Simulink Design Documenter

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Contents

1 Introduction

The purpose of the Simulink Design Documenter is to facilitate the production of useful Software Design Description documents for software systems developed with Simulink. While producing documentation is often seen as a tedious task, it is not possible to disregard it since many projects are too large and complex to easily understand without it. The existence of documentation reduces difficulty and time required for software changes and maintenance.

1.1 More Information

Further details, as well as additional options and capabilities, can be found in the full guide, located in SimulinkDesignDocumenter_FullGuide.pdf.

For more information on the tool and how it can be used in model-based development with Simulink, please refer to the following papers:

Alexander Schaap, Gordon Marks, Vera Pantelic, Mark Lawford, Gehan Selim, Alan Wassyng, and Lucian Patcas. 2018. "Documenting Simulink Designs of Embedded Systems," *Proceedings of the 21st ACM/IEEE International Conference on Model Driven Engineering Languages and Systems (MODELS): Companion Proceedings*, ACM, Copenhagen, Denmark, 47–51.

Vera Pantelic, Alexander Schaap, Alan Wassyng, Victor Bandur, and Mark Lawford. 2019. "Something is Rotten in the State of Documenting Simulink Models," *Proceedings of the 7th International Conference on Model-Driven Engineering and Software Development*, SciTePress, 503–510.

1.2 What the Simulink Design Documenter Provides

The Simulink Design Documenter generates a Word document with a title page, clickable table of contents, Changelog, Document Purpose section, Scope section, design details, a glossary, appendix, and a summary of warnings (if there were any during generation). The table of contents as well as overall formatting of the document are handled completely automatically, while the title page, Document Purpose, and Scope are also included automatically, though they may be configured or edited.

To provide design details for the system, the Simulink Design Documenter approaches documentation with the mentality that there will be subsystems within the 'main system' which are complex enough to warrant documentation for themselves and as such the Simulink Design Documenter allows the user to designate subsystems to document and will nest a subsystem's design details within an upper-level system's design details. For each system/subsystem being documented the Simulink Design Documenter will automatically produce a picture of the system, a list of subsystems within it, and an Interface section with information about the blocks which are involved in the interface. Beyond this each system will be documented with Purpose, Internal Design, Rationale, and

Anticipated Changes sections as well as a Requirements Specification section if desired.

1.3 A Note on Other Software Documentation

A Software Design Description document is not the only document that *should* be produced in a project that uses Simulink. Among other documents, Software Requirements Specification documents are also very important to a successful project and they should not be overlooked. However, the Simulink Design Documenter focuses only on Software Design Description documents.

2 How to Use the Tool

This section describes what must be done to setup the tool, as well as how to use the tool.

2.1 Prerequisites and Installation

1. Use MATLAB/Simulink R2016b or newer to generate (the model can be saved in earlier versions).
2. Install the Signature Tool.
3. Ensure Simulink Report Generator is installed (check for it with the `ver` command in MATLAB).
4. To install the tool,
   (a) from a `.zip` file — unzip the contents into your desired location. Ensure the unzipped folder and subfolders are present in your MATLAB search path, or add them if they are not present. Run sl_refresh_customizations to refresh the Context Menu.
   (b) from a `.mltbx` file — simply open MATLAB and double-click on the file. Your MATLAB search path should be automatically configured.
   (c) from the files only — add the folders and subfolders to your MATLAB search path. Run sl_refresh_customizations to refresh the Context Menu.
   - *Note:* If running the command "`which Interface`" indicates that the script is not found, then the tool needs to be added to the MATLAB search path. For information on adding files to the MATLAB search path, please see the MathWorks documentation.
5. Ensure the Simulink-Utility folder is on your MATLAB search path. This is a dependency for the tool to work correctly.
6. Ensure your model is open (or loaded, for command line use).

2.2 Getting Started

The Simulink Design Documenter can be used via the Simulink Context Menu, which can be viewed by right-clicking in a model. The following option will be available in the Context Menu (as shown in Figure 1):

- *Generate Simulink Design Document*

2.3 Functionality

This section describes the tool functionality when being used from the Simulink Context Menu.

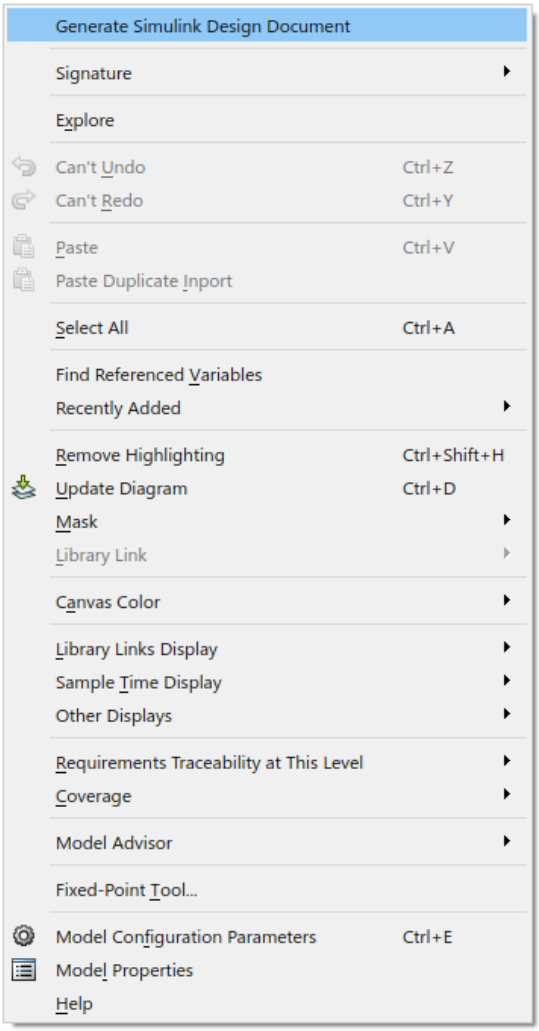


Figure 1: Simulink Context Menu with tool option visible

2.3.1 Report Configuration

Prior to report generation, the report needs to be configured by the user. Specifically, a configuration file is needed to set up options on how the document will generate (e.g., adding a title image, specifying authors, etc.). This file must be placed on the MATLAB path and named `<MySystem>_SDD_Config.m`. A template configuration file, that also explains the different options available, can be found at `Report_Specific_Files/TopsysName_SDD_Config.m`. This template can be duplicated, renamed according to the system you wish to document, and altered to fit one's needs. In particular, users are urged to choose a list of subsystems in `MySystem` to document, and set the *subsystemList* variable with this information.

2.3.2 Report Content

Next, the user must add DocBlocks to the system being documented as well as those subsystems listed by the subsystemList variable. The four mandatory DocBlocks are: "Purpose", "Internal Design", "Rationale", and "Anticipated Changes". The purpose of these blocks is to store useful information describing the system, in order to help others to understand and work with the model. Therefore, after adding these four blocks, the user should open them and populate them with information:

- The Purpose DocBlock should describe the purpose of the system.
- The Internal Design DocBlock should describe how the system works to accomplish the purpose.
- The Rationale DocBlock should describe why certain design decisions were made.
- The Anticipated Changes DocBlock should describe expected changes to the system (such as from changes in project scope or requirements).

To assist the user, the `SDD Blocks` block library provides these blocks. This library contains both mandatory and other optional DocBlocks. The mandatory blocks are shown in Figure 2). The default contents of the blocks briefly explains what content should be stored in them.

Note, one may use ordinary DocBlocks, however they must have the specific names required by the tool, as given in the `SDD Blocks` library.

If a user attempts to generate without creating the configuration file or adding the DocBlocks, the generated document will include warnings at the end of the document which explain what to do (as shown in Figure 3):

2.3.3 Report Generation

Finally, to generate the Software Design Description document, right-click anywhere in the model and then select `Generate Simulink Design Document`

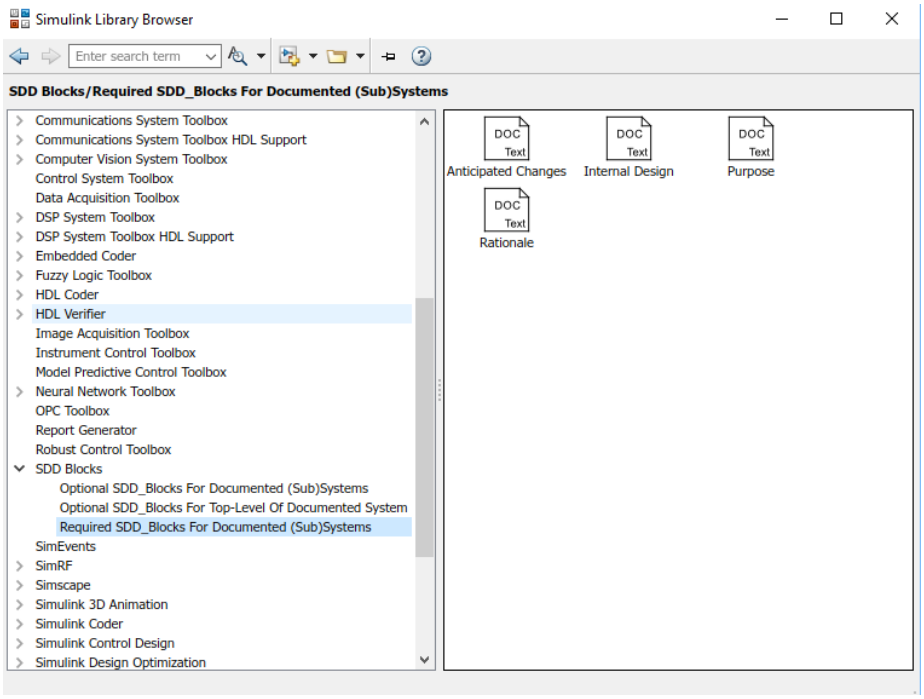
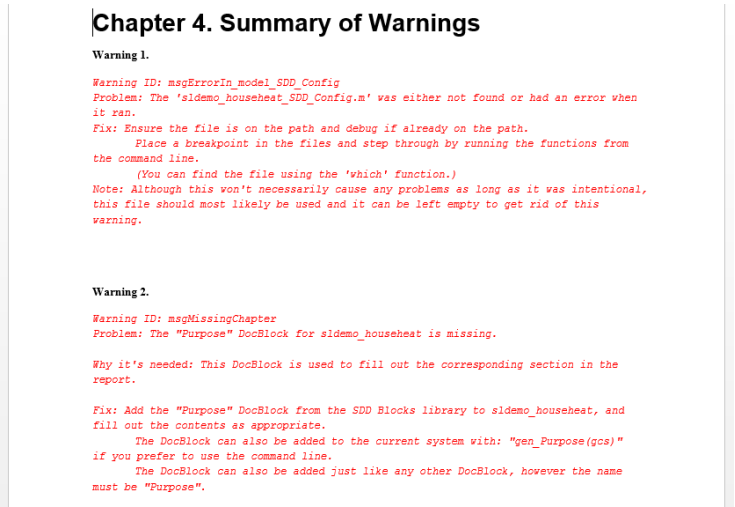


Figure 2: `SDD Blocks` library in the library browser, showing which DocBlocks are required for each system/subsystem being documented



Chapter 4. Summary of Warnings

Warning 1.

Warning ID: msgErrorIn_model_SDD_Config
Problem: The 'sldemo_househeat_SDD_Config.m' was either not found or had an error when it ran.
Fix: Ensure the file is on the path and debug if already on the path.
Place a breakpoint in the files and step through by running the functions from the command line.
(You can find the file using the 'which' function.)
Note: Although this won't necessarily cause any problems as long as it was intentional, this file should most likely be used and it can be left empty to get rid of this warning.

Warning 2.

Warning ID: msgMissingChapter
Problem: The "Purpose" DocBlock for sldemo_househeat is missing.

Why it's needed: This DocBlock is used to fill out the corresponding section in the report.

Fix: Add the "Purpose" DocBlock from the SDD Blocks library to sldemo_househeat, and fill out the contents as appropriate.
The DocBlock can also be added to the current system with: "gen_Purpose(gcs)" if you prefer to use the command line.
The DocBlock can also be added just like any other DocBlock, however the name must be "Purpose".

Figure 3: Summary of Warnings section in a report generated for the `sldemo_househeat` system

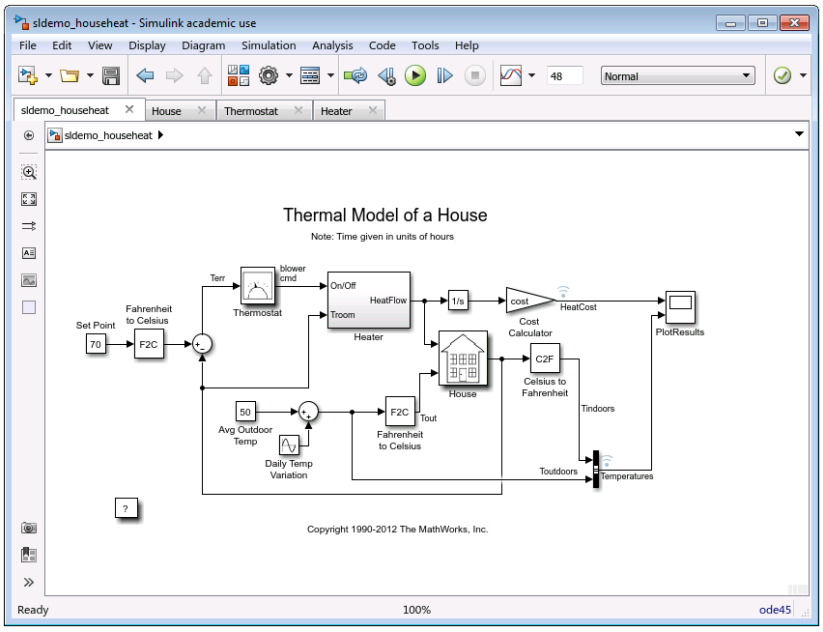


Figure 4: The `sldemo_househeat` system

from the Context Menu. This will begin the generation of a Software Design Description document. This document will be named `SDD_<MySystem>.docx`, and saved in the current folder in MATLAB.

2.4 Errors and Warnings

Any errors or warnings during tool use will be visible in the MATLAB Command Window or at the bottom of the generated document. Typically, warnings will occur when any of the mandatory DocBlocks are missing (i.e., Purpose, Internal Design, Rationale, or Anticipated Changes), or if an appropriately named configuration file is not found.

3 Example

This section provides simple demonstration of the Simulink Design Documenter. For a more in depth example, please see the full guide, located in `SimulinkDesignDocumenter_FullGuide/Full`

Let us create documentation for the top-level of the `sldemo_househeat` model, which is built into MATLAB. It is shown in Figure 4.

The following steps will demonstrate the creation of a simple Software Design Description document.

1. Use the command `sldemo_househeat` in the Simulink command window

to open the example model

2. Create a file on the MATLAB path called "`sldemo_househeat_SDD_Config.m`". Insert the following lines:

   - `author = 'John Smith';`
   - `subsystemList = {};`

   This sets the author name and tells the Simulink Design Documenter to only generate documentation for the top-level of the system.

3. Add the four mandatory DocBlocks from the `SDD Blocks` block library to the top-level system. For each of the DocBlocks, write meaningful content, as described in Section 2.3.2.

4. Save each DocBlock before closing them, and then save the model as well.

5. From the top-level system, right-click to access the Simulink Context Menu and select `Generate Simulink Design Document`

6. The Software Design Description document will automatically open when generation is complete.

4 Matlab Commands

The tool can also be used via the MATLAB command line, with the following function(s).

Function	`GenSDD`
Syntax	`GenSDD`(*topsys*)
Description	Generate the Software Design Description document for *topsys*.
Inputs	*topsys*: Name of the system to generate the documentation for. It should be a specific subsystem name.
Outputs	N/A