ConfigurationDesk

Tutorial MicroAutoBox III

For ConfigurationDesk 6.7

Release 2021-A – May 2021

dSPACE

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Contents

About This Tutorial

Content

The dSPACE software provides demo projects for ConfigurationDesk. This tutorial uses the `CfgMicroAutoBoxIIITutorial` demo project to help you learn the basic steps in ConfigurationDesk when working with a MicroAutoBox III.

> **Tip**
>
> If you want to learn how to work with ConfigurationDesk starting with an external device, such as an ECU, refer to ConfigurationDesk Tutorial Starting with External Devices 🕮.
> For a similar, but more complex workflow including lessons on I/O events and conflict handling, but using no MicroAutoBox III hardware, refer to ConfigurationDesk Tutorial Starting with Simulink 🕮.

Required knowledge

This tutorial is primarily intended for engineers who implement and build real-time applications. Knowledge of Windows applications and the basics of MicroAutoBox III hardware is assumed.

Symbols

dSPACE user documentation uses the following symbols:

Symbol	Description
⚠ DANGER	Indicates a hazardous situation that, if not avoided, will result in death or serious injury.
⚠ WARNING	Indicates a hazardous situation that, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates a hazard that, if not avoided, could result in property damage.
Note	Indicates important information that you should take into account to avoid malfunctions.

Symbol	Description
Tip	Indicates tips that can make your work easier.
❓	Indicates a link that refers to a definition in the glossary, which you can find at the end of the document unless stated otherwise.
📖	Precedes the document title in a link that refers to another document.

Naming conventions

dSPACE user documentation uses the following naming conventions:

%name% Names enclosed in percent signs refer to environment variables for file and path names.

< > Angle brackets contain wildcard characters or placeholders for variable file and path names, etc.

Special folders

Some software products use the following special folders:

Common Program Data folder A standard folder for application-specific configuration data that is used by all users.

`%PROGRAMDATA%\dSPACE\<InstallationGUID>\<ProductName>`

or

`%PROGRAMDATA%\dSPACE\<ProductName>\<VersionNumber>`

Documents folder A standard folder for user-specific documents.

`%USERPROFILE%\Documents\dSPACE\<ProductName>\<VersionNumber>`

Local Program Data folder A standard folder for application-specific configuration data that is used by the current, non-roaming user.

`%USERPROFILE%\AppData\Local\dSPACE\<InstallationGUID>\<ProductName>`

Accessing dSPACE Help and PDF Files

After you install and decrypt dSPACE software, the documentation for the installed products is available in dSPACE Help and as PDF files.

dSPACE Help (local) You can open your local installation of dSPACE Help:

- On its home page via Windows Start Menu
- On specific content using context-sensitive help via **F1**

dSPACE Help (Web) You can access the Web version of dSPACE Help at www.dspace.com/go/help.

To access the Web version, you must have a *mydSPACE* account.

PDF files You can access PDF files via the 📄 icon in dSPACE Help. The PDF opens on the first page.

Introduction to the Tutorial

Where to go from here

Information in this section

Working with the Tutorial

Purpose of the tutorial

This tutorial shows you the basic configuration steps if you want to use MicroAutoBox III hardware in ConfigurationDesk.

Tip

If you want to learn how to work with ConfigurationDesk starting with an external device, such as an ECU, refer to ConfigurationDesk Tutorial Starting with External Devices 🕮.

For a similar, but more complex workflow including lessons on I/O events and conflict handling, but using no MicroAutoBox III hardware, refer to ConfigurationDesk Tutorial Starting with Simulink 🕮.

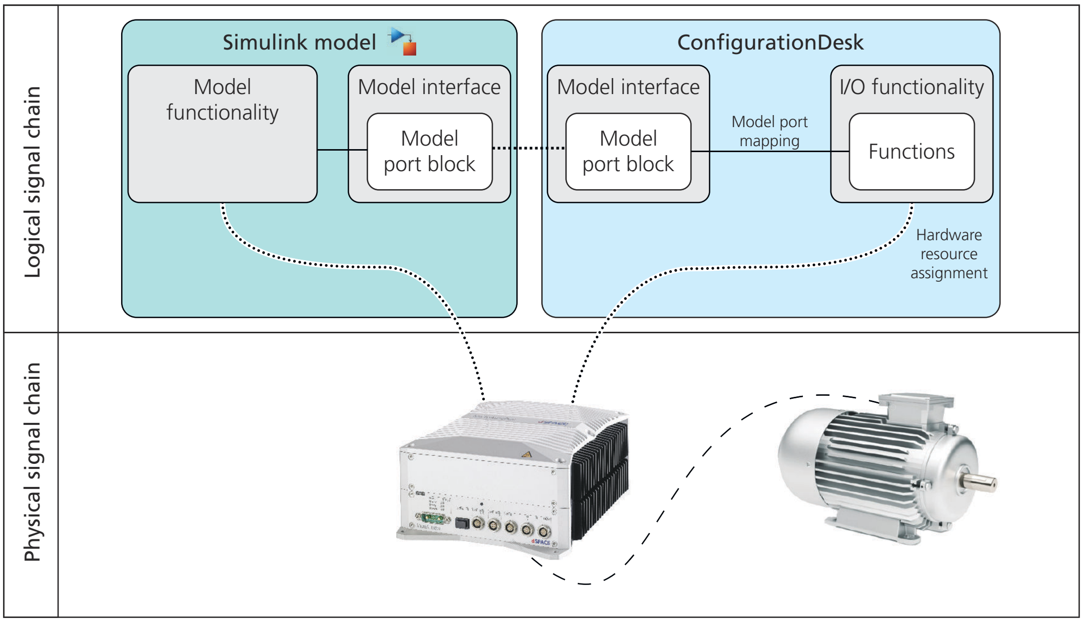
Recommended knowledge

Knowledge of the basic concepts of ConfigurationDesk will help you understand the context of the different lessons. For more information, refer to Basic Concepts of ConfigurationDesk (ConfigurationDesk Getting Started 🕮).

Differences to MicroAutoBox II and RTI If you have previously worked with the MicroAutoBox II and RTI blocks, refer to Information for MicroAutoBox II Users (MicroAutoBox III - Getting Started 🕮).

Use scenario

The tutorial use scenario is based on a simple PID controller model for a DC motor. The following illustration shows the logical and the physical signal chain for the tutorial use scenario:



The signals required to control the DC motor must be made available from the Simulink model to the I/O interface of the MicroAutoBox III. For this purpose the model signals are transformed to electrical signals by using ConfigurationDesk I/O functionality that is assigned to the required hardware channels. The DC motor must be wired to connector pins providing/measuring the required signals.

Tip

You do not require a MicroAutoBox III system or a DC motor to perform the steps of the tutorial.

Lessons of the tutorial

The real-time application for the tutorial use scenario is implemented in several lessons that address different areas of the implementation. Refer to Overview of Lessons on page 10.

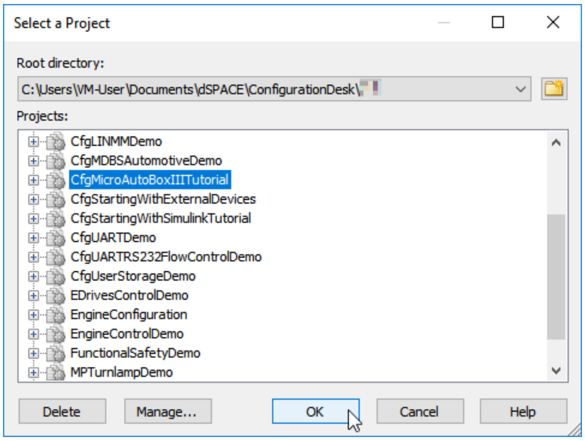
You can activate a specific application of the `CfgMicroAutoBoxIIITutorial` demo project to complete a specific lesson, for example, Lesson_2, to learn how to add I/O functionality. The Results application serves as a reference for your working results after finishing all lessons.

Handling the CfgMicroAutoBoxIIITutorial demo project

File location The files of the demo project are automatically unpacked to the *Documents folder* when ConfigurationDesk is first started.

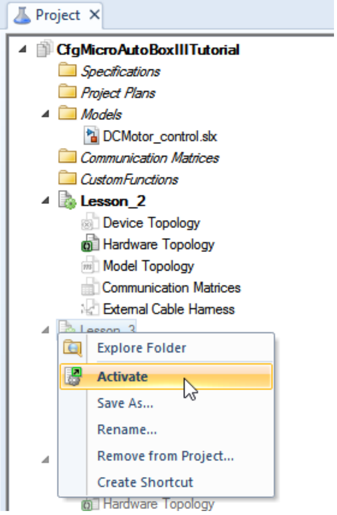
They are also backed up in the `CfgMicroAutoBoxIIITutorial.zip` archive, which is located in the `<RCP and HIL installation folder>\Demos\ConfigurationDesk\Tutorial` folder after you install the dSPACE software.

Opening the demo project You can open the demo project like any ConfigurationDesk project, for example, via File – Open – Open Project and Application. ConfigurationDesk lets you select a specific application to activate after the project is opened. If you do not select an application, the first application will automatically be activated.



Root directory: C:\Users\VM-User\Documents\dSPACE\ConfigurationDesk\

Activating applications for each lesson You can activate a different application in the Project view set.



The demo project contains applications for the tutorial lessons. Each lesson contains only very few work steps, so you can easily switch between the applications to complete different lessons.

Note

There is no Lesson_1 application because the tutorial starts in Simulink.

Handling conflicts

While you complete the lessons of the tutorial, several conflicts will be displayed in and removed from the **Conflicts Viewer** depending on the current configuration steps. You can ignore these conflicts while you complete the lessons, because ConfigurationDesk allows for a flexible configuration without strict constraints to let you work more freely. For more information on conflict handling, refer to Resolving Conflicts (ConfigurationDesk Real-Time Implementation Guide 📖).

Overview of Lessons

Lessons and applications

The following table shows the contents of the tutorial lessons and the associated demo applications.

Content	Lesson	Demo Application
▪ How to create a ConfigurationDesk project from a Simulink behavior model	Lesson 1: Creating a ConfigurationDesk Project from a Simulink Model on page 11	No application available because the tutorial starts with a prepared model in Simulink.
▪ How to create and map function blocks starting from hardware resources	Lesson 2: Adding I/O Functionality in ConfigurationDesk on page 17	Lesson_2
▪ How to propagate changes from ConfigurationDesk to the Simulink behavior model	Lesson 3: Synchronizing the ConfigurationDesk I/O Functionality and the Simulink Behavior Model on page 23	Lesson_3
▪ How to prepare the build process and build a real-time application	Lesson 4: Building the Real-Time Application on page 29	Lesson_4

Tip

The lessons of the tutorial show you one method of obtaining the result. In many cases, other methods are also possible.

Lesson 1: Creating a ConfigurationDesk Project from a Simulink Model

Where to go from here

Information in this section

Overview of Lesson 1

From Simulink behavior model to ConfigurationDesk project

You can create a ConfigurationDesk project from a Simulink behavior model. The project contains a model interface representing the structure of the Simulink behavior model.

What will you do?

In this lesson you will:

- Create a ConfigurationDesk project from a Simulink behavior model. The project will include a ConfigurationDesk application with a model interface representing the structure of the behavior model and a hardware topology representing dSPACE real-time hardware in ConfigurationDesk.

Steps

This lesson contains the following steps:

- Step 1: How to Create a ConfigurationDesk Project from a Simulink Behavior Model on page 12

Step 1: How to Create a ConfigurationDesk Project from a Simulink Behavior Model

Precondition

A compatible MATLAB version (including Simulink) must be installed on the host PC and connected to the RCP and HIL installation (containing the ConfigurationDesk software).

Method

To create a ConfigurationDesk project from a Simulink behavior model

1 Copy the following Simulink model to a working directory of your choice:

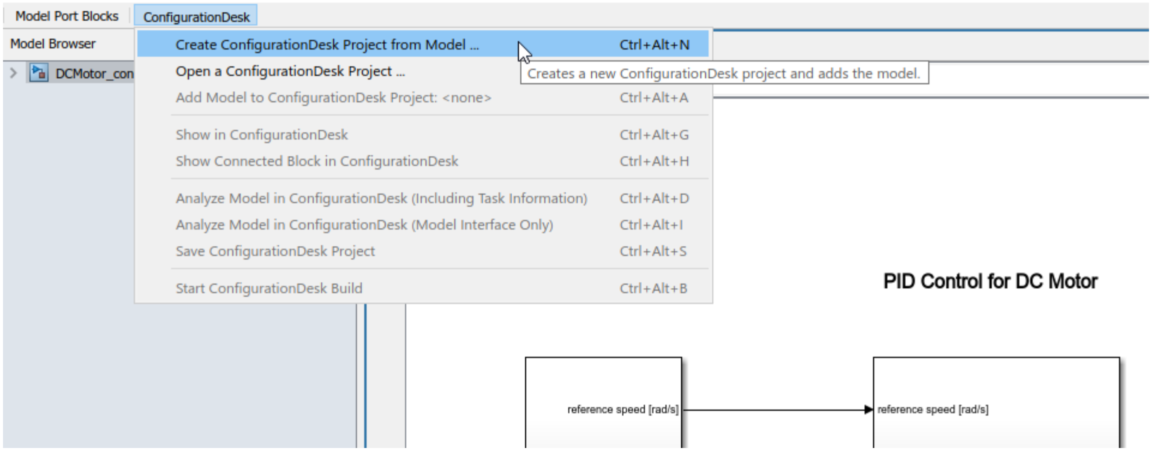
```
<Documents folder>\Tutorials\CfgMicroAutoBoxIIITutorial\Models\
DCMotor_control.slx
```

> **Note**
>
> The model is available only if ConfigurationDesk has been started at least once.

> **Tip**
>
> If you are not sure if the model has already been modified by a different user, copy the following model and rename it:
>
> ```
> <Documents folder>\Tutorials\CfgMicroAutoBoxIIITutorial\Models\
> DCMotor_control_backup.slx
> ```

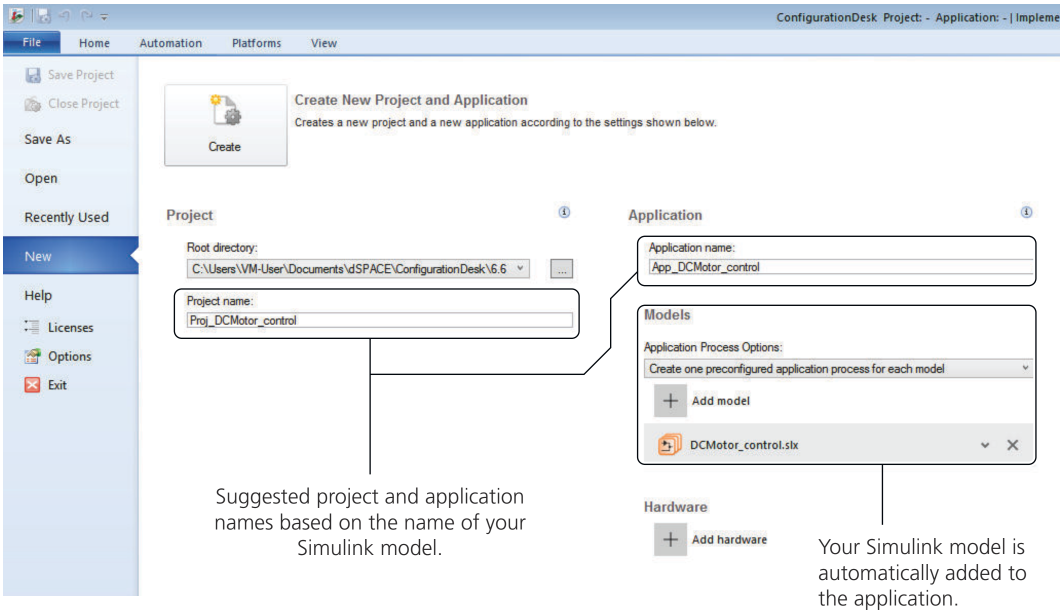
2 Open the copied model in Simulink.

3 In Simulink, select Create ConfigurationDesk Project from Model from the ConfigurationDesk menu.


Model Port Blocks
ConfigurationDesk
Model Browser
DCMotor_con
Create ConfigurationDesk Project from Model ... Ctrl+Alt+N
Open a ConfigurationDesk Project ...
Add Model to ConfigurationDesk Project: <none> Ctrl+Alt+A
Show in ConfigurationDesk Ctrl+Alt+G
Show Connected Block in ConfigurationDesk Ctrl+Alt+H
Analyze Model in ConfigurationDesk (Including Task Information) Ctrl+Alt+D
Analyze Model in ConfigurationDesk (Model Interface Only) Ctrl+Alt+I
Save ConfigurationDesk Project Ctrl+Alt+S
Start ConfigurationDesk Build Ctrl+Alt+B
PID Control for DC Motor
reference speed [rad/s]
reference speed [rad/s]

Creates a new ConfigurationDesk project and adds the model.

ConfigurationDesk is started (if necessary) and the New backstage view opens.


ConfigurationDesk Project: - Application: - | Impleme
File
Home
Automation
Platforms
View
Save Project
Close Project
Save As
Open
Recently Used
New
Help
Licenses
Options
Exit
Create
Create New Project and Application
Creates a new project and a new application according to the settings shown below.
Project
Application
Models
Add model
Hardware
Add hardware

Root directory: C:\Users\VM-User\Documents\dSPACE\ConfigurationDesk\6.6

Project name: Proj_DCMotor_control

Application name: App_DCMotor_control

Application Process Options: Create one preconfigured application process for each model

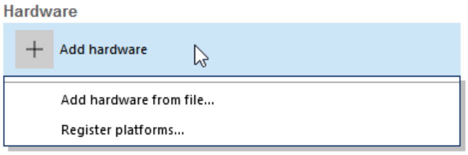
DCMotor_control.slx

Suggested project and application names based on the name of your Simulink model.

Your Simulink model is automatically added to the application.

4 Change Project name to `MyCfgMicroAutoBoxIIITutorial` and Application name to `Lesson_1`.

5 Open the Add hardware menu.



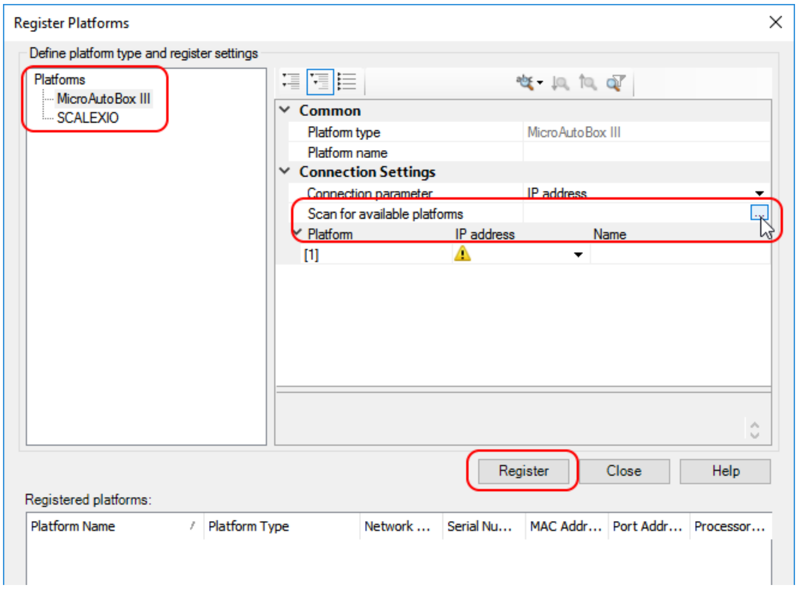
Select one of the following options:

- If a MicroAutoBox III system is available to you, select Register platforms.

Note

Make sure that your MicroAutoBox III system provides Analog In and Analog Out channel types. This is the case, for example, if your system contains a DS1511 or a DS1513 Multi-I/O Board. To check your available channel types and channels, refer to Overview of MicroAutoBox III Channel Types (MicroAutoBox III Hardware Installation and Configuration 🕮).

In the Register platforms dialog, you can scan for available MicroAutoBox III systems and register your system as a platform in ConfigurationDesk.



Common

Platform type	MicroAutoBox III
Platform name	

Connection Settings

Connection parameter	IP address
Scan for available platforms	

Platform	IP address	Name
[1]	⚠	

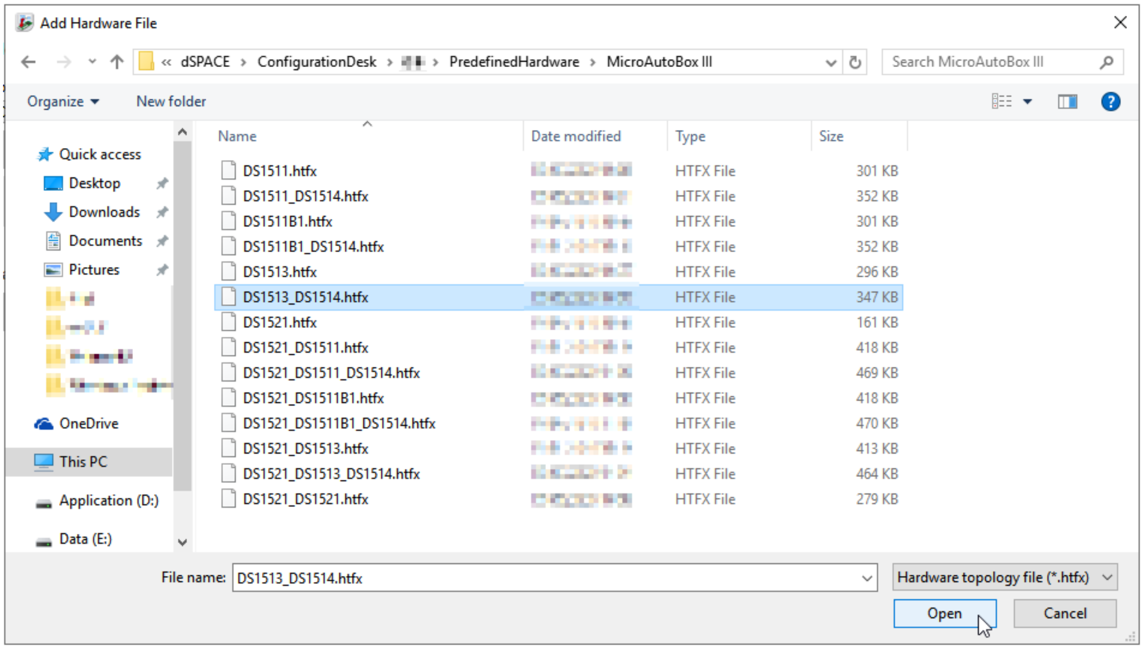
Registered platforms:

Platform Name	Platform Type	Network ...	Serial Nu...	MAC Addr...	Port Addr...	Processor...

A hardware topology matching the registered platform will automatically be added to the project.

- If no MicroAutoBox III system is available to you, select Add hardware from file.

In the Add Hardware File dialog, you can select hardware topology files for import.



Name	Date modified	Type	Size
DS1511.htfx	[redacted]	HTFX File	301 KB
DS1511_DS1514.htfx	[redacted]	HTFX File	352 KB
DS1511B1.htfx	[redacted]	HTFX File	301 KB
DS1511B1_DS1514.htfx	[redacted]	HTFX File	352 KB
DS1513.htfx	[redacted]	HTFX File	296 KB
DS1513_DS1514.htfx	[redacted]	HTFX File	347 KB
DS1521.htfx	[redacted]	HTFX File	161 KB
DS1521_DS1511.htfx	[redacted]	HTFX File	418 KB
DS1521_DS1511_DS1514.htfx	[redacted]	HTFX File	469 KB
DS1521_DS1511B1.htfx	[redacted]	HTFX File	418 KB
DS1521_DS1511B1_DS1514.htfx	[redacted]	HTFX File	470 KB
DS1521_DS1513.htfx	[redacted]	HTFX File	413 KB
DS1521_DS1513_DS1514.htfx	[redacted]	HTFX File	464 KB
DS1521_DS1521.htfx	[redacted]	HTFX File	279 KB

File name: DS1513_DS1514.htfx

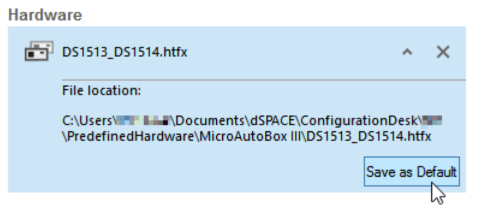
Hardware topology file (*.htfx)

You can select example MicroAutoBox III hardware toplogy files from the `<Documents folder>\PredefinedHardware\MicroAutoBox III` folder.

Select the `DS1513_DS1514.htfx` hardware topology file from the folder and click **Open**.

The example hardware topology will be added to the project.

> **Tip**
>
> You can click the down arrow next to the added hardware to make the **Save as Default** command available. Using the command makes the hardware the default hardware for future ConfigurationDesk applications so that you do not have to select the same hardware each time you create a project or application.



Hardware

DS1513_DS1514.htfx

File location:

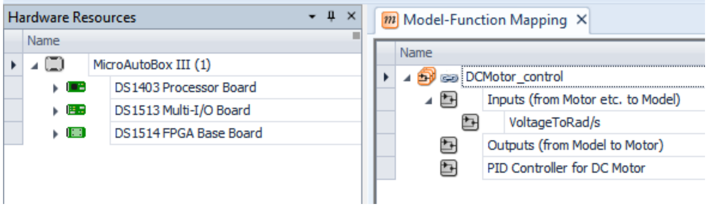
C:\Users\[redacted]\Documents\dSPACE\ConfigurationDesk\[redacted]\PredefinedHardware\MicroAutoBox III\DS1513_DS1514.htfx

6 Click **Create**.

- A new ConfigurationDesk project with the specified project name is created in the selected root directory.
- A ConfigurationDesk application with the specified application name is added to it.
- The new application is active and opens in the **Model-Function** view set.

7 The **Model-Function Mapping Browser** contains a model interface with the `DCMotor_control` model and its subsystems.

The **Hardware Resources Browser** contains the hardware topology imported from the platform you registered and scanned or the example file you selected.



Hardware Resources

Name

- MicroAutoBox III (1)
  - DS1403 Processor Board
  - DS1513 Multi-I/O Board
  - DS1514 FPGA Base Board

Model-Function Mapping

Name

- DCMotor_control
  - Inputs (from Motor etc. to Model)
    - VoltageToRad/s
  - Outputs (from Model to Motor)
  - PID Controller for DC Motor

Result

You created a ConfigurationDesk project and application from a Simulink behavior model. The ConfigurationDesk application contains a reference to the model so that both are connected as long as the ConfigurationDesk application is active.

Result of Lesson 1

Result

You created a ConfigurationDesk project from a Simulink behavior model. The project includes a ConfigurationDesk application with a model interface and a hardware topology.

Now, your application is equivalent to the Lesson_2 application of the `CfgMicroAutoBoxIIITutorial` demo project.

Further information

For detailed descriptions and instructions regarding Simulink behavior models in ConfigurationDesk, refer to:

- Working with Simulink Behavior Models (ConfigurationDesk Real-Time Implementation Guide 🕮)

What's next

You can now continue with Lesson 2: Adding I/O Functionality in ConfigurationDesk on page 17 for your `MyCfgMicroAutoBoxIIITutorial` project, or you can open the existing `CfgMicroAutoBoxIIITutorial` demo project and activate an application to continue with the associated lesson.

Lesson 2: Adding I/O Functionality in ConfigurationDesk

Where to go from here

Information in this section

Overview of Lesson 2

Adding I/O functionality to the signal chain

In ConfigurationDesk, I/O functionality is added to the signal chain by using function blocks. The data flow between the function blocks and the connected behavior model is implemented with model interfaces containing model port blocks. The model port blocks of the ConfigurationDesk model interface are mapped to the function blocks. Function blocks also provide access to hardware resources of the dSPACE real-time hardware (hardware resource assignment).

What will you do?

In this lesson you will:

- Create and map more function blocks starting from hardware resources.

Before you begin

Before you begin this lesson, one of the following preconditions must be met:

- You completed all the lessons of the tutorial up to this point.

or

- You opened the `CfgMicroAutoBoxIIITutorial` demo project and activated the Lesson_2 application.

Steps

This lesson contains the following steps:

- Step 1: How to Create and Map Function Blocks Starting from Hardware Resources on page 18

Step 1: How to Create and Map Function Blocks Starting from Hardware Resources

Objective

ConfigurationDesk offers a simple way to create function blocks, map them to the model interface, and assign hardware resources to them in one step starting from hardware resources.

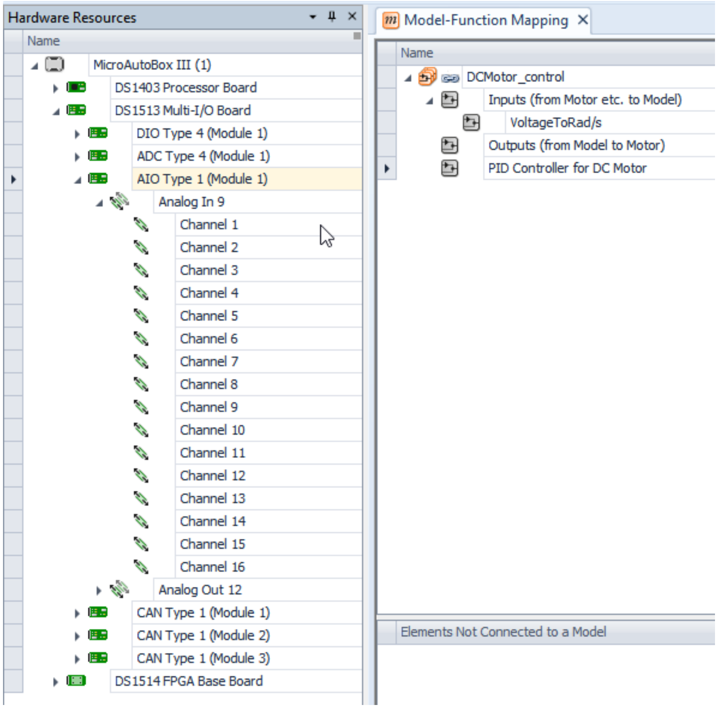
> **Tip**
>
> All the steps of adding I/O functionality can also be done individually and in different orders. You can, for example, start by creating and configuring function blocks before assigning hardware resources.
> The advantage of creating function blocks from hardware resources is that some function block settings are automatically adjusted to the characteristics of specific hardware resources.

Method

To create and map function blocks starting from hardware resources

1 In the Hardware Resource Browser, expand an Analog In channel set. For example, the Analog In 9 channel set of the DS1513 Multi I/O Board.

> **Tip**
>
> The images show the state of the application when you started with lesson 1 and continued to work with your project. If you activated an application of the tutorial demo project to do this lesson, the connected model and its name are different. This does not affect the steps that you perform.



Hardware Resources

Name

- MicroAutoBox III (1)
  - DS1403 Processor Board
  - DS1513 Multi-I/O Board
    - DIO Type 4 (Module 1)
    - ADC Type 4 (Module 1)
    - AIO Type 1 (Module 1)
      - Analog In 9
        - Channel 1
        - Channel 2
        - Channel 3
        - Channel 4
        - Channel 5
        - Channel 6
        - Channel 7
        - Channel 8
        - Channel 9
        - Channel 10
        - Channel 11
        - Channel 12
        - Channel 13
        - Channel 14
        - Channel 15
        - Channel 16
      - Analog Out 12
    - CAN Type 1 (Module 1)
    - CAN Type 1 (Module 2)
    - CAN Type 1 (Module 3)
  - DS1514 FPGA Base Board

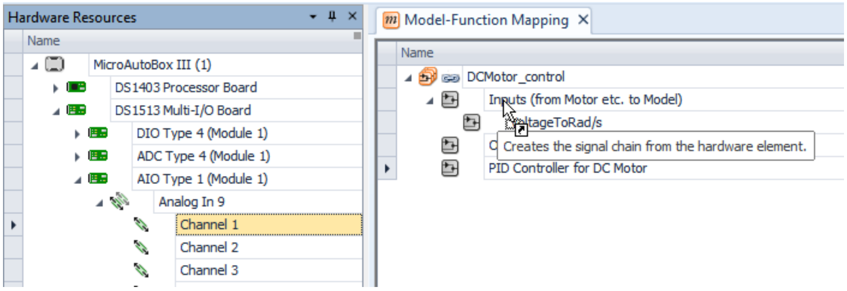
Model-Function Mapping

Name

- DCMotor_control
  - Inputs (from Motor etc. to Model)
    - VoltageToRad/s
  - Outputs (from Model to Motor)
  - PID Controller for DC Motor

Elements Not Connected to a Model

2 Click and drag a channel of the Analog In channel set to the Inputs (from Motor etc. to Model) subsystem in the Model-Function Mapping Browser.



Hardware Resources

Name

- MicroAutoBox III (1)
  - DS1403 Processor Board
  - DS1513 Multi-I/O Board
    - DIO Type 4 (Module 1)
    - ADC Type 4 (Module 1)
    - AIO Type 1 (Module 1)
      - Analog In 9
        - Channel 1
        - Channel 2
        - Channel 3

Model-Function Mapping

Name

- DCMotor_control
  - Inputs (from Motor etc. to Model)
    - VoltageToRad/s
  - O
  - PID Controller for DC Motor

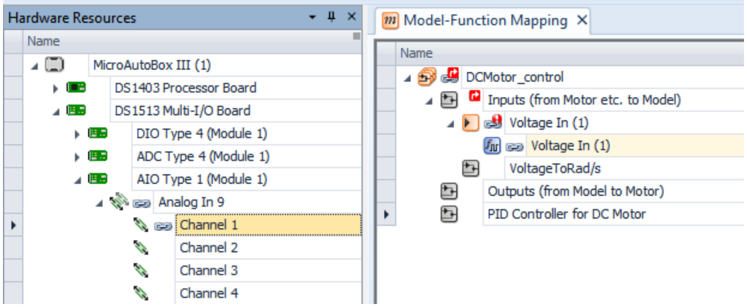
Creates the signal chain from the hardware element.

Tip

If several function block types are suitable for a channel you can select the required function block type from a list. Here, only the Voltage In function block type is suitable and thus automatically selected.

The following actions are executed with this single step:

- A Voltage In (1) function block is created.
- A Voltage In (1) model port block is created.
- The Voltage In (1) function block is mapped to the Voltage In (1) model port block in the Inputs (from Motor etc. to Model) subsystem.
- The channel and the Analog In channel set are assigned to the Voltage In (1) function block.
- The function block settings are adjusted to the hardware resource.



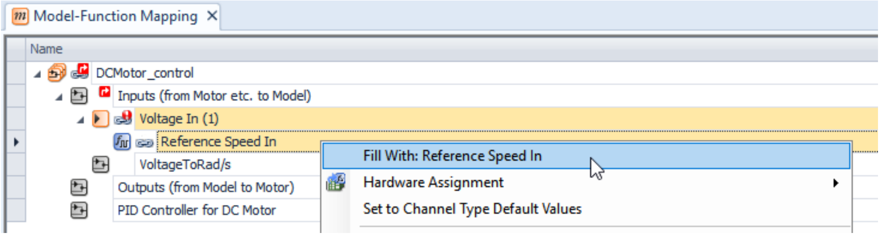
The ❗ symbol shows that a model port block is unresolved. This means it is used in the ConfigurationDesk application, but not in the connected Simulink model.

The 🟥 symbol shows that a model or subsystem contains differences to the connected Simulink behavior model.

3 Double-click the Voltage In (1) function block and rename it Reference Speed In.

4 Press `Ctrl` and select the Reference Speed In function block and the Voltage In (1) model port block.

5 Right-click the Reference Speed In and select Fill With: Reference Speed In.


Model-Function Mapping
Name
DCMotor_control
Inputs (from Motor etc. to Model)
Voltage In (1)
Reference Speed In
VoltageToRad/s
Outputs (from Model to Motor)
PID Controller for DC Motor
Fill With: Reference Speed In
Hardware Assignment
Set to Channel Type Default Values

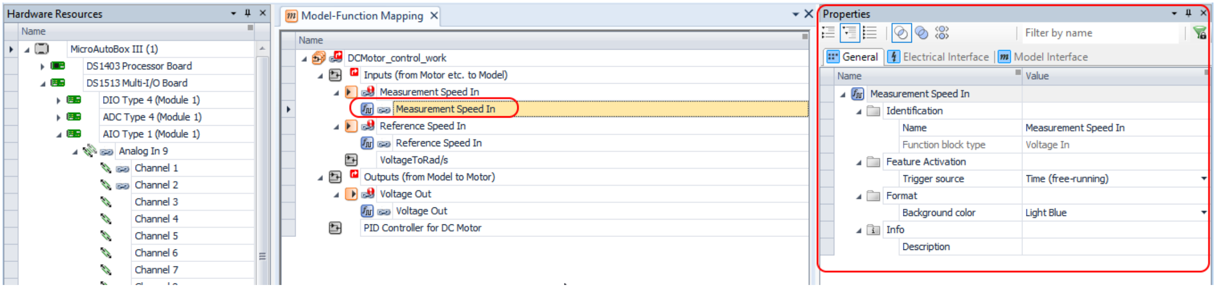
The model port block is named after the function block.

6 Repeat steps 1 on page 18 to 5 on page 20 to create the following function blocks:

Channel Type	Subsystem	Function Block/Model Port Block Name
Analog In	Inputs (from Motor etc. to Model)	Measurement Speed In
Analog Out	Outputs (from Model to Motor)	Voltage Out

Result

You created and mapped function blocks from hardware resources. You can access and configure function block properties in the **Properties Browser**.



Name	Value
Measurement Speed In	
Identification	
Name	Measurement Speed In
Function block type	Voltage In
Feature Activation	
Trigger source	Time (free-running)
Format	
Background color	Light Blue
Info	
Description	

Result of Lesson 2

Result

You added I/O functionality to the ConfigurationDesk application, configured function blocks and assigned hardware resources to them, and connected the I/O functionality to the model interface.

Now, your application is equivalent to the Lesson_3 application of the `CfgMicroAutoBoxIIITutorial` demo project.

Further information

For detailed descriptions and instructions on the topics in this lesson, refer to:

- Implementing I/O Functionality (ConfigurationDesk Real-Time Implementation Guide 🕮)
- Assigning Hardware Resources to Function Blocks (ConfigurationDesk Real-Time Implementation Guide 🕮)
- User-Friendly Connection of ConfigurationDesk and Simulink Models (ConfigurationDesk Real-Time Implementation Guide 🕮)

What's next

You can now continue with Lesson 3: Synchronizing the ConfigurationDesk I/O Functionality and the Simulink Behavior Model on page 23 for your `MyCfgMicroAutoBoxIIITutorial` project, or you can open the existing `CfgMicroAutoBoxIIITutorial` demo project and activate an application to continue with the associated lesson.

Lesson 3: Synchronizing the ConfigurationDesk I/O Functionality and the Simulink Behavior Model

Where to go from here

Information in this section

Overview of Lesson 3

Synchronizing model interfaces

To synchronize the I/O functionality you added in Lesson 2: Adding I/O Functionality in ConfigurationDesk on page 17 with the Simulink behavior model, you must propagate the model port blocks from the ConfigurationDesk model interface to the Simulink model interface and connect them in the Simulink behavior model.

If you modify the Simulink behavior model, you must analyze it from ConfigurationDesk to synchronize.

Tip

Depending on the state of the implementation work in a ConfigurationDesk application or a Simulink behavior model, propagating changes to Simulink or analyzing a Simulink behavior model might have different effects.

For example, it is easier to completely finish configuring the I/O functionality in ConfigurationDesk before propagation, because this generates only correctly configured model port blocks in Simulink. Also, any undo operation in ConfigurationDesk does not undo changes that you have already propagated to Simulink.

On the other hand, you can modify the structure, e.g., add subsystems, only in Simulink and then analyze the modifications from ConfigurationDesk.

To prevent parts of a Simulink model from being accidentally changed by a propagate operation, you can protect specific subsystems by setting them to read-only in Simulink. When analyzed, these subsystems are marked with a lock symbol in ConfigurationDesk.

For more information on synchronizing ConfigurationDesk applications and Simulink models, refer to User-Friendly Connection of ConfigurationDesk and Simulink Models (ConfigurationDesk Real-Time Implementation Guide 📖).

What will you do?

In this lesson you will:

- Propagate changes from ConfigurationDesk to the Simulink behavior model.

Before you begin

Before you begin this lesson, one of the following preconditions must be met:

- You completed all the lessons of the tutorial up to this point.

or

- You opened the `CfgMicroAutoBoxIIITutorial` demo project and activated the Lesson_3 application.

Steps

This lesson contains the following steps:

- Step 1: How to Propagate Changes from ConfigurationDesk to the Simulink Behavior Model on page 25

Step 1: How to Propagate Changes from ConfigurationDesk to the Simulink Behavior Model

Objective

You have to propagate the added I/O functionality and the resulting model port blocks to the Simulink model interface and connect them in the behavior model.

Method

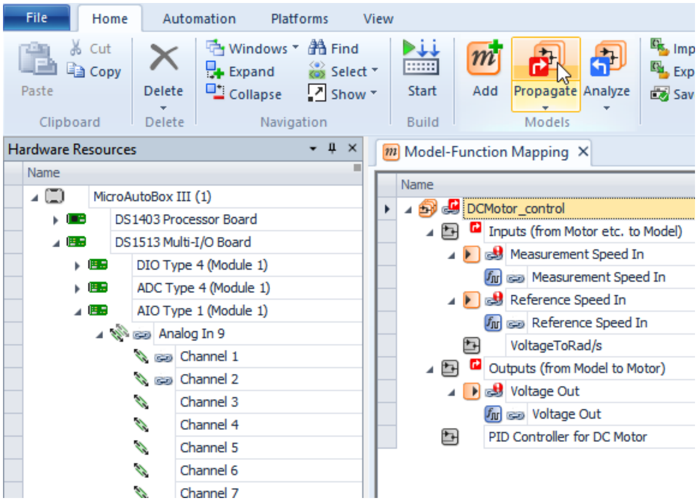
To propagate changes from ConfigurationDesk to the Simulink behavior model

1 In the Model-Function Mapping Browser, select the DCMotor_control model.

> **Tip**
>
> If you activated the Lesson_3 application of the tutorial demo project to do this lesson, the model is named DCMotor_control_work.

2 On the Home ribbon, click Models – Propagate.

> **Tip**
>
> The images show the state of the application when you started with lesson 1 and continued to work with your project. If you activated an application of the tutorial demo project to do this lesson, the connected model and its name are different. This does not affect the steps that you perform.



Hardware Resources

Name
- MicroAutoBox III (1)
  - DS1403 Processor Board
  - DS1513 Multi-I/O Board
    - DIO Type 4 (Module 1)
    - ADC Type 4 (Module 1)
    - AIO Type 1 (Module 1)
      - Analog In 9
        - Channel 1
        - Channel 2
        - Channel 3
        - Channel 4
        - Channel 5
        - Channel 6
        - Channel 7

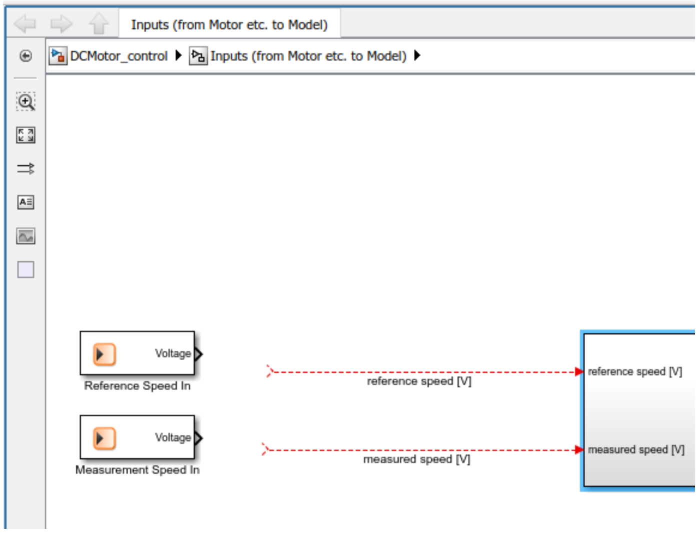
Model-Function Mapping

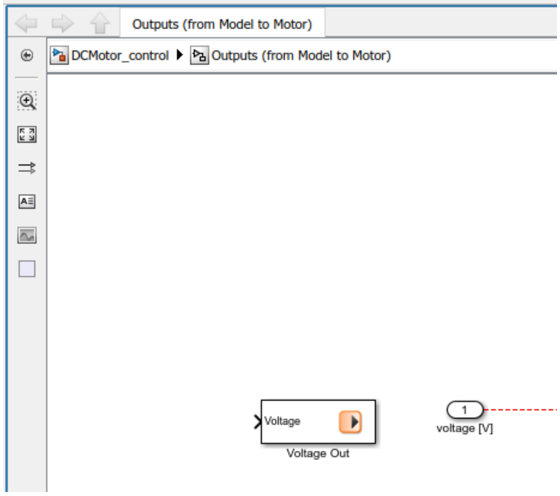
Name
- DCMotor_control
  - Inputs (from Motor etc. to Model)
    - Measurement Speed In
      - Measurement Speed In
    - Reference Speed In
      - Reference Speed In
    - VoltageToRad/s
  - Outputs (from Model to Motor)
    - Voltage Out
      - Voltage Out
  - PID Controller for DC Motor

This causes the following steps to be executed:

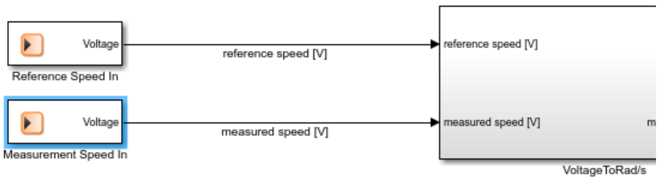
- ConfigurationDesk opens the connected Simulink behavior model if necessary and propagates the changes from Lesson 2: Adding I/O Functionality in ConfigurationDesk on page 17 to the Simulink model interface.

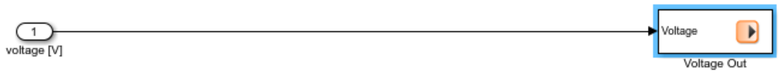
- The symbols marking the unresolved model port blocks and the model containing changes are removed.
- In the Simulink model, model port blocks are created according to the model port blocks in ConfigurationDesk.





3 Connect the newly created model port blocks in the Simulink behavior model.





Result

You propagated changes from ConfigurationDesk to the Simulink behavior model.

The model interfaces are now synchronized.

Result of Lesson 3

Result

You synchronized the ConfigurationDesk I/O functionality and the Simulink behavior model by propagating the ConfigurationDesk model interface to the Simulink behavior model and connecting the model port blocks in Simulink.

Further information

For details on synchronizing ConfigurationDesk projects and Simulink behavior model, refer to User-Friendly Connection of ConfigurationDesk and Simulink Models (ConfigurationDesk Real-Time Implementation Guide 🕮).

What's next

You can now continue with Lesson 4: Building the Real-Time Application on page 29 for your `MyCfgMicroAutoBoxIIITutorial` project, or you can open the existing `CfgMicroAutoBoxIIITutorial` demo project and activate an application to continue with the associated lesson.

Lesson 4: Building the Real-Time Application

Where to go from here

Information in this section

Overview of Lesson 4

Build process

Building real-time applications is a process which generates executable code that can be run on the real-time hardware.

What will you do?

In this lesson you will:

- Prepare the build process by applying build configuration settings.
- Build the executable real-time application.

Before you begin

Before you begin this lesson, one of the following preconditions must be met:

- You completed all the lessons of the tutorial up to this point.

or

- You opened the `CfgMicroAutoBoxIIITutorial` demo project and activated the Lesson_4 application.

Steps

This lesson contains the following steps:

- Step 1: How to Prepare the Build Process and Build the Real-Time Application on page 30

Step 1: How to Prepare the Build Process and Build the Real-Time Application

Objective

To execute a real-time application, you need to build it. You can then download it to a matching hardware platform.

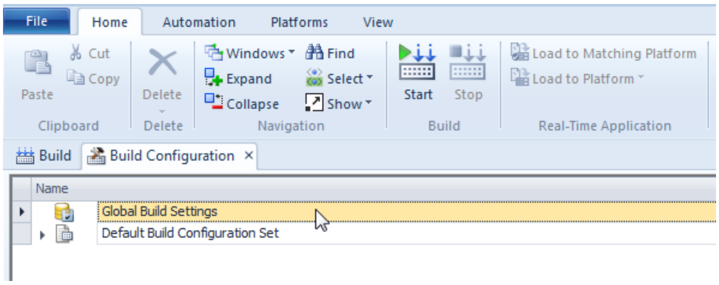
Before you build the real-time application, you can specify several build settings that influence the build process.

Method

To prepare the build process and build the real-time application

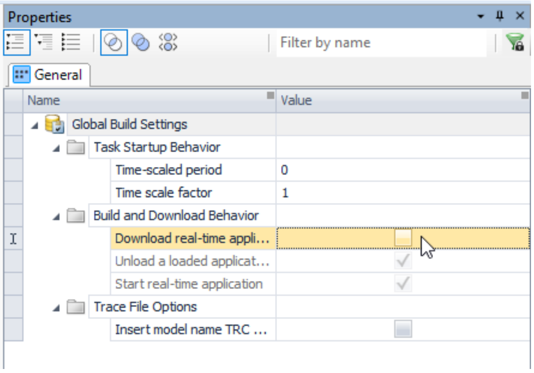
1 Switch to the Build view set.

2 In the Build Configuration table, select Global Build Settings.



Name
Global Build Settings
Default Build Configuration Set

3 In the Properties Browser, clear the checkbox next to the Download real-time application after build property.



Name	Value
Global Build Settings	
Task Startup Behavior	
Time-scaled period	0
Time scale factor	1
Build and Download Behavior	
Download real-time appli…	☐
Unload a loaded applicat…	✓
Start real-time application	✓
Trace File Options	
Insert model name TRC …	☐

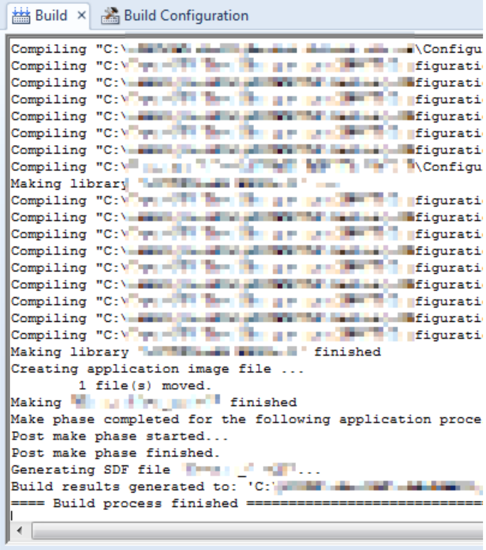
Tip

If you scanned an actual MicroAutoBox III system in lesson 1, you can download the real-time application to it. However, the tutorial represents only a theoretical use scenario and the real-time application is of limited use.

4 On the **Home** ribbon, click **Build – Start**.

The build process starts. If MATLAB is not running when you start the build process, it opens automatically for model code generation. The build process is aborted only for serious errors. Most problems that occur during the build process are categorized as warnings. They are displayed in the **Build Log Viewer**. Messages regarding model code generation are displayed in the MATLAB Command Window.

5 Wait until the message **Build process finished** is displayed in the **Build Log Viewer**.



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Making library [redacted]
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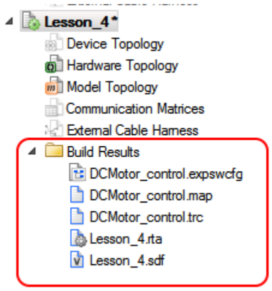
Compiling "C:\[redacted]figurati
Making library [redacted] finished
Creating application image file ...
        1 file(s) moved.
Making [redacted] finished
Make phase completed for the following application proce
Post make phase started...
Post make phase finished.
Generating SDF file [redacted]...
Build results generated to: 'C:[redacted]
==== Build process finished =============================
```

Result

You prepared the build process and built the real-time application.

The build result files are displayed in the **Project** view set in the **Project Manager**.



Tip

You can also start the build process from the Simulink model by using the Start ConfigurationDesk Build command from the ConfigurationDesk menu.

In a real use scenario, you could now download the real-time application to a hardware platform. For more information, refer to Downloading and Executing Real-Time Applications (ConfigurationDesk Real-Time Implementation Guide 🕮).

Result of Lesson 4

Result	You prepared the build process and built the executable real-time application.
Further information	For detailed descriptions and instructions on build settings and building real-time applications, refer to Building Real-Time Applications (ConfigurationDesk Real-Time Implementation Guide 🕮).
What's next	You finished the last lesson of the tutorial. To repeat a previous lesson or complete a lesson that you skipped, activate the corresponding application in the `CfgMicroAutoBoxIIITutorial` demo project. For a summary of your working results, refer to Summary on page 33.

Summary

Your Working Results

What you learned

You learned:

- How to create a ConfigurationDesk project from a Simulink behavior model.
- How to add I/O functionality to your model in a ConfigurationDesk application.
- How to synchronize the ConfigurationDesk I/O functionality with the Simulink behavior model.
- How to prepare the build process and build an executable real-time application.

ConfigurationDesk Glossary

Introduction

The glossary briefly explains the most important expressions and naming conventions used in the ConfigurationDesk documentation.

Where to go from here

Information in this section

A

Application There are two types of applications in ConfigurationDesk:

- A part of a ConfigurationDesk project: ConfigurationDesk application.
- An application that can be executed on dSPACE real-time hardware: real-time application.

Application process A component of a processing unit application. An application process contains one or more tasks.

Application process component A component of an application process. The following application process components are available in the **Components** subfolder of an application process:

- Behavior models that are assigned to the application process, including their predefined tasks, runnable functions, and events.
- Function blocks that are assigned to the application process.

AutomationDesk A dSPACE software product for creating and managing any kind of automation tasks. Within the dSPACE tool chain, it is mainly used for automating tests on dSPACE hardware.

AUTOSAR system description file An AUTOSAR XML (ARXML) file that describes a system according to AUTOSAR. A system is a combination of a hardware topology, a software architecture, a network communication, and information on the mappings between these elements. The described network communication usually consists of more than one bus system (e.g., CAN, LIN, FlexRay).

B

Basic PDU A general term used in the documentation to address all the PDUs the Bus Manager supports, except for container IPDUs, multiplexed IPDUs, and secured IPDUs. Basic PDUs are represented by the ▶ or ⊐ symbol in tables and browsers. The Bus Manager provides the same functionalities for all basic PDUs, such as ISignal IPDUs or NMPDUs.

Behavior model A model that contains the control algorithm for a controller (function prototyping system) or the algorithm of the controlled system (hardware-in-the-loop system). It does not contain I/O functionality nor access to the hardware. Behavior models can be modeled, for example, in MATLAB/Simulink by using Simulink Blocksets and Toolboxes from the MathWorks®.

You can add Simulink behavior models to a ConfigurationDesk application. You can also add code container files containing a behavior model such as Functional Mock-up Units, or Simulink implementation containers to a ConfigurationDesk application.

Bidirectional signal port A signal port that is independent of a data direction or current flow. This port is used, for example, to implement bus communication.

BSC file A bus simulation container file that is generated with the Bus Manager and contains the configured bus communication of one application process.

Build Configuration table A pane that lets you create build configuration sets and configure build settings, for example, build options, or the build and download behavior.

Build Log Viewer A pane that displays messages and warnings during the build process.

Build process A process that generates an executable real-time application based on your ConfigurationDesk application that can be run on a SCALEXIO system or MicroAutoBox III system. The build process can be controlled and configured via the Build Log Viewer. If the build process is successfully finished, the build result files (build results) are added to the ConfigurationDesk application.

Build results The files that are created during the build process. Build results are named after the ConfigurationDesk application and the application process from which they originate. You can access the build results in the Project Manager.

Bus access The representation of a run-time communication cluster. By assigning one or more bus access requests to a bus access, you specify which communication clusters form one run-time communication cluster.

In ConfigurationDesk, you can use a bus function block (CAN, LIN) to implement a bus access. The hardware resource assignment of the bus function block specifies the bus channel that is used for the bus communication.

Bus access request The representation of a request regarding the bus access. There are two sources for bus access requests:

- At least one element of a communication cluster is assigned to the Simulated ECUs, Inspection, or Manipulation part of a bus configuration. The related bus access requests contain the requirements for the bus channels that are to be used for the cluster's bus communication.

- A frame gateway is added to the **Gateways** part of a bus configuration. Each frame gateway provides two bus access requests that are required to specify the bus channels for exchanging bus communication.

Bus access requests are automatically included in BSC files. To build a real-time application, each bus access request must be assigned to a bus access.

Bus Access Requests table A pane that lets you access bus access requests of a ConfigurationDesk application and assign them to bus accesses.

Bus configuration A Bus Manager element that implements bus communication in a ConfigurationDesk application and lets you configure it for simulation, inspection, and/or manipulation purposes. The required bus communication elements must be specified in a communication matrix and assigned to the bus configuration. Additionally, a bus configuration lets you specify gateways for exchanging bus communication between communication clusters. A bus configuration can be accessed via specific tables and its related Bus Configuration function block.

Bus Configuration Function Ports table A pane that lets you access and configure function ports of bus configurations.

Bus Configurations table A pane that lets you access and configure bus configurations of a ConfigurationDesk application.

Bus Inspection Features table A pane that lets you access and configure bus configuration features of a ConfigurationDesk application for inspection purposes.

Bus Manager

- Bus Manager in ConfigurationDesk

  A ConfigurationDesk component that lets you configure bus communication and implement it in real-time applications or generate bus simulation containers.
- Bus Manager (stand-alone)

  A dSPACE software product based on ConfigurationDesk that lets you configure bus communication and generate bus simulation containers.

Bus Manipulation Features table A pane that lets you access and configure bus configuration features of a ConfigurationDesk application for manipulation purposes.

Bus simulation container A container that contains bus communication configured with the Bus Manager. Bus simulation container (BSC) files can be used in the VEOS Player and in ConfigurationDesk. In the VEOS Player, they let you implement the bus communication in an offline simulation application.

In ConfigurationDesk, they let you implement the bus communication in a real-time application independently from the Bus Manager.

Bus Simulation Features table A pane that lets you access and configure bus configuration features of a ConfigurationDesk application for simulation purposes.

Buses Browser A pane that lets you display and manage the communication matrices of a ConfigurationDesk application. For example, you can access communication matrix elements and assign them to bus configurations. This pane is available only if you work with the Bus Manager.

C

Cable harness A bundle of cables that provides the connection between the I/O connectors of the real-time hardware and the external devices, such as the ECUs to be tested. In ConfigurationDesk, it is represented by an external cable harness component.

CAFX file A ConfigurationDesk application fragment file that contains signal chain elements that were exported from a user-defined working view or the Temporary working view of a ConfigurationDesk application. This includes the elements' configuration and the mapping lines between them.

CDL file A ConfigurationDesk application file that contains links to all the documents related to an application.

Channel multiplication A feature that allows you to enhance the max. current or max. voltage of a single hardware channel by combining several channels. ConfigurationDesk uses a user-defined value to calculate the number of hardware channels needed. Depending on the function block type, channel multiplication is provided either for current enhancement (two or more channels are connected in parallel) or for voltage enhancement (two or more channels are connected in series).

Channel request A channel assignment required by a function block. ConfigurationDesk determines the type(s) and number of channels required for a function block according to the assigned channel set, the function block features, the block configuration and the required physical ranges. ConfigurationDesk provides a set of suitable and available hardware resources for each channel request. This set is produced according to the hardware topology added to the active ConfigurationDesk application. You have to assign each channel request to a specific channel of the hardware topology.

Channel set A number of channels of the same channel type located on the same I/O board or I/O unit. Channels in a channel set can be combined, for example, to provide a signal with channel multiplication.

Channel type A term to indicate all the hardware resources (channels) in the hardware system that provide exactly the same characteristics. Examples for channel type names: Flexible In 1, Digital Out 3, Analog In 1. An I/O board in a hardware system can have channel sets of several channel types. Channel sets of one channel type can be available on different I/O boards.

Cluster Communication cluster.

Common Program Data folder A standard folder for application-specific configuration data that is used by all users.

`%PROGRAMDATA%\dSPACE\<InstallationGUID>\<ProductName>`

or

`%PROGRAMDATA%\dSPACE\<ProductName>\<VersionNumber>`

Communication cluster A communication network of network nodes that are connected to the same physical channels and share the same bus protocol and address range.

Communication matrix A file that defines the communication of a bus network. It can describe the bus communication of one communication cluster or a bus network consisting of different bus systems and clusters. Files of various file formats can be used as a communication matrix: For example, AUTOSAR system description files, DBC files, LDF files, and FIBEX files.

Communication package A package that bundles Data Inport blocks which are connected to Data Outport blocks. Hence, it also bundles the signals that are received by these blocks. If Data Inport blocks are executed within the same task and belong to the same communication package, their data inports are read simultaneously. If Data Outport blocks that are connected to the Data Inport blocks are executed in the same task, their output signals are sent simultaneously in one data package. Thus, communication packages guarantee simultaneous signal updates within a running task (data snapshot).

Configuration port A port that lets you create the signal chain for the bus communication implemented in a Simulink behavior model. The following configuration ports are available:

- The configuration port of a Configuration Port block.
- The Configuration port of a CAN, LIN, or FlexRay function block.

To create the signal chain for bus communication, the configuration port of a Configuration Port block must be mapped to the Configuration port of a CAN, LIN, or FlexRay function block.

Configuration Port block A model port block that is created in ConfigurationDesk during model analysis for each of the following blocks found in the Simulink behavior model:

- RTICANMM ControllerSetup block
- RTILINMM ControllerSetup block
- FLEXRAYCONFIG UPDATE block

Configuration Port blocks are also created for bus simulation containers. A Configuration Port block provides a configuration port that must be mapped to the Configuration port of a **CAN**, **LIN**, or **FlexRay** function block to create the signal chain for bus communication.

ConfigurationDesk application A part of a ConfigurationDesk project that represents a specific implementation. You can work with only one application at a time, and that application must be activated.

An application can contain:

- Device topology
- Hardware topology
- Model topology
- Communication matrices
- External cable harness
- Build results (after a successful build process has finished)

You can also add folders with application-specific files to an application.

ConfigurationDesk model interface The part of the model interface that is available in ConfigurationDesk. This specific term is used to explicitly distinguish between the model interface in ConfigurationDesk and the model interface in Simulink.

Conflict A result of conflicting configuration settings that is displayed in the Conflicts Viewer. ConfigurationDesk allows flexible configuration without strict constraints. This lets you work more freely, but it can lead to conflicting configuration settings. ConfigurationDesk automatically detects conflicts and provides the **Conflicts Viewer** to display and help resolve them. Before you build a real-time application, you have to resolve at least the most severe conflicts (e.g., errors that abort the build process) to get proper build results.

Conflicts Viewer A pane that displays the configuration conflicts that exist in the active ConfigurationDesk application. You can resolve most of the conflicts directly in the **Conflicts Viewer**.

Container IPDU A term according to AUTOSAR. An IPDU that contains one or more other IPDUs (i.e., contained IPDUs). When a container IPDU is mapped to a frame, all its contained IPDUs are included in that frame as well.

ControlDesk A dSPACE software product for managing, instrumenting and executing experiments for ECU development. ControlDesk also supports calibration, measurement and diagnostics access to ECUs via standardized protocols such as CCP, XCP, and ODX.

CTLGZ file A ZIP file that contains a V-ECU implementation. CTLGZ files are exported by TargetLink or SystemDesk. You can add a V-ECU implementation based on a CTLGZ file to the model topology just like adding a Simulink model based on an SLX file.

Cycle time restriction A value of a runnable function that indicates the sample time the runnable function requires to achieve correct results. The cycle time restriction is indicated by the **Period** property of the runnable function in the Properties Browser.

D

Data inport A port that supplies data from ConfigurationDesk's function outports to the behavior model.

In a multimodel application, data inports also can be used to provide data from a data outport associated to another behavior model (model communication).

Data outport A port that supplies data from behavior model signals to ConfigurationDesk's function inports.

In a multimodel application, data outports also can be used to supply data to a data inport associated to another behavior model (model communication).

DBC file A Data Base Container file that describes CAN or LIN bus systems. Because the DBC file format was primarily developed to describe CAN networks, it does not support definitions of LIN masters and schedules.

Device block A graphical representation of devices from the device topology in the signal chain. It can be mapped to function blocks via device ports.

Device connector A structural element that lets you group device pins in a hierarchy in the External Device Connectors table to represent the structure of the real connector of your external device.

Device pin A representation of a connector pin of your external device. Device ports are assigned to device pins. ConfigurationDesk can use the device pin assignment together with the hardware resource assignment and the device port mapping to calculate the external cable harness.

Device port An element of a device topology that represents the signal of an external device in ConfigurationDesk.

Device port group A structural element of a device topology that can contain device ports and other device port groups.

Device topology A component of a ConfigurationDesk application that represents external devices in ConfigurationDesk. You can create a device topology from scratch or easily extend an existing device topology. You can also merge device topologies to extend one. To edit or create device topologies independently of ConfigurationDesk, you can export and import DTFX and XLSX files.

Documents folder A standard folder for user-specific documents.

```
%USERPROFILE%\Documents\dSPACE\<ProductName>\
<VersionNumber>
```

DSA file A dSPACE archive file that contains a ConfigurationDesk application and all the files belonging to it as one unit. It can later be imported to another ConfigurationDesk project.

dSPACE Help The dSPACE online help that contains all the relevant user documentation for dSPACE products. Via the **F1** key or the **Help** button in the dSPACE software you get context-sensitive help on the currently active context.

dSPACE Log A collection of errors, warnings, information, questions, and advice issued by all dSPACE products and connected systems over more than one session.

DTFX file A device topology export file that contains information on the interface to the external devices, such as the ECUs to be tested. The information includes details of the available device ports, their characteristics, and the assigned pins.

E

ECHX file An external cable harness file that contains the wiring information for the external cable harness. The external cable harness is the connection between the I/O connectors of the real-time hardware and the devices to be tested, for example, ECUs.

ECU Abbreviation of *electronic control unit*.

An embedded computer system that consists of at least one CPU and associated peripherals. An ECU contains communication controllers and communication connectors, and usually communicates with other ECUs of a bus network. An ECU can be member of multiple bus systems and communication clusters.

ECU application An application that is executed on an ECU. In ECU interfacing scenarios, parts of the ECU application can be accessed (e.g., by a real-time application) for development and testing purposes.

ECU function A function of an ECU application that is executed on the ECU. In ECU interfacing scenarios, an ECU function can be accessed by functions that are part of a real-time application, for example.

ECU Interface Manager A dSPACE software product for preparing ECU applications for ECU interfacing. The ECU Interface Manager can generate ECU interface container (EIC) files to be used in ConfigurationDesk.

ECU interfacing A generic term for methods and tools to read and/or write individual ECU functions and variables of an ECU application. In ECU interfacing scenarios, you can access ECU functions and variables for development and testing purposes while the ECU application is executed on the ECU. For example, you can perform ECU interfacing with SCALEXIO systems or MicroAutoBox III systems to access individual ECU functions by a real-time application.

EIC file An ECU interface container file that is generated with the ECU Interface Manager and describes an ECU application that is configured for ECU interfacing. You can import EIC files to ConfigurationDesk to perform ECU interfacing with SCALEXIO systems or MicroAutoBox III systems.

Electrical interface unit A segment of a function block that provides the interface to the external devices and to the real-time hardware (via hardware resource assignment). Each electrical interface unit of a function block usually needs a channel set to be assigned to it.

Event A component of a ConfigurationDesk application that triggers the execution of a task. The following event types are available:

- Timer event
- I/O event
- Software event

Event port An element of a function block. The event port can be mapped to a runnable function port for modeling an asynchronous task.

Executable application The generic term for real-time applications and offline simulation applications. In ConfigurationDesk, an executable application is always a real-time application since ConfigurationDesk does not support offline simulation applications.

Executable application component A component of an executable application. The following components can be part of an executable application:

- Imported behavior models including predefined tasks, runnable functions, and events. You can assign these behavior models to application processes via drag & drop or by selecting the Assign Model command from the context menu of the relevant application process.
- Function blocks added to your ConfigurationDesk application including associated I/O events. Function blocks are assigned to application processes via their model port mapping.

Executable Application table A pane that lets you model executable applications (i.e., real-time applications) and the tasks used in them.

EXPSWCFG file An experiment software configuration file that contains configuration data for automotive fieldbus communication. It is created during the build process and contains the data in XML format.

External cable harness A component of a ConfigurationDesk application that contains the wiring information for the external cable harness (also known as cable harness). It contains only the logical connections and no additional information such as cable length, cable diameters, dimensions or the arrangement of connection points, etc. It can be calculated by ConfigurationDesk or imported from a file so that you can use an existing cable harness and do not have to build a new one. The wiring information can be exported to an ECHX file or XLSX file.

External device A device that is connected to the dSPACE hardware, such as an ECU or external load. The external device topology is the basis for using external devices in the signal chain of a ConfigurationDesk application.

External Device Browser A pane that lets you display and manage the device topology of your active ConfigurationDesk application.

External Device Configuration table A pane that lets you access and configure the most important properties of device topology elements via table.

External Device Connectors table A pane that lets you specify the representation of the physical connectors of your external device including the device pin assignment.

F

FIBEX file An XML file according the ASAM MCD-2 NET standard (also known as Field Bus Exchange Format) defined by ASAM. The file can describe more than one bus system (e.g., CAN, LIN, FlexRay). It is used for data exchange between different tools that work with message-oriented bus communication.

Find Results Viewer A pane that displays the results of searches you performed via the Find command.

FMU file A Functional Mock-up Unit file that describes and implements the functionality of a model. It is an archive file with the file name extension FMU. The FMU file contains:

- The functionality defined as a set of C functions provided either in source or in binary form.
- The model description file (`modelDescription.xml`) with the description of the interface data.
- Additional resources needed for simulation.

You can add an FMU file to the model topology just like adding a Simulink model based on an SLX file.

Frame A piece of information of a bus communication. It contains an arbitrary number of non-overlapping PDUs and the data length code (DLC). CAN frames and LIN frames can contain only one PDU. To exchange a frame via bus channels, a frame triggering is needed.

Frame triggering An instance of a frame that is exchanged via a bus channel. It includes transmission information of the frame (e.g., timings, ID, sender, receiver). The requirements regarding the frame triggerings depend on the bus system (CAN, LIN, FlexRay).

Function block A graphical representation in the signal chain that is instantiated from a function block type. A function block provides the I/O functionality and the connection to the real-time hardware. It serves as a container for functions, for electrical interface units and their logical signals. The function block's ports (function ports and/or signal ports), provide the interfaces to the neighboring blocks in the signal chain.

Function block type A software plug-in that provides a specific I/O functionality. Every function block type has unique features which are different from other function block types.

To use a function block type in your ConfigurationDesk application, you have to create an instance of it. This instance is called a function block. Instances of function block types can be used multiple times in a ConfigurationDesk application. The types and their instantiated function blocks are displayed in the function library of the Function Browser.

Function Browser A pane that displays the function library in a hierarchical tree structure. Function block types are grouped in function classes. Instantiated function blocks are added below the corresponding function block type.

Function inport A function port that inputs the values from the behavior model to the function block to be processed by the function.

Function library A collection of function block types that allows access to the I/O functionality in ConfigurationDesk. The I/O functionality is based on function block types. The function library provides a structured tree view on the available function block types. It is displayed in the Function Browser.

Function outport A function port that outputs the value of a function to be used in the behavior model.

Function port An element of a function block that provides the interface to the behavior model via model port blocks.

Functional Mock-up Unit An archive file that describes and implements the functionality of a model based on the Functional Mock-up Interface (FMI) standard.

G

Global working view The default working view that always contains all signal chain elements.

H

Hardware resource A hardware element (normally a channel on an I/O board or I/O unit) which is required to execute a function block. A hardware resource can be localized unambiguously in a hardware system. Every hardware resource has specific characteristics. A function block therefore needs a hardware resource that matches the requirements of its functionality. This means that not every function block can be executed on every hardware resource. There could be limitations on a function block's features and/or the physical ranges.

Hardware resource assignment An action that assigns the electrical interface unit of a function block to one or more hardware resources. Function blocks can be assigned to any hardware resource which is suitable for the functionality and available in the hardware topology of your ConfigurationDesk application.

Hardware Resource Browser A pane that lets you display and manage all the hardware components of the hardware topology that is contained in your active ConfigurationDesk application in a hierarchical structure.

Hardware topology A component of a ConfigurationDesk application that contains information on a specific hardware system which can be used with ConfigurationDesk. It provides information on the components of the system, such as channel type and slot numbers. It can be scanned automatically from a registered platform, created in ConfigurationDesk's Hardware Resource Browser from scratch, or imported from an HTFX file.

HTFX file A file containing the hardware topology after an explicit export. It provides information on the components of the system and also on the channel properties, such as board and channel types and slot numbers.

I/O event An asynchronous event triggered by I/O functions. You can use I/O events to trigger tasks in your application process asynchronously. You can assign the events to the tasks via drag & drop, via the Properties Browser if you have selected a task, or via the Assign Event command from the context menu of the relevant task.

Interface model A temporary Simulink model that contains blocks from the Model Interface Blockset. ConfigurationDesk initiates the creation of an interface model in Simulink. You can copy the blocks with their identities from the interface model and paste them into an existing Simulink behavior model.

Interpreter A pane that lets you run Python scripts and execute line-based commands.

Inverse model port block A model port block that has the same configuration (same name, same port groups, and port names) but the inverse data direction as the original model port block from which it was created.

IOCNET Abbreviation of I/O carrier network.

A dSPACE proprietary protocol for internal communication in a SCALEXIO system between the real-time processors and I/O units. The IOCNET lets you connect more than 100 I/O nodes and place the parts of your SCALEXIO system long distances apart.

IPDU Abbreviation of interaction layer protocol data unit.

A term according to AUTOSAR. An IPDU contains the communication data that is routed from the interaction layer to a lower communication layer and vice versa. An IPDU can be implemented, for example, as an ISignal IPDU, multiplexed IPDU, or container IPDU.

ISignal A term according to AUTOSAR. A signal of the interaction layer that contains communication data as a coded signal value. To transmit the communication data on a bus, ISignals are instantiated and included in ISignal IPDUs.

ISignal IPDU A term according to AUTOSAR. An IPDU whose communication data is arranged in ISignals. ISignal IPDUs allow the exchange of ISignals between different network nodes.

L

LDF file A LIN description file that describes networks of the LIN bus system according to the LIN standard.

LIN master A member of a LIN communication cluster that is responsible for the timing of LIN bus communication. A LIN master provides one LIN master task and one LIN slave task. The LIN master task transmits frame headers on the bus, and provides LIN schedule tables and LIN collision resolver tables. The LIN slave task transmits frame responses on the bus. A LIN cluster must contain exactly one LIN master.

LIN schedule table A table defined for a LIN master that contains the transmission sequence of frame headers on a LIN bus. For each LIN master, several LIN schedule tables can be defined.

LIN slave A member of a LIN communication cluster that provides only a LIN slave task. The LIN slave task transmits frame responses on the bus when they are triggered by a frame header. The frame header is sent by a LIN master. A LIN cluster can contain several LIN slaves.

Local Program Data folder A standard folder for application-specific configuration data that is used by the current, non-roaming user.

```
%USERPROFILE%\AppData\Local\dSPACE\<InstallationGUID>\
<ProductName>
```

Logical signal An element of a function block that combines all the signal ports which belong together to provide the functionality of the signal. Each logical signal causes one or more channel requests. Channel requests are available after you have assigned a channel set to the logical signal.

Logical signal chain A term that describes the logical path of a signal between an external device and the behavior model. The main elements of the logical signal chain are represented by different graphical blocks (device blocks, function blocks and model port blocks). Every block has ports to provide the mapping to neighboring blocks.

In the documentation, usually the short form 'signal chain' is used instead.

M

MAP file A file that maps symbolic names to physical addresses.

Mapping line A graphical representation of a connection between two ports in the signal chain. You can draw mapping lines in a working view.

MCD file A model communication description file that is used to implement a multimodel application. It lets you add several behavior models that were separated from an overall model to the model topology.

The MCD file contains information on the separated models and information on the connections between them. The file is generated with the Model Separation Setup Block in MATLAB/Simulink. The block resides in the Model Interface Blockset (dsmpblib) from dSPACE.

MDL file A Simulink model file that contains the behavior model. You can add an MDL file to your ConfigurationDesk application.

As of MATLAB® R2012a, the file name extension for the Simulink model file has been changed from MDL to SLX by The MathWorks®.

Message Viewer A pane that displays a history of all error and warning messages that occur during work with ConfigurationDesk.

Model analysis A process that analyzes the model to determine the interface of a behavior model. You can select one of the following commands:

- Analyze Simulink Model (Model Interface Only)

  Analyzes the interface of a behavior model. The model topology of your active ConfigurationDesk application is updated with the properties of the analyzed behavior model.

- Analyze Simulink Model (Including Task Information)

  Analyzes the model interface and the elements of the behavior model that are relevant for the task configuration. The task configuration in ConfigurationDesk is then updated accordingly.

Model Browser A pane that lets you display and access the model topology of an active ConfigurationDesk application. The Model Browser provides access to all the model port blocks available in the behavior models which are linked to a ConfigurationDesk application. The model elements are displayed in a hierarchy, starting with the model roots. Below the model root, all the subsystems containing model port blocks are displayed as well as the associated model port blocks.

Model communication The exchange of signal data between the models within a multimodel application. To set up model communication, you must use a mapping line to connect a data outport (sending model) to a data inport (receiving model). The best way to set up model communication is using the Model Communication Browser.

Model Communication Browser A pane that lets you open and browse working views like the **Signal Chain Browser**, but shows only the Data Outport and Data Inport blocks and the mapping lines between them.

Model Communication Package table A pane that lets you create and configure model communication packages which are used for model communication in multimodel applications.

Model implementation An implementation of a behavior model. It can consist of source code files, precompiled objects or libraries, variable description files and a description of the model's interface. Specific model implementation types are, for example, model implementation containers, such as Functional Mock-up Units or Simulink implementation containers.

Model implementation container A file archive that contains a model implementation. Examples are FMUs, SIC files, and VECU files.

Model interface An interface that connects ConfigurationDesk with a behavior model. This interface is part of the signal chain and is implemented via model port blocks. The model port blocks in ConfigurationDesk can provide the interface to:

- Model port blocks (from the Model Interface Package for Simulink) in a Simulink behavior model. In this case, the model interface is also called ConfigurationDesk model interface to distinguish it from the Simulink model interface available in the Simulink behavior model.
- Different types of model implementations based on code container files, e.g., Simulink implementation containers, Functional Mock-up Units, and V-ECU implementations.

Model Interface Package for Simulink A dSPACE software product that lets you specify the interface of a behavior model that you can directly use in ConfigurationDesk. You can also create a code container file (SIC file) that contains the model code of a Simulink behavior model. The SIC file can be used in ConfigurationDesk and VEOS Player.

Model port An element of a model port block. Model ports provide the interface to the function ports and to other model ports (in multimodel applications).

These are the types of model ports:

- Data inport
- Data outport
- Runnable function port
- Configuration port

Model port block A graphical representation of the ConfigurationDesk model interface in the signal chain. Model port blocks contain model ports that can be mapped to function blocks to provide the data flow between the function blocks in ConfigurationDesk and the behavior model. The model ports can also be mapped to the model ports of other model port blocks with data inports or data outports to set up model communication. Model port blocks are available in different types and can provide different port types:

- Data port blocks with data inports and data outports
- Runnable Function blocks with runnable function ports
- Configuration Port blocks with configuration ports. Configuration Port blocks are created during model analysis for each of the following blocks found in the Simulink behavior model:
  - RTICANMM ControllerSetup block
  - RTILINMM ControllerSetup block
  - FLEXRAYCONFIG UPDATE block

  Configuration Port blocks are also created for bus simulation containers.

Model Separation Setup Block A block that is contained in the Model Interface Package for Simulink. It is used to separate individual models from an overall model in MATLAB/Simulink. Additionally, model separation generates a model communication description file (MCD file) that contains information on the separated models and their connections. You can use this MCD file in ConfigurationDesk.

Model topology A component of a ConfigurationDesk application that contains information on the subsystems and the associated model port blocks of all the behavior models that have been added to a ConfigurationDesk application.

Model-Function Mapping Browser A pane that lets you create and update signal chains for Simulink behavior models. It directly connects them to I/O functionality in ConfigurationDesk.

MTFX file A file containing a model topology when explicitly exported. The file contains information on the interface to the behavior model, such as the implemented model port blocks including their subsystems and where they are used in the model.

Multicore real-time application A real-time application that is executed on several cores of one PU of the real-time hardware.

Multimodel application A real-time application that executes several behavior models in parallel on dSPACE real-time hardware (SCALEXIO or MicroAutoBox III).

Multiplexed IPDU A term according to AUTOSAR. An IPDU that consists of one dynamic part, a selector field, and one optional static part. Multiplexing is used to transport varying ISignal IPDUs via the same bytes of a multiplexed IPDU.

- The dynamic part is one ISignal IPDU that is selected for transmission at run time. Several ISignal IPDUs can be specified as dynamic part alternatives. One of these alternatives is selected for transmission.

- The selector field value indicates which ISignal IPDU is transmitted in the dynamic part during run time. For each selector field value, there is one corresponding ISignal IPDU of the dynamic part alternatives. The selector field value is evaluated by the receiver of the multiplexed IPDU.
- The static part is one ISignal IPDU that is always transmitted.

Multi-PU application Abbreviation of multi-processing-unit application. A multi-PU application is a real-time application that is partitioned into several processing unit applications. Each processing unit application is executed on a separate PU of the real-time hardware. The processing units are connected via IOCNET and can be accessed from the same host PC.

N

Navigation bar An element of ConfigurationDesk's user interface that lets you switch between view sets.

Network node A term that describes the bus communication of an ECU for only one communication cluster.

O

Offline simulation A purely PC-based simulation scenario without a connection to a physical system, i.e., neither simulator hardware nor ECU hardware prototypes are needed. Offline simulations are independent from real time and can run on VEOS.

Offline simulation application An application that runs on VEOS to perform offline simulation. An offline simulation application can be built with the VEOS Player and the resulting OSA file can be downloaded to VEOS.

OSA file An offline simulation application file that is built with the VEOS Player and can be downloaded to VEOS to perform offline simulation.

P

Parent port A port that you can use to map multiple function ports and model ports. All child ports with the same name are mapped. ConfigurationDesk enforces the mapping rules and allows only mapping lines which agree with them.

PDU Abbreviation of protocol data unit.

A term according to AUTOSAR. A PDU transports data (e.g., control information or communication data) via one or multiple network layers according to the AUTOSAR layered architecture. Depending on the involved layers and the function of a PDU, various PDU types can be distinguished, e.g., ISignal IPDUs, multiplexed IPDUs, and NMPDUs.

Physical signal chain A term that describes the electrical wiring of external devices (ECU and loads) to the I/O boards of the real-time hardware. The physical signal chain includes the external cable harness, the pinouts of the connectors and the internal cable harness.

Pins and External Wiring table A pane that lets you access the external wiring information

Platform A dSPACE real-time hardware system that can be registered and displayed in the Platform Manager.

Platform Manager A pane that lets you handle registered hardware platforms. You can download, start, and stop real-time applications via the Platform Manager. You can also update the firmware of your SCALEXIO system or MicroAutoBox III system.

Preconfigured application process An application process that was created via the Create preconfigured application process command. If you use the command, ConfigurationDesk creates new tasks for each runnable function provided by the model which is not assigned to a predefined task. ConfigurationDesk assigns the corresponding runnable function and (for periodic tasks) timer events to the new tasks. The tasks are preconfigured (e.g., DAQ raster name, period).

Processing Resource Assignment table A pane that lets you configure and inspect the processing resources in an executable application. This table is useful especially for multi-processing-unit applications.

Processing unit application A component of an executable application. A processing unit application contains one or more application processes.

Project A container for ConfigurationDesk applications and all project-specific documents. You must define a project or open an existing one to work with ConfigurationDesk. Projects are stored in a project root folder.

Project Manager A pane that provides access to ConfigurationDesk projects and applications and all the files they contain.

Project root folder A folder on your file system to which ConfigurationDesk saves all project-relevant data, such as the applications and documents of a project. Several projects can use the same project root folder. ConfigurationDesk uses the Documents folder as the default project root folder. You can specify further project root folders. Each can be made the default project root folder.

Properties Browser A pane that lets you access the properties of selected elements.

PU Abbreviation of processing unit.

A hardware assembly that consists of a motherboard or a dSPACE processor board, possibly additional interface hardware for connecting I/O boards, and an enclosure, i.e., a SCALEXIO Real-Time PC.

R

Real-time application An application that can be executed in real time on dSPACE real-time hardware. The real-time application is the result of a build process. It can be downloaded to real-time hardware via an RTA file. There are different types of real-time applications:

- Single-core real-time application.
- Multicore real-time application.
- Multi-PU application.

Restbus simulation A simulation method to test real ECUs by connecting them to a simulator that simulates the other ECUs in the communication clusters.

RTA file A real-time application file. An RTA file is an executable object file for processor boards. It is created during the build process. After the build process it can be downloaded to the real-time hardware.

Runnable function A function that is called by a task to compute results. A model implementation provides a runnable function for its base rate task. This runnable function can be executed in a task that is triggered by a timer event. In addition, a Simulink behavior model provides a runnable function for each Hardware-Triggered Runnable Function block contained in the Simulink behavior model. This runnable function is suitable for being executed in an asynchronous task.

Runnable Function block A type of model port block. A Runnable Function block provides a runnable function port that can be mapped to an event port of a function block for modeling an asynchronous task.

Runnable function port An element of a Runnable Function block. The runnable function port can be mapped to an event port of a function block for modeling an asynchronous task.

RX Communication data that is received by a bus member.

S

SCALEXIO system A dSPACE hardware-in-the-loop (HIL) system consisting of one or more real-time industry PCs (PUs), I/O boards, and I/O units. They communicate with each other via the IOCNET. The system simulates the environment to test an ECU. It provides the sensor signals for the ECU, measures the signals of the ECU, and provides the power (battery voltage) for the ECU and a bus interface for restbus simulation.

SDF file A system description file that contains information on the CPU name(s), the corresponding object file(s) to be downloaded and the corresponding variable description file(s). It is created during the build process.

Secured IPDU A term according to AUTOSAR. An IPDU that secures the payload of another PDU (i.e., authentic IPDU) for secure onboard communication (SecOC). The secured IPDU contains the authentication information that is used to secure the authentic IPDU's payload. If the secured IPDU is configured as a cryptographic IPDU, the secured IPDU and the authentic IPDU are mapped to different frames. If the secured IPDU is not configured as a cryptographic IPDU, the authentic IPDU is directly included in the secured IPDU.

SIC file A Simulink implementation container file that contains the model code of a Simulink behavior model. The SIC file can be used in ConfigurationDesk and in VEOS Player.

Signal chain A term used in the documentation as a short form for logical signal chain. Do not confuse it with the physical signal chain.

Signal Chain Browser A pane that lets you open and browse working views such as the Global working view or user-defined working views.

Signal inport A signal port that represents an electrical connection point of a function block which provides signal measurement (= input) functionality.

Signal outport A signal port that represents an electrical connection point of a function block which provides signal generation (= output) functionality.

Signal port An element of a function block that provides the interface to external devices (e.g., ECUs) via device blocks. It represents an electrical connection point of a function block.

Signal reference port A signal port that represents a connection point for the reference potential of inports, outports and bidirectional ports. For example: With differential signals, this is a reference signal, with single-ended signals, it is the ground signal (GND).

Simulink implementation container A container that contains the model code of a Simulink behavior model. A Simulink implementation container is generated from a Simulink behavior model by using the Model Interface Package for Simulink. The file name extension of a Simulink implementation container is SIC.

Simulink model interface The part of the model interface that is available in the connected Simulink behavior model.

Single-core real-time application An executable application that is executed on only one core of the real-time hardware.

Single-PU system Abbreviation of single-processing-unit system.

A system consisting of exactly one PU and the directly connected I/O units and I/O routers.

SLX file A Simulink model file that contains the behavior model. You can add an SLX file to your ConfigurationDesk application.

As of MATLAB® R2012a, the file name extension for the Simulink model file has been changed from MDL to SLX by The MathWorks®.

Software event An event that is activated from within a task to trigger another subordinate task. Consider the following example: A multi-tasking Simulink behavior model has a base rate task with a sample time = 1 ms and a periodic task with a sample time = 4 ms. In this case, the periodic task is triggered on every fourth execution of the base rate task via a software event. Software events are available in ConfigurationDesk after model analysis.

Source Code Editor A Python editor that lets you open and edit Python scripts that you open from or create in a ConfigurationDesk project in a window in the working area. You cannot run a Python script in a **Source Code Editor** window. To run a Python script you can use the **Run Script** command in the Interpreter or on the **Automation** ribbon or the **Run** context menu command in the Project Manager.

Structured data port A hierarchically structured port of a Data Inport block or a Data Outport block. Each structured data port consists of more structured and/or unstructured data ports. The structured data ports can consist of signals with different data types (single, double, int8, int16, int32, int64, uint8, uint16, uint32, uint64, Boolean).

SystemDesk A dSPACE software product for development of distributed automotive electrics/electronics systems according to the AUTOSAR approach.

SystemDesk is able to provide a V-ECU implementation container (as a VECU file) to be used in ConfigurationDesk.

T

Table A type of pane that offers access to a specific subset of elements and properties of the active ConfigurationDesk application in rows and columns.

TargetLink A dSPACE software product for production code generation. It lets you generate highly efficient C code for microcontrollers in electronic control units (ECUs). It also helps you implement control systems that have been modeled graphically in a Simulink/Stateflow diagram on a production ECU.

TargetLink is able to provide a V-ECU implementation container (as a VECU file) or a Simulink implementation container (SIC file) to be used in ConfigurationDesk.

Task A piece of code whose execution is controlled by a real-time operating system (RTOS). A task is usually triggered by an event, and executes one or more runnable functions. In a ConfigurationDesk application, there are predefined tasks that are provided by executable application components. In addition, you can create user-defined tasks that are triggered, for example, by I/O events. Regardless of the type of task, you can configure the tasks by specifying the priority, the DAQ raster name, etc.

Task Configuration table A pane that lets you configure the tasks of an executable application.

Temporary working view A working view that can be used for drafting a signal chain segment, like a notepad.

Timer event A periodic event with a sample rate and an optional offset.

Topology A hierarchy that serves as a repository for creating a signal chain. All the elements of a topology can be used in the signal chain, but not every element needs to be used. You can export each topology from and import it to a ConfigurationDesk application. Therefore a topology can be used in several applications.

A ConfigurationDesk application can contain the following topologies:

- Device topology
- Hardware topology
- Model topology

TRC file A variable description file that contains all variables (signals and parameters) which can be accessed via the experiment software. It is created during the build process.

TX Communication data that is transmitted by a bus member.

U

User function An external function or program that is added to the Automation – User Functions ribbon group for quick and easy access during work with ConfigurationDesk.

V

VECU file A ZIP file that contains a V-ECU implementation. A VECU file can contain data packages for different platforms. VECU files are exported by TargetLink or SystemDesk. You can add a V-ECU implementation based on a VECU file to the model topology in the same way as adding a Simulink model based on an SLX file.

VEOS The dSPACE software product for performing offline simulation. VEOS is a PC-based simulation platform which allows offline simulation independently from real time.

VEOS Player A software running on the host PC for building offline simulation applications. Offline simulation applications can be downloaded to VEOS to perform offline simulation. ConfigurationDesk lets you generate a bus simulation container (BSC file) via the Bus Manager. You can then import the BSC file into the VEOS Player.

View set A specific arrangement of some of ConfigurationDesk's panes. You can switch between view sets by using the navigation bar. ConfigurationDesk provides preconfigured view sets for specific purposes. You can customize existing view sets and create user-defined view sets.

VSET file A file that contains all view sets and their settings from the current ConfigurationDesk installation. A VSET file can be exported and imported via the View Sets page of the Customize dialog.

W

Working area The central area of ConfigurationDesk's user interface.

Working view A view of the signal chain elements (blocks, ports, mappings, etc.) used in the active ConfigurationDesk application. A working view can be opened in the Signal Chain Browser or the Model Communication Browser. ConfigurationDesk provides two default working views: The Global working view and the Temporary working view. In the Working View Manager, you can also create user-defined working views that let you focus on specific signal chain segments according to your requirements.

Working View Manager A pane that lets you manage the working views of the active ConfigurationDesk application. You can use the Working View Manager for creating, renaming, and deleting working views, and also to open a working view in the Signal Chain Browser or the Model Communication Browser.

X

XLSX file A Microsoft Excel™ file format that is used for the following purposes:

- Creating or configuring a device topology outside of ConfigurationDesk.
- Exporting the wiring information for the external cable harness.
- Exporting the configuration data of the currently active ConfigurationDesk application for documentation purposes.