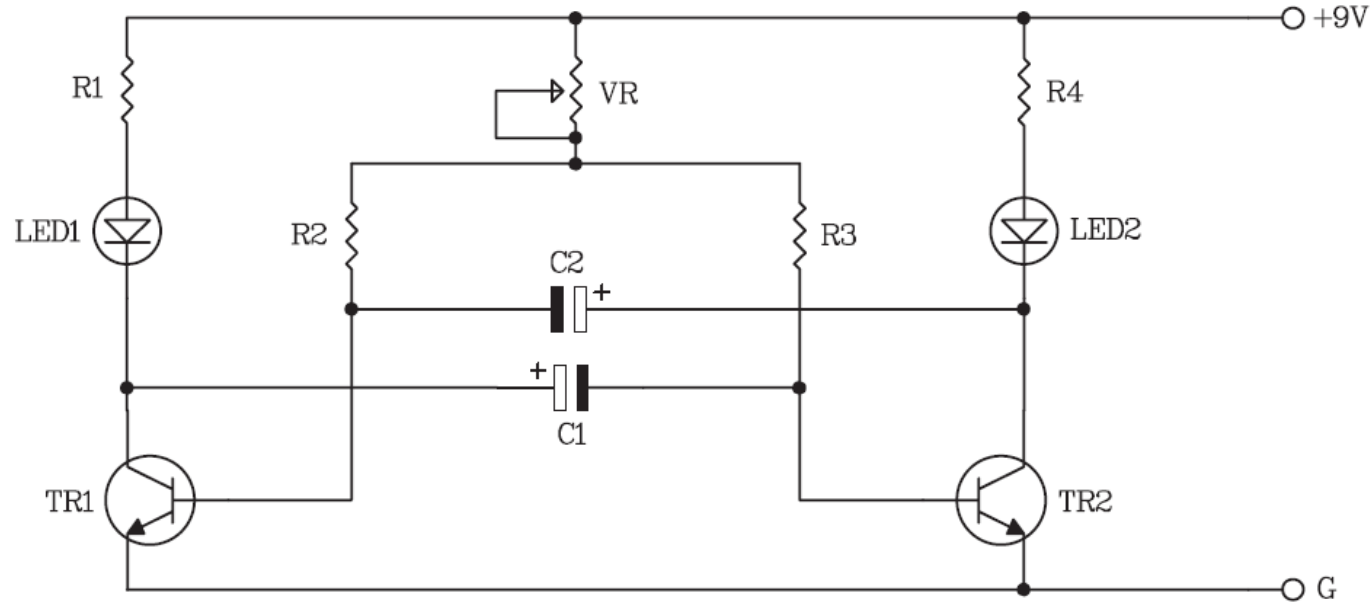


Explaining the Current Flow in FK109



The Circuit Diagram for FK109

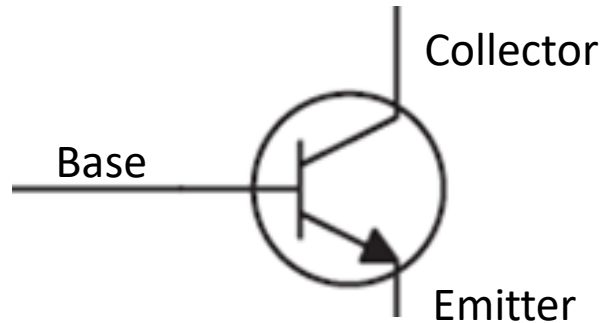
Note: we think of “Conventional Current” as flowing from Positive (+) to Negative (-)

Explaining the Current Flow in FK109

Background information:

Please consider the Transistors as acting like a Switch in this application.

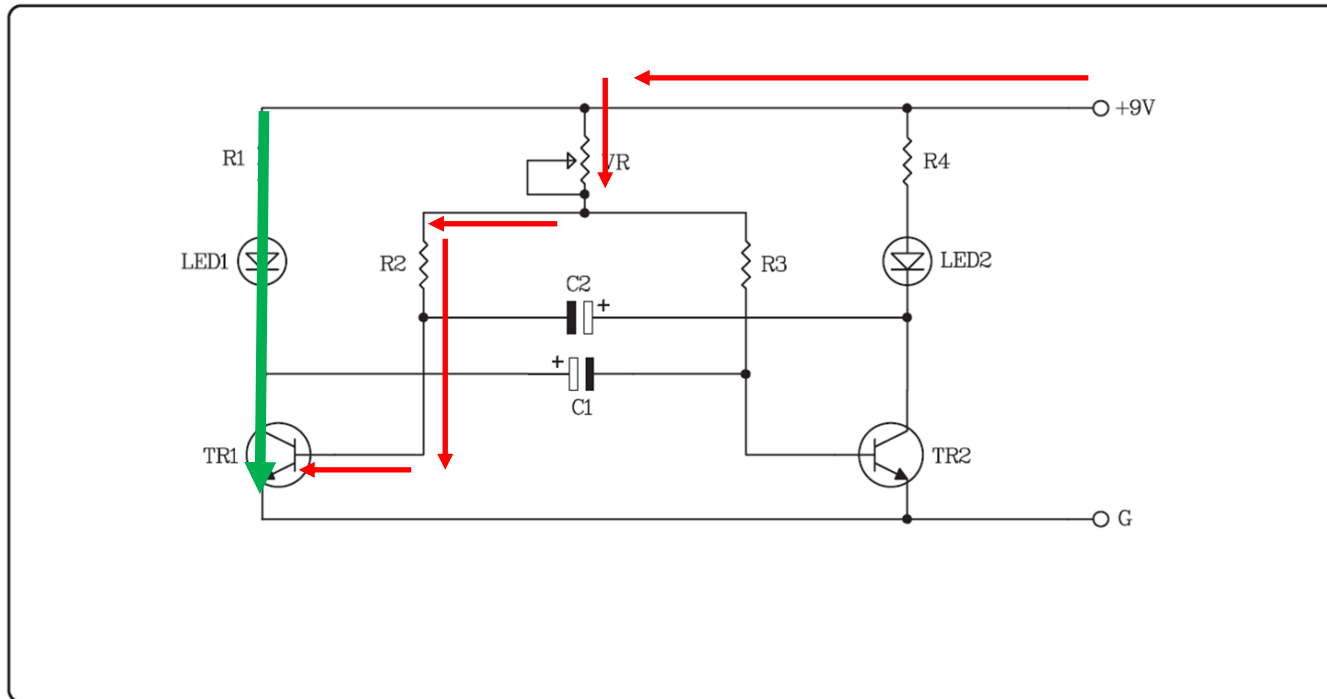
- a. When the voltage on their “Base” rises above 0.6V , the transistor will turn ON.
- b. When the Transistor is OFF , the “Collector” and the “Emitter” are effectively isolated from each other.
- c. When the Transistor is ON, the “Collector” is effectively Short-circuited to the Emitter.



Explaining the Current Flow in FK109

Let us consider the “instant” that power is first applied.... (Follow the red arrows of the electrical current)

- 1) One transistor will turn ON just a fraction before the other.
(We don't care which at this moment, so let's just say TR1 turns ON first.).



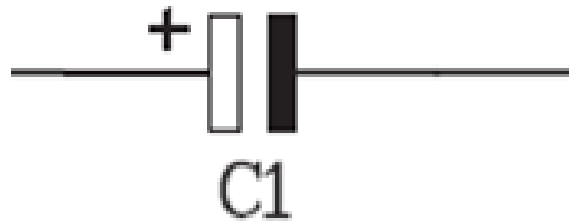
- 2) As soon as the TR1 turns ON , then current will flow through LED1 (Follow the green arrows) and turn it ON
- 3) To be continued... after we first explain a little about “Capacitors”

Explaining the Current Flow in FK109

Background information:

Let us now consider the Capacitors for a few moments:.

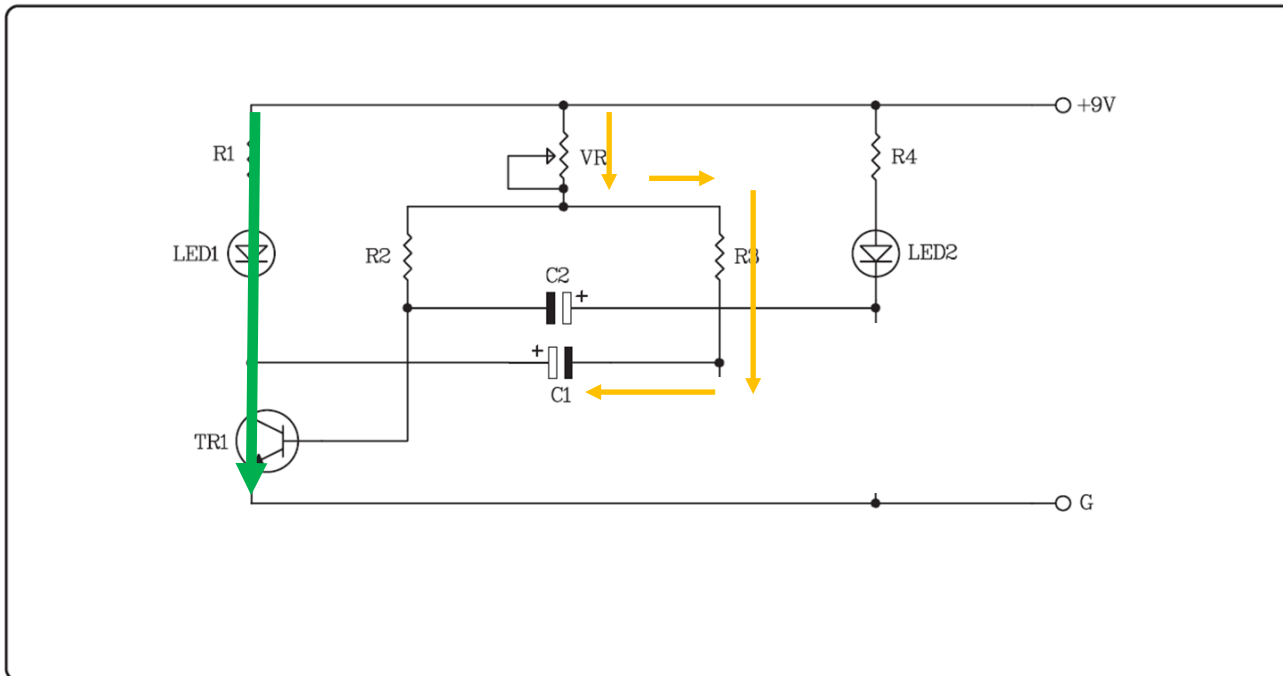
- a. When a voltage is first applied to a capacitor, it acts almost as though the capacitor was not present.
(For an instant the capacitor is almost a Short circuit.)
- b. Slowly the Capacitor will “charge up”.
The rate at which a capacitor will “charge up” depends on the capacitor’s capacity and also on how quickly can the current flow into it?
 - i. The size of a capacitor’s Capacity is measured in “Farads” .
We often refer to a capacitor’s value as simply “C”
 - ii. How quickly can the current flow is usually related to the series Resistance (“R”) which is measured in Ohms.
- c. Slowly the voltage across the capacitor will increase and approach the newly applied voltage.



Explaining the Current Flow in FK109

Back to considering the “instant” that power is first applied....

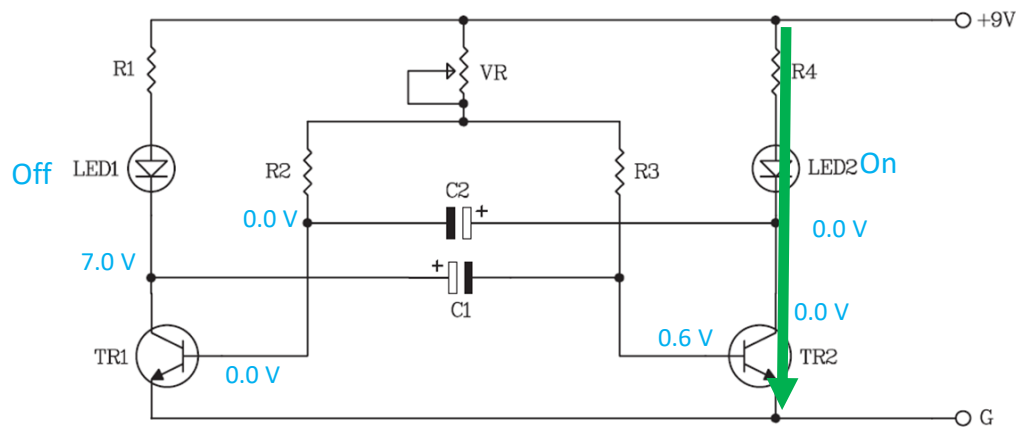
- 3) At the same time as the LED1 turns ON , the capacitor C1 will apply a very low voltage to the base of TR2, and hence this will reinforce turning OFF TR2.
- 4) For a short amount of time , while TR2 is OFF, we can almost consider it as “Missing from the circuit”... as almost zero current will flow into or through it.



- 5) Considering what happens when TR2 is OFF:
 - i) A current will flow via VR , R3 and into C1 which will slowly charge up C1.
 - ii) The rate at which C1 charges up, will be controlled by the values of C1 , R3 and VR.
 - iii) The higher the value of VR, the slower will C1 to charge up.

Explaining the Current Flow in FK109

- 6) Let us now consider the scenario as C1 “charges up” .
- a) The voltage across C1 will eventually climb up and reach the threshold to turn ON TR2 (typically 0.6V).
 - b) When TR2 turns ON, four things begin to happen at once:
 - i. The Collector of TR2 will be pulled almost to Ground.
 - ii. Current will begin to flow in LED2 (green arrow) and LED2 will turn ON.
 - iii. C2 will instantly appear to pull the base of TR1 low and turn it OFF
 - iv. LED1 will turn OFF.

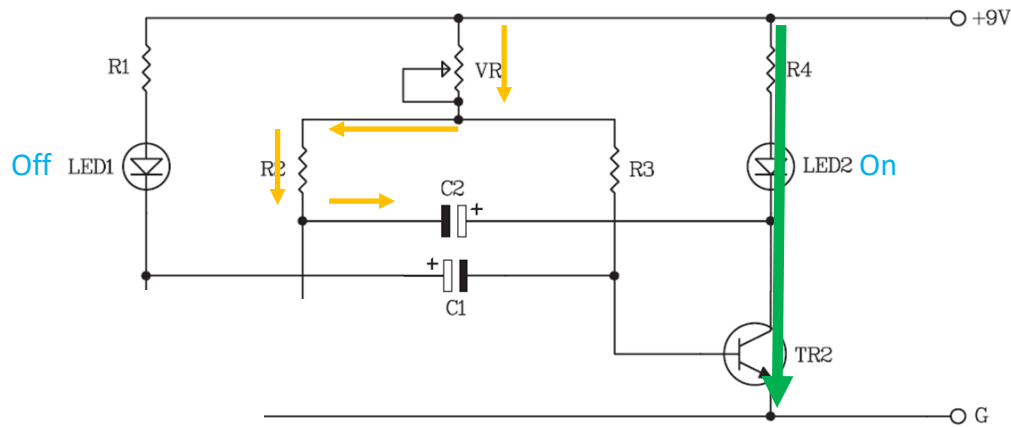


Scenario the instant that C1 reaches threshold to turn on base of TR2 (typically 0.6 V)

Explaining the Current Flow in FK109

7) Considering what happens when TR1 is OFF:

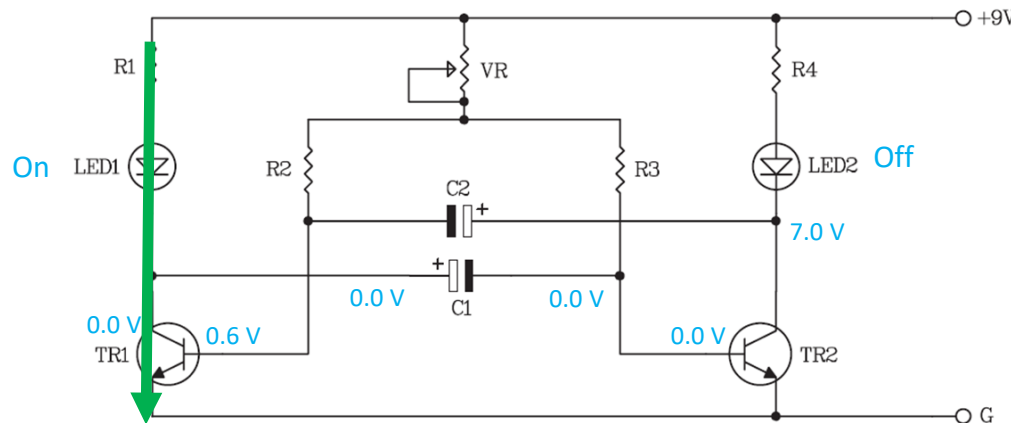
- i) A current will flow via VR , R2 and into C2 which will slowly charge up C2.
- ii) The rate at which C2 charges up, will be controlled by the values of C2 , R2 and VR.
- iii) The higher the value of VR, the slower will C2 to charge up.



Effective scenario when TR2 is ON , and TR1 is OFF

Explaining the Current Flow in FK109

- 8) Let us now consider the scenario as C2 “charges up” .
- a) The voltage across C2 will eventually climb up and reach the threshold to turn ON TR1 (typically 0.6V).
 - b) When TR1 turns ON, four things begin to happen at once:
 - i. The Collector of TR1 will be pulled almost to Ground.
 - ii. Current will begin to flow in LED1 (green arrow) and LED1 will turn ON.
 - iii. C1 will instantly appear to pull the base of TR2 low and turn it OFF
 - iv. LED2 will turn OFF.



Scenario the instant that C1 reaches threshold to turn on base of TR2 (typically 0.6 V)

Explaining the Current Flow in FK109

The Circuit will now cycle around steps 5,6,7 and 8 until something interrupts it.

This means that LED1 and LED2 will turn ON and OFF alternatively.

The rate at which they flash can be controlled by changing VR.

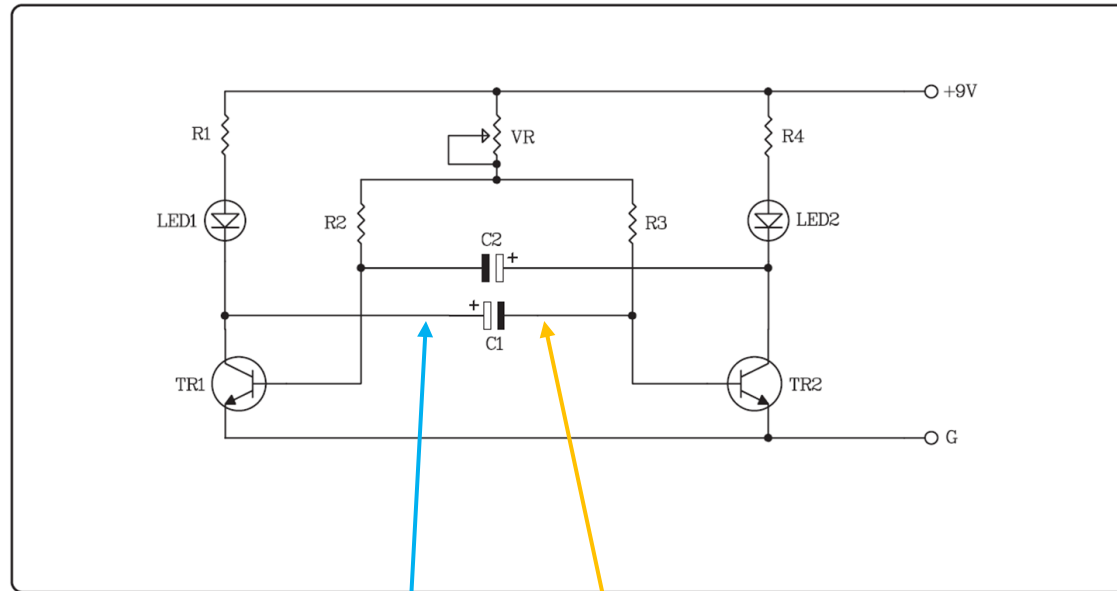
They can also be changed to flash in unequal ("asymmetrical") pattern by changing any of R2, R3, C1 or C2.

Using an Oscilloscope to examine the Voltage changes

Let us look at the Voltage across the Charging Capacitor “C1” (refer next 2 slides)

Yellow line is the negative side of the capacitor (attached to the base of Transistor TR2)

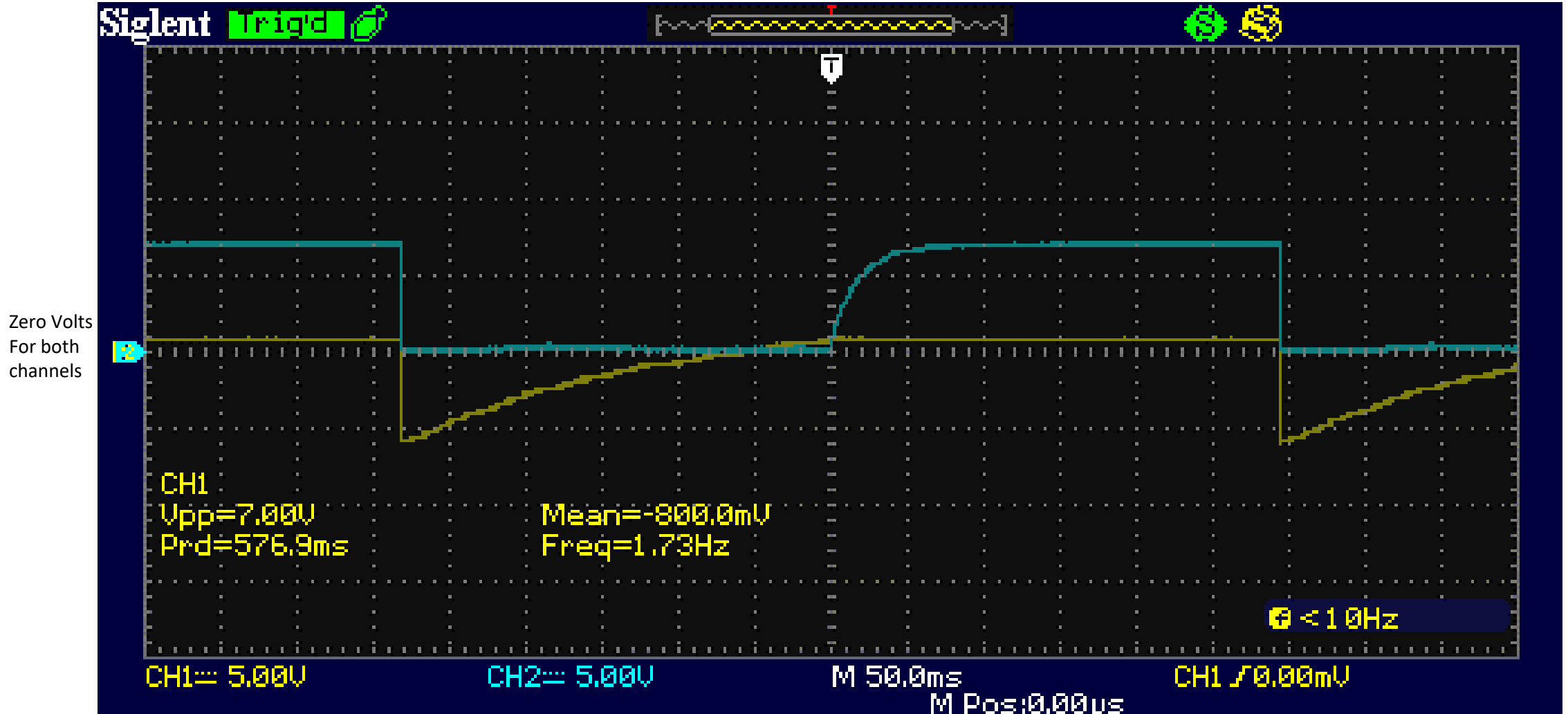
Blue line is the positive side of the capacitor (attached to the Collector of TR1)



Channel 2 on the CRO = blue trace.

Channel 1 on the CRO = yellow trace.

Using an Oscilloscope to examine the Voltage changes



Actual oscilloscope traces from FK109

Using an Oscilloscope to examine the Voltage changes

