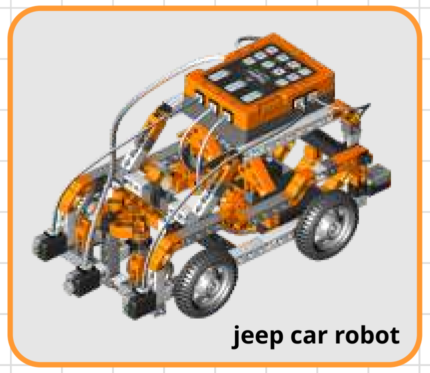
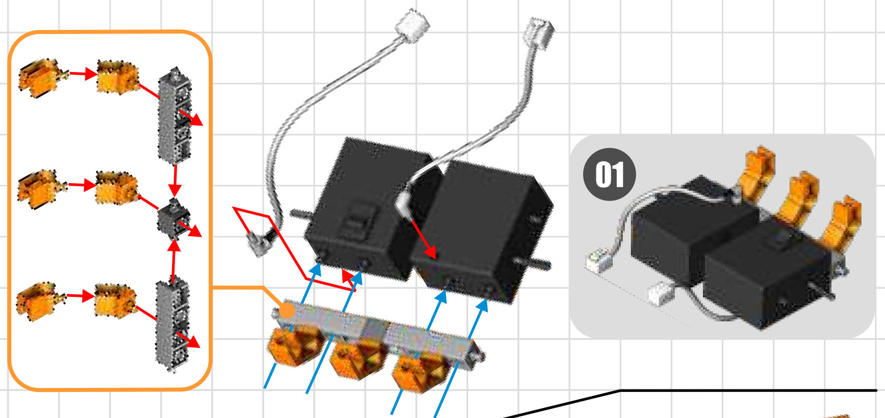

jeep car robot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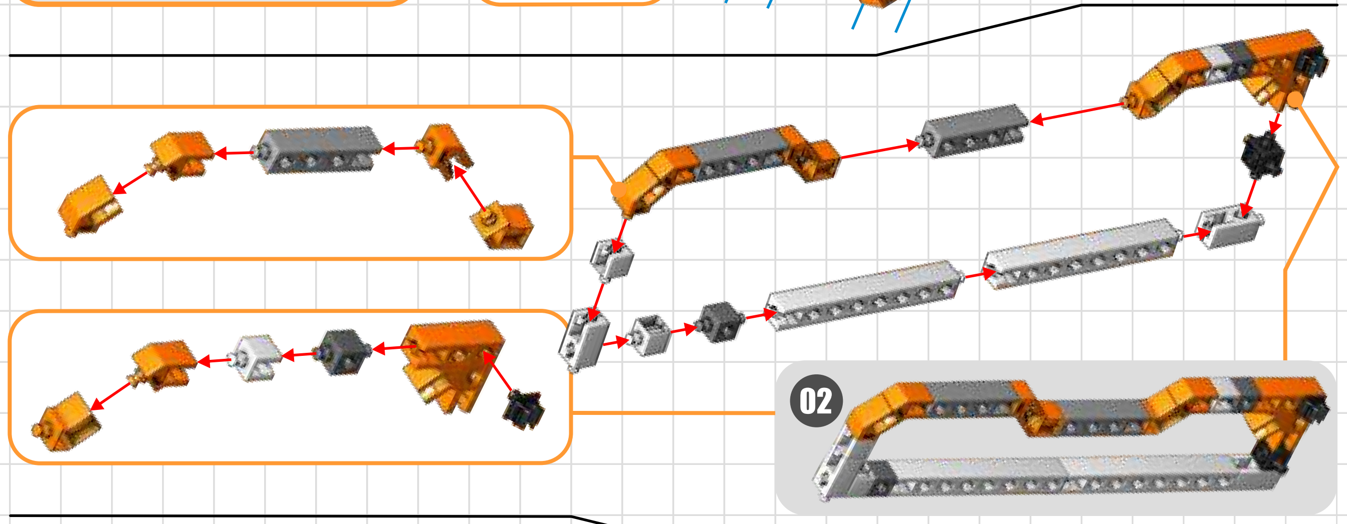
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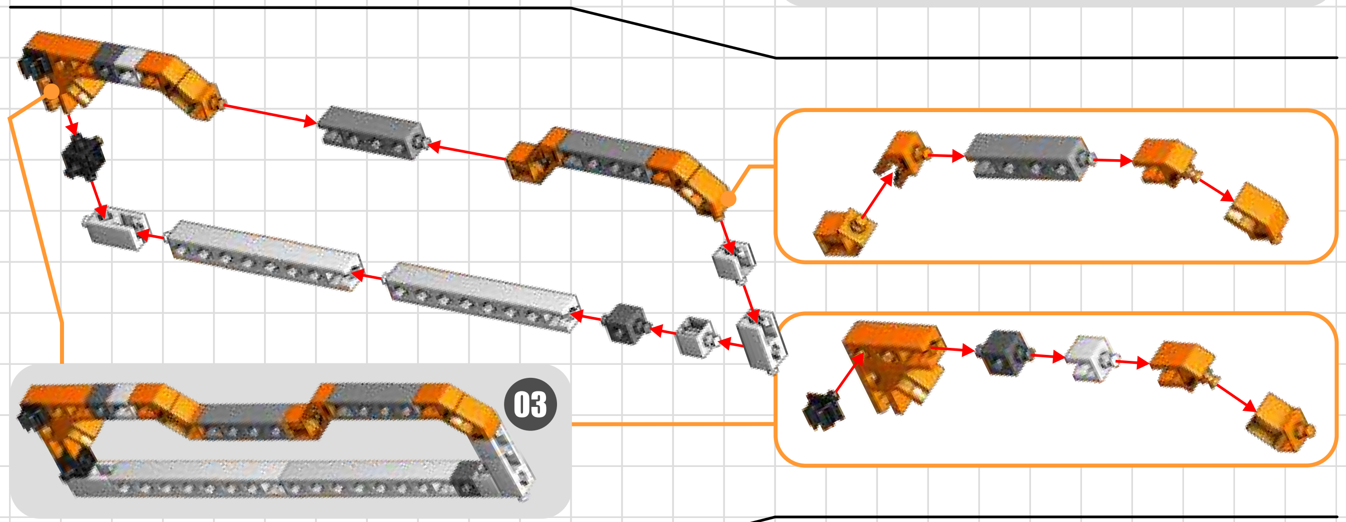
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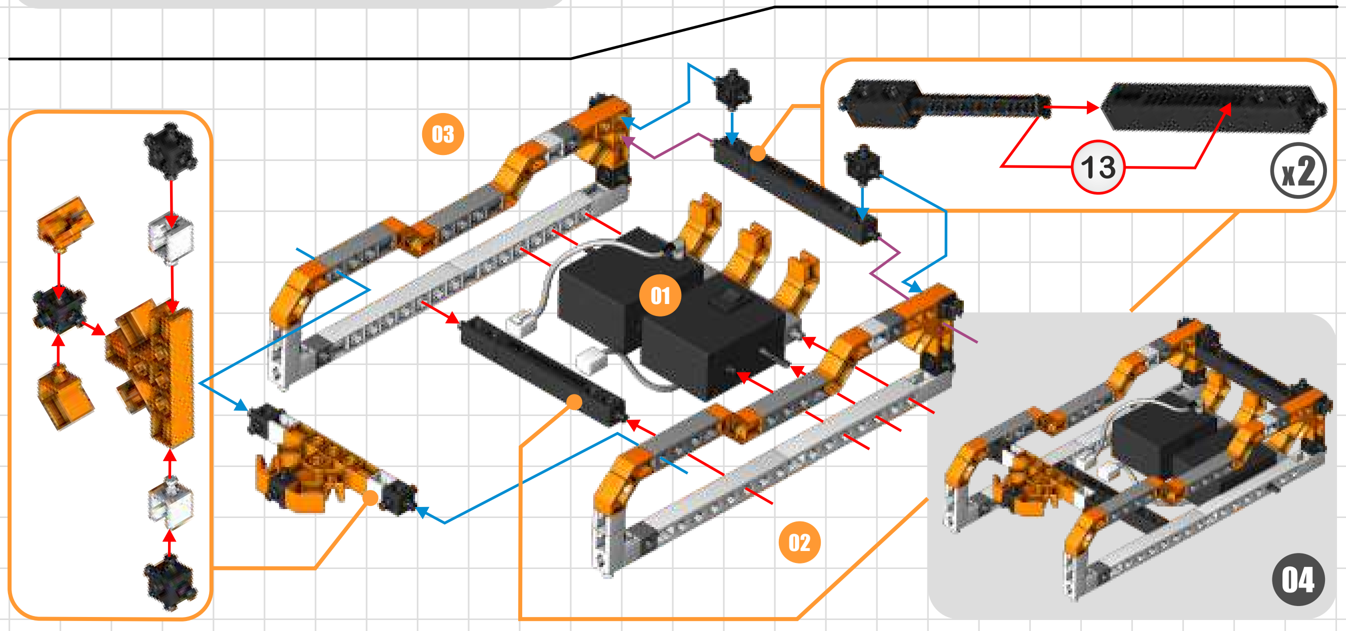
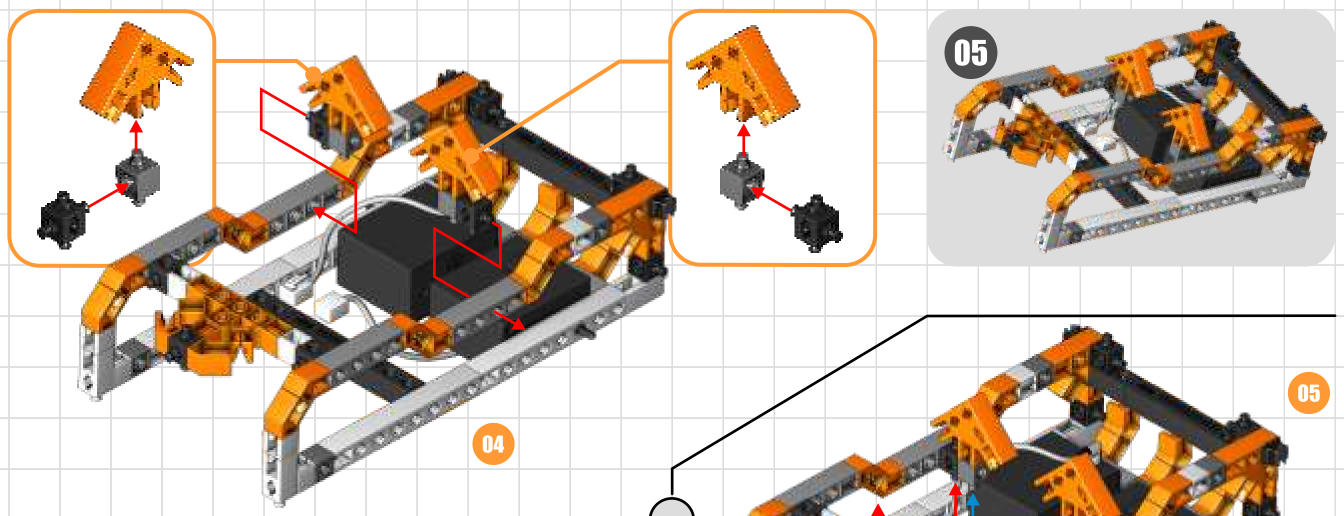
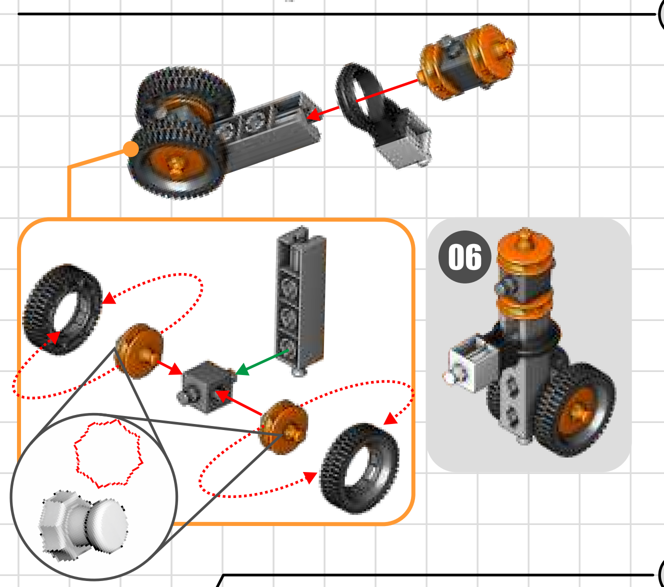
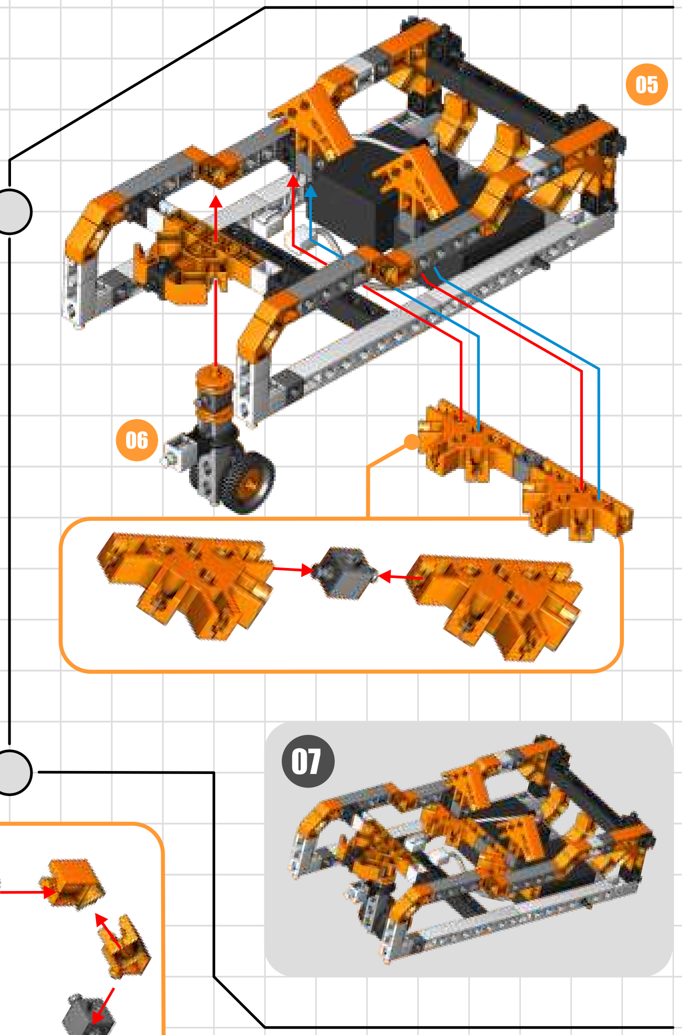
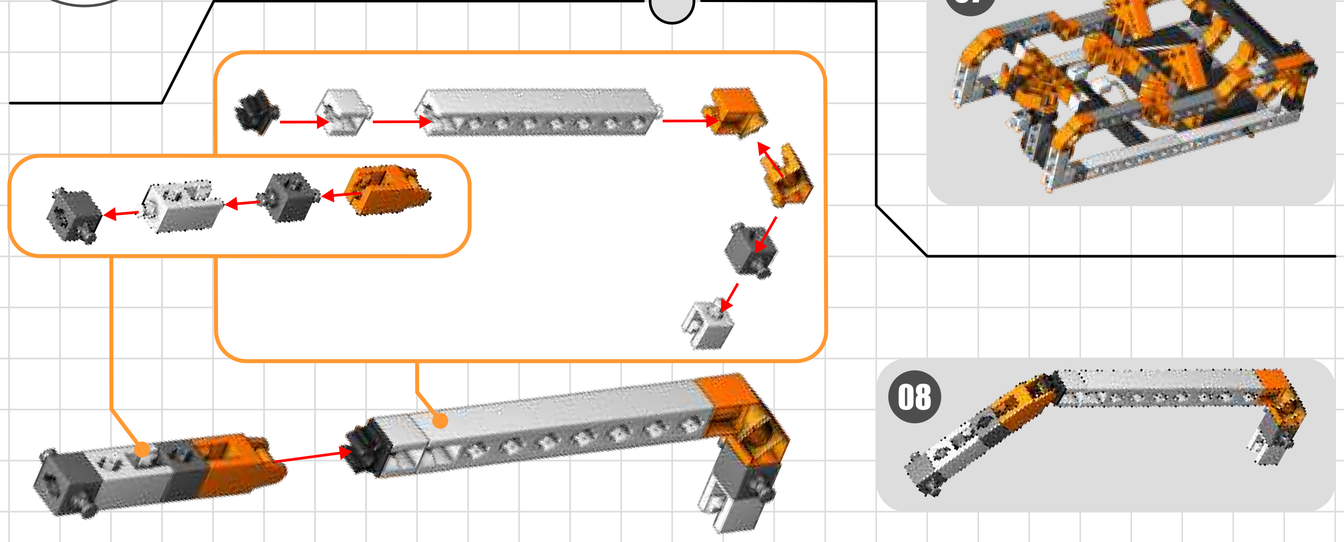

03
13
x2
01
02
04


04
05


06


05
06
07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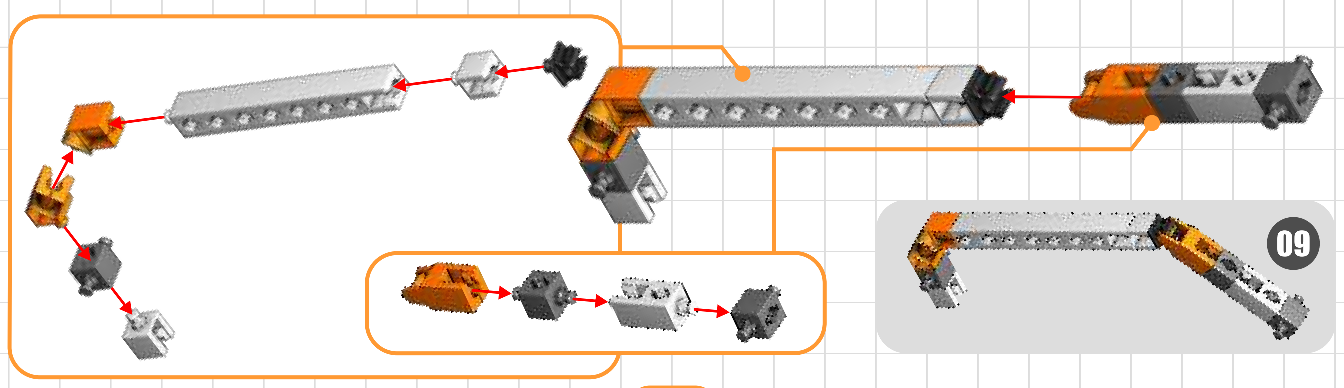
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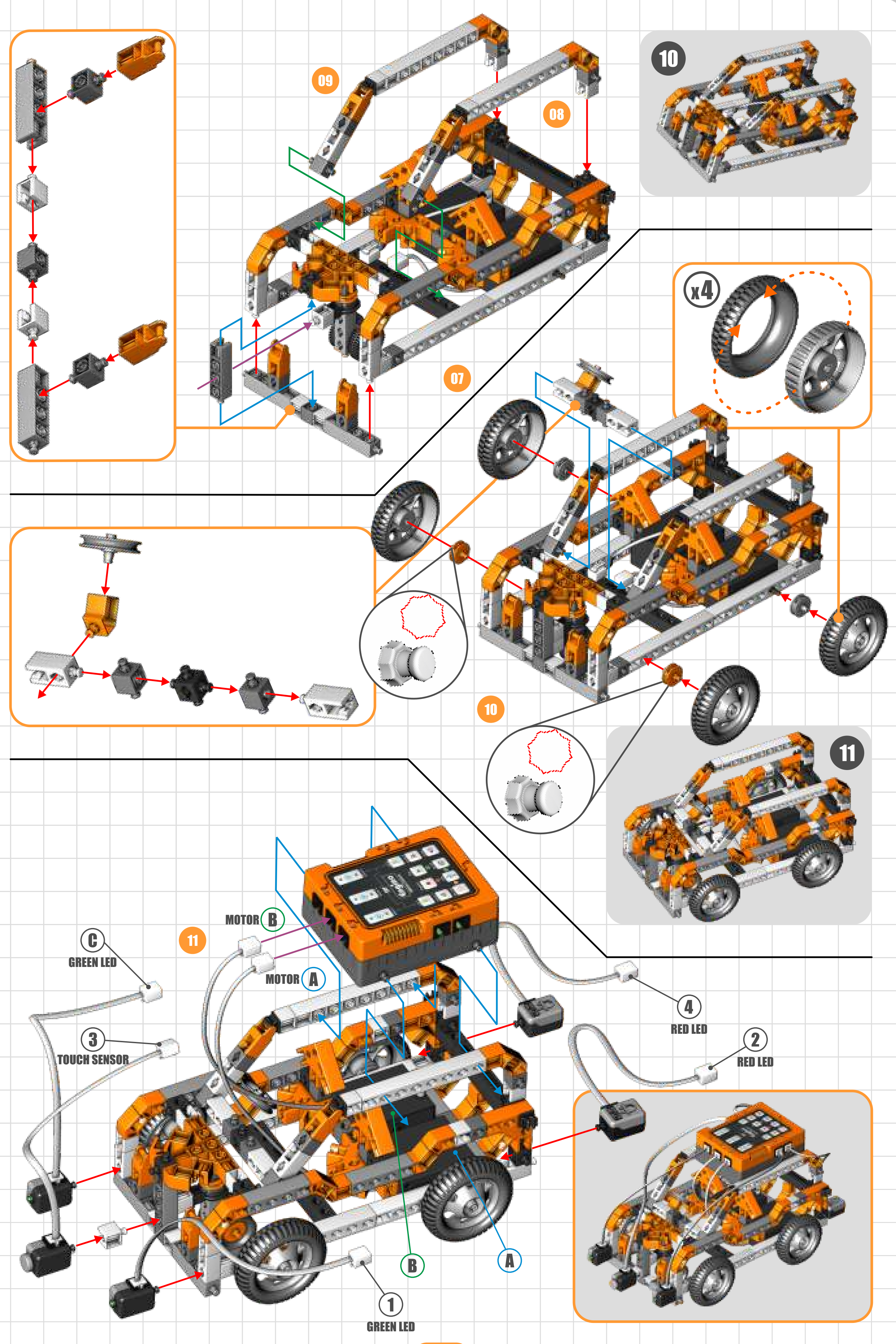
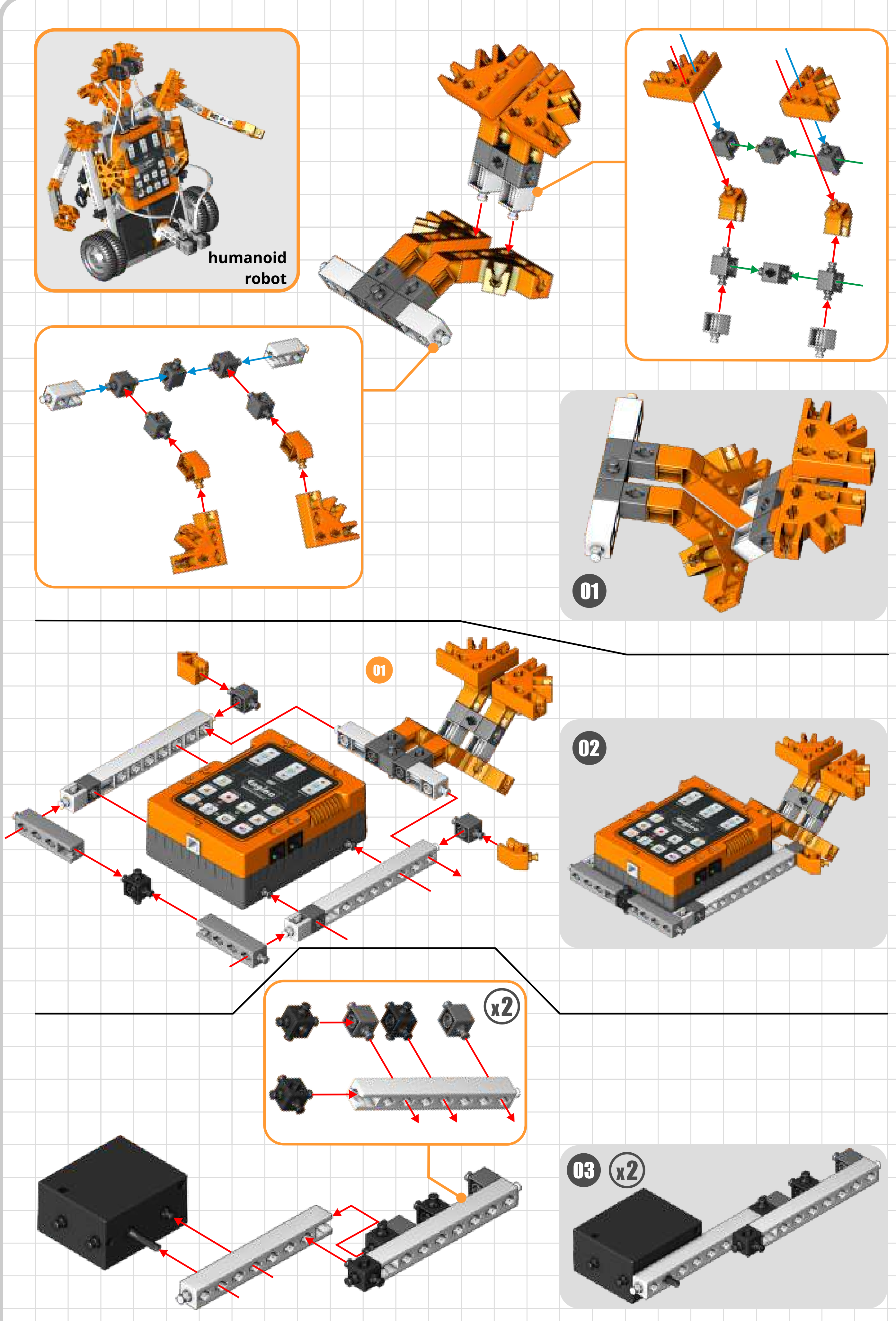
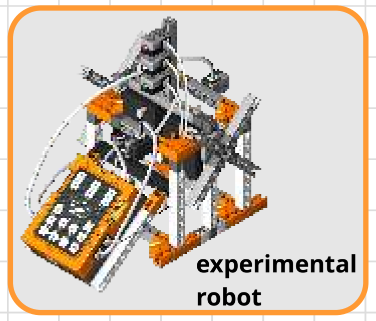
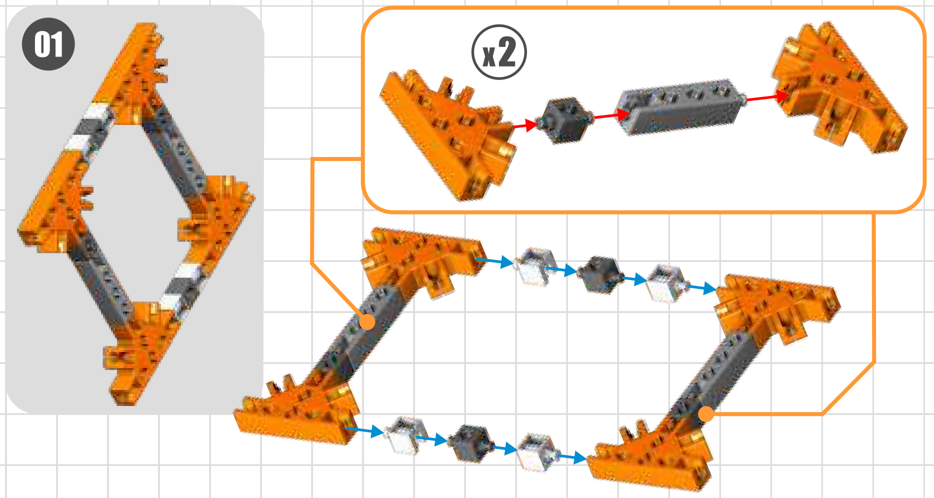
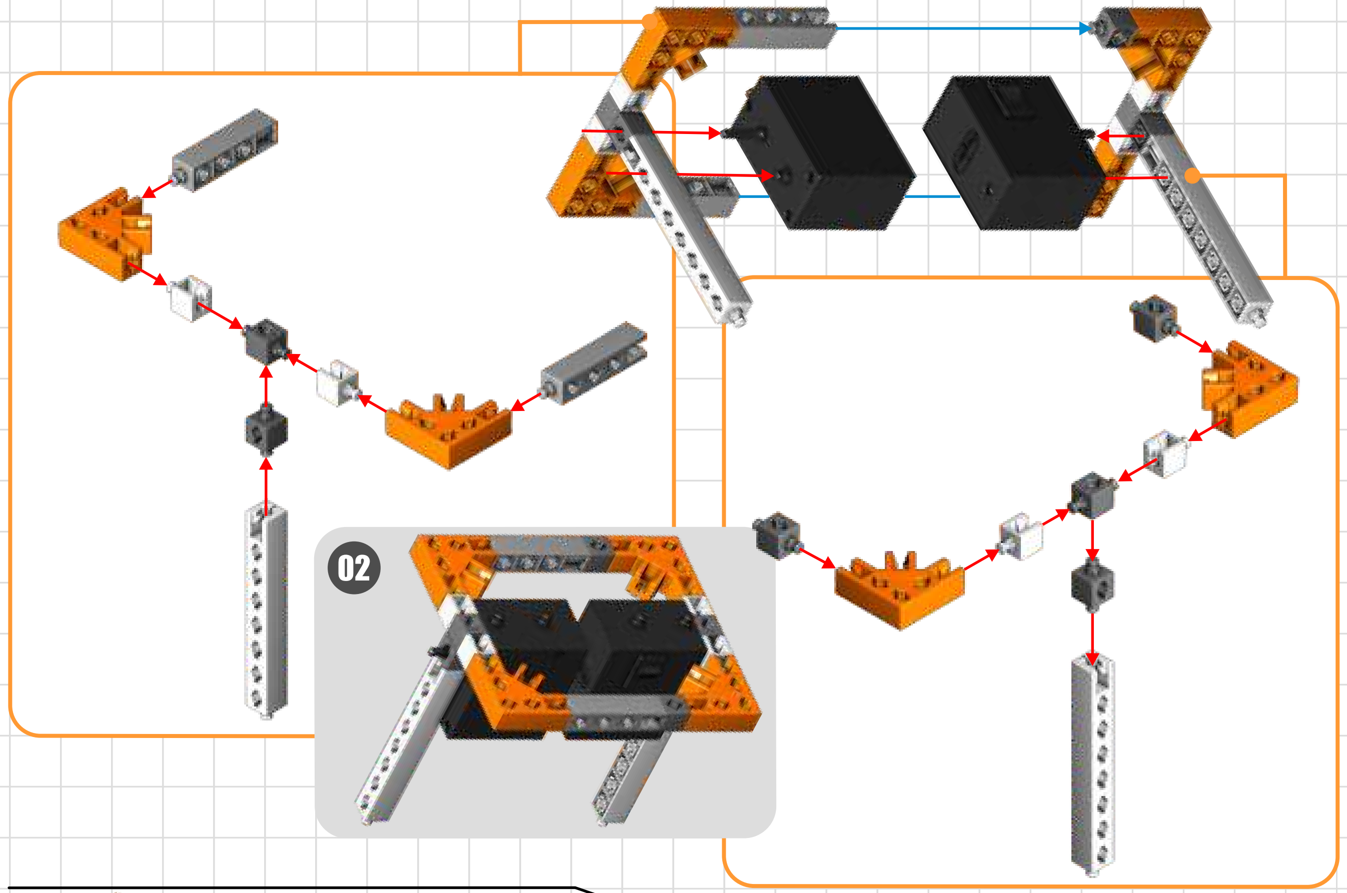

09
08
10
07
x4
10
11
MOTOR B
MOTOR A
C
GREEN LED
11
3
TOUCH SENSOR
4
RED LED
2
RED LED
B
A
1
GREEN LED

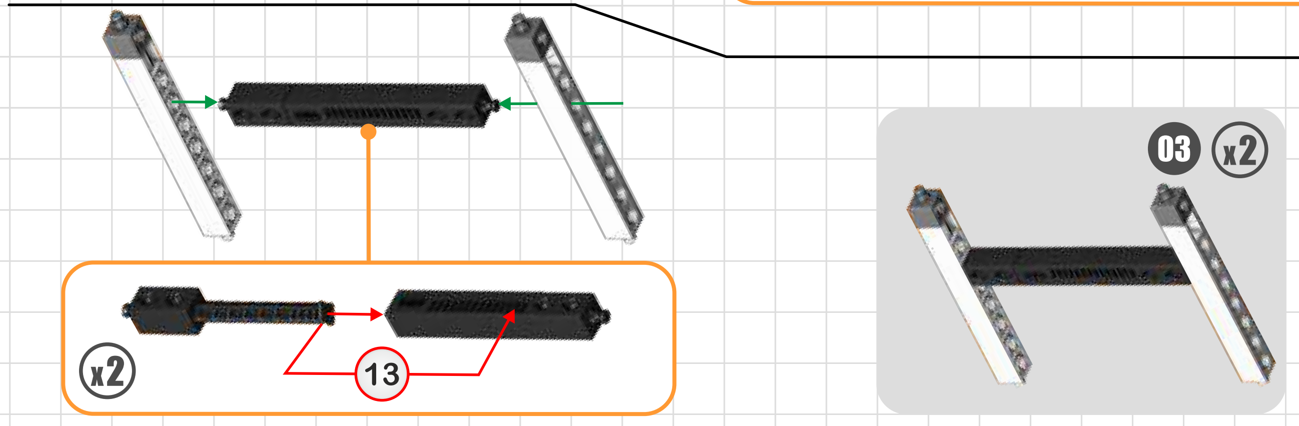

humanoid robot
01
01
02
x2
03
x2

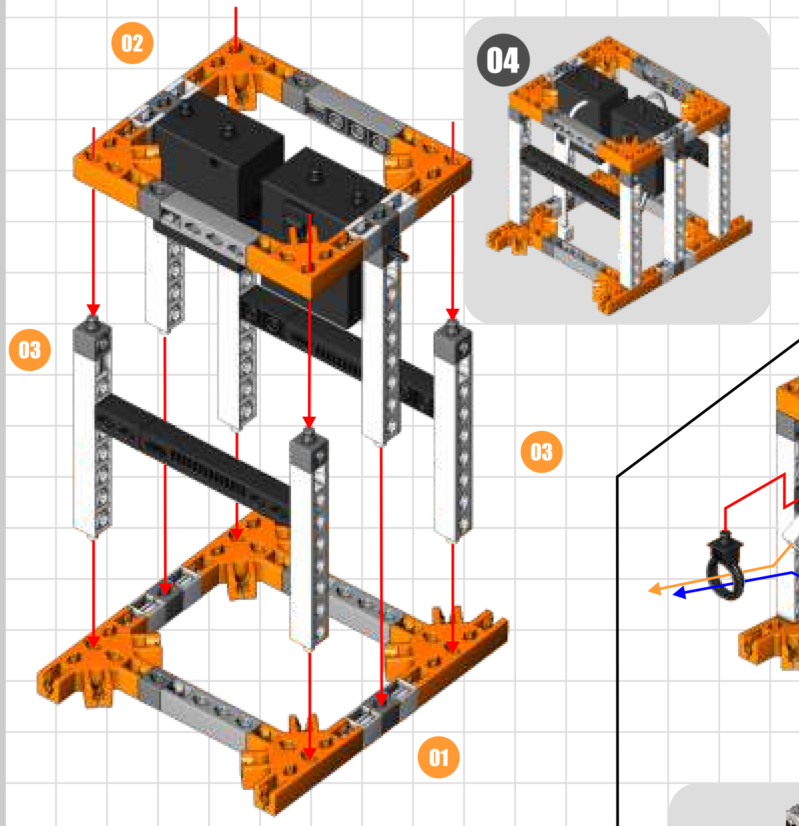
Building Instructions

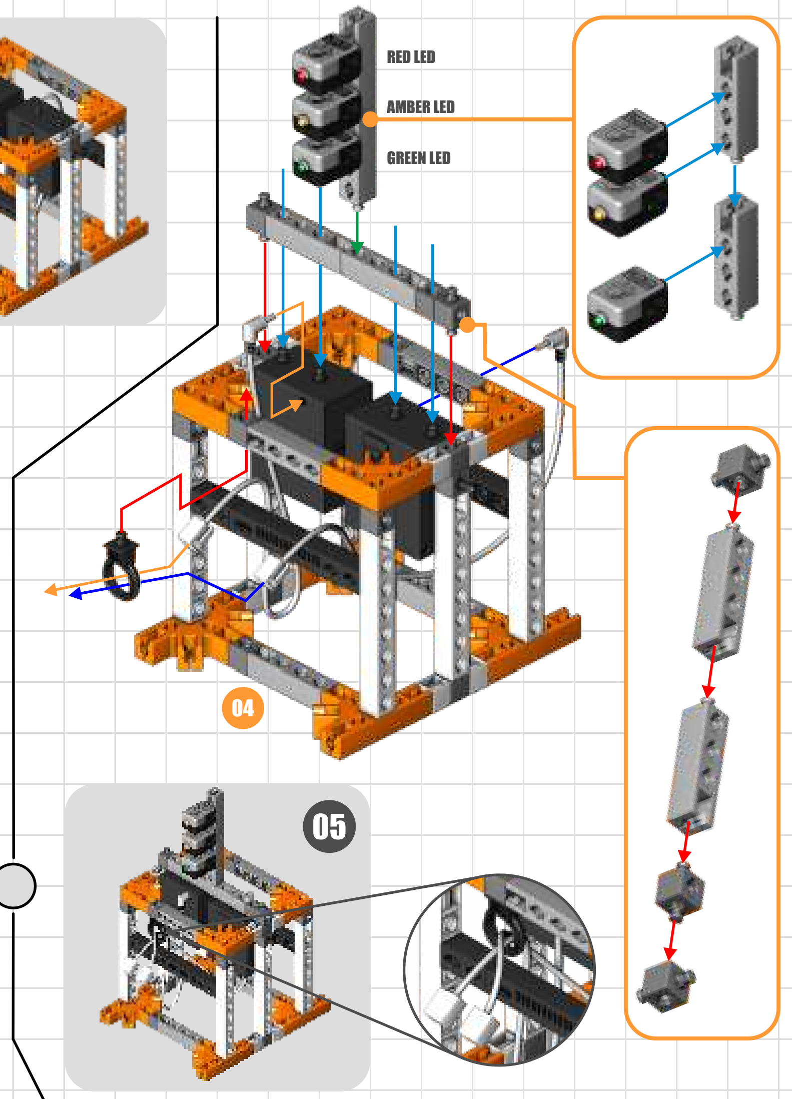


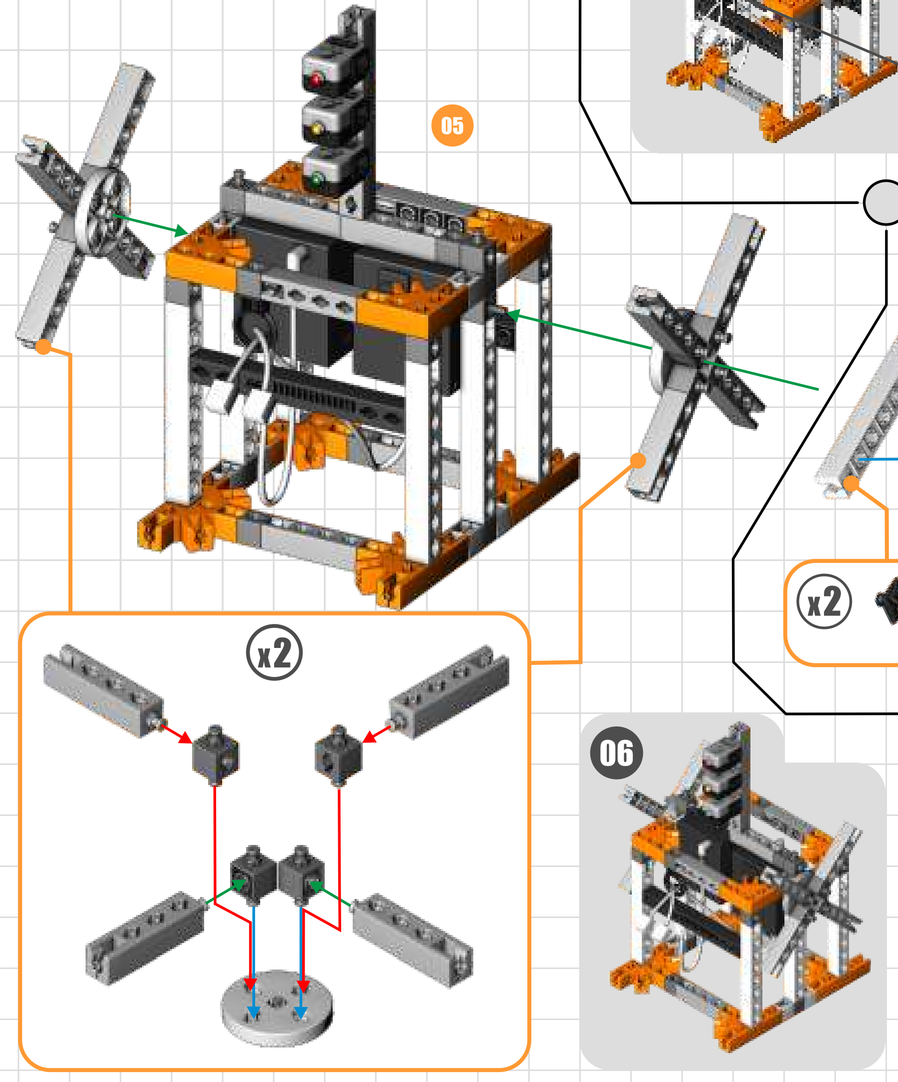


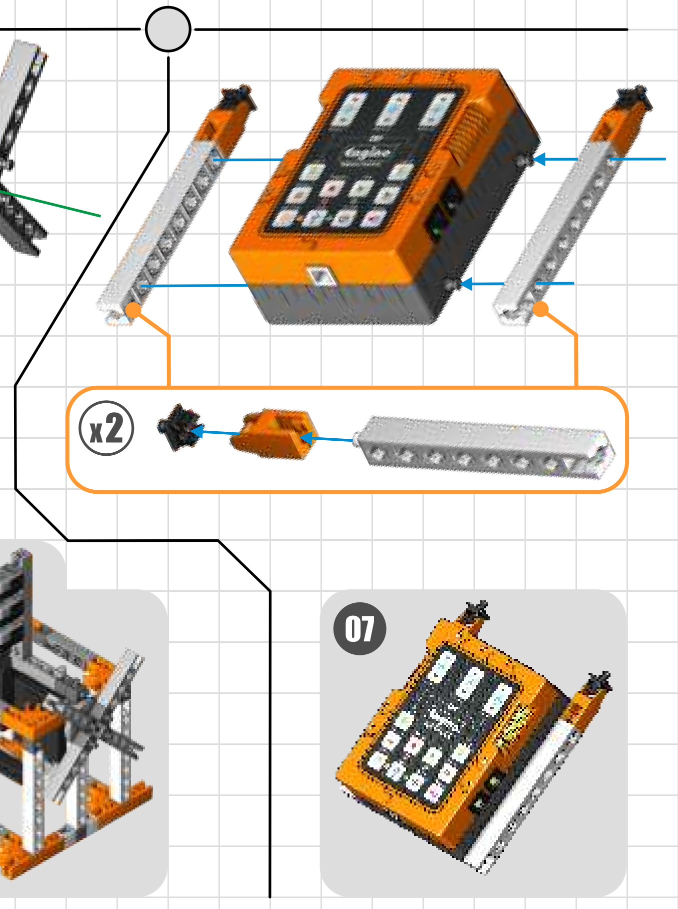


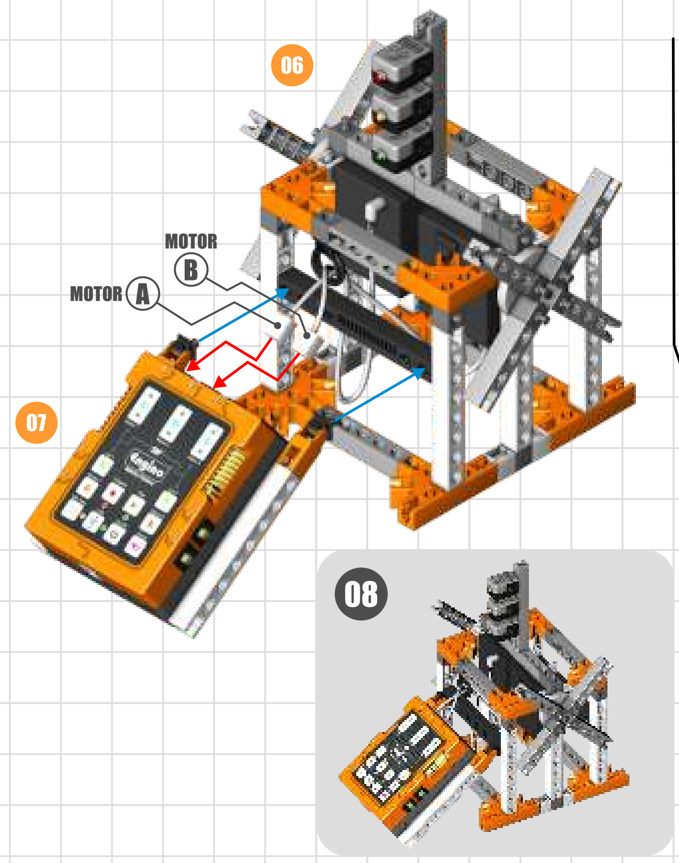




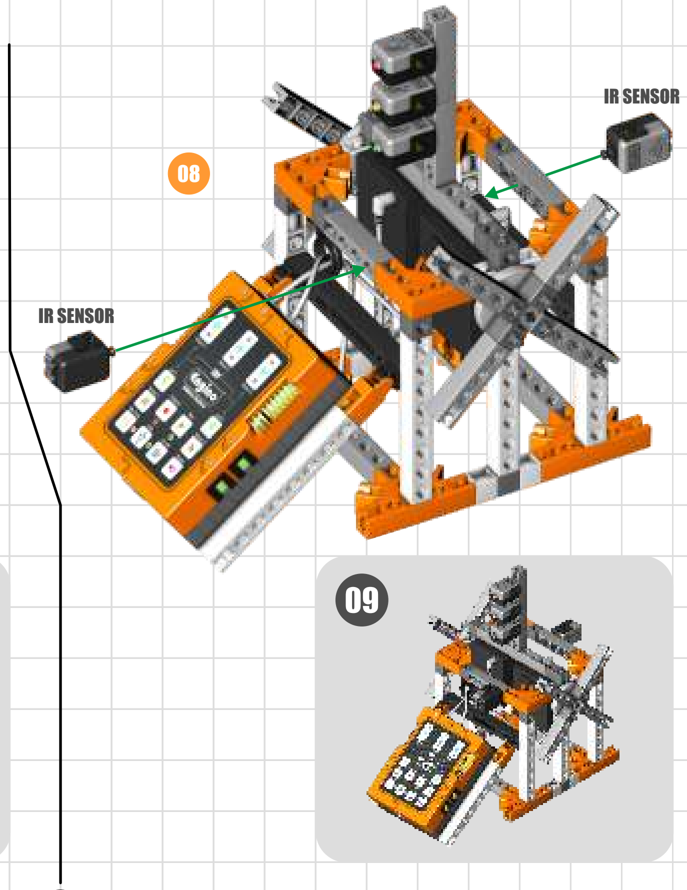




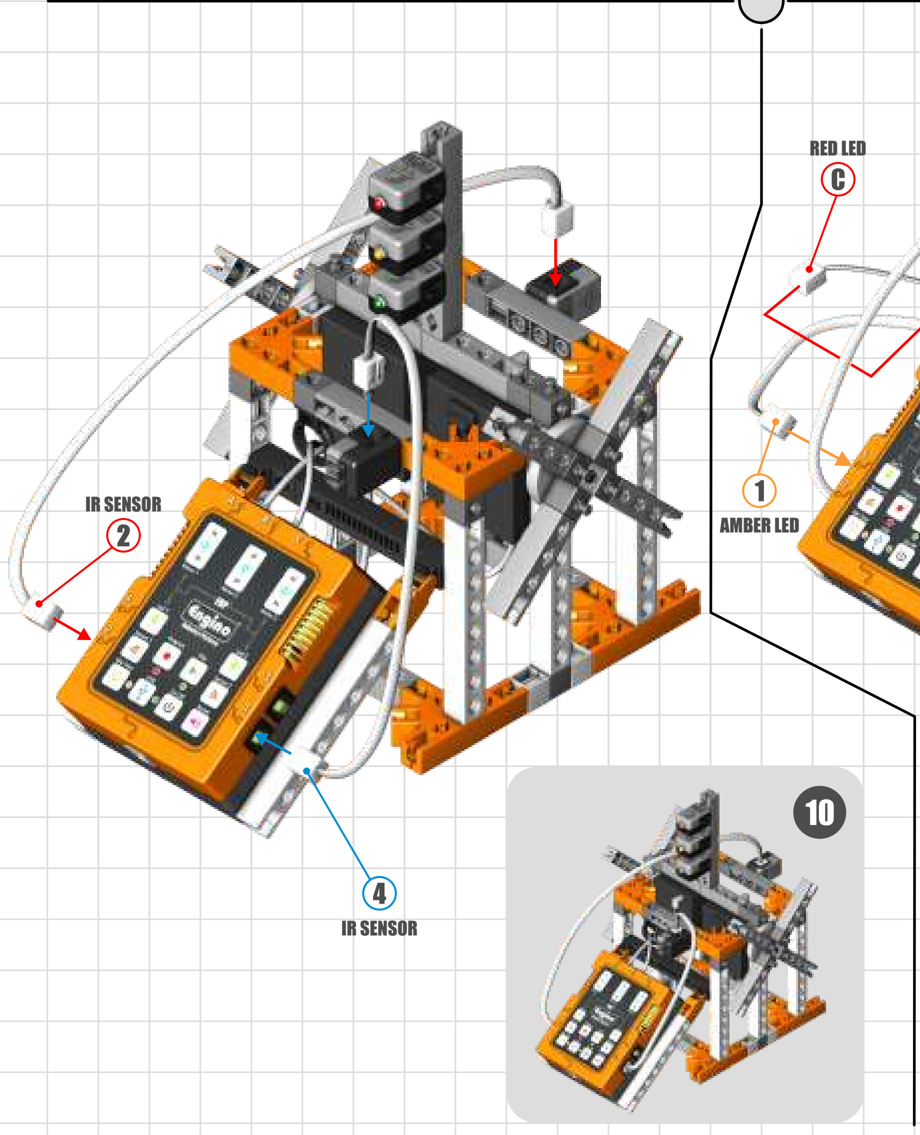




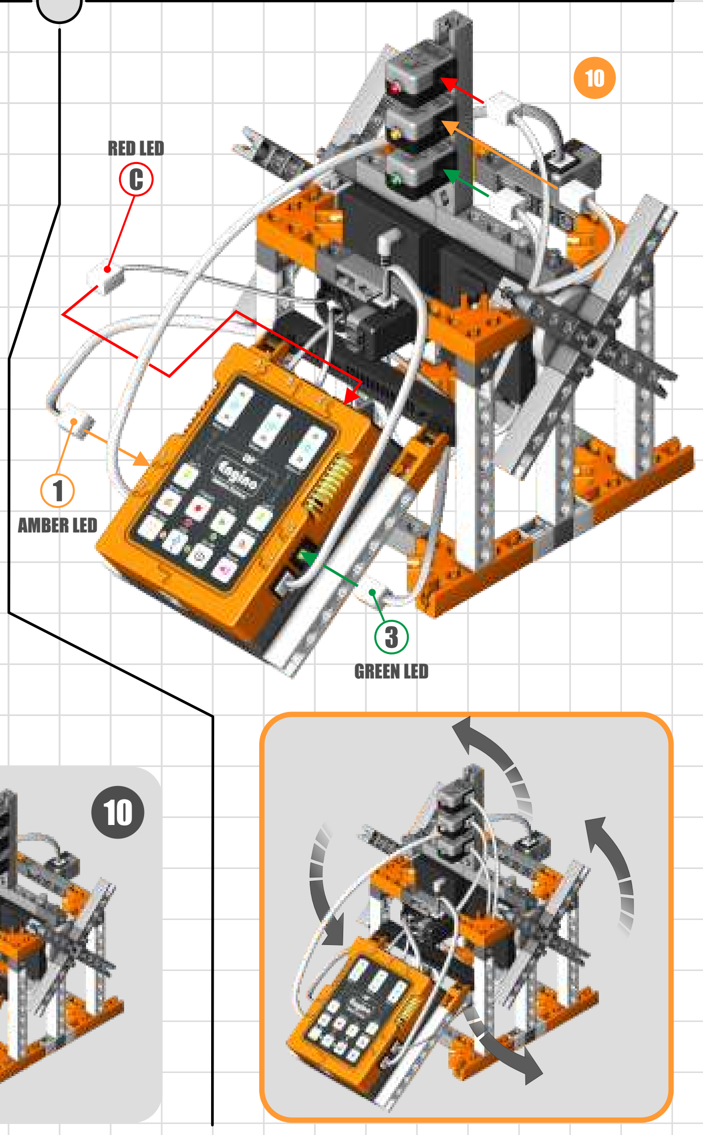
06
MOTOR
B
MOTOR
A
07
08



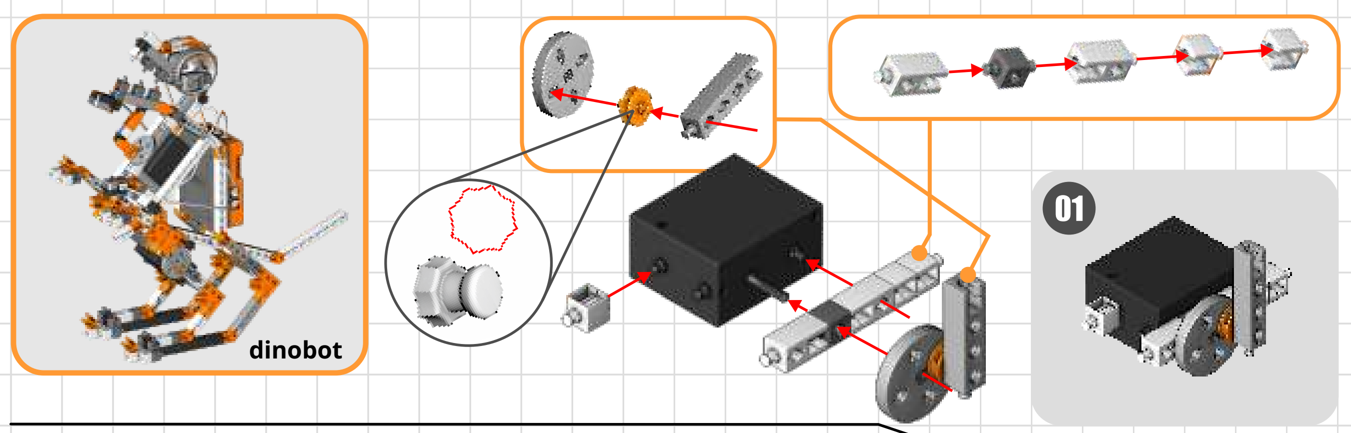
08
IR SENSOR
IR SENSOR
09



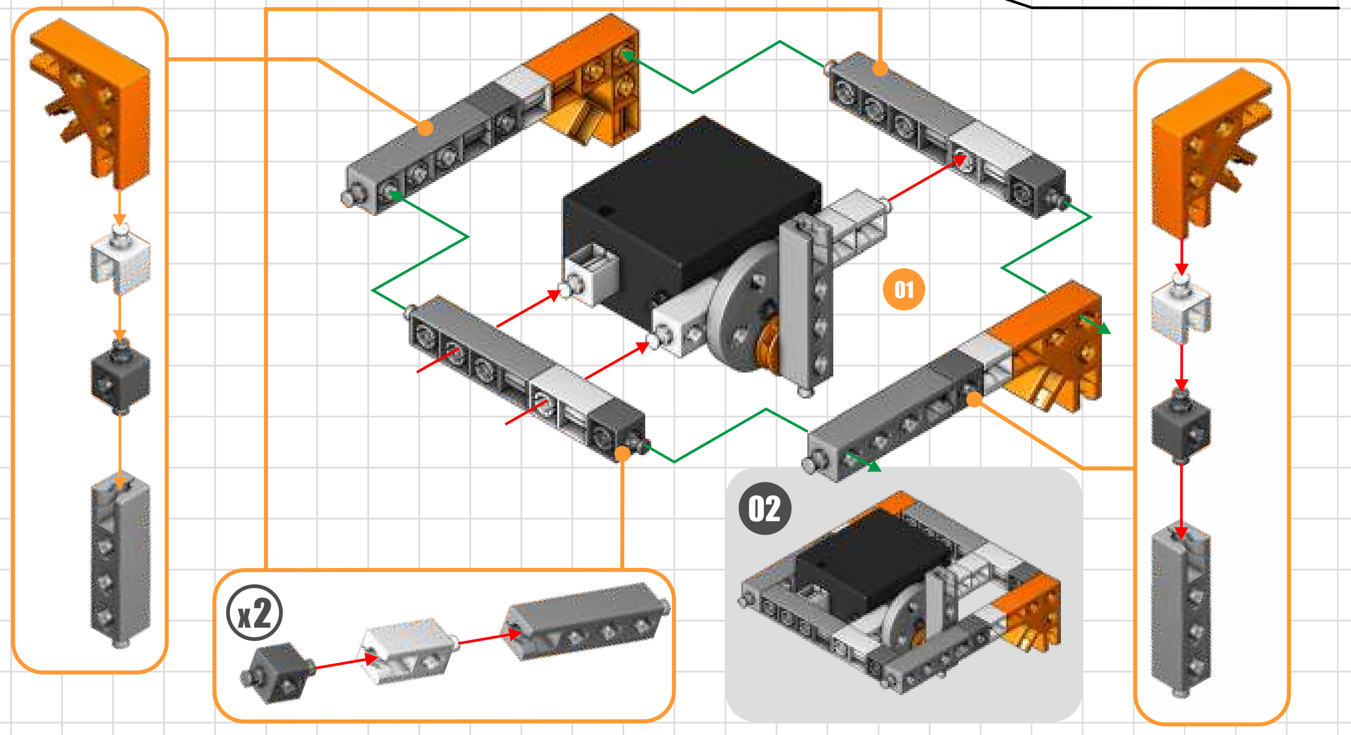
IR SENSOR
2
4
IR SENSOR
10



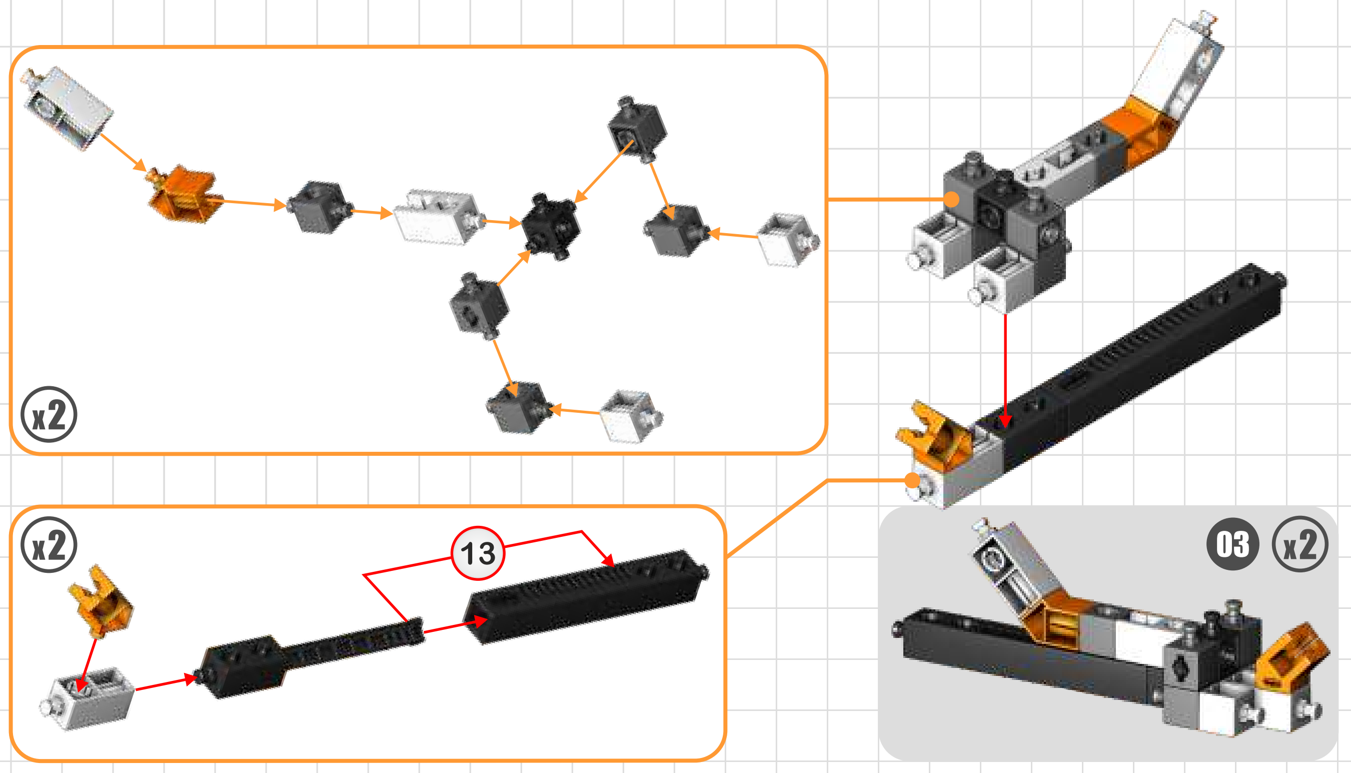
10
RED LED
C
1
AMBER LED
3
GREEN LED



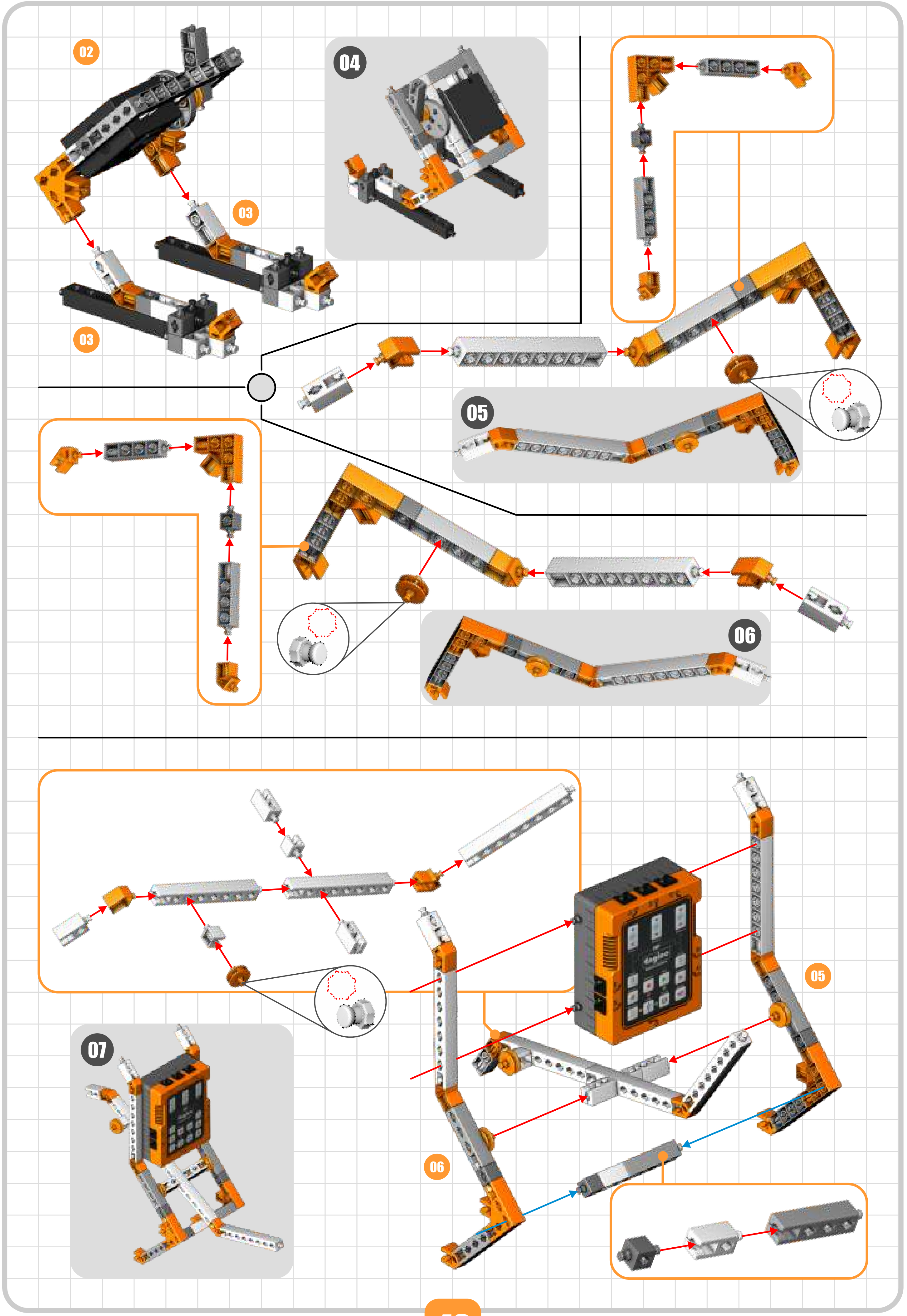
dinobot
01



01
02
x2



x2
x2
13
03
x2


02
03
03
04
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06
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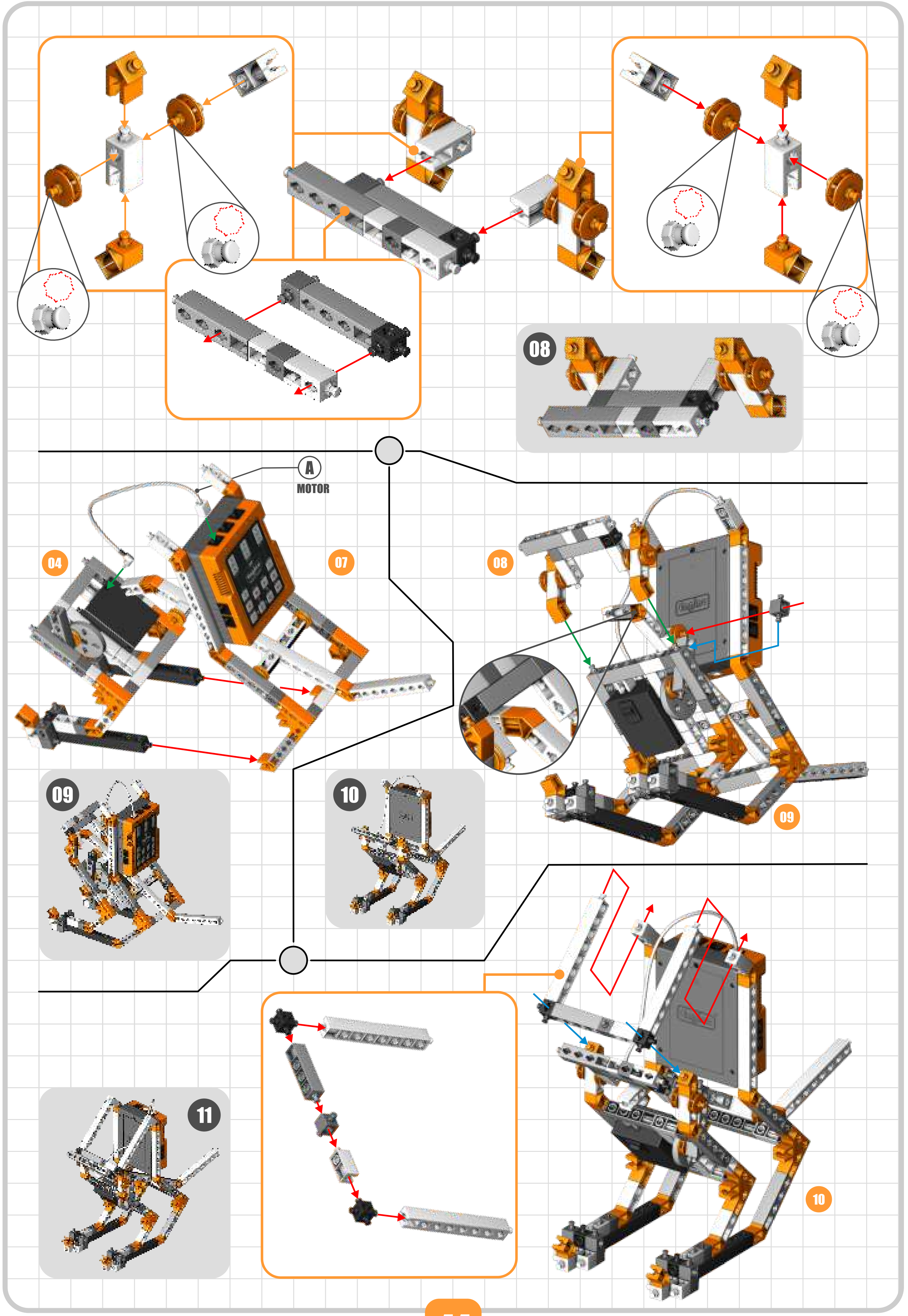
08
A
MOTOR
04
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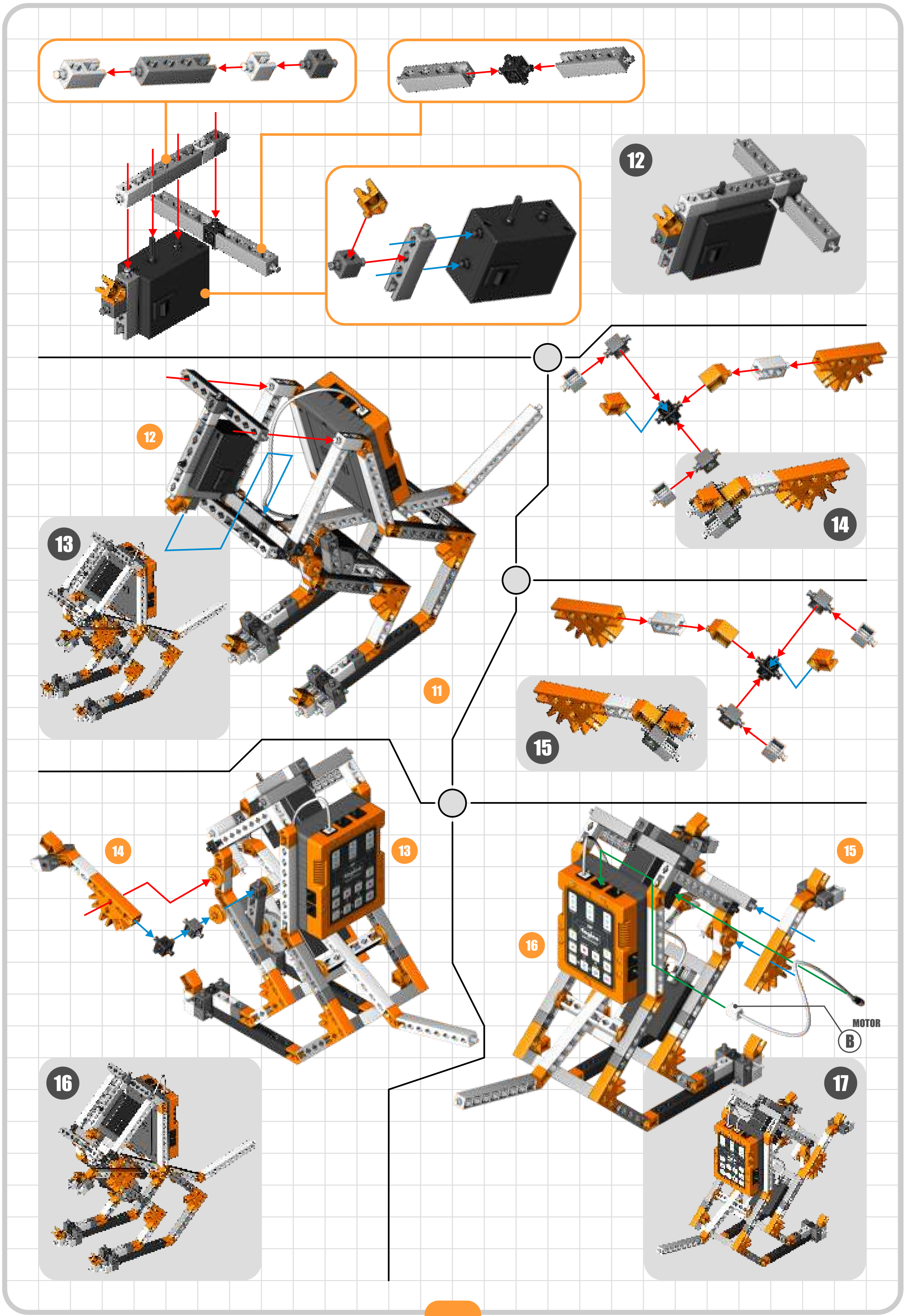
11
10


12
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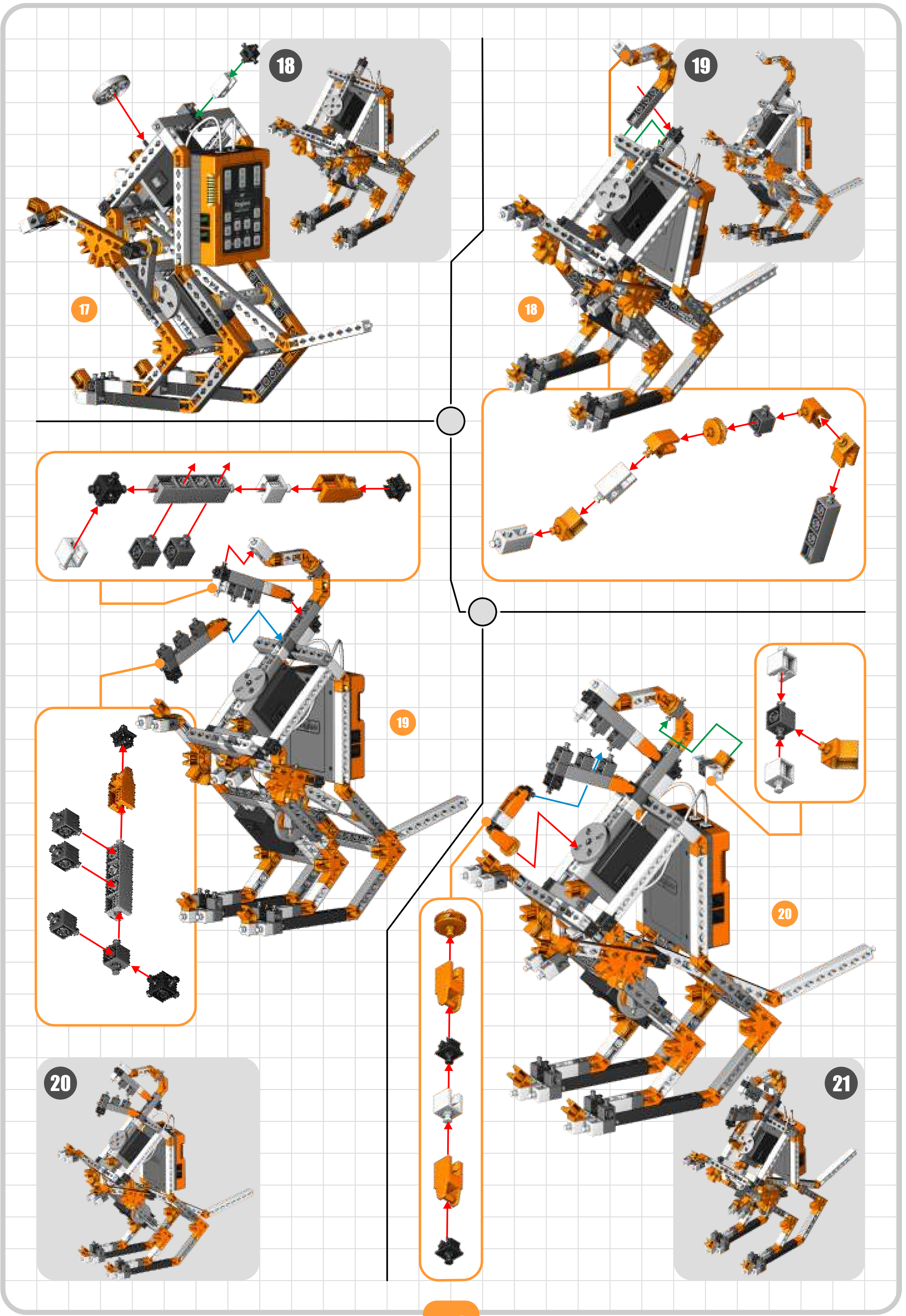
16
15
MOTOR
B
16
17


18
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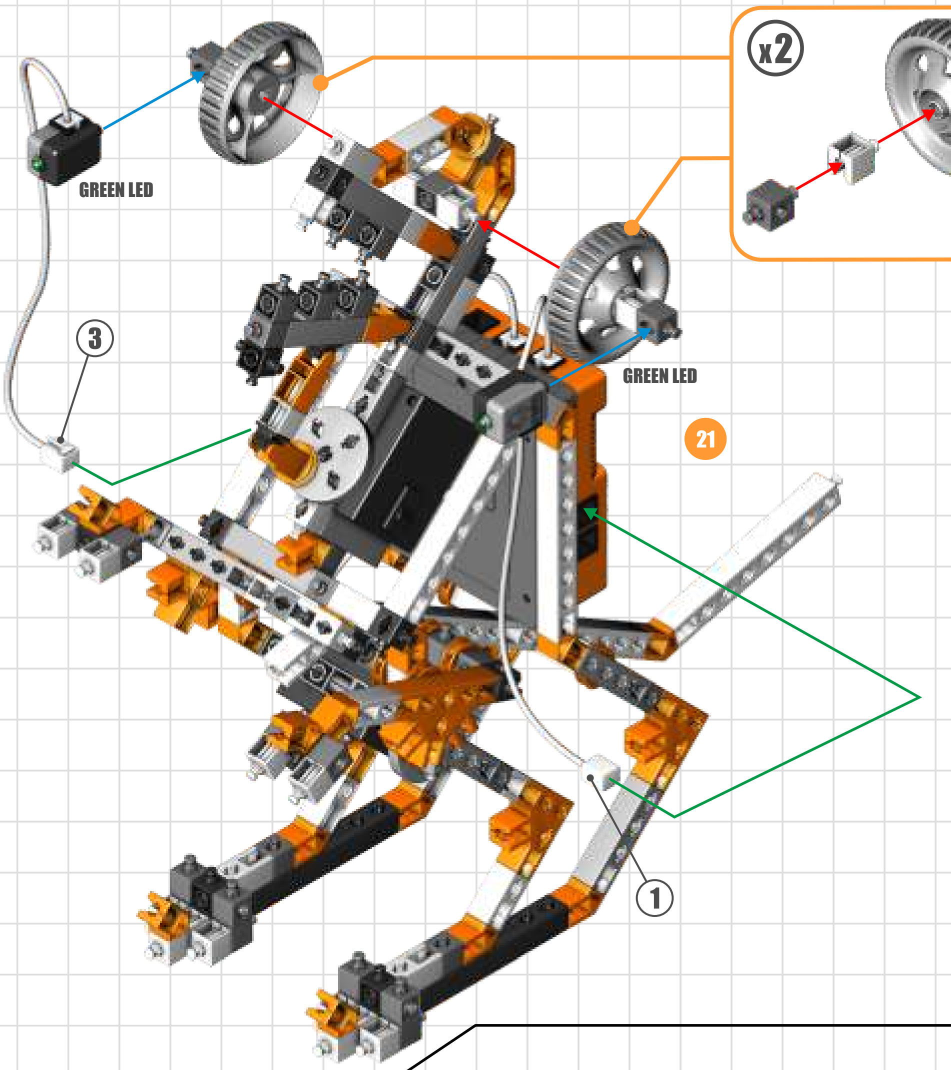
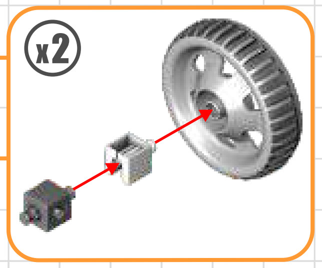
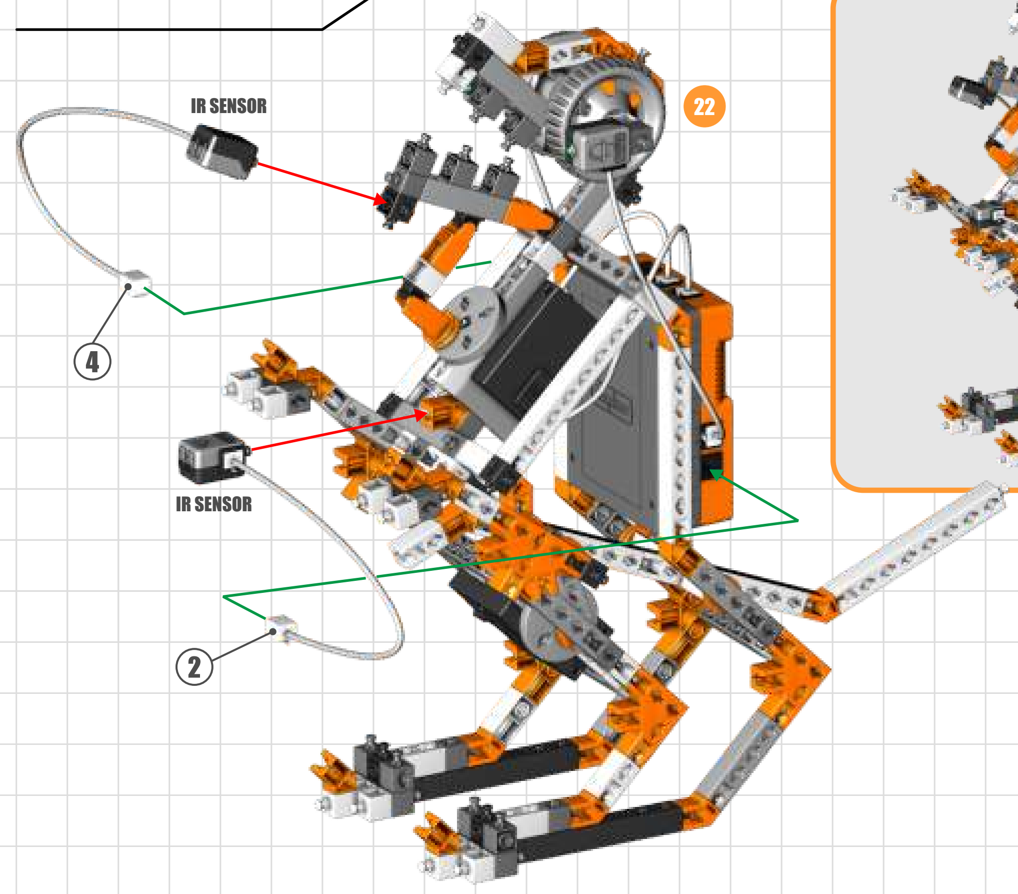
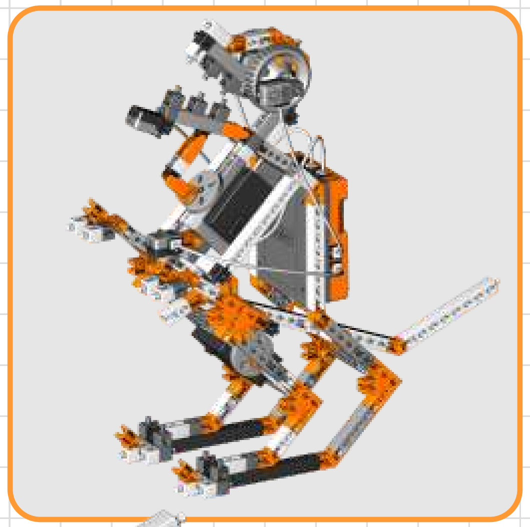
21

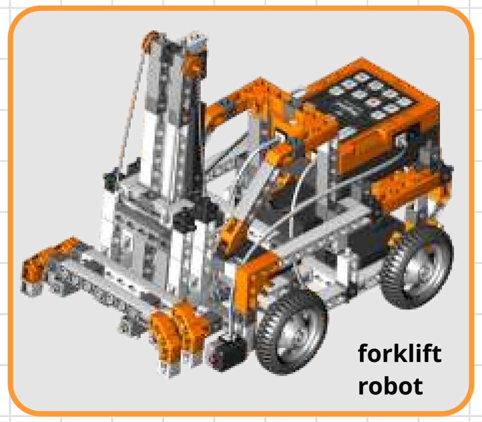

GREEN LED
GREEN LED
3
1
21

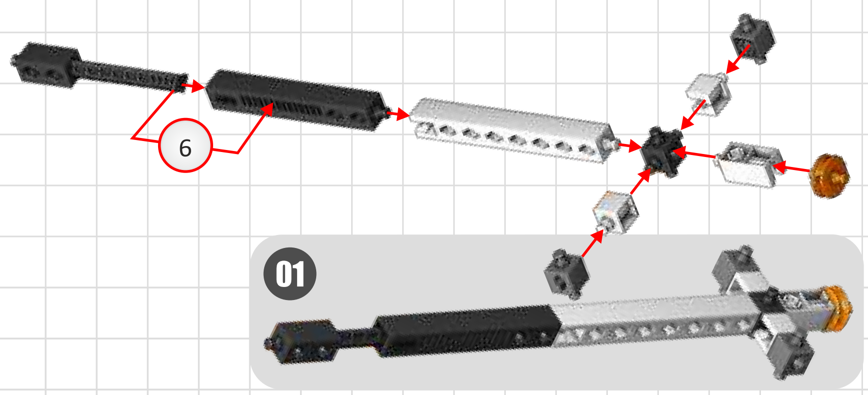

x2

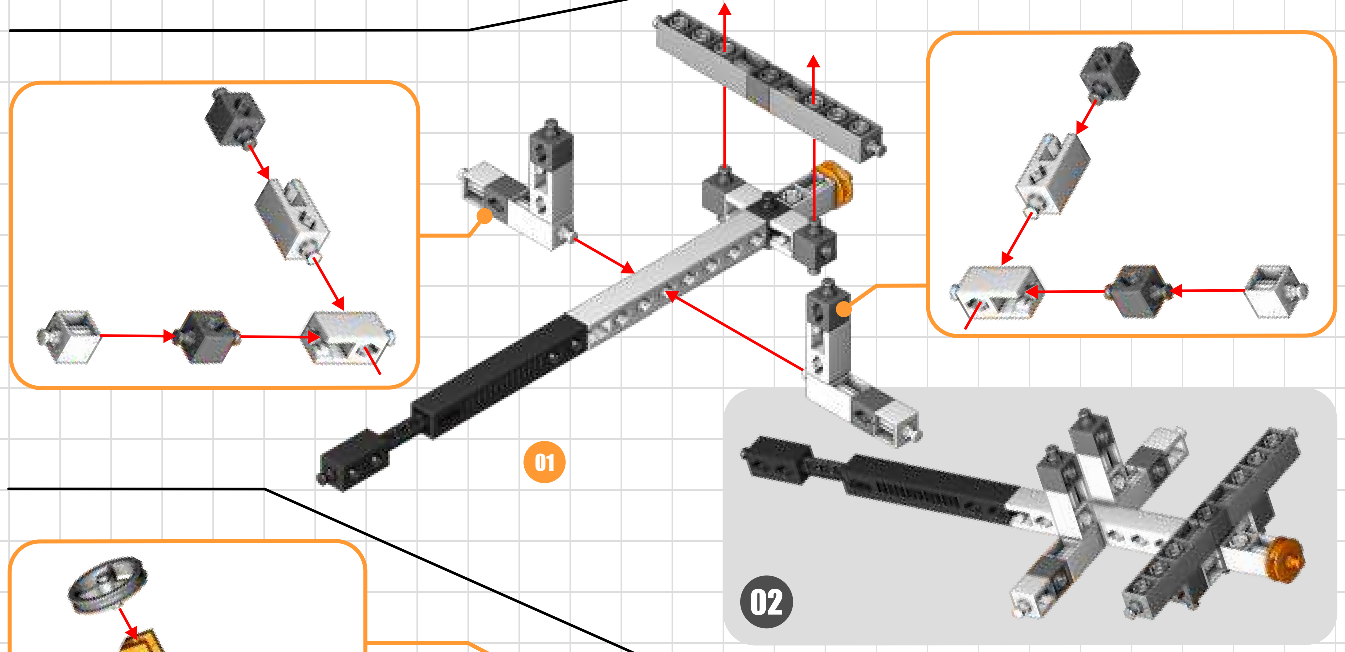
22

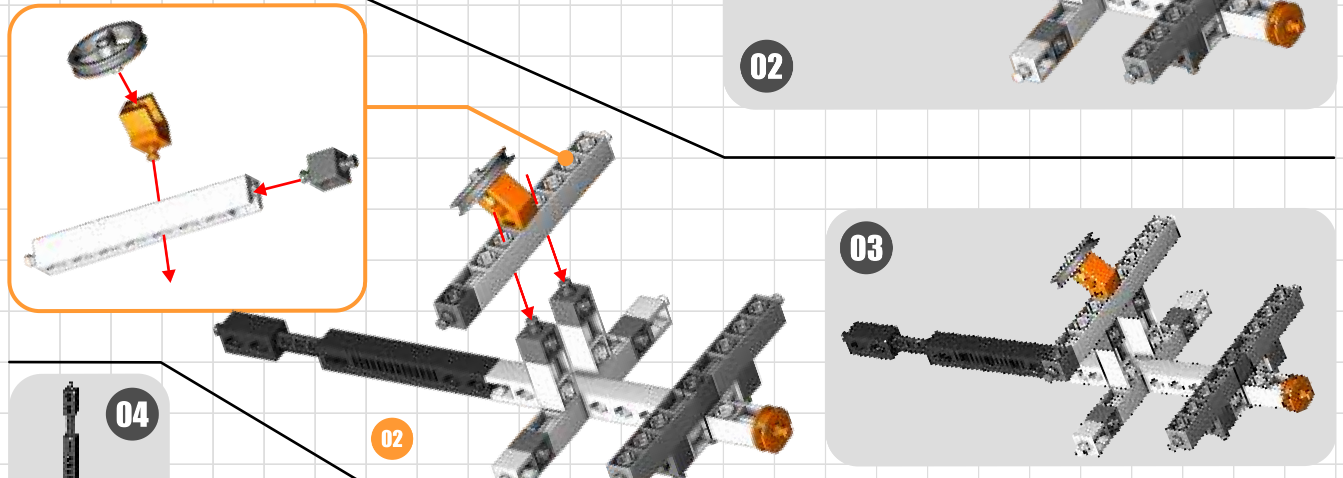

IR SENSOR
IR SENSOR
4
2
22

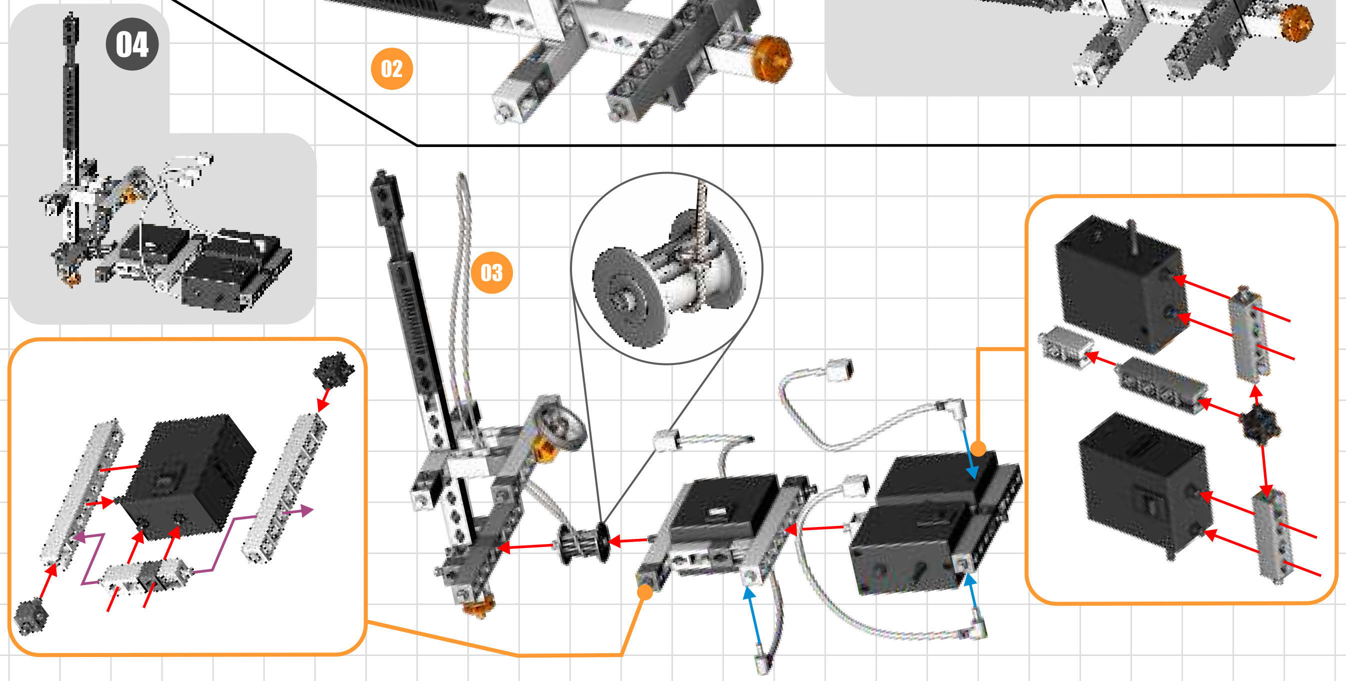



forklift robot


6
01


01
02


02
03


04
03

Learning about: ROBOTICS

Manual Programming

The Engino® Robotics Platform (ERP) is a robotic system consisting of a main controller with different buttons, able to connect with various peripherals: motors, lights and sensors. Learn how to program the ERP device manually and create a sequence of commands for traffic lights control.

Discover:

- What inputs and outputs are.
- What a command sequence is.
- How to program a robot manually.

Level Of Difficulty ★★☆☆☆

Materials Needed:
- Engino® Robotics PRO (STEM 70).

Procedure:

1. Find the instructions in **pages 39-41** and build the **experimental robot** model. Make sure you connect each cable with the correct port. You can also twist the cables around other parts so they do not get in the way. Install 3 or 6 AA batteries on the back of the ERP and power up the device by pressing the On-Off button.

2. Press the buttons (input) on the ERP in **exercise 1** and write the results you observe (output). On the motors, place the switch in position **II** and try both buttons on the ERP. Note that in position **O** the motor does not work and in position **I** direction is reversed.

3. A useful function of the ERP is the ability to record the buttons' sequence. To test this, press the "Program" button to record the sequence in **exercise 2**. To save recording press the "Program" button again and then "Play" to test it. You can make many trials until you find the corresponding buttons.

4. Did you notice that there is no delay time between the button pushes during the playback? Read **exercise 3** to add this.

5. Use what you have learnt so far in order to create a program concerning traffic lights control. If you are unsure about the correct order you can review it in **exercise 4**.

Engino® experimental robot

Exercise 1. Push the buttons on the ERP device (input) and write briefly the outcome you observe on the model (output).

Input		Output
Motor 1	→	motor switch in position **II** →
Motor 2	→	motor switch in position **II** →
Motor 3	→	
LED 1	→	
LED 2	→	
Buzzer	→	

Exercise 2. Press "**Program**" (the red flashing light indicates that the program is being recorded) and then the necessary buttons in order to create the following sequence:

- *left fan rotates clockwise;*
- *both fans rotate at the same time in any direction;*
- *red LED on;*
- *orange and green LEDs on at the same time.*

Once you finish, press the "**Program**" button again to save the program and then press the "**Play**" button to check if the command sequence is correct. If you press and hold the play button for longer time the program will go into loop (endless repeat).

Exercise 3. Note that the ERP does not record the elapsed time between the button pushes and it just plays all the recordings without delay. Record again, but this time add delay between each command of exercise 2 by pushing the "Idle Time" button. Check the results on your model.

Exercise 4. Record the following sequence in order to simulate traffic lights control. Don't forget to use appropriate times:

- *red light on (cars stop);*
- *red and amber light on simultaneously (cars ready to go);*
- *green light on (cars go);*
- *amber light on (cars ready to stop);*
- *red light on (cars stop).*

Learning about: ROBOTICS

Flow diagram and ERP Simulator

A robotic system could not be complete without a programming software. The ERP software is capable of receiving a recorded program from the device or send a program to it. Wake up the dinobot first manually and then through the software by using the ERP simulator, the digital version of the actual ERP controller.

Discover:

- How to reverse-engineer a program.
- How to use the ERP simulator.
- What a flow diagram is.

Level Of Difficulty ★★☆☆☆

Materials Needed:
- Engino® Robotics PRO (STEM70).
- Computer with ERP software downloaded (www.enginorobotics.com) and installed.

Procedure:

1. Find the instructions in **pages 42-47** and build the **dinobot** model. Lets wake it up, by recording the sequence of **exercise 1**.

2. Connect the ERP device with the PC using the USB cable. **Open** the *Engino Robotics Platform Pro 1.2* software and click the **Connect USB** button.

3. Click the "**Receive Program**" button, so the recorded sequence is uploaded on the computer. A vertical line of blocks should appear, called "**flow diagram**".

4. Click the "**ERP Simulator view**" button and answer **exercise 2**.

5. Follow **exercise 3** to learn more about the action blocks and their variables on the flow diagram. Make changes by dragging and dropping the blocks. Right-click on each one (motor, light, buzzer and idle), observe the pop-up windows and complete the table.

6. Clear the screen by clicking the icon "**New**". Click the "Program" button on the simulator (on the computer) and record the same program as in procedure 1. Observe what happens to the model and on the screen.

7. Make changes on the flow diagram, according to **exercise 4**. Send the program to the ERP by clicking the "**Send Program**" button and check it. **Save** the program as ***"dinobot"***.

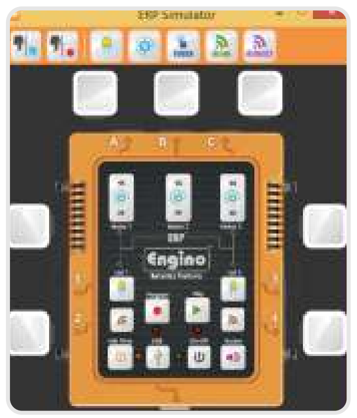
Engino® dinobot

Exercise 1. Using the ***dinobot*** model record the following sequence:

- *both green LEDs on at the same time (eyes open);*
- *motor 2 rotates clockwise (mouth opens);*
- *motor 2 rotates anti-clockwise (mouth closes);*
- *motor 1 rotates clockwise (small legs move);*
- *buzzer on (dinobot roars).*

Upload your program on the computer (see steps 2 and 3).

Exercise 2. Drag and drop the peripherals (motors, LEDs and sensors) into the ports of the ERP simulator, according to the dinobot model. Make sure that you set them up correctly as this affects the program and the way your robot will behave. Design them here as well.



Exercise 3. In the flow diagram, **delete** the first motor icon (**drag and drop** in the bin) and **add** an "**Idle**" icon (from the left). Tick the boxes below to indicate which variables can be changed for each action block.

Can you modify...?	*port*	*time*	state	direction	*delay*	*after/ with prev.*	*speed*
Motor							
LED							
Buzzer							
Idle							

Exercise 4. On the flow diagram make the following changes:

- *the eyes light up at the same time and blink 2 times;*
- *the mouth opens and closes (use only one block);*
- *there is sound at the same time that the mouth moves;*
- *there is delay for 2 seconds and then the small legs move;*
- *the program should repeat for 2 times, not forever.*

Tip: for this, right-click on the "**start**" block to choose the number of repeats, also called **loops.**

Learning about: ROBOTICS

EnginoRobot app and GamePad

There are many ways to control your Engino® robots. One of them is through the EnginoRobot application for smart devices with a wireless Bluetooth connection. Try also the Engino® GamePad within the software and notice the difference between manual button control and digital programming.

Discover:
- How to control your robot wirelessly.
- Why controlling your robot using digital programming is usually better than manual programming.

Level Of Difficulty ★★☆☆☆

Materials Needed:
- Engino® Robotics PRO (STEM70).
- Computer with ERP software installed.
- Smart device with Android or iOs operating system and the EnginoRobot BT app installed.

Procedure:

1. Find the instructions in **pages 48-52** and build the **forklift robot** model with its load. Put motors' switches in position **II**.

2. The ERP can connect wirelessly with a smart device. To enable this feature, push **idle time** button, find the ERP's Bluetooth network through the EnginoRobot BT app and connect.

3. You can use the app the same way as the actual device. Test the digital buttons and program your model according to **exercise 1**.

4. Upload the program on the software of the computer (through USB). Follow instructions in **exercise 2** about the "**TextEditor**" window.

5. Click on the "**GamePad**" button and choose ports **A-B** on the pop-up window. Click to test the arrows and answer **exercises 3** and **4**.

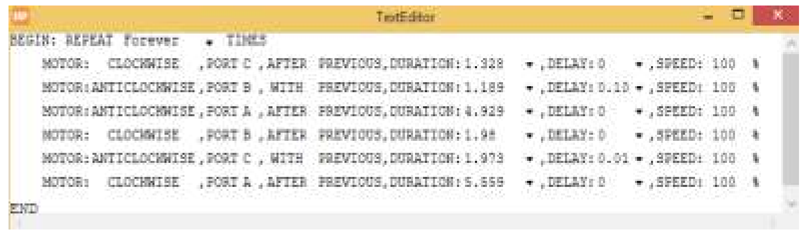
6. Use the GamePad and the Simulator to record the sequence described in **exercise 5**.

Engino® forklift robot

Exercise 1. On your smart device record the following sequence:
- *the forklift robot moves forward;*
- *the teeth lift the load;*
- *the forklift moves backwards;*
- *the teeth lower the load.*

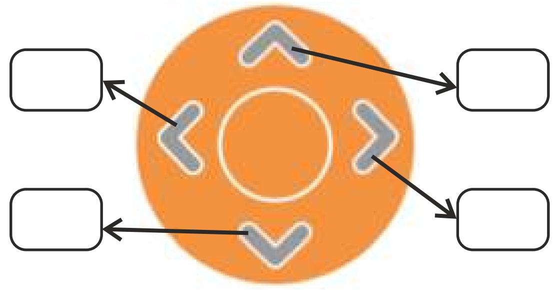
Tips: to move forward and backwards you should tap on two motor buttons at the same time. Test which is the correct direction for each one.

Exercise 2. Use your mouse and keyboard in order to make necessary changes on different variables inside the TextEditor (speed, duration, direction of motion and delay), so that the forklift model executes its work more accurately. Circle the changes you have made on the picture below.



```
BEGIN: REPEAT Forever   ▾ TIMES
    MOTOR:   CLOCKWISE   ,PORT C ,AFTER  PREVIOUS,DURATION:1.328  ▾ ,DELAY:0    ▾ ,SPEED: 100  %
    MOTOR:ANTICLOCKWISE ,PORT B , WITH  PREVIOUS,DURATION:1.189  ▾ ,DELAY:0.10 ▾ ,SPEED: 100  %
    MOTOR:ANTICLOCKWISE ,PORT A ,AFTER  PREVIOUS,DURATION:4.929  ▾ ,DELAY:0    ▾ ,SPEED: 100  %
    MOTOR:   CLOCKWISE   ,PORT B ,AFTER  PREVIOUS,DURATION:1.98   ▾ ,DELAY:0    ▾ ,SPEED: 100  %
    MOTOR:ANTICLOCKWISE ,PORT C , WITH  PREVIOUS,DURATION:1.973  ▾ ,DELAY:0.01 ▾ ,SPEED: 100  %
    MOTOR:   CLOCKWISE   ,PORT A ,AFTER  PREVIOUS,DURATION:5.555  ▾ ,DELAY:0    ▾ ,SPEED: 100  %
END
```

Exercise 3. Do the wheels rotate in the same direction when each of the 4 arrows are pressed? Write **YES** or **NO** in the boxes.



Exercise 4. How the model turns (refer to the wheels' direction)?

....

....

....

Exercise 5. With the help of the GamePad and the Simulator record the following sequence:
- *the forklift robot moves forward and then turns to the right;*
- *the forklift robot moves forward until it finds the load;*
- *the teeth lift the load;*
- *the forklift robot turns to the left;*
- *the teeth lower the load.*

Learning about: ROBOTICS

Functions, touch sensor, IF and IF/ELSE statements

Decision making is what distinguishes a real robot from an automated machine. This task is made possible by sensors which receive feedback from the environment helping the robot to decide what action to follow according to its program. Learn about the touch sensor and the IF conditional statement below.

Discover:
- How to use functions.
- How to use a touch sensor.
- What an IF conditional statement is.
- What an IF/ELSE conditional statement is.

Level Of Difficulty ★★★☆☆

Materials Needed:
- Engino® Robotics PRO (STEM70).
- Computer with ERP software installed.

Procedure:

1. Find the instructions in **pages 53-55** and build the **jeep car robot** model.

2. Make sure you connect all cables correctly. The touch sensor must be connected in **port 3** of the ERP controller.

3. Open the *ERP* software and follow the instructions in **exercise 1**. You can use a **function** block to save the subprogram of moving forward. Once finished, send the program to the ERP and test it. Save it as "**jeep forward**".

4. Add the necessary blocks on the program you just made in order to create the program of **exercise 2**. Save it as "**jeep forward-turn**".

5. What happens if the model finds another obstacle in its path? Follow the instructions of **exercises 3 and 4** to learn about the **touch sensor** and the **IF statement**. Use this to program your model, so that it reacts in every obstacle it finds accordingly. Save the program as "**jeep touch-IF**"

6. Create a more challenging program with the **if/else statement** in **exercise 5.**

Engino® jeep car robot

Exercise 1. On the computer, place the correct icons on the ERP simulator according to the jeep car robot model. Drag and drop the necessary blocks inside the flow diagram in order to create the following program:
- *the jeep moves forward for 3 seconds and the front LED lights are both on at the same time.*

Tip: use a "function" block to save the subprogram "move forward". Use the after/with previous command accordingly and set the program to activate only once.

Exercise 2. Place an obstacle in front of the jeep car robot. Make the necessary changes on the program of exercise 1 above so that:
- *the jeep moves forward for 3 seconds and the front LED lights are both on at the same time until it gets close to the obstacle;*
- *the jeep moves backwards for 1 second with all lights on;*
- *the jeep turns 90 degrees to the right with front LED lights on.*

Tip: in order for the jeep to turn, you can either set the wheels to turn in reverse or stop one wheel from moving altogether. Also, conduct several tests to adjust the appropriate time needed to turn.

Exercise 3. Drag and drop the IF statement block in the flow diagram. Right-click on it and write below which variables can be modified (ignore "advanced" tab).

....

....

Exercise 4. Use blocks inside the IF statement so that:
- *the jeep moves forward **continuously** and the front LED lights are both on at the same time;*
- ***if** the touch sensor is pushed, then the jeep should go backwards for 1 second with all lights on and turn 90 degrees to the right with front LED lights on.*

Tip: place the blocks that you used in exercise 2 inside the If statement and change the program so that it repeats forever.

Exercise 5. Drop the blocks inside the IF/ELSE statement so:
- *the jeep moves forward **continuously** and the front LED lights are both on at the same time;*
- ***if** the touch sensor is pushed, then it should go backwards for 1 second with all lights on and turn 90 degrees to the right with front lights on. **Else** an interrupted beep should sound.*

Learning about: ROBOTICS

IR sensor, WHILE statement and logic gates

Infrared sensors are used very frequently in robotics in two very important applications: for distinguishing between black and white colours and for object detection. Try both programming challenges and learn how to configure the IR sensors, how to use the WHILE conditional statement and logic gates.

Discover:
- How to use the infrared sensor.
- What a WHILE conditional statement is.
- What logic gates are.

Level Of Difficulty ★★★★☆

Materials Needed:
- Engino® Robotics PRO (STEM70).
- Computer with ERP software installed.
- 4 x A3 white carton papers.
- Black sticky tape or black marker.
- 4 white objects for detection.

Procedure:

1. Find the instructions in **pages 56-58** and build the **humanoid robot** model.

2. Stick the A3 papers together as to create a big white rectangle. Draw a black ellipse, 5cm thick, using a marker or sticky tape (see picture on the right). You can also download another path at www.enginorobotics.com (teaching resources).

3. Open the *ERP PRO* 1.2 software and follow the instructions in **exercise 1**, in order to create a **black line following program**.

For this, the two **IR sensors should face the ground**, so turn them downwards.

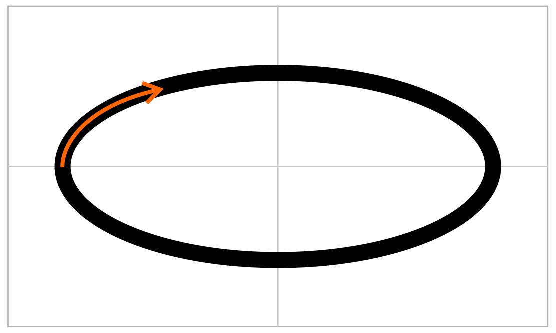
4. Read **exercise 2** in order to transform your humanoid into an **object detecting robot**. For this, turn the two **IR sensors to face forward**. Once you create the program, test it by placing four white objects (as tall as the height of the sensors) as to create an imaginary square for the robot to move along its sides (see picture on the right).

Engino® humanoid robot

Exercise 1. On the computer, place the correct icons on the ERP simulator according to the humanoid robot model. Drag and drop the necessary blocks inside the flow diagram in order to create the following program:
- ***while*** *the IR sensor in port 2 detects black colour, the motor in port B should move the humanoid forward and both lights should be on;*
- ***while*** *the IR sensor in port 4 detects black colour, the motor in port A should move the humanoid forward and both lights should be on.*

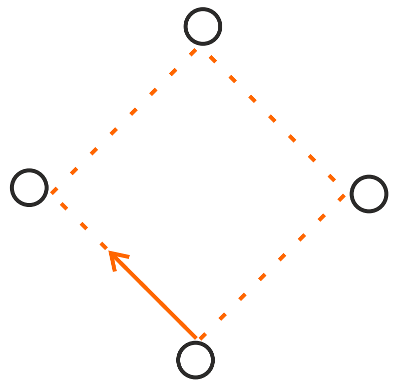
Once you place the appropriate blocks, you will need to **configure the infrared sensors**, so that they **follow black line**. For this, consult the user manual under the section "Sensors / Infrared sensor configuration" in **pages 25-26**.

With this program the humanoid will follow a black line. In order to test your program, place your robot on the black ellipse you created and see if it goes around with its lights on.



Exercise 2. Drag and drop the necessary blocks inside the flow diagram in order to create the following program:
- *humanoid moves forward;*
- ***if*** *it detects a white object with* ***either sensor or both****, the robot should stop and warn with beeping sound and lights on;*
- *after 5 seconds the humanoid should turn 90 degrees to the right in order to detect the next object.*

Tips: the angle is always the same, so only one program is needed for turning. To set both or either sensor to detect objects you must choose the appropriate logic gate (AND or OR). You should also **configure the sensors** again so they will activate on **object detection** this time.



Learning about: ROBOTICS

REPEAT and REPEAT UNTIL statements

Doing repetitive tasks with precision is one of the most important features in programming and robotics. We can create a program and make it repeat many times, thus entering into a "loop". Find out how to create loops with the ERP and how the robot can get out of it and continue with the rest of the program.

Discover:
- What a REPEAT statement is.
- What a REPEAT UNTIL conditional statement is.

Level Of Difficulty ★★★★★

Materials Needed:
- Engino® Robotics PRO (STEM70).
- Computer with ERP software installed.
- 4 x A3 white carton papers.
- Black sticky tape or black marker.
- 1 small water bottle (half full with 250 mL).

Procedure:

1. Find the instructions in **pages 59-63** and build the **grabber robot** model.

2. Follow **exercise 1** in order to create a loop program using the "repeat" block.

3. Sometimes we need a loop to be executed continuously until a sensor's condition is met. Follow **exercise 2** to learn how to do this using the "repeat until" block.

4. Stick the A3 pieces of papers together as to create a big white rectangle. Draw a black half circle ending with two vertical lines and a red circle, as you see in the next picture. Or download this at www.enginorobotics.com (teaching resources). The grip should be in the circle when the grabber stops on a line. Place the bottle on the red circle.

5. Read **exercise 3** in order to make a robotic carrying device that would pick up the bottle and take it to the other side.

Engino® grabber robot

Exercise 1. On the computer, place the correct icons on the ERP simulator according to the grabber robot model. Drag and drop the necessary blocks inside the flow diagram in order to create the following program:
- *the grabber should move forward for 2 seconds precisely. This should be repeated 5 times.*
- *when the loop finishes the buzzer should sound for 2 seconds.*

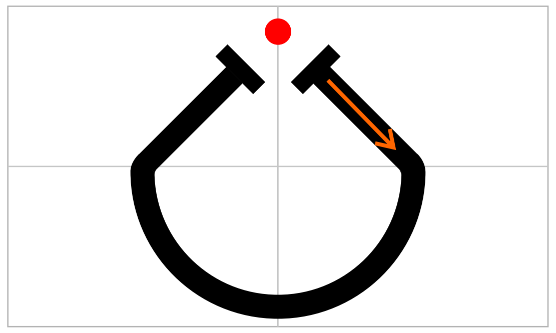
Tip: change the variable of the "start" block from "forever" to "1" and use the "repeat" block to create the program.

Exercise 2. Create the following program (the grip of the grabber should be open at the beginning):
- *the grabber should move forward continuously* ***until*** *the touch sensor is pressed.*
- *when the touch sensor is pressed, the grabber should stop and the grip should close with beeping sound.*

Tip: change the variable of the "start" block from "forever" to "1" and use the "repeat until" block.

Exercise 3. Create the following program (the grip of the grabber should be open at the beginning):
- ***while*** *the IR sensor in port 2 detects white colour, the motor in port A should move the grabber forward;*
- ***while*** *the IR sensor in port 4 detects white colour, the motor in port C should move the grabber forward;*
- ***if*** *the touch sensor is pressed, the grip should close and grab the bottle. Then the grabber should turn around for a specific amount of time until it finds the black line;*
- *the program will be considered successful if the model reaches the other black line.*

With this program the grabber will follow the line by avoiding the black colour, pick up the bottle and go back. Place your model on the paper and see If it works.



Learning about: ROBOTICS

Real-life example: pedestrian crossing

After experimenting thoroughly with all features of the Engino Robotics Platform, you are now ready to put your knowledge into practice! This can be achieved by programming real-life example models, just like the one of pedestrian crossing that follows. Can you make sure that Engino-man crosses the road safely?

Discover:
- How to program a real-life example of pedestrian crossing.
- What safety requirements should be followed.

Level Of Difficulty ★★★★☆

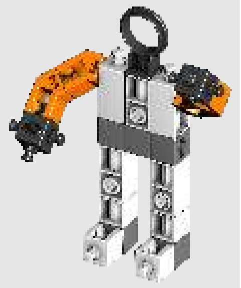
Materials Needed:
- Engino® Robotics PRO (STEM70).
- Computer with ERP software installed.

Procedure:
1. Find the instructions in **pages 64-67** and build the **pedestrian crossing** model. You will find the carton paper for the road inside your Robotics package.

2. Follow **exercise 1** in order to simulate the main traffic lights control for the cars.

3. Programming real-life traffic lights is a very important task. People entrusted with this, need to make absolutely sure that when one light is green the vertical side light is always red. This way cars or pedestrians will never cross each other's paths. With this in mind, add the pedestrian crossing lights in your existing program by following **exercise 2**.

4. Here comes Engino-man wishing to cross the road! To do this safely he must use the pedestrian crossing. Follow **exercise 3** in order to create a program that meets all the safety requirements. When you finish, tick the boxes below for every point you got right.



Engino® pedestrian crossing

Exercise 1. On the computer, place the correct icons on the ERP simulator according to the pedestrian crossing model. Drag and drop the necessary blocks inside the flow diagram in order to create the following program that simulates main traffic lights control for the car (don't forget to use appropriate times):
- *green light on (cars free to go);*
- *amber light on (cars ready to stop);*
- *red light on (cars stop);*
- *red and amber lights on at the same time (cars ready to go);*

Tip: if you put the program into loop, there is no need to add green light as a final step, as it already exists in the beginning.

Exercise 2. Make the appropriate changes on the program of exercise 1 in order to add the pedestrian crossing lights. These will work in parallel with the main traffic lights so that:
- *when is green light for cars, it should be red for pedestrians;*
- *when it changes to amber light for cars (ready to stop), it should still be red light for pedestrians;*
- *when it changes to red light for cars (stop), it should be green for pedestrians (go);*
- *when is red and amber lights for cars simultaneously (ready to go), light should change to red for pedestrians.*

Exercise 3. Make the appropriate changes on the program of exercise 2 in such a way that:
- *the lights interchange between the pedestrian crossing lights and the main traffic lights should occur only if the pedestrian pushes the button.*

Tips: read the safety requirements below and adjust your program accordingly. Remember that before the interchange, lights should still work!

SAFETY REQUIREMENTS:
- ☐ Is the amber light's time adequate enough to warn car drivers to stop?
- ☐ Do the lights interchange in the correct order, not conflicting with each other? For example, green light for cars and pedestrians should never occur simultaneously.
- ☐ Is the green light's time adequate enough for pedestrians to cross the road?
- ☐ Did you add buzzer sound to warn pedestrians when to go?

Learning about: ROBOTICS

Real-life example: automated house

Another real-life example is the automated house. One of the main advantages of using robots is their ability to work only when specific conditions are met. This can come in handy if we want the air-condition of a house to work only when doors are closed, thus saving energy. Can you simulate the same?

Discover:
- How to program a real-life example of an automated house.
- How to make a building more energy efficient using robotics.

Level Of Difficulty ★★★☆☆

Materials Needed:
- Engino® Robotics PRO (STEM70).
- Computer with ERP software installed.

Procedure:
1. Find the instructions in **pages 68-70** and build the **automated house** model. With the remaining parts you can create again an Engino-man (page 65, step 6), who will trigger the sensors of the house.

2. When building a house, usually the wires are inserted inside the walls for safety and aesthetic reasons. Twist the wires of your model around the "columns" of the house to simulate this, but keep the same ports.

3. Besides wiring, another problem is to construct buildings that are as much **energy efficient** as possible. And by this we mean that the house should use power only when is needed and at the least amount possible. Follow **exercises 1 and 2** in order to create an energy efficient robotic house.

4. You can make your Engino model more energy efficient structurally if you close the walls entirely or even place an Engino solar panel on the roof (available in solar set). Answer **question 3** about real-life houses' efficiency, but from robotics perspective.

Engino® automated house

Exercise 1. It is a hot summer day! Engino-man is returning to his house after a pleasant walk at the park. Tired as he is, he wonders whether is it possible to install an automatic system that would open the front door at the press of a button. Can you help him?

On the computer, place the correct icons on the ERP simulator according to the automated house model. Drag and drop the necessary blocks inside the flow diagram in order to create the following program:
- ***if** the touch sensor is pressed, the motor should open the door.*

Tip: note that the motor should work accurately so that the door will not close back.

Exercise 2. Engino-man can now enter his house in automatic way. But why stop there? He thinks that it will be nice if there was a way for the house to "sense" his presence so that the door would close back and some devices would start working after. These can be the **air-condition** (simulated by the fan) to cool his house and the **LED light** to brighten the room. Can you be so kind to help him again?

Make the appropriate changes on the program of exercise 1 in such a way that:
- ***if** the IR sensor detects motion inside the house, then the door should close back. After this, the fan should start working and the LED light should be on.*

With this program you save energy because the air-condition works only if the door is closed, keeping the cool air inside the house. You can make your program more energy efficient if you add minimum time for the fan to work. In real life, air-conditions stop when a pre-set temperature is reached.

Exercise 3. Can you think of some other ways to make real houses more energy efficient using robotics?

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ERP Manual

Engino® Robotics philosophy

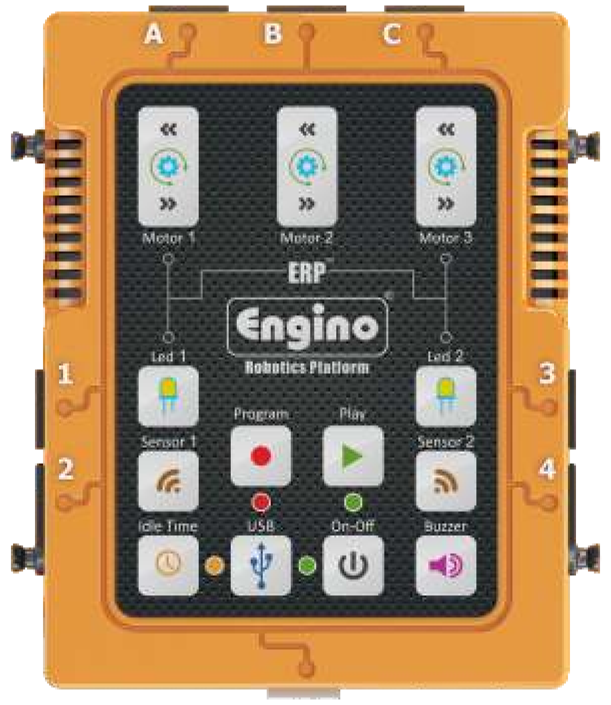
The Engino® Robotics Platform (ERP) is specially designed for Primary and Secondary school children, taking into account the latest technological trends and the most modern pedagogical principles of learning. Intellectual development is approached in a spiral way, helping students to reconstruct their ideas formed based on their existing knowledge merged with new information, acquiring higher order concepts and taking it to the next level. The innovative ERP controller in conjunction with the patent pending ERP software are ideal for ICT teaching, allowing various levels of robotic programming to be implemented in a fun and challenging way.

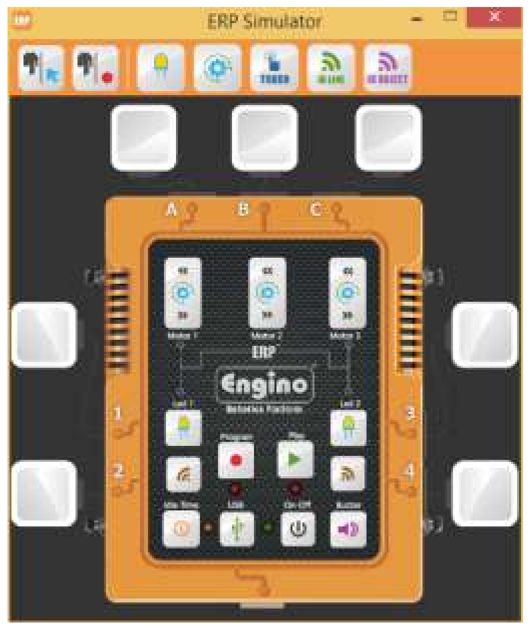
Two innovative ideas make the patent pending Engino® Robotics Platform a unique teaching tool! Firstly, the ERP allows **five interconnected ways of programming**, so the users can choose the method that suits them best according to their age and experience. Each method is described briefly below and in more details with programming examples in the following pages. Secondly, **parallel programming** (doing tasks simultaneously) has never been easier with the introduction of the ***After/With Previous*** variable in every block of the ERP software.

Five programming methods

Manual ERP programming

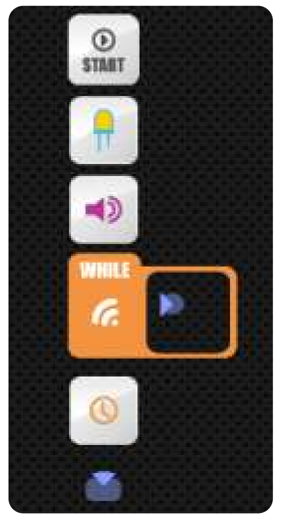
The ERP device is designed in such a way that it allows manual program recording through simple button press. The user can easily push the "Program" button in order to record any desired sequence of commands, one by one or simultaneously, which is then saved on the device and can be reviewed after by pushing the "Play" button. This first level of programming is about interacting physically with the learning material, using a method (pushing buttons) that all children are familiar with. The programming procedure provides immediate visible feedback, enabling the user to adjust the time and order of the commands through unlimited number of attempts.





ERP Simulator

The ERP Simulator is a special window within the ERP software that simulates the functions of the actual controller, though the buttons in this case are digital instead of physical. Once the computer is connected with the ERP (through USB), the user may record a program using the "Program" button and get a visible feedback from the robot as before. The great advantage of this method is that while the program is being recorded, the commands are transferred into the other two windows of the software: in the Flow Diagram, as visual blocks and in the TextEditor, as lines of text of a special pseudolanguage (not actual programming language).

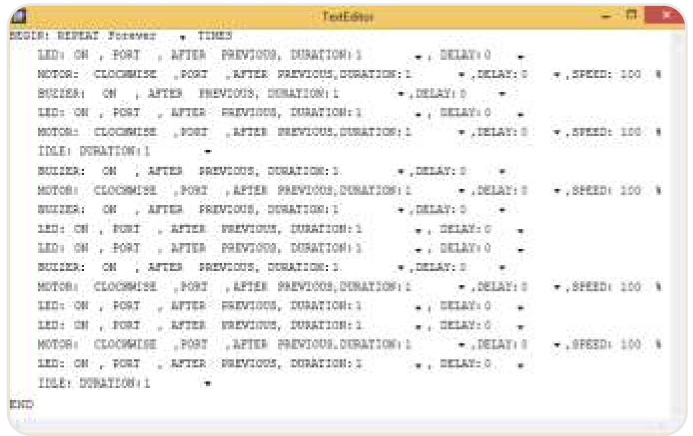


Flow diagram

Once a program is created manually on the controller, it is impossible to edit through the controller. The user must record it again in order to adjust the commands. Also, there is no way to add advanced programming features like "If" statements and "While" loops. This can only be done through the "Flow Diagram", the main programming feature of the ERP software. In this window, the user can program complex commands and take full advantage of the robot's capabilities and sensors. The Engino® robotics is designed for the gradual transition from physical manual programming to abstract software control, by applying an innovative **reverse engineering method!** The "**receive**" button uploads the manual program from the device into the PC in the form of pictorial flow diagram and text! This can be edited and fine tuned as needed. Then, the user can click the "**send**" button in order to import the program back to the device for testing.

Text Editor

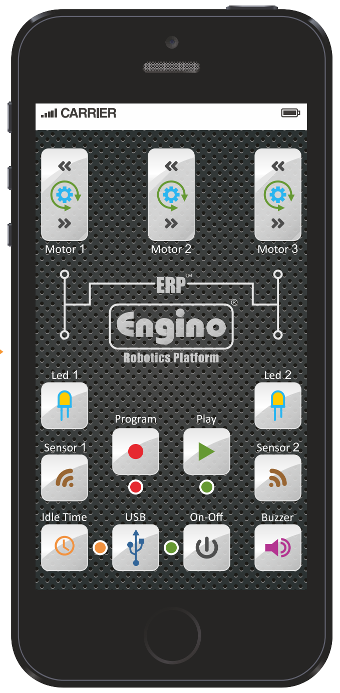
Most advanced programming languages based on text and visual representation of commands may become difficult as the program becomes bigger and more complex. The Text Editor is using a "pseudolanguage" created specifically for the ERP. It has many familiar terms of programming languages (such as START, END, IF etc). It is the ideal tool for introducing advanced programming, as it allows the user to have a quick review of the program and edit the variables easily.


TextEditor

```
BEGIN: REPEAT Forever    TIMES
    LED: ON  , PORT   , AFTER  PREVIOUS, DURATION:1       , DELAY:0
    MOTOR:  CLOCKWISE  ,PORT   ,AFTER PREVIOUS,DURATION:1      ,DELAY:0    ,SPEED: 100
    BUZZER:  ON   , AFTER  PREVIOUS, DURATION:1        ,DELAY:0
    LED: ON  , PORT   , AFTER  PREVIOUS, DURATION:1       , DELAY:0
    MOTOR:  CLOCKWISE  ,PORT   ,AFTER PREVIOUS,DURATION:1      ,DELAY:0    ,SPEED: 100
    IDLE: DURATION:1
    BUZZER:  ON   , AFTER  PREVIOUS, DURATION:1        ,DELAY:0
    MOTOR:  CLOCKWISE  ,PORT   ,AFTER PREVIOUS,DURATION:1      ,DELAY:0    ,SPEED: 100
    BUZZER:  ON   , AFTER  PREVIOUS, DURATION:1        ,DELAY:0
    LED: ON  , PORT   , AFTER  PREVIOUS, DURATION:1       , DELAY:0
    LED: ON  , PORT   , AFTER  PREVIOUS, DURATION:1       , DELAY:0
    BUZZER:  ON   , AFTER  PREVIOUS, DURATION:1        ,DELAY:0
    MOTOR:  CLOCKWISE  ,PORT   ,AFTER PREVIOUS,DURATION:1      ,DELAY:0    ,SPEED: 100
    LED: ON  , PORT   , AFTER  PREVIOUS, DURATION:1       , DELAY:0
    LED: ON  , PORT   , AFTER  PREVIOUS, DURATION:1       , DELAY:0
    MOTOR:  CLOCKWISE  ,PORT   ,AFTER PREVIOUS,DURATION:1      ,DELAY:0    ,SPEED: 100
    LED: ON  , PORT   , AFTER  PREVIOUS, DURATION:1       , DELAY:0
    IDLE: DURATION:1
END
```

Smart device application

Complying with modern technological advancements, the ERP can also be controlled with a smart device (mobile or tablet) that runs on either Android or iOs operating system. The user may download the **EngineRobot BT app,** free of charge, available on Google Play or Apple Store. The app simulates the actual controller and can be used wirelessly, once the ERP is connected with the smart device over Bluetooth.

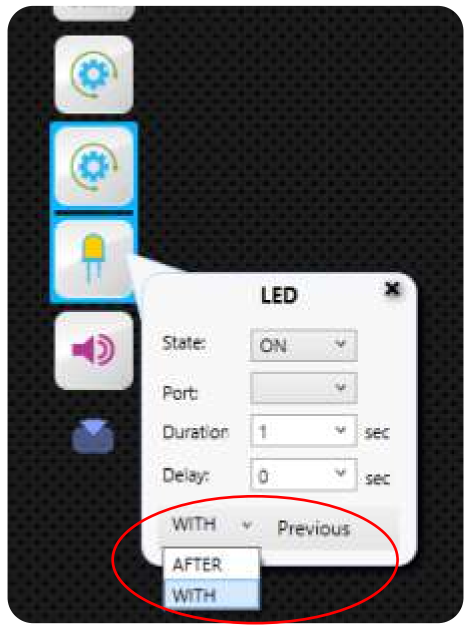


Available on the App Store

GET IT ON Google play

Parallel programming

The second main innovation of Engino in educational robotics is the function of parallel programming. The Engino® Robotics Platform software uses **visual programming** (blocks with symbols instead of text), which contain an innovative **After/With Previous** variable that provides the parallel feature. The user can choose between **after previous** if he/she wants the command to be executed when the previous command is finished or **with previous** if he/she wants the command to be executed at the same time. The blocks that work in parallel are joined together with a coloured line. This reduces the complexity of programming in a great extend, as the order of commands become more clear and easy to formulate.


LED

State: ON

Port:

Duration: 1 sec

Delay: 0 sec

WITH Previous

AFTER

WITH

ERP controller

The Engino® Robotics Platform (ERP) is a robotic system consisting of a main controller with different buttons and indicators, able to connect with various peripherals: motors, lights and sensors. The ERP is a powerful and flexible tool that is easy to use and can connect with the rest of the Engino parts! In this manual you can find all the necessary information about: how to program your robots with illustrated examples, the main features of the ERP controller, how to install the ERP software, how to update the firmware, safety guidelines, tips and much more. But first, see below the various buttons, ports and peripherals of the ERP.

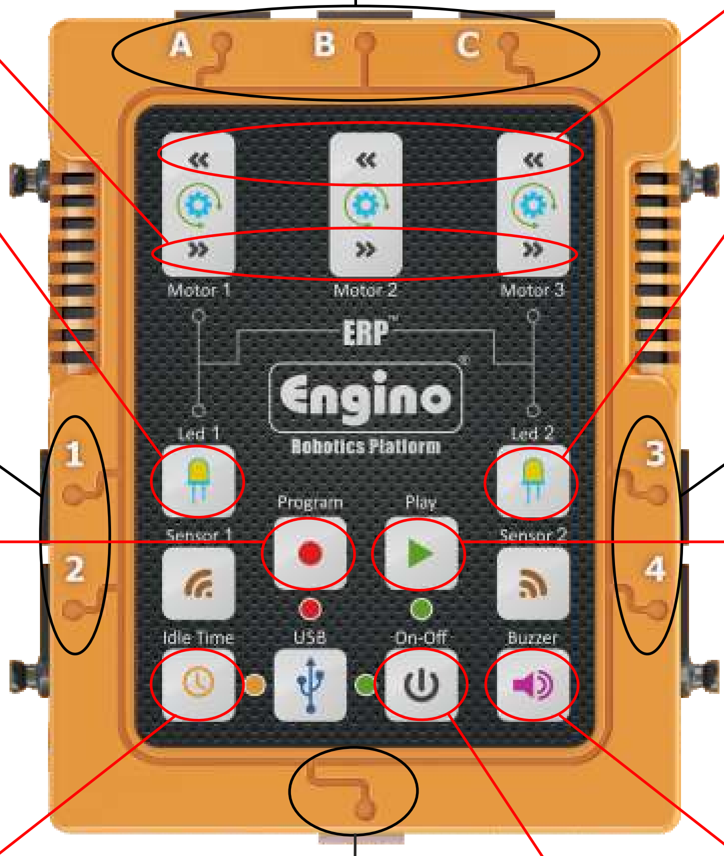
MOTOR BUTTONS
Press these buttons to turn the motors clockwise.

MOTOR OR **LED** PORTS

MOTOR BUTTONS
Press these buttons to turn the motors anti-clockwise.

LED BUTTON
Press this button to light up the connected LED.

LED BUTTON
Press this button to light up the connected LED.



SENSOR OR **LED** PORTS

SENSOR OR **LED** PORTS

PROGRAM BUTTON
Only for manual programming. Press this button to start recording. Once the red light starts blinking the controller goes in record mode. When you finish, press the same button again to store in memory.

PLAY BUTTON
Press the button once to start the program. Press and hold the button for 3 seconds to repeat the program in a loop.

IDLE TIME BUTTON
This button has two functions:
- it adds idle time during manual programming;
- press once to activate the Bluetooth when the controller is switched on (but not in recording or play mode). Open the ***EnginoRobot BT*** *app, find the ERP Bluetooth network and connect. Note that if the ERP is not connected with any Bluetooth device within 1 minute, it will turn off to save energy.*

USB PORT
for computer connection

ON/OFF
BUTTON

BUZZER BUTTON
Press this button to play a buzzer sound.

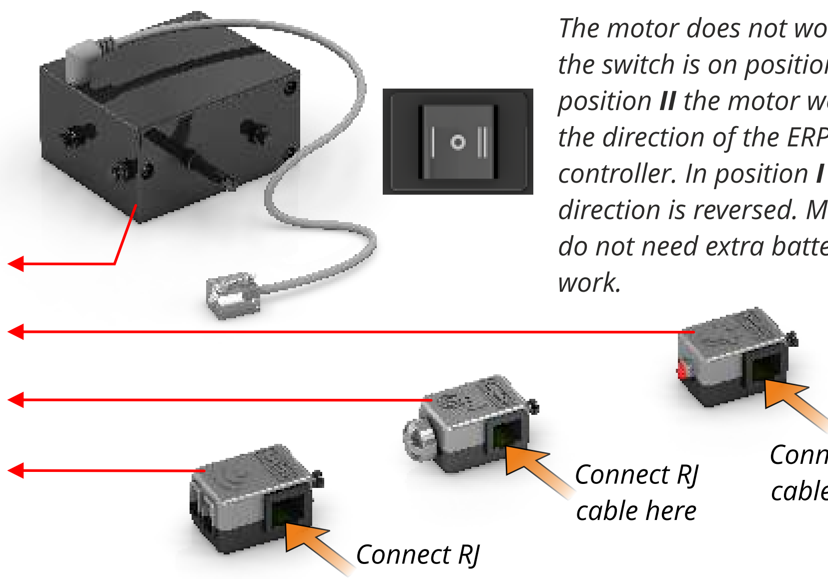
ATTENTION:
Bluetooth must be turned off in order to turn off the device smoothly. Also, make sure that the USB cable is not connected.

Batteries: To turn on the controller you need to install 6 new AA batteries (it works also with 3 batteries placed continuously up or down). You will need a cross-head screw driver. Unscrew the battery cap at the back of the controller. Place the batteries carefully making sure that the + and - signs match those indicated in each battery position. After you place the batteries, screw the cap back in position if you want.

Safety guidelines: Do not mix alkaline, standard or rechargeable batteries. Non-rechargeable batteries are not to be re-charged. Do not mix old with new batteries. Remove dead or old batteries from the ERP if they will not be used for a long time. Never dispose off batteries in fire. Supply terminals are not to be short circuited.

Peripherals and ports: different types of peripherals work only in specific ports of the ERP controller, as indicated below:

Peripherals	Ports to connect
Motors	A, B, C
LED lights	1, 2, 3, 4, A ,B, C
Touch sensors	1, 2, 3, 4
InfraRed sensors	2, 4



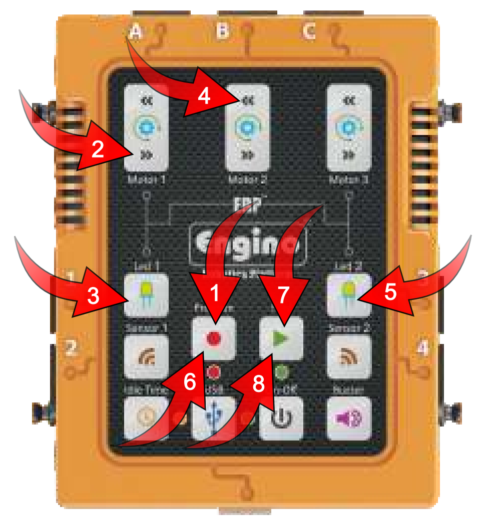
The motor does not work if the switch is on position ***O****. In position* ***II*** *the motor works in the direction of the ERP controller. In position* ***I*** *the direction is reversed. Motors do not need extra batteries to work.*

Manual ERP programming

The ERP, once switched ON, can be operated manually by pressing the various buttons in real time. To begin manual recording press the “Program” button once. The red flashing light indicates that the ERP is in record mode. In order to create a programming sequence, press the buttons of the LEDs, Motors, Buzzer or Idle Time at any desired order, either separately or simultaneously. Each step is recorded for a period of time that the button is being pressed. When the programming procedure is finished, press again the “Program” button to save the program in the controller’s memory. Press “play” to start the program; if you hold it for 3 seconds the program will repeat in a loop. **Note that the device can save only one program in its memory.** You can also operate the ERP without setting it in record mode; just press the buttons and it will work as a controller in order to see how the various outputs work.

Recording example 1: Connect 2 motors in each of the ports A and B and 2 LED lights on ports 1 and 3. The peripherals will run for as long as their buttons are pressed. You can try to press the Buzzer as well. For the program, the motor in port A should move clockwise for 3 seconds, the LED in port 1 to light up for 5 seconds, the motor in port B to turn anti-clockwise for 3 seconds and the LED in port 3 to light up for 5 seconds.

Instructions:
1. Press the “Program” button to begin recording (a flashing red light should be on).
2. Hold pressed the clockwise button of the motor 1 in port A for 3 seconds.
3. Hold pressed the button of the LED 1 in port 1 for 5 seconds.
4. Hold pressed the anti-clockwise button of the motor 2 in port B for 3 seconds.
5. Hold pressed button of the LED 2 in port 3 for 5 sec.
6. Press the “Program” button once to save the program in memory.
7. Press the “Play” button to run the program.
8. After the program finishes you can repeat it continuously in a loop if you hold pressed the “Play” button for 3 seconds.



Note that the delay time between button pressing is not recorded. While the program is in play mode each command follows the other without any time delay. If we want to have a time delay between steps then we can use the “Idle Time” button. For as long as the “Idle Time” button is pressed, interval time is recorded between steps.

Recording example 2: The ERP also allows many commands to play simultaneously. For example you can press two or more buttons at the same time and they will play together. Repeat the same sequence as in example 1, but this time follow commands 2 and 3 simultaneously. Then press and hold the “Buzzer” for 2 seconds; then press the “Idle Time” for 5 seconds and carry out commands 4 and 5 simultaneously. Finally, save and play (commands 6, 7 and 8).