

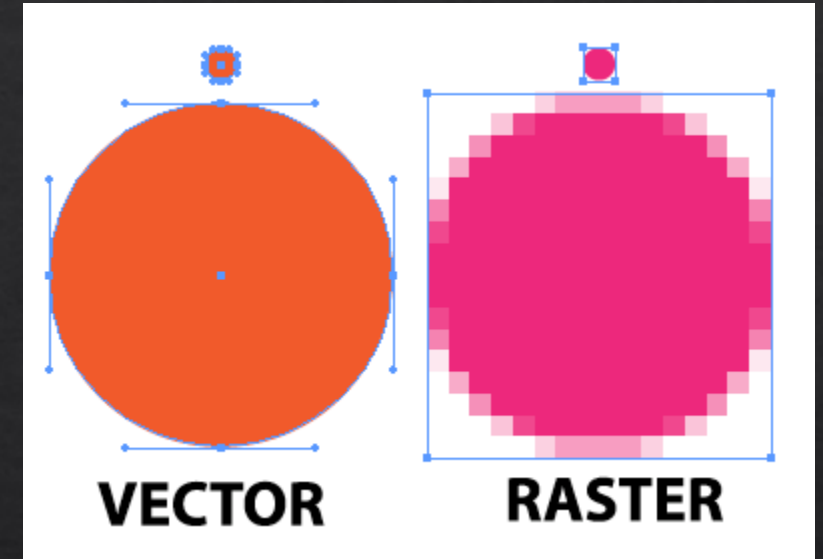
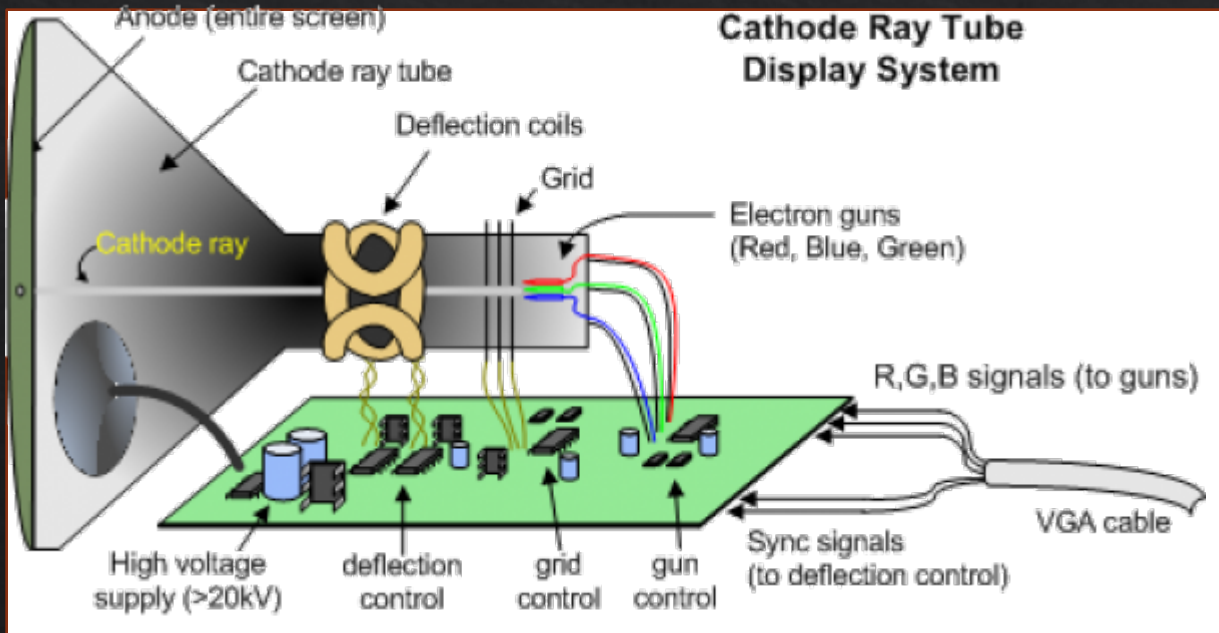
# Lab 6 Overview

Basics Of VGA

By: Daniel Jones

# How do screens work?

- ◇ CRT
- ◇ Vector Vs Raster
- ◇ Scan Lines
- ◇ <https://www.youtube.com/watch?v=3BJU2drrtCM>



# VGA

- ◇ Digital Version of the CRT
- ◇ RGB Analog Lines
- ◇ Vertical/Horizontal Sync
- ◇ Monitor Communication

Pin	Name	Dir	Description
1	RED	→	Red Video (75 ohm, 0.7 V p-p)
2	GREEN	→	Green Video (75 ohm, 0.7 V p-p)
3	BLUE	→	Blue Video (75 ohm, 0.7 V p-p)
4	RES	-	Reserved
5	GND	—	Ground
6	RGND	—	Red Ground
7	GGND	—	Green Ground
8	BGND	—	Blue Ground
9	+5V	→	+5 VDC
10	SGND	—	Sync Ground
11	ID0	←	Monitor ID Bit 0 (optional)
12	SDA	↔	DDC Serial Data Line
13	HSYNC or CSYNC	→	Horizontal Sync (or Composite Sync)
14	VSNC	→	Vertical Sync
15	SCL	↔	DDC Data Clock Line

# Our Board

- ◇ 640x480 pixels, at 25 MHz
- ◇ Resistor array creates varied voltages (DAC)
- ◇ Sync Lines
- ◇ 4,095 colors!

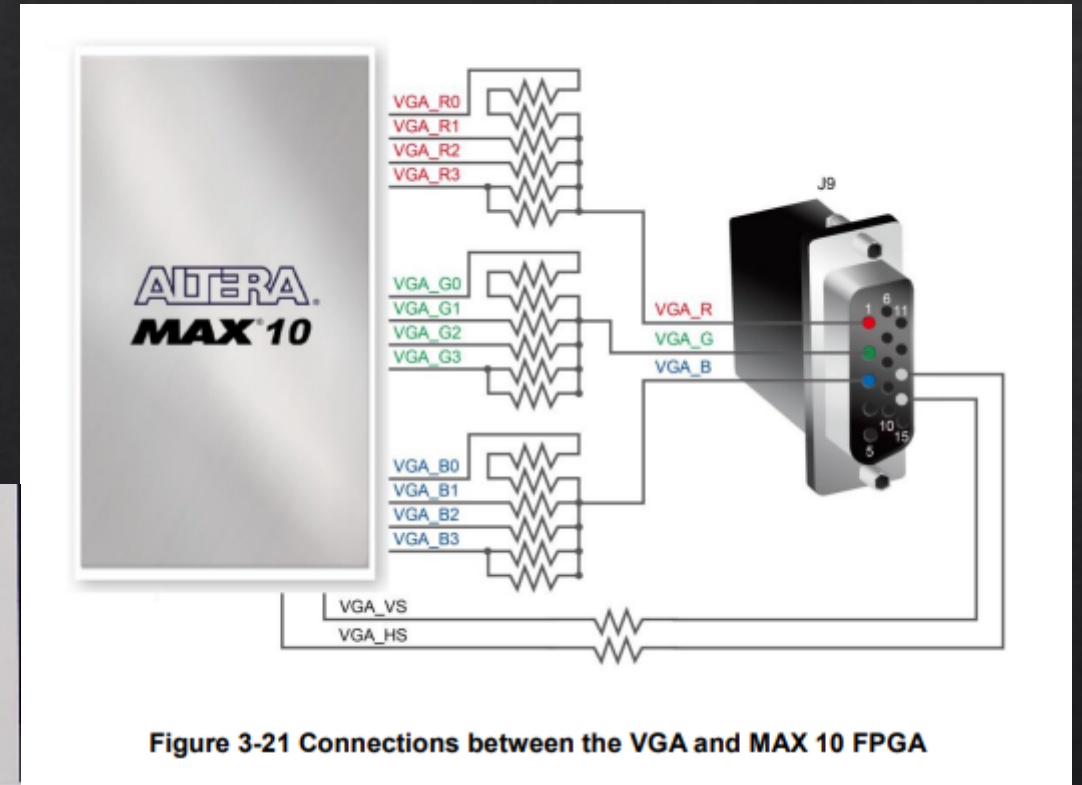
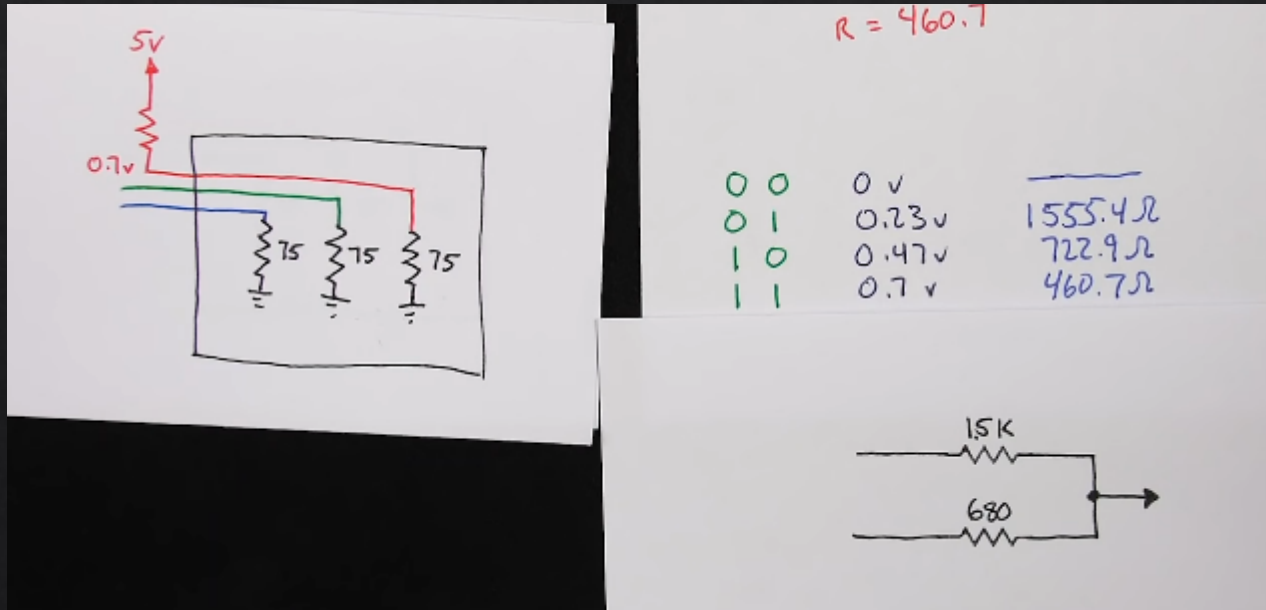


Figure 3-21 Connections between the VGA and MAX 10 FPGA

# Timing

- ◇ Important things to look for
  - ◇ Visible Area
  - ◇ Front Porch
  - ◇ Back Porch

## 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 [ $\mu$ s]
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

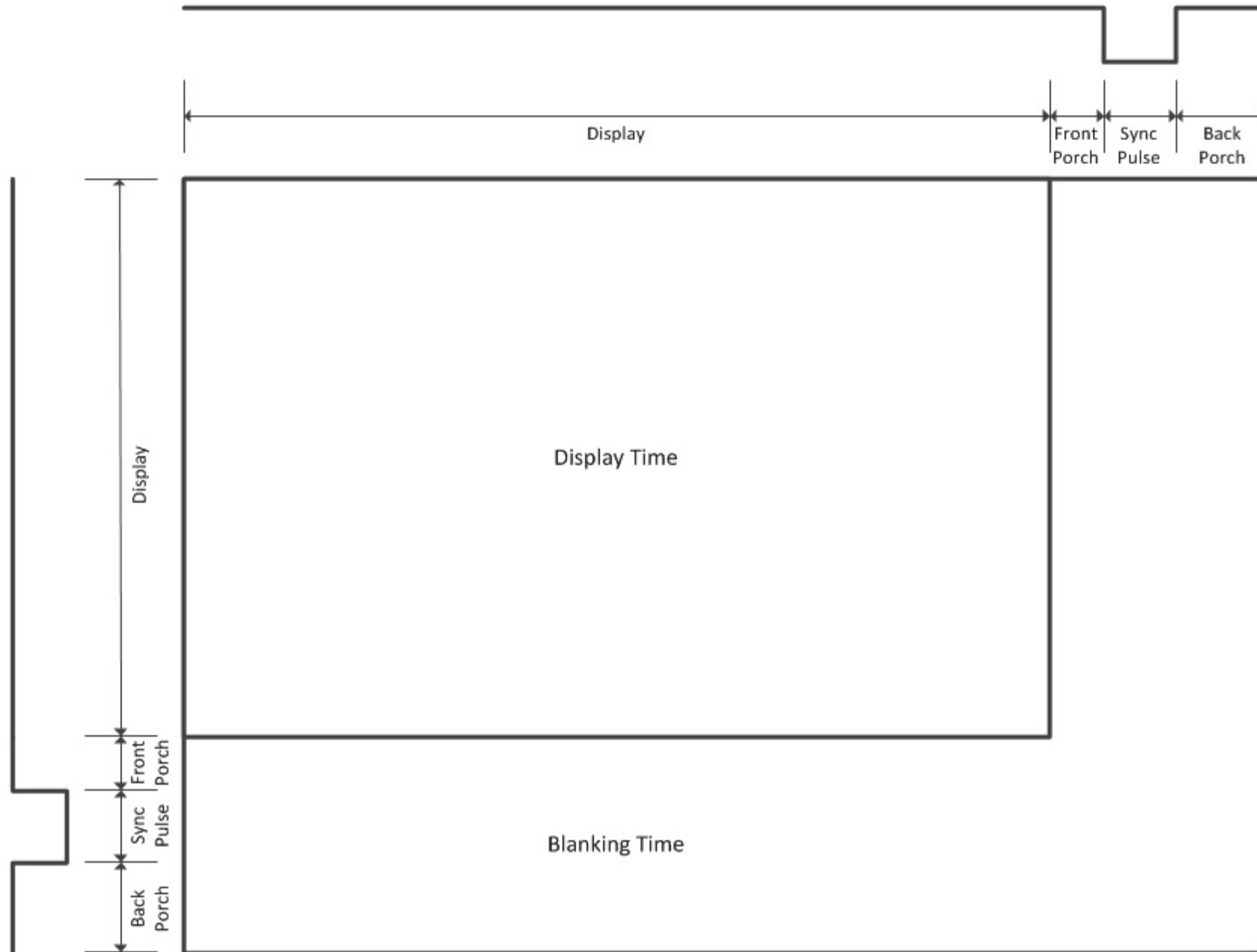
## Vertical timing (frame)

Polarity of vertical sync pulse is negative.

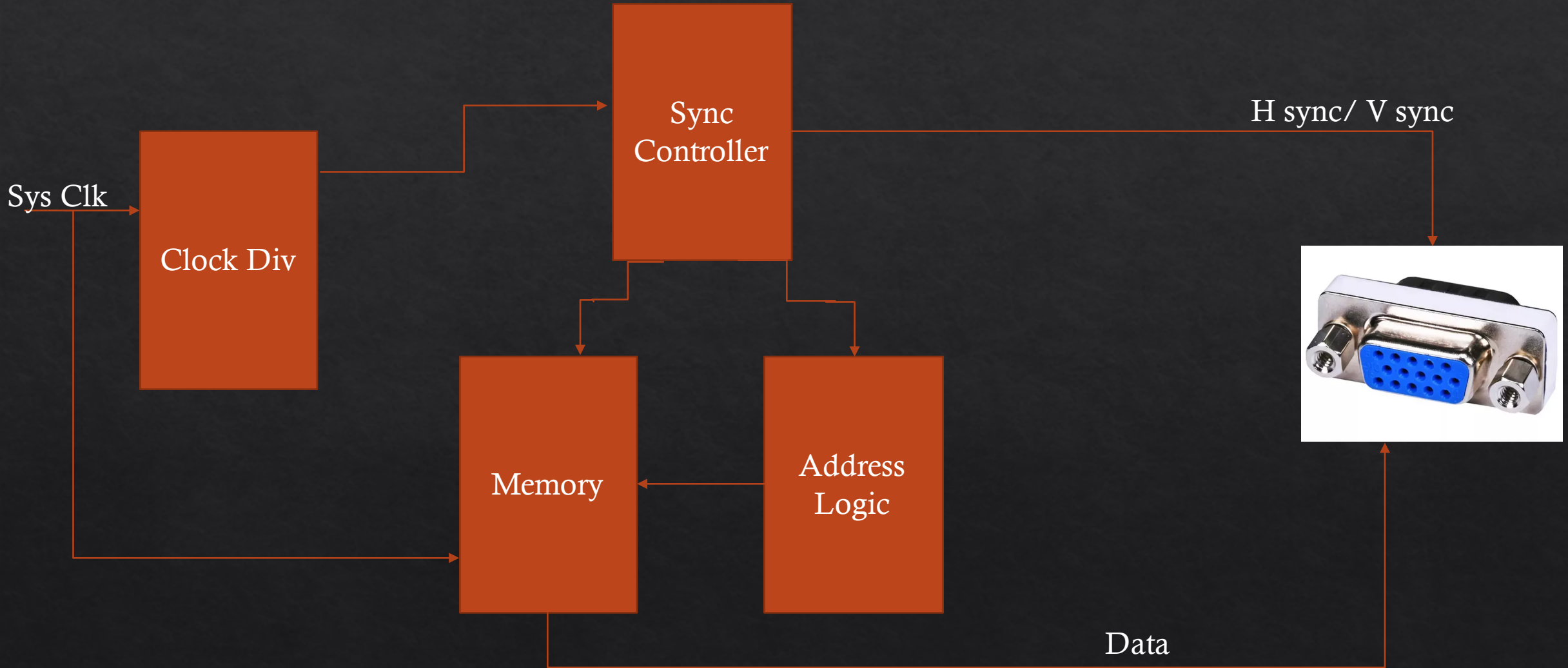
Frame part	Lines	Time [ms]
Visible area	480	15.253227408143
Front porch	10	0.31777557100298
Sync pulse	2	0.063555114200596
Back porch	33	1.0486593843098
Whole frame	525	16.683217477656

# Horizontal Timing (h\_sync signal)

# Vertical Timing (v\_sync signal)



# Black Box Model



# Additional References

- ◇ Ben Eater VGA Video Card - <https://eater.net/vga>
- ◇ VGA Pin out Reference [https://pinouts.ru/Video/VGAVesaDdc\\_pinout.shtml](https://pinouts.ru/Video/VGAVesaDdc_pinout.shtml)
- ◇ VGA timing reference - <http://www.tinyvga.com/vga-timing>
- ◇ Interface overview - <https://www.digikey.com/eewiki/pages/viewpage.action?pageId=15925278>