Digital Video Cursor Generator

by Stephen Beck

This abstract describes an all digital technique for locating two coordinates on the TV raster plane. It incorporates the "absolute position counter" scheme described elsewhere in my papers.

Refering to the drawing see that the circuit consists of two 8 bit synchronous counters. (Other bit lengths may be used for more or less resolution, depending upon desired results.)

The H counter identifies pixel locations while the V counter identifies line locations. Counter H is clocked with a high freqency pulse train Ø, derived from either subcarrier @ 3.58 MHz or a crystal clock of 1-2 MHz. The former yields 187 pixels/line with a duration of 280 nsec, while a clock of 2.44 Mhz yields 128 pixels/line with duration of 410 nsec; both values refer to the active part of the video line only (52.5 usec).

Horizontal drive HD clears the H counter at the end of each line. HD also serves as the clock pulse to the V counter which counts each line of the TV scan sequentially. Each TV field contains 262½ lines with 10 inactive lines, a convenient figure for an 8 bit counter. The V counter is cleared by vertical drive VD pulses at the end of each field.

Thus the two counters, driven only by existing video system pulses specify coordinates (H,V) of the raster at all times. These two counters are the only master counters required to drive many video position circuits, and need only be appropriately buffered to service ten or twenty position units.

The output bits of each counter feed one set of input ports of two 8-bit comparators (DM7200). The other input port of each comparator is in turn fed from one of two 8-bit counters called h and v.

Counters h and v are up/down, programmable types of the 74193 variety. The cursor movement clock Ø1 is steered to each counter via two gates which are controlled by pushbutton switches. Each counter may be incremented or decremented by pushing the appropriate button, and continues to be clocked as long as the button is held. The speed of clocking is set by the frequency of clock Ø1. If VD is used as this clock, approximately 4 seconds is required for the complete cycle for each counter.

When corrdinates (h,v)=(H,V) the X and Y outputs of each comparator are both active high (logical 1). Some NAND gating, inversion, and additional NAND gating of these pulses produce the cursor pulse outputs, in complementary form, at the single location specified by (h,v). The negative going pulse can be used to write a word into RAM memory at this point, while the positive pulse can be fed out as video, indicating a bright point at the coordinate.

When switch SW1 is activated, the coordinate spot moves left on the screen by virtue of the value in counter h being decreased, or thespot moves right on the screen if SW2 is depressed because the value in the h counter increses. By a similar action in the v counter pushing SW3 moves the spot up the screen, and pushing SW4 moves the spot down the screen. Obviously, using two combinations of h and v switches, the spot can be moved diagonally.

If a movement clock Ø1 of VD is used (60 Hz), the vertical movement will be 60 lines/ second, traversing the screen height in about 4 seconds, while the horizontal movement will be 60 pixels/sec., traversing the width of the screen in about 3 seconds for a pixel clock Ø of 3.58 Mhz.

An additional aspect of motion can be acheived with the following modifications to the circuit. 1) The speed of movement can be varied by using higher or lower clock frequencis than 60Hz, for clock Ø1. If fact, a variable modulo divider coud be utilized to achieve many possible movement speeds, with programming used to put "english" on the movement. If these dividers are used to divide a 180 Hz clock rate by 4-bits, 15 possible speeds from very fast (cover screen in about 1 sec.) to very slow (cover screen in about 20 seconds) can be acheived. Acceleration or deceleration could be achieved by varying the divide modulus up or down. 2) As an additional improvement, the h and v counters could be fed with separate clocks Ø1 and Ø2 to obtain independent speeds of movement in each dimension, allowing for diagonal movements of any slope.
The most complete motion possibilities for this circuit would be a combination of the modifications 1 and 2.

One final aspect of this cursor generator is its programmable feature. In this mode the h and v counters are jam loaded with coordinate values obtained from locations in master memory. The loading of a new value need only occur once per TV frame (30 Hz) allowing some 16 msec for a new value of coordinate to be computed by a microprocessor. In this manner complex curves may be followed by the cursor under direction of a program.

Once the cursor point is generated, it can be used to draw pictures by activating the RAM write mode of the video weaver circuit, and writing in 1's to fill in colors or 0's to erase colors. The cursor point may also be used to activate the readout of picture cells contained in ROM of symbols or shapes such as a football, puck, birdie, or other plaing piece.

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