

Introduction to Simulation Environment

Targeted simulator: SIMetrix

Scope and purpose:

The current document provides guidance on how to get started with the attached behavioral model using the SIMetrix Simulator either by creating a new project from scratch or based on an existing testbench like the one attached to the current archive.

Important note:

This document has been created for general purposes and has NOT been tailored to any specific product. Therefore, the naming of symbols, testbenches and other files will differ from the ones included in the delivery package.



Table of contents

1 **Resources 3**

2 **Starting a new project 4**

2.1 Create a new project4

2.2 Import of an existing model.....5

2.2.1 Install the model5

2.2.2 Associate model with symbol6

2.3 Set up and run a transient analysis9

2.4 Set up global parameters.....11

2.5 Recommended simulation settings.....13

3 **Opening an existing project..... 14**

3.1 Transient simulation considerations.....14

4 **INFINEON’S SIMULATION MODEL TERMS OF USE 18**

Revision history 20



1 Resources

The minimum files required to follow the steps from this document can be found in the current archive with the following extensions:

- **.lib** : the model code – to be found either as encrypted (to protect Infineon's IP) or unencrypted format
- **.sxslb** : schematic symbol view for graphical user interface
- **.sxsch** : project file which contains one/several application setup(s)

2 Starting a new project

The instructions presented below assume basic knowledge like opening a schematic and running a simulation. If necessary, please get familiar with simulation environment before proceeding.

2.1 Create a new project

Begin by opening the **SIMetrix** application. Select from the main menu **File**→**New**→**Schematic** and the window will display a new schematic panel, similar to that below:

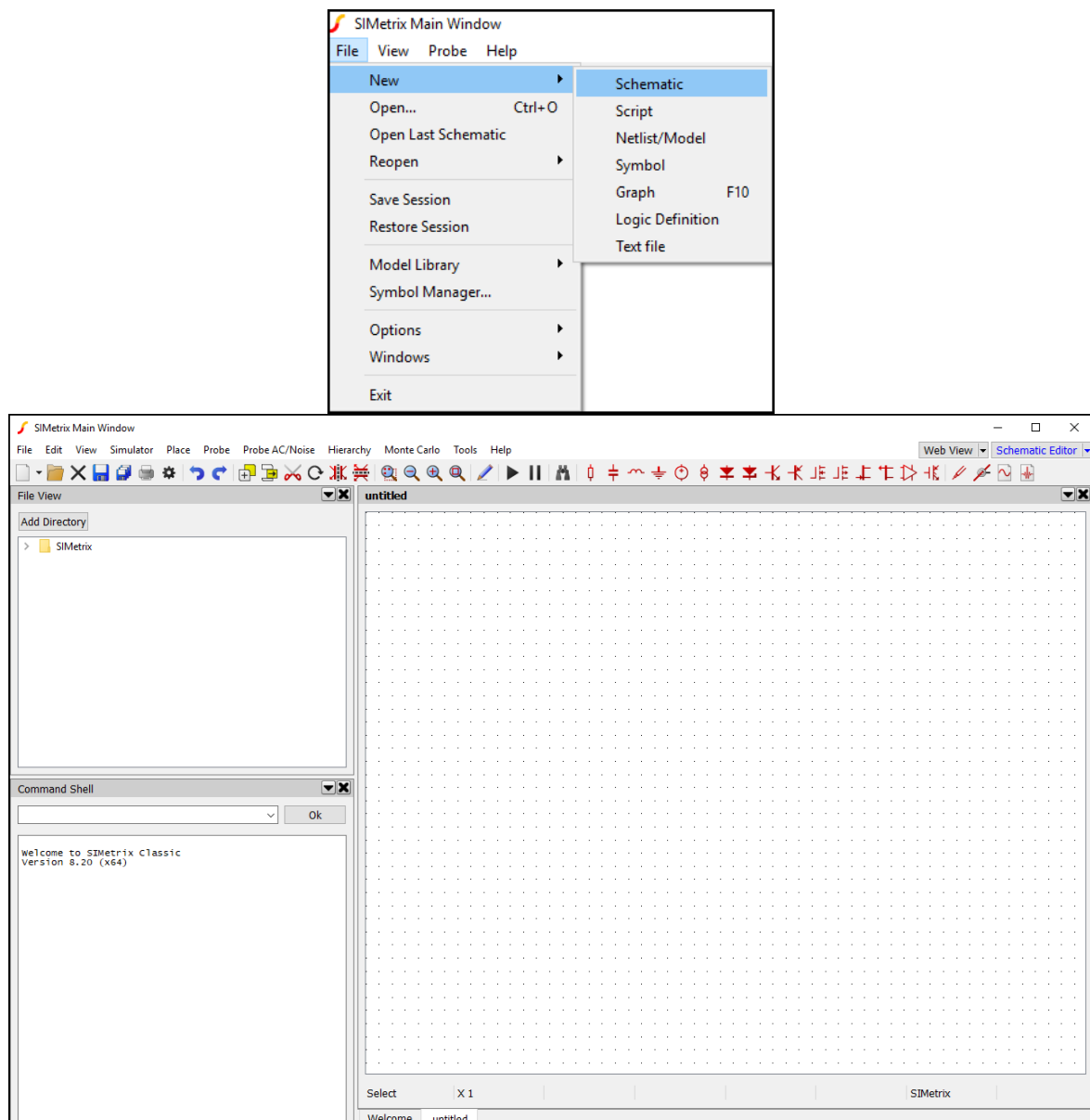


Figure 1 Create new Schematic

2.2 Import of an existing model

Before setting up a simulation, the model libraries of interest must be integrated in the simulator tool. This section gives an introduction about the installation of the simulation model files in **SIMetrix**.

All simulation models are installed using two-step procedure:

- Install the model
- Associate model with symbol

2.2.1 Install the model

SIMetrix present two ways of model installation: “*drag and drop method*” and “*local installation method*”.

“Drag and Drop method”

To install a model select and drag *the code source file (.lib)*, e.g. GENERIC_MODEL.lib and *the symbol file (.sxslib)*, e.g. simulation_model.sxslib and drop them in the **SIMetrix** Command Shell:

- Open windows explorer and locate the device models.
- Select items to be installed.
- Make sure that the **SIMetrix command shell** is in focus. If not, select a schematic or graph and press the spacebar.
- Select the files in windows explorer, then drag and drop them into the **command shell**.
- For files which are processed individually, a message box will pop up. Once confirmed the simulation model will be installed.

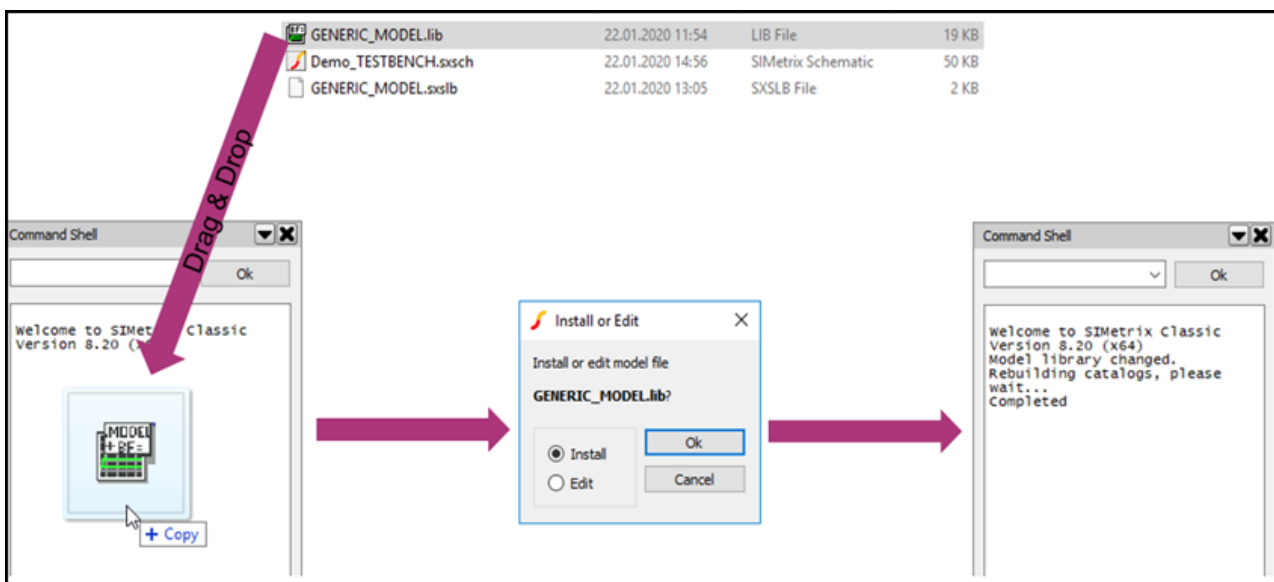


Figure 2 Drag & Drop

“Local Installation method”

A model (.lib file) can also be enabled for a certain schematic only – by including a reference in the Command Window.

Steps to follow:

- Open the schematic sheet, press **F11** on keyboard to toggle **Command Window**.
- Use **.include** command followed by library name. The model library file (.lib) must be placed in the same folder with the schematic.

```
1 .simulator SIMETRIX
2 .TRAN 0 2m 0 1u
3 .simulator DEFAULT
4 .include GENERIC_MODEL.lib
5
6
```

Figure 3 Local model

2.2.2 Associate model with symbol

Once the simulation model has been installed, *the symbol (.xsblb)* and *the code source file (.lib)* can be placed on the schematic and start a simulation:

- To associate a symbol to a new installed library, go to **Place → From Model Library**.

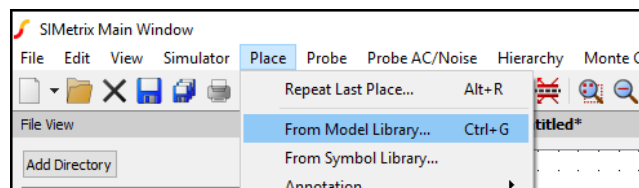


Figure 4 Associate Symbol with Model

- In the “**Recently Added Models**” section select the chosen part, e.g. **GENERIC_MODEL** and a schematic symbol will appear in the preview window, like in **Figure 5**.

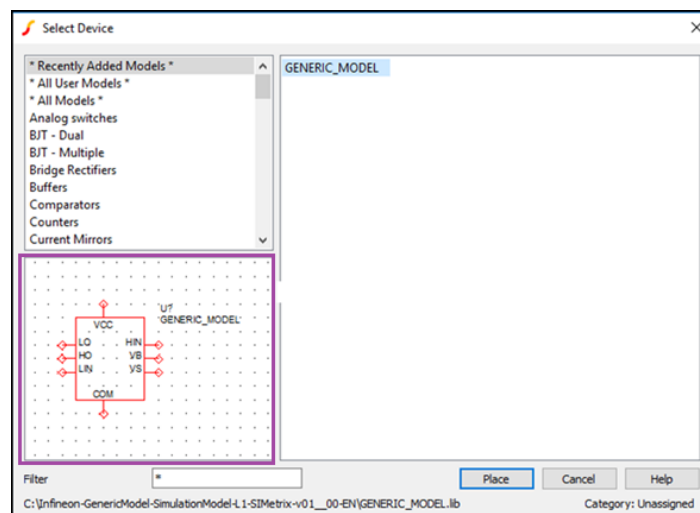


Figure 5 Associate Symbol with Model

- In case **SIMetrix** display the following message: “**SIMetrix does not know what symbol to use for this model**” like in **Figure 6**, press **Place**, select **Auto Create Symbol** (Figure 7) and a default rectangular shape will be associated.

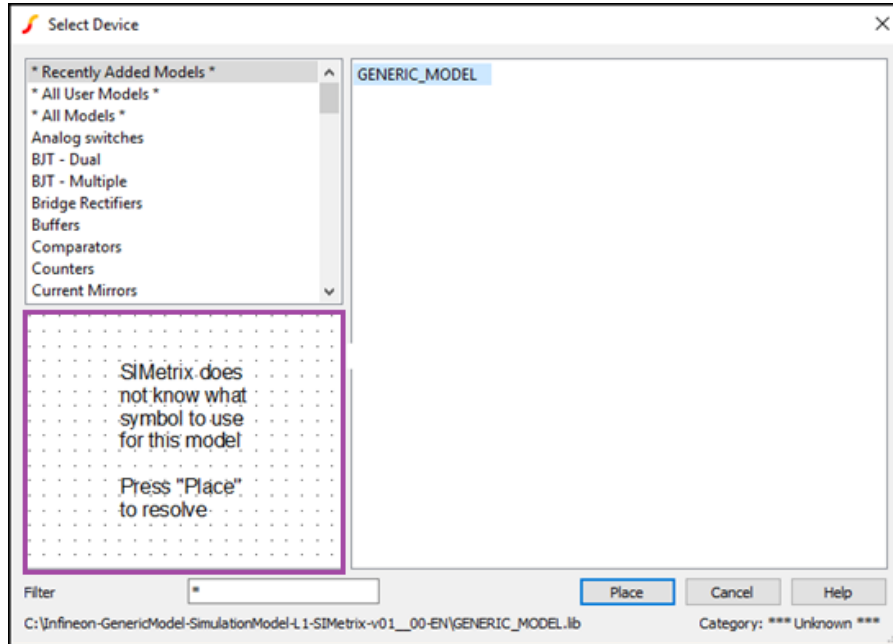


Figure 6 Associate Symbol with Model for unknown part

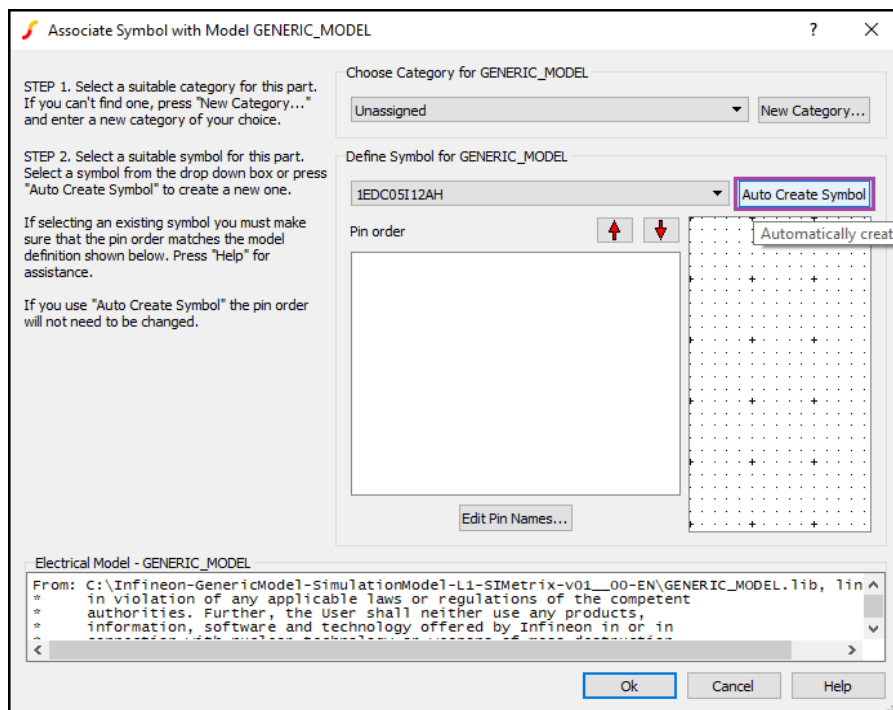


Figure 7 Associate Symbol with Model – Auto Create Symbol

- A preview of the model can be observe in the **Electrical Model** window.

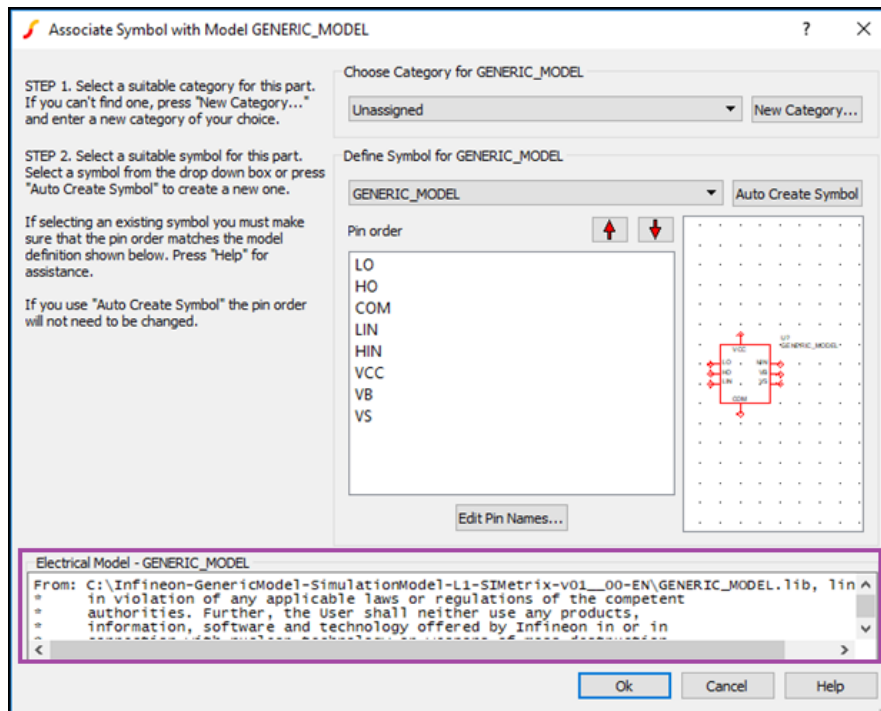


Figure 8 Associate Symbol with Model – Auto Create Symbol

- If the part will be placed in the “**Unassigned**” category, press OK and select **Yes, leave at “Unassigned”** (Figure 9), otherwise select a proper category or create a new one.

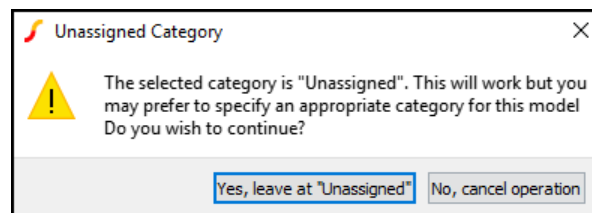


Figure 9 Associate Symbol with Model – Auto Create Symbol

The symbol is now ready and could be place in the schematic.

2.3 Set up and run a transient analysis

A Transient Analysis will evaluate the behavior of the circuit in the time domain, similar to what an oscilloscope displays in the lab.

To perform this analysis follow the next steps:

- From the main menu select **Simulator** → **Choose Analysis**

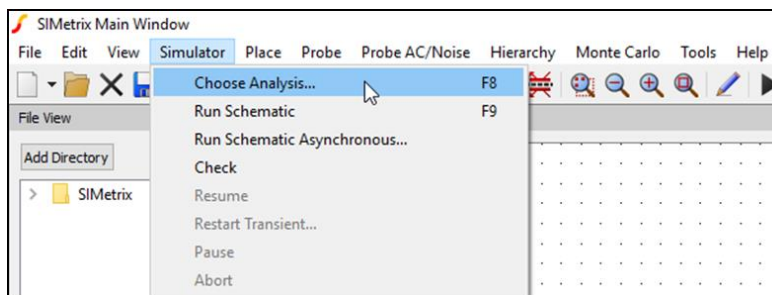


Figure 10 Choose Analysis

- From „Choose Analysis” dialog box select **Transient** check box situated on the right under „Analysis Mode”.

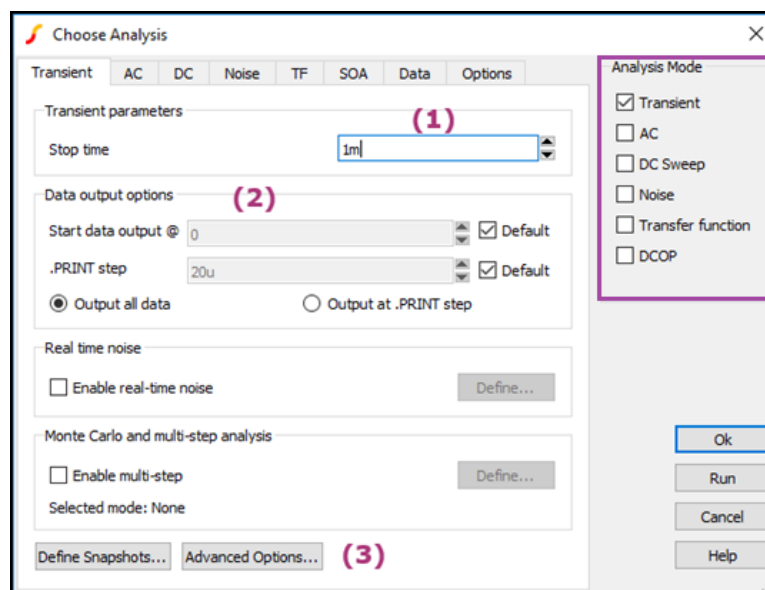


Figure 11 Simulation settings

- Select **Transient** tab at the top and enter the simulation parameters as described below:
 - Stop time (1)** = total simulation time. Note that the simulation can be paused before the **Stop time** is reached, allowing the results obtained so far to be examined.
 - Data output option (2)** = Sometimes it is desirable to restrict the amount of data being generated by the simulator which in some situations can be very large. It can be specified that data output does not begin until after a certain duration. It can also be specified a certain time interval for the data to be displayed.

- **Advanced option (3)** = press on the button and will opens the dialog box (Figure 12 Transient Advanced Options).

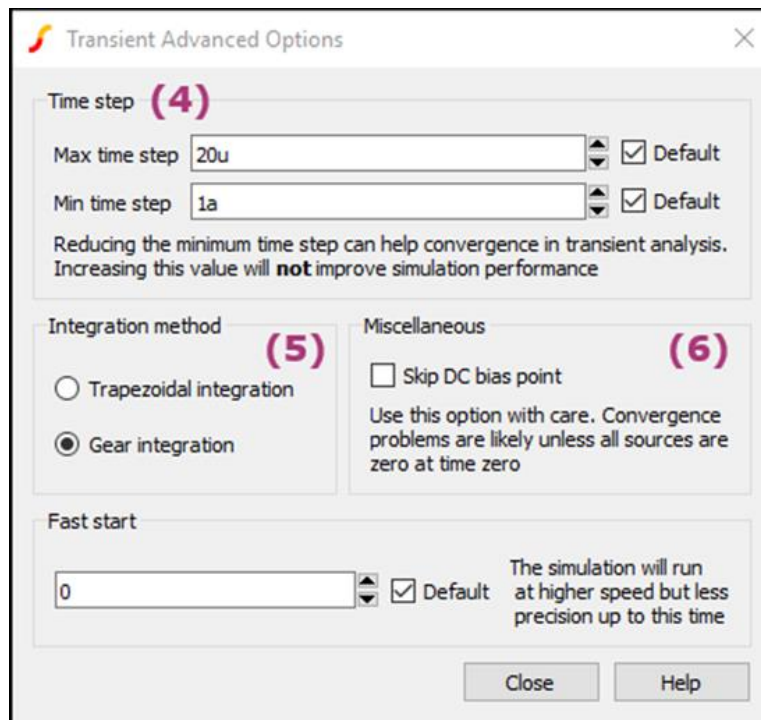


Figure 12 Simulation settings

- **Time Step (4)** = defines the maximum internal step size, which is dependent on the specified Stop Time parameter.
- **Integration Method (5)** = it is recommended to set this to **Gear integration** because in most cases it works better and is less noisy than Trapezoidal integration.
- **Skip DC bias point (6)** = the simulation will start with all nodes at zero volts (transient analysis convergence problems are very likely if this is not the case as the circuit will be starting from an unknown state).
- From the main menu, select **Simulator** → **Run Schematic** to perform the analysis.

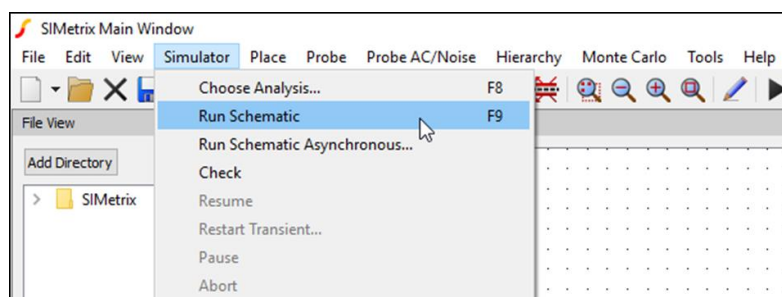


Figure 13 Run the simulation

2.4 Set up global parameters

A model parameter allows the user to have a direct control over specific components inside the circuit at any hierarchical level with the following purposes:

- Apply the same value to multiple part instances.
- Set up an analysis that sweeps a variable through a range of values (for example, DC sweep or parametric analysis).

To declare a global parameter in **SIMetrix**:

- Open the schematic sheet ;
- Press **F11** on keyboard to toggle **Command Window**;
- Use **.PARAM** command followed by parameter name and value.

```
1 .simulator SIMETRIX
2 .TRAN 1m
3 .options conv=2
4 .param Param1=1
5 .simulator DEFAULT
6
```

Figure 14 Define global parameter

Two practical examples are shown below:

- Apply the same value to multiple instances: in the value field of any component use the parameter name between curly brackets.

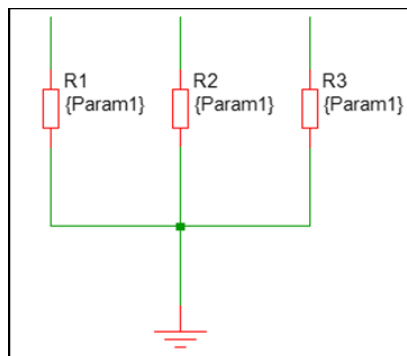


Figure 15 Global parameter for multiple instances

- Set up an analysis to sweep a variable through a range of values. The effect is the same as running the circuit several times, once for each value of the swept variable. To perform this analysis follow the steps from **Figure 16**.
- In “**Chose Analysis**” menu select “**Enable multi-step**” (1) and click on “**Define...**”

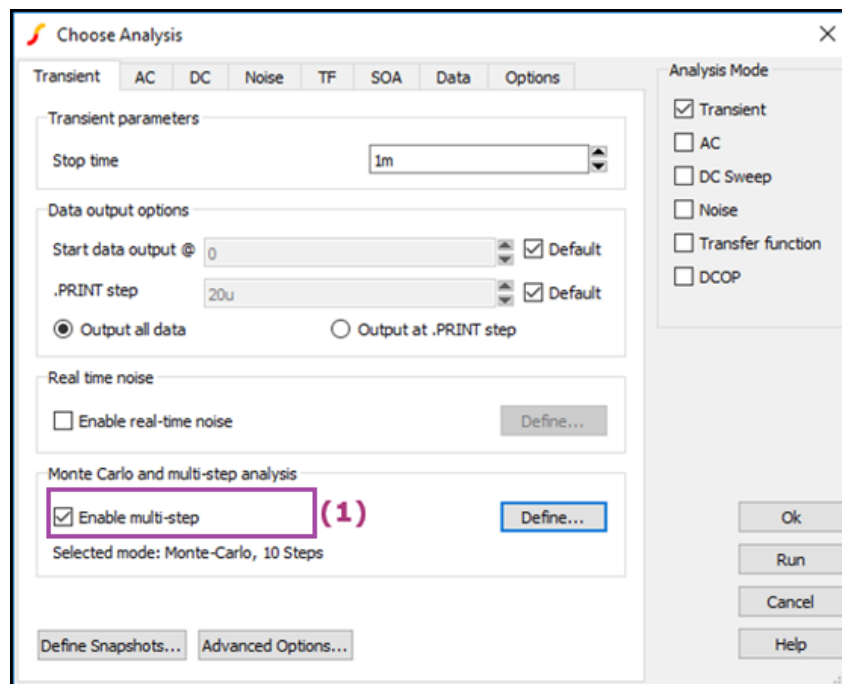


Figure 16 Set up a parametric simulation

- Select “**Parameter**” from “**Sweep mode**” menu (3), enter the “**Parameter name**” (4) and define the “**Step parameters**” (5).

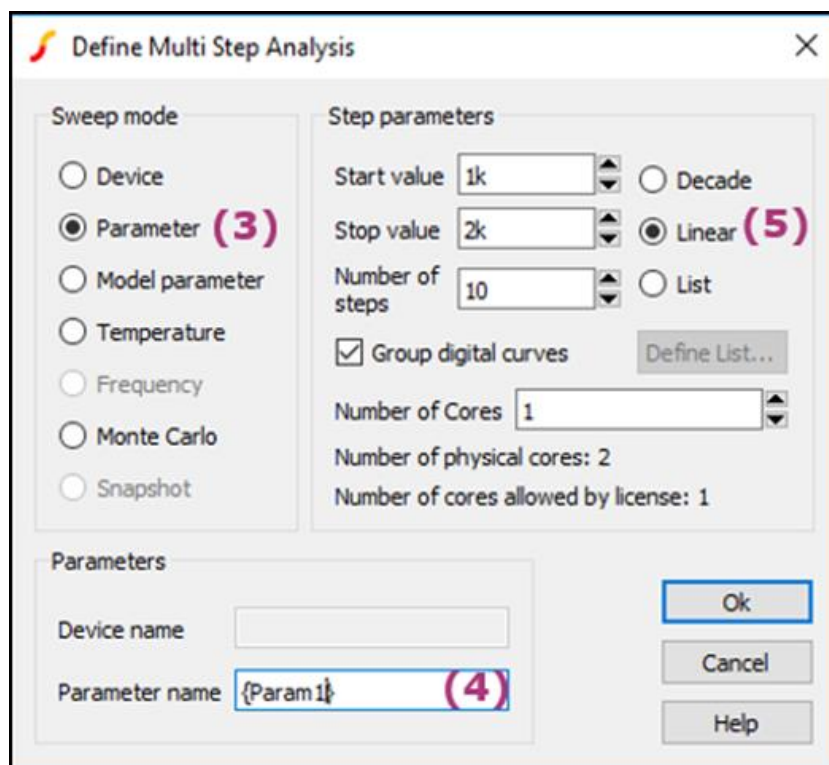


Figure 17 Set up a parametric simulation

2.5 Recommended simulation settings

As **Spice** was not originally designed for power electronics and highly non-linear components, the simulation parameters (**Simulator** → **Choose Analysis** → **Options**) may be optimized for a specific design.

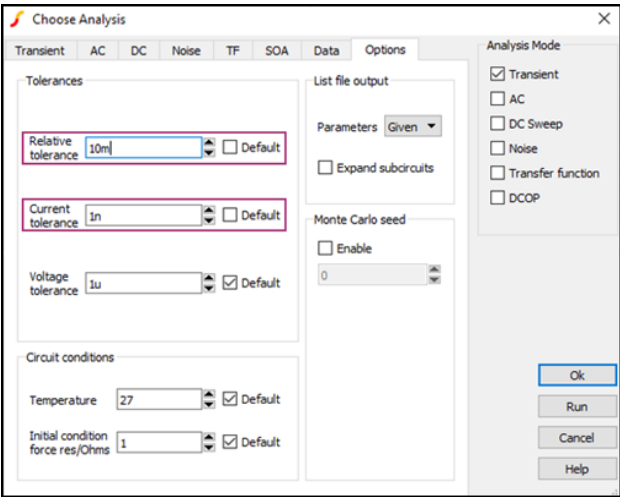


Figure 18 Simulation settings

The following recommended values facilitate convergence:







Table 1 Recommended values for simulation parameters

Relative tolerance=10m	relative accuracy of voltage and currents
Current tolerance=1n	maximum current accuracy
Integration method=Gear	see Chapter 5.3
Skip DC bias point	see Chapter 5.3
.options noOplter	skip the initial attempt at solving the DC operating point; can be define in the schematic's F11 window

In general, the delivered models need to detect a rising edge starting from 0V on Inputs and Supply voltages to properly for a proper start-up sequence. It is recommended to use **VPWL** or **VPULSE** instead of **VDC** component.

TIP: In order to avoid the simulator's potential convergence issues please avoid using voltage sources such as VDC components as most of the models require a power-up pattern starting for at least a couple of micro-seconds from a zero volts supply. Therefore, it is best practice to use sources like VPULSE or VPWL as shown below:

Table 2 Table A

VDC	VPULSE	VPWL
		
		

3 Opening an existing project

Typically, the model is delivered with an attached *demo_testbench*, which is already configured and is ready for use.

3.1 Transient simulation considerations

- Open the **SIMetrix** application and from the main menu select **File** → **Open**.
- In the browse window locate and open the **schematic file** (.sxsch), e.g. “**DEMO_TESTBENCH.sxsch**” file from the *Infineon-GenericModel-SimulationModel-L1-SIMetrix-v01_00-EN* package directory. For example:

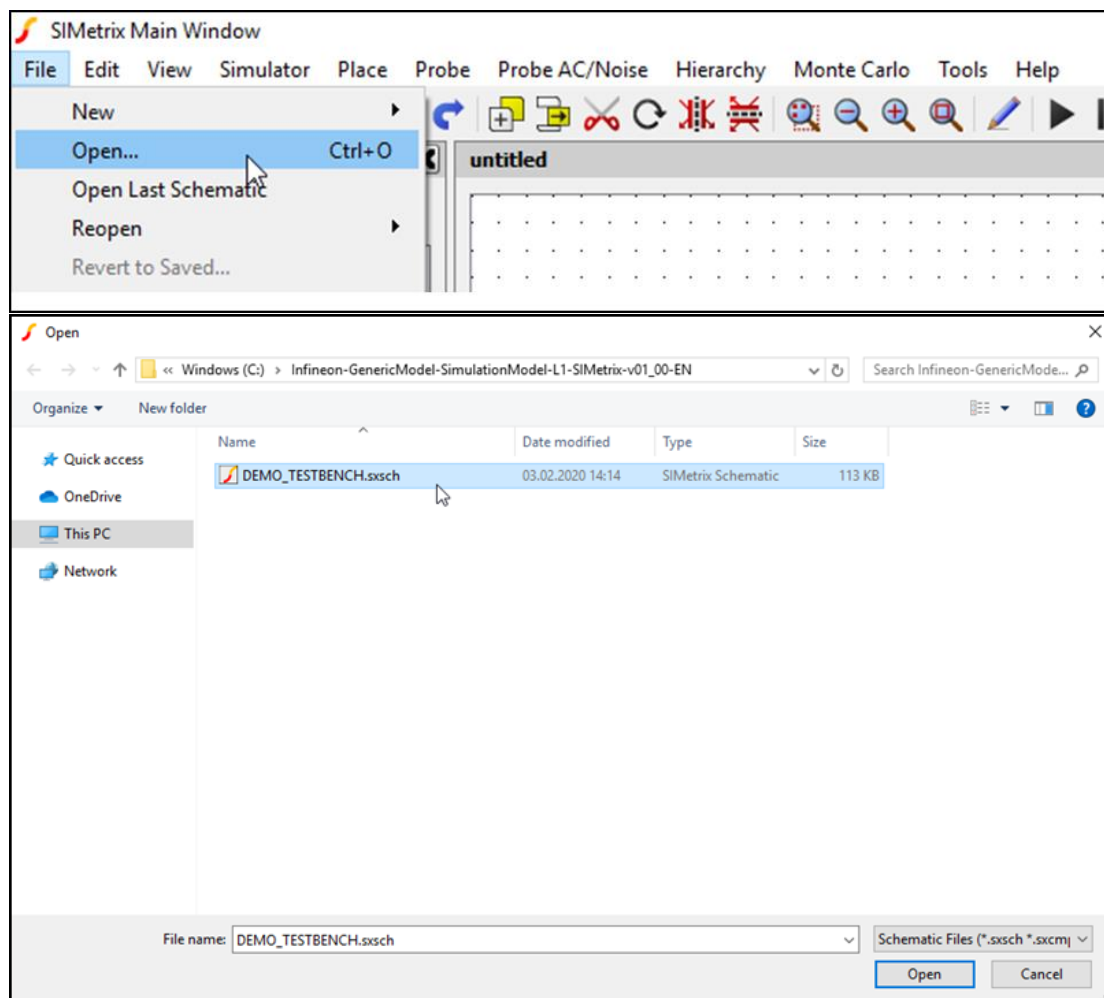


Figure 19 Open an existing project

- The window will display the application testbench schematic, similar to that below:

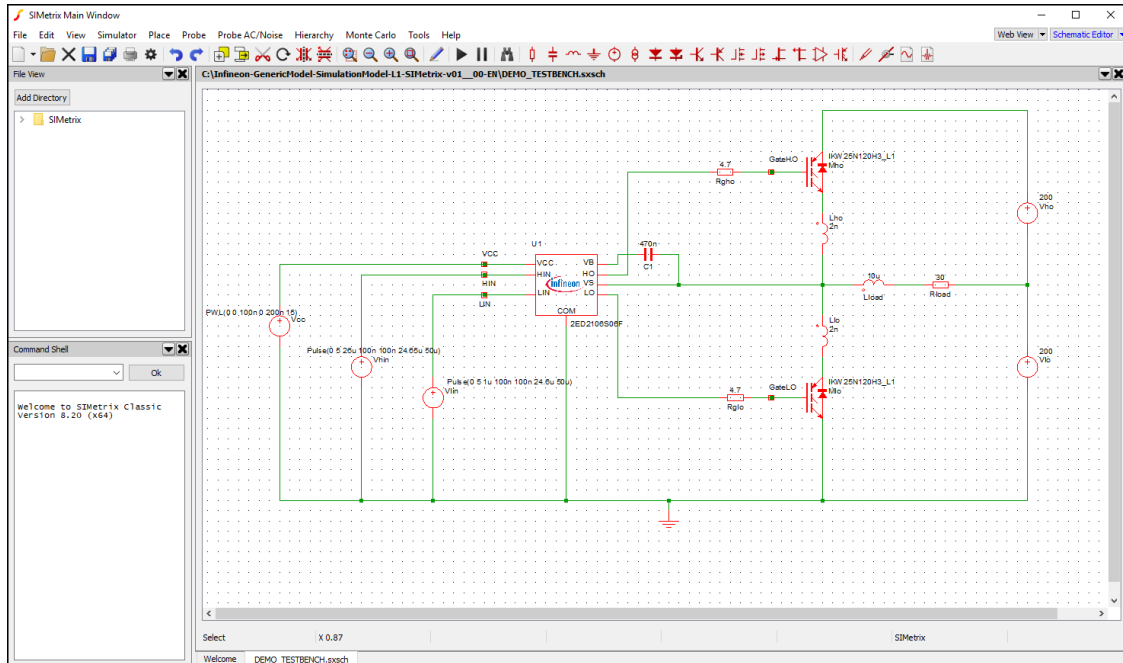


Figure 20 Open the demo_testbench

- To start the simulation, press “F9” on the keyboard or open the **Simulator** → **Run Schematic**. Alternatively, the play button on the **SIMetrix** toolbar may be used.

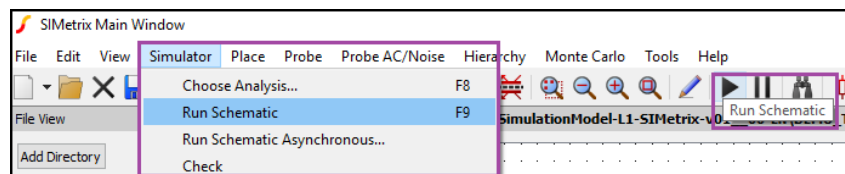


Figure 21 Start a simulation

- Once the netlist has been generated, the “**Simulator**” will open and the simulation will automatically start.
- After the **Simulator Status** will show Complete (1) the signals can be plotted. To do this, close the Simulator window (2) and from the main menu select **Probe** → **Add curve** (3).

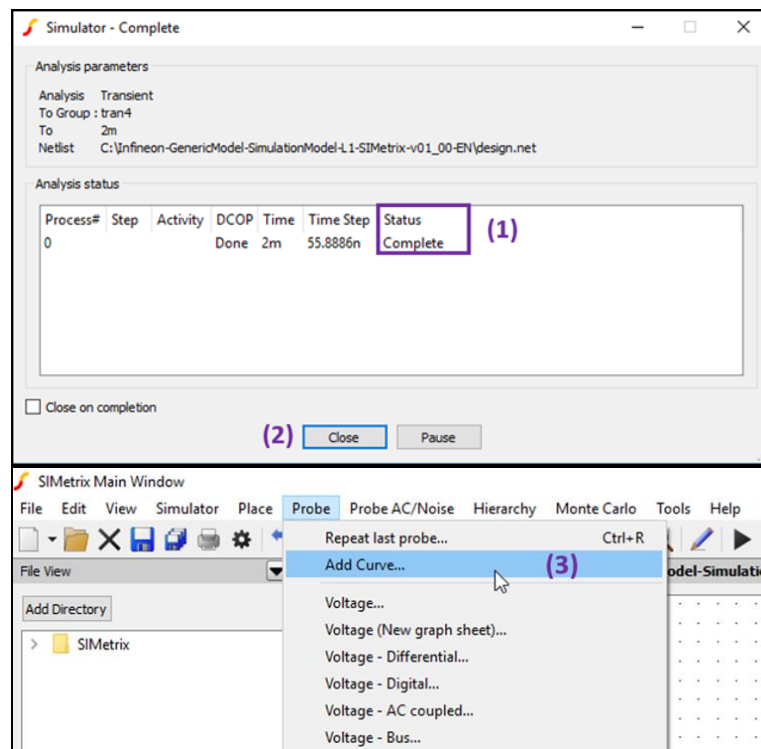


Figure 22 Plot signals

- To plot the signals please select them from the **Available vectors** (4) then press “OK” button (5).

Note: Filtering of the desired signals can be done from “**Edit Filter**” menu (6), using the check boxes in the right of the window by their type (e.g. voltages, currents (7)).

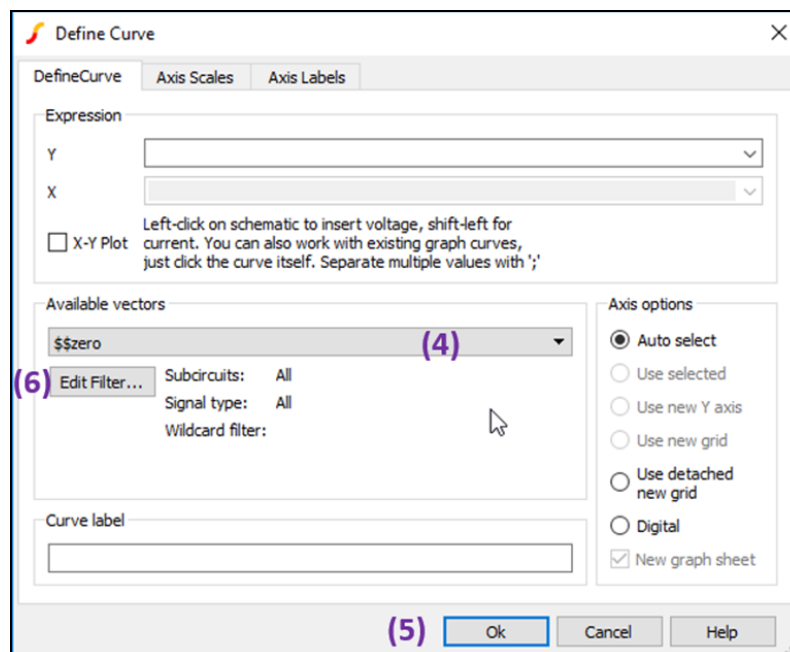


Figure 23 Plot signals

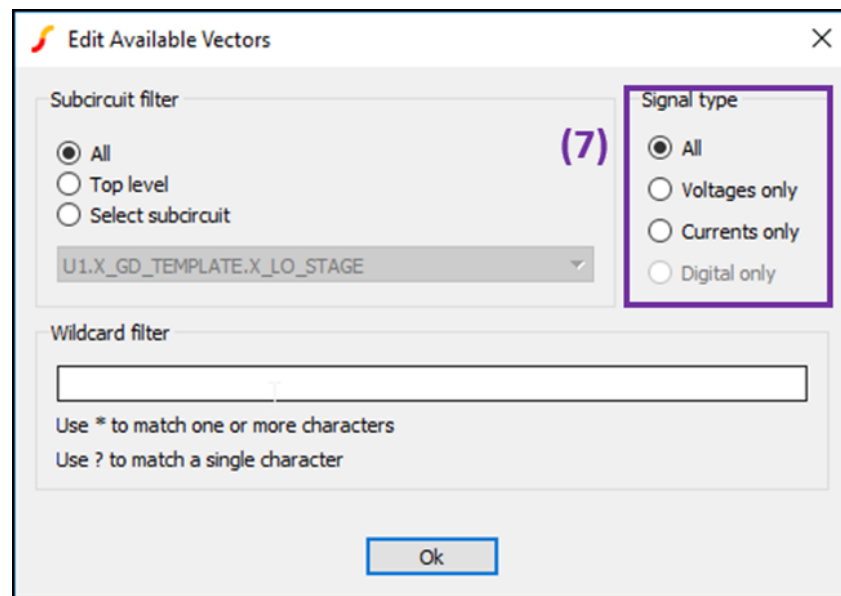


Figure 24 Plot signals

- To add other windows, select from the main menu **Axes** → **New Grid**.

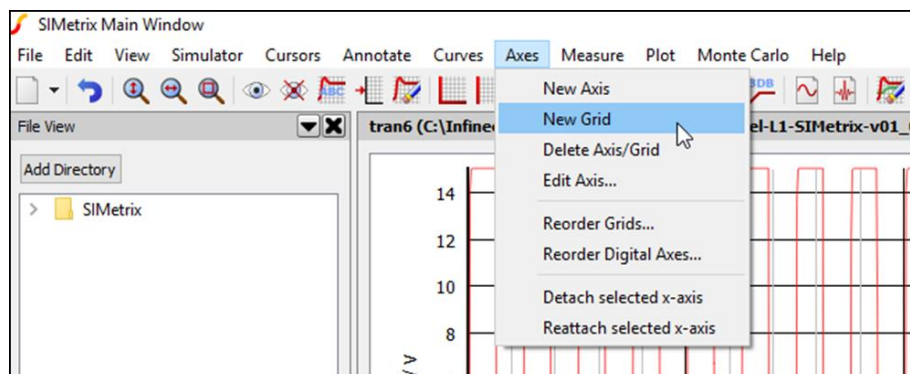


Figure 25 Plot signals



4 INFINEON'S SIMULATION MODEL TERMS OF USE

BY DOWNLOADING AND/OR USING THIS INFINEON MODEL ("MODEL"), THE USER (INCLUDING YOU) AGREES TO BE BOUND BY THE TERMS OF USE HERE STATED. IF USER DOES NOT AGREE TO ALL TERMS OF USE HERE STATED, USER SHALL NOT DOWNLOAD, USE OR COPY THE MODEL BUT IMMEDIATELY DELETE IT (TO THE EXTENT THAT IT WAS DOWNLOADED ALREADY).

1. SCOPE OF USE

1.1 Any use of this Model provided by Infineon Technologies AG is subject to these Terms of Use.

1.2 This Model, provided by Infineon, does not fully represent all of the specifications and operating characteristics of the product to which this Model relates.

1.3 This Model only describes the characteristics of a typical product. In all cases, the current data sheet information for a given product is the final design guideline and the only actual performance specification. Although this Model can be a useful tool to evaluate the product performance, it cannot simulate the exact product performance under all conditions and it is also not intended to replace bread-boarding for final verification.

2. IMPORTANT NOTICE

2.1 Infineon Technologies AG ("Infineon") is not and cannot be aware of the specific application of the Infineon's Model by User. However, Model may from time to time be used by User in potentially harmful and/or life-endangering applications such as traffic, logistic, medical, nuclear or military applications or in other applications where failure of the Model may predictably cause damage to persons' life or health or to property (hereinafter "Critical Applications").

2.2 User acknowledges that Infineon has not specifically designed or qualified the Model for Critical Applications that the Model may contain errors and bugs and that User is required to qualify the Model for Critical Applications pursuant to the applicable local quality, safety and legal requirements before permitting or giving access to any such use.

3. CONFIDENTIAL INFORMATION

User shall treat ideas, concepts and information incorporated in the Model, the documentation and the content of this Terms of Use (together hereinafter "Confidential Information") confidential, not disclose it to any third party unless otherwise agreed in writing between User and Infineon, not use it for any other purposes than using the Model for simulation and testing purposes only.

4. WARRANTY

4.1 User acknowledges that the Model is provided by Infineon under this Terms of Use is provided free of charge and "AS IS" without any warranty or liability of any kind and Infineon hereby expressly disclaims any warranties or representations, whether express, implied, statutory or otherwise, including but not limited to warranties of workmanship, merchantability, fitness for a particular purpose, defects in the Model, or non-infringement of third parties intellectual property rights.

4.2 Infineon reserves the right to make corrections, deletions, modifications, enhancements, improvements and other changes to the Model at any time or to move or discontinue any Model without notice.

5. LIABILITY



5.1 Nothing in this Terms of Use shall limit or exclude Infineon's liability under mandatory liability laws, for injuries to life, body or health, for fraudulent concealment of defects in the software, or in cases of Infineon's intentional misconduct or gross negligence.

5.2 Without prejudice to Sections 5.1, in cases of Infineon's slight negligent breach of obligations that restrict essential rights or duties arising from the nature of this Terms of Use in a way that there is a risk of non-achievement of the purpose of this Terms of Use or of an obligation whose observance

User regularly may trust in and whereas compliance with only makes proper execution of this Terms of Use possible, Infineon's liability shall be limited to the typically, foreseeable damage.

5.3 Without prejudice to Sections 8.1 and 8.2, Infineon's liability under this Agreement shall be excluded in all other cases.

6. EXPORT REGULATIONS

The User shall comply with all applicable national and international laws and regulations, in particular the applicable export control regulations and sanction programs. The User also agrees not to export, re-export or transfer any software or technology developed with or using information, software or technology offered by Infineon, in violation of any applicable laws or regulations of the competent authorities. Further, the User shall neither use any products, information, software and technology offered by Infineon in or in connection with nuclear technology or weapons of mass destruction (nuclear, biological or chemical) and carriers thereof nor supply military consignees.

7. TERMINATION OF USE PERMIT

If the User violates these Terms of Use, such User's permit to use this Model terminates automatically. In addition, Infineon may terminate the User's permit to use this Model at its discretion and at any time regardless of any violation of these Terms of Use. In any of the foregoing events, the User is obliged to immediately destroy any content that has been downloaded or printed from Infineon's website.

8. MISCELLANEOUS

8.1 These Terms of Use are subject to the laws of the Federal Republic of Germany with the exception of the United Nations on Purchase Contracts on the International Sale of Goods dated April 11, 1980 (CISG). The exclusive place of jurisdiction is Munich, Germany.

8.2 Should any provision in these Terms of Use be or become invalid, the validity of all other provisions or agreements shall remain unaffected thereby.



Revision history

Document version	Date of release	Description of changes
Rev 1.0	2020-02-04	GettingStarted released