How to Convert Hexadecimal to Decimal and Decimal to Hex Manually

EASYGUYEVO • JUL 27, 2022

I'm an online writer and car enthusiast with years of car maintenance experience.

Before you convert a decimal to a hexadecimal and a hexadecimal to a decimal you must know what decimal bits and hex bits are.

What Is a Decimal?

First, a decimal or hex bit in this tutorial represents a single number, digit, or letter. A decimal is also called base 10 and denary because it consists of ten numbers. These are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.

A decimal is a number system and can be represented using a subscript of 10 (i.e. 235_{10} reads as two hundred and thirty-five base 10).

Decimals are the numbers we use in everyday counting. We mostly use the decimal number system because we have ten fingers. The number 10 is made by using a combination of two of these decimal numbers: 1 and 0 while a number like 209 is a combination of three decimal numbers: 2, 0, and 9.

There is no limit as to how many times the numbers can be reused, that's why it is often said that numbers are never ending.

What Is a Hexadecimal?

A hexadecimal, which is also called base 16 or "hex" for short, is a representation of four binary bits and consists of sixteen numbers and letters. The numbers in a hex are the same as decimal numbers: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. The big difference between a hex and a decimal is that a hex also contains letters. These letters are: A, B, C, D, E, F.

A hex number can be represented using a subscript of 16 (i.e. 235_{16}). These letters come after the decimals in ascending order. Therefore, the hexadecimal series looks like this: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F. A hex can be considered a shorter version of a decimal. For example a large number in decimal form has a much smaller hex equivalent (using less hex bits to represent the decimal number). I will demonstrate this later.

Converting a Hexadecimal to a Decimal

Now, how do you convert a hex to a decimal and a decimal to a hex manually? First, you must know the letters in a hex all have decimal equivalents, as listed in the table below.

There are other number system table with more values for octals, hexes, decimals, and binaries, however the table below provides all that we need for this tutorial.

Hexadecimal to Decimal Table

Hexadecimal	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Decimal	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

How Do You Convert From Hex to Decimal Manually?

To convert a hexadecimal to a decimal manually, you must start by multiplying the hex number by 16. Then, you raise it to a power of 0 and increase that power by 1 each time according to the hexadecimal number equivalent.

We start from the right of the hexadecimal number and go to the left when applying the powers. Each time you multiply a number by 16, the power of 16 increases.

When converting a C9 hexadecimal to a decimal your work should look something like this:

Example 1

> ***9 = 9 * (16 ^ 0) = 9***
>
> ***C = 12 * (16 ^ 1) = 192***

Then, we add the results.

> ***192 + 9 = 201_{10} decimal***

Review

1. First, we converted all of our hex numbers to their decimal equivalents. C is equal to decimal 12 (refer to table above) and 9 is equal to decimal 9.
2. Then, we multiplied the numbers 12 and 9 starting from the last number in the question by 16 and its power. Remember, the powers start from zero.
3. Our first multiplication had a power of 0 and the second multiplication had a power of 1. If there was a third it would have had a power of 2.
4. The (^) symbol represents "raised to the power of." Therefore, the first terms in brackets read, "16 to the power of 0." This means that sixteen was multiplied by itself zero times. Anything raised to the power of zero is 1. Therefore, 9 was multiplied by one.
5. In the second bracket, the term read, "16 to the power of 1." A number raised to the power of one is equal to that number. Therefore 12 was multiplied by 16. When we multiplied these we got 192.
6. We then added the results to get our decimal equivalent number, which was 201.

Example 2

In this example, we want to convert hex ABC to a decimal.

Remember that we raise the number 16 to 0 for the rightmost bit of the question. As we move across the numbers and letters, the power 16 is raised by one more than the previous bit. For example, if we had a number with 22 in the leftmost bit it would be multiplied by 16 to the power of 21.

> ***C = 12 * (16 ^ 0) 12***
> ***B = 11 * (16 ^ 1) 176***
> ***A = 10 * (16 ^ 2) 2560***

Then, we add the results.

> ***2560 + 176 + 12 = 2748_{10} decimal***

Test Yourself!

1. Convert Hex AF, ACD, AB2 and FF to base 10

Answers are 175_{10}, 2765_{10}, 2738_{10}, and 255_{10} respectively.

How Do You Convert From Decimal to Hexadecimal Manually?

To convert from decimal to hexadecimal you must divide the decimal number by 16 repeatedly. Then, write the last remainder you obtained in the hex equivalent column. If the remainder is more than nine, remember to change it to its hex letter equivalent. The answer is taken from the last remainder obtained. Refer to the diagram below as an example:

Example 1

Divisor	Base Ten Number	Remainder	Hex Equivalent
16	201	X	X
16	12	9	9
X	0	12	C

Thus, the answer is C9. As you can see, it contains less bits than its decimal equivalent, 201.

Review

1. We divided our decimal number (base 10) by 16 to convert it to a hex equivalent (base 16).

2. Our decimal number was 201. We divided this by 16 to get a value of 12 with a remainder of 9. The hex equivalent for 9 is 9 so no change was made.

3. We then divided our previous answer, 12, by 16. We got a value of zero and a remainder of 12. We then converted 12 to hex. The hex equivalent of 12 is C (refer to the first table). We then wrote our answer from the last remainder we received to the first in the order from left to right.

Example 2

In this example, we want to convert decimal 3000 to a hexadecimal.

Divisor	Base Ten Number	Remainder	Hex Equivalent
16	3000	X	X
16	187	8	8
16	11	11	B
16	0	11	B

The answer is BB8 hexadecimal. Remember, we write the last remainder we received at the front of our answer

Test Yourself!

1. Convert decimal 39554, 2856, 37 to base 16/Hex.

Answers are 9A82, B28, and 25 respectively.

Conclusion

For some, this may seem difficult at first. But rest assured that with a little practice, converting from a decimal to a hexadecimal and a hexadecimal to a decimal can be easily mastered.

It may help you to check your answers using a calculator, or to type your decimal value in the dec setting and then select "hex" and press equal. Just do the opposite for hex to decimal. Another option is using a decimal to hexadecimal converter or a hexadecimal to decimal converter.

Still, I strongly recommend you learn how to convert these number systems manually

before using the calculator. That way, you won't feel that you need to rely on a calculator.

How to Change a Hexadecimal to a Decimal Manually (Video)

How Do You Convert a Decimal to a Hexadecimal Using a Calculator? (Video)

How to Convert a Hexadecimal to a Decimal Manually (Video)

Comments

Uvaiz on March 17, 2020:

I loved this website

sk on March 03, 2020:

hexadecimal 167A convert decimal

Hameedullah Hami on October 16, 2019:

Thank you for such amazing and easy way to understand us.

Macbeth Quotes on July 08, 2019:

YEAH

I'M GON

TAKE MY HORSE

JNash on March 19, 2019:

Thank you! I use https://www.bin-dec-hex.com/hex-to-decimal-convert... to check the conversion result.

Gonesh Chandra Roy on November 29, 2018:

It was a very helpful.

Thanks for your easy way to understand these...

Bikibompo on July 20, 2018:

easy explanations.

thanks bro.

bob on July 18, 2018:

Very good extremely clear in the instructions

nigky on July 01, 2018:

got it easily

Thanks lot I understand on June 25, 2018:

Thanks

roshni on June 11, 2018:

thanks a lot i understood it clearly

Mina M. Parmar on May 26, 2018:

Convert decimal 201 to hexadecimal

Solution:

Integer Remainder

201/16 =12. 9

12/16 = 0. 12 i.e. C

Hence decimal 201 = hex C9

Swarnim on May 15, 2018:

Nicely explained. Thank you.

PAYAL on May 07, 2018:

easy for me to understand , thank you

savage on March 27, 2017:

i didnt read it

Sebastian on December 09, 2016:

I found some parts of this quite hard to understand, like the remainders and how to do it without a calculator. Please help me to understand, my maths isn't that good with division.

Doming su gatsaulo on January 11, 2016:

Nice one!!! Its more fun in the Phillipines

Fernando Idontkno from El Paso, Texas on June 07, 2014:

On example 2:

Multiplication Result

C = 12 * (16 * 0) 12

12 * (16 * 0) should equal zero.

it should be:

12 * (16 ^ 0) = 12

easyguyevo (author) from Barbados on February 11, 2013:

You are correct Alex. It was my mistake sorry for the trouble.

Alex Lomas on September 27, 2012:

On the last set of TRY THESE examples

I get 2857 = B29 .....NOT B28 or am I mistaken

I have worked this back and again it is not

B28 = 2856

Please comment, Alex Lomas

Gemma on April 02, 2012:

I've found most sites do not mention what you need to do with the remainder.

201 / 16 = 12.5625

To get the remainder of 9, like in the example, you need to take the remainder .5625 and multiply by 16.

201 / 16 = 12.5625

.5625 * 16 = 9

Converting is a two step process, yet for some reason no one ever mentions this, hope this helps someone!

easyguyevo (author) from Barbados on September 07, 2010:

NO prob, lol.

coder on September 07, 2010:

Thanks for the directions and source code! :-)