

## Embedded C Training: Programming Methods and Tools for Embedded Applications - Live Online Training

This training focuses on the hardware-near C-programming of 8, 16 or 32 bit microcontroller architectures. It shows you how to identify and avoid the pitfalls of C programming. You learn how to program a HW abstraction layer according to an architecture model. Operating system mechanisms and services are explained by programming a scheduler. You get an overview of the whole lifecycle of a product - from the idea to project planning, software development process, test planning, quality planning, acceptance, commissioning, operation and decommissioning.

### Objectives

This training focuses on the hardware-near C-programming of 8, 16 or 32 bit microcontroller architectures.

You learn how to program a HW abstraction layer according to an architecture model. OS mechanisms and services are explained by programming a scheduler.

You get an overview of the entire lifecycle of a product - from the idea to project planning, SW development process, test planning, quality planning, acceptance, commissioning, operation and decommissioning.

You are able to efficiently develop programs for an embedded system in "C" according to the guidelines of modern software engineering.

You are familiar with using pointers, function pointers and structures.

Based on your knowledge of programming/coding guidelines and software quality features, functional and non-functional requirements as well as internal quality and generate software that is reusable, extendable and easily tested.

In addition, you know all stages of a software development process, from the idea to system acceptance.

### Participants

Software developers, software architects

### Requirements

A good understanding of ANSI-C and microcontroller architectures.

### Live-Online-Training

03.02. – 06.02.2025 2.400,00 € 4 Days

\* Price per attendee, in Euro plus VAT

Training code: LE-EMB-C

### Face-To-Face - English

Date	Duration
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26.08. – 29.08.2024	4 days
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31.03. – 03.04.2025	4 days
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**Live Online - German****Date**                      **Duration**

03.02. – 06.02.2025 4 days

**Face-To-Face - German****Date**                      **Duration**

26.08. – 29.08.2024 4 days

11.11. – 14.11.2024 4 days

31.03. – 03.04.2025 4 days

**Embedded C Training: Programming Methods and Tools for Embedded Applications - Live Online Training****Content****Essentials of Hardware-near C Programming**

- Data types
- Pointers, function pointers
- Structures, linked lists
- Circular buffer, queues, FIFO, LIFO
- Programming rules and guidelines
- Pitfalls and stumbling blocks in C

**Software Architecture**

- Selection of a layered model based on requirements
- Communication between layers
- Synchronous and asynchronous interfaces

**Driver Programming**

- HW abstraction, driver programming: access to HW registers in "C"
- Interfaces, callback interfaces, queues
- Interrupt handling / service routines, callback function

**Using Pointers, Function Pointers and Linked Lists**

- Example: scheduler programming
- Task management as linked list

**Programming a Finite State Machine FSM**

- Philosophy and implementation of an FSM in C

**Locating Code and Data in ( $\mu$ C) Memory (Flash, RAM Address Space)**

- Sectioning (.text, .data, .bss)
- Linker description file

**Library Management**

- Adapting standard library functions to HW
- User library creation and management

**Overview: Real-time Operating Systems (RTOS)**

- Types, services, selection criteria

**Outlook: OOP Techniques**

- Advantages and issues of object oriented programming
- Most important UML diagrams

**Introduction: Structured Methods for Project Planning**

- Preliminary study, project start, project plan, project implementation

**Software Development Process Models**

- V-model, spiral model, RUP, COPES
- Interactive-incremental
- Agile software development, XP

**Quality of Embedded Systems**

- How to design and develop quality
- Overview: Standards (MISRA, IEC61508)

**Overview: Software Test Process for Developers**

- Test phases and test methods
- Static test, dynamic test
- Review, whitebox test, blackbox test

**MicroConsult PLUS:**

- Extensive exercises on a target hardware
- Programs are developed with Keil  $\mu$ Vision and Arm RealView tools or with IAR Workbench and tested on Arm-7 or Cortex<sup>®</sup>-M3 based HW.