Deep-The Lamp

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Contents

Chapter 1

DEEP

1.1 The purpose

- DEEP means light.
- DEEP is used to light up the room in case of electricity failure.
- A set of LED lamps is used for illumination in DEEP.
- These LEDs emit white light.

If *you manufature DEEP using the information in this booklet, please do let us know. In case you face any problems while manufacturing DEEP, please contact us at Vidnyan Kendra by post or by e-mail.*

1.2 INTRODUCTION TO DEEP

1.2.1 LED technology

LED or light emitting diode means electronic bulb which produces light. When electricity is supplied to an LED, the LED converts it to light energy. This light can be of different colours. The LEDs we use produce bright white light. You may be familiar of the white

LEDs used in mobile phones. This LED is an important component of DEEP.

1.2.2 Capacity

DEEP is useful to illuminate a room of approx. 10 ft by 10 ft. It consumes 1.5 Watt energy when lit. Another model of DEEP works on a 12 V battery cell. For this model, it is necessary to run the wire through the room. However, three LED sets of 1 Watt each give adequate light in a room. In addition to this, DEEP can also be used to play a radio or audio CD player.

1.2.3 It is Automatic

Like regular emergency lamp, DEEP also starts automatically upon power failure. There is no need to switch it on in the dark. Just as it comes on in case of power failure, it can also be switched off when not needed. For automatic operation, a switch is fixed on the cabinet of DEEP. If this switch is on, DEEP will be turned on automatically due to a relay. This means that in the evening this switch should be turned on to use the automatic feature of DEEP. It is advisable to leave this switch off during the day to avoid the battery drain due to DEEP coming on automatically.

1.2.4 SALIENT FEATURES

1.2.4.1 The life

LEDs used in lights in DEEP is approximately ten years. The calculated life is approximately 87600 hours.

1.2.4.2 The most important feature

The battery used also lasts for a very long time. Use of LEDs for light production ensure that very little energy is consumed. Once

charged, DEEP runs continuously for a minimum of ten hours. In comparison, the traditional emergency lights give a back-up of maximum four to five hours. DEEP battery back-up is two to two-and-a-half times more.

1.2.4.3 Cost

DEEP is less expensive in comparison to other emergency lamps.

1.2.4.4 Technology

One more feature of DEEP is that the technology used is appropriate technology. The technology is very simple. Generally the technology used for emergency lamps requires inverters, requiring a great deal of switching, which means the electric supply we get is not flawless (sinocidal or pure DC). No such technology is used in DEEP, so the technology is very simple and convenient. The functioning is also reliable.

1.2.4.5 Simplicity

Due to the simple technology, manufacturing and repairing DEEP is simple. The raw material and spare parts are readily available in the market.

1.2.4.6 Easy to produce

No complicated machinery is required for the manufacture of DEEP. With an investment of about Rs.500.00 and simple equipment like soldering gun, soldering metal and multimeter, and spare parts, it is possible to produce and market DEEP.

1.2.5 VARIOUS APPLICATIONS OF DEEP

1. General : The most important use is to illuminate a dark room in case of power failure. As mentioned earlier, a room of the size of 10 ft. x 10 ft. can be illuminated adequately to move about in it.

2. Table lamp : DEEP can be used very well like a table lamp. DEEP throws adequate light up to a certain distance to facilitate reading.

3. Torch : DEEP is light and portable, and can be taken to any dark area like a torch.

4. Special use : It is inconvenient to use the bathroom or toilet in case of power failure. Here DEEP can be used very well. DEEP can even replace normal bulbs in smaller areas.

5. Fridge light : LED lights with transformer can be used inside a fridge to see the contents of the fridge. It gives the same amount of light and consumes 70% less energy.

6. Road side vendors could use DEEP in the evening.

7. DEEP can also be charged using a solar panel. The 12V model is very effective here. Remote places, farms where there is no electricity available, can be illuminated using DEEP in conjuction with a solar panel. A prototype has been installed at a farm in Maval.

Chapter 2

HOW TO MANUFACTURE DEEP ?

2.1 LED panel

DEEP uses bright white LEDs for illumination. The circuit has been designed in a manner that each LED gets approx. 9 milli ampere power supply. There are two circuit configurations :

2.1.1 Circuit for 6 V

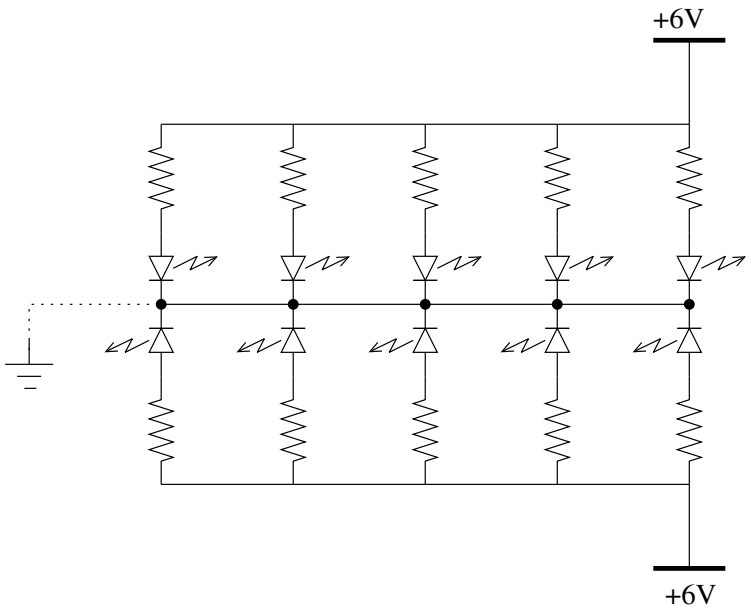
The diagram 2.1 on the following page illustrates the LED set using a 6 V battery:

Total 28 LEDs are used to create an LED set as shown in diagram. Each LED has a 330 Ohm resistor in series. This resistor controls the current to 9 milli amperes.

The advantage of this method is that this set can be run on a 6 V rechargeable battery. It does not require a 12V battery. The diagram uses 6 V, 4.5 Ampere/hour battery, which is readily available in the market.

However, due to one resistor per LED being used, the proportion of light to the total energy used is low. The wastage of electricity in

Figure 2.1: 6 Volts LED panel circuit diagram



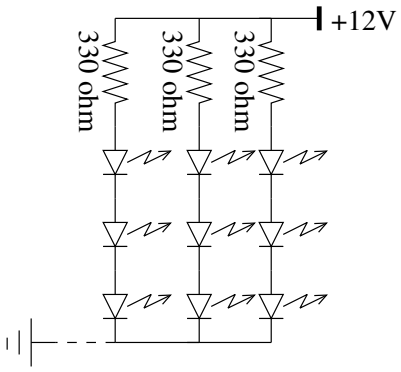
resistance is comparatively high.

Note The printed circuit boards (PCBs) are available at Vidnyan Kendra.

2.1.2 Circuit for 12 Volts

In this system, 3 LEDs and a common resistor of 330 Ohm are connected in a series. In this manner, a set of 27 LEDs and 9 resistors is created. The current passing through all the LEDs is 9 milliampere, i.e. same as in the earlier circuit. The speciality of this circuit is that the number of resistors is less and hence the electricity wasted in resistors is also less. The light output is however equal to the earlier design. This set consumes 1 W electricity. In comparison to this, the other design using 6 V battery consumes 1.5 W electrical energy. This design requires a 12 V battery. It is also possible to use two batteries of 6 V each, connected in series.

Figure 2.2: 12 Volts LED panel circuit diagram



The diagram 2.2 shows three sets of three LEDs each. Nine such sets are to be used for a 12V design.

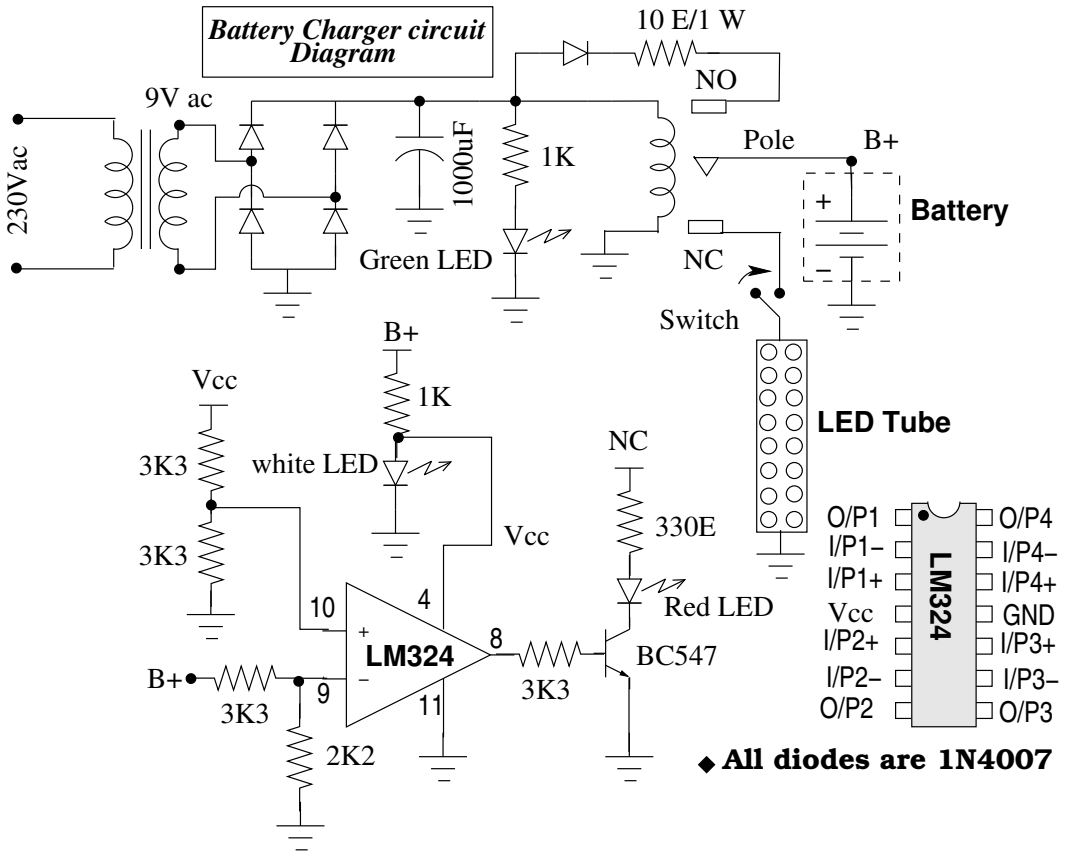
2.1.3 Battery charger

The battery supplying electric power to the LEDs can be recharged several times. For this, an electric charger is used. The circuit shown in the diagram 2.3 on the following page , containing transformer, diode, capacitor etc. charges the battery. The transformer is used to convert the 220 V supply from the electricity board to low voltage (9 V or 12 V) Diode and capacitor convert AC electricity to DC electricity. This DC voltage is used to recharge the battery.

Use 9 V transformer for charging a 6 V battery. You may also join two 6V batteries to run a 12V LED set. To charge this unit, use a transformer which has 12 V AC secondary. IC LM324 protects the battery (see battery charger circuit). Especially if the battery voltage drops below 11 V due to constant use (below 5.5 V in case of a 6 V battery), the charger circuits indicates this with a red light.

When the domestic electric supply is available, the charger keeps on charging the battery. Eight hours are adequate to charge a 6 V battery or a 12 V battery unit. The circuit diagram and its units can be used to charge a 6 V or a 12 V battery. Please do not charge

Figure 2.3: ***Battery Charger***

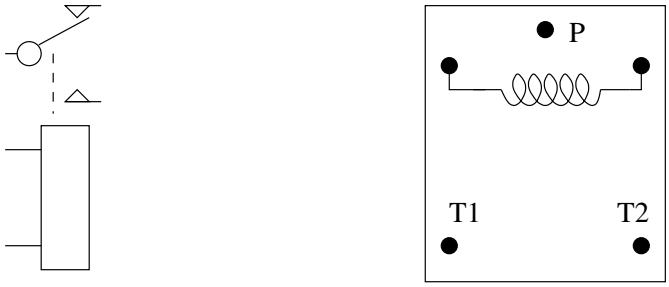


more batteries on this circuit. Use this charger for 6 V, 4.5 Ah or similar battery, or 12 V, 7.5Ah (or two connected batteries of 6 V, 4.5 Ah) only. This battery charger cannot be used to charge a four wheeler battery.

2.1.4 Circuit diagram

You can manufacture your own PCB using the above circuit, or you can use the PCB manufactured by Vidnyan Kendra. This circuit is constantly under modifications and improvements. However, it is defiitely possible to manufacture DEEP using this circuit. Please

Figure 2.4: ***relay symbol explained***



contact Vidnyan Kendra Talegaon for more information or for training in manufacture of DEEP.

2.1.5 Relay and it's uses

Diagram 2.4 shows a symbol of the relay on the left, whereas on the right hand side, the bottom portion of a relay is shown.

When there is no current flowing through the coil, P and T1 are joined. When the current is flowing, P and T2 are joined. This feature is used to start DEEP in case of power failure. When power is available, P and T2 are used for battery charging.

The relay used in DEEP is called cube relay.

The plastic cubical box in diagram 5 is the relay. The electronic symbol for the relay is also shown in the diagram. The box at the bottom of the diagram is the coil and the contact switch is shown on the top. The switc cuts the contact with one point and makes contact with another point. The box has got five small "feet" at the bottom. As shown in the diagram, the relay coil is under P. P, T1 and T2 are used to start or cut off a circuit.

2.1.5.1 Arrangement in a relay

Figure 2.5: ***Relay-structure***

Coil and iron core As shown in image 2.5, copper wire is tied around a cylindrical iron piece several times to create a coil (in the above diagram, see the part with roman alphabets on it). When connected to a charger, the electric current passes through this coil, converting the cylinder temporarily into a magnet. When the electric current stops, the magnetic properties disappear.

This temporary magnet attracts an iron plate and the two parts called pole and throw (NO) are connected. At the back of the iron plate, a spring is fixed. When the electric supply to the coil is disconnected, this spring pulls the iron plate back, connecting the pole and the throw (NC). Thus pole and throw (NC) are connected when there is no electric current passing through the relay. NC means normally closed contact and NO means normally open contact.

Note we are presuming that there is no current passing through the relay coil, to specify NO and NC.

2.1.6 Function of relay in DEEP

When electricity from the electricity board is available, DC voltage from the rectifier is supplied to the relay coil. So the iron core becomes magnetic and P and T2 are connected. In the charger circuit, the iron plate between P and T2 is used like a switch. This switch ensures that the electric current charging the battery flows from rectifier to the battery and the battery keeps on getting charged.

As shown in the diagram, the P of the relay is connected to the positive pole of the battery. T2 is connected to the positive pole of the rectifier. T1 is connected to the LED set.

When there is no electric supply, no current flows through the relay coil. The spring connected to the iron plate pulls the plate back and P and T2 get disconnected. Battery charging stops and P and T1 get connected, resulting in the LEDs glowing by consuming the battery power. This happens automatically.

2.1.7 Relay Specifications

The relay selected by us can be described as follows :

1. Coil voltage 12 V
2. Coil current approx 30 mA
3. Relay contact rating 5 Amp (DC)
4. Relay shape cubical, plastic cover, 20 mm x 15 mm x 15 mm box
5. Suitable for PCB mounting

2.1.8 DEEP cabinet and fitting

In case of 6 V battery being used, this battery, charger circuit and LED set can all be fitted into a cabinet. This cabinet has its own

Figure 2.6: Photograph of Deep

handle as well. A cabinet readily available in the market is shown here. As shown in diagram 7, all the parts can be fitted in the cabinet.

In the photograph , a PCB with LED set has been fitted behind a reflector with holes. This reflector has 5 mm holes corresponding to the LEDs located on the PCB and is shown in diagram 8.

Insert the PCB in a manner that the LEDs protrude from the holes in the reflector. This way only the LEDs are seen and not the PCB. Additionally, the reflector increases the intensity of the light to some extent.

2.1.9 Use of switch

It is essential to connect a switch in series with the lights as shown in the diagram on page 10 . Although the relay is used to switch

on the light automatically, the light will also come on in broad daylight, which is not convenient to us. Hence it is of utmost importance to use a switch. If this switch is on, the relay will cause the light to come on automatically. If this switch is switched ON in the evening, the ***automatic on*** feature of DEEP will be useful. During daytime however it is advisable to leave the switch off. This will avoid the lights coming on during daytime, and thus conserve battery.

2.1.10 Cabinet and fitting

A readymade cabinet has slots for fitting various parts of the charger. These can be used to fit in the charger PCB, transformer etc. in the cabinet.

At present no ready cabinet is available in the market for 12 V battery and LED set. The 12 V battery and charger circuit could be fitted in any other cabinet of a suitable size available in the market. You may also get a metal or plastic box manufactured locally.

The other alternative is to fit the LED strips independent of each other in a room, and use separate wiring for these strips from the battery. If a switch is used for each strip, this can be switched on or off independently.

2.1.11 Illumination

Total four LED strips installed in a room of approx. 100 sq. ft. adequately illuminate the room. This consumes only 4 W electricity. This model (12 V = 2 batteries of 6 V, 4.5 Ah each) runs continuously for at least 7 hours in such conditions. Additionally, the same model can be used to run a radio or an audio CD player of 12 V.

6 V battery and 6 V LED set fitted in a cabinet runs for 8 hours continuously, after which it needs to be recharged fully. 6 V 4.5 Ah

battery should be used for this.

For 12 V LED set, a 12 V 7.5 Ah battery is available in the market. If this battery is not readily available, two batteries of 6 V 4.5 Ah can be used in series to get a 12 V 4.5 Ah battery supply. This battery supply can run for minimum 8 hours continuously for an output of 4 strips of 12 V before recharging is needed. See diagram 9.

If you do not wish to use a cabinet, you can use the LED strips with the help of wiring anywhere in the room. These strips should be installed at 7 ft. height or more. You could use velcro strips to fit the LED strips to the roof or walls.

Chapter 3

Battery charger circuit

3.0.12 Transformer rectifier and filter

1. Transformer : You may use a transformer readily available in the market. The specs are : 230 V. primary 0-9 V, AC - 500 mA secondary for 6 V circuit. For 12 V circuit : Primary 230 V, secondary 12 V AC 500 mA

2. Rectifier : 4 diode bridge rectifier has been used. Each diode should be 1 N 4007.

3. Capacitor filter: For both the chargers (6 V and 12 V), a capacitor of 1000 mfd/25 V can be used as a filter.

4. Without attaching the battery to the charger, the voltages at the positive poles of the capacitor should be as follows

   (a) for 12 V charger : 16 V or slightly more

   (b) for 6 V charger : 8.2 V or slightly more

5. Relay: See section 2.1.5 on page 11 for information about relay. The relay is connected as shown in the diagram, so that the battery continues to get charged when the electric supply is available, and in case of power failure, the LEDs immediately get illuminated.

6. Charger controller: The kind of battery being used here is called ***sealed lead acid battery***. There is no harm in charging it continuously and when not in use. However, if the lights stay on and the voltage drops below a certain point (less than 5.5 V for a 6 V battery, and less than 11 V in case of a 12 V battery), the battery can get damaged. To overcome this problem, if the voltage drops too much (5.5 V or 11 V respectively), a red light indicator comes on. ***In such a case, it is essential to switch off the white lights and recharge the battery. If you continue to use the white lights despite the red light coming on, the battery will be damaged and cannot be reused.***

7. To monitor the battery voltage, IC LM 324 is used. One of the four op amps of this IC has been used as a comparator. See diagram 2.3 on page 10.

3.0.13 Various PCB layouts

The PCBs shown here have been manufactured as per the diagrams shown in this booklet. You may wish to buy the PCBs from Vidnyan Kendra for a reasonable price. You may also manufacture your own PCBs with the help of diagrams given here. **You need not obtain any permission from Vidnyan Kendra for this.**

3.0.13.1 The 6V volts pcb

The track side layout of the 6V pcb is shown in figure 3.1 on the following page. You may directly photocopy this page and use it as your artwork to develop the pcb for 6V model. **The bigger layout out of the two is for the 6V led module.** Component assembly layouts for 6V the boards are shown on page 20 .

Figure 3.1: The two PCB layouts

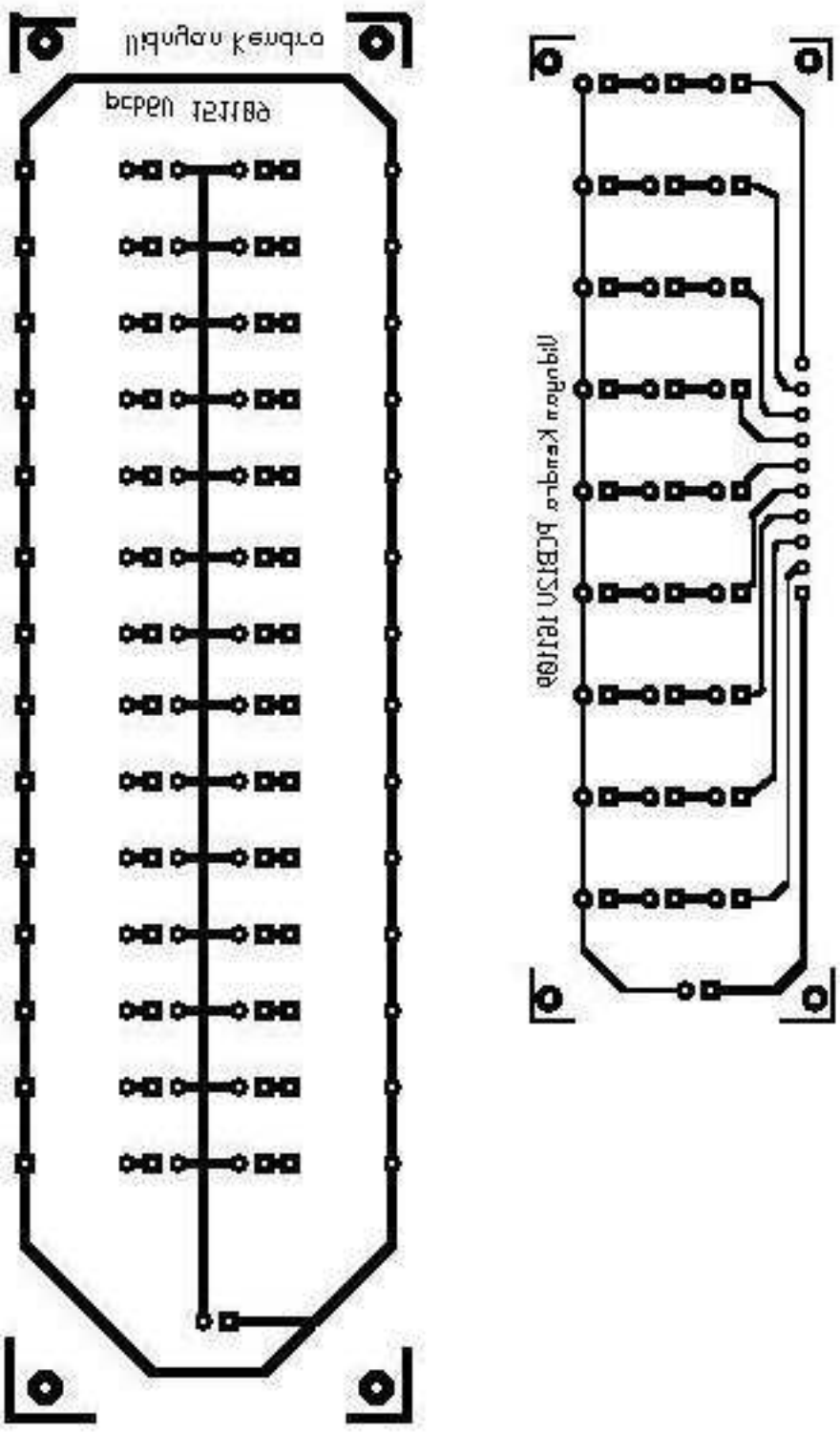


Figure 3.2: 6V LED assembly

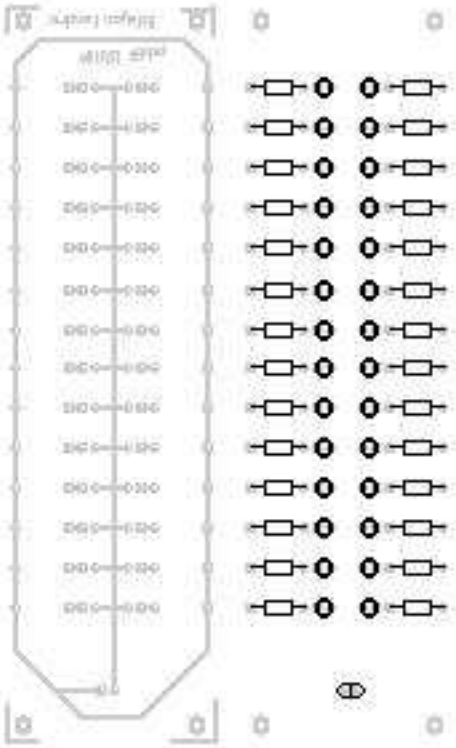
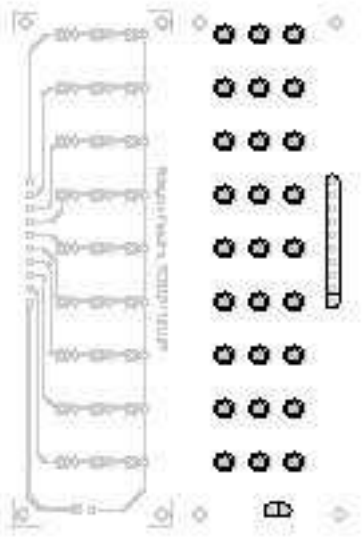


Figure 3.3: 12V LED assembly



3.0.13.2 12 V LED set PCB

The track side layout of the 12V pcb is shown in figure 3.1 on page 19. You may directly photocopy this page and use it as your artwork to develop the pcb for 12V model. **The smaller layout out of the two is for the 12V led module.** Component assembly layouts for 12V the boards are shown 3.3 .

3.0.13.3 PCB for battery charging

All three PCBs (without the components) are available at Vidnyan Kendra at a reasonable price.

Chapter 4

Quality Control

You will have to buy various spare parts to manufacture DEEP. Before connecting them, you need to test them for quality. You may use the following methods for testing :

4.1 LED :

Use white LEDs emitting bright lights. These are readily available in the market. Before soldering each LED on to the PCB, test it in the manner shown in the circuit 4.1.

Please remember :

- Do not connect the LED directly to the positive and negative poles of the battery. This will cause a permanent damage to the LED due to over-voltage. Please test the LED as shown in the diagram with a resistance in series.

Figure 4.1: Testing the LED

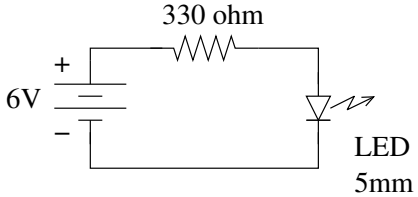
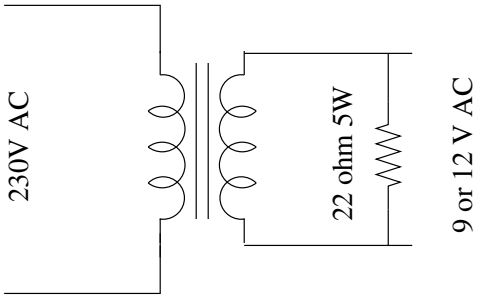


Figure 4.2: Transformer test

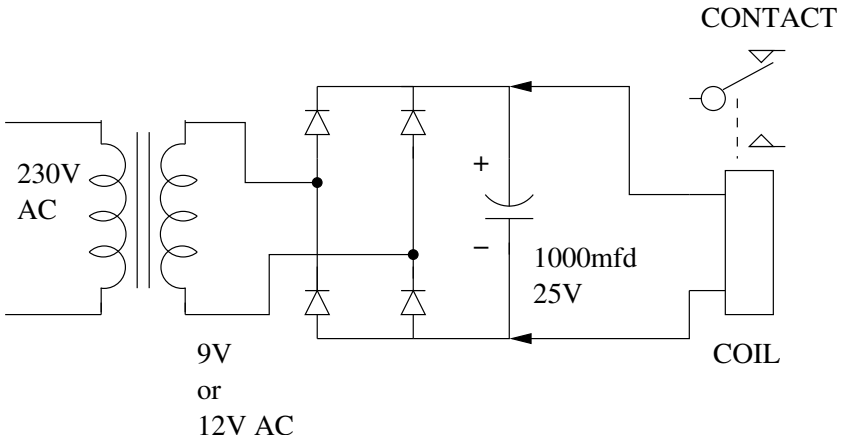


- LED has to be connected in a particular direction to generate light. If you are testing in the manner shown in the circuit, there will be no damage caused to the LED even if it is connected in the wrong direction. The LED is a diode. As shown in the circuit, its cathode must be connected to the negative terminal of the battery.
- When the LED is connected in the checking circuit, place a wrist watch at about 1 foot distance in the dark. If you are able to see the time, the light LED selected by you is appropriate and suitable.

4.2 Transformer

- **Cold test of transformer :** No voltage is applied to the transformer for this test. On the multimeter, set to check the resistance, check the primary and secondary of the transformer and note down the resistance readings. Primary resistance is approx. 600-700 Ohm and secondary resistance is approx. 5 to 8 Ohm. (These are representative figures).
- **Voltage test:** Apply 230 V to the primary. Attach 22 Ohm 5 Watt resistor to the secondary. If the secondary shows 8 to 9 Volts, then the transformer is suitable. This voltage should be 12 V for charging a 12 V battery. See diagram 4.2

Figure 4.3: Relay Testing



- **Relay:**

  1. Check the relay coil on the resistance range of the multimeter. The expected resistance of this coil is approx. 400 Ohm.
  2. Apply charger output voltage to the relay coil. This will cause a noise "Kat" and it will make and break between the pole and throw. See diagram

4.3 Production-related and commercial information

List of spare parts is in the table 4.1 on the following page

4.3.1 Some sources in Pune for the spare parts:

1. M/s Shreetronics, Siddhartha Chambers, A.B. Chowk, Pune (tel. 24450940)
2. M/s Pioneer Electronics, Opp. Vasant Talkies, Near Budhwar Chowk, Pune

Table 4.1: Bill of materials

Sr.No.	**Component**	**Description**	**Qty**	**Cost Rs.**	**Remark**
1	PCB for LEDs	15 cm x 4 cm	1	35	Vidnyan kendra
2	Battery Charger PCB	5cm x 6cm	1	25	Vidnyan kendra
3	Bright white LEDs	5mm dia	28	28	chinese make
4	Resistors	330/0.25W	28	4.2	-
5	red wire	7/36, 1ft	1	0.25	-
6	black wire	7/36, 1ft	1	0.25	-
7	Relay	12V, DC	1	10	Cube type
8	Capacitor	1000μf/35V	1	4	electrolytic
9	Diodes	1N4007	5	2.5	-
10	IC-1	LM324	1	3	quad op-amp
11	Red LED	3mm	1	1	-
12	Transformer	12V-500mA	1	55	Vidnyan Kendra
13	Power Cable	2pin/5Amp	1	15	-
14	Cabinet & switch	standard	1	80	-
15	Battery	6V,4.5AH	1	155	standard
16	Misc			25	
	Total			**443.2**	

You may buy the components from any other source suitable to you. Also let us know electronic component suppliers from your town. We can add their name and addresses in the internet version for free of cost.

Chapter 5

Frequently Asked Questions

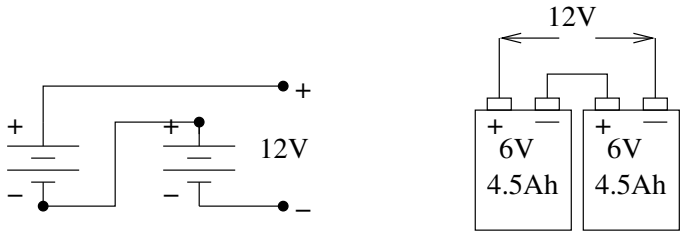
Does DEEP illuminate in the same manner as the other lamps available in the market?

No. The light thrown by DEEP spreads less. So, if you directly look at DEEP, your eyes will in fact feel the glare. Please direct DEEP towards the ceiling if it is white. This way the glare will reduce and you will get reflected light in the entire room. When you use DEEP in this manner, the light is adequate to move about in the room. If you use more than one DEEP in various directions in one room, the luminance is very good. *Now a days, dispersed light LEDs are available in the market. They are bit costlier, however we can use them the same way described in this book.*

How to connect two batteries of 6 V each, so as to get a battery unit of 12 V?

See diagram 5.1 on the next page

Figure 5.1: Joining the batteries



I have no knowledge of electronics. Can I still manufacture DEEP?

If you are capable of using a soldering gun, you need not have any knowledge of electronics. Vidnyan Kendra offers training at reasonable cost for manufacturing DEEP. This includes some knowledge of electronics. For more information, please contact:

VIDNYAN KENDRA
28, Tapodham Colony
Talegaon 410507
Tel: 02114 224328
Email: microteacher@gmail.com

THIS BOOK IS FOR YOU, IF....

- you wish to illuminate your room in a simple, easy and cost-effective manner,
- you wish to manufacture DEEP on your own,
- you wish to start a small business and earn money
- you have some knowledge of electronics, and wish to use it
- you are a student desirous of executing a science project
- you wish to overcome darkness and spread light in the world

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About Vidnyan Kendra

Vidnyan Kendra is an informal group of science and technology enthusiasts. They are interested in developing appropriate technology for the rural folk. Training rural youth in various technical skills like transformer coil winding, PCB designing, soldering is a regular activity run by Vidnyan Kendra. Writing booklets on science popularisation and recycling is another activity.

About the book

DEEP as a product and this book have been created by the following members of Vidnyan Kendra :

- Sudhir Sasane
- Ameya Sambhare
- Prasad Mehendale and
- Pramod Solkar.

Translation

The book was originally written in Marathi. It is translated into English by Chitrarekha Mehendale. If you are interested in translating the book in any other language, please contact us on email **microteacher@gmail.com**

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