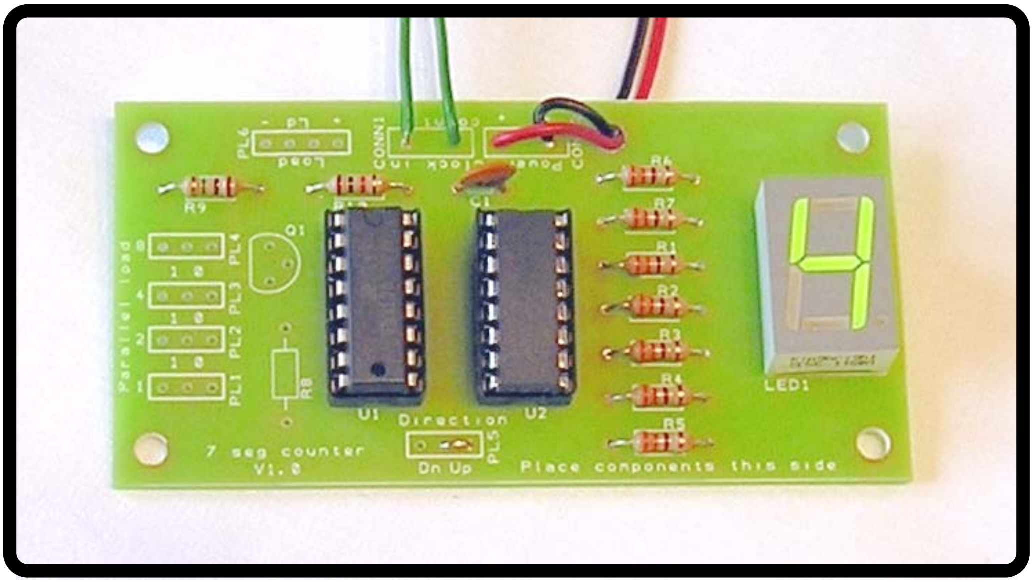
7 segment LED counter / display kit



Build Instructions

Issue 1.2

Build Instructions – explanation

The seven segment counter has been designed to be flexible in the way that it is built. Unfortunately this configuration makes the standard case of just wanting the board to count rather complicated.

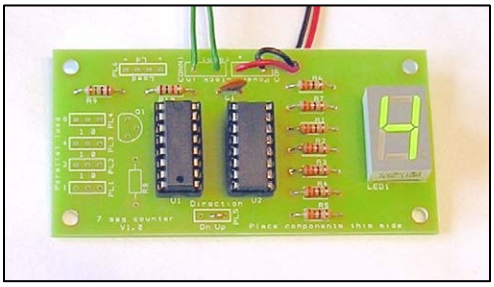
The build instructions are therefore written in two parts. You should always start with the first page of build instructions, which are titled ‘build instructions’.

If you are building the standard configuration, which will either count up or down when the button is pressed follow the first page of instructions with ‘built instructions – standard configuration’.

If you would like to use a switch to set the count direction, load a predetermined value on demand or use a separate circuit to do the counting then you should follow the first page of instructions with the two pages titled ‘build instructions – options’.

It is possible to make a 7 segment dice, using this kit with a tone generator kit. Full details of this can be found in an application note on the resources section of the Kitronik website.

Build Instructions

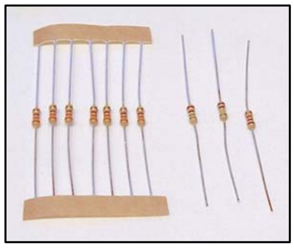


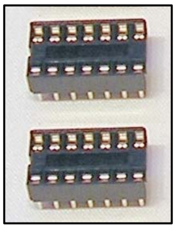
Before you put any components in the board or pick up the soldering iron, just take a look at the Printed Circuit Board (PCB). The components go in the side with the writing on and the solder goes on the side with the tracks and silver pads.

You will find it easiest to start with the small components and work up to the taller larger ones. If you've not soldered before get your soldering checked after you have done the first few joints.

As this kit can be configured in a number of different ways, you might not need to use all the parts.

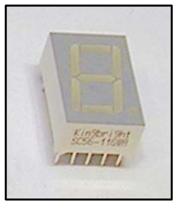
Step 1
Solder the seven LED current limit resistors (shown right) in to R1 to R7, they are 330Ω (orange, orange, brown coloured bands).
The text on the PCB shows where R1, R2, etc go. Make sure that you put the resistors in the right place.
You don't need to worry about the three 10K resistors at the moment.



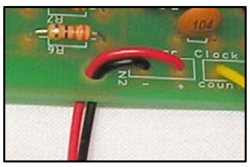


Step 2
Solder the two Integrated Circuit (IC) holders (shown left) in to U1 and U2. When putting them into the board, be sure to get them the right way around. The notch on the IC holders should line up with the notch on the lines marked on the PCB.

Step 3
Insert the seven segment display where it is labeled LED1. It is important that the dot on the display matches the position of the dot on the outline. This will be at the bottom right as you look at the PCB

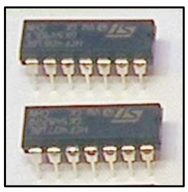


Step 4
Now you must attach the battery clip (shown left). Start by feeding the leads through the strain relief hole near R6. The wire should be fed in from the rear of the board (see below left).

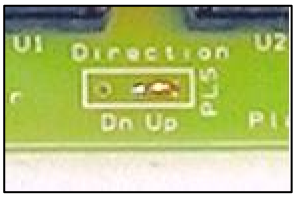


The leads should be connected to the 'power' terminals. The red lead should be soldered to the '+' terminal and the black lead should be soldered to the '-' terminal.

Step 5
The ICs can now be put into the holders ensuring the notch on the chip lines up with the notch on the holder. IC 4510B should go into U1 and IC 4511B should go into U2.

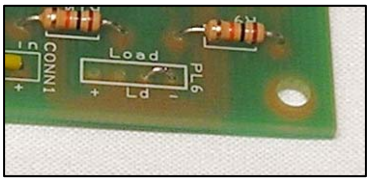


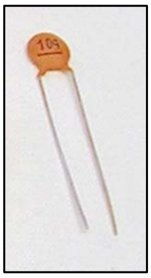
Build instructions – standard configuration



Step 6
Setting the direction in which the counter will count (either up or down) is done by soldering a wire link in to the PCB. Find the terminals labeled 'Direction' (shown left). You need to link the terminals above the text of the desired direction. In the picture, the terminals above the text 'up' have been linked therefore it will count up.

Step 7
The parallel load option is not needed, so must be disabled. This is done by soldering a wire link between the right most two connections on the load terminal ('Ld' and '-') see right.





Step 8
Solder a 10K resistor (brown, black, orange coloured bands) in to the board where it is labeled R10.

Step 9
Solder the 10nF capacitor (shown left) in to the board where it is labeled C1. It does not matter which way around the device is fitted.

Step 10
Cut and strip two pieces of wire to the required length for connecting to the switch (shown right). Solder one end of each wire to each of the terminals on the switch and the other end to the terminals labeled 'CONN1 - Clock In'. It does not matter which wire goes to which terminal.

Adding an on / off switch

To add a power switch, don't solder both ends of the battery clip directly into the board, instead:

- Solder one end of the battery clip to the PCB, either black to '-' or red to '+'.
- Solder the other end of the battery clip to the on / off switch.
- Using a piece of wire, solder the remaining terminal on the on / off switch to the remaining power connection on the PCB.

Checking Your PCB

Check the following before you insert the batteries:

Check the bottom of the board to ensure that:
- All the leads are soldered.
- Pins next to each other are not soldered together.

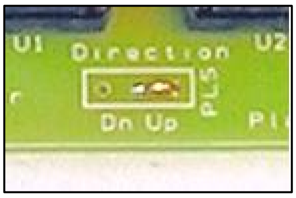
Check the top of the board to ensure that:
- The shape of the IC's and IC holders match the outline on the PCB.
- The dot on the 7 segment display is on the bottom right and NOT the top left.
- The coloured bands on R1 – R7 are orange, orange, brown.
- The battery clip red wire connects to '+' and the black wires to '-'.

Build instructions – options

Count direction

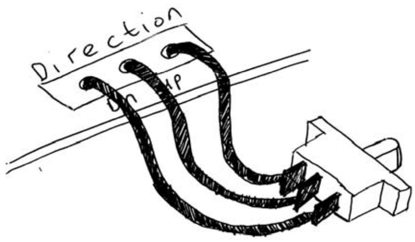
Up or down

Setting the direction in which the counter will count (either up or down) is done by adding a wire link on the PCB. Find the terminals labeled 'Direction' (shown below). You need to link the terminals above the text of the desired direction. In the picture below, the terminals above the text 'up' have been linked therefore it will count up.

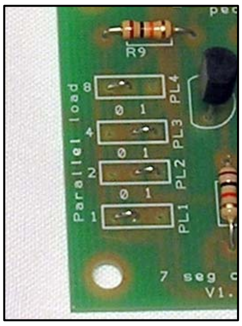


Selectable by the user

To allow the direction to be changed whilst the counter is in use you will need a SPDT switch, which should be connected as shown below:



Loading a preset value on demand (Parallel Load)



Example of loading 6

With parallel load

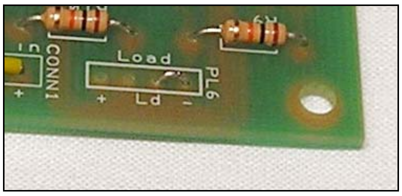
A predetermined value can be loaded on demand. To do this the number that is going to be loaded needs to be set using the 'Parallel load' terminals and a means of triggering the load will need to be added. The number that will be loaded is selected by placing four wire links into the 'parallel load' terminals. The table below shows how PL1 to PL4 need to be linked (either as a 1 or 0) for different parallel load numbers.

Parallel Load Selector

PL4 (8)	PL3 (4)	PL2 (2)	PL1 (1)	= Number
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9

Without parallel load

If you do not wish to use the parallel load function you should insert a wire link across the negative (-) labeled 'Load' terminals. This is shown in the picture shown below:

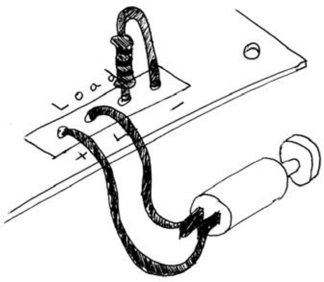


Now go to count input on the next page

Triggering a parallel load to take place

Using a load switch

With a load switch, when the switch is pressed the number set by the parallel load terminals will be loaded. To connect a load switch you should use one of the 10K resistors (brown, black, orange) and solder this in to the right two terminals on the load connection. A push to make switch can then be connected to the other two connections, as shown below:



Loading upon count value

The board has been set-up so that when counting down, as zero is reached a parallel load can happen; in this case zero is not displayed but changed for the value as given by the parallel load setting.

To do this R8 & R9 need to have a 10K resistor (brown, black orange) soldered in place.

Q1 should be fitted with the transistor.

The load terminal should not have any connections.

Count input

Count upon button press

To count when a button is pressed you will need to connect a push button to the clock in connection and also add a resistor and capacitor.
Solder a 10K resistor (brown, black orange) in to R10.
Solder the 10nF capacitor into C1.

Fitting the switch
Cut and strip two pieces of wire to the required length for connecting to the switch (shown right). Solder one end of each wire to each of the terminals on the switch and the other end to the terminals labeled 'CONN1 - Clock In'.
It does not matter which wire goes to which terminal.

Count upon logic input

When a logic input is used to connect a count from a separate circuit the switch de-bounce components (R10 & C1) are not required.

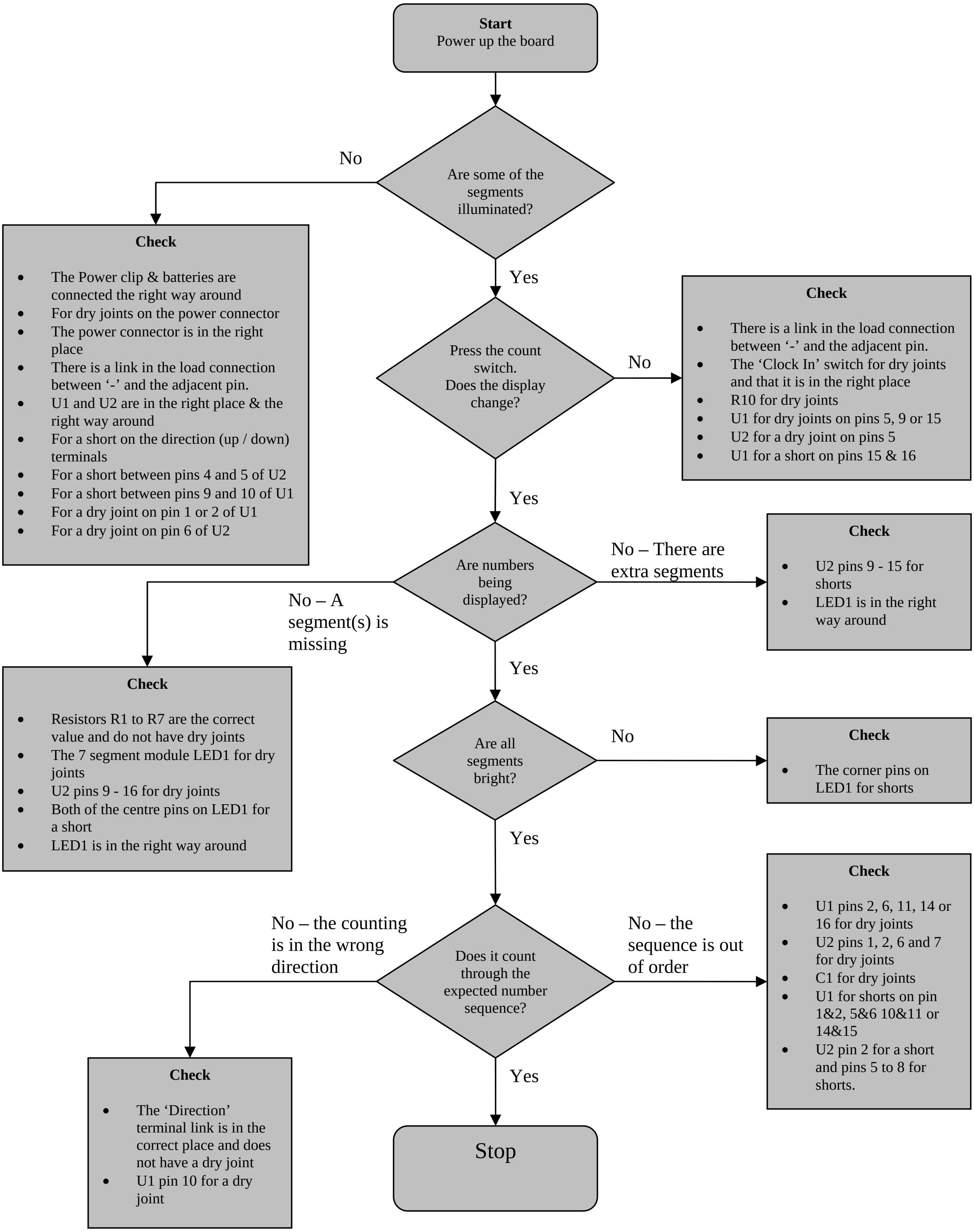
The clock out of your circuit should be connected to the 'clock in' terminal, only the 'count' connection needs to be used. But be sure that the 0v of both circuits are connected together.

Adding an on / off switch

To add a power switch, don't solder both ends of the battery cage directly into the board, instead:

- Solder one end of the battery clip to the PCB, either black to '-' or red to '+'.
- Solder the other end of the battery clip to the on / off switch.
- Using a piece of wire, solder the remaining terminal on the on / off switch to the remaining power connection on the PCB.

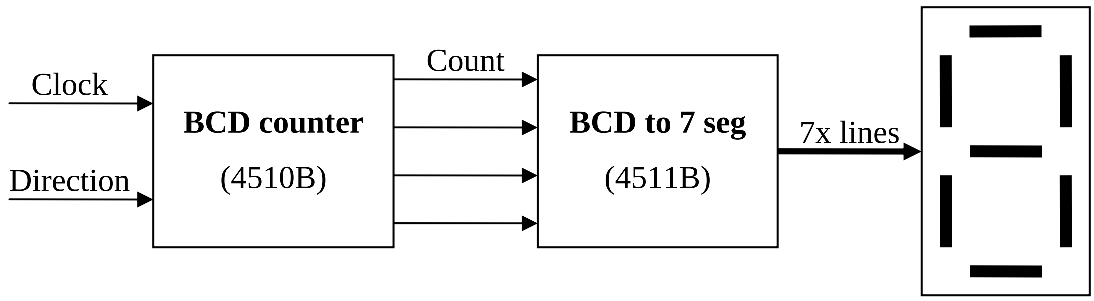
This fault finding flow chart is for a standard set-up with a count switch and no parallel load



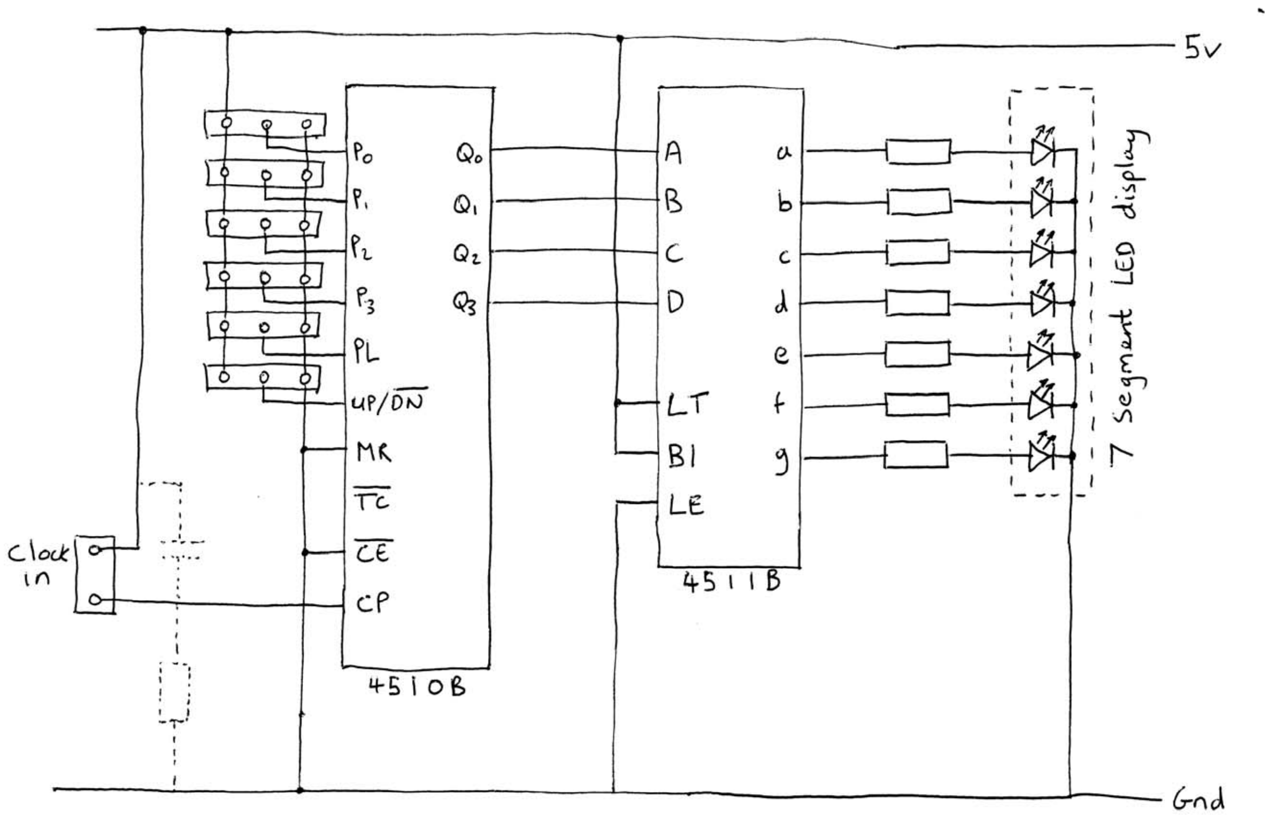
How the seven segment display counter works

Introduction

The basic block diagram for the system is shown below:

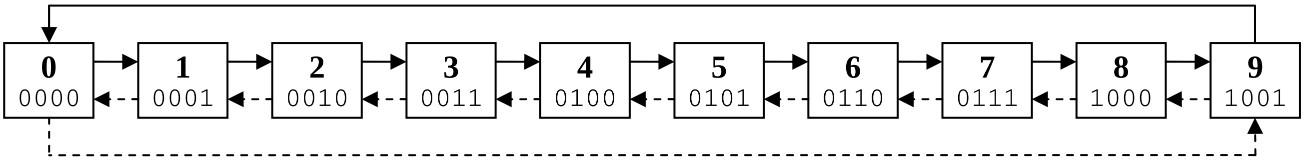


On the left of the diagram is a clock source. When this signal changes it clocks (steps) the binary coded decimal (BCD) counter. Each time the counter is clocked it moves on to the next number in the sequence. The next stage in the process is to convert the binary number from the counter into an output which can be shown on the 7 segment display.



Counter (4510B)

The counter is a binary coded decimal four bit up down counter (4510B). This means that it can either count up from 0 to 9 or down from 9 to 0 and that the output of this is indicated in binary.



The diagram above shows how the counter operates when clocked, the solid line indicating a clock when set to up and the dotted line shows the step when clocked in the down mode. The second number in each of the boxes is the binary representation of the data that will be present on the counter outputs Q_4 to Q_1. The direction in which the counter counts is determined by the state of the up down pin. When low it counts down, when high it counts up.

Parallel load

The board has the option to allow a number to be loaded via the parallel load pins. When parallel load is not in use the parallel load pin is held low. When the parallel load pin is taken high the data on the inputs P_3 to P_0 are loaded into the counter. This functionality can be used to reload the counter with any value between 0 and 9.

Other control pins

A number of the pins on the IC don't change, but need to be connected to allow the counter to work. There is an enable pin (EN), this is low so that counting is enabled, in a high state counting is disabled. The Master Reset (MR) pin is held low for normal operation, in a high state the device is kept in reset and all inputs & outputs are disabled.

BCD to seven segment display conversion (4511B)

The 4511 IC does the simple job of converting the binary coded decimal output of the 4510 counter IC into the correct format to drive the 7 segment display. Each separate section of the 7 segment display is an individual LED. Each of these segments has a corresponding input line. The circuit uses a common cathode display which means that all the cathodes on the 7 LEDs are connected together and in turn to 0V. Therefore to turn a segment on its line is taken high.
There are a few other pins on the BCD to seven segment converter IC that have a fixed setting. Lamp Test (LT) is held high in normal operation, if taken low all the segments light, to test the LEDs. Blanking (BL) is held in a high state for normal operation. The IC could be driven by a square wave should a dimming function be required. Latch Enable (LE) this is kept in a low state, if taken high the last number is latched allowing the binary number on the input to be changed without the output changing.

The resistors R1-R7 are 330Ω. These resistors limit the current that can flow through the LED's. This protects the LEDs and controls their brightness.