# QUASAR PROJECT KIT # 3079A - LDR LIGHT/DARK ACTIVATED RELAY SWITCH

## General Guidelines for Electronic Kits and Assembled Modules

Thank you for choosing one of our products. Please take some time to carefully read the important information below concerning use of this product. The assembly and operating instructions are on the following pages.

**WEEE Directive (Waste Electrical and Electronic Equipment)**
**Notice To All European Union Citizens. Important environmental information about this product.**
The crossed out wheeled bin symbol on this product, package or documentation indicates that disposal of this product after its lifecycle could harm the environment. Do not dispose of this product (or batteries if used) as unsorted municipal waste. It should be disposed by a specialized company for recycling.
The unit should be returned to your distributor or to a local recycling service. Please respect the local environmental rules. If in doubt contact your local authorities about waste disposal rules.

**Safety: General rules concerning safe use of our Kits or Modules.**
**To ensure your safety, please observe these safety measures. In no way are these complete. As safety requirements vary, please check with your local authorities, in order to comply with local requirements. If in doubt, seek the help of a qualified person.**

**Battery or wall-adaptor operated devices are safe devices. They do not require special attention unless mains voltage is connected to an output e.g. a relay.**

To ensure electrical safety, and also protection from fire or personal injury, make sure your mains operated equipment complies with these safety hints:

- Use a suitable plastic enclosure. If a metal enclosure is used, make sure it is properly earthed.
- Use a power switch if the device consumes more than 10W. Use a double pole switch for mains operated, transformer-less kits.
- Mount a fuse in series with the mains switch. Use a slow blow (T) 50mA fuse for transformers up to 10W and a 100mA fuse for transformers up to 20W.
- Use a mains input connector, or a robust power cord with a clamp.
- Internal wiring carrying mains voltages must have a minimum cross-sectional area of 0.5mm$^2$.

If supplied, attach the power rating label near the power cord of the device and fill-out the mains voltage, frequency, power consumption and fuse values.

**Troubleshooting and Support**
90% of non working kits are due to poor soldering.
We operate a Get-You-Going service for non-working kits but there is a charge based on the time and components needed to complete the repair. Quite often it is not economically viable for us to repair and it is cheaper to supply a new ready made product at full cost.

**Disclaimer**
Quasar Electronics reserves the right to change product specifications or to discontinue products without notice. Quasar Electronics cannot be held responsible for any loss or damage, direct or indirect, which might occur from the use of a product. Quasar Electronics Kits or Modules are intended for educational and demonstration purposes only. They are not intended for use in commercial applications. If they are used in such applications the purchaser assumes all responsibility for ensuring compliance with all local laws. In addition, they are not suitable for use as or as a part of life support systems, or systems that might create a hazardous situation of any kind.

# QUASAR PROJECT KIT # 3079A - LDR LIGHT/DARK ACTIVATED RELAY SWITCH

We wanted to do a light/dark switch as a kit but we found there were several types of basic circuit. This is one type of circuit. Two other types may be found in Kits 3079B and 3079C. You may read the documentation on our website at **www.quasarelectronics.co.uk/pdf.htm**

By reading about all three Light/Dark Kits 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.

**RELAY OUTPUT RATING**

**The relay output is rated to switch resistive and light inductive loads of up to 48Vac or 28Vdc @ 2 Amps maximum current.**

*Some users have questioned the output rating we specify as they noticed higher voltage and current figures printed on the relay. The output rating we quote takes into account the overall board design.*

The NO, C and NC contacts are brought out to a terminal block. For more information on using the relay see: **www.quasarelectronics.co.uk/ds/relay_faq.pdf**

**ASSEMBLY INSTRUCTIONS**
Before you do any construction we suggest that you connect a resistance meter to 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 circuit 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. (If you get it the wrong way around you will blow up the transistors.)

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 the 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 12Vdc to the power input terminal block. The relay should click on or off when the potentiometer is adjusted, the switch is moved or the light falling on the LDR varies.

**What to do if they do not work.** Poor soldering is the most likely reason that the kit does 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 switch.

**CIRCUIT DESCRIPTION**
The circuit depends on a light sensitive device called a LDR, light dependent resistor, as already described above. 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. You may view the data sheet of the LDR at

**www.quasarelectronics.co.uk/ds.htm**

The LDR and a trimpot form a voltage divider which is used to apply bias to a transistor. The more dark it is, the higher the LDR resistance. As the LDR changes resistance the change in potential is detected by the circuit and the relay is activated.

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.

This kit is the most basic, practical circuit to build using an LDR to turn on a relay. The two transistors connected as a Darlington pair give the circuit enough sensitivity,

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while the trimpot give sensitivity adjustment. The switching point of the relay is dependent on the supply voltage and temperature.

This circuit is satisfactory if the changes in light level to be detected are large and the transition is quick - for example, a person walking past a doorway. But an inherent problem of the circuit is chattering of the relay for slowly changing light levels just at the transistion point between turning on/odd and vice versa.

Look what happens when the relay turns on: the input voltage drops slightly (say around 20 mV) when the relay turns on and loads the circuit. If the voltage applied to the base-emitter junction of Q1 is only just sufficient to turn it on then this slight drop will immediately start to turn Q1 off. But then with the relay load reducing the supply voltage will start to rise & Q1 will start to turn on etc. This leads to the relay chattering as it rapidly turns on/off. (This problem is overcome in 3079B by the built-in hysteresis of the op-amp, and the Schmidt Trigger arrangment of the circuit in 3079C.)

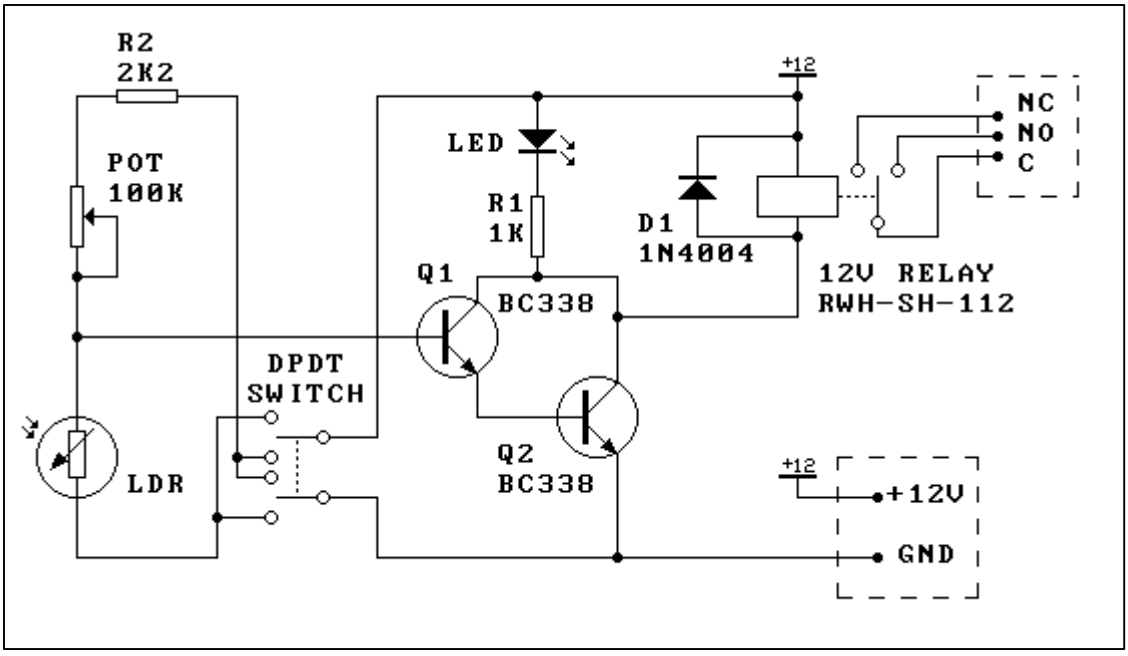
11/2002. protection resistor R2 added to circuit to protect transistors if the trimpot is fully turned to zero.

A good reference is **Optoelectronics Circuits Manual,** by R. M. Marston, published by Heimann Newnes, 1988, Chapter 5.

For Technical Support on this kit please email:
**support@quasarelectronics.co.uk**

**For our full range of kits please see our website at:**
**www.quasarelectronics.co.uk**

| Components | |
|---|---|
| 1K resistor brown black red R1 | 1 |
| 2K2 resistor red red red R2 | 1 |
| 1N4004 diode | 1 |
| 100K trimpot (104) | 1 |
| BC338 transistor | 2 |
| 5mm red LED | 1 |
| 3mm LDR | 1 |
| 12V Relay | 1 |
| DPDT PCB-mounted switch | 1 |
| 3 pole terminal block | 1 |
| 2 pole terminal block | 1 |
| 3079A PCB | 1 |



# GENERAL RELAY INFORMATION

**Warning! Risk of Electric Shock!**

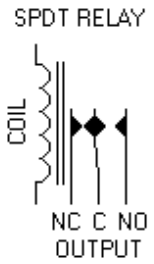
This information concerns kits and modules with relay outputs. TO USE THE RELAY OUTPUTS SAFELY YOU MUST OBSERVE THE MAXIMUM VOLTAGE AND CURRENT LIMITS QUOTED IN THE **PRODUCT DOCUMENTATION** (this is because the board design may not be rated to switch the maximum voltage and current limits printed on the relay itself or specified in the relay manufacturer's data sheet).
Controlling mains equipment with relay outputs must be treated with extreme caution. Electric shocks can cause severe and permanent injury or even death. Construction, installation, testing and commissioning should only be attempted by suitably qualified persons, or under the supervision of a suitably qualified person. These products are not suitable for children. Before connecting mains powered equipment to the relay outputs please check with the relevant authorities in order to ensure compliance with all current safety regulations.
Many areas of the assembly may operate at mains voltage. A suitable isolating enclosure must be used. Exposed screw terminal blocks on some products must be insulated to prevent contact with exposed metallic parts at mains potential. Connected equipment should be suitably fused.

You will find relay outputs on many of the kits and modules that we sell. A relay is an electrically operated on/off switch. The voltage and current limits specified in the product documentation generally relate to resistive or light inductive loads.

## Relay Terminals

Most boards have SPDT (Single Pole Double Throw) style relays. These have three outputs:

**C** = Common
**NO** = Normally-Open contacts connect the circuit when the relay is activated; the circuit is disconnected when the relay is inactive. It is also called a Form A contact or "make" contact.
**NC** = Normally-Closed contacts disconnect the circuit when the relay is activated; the circuit is connected when the relay is inactive. It is also called a Form B contact or "break" contact.

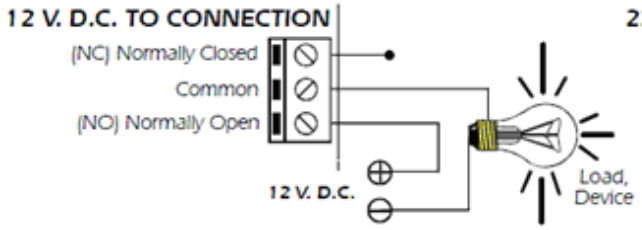


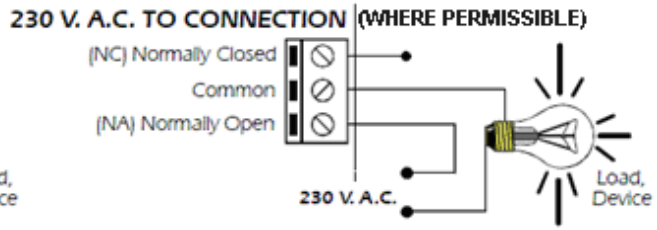

## Connecting the Device you want to Control

You must provide an external power source to the device you want to control. No voltage is present at the relay terminals (remember it is just a switch). The relay is normally connected in *series* with the positive (+) power wire of the device you want to control.

In this case, the positive wire from the power source should be connected to Common. Then either the NO or NC terminal (as appropriate for your purpose) is connected to the positive (+) wire going to the device you want to control. The negative (-) wire does not connect to the relay at all. It goes directly from the power source negative output to the device negative (-) terminal.

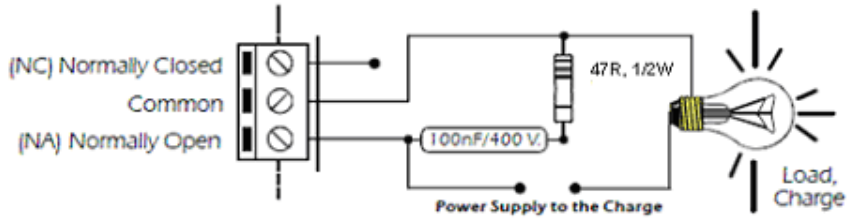
## Typical SPDT Relay Connection Diagrams




## Anti-Spark SPDT Relay Connection Diagram

Sometimes the connected equipment can cause arcing across the relay contacts. This must be corrected by installing a resistor and capacitor (not supplied) between the two contacts of the relay as shown below. Component values are for 230Vac mains.




We accept no responsibility for injury, loss, or damage of any kind caused by or resulting from improper product assembly, testing, commissioning or use.