Universal Evaluation Board for programmable logic devices with plug-in modules

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Abstract

This article deals with the design of a universal evaluation board. The board is dedicated to work with programmable logic devices, especially CPLDs and FPGAs. This board is designed for its utilisation in the teaching of programmable logic devices. All laboratory practices at FEE in Pilsen are performed on these boards.

Introduction

At present, programmable logic devices and their application evolve very quickly. These devices are used in the digital designs of many electronic systems. This strong expansion of PLDs necessitates the requirement to teach the theory and practice of these devices. There are several architectures of programmable logic devices e.g. the CPLD and the FPGA. Differences are in the utilised technologies, in the type of device and by the manufacturer of the device. So when it is required to present and work with different devices, several evaluation boards are required. This solution is expensive; therefore a universal evaluation board was developed that supports devices with different architectures and different producers.

Description of board

The evaluation board is very universal because only the peripheral circuits we included on the board and not the CPLDs and the FPGAs. The characteristic peripheral circuits for an evaluation board are used (i.e. pushbuttons, DIP switches, LEDs, 7 segment LED displays, an oscillator and expansion connectors to link with some external circuits). In addition, a VGA connector and a PC keyboard connector are placed on the board. The PLD and connectors for their programming are placed on special plug-in modules, which are plugged into the evaluation board, and because of this they can be easily changed.

This evaluation board supports those devices whose supply voltage is 5 V. The on board oscillator can be easily changed. By means of jumper leads most of peripheral circuits can be detached from the programmable device. The I/O pins of the PLD are connected to the expansion connectors and can be used for connection with the external peripherals.

The evaluation board provides a LED bargraph and two 7 segment LED displays. All of these LEDs are active-low. Only one LED display and the bargraph are accessible when the Lattice module is used.

The board has eight DIP switches and four push buttons. When each DIP switch is ON or when each push button is pressed, the connected pin is pulled to ground. Otherwise, the pin is pulled to 'high' through a pull-up resistor.

A VGA monitor interface is available on the board. The VGA monitor is connected through the VGA connector. A programmable logic device drives H/V sync. signals and RGB colour signals. The interface provides two bits for each of the red, green and blue colour signals, and so it can generate pixels in 64 different colours.

The board includes a keyboard interface which consists of two signals. The first one is a clock signal and the second is a data signal.

Three plug-in modules have been designed and constructed. The first module supports a Lattice CPLD. The others support Xilinx FPGAs. There are two JTAG connectors on the plug-in module. Modules can be connected through these connectors to a JTAG chain and because of this more devices can be programmed simultaneously. Either 4-wire or 5-wire JTAG is used for configuring the devices.

The main properties of the evaluation board

Supply voltage: 5 V

Onboard oscillator: 40 MHz (with possibility of easy change)

Optical signalling of programming in progress and the supply voltage

Inputs/Outputs: 4 pushbuttons, 8 DIP switches, DIN5 connector (keyboard),
VGA connector, 8 LEDs, 2 LED displays

Possibility of disconnection of the input/output devices on the board

Possibility of connection to external devices

The main properties of the plug-in modules

1. *Module for CPLD devices (Lattice)*
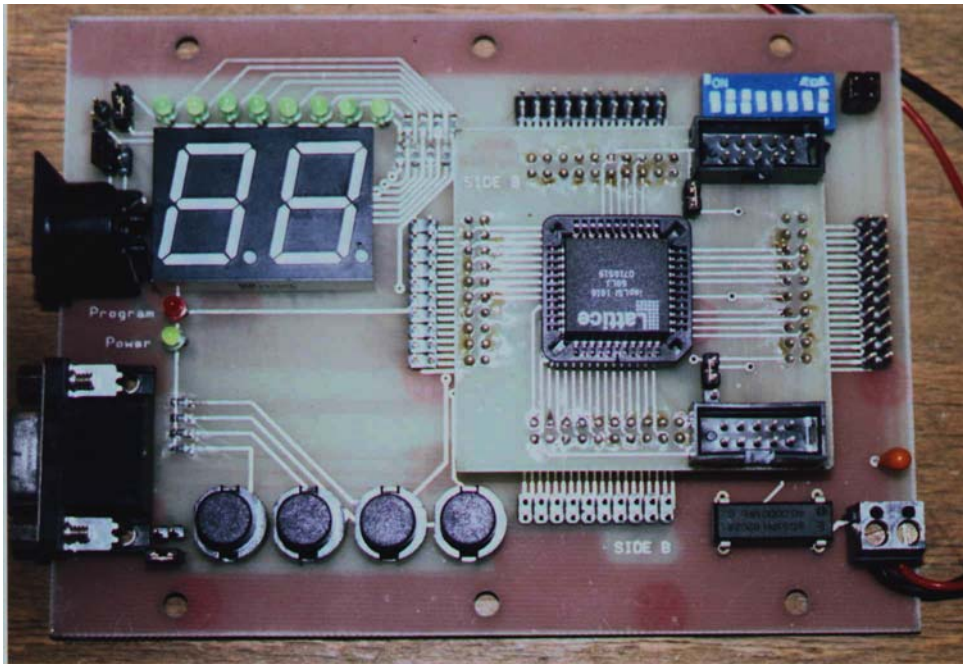
Programming by 4 or 5-wire JTAG chain.

Supports: ispLSI 1016, 1016E, 1016EA (package PLCC 44)

2. *Module for FPGA devices (Xilinx)*

Programming in mode "Slave serial" in daisy chain.

a) Supports: XC 3020A, 3030A, 3120A, 3130A (package PLCC 68)

b) Supports: XC 3020A, 3030A, 3120A, 3130A, 3142A (package PLCC 84)

Conclusion

The main goal of the design was to create a universal evaluation board for both types of programmable logic devices i.e. CPLDs and FPGAs. And, of course, the devices of different producers should be supported. This goal was reached and so this board is a powerful tool in laboratory practical sessions. Students can be familiarized with different types and architectures of programmable logic devices and this is the main goal of teaching. In summary several original evaluation boards have been incorporated into one universal board at a lower overall cost.

Acknowledgement

References

[1]   Lattice Semiconductor, Datasheets of ispLSI 1016/E/EA devices

[2]   Xilinx, Datasheets of XC 3000 family

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