

Section 8: Bit Manipulation and Control Features

With the powerful bit manipulation and control features of XYBASIC you can perform tasks which would otherwise require assembly language programs. Additional commands make it possible to perform real time delays without a real time clock.

Integer Representations

XYBASIC lets you specify integers in the decimal notation you normally use, but it actually stores them in a notation which is more convenient (and efficient) for your computer. The memory of your 8080 system consists of many bytes, each capable of storing 8 bits, i.e. $2^8 = 256$ possible values. XYBASIC uses two bytes (16 bits) to store $2^{16} = 65536$ possible integer values, and uses those values to represent integers between -32768 and 32767. Positive integers between 0 and 32767 are stored in their binary representation; for example, 4 decimal is 0000 0000 0000 0100 binary and 32766 decimal is 0111 1111 1111 1110 binary. Integers between -32768 and -1 are stored in two's complement representation, found by complementing each digit of the binary representation of the integer's absolute value, and then adding 1 to the result. For example, -4 decimal is 1111 1111 1111 1011 + 1 = 1111 1111 1111 1100 binary, and -32766 decimal is 1000 0000 0000 0001 + 1 = 1000 0000 0000 0010 binary.

In keeping with standard 8080 conventions the rightmost (least significant) bit of an integer value is called bit 0, and the leftmost (most significant) bit is called bit 15. Many of the bit manipulation functions described below use bit numbers to specify bits to be examined or changed.

Sometimes you may want to consider the representation of an integer to be an unsigned 16-bit value between 0 and 65535, so that for example 1000 0000 0000 0010 binary represents 32770 instead of -32766. In particular, commands or functions (like POKE and PEEK) which take memory addresses as arguments consider such arguments to be unsigned 16-bit representations. You can PRINT the unsigned value of a formula with the function UNS, described in Section 3.

In Extended XYBASIC, any floating point values you use as arguments to control and bit manipulation functions are automatically truncated to integer values, as described under Conversions in Section 3.

TEST

The TEST function allows you to examine a specified bit in an integer value, returning the value (zero or one) of the bit. The first argument of TEST specifies the variable or formula you wish to TEST, the second which bit you wish to look at. Suppose for example that you want to look at bit 2 of I, which contains 7 (binary &111). Just type

```
PRINT TEST (I,2)
```

```
1
OK
```

The following binary conversion program using TEST will show you how useful