Chapter 1: Introduction

After completing this chapter, you will understand what this class is, what topics are covered, and the overall class objectives. You will also have an overview of the XMC7000 and TRAVEO T2G family MCUs.

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Document conventions

Convention	Usage	Example
`Courier New`	Displays code and text commands	`CY_ISR_PROTO(MyISR);` `make build`
Italics	Displays file names and paths	*sourcefile.hex*
[**bracketed, bold**]	Displays keyboard commands in procedures	[**Enter**] or [**Ctrl**] [**C**]
Menu > Selection	Represents menu paths	**File > New Project > Clone**
Bold	Displays GUI commands, menu paths and selections, and icon names in procedures	Click the **Debugger** icon, and then click **Next**.

1.1 What is this class?

This class is an in-depth look into the XMC7000 and TRAVEO T2G MCU family. The learning objective is to introduce you to the basic operation of XMC7000 MCU devices and familiarize you with their development flow within the ModusToolbox™ ecosystem. This should enable you to create your own applications for XMC7000 and TRAVEO T2G devices. The KIT_XMC72_EVK containing an XMC7200 MCU will be used during exercises. KIT_T2G-B-H_EVK with TRAVEO T2G MCU can also be used for these exercises.

The XMC7000 shown in this training and exercise can be replaced as TRAVEO T2G. Also, KIT_XMC72_EVK can be replaced as KIT_T2G-B-H_EVK.

This is a "Level 2" class, meaning that it is intended to be a detailed look into a specific product, in this case XMC7000 and TRAVEO T2G MCUs. This class is part of a series of classes that also include these other "levels":

- "Level 1" classes are intended as an entry point into a particular topic and cover a broad range of topics at a shallow depth.
- "Level 3" classes dig even deeper by looking at complete solutions such as Bluetooth®, Wi-Fi, Motor Control, or Machine Learning.

1.2 Prerequisites

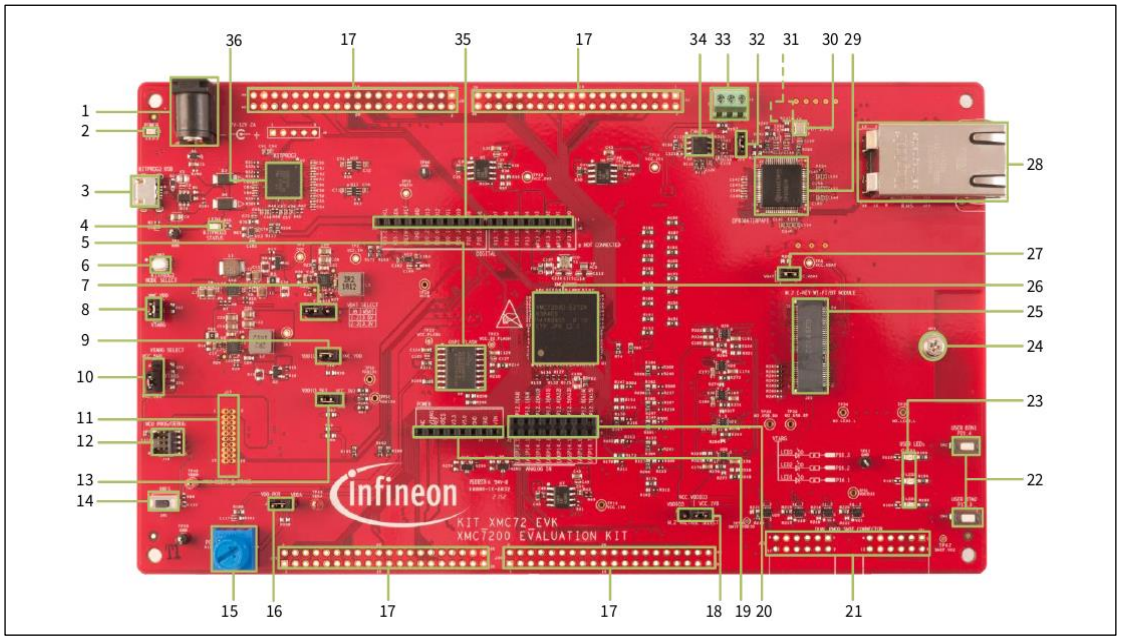
- ModusToolbox™ Software Training Level 1 - Getting Started

This class will not cover what ModusToolbox™ software is, what tools it includes, or how to use any of its features. If you are unfamiliar with ModusToolbox™ software, you should take the "ModusToolbox™ Software Training Level 1 - Getting Started" class before continuing with this chapter.

1.3 KIT_XMC72_EVK Evaluation kit

The KIT_XMC72_EVK evaluation kit includes all the components required to ensure the proper functioning and evaluation of the XMC7000 MCU series. It contains the XMC7200 MCU. The kit primarily demonstrates the key features of this silicon and provides an Arduino UNO compatible header to evaluate analog, digital communication, and other digital features. The kit features peripheral interfaces such as CAN FD interface, Gigabit Ethernet interface, QSPI flash, and M.2 connector for WLAN and Bluetooth® verification.

KIT_T2G-B-H_EVK is available for TRAVEO T2G device.



KIT_XMC72_EVK evaluation kit – top view

1. External power supply VIN connector (J6)
2. Power LED (LED5)
3. KitProg3 USB connector (J7)
4. KitProg3 status LED (LED4)
5. 512-Mbit serial NOR flash memory (S25FL512S, U9)
6. KitProg3 programming mode selection button (SW3)
7. VBAT power selection jumper (J8)
8. XMC7200D VTARG current measurement jumper (J15)
9. XMC7200D VDDIO2 current measurement jumper (J12)
10. System power (VTARG) selection jumper (J10)
11. XMC7200D 20-pin debug and trace header (J17)*
12. XMC7200D 10-pin SWD/JTAG program and debug header (J16)

13. XMC7200D target I/O current measurement jumper (J14)
14. XMC7200D reset button (SW1)
15. Potentiometer (R105)
16. Potentiometer connection jumper (J18)
17. XMC7200D extended I/O headers (J29, J30, J31, J32)*
18. M.2 I/O power selection jumper (J27)
19. Power header compatible with Arduino Uno R3 (J1)
20. Analog-IN header compatible with Arduino Uno R3 (J2)
21. SMIF dual header compatible with Digilent Pmod ™ (J21, J22)*
22. XMC7200D user buttons (SW2, SW4)
23. XMC7200D user LEDs (LED1, LED2, LED3)
24. M.2 stand-off (MT1)
25. M.2 interface connector (J25)
26. XMC7200D microcontroller (XMC7200D-E272K8384 – U1)
27. VBAT current measurement jumper (J28)
28. RJ45 Gigabit Ethernet connector (J23)
29. Ethernet physical layer (PHY) transceiver (U22)
30. 25-MHz crystal for Ethernet transceiver (Y3)
31. 125-MHz crystal for Ethernet transceiver (Y4)**
32. CAN FD resistor termination jumper (J20)
33. CAN FD interface connector (J19)
34. CAN FD transceiver (TLE9251VSJ – U8)

For more details about XMC72 Evaluation Kit visit here:
https://www.infineon.com/cms/en/product/evaluation-boards/kit_xmc72_evk/

For more details about TRAVEO T2G Evaluation Kit visit here:

https://www.infineon.com/cms/en/product/evaluation-boards/kit_t2g-b-h_evk/

1.4 Introduction

1.4.1 Introduction to XMC7000 MCU

The XMC7000 is a microcontroller family targeted at industrial applications. These devices have up to two Arm® Cortex®-M7 CPUs for primary processing, and a Cortex®-M0+ CPU for peripheral and security processing. These devices contain embedded peripherals supporting controller area network with flexible data rate (CAN FD) and gigabit Ethernet. XMC7000 devices are manufactured on an advanced 40-nm process. They incorporate Infineon's low-power flash memory, multiple high-performance analog and digital peripherals, and enable the creation of a secure computing platform.

The XMC7000 family comes in 2 series: **XMC7100** and **XMC7200** and it is available in TQFP and LFBGA packages scaling from 100 to 272 pins.

For more details about XMC7000 visit: https://www.infineon.com/cms/en/product/microcontroller/32-bit-industrial-microcontroller-based-on-arm-cortex-m/32-bit-xmc7000-industrial-microcontroller-arm-cortex-m7/

1.4.2 Introduction to TRAVEO T2G MCU

The TRAVEO T2G is a microcontroller family targeted at automotive and industrial applications. The TRAVEO T2G has body high and entry series targeted body control units. Body high devices have up to two Arm® Cortex®-M7 CPUs for primary processing, and a Cortex®-M0+ CPU for peripheral and security processing. Body entry devices have an Arm® Cortex®-M4 CPU for primary processing, and a Cortex®-M0+ CPU for peripheral and security processing. These devices contain embedded peripherals supporting controller area network with flexible data rate (CAN FD), and Local Interconnect Network (LIN). In addition, body High devices have gigabit Ethernet. TRAVEO T2G devices are manufactured on an advanced 40-nm process. They incorporate Infineon's low-power flash memory, multiple high-performance analog and digital peripherals, and enable the creation of a secure computing platform.

TRAVEO T2G body high devices are available in 176pin-TEQFP, 272pin-BGA, and 320pin-BGA packages. Body entry devices are available in LQFP package scaling from 64 to 176 pins.

1.5 XMC7000 Kit Programmer/Debugger

The programmer firmware on the XMC7000 development kits is called KitProg3 (some kits ship with KitProg2 firmware, but we'll show you how to update it later). It runs on a PSoC™ 5LP chip also located on the kit. This firmware talks to your computer via USB and to the XMC7000 target device via a protocol called Serial Wire Debug (SWD). The host application on your computer needs to talk to the programmer to debug the XMC7000 MCU and to download firmware into the XMC7000 flash. There are many different protocols out there for accomplishing this task. However, a few years ago Arm developed a standard called CMSIS-DAP, which has two variants that are implemented in the KitProg firmware (Bulk and DAPLink).

Note: Older versions of KitProg firmware also support HID mode, which we typically don't use anymore.

In addition to the CMSIS functions, there is also a function called "Mass storage". When the mass storage functionality is turned on, the programmer appears as a "flash drive" on your computer. You can copy – using the file manager – hex files to the flash drive, which will then be programmed. This function typically runs at the same time as the DAPLink functionality. The programming firmware typically provides one or more

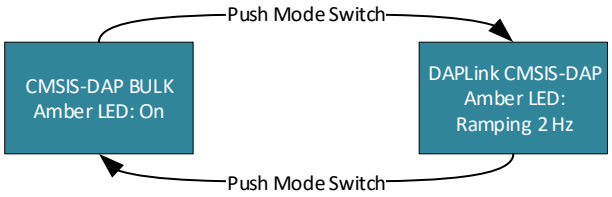
communication bridge modes that allow the XMC7000 MCU to talk to your PC via I^2C or UART. These also typically run at the same time as the programming firmware.

The KitProg will appear to your computer to be multiple USB endpoints that implement each of the functions described in the previous paragraphs.

In order to program the XMC7000 MCU, KitProg needs to be in the right mode – meaning the mode that has the functionality that works with your environment.

You can **switch modes by long pressing the mode button on the development kit**, or by using the firmware loader program. Each XMC7000 development kit has an LED that will be solid or ramping (~2 Hz) to indicate the mode. See the following table for more details.

CMSIS Mode	Application	Mass Storage	Bridges	Solution	Description	LED
BULK	Eclipse IDE	No	UART I2C	XMC7000 devices & AFR	The latest version of the protocol which uses USB bulk mode – by far the fastest.	Solid
DAPLink	N/A	Yes	UART	N/A	A modified version of CMSIS-DAP that enables web debugging	2 Hz Ramping



1.6 Firmware Loader

Firmware loader (fw-loader) is a tool that we deliver as part of ModusToolbox™ software. It is a command-line tool that allows you to install new KitProg firmware onto a XMC7000 kit, and switch modes programmatically.

You can find it in the following directory:

<install_dir>/ModusToolbox/tools_<version>/fw-loader/bin

It is also available independently on GitHub at http://github.com/infineon/firmware-loader.

The following table shows some of the basic fw-loader commands:

Command	Description
`fw-loader --help` (or no argument)	Print out help information.
`fw-loader --device-list`	List all the KitProg devices attached to your computer.
`fw-loader --update-kp3`	Install the latest firmware onto your KitProg.
`fw-loader --mode kp3-daplink`	Put the KitProg into DAPLink CMSIS-DAP mode.
`fw-loader --mode kp3-bulk`	Put the KitProg into CMSIS-DAP Bulk mode.
`fw-loader --mode kp3-hid`	Put the KitProg into CMSIS-DAP HID mode (not typically used).

Command	Description
`fw-loader --mode kp3-bootloader`	Put the KitProg into bootloader mode (not typically used).

You will practice using this tool in exercise 3.

1.7 Exercises

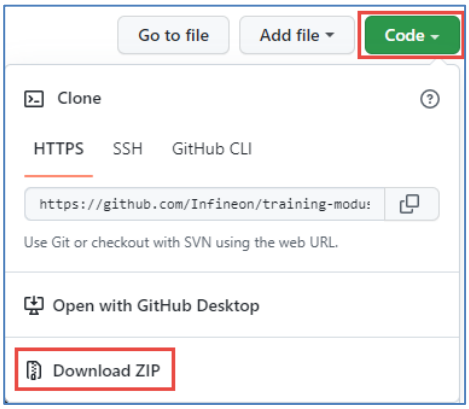
Exercise 1: Download Class Material

In this exercise, you will download the class material from GitHub. This will give you local access to the manuals and projects.

1. Use a Web browser to go to the GitHub site: https://github.com/Infineon/training-modustoolbox

Note: After completing Level-1-Getting started, navigate to Level-2-XMC7x section.

2. Click the **Code** button.



3. Click the **Download ZIP** button to download the repo to your local disk to a convenient location and then unzip it.

Note: If you are familiar with Git operations, you can clone the repository to your local disk using the URL instead of downloading a ZIP fie if you prefer.

Exercise 2: Look at kit documentation

1. Visit the websites for the kits used in this class and familiarize yourself with the kit documentation.

2. Open and review the User Manual for the kit.

Exercise 3: Update Kitprog Firmware

Your kits may have KitProg2 installed rather than KitProg3. In this exercise we will determine what version of KitProg your kits have and update them if necessary.

1. Connect your kit to your computer using the provided USB cable. If your kit has multiple USB connectors, be sure to connect to the one labeled KITPROG.
2. Run a command line terminal

   Windows: run `modus-shell` from the Start menu or enter `modus-shell` in the Windows search box.
   MacOS or Linux: start a standard command terminal
3. Navigate to the directory *<install_dir>/ModusToolbox/tools_<version>/fw-loader/bin*

Note: On Windows, steps 2 and 3 can be done together by either running `fw-loader` from the Start menu list or by entering `fw-loader` in the Windows search box.

4. Check the KitProg firmware version on the kit:

   ```
   ./fw-loader --device-list
   ```
5. Does a device show up? What mode is it in? What version of KitProg does it have installed? Update it to the latest version of KitProg3:

   ```
   ./fw-loader --update-kp3
   ```

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