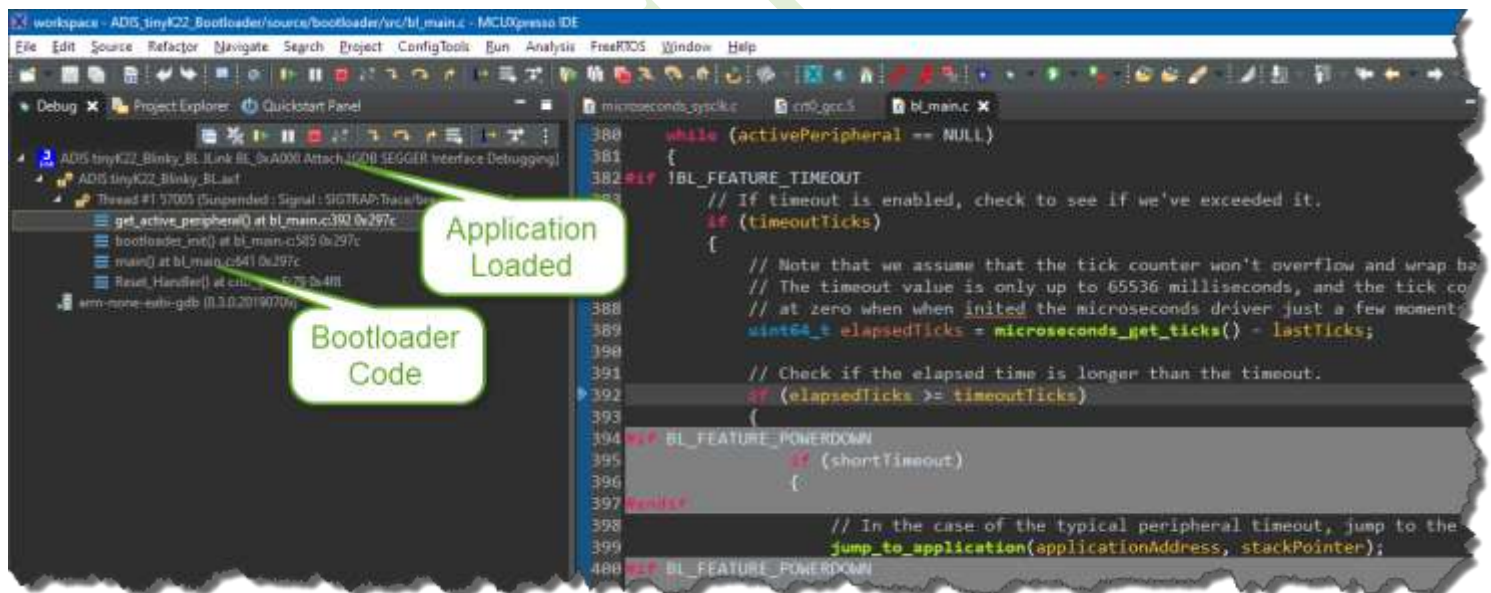




Bootloader Course Syllabus



MONTH 2 – CAN Family Protocols

Bootload MASTER COURSE – 6 MONTHS

Module 1 – Bootloader Fundamentals

- ❖ What is a Bootloader?
- ❖ Importance in Embedded Systems
- ❖ Types of Bootloaders
- ❖ Boot process in microcontrollers
- ❖ Secure Boot & Firmware Update basics

Module 2 – Microcontroller Boot Process

- ❖ Reset sequence & startup code
- ❖ Processor initialization (Clock, Stack, Registers)
- ❖ Interrupt vector table basics
- ❖ Memory layout (ROM, RAM, Flash)
- ❖ Linker script fundamentals

Module 3 – Reliability & Data Integrity

- ❖ Power-On Self-Test (POST) overview
- ❖ CRC & checksum concepts
- ❖ Overview of Firmware update methods (UART, CAN, USB, Ethernet, Wi-Fi OTA)
- ❖ Basic security in bootloaders

Module 4 – Demo Bootloader Implementation

- ❖ Writing a minimal UART bootloader in C (demo)
- ❖ Configuring stack & flash memory for demo
- ❖ Flashing & testing the sample code
- ❖ Recap & pathway to advanced practical learning

Module 5 – Practical Development

- ❖ Power-On Self-Test (POST) overview
- ❖ Firmware update mechanisms (UART, CAN, USB)
- ❖ Implementing CRC/checksum in code
- ❖ Writing a UART bootloader from scratch
- ❖ Configuring stack, memory map & Flash programming APIs
- ❖ Debugging with ST-Link/J-Link

Module 6 – Secure Boot & Final Project

- ❖ Advanced security: AES/RSA/SHA for firmware validation
- ❖ Implementing rollback & fail-safe features
- ❖ CAN bootloader for automotive applications
- ❖ Manual testing & flashing with PCAN tool
- ❖ **Final Project:** Single-interface secure bootloader with documentation & live demo

Module 7 – Multi-Interface Bootloaders & Automotive Protocols

- ❖ Firmware updates via UART, CAN, USB, Ethernet, Wi-Fi OTA
- ❖ UDS protocol integration for automotive bootloaders (Service 0x10–0x36)
- ❖ Bootloader updater concept & implementation
- ❖ Manual testing & flashing with PCAN tool
- ❖ Automation testing with TESAF tool

Module 8 – Advanced Security & Reliability

- ❖ AES-256, RSA-2048, and SHA-256 security for firmware validation
- ❖ Anti-cloning & anti-tamper techniques
- ❖ Advanced Power-On Self-Test (POST) and diagnostics integration
- ❖ Brown-out, watchdog & fail-safe recovery mechanisms
- ❖ Automotive ECU bootloader with OEM-style security

Module 9 – Real Automotive Projects & Job Readiness

- ❖ **Project 1:** Multi-interface secure bootloader with UDS + OTA update
- ❖ **Project 2:** Automotive ECU bootloader solving a real OEM field issue
- ❖ Complete manual & automation testing (PCAN + TESAF)
- ❖ Industry-style code reviews & debugging sessions
- ❖ Job interview preparation, resume building & final certification

Bootload MASTER COURSE – 3 MONTHS

Module 1 – Bootloader Fundamentals

- ❖ What is a Bootloader?
- ❖ Importance in Embedded Systems
- ❖ Types of Bootloaders
- ❖ Boot process in microcontrollers
- ❖ Secure Boot & Firmware Update basics

Module 2 – Microcontroller Boot Process

- ❖ Reset sequence & startup code
- ❖ Processor initialization (Clock, Stack, Registers)
- ❖ Interrupt vector table basics
- ❖ Memory layout (ROM, RAM, Flash)
- ❖ Linker script fundamentals

Module 3 – Reliability & Data Integrity

- ❖ Power-On Self-Test (POST) overview
- ❖ CRC & checksum concepts
- ❖ Overview of Firmware update methods (UART, CAN, USB, Ethernet, Wi-Fi OTA)
- ❖ Basic security in bootloaders

Module 4 – Demo Bootloader Implementation

- ❖ Writing a minimal UART bootloader in C (demo)
- ❖ Configuring stack & flash memory for demo
- ❖ Flashing & testing the sample code
- ❖ Recap & pathway to advanced practical learning

Module 5 – Practical Development

- ❖ Power-On Self-Test (POST) overview
- ❖ Firmware update mechanisms (UART, CAN, USB)
- ❖ Implementing CRC/checksum in code
- ❖ Writing a UART bootloader from scratch
- ❖ Configuring stack, memory map & flash programming APIs
- ❖ Debugging with ST-Link/J-Link

Module 6 – Secure Boot & Final Project

- ❖ Advanced security: AES/RSA/SHA for firmware validation
- ❖ Implementing rollback & fail-safe features
- ❖ CAN bootloader for automotive applications
- ❖ Manual testing & flashing with PCAN tool
- ❖ **Final Project:** Single-interface secure bootloader with documentation & live demo

Bootload MASTER COURSE – 1 MONTHS

Module 1 – Bootloader Fundamentals

- ❖ What is a Bootloader?
- ❖ Importance in Embedded Systems
- ❖ Types of Bootloaders
- ❖ Boot process in microcontrollers
- ❖ Secure Boot & Firmware Update basics

Module 2 – Microcontroller Boot Process

- ❖ Reset sequence & startup code
- ❖ Processor initialization (Clock, Stack, Registers)
- ❖ Interrupt vector table basics
- ❖ Memory layout (ROM, RAM, Flash)
- ❖ Linker script fundamentals

Module 3 – Reliability & Data Integrity

- ❖ Power-On Self-Test (POST) overview
- ❖ CRC & checksum concepts
- ❖ Overview of Firmware update methods (UART, CAN, USB, Ethernet, Wi-Fi OTA)
- ❖ Basic security in bootloaders

Module 4 – Demo Bootloader Implementation

- ❖ Writing a minimal UART bootloader in C (demo)
- ❖ Configuring stack & flash memory for demo
- ❖ Flashing & testing the sample code
- ❖ Recap & pathway to advanced practical learning