dSPACE Simulator Mid-Size

Standardized, off-the-shelf HIL simulator based on DS2202 or DS2211 HIL I/O Board

Highlights

- For ECU function and integration tests
- Ideally tailored for testing powertrain, vehicle dynamics and body ECUs
- Signal conditioning, load simulation and electrical fault simulation
- Open and scalable

Open Hardware Concept

dSPACE Simulator Mid-Size is a ready-to-use, standard hardware-in-the-loop (HIL) simulator for testing automotive ECUs systematically and automatically. The simulation model runs on the processor hardware (single-processor or multiprocessor systems). dSPACE Simulator Mid-Size generates and measures I/O signals via the integrated dSPACE I/O boards. The function range is complemented by load and fault simulation.

Typical Fields of Application

- Engine, transmission, vehicle dynamics and body electronics HIL
- Open-loop or closed-loop environment
- Realistic unit tests
- Function integration tests, release tests, and ECU diagnostics tests
- Automated testing
- Real-time simulation
- Electric drives applications (combined with Electric Motor HIL Solution (p. 594) or DS5203 FPGA Board (p. 576))

Hardware Details

The hardware of dSPACE Simulator Mid-Size is mounted in a 19” desktop rack (standard height: 6-12 U). The DS1006 Processor Board can be used as processor board. The DS2202 or DS2211 HIL I/O Board generate and measure the I/O signals. The signal conditioning, loads, Failure Insertion Units (FIUs) and power supply are also mounted in the 19” rack. Additional I/O, signal conditioning, fault simulation, and current measurement can be added on request.

Connection to Host PC

All dSPACE software for experiment setup and control or test automation runs on your PC or notebook. The dSPACE Simulator hardware is connected to your PC via link boards (p. 620).

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1) The end of life of the dSPACE Simulator Mid-Size is planned for December 31, 2024. You can still buy the product until December 31, 2021. New releases of dSPACE software are guaranteed to continue supporting the dSPACE Simulator Mid-Size until at least the end of 2023. After the end of life, no services of any kind will be available for this product. We advise against using the dSPACE Simulator Mid-Size in new projects. For new projects we recommend that you use the successor, a SCALEXIO rack system which is available in different sizes according to your needs (p. 576). For general information on the dSPACE product life cycle, please see p. 674.
## Hardware Summary

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Form factor</strong></td>
<td>19” desktop rack</td>
</tr>
<tr>
<td><strong>Processor hardware</strong></td>
<td>DS1006 Processor Board</td>
</tr>
<tr>
<td><strong>I/O hardware</strong></td>
<td>DS2202 HIL I/O Board or DS2211 HIL I/O Board</td>
</tr>
<tr>
<td><strong>Additional I/O optional</strong></td>
<td></td>
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<tr>
<td><strong>Signal conditioning</strong></td>
<td></td>
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<tr>
<td><strong>Substitute loads</strong></td>
<td></td>
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<tr>
<td><strong>Real-load connector</strong></td>
<td></td>
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<tr>
<td><strong>Failure Insertion Units for actuator signals</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Failure Insertion Units for sensor signals</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Integration of additional signal conditioning</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Integration of third-party hardware, e.g., load panels</strong></td>
<td></td>
</tr>
<tr>
<td><strong>ECU connectors</strong></td>
<td>Three 90-pin connectors for each load/FIU unit</td>
</tr>
<tr>
<td><strong>Break-out box</strong></td>
<td></td>
</tr>
<tr>
<td><strong>OBDII diagnostic connector / connection to diagnostic tools</strong></td>
<td>Sub-D connector with optional CARB adapter</td>
</tr>
<tr>
<td><strong>Truck-application-capable (24 V/36 V)</strong></td>
<td>CAN connector</td>
</tr>
<tr>
<td><strong>48 V-capable</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Power supply (remote-controlled)</strong></td>
<td>One or two power supplies for simulating 1-or 2-voltage systems</td>
</tr>
</tbody>
</table>

- **included**
- **optional**

## Examples of Rack Variants

<table>
<thead>
<tr>
<th>dSPACE Simulator Mid-Size</th>
<th>Single Mid-Size (6 HU)</th>
<th>Double Mid-Size (12 HU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS1006 Processor Board</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DS2202 HIL I/O Board or DS2211 HIL I/O Board</td>
<td>(1 x)</td>
<td>(2 x)</td>
</tr>
<tr>
<td>Failure Insertion Units for actuator signals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load cards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second power supply</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Free ISA slots for expansion</td>
<td>–</td>
<td>2 (PX10 version), 12 (PX20 version)</td>
</tr>
<tr>
<td>Height units</td>
<td>6</td>
<td>12</td>
</tr>
</tbody>
</table>

- **included**
- **optional**
  - **not available**

1) Devices connected to the dSPACE HIL system, for example, electronic control units, can feed in high currents and high voltages (voltages over 60 V DC or 30 V ACRMS), which can be dangerous for the user. This can happen, for example, in systems for piezoelectric or hybrid applications. Such currents and voltages can result in property damage, personal injury, or death. Under all circumstances, you must observe all the safety precautions described in the documentation. Please contact dSPACE for additional safety-related equipment, such as electrically safe interface cables.
Hardware Components

Signal Conditioning
- Onboard for DS2202/DS2211 HIL I/O Board signals
- Spare slots for additional signal conditioning (e.g., current measurement for direct injection applications, lambda probe simulation or signal conditioning for additional I/O boards)

Load Capabilities
- Five load boards (per load/FIU unit), 10 single-ended loads or 5 double-ended loads each
- Cascading of loads/FIU units with additional DS2211/DS2202 boards
- Extendable by electrically equivalent loads or low-power resistor loads (2 W maximum continuous power per load)
- Front connector for measurement or connection of real loads
- 6 A maximum load current per pin (real loads)
- LED indicators displaying current load states (display mode selectable)

Power Supply
- Simulation of car battery
- Programmable switched-mode power supply
- Remote-controlled
- Up to two power supply units for 2-voltage systems
  - $V_{\text{Bat}_1}$: 0 ... 30 V output voltage range
  - $V_{\text{Bat}_2}$: 0 ... 60 V output voltage range
- 48 V and truck-capable using $V_{\text{Bat}_2}$
- Three switched battery rails for each battery voltage, e.g., main relay, ECU-controlled high rail
- 16 A maximum current for each rail of first battery voltage
- 6 A maximum current for each rail of second battery voltage

Connectors
- Three 90-pin connectors for the ECU
- One Sub-D CARB connector (SAE J1962) for diagnostic tools (an adapter to the standard CARB connector is optionally available)
- One CAN connector for access to the CAN bus
- Jacks for battery voltage (for power supplies 1 and 2) and ground
- External load connectors
Failure Insertion Units
A standard dSPACE Simulator Mid-Size supports electrical fault simulation on all ECU output pins connected to the HIL I/O Board. A hardware extension allows electrical faults to be simulated on ECU inputs as well. The host PC controls both types of fault simulation via an RS232 interface.
- ECU outputs (per load/FIU unit\(^1\)): DS791 Failure Insertion Units (FIUs)
- ECU inputs: optional DS793/DS794 Failure Insertion Units
- Remote-controlled with ControlDesk Failure Simulation and automated with AutomationDesk
- Broken wire simulation (open circuit)
- Simulation of short circuits: from ECU pins to ground or battery voltages
- Simulation of cross-wired short circuits between ECU pins via common fail planes
- Simultaneous activation of multiple faults (latch mode)
- dSPACE Simulator Mid-Size is also available without FIU cards on request

For more information on high-current fault simulation, please see p. 632.

Fault Simulation Overview

<table>
<thead>
<tr>
<th>dSPACE Simulator Mid-Size</th>
<th>Actuator FIU</th>
<th>Sensor FIU (Optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIU cards</td>
<td>DS791</td>
<td>DS793/DS794</td>
</tr>
<tr>
<td>Number of cards per load/FIU unit</td>
<td>5</td>
<td>Up to 2</td>
</tr>
<tr>
<td>Number of channels per card</td>
<td>10</td>
<td>Up to 81</td>
</tr>
<tr>
<td>Switch type</td>
<td>Relay</td>
<td>CMOS switch</td>
</tr>
<tr>
<td>Max. continuous current</td>
<td>6 A</td>
<td>0.5 A</td>
</tr>
</tbody>
</table>

Possible fault types

- Cable break
- Short circuit to ground
- Short circuit to battery voltage \(V_{BAT1}\) or \(V_{BAT2}\)
- Short circuit to another ECU pin via common plane
- Simulation of loose contact or switch bouncing

\* included
\- not available

Other Hardware Components
- Break-out box (optional) (p. 645)
- Simulation of linear lambda probes (p. 635)

Expandability
- Two or more HIL I/O Boards\(^2\)
- Integration of additional dSPACE I/O board possible
- Signal conditioning for additional I/O boards
- Custom signal conditioning
- Connection of real loads, dummy resistive loads or electrical equivalent loads
- Customer-specific modifications/extensions possible, for example larger 19" rack with break-out boxes, ECU subracks, real load drawers, etc.
- 1- or 2-voltage systems

\(^1\) The number of load/FIU units depends on the number of HIL I/O Boards.
\(^2\) Requires larger 19" rack.