Assembly Instructions for FK233 ***(Fire Siren with Speaker)***

What it does:

This is a siren which increases in frequency while the button (SW1) is pressed and then slowly decreases in frequency when the button is released. The siren eventually reaches a threshold when it will switch off.

It emulates the sound of an old style “Fire siren”.

What we are making:

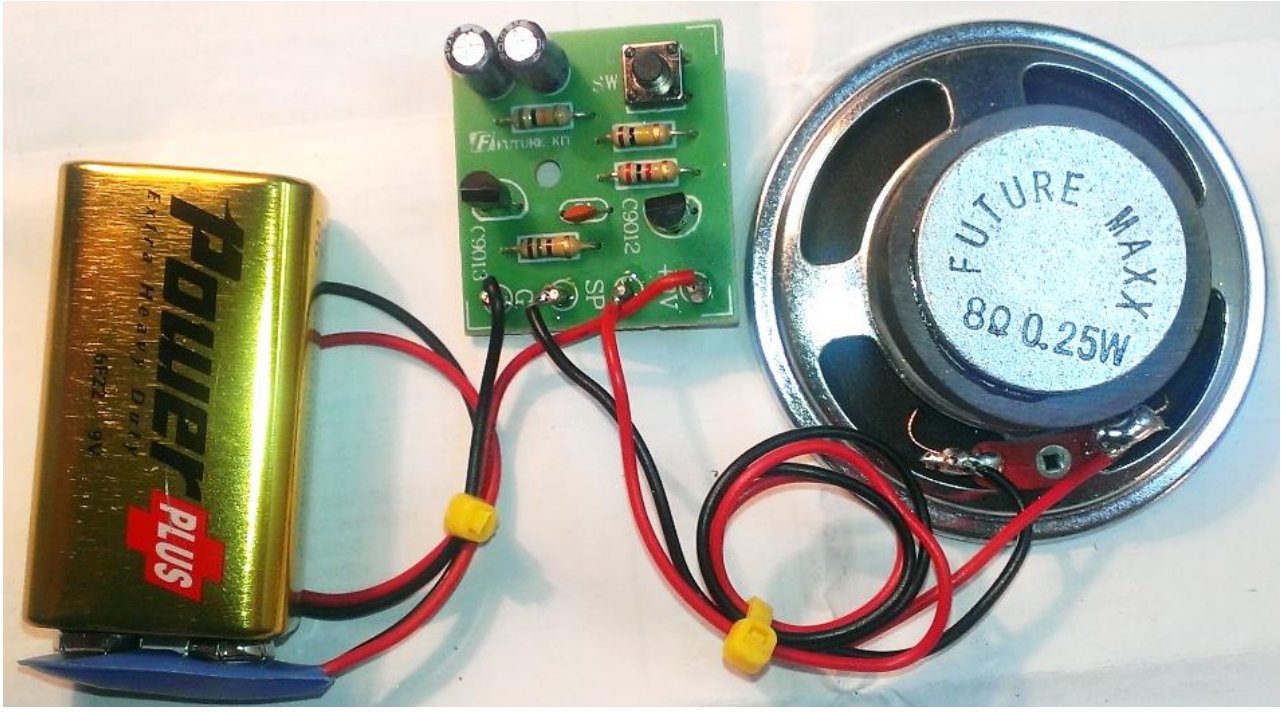


Fig 1: Finished Product

Assembly Instructions for FK233 ***(Fire Siren with Speaker)***

Technical Specs:

- Power supply: 9 VDC
- Current Average: 20mA (max.)
- Max output power: 0.25 W loudspeaker – 8 Ohm
- Volume control equipped
- PCB dimensions: 28.2 x 32.5 mm

How it works:

This circuit is mostly a Frequency generator comprised of TR1, TR2, R3 C2 and the loudspeaker.

The frequency that is generated is controlled by the voltage applied into the base of Transistor TR1. This applied voltage will vary up and down as it reflects the voltage at the positive terminal of Capacitor C1.

C1 is charging up while the Switch1 is pressed, and then will slowly discharge when SW1 is released.

Circuit Diagram:

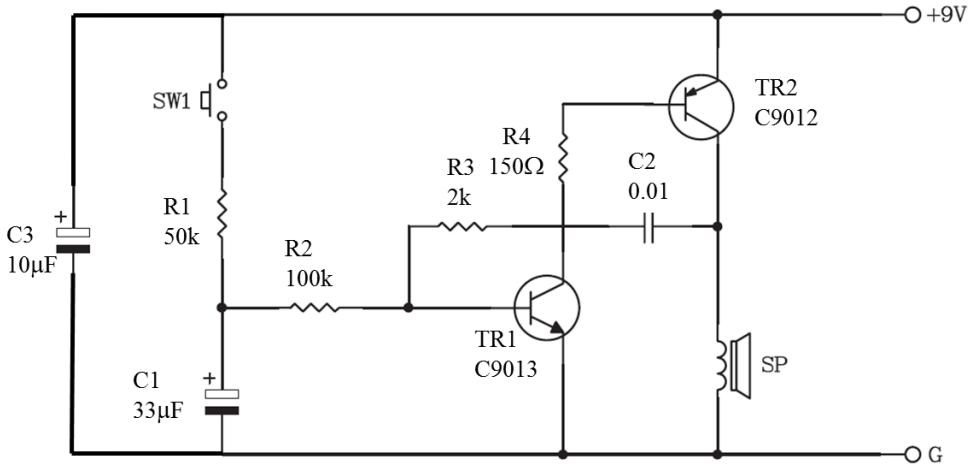


Fig 2: Fire Siren Circuit Diagram

Assembly Instructions for FK233 ***(Fire Siren with Speaker)***

Before you start:

1) Make sure that you have all your equipment available. You will need:
   a. Soldering Iron
   b. Solder
   c. Cleaning pad (We recommend sponge which is wet with water).
   d. Side Cutters
   e. Kit FK233
   f. Instruction sheet
   g. A waste bin (or bag) close by for a lot of small "off cuts".
   h. We recommend a clean mat or surface protector for your desk.
   i. Ensure that you are in a well ventilated area. The fumes from the solder resin can become annoying (though they are not toxic to humans).
   j. Wash your hands after working with the electronics kits and the solder. Especially before you eat anything ! !

2) Ensure that you have plenty of space around you. (You are going to need to "spread out" your components at the start, and avoid getting them mixed with some-one else's.)

3) Ensure that you have good lighting to see and read your components.

4) We recommend that you also have some spare "bags" (or other containers) to store your components and work between classes. This is in the event that you do not get everything finished in one session.
   (It can be disappointing to spend some time sorting your components and then finding them all mixed up again when you return!)

5) Do NOT rush! Time spent carefully sorting at the start and avoiding errors is wisely invested, rather than trying to fix problems later!

6) Read through the instructions for each "Step" before you start doing that step. There are often handy tips & advice in the instructions!

Assembly Instructions for FK233 *(Fire Siren with Speaker)*

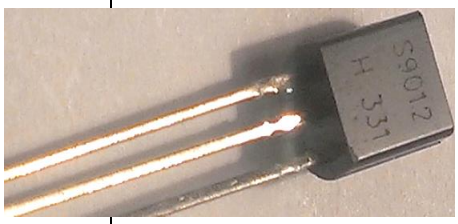
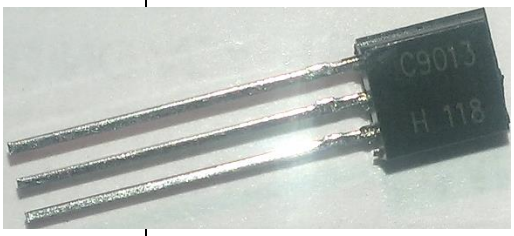
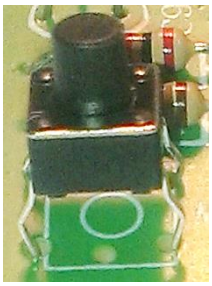
How to build it:

Step 1. Identify your components and sort them into groups.

Use the checklist below to ensure that you have all your necessary components. *(We recommend that you "tick off" each component when you know you have it clearly identified).*

For this task you are required to :				
	Identify all of the components within your kit, to ensure that your kit is complete			
	Assemble the kit so that it works as per the instructions			
Component Name	**Value**	**Qty**	**Identification Markings**	**Image**
Resistor 50kΩ	50,000 Ohms	1	Green-black-orange-gold	
Resistor 100kΩ	100,000 Ohms	1	Brown-black-yellow-gold	
Resistor 2kΩ	2,000 Ohms	1	Red-black-red-gold	
Resistor 150Ω	150 Ohms	1	Brown-green-brown-gold	
Capacitor (Electrolytic) 10µF	0.00001 Farads or $10X10^{-6}$ Farads	1	10µF	

Assembly Instructions for FK233 *(Fire Siren with Speaker)*

Capacitor (Electrolytic) 33µF	0.000033 Farads or $33X10^{-6}$ Farads	1	33µF	
Capacitor (Ceramic) 10nF	0.00000001 Farads or 1.0 $X10^{-8}$ Farads	1	103	
Transistor C9012		1	C9012	
Transistor C9013		1	C9013	
Switch (Tactile)		1		

Assembly Instructions for FK233 *(Fire Siren with Speaker)*

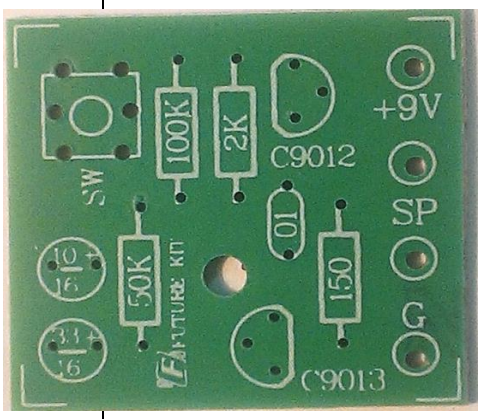
Battery Snap (9V)		1		
Stakes (for wire connections)		4		
Speaker		1		
PCB (Empty)		1		

Fig 3.1 Identifying Component Values

Step 2. Installing the Resistors

By referring to *Fig 3.1* determine the value of each resistor and place them in their correct positions as indicated on the printed circuit board (PCB).

Do this by carefully bending their wires down to form a 'U' shape and poke through the holes in the PCB as shown in *Fig4.1*.

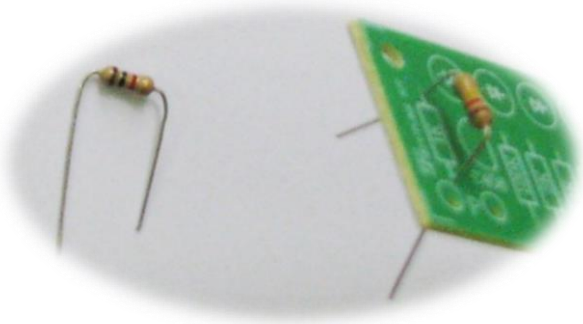


Fig 4.1 Installing Resistors

As far as possible, try to keep the resistors "oriented" in the same direction. (Try to keep the gold band at the same end of the installed resistors.) See Fig 4.2 for a suggested pattern.

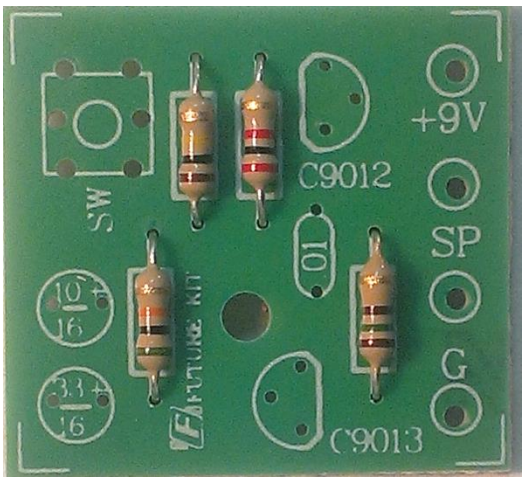


Fig 4.2 Installing Resistors with consistent orientation.

Step 3. Installing the Capacitors

Carefully identify all the different capacitors to be used.

There are two “families” of capacitors used in this kit. These are “Electrolytic” Capacitors and “Ceramic” Capacitors
Refer to Fig 3.1 to determine the values of the different capacitors.

Start by identifying the (small) ceramic capacitor to be installed. For these devices polarity does not matter, so you can insert it in either direction. We started by inserting the 10nF into the small oval marked with “0.01”. Refer to Figure 5.1 for the PCB with the first Capacitor installed.

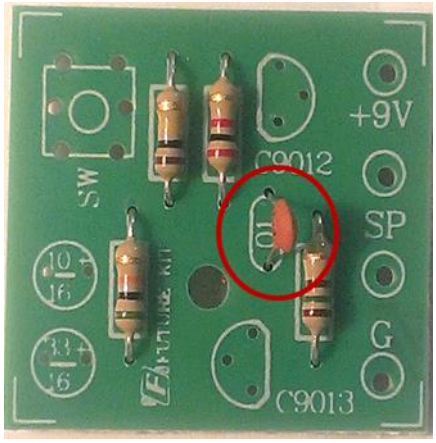


Fig 5.1 Identifying the position of the first Ceramic Capacitor.

Once this capacitor is in the correct position solder it into place and trim the excess wire from under the PCB.

Assembly Instructions for FK233 *(Fire Siren with Speaker)*

Next identify the "electrolytic" Capacitors *(They are the larger, blue cylindrical ones. There are two different values used in this kit.)* Now carefully identify which are their "+" and "-" legs. This is important!

Hints:

i) On new components, the longer leg is the "+" leg.
ii) These capacitors also have a big stripe marking their "-" leg.

Refer to Figure 5.2

Fig 5.2 Showing the different leg lengths and the "-" marking on the body of an electrolytic Capacitor.

Next , identify the "+" hole on the PCB for each of the electrolytic capacitors. This MUST have the longer leg inserted into it! Refer to Figure 5.3 for some of the marked holes.

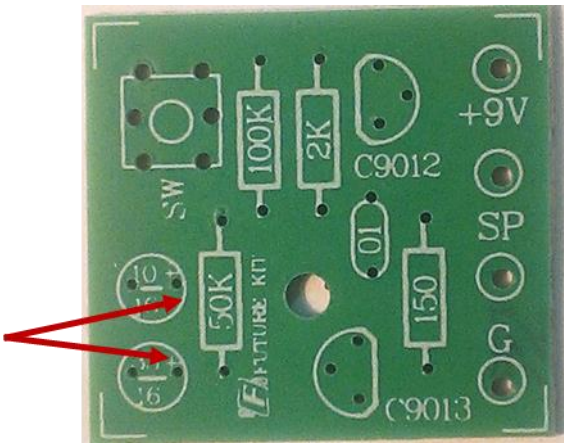


Fig 5.3 Showing the "+" holes on the PCB for some of the electrolytic Capacitors.

Once all your capacitors are in their correct positions and facing the correct way, solder each one into place and trim the excess wire from under the PCB. Refer to Figure 5.4 .

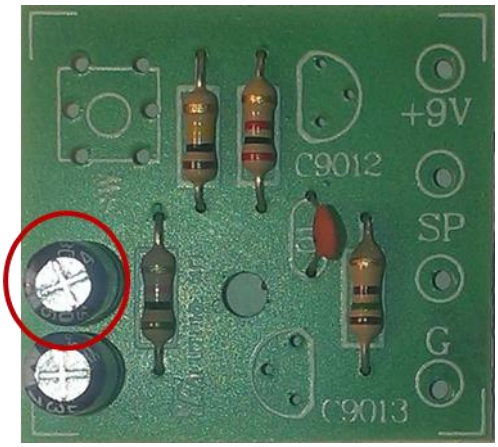


Fig 5.4 Showing the PCB with both of the electrolytic Capacitors installed, and the 10µF capacitor circled in red for positive identification.

Step 4. Transistors

There are two different transistors to be installed in this kit.

CAUTION:

- Make sure you have the correct transistor in the correct location.
- If you install them in the wrong location, you will damage the transistors beyond repair.
- The markings on each transistor can be hard to read correctly!
- TAKE TIME AND CARE !

Carefully bend the middle leg of the transistor slightly backward (Away from the flat face of the transistor) and the two side legs outwards away from the center line. Now carefully manipulate them as you place them through the holes and onto the PCB as shown in *Fig6.1* . Pull the legs through until the transistor is sitting about 10mm off the PCB. Once in the correct position solder it into place and trim the excess wire.

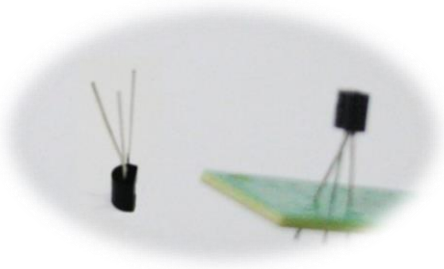


Fig 6.1 Installing the Transistor

Install C9012:

Refer to Figure 6.2 which shows TR2 ("C9012") installed into it's correct location.

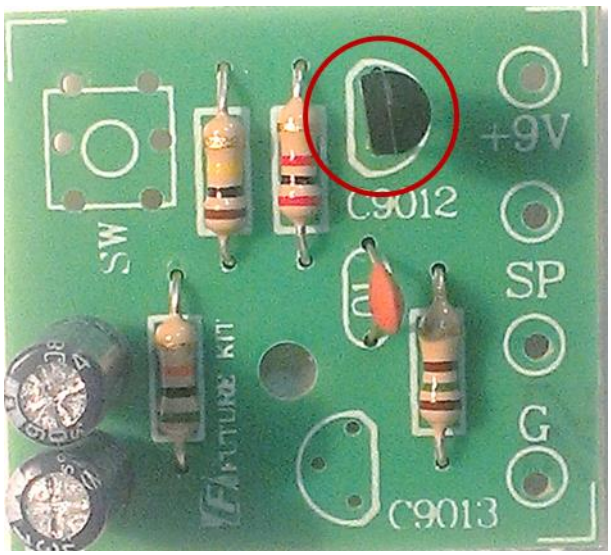


Fig 6.2 TR2 ("C9012") installed into it's correct location.

Repeat this process and install C9013:

Refer to Figure 6.3 which shows TR1 ("C9013") installed into it's correct location.

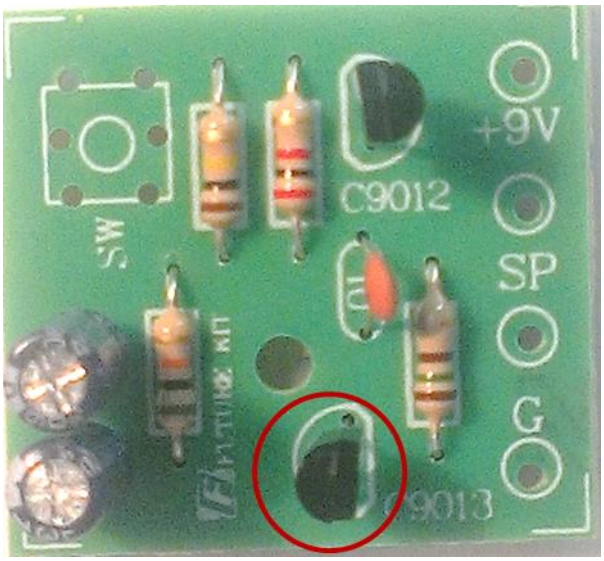


Fig 6.3 TR1 ("C9013") installed into it's correct location.

Step 5. The Push button Switch:

Carefully orient the switch legs with the holes in the PCB. With care you will observe that the switch legs are arranged in a rectangular pattern, and are more easily aligned in the correct direction.

Refer to Fig 7.1 to see a sample of switch before it is fully installed. Note the direction of the angled (spring) legs of the switch!

Assembly Instructions for FK233 *(Fire Siren with Speaker)*

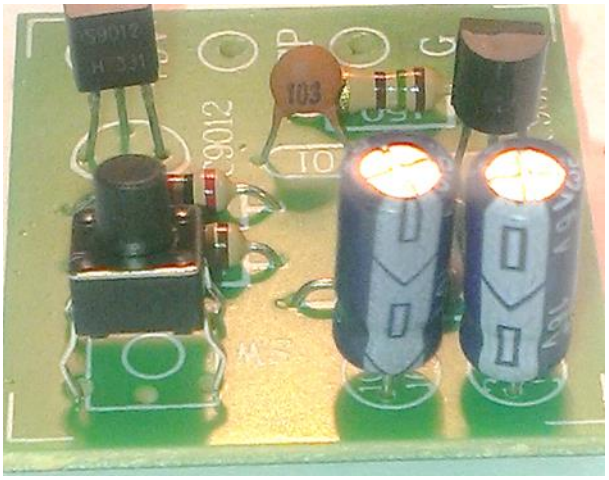


Fig 7.1 Showing the switch about to be installed .

Refer to Fig 7.2 to see the PCB with the switch now fully installed. Note the direction of the legs on two of the sides of the switch!

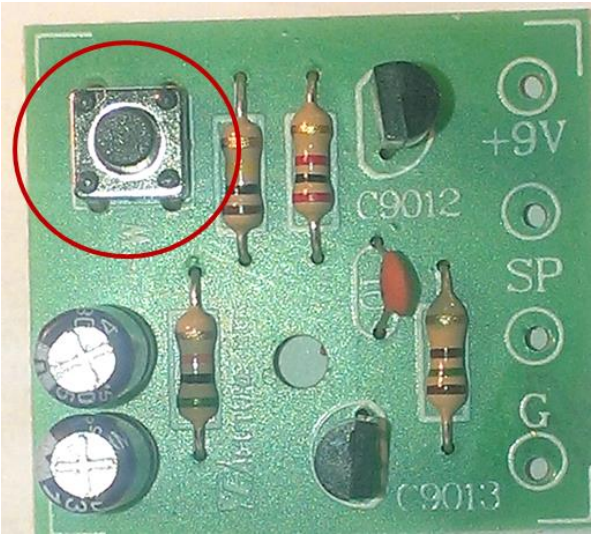


Fig 7.2 Showing the switch fully installed .

Step 6. Insert the "Stakes"

These are the short, thick gold pins which are inserted from the rear of the PCB, and then soldered into place. Refer to Figure 8.1 showing the Stakes installed and tinned, ready for the wires to be attached.

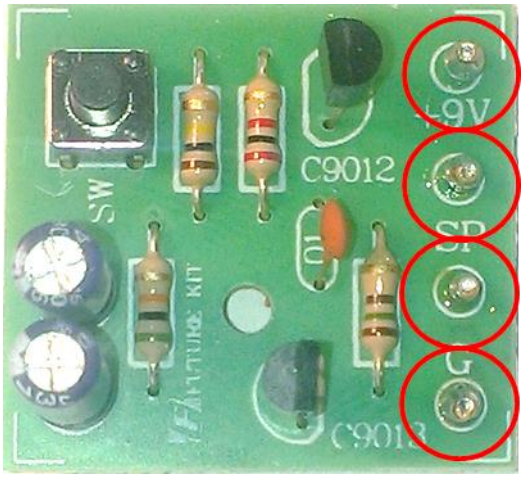


Fig 8.1 Showing the four stakes installed and tinned, ready for the wires to be attached .

Step 7. Connecting wires, speaker and Battery snap.

Once the stakes are set, 'tin' each with solder. *(For more information on "tinning", please refer to our separate document "Towards Better Soldering").* The battery snap can be soldered into place by 'tinning' the leads and ensuring the black wire is attached to the 'ground' (G) pole and the red wire to the positive stake marked with "+9V".

Repeat this process for the Speaker wires. The Speaker output is marked with "SP" on the PCB.

Refer to Figure 9 for final product, and Figure 10 for clarity of the wire connections.

Assembly Instructions for FK233 *(Fire Siren with Speaker)*

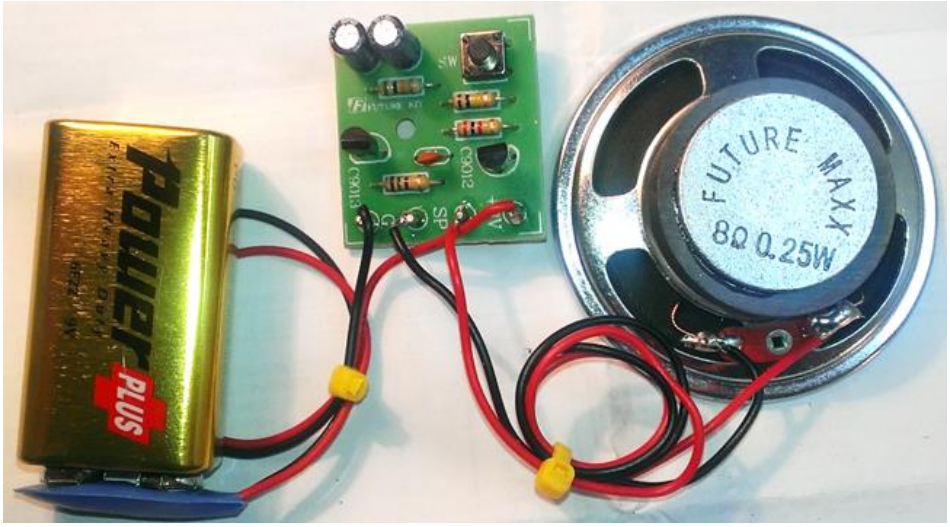


Fig 9 Showing the assembled product .

Connecting an Battery and the external Speaker:

Refer to Figure 10 for recommended wiring to external components.

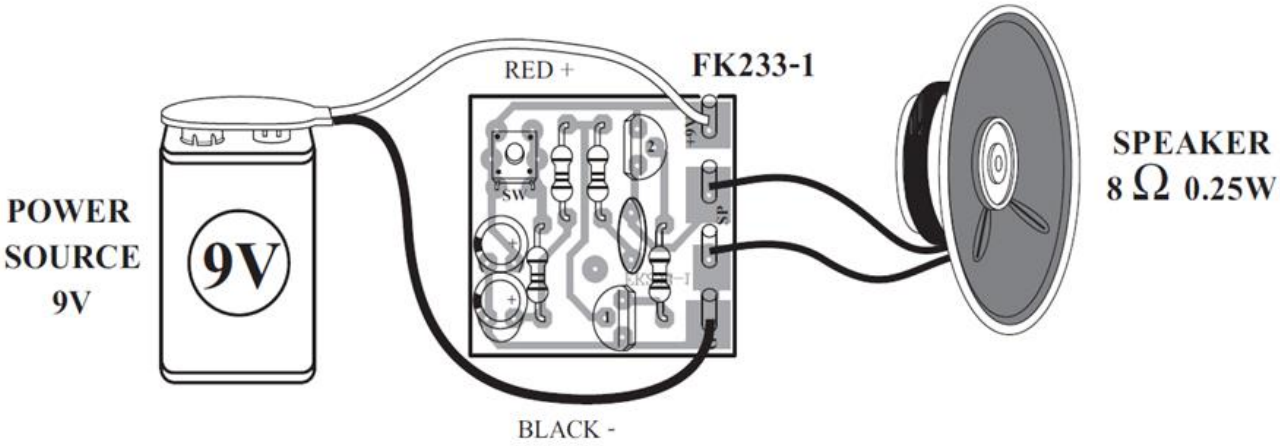


Fig 10 Attaching the wires

Testing:

Gently touch the terminals of the 9V battery to the Battery snap. (Do not "snap" them into position yet.)

Watch for any sparks or signs of overheating on the PCB.

If you see any sparks:

- Do not worry (yet). It is common for many circuits which have capacitors in them (like this one) to draw a large "inrush" current at the first contact.
- Disconnect the power immediately.
- Test for any "hot spots".
- If no obvious hot spots, then
    - Reconnect the power and watch for sparks a second time.
    - If NO sparks a second time, this is normal! Things are looking good! Connect the battery properly .
    - If you continue to see sparks, you will need to recheck all of your soldering for any "Short Circuit" bridges.
    - There should be NO sound coming from your speaker until the push button switch is pressed.
- If you find a "hot spot" :
    - Check for solder bridges which are causing a short circuit somewhere.
    - Check that all components have been inserted correctly.
    - Check for any loose "wire" off cuts which may be causing a short circuit.

Once you have the battery connected and no signs of other problems, it is time to test the push button switch.

- Press the switch briefly.
- The siren should sound.
- Press and hold the switch in for a longer period of time.
    - The siren should rise in frequency while the button is held on.
    - The siren should slowly decrease in frequency while the button is released.
    - Eventually the siren should stop completely.

Trouble shooting:

Most of the problems we have experienced with this kit are one of three kinds:

1) Soldering induced problems. (Short circuit bridges as well as poor quality "cold solder joints")
2) Component misplaced or misaligned.
3) Wire connections intermittent.

Two common problems at "initial testing":

1) Siren is on continuously …
    a. May be a result of the pushbutton switch inserted at right angles to the correct direction.
    b. May be the result of a Short Circuit in the soldering.

2) NO sound at all from the speaker.
    a. Carefully check the soldering again.
    b. We have found a common error is solder bridges (short circuits) on the legs of the transistors…. Easily bridged by accident, since they are so close together!