Application Note #148:

Procedure to Convert between Decimal, Hexadecimal and ASCII Formats

INTRODUCTION

When fine tuning the iModem's performance, it is convenient to have a simple procedure – and the associated look-up tables – readily available to assist with conversions between decimal, hexadecimal and ASCII. This application note is intended to serve as a handy reference to facilitate these conversion activities.

DECIMAL TO HEXADECIMAL CONVERSION

Table 1 contains a conversion lookup chart that allows easy conversion between decimal and hexadecimal for values to decimal 99.

Table 1. Decimal to Hexadecimal Conversion Table.

HEX	DEC	HEX	DEC	HEX	DEC	HEX	DEC
00	00	19	25	32	50	4B	75
01	01	1A	26	33	51	4C	76
02	02	1B	27	34	52	4D	77
03	03	1C	28	35	53	4E	78
04	04	1D	29	36	54	4F	79
05	05	1E	30	37	55	50	80
06	06	1F	31	38	56	51	81
07	07	20	32	39	57	52	82
08	08	21	33	3A	58	53	83
09	09	22	34	3B	59	54	84
0A	10	23	35	3C	60	55	85
0B	11	24	36	3D	61	56	86
0C	12	25	37	3E	62	57	87
0D	13	26	38	3F	63	58	88
0E	14	27	39	40	64	59	89
0F	15	28	40	41	65	5A	90
10	16	29	41	42	66	5B	91
11	17	2A	42	43	67	5C	92
12	18	2B	43	44	68	5D	93
13	19	2C	44	45	69	5E	94
14	20	2D	45	46	70	5F	95
15	21	2E	46	47	71	60	96
16	22	2F	47	48	72	61	97
17	23	30	48	49	73	62	98
18	24	31	49	4A	74	63	99

The following simple algorithm may be employed to calculate the hexadecimal equivalent of a decimal number and is accurate for numbers to 255 decimal. This algorithm is expandable to decimal numbers >255 by including additional division steps using higher powers of 16. For instance, division by 16^2 (i.e., 256 decimal) extends the algorithm to FFF hexadecimal (or 4095 decimal). However, extension beyond FF hexadecimal (i.e., 255 decimal) is not needed for the case of email addresses because each segment of the address is limited to one octet or hexadecimal FF.

Step 1. Divide the decimal number by 16. Keep the whole number portion of the dividend, but ignore the remainder. If the whole number portion is 0, then 0 is to placed in the 16^1 column. See step 2 below.

Step 2. Convert the decimal dividend to hexadecimal. This number shall be placed in the 16^1 column.

Step 3. Take the decimal dividend (excluding the remainder) from step 1 and multiply by 16.

Step 4. Subtract the result obtained in step 3 from the initial decimal number to be converted in step 1.

Step 5. Convert the result from step 4 to hexadecimal. This number shall be placed in the 16^0 column.

Note that the calculator function provided as part of the Microsoft Windows 95, 97 and 2000 Accessories application will perform conversions between decimal and hexadecimal.

Example 1: Convert decimal **25** to its hexadecimal equivalent using Table 1.

Find **25** under **DEC** column. Staying in the same row, read the entry immediately to the right under the **HEX** column. This is the hexadecimal equivalent.

DEC: **25**
HEX: **19**

Example 2: Convert hexadecimal **6A** to its decimal equivalent using Table 1.

Find **6A** under **HEX** column. Staying in the same row, read the entry immediately to the left under the **DEC** column. This is the decimal equivalent.

HEX: **5A**
DEC: **90**

Example 3 below contains a more complicated hexadecimal conversion case. This example also highlights some aspects of hexadecimal email addresses that may not be common knowledge.

Example 3: Primenet identifies its outgoing email server by the name: **smtp.primenet.com**, and by the decimal IP address: **206.165.6.132**. Convert the decimal address **206.165.6.132** to its hexadecimal equivalent.

Treat each set of digits delimited by decimal points as a unique 3 digit decimal number. Convert each 3 digit decimal number into an equivalent 2 digit hexadecimal number.

Use the decimal to hexadecimal algorithm above to convert **206** decimal to its hexadecimal equivalent.

Step 1: **206**/16=12.875. Keep the whole number, **12**, and ignore the remainder.

Step 2: Convert decimal **12** to hexadecimal using Table 1.

DEC: **12**
HEX: **C**

Step 3: **12**x16=192.

Step 4: **206**-192=**14**.

Step 5: Convert decimal **14** to hexadecimal using Table 1.

DEC: **14**

HEX: **E**

The equivalent hexadecimal is **CE**.

Using the same procedure defined above, the remaining segments of the email address are converted as follows:

DEC: **165**
HEX: **A5**

DEC: **6**
HEX: **06**

DEC: **132**
HEX: **84**

The equivalent hexadecimal address is **CE.A5.06.84**.

Hexadecimal to ASCII Conversion

Table 2 contains a conversion lookup chart that allows easy conversion between hexadecimal and ASCII.

Example 4: Convert hexadecimal 0D to ASCII equivalent.

Find **OD** under **HEX** column. Staying in the same row, the entry immediately to the right under the **ASCII** column is the ASCII equivalent.

HEX: **0D**
ASCII: **<CR>**

Example 5: Convert ASCII K to hexadecimal equivalent.

Find **G** under **ASCII** column. Staying in the same row, the entry immediately to the left under the **HEX** column is the hexadecimal equivalent.

ASCII: **K**
HEX: **4B**

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Table 2. Hexadecimal to ASCII Conversion Table.

HEX	ASCII	HEX	ASCII	HEX	ASCII	HEX	ASCII
00	NUL	20	SP space	40	@	60	` grave
01	SOH	21	!	41	A	61	a
02	STX	22	“	42	B	62	b
03	ETX	23	#	43	C	63	c
04	EOT	24	$	44	D	64	d
05	ENQ	25	%	45	E	65	e
06	ACK	26	&	46	F	66	f
07	BEL beep	27	‘ apostr.	47	G	67	g
08	BS back sp	28	(	48	H	68	h
09	HT tab	29	)	49	I	69	i
0A	<LF> linefeed	2A	*	4A	J	6A	j
0B	VT	2GB	+	4B	K	6B	k
0C	FF	2C	‘ comma	4C	L	6C	l
0D	<CR> return	2D	- dash	4D	M	6D	m
0E	SO	2E	. period	4E	N	6E	n
0F	SI	2F	/	4F	O	6F	o
10	DLE	30	0	50	P	70	p
11	DC1	31	1	51	Q	71	q
12	DC2	32	2	52	R	72	r
13	DC3	33	3	53	S	73	s
14	DC4	34	4	54	T	74	t
15	NAK	35	5	55	U	75	u
16	SYN	36	6	56	V	76	v
17	ETB	37	7	57	W	77	w
18	CAN	38	8	58	X	78	x
19	EM	39	9	59	Y	79	y
1A	SUB	3A	:	5A	Z	7A	z
1B	ESC	3B	;	5B	[	7B	{
1d	FS	3C	<	5C	\	7C	|
1D	GS	3D	=	5D	]	7D	}
1E	RS	3E	>	5E	^	7E	~
1F	US	3F	?	5F	_ under	7F	DEL delete

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