DIY Kit 79B. LDR LIGHT/DARK ACTIVATED RELAY SWITCH

Note: this is Kit 79B. It is one of three kits which are part of Kit 79. However, there has been a demand for the sale of the individual kits which is what this is. The documentation below makes references to the other kits.

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We wanted to do a light/dark switch as a kit. But we found there were several types of basic circuit. So rather than choose one, 2 or 3 & put each out as a separate kit we have presented here in the one kit three complete, practical, light or dark LDR (light dependent resistor) activated switches with a relay output. Each has its own features and disadvantages which will be discussed. By testing all three you will be able to decide which circuit is the best for your particular application. If your application is in very bright or very dark conditions then you can easily experiment with different resistor values to get better control over the switching range you need.

There is nothing original in these circuits. We have taken them from published material (see end of this paper for References.) But we have redesigned them each onto similar PCB's to allow easy comparison. And in addition a light/dark option has been incorporated into each. We say 'light/dark' because each circuit has a PCB-mounted switch on-board. In one switch position a light-to-dark transition will activate the relay. In the other position a dark-to-light transition is required.

So you can use the light falling on the detector to switch on a normally off circuit, or switch off a normally on circuit.

Each kit has a 12V relay rated to switch 240VAC/5A mounted on-board. Using a relay allows the light/dark switch to form a module separate from the circuit which is to be switched. The Common, Normally Open, and Normally Closed contacts are brought out to terminal blocks. Power is also brought to the kit through terminal blocks.

These kits are constructed on a single-sided printed circuit board (PCB) with a printed overlay and bottom solder mask. Protel Autotrax and Schematic were used to produce them.

ASSEMBLY INSTRUCTIONS

Before you do any construction we suggest that you connect a resistance meter to one of the LDR's - the component with the transparent face and a spiral pattern inside it - and note how the resistance depends inversely on the amount of light falling on it. Note the wide range of resistance. Play with the LDR in very bright and very dark conditions. A feel for what is happening in the LDR will help you understand the three circuits you are about to build. In the dark, the resistance is very high, typically around 1M ohm. In bright light it is low, typically 1K ohm. The peak spectral response of the LDR (VT936G from EG&G) is at 550nm. The continuous power dissipation is 80mW and the maximum voltage which can be applied to it is 100V.

Check off the components in the bag against the Component listing. It is generally easiest to solder the lowest height components first - the resistors and links. Make sure you get the diode around the correct way according to the overlay.

The two terminal blocks on each board slide fit together in a tongue & groove arrangement. On the LED's the cathode or the bar on the overlay corresponds to the short lead of the LED. The LDR has a long lead. We suggest you leave it long to start with. You can always shorten it later. The LDR can go in either way.

There are two links to add to each PCB on either side of the DPDT switch. Use some of the leads cut off from the resistors and LED to make these links. Finally connect 12V DC power to the terminal blocks. The relay should click on or off when the potentiometer is adjusted, the switch is moved or the light falling on the LDR varies. Experimenting with each kit to see how it works.

What to do if they do not work. Poor soldering is the most likely reason that any of the kits do not work. Check all solder joints carefully under a good light. Next check that all components are in their correct position on the PCB especially the diodes. Did you put in the links next to the DPDT.

CIRCUIT DESCRIPTION

The circuit depends on a light sensitive device called a LDR, light dependent resistor. The resistance of the LDR depends on the amount of light falling on it. The snake-like track on the face of the LDR is a cadmium sulphide (CdS) film. On each side is a metal film which is connected to the terminal leads. If you played with an LDR & resistance meter as suggested above then you will know what it does. The CdS LDR used in these kits are relative slow response devices. This one has a time constant of about 100msec. So it is quite fast enough to switch on/off when people pass or run through it. But if you wanted to use a LDR for fast light-activated photography then other LDR materials, or a different circuit would have to be used.

The PCB-mounted switch just interchanges the trimpot & the LDR as far as the detection circuit is concerned. So a dark activated switch becomes a light activated switch or vice versa. A protection diode is fitted across the relay. This is to short circuit the 'back-emf' generated by the collapsing magnetic field when the relay is turned off. Otherwise a high-voltage spike transient would enter the circuit and quickly damage the other components. In all three circuits an LED with current limiting resistor is in parallel to the relay to give a visual indication of when the relay is turned on.

In this circuit the trimpot and the LDR are connected with R1 & R2 to form a Wheatstone Bridge circuit. The op-amp acts as a balance detecting switch. R1-R2 applies a fixed half-supply voltage to one op-amp input, while the LDR & trimpot applies a light-dependent variable voltage to the other input. It is much less sensitve than Kit 79A to changes in voltage level and temperature. Hysteresis is added to the op-amp by R5. This is necessary if the change in light levels is slow since a fluctuating light level just on the threshold of turning the relay will result in the relay chattering 'on/off'. R3 & R4 set the bias level of Q1 as explained in the next paragraph.

Note that the output of the 741 op-amp cannot be taken directly to the base of Q1. This is because the 741 is really designed to be powered from a dual supply voltage. When powered by a single sided supply it does not drop to zero when turned off; it goes to around 2V which is not low enough to switch a *npn* transistor. So the trick is to take the output to a voltage divider as shown and use a *pnp* transistor. When the output of the LM741 is high the input to Q1 is less than 0.6V so Q1 is off. When the output is low the input to Q1 is greater than 0.6V so Q1 turns on.

References:

Similar circuits to those presented here are common in most modern electronic test books. One particularly good reference we used is:

Optoelectronics Circuits Manual by R. M. Marston, published by Heimann Newnes, 1988, Chapter 5.

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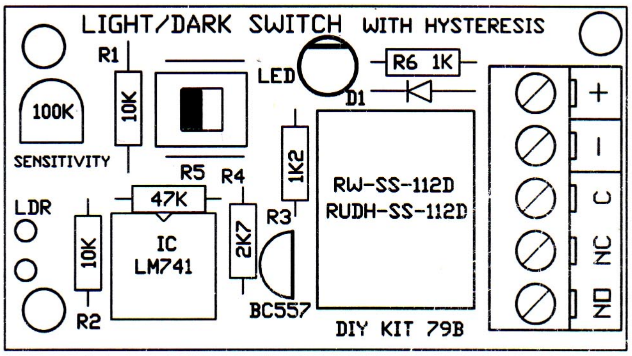
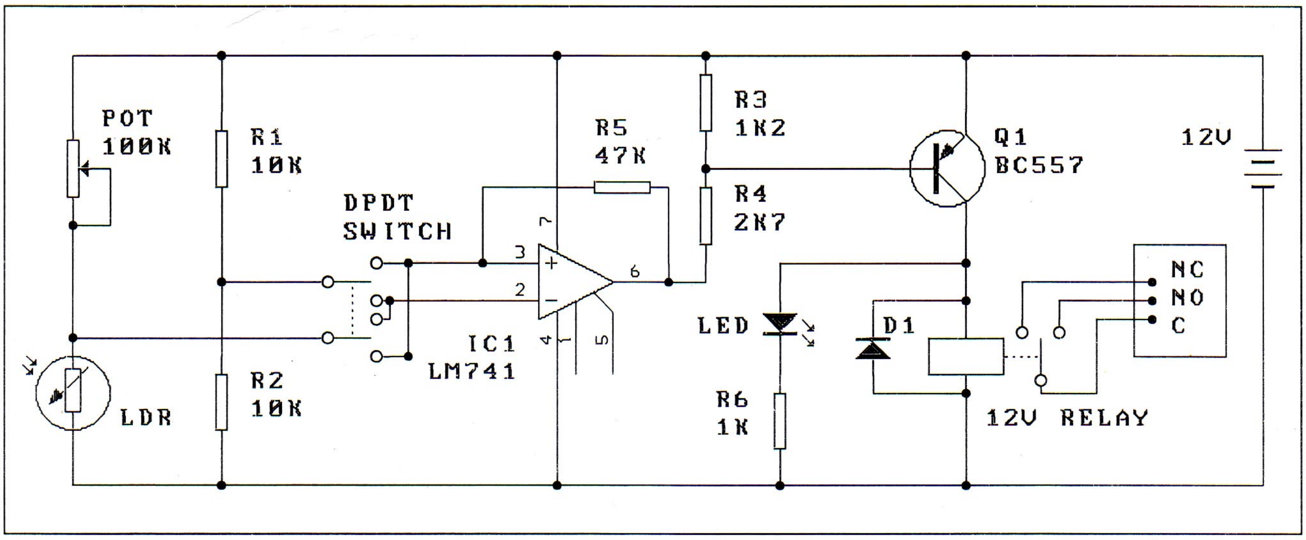
K79B Components

1K	R6	brown black red	1
1K2	R3	brown red red	1
2K7	R4	red violet red	1
10K	R1 R1	brown black orange	2
47K	R5	yellow violet orange	1
100K Koa trimpot (104)			1
1N4004 diode			1
BC557 Q1			1
5mm red LED			1
LM741 opamp IC			1
8-pin IC socket			1
3 pole terminal block			1
2 pole terminal block			1
DPDT PCB-mounted switch			1
3mm LDR			1
Relay			1
Kit 79B PCB			1





Kit 78B Schematic