CSULB
CECS 360

VGA Design
Fixed Objects

Introduction

- The previous project generated the Horizontal and Vertical sync signals along with the RGB color indicators

- This project will display fixed objects on the display

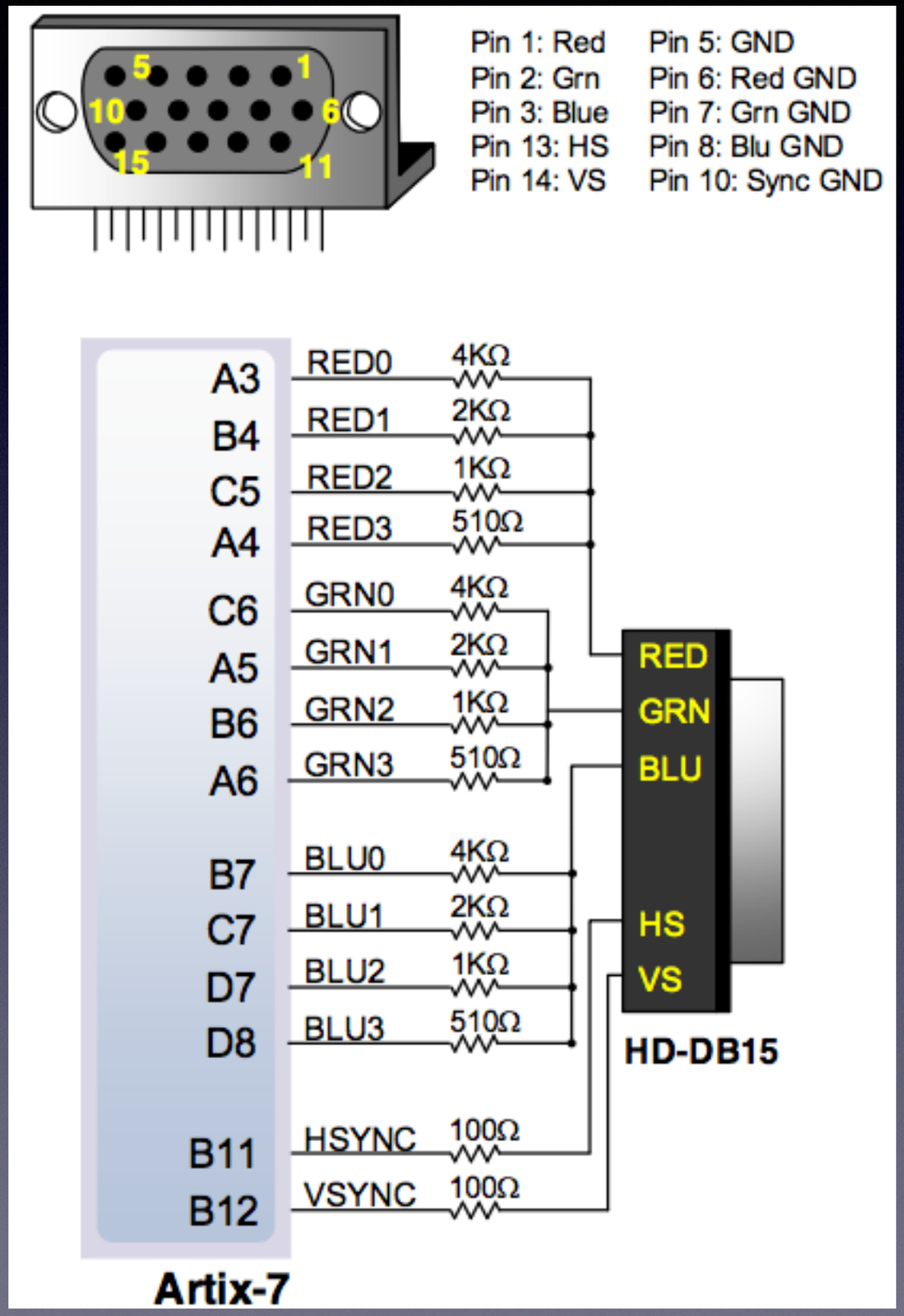
Color Control

- The older boards have three bits for color (R/G/B) while the newer boards have more
- Combinations of these bits produce the various colors seen on the display

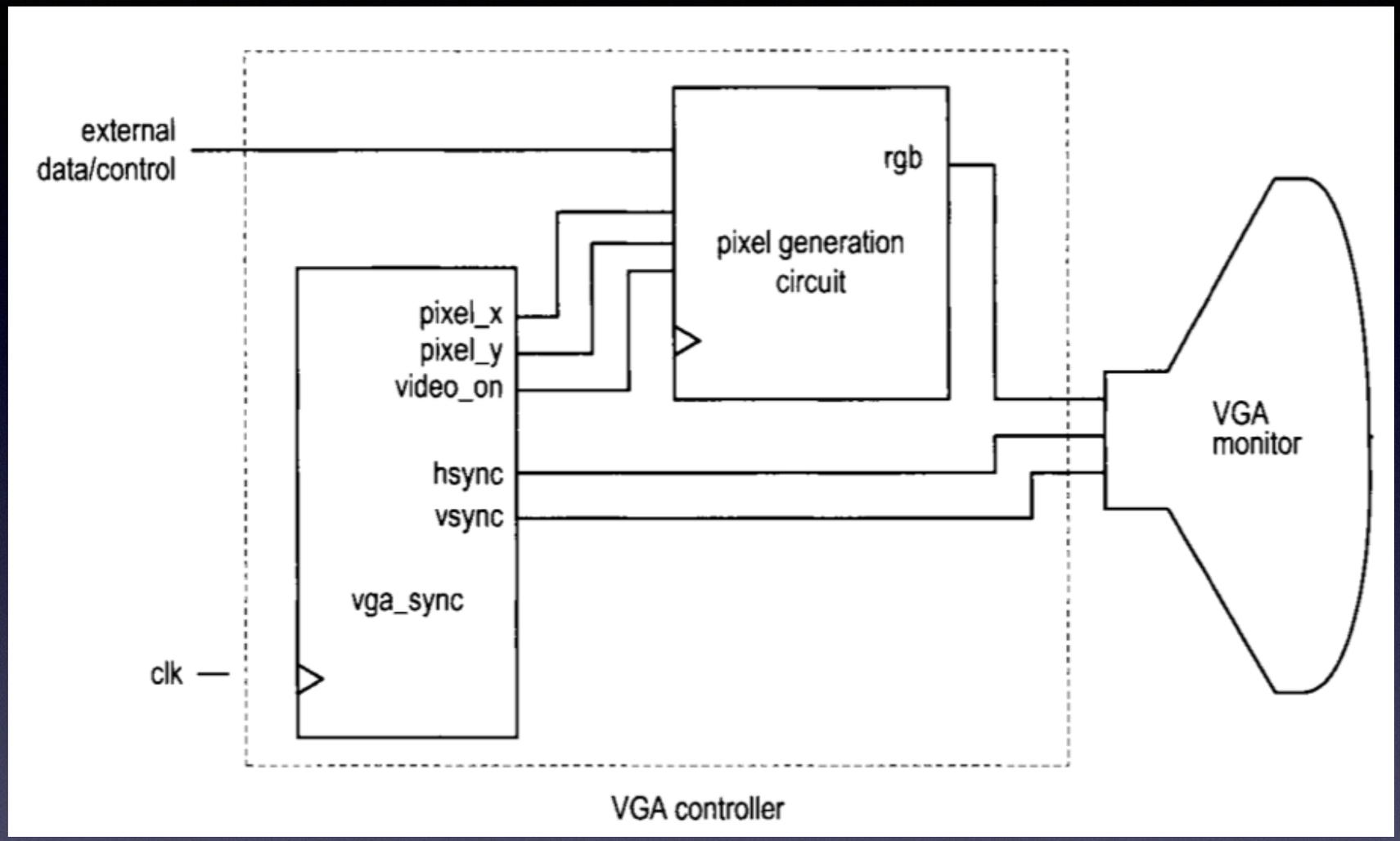
Red (R)	Green (G)	Blue (B)	Resulting color
0	0	0	black
0	0	1	blue
0	1	0	green
0	1	1	cyan
1	0	0	red
1	0	1	magenta
1	1	0	yellow
1	1	1	white

VGA Port

- Nexys4 uses 14 FPGA signals to create a VGA port with 4 bits per color and two standard sync signals (HS-Horizontal Sync, VS-Vertical Sync)
- With this board 4096 different colors may be displayed
- We need to create the video controller circuit to drive the syncs and color signals to produce our display



VGA Controller



- Our design will have two blocks: the vga_sync and the pixel generation circuit (what color where)
- The syncs go directly to the monitor while the pixel indication goes to the generation circuit to identify where on the monitor the output is being displayed

hsync and vsync

- The *hsync* signal may be obtained from a mod-800 counter and a decoding circuit. The counts are used as the milestones for the display

- The *vsync* signal may be obtained from a mod-525 counter and a decoding circuit. This count is also used as milestones for the display

- We will use these counters to identify where in the display we are currently outputting

VGA Synchronization Requirements

VGA SYNCHRONIZATION REQUIREMENTS

1. The VGA Synchronization Logic shall be updated at a 25 MHz rate.
2. The Horizontal Scan Count shall range from 0 to 799.
3. The Horizontal Scan Count shall be updated at the 25 MHz rate.
4. The Horizontal Sync signal shall be LOW ACTIVE and shall be active from Horizontal Scan Count 656 through 751.
5. The Horizontal Video On signal shall be HIGH ACTIVE and shall be active from Horizontal Scan Count 0 through 639.
6. The Vertical Scan Count shall range from 0 to 524.
7. The Vertical Scan Count shall be updated at the completion of a Horizontal Scan.
8. The Vertical Sync signal shall be LOW ACTIVE and shall be active from Vertical Scan Count 490 through 492.
9. The Vertical Video On signal shall be HIGH ACTIVE and shall be active from Vertical Scan Count 0 through 479.
10. The Video On signal shall be HIGH ACTIVE and shall be active when Horizontal Video On and Vertical Video On are active at the same time.

Object Mapping Requirements

GRAPHIC GENERATION WITH AN OBJECT-MAPPED SCHEME

1. You will display three fixed objects on the display in the regions specified by these requirements: a Wall, a Bar and a Ball.
2. Each object will have a specified region and a unique color to be selected by the designer.
3. The Wall shall occupy the region from horizontal scan count 32 through 35.
4. The Paddle shall occupy the region from horizontal scan count 600 through 603 and vertical scan count 204 to 276.
5. The Ball shall occupy the region from horizontal scan count 580 through 588 and vertical scan count 238 through 246.

Verification

- This project will utilize a self-checking test bench
- Your test bench should anticipate the positioning and color of the objects you display and should report any discrepancies

Demonstration

- Demonstrate the project to your instructor
- Have your report prepared at that time
- This project is due 10/19