```
`timescale 1ns / 1ps
//////////////////////////////////////////////////////////////////////////////////
// Company:
// Engineer:
//
// Create Date: 2016/03/28 22:19:17
// Design Name:
// Module Name: vga
// Project Name:
// Target Devices:
// Tool Versions:
// Description:
//
// Dependencies:
//
// Revision:
// Revision 0.01 - File Created
// Additional Comments:
//
//////////////////////////////////////////////////////////////////////////////////


 module vga(
    input clk,
    input rst,
    output reg hs,
    output reg vs,
    output  [3:0] r,
```

```
    output [3:0] g,
    output [3:0] b
    );
//maximum value for the horizontal pixel counter
parameter HMAX=10'b1100100000;   // 800
//maximum value for the vertical pixel counter
parameter VMAX=10'b1000001101;   // 525
//total number of visible columns
parameter HS_WIDTH=10'b0001100000; //96
//HS pluse width
parameter HP=10'b0000101000; //40
//H Back Porch
parameter HLB=10'b0000001000;  //8
//H Left Board
parameter LEFT_NO_DISPLAY_ZONE=HS_WIDTH+HP+HLB;
// horizontal and vertical counters
reg [9:0] hcounter=10'b0000000000;
reg [9:0] vcounter=10'b0000000000;
reg [11:0] color=12'b000000000000;
// active when inside visible screen area.
wire video_enable ;
reg vidon;
assign r=color[11:8];
assign g=color[7:4];
assign b=color[3:0];

// increment horizontal counter at pixel_clk rate
// until HMAX is reached, then reset and keep counting
always @(posedge clk or posedge rst)
```

```
begin
if(rst)
  begin
    hcounter<=10'b0000000000;
    hs<=1;
  end
else
  begin
   if(hcounter == HMAX-1)
       hcounter<=10'b0000000000;
    else
       hcounter <= hcounter+1;
   if(hcounter<96)
         hs<=0;
   else
         hs<=1;
   end
end

//increment vertical counter when one line is finished
//(horizontal counter reached HMAX)
//until VMAX is reached, then reset and keep counting
always @(posedge clk or posedge rst)
begin
if(rst)
  begin
    vcounter<=10'b0000000000;
    vs<=1;
  end
```

```
else
   begin
      if(hcounter == HMAX-1)
        if(vcounter == VMAX-1)
           vcounter<=10'b0000000000;
        else
           vcounter <= vcounter + 1;
      else
           vcounter<=vcounter;
        if(vcounter<2)
                vs<=0;
        else
                vs<=1;
       end
end

always @(*)
begin
 if(hcounter<(LEFT_NO_DISPLAY_ZONE+128))
   color=12'h000;
 else if(hcounter<(LEFT_NO_DISPLAY_ZONE+128*2))
   color=12'hf00;
 else if(hcounter<(LEFT_NO_DISPLAY_ZONE+128*3))
   color=12'h0f0;
 else if(hcounter<(LEFT_NO_DISPLAY_ZONE+128*4))
   color=12'h0ff;
 else
   color=12'hf0f;
```

```
end
endmodule
```