

ADuCM4x50 EZ-KIT Board Support Package Users Guide

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1 Introduction

1.1 Purpose

This document describes the ADuCM4x50 EZ-KIT Board Support Pack (BSP), a software package that can be used on the ADuCM4x50 EZ-Kit evaluation board with Keil Microcontroller Development Kit (MDK) , CrossCore Embedded Studio® (CCES) and IAR Embedded Workbench.

If each ADuCM4x50 EZ-KIT Board Support Pack has a revision number ; this document assumes no specific BSP version. The Release Notes published with a specific ADuCM4x50 EZ-KIT Board Support Pack version details the different products versions required.

The ADuCM4x50 EZ-Kit evaluation board contains the ADuCM4x50 processor. This processor integrates an ARM Cortex-M4 microcontroller with various on-chip peripherals within a single package.

Scope of this Manual

This document describes how to install and work with the ADuCM4x50 EZ-KIT Board Support Pack. It explains what is included with the pack and how to configure the software to run the example applications that accompanies this package.

This document is intended for engineers who integrate ADI's device drivers with other software to build a system based on the ADuCM4x50 EZ-Kit. This document assumes background in ADI's ADuCM4x50 processor.

1.2 Acronyms and Terms

ADI	Analog Devices, Inc.
API	Application Programming Interface
ARM	Advanced RISC Machine
BSP	Board Support Pack
CCES	CrossCore Embedded Studio
CMSIS	Cortex Microcontroller Software Interface Standard
Cortex	A series of ARM microcontroller core designs
CRC	Cyclic Redundancy Check
DFP	Device Family Pack
HRM	Hardware Reference Manual
ISR	Interrupt Service Routine
IVT	Interrupt Vector Table
JTAG	Joint Test Action Group
MDK	Microcontroller Development Kit
NVIC	Nested Vectored Interrupt Controller
RISC	Reduced Instruction Set Computer
RTE	Run-Time Environment
RTOS	Real-Time Operating System

1.3 Conventions

Throughout this document, we refer to several important installation locations: the ADuCM4x50 EZ-KIT Board Support Pack, ARM CMSIS, Keil Microcontroller Development Kit toolchain installation root, CrossCore Embedded Studio toolchain installation root and IAR Embedded Workbench pack repository. Software packages can be installed in various places, which are referred to as follows:

- `<bsp_version>`
 - The version of the ADuCM4x50 EZ-KIT Board Support Pack, e.g. 1.0.0 or 3.1.0.
- `<ARM_CMSIS_version>`
 - The version of the ARM CMSIS pack, e.g. 4.5.0 or 5.1.0.

For Keil tool chain:

- `<Keil_root>`
 - The default installation path for Keil MDK 5.22 is **C:/Keil_v5**, but the install location may vary depending on user preferences.
- `<keil_bsp_root>`
 - The location where Keil pack installer will install a specific version of ADuCM4x50 EZ-KIT Board Support Pack in `<Keil_root>/ARM/Pack/AnalogDevices/ADuCM4x50_EZ_KIT_BSP/<bsp_version>`.

For CCES tool chain:

- `<cces_root>`
 - The default installation path for CCES is **C:/Analog Devices/CrossCore Embedded Studio x.y.z**, with x.y.z the version of CCES installed, but the install location may vary depending on user preferences.
- `<cces_bsp_root>`
 - CCES will install a specific version of ADuCM4x50 EZ-KIT Board Support Pack in `<cces_root>/ARM/packs/AnalogDevices/ADuCM4x50_EZ_KIT_BSP/<bsp_version>`.
- `<cces_ARM_CMSIS_root>`
 - The directory `<cces_root>/ARM/packs/ARM/CMSIS/<ARM_CMSIS_version>` which contains the content of the ARM CMSIS pack.

For IAR tool chain:

- `<appdata_root>`
 - User's AppData directory, e.g. **C:/Users/<windows_username>/AppData.**
- `<iar_packrepo>`
 - The repository where IAR Embedded Workbench installs CMSIS Packs:
`<appdata_root>/Roaming/IAR Embedded Workbench/PackRepo.`
- `<iar_bsp_root>`
 - IAR will install a specific version of ADuCM4x50 EZ-KIT Board Support Pack in
`<iar_packrepo>/AnalogDevices/ADuCM4x50_EZ_KIT_BSP
/<bsp_version>.`

1.4 References

1. Analog Devices : `<cces_bsp_root>/Documents`, `<keil_bsp_root>/Documents` or `<iar_bsp_root>/Documents`
 - a. ADuCM4x50_EZ-KIT_BSP_<bsp_version>_Release_Notes.pdf
 - b. ADuCM4x50_EZ-KIT_BSP_UsersGuide.pdf (this document)
 - c. ADuCM4050-EZ-KIT_Manual.pdf
 - d. ADuCM4050-LFCSP-EZ-KIT-BOM.pdf
 - e. ADuCM4050-LFCSP-EZ-KIT-schematic.pdf
 - f. ADuCM4050-WLCSP-EZ-KIT-BOM.pdf
 - g. ADuCM4050-WLCSP-EZ-KIT-Schematic.pdf
 - h. ADuCM4x50 Device Drivers API Reference Manual (`Documents/html` and hyperlinked)
2. For Keil `<Keil_root>/ARM/Hlp` [<http://www.keil.com>]
 - a. Keil MDK for Cortex-M micro controller.
 - b. `<keil_bsp_root>/Documents`: Release notes.
3. For CrossCore Embedded Studio (CCES) [<http://www.analog.com>]
 - a. In CCES IDE, open **Help->Help Contents**: CCES on-line help.
 - i. CrossCore Embedded Studio x.y.z documentation
 - ii. CMSIS C/C++ Development User's Guide
 - b. `<cces_bsp_root>/Documents`: Release notes.

4. For IAR Embedded Workbench [<http://www.iar.com>]
 - a. IAR Embedded Workbench.
 - b. `<iar_bsp_root>/Documents`: Release notes.
5. Micrium [<http://micrium.com>]
 - a. uC/OS-II RTOS for ARM Cortex-M4
 - b. uC/OS-II User's Manual
6. SEGGER J-Link Emulator [<http://www.segger.com>]
7. ICE-1000 or ICE-2000 Emulator [<http://www.analog.com>]
8. ARM CMSIS pack [www.keil.com/cmsis/pack]

1.5 Additional Information

For more information on the latest ADI processors, silicon errata, code examples, development tools, system services and devices drivers, technical support and any other additional information, please visit our website at www.analog.com/processors.

2 Product Overview

The ADuCM4x50 EZ-KIT Board Support Package provides the drivers for off-chip peripherals which are on the ADuCM4x50 EZ-Kit and examples for all the peripherals in the ADuCM4x50 processor.

The examples in the ADuCM4x50 EZ-KIT Board Support Package depend on the drivers from ADuCM4x50 Device Family Pack (DFP). The Release Notes for the ADuCM4x50 EZ-KIT Board Support Package to be used details the ADuCM4x50 Device Family Pack version required.

The ADuCM4x50 EZ-KIT Board Support Package is designed to work with CrossCore Embedded Studio, Keil uVision and IAR Embedded Workbench.

3 Installation Components

Before installing the ADuCM4x50 EZ-Kit Board Support Pack, the following should be installed.

- Install any of the following tool chains
 - CrossCore Embedded Studio
 - Keil uVision
 - IAR Embedded Workbench
- Install ADuCM4x50 Device Family Pack



Please refer to the Release Notes for the products versions required

The ADuCM4x50 EZ-Kit Board Support Pack contents (device drivers, examples, documentation, etc.) are placed at the following location depending upon the tool chain

- CrossCore Embedded Studio : `<cces_root>/ARM/packs/AnalogDevices/ADuCM4x50_EZ_KIT_BSP/<bsp_version>`
- Keil uVision : `<Keil_root>/ARM/Pack/AnalogDevices/ADuCM4x50_EZ_KIT_BSP/<bsp_version>`
- IAR Embedded Workbench : `<iar_packrepo>/AnalogDevices/ADuCM4x50_EZ_KIT_BSP/<bsp_version>`

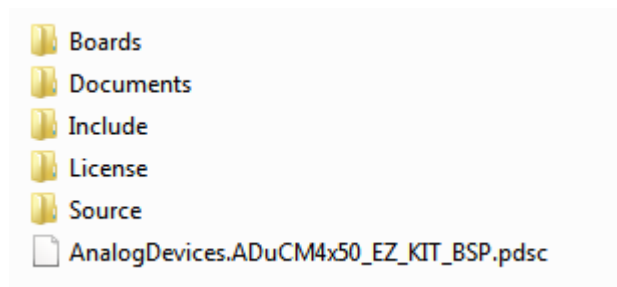


Figure 1. Installation Directory Structure

3.1 How to install new BSP in CCES environment

To install a new BSP or update an existing BSP go to CMSIS Pack Manager perspective and click on the Import Existing Packs icon. This opens a dialog box (Fig. 2). Chose the downloaded pack and click on **Open** button to install the BSP. If the Pack Manager perspective was not opened

previously, the **CMSIS Pack Manager** icon may not be present on the toolbar as shown below. In that case, the Pack Manager perspective can be opened by clicking **Window Perspective Open Perspective Other Pack Manager**. Figure 2 illustrates this feature with ADuCM4x50 EZ-KIT BSP 1.0.0.

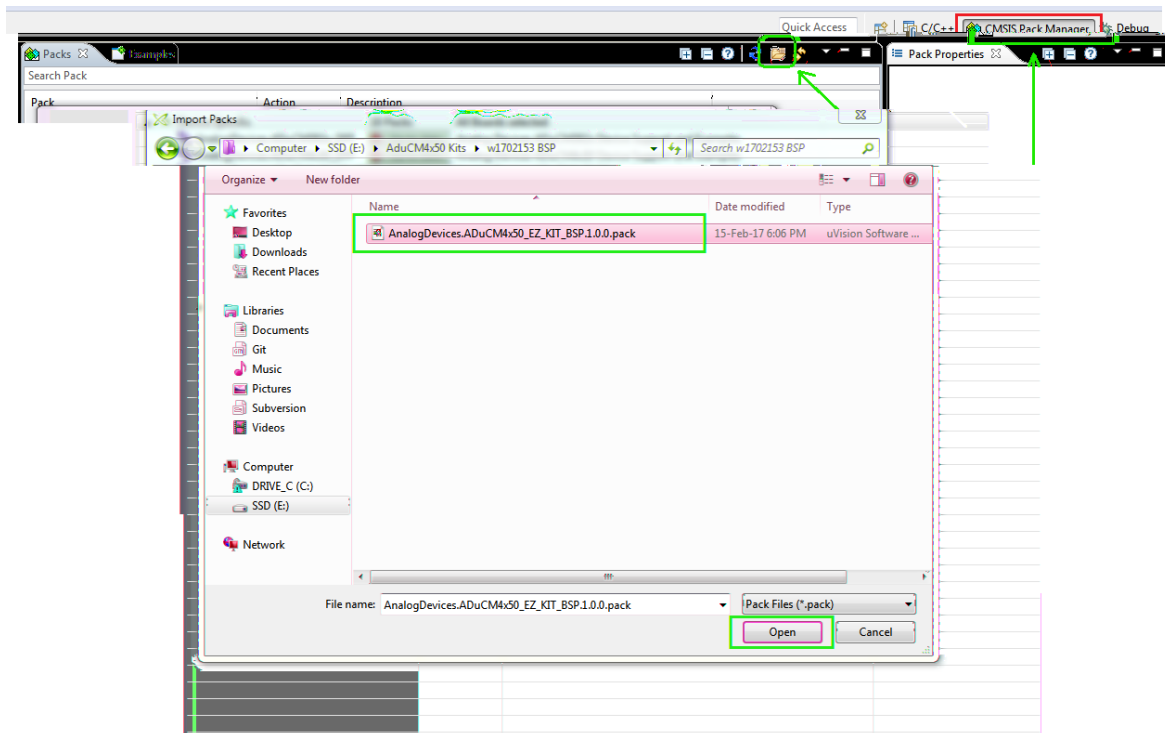


Figure 2. Import Existing Packs

3.2 How to install new BSP in Keil environment

To install or update an existing BSP pack in Keil environment double click on the downloaded CMSIS pack. This will open a dialog box (Fig. 3). Click on button Next to install the BSP. Figure 3 illustrates this feature with ADuCM4x50 EZ-KIT BSP 1.0.0.

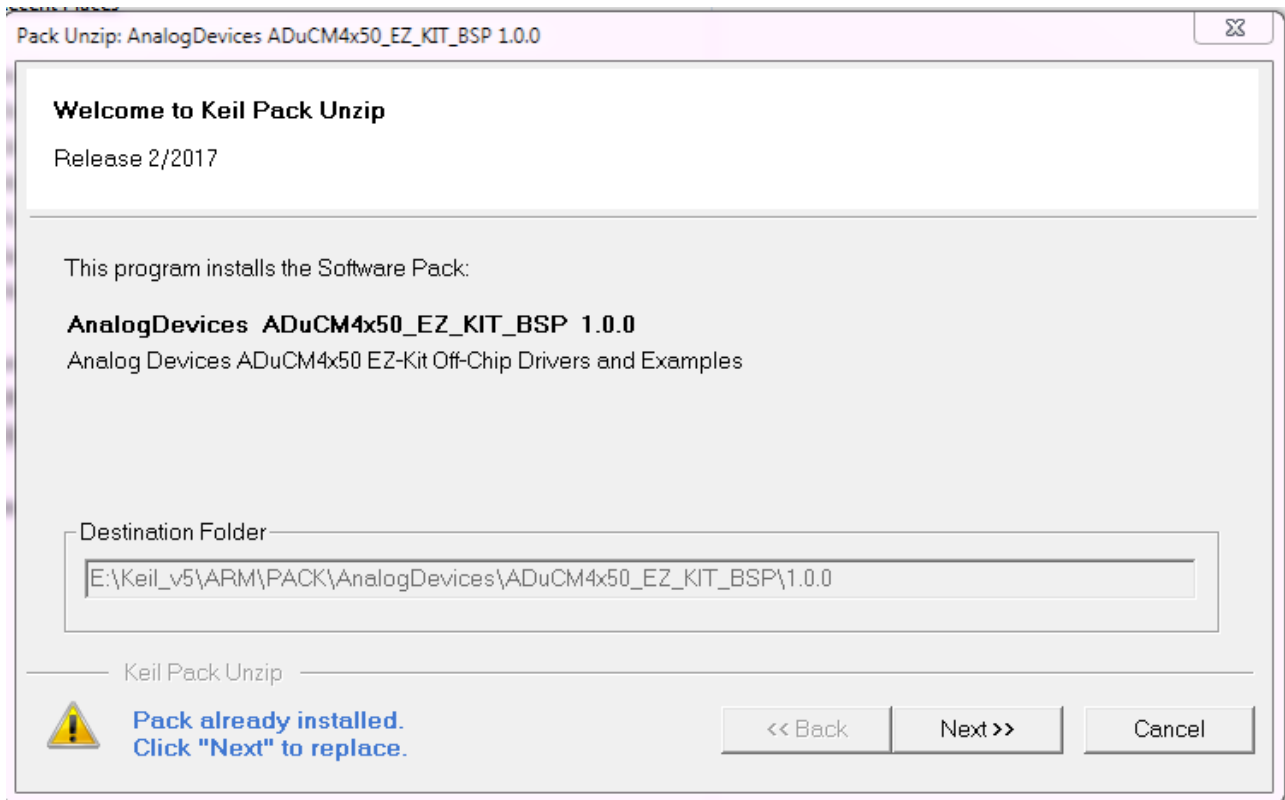


Figure 3. Install Keil Pack

3.3 How to install new BSP in IAR environment

To install or update an existing BSP pack in IAR environment, select Project CMSIS-Pack Pack Installer (Fig. 4a). Alternatively, you can click on the CMSIS-Pack Installer icon (Fig. 4b).

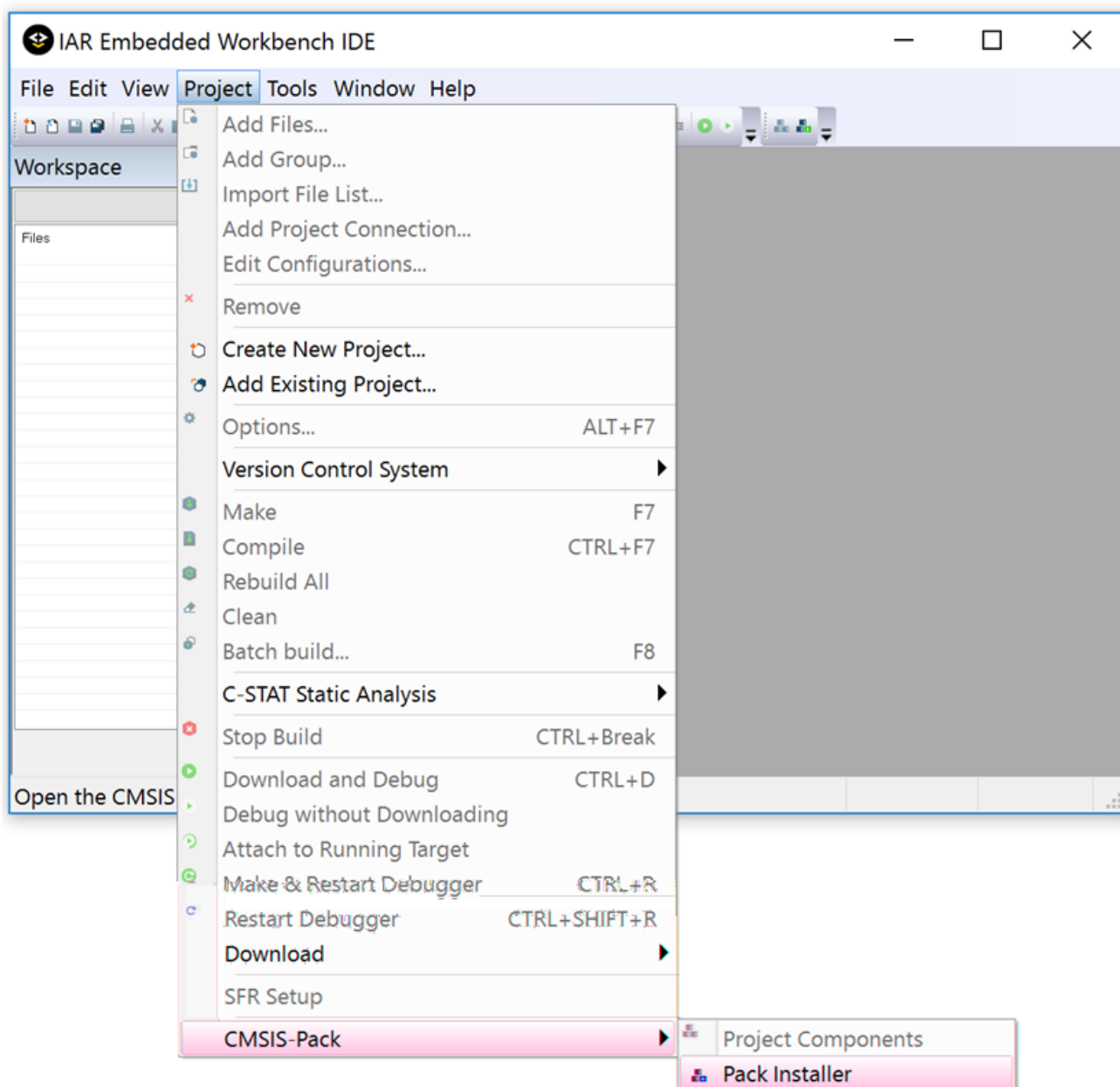


Figure 4a. Launch IAR Pack Installer

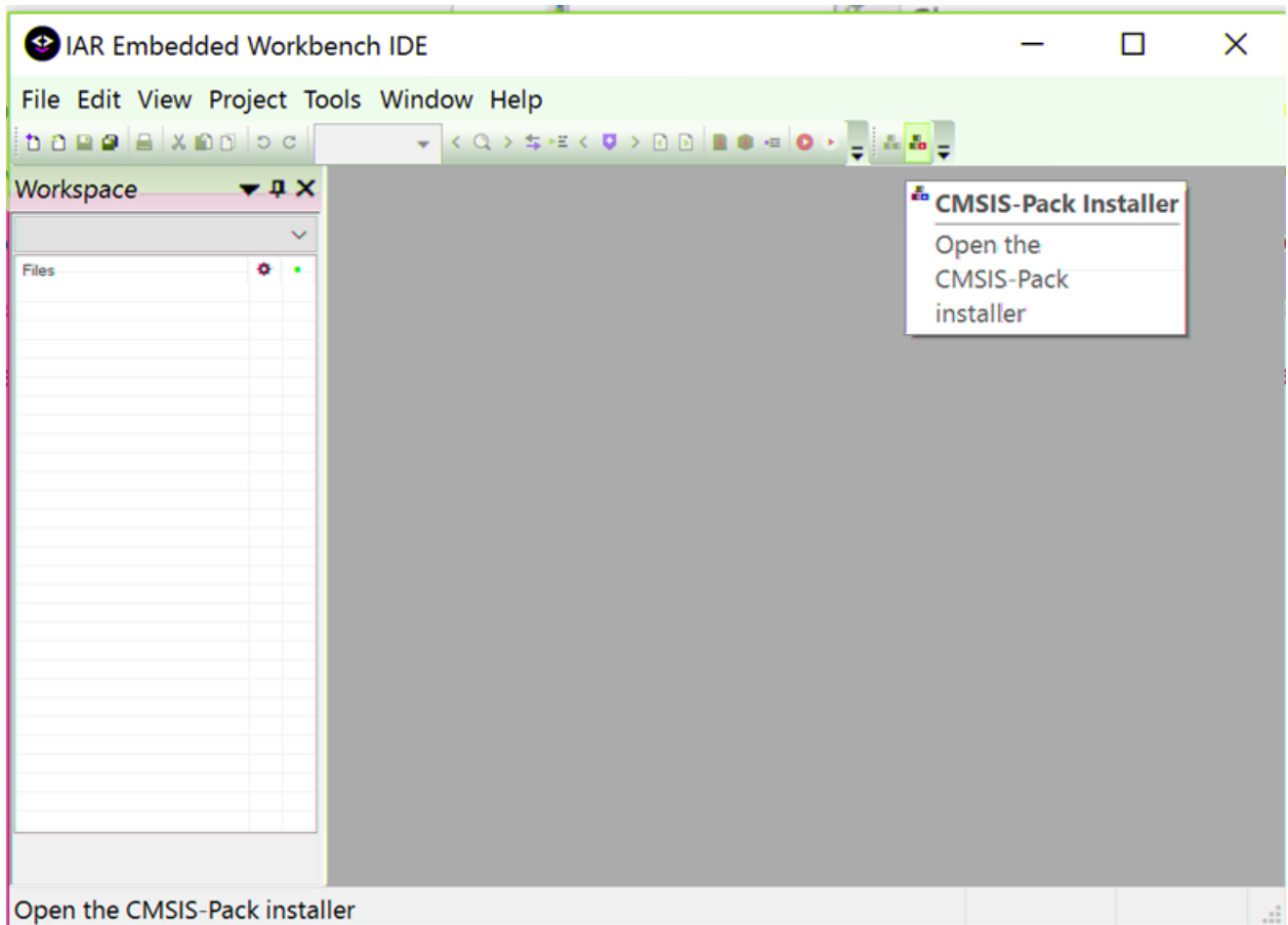


Figure 4b. Click the IAR Pack Installer icon

This will open a dialog box (Fig. 5). Click Install local pack to install the BSP.

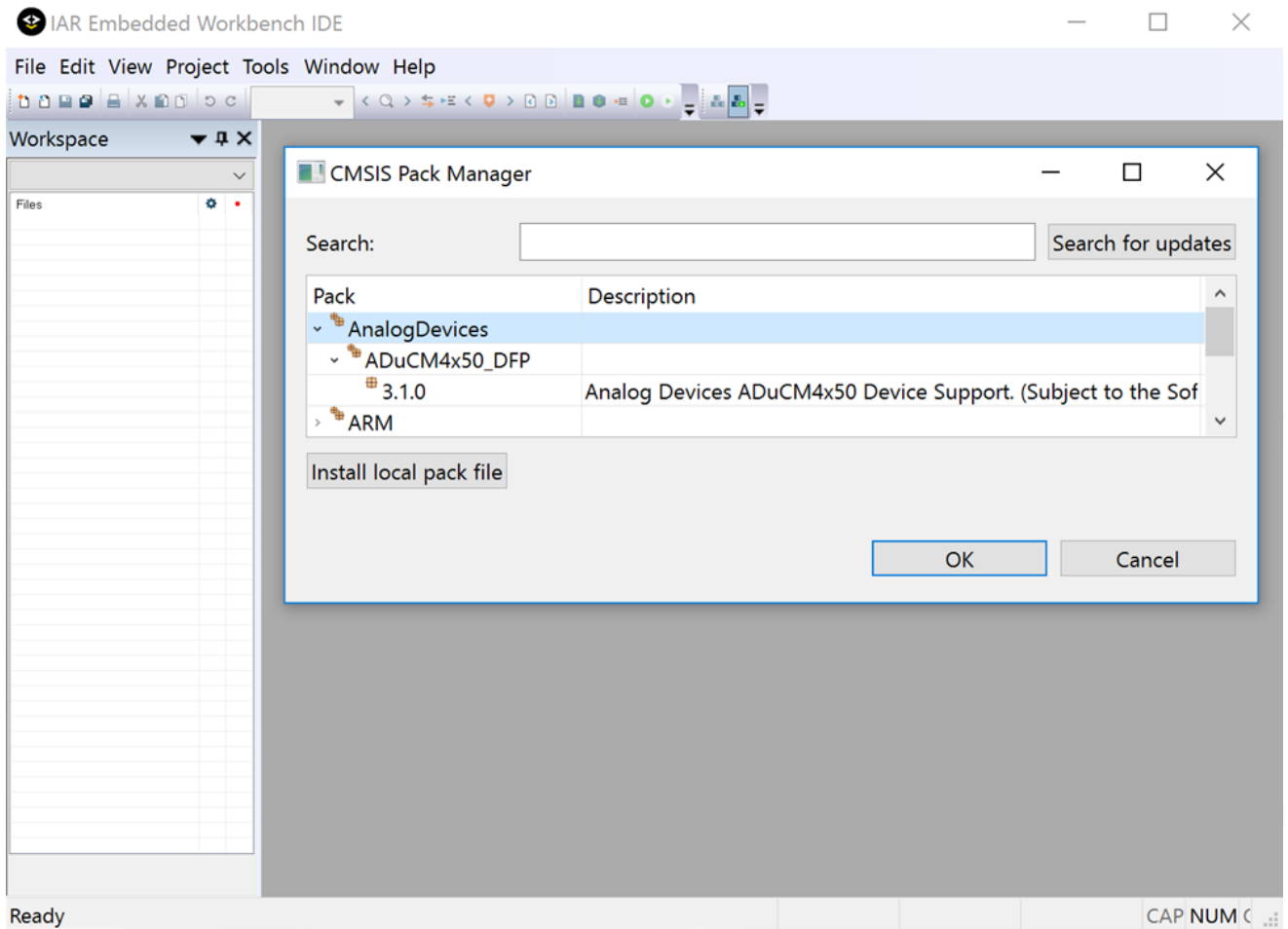


Figure 5. Install IAR Pack (1/2)

A window pops up to select a local CMSIS Pack (Fig. 6). Select the BSP file to be installed and click OK. Figure 6 illustrates this with ADuCM4x50 EZ-KIT BSP 3.1.0.

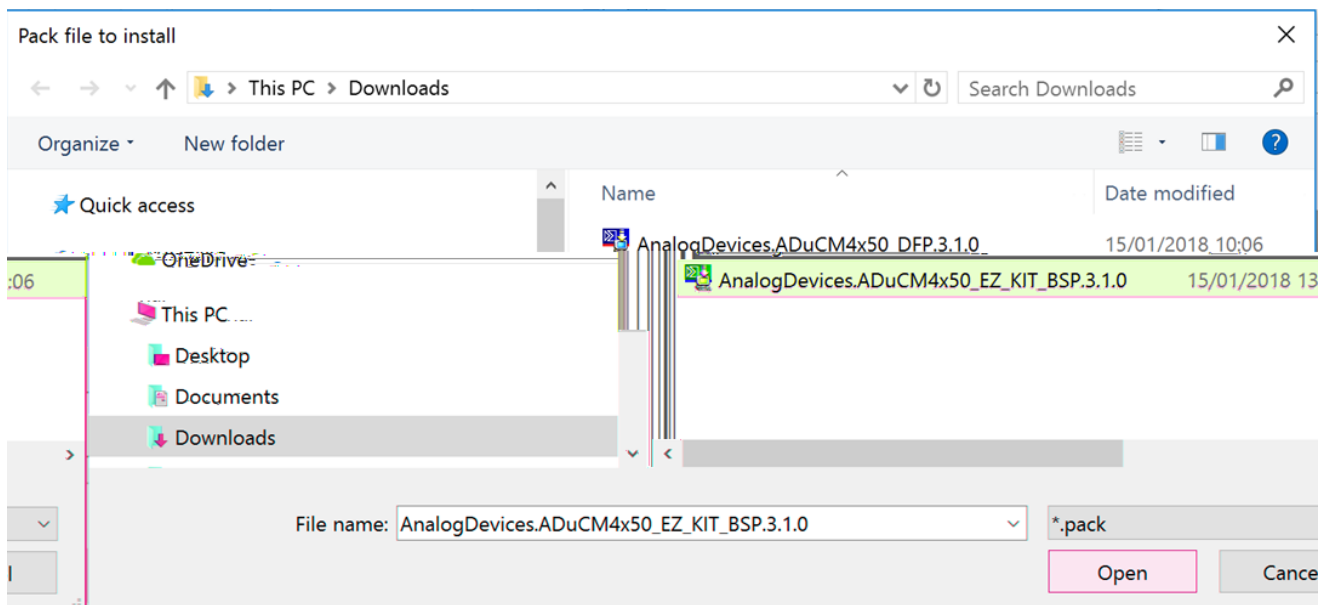


Figure 6. Install IAR Pack (2/2)

The ADuCM4x50 EZ-KIT BSP pack now appears in the list of installed packs: its version number, 3.1.0 in this example, is displayed in yellow (fig. 7); white color indicates that a pack version is not installed.

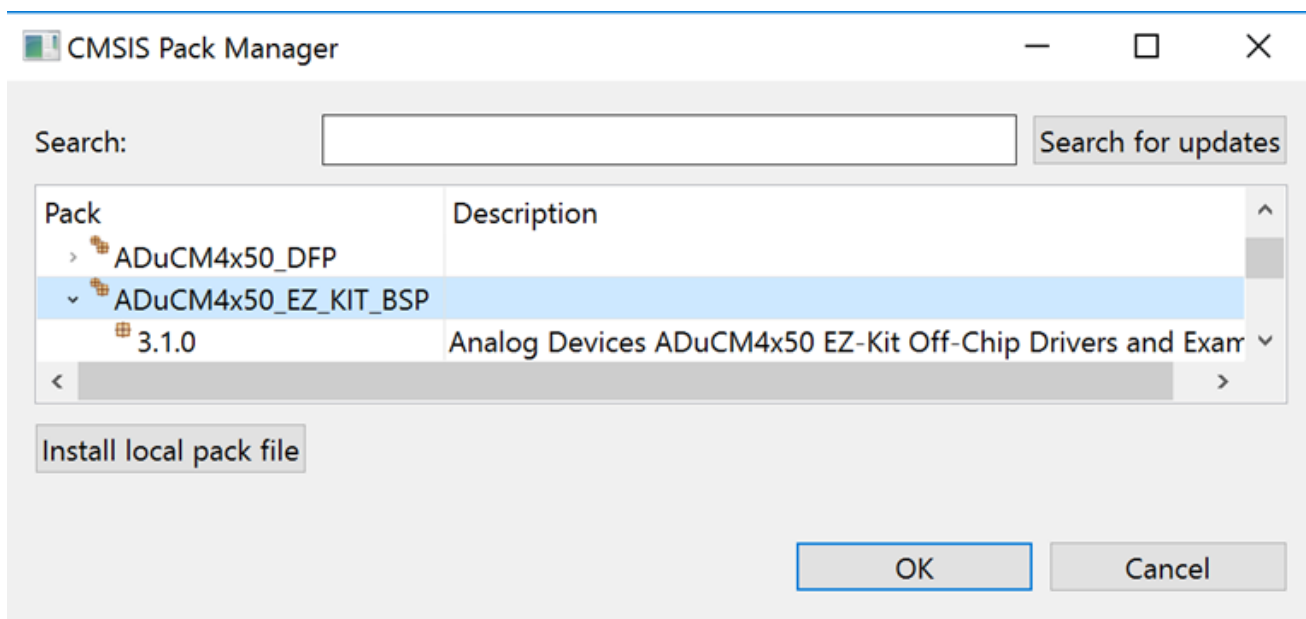


Figure 7. IAR Pack Installed

4 Drivers and Example Layout

The Peripheral Device Drivers installed with this software package are used to configure and use various off-chip peripherals on the ADuCM4x50 EZ-Kit. Figure 8 illustrates the drivers and examples layout under the **<keil_bsp_root>** directory for Keil, the **<cces_bsp_root>** directory for CCES, and the **<iar_bsp_root>** directory for IAR. We shall refer to these three directories as the **<bsp_pack_root>** directory.

In general, the driver sources are located in the **<bsp_pack_root>/Source** directory. The include files are located in the path **<bsp_pack_root>/Include**. The include path is automatically added in the compiler/preprocessor options when the driver is added to the project from the CMSIS pack.

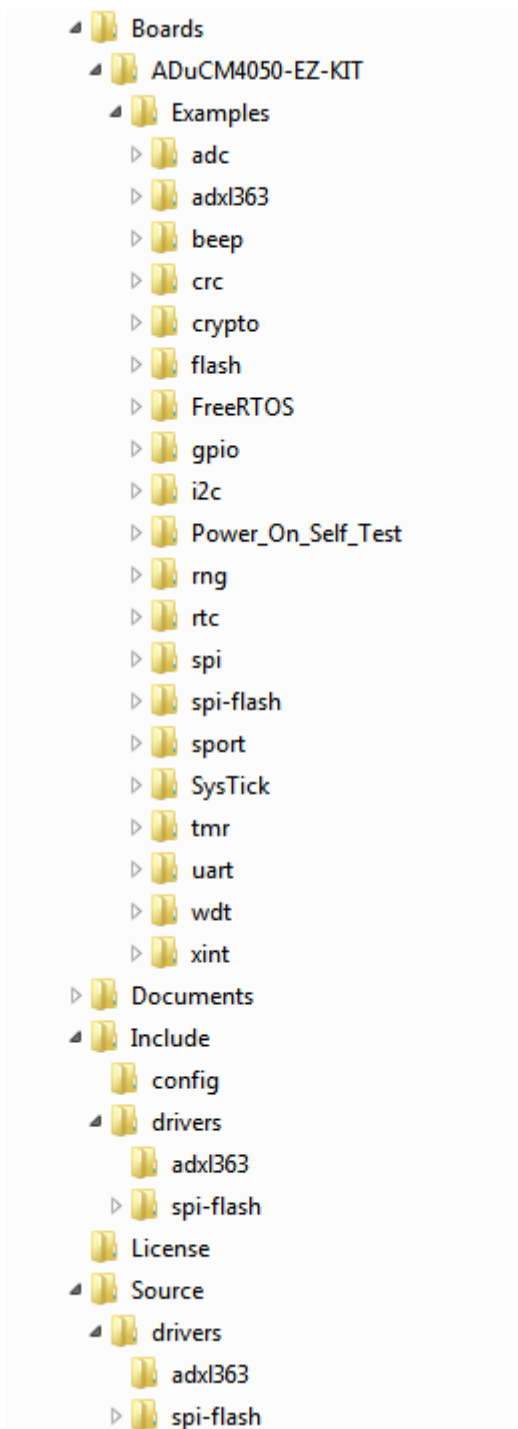


Figure 8. Driver Source and Examples for ADuCM4x50 EZ-KIT BSP 1.0.0

5 Off-chip Peripheral drivers

The ADuCM4x50 Board Support Pack includes drivers for the peripherals that are on the ADuCM4x50 EZ-Kit. Depending upon the tool chain the procedure of adding the drivers to the project varies. The following sections will describe the procedure to add the drivers to the project.

5.1 Adding off-chip peripheral drivers to the project in CCES

The driver component can be added to a project from `system.rteconfig` (fig. 9). Click on the check box to add the corresponding driver to the project.

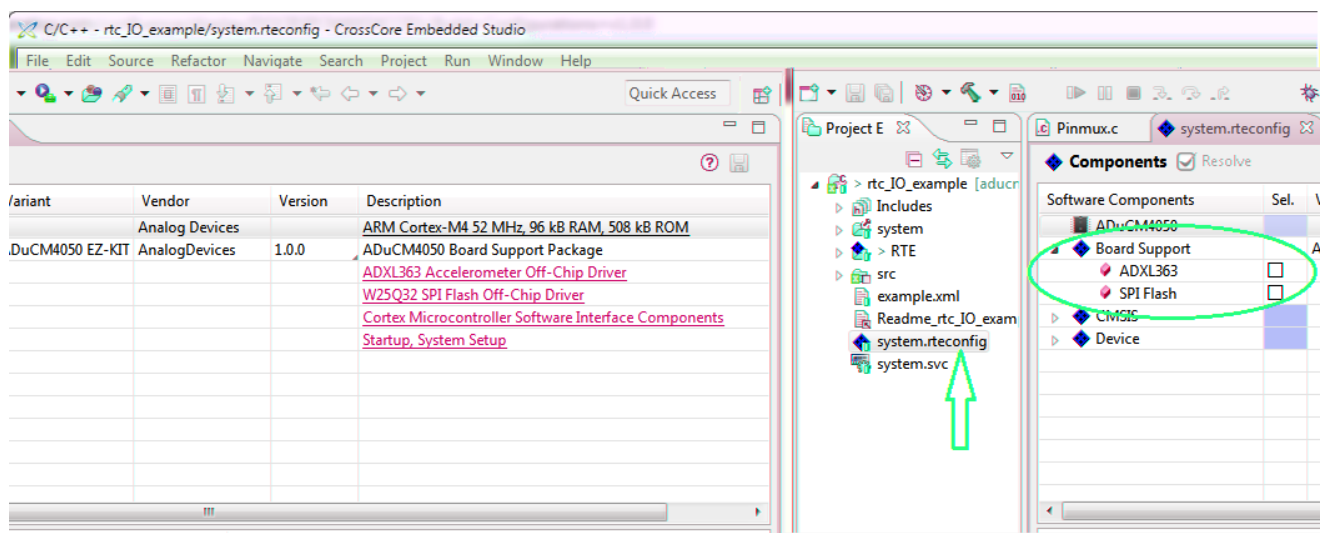


Figure 9: system.rteconfig

5.2 Adding off-chip peripheral drivers to the project in Keil

The driver component can be added to the project by the Manage Run-Time Environment window (fig. 10).

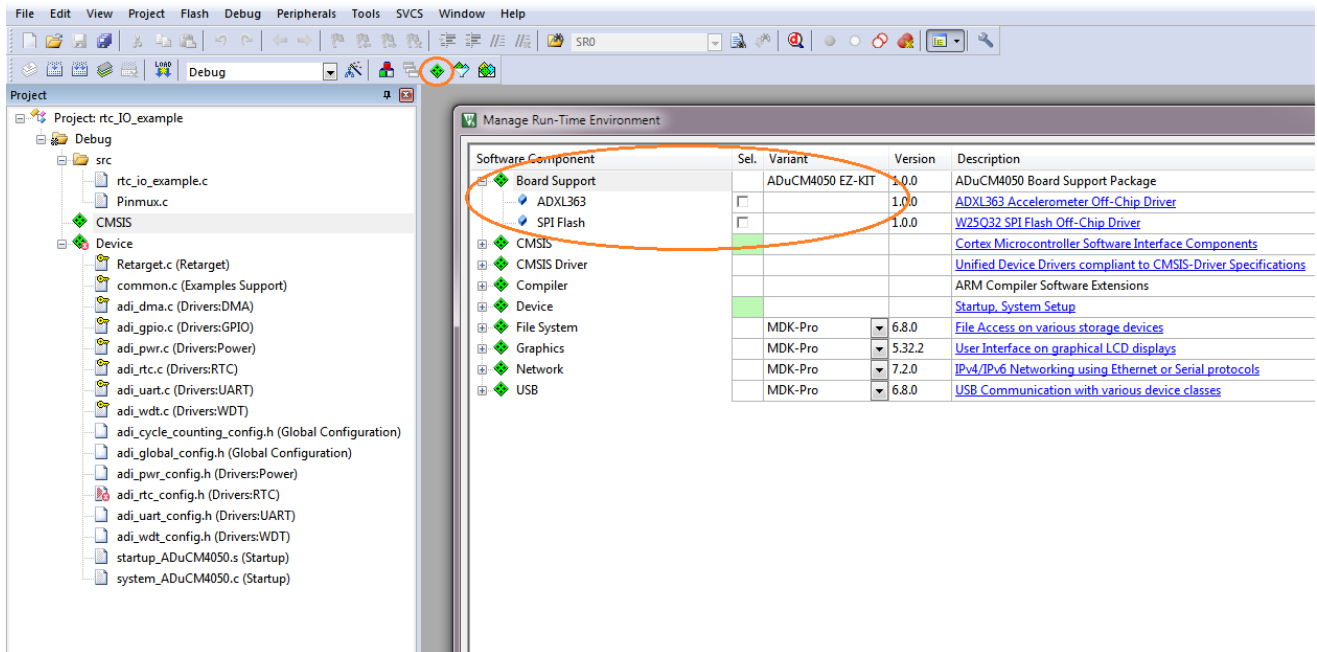


Figure 10: Manage Run-Time Environment

5.3 Adding off-chip peripheral drivers to the project in IAR

The driver component can be added to the project by the Project CMSIS Component Manager window. To open this window, click on the Project CMSIS-Pack Configuration icon (fig. 11). *Project CMSIS-Pack Configuration icon.*

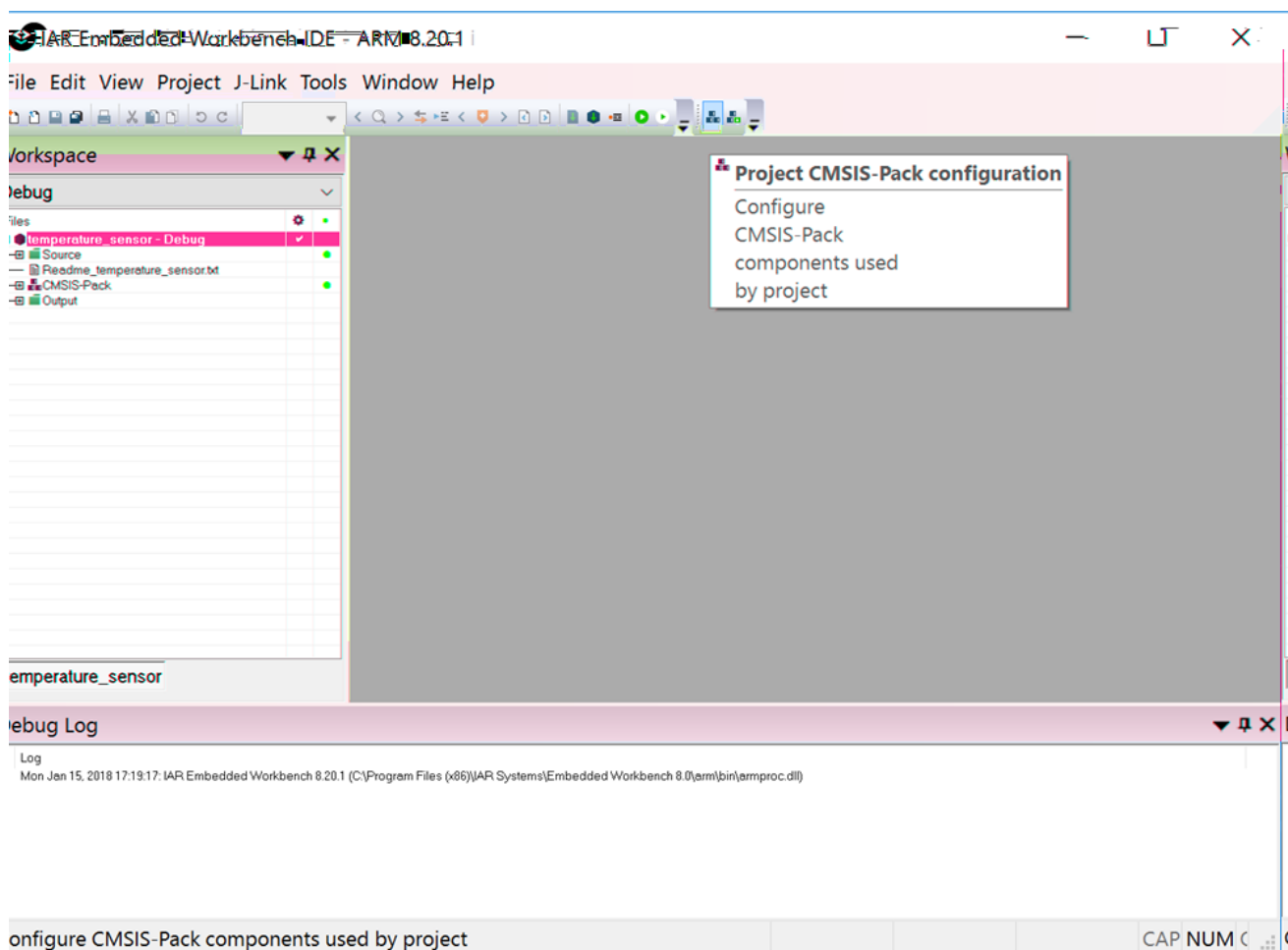


Figure 11: Project CMSIS-Pack Configuration icon

The Project CMSIS Component Manager window pops up (fig. 12).

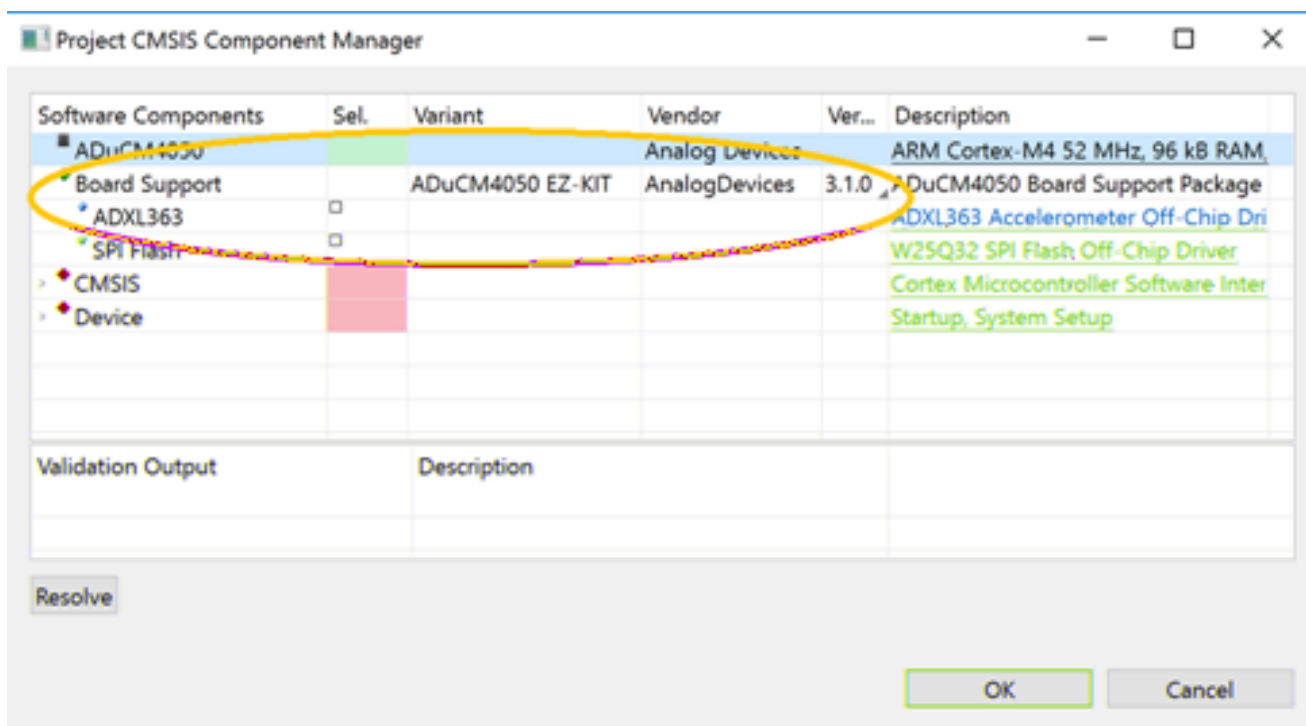


Figure 12: Project CMSIS Component Manager window

6 Examples

The ADuCM4x50 EZ-Kit Board Support Pack includes examples for all the on-chip and off-chip peripherals. The examples will showcase various features supported by the driver and the peripheral. The examples are targeted to work on ADuCM4x50 EZ-Kit. To open/run the examples, the examples should be copied to workspace. This allows users to alter the sources if needed and keep the original sources safe. The method of copying the examples to workspace and opening is different depending upon the tool chain. The following section will describe how to copy/open the examples to workspace.

Through this tutorial, the examples shown in figures cover different ADuCM4x50 EZ-KIT Board Support Pack versions: the features illustrated here are **ADuCM4x50 EZ-KIT Board Support Pack** version independent.

6.1 Copying examples to workspace in CCES

The examples can be copied to workspace from the **Help Browse Examples** menu (fig. 13).

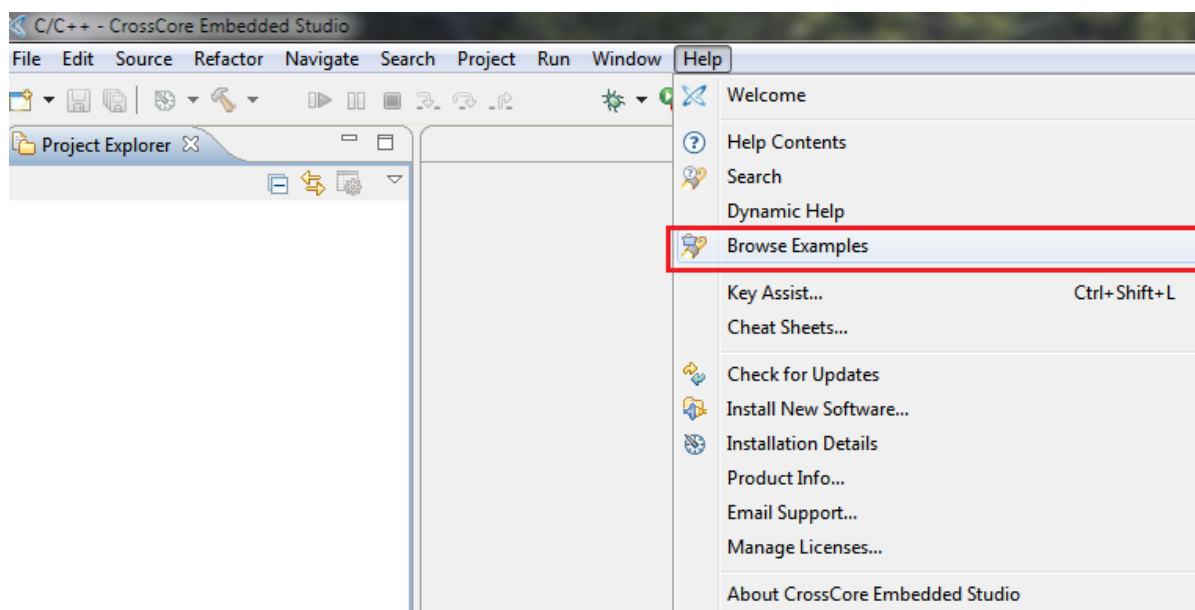


Figure 13. Browse Examples

The browse examples provides filter options to quickly find the examples the user is looking for. To find the examples related to ADuCM4x50 EZ-Kit, set the filter options (fig. 14).

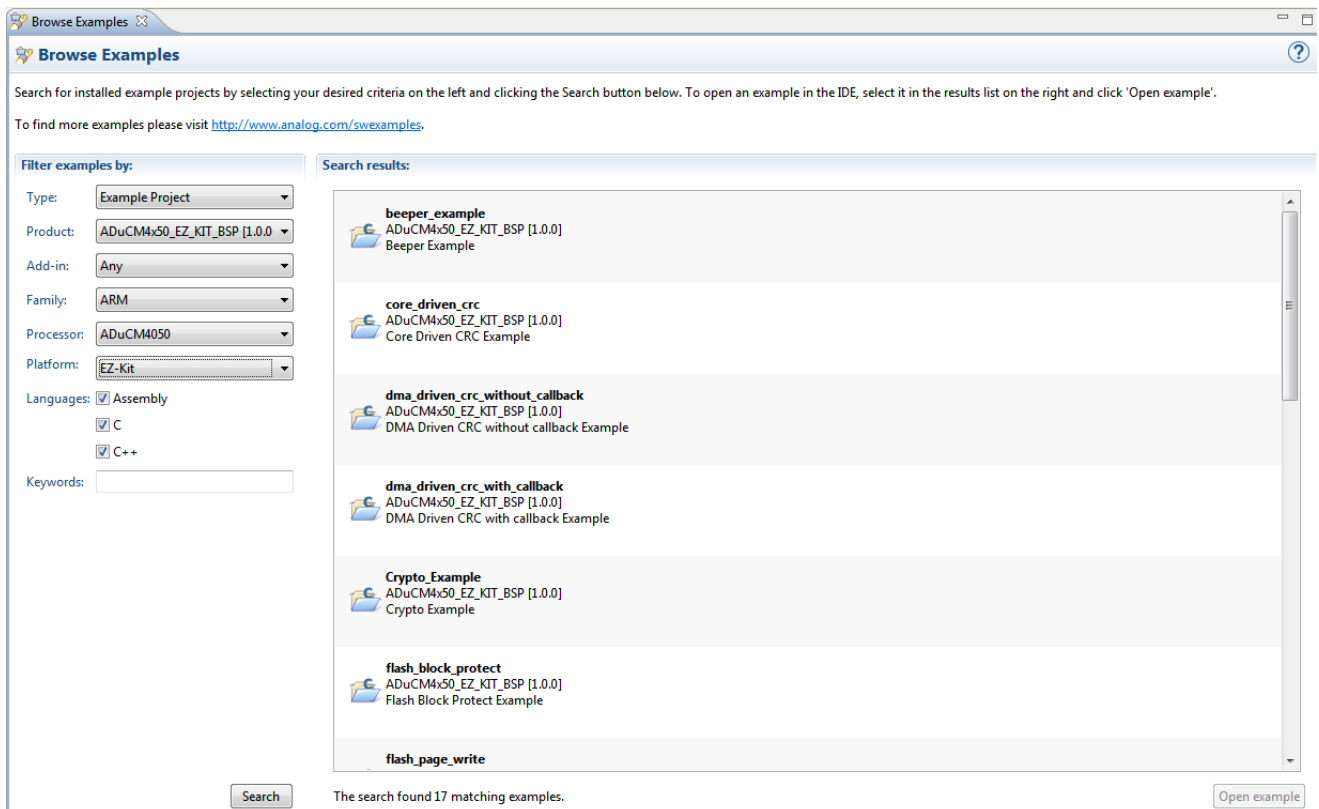


Figure 14. Example Filter options

Once the examples are filtered, click on the selected example and then on the **Open example** button (fig. 15); the example can be copied by double clicking on the example. When the example is copied to workspace it is automatically opened.

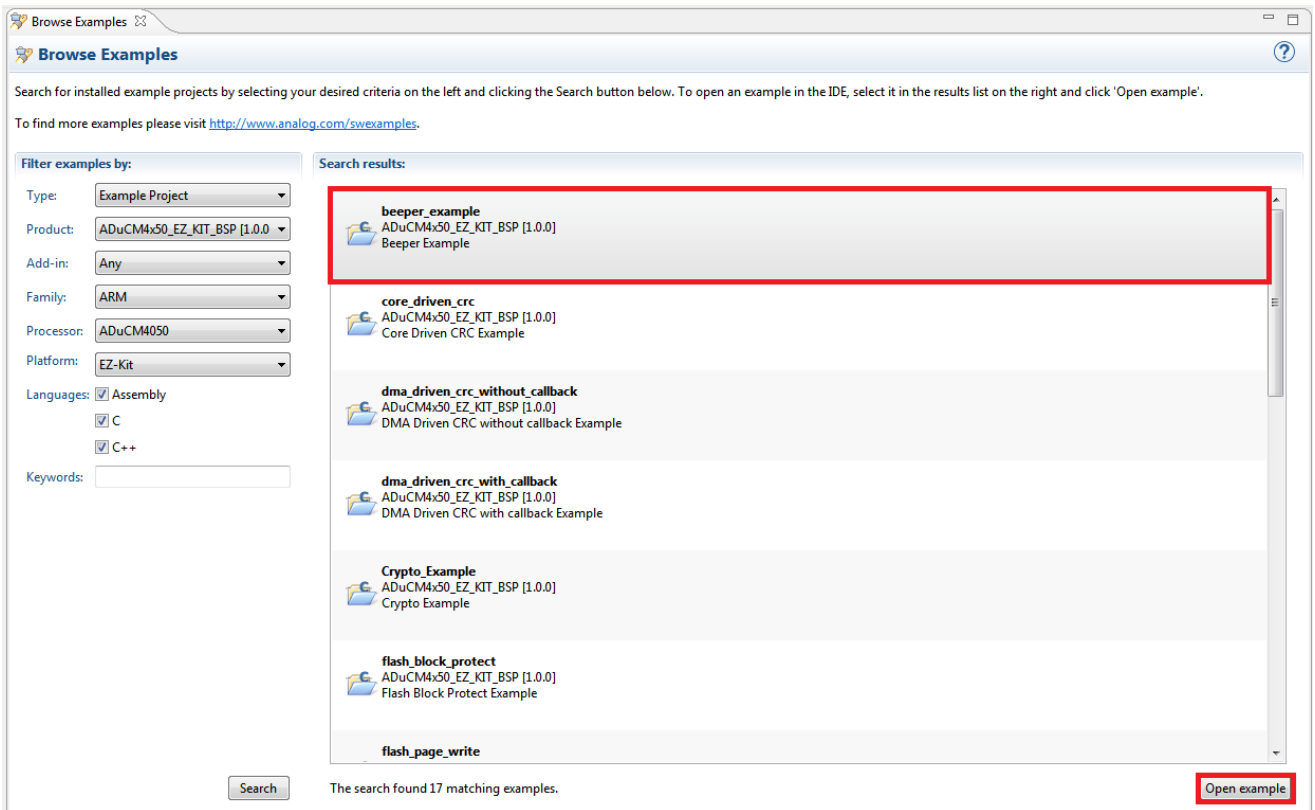


Figure 15. Open Example

6.2 Copying examples to workspace in Keil uVision

In Keil toolchain examples can be copied to workspace through the Pack Installer (fig. 16).

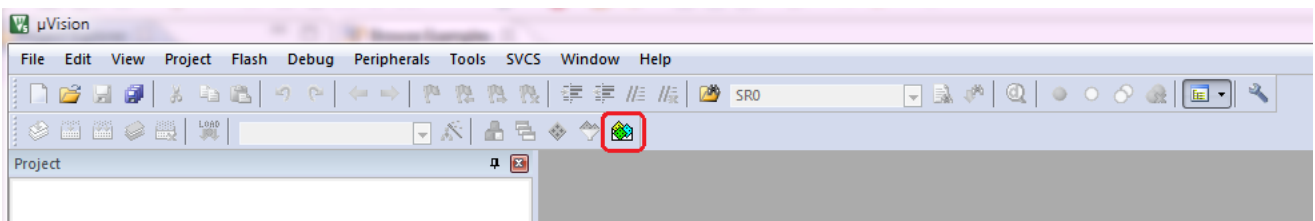


Figure 16. Pack Installer

In the Pack Installer dialog box select the **Boards** tab on the left hand side and choose the **ADuCM4050** device in the tree view (fig. 17). On the right hand side of the Pack Installer dialog box select the **Examples** tab. Once the **Examples** tab is chosen, all the available examples for the ADuCM4x50 are listed. Click on the **Copy** button to copy the example to workspace. This will open another dialog box asking for the location where to copy the example and two check boxes (fig. 18). Leave the check boxes ticked and click on **Ok** button. This will copy the example to the given folder and open the example in the newly launched Keil instance.

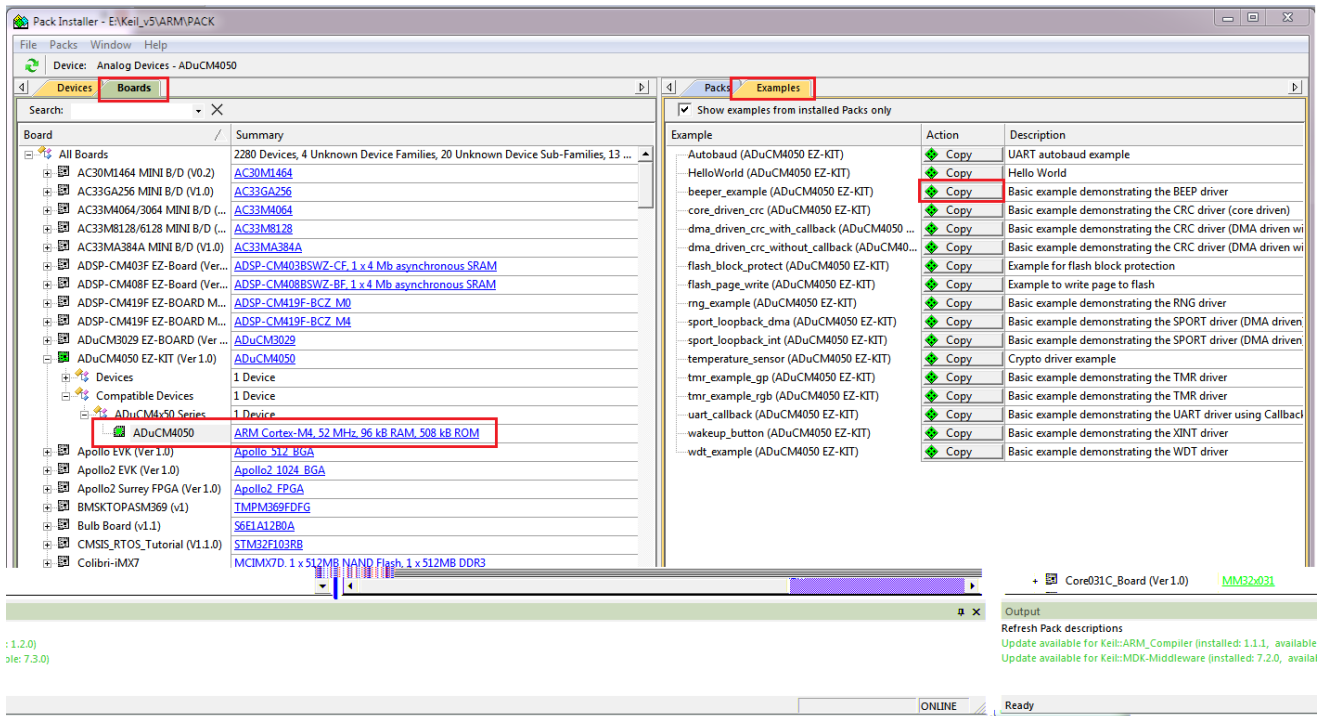


Figure 17. Open Example through Pack Installer

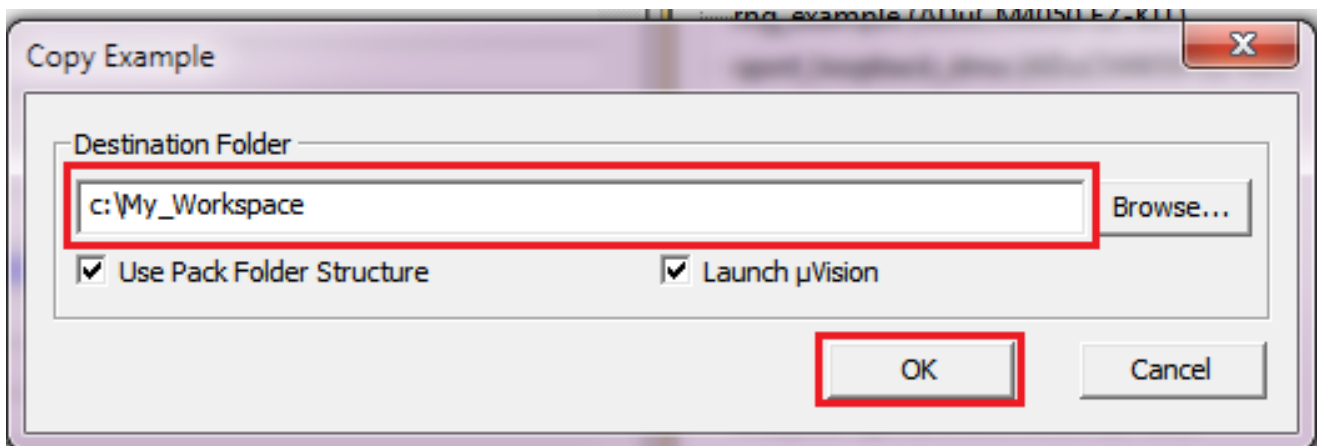


Figure 18. Copy Example

6.3 Copying examples to workspace in IAR Embedded Benchmark

To copy examples in your workspace with the IAR toolchain, select **Project Create New Project** menu item (fig. 19).

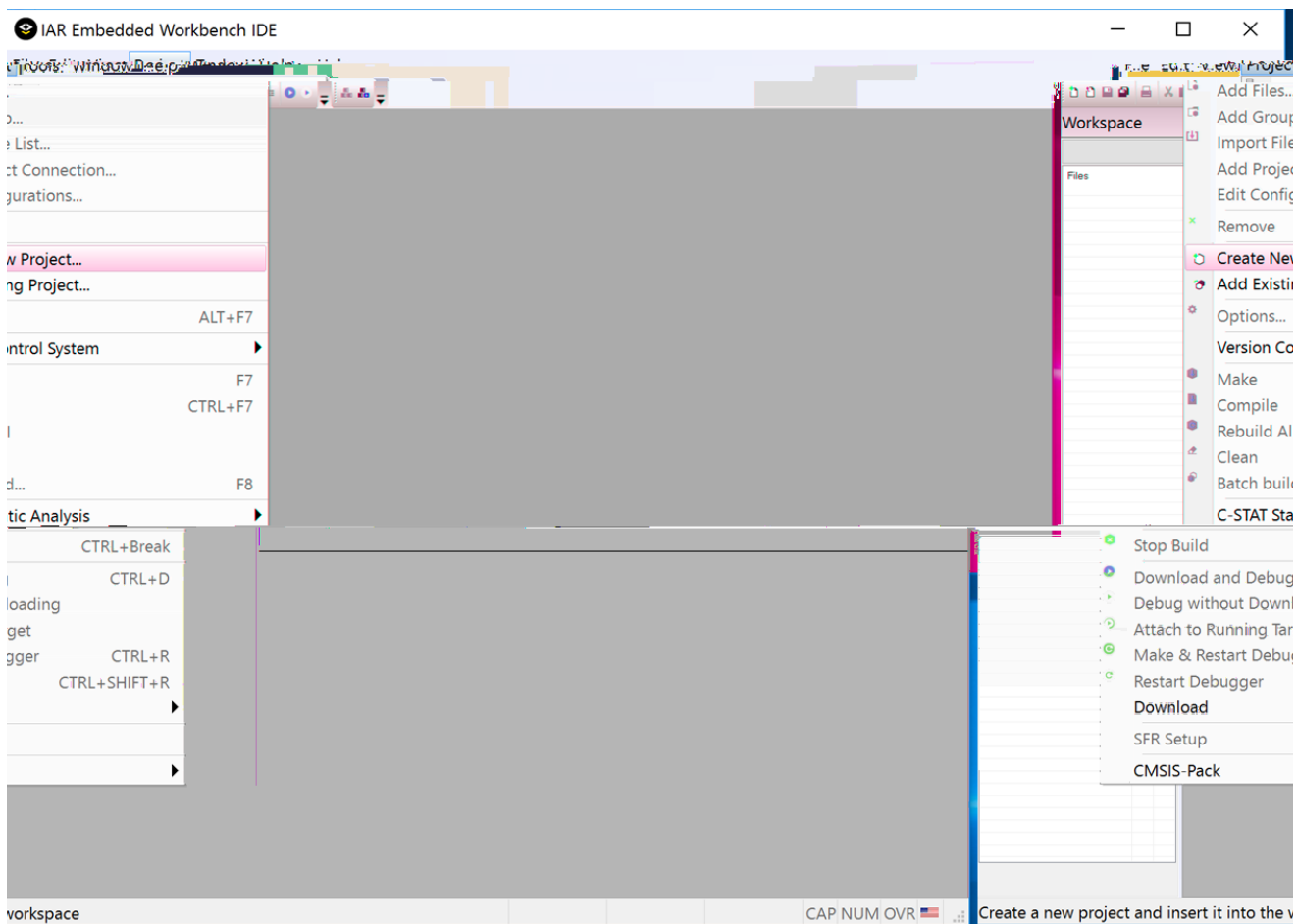


Figure 19. Create New Project with IAR

Next, select **CMSISPack example** and click on button **OK** (fig. 20).

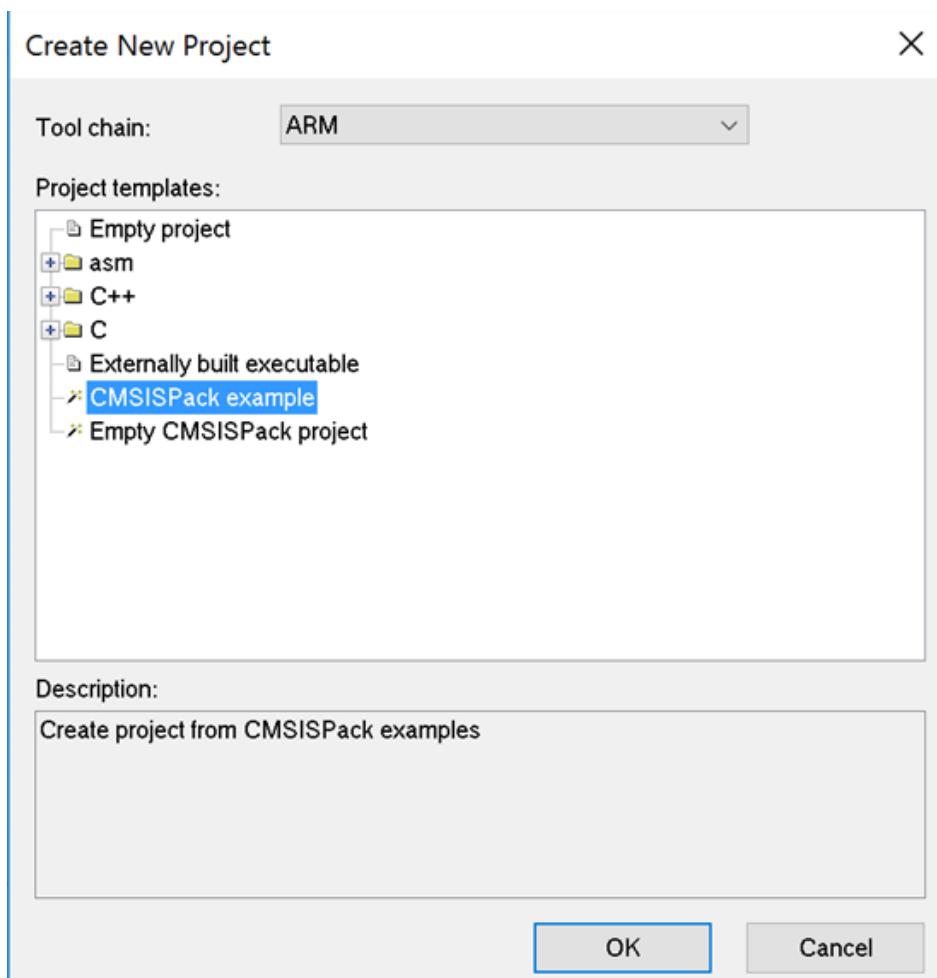


Figure 20. Copy Example with IAR

Select **Analog Devices ADuCM4x50 Series ADuCM4050**, and click **Next** (fig. 21).

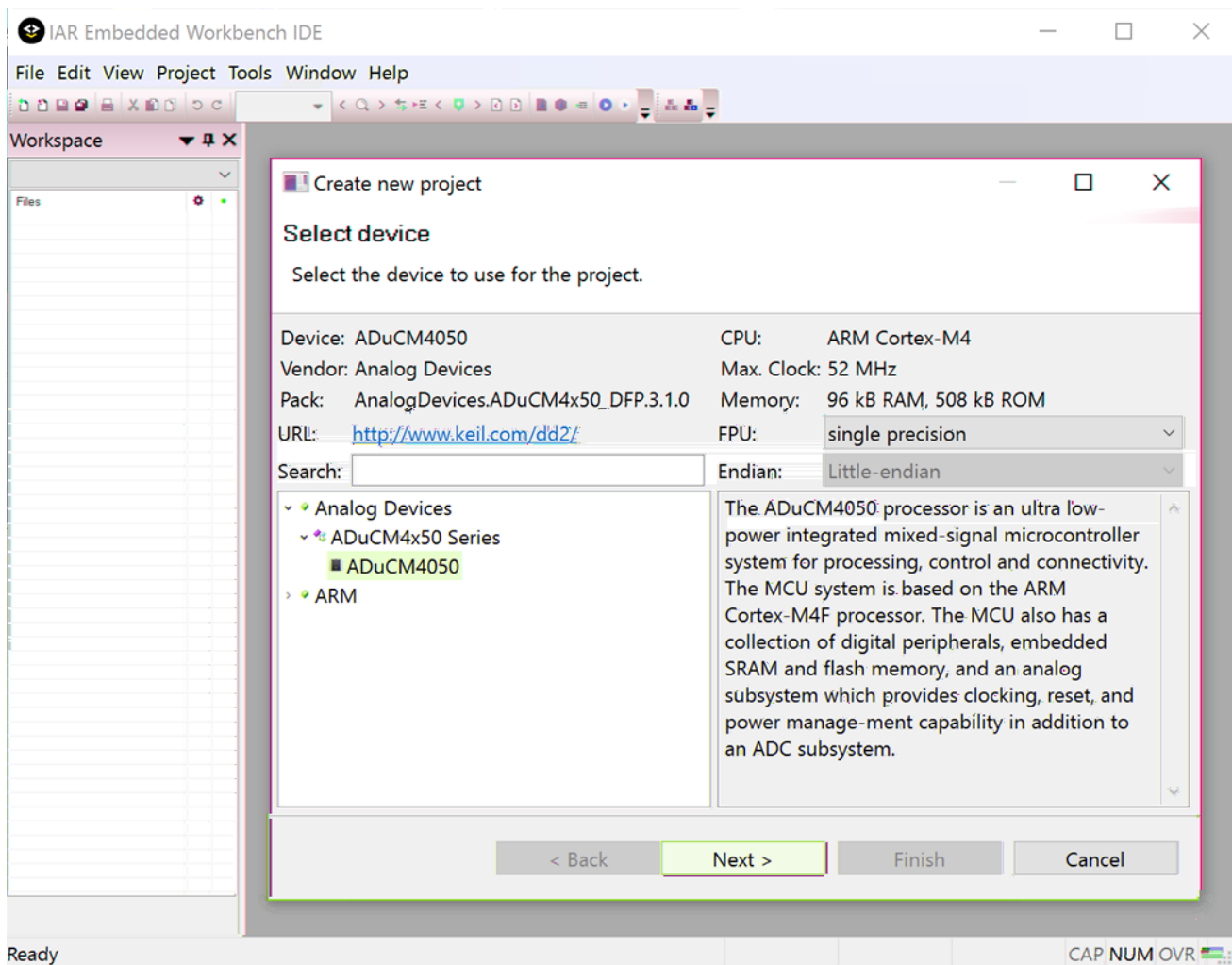


Figure 21. Select the device for the examples

A list of examples is displayed (fig. 22) : select the example to be used: its description can be read in the right part of the window. Click **Finish**,

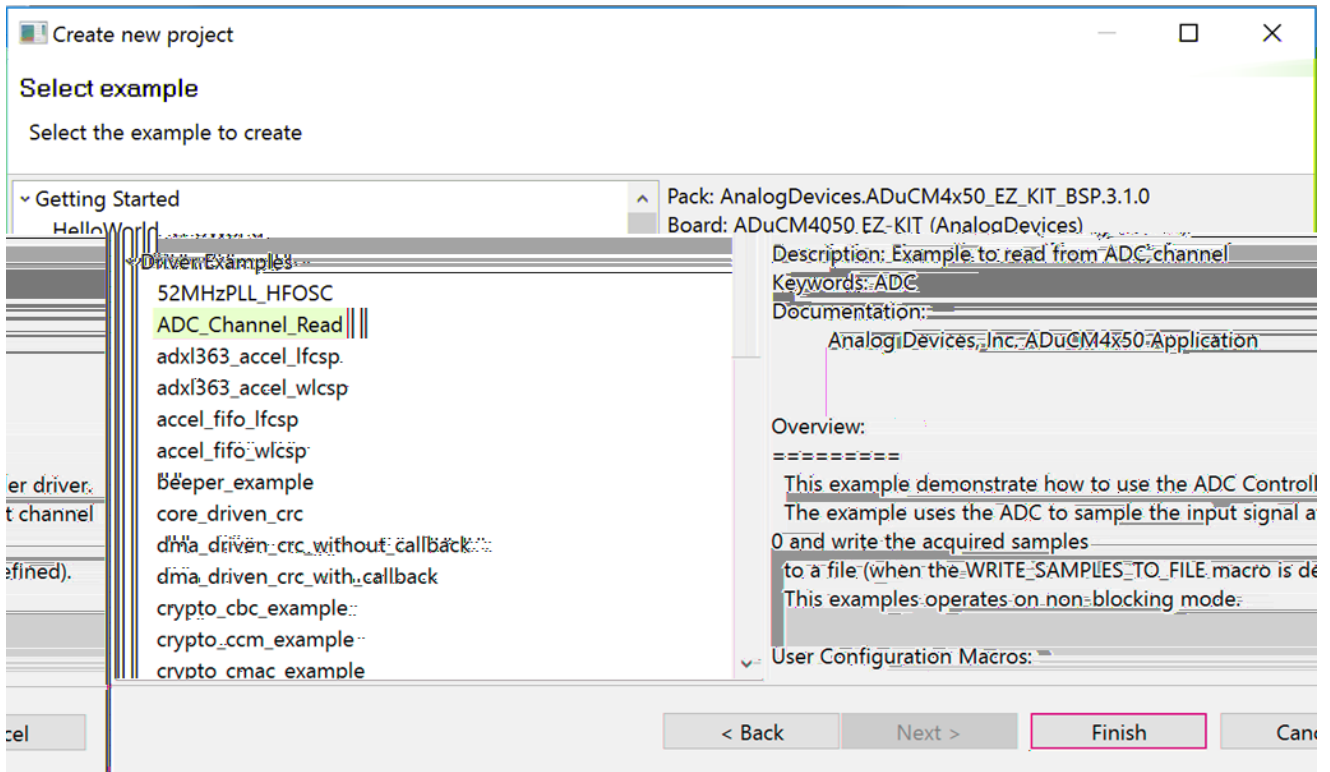


Figure 22. Select the example from the list of examples displayed

A window pops up to select the location where the example will be copied (fig. 23) : choose the destination and click **OK**.

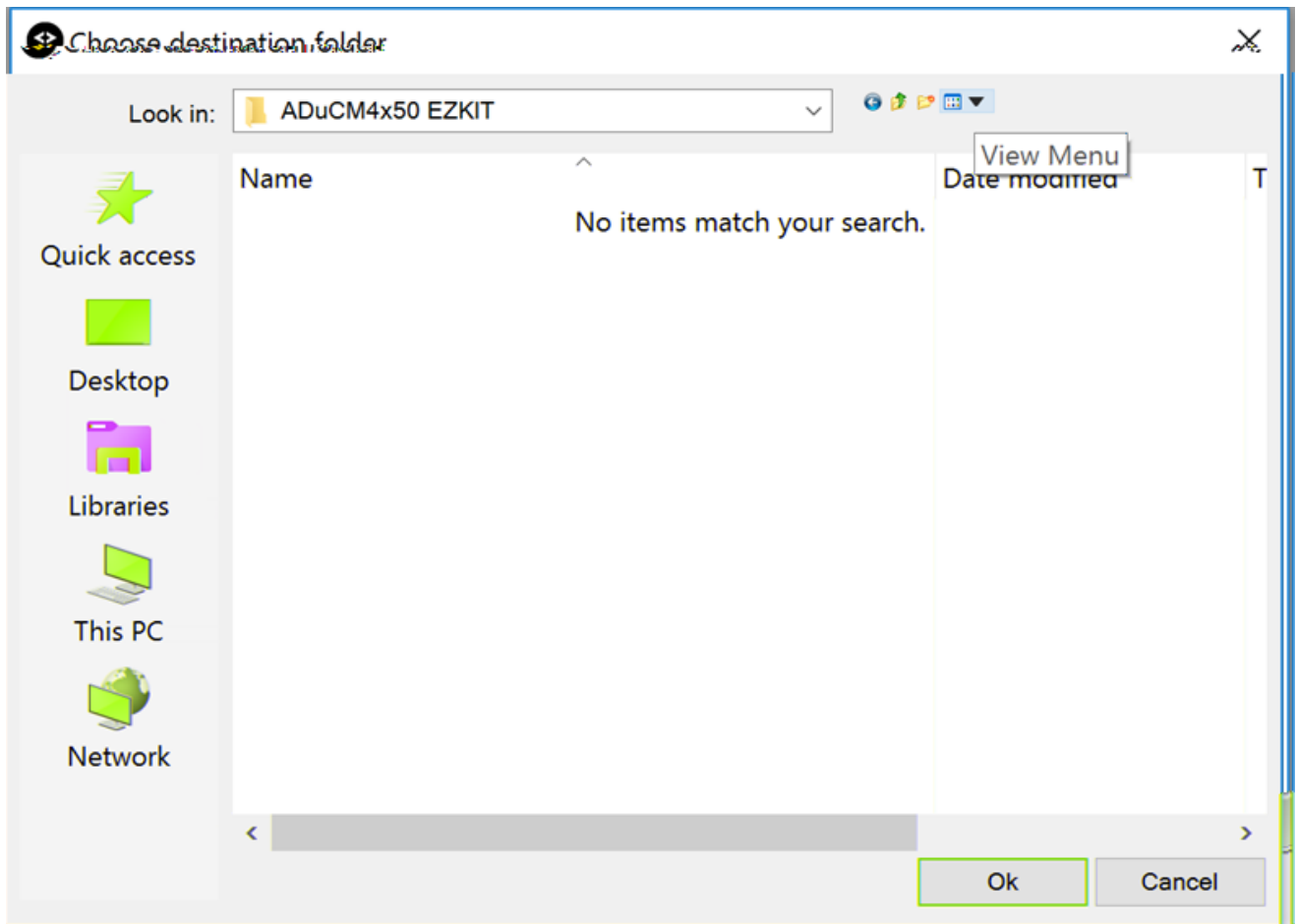


Figure 23. Select the destination folder

The example is copied in the chosen destination and loaded in IAR Embedded Workbench, ready to be built and executed (fig. 24).

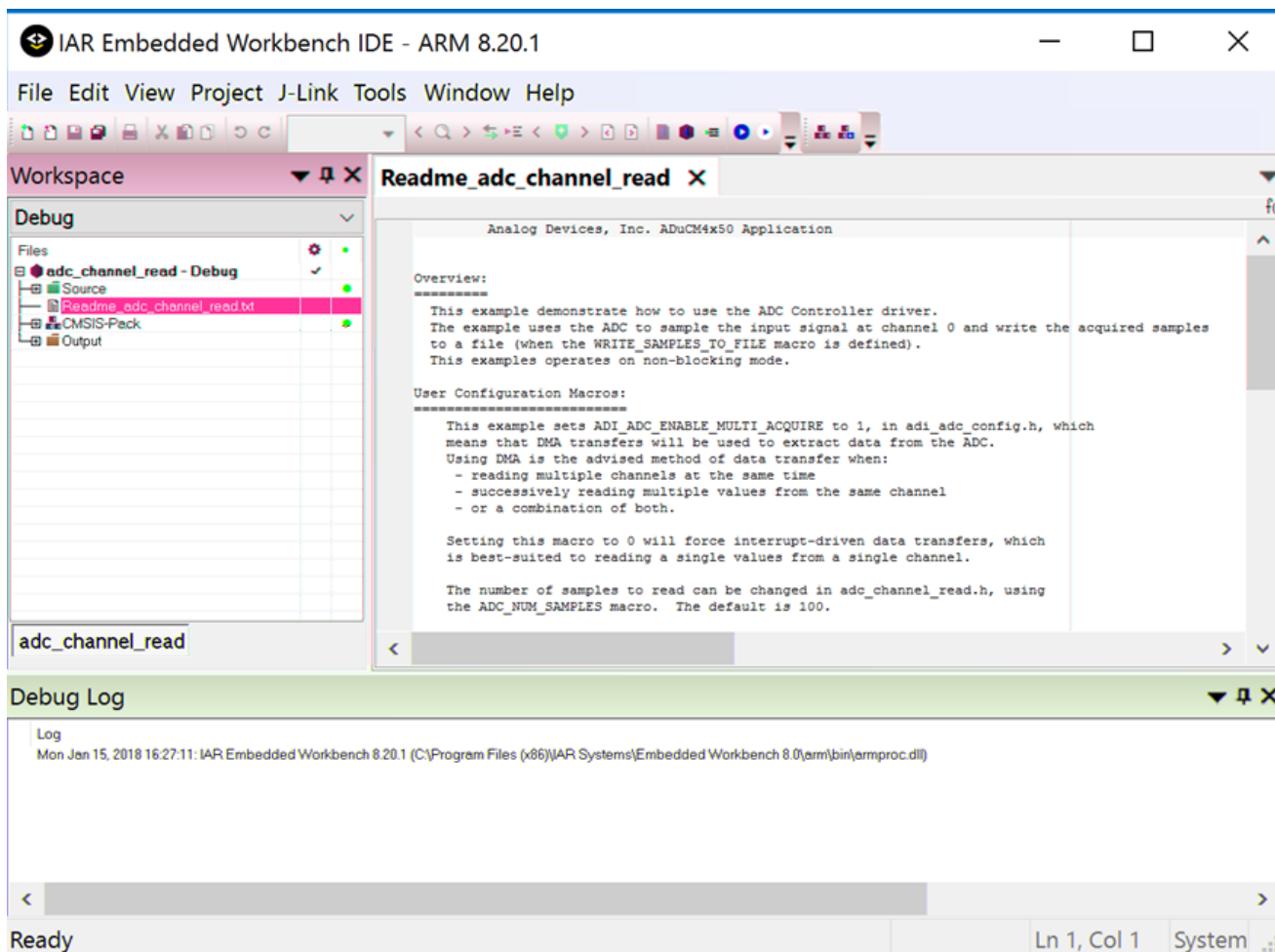


Figure 24. Example ready to be built and executed