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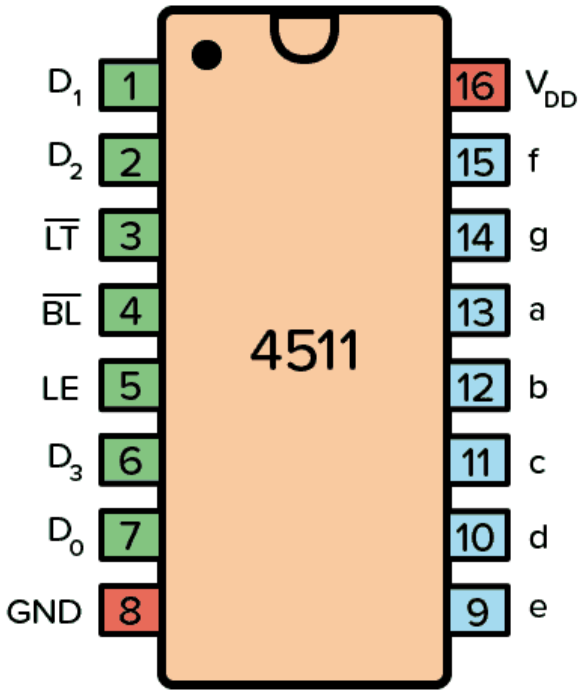
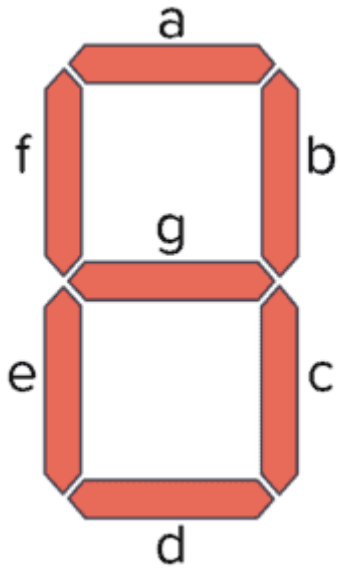
CD4511 – A BCD to 7-Segment Display Driver Chip



The CD4511 is a BCD to 7-segment decoder. It means it takes a number in binary form as an input, then displays this number on a 7-segment display using its outputs.

A 7-segment display is a component with seven Light-Emitting Diodes (LED) arranged as shown below. By turning on different combinations of the LEDs, a number between 0 and 9 is displayed.



Pin Overview

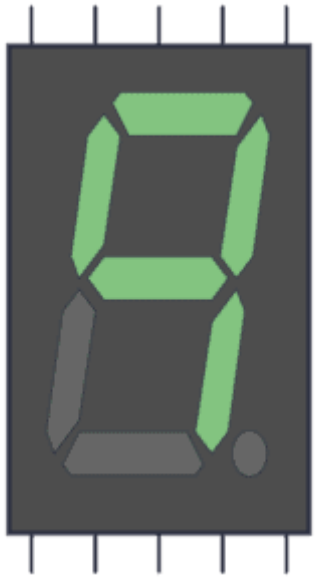
Pin Name	Pin #	Type	Description
VDD	16	Power	Supply Voltage (+3 to +15V)
GND	8	Power	Ground (0V)
a-f	9-15	Output	Outputs for the 7-segment display
D0-D3	7, 1, 2, 6	Input	4-bit data input
$\overline{LT}$	3	Input	Lamp Test. Turns on all segments when LOW.
$\overline{BL}$	4	Input	Blanking Test. Turns off all segments when LOW.
LE	5	Input	Latch Enable. Stores the current state when HIGH.

Pin overview for the 4511 IC

What is a BCD to 7-Segment Driver?

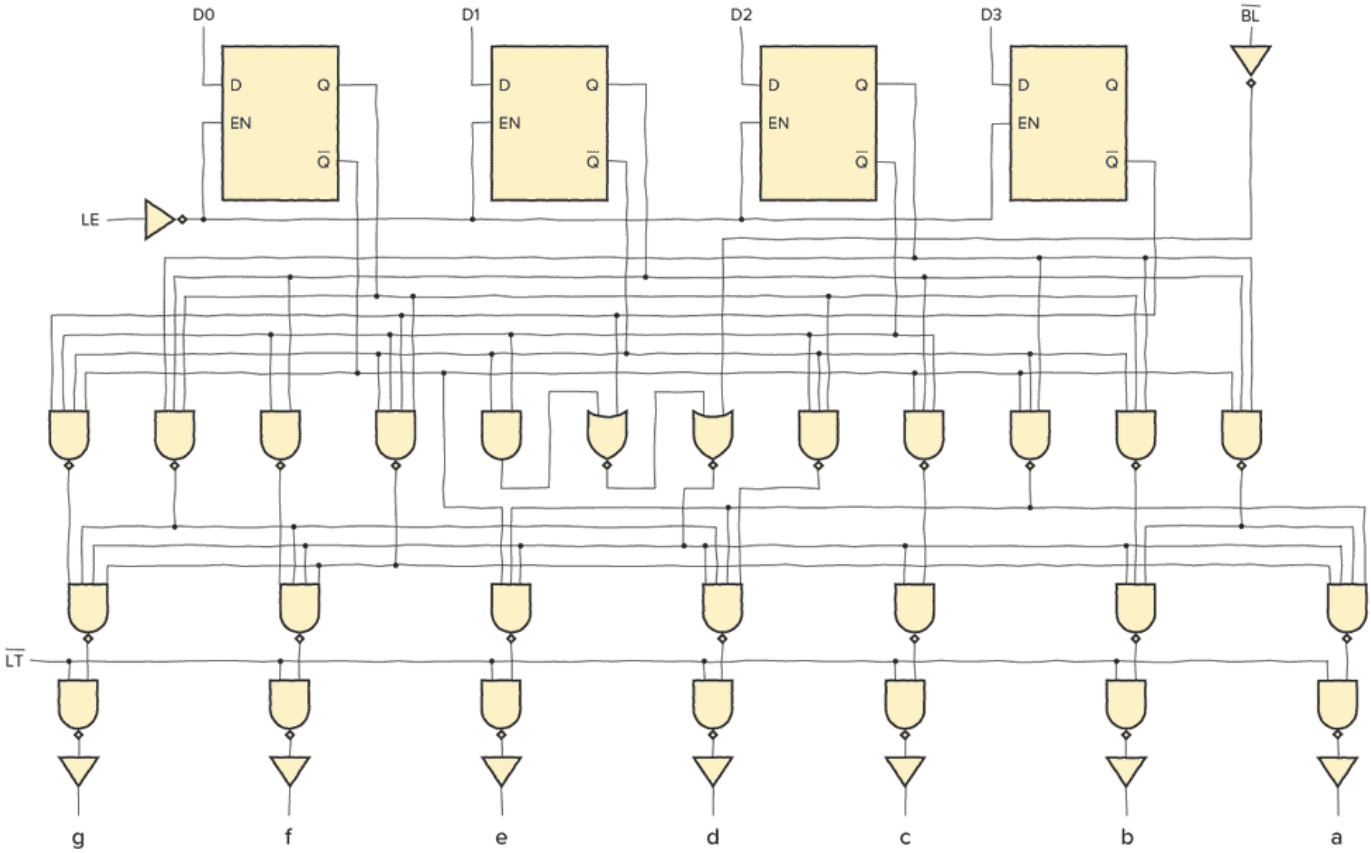
A 7-segment display driver turns on the correct segments of a 7-segment display according to an input.

In this case, the input is Binary-Coded Decimal (BCD). For example, an input of 1001, which is 9 in decimal, would turn on the segments a, b, c, f, and g so that a “9” is displayed on the 7-segment display:



So, how exactly does this IC convert binary codes to decimal numbers? It does so by using a combination of several digital gates.

From the HEX4511B datasheet (https://www.build-electronic-circuits.com/wp-content/uploads/2020/08/HEF4511B.pdf), we can find the internal circuit of the 4511:



(https://www.build-electronic-circuits.com/wp-content/uploads/2020/08/4511-internal-schematics-drawing.png)

For each input bit (D0-D3), there is a D latch.

When the **EN** input of a D latch is HIGH, whatever is on the **D** input is transferred to the **Q** output. But when **EN** goes low, the last input value is stored onto the output **Q** and cannot change.

This means that when **LE** is LOW, the segment outputs (**a** to **g**) are determined by the data on **D0** to **D3**. But when **LE** goes HIGH, the last data present on **D0** to **D3** is stored in the latches and the segment outputs stay unchanged.

The logic gates below convert the bits from the latches into 7-segment output.

How To Use the CD4511

To be able to use the BCD to 7-segment decoder in the chip, you need to first connect the **VDD pin** to the positive supply terminal and the **GND pin** to the negative supply terminal.

You can use a power supply voltage between 3V and 15V. Although, some versions of the 4511 chip support up to 20V. Check the datasheet of your version of the chip for exact values.

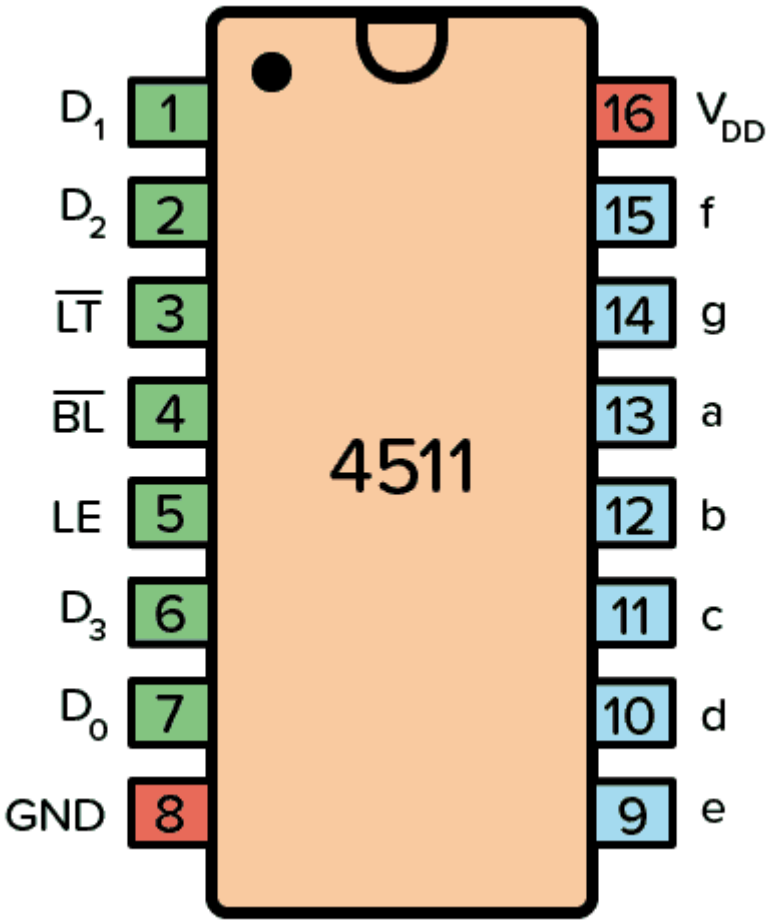
Pins D0, D1, D2, D3 are the BCD inputs through which you feed the number you want to show on the display in binary format.

Pins a to g are the output pins that you connect to your 7-segment display.

The $\overline{\text{LT}}$ **(Lamp Test) pin** is there to test that all the segments of the display work. Set LOW to test the segments. Set HIGH for normal operation.

The **$\overline{BL}$ (Blanking Test) pin** turns off all segments when LOW. You can use it to control the brightness of the display with pulse-width modulation (PWM). Set to HIGH for normal operation.

The **LE (Latch Enable) pin**, also called *store*, is used to store the current value. When HIGH, the last data is displayed regardless of the changes to the BCD inputs. Set this pin LOW for normal operation.

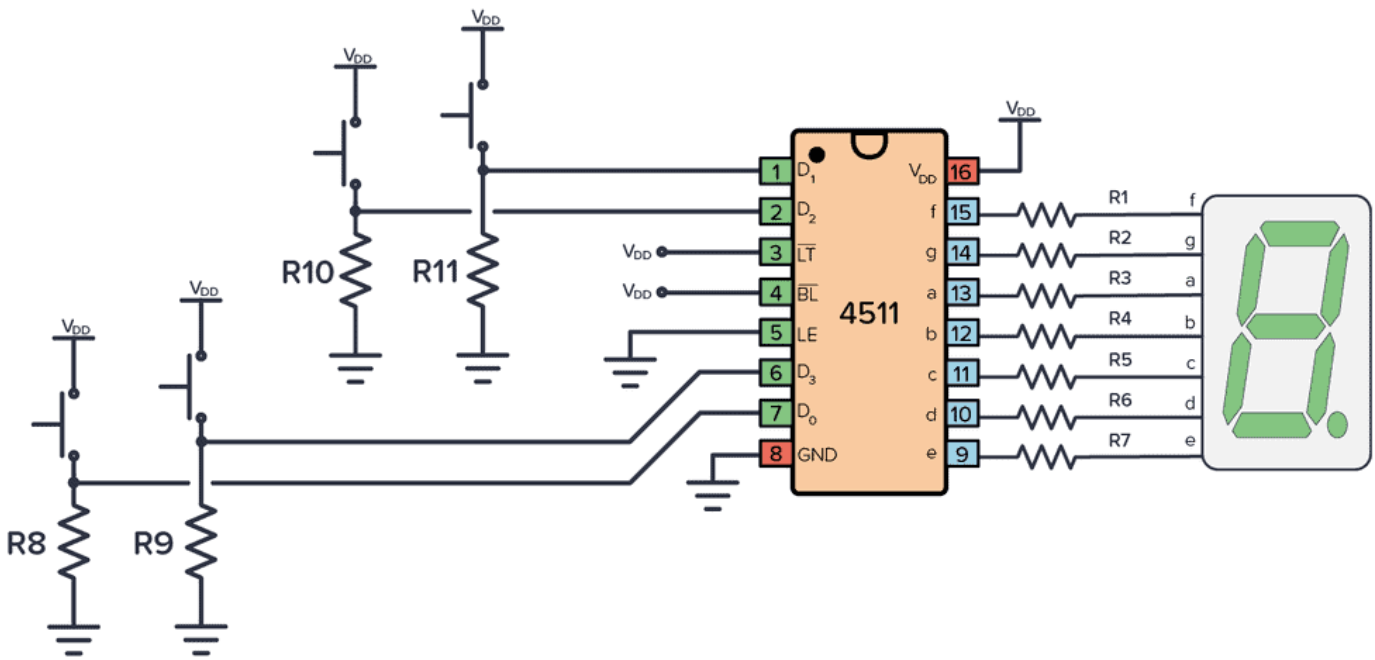


(https://www.build-electronic-circuits.com/wp-content/uploads/2020/08/4511_Pinout-white.png)

CD4511 Pinout

CD4511 Example Circuit

Below is an example circuit where you set the input number using switches. The CD4511 controls the 7-segment display so that it turns on the correct segments for displaying the number.



(https://www.build-electronic-circuits.com/wp-content/uploads/2020/08/Binary-to-7-segment-circuit.png)

To build this circuit you'll need:

- A 4511 chip, such as the CD4511BE
- A 7-segment display (Must be common cathode. For example LSHD-5503)
- Seven resistors (R1-R7) of 1kΩ

- Four resistors (R8-R11) of 10kΩ resistors
- Four pushbuttons

This is a fun circuit to build as your first 7-segment display circuit. Later, you can modify the input of this circuit to instead be the output of a counter that counts seconds, to create a stopwatch.

Alternatives and Equivalents for CD4511

You likely find the 4511 IC marked as CD4511, NTE4511, MC14511, HCF4511, TC4511, or HEF4511. Usually with a few extra characters at the end (Ex: CD4511BE).

This has to do with the manufacturer of the chip and the technology used. But the functionality and the pins are the same.

Can't find any of these in your local electronics store? Then check out my list of online stores (https://www.build-electronic-circuits.com/buy-electronic-components/) where you can find components and tools for all your electronics projects.

Or try one of the following 7-segment decoder alternatives:

- **4026**: Decade counter with 7-segment display outputs
- **4054/4055/4056**: BCD to 7-segment decoder (for LCD)
- **74HC46/47/48/49**: BCD to 7-segment decoder

4511 Datasheet

Download the PDF datasheet for the IC 4511 here:

CD4511B (https://www.ti.com/lit/ds/symlink/cd4511b.pdf) (Texas Instruments)
HEF4511B (https://www.build-electronic-circuits.com/wp-content/uploads/2020/08/HEF4511B.pdf) (Nexperia)

Comments

Steve says
January 23, 2022

Excellent information.
Thank you!

REPLY

admin says
January 24, 2022

Glad you liked it!

REPLY

Michael Cole says
April 1, 2022

Very Helpful. I had not designed anything with ICs for over 40 years. Blame it on the Asiatic Indianization of the tech work force so I had to fall back on the electrical contracting.

Mike Cole

REPLY

ALBERTO FRANCISCO says
February 22, 2022

Hi,
I like your presentation.
Can you send me a circuit example for a 6 digit, 7 seven segment display?

Thanks!

REPLY

Bret Tschacher says

March 22, 2022

Ok so I assemble a circuit similar to this one for which it was supposed to display only the digits 1 -4 to indicate which gear an automatic transmission is in. The trans is controlled by a TCU which I assembled from a kit. I finished the display circuit and was attempting to test it. I only activated the inputs at pins 1,2,6 and 7 one at a time and made the mistake of applying the full 12v which is supplying the circuit which I used a 5v reg to power the IC. I used resistors to limit current to the LED which is a 1 inch 7 segment. I got a bright partial display that made on sensible numerical figure. Anyhow, once I realized I had made that mistake, I used the 5v side of the regulator to retest the display and very shortly I had no display at all. The display is still functional so I didn't burn out any LED segments but now I get NO lit LEDs at all. Pretty sure I toasted the IC. I have more 4511's but I'm nervous about installing any of them. I suppose I shouldn't be so because as I said the 7 seg still functions and I still have a functioning Vreg section of the circuit. Point is, apparently to get a sensible output that resembles a complete numerical image more than one switch must be activated? From what I can tell, the outputs from the trans controller drive the input terminals by pull up voltages? I'm going to redo the circuit on a solderless bread board. The first circuit I assembled from a schematic supplied by the instructions to assemble the GPIO kit which is now the trans controller by way of the correct assembly kit parts package and now needs to be loaded with the firmware file so it can be programmed to control the shifting of the trans. This is a pretty simple circuit but apparently applying more voltage to the inputs than what the IC is powered by is a sure way to make it fail. Anyone do this so far?

REPLY

admin says

April 7, 2022

The CD4511B can handle up to 18V, so if you used that one it shouldn't have been a problem using 12V.

Pins D0, D1, D2, D3 are the BCD inputs through which you feed the number you want to show on the display in binary format. So for example to show the number 9, you have to input the binary 1001

REPLY

Nazmul (http://3rd%20engineer%20at%20Eaglestarshipmanagement) says
May 8, 2022

@BRET you need to limit the current in the BCD input pins. You probably inputted more 10mA or inputted voltage more than supply voltage VDD=12v. Make sure your input to BCD is less than your 4511 supply voltage and not more than 10mA in any input. 7-segment current limit to 15mA (20mA max.)

REPLY

Max says
April 10, 2022

This was very helpful. Thank you.

How does one connect multiple 4511 ics together to display double digit numbers?

Thanks

REPLY

admin says
May 20, 2022

It depends a bit. Where is your number coming from and what format is it in?

REPLY

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