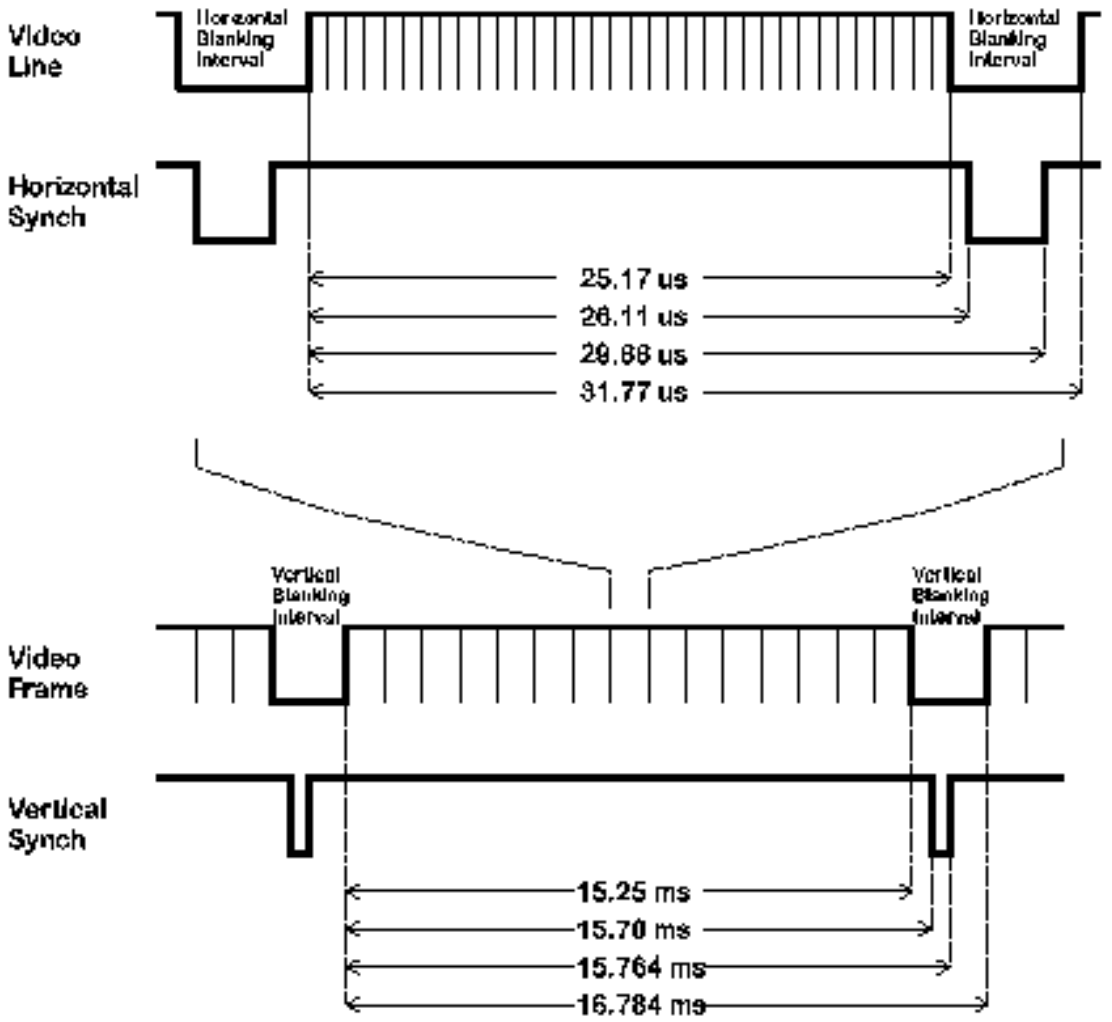
CRT Display Technology

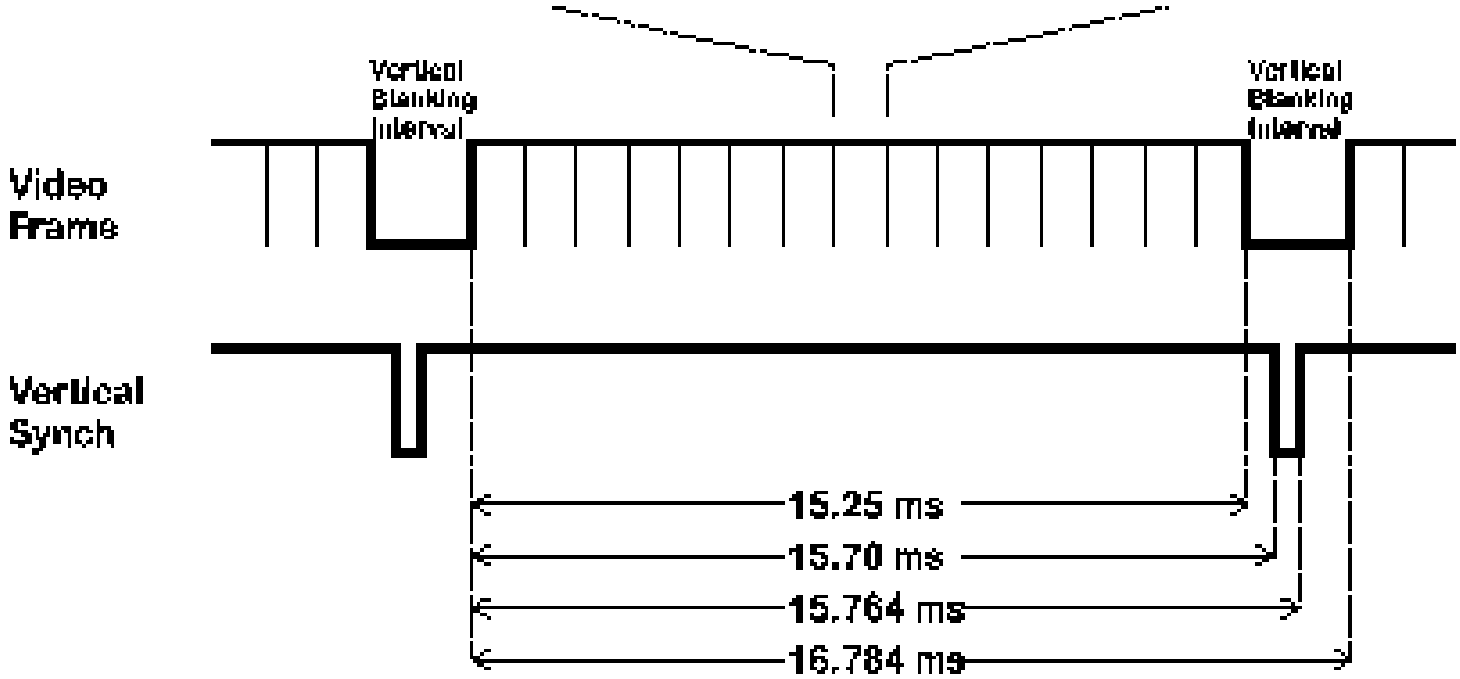
- Cathode Ray Tube
  - Electron gun fires electrons at the screen
  - Electric field steers the electron (X field and Y field)
  - Screen phosphor emits light when electron hits
- Electron beams scans the screen, left-to-right, top-to-bottom
  - As the beam moves, we can set the brightness of each color
  - We turn on each pixel for the right about of time
- We set the horizontal and vertical scan rate using SYNC signals
  - HSYNC - horizontal scan frequency
  - VSYNC - vertical scan frequency
- VGA - Video Graphics Adapter
  - Ancient PC CRT interface standard
  - But still used, just like the 8086 ISA

VGA Timing


Video Line
Horizontal Blanking Interval
Horizontal Blanking Interval
Horizontal Synch
25.17 us
26.11 us
29.68 us
31.77 us
Video Frame
Vertical Blanking Interval
Vertical Blanking Interval
Vertical Synch
15.25 ms
15.70 ms
15.764 ms
16.784 ms

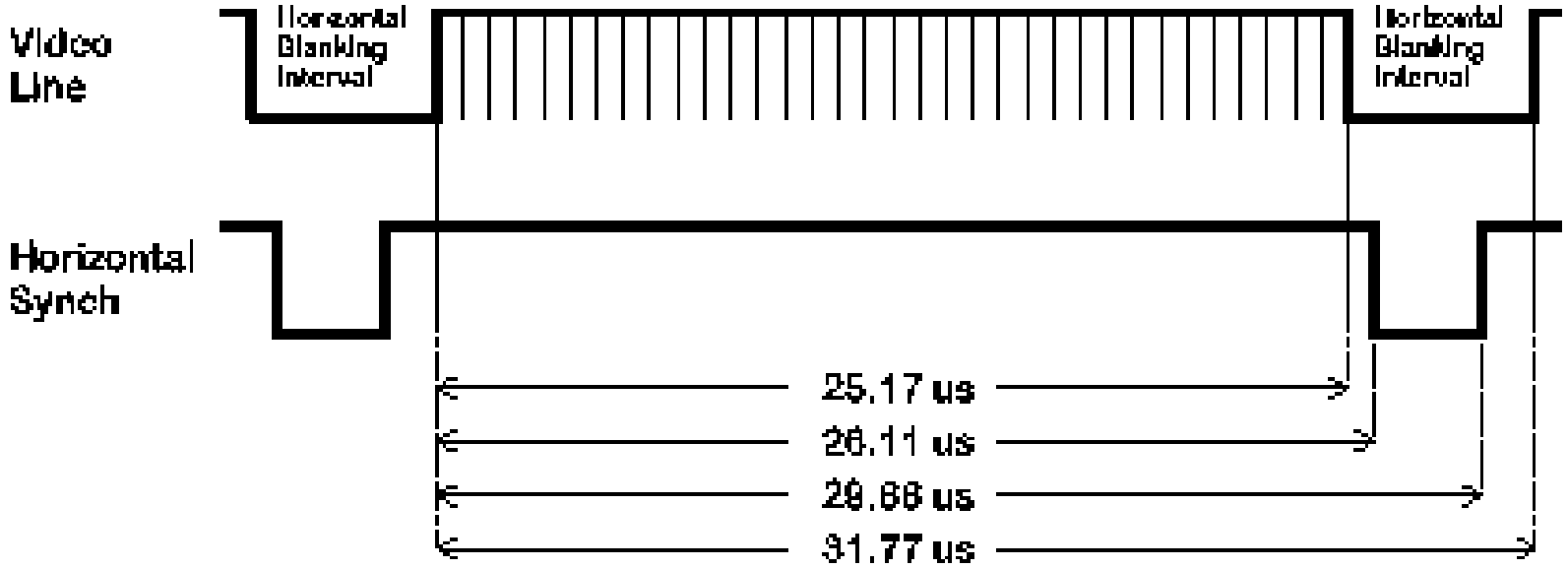
One Frame

- Vertical Synch tells the monitor when to go back to the top
- The Blanking Interval turns off the video at the top and bottom of the screen



One Line

- Each frame is divided into many lines
  - Horizontal synch tells the monitor to go back to the start of the next line
- Each line is divided into pixels
  - No timing signal: just change the value from one pixel to the next



VGA Interface

- This is what the image really looks like
  - Horizontal retrace during HSYNC
  - Vertical retrace during VSYNC
  - "Front porch"
  - "Back porch"