

VGA

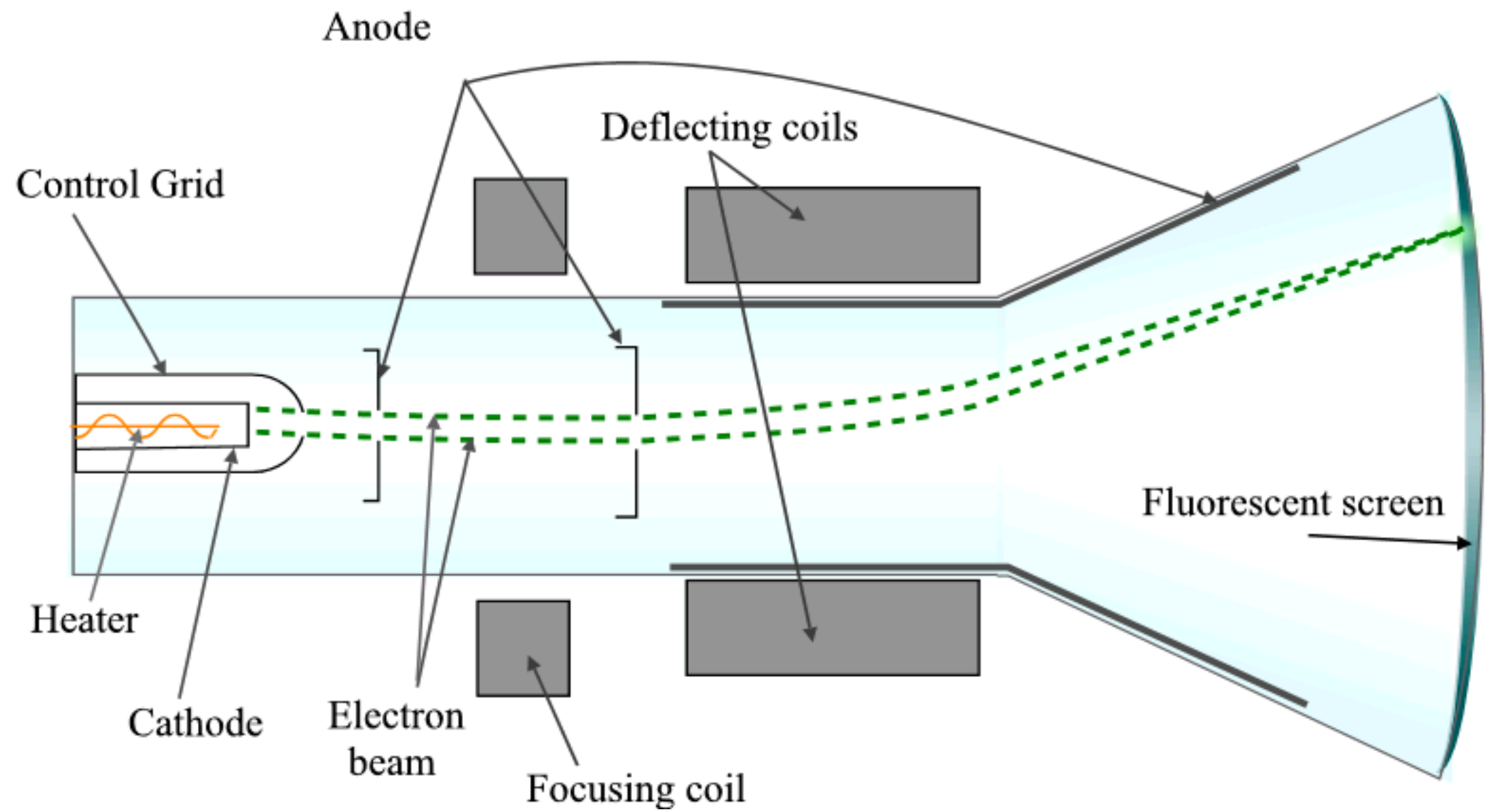
(video graphics array)

ECE3534

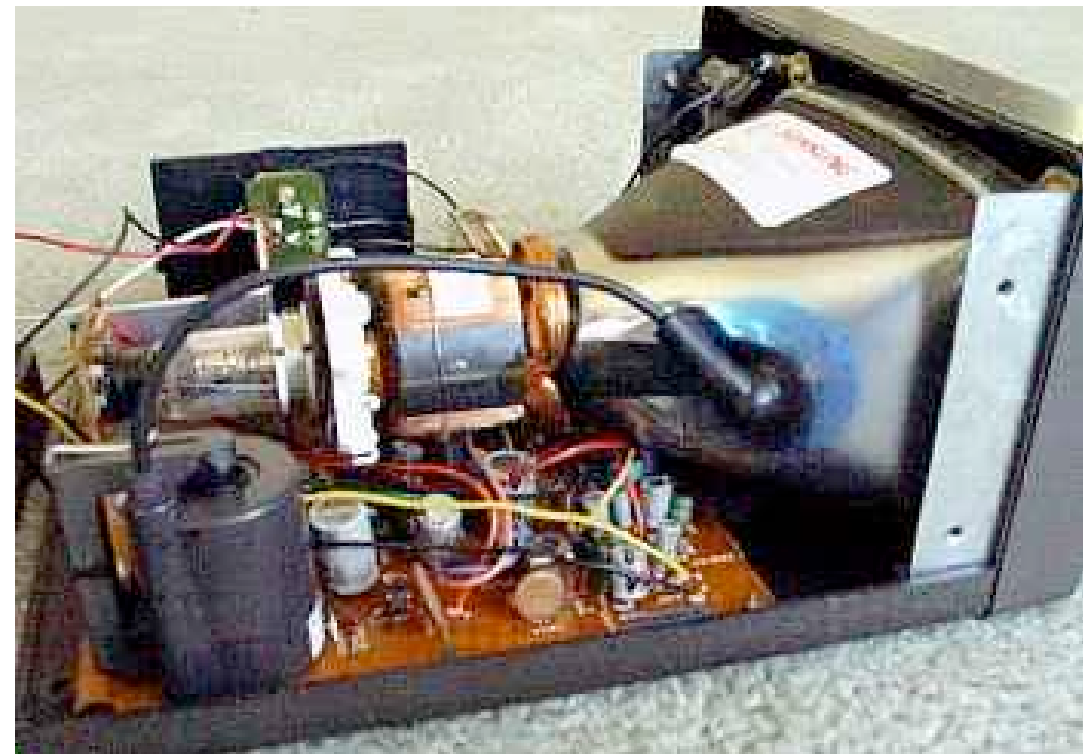
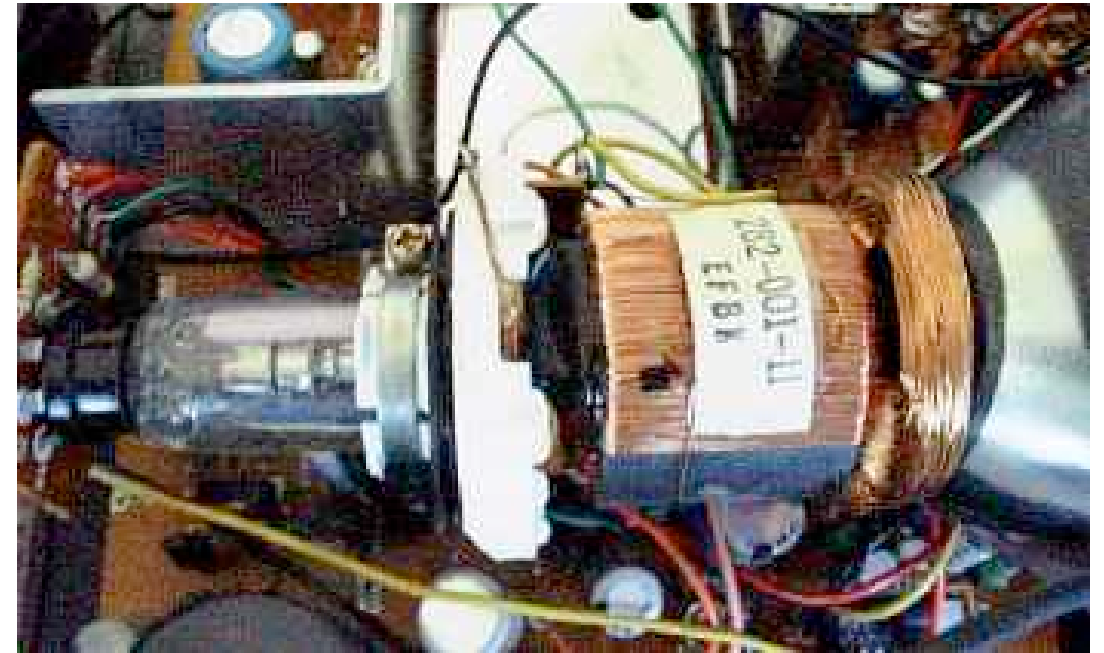
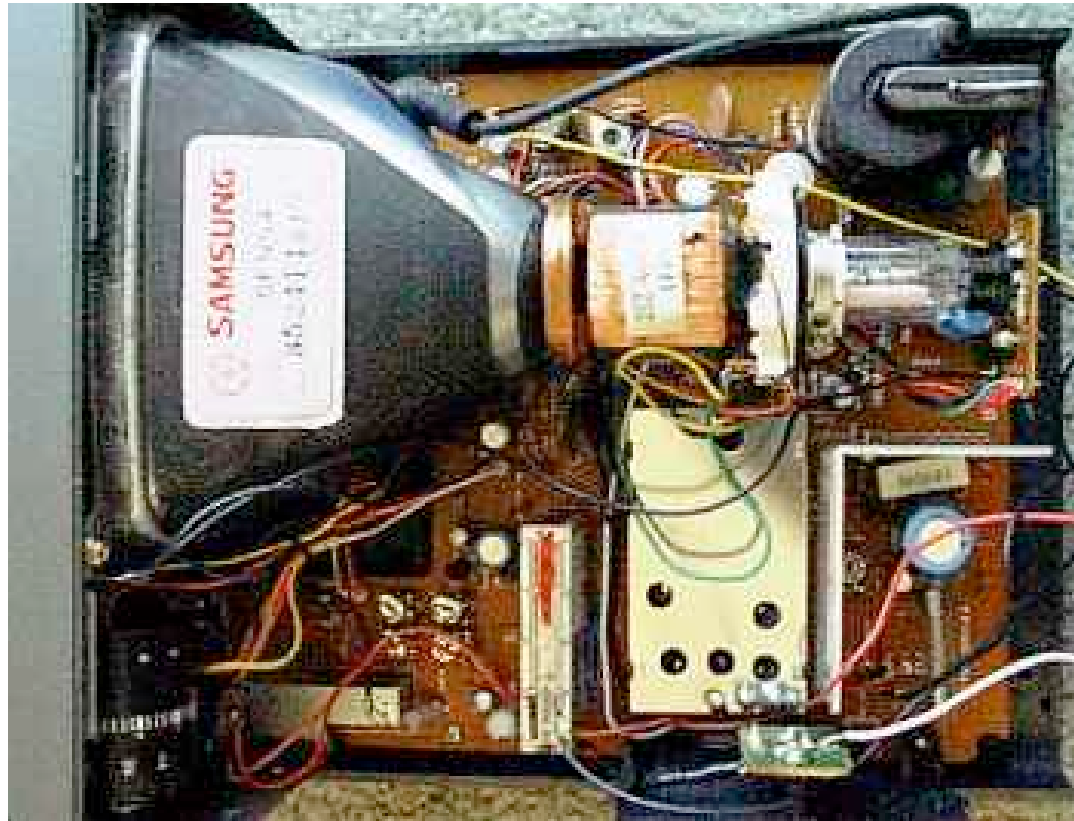
Plug it in



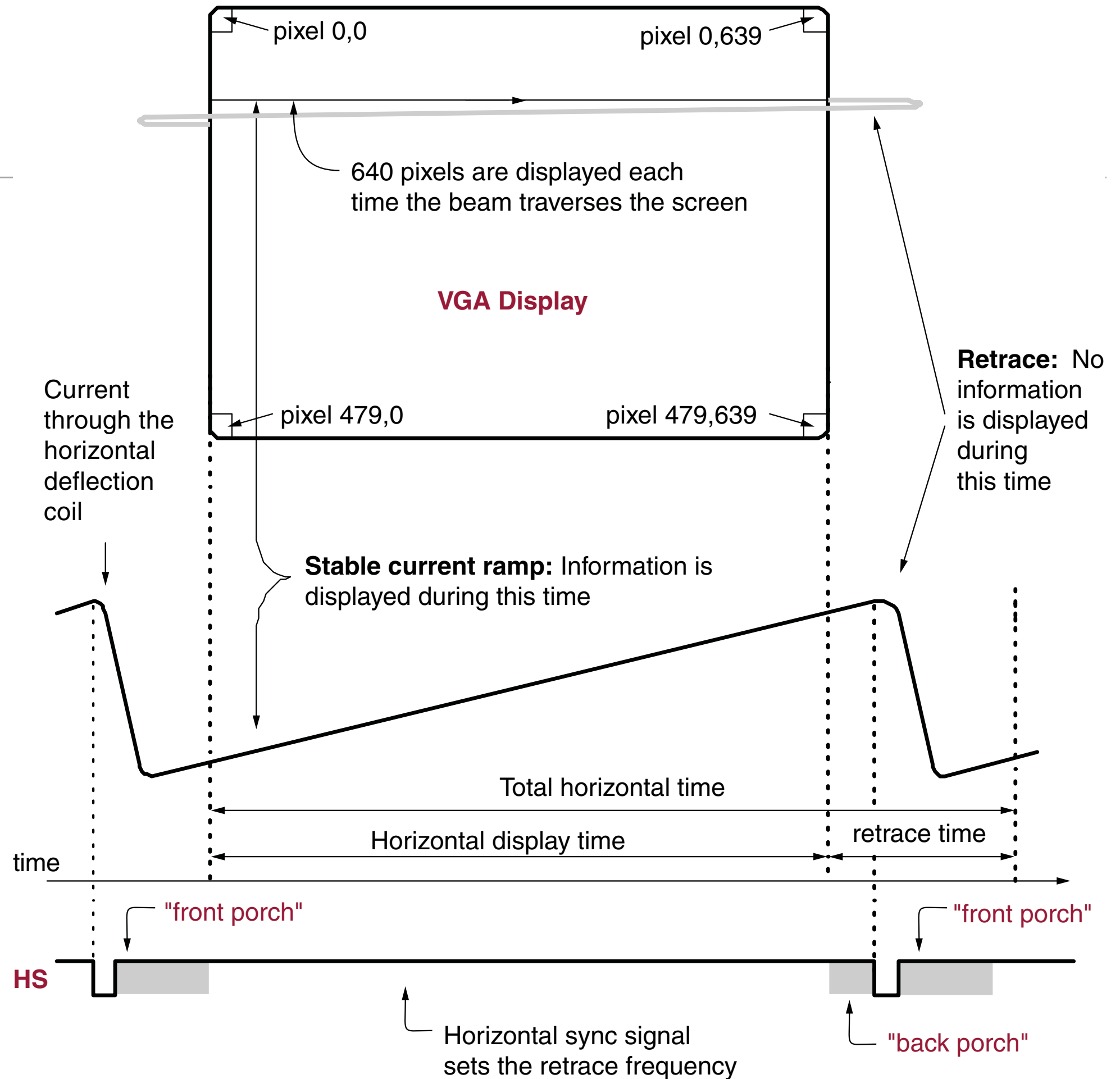
CRT



CRT Guts

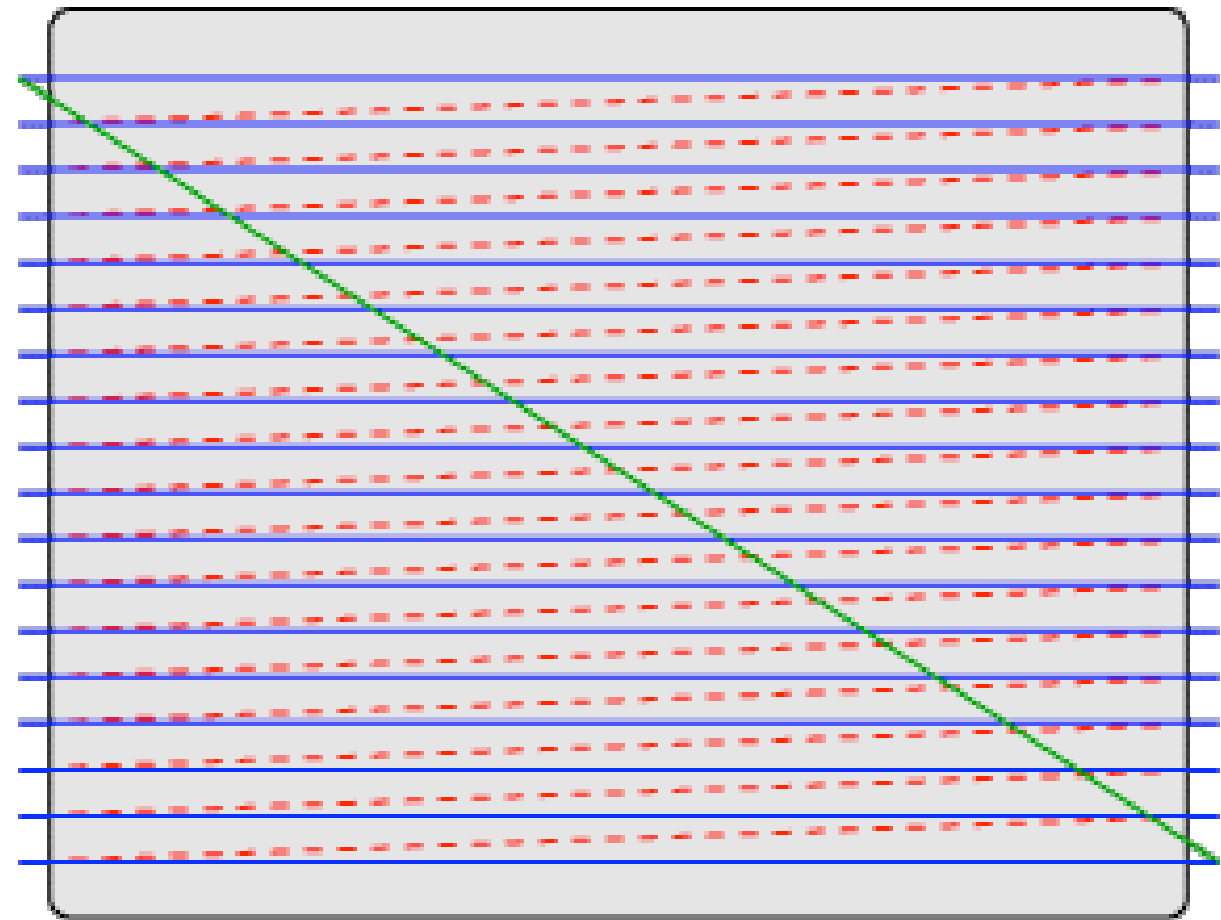


Timing



Scanning

- Electron beam scans across
- Turned off when:
 - Scanning back to the left (horizontal retrace)
 - Scanning to the top (vertical retrace)

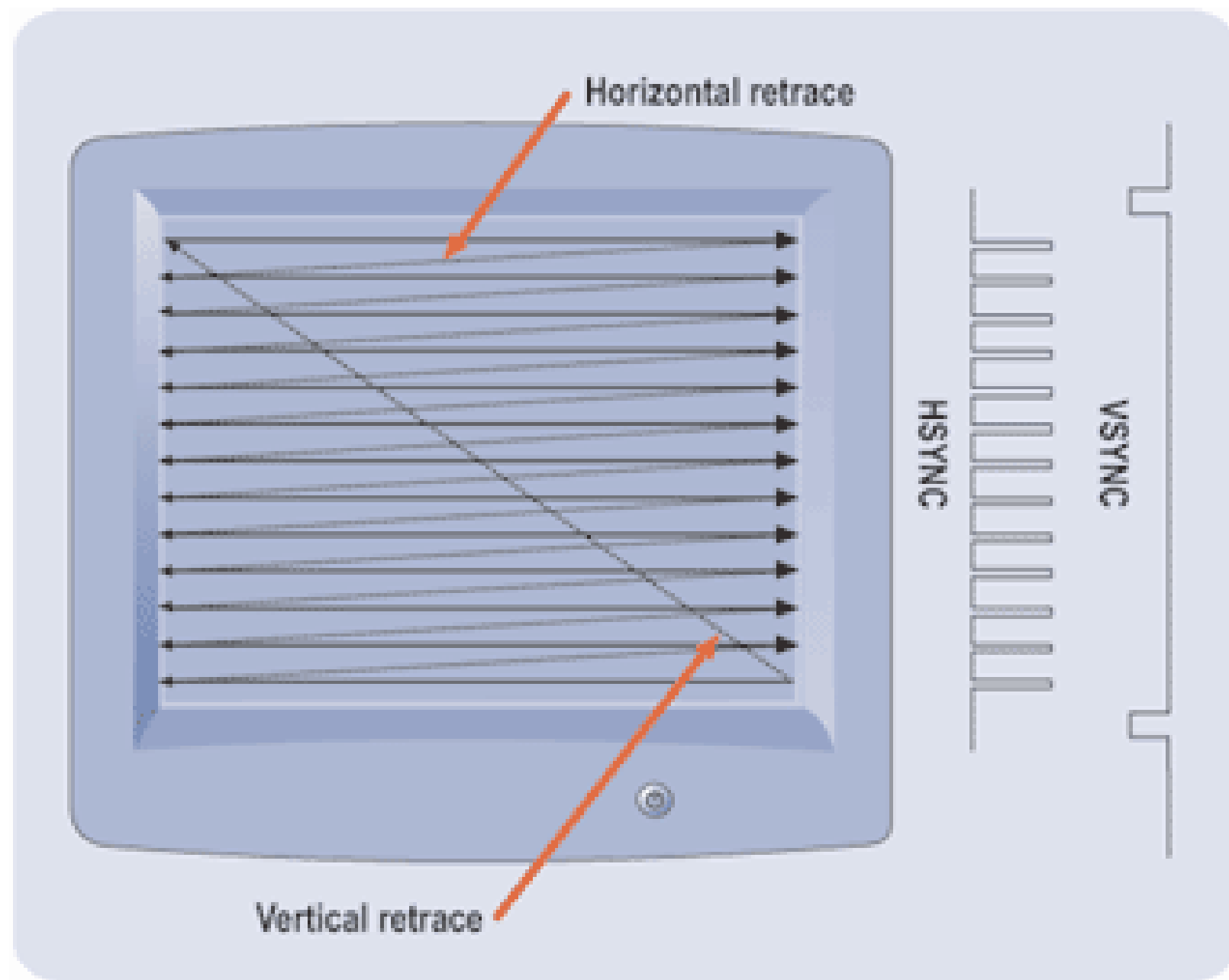


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Scanning

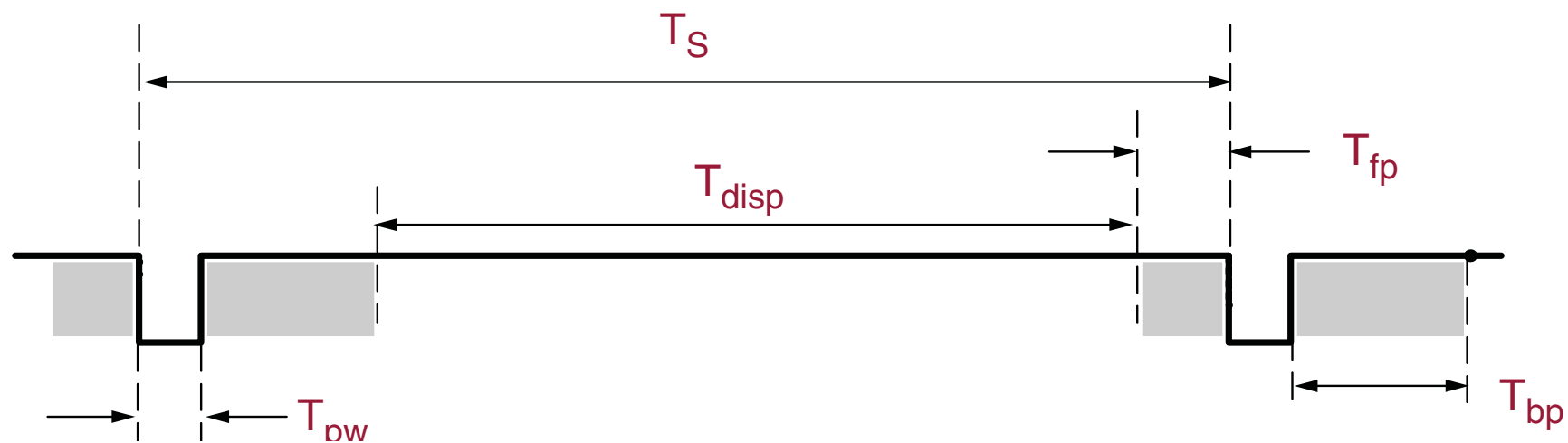
- TVs use interlacing
 - Every other scan line is swept per field
 - Two fields per frame (30Hz)
 - Way to make movement less disturbing
- Computers use progressive scan
 - Whole frame refreshed at once
 - 60Hz or more, 72Hz looks better

Scanning

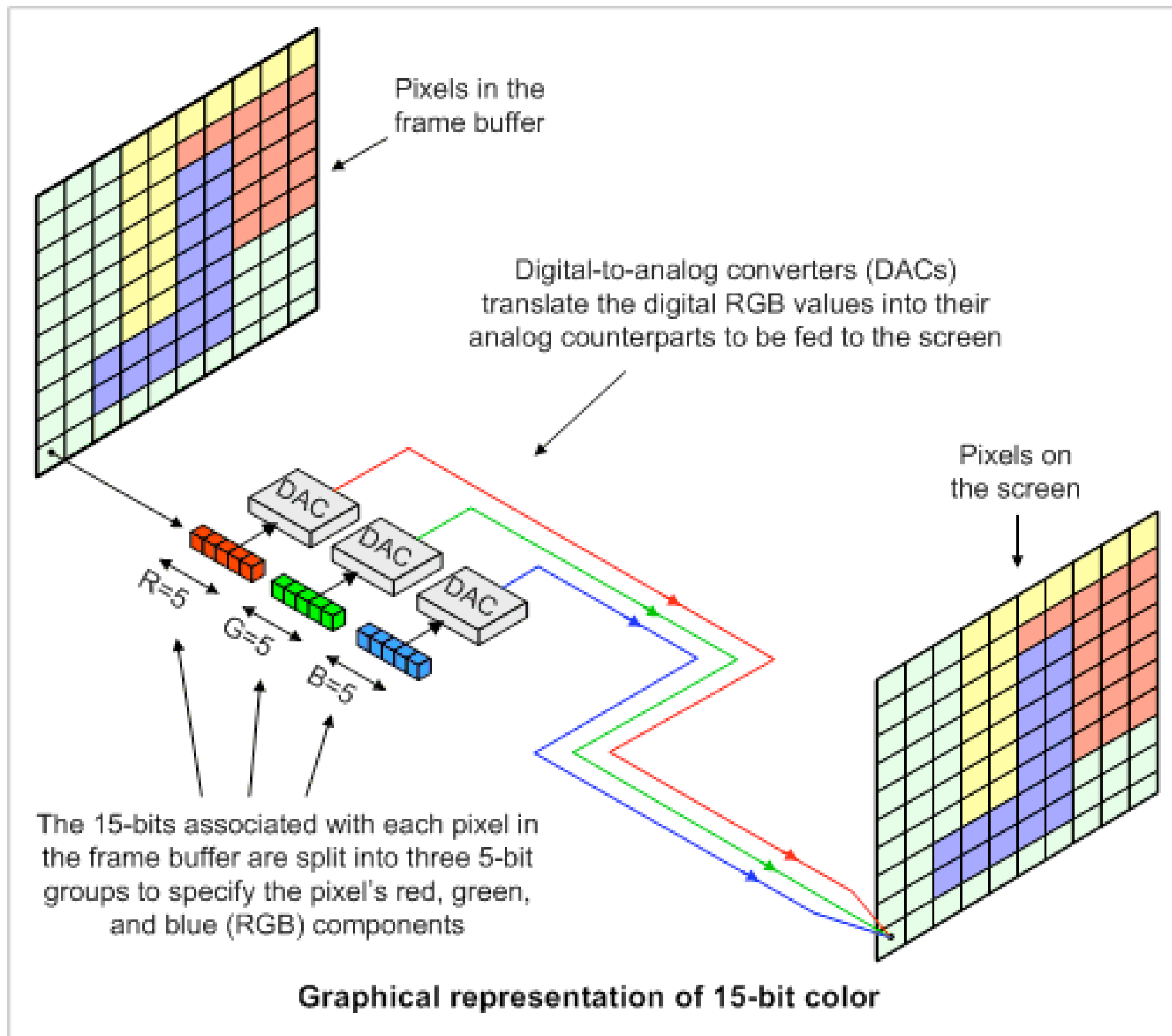


Timing

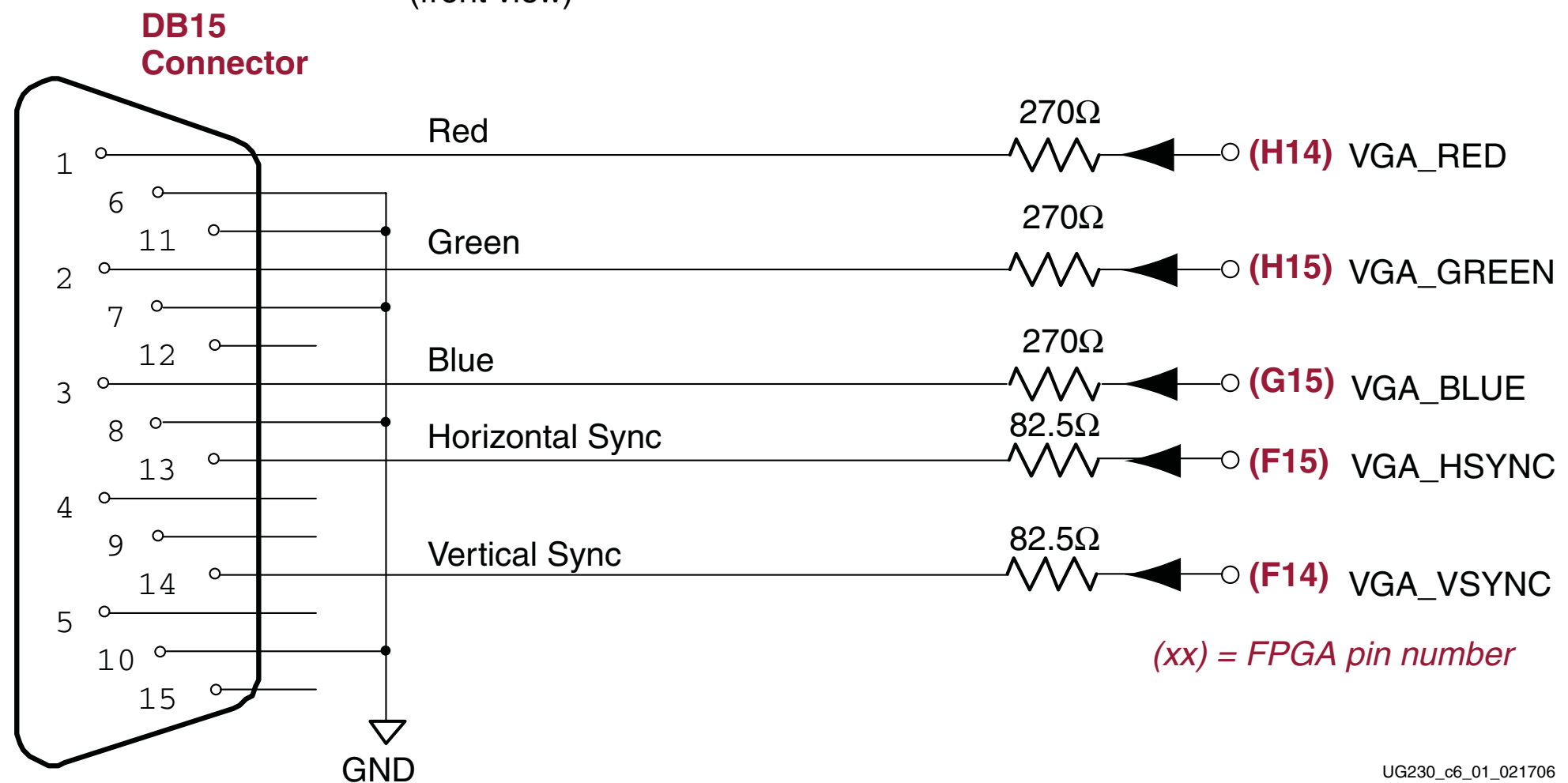
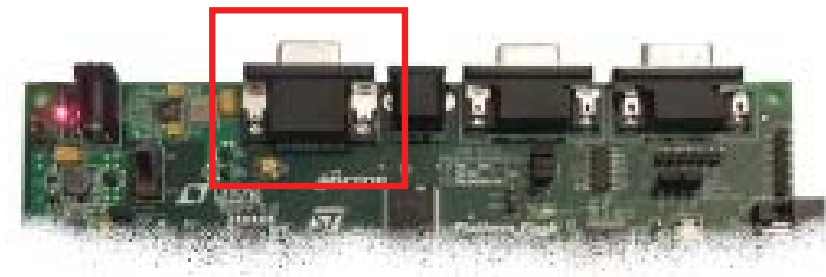
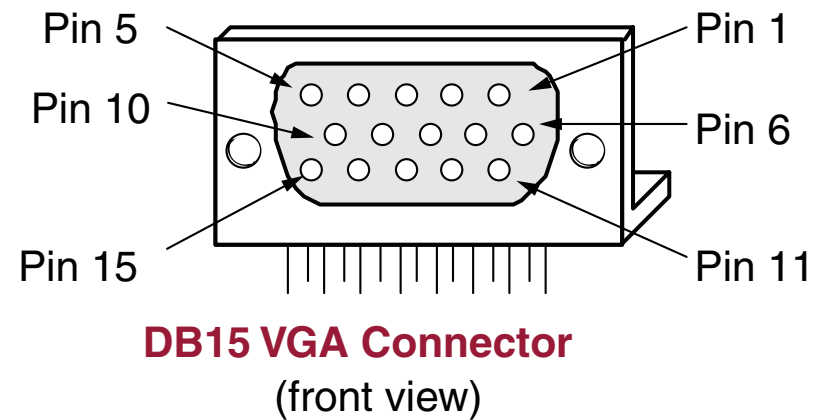
Symbol	Parameter	Vertical Sync			Horizontal Sync	
		Time	Clocks	Lines	Time	Clocks
T_S	Sync pulse time	16.7 ms	416,800	521	32 μ s	800
T_{DISP}	Display time	15.36 ms	384,000	480	25.6 μ s	640
T_{PW}	Pulse width	64 μ s	1,600	2	3.84 μ s	96
T_{FP}	Front porch	320 μ s	8,000	10	640 ns	16
T_{BP}	Back porch	928 μ s	23,200	29	1.92 μ s	48



Pixels to Video

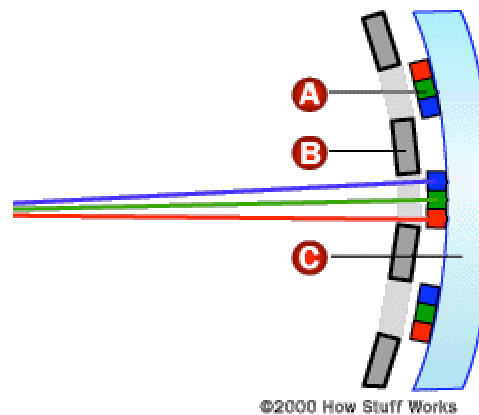


S3E Video



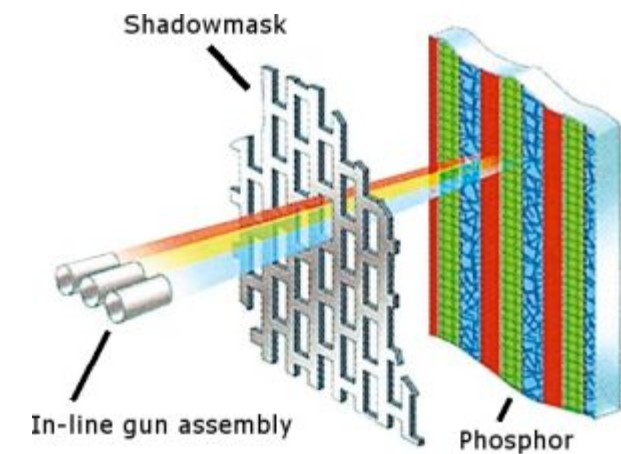
Colors

- Three colors of phosphor
 - Beams hit each
 - Black – beam off
 - White – all on



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- A** Phosphors
- B** Shadow mask
- C** Glass



Picture is a bit misleading. Mask (or aperture grill) ensures beams hit only correct color phosphor.

S3E Colors

VGA_RED	VGA_GREEN	VGA_BLUE	Resulting Color
0	0	0	Black
0	0	1	Blue
0	1	0	Green
0	1	1	Cyan
1	0	0	Red
1	0	1	Magenta
1	1	0	Yellow
1	1	1	White

More Information

- Wikipedia has many useful links:

<http://en.wikipedia.org/wiki/Vga>