

# KIT 29. COMBINATION LOCK

This Kit gives a cheap, easily understandable and adaptable combination lock. The relay will only respond to the right sequence of four numbers keyed in on the remote keypad. Touching any other key will reset the lock. The key combination can be easily changed on the main mother board.

The kit is constructed on a single-sided printed circuit board (PCB). Protel Autotrax and Schematic were used.

## ASSEMBLY INSTRUCTIONS

Components may be added to the PCB in any order. It is usually easiest to add the lowest height components first; the resistors. Make sure you get the diode, electrolytic capacitor and LED around the correct way. The short lead of the LED is the cathode. The bar on the overlay shows the hole for the LED cathode. There are 3 links to add to the main PCB. These are short links - use some of the wire cut off the resistor legs for them. They are shown by the 3 lines next to three 4M7 resistors. The overlay shows how to solder the two box headers to each PCB.

**Connecting the Wire Cable.** We have supplied the cable connected to 10 pin sockets at both ends. Check that pin 1 on both sockets (marked by a triangle on the body of the socket) are electrically connected together. Pin 1 is the cable strand marked in red. It is connected to the pin marked with a triangle on the plastic body of the socket. Check that when you connect the two PCB's together that pad 1 on the main PCB connects to pad 1 on the keypad PCB. (Use a multi-meter to do this.)

## OPERATING INSTRUCTIONS

Choose four numbers you want to be the secret combination. The numbers must be different. Let us choose 1357. That is, we want to touch 1 then 3 then 5 then 7 on the Remote Keypad for the relay to trigger. Touching any other number we want to reset the unit.

On the main PCB connect Pad A to one of the pads on line 1 using some of the hookup wire provided. Connect Pad B to a pad on line 3, pad C to a pad on 5, pad D to a pad on line 7. Now connect the five remaining numbers to the five pads on the RESET pad.

Connect a 9 to 12V power supply. The Combination Lock is now ready. A mains-rated 12V relay is provided with the Kit. It can switch a main powered device such as a light. The 4013 IC's will work from 3V to 18V so the unit is quite flexible and can be adapted to many situations.

## CIRCUIT DESCRIPTION

The circuit is built around two 4013 dual D flip-flop (FF.) Each 4013 contains two D flip-flops. The four FF are connected to A, B, C and D pads. ABCD gives the 4 digits which must be keyed in in sequence for the relay to trigger. The five remaining digits may be connected to the RESET PAD. If one of these digits is keyed in during the ABCD sequence then the circuit will reset.

The circuit diagram and the block diagram of the 4013 show how the lock works. The ABCD touch pads are connected to the Clock input pins 3 and 11 of each 4013. ABCD pads are normally tied low by the 4M7 resistors. Touching the pads of each keypad briefly pulls the input high and the state of the FF is altered. The output Q pins (1 and 13) are wired so that when the correct sequence is keyed in then pin 13 of IC2 turns on the transistor.

The reset keys are all wired to the Set pins (6 and 8) of each IC.

## 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 - the IC's, and the electrolytic capacitors. Thirdly, follow the track with a voltmeter to check the voltage at various parts of the circuit. Did you add the 3 links?

Did you check the cable? Use a continuity tester or resistance meter to check the cable connections. Insert the cable into both PCB's and use the meter to check that pad 1 connects to pad 1 on the other PCB. Check for all 9 pads and the high voltage pad.

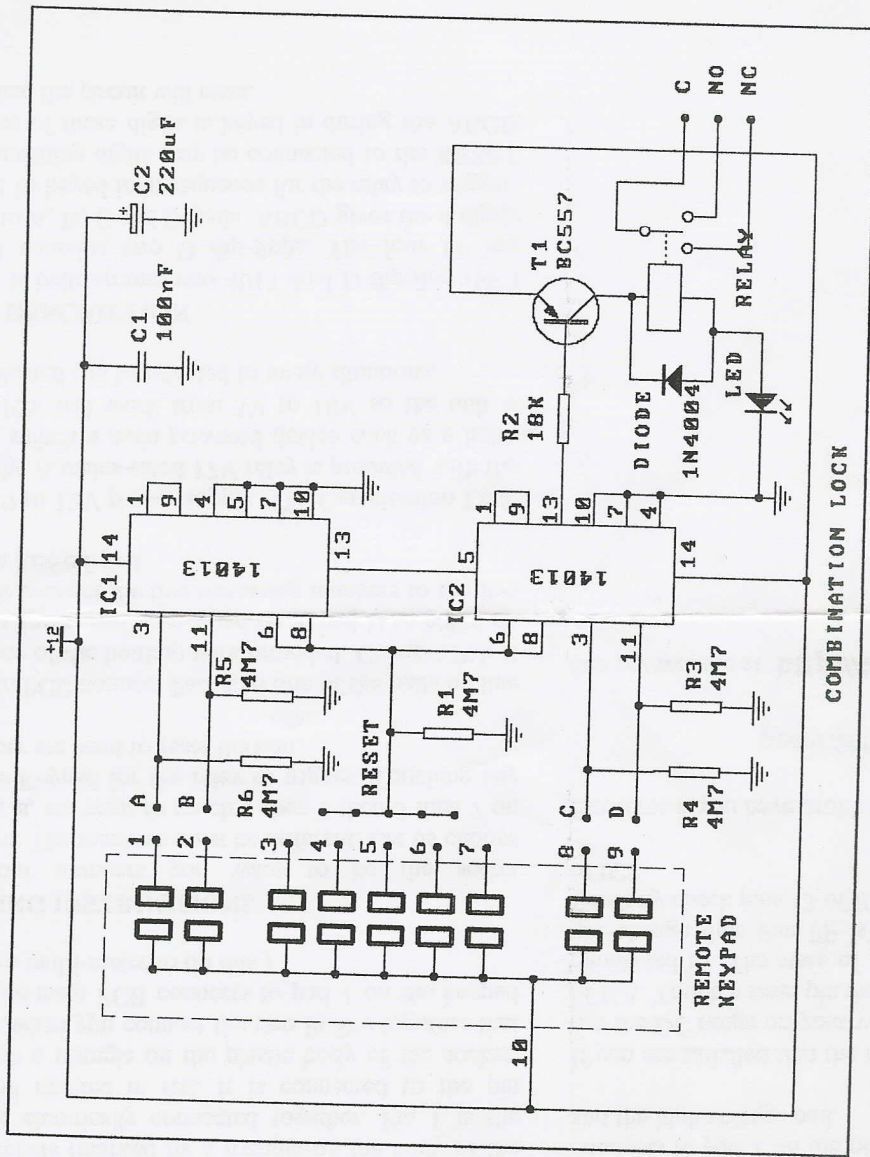
If you are satisfied that the lock is assembled correctly then use the DC range on your voltmeter and connect it to pin 1 of IC1. Touch a reset pin then the pad number that Pad A is connected to. The state of pin 1 should change. If it does not change then that FF is not working for some reason. Similarly check pins 13 of IC1. Then move to pins 1 and 13 of IC2.

Email me if you have problems or comments:

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See my website at <http://kitsrus.com>

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COMPONENTS	
Resistors 5%:	5✓
4M7 yellow, violet, green	1✓
18K brown, grey, orange	1✓
Capacitors:	1✓
100 nF monoblock 104	1✓
220uF electrolytic	2✓
Dual D flip-flop 4013 IC	2✓
14 pin IC socket	1✓
BC557	1✓
9V Battery snap	1✓
5 mm LED	1✓
Diode 1N4004	1✓
12V Relay	1✓
K29 main PCB	1✓
K29 keypad PCB	1✓
10 pin box header	2✓
10 strand flat cable & sockets	2 feet
Hookup wire	12"✓
3 pole terminal block	1✓