Avnet Zynq Mini-ITX Development Board
Embedded Design

Version 1.0
August 2015

1 Introduction

This document describes a Zynq standalone OS embedded design implemented and tested on the Avnet Zynq Mini-ITX development board.

2 Reference Design Requirements

This reference design will require the following software and hardware setups.

2.1 Software

The software requirements for this reference design are:

- Xilinx Vivado 2015.2

2.2 Hardware

The hardware setup for this reference design is:

- Computer with 4 GB RAM and 1 GB virtual memory (recommended)
- Avnet Zynq Mini-ITX Development Board
- Power supply Module
- ATX power supply
- RJ45 Ethernet cable
- USB A-mini-B cables (2)
- microSD card

3 Reference Design Block Diagram

The following figure shows a high-level block diagram of the reference design. The design consists of:

- ARM Cortex-A9 Processor
- 1GB of PS DDR3 SDRAM
- 1GB of PL DDR3 SDRAM
- 32MB of QSPI Flash
- 1KB I2C EEPROM
- Real-Time Clock
- USB 2.0 4-Port Hub
- microSD Card Interface
- Gigabit Ethernet Interface
- USB-UART Port
- 8-position DIP Switch
- Four Push Switches
- Eight User LEDs

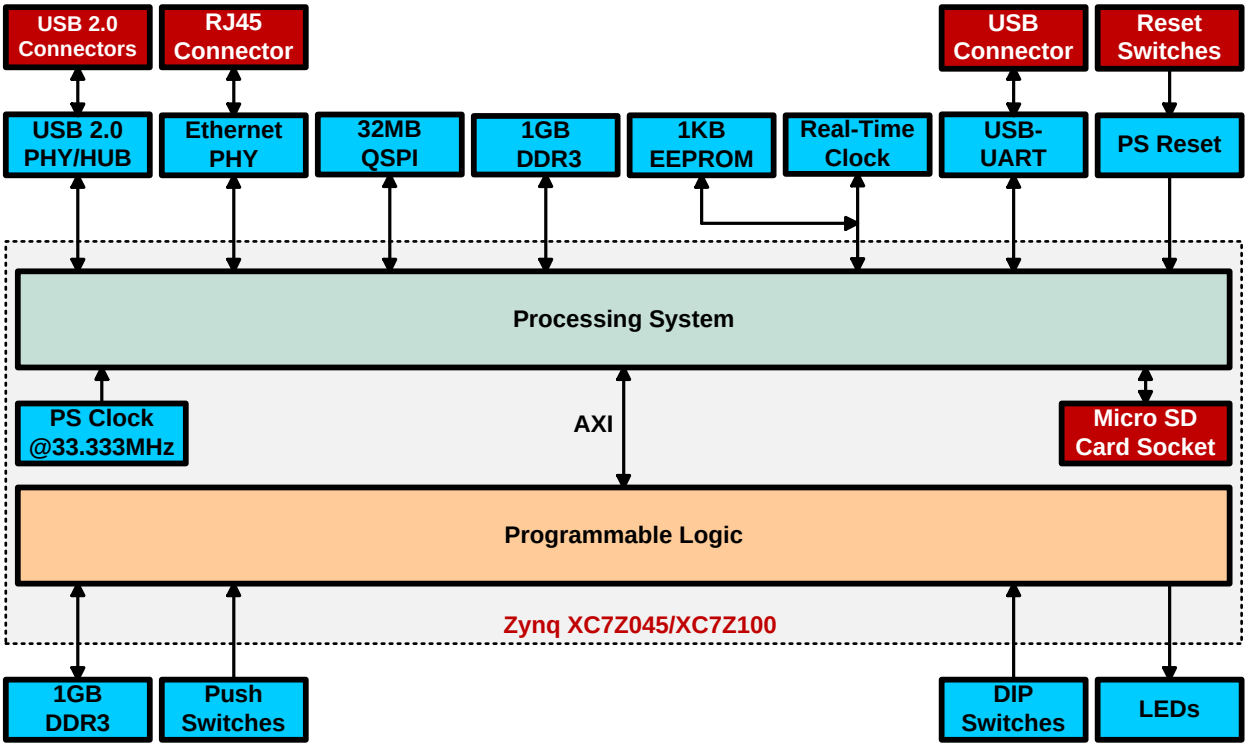
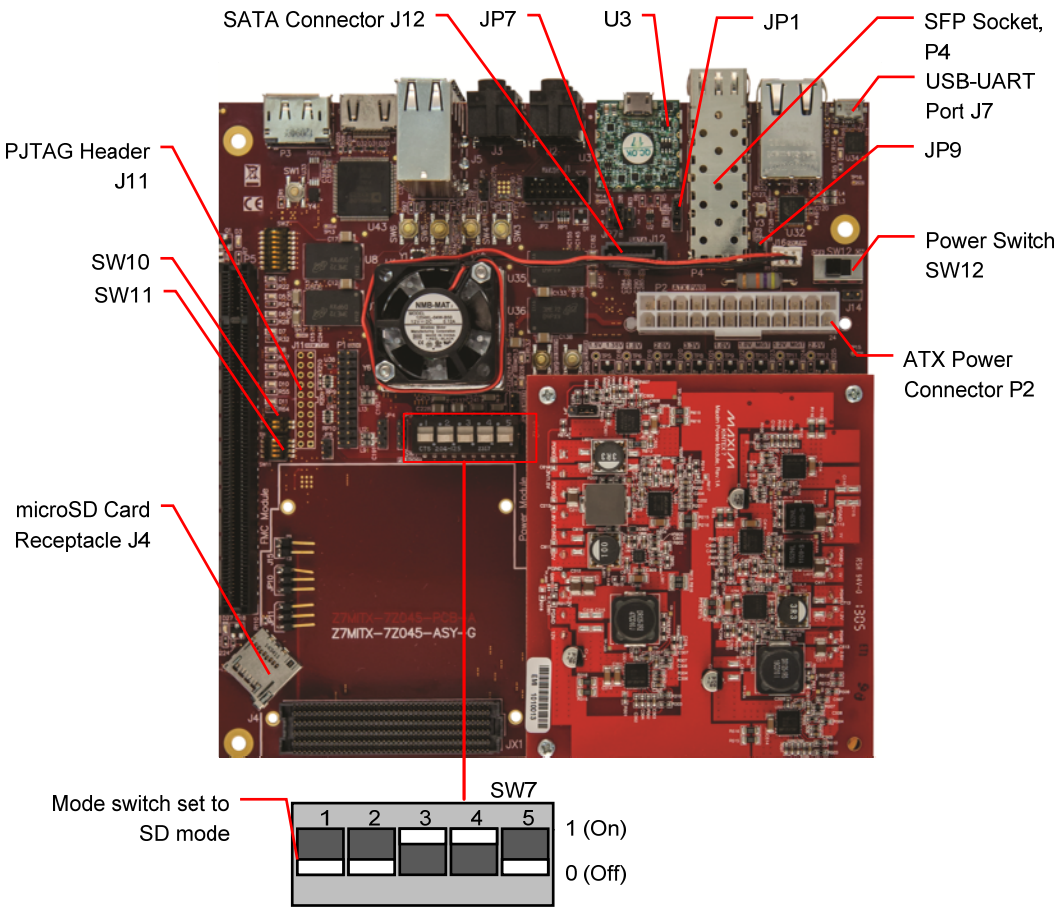


Figure 1 – Reference Design Block Diagram

4 Setting up the Board and the PC

Please perform the following steps to setup the Zynq Mini-ITX development board.

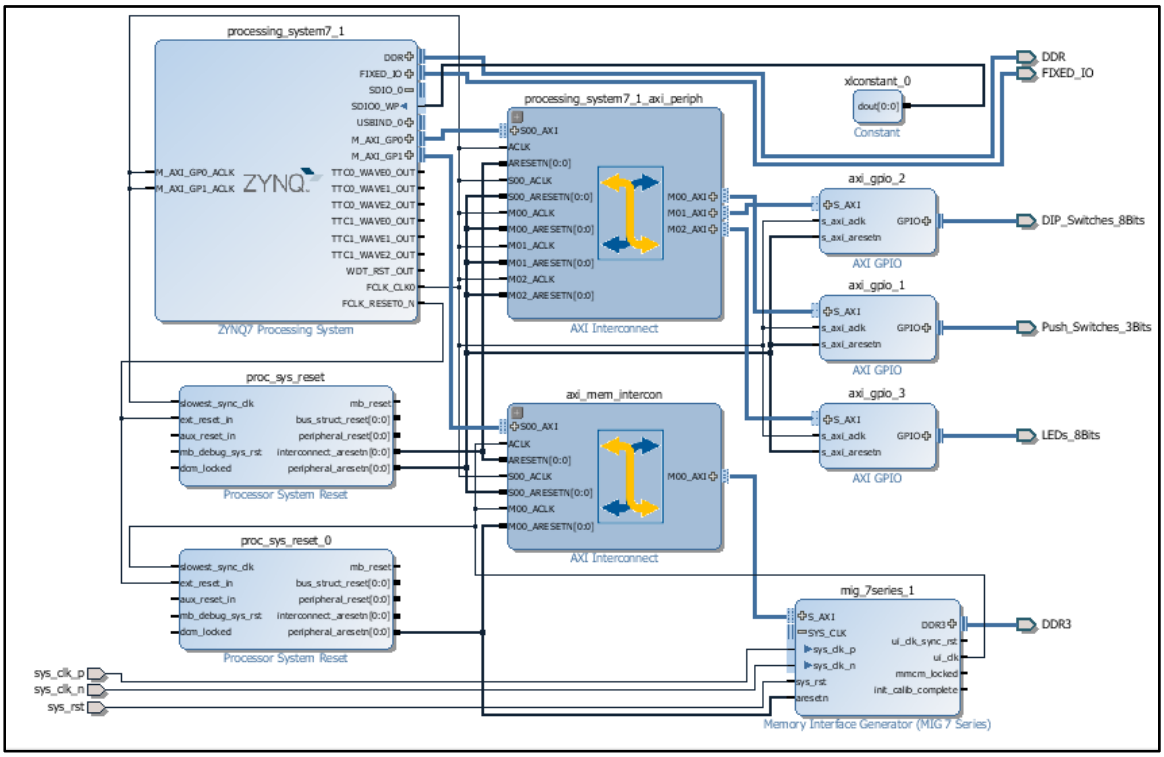
1. Install a jumper on JP1 pins 1-2.
2. Install a jumper on JP7 pins 3-4.
3. Install a jumper on JP12 pins 2-3.
4. Connect the USB A-mini-B cable to J7 and the USB port of the PC (USB-UART connection).
5. If not already installed, install the power module onto the Mini-ITX board via J8, J9, and J10 connectors.
6. Connect the ATX power supply to P2 connector.
7. Connect the USB A-mini-B cable to the U3 (Digilent USB-JTAG SMT-2 module) USB port and the USB port of the PC (JTAG connection).
8. Connect the Ethernet cable to the RJ45 connector on the board and the Gigabit Ethernet port of the PC.
9. Slide the SW12 power switch to the **ON** position.
10. Start a Tera Term session and set the serial port parameters to 115200 baud rate, 8 bits, 1 stop bit, no parity and no flow control (please refer to the **Setting up the Host PC** section at the end of this document for installing the software driver for the USB-UART port and setting up the UART).
11. Set the IP address of your PC to **192.168.1.1** with subnet mask of **255.255.255.0**.



5 Reference Design Vivado IPI Project

- Start the Vivado tool via **Start > All Programs > Xilinx Design Tools > Vivado 2015.2 > Vivado 2015.2**

- Open the Vivado IPI **zynq_mini_itx_embedded_design** project (the archived project file is located in the root directory of the reference design folder). Click on the **Open Block Design** (under the IP Integrator) and select **zynq_design_1.bd** file. The Vivado IPI GUI should look as shown in the following figure.



Note: If you are using a Windows PC and encounter Windows 260 character path limit issue when trying to rebuild the hardware platform in Vivado (the hardware platform is already built for you), please refer to the Xilinx Answer Record #52787 to resolve the issue.

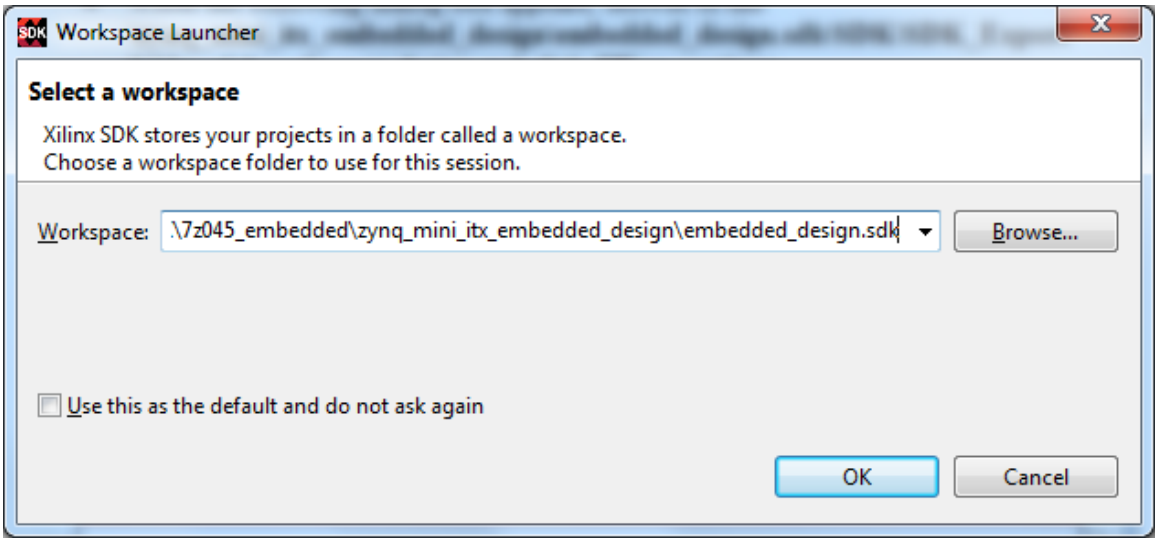
http://www.xilinx.com/support/answers/52787.htm

In addition to the above Answer Record, you could set your "**Temp**" environment variable to a short path. To do this, create a folder on your C drive and call it **MyTemp**. Set the "**Temp**" environment variable to **C:\MyTemp**.

6 Reference Design SDK Project

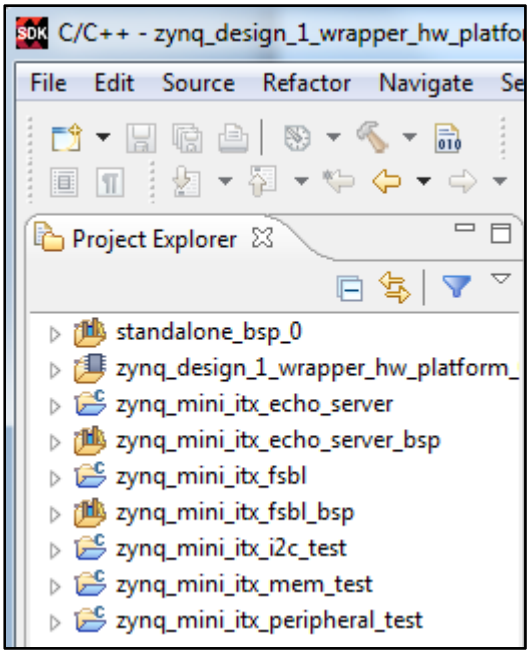
- Start the SDK tool via **All Programs > Xilinx Design Tools > SDK 2015.2 > > Xilinx SDK 2015.2**

- When the following dialog box appears, browse to the **\zynq_mini_itx_embedded_design\embedded_design.sdk** folder of the reference design and click **OK** to continue.



Note: You could also invoke SDK from the Vivado GUI via **File > Launch SDK**.

The SDK GUI should look as shown in the following figure.



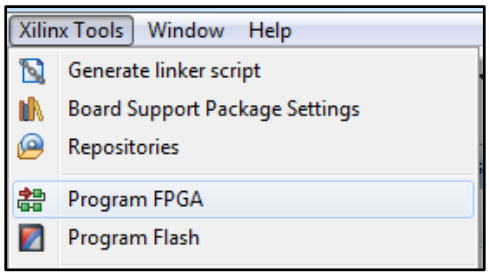
7 Booting from JTAG

Prior to booting from JTAG, the PS boot mode switch must be set for the "Cascaded JTAG". Please set the boot mode switch (SW7, positions 1-5) on the Mini-ITX board to 00000.

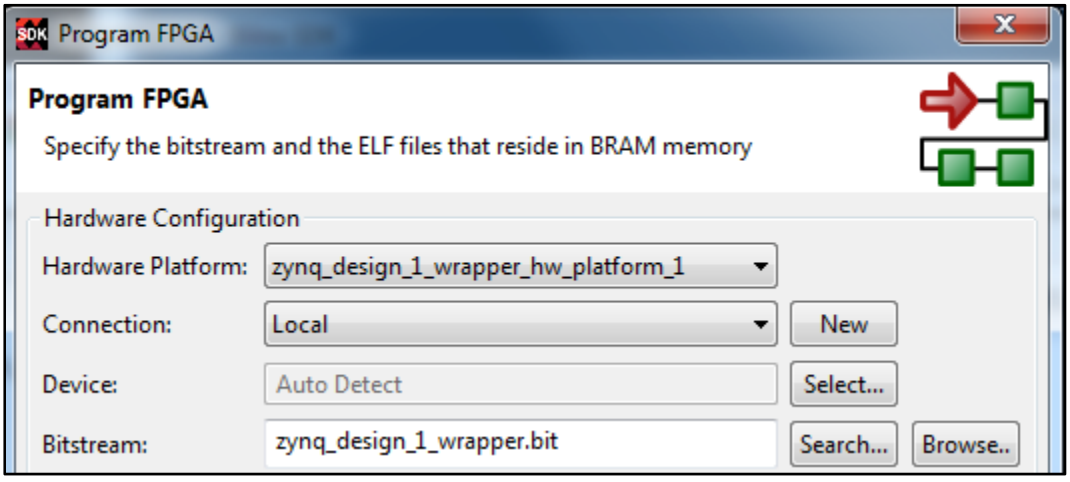
7.1 Configuring the Programmable Logic (PL)

Since this reference design uses peripheral and memory devices connected to the Zynq PL, the PL must be configured prior to testing the devices connected to it.

- From the SDK GUI, select **Xilinx Tools > Program FPGA** as shown in the following figure.



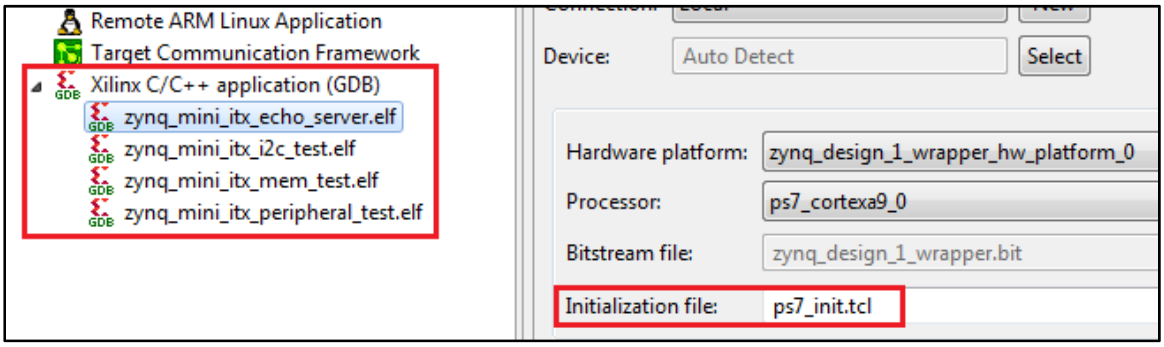
- In the **Program FPGA** dialog box, set the **Bitstream** to **\zynq_mini_itx_embedded_design\embedded_design.sdk\zynq_design_1_wrapper_hw_platform_1\zynq_design_1_wrapper.bit** and click on the **Program** to configure the Zynq PL as shown in the following figure (make sure upon PL configuration completion the blue DONE LED is illuminated on the MINI-ITX BOARD baseboard).



Note: Your path to the **zynq_mini_itx_embedded_design** folder may be different than the one shown in the above figure. Please use the browse button to point to the location of the **zynq_design_1_wrapper.bit** file on your hard drive.

7.2 Setting up the Run Configurations

- From the SDK toolbar, select **Run > Run Configurations**, the following dialog box will appear.

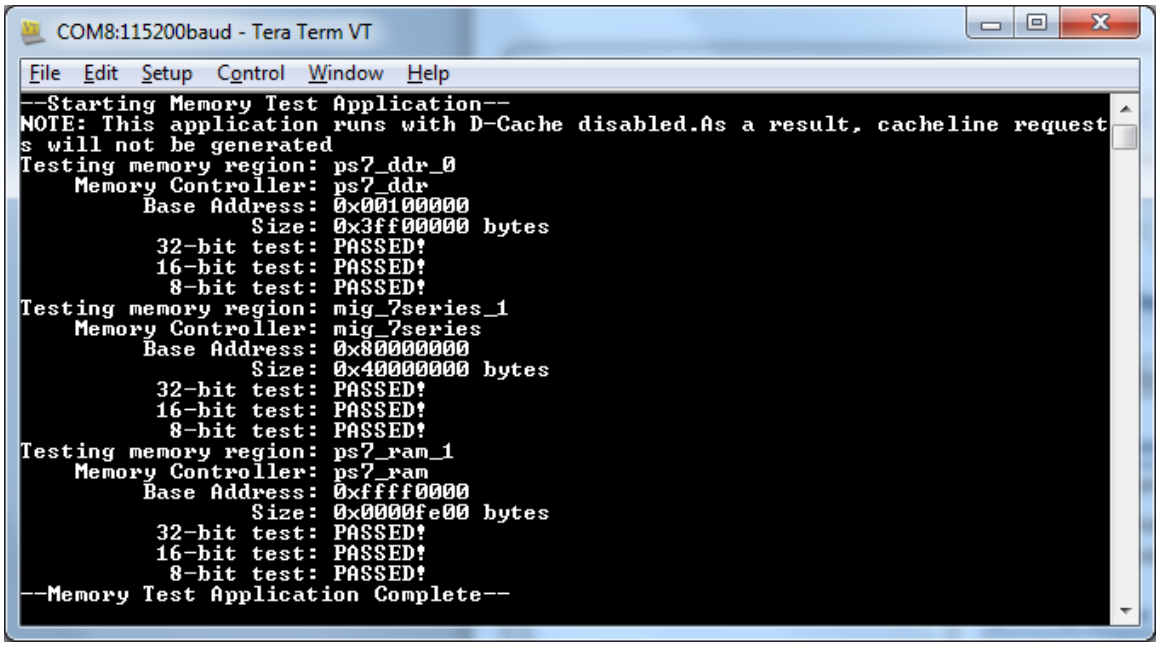


- In the **Run Configuration** dialog box, click on the **zynq_mini_itx_echo_server.elf** to highlight it and set the **Initialization file** to **\zynq_mini_itx_embedded_design\embedded_design.sdk\zynq_design_1_wrapper_hw_platform_1\ps7_init.tcl** on your hard drive and click **Apply**.
    - Repeat the above step for the remainder of the elf files (begin by single clicking on **zynq_mini_itx_i2c_test.elf** file and setting the **Initialization file** to the **ps7_init.tcl** file on your hard drive). Please do not forget to click on **Apply** after setting the **ps7_init.tcl path** for each elf file).
    - **zynq_mini_itx_i2c_test.elf**
    - **zynq_mini_itx_mem_test.elf**
    - **zynq_mini_itx_peripheral_test.elf**

- When the above step is completed, click on **Close** to close the **Run Configurations** GUI.

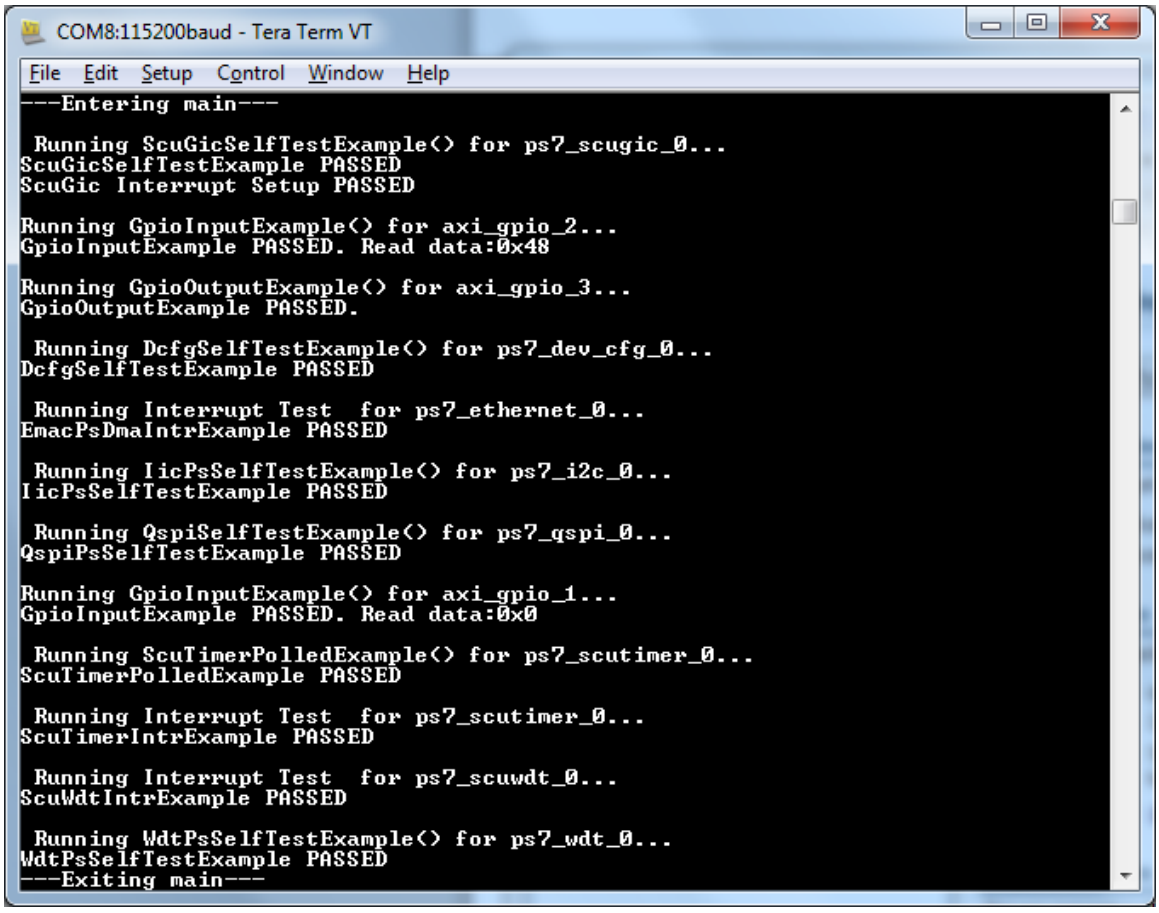
7.3 Running the Memory Test

- From the SDK GUI, right-click on the **zynq_mini_itx_mem_test** software project and select **Run As > Launch on Hardware (GDB)** to load the memory test to the board and run it. You should see the following on the Tera Term terminal.



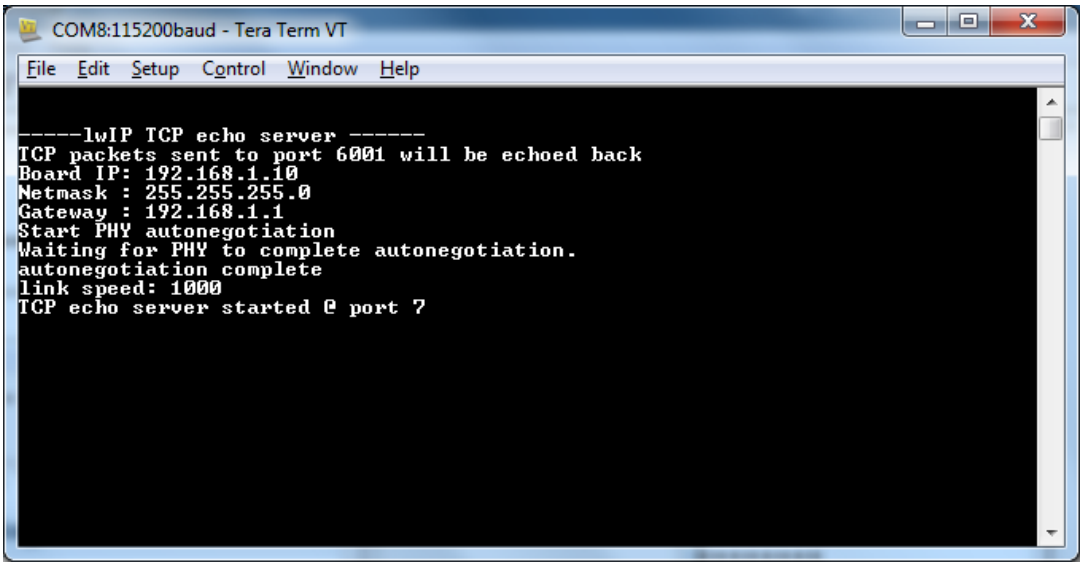
7.4 Running the Peripheral Test

- From the SDK GUI, right-click on the **zynq_mini_itx_peripheral_test** software project and select **Run As > Launch on Hardware (GDB)** to load the Peripheral test to the board and run it. You should see the following on the Tera Term terminal.

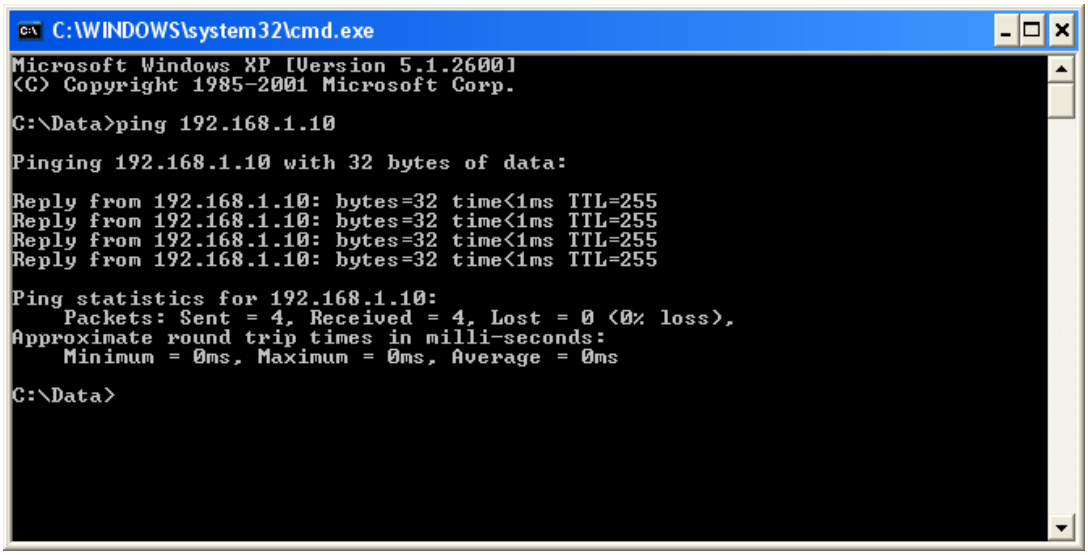


7.5 Running the Echo Server Demo

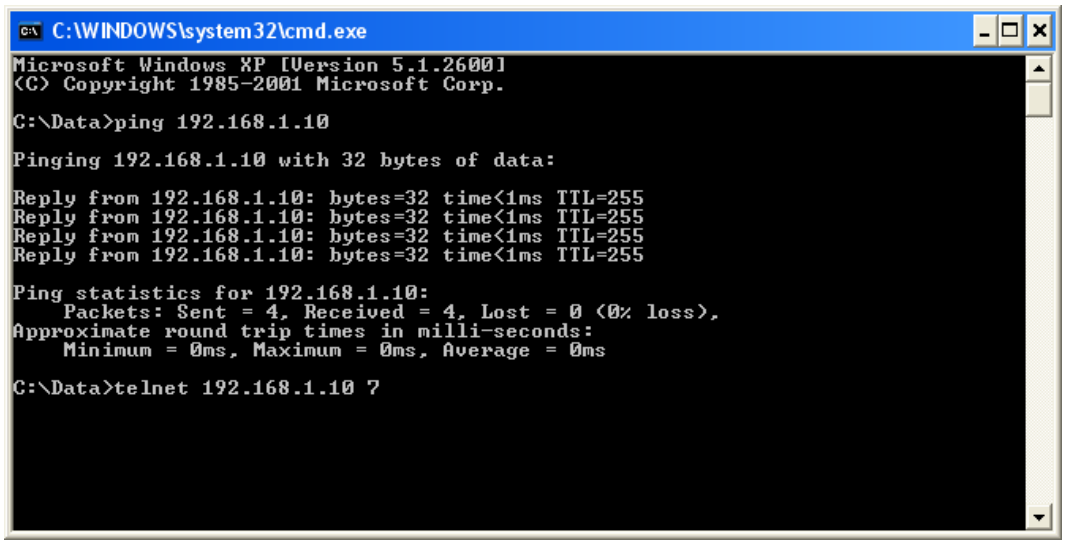
- From the SDK GUI, right-click on the **zynq_mini_itx_echo_server** software project and select **Run As > Launch on Hardware (GDB)** to load the Echo Server program to the board and run it. You should see the following on the Tera Term terminal.



- Open a command window and ping the board as shown below. If the Ethernet connection is working, you should see 4 replies back as shown.

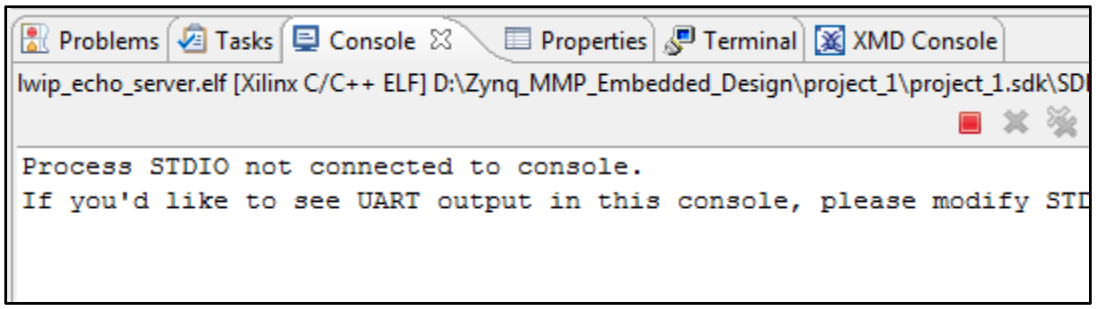


- To connect to the echo server, use the telnet utility program. Type the following telnet command as shown below and hit the return key.



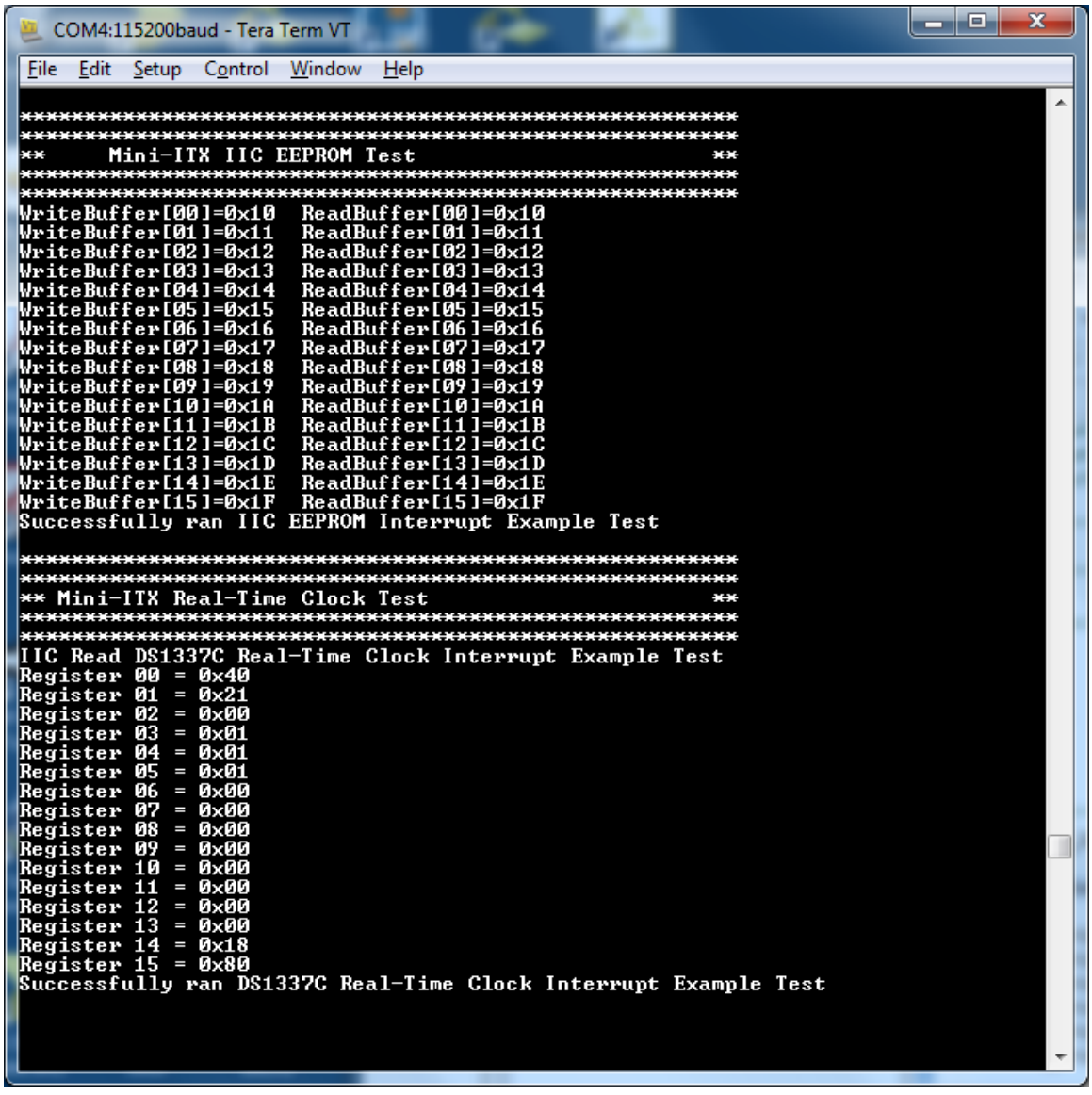
When the echo server works properly, any data sent to the board is echoed in response. Some telnet clients immediately send the character to the server and echo the received data back instead of waiting for the carriage return. Simply type a few characters and see them echoed back on the terminal.

- In the SDK GUI, if a **Run** session is currently running, click on the Red square to terminate the Run as shown in the following figure before running another test.



7.6 Running the I2C Test

- From the SDK GUI, right-click on the **zynq_mini_itx_i2c_test** software project and select **Run As > Launch on Hardware (GDB)** to load the I2C test to the board and run it. You should see the following on the Tera Term terminal.



8 Booting from the microSD Card

Prior to booting from the microSD card, the PS boot mode switch must be set for the "SD Card Boot". Please set the boot mode switch (SW7, positions 1-5) on the Mini-ITX board to 00110.

8.1 Generating the microSD card boot image

The microSD card image can be generated using the SDK tool or a batch file. For this example we will be using a batch file to generate the microSD card **boot.bin** image. The Peripheral Test, which we previously ran on the board using the JTAG port, will be used to generate the microSD card **boot.bin** image.

- Please go to the **make_mcs_and_bin_files** folder of the reference design and double-click on **make_bin_file.bat** file to generate the microSD card **boot.bin** image.

  Note: The **boot.bin** file for the Peripheral Test design is already generated for you and is located in the **ready_to_download** folder of the reference design, should you have any issues with the **boot.bin** file generations using the above batch file.

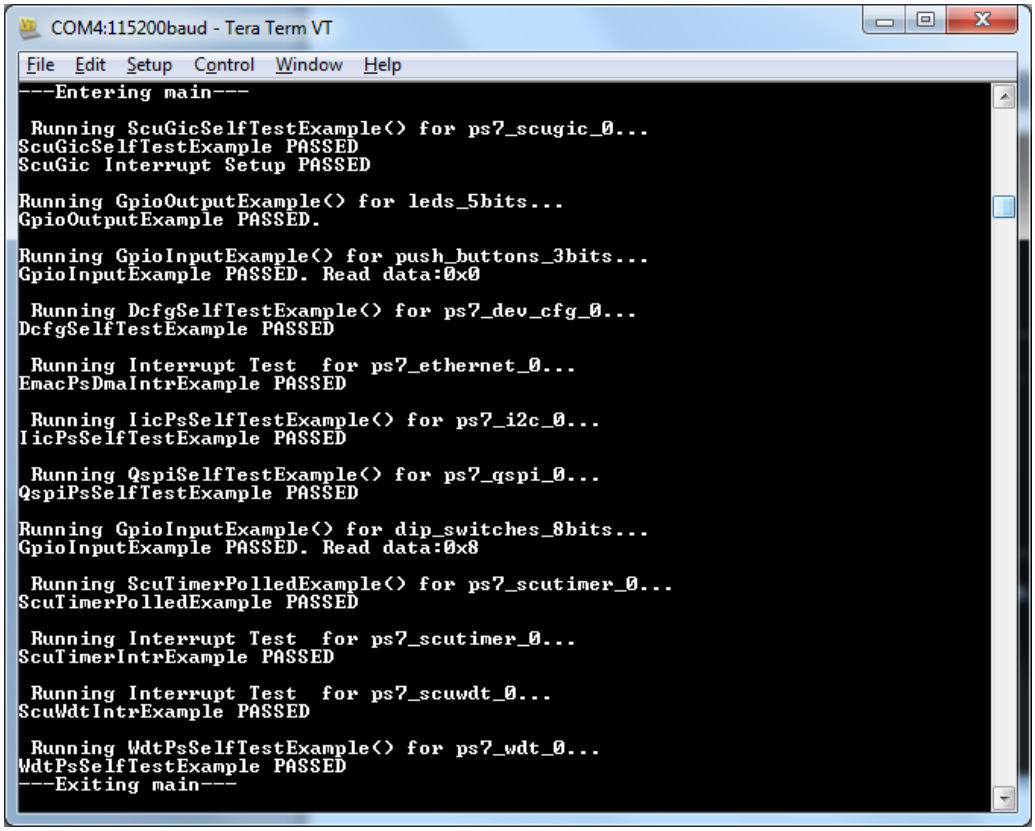
- Copy the content of your microSD card to your hard drive so that you can restore the microSD card content that was shipped with your Zynq Mini-ITX board.

- Delete the content of the microSD card.

- Use your PC to copy the **ready_to_download\boot.bin** file to the root directory of the microSD card.

- Make sure the board is powered down and the boot mode switch (SW7, positions 1-5) on the Mini-ITX board is set to 00110.

- Insert the microSD card into the microSD card socket on the Mini-ITX board and power up the board. The blue DONE LED will be illuminated and you should see the Peripheral Test results on the Tera Term terminal.



9 Booting from the QSPI Flash

Prior to booting from the QSPI Flash, the QSPI device must be programmed using the SDK Flash programming utility.

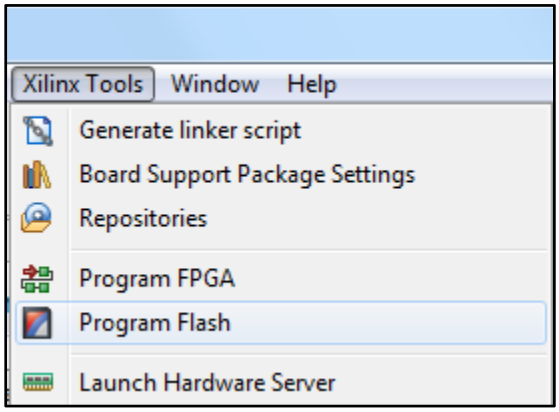
- Please go to the **make_mcs_and_bin_files** folder of the reference design and double-click on **make_mcs_file.bat** file to generate the QSPI **zynq_mini_itx_peripheral_test.mcs** file.

  Note: The **MCS** file for the Peripheral Test design is already generated for you and is located in the **ready_to_download** folder of the reference design, should you have any issues with the **MCS** file generations using the above batch file.

- Power down the board and set the boot mode switch (SW7, positions 1-5) on the Mini-ITX board to 00000 (Cascaded JTAG mode).

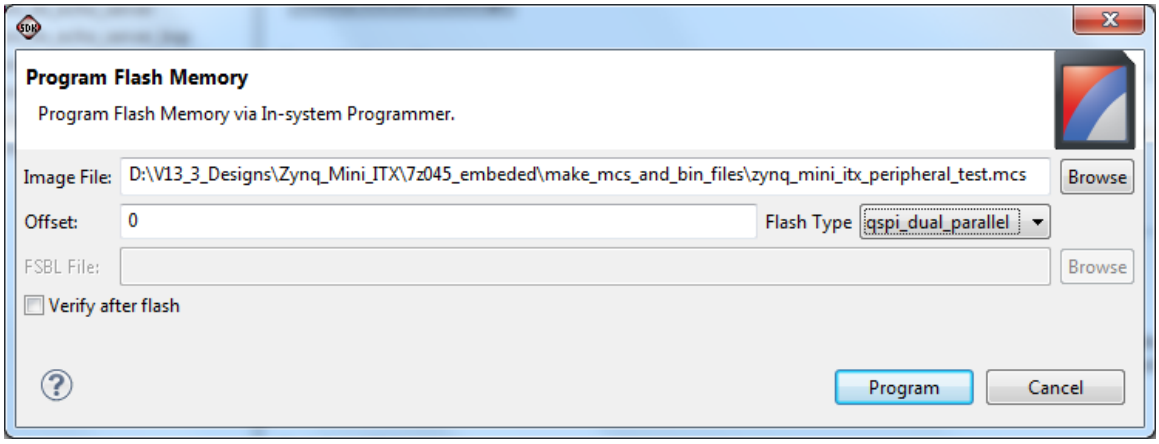
- Power up the board.

- Select **Xilinx Tools > Program Flash** from the SDK toolbar as shown in the following figure.

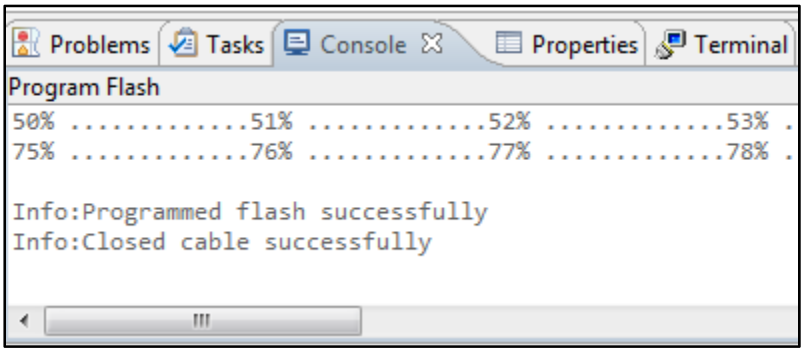


- In the following figure, use the browse button to set the **Image File** to the **ready_to_download\zynq_mini_itx_peripheral_test.mcs** file generated in the previous section.

- Set the **Offset** to **0**, **Flash Type** to **qspi_dual_parallel**, and click **Program**. It will take a few minutes to program the QSPI Flash.

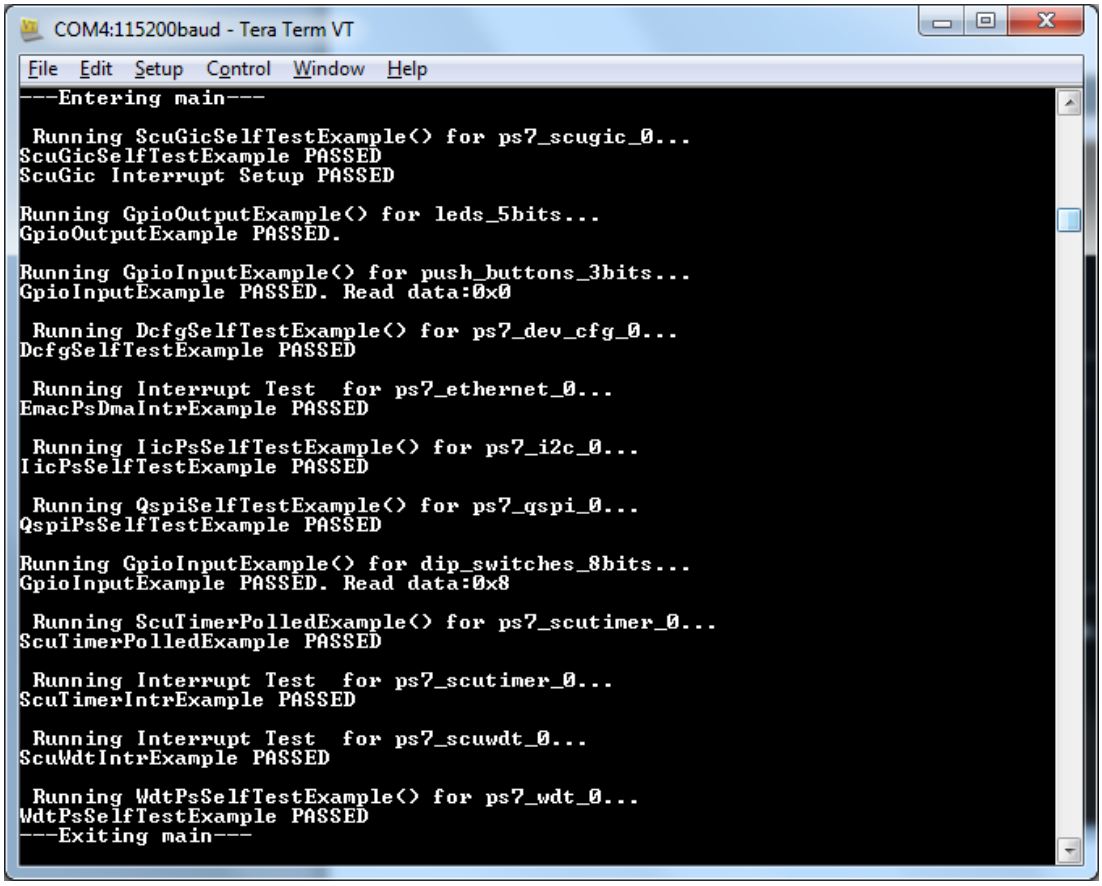


- Upon successful programming of the QSPI Flash, you should see the following in the SDK GUI.



- Power down the Mini-ITX board and set the boot mode switch (SW7, positions 1-5) to 00010 (QSPI boot mode).

- Power up the board, the blue DONE LED will be illuminated and you should see the Peripheral Test results on the Tera Term terminal.



10 Setting up the Host PC

This section describes how to install the USB drivers on the host PC for the USB-UART connection to the Zynq Mini-ITX board.

10.1 Install the USB UART Drivers

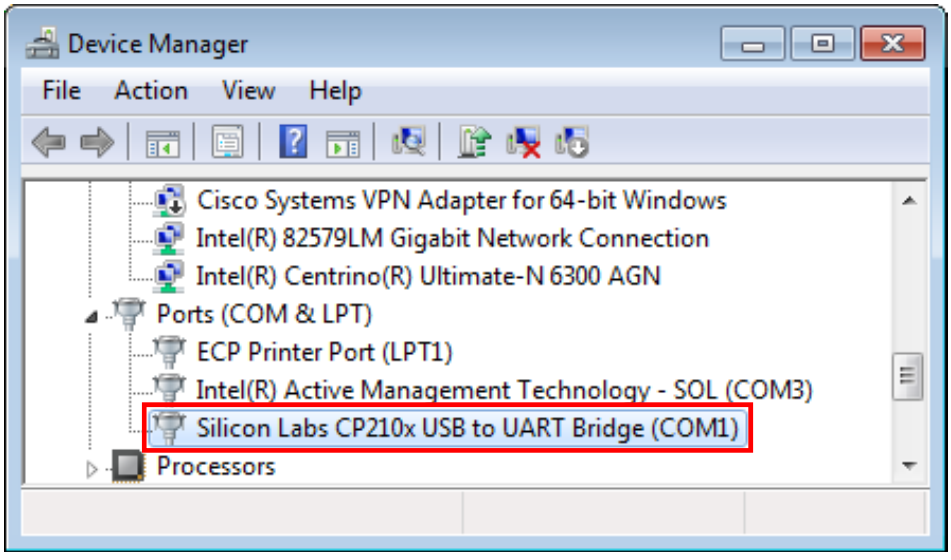
Download and install the Silicon Laboratories CP210x VCP drivers on the host computer. The drivers are available for download at http://www.silabs.com/products/mcu/Pages/USBtoUARTBridgeVCPDrivers.aspx

10.2 Configure the Host Computer COM Port

The Reference design uses a terminal program to communicate between the host computer and the Mini-ITX board. To configure the host computer COM port for this purpose:

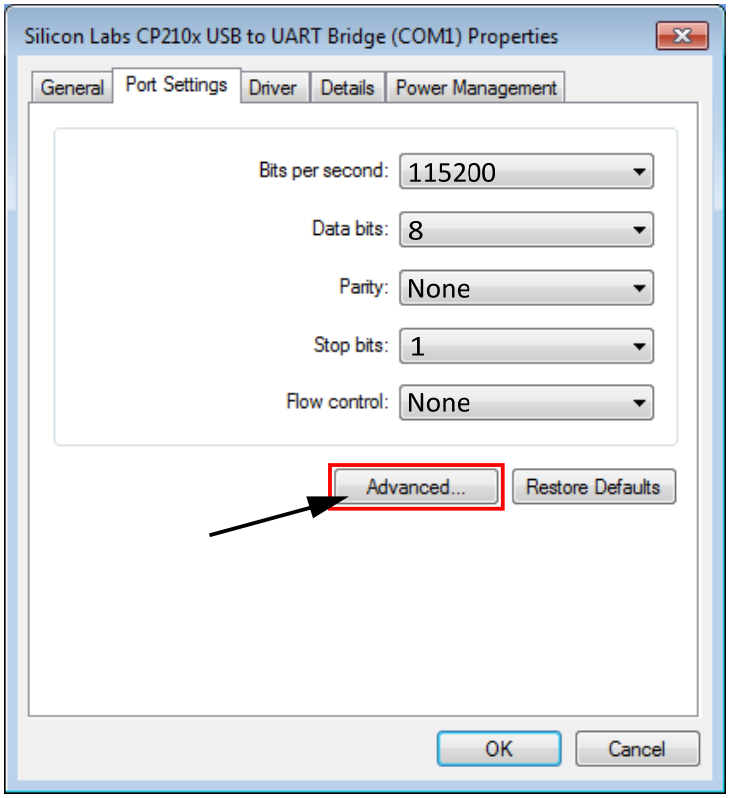
1. Connect the Mini-ITX board to the host computer via the J7 USB-UART port and power up the board.

2. Open the host computer Device Manage as shown in the following figure. In the Windows task bar, click Start, click Control Panel, and then click Device Manager.

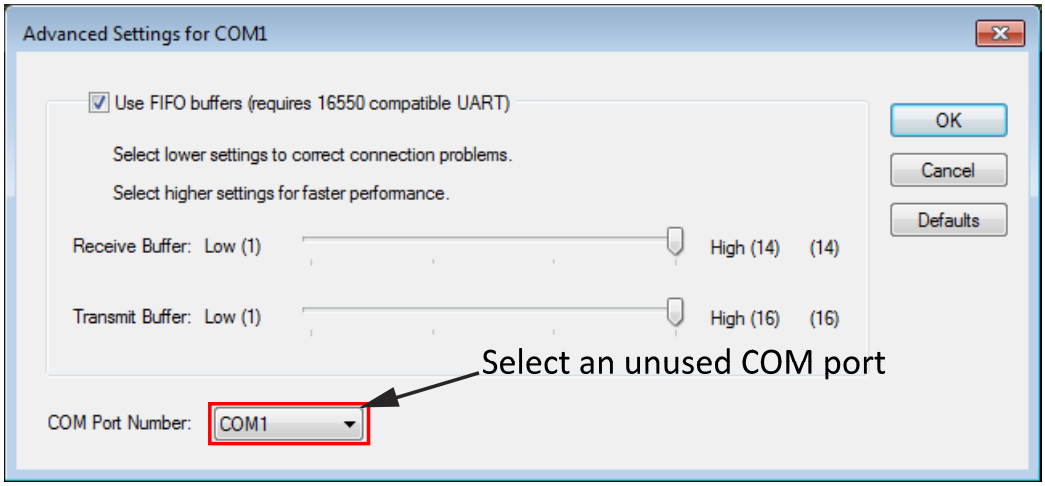


3. Open UART properties. Expand Ports (COM & LPT), right-click Silicon Labs CP210x USB to UART Bridge, and then click Properties.

4. In the properties window, select the Port Settings tab, verify the settings match the values shown in the following figure. Click on the Advanced button to continue.



5. Select an unused COM Port Number and then click OK. The following figure shows COM1 as the selected COM port number.



6. Click OK in the properties window, close the Device Manager and the Control Panel.

10.3 Install the Terminal Program

Download and install the TeraTerm Pro terminal program on the host computer. TeraTerm Pro is available for download at http://ttssh2.sourceforge.jp/index.html.en. To communicate with the Mini-ITX board, configure the New Connection and Serial Port settings as shown in the following figure. These settings must match the host computer COM port settings shown in the previous section.