

FACTFILE: GCSE

Technology and Design



OPTION A: ELECTRONIC AND MICROELECTRONIC CONTROL SYSTEMS



2.3 Printed Circuit Boards

Learning Outcomes

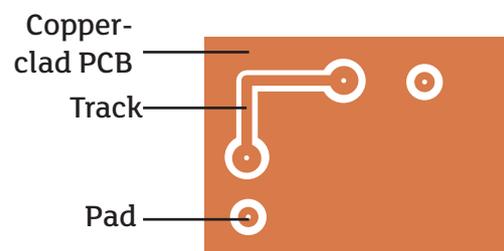
You should be able to:

- design a printed circuit board (PCB) from a circuit diagram by placing components, tracks and pads appropriately; and
- amend designs to reflect changes in circuit diagrams, to improve on existing designs or to correct errors.

Course Content



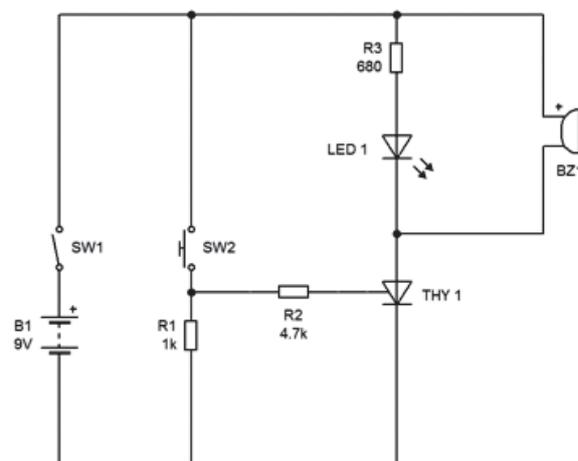
Electronic circuits are usually constructed on Printed Circuit Boards (PCBs). These not only hold the components in place but make the electrical connections to connect the components together. PCBs consist of a layer of copper, which is a very good conductor of electricity, glued to an insulating board. Areas of copper may be removed to leave copper pads for the components to be soldered to, and copper tracks to join the copper pads.



Some electronic circuit design computer applications will automatically convert a circuit diagram to a PCB design. Whilst these may work satisfactorily, there is much to be gained by controlling where the components are placed, particularly when it is necessary to engage in testing or fault-finding on a circuit which does not perform as expected. The following worked example will show how a PCB design for a simple circuit may be produced.

WORKED EXAMPLE 1

Produce a PCB design for the following simple electronic circuit.



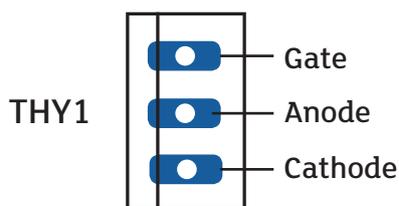
When a PCB is made, there are usually some components which are soldered onto the board and sit on the board surface. These are called on-board components. The spacing of the pads is determined by the physical size of the component which may be obtained from a datasheet or by measuring the component. For historical reasons, the legs on integrated circuits and pads on a PCB are usually spaced in multiples of 0.1 inch and PCB design software usually takes this into account. For the purposes of this question, we will approximate the spacing to 2.5mm.

The on-board components in this circuit are:

Resistors: R1, R2, R3 (spacing 12.5mm)

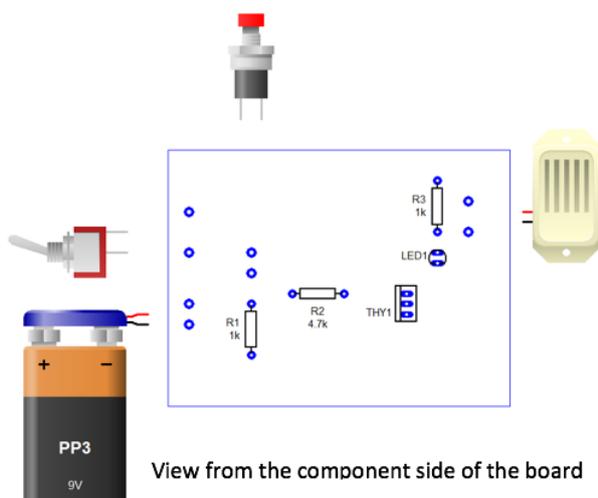
LED 1 (spacing 2.5mm) , and

THY 1 (spacing 2.5mm). The data sheet shows the thyristor connections, viewed from above, to be:

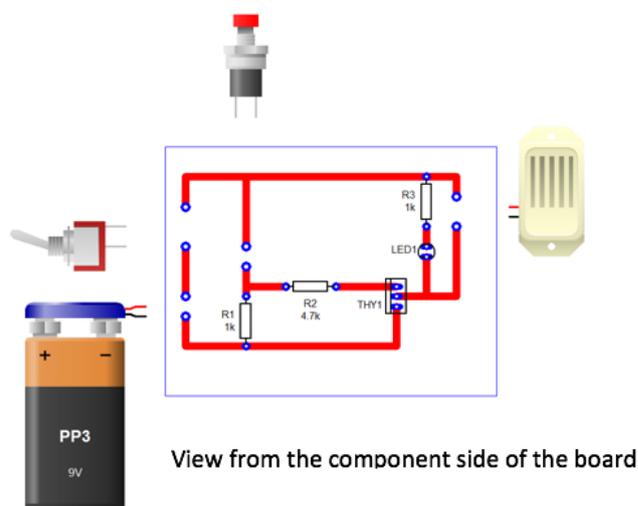


The remainder of the components are connected to the PCB by flying wires and so the spacing of the pads is unimportant.

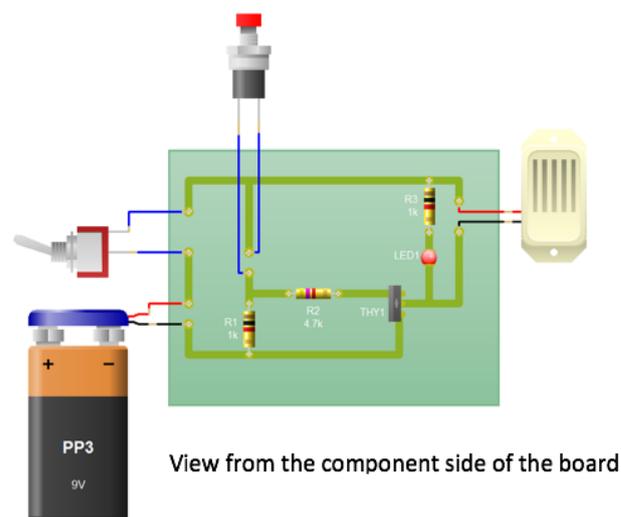
The on-board components and pads for the off-board components are now drawn in the correct positions:



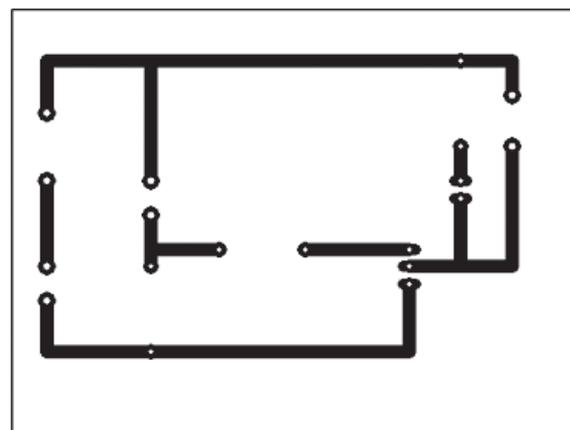
The tracks are now added to make the connections between the components.



Finally the connections to the off-board components are added.



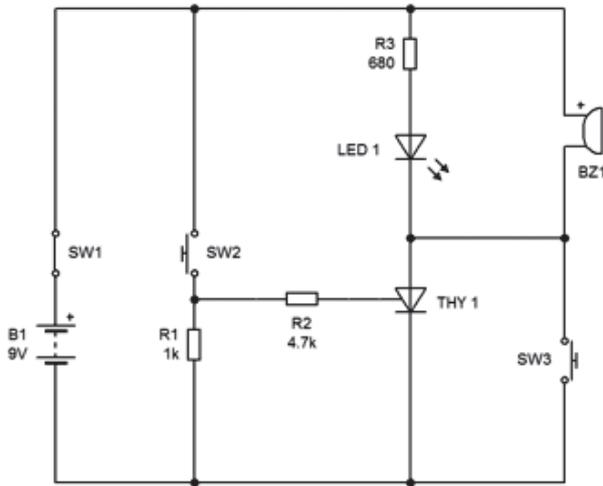
The artwork for the circuit board looks like this:



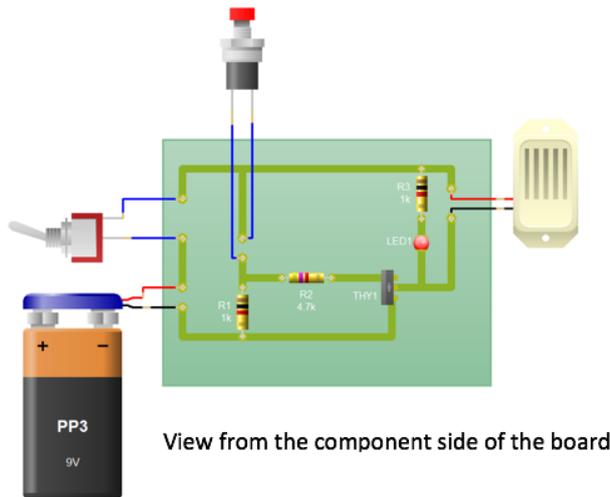
It is also necessary to be able to amend and correct PCB designs. This worked example illustrates this.

WORKED EXAMPLE 2

A pupil has drawn a circuit diagram for a simple latching circuit.



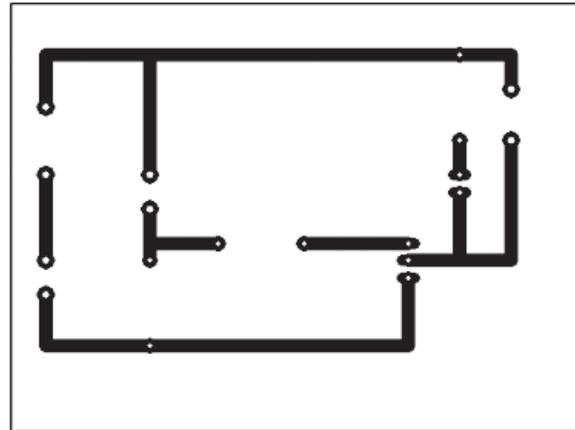
A PCB design for the manufacture of the circuit is shown below.



The pupil has omitted a component and the pads and tracks necessary to connect this to the circuit.

(a) Name the missing component.

(b) Complete the PCB design by drawing pads and tracks on the following artwork. Label the connections to the missing component.

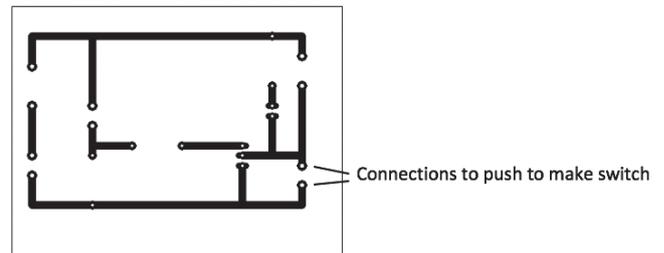


View from the component side of the board

ANSWER

(a) Push to make switch

(b)



REVISION QUESTION

1 Fig. 1 shows a circuit diagram for a transistor circuit.

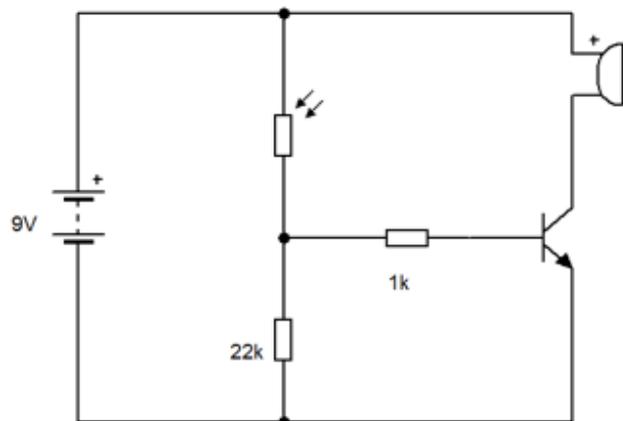


Fig.1

A pupil is manufacturing a PCB for the circuit shown in Fig. 1. The incomplete simulated PCB design is shown in Fig. 2.

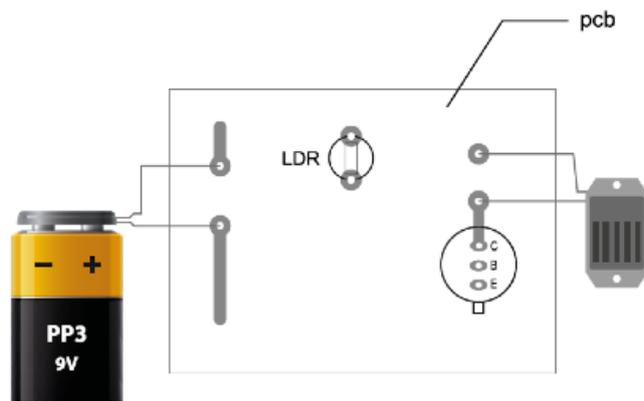


Fig. 2

(i) What do the letters PCB stand for?

(ii) What material is used for the PCB track and why is this material used?

(iii) Complete Fig. 2 as follows:

- Draw the 1 k Ω and 22 k Ω resistors on the PCB design using the appropriate symbols and terminals, in suitable positions and label the resistors.
- Draw PCB tracks to connect the components so that the PCB connections are the same as in the circuit diagram in Fig. 1.
- Label the + battery terminal on the PCB board.

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