

DIY Kit 5. STAIRWAY TO HEAVEN

Construct your own game of skill. Press the switch when the bicolor LED is Green and the chain of LED's will gradually light up. But press it when the bi-LED is Red and all your hard work is undone - the chain of illuminated LED's goes out.

A Kit to introduce many basic concepts in electronics. The kit is constructed on a single-sided printed circuit board (PCB). Protel Autotrax and Schematic were used to design the board.

ASSEMBLY INSTRUCTIONS

It is usually best to add the lowest height components first. So we suggest you solder all the resistors first, followed by the transistors, LED's and remaining components. Follow the overlay when you put in the LED's. Find the BC557 and do not put it in a BC547 position by mistake.

NOTE: we have found that 2 legged bi-LEDs even from the same supplier can vary from batch to batch as to which side (the red or the green) has the flat. To overcome this problem solder the bi-LED last and mount it high above the board. Do not trim the legs. Then test it out. Pressing the button when the bi-LED is green should start to light up the stair. If this does not work then press the switch when the bi-LED is red. If the stair starts to light up then you know to turn the bi-LED around. Then you can remove it, and solder it flush with the circuit board.

CIRCUIT DESCRIPTION

The 3 inverters of the hex Inverting Schmidt trigger IC 74C14 (or the equivalent 40106) form an oscillator which cycles at a rate determined by the 22uF and the value of the potentiometer. The chip has Schmidt trigger inputs which makes the circuit noise free and give sharp transitions from one state to the other. The flash rate is set by the position of the potentiometer. You may download the Data Sheet for the 74C14/40106 from the National Semiconductor website at www.national.com

When pin 6 of the 74C14 is HIGH, the bicolored LED is green. Pressing the keyswitch will allow C2 to charge up via the 22K. T8, the BC557, is turned OFF. The charging of C2 is at an exponential rate. So that many more pushes at the correct time are needed to get the last 10% of charge than are needed to get the first 10%.

When pin 6 changes to LOW we have the following situations:

- if the switch is pressed the charge in C2 will rapidly discharge via the 470R resistor.
- if the switch is not pressed then any charge in C2 is placed across 7 BC547's, and a diode. At each there is an approximate 0.6V drop. So the number of LED's which can turn ON is determined by the charge in C2; the greater the charge the more LED's will be able to be turned ON. Eg, if the charge in C2 is 1.5V then T1

will be partially ON; there is a 0.6V drop across the diode and T7 leaving 0.3V to partially turn ON T1.

- T8 the BC557 is turned ON. This allows some of the LED's to turn ON depending on the charge in C2 as just discussed in the previous paragraph.
- the bicolored LED is red

WHAT TO DO IF IT DOES NOT WORK

Poor soldering is the most likely reason that the circuit 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. Thirdly, follow the track with a voltmeter to check the potential differences at various parts of the circuit. Check that the transistors, capacitors & LED's in the correct way. If none of the red LED's lights up when you push on green then try pushing on red. If that works then the bi-colored LED is in the wrong way.

COMPONENTS

Resistors, 1/4W, 5%:	
150R brown green brown	1
270R red violet brown	1
330R orange orange brown	1
390R orange white brown	1
470R yellow violet brown	4
560R green blue brown	1
1K brown black red	2
2K2 red red red	2
4K7 yellow brown red	2
10K brown black orange	1
22K red red orange	1
100K KOA trimpot 104	1
1N4148 diode	2
10uF ecap	1
22uF ecap	1
470uF ecap	1
74C14/40106	1
14 pin IC socket	1
BC547 transistor	7
BC557 transistor	1
Bi-color LED	1
Hat keyswitch	1
5mm red LED	6
Single pole, double throw PCB-mounted switch	1
Kit 5 PCB	1
9V battery snap	1
Box and 4 screws	1

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