NP1 - LPC21XX/LPC22XX microcontroller implementation

This course covers NXP ARM-based MCU family

Objectives

- The course details the hardware implementation of the LPC2294 microcontrollers.
- The boot sequence and the clocking are explained.
- The training helps to become familiar with the development environment chosen by the customer.
- Practical labs on integrated peripherals are based on I/O functions provided by NXP.
- The course focuses on the low level programming of the ARM7TDMI core.
- The course provides examples of internal peripheral software drivers.

- Note that ACSYS does not sell emulation probes and IDEs. Consequently this course has not been designed to convince attendees to buy a particular IDE. The unique objective consists in providing sufficient knowledge to attendees so that they can successfully design a system based on LPC21XX/LPC22XX.

- This course has been delivered several times to companies developing embedded systems, such as voltage counters.

A lot of programming examples have been developed by ACSYS to explain the boot sequence, the vector table and the operation of embedded peripherals.
• They have been developed with 2 different IDEs : Keil and IAR.
• Consequently for on site course, it is up to the customer to select the IDE under which labs will be run.
A more detailed course description is available on request at training@ac6-training.com

Prerequisites and related courses

- This course provides an overview of the ARM7TDMI core. Our course reference R1 - ARM7/9 implementationcourse details the operation of this core.
- The following course could be of interest:
  - CAN bus, reference IA1 - CAN buscourse

Course Environment

- Theoretical course
  - PDF course material (in English) supplemented by a printed version for face-to-face courses.
  - Online courses are dispensed using the Teams video-conferencing system.
  - The trainer answers trainees' questions during the training and provide technical and pedagogical assistance.
- At the start of each session the trainer will interact with the trainees to ensure the course fits their expectations and correct if needed

Target Audience

- Any embedded systems engineer or technician with the above prerequisites.

Course Outline

INTRODUCTION TO LPC2210 AND LPC2294

Overview

- ARM core based architecture
- ARM7 local bus
- AMBA AHB/APB internal buses
- The main three blocks : platform, core and input / output peripherals
- APB Bridges
- Memory mapping, internal flash (2294) and SRAM

THE PROCESSOR CORE

ARCHITECTURE OF THE ARM7TDMI CORE

- Presentation of the core, architecture and programming model
- Operating modes : user, system, super, IRQ, FIQ, undef and abort
- Pipeline, calculation of the CPI
- Effects of branches and exceptions on the performance
- ALU data path

SOFTWARE IMPLEMENTATION, V4T SPECIFICATION

- Parameterizing the linker to define sections
- Branch instructions, implementation of C call and return statements, long branch veneers
- ARM vs Thumb instruction sets, interworking
- ARM instruction set
- Inline barrel shifter
- Access to memory-mapped locations, addressing modes
- Arithmetical and logic instructions
- Thumb instruction set, highlighting restrictions with regard to ARM instruction set
- Compiler hints and tips, optimisations supported by RVCT
- Stack management
- Benefits of condition set capability in ARM state
- C-to-Assembly interface, ATPCS specification

EXCEPTION MECHANISM

- Reset
- FIQ vs IRQ
- Exception return instructions
- Latency estimation, impact of load and store multiple instructions
- Organization of the handler table, priority decoder, pre-emption and nesting
- ISR header and footer routines
- Development of a generic exception handler

INTEGRATED DEBUG FACILITIES

- JTAG interface
- Debug facilities, hardware breakpoint
- Executing code from RAM to take benefit of software breakpoints

PLATFORM

THE VECTORED INTERRUPT CONTROLLER

- Assigning a priority to each interrupt source
- Steering external interrupts and local interrupts to either the core FIQ or IRQ
- Developing a generic interrupt handler performing nesting according to peripheral priorities defined by the user
- Integrated timers
- Using timers to understand the operation of the VIC

SYSTEM CONTROL

- Pin connect block
- Clocking
- Reset and wake-up timer
- Low power modes
- Watchdog timer
- Real-Time clock

ON-CHIP FLASH MEMORY (2294)

- Organization
- Erase sequence
- Program sequence
- In system programming via serial port
- On-chip bootloader

EXTERNAL MEMORY CONTROLLER

- Address decoding
- Chip-select registers
- Parameterizing the memory bank registers to support external burst flash

INTEGRATED I/Os

SERIAL INTERFACES

- I2C basics
- I2C controller
- UART controller
- SPI and SSP interfaces
- CAN protocol basics
- CAN controller (2294)