

Binary 0,1 base 2

Review of binary conversions.

1	0	1	1	0	face	
1	0	1	1	0	place value	
$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$	positional value
32	16	8	4	2	1	

$$1 \times 16 = 16$$

$$0 \times 16 = 0$$

$$1 \times 4 = 4$$

$$1 \times 2 = 2$$

$$0 \times 1 = 0$$

---


$$22_{10}$$

$$\begin{array}{r}
 22_{10} \\
 -16 \\
 \hline
 6 \\
 -4 \\
 \hline
 2 \\
 -2 \\
 \hline
 0
 \end{array}$$

Checking in decimal.

$$\begin{array}{r}
 111 \\
 110 \\
 + 011 \\
 \hline
 1011 \\
 168421 \\
 \hline
 23_{10}
 \end{array}$$

Adding in binary.

$$\begin{array}{r}
 11 \\
 + 1 \\
 \hline
 10 \\
 + 1 \\
 \hline
 11 \\
 + 1 \\
 \hline
 100 \\
 + 1 \\
 \hline
 101 \\
 + 1 \\
 \hline
 110 \\
 + 1 \\
 \hline
 111 \\
 + 1 \\
 \hline
 1000
 \end{array}$$

Bin	Dec
0	0
1	1
10	2
11	3
100	4
101	5
110	6
111	7
1000	8

13<sub>10</sub> + 7<sub>10</sub> + 3<sub>10</sub> = 23<sub>10</sub>

1 1 1 1 9

$$\begin{array}{r}
 \phantom{1} \phantom{1} \phantom{1} \phantom{1} \\
 110111 \\
 \phantom{1} 1001 \\
 + 11111 \\
 \hline
 1011111
 \end{array}$$

Checking by converting to decimal.

10	10	10								
1	0	1	1	1	1	1	1	1	1	
8	4	2	1	1	1	1	1	1	1	
									-	11
									-	7
									-	15
									-	5
									-	38

1001	10	
32	16	8
4	2	1
38		

Subtract in binary.

$$\begin{array}{r}
 \begin{array}{r}
 10 \\
 1101 \\
 - 11 \\
 \hline
 1010 \\
 \begin{array}{r}
 8 \quad 2 \\
 10
 \end{array}
 \end{array} \\
 \begin{array}{r}
 13 \\
 - 3 \\
 \hline
 10
 \end{array}
 \end{array}$$

Checking by converting to decimal.

$$\begin{array}{r}
 \begin{array}{r}
 10 \\
 0110 \\
 10010 \\
 11010 \\
 \hline
 101011 \\
 \begin{array}{r}
 32 \quad 16 \quad 8 \quad 4 \quad 2 \quad 1 \\
 43
 \end{array}
 \end{array} \\
 \begin{array}{r}
 58 \\
 - 15 \\
 \hline
 43
 \end{array}
 \end{array}$$

The screenshot shows the SMART Notebook application interface. The main workspace contains two binary subtraction problems. The left problem is  $1x01 - 13$  with a result of  $1010$ . The right problem is  $1x1010 - 15$  with a result of  $101011$ . A Windows Calculator window is open in the foreground, displaying hexadecimal values: 63, 47, 32, 31, and 15. The Windows taskbar at the bottom shows the time as 11:34 AM on 3/26/2015.

**Binary Subtraction 1:**

$$\begin{array}{r} 1x01 - 13 \\ - \quad 11 - 3 \\ \hline 1010 \quad 10 \\ \begin{array}{l} 8 \quad 2 \\ 10 \end{array} \end{array}$$

**Binary Subtraction 2:**

$$\begin{array}{r} 1x1010 - 15 \\ \begin{array}{l} 10 \\ 01 \\ 10 \\ 10 \end{array} \\ - \quad 1111 - 15 \\ \hline 101011 \\ \begin{array}{l} 8 \quad 4 \quad 2 \quad 1 \\ 43 \end{array} \end{array}$$

**Calculator Window:**

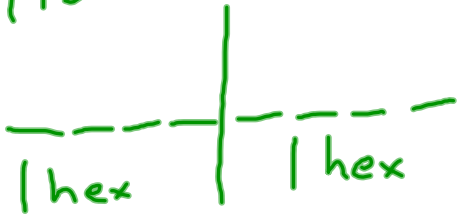
0000	0000	0000	0000	0000	0000	0000	0000
63				47			32
0000	0000	0000	0000	0000	0000	0000	0000
31				15			0

Hex	base 16	Dec	Hex	Binary
-----	---------	-----	-----	--------

Introducing hexadecimal with characters from 0 to F.

0	0	0
1	1	10
2	2	11
3	3	100
4	4	101
5	5	110
6	6	111
7	7	1000
8	8	1001
9	9	1010
10	A	1011
11	B	1100
12	C	1101
13	D	1110
14	E	1111
15	F	10000
16	10	

ASCII = 8 binary bits



Every hex digit

can be expressed

with 4 binary digits and every

set of 4 binary digits = 1 hex digit

The screenshot shows a SMART Notebook window with the following content:

- Header:** "Untitled - SMART Notebook" with a menu bar (File, Edit, View, Insert, Format, Draw, Help) and a toolbar.
- Left Panel:** A "Groups" sidebar with "Group 1" containing eight thumbnails of previous pages.
- Main Canvas:**
  - Handwritten text in green: "ASCII = 8 binary bits".
  - A diagram showing a vertical line separating two dashed horizontal lines, with "hex" written below each side.
  - Handwritten text in red: "Every hex digit can be expressed with 4 binary digits and every set of 4 binary digits = 1 hex digit".
  - A vertical list of numbers 7 through 16, with a blue arrow pointing to 7.
  - A vertical list of hex characters: 8, 9, A, B, C, D, E, F, 10, with a blue arrow pointing to 8.
  - A vertical list of binary strings: 111, 1000, 1001, 1010, 1011, 1100, 1101, 1110, 1111, 10000.
  - A blue horizontal line is drawn across the bottom of the hex and binary columns.
- Bottom Panel:** Windows taskbar with icons for Internet Explorer, File Explorer, and other applications. The system tray shows the time "11:41 AM" and date "3/26/2015".

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same value as decimal 10, the letter B carries the same value as decimal 11, the letter C carries the same value as decimal 12, the letter D carries the same value as decimal 13, the letter E carries the same value as decimal 14, and the letter F carries the same value as decimal 15. Hexadecimal, like any other numbering system has the face value of digits and the positional value. The positional value is based on the powers of 16 since hexadecimal is the base 16 numbering system.

Example: Hexadecimal number A359

A	3	5	9	face value
$16^3$	$16^2$	$16^1$	$16^0$	positional value (powers of 16)
4096	256	16	1	resolved positional value

**Converting hexadecimal to decimal:**

To convert hexadecimal to its decimal equivalent, we multiply the face value times the positional value:

$A \times 16^3 =$	$10 \times 4096 =$	40960 (note A is equivalent to decimal 10)
$3 \times 16^2 =$	$3 \times 256 =$	768
$5 \times 16^1 =$	$5 \times 16 =$	80
$9 \times 16^0 =$	$9 \times 1 =$	9
		41817

The equivalent of hexadecimal A359 in decimal is 41817.

**Converting decimal to hexadecimal:**

Now we will take the decimal number 41817 and convert it back to hexadecimal. To do this, we will follow the same steps we used in converting decimal to binary with one change. This time we are concerned with multiplying by the face value (in binary this was not a concern because multiplying by 1 doesn't change anything).

The following are the decimal equivalents for some of the commonly used powers of 16:

$16^0 = 1$      $16^1 = 16$      $16^2 = 256$      $16^3 = 4096$      $16^4 = 65536$

The following steps convert decimal 41817 to hexadecimal:

1. First we need to find out the highest base of 16 that can be subtracted from our number, 41817. Clearly 16 to the 4th which is equivalent to 65536 is too big. However, 16 to the 3rd which is equivalent to 4096 will work. Our next question is how many 16 to the 3rd s can be subtracted from 41817. Through trying different calculations, we discover that 10 x 4096 or 40960 is the most powers of 16 to the 3rd that we can subtract so we place A (the equivalent of 10) in the 16 to the 3rd position.  
We subtract:  $41817 - 40960 = 857$

A			
$16^3$	$16^2$	$16^1$	$16^0$
4096	256	16	1

2. Now, we have established the first power of 16 that we can use. We now move over to 16 to the 2nd power which has the equivalent of 256 and ask how many times can 256 be subtracted from 857.

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same value as decimal 10, the letter B carries the same value as decimal 11, the letter C carries the same value as decimal 12, the letter D carries the same value as decimal 13, the letter E carries the same value as decimal 14, and the letter F carries the same value as decimal 15. Hexadecimal, like any other numbering system has the face value of digits and the positional value. The positional value is based on the powers of 16 since hexadecimal is the base 16 numbering system.

Example: Hexadecimal number A359

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$16^3$	$16^2$	$16^1$	$16^0$	positional value (powers of 16)
4096	256	16	1	resolved positional value

Converting hexadecimal to decimal:

To convert hexadecimal to its decimal equivalent, we multiply the face value times the positional value:

$A \times 16^3 =$	$10 \times 4096 =$	40960 (note A is equivalent to decimal 10)
$3 \times 16^2 =$	$3 \times 256 =$	768
$5 \times 16^1 =$	$5 \times 16 =$	80
$9 \times 16^0 =$	$9 \times 1 =$	9
		41817

— decimal

A 3 5 9

$\overline{16^3}$     $\overline{16^2}$     $\overline{16^1}$     $\overline{16^0}$   
 4096   256   16   1

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Converting decimal to hexadecimal:

Now we will take the decimal number 41817 and convert it back to hexadecimal. To do this, we will follow the same steps we used in converting decimal to binary with one change. This time we are concerned with multiplying by the face value (in binary this was not a concern because multiplying by 1 doesn't change anything).

The following are the decimal equivalents for some of the commonly used powers of 16:

$16^0 = 1$	$16^1 = 16$	$16^2 = 256$	$16^3 = 4096$	$16^4 = 65536$
------------	-------------	--------------	---------------	----------------

The following steps convert decimal 41817 to hexadecimal:

- First we need to find out the highest base of 16 that can be subtracted from our number, 41817. Clearly 16 to the 4th which is equivalent to 65536 is too big. However, 16 to the 3rd which is equivalent to 4096 will work. Our next question is how many 16 to the 3rd s can be subtracted from 41817. Through trying different calculations, we discover that 10 x 4096 or 40960 is the most powers of 16 to the 3rd that we can subtract so we place A (the equivalent of 10) in the 16 to the 3rd position.  
 We subtract:  $41817 - 40960 = 857$

A			
$16^3$	$16^2$	$16^1$	$16^0$
4096	256	16	1

- Now, we have established the first power of 16 that we can use. We now move over to 16 to the 2nd power which has the equivalent of 256 and ask how many times can 256 be subtracted from 857.

$$B7F_{16} = \frac{2943}{10}$$

$\frac{B}{16^2}$	$\frac{7}{16^1}$	$\frac{F}{16^0}$		$11 \times 256 = 2816$
256	16	1		112
				15
				<u>2943</u>

$$2ED5_{16} = \frac{11989}{10}$$

2	<sup>14</sup>	<sup>13</sup>	
E	D	5	
$16^3$	$16^2$	$16^1$	$16^0$
4096	256	16	1

$$\begin{array}{r}
 2 \times 4096 = 8192 \\
 14 \times 256 = 3584 \\
 13 \times 16 = 208 \\
 5 \times 1 = 5 \\
 \hline
 11989
 \end{array}$$

41817

The equivalent of hexadecimal A359 in decimal is 41817.

**Converting decimal to hexadecimal:**

Now we will take the decimal number 41817 and convert it back to hexadecimal. To do this, we will follow the same steps we used in converting decimal to binary with one change. This time we are concerned with multiplying by the base value (in binary this was not a concern because multiplying by 2 doesn't change anything).

The following are the decimal equivalents for some of the commonly used powers of 16:

$$16^0 = 1 \quad 16^1 = 16 \quad 16^2 = 256 \quad 16^3 = 4096 \quad 16^4 = 65536$$

The following steps convert decimal 41817 to hexadecimal:

1. First we need to find out the highest base of 16 that can be subtracted from our number, 41817. Clearly 16 to the 4th which is equivalent to 65536 is too big. However, 16 to the 3rd which is equivalent to 4096 will work. Our next question is how many 16 to the 3rd s can be subtracted from 41817. Through trying different calculations, we discover that 10 x 4096 or 40960 is the most powers of 16 to the 3rd that we can subtract so we place A (the equivalent of 10) in the 16 to the 3rd position.  
We subtract:  $41817 - 40960 = 857$

A			
$16^3$	$16^2$	$16^1$	$16^0$
4096	256	16	1

2. Now, we have established the first power of 16 that we can use. We now move over to 16 to the 2nd power which has the equivalent of 256 and ask how many times can 256 be subtracted from 857. Again, we try the calculations and discover 3 256s (768) can be subtracted from 857 which means we enter a 3 in the 16 to the 2nd position.  
We subtract:  $857 - 768 = 89$

A	3		
$16^3$	$16^2$	$16^1$	$16^0$
4096	256	16	1

3. Now we have 89 left. Looking at 16 to the 1st with the equivalent of 16, we ask how many 16s can be subtracted from 89. The answer is 5 ( $16 \times 5 = 80$ ), so we place a 5 in the 16 to the 1st position.  
We subtract:  $89 - 80 = 9$

A	3	5	
$16^3$	$16^2$	$16^1$	$16^0$
4096	256	16	1

4. Now we have 9 left. There is only the 16 to the 0th position with the equivalent value of 1 left. Clearly if we subtract 9 x 1 from 9 we will have 0 left and that is our goal, so we place a 9 in the 16 to the 0th position.  
We subtract:  $9 - 9 = 0$

A	3	5	9
---	---	---	---

$$2943_{10} = \underline{137F}_{16}$$

	11	7	F
$16^3$	$16^2$	$16^1$	$16^0$
4096	256	16	1

$$\begin{array}{r} 16 \overline{) 127} \\ \underline{112} \\ 15 \end{array}$$

$$\begin{array}{r} 2943 \\ - 2560 \\ \hline 383 \\ - 256 \\ \hline 127 \\ - 112 \\ \hline 15 \end{array}$$

10 256  
1 256  
11 256

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Ascii Table - ASCII charact... x

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## ASCII Table and Description

ASCII stands for American Standard Code for Information Interchange. Computers can only understand numbers, so an ASCII code is the numerical representation of a character such as 'a' or '@' or an action of some sort. ASCII was developed a long time ago and now the non-printing characters are rarely used for their original purpose. Below is the ASCII character table and this includes descriptions of the first 32 non-printing characters. ASCII was actually designed for use with teletypes and so the descriptions are somewhat obscure. If someone says they want your CV however in ASCII format, all this means is they want 'plain' text with no formatting such as tabs, bold or underscoring - the raw format that any computer can understand. This is usually so they can easily import the file into their own applications without issues. Notepad.exe creates ASCII text, or in MS Word you can save a file as 'text only'

AdChoices | ASCII Code | Hex to ASCII | ASCII Table | Binary Code

Dec	Hex	Oct	Char	Dec	Hex	Oct	HTML	Chr	Dec	Hex	Oct	HTML	Chr	Dec	Hex	Oct	HTML	Chr
0	0	000	NUL (null)	32	20	040	#32;	Space	64	40	100	#64;	@	96	60	140	#96;	`
1	1	001	SOH (start of heading)	33	21	041	#33;	!	65	41	101	#65;	A	97	61	141	#97;	a
2	2	002	STX (start of text)	34	22	042	#34;	"	66	42	102	#66;	B	98	62	142	#98;	b
3	3	003	ETX (end of text)	35	23	043	#35;	#	67	43	103	#67;	C	99	63	143	#99;	c
4	4	004	EOF (end of transmission)	36	24	044	#36;	\$	68	44	104	#68;	D	100	64	144	#100;	d
5	5	005	ENQ (enquiry)	37	25	045	#37;	%	69	45	105	#69;	E	101	65	145	#101;	e
6	6	006	ACK (acknowledge)	38	26	046	#38;	&	70	46	106	#70;	F	102	66	146	#102;	f
7	7	007	BEL (bell)	39	27	047	#39;	'	71	47	107	#71;	G	103	67	147	#103;	g
8	8	010	BS (backspace)	40	28	050	#40;	(	72	48	110	#72;	H	104	68	150	#104;	h
9	9	011	TAB (horizontal tab)	41	29	051	#41;	)	73	49	111	#73;	I	105	69	151	#105;	i
10	A	012	LF (NL line feed, new line)	42	2A	052	#42;	*	74	4A	112	#74;	J	106	6A	152	#106;	j
11	B	013	VT (vertical tab)	43	2B	053	#43;	+	75	4B	113	#75;	K	107	6B	153	#107;	k
12	C	014	FF (NF form feed, new page)	44	2C	054	#44;	,	76	4C	114	#76;	L	108	6C	154	#108;	l
13	D	015	CR (carriage return)	45	2D	055	#45;	-	77	4D	115	#77;	M	109	6D	155	#109;	m
14	E	016	SO (shift out)	46	2E	056	#46;	.	78	4E	116	#78;	N	110	6E	156	#110;	n
15	F	017	SI (shift in)	47	2F	057	#47;	/	79	4F	117	#79;	O	111	6F	157	#111;	o
16	10	020	DLE (data link escape)	48	30	060	#48;	0	80	50	120	#80;	P	112	70	160	#112;	p
17	11	021	DC1 (device control 1)	49	31	061	#49;	1	81	51	121	#81;	Q	113	71	161	#113;	q
18	12	022	DC2 (device control 2)	50	32	062	#50;	2	82	52	122	#82;	R	114	72	162	#114;	r
19	13	023	DC3 (device control 3)	51	33	063	#51;	3	83	53	123	#83;	S	115	73	163	#115;	s
20	14	024	DC4 (device control 4)	52	34	064	#52;	4	84	54	124	#84;	T	116	74	164	#116;	t
21	15	025	NAK (negative acknowledge)	53	35	065	#53;	5	85	55	125	#85;	U	117	75	165	#117;	u
22	16	026	SYN (synchronous idle)	54	36	066	#54;	6	86	56	126	#86;	V	118	76	166	#118;	v
23	17	027	ETB (end of trans. block)	55	37	067	#55;	7	87	57	127	#87;	W	119	77	167	#119;	w
24	18	030	CAN (cancel)	56	38	070	#56;	8	88	58	130	#88;	X	120	78	170	#120;	x
25	19	031	EM (end of medium)	57	39	071	#57;	9	89	59	131	#89;	Y	121	79	171	#121;	y
26	1A	032	SUB (substitute)	58	3A	072	#58;	<	90	5A	132	#90;	Z	122	7A	172	#122;	z
27	1B	033	ESC (escape)	59	3B	073	#59;	>	91	5B	133	#91;	[	123	7B	173	#123;	{
28	1C	034	FS (file separator)	60	3C	074	#60;	<	92	5C	134	#92;	\	124	7C	174	#124;	
29	1D	035	GS (group separator)	61	3D	075	#61;	>	93	5D	135	#93;	]	125	7D	175	#125;	}
30	1E	036	RS (record separator)	62	3E	076	#62;	>	94	5E	136	#94;	^	126	7E	176	#126;	~
31	1F	037	US (unit separator)	63	3F	077	#63;	>	95	5F	137	#95;	_	127	7F	177	#127;	DEL

Source: www.LookupTables.com

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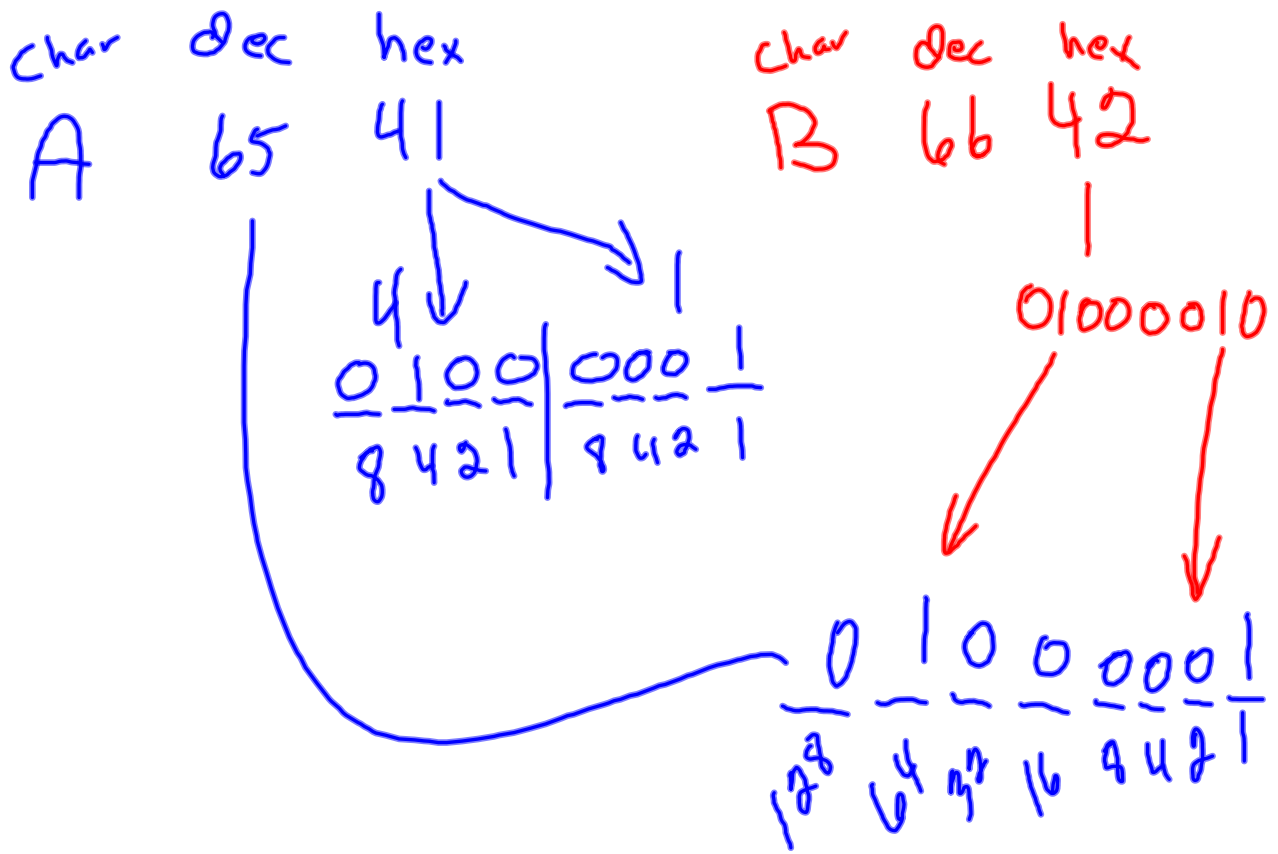
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Source: CB 2013 Nielsen Buyer Insights study of 22 large PayPal merchants across 7 categories.

Unit Conversion

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12:04 PM 3/26/2015



A	65	41	01000001
B	66	42	01000010
C	67	43	01000011
D	68	44	01000100

UPPER  
CASE

The first three digits tell us it is uppercase. The last 4 digits tell us which one from 1 for A to 26 for Z.

Z 90 5A

26 Dec  
0101 1010  
5 A

26  
0101 1010  
168421



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Ascii Table - ASCII character co... x

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1	1	001	SOH (start of heading)	33	21	041	#33;	!	65	41	101	#65;	A	97	61	141	#97;	a
2	2	002	STX (start of text)	34	22	042	#34;	"	66	42	102	#66;	B	98	62	142	#98;	b
3	3	003	ETX (end of text)	35	23	043	#35;	#	67	43	103	#67;	C	99	63	143	#99;	c
4	4	004	EOF (end of transmission)	36	24	044	#36;	\$	68	44	104	#68;	D	100	64	144	#100;	d
5	5	005	ENQ (enquiry)	37	25	045	#37;	%	69	45	105	#69;	E	101	65	145	#101;	e
6	6	006	ACK (acknowledge)	38	26	046	#38;	&	70	46	106	#70;	F	102	66	146	#102;	f
7	7	007	BEL (bell)	39	27	047	#39;	'	71	47	107	#71;	G	103	67	147	#103;	g
8	8	010	BS (backspace)	40	28	050	#40;	(	72	48	110	#72;	H	104	68	150	#104;	h
9	9	011	TAB (horizontal tab)	41	29	051	#41;	)	73	49	111	#73;	I	105	69	151	#105;	i
10	A	012	LF (NL line feed, new line)	42	2A	052	#42;	*	74	4A	112	#74;	J	106	6A	152	#106;	j
11	B	013	VT (vertical tab)	43	2B	053	#43;	+	75	4B	113	#75;	K	107	6B	153	#107;	k
12	C	014	FF (NP form feed, new page)	44	2C	054	#44;	,	76	4C	114	#76;	L	108	6C	154	#108;	l
13	D	015	CR (carriage return)	45	2D	055	#45;	-	77	4D	115	#77;	M	109	6D	155	#109;	m
14	E	016	SO (shift out)	46	2E	056	#46;	.	78	4E	116	#78;	N	110	6E	156	#110;	n
15	F	017	SI (shift in)	47	2F	057	#47;	/	79	4F	117	#79;	O	111	6F	157	#111;	o
16	10	020	DLE (data link escape)	48	30	060	#48;	0	80	50	120	#80;	P	112	70	160	#112;	p
17	11	021	DC1 (device control 1)	49	31	061	#49;	1	81	51	121	#81;	Q	113	71	161	#113;	q
18	12	022	DC2 (device control 2)	50	32	062	#50;	2	82	52	122	#82;	R	114	72	162	#114;	r
19	13	023	DC3 (device control 3)	51	33	063	#51;	3	83	53	123	#83;	S	115	73	163	#115;	s
20	14	024	DC4 (device control 4)	52	34	064	#52;	4	84	54	124	#84;	T	116	74	164	#116;	t
21	15	025	NAK (negative acknowledge)	53	35	065	#53;	5	85	55	125	#85;	U	117	75	165	#117;	u
22	16	026	SYN (synchronous idle)	54	36	066	#54;	6	86	56	126	#86;	V	118	76	166	#118;	v
23	17	027	ETB (end of trans. block)	55	37	067	#55;	7	87	57	127	#87;	W	119	77	167	#119;	w
24	18	030	CAN (cancel)	56	38	070	#56;	8	88	58	130	#88;	X	120	78	170	#120;	x
25	19	031	EM (end of medium)	57	39	071	#57;	9	89	59	131	#89;	Y	121	79	171	#121;	y
26	1A	032	SUB (substitute)	58	3A	072	#58;	:	90	5A	132	#90;	Z	122	7A	172	#122;	z
27	1B	033	ESC (escape)	59	3B	073	#59;	;	91	5B	133	#91;	[	123	7B	173	#123;	{
28	1C	034	FS (file separator)	60	3C	074	#60;	<	92	5C	134	#92;	\	124	7C	174	#124;	
29	1D	035	GS (group separator)	61	3D	075	#61;	=	93	5D	135	#93;	]	125	7D	175	#125;	}
30	1E	036	RS (record separator)	62	3E	076	#62;	>	94	5E	136	#94;	^	126	7E	176	#126;	~
31	1F	037	US (unit separator)	63	3F	077	#63;	?	95	5F	137	#95;	_	127	7F	177	#127;	DEL

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Unit Conversion

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