Low level C-programming and microprocessor architecture

Welcome

VGA = Video Grafics Array

Graphical User Interface – GUI Engineering job

Version	Date	Responsible	Description
0.0	2011	LL & Mia	Preliminary version
1.0	201510	LL	Changed HW to BeMicro

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Standard VGA

Video Graphics Array (**VGA**) was first marketed in 1987 by IBM. Since then it has been a well established standard, used in many applications.

Standard VGA graphics modes are

640×480 - 16 colors
640×350 - 16 colors
320×200 - 16 colors
320×200 - 256 colors

320×200 - 8 colors (TEIS standard!)

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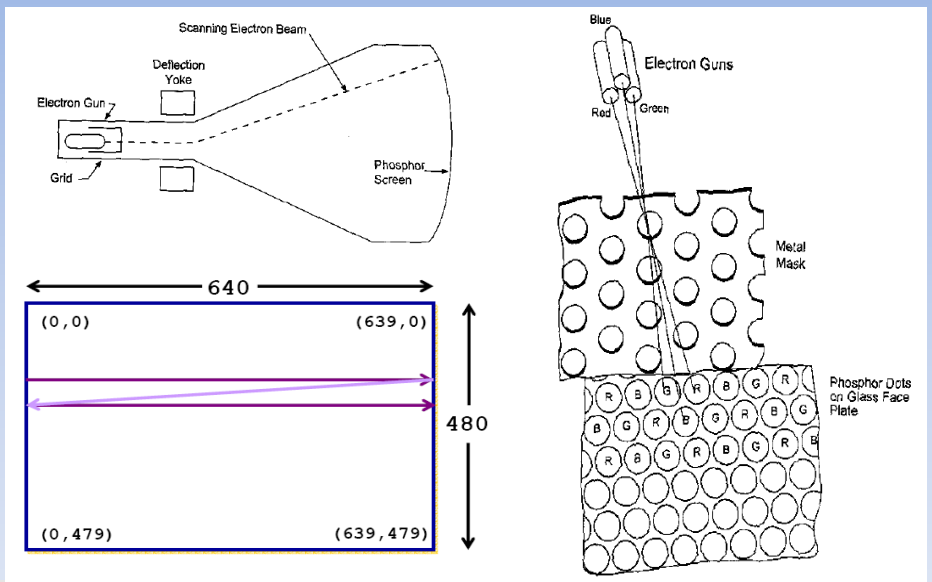
History



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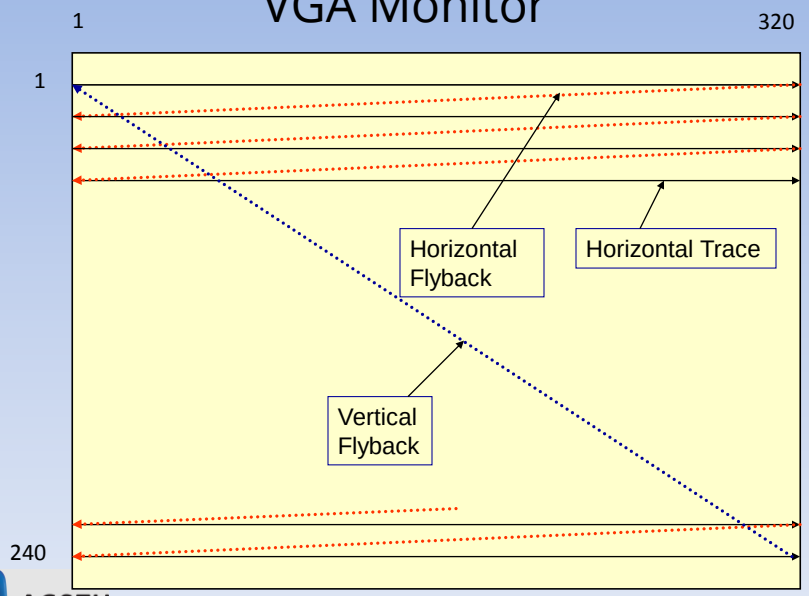
VGA Monitor



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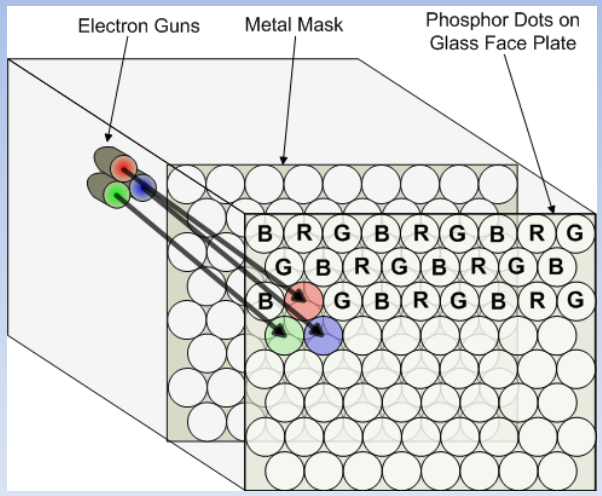
VGA signal production



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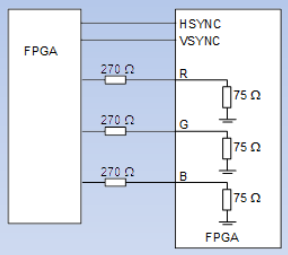
VGA interface



	Red	Green	Blue	Color
0	0	0	0	Black
1	0	0	1	Blue
2	0	1	0	Green
3	0	1	1	Cyan
4	1	0	0	Red
5	1	0	1	Magenta
6	1	1	0	Yellow
7	1	1	1	White

http://www.xess.com/blog/a-simple-vga-interface-for-the-xula-fpga-board/

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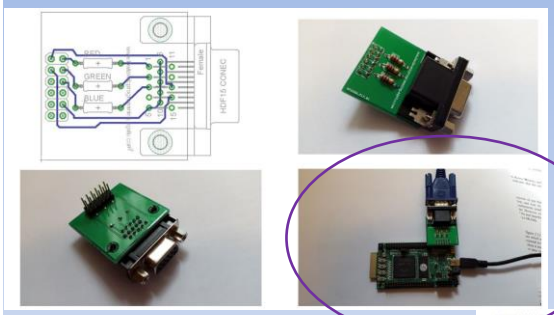
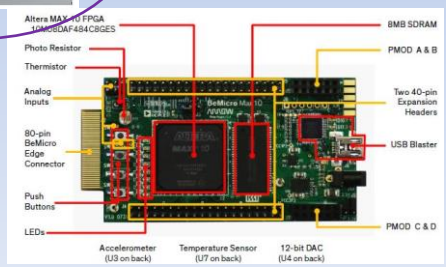
FPGA board





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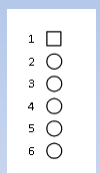
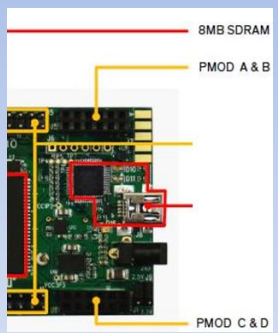
Pmod

Pmod™: Registered trademark of Diligent Inc.

Pin	Signal	Direction
1	IO1	In/Out
2	IO2	In/Out
3	IO3	In/Out
4	IO4	In/Out
5	GND	
6	VCC	





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VHDL VGA control the screen

	Red	Green	Blue	Color
0	0	0	0	Black
1	0	0	1	Blue
2	0	1	0	Green
3	0	1	1	Cyan
4	1	0	0	Red
5	1	0	1	Magenta
6	1	1	0	Yellow
7	1	1	1	White

Screen

Pixel RAM
1 – 320 Pixels
1 -239 rows
Ca 77000 rows with three bits

Address = X + Y*320;
//X = 1 – 320 Y = 1-239

VGA-contr oller

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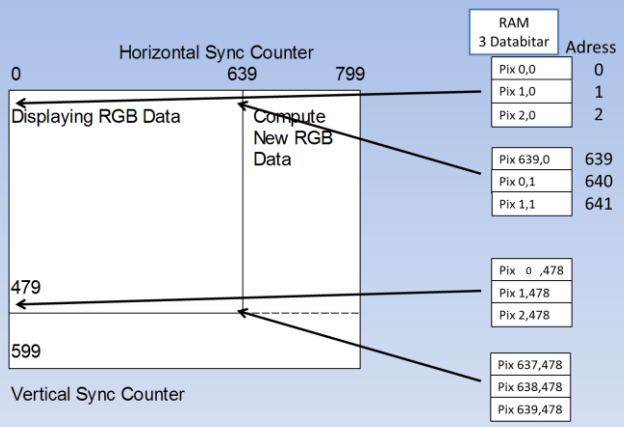
Pixel ram or graphic memory



OBS: 320*240

Pixel RAM Address = X + Y*320;

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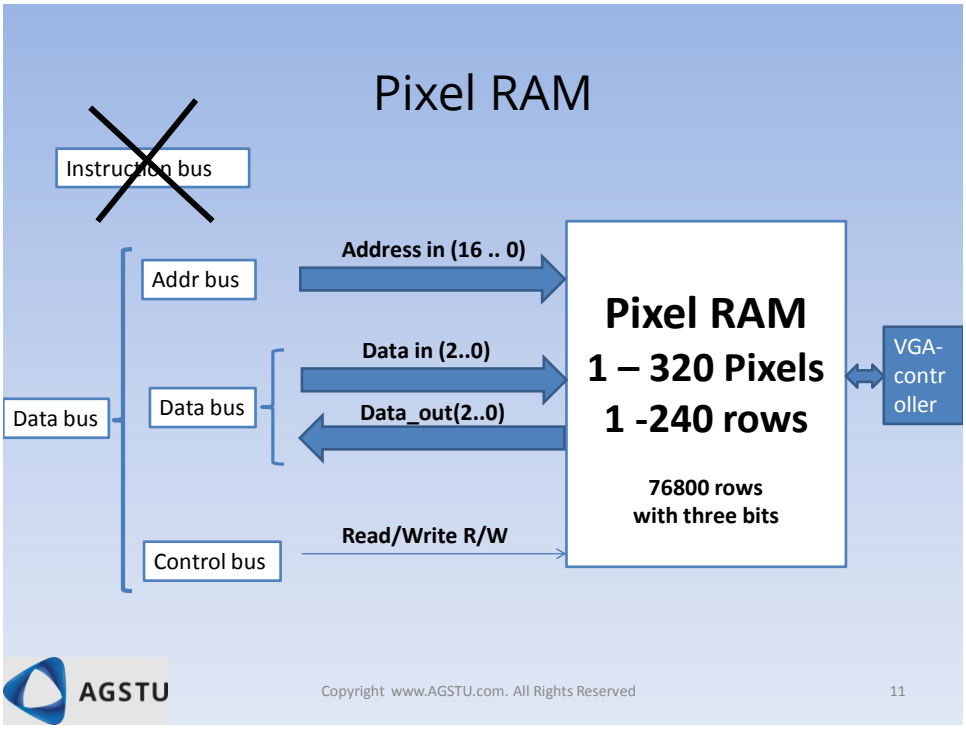

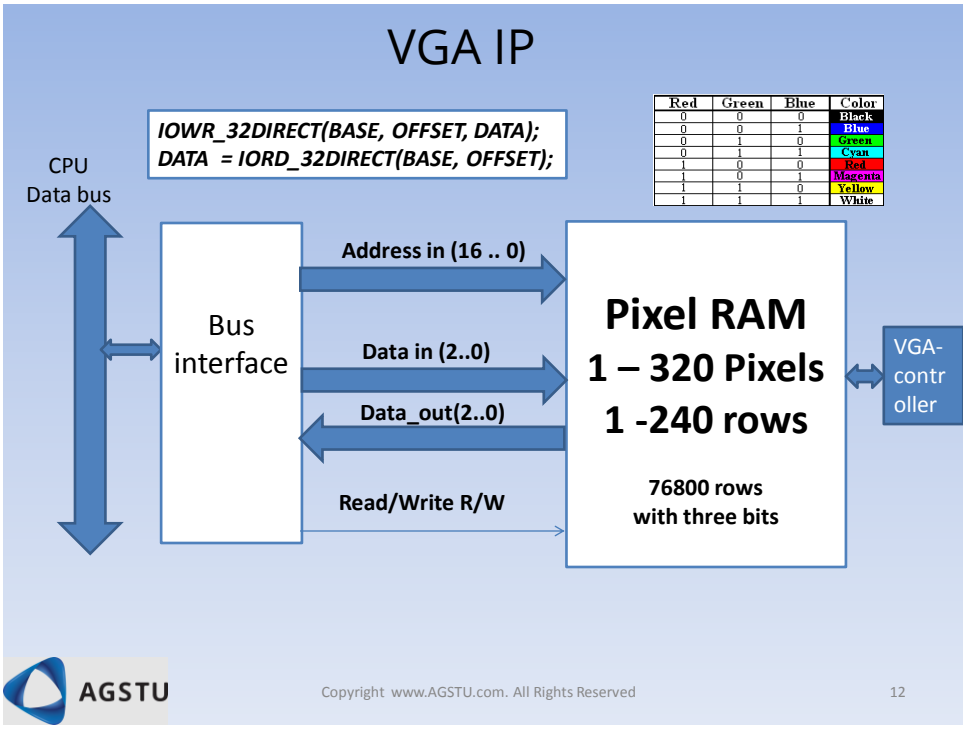

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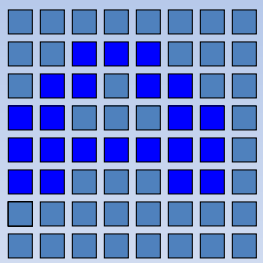
A character-glyph example

- Here's a sample 8x8 character glyph ('A'):



```
alt_u8 font[3072] =
{
0x00, 0x38, 0x6C, 0xC6, 0xFE,
0xC6, 0x00, 0x00, // Char A
... •
```

font[font_row]

```
print_str(100, 85, blue, "Arbete Genom STUdier ");
    print_char
```

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Communication protocol

- The communication between the software and the hardware is a best effort communication.
  - That is, the software read or write to the register without acknowledgment.

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VGA-driver – “print_vline”

Function: *print_vline(unsigned int address, unsigned int x_start, unsigned int y_start, unsigned int len, unsigned int RGB);*

Function description: Prints a vertical line with the color *rgb* with the length *len* which starts at the coordinate (x_start, y_start).

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Print_vline

```
print_vline(unsigned int address, unsigned int
x_start, unsigned int y_start, unsigned int len,
unsigned int RGB);
```

C-code?

```
#define VGA_WRITE(address, data)
IOWR_32DIRECT(PIXEL_RAM_BASE, address * 4,data);
// address = X + Y*320;
```

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Analog

Chapter 8. CASE 6

- ✓Analog signals
- ✓ADC: flash, **SAR**, dual slope
- ✓Theory: resolution, quantization and quantization error
- ✓Theory: sampling, sampling rate, sampling theorem
- ✓MAX 10 ADC: ”sequence”, ”sequencer”
- ✓BeMicro board: LDR, temperature sensor

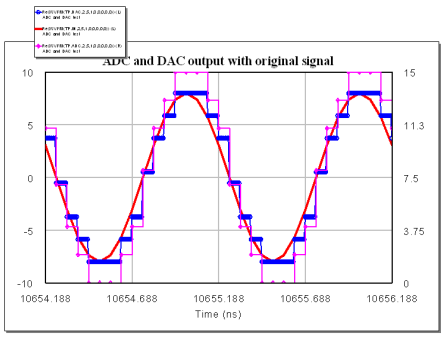

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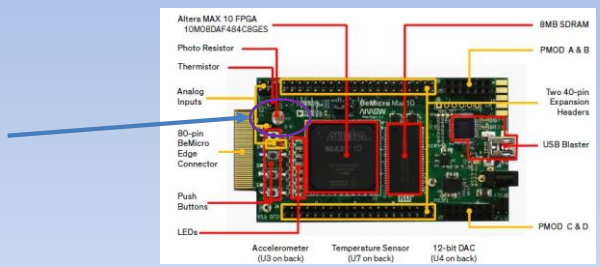
Photo Resistor



Do CASE 6

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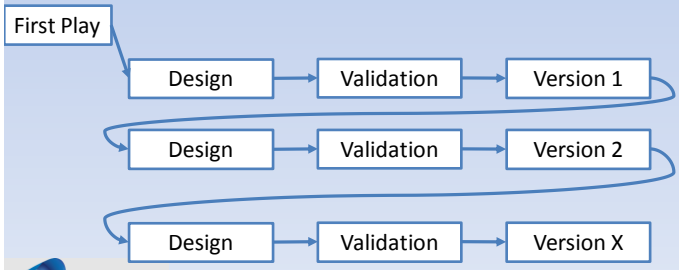
Development tips
Structural Design Methods!

- Develop and test one function at the time
- Integrate and test the function one after another
- Backup after each new version



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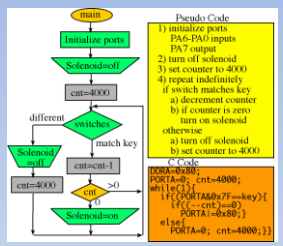
Tips

Pseudo Code => use as comments in the C code

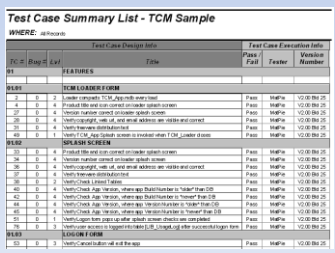


Write design report

Design → Validation → Version 1 → Backup!!!

Next version

Test cases Simple on low level



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Tips

- Version 0: Design&validate print_pixel (first the code in application and then move to BSP)
- Version 1: Design&validate vline…….
- Version 2: Design&validate Photo Resistor
- Version 3: Design&validate to move pixel from Photo Resistor

- Version X: Ready

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