Spartan™-3A / Spartan™-3AN Starter Kit Pre-Loaded Demo

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Agenda

- How to set up the demonstration
- How to operate the demonstration
- Evaluating MultiBoot
- Evaluating Suspend
- Demo technical details
Demonstration Setup (1)

- Make sure power switch is turned off; connect power supply to circuit board
- Make sure suspend switch is set to run
- Connect suitable VGA display device to board
  - CRT
  - Projector
  - Flat panel
- Connect headphones or amplified speakers
Demonstration Setup (2)

• Optional: Connect PS/2 keyboard to the board
• Optional: Connect serial cable between board and PC, start the provided HyperTerminal session
Demonstration Setup (3)

• Optional: Install meters for current measurement (meters not provided)
  – Meters must be set to 200mA or higher range
  – Meters must be on before board power is applied
  – Reverse connections if values shown during operation are negative

VCCAUX and VCCINT shunts removed to accommodate meters
Demonstration Setup (4)

• Turn on power
  – Audio and video output generation begins
  – Messages are sent to the on-board LCD and the serial port

• Several forms of user interaction are possible
  – Manipulate image in real time
  – MultiBoot to other designs
  – Enter and exit Suspend

You may need to adjust display device settings (horizontal and vertical position) to center the display
How to Operate

• There are different ways to “operate” the demo
  – Switches and buttons, while viewing the VGA output
  – Switches and buttons, while viewing the LCD output
  – Through the RS232 port, using HyperTerminal on PC

• Although the demo setup states that the VGA display is required, you can run a demonstration by other means…
How to Operate (VGA - 1)

- A menu is displayed at the bottom of the display in **blue** text
- First, the MultiBoot menu
  - Spin knob to select next configuration to load
  - Press any N/E/W/S button to initiate MultiBoot
  - Press knob for next menu
How to Operate (VGA - 2)

• Image control menu 1
  – Press N/E/W/S buttons to scroll displayed image
  – Spin knob to rotate image
  – Press knob for next menu

• The “autopilot” (automatic demo) will stop if the user performs manual image transformations
How to Operate (VGA - 3)

• Image control menu 2
  – Press N/E/W/S buttons to scroll displayed image
  – Spin knob to scale image
  – Press knob for next menu

• The “autopilot” (automatic demo) will stop if the user performs manual image transformations
How to Operate (VGA - 4)

• Volume and Auto Menu
  – Press any N/E/W/S button to resume the “autopilot” (automatic demo)
  – Spin knob to adjust audio output volume (useful for headphones and speakers without volume control)
  – Press knob to return to MultiBoot menu
How to Operate (LCD)

• When the demo begins, it sends a greeting to the LCD for 1 second
• Next, a MultiBoot menu
  – Spin knob to select next configuration to load
  – Press any N/E/W/S button to initiate Multi-Boot
• LCD menu tracks VGA menu but only shows MultiBoot options
How to Operate (RS232)

• When the demo begins, it sends a message through the serial port
  – View with HyperTerminal
  – Use provided session file

• Pressing a number key will MultiBoot to other FPGA configurations
Evaluating MultiBoot

- Use the MultiBoot menu to select from one of the four additional FPGA configurations
- The LCD and RS232 outputs allow MultiBoot without the use of an attached VGA display
- To return to the demo from any of the additional FPGA configurations, press the rotary knob
Evaluating MultiBoot

• Configuration 1
  – DeviceDNA reader design
  – Provided by Ken Chapman, Xilinx
  – Reads Spartan-3A / Spartan-3AN identifier and displays on LCD
  – For more information, please download the original reference design on the Spartan-3A Starter Kit Reference Design Page

• Configuration 2
  – Fractal generator design
  – A user-contributed design by Matthias Alles
  – Computes image in real time and displays on VGA
  – Rotate knob to zoom, press N/E/S/W buttons to scroll
  – For more information, please download the original design from http://www-user.rhrk.uni-kl.de/~alles/fpga/
Evaluating MultiBoot

• Configuration 3
  – ASCII Terminal
  – Provided by Eric Crabill, Xilinx
  – Implements a terminal using a VGA display and PS/2 keyboard and will communicate with HyperTerminal on a PC
  – For more information, consult the provided design source

• Configuration 4
  – Parallel Flash Programmer
  – Provided by Ken Chapman, Xilinx
  – Enables user to exercise, erase, and program the parallel flash device on the board through HyperTerminal on a PC
  – For more information, please download the original reference design on the Spartan-3A Starter Kit Reference Design Page
Evaluating Suspend

• All five of the designs may be suspended at any time
  – Observe demo state and optional meters prior to entering suspend
  – Move suspend switch to suspend; observe optional meters and note supply current reduction
  – Move suspend switch to run; observe that demo state has been preserved during suspend
• Do not suspend the flash programmer during a flash memory operation!
Demo Technical Details

• In the main demo, a PicoBlaze processor evaluates user inputs and programs the hardware peripherals to generate outputs
  – Video text from character mode video controller
  – Video bitmaps stored in parallel flash, and transformed using “rotozoom” (resampling)
  – Audio waveforms stored in serial flash, played back using digital I/O with XAPP154 technique
  – Other peripherals include ICAP-based MultiBoot controller and hardware trigonometric function
Demo Block Diagram
Tech: PicoBlaze / UART

• These modules were obtained from the Xilinx website, http://www.xilinx.com/picoblaze and are not included in the source download
• The primary function of PicoBlaze is to drive the hardware based on user inputs
  – Demo program is stored in a single BlockRAM
  – Excellent “programmed” alternative to an FSM
• UARTs are used for serial port communication
Tech: Video Generation

- PicoText is a video timing controller and character display generator that accepts images from the rotozoom hardware (data stored in parallel flash)
- May be programmed on-the-fly to virtualize the character display hardware
  - Reduces buffer size by eliminating storage of characters to represent “empty space”
  - Uses interrupt to advance the active region ahead of the raster; programmed by a display list stored in the character buffer
Tech: Audio Generation

• PicoTune is a simple audio controller that plays back stored audio waveforms from SPI flash
  – Data is retrieved in a burst during vertical blank while graphics fetch for rotozoom is idle; all flash memories on board share a data line
  – Buffered data is consumed at sample rate by PWM audio output scheme based on Xilinx XAPP154
Tech: PicoBoot

- PicoBoot is a simple counter-based ICAP interface which may be programmed with MultiBoot parameters by the processor
  - Internal mode, internal use, address, etc…
  - Single strobe event initiates MultiBoot

- For details on the ICAP command and data sequences, consult the Spartan-3 Generation Configuration User Guide
Tech: Lookup Tables

• Two large lookup tables are implemented
  – AutoPilot ROM stores a table of “scripted” user inputs to control the demonstration in the absence of interactive user input
  – Polar to Rectangular converter consists of a \( \sin(x)/\cos(x) \) table followed by a multiplier to implement magnitude scaling; used to convert angle and step size (scale) into delta x,y values for rotozoom hardware
Tech: User and LCD

• User interface consists of quadrature decoder for rotary knob, plus synchronizers and debouncers for ordinary buttons

• LCD interface is effectively general purpose I/O controlled by software to drive this display