



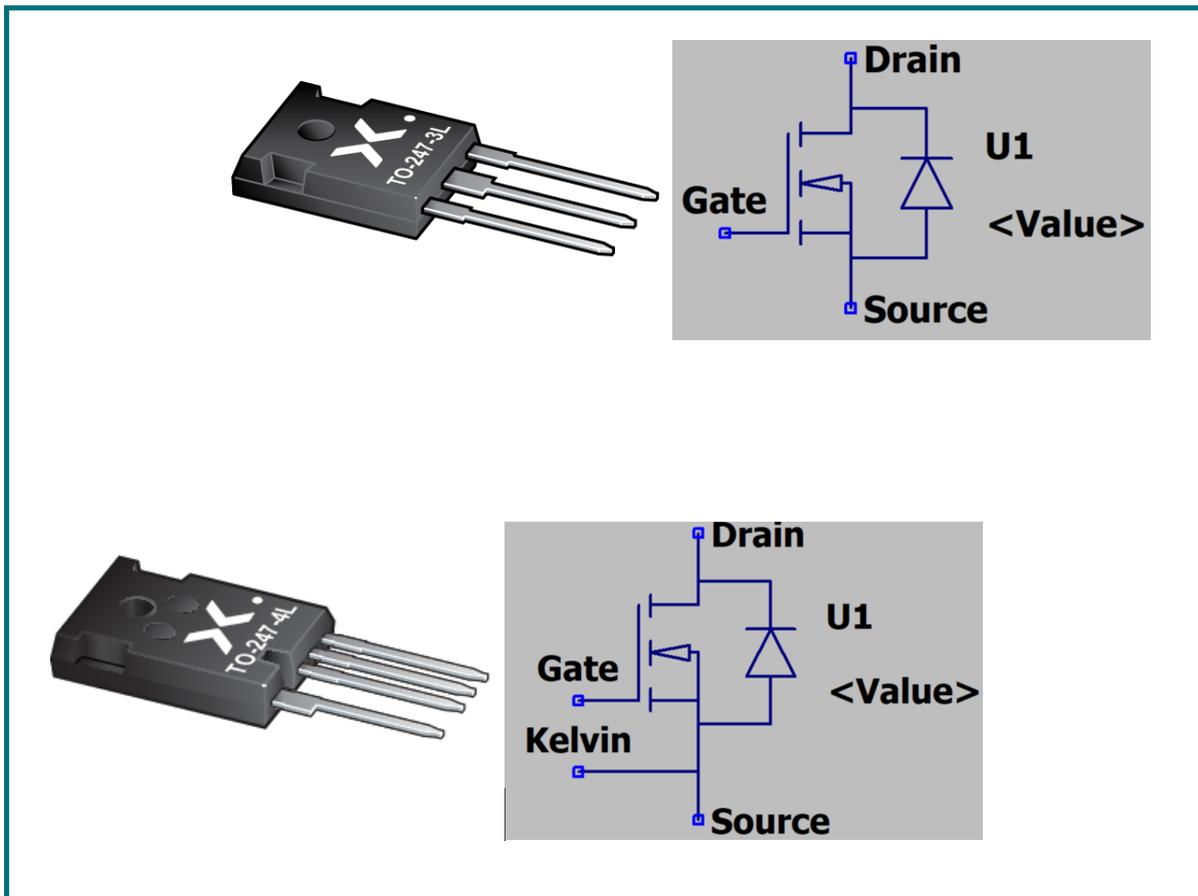
UM90031

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User manual

A guide to using Nexperia SiC MOSFET LTspice models



Abstract: This user guide provides details on installing and using Nexperia's SiC MOSFET LTspice models.

Keywords: SiC, MOSFET, LTspice, SPICE, model

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Models provided by Nexperia are not warranted by Nexperia as fully representing all of the specifications and operating characteristics of the semiconductor product to which the model relates. The model describes the characteristics of a typical device. In all cases, the current data sheet information for a given device is the final design guideline and the only actual performance specification. Although models can be a useful tool in evaluating device performance, they cannot model exact device performance under all conditions, nor are they intended to replace bread-boarding for final verification. Nexperia therefore does not assume any liability arising from their use. Nexperia reserves the right to change models without prior notice. The Simulation Model is subject to change without notice. In addition, models can be a useful tool in evaluating device performance, they cannot reflect the accurate device performance under all conditions, nor are they intended to replace bread boarding for final verification.

2. Introduction

Nexperia provides LTspice models to support users to understand the design and performance of a SiC MOSFET converter circuit by building it in a LTspice environment. Nexperia provides LTspice models for SiC MOSFETs, as shown in [Table 1](#). Currently, models are provided for TO-247-3L (SOT429-2) and TO-247-4 (SOT8071-1) package devices.

3. SPICE model pack

Nexperia model pack comes as a zipped file. For each part, it consists of:

1. Encrypted SPICE model (.lib), see [Table 1](#).
2. Model schematic symbol (.asy), see [Table 2](#).
3. A guide to using Nexperia SiC MOSFET LTspice models, (this document)

Table 1. Nexperia 1200 V SiC MOSFET LTspice .lib model files

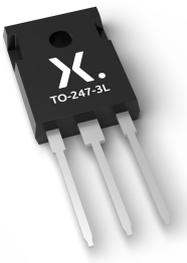
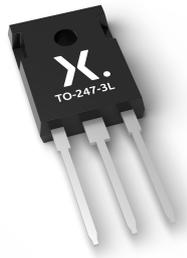
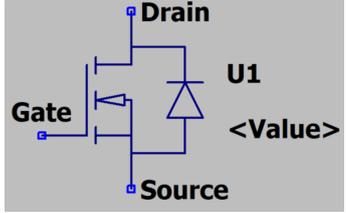
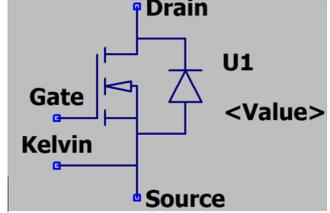
		
	TO-247-3L (SOT429-2)	TO-247-4 (SOT8071-1)
$V_{DS}; R_{DS(on)} @ V_{GS} = 15 \text{ V}$		
1200 V; 40 mΩ	NSF040120L3A0.lib	NSF040120L4A0.lib
1200 V; 80 mΩ	NSF080120L3A0.lib	NSF080120L4A0.lib

Table 2. Nexperia SiC MOSFET LTspice .asy symbol files

		
	TO-247-3L (SOT429-2)	TO-247-4 (SOT8071-1)
Symbol name	Nexperia_nmos_TO247_3L.asy	Nexperia_nmos_TO247_4L.asy
Symbol schematic view		

Note: Users can't read the details of the actual model code as the code is encrypted. However, the model's encryption doesn't affect the model simulations. So, the user can easily install and simulate the models. The installation procedure is described in [Section 6](#) of this document.

4. Model description

The SiC MOSFET LTspice models are Level 1 models, designed for fixed/constant temperature operations. The junction temperature is defined externally via simulator environment with the parameter command '.temp' in LTspice. The junction temperature can be simulated in the range of -55 °C to 175 °C using '.temp' command.

These models are designed and tested for the following features:

- Gate-source threshold voltage (V_{GSth}) as a function of junction temperature (T_j)
- R_{DSon} as a function of V_{GS} and temperature
- Output characteristics (I_D as a function of V_{DS} and V_{GS}) vs temperature
- Transfer characteristics (I_D as a function of V_{GS}) vs temperature
- Diode forward characteristics (V_{SDS}) as a function of temperature
- Drain source leakage (I_{DSS}) as a function of temperature
- Breakdown voltage (BV_{DSS}) as a function of temperature
- Internal capacitances as a function of drain-source voltage
- Diode reverse recovery as a function of switching speed

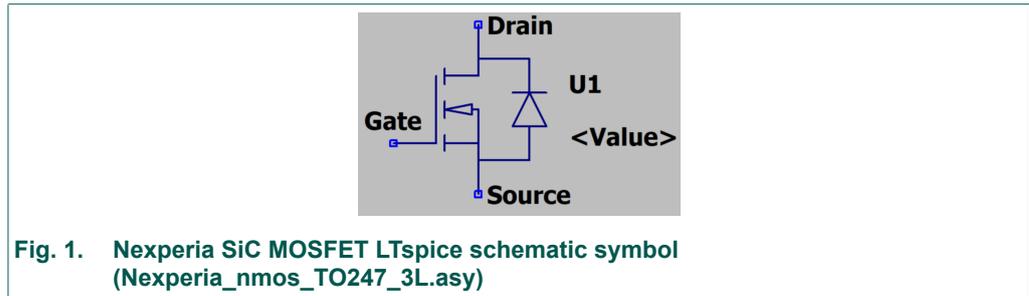
5. Requirement

Download the LTspice simulation tool: (<http://www.linear.com/designtools/software/#LTspice>).

6. Installation

The model pack of Nexperia comes as a ZIP file. The following instructions allow the customer to install and use the model into LTspice simulator:

1. Extract the ZIP file to your local folder.
2. Cross-check the materials available in the Nexperia model pack.
3. Copy the model schematic symbol (.asy) file and paste into your default LTspice symbols directory. Example location: (C:\Users\Admin\Documents\LTspiceXVII\lib\sym\NexSiCMOSFET). 'NexSiCMOSFET' folder is created inside the 'sym' folder, here. This helps to identify the Nexperia symbols in the component selection window of LTspice.



4. Copy the encrypted SPICE models (.lib) files and paste into your default LTspice library directory. Example location: (C:\Users\Admin\Documents\LTspiceXVII\lib\NexSiCMOSFET). 'NexSiCMOSFET' folder is created inside the 'lib' folder, here. This helps to identify the Nexperia model files easily.
5. Open or restart LTspice to load the new symbols into the software.

7. Model usage

Nexperia SiC MOSFET LTspice models are provided with the following terminals:

- **TO-247-3 devices:**
 - Drain
 - Gate
 - Source
- **TO-247-4 devices**
 - Drain
 - Gate
 - Source
 - Kelvin source

The symbol 'Nexperia_nmos_TO247_3L.asy' is for TO-247-3 SiC MOSFET devices and the symbol 'Nexperia_nmos_TO247_4L.asy' is for TO-247-4 SiC MOSFET devices. For example, SiC MOSFET models, NSF040120L3A0.lib and NSF080120L3A0.lib belong to TO-247-3 devices (3-pin terminals), the symbol 'Nexperia_nmos_TO247_3L.asy' is used for both the models.

To use the same symbol for different SiC MOSFET models, please follow the below instructions.

1. Place 'Nexperia_nmos_TO247_3L.asy' symbol into the LTspice schematic using the 'Select Component Symbol' window from the Toolbar.
2. Move the mouse cursor on the placed symbol and right click on it. It opens the 'Component Attribute Editor' window. The value field in the window must be given the model name to be used it for a particular model. For example, in [Fig. 2](#) the attribute value is given to NSF040120L3A0.
3. The user must include library path for the models manually into the schematic. The .lib SPICE directive command will link the respective model library file (.lib) with the symbol in the schematic. For example, the symbol placed with the attribute value, NSF040120L3A0 must be linked with the NSF040120L3A0.lib file. This is done by placing the library path with SPICE directive as shown in [Fig. 4](#), example location: "C:\Users\Admin\Documents\LTspiceXVII\lib\NexSiCMOSFET\NSF040120L3A0.lib"
4. The model is now ready to use in circuit designs and simulations.

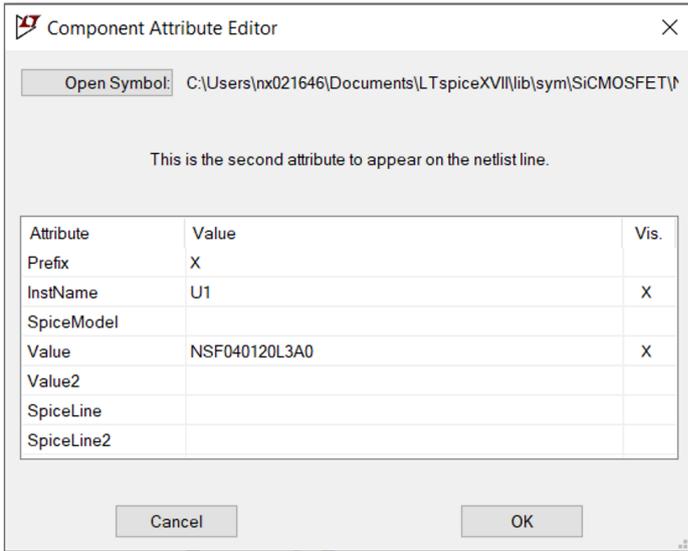


Fig. 2. Component attribute editor with the value changed to Nexperia model name, NSF040120L3A0

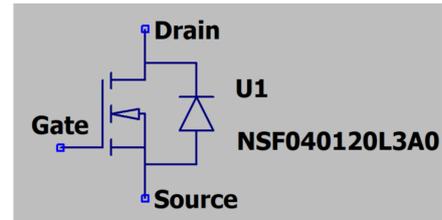


Fig. 3. Symbol after changing attribute value to Nexperia model name, NSF040120L3A0

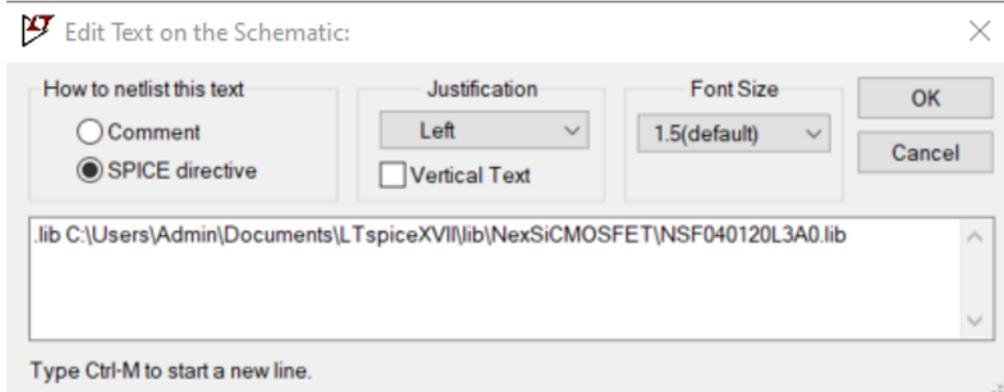


Fig. 4. SPICE directive editor with '.lib' command to link with NSF040120L3A0.lib library path

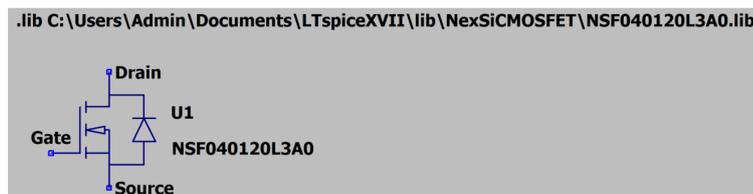


Fig. 5. SPICE directive '.lib' command with library path placed on the schematic

8. Revision history

Table 3. Revision history

Revision number	Date	Description
1.0	2024-02-29	Initial version.

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