FK109 - 2 LED Flasher (Student Guide)

What it does:

This has two LEDs which will blink alternatively. The rate of blinking is adjustable.

What we are making:

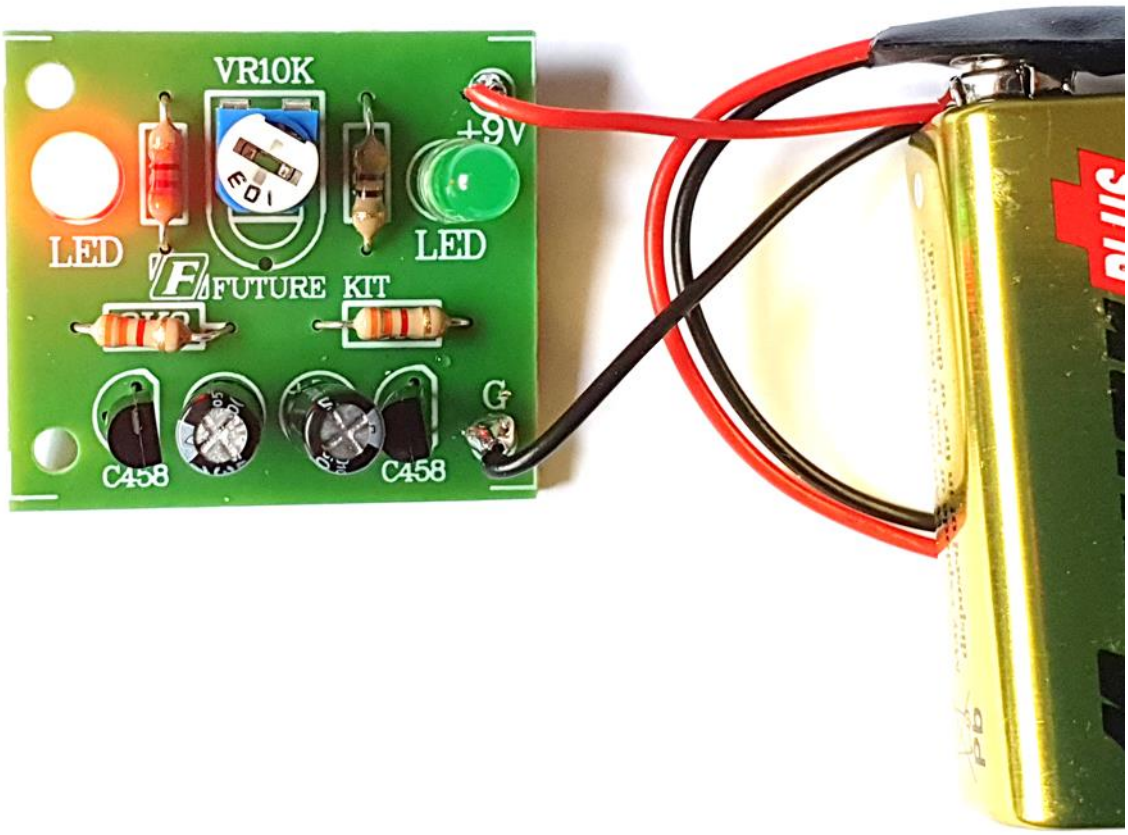

Fig 1: Finished Product

Technical Specifications:

- Supply Voltage: 9 – 12 V DC
- Consumption: 16-22 mA (max.)
- Adjustable Flashing rate with on board potentiometer
- PCB dimensions: 35.3 X 31.0 mm (1.39 X 1.22 in.)

KitStop and KitStop Retail Systems are units of
Perrin Wright and Associates ABN 86 481 210 935

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How it works:

Transistor 1 ("TR1") and Transistor 2 ("TR2") are configured as a "multi-vibrator". This means when TR1 turns ON, it will turn OFF TR2 for a short period. Then when TR2 goes ON, it will turn OFF TR1 for a short period. The "short period" and also which transistor turns ON and OFF is controlled by the Capacitors ("C1" and "C2) and the resistors ("R2" , "R3" and "VR").

When power is first applied to the module, one transistor will turn ON just a fraction of a second faster than the other.

Let us assume for a moment that TR1 turns ON first (but in reality it could be either of the transistors). As soon as TR1 is ON, it will:

- Pull the output of LED1 low, and so LED1 will also turn ON.
- Pull the "+" end of C1 low, and so instantly turn OFF TR2.
- With TR2 OFF, LED2 will also stay OFF.
- Start to charge up Capacitor C2 .
- Start to discharge Capacitor C1.

As the charge in C1 falls, it will allow the voltage stored in C1 to fall also, and hence the "-" end of the C1 will approach the same voltage as the "+" end. Eventually the "-" end of C1 will rise to a point where it turns ON TR2.

Once TR2 is ON, it will:

- Pull the output of LED2 low, and so LED2 will now turn ON.
- Pull the "+" end of C2 low, and so instantly turn OFF TR1.
- With TR1 OFF, LED1 will also go OFF.
- Start to charge up Capacitor C1 .
- Start to discharge Capacitor C2.

As the charge in C2 has falls, it will allow the voltage stored in C2 to fall also, and hence the "-" end of the C2 will approach the same voltage as the "+" end. Eventually the "-" end of C2 will rise to a point where it turns ON TR1. This sequence will keep repeating while there is power applied.

The rate of charging and discharging of the capacitors is controlled by:

- The values of C1 and C2
- The values of R2, R3 and VR
- The supply voltage applied.

Resistors R1 and R4 limit the current flowing in the LEDs, which directly affects the brightness of the LEDs.

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 FK109
    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!

Circuit Diagram:

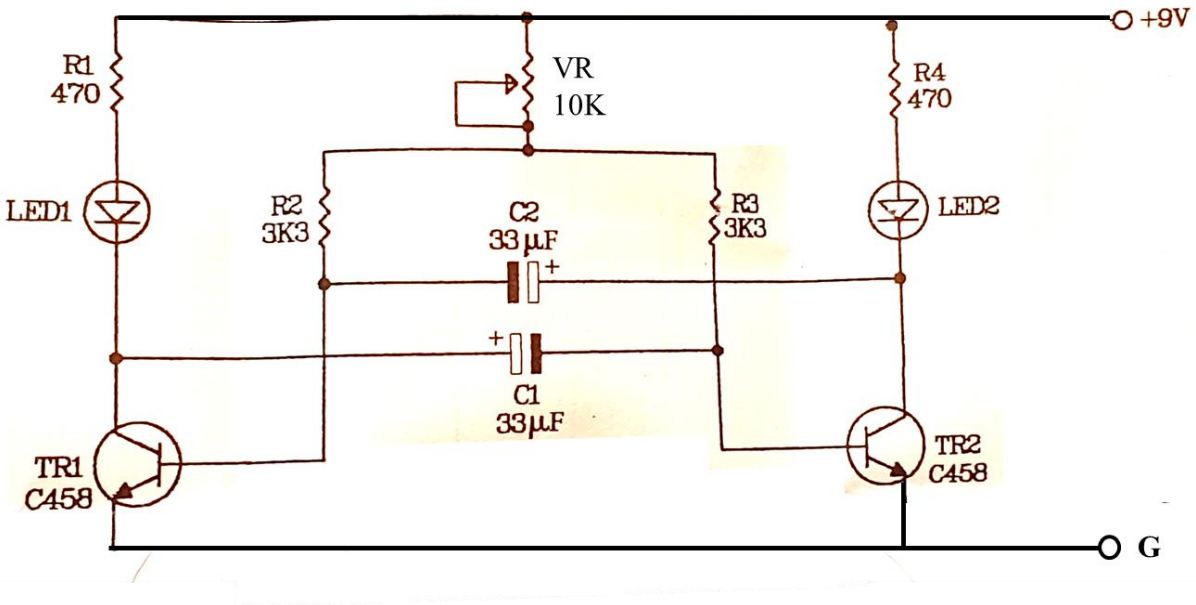
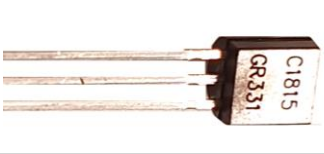


Fig 2: Circuit Diagram for the system.

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).*

FK109 2 LED Flasher				
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 Marking**	**Image**
Resistor 470Ω	470 Ohms	2	yellow-violet-brown-gold	
Resistor 3k3Ω	3300 Ohms	2	orange-orange-red-gold	
Trimmer Potentiometer (Sometimes called a "trimpot")	10,000 Ohms	1	103	
Capacitor (Electrolytic) 33µF	0.000033 Farads or $33X10^{-6}$ Farads	2	33µF	
Red LED		1		
Green LED		1		
Transisor C458 or C828 or C945 or C1815		2	C458 or C828 or C945 or C1815	
Battery Snap (9V)		1		

Component Name	Value	Qty	Identification Marking	Image
Stakes (for wire connections)		2		
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*.

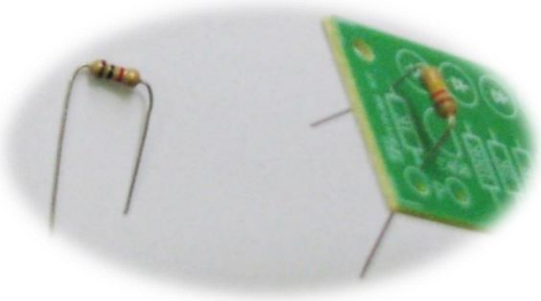


Fig 4.1 Installing Resistors

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 Transistors:

Carefully bend the middle leg of each transistor slightly forward and the two outer legs should bend slightly outwards away from each other. Carefully manipulate them as you place them through the holes and onto the PCB as shown in *Figs 5.1.* & 5.2 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.

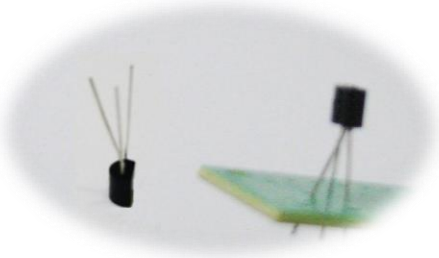


Fig 5.1 Installing the Transistors

Fig 5.2 Showing the Transistors installed .

Step 4. Installing the Potentiometer:

Carefully align the three legs of the Trimpot (VR1) with the mounting holes. *(Please note that there are several different styles and sizes of trimpots, hence the board has been laid out to accept any of three different sized trimpots.)*
Refer to Fig 6.1 to see a sample of mounted trimpot.

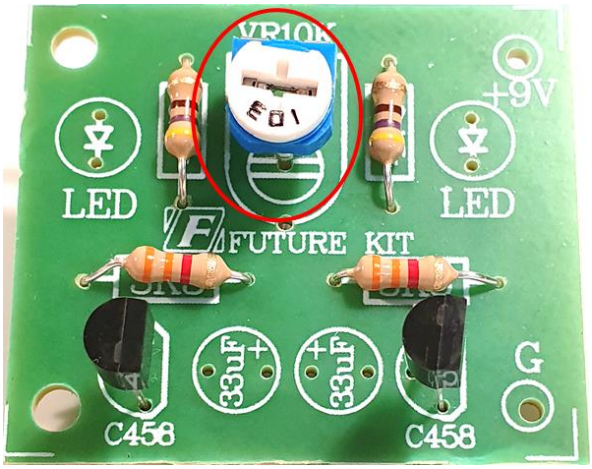


Fig 6.1 Showing the trimpot installed .

Step 5. Installing the LED's.

Place the LED's into the PCB in either side of the PCB as you wish. Refer to our example as shown in *Fig 7.1* .
Take care with the polarity of the LED's, they must be installed facing the correct way. Ensure the longer leg of each LED is placed at the back of the triangle in the diode symbol which is shown on the PCB (see *Fig 7.1*). Once in the correct orientation, solder them in place and trim the excess wire.

Fig 7.1 Installing the LEDs

Step 6. Installing the Capacitors

Identify which are the "+" and "-" legs on the two electrolytic capacitors.. 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 8.1

Fig 8.1 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 8.2 for some of the marked holes.

Fig 8.2 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 8.3 .

Fig 8.3 Showing the PCB with both of the electrolytic Capacitors installed.

Step 7. Connecting stand-off stakes and Battery snap.

Inert the stand-off stakes from the rear of the PCB. Solder them into place and use plenty of solder on their base.

Refer to Figure 9.1 for the underneath side of the PCB and Figure 9.2 for the top side of the PCB.

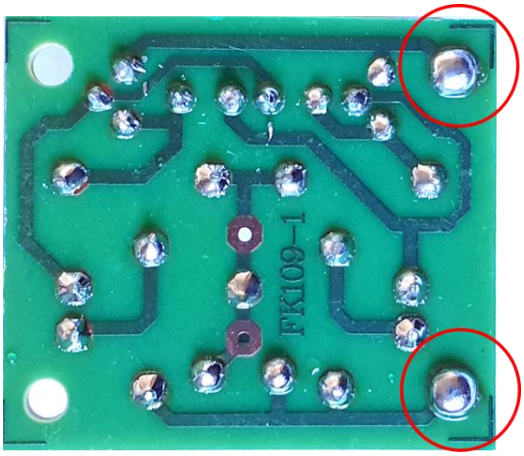


Fig 9.1 Underneath – Note generous solder vvvv amount applied to base of the stakes.

Fig 9.2 Top side of PCB with stakes highlighted .

Once the standoffs 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) or negative (-) pole and the red wire to the positive (+).

Refer to Figure 1 for final product with battery attached and LEDs now working.

Step 8 Testing:

1) Double check your work . Ensure all components are installed and oriented correctly.
2) Check for solder bridges (solder blobs across multiple tracks and leads).
3) Check for any “cold-solder” joints. (All joints should look bright and shiny… not smoky of crazed. If any joints are not “shiny”, re-melt them with your soldering iron and allow them to cool without any movement.)
4) Connect the power supply.
5) The LED’s should start to blink alternatively.
6) Adjust the flashing rate with the potentiometer.
7) If step 6 here is working OK, your kit is working properly!

Trouble shooting:

Most problems with this kit arise from the following causes:

- Component inserted incorrectly. (Check LED’s, Transistors and Capacitors for correct orientation)
- Solder bridge is creating a “Short Circuit” path.
- Poor solder joint is not making connection (This is a “Cold Solder” joint).
    - Please read our tips in “Towards Better Soldering” on how to recognize a good solder joint versus a poor joint.
    - Alternatively you may like to view our short YouTube video introducing our Soldering Trainer. This video includes some basic soldering skills, tips and techniques. It is available at this link: https://youtu.be/8pJK4TxPU00