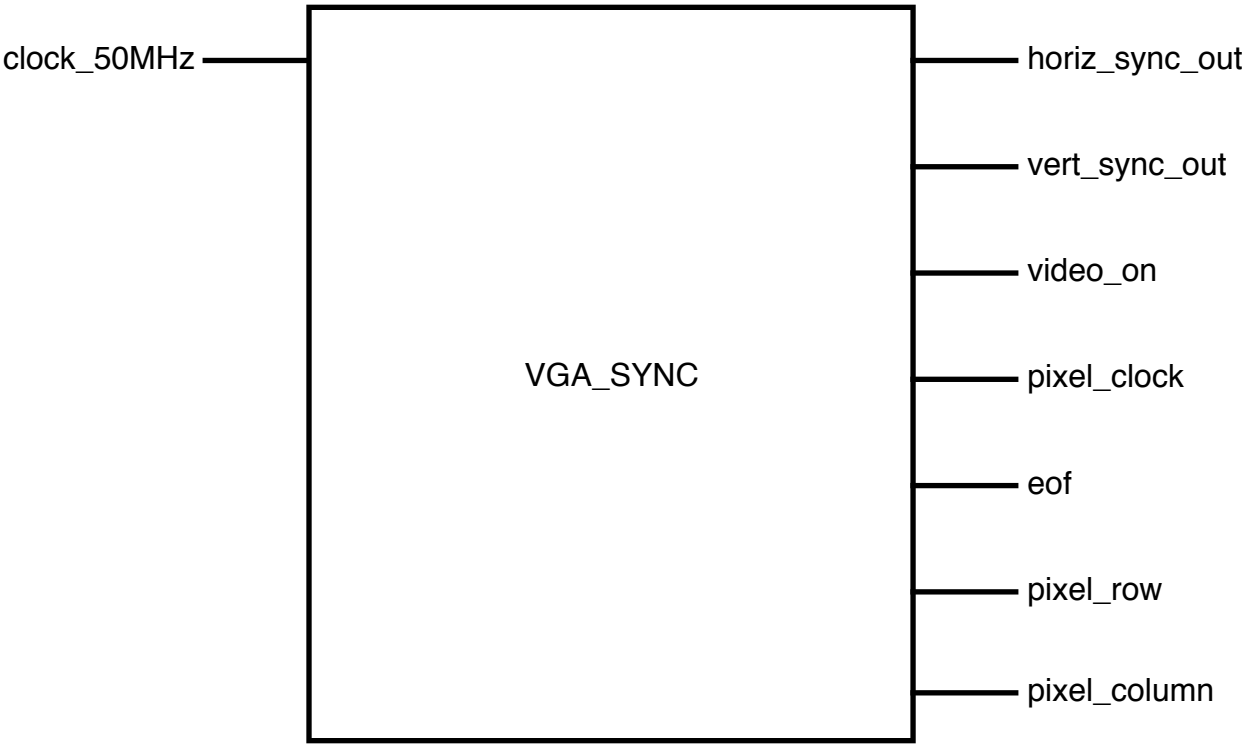
EECS 355 — Mini-Project 3 — VGA Controller

The purpose of this project is to demonstrate how to use the signals generated by the provided *VGA_SYNC* component to create useful pixel information for display on a VGA monitor.

***VGA_SYNC* Description:**



1) horiz_sync_out – causes the monitor to move to the next line on the screen

2) vert_sync_out – causes the monitor to move back to the first line on the screen

3) video_on – turns off the display if the current pixel is out of frame

4) pixel_clock – drives the VGA monitor at 25MHz

5) eof – raises end-of-frame flag indicating that the current pixel has gone out of frame

6) pixel_row – displays the row value of the current pixel

7) pixel_column – displays the column value of the current pixel

VGA Operational Description:

VGA displays output a pixel per cycle at a frequency of approximately 25MHz. One pixel consists of the amplitude values for each of the red, green, and blue colors. The number of bits used to represent each color is given by the color-depth of the system. The VGA output on the DE2 features 30-bit color, which in turn means that the values for each color are represented with 10 bits as shown below:

[29 … 20 | 19 … 10 | 9 … 0]
[red | green | blue]

To generate a perfect red, set all the bits in the red field to '1' and all the other bits to '0'. To generate magenta, set all the bits in the red and blue fields to '1' and all the bits in the green field to '0'. You can experiment with different combinations to generate different colors.

The monitor will display the pixels in order by scanning across a scanline. That is, it will draw all of the pixels along the first line (top of the screen) in order, and then will move on to the second line. It will continue this until it reaches the end of the frame (last pixel in the last row), and then will go back to the top and begin again. The *VGA_SYNC* component will output the row and column of the current pixel. This allows you to make decisions about which color to output based on the current location, which is useful for drawing shapes in certain locations, and a background everywhere else.

Project Notes:

Compile the Quartus II project and observe the output of the DE2 when connected to a VGA monitor. In your project, the *VGA_SYNC* component will be given to you so don't worry too much about trying to understand how it generates its outputs, but you are responsible for creating the logic that determines the color value based on the pixel row and column so you need to understand what the outputs are for and how they should be used.