

OpenRadiation V2 EDUCATIONAL KIT ASSEMBLY INSTRUCTIONS











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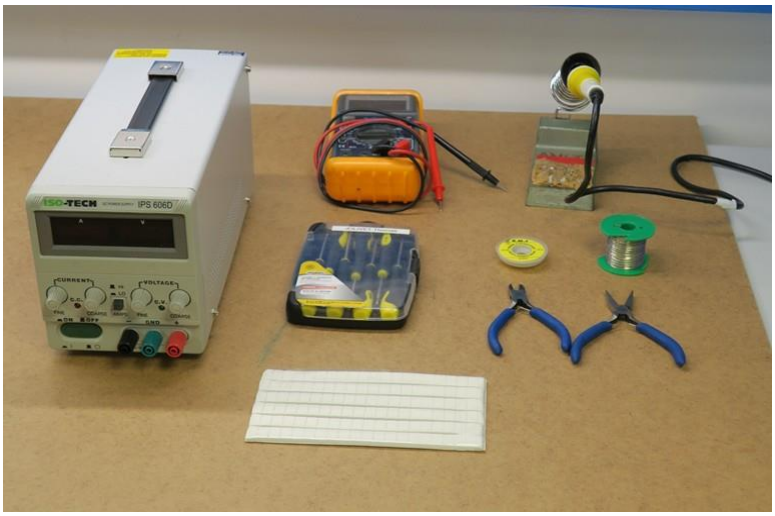
1. Introduction

The OpenRadiation educational kit contains all the components you need to build your own dosemeter using a Geiger-Müller sensor controlled by a smartphone or a tablet.

2. Materials needed to assemble the kit

- A small soldering iron
- Tin wire less than 1mm in diameter
- A small wire cutters
- A Cutter



- A tablet or a smartphone equipped with the OpenRadiation application
- An USB A – mini-B cable

3. Kit content

Before you start assembling the kit, you need to make sure that you have all the components you need to build it.

Description	Qty	Ref
Bare electronic board	1	
Pre-wired battery	1	
Geiger-Müller tube	1	
Plexiglas sheet (upper side)	1	
Plexiglas sheet (lower side)	1	
Plexiglas sheet (longitudinal side)	2	
Plexiglas sheet (Left side)	1	
Plexiglas sheet (right side)	1	
Nylon washer diam. 3	8	
Threat-locking nut M3	4	
Countersunk head screw M3 x 8mm	4	
Spacer Male / Female M3 x 20mm	4	
breakaway clip 12 points	1	(U2)
breakaway clip 14 points	1	(U2)
Programmed Adafruit Feather module (ESP32)	1	
Digital RGB LED	2	U5, U6
Yellow LED 5mm	1	D12
MCP6002 integrated circuit	1	U1
Support for 8-pin integrated circuit	1	(U1)
Integrated circuit 74HC132	1	U4
Support for 14-pin integrated circuit	1	(U4)
Angled slide switch	1	SW1
Electric piezo Buzzer	1	BZ1
UF4002 diode	1	D11
RGP10M diode	4	D7, D8, D9, D10
Zener diode 1N5377	6	D1, D2, D3, D4, D5, D6
4,7 mH Inductance	1	L1
BC337 transistor	1	Q1
MPSA42 transistor	1	Q2
DS18B20+ temperature sensor	1	U7

Angled male connector 2 points	1	J1
Fuse holder	2	J2
12pF 1kV capacitor (brown disk with a black dot)	1	C1
47pF 100V capacitor (brown disk)	1	C2
47nK 100V capacitor	1	C5
1µF 50V chemical capacitor	1	C3
10nF 630V capacitor	4	C4, C6, C7, C8
180 Ohms 1/4W resistor Brown / Grey / Brown / Gold	1	R9
4,7 KOhms 1/4W resistor Yellow / Violet / Red / Gold	2	R12, R13
10 KOhms 1/4W resistor Brown / Black / Orange / Gold	1	R1
100 KOhms 1/4W resistor Brown / Black / Yellow / Gold	1	R2
330 KOhms 1/4W resistor Orange / Orange / Yellow / Gold	2	R4, R7
1 MOhms 1/4W resistor Brown / Black / Green / Gold	2	R6, R8
5,6 MOhms 1/4W resistor Green / Blue / Green / Gold	2	R3, R10
10 MOhms 1/4W resistor Brown / Black / Blue / Gold	1	R5
33 MOhms 1/2W resistor Orange / Orange / Blue / Gold	1	R11

4. Assembly procedure

Before starting installation, please:

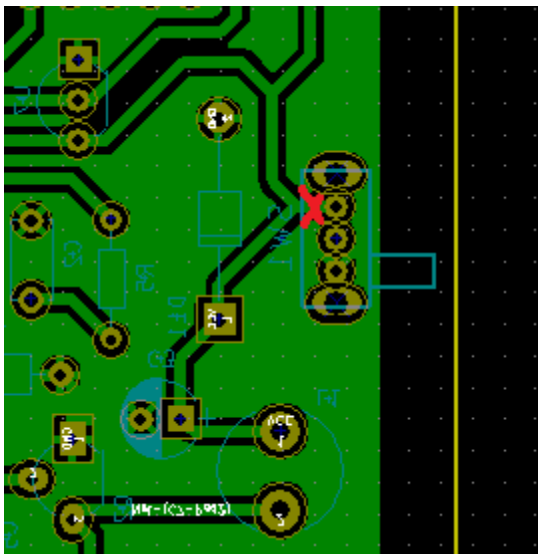
1. Check that you have all the components in the kit.
2. Mount the parts correctly oriented on the printed circuit board.
3. Assemble the parts in the order requested.
4. Take account of any comment in the text.

To assemble an electronic board correctly, it is important to solder the components from the thinnest to the thickest. The order in which the components are assembled on the circuit board is as follow:

1. Solder resistor R1
2. Solder resistor R2
3. Solder resistors R3 and R10

4. Solder resistors R4 and R7
5. Solder the R5 resistors
6. Solder resistors R6 and R8
7. Solder resistor R9
8. Solder resistors R12 and R13
9. Solder diode D11 **Pay attention to direction**
10. Solder diodes D7, D8, D9, D10 **Pay attention to direction**
11. Solder the Zener diodes D1, D2, D3, D4, D5, D6 **Pay attention to direction**
12. Solder resistor R11
13. Solder the SW1 switch

    Due to a design error (present only on OpenRadiation V2 rev2 boards), do not solder pin 1 of this board and use a cutter to cut the track connecting it at the place of the cross on the picture.



Location of the cut to be made from the welding side.

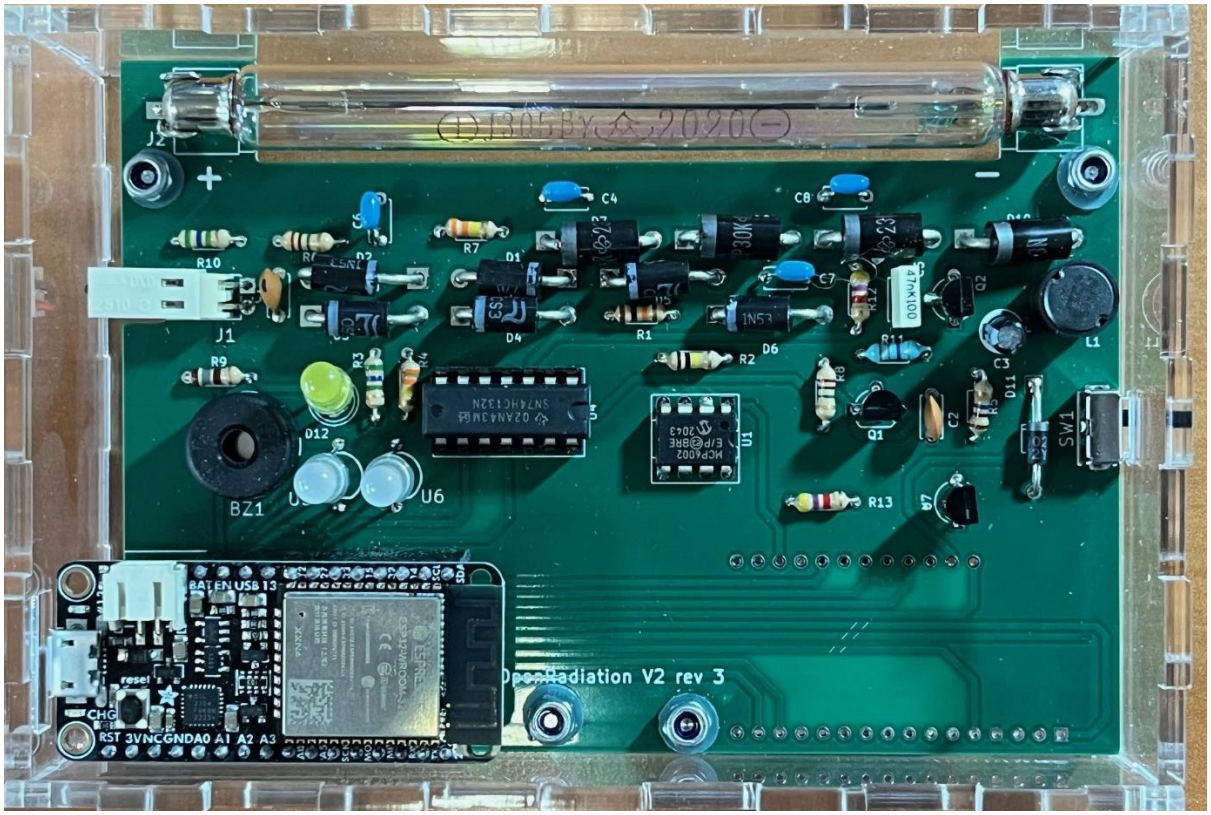
14. Solder connector J1
15. Solder the integrated circuit support U1 (DIP8) **Pay attention to the position of the notch**
16. Solder the integrated circuit support U2 (DIP14) **Pay attention to the position of the notch**
17. Solder the BZ1 buzzer
18. Solder capacitors C4, C6, C7, C8 (10nF)
19. Solder capacitor C1 (47pF)
20. Solder capacitor C2 (12pF)
21. Solder capacitor C5 (47nF)
22. Solder transistor Q1 (BC337)
23. Solder transistor Q2 (MPSA42)
24. Solder the U7 temperature sensor U7 (DS18B20+)
25. Solder capacitor C3 (1µF) **Pay attention to polarity**
26. Solder the fuse clips J2. **We advise you to fix the tube on the fuse clips to determine the correct position of the clips.**
27. Solder the L1 inductor

28. Solder the break-off strips to secure the ESP32 module

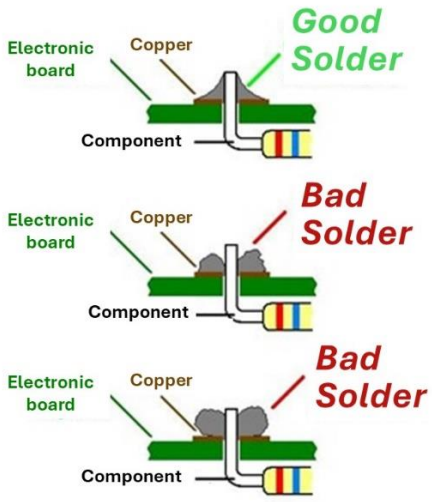
To determine the height of the LEDs, place the ESP32 module on the two divisible strips.

29. Solder LEDs U5 and U6. **LEDs must be at the same height as the ESP32 module.**
30. Solder the D12 LED. **The LED must be at the same height as the ESP32 module.**

Here is a photo of the kit with all the components in place:



Once you have made all the welds, make sure all your welds are of good quality and not in contact with other tracks.



Preliminary assembly of the case:

31. Place the 4 countersunk screws on the underside
    Make sure you place them on the side where they will be flush.
32. Attach a spacer on each screw
33. Place a nylon washer on each of the spacer.
34. Place the circuit board on the spacers so that you can carry out the initial tests.

5. List of tests to be carried out after assembly

The kit consists of expensive components (the Adafruitfeather Huzzah ESP32 (ESP32) module and the Geiger-Müller tube). As the ESP module provides the power supply for the electronic circuit, we will first carry out various tests without the Geiger-Müller tube.

5.1. List of tests to be carried out in the absence of the Geiger-Müller tube

A. Disconnect the battery
B. Power the ESP32 via its USB port
C. Operate switch SW1 to wake up the ESP32 module
D. When the ESP32 is woken up, LEDs U5 and U6 should light up and change colour, the buzzer should sound for 250 ms and LED D12 should also light up.

If you have this sequence, this means that your exit is operational. You can then:
E. disconnect the USB cable from the ESP32 module
F. Place the integrated circuits U3 and U4 on their supports **making sure that the notch is oriented correctly.**
F. Reconnect the battery
G. Reactivate the ESP32 module using switch SW1

If one of the buzzers, the yellow LED or the multi-coloured LEDs does not work, this means that the ESP32 module is working but that the component is not correctly connected to it.
H. Check the soldering
I. Check the orientation of components U5, U6 and D12

If none of the elements light up, this means that your ESP32 module is not waking up.

J. Check that your ESP32 module is powered, an orange CHG LED should be lit
K. Check that the track connecting the centre pin of switch SW1 to the ESP32 module is cut
L. Check that there is no short-circuit on the track

5.2. Testing the card with the ESP32 module

During these tests, the card can be powered via the USB port or the battery.

The following tests will ensure that you are able to connect to the map using the OpenRadiation application and that the hover functions properly.

5.2.1. Testing the connection with the OpenRadiation application

A. From your smartphone launch the OpenRadiation application.

The screen below should appear.



B. Switch on your kit if you have not already done so. Be careful, only switch on one kit at a time.

C. Click on the dark blue rectangle with the mention « no sensor, click here » to display the screen below:

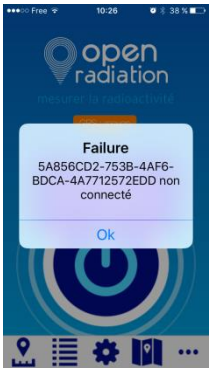


If you see the word « OG-KiTX » on this screen, this means that the ESP32 module in your kit is communicating correctly with your smartphone.

Click on the « connect » button to link your kit to your smartphone. When the connection is established, the screen below should appear:



If not, you should see the message below:



If this is the case, you need to make sure:

1. That you kit is still powered up
2. That it is not already connected to another smartphone.

If not, repeat the procedure for connecting the OpenRadiation application to your kit.

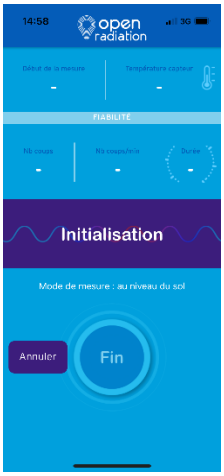
5.3. Testing the card with the ESP32 and the Geiger-Müller tube

Once you have ensured that the OpenRadiation application detects and connects with your kit, we need to check that it is capable of taking measurements.

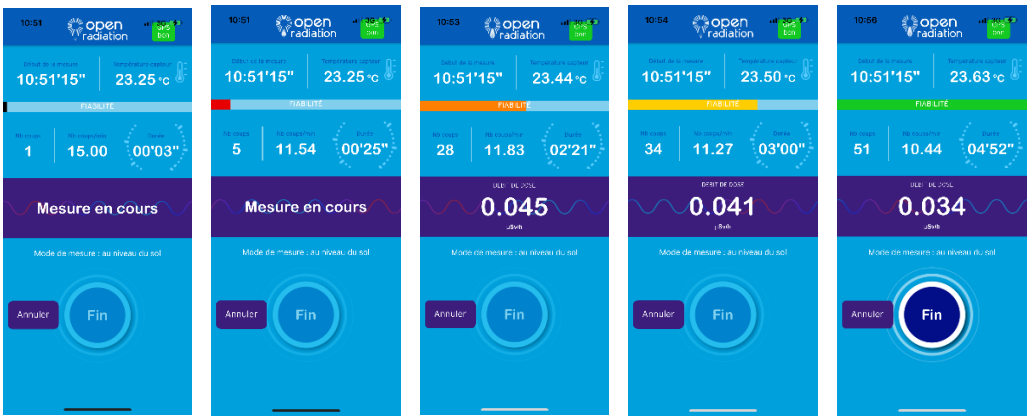
To do this, when your kit is connected to the OpenRadiation application, press the button in the centre of the screen.



The screen below should appear for a few seconds while the bulb is supplied with its rated voltage using the booster.



As soon as the Geiger-Müller tube is correctly powered, the screen should change to the usual counting screen, with the number of counts increasing and the progress bar that changes colour according to the number of counts detected.



When the progress bar turns green, you can click on the END button which saves your measurements.

6. Final assembly of the enclosure

When the tests are conclusive, the box is assembled as follows:

1. Remove the card so that you can stick the battery in place.
2. Stick the double-sided adhesive tape to the underside plate.
3. Remove the protective film from the double-sided adhesive tape at the top.
4. Attach the battery to the adhesive strip.
5. Replace the circuit board on the spacers so that you can carry out the initial tests.
6. Place a second nylon washer on each of the spacers.
7. Place a thread-locking nut on each spacer and tighten using a pair of flat-nose pliers or a 5'' spanner.
8. Make sure you have in place
   - The ESP32 module
   - The integrated circuits U1 and U4 are present and correctly oriented.
   - The presence and the correct orientation of the Geiger-Müller tube (the + sign must be on the left of the card).
   - The battery correctly connected to the card
   - The card is correctly secured using 4 lock nuts.
9. Position the right-hand side panel, which can be easily identified by the opening for the slide switch.
10. Position the two longitudinal plates.
11. Position the left side panel.
12. Position the top plate, taking care to place the LED s in the opening provided.

7. Conclusion

Your OpenRadiation teaching kit is now complete.

We hope that you have enjoyed assembling this kit and that you won't hesitate to use you kit to carry out numerous measurements and add to the OpenRadiation Database.

In case of trouble, please feel free to contact us at contact@openradiation.org