Home Theatre **Backlight Unit**

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If you have watched your LCD/plasma television late at night in complete darkness with all lights switched off, you might have experienced an irritating eye strain or headache after some time. The reason behind this is that, the lone light source, the television set, has an ever-shifting level of light as the images roll across the screen, sometimes rather too dark and other times very bright. With this rapid changing of light, your pupils dilate and contract to adjust to the change. The proven way to address this is to shrink the pupils with some incidental lighting, or even better, backlighting.

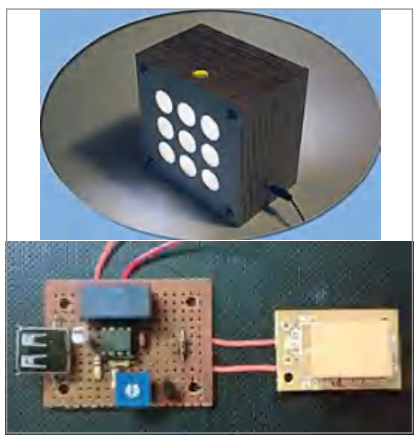

Fig. 1: Author's prototype

Backlighting works best when a flat-panel TV is set up on a TV stand close and parallel to the wall. Backlighting offers an advantage over incidental lighting; it delineates the black bezel around the screen and highlights it. This heightens the already high contrast of the black bezel to the screen and wall, and gives it a 3D effect, which is very pleasing. Fig. 1 shows the author's prototype of the home theatre backlight unit.

Described here is a no-frills home theatre backlight system based on inexpensive white/blue LEDs.

The unit is compact and has a rich light output offered by a total of nine LEDs. As shown in the circuit diagram, the system is an improved version of the classic ambient-light sensor circuitry.

The circuit needs a supply voltage of 12V, but care should be taken to ensure that adequate current is available for the whole system. (In dormant state, the circuit draws a current of about 10mA and in operating state, a current determined by the electromagnetic relay and LEDs.) The backlight unit may be encased using a small homemade wooden box as shown in Fig. 1.

Circuit and working

Circuit diagram of the home theatre backlight unit is shown in Fig. 2. It is built around light-dependent resistor LDR1, op-amp LM358 (IC1), transistor BC547 (T1), nine LEDs (LED1 through LED9), 12V, 1C/O relay (RL1) and a few other components.

The LDR has very low resistance when exposed to high-intensity light and very high resistance when it is in the dark. LDR1 and resistor R1 form a voltage divider connected at the inverting (IN1-) input of IC1. Non-inverting (1N1+) input of IC1 is connected to 10-kilo-ohm potmeter VR1 to adjust the switching-threshold level as desired.

If ambient light level is sufficient, the circuit is in quiescent state. When the light level decreases, resistance of LDR1 increases, which causes voltage across resistor R1 to decrease,

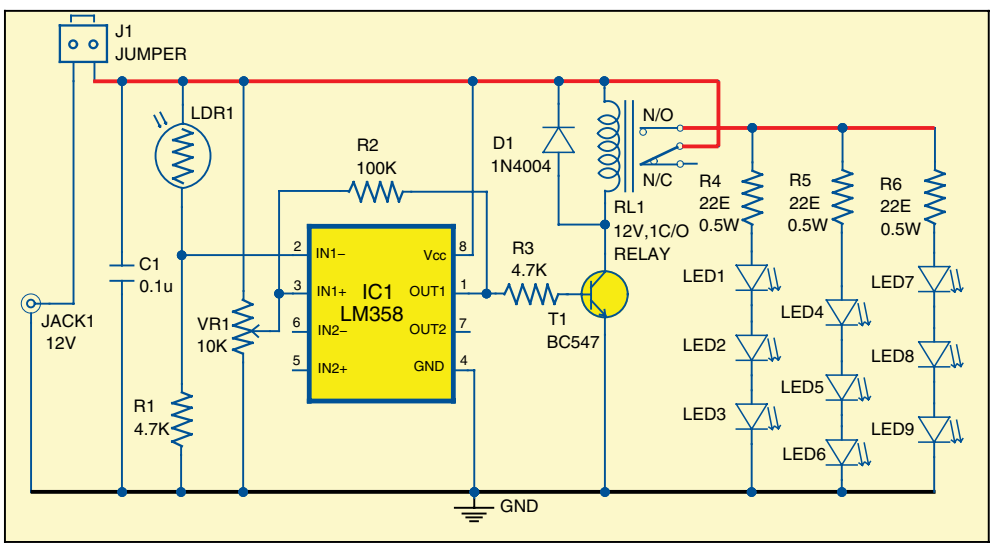

Fig. 2: Circuit diagram of the home theatre backlight unit

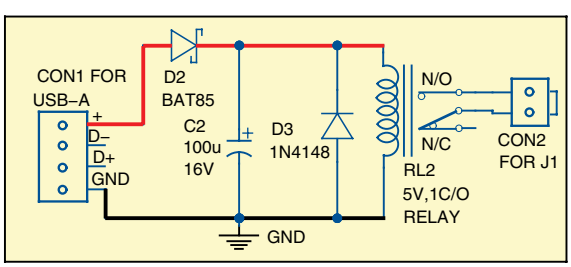

Fig. 3: Circuit diagram of the USB switch

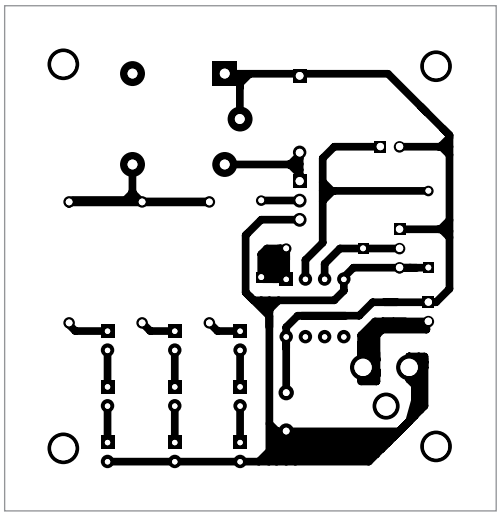

Fig. 4: Actual-size PCB of the home theatre backlight unit

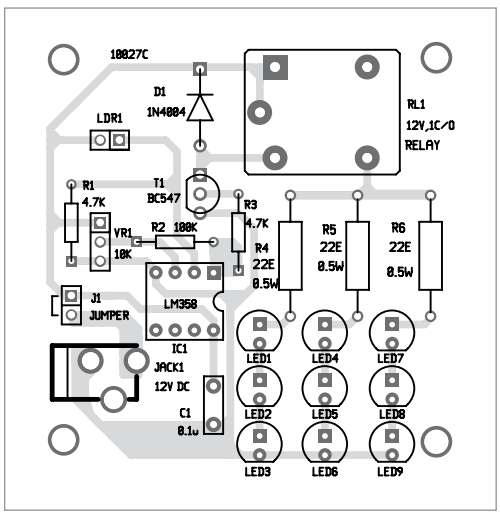

Fig. 5: Component layout of the PCB shown in Fig. 4

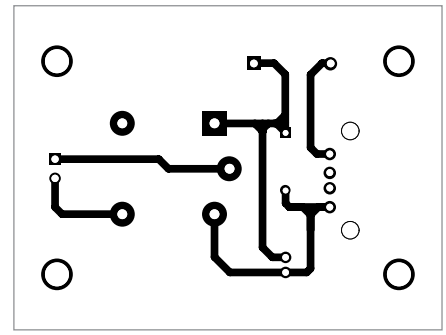

Fig. 6: Actual-size PCB of the add-on USB switch circuit

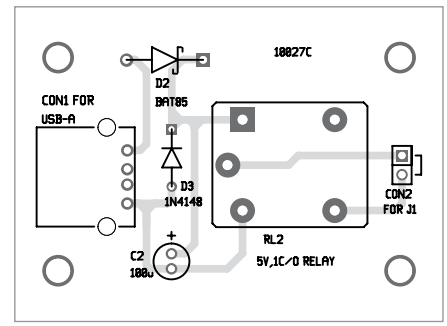

Fig. 7: Component layout of the PCB shown in Fig. 6

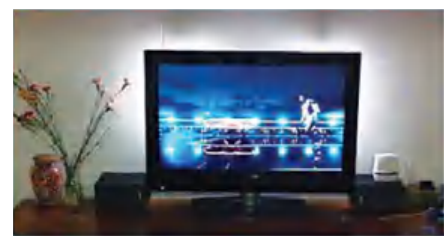

Fig. 8: Real-world application of the home theatre backlight unit

Input of the add-on USB switch circuit (J1) should be connected to a vacant USB port in the television/ set-top box using a standard USB cable so that when the system is in on state, the circuit is activated by the 5V DC supply available from the USB port of the television/ set-top box.

It is very important to prevent the LDR1 to be illuminated by sources other than the natural ambient light.

Construction and testing

An actual-size, single-side PCB for the home theatre backlight unit is shown in Fig. 4 and its component layout in Fig. 5. Similarly, an actual-size, single-side PCB for the add-on USB switch circuit is shown in Fig. 6 and its component layout in Fig. 7. Enclose the PCB(s) in a small wooden box as shown in author's prototype.

LDR1, jumper J1, potmeter VR1 and other components are fitted on the cabinet. Place LDR1 in such a way that only ambient light falls on it. Connect jumper J1 externally through wire in case you are not using a USB circuit.

A picture of the real-world application example is shown in Fig. 8.

EFY notes. 1. White bright 5mm LEDs (LED1 through LED9) were used during testing.

2. The circuit can work with 3.4V/80mA, 10mm white LEDs or with 8mm blue LEDs.

PARTS LIST

Semiconductors:

IC1	- LM358 op-amp
T1	- BC547 npn transistor
D1	- 1N4004 rectifier diode
D2	- BAT85 Schottky diode
D3	- 1N4148 signal diode
LED1-LED9	- 5mm white/blue LEDs

Resistors (all 1/4-watt, ±5% carbon, unless stated otherwise):

R1, R3	- 4.7-kilo-ohm
R2	- 100-kilo-ohm
R4-R6	- 22-ohm, 0.5W
VR1	- 10-kilo-ohm potmeter

Capacitors:

C1	- 0.1µF ceramic disk
C2	- 100F, 16V electrolytic

Miscellaneous:

JACK1	- 12V DC jack
CON1	- USB-A connector
CON2	- 2-pin connector
RL1	- 12V, 1 C/O relay
RL2	- 5V, 1 C/O relay
J1	- 2-pin jumper connector
LDR1	- Light dependent resistor (5mm)

which, in turn, causes output of IC1 (pin 1) to go high. This activates RL1 through relay driver transistor T1 and turns on the 5mm white/blue LED strings, LED1 through LED9, connected via N/O relay contacts. Here, creation of hysteresis is achieved by adding resistor R2 in the positive feedback path.

If you want an extra AND function, that is, you want the backlight unit to work only when the television is switched on and ambient-light level is very poor, remove jumper J1 in the main circuit and attach the add-on circuit (USB switch shown in Fig. 3) at CON2. It will work as a shorting jumper when relay RL2 is energised.

T.K. Hareendran is an electronics hobbyist, freelance technical writer and circuit designer