



## This course covers STR7 ARM-based MCU family

### Objectives

- The course details the hardware implementation of the STR71x microcontrollers.
- The boot sequence and the clocking are explained.
- The course focuses on the low level programming of the ARM7TDMI core.
- The course provides examples of internal peripheral software drivers and explains how to interact with the software package provided by ST.
- 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 STR7.
- 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 [formation@ac6-formation.com](mailto:formation@ac6-formation.com)*

### Prerequisites

- This course provides an overview of the ARM7TDMI core. Our course reference course [R1 - ARM7/9 implementation](#) details the operation of this core.
- The following courses could be of interest:
  - USB Full Speed High Speed and USB On-The-Go, reference course [IP2 - USB 2.0](#)
  - CAN bus, reference course [IA1 - CAN bus](#)

### Environnement du cours

- Cours théorique
  - Support de cours au format PDF (en anglais) et une version imprimée lors des sessions en présentiel
  - Cours dispensé via le système de visioconférence Teams (si à distance)
  - Le formateur répond aux questions des stagiaires en direct pendant la formation et fournit une assistance technique et pédagogique
- Au début de chaque demi-journée une période est réservée à une interaction avec les stagiaires pour s'assurer que le cours répond à leurs attentes et l'adapter si nécessaire

### Audience visée

- Tout ingénieur ou technicien en systèmes embarqués possédant les prérequis ci-dessus.

### Modalités d'évaluation

- Les prérequis indiqués ci-dessus sont évalués avant la formation par l'encadrement technique du stagiaire dans son entreprise, ou par le stagiaire lui-même dans le cas exceptionnel d'un stagiaire individuel.
- Les progrès des stagiaires sont évalués par des quizz proposés en fin des sections pour vérifier que les stagiaires ont assimilé les points présentés

- En fin de formation, une attestation et un certificat attestant que le stagiaire a suivi le cours avec succès.
  - En cas de problème dû à un manque de prérequis de la part du stagiaire, constaté lors de la formation, une formation différente ou complémentaire lui est proposée, en général pour conforter ses prérequis, en accord avec son responsable en entreprise le cas échéant.

## Plan

### INTRODUCTION TO STR71XF

#### Overview

- ARM core based architecture
- APB internal busses
- The main three blocks : platform, core and input / output peripherals

### THE PROCESSOR CORE

#### ARM7TDMI CORE

- Presentation of the core, architecture and programming model
- Operating modes : user, system, super, IRQ, FIQ, undef and abort
- Pipeline
- ALU data path
- ARM vs Thumb instruction sets, interworking
- Access to memory-mapped locations, addressing modes
- Stack management
- Branch instructions, implementation of C call and return statements
- Benefits of condition set capability in ARM state
- C-to-Assembly interface
- Exception mechanism, handler table
- Debug facilities

### PLATFORM

#### INFRASTRUCTURE

- APB Bridges, individual peripheral reset control, individual peripheral clock control
- Memory organization, linear 4 GB mapping
- Internal 64 kB SRAM, dynamic remapping capability
- Flash memory, bank and sector mapping, burst mode
- Program and erase sequences
- Interrupt controller
- ISR header and footer routines
- External interrupts Unit
- System timers : Real Time Clock, Watchdog timer

#### HARDWARE IMPLEMENTATION

- Power supplies, external 3.3V, internal generation of 1.8V, related pins
- Low voltage detectors
- Clocking
- Reset causes
- Start-up sequence, fetch of the first instruction
- Boot configuration register
- Low power modes

- External Memory Interface
- Description of the programming interface related to the 4 external chip-selects

## **INTEGRATED I/Os**

### **NON COMMUNICATION ORIENTED INPUT / OUTPUT PERIPHERALS**

- Timers
  - 16-bit timers, block diagram, clock selection and prescalers
  - Output compare and input capture capabilities, force compare modes
  - Output PWM mode, on-the-fly modification of the duty cycle
  - Input PWM mode, pulse measurement
- Analog-to-Digital Converter
  - High impedance-analog input configuration
  - ADC features : 12-bit resolution, 0 to 2.5 V range
  - Round-robin or single channel mode
  - Clock timing
  - The Sinc decimation filter
  - Gain and offset errors

### **COMMUNICATION CONTROLLERS**

- I2C interface
  - I2C protocol basics
  - Slave mode vs master mode
  - Transmit and receive sequences
- Buffered SPI
  - SPI protocol basics
  - Queue mode operation
  - Transfer sequence
- UART
  - Queue operation mode
  - Time-out mechanism
  - SmartCard asynchronous protocol
- CAN controller
  - CAN protocol basics
  - CAN controller organization
  - Message objects
  - Filtering received messages
  - FIFO mode management
  - Configuring the bit timing
- USB slave interface
  - USB protocol basics
  - Buffer description block, buffer descriptor table
  - Double buffer usage to support isochronous and high throughput bulk transfers
  - Endpoint initialization
- HDLC controller
  - HDLC protocol basics
  - Address decode
  - DPLL use for clock recovery
  - Abort sequence generation
  - Transmit and receive sequences

## Renseignements pratiques

**Renseignements : 4 jours**