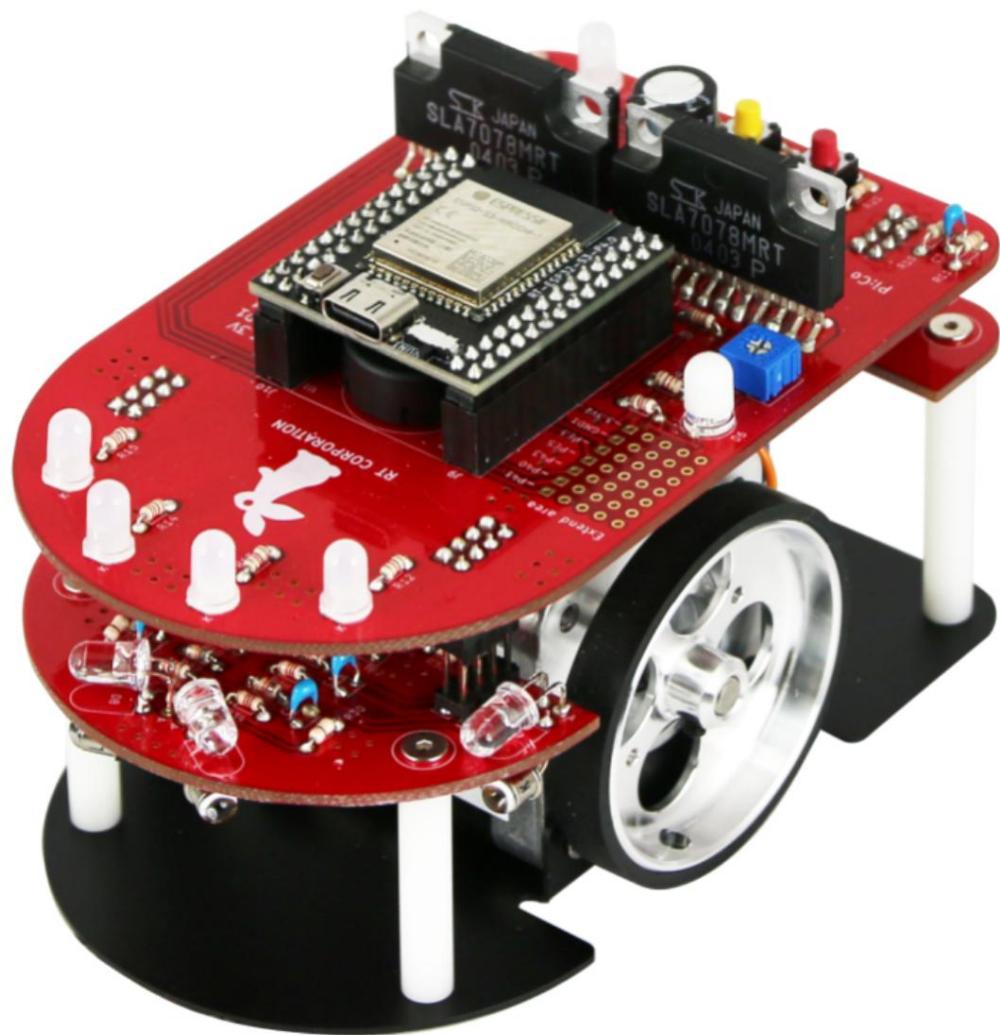


# Pi:Co Classic3

## Assembly Manual



**Version 1.0 RT Co., Ltd.**

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# Before Use

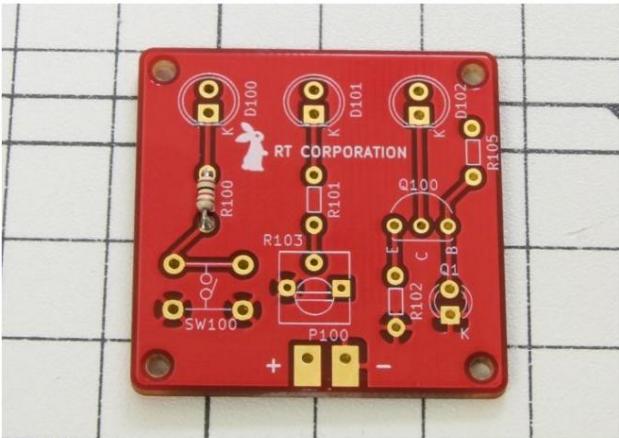
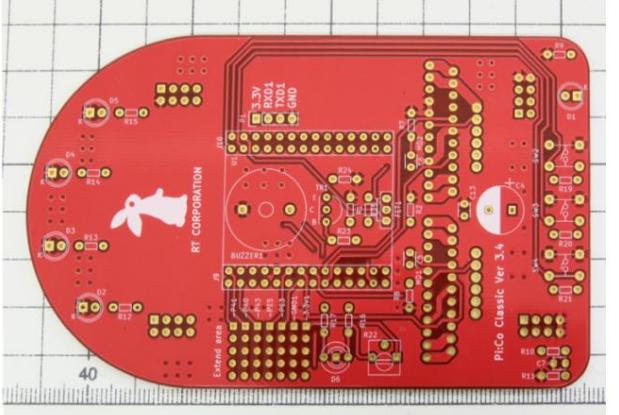
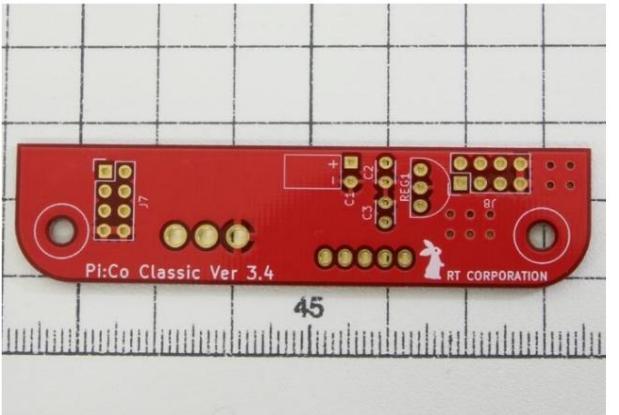
Thank you very much for purchasing our "Pi:Co Classic3 (hereinafter referred to as "this product").

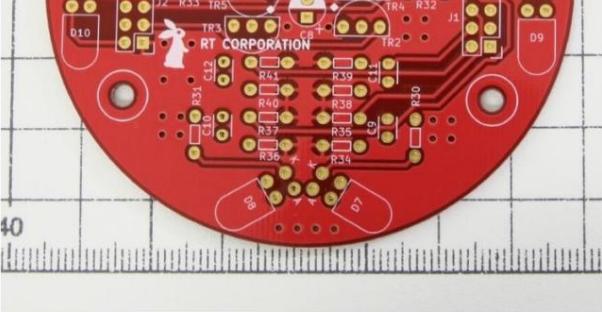
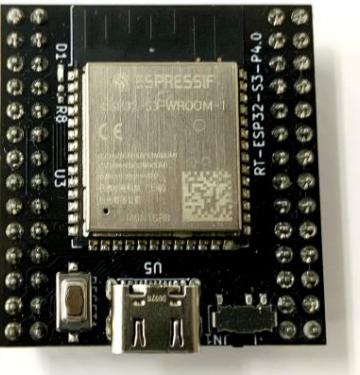
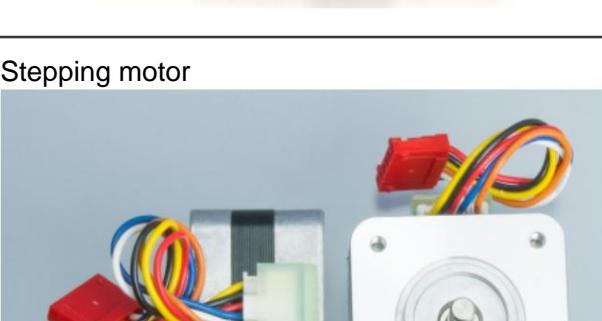
This manual explains how to assemble the hardware of this product.

Please read the attached Pi:Co **Classic3** Getting Started Guide before purchasing .

## What you need for assembly

The following items are required to assemble this product.

Number	Item	quantity
1	Practice Board 	1
2	Main Board 	1
3	Power Supply Board 	1

4	Sensor Board	 A red semi-circular PCB with various electronic components, including resistors (R33-R37, R39-R40, R35-R36, R34), transistors (TR3, TR4, TR5, TR6), and connectors (J1, J2, J3). The board is labeled "RT CORPORATION". A ruler is visible at the bottom for scale.	1
5	ESP32-S3 microcontroller board	 A black PCB featuring an ESPRESSIF ESP32-S3-WROOM-1 chip. The board has multiple pins and a small pushbutton labeled "S0". It is labeled "RT-ESP32-S3-P4.0" on the right side.	1
6	Stepping motor	 A stepping motor assembly with a silver metal housing and a white plastic end cap. It has a green ribbon cable and a red multi-colored ribbon cable attached to its rear.	2

7	Tires and wheels 	2
8	Chassis (bottom plate) 	1
9	Lithium polymer rechargeable battery (LiPo battery) 	1

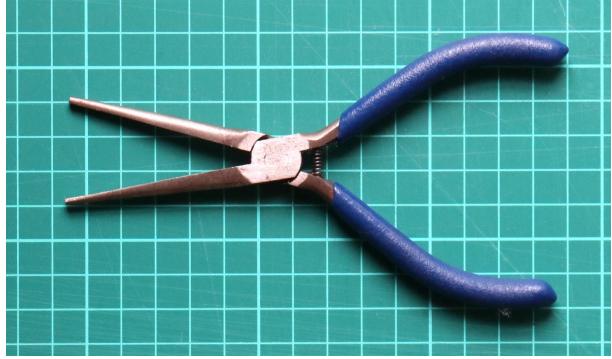
## Pi:Co Classic3 Assembly Manual

10	<p>Parts sorted into bags</p> <ul style="list-style-type: none"> <li>• Practice board 1 to Practice board 3</li> <li>• Power supply board 1 to power supply board 2</li> <li>• Main board 1 to main board 13</li> <li>• Sensor board 1 to sensor board 9</li> <li>• Assembly parts 1 to 3</li> </ul> 	Total 30 bags
11	<p>AA battery box (2 AA batteries)</p> 	1

## 必要工具一覧

本製品を組み立てるために必要な工具は次のとおりです。

1	半田	
2	半田小手 (30~60W出力) ※本製品の基板は初心者向けに作成されているため、通常よりもパターンが太くなっています。そのため、30W以上の半田小手を使用することを推奨します。 白光株式会社の温度調整機能付き半田小手FX-600Dがお勧めです。	
3	半田小手台	

4	ニッパ	
5	ラジオペンチ	
6	プラスドライバ0番	

7	セロテープ、またはマスキングテープ	
8	六角レンチ 1.5mm（本製品に付属）	

※その他に、電圧の測定と導通チェック用の簡易的なテスタがあると半田不良の確認ができます。

## Soldering practice

If someone with little experience in soldering tries to solder on the board of this product, there is a risk of causing problems such as poor soldering or damage to the patterns on the board. Therefore, we recommend that you practice on the practice board first.

The practice board's land (soldering point) is designed to be the same size as the board for this product. In addition, we have prepared a solid pattern (a large area of copper foil) that is difficult to solder because heat easily escapes. Be sure to master your soldering skills with this practice board.

## Soldering precautions

Before we begin, here are some points to keep in mind when soldering.

For simplicity, start soldering from the lowest components. Also, be careful not to short the power and GND wiring (unexpected electrical continuity caused by soldering in an unnecessary place). In addition, when soldering the components, bending the lead wires as shown in the figure below makes it difficult for the components to come out of the holes, making the work easier. It is also effective to temporarily fix the components with cellophane tape or masking tape.



Fixing components: Example of bending lead wires



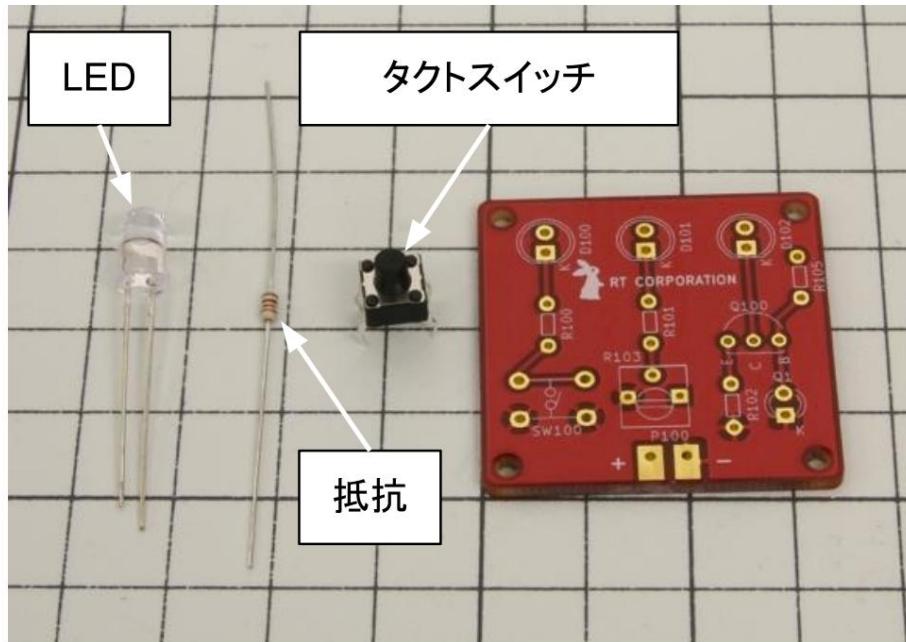
Fixing parts: Example of temporary fixing with tape

Now let's practice soldering. Please prepare the following parts.

- Practice board •
- Battery box • Purple bag with Practice board 1 to Practice board 3 written on it

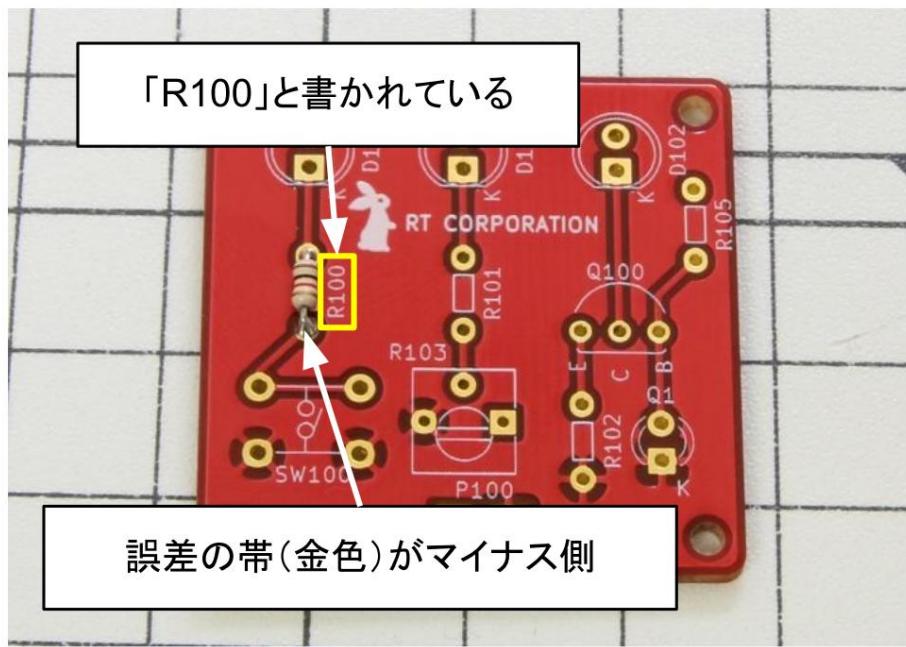
## Practice board 1: A circuit that lights up an LED when the switch is pressed

The practice board 1 bag contains an LED, a  $1k\Omega$  resistor, and a tactile switch, as shown in the figure below. First, we will use these components to create a circuit that will light up an LED when the switch is pressed.



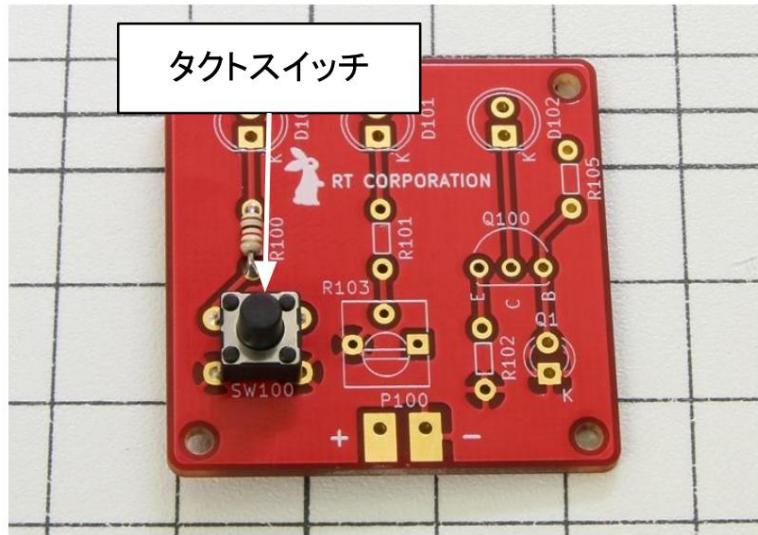
Practice Board 1 Parts

First, solder a  $1k\Omega$  resistor (band colors are brown, black, red, and gold) into the hole on the board marked "R100." There is no orientation for resistors, but we recommend aligning the error band (gold in this case) to the VDD side (positive side) or GND side (negative side). By aligning the orientation, you can check the direction of the current when inspecting with a tester or the like without having to look at the circuit diagram. In this manual, the error band is aligned to the negative side.



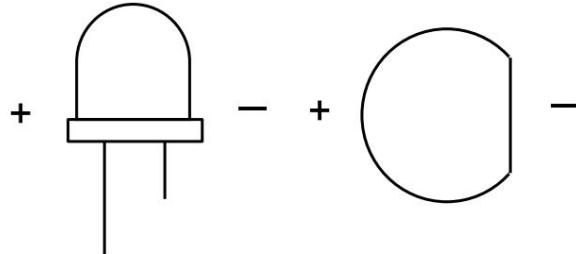
Resistor soldered in

Next, solder the tactile switch to SW100. The tactile switch has a specific orientation, so please check carefully before soldering. If you try to forcibly install it in the wrong orientation, it may always be in the ON position.



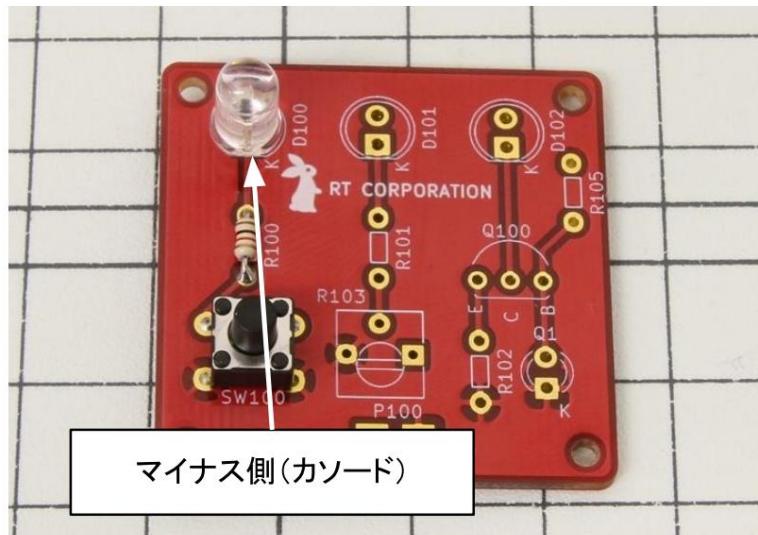
Tact switch soldered

Finally, solder the LED to D100. LEDs have polarity, so pay attention to the orientation when installing them. As shown in the diagram below, the short, flat side of the electrode is the negative side (cathode side).



LED Polarity

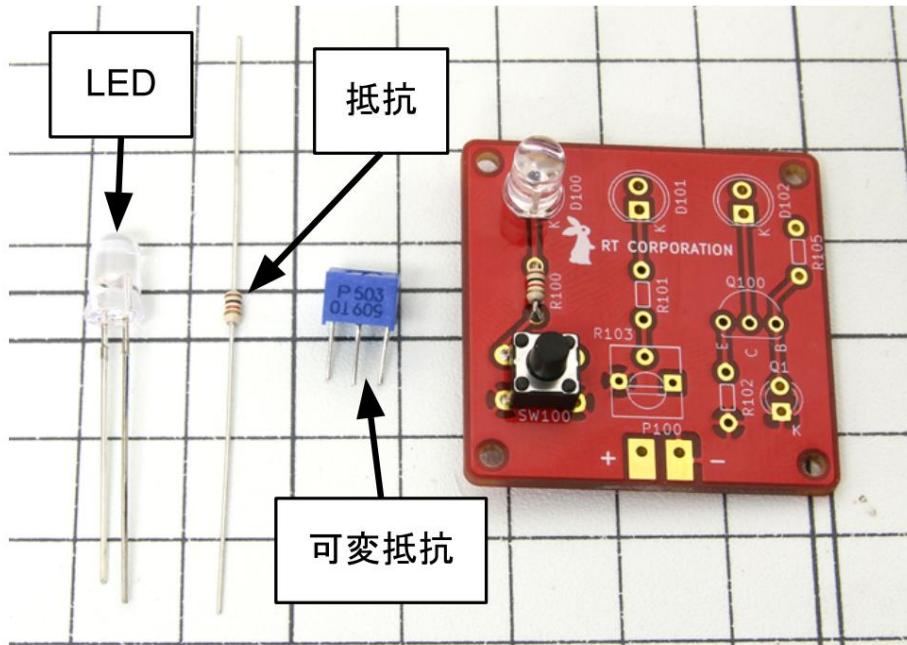
The side marked "K" on the board is the negative side (cathode side) of the LED.



LED soldered in

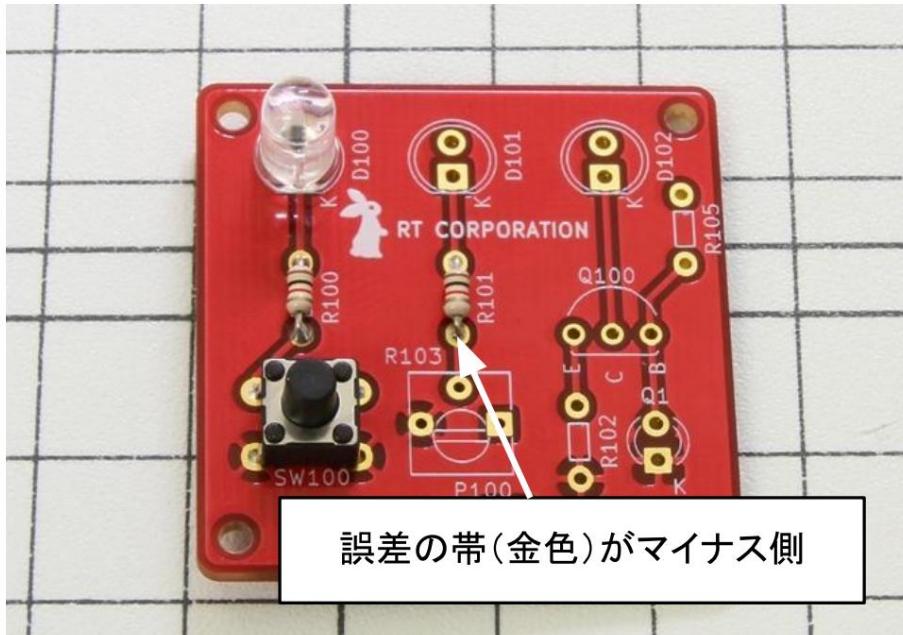
## Practice board 2: A circuit that changes the brightness of an LED when you turn a variable resistor

As shown in the diagram below, the bag containing practice board 2 contains an LED, a  $1\text{k}\Omega$  resistor, and a  $50\text{k}\Omega$  variable resistor. Next, we will use these components to create a circuit that changes the brightness of the LED when the variable resistor is turned.



Practice Board 2 Parts

First, solder a  $1\text{k}\Omega$  resistor (brown, black, red, gold) to R101.



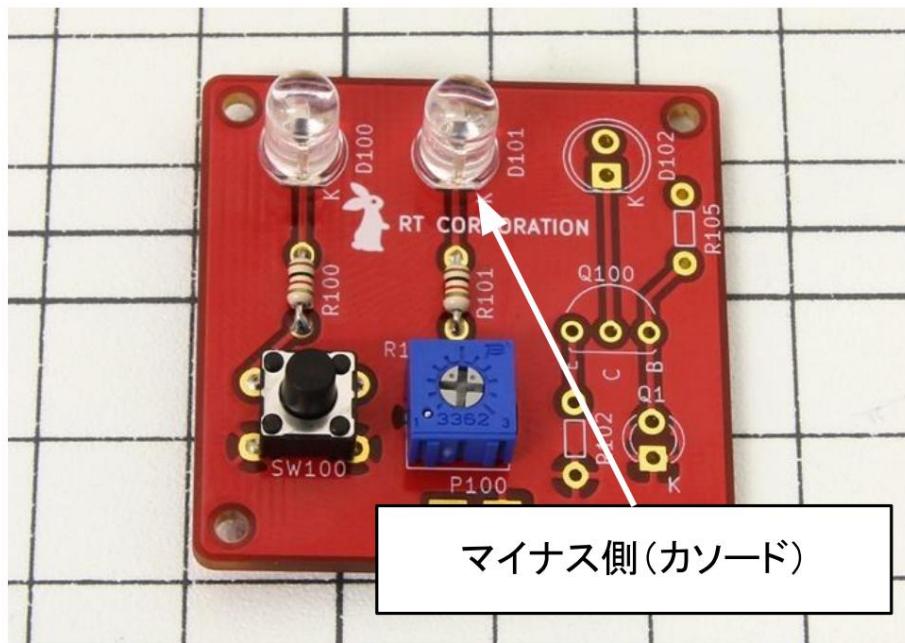
Resistor soldered in

Next, solder the variable resistor to R103.



Variable resistor soldered

Finally, solder the LED to D101. Be careful about the orientation of the LED.

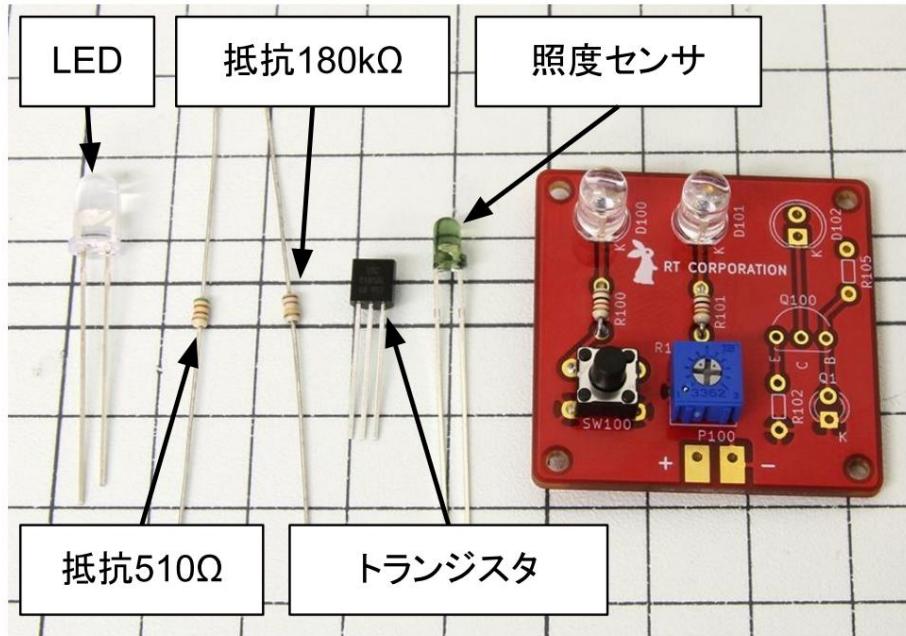


LED soldered in

Practice board 3: A circuit that changes the brightness of an LED depending on the amount of light received by the illuminance sensor

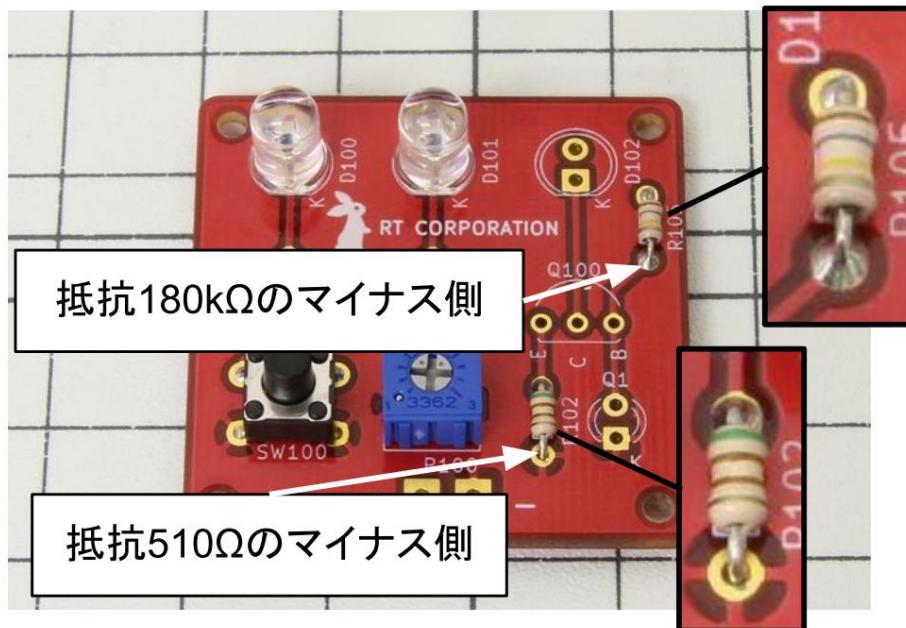
The practice board 3 bag contains an LED, a  $510\text{\AA}$  resistor, a  $180\text{k\AA}$  resistor, a transistor, as shown in the figure below. The illuminance sensor is included. Next, we will use these components to:

Create a circuit that changes the brightness of an LED.



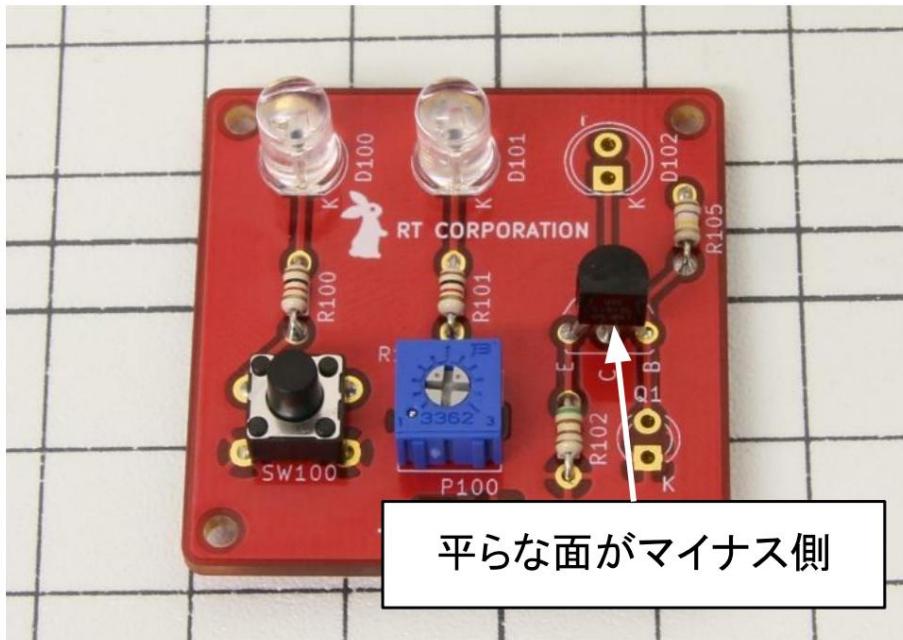
Practice Board 3 Parts

First, solder a  $510\text{\AA}$  resistor (green-brown-brown-gold) to R102 and a  $180\text{k\AA}$  resistor (brown-gray-gold) to R105.



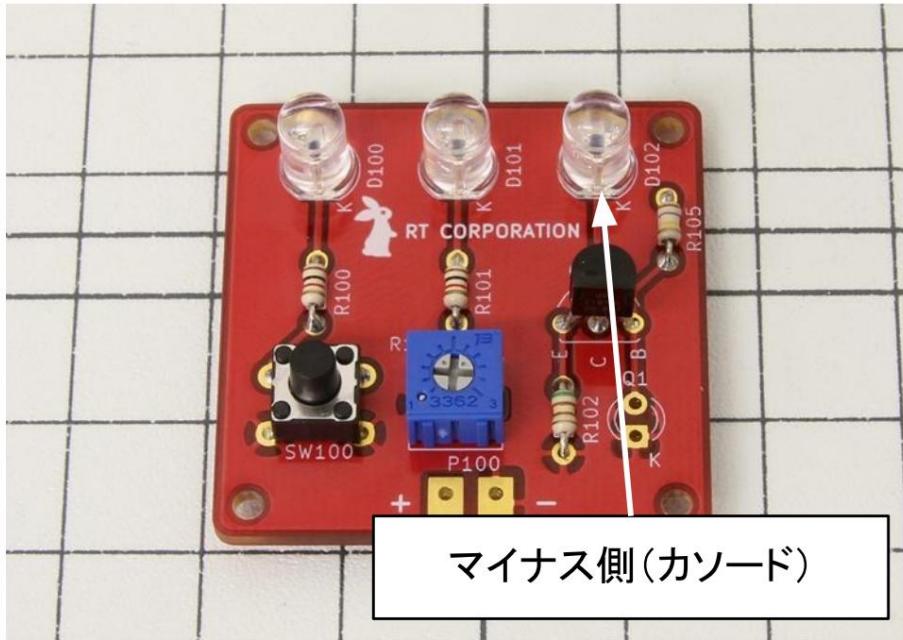
Resistor soldered in

Next, solder the transistor to Q100. Please note that transistors have polarity, so be careful about the orientation when installing them. Install the transistor so that the flat side faces downwards (towards the negative side) of the board, as shown in the figure below. Also, if the pin pitch of the transistor is narrower than the pitch of the board, spread the transistor pins as you pass them through the holes.



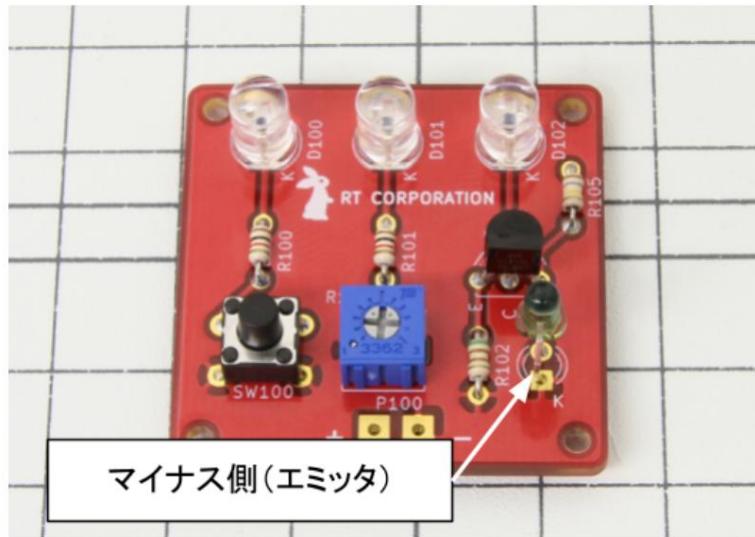
Transistor soldered in

Next, solder the LED to D102. Be careful about the orientation of the LED.



LED soldered in

Finally, solder the illuminance sensor to Q1. The illuminance sensor has polarity, so pay attention to the orientation when attaching it. The side with the shortest electrode leg and the flat side (the side with K written on the board) is the negative side (emitter side). The difference in the length of the electrode legs is small, so be careful not to confuse them.



Illuminance sensor soldered

### Testing the operation of the practice board

After soldering is complete, check the operation of the practice board. First, solder the AA battery box to P100. As shown in the figure below, connect the red wire (power) to the positive side and the black wire (GND) to the negative side. Then, install two AA batteries into the battery box.



Battery box soldered

The procedure for checking operation is as follows:

1. When you press the tactile switch, the left LED lights up, and when you release it, it goes out.
2. When you turn the variable resistor to the right, the center LED becomes brighter, and when you turn it to the left, it becomes dimmer.
3. When you bring your hand close to the light sensor, the right LED becomes brighter, and when you release it, it becomes dimmer.

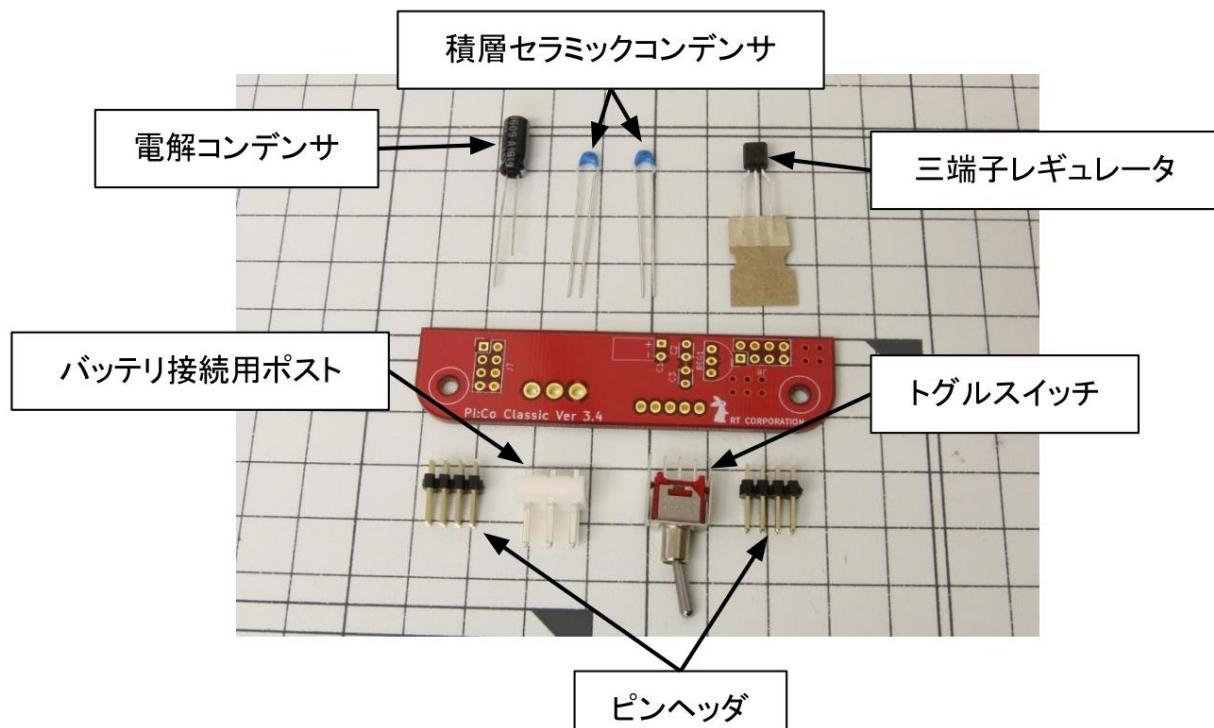
Once you have confirmed that it works, the soldering practice is complete. Please proceed to soldering the product board.

## Soldering the product board

### Power Supply Board

We will solder the boards for this product. First, we will start with the power supply board. The power supply board has a very simple circuit and is easy to check for operation, making it a good place to check

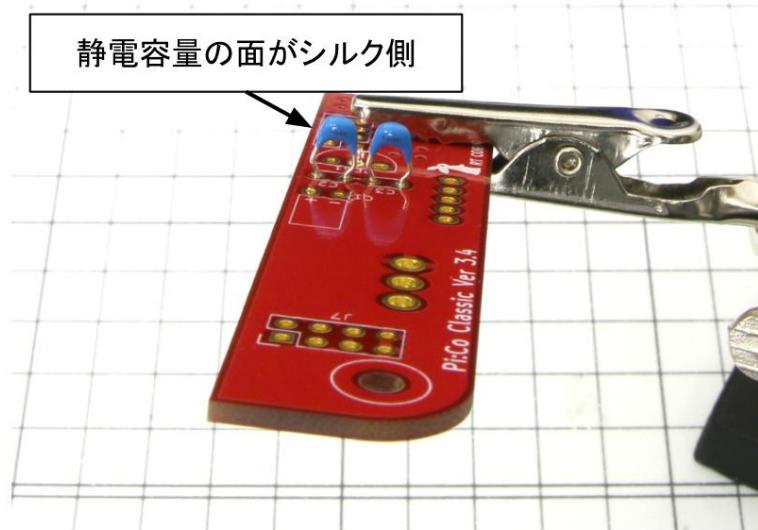
the results of your soldering practice. First, prepare the power supply board and the light blue bags labeled Power Supply Board 1 and Power Supply Board 2. As shown in the figure below, the bag for power supply board 1 contains a 3.3V three-terminal regulator, a 100 $\mu$ F electrolytic capacitor, and a 0.1 $\mu$ F multilayer ceramic capacitor. The bag for power supply board 2 contains a battery connection post, a toggle switch, and a pin header (2x4).



Power Board Components

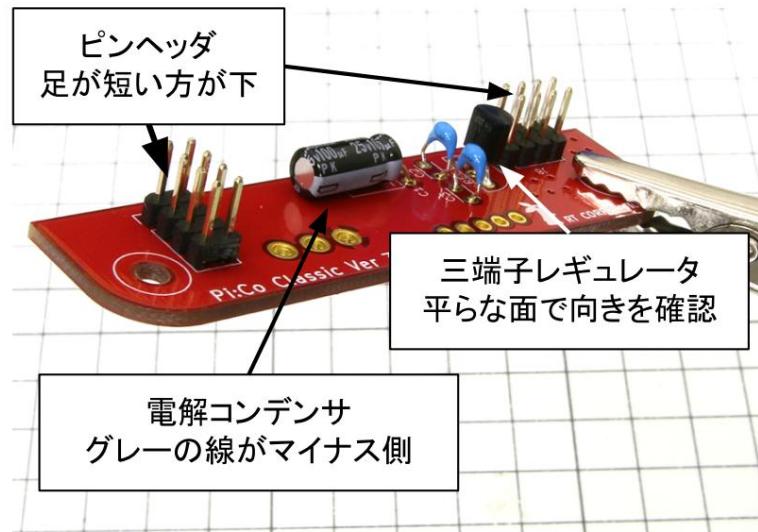
First, solder the 0.1 $\mu$ F multilayer ceramic capacitor to C2 and C3.

The capacitor does not have any orientation, but if you solder it with the side that has the capacitance (104) written on it facing the silk screen (the side with C2 and C3 written on the board), it will be easier to check the capacitance later.



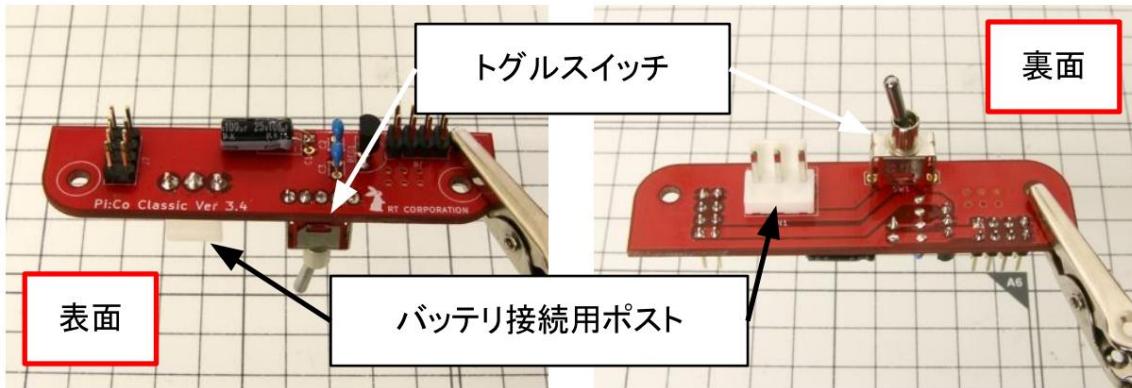
Multilayer ceramic capacitors soldered

Next, solder the three-terminal regulator to REG1, the electrolytic capacitor to C1, and the pin headers to J7 and J8. Solder the components in order starting from the shortest to the tallest to make the job easier. The three-terminal regulator and electrolytic capacitor have polarity, so install them according to the direction of the silk screen on the board. Also, install the electrolytic capacitor with its legs bent and laid to the side as shown in the figure below. Insert the short leg of the pin header into the hole in the board and solder it.



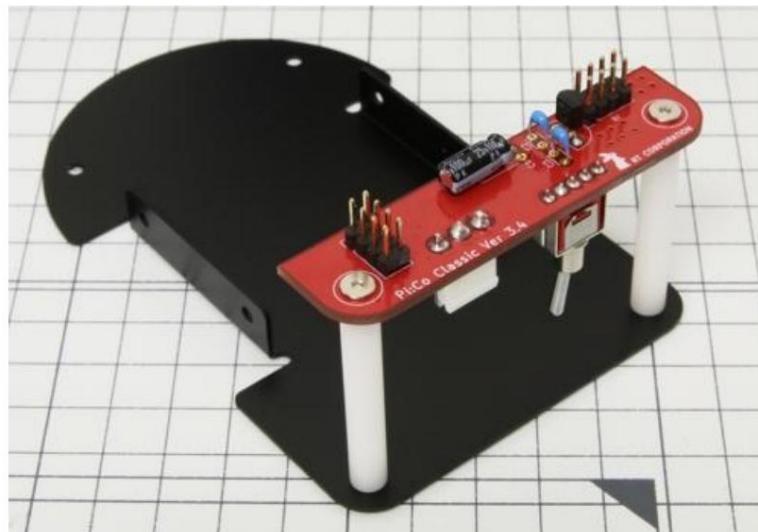
Three-terminal regulator, electrolytic capacitor, and pin header soldered

Finally, solder the battery connection post to CN1 and the toggle switch to SW1. The toggle switch does not have a direction, but the battery connection post does, so please install it carefully while referring to the diagram below. Installing the battery connection post in the wrong direction may cause the product to malfunction. Also, the power supply board has a front and back, so please check which side is which before soldering.



Toggle switch and battery connection post soldered in place

The power supply board is soldered on both sides. If you fix the board to the chassis as shown below, it will be easier to solder the other side. The white spacers and screws required for assembly are included in the bag of assembly parts 1. There are short and long white spacers, but we will use the long ones here.

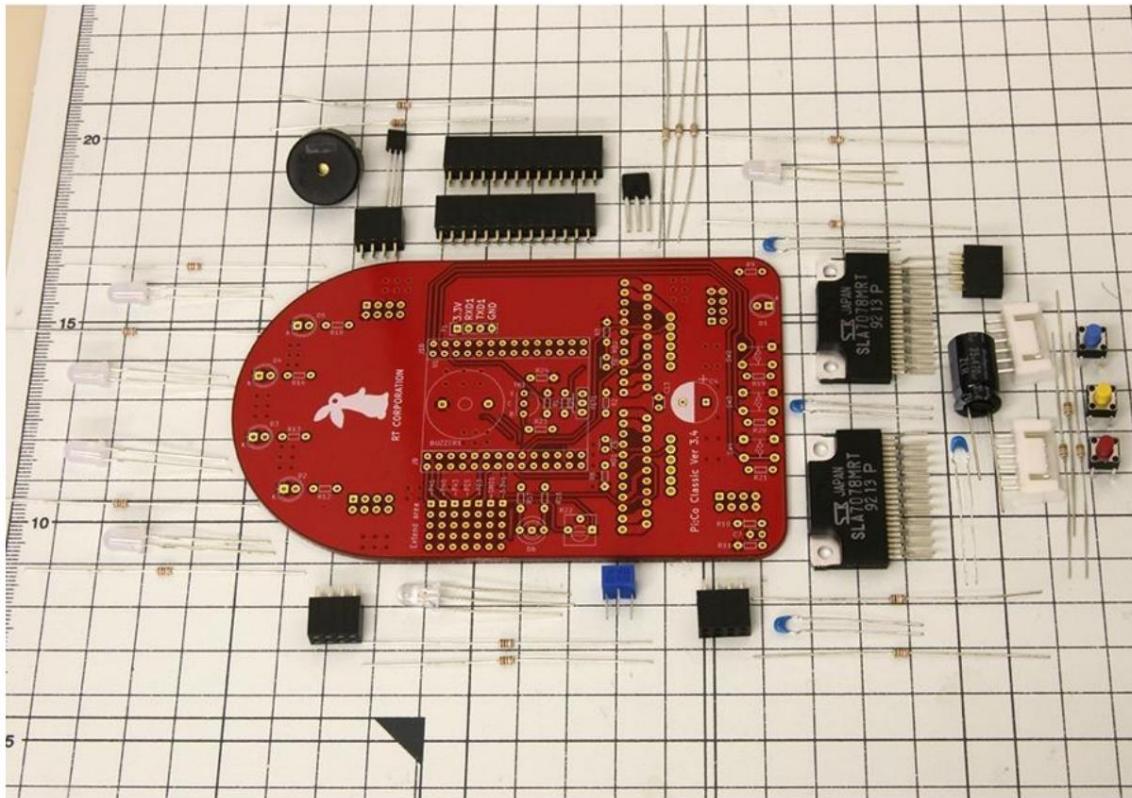


Power supply board attached to the chassis

This completes the soldering of the power supply board.

## Main Board

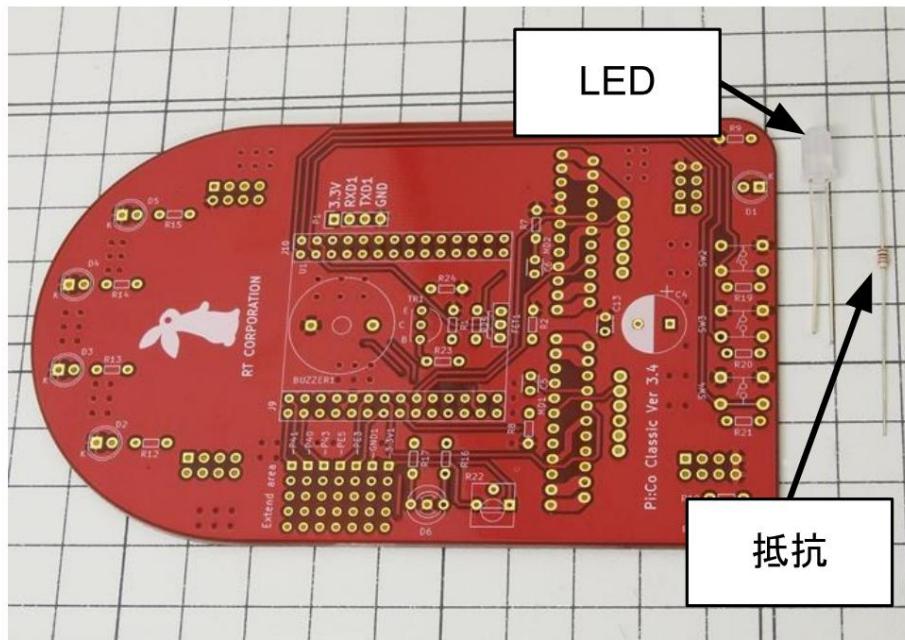
Next, solder the main board. First, solder the main board and the boards labeled Main Board 1 to Main Board 13.  
Please prepare the green bags marked with the name of the items in each bag.



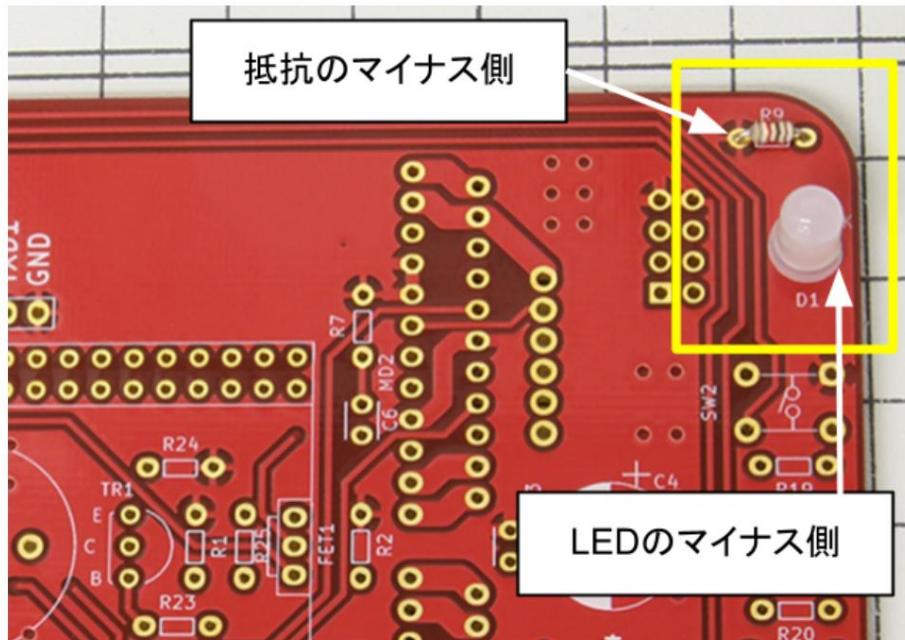
Main board components (component names will be described later)

## Pi:Co Classic3 Assembly Manual

First, attach the power supply confirmation LED. Solder the LED (milky white/red) in the bag on the main board 1 to D1 and the 1k $\Omega$  resistor to R9. The LED has polarity, so be careful of the direction when soldering.

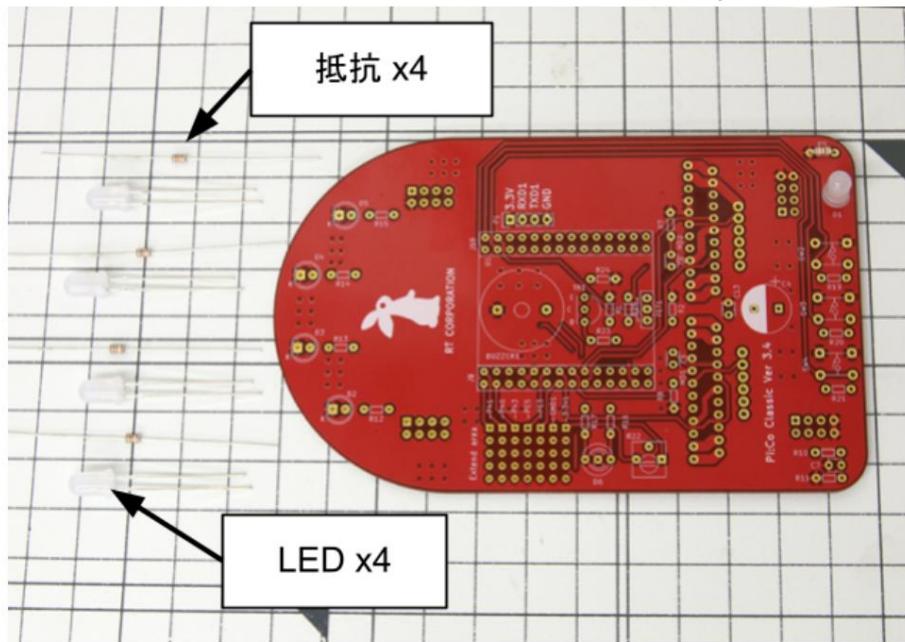


Main board 1 components

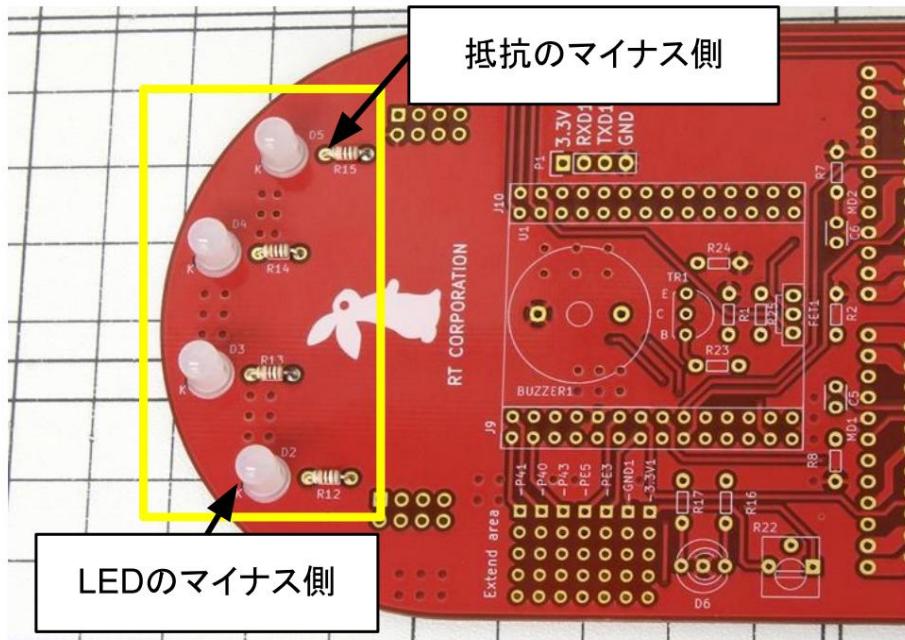


Main board 1 components soldered

Next, attach the mode display LED. Solder the LEDs (milky white and red) in the bag on the main board 2 to D2, D3, D4, and D5, and the 1k $\Omega$  resistors to R12, R13, R14, and R15. The LEDs have polarity, so be careful of the direction when soldering.

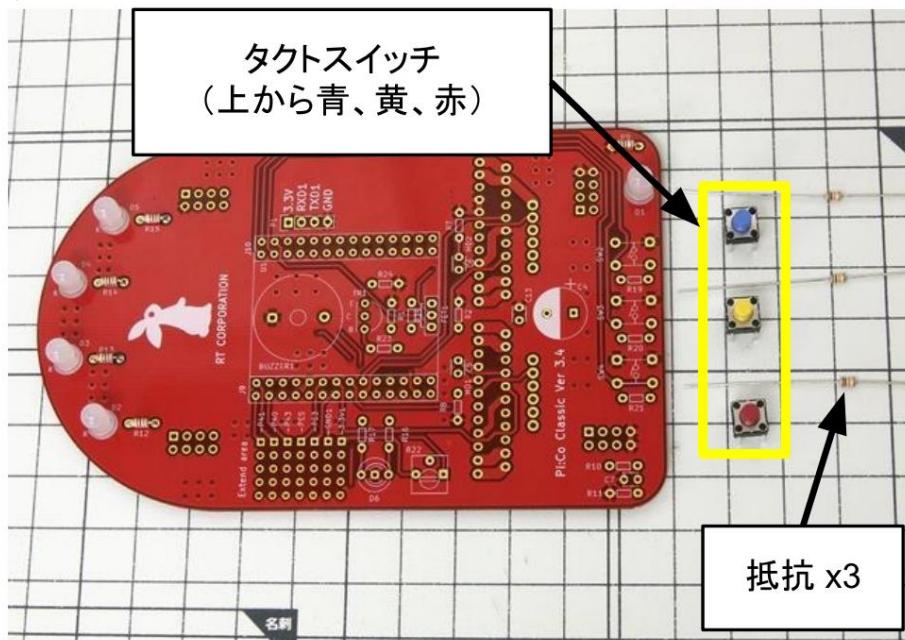


Main board 2 parts

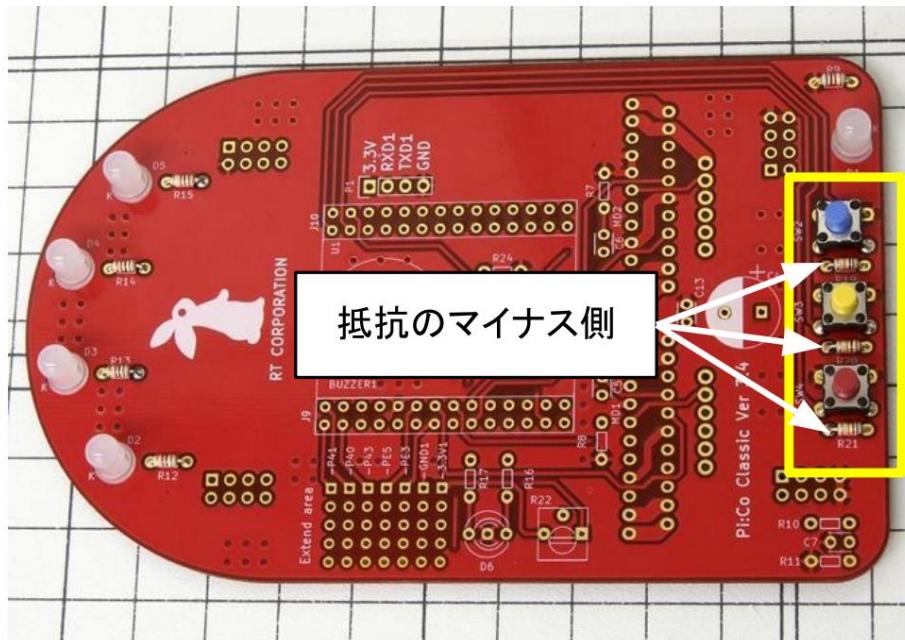


Main board 2 components soldered

Next, solder the sample mode selection button circuit. Solder the tact switch (blue) in the bag on the main board 3 to SW2, the tact switch (yellow) to SW3, the tact switch (red) to SW4, and the 1k $\Omega$  resistors to R19, R20, and R21. Please note that it is difficult to pass the legs of the tact switch through the holes in the board.



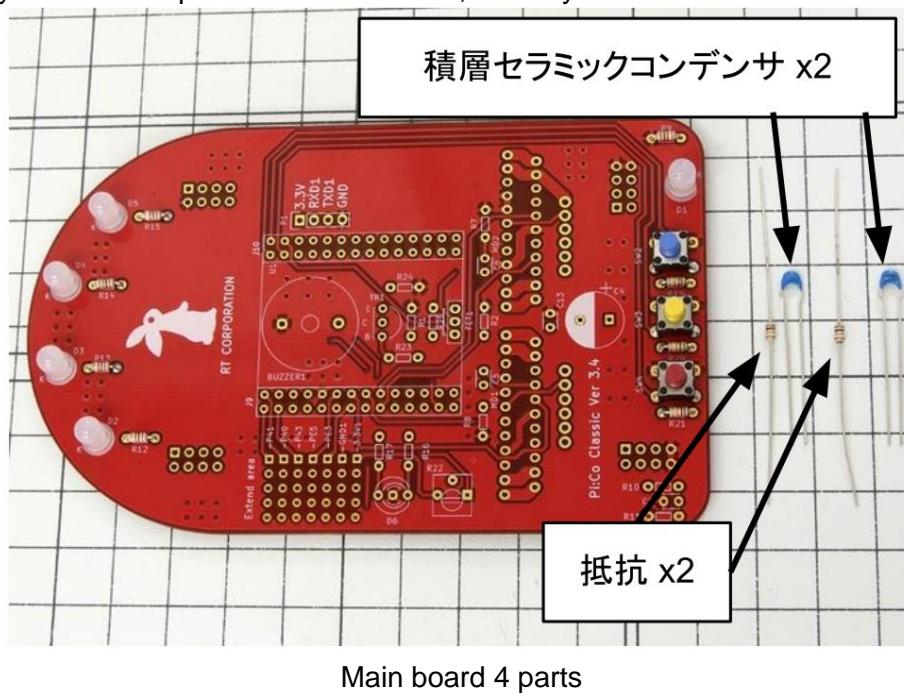
Main board 3 parts



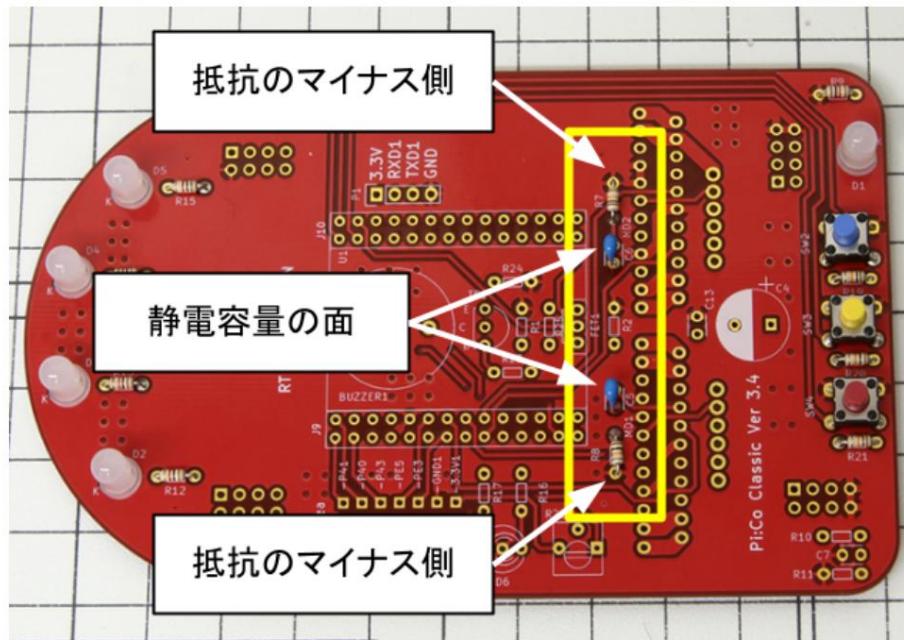
Main board 3 components soldered

Next, we will attach parts to the motor driver circuit.

Solder 0.1 $\mu$ F ceramic capacitors to C5 and C6, and 1k $\Omega$  resistors to R7 and R8.

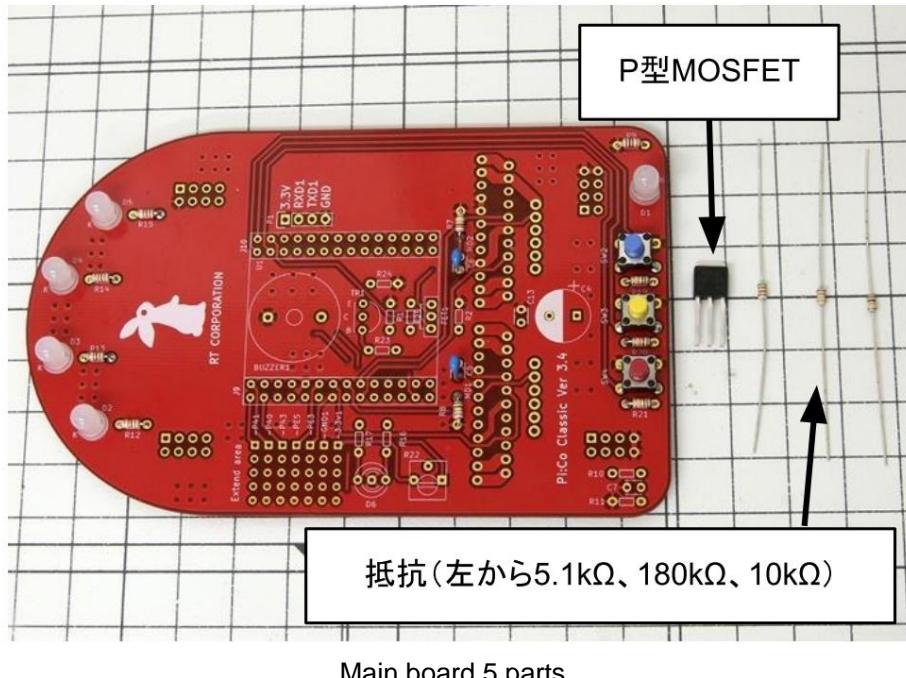


Main board 4 parts

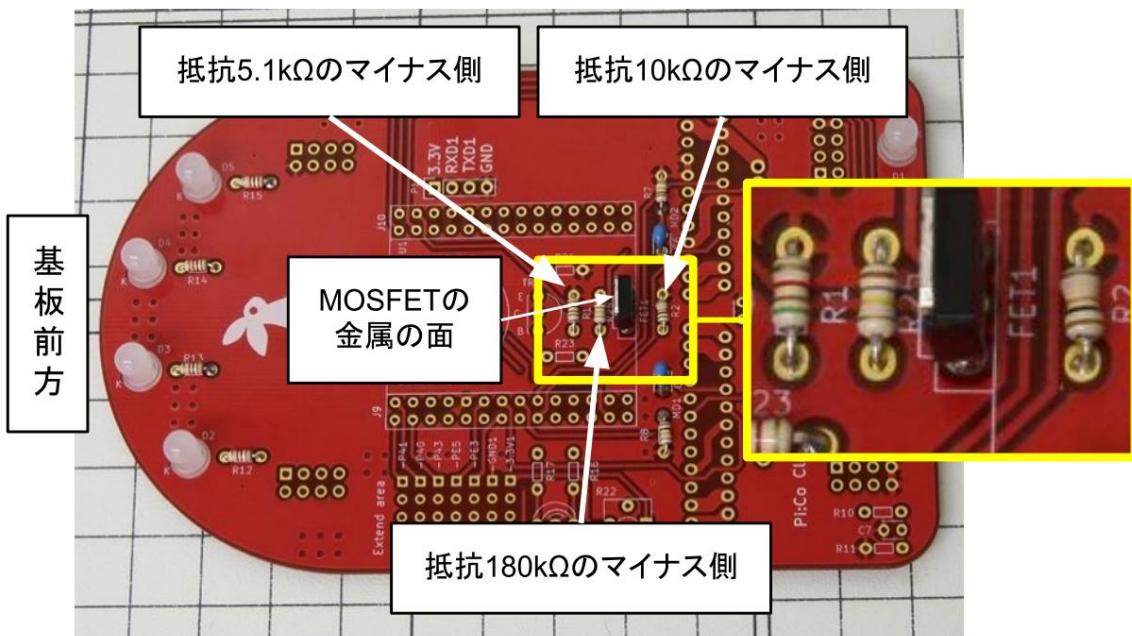


Main board 4 components soldered

Next, install the parts to turn the motor driver on and off. Solder the P-type MOSFET (IRFU5505PBF) on the main board 5 to FET1, the 5.1k $\Omega$  resistor (green-brown-red-gold) to R1, the 10k $\Omega$  resistor (brown-black-orange-gold) to R2, and the 180k $\Omega$  resistor (brown-gray-gold) to R25. Please note that MOSFETs have polarity. Install the MOSFET with the metal side facing the front of the board (where the four LEDs are lined up).

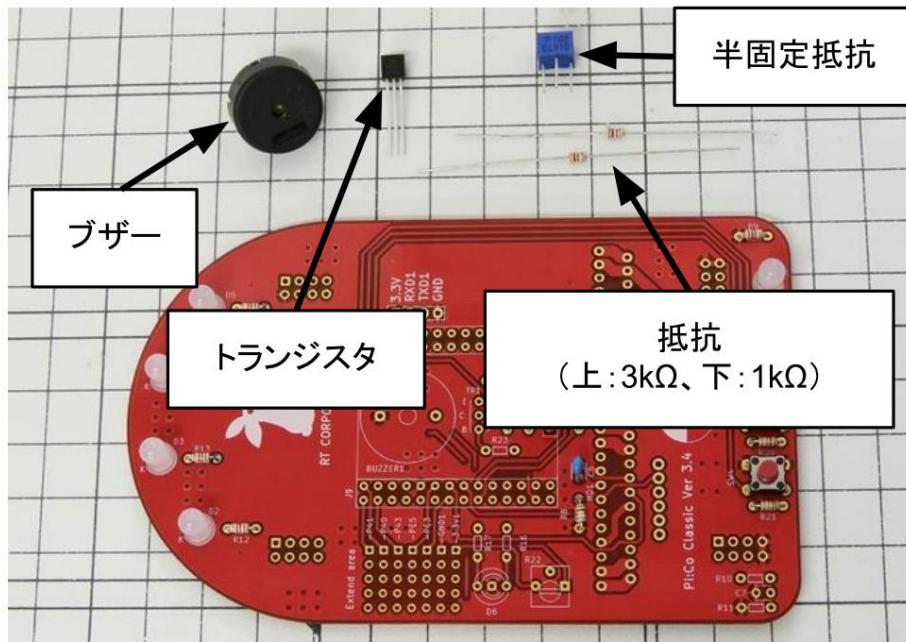


Main board 5 parts

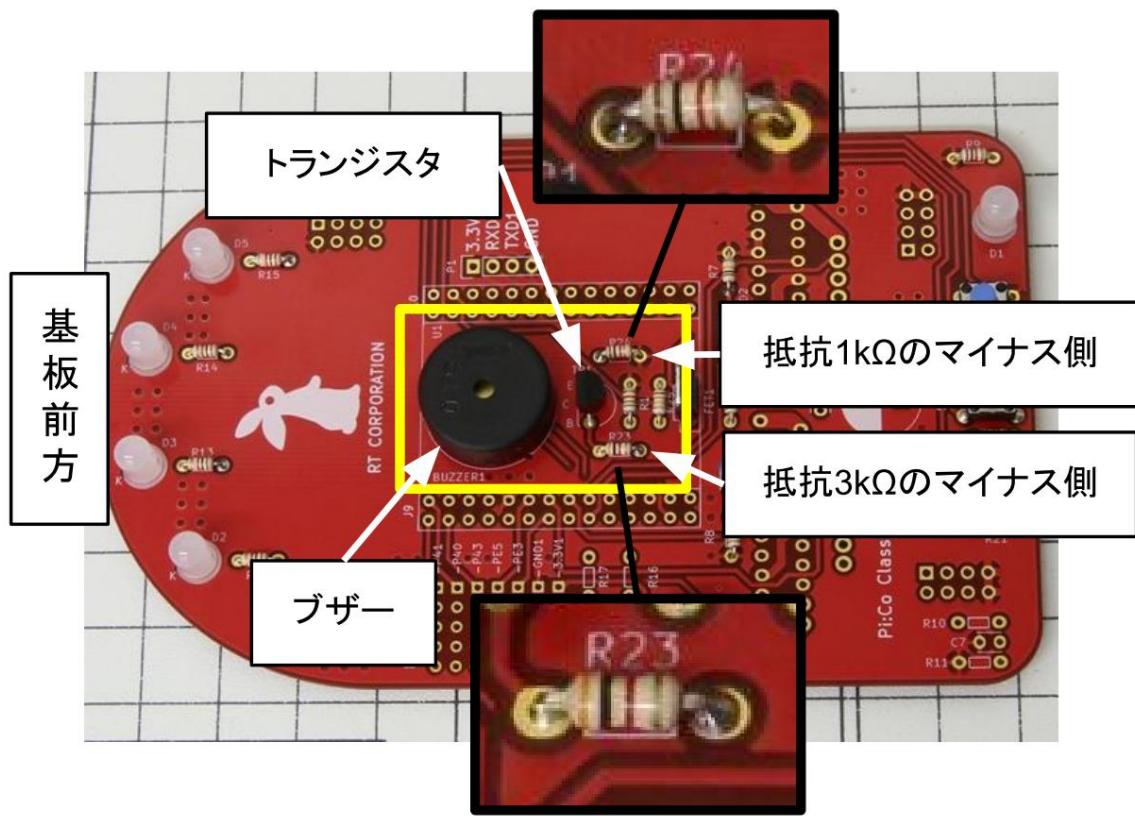


Main board 5 components soldered

Next, install the components for the buzzer circuit. Solder the buzzer on main board 6 to BUZZER1, the transistor (A1015) to TR1, the 10k $\Omega$  tri-fixed resistor to R22, the 3k $\Omega$  resistor (orange, black, red, gold) to R23, and the 1k $\Omega$  resistor (brown, black, red, gold) to R24. Since transistors have polarity, pay attention to the orientation when installing them. Solder so that the flat surface faces the front of the board when viewed from above. Also, if the pin pitch of the transistor is narrower than the pitch of the board, spread the transistor pins as you insert them.



Main board 6 parts

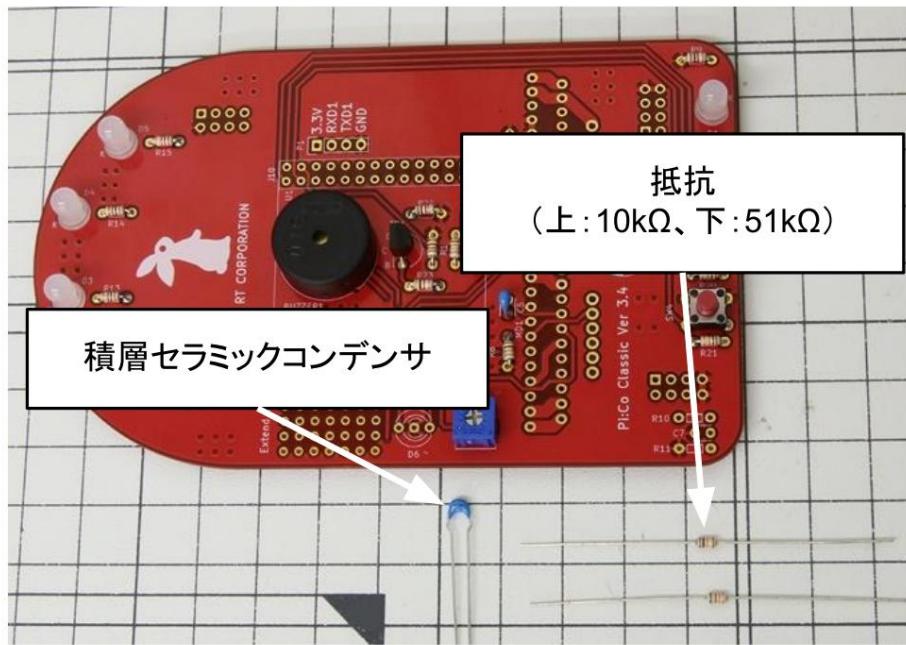


Main board 6 components soldered

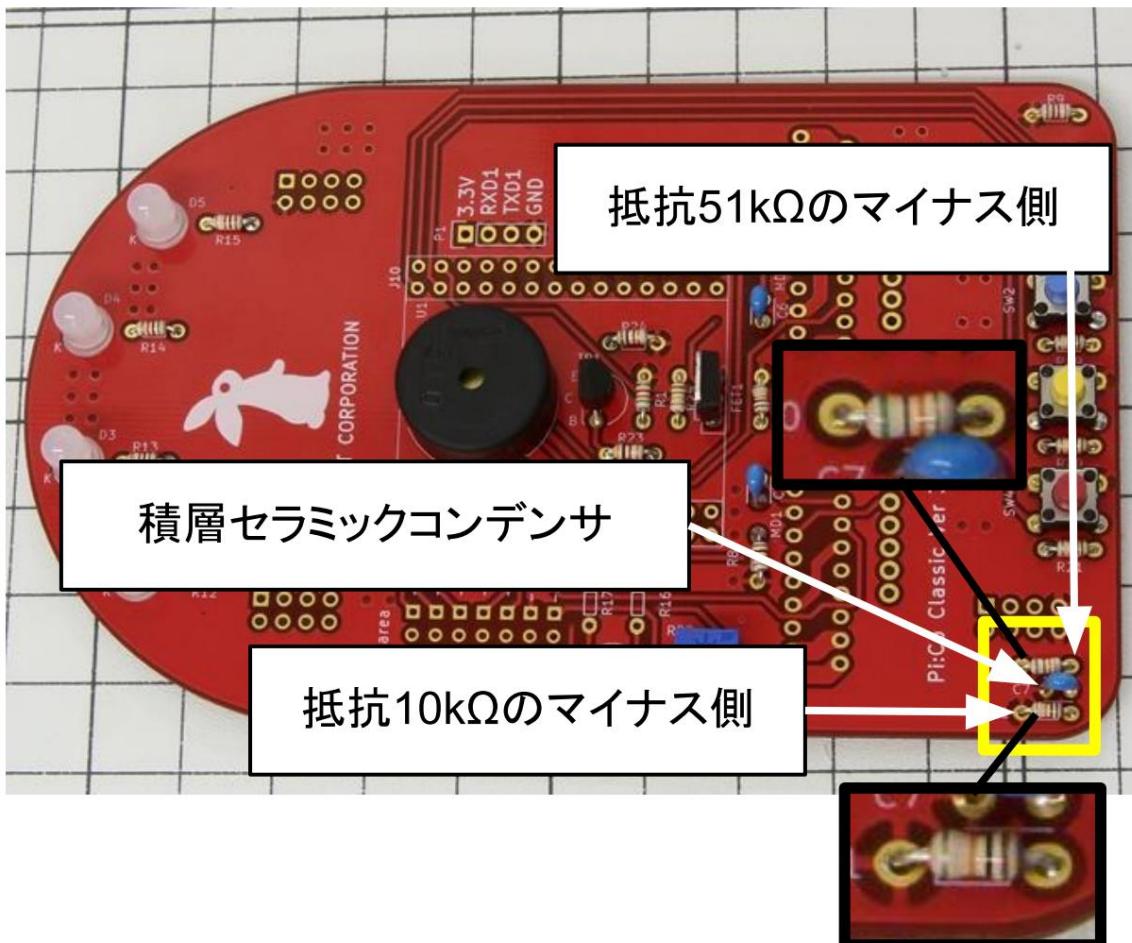
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Next, we will install the power supply voltage monitor voltage divider circuit components.

Solder a 0.1  $\mu\text{F}$  differential capacitor to C7, a 51  $\text{k}\Omega$  (green-brown-orange-gold) resistor to R10, and a 10  $\text{k}\Omega$  (brown-black-orange-gold) resistor to R11.

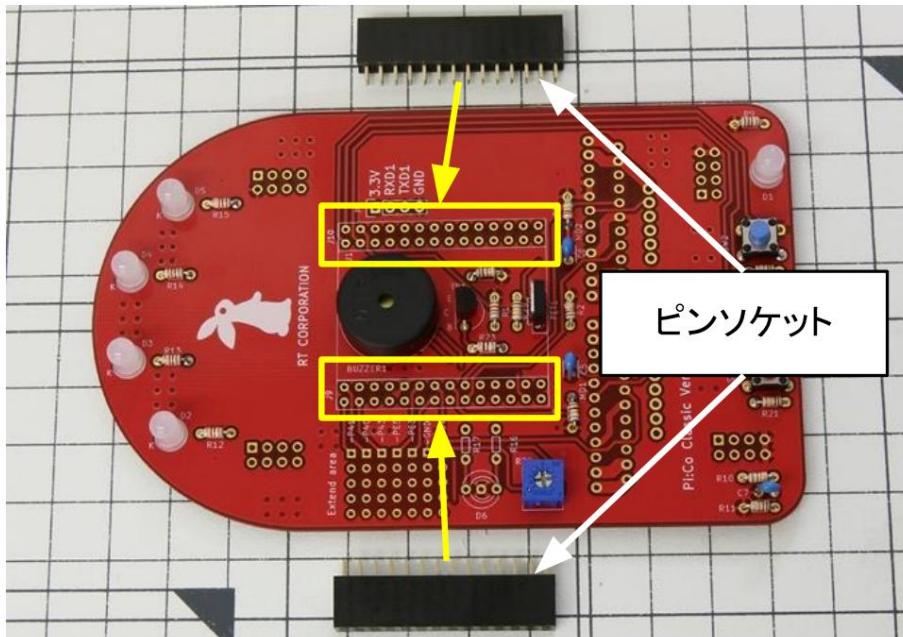


Main board 7 parts

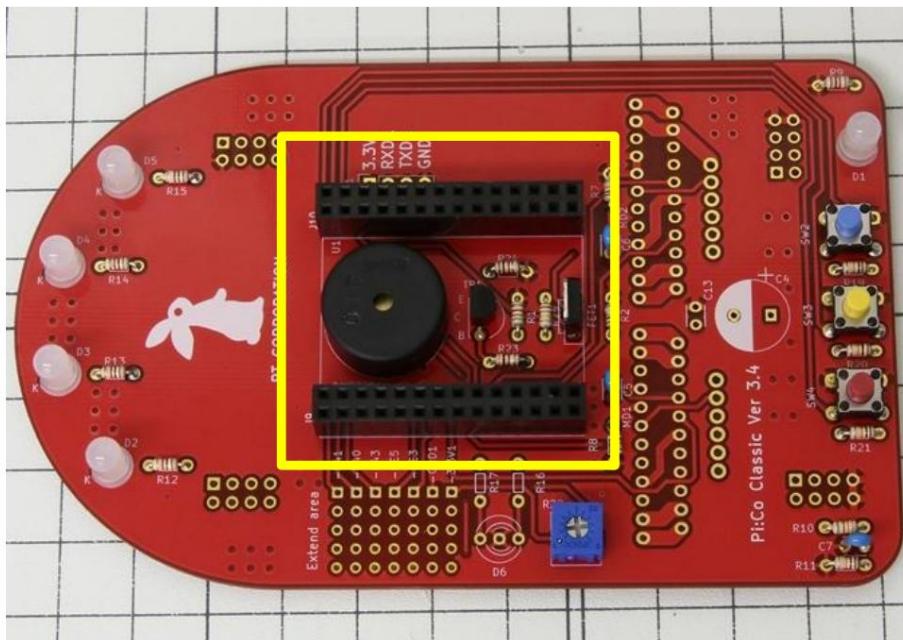


Main board 7 components soldered

Next, attach the socket for connecting the microcontroller board. Solder the pin socket (2x14) in the bag on the main board 8 to J9 and J10. Install it as vertically as possible so that the microcontroller board can be connected. First, temporarily fasten only the two diagonal ends of the pin socket. After making sure that the socket is vertical, solder the remaining pins.

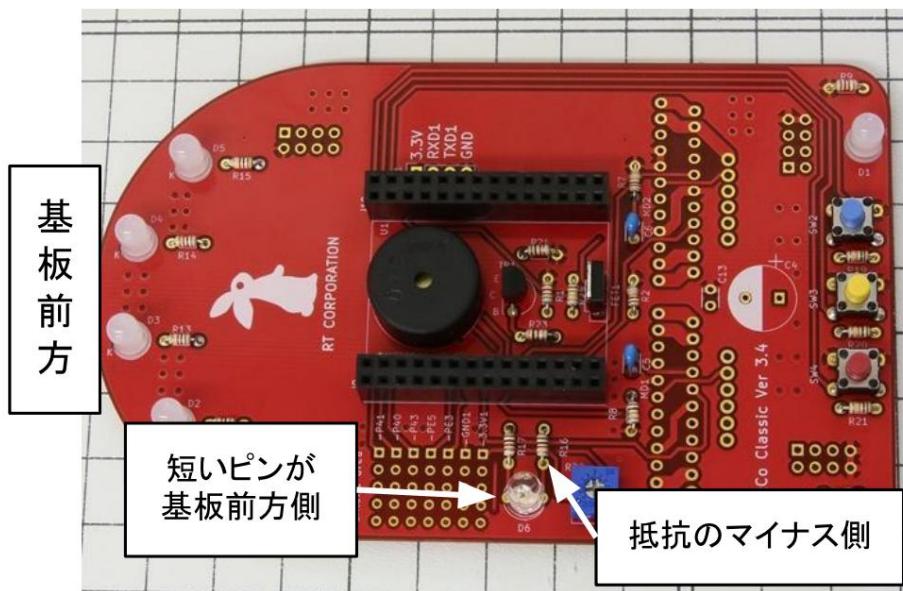
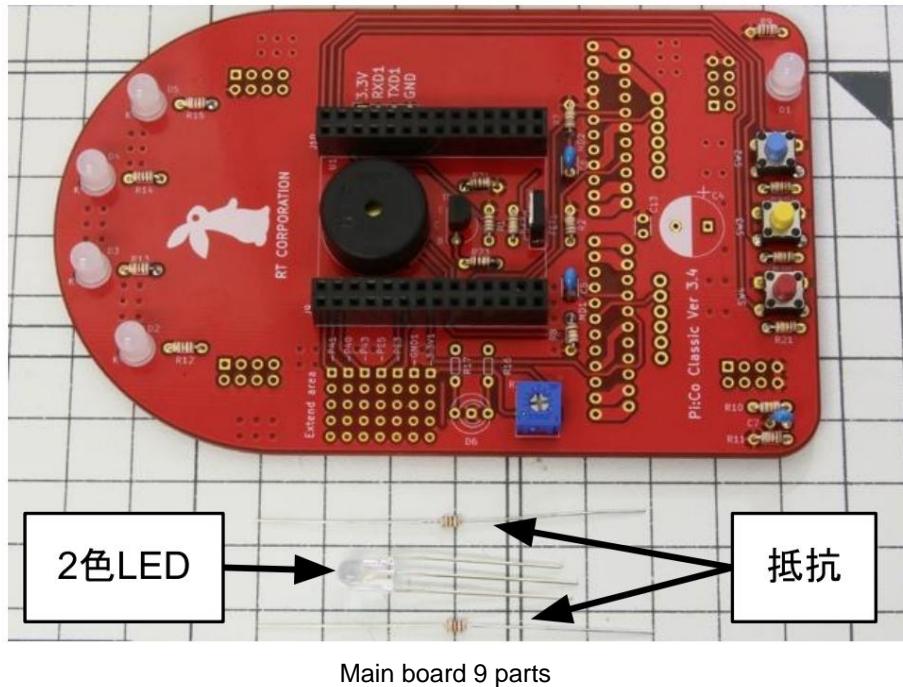


Main board 8 parts



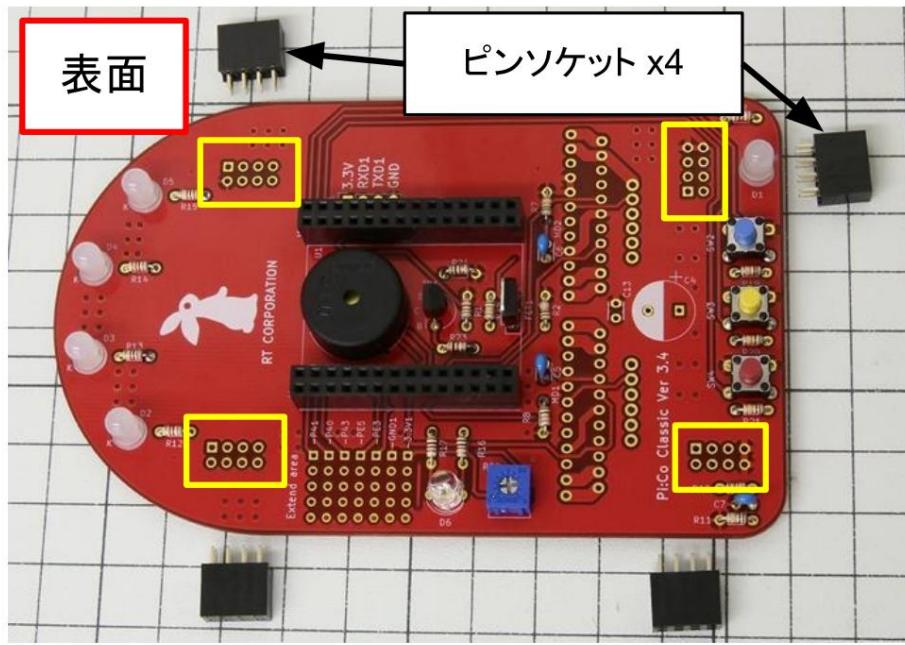
Main board 8 components soldered

Next, install the components for the LED circuit to monitor the power supply voltage. Solder the two-color LED (red and blue common cathode) in the bag on the main board 9 to D6, and the 1k $\Omega$  resistors (brown, black, red, gold) to R16 and R17. The long pin of the two-color LED is GND (negative), the short pin is blue (positive), and the medium pin is red (positive). Install it so that the short pin is at the front of the board.

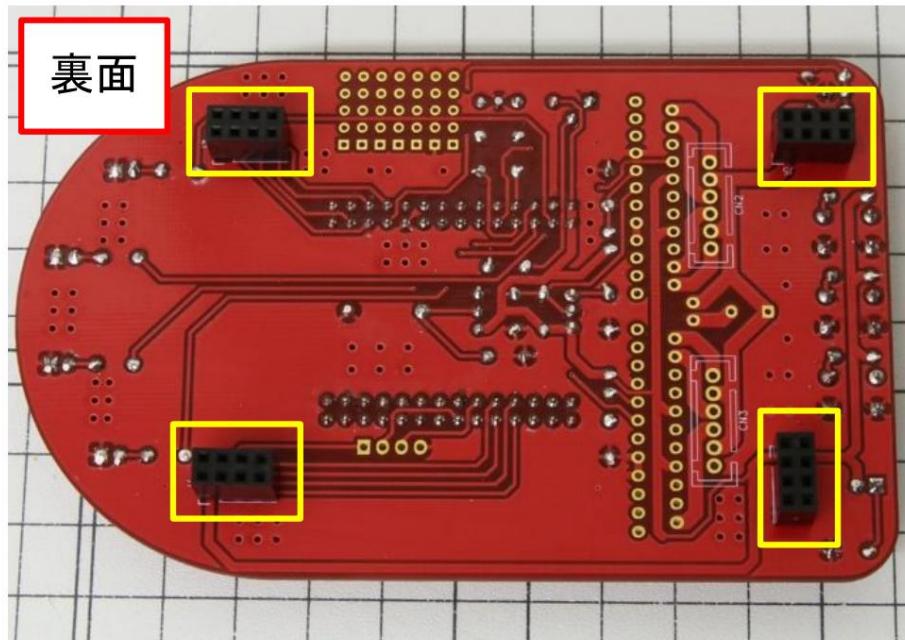


Next, attach the connectors for each board. Solder the pin sockets (2x4) in the bag of the main board 10 to J3, J4, J5, and J6. However, these pin sockets are on the back of the main board.

Please check the front and back of the board before soldering.



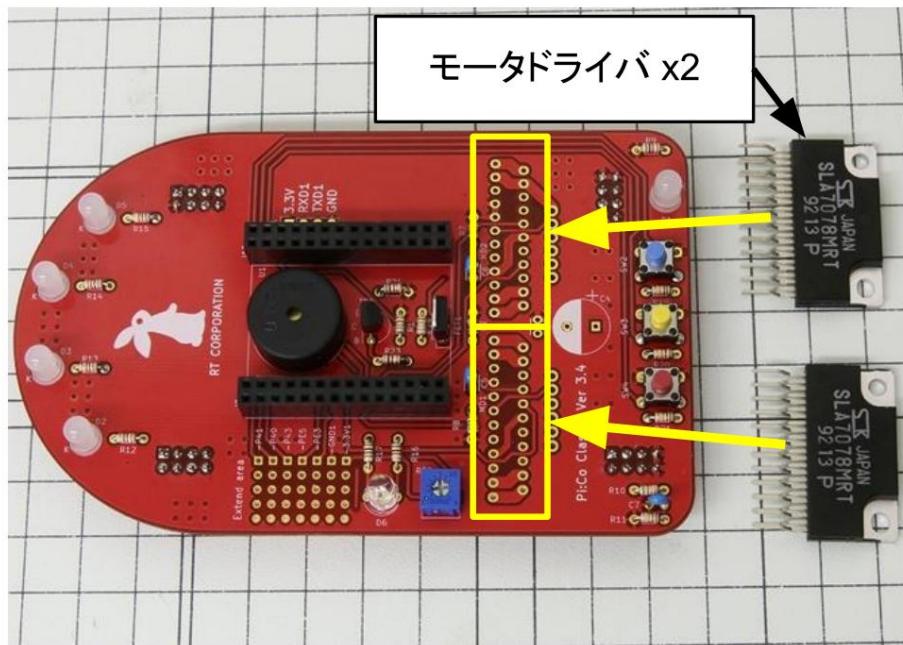
## Components of the main board 10 (front surface)



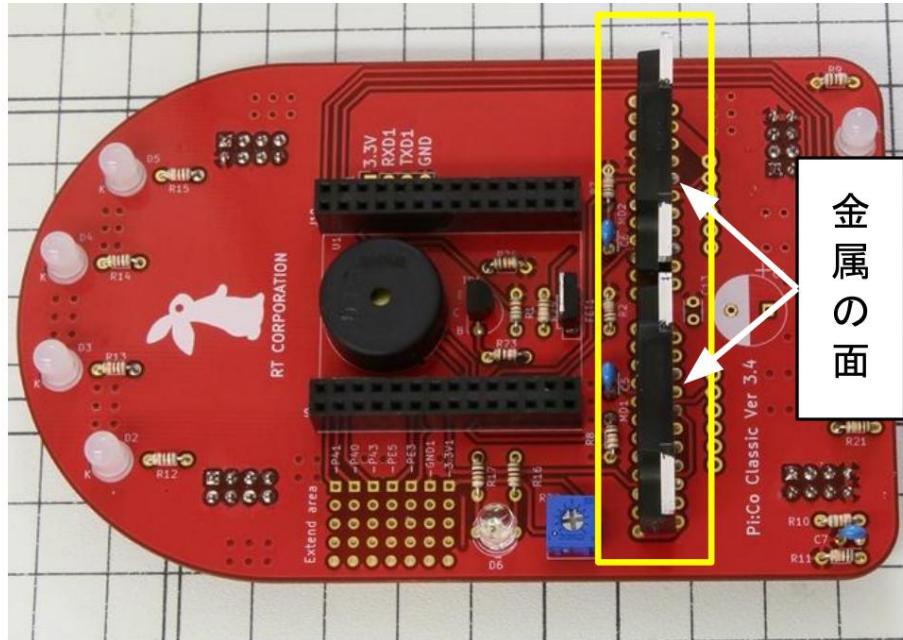
Main board 10 with components soldered (reverse side)

## Pi:Co Classic3 Assembly Manual

Next, install the motor driver. The unipolar stepper motor included in the main board 11 bag is soldered to the pin motor driver (SLA7078M) to MD1 and MD2. Install it so that the metal side faces the back of the board as shown in the figure below. This motor driver is very sensitive to static electricity, so be sure to discharge any static electricity from your body before starting work.



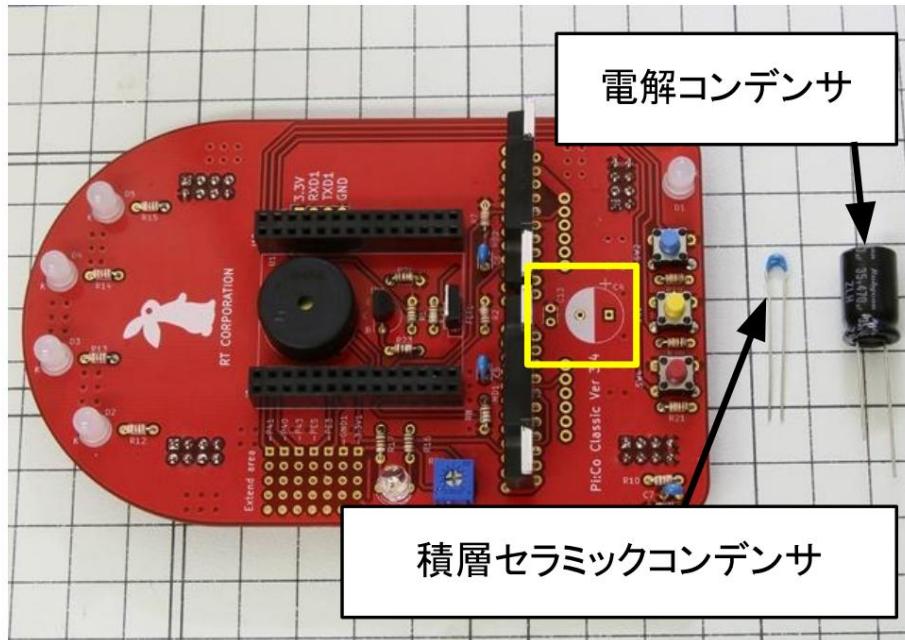
Main board 11 parts



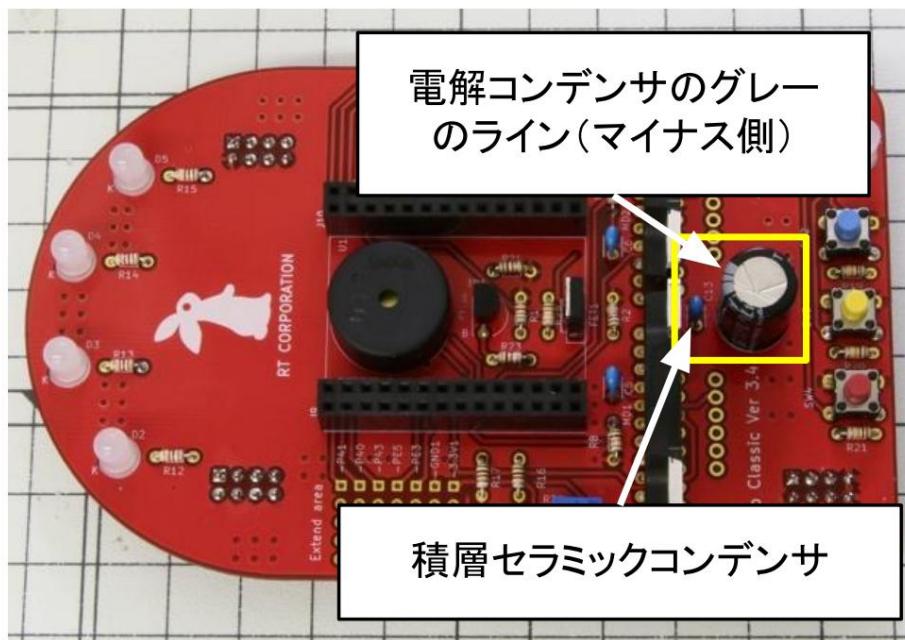
Main board 11 components soldered

Next, we will install the bypass capacitor for the motor driver.

Solder the 470 $\mu$ F electrolytic capacitor attached to C4 and the 0.1 $\mu$ F multilayer ceramic capacitor (104) to C13. It is easier to attach the low profile multilayer ceramic capacitor first. The electrolytic capacitor has polarity, so pay attention to the orientation when attaching it. Solder the electrolytic capacitor so that the grey line (negative side) faces the motor driver as shown in the diagram below.



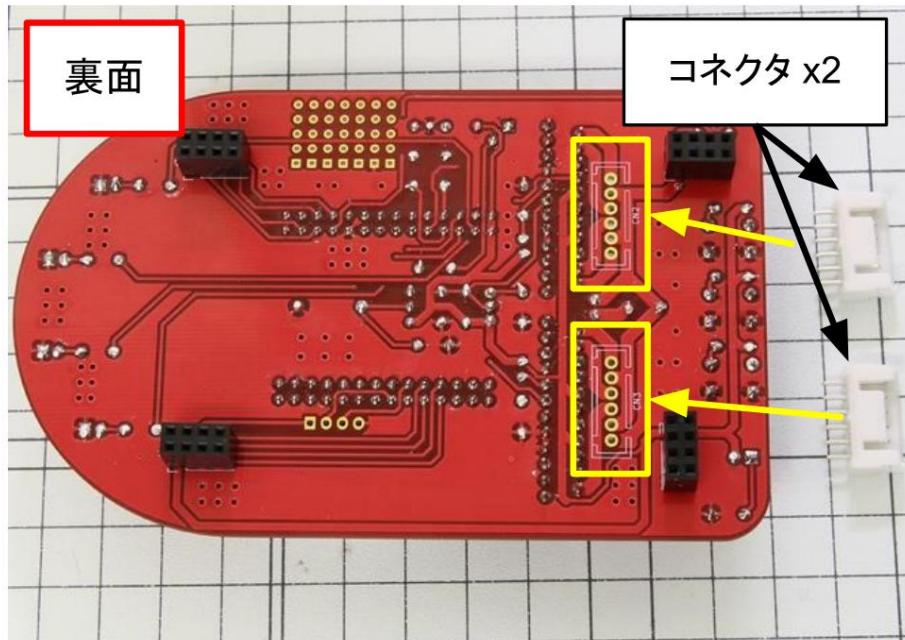
Main board 12 components



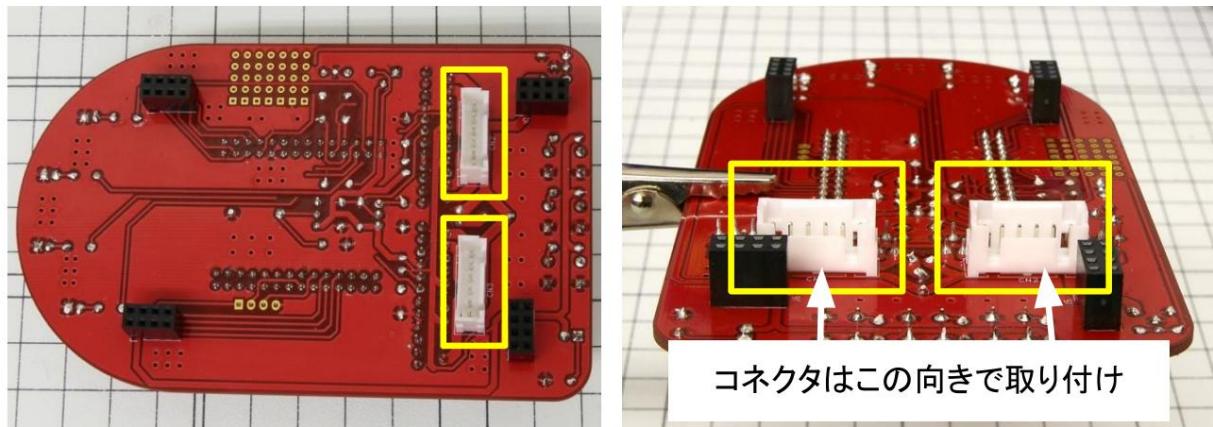
Main board 12 components soldered

## Pi:Co Classic3 Assembly Manual

Next, attach the motor connector. The 6-pin male connector in the bag of the main board 13 Solder the tact switch to CN2 and CN3. Attach this connector to the back side of the main board. Also, the connector has a direction, so attach it as shown in the figure below. When soldering, be careful not to tilt the soldering tip too far down and melt the tact switch with heat.



Main board 13 parts



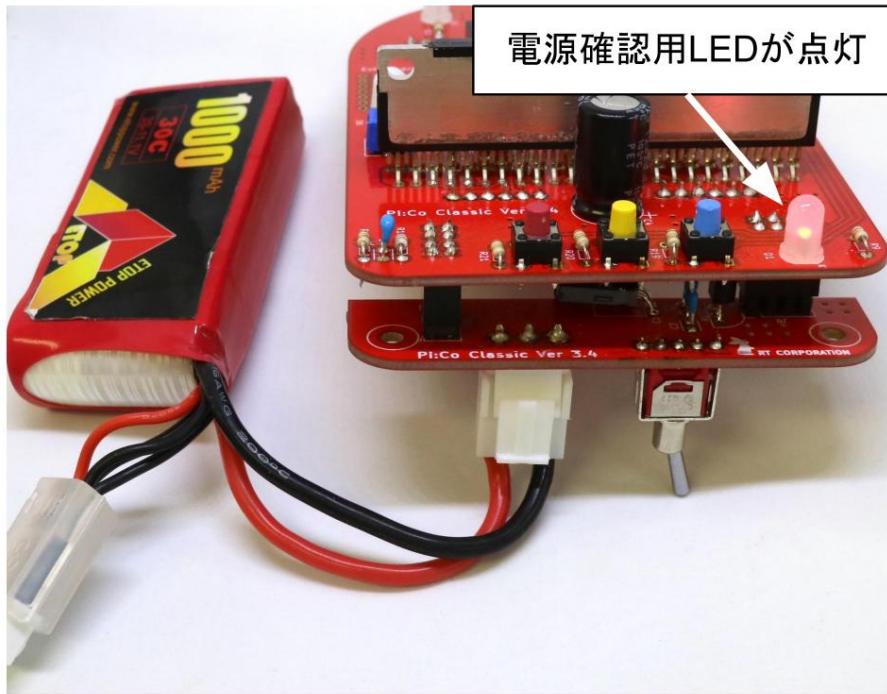
Main board 13 components soldered

#### Power supply board operation check

To check the operation of the power supply board, turn on the power check LED on the main board. If you have a tester, measure the resistance of the VDD and GND of the power connector to make sure there is no short circuit before connecting the battery. First, connect the power supply board

and main board with the pin header. Next, turn the power switch OFF and connect the battery. Finally, turn the switch ON and check if the power check LED is lit.

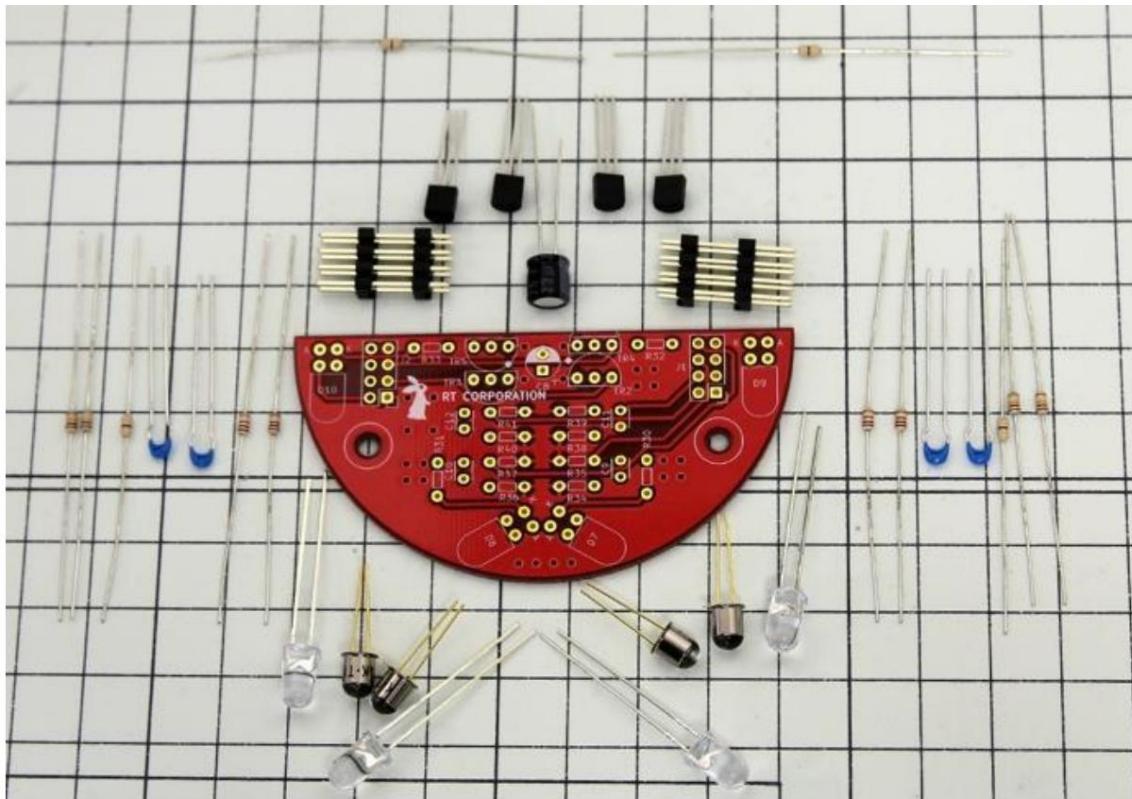
If the LED does not light up, turn the switch off, remove the battery, and make sure there is no problem with the soldering. Please check if



Checking the operation of the power supply board

## Sensor Board

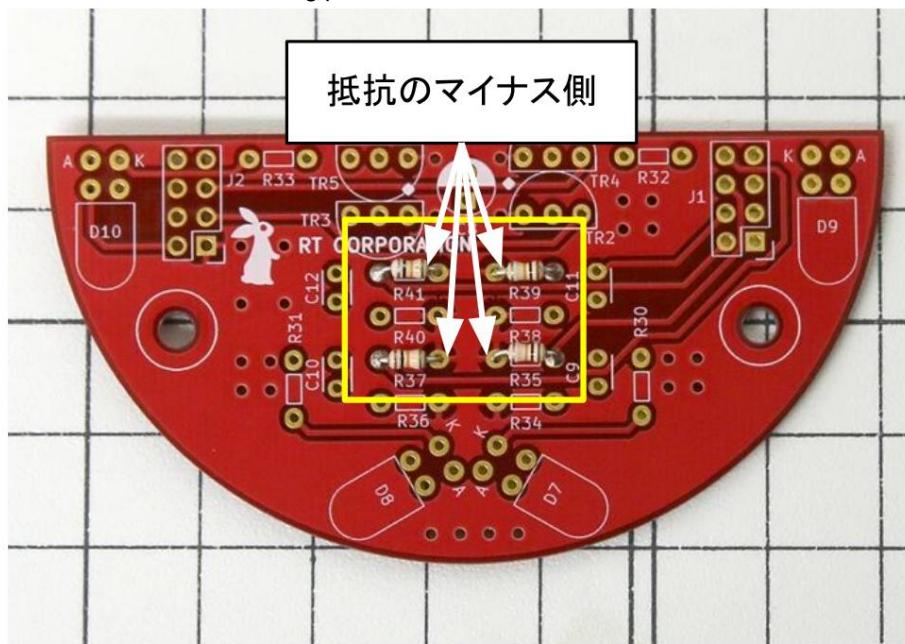
Next, solder the sensor board. First, solder the sensor board and the boards labeled Sensor Board 1 to Sensor Board 9. Please prepare the red bags that are marked with the names of the items in each bag.



Sensor board components (the names of each component are explained below)

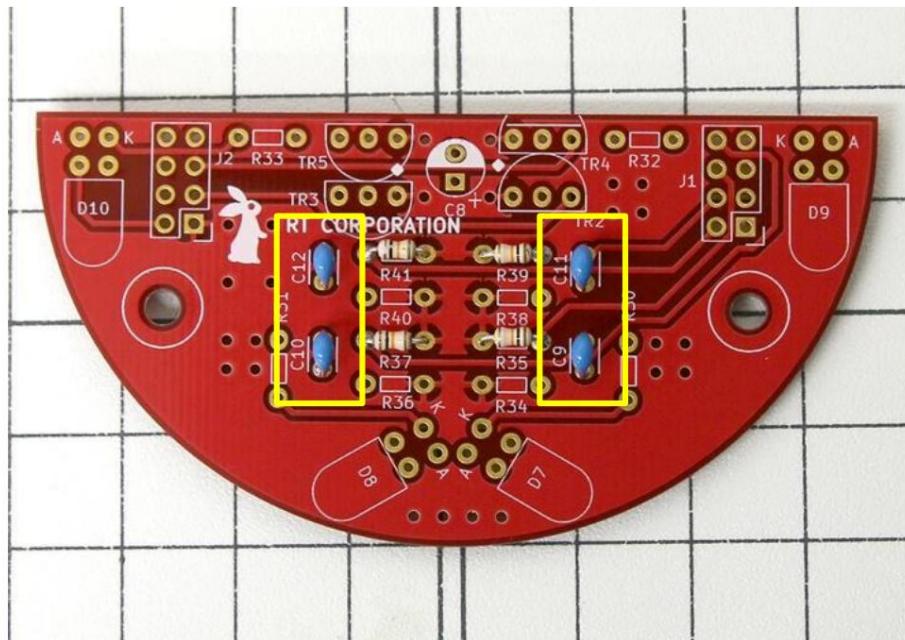
## Pi:Co Classic3 Assembly Manual

First, install the resistor for the filter circuit. The resistor included in the sensor board 1 bag is 10k $\Omega$  (brown). Solder the resistors (black, orange, gold) to R35, R37, R39, and R41. The resistors are closely spaced, so be careful not to install them in the wrong positions.



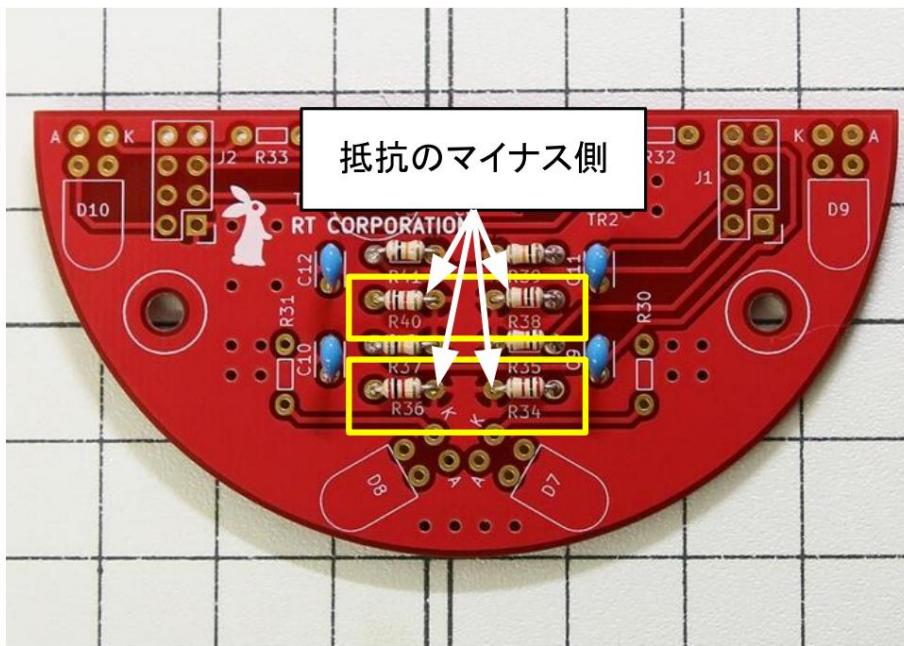
Sensor board 1 components soldered

Next, we will attach the capacitor for the filter circuit.  
Solder 0.01uF (103) differential capacitors to C9, C10, C11, and C12.



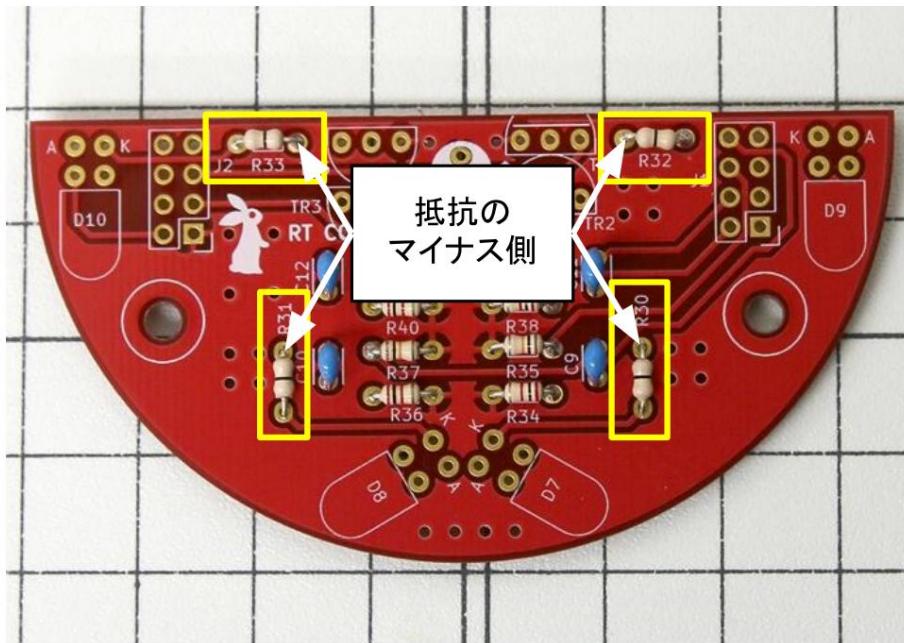
Sensor board 2 components soldered

Next, install the resistors for the light receiving circuit. Solder the 2k $\Omega$  resistors (red, black, red, gold) included in the bag for sensor board 3 to R34, R36, R38, and R40.



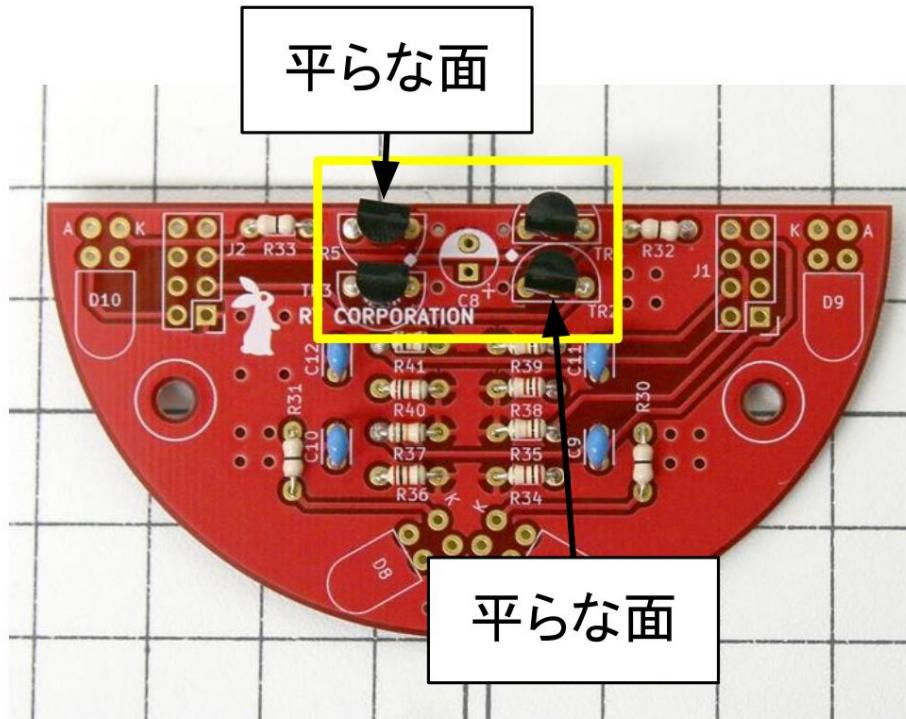
Sensor board 3 components soldered

Next, attach the resistors for the light emission circuit. Replace the 0  $\Omega$  (black) resistor in the bag of the sensor board 4 with R30. Solder to R31, R32, and R33.

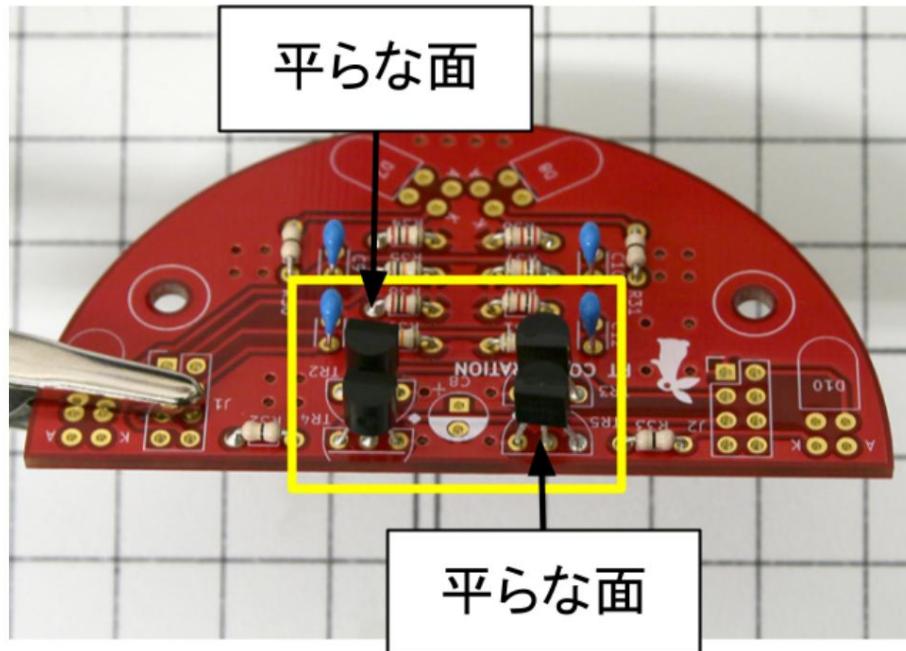


Sensor board 4 components soldered

Next, install the transistors for the light emission circuit. Solder the digital transistors (DTC123EL) included in the bag of sensor board 5 to TR2, TR3, TR4, and TR5. The digital transistors have a direction, so refer to the diagram below and align the flat side of the transistor with the silk screen of the board.

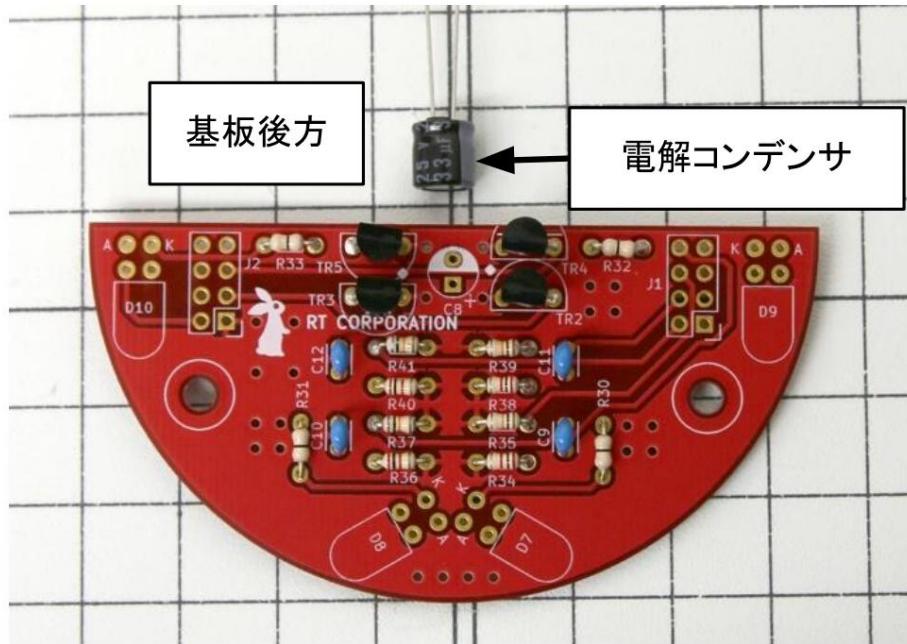


Digital transistors soldered in (viewed from the front of the board)

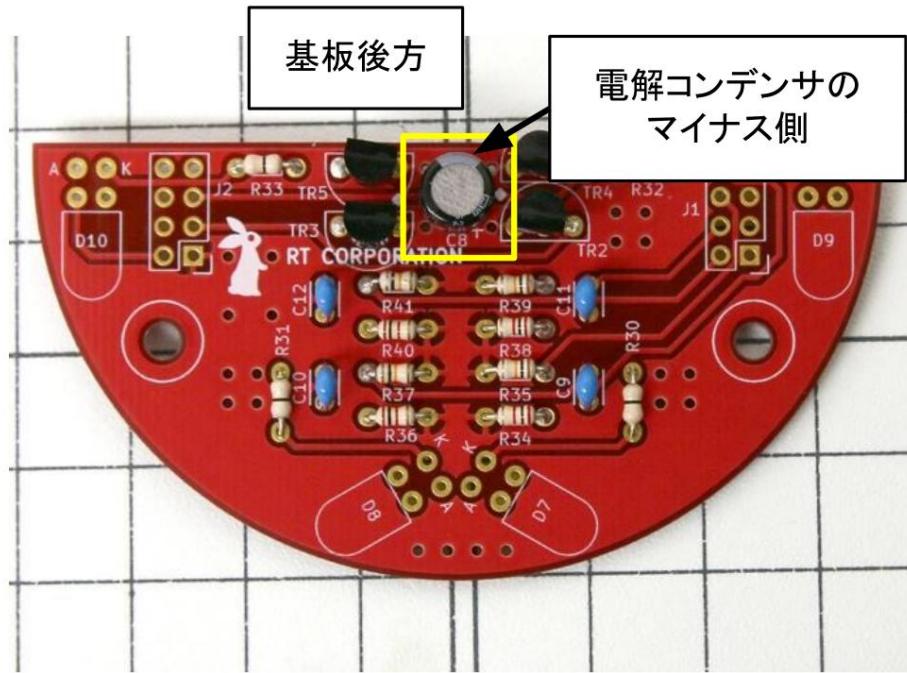


Digital transistors soldered in (view from the rear of the board)

Next, install the bypass capacitor for the sensor board. Solder the 33 $\mu$ F electrolytic capacitor included in the bag for sensor board 6 to C8. Capacitors have polarity, so pay attention to the orientation when installing them. Install the capacitor so that the gray line (negative side) faces the rear of the board as shown in the diagram below.

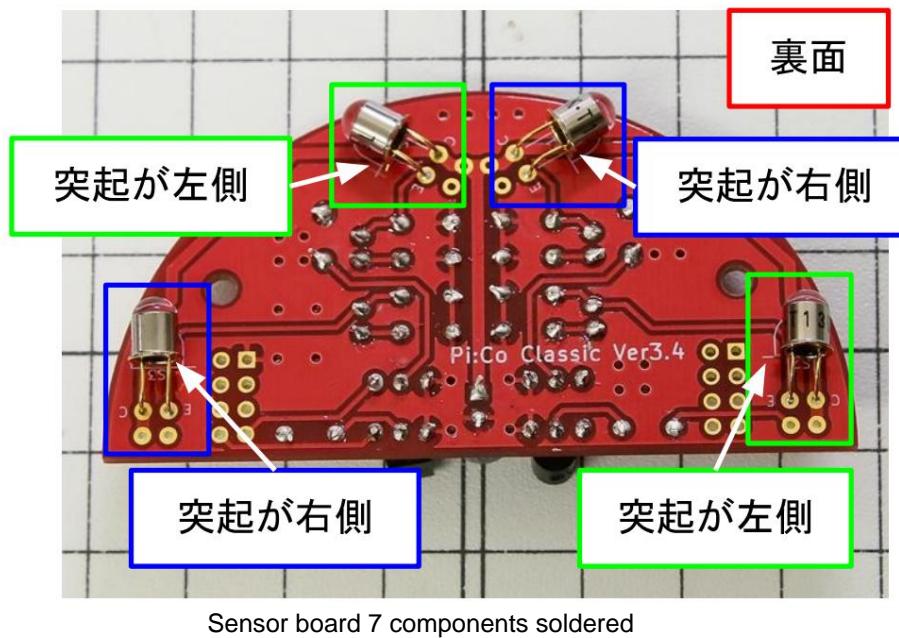


Sensor board 6 parts



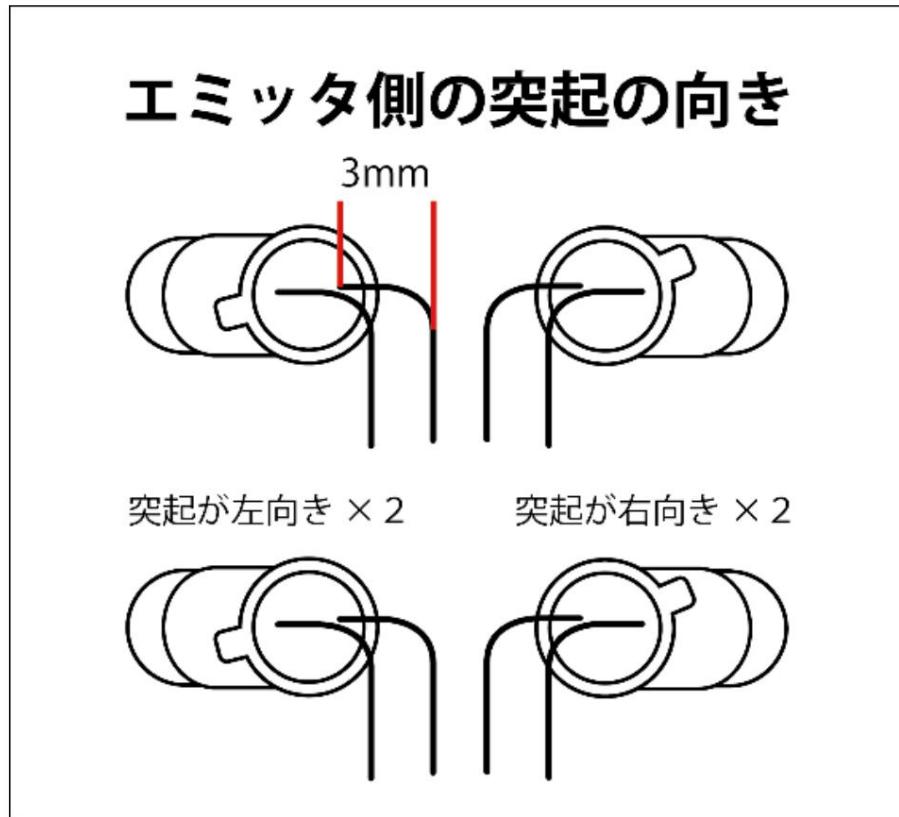
Sensor board 6 components soldered

Next, attach the sensor of the light receiving circuit. Solder the phototransistors in the bag of the sensor board 7 to S1, S2, S3, and S4. Attach the phototransistors to the back side of the sensor board. Also, since the phototransistor has a direction, attach it so that the side with the protrusion is on the emitter (E) side (the opposite side is the collector (C)).



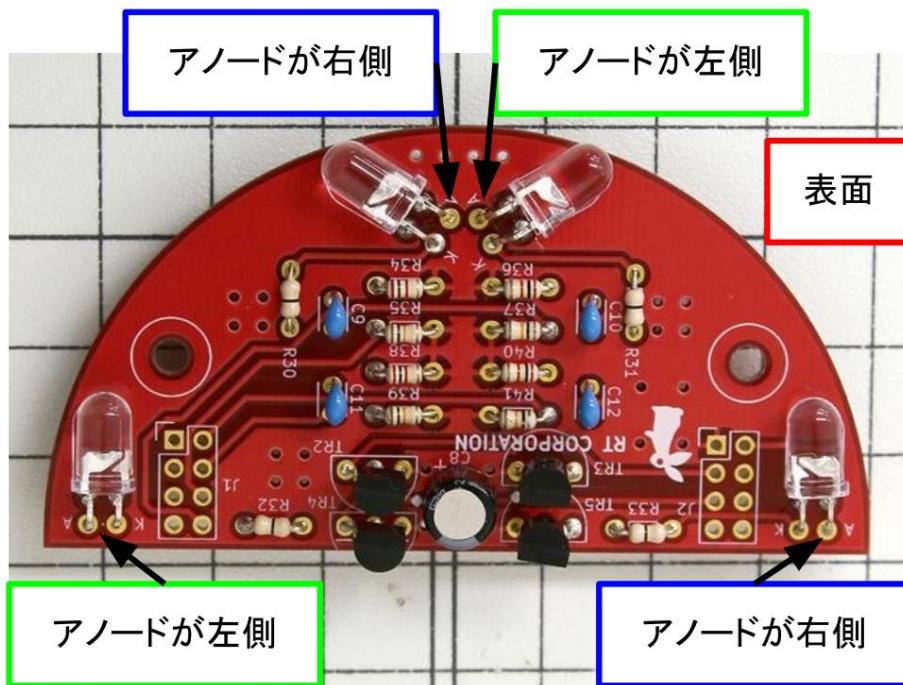
Sensor board 7 components soldered

Refer to the diagram below to bend the phototransistor terminals 90 degrees. You can bend them neatly using needle-nose pliers.



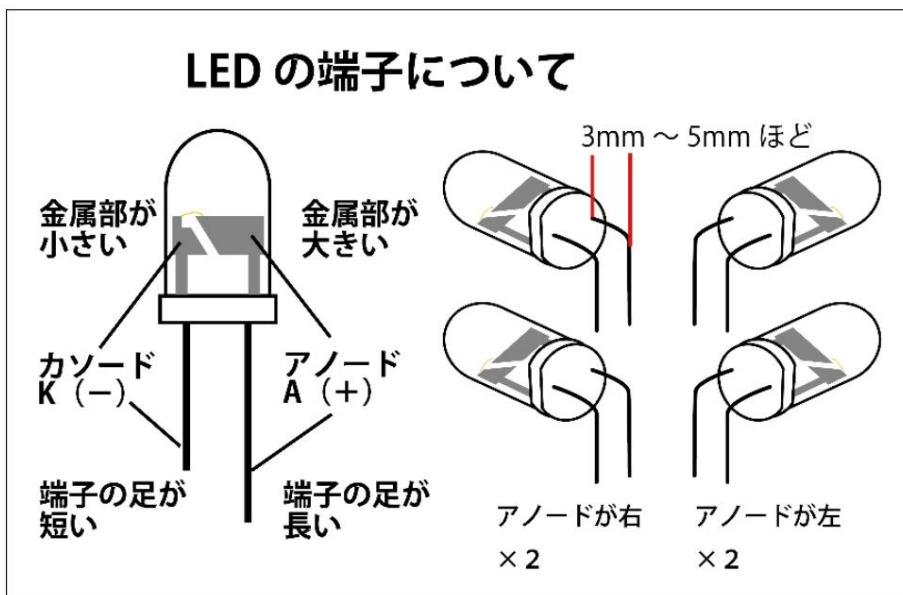
How to bend the terminals of a phototransistor

Next, attach the LEDs to the light-emitting circuit. Solder the LEDs (transparent red) in the bag on sensor board 8 to D7, D8, D9, and D10. LEDs have polarity, so be sure to attach them in the correct direction while referring to the diagram below.



Sensor board 8 components soldered

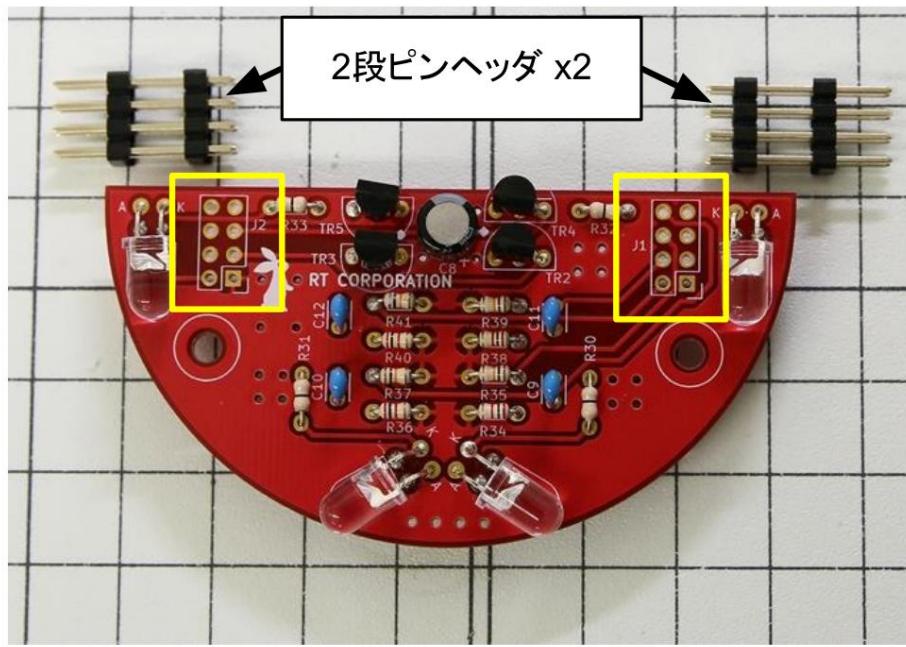
Refer to the diagram below to bend the LED terminals 90 degrees.  
It can be bent neatly.



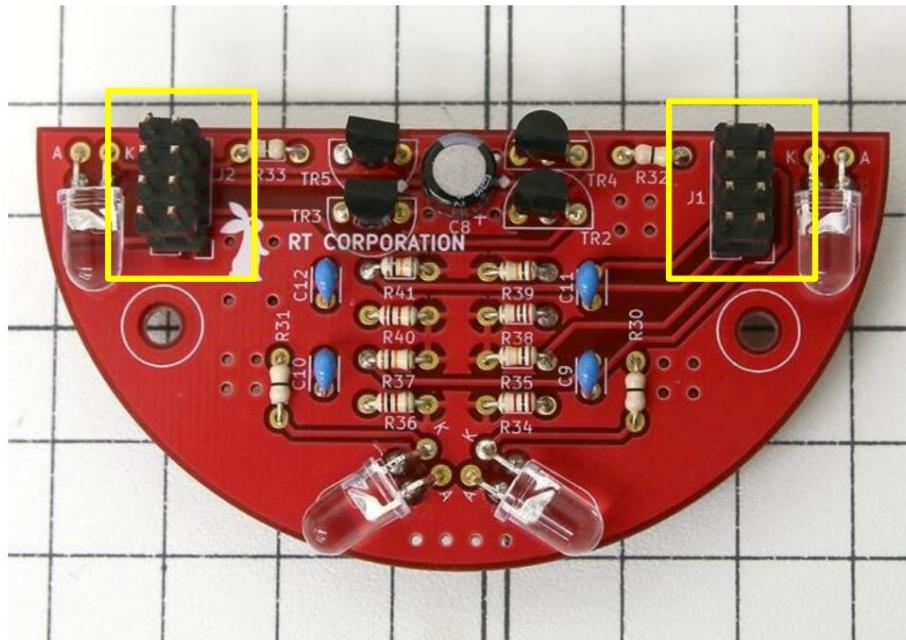
How to bend the LED terminals

Finally, attach the connector for connecting to the main board.

Solder the header (2x4) to J1 and J2. Insert the short legs of the pin header into the holes in the board and solder them.

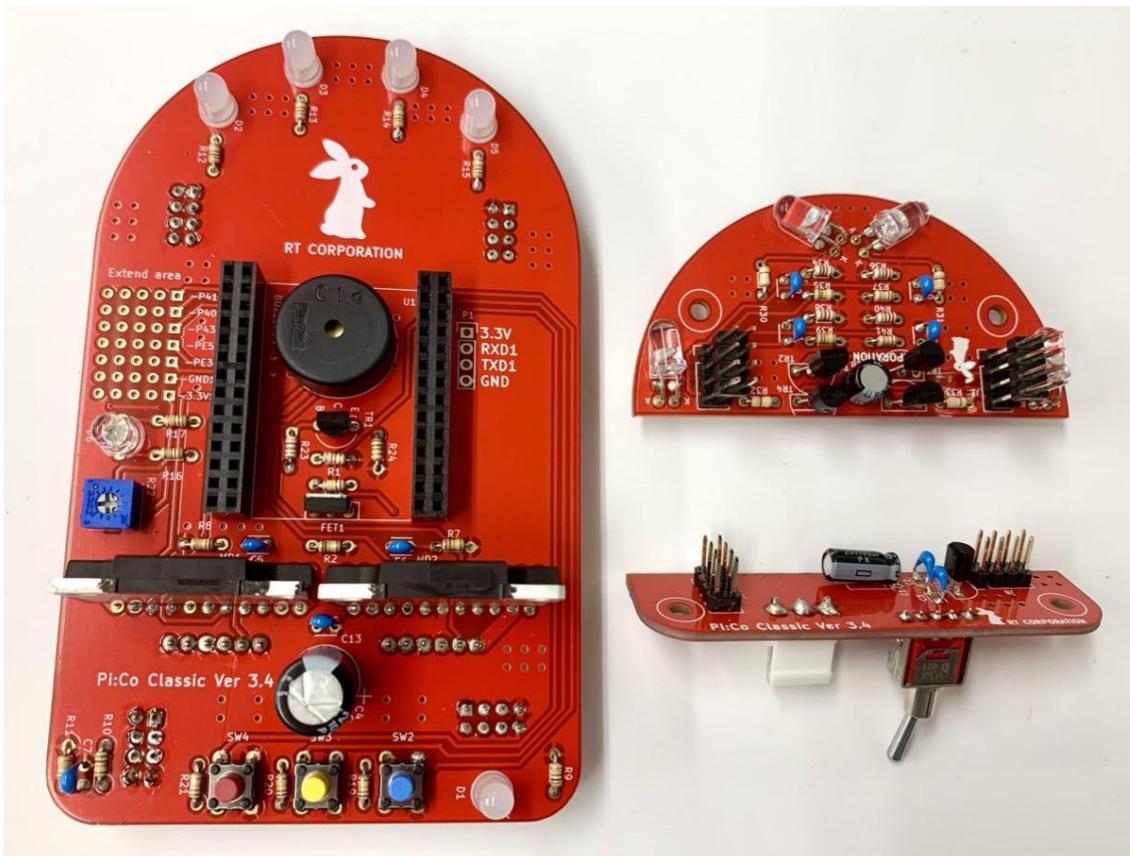


Sensor board 9 components



Sensor board 9 components soldered

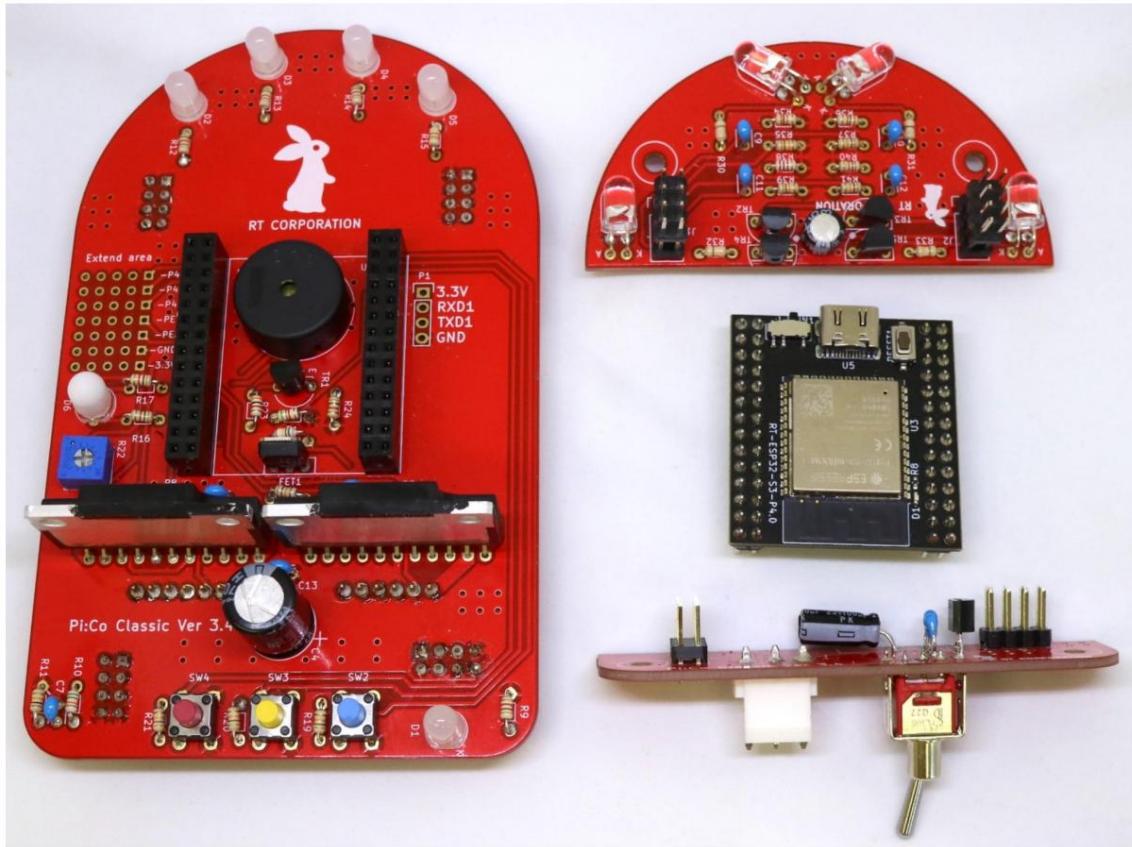
This completes the soldering of the board.



The board after soldering is completed

## Assembly of this product

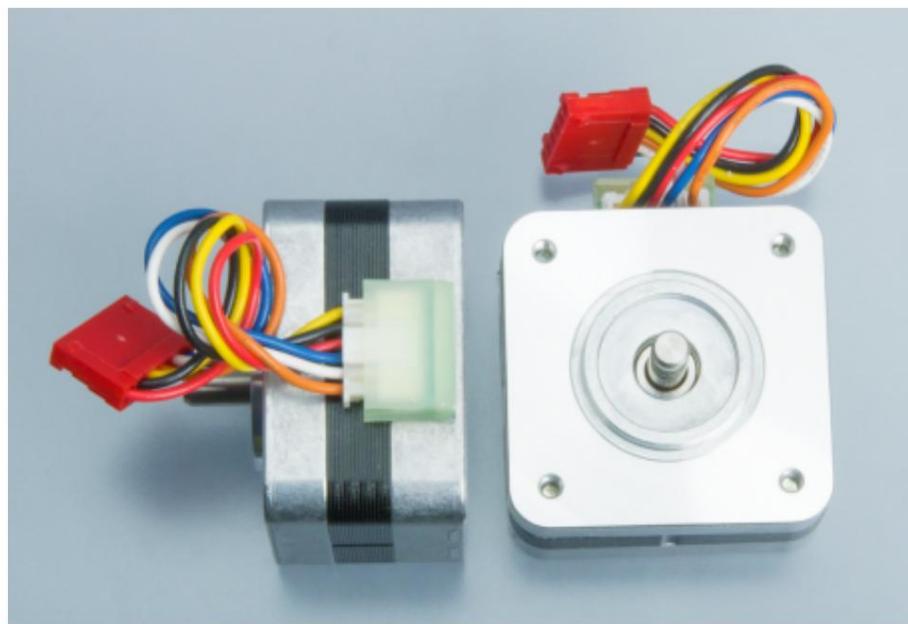
Assemble this product. Prepare the power supply board, main board, sensor board, microcomputer board, wheels, tires, chassis, stepping motor, yellow bags labeled Assembly Parts 1 to 3, and a hex wrench (1.5 mm).



substrate



Wheels and tyres



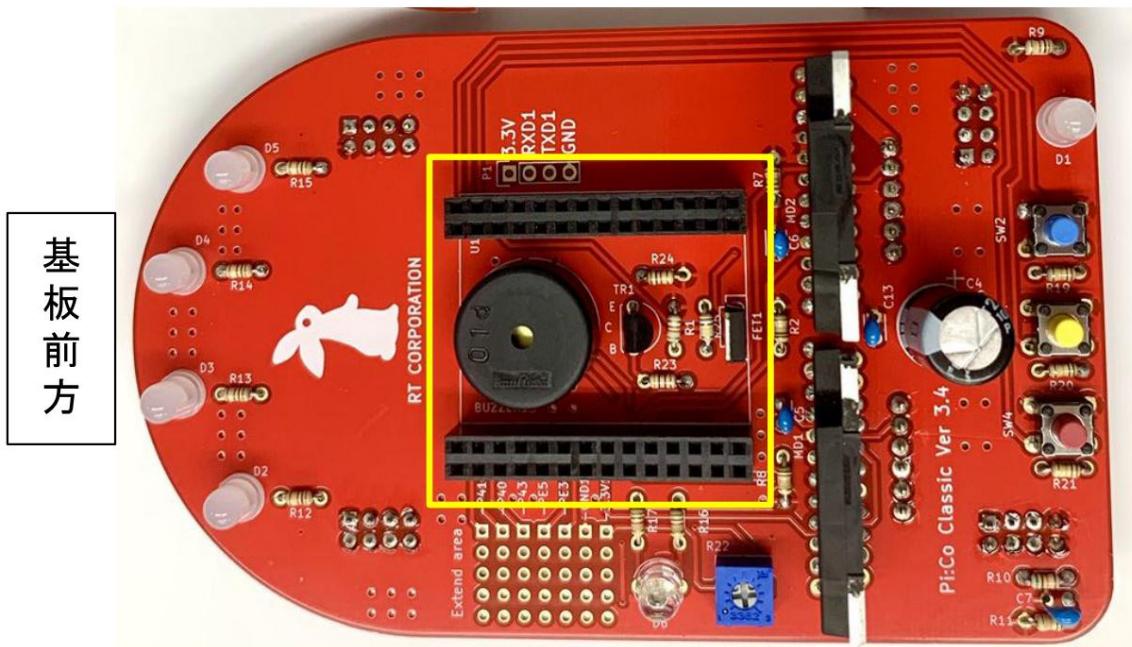
Stepping motor



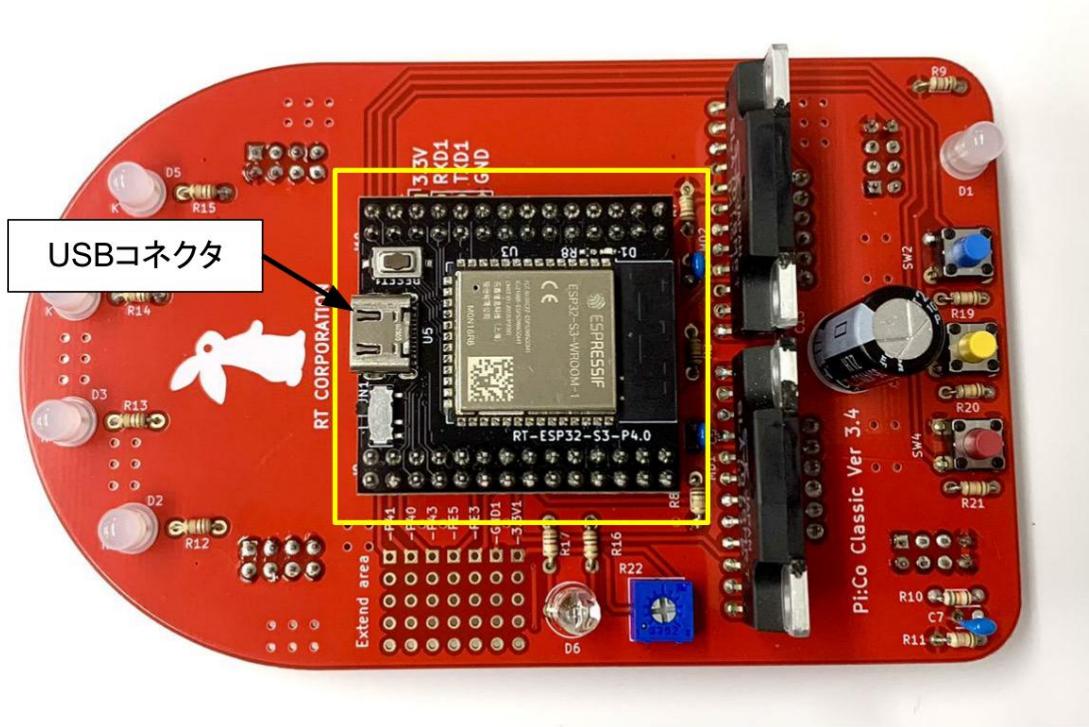
Chassis and Assembly

First, attach the microcontroller board to the main board.

Therefore, make sure that the USB connector faces the front of the board (the side with the four LEDs).



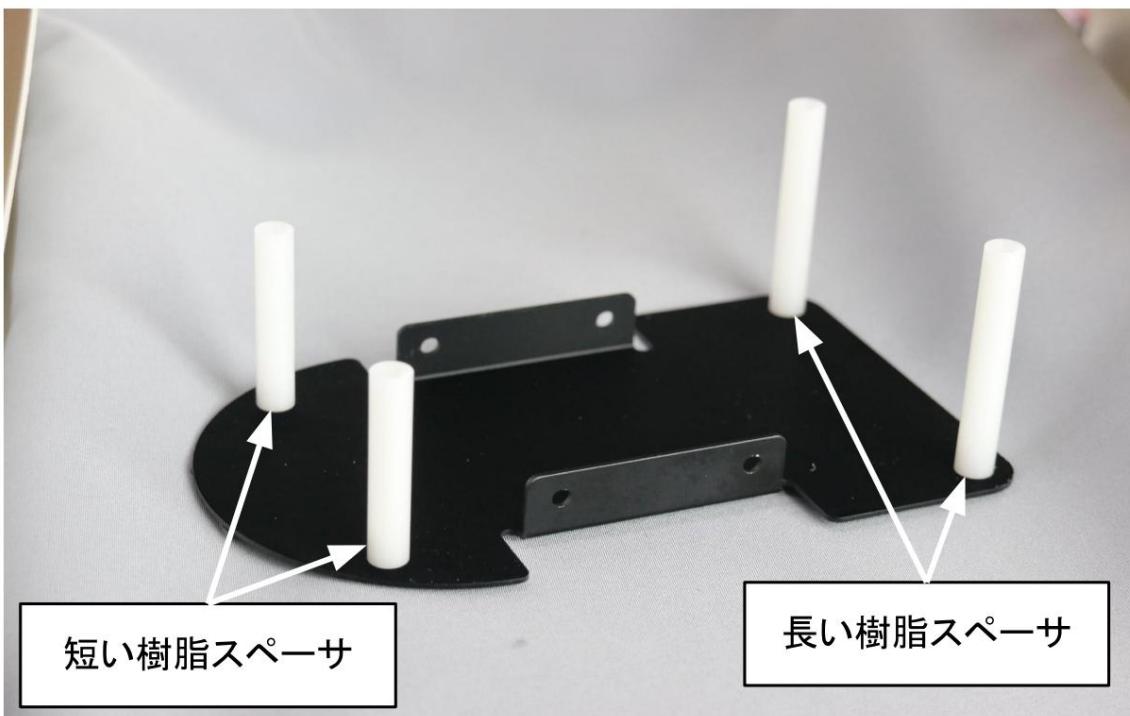
Where to install the CPU board



Microcomputer board installed

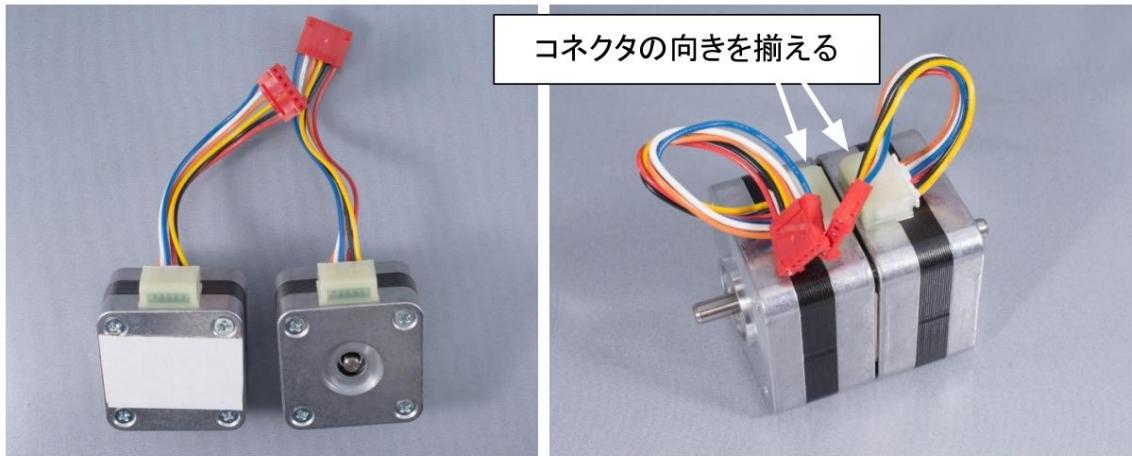
## Pi:Co Classic3 Assembly Manual

Next, attach the plastic spacers that will support the chassis. Attach the long plastic spacer (M3x40) and short plastic spacer (M3x32) included in the bag of assembly parts 1 as shown in the figure below. Use M3x6mm screws. Tighten the screws from the back of the chassis.



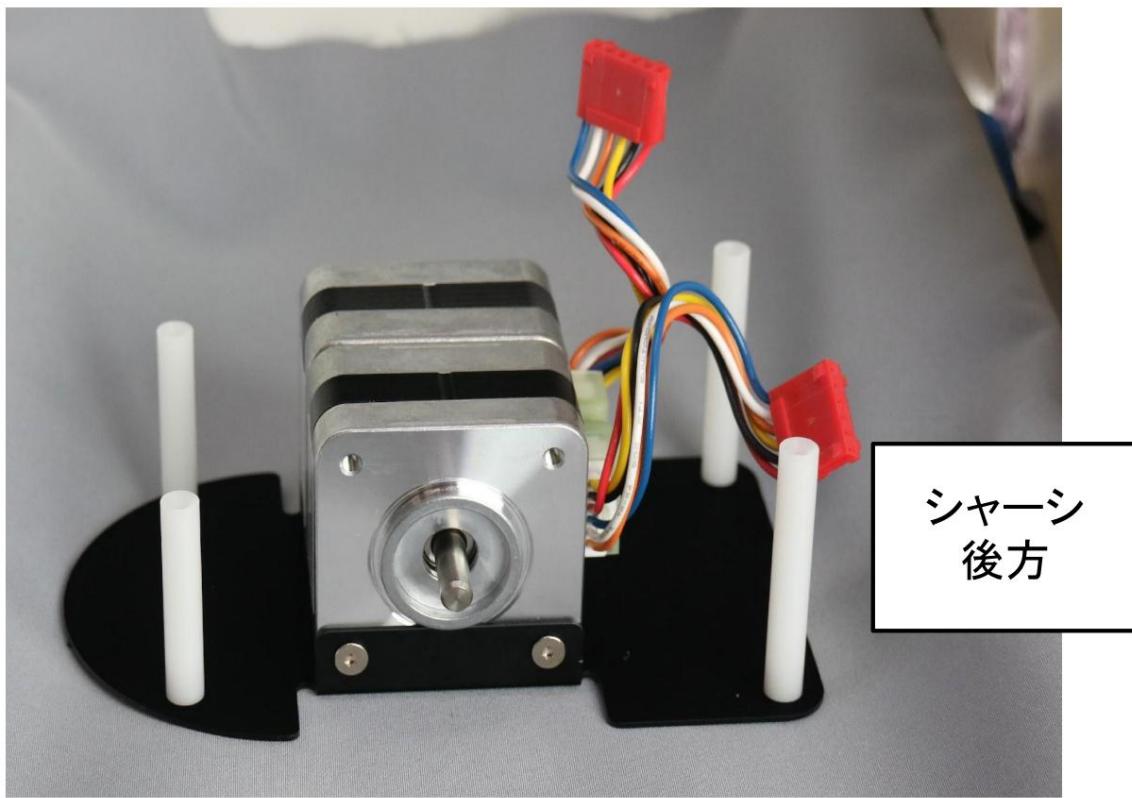
Spacers attached to the chassis

Next, attach the two stepping motors together with double-sided tape. Make sure the motor connectors are aligned as shown in the figure below. Also, place the motors on a flat surface to minimize misalignment between the motors.



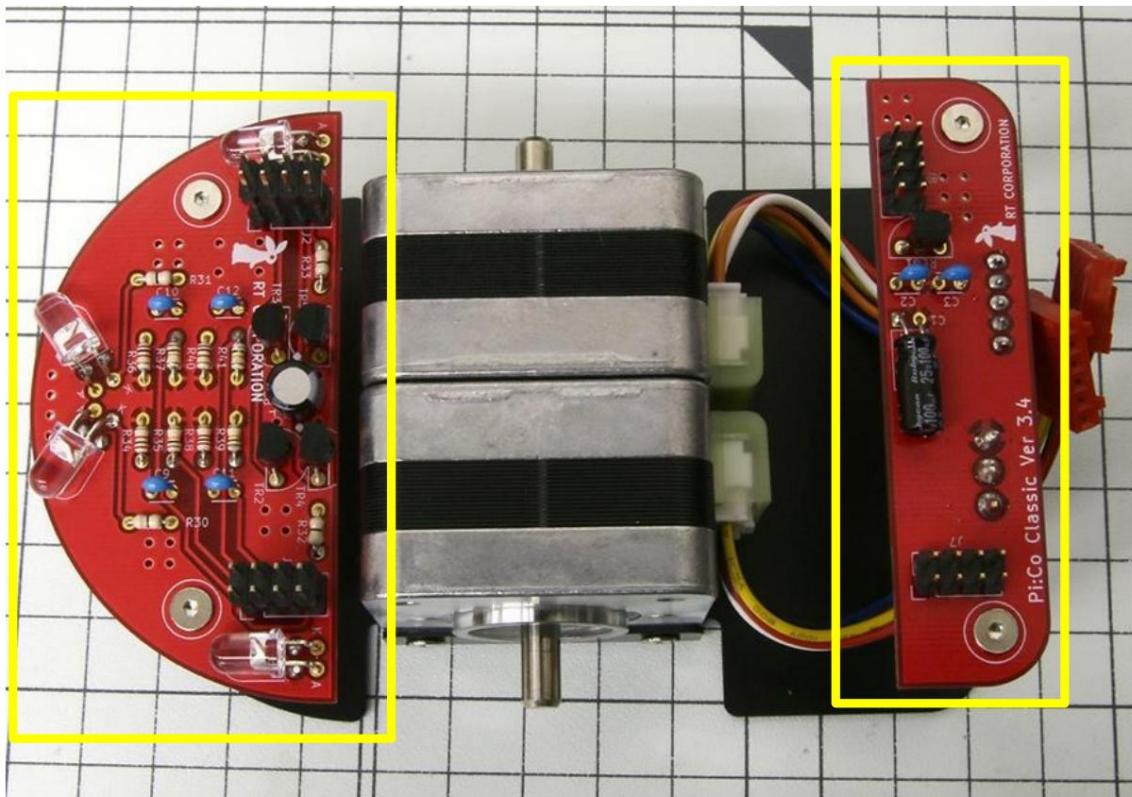
Stepping motor attached with double-sided tape

Next, attach the stepper motor to the chassis. Use M3x6mm screws. Install the stepper motor so that the connector faces the rear of the chassis as shown in the figure below.



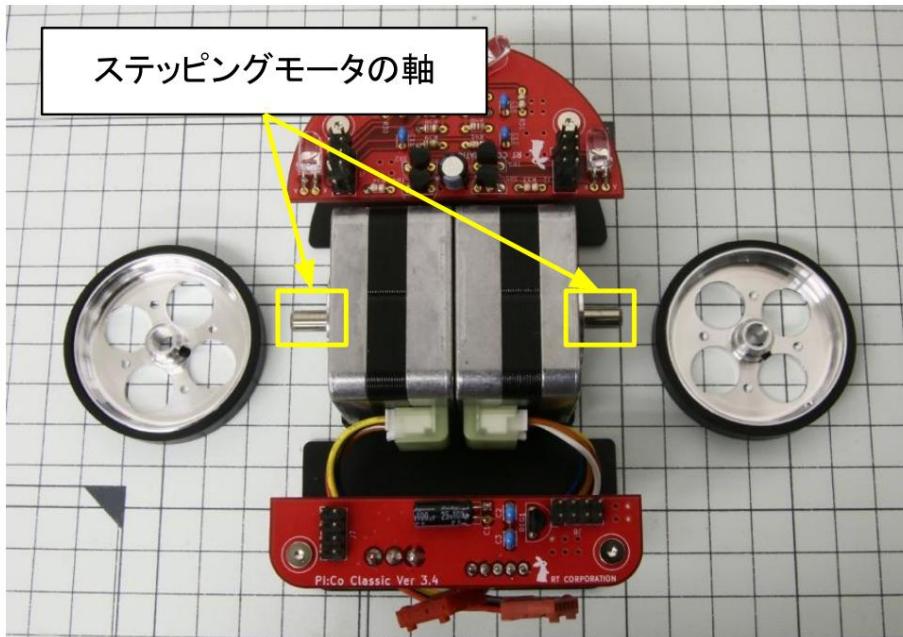
Stepping motor attached to the chassis

Next, attach the power supply board and sensor board to the resin spacer. Refer to the diagram below and install the boards while paying attention to the orientation. Use M3x6mm screws.

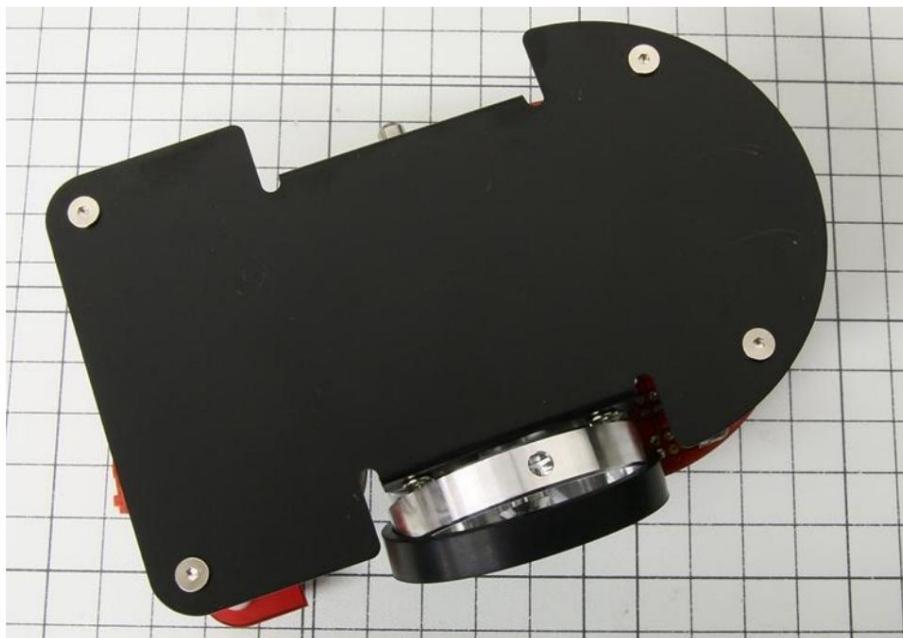


Power supply board and sensor board installed

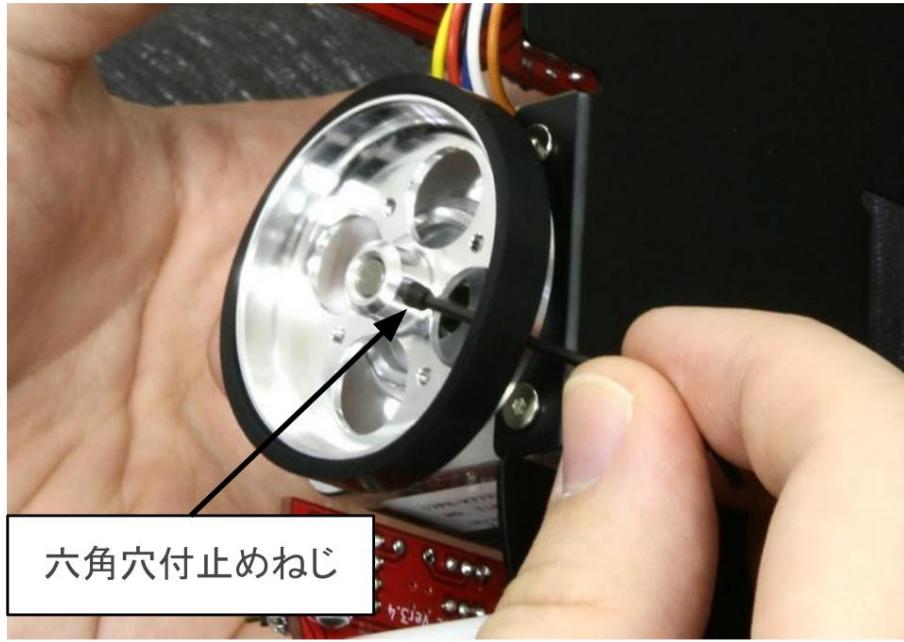
Next, attach the wheel to the stepper motor shaft. Insert the wheel onto the motor shaft and adjust it so that the tip of the shaft is aligned with the tip of the wheel hole. Then use a 1.5mm hexagonal wrench to tighten the hexagon socket set screw to secure the wheel in place. Make sure the wheels are attached symmetrically. If there is a large misalignment between the left and right wheels, this may affect driving performance.



Stepping motor shaft

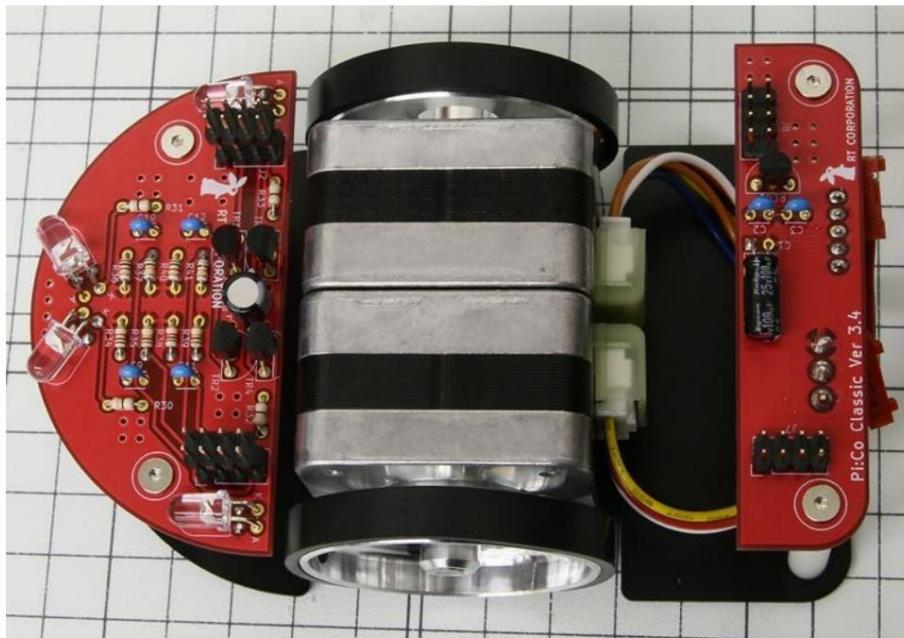


Stepping motor shaft with a wheel



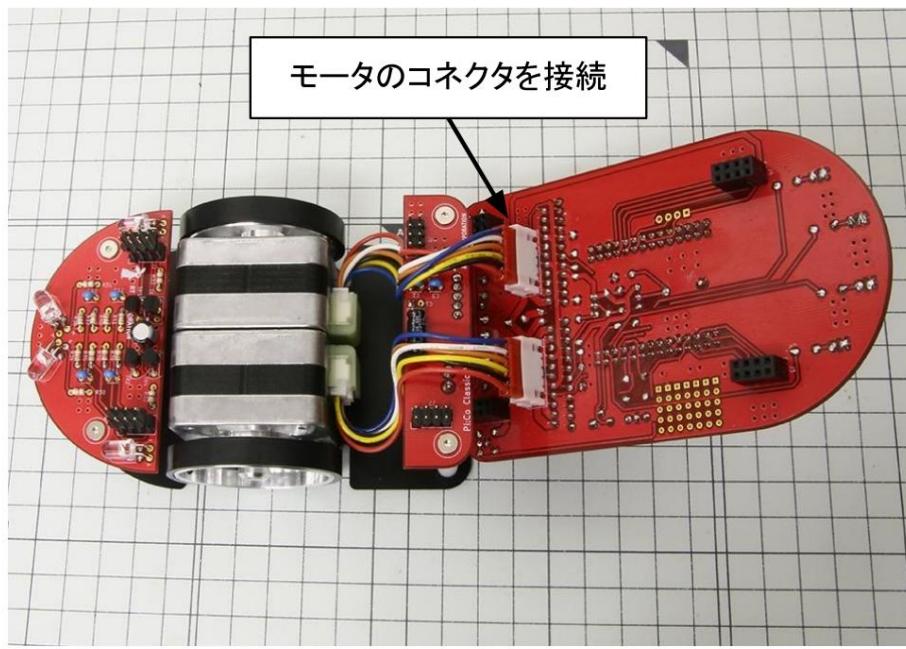
Tightening the hexagon socket set screw

Next, attach the tire to the wheel. Fixing the wheel and tire with double-sided tape will prevent them from slipping.

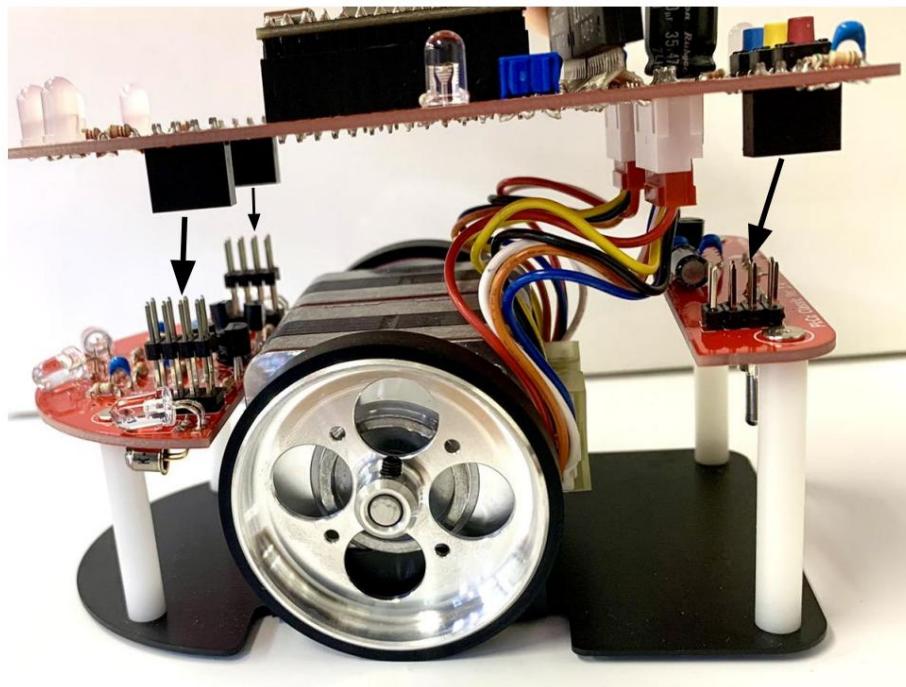


Tire mounted on wheel

Next, install the main board. First, connect the motor connector to the main board as shown in the figure below. Then connect the main board to the sensor board and power board.



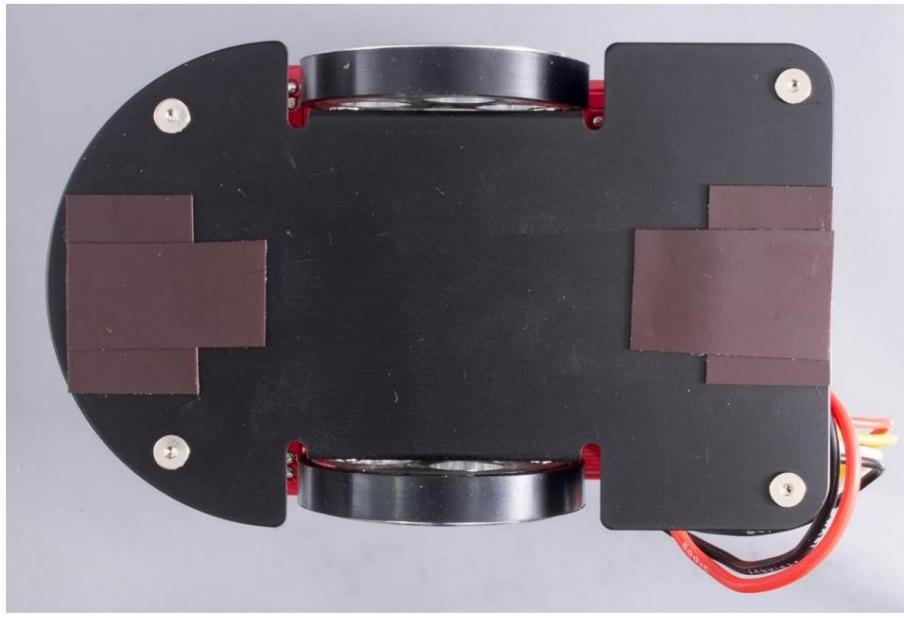
Stepping motor connector connected to the main board



Connecting the main board to the power board and sensor board

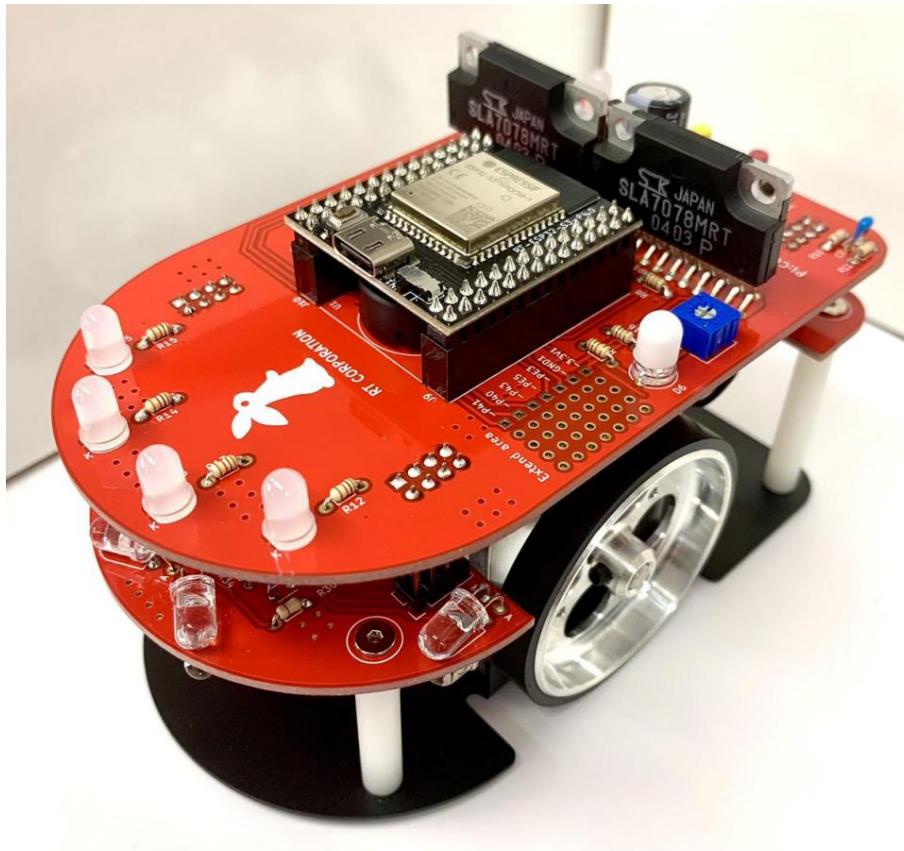
**Pi:Co Classic3 Assembly Manual**

Finally, attach the Teflon sheet to the back of the chassis. By attaching the Teflon sheet as shown in the figure below, you can avoid interference between the floor and the screws.



Teflon sheet attached to the back of the chassis

This completes the assembly of this product.



This product is fully assembled

## Revision History

Issue date (YY/MM/DD)	Version number	Revision details
24/07/03	1.0	New Creation

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