Model-Based Design Toolbox i.MX RT 1xxx Series

Release Notes

Automatic Code Generation for the i.MX RT 1xxx Family of Processors
Version 1.1.0

Target Based Automatic Code Generation Tools
For MATLAB™/Simulink™/Stateflow™ Models working with Simulink Coder ™ and Embedded Coder®

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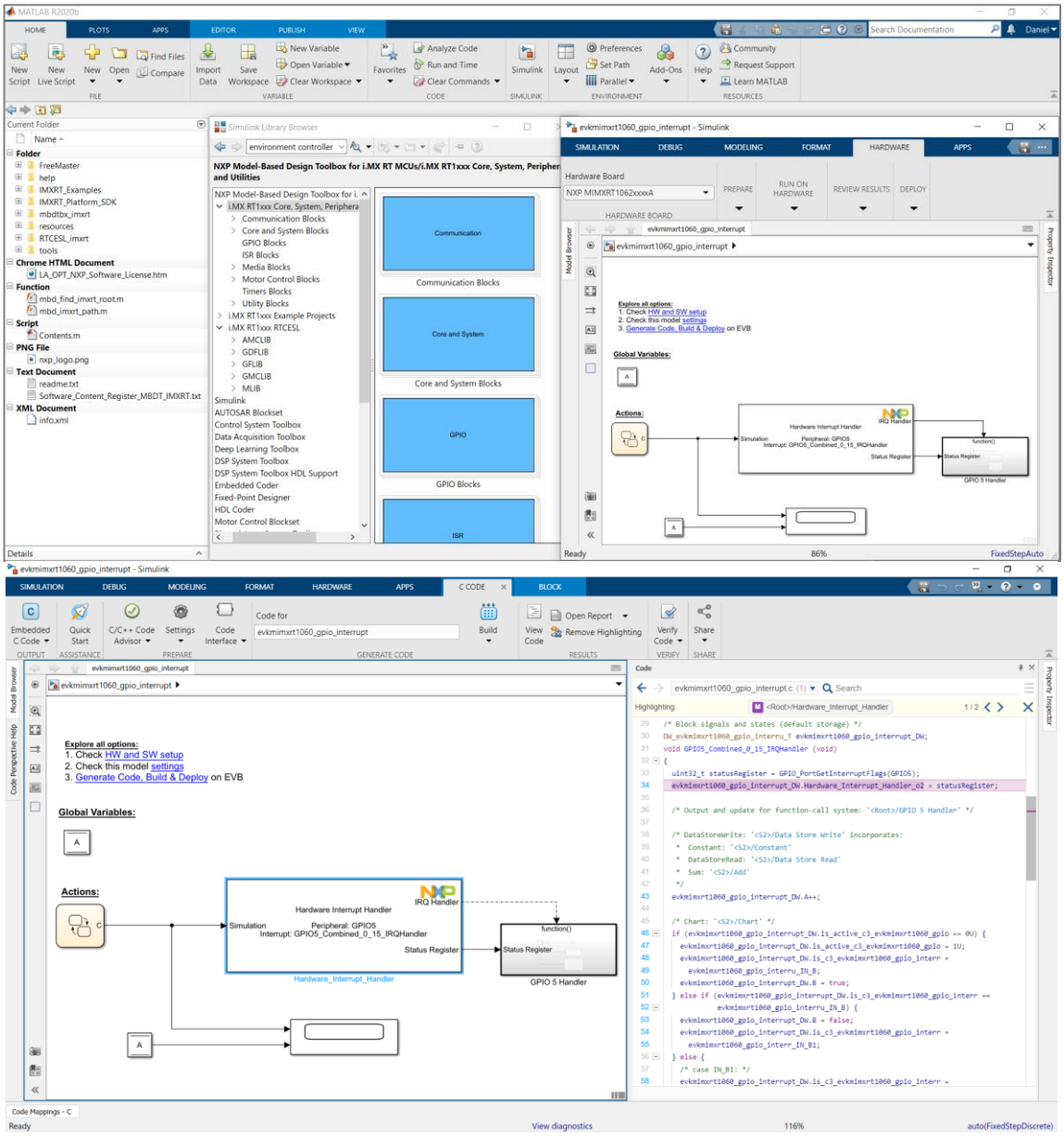
1 Main Features

The NXP's Model-Based Design Toolbox for i.MX RT 1xxx Series version 1.1.0 is designed to support all the i.MX RT 106x & 101x Crossover MCUs into MATLAB/Simulink environment, allowing users to:

- **Design** applications using Model-Based Design methodologies;
- **Simulate** and **Test** Simulink models for i.MX MCU before deploying the modes to the hardware targets;
- **Configure** the MCU peripherals from Simulink Block via MCUXpresso Configuration Tools
- **Generate** the application code automatically without any needs for hand coding C/ASM
- **Deployment** of the application directly from MATLAB/Simulink to the NXP evaluation boards



The main features and functionalities supported in this release of the toolbox are:

- Support for the **i.MX RT 1061**, **i.MX RT 1062** and **i.MX RT 1064** MCUs and their correspondent Evaluation Boards **EVK-MIMXRT1060** and **EVK-MIMXRT1060**;
- Support for the i.MX RT 1011 and the correspondent Evaluation Boards EVK-MIMXRT1010;
- Integrates the latest **MCUXpresso i.MX RT 106x/101x SDK version 2.8.2**. NXP's Model-Based Design Toolbox generates codes based on standard SDK API, covering most of the functionalities exposed by SDK;
- Compatible with **Configuration Tools 8.1** and **GCC 9.2.1**;
- Compatible with MATLAB releases **R2019a/b** and **R2020a/b**;
- Fully integrated with **Simulink Toolchain**;
- Includes extensive **Simulink Library Blocks** for i.MX RT 1xxx devices, providing multiple dedicated NXP blocks to configure most of the MCU peripherals.
- Includes an **Example library with more than 100 examples** that cover a wide range of topics like:
    - I/O control: GPIO
    - Timers: Programmable (PIT), General Purpose (GPT), Quad Timers (QT
    - Motor Control: Pulse Width Modulation (PWM), Analogue Converter (ADC, ATC-ETC), Sensors (ENC)
    - Communication: CAN/CAN-FD, SPI, I2C, UART, FlexIO, Ethernet
    - Core & Systems: DMA, WatchDog
    - Software-in-the-Loop, Processor-in-the-Loop, and External Mode
    - Flash Programming over UART and JTAG
    - CAMERA, PXP, LCD, and SAI support for multimedia application

For more details about each of the topics highlighted above please refer to the following chapters.

2 i.MX RT MCU Support

2.1 Packages & Derivatives

The NXP's Model-Based Design Toolbox for i.MX RT 1xxx Series version 1.1.0 supports:

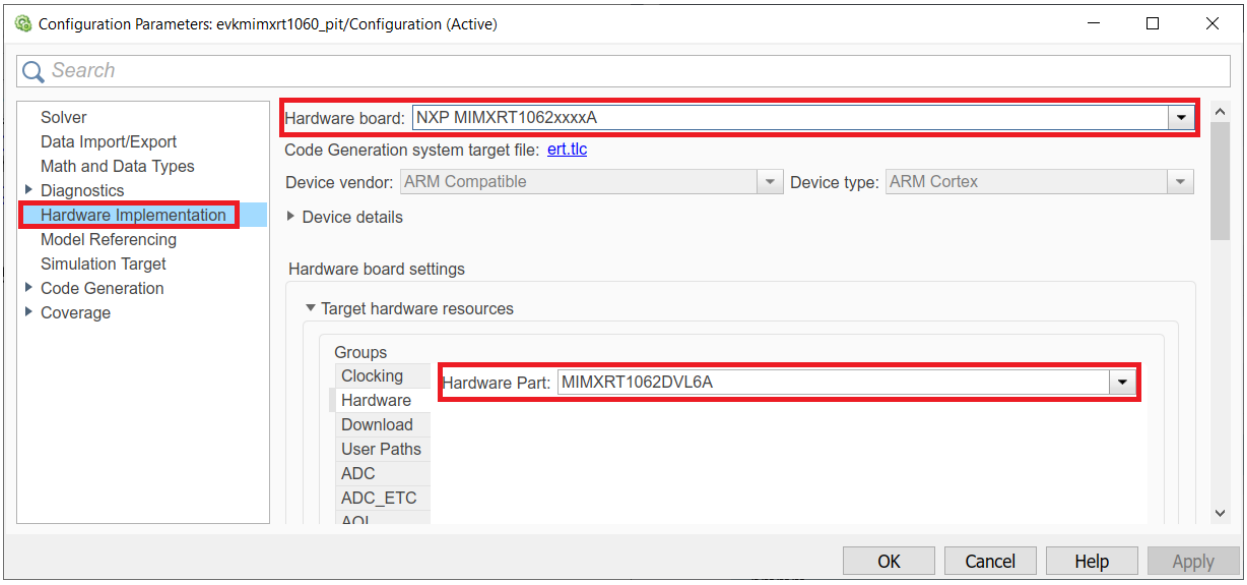
- i.MX RT 1061 MCU Packages:
  - MIMXRT1061CVJ5A
  - MIMXRT1061CVL5A
  - MIMXRT1061DVJ6A
  - MIMXRT1061DVL6A

- i.MX RT 1062 MCU Packages:
  - MIMXRT1062CVJ5A
  - MIMXRT1062CVL5A
  - MIMXRT1062DVJ6A
  - MIMXRT1062DVL6A

- i.MX RT 1064 MCU Packages:
  - MIMXRT1064CVJ5A
  - MIMXRT1064CVL5A
  - MIMXRT1064DVJ6A
  - MIMXRT1064DVL6A

- i.MX RT 1011 MCU Packages:
  - MIMXRT1011CAE4A
  - MIMXRT1011DAE5A

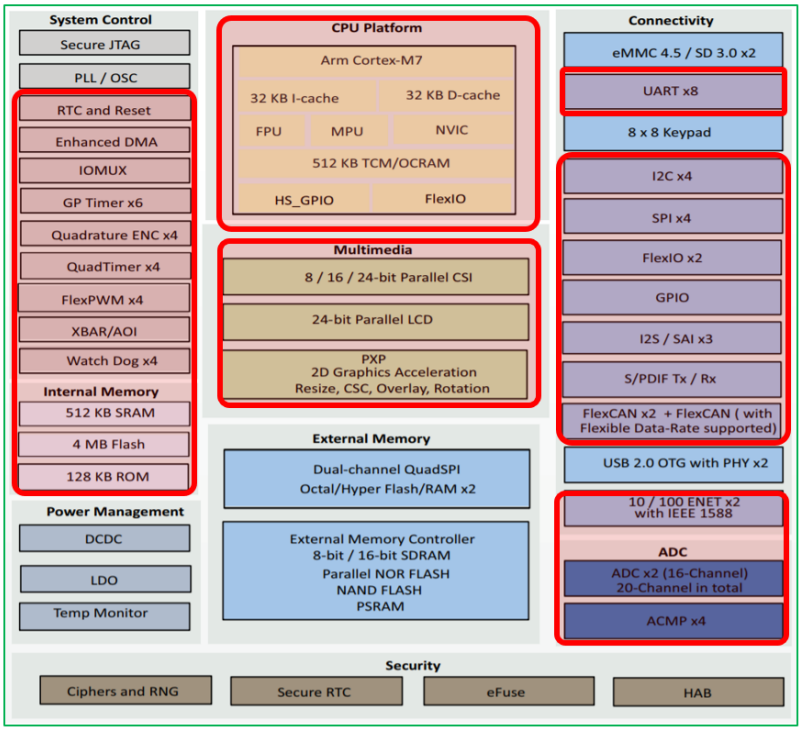
The configurations can be easily changed for each Simulink model from the **Model Configuration Parameters** menu:



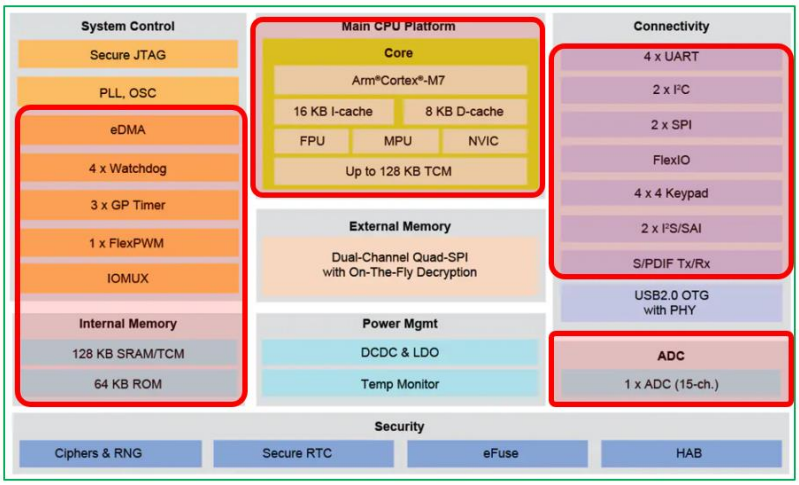
2.2 Peripherals & Devices

The NXP's Model-Based Design Toolbox for i.MX RT 1xxx Series version 1.1.0 supports the following peripherals and devices that are highlighted in red:

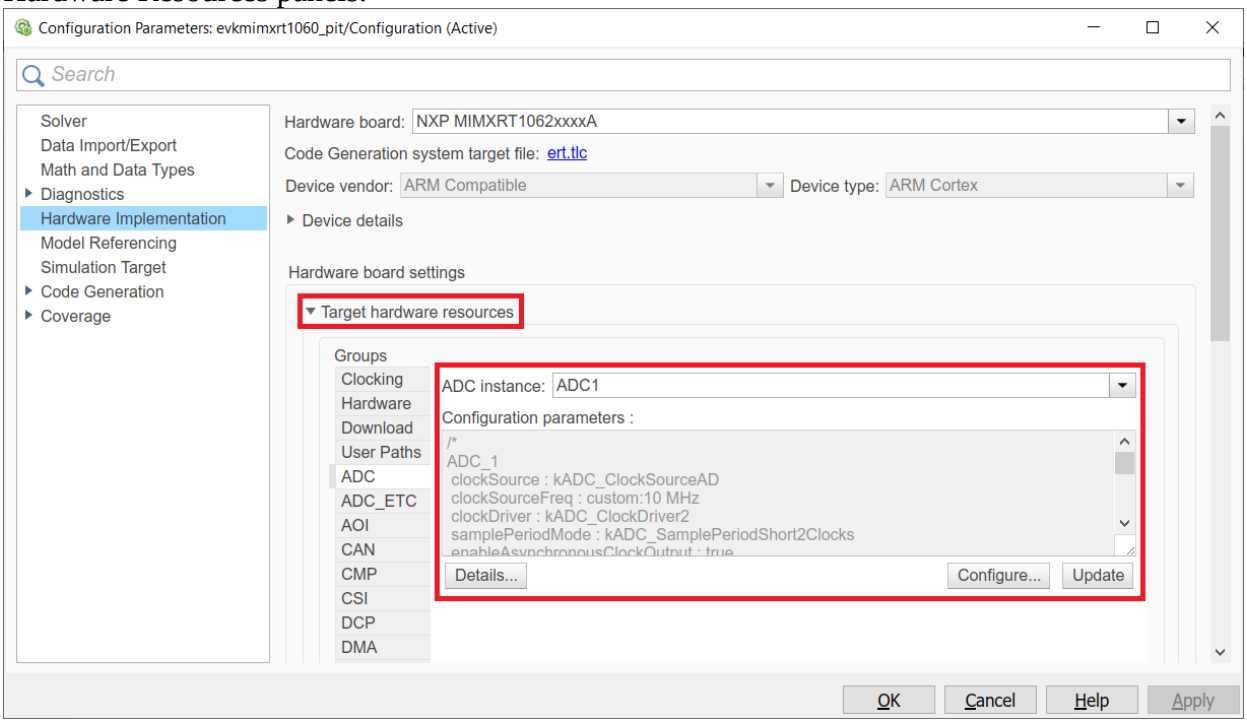
i.MX RT 106x derivatives



i.MX RT 101x derivatives

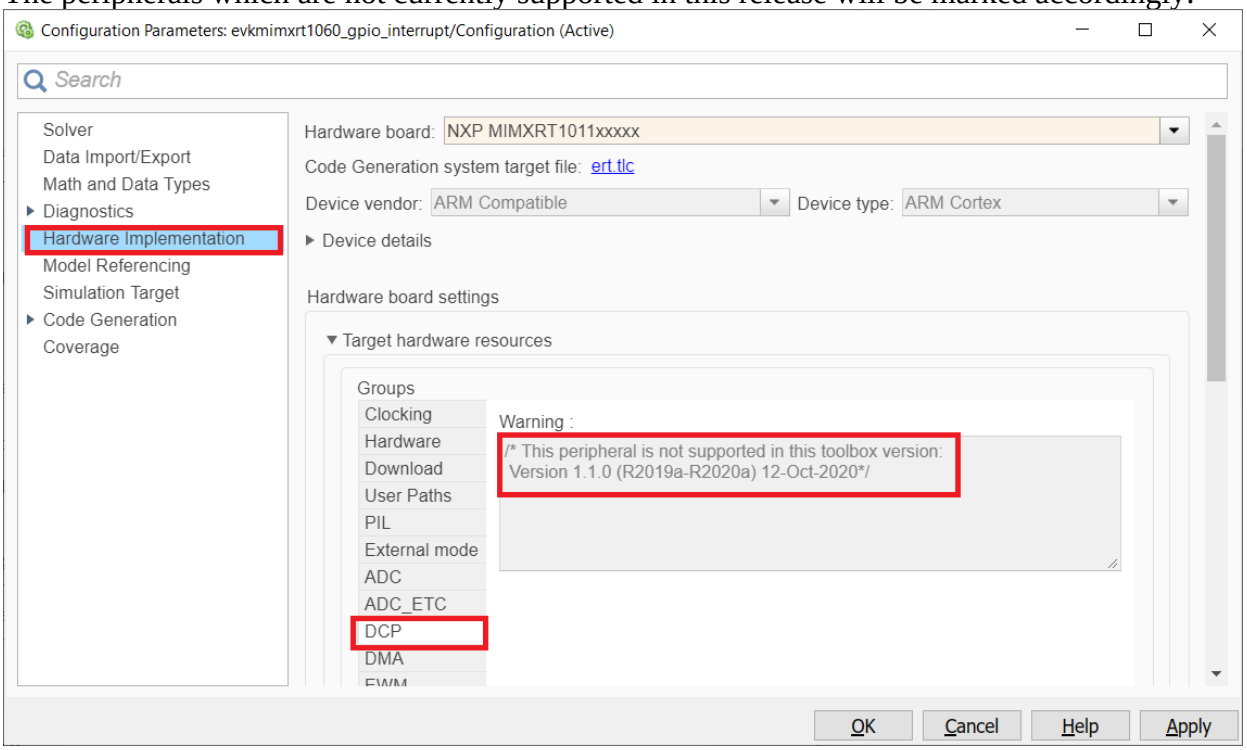


The default configuration supported by the toolbox for each peripheral is available Target Hardware Resources panels.



From this panel, the user can access the PDF document using the **Details**… button or update the model configuration using the **Configure…** button to open the MCUXpresso Configuration Tools

The peripherals which are not currently supported in this release will be marked accordingly:



The NXP's Model-Based Design Toolbox for i.MX RT 1xxx Series version 1.1.0 has been tested using the official NXP Evaluation Boards for i.MX RT 106x/101x:

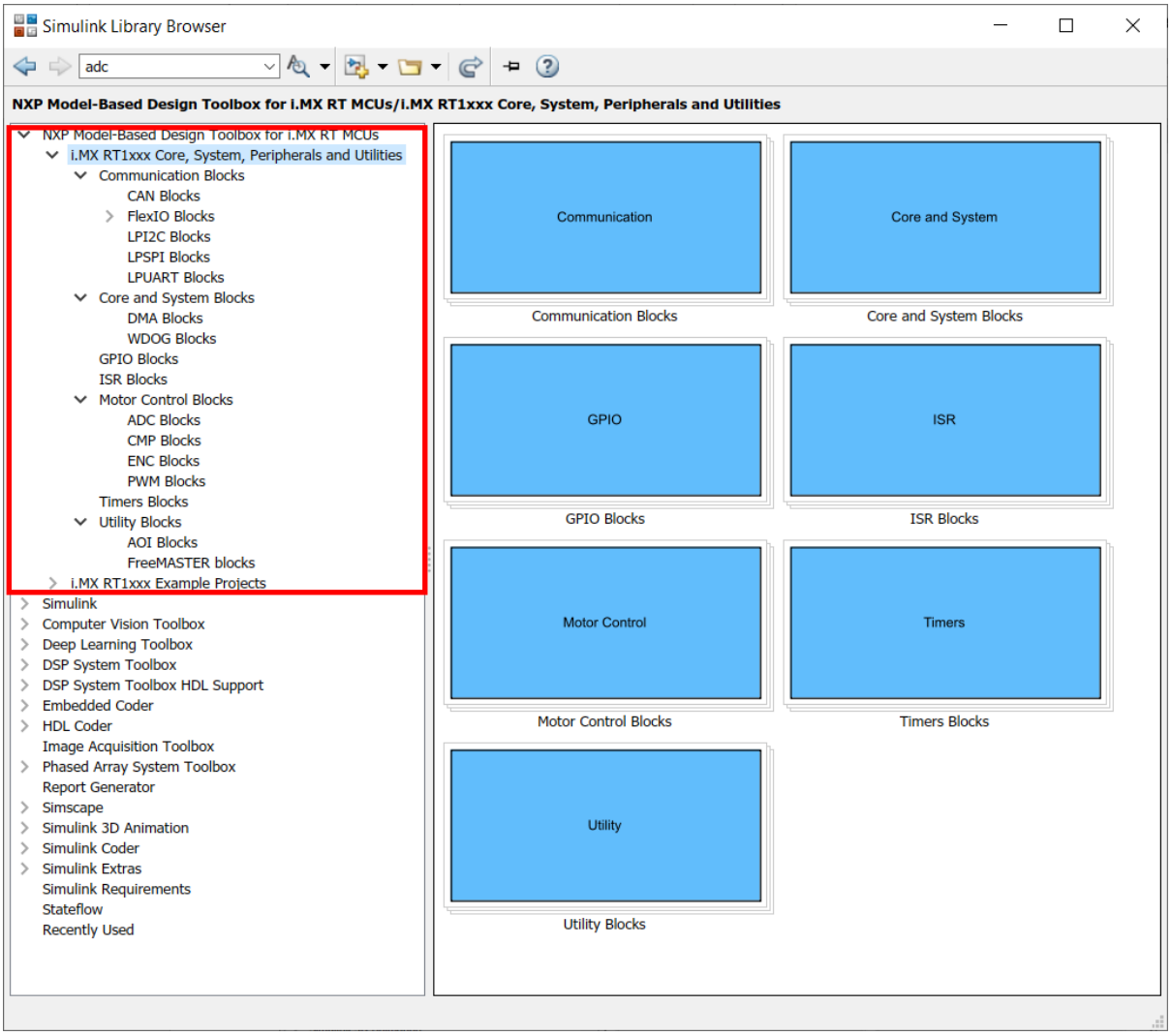
- EVK-MIMXRT1060
- EVK-MIMXRT1064
- EVK-MIMXRT1010

3 Model-Based Design Toolbox Features

The NXP's Model-Based Design Toolbox for i.MX RT 1xxx Series version 1.1.0 is delivered with complete i.MX RT1xxx MCUs Simulink Block Library as shown below.

There are two main categories:

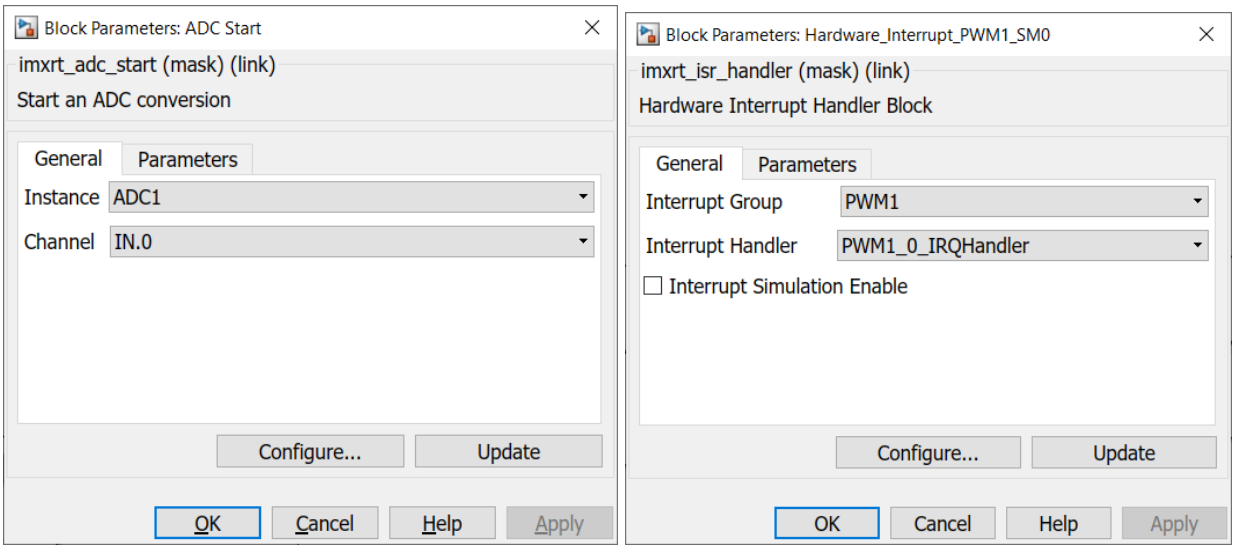
- **Core and System, Peripherals and Utilities** which contains all blocks related to MCU configuration
- **S32K1xx Example Projects** which contains all the examples that exercise all the other blocks



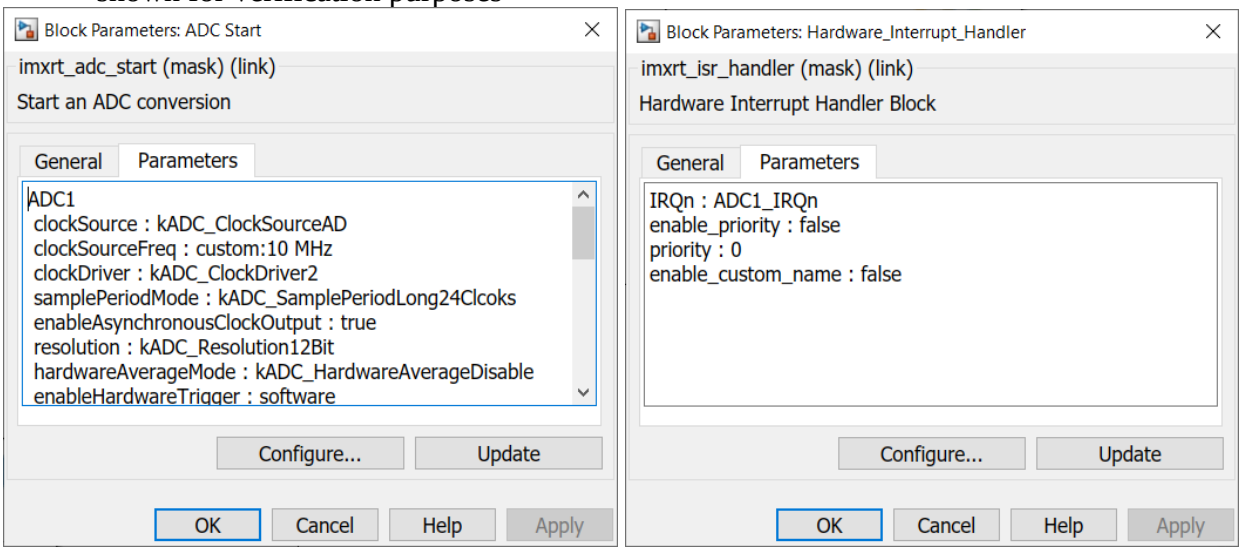
3.1 i.MX RT 1xxx Simulink Library Blocks

All Simulink blocks supported by the NXP Toolbox are designed to offer the best experience out-of-the-box by providing a basic peripheral configuration that covers most of the hardware capabilities. Most of the Simulink Blocks contains just two tabs:

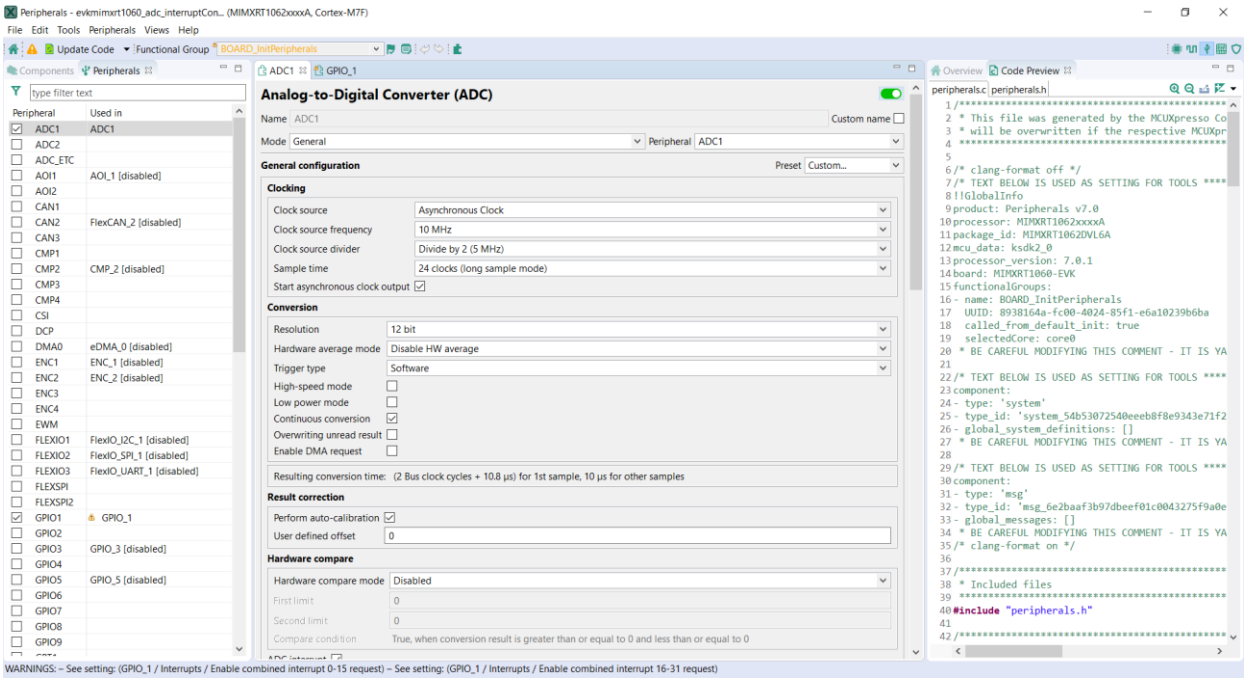
1. **General** Tab allows various selections that are defined in the default configuration. This represents the BASIC operation mode, where the user just picks up only what has been enabled as “default toolbox” configuration



2. **Parameters** Tab which contains the detailed configuration available. This information is shown for verification purposes



From any of these blocks by clicking on the **Configure…** button, the users can open the Configuration Tools to alter the default configuration used by the Simulink model.

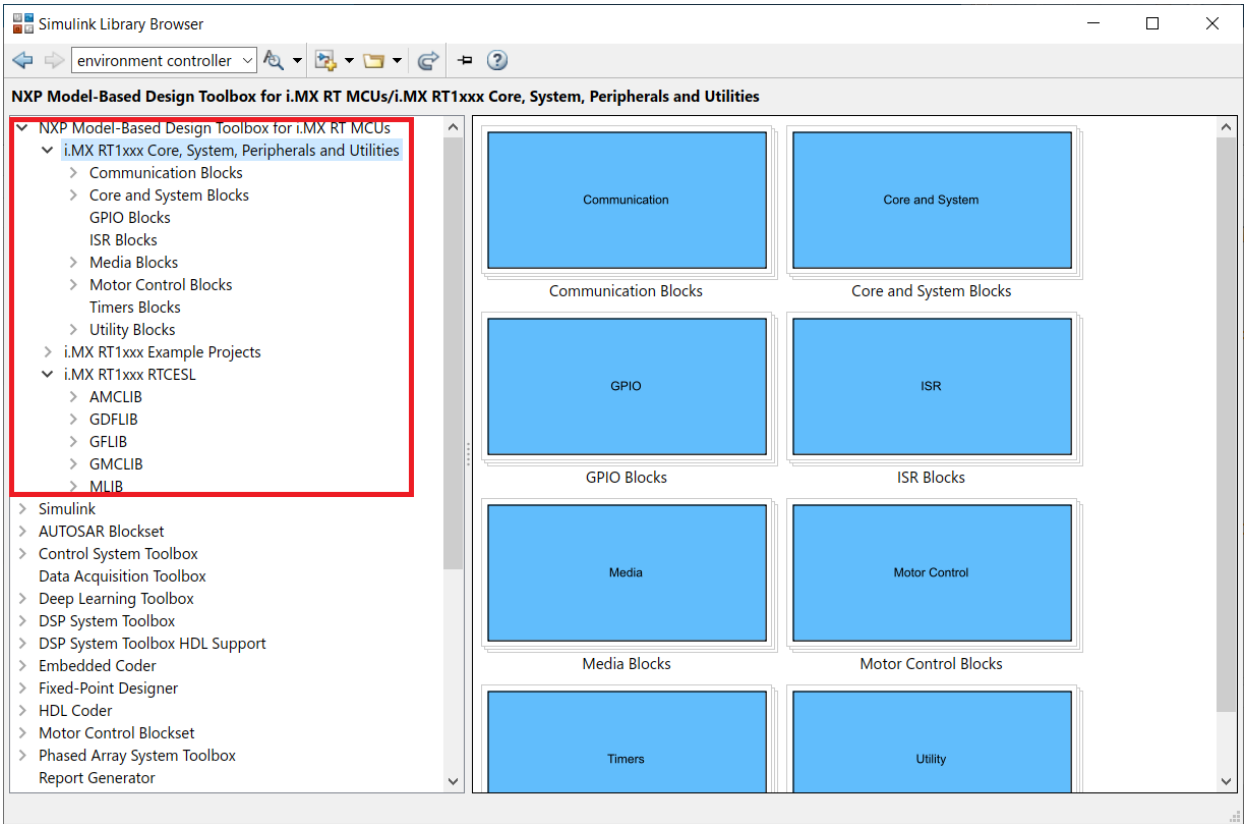


Using MCUXpresso Configuration Tools, the users can perform ADVANCED configurations and then use these new options into Simulink models. The validation of the configuration and peripheral code generation is done outside of Simulink.

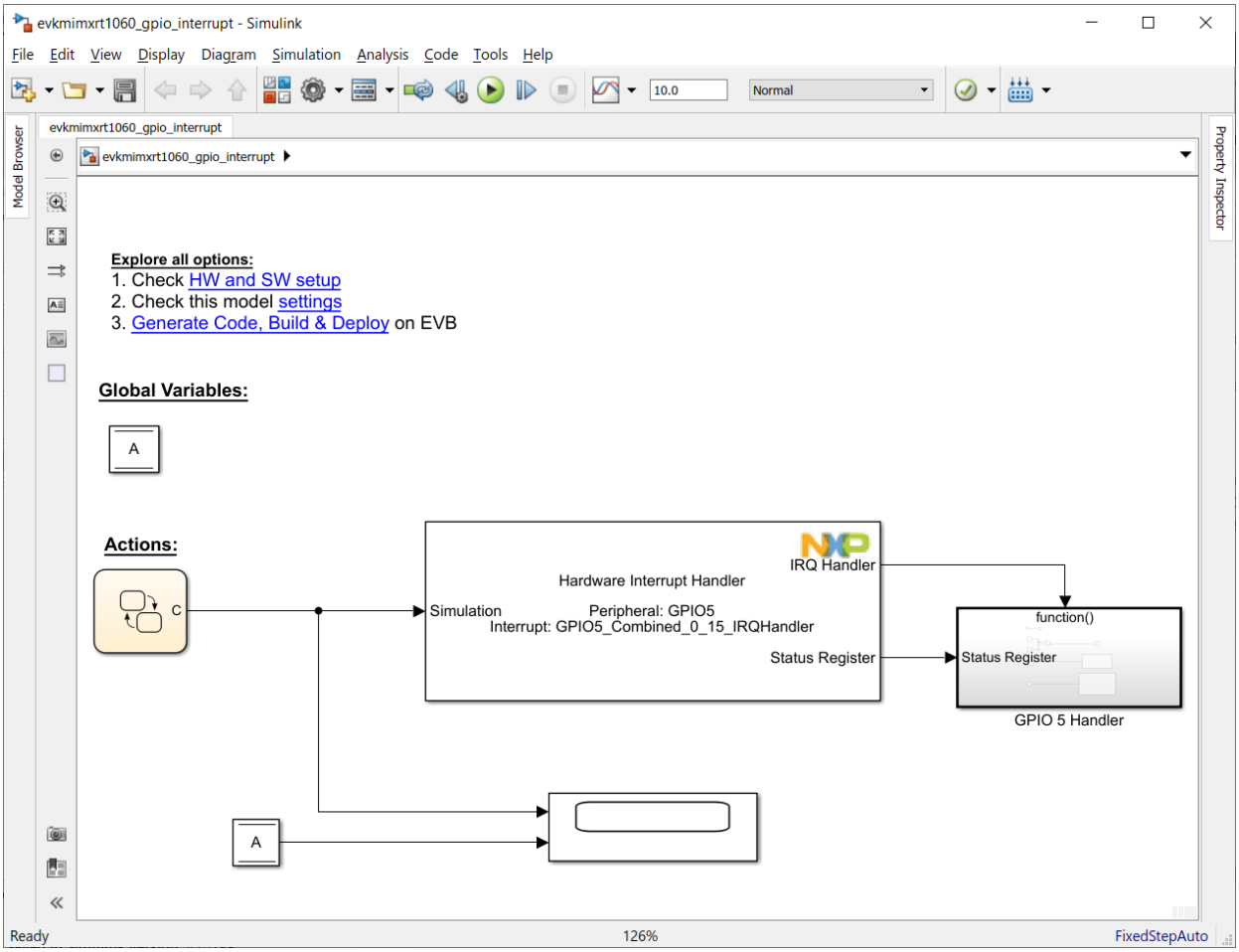
3.2 i.MX RT 1xxx Example Library

The Examples Library represents a collection of Simulink models that let you test different MCU on-chip modules and run complex applications.

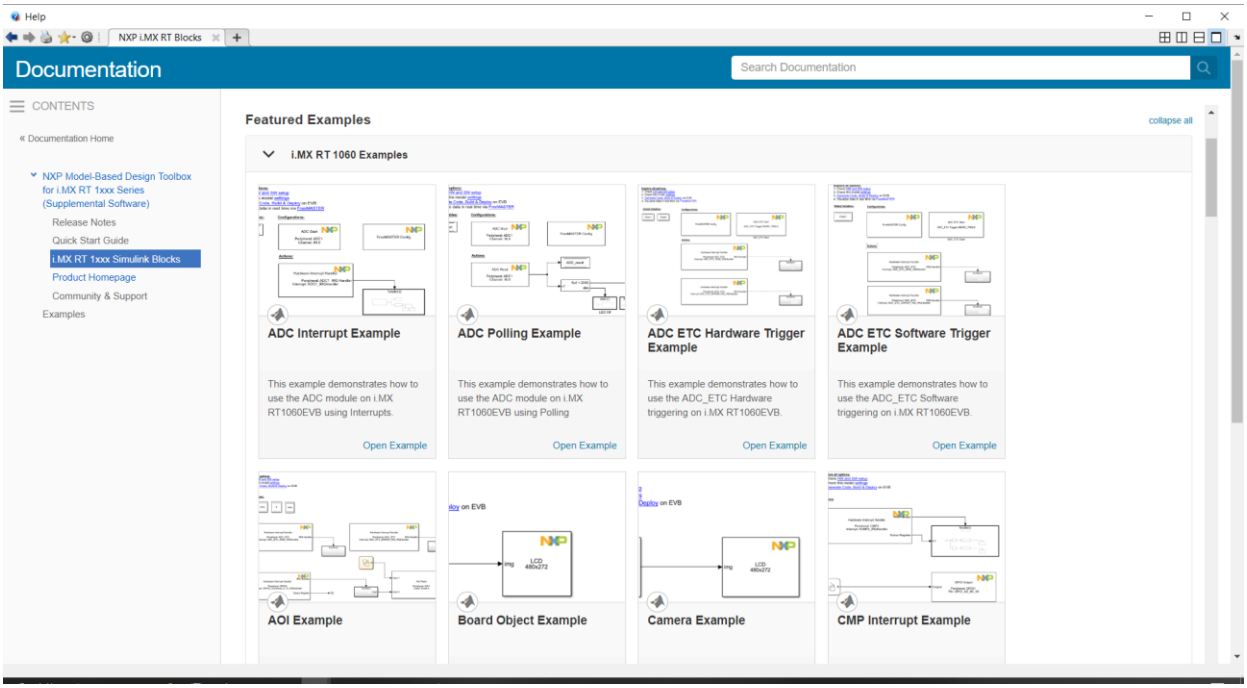
The examples are grouped in different layers that mimic a typical development flow: starting with basic building blocks that expose the MCU HW functionalities up to more complex applications that incorporate multiple building blocks.



The Simulink models shown as examples are enhanced with a comprehensive description to help users understand better the functionality that is exercised, hardware setup instructions whenever are necessary, and a result validation section.


evkmimxrt1060_gpio_interrupt - Simulink
File Edit View Display Diagram Simulation Analysis Code Tools Help
10.0
Normal
Model Browser
Property Inspector
evkmimxrt1060_gpio_interrupt
Explore all options:
1. Check HW and SW setup
2. Check this model settings
3. Generate Code, Build & Deploy on EVB
Global Variables:
A
Actions:
C
Hardware Interrupt Handler
IRQ Handler
Simulation
Peripheral: GPIO5
Interrupt: GPIO5_Combined_0_15_IRQHandler
Status Register
function()
Status Register
GPIO 5 Handler
A
Ready
126%
FixedStepAuto

The examples are available from the MATLAB help page too:



4 Prerequisites

4.1 MATLAB Releases and OSes Supported

This toolbox is developed and tested to supports the following MATLAB releases:

- R2019a;
- R2019b;
- R2020a;
- R2020b;

For a flowless development experience the minimum recommended PC platform is:

- *Windows® OS*: any x64 processor
- At least 4 GB of RAM
- At least 6 GB of free disk space.
- Internet connectivity for web downloads.

Operating System Supported

	SP Level	64-bit
Windows 7	SP1	X
Windows 10		X

4.2 Build Toolchain Support

The following compilers are supported:

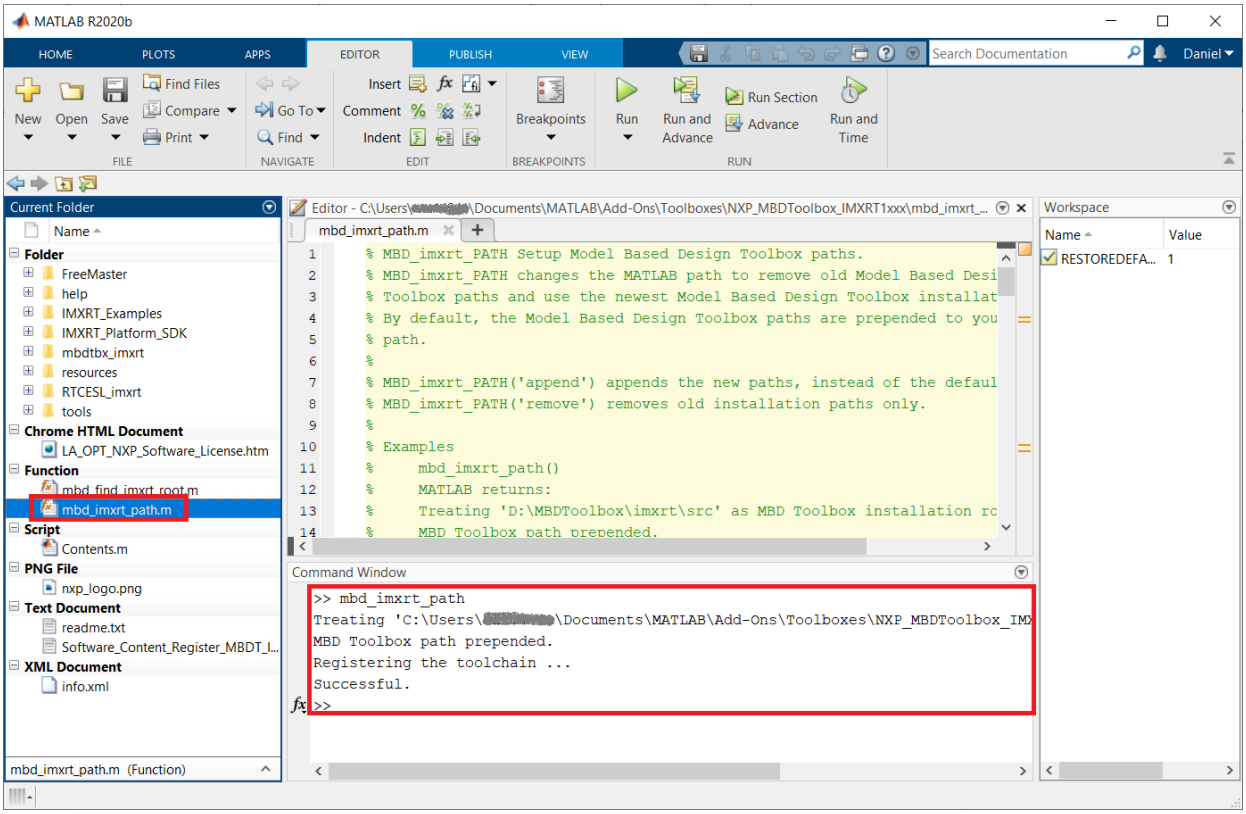
Compiler Supported	Release Version
GCC for ARM Embedded Processors	V9.2.1

The target compiler for the Model-Based Design Toolbox needs to be configured.

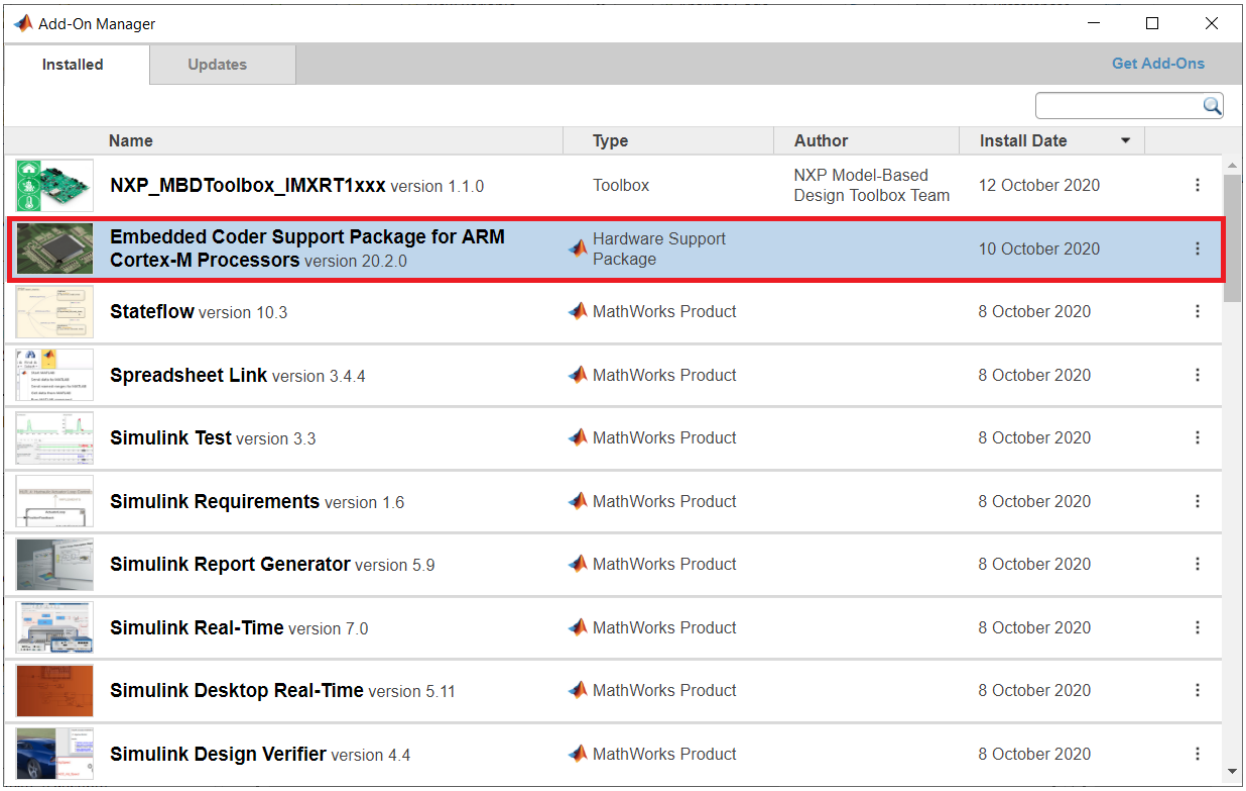
The Model-Based Design Toolbox uses the Toolchain mechanism exposed by the Simulink to enable automatic code generation with the Embedded Coder toolbox. By default, the toolchain is configured for the MATLAB 2019a release. For any other MATLAB release, the user needs to execute a toolbox m-script to generate the appropriate settings for his/her installation environment.

This is done by changing the MATLAB Current Directory to the toolbox installation directory (e.g.: `..\MATLAB\Add-Ons\Toolboxes\NXP_MBDToolbox_IMXRT1xxx\`) and running the "`mbd_imxrt_path.m`" script.

```
>> mbd_imxrt_path
Treating …\MATLAB\Add-Ons\Toolboxes\NXP_MBDToolbox_IMXRT1xxx' as MBD
Toolbox installation root.
MBD Toolbox path prepended.
Registering the toolchain ...
Successful.
>>
```

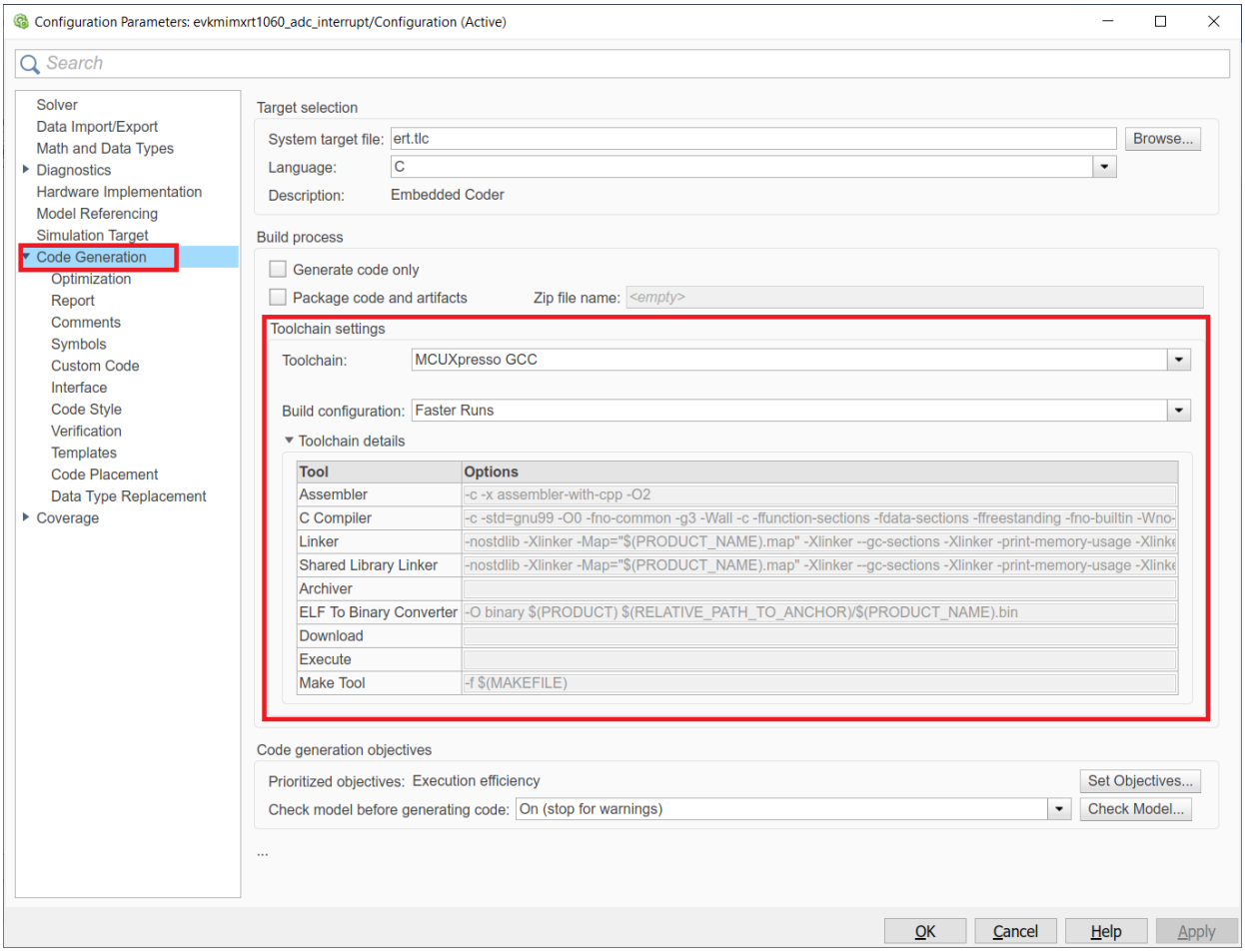


This mechanism requires users to install the Embedded Coder Support Package for ARM Cortex-M Processor as a prerequisite.



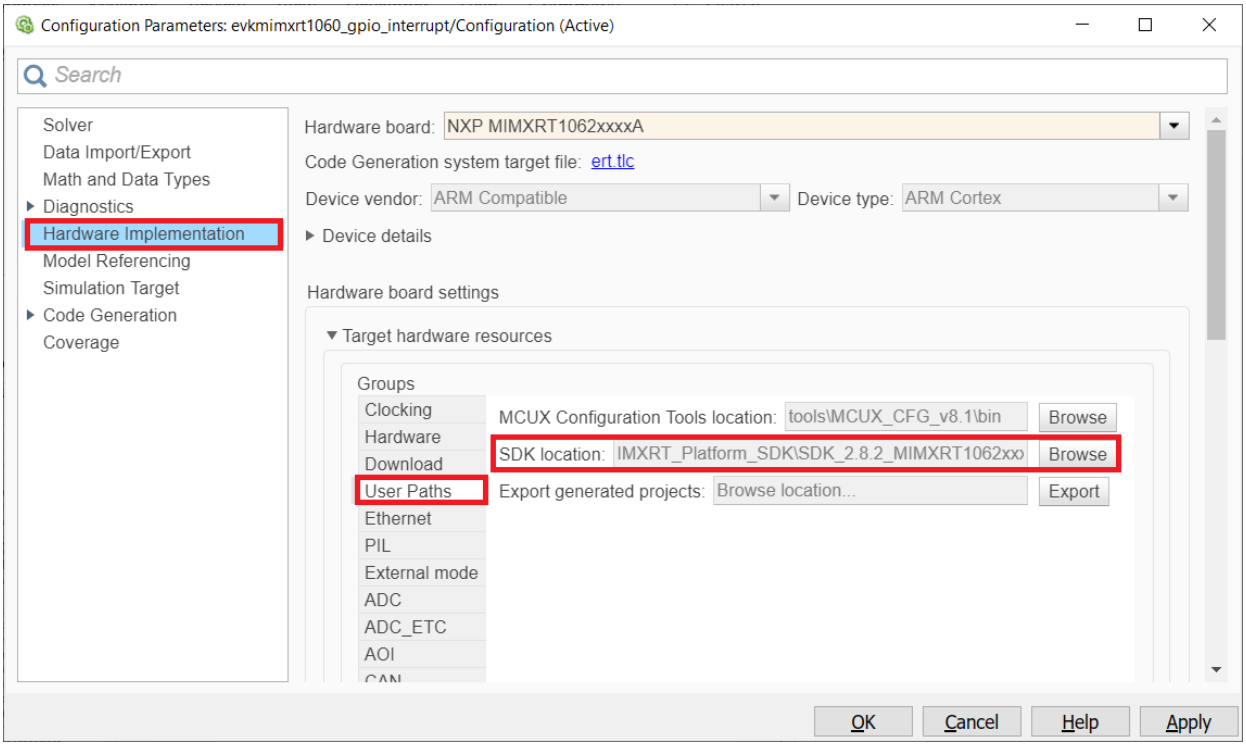
The "`mbd_imxrt_path.m`" script verifies the user setup dependencies and will issue instructions for a successful installation and configuration of the toolbox.

The toolchain can be further enhanced using the Simulink **Model Configuration Parameters** menu:


Configuration Parameters: evkmimxrt1060_adc_interrupt/Configuration (Active)
Search
Solver
Data Import/Export
Math and Data Types
Diagnostics
Hardware Implementation
Model Referencing
Simulation Target
Code Generation
Optimization
Report
Comments
Symbols
Custom Code
Interface
Code Style
Verification
Templates
Code Placement
Data Type Replacement
Coverage
Target selection
System target file: ert.tlc
Browse...
Language: C
Description: Embedded Coder
Build process
Generate code only
Package code and artifacts
Zip file name: <empty>
Toolchain settings
Toolchain: MCUXpresso GCC
Build configuration: Faster Runs
Toolchain details
Tool
Options
Assembler
-c -x assembler-with-cpp -O2
C Compiler
-c -std=gnu99 -O0 -fno-common -g3 -Wall -c -ffunction-sections -fdata-sections -ffreestanding -fno-builtin -Wno-
Linker
-nostdlib -Xlinker -Map="$(PRODUCT_NAME).map" -Xlinker --gc-sections -Xlinker -print-memory-usage -Xlink
Shared Library Linker
-nostdlib -Xlinker -Map="$(PRODUCT_NAME).map" -Xlinker --gc-sections -Xlinker -print-memory-usage -Xlink
Archiver
ELF To Binary Converter
-O binary $(PRODUCT) $(RELATIVE_PATH_TO_ANCHOR)/$(PRODUCT_NAME).bin
Download
Execute
Make Tool
-f $(MAKEFILE)
Code generation objectives
Prioritized objectives: Execution efficiency
Set Objectives...
Check model before generating code: On (stop for warnings)
Check Model...
...
OK
Cancel
Help
Apply

4.3 MCUXpresso SDK Support

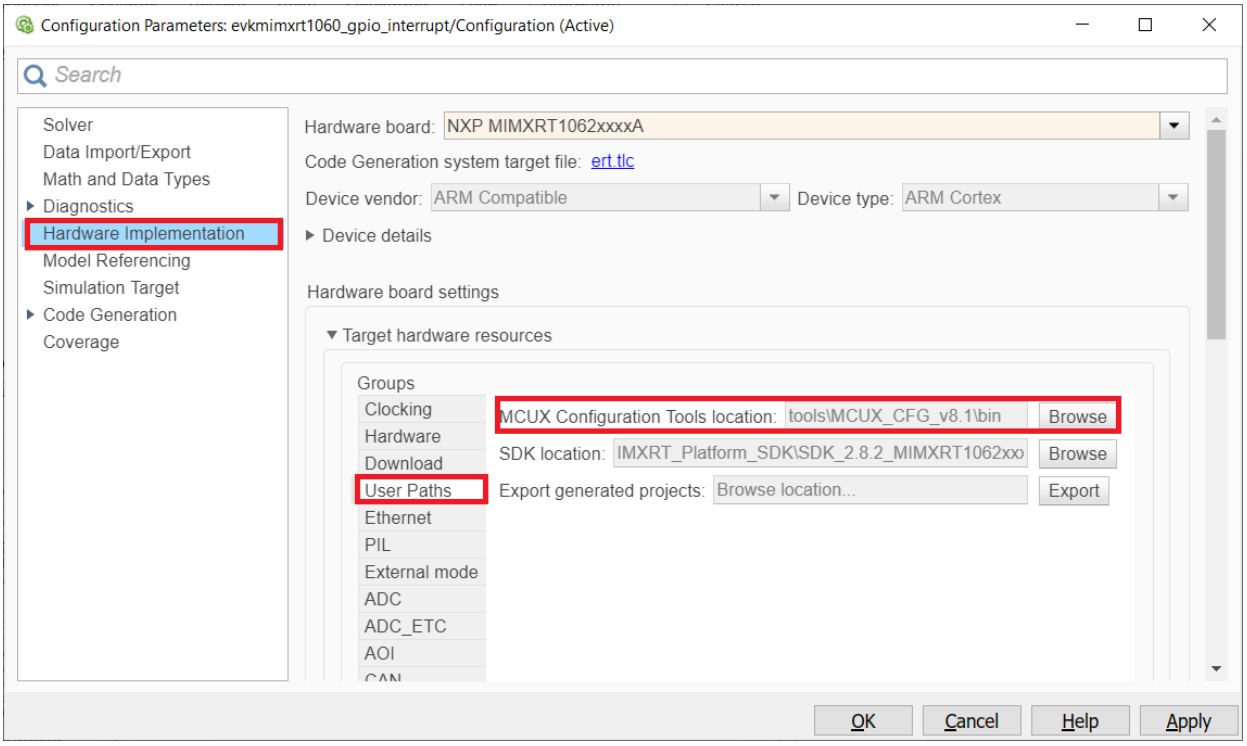
The toolbox is delivered with SDK 2.8.2 support. The user can change the SDK package from the Simulink **Model Configuration Parameters** menu



New SDK packages can be created online with the MCUXpresso SDK Builder here: https://mcuxpresso.nxp.com/en/welcome

4.4 MCUXpresso Configuration Tools Support

The toolbox is delivered with Configuration Tools version 8.1. The user can change the Configuration Tools version used by the Simulink from the Simulink **Model Configuration Parameters** menu



5 Known Limitations

The list of know limitations can be found in the readme.txt file that is delivered with the toolbox and can be consulted in the MATLAB Add-on installation folder of the Model-Based Design Toolbox for is.MX RT 1xxx Series.

6 Support Information

For technical support please sign on to the following NXP's Model-Based Design Toolbox Community: https://community.nxp.com/community/mbdt

How to Reach Us:

Home Page:
www.nxp.com

Web Support:
www.nxp.com/support

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