

ASM Gasoline Engine

Model Description

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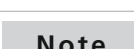



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About This Document

Content This document shows you how to work with the ASM Gasoline Engine model.

Symbols dSPACE user documentation uses the following symbols:

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

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Demo Information

Demo model

This model simulates gasoline engines extended by longitudinal models for drivetrain, vehicle and driver.

The engine model consists of components for the complete air path, for the fuel system, the combustion and the exhaust system. Generally it is modeled as a mean value engine model with additional combustion torque modulation. The engine is controlled by a soft ECU.

The drivetrain has two options for the transmission system: a manual transmission and an automatic transmission. Instead of a drivetrain the engine can also be simulated on an engine test bench.

The longitudinal vehicle model takes into account slope and air, rolling and braking resistance. The driver model is used to follow reference velocities given by standard driving cycles like FTP-75 (Federal Test Procedure), NEUDC (New European Driving Cycle), Japanese 10-15, ...

The initial default parameterization of the model simulates a

- 6 cylinder 2.9 l gasoline engine
- Manual 5-gear transmission

- Mid-size car with a vehicle mass of 1000 kg
- No slope, standard ambient parameters

The initial maneuver defines that the driver should follow reference velocity given by the standard driving cycle FTP-75. The default engine parameterization can be exchanged with a 4 cylinder 1.5 l turbocharged gasoline engine.

Note

From ASM 2.3, there are two library versions available: the ASM Developer library and the ASM Operator library. The Developer library consists of same block types as before, i.e. open Simulink blocks even below the block's mask. The Operator library, in contrast, consists of S-function blocks only. Thus, you cannot look inside the block's implementation. The look and feel up to the block's mask, however, is the same.

Model Preparation for Real-Time Simulation (PHS-Bus-Based Platforms)

Model preparation

Before you use the model for real-time simulation, you have to prepare the model. To avoid the real-time process from being stopped by task overruns during the initialization phase of the model, it is recommended to allow a number of queued task calls before the simulation is stopped.

Note

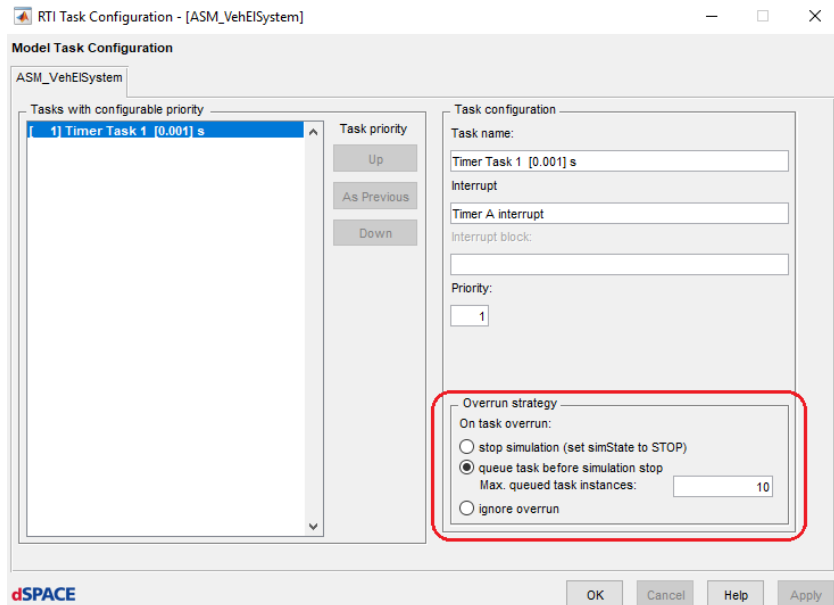
If you use the Operator version of the ASM, you cannot generate code for real-time simulation.

Method**To avoid stopping the real-time process on a singular task overrun**

- 1 In Simulink, select Code – C/C++ Code – Code Generation Options to open the Configuration Parameters dialog.
- 2 In the Configuration Parameters dialog, select RTI simulation options from the Select tree.

3 Click Task Configuration.

After a few seconds the RTI Task Configuration dialog opens.



4 In this dialog, select queue task before simulation stop as the overrun strategy.

5 In Max. queued task instances, enter 10 and click OK.

This setting has no appreciable effect on your normal task overrun behavior, because only a few singular task overruns (for example, 10) are accepted.

Tutorials

Where to go from here

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Handling the Model

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How to Open an ASM Library

Objective

After successfully installing ASM on your PC, you can now easily open an ASM library.

This lesson explains how to open the Gasoline Engine library. You can start all ASM products in a similar way. The MATLAB Command Window shows you all the products that are installed and covered by your license.

Method

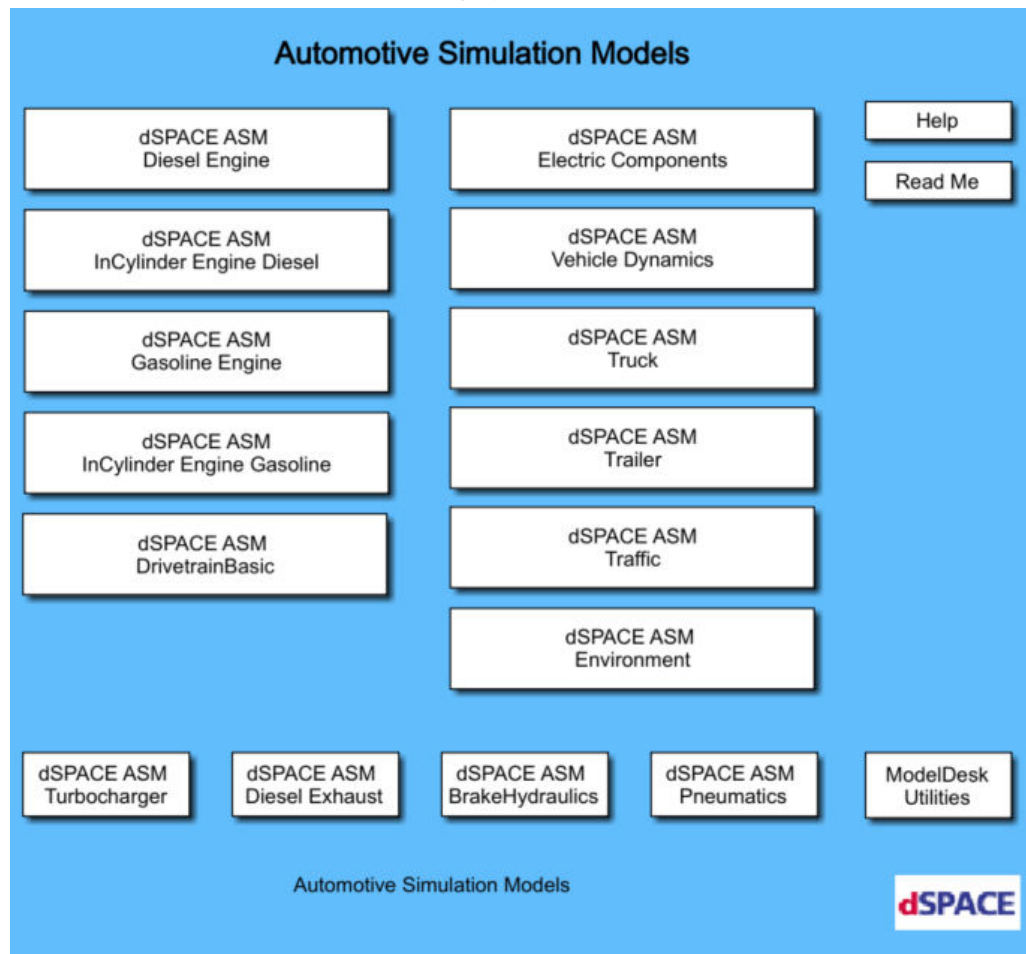
To open an ASM library

- 1 Start a MATLAB session.

When MATLAB starts, the MATLAB Command Window lists all the ASM blocksets that are installed on the PC.

- 2 Type `asm` in your MATLAB Command Window.

The central ASM library opens.



It provides an overview of all the accessible major ASM libraries:

- ASM Diesel Engine
- ASM InCylinder Engine Diesel
- ASM InCylinder Engine Gasoline
- ASM Gasoline Engine
- ASM Drivetrain Basic
- ASM Vehicle Dynamics

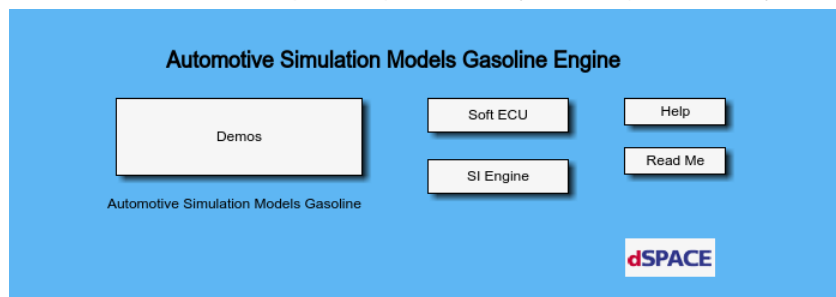
- ASM Electric Components
- ASM Trailer
- ASM Traffic
- ASM Truck
- ASM Environment

Depending on your software license, some of the libraries are grayed out. If a library is grayed, you do not have a valid license for it.

3 Double-click the dSPACE ASM Gasoline Engine subsystem.

The subsystem opens. Depending on the installed license, you can open the developer or operator library. For details, refer to [Operator Version \(ASM User Guide\)](#).

4 Double-click the Developer or Operator subsystem to open the library.



Result

The library opens. It is subdivided into three sections.

- On the left is a subsystem with all the demo models belonging to the library.
- The middle section contains the subsystems that are part of the library and which are contained in the example model as links.
- On the right are links to the documentation and to the last-minute information in the readme section.

Related topics

HowTos

[How to Start with an ASM Demo Model via MATLAB.....](#) 14

How to Start with an ASM Demo Model via MATLAB


Objective

After successfully installing ASM on your PC, you can now easily start a demo model of your ASM installation via MATLAB.

This lesson explains how to start the Gasoline Engine model via MATLAB. You can start all ASM products in a similar way. The MATLAB Command Window shows you all the products that are installed and covered by your license.

Methods to start with an ASM demo model

You can start an ASM demo model with the following methods:

- Start an ASM demo model via MATLAB, see below.
- Generate an ASM project by using ModelDesk or by using MATLAB/Simulink. Refer to [How to Create a Project Based on an ASM Demo \(ModelDesk Project and Experiment Management\)](#) .

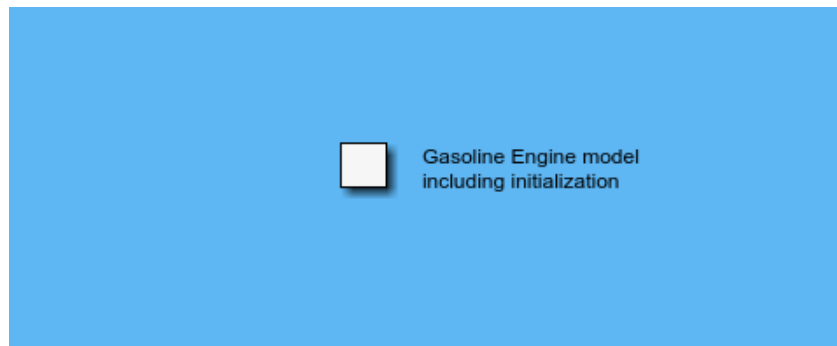
Preconditions

The ASM library is open. Refer to [How to Open an ASM Library](#) on page 12.

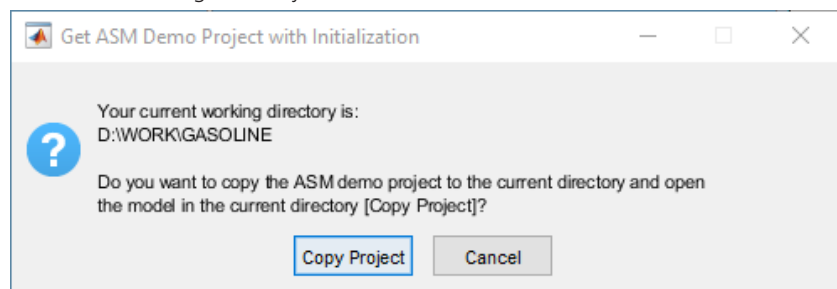
Method

To start with an ASM demo model via MATLAB

- 1 Double-click the Demos subsystem to open a new window which presents all the demo models that are part of the library.



- 2 Double-click the demo model to start it.
This opens a dialog that offers you the possibility to copy the project to your current working directory.



- 3 Click Copy Project to copy the current demo folder to your current MATLAB work folder.
All the files related to the demo model are copied to the current MATLAB work folder. This includes the entire parameterization and the ControlDesk example layouts.

Result

Now the demo model opens. All the initialization files are executed and you can start simulation.

Related topics**HowTos**

[How to Create a Project Based on an ASM Demo \(ModelDesk Project and Experiment Management !\[\]\(3d8c13c92b853674f749aac6fa869926_img.jpg\)\)](#)

How to Start with an ASM Demo Model Using ModelDesk

Objective

After successfully installing ASM on your PC, you can now easily start a demo model of your ASM installation using ModelDesk.

Methods to start with an ASM demo model

You can start an ASM demo model with the following methods:

- Generate an ASM project by using ModelDesk or by using MATLAB/Simulink, see below.
- Start an ASM demo model via MATLAB. Refer to [How to Start with an ASM Demo Model via MATLAB](#) on page 14.

ASM demos

The ASM installation contains several ASM demos. The ASM demos include all the necessary files for the simulation, for example:

- Simulation model based on the ASM blocks
- Simulation applications for the simulation platforms
- ModelDesk project for parameterizing the model
- ControlDesk project for experimenting with the model
- MotionDesk project for animation (if useful)

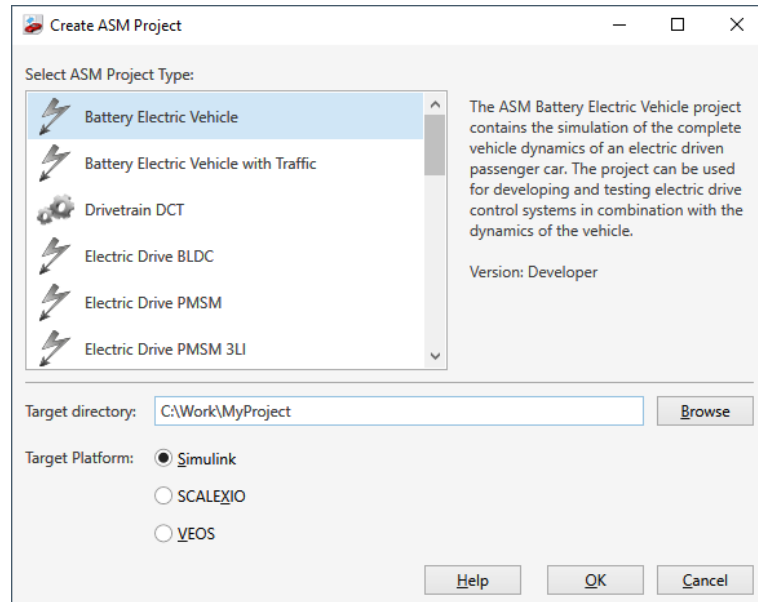
Preconditions

- No other project must be open.
- The license of the ASM library that is used by the ASM demos must be available.
- The ASM library must be decrypted.

Method**To to start with an ASM demo model using ModelDesk**

- 1 On the File ribbon, click New – ASM Project.

The Define a Project dialog opens.



- 2 Select an ASM project type.
- 3 Specify the target directory. Select an empty directory or specify a new directory. You must have write permission to the directory.
- 4 Select the target platform to be activated in the experiment.
- 5 Click OK.

Result

ModelDesk copies all files of the selected ASM demo to the specified target folder and opens the project.

How to Open a Parameterization Project

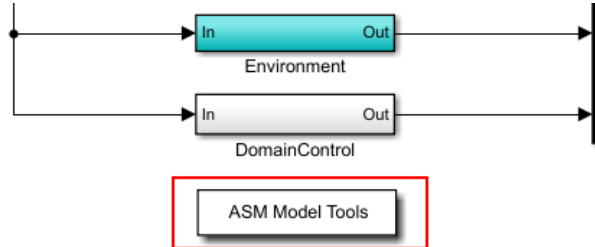
Objective

You can open a parameterization project from the model.

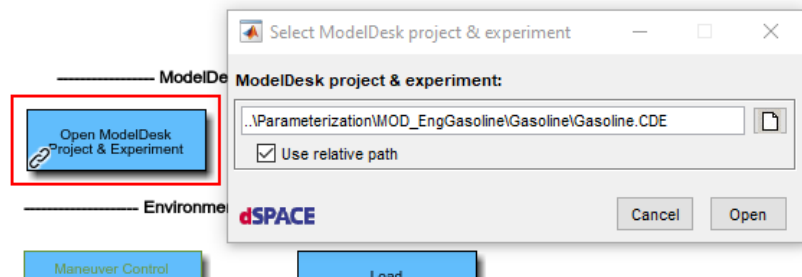
The parameterization project for the current model is accessible via the Open ModelDesk Project & Experiment button.

Method**To open a parameterization project**

- 1 In the ASM model, double-click the ASM Model Tools button below the modules.



- 2 Double-click the Open ModelDesk Project & Experiment button.



- 3 In the dialog, click Open to open the selected ModelDesk project.

Result

ModelDesk is started and the selected project and experiment is loaded.

How to Parameterize ASM via ModelDesk

Objective

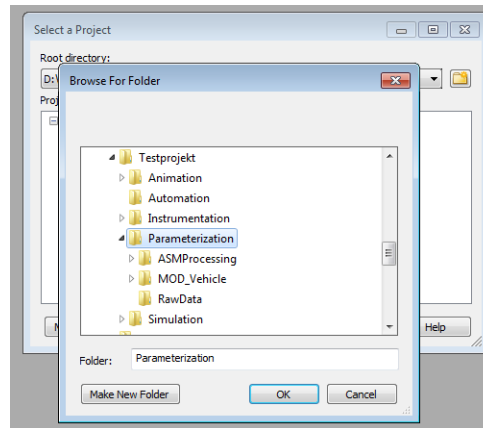
The <Projectfolder>\Parameterization folder includes a complete ModelDesk project. You can perform the complete parameterization of the ASM model with ModelDesk.

In the following method, an ASM Electric Components demo is used as an example.

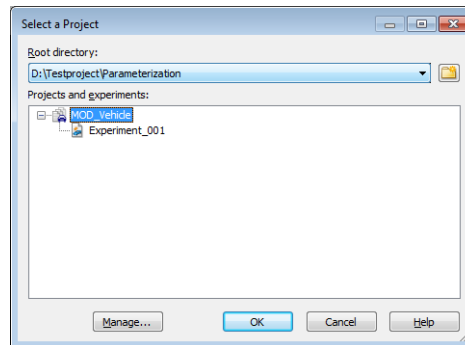
Method**To parameterize ASM via ModelDesk**

- 1 Start ModelDesk and open the project from <Projectfolder>\Parameterization.

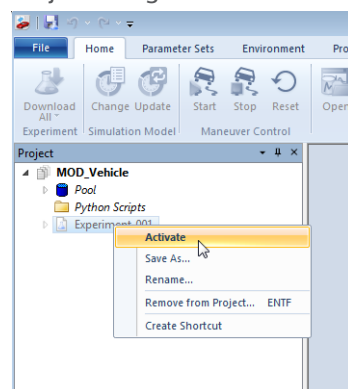
1. Click File – Open – Project + Experiment.
2. Define the root directory in <Projectfolder>\Parameterization.



3. Select the project.

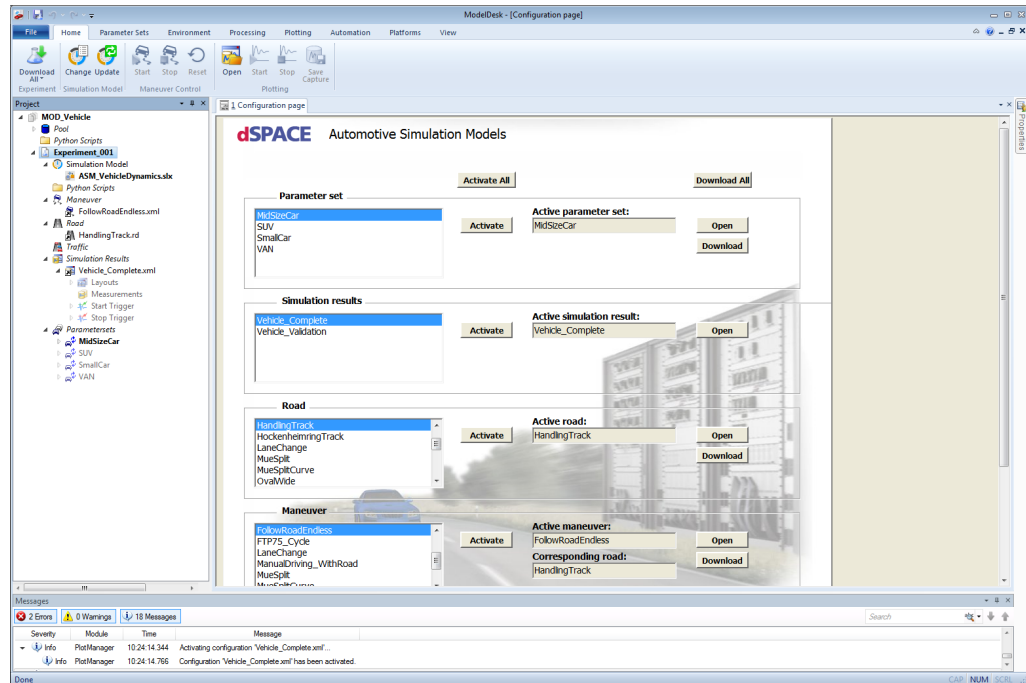


- 2 Activate the demo experiment via context menu on the experiment in the Project Navigator.



The project structure is available in the Project Navigator and all parameters are available for configuration.

3 Switch to the experiment's Configuration page.



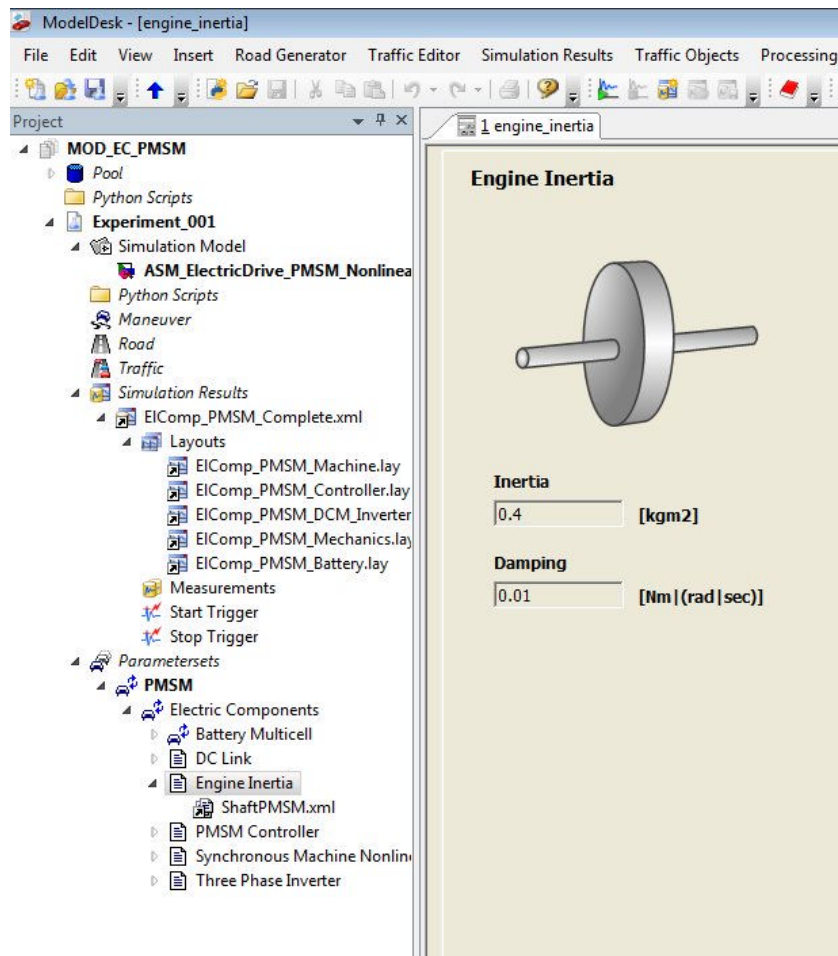
The Configuration page of the experiment lets you select parameter sets for activating and downloading them to the simulation model or for activating and editing (Open button) them.

You can also activate plotting sets and open them to obtain simulation results in ModelDesk via the ModelDesk Plotting feature.

- 4 Click Activate and then Download to activate and download the parameter set.
- 5 Start a simulation (if possible in accelerator mode) and observe the results in the Simulink plotters, and/or ModelDesk plotting.

- 6 Modify, for example, the engine inertia in ModelDesk.

In the Project Navigator, select Parametersets – <ParameterSet name> – ElectricComponents – Engine Inertia.



- 7 Use the context menu of the current page to save and download the new setting or switch back to the main experiment page and download the current parameter setting.
- 8 Start a simulation (if possible in accelerator mode) and observe the results in the Simulink plotters, ModelDesk plotting, and/or MotionDesk.
- 9 Switch to the MATLAB workspace and look at the value of the engine inertia, `MDL.ElectricComponents.Mechanics.EngineInertia.Const_Inertia`. If you are working with the Simulink simulation, all parameters are available in the structure `MDL` in the MATLAB workspace and ModelDesk can download new values to the `MDL` structure.

```
>> MDL.ElectricComponents.Mechanics.EngineInertia.Const_Inertia
ans =
```

```

Comment: 'Inertia'
Author: '(null)'
Origin: ' '
Version: '2'
LastModified: '16.01.2015 11:21'
vName: 'Const_Inertia'
vUnit: '[kgm2]'
v: [0.4000]

```

Result

You parameterized the model in ModelDesk.

Related topics**Basics**

[Working with Parameter Sets \(ModelDesk Parameterizing !\[\]\(5a132f13505a6571904d622757b7a8f0_img.jpg\)\)](#)

References

[Settings \(ModelDesk Road Creation !\[\]\(e1d6102fe77919492c04879c8450f1f5_img.jpg\)\)](#)

How to Select Maneuver Conditions

Objective

You can select different maneuver conditions.

Maneuver type

The following table describes the options for the maneuver type:

Maneuver Type	Description
Manual	To simulate the model manually in ControlDesk on a dSPACE platform or in Simulink on a standard PC.
Stimulus	To define a time-dependent stimulus maneuver to test the behavior of the model.
Test cycle	Contains the longitudinal driving and engine cycles, which can be defined by a MATLAB function that is part of your installation.

Maneuver state

Different states are possible for the Test cycle and Stimulus maneuver types.

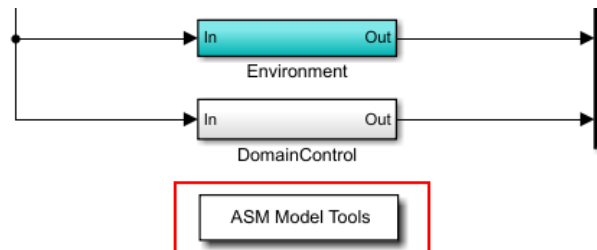
The following table describes the options for the maneuver state:

Maneuver State	Description
Stop	Maneuver stopped.
Start	Maneuver started.

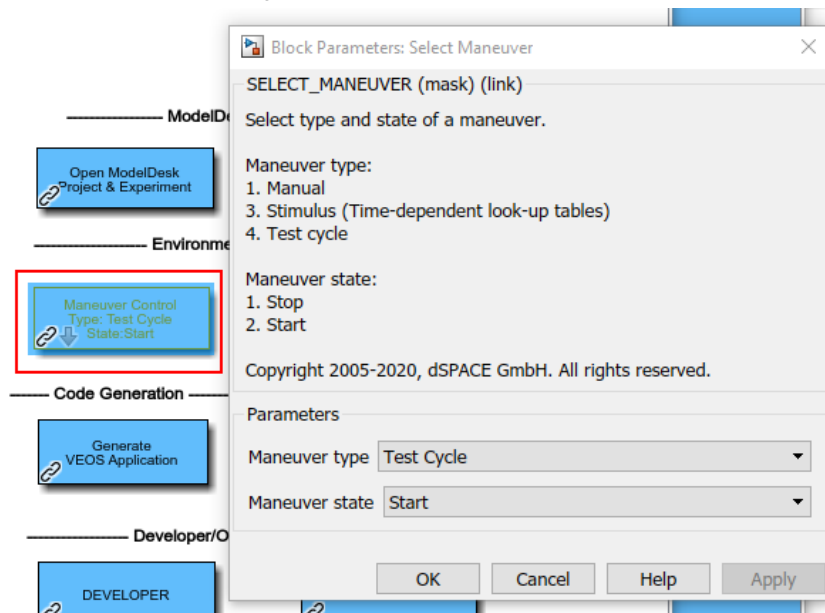
Method

To select maneuver conditions

- 1 In the ASM model, double-click the ASM Model Tools button below the modules.



- 2 Double-click the Test cycle Start button.



- 3 In the Simulink dialog, adjust the maneuver type and the maneuver state and click OK.

Result You selected maneuver conditions.

Related topics

References

[Select Maneuver \(ASM User Guide !\[\]\(96cc62f861fdd6e50510c0224a756dff_img.jpg\)\)](#)

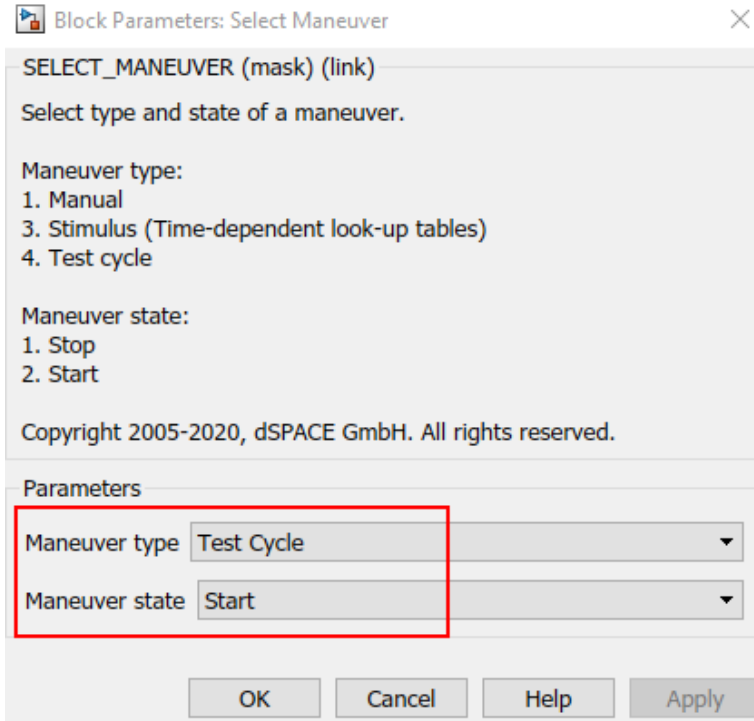
How to Select a Test Cycle

Objective You can select different test cycles.

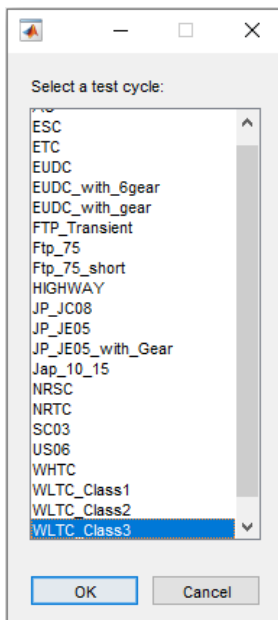
Description The test cycles are stored in the ASM project at `<Projectfolder>\Simulation\IniFiles\DrivingCycles`. You can select a test cycle via a Simulink dialog.

Method**To select a test cycle**

- 1 In the ASM Tools, set the maneuver type to *Test Cycle* and the maneuver state to *Start*. Refer to [How to Select Maneuver Conditions](#) on page 22.



- 2 In the ASM Tools, double-click the Load Test Cycles button to open the Simulink dialog which lists all the driving cycles.



- 3 In the Simulink dialog, select a new test cycle and click OK.
- 4 Restart the simulation with the new test cycle.

Result You selected the test cycle.

Related topics

References

[Test Cycle \(ASM User Guide !\[\]\(339a16584d5da0f0a3ca4e9ec17bf6a1_img.jpg\)](#))

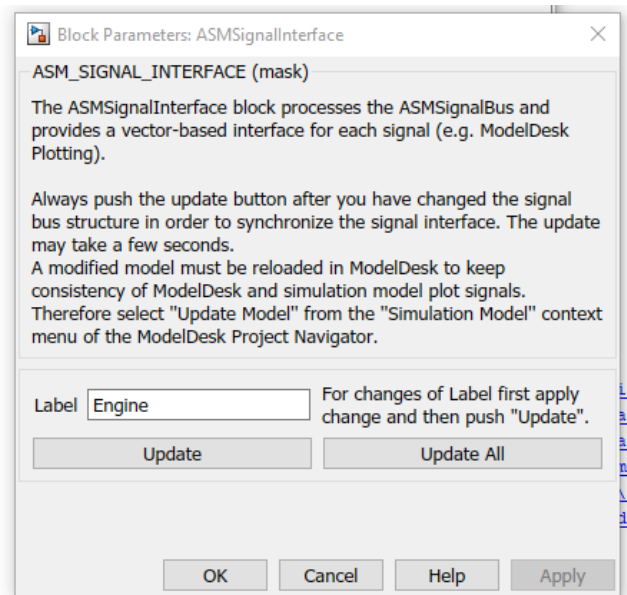
How to Plot Simulation Results in ModelDesk

Objective You can plot simulation results in ModelDesk via the SignalInterfaces.

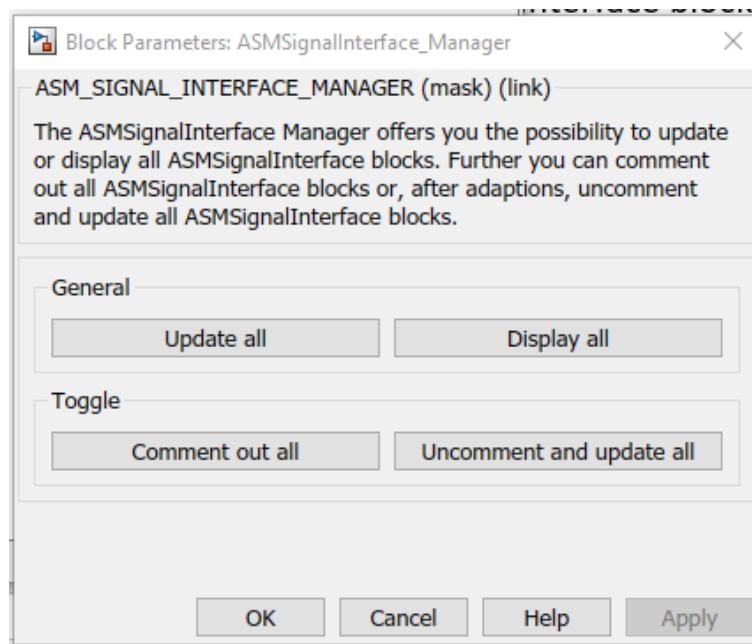
Description

You can use the ASMSignalInterface block and the ASMSignalInterface Manager to toggle the plotting.

ASMSignalInterface block Simulation data is transferred from the ASM model to ModelDesk via the ASMSignalInterface block. There is one block inside each ASM module. Refer to [ASMSignalInterface \(ASM User Guide !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d_img.jpg\)](#)).



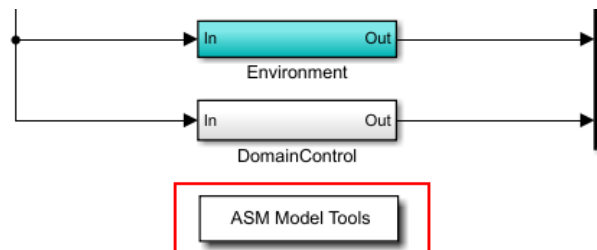
ASMSignal Interface Manager The ASMSignalInterface Manager collects the signals of all modules of your model. You can open it via the ASM Tools. Refer to [ASMSignalInterface Manager \(ASM User Guide !\[\]\(e3275251d0893157c3584e20c81dc3ba_img.jpg\)](#)).



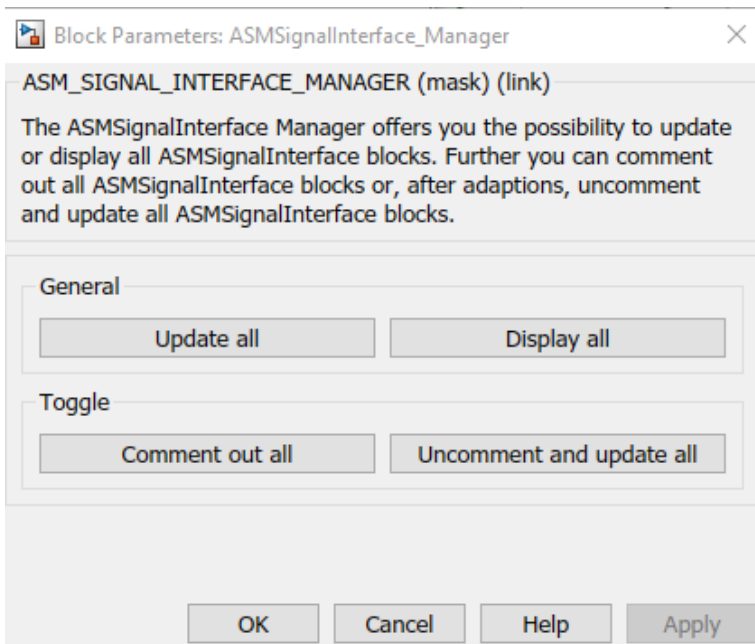
Method

To plot simulation results in ModelDesk

- 1 In the ASM model, double-click the ASM Model Tools button below the modules.



- 2 Double-click the ASMSignalInterface Manager button and press one of the two buttons:
 - Uncomment and update all: for plotting in ModelDesk.
 - Comment out all: if you do not need plotting in ModelDesk. Commenting out the blocks will improve the simulation performance.

**Result**

You activated or deactivated plotting in ModelDesk.

Related topics**HowTos**

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How to Switch the Library Type

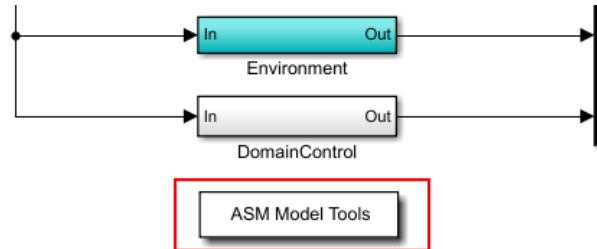
Objective

You can switch between the developer library and the operator library.

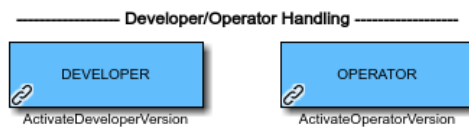
The developer library is a Simulink library containing the open-source ASM blocks. In the operator library, the ASM blocks are Simulink S-functions for offline simulation.

Method**To switch the library type**

- 1 In the ASM model, double-click the ASM Model Tools button below the modules.



- 2 Depending on the library type, you want to switch to, double-click the DEVELOPER button or the OPERATOR button.

**Result**

You switched between the developer library and the operator library.

Related topics**References**

[Activate Developer Version \(ASM User Guide !\[\]\(47734e4656765d20df4fdbd5b7aff048_img.jpg\)](#))
[Activate Operator Version \(ASM User Guide !\[\]\(effba44ea72cb8c77bdc1dac75561f86_img.jpg\)](#))

How to Handle Multi-Instances

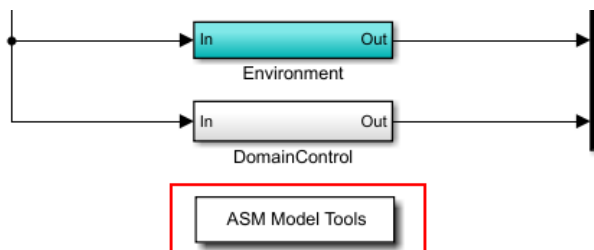
Objective

The Multi-Instance Overview button opens a dialog to get an overview of all multi-instance blocks in the model and to set the multi-instance parameters.

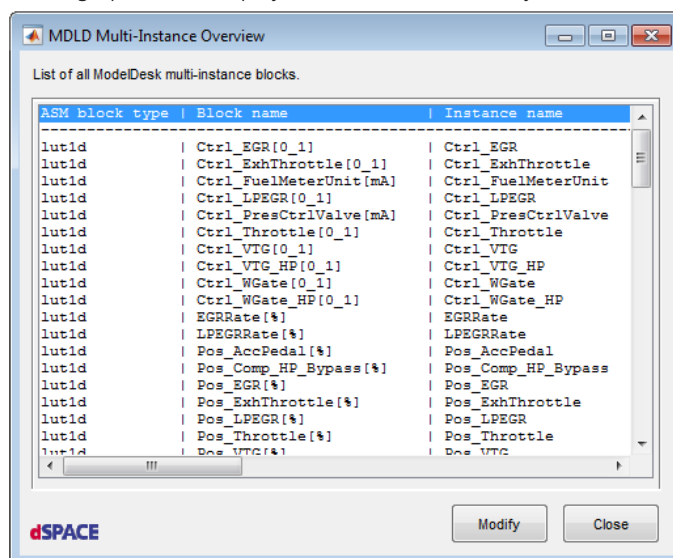
For more information on multi-instances, refer to [Multi-Instance \(ASM User Guide !\[\]\(41aea2746216b27a6939d696d8e035da_img.jpg\)](#)).

Method**To handle multi-instances**

- 1 In the ASM model, double-click the ASM Model Tools button below the modules.



- 2 Double-click the Multi-Instance Overview button.
A dialog opens that displays the multi-instances in your model.



- 3 To modify a multi-instance, select it in the dialog and click Modify.

Result

You modified multi-instances.

Related topics**Basics**

[Multi-Instance \(ASM User Guide\)](#)


How to Display the ModelDesk Parameter Group

Objective

You can modify the grouping in the parameter set that is displayed in the project tree of your ModelDesk experiment.

For more information, refer to [Basics on Grouping the View of a Parameter Set \(ModelDesk Parameterizing\)](#) .

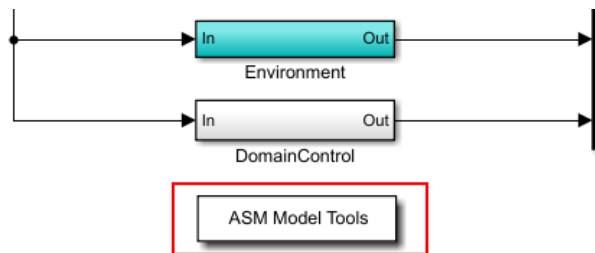
The ModelDesk Parameter Group Overview block in the ASM Tools opens an overview of the ModelDesk parameter group blocks that are contained in the simulation model.

For more information, refer to [ModelDesk Parameter Group \(ASM User Guide\)](#) .

Method

To display the ModelDesk parameter group

- 1 In the ASM model, double-click the ASM Model Tools button below the modules.



- 2 Double-click the ModelDesk Parameter Group Overview button.





Result

The MDLD Parameter Group Overview dialog opens. It displays all ModelDesk parameter groups.

Select a group in the list and click Open System to open the group in your model.

Related topics

Basics

[Basics on Grouping the View of a Parameter Set \(ModelDesk Parameterizing\)](#) 
[ModelDesk Parameter Group \(ASM User Guide\)](#) 

Simulating in Simulink

Where to go from here

Information in this section

How to Use the Simulink Accelerator Mode.....	32
You can speed up the simulation by using the Simulink Accelerator mode.	
How to Simulate the Model Manually in Simulink.....	33
You can manually simulate your model in Simulink with prepared dashboard instruments.	
How to Simulate the Model and Observe the Results in Simulink.....	36
You can observe the simulation results in Simulink by using Simulink scopes.	
How to Handle Simulink Plotters.....	36
You can handle the Simulink plotters in your simulation model.	
How to Update a Plot Configuration for ModelDesk for a Simulink Simulation.....	38
If the ASMSignalBus is changed, you must update the plotting interface block and the model in ModelDesk.	
How to Configure a Plotter in ModelDesk for a Simulink Simulation.....	39
To plot a signal from the ASMSignalBus, you have to configure a project and an experiment in ModelDesk.	

How to Use the Simulink Accelerator Mode

Objective

You can use the Simulink accelerator mode to speed up the simulation (Pentium 4 Processor with 2 GB RAM: up to 2.5 times faster than real time).

Note

You can perform all steps in this tutorial by using the accelerator mode.

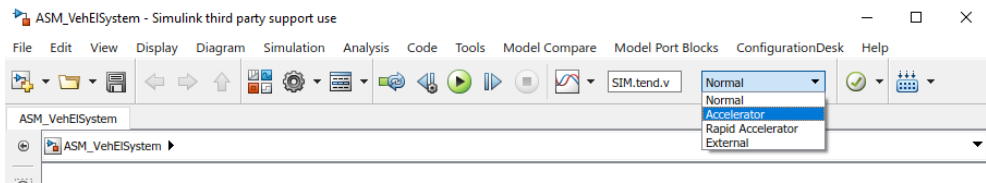
Prerequisite

You need a license for the Simulink Performance Tools.

Method

To use the Simulink Accelerator mode

- 1 In Simulink, activate the accelerator mode for the ASM demo model on the menu bar.



- 2 Start the simulation and observe the results on the Simulink plotters.

Result

The model is simulated in accelerator mode.

First, the build process for the accelerator mode is performed, which takes some time.

Whenever you perform an accelerator mode simulation and the model structure has not changed, no new code is generated, even if new parameters for the model are loaded, for example, from ModelDesk.

How to Simulate the Model Manually in Simulink

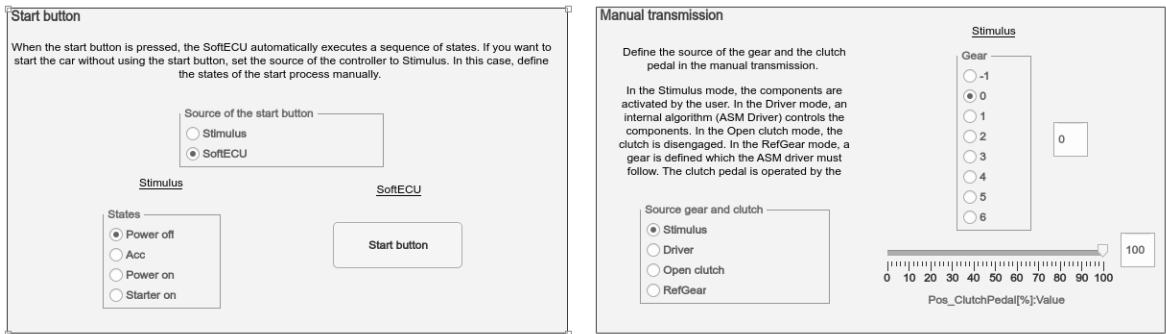
Objective

You can manually simulate your model in Simulink with prepared dashboard instruments that come with your ASM model.

Dashboard instruments

You can find the dashboard instruments in: `/Environment/Plant/UserInterface/PAR_Plant/Manual_Controller`.

There are the following instruments:



Accelerator / brake pedal

Define the source of the accelerator and brake pedal.
In the Stimulus mode, the pedals are activated by the user. In the Driver mode, an internal algorithm (ASM Driver) controls the pedals. Here, define the desired vehicle speed.

Source of accelerator and brake pedal

☒ Stimulus
☐ Driver

Stimulus

0 10 20 30 40 50 60 70 80 90 100

Pos_AccPedal[%].Value

100

Pos_BrakePedal[%].Value

Driver

0

v_Vehicle_Set[km/h].Value

0

v_Vehicle_Preview_Set[km/h].Value

Automatic transmission

Specify the source of the selector lever for the automatic transmission.
In the Stimulus mode, the selector lever is activated by the user. In the Driver mode, an internal algorithm (ASM Driver) controls the component.

Source of selector lever

☒ Stimulus
☐ Driver

Stimulus

Selector lever

☐ T
☐ P
☐ R
☒ N
☐ D

Sw_TipShift

Up

Down

0

Gear_Max[0Off1_n].Value

Testbench

Manual Stimulus

Testbench

☒ Off
☐ On

Torque controller

☒ Off
☐ On

0 1000 2000 3000 4000 5000

n_Engine_Set[rpm].Value

1000

0 50 100 150 200 250

Trq_Engine_Set[Nm].Value

0

0 10 20 30 40 50 60 70 80 90 100

Pos_AccPedal[%].Value

Stimulus from measurement interface

Rerun the engine measurement. Define the engine operating point (engine speed and accelerator pedal position).
If you do not use this feature, leave the value of the variable at zero.

0

EngOPNum[]:Value

Road

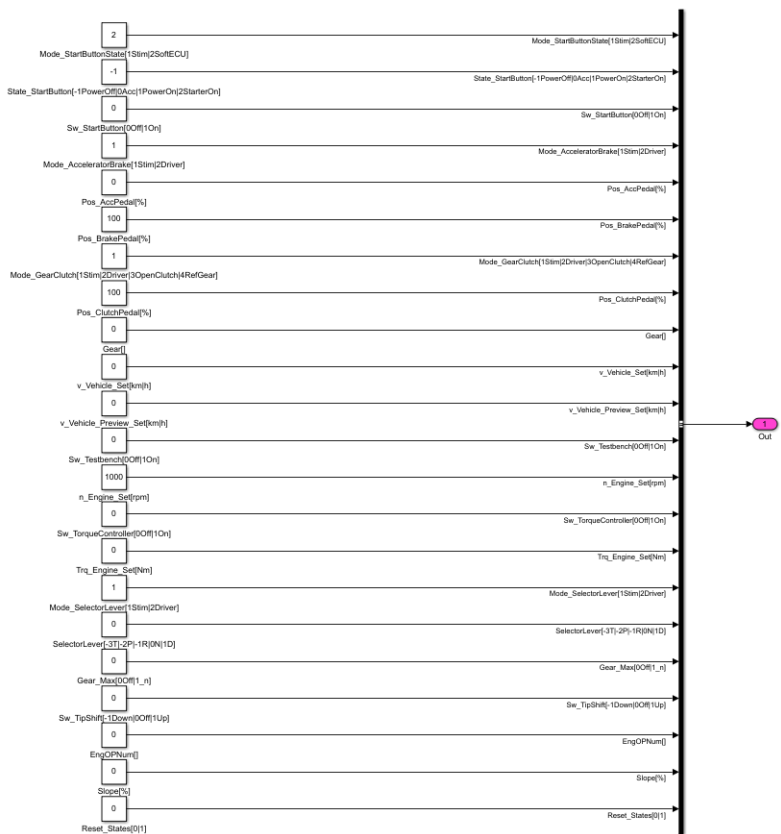
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30

Slope[%].Value

0

With these instruments, you can change the settings of the model controllers in /Environment/Plant/UserInterface/PAR_Plant/Manual_Controller/Controller.





Method

To simulate the model manually in Simulink

- 1 In the ASM Model Tools, set the maneuver type to *Manual*. This lets you run the model manually.
- 2 Start the simulation in Simulink.
- 3 Use the instruments on the dashboard to manipulate parameters in the model.

Result



You can now observe the results of the simulation in Simulink. Refer to [How to Simulate the Model and Observe the Results in Simulink](#) on page 36.

Related topics

HowTos

How to Select Maneuver Conditions.....	22
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How to Simulate the Model and Observe the Results in Simulink

Starting simulation	The demo model is prepared for a Simulink simulation. When you start simulation after you opened the demo model, a standard vehicle dynamics maneuver or engine driving cycle starts.
Simulation results	<p>You can observe the simulation results in Simulink using Simulink scopes. The scopes are in the <code>UserInterface/DISP_xyz</code> subsystem of an ASM module. For example, you can find a scope in the <code>Engine/Control/UserInterface/DISP_Control</code> subsystem.</p> <p>You can also watch the simulation results in oversampled model parts. For more information, refer to Watching the Simulation Results in Oversampled Model Parts (ASM Gasoline Engine InCylinder Model Description ) or Watching the Simulation Results in Oversampled Model Parts (ASM Diesel Engine InCylinder Model Description ).</p>
Method	<p>To simulate the model and observe the results in Simulink</p> <ol style="list-style-type: none"> 1 In MATLAB, switch to <code><Projectfolder>\Simulation</code> in the project and call go to open the model. 2 Start the simulation. 3 Open one of the scopes from the <code>UserInterface</code> subsystem, for example, in <code>Engine/Control/UserInterface/DISP_Control</code>. After a few seconds, look at the scope signals.
Result	You simulated the model and observed the results in Simulink.

How to Handle Simulink Plotters

Objective	You can handle the Simulink plotters in your simulation model.
Handling Simulink Plotters	<p>The <code>SCOPE HANDLING</code> GUI button opens a dialog that lets you perform the following actions:</p> <ul style="list-style-type: none"> ▪ Disable: Comments out all Simulink plotters, displays, and xy-graphs in the model. ▪ Restore: Uncomments all Simulink plotters, displays, and xy-graphs in the model. ▪ Show: Shows a list with all the Simulink plotters, displays, and xy-graphs in the model.



The block makes directly use of the *commented* block property in Simulink. Disabled blocks are excluded from simulation and signals are terminated and grounded.

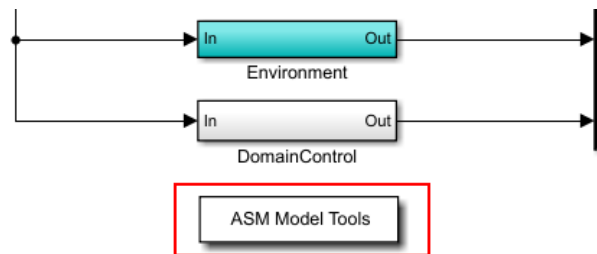
For ASM Engine Models: If you want to simulate your model with `asm_eng_testbench.m`, it is sufficient to store the simulation results in the variables under `TEST_CONTROL` or `TEST_PLANT`. No plotters are necessary.

The testbench script contains a postprocessing.

Method

To handle Simulink plotters

- 1 In the ASM model, double-click the ASM Model Tools button below the modules.



- 2 Double-click the SCOPE HANDLING GUI button.
The ASM Scope Handling GUI dialog opens.
- 3 In the ASM Scope Handling GUI dialog, click one of the buttons to handle Simulink plotters.
For information on the options, refer to [Handling Simulink Plotters](#) on page 36 above.

Result

You handled the Simulink plotters in your simulation model.

Related topics

References

[Scope Handling User Interface \(ASM User Guide !\[\]\(799877f5c2f906134441300079881630_img.jpg\)](#))

How to Update a Plot Configuration for ModelDesk for a Simulink Simulation

Objective

The ASM package includes a signal interface block for ModelDesk so that signals of the ASMSignalBus can be plotted. This block must be updated manually if the ASMSignalBus is changed.

If the respective simulation model is an operator version, it is mandatory to perform a manual update of the plotting block and plotting configuration, before using the plotting feature.

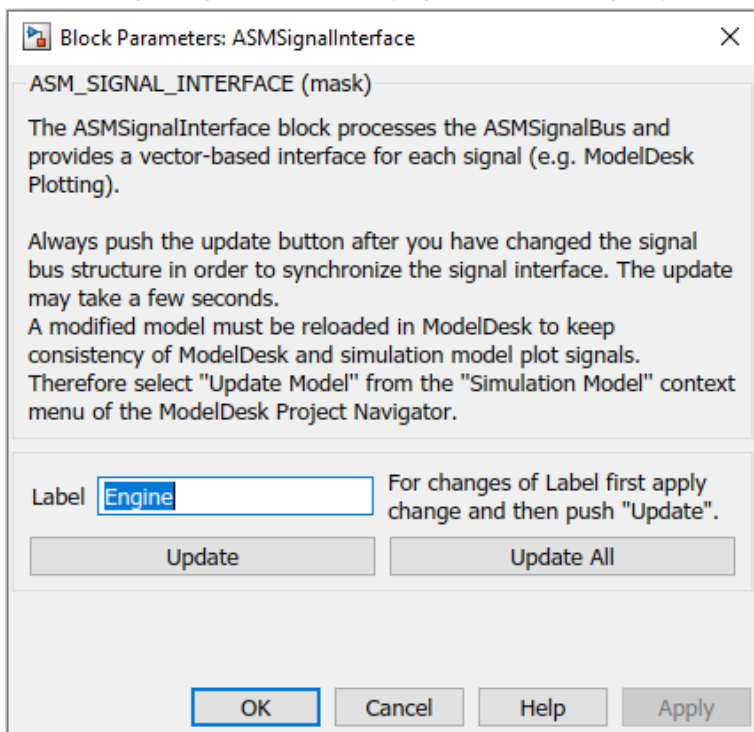
Method

To update a plot configuration for ModelDesk for a Simulink simulation

1 Inside an ASM module, open the SignalInterface subsystem.

2 Double-click the ASMSignalInterface block.

The following dialog appears with varying labels, depending on your model.

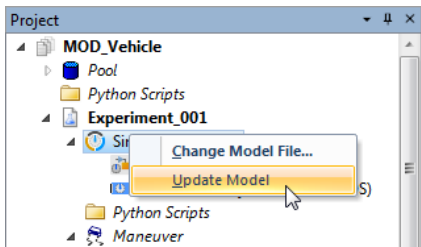


3 Click:

- Update: To update only the current block.
- Update all: To update all blocks in the model that are currently not commented out.

All the ASMSignalInterface blocks are updated. This also changes the model, which you must update in ModelDesk.

- 4 In ModelDesk's Project Manager, right-click the Simulation model element and select Update Model.



Result The plot configuration is updated.

Related topics

Basics

[Collecting Signals for Plotting in the ASM Model \(ModelDesk Plotting\)](#)

References

[Signal Selector \(ModelDesk Plotting\)](#)

How to Configure a Plotter in ModelDesk for a Simulink Simulation

Objective To plot a signal from the ASMSignalBus, you have to configure a project and an experiment in ModelDesk.

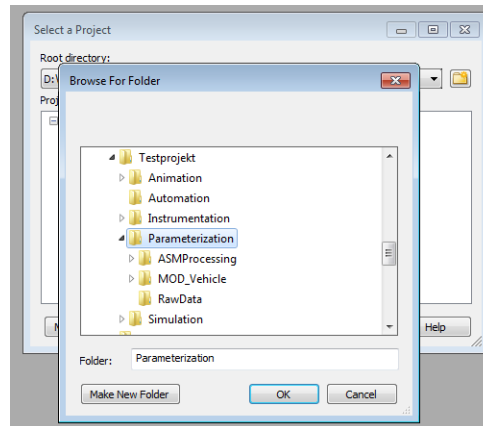
The <Projectfolder>\Parameterization\MOD_<Blockset> folder includes a complete ModelDesk project. You can completely parameterize the engine in ModelDesk. The demo project includes examples of typical plotter signals.

Method

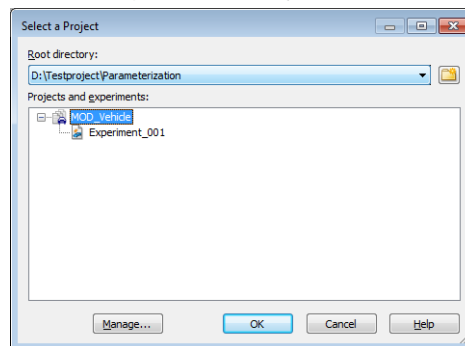
To configure a plotter in ModelDesk for a Simulink simulation

- 1 Start ModelDesk and open the provided ModelDesk project from <Projectfolder>\Parameterization.
 1. Click File – Open - Project + Experiment.

2. Select the <Projectfolder>/Parameterization folder.

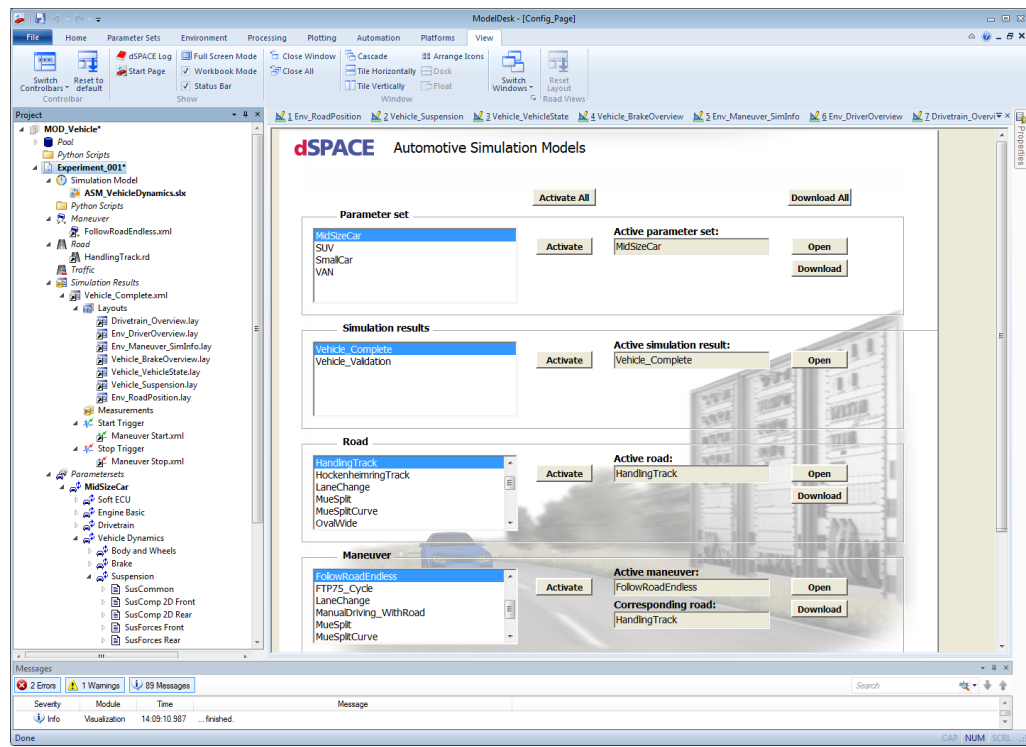


3. Select an experiment from your ModelDesk folder.

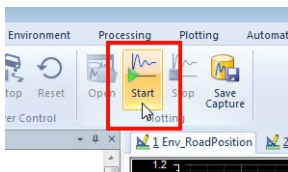


- 2 Switch to the experiment's Configuration page.

- 3 Select a plot configuration from the Simulation results list, click Activate and Open.



- 4 To start a simulation, go to the Home ribbon and click Plotting – Start (if possible in Simulink Accelerator mode).



Result

ModelDesk starts the simulation and plots the selected signals. You can observe the results in the ModelDesk plotters.

Related topics

Basics

[Plotting Signals \(ModelDesk Plotting\)](#)

Simulating on dSPACE Platforms

Where to go from here

Information in this section

[How to Generate an OSA File for VEOS.....42](#)

You can generate an Offline Simulation Application (OSA) file for VEOS either manually or automatically.

[Generating the Real-Time Application for SCALEXIO.....44](#)

You can generate the real-time application for SCALEXIO in ConfigurationDesk.

[Generating a Real-Time Application for PHS-Bus-Based Platforms.....44](#)

If you have a dSPACE Real-Time Interface (RTI) license, you can generate a new real-time application for the ASM.

[How to Observe Results in ControlDesk.....45](#)

When simulating the model, you can observe the results in ControlDesk.

[How to Update a Plot Configuration for ModelDesk for a dSPACE Platform.....47](#)

If the ASMSignalBus is changed, you must update the plotting interface block and the model in ModelDesk.

[Changing the Simulation Platform.....48](#)

You can change the platform and reuse the experiment.

How to Generate an OSA File for VEOS

Objective

You can generate an Offline Simulation Application (OSA) for VEOS either manually or automatically.

Model preparation for VEOS

If the model has an oversampled engine part, it must be implemented as a Simulink For-Iterator subsystem for VEOS simulation. This 'offline' mode is automatically inserted if the model is opened with `go ('simmode', 'PC')`. For more information on the different oversampling strategies, refer to [Basic Model Concept \(ASM Gasoline Engine InCylinder Model Description !\[\]\(291e070cef6c4d5e78fefe4696ef53be_img.jpg\)](#)).

Possible methods

There are two ways to generate code for VEOS:

- Manually. Refer to [Method 1](#) on page 43.
- Automatically. Refer to [Method 2](#) on page 43.

Method 1**To generate code for VEOS manually**

- 1 Open the model with `go ('simmode','CPT','platform','VEOS')`. This selects the system target `dsrt.tlc` file provided by the Model Interface Package for Simulink.
- 2 Generate code for the ASM model.
The Model Interface Package for Simulink generates a Simulink implementation container (SIC) file containing ASM model code.
For instructions, refer to [Generating Simulink Implementation Containers \(Model Interface Package for Simulink - Modeling Guide\)](#).
- 3 Create a new OSA file:
 1. Start the VEOS Player.
 2. On the Home ribbon, select New to create an empty OSA file.
 For instructions, refer to [Basics on the VEOS Player \(VEOS Manual\)](#).
- 4 Import the SIC file to the VEOS Player to integrate the model in an Simulink simulation application for VEOS.
The VEOS Player builds the OSA for simulation on VEOS.

Note

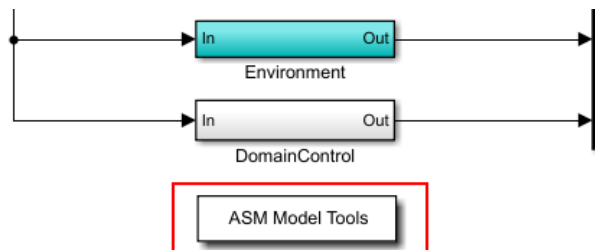
ASM does not support a 32 bit version of VEOS. Make sure to select HostPC64 as simulation target on the Build Options tab during import to the VEOS Player.

You can also set HostPC64 as default simulation target via the Simulation Target Manager in VEOS.

For instructions, refer to [How to Import Simulink Implementations \(VEOS Manual\)](#).

Method 2**To automate code generation for VEOS**

- 1 Open the model in MATLAB.
- 2 In the ASM model, double-click the ASM Model Tools button below the modules.



- 3 Double-click the Generate VEOS Application button.
- 4 A Code Generation confirmation prompt opens. Click Yes to start code generation.

Result

You have generated code for VEOS.

Related topics**References**

[Generate VEOS \(ASM User Guide !\[\]\(23d9fc146e83b5c3013cfa32c784f8d5_img.jpg\)\)](#)

Generating the Real-Time Application for SCALEXIO

Generating code for SCALEXIO

Generation of the real-time application has to be started from ConfigurationDesk. For information on how to set up a ConfigurationDesk project and start code generation, refer to [Building Real-Time Applications \(ConfigurationDesk Real-Time Implementation Guide !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)\)](#).

Generating a Real-Time Application for PHS-Bus-Based Platforms

Introduction

If you have a dSPACE Real-Time Interface (RTI) license, you can generate a new real-time application for the ASM. This is needed if you want to modify the model, for example, by adding I/O blocks for HIL simulation, or to have different initial settings for the model (engine settings).

Note

RTI code generation of ASM models is currently not supported if the *Accelerator* simulation mode is selected.

For real-time simulation, the model must be adapted. The model can be switched to online (real-time) mode by opening it with the following:

```
go('simmode', 'HIL', 'platform', 'RTI')
```

Note

Make sure that the MATLAB current folder is in the Simulation folder of your project, <Project>\Simulation

If the online mode is activated, code generation can start. This can be done via the Simulink Preferences or with Ctrl+B when clicking a Simulink model.

Code is always generated in the current folder.

To generate real-time code to another folder, change the MATLAB current folder after running the `go` file.

Generating code for PHS-bus-based platforms

For information on how to generate code, refer to [Building and Downloading the Model \(RTI and RTI-MP Implementation Guide !\[\]\(2e897e890e69d81eae4503a8342c36b0_img.jpg\)](#).

How to Observe Results in ControlDesk

Objective

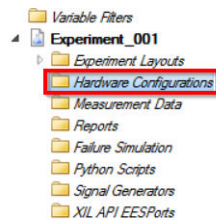
When simulating the model, you can observe the results in ControlDesk.

The ASM demo model contains preconfigured real-time application files for the SCALEXIO and VEOS platforms. You can use these files to observe simulation results with the preconfigured ControlDesk experiment.

Method

To observe results in ControlDesk

- 1 Start ControlDesk.
On the ribbon, click File – Open – Open Project and Experiment to open the preconfigured ControlDesk experiment. Select
`<Projectfolder>\Instrumentation\CD_<Blockset>\CD_<Blockset>.CDP`.
- 2 In ControlDesk, right-click Hardware Configurations in the project tree. On the context menu, select Add Platform/Device to add the platform.

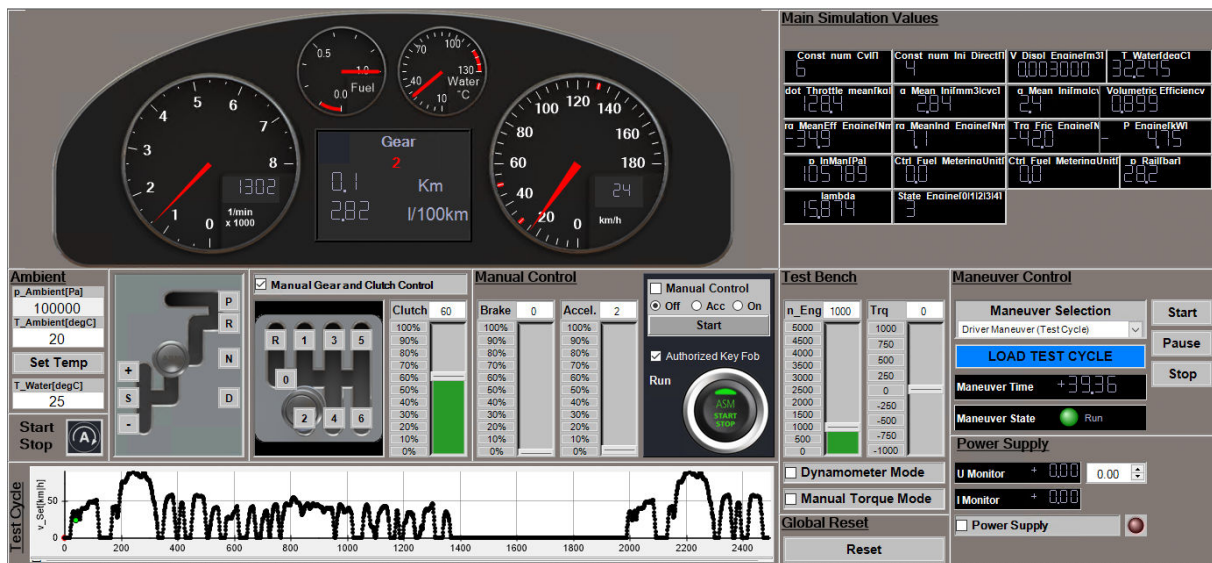


Select your simulation platform and click Next. Import the prebuilt real-time application from

`<Projectfolder>\Simulation\RealTimeObjects\<platform>\ASM_<Blockset>.sdf`.

- 3 On the Platforms ribbon, select Register Platforms to register your platform.
- 4 Open the platform's context menu.
Open the predefined layout in the Experiment Layouts folder in the project tree of the ControlDesk experiment.
- 5 Save the experiment.
On the Home ribbon, select Go Online to start online calibration.

The application runs on the selected platform. You can observe the Simulation results on the available layouts.



- Use the instruments in the dashboard layout to control the maneuver, to start and stop the engine and to observe variables such as vehicle speed and engine speed.

You can also select whether you would like to drive with the ASM driver model, with stimulated input signals, or with a manual control, by changing the maneuver selection. In real-time simulation, you have to set the pedal positions and the gear switch yourself, for example, by using the instruments of the Manual Control area in the dashboard layout.

Depending on the ASM used, you can use further layouts to observe engine or vehicle dynamics signals.

Result

You observed results in ControlDesk.

Note

If you want to update the real-time application, note the following points: For RTI and VEOS, the real-time code is generated and saved in the MATLAB working directory, which is typically the `Simulation` folder. When you generate the code repeatedly in the same directory, ControlDesk detects the update and prompts you to reload the real-time application when going online.

How to Update a Plot Configuration for ModelDesk for a dSPACE Platform

Objective

The ASM package includes a signal interface block for ModelDesk so that signals of the ASMSignalBus can be plotted. This block must be updated manually if the ASMSignalBus is changed.

If the respective simulation model is an operator version, it is mandatory to perform a manual update of the plotting block and plotting configuration, before using the plotting feature.

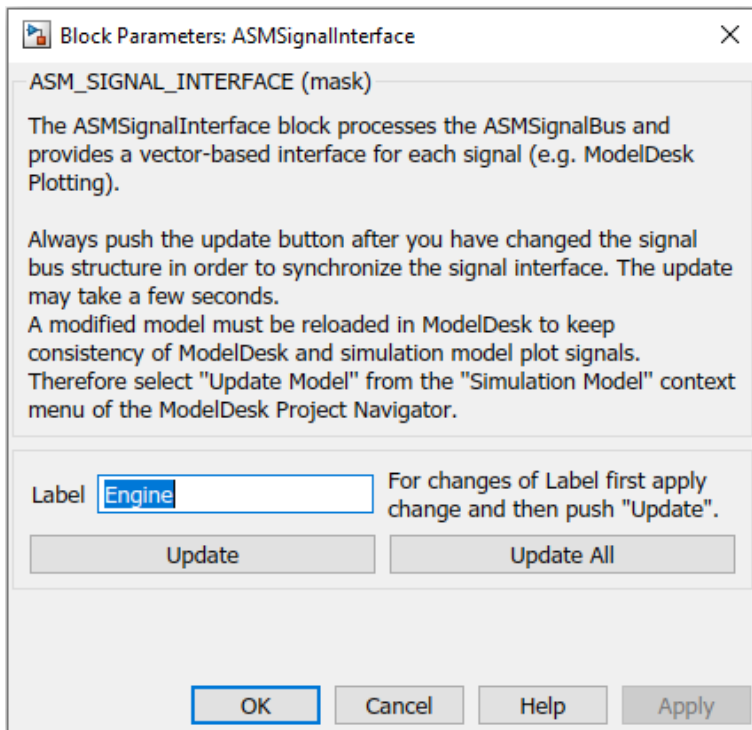
Method

To update a plot configuration for ModelDesk for a real-time simulation

1 Inside an ASM module, open the SignalInterface subsystem.

2 Double-click the ASMSignalInterface block.

The following dialog appears with varying labels, depending on your model.



3 Click:

- Update: To update only the current block.
- Update all: To update all blocks in the model that are currently not commented out.

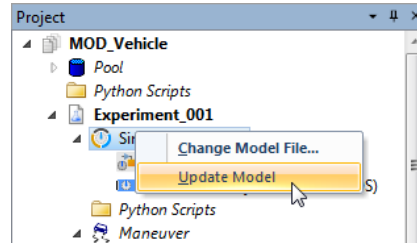
All the ASMSignalInterface blocks are updated. This also changes the model, which you must update in ModelDesk.

4 Start a new code generation process.

You must update the simulation model in ModelDesk to make all changes in the ASMSignalBus visible to ModelDesk.

Make sure your experiment is linked with the correct real-time model SDF file. ModelDesk shows the active model in bold.

- 5 In ModelDesk's Project Manager, right-click the Simulation model element and select Update Model.



Result

The plot configuration is updated.

Related topics

Basics

[Collecting Signals for Plotting in the ASM Model \(ModelDesk Plotting !\[\]\(e8fb589d58dad1692debababa5e928b6_img.jpg\)](#))

References

[Signal Selector \(ModelDesk Plotting !\[\]\(e1c624d4757f08486e89482c18364c17_img.jpg\)](#))

Changing the Simulation Platform

Introduction

You can change the simulation platform and reuse ControlDesk experiments. For how to change from VEOS to SCALEXIO, for example, refer to [Switching the Simulation Platform and Reusing Experiment Parts \(ControlDesk Platform Management !\[\]\(e9474ce1d70442456f8fe9c393ea149c_img.jpg\)](#)).

Changing between other platforms works similarly.

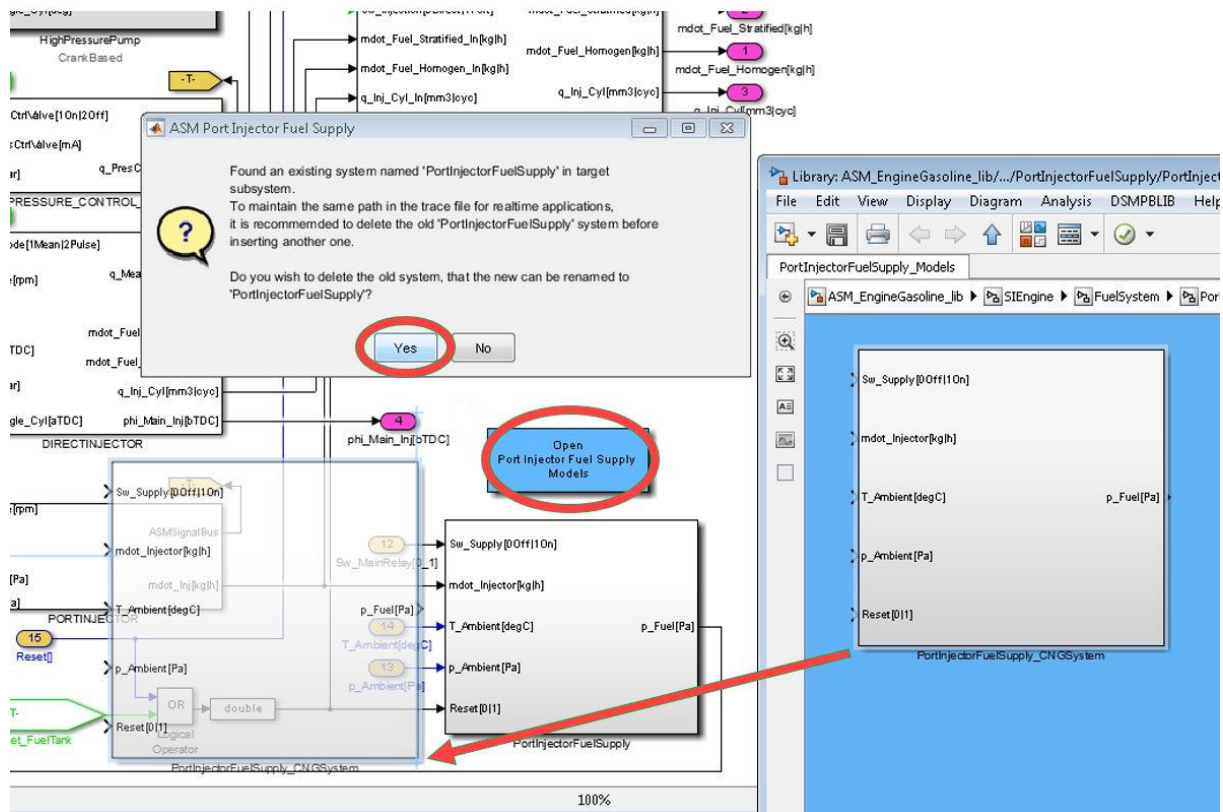
Adapting the Model to Special Needs

Where to go from here	Information in this section
	How to Replace the Port Injector Fuel Supply Model..... 49
	You can replace the Port Injector Fuel Supply Model without the need to change the rest of the model.
	How to Replace the Evaporator Models..... 52
	You can replace the evaporator models without the need to change the rest of the model.
	Working with Different Engine Configurations..... 53
	The ASM InCylinder model lets you define engine configurations.

How to Replace the Port Injector Fuel Supply Model

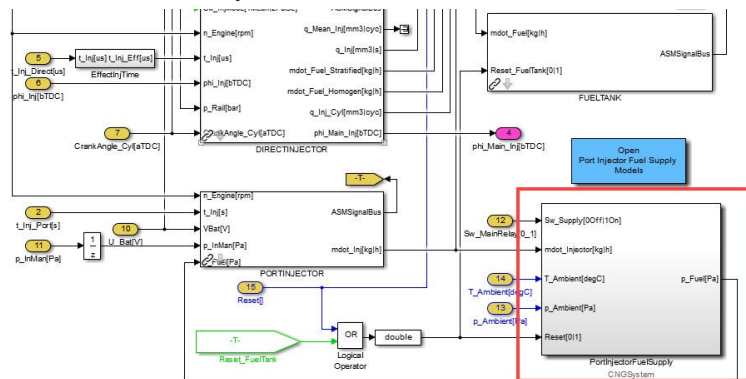
Objective	You can replace the Port Injector Fuel Supply Model without the need to change the rest of the model.
Demo models for fuel supply	<p>The ASM Gasoline Engine blockset contains two demo models for fuel supply of the port injector. The gasoline engine demo model contains the PortInjectorFuelSupply model, which is a default model for the fuel supply with a fixed value. You can replace it by the PortInjectorFuelSupply_CNGSystem model, without the need to change the rest of the model.</p> <p>The replacing is done in the FuelSystem submodel, located in ASM_EngineGasoline/MDL/Engine/FuelSystem.</p>
Method	<p>To replace the port injector fuel supply model</p> <ol style="list-style-type: none">1 In the FuelSupply model, click Open Port Injector Fuel Supply Models.2 Drag the PortInjectorFuelSupply_CNGSystem block from the library into the model.

The ASM Port Injector Fuel Supply dialog opens.



- 3 In the dialog, click Yes to replace the PortInjector_Fuel_Supply in the model.

The model is replaced and the new model's inports and outports are connected automatically. It now looks like this:



- 4 Save your model in MATLAB.
- 5 Update your model in ModelDesk to get a default parameterization for the CNG system. Download or generate Ini files to be able to run the model.

Result

You have replaced the PortInjectorFuelSupply model with the PortInjectorFuelSupply_CNGSystem model.

Other parameterizations

To fully utilize the CNG functionality, you should use the COMMON_ENGINE_PARAMETERS model in ModelDesk and set the fuel parameters to natural gas values.

- Const_kappa_Fuel, e.g.: 1.3[-]
- Const_R_Fuel, e.g.: 496 [J/KgK]
- Const_L_st, e.g.: 14.5[-]
- Soft ECU Injector Mode: Sw_Injector has to be switched to Port

Also refer to the following illustration:

Bulk modulus of gasoline fuel	13800	[bar]
Gasoline Fuel Density	725	[kg/m3]
Gas constant of Air	287	[J/(kgK)]
Gas constant of Exhaust	285	[J/(kgK)]
Gas constant of Fuel	496	[J/(kgK)]
Isentropic ratio of air	1.4	[-]
Isentropic ratio of exhaust gas	1.34	[-]
Isentropic ratio of gaseous fuel for CNG only	1.3	[-]
Universal gas constant	8.3145	[J/mol*K]
Lower heat value of fuel	4.44e+07	[J/kg]
Stoichiometric Ratio	14.5	[-]
Diffusion coefficient between fuel and air for evaporation		

If the structure fields are set to default, you can use the commands in MATLAB.

```
MDL.SoftECU.SoftECUGasoline.InjectorMode.Sw_Injector.v=1;
MDL.EngineGasoline.Const.Const_R_Fuel.v=496.4134;
MDL.EngineGasoline.Const.Const_Lst.v=14.5;
MDL.EngineGasoline.Const.Const_kappa_Fuel.v=1.3;
```

How to Replace the Evaporator Models

Objective

You can replace the evaporator models without the need to change the rest of the model.

Demo models for tank evaporation

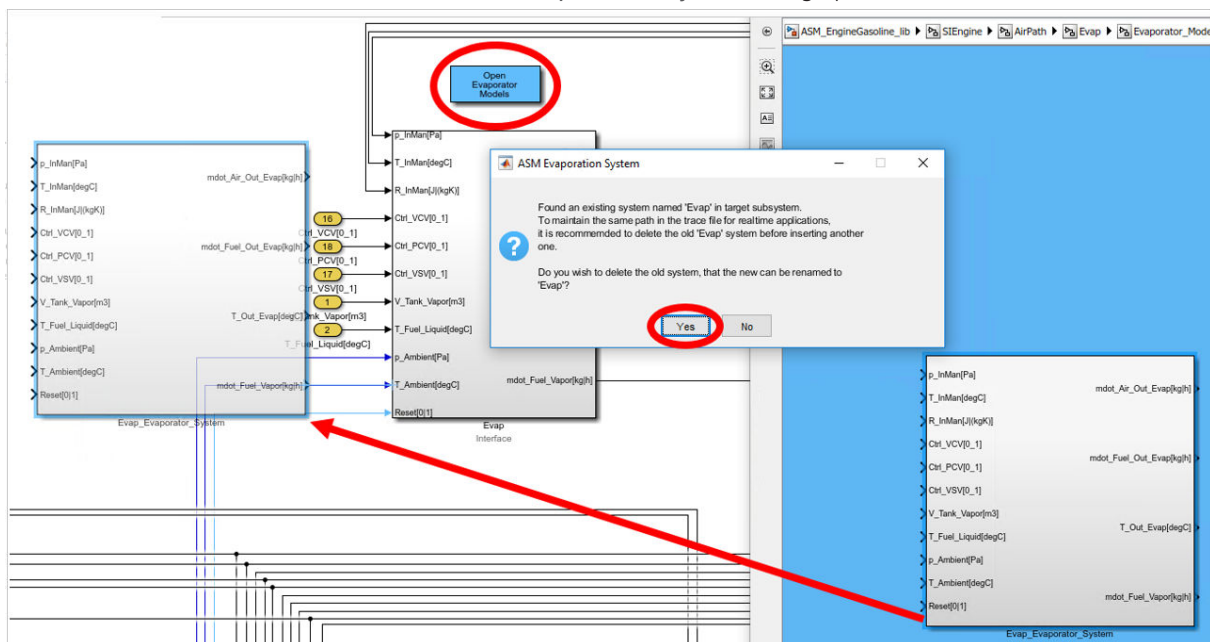
The ASM Gasoline Engine blockset contains two demo models for tank evaporation. The gasoline engine demo model contains the Evap_Interface model, which is a default model for the tank evaporation. You can replace it by the Evap_Evaporator_System model, without the need to change the rest of the model.

The replacing is done in the Airpath submodel, located in ASM_EngineGasoline/MDL/Engine/Airpath.

Method

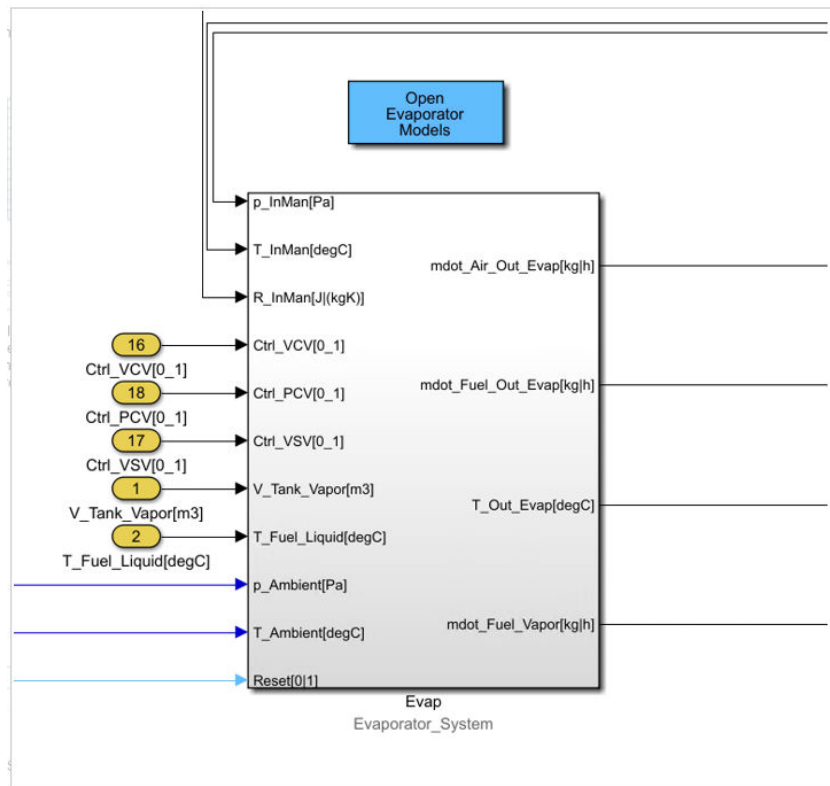
To replace the evaporator models

- 1 In the Airpath System, click Open Evaporator Models.
- 2 Drag the Evap_Evaporator_System block from the library into the model. The ASM Evaporation_System dialog opens.



- 3 In the dialog, click Yes to replace the Evaporation system in the model.

The model is replaced and the new model's inports and outports are connected automatically. It now looks like this:



- 4 Save your model in MATLAB.
- 5 Update your model in ModelDesk to get a default parameterization for the Evaporator system. Download or generate Ini files to be able to run the model.

Result

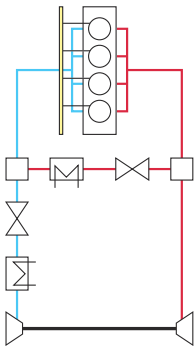
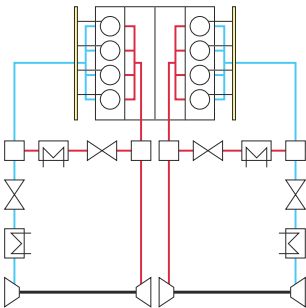
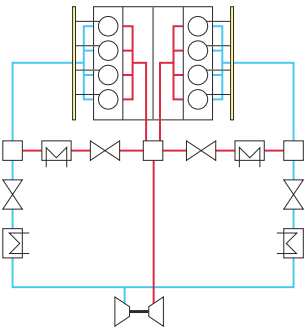
You have replaced the Evap_Interface model with the Evap_Evaporator_System model.

Working with Different Engine Configurations

Configuration overview

The ASM model lets you define engine configurations. The installation version contains three default configurations. Each configuration is stored in a parameter XML file for the Engine Setup

The following table shows three different configurations:

Configuration	Row engine	V engine with 2 air paths and 2 exhaust paths	V engine with 2 air paths and 1 exhaust path
Schematic			
Fuel systems	1	2	2
Air paths	1	2	2
Exhaust paths	1	2	1
Turbochargers	1	2	1

The row engine is the default configuration and is stored in the <Model>.xml file.

The V-engine with two air paths and two exhaust paths is stored in <Model>_VEngine_2In_2Exh.xml.

The V-engine with two air paths and one exhaust path is stored in <Model>_VEngine_2In_1Exh.xml.

Note

If you use the operator version, it is not possible to use an advanced or two-stage turbocharger model with more than one exhaust manifold/turbocharger/exhaust system.

Measurement Interface

Where to go from here

Information in this section

Basics on Measurement Interface.....	56
The measurement interface allows easy evaluation of the simulation results by comparing them to the results of a steady state measurement.	
Steady-State Measurement.....	57
Settings can be made in the ModelDesk project.	
Simulink Model.....	63
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You can compare the simulation result with the measurement data.	

Basics on Measurement Interface

Basics on Measurement Interface

Basics

The Measurement Interface allows easy evaluation of the simulation results by comparing them to the results of a steady state measurement (for example, engine speed, injection quantity, manifold pressure, mean effective torque). In case of InCylinder models also crank angle resolved data (for example, in cylinder pressure) will be evaluated. It is therefore important to provide the same conditions to the model, which have existed during the test bench run of the real engine. This is done by using some of the measurement signals (ambient pressure and temperature, engine speed, accelerator pedal position or injection signals) as stimulus signals for the engine model. Each measurement of the steady state measurement is an operating point. They are numbered from one to the total number of operating points.

The influence of (optimized) parameters can be easily investigated by modifying the parameters and observing the change in the simulation results in comparison to the measurement signals.

The following topics describe the required settings in the parameterization project and the related parts in the Simulink model.

Note

The Measurement Interface is designed to work on real-time hardware. If you want to test the model parameterization in a Simulink simulation, it is recommended to use the ASM Engine Testbench. Refer to [ASM Engine Testbench \(ASM User Guide !\[\]\(e8fb589d58dad1692debababa5e928b6_img.jpg\)](#)).

Steady-State Measurement

Where to go from here	Information in this section
	Basics on Steady State Measurement..... 57
	ModelDesk allows generating the steady state measurement interface subsystem according to the available measurement variables from a Measurement Type.
	Steady-State Measurement..... 57
	There is a file to control the generation of the steady-state measurement interface.

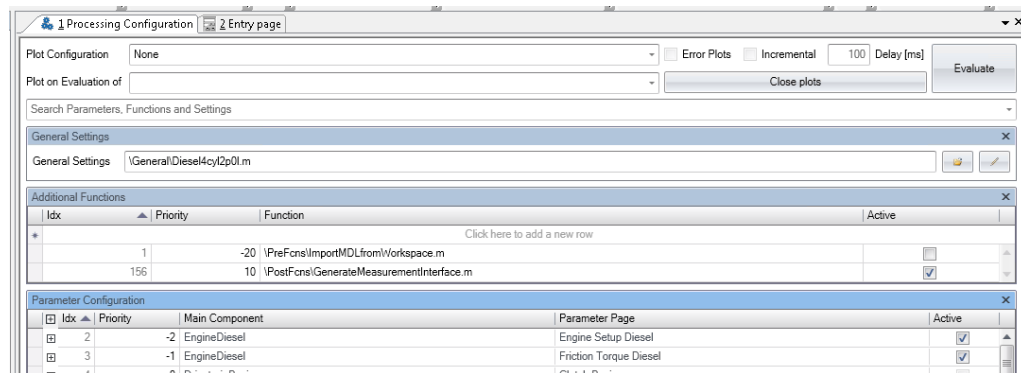
Basics on Steady State Measurement

Basics	ModelDesk allows generating the steady state measurement interface subsystem according to the available measurement variables from a Measurement Type. This steady state interface subsystem is created with LUT1D records which can be parametrized by processing functions. In ASM InCylinder demo projects, in addition, crank angle resolved data can be provided with the LUT2D block.
--------	---

Steady-State Measurement

Introduction	There is a file to control the generation of the steady-state measurement interface. You must select the file in ModelDesk. You can generate a measurement interface for each measurement type.
Settings in ModelDesk	The following illustration shows the Processing Configuration pane in ModelDesk with the Additional Functions section.

Select the `GenerateMeasurementInterface.m` function in the **Additional Functions** section via the corresponding checkbox.



Function

The generation of the steady state measurement interface is controlled by the `GeneralSettings` file. A measurement interface can be generated for each measurement type.

```
Settings.GenerateMeasurementInterface(1).Active = true
Settings.GenerateMeasurementInterface(1).MeasurementTypeName = 'Engine';
Settings.GenerateMeasurementInterface(1).ModelName = 'Engine_MeasurementInterface';
Settings.GenerateMeasurementInterface(1).ModelPath = fileparts(mfilename('fullpath'));
Settings.GenerateMeasurementInterface(1).Calculated = {...% activation, result signal, operation (+ or *) ,
first signal, second signal or factor
    1, 'p_In_Throttle[Pa]', '+', 'p_Ambient[Pa]', 'p_In_Throttle_Rel[Pa]';
    1, 'p_InMan[Pa]', '+', 'p_Ambient[Pa]', 'p_InMan_Rel[Pa]';
    1, 'p_ExhMan[Pa]', '+', 'p_Ambient[Pa]', 'p_ExhMan_Rel[Pa]';
};
```

The struct fields have the following meaning.

Active Boolean to activate the generation of the measurement interface to the specific type.

MeasurementTypeName Name of the measurement type for which the interface is generated.

ModelName Name of the generated Simulink model.

ModelPath Folder where the Simulink model is created. The folder of the general settings file is the default folder.

Calculated Cell array which defines additional variables. These can be calculated by combining existing variables or scaling them. This can be used to convert relative to absolute pressure or scale units.

Each row defines one calculated variable with the following cells:

- Activation flag
- Name of the calculated variable
- Operation how to combine signals. Either '+' or '*'
- Name of first signal
- Name of second signal or factor

A **SteadyState** subsystem is generated within this model which includes LUT1D blocks for all measurement variables in the measurement type. The mask parameter of the LUT1D subcomponent blocks are set to `MDL.MeasurementInterface.SteadyState.<MeasurementTypeName>.<VariableName>`. For details on the LUT1D block, refer to [Look-Up Table 1-D \(ASM Drivetrain Basic Reference !\[\]\(1d3a1175dd4902218e694b9c098adb83_img.jpg\)\)](#).

The instance names are also set to the variable names. The input is connected to the engine operating point number. Behind the **SteadyState** subsystem, a calculation subsystem is generated in order to build up the variables as specified. Further, all variables are routed through a subsystem with the variable name. In this way, they can easily be accessed by ControlDesk. This subsystem has to be copied to the Simulink model that is used in the project. After this, the model has to be updated in ModelDesk for the new blocks to be added to the parameter set. For details, refer to [Simulink Model](#) on page 63.

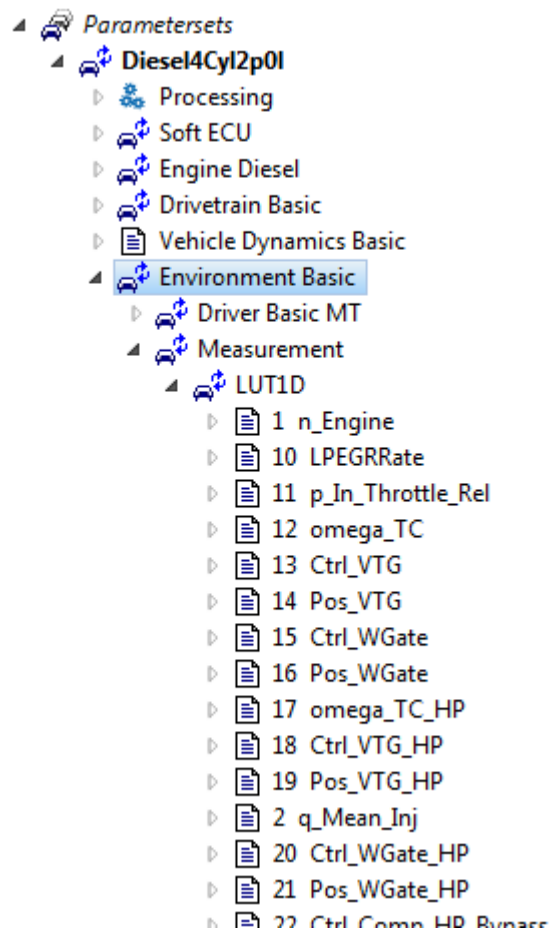
LUT1D records

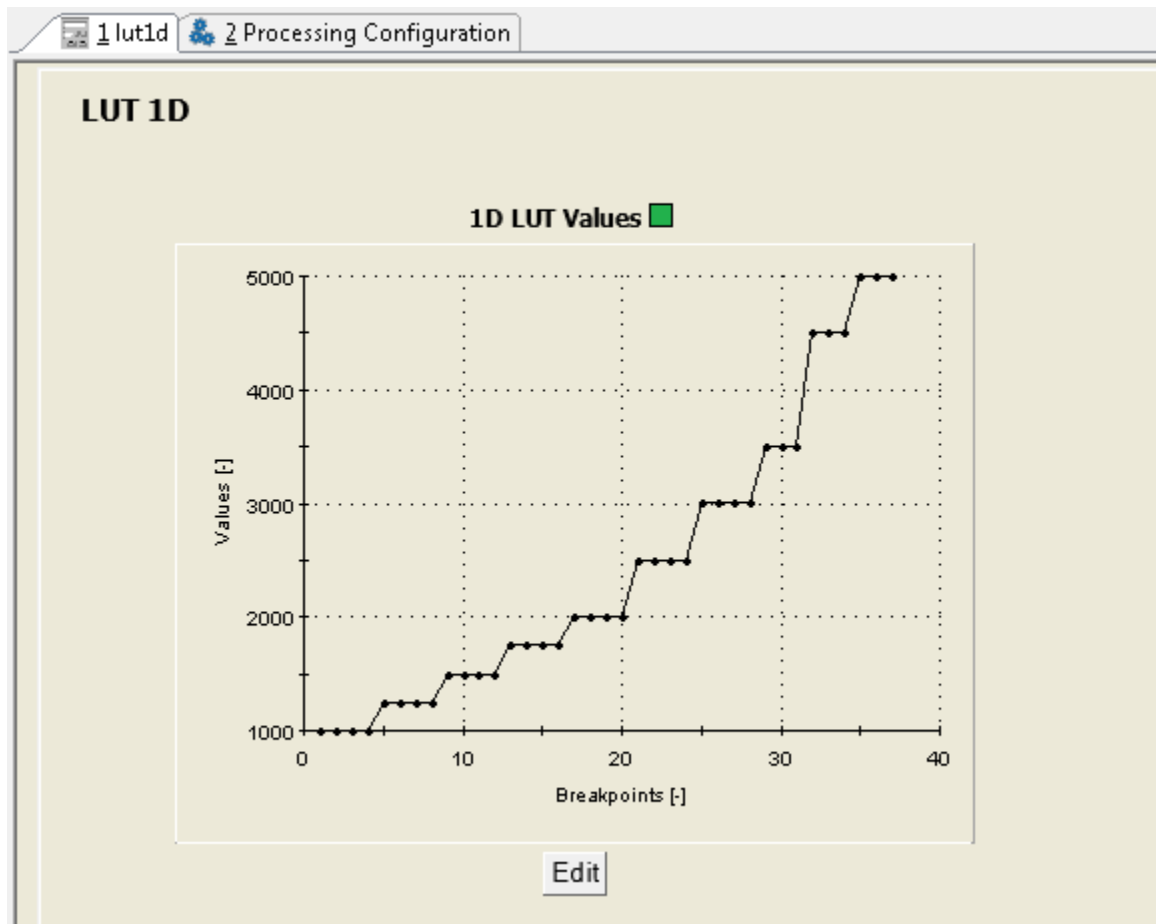
The following illustrations show the LUT1D records that are used in the generated measurement interface model. To show these tables it is necessary to update the Simulink model in ModelDesk by right-clicking **Simulation Model** in the project tree and select **Update Model** from the context menu.

For each measurement variable, a LUT1D record with a 1-D look-up table is provided. By default, the `\Environment\LUT_1D\LUT_1D_CopyMeasurement.m` processing function is connected. The measurement type and measurement variable name are determined by the place the variable has to be copied to. This is done by the mask variable.

Note

After updating the model new instances of the LUT1D record are linked to the `LUT1D.xml` parameter file by default. Make sure that each instance refers to an independent parameter file to ensure the correct measurement variable is stored. This can easily be done with the `CreateIndependentParameter.xml.py` file which is available in the Python Script folder of the project. Keep in mind that running the script affects all records, not only the LUT1D.





Initialization file When generating initialization files for EnvironmentBasic, the measurement data information is written to the MDL structure. The following example shows the created MDL structure `MDL.MeasurementInterface.SteadyState` for the engine speed:

```
...SteadyState.Engine.n_Engine.Comment = '1D LUT Values';
...SteadyState.Engine.n_Engine.Author = '(null)';
...SteadyState.Engine.n_Engine.Origin = '';
...SteadyState.Engine.n_Engine.Version = '3';
...SteadyState.Engine.n_Engine.LastModified = '02.02.2015';
...SteadyState.Engine.n_Engine.xName = 'Breakpoints';
...SteadyState.Engine.n_Engine.xUnit = '[-]';
...SteadyState.Engine.n_Engine.vName = 'Values';
...SteadyState.Engine.n_Engine.vUnit = '[-]';
table = [
1 1000.01
2 1000.01
...
208.31 4999.99
];
...SteadyState.Engine.n_Engine.x = table(:,1);
...SteadyState.Engine.n_Engine.v = table(:,2);
```

The <x> struct field is always the engine operating point number which is just counted from 1 to the total number of provided engine operating points.
The <v> field contains the related data.

Related topics

Basics

[Additional Functions \(ASM User Guide !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)\)](#)

References

[Look-Up Table 1-D \(ASM Drivetrain Basic Reference !\[\]\(5a132f13505a6571904d622757b7a8f0_img.jpg\)\)](#)
[Processing Configuration \(ModelDesk Processing !\[\]\(0f17417dd77a61b2fdbff69a33adf9f2_img.jpg\)\)](#)

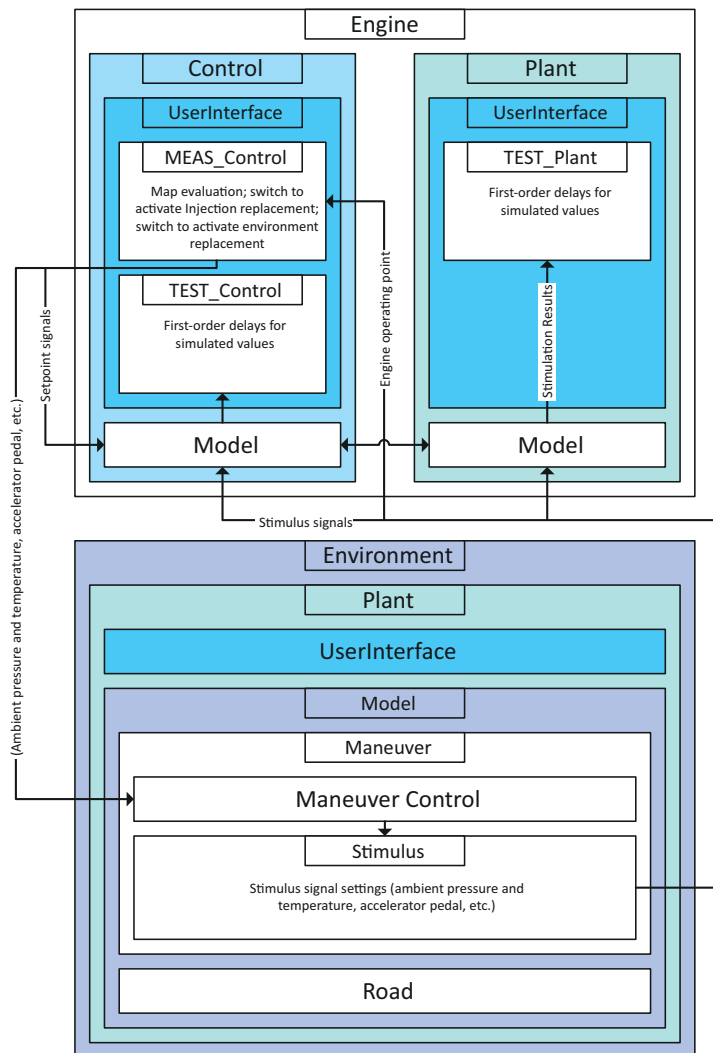
Simulink Model

Where to go from here	Information in this section
	Overview of the Simulink Model..... 63 The following illustration gives an overview on the parts of the Simulink model, which are important for the measurement interface.
	Environment Maneuver..... 64 Some settings are made inside the Maneuver subsystem.
	Measurement Control..... 65 You can use steady-state measurement signals in the simulation model. You can use the measurement as reference data in the control algorithm of the soft ECU of the model, for example.

Overview of the Simulink Model

Introduction	The following illustration gives an overview of the parts of the Simulink model which are important for the measurement interface.
Model overview	The emphasis of the model overview is in the signal flow which can be done by real line connections.

The model structure itself is reduced as much as possible and a lot of parts with lower importance are skipped.



Environment Maneuver

Description

If the engine operating point which is selected in the Measurement Interface is not zero, inside the Environment/Maneuver subsystem, the **Pos_AccPedal**, **n_Engine_Set**, and **Trq_Engine_Set** signals are replaced by the corresponding values from the Measurement Interface.

Also, you can activate the ASM Engine Testbench by setting **Sw_ModelTestCaptureEnable** in Engine/PAR_Control to **one**.

If the flag to replace the environment signals (`Sw_Replace_Env[0|1]`) is active, the `p_Ambient`, `T_Ambient`, and `T_Water` signals are additionally replaced by their corresponding values from the measurement interface.

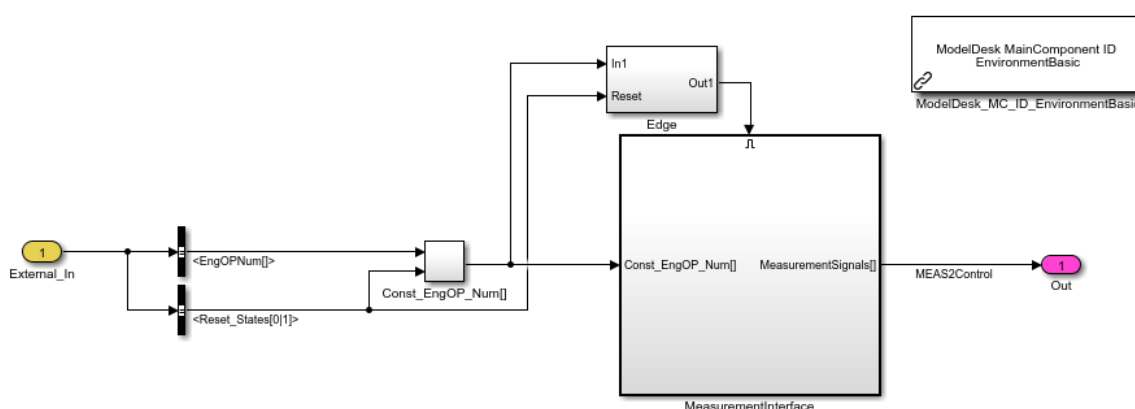
Measurement Control

Basics

You can use steady-state measurement signals in the simulation model. You can use the measurement as reference data in the control algorithm of the soft ECU of the model, for example. The signals of the steady-state measurement are located in the `Engine/Control/UserInterface/MEAS_Control` system.

Main task measurement

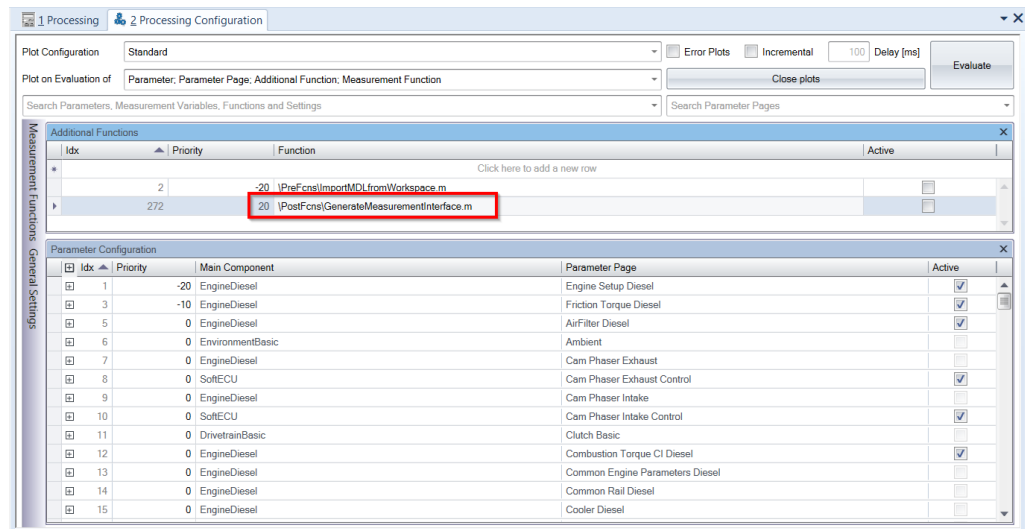
The following illustration shows the contents of the subsystem:



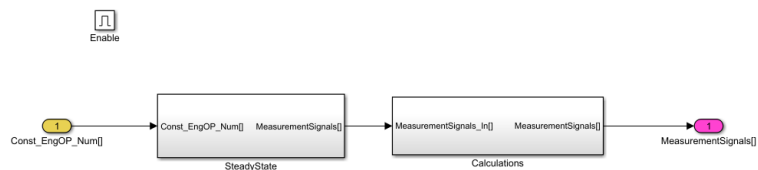
The engine operating number is selected from the Environment module. Only if the engine operating number is changed, the `MeasurementInterface` block is executed. The output bus contains the measurement signals of the current operating point.

To change the signals of the block, use the **Additional Functions** feature of ModelDesk Processing. Refer to [Additional Functions \(ASM User Guide\)](#).

When you execute the `GenerateMeasurementInterface.m` function, a new Simulink system measurement interface is created. The MATLAB function analyses the measurement associated with the parameter set active in ModelDesk and generates a Simulink look-up table for each measurement variable. Refer to [Steady-State Measurement](#) on page 57.



The MeasurementInterface block contains two blocks:



The output of the SteadyState block is a Simulink bus containing all the signals of the measurement at the current operating point. The engine operating point number is included as EngOp_Num[] parameter.

The Calculations block has two tasks.:

- It calculates additional signals. For example, it calculates the absolute intake manifold pressure from the ambient and the relative intake manifold pressure. This signal can then be easily compared to the simulated intake manifold pressure, which is always an absolute value. This subsystem will also be generated by ModelDesk Processing.

Two signals are used as flags.

- Sw_Replace_Env[0|1]:**
Depending on the Sw_Replace_Env[0|1] flag, the environment pressure and temperature is replaced by the values from the measurement.
- Sw_Replace_IOSignals[0|1]:**
Use this flag to replace the IO signals by the measurement data.
- It provides easy access to the measurement signals from ControlDesk.

Related topics

Basics

[Additional Functions \(ASM User Guide\)](#)

[Steady-State Measurement](#)..... 57

Working with the Measurement Interface

How to Work with the Measurement Interface

Objective

You can compare the simulation result with the measurement data.

Note

The Measurement Interface data functionality is currently not supported by ModelDesk. Hence, if you want to use ModelDesk to generate the initialization files for the model, the Measurement Interface blocks must be removed. In this case, you can generate dummy measurement interface subsystems, which can be inserted in the model. This is done by selecting -2 for the Sw-Selection flag of all variables in the measurement interface settings file. Refer to [Steady-State Measurement](#) on page 57.

Method

To work with the measurement interface

- 1 To replace the environment signals, set the value of the Sw_Replace_Env[0] in Engine/Control/UserInterface/MEAS_Control/MeasurementInterface/Calculations to 1.

Note

A change of this parameter only has an effect on the simulation results, when the engine operating point is once changed afterwards.

- 2 Set the desired engine operating point number.
This evaluates all look-up tables with measurement data once. Furthermore, it is switched to the test bench mode using the accelerator pedal position and the set engine speed from the measurement.
- 3 Wait until the simulation results reach their steady state. Depending on the observed signals this can be after a few seconds (for example, pressures) or take several minutes (for example, temperatures of exhaust system).
- 4 Compare the simulation results.
- 5 You can now change to another operating point or try to change parameters to improve simulation results.
- 6 To quit the measurement comparison, set the engine operating point to zero.
This stops the replacement of environment and sets the test bench to the previous state. If external setpoints for the SoftECU controller have been activated, they must be set back to Map or Calculated setpoint.

Result You used the Measurement Interface to compare simulation results.


Related topics	Basics
	Steady-State Measurement..... 57

Troubleshooting

Troubleshooting with Rising Turnaround Times at Steady Operating Point

Description

Simulating the model on a real-time processor board at a steady state, might lead to a significant increase in turnaround time after several seconds of simulating this operating point. When changing to another operating point, the turnaround time decreases to the original lower value. For example, in case of an engine model this behavior might occur when you drag the engine to test bench mode at a fixed operating point.

For information on possible reasons and workarounds, refer to [Troubleshooting with Rising Turnaround Times at Steady Operating Points](#) (ASM User Guide ).

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