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
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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

- eMMC 4.5 / SD 3.0 x2
- UART x8
- 8 x 8 Keypad
- I2C x4
- SPI x4
- FlexIO x2
- GPIO
- U5 / SM x3
- S/PDIF Tx / Rx
- FlexCAN x2 + FlexCAN [with Flexible Data Rate supported]
- USB 2.0 OTG with PHY x2
- 10 / 100 Ethernet x2 with IEEE 1588
- ADC x2 (16-channel)
- 20-channel in total
- 1 x ADC

### i.MX RT 101x derivatives

- 4 x UART
- 2 x I2C
- 2 x SPI
- FlexIO
- 4 x 4 Keypad
- 2 x FIS/SAI
- S/PDIF Tx/Rx
- USB 2.0 OTG with PHY
- 1 x ADC (16-channel)
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 RT 1xxx 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.
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 support the following MATLAB releases:
- R2019a;
- R2019b;
- R2020a;
- R2020b;

For a flawless 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.

<table>
<thead>
<tr>
<th>Operating System Supported</th>
<th>SP Level</th>
<th>64-bit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows 7</td>
<td>SP1</td>
<td>X</td>
</tr>
<tr>
<td>Windows 10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.2 Build Toolchain Support

The following compilers are supported:

<table>
<thead>
<tr>
<th>Compiler Supported</th>
<th>Release Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCC for ARM Embedded Processors</td>
<td>V9.2.1</td>
</tr>
</tbody>
</table>

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.

```matlab
>> 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:
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 known 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 i.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