

Educational Project Pack Design Brief

KI0208EP LIGHT ALARM KIT

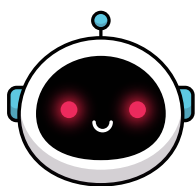
Curriculum & Standards Framework Systems (Producing) Level 5.

At the completion of this project a student will be able to:

- Plan and carry out a production process according to instructions, with minimum waste materials.
- Test the operation of the project and develop it as a part of a system.

Tekky Kit

Designed and Supplied by



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KI0208 - Light Alarm Project

Brief description of circuit operation.

The Light alarm has a type of simple sight. When we are moving around, we do things automatically like listening for sounds, walking, being aware of obstacles; even switching on a light to see what is happening. The example below shows what happens if we feel the need to turn on a torch when it gets dark. I made this example to show how we behave when we find ourselves going from a lit area into darkness. The example is a simple horizontal flow chart.

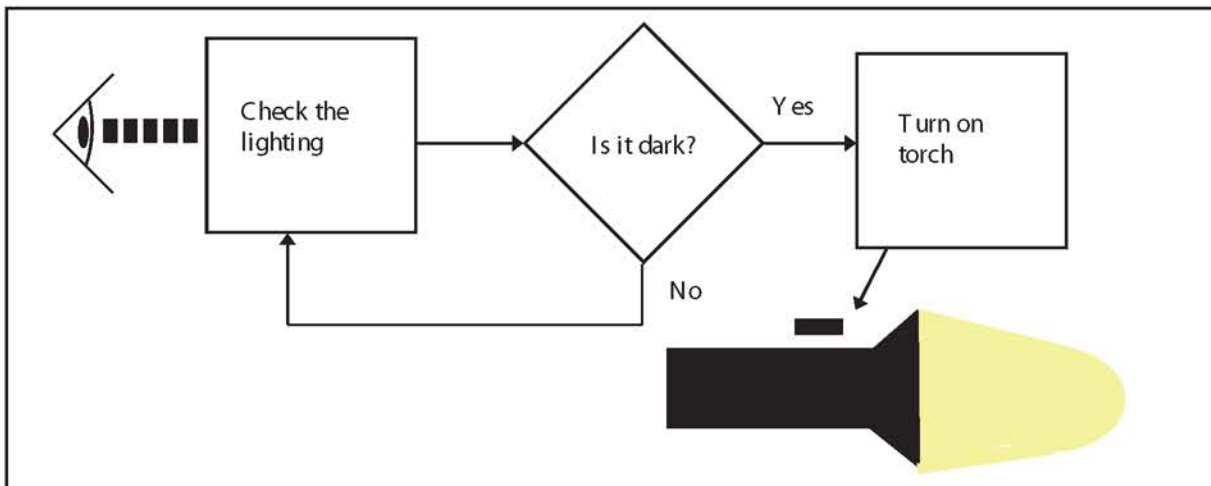


Figure 1.

The design of kit 0208 makes it behave almost the same as someone in the dark. The light alarm waits for the presence of light. When the light enters the eye of the circuit; it tells you this by sounding an alarm. (See the flow chart Figure 2). you may think this has little value but if you are a blind person you would then have an instrument to tell you when the light was present . Keep this in mind for questions later. You are blind to some light waves that the light alarm can see. Test it with a remote controll from a tv or video and see what happens. Kit 0208 is an instrument to tell us when there is light and the presence of some electro magnetic waves. For instance, instruments of this type are used for process control in industry, detecting visable and invisable radiation.

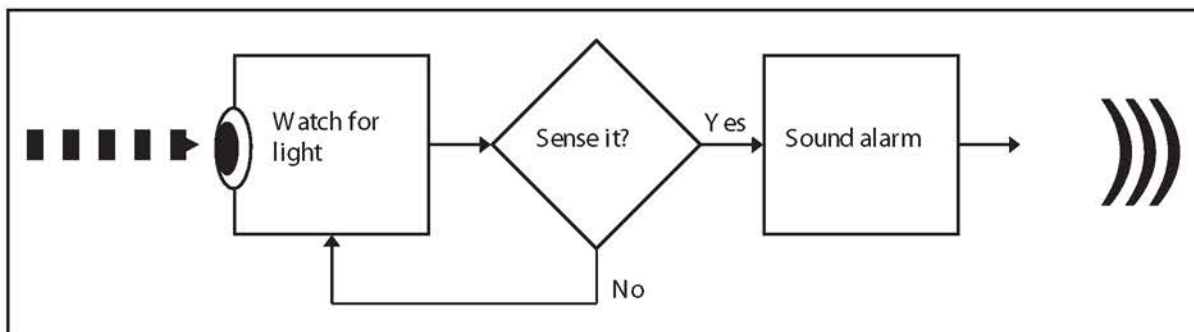


Figure 2.

Pre-construction Assignment.

Name _____ Date _____ Yr Level _____

This part of your learning experience is related to “The Producing” in Frameworks.
Do the exercises below to guide you through your project.

Investigating:

From the details of page three, you may think of different ways to use the alarm as a light sensing device. List five below.

General hints: Safety, industry, the disadvantaged, entertainment, medical, environmental studies.

- _____
- _____
- _____
- _____
- _____

Designing:

Draw a picture in the space above, showing in simple form, how you think you would like to use your project. Eg: Using my example on page 3 as a guide draw a sketch of your idea.

Include a brief description below.

Component Recognition and Evaluation:

Activity 1.

In the circuit diagram on page 7 you will see the components for the questions below.

Questions:

- What type of component is R2? The value is written in as 4M7. (See Fig 3 Page 7.) Also find it on the table on page 8.
- The value is written as 4M7. What is the value of this part?
- Why is the “M” in between the 4 and the 7?
- What colours will be found on R2 assuming that it has a tolerance value of 5%?
- What will be the colours on R1 if it is a 100k resistor? Check it now.
- In the diagram on page 7, what is C1?

Answers:

- _____
- _____
- _____
- _____
- _____
- _____
- _____

Activity 2.

In the Wiltronics catalogue, use the index to find various components and identify and list ten types.

Include R1, R2, R3, R4, Q1 and Q2 from the light alarm circuit on Page 7.

Include a note of the descriptions for future reference.

- _____
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Activity 3.

Describe the difference between (a) Axial Leads and (b) Radial Leads. You will find this information by referring to capacitors in the Wiltronics catalogue.

(a) Axial Leads:

(b) Radial Leads:

Activity 4.

The circuit diagram is a schematic drawing. The components are drawn as schematic symbols. There are many schematic symbols. Investigate this area of knowledge. Draw and name five components in the area below, include a drawing of the component and the symbol. Include components in KI0208 circuit diagram (Figure 3 on page 7).

Circuit Description.

The Light alarm circuit uses an L51P3C Photo Diode. It is not as sensitive as a normal photo-transistor. A photo-transistor is typically 100 times more sensitive than a photo-diode; but the frequency response is different - something that we are not concerned with here.

The devices are opto sensors; their electrical characteristics change in the presence of light. The light sensed may or may not be in the visible spectrum. In dark conditions their resistance is high: typically millions of ohms. In light conditions, the resistance falls to something like 30 ohms in bright sunlight. Many practical uses of this property are possible. The circuit diagram shows that the circuit consists of three main stages. see figure 3

Front Detector.

In dark conditions the L51P3C is virtually an open circuit. No current flows through the 500K potentiometer into the base of the transistor. Thus the transistor is OFF and the logic level on the input line to the 4093 is LOW. (We will return to the 1uF and the 4M7 later)

The 4093 Tank circuit

The 4093 CMOS IC is a quad (there are four of them), 2 input NAND SCHMIDT TRIGGER IC and the four gates shown on the schematic diagram (Figure 3) are all in the one IC. It is wired up to oscillate when the input to it goes high, that is the BC557 transistor turns on after light is detected by the L51P3C. The oscillating output from the 4093 turns the BC547 on and off creating a square wave signal which drives the speaker. After the alarm has been operating and it is put back in to dark conditions again, the alarm will continue to sound for about 3 seconds. This is due to the 1uF capacitor keeping the input to the 4093 HIGH. In digital logic a HIGH is also referred to as a "1" and a LOW as a "0". To increase the delay increase the value of this component.

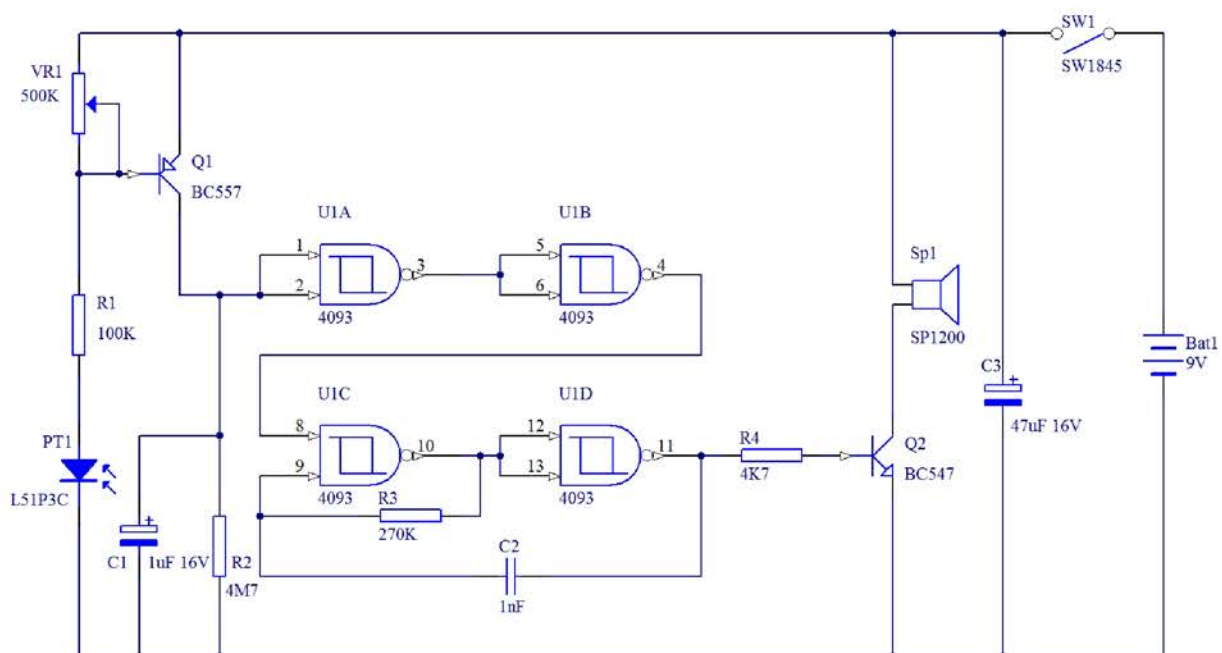


Figure 3. Schematic Diagram

Assembly Instructions.

Always read the instructions first, then check the components to make sure that they are all there. You may have to take time out to identify some of the parts and to work out the values.

Assembly is straight forward; components may be added to the PCB in any order. It is generally good practice to add the lowest height components first.

Fit the electrolytic capacitors with the correct leads in the holes. The long lead is the positive lead and must go in the hole with the plus (+) sign near it. Take care with the transistors too. They will not work if you fit them in the wrong socket. The BC557 is a PNP type and the BC547 an NPN. The L51P3C is polarity conscious. Fit it according to the overlay. Leave the leads of the L51P3C at their longest. Longer leads will allow you to easily shield the L51P3C against a light source. Fit the IC socket making certain that the notch matches the design of the overlay. When you fit the IC the overlay indicates the correct pin location. Static charges from fingers will destroy some CMOS devices, do not handle the 4093 unnecessarily; avoid touching the pins. Fit the IC last so as it is handled as least as possible.

Component List

Resistors (carbon, 0.25 W, 5%):

R1 100K (brown, black, yellow)	1
R2 4M7 (yellow, violet, green)	1
R3 270K (red, violet, yellow)	1
R4 4K7 (yellow, violet, red)	1

Capacitors:

C1 1 μ F 50V RB	1
C2 1nF mylar	1
C3 47 μ F 16V RB	1

IC 4093 CMOS IC	1
SW1 switch SW1845	1
SP1 speaker SP1200	1
PT1 photo diode L51P3C	1
Q1 transistor BC557	1
Q2 transistor BC547	1
PCB PC9208	1
9V battery snap BA9000	1
14 pin IC socket IC1014	1

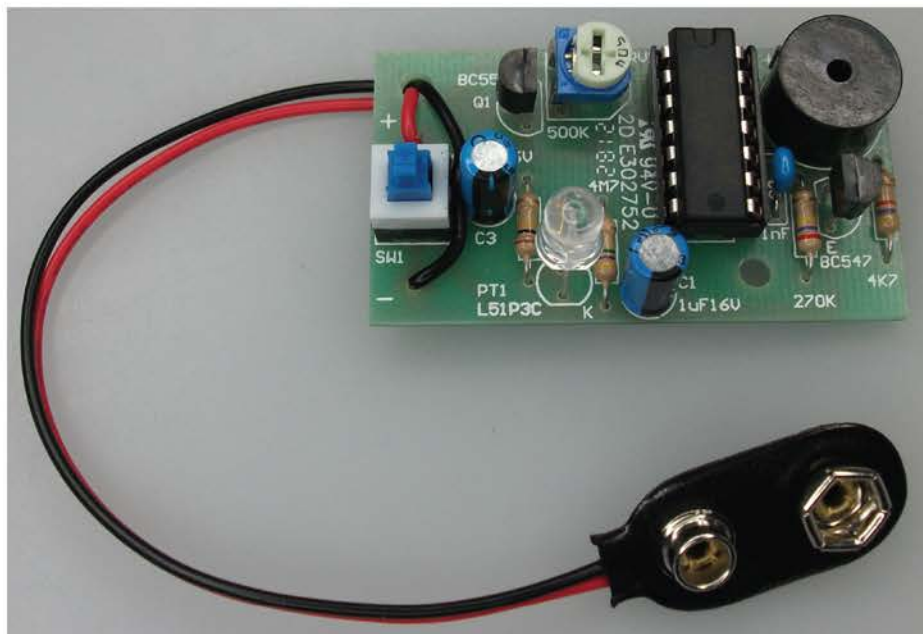


Figure 4.

What to do if it does not work.

Poor soldering is the most likely reason that the circuit does not work.

- Check all solder joints carefully under a good light.
- Check that all components are in their correct position on the PCB.
- Follow the track with a voltmeter to check the potential differences at various parts of the circuit.
- Other items to check: is the IC in the correct way?
- Check that no pins are bent up?
- Are the electrolytic capacitors and transistors in correctly?
- Is the battery flat?

Using the kit.

Protect your medicine cabinet, cash drawer or lolly cupboard with this light alarm. It will sound when the drawer is opened and light falls on the photo-transistor. Connect it remotely at the end of two pieces of wire. Redesign the alarm to activate a relay or triac. Kit 8 will not work as well as the human eye which is a very sensitive light detector; but it is still very sensitive. Point the L51P3C in the direction from which the light will come for best results.

Technical.

Construction of kit 0208 is on a single-sided printed circuit board (PCB). Design of the kit was under Protel Autotrax a popular circuit drawing package.

What to learn from this project.

The kit introduces the 4011B integrated circuit. Go through the connections of the IC to determine the HIGH/LOW levels as the input is HIGH and LOW. Change some of the component values - the 270K and 1nF - and notice how the frequency and tone of the alarm changes. Notice how tolerant the circuit is; the value of the components may vary by an order of magnitude or more and still give an acceptable alarm. Replace the Photo diode with an LDR - a Light Dependant Resistor. The LDR is the most well known opto-sensor.

Note how the unit is now less sensitive to light. You can experiment with different audio output devices to find which is best.

Post construction Assignment.

Questions and activities to study the operation of this circuit.

1. When we refer to an integrated circuit as being a "Quad NAND Gate". What does this mean?
2. What is the most likely reason for a circuit to fail to work after you have assembled it?
3. What does the one in inverted commas mean when using digital logic?
4. What effect does light falling on the L51P3C have on its resistance?
5. The L51P3C is said to be less sensitive than a normal phototransistor. How much more?
6. Draw the symbols to show the difference between a Darling ton transistor and a normal transistor.

Conclusion

Now you should have completed some of the "Producing in your "Evaluating" phase. Your report should develop your investigating and designing work. Look for opportunities to improve your project; perhaps by thinking and recording ways to make the design more presentable like fitting it into a suitable enclosure or box.

Teacher Notes

KI0208 Light Alarm Project.

Student Prerequisites

At least introduction to:

- Classroom behaviour.
- **Identification to tools.**
- Safe use of tools.
- Soldering practice on PCB.
- Knowledge of OHM's Law.
- Knowledge of resistor colour code.
- **Identification of electronic equipment.**
- Use of voltmeter, current meter, cathode ray oscilloscope.
- Component recognition.
- Introduction to schematic diagrams and symbols.

Answers to questions

Pre-construction Assignment:

Investigation Examples:

- Darkness sensor.
- Cloud sensor.
- Light sensor for disabled person.
- Receiver for light beam in a doorway control.
- Burglar light sensing alarm.

Designing:

Individual answer.

Activity 1

- A resistor.
- Four point Seven Megohms.
- To show the position of the decimal point.
- Yellow, Violet, Green, and Gold for the 5% tolerance value.
- Brown, black, yellow and gold for the tolerance value of 5%.
- C1 is an electrolytic capacitor of 1 microfarad (1MF).

Activity 2

Individual Answers

Activity 3

(a) Axial leads are along the axis of the component (out each end)

(b) Radial leads extend from one end of the component.

Activity 4



Individual answers.

Post construction exercises.

- This is an integrated circuit with four NAND gates in the one package.
- Poor soldering.
- Logic one. This is the symbol to show that the logic voltage is in the HIGH state.
- The resistance falls to a very low value, typically 30 ohms.
- One Hundred times.

Investigation Samples & References:

- Dictionary of Electronics E.C. Young. Penguin.
- Wiltronics Catalogue (Latest Edition)
- Curriculum Standards and Framework. Board of Studies Victoria.
- Protel Technology. Circuit drawings, diagrams.
- Teaching notes and Photography.

