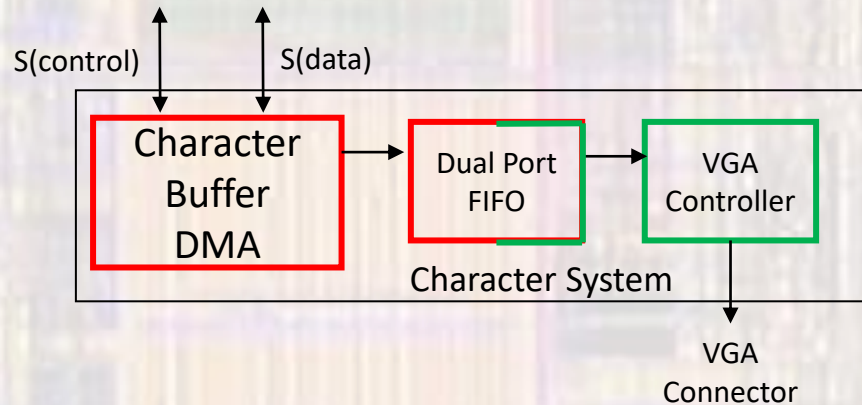


# NIOS Character Intro

Last updated 7/20/23

# NIOS II Character Display - Intro

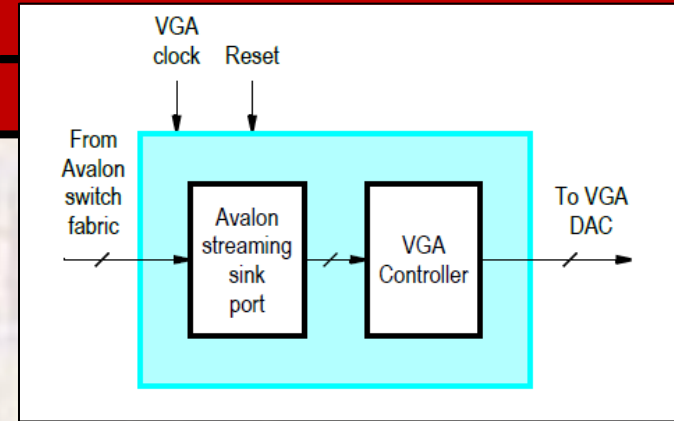
- Character Buffer System
  - Display characters (letters) on a VGA display



# NIOS II Character Display -

- VGA Controller Block

- Receives VGA data to be displayed
- Adds the required VGA timing signals
- Transmits the new data to the VGA block (DAC) on the DE10 Lite board
- Supports various screen resolutions from VGA 640×480 pixels to WSXGA 1680x1050, including HDTV 1280x720
  - Note - different resolutions require different clock frequencies
- Input: Requires 3 planes (RGB) of 10bits each
  - Note – The DE10 DAC outputs 4 bit data
  - It's not clear how the 10bit to 4bit conversion is mapped



# NIOS II Character Display - Intro

- Character Buffer Block
  - Converts ASCII character code to a graphical representation suitable for use with a VGA display
    - Processor (code) sends ASCII character codes to the Character Buffer block
    - The block stores the characters in its on-chip memory
    - A DMA controller reads the ASCII characters from the on-chip memory and sends them to the character renderer
    - The renderer converts the ASCII characters to their graphical representation and sends them out

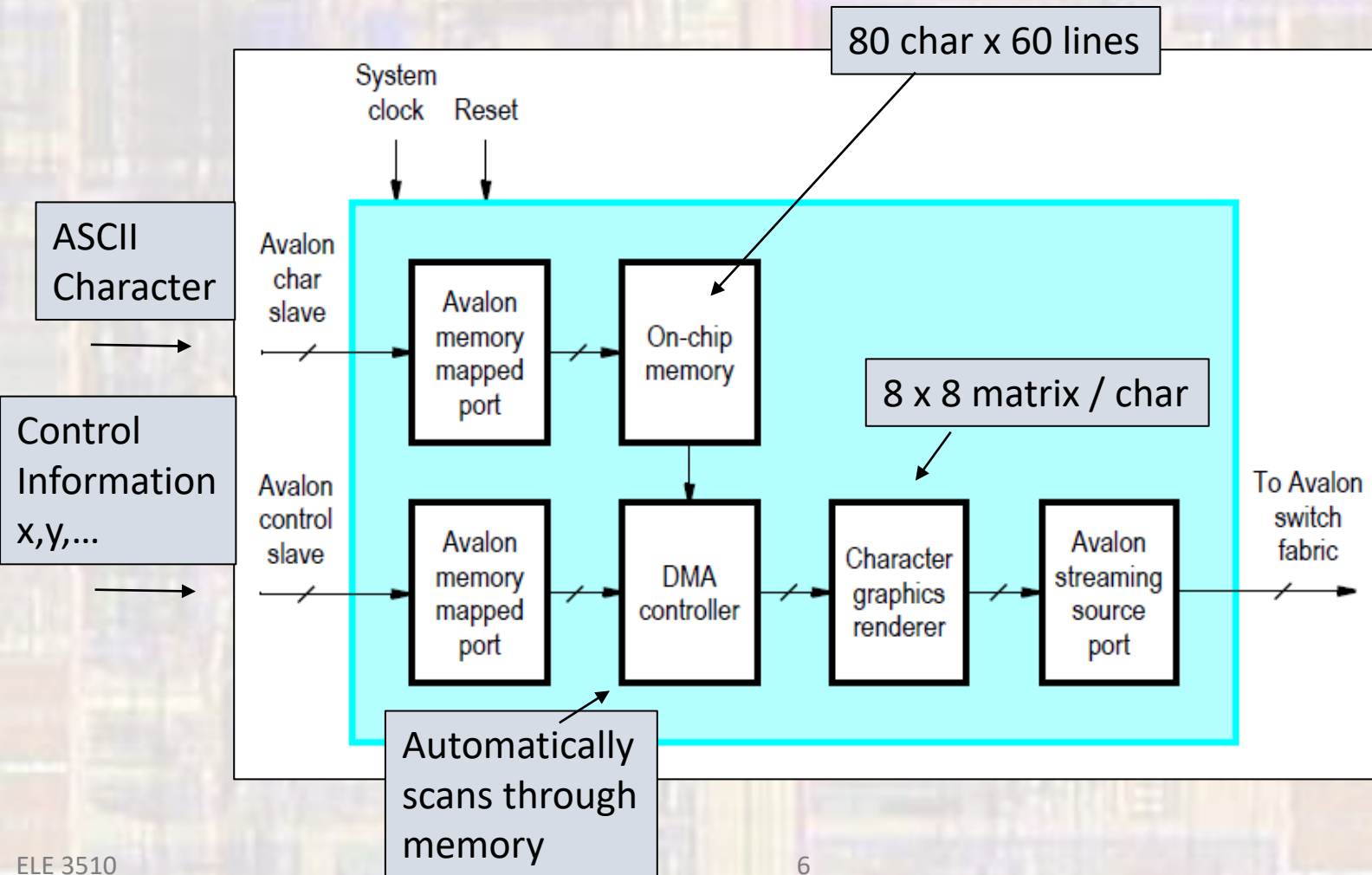


# NIOS II Character Display - Intro

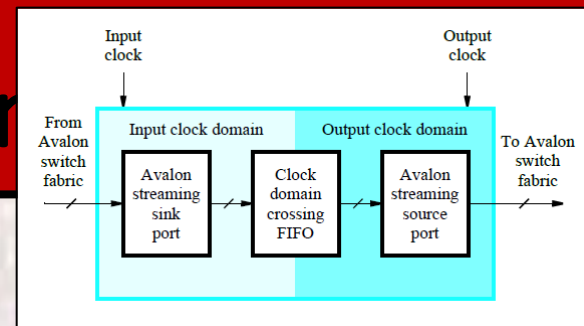
- Character Buffer Block
  - Supports 80 characters x 60 lines
    - Standard VGA
    - Size of internal memory
  - Outputs only 1 color (white)
    - Uses 10bits/color, 3 color planes in normal mode (still only white)
    - Uses 10bits/color, 4 color planes in transparent mode for use with the pixel buffer (still only white)
  - Separate control and ASCII data inputs

# NIOS II Character Display - Intro

- Character Buffer Block



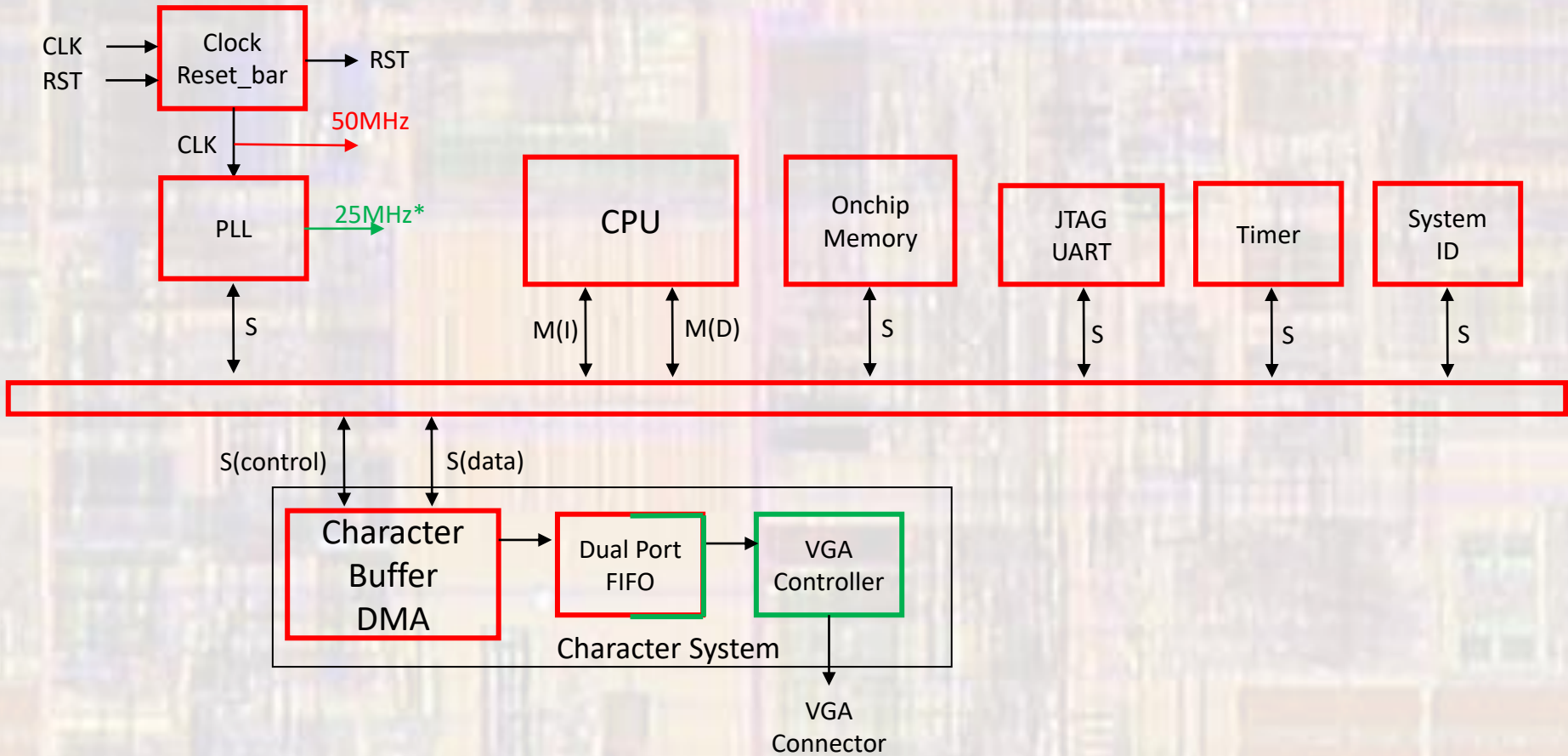
# NIOS II Character Display - In



- Dual Clock FIFO
  - Transfers data across two different clock domains
  - Output clock is set by the output resolution
    - VGA 640x480 clock is 25MHz
  - Input clock is determined by system design requirements
    - We will typically use 50MHz
  - Data format is programmable
    - Symbol: a complete piece of data
    - Beat: a unit of transmission – one complete set of data
    - The VGA driver requires:
      - 10bits/color      3 colors per pixel location
      - 
      - 10bit symbols      3 symbols / beat

# NIOS II Character Display - Intro

- Character Buffer Block Diagram



25MHz\*\* - VGA clk