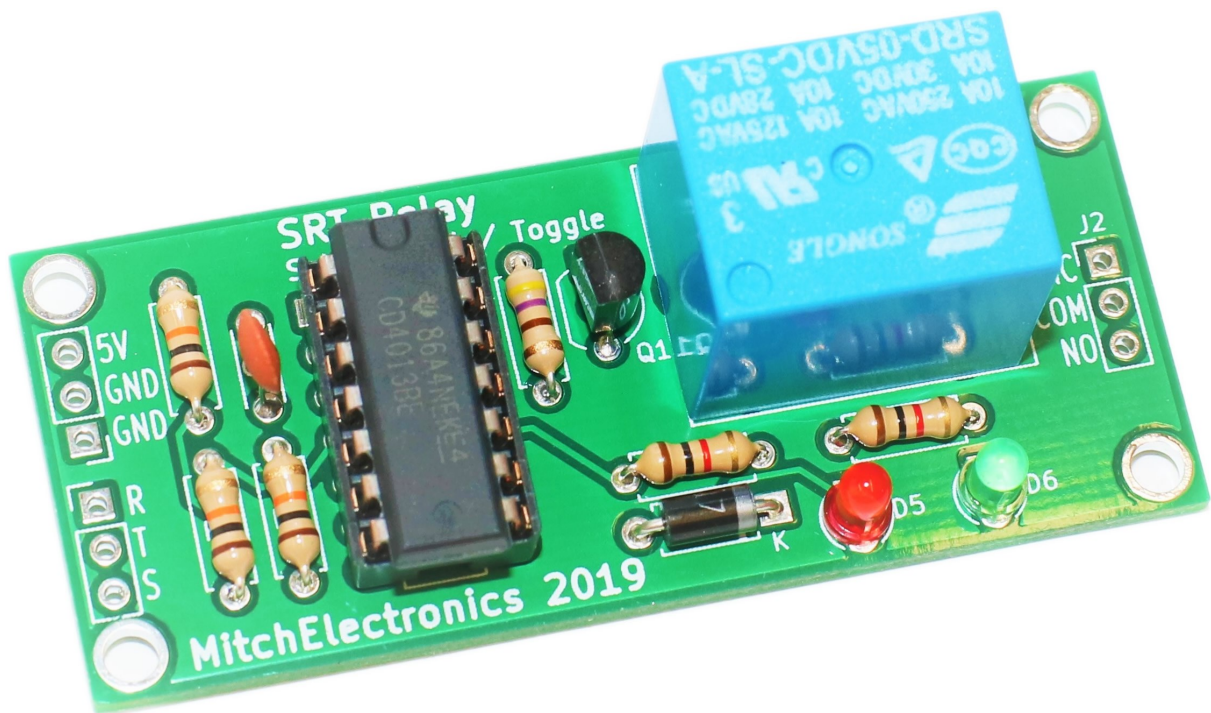


# Latched Relay

MitchElectronics® 2019

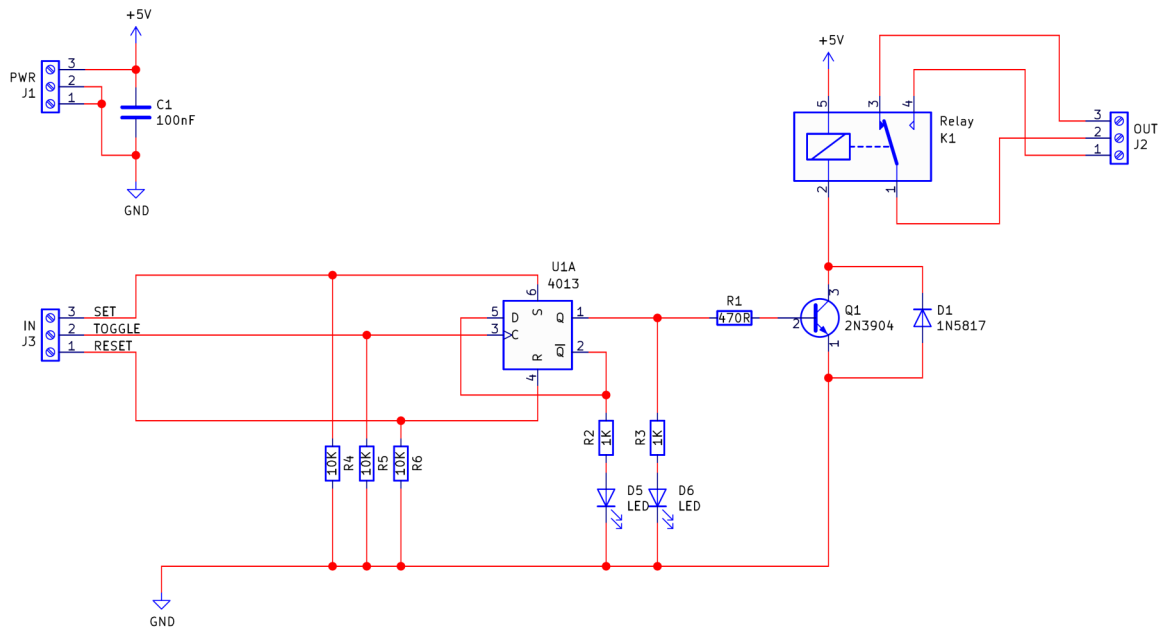


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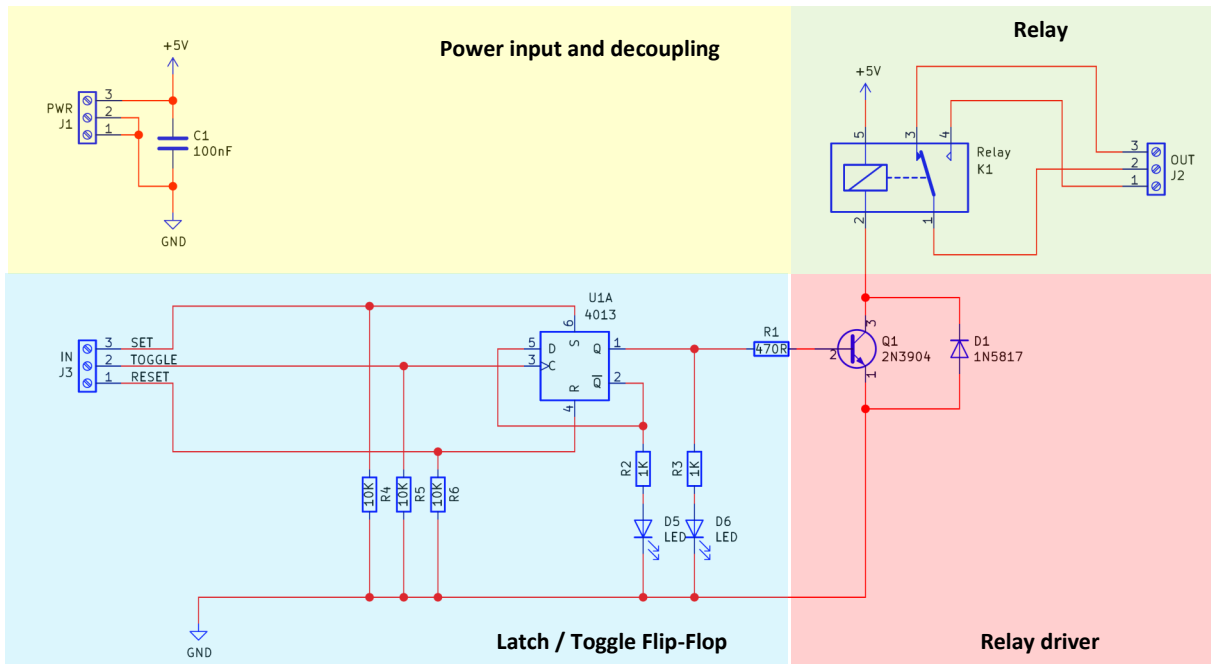
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# SCHEMATIC



## Schematic (Blocktised)



# SCHEMATIC EXPLANATION

The Latched Relay Kit is a simple module that allows 5V digital signals to control a relay without the need for additional drivers or logic circuits. The module has three inputs that can be used to make the relay do one of three things:

- SET—This will set the relay to its on position
- RESET—This will reset the relay to its off position
- TOGGLE— Switches the relay to its opposite state

The circuit is made up of three main sub-circuits; a 4013 flip-flop, a relay driver, and a relay. The 4013 is an IC that contains two flip-flops but only one is used in this circuit and it is configured as a toggle latch. The 4013 has several inputs and two outputs;

- CLK—This is an **input** and is used to set the output to the state of the D pin
- D—This is an **input** and is used to set the output to a specific state when CLK is pulsed
- S—This is an **input** and is used to set the output of the latch to on
- R—this is an **input** and is used to set the output of the latch to off
- Q—This is the **output** of the latch
- /Q—This is the second **output** of the latch and is the opposite to the Q output

Simplified logic table for the 4013

S	R	D	CLK	Q	/Q
1	0	X	X	1	0
0	1	X	X	0	1
0	0	1	0 to 1 (rise)	1	0
0	0	0	0 to 1 (rise)	0	1

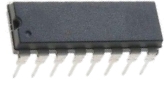
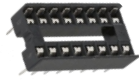



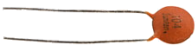





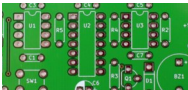
You can see in the logic table above that the 4013 does not have a toggle function whereby the output flips to the opposite state. To achieve this, the inverting output (/Q) is connected to the D pin and the TOGGLE signal is connected to the CLK input. Since the output of the 4013 will become the value of D on the rising edge of a CLK signal then the inverting output will always become the opposite value of D on a rising CLK signal. Therefore, if the /Q is connected to D then the output will always flip on every rising edge of a CLK signal!

The 4013 cannot drive a relay as it cannot provide the current to drive the electromagnetic coil therefore a simple single transistor driver circuit is used. When the output of the 4013 is on then the transistor turns on and completes the circuit between power, the relay coil, and ground which causes the relay to switch on. When the output of the 4013 is off, current cannot flow through the relay coil and therefore the magnetic field collapses and causes the relay to reset back into its off state. A diode is placed across the transistor driver because magnetic fields that collapse in coils can generate large back EMFs which are able to damage sensitive silicon devices such as ICs and transistors. The diode will conduct this large back EMF and safely keep it away from the transistor.

**Note—While not guaranteed, the relay module should work with 3.3V logic signals but still requires a 5V power source! This is because 3.3V output logic is compatible with 5V input logic**

# MATERIALS

Check that you have the following components

Component	Component Name	Quantity	Looks like
4013	U1	1	
14 DIP Socket	U1	1	
470Ω Resistor	R1	1	
1KΩ Resistor	R2, R3	2	
10KΩ Resistor	R4, R5, R6	3	
100nF Capacitor	C1	1	
1N5817	D1	1	
LED Green	D6	1	
LED Red	D5	1	
2N3904	Q1	1	
Relay	K1	1	
PCB	-	1	

# CONSTRUCTION

## Download the electronics construction manual

To learn how to construct circuits on PCBs download the Electronics Construction Manual from MitchElectronics using the link below. This document shows you how to install all electronic components used in MitchElectronics kits. The list below shows the sections relevant to this kit so do not worry if you see component sections in the document that don't come with this kit!

[www.mitchelectronics.co.uk/electronicsConstructionManual.pdf](http://www.mitchelectronics.co.uk/electronicsConstructionManual.pdf)

## Relevant sections in the electronics construction manual

Resistors

Capacitors

Diodes

ICs

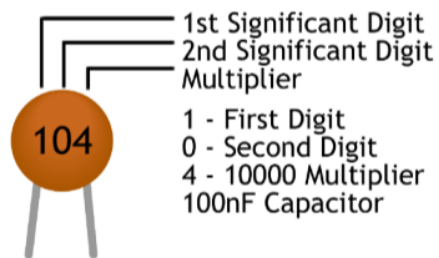
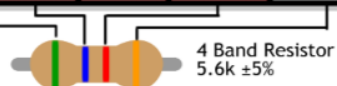
Transistors

Relays

Wires

## RESISTOR AND CAPACITOR IDENTIFICATION

Colour	1 <sup>ST</sup> Band	2 <sup>ND</sup> Band	3 <sup>RD</sup> Band	Multiplier	Tolerance
BLACK	0	0	0	1Ω	
BROWN	1	1	1	10Ω	±1%
RED	2	2	2	100Ω	±2%
ORANGE	3	3	3	1kΩ	
YELLOW	4	4	4	10kΩ	
GREEN	5	5	5	100kΩ	±0.50%
BLUE	6	6	6	1MΩ	±0.25%
VIOLET	7	7	7	10MΩ	±0.10%
GREY	8	8	8		±0.05%
WHITE	7	7	7		
GOLD					±5%
SILVER					±10%



# IMPORTANT INFORMATION

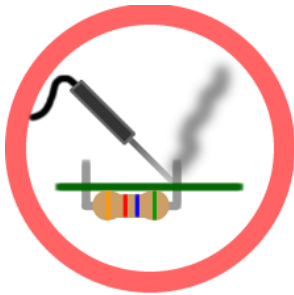
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*RoHS Compliant Kit (Lead free)*



*Low Voltage Kit*



*Caution! Soldering Required*

# TERMS AND CONDITIONS

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## **MitchElectronics Mission**

The main goal of MitchElectronics products is to provide safe electronics to makers and professionals alike while keeping the cost affordable. MitchElectronics kits are ideal for classrooms whereby students can learn about electronics using a hands-on approach which is not only highly effective at teaching students but also improves hand-eye co-ordination as well as grow interest in electronics. Since MitchElectronics kits are aimed at novices and those who are new to electronics they are designed to use low voltage power supplies such as 9V batteries which are inherently safe due to their limited voltage and current capabilities.

## **MitchElectronics Liability**

MitchElectronics kits must be inspected and tested by a competent individual before use and must be constructed by those who are competent to do so. MitchElectronics is not liable for kits and products that are constructed incorrectly or to a poor standard whereby poor standard includes (but not limited to) poor solder connections, overheated components, and damaged components. MitchElectronics is not liable for harm, injury, or damage caused by the misuse of kits and/or products if

- Incorrectly constructed
- Powered by sources other than “portable batteries” or the specified power supply
- Kits used outside their operational range (such as voltage supply, temperature etc.)
- Used as a sub-system (i.e. connected to additional circuits and modules)
- Used in a non-educational environment
- Used in a commercial environment
- Used in any dangerous or potentially hazardous environment
- Purchased from an unauthorised third party

*Portable batteries refers to low powered alkali batteries. Lithium-based batteries and those with large current capabilities (such as lead-acid batteries) are not considered portable or safe*

The use of the kits or products in the above scenarios automatically voids any warrantee or guarantee of that kit or product.

## **Kits must be**

- Inspected for damage before and after construction
- Inspected for missing parts
- Constructed correctly by a qualified individual
- Used in an appropriate manner (i.e. within operational ranges)
- Purchased from an authorised seller

Those who are not competent to construct, inspect, and test kits and products must be accompanied by a competent individual and that competent individual assumes all responsibility for harm or damages and MitchElectronics is not liable for any harm or damage.

## **Missing Parts**

MitchElectronics is only liable for missing parts for kits that have been purchased within 28 days and that have been purchased directly from [www.mitchelectronics.co.uk](http://www.mitchelectronics.co.uk). MitchElectronics is not liable for any product sold by an unauthorised third party.