



ARM VGA CONTROLLER

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IMT2015523

VGA

- Video Graphics Array
- Analog display protocol
- Very widely used

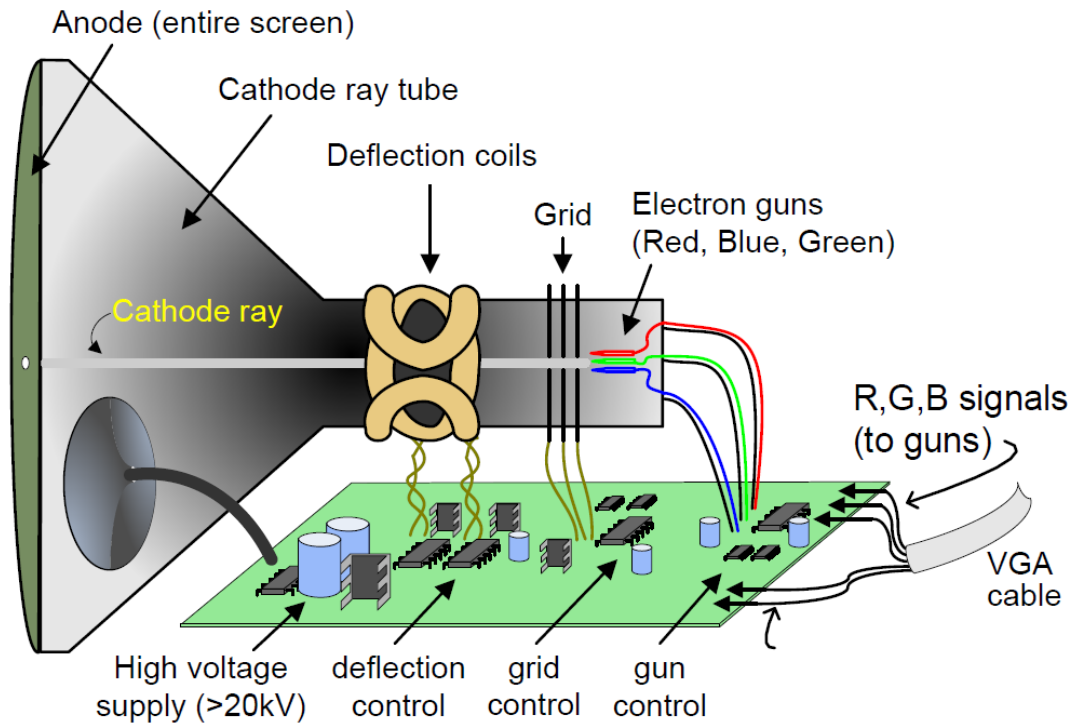
VGA cable



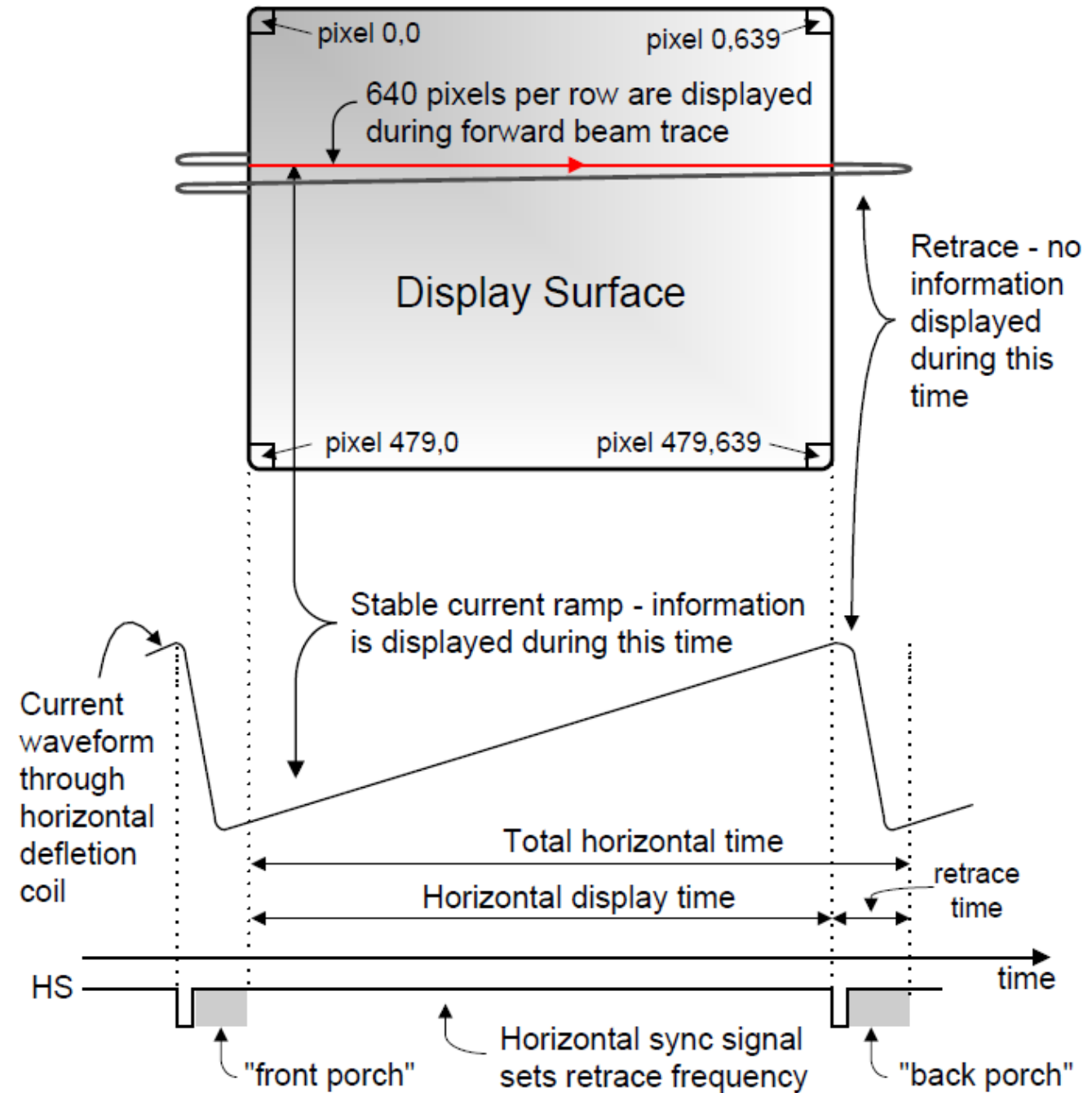
VGA connector



HOW?



Courtesy: Basys3 datasheet



VESA Signal 1280 x 1024 @ 60 Hz timing

General timing

Screen refresh rate	60 Hz
Vertical refresh	63.981042654028 kHz
Pixel freq.	108.0 MHz

Horizontal timing (line)

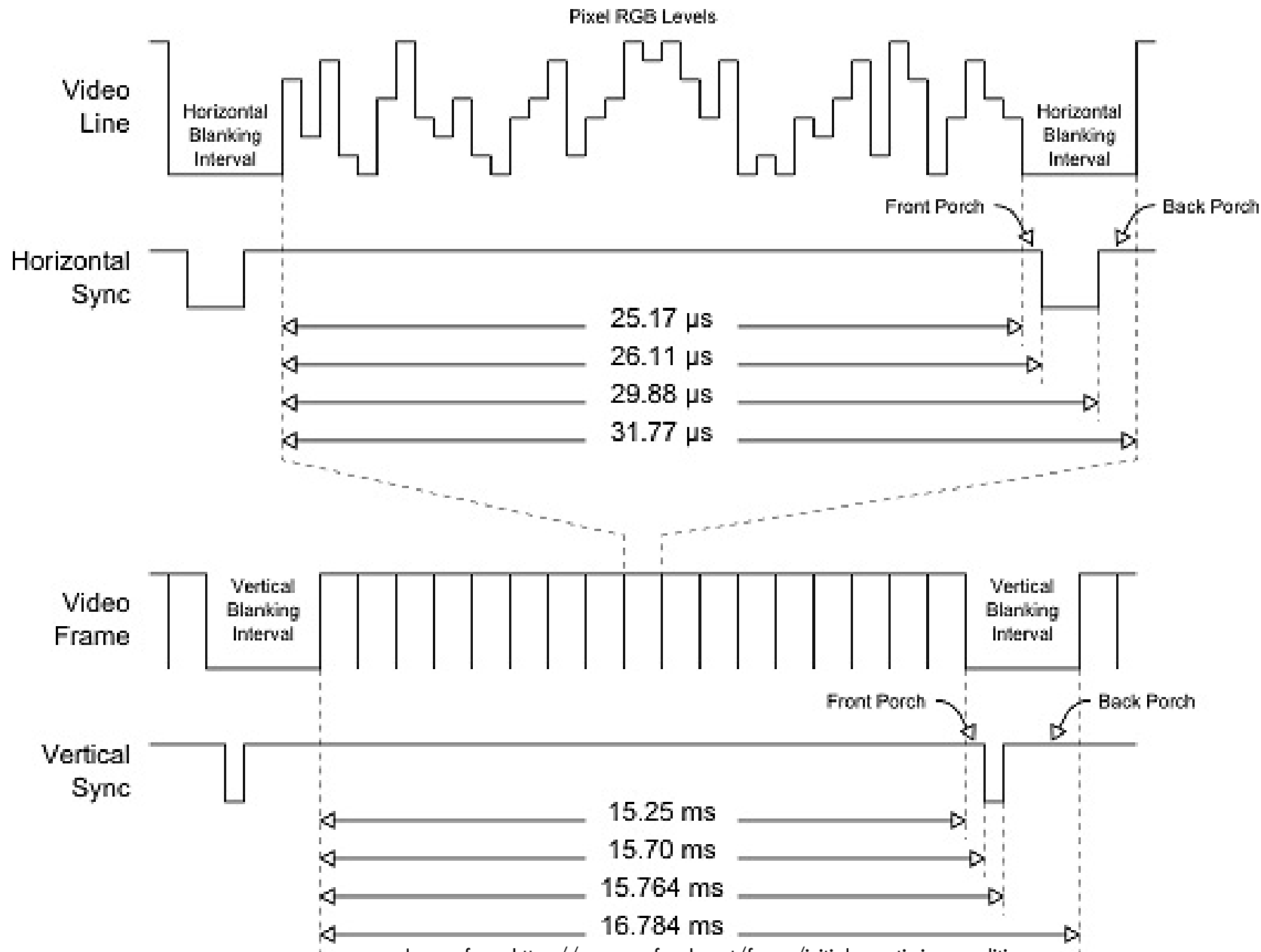
Polarity of horizontal sync pulse is positive.

Scanline part	Pixels	Time [μs]
Visible area	1280	11.851851851852
Front porch	48	0.44444444444444
Sync pulse	112	1.037037037037
Back porch	248	2.2962962962963
Whole line	1688	15.62962962963

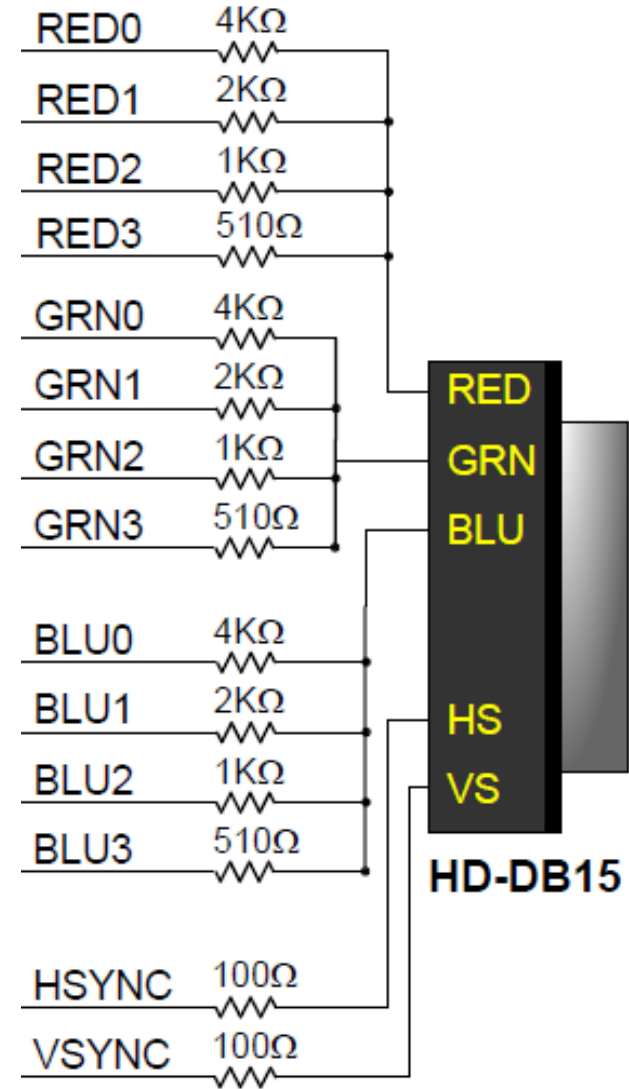
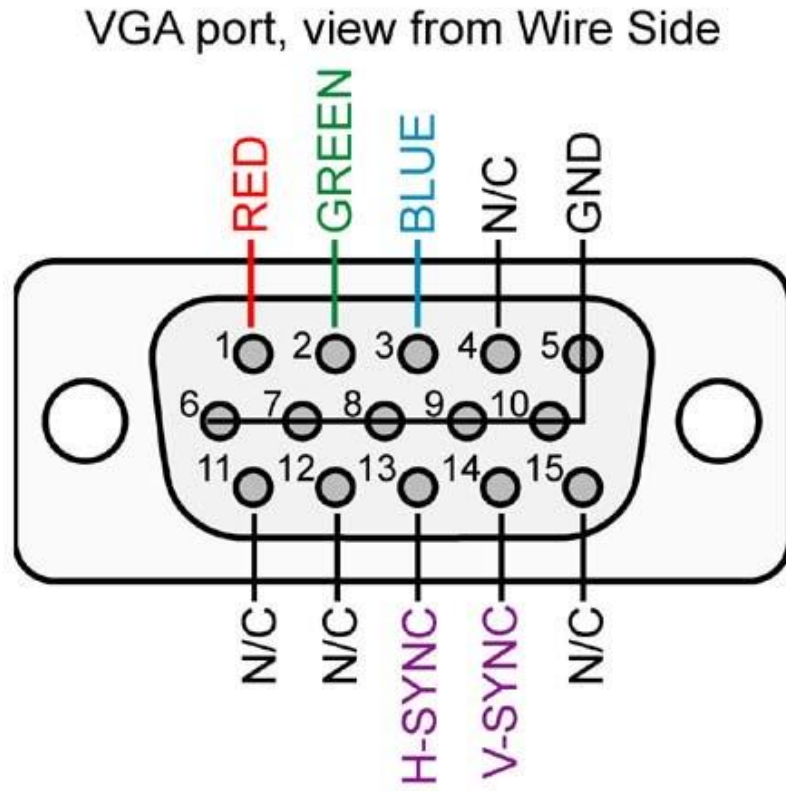
Vertical timing (frame)

Polarity of vertical sync pulse is positive.

Frame part	Lines	Time [ms]
Visible area	1024	16.004740740741
Front porch	1	0.01562962962963
Sync pulse	3	0.046888888888889
Back porch	38	0.59392592592593
Whole frame	1066	16.661185185185



SIGNALS



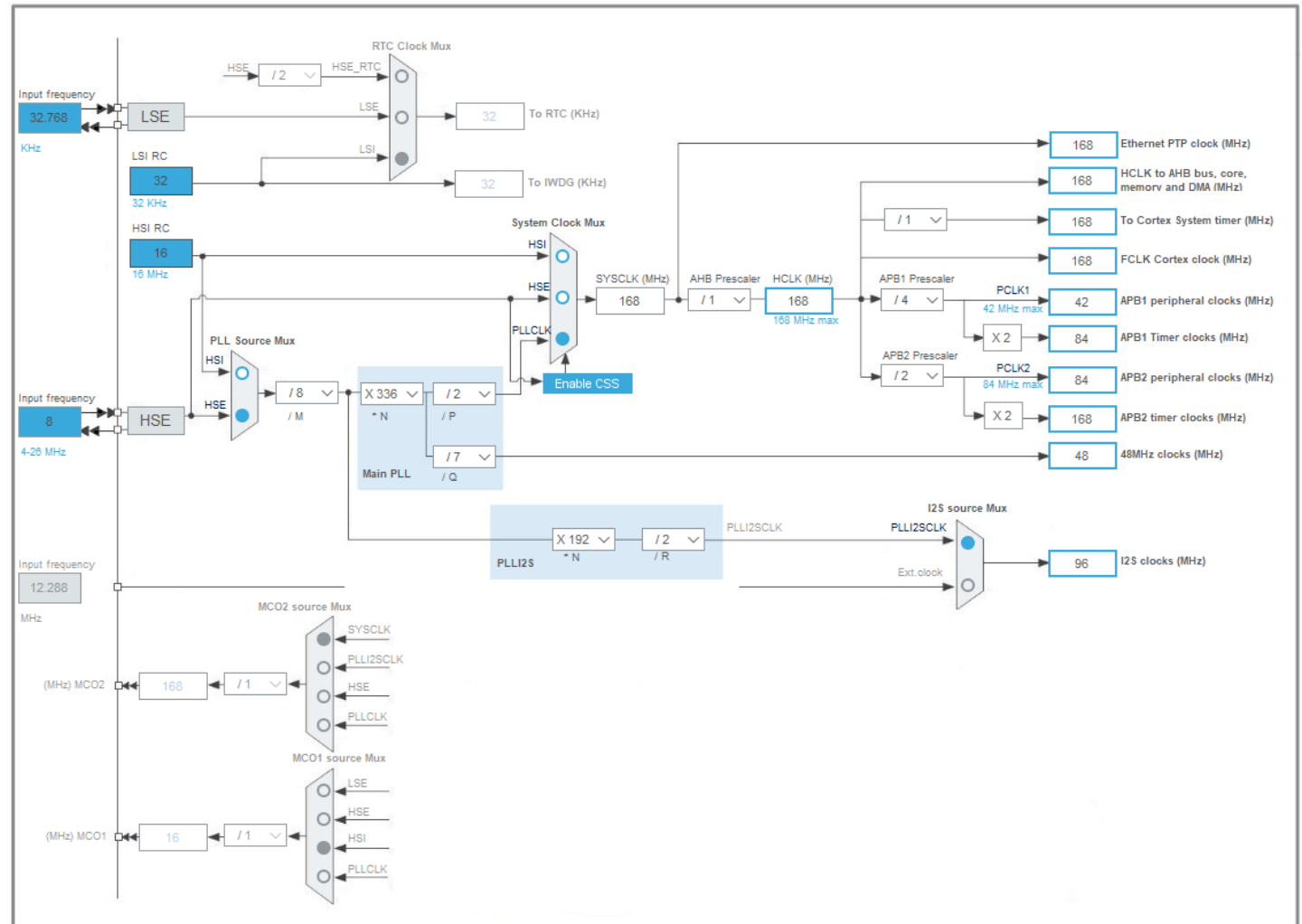
- ARM STM32F4 Discovery
- Max 168 MHz
- Cortex M4



HOW TO: PROCESS

- How to program the board using assembly?
- First figure out how to control GPIO Pins and blink LED
- Learn that board by default works at 16MHz
- Increase clock to 168 MHz
- Setup timer for accurate time measurement
- Figure out how to use interrupts to manage time
- Write code for HSYNC, VSYNC
- Test and Finish

168 MHz CLOCK



TIMER

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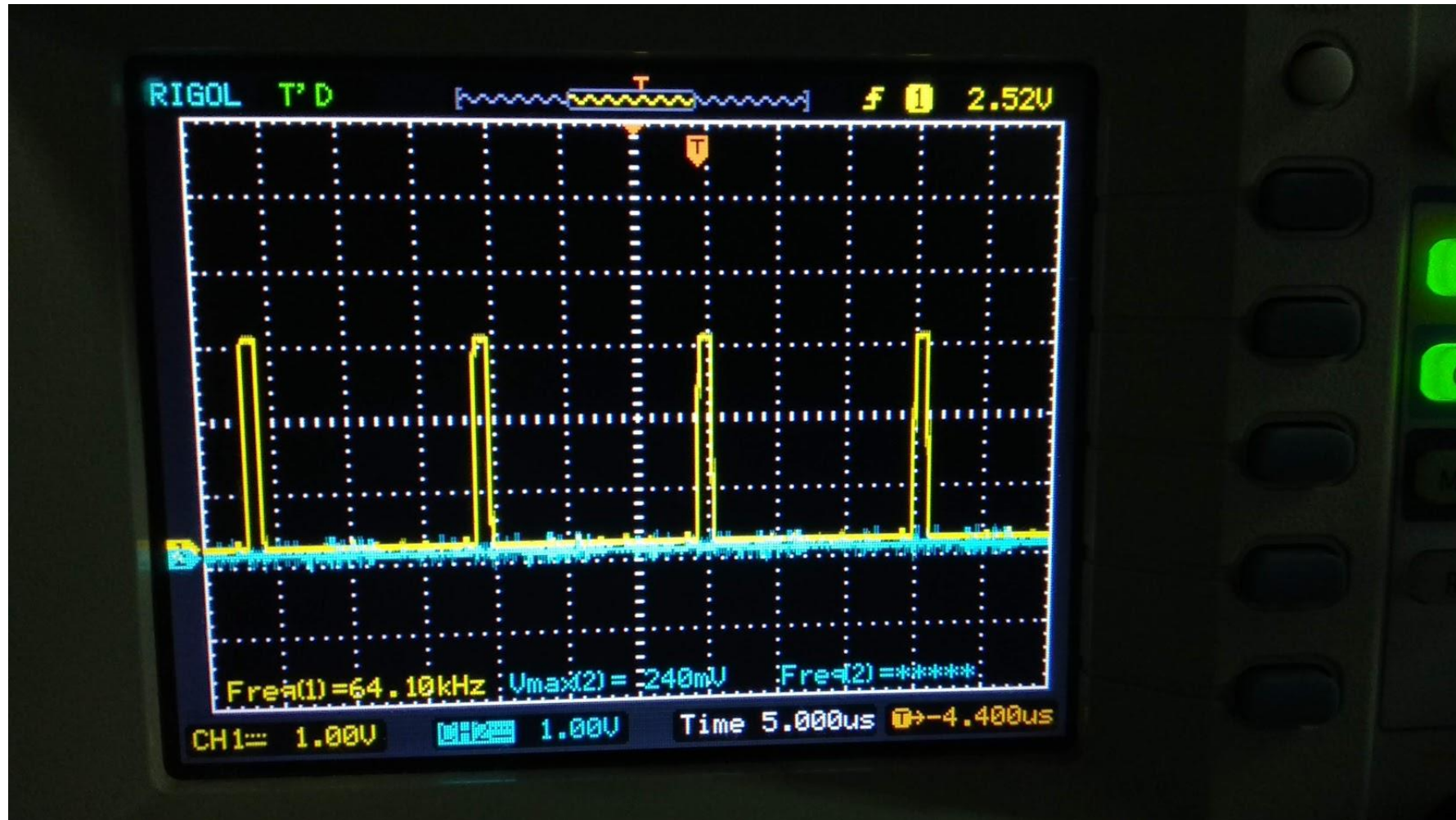
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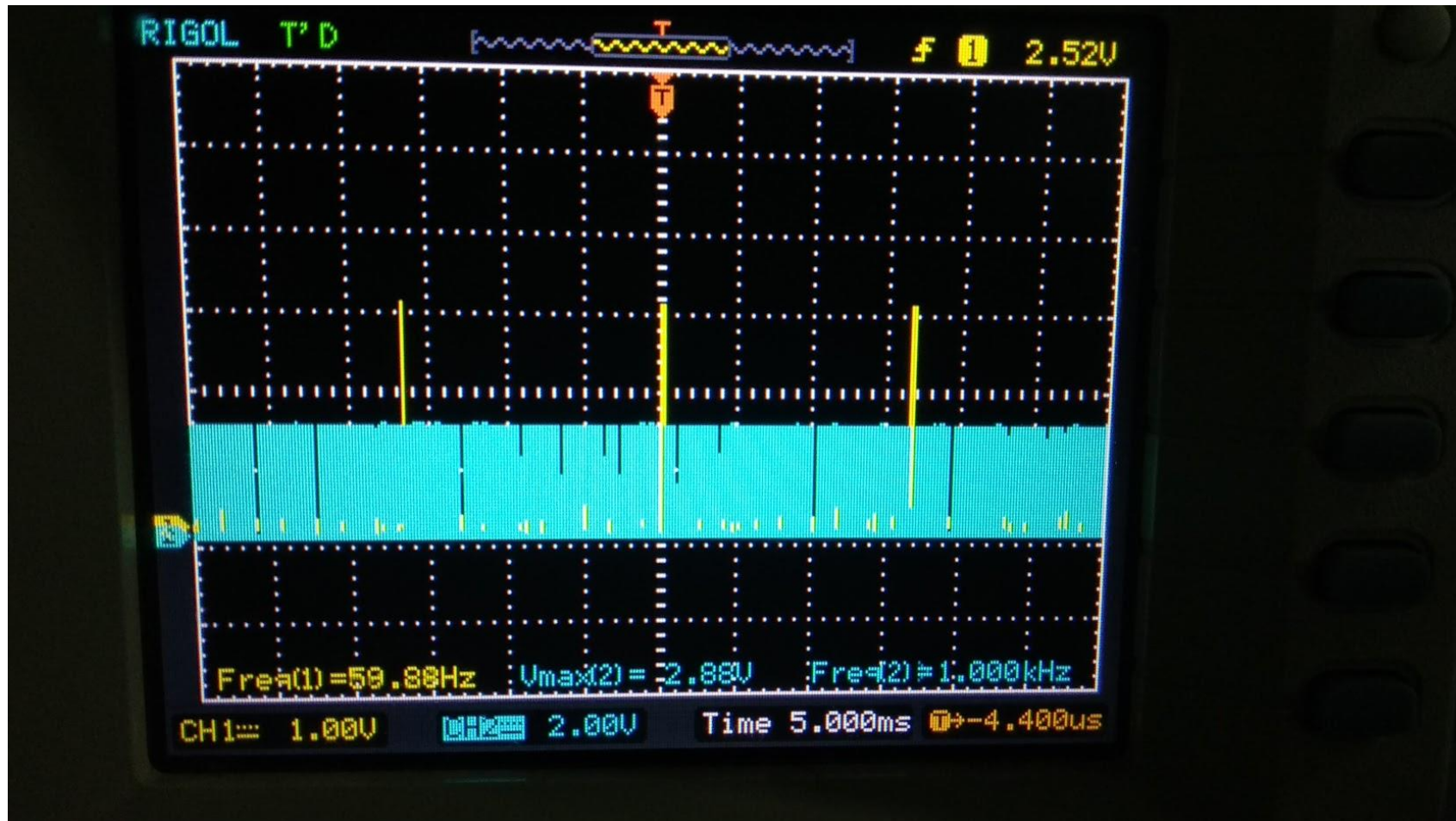
CHALLENGES

- Needed a clock frequency of 108 MHz, but ended up at ~5MHz: Because of loop
- Hence only about 50+ pixels in a line
- Able to achieve 1024 lines
- Space to store the image

RESULTS : HSYNC (MUST BE $\sim 64\text{KHZ}$)



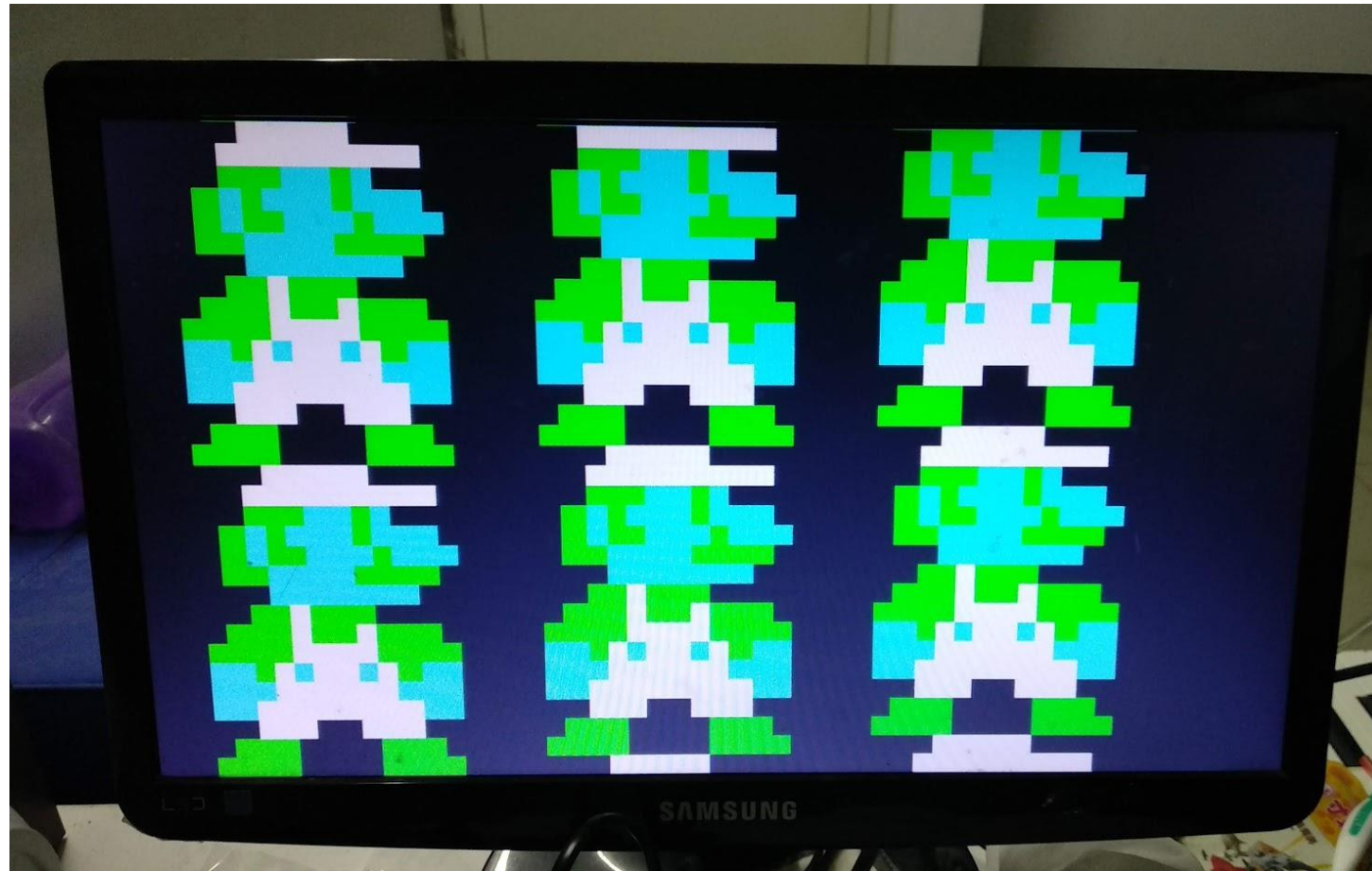
RESULTS : VSYNC (MUST BE $\sim 60\text{Hz}$)



RESULTS : ALL COLORS DISPLAYED



RESULTS : A BITMAP IMAGE



THANK YOU

