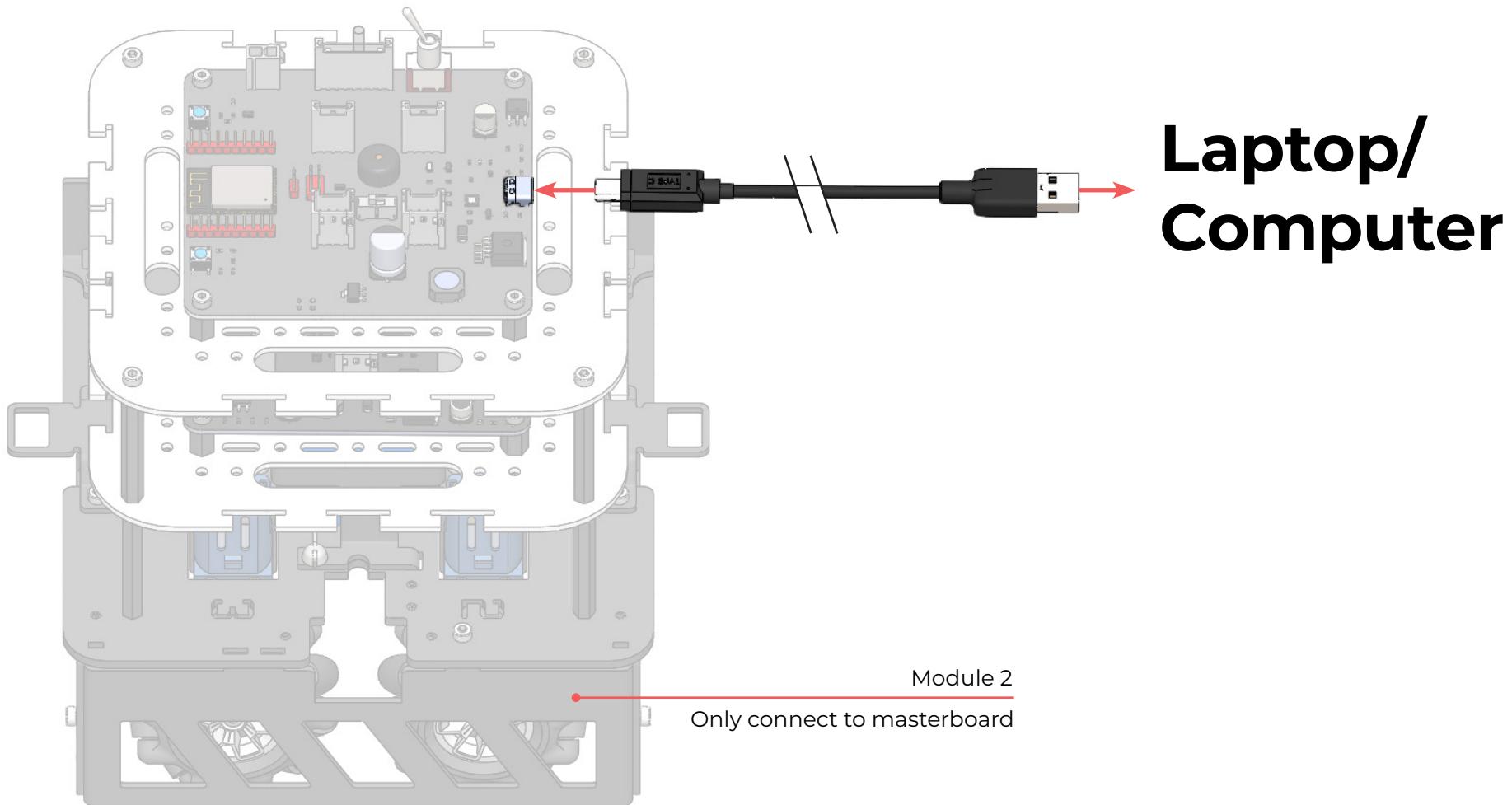
(mounting the pixycam)



Module 2
Only connect to masterboard

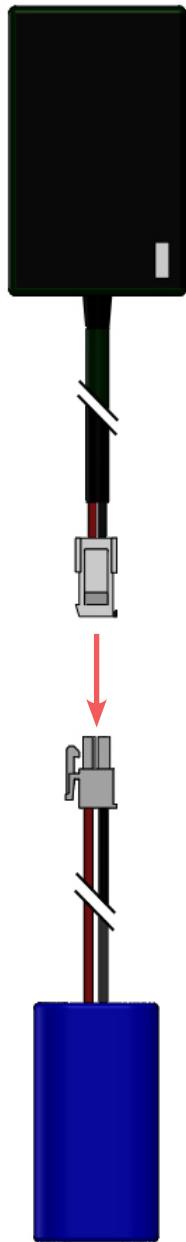
Pixycam can be mounted on anywhere on the acrylic board.

(connect to laptop)

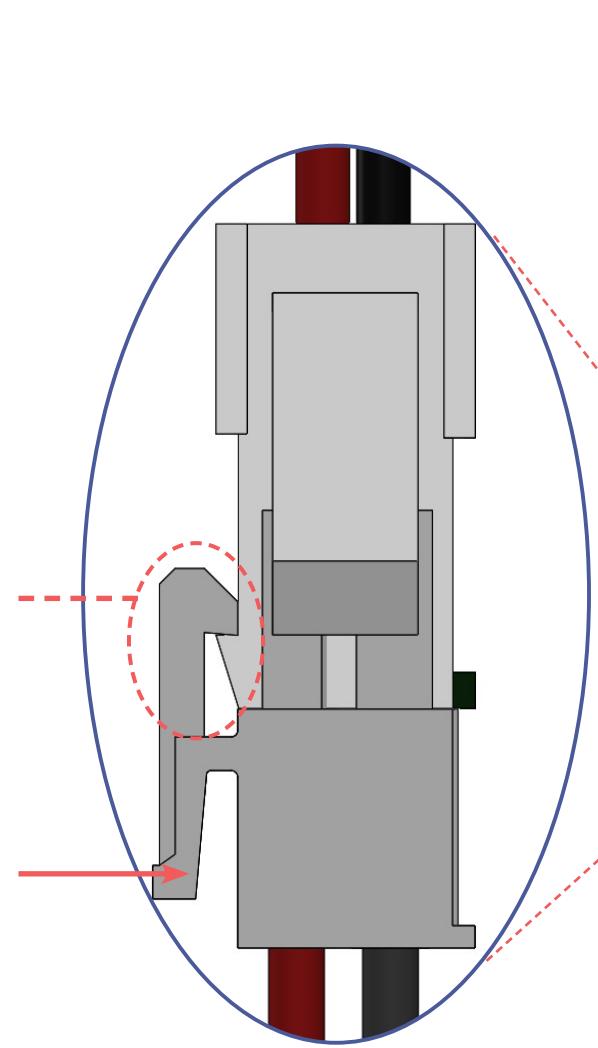


- Plug in the USB-C cable as shown above to connect the masterboard to the computer.
It allows us to upload our code from our computer onto the masterboard.

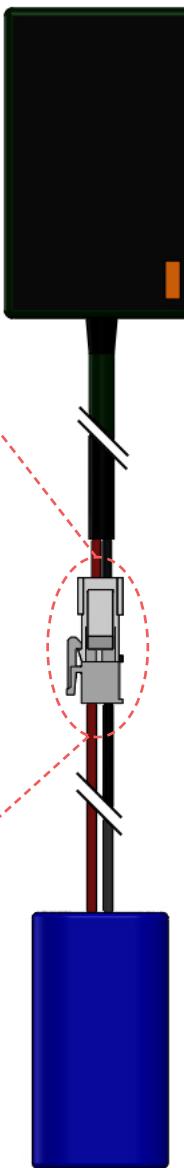
(charging)



Make sure the battery connector is latched onto the charger connector



Press to release the latch when inserting or plugging out the charger



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

