dSPACE Simulator Mid-Size Based on DS2211

Hardware Installation and Configuration

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How to Contact dSPACE Support

If you encounter a problem when using dSPACE products, contact your local dSPACE representative:

- Local dSPACE companies and distributors: http://www.dspace.com/go/locations
- For countries not listed, contact dSPACE GmbH in Paderborn, Germany.
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You can also use the support request form: http://www.dspace.com/go/supportrequest. If you are logged on to mydSPACE, you are automatically identified and do not need to add your contact details manually.

If possible, always provide the relevant dSPACE License ID or the serial number of the CmContainer in your support request.

Software Updates and Patches

dSPACE strongly recommends that you download and install the most recent patches for your current dSPACE installation. Visit http://www.dspace.com/go/patches for software updates and patches.

Important Notice

Contents

About This Document

Introduction

This document guides you through the installation and configuration of dSPACE Simulator Mid-Size based on DS2211. It describes the hardware installation procedure, shows how to configure the system, and explains how to get started with your dSPACE system using an appropriate example.

Required knowledge

Knowledge in handling the host PC and the Microsoft Windows operating system is presupposed.

> **Note**
>
> Before starting to work with dSPACE Simulator Mid-Size, read the safety precautions. Refer to Safety Precautions on page 19.

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.

Symbol	Description
	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

Introduction

The following topics give you an introduction to dSPACE Simulator Mid-Size.

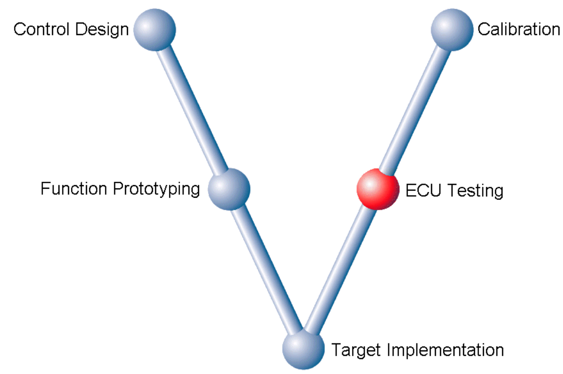
Where to go from here

Information in this section

Hardware-in-the-Loop Simulation

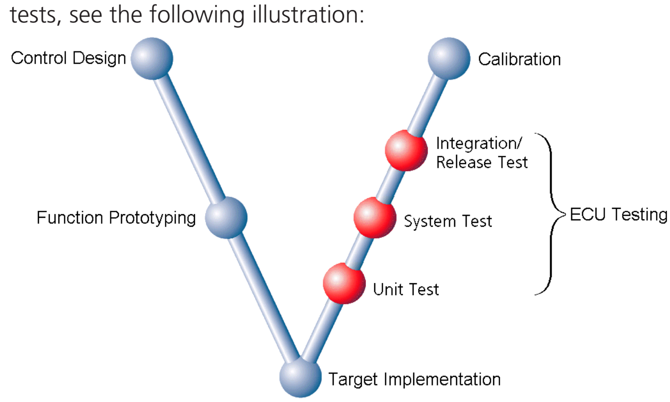
Introduction

The V-cycle represents a widely recognized approach to the development of electronic control units (ECUs):



Hardware-in-the-loop simulation

With hardware-in-the-loop simulation, you can test the functions and diagnostics of your ECU quickly and automatically. This can be split up into three different tests, see the following illustration:



Unit test This test new functions that are mainly developed at the supplier and then implemented on the ECU prototype.

System test An ECU prototype is integrated in a network, which may be virtual (with a dSPACE simulator, this is normally the case). The ECU prototype is tested in its technical environment, i.e., is defined by the vehicle components like engine or transmission and the peripheral ECUs communicating with each other.

Release test When all the ECUs are available, they are integrated into the (virtual) car, and the functionality of the distributed system is tested. The whole electronic system is also tested to check whether all the requirements have been met and the ECUs can be released for series manufacturing.

dSPACE Simulator Mid-Size

The unit and system tests can be performed with dSPACE Simulator Mid-Size. It is a closed-loop HIL simulator that supports the following features:

- signal conditioning
- equivalent and real loads for ECU outputs
- failure simulation
- remote-controlled power supplies (two voltage systems)

Related topics

References

Abbreviations..197

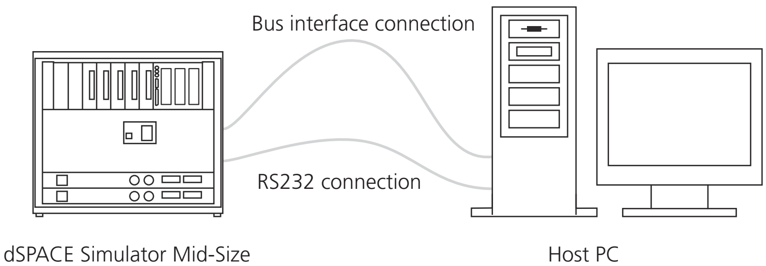
Hardware Overview

Introduction

dSPACE Simulator Mid-Size Based on DS2211 consists of several hardware components, which are built-in a 19" desktop rack. To test ECUs, the HIL simulator must be connected to a host PC.

Host PC

The host PC contains the dSPACE software to implement the model on the HIL simulator and to control the simulation. The host PC must be connected to the simulator via the bus interface connection and RS232 connection.



Bus interface connection

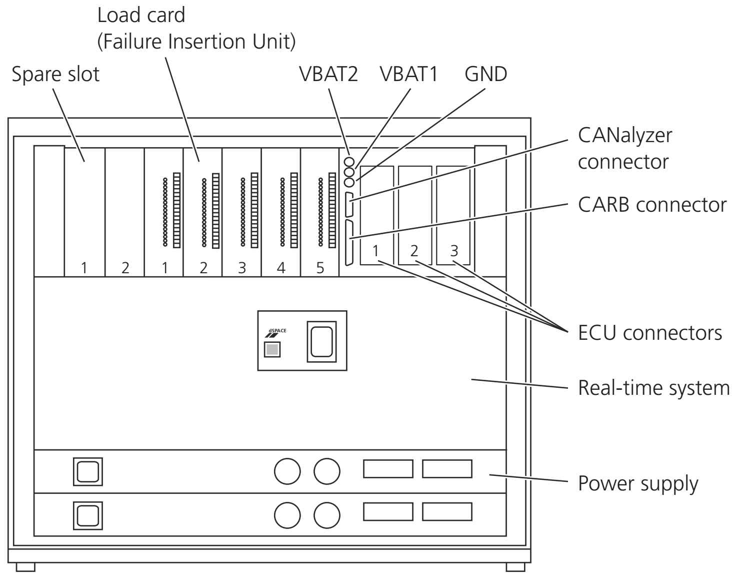
The host PC must be equipped with a Link Board for the bus interface connection. dSPACE provides three different types of Link Board to match the different bus types of the host PC (ISA bus, PCI bus, or PCMCIA interface). The bus interface connection is used to download the real-time model to the simulator and to control the simulation.

RS232 connection

The RS232 connection connects the serial interface of the host PC to the serial interface of the simulator. It is used to control the failure insertion units.

HIL simulator

dSPACE Simulator Mid-Size is mounted in a 19" desktop rack with 6, 9, or 12 HU (height units). The following illustration shows the front view of dSPACE Simulator Mid-Size.



Architecture

For information on the internal connection of dSPACE Simulator Mid-Size, refer to Architecture of the Simulator on page 16.

Related topics

References

Components of dSPACE Simulator Mid-Size

Components

dSPACE Simulator Mid-Size consists of:

- DS1006 Processor Board
- DS2211 HIL I/O Board or DS2202 HIL I/O Board
- DS814 Link Board for the connection to the host PC
- Load/FIU unit containing:
  - Five DS790 Load cards, 10 channels each, to be equipped with low-power resistive or inductive loads.
  - Five DS791 Failure Insertion Units (FIU), 10 channels each.
  - Optional: The DS791 can be replaced by DS792 Fuse Cards if failure simulation is not required.

    - Optional: Two DS793 Input FIUs, 81 and 43 channels
    - One DS686 Backplane
    - One DS685 Midplane
- Remote-controlled power supply
- Connectors

Processor Board

The simulation model runs on the processor board. The main processing unit on this is the real-time processor (RTP). The processor board has access to the DS2211 HIL I/O Board and other modular I/O boards if necessary via its PHS bus. Via the optional high-speed optical interface (Gigalink), it can be connected to other processor boards of the same type, which makes it capable of multiprocessing in a multiprocessor environment. However, a multiprocessor system with different types of processor boards is not supported.

For further information on the processor boards, refer to Processor Board (dSPACE Simulator Mid-Size Based on DS2211 Features 🕮).

DS2211 HIL I/O Board

The DS2211 HIL I/O Board has been designed for hardware-in-the-loop simulation in automotive applications, and is tailored to the simulation and measurement of automotive signals. It combines a variety of typical HIL I/O functions on one board. The board contains signal conditioning for typical signal levels of 12-V, 24-V and 42-V automotive systems and supports 2-voltage systems.

As an I/O board, the DS2211 is always part of a modular system. It measures and generates the signals required, while the processor board computes the real-time model. This means that applications using DS2211 I/O features are implemented on the processor board. Together with a processor board, the DS2211 constitutes a basic HIL simulator.

For further information, refer to DS2211 HIL I/O Board (dSPACE Simulator Mid-Size Based on DS2211 Features 🕮).

DS2202 HIL I/O Board

Instead of a DS2211 HIL I/O Board, a DS2202 HIL I/O Board can be build in dSPACE Simulator Mid-Size. A DS2202 is a lower-cost alternative to DS2211 HIL I/O Board, without signal processor and angular processing unit.

The DS2202 HIL I/O Board has been designed for hardware-in-the-loop simulation in automotive applications, and is tailored to the simulation and measurement of automotive signals. The board contains signal conditioning for typical signal levels of 12-V, 24-V and 42-V automotive systems and supports 2-voltage systems.

As an I/O board, the DS2202 is always part of a modular system. It measures and generates the signals required, while the processor board computes the real-time model. This means that applications using DS2202 I/O features are implemented on the processor board. Together with a processor board, the DS2202 constitutes a basic HIL simulator.

For further information on the boards's features, refer to Features of the DS2202 (DS2202 Features 📖). For further information on the pinouts of the simulator when a DS2202 is built in, refer to Pinouts of dSPACE Simulator Mid-Size Based on DS2202 on page 156.

Load cards

dSPACE Simulator Mid-Size is equipped with five low-power load cards (DS790 Load Card) with the following characteristics:

- 10 single-ended loads or 5 double-ended loads per card, or mixed
- 2 W maximum continuous power per load
- 50 W maximum continuos power per load/FIU unit
- 6 A maximum load current
- LED indicators displaying current load states, battery voltage and switched voltage
- Front panel for measurement or connection of real loads

For further information, refer to Load Simulation (dSPACE Simulator Mid-Size Based on DS2211 Features 📖).

Failure insertion units

A Load/FIU unit is equipped with 5 failure insertion units (DS791 FIU) with the following characteristics:

- Support of 50 ECU pins in total
- Failure simulation for ECU outputs (Channels are directly connected to the pins of the ECU 1 connector, which contains the signals for the ECU outputs)
- Remote control using ControlDesk's Failure Simulation module
- Simulation of short circuits:
  - Short circuits from one or more ECU pins to ground or battery voltage via fail plane 1 or fail plane 2
  - Short circuits between two or more ECU pins via fail plane 1 or fail plane 2
- Cable break simulation
- Simultaneous simulation of multiple failures
- 6 A maximum load current
- Make before break (the failure is switched first, and after a defined transition period the channel is disconnected from the load, only for DS791 FIUs with firmware version 1.2)

For further information, refer to Failure Simulation (dSPACE Simulator Mid-Size Based on DS2211 Features 📖).

Optional FIU for ECU Inputs

A Load/FIU unit can optionally be equipped with two failure insertion units for ECU inputs (DS793 Sensor FIU)

- Failure simulation for ECU inputs (Channels are directly connected to the pins of the ECU 2 and ECU 3 connectors, which contains the signals for the ECU inputs)

- One simulator requires two DS793s. Each supports a maximum of 81 ECU pins
  - The DS793 connected to the ECU 2 connector uses all 81 channels
  - The DS793 connected to the ECU 3 connector uses 43 channels
- Remote control using ControlDesk's Failure Simulation module
- Simulation of short circuits:
  - Short circuits from one or more ECU pins to ground or battery voltage via fail plane 1 or fail plane 2
  - Short circuits between two or more ECU pins via fail plane 1 or fail plane 2
- Cable break simulation
- Simultaneous simulation of multiple failures
- Make before break (the failure is switched first, and after a defined transition period the channel is disconnected from the DS2211)

For further information, refer to DS793 Sensor FIU (dSPACE Simulator Mid-Size Based on DS2211 Features 📖).

Power supply

dSPACE Simulator Mid-Size is equipped with one switched-mode power supply. A second power supply can be added to simulate a two-voltage system. Each power supply has the following characteristics:

- Remote control by the model
- Three switched battery rails, e.g., ECU-controlled high rail
- Output voltage 0 … 20 V or 0 … 60 V (depending on the power supply used)
- Maximum output voltage for VBAT1: 30 V
- Maximum output voltage for VBAT2: 60 V
- Maximum current of each high rail (VBATx, VSWxy)
  - At a load card: 8 A
  - At a Load/FIU unit: 16 A
- Maximum current of the ground line
  - At a load card: 8 A
  - At a Load/FIU unit: 40 A

For details on the current limits allowed, refer to Basics of Configuring the Simulator on page 34.

For further information on the power supply, refer to Power Supply Unit (dSPACE Simulator Mid-Size Based on DS2211 Features 📖).

Connectors

The simulator has connectors on the front to connect the ECU, external loads and a diagnostic tool:

- Three 90-pin connectors for the ECU
- One Sub-D CARB connector for diagnostic tools (an adapter to the standard CARB connector is optionally available)
- One CANalyzer connector for access to the CAN bus
- Jacks for battery voltage (for power supplies 1 and 2) and ground
- External load connectors

The simulator has connectors on the rear to connect the host PC and mains:
- PC interface connector
- RS232 FIU connector
- Mains connector

Related topics

Basics

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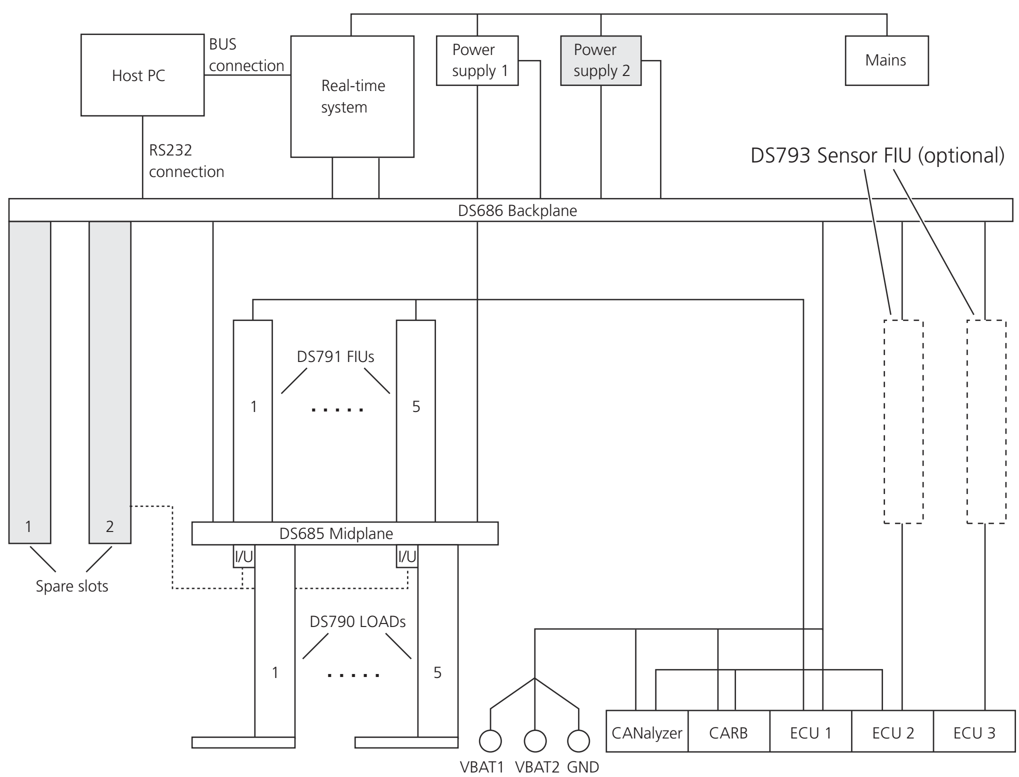
Architecture of the Simulator

Overview

The hardware components are connected inside the simulator. The following illustration gives you an overview of the internal architecture of dSPACE Simulator Mid-Size.



Real-time system

The real-time system consists of a processor board, a DS2211 and a DS814 Link Board. The boards are connected in a PX5 or PX10 expansion box.

A PX5 expansion box has a height of 2 HU. It has 5 ISA slots. In a real-time system based on a DS1006, all ISA slots are used.

A PX10 expansion box has a height of 4 HU. It has 10 ISA slots. The standard real-time system uses not all ISA slots. You can integrate other I/O boards (see Setting Up and Installing Further I/O Boards on page 73).

DS790 Load card

The DS790 Load cards are connected to the DS685 Midplane. They are directly connected to the DS791 FIUs through the DS685 Midplane. Loads are connected on the board or at the front of the DS790.

DS791 FIU

The DS791 FIUs are connected to the ECU 1 connector and the DS685 Midplane. As the ECU 1 connector is the connector for the ECU outputs, all ECU outputs can be failure-simulated. The DS685 Midplane has two independent fail planes. Two or more ECU outputs can be connected to the same fail plane to simulate a short circuit between them. One or more ECU outputs can be connected to a fail plane which can additionally be connected to a battery voltage or ground to simulate a short circuit to those. For more information, refer to Failure Simulation for ECU Outputs (dSPACE Simulator Mid-Size Based on DS2211 Features 📖).

DS793 Sensor FIU

The DS793 Sensor FIUs are optional. They are connected to the ECU 2 and ECU 3 connectors and the DS686 Backplane. As these connectors are the connectors for the ECU inputs, all ECU inputs can be failure-simulated. In addition, the DS793 Sensor FIU are connected to the DS686 Backplane to use the two independent fail planes. Failures are simulated in the same way as for ECU outputs (see DS791 FIU above). For more information, refer to DS793 Sensor FIU (dSPACE Simulator Mid-Size Based on DS2211 Features 📖).

DS685 Midplane

The DS685 Midplane connects the FIUs to the load cards. It is connected to the backplane to provide the ECU output signals for the real-time system. It contains connectors for each ECU output for current measurement.

DS686 Backplane

The DS686 Backplane has the connectors for the real-time system and the FIU/load/FIU unit. Additionally, it has the jumpers to set the reference potential for signals. Refer to Connectors, Switches and Jumpers in the Load/FIU Unit on page 144.

Spare slots

The spare slots can be used for additional signal conditioning. Additional boards can be inserted in the spare slots and directly connected to the DS686 Backplane, for example, for current measurement of the ECU output channels. Refer to Spare Slot 1 Pinout on page 149 and Spare Slot 2 Pinout on page 151.

Related topics

Basics

Software Overview

Introduction

The dSPACE software, such as the implementation and the experiment software, comes via DVD and has to be installed first. For information on the software package, the installation and license handling, refer to Basics on dSPACE Software Installation (Installing dSPACE Software 📖).

Safety Precautions

Introduction

To avoid risk of injury and/or damage to the dSPACE hardware, read and ensure that you comply with the following safety precautions. These precautions must be observed during all phases of system operation.

Where to go from here

Information in this section

General Safety Precautions for Working with the Simulator

Potential hazards

⚠ WARNING

Risk of death, serious injury, fire, and/or property damage

Using and installing a dSPACE HIL simulator can be dangerous. Your actions affect or control electronic systems using the simulator. Your actions can cause hazards which result in death, serious injury, fire, and/or property damage.

Therefore, it is essential to read carefully the following notes and the documents provided by dSPACE. Observe all the warnings which are attached to the simulator.

Liability

It is your responsibility to adhere to instructions and warnings. Any unskilled operation or other improper use of this product in violation of the respective safety instructions, warnings, or other instructions contained in the user documentation constitutes contributory negligence, which may lead to a limitation of liability by dSPACE GmbH, its representatives, agents and regional dSPACE companies, to the point of total exclusion, as the case may be. Any exclusion or limitation of liability according to other applicable regulations, individual agreements, and applicable general terms and conditions remain unaffected.

User qualification

Work on the simulator, and on the connected electrical equipment, must be carried out only by a skilled electrician or by instructed persons under the supervision and guidance of a skilled electrician and in accordance with electrical engineering rules and regulations.

A skilled electrician is a person with sufficient technical training, knowledge, and experience, and knowledge of the relevant regulations, to assess the tasks assigned to him/her and to recognize possible dangers.

Notes and instructions

Read all the instructions in this document before configuring and operating the dSPACE HIL simulator.

Observe all the warnings which are attached to the dSPACE HIL simulator.

Risks of electric shock

⚠ WARNING

Risks of serious injury or death due to electric shock

The dSPACE HIL simulator can carry high currents and high voltages. According to international standards, a voltage higher than 60 V DC or 42.4 V AC_{peak} is specified as hazardous. This presents a risk to people and equipment (death, personal injury or property damage). Devices connected to the dSPACE HIL simulator, for example, electronic control units, can feed in high voltages which can be dangerous for the user. This can happen, for example, to simulators for piezoelectric applications.

- The high voltages can be present at connector pins (internal and external). This presents a risk to people and equipment (death, personal injury or property damage).
- The high voltages can be present at connector pins or interfaces where they are not expected, for example, due to the failure simulation or incorrect external wiring.
- The operator must keep unauthorized people away from the dSPACE HIL simulator by taking suitable safety precautions, for example, locking the simulator, training personnel.

The dSPACE HIL simulator has a power supply unit for simulating the battery voltage. A power supply unit can generate a maximum voltage of 60 V DC in standard automotive applications, for example, testing ECUs for combustion engine or vehicle dynamics. Higher voltages must be generated only by externally connected components, for example, piezoelectric components. However, dSPACE HIL simulators for hybrid applications have power supply units which can generate higher voltages. In this case you must take special safety precautions which are not described in this documentation.

⚠ WARNING

Risk of electric shock

Read the following carefully to avoid an electric shock.

- Personnel who work with dSPACE HIL simulators must be informed about the possible dangers and must take suitable safety precautions.
- There is a danger of electric shocks or burns from open power terminals. Some circuits are live even with the main supply turned off. Before opening the enclosure, disconnect the power connector and wait at least five minutes to allow all components to discharge. Some of the components, for example, power supply capacitors, can carry residual voltage.
- The dSPACE HIL simulator has protective earth (or grounding) protection class 1:

  The dSPACE HIL simulator must be operated with a protective earth/ground connection via the protective earth/grounding conductor of the AC line supply cable.
- Operate the dSPACE HIL simulator only with the enclosure closed.
- Operate the dSPACE HIL simulator only from the kind of power source indicated on the rear panel.
- Before switching on the dSPACE HIL simulator, perform a visual inspection of the enclosure and all the connected cables. Do not operate the dSPACE HIL simulator if they look damaged.
- Always use approved wiring material with an adequate cross-sectional area for external cable harness on ECU and Load Card connectors.
- Always use approved power cord with an adequate cross-sectional area for connection to the mains.
- The rear side on/off switch does not disconnect the dSPACE HIL simulator from the mains. For complete disconnection, unplug the power connector from the socket.

Risks of smoke or fire

⚠ **WARNING**

Risks of smoke or fire

Read the following carefully to avoid smoke or fire.

- Do not exceed the maximum voltages and currents of the channels. Currents higher than allowed heat wires and conductors. This can damage their isolation. A damaged isolation can lead to a short circuit between the conductors and can cause smoke or fire.
- Operate the dSPACE HIL simulator only with its enclosure closed. The simulator's enclosure is fire-protected according to the European norm EN 61010 and EN 60950. Fire inside the simulator cannot inflame something nearby if its enclosure is closed. Otherwise, it cannot prevent smoke emission.
- The fuses used for protecting the channels are time-lag fuses. They protect the dSPACE HIL simulator and do not protect the test setup, for example, the electronic control unit or external cable harness.
- Operate the dSPACE HIL simulator only under supervision, especially if you work with failure simulation. During failure simulation currents can occur which are higher than currents of normal operation.
- Install a fire detector in the room where the simulator operates.
- It is recommended to operate the simulator in a fire-protected room.

Operating the simulator

To avoid an electric shock, note the following points during the operation of dSPACE HIL simulator:

- Do not work at the cabling inside the simulator or the cable harness while the simulator is running.
- Use only suitable and tested measuring instruments. Observe all the safety instructions when making measurements.
- Connect and disconnect the measuring instruments only when the simulator is turned off.
- Before starting measurements, check whether the measuring instruments and their cables are in perfect condition.

Safety precautions for failure simulation

Failure simulation simulates electrical failures in the wiring of an ECU, for example, a short circuit of a signal to the battery voltage. To simulate the failures, the wires are electrical connected to the failure potential. Note the following points for failure simulation:

- Currents can be higher than during normal operation.
- High voltages can occur at pins where they are not expected.
- If the circuit which is failure-simulated contains an inductance, a high voltage can be induced (see Safety Precautions When Using Inductive Loads on page 54).

- Overvoltage pulses in relays can cause electric arcs at the contacts of the relays. The electric arcs can weld the relay's contacts so that the contacts are permanently short-circuited. A permanent short-circuit can cause further damages, for example, overheating.

Unexpected behavior of the simulator

If the miniature circuit breaker or residual current device switches off the simulator several times, disconnect the simulator from the mains immediately and make sure that it cannot be switched on unintentionally. The simulator must not be put into operation again until it is analyzed, repaired, and approved by dSPACE or an authorized support personnel.

Risk of stumbling

To avoid the risk of stumbling, do not lay the external cables along a route where people have to walk.

Protecting the dSPACE HIL simulator

- During a lightning storm, disconnect the power cord. Alternatively, install an appropriate protection device.
- Do not unplug the power connector by pulling the power cord. Hold the plug itself to pull it out.
- Route external cables so that they are not likely to be walked on or pinched by items placed upon or against them.

Cleaning the dSPACE HIL simulator

- Disconnect the power connector before cleaning the simulator.
- Do not use liquid or aerosol cleaners. Use a damp cloth for cleaning.

Related topics

Basics

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Safety Precautions for Installing and Connecting dSPACE Boards..26

Environmental Conditions for the Simulator

Environment

Ensure that the following environment conditions are fulfilled:

Environment	Indoor use
Altitude	Up to 2000 m
Temperature, operating	+15 °C … +35 °C
Relative humidity	Maximum 80% if < 31 °C, decrease linearly to 50% at 40 °C, noncondensing
Pollution degree	2, according to IEC 61010-1 (normal clean environment)
Protection class	1
Power supply	Nominal 230 V or 120 V, single phase (type label on rear panel)
Fluctuations	+6%, -10%
Rating	230 V, 50 Hz, 15 A or 120 V, 60 Hz, 15 A
Power supply fusing	Line 1: 6.3 A 230 V~ T 1.5 kA Line 2: 6.3 A 230 V~ T 1.5 kA (if applicable) Line 3: 2.4 A 230 V~ T 1.5 kA Use approved fuses only.
Measurement category	I.
Mass	Approx. 80 kg (depending on system setup)

Connecting to power supply

Carry out the following instructions when connecting the dSPACE HIL simulator to the power network:

- Use an appropriate miniature circuit breaker with a rated current of maximal 16 A.
- It is recommend to connect the dSPACE HIL simulator via a residual current device.
- Use an emergency switch if high voltages are present at the dSPACE HIL simulator.
- Make sure that the power cord fulfills the mains input characters of the dSPACE HIL simulator.

Requirements on the location

- Do not place this system on an unstable cart, stand or table.
- Take care not to drop the system or its components.
- Position the system away from heat sources such as radiators, heat storage devices, power amplifiers, and other products producing heat.

- Do not block ventilation outlets. Slots and openings in the cabinet's sides, rear and bottom are for ventilation purposes and necessary for reliable operation without overheating. There should be at least 150 mm (6.0 in) of space from these openings.
- The system and its components are not waterproof. Do not expose it to water or other liquids.
- Using the dSPACE HIL Simulator on wet locations might results in electric shock due to hazardous voltages or might damage the dSPACE HIL Simulator.

  According to IEC 61010 (product safety), the dSPACE HIL Simulator is not intended to be used on wet locations.
- Route all the external cables so that they are not likely to be walked on or pinched by items placed upon or against them.
- If the simulator rack has wheels, move it only on a firm level surface. Do not move it on stairs or steps. Move it only when it is disconnected from the mains and external devices.

Electromagnetic compatibility

dSPACE Simulator Mid-Size is a CE class A device. This equipment may cause interference in a residential installation. In this case the user is encouraged to perform appropriate measures to correct the interference. For details on CE compliance, refer to Certifications on page 183.

Related topics

Basics

Safety Precautions for Installing and Connecting dSPACE Boards

Installation sequence

- Install the components of your system in exactly the order stated. Any other sequence may lead to unpredictable results or even damage the system.
- Read the instructions carefully before starting installation.
- Note all warnings given.

Notes for handling hardware with electrostatic sensitive devices (ESD)

dSPACE boards contain sensitive electronic devices. Before unpacking, installing, or removing them, take the following precautions to avoid damage caused by high electrostatic voltage:

- Make sure that you and all material the board comes in contact with are properly grounded.
- During storage or handling, place the board on conductive foam or in a protective bag.
- Do not touch the contact of the connectors.

Handling boards with fans

Improper handling will damage the fan of the board and/or Gigalink module:
- Do not touch any components of the fan, whether during operation or when it has stopped.
- Do not try to stop a rotating fan with your fingers or with the help of tools.
- Do not apply pressure to the fan bearing during installation and removal of the board.

Installing hardware

Only qualified persons with experience in installing computer hardware and electric devices should perform the installation. Any damage to or malfunction of dSPACE hardware caused by improper installation is not covered by the warranty, unless the handling and installation instructions are shown to be defective.

Before doing any installation work, make sure that:
- The power supplies of the host PC and dSPACE HIL simulator are switched off.
- No external devices are connected to the dSPACE HIL simulator.
- Make sure that you hold the PHS-bus cable connectors straight to connect or disconnect them. Holding them at an angle will damage the pins of the connectors on the boards or break the connector shells.

Connecting devices

To avoid risk of injury and prevent damage to the hardware:
- Do not connect any high-voltage devices to the I/O connectors of the hardware.
- Do not apply voltages/currents outside the specified ranges to the connector pins.
- Do not connect or disconnect any devices while the dSPACE HIL simulator is powered up and/or external devices are switched on. Make sure that the host PC, dSPACE HIL simulator and external devices are turned off beforehand.

Related topics

Basics

Environmental Conditions for the Simulator........................ 25
General Safety Precautions for Working with the Simulator........................ 19

Before You Start

Where to go from here

Information in this section

Installation and Configuration Overview

Installation Overview

⚠ WARNING

Read the instructions carefully before starting installation. Consider all warnings given.

Installing dSPACE Simulator Mid-Size Based on DS2211 requires the following steps in the given order.

1. Before starting installation, check whether the host PC meets the requirements of dSPACE Simulator Mid-Size Based on DS2211, refer to Checking the System Requirements on page 31.
2. Wire the cable harness for your ECU, refer to Signal Overview on page 37 and Connecting the ECU on page 43.
3. Install loads into the simulator for the ECU outputs, refer to Installing Loads on page 51.
4. If necessary, install additional signal conditioning, refer to Additional Signal Conditioning on page 61.
5. Connect the simulator to your host PC, refer to Connecting the Simulator to the Host PC on page 63.

6. Then you can install the software, refer to Installing dSPACE Software 📖.

Tip

- After you install the software, you can use dSPACE's online help provided by *dSPACE Help*.
- For detailed reference information on the hardware of your system as well as for troubleshooting information, refer to Pinouts on page 121, Data Sheets on page 183, or Troubleshooting on page 193.

Installation problems

Tip

If you encounter any problems during installation and configuration:

- Check the documentation again.
- Contact dSPACE support using the dSPACE Installation Manager. It is available:
  - On your dSPACE DVD at `\Tools\InstallationManager.exe`
  - Via Start – Programs – dSPACE Installation Manager (after installation of the dSPACE software)
  - At http://www.dspace.com/go/im
    You can always find the latest version of the dSPACE Installation Manager here.

Uninstallation

For information on how to uninstall your software and hardware, refer to Uninstalling the System on page 117.

Tip

For detailed reference information on the hardware of your system as well as for troubleshooting information, refer to Pinouts on page 121, Data Sheets on page 183, or Troubleshooting on page 193.

Configuration overview

After you install your dSPACE Simulator Mid-Size Based on DS2211, you can configure it according to the following steps:

1. The processor board has to be registered in ControlDesk.
2. After you install and configure your system, you are ready to implement a model – either via a Simulink model including blocks from dSPACE’s Real-Time Interface (RTI) or via a handcoded algorithm – and download the corresponding application to your real-time hardware. ControlDesk can be used to experiment with your real-time application.

For detailed instructions on your first work steps, refer to DS100x, DS110x, MicroAutoBox II, MicroLabBox – Software Getting Started 📖.

Related topics

Basics

Checking the System Requirements

Introduction

Before installing dSPACE's hardware, you have to check whether your hardware meets the system requirements.

Host PC

Your host PC must fulfill the system requirements concerning:

- The dSPACE software and other required third-party software,
- The hardware equipment.

  Your PC must fulfill the requirements for the hardware which is needed for connecting the host PC and the simulator. This connection has to be established via a bus interface.

For details, refer to Appendix (Installing dSPACE Software 📖).

Resources of dSPACE boards

The resources in the host PC and in the simulator (= expansion box) needed by your dSPACE boards depend on your installation, refer to Appendix: Resource Requirements of dSPACE Boards on page 74.

CompactFlash card for DS1006

The DS1006 provides a slot for a CompactFlash card to be used as an application flash memory. This card is not included in the shipment. It is recommended to use a CompactFlash card prepared by dSPACE (SanDisk SDCFB-128-101-00 with special shield applied and preformatted), which fulfills all EMC specifications.

If you use your own CompactFlash card, note the following points:

- A SanDisk SDCFB-128-101-00 CompactFlash card is recommended.
- The CompactFlash card must be DOS-formatted (FAT16) before use.

Environmental conditions

The DS1006-based modular system may be used only in specific ambient conditions.

- The DS1006 is designed only for laboratory use.
- Due to the weight of the heat sink the processor requires, the DS1006 cannot be used in a vehicle or other environments causing mechanical shocks or vibration.
- Ambient temperature range 0 … 40 °C (32 … 104 °F).

dSPACE Releases dSPACE Release 4.1 or later supports the DS1006 Processor Board.

Configuring the Simulator

Where to go from here

Information in this section

Information in other sections

Basics of Configuring the Simulator

Where to go from here

Information in this section

Safety Precautions for Configuring the Simulator

Introduction

Read the following notes carefully before you configure your simulator.

General

- Only qualified technicians are allowed to configure the simulator.
- Disconnect the power connector before opening the enclosure. Wait several minutes to allow discharge of all components. Some of the components, for example, power supply capacitors, may carry residual voltage.
- Make sure that you and all material the boards comes in contact with are properly grounded.
- Always use approved wiring material with an adequate cross-sectional areas for external cable harness on ECU and load card connectors.
- The ECU outputs are directly connected to the front panels of the load cards. Voltages higher than 60 V may therefore be present at the front panels. The connectors of the front panels are screwable and thus not shockproofed.
- Do not exceed the maximum ranges of the channels's voltages and currents. For information on the maximum ranges, refer to Pinouts on page 121.

Load Cards, Load/FIU Unit, ECU Connector

The current limits stated are valid for an ambient temperature of 20 °C. To avoid irreparable damage to the hardware caused by overheating, for example, the maximum permitted currents must not be exceeded. All currents are stated in RMS.

DS790 Load Card

The technical details of the DS790 Load Card front connector:

- The actuator channels are fused by two parallel-wired polyswitch fuses 3.75 A, 60 V. The maximum current of one channel is 6 A. The fuses protects the channels of the simulator only and do not protect the devices connected to the simulator.
- The high rails (VBATx, VSWxy) and ground are not fused. The maximum current of one high rail or ground is 8 A.
- The ground is not fused. The maximum current of ground is 8 A.
- The load sockets on the load card are intended for installation of low-power resistive, inductive, or capacitive axial leaded loads, or a mixture of these types.
- The maximum power dissipation per channel is 2 W.
- There should be at least 15 mm space between the heat emitting body of the load and the connector housing.

Load/FIU unit

The following values are valid for the Load/FIU unit containing five DS790 Load Cards:

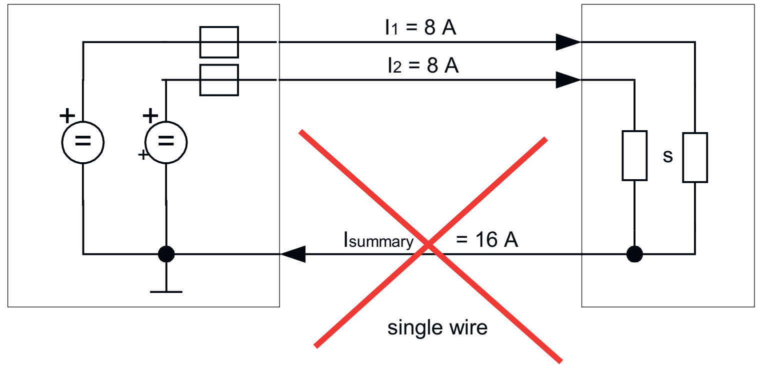
- The high rails (VBATx, VSWxy) are not fused. The maximum current of one high rail is 16 A.
- The ground (GND) is not fused. The maximum current of GND is 40 A.
- The maximum power dissipation per Load/FIU unit is 50 W.

ECU connectors

The technical details of the ECU connectors:

- The high rails of power supply 1 (VBAT1a, VBAT1b, VSW1ya, VSW1yb) are fused by polyswitch fuses 8 A, 30 V. The maximum current of a high rail pin is 8 A.
- The high rails of power supply 2 (VBAT2a, VSW2ya) are fused by two parallel-wired polyswitch fuses 3.75 A, 60 V. The maximum current of a high rail pin is 6 A.
- The ground (GND) is not fused.
  - On the ECU 1 connector, the maximum current of a GND pin is 8 A.
  - On the ECU 2 and ECU 3 connectors, GND is intended for shielding purposes only and must not be connected to any ECU power ground. If sensor ground is connected to power ground, GND must not be connected to sensor ground.

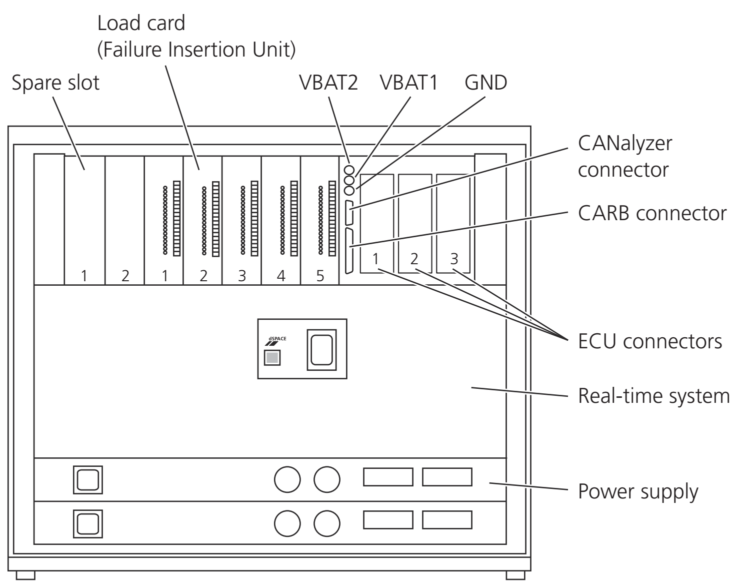
Due to the current limit, the following external wiring must be avoided.



Electromagnetic compatibility It is recommended to connect the housing of the ECU connectors to GND for electromagnetic compatibility.

Simulator Front

Simulator front Before you can use the simulator you have to adapt it to your ECU. The ECU is connected to three connectors on the front of the simulator. The following illustration shows the front of the simulator.



Signal Overview

Signal overview

The following table gives an overview of all the simulator signals provided by a DS2211. For more information on the signals, refer to DS2211 HIL I/O Board (dSPACE Simulator Mid-Size Based on DS2211 Features 📖). Keep in mind that the naming of the signals is viewed from the simulator side, for example, DIGOUTs are the simulator's digital outputs and therefore the digital inputs for the ECU.

Signal	Name	Notes	
Analog digital converter	ADC	Connected to FIU/load card:	Yes (ADC13: no)
		ECU connector:	1 (for all ADCxx, except ADC13: 2) 3 (for all $\overline{\text{ADCxx}}$ reference pins, except $\overline{\text{ADC13}}$: 2)
		Described in:	*ADC Unit*
		Remarks:	ADC15 and ADC16 are reserved for power supply 1. ADC13 and ADC14 are reserved for power supply 2. If it is not used, ADC13 can be used as an ordinary ADC channel. Reference pins $\overline{\text{ADC1}}$ … $\overline{\text{ADC13}}$ can be connected internally to battery ground (GND)
Digital analog converter	DAC	Connected to FIU/load card:	No
		ECU connector:	2 (DAC1 … DAC11) 3 (DAC13 … DAC20)
		Described in:	*DAC Unit*
		Remarks:	DAC12 is reserved for power supply 1. DAC11 is reserved for power supply 2. If it is not used, DAC11 can be used as an ordinary DAC channel. Reference pins $\overline{\text{DAC1}}$ … $\overline{\text{DAC20}}$ (except DAC12) can be switched internally to sensor ground (SGND).
Digital analog converter (of the DS2211's slave DSP)	DSP_DAC	Connected to FIU/load card:	No
		ECU connector:	3
		Described in:	*DSP DAC Unit*
		Remarks:	
Digital resistance converter	RES	Connected to FIU/load card:	No
		ECU connector:	2 (RES1 … RES6) 3 (RES7 … RES10)
		Described in:	*D/R Converter*
		Remarks:	Pins RES1- … RES10- can be switched internally to sensor ground (SGND).

Signal	Name	Notes	
Digital input	DIGIN	Connected to FIU/load card:	Yes
		ECU connector:	1
		Described in:	*Bit I/O Unit*
		Remarks:	
Digital output	DIGOUT	Connected to FIU/load card:	No
		ECU connector:	2
		Described in:	*Bit I/O Unit*
		Remarks:	
PWM measurement	PWMIN	Connected to FIU/load card:	Yes
		ECU connector:	1
		Described in:	*PWM Signal Measurement*
		Remarks:	
PWM generation	PWMOUT	Connected to FIU/load card:	No
		ECU connector:	2
		Described in:	*PWM Signal Generation*
		Remarks:	
Serial interface	RXD, TXD	Connected to FIU/load card:	No
		ECU connector:	2
		Described in:	*Serial Interface*
		Remarks:	
Crankshaft signal	CRANK, DIGCRANK	Connected to FIU/load card:	No
		ECU connector:	2
		Described in:	*Crankshaft Sensor Signal Generation*
		Remarks:	
Camshaft signal	CAM DIGCAM	Connected to FIU/load card:	No
		ECU connector:	2
		Described in:	*Camshaft Sensor Signal Generation*
		Remarks:	
Ignition capturing	IGN	Connected to FIU/load card:	Yes
		ECU connector:	1
		Described in:	*Spark Event Capture*
		Remarks:	
Injection capturing	INJ	Connected to FIU/load card:	Yes
		ECU connector:	1
		Described in:	*Injection Pulse Position and Fuel Amount Measurement*
		Remarks:	

Signal	Name	Notes	
Knock sensor	WAVE	Connected to FIU/load card:	No
		ECU connector:	2
		Described in:	*Knock Sensor Simulation*
		Remarks:	Wheel speed sensor simulation and knock sensor simulation cannot be used at the same time.
Wheel speed sensor	WAVE	Connected to FIU/load card:	No
		ECU connector:	2
		Described in:	*Wheel Speed Sensor Simulation*
		Remarks:	Wheel speed sensor simulation and knock sensor simulation cannot be used at the same time.
CAN bus	CAN	Connected to FIU/load card:	No
		ECU connector:	2
		Described in:	*CAN Support*
		Remarks:	
Diagnostic interface	CARB	Connected to FIU/load card:	No
		ECU connector:	1
		Described in:	*Diagnostics*
		Remarks:	The CARB pins of the ECU 2 connector are connected internally to the CARB connector.
Power supply	VBATx, VSWx, SWRELx	Connected to FIU/load card:	No
		ECU connector:	1, 2, 3
		Described in:	*Power Supply Unit*
		Remarks:	
Ground	GND	Connected to FIU/load card:	No
		ECU connector:	1
		Described in:	*Power Supply Unit* and Signal Reference Overview on page 41
		Remarks:	GND of ECU 2 and ECU 3 is only for shielding.
Sensor ground	SGND	Connected to FIU/load card:	No
		ECU connectors:	2, 3
		Described in:	See Signal Reference Overview on page 41
		Remarks:	

Reference pin

Some signals are measured or generated as the voltage difference between two pins, the signal pin and its reference pin. Together, these forms a single channel. The reference pin is marked with an overline, for example, $\overline{\text{ADC3}}$.

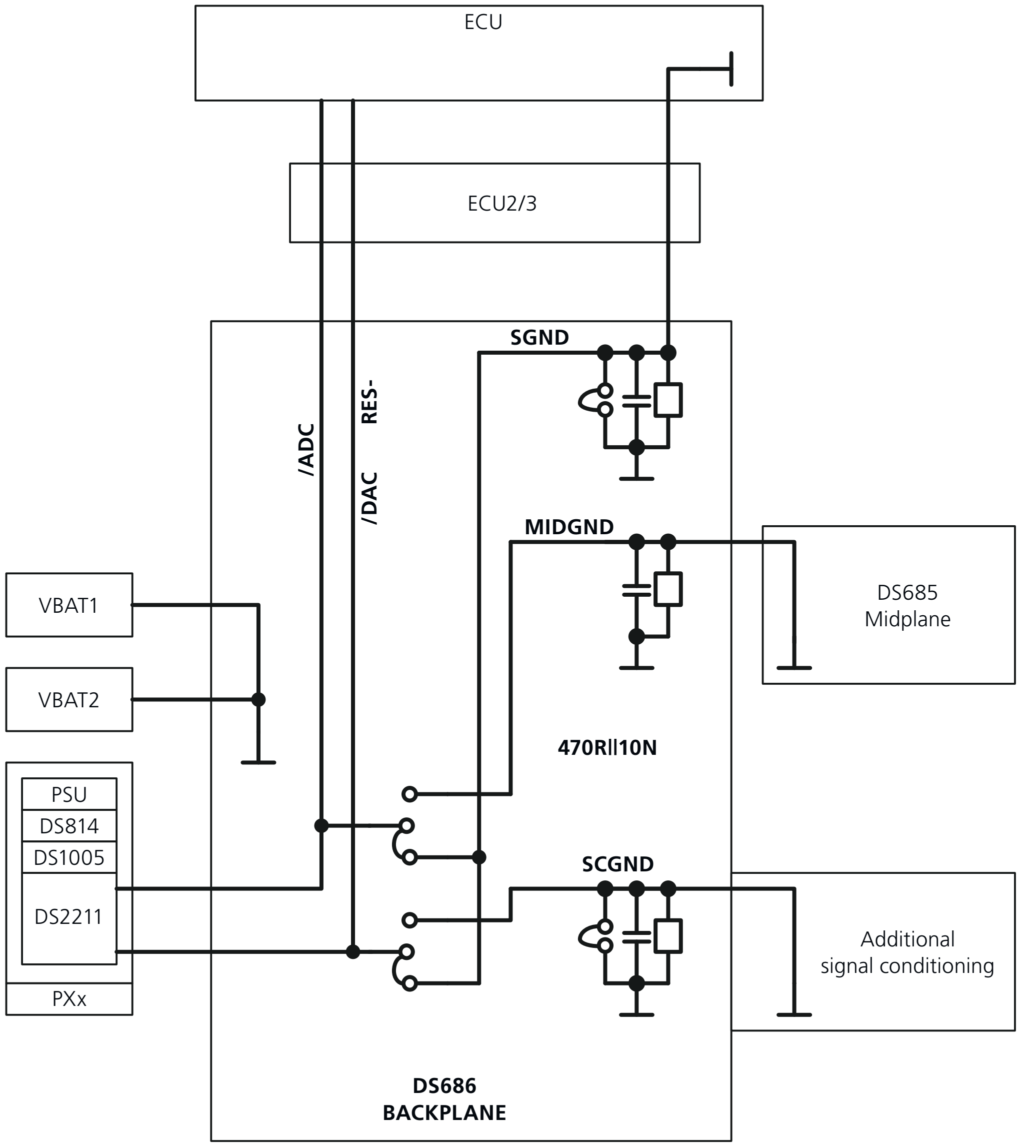
Related topics

References

Signal Reference Overview

Signal references

There are several ground potentials inside the simulator. The following illustration gives an overview of the different ground potentials.



Ground potentials

The simulator has four different ground potentials.

GND GND is the ground of the power supplies. If a simulator has two power supplies, their grounds are connected. The ground is connected to the DS686 Backplane.

SGND SGND is a common ECU reference ground. SGND is provided at the ECU connector. Using a SGND as the reference ground reduces the number of wires to the ECU. SGND is connected to GND via an R-C network (see illustration above). The R-C network can be bypassed via a jumper. Refer to Connectors, Switches and Jumpers in the Load/FIU Unit on page 144.

MIDGND MIDGND is the ground potential of the DS685 Midplane. MIDGND is connected to GND via an R-C network (see illustration above).

SCGND SCGND is the ground potential for the additional signal conditioning of the spare slot. SCGND is connected to GND via an R-C network (see illustration above). The R-C network can be bypassed via a jumper. Refer to Connectors, Switches and Jumpers in the Load/FIU Unit on page 144.

References for ECU signals

You can select the reference for a signal via jumper. Refer to Reference Signal Jumpers on page 153.

Connecting the ECU

Introduction

The simulator has 3 ECU connectors on the front to connect the ECU or the breakout box. All simulator outputs (ECU inputs) are connected to the ECU 2 and ECU 3 connectors, and all simulator inputs (ECU outputs) are connected to the ECU 1 connector via the Failure Insertion Units and load cards.

Where to go from here

Information in this section

Information in other sections

Connecting to the Battery Voltage

Power Supply

dSPACE Simulator Mid-Size based on the DS2211 has either one or two power supplies. Each power supply is connected to a high rail system with four high rails. Three of them can be switched by the ECU or the real-time application. Switching by the ECU can simulate an external, ECU-controlled relay. Switching by the simulator can be used to simulate the different states for switched battery voltages, for example, ignition key on. For further information, refer to Power Supply Unit (dSPACE Simulator Mid-Size Based on DS2211 Features 🕮). The following signals are available at the ECU 1 connector for the power supply:

Signal	Description
VBATx	Direct battery rail output[1)]
VSWxy	Switched high rail output[1), 2)]
GND	Ground
SWRELxy+	Controls switched high rail, positive port[1), 2)]
SWRELxy-	Controls switched high rail, negative port[1), 2)]

1) x: Number of the power supply, x = 1, 2
2) y: Number of the switched high rail, y = 1 … 3

For examples of how to connect the control lines, see

- How to Control a High Rail via the ECU on page 46
- How to Control a High Rail via the Simulator on page 47

Related topics

References

Connecting to Sensor Signals

Sensor signals (simulator outputs)

The simulator outputs provide the sensor signals for the ECU. They are connected to the ECU 2 and ECU 3 connectors. If the ECU has a sensor ground, connect it to pin B2 of the ECU 2 connector and pin B2 of the ECU 3 connector. To reduce the cabling, the pins for signals $\overline{\text{DAC1}}$ … $\overline{\text{DAC20}}$ and RES1- … RES10- can be switched to the ECU sensor ground internally by DIP switches, see How to Set the Reference Potential for Signals on page 49. For an overview of the signals, refer to Signal Overview on page 37.

Related topics

Basics

References

Connecting to Actuator Signals

Actuators (simulator inputs)

The ECU outputs for the actuator have to be connected to the simulator inputs. The simulator inputs are connected to the ECU 1 connector via the load cards and FIUs. This means loads can be connected to the ECU outputs and failures can be simulated. The installation of the loads is described in Installing Loads on page 51. For an overview of the signals, refer to Signal Overview on page 37.

Related topics

Basics

References

Connecting Communication Channels

Communication

You can connect the ECU to the CAN bus or the serial interface of the DS2211. Both bus connections are available at the ECU 2 connector. Additionally, the CAN bus is available via the CANalyzer connector.

Related topics

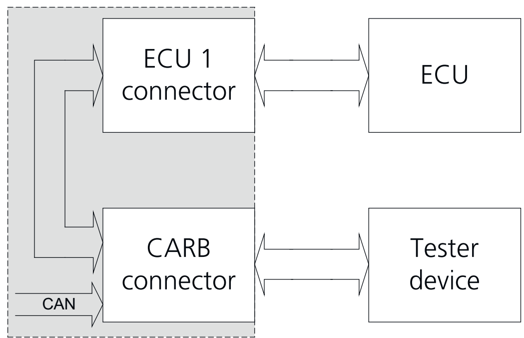
References

Connecting a Tester Device

Tester device

To connect a tester device to the ECU, the simulator has a CARB (California Air Resources Board) Sub-D connector and a CANalyzer connector on the front.

The pins of the CARB connector are directly connected to the CARB pins of the ECU 1 connector and the CAN bus. Thus, signals of the ECU pins are available at the CARB connector if they are connected to the CARB pins.



The pins of the CANalyzer connector are directly connected to the CAN bus of the DS2211. The VBat jacks on the simulator's front can be used as the power input voltage for the tester device.

Related topics

References

CANalyzer Connector Pinout.......... 138
CARB Connector Pinout.......... 136
ECU 1 Connector Pinout.......... 124

How to Control a High Rail via the ECU

Introduction

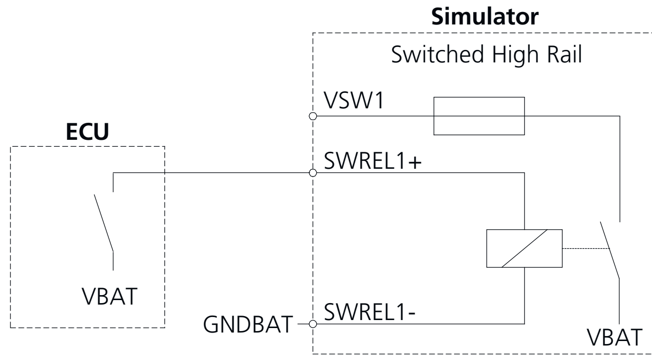
As the control lines for controlling the high rails are differential inputs, the ECU can control the high rails by switching to battery voltage or to ground.

Method 1

To control a high rail with an ECU switching the battery voltage

1 Connect the ECU control line to the SWRELxy+ pin.

2 Connect the SWRELxy- pin to GND (for example, by bridge within the connector), see the following illustration.

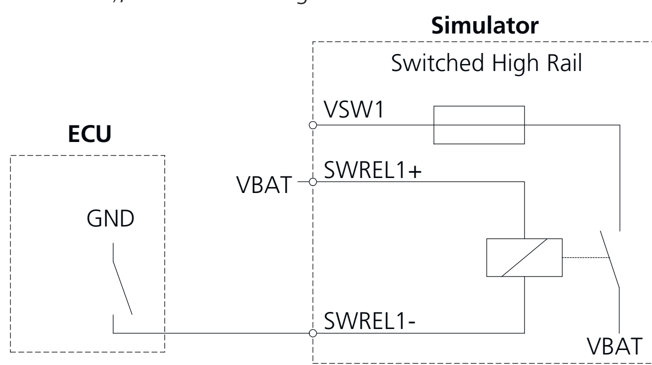


Method 2

To control a high rail with an ECU switching the ground

1 Connect the ECU control line to the SWRELx- pin.

2 Connect the SWRELx+ pin to VBAT (for example, by bridge within the connector), see the following illustration.



Related topics

HowTos

How to Control a High Rail via the Simulator

Introduction

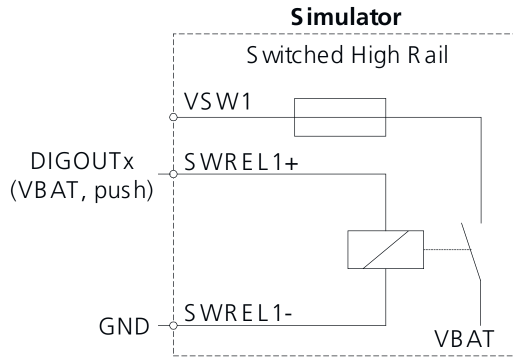
If you want to control a high rail by the model, you must use a digital simulator output. The high rail can be switched with the battery voltage or ground.

Switching the ground is useful for tests where the battery voltage is lower than the normal operating voltage range (< 9 V).

Method 1

To control a high rail via the simulator by switching the battery voltage

1. Connect the SWRELxy+ pin to a digital simulator output DIGOUTx (for example, by bridge between the connectors inside the cable harness).
2. Connect the SWRELxy- pin to GND (for example, by bridge between the connectors inside the cable harness), see the following illustration.

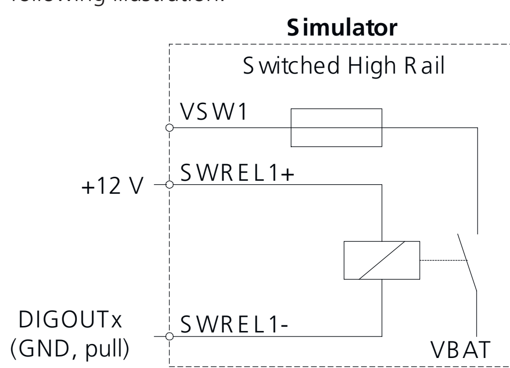


3. In the Simulink model, use the DIGOUTx signal to control the high rail.

Method 2

To control a high rail via the simulator by switching the ground

1. Connect the SWRELxy– pin to a digital simulator output DIGOUTx (for example, by bridge between the connectors inside the cable harness).
2. Connect the SWRELxy+ pin to +12 V (pin E16 at ECU 1 connector), see the following illustration.



3. In the Simulink model, use the DIGOUTx signal to control the high rail.

Related topics

HowTos

How to Control a High Rail via the ECU... 46

How to Configure the Standard Simulator for Failure Simulation of ECU Inputs

Objective

The ECU 1 connector is the connector for the ECU outputs. It is connected to the failure insertion unit (FIU) for failure simulation.

The ECU 2 and ECU 3 connectors are for ECU inputs. The standard version of dSPACE Simulator Mid-Size is not connected to an FIU. However, you can configure the standard simulator for failure simulation of an ECU input.

Preconditions

One channel of the FIU must be unused.

Method

To configure the standard simulator for failure simulation of ECU inputs

1. Disconnect the simulator from the supply network and host PC.
2. Open the rear cover of the simulator to access the backplane of the Load/FIU unit.
3. Disconnect the selected ECU 1 connector pin from the DS2211 by removing the corresponding load disconnect jumper on the backplane. Refer to Input Disconnect Jumpers on page 152.
4. On the simulator's front, connect the ECU input to a pin of the simulator input (ECU 1 connector) that has an FIU. Refer to ECU 1 Connector Pinout on page 124.
5. On the simulator's front, connect the external load pin that corresponds to the selected ECU 1 connector to the ECU 2 or ECU 3 connector. Refer to Load Card/FIU Pinout on page 147 and Connectors on the Front on page 122.

Result

The simulator is prepared for failure simulation of the ECU input.

Related topics

Basics

Failure Simulation for ECU Inputs (dSPACE Simulator Mid-Size Based on DS2211 Features 🕮)

How to Set the Reference Potential for Signals

Objective

The differential simulator outputs $\overline{\text{DAC1}}$ … $\overline{\text{DAC20}}$, $\overline{\text{ADC1}}$ … $\overline{\text{ADC13}}$, and RES1- … RES10- can be switched to sensor ground (SGND). This avoids excessive cabling when all outputs need to be connected to the sensor ground, which is then available at a single pin.

Reference signal jumper

The differential outputs are connected to the sensor ground via the reference signal jumper. They are located on the rear of the Load/FIU backplane, see Reference Signal Jumpers on page 153.

Method

To set the reference potential for signals

1 Disconnect the simulator from the supply network and host PC.
2 Open the rear cover of the simulator.
3 Set the jumper of the reference signal:
   - Left position for connection to SGND
   - Right position for connection to SCGND
   - Open for connection to the ECU

Result

The reference potential for the signal is set.

Installing Loads

Introduction

You can install loads for the simulator inputs on the load cards inside the simulator or connect them to the front panel.

Where to go from here

Information in this section

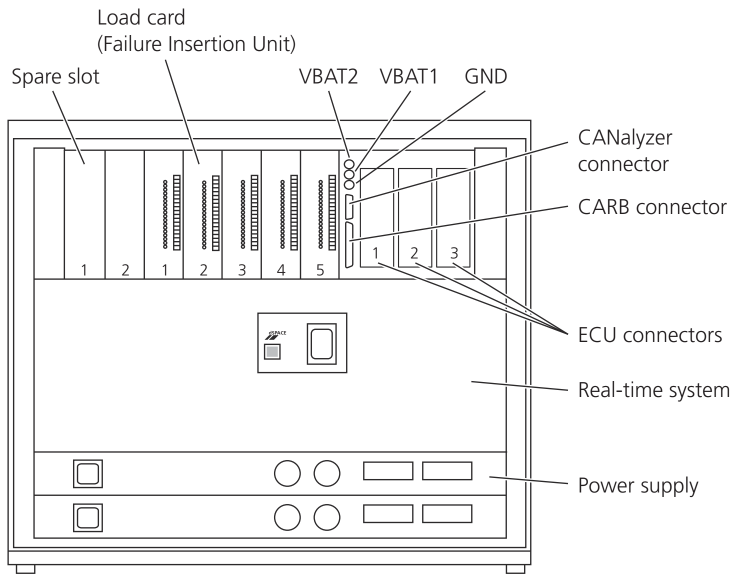
Load Cards and Failure Insertion Units

Introduction

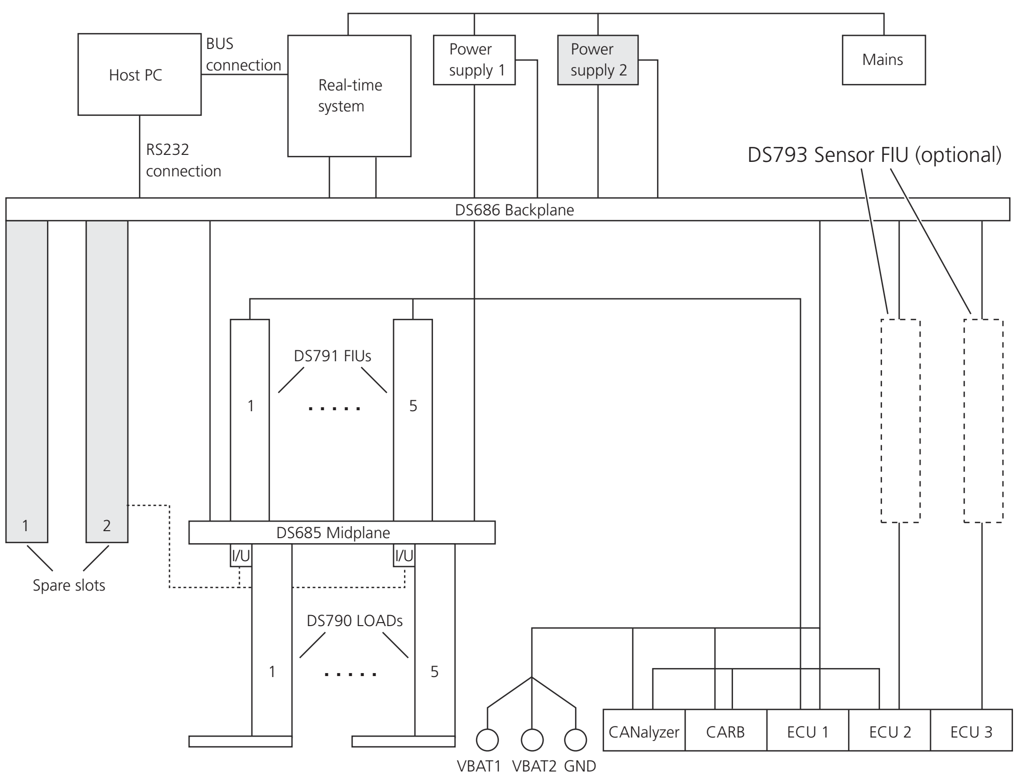
The simulator has load cards to simulate currents of actuators and failure insertion units (FIUs) to simulate failures in the wiring to actuators.

Simulator overview

The following illustration shows an overview of the simulator.



The following illustration gives you an overview of the internal architecture of the simulator.



ECU 1 connector

The ECU 1 connector comprises the pins for the ECU outputs. The pins of the ECU 1 connector are connected to the FIU inside the simulator via a midplane. For information on the assignments of the ECU 1 connector pins to the board and channels of the FIU, refer to Load Card/FIU Pinout on page 147.

Failure Insertion Unit

The Failure Insertion Units are used to simulate failures in the wiring of the ECU outputs, for example, a short to ground. The FIUs are directly connected to the load cards by the midplane.

Midplane

The midplane connects the Failure Insertion Units and the load cards. It connects the ECU outputs to the backplane via the load cards. Additionally, it contains connectors for current measurement (see Architecture of the Simulator on page 16).

Load card

The load cards are the cards that the loads are connected to. The loads are mounted on the load sockets or plugged into the load card’s front panel. The load cards are directly connected to the midplane.

External load connectors

The real loads are usually connected to the external load connectors. The external load connectors and the status LEDs are on the front panel of dSPACE Simulator Mid-Size. The front panel is shown in How to Install Loads on page 55.

Backplane to DS2211

The backplane to the DS2211 is fitted with the connectors of the load/FIU unit to the real-time system and the host PC. For further information, refer to Connectors, Switches and Jumpers in the Load/FIU Unit on page 144.

Related topics

References

ECU 1 Connector Pinout.. 124

Basics on Loads

Load cards

dSPACE Simulator Mid-Size is equipped with five load cards. Each load card has 10 channels that are connected to the ECU 1 connector (see Load Card/FIU Pinout on page 147). This means you can connect loads to your ECU outputs to obtain the current that prevents the ECU's open load detection. Depending on the required authenticity of the electrical ECU environment, substitute loads or real loads can be used with a single-ended or double-ended connection to your ECU outputs.

Substitute load

Resistive or inductive loads can be used as substitute loads. Except for current-controlled ECU outputs, it is sufficient to work with only the levels of current that are necessary to prevent the ECU's open load detection. Substitute loads are directly mounted on the load cards.

Real load

If you cannot replace a real load by a substitute load, you can use the real load itself. Real loads can be connected via the front panels of the load cards. If they are small enough, they can be installed in the simulator's spare slot. For more information on the spare slot, refer to Additional Signal Conditioning on page 61.

Single-ended load

Only one junction of a load is connected to a load channel. The other junction is connected to ground, the battery high rail or one of the switchable high rails.

Double-ended load

Both junctions of a load are connected to load channels. Double-ended loads are used, for example, by a circuit of a current-controlled solenoid or a stepper motor.

Related topics

Basics

Safety Precautions When Using Inductive Loads.......... 54

References

Load Card/FIU Pinout.......... 147

Safety Precautions When Using Inductive Loads

Introduction

If the loads installed or connected to your system are inductive and you want to simulate eletrical errors in their wiring, you must protect the dSPACE hardware from induced high voltages.

Basics on inductors

Inductors (inductive loads) store energy in a magnetic field. The energy W stored in the load depends on the inductance L and the current i that flows through the inductor:

$$W = \frac{1}{2} \cdot L \cdot i^2$$

If the current i is suddenly reduced, for example, by opening the circuit, the energy stored in the load will induce high voltage u according to the following formula:

$$u = L \cdot \frac{di}{dt}$$

The induced high voltage can damage the connected hardware.

Inductors and electrical error simulation

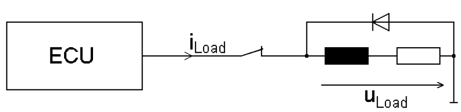
When you simulate electrical faults in the wiring, the error potentials are switched by relays. If an inductor is connected to your system, you must take precautionary measures to prevent the connected hardware from being damaged due to induced high voltage. You are recommended to use a freewheeling diode to avoid induced high voltage.

NOTICE

Overvoltage pulses in relays can cause electric arcs at the contacts of the relays. The electric arcs can weld the relays' contacts, which causes the contacts to be permanently short-circuited. A permanent short circuit can damage the hardware due to overheating.

Freewheeling diode

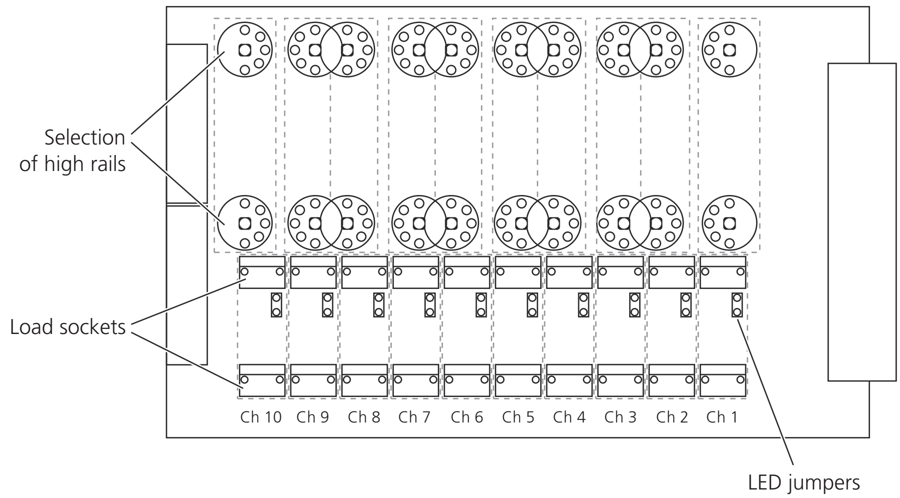
A freewheeling diode can avoid induced high voltage. It provides a discharge current path for the energy stored in a load. It allows the energy to dissipate slowly, rather than appearing as a voltage spike as it dissipates instantaneously. The following illustration shows an inductive load with a connected freewheeling diode.



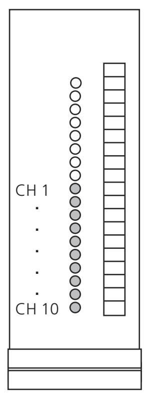
How to Install Loads

Objective

Loads are installed on the load cards inside the simulator or plugged to the panel on the front of the simulator. Inside the simulator there are load sockets that the loads can be connected to. One load socket connects the load to the ECU channel, the other load socket connects the load to a high rail or to the adjacent channel (for double-ended loads).



The following illustration shows the front panel of a load card.



Determining the load value

Determine the required load value and select a suitable resistor or inductive load. Note that:

- The currents of the signals and high rails are limited (all values are stated in RMS):
  - Each signal of a load card has a maximum current of 6 A.
  - Each high rail (VBATx, VSWxy) and GND of a load card has a maximum current of 8 A.
  - The high rail (VBAT1, VBAT2, VSW1y) of one Load/FIU unit has a maximum current of 16 A.
  - The switched high rail of power supply 2 (VSW2y) of one Load/FIU unit has a maximum current of 8 A.
  - The GND line of one Load/FIU unit has a maximum current of 40 A.

Note

There is usually more than one load connected to a high rail or GND. Ensure that the total current of the connected load does not exceed the maximum current allowed on the load card and Load/FIU unit.

- The maximum continuous power dissipation for one load is 2 W.
- The maximum continuous power dissipation for a Load/FIU unit is 50 W.
- The minimum current is the current level that prevents the ECU's open load detection.
- The highest load possible should be selected to reduce power dissipation.

Preconditions

- Read the safety precautions. Refer to Basics of Configuring the Simulator on page 34.
- If you install inductive loads, observe the safety precautions for using them. Refer to Safety Precautions When Using Inductive Loads on page 54.
- Ensure that the simulator is switched off and disconnected from the power network.
- Determine the load value which you want to install on the ECU output (see above).

⚠ WARNING

High voltage at the front panels of the load card

The ECU outputs are directly connected to the front panels of the load cards. Voltages higher than 60 V may therefore be connected to the front panels, which are screwable and thus not shockproofed.

Possible methods

The installation procedure depends on the load:

- If you want to install a single-ended load on the load socket inside the simulator (a substitute load), refer to Method 1 on page 57.
- If you want to install a double-ended load on the load socket inside the simulator (a substitute load), refer to Method 2 on page 58.
- If you want to install a single-ended load on the front panel, for example, a real load, refer to Method 3 on page 59.
- If you want to install a double-ended load on the front, for example, a real load, refer to Method 4 on page 59.

Method 1

To install a single-ended load on the load socket

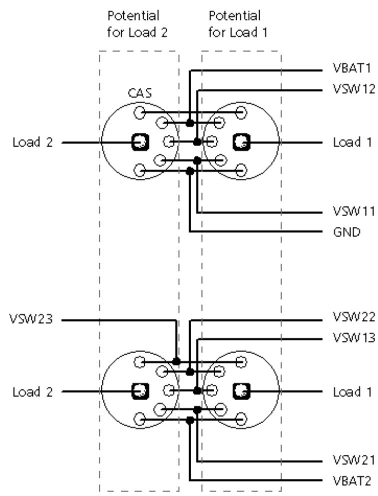
1. Choose the load card and the channel that is connected to the ECU output. For the assignment of the ECU outputs and load channels, refer to Load Card/FIU Pinout on page 147.
2. Remove the selected load card from the simulator.

3 On the rotation switches, plug a bridge beween the load pin and the pin for the potential you want to connect the load to.

Note

Use only one bridge. Inserting bridges at two potentials at the same time generates a short circuit between them.

See the following illustration (the dashed line frames the potential selection for one channel).



4 Connect the load to the load socket of the selected channel.

5 Insert the load card into the simulator.

Result

The single-ended load is installed.

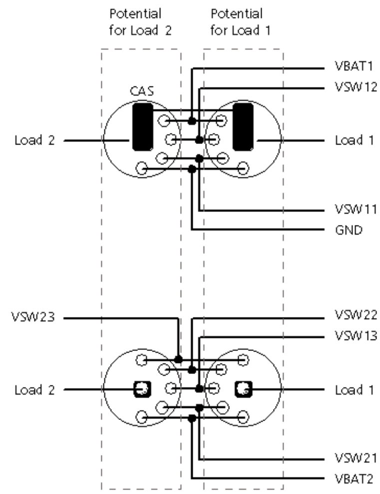
Method 2

To install a double-ended load on the load socket

1 Choose the load card and two channels that are connected to the ECU output. For a double-ended load, you need two adjacent channels (Ch 1 – Ch 2, Ch 3 – Ch 4, …, Ch 9 – Ch 10). For the assignment of the ECU outputs and load channels, refer to Load Card/FIU Pinout on page 147.

2 Remove the selected load card from the simulator.

3 On the rotation switches, plug a bridge beween the load pin and the CAS pins for both channels. See the following illustration.



4 Connect the load to the load socket of one of the selected channels.

5 Connect a second load or a bridge to the load socket of the other selected channel.

6 Insert the load card into the simulator.

Result

The double-ended load is installed.

Method 3

To install a single-ended load on the front panel

1 Choose the load card and channel that is connected to the ECU output. For the assignment of the ECU outputs and load channels, refer to Load Card/FIU Pinout on page 147.

2 Plug a pin of the load to the connector on the front of the selected load card and channel.

3 Plug the other pin of the load to a connector for a high rail or ground.

Result

The single-ended load is installed.

Method 4

To install a double-ended load on the front panel

1 Choose the load card and two channels that are connected to the ECU output. For the assignment of the ECU outputs and load channels, refer to Load Card/FIU Pinout on page 147.

2 Plug the pins of the load to the connectors on the front of the selected load card and channels.

Result

The double-ended load is installed.

Related topics

Basics

HowTos

How to Label Load Cards

Objective

You can label the load cards at the front plate. In your dSPACE installation is a PDF file which you can use as template. The template has editable fields for each signal name. The fields have the standard signal names by default. You can replace them by your own signal names.

File location

The name of the file is `dSPACESimulatorMidSizeBasedOnDS2211LoadCardLabels.pdf`. It is installed in `C:\Program Files <x86>\Common Files\dSPACE\Help <ReleaseVersion>\Print`.

Method

To label load cards

1. Open the PDF file in Acrobat Reader: dSPACESimulatorMidSizeBasedOnDS2211LoadCardLabels.pdf
2. Fill in your signal names in the editable fields.
3. From the menu bar, choose File – Save a Copy to save the file under another name.
4. Under File, choose Print.
   The Print dialog opens. The Print dialog lets you specify some options for the print job.
5. Under Print Range, select Pages and enter "2".
6. Under Page Handling - Page Scaling, select "None" to get the correct size.
7. Insert an adhesive foil in your printer and click OK.
8. Cut out the labels for each load card and stick them on the load cards.

Result

The load cards are labeled.

Additional Signal Conditioning

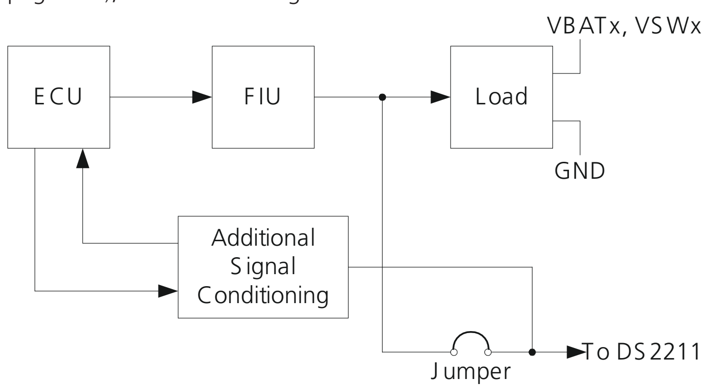
Introduction

You can integrate boards for additional signal conditioning in the simulator. The simulator has two spare slots for this purpose.

Spare Slots

Introduction

dSPACE Simulator Mid-Size is equipped with two spare slots, which can be used for additional signal conditioning (see illustration in Load Cards and Failure Insertion Units on page 51). The load/FIU channels can be disconnected from the DS2211 using the Load disconnect jumper (see Input Disconnect Jumpers on page 152), see the following illustration:



If the jumper of a load/FIU channel is removed, the channel is completely separated from the DS2211, which allows you to use additional signal conditioning for it. Additionally, you can set the ground of the additional signal conditioning as the reference potential for the signals. Refer to Signal Reference Overview on page 41.

Physical size

The length of a board must not exceed 350 mm (13.78"). The board is connected to a connector which is mounted on the backplane. The pinouts of the connector are described in Spare Slot 1 Pinout on page 149 and Spare Slot 2 Pinout on page 151.

Connecting the Simulator to the Host PC

Introduction

A bus interface must be installed in the host PC to connect simulator and host PC.

Where to go from here

Information in this section

Connecting via Bus Interface

Introduction

You have to connect the simulator to your host PC via a bus interface. To do this, you have to install one of dSPACE's link boards (DS815, DS817, DS819, DS821) in your host PC.

Where to go from here

Information in this section

Basics on Connecting the Simulator to the Host PC

Introduction

When the simulator is configured for your ECU, you can connect it to the host PC. For this, a bus interface must be installed in the host PC. The bus interface is responsible for data exchange. To install the bus interface in the host PC, see Connecting via Bus Interface on page 64.

Afterwards you can connect the simulator and the host PC. To connect them, you must switch off the simulator, see

- How to Switch Off a dSPACE System on page 72
- How to Connect the Simulator to the Host PC on page 71
- How to Switch On the dSPACE System on page 72

NOTICE

Before unpacking the board, take the following precautions to avoid damage caused by high electrostatic voltage:

- Before inserting any board, turn off the host PC and disconnect the devices from the power supply.
- Make sure that you and all material the board comes in contact with is properly grounded.
- During storage or handling, place the board on conductive foam or in a protective bag.
- Do not touch the board connectors.
- Do not connect or disconnect any devices while the power supply is switched on.

Note

All boards are installed at your own risk. dSPACE cannot be held liable for damage caused by improper handling.

Link Boards Variants

Overview of alternatives

As a bus interface is used to connect the simulator to the host PC, you currently have the five alternatives listed in the following table. The DS814 Link Board (Box) is installed in the simulator.

Link Boards (PC)	Link Boards (Box)
DS815	DS814
DS817	DS814
DS819	DS814
DS821	DS814

DS814 Link Board (Box)

The DS814 Link Board (Box) is installed in the simulator. It requires a free 16-bit ISA slot in the expansion box.

DS815 Link Board (PC)

The DS815 to be installed in the host PC (usually a notebook) is a PC Card, and requires a free PC card slot in the host PC.

DS817 Link Board (PC)

The DS817 to be installed in the host PC is a PCI interface, and requires a free PCI slot in the host PC.

DS819 Link Board (PC)

The DS819 to be installed in the host PC is a PCI Express x1 interface, and requires a free PCI Express slot (x1 … x32) in the host PC.

DS821 Link Board (PC)

The DS821 to be installed in the host PC (usually a notebook) is available in two variants:

- DS821-54 mm, requires a free ExpressCard/54 slot in the host PC
- DS821-34 mm, requires a free ExpressCard/34 slot or a free ExpressCard/54 slot in the host PC

  To use the DS821-34 mm in an ExpressCard/54 slot, dSPACE highly recommends to improve lateral stability in the notebook slot by using an ExpressCard Kit. Contact dSPACE for further information.

  dSPACE recommends to use the DS821-34 mm only in combination with newer notebooks which provide a free ExpressCard/34 slot. If you use them with older notebooks (for example, which provide only ExpressCard/54 slots), your system might crash when you boot your notebook. To solve this problem, update the BIOS of your notebook.

Limitations With Link Boards

Introduction

The following limitations currently apply for the link boards DS814, DS815, DS817, DS819, and DS821.

Required software

The DS819 and DS821 link boards are supported as of dSPACE Release 5.2.

Number of link boards (PC)

- You can install only up to eight DS817, or DS819 boards in one host PC.
- Windows allows only one DS815. This limitation also applies to DS815 boards which are installed in the host PC via a PCI-to-PC Card adapter.

  If you want to work with more than one simulator or an additional expansion box use the DS817, DS819, DS821.

Other limitations

- The length of the cable between a link board (PC) and a link board (Box) is limited to 10 m (patch cable) and 100 m (fiber-optic cable).
- You cannot connect the dSPACE boards that are currently being offered to the host PC via DS811 and DS812 Link Board.
- The DS815 and DS821 link boards do not support Hot-Plug mode (= installing and uninstalling the boards while the PC is powered).
- After installing a DS815 or DS821, your host PC cannot switch to stand-by mode.

How to Establish the DS817/DS819 <–> DS814 Bus Interface

Objective

The following instructions apply if you want to install a bus connection with the link boards DS817/DS819 and DS814.

Cables

Use only the cables (crossed-over patch cable or fiber-optic cable) which come with the hardware package.

Preconditions

- The system is switched off. For instructions, refer to How to Switch Off a dSPACE System on page 72.
- A link board (DS817 or DS819) is installed in your host PC.
- The DS814 is installed in your simulator.

Possible methods

There are two ways you can establish a bus connection:

- Via crossed-over patch cable. Refer to Method 1.
- Via fiber-optic cable. Refer to Method 2.

Method 1

To establish the bus interface via crossed-over patch cable

1 Connect the DS817 or the DS819 to the DS814.

> **Note**
>
> Do not connect the crossed-over patch cable to an Ethernet LAN or the LAN connectors of a PC or a notebook.

2 Switch on the system. Refer to How to Switch On the dSPACE System on page 72.

Method 2

To establish the bus interface via fiber-optic cable

> ***NOTICE***
>
> **Bending may damage the fiber-optic cable.**
> - Do not bend the fiber-optic cable beyond a radius of less than 40 mm.

1 Remove the protective caps from the connectors of the DS817 or DS819 and DS814.

2 Remove the small protective caps from the plugs.

3 Connect the DS817 or the DS819 to the DS814.

4 Switch on the system. Refer to How to Switch On the dSPACE System on page 72.

Next steps

The dSPACE system is now ready to run real-time applications.

To check the proper installation and the board properties, and to get started with the system, refer to DS100x, DS110x, MicroAutoBox II, MicroLabBox – Software Getting Started 🕮.

Related topics

Basics

Working with the Simulator.. 71

How to Establish the DS815/DS821 <–> DS814 Bus Interface

Objective

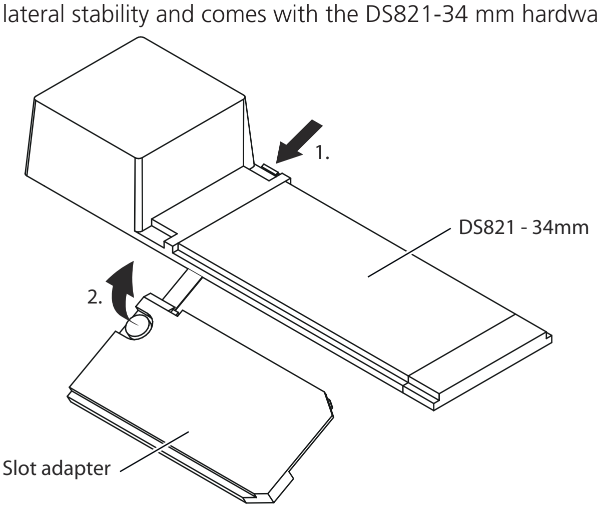
The following instructions apply if you want to install a bus connection with link boards DS815, DS821 and DS814.

Cables

- Use only the cables which come with the hardware package.

Using the DS821-34 mm in an ExpressCard/54 notebook slot

If you use a DS821-34 mm in an ExpressCard/54 notebook slot, dSPACE highly recommends to use a slot adapter (ExpressCard Kit). The slot adapter improves lateral stability and comes with the DS821-34 mm hardware package.



Preconditions

- The system is switched off. For instructions, refer to How to Switch Off a dSPACE System on page 72.
- A DS815 or DS821 is inserted in your host PC.
- A DS814 is installed in your simulator.

Method

To establish the DS815/DS821 <–> DS814 bus interface

1 Attach the connector of the DS815 or DS821 to the DS814 Link Board (Box) with the crossed-over patch cable.

> **Note**
>
> Do not connect the crossed-over patch cable to an Ethernet LAN or the LAN connectors of a PC or a notebook.

2 Switch on the system. Refer to How to Switch On the dSPACE System on page 72.

Result

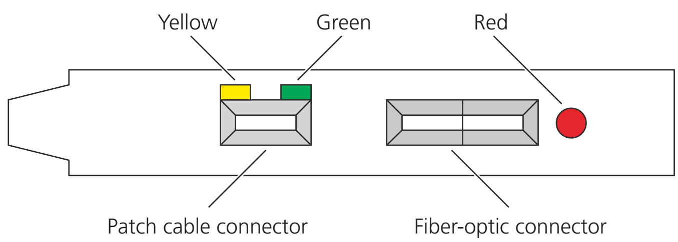
If you use the DS821-34 mm with older notebooks (for example, which provide only ExpressCard/54 slots), your system might crash when you boot your notebook. To solve this problem, update the BIOS of your notebook.

The system is now ready to run real-time applications.

Identifying the Connection Status

DS814, DS817, DS819

Three LEDs on the brackets of the DS814, DS817 and DS819 indicate the current status of the connection.



Yellow LED A lit yellow LED indicates that the connection between the host PC and the simulator is ready for communication.

Red LED A lit red LED indicates that the active connection between the host PC and the simulator uses a fiber-optic cable.

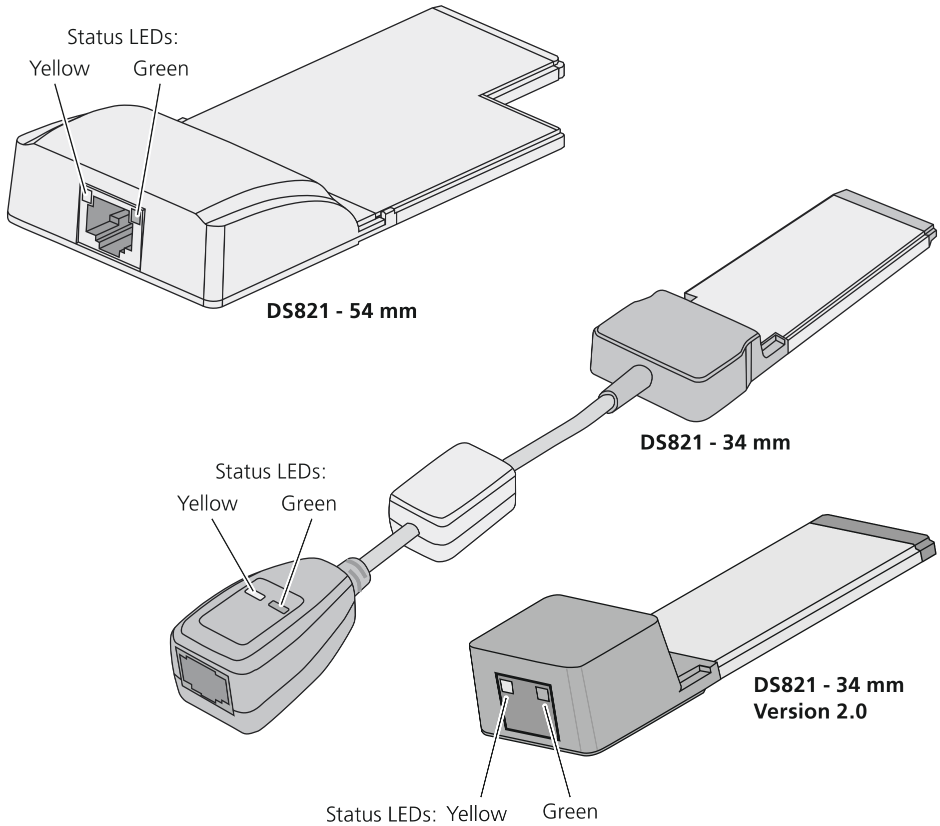
Green LED A lit green LED indicates that data is being sent or received.

DS815

The DS815 is not equipped with optical status indicators.

DS821

Two LEDs indicate the current status of the connection.



Working with the Simulator

Introduction

The following provides some basic information on how to handle the simulator.

Where to go from here

Information in this section

How to Connect the Simulator to the Host PC

Objective

When the simulator and the host PC are configured, you can connect to one another.

Precondition

The dSPACE system is switched off.

Method

To connect the simulator to the host PC

1. Connect the bus interface between the simulator and the host PC. Refer to Connecting via Bus Interface on page 64.
2. Connect a serial cable between the RS232/FIU connector and a COM port of the host PC for the failure simulation.
3. Connect the simulator to the mains.

Turning the simulator on

After you have successfully connected the simulator to your host PC, you should always turn on the simulator before the host PC.

Turning the simulator off

Do not switch off the simulator while the host PC is still running. This might lead to unpredictable errors.

Related topics

HowTos

How to Switch Off a dSPACE System...72

How to Switch Off a dSPACE System

Objective	You must follow the instructions below.
Method	**To switch off a dSPACE system** **1** Turn off all external devices connected to the simulator. **2** Shut down the host PC and turn it off. **Note** Do not switch off the simulator while the host PC is still running. This might lead to unpredictable errors. **3** Turn off the simulator and the power supplys.
Result	The simulator is ready for installing or removing hardware components and connecting or disconnecting devices.

How to Switch On the dSPACE System

Objective	You must follow the instructions below.
Precondition	The connecting/disconnecting of devices is completed.
Method	**To switch on the dSPACE system** **1** Turn on the simulator. **Note** To avoid unpredictable errors, you should always turn on the simulator before the host PC. **2** Turn on the host PC.
Result	The simulator is running and you can work with it.

Setting Up and Installing Further I/O Boards

Introduction

If the real-time system is built in a PX10 expansion box (height of 4 U), you can add further I/O boards. Keep in mind, if you add I/O boards, an additional signal conditioning may be necessary.

Before adding an I/O board into the simulator, check if any of the board's default settings must be changed.

Where to go from here

Information in this section

Appendix: Resource Requirements of dSPACE Boards

Motivation

Depending on the installation, dSPACE boards require resources in the host PC and the expansion box of the simulator.

Where to go from here

Information in this section

Installation in the Host PC

Resources in the host PC

The following table lists the required I/O address range together with the default address and the required memory of dSPACE boards, when installed in the host PC. Some dSPACE boards support plug & play, in which case they require an interrupt request line (IRQ). However, the boards operate correctly even if no free IRQ is available.

Note

The resource requirements listed in this table apply to the host PC.

Board	Required I/O Address Range	Default I/O Base Address	Required Memory Range	Required IRQ
DS817	10H	Plug & play	None	1 (PCI)
DS819	10H	Plug & play	None	1 (PCI Express)
DS821	10H	Plug & play	None	1 (PCI Express)

Installation in the Expansion Box of the Simulator

Resources in the expansion box

When installed in an expansion box, dSPACE boards require the following resources in the expansion box:

Note

The resource requirements listed in this table apply to the expansion box, not to the host PC.

Board	Required Address Bytes	Default I/O Base Address
DS1006 up to board revision DS1006-03	10H	300H
DS1006 as of board revision DS1006-06 (multicore processor board)	40H	300H
DS2302	10H	380H

Resources in the host PC

The resource requirements for the host PC depend on the connection between the host PC and the expansion box:

Connection via DS817, DS819, or DS821 Link Board The Link Boards require the following resources in the host PC:

Required Address Bytes	Default I/O Base Address	Required Memory	IRQ	
10H	Plug & play	None	1	▪ PCI for DS817 ▪ PCI Express for DS819/DS821

Basics on Specific Board Settings

Motivation

The I/O base address (port address) of the DS1006 and the DS2302 (if used) must be changed for several conditions to avoid conflicts with other devices within your system.

Basics on Changing I/O Base Addresses

Motivation

For several conditions you have to change the default I/O base addresses (port addresses) of dSPACE boards. This is to avoid conflicts with other devices within your system.

Notes and hints

Note the following hints on changing the default I/O base address.

NOTICE

Assigning I/O addresses already used by other devices may lead to system failure, data loss on the hard disk, and even hardware damage.

- Refer to your PC's technical reference manual for a description of the standard I/O map and to the documentation of additional I/O boards that might be inserted in the PC.
- Refer also to the lists of resources used in the diagnostic utilities of the PC's operating system. However, these are not always complete.

Note the following hints on changing the default I/O base address of dSPACE boards:

- The I/O address ranges of dSPACE boards in your system must not overlap. If your expansion box is connected via Ethernet, this applies also to the address ranges of the slot CPU.
- Suppose you have connected several expansion boxes to your host PC via one of the link boards (PC) DS815, DS817, DS819 or DS821, or via a MultiLink Panel DS830. If two (or more) of these boxes contain a dSPACE board of the same type, you have to set them to different I/O base addresses to allow the identification in ControlDesk.

Instructions on address changing

For detailed instructions on changing the I/O base address, refer to

- How to Change the I/O Base Address on page 77
- DS2302: How to Change the I/O Base Address on page 91

Setting Up the Processor Board

Checking default factory setting

Before inserting the processor board in the simulator, you have to check if the default factory setting of the I/O base address (port address) must be changed.

How to Change the I/O Base Address

Objective

The I/O base address, meaning the port address, is selected via three rotary switches on the DS1006.

Basics

The I/O base address of dSPACE boards in your system must be unique and the I/O address range must not overlap. This also applies if the members of the system are installed in different expansion boxes.

As of board revision DS1006-06 (multicore processor board), each core of the DS1006 is automatically assigned an individual port address. This address is derived from the processor board's I/O base address, which you have selected via the three rotary switches on the board. For example, if the I/O base address of the DS1006 is 300H, the cores of a quad-core system are assigned the addresses 300H, 310H, 320H, and 330H.

> **Note**
>
> If your expansion box is connected via Ethernet, the I/O base address of the DS1006 must be within the address range 300H ... 330H or 1000H ... FFC0H.

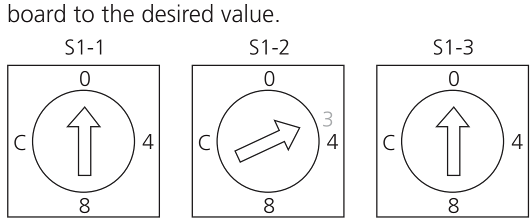
Precondition

The DS1006 is removed to get access to the rotary switches. For detailed instructions, refer to How to Remove Hardware from the Simulator on page 118.

Method

To change the I/O base address

1 Set the three rotary address switches located on the component side of the board to the desired value.



I/O base addresses usable for the DS1006

The following table shows the switch settings for some I/O base addresses for the DS1006.

I/O Base Address (Port Address)	S1-1	S1-2	S1-3
000H[1]	–	–	–
240H[2]	0	2	4
280H[2]	0	2	8
300H (factory default setting)	0	3	0
310H	0	3	1
380H[2]	0	3	8
1000H	1	0	0

[1] The I/O base address 000H is not permissible.

[2] Not permissible if the connection between host PC and expansion box is established via Ethernet.

Related topics

HowTos

DS2302: How to Change the I/O Base Address.. 91

Setting Up I/O Boards

Motivation

For some I/O boards, it is necessary to perform manual settings before inserting the boards into the simulator.

Where to go from here

Information in this section

Information in other sections

Basics on Changing I/O Base Addresses... 76
For several conditions you have to change the default I/O base addresses (port addresses) of dSPACE boards. This is to avoid conflicts with other devices within your system.

Appendix: Resource Requirements of dSPACE Boards.............................. 74

Setting Up the Processor Board.. 77
You have to check if the default factory setting of the I/O base address (port address) must be changed.

Overview of Settings

Required settings

The following table gives an overview of the boards and their required settings:

Board	Manual Settings	For Instructions Refer to ...
DS802	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
DS2001		
DS2002		
DS2003		
DS2101		
DS2102		
DS2103		
DS2201		
DS2202		
DS2210	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
	You can connect the digital inputs (DIG_INx, PWM_INx, INJx, IGNx, AUXCAPx) on the DS2210 to various voltage levels (VBAT, +5 V or GND).	DS2210: How to Connect all Digital Inputs to Various Voltage Levels on page 86
	You can set the analog outputs of the C31 slave DSP and angular processing unit to different output modes: ▪ Transformer output mode (= signals decoupled from ground) ▪ DC output mode	DS2210: How to Set the Output Mode for the Transformer Outputs on page 87

Board	Manual Settings	For Instructions Refer to ...
DS2211	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
	You can set the analog outputs of the C33 slave DSP and angular processing unit to different output modes: ▪ Transformer output mode (= signals decoupled from ground) ▪ DC output mode	DS2211: How to Set the Output Mode for the Transformer Outputs on page 89
DS2302	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
	Jumper setting on the DS2302.	DS2302: Recommended Jumper Setting on page 91
	Setting up the I/O base address.	DS2302: How to Change the I/O Base Address on page 91
	You can insert up to six DAC analog output stages (piggyback) onto the DS2302.	How to Insert Modules onto I/O Boards on page 106
DS2401	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
DS3001	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
DS3002	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
	You have to select the encoder signal type and the use of line termination for each channel.	DS3002: How to Select the Encoder Signal Type on page 93
DS4001	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
DS4002	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
	You can set up (or change) the logical level for the timing I/O channels (CH1 ... CH8) to a predefined pull-up or pull-down level after power-up.	DS4002: How to Change the Logical Level of the Timing I/O on page 95
DS4003	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
	For supporting signal levels other than TTL, you can mount customization modules (piggyback) onto the DS4003.	How to Insert Modules onto I/O Boards on page 106
DS4004	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84

Board	Manual Settings	For Instructions Refer to ...
DS4120 DS4121	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
DS4201	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
	Custom software can use the sub-ID number of the board: ▪ To distinguish several DS4201 and/or DS4201-S boards with differential functionalities in one PHS-bus-based system or ▪ To perform hardware-specific setups	DS4201, DS4201-S: How to Change the Sub-ID on page 99
	You have to insert your custom board onto the DS4201.	How to Insert Modules onto I/O Boards on page 106
DS4201-S	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
	You have to set up a special transceiver mode (RS232, RS422 or RS485) on each of the four serial communication channels.	DS4201-S: How to Set Up the Transceiver Mode on page 97
	Custom software can use the sub-ID number of the board: ▪ To distinguish several DS4201 and/or DS4201-S boards with differential functionalities in one PHS-bus-based system or ▪ To perform hardware-specific setups	DS4201, DS4201-S: How to Change the Sub-ID on page 99
DS4302	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
	You can insert up to four customization modules (piggyback) onto the DS4302. Each module may carry a custom CAN transceiver.	How to Insert Modules onto I/O Boards on page 106
DS4330	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
	You can insert up to four customization modules (piggyback) for custom LIN transceivers onto the DS4330.	How to Insert Modules onto I/O Boards on page 106
DS4501	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
	You can insert up to four IP modules onto the DS4501.	How to Insert Modules onto I/O Boards on page 106
DS4502	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84

Board	Manual Settings	For Instructions Refer to ...
DS4504	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
DS4505	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
	You can insert up to four DS4340 FlexRay Interface Modules and/or DS4342 CAN FD Interface Modules onto the DS4505.	How to Insert Modules onto I/O Boards on page 106
DS5001	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
	You can increase the hysteresis level of the input comparators of the timing I/O unit to eliminate voltage spikes on the inputs.	DS5001: How to Increase the Hysteresis Level of the Inputs on page 101
DS5101	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
	▪ Up to board revision DS5101-02: You can insert up to eight output modules (piggyback), containing two waveform generation channels each, onto the DS5101. ▪ As of board revision DS5101-04: The board has no output modules. The functional design is integrated in one FPGA (field-programmable gate array).	How to Insert Modules onto I/O Boards on page 106
	Only as of board revision DS5101-04: Setting up the pull-up behavior of each channel individually.	DS5101: How to Set Up the Pull-up Behavior on page 103
DS5202	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
DS5203	Setting up the PHS-bus address.	How to Set the PHS-bus Address on page 84
	Mounting a DS5203 Multi-I/O Module onto the board	▪ How to Mount a DS5203M1 Multi-I/O Module on the DS5203 FPGA Board on page 104 ▪ How to Remove a DS5203M1 Multi-I/O Module from the DS5203 FPGA Board on page 105

Related topics

Basics

Basics on Changing I/O Base Addresses.. 76
Setting Up the Processor Board.. 77

How to Set the PHS-bus Address

Objective

If you use boards with the same default PHS-bus address or several boards of the same type, you have to change addresses to avoid address conflicts.

PHS bus

The Peripheral High Speed (PHS) bus is a fast 32-bit bus for the communication between the processor board and the I/O boards. The PHS bus contains four address lines to select up to 16 I/O boards.

All the I/O boards used in a PHS-bus-based system have to use different PHS-bus addresses.

> **Note**
>
> Do not connect more than one processor board to the same PHS bus. The processor board is the master of the PHS bus and does not have a PHS-bus address.

The PHS-bus address can be configured via a rotary switch or via four DIP switches.

Limitation

Do not set the DS802 PHS Link Board that acts as a master to the PHS-bus base address 00H. This setting might cause malfunctions. Instead, set this DS802 to another available PHS-bus base address.

For details on the PHS-bus address settings of the DS802, refer to Installation and Configuration Notes on page 113.

Precondition

The board is removed to get access to the switches. For instructions, refer to How to Remove Hardware from the Simulator on page 118.

Method

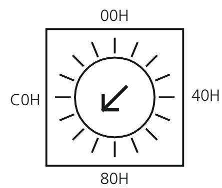
To set the PHS-bus address

1. Determine the PHS-bus base addresses for each I/O board. Make sure to use each address only once.

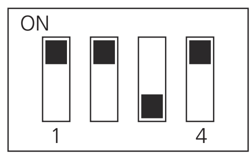
   Write down the addresses, the boards' serial numbers and their slot number to distinguish them.

   > **Tip**
   >
   > If your system is preconfigured by dSPACE and non-default values were used, the "Expansion Box Configuration" sheet (delivered with your system) gives you this information.

2 For boards with a rotary address switch, use the switch to change the address if necessary. The following figure shows the rotary switch setting for address A0H as an example.



3 For the other I/O boards, use the four DIP switches (located next to the PHS-bus connector) to change the addresses if necessary. The following figure shows the setting (0010) for address 20H as an example.



A switch turned ON represents a binary zero and OFF a binary one.

Available PHS-bus base addresses

The following table shows the available PHS-bus base addresses and the corresponding switches settings. It also displays the default PHS-bus address settings of the boards:

PHS-Bus Base Address (Hex)	Setting of the DIP Switches (Binary)	Position of Rotary Switch	Default Setting of the ...
00H [1)]	0000	0	DS2001, DS2004, DS4501
10H	0001	1	DS4330, DS4505
20H	0010	2	DS2002, DS2003
30H	0011	3	–
40H	0100	4	DS3001, DS3002
50H	0101	5	–
60H	0110	6	DS4302
70H	0111	7	–
80H	1000	8	DS2101, DS4504
90H	1001	9	DS2102, DS2103
A0H	1010	A	DS2201, DS2202, DS2210, DS2211
B0H	1011	B	DS2302, DS2401, DS4120, DS4121, DS4401, DS4502
C0H	1100	C	DS4001, DS4002, DS4003, DS4004
D0H	1101	D	DS5101

PHS-Bus Base Address (Hex)	Setting of the DIP Switches (Binary)	Position of Rotary Switch	Default Setting of the ...
E0H	1110	E	DS5001
F0H	1111	F	DS802, DS4201, DS4201-S, DS5202, DS5203

[1)] Do not set the DS802 PHS Link Board that acts as a master to the PHS-bus base address 00H.

Related topics

Basics

DS2210: How to Connect all Digital Inputs to Various Voltage Levels

Objective

Before inserting the DS2210 in the simulator, you have to check if the setting of *jumper J8* is the required setting for your connected external devices.

By inserting jumper J8 you connect all digital inputs (DIG_INx, PWM_INx, INJx, IGNx, AUXCAPx) of the DS2210 to various voltage levels (VBAT, +5 V or GND) via 4.7 kΩ resistors.

Factory default setting

The digital inputs are connected to VBAT.

Board revision

The pin header for jumper J8 is available as of board revision DS2210-04.

Tip

The revision number is printed on the board. You can also read out the number in ControlDesk. Refer to Board Details Properties (ControlDesk Platform Management 📖).

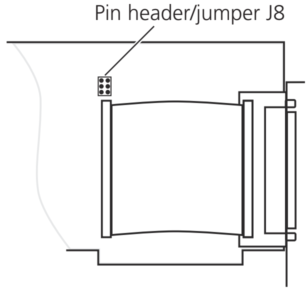
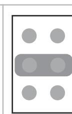
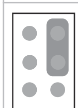
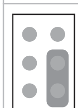
Precondition

The board is removed to get access to the jumpers. For instructions, refer to How to Remove Hardware from the Simulator on page 118.

Method

To select the desired voltage level

1 Insert the jumper J8 according to the level required as shown in the table below.

Jumper Setting		**Description**
		All digital inputs are connected to VBAT via 4.7 kΩ resistors. (Factory default setting) VBAT is an external power supply. The nominal voltage is 12 V, the permitted range is +8 V … +18 V including all tolerances.
		All digital inputs are connected to +5 V via 4.7 kΩ resistors.
		All digital inputs are connected to GND (ground) via 4.7 kΩ resistors.

Note

The digital inputs of the DS2210 are usable only if jumper J8 is inserted in one of the positions shown above.

Related topics

Basics

Setting Up the Processor Board........ 77

HowTos

DS2210: How to Set the Output Mode for the Transformer Outputs........ 87
How to Set the PHS-bus Address........ 84

DS2210: How to Set the Output Mode for the Transformer Outputs

Objective

Before inserting the DS2210 in the simulator, you have to check if the setting of *jumpers J1 … J7* is the required setting for your connected external devices.

The analog outputs of the C31 slave DSP and the angular processing unit (APU) are equipped with transformers in order to provide signals that are decoupled from ground. Jumpers J1 … J7 allow you to switch between the transformer output mode and the DC output mode.

Factory default setting

Transformer output mode

Board revision

The pin header for jumper J1 … J7 is available as of board revision DS2210-04.

> **Tip**
>
> The revision number is printed on the board. You can also read out the number in ControlDesk. For details, refer to Board Details Properties (ControlDesk Platform Management 📖).

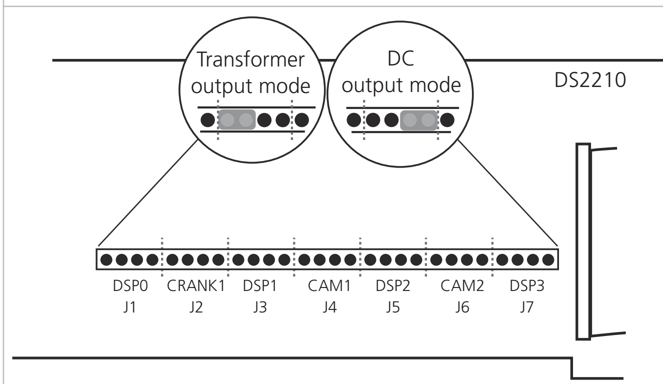
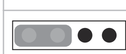
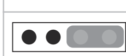
Precondition

The board is removed to get access to the jumpers. For instructions, refer to How to Remove Hardware from the Simulator on page 118.

Method

To select the desired output mode

1 Insert the jumpers according to the output mode required as shown in the table below:

Jumper Setting		**Description**
		DSP0, DSP1: Analog differential knock sensor or wheel speed sensor outputs (C31 Waveform 0 and 1)
		DSP2, DSP3: Analog differential wheel speed sensor outputs (C31 Waveform 2 and 3)
		CRANK1: Analog crankshaft differential outputs
		CAM1, CAM2: Analog camshaft differential outputs
	Transformer output mode (Factory default setting)	The outputs are transformer coupled and isolated from system ground. DC voltages cannot be passed to the outputs.
	DC output mode	The outputs are referenced to ground. DC voltages can be passed to the outputs.

> **Note**
>
> A digital output is usable only if the corresponding jumper J1 … J7 is inserted in one of the positions shown above.

Related topics

Basics

HowTos

DS2211: How to Set the Output Mode for the Transformer Outputs

Objective

Before inserting the DS2211 in the simulator, you have to check if the setting of *jumpers J1 … J7* is the required setting for your connected external devices.

The analog outputs of the slave DSP and the angular processing unit are equipped with transformers to provide signals that are decoupled from ground. Jumpers J1 … J7 allow you to switch between the transformer (= AC) output mode and the DC output mode.

Factory default setting

Transformer output mode.

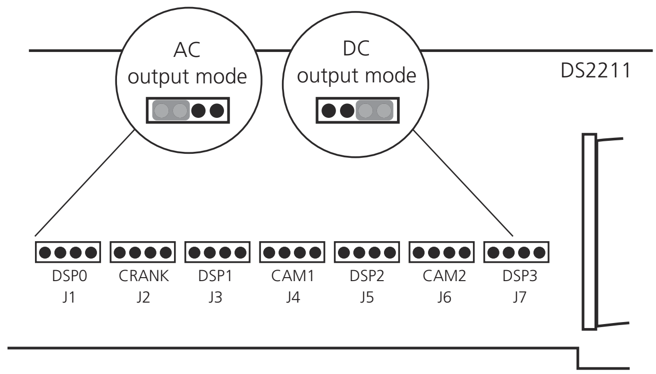
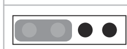
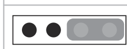
Precondition

The board is removed to get access to the jumpers. For instructions, refer to How to Remove Hardware from the Simulator on page 118.

Method

To set the output mode for the transformer outputs

1 Insert the jumpers according to the output mode required as shown in the table below:

Jumper Setting		Description
		DSP0 … DSP3: Analog differential knock sensor or wheel speed sensor outputs (VC33-Waveform 0 … VC33-Waveform 3)
		CRANK: Analog differential crankshaft outputs
		CAM1, CAM2: Analog differential camshaft outputs
	Transformer (AC) output mode (factory default setting)	The outputs are transformer coupled and isolated from system ground. DC voltages cannot be passed to the outputs.
	DC output mode	The outputs are referenced to ground. DC voltages can be passed to the outputs.

Note

An output signal is usable only if the corresponding jumper J1 … J7 is inserted in one of the positions shown above.

Related topics

Basics

Setting Up the Processor Board... 77

HowTos

How to Set the PHS-bus Address... 84

DS2302: Recommended Jumper Setting

Jumper setting as of revision DS3202-04

The jumper (J1) on the DS2302 Direct Digital Synthesis Board as of revision DS2302-04 must be closed. This ensures the proper function of the PHS-bus connection.

Only if you use ControlDesk 3.x as experiment and instrumentation software, it es recommended that you open the jumper (J1).

To locate the jumper on the board, refer to Board Overview (as of Revision DS2302-04) (PHS Bus System Hardware Reference 📖).

Jumper setting of revision DS3202-01

The jumper (J1) on the DS2302 Direct Digital Synthesis Board as of revision DS2302-01 must be opened. This ensures the proper function of the PHS-bus connection.

To locate the jumper on the board, refer to Board Overview (Revision DS2302-01) (PHS Bus System Hardware Reference 📖).

DS2302: How to Change the I/O Base Address

Objective

Before inserting the DS2302 in the simulator, you have to check if the factory default setting of the I/O base address must be changed.

Changing via switches

The I/O base address, meaning the port address on the ISA bus, is selected by eight DIP switches (on the DS2302-01) or three rotary switches (on the DS2302-04).

> **Note**
>
> DS2302-01: Do not mix up the DIP switches for the I/O address and for the PHS-bus address. The PHS-bus address switch is located next to the PHS-bus connector and only contains four individual switches. The I/O address switch contains eight individual switches.

Factory default setting

- DS2302-01: 320H
- DS2302-04: 380H

Precondition

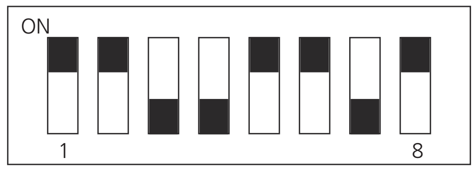
The board is removed to get access to the switches. For instructions, refer to How to Remove Hardware from the Simulator on page 118.

Method

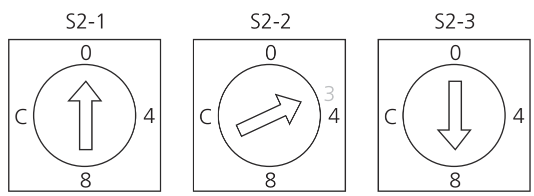
To configure the board manually

1. Set the eight DIP switches or the three rotary switches of the board to the desired value.

   The following illustration shows the default setting (320H) of the DIP switches on the DS2302-01. A switch turned "ON" represents a binary zero and "OFF" a binary one.



   The following illustration shows the default setting (380H) of the rotary switches on the DS2302-04.



I/O base addresses usable for the DS2302

The following table shows the switch settings for some I/O base addresses for the DS2302.

I/O Base Address (Port Address)	DIP Switches (on DS2302-01)								Rotary Switches (on DS2302-04)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**S2-1**	**S2-2**	**S2-3**
200H	0[1)]	0	1	0	0	0	0	0	0	2	0
280H	0	0	1	0	1	0	0	0	0	2	8
300H	0	0	1	1	0	0	0	0	0	3	0
310H	0	0	1	1	0	0	0	1	0	3	1
320H	0	0	1	1	0	0	1	0	0	3	2
380H (default)	0	0	1	1	1	0	0	0	0	3	8
8300H	1	0	1	1	0	0	0	0	8	3	0

1) 0 = on; 1 = off

Address lines (only DS2302-01)

Switches 1 and 2 determine the address lines A15 and A14, switches 3 to 8 the address lines A9 to A4 of the I/O base address. The address lines A10 and A11 are always treated as binary zero, the values of lines A12 and A13 are not relevant (X).

A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4
S1-1	S1-2	X	X	0	0	S1-3	S1-4	S1-5	S1-6	S1-7	S1-8

Related topics

Basics

DS3002: How to Select the Encoder Signal Type

Objective

Before inserting the DS3002 in the simulator, you have to select the encoder signal type and the use of line termination manually via jumpers. For each channel a pin header allows you to insert jumpers.

Factory default setting

The TTL single-ended mode without line termination is selected for all channels.

Precondition

The board is removed to get access to the jumpers. For instructions, refer to How to Remove Hardware from the Simulator on page 118.

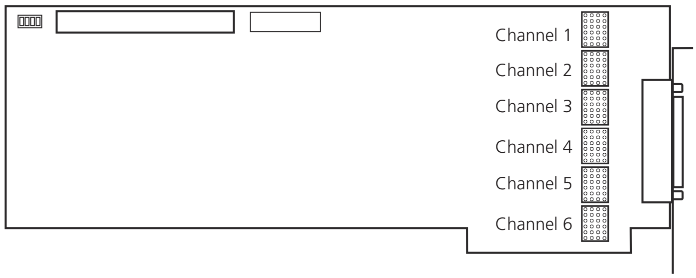
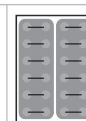
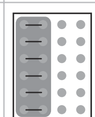
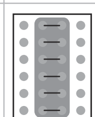
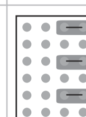
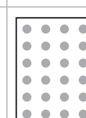
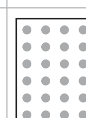
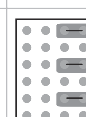
Method

To select the encoder signal type

1 Insert or remove jumpers according to the encoder signal type required and the desired line termination (as shown in the table below).

> **Note**
>
> Take care not to bend the pins when inserting and removing jumpers. Use a pair of pliers to remove multi-way jumpers.

The following table shows the necessary jumper positions:

Encoder Signal Type		Line Termination	Jumper Settings
			
Analog (sinusoidal) signal	1 V_{pp} differential mode	With line termination (recommended setting)	
		Without line termination	
	11 μA_{pp} differential mode (without line termination)		
Digital signal	RS422 differential mode	With line termination (recommended setting)	
		Without line termination	
	TTL single-ended mode	Without line termination (recommended setting; factory default setting)	
		With line termination	

Tip

18 individual jumpers for digital signal settings and 12 six-way jumpers for analog signal settings are shipped with the board.

Further information

For further information on terminating the lines, refer to *Line Termination* in the DS3002 chapter of the *PHS Bus System Hardware Reference*.

Related topics

Basics

HowTos

DS4002: How to Change the Logical Level of the Timing I/O

Objective

Before inserting the DS4002 in the simulator, you have to check if the default logical level of the timing I/O must be changed.

Background

After power-up the timing I/O channels (CH1 ... CH8) are set to the input mode. To avoid damage, some external devices need a predefined logical voltage level at a pin, which might be programmed as an output at a later time.

Changing via a pin socket

To allow you to set up (or change) a predefined logical level, a 10-pin single inline socket is built into the board. Here you can insert a resistor network to provide a pull-up (high) or pull-down (low) default level to *all* channels (CH1 … CH8) after power-up.

Factory default setting

A 9-pin resistor network with eight 2.2 kΩ resistors is mounted as a pull-down resistor (= logical low level).

Precondition

The board is removed to get access to the resistor network. For instructions, refer to How to Remove Hardware from the Simulator on page 118.

Method

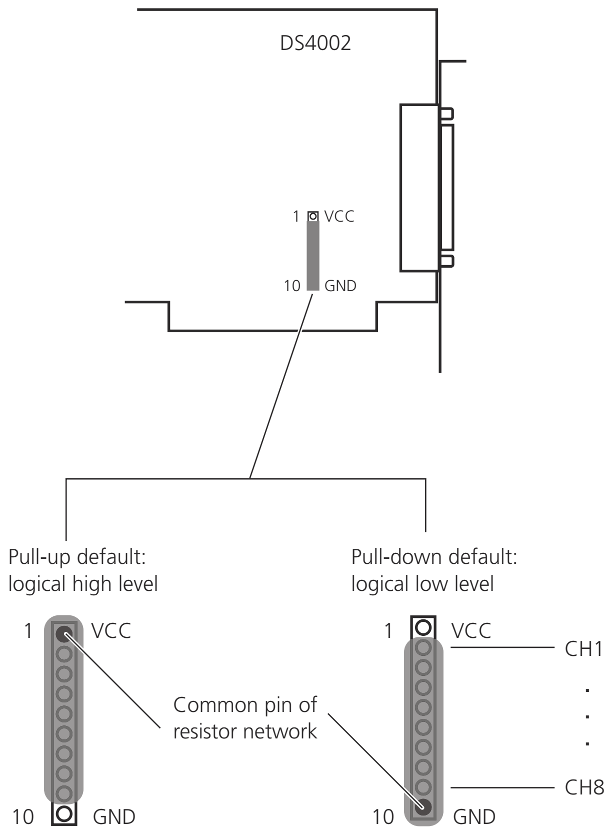
To change the default logical voltage level

1 Carefully remove the resistor network from the socket, and insert it at the desired position.

   Depending on the setting, *all* timing I/O pins (CH1 ... CH8) are either pulled up to VCC or down to GND:

   - *GND* = The default logical voltage level after power-up is *low*.
   - *VCC* = The default logical voltage level after power-up is *high*.

The following illustration shows the setup options.



Note

If no resistor network is inserted, the logical voltage level of the timing I/O is not defined after power-up.

Using your own resistor network

The resistor network must be a 9-pin type with a common pin at one end (pin 1) and single resistors at pins 2 to 9. The single resistor values should be not less than 330 Ω.

Related topics

Basics

Setting Up the Processor Board..77

HowTos

How to Set the PHS-bus Address..84

DS4201-S: How to Set Up the Transceiver Mode

Objective

The DS4201-S board provides four independent serial communication channels and supports the RS232-C, RS422 and RS485 transceiver modes. The transceiver modes of the four channels can be mixed as required.

The different modes are selected by inserting appropriate components into the relevant sockets.

Factory default setting

Either the components for the RS232-C transceiver mode (standard) or the components of your ordered setup (option) are inserted.

Precondition

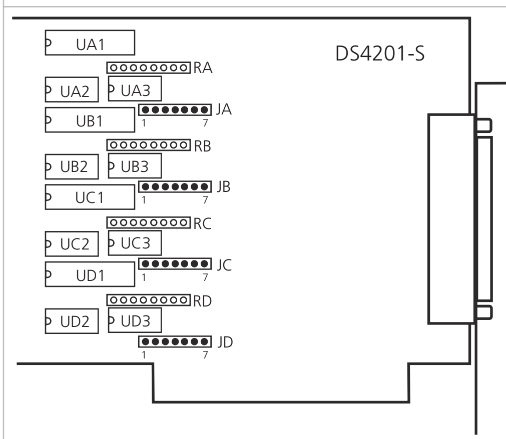
The board is removed to get access to the sockets. For instructions, refer to How to Remove Hardware from the Simulator on page 118.

Method

To set up a special transceiver mode on a particular channel

1 Insert (or remove) the desired types of components (ICs, resistor arrays and pin headers) as shown in the illustration below.

DS4201-S



- *Ux1*[1], *Ux2*, *Ux3*: IC sockets for transceiver chips
- *JA* … *JD*: pin headers for jumpers
- *RA* … *RD*: resistor array sockets for termination resistor arrays

Transceiver Mode			
Socket	*RS232-C*	*RS422*	*RS485*
Ux1 [1]	AD239	– [2]	– [2]
Ux2	– [2]	75ALS180	75ALS180
Ux3	–	75ALS180	75ALS180
Jx	–	Pin 5–6 [3]	Pin 1–2 [3], 3–4, 6–7
Rx	–	120 Ω	270 Ω

[1] x = A … D = Ch1 … Ch4
[2] – = There must be no component inserted at this position
[3] These pins must be jumpered.

Related topics

Basics

HowTos

DS4201-S: How to Change the Quartz Oscillator

Objective

You can change the quartz oscillator of the DS4201-S board to change the possible baud rate range.

Possible quartz oscillator versions

You can mount quartz oscillators with frequencies from 1.8432 MHz (default) up to 24 MHz.

Precondition

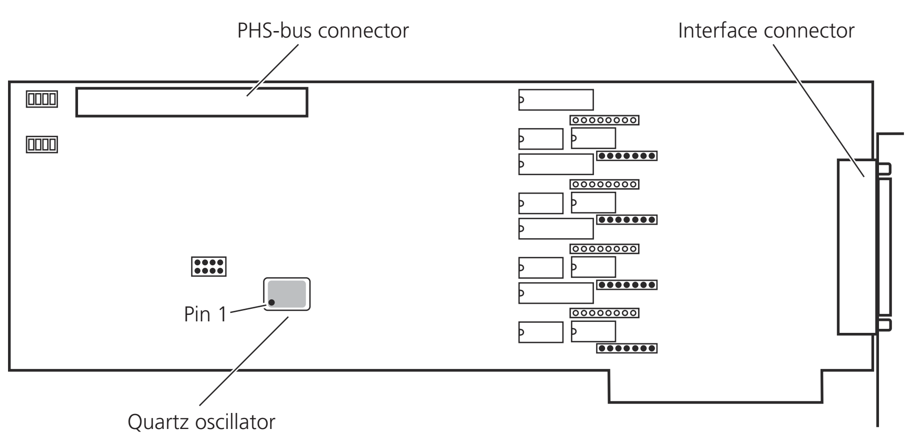
- The housing of the quartz oscillator must be a 14-pin DIP.
- The board is removed to get access to the socket of the quartz oscillator. For instructions, refer to How to Remove Hardware from the Simulator on page 118.

Method

To change the quartz oscillator

1 Release the binder that secures the mounted quartz against accidental disconnection with an appropriate tool (e.g., cable cutter).

2 Plug the quartz oscillator. Note the marking on the device and the alignment on the DS4201-S board as shown in the illustration below.



3 Secure the new quartz oscillator with a binder to avoid accidental disconnection.

Necessary settings in the RTI blockset

If you have changed the quartz oscillator on the board you must adapt the new quartz frequency on the Advanced page of the Serial Setup in the DS4201-S blockset. For further information, refer to Advanced Page (DS4201SER_SETUP_Bx_Cy) (DS4201-S RTI Reference 📖).

Actual baud rate

When you specify a baud rate within RTI or RTLib, the closest physically available baud rate is actually used for serial communication. For example, if you specify 70,000 baud as the baud rate, the baud rate actually used is 57,600 baud (f_{osc} = 1.8432 MHz) or 71,429 baud (f_{osc} = 24 MHz).

For further information, refer to Specifying the Baud Rate of the Serial Interface (DS4201-S Features 📖).

Related topics

HowTos

DS4201, DS4201-S: How to Change the Sub-ID

Objective

The sub-ID is intended only to be used by custom software:

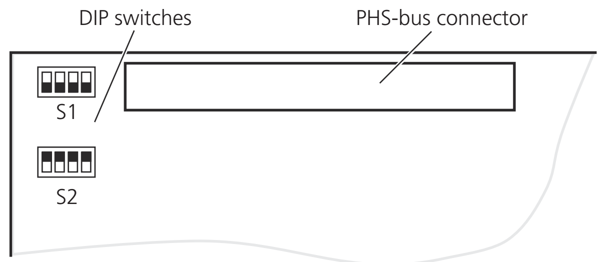
- To perform hardware specific setups, etc.
- To distinguish several DS4201 and/or DS4201-S boards with different functionalities in one PHS-bus-based system.

Note

The sub-ID is not used by dSPACE software.
dSPACE software recognizes several DS4201/DS4201-S in one PHS-bus-based system by the PHS-bus base address. So sub-IDs of several boards could be identical.

Changing via DIP switches

Change the sub-ID of the DS4201/DS4201-S board by using DIP switch *S2*, located on the component side of the board (see below).



Precondition

The board is removed to get access to the DIP switches. For instructions, refer to How to Remove Hardware from the Simulator on page 118.

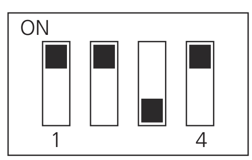
Method

To change the sub-ID

1 Determine the sub-ID for each DS4201 and DS4201-S board you want to distinguish by custom software.

> **Note**
>
> Do not use sub-ID “FH”! dSPACE software cannot recognize a board with this sub-ID.

2 Use the four DIP switches to change the sub-ID. The following illustration shows the setting (0010) for sub-ID 2H as an example.



A switch turned ON represents a binary zero and OFF a binary one.

DIP switch settings

The following table shows the available sub-IDs and the corresponding DIP switch settings.

Sub-ID (Hex)	Setting of the DIP Switches (Binary)
0H	0000 (factory default setting)
1H	0001
2H	0010
3H	0011
4H	0100
5H	0101
6H	0110

Sub-ID (Hex)	Setting of the DIP Switches (Binary)
7H	0111
8H	1000
9H	1001
AH	1010
BH	1011
CH	1100
DH	1101
EH	1110

Related topics

Basics

HowTos

DS5001: How to Increase the Hysteresis Level of the Inputs

Objective

Before inserting the DS5001 in the simulator, you have to check if the hysteresis level of the input comparators (timing I/O unit) must be increased to eliminate voltage spikes on the inputs.

A fixed hysteresis of about 80 mV prevents ringing on slow changing signals. As of *board revision DS5001-06* the board allows you to increase the hysteresis by inserting resistors or resistor networks in a socket on the DS5001.

For information on the effect of increasing the hysteresis level, refer to I/O Circuits and Electrical Characteristics in the DS5001 chapter of the PHS Bus System Hardware Reference.

Factory default setting

No resistors are inserted = 80 mV hysteresis.

Precondition

The board is removed to get access to the resistor socket. For instructions, refer to How to Remove Hardware from the Simulator on page 118.

Method

To increase the hysteresis level

1 Use appropriate resistors for the desired hysteresis.

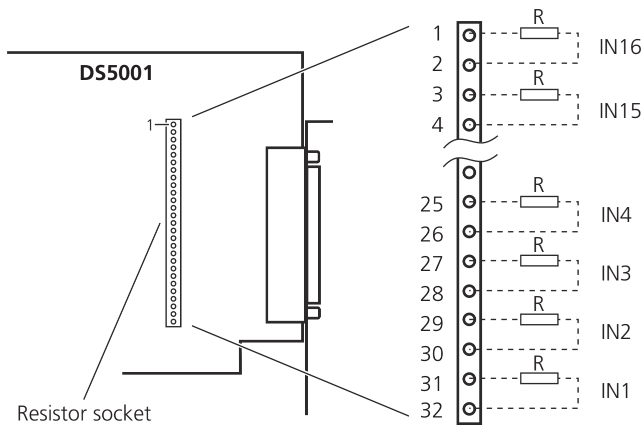
The following table shows the hysteresis levels for various resistance values.

Hysteresis	Resistance
80 mV	No resistor inserted (factory default setting)
150 mV	1 MΩ
210 mV	470 kΩ
360 mV	220 kΩ
680 mV	100 kΩ
1.35 V	47 kΩ
2.8 V	22 kΩ

Tip

To achieve equal resistance values on neighboring channels you should use resistor networks, like BOURNS 4608X-102 (= 4 resistors/package).

2 Plug the resistors (or resistor networks) onto the socket pins of the desired input channel as shown in the illustration below.



Related topics

Basics

HowTos

DS5101: How to Set Up the Pull-up Behavior

Objective

You can set the pull-up behavior using jumpers for each channel individually.

Board revision

The pull-up behavior can only be set for DS5101 as of board revision DS5101-04.

> **Tip**
>
> The revision number is printed on the board. You can also read out the number in ControlDesk, refer to Board Details Properties (ControlDesk Platform Management 📖).

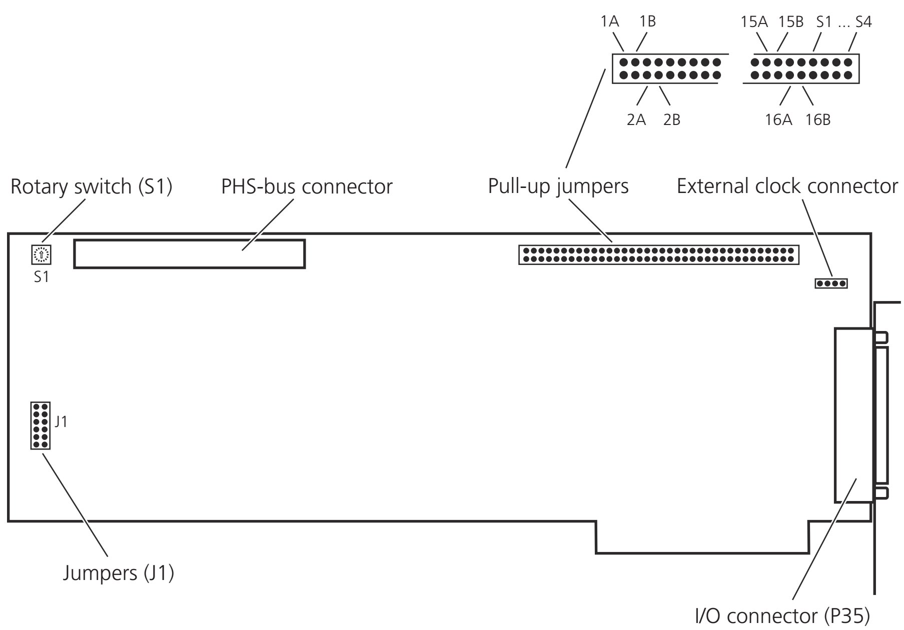
Precondition

The board is removed to get access to the jumpers. For instructions, refer to How to Remove Hardware from the Simulator on page 118.

Method

To set up the pull-up behavior

1 Insert the S1 jumper of the pull-up jumpers (see the following illustration).



2 Insert the xA and xB jumpers for each channel (x = 1 … 16) according to the following table

xA Jumper	xB Jumper	Pull-up Behavior on Pin x
Open	Open	No pull function
Closed	Open	Pull down

xA Jumper	xB Jumper	Pull-up Behavior on Pin x
Open	Closed	Pull up
Closed	Closed	Hold function. The last I/O voltage level on pin x is hold.

How to Mount a DS5203M1 Multi-I/O Module on the DS5203 FPGA Board

Objective

The following instructions apply if you want to mount a DS5203M1 Multi-I/O Module to a DS5203 FPGA Board. The DS5203 FPGA Board provides one slot for the module.

Preconditions

- The board is removed to get access to the module slots. For instructions, refer to How to Remove Hardware from the Simulator on page 118.
- To avoid risk of injury and/or damage to the dSPACE hardware, read and ensure that you comply with the safety precautions, see Safety Precautions for Installing and Connecting dSPACE Boards on page 26.
- Ensure you have all the items in the table below before starting:

Items	Count	Description
Wrench	1	3 mm
Phillips screwdriver	1	PH0

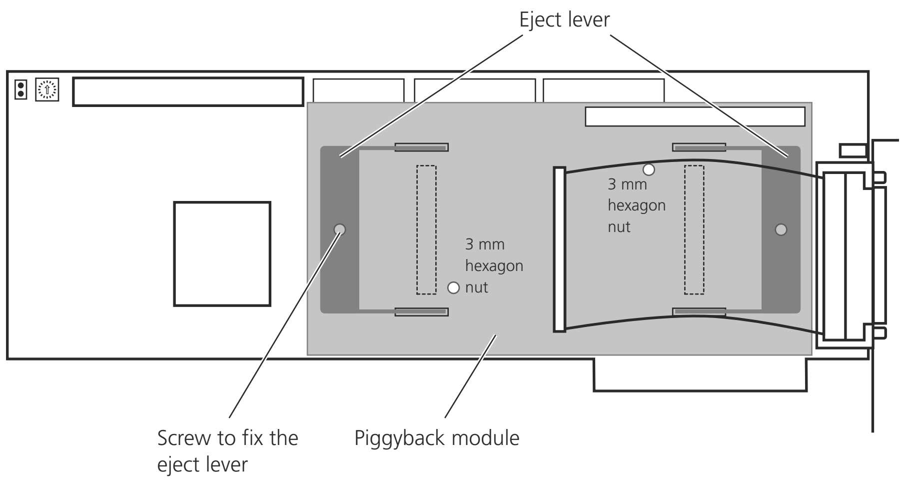
Method

To mount a DS5203M1 Multi-I/O Module on the DS5203

1 Put the DS5203 FPGA Board on an ESD protection surface (for example, the bag the board is delivered in) to avoid electrostatic discharges.

2 Look at the connectors on the bottom of the DS5203M1 Multi-I/O Module and on the top of the DS5203 FPGA Board to get the correct position for mounting.

> **Note**
>
> Ensure that the eject levers are fixed with screws to the piggyback module.



3 Carefully insert the module into the slot of the I/O board.

4 Secure the module against accidental disconnection using the washers and the 3 mm hexagon nuts.

Result

The DS5203M1 Multi-I/O Module is mounted on the DS5203.

How to Remove a DS5203M1 Multi-I/O Module from the DS5203 FPGA Board

Objective

The following instructions apply if you want to remove a DS5203M1 Multi-I/O Module from a DS5203 FPGA Board.

Preconditions

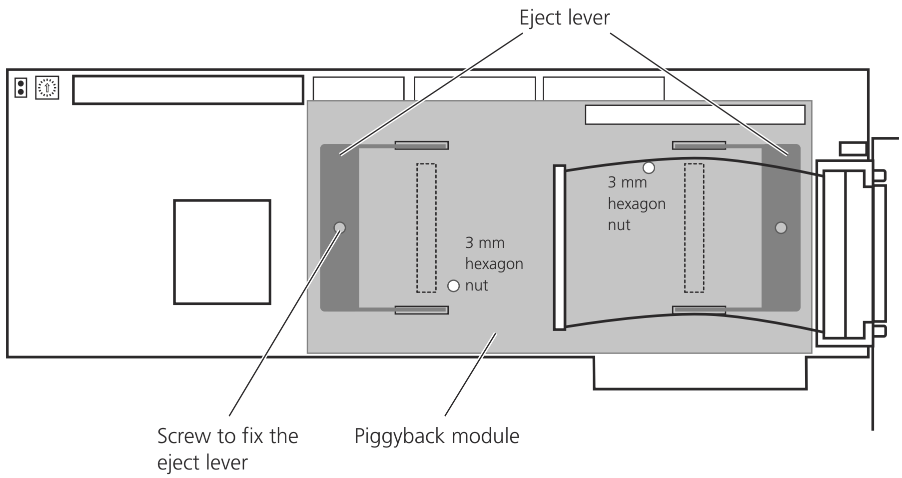
- The board is removed to get access to the module slots. For instructions, refer to How to Remove Hardware from the Simulator on page 118.
- To avoid risk of injury and/or damage to the dSPACE hardware, read and ensure that you comply with the safety precautions, see Safety Precautions for Installing and Connecting dSPACE Boards on page 26.
- Ensure you have all the items in the table below before starting:

Items	Count	Description
Wrench	1	3 mm
Phillips screwdriver	1	PH0

Method

To remove a DS5203M1 Multi-I/O Module

1. Put the DS5203 FPGA Board on an ESD protection surface (for example, the bag the board is delivered in) to avoid electrostatic discharges.
2. Unscrew the screws of both eject levers.



3. Unscrew the 3 mm hexagon nuts and remove the washers.
4. Carefully pull up the eject levers and remove the module from the board.

Result

The DS5203M1 Multi-I/O Module is removed from the board.

How to Insert Modules onto I/O Boards

Preconditions

- The board is removed to get access to the module slots. For instructions, refer to How to Remove Hardware from the Simulator on page 118.
- Precautions are taken to avoid damage by high electrostatic voltages. For details, refer to Safety Precautions for Installing and Connecting dSPACE Boards on page 26.

Method

To insert a module onto an I/O board

1. Put the board on an ESD-protecting surface (for example, the bag the board is delivered in) to avoid electrostatic discharges.
2. Insert the module into the desired slot of the I/O board.
3. If the I/O board provides mounting holes: Fix the module onto the board with suitable screws.

Next steps

Now you can reinstall the board.

Partitioning a PHS-Bus-Based System with the DS802 PHS Link Board

Introduction

With the DS802 PHS Link Board, you can spatially partition the PHS bus by arranging the I/O boards in several expansion boxes.

Where to go from here

Information in this section

Introduction to the DS802

Use scenarios

Usually the processor board and the I/O boards of a PHS-bus-based system are installed in a single expansion box. With the DS802 PHS Link Board, you can spatially partition the PHS bus by arranging the I/O boards in several expansion boxes.

You can use the DS802, for example, in the following scenarios:

- According to your development stage, you can easily extend the PHS-bus-based system with new I/O boards by connecting a separate preconfigured expansion box to the existing expansion box.
- Components of the PHS-bus-based system (installed in a separate expansion box) can easily be replaced and reused, for example, in other projects, without additional configuration work.
- If the devices of a test bench are spread out over a large area, you can shorten the cabling between dSPACE hardware and external devices (sensors/actuators) by installing I/O boards in a separate expansion box which is near the external devices.

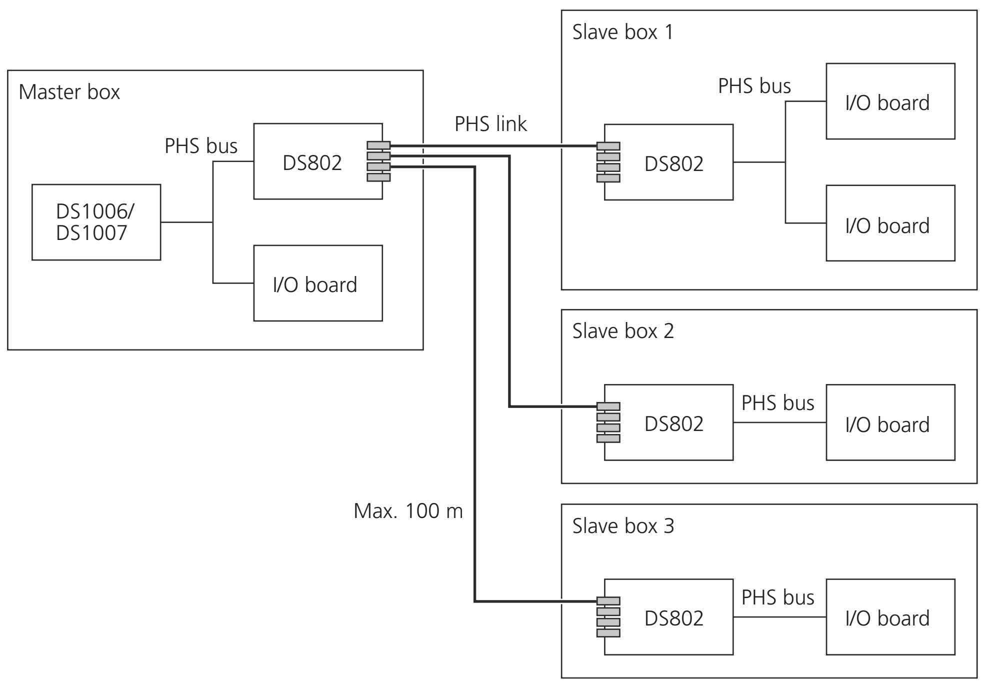
- In a few cases the components of your PHS-bus-based system might require more power than the maximum that a single expansion box supplies. In this case, you can distribute the I/O boards on several boxes via DS802. This avoids power limitations in your system caused by single expansion boxes.

Note

The DS802 does not increase the number of usable I/O boards in a PHS-bus-based system. Note that the PHS bus provides 16 PHS-bus base addresses. Each I/O board in a PHS-bus-based system and each DS802 installed in a master box require a unique PHS-bus address. So, up to 15 I/O boards can be used in a PHS-bus-based system with one DS802.

System overview

The following illustration shows a typical system architecture of a partitioned PHS-bus-based system.



The box which contains the processor board is called the master box. Boxes which contain only I/O boards are called slave boxes. One DS802 must be installed in the master box and one in every slave box.

The DS802 boards provide the necessary link between the boxes via fiber-optic cable (up to 100 m). As shown above, the link must be a direct connection between the communication ports of a master box and a slave box. It does not matter which ports you use to connect a master box to a slave box. All ports provide the same functionality. DS802 boards installed in a slave box can use only one communication port. You must not connect one slave box to several master boxes at the same time or connect slave boxes in series.

You can also partition the PHS bus in multiprocessor systems, where several processor boards are connected via Gigalink modules.

For examples on partitioned PHS bus, refer to Examples of Using the DS802 on page 110.

Number of connectable boxes

The DS802 provides four communication ports (fiber-optic connectors) to connect max. four slave boxes to one DS802 installed in a master box.

The DS802 is extendable by an optional extension module. It is not shown in the illustration above. The extension module is a piggy-back module and provides four additional communication ports.

Each master box can contain max. two DS802 boards, so max.16 slave boxes can be connected to one master box (with extension module). However, only up to 14 I/O boards can be used in this scenario due to the address requirements.

Note

Note that the PHS bus provides 16 PHS-bus base addresses. Each DS802 installed in the master box requires one PHS-bus address.

Behavior of the real-time application

The logical behavior of the real-time application (for example, building or executing) when used with a partitioned PHS-bus-based system is the same as when used with a non-partitioned PHS-bus-based system.

There is one difference. Partitioning results in additional latencies. This means that the execution times for C functions of I/O boards installed in a slave box increase with the number of PHS-bus accesses.

The execution times increase by a factor in a range of approx. 3 ... 7. You can use this range for other functions and I/O boards, to estimate the function execution time for an I/O board installed in a slave box.

Tip

The function execution times for boards used in a non-partitioned PHS-bus-based system are documented in the *RTLib References* of the respective I/O board. The function execution times for I/O boards installed in a slave box are not documented. Use the above mentioned factor to get comparable values.

Compatibility information

Compatibility with processor boards The DS802 can be used in PHS-bus-based systems. Newer versions of the DS1006 Processor Boards are fully compatible with the DS802. There are older versions which are compatible after an update done by dSPACE.

For a complete list of compatible processor board versions, refer to DS802 Data Sheet (PHS Bus System Hardware Reference 📖).

Supported I/O boards The DS802 can be used in combination with many types of available dSPACE I/O boards. However, some I/O boards and some functionalities of specific I/O boards are not supported.

The I/O board support depends on the dSPACE software release which you use. For a list of supported I/O boards, refer to DS802 Data Sheet (PHS Bus System Hardware Reference 📖).

Board components

For further hardware information on the DS802 (overview illustration, board components, etc.), refer to DS802 Board Overview (PHS Bus System Hardware Reference 📖).

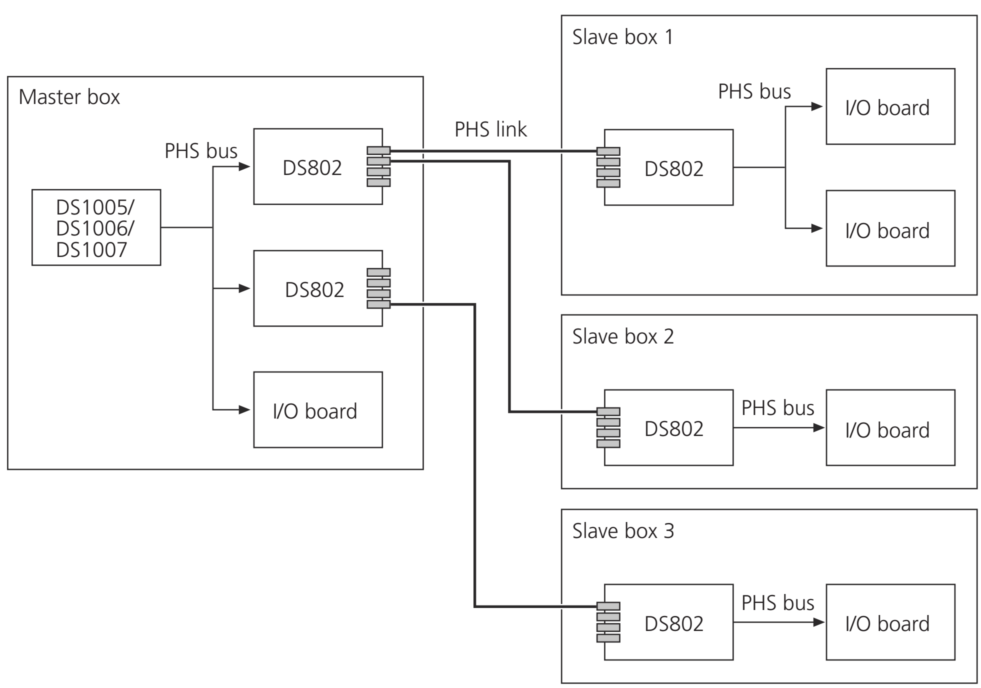
Examples of Using the DS802

Introduction

The following illustrations show some examples of correct and incorrect use of the DS802 PHS Link board.

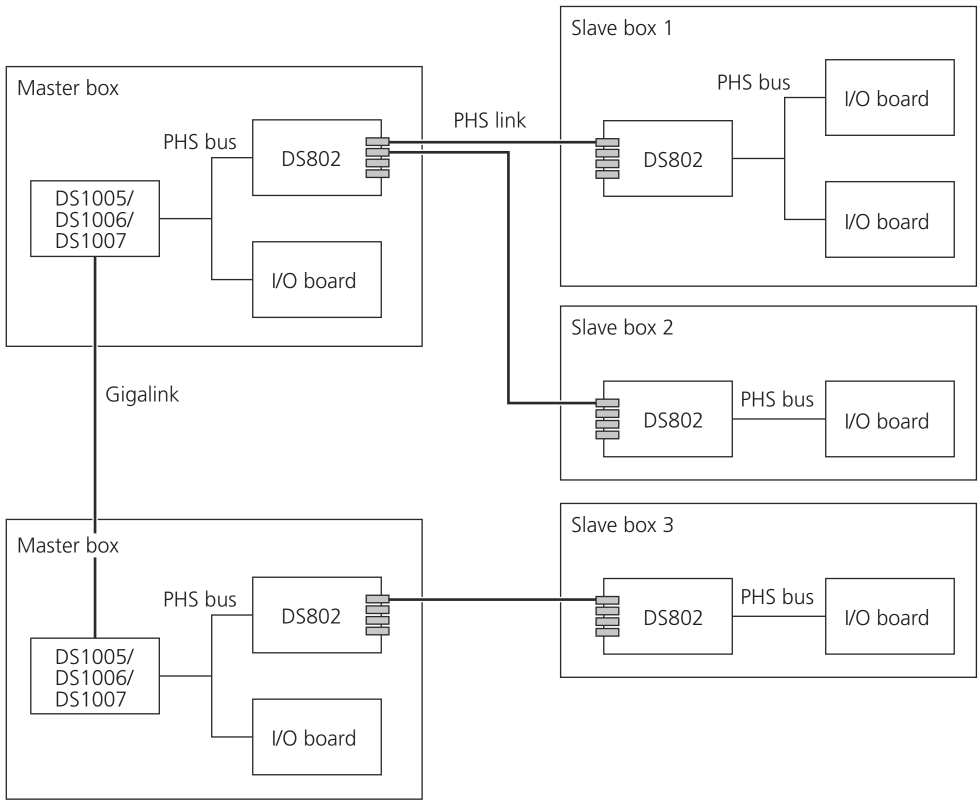
System with two DS802 in a master box

You can install max. two DS802 in a master box. Keep in mind, that each DS802 installed in a master box needs a unique PHS-bus address. This reduces the number of usable I/O boards in the partitioned PHS-bus-based system.



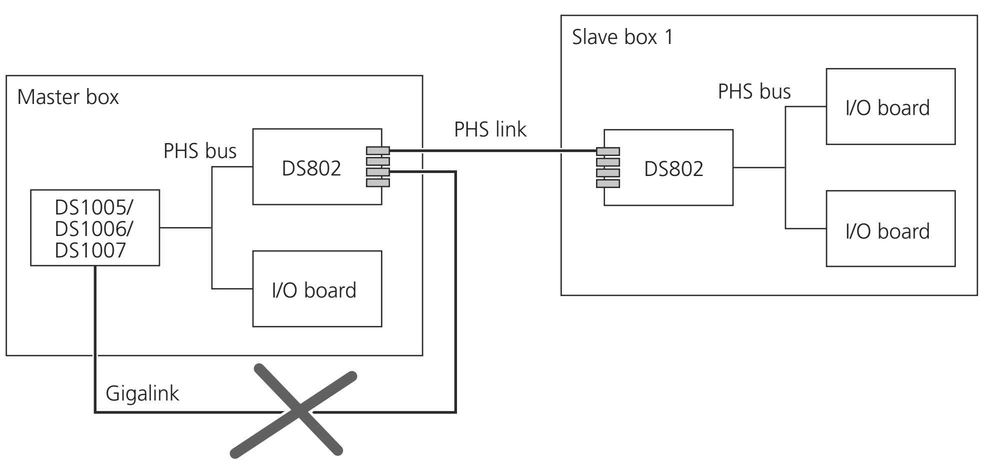
System with Gigalink connection

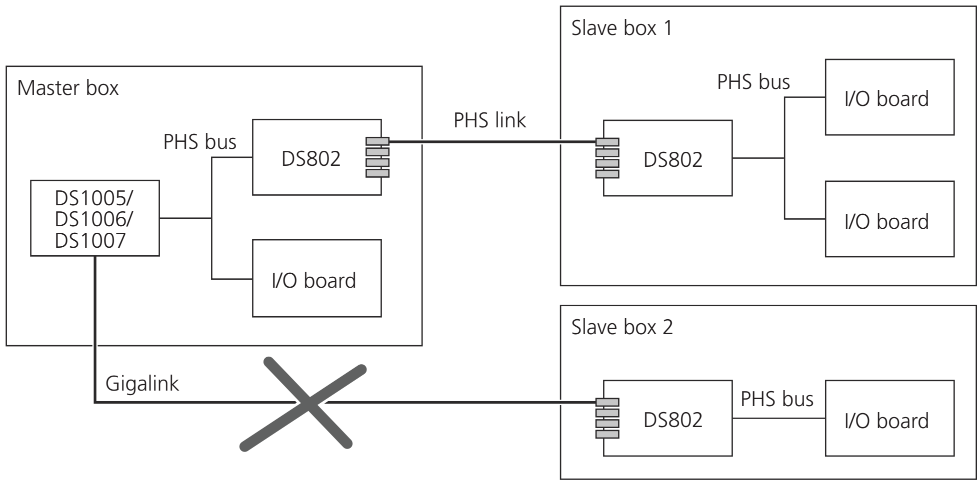
The illustration below shows a multiprocessor system based on Gigalink modules with PHS-bus partitioning.



System with incorrect Gigalink connections

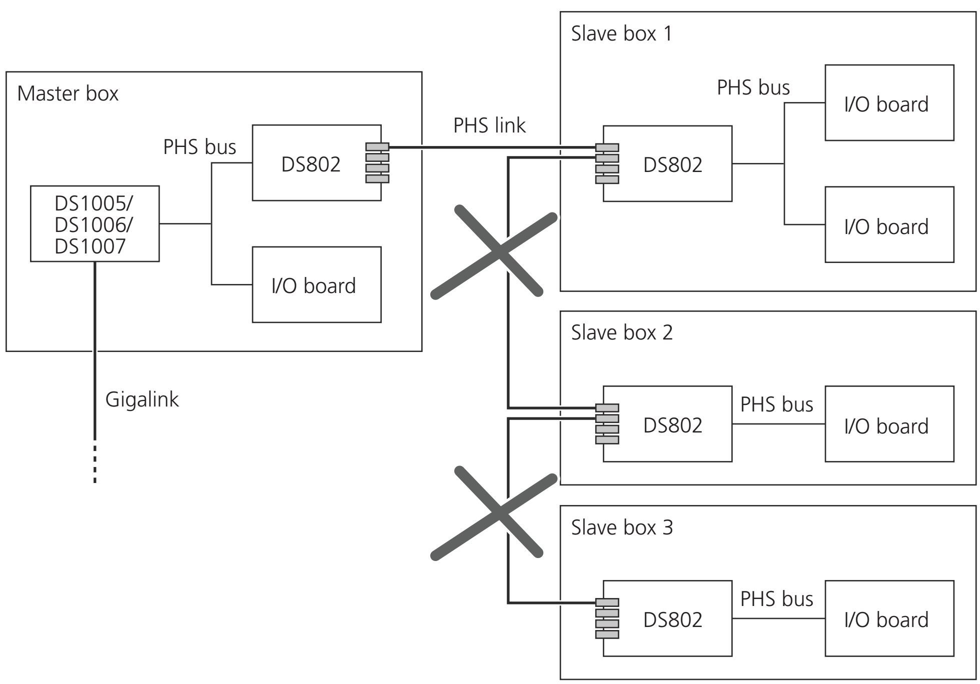
Do not mix the Gigalink connection with the PHS link connection as shown below.



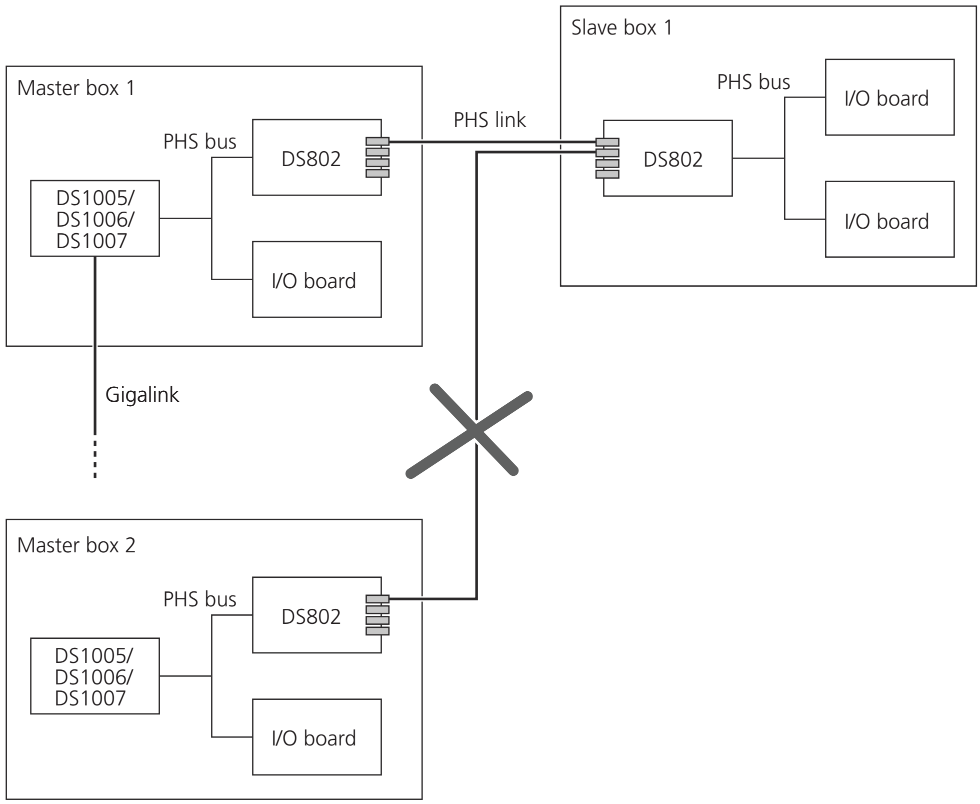


System with incorrect PHS-link connection

You cannot cascade the PHS bus by connecting several DS802 in series as shown below.



Several master boxes cannot share one slave box at the same time as shown below. Keep in mind that you can use and connect only one communication port of a DS802 installed in a slave box.



Installation and Configuration Notes

Introduction

Before you install the DS802, you should note some specifics for the DS802 to achieve optimum results and to avoid malfunctions.

Supported expansion boxes

You can install the DS802 PHS Link Board in a PX4, PX10 or PX20 Expansion Box.

> **Note**
>
> - If you want to install the DS802 in a PX5 Expansion Box, contact dSPACE for further instructions.
> - Installation in an AutoBox/Tandem-AutoBox is not supported.

Placing the DS802

The DS802 requires:

- One slot (without extension module)
- One slot and one additional bracket (with extension module)

The placing of the DS802 depends on whether it is installed in a slave or a master box.

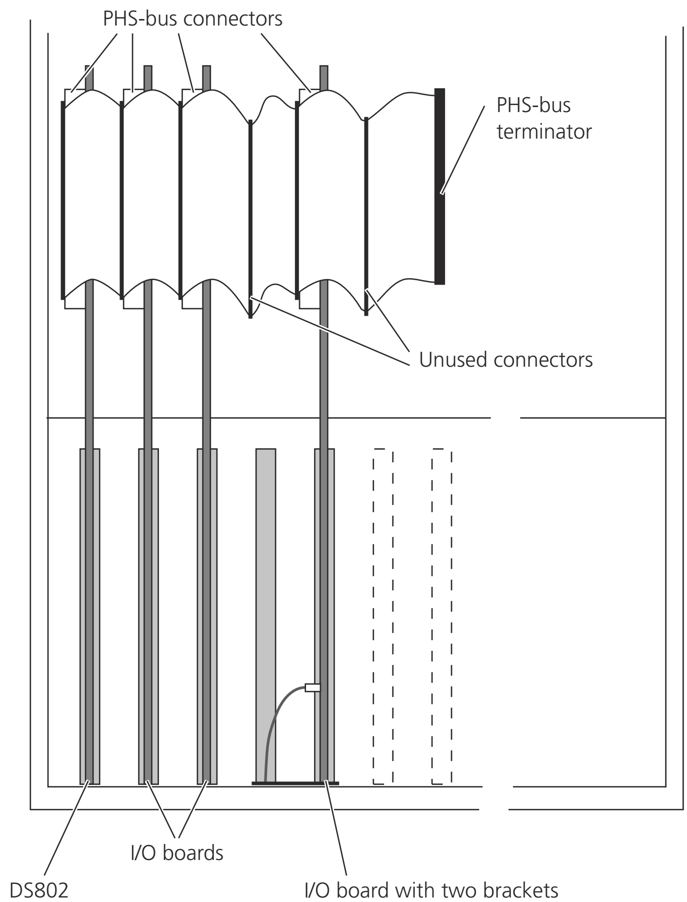
Placing the DS802 in a master box Insert the DS802 like an I/O board in one of the slots which are not required for the processor board.

Tip

It is easier to replace the DS802 if you mount it next to the outermost I/O board.

Placing the DS802 in a slave box Insert the DS802 in the leftmost slot in the expansion box as shown below.

The PHS-bus terminator must be placed next to the outermost I/O board, not next to the DS802.

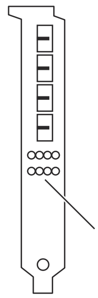


Master/slave configuration

The DS802 automatically detects whether it has to act as a master or as a slave. No further configuration is necessary. If a malfunction occurs, the automatic detection can be overwritten via jumpers. For details, refer to DS802 Board Overview (PHS Bus System Hardware Reference 📖).

Identification via status LEDs If no fiber-optic cable is connected to the DS802, the status LEDs (on the board's bracket) display the master/slave usage.

- All LEDs lit *green*: The DS802 is installed in a master box (= processor board inside).
- All LEDs lit *orange*: The DS802 is used in a slave box (= no processor board inside).



For further details on the status LEDs, refer to DS802 Status LEDs (PHS Bus System Hardware Reference 📖).

PHS-bus address setting

To identify the I/O boards (and also the DS802) in a PHS-bus-based system unambiguously, all the boards used in the system must have different PHS-bus addresses. The following rules apply to the DS802:

- DS802 installed in a *master box*

  Each DS802 is treated as an I/O board, and the configured address must be unique and differ from the settings of other I/O boards (master box and connected slave boxes) used in the PHS-bus-based system. Do not set the DS802 to the PHS-bus base address 00H. This setting might cause malfunctions.
- DS802 installed in a *slave box*

  Unlike the I/O boards used in a slave box, the PHS-bus address of the DS802 is ignored. Therefore the setting has no effect.

For instructions, refer to How to Set the PHS-bus Address on page 84.

Mounting the extension module

If you order a board with an extension module, they will be sent to you with the module already mounted. If you want to extend any of your existing DS802 boards, send it/them back to dSPACE (local representative) for an upgrade. You cannot mount the extension modules yourself.

Putting the DS802 into Operation

Connecting the boxes

Before you power up your PHS-bus-based system, all connection work has to be completed, including the connection between master and slave boxes.

It does not matter which ports (fiber-optic connector) you use to connect a master box to a slave box. All ports provide the same functionality.

Switching on a system with DS802

After the boxes are connected, you can switch on the system.

To avoid unpredictable errors, you should always apply the following sequence:

1. Turn on the expansion boxes used as slave boxes.
2. Turn on the expansion box used as master box.
3. Turn on the host PC.

Identifying the connection status

The DS802 is equipped with eight status LEDs, which display the current status of the connection. Each LED belongs to one fiber-optic connector (communication port).

The LEDs are located on the bracket of the DS802. For the meaning of the display, refer to DS802 Status LEDs (PHS Bus System Hardware Reference 📖).

Displaying the DS802 in ControlDesk

After you have registered your PHS-bus-based system in ControlDesk, the DS802 is displayed in the Platform Navigator. You can identify a partitioned PHS-bus-based system by a board-specific entry. For details, refer to Board Details Properties (ControlDesk Platform Management 📖).

Switching off a system with DS802

To avoid unpredictable errors, you should always apply the following sequence:

1. Shut down the host PC and turn it off.
2. Turn off the expansion boxes (master and slave boxes).

Related topics

HowTos

How to Switch Off a dSPACE System.. 72
How to Switch On the dSPACE System... 72

Uninstalling the System

Introduction

All components of a dSPACE system, software and hardware, can be removed from the host PC in the following order:

1. You have to remove the software first. For further information, refer to Removing dSPACE Software (Installing dSPACE Software 📖).
2. Afterwards you can remove the hardware.

Where to go from here

Information in this section

How to Remove Hardware from the Host PC

Objective

As the simulator is connected to the host PC via a bus interface, the link boards (PC) must be removed. The DS815 can simply be ejected from the host PC.

Preconditions

- The system is switched off.
- Precautions are taken to avoid damage by high electrostatic voltages. For details, refer to Safety Precautions for Installing and Connecting dSPACE Boards on page 26.

Method

To remove dSPACE hardware from the host PC

⚠ WARNING

Hazardous voltages

Risk of electric shock and/or damage to the hardware.

Before removing any board, make sure that:
- The power supply of the host PC and the simulator are switched off.
- No external device is connected to the dSPACE system.

1. Disconnect the host PC, the simulator and all external devices connected to them from the power supply.
2. Open the enclosure of the host PC.
3. Remove the boards from the slots.
4. Reinstall the original brackets to cover the openings at the rear side of the enclosure.
5. Close the enclosure, reconnect the PC to the power supply, and turn it on.

Result

The host PC should boot as usual.

Related topics

HowTos

How to Switch Off a dSPACE System.. 72

How to Remove Hardware from the Simulator

Objective

The following instructions will guide you through the uninstallation of boards in the PX5 expansion box of the simulator.

Preconditions

- The system is switched off.
- Precautions are taken to avoid damage by high electrostatic voltages. For details, refer to Safety Precautions for Installing and Connecting dSPACE Boards on page 26.

Method

To remove dSPACE hardware from the simulator

> **⚠ WARNING**
>
> **Hazardous voltages**
>
> **Risk of electric shock and/or damage to the hardware.**
>
> Before doing any installation work, make sure that:
> - The power supply of the host PC and the dSPACE Simulator Mid-Size are switched off.
> - No external device is connected to the dSPACE system.

1. Switch of the host PC, the simulator and all external devices. For instructions, refer to How to Switch Off a dSPACE System on page 72.
2. Disconnect the host PC, the simulator and all external devices from the power supply.
3. Open the backplate of the simulator.
4. Remove all cables connected to the PX5 expansion box.
5. Pull the PX5 expansion box out of the simulator (from the simulator's front side).
6. Open the PX5 expansion box.

   > **⚠ WARNING**
   >
   > CAUTION! Improper handling will damage the fan of the board and/or Gigalink module.
   > Do not touch any components of the fan, either during operation or when it has stopped.
   > Do not apply pressure to the fan bearing during installation and deinstallation of the board.

7. Beginning with the processor board, remove the PHS-bus cable from the board and remove the board itself.
8. Repeat this procedure until you have removed all boards.

Next step

Now you can rearrange your simulator.

Related topics

HowTos

Pinouts

Introduction

The following show the pinouts of all relevant connectors, switches, and jumpers of the simulator.

Where to go from here

Information in this section

The following topics show the pinouts of the simulator if a DS2211 is built in (standard use case).

The following topics show the pinouts of the DS2211.

DS2211 Components (PHS Bus System Hardware Reference 📖)
Contains an illustration of the board, and shows the pinout of the different board connectors.

Instead of a DS2211, a DS2202 can be built in the simulator. The following topics show the pinouts in this case.

The following topics show the pinouts of the DS2202.

DS2202 Components (PHS Bus System Hardware Reference 📖)
Contains an illustration of the board, and shows the pinout of the different I/O connectors.

Connectors on the Front

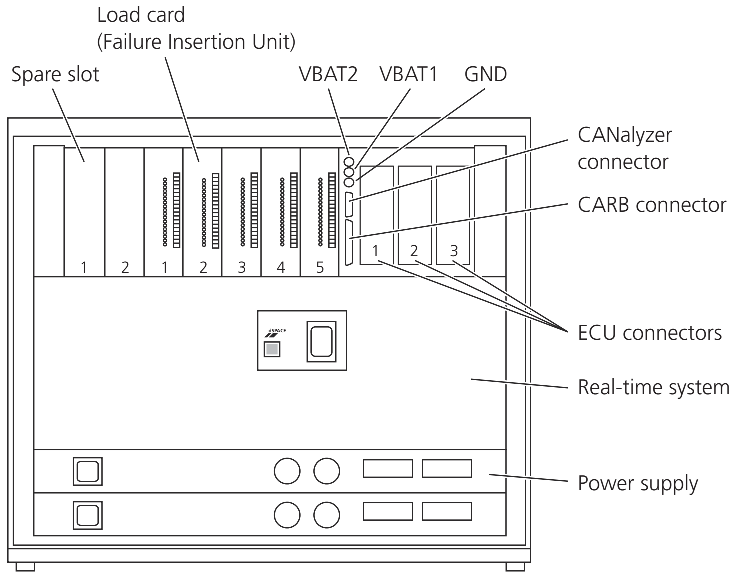
Where to go from here

Information in this section

Overview of the Front Connectors

Front view

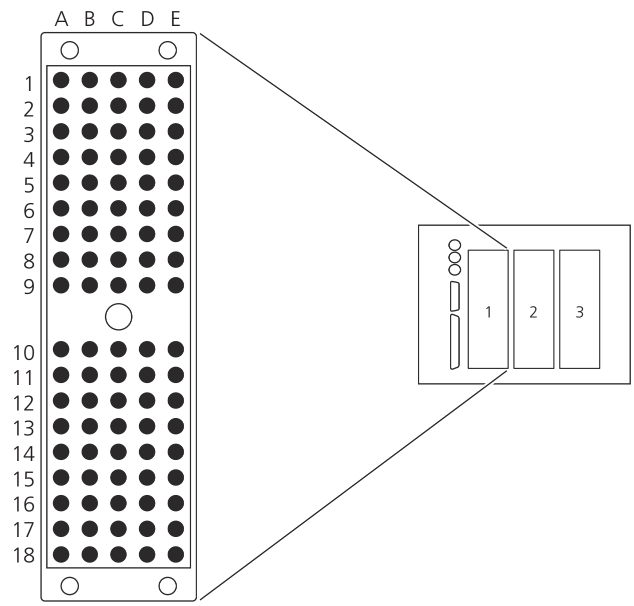
The following illustration shows the front view of the Load/FIU unit:



ECU 1 Connector Pinout

ECU 1 connector

The ECU 1 connector is located on the simulator front panel (see Connectors on the Front on page 122).



Pinout

The following table shows the pinout of this connector.

Row	Column A	Column B	Column C	Column D	Column E
1	CARB1	SWREL13-	DIG_IN1	PWM_IN3	AUXCAP1
2	CARB2	GND	DIG_IN2	PWM_IN4	AUXCAP2
3	CARB3	GND	DIG_IN3	PWM_IN5	ADC1
4	CARB4	VBAT2A	DIG_IN4	PWM_IN6	ADC2
5	CARB5	VSW21a	DIG_IN5	PWM_IN7	ADC3
6	VBAT1A	VSW22a	DIG_IN6	PWM_IN8	ADC4
7	VBAT1B	VSW23a	DIG_IN7	INJ1	ADC5
8	VSW11A	SWREL21+	DIG_IN8	INJ2	ADC6
9	VSW11B	SWREL21-	DIG_IN9	INJ3	ADC7
10	VSW12A	SWREL22+	DIG_IN10	INJ4	ADC8
11	VSW12B	SWREL22-	DIG_IN11	INJ5	ADC9
12	VSW13A	SWREL23+	DIG_IN12	INJ6	ADC10
13	VSW13B	SWREL23-	DIG_IN13	IGN1	ADC11
14	SWREL11+	GND	DIG_IN14	IGN2	ADC12
15	SWREL11-	GND	DIG_IN15	IGN3	GND
16	SWREL12+	GND	DIG_IN16	IGN4	+12V

Row	Column A	Column B	Column C	Column D	Column E
17	SWREL12-	GND	PWM_IN1	IGN5	+5V
18	SWREL13+	GND	PWM_IN2	IGN6	-12V

Signal description

The following table gives a short description of the signals:

Pin	Signal	Description	Voltage Range/Output Current
A1	CARB1	Connection to CARB connector	–
A2	CARB2	Connection to CARB connector	–
A3	CARB3	Connection to CARB connector	–
A4	CARB4	Connection to CARB connector	–
A5	CARB5	Connection to CARB connector	–
A6	VBAT1A	Voltage of power supply 1	VBAT1, Imax = 8 A
A7	VBAT1B	Voltage of power supply 1	VBAT1, Imax = 8 A
A8	VSW11A	Switched battery rail 1 of power supply 1	VBAT1, Imax = 8 A
A9	VSW11B	Switched battery rail 1 of power supply 1	VBAT1, Imax = 8 A
A10	VSW12A	Switched battery rail 2 of power supply 1	VBAT1, Imax = 8 A
A11	VSW12B	Switched battery rail 2 of power supply 1	VBAT1, Imax = 8 A
A12	VSW13A	Switched battery rail 3 of power supply 1	VBAT1, Imax = 8 A
A13	VSW13B	Switched battery rail 3 of power supply 1	VBAT1, Imax = 8 A
A14	SWREL11+	Control battery rail 1 of power supply 1	Voltage for switching: (SWREL11+ – SWREL11-) > 8 V
A15	SWREL11-	Control battery rail 1 of power supply 1	Voltage for switching: (SWREL11+ – SWREL11-) > 8 V
A16	SWREL12+	Control battery rail 2 of power supply 1	Voltage for switching: (SWREL12+ – SWREL12-) > 8 V
A17	SWREL12-	Control battery rail 2 of power supply 1	Voltage for switching: (SWREL12+ – SWREL12-) > 8 V
A18	SWREL13+	Control battery rail 3 of power supply 1	Voltage for switching: (SWREL13+ – SWREL13-) > 8 V
B1	SWREL13-	Control battery rail 3 of power supply 1	Voltage for switching: (SWREL13+ – SWREL13-) > 8 V
B2	GND	Ground	Imax = 8 A
B3	GND	Ground	Imax = 8 A
B4	VBAT2a	Voltage of power supply 2	VBAT2, Imax = 6 A
B5	VSW21a	Switched battery rail 1 of power supply 2	VBAT2, Imax = 6 A
B6	VSW22a	Switched battery rail 2 of power supply 2	VBAT2, Imax = 6 A
B7	VSW23a	Switched battery rail 3 of power supply 2	VBAT2, Imax = 6 A
B8	SWREL21+	Control battery rail 1 of power supply 2	Voltage for switching: (SWREL21+ – SWREL21-) > 8 V
B9	SWREL21-	Control battery rail 1 of power supply 2	Voltage for switching: (SWREL21+ – SWREL21-) > 8 V
B10	SWREL22+	Control battery rail 2 of power supply 2	Voltage for switching: (SWREL22+ – SWREL22-) > 8 V
B11	SWREL22-	Control battery rail 2 of power supply 2	Voltage for switching: (SWREL22+ – SWREL22-) > 8 V
B12	SWREL23+	Control battery rail 3 of power supply 2	Voltage for switching: (SWREL23+ – SWREL23-) > 8 V
B13	SWREL23-	Control battery rail 3 of power supply 2	Voltage for switching: (SWREL23+ – SWREL23-) > 8 V
B14	GND	Ground	Imax = 8 A
B15	GND	Ground	Imax = 8 A
B16	GND	Ground	Imax = 8 A

Pin	Signal	Description	Voltage Range/Output Current
B17	GND	Ground	Imax = 8 A
B18	GND	Ground	Imax = 8 A
C1	DIG_IN1 / PWM_IN9	Digital input / PWM signal measurement	12/42 V compatible
C2	DIG_IN2 / PWM_IN10	Digital input / PWM signal measurement	12/42 V compatible
C3	DIG_IN3 / PWM_IN11	Digital input / PWM signal measurement	12/42 V compatible
C4	DIG_IN4 / PWM_IN12	Digital input / PWM signal measurement	12/42 V compatible
C5	DIG_IN5 / PWM_IN13	Digital input / PWM signal measurement	12/42 V compatible
C6	DIG_IN6 / PWM_IN14	Digital input / PWM signal measurement	12/42 V compatible
C7	DIG_IN7 / PWM_IN15	Digital input / PWM signal measurement	12/42 V compatible
C8	DIG_IN8 / PWM_IN16	Digital input / PWM signal measurement	12/42 V compatible
C9	DIG_IN9 / PWM_IN17	Digital input / PWM signal measurement	12/42 V compatible
C10	DIG_IN10 / PWM_IN18	Digital input / PWM signal measurement	12/42 V compatible
C11	DIG_IN11 / PWM_IN19	Digital input / PWM signal measurement	12/42 V compatible
C12	DIG_IN12 / PWM_IN20	Digital input / PWM signal measurement	12/42 V compatible
C13	DIG_IN13 / PWM_IN21	Digital input / PWM signal measurement	12/42 V compatible
C14	DIG_IN14 / PWM_IN22	Digital input / PWM signal measurement	12/42 V compatible
C15	DIG_IN15 / PWM_IN23	Digital input / PWM signal measurement	12/42 V compatible
C16	DIG_IN16 / PWM_IN24	Digital input / PWM signal measurement	12/42 V compatible
C17	PWM_IN1	PWM signal measurement	12/42 V compatible
C18	PWM_IN2	PWM signal measurement	12/42 V compatible
D1	PWM_IN3	PWM signal measurement	12/42 V compatible
D2	PWM_IN4	PWM signal measurement	12/42 V compatible
D3	PWM_IN5	PWM signal measurement	12/42 V compatible
D4	PWM_IN6	PWM signal measurement	12/42 V compatible
D5	PWM_IN7 / INJ7	PWM signal measurement / Injection capture	12/42 V compatible
D6	PWM_IN8 / INJ8	PWM signal measurement / Injection capture	12/42 V compatible

Pin	Signal	Description	Voltage Range/Output Current
D7	INJ1	Injection capture	12/42 V compatible
D8	INJ2	Injection capture	12/42 V compatible
D9	INJ3	Injection capture	12/42 V compatible
D10	INJ4	Injection capture	12/42 V compatible
D11	INJ5	Injection capture	12/42 V compatible
D12	INJ6	Injection capture	12/42 V compatible
D13	IGN1	Ignition capture	12/42 V compatible
D14	IGN2	Ignition capture	12/42 V compatible
D15	IGN3	Ignition capture	12/42 V compatible
D16	IGN4	Ignition capture	12/42 V compatible
D17	IGN5	Ignition capture	12/42 V compatible
D18	IGN6	Ignition capture	12/42 V compatible
E1	AUXCAP1	Auxiliary capture	12/42 V compatible
E2	AUXCAP2	Auxiliary capture	12/42 V compatible
E3	ADC1	14-bit ADC	(ADC1 – $\overline{\text{ADC1}}$) = 0 … 60 V
E4	ADC2	14-bit ADC	(ADC2 – $\overline{\text{ADC2}}$) = 0 … 60 V
E5	ADC3	14-bit ADC	(ADC3 – $\overline{\text{ADC3}}$) = 0 … 60 V
E6	ADC4	14-bit ADC	(ADC4 – $\overline{\text{ADC4}}$) = 0 … 60 V
E7	ADC5	14-bit ADC	(ADC5 – $\overline{\text{ADC5}}$) = 0 … 60 V
E8	ADC6	14-bit ADC	(ADC6 – $\overline{\text{ADC6}}$) = 0 … 60 V
E9	ADC7	14-bit ADC	(ADC7 – $\overline{\text{ADC7}}$) = 0 … 60 V
E10	ADC8	14-bit ADC	(ADC8 – $\overline{\text{ADC8}}$) = 0 … 60 V
E11	ADC9	14-bit ADC	(ADC9 – $\overline{\text{ADC9}}$) = 0 … 60 V
E12	ADC10	14-bit ADC	(ADC10 – $\overline{\text{ADC10}}$) = 0 … 60 V
E13	ADC11	14-bit ADC	(ADC11 – $\overline{\text{ADC11}}$) = 0 … 60 V
E14	ADC12	14-bit ADC	(ADC12 – $\overline{\text{ADC12}}$) = 0 … 60 V
E15	GND	Ground	Imax = 8 A
E16	+12V	–	+12 V, Imax = 750 mA
E17	+5V	–	+5 V, Imax = 750 mA
E18	-12V	–	-12 V, Imax = 750 mA

Related topics

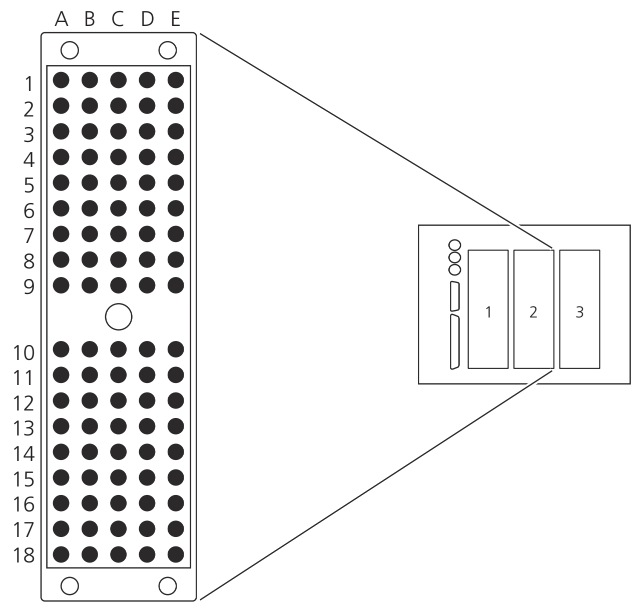
References

ECU 2 Connector Pinout....................128
ECU 3 Connector Pinout....................132

ECU 2 Connector Pinout

ECU 2 connector

The ECU 2 connector is located on the simulator front panel (see Connectors on the Front on page 122).



Pinout

The following table shows the pinout of this connector.

Row	Column A	Column B	Column C	Column D	Column E
1	ADC13	$\overline{\text{ADC13}}$	DAC1	$\overline{\text{DAC1}}$	DAC2
2	$\overline{\text{DAC2}}$	SGND	DAC3	$\overline{\text{DAC3}}$	DAC4
3	$\overline{\text{DAC4}}$	DAC5	$\overline{\text{DAC5}}$	DAC6	$\overline{\text{DAC6}}$
4	DAC7	$\overline{\text{DAC7}}$	DAC8	$\overline{\text{DAC8}}$	DAC9
5	$\overline{\text{DAC9}}$	DAC10	$\overline{\text{DAC10}}$	DAC11	$\overline{\text{DAC11}}$
6	RES1+	RES1-	RES2+	RES2-	RES3+
7	RES3-	GND	RES4+	RES4-	GND
8	RES5+	RES5-	RES6+	RES6-	DIG_OUT1
9	GND	DIG_OUT2	DIG_OUT3	DIG_OUT4	DIG_OUT5
10	DIG_OUT6	DIG_OUT7	DIG_OUT8	DIG_OUT9	DIG_OUT10
11	DIG_OUT11	DIG_OUT12	DIG_OUT13	DIG_OUT14	DIG_OUT15 / CAM3_DIG
12	DIG_OUT16 / CAM4_DIG	PWM_OUT1	PWM_OUT2	PWM_OUT3	PWM_OUT4
13	PWM_OUT5	PWM_OUT6	CRANK_DIG	CRANK+	CRANK-
14	CAM1+	CAM1-	CAM1_DIG	CAM2+	CAM2-
15	CAM2_DIG	VC33-Waveform0+	VC33-Waveform0-	RXD+	GND
16	GND	VC33-Waveform1+	VC33-Waveform1-	VC33-Waveform2+	VC33-Waveform2-

Row	Column A	Column B	Column C	Column D	Column E
17	VC33-Waveform3+	VC33-Waveform3-	CAN1H	CAN1L	TXD+
18	GND	$\overline{\text{RXD}}$	$\overline{\text{TXD}}$	CAN2H	CAN2L

Note

The GND pins of the ECU 2 and ECU 3 connector are designed for shielding purpose only. Do not connect them to any ECU power ground or an ECU sensor ground, which is internally connected to ECU power ground.

Signal description

The following table gives a short description of the signals:

Pin	Signal	Description	Voltage Range/ Output Current
A1	ADC13	14-bit ADC	(ADC13 – $\overline{\text{ADC13}}$) = 0 … 60 V
A2	$\overline{\text{DAC2}}$	12-bit DAC/20 µs	(DAC2 – $\overline{\text{DAC2}}$) = 0 … 10 V; ±5 mA
A3	$\overline{\text{DAC4}}$	12-bit DAC/20 µs	(DAC4 – $\overline{\text{DAC4}}$) = 0 … 10 V; ±5 mA
A4	DAC7	12-bit DAC/20 µs	(DAC7 – $\overline{\text{DAC7}}$) = 0 … 10 V; ±5 mA
A5	$\overline{\text{DAC9}}$	12-bit DAC/20 µs	(DAC9 – $\overline{\text{DAC9}}$) = 0 … 10 V; ±5 mA
A6	RES1+	Resistance output	Pmax = 250 mW; Imax = ±80 mA
A7	RES3-	Resistance output	Pmax = 250 mW; Imax = ±80 mA
A8	RES5+	Resistance output	Pmax = 250 mW; Imax = ±80 mA
A9	GND	Ground	Only for shielding.
A10	DIG_OUT6	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
A11	DIG_OUT11	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
A12	DIG_OUT16 / CAM4_DIG	Digital output / Digital camshaft output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
A13	PWM_OUT5	PWM signal generation	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
A14	CAM1+	Camshaft wave form output	With transformer (AC output mode): (CAM1+ – CAM1–) = ±20 V Bypassed transformer (DC output mode): (CAM1+ – CAM1–) = ±10 V; ±5 mA
A15	CAM2_DIG	Digital camshaft output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
A16	GND	Ground	Only for shielding.
A17	VC33-Waveform3+	Knock sensor / wheel speed sensor signal	(VC33-Waveform3+ – VC33-Waveform3–) = ±20 V
A18	GND	Ground	Only for shielding.
B1	$\overline{\text{ADC13}}$	14-bit ADC	(ADC13 – $\overline{\text{ADC13}}$) = 0 … 60 V
B2	SGND	Signal ground	–
B3	DAC5	12-bit DAC/20 µs	(DAC5 – $\overline{\text{DAC5}}$) = 0 … 10 V; ±5 mA
B4	$\overline{\text{DAC7}}$	12-bit DAC/20 µs	(DAC7 – $\overline{\text{DAC7}}$) = 0 … 10 V; ±5 mA
B5	DAC10	12-bit DAC/20 µs	(DAC10 – $\overline{\text{DAC10}}$) = 0 … 10 V; ±5 mA
B6	RES1-	Resistance output	Pmax = 250 mW; Imax = ±80 mA
B7	GND	Ground	Only for shielding.
B8	RES5-	Resistance output	Pmax = 250 mW; Imax = ±80 mA

Pin	Signal	Description	Voltage Range/ Output Current
B9	DIG_OUT2	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
B10	DIG_OUT7	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
B11	DIG_OUT12	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
B12	PWM_OUT1	PWM signal generation	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
B13	PWM_OUT6	PWM signal generation	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
B14	CAM1-	Camshaft wave form output	With transformer (AC output mode): (CAM1+ – CAM1–) = ±20 V Bypassed transformer (DC output mode): (CAM1+ – CAM1–) = ±10 V; ±5 mA
B15	VC33-Waveform0+	Knock sensor / wheel speed sensor signal	(VC33-Waveform0+ – VC33-Waveform0–) = ±20 V
B16	VC33-Waveform1+	Knock sensor / wheel speed sensor signal	(VC33-Waveform1+ – VC33-Waveform1–) = ±20 V
B17	VC33-Waveform3-	Knock sensor / wheel speed sensor signal	(VC33-Waveform3+ – VC33-Waveform3–) = ±20 V
B18	$\overline{\text{RXD}}$	RS422 receive	RS422
C1	DAC1	12-bit DAC/20 µs	(DAC1 – $\overline{\text{DAC1}}$) = 0 … 10 V; ±5 mA
C2	DAC3	12-bit DAC/20 µs	(DAC3 – $\overline{\text{DAC3}}$) = 0 … 10 V; ±5 mA
C3	$\overline{\text{DAC5}}$	12-bit DAC/20 µs	(DAC5 – $\overline{\text{DAC5}}$) = 0 … 10 V; ±5 mA
C4	DAC8	12-bit DAC/20 µs	(DAC8 – $\overline{\text{DAC8}}$) = 0 … 10 V; ±5 mA
C5	$\overline{\text{DAC10}}$	12-bit DAC/20 µs	(DAC10 – $\overline{\text{DAC10}}$) = 0 … 10 V; ±5 mA
C6	RES2+	Resistance output	Pmax = 250 mW; Imax = ±80 mA
C7	RES4+	Resistance output	Pmax = 250 mW; Imax = ±80 mA
C8	RES6+	Resistance output	Pmax = 250 mW; Imax = ±80 mA
C9	DIG_OUT3	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
C10	DIG_OUT8	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
C11	DIG_OUT13	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
C12	PWM_OUT2	PWM signal generation	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
C13	CRANK_DIG	Digital crankshaft output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
C14	CAM1_DIG	Digital camshaft output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
C15	VC33-Waveform0-	Knock sensor / wheel speed sensor signal	(VC33-Waveform0+ – VC33-Waveform0–) = ±20 V
C16	VC33-Waveform1-	Knock sensor / wheel speed sensor signal	(VC33-Waveform1+ – VC33-Waveform1–) = ±20 V
C17	CAN1H	CAN bus interface 1 high	ISO 11898
C18	$\overline{\text{TXD}}$	RS422 transmit	RS422
D1	$\overline{\text{DAC1}}$	12-bit DAC/20 µs	(DAC1 – $\overline{\text{DAC1}}$) = 0 … 10 V; ±5 mA
D2	$\overline{\text{DAC3}}$	12-bit DAC/20 µs	(DAC3 – $\overline{\text{DAC3}}$) = 0 … 10 V; ±5 mA
D3	DAC6	12-bit DAC/20 µs	(DAC6 – $\overline{\text{DAC6}}$) = 0 … 10 V; ±5 mA
D4	$\overline{\text{DAC8}}$	12-bit DAC/20 µs	(DAC8 – $\overline{\text{DAC8}}$) = 0 … 10 V; ±5 mA
D5	DAC11	12-bit DAC/20 µs	(DAC11 – $\overline{\text{DAC11}}$) = 0 … 10 V; ±5 mA
D6	RES2-	Resistance output	Pmax = 250 mW; Imax = ±80 mA
D7	RES4-	Resistance output	Pmax = 250 mW; Imax = ±80 mA

Pin	Signal	Description	Voltage Range/ Output Current
D8	RES6-	Resistance output	Pmax = 250 mW; Imax = ±80 mA
D9	DIG_OUT4	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
D10	DIG_OUT9	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
D11	DIG_OUT14	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
D12	PWM_OUT3	PWM signal generation	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
D13	CRANK+	Crankshaft wave form output	With transformer (AC output mode): (CRANK+ – CRANK–) = ±20 V Bypassed transformer (DC output mode): (CRANK+ – CRANK–) = ±10 V; ±5 mA
D14	CAM2+	Camshaft wave form output	With transformer (AC output mode): (CAM2+ – CAM2–) = ±20 V Bypassed transformer (DC output mode): (CAM2+ – CAM2–) = ±10 V; ±5 mA
D15	RXD+	RS232/RS422 receive	RS232/RS422
D16	VC33-Waveform2+	Knock sensor / wheel speed sensor signal	(VC33-Waveform2+ – VC33-Waveform2–) = ±20 V
D17	CAN1L	CAN bus interface 1 low	ISO 11898
D18	CAN2H	CAN bus interface 2 high	ISO 11898
E1	DAC2	12-bit DAC/20 µs	(DAC2 – $\overline{\text{DAC2}}$) = 0 … 10 V; ±5 mA
E2	DAC4	12-bit DAC/20 µs	(DAC4 – $\overline{\text{DAC4}}$) = 0 … 10 V; ±5 mA
E3	$\overline{\text{DAC6}}$	12-bit DAC/20 µs	(DAC6 – $\overline{\text{DAC6}}$) = 0 … 10 V; ±5 mA
E4	DAC9	12-bit DAC/20 µs	(DAC9 – $\overline{\text{DAC9}}$) = 0 … 10 V; ±5 mA
E5	$\overline{\text{DAC11}}$	12-bit DAC/20 µs	(DAC11 – $\overline{\text{DAC11}}$) = 0 … 10 V; ±5 mA
E6	RES3+	Resistance output	Pmax = 250 mW; Imax = ±80 mA
E7	GND	Ground	–
E8	DIG_OUT1	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
E9	DIG_OUT5	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
E10	DIG_OUT10	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
E11	DIG_OUT15 / CAM3_DIG	Digital output / Digital camshaft output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
E12	PWM_OUT4	PWM signal generation	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
E13	CRANK-	Crankshaft wave form output	With transformer (AC output mode): (CRANK+ – CRANK–) = ±20 V Bypassed transformer (DC output mode): (CRANK+ – CRANK–) = ±10 V; ±5 mA
E14	CAM2-	Camshaft wave form output	With transformer (AC output mode): (CAM2+ – CAM2–) = ±20 V Bypassed transformer (DC output mode): (CAM2+ – CAM2–) = ±10 V; ±5 mA
E15	GND	Ground	Only for shielding.
E16	VC33-Waveform2-	Knock sensor / wheel speed sensor signal	(VC33-Waveform2+ – VC33-Waveform2–) = ±20 V
E17	TXD+	RS232/RS422 transmit	RS232/RS422
E18	CAN2L	CAN bus interface 2 low	ISO 11898

Related topics

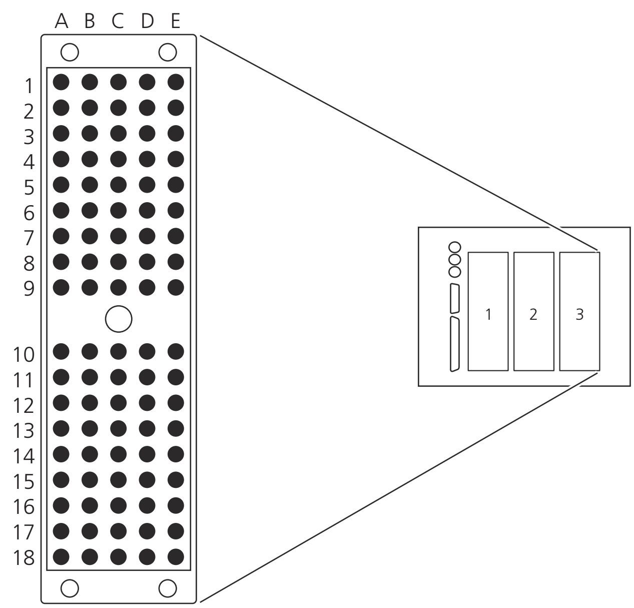
References

ECU 1 Connector Pinout....124
ECU 3 Connector Pinout....132

ECU 3 Connector Pinout

ECU 3 connector

The ECU 3 connector is located on the simulator front panel (see Connectors on the Front on page 122).



Pinout

The following table shows the pinout of this connector.

Row	Column A	Column B	Column C	Column D	Column E
1	Reserved	Reserved	–	–	–
2	DAC13	SGND	–	–	–
3	$\overline{\text{DAC13}}$	DAC14	$\overline{\text{DAC14}}$	–	–
4	DAC15	$\overline{\text{DAC15}}$	DAC16	–	–
5	$\overline{\text{DAC16}}$	DAC17	$\overline{\text{DAC17}}$	–	–
6	DAC18	$\overline{\text{DAC18}}$	DAC19	–	–
7	$\overline{\text{DAC19}}$	GND	DAC20	–	–
8	$\overline{\text{DAC20}}$	RES7+	RES7-	–	–
9	GND	RES8+	RES8-	–	–

Row	Column A	Column B	Column C	Column D	Column E
10	RES9+	RES9-	RES10+	–	–
11	RES10-	$\overline{\text{ADC1}}$	$\overline{\text{ADC2}}$	–	–
12	$\overline{\text{ADC3}}$	$\overline{\text{ADC4}}$	$\overline{\text{ADC5}}$	–	–
13	$\overline{\text{ADC6}}$	$\overline{\text{ADC7}}$	$\overline{\text{ADC8}}$	–	–
14	$\overline{\text{ADC9}}$	$\overline{\text{ADC10}}$	$\overline{\text{ADC11}}$	–	–
15	$\overline{\text{ADC12}}$	DSP_DAC4	DSP_DAC5	–	–
16	GND	DSP_DAC6	DSP_DAC7	–	–
17	PWM_OUT7	PWM_OUT8	–	–	–
18	GND	PWM_OUT9	–	–	–

Note

The GND pins of the ECU 2 and ECU 3 connector are designed for shielding purpose only. Do not connect them to any ECU power ground or an ECU sensor ground, which is internally connected to ECU power ground.

Signal description

The following table gives a short description of the signals.

Pin	Signal	Description	Voltage Range/ Output Current
A1	Reserved	Reserved	–
A2	DAC13	12-bit DAC/20 µs	(DAC13 – $\overline{\text{DAC13}}$) = 0 … 10 V; ±5 mA
A3	$\overline{\text{DAC13}}$	12-bit DAC/20 µs	(DAC13 – $\overline{\text{DAC13}}$) = 0 … 10 V; ±5 mA
A4	DAC15	12-bit DAC/20 µs	(DAC15 – $\overline{\text{DAC15}}$) = 0 … 10 V; ±5 mA
A5	$\overline{\text{DAC16}}$	12-bit DAC/20 µs	(DAC16 – $\overline{\text{DAC16}}$) = 0 … 10 V; ±5 mA
A6	DAC18	12-bit DAC/20 µs	(DAC18 – $\overline{\text{DAC18}}$) = 0 … 10 V; ±5 mA
A7	$\overline{\text{DAC19}}$	12-bit DAC/20 µs	(DAC19 – $\overline{\text{DAC19}}$) = 0 … 10 V; ±5 mA
A8	$\overline{\text{DAC20}}$	12-bit DAC/20 µs	(DAC20 – $\overline{\text{DAC20}}$) = 0 … 10 V; ±5 mA
A9	GND	Ground	Only for shielding.
A10	RES9+	Resistance output	Pmax = 250 mW; Imax = ±80 mA
A11	RES10-	Resistance output	Pmax = 250 mW; Imax = ±80 mA
A12	$\overline{\text{ADC3}}$	14-bit ADC	(ADC3 – $\overline{\text{ADC3}}$) = 0 … 60 V
A13	$\overline{\text{ADC6}}$	14-bit ADC	(ADC6 – $\overline{\text{ADC6}}$) = 0 … 60 V
A14	$\overline{\text{ADC9}}$	14-bit ADC	(ADC9 – $\overline{\text{ADC9}}$) = 0 … 60 V
A15	$\overline{\text{ADC12}}$	14-bit ADC	(ADC12 – $\overline{\text{ADC12}}$) = 0 … 60 V
A16	GND	Ground	Only for shielding.
A17	PWM_OUT7	PWM signal generation	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
A18	GND	Ground	Only for shielding.
B1	Reserved	Reserved	–
B2	SGND	Signal ground	–
B3	DAC14	12-bit DAC/20 µs	(DAC14 – $\overline{\text{DAC14}}$) = 0 … 10 V; ±5 mA
B4	$\overline{\text{DAC15}}$	12-bit DAC/20 µs	(DAC15 – $\overline{\text{DAC15}}$) = 0 … 10 V; ±5 mA

Pin	Signal	Description	Voltage Range/ Output Current
B5	DAC17	12-bit DAC/20 µs	(DAC17 – $\overline{\text{DAC17}}$) = 0 … 10 V; ±5 mA
B6	$\overline{\text{DAC18}}$	12-bit DAC/20 µs	(DAC18 – $\overline{\text{DAC18}}$) = 0 … 10 V; ±5 mA
B7	GND	Ground	Only for shielding.
B8	RES7+	Resistance output	Pmax = 250 mW; Imax = ±80 mA
B9	RES8+	Resistance output	Pmax = 250 mW; Imax = ±80 mA
B10	RES9-	Resistance output	Pmax = 250 mW; Imax = ±80 mA
B11	$\overline{\text{ADC1}}$	14-bit ADC	(ADC1 – $\overline{\text{ADC1}}$) = 0 … 60 V
B12	$\overline{\text{ADC4}}$	14-bit ADC	(ADC4 – $\overline{\text{ADC4}}$) = 0 … 60 V
B13	$\overline{\text{ADC7}}$	14-bit ADC	(ADC7 – $\overline{\text{ADC7}}$) = 0 … 60 V
B14	$\overline{\text{ADC10}}$	14-bit ADC	(ADC10 – $\overline{\text{ADC10}}$) = 0 … 60 V
B15	DSP_DAC4	12-bit DAC/10 µs	(DSP DAC4 – GND) = ±10 V; ±5 mA
B16	DSP_DAC6	12-bit DAC/10 µs	(DSP DAC6 – GND) = ±10 V; ±5 mA
B17	PWM_OUT8	PWM signal generation	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
B18	PWM_OUT9	PWM signal generation	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
C1	–	Unused	–
C2	–	Unused	–
C3	$\overline{\text{DAC14}}$	12-bit DAC/20 µs	(DAC14 – $\overline{\text{DAC14}}$) = 0 … 10 V; ±5 mA
C4	DAC16	12-bit DAC/20 µs	(DAC16 – $\overline{\text{DAC16}}$) = 0 … 10 V; ±5 mA
C5	$\overline{\text{DAC17}}$	12-bit DAC/20 µs	(DAC17 – $\overline{\text{DAC17}}$) = 0 … 10 V; ±5 mA
C6	DAC19	12-bit DAC/20 µs	(DAC19 – $\overline{\text{DAC19}}$) = 0 … 10 V; ±5 mA
C7	DAC20	12-bit DAC/20 µs	(DAC20 – $\overline{\text{DAC20}}$) = 0 … 10 V; ±5 mA
C8	RES7-	Resistance output	Pmax = 250 mW; Imax = ±80 mA
C9	RES8-	Resistance output	Pmax = 250 mW; Imax = ±80 mA
C10	RES10+	Resistance output	Pmax = 250 mW; Imax = ±80 mA
C11	$\overline{\text{ADC2}}$	14-bit ADC	(ADC2 – $\overline{\text{ADC2}}$) = 0 … 60 V
C12	$\overline{\text{ADC5}}$	14-bit ADC	(ADC5 – $\overline{\text{ADC5}}$) = 0 … 60 V
C13	$\overline{\text{ADC8}}$	14-bit ADC	(ADC8 – $\overline{\text{ADC8}}$) = 0 … 60 V
C14	$\overline{\text{ADC11}}$	14-bit ADC	(ADC11 – $\overline{\text{ADC11}}$) = 0 … 60 V
C15	DSP_DAC5	12-bit DAC/10 µs	(DSP DAC5 – GND) = ±10 V; ±5 mA
C16	DSP_DAC7	12-bit DAC/10 µs	(DSP DAC7 – GND) = ±10 V; ±5 mA
C17	–	Unused	–
C18	–	Unused	–
D1	–	Unused	–
D2	–	Unused	–
D3	–	Unused	–
D4	–	Unused	–
D5	–	Unused	–
D6	–	Unused	–
D7	–	Unused	–
D8	–	Unused	–
D9	–	Unused	–

Pin	Signal	Description	Voltage Range/ Output Current
D10	–	Unused	–
D11	–	Unused	–
D12	–	Unused	–
D13	–	Unused	–
D14	–	Unused	–
D15	–	Unused	–
D16	–	Unused	–
D17	–	Unused	–
D18	–	Unused	–
E1	–	Unused	–
E2	–	Unused	–
E3	–	Unused	–
E4	–	Unused	–
E5	–	Unused	–
E6	–	Unused	–
E7	–	Unused	–
E8	–	Unused	–
E9	–	Unused	–
E10	–	Unused	–
E11	–	Unused	–
E12	–	Unused	–
E13	–	Unused	–
E14	–	Unused	–
E15	–	Unused	–
E16	–	Unused	–
E17	–	Unused	–
E18	–	Unused	–

Related topics

References

ECU 1 Connector Pinout..124
ECU 2 Connector Pinout..128

VBAT1, VBAT2, and GND Connector

Introduction

The VBAT1, VBAT2, and GND connector are located on the simulator front panel. They are 4 mm jack plugs. They can be used to access the battery voltages and ground potential.

⚠ CAUTION

Never connect an external power supply on VBAT1. This would result in a short between internal and external power supply.

Signal description

The following table gives a short description of the signals:

Signal	Description	Voltage Range / Output Current
VBAT1	Voltage of power supply 1	VBAT1 = 0 … 30 V DC[1)] Imax = 1.1 A[2)]
VBAT2	Voltage of power supply 2 (if used)	VBAT2 = 0 … 60 V DC[1)] Imax = 1.1 A
GND	Ground of the power supplies	Imax = 8 A

1) The maximum voltage depends on the type of the power supply built-in the simulator.
2) The VBAT1 connector and the CARB connector are protected by the same fuse. The maximum current is the sum of the currents flowing through the VBAT1 connector and the VBAT1 pin of the CARB connector.

Related topics

Basics

Signal Reference Overview.. 41

References

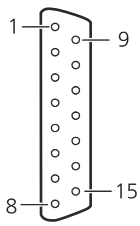
Characteristics and I/O Mapping of the Power Supply Unit (dSPACE Simulator Mid-Size Based on DS2211 Features 📖)

CARB Connector Pinout

CARB connector

The following illustration shows the numbering used (viewed from the front of the simulator).

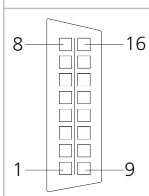
The CARB diagnostic connector is internally connected to the ECU 1 connector, VBAT1 and CAN bus 1. The following table shows the pinouts of the CARB connector and the pins of the ECU connectors that the signals are connected to:

	Pin	Signal	ECU Connector		Pin	Signal	ECU Connector	
			Connector	Pin			Connector	Pin
	1	CARB1	1	A1	9	–	–	–
	2	CARB2	1	A2	10	CAN1L	2	D17
	3	CARB3	1	A3	11	CAN1H	2	C17
	4	CARB4	1	A4	12	–	–	–
	5	CARB5	1	A5	13	–	–	–
	6	GND	1	B2, B3, B14, B15, B16, B17, B18, E15	14	–	–	–
	7	VBAT1[1)]	1	A6, A7	15	–	–	–
	8	–	–	–	–	–	–	–

[1)] The VBAT1 pin and the VBAT1 connector on the front are protected by the same fuse. The maximum current (Imax = 1.1 A) is the sum of the currents.

Standard 16 pin OBD/EOBD connector

dSPACE provides an adapter cable for the Sub-D CARB Connector to the standard 16 pin OBD/EOBD connector. The following table shows the pinouts of the standard 16 pin OBD/EOBD connector and ECU connector that the signals are connected to via the adapter cable:

	CARB Pin	*Signal*	*ECU Connector*		*CARB Pin*	*Signal*	*ECU Connector*	
			Connector	*Pin*			*Connector*	*Pin*
	8	–	–	–	16	VBAT1	1	A6, A7
	7	CARB4	1	A4	15	CARB5	1	A2
	6	CAN1H	2	C17	14	CAN1L	2	D17
	5	GND	1	B2, B3, B14, B15, B16, B17, B18, E15	13	–	–	–
	4	GND	1	B2, B3, B14, B15, B16, B17, B18, E15	12	–	–	–
	3	–	–	–	11	–	–	–
	2	CARB2	1	A2	10	CARB3	1	A3
	1	CARB1	1	A1	9	–	–	–

Related topics

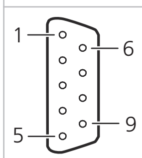
References

Diagnostic Connector (dSPACE Simulator Mid-Size Based on DS2211 Features)
ECU 1 Connector Pinout........ 124
ECU 2 Connector Pinout........ 128

CANalyzer Connector Pinout

CANalyzer connector

The following table shows the pinouts of the CANalyzer connector and the pins of the ECU connectors that the signals are connected to (connector viewed from the front of the simulator):



	Pin	Signal	ECU Connector		Pin	Signal	ECU Connector	
			Connector	Pin			Connector	Pin
	1	–	–	–	6	–	–	–
	2	CAN1L	2	D17	7	CAN1H	2	C17
	3	GND	1	B2, B3, B14, B15, B16, B17, B18, E15	8	–	–	–
	4	–	–	–	9	–	–	–
	5	–	–	–				

Related topics

References

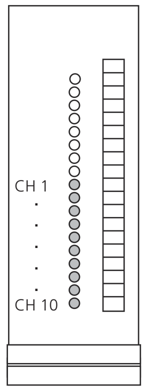
External Load Connectors and Status LEDs

Introduction

The external load connectors and status LEDs are located on the front of dSPACE Simulator Mid-Size. The following tables shows the pinouts of the load cards. The load cards are numbered from left to right.

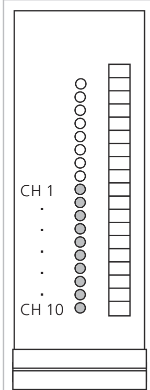
Load card 1

The following table shows the assignment of load card 1:

	Signal	Channel	ECU Connector	Pin
	GND	–	–	–
	VBAT1	–	1	A6
	VSW11	–	1	A8
	VSW12	–	1	A10
	VSW13	–	1	A12
	VBAT2	–	1	B4
	VSW21	–	1	B5
	VSW22	–	1	B6
	VSW23	–	1	B7
	ADC12	1	1	E14
	ADC7	2	1	E9
	ADC2	3	1	E4
	DIG_IN13	4	1	C13
	DIG_IN8	5	1	C8
	DIG_IN3	6	1	C3
	DIG_IN2	7	1	C2
	DIG_IN1	8	1	C1
	AUX_CAP2	9	1	E2
	AUX_CAP1	10	1	E1

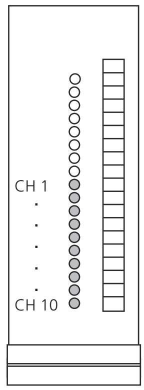
Load card 2

The following table shows the assignment of load card 2:

	Signal	Channel	ECU Connector	Pin
	GND	–	–	–
	VBAT1	–	1	A6
	VSW11	–	1	A8
	VSW12	–	1	A10
	VSW13	–	1	A12
	VBAT2	–	1	B4
	VSW21	–	1	B5
	VSW22	–	1	B6
	VSW23	–	1	B7
	ADC11	1	1	E13
	ADC6	2	1	E8
	ADC1	3	1	E3
	DIG_IN12	4	1	C12
	DIG_IN7	5	1	C7
	PWM_IN8	6	1	D6
	PWM_IN4	7	1	D2
	INJ6	8	1	D12
	INJ5	9	1	D11
	INJ4	10	1	D10

Load card 3

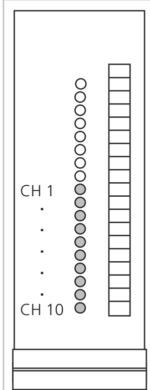
The following table shows the assignment of load card 3:



Signal	Channel	ECU Connector	Pin
GND	–	–	–
VBAT1	–	1	A6
VSW11	–	1	A8
VSW12	–	1	A10
VSW13	–	1	A12
VBAT2	–	1	B4
VSW21	–	1	B5
VSW22	–	1	B6
VSW23	–	1	B7
ADC10	1	1	E12
ADC5	2	1	E7
DIG_IN16	3	1	C16
DIG_IN11	4	1	C11
DIG_IN6	5	1	C6
PWM_IN7	6	1	D5
PWM_IN3	7	1	D1
INJ3	8	1	D9
INJ2	9	1	D8
INJ1	10	1	D7

Load card 4

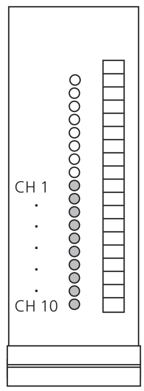
The following table shows the assignment of load card 4:



Signal	Channel	ECU Connector	Pin
GND	–	–	–
VBAT1	–	1	A6
VSW11	–	1	A8
VSW12	–	1	A10
VSW13	–	1	A12
VBAT2	–	1	B4
VSW21	–	1	B5
VSW22	–	1	B6
VSW23	–	1	B7
ADC9	1	1	E11
ADC4	2	1	E6
DIG_IN15	3	1	C15
DIG_IN10	4	1	C10
DIG_IN5	5	1	C5
PWM_IN6	6	1	D4
PWM_IN2	7	1	C18
IGN6	8	1	D18
IGN5	9	1	D17
IGN4	10	1	D16

Load card 5

The following table shows the assignment of load card 5:

	Signal	Channel	ECU Connector	Pin
	GND	–	–	–
	VBAT1	–	1	A6
	VSW11	–	1	A8
	VSW12	–	1	A10
	VSW13	–	1	A12
	VBAT2	–	1	B4
	VSW21	–	1	B5
	VSW22	–	1	B6
	VSW23	–	1	B7
	ADC8	1	1	E10
	ADC3	2	1	E5
	DIG_IN14	3	1	C14
	DIG_IN9	4	1	C9
	DIG_IN4	5	1	C4
	PWM_IN5	6	1	D3
	PWM_IN1	7	1	C17
	IGN3	8	1	D15
	IGN2	9	1	D14
	IGN1	10	1	D13

Related topics

References

Connectors on the Front..122

Connectors, Switches and Jumpers in the Load/FIU Unit

Introduction

The load/FIU unit contains the load cards, the Failure Insertion Units, spare slots, the DS686 Backplane, and the DS685 Midplane.

Where to go from here

Information in this section

Information in other sections

Overview of Connectors, Switches and Jumpers in the Load/FIU Unit

Introduction

The load/FIU unit contains the load cards, the Failure Insertion Units, spare slots, the DS686 Backplane, and the DS685 Midplane.

Load cards/FIUs

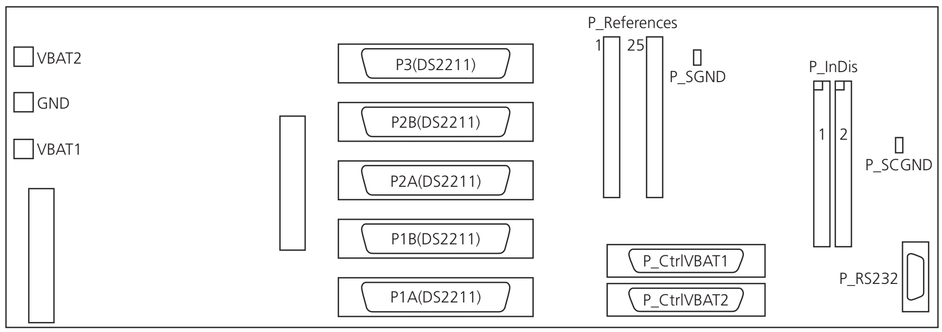
The pinouts of the load cards/FIUs are described in Load Card/FIU Pinout on page 147.

Spare slots

The pinouts of the spare slots are described in Spare Slot 1 Pinout on page 149 and Spare Slot 2 Pinout on page 151.

DS686 Backplane

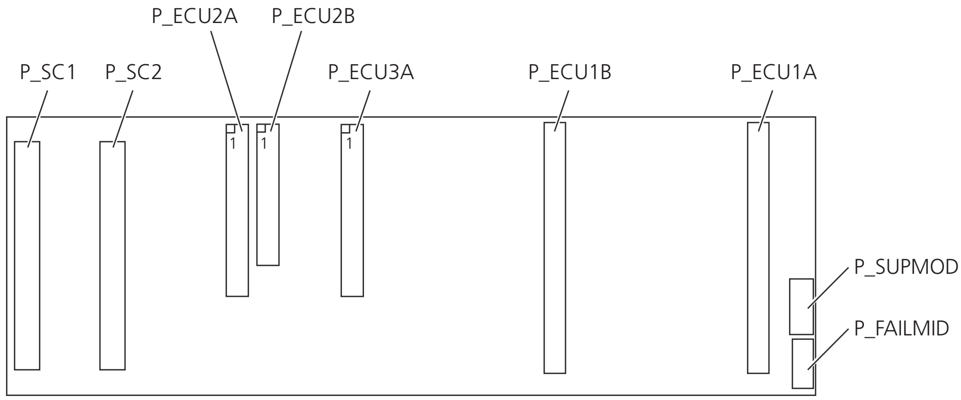
The following illustration shows the top view of the DS686 Backplane (illustration is not complete, only the most important connectors are shown):



The backplane has the following switches, jumpers and connectors on the top side:

Symbol	Description
P_References	See Reference Signal Jumpers on page 153
P_InDis	See Input Disconnect Jumpers on page 152
P1A, P1B, P2A, P2B, P3	DS2211 connectors
P_RS232	RS232/FIU connector
VBAT1, VBAT2, GND	Connectors for the power supplies
P_CtrlVBAT1, P_CtrlVBAT2	Connector for the power supply control
P_SGND	Jumper open: SGND is connected via 470R / 10n to DS686 GND Jumper set: SGND is connected directly to DS686 GND See Signal Reference Overview on page 41
P_SCGND	Jumper open: SCGND is connected via 470R / 10n to DS686 GND Jumper set: SCGND is connected directly to DS686 GND See Signal Reference Overview on page 41

The following illustration shows the bottom view of the DS686 Backplane (illustration is not complete, only the most important connectors are shown):

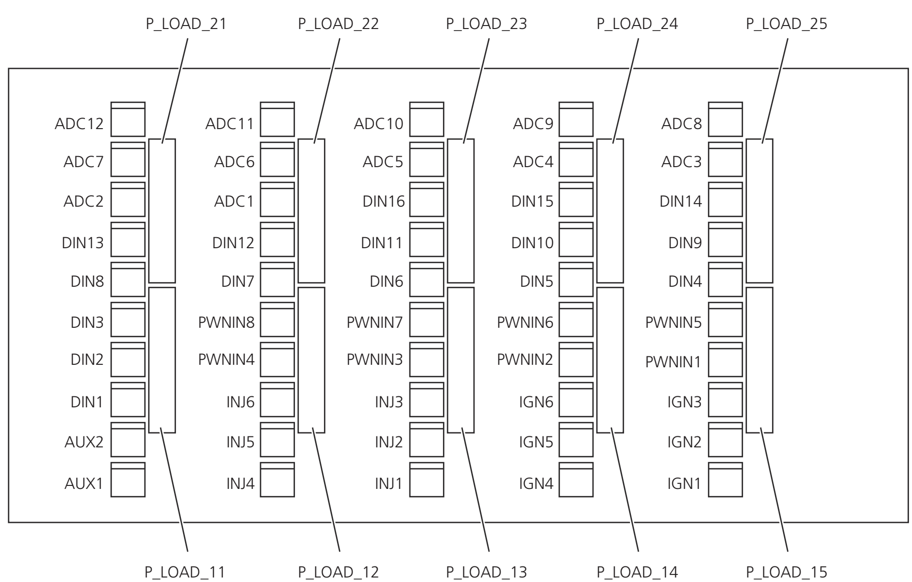


The backplane has the following switches, jumpers and connectors on the bottom side:

Symbol	Description
P_SCx	Connector of the spare slot (see Spare Slot 1 Pinout on page 149 and Spare Slot 2 Pinout on page 151)
P_ECUxy	Connector to connect the ECU signals to the backplane

DS685 Midplane

The following illustration shows the top view of the DS685 Midplane (illustration is not complete, only the connectors for the load cards and current measurement are shown):



Related topics

Basics

Load Card/FIU Pinout

Introduction

The following table shows the signals which are connected to a load board and a Failure Insertion Unit respectively. In addition, the ECU 1 connector pins from where the signals come are given. For a description of the signals, refer to ECU 1 Connector Pinout on page 124. The load cards are numbered from left to right.

Load Card	Channel	Signal	ECU 1 Connector Pin
1	1	ADC12	E14
	2	ADC7	E9
	3	ADC2	E4
	4	DIG_IN13	C13
	5	DIG_IN8	C8
	6	DIG_IN3	C3
	7	DIG_IN2	C2
	8	DIG_IN1	C1
	9	AUXCAP2	E2
	10	AUXCAP1	E1
2	1	ADC11	E13
	2	ADC6	E8
	3	ADC1	E3
	4	DIG_IN12	C12
	5	DIG_IN7	C7
	6	PWM_IN8	D6
	7	PWM_IN4	D2
	8	INJ6	D12
	9	INJ5	D11
	10	INJ4	D10

Load Card	Channel	Signal	ECU 1 Connector Pin
3	1	ADC10	E12
	2	ADC5	E7
	3	DIG_IN16	C16
	4	DIG_IN11	C11
	5	DIG_IN6	C6
	6	PWM_IN7	D5
	7	PWM_IN3	D1
	8	INJ3	D9
	9	INJ2	D8
	10	INJ1	D7
4	1	ADC9	E11
	2	ADC4	E6
	3	DIG_IN15	C15
	4	DIG_IN10	C10
	5	DIG_IN5	C5
	6	PWM_IN6	D4
	7	PWM_IN2	C18
	8	IGN6	D18
	9	IGN5	D17
	10	IGN4	D16
5	1	ADC8	E10
	2	ADC3	E5
	3	DIG_IN14	C14
	4	DIG_IN9	C9
	5	DIG_IN4	C4
	6	PWM_IN5	D3
	7	PWM_IN1	C17
	8	IGN3	D15
	9	IGN2	D14
	10	IGN1	D13

Related topics

References

Connectors, Switches and Jumpers in the Load/FIU Unit.. 144

Spare Slot 1 Pinout

Introduction

The following table shows the signals available on the spare slot 1.

Pin	Signal	Pin	Signal	Pin	Signal
A1	Vcc (+5 V)	B1	+12 V	C1	-12 V[1)]
A2	Vcc (+5 V)	B2	+12 V	C2	-12 V[1)]
A3	VBAT(x)[2)]	B3	VBAT(x)[2)]	C3	RXD[3)]
A4	CAM1-	B4	CAM2+	C4	CAM2-
A5	CRANK+	B5	CRANK-	C5	CAM1+
A6	VC33-Waveform2-	B6	VC33-Waveform3+	C6	VC33-Waveform3-
A7	VC33-Waveform1+	B7	VC33-Waveform1-	C7	VC33-Waveform2+
A8	GND	B8	VC33-Waveform0+	C8	VC33-Waveform0-
A9	CRANK_DIG	B9	CAM1_DIG	C9	CAM2_DIG
A10	PWM_OUT4	B10	PWM_OUT5	C10	PWM_OUT6
A11	PWM_OUT1	B11	PWM_OUT2	C11	PWM_OUT3
A12	DIG_OUT7	B12	DIG_OUT8	C12	GND
A13	DIG_OUT4	B13	DIG_OUT5	C13	DIG_OUT6
A14	DIG_OUT1	B14	DIG_OUT2	C14	DIG_OUT3
A15	AUXCAP1	B15	AUXCAP2	C15	GND
A16	IGN4	B16	IGN5	C16	IGN6
A17	IGN1	B17	IGN2	C17	IGN3
A18	INJ4	B18	INJ5	C18	INJ6
A19	INJ1	B19	INJ2	C19	INJ3
A20	ADC7+	B20	ADC8+	C20	MIDGND
A21	ADC4+	B21	ADC5+	C21	ADC6+
A22	ADC1+	B22	ADC2+	C22	ADC3+
A23	DAC7+	B23	DAC8+	C23	GND of SC board[4)]
A24	DAC4+	B24	DAC5+	C24	DAC6+
A25	DAC1+	B25	DAC2+	C25	DAC3+
A26	PWM_IN7	B26	PWM_IN8	C26	GND
A27	PWM_IN4	B27	PWM_IN5	C27	PWM_IN6
A28	PWM_IN1	B28	PWM_IN2	C28	PWM_IN3
A29	DIG_IN7	B29	DIG_IN8	C29	GND
A30	DIG_IN4	B30	DIG_IN5	C30	DIG_IN6
A31	DIG_IN1	B31	DIG_IN2	C31	DIG_IN3
A32	GND	B32	GND	C32	GND

1) Voltage is generated onboard, Imax = 250 mA
2) Can be configured to VBAT1 or VBAT2 via jumper
3) Buffered RXD line from host PC
4) Must be connected to ground on the SC board

For a description of the signal, refer to ECU 1 Connector Pinout on page 124, ECU 2 Connector Pinout on page 128 and ECU 3 Connector Pinout on page 132.

Related topics

References

Spare Slot 2 Pinout

Introduction

The following table shows the signals available on the spare slot 2.

Pin	Signal	Pin	Signal	Pin	Signal
A1	Vcc (+5 V)	B1	+12 V	C1	-12 V[1)]
A2	Vcc (+5 V)	B2	+12 V	C2	-12 V[1)]
A3	VBAT(x)[2)]	B3	VBAT(x)[2)]	C3	RXD[3)]
A4	CAM1-	B4	CAM2+	C4	CAM2-
A5	CRANK+	B5	CRANK-	C5	CAM1+
A6	VC33-Waveform2-	B6	VC33-Waveform3+	C6	VC33-Waveform3-
A7	VC33-Waveform1+	B7	VC33-Waveform1-	C7	VC33-Waveform2+
A8	GND	B8	VC33-Waveform0+	C8	VC33-Waveform0-
A9	CRANK_DIG	B9	CAM1_DIG	C9	CAM2_DIG
A10	PWM_OUT4	B10	PWM_OUT5	C10	PWM_OUT6
A11	PWM_OUT7	B11	PWM_OUT8	C11	PWM_OUT9
A12	DIG_OUT15	B12	DIG_OUT16	C12	GND
A13	DIG_OUT12	B13	DIG_OUT13	C13	DIG_OUT14
A14	DIG_OUT9	B14	DIG_OUT10	C14	DIG_OUT11
A15	AUXCAP1	B15	AUXCAP2	C15	GND
A16	IGN4	B16	IGN5	C16	IGN6
A17	IGN1	B17	IGN2	C17	IGN3
A18	INJ4	B18	INJ5	C18	INJ6
A19	INJ1	B19	INJ2	C19	INJ3
A20	ADC7+	B20	ADC8+	C20	MIDGND
A21	ADC12+	B21	ADC5+	C21	ADC6+
A22	ADC9+	B22	ADC10+	C22	ADC11+
A23	DAC17+	B23	DAC18+	C23	GND of SC board[4)]
A24	DAC14+	B24	DAC15+	C24	DAC16+
A25	DAC9+	B25	DAC10+	C25	DAC13+
A26	PWM_IN7	B26	PWM_IN8	C26	GND
A27	PWM_IN4	B27	PWM_IN5	C27	PWM_IN6
A28	PWM_IN1	B28	PWM_IN2	C28	PWM_IN3
A29	DIG_IN15	B29	DIG_IN16	C29	GND
A30	DIG_IN12	B30	DIG_IN13	C30	DIG_IN14
A31	DIG_IN9	B31	DIG_IN10	C31	DIG_IN11
A32	GND	B32	GND	C32	GND

1) Voltage is generated onboard, Imax = 250 mA

2) Can be configured to VBAT1 or VBAT2 via jumper, see Reference Signal Jumpers on page 153

3) Buffered RXD line from host PC

4) Must be connected to ground on the SC board

For a description of the signal, refer to ECU 1 Connector Pinout on page 124, ECU 2 Connector Pinout on page 128 and ECU 3 Connector Pinout on page 132.

Related topics

References

Connectors, Switches and Jumpers in the Load/FIU Unit..144

Input Disconnect Jumpers

Introduction

The input disconnect jumpers are located on the backplane to the DS2211, see the illustration in Connectors, Switches and Jumpers in the Load/FIU Unit on page 144. The jumpers disconnect the DS2211 from the Load/FIU unit. If a jumper is open, its channel is diconnected. If a jumper is set, its channel is connected. The following table shows the pin assignments of the jumpers to the channels:

Connector	Jumper	Signal		Connector	Jumper	Signal
P1	1	IGN1		P2	1	DIG_IN4
P1	2	IGN2		P2	2	DIG_IN5
P1	3	IGN3		P2	3	DIG_IN6
P1	4	IGN4		P2	4	DIG_IN7
P1	5	IGN5		P2	5	DIG_IN8
P1	6	IGN6		P2	6	DIG_IN9
P1	7	INJ1		P2	7	DIG_IN10
P1	8	INJ2		P2	8	DIG_IN11
P1	9	INJ3		P2	9	DIG_IN12
P1	10	INJ4		P2	10	DIG_IN13
P1	11	INJ5		P2	11	DIG_IN14
P1	12	INJ6		P2	12	DIG_IN15
P1	13	AUXCAP1		P2	13	DIG_IN16
P1	14	AUXCAP2		P2	14	ADC1
P1	15	PWM_IN1		P2	15	ADC2
P1	16	PWM_IN2		P2	16	ADC3
P1	17	PWM_IN3		P2	17	ADC4
P1	18	PWM_IN4		P2	18	ADC5
P1	19	PWM_IN5		P2	19	ADC6
P1	20	PWM_IN6		P2	20	ADC7
P1	21	PWM_IN7		P2	21	ADC8
P1	22	PWM_IN8		P2	22	ADC9
P1	23	DIG_IN1		P2	23	ADC10
P1	24	DIG_IN2		P2	24	ADC11
P1	25	DIG_IN3		P2	25	ADC12

Related topics

References

Connectors, Switches and Jumpers in the Load/FIU Unit..144

Reference Signal Jumpers

Introduction

The Reference Signal jumper can be used to set the reference potential for signals. The jumpers are placed on the DS686 Backplane, see the illustration in Connectors, Switches and Jumpers in the Load/FIU Unit on page 144. The following table shows the pin assignment of the jumper blocks:

No.	Signal	Position Left	Position Right	Open
1	$\overline{\text{DAC9}}$	SGND	SCGND	ECU reference
2	$\overline{\text{DAC10}}$	SGND	SCGND	ECU reference
3	$\overline{\text{DAC11}}$	SGND	SCGND	ECU reference
4	$\overline{\text{DAC13}}$	SGND	SCGND	ECU reference
5	$\overline{\text{DAC14}}$	SGND	SCGND	ECU reference
6	$\overline{\text{DAC15}}$	SGND	SCGND	ECU reference
7	$\overline{\text{DAC16}}$	SGND	SCGND	ECU reference
8	$\overline{\text{DAC17}}$	SGND	SCGND	ECU reference
9	$\overline{\text{DAC18}}$	SGND	SCGND	ECU reference
10	$\overline{\text{DAC19}}$	SGND	SCGND	ECU reference
11	$\overline{\text{DAC20}}$	SGND	SCGND	ECU reference
12	RES1-	SGND	SCGND	ECU reference
13	RES2-	SGND	SCGND	ECU reference
14	RES3-	SGND	SCGND	ECU reference
15	RES4-	SGND	SCGND	ECU reference
16	RES5-	SGND	SCGND	ECU reference
17	$\overline{\text{ADC12}}$	SGND	MIDGND	ECU reference
18	$\overline{\text{ADC13}}$	SGND	MIDGND	ECU reference
19	ADC13*	ADC13 is used as analog input	IBAT2 (ADC13 is used to control power supply 2)	not allowed
20	$\overline{\text{ADC13}}$*	$\overline{\text{ADC13}}$is used as analog input	IBAT2 ($\overline{\text{ADC13}}$ is used to control power supply 2)	not allowed
21	DAC11*	DAC11 is used as analog output	VBAT2 (DAC11 is used to control power supply 2)	not allowed
22	$\overline{\text{DAC11}}$*	$\overline{\text{DAC11}}$is used as analog output	VBAT2 ($\overline{\text{DAC11}}$ is used to control power supply 2)	not allowed
23	VBATSC1	VBAT2	VBAT1	no VBAT on P_SC1
24	VBATSC2	VBAT2	VBAT1	no VBAT on P_SC2
25	$\overline{\text{DAC1}}$	SGND	SCGND	ECU reference
26	$\overline{\text{DAC2}}$	SGND	SCGND	ECU reference
27	$\overline{\text{DAC3}}$	SGND	SCGND	ECU reference
28	$\overline{\text{DAC4}}$	SGND	SCGND	ECU reference
29	$\overline{\text{DAC5}}$	SGND	SCGND	ECU reference
30	$\overline{\text{DAC6}}$	SGND	SCGND	ECU reference
31	$\overline{\text{DAC7}}$	SGND	SCGND	ECU reference
32	$\overline{\text{DAC8}}$	SGND	SCGND	ECU reference
33	RES6-	SGND	SCGND	ECU reference
34	RES7-	SGND	SCGND	ECU reference
35	RES8-	SGND	SCGND	ECU reference
36	RES9-	SGND	SCGND	ECU reference
37	RES10-	SGND	SCGND	ECU reference
38	$\overline{\text{ADC1}}$	SGND	MIDGND	ECU reference

No.	Signal	Position Left	Position Right	Open
39	$\overline{\text{ADC2}}$	SGND	MIDGND	ECU reference
40	$\overline{\text{ADC3}}$	SGND	MIDGND	ECU reference
41	$\overline{\text{ADC4}}$	SGND	MIDGND	ECU reference
42	$\overline{\text{ADC5}}$	SGND	MIDGND	ECU reference
43	$\overline{\text{ADC6}}$	SGND	MIDGND	ECU reference
44	$\overline{\text{ADC7}}$	SGND	MIDGND	ECU reference
45	$\overline{\text{ADC8}}$	SGND	MIDGND	ECU reference
46	$\overline{\text{ADC9}}$	SGND	MIDGND	ECU reference
47	$\overline{\text{ADC10}}$	SGND	MIDGND	ECU reference
48	$\overline{\text{ADC11}}$	SGND	MIDGND	ECU reference

Related topics

References

Connectors, Switches and Jumpers in the Load/FIU Unit..144

Pinouts of dSPACE Simulator Mid-Size Based on DS2202

Introduction

dSPACE Simulator Mid-Size can be equipped with a DS2202 instead of a DS2211. Signals which are available at both I/O boards are connected to the same load channel and ECU connector pins. The other pinouts differ.

Where to go from here

Information in this section

Overview of the Connector of a Simulator Based on DS2202

Introduction

dSPACE Simulator Mid-Size can be equipped with a DS2202 instead of a DS2211. Signals which are available at both I/O boards are connected to the same load channel and ECU connector pins. The other pinouts differ.

Simulator's front

The pinouts of the following connectors located at the simulator's front are changed:

- ECU 1 Connector Pinout (Using a DS2202) on page 158
- ECU 2 Connector Pinout (Using a DS2202) on page 161
- ECU 3 Connector Pinout (Using a DS2202) on page 165
- External Load Connectors and Status LEDs (Using a DS2202) on page 168

The following connector pinouts remains unchanged:

- CARB Connector Pinout on page 136
- CANalyzer Connector Pinout on page 138
- VBAT1, VBAT2, and GND Connector on page 136

Load/FIU unit

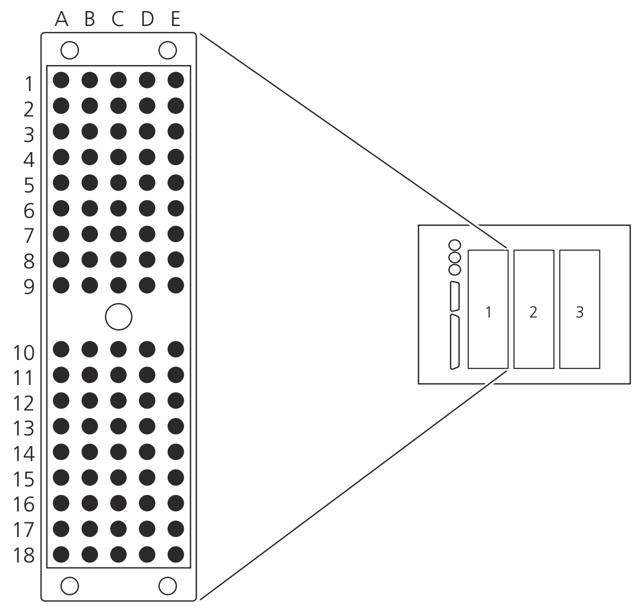
The pinouts of the following connectors, switches and jumpers in the Load/FIU unit are changed:

- Load Card/FIU Pinout (Using a DS2202) on page 173
- Spare Slot 1 Pinout (Using a DS2202) on page 175
- Spare Slot 2 Pinout (Using a DS2202) on page 177
- Input Disconnect Jumpers (Using a DS2202) on page 178
- Reference Signal Jumpers (Using a DS2202) on page 179

ECU 1 Connector Pinout (Using a DS2202)

Introduction

The ECU 1 connector is located on the simulator front panel (see Connectors on the Front on page 122).



The following table shows the pinout of this connector.

Row	Column A	Column B	Column C	Column D	Column E
1	CARB1	SWREL13-	DIG_IN1 / PWM_IN9	DIG_IN19 / PWM_IN3	DIG_IN31
2	CARB2	GND	DIG_IN2 / PWM_IN10	DIG_IN20 / PWM_IN4	DIG_IN32
3	CARB3	GND	DIG_IN3 / PWM_IN11	DIG_IN21 / PWM_IN5	ADC1
4	CARB4	VBAT2A	DIG_IN4 / PWM_IN12	DIG_IN22 / PWM_IN6	ADC2
5	CARB5	VSW21a	DIG_IN5 / PWM_IN13	DIG_IN23 / PWM_IN7	ADC3
6	VBAT1A	VSW22a	DIG_IN6 / PWM_IN14	DIG_IN24 / PWM_IN8	ADC4
7	VBAT1B	VSW23a	DIG_IN7 / PWM_IN15	DIG_IN33	ADC5
8	VSW11A	SWREL21+	DIG_IN8 / PWM_IN16	DIG_IN34	ADC6
9	VSW11B	SWREL21-	DIG_IN9 / PWM_IN17	DIG_IN35	ADC7
10	VSW12A	SWREL22+	DIG_IN10 / PWM_IN18	DIG_IN36	ADC8
11	VSW12B	SWREL22-	DIG_IN11 / PWM_IN19	DIG_IN37	ADC9
12	VSW13A	SWREL23+	DIG_IN12 / PWM_IN20	DIG_IN38	ADC10
13	VSW13B	SWREL23-	DIG_IN13 / PWM_IN21	DIG_IN25	ADC11
14	SWREL11+	GND	DIG_IN14 / PWM_IN22	DIG_IN26	ADC12
15	SWREL11-	GND	DIG_IN15 / PWM_IN23	DIG_IN27	GND
16	SWREL12+	GND	DIG_IN16 / PWM_IN24	DIG_IN28	+12V
17	SWREL12-	GND	DIG_IN17 / PWM_IN1	DIG_IN29	+5V
18	SWREL13+	GND	DIG_IN18 / PWM_IN2	DIG_IN30	-12V

The following table gives a short description of the signals:

Pin	Signal	Description	Voltage Range/Output Current
A1	CARB1	Connection to CARB connector	–
A2	CARB2	Connection to CARB connector	–
A3	CARB3	Connection to CARB connector	–
A4	CARB4	Connection to CARB connector	–
A5	CARB5	Connection to CARB connector	–
A6	VBAT1A	Voltage of power supply 1	VBAT1, Imax = 8 A
A7	VBAT1B	Voltage of power supply 1	VBAT1, Imax = 8 A
A8	VSW11A	Switched battery rail 1 of power supply 1	VBAT1, Imax = 8 A
A9	VSW11B	Switched battery rail 1 of power supply 1	VBAT1, Imax = 8 A
A10	VSW12A	Switched battery rail 2 of power supply 1	VBAT1, Imax = 8 A
A11	VSW12B	Switched battery rail 2 of power supply 1	VBAT1, Imax = 8 A
A12	VSW13A	Switched battery rail 3 of power supply 1	VBAT1, Imax = 8 A
A13	VSW13B	Switched battery rail 3 of power supply 1	VBAT1, Imax = 8 A
A14	SWREL11+	Control battery rail 1 of power supply 1	Voltage for switching: (SWREL11+ – SWREL11-) > 8 V
A15	SWREL11-	Control battery rail 1 of power supply 1	Voltage for switching: (SWREL11+ – SWREL11-) > 8 V
A16	SWREL12+	Control battery rail 2 of power supply 1	Voltage for switching: (SWREL12+ – SWREL12-) > 8 V
A17	SWREL12-	Control battery rail 2 of power supply 1	Voltage for switching: (SWREL12+ – SWREL12-) > 8 V
A18	SWREL13+	Control battery rail 3 of power supply 1	Voltage for switching: (SWREL13+ – SWREL13-) > 8 V
B1	SWREL13-	Control battery rail 3 of power supply 1	Voltage for switching: (SWREL13+ – SWREL13-) > 8 V
B2	GND	Ground	Imax = 8 A
B3	GND	Ground	Imax = 8 A
B4	VBAT2a	Voltage of power supply 2	VBAT2, Imax = 6 A
B5	VSW21	Switched battery rail 1 of power supply 2	VBAT2, Imax = 6 A
B6	VSW22	Switched battery rail 2 of power supply 2	VBAT2, Imax = 6 A
B7	VSW23	Switched battery rail 3 of power supply 2	VBAT2, Imax = 6 A
B8	SWREL21+	Control battery rail 1 of power supply 2	Voltage for switching: (SWREL21+ – SWREL21-) > 8 V
B9	SWREL21-	Control battery rail 1 of power supply 2	Voltage for switching: (SWREL21+ – SWREL21-) > 8 V
B10	SWREL22+	Control battery rail 2 of power supply 2	Voltage for switching: (SWREL22+ – SWREL22-) > 8 V
B11	SWREL22-	Control battery rail 2 of power supply 2	Voltage for switching: (SWREL22+ – SWREL22-) > 8 V
B12	SWREL23+	Control battery rail 3 of power supply 2	Voltage for switching: (SWREL23+ – SWREL23-) > 8 V
B13	SWREL23-	Control battery rail 3 of power supply 2	Voltage for switching: (SWREL23+ – SWREL23-) > 8 V
B14	GND	Ground	Imax = 8 A
B15	GND	Ground	Imax = 8 A
B16	GND	Ground	Imax = 8 A
B17	GND	Ground	Imax = 8 A
B18	GND	Ground	Imax = 8 A
C1	DIG_IN1 / PWM_IN9	Digital input / PWM signal measurement	12/42 V compatible
C2	DIG_IN2 / PWM_IN10	Digital input / PWM signal measurement	12/42 V compatible
C3	DIG_IN3 / PWM_IN11	Digital input / PWM signal measurement	12/42 V compatible
C4	DIG_IN4 / PWM_IN12	Digital input / PWM signal measurement	12/42 V compatible

Pin	Signal	Description	Voltage Range/Output Current
C5	DIG_IN5 / PWM_IN13	Digital input / PWM signal measurement	12/42 V compatible
C6	DIG_IN6 / PWM_IN14	Digital input / PWM signal measurement	12/42 V compatible
C7	DIG_IN7 / PWM_IN15	Digital input / PWM signal measurement	12/42 V compatible
C8	DIG_IN8 / PWM_IN16	Digital input / PWM signal measurement	12/42 V compatible
C9	DIG_IN9 / PWM_IN17	Digital input / PWM signal measurement	12/42 V compatible
C10	DIG_IN10 / PWM_IN18	Digital input / PWM signal measurement	12/42 V compatible
C11	DIG_IN11 / PWM_IN19	Digital input / PWM signal measurement	12/42 V compatible
C12	DIG_IN12 / PWM_IN20	Digital input / PWM signal measurement	12/42 V compatible
C13	DIG_IN13 / PWM_IN21	Digital input / PWM signal measurement	12/42 V compatible
C14	DIG_IN14 / PWM_IN22	Digital input / PWM signal measurement	12/42 V compatible
C15	DIG_IN15 / PWM_IN23	Digital input / PWM signal measurement	12/42 V compatible
C16	DIG_IN16 / PWM_IN24	Digital input / PWM signal measurement	12/42 V compatible
C17	DIG_IN17 / PWM_IN1	Digital input / PWM signal measurement	12/42 V compatible
C18	DIG_IN18 / PWM_IN2	Digital input / PWM signal measurement	12/42 V compatible
D1	DIG_IN19 / PWM_IN3	Digital input / PWM signal measurement	12/42 V compatible
D2	DIG_IN20 / PWM_IN4	Digital input / PWM signal measurement	12/42 V compatible
D3	DIG_IN21 / PWM_IN5	Digital input / PWM signal measurement	12/42 V compatible
D4	DIG_IN22 / PWM_IN6	Digital input / PWM signal measurement	12/42 V compatible
D5	DIG_IN23 / PWM_IN7	Digital input / PWM signal measurement	12/42 V compatible
D6	DIG_IN24 / PWM_IN8	Digital input / PWM signal measurement	12/42 V compatible
D7	DIG_IN33	Digital input	12/42 V compatible
D8	DIG_IN34	Digital input	12/42 V compatible
D9	DIG_IN35	Digital input	12/42 V compatible
D10	DIG_IN36	Digital input	12/42 V compatible
D11	DIG_IN37	Digital input	12/42 V compatible
D12	DIG_IN38	Digital input	12/42 V compatible
D13	DIG_IN25	Digital input	12/42 V compatible
D14	DIG_IN26	Digital input	12/42 V compatible
D15	DIG_IN27	Digital input	12/42 V compatible
D16	DIG_IN28	Digital input	12/42 V compatible
D17	DIG_IN29	Digital input	12/42 V compatible
D18	DIG_IN30	Digital input	12/42 V compatible
E1	DIG_IN31	Digital input	12/42 V compatible
E2	DIG_IN32	Digital input	12/42 V compatible
E3	ADC1	14-bit ADC	(ADC1 – $\overline{\text{ADC1}}$) = 0 … 60 V
E4	ADC2	14-bit ADC	(ADC2 – $\overline{\text{ADC2}}$) = 0 … 60 V
E5	ADC3	14-bit ADC	(ADC3 – $\overline{\text{ADC3}}$) = 0 … 60 V
E6	ADC4	14-bit ADC	(ADC4 – $\overline{\text{ADC4}}$) = 0 … 60 V
E7	ADC5	14-bit ADC	(ADC5 – $\overline{\text{ADC5}}$) = 0 … 60 V
E8	ADC6	14-bit ADC	(ADC6 – $\overline{\text{ADC6}}$) = 0 … 60 V
E9	ADC7	14-bit ADC	(ADC7 – $\overline{\text{ADC7}}$) = 0 … 60 V

Pin	Signal	Description	Voltage Range/Output Current
E10	ADC8	14-bit ADC	(ADC8 – $\overline{\text{ADC8}}$) = 0 … 60 V
E11	ADC9	14-bit ADC	(ADC9 – $\overline{\text{ADC9}}$) = 0 … 60 V
E12	ADC10	14-bit ADC	(ADC10 – $\overline{\text{ADC10}}$) = 0 … 60 V
E13	ADC11	14-bit ADC	(ADC11 – $\overline{\text{ADC11}}$) = 0 … 60 V
E14	ADC12	14-bit ADC	(ADC12 – $\overline{\text{ADC12}}$) = 0 … 60 V
E15	GND	Ground	Imax = 8 A
E16	+12V	–	+12 V, Imax = 750 mA
E17	+5V	–	+5 V, Imax = 750 mA
E18	-12V	–	-12 V, Imax = 750 mA

Related topics

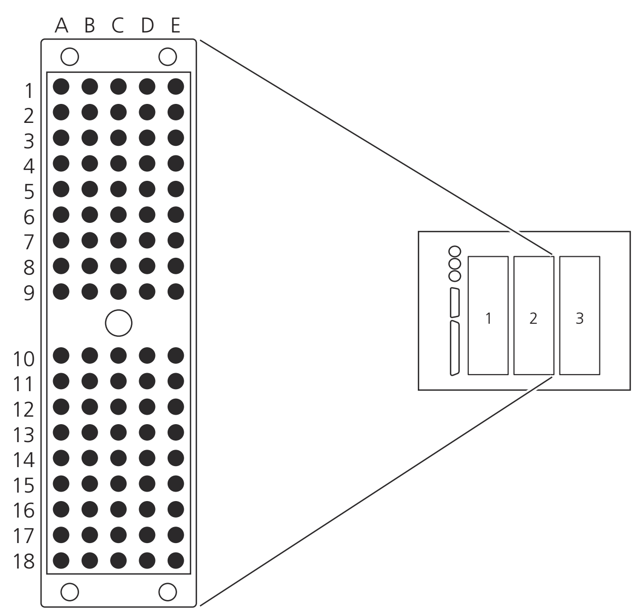
References

ECU 2 Connector Pinout (Using a DS2202)........161
ECU 3 Connector Pinout (Using a DS2202)........165

ECU 2 Connector Pinout (Using a DS2202)

Introduction

The ECU 2 connector is located on the simulator front panel (see Connectors on the Front on page 122).



The following table shows the pinout of this connector.

Row	Column A	Column B	Column C	Column D	Column E
1	ADC13	$\overline{\text{ADC13}}$	DAC1	$\overline{\text{DAC1}}$	DAC2
2	$\overline{\text{DAC2}}$	SGND	DAC3	$\overline{\text{DAC3}}$	DAC4
3	$\overline{\text{DAC4}}$	DAC5	$\overline{\text{DAC5}}$	DAC6	$\overline{\text{DAC6}}$
4	DAC7	$\overline{\text{DAC7}}$	DAC8	$\overline{\text{DAC8}}$	DAC9
5	$\overline{\text{DAC9}}$	DAC10	$\overline{\text{DAC10}}$	DAC11	$\overline{\text{DAC11}}$
6	–	–	–	–	–
7	–	GND	–	–	GND
8	–	–	–	–	DIG_OUT1
9	GND	DIG_OUT2	DIG_OUT3	DIG_OUT4	DIG_OUT5
10	DIG_OUT6	DIG_OUT7	DIG_OUT8	DIG_OUT9	DIG_OUT10
11	DIG_OUT11	DIG_OUT12	DIG_OUT13	DIG_OUT14	DIG_OUT15
12	DIG_OUT16	PWM_OUT1	PWM_OUT2	PWM_OUT3	PWM_OUT4
13	PWM_OUT5	PWM_OUT6	–	–	–
14	–	–	–	–	–
15	–	–	–	RXD+	GND
16	GND	–	–	–	–
17	–	–	CAN1H	CAN1L	TXD+
18	GND	$\overline{\text{RXD}}$	$\overline{\text{TXD}}$	CAN2H	CAN2L

Note

The GND pins of the ECU 2 and ECU 3 connector are designed for shielding purpose only. Do not connect them to any ECU power ground or an ECU sensor ground, which is internally connected to ECU power ground.

The following table gives a short description of the signals:

Pin	Signal	Description	Voltage Range/ Output Current
A1	ADC13	14-bit ADC	(ADC13 – $\overline{\text{ADC13}}$) = 0 … 60 V
A2	$\overline{\text{DAC2}}$	12-bit DAC/20 µs	(DAC2 – $\overline{\text{DAC2}}$) = 0 … 10 V; ±5 mA
A3	$\overline{\text{DAC4}}$	12-bit DAC/20 µs	(DAC4 – $\overline{\text{DAC4}}$) = 0 … 10 V; ±5 mA
A4	DAC7	12-bit DAC/20 µs	(DAC7 – $\overline{\text{DAC7}}$) = 0 … 10 V; ±5 mA
A5	$\overline{\text{DAC9}}$	12-bit DAC/20 µs	(DAC9 – $\overline{\text{DAC9}}$) = 0 … 10 V; ±5 mA
A6	–	Unused	–
A7	–	Unused	–
A8	–	Unused	–
A9	GND	Ground	Only for shielding
A10	DIG_OUT6	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
A11	DIG_OUT11	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
A12	DIG_OUT16	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
A13	PWM_OUT5	PWM signal generation	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
A14	–	Unused	–

Pin	Signal	Description	Voltage Range/ Output Current
A15	–	Unused	–
A16	GND	Ground	Only for shielding
A17	–	Unused	–
A18	GND	Ground	Only for shielding
B1	$\overline{\text{ADC13}}$	14-bit ADC	(ADC13 – $\overline{\text{ADC13}}$) = 0 … 60 V
B2	SGND	Signal ground	–
B3	DAC5	12-bit DAC/20 µs	(DAC5 – $\overline{\text{DAC5}}$) = 0 … 10 V; ±5 mA
B4	$\overline{\text{DAC7}}$	12-bit DAC/20 µs	(DAC7 – $\overline{\text{DAC7}}$) = 0 … 10 V; ±5 mA
B5	DAC10	12-bit DAC/20 µs	(DAC10 – $\overline{\text{DAC10}}$) = 0 … 10 V; ±5 mA
B6	–	Unused	–
B7	GND	Ground	Only for shielding
B8	–	Unused	–
B9	DIG_OUT2	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
B10	DIG_OUT7	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
B11	DIG_OUT12	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
B12	PWM_OUT1	PWM signal generation	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
B13	PWM_OUT6	PWM signal generation	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
B14	–	Unused	–
B15	–	Unused	–
B16	–	Unused	–
B17	–	Unused	–
B18	$\overline{\text{RXD}}$	RS422 receive	RS422
C1	DAC1	12-bit DAC/20 µs	(DAC1 – $\overline{\text{DAC1}}$) = 0 … 10 V; ±5 mA
C2	DAC3	12-bit DAC/20 µs	(DAC3 – $\overline{\text{DAC3}}$) = 0 … 10 V; ±5 mA
C3	$\overline{\text{DAC5}}$	12-bit DAC/20 µs	(DAC5 – $\overline{\text{DAC5}}$) = 0 … 10 V; ±5 mA
C4	DAC8	12-bit DAC/20 µs	(DAC8 – $\overline{\text{DAC8}}$) = 0 … 10 V; ±5 mA
C5	$\overline{\text{DAC10}}$	12-bit DAC/20 µs	(DAC10 – $\overline{\text{DAC10}}$) = 0 … 10 V; ±5 mA
C6	–	Unused	–
C7	–	Unused	–
C8	–	Unused	–
C9	DIG_OUT3	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
C10	DIG_OUT8	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
C11	DIG_OUT13	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
C12	PWM_OUT2	PWM signal generation	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
C13	–	Unused	–
C14	–	Unused	–
C15	–	Unused	–
C16	–	Unused	–
C17	CAN1H	CAN bus interface 1 high	ISO 11898
C18	$\overline{\text{TXD}}$	RS422 transmit	RS422
D1	$\overline{\text{DAC1}}$	12-bit DAC/20 µs	(DAC1 – $\overline{\text{DAC1}}$) = 0 … 10 V; ±5 mA

Pin	Signal	Description	Voltage Range/ Output Current
D2	$\overline{\text{DAC3}}$	12-bit DAC/20 µs	(DAC3 – $\overline{\text{DAC3}}$) = 0 … 10 V; ±5 mA
D3	DAC6	12-bit DAC/20 µs	(DAC6 – $\overline{\text{DAC6}}$) = 0 … 10 V; ±5 mA
D4	$\overline{\text{DAC8}}$	12-bit DAC/20 µs	(DAC8 – $\overline{\text{DAC8}}$) = 0 … 10 V; ±5 mA
D5	DAC11	12-bit DAC/20 µs	(DAC11 – $\overline{\text{DAC11}}$) = 0 … 10 V; ±5 mA
D6	–	Unused	–
D7	–	Unused	–
D8	–	Unused	–
D9	DIG_OUT4	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
D10	DIG_OUT9	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
D11	DIG_OUT14	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
D12	PWM_OUT3	PWM signal generation	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
D13	–	Unused	–
D14	–	Unused	–
D15	RXD+	RS232/RS422 receive	RS232/RS422
D16	–	Unused	–
D17	CAN1L	CAN bus interface 1 low	ISO 11898
D18	CAN2H	CAN bus interface 2 high	ISO 11898
E1	DAC2	12-bit DAC/20 µs	(DAC2 – $\overline{\text{DAC2}}$) = 0 … 10 V; ±5 mA
E2	DAC4	12-bit DAC/20 µs	(DAC4 – $\overline{\text{DAC4}}$) = 0 … 10 V; ±5 mA
E3	$\overline{\text{DAC6}}$	12-bit DAC/20 µs	(DAC6 – $\overline{\text{DAC6}}$) = 0 … 10 V; ±5 mA
E4	DAC9	12-bit DAC/20 µs	(DAC9 – $\overline{\text{DAC9}}$) = 0 … 10 V; ±5 mA
E5	$\overline{\text{DAC11}}$	12-bit DAC/20 µs	(DAC11 – $\overline{\text{DAC11}}$) = 0 … 10 V; ±5 mA
E6	–	Unused	–
E7	GND	Ground	–
E8	DIG_OUT1	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
E9	DIG_OUT5	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
E10	DIG_OUT10	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
E11	DIG_OUT15	Digital output	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
E12	PWM_OUT4	PWM signal generation	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
E13	–	Unused	–
E14	–	Unused	–
E15	GND	Ground	Only for shielding
E16	–	Unused	–
E17	TXD+	RS232/RS422 transmit	RS232/RS422
E18	CAN2L	CAN bus interface 2 low	ISO 11898

Related topics

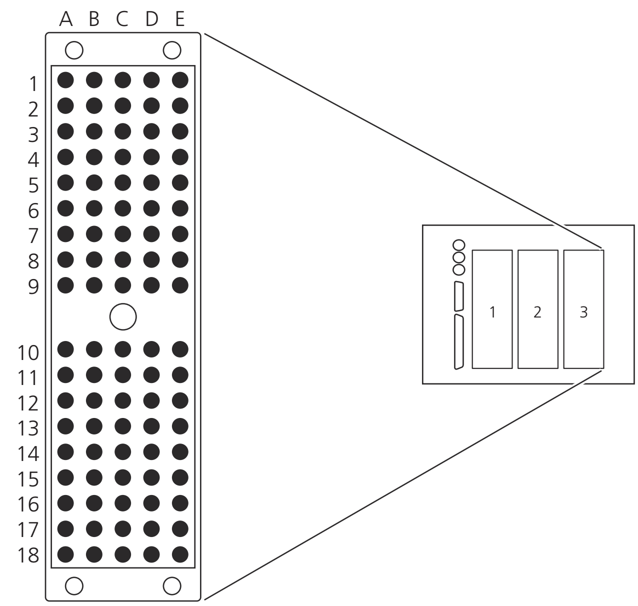
References

ECU 1 Connector Pinout (Using a DS2202)........ 158
ECU 3 Connector Pinout (Using a DS2202)........ 165

ECU 3 Connector Pinout (Using a DS2202)

Introduction

The ECU 3 connector is located on the simulator front panel (see Connectors on the Front on page 122).



The following table shows the pinout of this connector.

Row	Column A	Column B	Column C	Column D	Column E
1	Reserved	Reserved	–	–	–
2	DAC13	SGND	–	–	–
3	$\overline{\text{DAC13}}$	DAC14	$\overline{\text{DAC14}}$	–	–
4	DAC15	$\overline{\text{DAC15}}$	DAC16	–	–
5	$\overline{\text{DAC16}}$	DAC17	$\overline{\text{DAC17}}$	–	–
6	DAC18	$\overline{\text{DAC18}}$	DAC19	–	–
7	$\overline{\text{DAC19}}$	GND	DAC20	–	–
8	$\overline{\text{DAC20}}$	–	–	–	–
9	GND	–	–	–	–
10	–	–	–	–	–
11	–	$\overline{\text{ADC1}}$	$\overline{\text{ADC2}}$	–	–
12	$\overline{\text{ADC3}}$	$\overline{\text{ADC4}}$	$\overline{\text{ADC5}}$	–	–
13	$\overline{\text{ADC6}}$	$\overline{\text{ADC7}}$	$\overline{\text{ADC8}}$	–	–
14	$\overline{\text{ADC9}}$	$\overline{\text{ADC10}}$	$\overline{\text{ADC11}}$	–	–
15	$\overline{\text{ADC12}}$	–	–	–	–
16	GND	–	–	–	–
17	PWM_OUT7	PWM_OUT8	–	–	–
18	GND	PWM_OUT9	–	–	–

Note

The GND pins of the ECU 2 and ECU 3 connector are designed for shielding purpose only. Do not connect them to any ECU power ground or an ECU sensor ground, which is internally connected to ECU power ground.

The following table gives a short description of the signals.

Pin	Signal	Description	Voltage Range/ Output Current
A1	Reserved	Reserved	–
A2	DAC13	12-bit DAC/20 µs	(DAC13 – $\overline{\text{DAC13}}$) = 0 … 10 V; ±5 mA
A3	$\overline{\text{DAC13}}$	12-bit DAC/20 µs	(DAC13 – $\overline{\text{DAC13}}$) = 0 … 10 V; ±5 mA
A4	DAC15	12-bit DAC/20 µs	(DAC15 – $\overline{\text{DAC15}}$) = 0 … 10 V; ±5 mA
A5	$\overline{\text{DAC16}}$	12-bit DAC/20 µs	(DAC16 – $\overline{\text{DAC16}}$) = 0 … 10 V; ±5 mA
A6	DAC18	12-bit DAC/20 µs	(DAC18 – $\overline{\text{DAC18}}$) = 0 … 10 V; ±5 mA
A7	$\overline{\text{DAC19}}$	12-bit DAC/20 µs	(DAC19 – $\overline{\text{DAC19}}$) = 0 … 10 V; ±5 mA
A8	$\overline{\text{DAC20}}$	12-bit DAC/20 µs	(DAC20 – $\overline{\text{DAC20}}$) = 0 … 10 V; ±5 mA
A9	GND	Ground	Only for shielding
A10	–	Unused	–
A11	–	Unused	–
A12	$\overline{\text{ADC3}}$	14-bit ADC	(ADC3 – $\overline{\text{ADC3}}$) = 0 … 60 V
A13	$\overline{\text{ADC6}}$	14-bit ADC	(ADC6 – $\overline{\text{ADC6}}$) = 0 … 60 V
A14	$\overline{\text{ADC9}}$	14-bit ADC	(ADC9 – $\overline{\text{ADC9}}$) = 0 … 60 V
A15	$\overline{\text{ADC12}}$	14-bit ADC	(ADC12 – $\overline{\text{ADC12}}$) = 0 … 60 V
A16	GND	Ground	Only for shielding
A17	PWM_OUT7	PWM signal generation	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
A18	GND	Ground	Only for shielding
B1	Reserved	Reserved	–
B2	SGND	Signal ground	–
B3	DAC14	12-bit DAC/20 µs	(DAC14 – $\overline{\text{DAC14}}$) = 0 … 10 V; ±5 mA
B4	$\overline{\text{DAC15}}$	12-bit DAC/20 µs	(DAC15 – $\overline{\text{DAC15}}$) = 0 … 10 V; ±5 mA
B5	DAC17	12-bit DAC/20 µs	(DAC17 – $\overline{\text{DAC17}}$) = 0 … 10 V; ±5 mA
B6	$\overline{\text{DAC18}}$	12-bit DAC/20 µs	(DAC18 – $\overline{\text{DAC18}}$) = 0 … 10 V; ±5 mA
B7	GND	Ground	Only for shielding
B8	–	Unused	–
B9	–	Unused	–
B10	–	Unused	–
B11	$\overline{\text{ADC1}}$	14-bit ADC	(ADC1 – $\overline{\text{ADC1}}$) = 0 … 60 V
B12	$\overline{\text{ADC4}}$	14-bit ADC	(ADC4 – $\overline{\text{ADC4}}$) = 0 … 60 V
B13	$\overline{\text{ADC7}}$	14-bit ADC	(ADC7 – $\overline{\text{ADC7}}$) = 0 … 60 V
B14	$\overline{\text{ADC10}}$	14-bit ADC	(ADC10 – $\overline{\text{ADC10}}$) = 0 … 60 V
B15	–	Unused	–
B16	–	Unused	–
B17	PWM_OUT8	PWM signal generation	0.4 V … (VBAT(x) – 1.2 V); ±50 mA

Pin	Signal	Description	Voltage Range/ Output Current
B18	PWM_OUT9	PWM signal generation	0.4 V … (VBAT(x) – 1.2 V); ±50 mA
C1	–	Unused	–
C2	–	Unused	–
C3	$\overline{\text{DAC14}}$	12-bit DAC/20 µs	(DAC14 – $\overline{\text{DAC14}}$) = 0 … 10 V; ±5 mA
C4	DAC16	12-bit DAC/20 µs	(DAC16 – $\overline{\text{DAC16}}$) = 0 … 10 V; ±5 mA
C5	$\overline{\text{DAC17}}$	12-bit DAC/20 µs	(DAC17 – $\overline{\text{DAC17}}$) = 0 … 10 V; ±5 mA
C6	DAC19	12-bit DAC/20 µs	(DAC19 – $\overline{\text{DAC19}}$) = 0 … 10 V; ±5 mA
C7	DAC20	12-bit DAC/20 µs	(DAC20 – $\overline{\text{DAC20}}$) = 0 … 10 V; ±5 mA
C8	–	Unused	Pmax = 250 mW; Imax = ±80 mA
C9	–	Unused	Pmax = 250 mW; Imax = ±80 mA
C10	–	Unused	Pmax = 250 mW; Imax = ±80 mA
C11	$\overline{\text{ADC2}}$	14-bit ADC	(ADC2 – $\overline{\text{ADC2}}$) = 0 … 60 V
C12	$\overline{\text{ADC5}}$	14-bit ADC	(ADC5 – $\overline{\text{ADC5}}$) = 0 … 60 V
C13	$\overline{\text{ADC8}}$	14-bit ADC	(ADC8 – $\overline{\text{ADC8}}$) = 0 … 60 V
C14	$\overline{\text{ADC11}}$	14-bit ADC	(ADC11 – $\overline{\text{ADC11}}$) = 0 … 60 V
C15	–	Unused	–
C16	–	Unused	–
C17	–	Unused	–
C18	–	Unused	–
D1	–	Unused	–
D2	–	Unused	–
D3	–	Unused	–
D4	–	Unused	–
D5	–	Unused	–
D6	–	Unused	–
D7	–	Unused	–
D8	–	Unused	–
D9	–	Unused	–
D10	–	Unused	–
D11	–	Unused	–
D12	–	Unused	–
D13	–	Unused	–
D14	–	Unused	–
D15	–	Unused	–
D16	–	Unused	–
D17	–	Unused	–
D18	–	Unused	–
E1	–	Unused	–
E2	–	Unused	–
E3	–	Unused	–
E4	–	Unused	–

Pin	Signal	Description	Voltage Range/ Output Current
E5	–	Unused	–
E6	–	Unused	–
E7	–	Unused	–
E8	–	Unused	–
E9	–	Unused	–
E10	–	Unused	–
E11	–	Unused	–
E12	–	Unused	–
E13	–	Unused	–
E14	–	Unused	–
E15	–	Unused	–
E16	–	Unused	–
E17	–	Unused	–
E18	–	Unused	–

Related topics

References

ECU 1 Connector Pinout (Using a DS2202).. 158
ECU 2 Connector Pinout (Using a DS2202).. 161

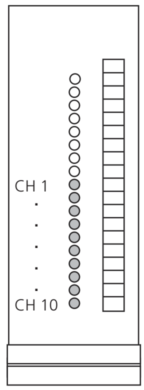
External Load Connectors and Status LEDs (Using a DS2202)

Introduction

The external load connectors and status LEDs are located on the front of dSPACE Simulator Mid-Size. The following tables shows the pinouts of the load cards. The load cards are numbered from left to right.

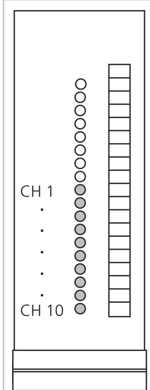
Load card 1

The following table shows the assignment of load card 1:

	Signal	Channel	ECU Connector	Pin
	GND	–	–	–
	VBAT1	–	1	A6
	VSW11	–	1	A8
	VSW12	–	1	A10
	VSW13	–	1	A12
	VBAT2	–	1	B4
	VSW21	–	1	B5
	VSW22	–	1	B6
	VSW23	–	1	B7
	ADC12	1	1	E14
	ADC7	2	1	E9
	ADC2	3	1	E4
	DIG_IN13 / PWM_IN21	4	1	C13
	DIG_IN8 / PWM_IN16	5	1	C8
	DIG_IN3 / PWM_IN11	6	1	C3
	DIG_IN2 / PWM_IN10	7	1	C2
	DIG_IN1 / PWM_IN9	8	1	C1
	DIG_IN32	9	1	E2
	DIG_IN31	10	1	E1

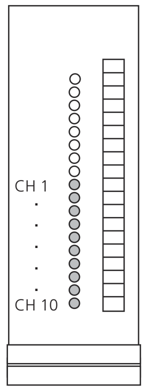
Load card 2

The following table shows the assignment of load card 2:

	Signal	Channel	ECU Connector	Pin
	GND	–	–	–
	VBAT1	–	1	A6
	VSW11	–	1	A8
	VSW12	–	1	A10
	VSW13	–	1	A12
	VBAT2	–	1	B4
	VSW21	–	1	B5
	VSW22	–	1	B6
	VSW23	–	1	B7
	ADC11	1	1	E13
	ADC6	2	1	E8
	ADC1	3	1	E3
	DIG_IN12 / PWM_IN20	4	1	C12
	DIG_IN7 / PWM_IN15	5	1	C7
	DIG_IN24 / PWM_IN8	6	1	D6
	DIG_IN20 / PWM_IN4	7	1	D2
	DIG_IN38	8	1	D12
	DIG_IN37	9	1	D11
	DIG_IN36	10	1	D10

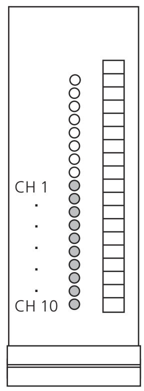
Load card 3

The following table shows the assignment of load card 3:

	Signal	Channel	ECU Connector	Pin
	GND	–	–	–
	VBAT1	–	1	A6
	VSW11	–	1	A8
	VSW12	–	1	A10
	VSW13	–	1	A12
	VBAT2	–	1	B4
	VSW21	–	1	B5
	VSW22	–	1	B6
	VSW23	–	1	B7
	ADC10	1	1	E12
	ADC5	2	1	E7
	DIG_IN16 / PWM_IN24	3	1	C16
	DIG_IN11 / PWM_IN19	4	1	C11
	DIG_IN6 / PWM_IN14	5	1	C6
	DIG_IN23 / PWM_IN7	6	1	D5
	DIG_IN19 / PWM_IN3	7	1	D1
	DIG_IN35	8	1	D9
	DIG_IN34	9	1	D8
	DIG_IN33	10	1	D7

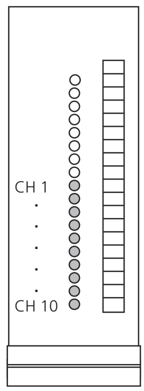
Load card 4

The following table shows the assignment of load card 4:

	Signal	Channel	ECU Connector	Pin
	GND	–	–	–
	VBAT1	–	1	A6
	VSW11	–	1	A8
	VSW12	–	1	A10
	VSW13	–	1	A12
	VBAT2	–	1	B4
	VSW21	–	1	B5
	VSW22	–	1	B6
	VSW23	–	1	B7
	ADC9	1	1	E11
	ADC4	2	1	E6
	DIG_IN15 / PWM_IN23	3	1	C15
	DIG_IN10 / PWM_IN18	4	1	C10
	DIG_IN5 / PWM_IN13	5	1	C5
	DIG_IN22 / PWM_IN6	6	1	D4
	DIG_IN18 / PWM_IN2	7	1	C18
	DIG_IN30	8	1	D18
	DIG_IN29	9	1	D17
	DIG_IN28	10	1	D16

Load card 5

The following table shows the assignment of load card 5:

	Signal	Channel	ECU Connector	Pin
	GND	–	–	–
	VBAT1	–	1	A6
	VSW11	–	1	A8
	VSW12	–	1	A10
	VSW13	–	1	A12
	VBAT2	–	1	B4
	VSW21	–	1	B5
	VSW22	–	1	B6
	VSW23	–	1	B7
	ADC8	1	1	E10
	ADC3	2	1	E5
	DIG_IN14 / PWM_IN22	3	1	C14
	DIG_IN9 / PWM_IN17	4	1	C9
	DIG_IN4 / PWM_IN12	5	1	C4
	DIG_IN21 / PWM_IN5	6	1	D3
	DIG_IN17 / PWM_IN1	7	1	C17
	DIG_IN27	8	1	D15
	DIG_IN26	9	1	D14
	DIG_IN25	10	1	D13

Related topics

References

Connectors on the Front..122

Load Card/FIU Pinout (Using a DS2202)

Load card/FIU pinout

The following table shows the signals which are connected to a load board and a Failure Insertion Unit respectively. In addition, the ECU 1 connector pins from where the signals come are given. For a description of the signals, refer to ECU 1 Connector Pinout (Using a DS2202) on page 158. The load cards are numbered from left to right.

Load Card	Channel	Signal	ECU 1 Connector Pin
1	1	ADC12	E14
	2	ADC7	E9
	3	ADC2	E4
	4	DIG_IN13 / PWM_IN21	C13
	5	DIG_IN8 / PWM_IN16	C8
	6	DIG_IN3 / PWM_IN11	C3
	7	DIG_IN2 / PWM_IN10	C2
	8	DIG_IN1 / PWM_IN9	C1
	9	DIG_IN32	E2
	10	DIG_IN31	E1
2	1	ADC11	E13
	2	ADC6	E8
	3	ADC1	E3
	4	DIG_IN12 / PWM_IN20	C12
	5	DIG_IN7 / PWM_IN15	C7
	6	DIG_IN24 / PWM_IN8	D6
	7	DIG_IN20 / PWM_IN4	D2
	8	DIG_IN38	D12
	9	DIG_IN37	D11
	10	DIG_IN36	D10
3	1	ADC10	E12
	2	ADC5	E7
	3	DIG_IN16 / PWM_IN24	C16
	4	DIG_IN11 / PWM_IN19	C11
	5	DIG_IN6 / PWM_IN14	C6
	6	DIG_IN23 / PWM_IN7	D5
	7	DIG_IN19 / PWM_IN3	D1
	8	DIG_IN35	D9
	9	DIG_IN34	D8
	10	DIG_IN33	D7
4	1	ADC9	E11
	2	ADC4	E6
	3	DIG_IN15 / PWM_IN23	C15
	4	DIG_IN10 / PWM_IN18	C10
	5	DIG_IN5 / PWM_IN13	C5
	6	DIG_IN22 / PWM_IN6	D4
	7	DIG_IN18 / PWM_IN2	C18
	8	DIG_IN30	D18
	9	DIG_IN29	D17
	10	DIG_IN28	D16

Load Card	Channel	Signal	ECU 1 Connector Pin
5	1	ADC8	E10
	2	ADC3	E5
	3	DIG_IN14 / PWM_IN22	C14
	4	DIG_IN9 / PWM_IN17	C9
	5	DIG_IN4 / PWM_IN12	C4
	6	DIG_IN21 / PWM_IN5	D3
	7	DIG_IN17 / PWM_IN1	C17
	8	DIG_IN27	D15
	9	DIG_IN26	D14
	10	DIG_IN25	D13

Related topics

References

Connectors, Switches and Jumpers in the Load/FIU Unit.. 144

Spare Slot 1 Pinout (Using a DS2202)

Spare slot 1 pinout

The following table shows the signals that are available on the spare slot 1. For a description of the signals, refer to ECU 1 Connector Pinout (Using a DS2202) on page 158, ECU 2 Connector Pinout (Using a DS2202) on page 161 and ECU 3 Connector Pinout (Using a DS2202) on page 165.

Pin	Signal		Pin	Signal		Pin	Signal
A1	Vcc (+5 V)		B1	+12 V		C1	-12 V[1)]
A2	Vcc (+5 V)		B2	+12 V		C2	-12 V[1)]
A3	VBAT(x)[2)]		B3	VBAT(x)[2)]		C3	RXD[3)]
A4	–		B4	–		C4	–
A5	–		B5	–		C5	–
A6	–		B6	–		C6	–
A7	–		B7	–		C7	–
A8	GND		B8	–		C8	–
A9	–		B9	–		C9	–
A10	PWM_OUT4		B10	PWM_OUT5		C10	PWM_OUT6
A11	PWM_OUT1		B11	PWM_OUT2		C11	PWM_OUT3
A12	DIG_OUT7		B12	DIG_OUT8		C12	GND
A13	DIG_OUT4		B13	DIG_OUT5		C13	DIG_OUT6
A14	DIG_OUT1		B14	DIG_OUT2		C14	DIG_OUT3
A15	DIG_IN31		B15	DIG_IN32		C15	GND
A16	DIG_IN28		B16	DIG_IN29		C16	DIG_IN30
A17	DIG_IN25		B17	DIG_IN26		C17	DIG_IN27
A18	DIG_IN36		B18	DIG_IN37		C18	DIG_IN38
A19	DIG_IN33		B19	DIG_IN34		C19	DIG_IN35
A20	ADC7+		B20	ADC8+		C20	MIDGND
A21	ADC4+		B21	ADC5+		C21	ADC6+
A22	ADC1+		B22	ADC2+		C22	ADC3+
A23	DAC7+		B23	DAC8+		C23	GND of SC board[4)]
A24	DAC4+		B24	DAC5+		C24	DAC6+
A25	DAC1+		B25	DAC2+		C25	DAC3+
A26	DIG_IN23 / PWM_IN7		B26	DIG_IN24 / PWM_IN8		C26	GND
A27	DIG_IN20 / PWM_IN4		B27	DIG_IN21 / PWM_IN5		C27	DIG_IN22 / PWM_IN6
A28	DIG_IN17 / PWM_IN1		B28	DIG_IN18 / PWM_IN2		C28	DIG_IN19 / PWM_IN3
A29	DIG_IN7 / PWM_IN15		B29	DIG_IN8 / PWM_IN16		C29	GND
A30	DIG_IN4 / PWM_IN12		B30	DIG_IN5 / PWM_IN13		C30	DIG_IN6 / PWM_IN14
A31	DIG_IN1 / PWM_IN9		B31	DIG_IN2 / PWM_IN10		C31	DIG_IN3 / PWM_IN11
A32	GND		B32	GND		C32	GND

[1)] Voltage is generated onboard, Imax = 250 mA
[2)] Can be configured to VBAT1 or VBAT2 via jumper
[3)] Buffered RXD line from host PC
[4)] Must be connected to ground on the SC board

Related topics

References

Connectors, Switches and Jumpers in the Load/FIU Unit.. 144

Spare Slot 2 Pinout (Using a DS2202)

Spare slot 2 pinout

The following table shows the signals that are available on the spare slot 2. For a description of the signal, refer to ECU 1 Connector Pinout (Using a DS2202) on page 158, ECU 2 Connector Pinout (Using a DS2202) on page 161 and ECU 3 Connector Pinout (Using a DS2202) on page 165.

Pin	Signal	Pin	Signal	Pin	Signal
A1	Vcc (+5 V)	B1	+12 V	C1	-12 V[1)]
A2	Vcc (+5 V)	B2	+12 V	C2	-12 V[1)]
A3	VBAT(x)[2)]	B3	VBAT(x)[2)]	C3	RXD[3)]
A4	–	B4	–	C4	–
A5	–	B5	–	C5	–
A6	–	B6	–	C6	–
A7	–	B7	–	C7	–
A8	GND	B8	–	C8	–
A9	–	B9	–	C9	–
A10	PWM_OUT4	B10	PWM_OUT5	C10	PWM_OUT6
A11	PWM_OUT7	B11	PWM_OUT8	C11	PWM_OUT9
A12	DIG_OUT15	B12	DIG_OUT16	C12	GND
A13	DIG_OUT12	B13	DIG_OUT13	C13	DIG_OUT14
A14	DIG_OUT9	B14	DIG_OUT10	C14	DIG_OUT11
A15	DIG_IN31	B15	DIG_IN32	C15	GND
A16	DIG_IN28	B16	DIG_IN29	C16	DIG_IN30
A17	DIG_IN25	B17	DIG_IN26	C17	DIG_IN27
A18	DIG_IN36	B18	DIG_IN37	C18	DIG_IN38
A19	DIG_IN33	B19	DIG_IN34	C19	DIG_IN35
A20	ADC7+	B20	ADC8+	C20	MIDGND
A21	ADC12+	B21	ADC5+	C21	ADC6+
A22	ADC9+	B22	ADC10+	C22	ADC11+
A23	DAC17+	B23	DAC18+	C23	GND of SC board[4)]
A24	DAC14+	B24	DAC15+	C24	DAC16+
A25	DAC9+	B25	DAC10+	C25	DAC13+
A26	DIG_IN23 / PWM_IN7	B26	DIG_IN24 / PWM_IN8	C26	GND
A27	DIG_IN20 / PWM_IN4	B27	DIG_IN21 / PWM_IN5	C27	DIG_IN22 / PWM_IN6
A28	DIG_IN17 / PWM_IN1	B28	DIG_IN18 / PWM_IN2	C28	DIG_IN19 / PWM_IN3
A29	DIG_IN15 / PWM_IN23	B29	DIG_IN16 / PWM_IN24	C29	GND
A30	DIG_IN12 / PWM_IN20	B30	DIG_IN13 / PWM_IN21	C30	DIG_IN14 / PWM_IN22
A31	DIG_IN9 / PWM_IN17	B31	DIG_IN10 / PWM_IN18	C31	DIG_IN11 / PWM_IN19
A32	GND	B32	GND	C32	GND

1) Voltage is generated onboard, Imax = 250 mA
2) Can be configured to VBAT1 or VBAT2 via jumper
3) Buffered RXD line from host PC

Pin	Signal	Pin	Signal	Pin	Signal

4) Must be connected to ground on the SC board

Related topics

References

Connectors, Switches and Jumpers in the Load/FIU Unit... 144

Input Disconnect Jumpers (Using a DS2202)

Input Disconnect Jumpers

The input disconnect jumpers are located on the backplane to the DS2202. The jumpers disconnect the DS2202 from the Load/FIU unit. If a jumper is open, its channel is diconnected. If a jumper is set, its channel is connected. The following table shows the pin assignments of the jumpers to the DS2202 channels. Additionally, the table shows the names of the corresponding DS2211 channels. These names are printed on the backplane:

Connector	Jumper	DS2211 Signal	DS2202 Signal	Connector	Jumper	DS2211 Signal	DS2202 Signal
P1	1	IGN1	DIG_IN25	P2	1	DIG_IN4	DIG_IN4 / PWM_IN12
P1	2	IGN2	DIG_IN26	P2	2	DIG_IN5	DIG_IN5 / PWM_IN13
P1	3	IGN3	DIG_IN27	P2	3	DIG_IN6	DIG_IN6 / PWM_IN14
P1	4	IGN4	DIG_IN28	P2	4	DIG_IN7	DIG_IN7 / PWM_IN15
P1	5	IGN5	DIG_IN29	P2	5	DIG_IN8	DIG_IN8 / PWM_IN16
P1	6	IGN6	DIG_IN30	P2	6	DIG_IN9	DIG_IN9 / PWM_IN17
P1	7	INJ1	DIG_IN33	P2	7	DIG_IN10	DIG_IN10 / PWM_IN18
P1	8	INJ2	DIG_IN34	P2	8	DIG_IN11	DIG_IN11 / PWM_IN19
P1	9	INJ3	DIG_IN35	P2	9	DIG_IN12	DIG_IN12 / PWM_IN20
P1	10	INJ4	DIG_IN36	P2	10	DIG_IN13	DIG_IN13 / PWM_IN21
P1	11	INJ5	DIG_IN37	P2	11	DIG_IN14	DIG_IN14 / PWM_IN22
P1	12	INJ6	DIG_IN38	P2	12	DIG_IN15	DIG_IN15 / PWM_IN23
P1	13	AUXCAP1	DIG_IN31	P2	13	DIG_IN16	DIG_IN16 / PWM_IN24
P1	14	AUXCAP2	DIG_IN32	P2	14	ADC1	ADC1
P1	15	PWM_IN1	DIG_IN17 / PWM_IN1	P2	15	ADC2	ADC2
P1	16	PWM_IN2	DIG_IN18 / PWM_IN2	P2	16	ADC3	ADC3
P1	17	PWM_IN3	DIG_IN19 / PWM_IN3	P2	17	ADC4	ADC4
P1	18	PWM_IN4	DIG_IN20 / PWM_IN4	P2	18	ADC5	ADC5
P1	19	PWM_IN5	DIG_IN21 / PWM_IN5	P2	19	ADC6	ADC6
P1	20	PWM_IN6	DIG_IN22 / PWM_IN6	P2	20	ADC7	ADC7
P1	21	PWM_IN7	DIG_IN23 / PWM_IN7	P2	21	ADC8	ADC8
P1	22	PWM_IN8	DIG_IN24 / PWM_IN8	P2	22	ADC9	ADC9
P1	23	DIG_IN1	DIG_IN1 / PWM_IN9	P2	23	ADC10	ADC10
P1	24	DIG_IN2	DIG_IN2 / PWM_IN10	P2	24	ADC11	ADC11
P1	25	DIG_IN3	DIG_IN3 / PWM_IN11	P2	25	ADC12	ADC12

Related topics

References

Connectors, Switches and Jumpers in the Load/FIU Unit.. 144

Reference Signal Jumpers (Using a DS2202)

Reference Signal jumpers

The Reference Signal jumpers can be used to set the reference potential for signals. The jumpers are placed on the DS686 Backplane. The following table shows the pin assignment of the jumper blocks:

No.	Signal	Position Left	Position Right	Open
1	$\overline{\mathrm{DAC9}}$	SGND	SCGND	ECU reference
2	$\overline{\mathrm{DAC10}}$	SGND	SCGND	ECU reference
3	$\overline{\mathrm{DAC11}}$	SGND	SCGND	ECU reference
4	$\overline{\mathrm{DAC13}}$	SGND	SCGND	ECU reference
5	$\overline{\mathrm{DAC14}}$	SGND	SCGND	ECU reference
6	$\overline{\mathrm{DAC15}}$	SGND	SCGND	ECU reference
7	$\overline{\mathrm{DAC16}}$	SGND	SCGND	ECU reference
8	$\overline{\mathrm{DAC17}}$	SGND	SCGND	ECU reference
9	$\overline{\mathrm{DAC18}}$	SGND	SCGND	ECU reference
10	$\overline{\mathrm{DAC19}}$	SGND	SCGND	ECU reference
11	$\overline{\mathrm{DAC20}}$	SGND	SCGND	ECU reference
12	–	SGND	SCGND	ECU reference
13	–	SGND	SCGND	ECU reference
14	–	SGND	SCGND	ECU reference
15	–	SGND	SCGND	ECU reference
16	–	SGND	SCGND	ECU reference
17	$\overline{\mathrm{ADC12}}$	SGND	MIDGND	ECU reference
18	$\overline{\mathrm{ADC13}}$	SGND	MIDGND	ECU reference
19	ADC13*	ADC13 is used as analog input	IBAT2 (ADC13 is used to control power supply 2)	not allowed
20	$\overline{\mathrm{ADC13}}$*	$\overline{\mathrm{ADC13}}$is used as analog input	IBAT2 ($\overline{\mathrm{ADC13}}$ is used to control power supply 2)	not allowed
21	DAC11*	DAC11 is used as analog output	VBAT2 (DAC11 is used to control power supply 2)	not allowed
22	$\overline{\mathrm{DAC11}}$*	$\overline{\mathrm{DAC11}}$is used as analog output	VBAT2 ($\overline{\mathrm{DAC11}}$ is used to control power supply 2)	not allowed
23	VBATSC1	VBAT2	VBAT1	no VBAT on P_SC1
24	VBATSC2	VBAT2	VBAT1	no VBAT on P_SC2
25	$\overline{\mathrm{DAC1}}$	SGND	SCGND	ECU reference
26	$\overline{\mathrm{DAC2}}$	SGND	SCGND	ECU reference
27	$\overline{\mathrm{DAC3}}$	SGND	SCGND	ECU reference
28	$\overline{\mathrm{DAC4}}$	SGND	SCGND	ECU reference
29	$\overline{\mathrm{DAC5}}$	SGND	SCGND	ECU reference
30	$\overline{\mathrm{DAC6}}$	SGND	SCGND	ECU reference
31	$\overline{\mathrm{DAC7}}$	SGND	SCGND	ECU reference
32	$\overline{\mathrm{DAC8}}$	SGND	SCGND	ECU reference
33	–	SGND	SCGND	ECU reference
34	–	SGND	SCGND	ECU reference
35	–	SGND	SCGND	ECU reference
36	–	SGND	SCGND	ECU reference
37	–	SGND	SCGND	ECU reference
38	$\overline{\mathrm{ADC1}}$	SGND	MIDGND	ECU reference
39	$\overline{\mathrm{ADC2}}$	SGND	MIDGND	ECU reference
40	$\overline{\mathrm{ADC3}}$	SGND	MIDGND	ECU reference
41	$\overline{\mathrm{ADC4}}$	SGND	MIDGND	ECU reference

No.	Signal	Position Left	Position Right	Open
42	$\overline{\text{ADC5}}$	SGND	MIDGND	ECU reference
43	$\overline{\text{ADC6}}$	SGND	MIDGND	ECU reference
44	$\overline{\text{ADC7}}$	SGND	MIDGND	ECU reference
45	$\overline{\text{ADC8}}$	SGND	MIDGND	ECU reference
46	$\overline{\text{ADC9}}$	SGND	MIDGND	ECU reference
47	$\overline{\text{ADC10}}$	SGND	MIDGND	ECU reference
48	$\overline{\text{ADC11}}$	SGND	MIDGND	ECU reference

Related topics

References

Connectors, Switches and Jumpers in the Load/FIU Unit... 144

Data Sheets

Where to go from here

Information in this section

Certifications

CE compliance

dSPACE Simulator Mid-Size meets the requirements of the European directives 2014/30/EU (Electromagnetic Compatibility Directive) and 2014/35/EU (Low Voltage Directive) for CE marking.

Applied standards

dSPACE Simulator Mid-Size fulfills the following standards:

Tested Characteristics	Applied Standard	Description
Electromagnetic compatibility (EMC)	EN 61326-1 Table 2	Immunity standard for industrial environments[1]
	CISPR 11, EN 55011 Group 1, Class A	Emission standard for industrial environments
Safety requirements	EN 61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use

[1] Tested with an I/O cable length < 3 m. Connected cables might affect the specified characteristics due to physical effects such as crosstalk, voltage drops, and influences through electromagnetic fields.

DS1006 Data Sheet (up to Revision DS1006-03)

Technical data

The following table shows the data sheet of the DS1006 Processor Board. The specifications stated are valid up to board revision DS1006-03.

Parameter	Specification [1] [2]		
	3.0 GHz Variant [3]	**2.6 GHz Variant [4]**	**2.2 GHz Variant [4]**
General	▪ AMD Opteron™ processor running at 3.0 GHz	▪ AMD Opteron™ processor running at 2.6 GHz	AMD Opteron™ processor running at 2.2 GHz

	▪ Designed for laboratory use with PX5, PX10 and PX20 Expansion Boxes [5]
	▪ Building multiprocessor systems with further processor boards:
	  ▪ Up to 20 processor boards
	  ▪ Up to 4 high-speed links via one DS911 Gigalink Module on each DS1006
	  ▪ Possible cable length of up to 100 m		

Processor	▪ AMD Opteron™ processor [1]		
	▪ 3.0 GHz [3]	▪ 2.6 GHz	▪ 2.2 GHz
	▪ 64 KB L1 data cache, 64 KB L1 instruction cache, 1 MB L2 cache		
	▪ 133.16 MHz bus clock		
	▪ Overtemperature protection of the AMD Opteron™ processor: triggers an exception if the temperature exceeds the overtemperature limit of 85 °C (185 °F). Program execution is interrupted and the processor is set to power save mode (emergency shutdown).		

Parameter	Specification 1) 2)		
	3.0 GHz Variant 3)	2.6 GHz Variant 4)	2.2 GHz Variant 4)
	Note: Only operating in the stated ambient temperature range ensures that the board works correctly.		
Memory	▪ 256 MB DDR-400 SDRAM local memory for the application and dynamic application data		▪ 256 MB DDR-333 SDRAM local memory for the application and dynamic application data
	▪ 128 MB SDRAM global memory for host data exchange ▪ 2 MB on-board boot flash memory ▪ Application flash memory on CompactFlash card (accessable via ControlDesk). The capacity depends on the card.		
Timer	▪ 3 general-purpose timers ▪ Synchronous Time Base Unit (STBU) for multiprocessor systems		
Interrupt controller	Interrupt controller for handling 20 different interrupt sources of the DS1006 devices		
CompactFlash card	▪ dSPACE recommends to use the Transcend 512 MB industrial CompactFlash card TS512MCF200i. ▪ The CompactFlash card must be DOS-formatted (FAT16) before use.		
Serial interface	RS232 interface with standard UART allowing transfer rates of up to 115.2 kBaud		
DS911 Gigalink Module for multiprocessing (optional)	▪ 4 optical, high-speed communication ports (Gigalinks), each providing: – 16 bidirectional interrupt lines – 16 bidirectional data channels (2 KWords width on each channel) ▪ I/O access speed of send operations adapted to Gigalink's capabilities: data is sent directly without a FIFO buffer ▪ Gross transfer rate: 1.25 Gbit/s ▪ 32-bit or 64-bit read/write operations allowed: – 32-bit access for single 32-bit (or shorter) data words – Fast 64-bit access for block transfer functions		
Host interface	▪ One full-size 16-bit ISA slot required. ▪ Interface via eight 16-bit I/O ports (ISA bus)		
Physical size	▪ 340 x 125 x 45 mm (13.4 x 4.9 x 1.8 in) ▪ The board requires up to four slots (depending on the expansion box used) because the AMD Opteron™ processor's heat sink and fan extend over three slots.		
Ambient temperature	0 … 40 °C (32 ... 104 °F)		
Cooling	▪ DS1006: active cooling ▪ DS911 Gigalink Module: – Active cooling with fan (module revision 1.0) – Passive cooling (as of module revision 2.0)		
Power supply	▪ ISA bus: +5 V ±5%, 2.0 A +12 V ±5%, 0.5 A (without DS911 Gigalink Module)		

Parameter	Specification 1) 2)		
	3.0 GHz Variant 3)	**2.6 GHz Variant 4)**	**2.2 GHz Variant 4)**
	+12 V ±5%, 1.3 A (with DS911 module revision 1.0) +12 V ±5%, 0.9 A (with DS911 as of module revision 2.0)		
	▪ CPU power connector: +5 V ±5%, 22.0 A		▪ CPU power connector: +5 V ±5%, 20.0 A
	▪ An additional power supply cable is required to supply the AMD Opteron™ processor via the CPU power connector (cable is included in delivery).		

1) The specifications of the mounted processor may be different. dSPACE may change the processor used to more powerful AMD Opteron™ processors without notice. This change does not affect the board revision number.

2) Unless stated otherwise, the specifications are valid only if the dSPACE hardware is correctly powered, switched on, and ready for operation.

3) AMD does not guarantee the long-term availability of the 3.0 GHz processor.

4) DS1006 boards with a 2.2 GHz processor can be upgraded with the 2.6 GHz or 3.0 GHz processor by dSPACE. Note that the local memory is not upgraded in this case. DS1006 boards with a 2.6 GHz processor can be upgraded with the 3.0 GHz processor by dSPACE. Contact dSPACE (local representative) to inquire about price and have the upgrade done.

5) The PX5/PX10/PX20 Expansion Boxes need special power supplies and connectors to support a DS1006 modular system. For information on whether your existing expansion box fulfills the requirements, refer to http://www.dspace.de/goto?pxboxvers.

DS1006 Data Sheet (as of Revision DS1006-06)

Technical data

The following table shows the data sheet of the DS1006 Processor Board. The specifications stated are valid as of board revision DS1006-06 (multicore processor board).

Parameter	Specification 1) 2)

General	▪ AMD Opteron™ quad core processor for multiprocessing running at 2.8 GHz
	▪ Designed for laboratory use with PX5, PX10 and PX20 Expansion Boxes 3)
	▪ Building multiprocessor systems with further DS1006 processor boards:
	  ▪ Up to 20 processor boards
	  ▪ Up to 4 high-speed links via one DS911 Gigalink Module on each DS1006
	  ▪ Possible cable length of up to 100 m

Processor	▪ AMD Opteron™ 2000 series ▪ 4 cores for internal multiprocessing ▪ 2.8 GHz ▪ 4 x 64 KB L1 data cache, 4 x 64 KB L1 instruction cache, 4 x 512 KB L2 cache, 6 MB L3 cache ▪ 133 MHz bus clock

Parameter	Specification 1) 2)
	▪ Overtemperature protection of the AMD Opteron™ processor: triggers an exception if the processor temperature exceeds the overtemperature limit of 80 °C (176 °F). Program execution is interrupted and the processor is set to power save mode (emergency shutdown). Note: Only operating in the stated ambient temperature range ensures that the board works correctly.
Memory	▪ 1 GB DDR2-800 SDRAM local memory for the application and dynamic application data ▪ 4 x 128 MB DDR2-267 SDRAM global memory for host data exchange ▪ 2 MB on-board flash memory for boot firmware ▪ Application flash memory on CompactFlash card (accessable via ControlDesk). The capacity depends on the card.
Timer	▪ For each core: three general-purpose timers ▪ Synchronous Time Base Unit (STBU) for external multiprocessor systems
Interrupt controller	▪ For each core: one interrupt controller with 18 different interrupt sources ▪ The interrupt sources of the connected I/O boards can be handled from each core via internal Gigalinks.
CompactFlash card	▪ dSPACE recommends to use the Transcend 512 MB industrial CompactFlash card TS512MCF200i. ▪ The CompactFlash card must be DOS-formatted (FAT16) before use.
Serial interface	RS232 interface with standard UART allowing transfer rates of up to 115.2 kBaud
DS911 Gigalink Module for external multiprocessing (optional)	▪ 4 optical, high-speed communication ports (Gigalinks), each providing: – 16 bidirectional interrupt lines – 16 bidirectional data channels (2 KWords width on each channel) ▪ I/O access speed of send operations adapted to Gigalink's capabilities: data is sent directly without a FIFO buffer ▪ Gross transfer rate: 1.25 Gbit/s ▪ 32-bit or 64-bit read/write operations allowed: – 32-bit access for single 32-bit (or shorter) data words – Fast 64-bit access for block transfer functions
Host interface	▪ One full-size 16-bit ISA slot required. ▪ Interface via eight 16-bit I/O ports (ISA bus)
Physical size	▪ 340 x 125 x 15 mm (13.4 x 4.9 x 0.6 in) ▪ The board requires up to three slots (depending on the expansion box used) because the AMD Opteron™ processor's heat sink and fan extend over three slots.
Ambient temperature	0 … 40 °C (32 ... 104 °F)
Cooling	▪ DS1006: active cooling ▪ DS911 Gigalink Module (revision 2.0): passive cooling
Power supply	▪ ISA bus: +5 V ±5%, 2.0 A (without DS911)

Parameter	Specification [1) 2)]
	+5 V ±5%, 3.0 A (with DS911 as of module revision 2.0) +12 V ±5%, 1.5 A
	▪ CPU power connector: +5 V ±5%, 20.0 A
	▪ An additional power supply cable is required to supply the AMD Opteron™ processor via the CPU power connector (cable is included in delivery).

1) The specifications of the mounted processor may be different. dSPACE may change the processor used to more powerful AMD Opteron™ processors without notice. This change does not affect the board revision number.

2) Unless stated otherwise, the specifications are valid only if the dSPACE hardware is correctly powered, switched on, and ready for operation.

3) The PX5/PX10/PX20 Expansion Boxes need special power supplies and connectors to support a DS1006 modular system. For information on whether your existing expansion box fulfills the requirements, refer to http://www.dspace.de/goto?pxboxvers.

DS2211 Data Sheet

Technical data

The following table shows the data sheet of the DS2211 HIL I/O Board:

Parameter		Specification [1)]
Channels and interfaces	Analog inputs	▪ 16 14-bit differential A/D channels (multiplexed) ▪ No sample-and-hold functionality
	Analog outputs	▪ 20 12-bit differential D/A channels ▪ 1 crankshaft signal (angular processing unit) ▪ 2 camshaft signals (angular processing unit) ▪ 4-channel wheel speed or 4-channel knock signal generation (based on DSP) ▪ 4 additional slave DSP DACs (based on DSP)
	Digital I/O	▪ PWM in (8 + 16 shared channels, up to 50 ns resolution) ▪ PWM out (9 channels, up to 50 ns resolution) ▪ PWM in/out channels can also be used for F/D and D/F ▪ Digital in (16 channels) ▪ Digital out (16 channels) ▪ Ignition in (8 channels, up to 16 sparks per event window or up to 16 sparks buffered for continuous readout)

Parameter		**Specification** [1]
		▪ Injection in (8 channels, up to 16 pulses per event-window or up to 16 pulses buffered for continuous readout)
	Resistance terminals	▪ 10 channels
	Communication interfaces	▪ Serial interface (RS232, RS422 mode) ▪ Serial interface based on TMS320VC33 slave DSP ▪ 2 CAN bus interfaces
ADC	Resolution	14 bits
	Input voltage range	0 … 60 V, differential inputs
	Overvoltage protection	±75 V continuous
	Conversion time [2]	1.1 µs per channel
	Offset error	±10 mV
	Gain error	±0.5 %
	Input impedance	> 1 MΩ
DAC	Resolution	12 bits
	Settling time	20 µs (full scale to 1 LSB)
	Output voltage range	0 … 10 V (with internal reference, or ratiometric with 5 … 10 V external reference)
	Output swing of DACx [3]	–10 V … +12 V
	Output current	±5 mA
	Offset error	±5 mV
	Gain error	±0.5 % (with internal reference)
Slave DSP DAC	Settling time	10 µs (full scale to 1 LSB)
	Output voltage range	±10 V
	Output current	±5 mA
Transformer outputs	Output voltage range	▪ ±20 V (transformer output mode) ▪ ±10 V (DC output mode)
	Output current	±5 mA
Resistance terminals	Topology	16-bit switched resistor ladder
	Resistance range	15.8 Ω … 1 MΩ
	Resistance error	±2 % or ±3 Ω, whichever is greater, with RESx– pin within ±5 V of system ground
	Voltage range	Each terminal must stay within ±10 V of system ground
	Output current range	Max. ±80 mA
	Power per channel	Max. 250 mW

Parameter		Specification [1]
Digital inputs	Input voltage	0 … +60 V
	Threshold voltage level	1 V … 22.65 V or 23.8 V (dependent on I/O circuit)
	Input impedance	390 kΩ
	Overvoltage protection	±75 V continuous
Digital outputs	External supply voltage	▪ +5 V… +60 V ▪ Supplied from two independent rails (VBAT1 and VBAT2)
	Output current range	Max. ±50 mA
	$V_{out\ high,\ min.}$	(VBATx – 1.2 V) at +50 mA
	$V_{out\ low}$, max.	0.4 V at –50 mA
Serial interface	Configuration	▪ TL16C550C single UART (universal asynchronous receiver and transmitter) ▪ RS232, RS422 compatibility
	Baud rate	▪ Up to 115.2 kBd (RS232) ▪ Up to 1 MBd (RS422)
CAN bus interface	Configuration	▪ 2 CAN channels ▪ ISO DIS 11898-2 CAN High-Speed standard
	Baud rate	Max. 1 MBit/s
DSP (digital signal processor)		I/O subsystem based on Texas Instruments TMS320VC33 DSP: ▪ 150 MHz clock rate ▪ 13.3 ns cycle time ▪ 32 KWords + 2 KWords on-chip RAM
Interrupt controller		▪ 6 angle position interrupts ▪ 1 CAN controller interrupt ▪ 1 serial interface (UART) interrupt
Host interface		One 8- or 16-bit ISA slot (power supply only)
Physical size		▪ 340 x 125 x 19 mm (13.4 x 4.9 x 0.7 in) ▪ The board requires three brackets.
Ambient temperature		0 … 55 °C (32 … 131 °F)
Power supply	From host PC/expansion box	▪ +5 V ±5%; 1.5 A (without load on power supply outputs on connector P2) ▪ +12 V ±5%; 0.25 A (typ.), 0.5 A max. (with load on all analog and transformer outputs) ▪ –12 V ±5%; 0.2 A (typ.), 0.5 A max. (with load on all analog and transformer outputs)
	VBAT	▪ Two VBAT rails (5 V … 60 V DC) ▪ Each rail (VBATx): 0.05 A + load on digital outputs ▪ VBATx has to be supplied from an external source.

[1] Unless stated otherwise, the specifications are valid only if the dSPACE hardware is correctly powered, switched on, and ready for operation.

Parameter	Specification [1]

[2] Speed and timing specifications describe the capabilities of the hardware components and circuits of dSPACE products. Depending on the software complexity the attainable overall performance can deviate significantly from the hardware specification.

[3] Output swing referenced to ground, when the reference pins to /DACx are connected to another potential than GND.

DS2202 Data Sheet

Technical data

The following table shows the data sheet of the DS2202 HIL I/O Board:

Parameter		Specification [1]
Channels and interfaces	Analog inputs	▪ 16 14-bit differential A/D channels (multiplexed) ▪ No sample-and-hold functionality
	Analog outputs	▪ 20 12-bit differential D/A channels
	Digital I/O	▪ PWM in (24 shared channels, up to 50 ns resolution) ▪ PWM out (9 channels, up to 50 ns resolution) ▪ PWM in/out channels can also be used for F2D and D2F ▪ Digital in (14 + 24 shared channels) ▪ Digital out (16 channels)
	Communication interfaces	▪ Serial interface (RS232, RS422 mode) ▪ 2 CAN bus interfaces
ADC	Resolution	14 bits
	Input voltage range	0 … 60 V, differential inputs
	Overvoltage protection	±75 V continuous
	Conversion time [2]	1.1 µs per channel
	Offset error	±10 mV
	Gain error	±0.5 %
	Input impedance	> 1 MΩ
DAC	Resolution	12 bits
	Settling time	20 µs (full scale to 1 LSB)
	Output voltage range	0 … 10 V (with internal reference, or ratiometric with 5 … 10 V external reference)
	Output swing of DACx [3]	–10 V … +12 V
	Output current	±5 mA
	Offset error	±5 mV
	Gain error	±0.5 % (with internal reference)

Parameter		Specification [1]
Digital inputs	Input voltage	0 … +60 V
	Threshold voltage level	1 V … 23.8 V
	Input impedance	390 kΩ
	Overvoltage protection	±75 V continuous
Digital outputs	External supply voltage	▪ +5 V … +60 V ▪ Supplied from two independent rails (VBAT1 and VBAT2)
	Output current range	Max. ±50 mA
	$V_{out\ high,\ min.}$	(VBATx – 1.2 V) at +50 mA
	$V_{out\ low}$, max.	0.4 V at –50 mA
Serial interface	Configuration	▪ TL16C550C single UART (universal asynchronous receiver and transmitter) ▪ RS232, RS422 compatibility
	Baud rate	▪ Up to 115.2 kBd (RS232) ▪ Up to 1 MBd (RS422)
CAN bus interface	Configuration	▪ 2 CAN channels based on ST10F269 microcontroller ▪ ISO DIS 11898-2 CAN High-Speed standard
	Baud rate	Max. 1 MBit/s
Interrupt controller		▪ 1 CAN controller interrupt ▪ 1 serial interface (UART) interrupt
Host interface		One 8- or 16-bit ISA slot (power supply only)
Physical size		▪ 340 x 125 x 19 mm (13.4 x 4.9 x 0.7 in) ▪ The board requires three brackets.
Ambient temperature		0 … 55 °C (32 … 131 °F)
Power supply	From host PC/expansion box	▪ +5 V ±5%; 1 A (without load on power supply outputs on connector P2) ▪ +12 V ±5%; 0.15 A (typ.), 0.3 A max. (with load on all analog outputs) ▪ –12 V ±5%; 0.15 A (typ.), 0.3 A max. (with load on all analog outputs)
	VBAT	▪ Two VBAT rails (+5 V … +60 V DC) ▪ Each rail (VBATx): 0.05 A + load on digital outputs ▪ VBATx has to be supplied from an external source.

[1] Unless stated otherwise, the specifications are valid only if the dSPACE hardware is correctly powered, switched on, and ready for operation.

[2] Speed and timing specifications describe the capabilities of the hardware components and circuits of dSPACE products. Depending on the software complexity the attainable overall performance can deviate significantly from the hardware specification.

[3] Output swing referenced to ground, when /DACx is connected to a potential other than GND.

Troubleshooting

Introduction

If any problem related to the installation and configuration of your system comes up, refer to the information given in this section.

Where to go from here

Information in this section

Getting Further Support

Getting further support

Support Knowledge Base If the information in this section does not help you to solve the problem, check the Support Knowledge Base on our website. See http://www.dspace.com/go/kb.

dSPACE Support If self-help does not help you to solve the problem, contact dSPACE Support and provide information about your dSPACE environment and the problems you have. It is recommended to use the support request form provided on the website at http://www.dspace.com/go/supportrequest. However, you can also send an e-mail or phone us.

Processor Board and I/O Boards

Method

Perform the following checks if the processor board and the connected I/O boards do not operate correctly:

1. Check whether host PC and dSPACE Simulator Mid-Size operate correctly.
2. Check the I/O base addresses of the boards. You can detect an address conflict of the processor board by observing the red LEDs on the board: If you download an application to the board this must be indicated by the red LEDs.

   An address conflict does not necessarily result in the expansion box not booting anymore (see How to Change the I/O Base Address on page 77).
3. Check the PHS-bus addresses of the I/O boards (see How to Set the PHS-bus Address on page 84).
4. Check the status of the red LEDs on the processor board. If none of them lights up when the simulator is running, the board's power supply is defective.

Related topics

Basics

Problems with Host PC After Installation

Host PC problem

If the host PC does not operate correctly after installation of a dSPACE board check the insertion and the I/O address range settings of the boards. Maybe other boards are using the same I/O addresses.

Problems with the Bus Connection

Guidelines to avoid problems

You should follow these guidelines when connecting the host PC to the simulator via a bus interface:

- When switching on the system, the simulator should usually be switched on first, followed by the PC.

- Do not switch off the simulator while the PC is still running. This might lead to unpredictable errors.

Problems Related to the Firmware

Firmware update

To update the firmware of the selected real-time platform, refer to Update Firmware (ControlDesk Platform Management 📖).

Appendix

Abbreviations

List of abbreviations

The following abbreviations are used in this document.

Abbreviation	Description
ADC	Analog/digital converter
BOB	Breakout box
CAN	Controller area network
CARB	California Air Resources Board
CRC	Cyclic redundancy check
CSMA/CR	Carrier sense multiple access with collision resolution
DAC	Digital/analog converter
DSP	Digital signal processor
ECU	Electronic control unit
EML	Error management logic
FIU	Failure Insertion Unit
HIL	Hardware-in-the-loop
ISR	Interrupt service routine
OBD	On-board diagnostics
PHS bus	Peripherial high speed bus
PWM	Pulse width modulation
RTD	Resistance temperature detector
RTI	Real-time interface
RTP	Real-time processor
RTR	Remote transmission request