A Development System for Rapid Prototyping of Dynamically Reconfigurable Mixed-Signal Low-Power Systems

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Introduction and Project Outline

• Prototyping of Analog and Digital Systems
  – Prototyping of Digital Systems with WDC W6502DB Board
  – Prototyping of Analog Systems with Motorola FPAA 3 Evaluation Board

• Mixed-Signal Development Board (MSDB)
  – Integration of Analog and Digital systems
  – Communication with PC

• Design of MSDB Mixed-Signal Rapid Prototyping System
  – Structure of Rapid Prototyping System
  – Development Board with FPAA and FPGA chips

• Software support of MSDB System
  – MSDB Project Manager Windows™ Application
Fast prototyping of mixed-signal circuits

Typical stages of design of mixed-signal circuits:
1. separated design of analog and digital part
2. consolidation of analog and digital part
3. validation of the design
4. if design is not working repeat execution of steps 1, 2 and 3

Resources for fast prototyping analog and digital circuits
- FPAA (Field Programmable Analog Array)
- FPGA (Field Programmable Gate Array)
Example of Mixed-Signal Application

Part 1

(V3) - RefDC = 1V

Part 2

(V1) - 2.5V

R1 = 1.5kΩ

Intgr/Prov.

ERC, "PGA"

FPAM-1

LAX

Part1

(G4) - In/Sum

0.09

k1 = 40000

Start download Part1

DAX D2X

FPAM-1 (Part1)

Download (1)

DP1

R1

R2

R3

R4

Download (Part2)
Solution with experimental boards
The MSDB solution
Prototyping of Analog Systems with Motorola FPAA 3 Evaluation Board

Motorola FPAA3 Evaluation Board:
- MPAA 020 Field Programmable Analog Array
- 20 basic cells with operational amplifiers and capacitors
- Prototyping of analog circuits
- Serial connection with PC

EasyAnalog™ Software:
- Constructing complex analog circuits
- Selecting, placing and wiring building-block circuits
- Downloading designed circuits via serial port
- Constructing and running multiple, independent circuits simultaneously
Prototyping of Digital Systems with WDC 65C02DB Board

WDC 65C02DB Developer Board:
• W65C02 8-bit microprocessor
• Parallel interface for connecting to PC
• W65C02 I/O microprocessor
• 20 Input/Output
• Reprogrammable logic based on PLD

WDC Development Systems:
• Assembler and linker
• C-Compiler
• Simulator and Debugger
Structure of Mixed-Signal Development Board

- Programming Slot for FPGA
  - Digital Output
  - Digital Input
  - RAM 32kB
  - FPGA
  - CPLD Logic
  - RAM 32kB
- PC
- Programming Slot for FPAA
  - Analog Input
  - Analog Output
  - ADC
  - DAC
  - FPAA
Structure of Mixed-Signal Rapid Prototyping System

Features of the MSD Board

- Integrated platform for development of mixed-signal systems
- Ability to build interconnection between analog and digital part of designed circuit using data converters
- Stand alone construction
- Parallel connection with PC
- Compact solution
- Flexibility of the Design
- Online programming of FPAA and FPGA
- Dynamic Reconfiguration Capability
Communication between elements of Mixed-Signal Fast Prototyping System

Interfaces:

Parallel port - between PC and WDC65C02DB Board

XC9572 - between WDC65C02DB Board and MSDB Board

Control:

PC - Project Manager Application

WDC Board - Control of data flow between WDC Board and

XC9572 - Programming of FPAA and FPGA
• **MSDB Project Manager**
  – Integration of Components
  – Management of the project data
  – Communication with external Applications
  – PC to WDC Board Communication
  – Communication with 65C02 Processor
  – Communication with Filter Banks
  – Communication with FPAA
  – Communication with FPGA
MSDB Project Manager Application - Communication Chart

- MSDB
- FPAA
- FPGA

MSDB Project Manager

- Project Data Export
- Compiler
- Debugger
- Linker

Xilinx Editor

Easy Analog Easy Filter

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MSDB Project Manager Application Examples
MSDB Project Manager
Communication Chart

Software Tools
- XILINX PROGRAMMING TOOLS
- FPAA EASY ANALOG

DEVICE ACCESS TOOLS
- FPAA PHYSICAL ACCESS
- FPGA PHYSICAL ACCESS

Communication Channel

MSDB PROJECT MANAGER
PC – MSDB Communication Channel Model

Introduction

Design

Conclusions

Device Access Routines

Monitor program

Vesatile Port 6522

Physical Link

Physical Centronics' Ports

Windows Virtual Device Model

Device Layer driver

DII Layer Command Driver

Memory Access

FPAA Access

FPGA Access

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Results and Future Work

Results

- Mixed-Signal Rapid Prototyping System
- Design and fabrication of Mixed-Signal Development Board comprising two programmable elements, FPAA and FPGA
- Development of inter-application communication

Future Work

- Development of Software Tools needed for testing of communication between MSDB Board and PC
- Extension of the MSDB Project Manager
- Measurements of dynamic properties of simple mixed-signal systems
- Development of system with two MSDB’s
- New version of the MSDB Board based on micro-controller and serial connection with PC

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