



## M5 - 440GP/GX implementation

*This course covers AMCC 440GP and 440GX processors*

### Objectives

- The course explains how to design a 440GX board.
- DDR SDRAM operation is described in order to understand the parameterizing of the memory controller.
- Book E PowerPC architecture is studied, especially the MMU.
- The course provides examples of internal peripherals software drivers.
- Gigabit Ethernet controller and TCP/IP Acceleration Hardware are viewed in detail.
- The training focusses on data path between PCI-X bus and internal PLB bus.
  
- This course has been delivered several times to companies developing embedded equipments (multimedia systems and avionics systems).
  
- A chapter on Linux porting can be appended on request.

Labs are compiled with Diab Data compiler and run under Lauterbach debugger.

A more detailed course description is available on request at [training@ac6-training.com](mailto:training@ac6-training.com)

### Prerequisites

- Experience of a 32 bit processor or DSP is mandatory.
- Knowledge of PCI-X bus is recommended, see our course reference [IC3 - PCI-X 2.0](#) course.
- Knowledge of Gigabit Ethernet is recommended, see our course reference [N1 - Ethernet and switching](#) course.

### 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 440GP/GX

- Block diagram
- Internal concurrent transfers examples
- Hardware introduction
- 440GP/GX mapping
- Programming model
- Comparison between 440GP and 440GX

## **CORECONNECT PROGRAMMING INTERFACE**

- PLB arbiter, OPB arbiter and PLB-to-OPB bridge configuration
- Bus errors recovering from syndrome registers
- PLB performance monitor

## **440 CORE**

- Pipeline operation
- Internal caches
- CCR0 register
- Speculative loads, storage ordering and synchronization : msync & mbar instructions
- MMU

## **BOOK E COMPLIANT CORE**

- Branch instructions
- Addressing modes, load & store instructions
- Integer instructions
- 16-bit mac instructions
- Exception management
- Core timers
- PowerPC EABI
- JTAG emulator use
- Real time trace

## **CLOCKS, RESET AND POWER MANAGEMENT**

- Clocks synthesizer
- Low power modes
- Reset
- Boot routine example
- IIC bootstrap controller

## **INTERRUPT CONTROLLER & GENERAL PURPOSE TIMERS**

- Interrupt masking and acknowledgement e
- Critical interrupt handlers using vectorization

## **THE INTERNAL SRAM**

- Write-through cache, understanding the data and instruction path
- Performance monitor
- SRAM utilization - base address definition
- Access errors

## **THE DDR-SDRAM CONTROLLER**

- DDR-SDRAM operation
- Jedec specification basics
- Hardware interface
- Bank activation, read, write and precharge timing diagrams
- ECC error correction
- Initial configuration following Power-on-Reset
- Address decode
- Timing parameters programming

## THE EXTERNAL BUS CONTROLLER

- External bus pinout, driver enables
- Dynamic bus sizing
- Address decoding
- Timing parameters initialization
- Device-paced transfers
- External bus master interface

## THE PCI-X BRIDGE

- Data flows
- Inbound and outbound transactions handling
- Address mappings
- Synchronization between CPUs : the MSI registers
- I2O messaging unit, passing messages between processor nodes
- Boot modes, initialization / Reset sequence

## THE 4 DMA CHANNELS

- The buffered transfer mode
- Related signals
- Channels bus priority
- Data packing / unpacking
- Buffers chaining

## THE FAST/GIGABIT ETHERNET CONTROLLER

- Frame format with and without VLAN option
- Ethernet controller organization
- PHY interface
- Hash table restrictions
- Buffer descriptors management
- Transmit sequence
- Receive sequence

## TCP/IP ACCELERATION HARDWARE

- Checksum management
- TCP segmentation in the transmit path
- VLAN tagged frames

## THE UARTS

- The UART frame : break, idle, start, stop
- Transmission and reception FIFOs use
- Flow control signals management

## THE IIC PORTS

- IIC protocol basics
- Transfer timing diagrams
- Transmit and receive sequences