Getting Started with the Kintex-7 FPGA KC705 Embedded Kit

UG913 (v1.0.1) May 31, 2012

XPN 0402910-01

Revision History

The following table shows the revision history for this document.

Date	Version	Revision
05/23/12	1.0	Initial Xilinx release.
05/31/12	1.0.1	Updated PDF document properties.

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Chapter 1

Getting Started with the Kintex-7 FPGA KC705 Embedded Kit

Introduction

The Kintex®-7 FPGA embedded kit conveniently delivers the key components of the Xilinx® Embedded Targeted Design Platform (TDP) required for developing embedded software and hardware in a wide range of applications in the broadcast, industrial, medical, and aerospace and defense markets. For software developers, a familiar Eclipse-based integrated development environment (IDE), GNU tools, operating systems, libraries, and a pre-verified reference design enables them to start programming right away. Similarly, hardware designers now have immediate access to a pre-integrated MicroBlaze™ processor subsystem that includes the most commonly used peripheral IP cores, enabling the designers to begin at once developing their custom logic.

This getting started guide identifies the steps required to set up the KC705 board and run the out-of-box video demonstration, which illustrates the flexibility and capability of a MicroBlaze processor subsystem for embedded design. If the Xilinx ISE® software has not already been installed, the user is directed through the steps to install the software, get updates, and generate a license.

KC705 Embedded Kit Contents

What's Inside the Box

- KC705 evaluation board featuring the XC7K325T-2FFG900C FPGA
- USB cables, Ethernet cable, and universal power supply
- SD card
- ISE Design Suite: Embedded Edition (device-locked for the XC7K325T-2FFG900C FPGA) which includes:
  - ISE Foundation with ISE Simulator
  - PlanAhead™ design tools
  - Embedded Development Kit (EDK)
  - Xilinx Platform Studio (XPS)
  - Software Development Kit (SDK)
  - ChipScope™ Pro logic analyzer
- Documentation:
  - UG913, *Getting Started with the Kintex-7 FPGA KC705 Embedded Kit*

- Reference designs and demonstrations:
  - BIST - MicroBlaze processor subsystem
  - Web server-based multi video streams demonstration system
- Reference designs, demonstrations, documentation, and applications delivered on USB flash drive to get started quickly

What's Available Online

- License for ISE Design Suite: Embedded Edition:
  - http://www.xilinx.com/support/licensing_solution_center.htm
  - http://www.xilinx.com/tools/faq.htm
- Embedded kit home page with documentation and reference designs:
  - http://www.xilinx.com/products/boards-and-kits/EK-K7-KC705-G.htm
- Technical support:
  - http://www.xilinx.com/support

Getting Started with the Video Demonstration

This Kintex-7 FPGA embedded kit comes with a video demonstration available on the provided USB flash drive. This demonstration can be run before installing any additional tools to get an overview of the features of the KC705 evaluation board using a MicroBlaze processor subsystem in the Kintex-7 (XC7K325T-FF900-2) FPGA.

Processor System Used for the Video Demonstration

The provided video demonstration uses a pre-built Kintex-7 FPGA design (Figure 1-1) with these features:

- MicroBlaze processor
- External DDR3 SDRAM interface
- External flash memory interface
- On-chip memory (block RAM)
- Integrated Tri-Mode Ethernet MAC
- UART (connected from the KC705 board via the USB-UART connector)
- Interrupt controller (Intc) and timer
- GPIO (LCD, LEDs, buttons, switches, and rotary)
- Software-configurable XADC block

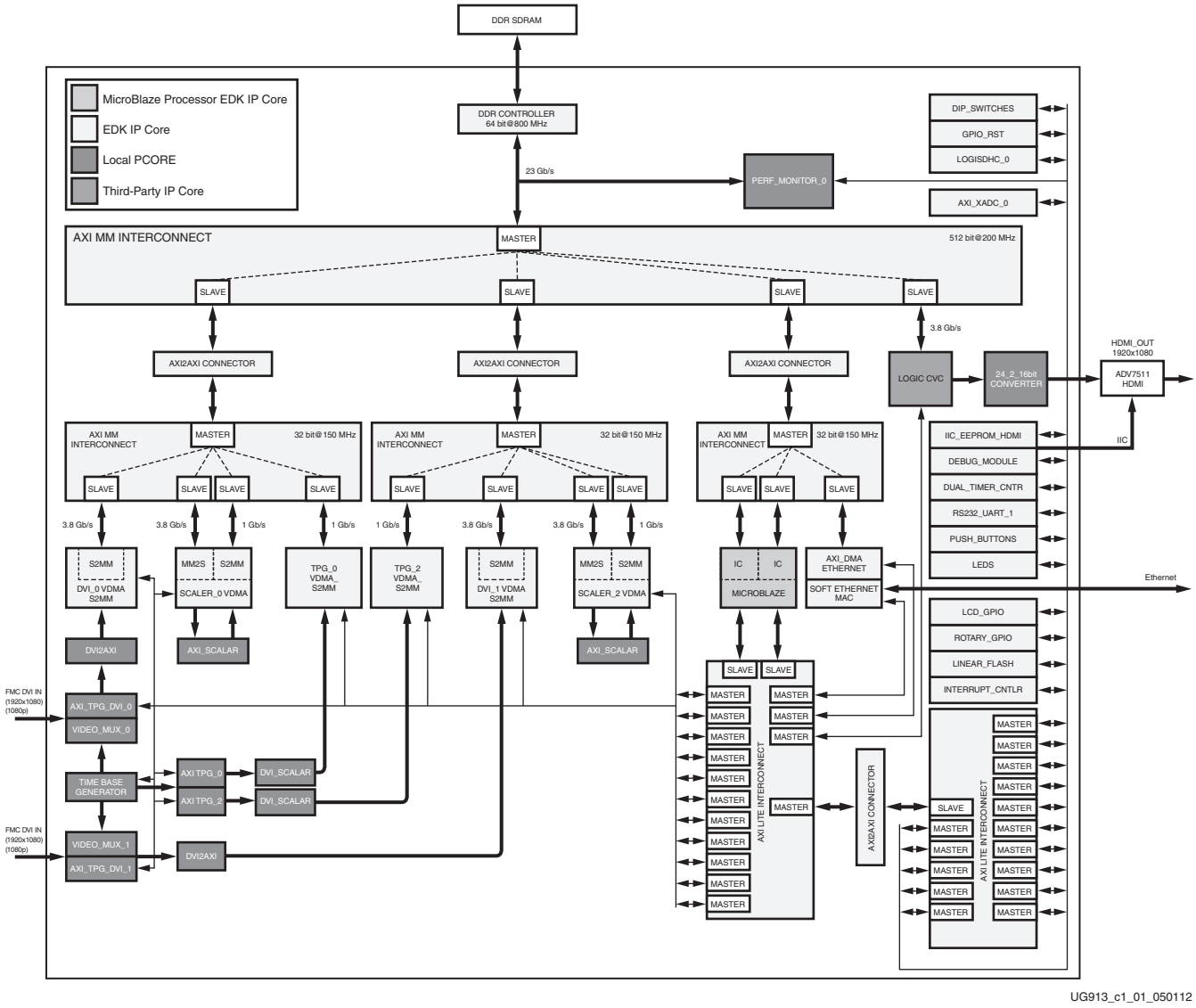

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Figure 1-1: **Kintex-7 FPGA Video Demonstration System**

Video Demonstration Hardware

The following hardware is provided with the evaluation kit:

- KC705 evaluation board with the Kintex-7 XC7K325T-2FFG900C device
- USB-to-Mini-B cable (for UART)
- AC power adapter (12V DC)
- Digilent USB cable (for JTAG)

The following prerequisites are not provided with the evaluation kit:

- One external monitor capable of displaying 1080p video through high-definition multimedia interface (HDMI) or digital visual interface (DVI)
- One HDMI-HDMI or HDMI-DVI cable
- A host PC with TeraTerm Pro terminal program
- Adobe SVG plug-in for Internet Explorer

Video Demonstration Hardware Setup Instructions

1. This demonstration requires default switch and jumper settings on the KC705 board. For more information on the default switch settings, refer to the "Hardware Test Board Setup Requirements" section of UG883, *Kintex-7 FPGA KC705 Evaluation Kit Getting Started Guide*.
2. Connect the KC705 board, HDMI cables, display monitor, Ethernet cable, and USB cables as shown in Figure 1-2.

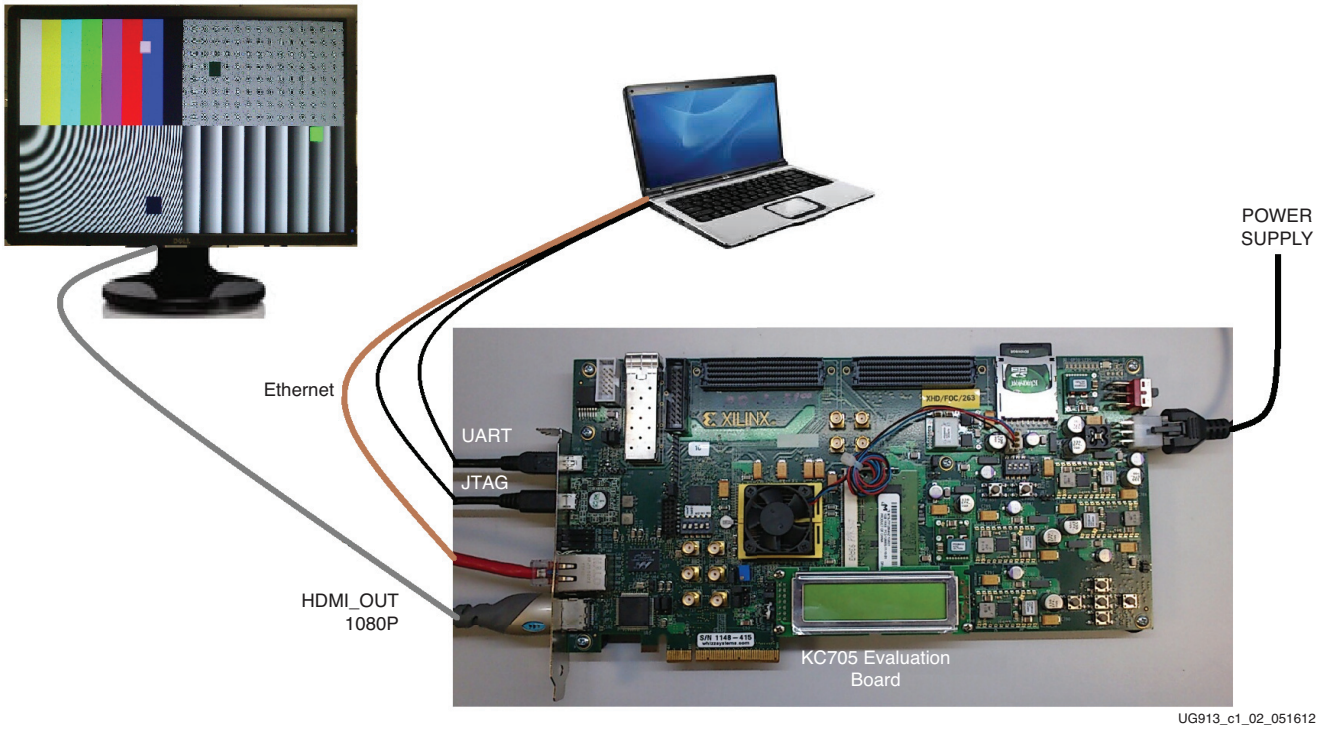

Figure 1-2: **Kintex-7 FPGA Video Demonstration Hardware Setup**

3. Set the IP address of the host PC to 192.168.1.100. Return the IP address of the PC back to its original setting after running the demonstration.

Note: The demonstration uses a hard-coded MAC address and a fixed IP address of 192.168.1.10 and does not connect to the regular LAN network using DHCP. Do not connect more than one board to the same network segment.

Running the Video Demonstration

To run the video demonstration, copy and unzip the demonstration package files either from the USB flash drive or from the Web to the host machine and follow these steps:

1. If the KC705 board is not already powered on, plug in the power adapter to local AC power. Plug the 12V power cable into the board connector on J49. Turn on the power by switching the SW15 to the ON position.
2. Open and configure a serial communications terminal utility program with these settings:
   - Baud Rate: **9600**
   - Data: **8 bit**

- Parity: **None**
- Stop: **1 bit**
- Flow Control: **None**

Note: Refer to Appendix B, Communicating with the KC705 USB-UART for setting up the UART communication.

3. Open a command shell with the ISE tools and EDK environment settings. Refer to Appendix C, Installation and Licensing of ISE Design Suite for ISE tool chain installation and licensing help.

   Note: To set environment variables, run the `settings32.bat` file located in the Xilinx installation area. At the command prompt, type **`C:\Xilinx\13.4\ISE_DS\settings32.bat`** (for Windows XP) or **`C:\Xilinx\13.4\ISE_DS\settings64.bat`** (for Windows 7) and press **Enter**.

4. Go to the unzipped directory of the demonstration package and execute these commands to download the design and connect to the MicroBlaze processor:

   ```
   $ cd KC705_Embedded_Kit/Video_Demo/ready_for_download
   ```

   ```
   $ xmd
   ```

   ```
   XMD% fpga -f ise_top.bit
   ```

   This command downloads the hardware bitstream into the FPGA but does not download the software application:

   ```
   XMD% connect mb mdm
   ```

   This command connects to the MicroBlaze processor debug module:

   ```
   XMD% dow Video_Demo.elf
   ```

   ```
   XMD% con
   ```

5. The UART output should be as shown in Figure 1-3.

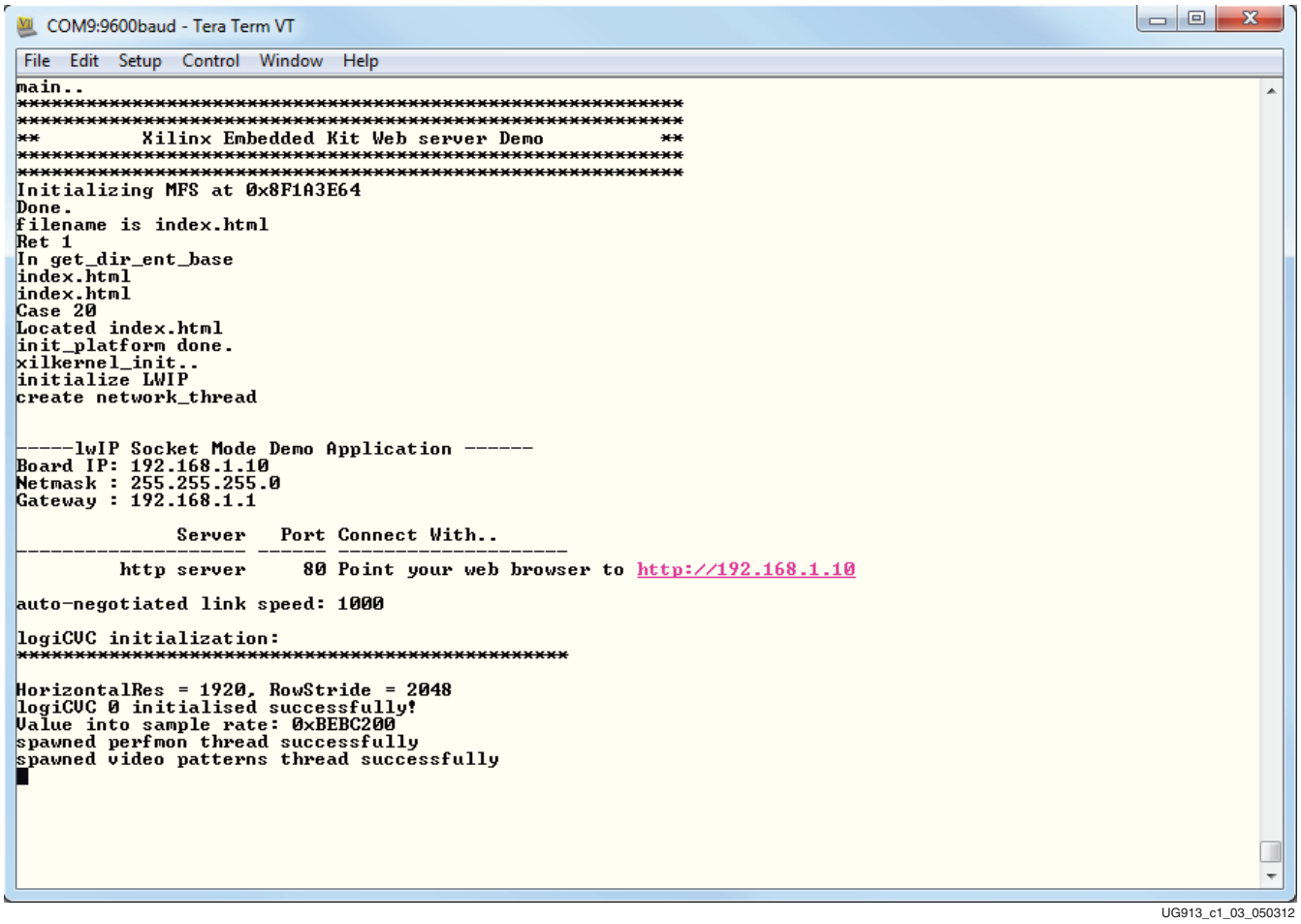

Figure 1-3: **Video Demonstration UART Output**

6. Open a Web browser on the host computer and set the URL to 192.168.1.10. The Web page shown in Figure 1-4 should be displayed. The page uses JavaScript, so the browser must have JavaScript enabled.

   Note: If using Internet Explorer, the Adobe SVG viewer plug-in or a similar plug-in that enables viewing of SVG files must be installed to view the graph. This demonstration is tested with Internet Explorer 8 on a Windows XP machine.

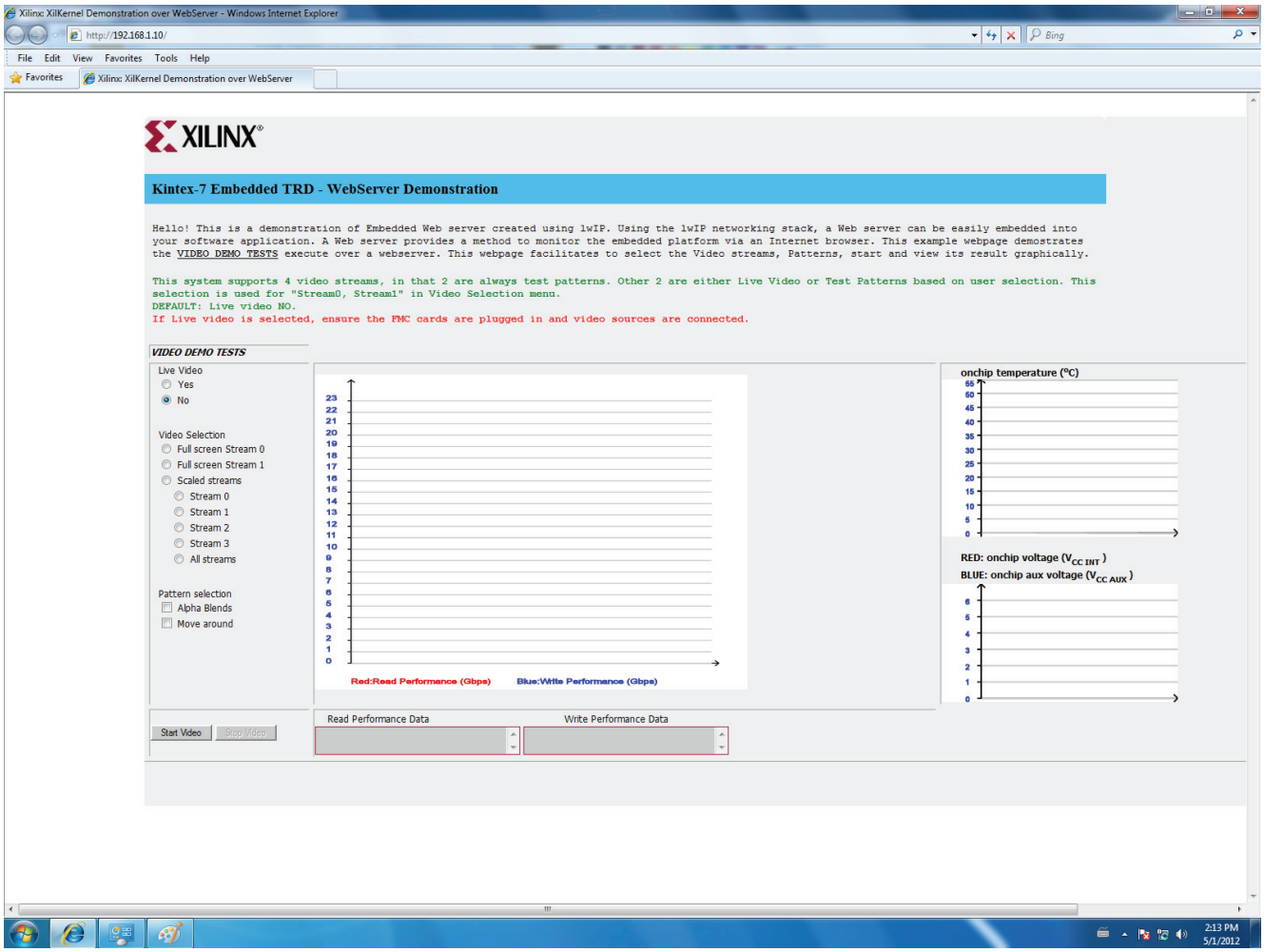

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Figure 1-4: **Initial Video Demonstration Web Page**

7. In the video demonstration Web page, make the following selections as shown in Figure 1-5:
   - Live Video: **No**
   - Video Selection: **Scaled streams > All streams**
8. After the video selection is made, click the **Start Video** button on the Web page. Performance and temperature graphs are plotted in the Web page with performance numbers shown in the text boxes (Figure 1-5).

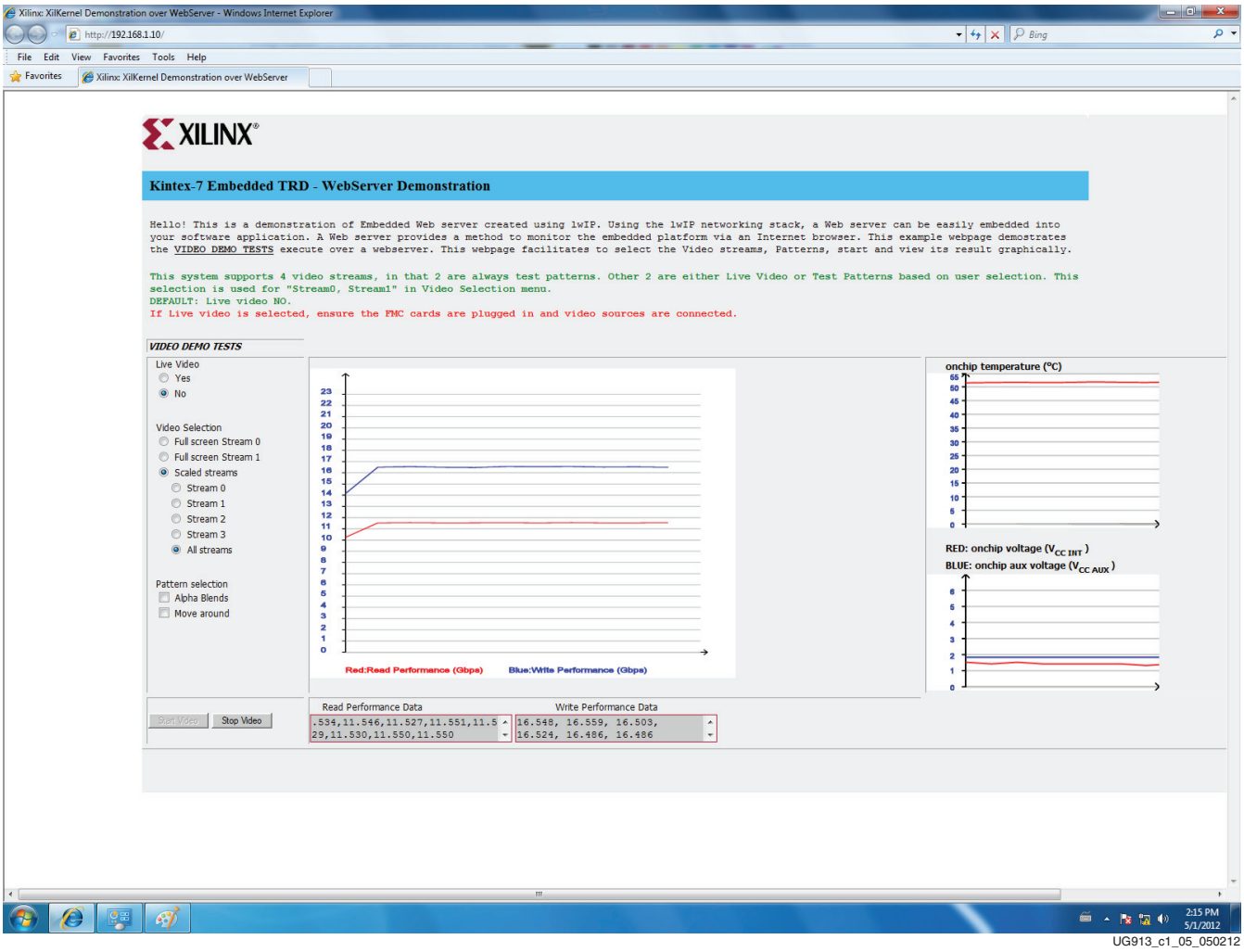

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Figure 1-5: **Video Demonstration Web Page with Data Plotted**

Figure 1-6 shows the output display for the selections made in step 7.

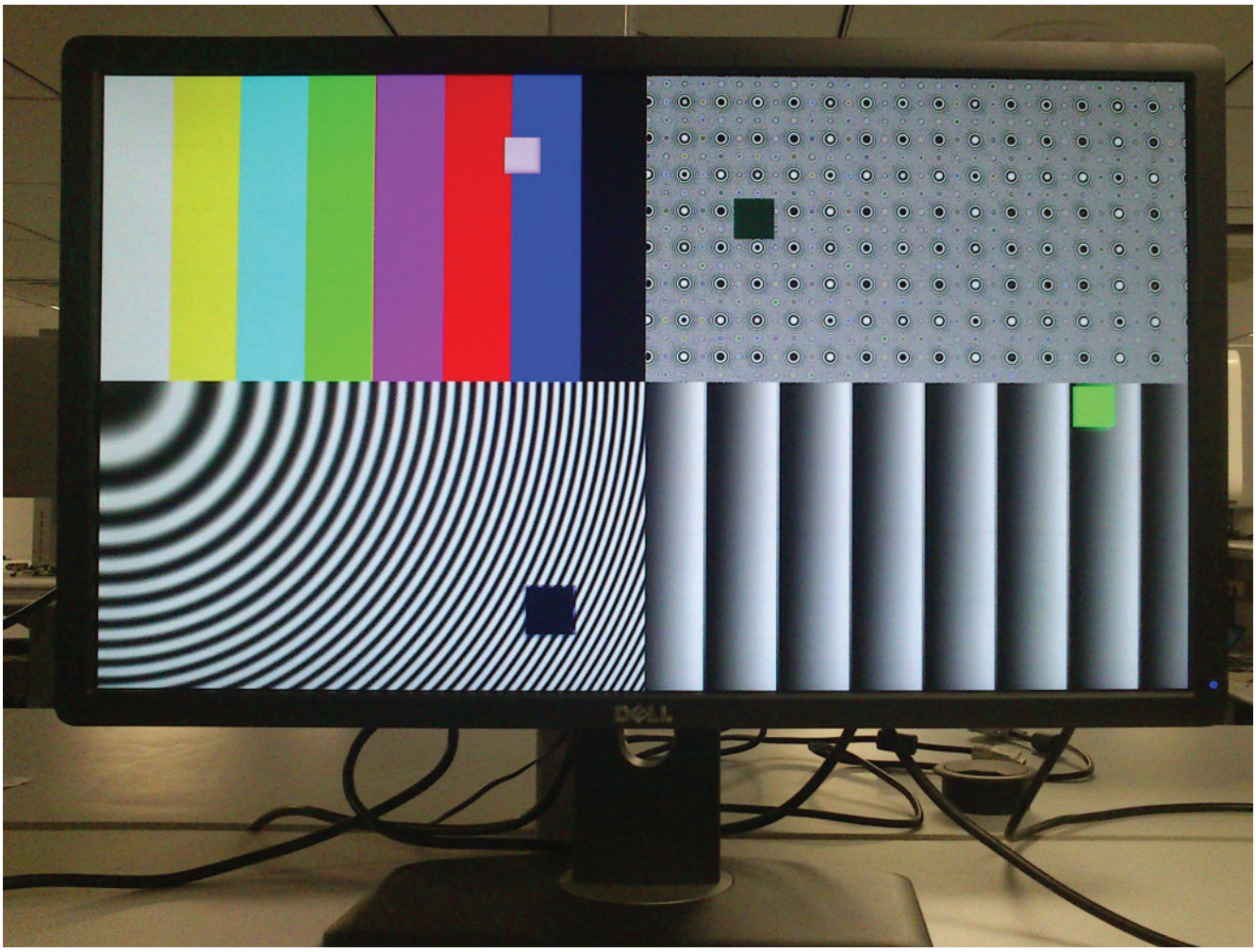

Figure 1-6: **Output Video Display**

The Web browser receives one packet of results at a time. This packet contain five results:

- Read throughput (Gb/s)
- Write throughput (Gb/s)
- On-chip temperature (°C)
- On-chip V_{CCINT} voltage (V)
- On-chip V_{CCAUX} voltage (V)

JavaScript is used to convert these results into coordinates and update the graphs. The graphs update every time a new data packet is received. The graph holds a maximum of 12 data points at a time. After the maximum has been reached, the oldest data point is dropped and the newest data point is added.

9. In the video demonstration Web page, click **Stop Video** to stop the video streams and stop requesting results data packets. After this button is clicked, any pending requests complete and then no additional data is requested. All the video streams are also stopped and the monitor displays only the background screen.

10. Repeat step 7, step 8, and step 9 to explore different VIDEO DEMO TESTS options by changing the selections mentioned in step 7.

Running BIST tests

11. A Web server-based BIST demonstration can also be run on the same hardware to test different peripherals. Enter these commands at the XMD prompt to run the BIST demonstration:

```
XMD% stop

XMD% dow Bist.elf

XMD% con
```

12. Reload the Web page with the same URL (192.168.1.10). The Web page should appear as shown in Figure 1-7.

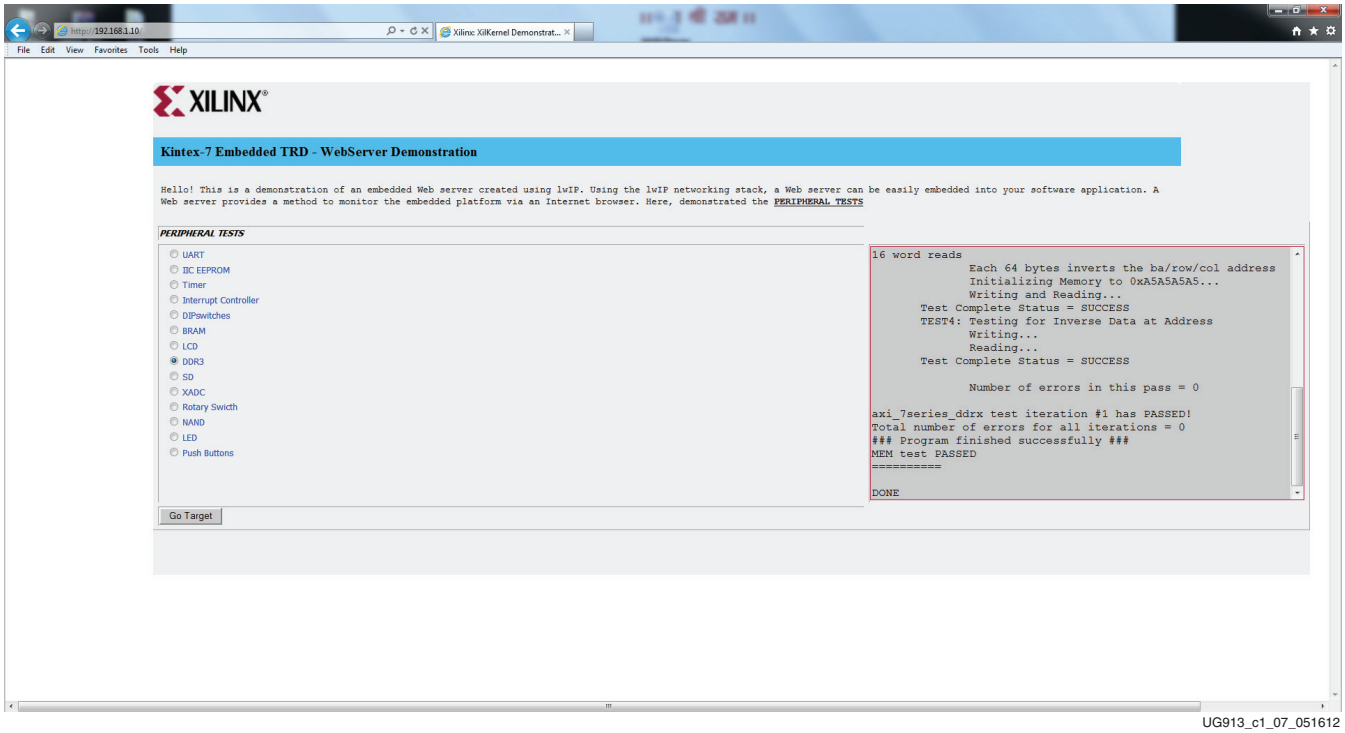

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Figure 1-7: **BIST Demonstration Web Page with DDR3 test results**

13. The left side of the Web page has different options for selecting the type of test to run on the hardware. For running the test, select any option from the list and press the **Go Target** button. The right side of the Web page has a messaging section that prints the results of the tests.

The Video and BIST demonstrations using the KC705 board are complete. Because a fully configured MicroBlaze processor subsystem has been provided, the user can start developing embedded applications. Because an FPGA is being used, the processor subsystem can also be fully customized. To do this, the ISE Design Suite and the USB-UART driver must be installed on the computer (see Appendix C, Installation and Licensing of ISE Design Suite).

Next Steps

After running through an FPGA-based embedded processor demonstration and installing the ISE Design Suite: Embedded Edition, the user is ready to create custom embedded systems for the Kintex-7 XC7K325T FPGA.

Figure 1-8 is a snapshot of the directory structure in the `KC705_Embedded_Kit` folder on the USB flash drive included in the embedded kit or from the Kintex-7 FPGA KC705 Evaluation Kit page: http://www.xilinx.com/products/boards-and-kits/EK-K7-KC705-G.htm. Xilinx recommends copying the contents of the USB drive to a working area on the user's host computer.

Note: There should be no spaces in the path name of the working area on the host computer.

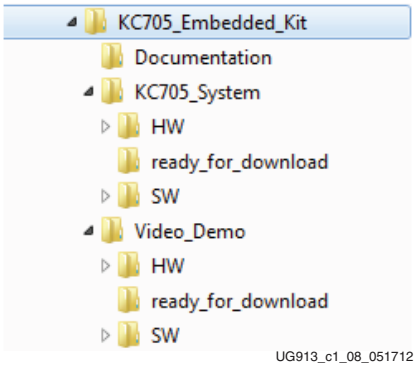

Figure 1-8: **KC705 Embedded Kit Directory Structure**

The `KC705_Embedded_Kit` directories and their content are explained in Table 1-1.

Table 1-1: **KC705 Embedded Kit Directory Structure Contents**

Directory	Purpose
`Documentation`	Includes the getting started guide and other supporting documentation provided with this embedded kit.
`KC705_BIST_System`	BIST MicroBlaze processor subsystem including the software applications and platforms.
`Video_Demo`	Contains the BIST MicroBlaze processor subsystem along with the cores for the video demonstration. Source files for the video demonstration are included here.

Reference Designs

MicroBlaze Processor BIST Subsystem

- KC705_System
  - This is the base MicroBlaze processor subsystem including the software applications and platforms.

MicroBlaze Processor Video Subsystem

- KC705_Video_Demo
  - This is the MicroBlaze processor subsystem with the video cores that were run as the power-on demonstration. Source files for the demonstration including the software application and platform are included here.

Appendix A

Additional Resources

Xilinx Resources

For support resources such as Answers, Documentation, Downloads, and Forums, see the Xilinx Support website at:

http://www.xilinx.com/support.

For a glossary of technical terms used in Xilinx documentation, see:

http://www.xilinx.com/support/documentation/sw_manuals/glossary.pdf.

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Appendix B

Communicating with the KC705 USB-UART

This appendix explains the procedure for setting up UART communication between the KC705 board and the host machine.

Installing the USB-UART driver

1. Execute the installer for the Silicon Labs USB-UART virtual COM port (VCP) driver from the `Drivers_and_Tools` folder on the USB drive shipped with the KC705 embedded kit: `Drivers_and_Tools\CP210x_VCP_Win2K_XP_S2K3.exe`.
2. Follow the installer instructions. Restart the computer when instructed to do so.

Connecting to the KC705 UART

3. Connect a USB Type-A to Mini-B 5-pin cable between the KC705 USB-UART connector (J21) and the host computer.
4. Power on the KC705 evaluation board if it is not already powered on.

Configuring the Host Computer

5. Right-click on **My Computer** and select **Properties**. Select the **Hardware** tab. Click on **Device Manager**.
6. Expand the **Ports (COM & LPT)** entry as shown in Figure B-1. This shows the COM port assigned to the **Silicon Labs CP210x USB to UART Bridge**. This is the COM port to use in the serial communications program.

   Note: The COM port setting for the user system might be different from the one shown in Figure B-1.

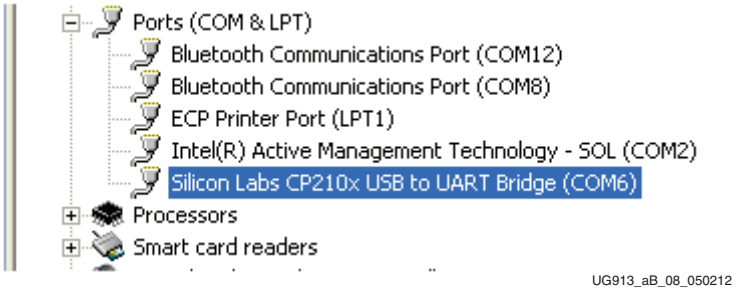

Figure B-1: **Silicon Labs USB to UART Bridge Properties**

If the Silicon Labs CP210x USB to UART bridge does not appear in the Ports list, a reboot of the computer might be required. After rebooting, repeat step 5 and step 6.

7. If using TeraTerm as the serial communications utility program, right-click on the **Silicon Labs CP210x USB to UART bridge** and select **Properties**.
   a. Click on the **Port Settings** tab and then click **Advanced**.
   b. Set the COM port to an open COM port setting from COM1 to COM4. The COM port setting for the user system might be different from the one shown in Figure B-2.

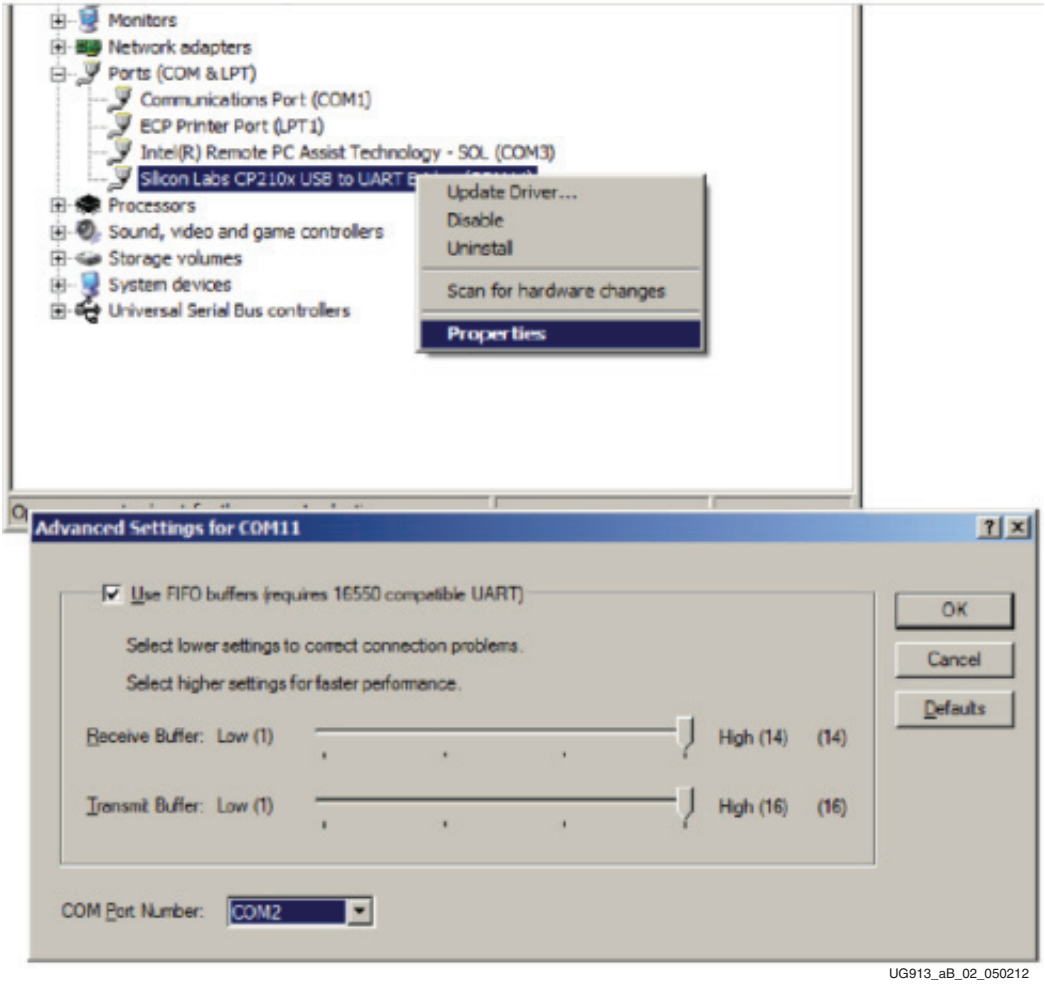

Figure B-2: **Setting the COM Port for the Silicon Labs USB to UART Bridge Driver**

8. Click **OK** to exit all open windows.

The Silicon Labs USB-UART VCP driver is now installed.

Appendix C

Installation and Licensing of ISE Design Suite

This KC705 embedded kit comes with entitlement to a full set of the ISE Design Suite: Embedded Edition that is device locked to the Kintex-7 XC7K325T device. This software can be installed from the DVD, or the Web installer can be downloaded from http://www.xilinx.com/support/download/index.htm.

For detailed information on licensing and installation, refer to UG798, *Xilinx ISE Design Suite: Installation and Licensing Guide*.

Getting Help and Support

For questions regarding products within your product entitlement account, send an e-mail message to your regional customer service representative:

- Canada, USA, and South America: isscs_cases@xilinx.com
- Europe, Middle East, and Africa: eucases@xilinx.com
- Asia Pacific including Japan: apaccase@xilinx.com

For technical support including the installation and use of your product license file, you may contact Xilinx Online Technical Support at www.support.xilinx.com. On this site you will also find the following resources for assistance:

- Software, IP, and documentation updates
- Access to technical support web tools
- Searchable answer database with over 4,000 solutions
- User forums
- Training in the form of select instructor-led classes and recorded e-learning options

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Appendix D

Warranty

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