ALBERT-LUDWIGS-UNIVERSITÄT FREIBURG

INSTITUT FÜR INFORMATIK

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**Mobiles Hardware-Praktikum
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**Lab 4
Fundamentals of Analog and Digital Circuits**

Exercise 1

Before you start this lab it might be an idea to read over *Das PICee++ System* from Heiko Falk and the *FPGA ⇔ PIC Interface* documentation and programs provided on the courses web page. Once familier with the documentation above connect the FPGA extension board and the related power and programming cables to the PICee development system.

Now, the idea of this lab is to use the EPM7128SLC84-15 FPGA and the PIC16F84 microprocessor together in order to implement certain functions. This will require you to write VHDL and assembly code. There is code that is already written on the courses web site that implements an FPGA ⇔ PIC interface in both VHDL and assembler. You can use these programs as a basis for your new programs. The functions to be implemented are:

- First, two arbitrary but different 4-Bit values are to be stored on the PIC16F84 microprocessor and are outputted on PORT0 and PORT1 of the interface FPGA ⇔ PIC.

- The conditions of the two pushbuttons (S5 and S6) are to be stored on PORT2 (interface FPGA ⇔ PIC).

- Now, depending on which pushbutton is pressed (PORT2) copy the values in PORT0 or PORT1 to PORTE and then display it on the LCD display.

Sketch your circuit that connects the FPGA with the appropriate signals of the PIC16F84 microprocessors. Remember to program both components and to double-check your wiring. Then test your design.

Note: During the programming of the PIC16F84 no connection to PORTB should be present, otherwise the programming process might not finish correctly. Also, remember that the global clock is already connected to pin 83 on the FPGA.

Lastly, there is a sample program called "Datenaustausch" on the courses web site that may be helpful when programming the microprocessor.

Exercise 2

In this exercise we will continue the work from part 1 and add a VHDL component. The idea is to use the 4-bit FPGA adder designed in the second series of labs (lab 2, exercise 1) and connect it to the PIC microprocessor. This circuit should have the

same functionality as the calculator you made in the first series of labs (lab4, exercise 2). All operands and operations should be shown on the LCD screen. However, in this case, buttons S5 and S6 are the control buttons. Addition and subtraction are required and multiplication is optional.

Sketch the circuit that connects the FPGA with the appropriate signals of the PIC16F84 microprocessors. Program both components and then connect them with the necessary wires. Lastly, test your design.

Note: During the programming of the PIC16F84 no connection to PORTB should be present otherwise the programming process might not finish correctly. Also, remember that the global clock is already connected to pin 83 on the FPGA.

If your 4-bit adder program was incorrect you can use the sample solution that will be posted on the web after the 4-bit adder lab is complete (available from 20.06.2003).

When you are finished with the lab you are required to hand in sketches, pin assignments, and other results obtained from the lab. Compress all appropriate files into one ZIP file and then submit it through the courses Web Site Portal.