

DESIGNING AND MAKING AN ALARM CIRCUIT

WHAT YOU WILL LEARN

After completing this project, you should understand:

- What an alarm is and why a latch is used in an alarm circuit.
- How to design an electronic system using a block diagram.
- How a thyristor can be used as an electronic latch.
- How trembler and pressure pad switches work and how they can be manufactured.
- How a light dependent resistor works and how to use it with a light beam as an input sensor.
- What a piezo transducer is and how to use it as an input sensor.

After completing this project you should be able to:

- Use the following components in electronic circuits:
 - Thyristor
 - Light emitting diode (LED)
 - Buzzer
 - Bulb
 - Resistor
 - Light dependent resistor (LDR)
 - Pressure pad and trembler switches
 - Piezo transducer as an input sensor.
- Build an alarm system for an identified purpose.

DESIGNING AND MAKING AN ALARM CIRCUIT

An alarm gives a warning signal to let people know that something has happened. The most common form of alarm you are likely to see is a burglar alarm on a house or other building. If the building is broken into, the burglar alarm gives a warning sound. A modern alarm is an electronic system that can have many other uses. For example, it can also warn of fire or high voltage levels.

There is a difference between an alarm and a sensor system. Alarms continue to indicate that something has happened even if the cause stops. e.g. A burglar opens a door and sets off an alarm. Even if he closes the door the alarm continues.

An electronic system that can continue to indicate that something has happened after the event has finished is known as a **latch**.



DESIGNING AN ELECTRONIC SYSTEM

Electronic systems can be represented using block diagrams. There are three basic building blocks and each block is used to represent a stage in the electronic system. The three blocks are:



Input Block - Enters information into the system. E.g., a switch which might be turned 'on' or 'off'.

Process Block - Uses information from the input to control the output. E.g., an electronic component such as a transistor.

Output Block - Makes things happen. E.g., a bulb lighting up or a motor turning on.

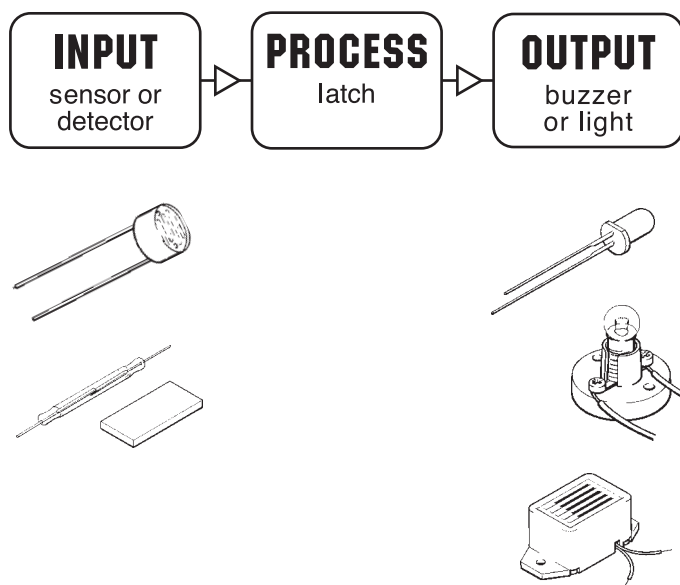
YOUR TASK



Design and make an alarm system that will latch to warn that something has happened. The alarm system must be designed to satisfy a need that has been identified and investigated by you.

DESIGNING THE SYSTEM

The alarm system can be represented in the form of a block diagram, like this:



DESCRIBING YOUR TASK

◀ DESIGN SPECIFICATION

First, you need to describe in detail what the product will be like, what it will do and who will use it. This is called a **design specification** and will guide your design work and help you to judge how well the outcome works.

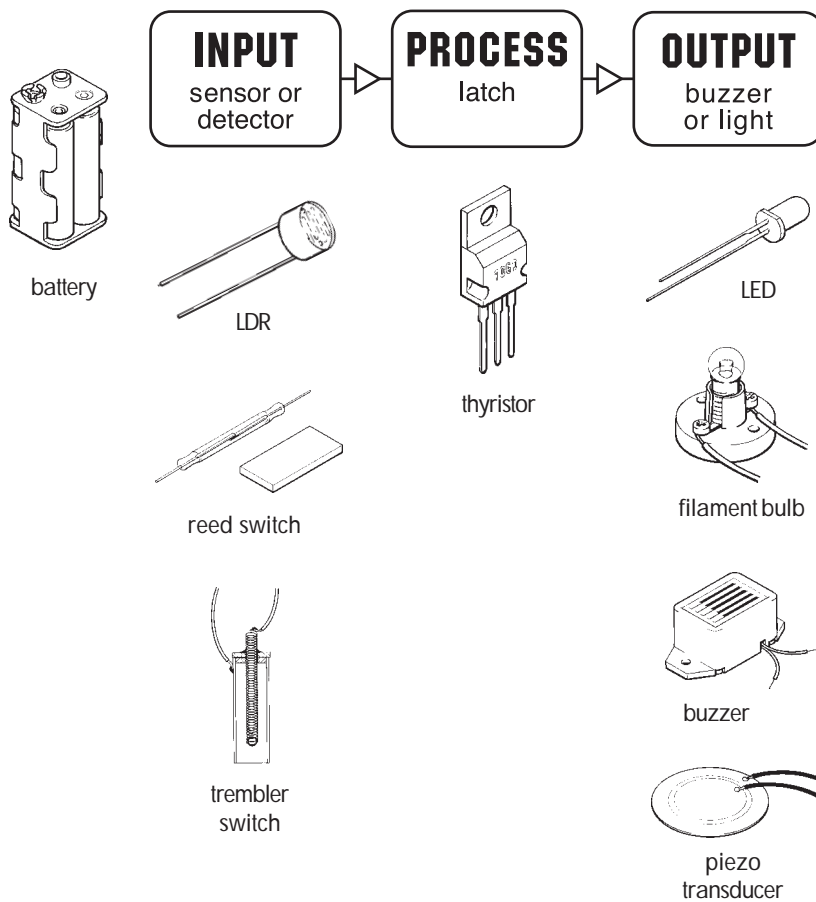
Here are some questions to help you with your design specification:

- *What is the alarm for?*
- *Who will use it?*
- *Should it be completely hidden?*
- *What should it cost?*
- *What sound, if any, should it make?*

MATERIALS AND COMPONENTS AVAILABLE

◀ DESIGNING AND MANUFACTURING CONSTRAINTS

Before you can go ahead with designing and making the alarm system you need some more information. You need to know what power supply to use, what components are available and how they are used.



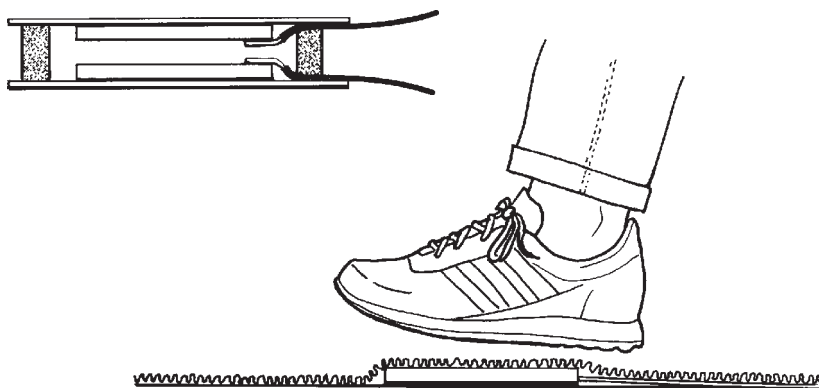
INPUT BLOCK

◀ SYSTEM INPUT
POSSIBILITIES

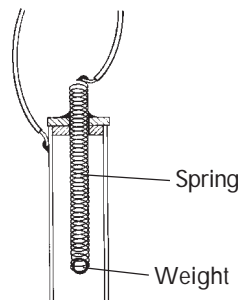
The components in the input block have to provide a voltage that rises from zero to approximately two volts when the event happens that sets the alarm off. There are several ways of doing this. The best one for you will be decided by what you intend to use your alarm system for.

A Switch - Different types of switch can be used to trigger the thyristor.

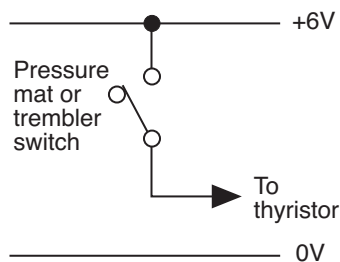
You could make a pressure mat switch. When somebody treads on the mat the alarm would go off.



A trembler switch can be used to alarm anything that moves - car, bicycle etc. When the switch is moved it makes a contact. Trembler switches are quite expensive but you can easily make one to fit your requirements.

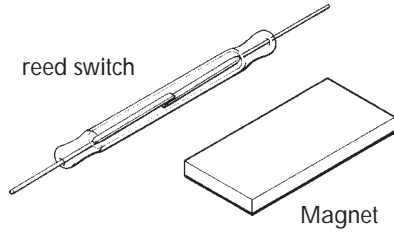


Both of the above switches would need to be connected like this.

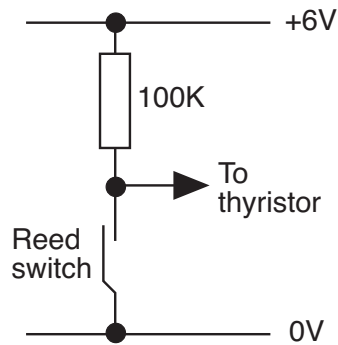


ELECTRONICS - ALARM CIRCUIT

A reed switch can be used on a door. Reed switches are operated by magnets. The magnet is fixed to the door and the reed switch to the door frame. When the magnet is close to the reed switch it switches on. If the door opens the magnet moves away from the reed switch and it switches off.



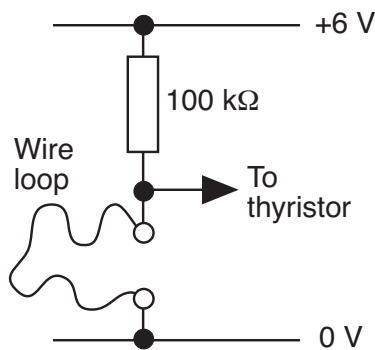
You would need to connect the reed switch like this.



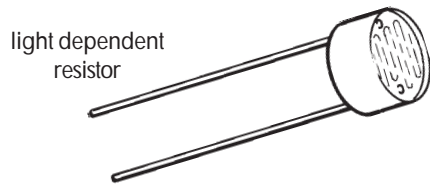
A Wire Loop - This would be used for an alarm system similar to the ones found in shops that protect a number of goods that still need to be handled. If the wire loop is broken or disconnected then the alarm goes off. The wire loop would need to be connected like this.

NOTE

The wire loop configuration is an unusual potential divider setup and needs careful explanation.

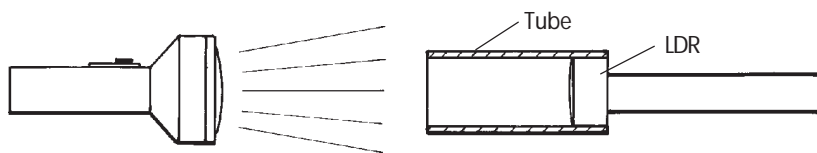


A Light Dependent Resistor (LDR) - An LDR is a special kind of resistor. It changes its resistance according to how much light is falling on it. If there is a lot of light falling on the LDR it will have a low resistance. As the amount of light falling on it decreases the resistance of the LDR increases.

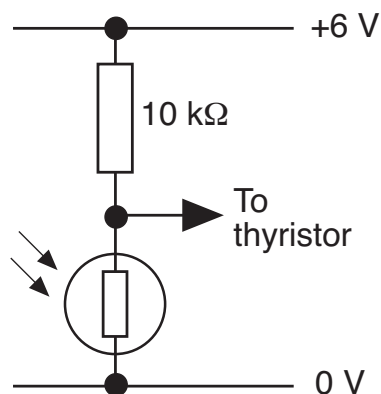


BRIGHT LIGHT - LOW RESISTANCE
DIM LIGHT - HIGH RESISTANCE

You could use an LDR with a 'light beam' shining on it from a torch. If the beam is broken the alarm goes off.



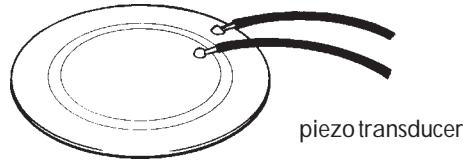
You would need to connect the LDR like this.



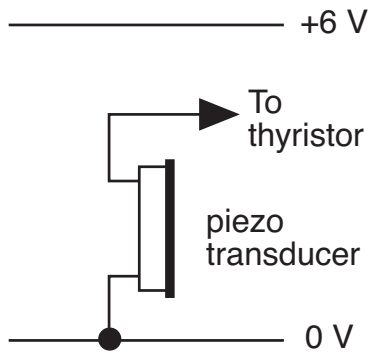
Piezo Transducer - The piezo transducer is a very interesting little device. It is normally used as a kind of speaker. If you 'flick' the transducer with your finger it will produce a voltage. This voltage is sufficient to trigger a thyristor.

◀ NOTE

The piezo triggering method is entirely different because a voltage is created on impact.



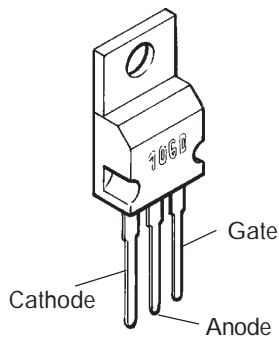
You would connect the piezo transducer like this.



PROCESS BLOCK

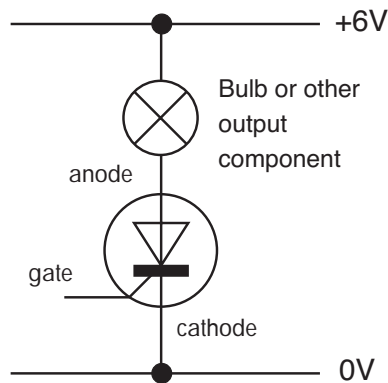
The main component in the process block is a thyristor. Use a type 106D which looks like this.

◀ SYSTEM PROCESSING
POSSIBILITIES



The three legs of the thyristor have names. It is quite easy to see which leg is which from the diagram.

The thyristor operates in a similar way to the transistor. The main difference is that once a thyristor is switched on, or *triggered*, it will latch (stay on). This makes it an ideal process component to use in an alarm system. To use the thyristor as an electronic switch connect it like this.



◀ NOTE

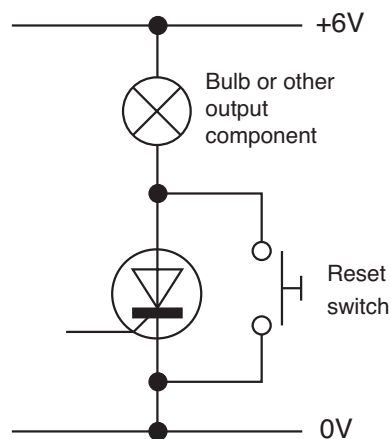
The thyristor is one of the most useful devices for 'single active component' circuits. See study file 12 for a demonstration board layout.

◀ NOTE

The thyristor symbol used in Crocodile Clips is slightly different. See study file 1a.

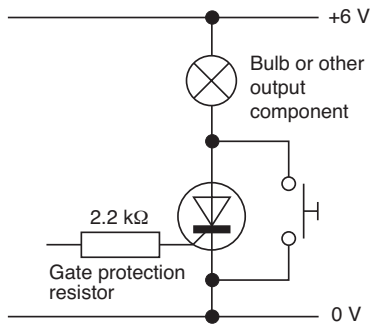
The thyristor switches the output component on or off. To make the thyristor latch you have to put a positive voltage on the gate. Typically about two volts will trigger it. Once it has been triggered it allows current to flow through the output component.

The thyristor remains switched on, or latched, until it is reset. The only way to reset it is to remove the positive voltage from the anode. This can be done by using a switch.



When the reset switch is on it shorts out the thyristor. This removes the positive voltage on the anode, by connecting it to 0V resetting the thyristor. (Note: the bulb stays on when the reset switch is closed and only goes off when it is open.)

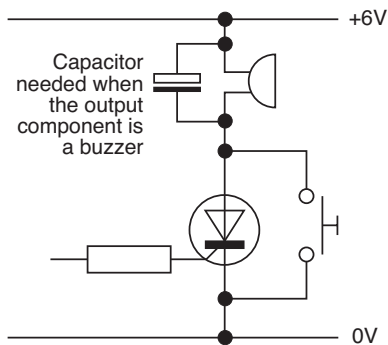
When you use the thyristor in this way you need to use a gate protection resistor in much the same way as you do when using a transistor. A 2.2 kΩ resistor prevents the thyristor from being damaged by too much current flowing into the gate.



Finally, if you are using a buzzer as the output device then you need to add one further component to your circuit. This is a capacitor that is connected across the buzzer. This component stops the buzzer from interfering with the thyristor operation.

◀ NOTE

For more information on capacitors see the electronic timer project.



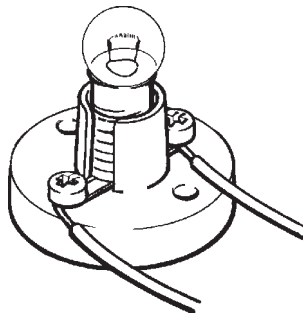
OUTPUT BLOCK

There are three types of output component available to you.

◀ SYSTEM OUTPUT POSSIBILITIES

1. Lamp

The type of lamp available to you is the same type used in a torch. Different lamps operate with different supply voltages. You need to choose a lamp that works at the same voltage as the supply you are using and which has a low wattage.

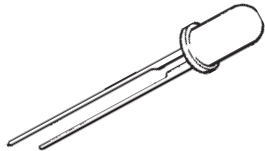


2. Light Emitting Diode (LED)

The LED is a small electronic light that is used as an indicator in many electronic products. You have probably seen a few examples of them in use in your home or school. (On computers, videos, stereo systems, games consoles, microwaves etc.)

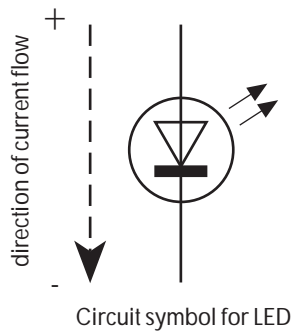
◀ NOTE

For more information see study file 9 (Investigating the LED).

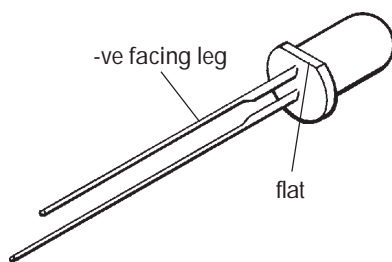


There are some important things to remember when using LEDs.

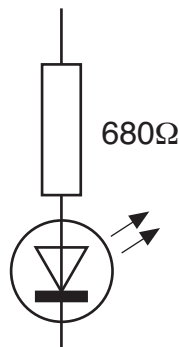
i) An LED only lights up when current flows through it in the correct direction. For this to happen it must be connected the right way round in the circuit.



To find out which leg is which you have to look carefully at the LED. One side of the circular case is flat. The leg that is next to the flat side is the negative connection.

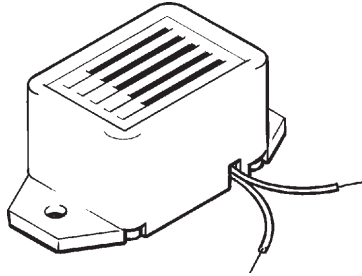


ii) Always use a resistor in series with an LED. The resistor prevents too much current from flowing through the LED which would damage it. You will need to use a 680Ω resistor.



3. Buzzer

The buzzer makes a loud buzzing sound when current flows through it.



i) Different buzzers use different supply voltages. Choose a buzzer that matches the supply voltage that you are using, i.e. 6 V.

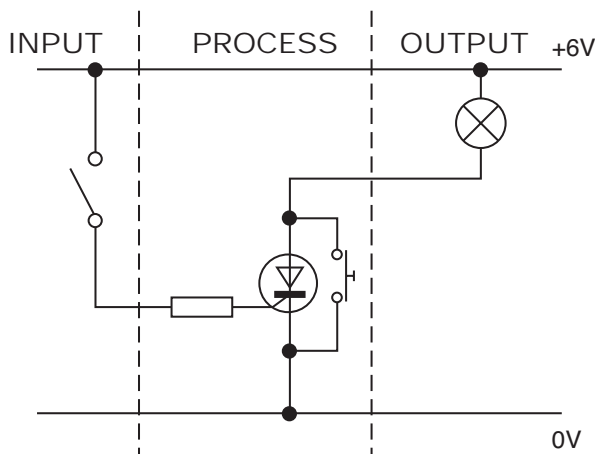
ii) Buzzers normally need to be connected the right way around in a circuit if they are going to work. They normally have one red lead and one black lead. Connect the red lead to the positive part of the circuit and the black lead to the negative part of the circuit.

PUTTING IT ALL TOGETHER

You can see from the design constraints that you can choose from six different input blocks and three different output blocks. This means that you have eighteen possible circuits!

Remember that you need one input, one process and one output.

◀ SYSTEM SYNTHESIS



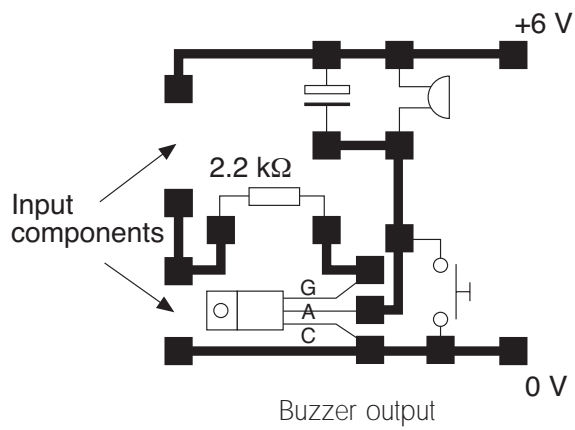
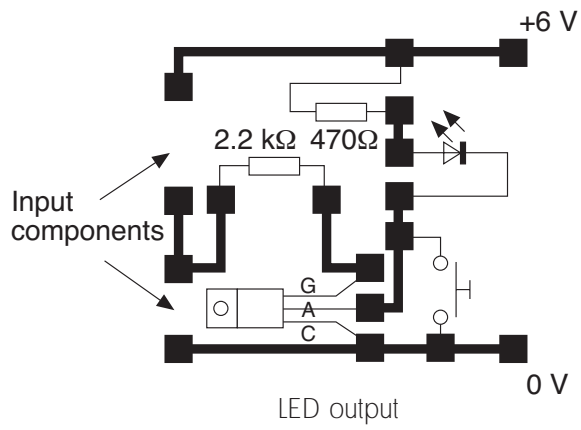
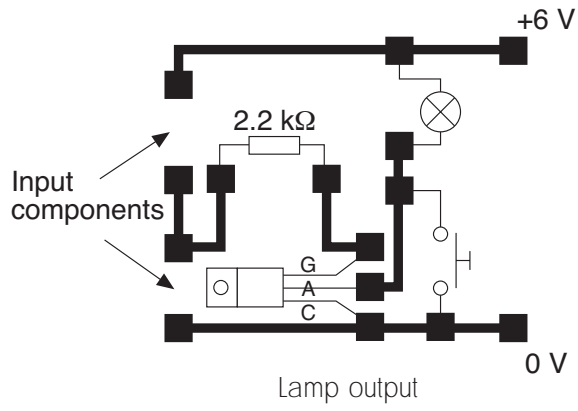
◀ NOTE
See Study File 1a, Crocodile Clips.

Try drawing the circuit diagram for your alarm system. It is a good idea to get it checked at this point before you carry on. You will need to make a printed circuit board (PCB) to mount the components on.

◀ NOTE
To find out about this see Technology Study File 2 (Making a PCB)

ELECTRONICS - ALARM CIRCUIT

Some possible PCB layouts are shown here with most of the components in position.



TESTING

When you have built the circuit you will need to test it. If the circuit does not work at all then try following this simple fault finding procedure,

- Check that the PCB layout is correct and that no tracks are bridged or broken. (Repair if necessary).
- Check that all soldered joints are good.
- Check that all components are connected correctly. Pay particular attention to the thyristor as mistakes are easily made.
- Check that the input voltage to the gate of the thyristor is 0 volts when the alarm is meant to be off and approximately 2 volts when the alarm is meant to be on.

EVALUATING THE ALARM

There are a number of things to consider when evaluating your alarm system.

- How well does it work? -
Did you choose the best input device for the job?
Is it sensitive enough?
Does the alarm work every time?
- Will it work in the situation for which it was designed?
- Did you choose the best materials and methods of manufacture?

◀ SYSTEM DIAGNOSTICS

◀ NOTE

See Technology Study File 2 (Making a PCB)

◀ EVALUATION