REPRESENTING NUMBERS

DECIMAL	BINARY	OCTAL	HEXADECIMAL
0	000	0	0
1	001	1	1
2	010	2	2
3	011	3	3
4	100	4	4
5	101	5	5
6	110	6	6
7	111	7	7
8	1000	10	8
9	1001	11	9
10	1010	12	A
11	1011	13	B
12	1100	14	C
13	1101	15	D
14	1110	16	E
15	1111	17	F
16	10000	20	10

...

$255=2^8-1$ 11111111 (8 bits = 1 byte)

...

$1023=2^{10}-1$ 1111111111 (10 bits) $2^{10}=1024=1K$

....

$4095=2^{12}-1$ 111111111111 (12 bits)

...

$32767=2^{15}-1$ 111111111111111 (15 bits)

$65535=2^{16}-1$ 1111111111111111 (16 bits = 1 word = 2 bytes)

Therefore, n bits can represent 2^n numbers, 0 --> 2^n-1 (fixed point)

For negative numbers, "two's complement" notation is used where the most significant bit is a "sign bit" (0 for positive, 1 for negative). The process is: invert all bits and add 1. For example:

for 12 bits, 4096 numbers can be represented (0 ->2047,-1 -> -2048)
for 16 bits, 65536 numbers can be represented

max positive:	32767	0111111111111111
	0	0000000000000000
	-1	1111111111111111
max negative:	-32768	1000000000000000

For "real numbers" (with decimals) either use "floating point" notation where groups of bits represent the exponent and mantissa or assign n bits as integers and 16-n bits as the "fraction".

For example, with a 1K wavetable (1024 values), the address of any value can be referenced as an "index" to be added to the base address of the table, where the index goes from 0 to 1023, and can be represented by 10 bits. With a 16-bit word, the remaining 6 bits can function as a "fraction" as if the table were actually 2^{16} in size. Therefore the frequency resolution using the table is:

$$\Delta f = \text{Sampling Rate/Table Size} = 2^{15} / 2^{16} = 0.5 \text{ Hz}$$

$$\text{SR} \quad / \quad \text{N}$$

To step through a wavetable, size N, at sampling rate SR, to produce a frequency F:

$$\text{Sample Increment} = F . N / SR$$

$$F = SI . SR / N$$