

smorph<sup>e</sup>

transforming learning with  
transformer robots

assembly & info

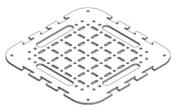


# ( contents )

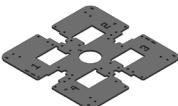
<b>PART LIST</b>	-----	( 02 )
<b>BASIC ASSEMBLY TIPS</b>	-----	( 03 )
<b>SMORPHI ASSEMBLY</b>		
<b>A MECHANICAL</b>	-----	( 05 )
<b>B ELECTRONIC</b>	-----	( 22 )
<b>APP</b>	-----	( 41 )
<b>FURTHER EXPLORATION</b>	-----	( 44 )

# ( 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)



12 x Mecanum Motor



4 x DC Encoder Motor



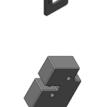
16 x Motor Shaft Sleeve



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



200 x Cap Screw M3x5



3 x Hinge Mechanism



45 x Cap Screw M3x10



1 x Battery



50 x Cap Screw M3x25



2 x Battery bracket



15 x Countersunk Screw M4x8



1 x Masterboard (ESP32)



45 x Hex Nut M3



4 x Slaveboard



2 x Wing Screw M3x5



1 x Sound Sensor



1 x USB-C Cable



1 x Temperature Sensor



8 x 4-pin Connector



4 x IR Sensor



4 x 8-pin Connector



1 x Husky Camera



1 x Battery Charger



1 x Husky Mount



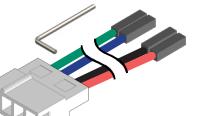
1 x Ceramic Screwdriver CD-25



10 x Sensor Lock



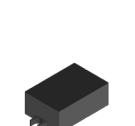
1 x HEX Key 1.5mm



32 x Hex M-F M3 Nylon 45mm



1 x Husky Cam Cable  
(included in huskycam package)



28 x Hex F-F M3 Nylon 10mm



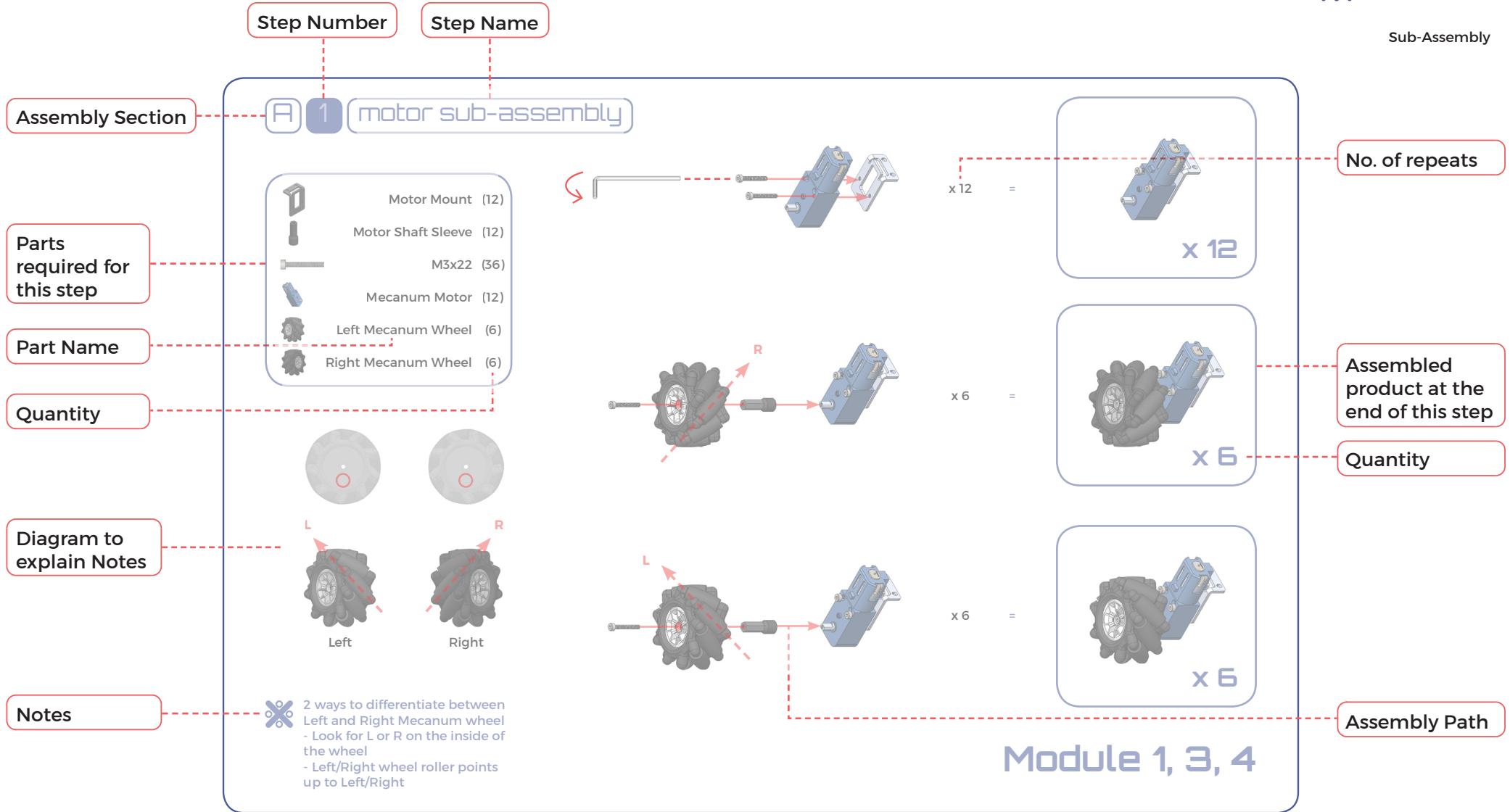
1 x Voltage Regulator

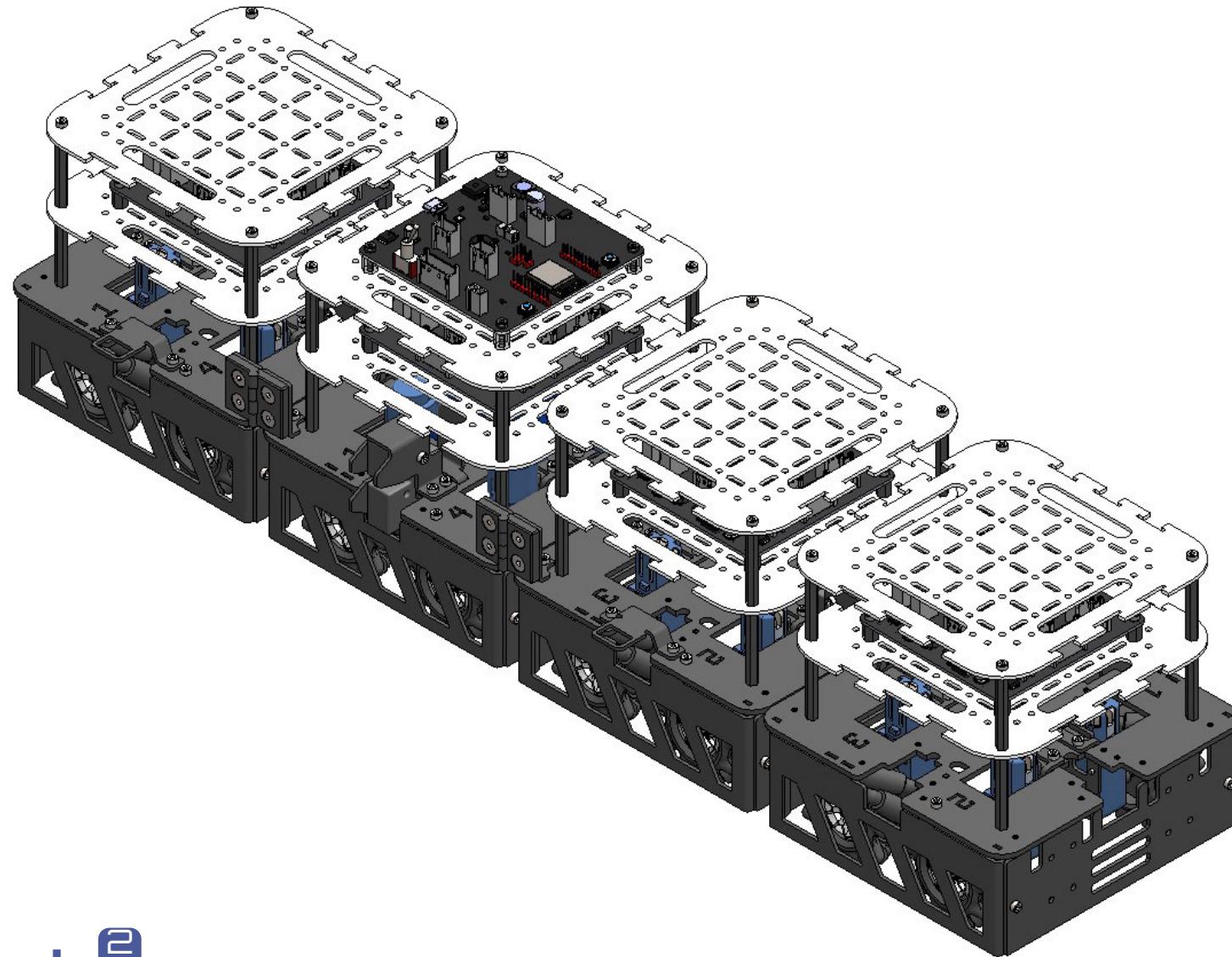


# ( basic assembly tips )

**Symbols Used**

- ↷ Rotate Part
- Assembly Path
- ☒ Important Note
- Sub-Assembly

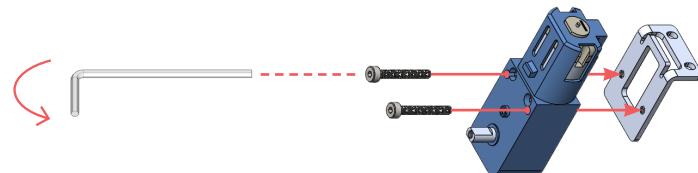
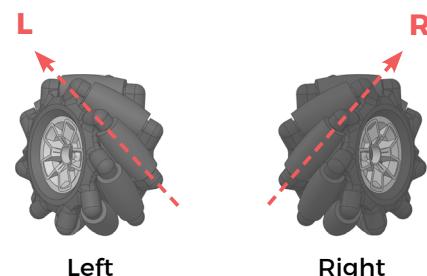




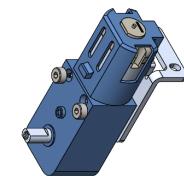
smorph<sup>e</sup>  
assembly start

## A 1 (motor sub-assembly)

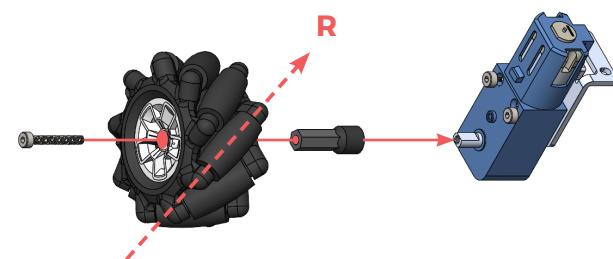
	Motor Mount (12)
	Motor Shaft Sleeve (12)
	M3x22 (36)
	Mecanum Motor (12)
	Left Mecanum Wheel (6)
	Right Mecanum Wheel (6)



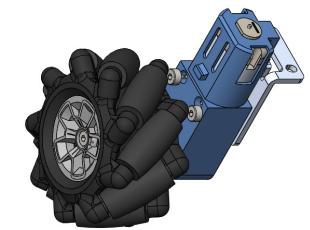
x 12 =



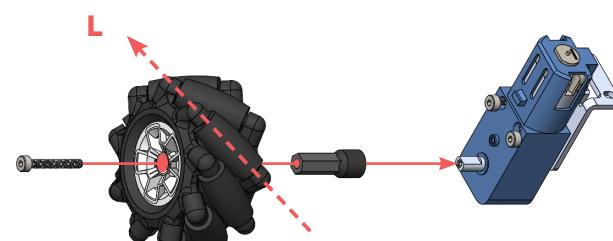
x 12



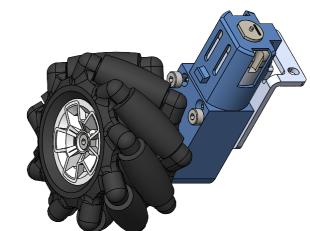
x 6 =



x 6



x 6 =



x 6

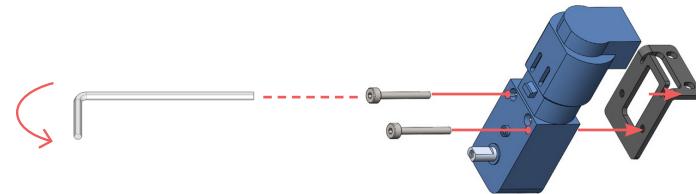
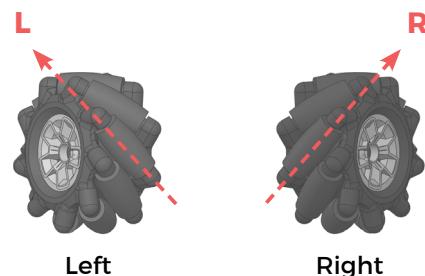
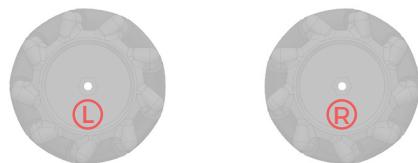


- 2 ways to differentiate between Left and Right Mecanum wheel
- Look for L or R on the inside of the wheel
- Left/Right wheel roller points up to Left/Right

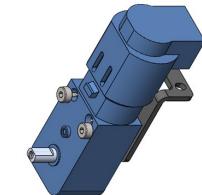
# Module 1, 3, 4

## A 1 (motor sub-assembly)

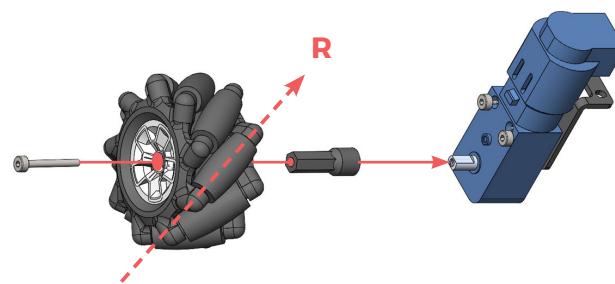
	Motor Mount (4)
	Motor Shaft Sleeve (4)
	M3x22 (12)
	DC Encoder Motor (4)
	Left Mecanum Wheel (2)
	Right Mecanum Wheel (2)



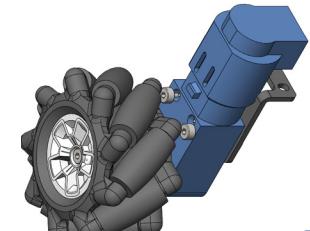
x 4 =



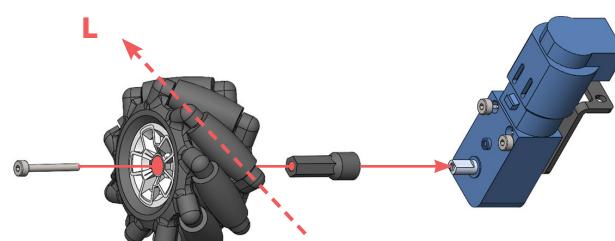
x 4



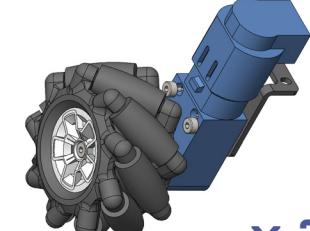
x 2 =



x 2



x 2 =

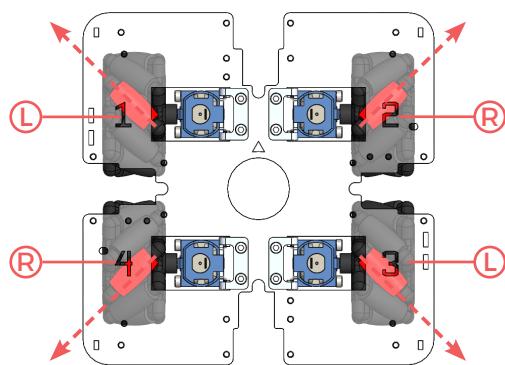
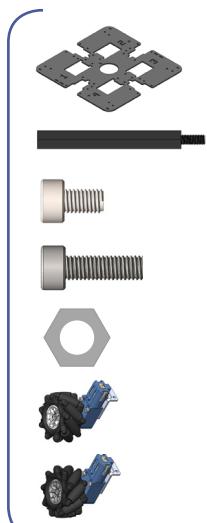


x 2

- ✖ 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

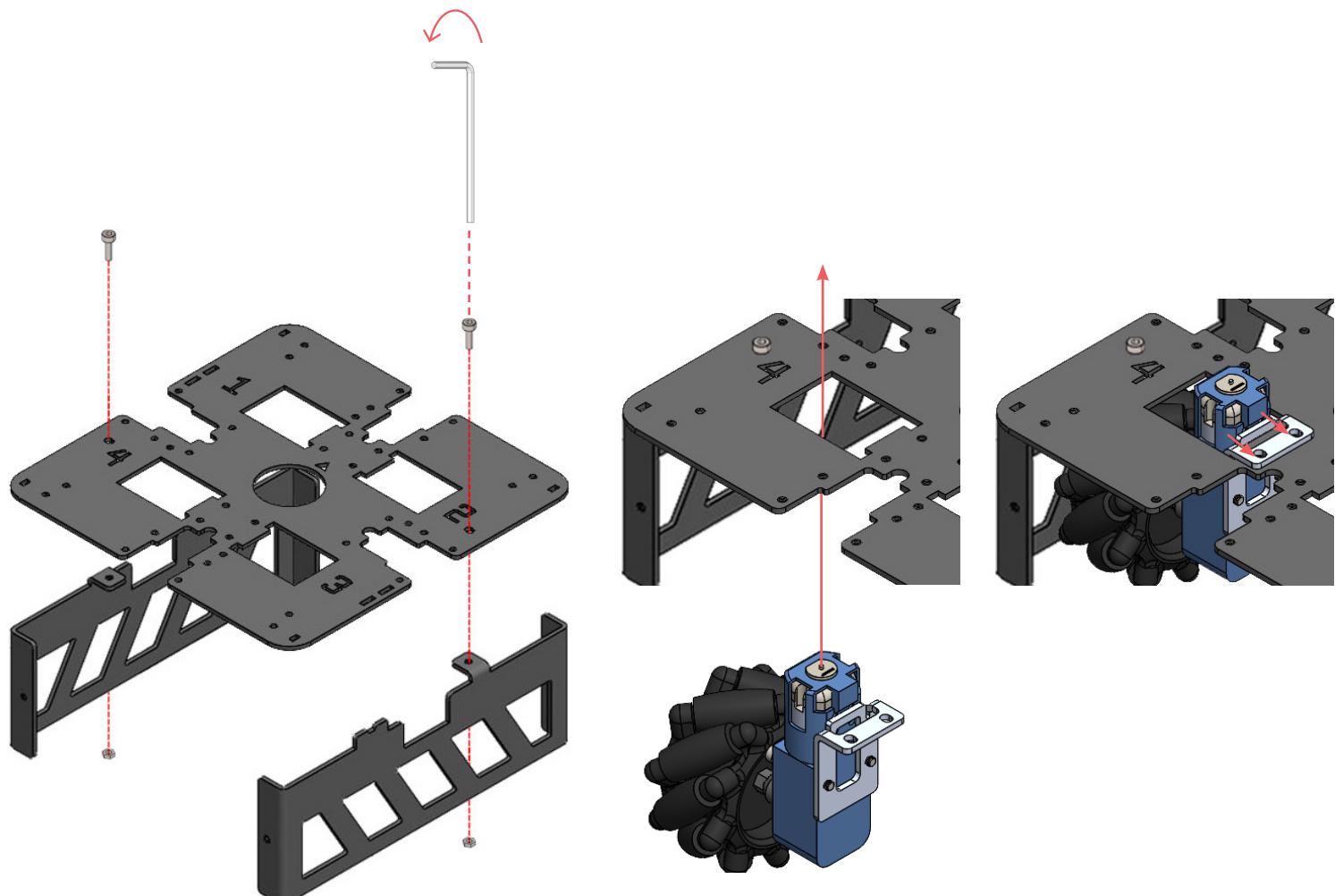
# Module 2

## A2 (base module 1, 3, 4 sub-assembly)

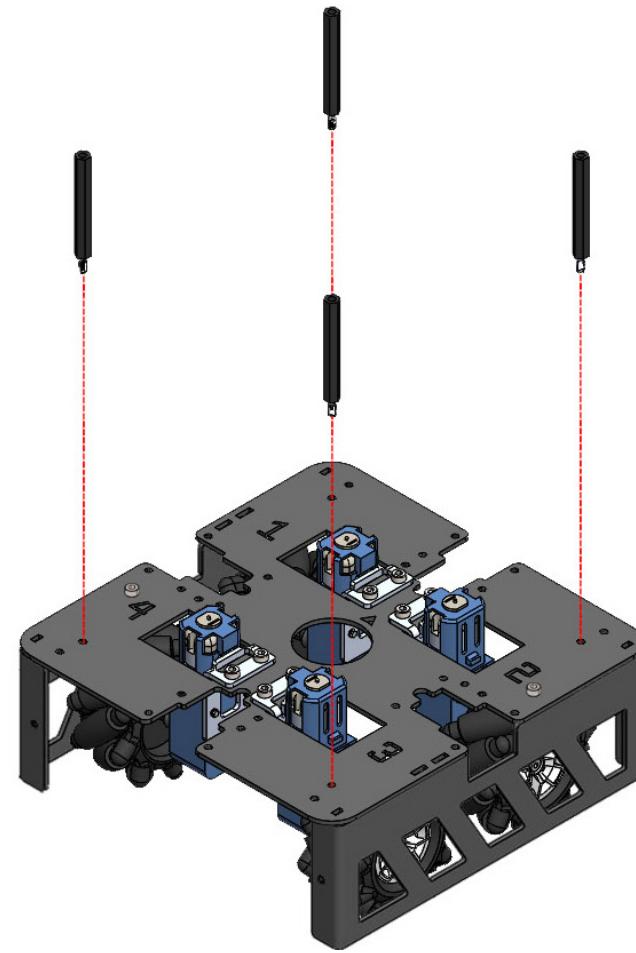
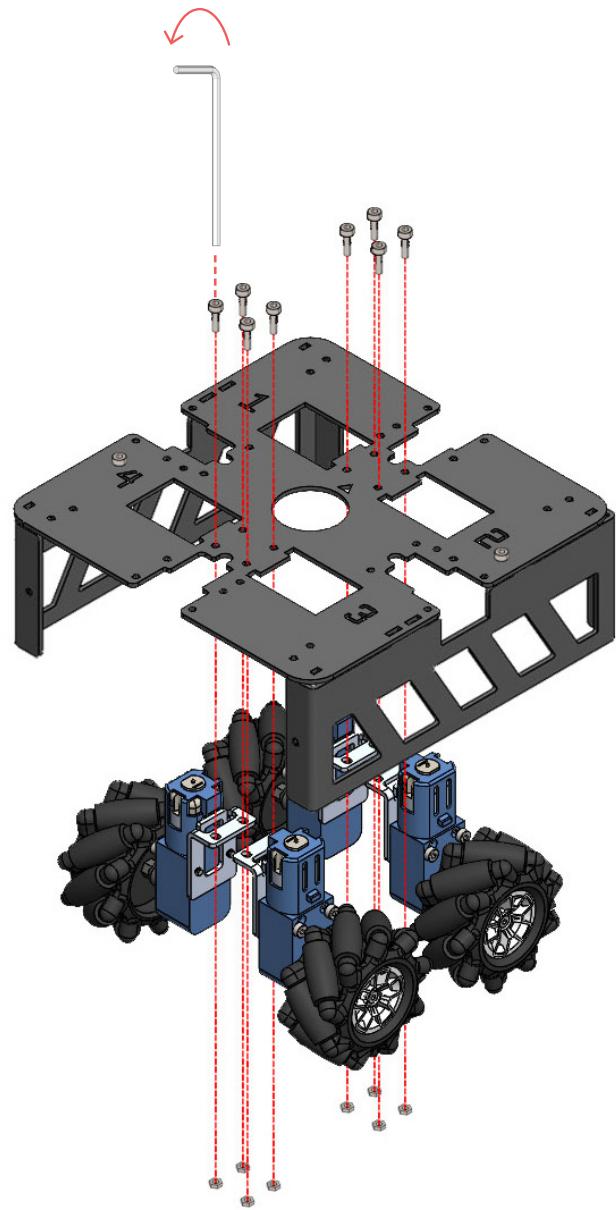


✖ Make sure that the numbers are facing the right way up as shown in the plan view above.

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



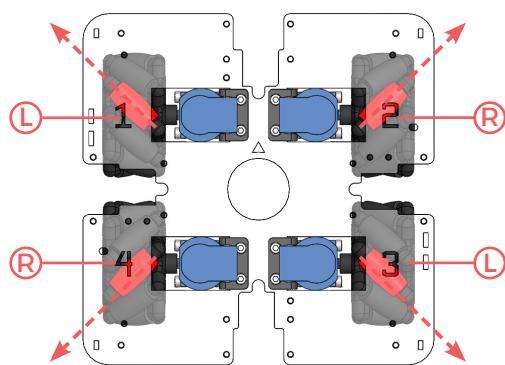
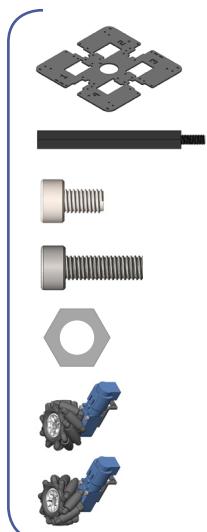
# Module 1, 3, 4



**Module 1, 3, 4**

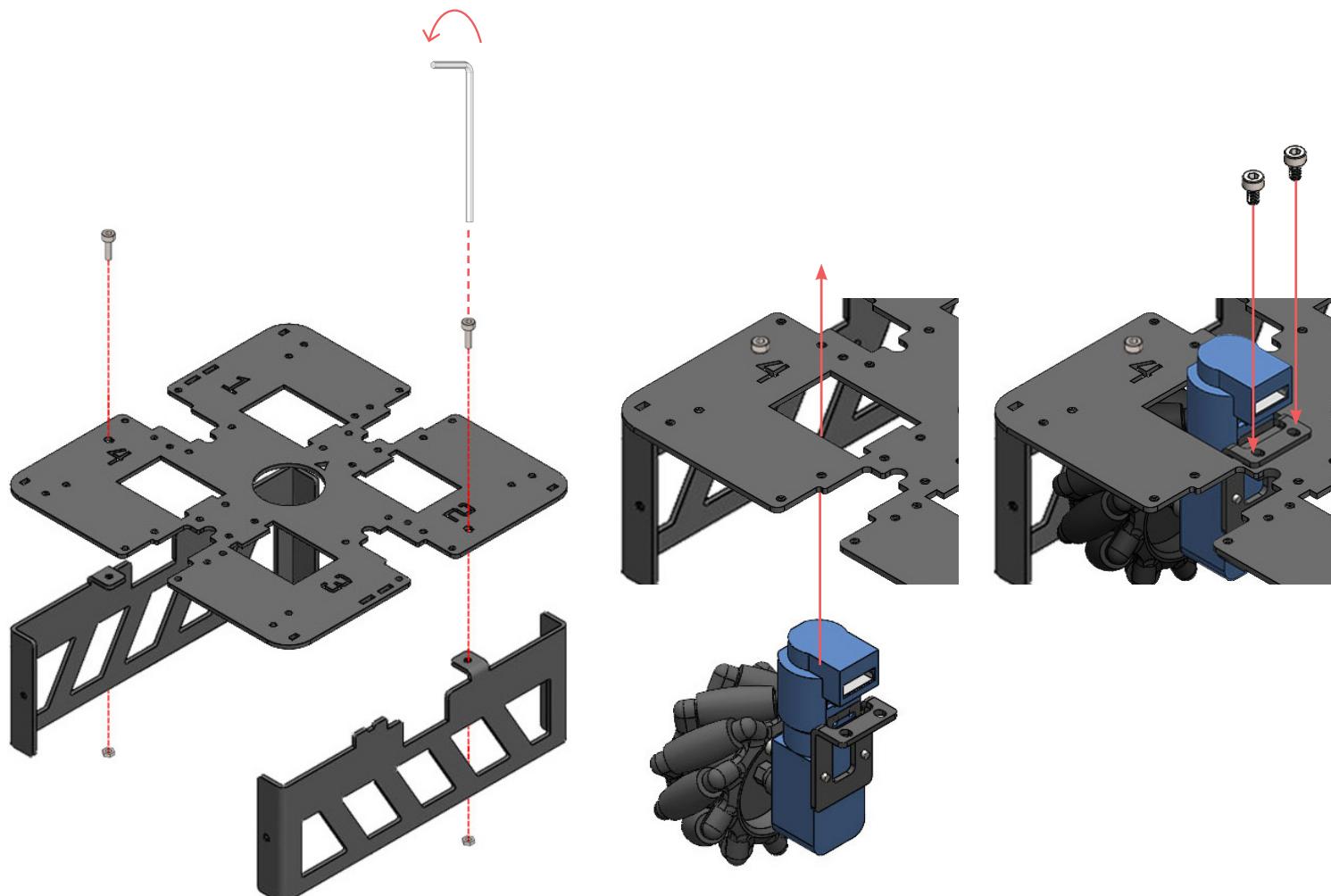


## A2 (base module 2 sub-assembly)

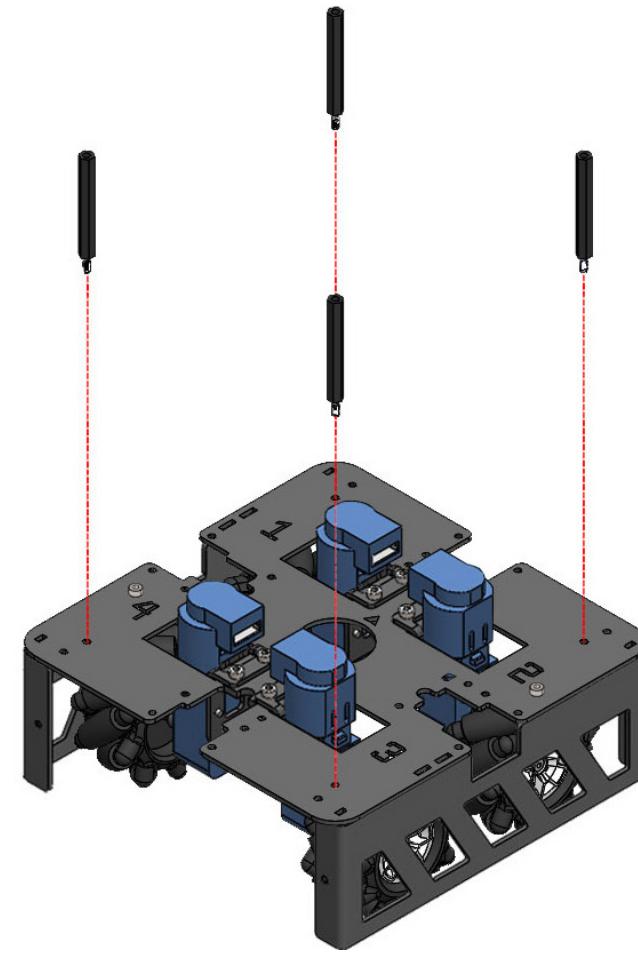
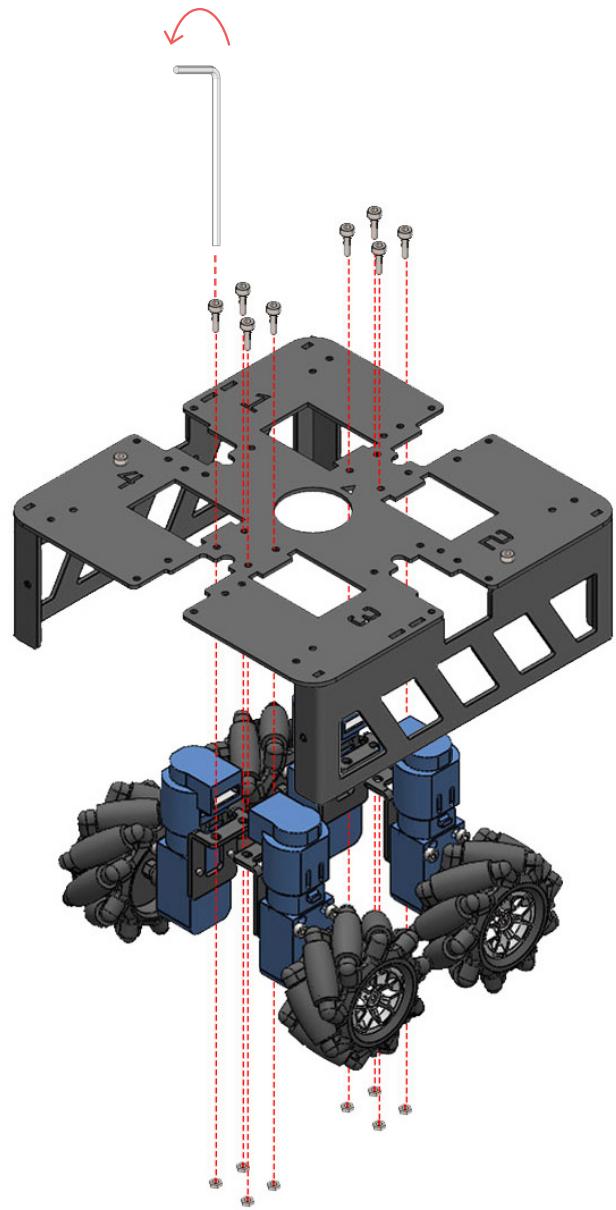


Make sure that the numbers are facing the right way up as shown in the plan view above.

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



# Module 2



**Module 2**



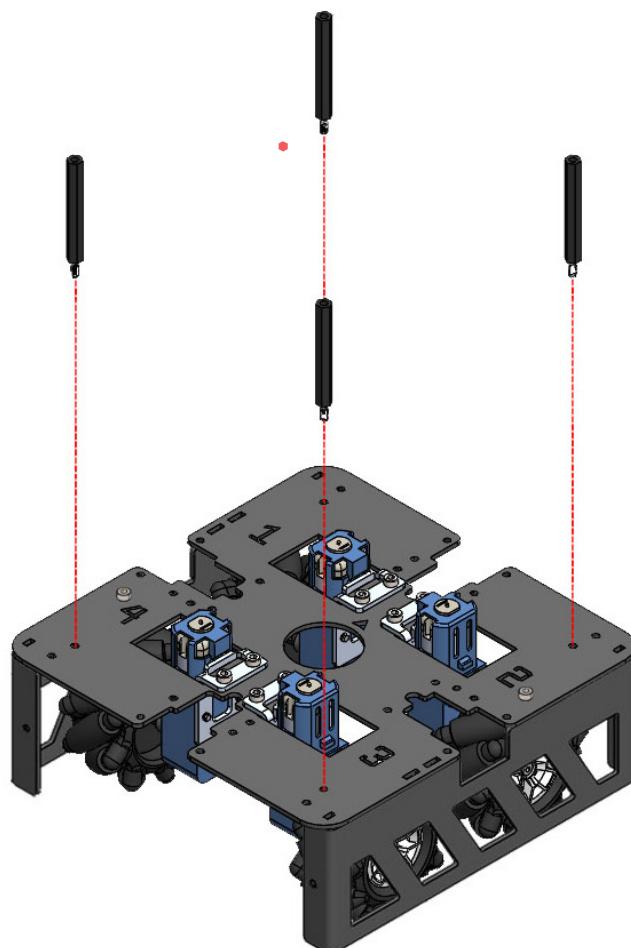
Base Skirt Panel A (6)



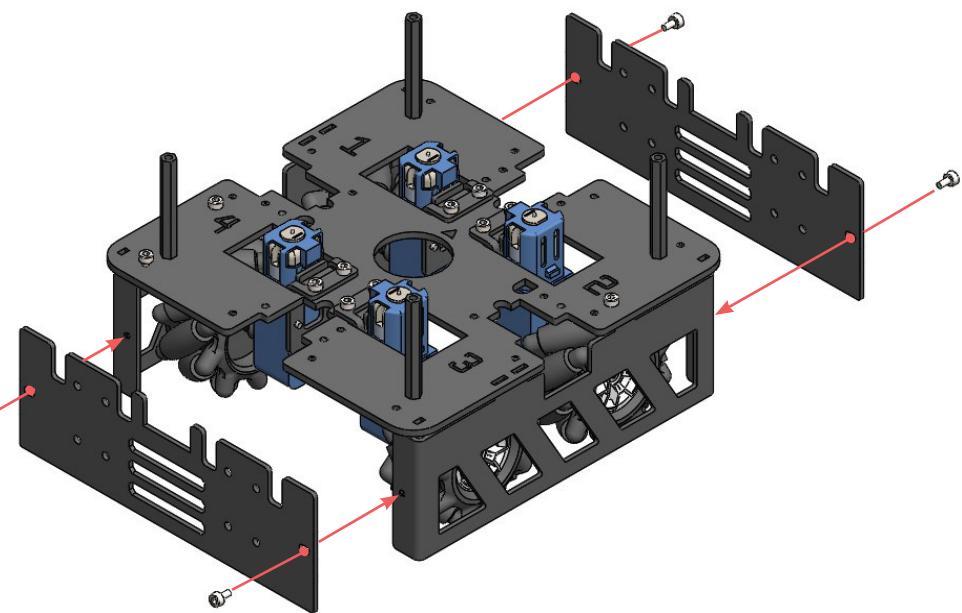
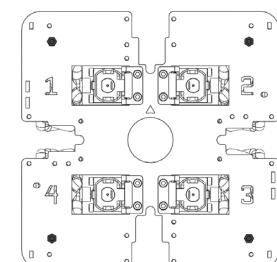
Base Skirt Panel B (6)



M3 x 5 (18)



plan view



Module 1, 3, 4



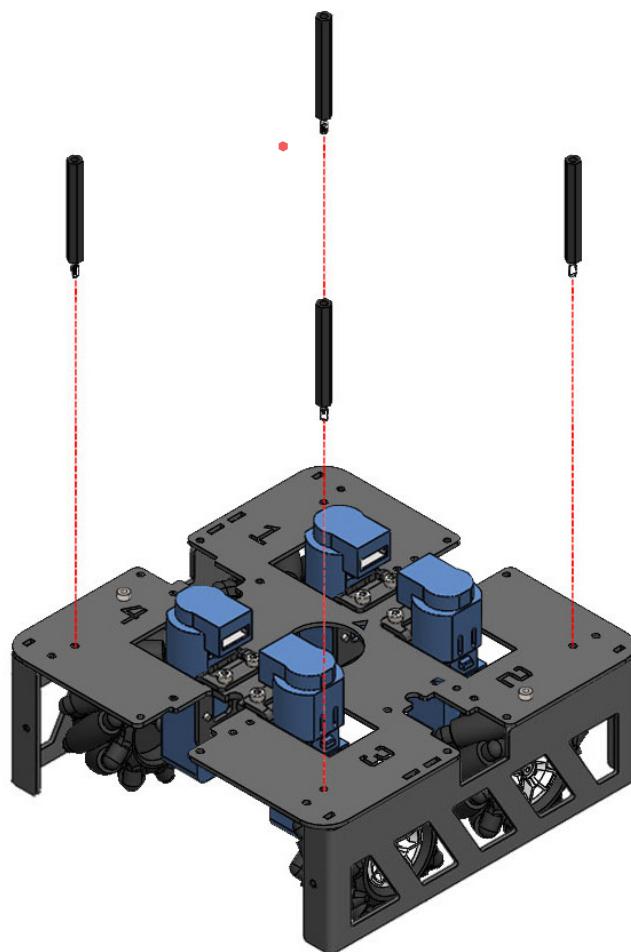
Base Skirt Panel A (2)



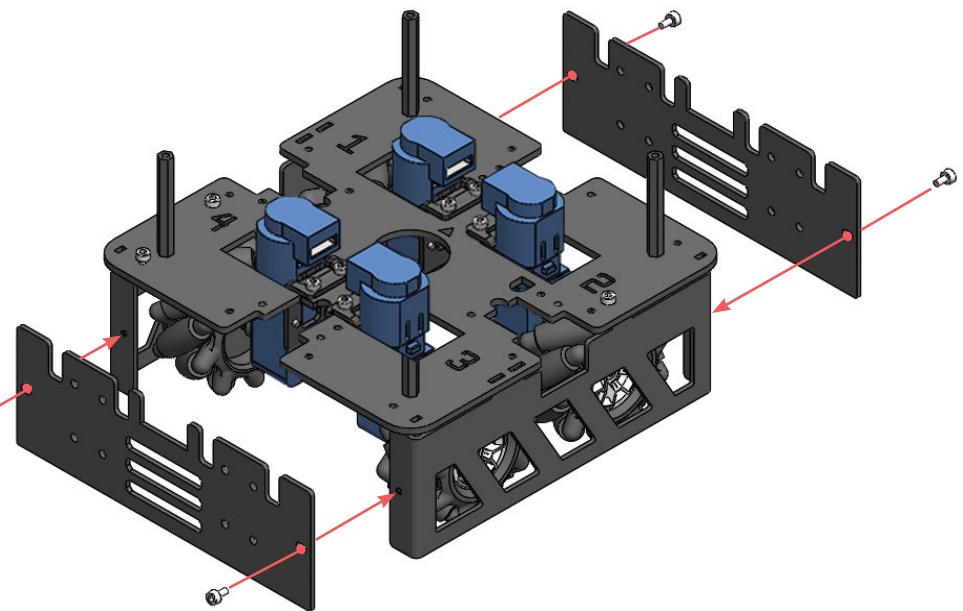
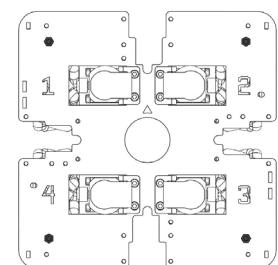
Base Skirt Panel B (2)



M3 x 5 (6)

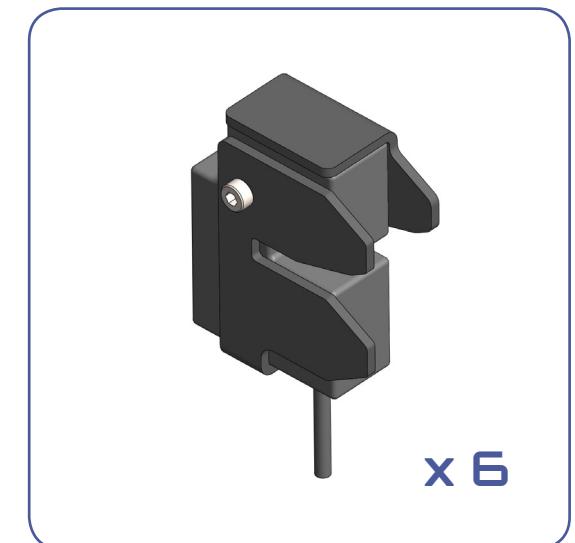
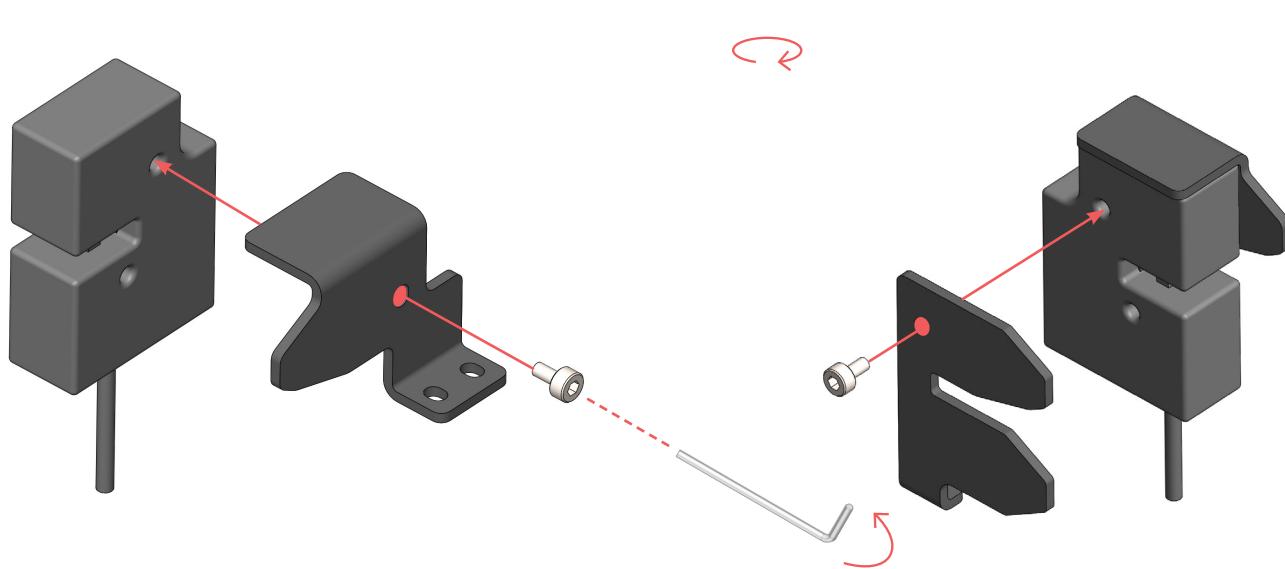


plan view

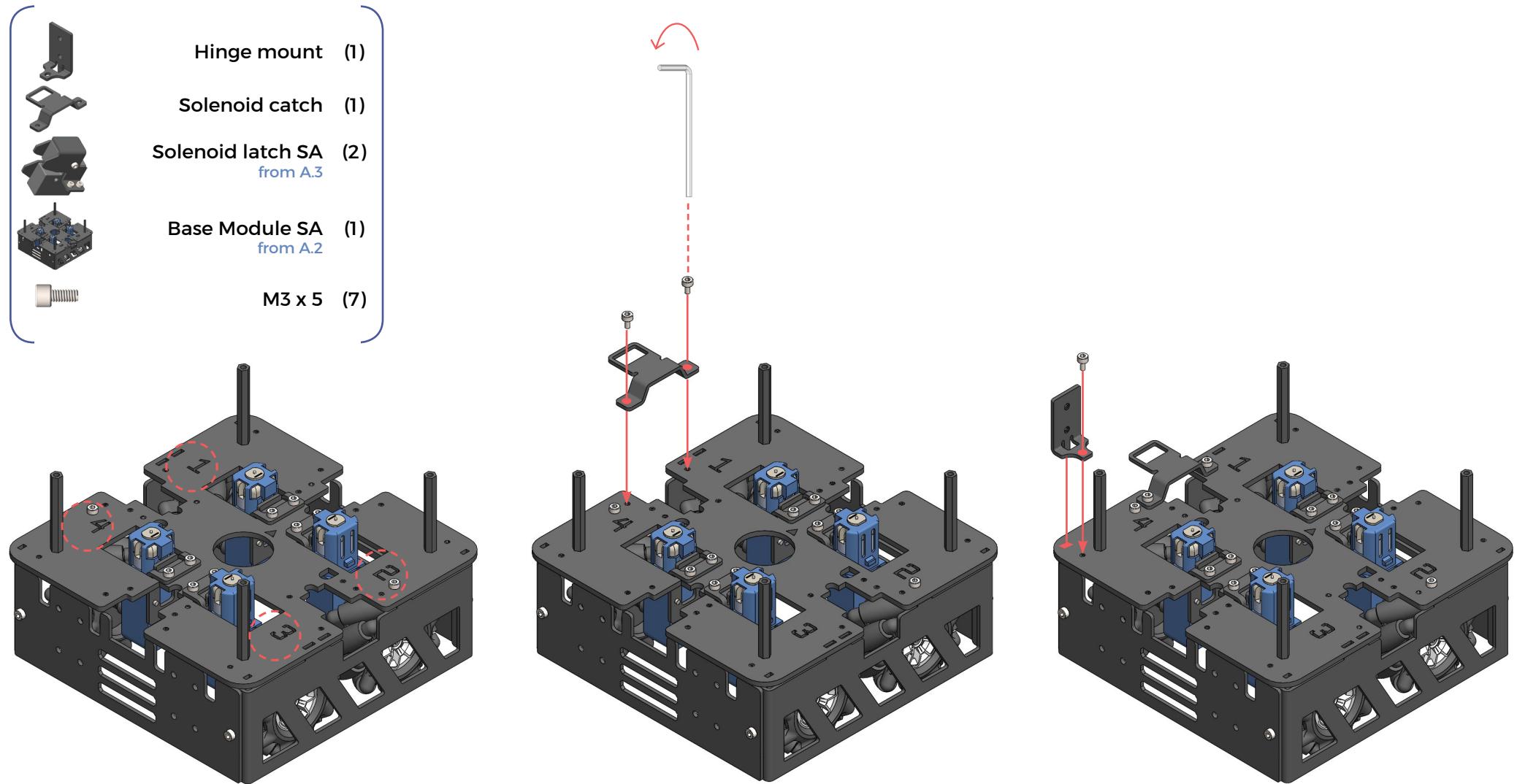


Module 2

## A 3 (solenoid latch sub-assembly)

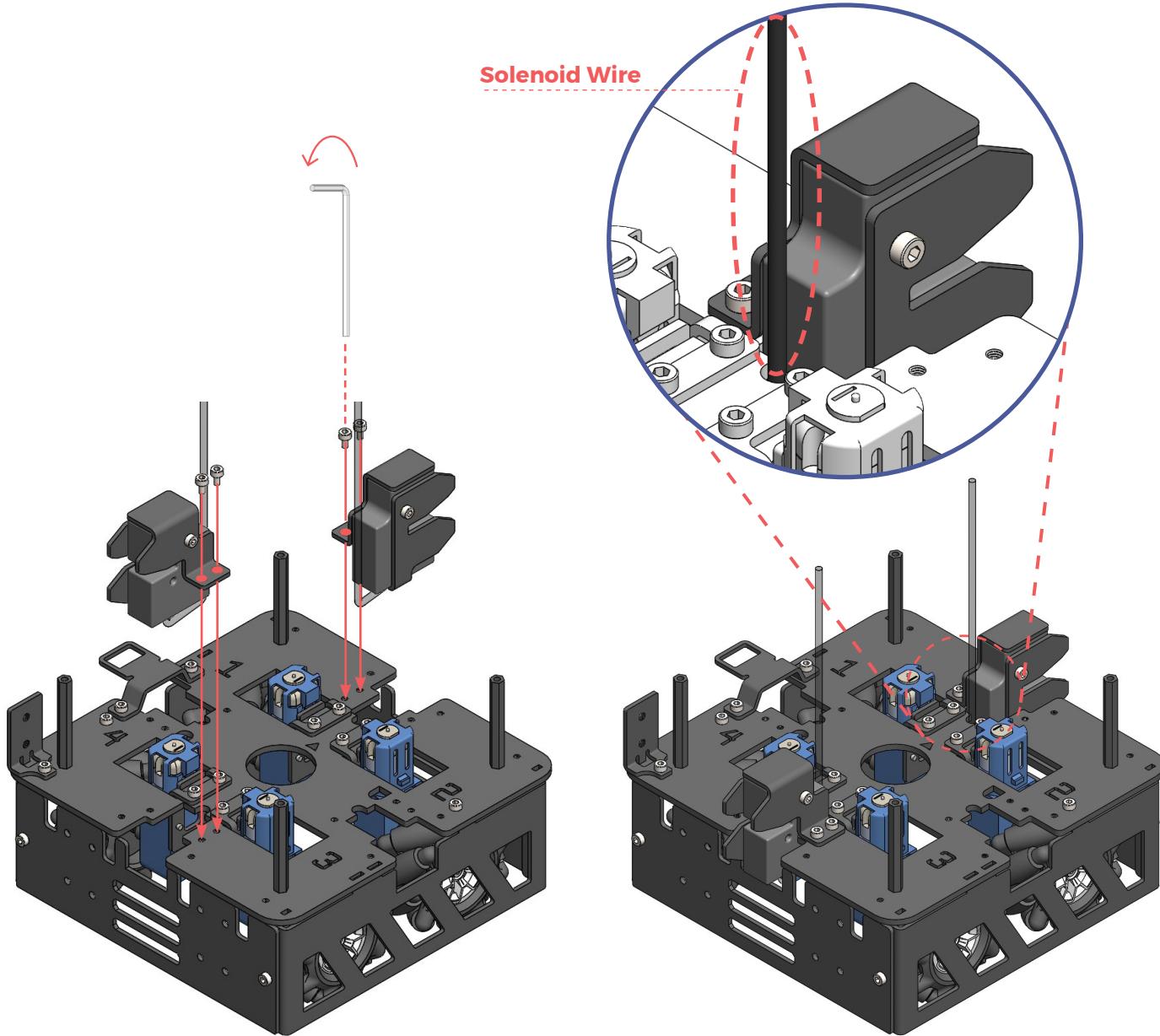


## A 4 (module 1 mechanical sub-assembly)

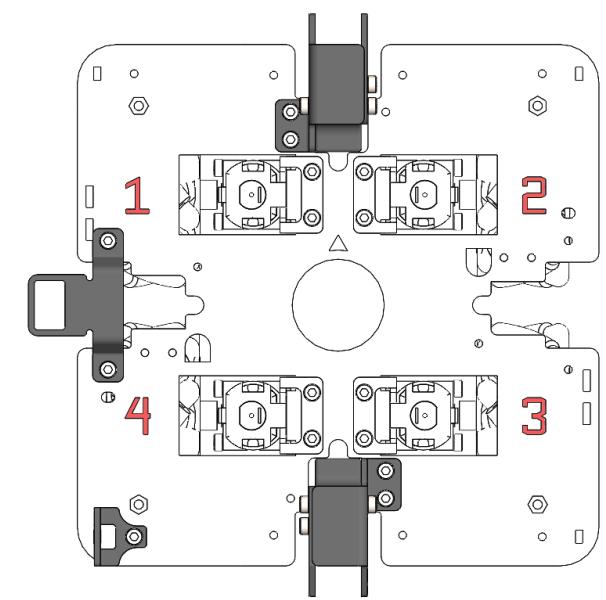
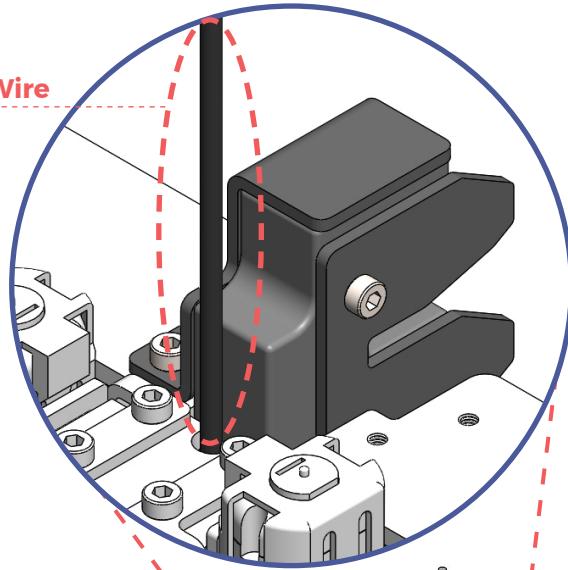


Pay attention to the numbers  
and their positions in relation  
to the parts being attached.

Module 1

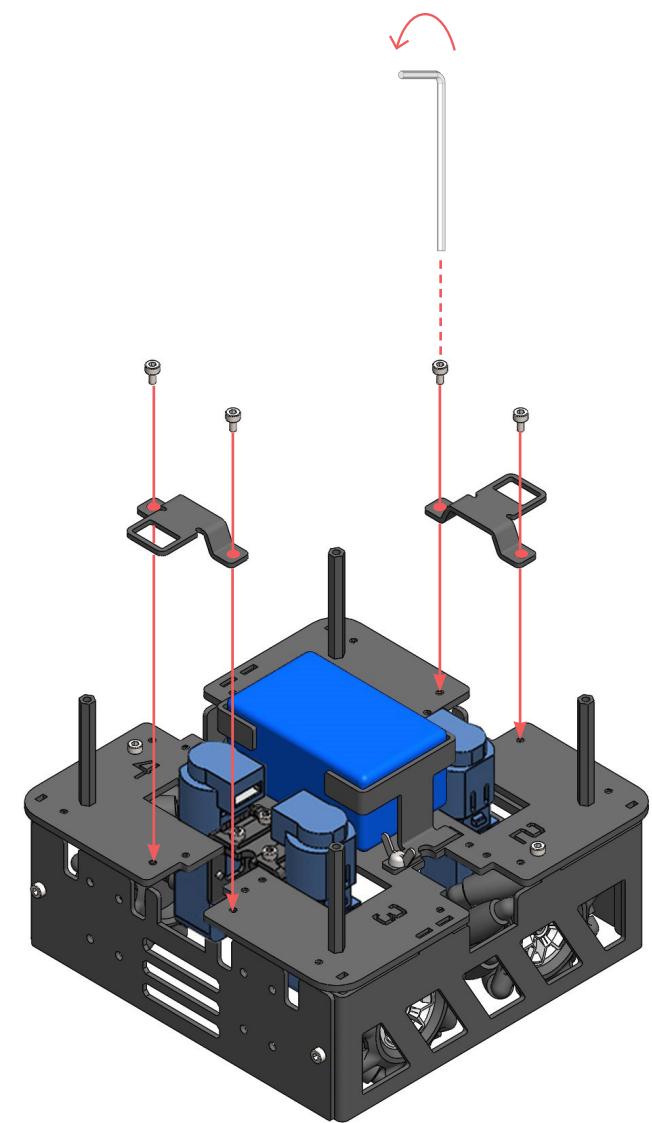
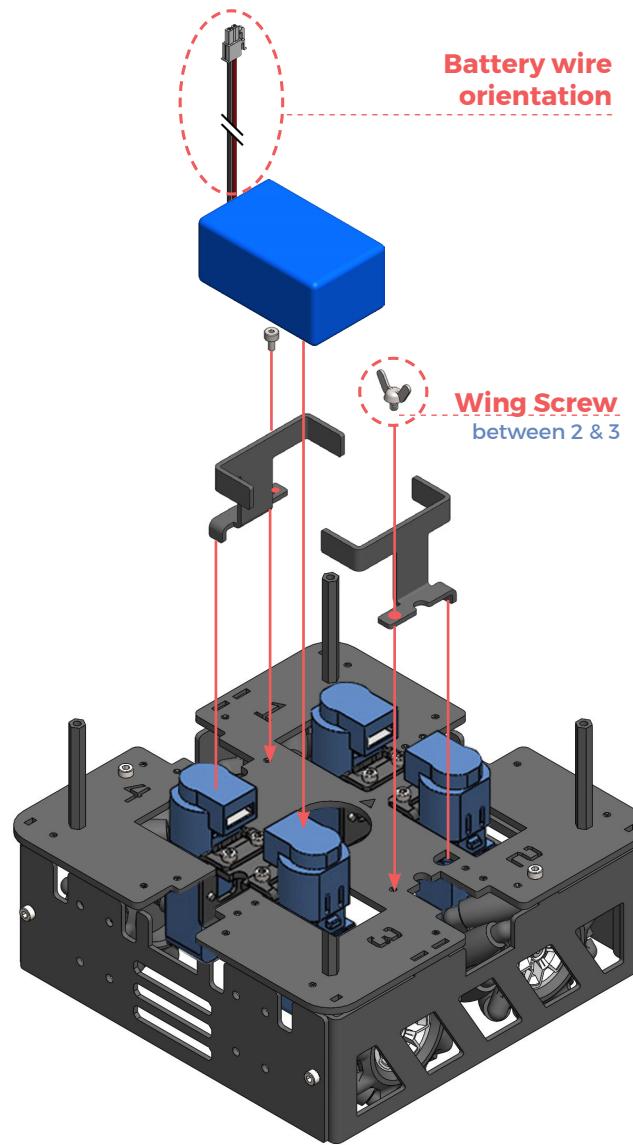
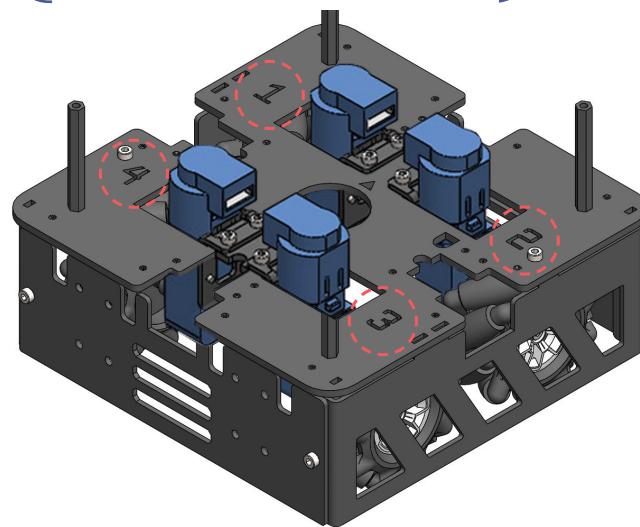
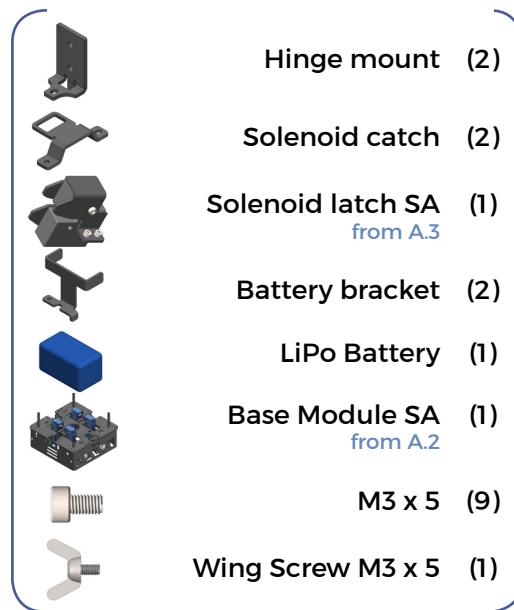


Check that the parts have been attached in the right location, in relation to the numbers.



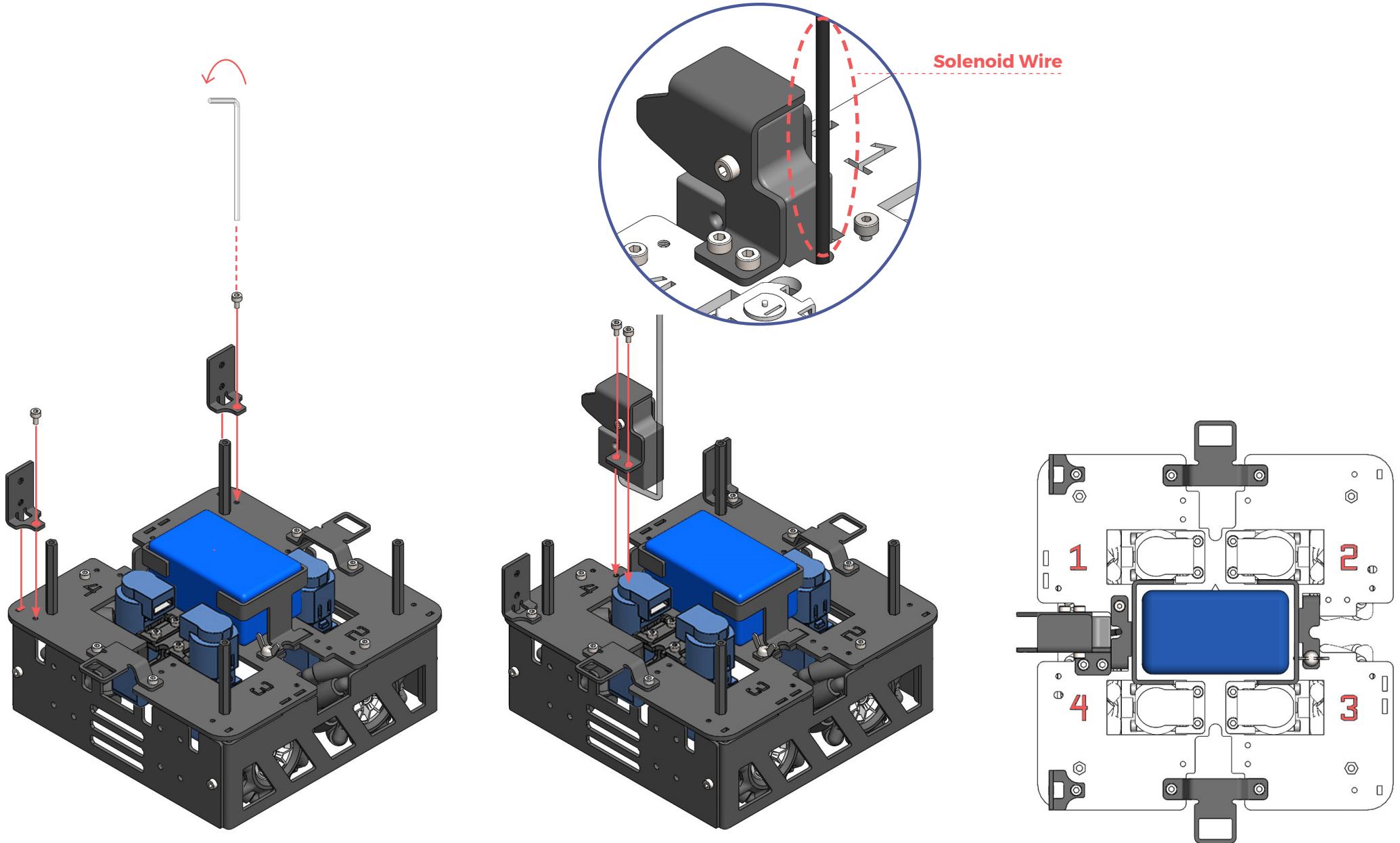
# Module 1

# A5 (module 2 mechanical sub-assembly)



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

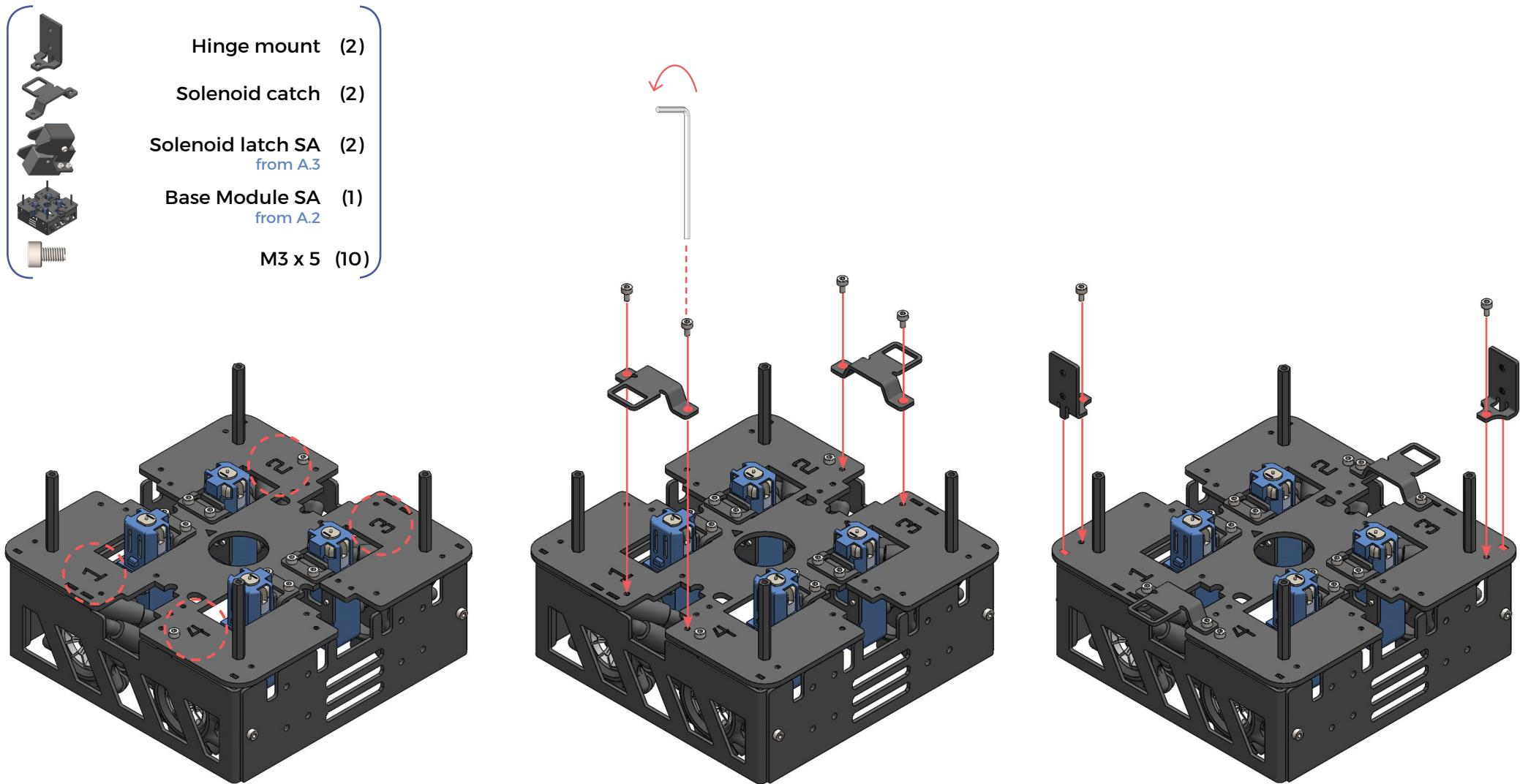
## Module 2



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

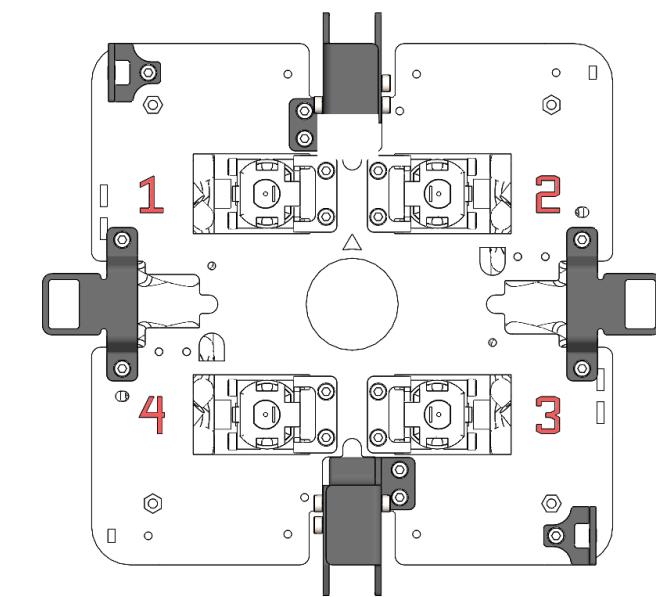
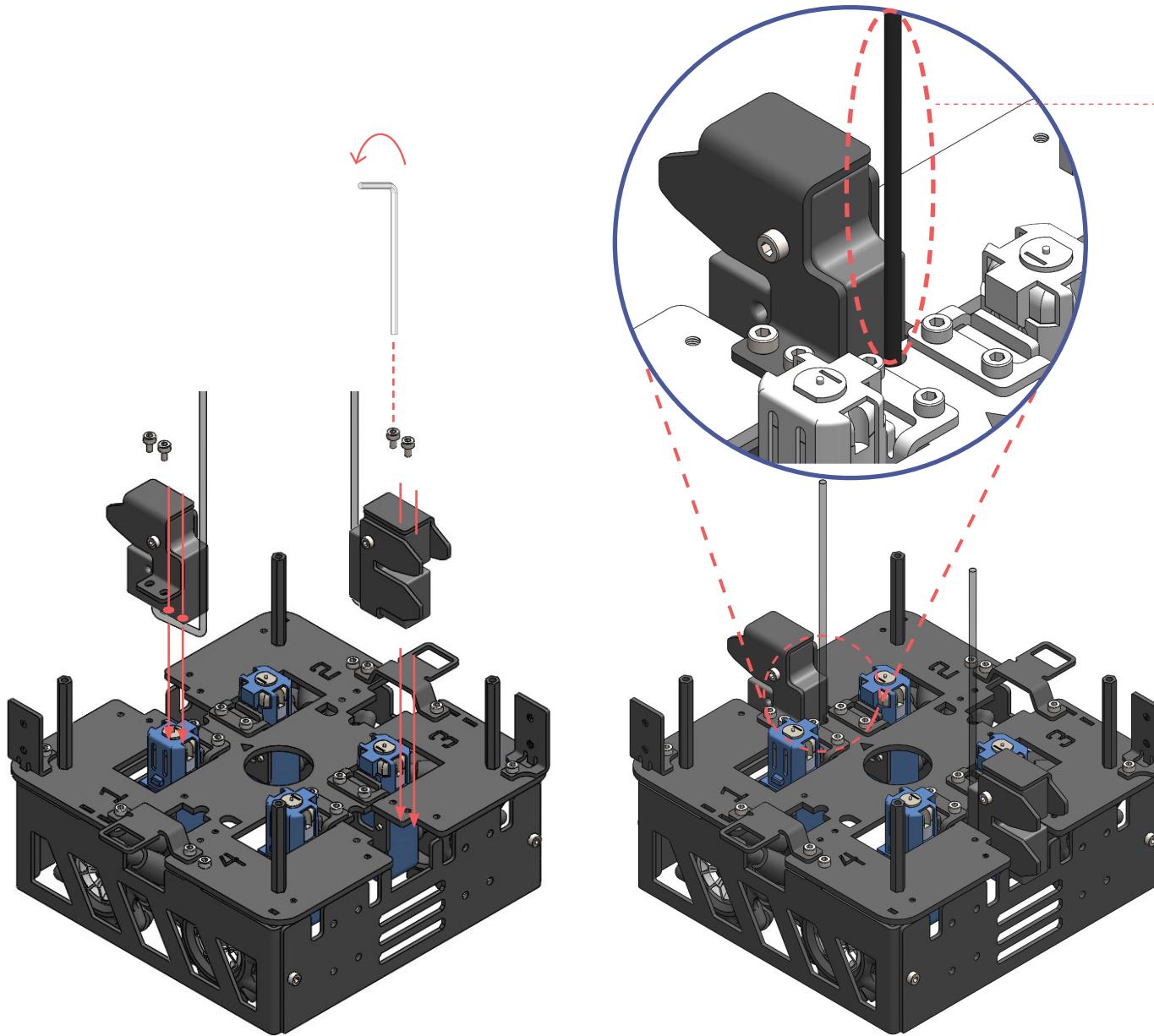
## Module 2

# A6 (module 3 mechanical sub-assembly)



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

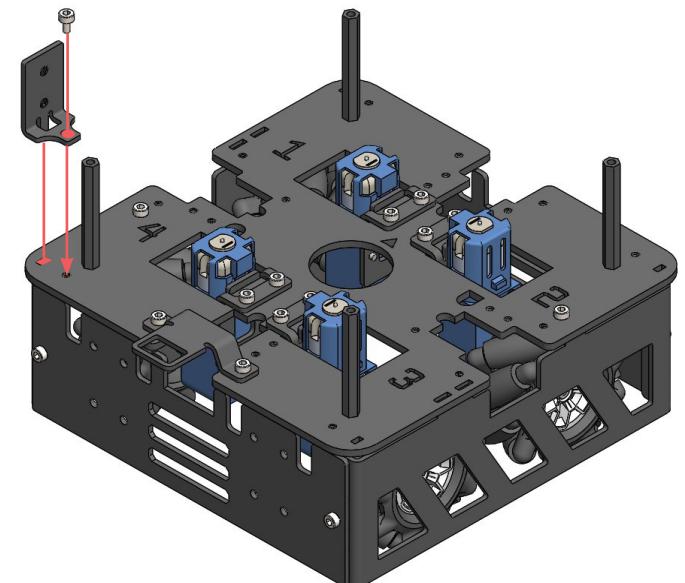
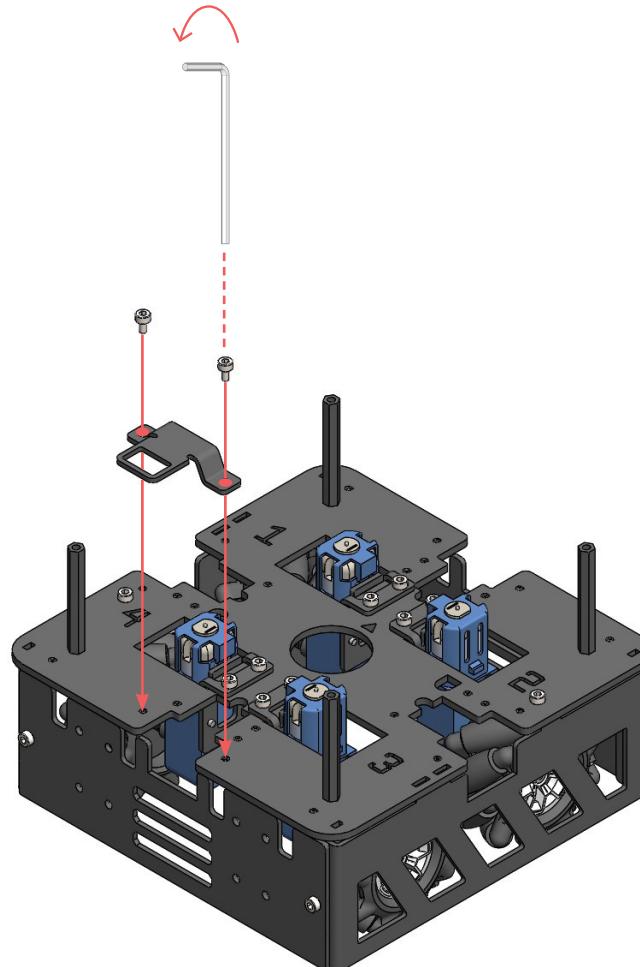
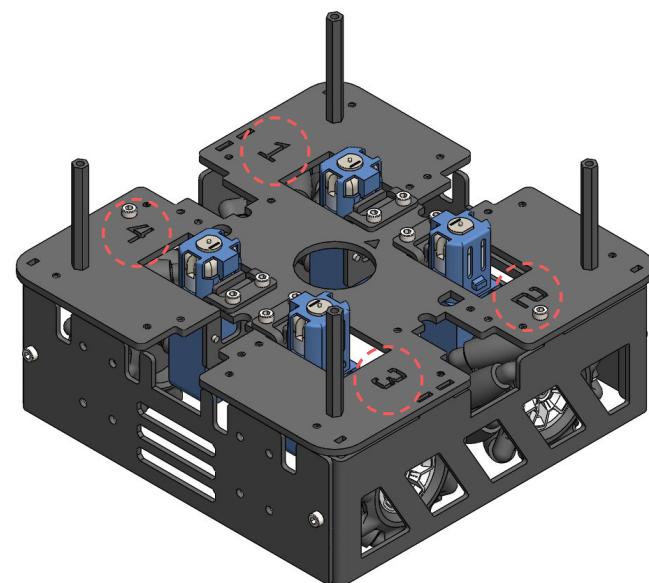
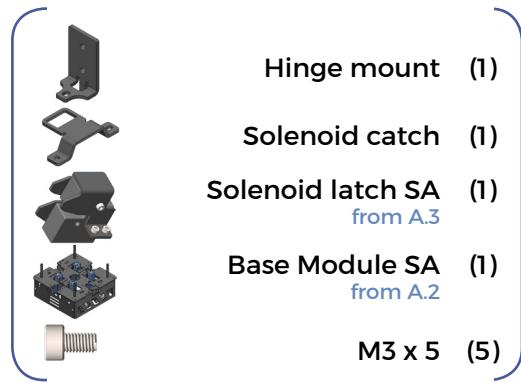
Module 3



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

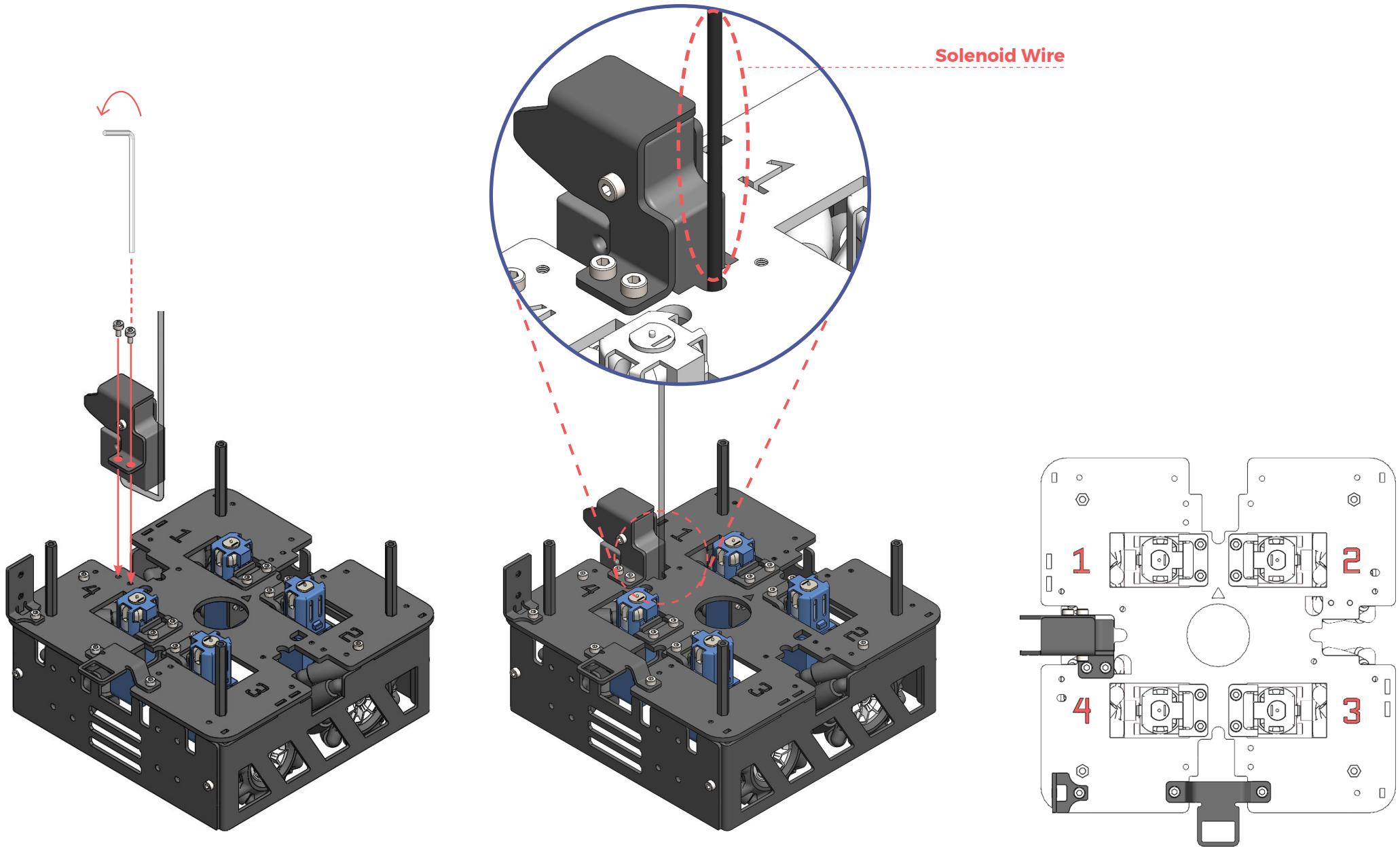
## Module 3

# A7 (module 4 mechanical sub-assembly)



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

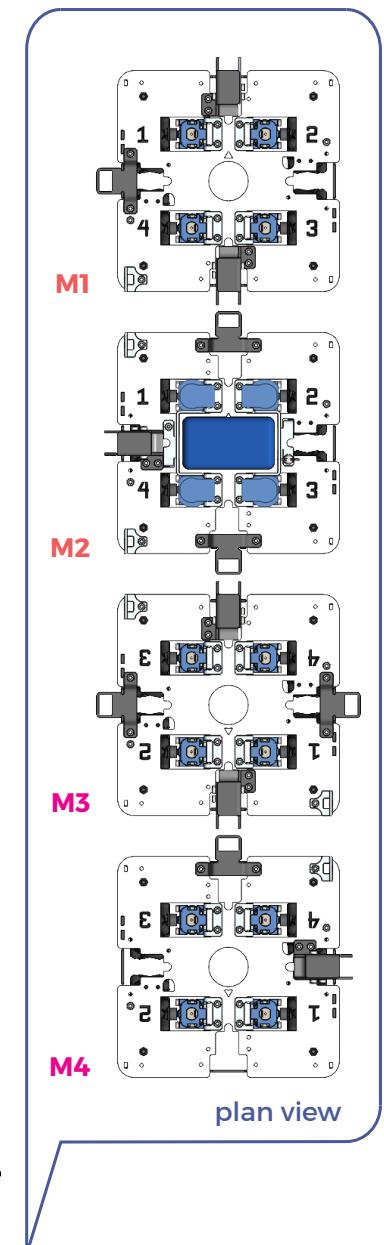
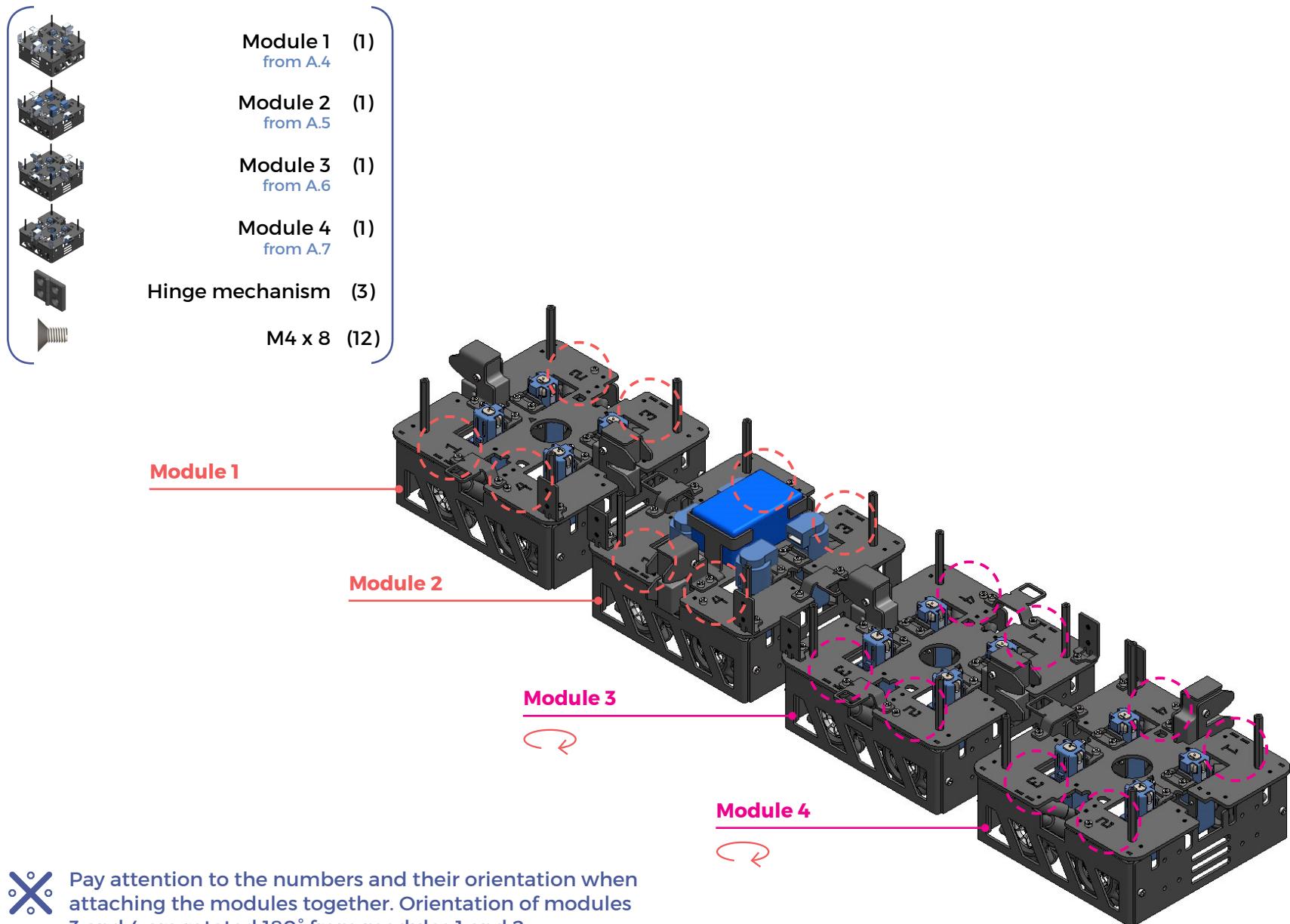
Module 4



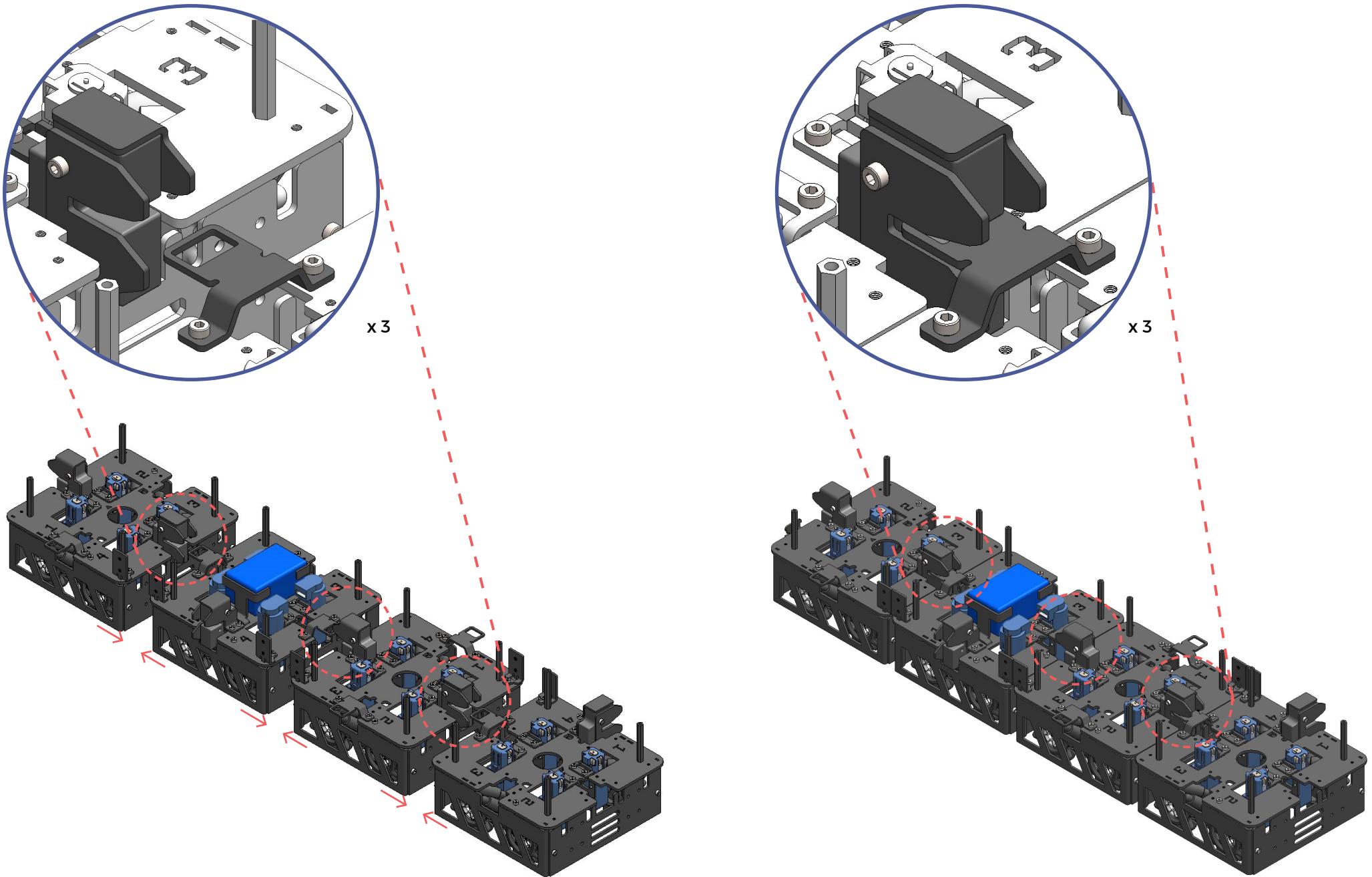
 Check that the parts have been attached in the right location.

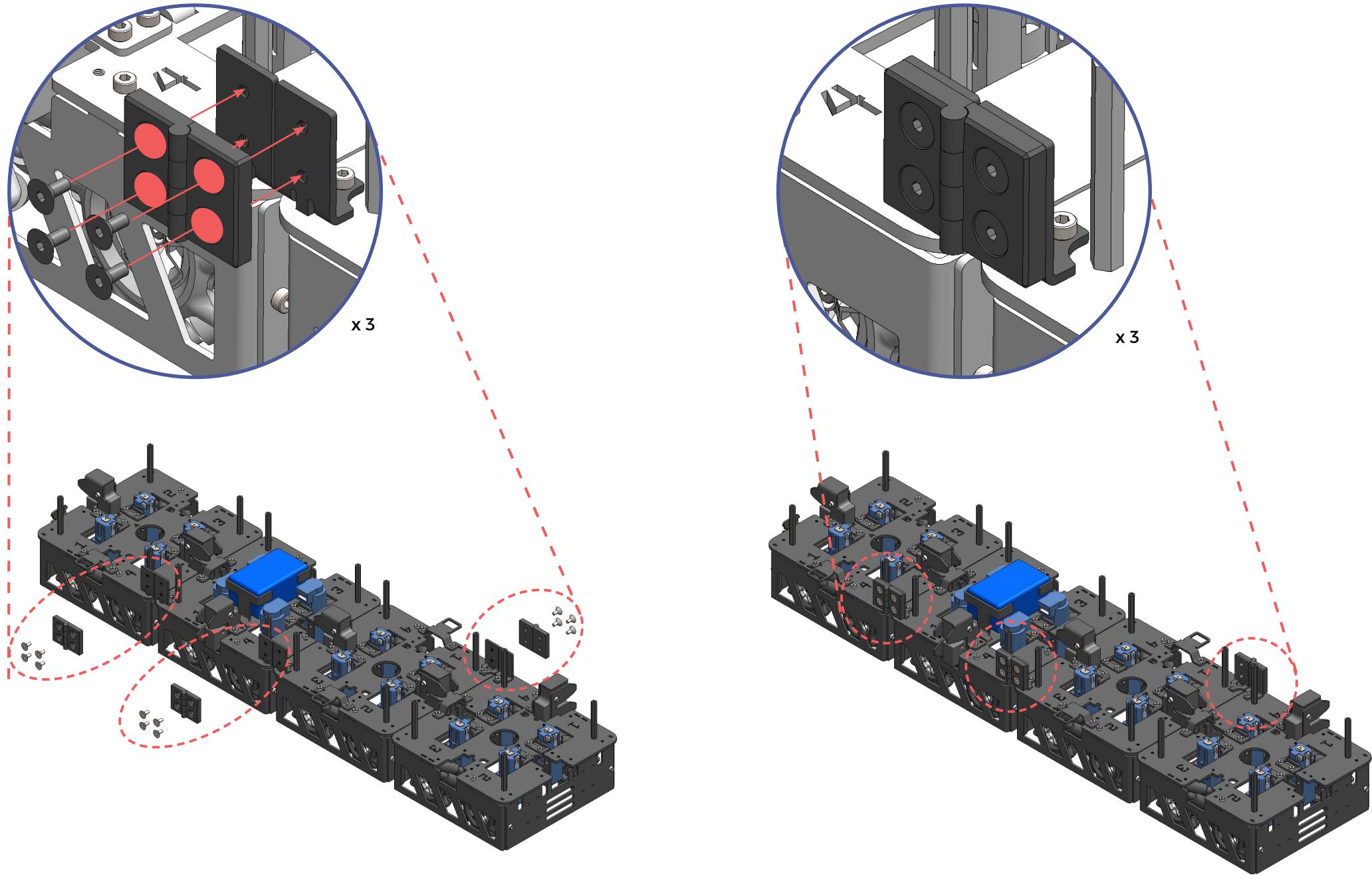
## Module 4

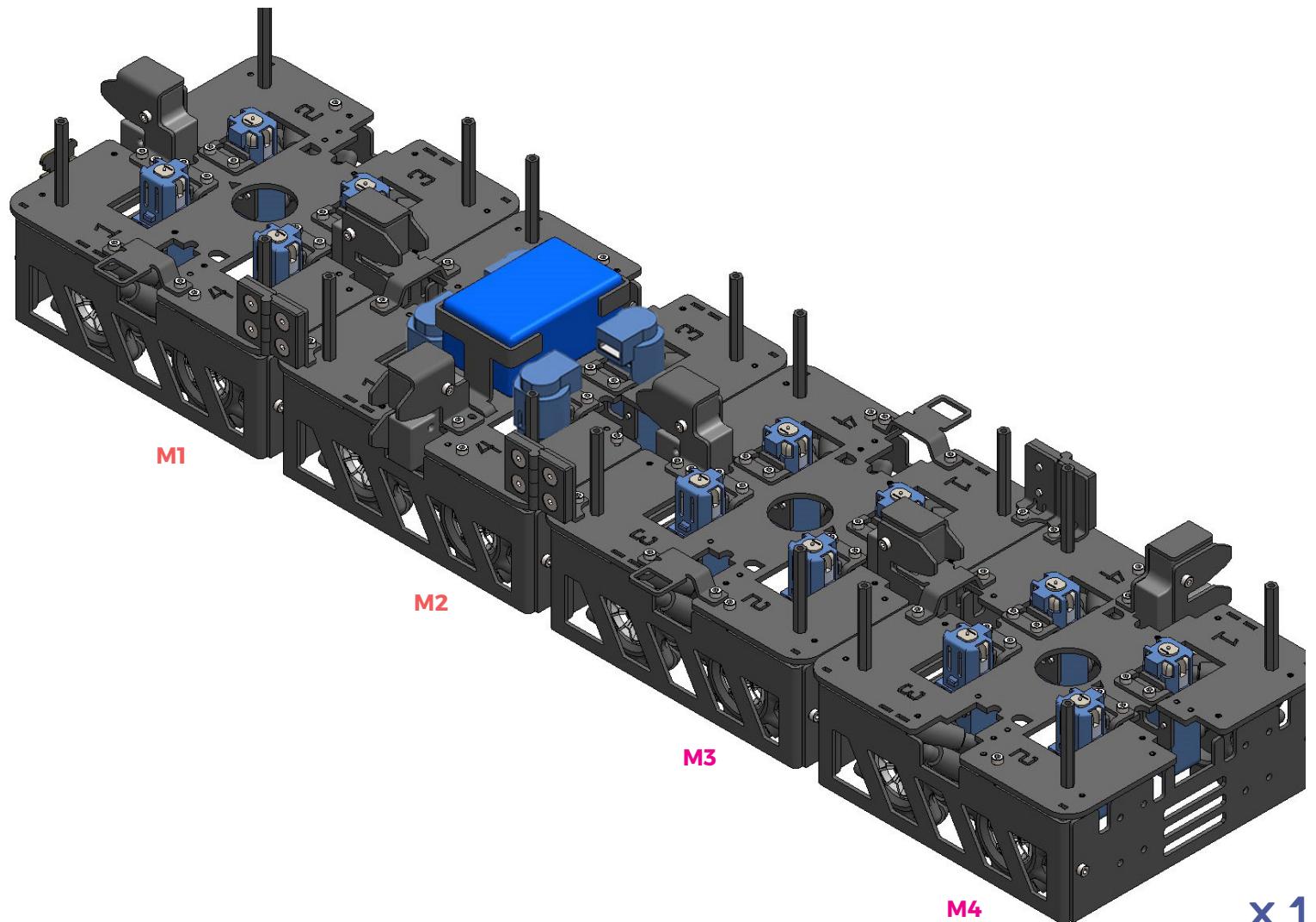
# A8 (full mechanical assembly)



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.





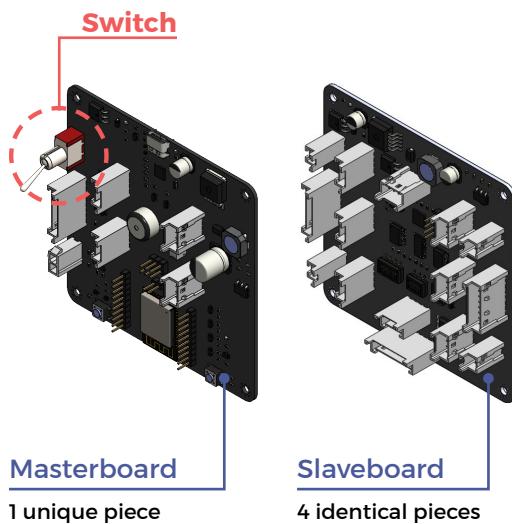


Check all the positions of solenoids, solenoid catches, hinge mounts before proceeding to section B.

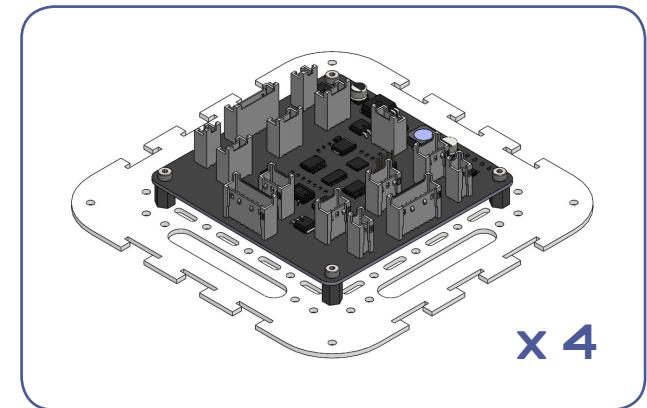
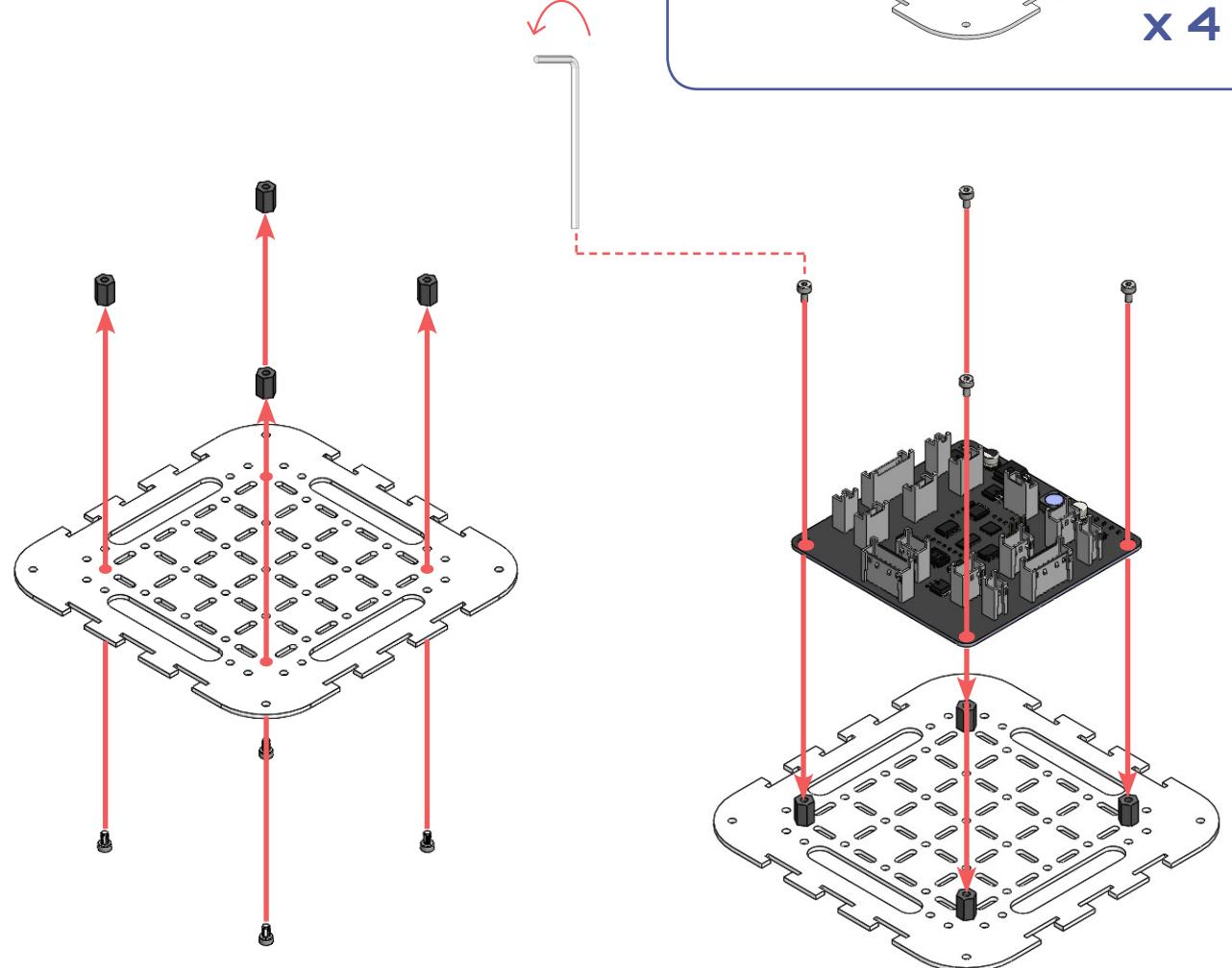


mechanical assembly completed

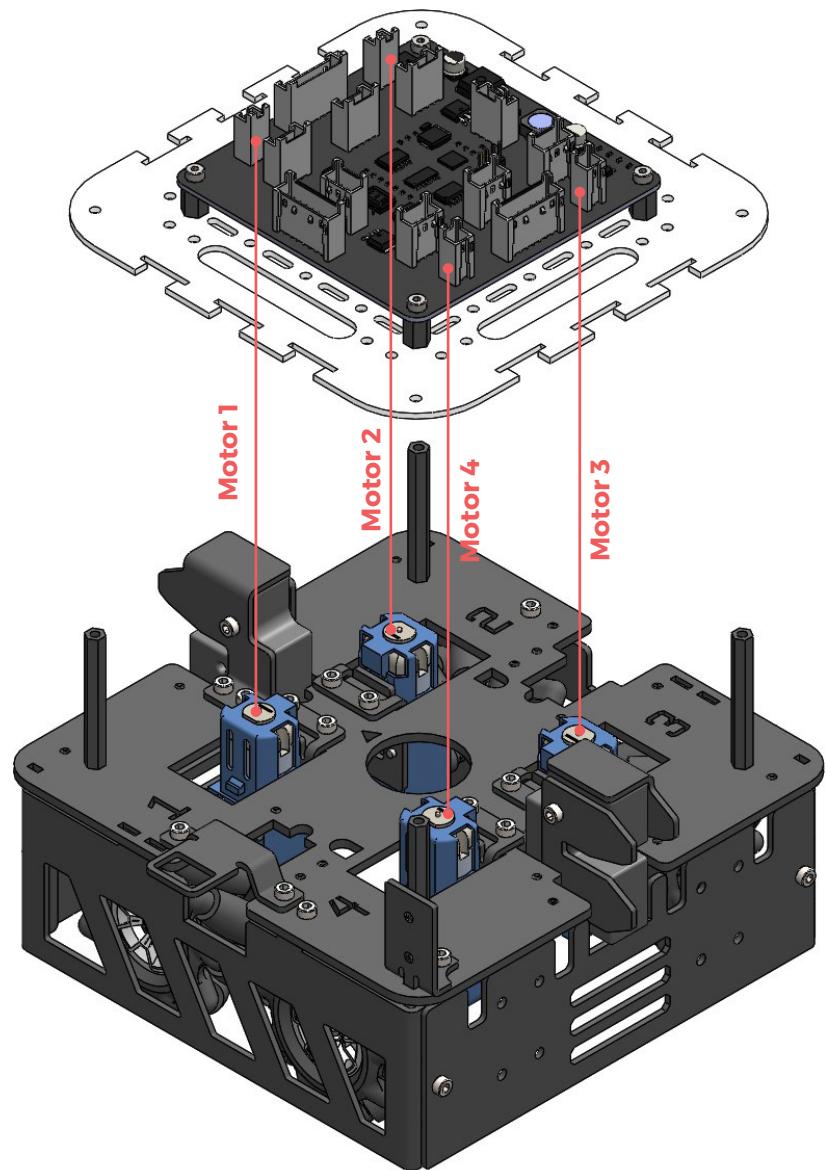
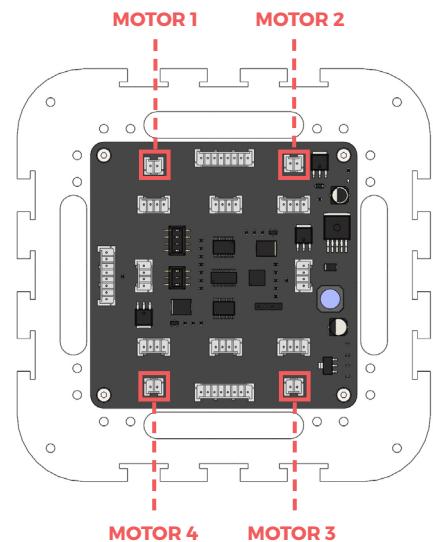
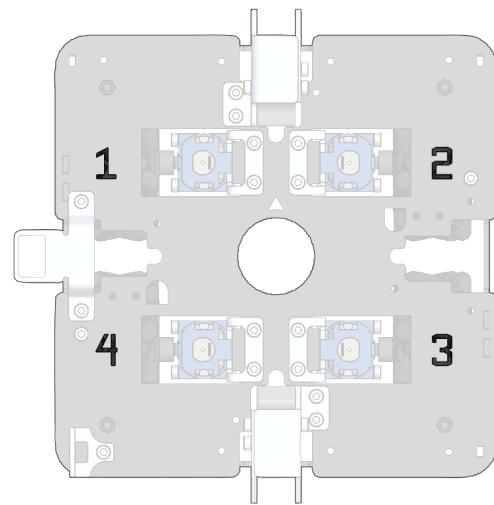
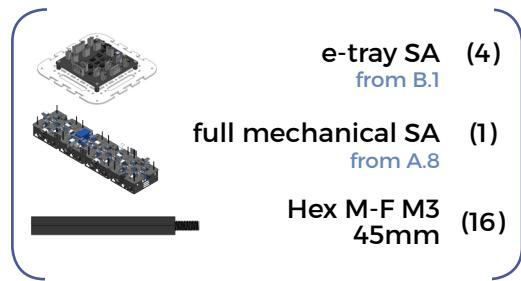
## B 1 (e-tray sub-assembly)



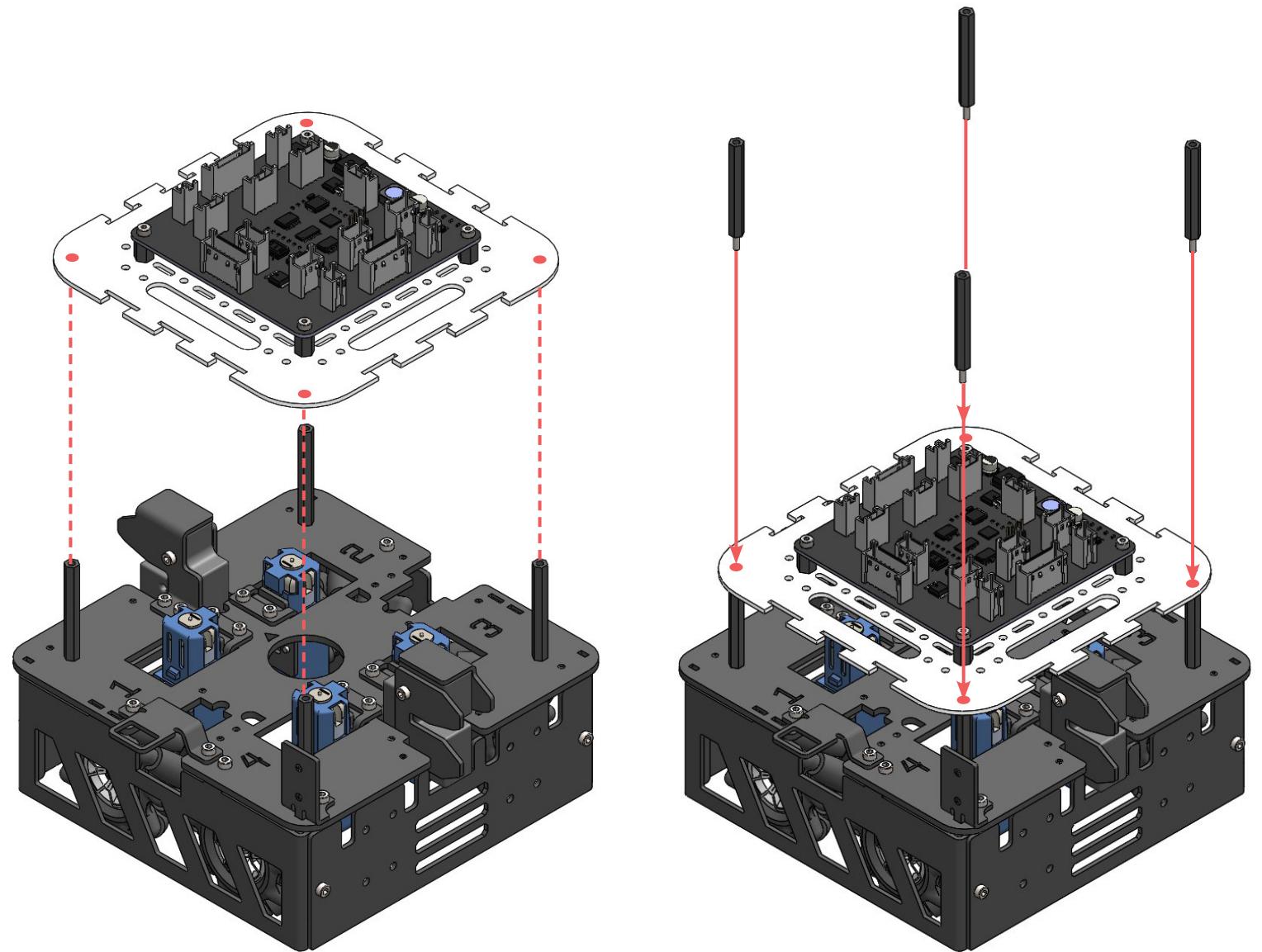
- ✖ Make sure that you are attaching the slaveboards and not the masterboard.
- ✖ How to differentiate between masterboard and slaveboards:
  - Masterboard has a special switch



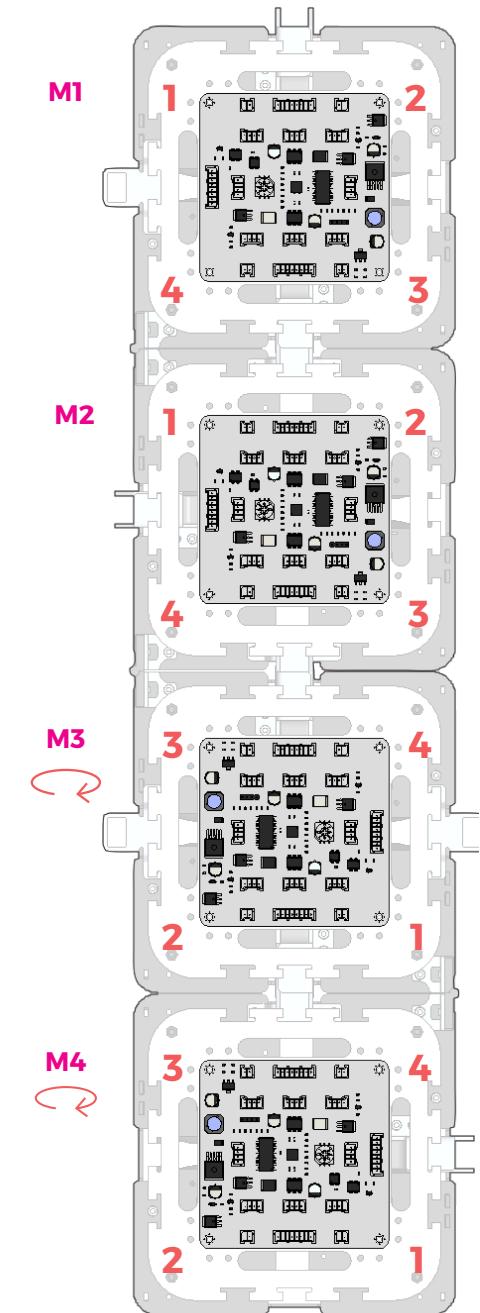
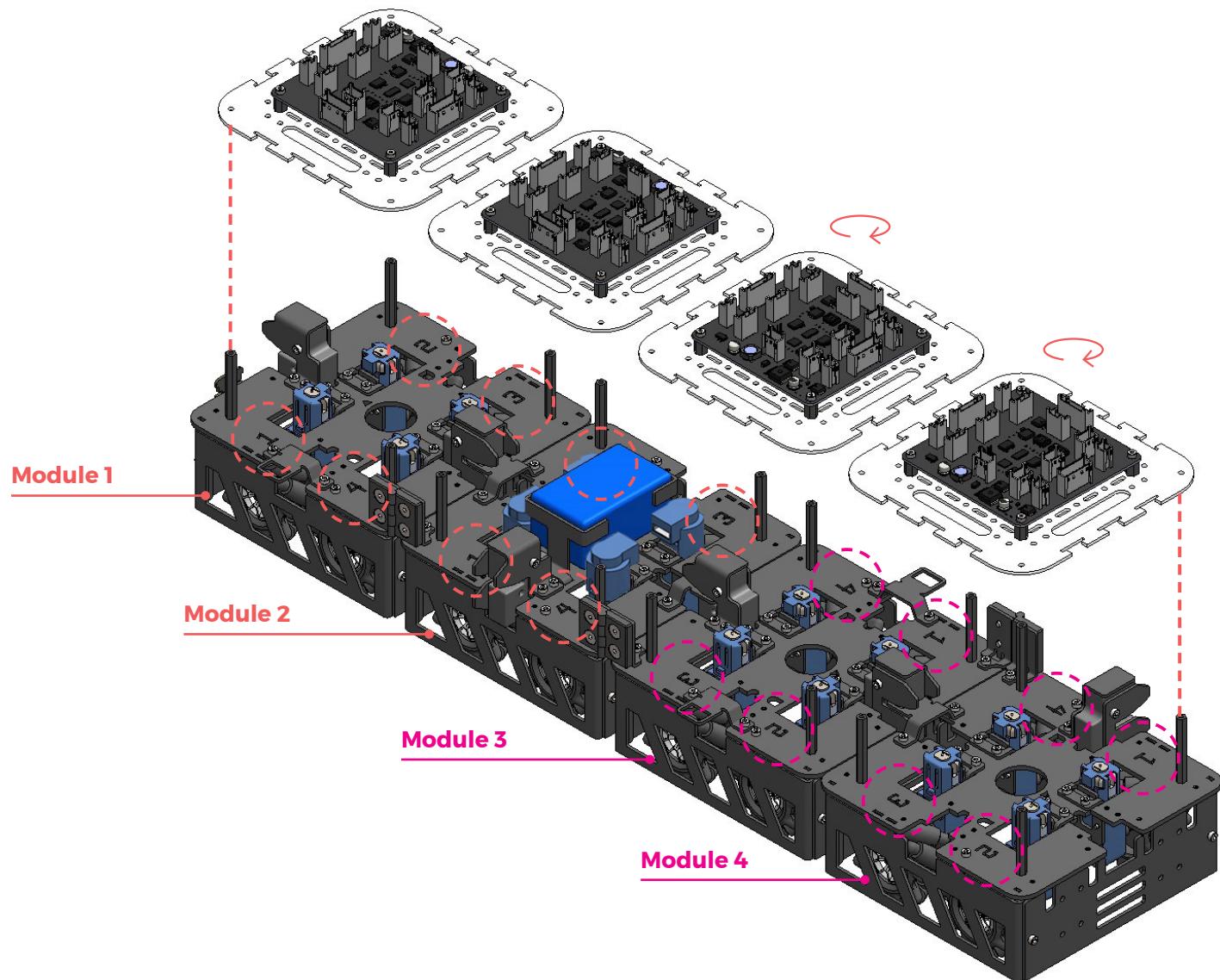
## B2 (e-tray onto mechanical assembly)



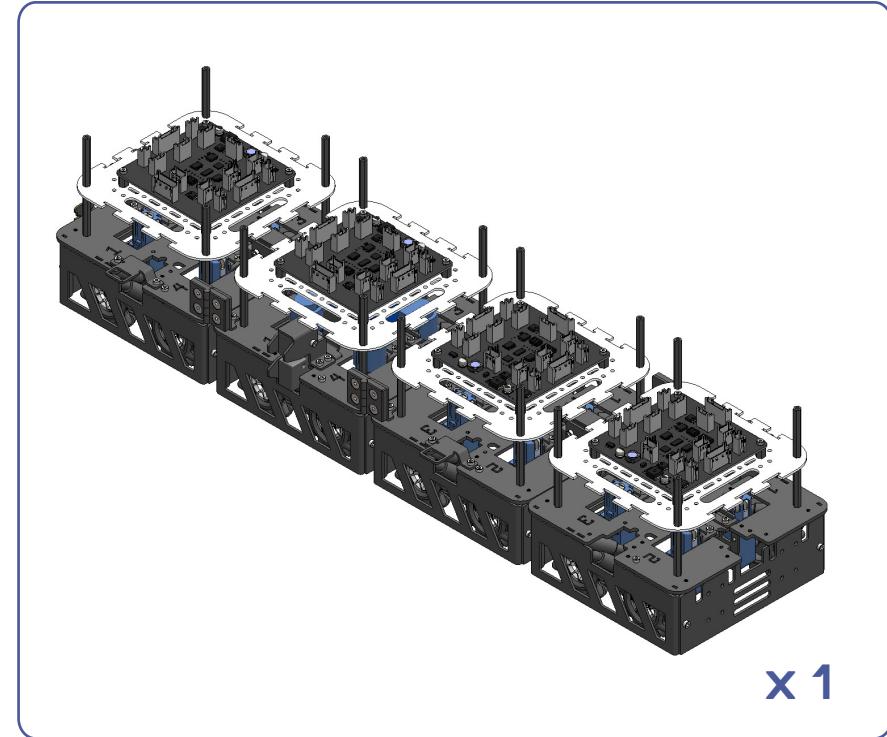
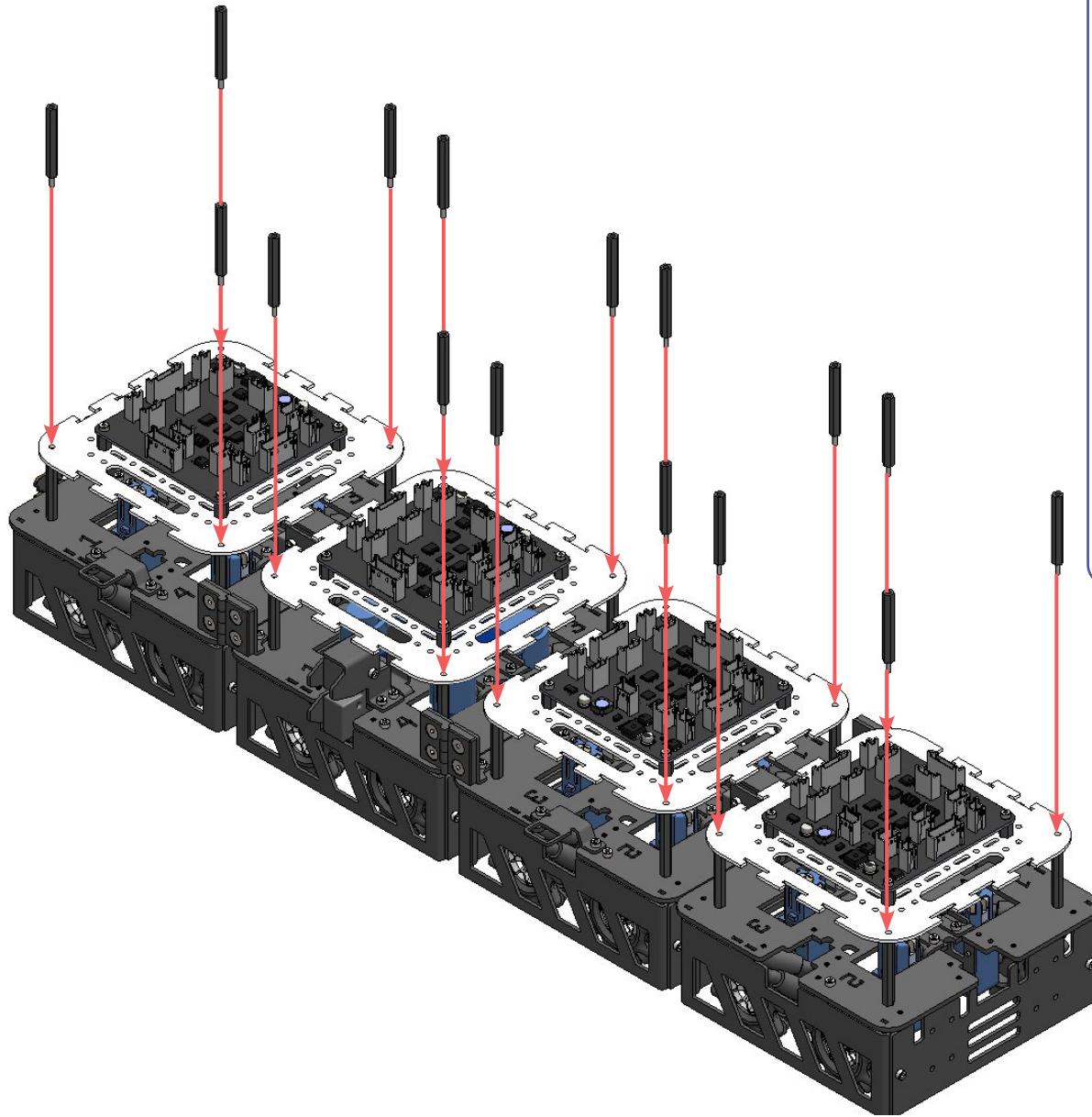
Orientate e-tray SA and base module as shown on the right.  
Motor 1 connector on e-tray should be on top of Motor 1 of base module.  
Same goes for Motor 2, 3 and 4.



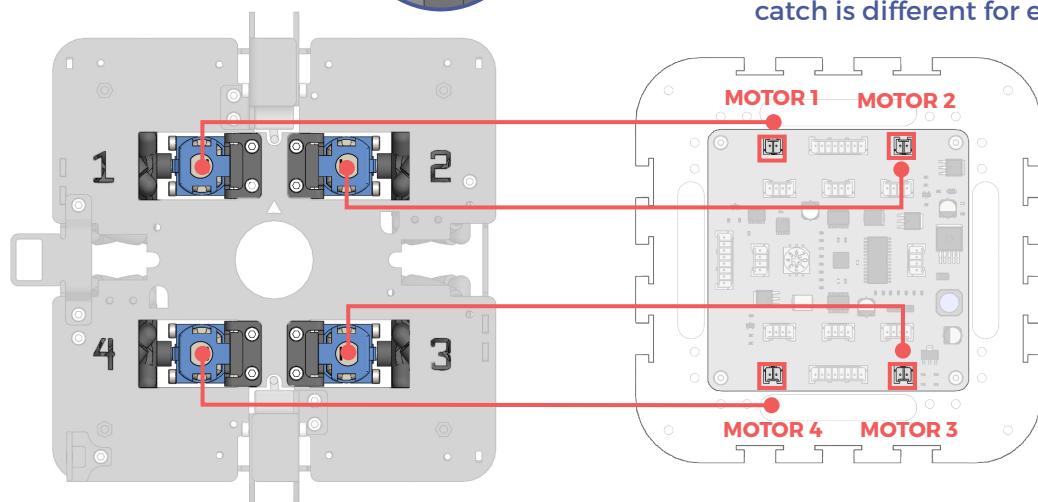
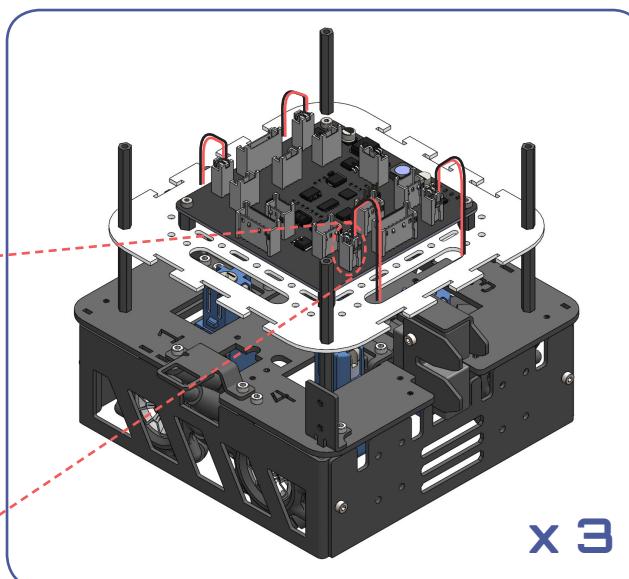
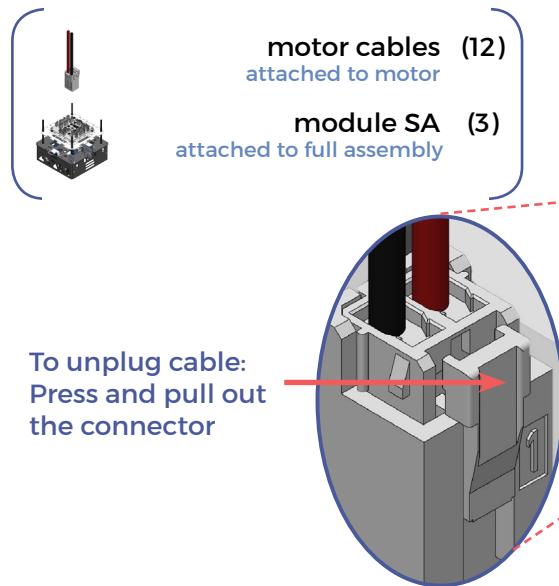
Before attaching the e-tray SA, please flip all the cables and connectors for motors and solenoids (not shown in diagram for clarity) out, for easy attachment later on.



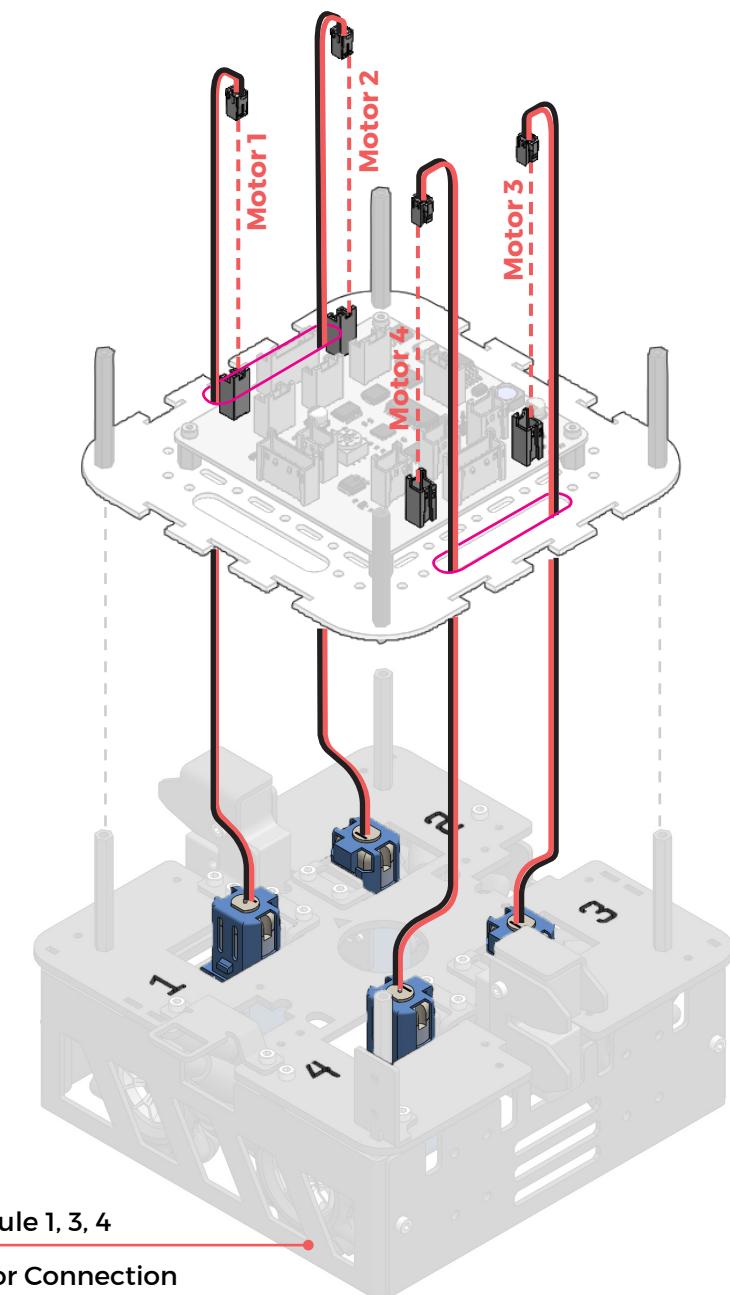
Orientation of modules 3 and 4 are rotated 180° from modules 1 and 2. Therefore, make sure that the e-tray SAs for module 3 and 4 are also rotated 180° to correspond to the motor orientation as numbered.



## B3 (all module motor cable connection)

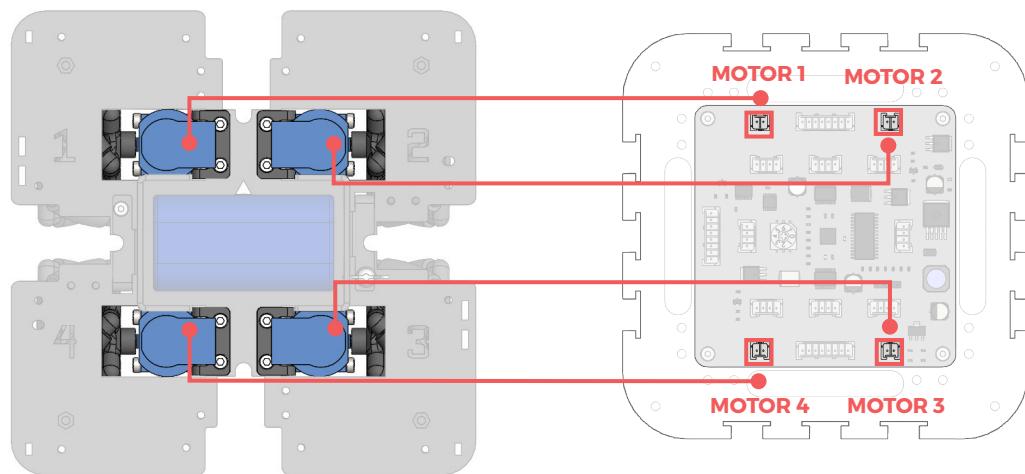
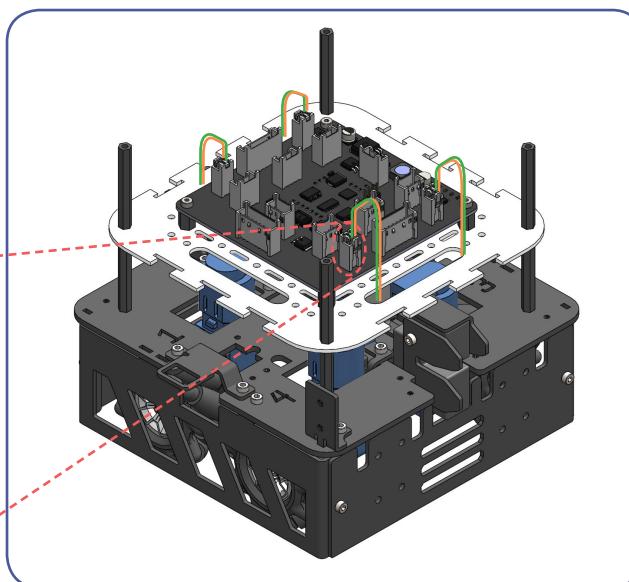
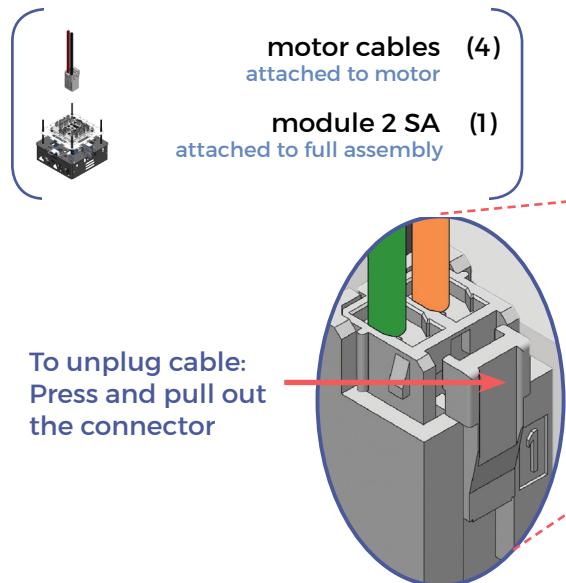


Make sure that Motor 1 is connected to Motor 1 connector on Slaveboard; the same goes for Motor 2, 3 and 4.

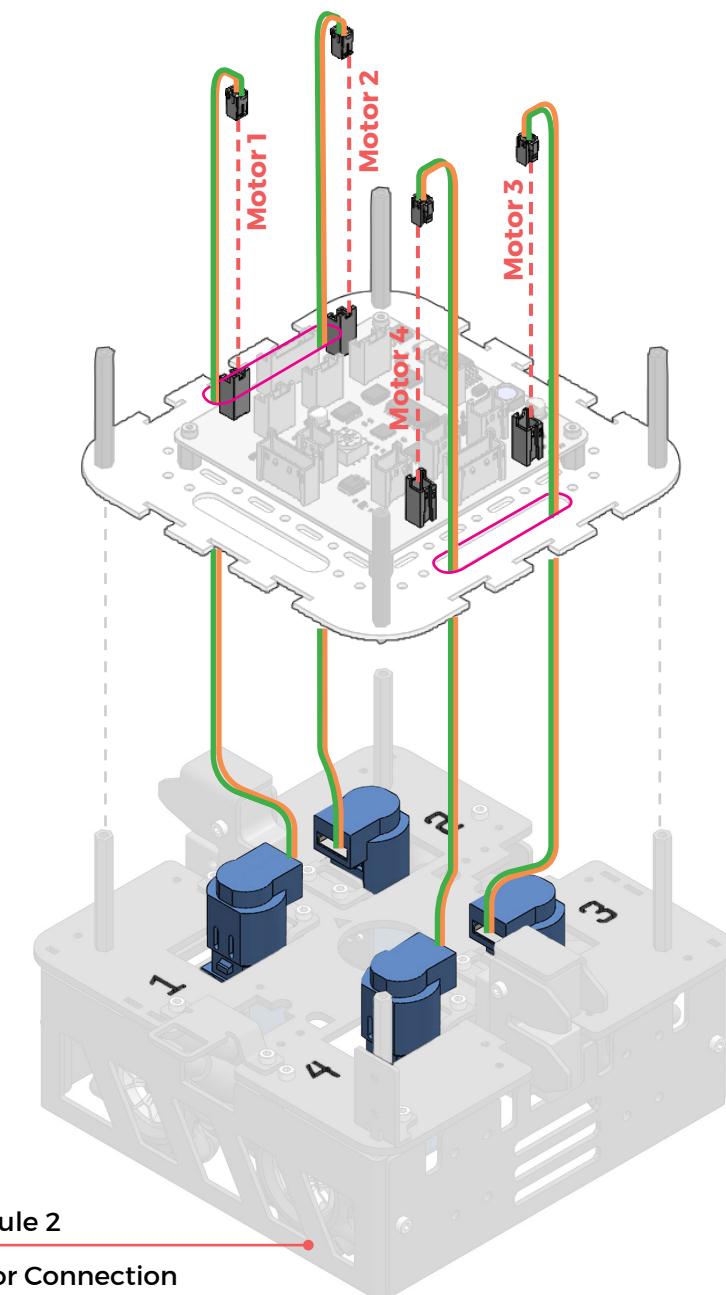


# Module 1, 3, 4

## B3 (all module motor cable connection)

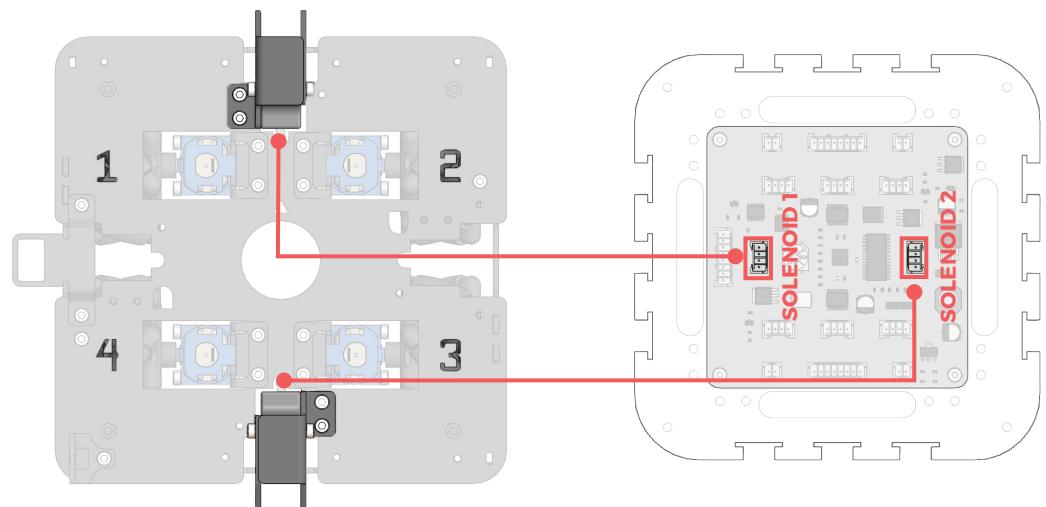
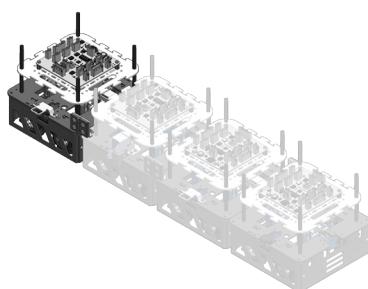


Make sure that Motor 1 is connected to Motor 1 connector on Slaveboard; the same goes for Motor 2, 3 and 4.

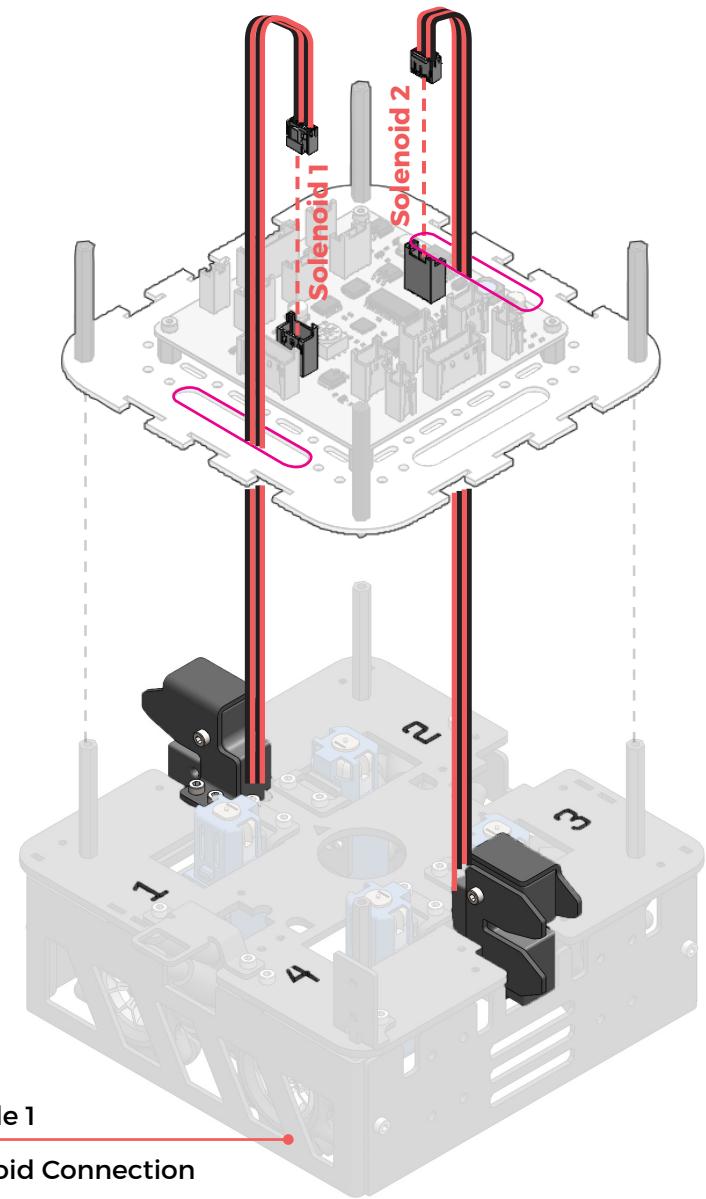


# Module 2

## B 4 (module 1 solenoid cable connection)



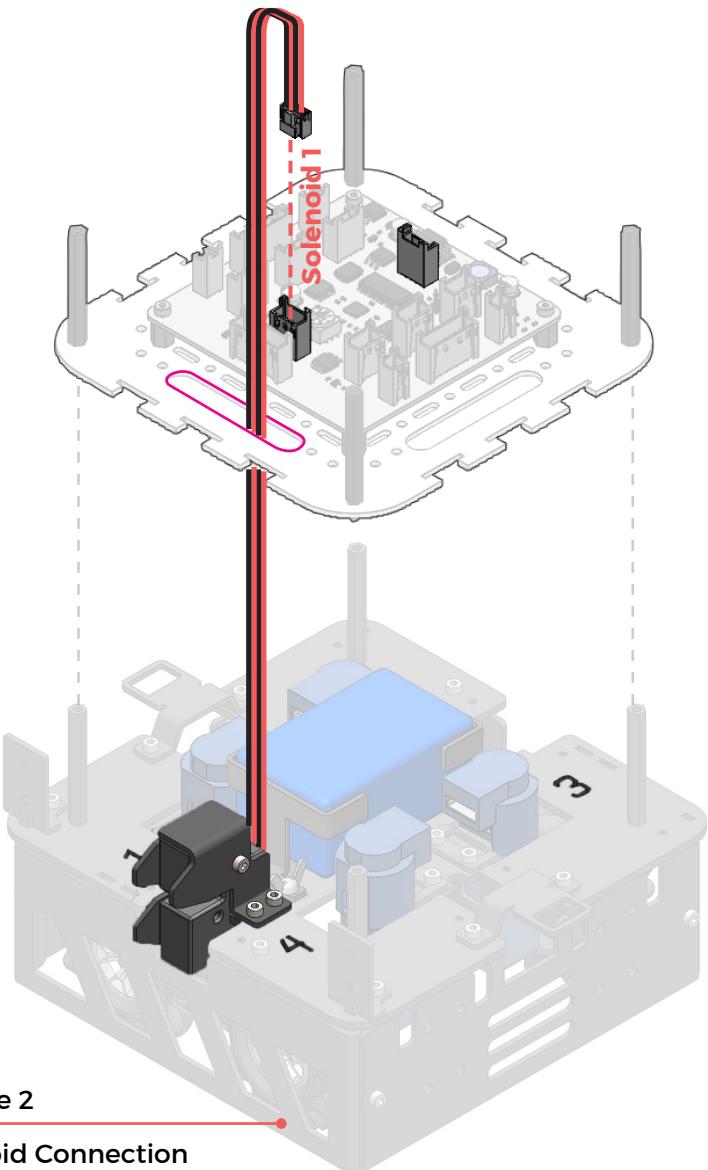
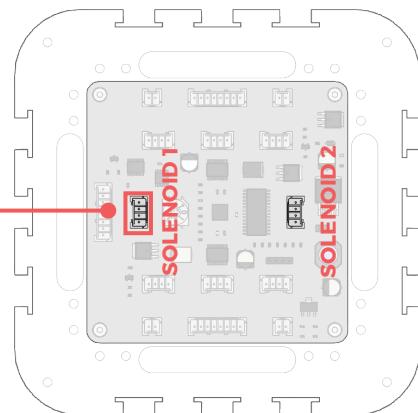
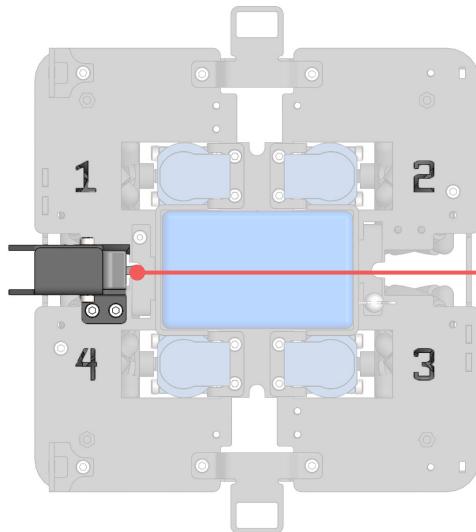
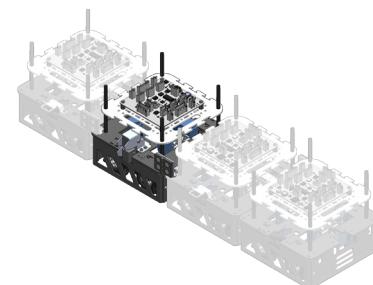
Make sure to connect the solenoid to the labelled solenoid connector exactly as in the diagram below.



Module 1  
Solenoid Connection

Opening to pass wire through

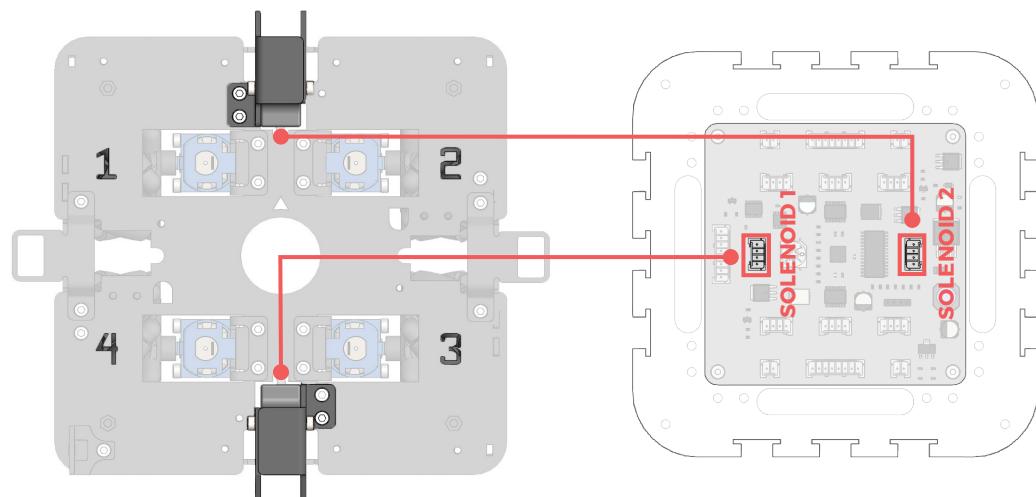
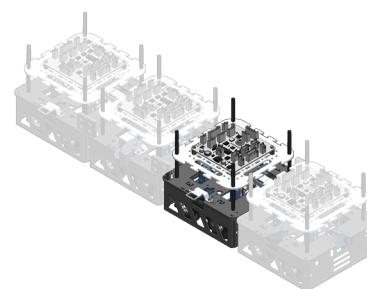
## B5 (module 2 solenoid cable connection)



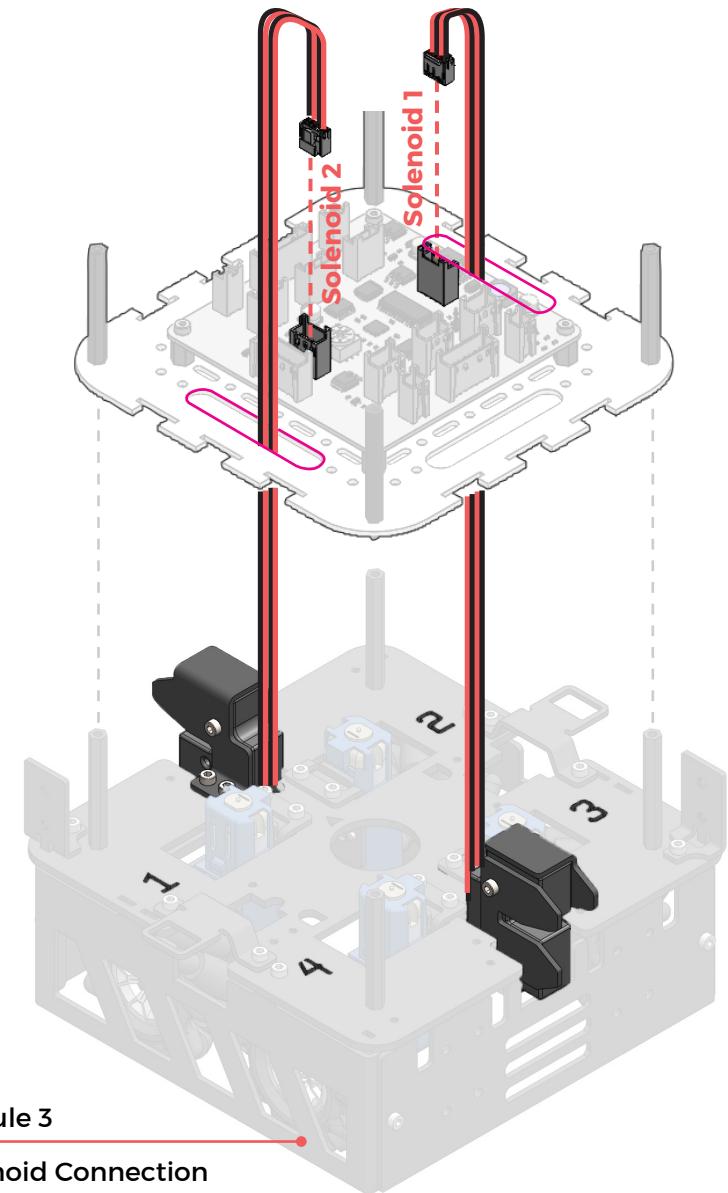
Make sure to connect the solenoid to the labelled solenoid connector exactly as in the diagram below.

Opening to pass wire through

## 86 (module 3 solenoid cable connection)



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

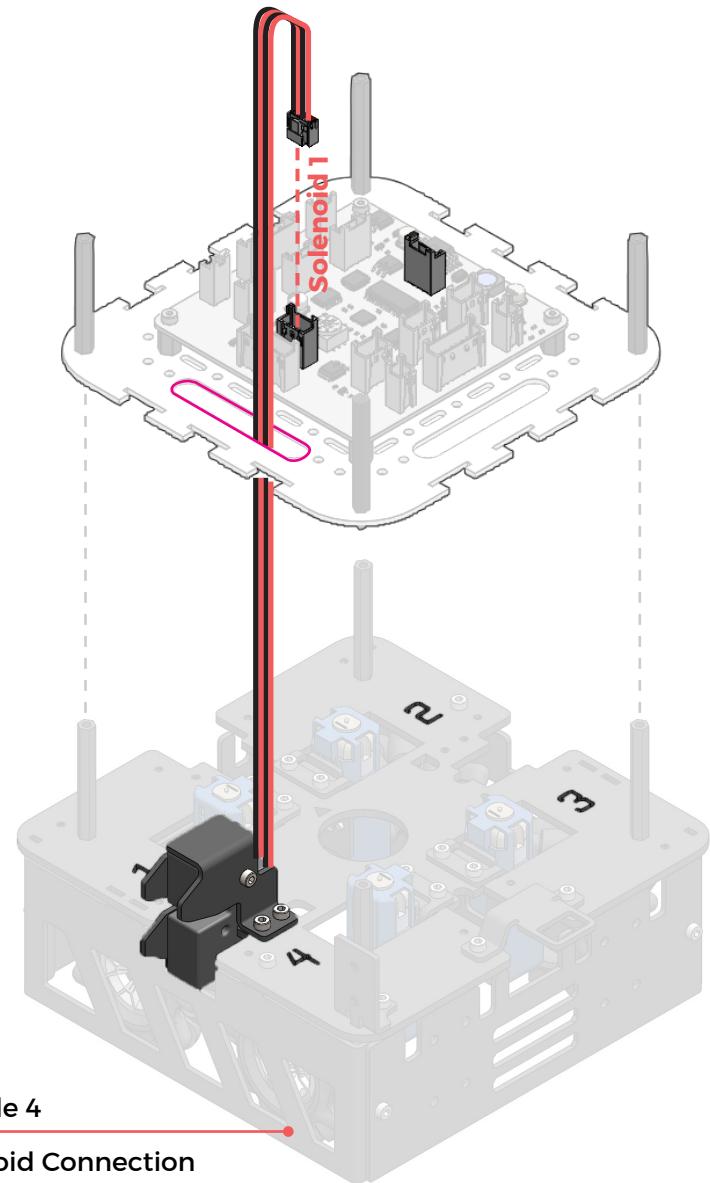
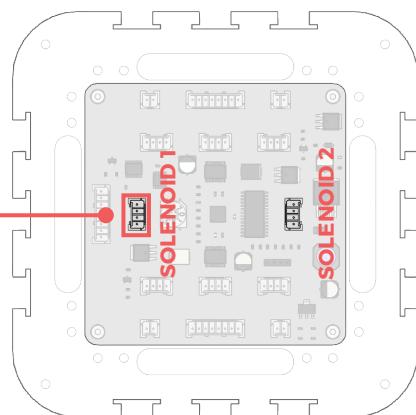
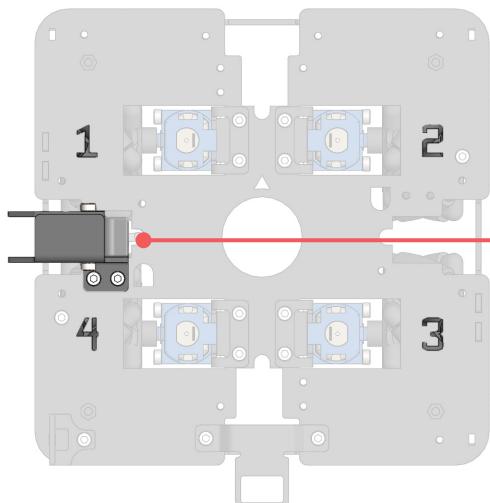
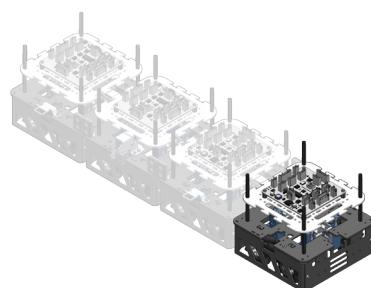


### Module 3

### Solenoid Connection

Opening to pass wire through

## 8 7 (module 4 solenoid cable connection)

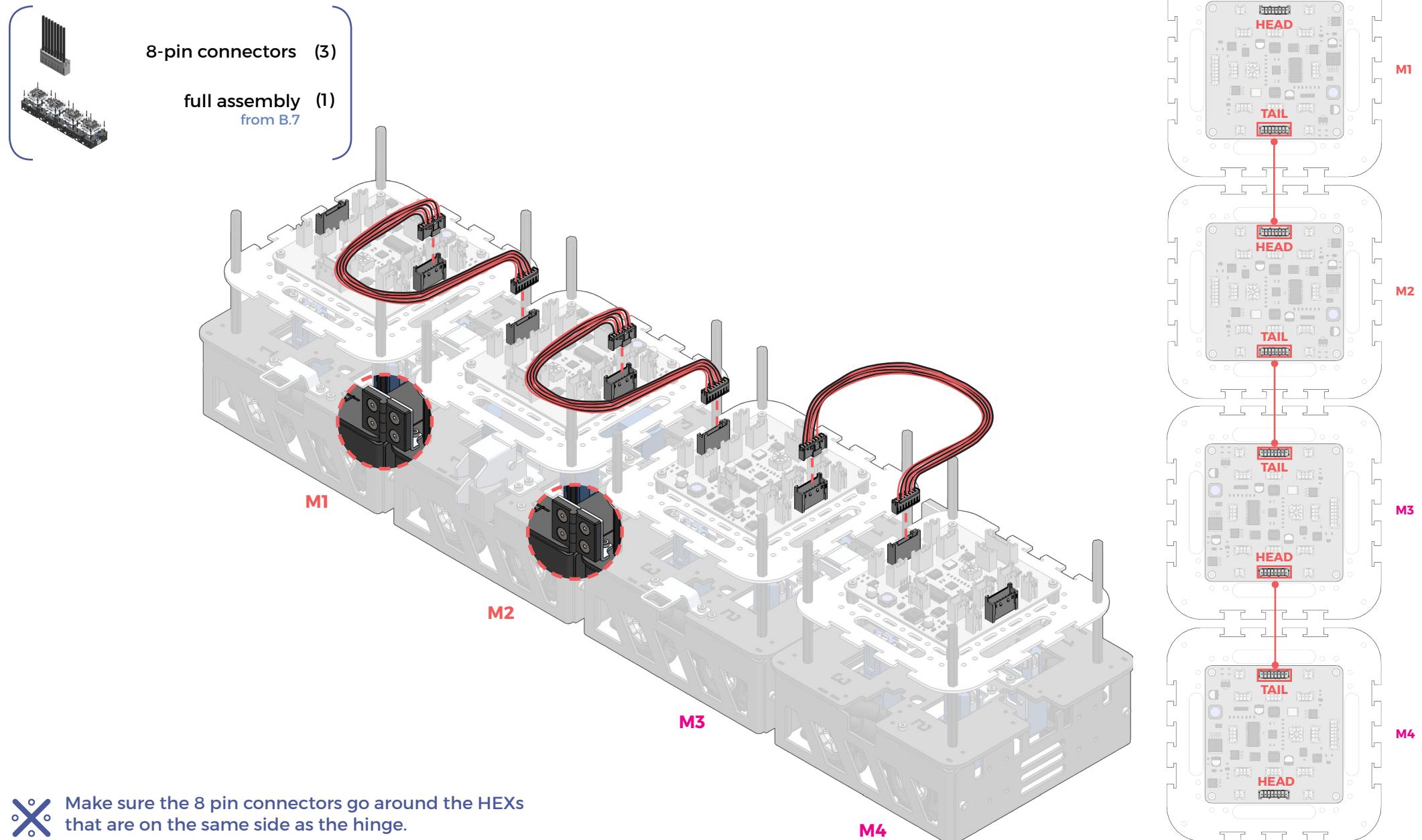


**Module 4**  
**Solenoid Connection**

Opening to pass wire through

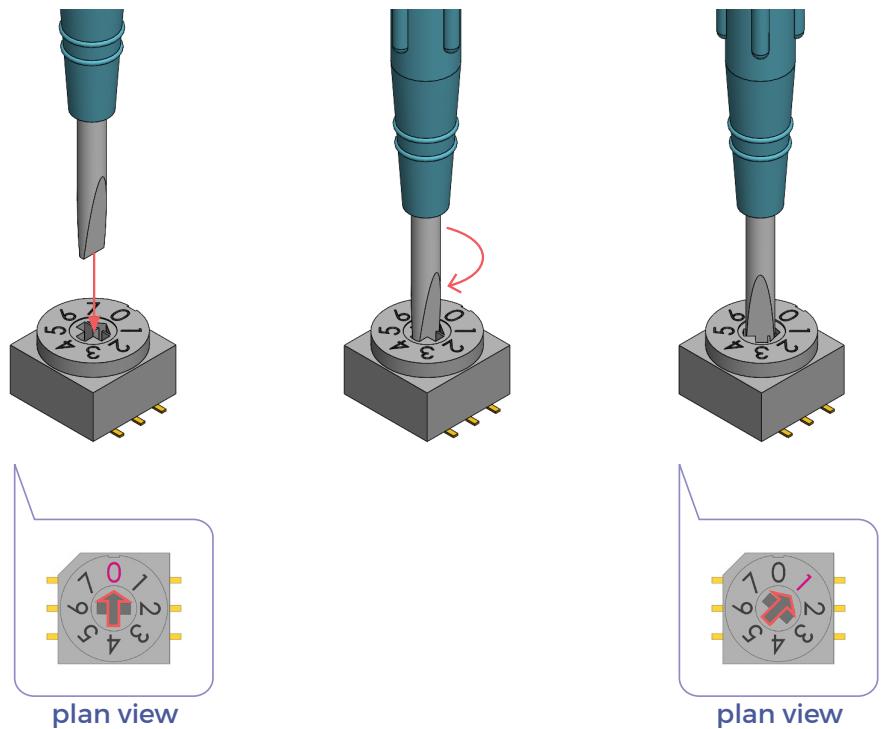
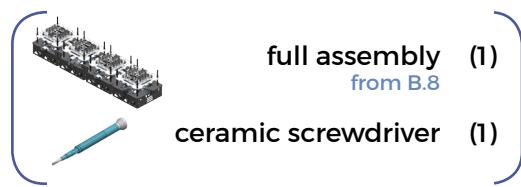
Make sure to connect the solenoid to the labelled solenoid connector exactly as in the diagram below.

## B8 (inter-module cable connection)



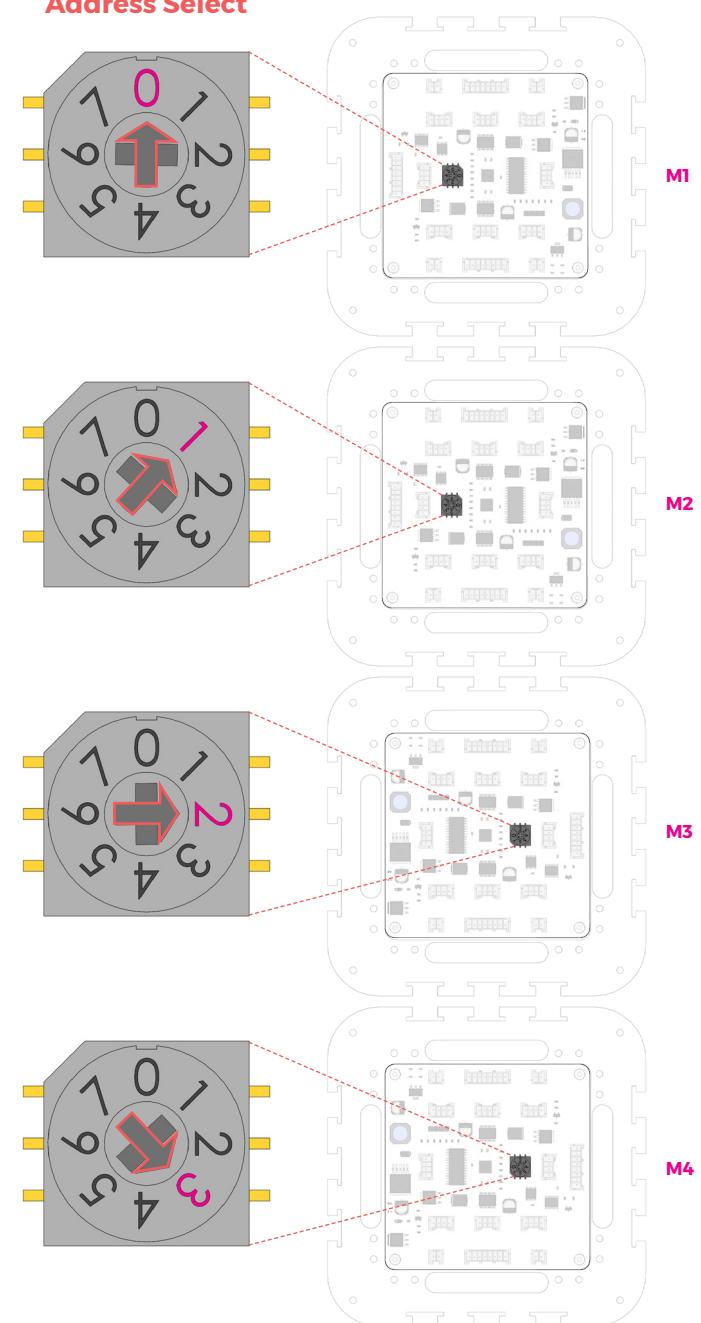
Make sure the 8 pin connectors go around the HEXs that are on the same side as the hinge.

## B9 (address selection)

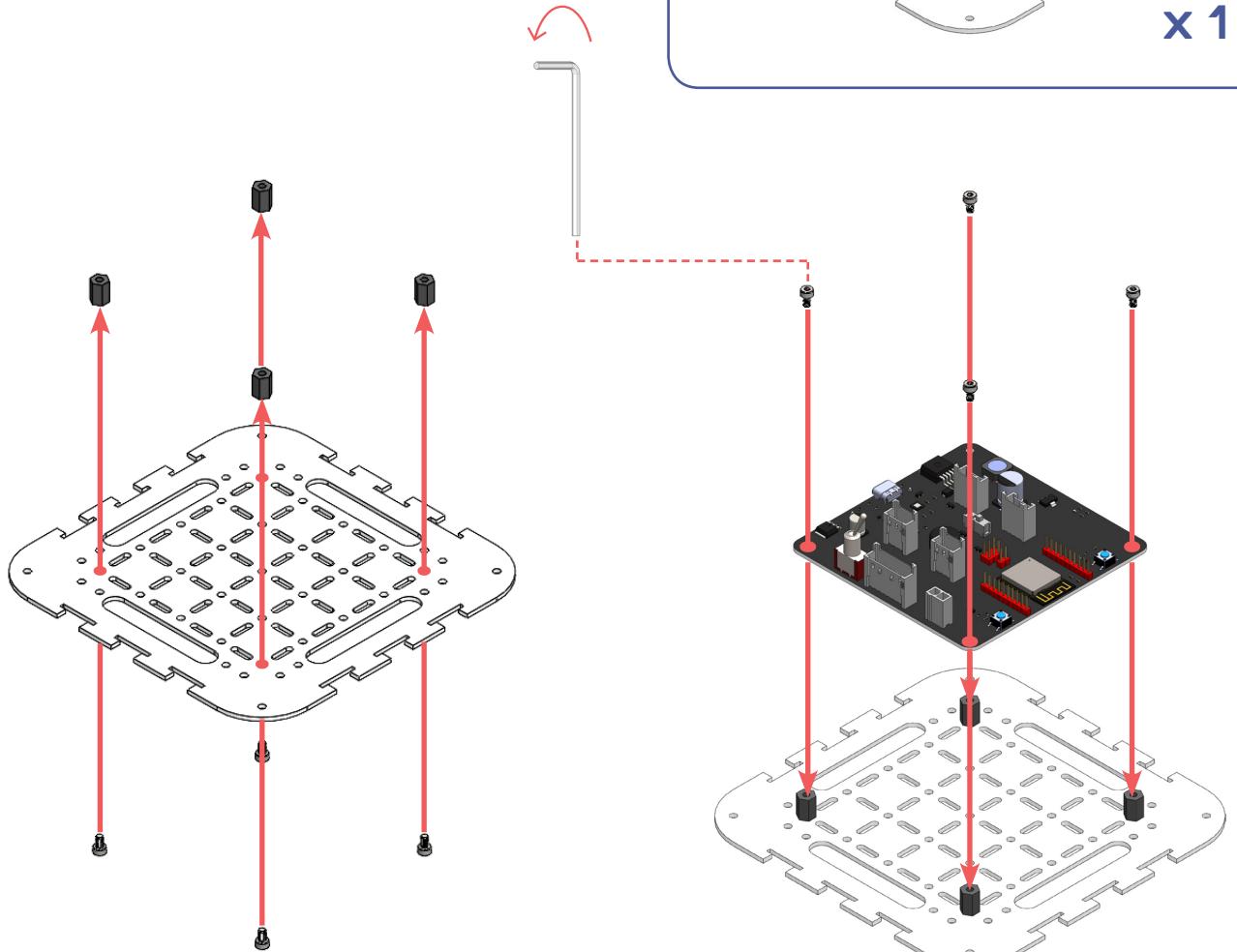
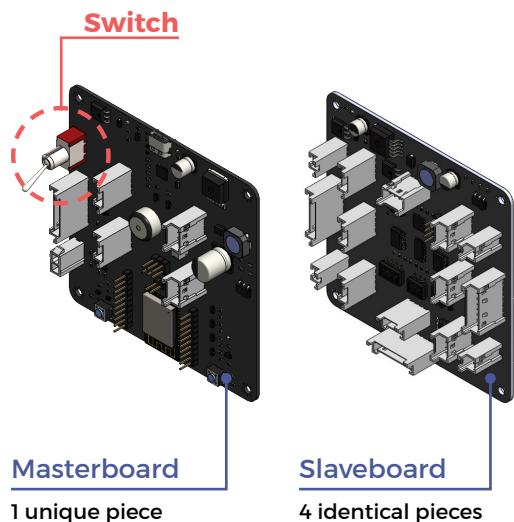
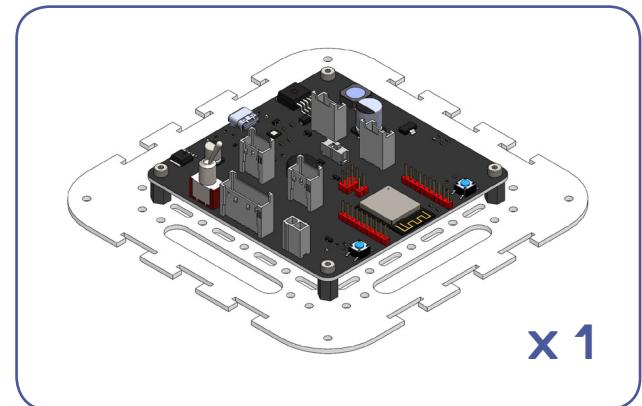
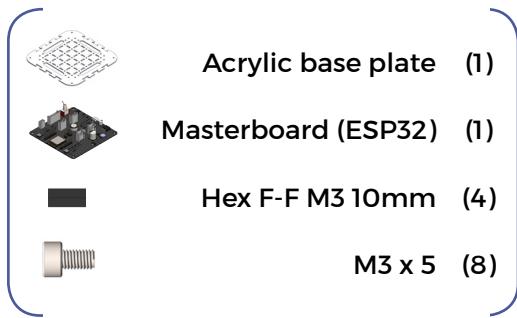


✖ Use the ceramic screwdriver to adjust the rotary switch and select the address for all 4 modules.  
Module 1: Address 0, Module 2: Address 1,  
Module 3: Address 2, Module 4: Address 3

### Address Select

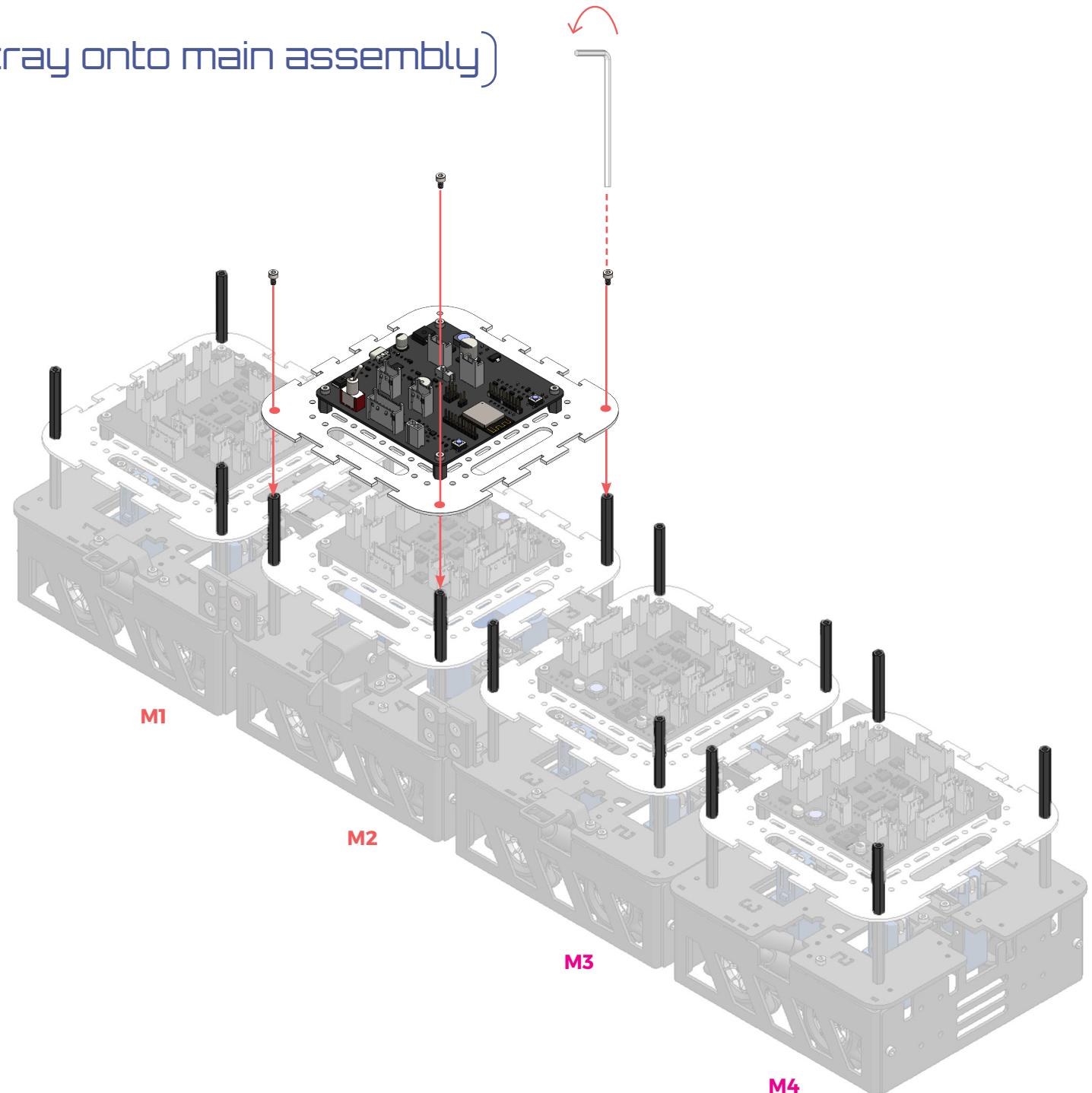
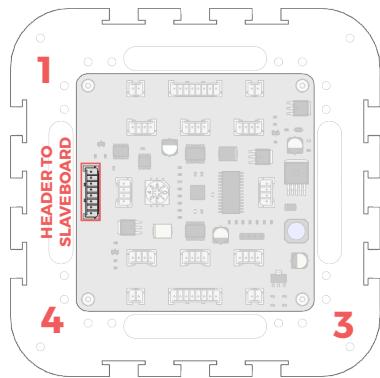
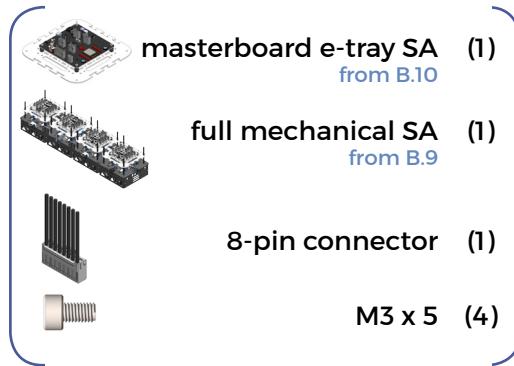


## B10 (masterboard e-tray sub-assembly)

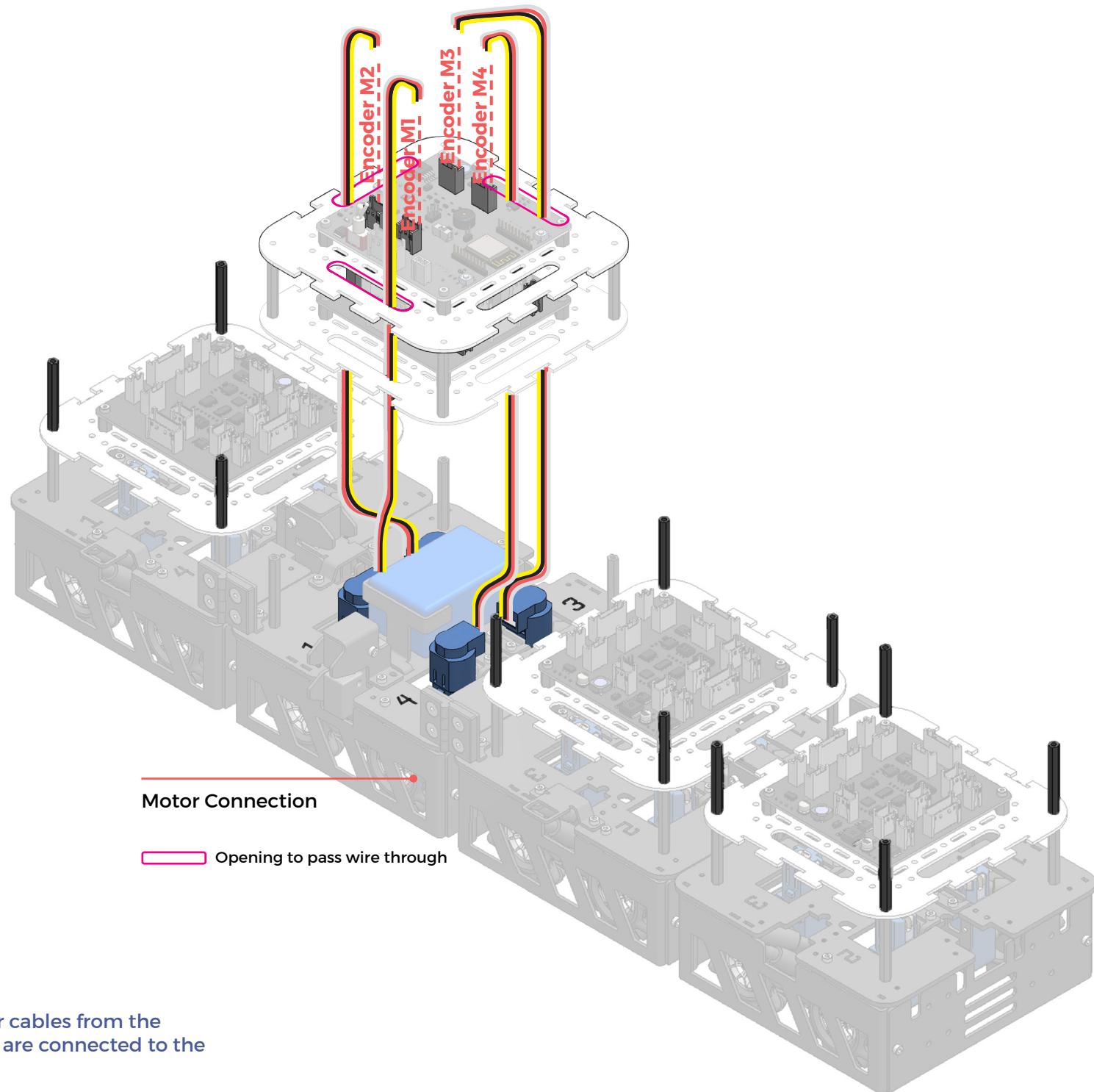


- ✖ Make sure that you are attaching the masterboard and not the slaveboards.
- ✖ How to differentiate between masterboard and slaveboards:
  - Masterboard has a special switch

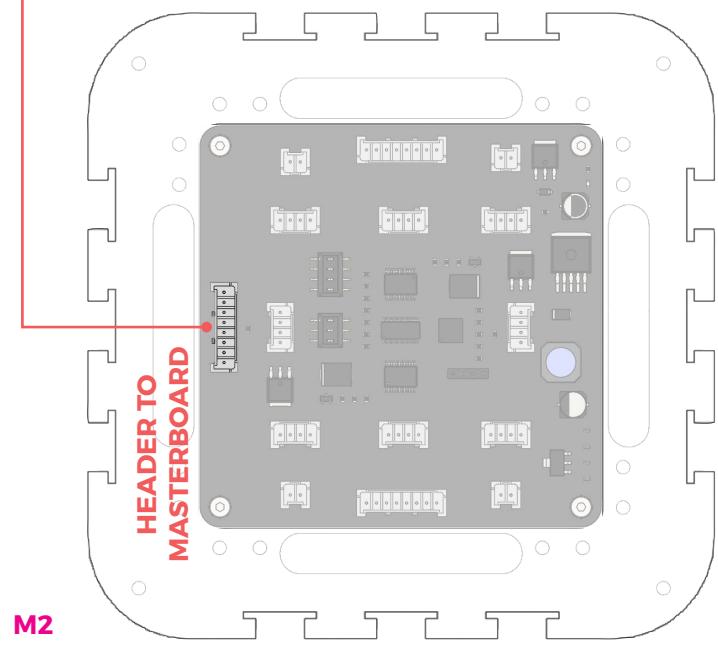
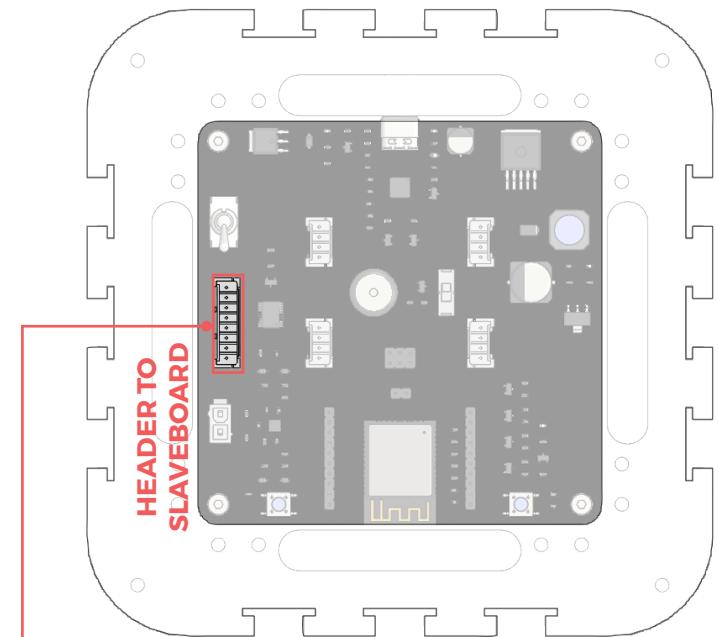
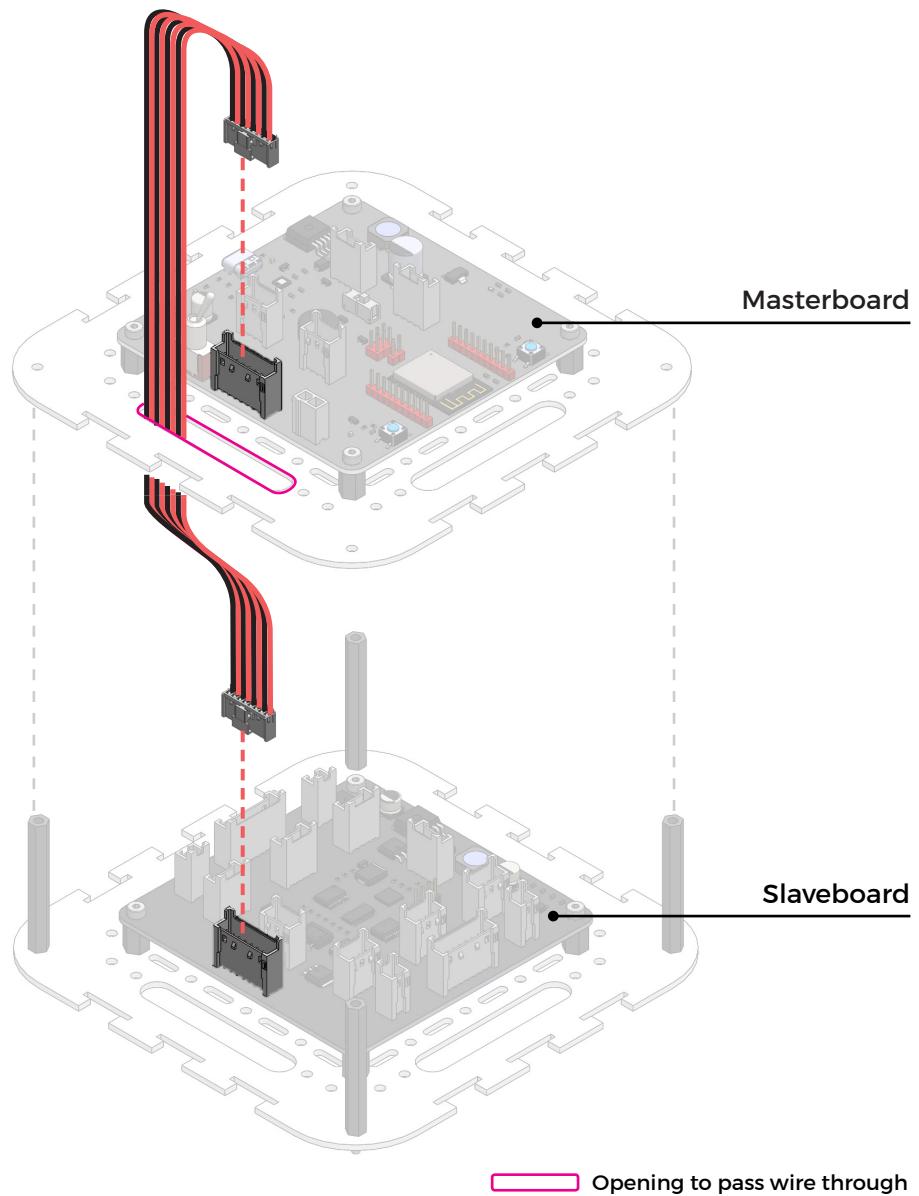
## B 11 (masterboard e-tray onto main assembly)



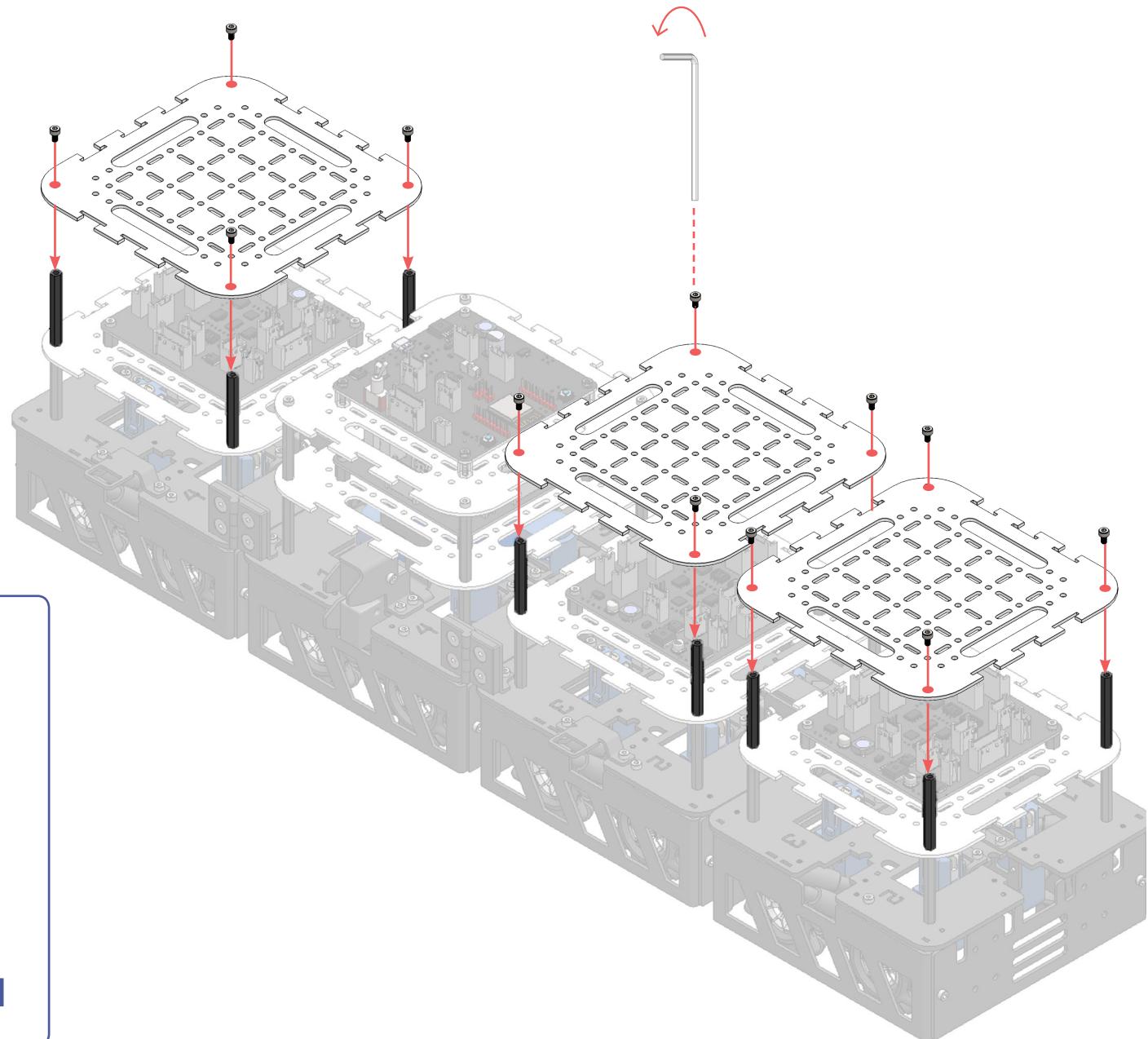
✗ Align the header to slaveboard connector on the masterboard to face the side connecting Motor 1 and 4.



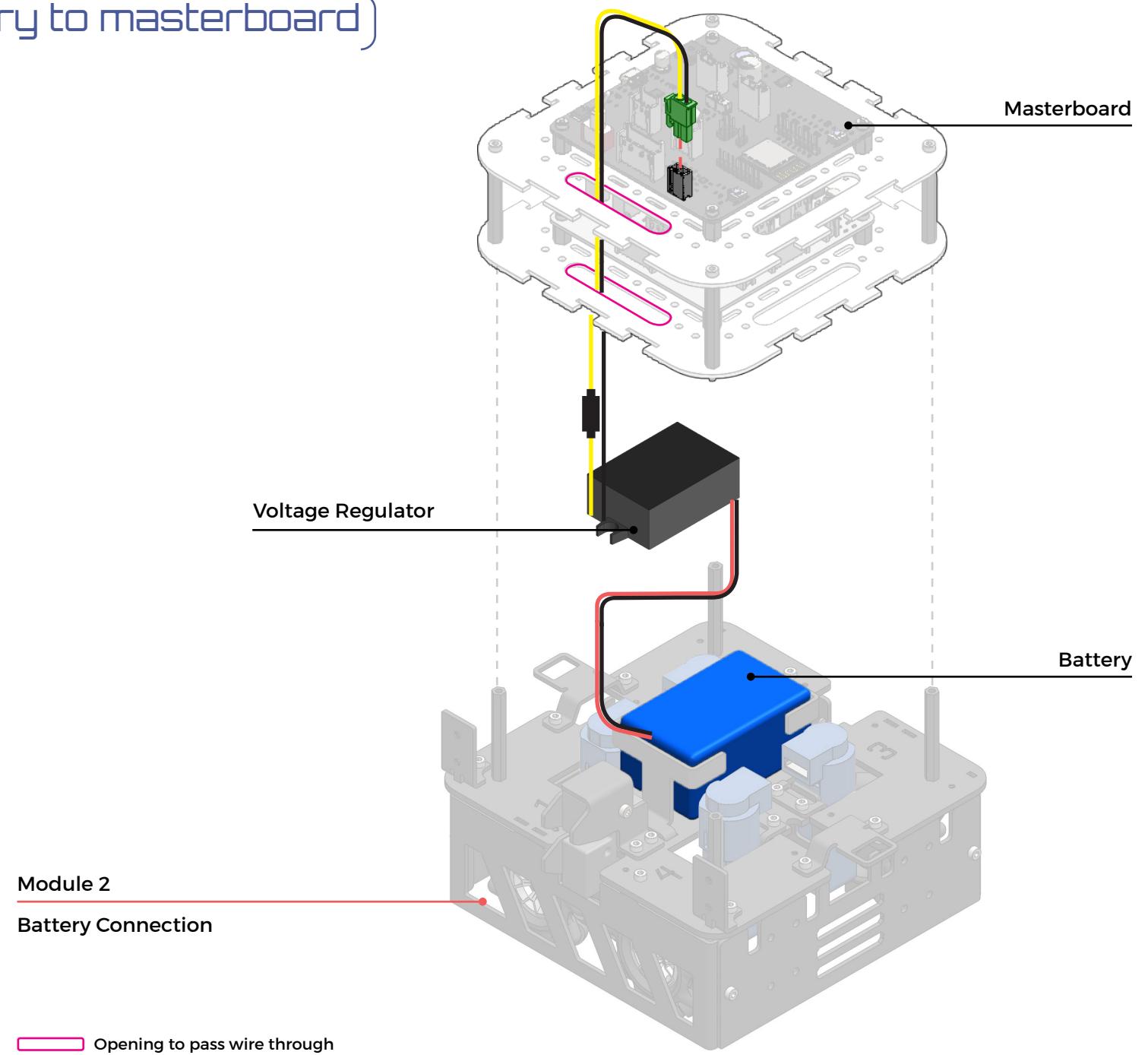
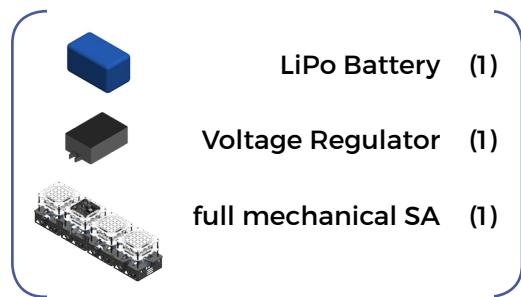
Ensure that encoder cables from the motors in module 2 are connected to the masterboard



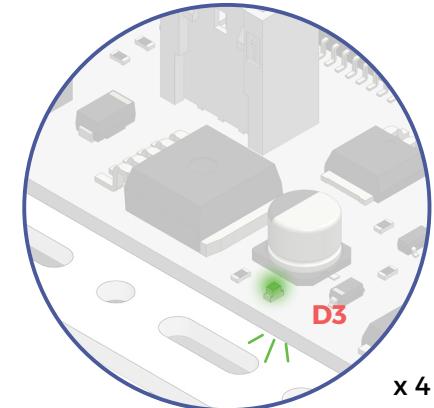
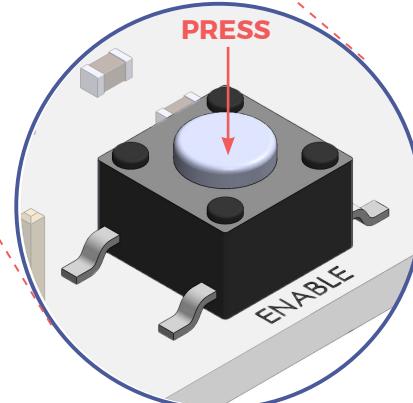
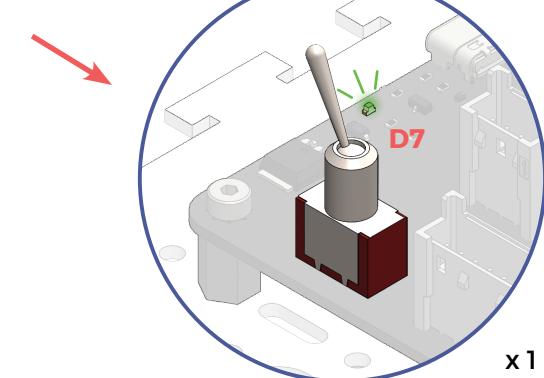
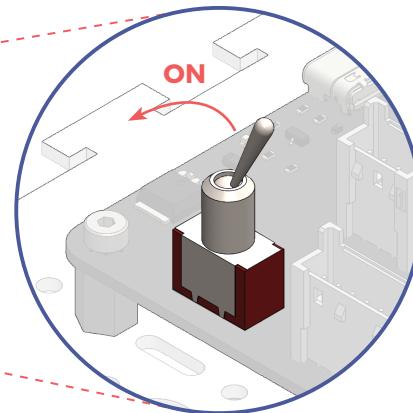
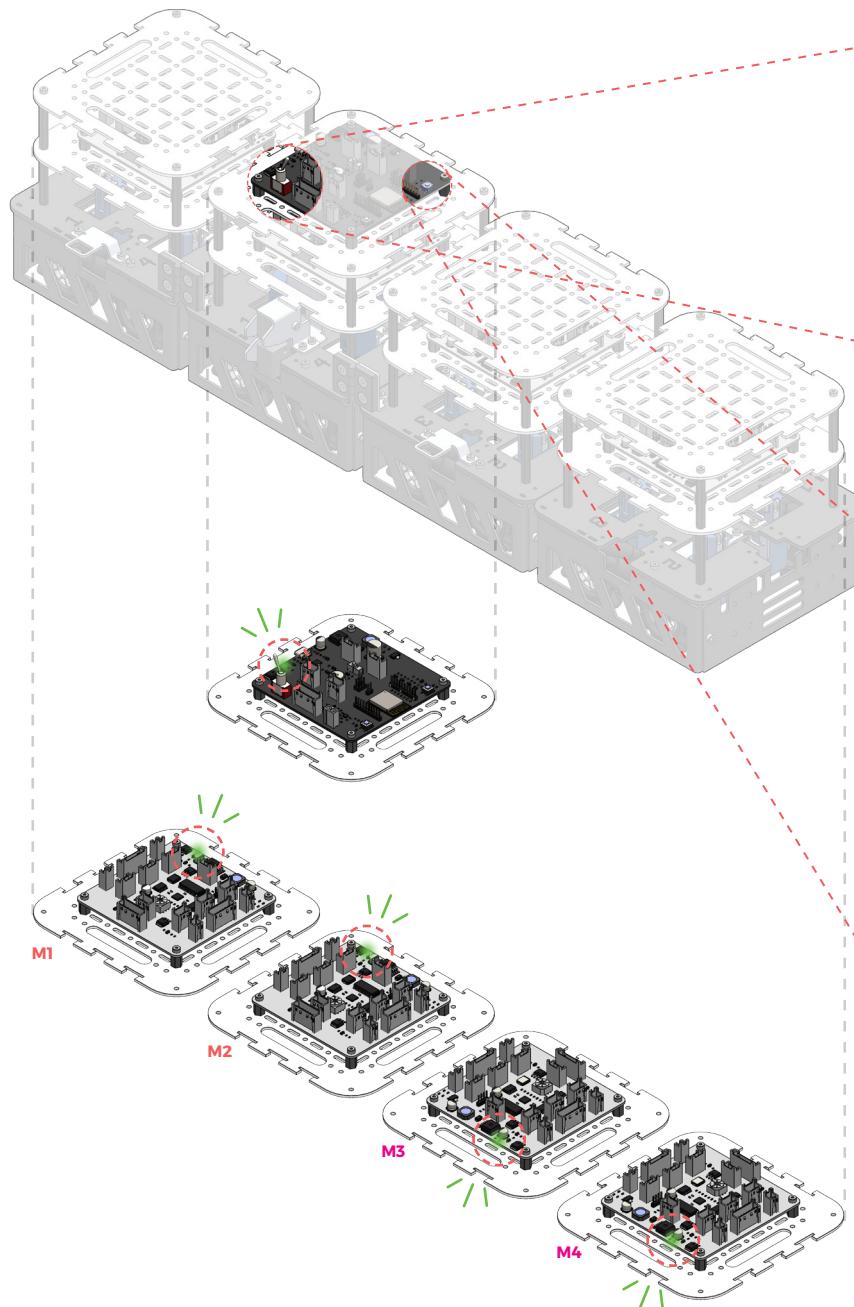
## B12 (attach acrylic covers)



**B13** (connect battery to masterboard)



## B 14 (check connection)



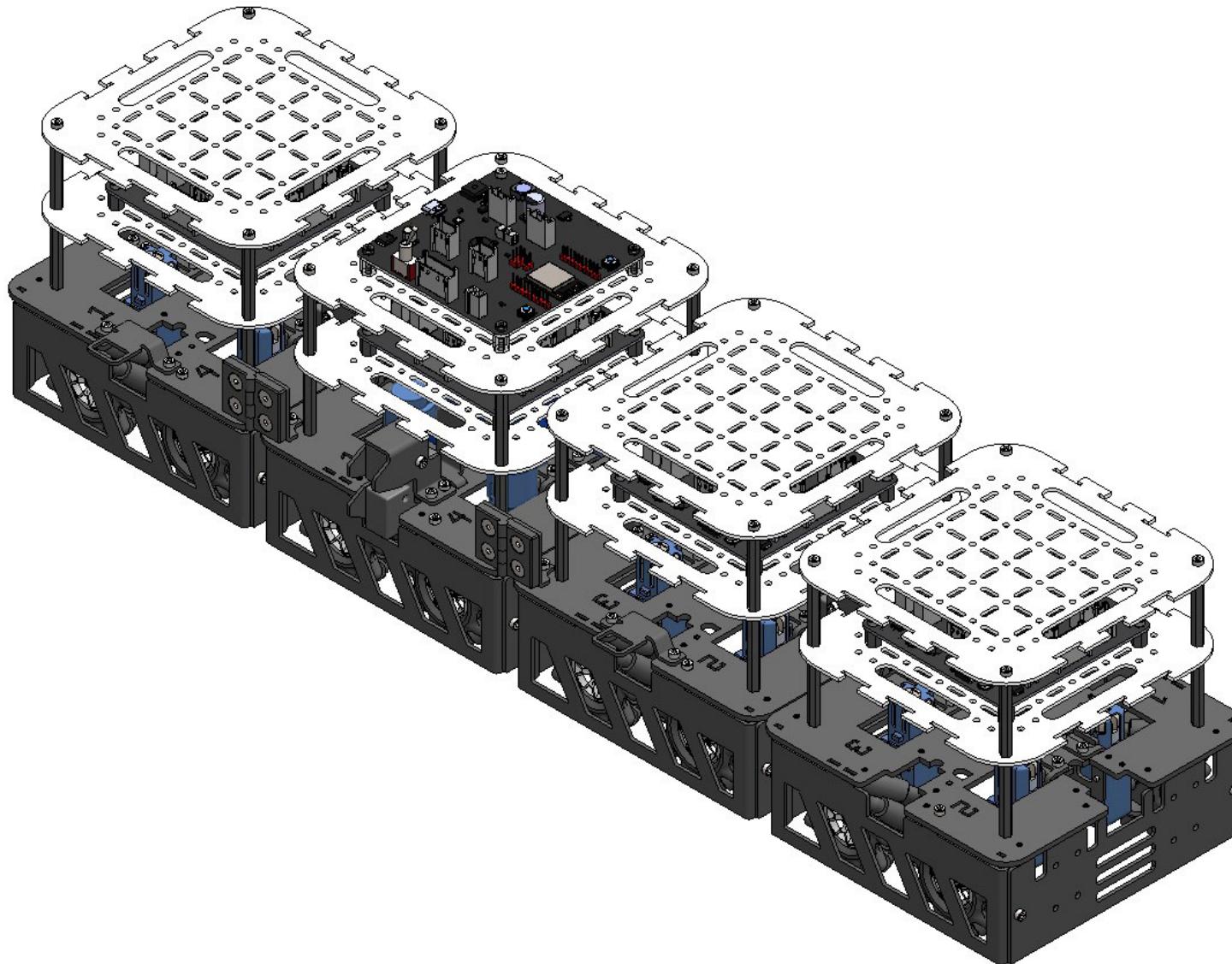
After checking that the lights are turned on, press on the enable button to activate the robot.



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, iOS    )

#### Download from

( Google Play, Apple Store )

#### App Icon & Name



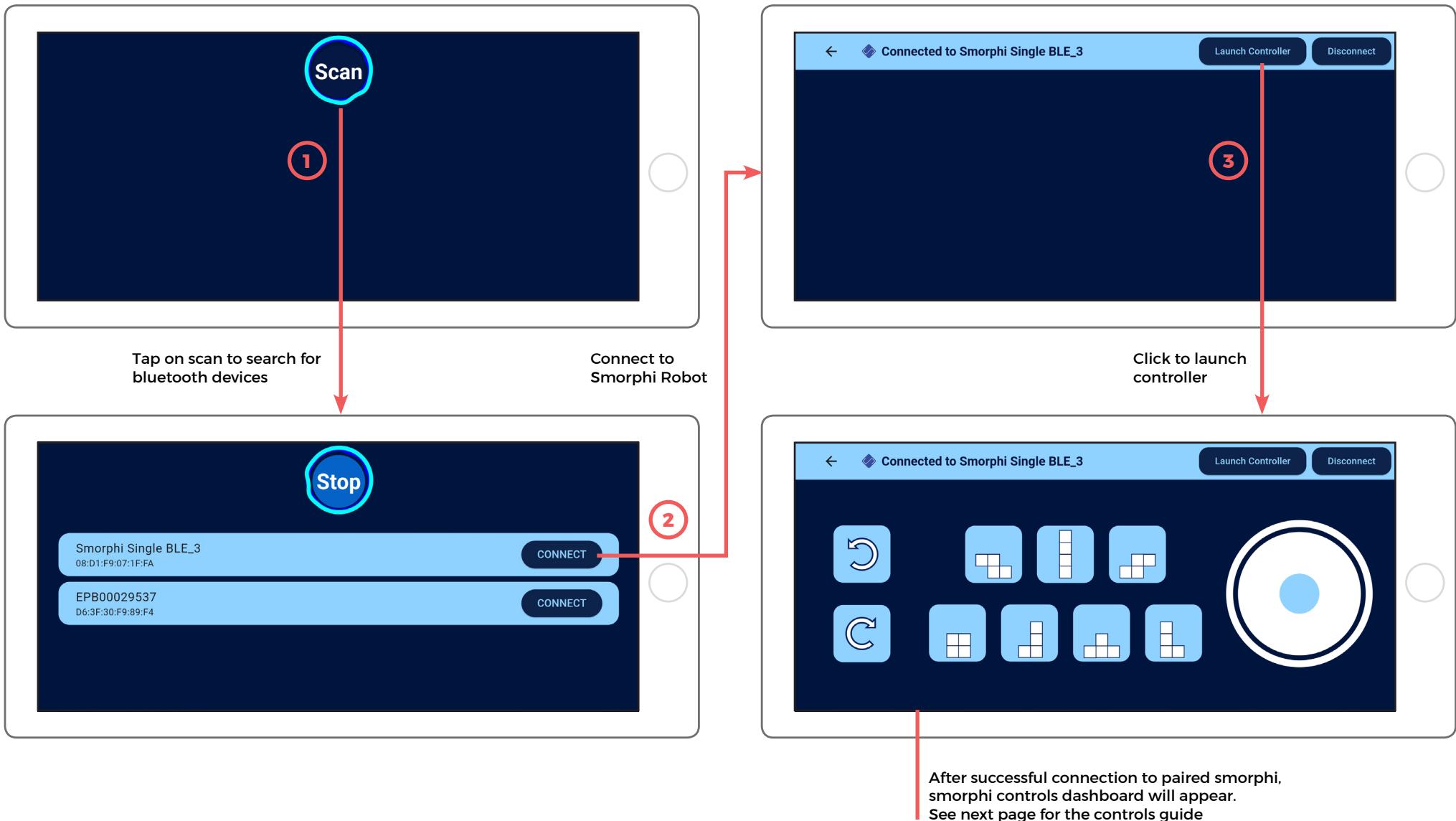
smorphi

#### System Requirements

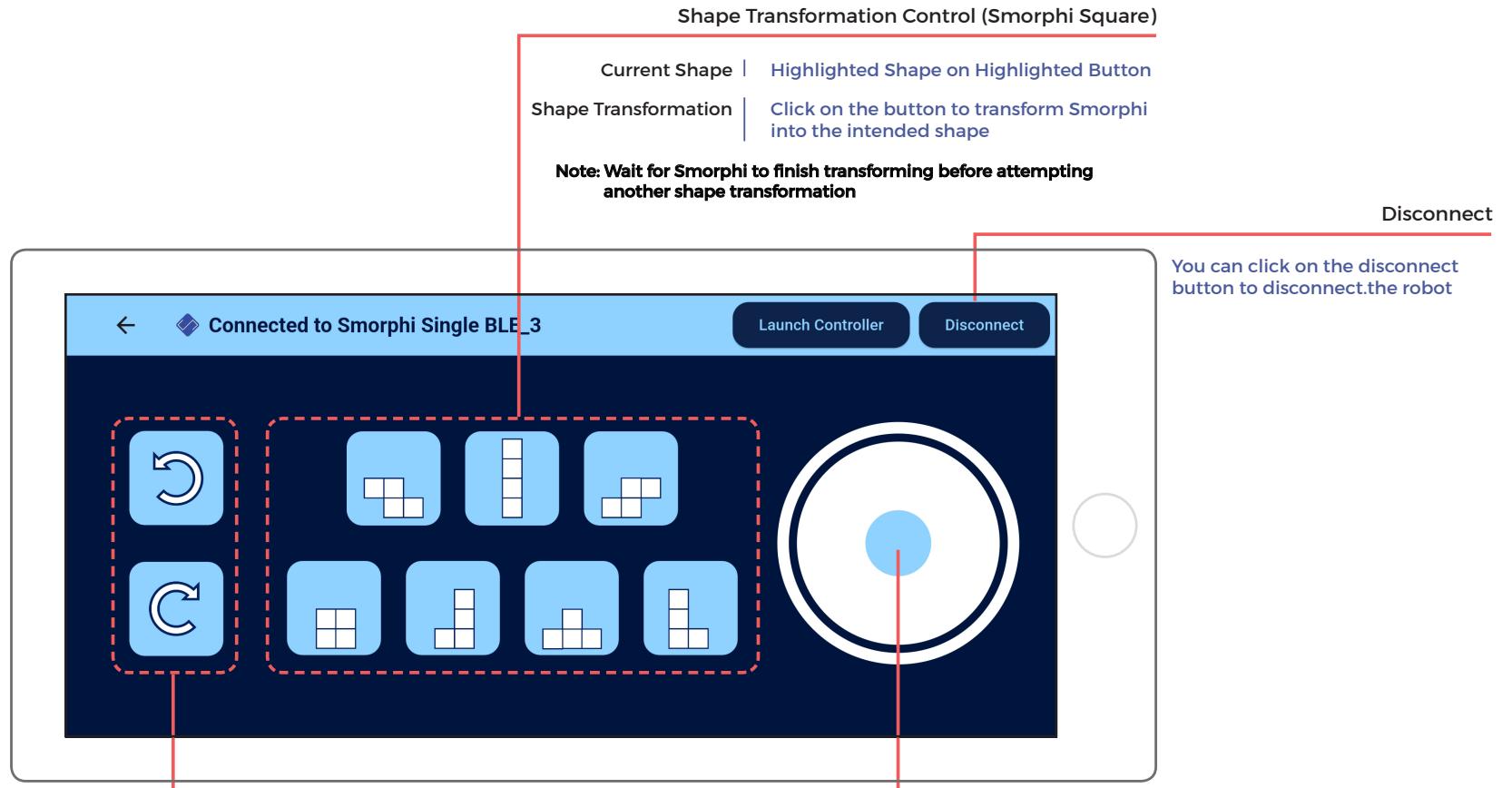
##### OS Requirements

{  
    Android 6+  
    Bluetooth 4.0+  
}

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



### 3. Smorphy controls dashboard guide.



#### Pivot Turning

Press and hold to pivot the robot around centre



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

#### Direction & Speed Joystick Control

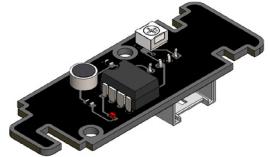
##### Direction Control

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

##### Speed Control

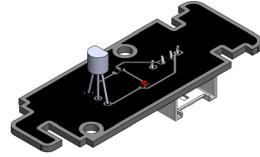
Speed of smorphy is controlled by how much the user push the joystick from centre

# ( sensors )



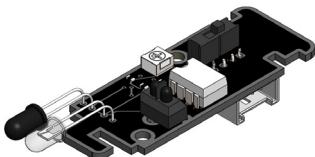
**sound sensor** (x1)

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.



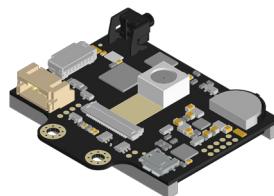
**temperature sensor** (x1)

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.



**Husky camera** (x1)

Husky Camera is an AI camera that is able to colour code, detect and track lines and intersections, and learn to detect objects taught to it.

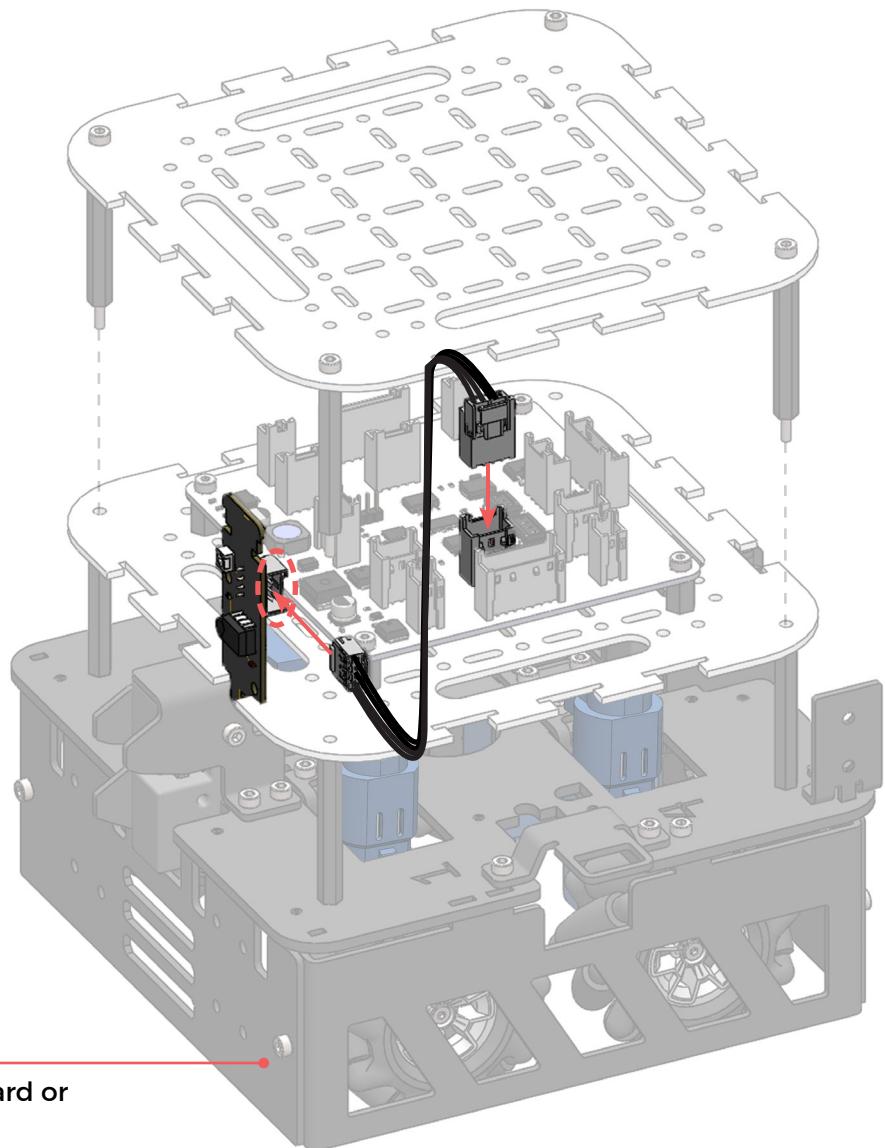
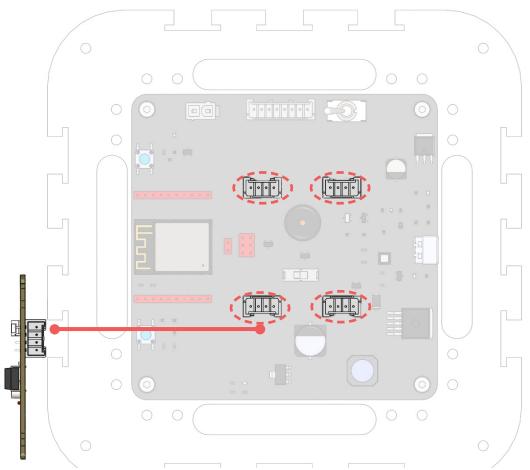
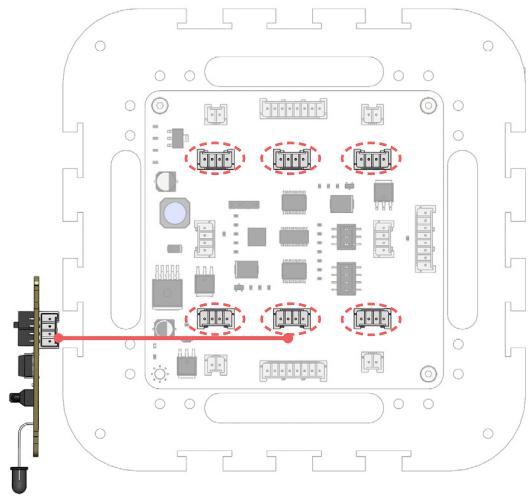


For sensor related activities and implementation, please refer to the online class exercises by following the link below:  
<https://github.com/WefaaRobotics/Smorphi/wiki/Robot-Exercises>



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 )



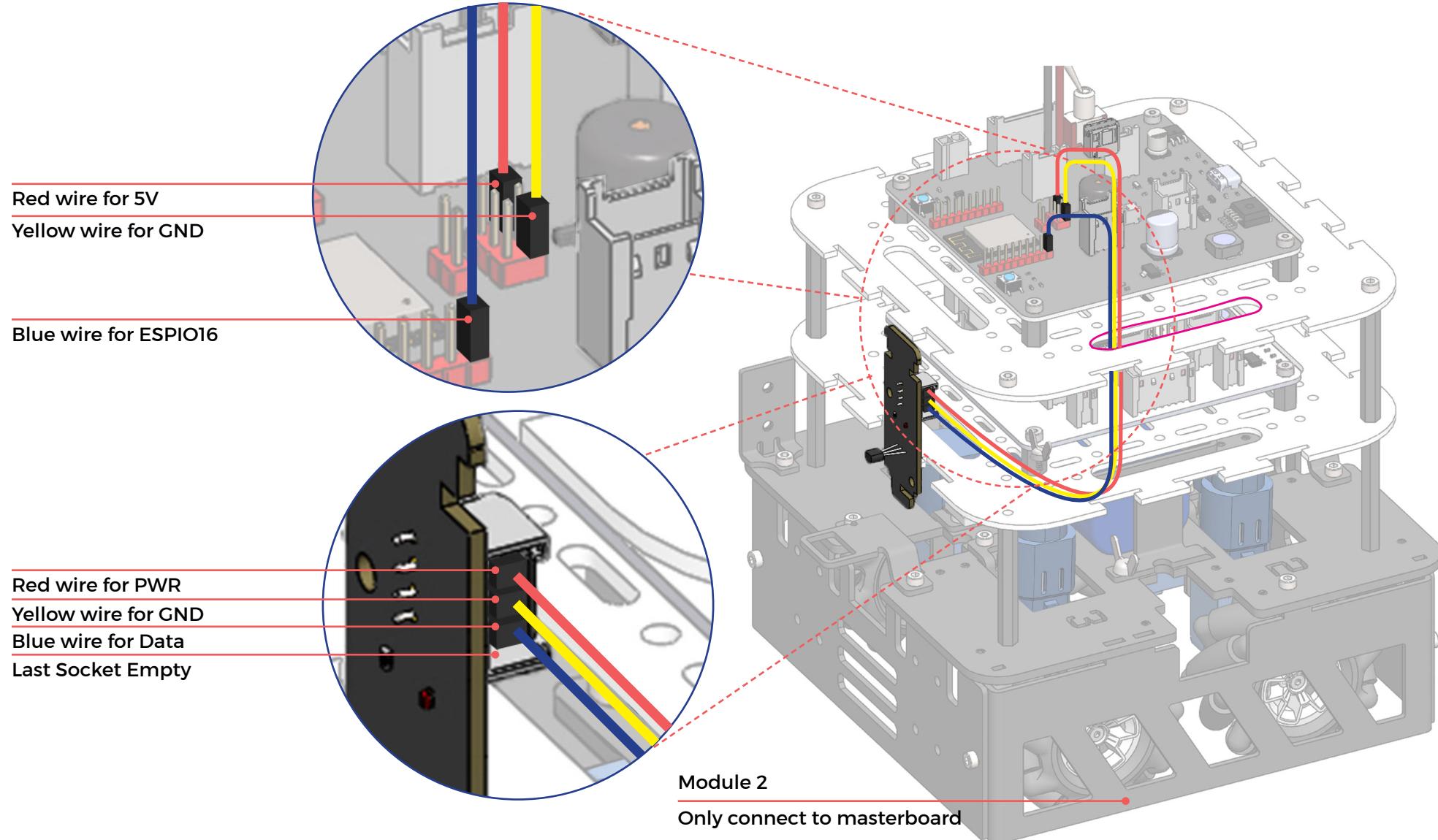
## Module 1/2/3/4

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).

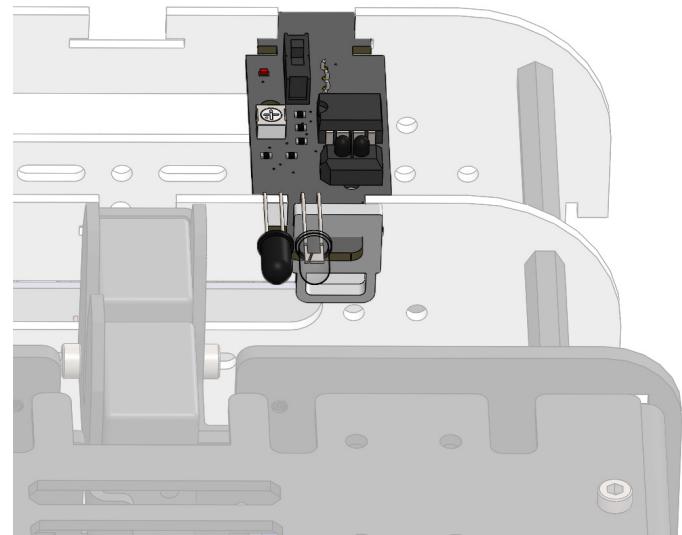
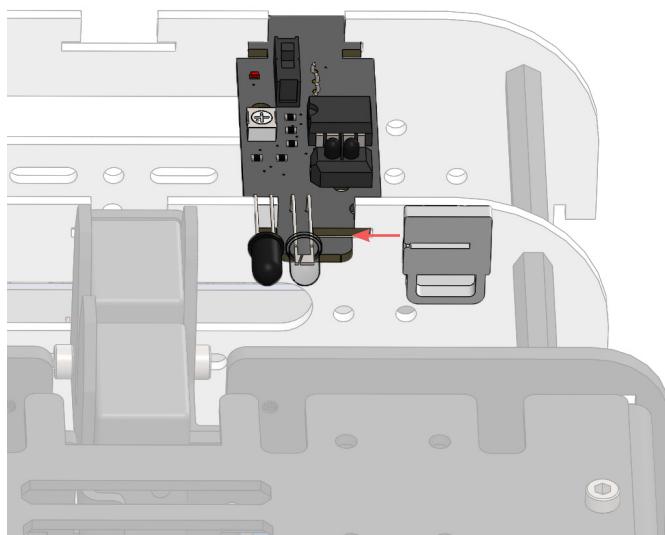
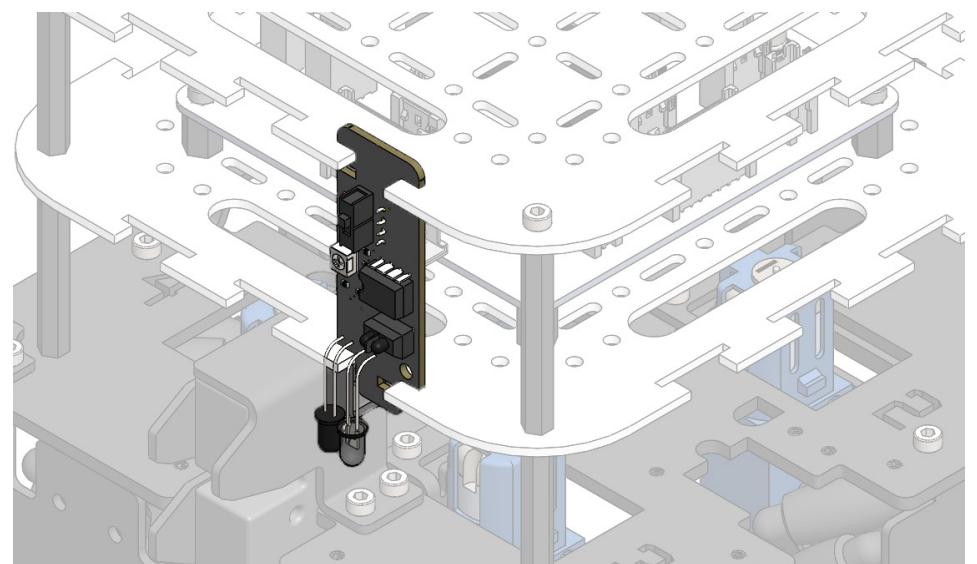
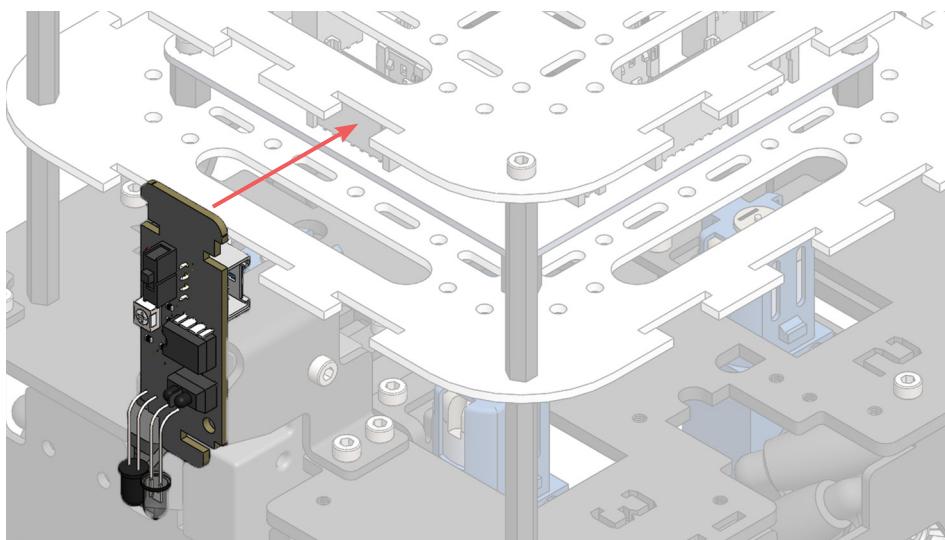
# ( temperature sensor wiring )



Temperature sensors can only be connected to the masterboard.

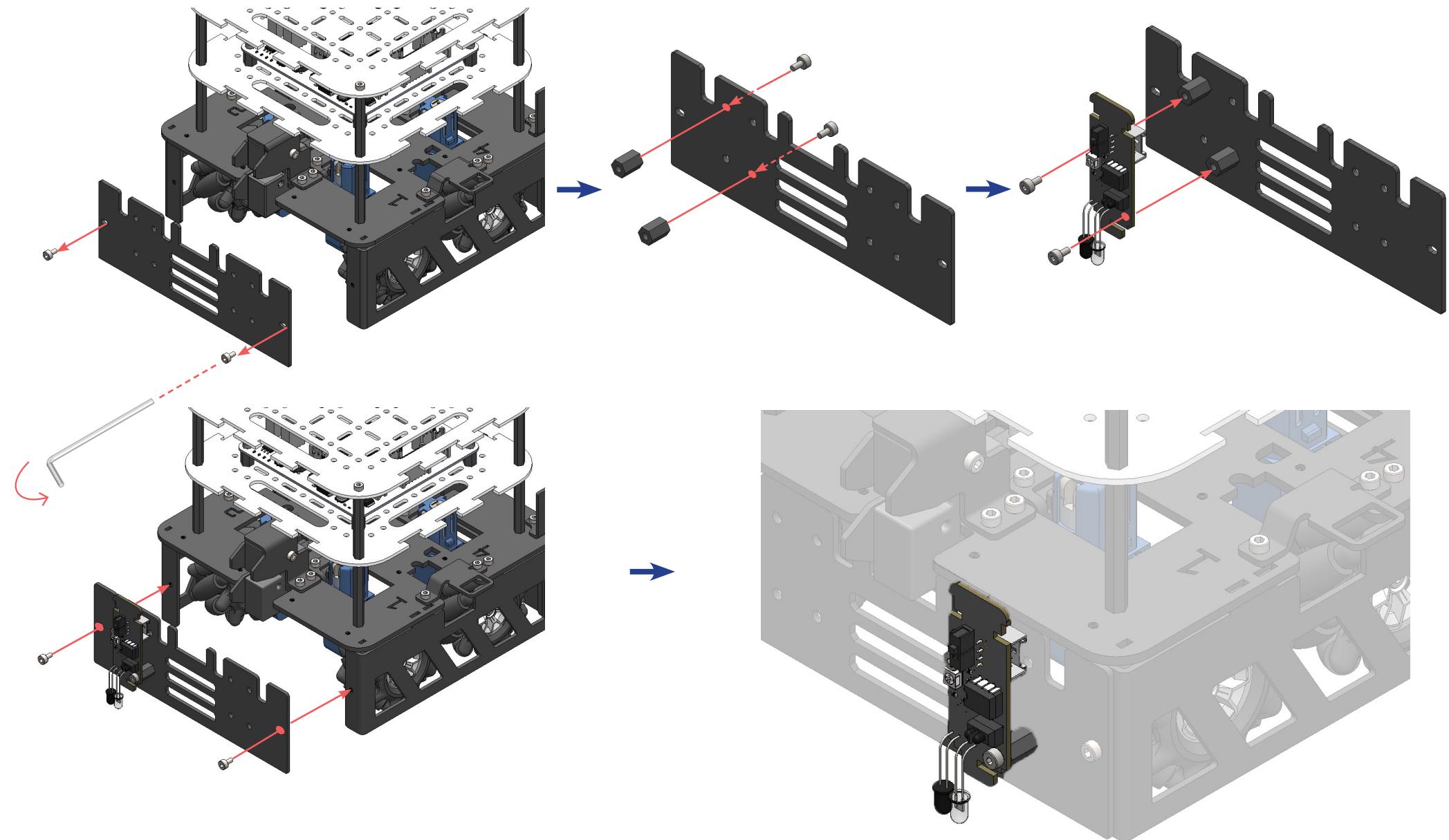
Opening to pass wire through

# ( sensor position 1 )



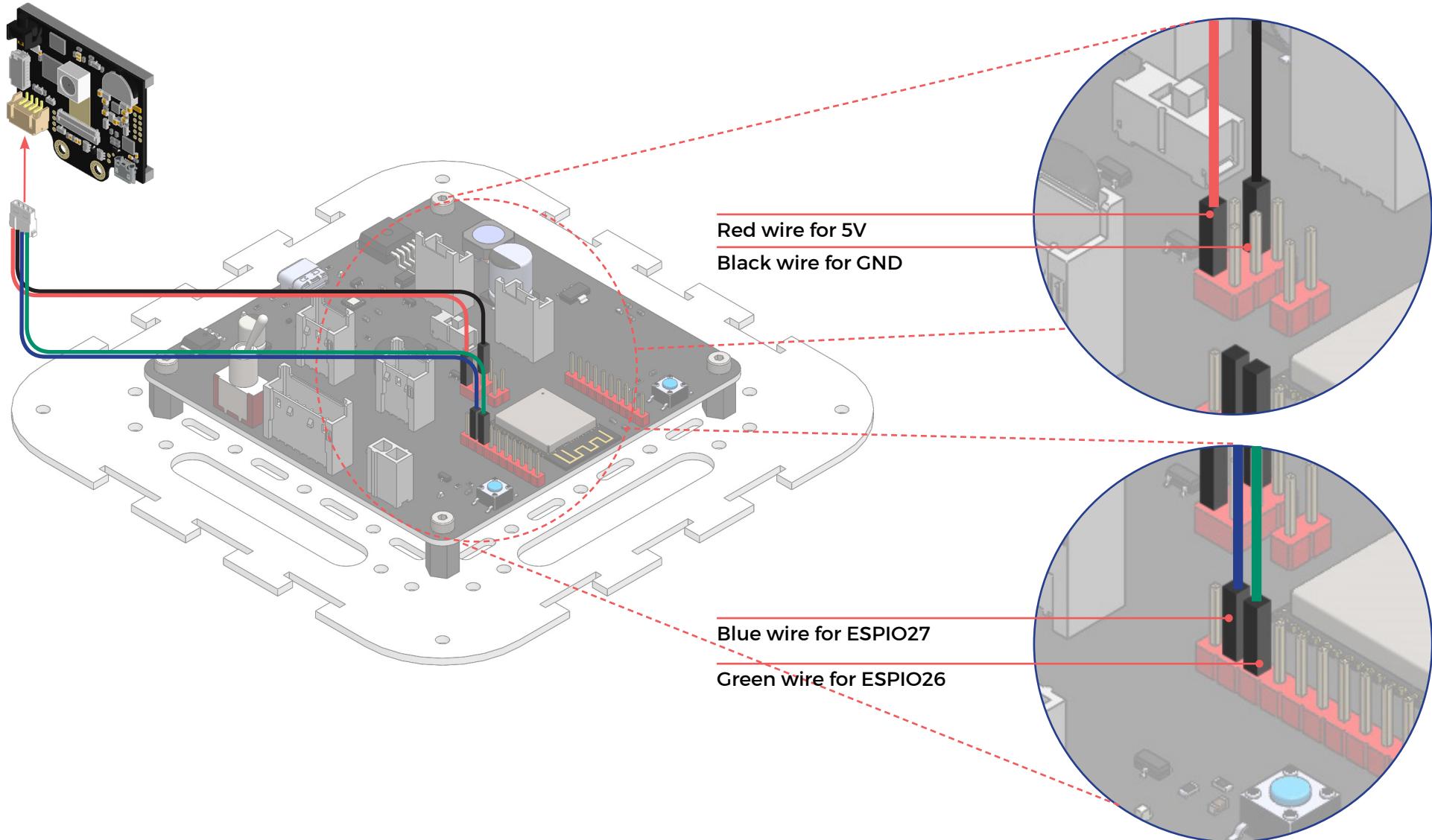
Sensors can be secured to the robot using the sensor lock provided.

## ( sensor position 2 )

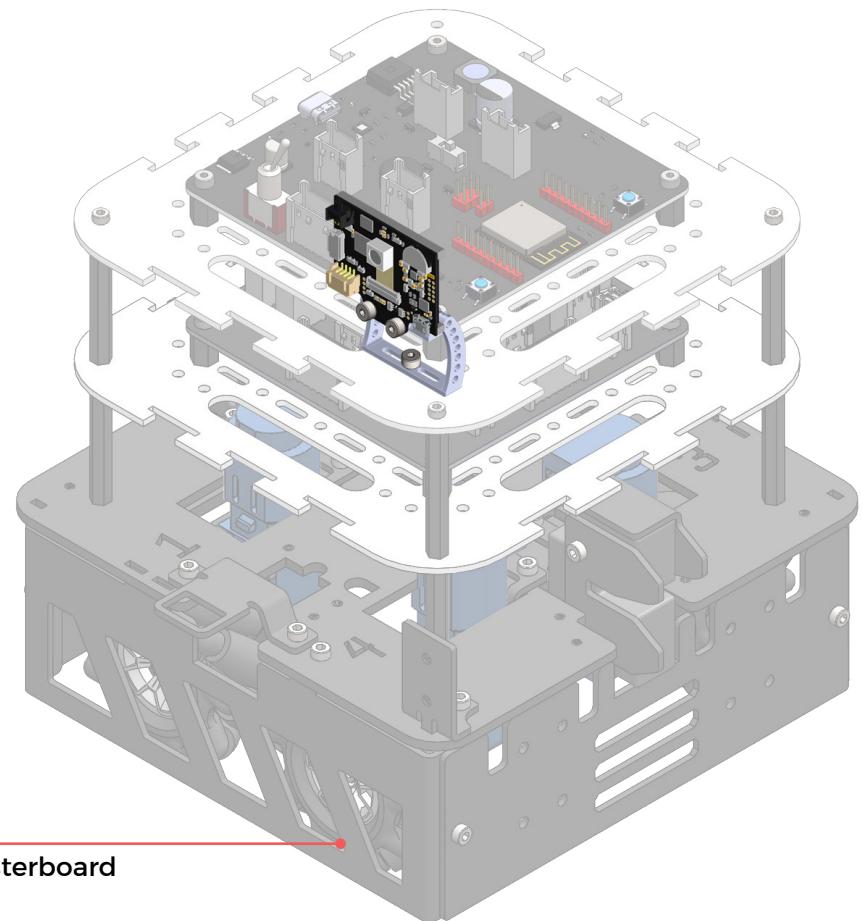
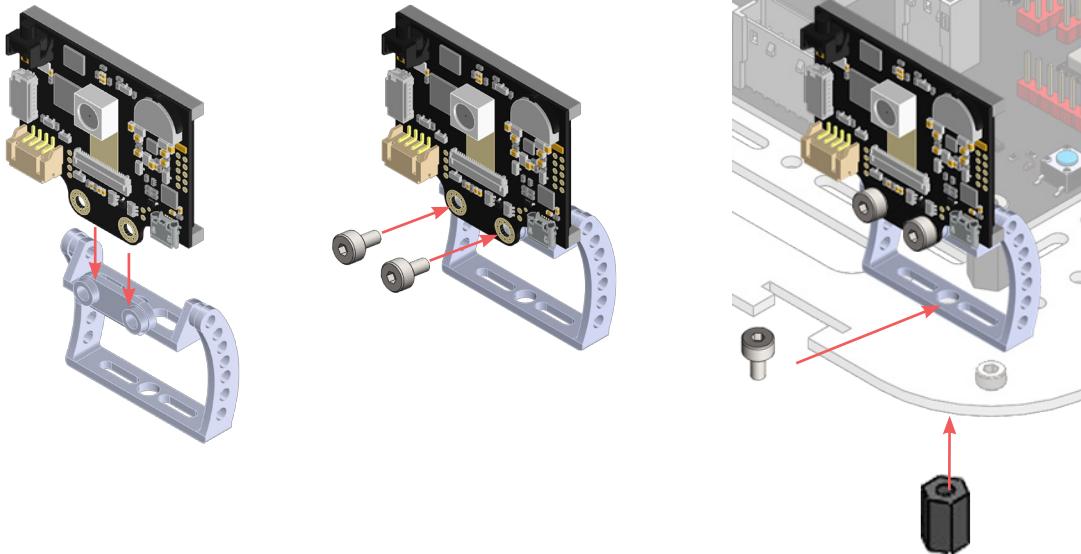


Sensors can also be attached at the skirt panel of the robot.

# ( huskycam wiring )

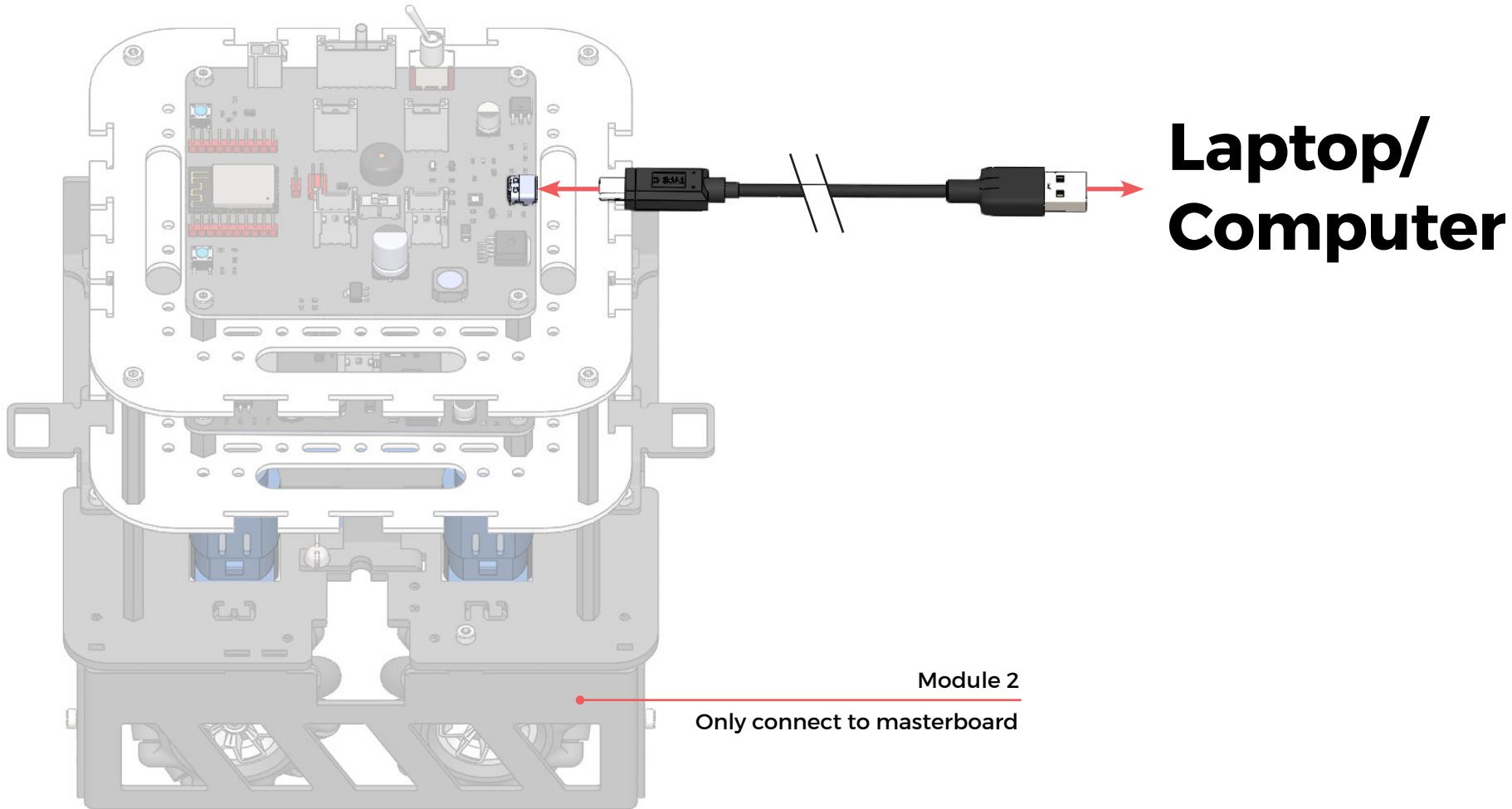


# ( mounting the huskycam )



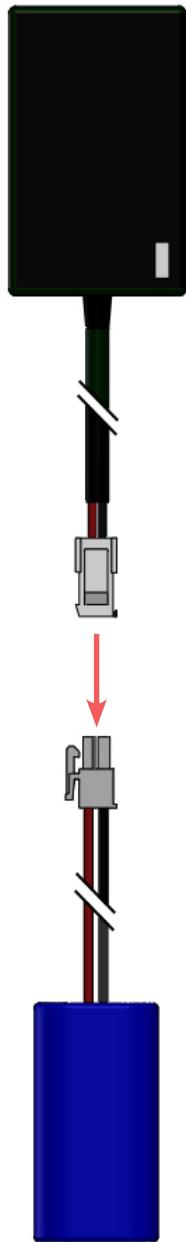
 Huskycam can be mounted on anywhere on the acrylic board.

( connect to laptop )



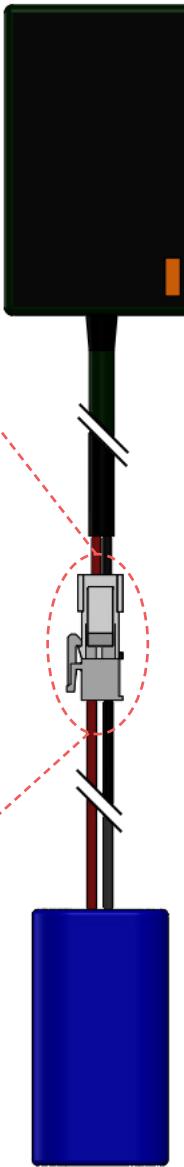
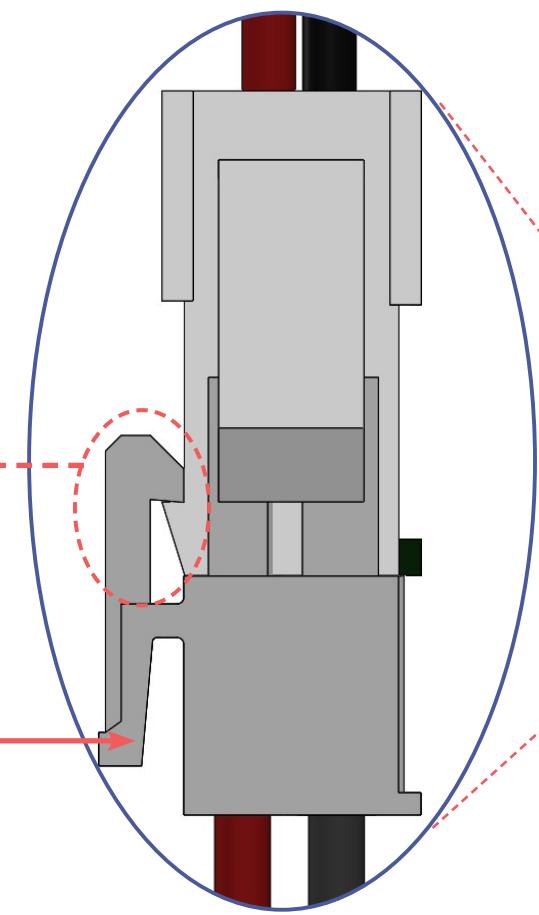
✖ Plug in the USB-C cable as shown above to connect the masterboard to the computer.  
It allows us to upload our code from our computer onto the masterboard.

# ( 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

