Model-Based Design Toolbox MPC57xx Series

Release Notes

An Embedded Target for the MPC57xx Family of Processors
Version 3.0.0

Summary

1 What is New in Version 3.0.0

The latest NXP's Model-Based Design Toolbox for MPC57xx version 3.0.0 is designed to support multiple MPC57xx microcontrollers and brings the following important enhancements compared with previous version of this toolbox (v.2.0.0)

- v.3.0.0 supports **3 new processor series and 12 new derivatives**. The new processors and derivatives are listed below:
    - MPC5741**P** (*previous MPC5742**P**, MPC5743**P**, MPC5744**P***)
    - MPC5744**B**, MPC5745**B**, MPC5746**B**
    - MPC5744**C**, MPC5745**C**, MPC5746**C**, MPC5747**C**, MPC5748**C**
    - MPC5746**G**, MPC5747**G**, MPC5748**G**

- v.3.0.0 supports the following **MPC57xx Motherboards and DEVKITS**:
    - DEVKIT-MPC5744P PCB RevX1 SCH RevB
    - DEVKIT-MPC5748G PCB RevA SCH RevB
    - Daughter Card MPC574XG-256DS RevB
    - Daughter Card X-MPC574XG-324DS RevA
    - Daughter Card MPC5744P-257DS RevB1
    - Daughter Card SPC5746CSK1MKU6
    - Motherboard X-MPC574XG-MB RevD
    - Motherboard MPC57XX RevC

- Enhanced user experience with a complete redesign of all **Simulink Library blocks** to support:
    - Same look&feel with Model-Based Design Toolbox for S32K14x Series
    - Basic and Advanced configurations modes based on SDK standard API
    - Multiple pin packages options
    - Multiple peripheral instances
    - Integration with MATLAB Installer, Help and MathWorks online Add-on Manager for distribution and installation

- v.3.0.0 integrates the latest **PA SDK version 2.0.0 RTM** (December 2018) for NXP MPC574x-B-C-G, MPC574x-P MCU. NXP's Model-Based Design Toolbox generates codes based on standard SDK API, covering most of the functionalities exposed by SDK;

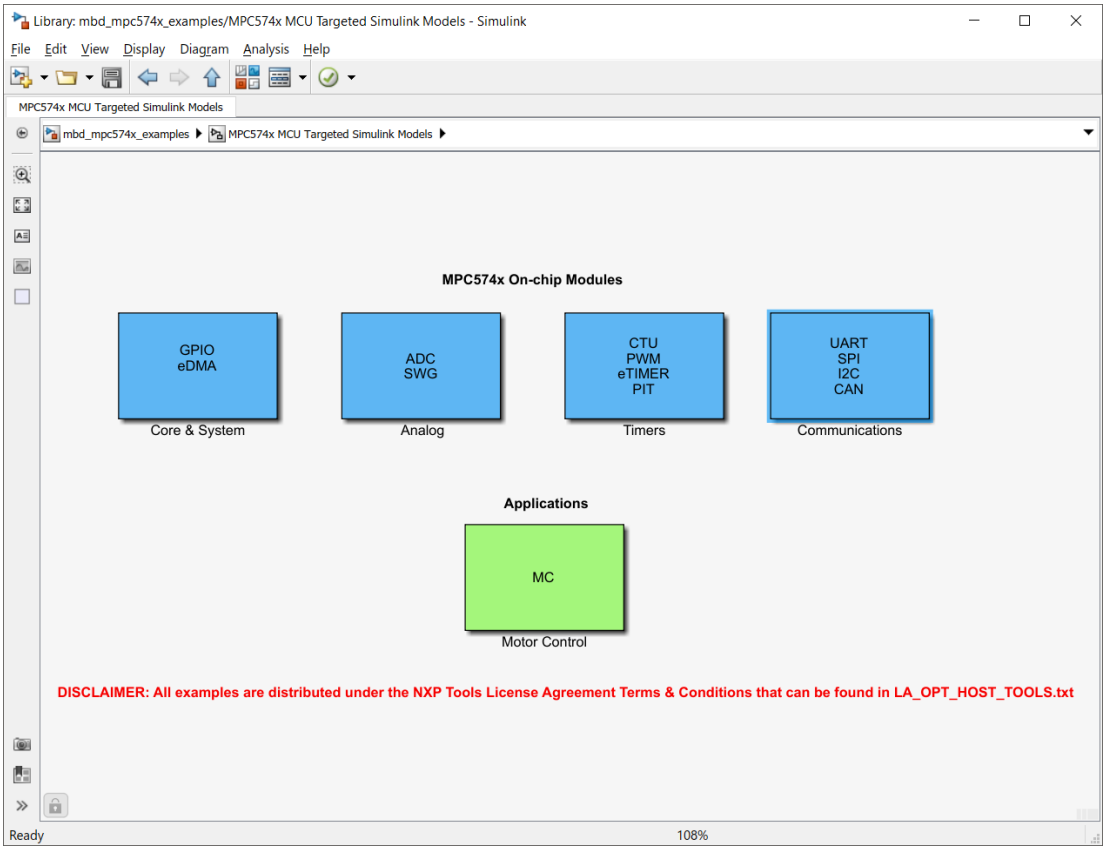
- v.3.0.0 integrates the **Automotive Math and Motor Control Library release 1.1.15** (January 2019) for PA e200 cores;

- Compatible with **S32 Design Studio 2017.R1 for Power Architecture** and **GCC 4.9**. The generated code from MATLAB/Simulink can imported and build as projects in S32 Design Studio, Downloaded and Debug;

- Enable **MATLAB Profiler** support for PIL/SIL targets;

- Expand the example library to cover all Simulink Blocks provided as part of the NXP Toolbox for MPC57xx devices. The **example library contains 102 examples** that covers a wide range of topics like:
    - I/O control: GPIO, Sine Wave Generator (SWG)
    - Timers: Programmable (PIT), eTimer
    - Motor Control: Pulse Width Modulation (PWM), Cross Triggering Unit (CTU), Analogue Converter (ADC)
    - Communication: CAN, SPI, I2C, UART
    - Core & Systems: DMA, Registers
    - Software-in-the-Loop (SIL) and Processor-in-the-Loop (PIL)
    - SRAM and Flash Programming over UART
- **Motor Control examples** for PMSM and BLDC built on top of DEVKIT MPC5744P and MotorGD

The Simulink Models are saved in the NXP Toolbox root directory under `MPC_Examples` folder and can be accessed easily from `mbd_mpc574x_examples.mdl` library file.



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

2 MPC57xx MCU Support

This release is currently supporting only MPC57**4**x B/C/G/P series. The support for MPC57**7**x will be added after PA SDK RTM will become available for mass market.

2.1 Packages & Derivatives

NXP's Model-Based Design Toolbox for MPC57xx version 3.0.0 supports the following MCU series and packages:

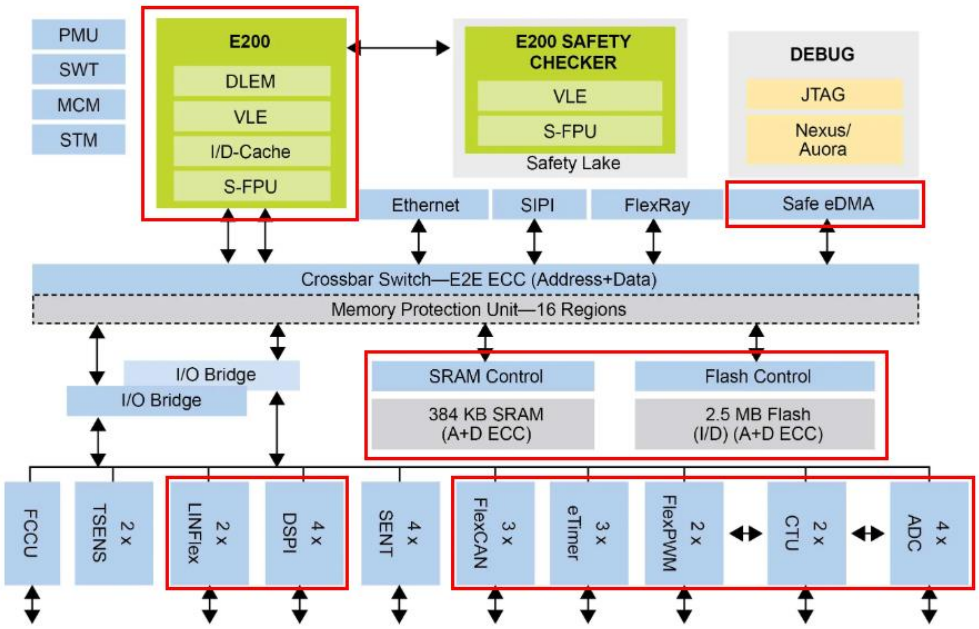
- MPC574xP MCU Packages with 128/198/256/384KB SRAM:
  - 144 LQFP;
  - 256 BGA;
- MPC574xB MCU Packages with 192/256/384/512KB SRAM:
  - 176 LQFP;
  - 100 BGA;
  - 256 BGA;
  - 324 BGA;
- MPC574xC MCU Packages with 256/384/512/768KB SRAM:
  - 176 LQFP;
  - 100 BGA;
  - 256 BGA;
  - 324 BGA
  - 512 BGA;
- MPC574xG MCU Packages with 768KB SRAM:
  - 176 LQFP;
  - 256 BGA;
  - 324 BGA;

The toolbox supports operation with 40MHz external XTAL and MCU system clock configuration frequencies of 200MHz.

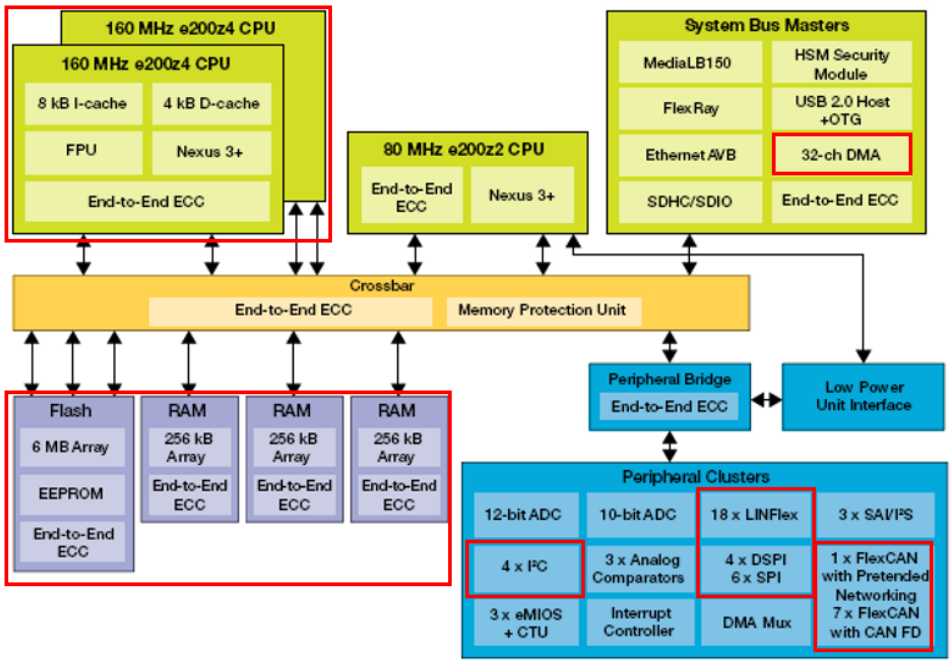
2.2 Peripherals & Devices

NXP's Model-Based Design Toolbox for MPC57xx version 3.0.0 supports the following peripherals and devices that are highlighted in RED:

- MPC574xP Ultra-Reliable MCU for Automotive & Industrial Safety Applications



- MPC574xB/C/G Ultra-Reliable MCUs for Automotive & Industrial Control and Gateway

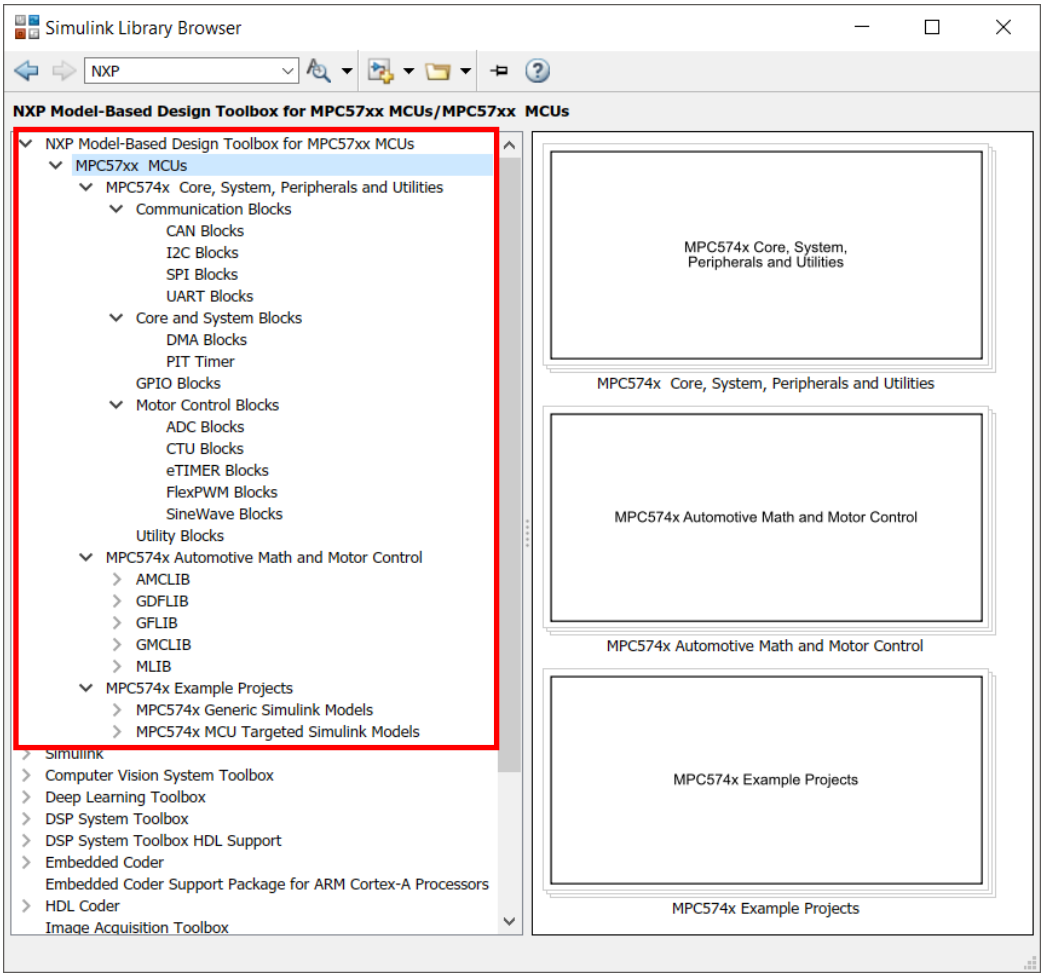


3 Model-Based Design Toolbox Features

NXP's Model-Based Design Toolbox for MPC57xx version 3.0.0 is delivered with a complete MPC57xx MCU Simulink Block Library as shown below.

There are three main categories:

- **MPC574x Core, System, Peripherals and Utilities** which contains all blocks related with MCU configuration
- **MPC574x Automotive Math and Motor Control** which generic 16bit, 32bit and floating point single precision blocks
- **MPC574x Example Projects** which contains all the examples that exercise all the other blocks



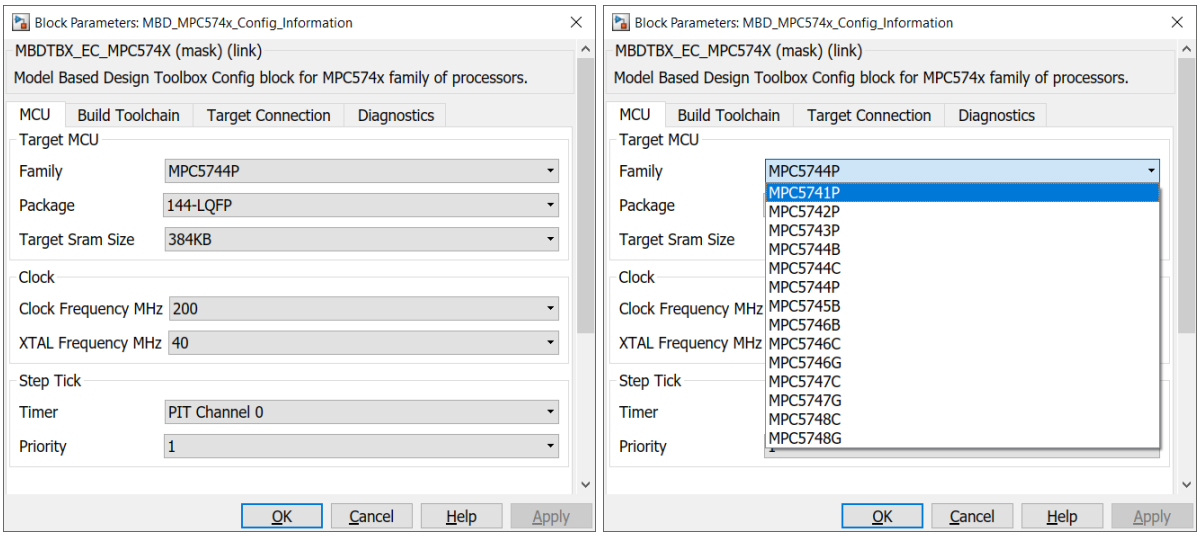
NOTE	In preparation for supporting multiple derivatives of MPC57xx series the Simulink Library for MPC574x has been redesigned. The Simulink models created with previous releases need be converted manually from Simulink to work with the newest version

3.1 New MBD MPC574x Configuration Block

For addressing the increased number of MCU and options the main toolbox configuration block has been completely redesigned. In the newest version of the NXP's Model-Based Design Toolbox for MPC57xx version 3.0.0 this is a standalone block with its own user interface designed to address four main scenarios:

3.1.1 MCU Support

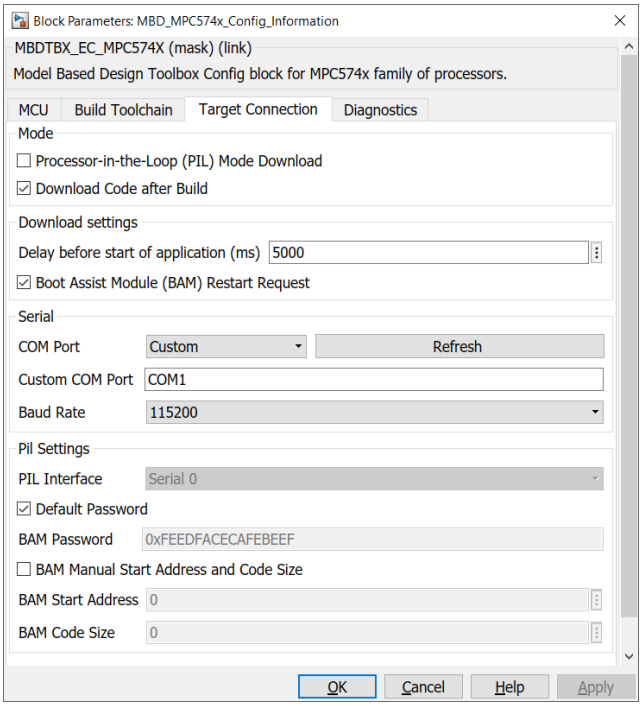
The MCU Tab allows the configuration of the MPC574x options used for code generation. In this tab the selection of the MCU, Package and Clock have a global influence over the Simulink Model.



NOTE	When changing the MCU or package the I/O pins might be reset to defaults in case the corresponding pins are not available. Make sure you check your model after changing the MCU and/or package

3.1.2 Target Connection

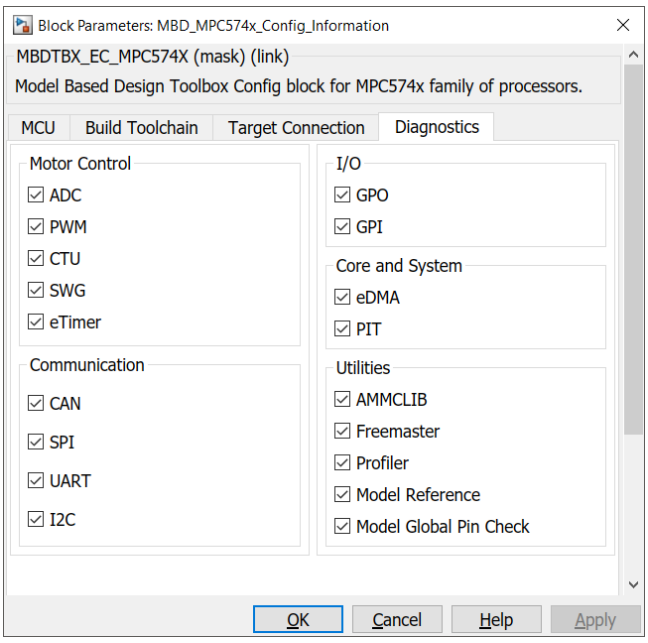
Connection with a NXP MPC57xx target is now easier. For both Serial and OpenSDA the MBD Toolbox has a discovery features that allows you to detect the ports automatically. Just click on Refresh button to get a list of available connections.



3.1.3 **Diagnostics**

The Diagnostics panels allow various checking for the correct usage of the Simulink blocks and dependencies between them:

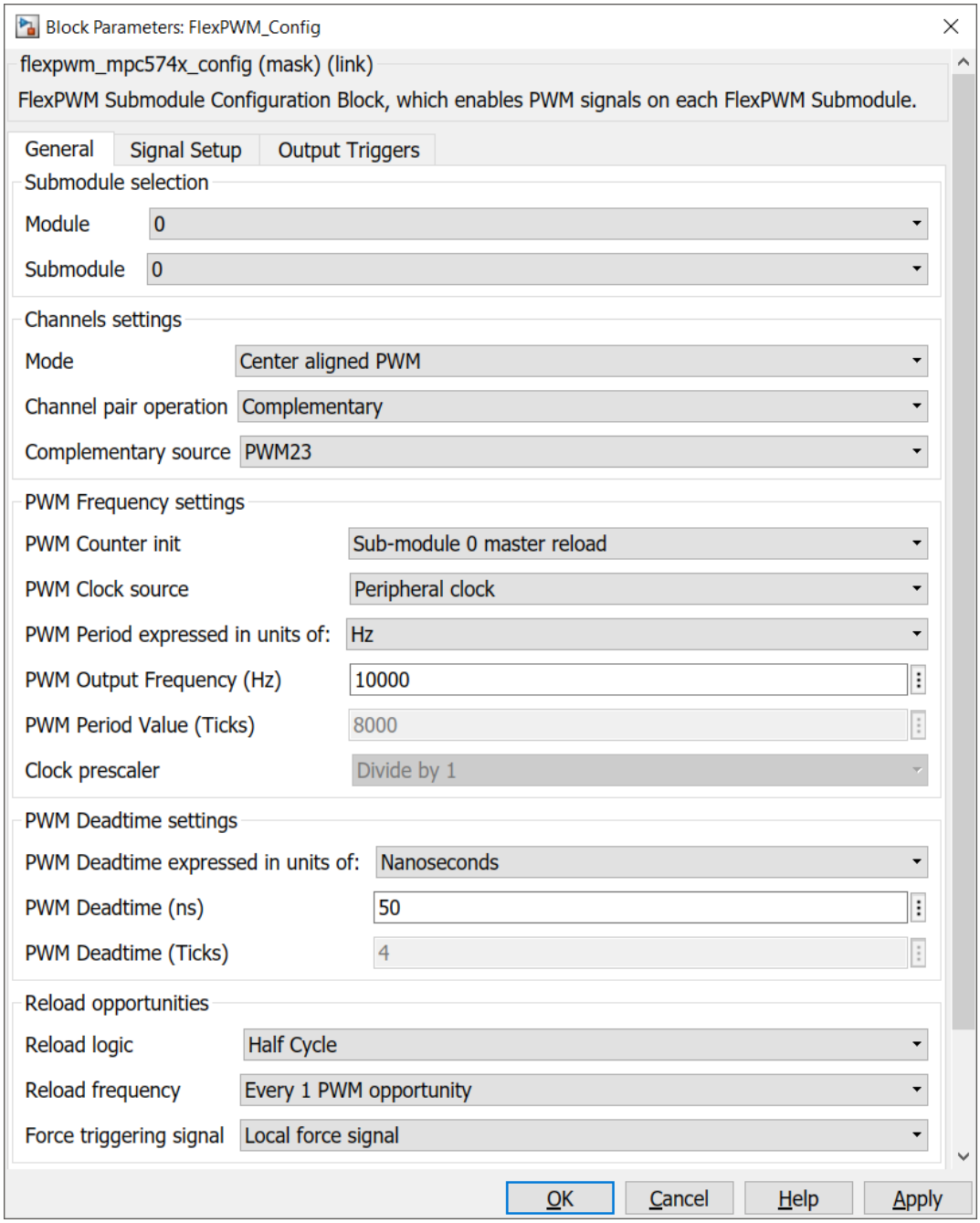
- Checks if pins are shares across various Simulink blocks within the model;
- Checks if incorrect instances of a configured peripheral are used;
- Consistency checks between the block options;



3.1.4 New PWM Configuration Block

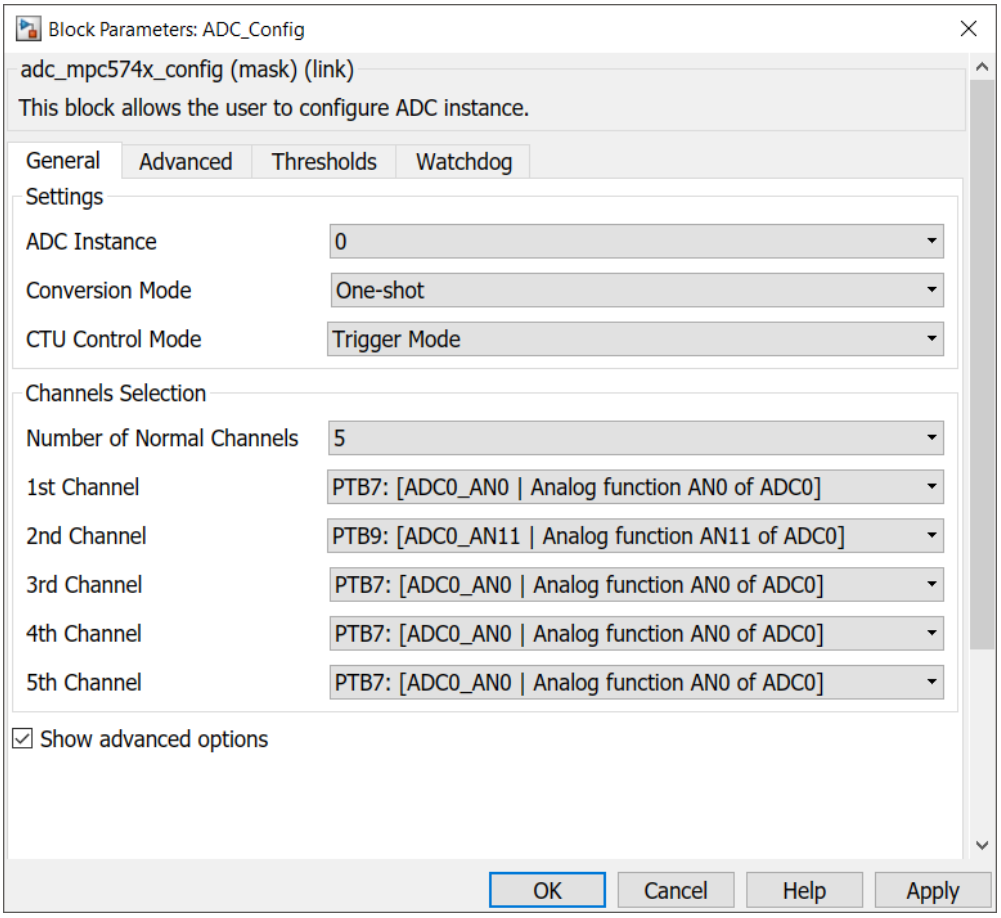
To address complex scenarios the PWM configuration the block was redesigned to be in sync with SDK 2.0.0 RTM drivers. The new configuration block follows now the overall NXP MBDT design philosophy to have a single configuration block per each peripheral. From the new PWM configuration block you can:

- Configure PWM to operate in various modes
- Assign output and input pins
- Control output triggers



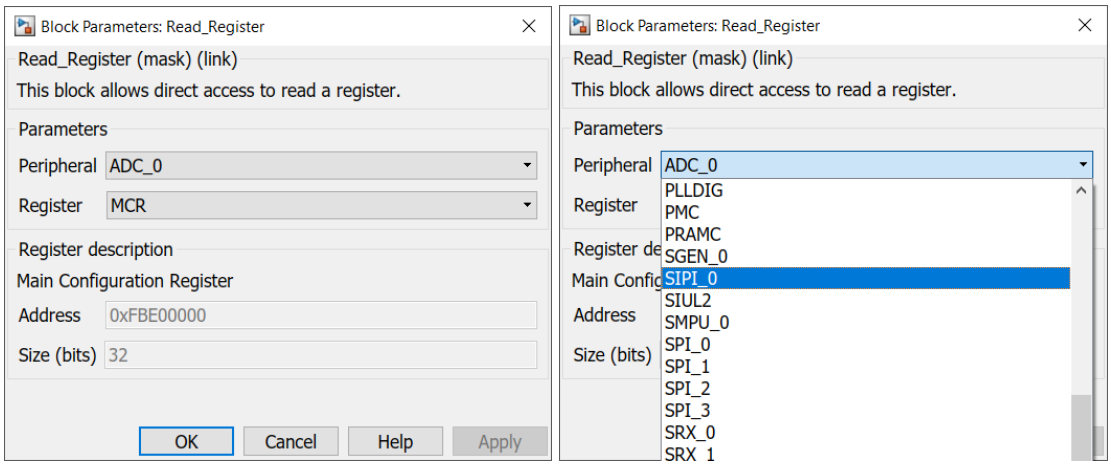
3.1.5 New ADC Configuration Block

To address complex scenarios the ADC configuration the block was redesigned to be in sync with SDK 2.0.0 RTM drivers. The new configuration block follows now to perform advanced motor control applications based on HW interrupts and synchronization with PWM and CTU.



3.1.6 **New REGISTER Support**

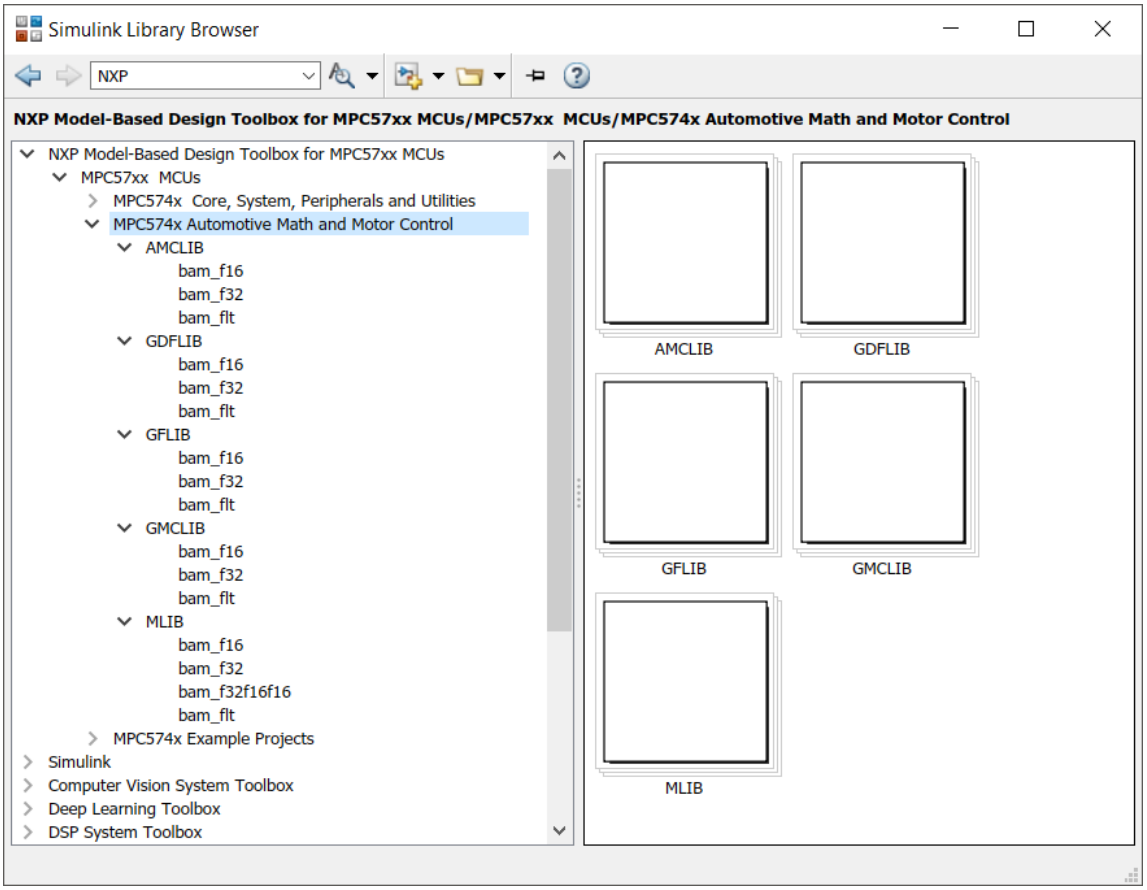
For unsupported peripherals, there is now an easy way to configure them from MATLAB/Simulink with the help of REGISTER READ/WRITE blocks. For each platform supported, a list of all available platform registers is available for read or write operations.



3.2 MPC574x Automotive Math and Motor Control

All functions in the Automotive Math and Motor Control Functions Library v1.1.15 are supported as blocks for simulation and embedded target code generation for:

- Bit Accurate Model for 16-bit fixed-point implementation;
- Bit Accurate Model for 32-bit fixed-point implementation;
- Bit Accurate Model for floating-point single precision implementation;

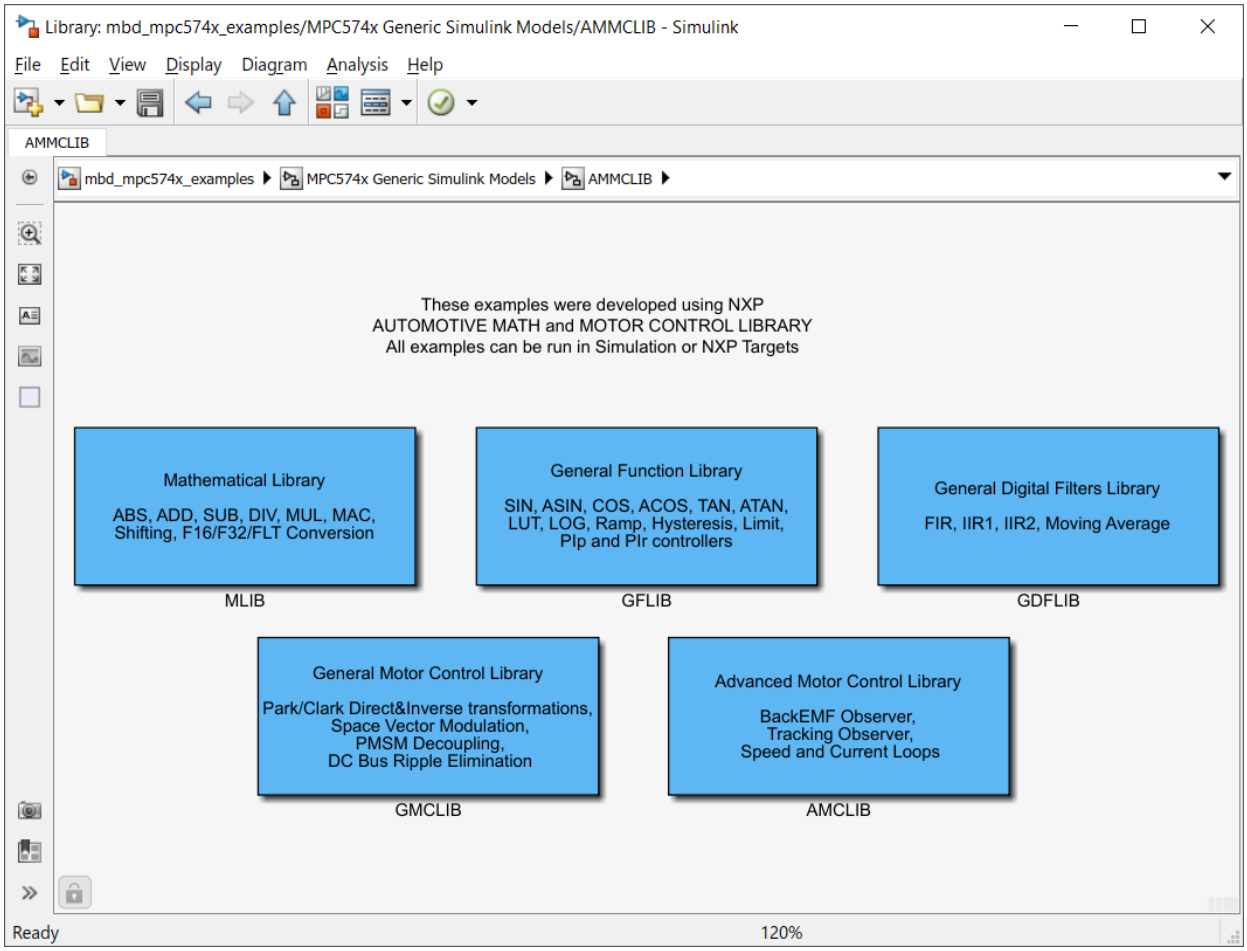


The main functionalities supported are:

- Mathematical Function Library (MLIB) – supports basic mathematical operations such as addition, multiplication, etc;
- General Function Library (GFLIB) – supports basic trigonometric and general math functions such as sine, cosine, tan, hysteresis, limit, etc;
- General Digital Filters Library (GDFLIB) – comprising digital IIR and FIR filters designed to be used in a motor control application;
- General Motor Control Library (GMCLIB) – supports standard algorithms used for motor control such as Clarke/Park transformations, Space Vector Modulation, etc;
- Advanced Motor Control Function Library (AMCLIB) – comprising advanced algorithms used for motor control purposes;

Check the `\mbdtbx_mpc574x\AMMCLIB_s32k14x\AMMCLIB_MPC574xY\xxx_AMMCLIB_RTM_1_1_15_ReleaseNotes.txt` for details about the latest changes

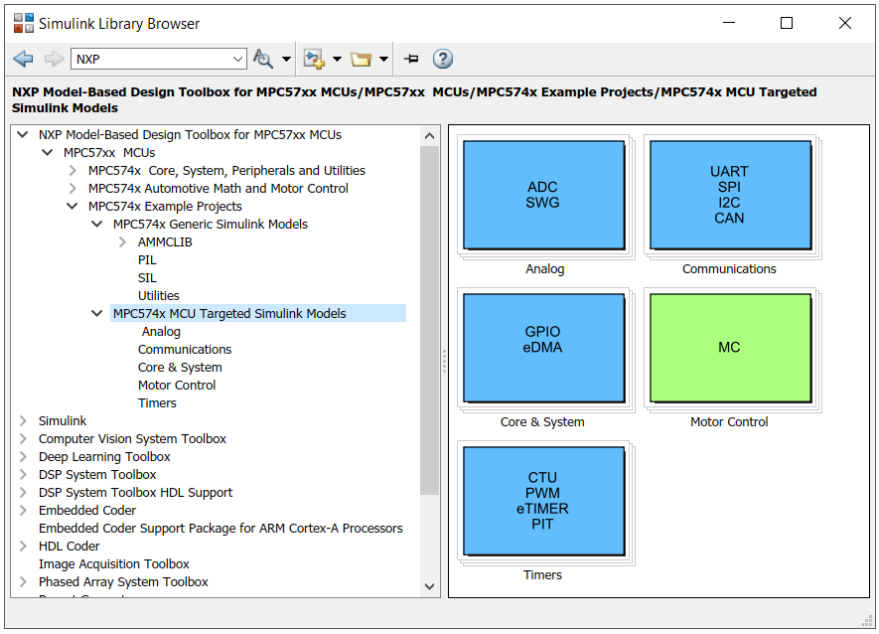
For each AMMCLIB block there is a Simulink Example available NXP Toolbox root directory `..\MPC_Examples\common\` folder.



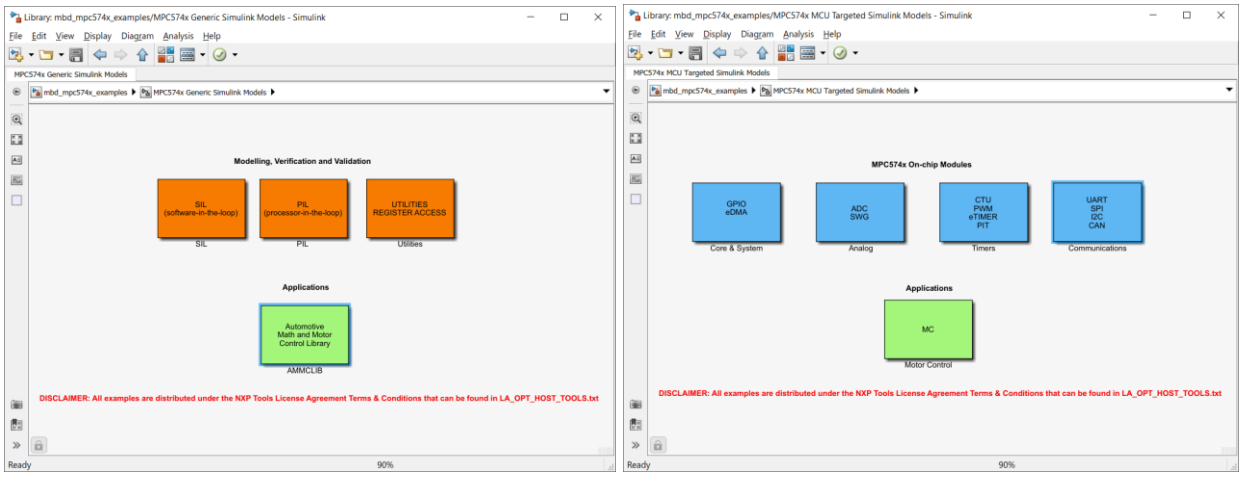
3.3 MPC574x Example Library

MPC574x Examples Library represents a collection of 102 Simulink models that let you test different MCU on-chip modules and run complex applications. The example library is split into:

- **MPC574x Generic** examples that can be run on any of the MPC574x Evaluation Boards
- **MPC574x Targeted** examples that are configured for a single target (e.g.: might contains peripherals that are available only on a specific target)



The examples are grouped in different layers that mimics a typical development flow: starting with basic building blocks that expose the MCU HW functionalities, build SIL and PIL models for verification and validation purposed and ending up with more complex applications that incorporates multiple building blocks.

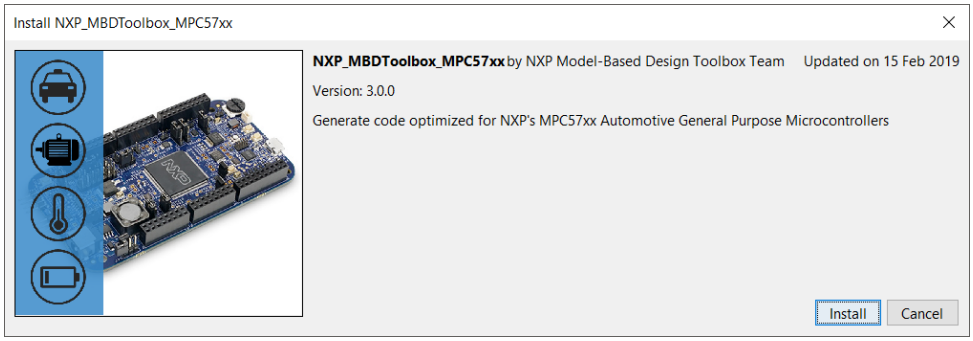


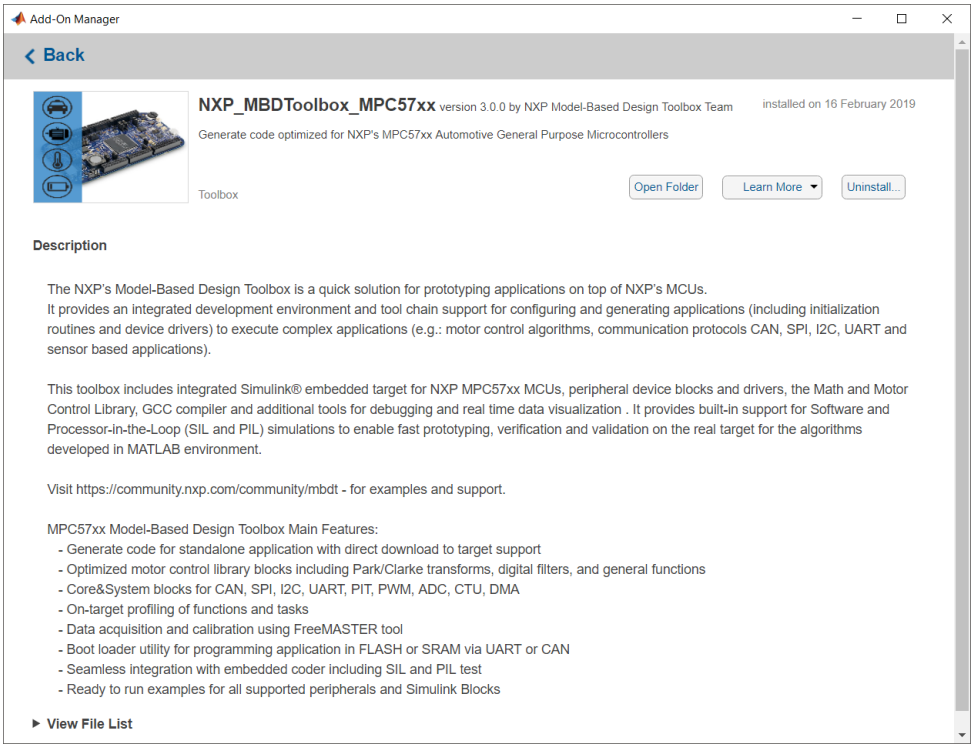
The Simulink models shown as examples are enhanced with a comprehensive description to help users understand better the functionality that is exercised, hardware setup instructions whenever are necessary and a result validation section.

3.4 MATLAB Integration

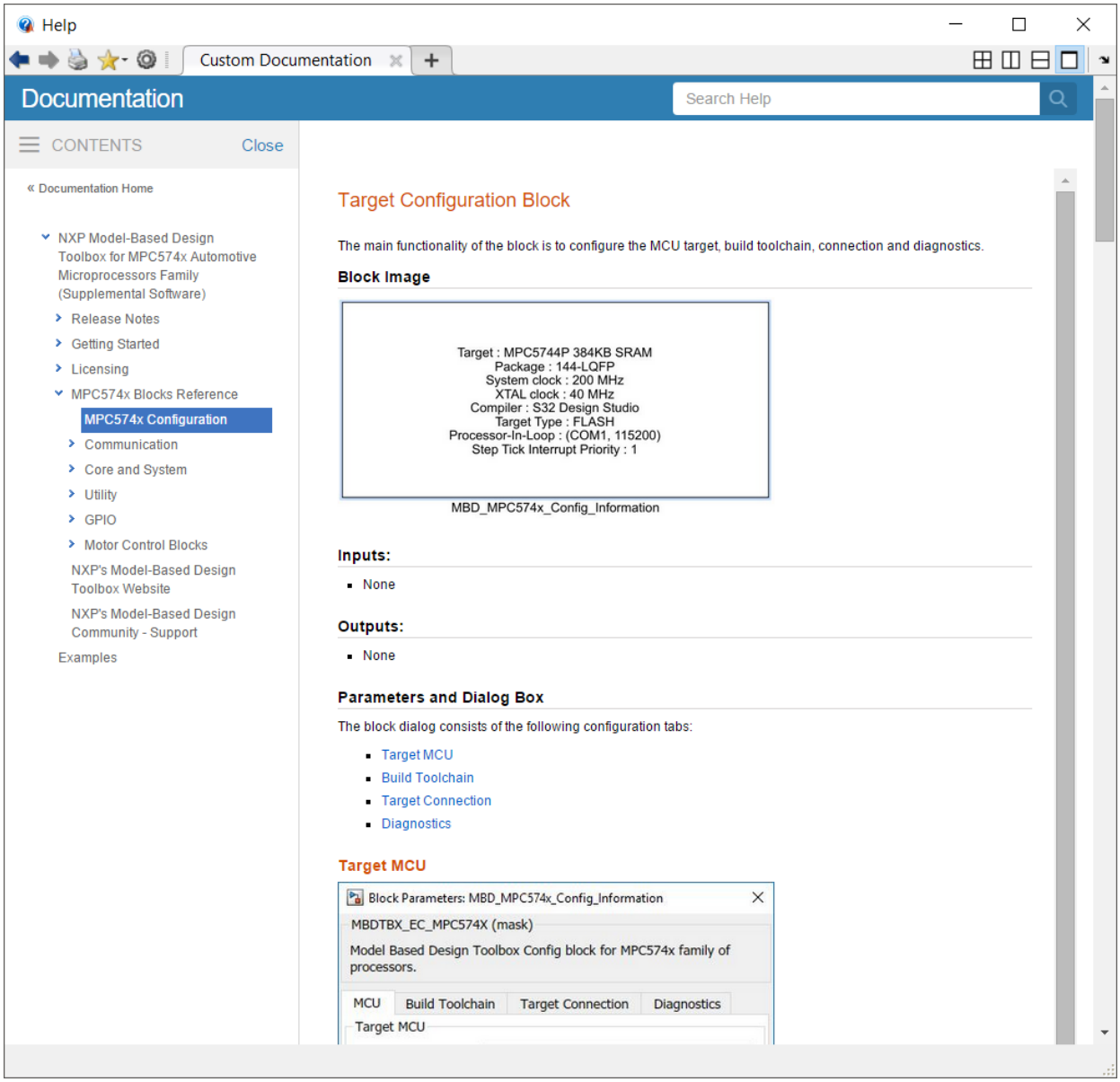
The NXP's Model-Based Design Toolbox for MPC57xx version 3.0.0 is fully integrated with MathWorks environment.

The installation/uninstall actions are available via MATLAB Add-on Manager





The help & documentation for each of the Simulink block supported are available directly into MATLAB Help by pressing F1 or simply clicking on the Help button on each of the Simulink blocks.

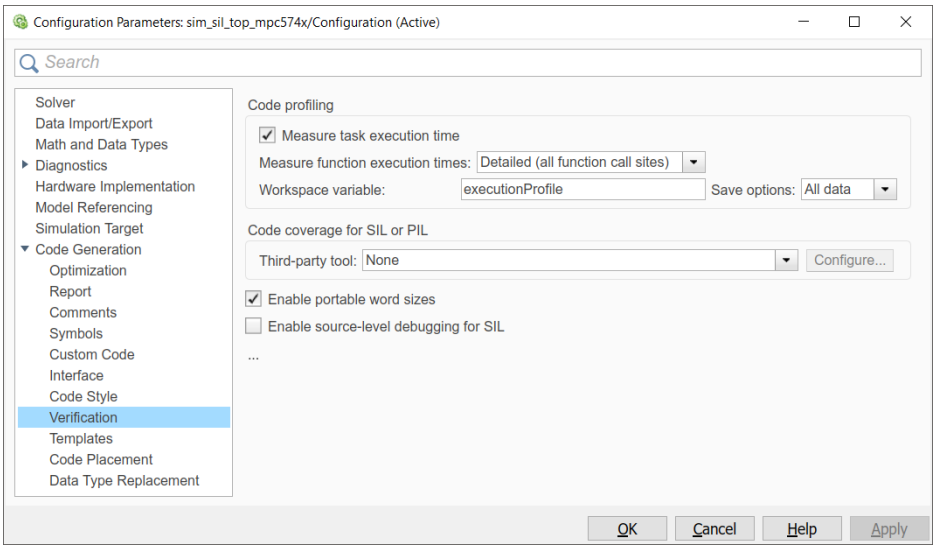


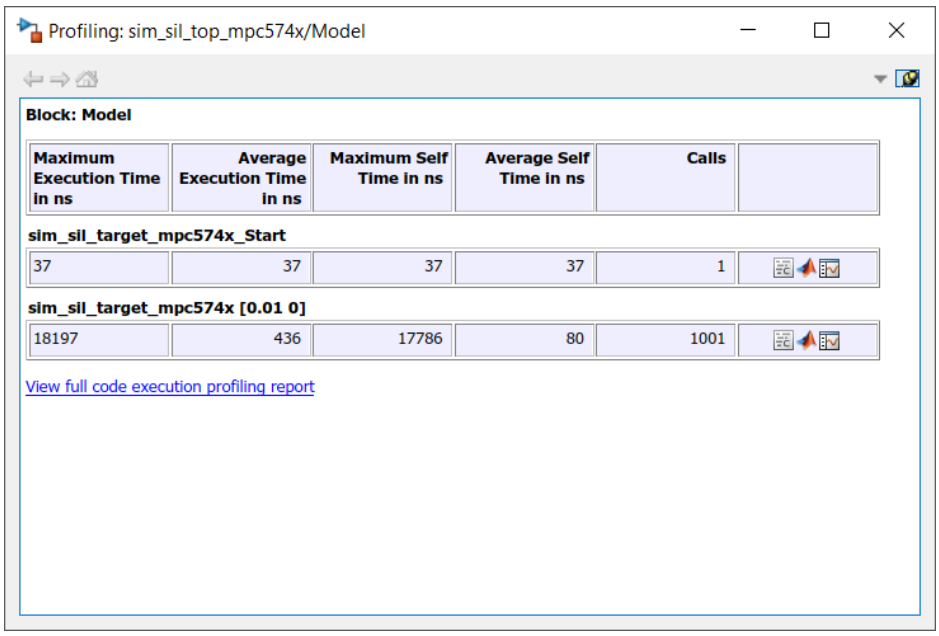
4 New Model-Based Design Toolbox Extras

NXP's Model-Based Design Toolbox for MPC57xx version 3.0.0 enables additional functionalities that are not MCU specific but could help faster prototyping, validation and verification of the developed models.

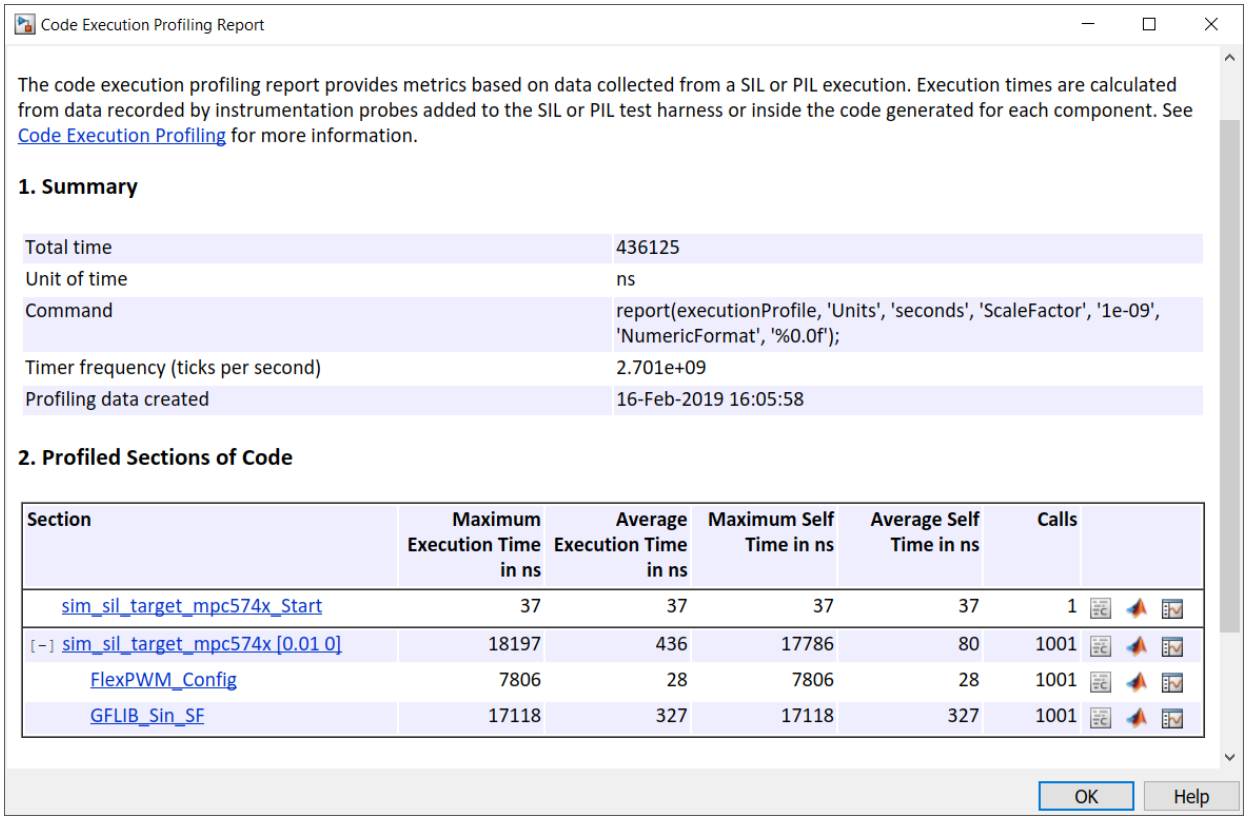
4.1 New Code Profiling

NXP Model-Based Design Toolbox for MPC57xx provides blocks to be used for On-Target function profiling that returns results in units of clock cycles of execution per execution iteration. In 3.0.0 release you can enable MATLAB profile to measure the task and functions execution time when using Processor-in-the-Loop Mode





The reports are automatically displayed in MATLAB



4.2 Processor-In-the-Loop Support (PIL)

The NXP Model-Based Design Toolbox for MPC574x provides PIL support for purposes of ASIL software development processes, “Model PIL Block” (Model Reference) and “PIL Block” modes of operation are supported “Top Model PIL” mode is not supported. PIL contains full support for Math and Motor Control Blocks, and limited support for peripheral blocks. No support for interrupts exist in supported PIL modes of execution, therefore no blocks with interrupts are supported in PIL mode.

For PIL support you need to install the Microsoft Windows SDK 7.1. Please refer to the following links for troubleshooting:

- https://www.mathworks.com/matlabcentral/answers/95039-why-does-the-sdk-7-1-installation-fail-with-an-installation-failed-message-on-my-windows-system
- https://www.mathworks.com/matlabcentral/answers/101105-how-do-i-install-microsoft-windows-sdk-7-1

An alternative to Microsoft Windows SDK is the MATLAB Support for MinGW-w64 C/C++ Compiler toolbox

4.3 Boot Loader

Internal Boot Loader is a standalone application which requires the Microsoft .NET Framework version 4.0 installed on PC. It may be required to download the package from http://www.microsoft.com/download and install if you are going to use PIL and internal Boot Loader. The board should be configured to work with BAM to use Internal Boot Loader. Please check board documentation.

The bootloader files have need updated to support all MPC574x derivatives and allows applications to be downloaded via UART or CAN interfaces to the boards.

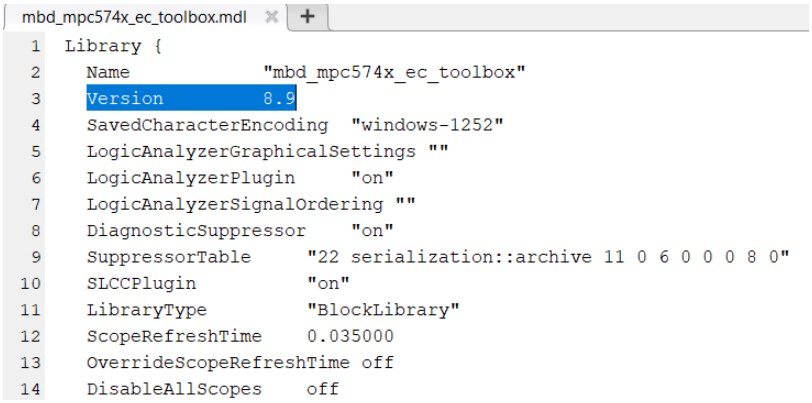
5 Prerequisites

5.1 MATLAB Releases and OSes Supported

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

- R2017A;
- R2017B;
- R2018A;
- R2018B;

In general, older version of MATLAB may be supported with small updates that can be done after installation. As a rule, if you are planning to use an older version you need to update the Simulink version in every MDL file delivered with the toolbox



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

5.2 Compiler Support

The following compilers are the NXP official build tools versions supported by the SDK and AMMCLIB Software Libraries & Driver which are a pre-requisite of the NXP Model-Based Design Toolbox:

Compiler Supported	Release Version
GCC E200 VLE GNU Compiler	V4.9.4
GreenHills MULTI 7.1.4 Compiler	2015.1.6
WindRiver DIAB Compiler	5.9.6.2

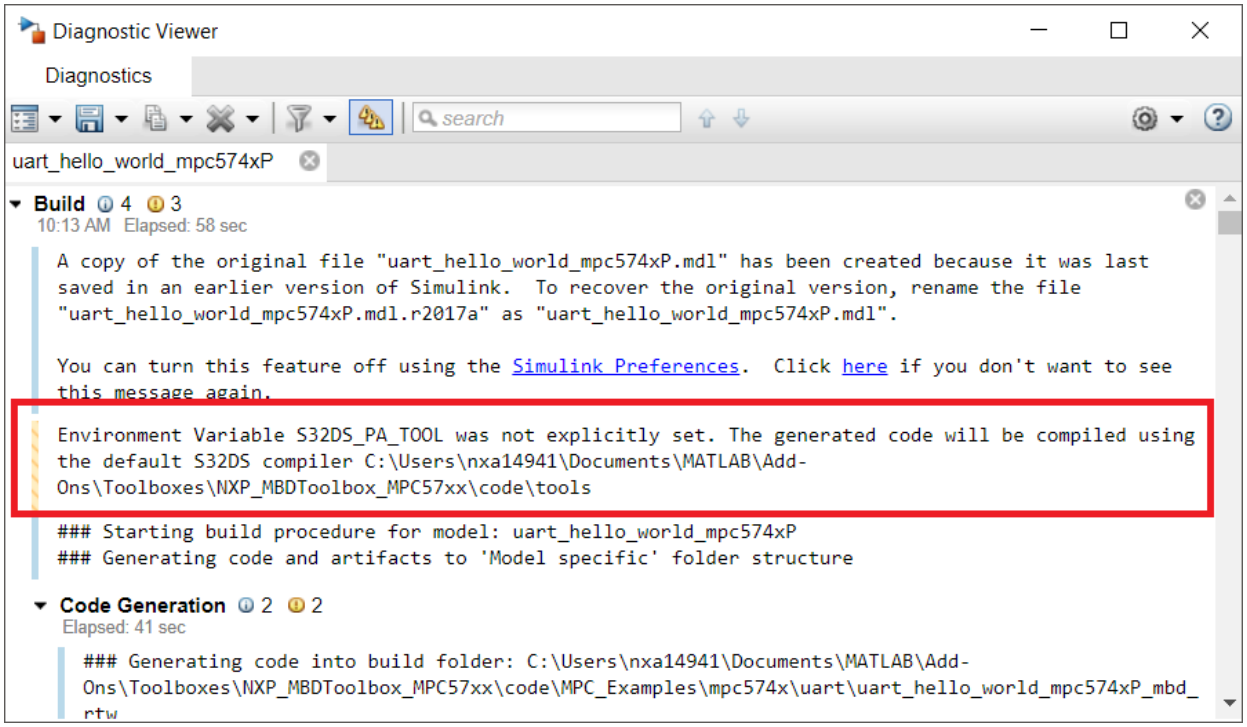
Any other version might produce wrong results or might fails to compile due to missing dependencies.

The target compiler for Model-Based Design Toolbox needs to be configured. Use the notation below to setup these compiler environmental variables. Ensure a system environment variable called `<COMPILER_STRING>_TOOL`, corresponding to the compiler(s) you have installed, is defined to compiler path value as shown below:

```
S32DS_PA_TOOL = {Toolbox installation path}/tools or
                {S32 Design Studio installation path}/
GHS_TOOL = {GHS installation path}/comp_201516/
DIAB_TOOL = {DIAB installation path}/diab/5.9.6.2/
```

Note: Paths shown are for illustration, your installation path may be different. Once environmental variables are setup you will need to restart MATLAB for the IDE environment to see these system variables.

In case there is no compiler installed, the NXP's Model-Based Design Toolbox is going to default to the internal GCC 4.9.4 compiler.



6 Known Limitations

NXP's Model-Based Design Toolbox for MPC57xx version 3.0.0 has the following limitations:

- The version 3.0.0 cannot coexist with previously installed version of the NXP Model-Based Design Toolbox for MPC57xx due to MATLAB global paths limitations. When the toolbox is install as Add-Ons the MATLAB will uninstall the previous version automatically. In case you have files, custom files saved with previous versions those will not be deleted.

  To avoid any complications, it is recommended to uninstall the previous toolboxes for MPC57xx manually prior of install the 3.0.0 release.
- The Simulink Function-Call Split block cannot be mixed with Model-Based Design Toolbox blocks.
- Download to target for Simulink is supported only via UART interface. For CAN download, you can use the RAppID Bootloader as a separate tool to load the generated application into target RAM/Flash Memories.
- In case of migrating a project from an earlier toolbox version to the latest 3.0.0 the user needs to manually check each Simulink model and relink the blocks to new Simulink Library available.

7 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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