# Assembly Instructions for FK401 *(Light Activated Switch)*

## What it does:

This circuit responds to the level of ambient light which it senses. If the light level goes above a threshold, then the module will switch on a relay as well as a small indicator LED.

## What we are making:

The finished circuit will have a Photo Transistor which changes it's characteristics depending upon how much light it can detect. This Photo Transistor is connected to an Amplifier which in turn can turn on a relay. The relay can be used to switch much larger Electrical loads, such as motors, lights, etc. The input to the amplifier can be easily adjusted so that the system will switch at different light levels.


*Fig 1: Finished Product*

## Technical Specs:

- Power supply: 12VDC
- Consumption: 46mA max.
- Maximum Relay Load: 10A , 12V DC
- PCB dimensions: 32.8 x 60.0 mm

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### How it works:

The Photo Transistor has a semi-conductor junction which is sensitive to visible light. The more light it detects, the lower the “resistance” the Photo Transistor presents to the outside world.

The circuit is designed so that VR1 , R1 and the Photo Transistor form the input to an amplifier. The amplifier uses TR1 as it’s main active element. The amplifier does not do much until it’s input reaches a threshold, at which time it then turns on TR2. TR2 is designed to control the Relay.

The input to the amplifier can be adjusted for different “sensitivity” of light levels, but adjusting VR1.

### Circuit Diagram:

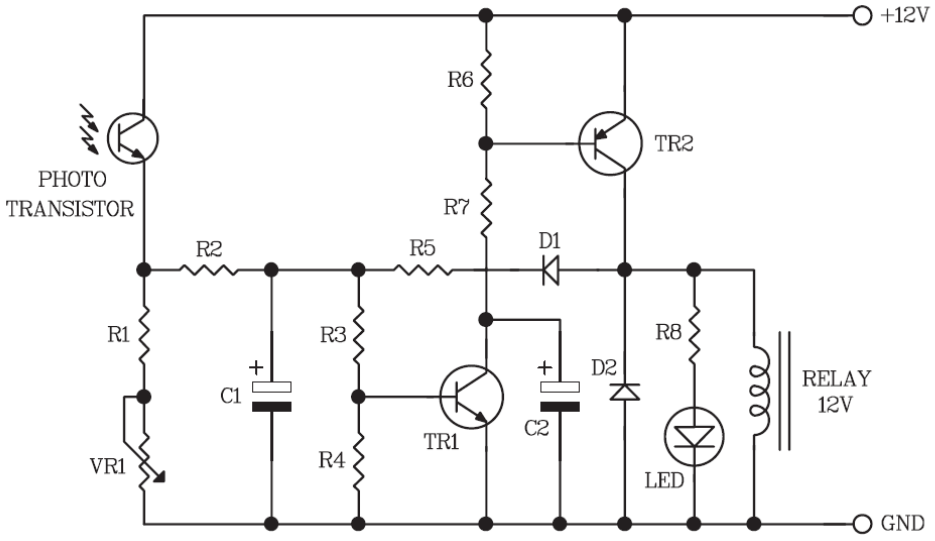


*Fig 2: Circuit Diagram*

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### How to build it:

Step 1. Installing the Diodes.

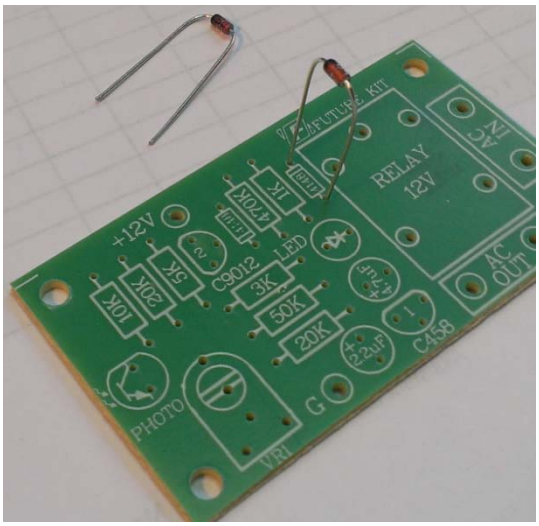


*Fig 3.1 Installing the Diodes*

By referring to *Fig 3.1* identify the position and orientation (Polarity) of each Diode.

Note that each diode has a clearly marked band around it's body at one end. The PCB will also have one end of the diodes marked with an extra stripe. Make sure you align the diodes banded end with the marked end on the PCB.

Insert the diodes in their correct positions as indicated on the printed circuit board (PCB). Do this by carefully bending their wires down to form a 'U' shape and poke through the holes in the PCB as shown in *Fig3.1*. Once they are in the correct positions solder them into place and trim the excess wire.

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## Step 2. Installing the resistors.

| | | |
|---|---|---|
| **RESISTORS** | | |
| R1 | 10kΩ | - brown-black-orange-gold |
| R2, R4 | 20kΩ | - red-black-orange-gold |
| R3 | 50kΩ | - green-black-orange-gold |
| R5 | 470kΩ | - orange-violet-yellow-gold |
| R6 | 5kΩ | - green-black-red-gold |
| R7 | 3kΩ | - orange-black-red-gold |
| R8 | 1kΩ | - brown-black-red-gold |
| **TRIMMER POTENTIOMETER** | | |
| VR | = | 104 or 15 or 100kΩ |
| **ELECTROLYTIC CAPACITOR** | | |
| C1 | = | 2.2µF |
| C2 | = | 4.7µF |
| **TRANSISTOR** | | |
| TR1 | = | C458,C828,C945,C1815 |
| TR2 | = | C9012 |
| DIODE | D1, D2 = | 1N4148 |

*Fig 3.2 Component Values*

By referring to *Fig 3.2* determine the value of each resistor and place them in their correct positions as indicated on the printed circuit board (PCB). Do this by carefully bending their wires down to form a 'U' shape and poke through the holes in the PCB as shown in *Fig3.3*.
Try to install the resistors so that their "Colour Codes" are aligned in the same direction. *(This is not mandatory, but highly recommended).*
Once they are in the correct positions solder them into place and trim the excess wire.

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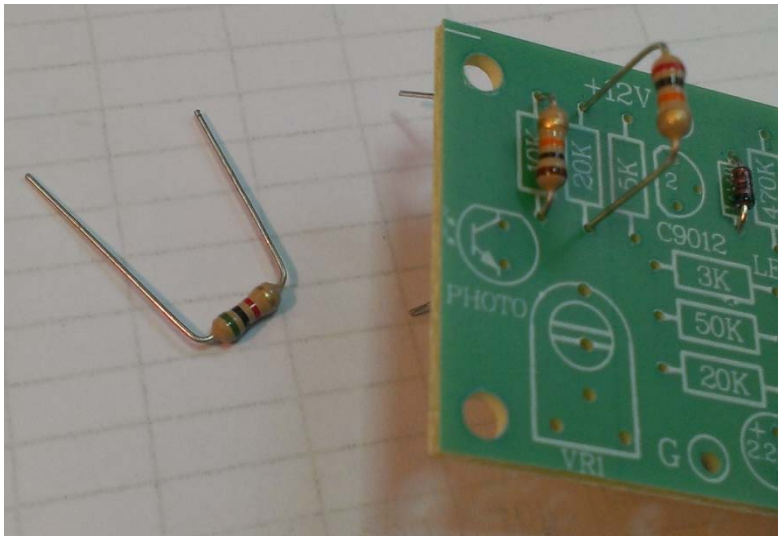


*Fig 3.3 Installing Resistors (Oops... notice that the 20K resistor is about to be inserted back-to-front!)*

Step 3. Installing the transistors.

Take care at this stage. The two transistors look alike from their outsides, but they are VERY different inside. If you install them in the wrong positions, you may easily destroy their insides!

Take time to find their part numbers on their case. Refer to figure 3.4 to 3.6 for suggestions on how to do this.

Carefully bend the middle leg of the transistor slightly backward and the two outer legs out and carefully manipulate them as you place them through the holes and onto the PCB as shown in *Fig3.6*. Pull the legs through until the transistor is sitting about 10mm off the PCB. Once in the correct position solder it into place and trim the excess wire.

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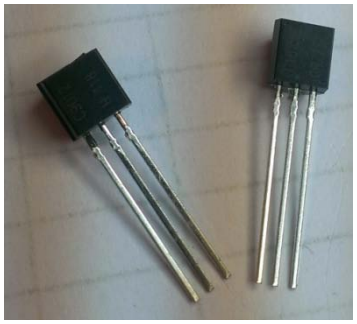

*Fig 3.4 Take care as the two transistors look alike but are actually very different inside!*

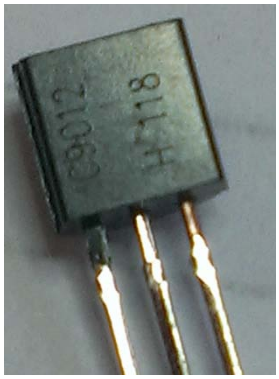


*Fig 3.5 Identifying the Transistor Part Number.*
*(This one is Part Number "C9012" and is used as TR2).*

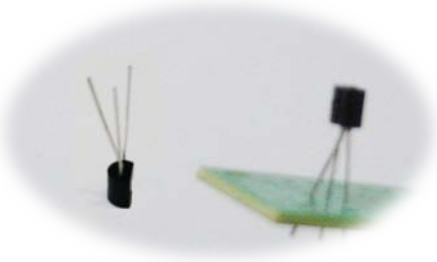

*Fig 3.6 Bending the legs and Installing the Transistor*

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Step 4. Installing the Photo Transistor and the LED.

Carefully identify and then orient the Photo Transistor as shown in Fig 3.7.

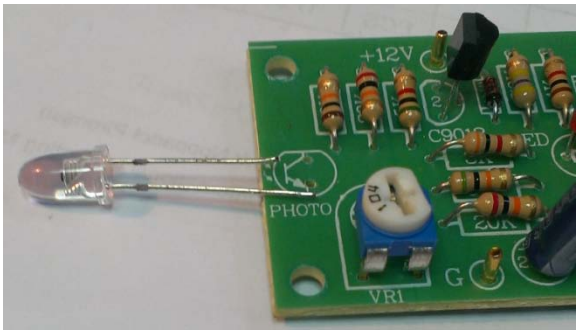


*Fig 3.7 Orienting the Photo Transistor correctly.*
*(The longer leg goes to the bottom of the white overlay on the PCB).*

Once it is installed correctly, leave the legs longer than the other components , and solder it in place. *(Refer Fig 1 for suggested installation).*

Repeat for the Red LED. Take care with the polarity of any LED. They must be installed facing the correct way. Ensure the longer leg of each LED is placed at the back of the triangle in the diode symbol which is shown on the PCB (see *Fig 3.8*). Once in the position solder it into place and trim the excess wire.

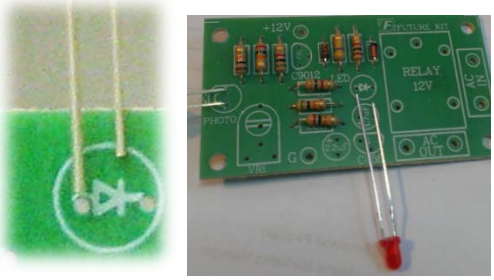


*Fig 3.8 Installing the Red LED*

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Step 5. Installing the Capacitors

Refer to *Fig 3.2* determine the value of each capacitor and place them in their correct positions as indicated on the printed circuit board (PCB).

Caution : These capacitors MUST be installed with the correct orientation.

The longer leg on a new capacitor is the positive ("+"). The PCB white overlay will also indicate which is the correct polarity for installing them.

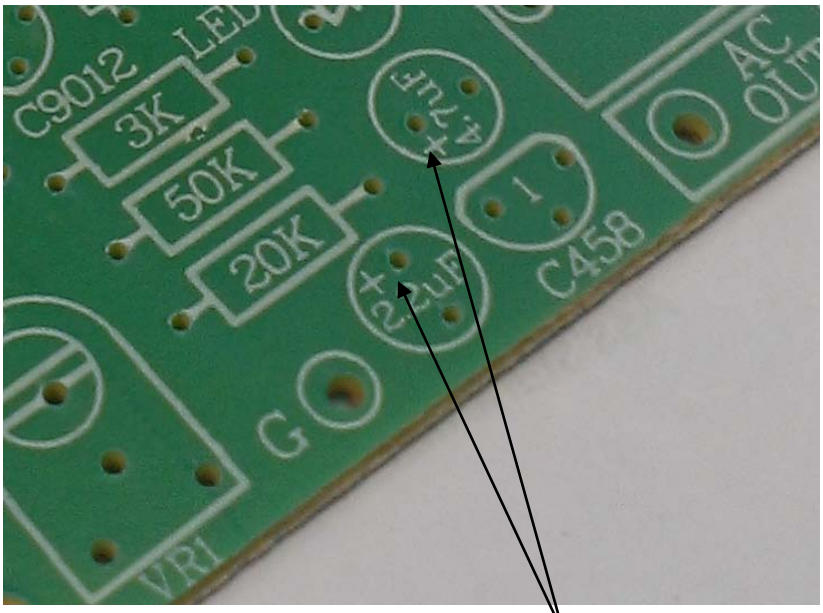


*Fig 3.9 showing the capacitor polarity markings (+ indicate the positive leg)*

## Step 6. Installing the connection Posts

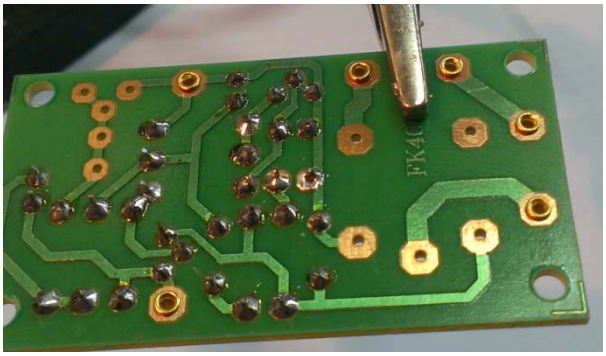

*Fig 3.10 The connection Posts have been inserted from behind and are about to be soldered into place.*

## Step 7. Installing the Trimmer Potentiometer (VR1)

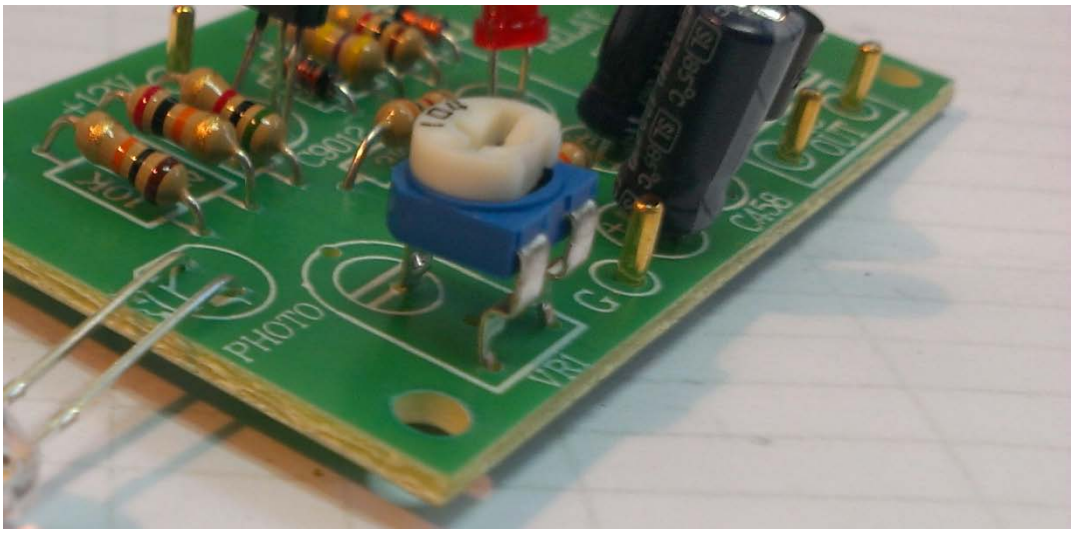


*Fig 3.11 Installing the Trimmer Potentiometer.*

Note that there are a wide variety of different Trimmer Potentiometer ("Trimpot") styles. Your kit may not have the exact same style as shown in this photo.

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The PCB has a variety of holes in it which will permit the most common style to be used.

Step 8. Installing the Relay:

Insert the relay and solder into place.

It will only fit in one orientation.

## Testing:

1) Double check your work . Ensure all components are installed and oriented correctly.
2) Check for solder bridges (solder blobs across multiple tracks and leads).
3) Check for any "cold-solder" joints. (All joints should look bright and shiny... not smoky of crazed. If any joints are not "shiny", re-melt them with your soldering iron and allow them to cool without any movement.)
4) Connect the power supply.
5) The LED and Relay may all come on when first connected.
6) Cover the Photo Transistor and make is as dark as possible. Does the Relay turn OFF ? (If "yes"... well done!)
7) You can adjust the sensitivity of the system to light levels by adjusting the VR1 trimpot.

## Trouble shooting:

Most problems with this kit arise from the following causes:

- Component inserted incorrectly. (Check LED's, Transistors and Capacitors for correct orientation)
- Solder bridge is creating a "Short Circuit" path.

- Poor solder joint is not making connection (This is a "Cold Solder" joint). Please read our tips in "Towards Better Soldering" on how to recognize a good solder joint versus a poor joint.

## Connecting wires and power supply:

'Tin' each Connection post with solder. *(For more information on "tinning", please refer to our separate document "Towards Better Soldering").* The power supply connection can be soldered into place by 'tinning' the leads and ensuring the black wire is attached to the 'ground' (G) or negative (-) pole and the red wire to the positive (+). Finally the four remaining connection posts can be tinned and connected to the load as required. (See *Fig 4* for attaching the wires).

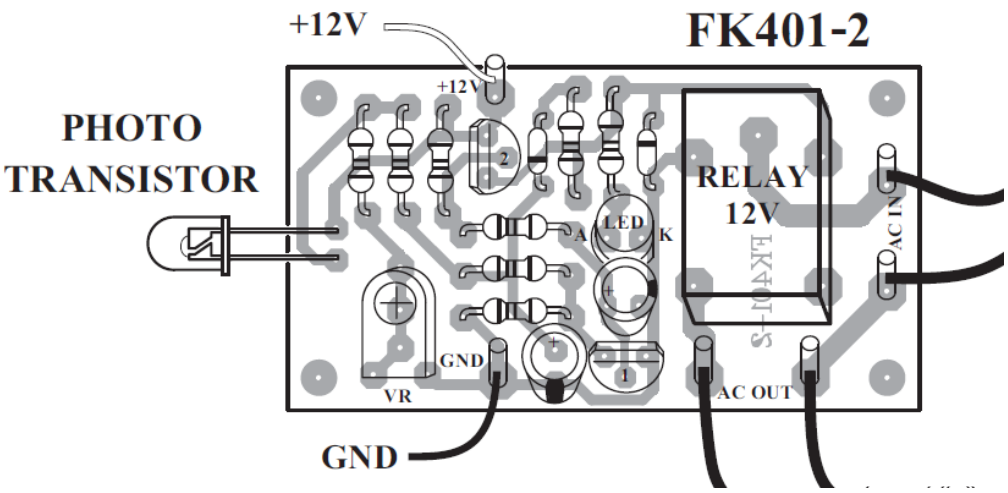


*Fig 4 Attaching the wires*

**CAUTION: DO NOT CONNECT TO 240 V AC!**