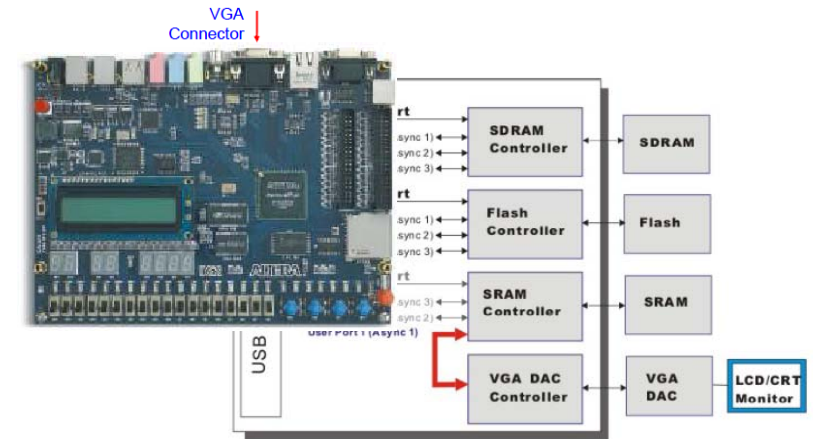


# Design Example

## VGA Controller



# VGA Controller

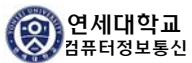
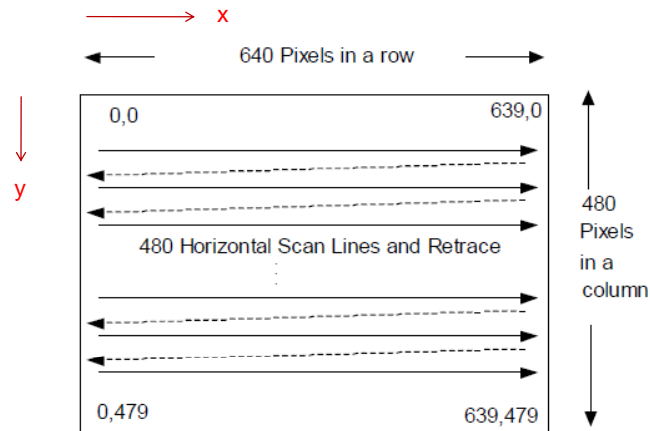


ADV7123 : triple10-bit high-speed video DAC



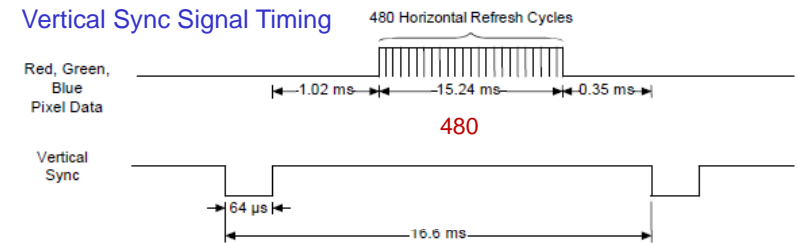
# VGA Image

- 640 x 480 Pixel layout

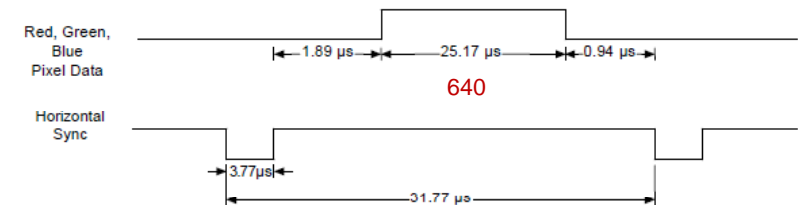


# Vsync and Hsync Signal at 60Hz

## Vertical Sync Signal Timing



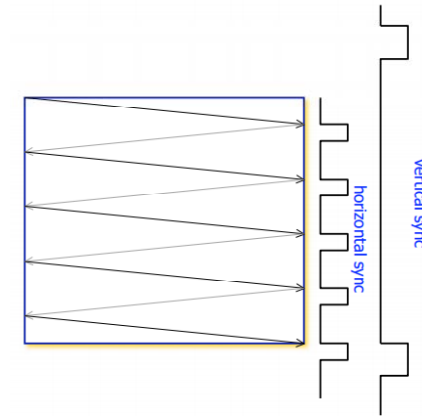
## Horizontal Sync Signal Timing



# VGA Timing Specification

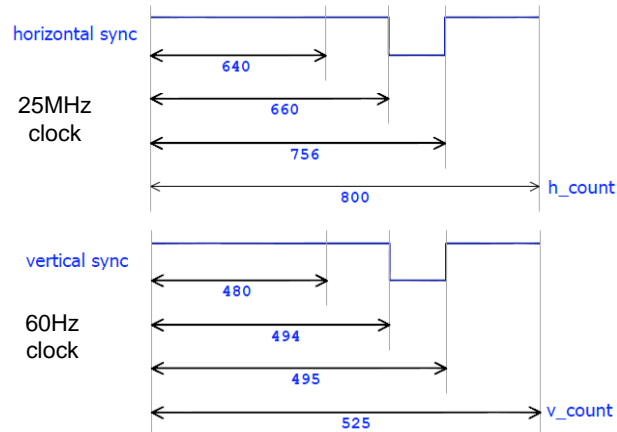
Format	Pixel Clock (MHz)	Horizontal (in Pixels)				Vertical (in Lines)			
		Active Video	Front Porch	Sync Pulse	Back Porch	Active Video	Front Porch	Sync Pulse	Back Porch
640x480, 60Hz	25.175	640	16	96	48	480	11	2	31
800x600, 72Hz	50.000	800	56	120	64	600	37	6	23

# Vsync, Hsync and Display



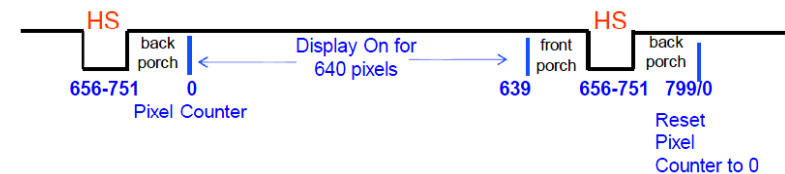
# VGA timing at DE2

- 60Hz Refresh rate, 25MHz Pixel clock (T=40ns)



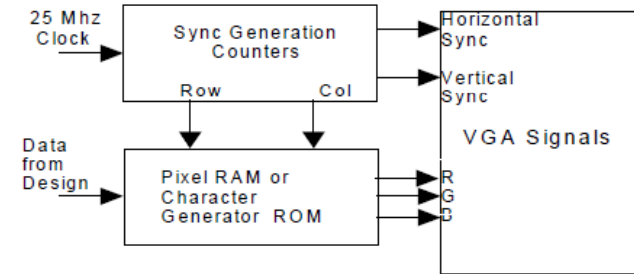
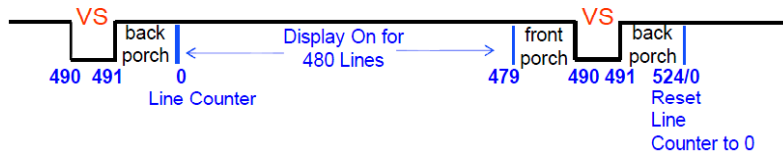
# VGA Horizontal Timing

- To generate a Horizontal Sync Pulse, use a 10-bit pixel counter modulo-800
  - Counter increments with a 25MHz clock (pixel clock)
  - Pixel Counts <0 thru 639>: Display On
  - Pixel Counts <640 thru 799>: Display Off
  - Pixel Count <656 thru 751>: HS Pulse Active for 96 pixels
  - Pixel Count 799: Reset pixel counter
  - HS Pulse is Active Low for most monitors



# VGA Vertical Timing

- To generate Vertical Sync Pulse (VS), start a 10-bit Line Counter modulo-525
  - Counter increments every 800 pixels
  - Line Counts <0 thru 479> : Display On
  - Line Counts <480 thru 524>: Display Off
  - Line Counts 490 and 491: VS Pulse Active
  - Line Count 524: Reset Line Counter
  - VS Pulse is Active Low for most monitors



## DE2

Signal Name	FPGA Pin No.
VGA_R[0]	PIN_C8
VGA_R[1]	PIN_F10
VGA_R[2]	PIN_G10
VGA_R[3]	PIN_D9
VGA_R[4]	PIN_C9
VGA_R[5]	PIN_A8
VGA_R[6]	PIN_H11
VGA_R[7]	PIN_H12
VGA_R[8]	PIN_F11
VGA_R[9]	PIN_E10
VGA_G[0]	PIN_B9
VGA_G[1]	PIN_A9
VGA_G[2]	PIN_C10
VGA_G[3]	PIN_D10
VGA_G[4]	PIN_B10
VGA_G[5]	PIN_A10
VGA_G[6]	PIN_G11
VGA_G[7]	PIN_D11

## DE2

VGA_G[8]	PIN_E12
VGA_G[9]	PIN_D12
VGA_B[0]	PIN_J13
VGA_B[1]	PIN_J14
VGA_B[2]	PIN_F12
VGA_B[3]	PIN_G12
VGA_B[4]	PIN_J10
VGA_B[5]	PIN_J11
VGA_B[6]	PIN_C11
VGA_B[7]	PIN_B11
VGA_B[8]	PIN_C12
VGA_B[9]	PIN_B12
VGA_CLK	PIN_B8
VGA_BLANK	PIN_D6
VGA_HS	PIN_A7
VGA_VS	PIN_D8
VGA_SYNC	PIN_B7

