

## 1. TASK

A tone generator is intended to produce different tones of different frequencies by varying hand movements.



## 2. SOLUTION APPROACH

To detect the hand movements we need a photosensitive sensor, e.g. a phototransistor. Via a voltage divider it should control the base of a second transistor in the dark stronger than in brightness.



## 3. EXPERIMENT DESCRIPTION

Preparation: Avoid direct sunlight on the phototransistor and if possible dim light in the room so far that no sound is just audible. (Thus the sound can be changed by hand at a distance of about 10 cm).

V1: Move your hand towards the phototransistor.

V2: Move your hand away from the phototransistor.

V3: Move your hand alternately towards and away to the phototransistor.



### LEARNING SUCCESS

A phototransistor can be used as a light intensity sensor. Depending on the incidence of light a corresponding collector current results. In conjunction with a resistor a photosensitive voltage divider can be used to drive other transistor stages.



## 4. OBSERVATION AND EXPLANATION

Transistor T2 operates as an emitter follower (collector circuit \*).

The emitter follows the base voltage reduced by about 0.7V. The transistor is therefore always conductive and operates in the linear region of the characteristic curve.

V1: If the hand covers the phototransistor then only a small photocurrent flows in the emitter circle. The internal resistance of the phototransistor increases. Due to the voltage divider R1 / T1 the voltage at the base of T2 also increases. T2 becomes more conductive which causes the 9V terminal of the tone generator to be more „pulled“ towards the positive pole giving it a higher positive voltage.

V2: If the hand no longer covers the phototransistor then a noticeable photocurrent flows in the collector circuit depending on the ambient brightness. Now its internal resistance and thus the voltage at the base of T2 decreases. Since T2 is driven less the internal resistance of T2 increases. The higher voltage drop between the collector and emitter shifts the potential at the 9V terminal of the tone generator more in the direction of negative potential.

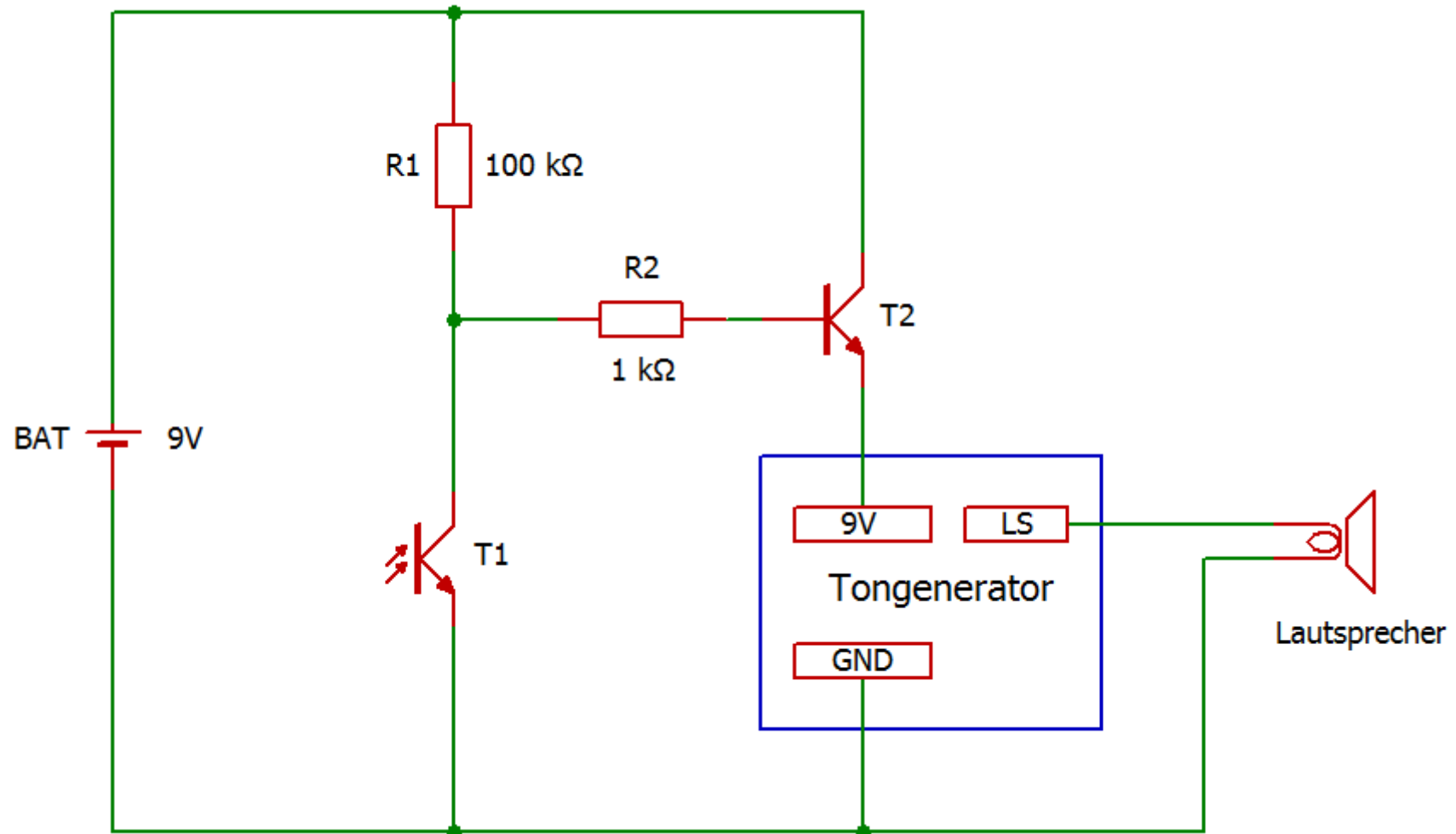
V3: By the varying hand movements T2 becomes more and less conductive. As a result the potential at the 9V terminal of the tone generator constantly fluctuates between approx. 0V and approx. 4V. This has the consequence that the operating voltage of the tone generator varies. This will produce different sounds. An effect that one can take advantage of.

### \*: COLLECTOR CIRCUIT

Common reference point is the collector.

Input is the base, output the emitter.





**RED LED LIGHTS UP ON THE BATTERY MODULE?**

**! PLEASE CHECK CIRCUIT FOR SHORT CIRCUIT !**