
Project 1
World's Worst Video Card

VGA Controller Design Using Verilog

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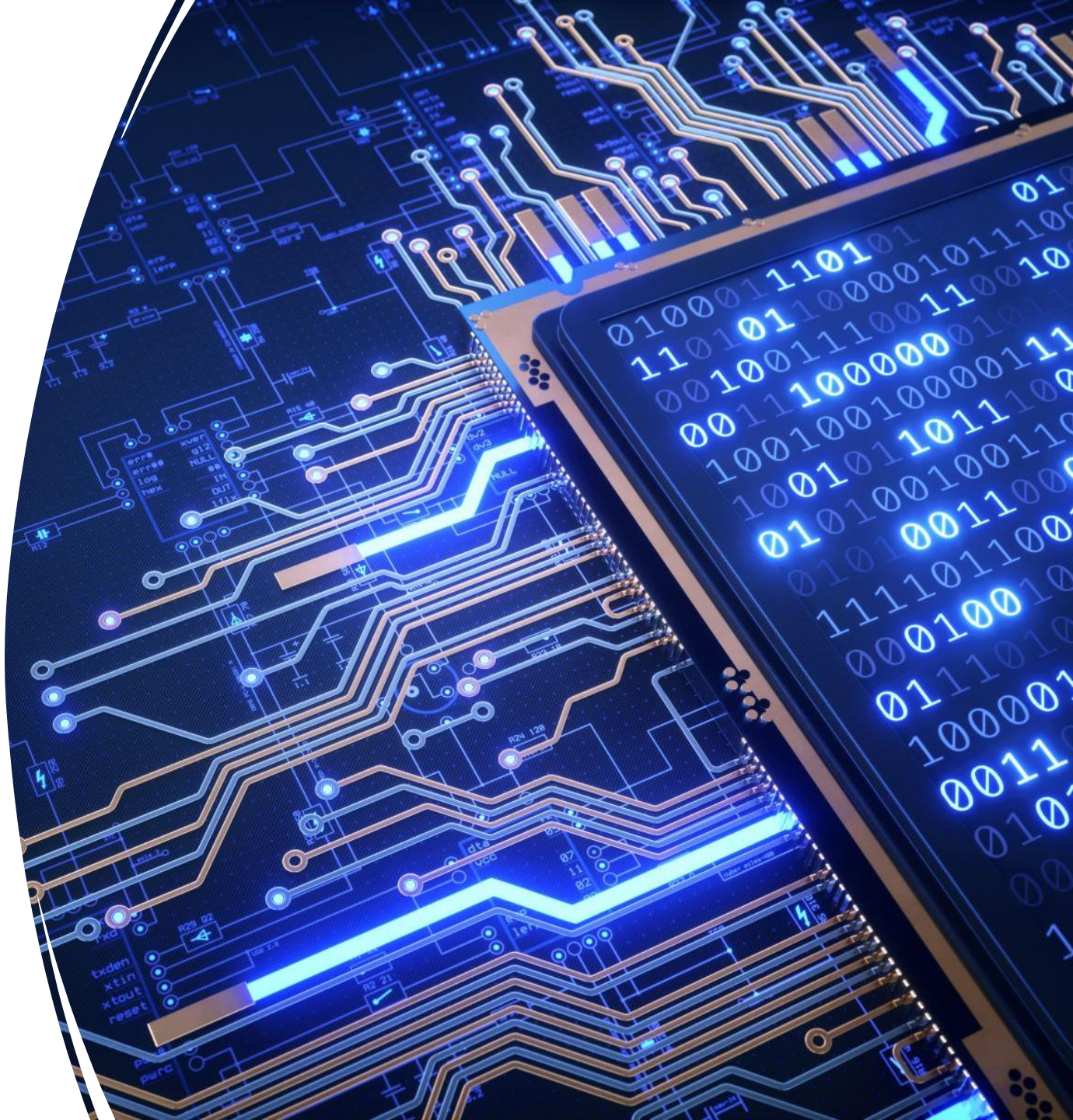
Outlines

- What is VGA
- Idea Of Work
- Architecture of VGA
- RTL Code
- Simulation & Verification

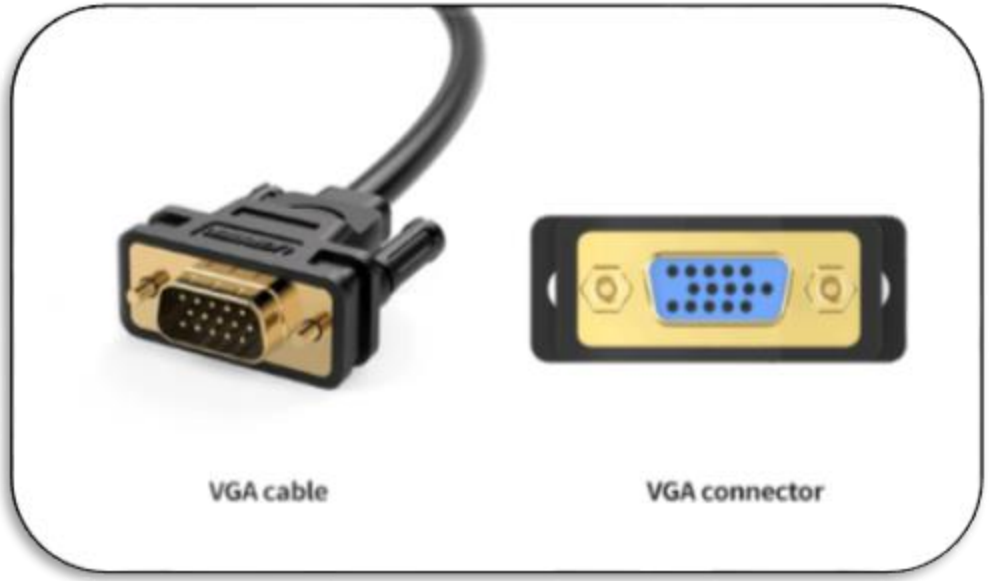


What is VGA

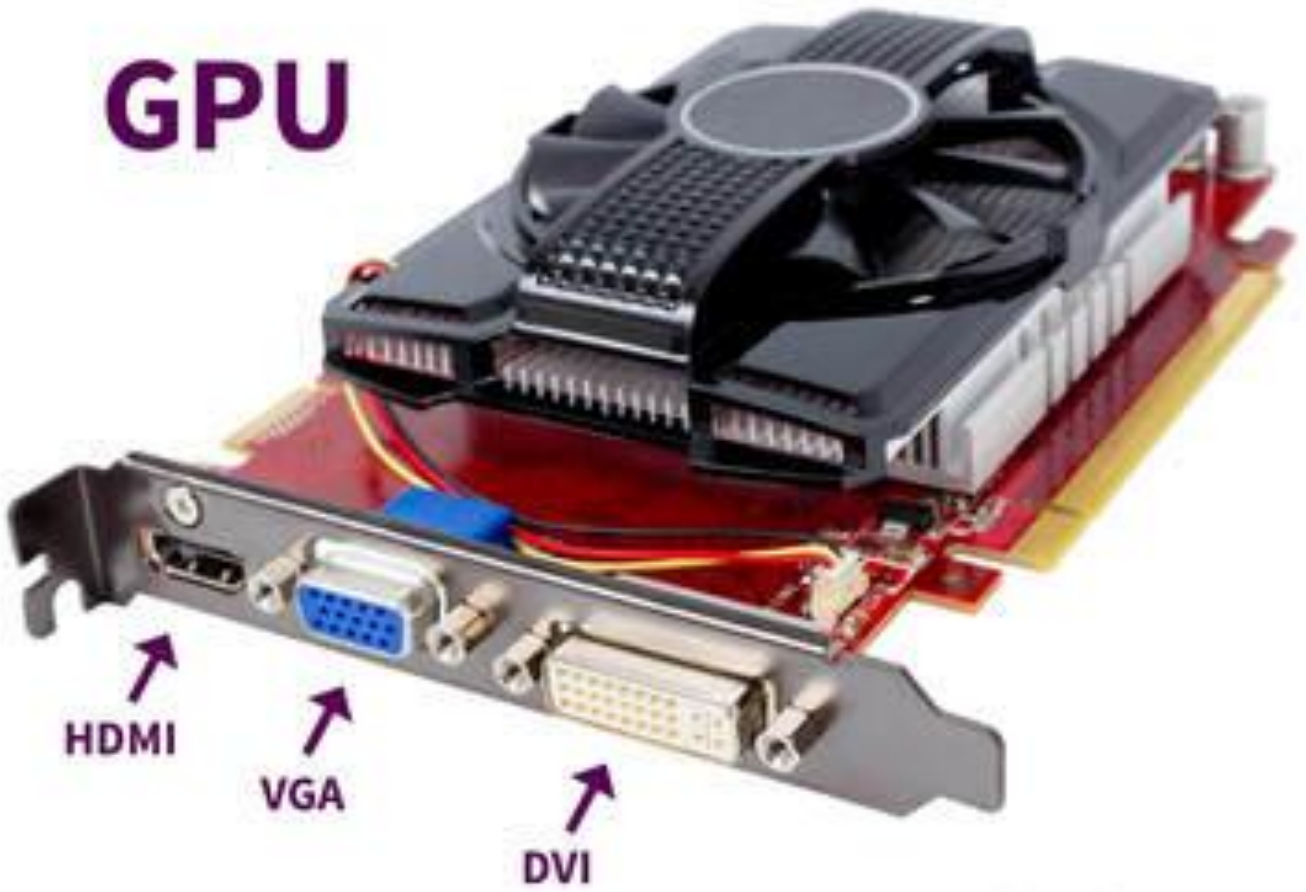
VGA stands for Video Graphics Array

it is a standard display interface used for connecting computers to monitors or other display devices

It was introduced by IBM in 1987

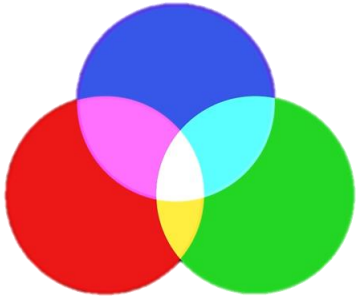


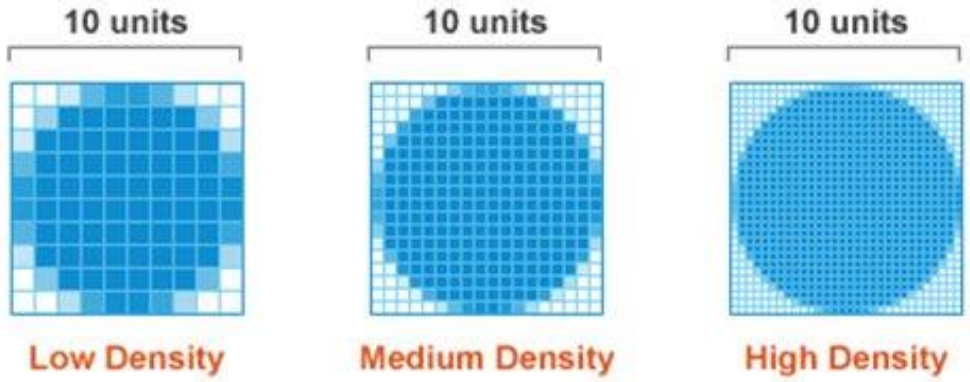
Other Types of Video Graphics Standards

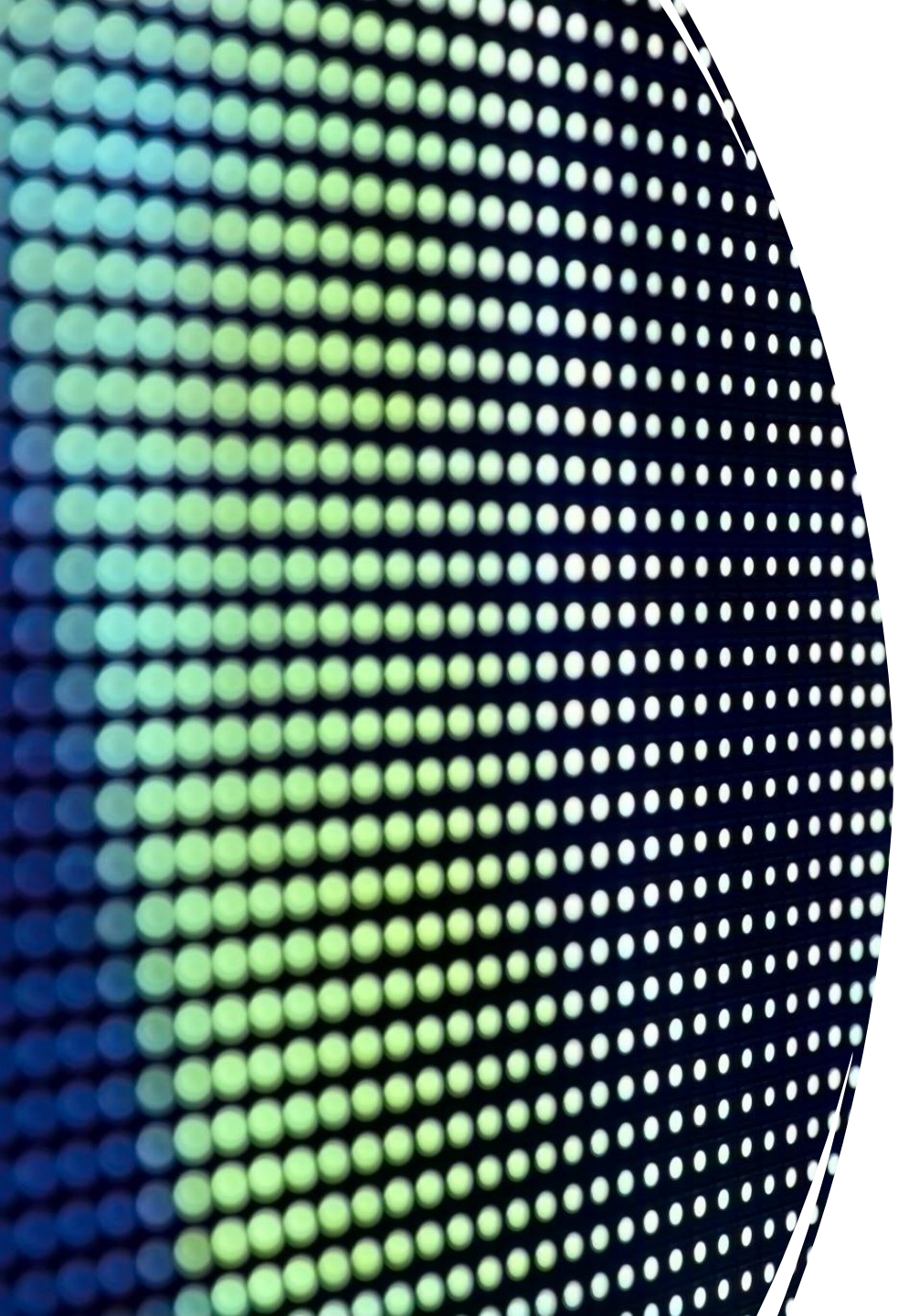

GPU
HDMI
VGA
DVI

Graphics

- Video is array of photos
- Photos are array of pixels
- Pixels consist of 3 dots (RGB)
- More pixels in same area = higher resolution



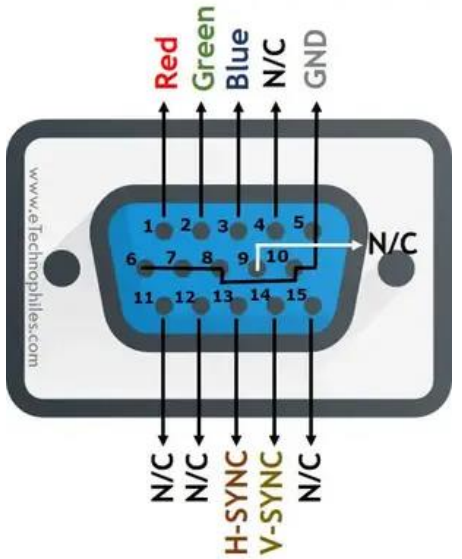




How does VGA Controller Work

VGA Controller

- handles the low-level details of communicating with a monitor over a VGA connector.



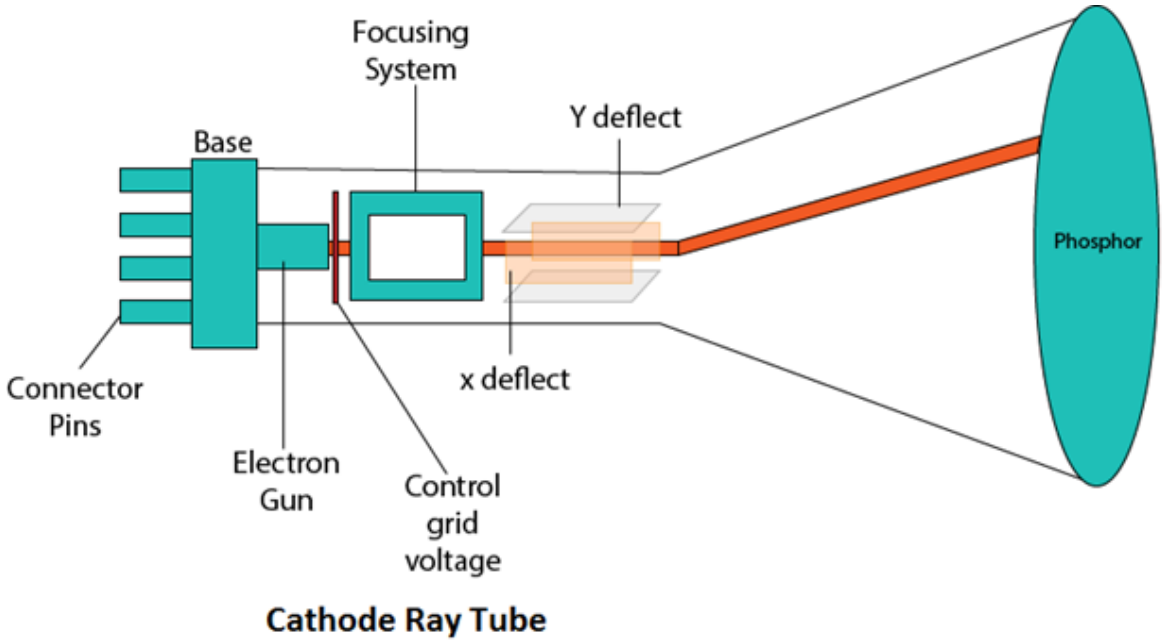
Specifications :

Resolution = > 640 x 480

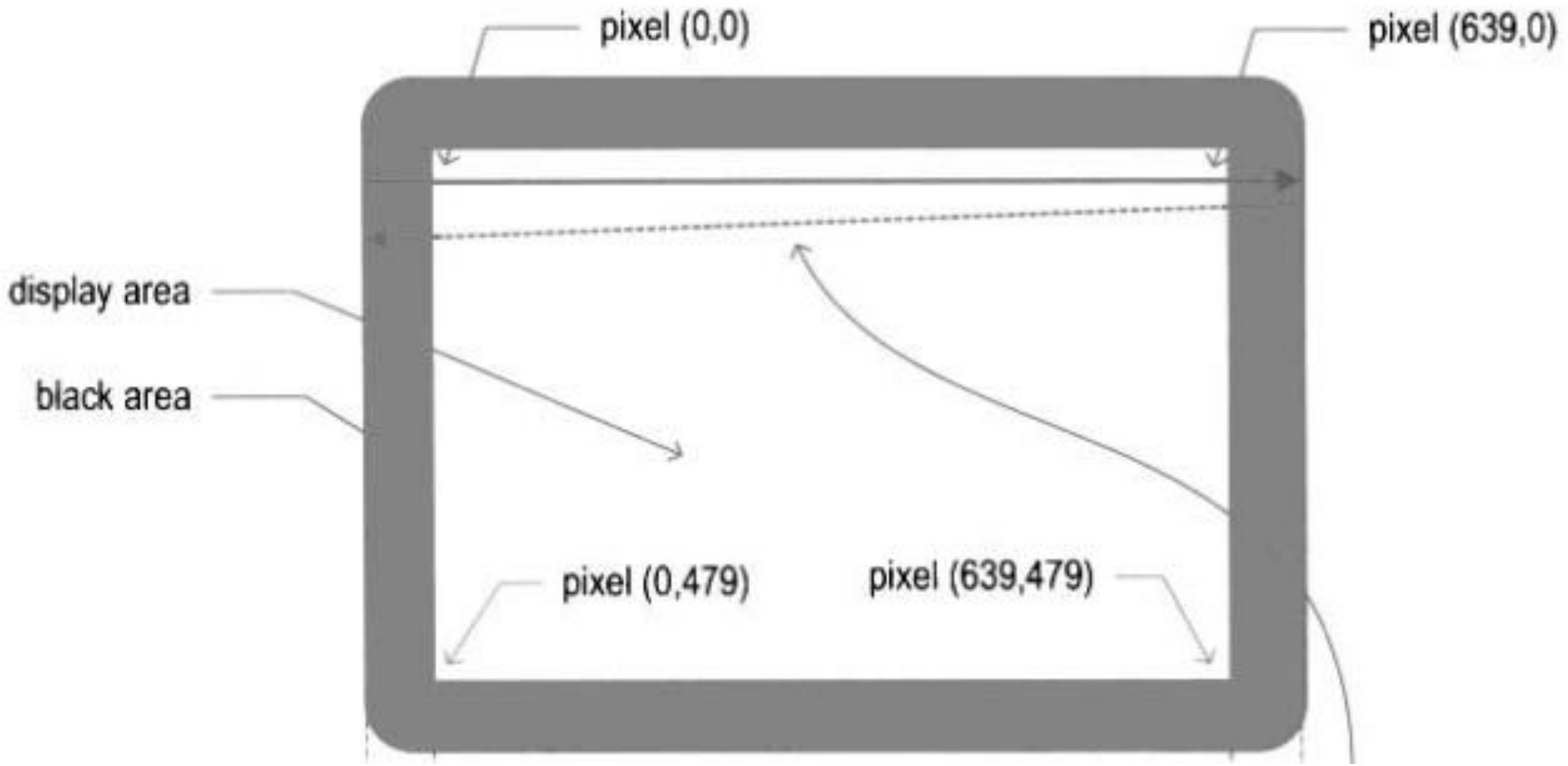
Refresh Rate => 60 HZ

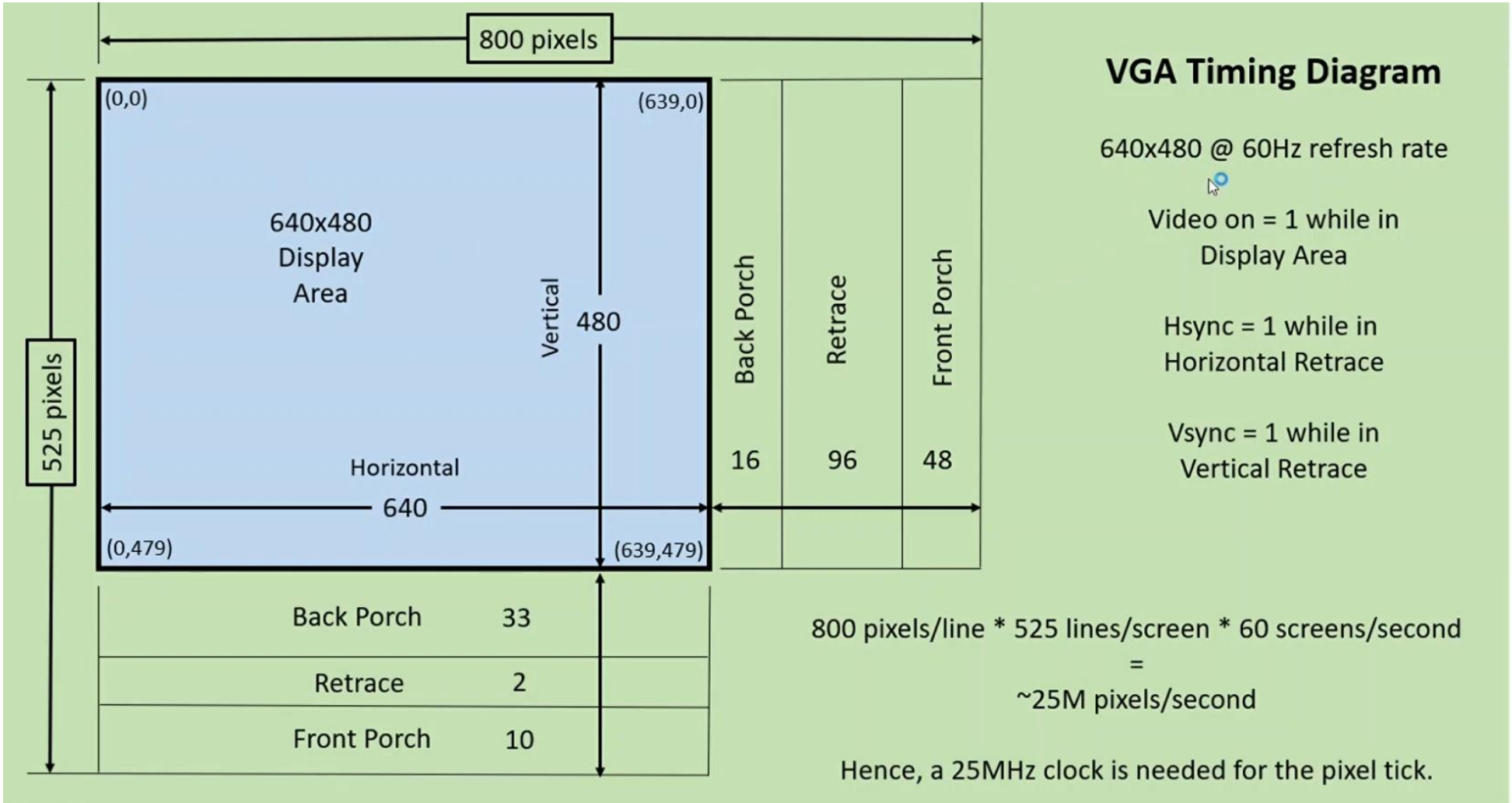
Color Depth => 1 Bit for each color

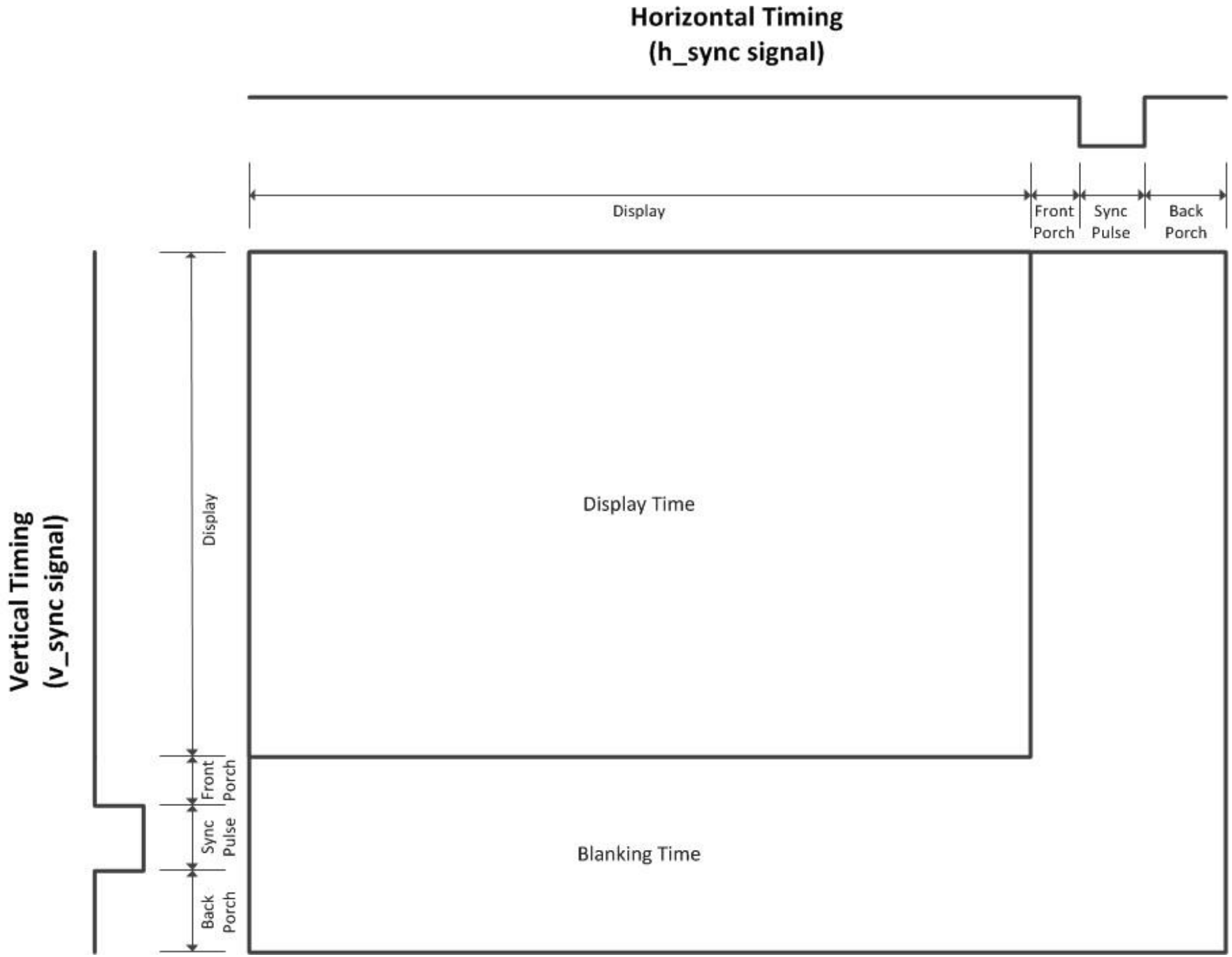
Cathode Ray Tube (CRT)



Cathode Ray Tube


pixel (0,0)
pixel (639,0)
display area
black area
pixel (0,479)
pixel (639,479)


800 pixels
525 pixels
(0,0)
(639,0)
640x480
Display
Area
Vertical
480
Back Porch
Retrace
Front Porch
16
96
48
Horizontal
640
(0,479)
(639,479)
Back Porch 33
Retrace 2
Front Porch 10
VGA Timing Diagram
640x480 @ 60Hz refresh rate
Video on = 1 while in
Display Area
Hsync = 1 while in
Horizontal Retrace
Vsync = 1 while in
Vertical Retrace
800 pixels/line * 525 lines/screen * 60 screens/second
=
~25M pixels/second
Hence, a 25MHz clock is needed for the pixel tick.


Horizontal Timing
(h_sync signal)
Display
Front Porch
Sync Pulse
Back Porch
Vertical Timing
(v_sync signal)
Display
Front Porch
Sync Pulse
Back Porch
Display Time
Blanking Time

VGA Signal 640 x 480 @ 60 Hz Industry standard timing

General timing

Screen refresh rate	60 Hz
Vertical refresh	31.46875 kHz
Pixel freq.	25.175 MHz

Horizontal timing (line)

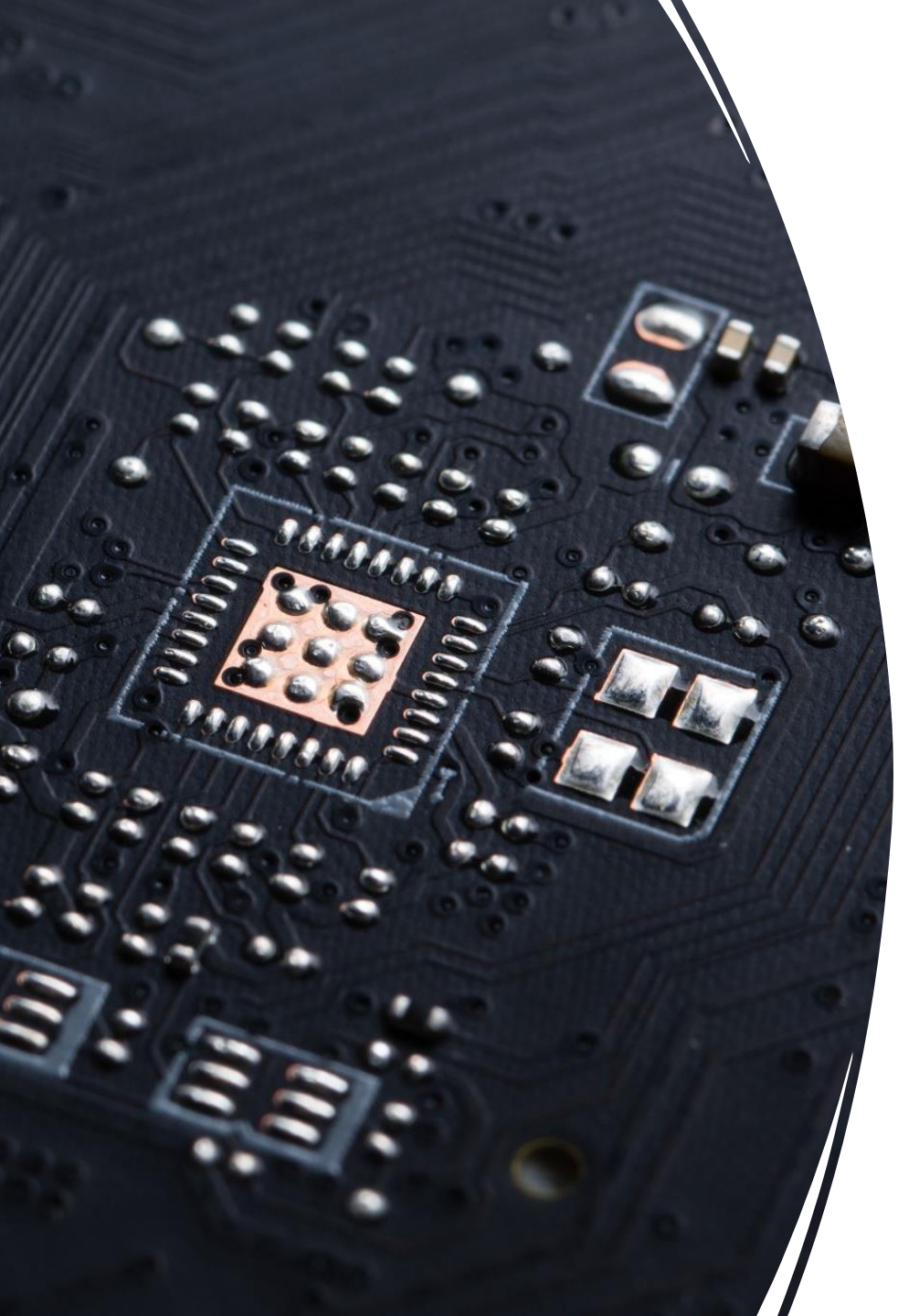
Polarity of horizontal sync pulse is negative.

Scanline part	Pixels	Time [µs]
Visible area	640	25.422045680238
Front porch	16	0.63555114200596
Sync pulse	96	3.8133068520357
Back porch	48	1.9066534260179
Whole line	800	31.777557100298

Vertical timing (frame)

Polarity of vertical sync pulse is negative.

Frame part	Lines	Time [ms]
Visible area	480	15.253227408143
Front porch	10	0.31777557100298
Sync pulse	2	0.063555114200596
Back porch	33	1.0486593843098
Whole frame	525	16.683217477656



Architecture Of VGA Controller

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