SP601 Built-In Self Test
Flash Application

December 2009
Overview

- Xilinx SP601 Board
- Software Requirements
- SP601 Setup
- SP601 BIST (Built-In Self Test)
- Compile SP601 BIST Design
- Program SP601 BPI
- References

Note: This presentation applies to the SP601
**SP601 BIST Design Description**

- **Description**
  - The Built-In System Test (BIST) application uses an EDK MicroBlaze system to verify board functionality. A UART based terminal program interface offers users a menu of tests to run.

- **Reference Design IP**
  - EDK IP: MicroBlaze, plb_v46, lmb_v10, mdm, lmb_bram_if_cntlr, bram_block, xps_bram_if_cntlr, xps_uart16550, xps_gpio, clock_generator, mpmc, proc_sys_reset, xps_intc, xps_timer, xps_iic, xps_mch_emc, xps_spi, util_io_mux, util_bus_split, xps_ethernetlite

- **Reference Design Source**
  - rdf0045.zip

**Note:** Presentation applies to the SP601
Embedded Processor Design

- The provided embedded reference design is supported “as is”
  - Please refer to the click through license agreement
- Embedded reference design has been verified on the SP601 Evaluation Kit
  - Design consists of Early Access IP
  - Design may change in subsequent releases
- The reference design will allow users to:
  - Re-build and verify functionality on the SP601 evaluation kit

Note: Presentation applies to the SP601
The SP601 MicroBlaze Design Hardware includes:

- DDR2 Interface (128 MB)
- BRAM
- External Memory Controller (EMC)
  - Flash Memory
- Networking
- UART
- Interrupt Controller
- GPIO (IIC, LEDs and LCD)
- PLB Arbiter
- SPI

Note: Presentation applies to the SP601
Xilinx SP601 Board

Note: Presentation applies to the SP601
**ISE Software Requirement**

- **Xilinx ISE 11.4 software**
  - Install the Webpack for the Spartan-6 LX16 devices
  - Run XilinxUpdate and download the Webpack devices

*Note: Presentation applies to the SP601*
EDK Software Requirement

- Xilinx EDK 11.4 software

Note: Presentation applies to the SP601
SP601 Setup

- Power on the SP601 board for UART Driver Install
- Connect a USB Mini-B Cable to the USB UART connector on the SP601 board
  - Connect this cable to your PC
SP601 Setup

- Install USB UART Drivers

**Note:** Presentation applies to the SP601
SP601 Setup

- Right-click on My Computer and select Properties
  - Select the Hardware tab
  - Click on Device Manager

Note: Presentation applies to the SP601
SP601 Setup

- Expand the Ports Hardware
  - Right-click on **Silicon Labs CP210x USB to UART Bridge** and select Properties

*Note: Presentation applies to the SP601*
SP601 Setup

- Under Port Settings tab
  - Click Advanced
  - Set the COM Port to an open Com Port setting from COM1 to COM4

Note: Presentation applies to the SP601
SP601 Setup

- **Board Power must be on before starting Tera Term**
- **Start the Terminal Program**
  - Select your USB Com Port
  - Set the baud to 9600

**Note:** Tera Term may need to be restarted if board power is cycled
SP601 Setup

- Set the mode pins for BPI Flash
  - M0 = 0
  - M1 = 0
Press PROG and view initial BIST screen

- Type “1” to start the UART Test

**Note:** Presentation applies to the SP601
SP601 BIST

- **UART Test completed**
  - Press **PROG** and type **2** to begin LED Test
**SP601 BIST**

- **LED Test completed**
  - Press **PROG** and type **3** to begin Timer Test

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**Note:** Presentation applies to the SP601
Timer Test completed

- Press PROG and type 4 to begin Flash test

Note: Do not press PROG until this test completes
**SP601 BIST**

- **Flash Test completed**
  - Press **PROG** and type **5** to begin IIC EEPROM Test

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**Presentation applies to the SP601**
IIC EEPROM Test completed

- Press **PROG** and type **6** to begin Ethernetlite Test

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**Note:** Presentation applies to the SP601
Ethernetlite Test completed
- Press **PROG** and type **7** to begin GPIO Switch Test

**Note:** Presentation applies to the SP601
### SP601 BIST

- **GPIO Switch Test completed**
  - Press **PROG** and type **8** to begin External Memory Test

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**Note:** Presentation applies to the SP601
### SP601 BIST

**External Memory Test running with caches on**

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST0:</td>
<td>Write all memory to 0x00000000 and check Writing... Reading... Test Complete Status = SUCCESS</td>
</tr>
<tr>
<td>TEST1:</td>
<td>Write all memory to 0xFFFFFFF and check Writing... Reading... Test Complete Status = SUCCESS</td>
</tr>
<tr>
<td>TEST2:</td>
<td>Testing for stuck together bank/row/col bits Clearing memory to zeros... Writing and Reading... Test Complete Status = SUCCESS</td>
</tr>
<tr>
<td>TEST3:</td>
<td>Testing for maximum bank/row/col noise This test performs 16 word writes followed by 16 word reads Each 64 bytes inverts the bank/row/col address Initializing Memory to 0xA5A5A5A5... Writing and Reading... Test Complete Status = SUCCESS</td>
</tr>
<tr>
<td>TEST4:</td>
<td>Testing for Inverse Data at Address Writing... Reading... Test Complete Status = SUCCESS</td>
</tr>
</tbody>
</table>

**Note:** Presentation applies to the SP601
Second part of External Memory test (caches off)

- IC: Off, DC: Off
- TEST0: Write all memory to 0x00000000 and check
  - Writing...
  - Reading...
  - Test Complete Status = SUCCESS
- TEST1: Write all memory to 0xFFFFFFFF and check
  - Writing...
  - Reading...
  - Test Complete Status = SUCCESS
- TEST2: Testing for stuck together bank/row/col bits
  - Clearing memory to zeros...
  - Writing and Reading...
  - Test Complete Status = SUCCESS
- TEST3: Testing for maximum ba/row/col noise
  - This test performs 16 word writes followed by 16 word reads
  - Each 64 bytes inverts the ba/row/col address
  - Initializing Memory to 0xA5A5A5A5...
  - Writing and Reading...
  - Test Complete Status = SUCCESS
- TEST4: Testing for Inverse Data at Address
  - Writing...
  - Reading...
  - Test Complete Status = SUCCESS

Number of errors in this pass = 0

MPMC memory test iteration #1 has PASSED!
Total number of errors for all iterations = 0
### Program finished successfully ###
Press the ‘PROG’ button to continue.
Compile SP601 BIST Design
Compile SP601 BIST Design

- Unzip the rdf0045.zip file

Note: Presentation applies to the SP601
Compile SP601 BIST Design

- The BIST Design can be compiled with EDK
- Open XPS project <design path>\system.xmp
- Generate the libraries needed to create the bitstream
  - Select **Software** → **Generate Libraries and BSPs** (1)

*Note: Presentation applies to the SP601*
Compile SP601 BIST Design

- Compile the Software Applications and create the application ELF files
  - Select Software → Build All User Applications (1)

Note: Presentation applies to the SP601
Compile SP601 BIST Design

- Create the hardware design, system.bit, located in <project directory>/implementation
  - Select **Hardware** → **Generate Bitstream** (1)

**Note:** Presentation applies to the SP601
Compile SP601 BIST Design

- **Init memory with the Bootloader Application ELF**
  - Update the bitstream (download.bit) with the bootloader ELF (executable.elf)
  - Select **Device Configuration → Update Bitstream (1)**

**Note:** Presentation applies to the SP601
Compile SP601 BIST Design

- The bitstream must be converted to hex format (.bin) prior to programming into flash
  - Select Project → Launch Xilinx Bash Shell (1)

Note: Presentation applies to the SP601
Compile SP601 BIST Design

- Generate a BIN file from the bitstream
  
  promgen -w -p bin -c FF -o implementation/download.bin -u 0 implementation/download.bit

Note: Presentation applies to the SP601
Program SP601 BPI
Program SP601 BPI

- Add a second USB Type-A to Mini-B cable to the USB JTAG connector on the SP601 board
  - Connect this cable to your PC
Program SP601 BPI

- Download the bitstream
  - Select Device Configuration → Download Bitstream (1)

Note: This step is required prior to programming the Flash with EDK
Program SP601 BPI

- Program the bitstream and ELF files into BPI Flash
  - Select Device Configuration → Program Flash Memory (1)

Note: This overwrites the BIST application delivered with the SP601 board.
Program SP601 BPI

- Program the BPI Flash with the bitstream
  - Bitstream download.\texttt{bin}
  - Offset: 0x00000000
  - Scratch Memory: \texttt{xps_bram_if_cntlr_1}

\textbf{Note:} Takes about 2 minutes
Program SP601 BPI

Program the BPI Flash with an SREC file:
- ELF: \texttt{hello_uart/hello_uart.elf}
- Select Auto-convert to SREC
- Offset: \texttt{0x00120000}
- Scratch Memory: \texttt{DDR2_SDRAM_c_mpmc_baseaddr}

\textbf{Note:} Takes about a minute
Program SP601 BPI

- Program the BPI Flash with an SREC file:
  - ELF: `hello_gpio/hello_gpio.elf`
  - Select Auto-convert to SREC
  - Offset: `0x00140000`
  - Scratch Memory: `DDR2_SDRAM_c_mpmc_baseaddr`

Note: Presentation applies to the SP601
Program SP601 BPI

- Program the BPI Flash with an SREC file:
  - ELF: hello_timer/hello_timer.elf
  - Select Auto-convert to SREC
  - Offset: 0x00160000
  - Scratch Memory: DDR2_SDRAM_c_mpmc_baseaddr

Note: Presentation applies to the SP601
Program SP601 BPI

- Program the BPI Flash with an SREC file:
  - ELF: `hello_flash/hello_flash.elf`
  - Select Auto-convert to SREC
  - Offset: `0x00180000`
  - Scratch Memory: `DDR2_SDRAM_c_mpcm_baseaddr`

Note: Presentation applies to the SP601
Program SP601 BPI

- Program the BPI Flash with an SREC file:
  - ELF: `hello_iic/hello_iic.elf`
  - Select Auto-convert to SREC
  - Offset: `0x001a0000`
  - Scratch Memory: `DDR2_SDRAM_c_mpmc_baseaddr`

Note: Presentation applies to the SP601
Program SP601 BPI

- Program the BPI Flash with an SREC file:
  - ELF: `hello_emac/hello_emac.elf`
  - Select Auto-convert to SREC
  - Offset: `0x001c0000`
  - Scratch Memory: `DDR2_SDRAM_c_mpmc_baseaddr`

Note: Presentation applies to the SP601
Program SP601 BPI

- Program the BPI Flash with an SREC file:
  - ELF: `hello_switch/hello_switch.elf`
  - Select Auto-convert to SREC
  - Offset: `0x001e0000`
  - Scratch Memory: `DDR2_SDRAM_c_mpmc_baseaddr`

Note: Presentation applies to the SP601
Program SP601 BPI

- Program the BPI Flash with an SREC file:
  - ELF: `hello_mem/hello_mem.elf`
  - Select Auto-convert to SREC
  - Offset: `0x00200000`
  - Scratch Memory: `DDR2_SDRAM_c_mpmc_baseaddr`

Note: Presentation applies to the SP601
Program SP601 BPI

- Press PROG and view initial BIST screen
  - Type “1” to start the UART Test

![Tera Term - COM2 VT window](image)

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Note: Presentation applies to the SP601
References
References

- **EDK Documentation**
  - Embedded System Tools Reference Guide

- **Spartan-6 Configuration**
  - Spartan-6 FPGA Configuration User Guide
Documentation
Documentation

- **Spartan-6**
  - Spartan-6 FPGA Family

- **SP601 Documentation**
  - Spartan-6 FPGA SP601 Evaluation Kit
  - SP601 Getting Started Guide
  - SP601 Hardware User Guide
  - SP601 Reference Design User Guide