ASM Drivetrain Basic Light

Reference

For ASM Drivetrain Basic Light Blockset 5.4.1 and ASM Drivetrain Basic Operator Light Blockset 5.4.1

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dSPACE

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Important Notice

Contents

About This Reference

Content

This reference introduces you to the features provided by the drivetrain model which is part of an ASM Engine library. It describes the structure and parts of the model, its physical background, and the data required for parameterization.

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.
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>`

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

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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.

Overview of the Drivetrain Basic Library

Where to go from here

Information in this section

Drivetrain Basic Light Library

Introduction

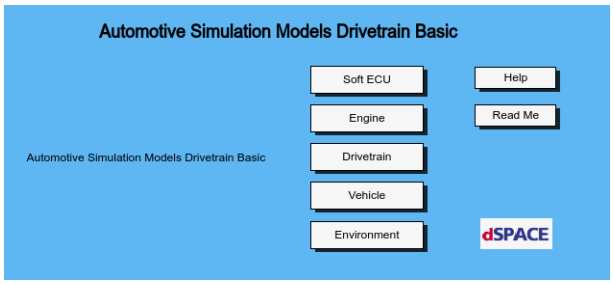
This topic gives you an overview of the ASM Drivetrain Basic Light Library.

Opening the library

You can open the library in MATLAB/Simulink. Refer to How to Open an ASM Library (ASM Drivetrain Basic Model Description 🕮) or .

Contents

The following illustration shows the first level of the library:



The library has the following main subsystems.

Soft ECU The Soft ECU subsystem contains all the subsystems that allows you to use the engine model offline or if a real ECU is not available. Refer to Soft ECUs on page 37.

Drivetrain The Drivetrain subsystem contains the blocks to model the vehicle drivetrain. Refer to Drivetrain on page 11.

Environment The Environment subsystem contains the blocks to simulate the vehicle environment. Refer to Environment on page 21.

Light Version

Description

The currently installed *light* version of the ASM DrivetrainBasic Library only offers a limited functionality. The following blocks are only empty frames without functionality.

- CLUTCH
- CLUTCH_ENGAGEMENT_CONTROL
- DIFFERENTIAL
- DRIVING_RESISTANCES
- ENGINE
- ENGINE_OPERATION_BASIC
- ESP_FAST_TORQUE_SET
- FUEL_CONSUMPTION
- GEAR_SHIFTER
- GEARBOX_AT
- GEARBOX_MT
- IDLE_SPEED_CONTROL_ENGINE_BASIC
- LOCKUP_CLUTCH
- LOCKUP_CLUTCH_CONTROL
- LONGITUDINAL_CONTROL
- LONGITUDINAL_CONTROLLER_HYBRID
- SHIFT_LOCK_CONTROL
- SHIFT_STRATEGY
- SOFT_ECU_TRANSMISSION_BASIC
- SOFTECU_TRANSMISSION_SETUP
- TIP_SHIFT_CONTROL
- TORQUE_CONVERTER
- TORQUE_INTERVENTION_BASIC
- TORQUE_INTERVENTION_CONTROL

Note

If you work with two variants, i.e., full and light library version, migration should always be performed under the full library version. Empty blocks in the light library version cannot be migrated properly and no related parameters initialization files will be generated by ModelDesk.

Drivetrain

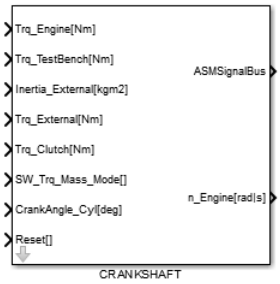
Where to go from here

Information in this section

Crankshaft

Description

The crankshaft calculates the engine speed by integration of the different drive torques, for example, clutch torque, mean effective torque of the engine.



Newton's first law is used to calculate the engine speed.

$$\left(J_{\text{Engine}} + J_{\text{External}}\right) \dot{\omega}_{\text{Engine}} = T_{\text{MeanEff,Engine}} + T_{\text{Clutch}} + T_{\text{External}} + T_{\text{TestBench}}$$

The effect of the moving piston and conrod is included as an additional mass torque. This is implemented as a look-up table depending on the crank angle. The cylinder-specific crank angle is calculated separately and provided by a signal line. The model uses a vector summation to calculate the mass torque for the entire crankshaft according to cylinder.

The mass torque look-up table is calculated from the following equation

$$T_{\text{mosz}} = \omega^2 \, f\left(\varphi\right)$$

where the function f is calculated with

$$f(\varphi) = m_{\text{osz}} \, r^2 \left(\frac{1}{4} \lambda \sin \varphi - \frac{1}{2} \sin 2\varphi - \frac{3}{4} \lambda \sin 3\varphi - \frac{1}{4} \lambda^2 \sin 4\varphi\right)$$

where:

λ is the ratio of crankshaft radius to conrod length
r is the crankshaft radius
φ is the crank angle
m_{osz} is the oscillating mass

Inports

The following table shows the inports:

Name	Unit	Description
CrankAngle_Cyl	[deg]	Individual cylinder crank angle
Inertia_External	[kg m²]	Additional external inertia, for example, from the starter
Reset	[]	Reset all integrators to their initial conditions
SW_Trq_Mass_Mode	[]	Enable for modulated mass torque
Trq_Clutch	[Nm]	Clutch torque
Trq_Engine	[Nm]	Mean effective engine torque
Trq_External	[Nm]	Additional external torque, for example, from the starter
Trq_TestBench	[Nm]	Test bench torque

Outports

The following table shows the outports:

Name	Unit	Description
n_Engine	[rad/s]	Engine speed

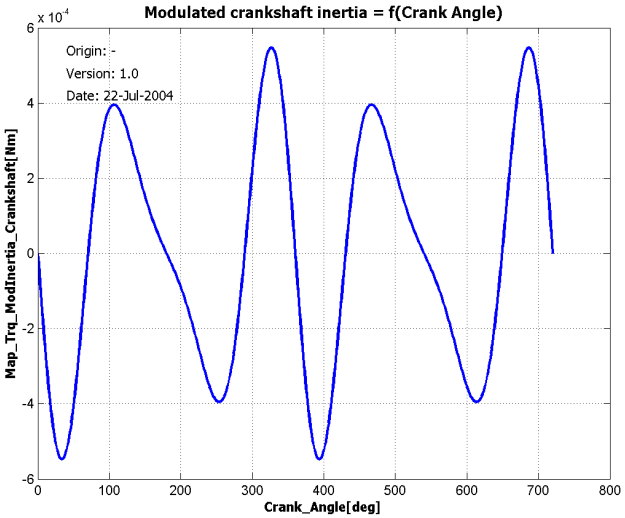
Parameters

The following table shows the block parameters:

Name	Unit	Description
Const_Inertia_Crankshaft	[kgm²]	Engine inertia (including all connected parts like camshaft, generator, first part of clutch/torque converter, rotating part of the connecting rods, mean value of the piston mass and so on with it's reduced inertia)
Const_n_Engine_Max	[rad/s]	Maximum engine speed
Const_n_Engine_Min	[rad/s]	Minimum engine speed
Map_Trq_ModInertia_Crankshaft	[Nm/(rad/s)^2]	Table of modulated crankshaft inertia [Nm/(rad/s)^2] = f(CrankAngle)
StepSize	[s]	Simulation step size

Processing information

The crankshaft mass torque is calculated during the parameterization process.



Related topics

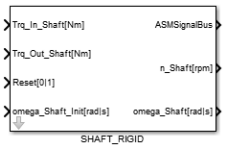
References

Crankshaft Basic (ModelDesk Parameterizing 🕮)
History of the CRANKSHAFT Block.....60

Rigid Shaft

Description

The SHAFT_RIGID block can be used as a general shaft. It calculates the shaft speed from the shaft inertia and the applied torques.



The shaft speed is calculated by integrating the following equation:

$$J_{\mathrm{Shaft}}\,\dot{\omega}_{\mathrm{Shaft}} = (T_{\mathrm{In}} - T_{\mathrm{Out}}) - D\,\omega$$

where:

J_{Shaft}	is the shaft inertia
$\dot{\omega}_{\mathrm{Shaft}}$	is the angular acceleration of the shaft
D	is the damping coefficient of the shaft rotation
T_{In}	is the applied torque on the shaft input side
T_{Out}	is the applied torque on the shaft output side

Inports

The following table shows the inports:

Name	Unit	Description
omega_Shaft_Init	[rad/s]	Initial shaft speed
Reset	[0|1]	Reset of states
Trq_In_Shaft	[Nm]	Applied torque on the shaft input side
Trq_Out_Shaft	[Nm]	Applied torque on the shaft output side

Outports

The following table shows the outports:

Name	Unit	Description
ASMSignalBus	[]	Signal bus that contains signals of ASM components. Refer to ASMSignalBus (ASM User Guide 🕮).
n_Shaft	[rpm]	Shaft speed in [rpm]
omega_Shaft	[rad/s]	Shaft speed in [rad/s]

Parameters

The following table shows the parameters:

Name	Unit	Description
Const_Damping_Coeff_Shaft	[Nm/(rad/s)]	Damping coefficient of the shaft rotation
Const_Inertia_Shaft	[kg m^2]	Shaft inertia
StepSize	[s]	Simulation step size

Related topics

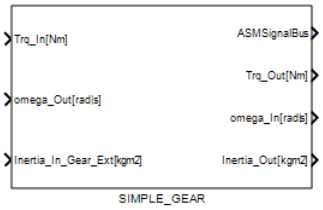
References

History of the SHAFT_RIGID Block 62
Shaft Rigid (ModelDesk Parameterizing 🕮)

Simple Gear

Description

The SIMPLE_GEAR block contains a simple gear train of two gear wheels.



It calculates output torque and input speed according to input torque, output speed and gear ratio:

$$T_{\text{out}} = i \times T_{\text{in}}$$

$$\omega_{\text{in}} = i \times \omega_{\text{out}}$$

Additionally, the following equation is used for the transmission output inertia:

$$J_{\text{Out}} = i^2 \times J_{\text{InputGear}} + J_{\text{OutputGear}}$$

The inertia of the input gear can be switched to an external input to consider the inertia of connected transmission components.

Inports

The following table shows the inports:

Name	Unit	Description
Inertia_In_Gear_Ext	[kg m^2]	Additional inertia at the input side
omega_Out	[rad/s]	Angular speed of the output shaft
Trq_In	[Nm]	Input torque

Outports

The following table shows the outports:

Name	Unit	Description
ASMSignalBus	[]	Signal bus that contains signals of ASM components. Refer to ASMSignalBus (ASM User Guide 🕮).
Inertia_Out	[kg m^2]	Inertia seen by the output shaft
omega_In	[rad/s]	Input shaft speed
Trq_Out	[Nm]	Output torque

Parameters

The following table shows the parameters:

Name	Unit	Description
Const_Inertia_In_Gear	[kg m^2]	Inertia of the input gear
Const_Inertia_Out_Gear	[kg m^2]	Inertia of the output gear
Const_i_Gear	[-]	Gear ratio
Sw_Inertia_In_Gear	[1|2]	Switch of the inertia source of the input gear ▪ 1: Internal ▪ 2: External

Related topics

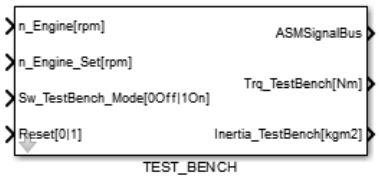
References

Simple Gear (ModelDesk Parameterizing 🕮)

Test Bench

Description

The TEST_BENCH block can be used to simulate an engine test bench. It generates torque to follow a reference engine speed. This is comparable to an engine test bench and can be used to examine the engine at a fixed engine speed.



The test bench model is implemented as a PI controller.

Inports

The following table shows the inports:

Name	Unit	Description
n_Engine	[rpm]	Engine speed
n_Engine_Set	[rpm]	Engine speed setpoint
Reset	[0|1]	Reset
Sw_TestBench_Mode	[0|1]	Switch to enable or disable test bench model: ▪ 0: Off ▪ 1: On

Outports

The following table shows the outports:

Name	Unit	Description
ASMSignalBus	[]	Signal bus that contains signals of ASM components. Refer to ASMSignalBus (ASM User Guide 🕮).
Inertia_TestBench	[kgm^2]	Test bench inertia
Trq_TestBench	[Nm]	Test bench torque

Parameters

The following table shows the parameters:

Name	Unit	Description
Const_I_Gain	[1/s]	I gain of the dynamometer controller
Const_Inertia_TestBench	[kg m^2]	Dynamometer inertia
Const_P_Gain	[]	P gain of the dynamometer controller
Const_Trq_Max_TestBench	[Nm]	Maximum dynamometer torque

Related topics

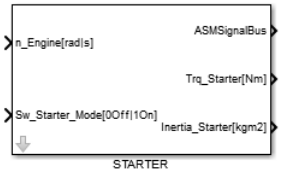
References

History of the TEST_BENCH Block.....64
Test Bench (ModelDesk Parameterizing 🕮)

Starter

Description

A combustion engine requires an initial crankshaft speed before the combustion process starts.



Therefore an external torque needs to be generated in order to accelerate the crankshaft. This is done by the starter, which initially speeds up the engine to its starting speed. When the engine reaches the startup speed, the electronic control unit starts fuel injection and ignition.

Inports

The following table shows the inports:

Name	Unit	Description
n_Engine	[rad/s]	Engine speed
Sw_Starter_Mode	[0|1]	Switch for enable or disable starter model ▪ 0: Off ▪ 1: On

Outports

The following table shows the outports:

Name	Unit	Description
Inertia_Starter	[kg m^2]	Starter inertia
Trq_Starter	[Nm]	Starter torque

Parameters

The following table shows the block parameters:

Name	Unit	Description
Const_Inertia	[kg m^2]	Starter inertia
Const_n_Starter_Max	[rpm]	Maximum starter speed
Const_Trq_init	[Nm]	Maximum starter torque

Related topics

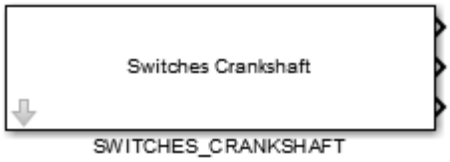
References

History of the STARTER Block 63
Starter Basic (ModelDesk Parameterizing 🕮)

Switches Crankshaft

Description

The SWITCHES_CRANKSHAFT block collects the switches of the crankshaft.



Outports

The following table shows the outports:

Name	Unit	Description
Const_LoadTorque	[Nm]	Load torque on crankshaft
Sw_LoadTorque	[0|1]	Switch to activate load torque ▪ 0: Clutch ▪ 1: Constant
Sw_Trq_Mass_Mode	[1|2]	Switch to activate modulated mass torque ▪ 1: On ▪ 2: Off

Parameters

The following table shows the parameters:

Name	Unit	Description
Const_LoadTorque	[Nm]	Load torque on crankshaft
Sw_LoadTorque	[0|1]	Switch to activate load torque ▪ 0: Clutch ▪ 1: Constant
Sw_Trq_Mass_Mode	[1|2]	Switch to activate modulated mass torque ▪ 1: On ▪ 2: Off

Switches Drivetrain Basic

Description

The SWITCHES_DRIVETRAINBASIC block collects the switches of the drivetrain basic.

Parameters

The following table shows the parameters:

Name	Unit	Description
Sw_Transmission_Mode	[1|2]	Switch to select transmission mode ▪ 1: Manual ▪ 2: Automatic

Related topics

References

Crankshaft Basic (ModelDesk Parameterizing 🕮)

Environment

Where to go from here

Information in this section

Maneuver

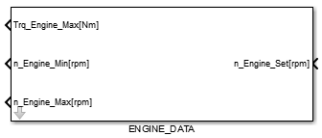
Where to go from here

Information in this section

Engine Data

Description

The ENGINE_DATA block provides the engine speed and torque characteristics. It is used in combination with the TEST_CYCLE block to simulate engine-dynamometer test cycles.



Inports

The following table shows the inports:

Name	Unit	Description
n_Engine_Set	[rpm]	Engine speed setpoints

Outports

The following table shows the outports:

Name	Unit	Description
n_Engine_Max	[rpm]	Maximum engine speed
n_Engine_Min	[rpm]	Minimum engine speed
Trq_Engine_Max	[Nm]	Maximum engine torque

Parameters

The following table shows the parameters:

Name	Unit	Description
Const_n_Engine_Max	[rpm]	Maximum engine speed
Const_n_Engine_Min	[rpm]	Minimum engine speed
Map_Trq_Engine_Max	[Nm]	Maximum engine torque f(n_Engine_Set)
StepSize	[s]	Simulation step size

Related topics

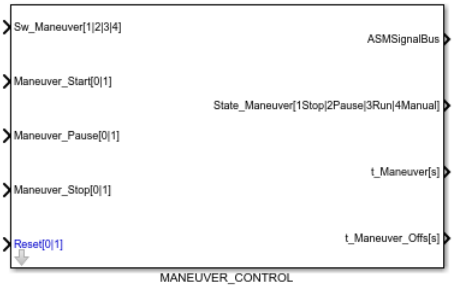
References

Engine Data (ModelDesk Parameterizing 🕮)
History of the ENGINE_DATA Block 61

Maneuver Control

Description

The MANEUVER_CONTROL block controls the maneuver time and provides the maneuver status. It is used with stimulus and driver maneuvers.

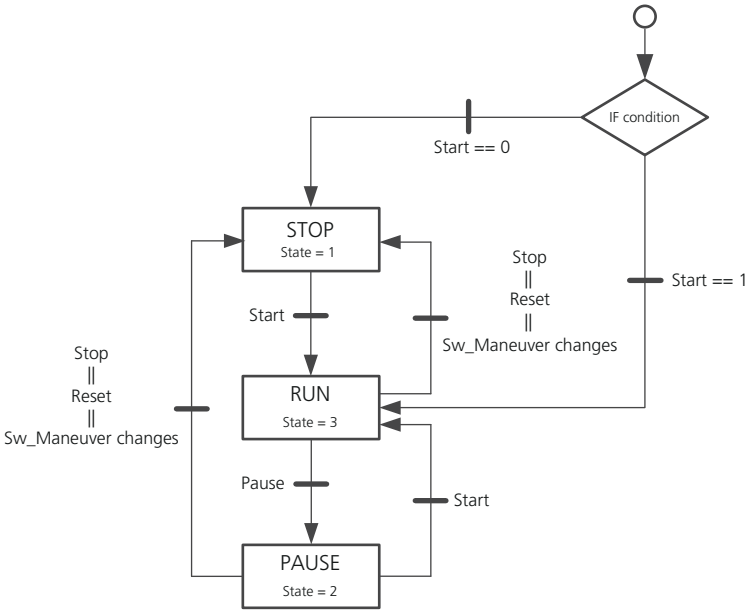


You can start, pause and stop the maneuver via inputs to the block. Inside the block, there is a state machine that changes the maneuver state in a certain logical sequence.

The block is active only during stimulus and driver maneuver, i.e., `Sw_Maneuver` = `2` or `3`. In other cases, the maneuver state is set to **Manual** and no time is calculated.

At the beginning of the simulation, the initial maneuver state is determined according to the **Maneuver_Start** and **Maneuver_Stop** inports. The maneuver is initialized in RUN state, but only if `Maneuver_Start` = `1` and `Maneuver_Stop` = `0`. In all other cases, the maneuver is initialized in STOP state.

The following illustration shows the state machine.



The transitions between the different states are rising edge-triggered. This means that a transition occurs only if the corresponding signal goes from low to high, e.g., from `0` to `1`.

Inports

The following table shows the inports:

Name	Unit	Description
Maneuver_Pause	[0|1]	Switch to pause maneuver
Maneuver_Start	[0|1]	Switch to start maneuver
Maneuver_Stop	[0|1]	Switch to stop maneuver
Reset	[0|1]	Reset of states
Sw_Maneuver	[1|2|3|4]	Switch to select the maneuver type: ▪ 1: Offline manual (Simulink) ▪ 2: Online manual (dSPACE hardware) ▪ 3: Stimulus maneuver (time-dependent stimuli) ▪ 4: Driver maneuver (test cycles)

Outports

The following table shows the outports:

Name	Unit	Description
ASMSignalBus	[]	Signal bus that contains signals of ASM components. Refer to ASMSignalBus (ASM User Guide 🕮).
State_Maneuver	[1|2|3|4]	Maneuver state: ▪ 1: Maneuver stopped ▪ 2: Maneuver paused

Name	Unit	Description
		▪ 3: Maneuver running ▪ 4: Manual state
t_Maneuver	[s]	Maneuver time
t_Maneuver_Offs	[s]	Maneuver time with offset

Parameters

The following table shows the parameters:

Name	Unit	Description
Const_Key_Time_Offset	[s]	Offset time before maneuver starts
Const_Start_Time	[s]	Initial time when maneuver starts
StepSize	[s]	Simulation step size

Related topics

References

History of the MANEUVER_CONTROL Block.....62
Maneuver Control (ModelDesk Parameterizing 🕮)

Test Cycle

Description

The TEST_CYCLE block provides the necessary data to simulate engine as well as chassis-dynamometer test cycles. It can be parameterized by the asm_eng_drivingcycles.m M file in your installation, asm_eng_drivingcycles (ASM User Guide 🕮). Several standard emission test procedures are included and can be used in combination with ASM demos.

For an engine-dynamometer test cycle, the block provides the engine speed and torque setpoints. This data is used in combination with a test bench to control the engine.

For a chassis-dynamometer test cycle, the block provides the vehicle speed setpoints. These setpoints are used as a reference for the longitudinal driver model.

The following standard emission test procedures are included in the installation:

Name	Description
AC	Aachen city cycle
ESC	European Stationary Cycle
ETC	New transient cycle for truck and bus engines
EUDC	Extra-urban driving cycle for low-powered vehicles without additional gear information
EUDC with 5 gears	Extra-urban driving cycle for low-powered vehicles including additional gear information for five gears
EUDC with 6 gears	Extra-urban driving cycle for low-powered vehicles including additional gear information for six gears
FFE_City	City cycle
FTP75	Federal test procedure
FTP75_short	Federal test procedure without pause
FTP75_transient	Engine dynamometer schedule for heavy-duty diesel engines
HIGHWAY	Highway fuel economy test driving cycle
Jap_10-15	Japanese 10-15 exhaust emission and fuel economy driving schedule
JP_JC05	The JE05 cycle (also known as the ED12) is a transient test based on Tokyo driving conditions.
JP_JC05 with 5 gears	The JE05 cycle (also known as the ED12) is a transient test based on Tokyo driving conditions. This data also includes gear information for a five-gear transmission.
JP_JC08	Japanese chassis dynamometer test cycle for light vehicles (< 3500 kg GVW)

Name	Description
US06	Supplemental FTP driving schedule
SC03	Supplemental FTP driving schedule
WHTC	Engine dynamometer schedule for truck and bus engines
WLTC_Class1	Worldwide Harmonized Light-duty Test Cycle of class 1
WLTC_Class2	Worldwide Harmonized Light-duty Test Cycle of class 2
WLTC_Class3	Worldwide Harmonized Light-duty Test Cycle of class 3

Inports

The following table shows the inports:

Name	Unit	Description
n_Engine_Min	[rpm]	Minimum engine speed
n_Engine_Max	[rpm]	Maximum engine speed
Trq_Engine_Max	[Nm]	Maximum engine torque
t_Preview_Driver	[s]	Driver preview time of the reference vehicle speed
t_Maneuver	[s]	Maneuver time
t_Maneuver_Offs	[s]	Maneuver time with offset

Outports

The following table shows the outports:

Name	Unit	Description
Gear	[]	Gear value
n_Engine_Set	[rpm]	Engine speed setpoints
Pos_ClutchPedal	[%]	Clutch pedal setpoints
State_Key	[-1_2]	Key state: ▪ -1: Lock ▪ 0: Acc ▪ 1: Ignition ▪ 2: Starter
Sw_Gear	[0|1]	Gear value activation switch: ▪ 0: Off ▪ 1: On
Sw_StartButton	[0|1]	Engine start button actuation switch: ▪ 0: Button released ▪ 1: Button pressed
Sw_Testbench	[0|1]	Test bench activation switch: ▪ 0: Off ▪ 1: On
Sw_TorqueController	[0|1]	Torque controller activation switch: ▪ 0: Off ▪ 1: On

Name	Unit	Description
Trq_Engine_Set	[Nm]	Engine torque setpoints
v_Vehicle_Preview_Set	[km/h]	Preview vehicle velocity setpoints
v_Vehicle_Set	[km/h]	Vehicle velocity setpoints

Parameters

The following table shows the parameters:

Name	Unit	Description
Map_Gear_Set	[]	Gear value
Map_KeyState	[-1_2]	Key state: ▪ -1: Lock ▪ 0: Acc ▪ 1: Ignition ▪ 2: Starter
Map_Pos_ClutchPedal	[%]	Clutch pedal setpoints
Map_Sw_Engine	[0|1]	Engine activation switch: ▪ 0: Turn the engine off ▪ 1: Turn the engine on
Map_Sw_Testbench	[0|1]	Test bench activation switch: ▪ 0: Off ▪ 1: On
Map_Sw_TorqueController	[0|1]	Torque controller activation switch: ▪ 0: Off ▪ 1: On
Map_Trq_Engine_Set	[]	Engine torque setpoints
Map_n_Engine_Testbench	[]	Engine speed setpoints
Map_v_Vehicle_Ref	[km/h]	Vehicle velocity setpoints
Sw_Gear_Set	[0|1]	Gear value activation switch: ▪ 0: Off ▪ 1: On
Sw_Unit_Trq_Engine	[1|2]	Unit of engine torque setpoints ▪ %: Percentage of the maximum value ▪ Nm: Absolute in Nm
Sw_Unit_n_Engine	[1|2]	Unit of engine speed setpoints ▪ %: Percentage of the maximum value ▪ Nm: Absolute in rpm

Related topics

References

History of the TEST_CYCLE Block 64
Test Cycle (ModelDesk Parameterizing 🕮)

Measurement

Where to go from here

Information in this section

Look-Up Table 1-D

Description

The LUT1D block evaluates the mask parameter with a 1-D look-up table by `output=f(input)`.

Inports

The following table shows the inports:

Name	Unit	Description
Input	[]	Input for evaluating the look-up table

Outports

The following table shows the outports:

Name	Unit	Description
Output	[]	Output = f(Input)

Parameters

The following table shows the parameters:

Name	Unit	Description
Map_LUT1D	[]	1-D Look-up table values

Related topics

References

LUT1D (ModelDesk Parameterizing 🕮)

Look-Up Table 2-D

Description

The LUT2D block evaluates the mask parameter with a 2-D look-up table by `output=f(Input_x, Input_y)`.

Inports

The following table shows the inports:

Name	Unit	Description
Input_x	[]	Input for x-axis
Input_y	[]	Input for y-axis

Outports

The following table shows the outports:

Name	Unit	Description
Output	[]	Output signal

Parameters

The following table shows the parameters:

Name	Unit	Description
Map_LUT2D	[]	2-D look-up table values

Related topics

References

History of the LUT2D Block.....61
LUT2D (ModelDesk Parameterizing 🕮)

Others

Where to go from here

Information in this section

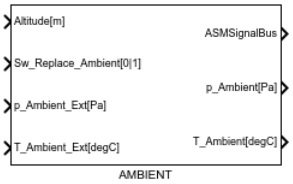
Ambient

Description

The AMBIENT block calculates ambient conditions such as the temperature and pressure.

There are different modes to determine the ambient conditions:

- Altitude: The ambient conditions are determined depending on the vehicle altitude.
- Constant: The temperature and pressure of the ambient are constant.
- External: The source for calculation is outside the block.



Inports

The following table shows the inports:

Name	Unit	Description
Altitude	[m]	Altitude of the vehicle
p_Ambient_Ext	[Pa]	External ambient pressure

Name	Unit	Description
Sw_Replace_Ambient	[0|1]	Switch to enable an external source for ambient conditions: ▪ 0: Disabled ▪ 1: Enabled
T_Ambient_Ext	[degC]	External ambient temperature

Outports

The following table shows the inports:

Name	Unit	Description
ASMSignalBus	[]	Signal bus that contains signals of ASM components. Refer to ASMSignalBus (ASM User Guide 🕮).
p_Ambient	[Pa]	Ambient pressure
T_Ambient	[°C]	Ambient temperature

Parameters

The following table shows the parameters:

Name	Unit	Description
Const_p_Ambient	[Pa]	Ambient pressure (constant)
Const_T_Ambient	[°C]	Ambient temperature (constant)
Map_p_Ambient	[Pa]	Ambient pressure, [Pa] = f(altitude)
Map_T_Ambient	[°C]	Ambient temperature, [°C] = f(altitude)
Sw_Ambient	[1|2|3]	Switch for source of ambient conditions: ▪ 1: Altitude ▪ 2: Constant ▪ 3: External

Related topics

References

History of the AMBIENT Block 59

Key States

Description

The KEY_STATES block calculates the ignition and starter request according to the key position.

Inports

The following table shows the inports:

Name	Unit	Description
Key	[-1_2]	Key position: ▪ -1: Off ▪ 0: Park ▪ 1: Ignition on ▪ 2: Starter request

Outports

The following table shows the outports:

Name	Unit	Description
Key_Lock	[0|1]	Key locked signal: ▪ 0: Key is not locked ▪ 1: Key is locked
Sw_Acc	[0|1]	State of accessories: ▪ 0: Accessories are off ▪ 1: Accessories are on
Sw_Ignition	[0|1]	Ignition request ▪ 0: Ignition is off ▪ 1: Ignition is on
Sw_StarterReq	[0|1]	Starter request ▪ 0: Starter is off ▪ 1: Starter is on

Parameter

The block contains no parameters.

Related topics

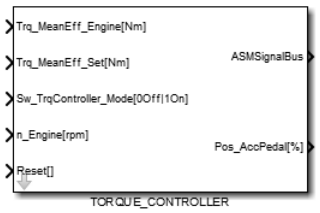
References

History of the KEY_STATES Block.....61

Torque Controller

Description

The torque controller model allows you to set a fixed engine torque controlled. This is comparable to an engine test bench and can be used to examine the engine at a fixed engine torque.



The torque controller model is implemented as a PI controller.

A feed forward controller is implemented in parallel to the PI controller for better control of the engine torque.

Note

When activating the torque controller, make sure the driver is completely inactive. Otherwise driver intervention may lead to inconsistent results.

Inports

The following table shows the inports:

Name	Unit	Description
n_Engine	[rpm]	Engine speed
Reset	[]	Reset all integrators to their initial conditions
Sw_TrqController_Mode	[0|1]	Switch for enable or disable torque controller model ▪ 0: Off ▪ 1: On
Trq_MeanEff_Engine	[Nm]	Mean effective engine torque
Trq_MeanEff_Set	[Nm]	Mean effective engine torque setpoint

Outports

The following table shows the outports:

Name	Unit	Description
Pos_AccPedal	[%]	Accelerator pedal position

Parameters

The following table shows the block parameters:

Name	Unit	Description
Const_I_Gain	[]	Torque controller I-gain
Const_P_Gain	[]	Torque controller P-gain
Map_Trq_Engine_Inv	[]	Inverse engine map, Pos_AccPed[%] = f(n_Engine, Trq_Engine)

Related topics

References

History of the TORQUE_CONTROLLER Block 64
Torque Controller (ModelDesk Parameterizing 🕮)
Torque Controller V3 (ModelDesk Parameterizing 🕮)

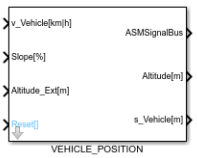
Vehicle Position

Description

The VEHICLE_POSITION block calculates the altitude of the vehicle and the driven distance. You can switch the source of the altitude data.

The following modes for the source of the altitude data are available:

- Calculation: The altitude is based on the vehicle speed and the slope of the road.
- Constant: The altitude is always constant.
- External: The source of the altitude is outside of the block.



The altitude is calculated as follows:

$$Altitude[m] = \int \sin(\alpha_{Slope}) \cdot V_{Vehicle} \cdot dt$$

Inports

The following table shows the inports:

Name	Unit	Description
Altitude_Ext	[m]	External altitude of the vehicle
Reset	[]	Reset integrators to their initial conditions
Slope	[%]	Slope of the road
v_Vehicle	[km/h]	Vehicle velocity

Outports

The following table shows the outports:

Name	Unit	Description
Altitude	[m]	Altitude of the vehicle
s_Vehicle	[m]	Driven distance of the vehicle

Parameters

The following table shows the parameters:

Name	Unit	Description
Const_Altitude_Init	[m]	Constant initial altitude
Const_s_Vehicle_Init	[m]	Initial position of the vehicle
StepSize	[s]	Simulation step size
Sw_Altitude	[1|2|3]	Switch for source of altitude: ▪ 1: Calculation ▪ 2: Constant ▪ 3: External

Related topics

References

Vehicle Position (ModelDesk Parameterizing 🕮)

Soft ECUs

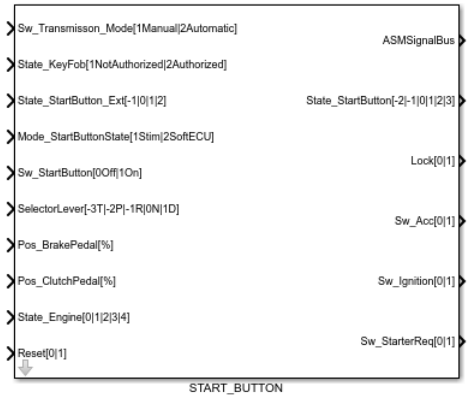
Where to go from here

Information in this section

Engine Start Button

Description

The START_BUTTON block simulates the engine start button ECU that starts and shuts down the engine. It uses a state machine to simulate the different states. An external switch is used to simplify the key authorization process.



You can use the block with vehicles equipped with manual or automatic transmissions. According to the transmission type, the engine starts when the start button is pressed and held while the start operator (driver) conditions are fulfilled. These conditions are shown in the following table:

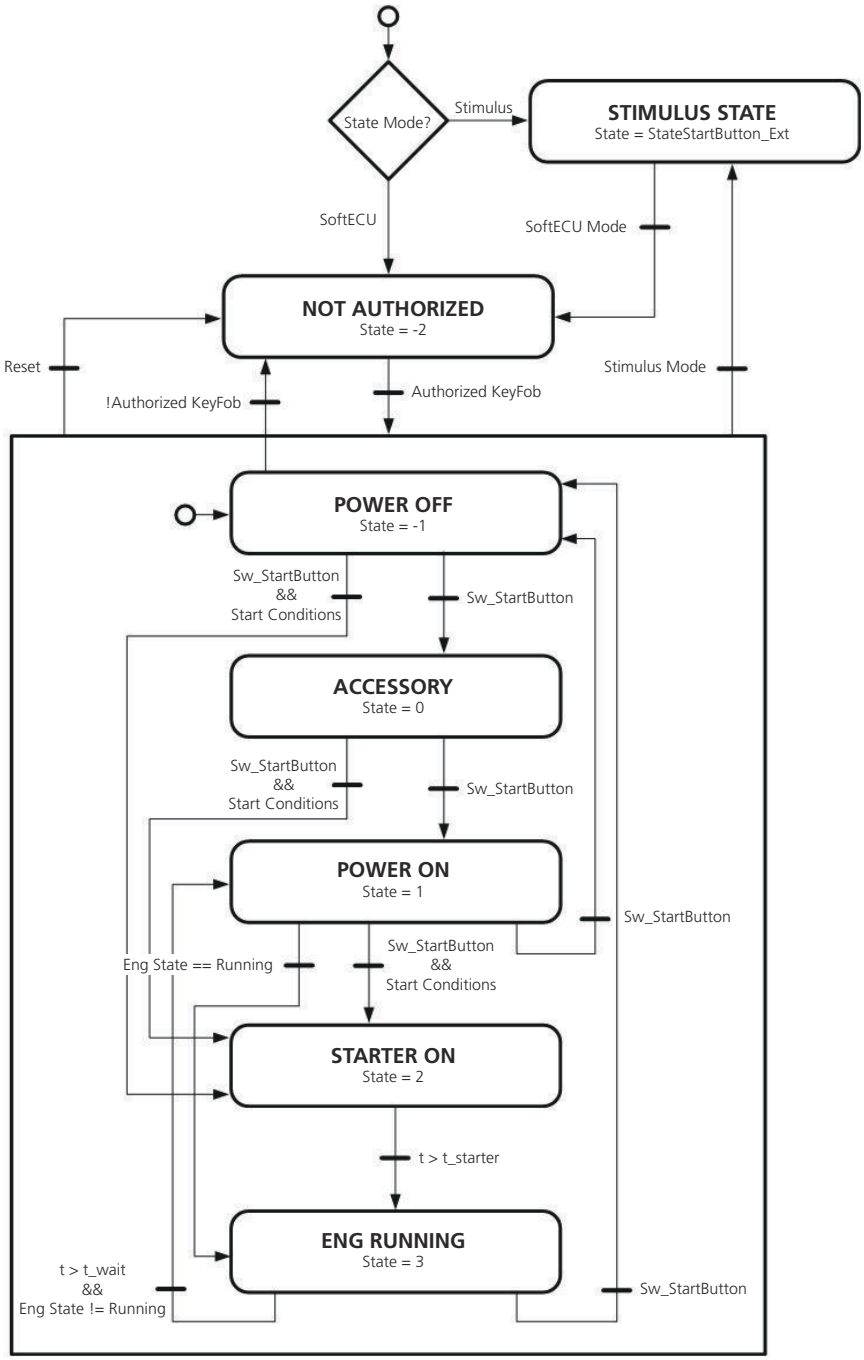
Transmission Type	Conditions
Manual	▪ Authorized key fob ▪ Clutch pedal pressed
Automatic	▪ Authorized key fob ▪ Selector lever in N or P Position ▪ Brake pedal pressed

In addition to the conditions stated above, the system responds only if you press the button and hold it for a time longer than a specified value (`Const_t_Min_Active` parameter). This means short button actuations are ignored.

If the engine is running and you press the button and hold it for a while, the engine switches off.

If the operator conditions above are not fulfilled and you press the button and hold it for a while, this leads to other states in which the engine is not started but other control signals are enabled, such as the accessory signal. You can also stimulate the different states and completely bypass the state machine.

The following state machine shows the working principle of the ECU:



In each state, the ECU calculates different control signals. The following table describes the states and their meanings:

State	Description
Not Authorized	Unauthorized key fob. The engine cannot start.

State	Description
Stimulus	Stimulus state. In this state, the ECU calculates the control signals according to the input: `State_StartButton_Ext[-1|0|1|2]`
Power Off	The default state with an authorized key fob.
Accessory	Accessory is on, for example, you can switch the radio on.
Power On	Power is on, for example, you can control car windows.
Starter On	The ECU sends a starter request to the engine ECU, which can then activate the engine starter.
Engine Running	The ECU detects the engine running state.

Inports

The following table shows the inports:

Name	Unit	Description
Mode_StartButtonState	[1|2]	Start button state mode: ▪ 1: Stimulus ▪ 2: Soft ECU
Pos_BrakePedal	[%]	Brake pedal position
Pos_ClutchPedal	[%]	Clutch pedal position
Reset	[0|1]	Reset of states
SelectorLever	[-3|-2|-1|0|1]	Selector lever position: ▪ -3: TipShift ▪ -2: Park ▪ -1: Reverse ▪ 0: Neutral ▪ 1: Drive
State_Engine	[0|1|2|3|4]	Engine state: ▪ 0: Engine off ▪ 1: Ignition on ▪ 2: Ignition on and starter activated ▪ 3: Engine is running ▪ 4: Ignition is switched off, shutdown active
State_KeyFob	[1|2]	An input that simplifies the key fob authentication process: ▪ 1: Not authorized ▪ 2: Authorized
State_StartButton_Ext	[-1|0|1|2]	Stimulated start button state if the `Mode_StartButtonState` input is set to `Stimulus`: ▪ -1: Power off ▪ 0: Accessory on ▪ 1: Power on ▪ 2: Starter on
Sw_StartButton	[0|1]	Start button actuation input
Sw_Transmission_Mode	[1|2]	Transmission type switch: ▪ 1: Manual

Name	Unit	Description
		▪ 2: Automatic

Outports

The following table shows the outports:

Name	Unit	Description
ASMSignalBus	[]	Signal bus that contains signals of ASM components. Refer to ASMSignalBus (ASM User Guide 🕮).
Lock	[0|1]	Button lock signal (in case of unauthorized key fob or power off): ▪ 0: Start button is not locked ▪ 1: Start button is locked
State_StartButton	[-2|-1|0|1|2|2]	Start button state: ▪ -2: Unauthorized key fob ▪ -1: Power off ▪ 0: Accessory on ▪ 1: Power on ▪ 2: Starter on ▪ 3: Engine running
Sw_Acc	[0|1]	State of accessories: ▪ 0: Accessories are off ▪ 1: Accessories are on
Sw_Ignition	[0|1]	Ignition signal (terminal 15): ▪ 0: Off ▪ 1: On
Sw_StarterReq	[0|1]	Starter request signal (usually sent to the engine ECU): ▪ 0: Off ▪ 1: On

Parameters

The following table shows the parameters:

Name	Unit	Description
Const_Pos_BrakePedal_LowLim	[%]	Minimum value for pressed brake pedal
Const_Pos_ClutchPedal_LowLim	[%]	Minimum value for pressed clutch pedal
Const_t_Min_Active	[s]	Minimum pushing time for active button
Const_t_Min_Starter	[s]	Minimum starter request activation time
StepSize	[s]	Simulation step size

Related topics

References

History of the START_BUTTON Block.....63
Start Button (ModelDesk Parameterizing 🕮)

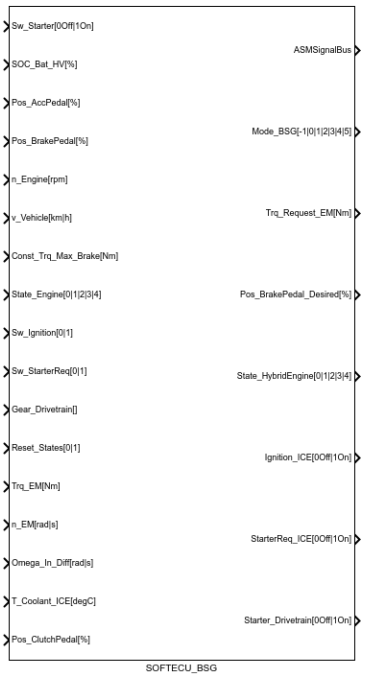
Soft ECU BSG

Description

The SOFTECU_BSG (belt-driven starter generator) block controls the hybrid engine mode and the electric machine torque.

The hybrid engine modes are switched based on acceleration and brake pedal positions.

The block also includes an additional brake control for recuperation.



Hybrid engine modes

There are different hybrid engine modes. The lower the number of the hybrid engine mode, the higher its priority.

The conditions are as follows:

Input	Mode
Mode 0: Stop ICE	
State_Engine	= 0 (Engine Off) or = 4 (Shutdown)
Mode 1: Start ICE	
State_Engine	= 2 (Ignition On, Starter On)
Mode 2: Generator	
State_Engine SOC_Bat	= 3 (Engine Running) = 0 (Low)

Input	Mode
Pos_Brake_Pedal	< Const_Pos_BrakePedal_LowLim
Mode 3: Recuperation	
State_Engine	= 3 (Engine Running)
SOC_Bat	≠ 2 (High)
Pos_BrakePedal	≥ Const_Pos_BrakePedal_LowLim
Pos_ClutchPedal	< Const_Pos_ClutchPedal_LowLim
Gear_Drivetrain	≠ 0
n_Engine	≥ Const_n_Recup
Mode 4: Boost	
State_Engine	= 3 (Engine Running)
SOC_Bat	≠ 0 (Low)
Pos_BrakePedal	< Const_Pos_BrakePedal_LowLim
Pos_AccPedal	≥ Const_Pos_AccPedal_LowLim
Pos_AccPedal Gear_Drivetrain	≥ Const_Pos_AccPedal_LowLim_Boost or ≠ Gear_Drivetrain (previous time step)
Mode 5: Idle	
	No other mode is active

Inports

The following table shows the inports:

Name	Unit	Description
Const_Trq_Max_Brake	[Nm]	Maximum brake torque
Gear_Drivetrain	[]	Manual and automatic gear
n_EM	[rad|s]	Electric machine rotational speed
n_Engine	[rpm]	Engine speed
Omega_In_Diff	[rad|s]	Differential input speed
Pos_AccPedal	[%]	Accelerator pedal position
Pos_BrakePedal	[%]	Brake pedal position
Pos_ClutchPedal	[%]	Clutch pedal position
Reset_States	[0|1]	Reset memory blocks to their initial condition
SOC_Bat_HV	[%]	Battery state of charge
State_Engine	[0|1|2|3|4]	Engine state: ▪ 0: Engine off ▪ 1: Ignition on ▪ 2: Ignition on and starter activated ▪ 3:Engine is running

Name	Unit	Description
		▪ 4: Ignition is switched off, shutdown active
Sw_Ignition	[0|1]	Ignition signal (terminal 15): ▪ 0: Off ▪ 1: On
Sw_Starter	[0Off|1On]	Switch to activate starter: ▪ 0: Off ▪ 1: On
Sw_StarterReq	[0|1]	Starter request signal (usually sent to engine ECU): ▪ 0: Off ▪ 1: On
T_Coolant_ICE	[°C]	Engine coolant temperature
Trq_EM	[Nm]	Electric machine torque

Outports

The following table shows the outports:

Name	Unit	Description
Ignition_ICE	[0Off|1On]	Ignition ICE: ▪ 0: Off ▪ 1: On
Mode_BSG	[-1|0|1|2|3|4|5]	Belt-driven starter generator mode: ▪ -1: ▪ 0: ▪ 1: ▪ 2: ▪ 3: ▪ 4: ▪ 5:
Pos_BrakePedal_Desired	[%]	Desired position of brake pedal
StarterReq_ICE	[0Off|1On]	Starter request ICE: ▪ 0: Off ▪ 1: On
Starter_Drivetrain	[0Off|1On]	Switch for drivetrain starter: ▪ 0: Off ▪ 1: On
State_HybridEngine	[0|1|2|3|4]	Hybrid engine state: ▪ 0: Stop ICE ▪ 1: Start ICE ▪ 2: Generator ▪ 3: Recuperation ▪ 4: Boost
Trq_Request_EM	[Nm]	Electric machine torque request

Parameters

The follwing table shows the parameters:

Name	Unit	Description
Const_Trq_Max_EM	[Nm]	Maximum electric machine torque
Const_n_Starter_Max	[rpm]	Maximum electric machine speed to start the engine
Const_Hyst_AccPedal_Boost	[%]	Acceleration pedal hysteresis for boosting
Const_Hyst_n_Recup	[rpm]	Engine speed hysteresis for recuperation
Const_n_Recup	[rpm]	Minimum engine speed for recuperation
Const_Pos_AccPedal_LowLim	[%]	Minimum pressed acceleration pedal position
Const_Pos_AccPedal_LowLim_Boost	[%]	Minimum acceleration pedal position for boosting
Const_Pos_BrakePedal_LowLim	[%]	Minimum pressed brake pedal position
Const_Pos_ClutchPedal_LowLim	[%]	Minimum pressed clutch pedal position
Const_SOC_Hyst_Battery	[%]	Hysteresis for battery state of charge
Const_SOC_Max_Battery	[%]	High battery state of charge
Const_SOC_Min_Battery	[%]	Low battery state of charge
Const_T_Min_Coolant_ICE	[°C]	Minimum engine coolant temperature
Map_Trq_EM_Boost	[Nm]	Electric machine torque map for boosting
Map_Trq_EM_Generator	[Nm]	Electric machine torque map for generation
Map_Trq_EM_Recuperation	[Nm]	Electric machine torque map for recuperation
Sw_State_BSG	[0|1]	BSG hybrid activation switch: ▪ 0: Off ▪ 1: On

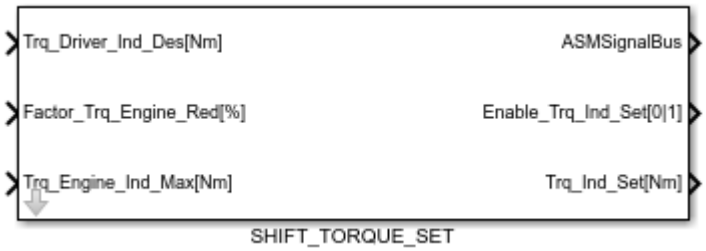
Shift Torque Set

Description

The SHIFT_TORQUE_SET block calculates the desired indicated engine torque depending on the driver's wish and the transmission control unit intervention.

The block offers a coupling with the Soft ECU Transmission and allows a torque reduction during the gearshift process.

The following illustration shows the Simulink representation of the engine model.



Inports

The following table shows the inports:

Name	Unit	Description
Factor_Trq_Engine_Red[%]	[%]	Engine torque reduction factor
Trq_Driver_Ind_Des	[Nm]	Induced engine torque setpoint of driver
Trq_Engine_Ind_Max	[Nm]	Maximum induced engine torque

Outports

The following table shows the outports:

Name	Unit	Description
Enable_Trq_Ind_Set	[0|1]	Activation flag of engine torque intervention
Trq_Ind_Set	[Nm]	Induced engine torque setpoint

Blocks from Former Versions

Introduction

The following topics provide information on blocks that were used in former library versions.

Where to go from here

Information in this section

Common Drivetrain Parameters (Version 4.0 or Earlier)

Description

Common parameters is a subsystem containing all parameters used several times in the model. It provides a central access point to the parameters for online access. If a parameter is changed, the change affects all the parts of the model that use the parameter online and offline.

Outports

The following table shows the outports:

Name	Unit	Description
Const_Diff_Ratio	[]	Final drive ratio
Const_m_Vehicle	[kg]	Vehicle mass
Const_r_Tire	[m]	Dynamics tire radius

Related topics

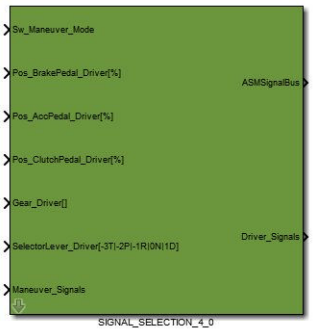
References

Common Drivetrain Parameters (Version 4.0) (ModelDesk Parameterizing 🕮)
Differential Basic V2 (ModelDesk Parameterizing 🕮)

Signal Selection (Version 4.0 or Earlier)

Description

The SIGNAL_SELECTION_4_0 subsystem is the interface between the maneuver, driver, and vehicle models. Depending on the maneuver definition, the pedals, gear, and selector lever wheel are actuated by stimulus or controlled by the driver.



Other signals in the Maneuver_Signals bus, such as ignition, starter request and test bench related signals are just routed through this block.

Inports

The following table shows the inports:

Name	Unit	Description
Gear_Driver	[]	Gear from longitudinal controller
Maneuver_Signals	[]	Signal bus containing maneuver signals
Pos_AccPedal_Driver	[%]	Accelerator pedal position from longitudinal controller
Pos_ClutchPedal_Driver	[%]	Clutch pedal position from longitudinal controller

Name	Unit	Description
SelectorLever_Driver	[-3|-2|-1|0|1]	Selector lever position from driver: ▪ -3: T ▪ -2: P ▪ -1: R ▪ 0: N ▪ 1: D
Sw_Maneuver_Mode	[1|2|3|4]	Switch to select signal source: ▪ 1: Offline manual ▪ 2: Online manual ▪ 3: Stimulus maneuver ▪ 4: Driver maneuver

Outports

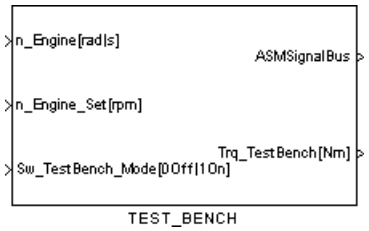
The following table shows the outports:

Name	Unit	Description
ASMSignalBus	[]	Signal bus that contains signals of ASM components. Refer to ASMSignalBus (ASM User Guide 🕮).
Driver_Signals	[]	Signal bus containing driver signals

Test Bench (Version 2.0 or Earlier)

Description

The test bench model allows you to set a fixed engine speed controlled by the test bench controller. This is comparable to an engine test bench and can be used to examine the engine at a fixed engine speed.



The test bench model is implemented as a PI controller.

Inports

The following table shows the inports:

Name	Unit	Description
n_Engine	[rad/s]	Engine speed
n_Engine_Set	[rpm]	Engine speed setpoint

Name	Unit	Description
Sw_TestBench_Mode	[0|1]	Switch for enable or disable test bench model ▪ 0: Off ▪ 1: On

Outports

The following table shows the outports:

Name	Unit	Description
Trq_TestBench	[Nm]	Test bench torque

Parameters

The following table shows the block parameters:

Name	Unit	Description
Const_P_Gain	[]	Test bench controller P-Gain
Const_I_Gain	[]	Test bench controller I-Gain
Const_Trq_max	[Nm]	Maximum dynamometer torque

Related topics

References

Test Bench..... 16
Test Bench V2 (ModelDesk Parameterizing 🕮)

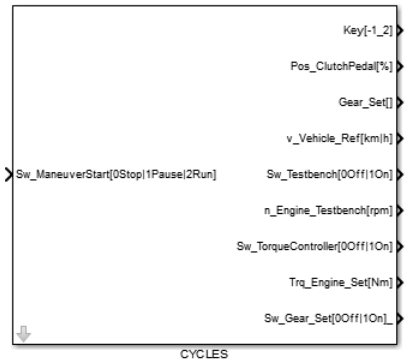
CYCLES Block (Version 7.0 or Earlier)

Description

The driver maneuver contains the engine and chassis dynamometer test cycles, which can be defined by a certain MATLAB function in your installation.

CYCLES

The CYCLES block provides the necessary data to simulate engine as well as chassis dynamometer test cycles. Several standard emission test procedures are included and can be used in combination with the ASM demos.



The longitudinal driver model follows the reference velocity, which is defined by the chassis dynamometer test cycles. The test bench and torque controller models are used to control the reference engine speed and torque, which are defined by the engine test cycles.

The following test cycles are included in the installation:

Test Cycle	Description
AC	Aachen city cycle
ESC	European Stationary Cycle
ETC	New transient cycle for truck and bus engines
EUDC	Extra-urban driving cycle for low-powered vehicles without additional gear information
EUDC with gear	Extra-urban driving cycle for low-powered vehicles including additional gear information for five gears
EUDC with 6 gears	Extra-urban driving cycle for low-powered vehicles including additional gear information for six gears
FFE_City	City cycle
FTP75	Federal test procedure
FTP75_short	Federal test procedure without pause
FTP75_transient	Engine dynamometer schedule for heavy-duty diesel engines
US06	Supplemental FTP driving schedule
SC03	Supplemental FTP driving schedule
JP_JC08	Japanese chassis dynamometer test cycle for light vehicles (< 3500 kg GVW)
JP_JE05	The JE05 cycle (also known as the ED12) is a transient test based on Tokyo driving conditions.
JP_JE05 with gear	The JE05 cycle (also known as the ED12) is a transient test based on Tokyo driving conditions. This data also includes gear information for a five-gear transmission.
HIGHWAY	Highway fuel economic test driving cycle
Jap_10-15	Japanese 10-15 exhaust emission & fuel economy driving schedule
WHTC	Engine dynamometer schedule for truck and bus engines
WLTC_Class1	Worldwide Harmonized Light Vehicle Test Procedure of class 1
WLTC_Class2	Worldwide Harmonized Light Vehicle Test Procedure of class 2
WLTC_Class3	Worldwide Harmonized Light Vehicle Test Procedure of class 3

Note

The test cycle has to be initialized by the `asm_eng_drivingcycles.m` function. For a detailed explanation, refer to asm_eng_drivingcycles (ASM User Guide 🕮).

Inports

The following table shows the inports:

Name	Unit	Description
Sw_ManeuverStart	[0|1|2]	Switch used to control the time of the Driver maneuver: ▪ 0: Stop maneuver ▪ 1: Pause maneuver ▪ 2: Run maneuver

Outports

The following table shows the outports:

Name	Unit	Description
Gear_Set	[]	Gear position setpoint for manual transmission
Key	[-1|0|1|2]	Key position: ▪ -1: Off ▪ 0: Park ▪ 1: Ignition on ▪ 2: Starter request
n_Engine_Testbench	[rpm]	Engine speed setpoint for the test bench
Pos_ClutchPedal	[%]	Clutch pedal position for the gear position setpoint
Sw_Gear_Set	[0|1]	Switch to activate external gear setting: ▪ 0: Off ▪ 1: On
Sw_Testbench	[0|1]	Switch to activate the engine test bench: ▪ 0: Off ▪ 1: On
Sw_Torque_Controller	[0|1]	Switch to activate the torque controller: ▪ 0: Off ▪ 1: On
Trq_Engine_Set	[Nm]	Engine torque setpoint for torque controller
v_Vehicle_Ref	[km/h]	Reference vehicle velocity

Parameters

The following table shows the block parameters:

Name	Unit	Description
Const_Key_Time_Offset	[s]	Key offset time
Const_Start_Time	[s]	Test cycle initial time
Const_n_Engine_Max	[rpm]	Maximum engine speed
Const_n_Engine_Min	[rpm]	Minimum engine speed
Map_Gear_Set	[]	Gear setpoints during chassis dynamometer cycle
Map_KeyState	[-1_2]	Key state
Map_Pos_ClutchPedal	[%]	Clutch pedal setpoints during chassis dynamometer cycle
Map_Sw_Testbench	[0|1]	Test bench activation switch during engine dynamometer cycle: ▪ 0: Off ▪ 1: On
Map_Sw_TorqueController	[0|1]	Torque controller activation switch during engine dynamometer cycle: ▪ 0: Off ▪ 1: On
Map_Trq_Engine_Max	[Nm]	Maximum engine torque map as a function of the engine speed
Map_Trq_Engine_Set	[]	Engine torque setpoints during engine dynamometer cycle
Map_n_Engine_Testbench	[]	Engine speed setpoints during engine dynamometer cycle
Map_v_Vehicle_Ref	[km/h]	Reference vehicle velocity during chassis dynamometer cycle
StepSize	[s]	Simulation step size
Sw_Gear_Set	[0|1]	Gear setpoints activation switch during chassis dynamometer cycle: ▪ 0: Off ▪ 1: On
Sw_Unit_Trq_Engine	[1|2]	Unit of engine torque setpoints: ▪ %: Percentage of the maximum value ▪ Nm: Absolute value in Nm
Sw_Unit_n_Engine	[1|2]	Unit of engine speed setpoints: ▪ %: Percentage of the maximum value ▪ rpm: Absolute value in rpm

Related topics

References

Cycles V7 (ModelDesk Parameterizing 🕮)
Engine Data V7 (ModelDesk Parameterizing 🕮)

New Features/Migration History of the ASM Drivetrain Basic Light Blockset

Introduction

The following topics provide an overview of the changes to the ASM products in the previous Releases.

For an overview of the new features and migration of the current Release, refer to Automotive Simulation Models (ASM) (New Features and Migration 🕮).

Where to go from here

Information in this section

General Changes to the ASM Drivetrain Basic Blockset

Release 2020-B

The Road subsystem has been upgraded with new blocks to calculate the vehicle position and ambient conditions.

Release 2018-A

Environment subsystem The library blocks of the Environment subsystem were rearranged with respect to their functionality.

Relocated library blocks Blocks that were moved in the library are automatically migrated. During the migration, the links to these blocks are changed according to the new positions in the library.

Release 2017-B

Rearranged library The library blocks are rearranged because of the newly introduced dual-clutch transmission demo. The blocks in the library are grouped

according to their functionality. Moreover, several new blocks are introduced to cover a comprehensive simulation of the dual-clutch transmission.

Blocks that were moved in the library are automatically migrated. During the migration, the links to these blocks are changed according to the new positions in the library.

Release 2017-A

ASM Driver The driver is now able to automatically drive backwards with manual transmission. In case of a negative reference velocity course, it controls the clutch and the gear to follow it. Moreover, the driver can now be used for the simulation with a start-stop system.

Release 2016-B

Look-up table migration The discontinued Simulink blocks Lookup and Lookup2D in the ASM library blocks were updated to the new standard Simulink Look-up table (n-D) block. Refer to Changes to all ASM Products (ASM User Guide 🕮).

The look-up tables were updated in the following blocks within this library:

- CRANKSHAFT
- CYCLES_7_0
- GEARBOX_AT, GEARBOX_AT_1_0, GEARBOX_AT_8_0
- GEARBOX_MT, GEARBOX_MT_1_0, GEARBOX_MT_8_0
- GEAR_SHIFTER_2_0, GEAR_SHIFTER_6_0
- LONGITUDINAL_CONTROL
- SOFT_ECU_TRANSMISSION_1_0
- SOFT_ECU_TRANSMISSION_BASIC_7_0
- TORQUE_CONTROLLER_3_0
- TORQUE_CONVERTER, TORQUE_CONVERTER_4_0

License check of ASM Utils blocks The ASM_UTILS license was discontinued. The ASM Utils blocks now check the license of the ASM blockset in which they are used.

The Utils blocks in the following blocks within this library were updated:

- GEAR_SHIFTER_6_0
- SOFT_ECU_TRANSMISSION_BASIC_7_0

Release 2016-A

Engine simulation New blocks have been introduced to simulate a simplified engine. It is now possible to build a simplified virtual vehicle by using only the ASM Drivetrain Basic Blockset.

The new blocks are:

- ENGINE: Simulates simplified engine dynamics
- FUEL_CONSUMPTION: Used with the ENGINE block to calculate the fuel consumption and the carbon dioxide emissions
- ENGINE_OPERATION_BASIC: Part of the soft ECU model of the engine. It detects the engine state and activates the starter.

- IDLE_SPEED_CONTROL_ENGINE_BASIC: Part of the soft ECU model of the engine. It simulates the idle speed controller.
- TORQUE_INTERVENTION_ENGINE_BASIC: Part of the soft ECU model of the engine. It implements an external engine torque request.

Rearranged library blocks A new subsystem named Engine has been added at the top level. It contains the ENGINE and FUEL_CONSUMPTION blocks.

Inside the Soft ECU subsystem, two new subsystems have been added:

- Transmission: Contains the soft ECU blocks of the transmission.
- Engine: Contains the new soft ECU blocks of the engine.

Release 2013-A

The ASM DrivetrainBasic_lib has been significantly changed. The new blocks now have similar interfaces to the drivetrain in the ASM VehicleDynamics_lib. This makes it easier to exchange the third party models. In addition, the implementation of the library blocks is now easier to understand.

Restructuring the library meant that many blocks were changed. This might include changes in the implementation, block interfaces and parameters to make the blocks compatible with the restructured library.

Release 7.3

An integrator reset has been inserted to support a global reset in the ASM mean value engine models.

The library blocks now support reverse engine rotations, for example, for start-stop applications.

Release 7.0

The driving cycle JC08 is now included as a demo cycle.

Release 6.6

The ASM Drivetrain Basic Operator Blockset is new. It is the operator version of the ASM Drivetrain Basic Blockset.

The operator version has been designed for Simulink simulation only.

The operator model offers the same functionality, simulation quality and parameterization options as the standard simulation package. The operator version is compatible with the standard model (developer version) and can be parameterized by using ASMParameterization and ModelDesk.

The fundamental difference is the implementation of the library components: The components are encapsulated in S-functions. The blocks are accessible in the model so that the input and output behavior can be studied and parameters can be changed.

History of the AMBIENT Block

Release 2019-B

The AMBIENT block was split in two blocks: VEHICLE_POSITION and AMBIENT.

The VEHICLE_POSITION block calculates the altitude of the vehicle and the driven distance.

The AMBIENT block calculates the temperature and pressure of the ambient area.

In previous Releases, both functionalities were implemented in one AMBIENT block.

Note

The altitude calculation, now in the VEHICLE_POSITION block and based on the road slope and the vehicle speed, was incorrect in previous Releases. If you use the ambient pressure and temperature based on this calculation, the simulation behavior of your model changes after migration. The migration process automatically corrects this error.

Release 2018-A

The following inports were added:

- Sw_Replace_Ambient
- p_Ambient_Stim
- T_Ambient_Stim

The following parameters were added:

- Const_p_Ambient
- Const_T_Ambient

Also, a new outport was added to output the current altitude of the vehicle: Altitude_Vehicle[m]. Before, this signal was a part of the ASMSignalBus but not as an outport. The unit of the signal was changed from [m] to [km].

Now, when you set the Sw_Replace_Ambient variable to 1, the ambient conditions are specified as stimulus signals (e.g., measurement) that provide the block input via p_Ambient_Stim and T_Ambient_Stim.

Release 2017-B

The new AMBIENT block calculates the ambient temperature and pressure depending on the altitude. The block is part of the Environment/Road system.

Related topics

References

Ambient....31

History of the CRANKSHAFT Block

Release 2016-B	The continuous integrator inside the block has been replaced with a discrete one.
Release 2013-A	The maximum and minimum engine speed can now be parameterized in the CRANKSHAFT block. Two new parameters have been added: ▪ Const_n_Engine_Max ▪ Const_n_Engine_Min The sign of the Trq_Clutch[Nm] inport has been changed to compensate for the restructuring of the connected blocks.
Release 7.3	The engine speed integrator lower limit has been changed from zero to minus infinity to allow negative engine speeds, for example, for start-stop applications. An absolute block in MassTorqueModulation has been added to also process negative engine speeds. The block has been adapted to support engine reset functionality.
Release 6.5	The "^" sign has been removed from the block name.
Related topics	References Crankshaft..... 11

History of the COMMON_DRIVETRAIN_PARAMETERS Block

Release 2013-A	The block was deleted, but its parameters have been assigned to other blocks. These parameters can now be changed from a unique location in the model, i.e., in the DRIVING_RESISTANCES and DIFFERENTIAL block. This avoids the multiple use of the same parameter in different blocks. The old implementation is still available in the blocks of the previous version. Because the block no longer exists in the library, its link is changed to the former implementation during migration from older ASM releases. The former implementation is located in FormerVersions/COMMON_DRIVETRAIN_PARAMETERS_4_0.

Release 7.3	The internal Goto blocks have been converted to output ports. Goto blocks with the original tags are added to the new output ports during migration. Now multi-instances of the block can be used within one model.
Release 6.2	The Mux for creating a bus have been replaced by BusCreator blocks.

History of the ENGINE_DATA Block

Release 2020-A	The size of the Map_Trq_Engine_Max parameter was changed from [14,2] to [21,2] values.

Related topics

References

Engine Data 22

History of the KEY_STATES Block

Release 6.5	This block is new. It calculates the ignition and starter request according to the key position.

Related topics

References

Key States 33

History of the LUT2D Block

Release 2015-A	This block is new. It can be used to include measurement data in the model. For the block, a new subsystem is created in ASM_DrivetrainBasic_lib/Driver/Measurement.

Related topics

References

Look-Up Table 2-D 30

History of the MANEUVER_CONTROL Block

Release 2018-B

The ASMSignalBus outport was added.

Release 2016-B

The new block MANEUVER_CONTROL is introduced which describes a central maneuver control for the engine demos. This block controls the start, pause and stop of maneuver time, as well as the maneuver status.

Until now, the maneuver control functionality was divided between the CYCLES and other non-library blocks. Using linked library blocks, offers a unified implementation for all engine demos. This implementation can be extended and benefit from new features in the future.

Moreover, with the new block, it is now possible to start, stop and reset the maneuver during the simulation on dSPACE platforms using only ModelDesk.

Related topics

References

Maneuver Control 23

History of the SHAFT_RIGID Block

Release 2016-B

A new parameter has been added to describe the rotation damping.

A new inport has been added for an external initialization of the speed integrator.

Release 2015-A

This new block represents a general shaft. The block calculates the shaft speed from the shaft inertia and the applied torques.

Related topics

References

Rigid Shaft....14

History of the STARTER Block

Release 6.5

The "^" sign has been removed from the block name.

Release 6.2

The Mux for creating a bus have been replaced by BusCreator blocks.

The MDL.DrivetrainBasic.Starter.Const_n_Starter_Max mask parameters is now only used once in the model.

The n_Engine[rad/s] input value is converted to unit [rpm] internally.

Related topics

References

Starter....18

History of the START_BUTTON Block

Release 2020-B

The data type of the State_Engine[0|1|2|3|4] inport was changed from *uint8* to *double*.

Release 2018-B

A new START_BUTTON block was added to the SoftECU subsystem to simulate an engine start button.

Related topics

References

Engine Start Button....37

History of the TEST_BENCH Block

Release 2015-A

The dynamometer inertia is now considered as a parameter.

The block cannot be automatically migrated, due to the new added block parameter. Therefore, during migration, the link to the TEST_BENCH block is changed to the former implementation in FormerVersions/TEST_BENCH_2_0.

To use the new implementation, drag the TEST_BENCH block from the ASM Drivetrain Basic Library to the model. However a hand adaptation of the parameters is necessary.

Release 6.5

The anti-windup of the controller has been improved. The Const_Trq_Max parameter is now unique below the mask, so the real-time path to this variable has been changed.

Related topics

References

Test Bench 16

History of the TEST_CYCLE Block

Release 2018-B

The new Map_Sw_Engine parameter has been added to simulate the engine start button for test cycles.

Release 2018-A

The calculation of v_Vehicle_Set_Preview[m|s] was activated.

Related topics

References

Test Cycle 25

History of the TORQUE_CONTROLLER Block

Release 2016-B

The size of the inverse engine torque parameter has been expanded from [40x40] to [41x40]. The old parameter is extrapolated and initialized in `asmmigratepost`.

Release 2014-B	The TORQUE_CONTROLLER block can now also be activated if a negative torque set is provided. During the migration, a set of blocks is added to the Sw_TrqController_Mode[0Off|1On] inport, so that the block is inactive if there is a negative torque set. This ensures the old functionality of the block.
Release 7.3	The block has been adapted to support engine reset functionality. To get the reset functionality, you must connect the new port manually. See the demo model for an example.
Release 7.1	The torque controller now has its own inverted engine map instead of using the one from the driver, and the implementation has been redesigned. These changes are automatically migrated. The link is changed to the former version during migration. You can also copy the new block manually, in which case you must also adapt the parameterization project and the controller parameter.
Related topics	References Torque Controller 34

Appendix

Bibliography

List of literature

The following literature provides more details:

[Bre02] Brendecke T.: Virtuelle Echtzeitumgebung für Getriebesteuergeräte mit Hardware-in-the-Loop. Shaker Verlag, 2002.

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[Mit95] Mitschke M.: Dynamik der Kraftfahrzeuge. Berlin: Springer, 1995.

[Wal99] Wallentwoitz H.: Längsdynamik von Kraftfahrzeugen. Lecture note, RWTH Aachen, 1999.