

3.2.1 Convergence Waveforms

Six convergence waveforms are output from the Control Module; RH-CONV, RV-CONV, GH-CONV, GV-CONV, BH-CONV and BV-CONV. These allow the red, green and blue components of a projected image to be aligned on top of each other in the horizontal and vertical axes at multiple points on the raster. The waveforms are created by a hybrid digital/analog circuit. For every scan line in the raster, bytes of data are read sequentially from RAM and converted to analog. As the scan progresses from the top of the image to the bottom, the circuit smoothly interpolates from one waveform to another.

The circuitry can be divided into the following sections; RAM, the alpha circuit, and the output stage. These are described below.

3.2.1.1 RAM

Three static RAM chips hold nine rows of 64 correction values for each convergence waveform. RAM U46 stores data for red horizontal and red vertical. Similarly, U65 stores data for the green waveforms, and U75 stores data for blue. Convergence values are loaded into the RAMs by the 68000 microprocessor. PAL U81 decodes the address space defined by chip select CS-WAVE*, producing read and write control signals for each RAM (R-WE*, GATE-R*, G-WE*, GATE-G*, etc).

Each convergence value is a byte of data stored in offset binary form and accessed on the MSB of the 68000's data bus (D8-D15). Values in the range 00H to 7FH produce negative voltage excursions in the final waveform output. Values in the range 81H to FFH produce positive voltages. A value of 80H results in an output of zero volts.

The data bytes are continually read out of the RAMs by the convergence circuitry to produce the waveforms, interrupted only when the 68000 reads or writes convergence data (eg. during user adjustment). Counters implemented within U45, a programmable logic device (PLD), divide the active horizontal scan into 64 time slots (columns), and divide the raster into 8 vertical zones, each containing an equal number of scan lines. The nine rows of data stored in RAM for each waveform lie on the edges of each zone. U45 outputs a column address (RAMA0-RAMA5) and a zone address (RAMA6-RAMA9) to the RAMs. All three RAMs receive the same address from U45 in parallel, and thus output the waveform data in parallel.

Four accesses are made to the RAMs by U45 during each horizontal time slot; two for vertical correction data and two for horizontal correction data. RAMA10 indicates whether the values are vertical or horizontal. The first address of each pair fetches a data byte from each of the RAMs for the zone (n) containing the current scan line. The second address fetches a byte from each RAM at the same horizontal address, but from the following zone (n+1). Each pair of bytes goes to one of six "waveform channels", as described below in section 2.1.3.

The column address (RAMA0-RAMA5) is produced by an up-counter in U45 clocked by WAVE-CLKB. The count begins when a pulse on START-CB is received at the start of a scan line. At the end of the scan line, the counter is reset and data for the beginning of the next line is immediately accessed. This gives the analog output stage as much time as possible during horizontal retrace to slew to the new value before the next line begins.