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DS1103 PPC Controller Board

Hardware Installation and Configuration

Release 2014-B – November 2014

Embedded Success dSPACE

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The request form helps the support team handle your difficulties quickly and efficiently.

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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/support for software updates and patches.

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About This Document

Contents	This document will show you the installation and hardware configuration of the DS1103 PPC Controller Board and CP1103/CLP1103 Connector Panels. It describes the hardware installation procedure and shows how to configure the hardware. It also gives you information about connecting external devices to the dSPACE system.
Required knowledge	Knowledge in handling computer hardware and Microsoft Windows operating systems is presupposed.
Where to go from here	Information in this section

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Document Symbols and Conventions

Symbols

The following symbols may be used in this document.

	Indicates a general hazard that may cause personal injury of any kind if you do not avoid it by following the instructions given.
	Indicates the danger of electric shock which may cause death or serious injury if you do not avoid it by following the instructions given.
	Indicates a hazard that may cause material damage if you do not avoid it by following the instructions given.
	Indicates important information that should be kept in mind, for example, to avoid malfunctions.
	Indicates tips containing useful information to make your work easier.

Naming conventions

The following abbreviations and formats are used in this document:

%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.

📖 Precedes the document title in a link that refers to another document.

Indicates that a link refers to another document, which is available in dSPACE HelpDesk.

Special folders

Some software products, for example, ControlDesk Next Generation and AutomationDesk, 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>`

Documents folder A standard folder for user-specific documents.

`%USERPROFILE%\My 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 Online Help and PDF Files

Objective

After you install your dSPACE software, the documentation for the installed products is available as online help and Adobe® PDF files.

Online help

You can access the online help, dSPACE HelpDesk, as follows:

Windows Start menu Select Start – (All) Programs – <ProductName> – dSPACE HelpDesk (<ProductName>) to open dSPACE HelpDesk with the start page of the selected product displayed. You can also navigate and search in the user documentation of any other installed software product and its supported hardware.

Context-sensitive Press the **F1** key or click the Help button in the dSPACE software to get help on the currently active context.



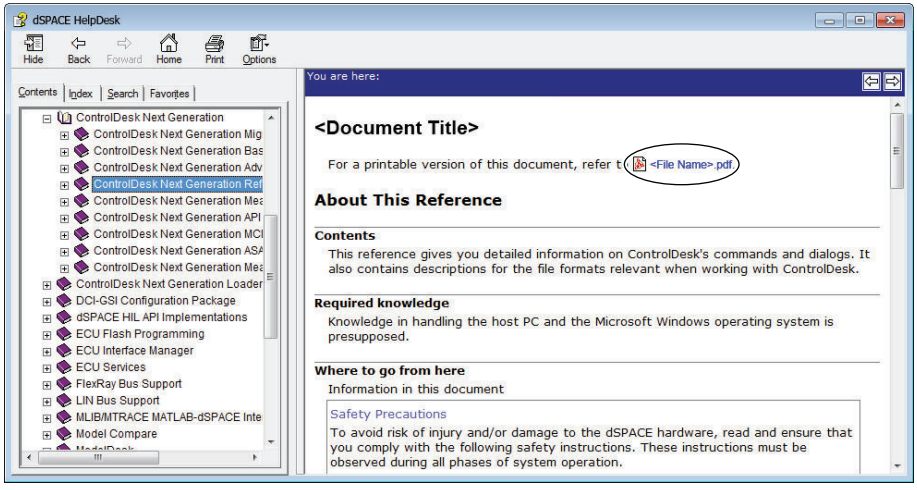
In some software products, context-sensitive help is not available.

Help menu in the dSPACE software On the menu bar, select Help – Contents or Help – Search (not available in all software products) to open dSPACE HelpDesk. It opens at the start page of the currently active product. You can also navigate and search in the user documentation of any other installed software product and its supported hardware.

PDF files

You can access the PDF files as follows:

dSPACE HelpDesk Click the PDF link at the beginning of a document:



Related Documents

Below is a list of documents that you are recommended to read when working with the DS1103:

Information in other documents

Installation documents **🕮 *Software Installation and Management Guide*** Provides detailed instructions on installing and handling the dSPACE software. It also shows you how to manage dSPACE licenses.
Getting started with the DS1103 **🕮 *First Work Steps with a dSPACE System*** Provides information on configuring dSPACE systems after you installed the dSPACE hardware. It shows you how to get started with your dSPACE system after installation. This document is aimed at users who have no experience with dSPACE systems. **🕮 *DS1103 Features*** Provides the feature information you need to implement your real-time models on your dSPACE hardware.

Safety Precautions

Objective

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

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Safe Invehicle Usage of dSPACE Products

Guidelines for safe in-vehicle usage of dSPACE products

Any in-vehicle use of dSPACE products in line with the contractual purposes requires the use of enclosed test tracks that are specially safety-secured for the specific purpose, i.e. with appropriately restricted access and further appropriate safety measures.

If you intend to use dSPACE products outside enclosed tracks, you have to check with the relevant authorities in your country under which circumstances this is possible. You and the local authorities involved bear full responsibility for such use.

You must take appropriate measures to ensure that the overall system enters a safe state if a dangerous situation occurs, for example, by implementing emergency shutdown or a limp-home mode. This especially applies in the following cases:

- Where safety-critical interventions that affect vehicle behavior are performed, for example, the stimulation of a bus system such as CAN, or the calibration or bypassing of in-vehicle electronic control units (ECUs) that control powertrain, chassis, or body systems.
- Where dSPACE products are deployed in conjunction with ECUs which would be a hazard if they malfunctioned.

The guidelines accordingly apply to the use of dSPACE products in aircraft or vessels in line with the contractual purposes.

Safety Precautions for Transportation

Transportation of DS1103 installed in an Expansion Box

The DS1103 PPC Controller Board installed inside the expansion box will be damaged during transportation and shipment!

Due to the weight of the heat sinks on the board, both the expansion box and the board itself will be damaged by acceleration and shocks.

- For shipment and transportation, remove a DS1103 from the expansion box (PX4, PX10 or PX20).
- Ship the board separately from the box.
- Put it in an antistatic bag and then in a strong cardboard box, in which the board is firmly fixed against movement.

Safety Precautions for Installing and Connecting the Hardware

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 and 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 board connectors.

Handling boards with fans

Only valid for boards up to board revision DS1103-07: Improper handling will damage the fan of the board:

- Do not touch any components of the fan, neither during operation nor 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

You install dSPACE hardware at your own risk. 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 the expansion box (if used) are switched off.
- No external devices are connected to the dSPACE system.

Connecting devices	To avoid risk of injury and prevent damage to 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 system is powered up and/or external devices are switched on. Make sure that the expansion box (if used) and external devices are turned off beforehand.

Safety Precautions for Using Expansion Boxes

Objective	To avoid damage to the expansion box and to achieve safe and trouble-free operation, the following guidelines have to be observed.
Installing	Before doing any installation work on an expansion box: ■ Make sure that the PC is turned off and no external devices are connected to the box. ■ Unplug all external connectors from all boards already installed, because these connectors might conduct dangerous high voltage into the chassis or parts of the circuit.
Grounding	■ If there is any chance that external devices connected to the boards might conduct dangerous high voltage into the chassis, never unplug the power cord, which is the system's protective ground, unless all other connectors are unplugged. ■ The power cord must be plugged into a grounded wall outlet only.
Turning expansion boxes on and off	■ Before you work with an expansion box, you should always turn on the expansion box before the host PC. ■ Do not switch off the expansion box while the host PC is still running. This might lead to unpredictable errors.
Expansion box in use	■ The operating temperatures of hardware devices directly affect their life time and their function. You must therefore ensure that the ambient temperature of the dSPACE system does not exceed the specified maximum temperature. For details, refer to *PX4: Ensuring Correct Operating Temperatures* on page 247, *PX10: Ensuring Correct Operating Temperatures* on page 252, *PX20: Ensuring Correct Operating Temperatures* on page 262, or *AutoBox: Ensuring Correct Operating Temperatures* on page 275.

- Do not block the air vents or place the unit too close to a wall or other obstacle.
- Guard against foreign objects (staples, etc.) falling or blowing into the box, or liquids being spilled into it.
- Do not expose the system to excessive dust or moisture.
- The fans of the expansion boxes have a dust filter. You have to check the dust filter for dirt at least once a year. More frequent checks may be necessary depending on the operating conditions. If the dust filter is dirty, you must replace it.

  A dirty dust filter blocks the input air stream and increases the temperature in the box, which may shorten the life of the hardware components. For instructions, refer to *How to Check and Replace the Dust Filter of an Expansion Box* on page 50.

Safety Precautions for Using AutoBox/Tandem-AutoBox in a Vehicle

Objective

To avoid damage to the AutoBox/Tandem-AutoBox and to achieve safe and trouble-free operation, the following special guidelines have to be observed.

Guidelines

- Turn off the engine while connecting or disconnecting the car battery. Even a brief disconnection of the battery while the engine is running results in a load dump of the car generator producing hazardous voltages of more than 100 V.
- Only valid for AutoBox up to Version 3.0 and Tandem-AutoBox up to Version 4.0:

  Double check the supply voltage polarity of the AutoBox/Tandem-AutoBox. Reverse polarity will immediately destroy the AutoBox/Tandem-AutoBox power supply even if the remote control input is turned off.
- Do not block the air intake of the fan on the rear side, and provide sufficient space for free air flow.
- Do not operate the AutoBox/Tandem-AutoBox for extended periods of time when the cover is removed.

- The fans of the expansion boxes have a dust filter. You have to check the dust filter for dirt at least once a year. More frequent checks may be necessary depending on the operating conditions. If the dust filter is dirty, you must replace it.

  A dirty dust filter blocks the input air stream and increases the temperature in the box, which may shorten the life of the hardware components. For instructions, refer to *How to Check and Replace the Dust Filter of an Expansion Box* on page 50.

Safety Precautions for Using Connector Panels

Objective	To avoid damage to the hardware and to achieve safe and trouble-free operation, the following guidelines must always be observed.
Guidelines	■ Before connecting a panel to a board, make sure that the PC or the expansion box (if used) are turned off and no external devices are connected to the panel. ■ No chemicals other than alcohol (ethanol or isopropanol) should be used to remove writing from the panel templates, since they might damage the permanent print on the templates or even corrode the panel. ■ Guard against foreign objects (staples, etc.) falling or blowing into the unit, or liquids being spilled into it. ■ Do not expose the panel to excessive dust or moisture.

Introduction to the DS1103

Objective	The dSPACE system based on the DS1103 PPC Controller Board comprises hardware and software.
Where to go from here	Information in this section

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Hardware

Board description	The DS1103 PPC Controller Board is specifically designed for development of high-speed multivariable digital controllers and real-time simulations in various fields. It is a complete real-time control system based on a PowerPC processor. For advanced I/O purposes, the board includes a slave-DSP subsystem based on the Texas Instruments TMS320F240 DSP microcontroller.
Installation location	The DS1103 PPC Controller Board is a standard PC/AT card that can be plugged into a PC using the ISA bus as a backplane. The card can also be inserted in a dSPACE expansion box communicating with the host PC via an ISA-bus extension or Ethernet.

Easy access to input and output signals

For purposes of rapid control prototyping (RCP), specific interface connectors and connector panels provide easy access to all input and output signals of the board.

Using an *adapter cable* you can link your external signals from the 100-pin I/O connector on the board to Sub-D connectors. So you can make a high-density connection between the board and the devices of your application via Sub-D connectors.

Specific interface *connector panels* provide easy access to all the input and output signals of the DS1103 PPC Controller Board:

- The CP1103 *C*onnector *P*anel provides easy-to-use connections between the DS1103 PPC Controller Board and devices to be connected to it. Devices can be individually connected, disconnected or interchanged without soldering via BNC connectors and Sub-D connectors. This simplifies system construction, testing and troubleshooting.
- In addition to the CP1103, the CLP1103 *C*onnector/*L*ED Combi *P*anel provides an array of LEDs indicating the states of the digital signals.

Demo equipment

To demonstrate control design and implementation, demo equipment (VCFP Simulator) is available for the DS1103.

Shipment

The DS1103 PPC Controller Board is a single-board system. The package contains one board with a triple bracket and adapter cables with six Sub-D connectors.

If you ordered the DS1103 together with an expansion box, the board is not installed in the box.



To avoid damage to the hardware during transportation, the DS1103 PPC Controller Board is delivered separately and has to be installed in the expansion box.

Software

Objective

The dSPACE software, such as the implementation and the experiment software, comes on DVD and has to be installed first. For further information, refer to *Introduction to dSPACE Software Products on DVD* (📖 *Software Installation and Management Guide*).

Before You Start

Objective

Make yourself familiar with the installation and configuration procedures of the DS1103 PPC Controller Board and check if your system fulfills the system requirements.

Where to go from here

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Installation and Configuration Overview

Installation sequence



NOTICE

Changing the installation sequence may lead to unpredictable results or even damage the system.

- Install the components of your system in exactly the order stated.
- Read the instructions carefully before starting installation.
- Consider all warnings given.

Installing the DS1103 requires the following steps in the specified order.

1. Check whether the software has been installed on the host PC.

You must first install the software before installing any hardware component to the host PC and before connecting an expansion box to it. For detailed instructions on installing the software, refer to *Installing dSPACE Software* (🕮 *Software Installation and Management Guide*).



You need administrator rights to install dSPACE software.

2. Check whether your hardware meets the requirements for DS1103. Refer to *Checking the System Requirements* on page 26.
3. Check if the default setting of the board must be changed. Refer to *Setting up the DS1103* on page 34.
4. Now you can install the hardware. Refer to *How to Install the DS1103* on page 38.
5. If the DS1103 is installed in an expansion box, connect the box to your host PC. Refer to *Connecting an Expansion Box to the Host PC* on page 53.

Configuration sequence

After you install your DS1103, you can configure it in the following steps:

1. Set the connection mode and register your hardware.
2. Check if your platform is ready to run real-time applications.
3. The firmware of the DS1103 can be updated if you install a new dSPACE Release.

Installation problems



If you encounter any problems during installation and configuration:

- Check the Support section of our website.

  See http://www.dspace.com/go/support.

- The FAQ section and application notes provide a lot of useful information.

  See http://www.dspace.com/go/FAQ.

- To stay up-to-date with information on possible problems, you should periodically check the known problem reports.

  See http://www.dspace.com/go/ProblemReports.

If self-help does not solve the problem, contact dSPACE Support and give them information about your dSPACE environment and the problems you have. The best way to do this is with the support request form provided on the website at http://www.dspace.com/go/supportrequest, but you can also send an e-mail or phone us. For details, refer to *Contacting dSPACE Support* (🕮 *Software Installation and Management Guide*).

Next steps

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 Next Generation can be used to experiment with your real-time application. Refer to 🕮 *First Work Steps with a dSPACE System*.

External devices

For information on connecting external devices of your application to the dSPACE system, refer to *Connecting External Devices to the dSPACE System* on page 93.

Related topics

Basics

- *Hardware* on page 21
- *Installing dSPACE Software* (🕮 *Software Installation and Management Guide*)
- *Introduction to the DS1103* on page 21
- *Software* on page 22

Checking the System Requirements

Objective	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 requirements for the hardware which is needed for connecting the host PC and the expansion box. This connection has to be established via a bus interface. For details, refer to *Appendix: System Requirements* (🕮 *Software Installation and Management Guide*).
Expansion box	If you want to install the DS1103 in an expansion box, the box must fulfill the following requirements. **Required slots** You need one free full-size ISA slot and two free adjacent brackets (refer to the illustration in *How to Install the DS1103* on page 38). In addition, one free full-size ISA slot is required by the DS814 (bus connection) or the slot CPU (Ethernet connection). **Bus interface** If you want to connect the expansion box to the host PC via a bus interface, the DS814 has to be installed in the box. A suitable dSPACE link board has to be installed in the host PC. **Slot CPU** If you want to connect the expansion box to the host PC via Ethernet, a slot CPU has to be installed in the box. Keep in mind that the host PC requires a network adapter to establish an Ethernet communication.
Resources of dSPACE boards	The resources in the host PC and in the expansion box needed by your dSPACE boards depend on your installation, refer to *Resource Requirements of dSPACE Boards* on page 31.

Compatibility to dSPACE Releases

The following notes describe the compatibility of dSPACE Releases to the different board revisions of the DS1103 PPC Controller Board:

- If you use release *DS1103 Revision 09 for dSPACE Release 4.1* or later releases:
  - Programs or models that were prepared and compiled for board revision DS1103-07 (400 MHz CPU clock, cooling by fan) and earlier must be recompiled.
  - Programs or models that were prepared and compiled for the DS1103-09 run on earlier board revisions without changes. However, applications that use the new functions of the DS1103-09 are not supported on the DS1103-07.
- If you use *dSPACE Release 4.1 or earlier releases*:

  These releases do not support the DS1103-09.

Installing the Hardware

Objective	dSPACE's real-time boards can be installed in the host PC or in an expansion box connected to the PC via Ethernet or a bus interface. An expansion box is an enclosure to be used for dSPACE boards only. It provides 20 (PX20), 10 (PX10) or 4 (PX4) full-size 16-bit PC/AT slots with the standard 0.8 inch (20.3 mm) spacing.
Shipment with expansion box	If you order the DS1103 together with an expansion box, the DS1103 is not inserted in the expansion box. The board is shipped separately to avoid damage to itself and to the expansion box during transportation.
Where to go from here	Information in this section

Resource Requirements of dSPACE Boards Depending on the installation, dSPACE boards require resources in the host PC and the expansion box.	31
Setting up the DS1103 Before inserting the DS1103 in the host PC or expansion box, you have to check if any of the board's default settings must be changed.	34
Installing the DS1103 After setting up the DS1103, you can install it in your host PC or in an expansion box.	37
Installing a Connector Panel CP and CLP connector panels provide easy-to-use connections between the board and external devices.	42
Installing AutoBox/Tandem-AutoBox in a Vehicle AutoBox is an expansion box for in-vehicle applications. After the dSPACE boards are installed in an AutoBox, the AutoBox itself has to be installed in a vehicle.	45

PX20 Expansion Box Installation The PX20 Expansion Box is available as either a desktop box or a rack-mount version. You can also install the desktop box in a standard 19'' rack.	49
Maintenance Work for Expansion Boxes (PX10, PX20, AutoBox, Tandem-AutoBox) The fans of various expansion boxes (PX10, PX20, AutoBox, Tandem-AutoBox) have a dust filter. Check the filter periodically. If it is dirty, you must replace it.	50

Information in other sections

Safety Precautions for Installing and Connecting the Hardware	17

Resource Requirements of dSPACE Boards

Objective

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

Where to go from here

Information in this section

Installation in the Host PC	31
Installation in the Expansion Box	32
Connection of MicroAutoBox to the Host PC	33

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.



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

Board	Slot Type	Required I/O Address Range	Default I/O Base Address	Required Memory Range	Required IRQ
DS1104	PCI	–	–	2 x 4 KB	1 (PCI)
DS1104 (PCIe variant)	PCIe	–	–	2 x 4 KB	1 (PCIe)
DS815	PCMCIA	10H	Plug & Play	None	1 (ISA)
DS817	PCI	10H	Plug & Play	None	1 (PCI)

Board	Slot Type	Required I/O Address Range	Default I/O Base Address	Required Memory Range	Required IRQ
DS819[1)]	PCI Express	10H	Plug & Play	None	1 (PCI Express)
DS821[1)]	Express Card	10H	Plug & Play	None	1 (PCI Express)

[1)] Supported by the dSPACE software as of dSPACE Release 5.2.

Installation in the Expansion Box

Resources in the expansion box

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

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	Required Memory	Required IRQ
DS1005	10H	300H	None	None
DS1006 up to board revision DS1006-03	10H	300H	None	None
DS1006 as of board revision DS1006-06 (multicore processor board)	40H	300H	None	None
DS1103	10H	300H	None	None
DS2302	10H	380H	None	None

The DS1007 PPC Processor Board does not need any resources in the expansion box.

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 DS815, 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	■ ISA for DS815 ■ PCI for DS817 ■ PCI Express for DS819/DS821

The DS819 and DS821 Link Boards are supported by the dSPACE software since dSPACE Release 5.2.

Connection via Ethernet The boards installed in the expansion box require no resources in the host PC.



The slot CPUs installed in the expansion box as provided by dSPACE do not conflict with the default I/O base addresses of dSPACE boards.

Connection of MicroAutoBox to the Host PC

Resources in the host PC

MicroAutoBox can be connected to the host PC via the Link Boards DS815, DS817, DS819 or DS821. The following resources are required in the host PC:

Required Address Bytes	Default I/O Base Address	Required Memory	IRQ	
10H	Plug & Play	None	1	■ ISA for DS815 ■ PCI for DS817 ■ PCI Express for DS819/DS821

Setting up the DS1103

Objective

Before inserting the DS1103 in the host PC or in the expansion box, you have to check if the default factory setting of the I/O base address (port address) must be changed.

Where to go from here

Information in this section

Basics on Changing I/O Base Addresses 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.	34
How to Change I/O Base Addresses	35

Basics on Changing I/O Base Addresses

Objective

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 and the FlashDisk.
- There are other devices like network boards or SCSI controllers using the same I/O address range.

  This does not apply if the expansion box is connected to the PC via Ethernet or via the link boards DS815, DS817, DS819, DS821 and DS814. In this case, only the link boards (PC) need resources in the PC. These resources are assigned automatically by the link boards' plug & play feature.
- If you want to install the DS1103 in an expansion box, the plug & play circuit on the DS1103 must be disabled. This is done automatically, when the board's I/O base address is set to an address other than "000H".
- 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 Next Generation.
- Within an Ethernet multiconnect group, the I/O base addresses of all included dSPACE boards must be unique.

Instructions on address changing

For detailed instructions on changing the I/O base address, refer to *How to Change I/O Base Addresses* on page 35.

How to Change I/O Base Addresses

Objective

The I/O base address, meaning the port address, is selected via three rotary switches on the DS1103.

Basics

Before you check and change this address, you should first read the basic information in *Basics on Changing I/O Base Addresses* on page 34.

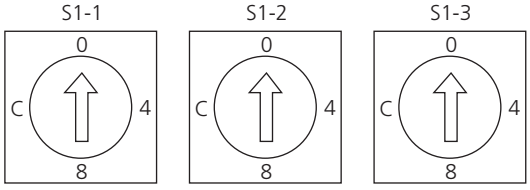
Factory default setting

000H

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 DS1103

The following table shows the switch settings for some I/O base addresses for the DS1103.

I/O Base Address (Port Address)	S1-1	S1-2	S1-3
000H (default) (= Plug & Play enabled)	0	0	0
240H[1)]	0	2	4
280H	0	2	8
300H	0	3	0
310H	0	3	1
380H	0	3	8

[1)] The I/O base address 240H is reserved for the slot CPU in the expansion box, if the connection between host PC and expansion box is established via Ethernet.

Related topics

Basics

- *Basics on Changing I/O Base Addresses* on page 34
- *Resource Requirements of dSPACE Boards* on page 31

Installing the DS1103

Objective

The DS1103 can be installed:

- in the host PC
- in an expansion box/AutoBox connected to the PC via Ethernet or a bus interface

Where to go from here

Information in this section

How to Switch Off a dSPACE System	37
How to Install the DS1103	38
How to Switch On the dSPACE System	41

Information in other sections

Safety Precautions for Installing and Connecting the Hardware	17

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 dSPACE system.
2. Shut down the host PC and turn it off.



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

3. Turn off the expansion box (if used).

Result

The dSPACE system is ready for installing or removing hardware components and connecting or disconnecting devices.

Related topics

HowTos

- *How to Install the DS1103* on page 38

How to Install the DS1103

Objective

The following instructions will guide you through the installation of dSPACE boards in an expansion box/AutoBox or in the host PC.

Important notes

You install dSPACE hardware at your own risk. 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.

Working with more than one dSPACE board in plug & play configuration may cause assignment problems. For details, refer to *Problems with Multiple Plug & Play Boards* on page 211.

Shipment by dSPACE

If you ordered a DS1103 together with an expansion box, the board is shipped separately to avoid damage to the board and to the expansion box during transportation. Thus, you have to install the board in the box.

Preconditions

- The system is switched off. For instructions, refer to *How to Switch Off a dSPACE System* on page 37.
- Precautions are taken to avoid damage by high electrostatic voltages. For details, refer to *Safety Precautions for Installing and Connecting the Hardware* on page 17.

Method

To install the DS1103

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 expansion box (if used) are switched off.
- No external device is connected to the dSPACE system.

1 Disconnect the host PC, the expansion box and all external devices connected to them from power supply.

2 Open the enclosure.

3 Select an empty full-size 16-bit slot with two free brackets next to it.

4 Remove the brackets that cover the openings on the rear side of the enclosure.



NOTICE

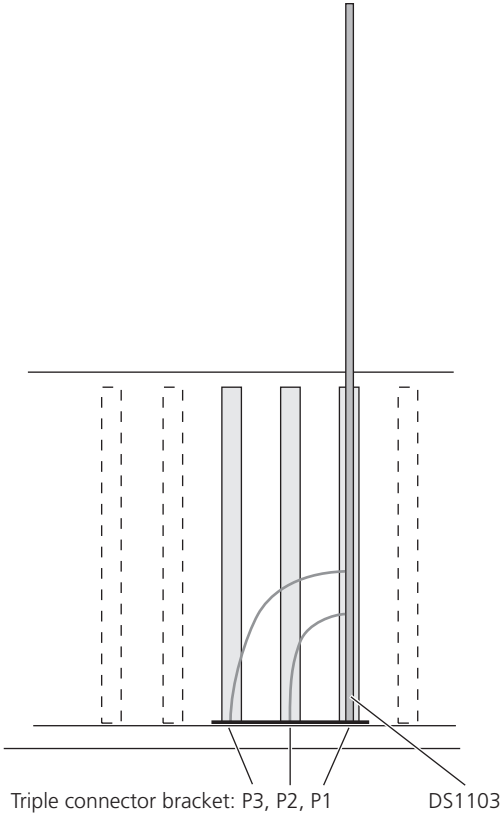
Improper handling will damage the fan of the board.

Only valid for boards up to board revision DS1103-07.

- Do not touch any components of the fan, neither during operation nor when it has stopped.
- Do not apply pressure to the fan bearing during installation and removal of the board.

5 Insert the DS1103 and screw on the board's triple connector.

The connector next to the board is labeled P1, the second connector is labeled P2 and the third one P3.



6 Close the enclosure.

7 Reconnect the PC, the expansion box and all connected devices to the power supply.

Result

The installation is complete.

Next steps

- If your system is installed in an expansion box, it must be connected to your host PC via Ethernet or a bus interface. For further information, refer to *Connecting an Expansion Box to the Host PC* on page 53.
- You can switch on the dSPACE system. Refer to *How to Switch On the dSPACE System* on page 41.

Related topics

Basics

- *Safety Precautions for Installing and Connecting the Hardware* on page 17
- *Setting up the DS1103* on page 34

HowTos

- *How to Switch Off a dSPACE System* on page 37
- *How to Switch On the dSPACE System* on page 41

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 expansion box (if used).



To avoid unpredictable errors, you should always turn on the expansion box before the host PC.

2 Turn on the host PC.

Result

The dSPACE system is running and you can work with it.

Installing a Connector Panel

Objective

The CP and CLP connector panels provide easy-to-use connections between the board and external devices. Devices can be individually connected, disconnected or interchanged without soldering. This simplifies system construction, testing and troubleshooting.

The CLPs additionally provide arrays of LEDs, which indicate the states of the digital signals.

Where to go from here

Information in this section

How to Connect a Panel (CP, CLP) to a Board After you have installed the board in the host PC or in an expansion box, you can connect the accompanying panel to the board.	42
How to Mount a Panel in a 19" Rack As a standard, the CP and CLP connector panels are installed in a desktop box made from aluminum profiles. They can optionally be mounted in a 19'' industry rack.	43

How to Connect a Panel (CP, CLP) to a Board

Safety precautions

For safe and trouble-free operation of the panels, various guidelines must be observed. For details, refer to *Safety Precautions for Using Connector Panels* on page 20.

Preconditions

- The system is switched off. For instructions, refer to *How to Switch Off a dSPACE System* on page 37.
- If the panel is to be mounted in a 19" rack, this should be done first (see *How to Mount a Panel in a 19" Rack* on page 43).

Method

To connect a panel to the DS1103



NOTICE

Connecting external devices while the power supply is switched on may damage the dSPACE hardware.

- Do not connect or disconnect any device while the power supply is switched on.
- Turn off the host PC, the expansion box (if used), and the external devices beforehand.

1. Plug the CP1103 or CLP1103 to the DS1103 and tighten the lock screws. Take care not to mix up the connectors of the DS1103. Connectors are installed correctly when ribbon cables are not twisted and do not cross over each other. Furthermore, the connectors are marked by labels P1A, P1B, etc.
2. Put templates on the panel. Turn the black clips on the panel through 90 degrees to secure the templates to the panel.

Next steps

Now you can:

- Connect devices to the panel. For detailed instructions, refer to *How to Connect External Devices to a Connector Panel* on page 95.
- Switch on the dSPACE system. Refer to *How to Switch On the dSPACE System* on page 41.

Related topics

Basics

- *Safety Precautions for Using Connector Panels* on page 20

HowTos

- *How to Connect External Devices to a Connector Panel* on page 95
- *How to Switch Off a dSPACE System* on page 37

How to Mount a Panel in a 19” Rack

Objective

The connector and LED panels are installed in a desktop box made from aluminum profiles as a standard. They can optionally be mounted in a 19'' industry rack.

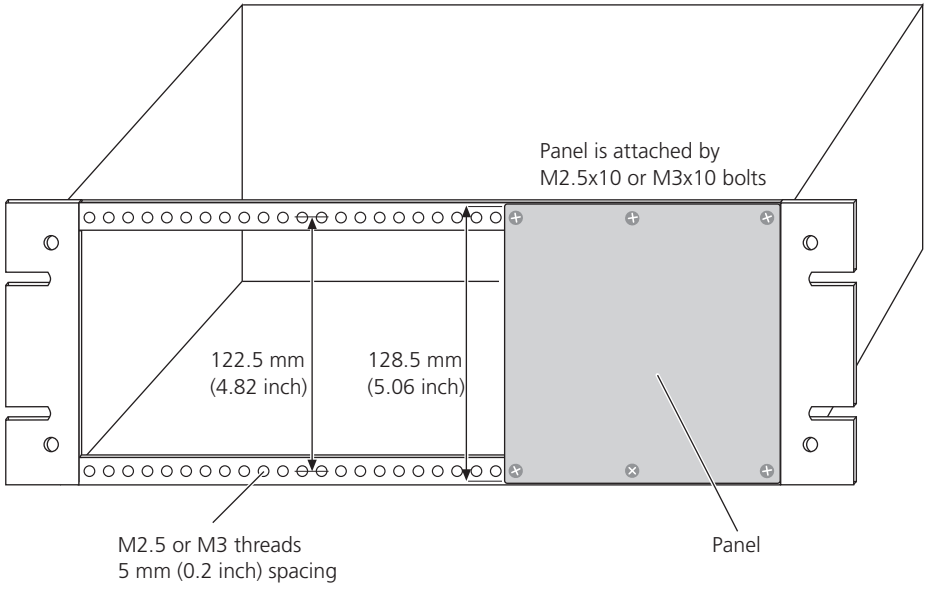
Preconditions

- The system is switched off. For instructions, refer to *How to Switch Off a dSPACE System* on page 37.
- All connections to external devices are removed.

Method

To mount panels in a standard 19'' industry rack

1. Remove the aluminum box. To do so, unscrew one of its side panels (4 screws). If there is a ribbon cable strain relief at the bottom of the box, it must be cut open.
2. Bolt the panel to the front of a 19'' rack as shown below. Depending on the rack used, several M2.5x10 or M3x10 bolts are required.



Installing AutoBox/Tandem-AutoBox in a Vehicle

Objective

The AutoBox/Tandem-AutoBox is the ideal environment for using your dSPACE real-time hardware for in-vehicle control experiments. It provides space for up to seven boards, on request even for up to 14 (one is reserved for a slot CPU), and can be mounted anywhere in a vehicle.

Where to go from here

Information in this section

Notes on Mounting and Connecting	45
Power Input Connector	48

Information in other sections

AutoBox	268
Tandem-AutoBox	286

Notes on Mounting and Connecting

Objective

The AutoBox/Tandem-AutoBox features a DC–DC power supply with a remote control input that should be used to turn the power supply on or off.

Mounting instructions

- Do not mount AutoBox/Tandem-AutoBox without rubber shoes at the shock mounts.
- Upside down mounting is not allowed.
- For mounting you should add approx. 0.1 m (3.9 in.) space to the outer dimensions of the AutoBox. This is to allow the AutoBox/Tandem-AutoBox to vibrate under extreme conditions without bumping against other devices.
- Do not block the air intake of the fan on the rear side, and provide sufficient space for free air flow.

Safety precautions

The DC–DC converter built into the AutoBox/Tandem-AutoBox lets you operate a dSPACE system connected to a car battery. Due to the high currents involved, special care must be taken when connecting the AutoBox/Tandem-AutoBox power supply to the car. Wires with high cross-section (6 mm^2 minimum) are mandatory to avoid poor performance of the power supply and excessive heating of the wires.

WARNING

Hazardous voltages

Risk of electric shock

Even a brief disconnection of the battery while the engine is running results in a load dump of the car generator producing voltages of more than 100 V.

- Turn off the engine while connecting or disconnecting the car battery.

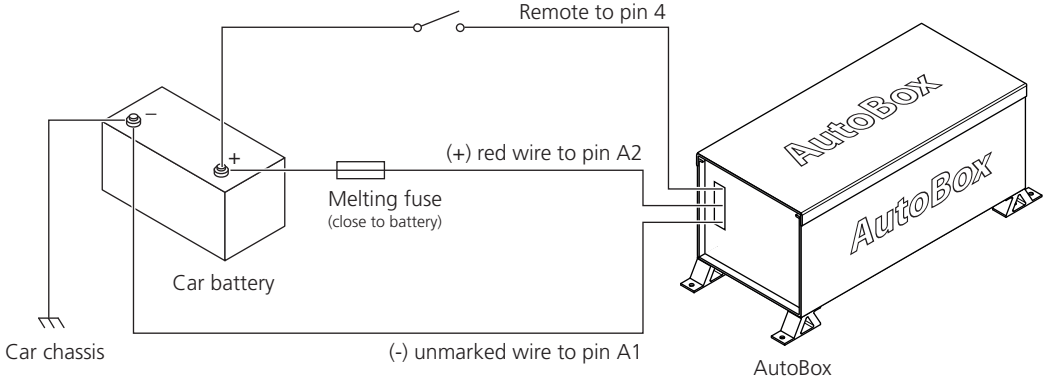
NOTICE

Only valid for AutoBox up to Version 3.0 and Tandem-AutoBox up to Version 4.0: Reverse polarity destroys the AutoBox/Tandem--AutoBox power supply even if the remote control input is turned off.

- Double check the supply voltage polarity of AutoBox/Tandem-AutoBox.

Wiring diagram

The wiring has to be performed according to the illustration below. If you use Tandem-AutoBox up to Version 4.0, both power supplies must be connected.



For operation with DC voltages > 32 V, set up a power cable with adequate cable and fuse ratings. For further information, refer to dSPACE support.



- The remote voltage should not exceed the supply voltage. Overvoltage protection of the remote pin is 100 V.
- The remote voltage may be used for starting AutoBox/Tandem-AutoBox with a remote switch: KL15, for example (output of the ignition/driving switch).
- If you connect the remote pin to the car battery directly, the AutoBox/Tandem-AutoBox will always be turned on, and the car battery will soon be exhausted if the engine is not running. Thus, a switch is highly recommended.

Cable supplied by dSPACE

A preconfigured cable for the supply voltage is provided by dSPACE. This cable is intended to operate the AutoBox/Tandem-AutoBox with a laboratory power supply during development. Therefore, pin 4 (remote) is shorted to pin A2 inside the connector in order to save a separate switch.



Do not use this cable in the vehicle. Otherwise, the AutoBox/Tandem-AutoBox will always be turned on.

As of March 2009, the VBAT wire (red) contains a melting fuse. The red wire has a cross-section of 10 mm², the black wire of 6 mm². Depending on the AutoBox/Tandem-AutoBox version, the melting fuse has the following characteristics:

- AutoBox:
  - Up to Version 3.0: 60 A/32 V, time lag
  - Version 4.0 and later: 25 A/32 V, time lag (label on the cable: CB402AB)
- Tandem-AutoBox
  - Up to Version 4.0: 60 A/32 V, time lag



NOTICE

To avoid damage, do not use a cable with cross-sections less than 6 mm².

Power Input Connector

Objective

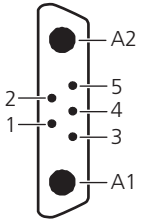
Each power supply unit provides a power input connector. It is a 7-pin, male connector with two high-current pins. It is adapted from a 15-pin Sub-D connector.

Matching cable

One mating connector with connecting leads is included in the AutoBox package (up to TandemAutoBox Version 4.0 = two connectors). The cable for AutoBox Version 4.0 is labeled CB402AB.

Connector pinout

The following illustration shows the pinout (front view).

Connector	Pin	Signal	Pin	Signal
	A2	Positive supply voltage [1]		
			5	Reserved, do not use
	2	Reserved, do not use	4	Remote control[2]
	1	Reserved, do not use	3	Reserved, do not use
	A1	Negative supply voltage (0 V)		

[1] Up to AutoBox Version 3.0: 8 V … 60 V DC; AutoBox Version 4.0 and later: 6 V … 60 V DC; Up to Tandem-AutoBox Version 4.0: 10 V … 60 V DC.

[2] If you use the matching cable supplied by dSPACE the remote control line is connected to positive supply voltage within the connector shell. This cable is intended for use with a laboratory power supply only.

PX20 Expansion Box Installation

Objective

You can install a PX20 desktop box in a 19'' rack.

Mounting a PX20 Expansion Box in a 19'' Rack

Objective

The PX20 Expansion Box is available as either a desktop box or a rack-mount version. However, you can also install the desktop box in a 19'' rack.

Notes for mounting

- When the outer decorative cover of a PX20 is removed, its chassis can be mounted in a standard 19'' rack. There are five M5 threads on either side of the chassis. The bolts should be as short as possible to prevent short circuits inside the unit, and must not protrude more than 5 mm (0.2") into the box. With common 19'' racks, M5 x 6 bolts can be used.
- To prevent the system from overheating make sure that the ventilation is not obstructed.



The plastic front cover can be snapped off and can be replaced by a special version with rack handles, which is available upon request.

Maintenance Work for Expansion Boxes (PX10, PX20, AutoBox, Tandem-AutoBox)

How to Check and Replace the Dust Filter of an Expansion Box

Objective

The fans of various expansion boxes (PX10, PX20, AutoBox, Tandem-AutoBox) have a dust filter. Check the filter periodically. If it is dirty, you must replace it. Cleaning the dust filter is not sufficient to restore the characteristics of a new one.

Checking interval

You have to check the dust filter for dirt at least once a year. More frequent checks may be necessary depending on the operating conditions.

Effect of using dirty dust filters



NOTICE

A dirty dust filter blocks the input air stream and increases the temperature in the box, which may shorten the life of the hardware components.

Tools and spare parts

You need the following tools and spare parts:

- Phillips screwdriver, PH 1
- If the filter is dirty, you need a new one: dSPACE provides a pack of three replacement dust filters for the different expansion boxes. The order numbers are as follows:
  - PX10: FILTER_PAD_PX10
  - PX20: FILTER_PAD_PX20
  - AutoBox, Tandem-AutoBox: FILTER_PAD_ABX

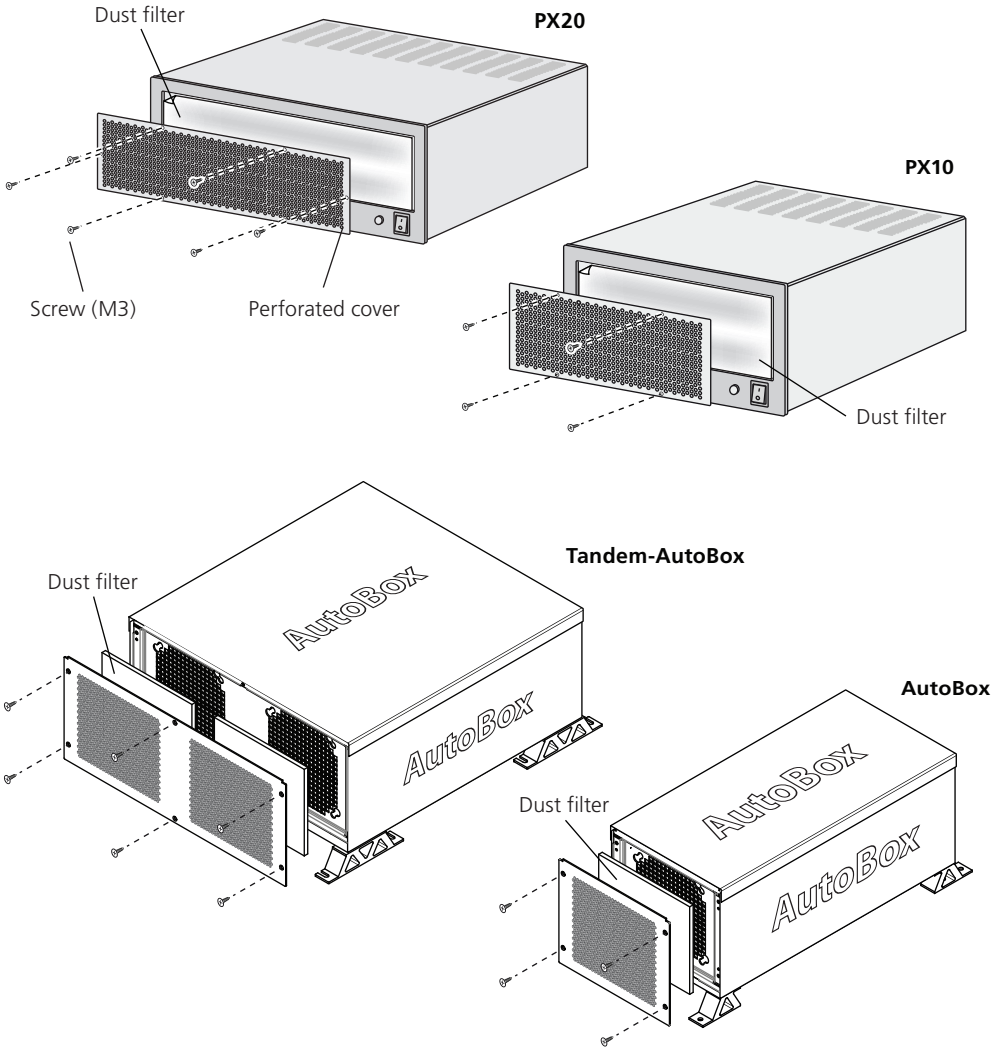
    The Tandem-AutoBox has two dust filters.

Method

To check and replace the dust filter of an expansion box

1 Switch off the expansion box or the power supply of the car engine (if using an AutoBox, Tandem-AutoBox).

2 Unscrew the Phillips screws (M3) as shown in the illustrations below.



3 Remove the perforated cover from the box.

4 Remove the dust filter and check it for dirt. If necessary replace it by a new one.

5 Replace the dust filter and fix it to the box with the perforated cover and the Phillips screws (M3).

Result

You have checked and if necessary replaced the dust filter.

Connecting an Expansion Box to the Host PC

Objective	Expansion boxes expand the host PC for large dSPACE systems.
Where to go from here	Information in this section

Prior to connecting or working with expansion boxes, ensure you have familiarized yourself with the relevant safety precautions.	
Safety Precautions for Using Expansion Boxes	18
If you install your system in an expansion box, the box must be connected to your host PC via Ethernet or a bus interface.	
Connecting via Ethernet	54
Connecting via Bus Interface	55

Connecting via Ethernet

Where to go from here

Information in this section

Basics on Connecting via Ethernet 54

Information in other sections

Setting Up an Ethernet Connection Between PC and Expansion Box 81

Basics on Connecting via Ethernet

Objective

You can connect an expansion box to your host PC via Ethernet. In this case, the expansion box is treated as a network client.

Preconditions

Both the host and client require a network adapter to establish communication. The expansion box with Ethernet connection is delivered with a slot CPU with a built-in network adapter.



If you want to install new dSPACE boards such as the DS1103 in an expansion box connected via Ethernet, contact dSPACE to check the slot CPU's compatibility with the new boards.

Setting up a Connection

After connecting the expansion box to the host PC via net cable, you have to set up the Ethernet connection. Refer to *Setting Up an Ethernet Connection Between PC and Expansion Box* on page 81.

Related topics

Basics

- *Connecting via Bus Interface* on page 55

Connecting via Bus Interface

Objective

You can connect an expansion box to your host PC via a bus interface. In this case you have to install dSPACE's link boards.

Where to go from here

Information in this section

Before using link boards you should familiarize yourself with the alternatives and limitations that apply to dSPACE's link boards.	
Link Boards Variants	56
Limitations With Link Boards	57
Establishing a bus connection via link boards	
How to Establish the DS817/DS819 <–> DS814 Bus Interface	58
How to Establish the DS815/DS821 <–> DS814 Bus Interface	59
Status LED for connection indication	
Identifying the Connection Status The link boards have LEDs on the bracket to indicate the current status of the connection.	62

Information in other sections

Connecting via Ethernet	54
Connecting dSPACE Boxes to the Host PC via DS830 dSPACE's DS830 MultiLink Panel allows you to connect up to 16 dSPACE boxes to one host PC. With the DS830, you need to install only one link board (PC) in the host PC.	74

Link Boards Variants

Overview of alternatives

If you use a bus interface to connect the host PC to an expansion box, you currently have the five alternatives listed in the following table.

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

DS814 Link Board (Box)

The DS814 Link Board (Box) must be installed in the expansion box. 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.



It is highly recommended to use the DS821 Link Board only in combination with the dSPACE CardSafe. For details, refer to *Using dSPACE CardSafe* on page 65.

Limitations With Link Boards

Objective	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 expansion box, use the DS817, DS819, DS821, or DS830. ■ If you want to work with several boxes, you can use the DS830 MultiLink Panel as an alternative. With the DS830, you need to install only one link board (PC) in the host PC. For further information, refer to *Connecting dSPACE Boxes to the Host PC via DS830* on page 74.

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 37.
- A link board (DS817 or DS819) is installed in your host PC.
- The DS814 is installed in your expansion box.

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.



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 41.

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 41.

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 the 🕮 *First Work Steps with a dSPACE System* document.

Related topics

HowTos

- *How to Install the DS1103* on page 38
- *How to Switch Off a dSPACE System* on page 37

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.
- DS815 Link Boards (PC) delivered before November 2001 are equipped with other connectors. You need a matching link cable. For details, refer to *DS815 Connector and PC Card Link* on page 60.
- To connect the DS815 with a standard patch cable an adapter cable is available from dSPACE. For details, refer to *DS815-RJ45 adapter cable* on page 62.

dSPACE CardSafe

To hold the DS815 or DS821 firmly in a notebook slot, you can use the dSPACE CardSafe. The dSPACE CardSafe protects a card against unwanted removal from the host PC.



It is highly recommended to use the DS821 only in combination with the dSPACE CardSafe.

For details, refer to *Using dSPACE CardSafe* on page 65.

Preconditions

- The system is switched off. For instructions, refer to *How to Switch Off a dSPACE System* on page 37.
- A DS815 or DS821 is inserted in your host PC.
- A DS814 is installed in your expansion box.

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.



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 41.

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.

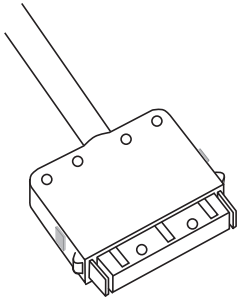
DS815 Connector and PC Card Link

PC card link cable

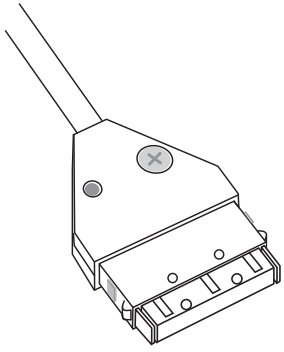
DS815 Link Boards (PC) delivered as of November 2001 are equipped with a new connector and come with a new matching link cable.

The PC card link cables of DS815 boards delivered before November 2001 are not compatible with the new cables.

Old PC card link cable ...

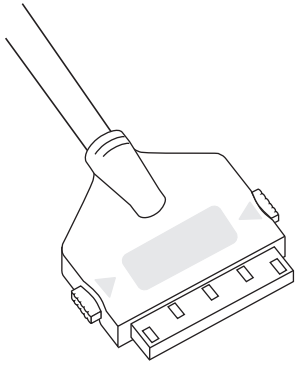


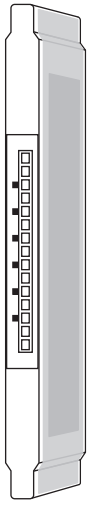
... without strain-relief clamp



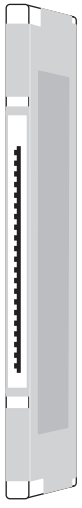
... with strain-relief clamp

New PC card link cable





Old DS815 connector

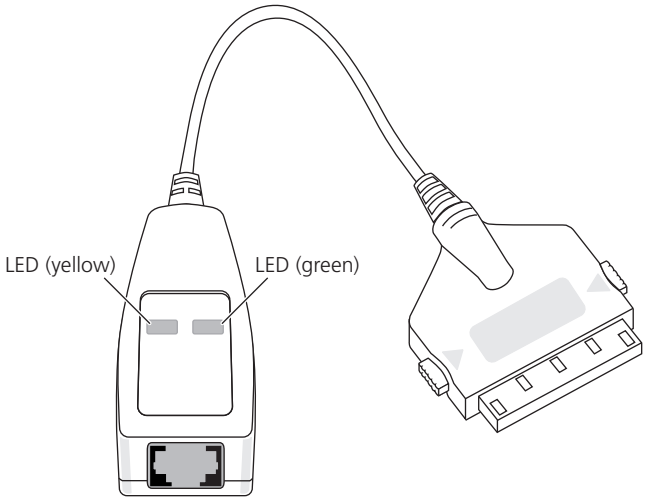


New DS815 connector

DS815 boards delivered before November 2001 have a blue label. Boards delivered later have a red label, or a blue label with “Vs. 2.0”.

DS815-RJ45 adapter cable

An adapter cable is available for the new DS815 connector to adapt the DS815 to a standard patch cable with an RJ45 connector. The adapter cable is labeled "DS815-RJ45 Vs 2.0".

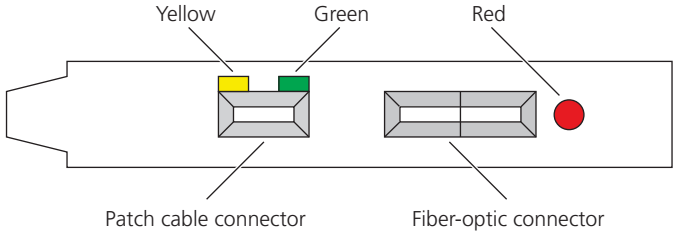


For the connection between the DS815-RJ45 adapter cable and the DS814 Link Board (Box), you must use a crossed-over patch cable.

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 expansion box is ready for communication.

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

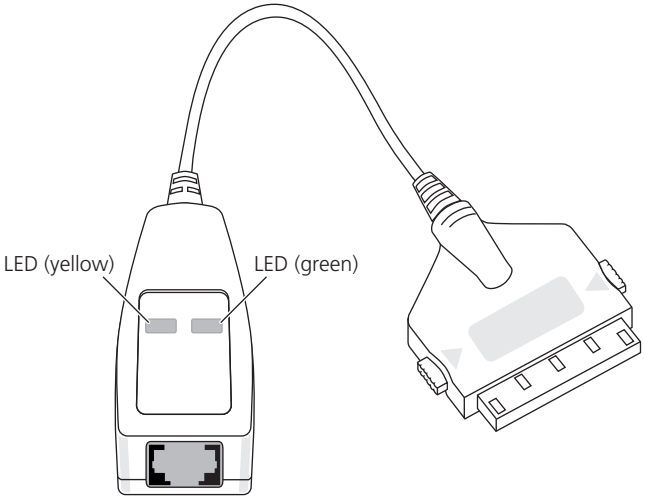
Green LED A lit green LED indicates that data is being sent or received.

DS815

The DS815 is not equipped with optical status indicators. Using the DS815-RJ45 adapter cable, you can identify the current status of the connection by the two LEDs integrated in the shell of the RJ45 connector.

DS815-RJ45 adapter cable

Two LEDs indicate the current status of the connection.

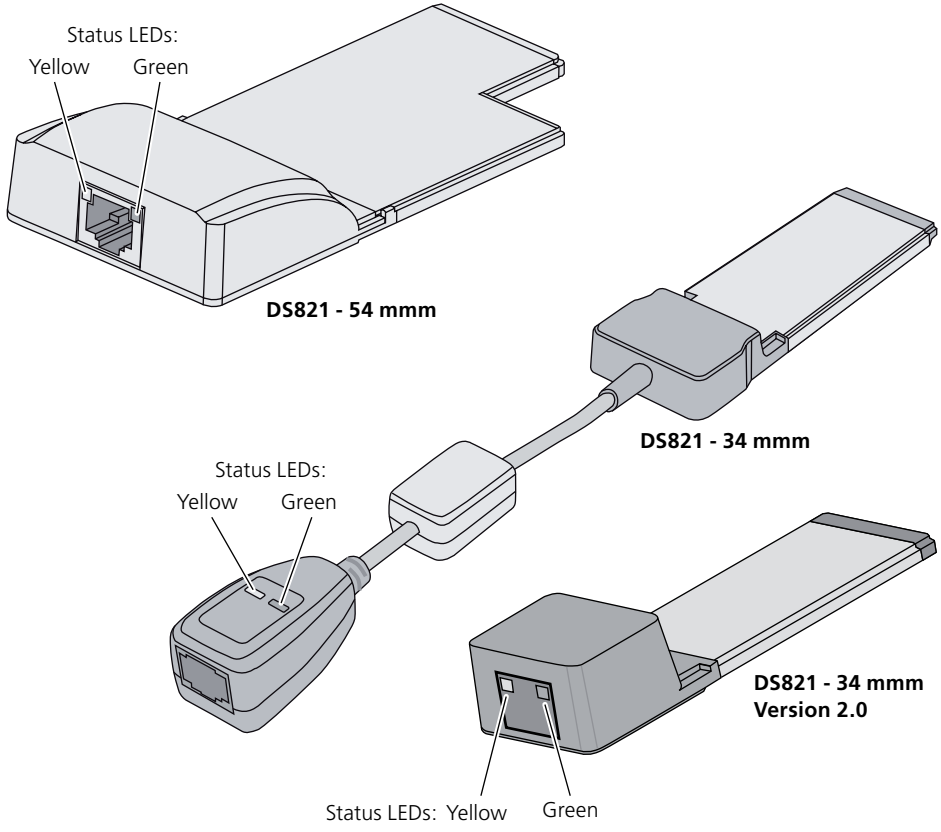


Yellow LED A lit yellow LED indicates that the connection between the host PC and the expansion box is ready for communication.

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

DS821

Two LEDs indicate the current status of the connection.



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

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

Using dSPACE CardSafe

Objective

To hold the DS815 or DS821 firmly in a notebook slot, you can use the dSPACE CardSafe. The dSPACE CardSafe protects the inserted dSPACE link boards, cables, or connectors against unwanted removal from the notebook and against damage.

Where to go from here

Information in this section

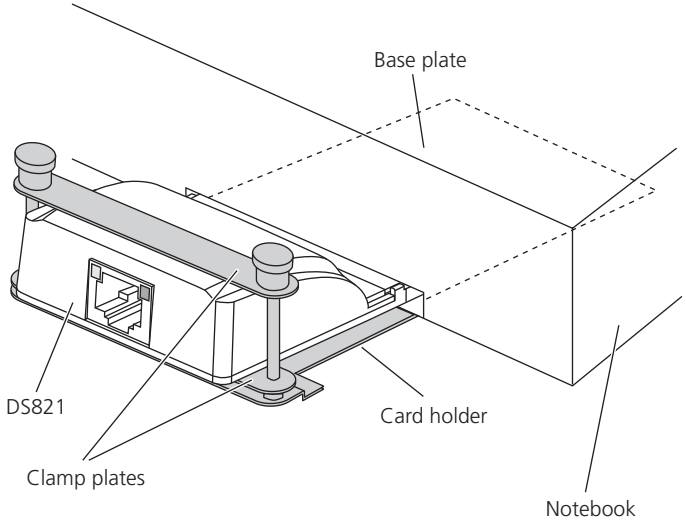
Introduction to dSPACE CardSafe	65
How to Mount dSPACE CardSafe	68
How to Remove dSPACE CardSafe for Transportation	72
How to Remove dSPACE CardSafe Completely	72

Introduction to dSPACE CardSafe

Overview

The dSPACE CardSafe consists of a base plate and a card holder. The base plate is fixed to the underside of the notebook and does not have to be removed for transportation. The card holder must be plugged into the base plate. The height of the clamp plates can be adapted to the notebook slot via bolt spacers.

The illustration below shows the main components of dSPACE CardSafe with a DS821-54 mm.

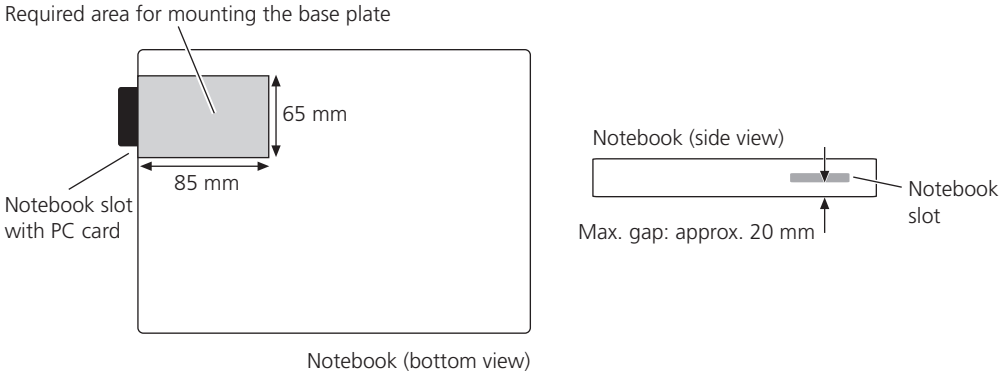


To use the DS821-34 mm in an ExpressCard/54 slot, dSPACE highly recommends to improve lateral stability in the notebook slot by using an ExpressCard Kit. Contact dSPACE for further information.

Required mounting area

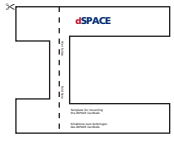
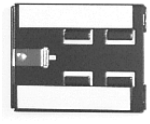
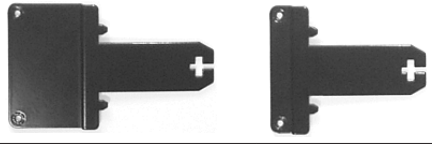
The illustration below shows the position and the space required for mounting the base plate on the underside of the notebook. You can level out an uneven surface on the underside with acrylic foam tapes, which are part of the delivery.

You can level out the gap between the underside of the notebook and the notebook slot via bolt spacers. The max. gap is approx. 20 mm (see below).



Items delivered

dSPACE CardSafe comes as a mounting kit with the following components:

Number	Item	Illustration
1 x	Acrylic foam tape	
1 x	Mounting template	
1 x	Base plate with velcro tape	
2 x	Card fixture (different sizes)	
2 x	Clamp plate	
6 x	Screw (different lengths)	

Number	Item	Illustration
2 x	Knurled nut	
10 x	Bolt spacer (different lengths)	
4 x	Rubber feet	
1 x	Mounting instructions	–

The items delivered are subject to change without notice.

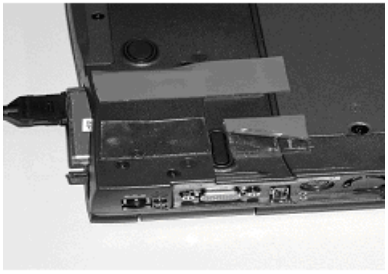
How to Mount dSPACE CardSafe

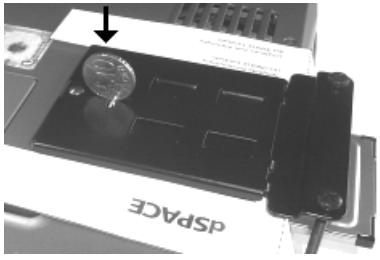
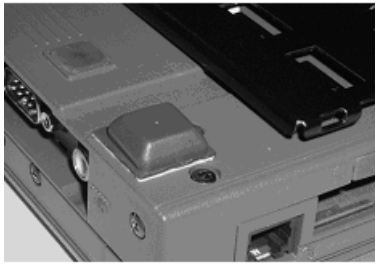
Method

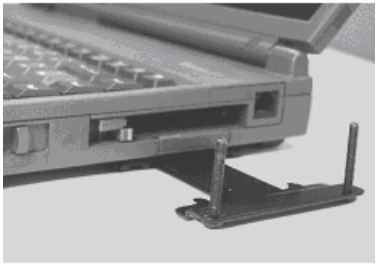
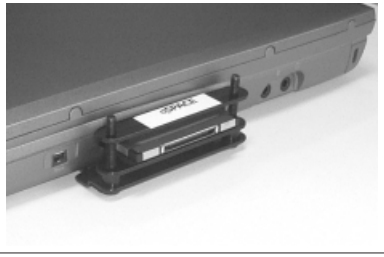
To mount dSPACE CardSafe

NOTICE

Do not mount the CardSafe over any ventilation slots at the bottom of the notebook. This could cause overheating and possibly destroy the notebook processor.

Step	Illustration	Instruction
1		Only if the surface of the notebook at the mounting position is not smooth: Remove the protective foil and put the acrylic foam tapes on the notebook so that there is a smooth surface at the mounting position.
2		Fold and then cut the template for mounting the dSPACE CardSafe.
3		Center the template on the underside of the notebook with a partially inserted link board.
4		Remove the protective foil from the velcro tape.

Step	Illustration	Instruction
5		Press the complete CardSafe (as delivered) to the underside of the notebook in the opening of the template. The procedure is the same for each card fixture type and for all the spacers and screws that can be mounted.
6		Push a small coin on the spring of the base plate to release the card fixture. *To avoid injury, do not use your fingernail to unlock the connector fixture.*
7		While pressing the spring, unplug the card fixture. The base plate stays in position. After this remove the template.
8		Fix the four rubber feet to the underside of the notebook. This is to compensate the height of the CardSafe and ensure the stability of the notebook.

Step	Illustration	Instruction
9		Plug in the card fixture. For a stable assembly, use the card fixture that best fits your link board in combination with your notebook.
10		Adjust the bottom clamp plate with spacers as needed.
11		Plug in the link board and mount the other clamp plate.
12		Fix the link board/connector with the knurled nuts.

How to Remove dSPACE CardSafe for Transportation

Objective

To transport the notebook in a bag, you have to remove only the card fixture of the CardSafe.

Preconditions

- *DS815*: The connector of the DS815 Link Board is removed. The link board can remain in the notebook.
- *DS821*: The DS821 Link Board is removed from the notebook.

Method

To remove dSPACE CardSafe for transportation

Step	Illustration	Instruction
1		Push a small coin on the spring of the base plate. *To avoid injury, do not use your fingernail to unlock the connector fixture.*
2		Remove the card fixture.

How to Remove dSPACE CardSafe Completely

Objective

Some notebooks with an installed CardSafe may no longer fit in docking stations. In such cases the CardSafe must be removed completely.

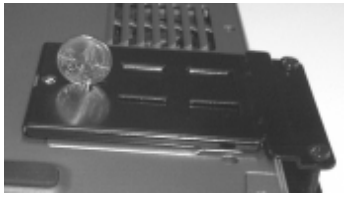
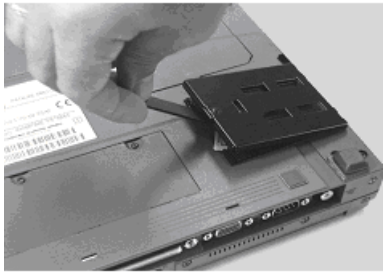
Preconditions

- *DS815*: The connector of the DS815 Link Board is removed. The link board can remain in the notebook.
- *DS821*: The DS821 Link Board is removed from the notebook.

Method

To remove dSPACE CardSafe completely

> ***NOTICE***
>
> **The base plate is fixed by velcro tape. Remove the base plate carefully when peeling the tape off, as the bottom of a notebook is very thin and sensitive.**

Step	Illustration	Instruction
1		Push a small coin on the spring of the base plate. *To avoid injury, do not use your fingernail to unlock the connector fixture.*
2		Remove the card fixture.
3		Carefully remove the base plate with a screwdriver.
4		Leave the velcro tapes on the notebook at the mounting positions.

Connecting dSPACE Boxes to the Host PC via DS830

Objective

dSPACE's DS830 MultiLink Panel allows you to connect up to 16 dSPACE boxes to one host PC. With the DS830, you need to install only one link board (PC) in the host PC.

Where to go from here

Information in this section

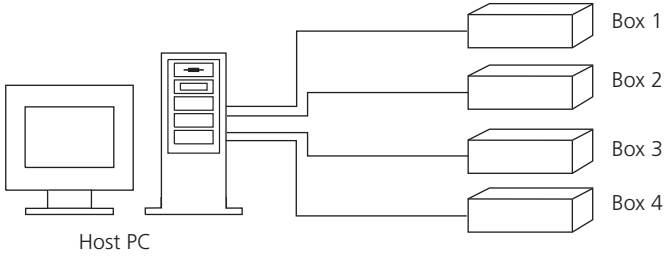
Features of DS830 MultiLink Panel	74
How to Connect the DS830	76
DS830: Identifying the Connection Status	78

Features of DS830 MultiLink Panel

Situation without DS830

You can connect several dSPACE boxes – expansion boxes and/or MicroAutoBoxes – to one host PC. Each connection requires a separate link board (PC) installed in the PC. The number of dSPACE boxes you can connect to the PC is limited by the number of free slots for link boards.

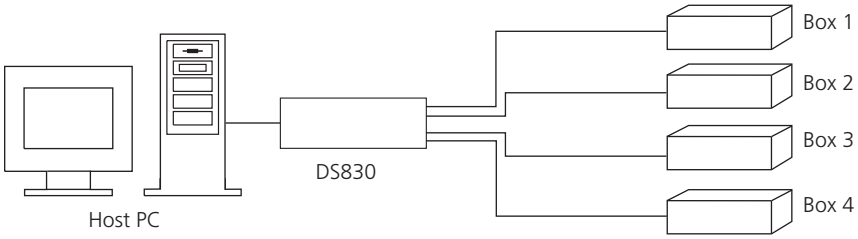
As an example, the following illustration shows how you can connect four boxes to your PC. You require four link boards (PC) in the PC.



Situation with DS830

dSPACE's DS830 MultiLink Panel allows you to connect up to 16 dSPACE boxes to one host PC. With the DS830, you need to install only one link board (PC) in the host PC.

As an example, the following illustration shows how to connect the DS830 to the host PC and four dSPACE boxes.



- You can connect any combination of expansion boxes and MicroAutoBoxes to the DS830.
- You can connect several DS830 panels to one host PC. Each DS830 has to be connected to the PC via a separate link board (PC).
- To install your dSPACE system in a vehicle, you can use the car battery as the power supply for the DS830.

Connecting and installing the DS830

To connect the DS830 to the host PC as well as to the dSPACE boxes, you can use any combination of crossed-over patch cables and fiber-optic cables. For example, you can connect the DS830 to the host PC and an expansion box via a fiber-optic cable, and to a MicroAutoBox via a patch cable.

The DS830 can be used in a laboratory or in vehicle. The cables required to supply power to the DS830 via a mains socket or a car battery are part of the DS830 hardware package. The cable for the mains socket includes a power supply unit (15.0 V, 4.0 A).

For instructions on the installation, see *How to Connect the DS830* on page 76.

Switching on a system with DS830

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 dSPACE boxes (expansion boxes and/or MicroAutoBox).
2. Turn on the DS830.
3. Turn on the host PC.

Limitations

The following limitations currently apply to the DS830:

- Up to 4 (DS830/4), 8 (DS830/8) or 16 (DS830/16) dSPACE boxes can be connected to one panel.
- The length of each connection is limited to
  - 10 m (crossed-over patch cable), and
  - 100 m (fiber-optic cable).

  Therefore, the maximum distance between a host PC and a box is 200 m (DS830 connected to both the PC and the box via fiber-optic cables).
- DS830 panels cannot be cascaded, which means that you cannot connect one DS830 to another. Each DS830 must be connected directly to a link board (PC).

Data sheet

For the specifications of the DS830, refer to *DS830 MultiLink Panel* on page 242.

Status LEDs

The DS830 is equipped with status LEDs: see *DS830: Identifying the Connection Status* on page 78.

Related topics

Basics

- *DS830: Identifying the Connection Status* on page 78

HowTos

- *How to Connect the DS830* on page 76

References

- *DS830 MultiLink Panel* on page 242

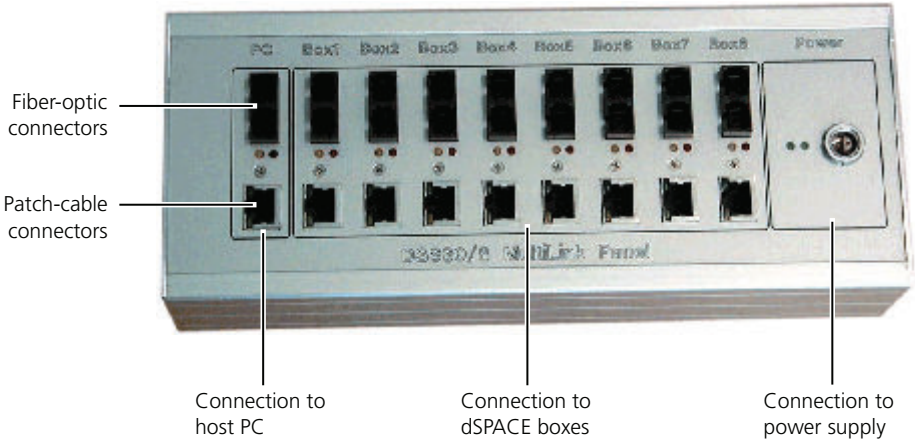
How to Connect the DS830

Objective

To install the DS830, you have to connect it to the host PC and the dSPACE boxes, and supply power to the panel.

Panel front

The front of the DS830 panel provides all the connectors required for installation. The following illustration shows the front of the DS830/8.



Cables

Use only the cable (fiber-optic or patch cable) supplied with the dSPACE hardware package.

The DS830 hardware package also includes the cables for connecting the DS830 to the power supply.

Possible methods

You can supply power to the DS830 Multilink Panel:

- Via mains socket. Refer to Method 1.
- Via car battery. Refer to Method 2.

Method 1

To connect the DS830 via mains socket

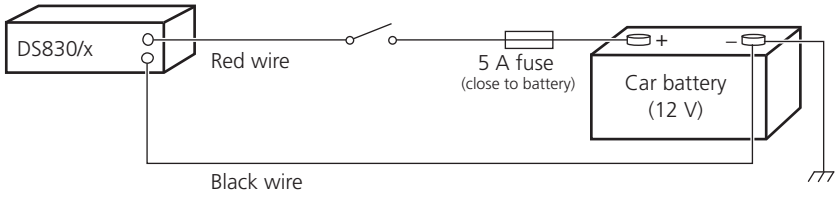
1. Connect the DS830 to the host PC.
2. Connect the DS830 to the dSPACE boxes (expansion box and/or MicroAutoBoxes).
3. Use the cable with the integrated power supply unit. Plug the power supply cable into the LEMO connector of the DS830.

Method 2

To connect the DS830 via car battery

1. Connect the DS830 to the host PC.
2. Connect the DS830 to the dSPACE boxes (expansion box and/or MicroAutoBoxes).
3. Use the cable with the unterminated end and connect this end to the car battery. Use a 5 A fuse to protect the DS830.

The illustration below shows how to supply power to the DS830 if installed in a vehicle.



It is highly recommended to insert a fuse into the main power supply wire. The fuse should be installed close to the battery.

If you connect the red wire to the car battery directly, the DS830 will always be turned on, and the car battery will soon run down if the engine does not operate. Thus, a switch is highly recommended.

Use only a switch and wires that are designed for at least 5 A.

Further steps

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

To avoid unpredictable errors, you should always turn on the dSPACE boxes (expansion box or MicroAutoBox) before the DS830 MultiLink Panel (if used) and the host PC.

Related topics

Basics

- *DS830: Identifying the Connection Status* on page 78

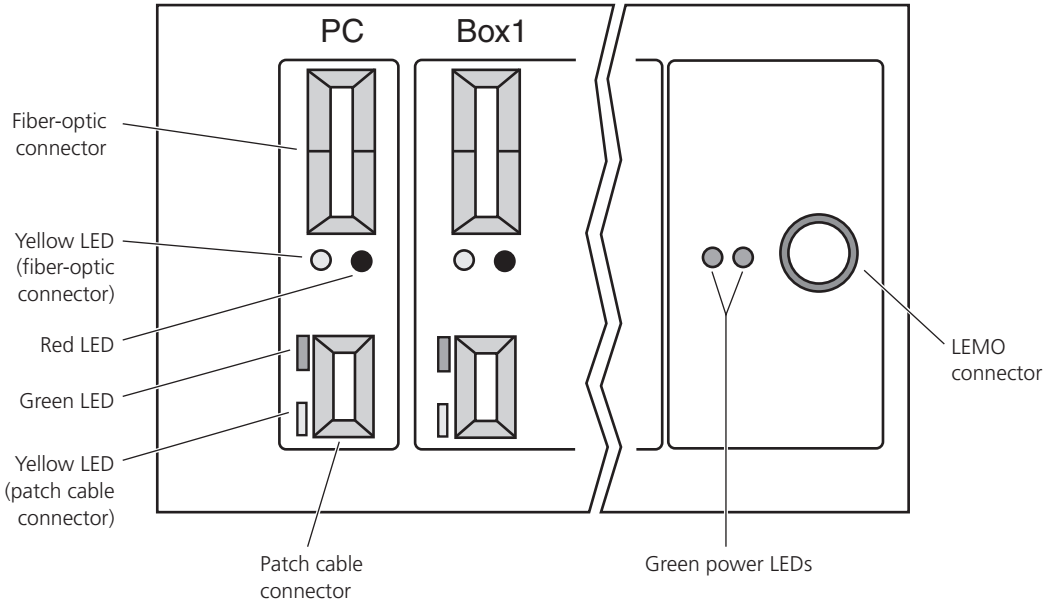
DS830: Identifying the Connection Status

Objective

The front of the DS830 panel has several LEDs, which indicate the current status of the connection to the host PC and the connected dSPACE boxes (expansion boxes or MicroAutoBoxes), as well as the status of the panel's power supply.

Status LEDs

The illustration below shows the status LEDs for one pair of fiber-optic and patch cable connectors.



Yellow LED (fiber-optic connector) Lit if the host PC and the corresponding dSPACE box are currently used for communication.

Red LED Lit if a fiber-optic cable is used.

Green LED Lit when data is being sent or received.

Yellow LED (patch cable connector) Lit if the connection to the host PC or a connected dSPACE box is ready for communication.

Green power LEDs Lit both when power is supplied correctly to the DS830.

Related topics

HowTos

- *How to Connect the DS830* on page 76

Setting Up an Ethernet Connection Between PC and Expansion Box

Objective

You can connect an expansion box (AutoBox/Tandem-AutoBox) to your host PC via Ethernet. In this case, the expansion box is treated as a network client.



Establishing a connection between an expansion box and the host PC via Ethernet is recommended for advanced users only.

Setting Up The Ethernet Connection

Objective

The connection between the PC (host) and an expansion box (client) is based on the TCP/IP protocol provided by Windows 7. There are two ways to connect a client to the host:

- *Peer-to-peer connection (P2P)*

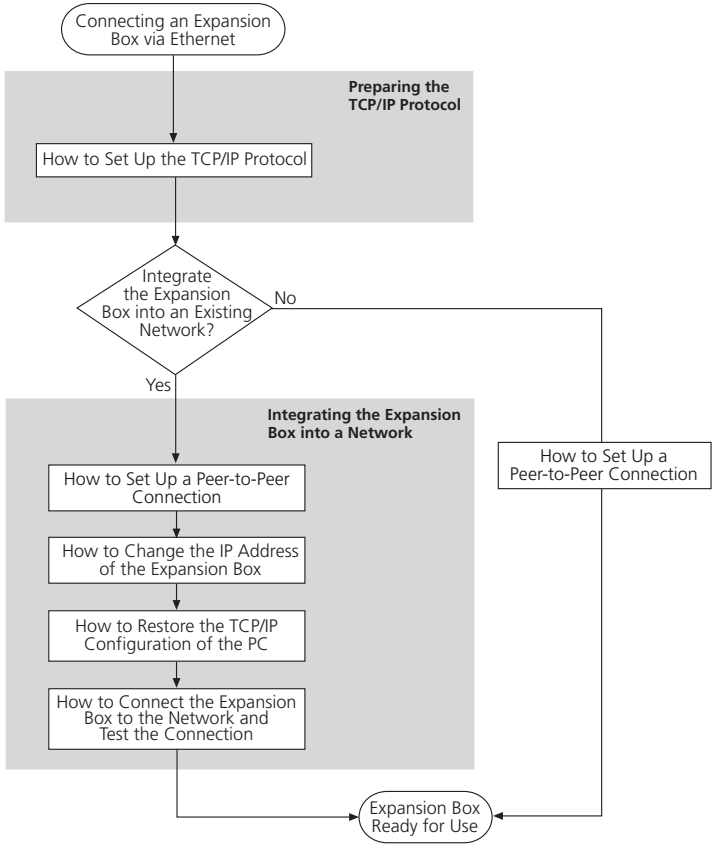
  The expansion box and the host PC are directly connected in a peer-to-peer configuration, and neither the host nor the client is connected to any other network.

- *Integration in an existing network*

  The expansion box becomes part of an existing network using TCP/IP, for example, a local area network.

Setup procedure

To connect an expansion box via Ethernet, follow the instructions given in the flow chart below. The boxes in the flow chart refer to the corresponding sections in the text.



Where to go from here

Information in this section

Preparing the TCP/IP Configuration	84
Setting Up a Peer-to-Peer Connection	85
Integrating the Expansion Box into a Network	87

Preparing the TCP/IP Configuration

How to Set up the TCP/IP Protocol

Objective

Before you can connect the expansion box to the host PC via Ethernet, you have to set up the TCP/IP protocol of the network adapter in your host PC.

Precondition

Setting up the TCP/IP configuration requires administrator rights.

Previous configuration

During this procedure, write down the previous TCP/IP configuration for later restoration.

Method

To set up the TCP/IP protocol

1 On the example of Windows 7:

From the Start menu, choose (depending on your PC configuration):

- Settings – Network Connections
- Settings – Control Panel – Double-click Network Connections and Sharing Center.
- Control Panel – Double-click Network Connections and Sharing Center.

2 Double-click Local Area Connection

- or -

Click View Status of Local Area Connection.

The Local Area Connection Status dialog opens.

3 Click Properties.

The Local Area Connection Properties dialog opens.

4 Select Internet Protocol Version 4 (TCP/IPv4), and click Properties.

The Internet Protocol (TCP/IP) Properties dialog opens.

5 From the Internet Protocol (TCP/IP) Properties dialog, write down all the configured values and options so that you can restore them later.

6 From the Internet Protocol (TCP/IP) Properties dialog, select Use the Following IP address. Enter the value **192.100.100.1** in the IP Address edit field.

7 In the Subnet Mask edit field, enter the value **255.255.255.0**.

8 Click OK to close the Internet Protocol (TCP/IP) Properties dialog.

9 Click OK to close the Local Area Connection Properties dialog.

10 Click Close to close the Local Area Connection Status dialog.

11 If prompted, confirm to restart the host PC.

Next steps

Proceed with:

- *How to Set Up a Peer-to-Peer Connection* on page 85 *or*
- *Integrating the Expansion Box into a Network* on page 87.

Solving problems



If a problem occurs when you set up the TCP/IP protocol, see *Problems When Setting Up the TCP/IP Protocol* on page 216.

Setting Up a Peer-to-Peer Connection

How to Set Up a Peer-to-Peer Connection

Objective

A peer-to-peer connection between the host and client means that neither the host nor the client is connected to any other network.

You must carry out this step, even if you want to integrate the expansion box into an existing network. In that case the IP address of the expansion box must comply with the conventions of the network. So its default IP address (192.100.100.98) must be changed after setting up a peer-to-peer connection between the host PC and the expansion box.

Method

To set up and test a peer-to-peer connection

1 If the host PC is already part of an existing network, switch it off, and disconnect it from the network.

2 Connect the expansion box to the host PC, using the supplied crossed-over patch cable.

> For a peer-to-peer connection, the crossed-over patch cable supplied with the expansion box must be used. If connecting to an existing network, for example, via a hub, a standard patch cable must probably be used. If you are uncertain, ask your network administrator.

3 Turn on the expansion box.

During booting, the expansion box beeps several times. The last beep sequence indicates whether the default IP address is active (three short beeps) or if the IP address has been changed by the user (one long beep). In the following it is assumed that the default IP address (192.100.100.98) is active.

4 Turn on the host PC.

> The host PC will take longer to boot and will display error messages because of the missing connection to the network. Ignore these error messages for now.

The connection between the host PC and the expansion box can now be tested.

5 Open a Command Prompt window (DOS window): For example, from the Start menu, choose Run ..., enter cmd and click OK.

6 Enter the command: **`ping 192.100.100.98`**, which is the default IP address of the expansion box.

If the following message appears, the peer-to-peer connection is ready for use (the values vary on different computers and networks):

```
Pinging 192.100.100.98 with 32 bytes of data:
Reply from 192.100.100.98: bytes=32 time<10ms TTL=32
Reply from 192.100.100.98: bytes=32 time<10ms TTL=32
Reply from 192.100.100.98: bytes=32 time<10ms TTL=32
Reply from 192.100.100.98: bytes=32 time<10ms TTL=32
```

Next steps

- If the expansion box is used *only in a peer-to-peer connection*, the network setup is now complete. Continue with the 🕮 *First Work Steps with a dSPACE System* document.
- If the expansion box is to be *used in an existing network*, proceed with *How to Change the IP Address of the Expansion Box* on page 88.

Solving problems



If any problem comes up when you set up a peer-to-peer connection, see *Problems with Peer-To-Peer Connection* on page 216.

Integrating the Expansion Box into a Network

Setup procedure

The following instructions show how to integrate an expansion box into an existing network step-by-step:

1. A peer-to-peer connection is needed temporarily to change the IP address of the expansion box. Refer to *How to Set Up a Peer-to-Peer Connection* on page 85.
2. The IP address of the expansion box must be changed to comply with the IP addresses used in the network. Refer to *How to Change the IP Address of the Expansion Box* on page 88.
3. After you have changed the IP address of the expansion box, you can restore the previous IP address of the host PC. Refer to *How to Restore the TCP/IP Configuration of the PC* on page 89.
4. Finish the work with *How to Connect the Expansion Box to the Network and Test the Connection* on page 90.

Where to go from here

Information in this section

How to Change the IP Address of the Expansion Box	88
How to Restore the TCP/IP Configuration of the PC	89
How to Connect the Expansion Box to the Network and Test the Connection	90

Information in other sections

How to Set Up a Peer-to-Peer Connection After setting up the TCP/IP protocol, you can set up the peer-to-peer connection.	85

How to Change the IP Address of the Expansion Box

Setip utility

To change the IP address, use the `setip` utility located in `<InstallationFolder>\exe`.

Preconditions

- Before trying to change the IP address, be sure that you have tested the peer-to-peer connection to your expansion box via the ping command.
- The IP address of the expansion box can be changed only if the old IP address is known and the host can connect to the expansion box. If the IP address of the expansion box is unknown, refer to *IP Address lost* on page 214.

Method

To change the IP Address

1. Contact your network administrator to obtain an unused IP address that you can use for the expansion box.
2. Open a Command Prompt window (DOS window): For example, from the Start menu, choose Run ..., enter cmd and click OK.
3. Enter the command **`setip <current IP address> <new IP address>`**

   The new IP address will be valid after rebooting the the expansion box.

   Write down the new IP address of the expansion box. You will need it later to establish the connection.

Example

The default IP address of the expansion box is 192.100.100.98. The IP address assigned to the host PC for the peer-to-peer connection is 192.100.100.1. With these settings the host PC can connect to the expansion box as described in *How to Set Up a Peer-to-Peer Connection* on page 85. Assume that the IP address of the host PC was previously set to 183.27.33.14. The IP address to be used for the expansion box is 183.27.33.18.

In a Command Prompt window (DOS window), enter the command:

```
setip 192.100.100.98 183.27.33.18
```

Next step

Proceed with *How to Restore the TCP/IP Configuration of the PC* on page 89.

How to Restore the TCP/IP Configuration of the PC

Objective

After you have changed the IP address of the expansion box to integrate it in a network, you can restore the previous IP address of the host PC.

Precondition

To restore the TCP/IP configuration of the host PC, you need the values and options which you wrote down when setting up the TCP/IP protocol (see *How to Set up the TCP/IP Protocol* on page 84).

Method

To restore the TCP/IP configuration of the host PC

1. On the example of Windows 7:

   From the Start menu, choose (depending on your PC configuration):

   - Settings – Network Connections
   - Settings – Control Panel – Double-click Network Connections and Sharing Center.
   - Control Panel – Double-click Network Connections and Sharing Center.

2. Double-click Local Area Connection

   - or -

   Click View Status of Local Area Connection.

   The Local Area Connection Status dialog opens.

3. Click Properties.

   The Local Area Connection Properties dialog opens.

4. Select Internet Protocol Version 4 (TCP/IPv4), and click Properties.

   The Internet Protocol (TCP/IP) Properties dialog opens

5. Enter all the configured values and options you wrote down before.
6. Click OK to close the Internet Protocol (TCP/IP) Properties dialog.
7. Click OK to close the Local Area Connection Properties dialog.
8. Click Close to close the Local Area Connection Status dialog.
9. If prompted, confirm to restart the host PC.

Next steps

Proceed with *How to Connect the Expansion Box to the Network and Test the Connection* on page 90.

How to Connect the Expansion Box to the Network and Test the Connection

Cabling

The supplied crossed-over patch cable cannot be used to connect the expansion box to an existing network. Use a normal (non crossed-over) cable.

Method

To connect the expansion box to the network and test the connection

1. Turn off the host PC and the expansion box.
2. Connect the expansion box and the host PC to the network.
3. Turn on the expansion box.

   To avoid unpredictable errors, you should always turn on the expansion box before the host PC.

4. Turn on the host PC.

   The connection between the host PC and the expansion box can now be tested.
5. Open a Command Prompt window (DOS window): For example, from the Start menu, choose Run ..., enter cmd and click OK.
6. Enter the command:

   ping<IP address of the expansion box>.

Result

If the following message appears, the network connection is ready for use (the values vary on different computers and networks). The IP address 10.1.202.178 serves as an example.

```
Pinging 10.1.202.178 with 32 bytes of data:
Reply from 10.1.202.178: bytes=32 time<10ms TTL=32
Reply from 10.1.202.178: bytes=32 time<10ms TTL=32
Reply from 10.1.202.178: bytes=32 time<10ms TTL=32
Reply from 10.1.202.178: bytes=32 time<10ms TTL=32
```

The network setup is now complete.

If you want to use the board with dSPACE Releases, continue with the 🕮 *First Work Steps with a dSPACE System* document.

Solving problems



If any problem comes up when you integrate an expansion box in a network, see *Problems with the Integration of an Expansion Box in a Network* on page 217.

Connecting External Devices to the dSPACE System

Objective

Prior to connecting external devices to the board or a connector panel, ensure you have familiarized yourself with the related instructions.

Where to go from here

Information in this section

How to Connect External Devices to a Board	93
How to Connect External Devices to a Connector Panel	95

How to Connect External Devices to a Board

Method

To connect external devices to the DS1103



NOTICE

Connecting external devices while the power supply is switched on may damage the dSPACE hardware.

- Do not connect or disconnect any device while the power supply is switched on.
- Turn off the host PC, the expansion box (if used), and the external devices beforehand.

1 Turn off all external devices which are to be connected to the dSPACE system.

2 Turn off the host PC.



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

3 Turn off the expansion box and all devices connected to it.

4 Disconnect the host PC, the expansion box and all devices connected to them from the power supply.



WARNING

Hazardous voltages

Risk of electric shock and/or 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.

5 Connect the devices belonging to your application to the board.

6 Reconnect the host PC, the expansion box and all external devices to the power supply.

7 Turn on the expansion box.



To avoid unpredictable errors, you should always turn on the expansion box before the DS830 MultiLink Panel (if used) and the host PC.

8 If used, turn on the DS830 MultiLink Panel.

9 Turn on the host PC.

The host PC should boot as usual.

10 Turn on all external devices connected to the dSPACE system.

Related topics

HowTos

- *How to Connect External Devices to a Connector Panel* on page 95

How to Connect External Devices to a Connector Panel

Method

To connect external devices to a connector panel



NOTICE

Connecting external devices while the power supply is switched on may damage the dSPACE hardware.

- Do not connect or disconnect any device while the power supply is switched on.
- Turn off the host PC, the expansion box (if used), and the external devices beforehand.

1. Turn off all external devices which are to be connected to the dSPACE system.
2. Turn off the host PC.



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

3. Turn off the expansion box and all devices connected to it.
4. Disconnect the host PC, the expansion box and all devices connected to them from the power supply.



WARNING

Hazardous voltages

Risk of electric shock and/or 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. The isolation of the panels has been designed for low-voltage operation only.

5. Connect the devices belonging to your application to the panel.
6. Reconnect the host PC, the expansion box and all external devices to the power supply.

7 Turn on the expansion box.



To avoid unpredictable errors, you should always turn on the expansion box before the DS830 MultiLink Panel (if used) and the host PC.

8 If used, turn on the DS830 MultiLink Panel.

9 Turn on the host PC.

The host PC should boot as usual.

10 Turn on all external devices connected to the dSPACE system.

Related topics

HowTos

- *How to Connect External Devices to a Board* on page 93

Uninstalling the System

Uninstallation order

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

1. You have to remove the software first.
2. Afterwards you can remove the hardware.

Where to go from here

Information in this section

Removing the Hardware 98

Information in other sections

Removing dSPACE Software (🕮 *Software Installation and Management Guide*)

Removing the Hardware

Objective	dSPACE hardware is installed in the host PC and/or in the expansion box.
Where to go from here	Information in this section

How to Remove the Hardware from the Host PC	98
How to Remove Hardware from an Expansion Box	100

How to Remove the Hardware from the Host PC

Objective	The boards to be removed from your host PC depend on the installation of the DS1103 PPC Controller Board.
Installation cases	■ If the DS1103 is installed in an expansion box connected to the host PC via a *bus interface*, the DS817 Link Board must be removed. The DS815 and DS821 can simply be ejected from the host PC. ■ The DS1103 is installed in an expansion box connected to the host PC via *Ethernet*, only the network cable of the expansion box needs to be disconnected from the PC or the local area network.
Preconditions	■ The system is switched off. For instructions, refer to *How to Switch Off a dSPACE System* on page 37. ■ Precautions are taken to avoid damage by high electrostatic voltages. For details, refer to *Safety Precautions for Installing and Connecting the Hardware* on page 17.

Method

To remove dSPACE boards



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/or the expansion box are switched off.
- No external device is connected to the dSPACE system.

1. Disconnect the host PC, the expansion box and all external devices connected to them from the power supply.
2. Unplug any external devices or connector panels from the I/O connectors of the DS1103.
3. Open the enclosure.



NOTICE

Improper handling will damage the fan of the board.

Only valid for boards up to board revision DS1103-07.

- Do not touch any components of the fan, neither during operation nor when it has stopped.
- Do not apply pressure to the fan bearing during installation and removal of the board.

4. Unscrew the triple bracket of the DS1103 or the bracket of the link board (PC).
5. Remove the DS1103 and/or the link board (PC) from the slot.
6. Reinstall the original bracket(s) to cover the opening(s) at the rear side of the enclosure.
7. Close the enclosure, reconnect the PC to the power supply, and turn it on.

Result

The host PC should boot as usual.

Related topics

Basics

- *Safety Precautions for Installing and Connecting the Hardware* on page 17

HowTos

- *How to Switch Off a dSPACE System* on page 37

How to Remove Hardware from an Expansion Box

Shipment and transportation in an expansion box



NOTICE

Processor boards installed inside the expansion box will be damaged during transportation and shipment.

Due to the weight of the heat sinks on the DS1103 PPC Controller Board, both the expansion box and the board itself will be damaged by acceleration and shocks.

- For shipment or transportation, remove the DS1103 PPC Controller Board from the expansion box.
- Ship the board separately from the box.
- Put it in an antistatic bag and then in a strong cardboard box, in which the board is firmly fixed against movement.

Preconditions

- The system is switched off. For instructions, refer to *How to Switch Off a dSPACE System* on page 37.
- Precautions are taken to avoid damage by high electrostatic voltages. For details, refer to *Safety Precautions for Installing and Connecting the Hardware* on page 17.

Method

To remove hardware from an expansion box



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 expansion box are switched off.
- No external device is connected to the dSPACE system.

1. Disconnect the host PC, the expansion box and all external devices connected to them from the power supply.
2. Unplug any external devices or connector panels from the I/O connectors of the DS1103.
3. Open the enclosure.
4. Unscrew the triple bracket of the DS1103.
5. Remove the DS1103 from the slot.

6 Close the enclosure.

Next steps

When all devices are reconnected to the system and to the power supply, you can switch on the dSPACE system. For detailed instructions, refer to *How to Switch On the dSPACE System* on page 41.

Related topics

Basics

- *Safety Precautions for Installing and Connecting the Hardware* on page 17

HowTos

- *How to Switch Off a dSPACE System* on page 37

Connector Pinouts and LEDs

Objective

This chapter provides hardware-related, reference information on the components of the DS1103 and its optional accessories, the CP1103 Connector Panel and the CLP1103 Connector/LED Combi Panel:

Where to go from here

Information in this section

DS1103 Components Contains an illustration of the board, and the pin assignments of the different board connectors.	104
CP1103/CLP1103 Components Shows the front view of the connector panel and the pin assignments of the connectors equipped on the panel.	127

Information in other sections

Mapping of I/O Signals Various connector pins can be assigned to RTI blocks and RTLib functions.	139

DS1103 Components

Connecting external devices



Prior to connecting external devices to the board, ensure you have familiarized yourself with the relevant instructions provided in the *Connecting External Devices to the dSPACE System* on page 93.

Where to go from here

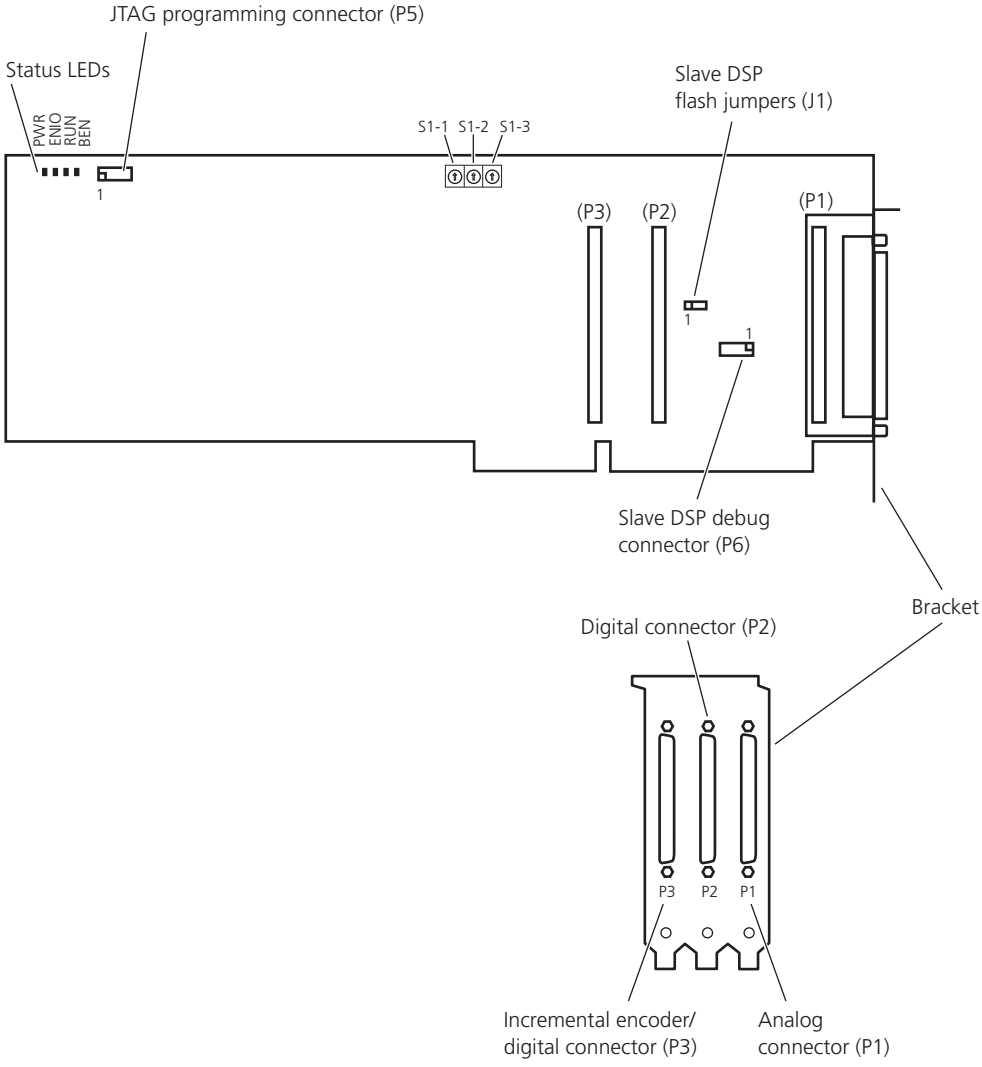
Information in this section

Overview	
Board Overview Contains an illustration of the board, showing the locations of connectors, jumpers and LEDs.	105
I/O connectors of the DS1103	
Analog Connector (P1)	107
Digital Connector (P2)	112
Incremental Encoder/Digital Connector (P3)	117
Other components	
Slave DSP Debug Connector (P6)	123
Slave DSP Flash Jumper (J1)	123
Status LEDs of the DS1103	124

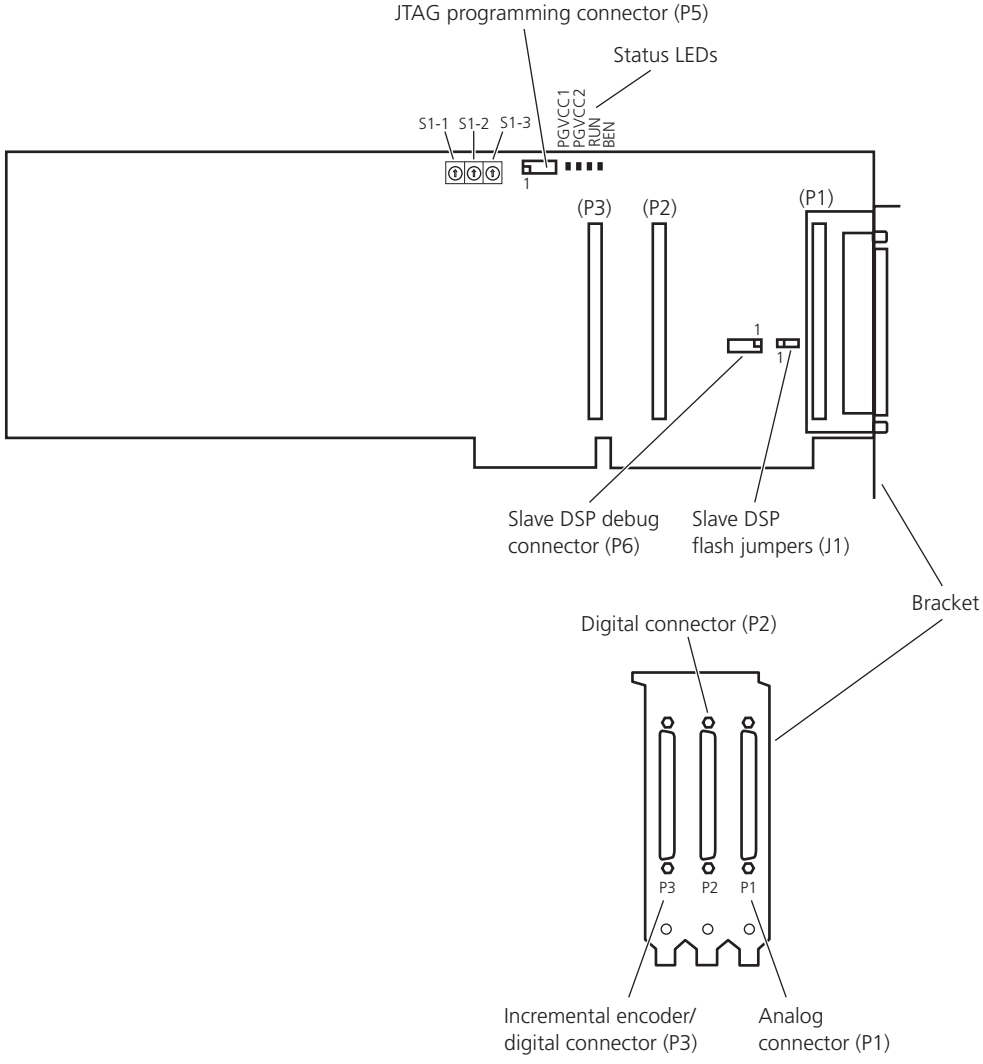
Board Overview

Overview illustration

The illustration below shows the locations of the connectors, jumpers and LEDs on the DS1103 *as of board revision DS1103-09*. The illustration is not to scale.



The illustration below shows the locations of the connectors, jumpers and LEDs on the DS1103 *up to board revision DS1103-07*. The illustration is not to scale.



Components

These are the most important connectors:

- The *analog connector (P1)* is a 100-pin connector. The signals available at this connector are described in *Analog Connector (P1)* on page 107.
- The *digital connector (P2)* is a 100-pin connector. The signals available at this connector are described in *Digital Connector (P2)* on page 112.
- The *incremental encoder/digital connector (P3)* is a 100-pin connector. The signals available at this connector are described in *Incremental Encoder/Digital Connector (P3)* on page 117.

Furthermore, the following connectors, jumpers and LEDs can be found on the DS1103 board:

- The *JTAG programming connector (P5)* is for internal use only.



NOTICE

To avoid damage, do not touch the JTAG programming connector when power is applied to the DS1103.

- The *slave DSP flash jumper (J1)* is used to control the protection mode and watchdog mode of the flash memory (see *Slave DSP Flash Jumper (J1)* on page 123).
- The *slave DSP debug connector (P6)* can be used for Slave DSP debugging. The signals available at this connector are described in *Slave DSP Debug Connector (P6)* on page 123.
- The 4 red *status LEDs* display the current status of the board. These LEDs can be used for troubleshooting purposes. For details, see *Status LEDs of the DS1103* on page 124.

Analog Connector (P1)

Purpose

The analog connector (P1) is a 100-pin, high density KEL connector. It is used to obtain access to the analog signals of the board. The connector is located on the bracket of the DS1103, see *Board Overview* on page 105.

Adapter cable

Using the adapter cable supplied with the board, the analog connector (P1) can be linked to two 50-pin, female Sub-D connectors (labeled P1A, P1B).

Signal specification

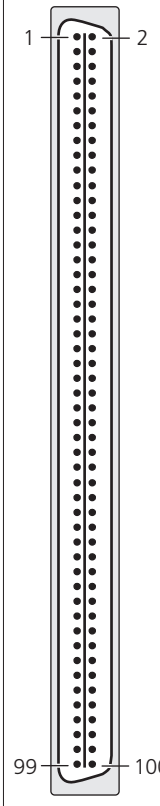
For detailed information (I/O circuits, electrical characteristics, etc.) on the I/O lines terminating at the I/O connector, see *Signal Connection to External Devices* on page 161.

Pinout of analog connector (P1)

Because the pin numbering used for KEL connectors is not standardized, the following figure shows the numbering scheme used (front view of the board connector).

Do not rely on the numbers written on the KEL connectors.

The following table shows the pin assignment of the analog connector (P1). It also provides the mapping to the Sub-D connectors of the adapter cable.

Connector (P1)	Pin	Sub-D Pin	Signal	Pin	Sub-D Pin	Signal
	P1 1	P1B 1	GND	P1 2	P1A 1	GND
	P1 3	P1B 34	ADCH1	P1 4	P1A 34	ADCH2
	P1 5	P1B 18	GND	P1 6	P1A 18	GND
	P1 7	P1B 2	ADCH3	P1 8	P1A 2	ADCH4
	P1 9	P1B 35	GND	P1 10	P1A 35	GND
	P1 11	P1B 19	ADCH5	P1 12	P1A 19	ADCH6
	P1 13	P1B 3	GND	P1 14	P1A 3	GND
	P1 15	P1B 36	ADCH7	P1 16	P1A 36	ADCH8
	P1 17	P1B 20	GND	P1 18	P1A 20	GND
	P1 19	P1B 4	ADCH9	P1 20	P1A 4	ADCH10
	P1 21	P1B 37	GND	P1 22	P1A 37	GND
	P1 23	P1B 21	ADCH11	P1 24	P1A 21	ADCH12
	P1 25	P1B 5	GND	P1 26	P1A 5	GND
	P1 27	P1B 38	ADCH13	P1 28	P1A 38	ADCH14
	P1 29	P1B 22	GND	P1 30	P1A 22	GND
	P1 31	P1B 6	ADCH15	P1 32	P1A 6	ADCH16
	P1 33	P1B 39	GND	P1 34	P1A 39	GND
	P1 35	P1B 23	ADCH17	P1 36	P1A 23	ADCH18
	P1 37	P1B 7	GND	P1 38	P1A 7	GND
	P1 39	P1B 40	ADCH19	P1 40	P1A 40	ADCH20
	P1 41	P1B 24	GND	P1 42	P1A 24	GND
	P1 43	P1B 8	GND	P1 44	P1A 8	GND
	P1 45	P1B 41	GND	P1 46	P1A 41	GND
	P1 47	P1B 25	DACH1	P1 48	P1A 25	DACH2
	P1 49	P1B 9	GND	P1 50	P1A 9	GND
	P1 51	P1B 42	DACH3	P1 52	P1A 42	DACH4
	P1 53	P1B 26	GND	P1 54	P1A 26	GND
	P1 55	P1B 10	DACH5	P1 56	P1A 10	DACH6
	P1 57	P1B 43	GND	P1 58	P1A 43	GND
	P1 59	P1B 27	DACH7	P1 60	P1A 27	DACH8
	P1 61	P1B 11	GND	P1 62	P1A 11	GND
	P1 63	P1B 44	GND	P1 64	P1A 44	GND

Connector (P1)	Pin	Sub-D Pin	Signal	Pin	Sub-D Pin	Signal
	P1 65	P1B 28	GND	P1 66	P1A 28	GND
	P1 67	P1B 12	SADCH1	P1 68	P1A 12	SADCH2
	P1 69	P1B 45	GND	P1 70	P1A 45	GND
	P1 71	P1B 29	SADCH3	P1 72	P1A 29	SADCH4
	P1 73	P1B 13	GND	P1 74	P1A 13	GND
	P1 75	P1B 46	SADCH5	P1 76	P1A 46	SADCH6
	P1 77	P1B 30	GND	P1 78	P1A 30	GND
	P1 79	P1B 14	SADCH7	P1 80	P1A 14	SADCH8
	P1 81	P1B 47	GND	P1 82	P1A 47	GND
	P1 83	P1B 31	SADCH9	P1 84	P1A 31	SADCH10
	P1 85	P1B 15	GND	P1 86	P1A 15	GND
	P1 87	P1B 48	SADCH11	P1 88	P1A 48	SADCH12
	P1 89	P1B 32	GND	P1 90	P1A 32	GND
	P1 91	P1B 16	SADCH13	P1 92	P1A 16	SADCH14
	P1 93	P1B 49	GND	P1 94	P1A 49	GND
	P1 95	P1B 33	SADCH15	P1 96	P1A 33	SADCH16
	P1 97	P1B 17	GND	P1 98	P1A 17	GND
	P1 99	P1B 50	SADCSOC	P1 100	P1A 50	GND

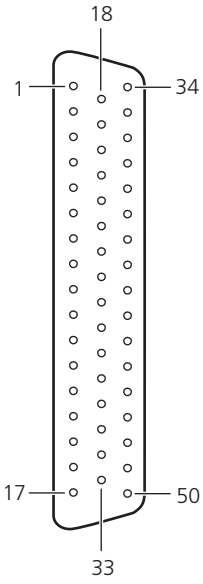
Pinout of Sub-D connectors

Because the pin numbering used for Sub-D connectors is not standardized, the following illustrations show the numbering scheme used (viewed from the top of a female connector)

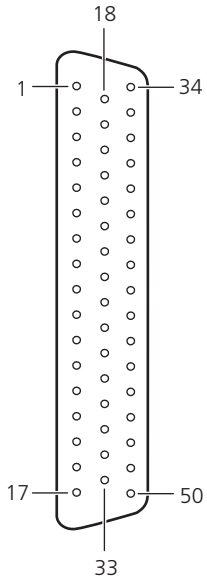


Do not rely on the numbers written on Sub-D connectors.

The table below shows the pin assignment of the *Sub-D connector P1A*.

Connector P1A	Pin	Signal	Pin	Signal	Pin	Signal
	1	GND			34	ADCH2
	2	ADCH4	18	GND	35	GND
	3	GND	19	ADCH6	36	ADCH8
	4	ADCH10	20	GND	37	GND
	5	GND	21	ADCH12	38	ADCH14
	6	ADCH16	22	GND	39	GND
	7	GND	23	ADCH18	40	ADCH20
	8	GND	24	GND	41	GND
	9	GND	25	DACH2	42	DACH4
	10	DACH6	26	GND	43	GND
	11	GND	27	DACH8	44	GND
	12	SADCH2	28	GND	45	GND
	13	GND	29	SADCH4	46	SADCH6
	14	SADCH8	30	GND	47	GND
	15	GND	31	SADCH10	48	SADCH12
	16	SADCH14	32	GND	49	GND
	17	GND	33	SADCH16	50	GND

The table below shows the pin assignment of the *Sub-D connector P1B*.

Connector P1B	Pin	Signal	Pin	Signal	Pin	Signal
	1	GND			34	ADCH1
	2	ADCH3	18	GND	35	GND
	3	GND	19	ADCH5	36	ADCH7
	4	ADCH9	20	GND	37	GND
	5	GND	21	ADCH11	38	ADCH13
	6	ADCH15	22	GND	39	GND
	7	GND	23	ADCH17	40	ADCH19
	8	GND	24	GND	41	GND
	9	GND	25	DACH1	42	DACH3
	10	DACH5	26	GND	43	GND
	11	GND	27	DACH7	44	GND
	12	SADCH1	28	GND	45	GND
	13	GND	29	SADCH3	46	SADCH5
	14	SADCH7	30	GND	47	GND
	15	GND	31	SADCH9	48	SADCH11
	16	SADCH13	32	GND	49	GND
	17	GND	33	SADCH15	50	SADCSOC

Related topics

References

- *Board Overview* on page 105

Digital Connector (P2)

Purpose

The digital connector (P2) is a 100-pin, high density KEL connector. It is used to obtain access to the digital signals of the board. The connector is located on the bracket of the DS1103, see *Board Overview* on page 105.

Adapter cable

Using the adapter cable supplied with the board, the digital connector (P2) can be linked to two 50-pin, female Sub-D connectors (labeled P2A, P2B).

Signal specification

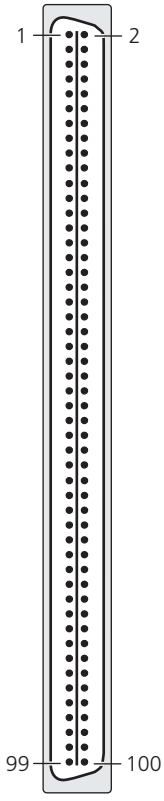
For detailed information (I/O circuits, electrical characteristics, etc.) on the I/O lines terminating at the I/O connector, see *Signal Connection to External Devices* on page 161.

Pinout of digital connector (P2)

Because the pin numbering used for KEL connectors is not standardized, the following figure shows the numbering scheme used (front view of the board connector).

Do not rely on the numbers written on the KEL connectors.

The following table shows the pin assignment of the digital connector (P2). It also provides the mapping to the Sub-D connectors of the adapter cable.

Connector (P2)	Pin	Sub-D Pin	Signal	Pin	Sub-D Pin	Signal
	P2 1	P2B 1	GND	P2 2	P2A 1	GND
	P2 3	P2B 34	GND	P2 4	P2A 34	GND
	P2 5	P2B 18	IO0	P2 6	P2A 18	IO1
	P2 7	P2B 2	IO2	P2 8	P2A 2	IO3
	P2 9	P2B 35	GND	P2 10	P2A 35	GND
	P2 11	P2B 19	IO4	P2 12	P2A 19	IO5
	P2 13	P2B 3	IO6	P2 14	P2A 3	IO7
	P2 15	P2B 36	GND	P2 16	P2A 36	GND
	P2 17	P2B 20	IO8	P2 18	P2A 20	IO9
	P2 19	P2B 4	IO10	P2 20	P2A 4	IO11
	P2 21	P2B 37	GND	P2 22	P2A 37	GND
	P2 23	P2B 21	IO12	P2 24	P2A 21	IO13
	P2 25	P2B 5	IO14	P2 26	P2A 5	IO15
	P2 27	P2B 38	GND	P2 28	P2A 38	GND
	P2 29	P2B 22	IO16	P2 30	P2A 22	IO17
	P2 31	P2B 6	IO18	P2 32	P2A 6	IO19
	P2 33	P2B 39	GND	P2 34	P2A 39	GND
	P2 35	P2B 23	IO20	P2 36	P2A 23	IO21
	P2 37	P2B 7	IO22	P2 38	P2A 7	IO23
	P2 39	P2B 40	GND	P2 40	P2A 40	GND
	P2 41	P2B 24	IO24	P2 42	P2A 24	IO25
	P2 43	P2B 8	IO26	P2 44	P2A 8	IO27
	P2 45	P2B 41	GND	P2 46	P2A 41	GND
	P2 47	P2B 25	IO28	P2 48	P2A 25	IO29
	P2 49	P2B 9	IO30	P2 50	P2A 9	IO31
	P2 51	P2B 42	GND	P2 52	P2A 42	GND
	P2 53	P2B 26	STINT1	P2 54	P2A 26	STINT2
	P2 55	P2B 10	STMRDIR	P2 56	P2A 10	STMRCLK
	P2 57	P2B 43	GND	P2 58	P2A 43	GND
	P2 59	P2B 27	ST1PWM	P2 60	P2A 27	ST2PWM
	P2 61	P2B 11	ST3PWM	P2 62	P2A 11	SPDPINT
	P2 63	P2B 44	GND	P2 64	P2A 44	GND

Connector (P2)	Pin	Sub-D Pin	Signal	Pin	Sub-D Pin	Signal
	P2 65	P2B 28	SPWM1	P2 66	P2A 28	SPWM2
	P2 67	P2B 12	SPWM3	P2 68	P2A 12	SPWM4
	P2 69	P2B 45	SPWM5	P2 70	P2A 45	SPWM6
	P2 71	P2B 29	SPWM7	P2 72	P2A 29	SPWM8
	P2 73	P2B 13	SPWM9	P2 74	P2A 13	GND
	P2 75	P2B 46	GND	P2 76	P2A 46	GND
	P2 77	P2B 30	SCAP1	P2 78	P2A 30	SCAP2
	P2 79	P2B 14	SCAP3	P2 80	P2A 14	SCAP4
	P2 81	P2B 47	GND	P2 82	P2A 47	GND
	P2 83	P2B 31	SXF	P2 84	P2A 31	SBIO
	P2 85	P2B 15	SSCLK	P2 86	P2A 15	SSTE
	P2 87	P2B 48	SSIMO	P2 88	P2A 48	SSOMI
	P2 89	P2B 32	GND	P2 90	P2A 32	GND
	P2 91	P2B 16	$\overline{\text{INT0}}$	P2 92	P2A 16	$\overline{\text{INT1}}$
	P2 93	P2B 49	$\overline{\text{INT2}}$	P2 94	P2A 49	$\overline{\text{INT3}}$
	P2 95	P2B 33	VCC1 (+ 5 V)	P2 96	P2A 33	VCC1 (+ 5 V)
	P2 97	P2B 17	VCC1 (+ 5 V)	P2 98	P2A 17	VCC1 (+ 5 V)
	P2 99	P2B 50	GND	P2 100	P2A 50	GND

The DS1103 provides three VCC lines. The total load of every VCC line (VCC1, VCC2, VCC3) must not exceed 500 mA.

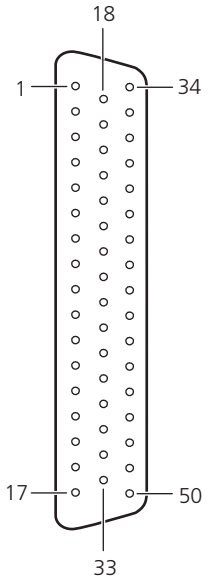
For details on the VCC lines refer to *Power Supply Outputs* on page 162.

Pinout of Sub-D connectors

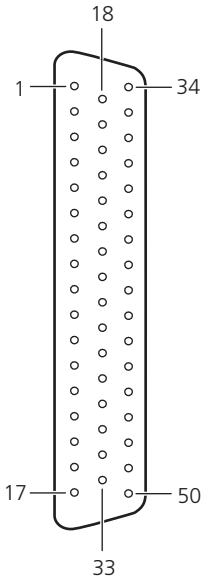
Because the pin numbering used for Sub-D connectors is not standardized, the following illustrations show the numbering scheme used (viewed from the top of a female connector)

Do not rely on the numbers written on Sub-D connectors.

The table below shows the pin assignment of the *Sub-D connector P2A*.

Connector P2A	Pin	Signal	Pin	Signal	Pin	Signal
	1	GND			34	GND
	2	IO3	18	IO1	35	GND
	3	IO7	19	IO5	36	GND
	4	IO11	20	IO9	37	GND
	5	IO15	21	IO13	38	GND
	6	IO19	22	IO17	39	GND
	7	IO23	23	IO21	40	GND
	8	IO27	24	IO25	41	GND
	9	IO31	25	IO29	42	GND
	10	STMRCLK	26	STINT2	43	GND
	11	SPDPINT	27	ST2PWM	44	GND
	12	SPWM4	28	SPWM2	45	SPWM6
	13	GND	29	SPWM8	46	GND
	14	SCAP4	30	SCAP2	47	GND
	15	SSTE	31	SBIO	48	SSOMI
	16	$\overline{\text{INT1}}$	32	GND	49	$\overline{\text{INT3}}$
	17	VCC1 (+ 5 V)	33	VCC1 (+ 5 V)	50	GND

The table below shows the pin assignment of the *Sub-D connector P2B*.

Connector P2B	Pin	Signal	Pin	Signal	Pin	Signal
	1	GND			34	GND
	2	IO2	18	IO0	35	GND
	3	IO6	19	IO4	36	GND
	4	IO10	20	IO8	37	GND
	5	IO14	21	IO12	38	GND
	6	IO18	22	IO16	39	GND
	7	IO22	23	IO20	40	GND
	8	IO26	24	IO24	41	GND
	9	IO30	25	IO28	42	GND
	10	STMRDIR	26	STINT1	43	GND
	11	ST3PWM	27	ST1PWM	44	GND
	12	SPWM3	28	SPWM1	45	SPWM5
	13	SPWM9	29	SPWM7	46	GND
	14	SCAP3	30	SCAP1	47	GND
	15	SSCLK	31	SXF	48	SSIMO
	16	$\overline{\text{INT0}}$	32	GND	49	$\overline{\text{INT2}}$
	17	VCC1 (+ 5 V)	33	VCC1 (+ 5 V)	50	GND

The DS1103 provides three VCC lines. The total load of every VCC line (VCC1, VCC2, VCC3) must not exceed 500 mA.

For details on the VCC lines refer to *Power Supply Outputs* on page 162.

Related topics

References

- *Signal Connection to External Devices* on page 161

Incremental Encoder/Digital Connector (P3)

Purpose

The incremental encoder/digital connector (P3) is a 100-pin, high density KEL connector. It is used to obtain access to the signals of the incremental encoder channels. The connector is located on the bracket of the DS1103, see *Board Overview* on page 105.

Adapter cable

Using the adapter cable supplied with the board, the incremental encoder/digital connector (P3) can be linked to two 50-pin, female Sub-D connectors (labeled P3A, P3B).

Signal specification

For detailed information (I/O circuits, electrical characteristics, etc.) on the I/O lines terminating at the I/O connector, see *Signal Connection to External Devices* on page 161.

Pinout of connector (P3)

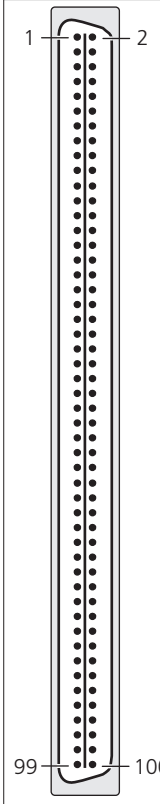
Because the pin numbering used for KEL connectors is not standardized, the following figure shows the numbering scheme used (front view of the board connector).



Do not rely on the numbers written on the KEL connectors.

The following table shows the pin assignment of the incremental encoder/digital connector (P3). It also provides the mapping to the Sub-D connectors of the adapter cable.

Signal names in parentheses apply when the UART is set to the RS422 mode.

Connector (P3)	Pin	Sub-D Pin	Signal	Pin	Sub-D Pin	Signal
	P3 1	P3B 1	GND	P3 2	P3A 1	GND
	P3 3	P3B 34	TXD (TXD)	P3 4	P3A 34	Not used for RS232 ($\overline{\text{TXD}}$)
	P3 5	P3B 18	RXD (RXD)	P3 6	P3A 18	DCD ($\overline{\text{RXD}}$)
	P3 7	P3B 2	RTS (RTS)	P3 8	P3A 2	DTR ($\overline{\text{RTS}}$)
	P3 9	P3B 35	CTS (CTS)	P3 10	P3A 35	DSR ($\overline{\text{CTS}}$)
	P3 11	P3B 19	RI (not used for RS422)	P3 12	P3A 19	GND
	P3 13	P3B 3	STXD	P3 14	P3A 3	$\overline{\text{STXD}}$
	P3 15	P3B 36	SRXD	P3 16	P3A 36	$\overline{\text{SRXD}}$
	P3 17	P3B 20	–	P3 18	P3A 20	–
	P3 19	P3B 4	–	P3 20	P3A 4	–
	P3 21	P3B 37	–	P3 22	P3A 37	–
	P3 23	P3B 21	–	P3 24	P3A 21	–
	P3 25	P3B 5	–	P3 26	P3A 5	–
	P3 27	P3B 38	GND	P3 28	P3A 38	GND
	P3 29	P3B 22	PHI0(7)	P3 30	P3A 22	$\overline{\text{PHI0(7)}}$
	P3 31	P3B 6	PHI90(7)	P3 32	P3A 6	$\overline{\text{PHI90(7)}}$
	P3 33	P3B 39	IDX(7)	P3 34	P3A 39	$\overline{\text{IDX(7)}}$
	P3 35	P3B 23	GND	P3 36	P3A 23	GND
	P3 37	P3B 7	PHI0(6)	P3 38	P3A 7	$\overline{\text{PHI0(6)}}$
	P3 39	P3B 40	PHI90(6)	P3 40	P3A 40	$\overline{\text{PHI90(6)}}$
	P3 41	P3B 24	IDX(6)	P3 42	P3A 24	$\overline{\text{IDX(6)}}$
	P3 43	P3B 8	GND	P3 44	P3A 8	GND
	P3 45	P3B 41	PHI0(1)	P3 46	P3A 41	$\overline{\text{PHI0(1)}}$
	P3 47	P3B 25	PHI90(1)	P3 48	P3A 25	$\overline{\text{PHI90(1)}}$
	P3 49	P3B 9	IDX(1)	P3 50	P3A 9	$\overline{\text{IDX(1)}}$
	P3 51	P3B 42	GND	P3 52	P3A 42	GND
	P3 53	P3B 26	PHI0(2)	P3 54	P3A 26	$\overline{\text{PHI0(2)}}$
	P3 55	P3B 10	PHI90(2)	P3 56	P3A 10	$\overline{\text{PHI90(2)}}$
	P3 57	P3B 43	IDX(2)	P3 58	P3A 43	$\overline{\text{IDX(2)}}$
	P3 59	P3B 27	GND	P3 60	P3A 27	GND
	P3 61	P3B 11	PHI0(3)	P3 62	P3A 11	$\overline{\text{PHI0(3)}}$
	P3 63	P3B 44	PHI90(3)	P3 64	P3A 44	$\overline{\text{PHI90(3)}}$

Connector (P3)	Pin	Sub-D Pin	Signal	Pin	Sub-D Pin	Signal
	P3 65	P3B 28	IDX(3)	P3 66	P3A 28	$\overline{\text{IDX(3)}}$
	P3 67	P3B 12	GND	P3 68	P3A 12	GND
	P3 69	P3B 45	PHI0(4)	P3 70	P3A 45	$\overline{\text{PHI0(4)}}$
	P3 71	P3B 29	PHI90(4)	P3 72	P3A 29	$\overline{\text{PHI90(4)}}$
	P3 73	P3B 13	IDX(4)	P3 74	P3A 13	$\overline{\text{IDX(4)}}$
	P3 75	P3B 46	GND	P3 76	P3A 46	GND
	P3 77	P3B 30	PHI0(5)	P3 78	P3A 30	$\overline{\text{PHI0(5)}}$
	P3 79	P3B 14	PHI90(5)	P3 80	P3A 14	$\overline{\text{PHI90(5)}}$
	P3 81	P3B 47	IDX(5)	P3 82	P3A 47	$\overline{\text{IDX(5)}}$
	P3 83	P3B 31	GND	P3 84	P3A 31	GND
	P3 85	P3B 15	CANL	P3 86	P3A 15	GND
	P3 87	P3B 48	CANH	P3 88	P3A 48	GND
	P3 89	P3B 32	GND	P3 90	P3A 32	GND
	P3 91	P3B 16	VCC2 (+ 5 V)	P3 92	P3A 16	VCC2 (+ 5 V)
	P3 93	P3B 49	VCC2 (+ 5 V)	P3 94	P3A 49	VCC2 (+ 5 V)
	P3 95	P3B 33	VCC3 (+ 5 V)	P3 96	P3A 33	VCC3 (+ 5 V)
	P3 97	P3B 17	VCC3 (+ 5 V)	P3 98	P3A 17	VCC3 (+ 5 V)
	P3 99	P3B 50	GND	P3 100	P3A 50	GND

The CAN bus lines (CANH, CANL) are not terminated with a resistor on the DS1103.

The DS1103 provides three VCC lines. The total load of every VCC line (VCC1, VCC2, VCC3) must not exceed 500 mA.

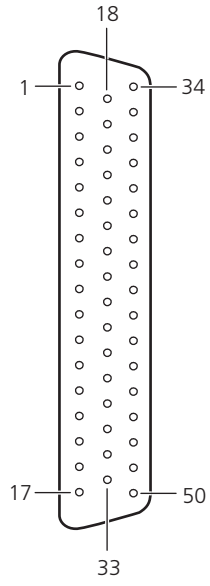
For details on the VCC lines refer to *Power Supply Outputs* on page 162.

Pinout of Sub-D connectors

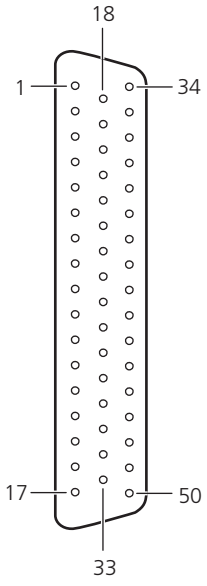
Because the pin numbering used for Sub-D connectors is not standardized, the following illustrations show the numbering scheme used (viewed from the top of a female connector)

Do not rely on the numbers written on Sub-D connectors.

The table below shows the pin assignment of the *Sub-D connector P3A*. Signal names in parentheses apply when the UART is set to the RS422 mode.

Connector P3A	Pin	Signal	Pin	Signal	Pin	Signal
	1	GND			34	Not used for RS232 ($\overline{\text{TXD}}$)
	2	DTR ($\overline{\text{RTS}}$)	18	DCD ($\overline{\text{RXD}}$)	35	DSR ($\overline{\text{CTS}}$)
	3	$\overline{\text{STXD}}$	19	GND	36	$\overline{\text{SRXD}}$
	4	–	20	–	37	–
	5	–	21	–	38	GND
	6	$\overline{\text{PHI90(7)}}$	22	$\overline{\text{PHI0(7)}}$	39	$\overline{\text{IDX(7)}}$
	7	$\overline{\text{PHI0(6)}}$	23	GND	40	$\overline{\text{PHI90(6)}}$
	8	GND	24	$\overline{\text{IDX(6)}}$	41	$\overline{\text{PHI0(1)}}$
	9	$\overline{\text{IDX(1)}}$	25	$\overline{\text{PHI90(1)}}$	42	GND
	10	$\overline{\text{PHI90(2)}}$	26	$\overline{\text{PHI0(2)}}$	43	$\overline{\text{IDX(2)}}$
	11	$\overline{\text{PHI0(3)}}$	27	GND	44	$\overline{\text{PHI90(3)}}$
	12	GND	28	$\overline{\text{IDX(3)}}$	45	$\overline{\text{PHI0(4)}}$
	13	$\overline{\text{IDX(4)}}$	29	$\overline{\text{PHI90(4)}}$	46	GND
	14	$\overline{\text{PHI90(5)}}$	30	$\overline{\text{PHI0(5)}}$	47	$\overline{\text{IDX(5)}}$
	15	GND	31	GND	48	GND
	16	VCC2 (+ 5 V)	32	GND	49	VCC2 (+ 5 V)
	17	VCC3 (+ 5 V)	33	VCC3 (+ 5 V)	50	GND

The table below shows the pin assignment of the *Sub-D connector P3B*. Signal names in parentheses apply when the UART is set to the RS422 mode.

Connector P3B	Pin	Signal	Pin	Signal	Pin	Signal
	1	GND			34	TXD (TXD)
	2	RTS (RTS)	18	RXD (RXD)	35	CTS (CTS)
	3	STXD	19	RI (not used for RS422)	36	SRXD
	4	–	20	–	37	–
	5	–	21	–	38	GND
	6	PHI90(7)	22	PHI0(7)	39	IDX(7)
	7	PHI0(6)	23	GND	40	PHI90(6)
	8	GND	24	IDX(6)	41	PHI0(1)
	9	IDX(1)	25	PHI90(1)	42	GND
	10	PHI90(2)	26	PHI0(2)	43	IDX(2)
	11	PHI0(3)	27	GND	44	PHI90(3)
	12	GND	28	IDX(3)	45	PHI0(4)
	13	IDX(4)	29	PHI90(4)	46	GND
	14	PHI90(5)	30	PHI0(5)	47	IDX(5)
	15	CANL	31	GND	48	CANH
	16	VCC2 (+ 5 V)	32	GND	49	VCC2 (+ 5 V)
	17	VCC3 (+ 5 V)	33	VCC3 (+ 5 V)	50	GND

The CAN bus lines (CANH, CANL) are not terminated with a resistor on the DS1103.

The DS1103 provides three VCC lines. The total load of every VCC line (VCC1, VCC2, VCC3) must not exceed 500 mA.

For details on the VCC lines refer to *Power Supply Outputs* on page 162.

Related topics

References

- *Board Overview* on page 105
- *Power Supply Outputs* on page 162
- *Signal Connection to External Devices* on page 161

Slave DSP Debug Connector (P6)

Objective

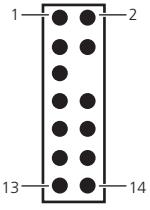
The TMS320F240 slave DSP features a superset of the IEEE 1149.1 JTAG standard emulation port. This emulation port can be used for software debugging. The DS1103 contains a JTAG connector to connect an external emulator such as the Texas Instruments XDS510.

The dSPACE software does not support the slave DSP debug connector.

Location

For the location of the connector on the board, see *Board Overview* on page 105.

Pinout

Connector	Pin	Signal	Pin	Signal
	1	TMS	2	$\overline{\text{TRST}}$
	3	TDI	4	GND
	5	VCC	6	
	7	TDO	8	GND
	9	TCK	10	GND
	11	TCK	12	GND
	13	EMU0	14	EMU1

Slave DSP Flash Jumper (J1)

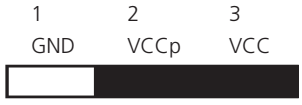
Objective

The slave DSP contains an on-chip flash memory. The flash jumper (see *Board Overview* on page 105) is used to set the protection mode of the flash memory and the slave DSP watchdog mode.

Jumper settings

The VCCp pin of the TMS320F240 slave DSP selects the protection mode of the flash memory and the slave DSP watchdog mode:

- If the jumper connects VCCp to VCC (default setting):
  - erase/write operations to the flash memory are enabled
  - the watchdog is disabled
- If the jumper connects VCCp to GND:
  - erase/write operations to the flash memory are disabled
  - the watchdog is enabled



The dSPACE software does not support the watchdog of the slave DSP. For this reason, do not change the jumper's default setting shown above.

Status LEDs of the DS1103

Objective

The DS1103 is equipped with 4 red status LEDs that provide information on the current board status.

LED location

For details on the location of the status LEDs, see the illustration in *Board Overview* on page 105.

LED description

The following table provides a description of the LEDs:

LED	Description
PGVCC1 (built-in up to DS1103-07)	Lit when power is supplied correctly to the processor core.
PGVCC2 (built-in up to DS1103-07)	Lit when power is supplied correctly to the digital logic of the DS1103.
PWR (built-in as of DS1103-09)	Lit when power is supplied correctly to the processor core and the digital logic of the DS1103.
ENIO (built-in as of DS1103-09)	Lit when the I/O functions of the DS1103 are enabled.

LED	Description
RUN	Lit when the PPC of the DS1103 is running. After power-up, this LED is not lit since the PPC is reset.
BEN	Lit whenever the host PC access the board.

The LEDs also indicate bad power supply or damage to the board.

Problems indicated by the PGVCC1, PGVCC2 and PWR LEDs

If the *PGVCC1* LED, *PGVCC2* LED (up to DS1103-07) or the *PWR* LED (as of DS1103-09) are not lit after power-up, check:

- If the DS1103 is inserted correctly in the expansion box.
- If the power supply is defective.

Problems indicated by the RUN LED

If the *RUN* LED is not lit when you want to start an application on the board or if this LED does not go off when you want to stop an application, the connection between ControlDesk 3.x/ControlDesk Next Generation and the board's host interface is interrupted.

- Check if the I/O base address settings on the DS1103 match the settings you specified with the Platform Manager of ControlDesk 3.x or ControlDesk Next Generation. For details, see *How to Change I/O Base Addresses* on page 35 and *How to Register a Platform* (🕮 *ControlDesk Next Generation Basic Practices Guide*).
- If the DS1103 is installed in an expansion box connected to the host PC via bus interface, see *Problems Using an Expansion Box via Bus Connection* on page 213 for possible errors.
- If the DS1103 is installed in an expansion box connected to the host PC via Ethernet, see *Problems with the Ethernet Connection* on page 214 for possible errors.

Problems indicated by the BEN LED

The following problems are indicated by the *BEN* LED:

- If the DS1103 is not operated in Plug & Play mode, the BEN LED must light up once when the board is registered by ControlDesk 3.x or ControlDesk Next Generation. Otherwise, there is no connection between ControlDesk 3.x or ControlDesk Next Generation to the board's host interface, which may have the following reasons:
  - Check if the I/O base address settings on the DS1103 match the settings you specified with the Platform Manager of ControlDesk 3.x or ControlDesk Next Generation. For details, see *How to Change I/O Base Addresses* on page 35 and *How to Register a Platform* (📖 *ControlDesk Next Generation Basic Practices Guide*).
  - If the DS1103 is installed in an expansion box connected to the host PC via bus interface, see *Problems Using an Expansion Box via Bus Connection* on page 213 for possible errors.
  - If the DS1103 is installed in an expansion box connected to the host PC via Ethernet, see *Problems with the Ethernet Connection* on page 214 for possible errors.
- If the DS1103 is operated in Plug & Play mode, the BEN LED must light up once when the board is registered automatically by ControlDesk 3.x or ControlDesk Next Generation. Otherwise, this indicates an error of the host PC's Plug & Play BIOS.

CP1103/CLP1103 Components

Objective

The connector panels CP1103 and CLP1103 provide easy-to-use connections between the DS1103 and devices to be connected to it. Devices can be individually connected, disconnected or interchanged without soldering. This simplifies system construction, testing and troubleshooting.

Where to go from here

Information in this section

Panel Overview Contains an illustration of the panel, showing the location of connectors.	127
CLP1103 LED Assignment Shows the LED array of the CLP.	128
BNC Connectors (CP1 ... CP28)	129
Slave ADC Connector (CP29)	130
Digital I/O Connector (CP30)	131
Slave I/O Connector (CP31)	132
Incremental Encoder Interface Connectors (CP32 ... CP37, CP39)	133
CAN Connector (CP38)	134
Master PPC UART RS232 Connector (CP40)	135
Slave DSP UART RS232 Connector (CP41)	136
Master PPC UART RS422 Connector (CP42)	137
Slave DSP UART RS422 Connector (CP43)	137

Panel Overview

Connecting devices



Prior to connecting external devices to the connector panel, ensure you have familiarized yourself with the relevant instructions provided in *How to Connect External Devices to a Connector Panel* on page 95.

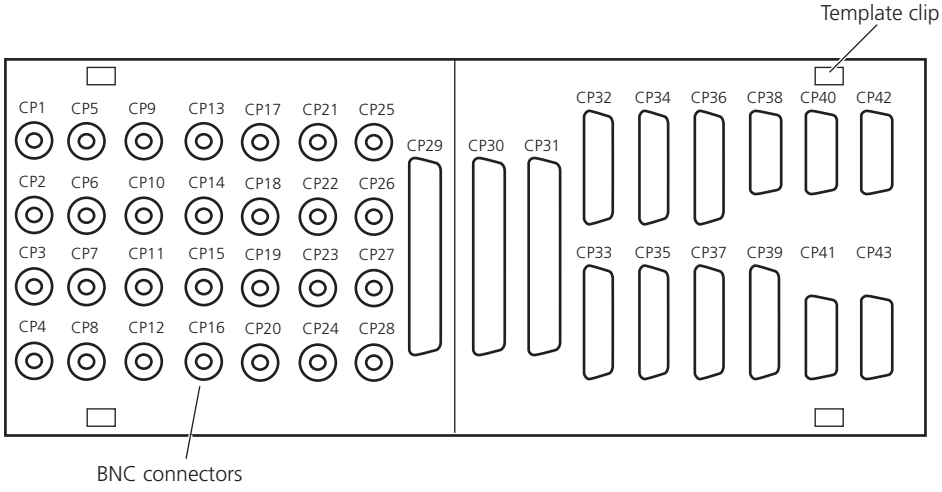
WARNING

Hazardous voltages

Risk of electric shock and/or damage to the hardware

- Do not connect any high-voltage devices to the I/O connectors of the panel.

Connectors



The VCC1, VCC2 and VCC3 line of the DS1103 are connected on the CP1103/CLP1103 and called VCC. The total load of *all* connector pins that provide access to the PC power supply must not exceed 1.5 A (CP1103) or 0.75 A (CLP1103).

For details on the VCC lines refer to *Power Supply Outputs* on page 162.

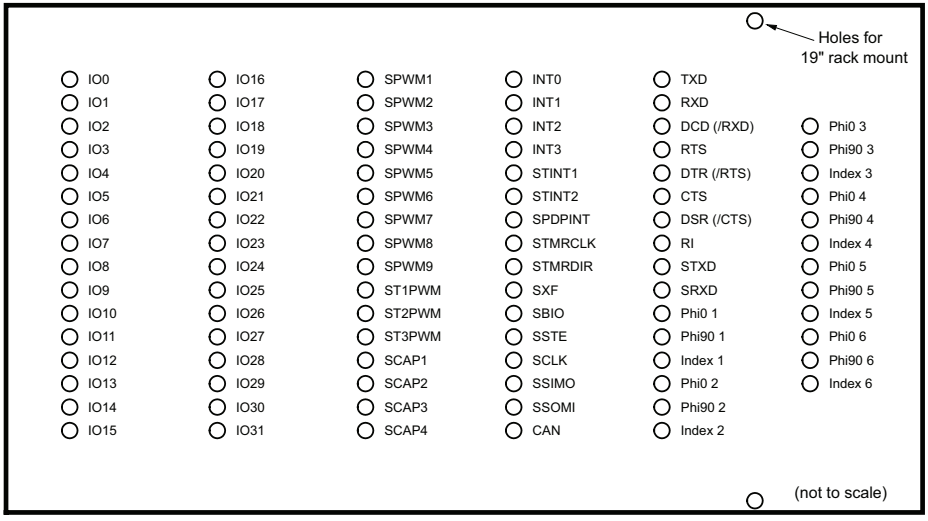
CLP1103 LED Assignment

Objective

The CLP1103 Connector/LED Combi Panel additionally provides an array of 92 LEDs indicating the states of the digital signals.

LED assignment

In the illustration below you will find the signal names as labeled on the panel template.



The LEDs display the TTL signal level, not the active status of the signal. (TTL "high" → LED is on; TTL "low" → LED is off).

Electrical characteristics

In order to keep the loading of the signals as low as possible, the LEDs are run through buffers.

For the incremental sensor signals, there are buffers with true differential inputs. The pulse length of data signals (CAN, RXD, TXD, SRXD, STXD) is extended to make even small blocks of data visible.

The power required by the LEDs is taken from the DS1103's supply voltage (VCC).

BNC Connectors (CP1 ... CP28)

Objective

The CP1 ... CP28 connectors are female BNC connectors. Their shells are connected to GND.

Pinout

Connector	Signal	Connector	Signal
CP1	ADCH1	CP15	ADCH15
CP2	ADCH2	CP16	ADCH16
CP3	ADCH3	CP17	ADCH17
CP4	ADCH4	CP18	ADCH18
CP5	ADCH5	CP19	ADCH19
CP6	ADCH6	CP20	ADCH20
CP7	ADCH7	CP21	DACH1
CP8	ADCH8	CP22	DACH2
CP9	ADCH9	CP23	DACH3
CP10	ADCH10	CP24	DACH4
CP11	ADCH11	CP25	DACH5
CP12	ADCH12	CP26	DACH6
CP13	ADCH13	CP27	DACH7
CP14	ADCH14	CP28	DACH8



In order to avoid poor performance of the analog subsystems, do not form ground loops within the BNC wiring.

Slave ADC Connector (CP29)

Objective

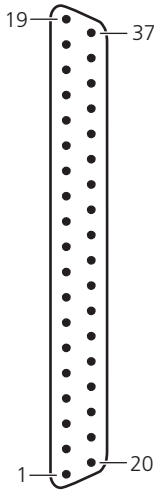
The slave ADC connector (CP29) is a 37-pin, male Sub-D connector located on the front of the connector panel.

Pinout

Because the pin numbering used for Sub-D connectors is not standardized, the following figure shows the numbering scheme used (front view).



Do not rely on the numbers written on Sub-D connectors.

Slave ADC Connector (CP29)	Pin	Signal	Pin	Signal
	19	GND		
	18	GND	37	SADCSOC
	17	GND	36	GND
	16	GND	35	SADCH16
	15	GND	34	SADCH15
	14	GND	33	SADCH14
	13	GND	32	SADCH13
	12	GND	31	SADCH12
	11	GND	30	SADCH11
	10	GND	29	SADCH10
	9	GND	28	SADCH9
	8	GND	27	SADCH8
	7	GND	26	SADCH7
	6	GND	25	SADCH6
	5	GND	24	SADCH5
	4	GND	23	SADCH4
	3	GND	22	SADCH3
	2	GND	21	SADCH2
	1	GND	20	SADCH1

Digital I/O Connector (CP30)

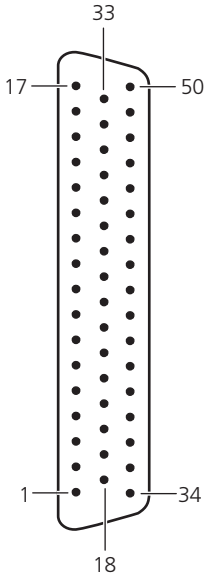
Objective

The digital I/O connector (CP30) is a 50-pin male, Sub-D connector located on the front of the connector panel.

Pinout

Because the pin numbering used for Sub-D connectors is not standardized, the following figure shows the numbering scheme used (front view).

Do not rely on the numbers written on Sub-D connectors.

Digital I/O Connector (CP30)	Pin	Signal	Pin	Signal	Pin	Signal
	17	GND			50	VCC (+5 V)
	16	IO30	33	IO31	49	$\overline{\text{INT3}}$
	15	IO28	32	IO29	48	$\overline{\text{INT2}}$
	14	IO26	31	IO27	47	$\overline{\text{INT1}}$
	13	IO24	30	IO25	46	$\overline{\text{INT0}}$
	12	IO22	29	IO23	45	GND
	11	IO20	28	IO21	44	GND
	10	IO18	27	IO19	43	GND
	9	IO16	26	IO17	42	GND
	8	IO14	25	IO15	41	GND
	7	IO12	24	IO13	40	GND
	6	IO10	23	IO11	39	GND
	5	IO8	22	IO9	38	GND
	4	IO6	21	IO7	37	GND
	3	IO4	20	IO5	36	GND
	2	IO2	19	IO3	35	GND
	1	IO0	18	IO1	34	GND

The VCC1, VCC2 and VCC3 line of the DS1103 are connected on the CP1103/CLP1103 and called VCC. The total load of *all* connector pins that provide access to the PC power supply must not exceed 1.5 A (CP1103) or 0.75 A (CLP1103).

Slave I/O Connector (CP31)

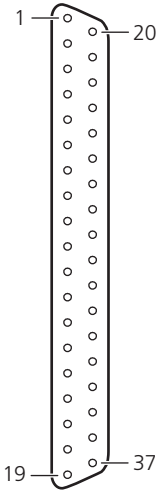
Objective

The slave I/O connector (CP31) is a 37-pin, female Sub-D connector located on the front of the connector panel.

Pinout

Because the pin numbering used for Sub-D connectors is not standardized, the following figure shows the numbering scheme used (front view).

Do not rely on the numbers written on Sub-D connectors.

Slave I/O Connector (CP31)	Pin	Signal	Pin	Signal
	1	GND		
	2	SCAP1	20	GND
	3	SCAP3	21	SCAP2
	4	GND	22	SCAP4
	5	ST2PWM	23	ST1PWM
	6	GND	24	ST3PWM
	7	SPWM1	25	GND
	8	SPWM3	26	SPWM2
	9	SPWM5	27	SPWM4
	10	SPWM7	28	SPWM6
	11	SPWM9	29	SPWM8
	12	STMRCLK	30	GND
	13	GND	31	STMRDIR
	14	STINT1	32	SPDPINT
	15	GND	33	STINT2
	16	SSIMO	34	SSOMI
	17	SCLK	35	SSTE
	18	SXF	36	SBIO
	19	VCC (+5 V)	37	GND

The VCC1, VCC2 and VCC3 line of the DS1103 are connected on the CP1103/CLP1103 and called VCC. The total load of *all* connector pins that provide access to the PC power supply must not exceed 1.5 A (CP1103) or 0.75 A (CLP1103).

Incremental Encoder Interface Connectors (CP32 ... CP37, CP39)

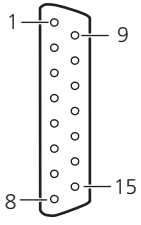
Objective

The incremental encoder interface connectors (CP32 ... CP37 and CP39) are 15-pin, female Sub-D connectors located on the front of the connector panel. Each of the connectors provides the signals for one of the seven available incremental encoder channels.

Pinout

Because the pin numbering used for Sub-D connectors is not standardized, the following figure shows the numbering scheme used (front view).

Do not rely on the numbers written on Sub-D connectors.

Connector (CP32 ... CP37, CP39)	Pin	Signal	Pin	Signal
	1	VCC (+5 V)		
	2	PHI0(x)	9	VCC (+5 V)
	3	$\overline{\text{PHI0(x)}}$	10	GND
	4	PHI90(x)	11	GND
	5	$\overline{\text{PHI90(x)}}$	12	GND
	6	INDEX(x)	13	GND
	7	$\overline{\text{INDEX(x)}}$	14	GND
	8	GND	15	GND

x corresponds to the seven available incremental encoder channels: The channels 1 ... 7 correspond to the connectors CP32 ... CP37 and CP39.

The VCC1, VCC2 and VCC3 line of the DS1103 are connected on the CP1103/CLP1103 and called VCC. The total load of *all* connector pins that provide access to the PC power supply must not exceed 1.5 A (CP1103) or 0.75 A (CLP1103).

If the encoder has SENSE lines, connect SENSE+ to VCC (Pin 9) and SENSE– to GND (Pin 15).

CAN Connector (CP38)

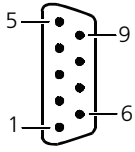
Objective

The CAN connector (CP38) is a 9-pin, male Sub-D connector located on the front of the connector panel. The pinout has been adopted from the standard, 9-pin CAN connector.

Pinout

Because the pin numbering used for Sub-D connectors is not standardized, the following figure shows the numbering scheme used (front view).

Do not rely on the numbers written on Sub-D connectors.

CAN Connector (CP38)	Pin	Signal	Pin	Signal
	5	GND		
	4	Not used	9	Not used
	3	GND	8	Not used
	2	CANL	7	CANH
	1	Not used	6	GND

The CAN bus lines (CANH, CANL) are not terminated with a resistor on the DS1103.

Master PPC UART RS232 Connector (CP40)

Objective

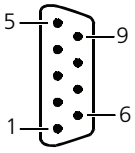
The master PPC UART RS232 connector (CP40) is a 9-pin, male Sub-D connector located on the front of the connector panel. The pinout has been adopted from the 9-pin, RS232 connector of a PC.

The master PPC of the DS1103 supports one serial interface. In RS232 mode the signals are available from the master PPC UART RS232 connector (CP40). In RS422 mode the signals are available from the master PPC UART RS422 connector (CP42). CP40 and CP42 are mutually exclusive and cannot be used at the same time.

Pinout

Because the pin numbering used for Sub-D connectors is not standardized, the following figure shows the numbering scheme used (front view).

Do not rely on the numbers written on Sub-D connectors.

Connector (CP40)	Pin	Signal	Pin	Signal
	5	GND		
	4	DTR ($\overline{\text{RTS}}$)	9	RI
	3	TXD	8	CTS
	2	RXD	7	RTS
	1	DCD ($\overline{\text{RXD}}$)	6	DSR ($\overline{\text{CTS}}$)

Signal names in parentheses apply when the UART is set to the RS422 mode. However, you should use the *Master PPC UART RS422 Connector (CP42)* on page 137 instead, when you are using RS422 mode.

Slave DSP UART RS232 Connector (CP41)

Objective

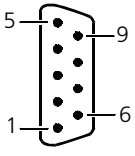
The slave DSP UART RS232 connector (CP41) is a 9-pin male Sub-D connector located on the front of the connector panel. The pinout has been adopted from the 9-pin RS232 connector of a PC.

The slave DSP of the DS1103 supports one serial communication interface. In RS232 mode the signals are available from the slave DSP UART RS232 connector (CP41). In RS422 mode the signals are available from the slave DSP UART RS422 connector (CP43). CP41 and CP43 are mutually exclusive and cannot be used at the same time.

Pinout

Because the pin numbering used for Sub-D connectors is not standardized, the following figure shows the numbering scheme used (front view).

Do not rely on the numbers written on Sub-D connectors.

Connector (CP41)	Pin	Signal	Pin	Signal
	5	GND		
	4	Not used	9	Not used
	3	STXD	8	Not used
	2	SRXD	7	Not used
	1	Not used	6	Not used

Master PPC UART RS422 Connector (CP42)

Objective

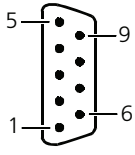
The master PPC UART RS422 connector (CP42) is a 9-pin male Sub-D connector located on the front of the connector panel.

The master PPC of the DS1103 supports one serial interface. In RS232 mode the signals are available from the master PPC UART RS232 connector (CP40). In RS422 mode the signals are available from the master PPC UART RS422 connector (CP42). CP40 and CP42 are mutually exclusive and cannot be used at the same time.

Pinout

Because the pin numbering used for Sub-D connectors is not standardized, the following figure shows the numbering scheme used (front view).

Do not rely on the numbers written on Sub-D connectors.

Connector (CP42)	Pin	Signal	Pin	Signal
	5	GND		
	4	$\overline{\text{RXD}}$	9	$\overline{\text{CTS}}$
	3	RXD	8	CTS
	2	TXD	7	RTS
	1	$\overline{\text{TXD}}$	6	$\overline{\text{RTS}}$

Slave DSP UART RS422 Connector (CP43)

Objective

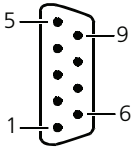
The slave DSP UART RS422 connector (CP43) is a 9-pin male Sub-D connector located on the front of the connector panel.

The slave DSP of the DS1103 supports one serial communication interface. In RS232 mode the signals are available from the slave DSP UART RS232 connector (CP41). In RS422 mode the signals are available from the slave DSP UART RS422 connector (CP43). CP41 and CP43 are mutually exclusive and cannot be used at the same time.

Pinout

Because the pin numbering used for Sub-D connectors is not standardized, the following figure shows the numbering scheme used (front view).

Do not rely on the numbers written on Sub-D connectors.

Connector (CP43)	Pin	Signal	Pin	Signal
	5	GND		
	4	$\overline{\text{SRXD}}$	9	Not used
	3	SRXD	8	Not used
	2	STXD	7	Not used
	1	$\overline{\text{STXD}}$	6	Not used

Mapping of I/O Signals

Objective	Various connector pins can be assigned to RTI blocks and RTLib functions.
Where to go from here	Information in this section

Signal Mapping to I/O Pins Shows the assignment of RTI blocks and RTLib functions to single connector pins.	139
Conflicting I/O Features Shows the I/O features on the DS1103 which conflict with other I/O features.	152

Signal Mapping to I/O Pins

Objective	The following table lists the I/O signals of the DS1103 by function groups, their electrical specifications, and the mapping of these signals to RTI blocks and RTLib functions. The table also provides the mapping of the I/O signals to the I/O pins on the DS1103, on the Sub-D connectors, and on the CP1103/CLP1103 connector panels.
Conflicting I/O features	Some I/O features of the DS1103 conflict with other I/O features. In the table below, these signals are marked with an asterisk "*". For an overview, see *Conflicting I/O Features* on page 152.

Signal mapping

Signal	Channel/Bit Numbers of Related RTI Blocks/RTLib Functions				I/O Pin on …		
	Related RTI Block(s)	Ch/Bit (RTI)	Related RTLib Functions	Ch/Bit (RTLib)	DS1103	Sub-D Conn.	CP/CLP
ADC Unit							
■ Input voltage range: ±10 V ■ ADCH1 … ADCH16: input for A/D converter with multiplexed input signals ■ ADCH17 … ADCH20: input for parallel (non-multipexed) A/D converters ■ I/O circuit and further electrical characteristics: see *Analog Inputs* on page 163							
ADCH1	DS1103MUX_ADC_CONx	Conv 1 ch 1	See *ADC Unit* (🕮 *DS1103 RTLib Reference*)	Ch 1 (conv 1)	P1 3	P1B 34	CP1
ADCH2		Conv 1 ch 2		Ch 2 (conv 1)	P1 4	P1A 34	CP2
ADCH3		Conv 1 ch 3		Ch 3 (conv 1)	P1 7	P1B 2	CP3
ADCH4		Conv 1 ch 4		Ch 4 (conv 1)	P1 8	P1A 2	CP4
ADCH5		Conv 2 ch 1		Ch 5 (conv 2)	P1 11	P1B 19	CP5
ADCH6		Conv 2 ch 2		Ch 6 (conv 2)	P1 12	P1A 19	CP6
ADCH7		Conv 2 ch 3		Ch 7 (conv 2)	P1 15	P1B 36	CP7
ADCH8		Conv 2 ch 4		Ch 8 (conv 2)	P1 16	P1A 36	CP8
ADCH9		Conv 3 ch 1		Ch 9 (conv 3)	P1 19	P1B 4	CP9
ADCH10		Conv 3 ch 2		Ch 10 (conv 3)	P1 20	P1A 4	CP10
ADCH11		Conv 3 ch 3		Ch 11 (conv 3)	P1 23	P1B 21	CP11
ADCH12		Conv 3 ch 4		Ch 12 (conv 3)	P1 24	P1A 21	CP12
ADCH13		Conv 4 ch 1		Ch 13 (conv 4)	P1 27	P1B 38	CP13
ADCH14		Conv 4 ch 2		Ch 14 (conv 4)	P1 28	P1A 38	CP14
ADCH15		Conv 4 ch 3		Ch 15 (conv 4)	P1 31	P1B 6	CP15
ADCH16		Conv 4 ch 4		Ch 16 (conv 4)	P1 32	P1A 6	CP16

Signal	Channel/Bit Numbers of Related RTI Blocks/RTLib Functions				I/O Pin on ...		
	Related RTI Block(s)	Ch/Bit (RTI)	Related RTLib Functions	Ch/Bit (RTLib)	DS1103	Sub-D Conn.	CP/CLP
ADCH17	DS1103ADC_Cx	Ch 17	See *ADC Unit* (🕮 *DS1103 RTLib Reference*)	Ch 17 (conv 5)	P1 35	P1B 23	CP17
ADCH18		Ch 18		Ch 18 (conv 6)	P1 36	P1A 23	CP18
ADCH19		Ch 19		Ch 19 (conv 7)	P1 39	P1B 40	CP19
ADCH20		Ch 20		Ch 20 (conv 8)	P1 40	P1A 40	CP20
DAC Unit							
■ Output voltage range: ±10 V ■ Output current range: ±5 mA ■ DACH1 … DACH8: D/A converter output ■ I/O circuit and further electrical characteristics: see *Analog Outputs* on page 165							
DACH1	DS1103DAC_Cx	Ch 1	See *DAC Unit* (🕮 *DS1103 RTLib Reference*)	Ch 1	P1 47	P1B 25	CP21
DACH2		Ch 2		Ch 2	P1 48	P1A 25	CP22
DACH3		Ch 3		Ch 3	P1 51	P1B 42	CP23
DACH4		Ch 4		Ch 4	P1 52	P1A 42	CP24
DACH5		Ch 5		Ch 5	P1 55	P1B 10	CP25
DACH6		Ch 6		Ch 6	P1 56	P1A 10	CP26
DACH7		Ch 7		Ch 7	P1 59	P1B 27	CP27
DACH8		Ch 8		Ch 8	P1 60	P1A 27	CP28

Signal	Channel/Bit Numbers of Related RTI Blocks/RTLib Functions				I/O Pin on ...		
	Related RTI Block(s)	Ch/Bit (RTI)	Related RTLib Functions	Ch/Bit (RTLib)	DS1103	Sub-D Conn.	CP/CLP
Bit I/O Unit							
■ TTL voltage range ■ Output current range: ±10 mA ■ I/O circuit and further electrical characteristics: see *Bit I/O* on page 168							
IO0	DS1103BIT_IN_Gx/ DS1103BIT_IN8_Gx/ DS1103BIT_OUT_Gx/ DS1103BIT_OUT8_Gx	Group 1 bit 0	See *Bit I/O Unit* (🕮 *DS1103 RTLib Reference*)	Bit 0 (group 1)	P2 5	P2B 18	CP30 1
IO1		Group 1 bit 1		Bit 1 (group 1)	P2 6	P2A 18	CP30 18
IO2		Group 1 bit 2		Bit 2 (group 1)	P2 7	P2B 2	CP30 2
IO3		Group 1 bit 3		Bit 3 (group 1)	P2 8	P2A 2	CP30 19
IO4		Group 1 bit 4		Bit 4 (group 1)	P2 11	P2B 19	CP30 3
IO5		Group 1 bit 5		Bit 5 (group 1)	P2 12	P2A 19	CP30 20
IO6		Group 1 bit 6		Bit 6 (group 1)	P2 13	P2B 3	CP30 4
IO7		Group 1 bit 7		Bit 7 (group 1)	P2 14	P2A 3	CP30 21
IO8		Group 2 bit 0		Bit 8 (group 2)	P2 17	P2B 20	CP30 5
IO9		Group 2 bit 1		Bit 9 (group 2)	P2 18	P2A 20	CP30 22
IO10		Group 2 bit 2		Bit 10 (group 2)	P2 19	P2B 4	CP30 6
IO11		Group 2 bit 3		Bit 11 (group 2)	P2 20	P2A 4	CP30 23
IO12		Group 2 bit 4		Bit 12 (group 2)	P2 23	P2B 21	CP30 7
IO13		Group 2 bit 5 bit 5		Bit 13 (group 2)	P2 24	P2A 21	CP30 24
IO14		Group 2 bit 6		Bit 14 (group 2)	P2 25	P2B 5	CP30 8
IO15		Group 2 bit 7		Bit 15 (group 2)	P2 26	P2A 5	CP30 25

Signal	Channel/Bit Numbers of Related RTI Blocks/RTLib Functions				I/O Pin on ...		
	Related RTI Block(s)	Ch/Bit (RTI)	Related RTLib Functions	Ch/Bit (RTLib)	DS1103	Sub-D Conn.	CP/CLP
IO16	DS1103BIT_IN_Gx/ DS1103BIT_IN8_Gx/ DS1103BIT_OUT_Gx/ DS1103BIT_OUT8_Gx	Group 3 bit 0	See *Bit I/O Unit* (📖 *DS1103 RTLib Reference*)	Bit 16 (group 3)	P2 29	P2B 22	CP30 9
IO17		Group 3 bit 1		Bit 17 (group 3)	P2 30	P2A 22	CP30 26
IO18		Group 3 bit 2		Bit 18 (group 3)	P2 31	P2B 6	CP30 10
IO19		Group 3 bit 3		Bit 19 (group 3)	P2 32	P2A 6	CP30 27
IO20		Group 3 bit 4		Bit 20 (group 3)	P2 35	P2B 23	CP30 11
IO21		Group 3 bit 5		Bit 21 (group 3)	P2 36	P2A 23	CP30 28
IO22		Group 3 bit 6		Bit 22 (group 3)	P2 37	P2B 7	CP30 12
IO23		Group 3 bit 7		Bit 23 (group 3)	P2 38	P2A 7	CP30 29
IO24		Group 4 bit 0		Bit 24 (group 4)	P2 41	P2B 24	CP30 13
IO25		Group 4 bit 1		Bit 25 (group 4)	P2 42	P2A 24	CP30 30
IO26		Group 4 bit 2		Bit 26 (group 4)	P2 43	P2B 8	CP30 14
IO27		Group 4 bit 3		Bit 27 (group 4)	P2 44	P2A 8	CP30 31
IO28		Group 4 bit 4		Bit 28 (group 4)	P2 47	P2B 25	CP30 15
IO29		Group 4 bit 5		Bit 29 (group 4)	P2 48	P2A 25	CP30 32
IO30		Group 4 bit 6		Bit 30 (group 4)	P2 49	P2B 9	CP30 16
IO31		Group 4 bit 7		Bit 31 (group 4)	P2 50	P2A 9	CP30 33

Signal	Channel/Bit Numbers of Related RTI Blocks/RTLib Functions				I/O Pin on …		
	Related RTI Block(s)	Ch/Bit (RTI)	Related RTLib Functions	Ch/Bit (RTLib)	DS1103	Sub-D Conn.	CP/CLP
Incremental Encoder Interface							
■ Ch 1 … Ch 6: digital (differential RS422 or single-ended TTL) input ■ Ch 7: analog (sinusoidal differential 1 V_{pp} or 11 μA_{pp}) input ■ PHI0(x): incremental encoder interface input 0° ($\overline{\text{PHI0(x)}}$: inverted signal) ■ PHI90(x): incremental encoder interface input 90° ($\overline{\text{PHI90(x)}}$: inverted signal) ■ IDX(x): incremental encoder interface index input ($\overline{\text{IDX(x)}}$: inverted signal) ■ I/O circuit and further electrical characteristics: see *Incremental Encoder Interface* on page 177							
PHI0(1)	DS1103ENC_POS_Cx/ DS1103ENC_SET_POS_Cx	Ch 1	See *Incremental Encoder Interface* (🕮 *DS1103 RTLib Reference*)	Ch 1	P3 45	P3B 41	CP32 2
$\overline{\text{PHI0(1)}}$					P3 46	P3A 41	CP32 3
PHI90(1)					P3 47	P3B 25	CP32 4
$\overline{\text{PHI90(1)}}$					P3 48	P3A 25	CP32 5
PHI0(2)		Ch 2		Ch 2	P3 53	P3B 26	CP33 2
$\overline{\text{PHI0(2)}}$					P3 54	P3A 26	CP33 3
PHI90(2)					P3 55	P3B 10	CP33 4
$\overline{\text{PHI90(2)}}$					P3 56	P3A 10	CP33 5
PHI0(3)		Ch 3		Ch 3	P3 61	P3B 11	CP34 2
$\overline{\text{PHI0(3)}}$					P3 62	P3A 11	CP34 3
PHI90(3)					P3 63	P3B 44	CP34 4
$\overline{\text{PHI90(3)}}$					P3 64	P3A 44	CP34 5
PHI0(4)		Ch 4		Ch 4	P3 69	P3B 45	CP35 2
$\overline{\text{PHI0(4)}}$					P3 70	P3A 45	CP35 3
PHI90(4)					P3 71	P3B 29	CP35 4
$\overline{\text{PHI90(4)}}$					P3 72	P3A 29	CP35 5
PHI0(5)		Ch 5		Ch 5	P3 77	P3B 30	CP36 2
$\overline{\text{PHI0(5)}}$					P3 78	P3A 30	CP36 3
PHI90(5)					P3 79	P3B 14	CP36 4
$\overline{\text{PHI90(5)}}$					P3 80	P3A 14	CP36 5
PHI0(6)		Ch 6		Ch 6	P3 37	P3B 7	CP37 2
$\overline{\text{PHI0(6)}}$					P3 38	P3A 7	CP37 3
PHI90(6)					P3 39	P3B 40	CP37 4
$\overline{\text{PHI90(6)}}$					P3 40	P3A 40	CP37 5
PHI0(7)		Ch 7		Ch 7	P3 29	P3B 22	CP39 2
$\overline{\text{PHI0(7)}}$					P3 30	P3A 22	CP39 3
PHI90(7)					P3 31	P3B 6	CP39 4
$\overline{\text{PHI90(7)}}$					P3 32	P3A 6	CP39 5

Signal	Channel/Bit Numbers of Related RTI Blocks/RTLib Functions				I/O Pin on ...		
	Related RTI Block(s)	Ch/Bit (RTI)	Related RTLib Functions	Ch/Bit (RTLib)	DS1103	Sub-D Conn.	CP/CLP
IDX(1)	DS1103ENC_SW_INDEX_Cx/ DS1103ENC_HW_INDEX_Cx	Ch 1	See *Incremental Encoder Interface* (📖 *DS1103 RTLib Reference*)	Ch 1	P3 49	P3B 9	CP32 6
$\overline{\text{IDX(1)}}$					P3 50	P3A 9	CP32 7
IDX(2)		Ch 2		Ch 2	P3 57	P3B 43	CP33 6
$\overline{\text{IDX(2)}}$					P3 58	P3A 43	CP33 7
IDX(3)		Ch 3		Ch 3	P3 65	P3B 28	CP34 6
$\overline{\text{IDX(3)}}$					P3 66	P3A 28	CP34 7
IDX(4)		Ch 4		Ch 4	P3 73	P3B 13	CP35 6
$\overline{\text{IDX(4)}}$					P3 74	P3A 13	CP35 7
IDX(5)		Ch 5		Ch 5	P3 81	P3B 47	CP36 6
$\overline{\text{IDX(5)}}$					P3 82	P3A 47	CP36 7
IDX(6)		Ch 6		Ch 6	P3 41	P3B 24	CP37 6
$\overline{\text{IDX(6)}}$					P3 42	P3A 24	CP37 7
IDX(7)		Ch 7		Ch 7	P3 33	P3B 39	CP39 6
$\overline{\text{IDX(7)}}$					P3 34	P3A 39	CP39 7
Serial Interface (RS232 mode)							
■ RS232 voltage range ■ DCD (data carrier detect), CTS (clear to send), RTS (ready to send), DSR (data set ready), DTR (data terminal ready), RI (ring indicator), RXD (receive), TXD (transmit) ■ I/O circuit and further electrical characteristics: see *Serial Interface* on page 187							
DCD *	DS1103SER_SETUP/ DS1103SER_STAT/ DS1103SER_TX/ DS1103SER_RX/ DS1103SER_INT_Iy/ DS1103SER_INT_REC_LEV				P3 6	P3A 18	CP40 1
CTS *					P3 9	P3B 35	CP40 8
RTS *					P3 7	P3B 2	CP40 7
DSR *					P3 10	P3A 35	CP40 6
DTR *					P3 8	P3A 2	CP40 4
RI *					P3 11	P3B 19	CP40 9
RXD *					P3 5	P3B 18	CP40 2
TXD *					P3 3	P3B 34	CP40 3
Serial Interface (RS422 mode)							
■ RS422 voltage range ■ CTS, $\overline{\text{CTS}}$ (clear to send and inverted signal), RTS, $\overline{\text{RTS}}$ (ready to send and inverted signal), RXD, $\overline{\text{RXD}}$ (receive and inverted signal), TXD, $\overline{\text{TXD}}$ (transmit and inverted signal) ■ I/O circuit and further electrical characteristics: see *Serial Interface* on page 187							
CTS *	DS1103SER_SETUP/ DS1103SER_STAT/ DS1103SER_TX/ DS1103SER_RX/ DS1103SER_INT_Iy/ DS1103SER_INT_REC_LEV				P3 9	P3B 35	CP42 8
RTS *					P3 7	P3B 2	CP42 7
$\overline{\text{CTS *}}$					P3 10	P3A 35	CP42 9
$\overline{\text{RTS *}}$					P3 8	P3A 2	CP42 6
RXD *					P3 5	P3B 18	CP42 3
TXD *					P3 3	P3B 34	CP42 2
$\overline{\text{RXD *}}$					P3 6	P3A 18	CP42 4
$\overline{\text{TXD *}}$					P3 4	P3A 34	CP42 1

Signal	Channel/Bit Numbers of Related RTI Blocks/RTLib Functions				I/O Pin on …		
	Related RTI Block(s)	Ch/Bit (RTI)	Related RTLib Functions	Ch/Bit (RTLib)	DS1103	Sub-D Conn.	CP/CLP
Synchronizing I/O Features of the Master PPC							
■ TTL input voltage range ■ I/O circuit and further electrical characteristics: see *Slave DSP Bit I/O* on page 171							
ST1PWM *	DS1103SYNC_IO_SETUP/ DS1103MASTER_SYNCINT		See *Synchronous I/O Trigger* (🕮 *DS1103 RTLib Reference*)		P2 59	P2B 27	CP31 23
Slave DSP ADC Unit							
■ Input voltage range: 0 … 5 V ■ SADCH1 … SADCH16: input for A/D converter with 10-bit resolution ■ I/O circuit and further electrical characteristics: see *Slave DSP Bit I/O* on page 171							
SADCH1 *	DS1103SL_DSP_ADC_Cx	Ch 1	See *Slave DSP ADC Unit* (🕮 *DS1103 RTLib Reference*)	Ch 1	P1 67	P1B 12	CP29 20
SADCH2 *		Ch 2		Ch 2	P1 68	P1A 12	CP29 21
SADCH3		Ch 3		Ch 3	P1 71	P1B 29	CP29 22
SADCH4		Ch 4		Ch 4	P1 72	P1A 29	CP29 23
SADCH5		Ch 5		Ch 5	P1 75	P1B 46	CP29 24
SADCH6		Ch 6		Ch 6	P1 76	P1A 46	CP29 25
SADCH7		Ch 7		Ch 7	P1 79	P1B 14	CP29 26
SADCH8		Ch 8		Ch 8	P1 80	P1A 14	CP29 27
SADCH9 *		Ch 9		Ch 9	P1 83	P1B 31	CP29 28
SADCH10 *		Ch 10		Ch 10	P1 84	P1A 31	CP29 29
SADCH11		Ch 11		Ch 11	P1 87	P1B 48	CP29 30
SADCH12		Ch 12		Ch 12	P1 88	P1A 48	CP29 31
SADCH13		Ch 13		Ch 13	P1 91	P1B 16	CP29 32
SADCH14		Ch 14		Ch 14	P1 92	P1A 16	CP29 33
SADCH15		Ch 15		Ch 15	P1 95	P1B 33	CP29 34
SADCH16		Ch 16		Ch 16	P1 96	P1A 33	CP29 35

Signal	Channel/Bit Numbers of Related RTI Blocks/RTLib Functions				I/O Pin on ...		
	Related RTI Block(s)	Ch/Bit (RTI)	Related RTLib Functions	Ch/Bit (RTLib)	DS1103	Sub-D Conn.	CP/CLP
Slave DSP Bit I/O Unit							
■ TTL voltage range ■ Output current range: ±13 mA ■ I/O circuit and further electrical characteristics: see *Slave DSP Bit I/O* on page 171							
SADCH1 *	DS1103SL_DSP_BIT_IN_Cx/ DS1103SL_DSP_BIT_OUT_Cx	Bit 0	See *Slave DSP Bit I/O Unit* (🕮 *DS1103 RTLib Reference*)	Group 1 bit 0	P1 67	P1B 12	CP29 20
SADCH2 *		Bit 1		Group 1 bit 1	P1 68	P1A 12	CP29 21
SADCH10 *		Bit 2		Group 1 bit 2	P1 84	P1A 31	CP29 29
SADCH9 *		Bit 3		Group 1 bit 3	P1 83	P1B 31	CP29 28
SPWM7 *		Bit 4		Group 2 bit 0	P2 71	P2B 29	CP31 10
SPWM8 *		Bit 5		Group 2 bit 1	P2 72	P2A 29	CP31 29
SPWM9 *		Bit 6		Group 2 bit 2	P2 73	P2B 13	CP31 11
ST2PWM *		Bit 7		Group 2 bit 4	P2 60	P2A 27	CP31 5
ST3PWM		Bit 8		Group 2 bit 5	P2 61	P2B 11	CP31 24
STMRDIR		Bit 9		Group 2 bit 6	P2 55	P2B 10	CP31 31
STMRCLK		Bit 10		Group 2 bit 7	P2 56	P2A 10	CP31 12
SADCSOC		Bit 11		Group 3 bit 0	P1 99	P1B 50	CP29 37
SXF		Bit 12		Group 3 bit 2	P2 83	P2B 31	CP31 18
SBIO		Bit 13		Group 3 bit 3	P2 84	P2A 31	CP31 36
SCAP1 *		Bit 14		Group 3 bit 4	P2 77	P2B 30	CP31 2
SCAP2 *		Bit 15		Group 3 bit 5	P2 78	P2A 30	CP31 21
SCAP3 *		Bit 16		Group 3 bit 6	P2 79	P2B 14	CP31 3
SCAP4 *		Bit 17		Group 3 bit 7	P2 80	P2A 14	CP31 22
ST1PWM *	_			Group 2 bit 3	P2 59	P2B 27	CP31 23

Signal	Channel/Bit Numbers of Related RTI Blocks/RTLib Functions				I/O Pin on …		
	Related RTI Block(s)	Ch/Bit (RTI)	Related RTLib Functions	Ch/Bit (RTLib)	DS1103	Sub-D Conn.	CP/CLP
1-Phase PWM Signal Generation (PWM), 3-Phase PWM Signal Generation (PWM3), Space Vector PWM Signal Generation (PWMSV)							
■ TTL output voltage range ■ Output current range: ±13 mA ■ I/O circuit and further electrical characteristics: see *Slave DSP Bit I/O* on page 171							
ST2PWM *	DS1103SL_DSP_PWM	Ch 1	See *Slave DSP PWM Generation* (🕮 *DS1103 RTLib Reference*)	Ch 1	P2 60	P2A 27	CP31 5
SPWM7 *		Ch 2		Ch 2	P2 71	P2B 29	CP31 10
SPWM8 *		Ch 3		Ch 3	P2 72	P2A 29	CP31 29
SPWM9 *		Ch 4		Ch 4	P2 73	P2B 13	CP31 11
SPWM1 *	DS1103SL_DSP_PWM3/ DS1103SL_DSP_PWMSV	Phase 1	See Slave DSP PWM3 Generation/*Slave DSP PWMSV Generation* (🕮 *DS1103 RTLib Reference*)	Phase 1	P2 65	P2B 28	CP31 7
SPWM3 *		Phase 2		Phase 2	P2 67	P2B 12	CP31 8
SPWM5 *		Phase 3		Phase 3	P2 69	P2B 45	CP31 9
SPWM2		Phase 1 (inverted)		Phase 1 (inverted)	P2 66	P2A 28	CP31 26
SPWM4		Phase 2 (inverted)		Phase 2 (inverted)	P2 68	P2A 12	CP31 27
SPWM6		Phase 3 (inverted)		Phase 3 (inverted)	P2 70	P2A 45	CP31 28
ST1PWM *	DS1103SLAVE_PWMINT		See *ds1103_slave_dsp_pwm3_init* (🕮 *DS1103 RTLib Reference*)		P2 59	P2B 27	CP31 23
Slave DSP Square-Wave Signal Generation (D2F)							
■ TTL output voltage range ■ Output current range: ±13 mA ■ I/O circuit and further electrical characteristics: see *Slave DSP Bit I/O* on page 171							
SPWM1 *	DS1103SL_DSP_D2F	Ch 1	See *Square Wave Signal Generation (D2F)* (🕮 *DS1103 RTLib Reference*)	Ch 1	P2 65	P2B 28	CP31 7
SPWM3 *		Ch 2		Ch 2	P2 67	P2B 12	CP31 8
SPWM5 *		Ch 3		Ch 3	P2 69	P2B 45	CP31 9
ST2PWM *		Ch 4		Ch 4	P2 60	P2A 27	CP31 5
Slave DSP PWM Signal Measurement (PWM2D)							
■ TTL input voltage range ■ I/O circuit and further electrical characteristics: see *Slave DSP Bit I/O* on page 171							
SCAP1 *	DS1103SL_DSP_PWM2D	Ch 1	See *Slave DSP PWM Measurement (PWM2D)* (🕮 *DS1103 RTLib Reference*)	Ch 1	P2 77	P2B 30	CP31 2
SCAP2 *		Ch 2		Ch 2	P2 78	P2A 30	CP31 21
SCAP3 *		Ch 3		Ch 3	P2 79	P2B 14	CP31 3
SCAP4 *		Ch 4		Ch 4	P2 80	P2A 14	CP31 22

Signal	Channel/Bit Numbers of Related RTI Blocks/RTLib Functions				I/O Pin on ...		
	Related RTI Block(s)	Ch/Bit (RTI)	Related RTLib Functions	Ch/Bit (RTLib)	DS1103	Sub-D Conn.	CP/CLP
Slave DSP Square-Wave Signal Measurement (F2D)							
■ TTL input voltage range ■ I/O circuit and further electrical characteristics: see *Slave DSP Bit I/O* on page 171							
SCAP1 *	DS1103SL_DSP_F2D	Ch 1	See *Square Wave Signal Generation (D2F)* (🕮 *DS1103 RTLib Reference*)	Ch 1	P2 77	P2B 30	CP31 2
SCAP2 *		Ch 2		Ch 2	P2 78	P2A 30	CP31 21
SCAP3 *		Ch 3		Ch 3	P2 79	P2B 14	CP31 3
SCAP4 *		Ch 4		Ch 4	P2 80	P2A 14	CP31 22
Slave DSP Serial Peripheral Interface (SPI)							
■ TTL voltage range ■ Output current range: ±13 mA ■ SSOMI: SPI slave out, master in ■ SSIMO: SPI slave in, master out ■ SSTE: SPI slave transmit enable ■ SSCLK: SPI clock ■ I/O circuit and further electrical characteristics: see *Slave DSP Bit I/O* on page 171							
SSOMI	–		See *Slave DSP Serial Peripheral Interface* (🕮 *DS1103 RTLib Reference*)		P2 88	P2A 48	CP31 34
SSIMO					P2 87	P2B 48	CP31 16
SSTE					P2 86	P2A 15	CP31 35
SCLK					P2 85	P2B 15	CP31 17
Slave DSP Serial Communication Interface (SCI) (RS232 mode)							
■ RS232 voltage range ■ SRXD (receive), STXD (transmit) ■ I/O circuit and further electrical characteristics: see *Slave DSP Bit I/O* on page 171							
SRXD	–		See *Slave DSP Serial Communication Interface* (🕮 *DS1103 RTLib Reference*)		P3 15	P3B 36	CP41 2
STXD					P3 13	P3B 3	CP41 3
Slave DSP Serial Communication Interface (SCI) (RS422 mode)							
■ RS422 voltage range ■ SRXD, $\overline{\text{SRXD}}$ (receive and inverted signal), STXD, $\overline{\text{STXD}}$ (transmit and inverted signal) ■ I/O circuit and further electrical characteristics: see *Slave DSP Bit I/O* on page 171							
SRXD	–		See *Slave DSP Serial Communication Interface* (🕮 *DS1103 RTLib Reference*)		P3 15	P3B 36	CP43 3
$\overline{\text{SRXD}}$					P3 16	P3A 36	CP43 4
STXD					P3 13	P3B 3	CP43 2
$\overline{\text{STXD}}$					P3 14	P3A 3	CP43 1

Signal	Channel/Bit Numbers of Related RTI Blocks/RTLib Functions				I/O Pin on …		
	Related RTI Block(s)	Ch/Bit (RTI)	Related RTLib Functions	Ch/Bit (RTLib)	DS1103	Sub-D Conn.	CP/CLP
CAN Support							
■ ISO11898 ■ CANL (CAN bus interface low), CANH (CAN bus interface high) ■ I/O circuit and further electrical characteristics: see *CAN Bus Interface* on page 193							
CANL CANH GND	■ RTICAN CONTROLLER SETUP ■ RTICANMM ControllerSetup		See *Slave MC Access Functions* (🕮 *DS1103 RTLib Reference*)		P3 85 P3 87 P3 83, 89	P3B 15 P3B 48 P3B 31, 32	CP38 2 CP38 7 CP38 3, CP38 5, CP38 6
User Interrupts							
■ TTL input voltage range ■ I/O circuit and further electrical characteristics: see *User Interrupt Inputs* on page 175							
$\overline{INT0}$	DS1103MASTER_HWINT_Ix	User int 1	See *Interrupt Handling* (🕮 *DS1103 RTLib Reference*)	Ext int 0	P2 91	P2B 16	CP30 46
$\overline{INT1}$		User int 2		Ext int 1	P2 92	P2A 16	CP30 47
$\overline{INT2}$		User int 3		Ext int 2	P2 93	P2B 49	CP30 48
$\overline{INT3}$		User int 4		Ext int 3	P2 94	P2A 49	CP30 49

GND pins

The following I/O pins provide GND potential:

Connector		Pin
DS1103		
Analog connector	P1	1, 2, 5, 6, 9, 10, 13, 14, 17, 18, 21, 22, 25, 26, 29, 30, 33, 34, 37, 38, 41 … 46, 49, 50, 53, 54, 57, 58, 61 … 66, 69, 70, 73, 74, 77, 78, 81, 82, 85, 86, 89, 90, 93, 94, 97, 98, 100
Digital connector	P2	1 … 4, 9, 10 ,15, 16, 21, 22, 27, 28, 33, 34, 39, 40, 45, 46, 51, 52, 57, 58, 63, 64, 74 … 76, 81, 82, 89, 90, 99, 100
Incremental encoder/ digital connector	P3	1, 2, 12, 27, 28, 35, 36, 43, 44, 51, 52, 59, 60, 67, 68, 75, 76, 83, 84, 86, 88 … 90, 99, 100
Sub-D connectors	P1A, P1B	1, 3, 5, 7, 8, 9, 11, 13, 15, 17, 18, 20, 22, 24, 26, 28, 30, 32, 35, 37, 39, 41, 43 … 45, 47, 49, 50 (only P1A)
	P2A, P2B	1, 13 (only P2A), 32, 34 … 44, 46, 47, 50
	P3A, P3B	1, 8, 12, 15 (only P3A), 19 (only P3A), 23, 27, 31, 32, 38, 42, 46, 48 (only P3A), 50
CP1103/CLP1103 Connector Panel		
BNC	CP1 … CP28	Shell
Slave ADC	CP29	1 … 19, 36
Digital I/O	CP30	17, 34 … 45

Connector		Pin
Slave I/O	CP31	1, 4, 6, 13, 15, 20, 25, 30, 37
Incremental encoder iInterface	CP32 … CP37, CP39	8, 10 … 15
CAN	CP38	3, 5, 6
UART RS232	CP40	5
Slave RS232	CP41	5
UART RS422	CP42	5
Slave RS422	CP43	5

GND of the DS1103 is internally connected to ground of the expansion box.

VCC pins

The following I/O pins provide access to the expansion box power supply VCC (5 V):

Connector		Pin
DS1103		
Digital connector	P2	■ VCC1: 95 … 98
Incremental encoder/ digital connector	P3	■ VCC2: 91 … 94 ■ VCC3: 95 … 98
Sub-D connectors	P2A, P2B	■ VCC1: 17, 33
	P3A, P3B	■ VCC2: 16, 49 ■ VCC3: 17, 33
CP1103/CLP1103 Connector Panel		
Digital I/O	CP30	50
Slave I/O	CP31	19
Incremental encoder interface	CP32 … CP37, CP39	1, 9

■ *DS1103 and Sub-D connector*

The DS1103 provides three VCC lines. The total load of every VCC line (VCC1, VCC2 or VCC3) must not exceed 0.5 A.

■ *CP1103/CLP1103 connector panels*

The VCC1, VCC2, and VCC3 line of the DS1103 are connected on the CP1103/CLP1103 and called VCC. The total load of all connector pins that provide access to the expansion box power supply must not exceed 1.5 A (CP1103) or 0.75 A (CLP1103).

Related topics

References

- *BNC Connectors (CP1 ... CP28)* on page 129
- *Incremental Encoder Interface Connectors (CP32 ... CP37, CP39)* on page 133
- *Master PPC UART RS422 Connector (CP42)* on page 137
- *Slave DSP UART RS232 Connector (CP41)* on page 136
- *Slave DSP UART RS422 Connector (CP43)* on page 137
- *Slave I/O Connector (CP31)* on page 132

Conflicting I/O Features

Types of I/O conflicts

There are I/O features that share the same board resources.

Conflicts concerning single I/O channels There are conflicts that concern single channels of an I/O feature. The dSPACE board provides only a limited number of I/O pins. The same pins can be shared by different I/O features. However, a pin can serve as the I/O channel for only one feature at a time.

Conflicts concerning an I/O feature as a whole There are conflicts that concern the use of an I/O feature as a whole. Suppose two I/O features of the dSPACE board use the same on-board timer device. In this case, only one of the two I/O features can be used at a time. The other feature is completely blocked.

Conflicts for the DS1103

The following I/O features of the DS1103 conflict with other I/O features:

- *Conflicts for the Serial Interface* on page 153
- see *Conflicts for Synchronizing I/O Features of the Master PPC* on page 153
- *Conflicts for the Slave DSP ADC Unit* on page 154
- *Conflicts for the Slave DSP Bit I/O Unit* on page 154
- *Conflicts for Slave DSP 1-Phase PWM Signal Generation (PWM)* on page 155
- *Conflicts for Slave DSP 3-Phase PWM Signal Generation (PWM3)* on page 156
- *Conflicts for Slave DSP Space Vector PWM Signal Generation (PWMSV)* on page 157
- *Conflicts for Slave DSP Square-Wave Signal Generation (D2F)* on page 157
- *Conflicts for Slave DSP PWM Signal Measurement (PWM2D)* on page 158
- *Conflicts for Slave DSP Square-Wave Signal Measurement (F2D)* on page 158

Conflicts for the Serial Interface

The master PPC of the DS1103 supports only one serial interface. It can be configured as either RS232 or RS422 transceiver.

Conflicts for Synchronizing I/O Features of the Master PPC

The following I/O features of the DS1103 conflict with the synchonizing I/O features of the master PPC.

Synchronizing I/O Features of the Master PPC *)		Signal	Conflicting I/O Feature **)		
Bit (RTI)	Bit (RTLib)			Ch (RTI)	Ch (RTLib)
		ST1PWM	■ Slave DSP PWM int ■ Slave DSP Bit I/O Unit		Group 2 bit 3
*) Related RTI blocks and RTLib functions: ■ DS1103SYNC_IO_SETUP DS1103MASTER_SYNCINT ■ See *Synchronous I/O Trigger* (🕮 *DS1103 RTLib Reference*)			**) Related RTI blocks and RTLib functions: Slave DSP PWM int: ■ DS1103SLAVE_PWMINT ■ See ds1103_slave_dsp_pwm3_int_init Slave DSP Bit I/O Unit: ■ DS1103SL_DSP_BIT_IN_Cx DS1103SL_DSP_BIT_OUT_Cx ■ See *Slave DSP Bit I/O Unit* (🕮 *DS1103 RTLib Reference*)		

Conflicts for the Slave DSP ADC Unit

The following I/O features of the DS1103 conflict with the Slave DSP ADC unit:

Slave DSP ADC Unit *)		Signal	Conflicting I/O Feature **)		
Ch (RTI)	**Ch (RTLib)**			**Ch (RTI)**	**Ch (RTLib)**
Conflicts Concerning Single Channels					
Ch 1	Ch 1	SADCH1	Slave DSP Bit I/O unit	Bit 0	Group 1, bit 0
Ch 2	Ch 2	SADCH2	Slave DSP Bit I/O unit	Bit 1	Group 1, bit 1
Ch 3	Ch 3	SADCH9	Slave DSP Bit I/O unit	Bit 3	Group 1, bit 3
Ch 4	Ch 4	SADCH10	Slave DSP Bit I/O unit	Bit 2	Group 1, bit 2
*) Related RTI blocks and RTLib functions: ■ DS1103SL_DSP_ADC_Cx ■ See *Slave DSP ADC Unit* (🕮 *DS1103 RTLib Reference*)			**) Related RTI blocks and RTLib functions: ■ DS1103SL_DSP_BIT_IN_Cx DS1103SL_DSP_BIT_OUT_Cx ■ See *Slave DSP Bit I/O Unit* (🕮 *DS1103 RTLib Reference*)		

Conflicts for the Slave DSP Bit I/O Unit

The following I/O features of the DS1103 conflict with the Slave DSP bit I/O unit:

Slave DSP Bit I/O Unit *)		Signal	Conflicting I/O Feature **)		
Bit (RTI)	**Bit (RTLib)**			**Ch (RTI)**	**Ch (RTLib)**
Conflicts Concerning Single Bits					
Bit 0	Group 1, bit 0	SADCH1	Slave DSP ADC unit	Ch 1	Ch 1
Bit 1	Group 1, bit 1	SADCH2	Slave DSP ADC unit	Ch 2	Ch 2
Bit 2	Group 1, bit 2	SADCH10	Slave DSP ADC unit	Ch 10	Ch 10
Bit 3	Group 1, bit 3	SADCH9	Slave DSP ADC unit	Ch 9	Ch 9
Bit 4	Group 2, bit 0	SPWM7	PWM	Ch 2	Ch 2
Bit 5	Group 2, bit 1	SPWM8	PWM	Ch 3	Ch 3
Bit 6	Group 2, bit 2	SPWM9	PWM	Ch 4	Ch 4
Bit 7	Group 2, bit 4	ST2PWM	■ PWM	■ Ch 1	■ Ch 1
			■ D2F	■ Ch 4	■ Ch 4
Bit 14	Group 3, bit 4	SCAP1	PWM2D/F2D	Ch 1	Ch 1
Bit 15	Group 3, bit 5	SCAP2	PWM2D/F2D	Ch 2	Ch 2
Bit 16	Group 3, bit 6	SCAP3	PWM2D/F2D	Ch 3	Ch 3
Bit 17	Group 3, bit 7	SCAP4	PWM2D/F2D	Ch 4	Ch 4

Slave DSP Bit I/O Unit *)		Signal	Conflicting I/O Feature **)		
Bit (RTI)	Bit (RTLib)			Ch (RTI)	Ch (RTLib)
	Group 2, bit 3	ST1PWM	■ Slave DSP PWM int ■ Synchronizing I/O Features of the Master PPC		
*) Related RTI blocks and RTLib functions: ■ DS1103SL_DSP_BIT_IN_Cx DS1103SL_DSP_BIT_OUT_Cx ■ See *Slave DSP Bit I/O Unit* (📖 *DS1103 RTLib Reference*)			**) Related RTI blocks and RTLib functions: Slave DSP ADC unit: ■ DS1103SL_DSP_BIT_IN_Cx DS1103SL_DSP_BIT_OUT_Cx ■ See *Slave DSP Bit I/O Unit* (📖 *DS1103 RTLib Reference*) PWM: ■ DS1103SL_DSP_PWM ■ See *Slave DSP PWM Generation* (📖 *DS1103 RTLib Reference*) D2F: ■ DS1103SL_DSP_D2F ■ See *Square Wave Signal Generation (D2F)* (📖 *DS1103 RTLib Reference*) PWM2D: ■ DS1103SL_DSP_PWM2D ■ See *Slave DSP PWM Measurement (PWM2D)* (📖 *DS1103 RTLib Reference*) F2D: ■ DS1103SL_DSP_F2D ■ See *Square Wave Signal Generation (D2F)* (📖 *DS1103 RTLib Reference*) Slave DSP PWM int: ■ DS1103SLAVE_PWMINT ■ See *ds1103_slave_dsp_pwm3_int_init* (📖 *DS1103 RTLib Reference*) Synchronizing I/O Features of the Master PPC: ■ DS1103SYNC_IO_SETUP DS1103MASTER_SYNCINT ■ See *Synchronous I/O Trigger* (📖 *DS1103 RTLib Reference*)		

Conflicts for Slave DSP 1-Phase PWM Signal Generation (PWM)

The following I/O features of the DS1103 conflict with Slave DSP 1-Phase PWM Signal Generation:

Slave DSP 1-Phase PWM Signal Generation (PWM) *)		Signal	Conflicting I/O Feature **)		
Ch (RTI)	Ch (RTLib)			Ch (RTI)	Ch (RTLib)
Conflicts Concerning Slave DSP 1-Phase PWM Signal Generation as a Whole					
■ If you use channel 4 of D2F, you cannot generate 1-phase PWM signals at the same time.					
Conflicts Concerning Single Channels					
Ch 1	Ch 1	ST2PWM	Slave DSP Bit I/O unit	Bit 7	Group 2, bit 4
Ch 2	Ch 2	SPWM7	Slave DSP Bit I/O unit	Bit 4	Group 2, bit 0
Ch 3	Ch 3	SPWM8	Slave DSP Bit I/O unit	Bit 5	Group 2, bit 1

Slave DSP 1-Phase PWM Signal Generation (PWM) *)		Signal	Conflicting I/O Feature **)		
Ch (RTI)	Ch (RTLib)			Ch (RTI)	Ch (RTLib)
Ch 4	Ch 4	SPWM9	Slave DSP Bit I/O unit	Bit 6	Group 2, bit 2
*) Related RTI blocks and RTLib functions: ■ DS1103SL_DSP_PWM ■ See *Slave DSP PWM Generation* (📖 *DS1103 RTLib Reference*)			**) Related RTI blocks and RTLib functions: D2F: ■ DS1103SL_DSP_D2F ■ See *Square Wave Signal Generation (D2F)* (📖 *DS1103 RTLib Reference*) Slave DSP Bit I/O Unit: ■ DS1103SL_DSP_BIT_IN_Cx DS1103SL_DSP_BIT_OUT_Cx ■ See *Slave DSP Bit I/O Unit* (📖 *DS1103 RTLib Reference*)		

Conflicts for Slave DSP 3-Phase PWM Signal Generation (PWM3)

The following I/O features of the DS1103 conflict with Slave DSP 3-Phase PWM Signal Generation:

Slave DSP 3-Phase PWM Signal Generation (PWM3) *)		Signal	Conflicting I/O Feature **)		
Ch (RTI)	Ch (RTLib)			Ch (RTI)	Ch (RTLib)
Conflicts Concerning Slave DSP 3-Phase PWM Signal Generation as a Whole					
■ If you perform space vector PWM signal generation (PWMSV) or square-wave signal generation (D2F), you cannot generate 3-phase PWM signals at the same time.					
*) Related RTI blocks and RTLib functions: ■ DS1103SL_DSP_PWM3 ■ See *Slave DSP PWM3 Generation* (📖 *DS1103 RTLib Reference*)			**) Related RTI blocks and RTLib functions: PWMSV: ■ DS1103SL_DSP_PWMSV ■ See *Slave DSP PWMSV Generation* (📖 *DS1103 RTLib Reference*) D2F: ■ DS1103SL_DSP_D2F ■ See *Square Wave Signal Generation (D2F)* (📖 *DS1103 RTLib Reference*)		

Conflicts for Slave DSP Space Vector PWM Signal Generation (PWMSV)

The following I/O features of the DS1103 conflict with Slave DSP Space Vector PWM Signal Generation:

Slave DSP Space Vector PWM Signal Generation (PWMSV) *)		Signal	Conflicting I/O Feature **)		
Ch (RTI)	**Ch (RTLib)**			**Ch (RTI)**	**Ch (RTLib)**
Conflicts Concerning Slave DSP 3-Phase PWM Signal Generation as a Whole					
■ If you perform 3-phase PWM signal generation (PWM3) or square-wave signal generation (D2F), you cannot generate space vector PWM signals at the same time.					
*) Related RTI blocks and RTLib functions: ■ DS1103SL_DSP_PWMSV ■ See *Slave DSP PWMSV Generation* (📖 *DS1103 RTLib Reference*)			**) Related RTI blocks and RTLib functions: 3-phase PWM signal generation (PWM3): ■ DS1103SL_DSP_PWM3 ■ See *Slave DSP PWM3 Generation* (📖 *DS1103 RTLib Reference*) D2F: ■ DS1103SL_DSP_D2F ■ See *Square Wave Signal Generation (D2F)* (📖 *DS1103 RTLib Reference*)		

Conflicts for Slave DSP Square-Wave Signal Generation (D2F)

The following I/O features of the DS1103 conflict with Slave DSP Square-Wave Signal Generation:

Slave DSP Square-Wave Signal Generation (D2F) *)		Signal	Conflicting I/O Feature **)		
Ch (RTI)	**Ch (RTLib)**			**Ch (RTI)**	**Ch (RTLib)**
Conflicts Concerning Slave DSP Square-Wave Signal Generation as a Whole					
■ If you perform 3-phase or space vector PWM signal generation (PWM3 or PWMSV), you cannot generate square-wave signals at the same time.					
Conflicts Concerning Single Channels					
Ch 4	Ch 4	ST2PWM	■ Slave DSP Bit I/O unit ■ PWM	■ Bit 7 ■ Ch 1	■ Group 2, bit 4 ■ Ch 1
*) Related RTI blocks and RTLib functions: ■ DS1103SL_DSP_D2F ■ See *Square Wave Signal Generation (D2F)* (📖 *DS1103 RTLib Reference*)			**) Related RTI blocks and RTLib functions: PWM3/PWMSV: ■ DS1103SL_DSP_PWM3 DS1103SL_DSP_PWMSV ■ See Slave DSP PWM3 Generation/*Slave DSP PWMSV Generation* (📖 *DS1103 RTLib Reference*) Slave DSP Bit I/O Unit: ■ DS1103SL_DSP_BIT_IN_Cx DS1103SL_DSP_BIT_OUT_Cx ■ See *Slave DSP Bit I/O Unit* (📖 *DS1103 RTLib Reference*) PWM: ■ DS1103SL_DSP_PWM ■ See *Slave DSP PWM Generation* (📖 *DS1103 RTLib Reference*)		

Conflicts for Slave DSP PWM Signal Measurement (PWM2D)

The following I/O features of the DS1103 conflict with Slave DSP PWM Signal Measurement:

Slave DSP PWM Signal Measurement (PWM2D) *)		Signal	Conflicting I/O Feature **)		
Ch (RTI)	**Ch (RTLib)**			**Ch (RTI)**	**Ch (RTLib)**
Conflicts Concerning Slave DSP PWM Signal Measurement as a Whole					
■ If you perform square-wave signal measurement (F2D), you cannot measure PWM signals at the same time.					
Conflicts Concerning Single Channels					
Ch 1	Ch 1	SCAP1	Slave DSP Bit I/O unit	Bit 14	Group 3, bit 4
Ch 2	Ch 2	SCAP2	Slave DSP Bit I/O unit	Bit 15	Group 3, bit 5
Ch 3	Ch 3	SCAP3	Slave DSP Bit I/O unit	Bit 16	Group 3, bit 6
Ch 4	Ch 4	SCAP4	Slave DSP Bit I/O unit	Bit 17	Group 3, bit 7
*) Related RTI blocks and RTLib functions: ■ DS1103SL_DSP_PWM2D ■ See *Slave DSP PWM Measurement (PWM2D)* (📖 *DS1103 RTLib Reference*)			**) Related RTI blocks and RTLib functions: F2D: ■ DS1103SL_DSP_F2D ■ See *Square Wave Signal Generation (D2F)* (📖 *DS1103 RTLib Reference*) Slave DSP Bit I/O Unit: ■ DS1103SL_DSP_BIT_IN_Cx DS1103SL_DSP_BIT_OUT_Cx ■ See *Slave DSP Bit I/O Unit* (📖 *DS1103 RTLib Reference*)		

Conflicts for Slave DSP Square-Wave Signal Measurement (F2D)

The following I/O features of the DS1103 conflict with Slave DSP Square-Wave Signal Measurement:

Slave DSP Square-Wave Signal Measurement (F2D) *)		Signal	Conflicting I/O Feature **)		
Ch (RTI)	**Ch (RTLib)**			**Ch (RTI)**	**Ch (RTLib)**
Conflicts Concerning Slave DSP Square-Wave Signal Measurement as a Whole					
■ If you perform PWM signal measurement (PWM2D), you cannot measure square-wave signals at the same time.					
Conflicts Concerning Single Channels					
Ch 1	Ch 1	SCAP1	Slave DSP Bit I/O unit	Bit 6	Group 3, bit 4
Ch 2	Ch 2	SCAP2	Slave DSP Bit I/O unit	Bit 7	Group 3, bit 5
Ch 3	Ch 3	SCAP3	Slave DSP Bit I/O unit	Bit 8	Group 3, bit 6

Slave DSP Square-Wave Signal Measurement (F2D) *)		Signal	Conflicting I/O Feature **)		
Ch (RTI)	**Ch (RTLib)**			**Ch (RTI)**	**Ch (RTLib)**
Ch 4	Ch 4	SCAP4	Slave DSP Bit I/O unit	Bit 9	Group 3, bit 7
*) Related RTI blocks and RTLib functions: ■ DS1103SL_DSP_F2D ■ See *Square Wave Signal Generation (D2F)* (🕮 *DS1103 RTLib Reference*)			**) Related RTI blocks and RTLib functions: PWM2D: ■ DS1103SL_DSP_PWM2D ■ See *Slave DSP PWM Measurement (PWM2D)* (🕮 *DS1103 RTLib Reference*) Slave DSP Bit I/O Unit: ■ DS1103SL_DSP_BIT_IN_Cx DS1103SL_DSP_BIT_OUT_Cx ■ See *Slave DSP Bit I/O Unit* (🕮 *DS1103 RTLib Reference*)		

Signal Connection to External Devices

Objective

This chapter provides descriptions of the on-board I/O circuits, lists important electrical characteristics and gives notes and tips on signal conditioning and signal connection to external devices.

The information given is sorted according to the I/O units of the DS1103.

Where to go from here

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Bit I/O	168
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User Interrupt Inputs	175
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Power Supply Outputs

Objective

The DS1103 provides three +5 V power supply output lines (*VCC1* … *VCC3*) internally connected to the host PC's 5 V supply voltage.

Electrical Characteristics

Objective

Each VCC line is protected against short circuits or overload by a multifuse on the DS1103.

Multifuse characteristics

If a power supply line is overloaded or short-circuited to ground, the corresponding multifuse heats up due to the overcurrent and abruptly raises its resistance. To reset the multifuse to its initial low resistance, turn off the power of the expansion box for a few minutes to allow the multifuse to cool down.

WARNING

Multifuses protect against occasional faults such as short circuits or overloads. They do not protect against repeated or continuous fault conditions, or conditions in which more than 13 V is present across a tripped multifuse. The multifuses are not suitable for failure simulation.

The total load on the connector pins providing access to VCC (power supply) must not exceed:

- 1.5 A (max. 0.5 A on each VCC line) without using a CP1103 or a CLP1103
- 1.5 A using a CP1103
- 0.75 A using a CLP1103

Analog Inputs

Objective

The DS1103 contains two different types of analog/digital converters (ADCs) for the analog input channels:

- Four ADCs with four multiplexed input signals each: *ADCH1 ... ADCH16*
- Four parallel (non-mulitplexed) ADCs with one input signal each: *ADCH17 ... ADCH20*

Where to go from here

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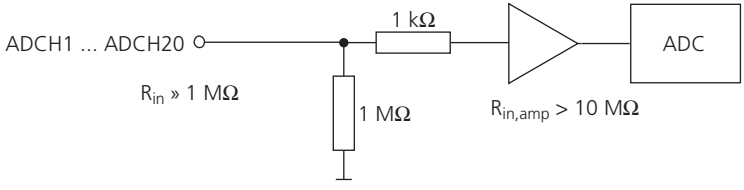
Information in other sections

Feature description	
ADC Unit (📖 *DS1103 Features*)	
Noise, crosstalk and inductive effects can degrade the signal and lead to incorrect results if you do not perform the following correctly.	
Grounding and Shielding Proper grounding and shielding reduces noise and inductive effects.	196
Reducing Crosstalk	200
Wiring Up External Devices	200

I/O Circuit and Electrical Characteristics

Input circuit

The following illustration is a simplified diagram of the input circuitry of the ADCs.



Electrical characteristics

The analog inputs are single-ended bipolar inputs with the following characteristics.

Parameter		Value	
		Min.	Max.
Input voltage		–10 V	+10 V
Overvoltage protection		–15 V	+15 V
Input resistance		Approx. 1 MΩ	
SNR (signal-to-noise ratio), as of board revision DS1103-09	16-bit muxed ADCs	> 83 dB	
	16-bit parallel ADCs	> 83 dB	
SNR (signal-to-noise ratio), up to board revision DS1103-07	16-bit muxed ADCs	> 80 dB	
	12-bit parallel ADCs	> 65 dB	
Power-up default		The behavior of inputs is not critical for connected devices.	

Analog Outputs

Objetive

The DS1103 provides a digital/analog converter (DAC) with eight parallel DAC channels. The analog output channels are called *DACH1 ... DACH8*.

Where to go from here

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Information in other sections

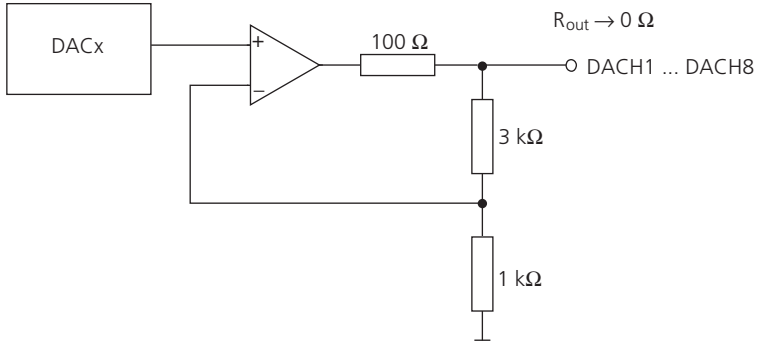
Feature description	
DAC Unit (📖 *DS1103 Features*)	
Noise, crosstalk and inductive effects can degrade the signal and lead to incorrect results if you do not perform the following correctly.	
Grounding and Shielding Proper grounding and shielding reduces noise and inductive effects.	196
Reducing Crosstalk	200
Wiring Up External Devices	200

I/O Circuit and Electrical Characteristics

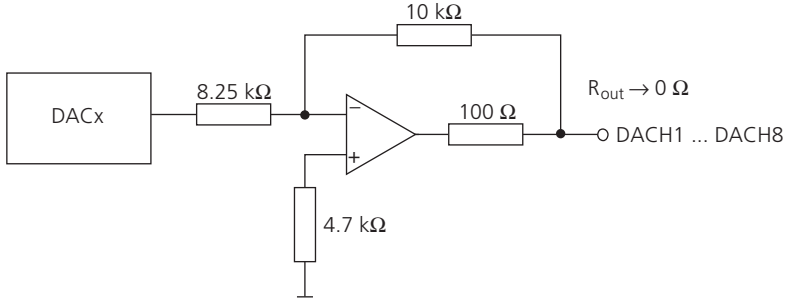
Output circuit

The following illustration is a simplified diagram of the output circuitry of the DACs.

Up to board revision DS1103-07



As of board revision DS1103-09



Electrical characteristics

The analog outputs are single-ended bipolar outputs with the following characteristics.

Parameter	Value	
	Min.	Max.
Output voltage	–10 V	+10 V
Output current		±5 mA
Output resistance	→ 0 Ω	

Parameter	Value
SNR (signal-to-noise ratio)	■ > 83 dB (as of DS1103-09) ■ > 78 dB (up to DS1103-07)
Power-up default	0 V

DAC outputs are low-impedance outputs.

Bit I/O

Objective

The DS1103 contains a bit I/O unit with 32 digital I/O pins called *IO0 ... IO31*. The I/O unit is organized in four 8-bit groups (bits 0 … 7, 8 … 15, 16 … 23, 24 … 31). Each group can be configured for input or output (programmable by software).

Where to go from here

Information in this section

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I/O Circuits and Electrical Characteristics	169
Changing Power-up Default	170

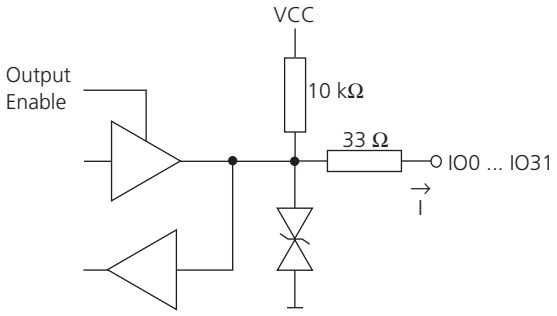
Information in other sections

Feature description	
Bit I/O Unit (📖 *DS1103 Features*)	
Noise, crosstalk and inductive effects can degrade the signal and lead to incorrect results if you do not perform the following correctly.	
Grounding and Shielding Proper grounding and shielding reduces noise and inductive effects.	196
Reducing Crosstalk	200
Wiring Up External Devices	200

I/O Circuits and Electrical Characteristics

I/O circuit

The following illustration is a simplified diagram of the input/output circuitry of the bit I/O.



All pins provide overvoltage protection circuits by using suppressor diodes. They short-circuit external voltage spikes above 6 V to ground.

Electrical characteristics

The bit I/O has TTL output/input levels with the following characteristics.

Parameter		Value	
		Min.	Max.
Input voltage	High	2.0 V	5.0 V
	Low	0 V	0.8 V
Output voltage	High	2.4 V	5.0 V
	Low	0 V	0.4 V
Output current			±10 mA
Input current [1)]			500 µA
Power-up default		All I/O channels are set to input mode and to a defined logical high level by the built-in 10 kΩ pull-up resistors.	

[1)] The current direction is shown in the circuit diagram above.

Changing Power-up Default

Default setting	After power-up the bit I/O unit is configured to input mode. In this case, the I/O pins have a defined logical high level because of the built-in 10 kΩ pull-up resistors.
Changing the setting	If you want to change the power-up default, you can set the I/O pins to a defined logical low level by connecting a 1 kΩ pull-down resistor from ground to each I/O pin.

Slave DSP Bit I/O

Objective

The slave DSP of the DS1103 provides I/O with the following pin names:

- Slave DSP Bit I/O Unit
  - *SADCH1*, *SADCH2*, *SADCH9*, *SADCH10*
  - *STMRDIR, STMRCLK, STINT1, STINT2, SPDPINT, SADCSOC, SXF, SBIO*
  - *SPWM7 ... SPWM9*
  - *ST1PWM ... ST3PWM*
  - *SCAP1 ... SCAP4*



Due to the board's limited number of I/O pins, the pins used to provide the slave DSP bit I/O signals are shared with other I/O signals of the slave DSP.

- Slave DSP ADC Unit
  - *SADCH1 ... SADCH16*
- Slave DSP Timing I/O Unit
  - *SPWM1 ... SPWM9*
  - *ST1PWM ... ST3PWM*
  - *SCAP1 ... SCAP4*
- Slave DSP Serial Peripheral Interface (SPI)
  - *SSOMI, SSIMO, SSTE, SSCLK*
- Slave DSP Serial Interface
  - *SRXD*, *STXD*, $\overline{SRXD}$, $\overline{STXD}$

Where to go from here

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Changing Power-up Default	174
Using the ST1PWM Pin	174

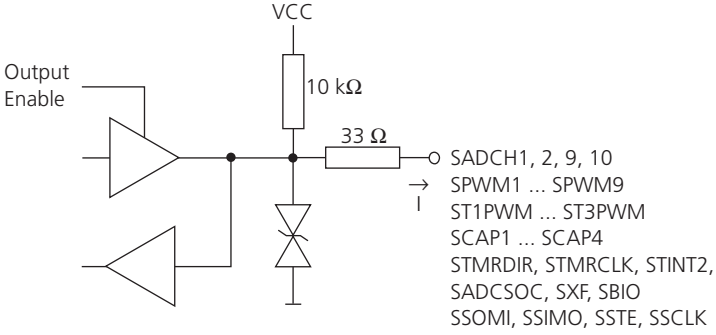
Information in other sections

Feature description	
Noise, crosstalk and inductive effects can degrade the signal and lead to incorrect results if you do not perform the following correctly.	
Grounding and Shielding Proper grounding and shielding reduces noise and inductive effects.	196
Reducing Crosstalk	200
Wiring Up External Devices	200

I/O Circuit and Electrical Characteristics

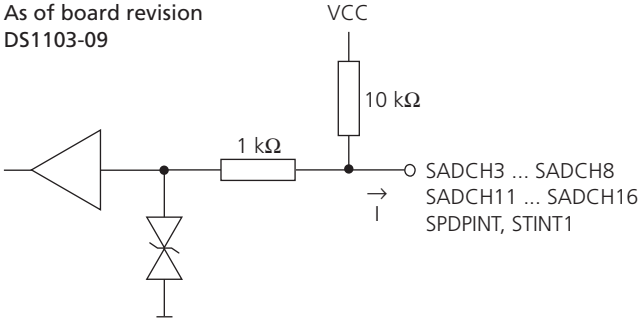
I/O circuit

The following illustrations are simplified diagrams of the input/output circuitry of the slave DSP I/O.



Up to board revision DS1103-07 the I/O circuit shown above is valid for all signals of the slave DSP I/O unit. As of board revision DS1103-09 the I/O circuit of some signals has changed (see below).

As of board revision DS1103-09



All pins provide overvoltage protection circuits by using suppressor diodes. They short-circuit external voltage spikes above 6 V to ground.

Electrical characteristics

The slave DSP I/O have output/input levels with the following characteristics.

Parameter		Value	
		Min.	Max.
ADC input voltage		0 V	+5.0 V
Input voltage	High	2.0 V	5.0 V
	Low	0 V	0.8 V
Output voltage	High	2.4 V	5.0 V
	Low	0 V	0.4 V
Output current			±13 mA
Input current [1)]			500 µA
Input resistance		10 kΩ pull-up to 5 V)	
Power-up default		All I/O channels are set to input mode and to a defined logical high level by the built-in 10 kΩ pull-up resistors.	

[1)] The current direction is shown in the circuit diagram above.

Changing Power-up Default

Default setting

After power-up the digital I/O are configured to input mode. In this case, the I/O pins have a defined logical high level because of the built-in pull-up resistors.

Changing the setting

If you want to change the power-up default, you can set the I/O pins to a defined logical low level by connecting a 1 kΩ pull-down resistor from ground to each I/O pin.

Using the ST1PWM Pin

Objective

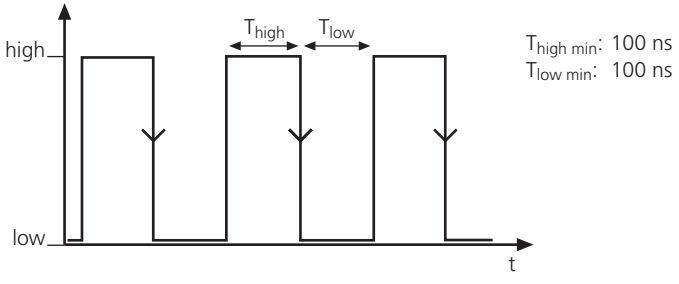
The ST1PWM pin is lead to the interrupt controller of the DS1103, so it is possible to generate interrupts that are synchronous to PWM signal generation. You can also use the pin as a further external interrupt input (user interrupt). In this case the ST1PWM pin has to be configured as an input (using RTLib1103).

Strobing I/O

As of board revision DS1103-09, you can use the ST1PWM pin also for strobing the I/O (ADCs, DACs and incremental encoder signals). The required trigger signal can be either generated by the slave DSP or driven externally. In the latter case the ST1PWM pin has to be configured as an input or the slave DSP must be in reset mode.

Recognizing signals at the ST1PWM pin

To allow the interrupt controller to recognize an incoming signal at the ST1PWM pin (PWM interrupt, external interrupt or trigger for strobing), the interrupt signal must be kept high for at least 100 ns. The interrupt is activated by the high to low transition of the signal. The signal must remain low for at least 100 ns after the transition.



User Interrupt Inputs

Objective

The DS1103 contains four external user interrupt inputs. The input channels are called *INT0* … *INT3*.

Where to go from here

Information in this section

Hardware details	
I/O Circuit and Electrical Characteristics	175
Recognizing User Interrupts	176

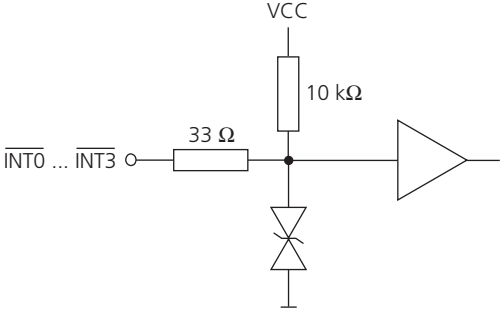
Information in other sections

Feature description	
User Interrupts (🕮 *DS1103 Features*)	
Noise, crosstalk and inductive effects can degrade the signal and lead to incorrect results if you do not perform the following correctly.	
Grounding and Shielding Proper grounding and shielding reduces noise and inductive effects.	196
Reducing Crosstalk	200
Wiring Up External Devices	200

I/O Circuit and Electrical Characteristics

Input circuit

The following illustration is a simplified diagram of the input circuitry of the user interrupt inputs.



All pins provide overvoltage protection circuits by using suppressor diodes. They short-circuit external voltage spikes above 6 V to ground.

Electrical characteristics

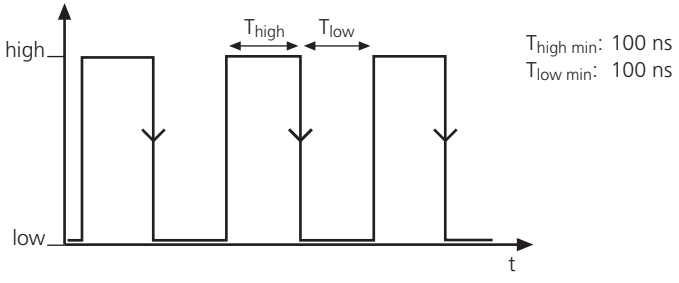
The interrupt inputs have TTL input levels with the following characteristics.

Parameter		Value	
		Min.	Max.
Input voltage	High	2.0 V	5.0 V
	Low	0 V	0.8 V
Power-up default		The inputs are set to a defined logical high level by the built-in 10 kΩ pull-up resistors.	

Recognizing User Interrupts

Requests for recognizing

To allow the interrupt controller to recognize incoming user interrupts, the input of the interrupts must be kept high for at least 100 ns. The interrupt is activated by the high to low transition of the signal. The signal must remain low for at least 100 ns after the transition.



Incremental Encoder Interface

Objective

The DS1103 provides a digital incremental encoder interface with input channels for seven incremental encoders. The pins which make up the inputs are called:

- *PHI0(1) … PHI0(7)*, $\overline{PHI0(1)}$ … $\overline{PHI0(7)}$
- *PHI90(1) … PHI90(7)*, $\overline{PHI90(1)}$ … $\overline{PHI90(7)}$
- *IDX(1) … IDX(7)*, $\overline{IDX(1)}$ … $\overline{IDX(7)}$

The incremental encoder interface supports:

- Six digital encoder channels (Ch1 …Ch6) providing single-ended TTL and differential RS422 signals (programmable by software).
- One analog encoder channel (Ch7) providing 1 V_{pp} or 11 μA_{pp} differential signals (programmable by software).



Ch6 and Ch7 are based on the TC3005H Tacho Controller. For detailed information on the TC3005H (for example the data sheet) contact dSPACE.

Where to go from here

Information in this section

Hardware details

Digital Encoder Interface: I/O Circuit and Electrical Characteristics 178

Analog Encoder Interface: I/O Circuit and Electrical Characteristics 179

Recognizing Encoder Index Interrupts 181

Connecting Encoders 182

Supplying Power to Encoders 186

Information in other sections

Feature description

Incremental Encoder Interface (📖 *DS1103 Features*)

Noise, crosstalk and inductive effects can degrade the signal and lead to incorrect results if you do not perform the following correctly.

Shielding 198
Provides notes on cabling and connecting the shield as well as further background information.

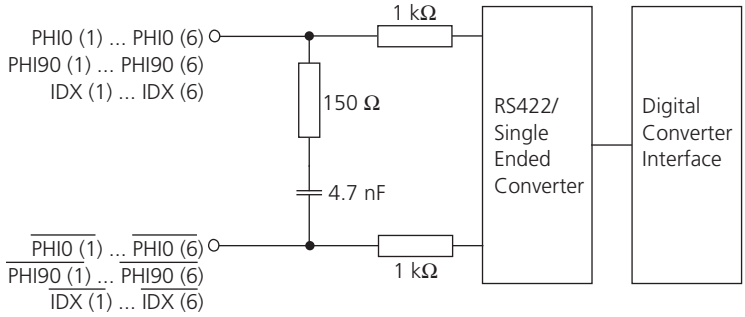
Digital Encoder Interface: I/O Circuit and Electrical Characteristics

Objective

The digital encoder interface (*Ch1* … *Ch6*) supports single-ended TTL and differential RS422 signals (programmable by software).

Input circuit

The following illustration is a simplified diagram of the input circuitry.



Electrical characteristics

The digital encoder interface (Ch1 … Ch6) supports single-ended TTL and differential RS422 signals with the following characteristics.

Parameter			Value	
RS422 differential mode	RS422 input voltage	High Low	Diff > +0.2 V Diff < –0.2 V ■ Diff = Voltage difference between inverted and non-inverted signal ■ The inverted and non-inverted signal must be in the range 0 … 5 V.	
	Input impedance		The input impedance gradually drops from 14 kΩ at DC to 210 Ω at the corner frequency of 225 kHz.	
TTL single-ended mode	TTL input voltage	High Low	Min. 2.0 V 0 V	Max. 5.0 V 0.8 V
	Input impedance		Approx. 14 kΩ	
Power-up default			The behavior of inputs is not critical for connected devices.	

Analog Encoder Interface: I/O Circuit and Electrical Characteristics

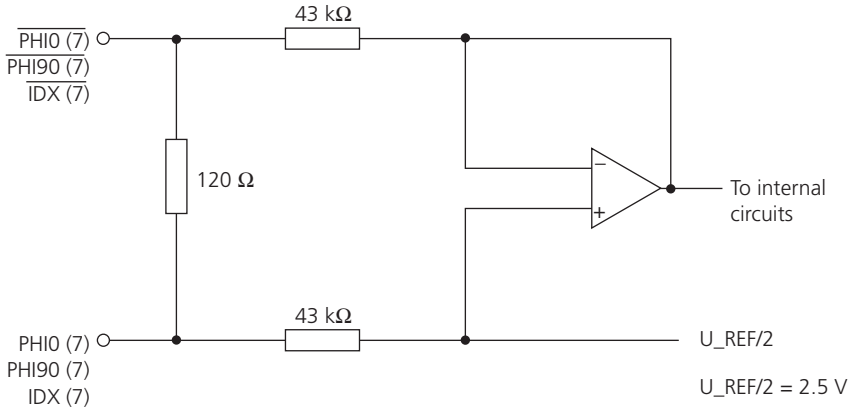
Objective

The analog encoder interface (*Ch7*) supports 1 V_{pp} or 11 μA_{pp} differential signals (programmable by software).

Input circuit

The input circuit depends on the selected signal type.

1 V_{pp} differential mode The following illustration shows a simplified diagram of the input channel circuitry when you select 1 V_{pp} differential mode for analog encoders.

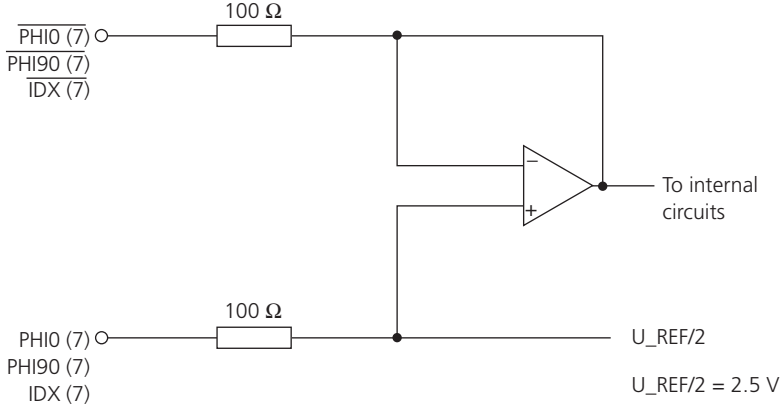


The input signals pass through a differential amplifier before the resulting difference is passed to further internal circuits.

The reference voltage U_REF/2 is used for centering the signals.

It is possible to provide single-ended 1 V_{pp} signals. For details on connecting the $\overline{\text{PHI0}}$, $\overline{\text{PHI90}}$ and $\overline{\text{INDEX}}$ lines, refer to *Encoder providing single-ended 1 V_{pp} signals* on page 184.

11 μA_{pp} differential mode The following illustration shows a simplified diagram of the input channel circuitry when you select 11 μA_{pp} differential mode for analog encoders.



The input signals pass through a differential amplifier before the resulting difference is passed to further internal circuits.

The reference voltage U_REF/2 is used for centering the signals.

Electrical characteristics

The analog encoder interface (Ch7) has the following input characteristics.

Parameter		Value
1 V_{pp} differential mode	Peak-to-peak input voltage	■ Min. 0.8 V_{pp} ■ Max. 1.2 V_{pp}
	Input impedance	120 Ω
	Voltage range for external mean voltage (V_{CM})	0 … 2.5 V
11 μA_{pp} differential mode	Peak-to-peak input current	■ Min. 7 μA_{pp} ■ Max. 16 μA_{pp}
	Input impedance	200 Ω
Power-up default		The behavior of inputs is not critical for connected devices.

Related topics

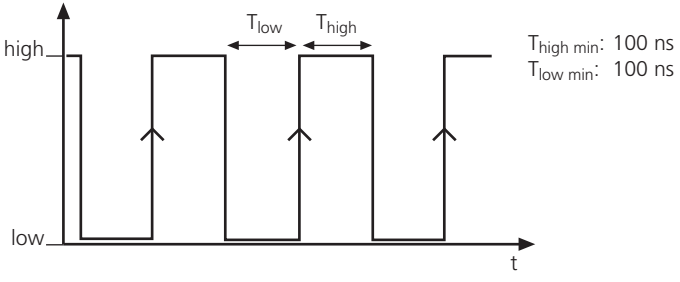
References

- *Encoder providing single-ended 1 V_{pp} signals* on page 184

Recognizing Encoder Index Interrupts

Request for recognizing

To allow the interrupt controller to recognize incoming index interrupts (IDX1 … IDX7), the input of the index interrupts must be kept low for at least 100 ns. The interrupt is activated by the low to high transition of the signal. The signal must remain high for at least 100 ns after the transition from low to high.



Connecting Encoders

Objective

The input and index signals of one encoder must use the same encoder channel of the DS1103. If you do not use all input channels, you do not have to connect any pins of the unused channels.

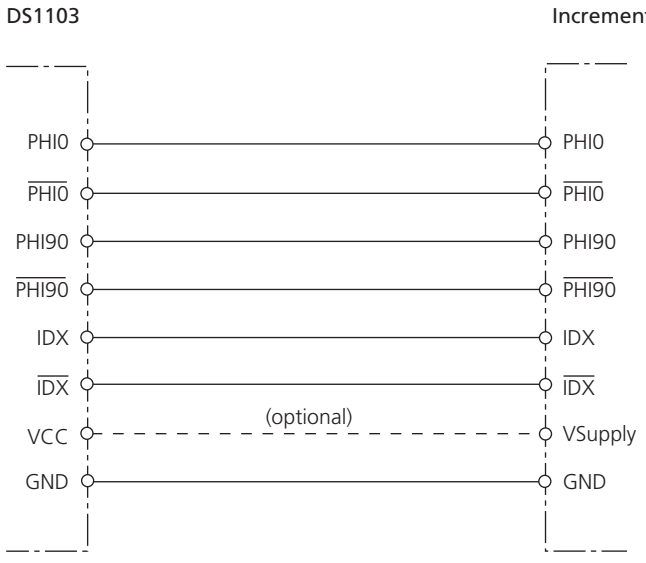
General

To allow proper operation, do not connect the outputs of your encoder to an AC-coupling network. The input signals must be DC signals. Otherwise, PHI0 and PHI90 would simultaneously be zero if your encoder stopped, which would falsify encoder line counting.

Encoder providing differential signals

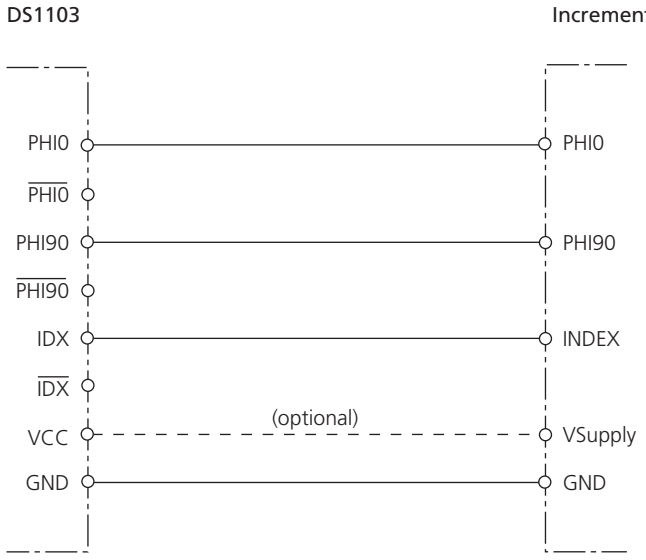
If your encoder provides differential signals (RS422, 1 V_{pp}, or 11 μA_{pp} signals), connect:

- The encoder output signals to the PHI0, PHI90 and IDX pins of the corresponding input channel.
- The inverted signals to the $\overline{\text{PHI0}}$, $\overline{\text{PHI90}}$ and $\overline{\text{IDX}}$ pins of the corresponding input channel.



Encoder providing single-ended TTL signals

If your encoder provides single-ended TTL signals, the inverted pins ($\overline{\text{PHI90}}$, $\overline{\text{PHI0}}$ and $\overline{\text{IDX}}$) must be left unconnected (see illustration below).



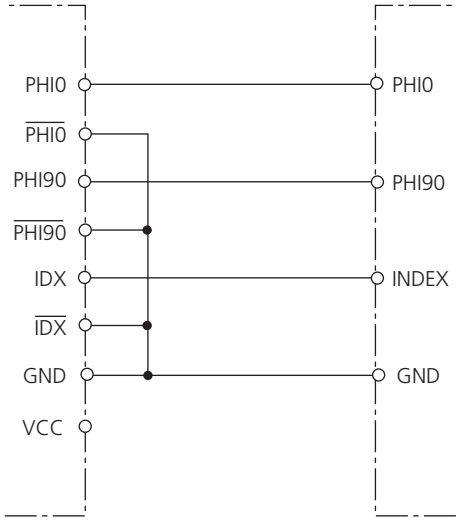
Encoder providing single-ended 1 V_{pp} signals

For single-ended 1 V_{pp} signals, the connection depends on the value of the mean voltage (V_{CM}) of the corresponding signals:

- If the mean voltage of the encoder signals is 0 V, you can connect pins $\overline{\text{PHI0}}$, $\overline{\text{PHI90}}$ and $\overline{\text{IDX}}$ to the GND pin (see example 1 below).
- If the mean voltage is not 0 V (0 V < V_{CM} < 2.5 V), you have to provide this voltage in the range 0 … 2.5 V yourself (see example 2 below).

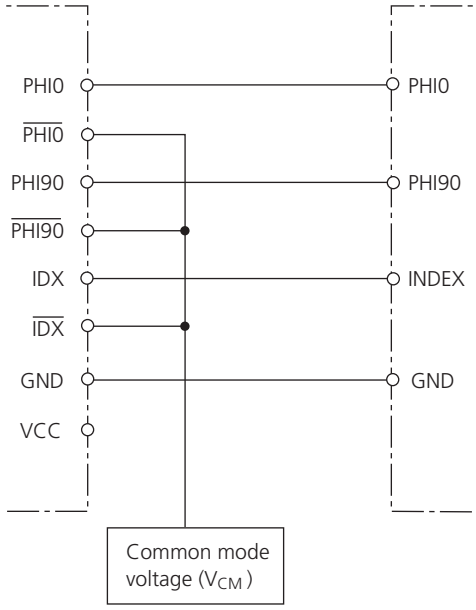
Example 1: DS1103 Incremental encoder

V_{CM} = 0 V



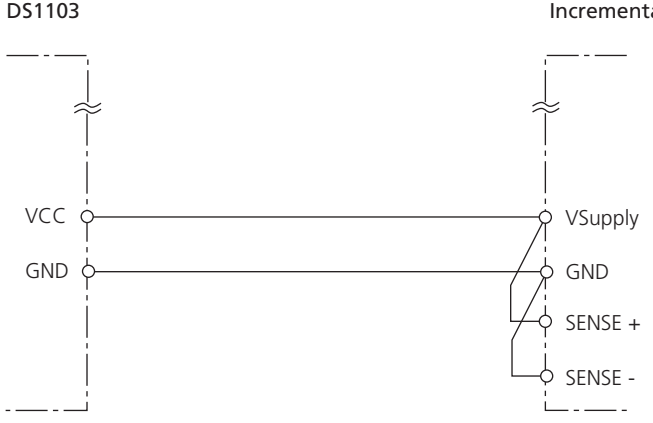
Example 2:

$0 V < V_{CM} < 2.5 V$



Encoder providing SENSE lines

If your encoder has sense lines, connect SENSE+ to Vsupply and SENSE– to GND. Connect the sense lines directly within the connector of the encoder (see illustration below).



Encoder without index signal

You can leave the IDX and IDX pins unconnected if your encoder does not provide an index signal. In this case, you cannot use RTLib functions or RTI blocks that require an index signal.

Supplying Power to Encoders

Using power from the DS1103

The DS1103 offers three power supply outputs (VCC pins). You should use these supply voltages for all connected incremental encoders.

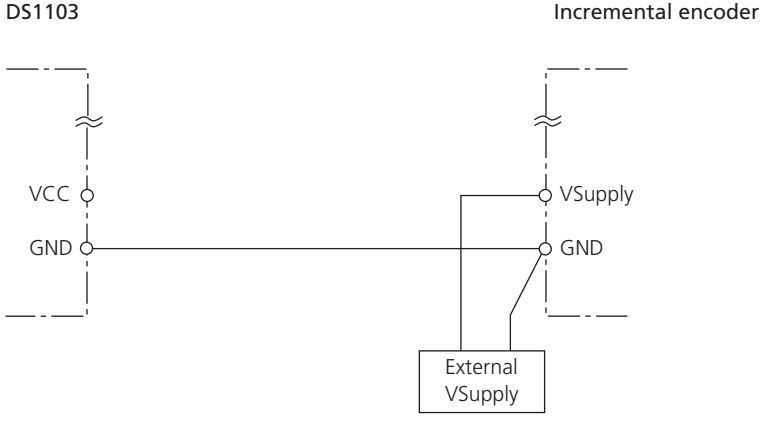
Connect all VCC pins so that the current is shared evenly by all pins. Use wires of sufficient diameter to avoid voltage drops. This does not apply if you use connector panels to connect your encoder(s) to the board since the VCC pins are internally connected at the connector panels.

For more details on the VCC outputs, refer to *Power Supply Outputs* on page 162.

Using an external power supply

If the encoder's supply requirements cannot be met by the DS1103, an external supply voltage must be used. In this case:

- You have to guarantee that no input voltages are fed to the DS1103 while it is switched off
- You have to connect the encoder's ground line to a ground pin of the board (see example below)



Serial Interface

Objective

The DS1103 contains a Universal Asynchronous Receiver and Transmitter (UART) to perform communication with external devices. The DS1103 allows you to use the serial interface in the RS232 or RS422 mode.

Signal names are dependent on the mode used. They are in accordance with the published specifications.

Where to go from here

Information in this section

Hardware details

I/O Circuit and Electrical Characteristics 188
Connecting RS232 Devices 189
Connecting RS422 Devices 191

Information in other sections

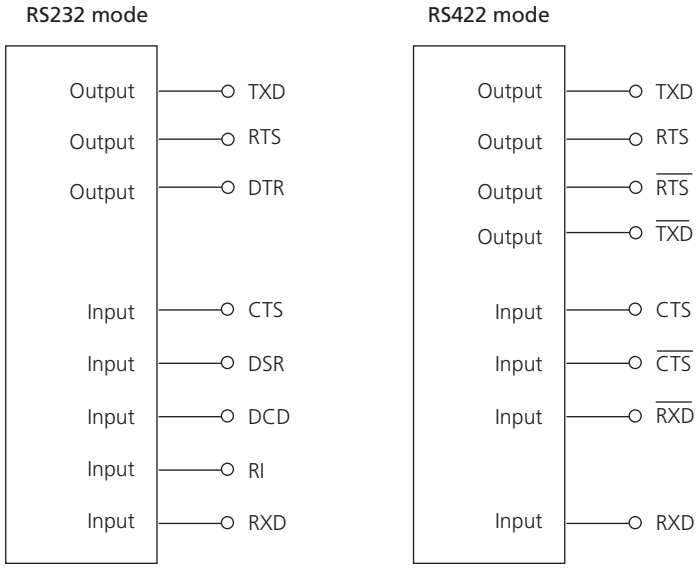
Feature description

Serial Interface (📖 *DS1103 Features*)
The board contains a universal asynchronous receiver and transmitter (UART) to communicate with external devices.

I/O Circuit and Electrical Characteristics

I/O circuit

The following illustration shows a simplified diagram of the I/O circuitry with the signal names dependent on the mode used.



Electrical characteristics

Serial communication is performed by a Texas Instruments TL16C550C single UART (Universal Asynchronous Receiver Transmitter). Complete modem control capability is included. The channels are RS232/RS422 compatible. For specifications refer to the TL16C550C data sheet (available at http://www.ti.com).

The electrical characteristics (signal levels, driver currents etc.) of the serial interface comply with the published electrical specifications for RS232 and RS422. In addition, the board has the following characteristics:

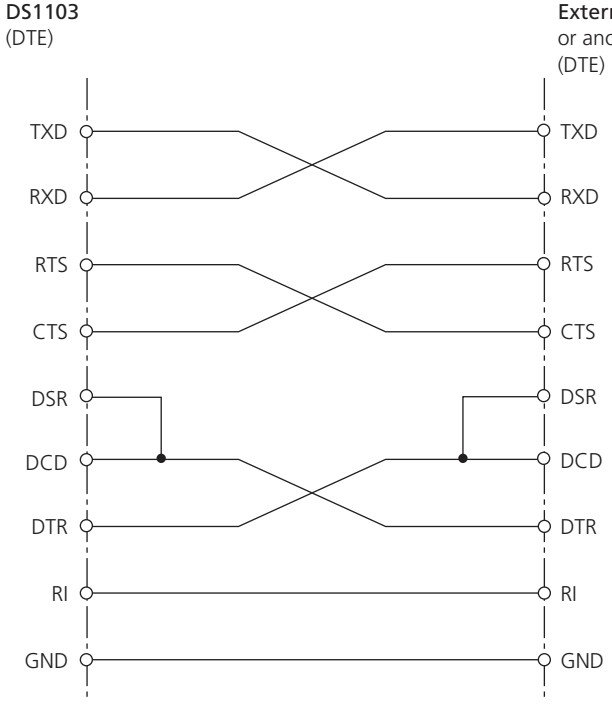
Parameter	Value
Baud rate	■ Up to 115.2 kBd (RS232) ■ Up to 1 MBd (RS422)
Power-up default	The UART is reset.

Connecting RS232 Devices

Guidelines

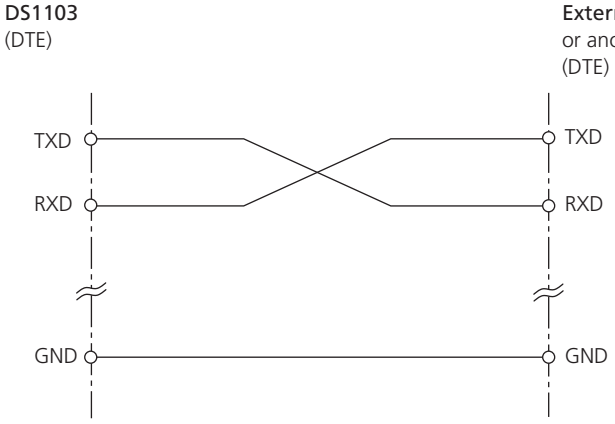
If you want to connect two DTE devices (data terminal equipment, such as a PC), you have to cross-connect the data lines and the handshake lines of the two RS232 devices.

To do this, connect the pins of the devices as shown below. This method is known as 'null modem cabling'.



DTE: data terminal equipment

If no handshaking is required or if handshaking is done by software the handshake lines can be left unconnected. In this case you can use the following wiring scheme.



DTE: data terminal equipment

You can use a null modem cable to communicate from one serial port to another.

Background information

The RS232 specification mainly involves connecting a DTE (data terminal equipment, such as a PC) directly to a DCE (data communications equipment, such as a modem) and vice versa. The pinouts are defined so that cabling is simple: You can connect a PC to a modem by wiring pin 1 to pin 1, pin 2 to pin 2, and so on. This method is called 'straight-through cabling'.

If two DTE devices are wired together using a straight-through cable, one transmitter (TXD) is connected to the other transmitter, and one receiver (RXD) is connected to the other receiver. In this setup no transmission can occur. You must therefore use a cabling scheme that connects the transmitter of one device to the receiver of the other device and vice versa (= null modem cabling).

Connecting RS422 Devices

Objective

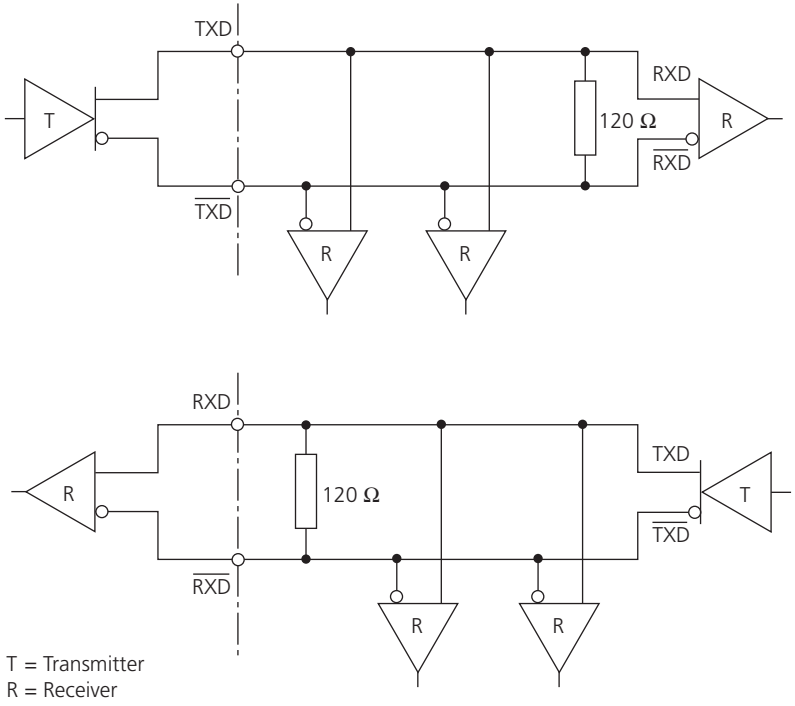
To use the serial interface in the RS422 mode you have to connect the pins of the devices as shown in the illustration below.

For proper operation of the serial interface (UART) you have to pay attention to *line termination* and *grounding*.

Line termination

In RS422 mode, line termination is essential, especially for faster data transfer rates and long cables. Because RS422 allows only one transmitter on the bus, the termination resistor (120 Ω) must be placed at the end of the cable near the last receiver between RXD and $\overline{\text{RXD}}$.

DS1103 (RS422 mode)

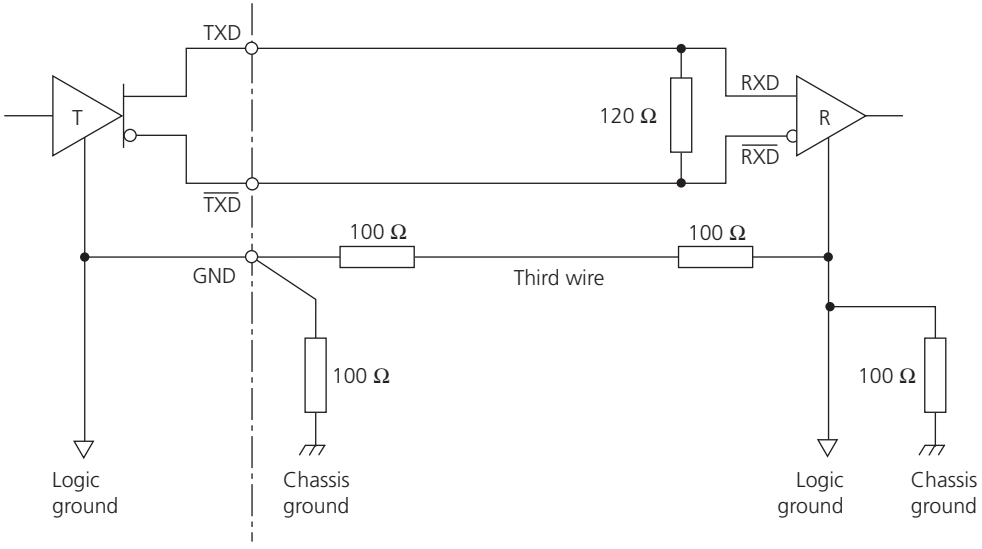


Ground connection

For correct operation of the transmitter and the receiver, a return signal path between the grounding of the individual devices is required. This can be realized by a third wire. Resistors should be connected in series to limit unwanted high currents resulting from ground potential differences.

The following illustration shows the grounding arrangement in an RS422 network.

DS1103 (RS422 mode)



T = Transmitter
R = Receiver

CAN Bus Interface

Objective

The CAN bus lines carry the signals:

- *CANL*: CAN_L bus line dominant low for the CAN channels
- *CANH*: CAN_H bus line dominant high for the CAN channels

Where to go from here

Information in this section

Hardware details
I/O Circuit and Electrical Characteristics 193
Connecting CAN Devices 194

Information in other sections

Feature description
CAN Support (📖 *DS1103 Features*)
The board has a CAN interface to communicate with CAN devices.

I/O Circuit and Electrical Characteristics

Electrical Characteristics

The CAN interface is based on the Siemens SAB 80C164 micro controller. For specifications refer to the SAB 80C164 data sheet (available at http://www.siemens.com).

The CAN bus lines have input/output levels in accordance with the published electrical specifications for the CAN High-Speed standard (ISO 11898-2).

Parameter			Value		
Output voltage	TX1-TX0	State	V_{CAN_H}	V_{CAN_L}	$V_{Diff_(H-L)}$
	> 0	Recessive	+2.5 V	+2.5 V	–0.5 V – +0.05 V
	< 0	Dominant	+3.5 V	+1.0 V	+1.5 V – +3.0 V
Clock frequency			10 MHz … 20 MHz		
Baud rate			Max. 1 Mbit/s		
Power-up default			■ The CAN controller is reset. ■ During power-up the CAN controller runs with 12.59 MHz clock frequency.		

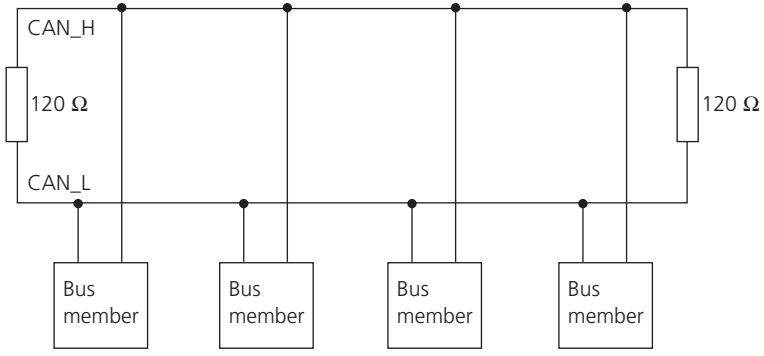
Connecting CAN Devices

Objective

For proper operation of the CAN interface you have to pay attention to line termination, the max. number of nodes connected to a CAN network and the cabling.

Line termination

A CAN network, according to ISO 11898-2 (high-speed CAN), must be terminated with a resistor at both ends of the cable.



- The DS1103 is not equipped with a terminator.
- If you do not terminate the CAN network:
  - Each signal change on the line causes reflections.
  - The minimum load requirements for the CAN transceivers are not met.

  Both may cause communication failures.

Max. number of nodes

To guarantee optimal signal quality the max. number of nodes in the CAN network should not exceed 110.

Cabling

The CAN devices should be connected using twisted-pair cable. The cable should meet the physical requirements specified in the ISO DIS 11898-2 CAN High-Speed standard.

The allowable cable length is affected by the characteristics of the cable and the desired baud rate. For detailed cable length recommendations, refer also to the above-mentioned CAN standard.

General Notes and Tips on Signal Conditioning

Where to go from here

Information in this section

Grounding and Shielding Proper grounding and shielding reduces noise and inductive effects.	196
Avoiding Noise and Crosstalk Noise and/or crosstalk can be reduced and maybe avoided.	200
ADC Performance of dSPACE Boards When you are sampling an unconnected A/D input, you are looking at a noisy signal traced in ControlDesk 3.x or ControlDesk Next Generation. This may give the impression that the performance of the A/D sections of dSPACE boards is poor. This chapter gives an explanation of this incorrect impression and further background information (definition of SNR, measuring noise).	202
Notes on Using AutoBox If you install your dSPACE boards in the AutoBox or Tandem-AutoBox you should (in addition) consider the notes given here.	204

Grounding and Shielding

Objective

Proper grounding and shielding reduces noise and inductive effects.



The advice given here also applies to the cabling of the devices inside your test bench. It is better to eliminate the cause, than to reduce the effects.

Where to go from here

Information in this section

Definitions of Different Ground Signals There are often different terms for ground signals which are often mixed up.	197
Grounding Signals Provides notes on cabling and connecting ground lines as well as further background information.	197
Shielding Provides notes on cabling and connecting the shield as well as further background information.	198

Information in other sections

Influences on Board Performance Using AutoBox/Tandem-AutoBox To handle the voltages and currents from a car battery, the boxes are supplied with a special power supply. If noise seems to be a problem for your dSPACE boards installed in the AutoBox/Tandem-AutoBox, you should consider the information in this chapter.	206

Definitions of Different Ground Signals

Terms and their definitions

There are four classes of signals often referred to as ground signals, i.e. signal return, power ground and shield. To achieve the best results regarding signal quality, noise rejection and EMC behavior, these different ground signals must not be mixed.

- A *signal return line* is the reference potential of a signal. It should carry the same current as the corresponding signal line, and this current should be kept small.
- *Power supply ground* is the return path for the supply voltage. It carries large and varying currents resulting in significant (AC) voltage drops along the cable. Never use the same wire for signal return and power supply ground.
- *Shield* is a barrier to keep in everything inside and keep out everything outside. It is usually connected to the device enclosures at both ends to form a closed cage around all signals and cards. It is not necessarily connected to power ground.
- *Protective earth (PE)* is a reference point, which has the same potential as the surrounding earth. Connections to protective earth are intended for safety purposes.

Grounding Signals

General

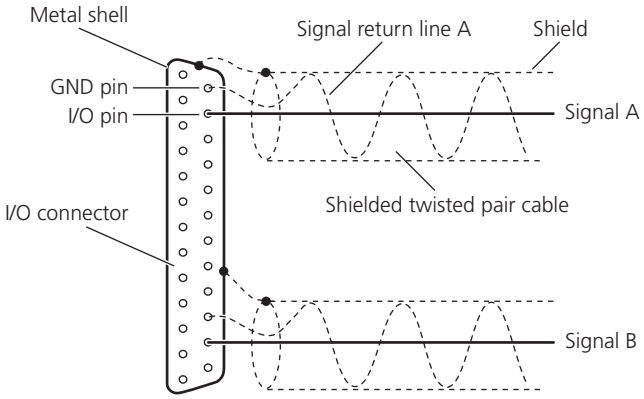
Do not use a ground line for more than one purpose. A grounding scheme has to be evaluated based on its AC current flow and not on its DC behavior. The DC resistance of a cable has only minor impact. Cable inductance plays a major role.

Avoiding ground loops and ground bounces

To avoid ground loops and ground bounces, use separate signal return (ground) lines for all connected sensors and actuators.

Each signal should have its own return line. The best results can be achieved with a shielded twisted pair cable. A twisted pair cable has the lowest inductance.

On the sensor/actuator side, connect one of the twisted wires to the signal and the other one to ground. On the board side, connect the first wire to the input/output and the second one to ground. The shield should be connected to the housing of the sensor/actuator and to the metal shell of the board connector. Do not connect the shield to ground anywhere.



If not enough ground pins are available at the connector, several return lines can be attached to a common ground pin. However, this common ground lead should be kept as short as possible to reduce ground line inductance.

If a cable contains unused leads, connect them to signal return (ground) lines at both ends to lower the inductance of the ground path between the dSPACE system and the sensor/actuator.

Star ground configuration

In a star ground configuration, ground loops are of no concern, if the signal return (ground) lines within the external devices are not connected to protective ground.

Always connect all signal return (ground) lines at both ends of a cable, i.e. board connector and sensor/actuator.

Shielding

General

The best shield is a low-inductance conductive barrier surrounding the complete setup of the device, cable and system, keeping in everything inside and keeping out everything outside (faraday cage). Low resistance, and most especially low inductance, are the key to a good shield.

EMC radiation and immunity are mostly affected by the outer cable shield. Individual lead shielding has only a minor effect if a common outer shield is present. Individual shielding is only necessary to reduce crosstalk.

Cabling

For cabling you should use shielded, twisted pair cables. The inner twisted-pair leads are used for the signal line and the return line (ground line). The return line should be connected to the ground pins of the respective board connector.

Ideally, each signal should be twisted with its return line so that any electromagnetic fields cancel one another.

Using the encoder interface with differential signals, the PHI90 line should be twisted with $\overline{\text{PHI90}}$, PHI0 with $\overline{\text{PHI0}}$ et cetera.

Connecting shield to the dSPACE system

Use a metal shell connector to the dSPACE board connector and connect the shield to the connector shell so that shield, connector shell and system enclosure form a closed shield surrounding all electronics. Use a large area connection and avoid pigtails.



Do not connect the shield to the GND pins of the dSPACE system.

Connecting shield to the external device

At the other end, the shield should be connected directly to the sensor/actuator housing. Sometimes sensors and actuators have dedicated shield pins available at their connector. The idea is to form one closed shielding cage consisting of the cable shield and sensor/actuator enclosure, which is ideally nowhere connected to signal ground. Use a large area connection and avoid pigtails.

Avoiding Noise and Crosstalk

Objective

Noise and/or crosstalk can be reduced and maybe avoided by the measures listed below.

Where to go from here

Information in this section

Reducing Crosstalk	200
Wiring Up External Devices	200

Reducing Crosstalk

Measures

Crosstalk occurs if a signal with steep edges runs close to a high impedance analog signal. The main reason for crosstalk is inductive coupling. It can be reduced by the following measures:

- Twist each signal line with its return line (ground).
- Never twist two signal lines.
- Separate digital and analog signal lines. Keep fast-changing signals far away from analog inputs.
- Avoid connecting high-impedance sources to the inputs of the dSPACE boards.
- If you use multiconductor cables, the individual twisted pairs should be shielded.
- You should also note the advice in *Wiring Up External Devices* on page 200.

Wiring Up External Devices

Objective

Noise and/or crosstalk can be reduced and maybe avoided by the following measures.

Using connector panels	■ Do not use a connector panel in areas of strong electromagnetic radiation. Note that a ribbon cable may pick up some of this radiation. ■ If optimum signal quality is a must, avoid using connector panels. Connect your external devices to the board connectors directly.
Using BNC cables	■ If your dSPACE hardware offers BNC cables: If noise is a problem, avoid the use of BNC connectors. BNC connectors use the outside of the connector for ground. They do not permit shielding. ■ To avoid poor signal performance, do not create ground loops within the BNC wiring.
Cabling	■ Use connections as short as possible between your test bench and the dSPACE board. ■ Keep cabling away from noise sources. ■ Separate signal lines from high-current or high-voltage lines. These lines are capable of inducing currents on the signal lines if they run parallel and close to them. To reduce the magnetic coupling between lines, separate them by a reasonable distance if they run in parallel, or run the lines at right angles to each other. ■ Do not route signal lines through conduits that also contain power lines. ■ Protect signal lines from magnetic fields caused by devices such as monitors, electric motors, welding equipment, transformers, and so on, by running these through special metal conduits.

ADC Performance of dSPACE Boards

Objective

We are frequently contacted because of the "poor" performance of the A/D sections of our boards. This is usually derived from looking at the noisy signal traced in ControlDesk 3.x or ControlDesk Next Generation when sampling an unconnected A/D input or an A/D input shorted to ground. However, this has nothing to do with the definition of the SNR (signal-to-noise-ratio) we publish in the data sheets of our boards.

A common misunderstanding is that theoretical maximum values of ideal ADCs are expected from real-world components in real-world board designs, even inside PC environments. This is impossible. A 16-bit ADC, for example, never has an effective number of bits equal to 16.

The A/D section of every dSPACE board is FFT (Fast Fourier Transform) tested during production so that we can guarantee the published data sheet values for every board. For 16-bit ADCs we typically achieve an SNR of 78 … 82 dB depending on the board type. This corresponds to an effective number of bits of about 12.5 … 13. This is the best that can be achieved in typical PC environments.

For background information, refer to:

- The following chapters
- "Noise Reduction Techniques in Electronic Systems" by Henry W. Ott, John Wiley & Sons, Inc.

Where to go from here

Information in this section

Definition of SNR	202
Notes on Measuring Noise	203

Definition of SNR

Objective

SNR (signal-to-noise-ratio) is defined as a true rms (root mean square) ratio between the input signal and the noise. SNR is usually expressed in dB.

Calculation of SNR

The SNR for a sinusoidal input signal can be described as:

$$\mathrm{SNR} = 20 \cdot \log \frac{\text{signal (rms)}}{\text{noise (rms)}} \mathrm{dB}$$

An application note from the well-known ADC manufacturer MAXIM describes the formula used and explains how the SNR parameter correlates with ADC performance: *Defining and Testing Dynamic Parameters in High-Speed ADCs, Part 1*. It is available at http://www.maxim-ic.com/appnotes.cfm/appnote_number/728.

Notes on calculation of SNR

Often the peak-to-peak values of the signal and the noise are mistakenly taken to calculate the SNR with the formula shown above. However, this results in much lower performance than the A/D converter really obtains. While the rms value of a sine wave can be obtained by dividing its peak-to-peak value by 2.828, the peak-to-peak value of a noise signal must be divided by approximately 6 … 8 to obtain its rms value (occasional extreme peaks must be ignored using this equation). Furthermore, the peak-to peak noise theoretically might be ±10 V (even if the inputs are shorted) without decreasing the SNR, assuming that such high peaks appear rarely enough.

Notes on Measuring Noise

Objective

It is often claimed that the noisy signal measured with the dSPACE board looks much better when measured with an oscilloscope.

Reason

The reason is that you are using the wrong "voltage range" for the dSPACE system!

dSPACE boards have an input range of ±10 V and you are looking at signals with a voltage range of a few mV. That is similar to using a ruler to measure 1/1,000 inches.

Measures

When you use your oscilloscope, you select an appropriate voltage range for the signal you are watching. You should do the same with the dSPACE system: You should adapt your input signal to the ±10 V scale of the dSPACE board before converting it. Use external amplifiers to ensure that the maximum amplitude range of the signal to be measured is mapped to the full scale range of the ADC, which is usually ±10 V.

Notes on Using AutoBox

Objective

AutoBox and Tandem-AutoBox are designed for in-vehicle experiments.

Where to go from here

Information in this section

Grounding Scheme for AutoBox/Tandem AutoBox Provides notes on connecting ground.	204
Influences on Board Performance Using AutoBox/Tandem-AutoBox To handle the voltages and currents from a car battery, the boxes are supplied with a special power supply. If noise seems to be a problem for your dSPACE boards installed in the AutoBox/Tandem-AutoBox, you should consider the information in this chapter.	206
Filter Circuit for AutoBox/Tandem-AutoBox Power Supply In special cases (mainly, if cabling and grounding is not performed properly) the AutoBox power supply can cause conducted interferences to other electronics installed in the car. However, only electronics that are sensitive to conductive interferences (like measuring amplifiers) are affected. A filter circuit at the AutoBox power input can reduce these interferences.	207

Grounding Scheme for AutoBox/Tandem AutoBox

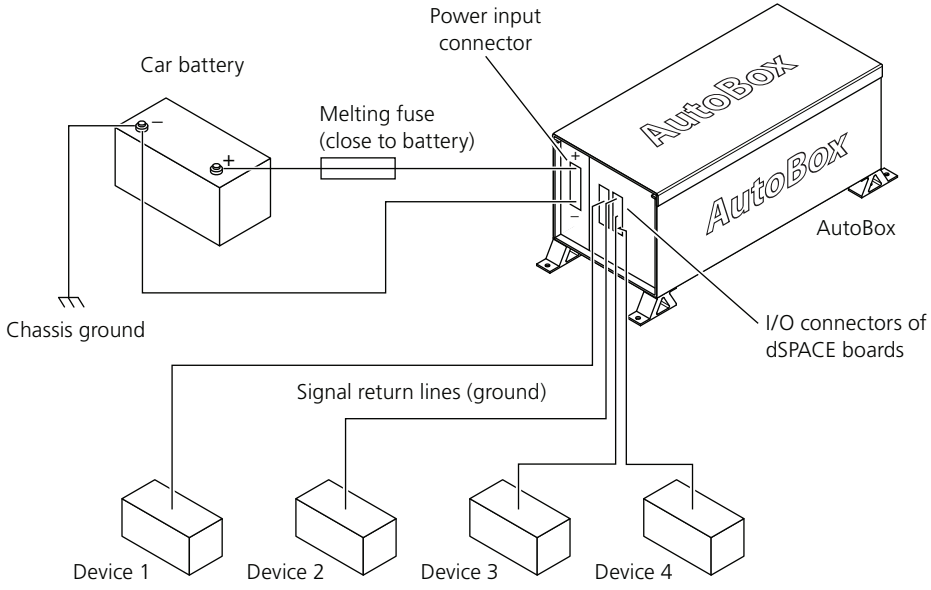
Guidelines

The AutoBox/Tandem-AutoBox should be made the center of the ground star.

The power supply should be routed by two twisted or parallel, large diameter wires from car battery to the AutoBox power input connector.

All sensor/actuator signal return (ground) lines should:

- Be connected to the ground pins of their board connectors.
- Not be connected to car battery ground (chassis ground) at their mounting positions.
- Not use common signal return lines.



Avoid any currents on the signal return line caused by sources other than the signal line. Currents on the signal line and the signal return line should ideally cancel each other out.

The signal return (ground) lines of the dSPACE boards are connected to ground of the backplane, which is isolated from car battery ground.

Influences on Board Performance Using AutoBox/Tandem-AutoBox

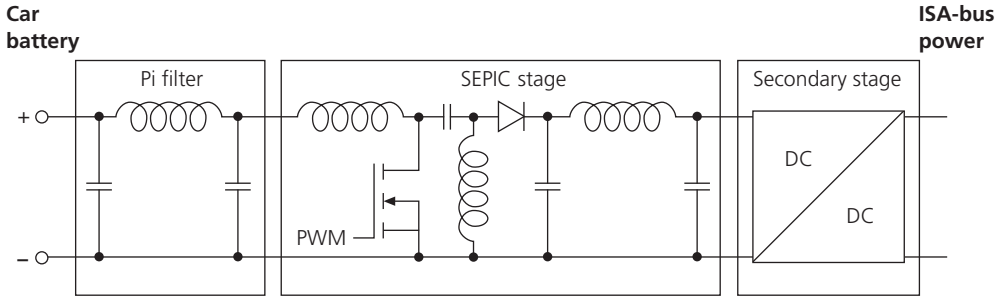
Objective

Starting from the description of the design of the AutoBox/Tandem-AutoBox power supply, power supply's influence on the I/O board performance is explained.

> The guidelines below apply to AutoBox through Version 3.0 and Tandem-AutoBox through Version 4.0. They are not relevant for later versions.

Design of AutoBox/Tandem-AutoBox power supply

The picture below shows a block diagram of the AutoBox/Tandem-AutoBox power supply. It is a two-stage switched mode supply. The first stage is a SEPIC converter translating the 8 V … 60 V input voltage range from the car battery into a constant 24 V for the following push-pull converter stages. These stages perform the galvanic isolation and provide the +5 V and ±12 V for the ISA bus, i.e. for the dSPACE boards.



Comparison to mains operated power supply

Compared to a switched mode power supply operated from the mains voltage, the input voltage of the SEPIC converter is low, requiring much higher input currents for the same output power. At a low input voltage, the input current can be up to 30 A. The amount of noise generated by a PWM stage is directly related to the switching current involved. The operating voltage has only minor impact. A mains-operated PWM power supply with a similar input current would supply several KW output power and would generate a similar amount of noise.

Measures for reducing noise

The noise spikes observed occur when the input current commutates between the MOSFET and the output diode of the SEPIC stage, i.e. at the edges of the PWM signal. The commutating current causes the circuit parasitics (lead inductance of MOSFET, diode plus junction capacitance) to oscillate in the MHz range. The oscillation is damped by snubber resistors and capacitors across the diode (not shown in the block diagram of the power supply) but it cannot be completely removed. The AutoBox/Tandem-AutoBox power supply contains an L/C Pi-filter at the input to attenuate the switching spikes. However, this filter can also not completely eliminate RF noise on the input voltage lines.

A further reduction in the noise at the input lines is difficult to achieve due to the high currents involved. Every component in series with the input has to withstand the 30 A input current. The series resistance must be low since the voltage drop across the component affects the minimum input voltage limit. High-current components usually have poor RF characteristics, so damping at high frequencies is low.

To electronic circuits (e.g. dSPACE I/O boards) mounted in the AutoBox/Tandem-AutoBox, the switching noise appears as common mode noise. It is not recognized.

Results of noise reducing measures

Experiments have shown that there is no visible (measurable) performance difference between dSPACE I/O boards installed in a expansion box or installed in the AutoBox/Tandem-AutoBox.

However, a prerequisite for this result is that the advice given in *Grounding and Shielding* on page 196 is followed.

Filter Circuit for AutoBox/Tandem-AutoBox Power Supply

Objective

The guidelines below apply to AutoBox through Version 3.0 and Tandem-AutoBox through Version 4.0. They are not relevant for later versions.

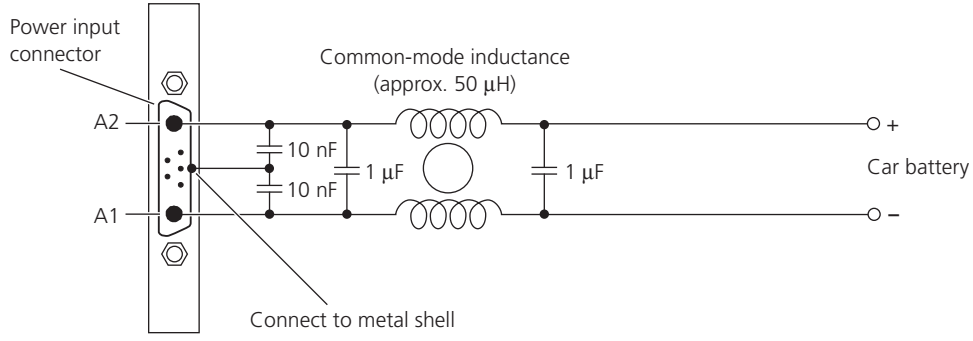
In special cases the AutoBox/Tandem-AutoBox power supply can cause conducted interferences to other electronics installed in the car. However, only electronics that are sensitive to conductive interferences (like measuring amplifiers) are affected.

A filter circuit at the AutoBox/Tandem-AutoBox power input can reduce these interferences.

> You do not need this filter circuit if you ensure proper cabling and grounding of all your electronic systems in the car.

Circuit diagram

The circuit shown below only reduces conductive interferences. It is not able to remove them.



The filter components must be placed close to the power input connector of the AutoBox/Tandem-AutoBox.

The value of the common-mode inductance is not critical. It should be approx. 50 µH. However, the inductance must be able to handle the max. current that can appear.

Troubleshooting

Objective	If any problem related to the installation and configuration of your system occurs, refer to the information given in this section.
Getting further support	If the information in this section does not help you solve the problem, you should: ■ Check the Support section of our website. See http://www.dspace.com/go/support. ■ The FAQ section and application notes provide a lot of useful information. See http://www.dspace.com/go/FAQ. ■ To stay up-to-date with information on possible problems, you should periodically check the known problem reports. See http://www.dspace.com/go/ProblemReports. If self-help does not solve the problem, contact dSPACE Support and give them information about your dSPACE environment and the problems you have. The best way to do this is with the support request form provided on the website at http://www.dspace.com/go/supportrequest, but you can also send an e-mail or phone us. For details, refer to *Contacting dSPACE Support* (📖 *Software Installation and Management Guide*).
Where to go from here	Information in this section

Hardware Problems	210
Problems with the Ethernet Connection	214

Hardware Problems

Where to go from here

Information in this section

Checking the DS1103	210
Problems with Multiple Plug & Play Boards	211
Problems Using an Expansion Box via Bus Connection	213
Problems Related to the Firmware	213

Checking the DS1103

Check list

Perform the following checks if the DS1103 does not operate correctly:

- Check whether host PC and expansion box operate correctly.
- Check the I/O base address of the DS1103. An address conflict does not necessarily result in the host PC or expansion box not booting anymore.
- If you use a DS821-34 mm Link Board with older notebooks (for example, which provide only ExpressCard/54 slots), your system might crash when you boot your host PC. To solve this problem, update the BIOS of your host PC.
- Use the Platform/Device Manager of ControlDesk Next Generation to check the board properties (see *Board Details Properties* (🕮 *ControlDesk Next Generation Reference*). The Properties pane displays the current temperature of the real-time processor. The processor is automatically put into the non-operating mode if the CPU temperature exceeds 80 °C. The CPU can be restarted if the temperature is fallen below 75 °C (there is a hysteresis of 5 °C).
- Check the status of the red LEDs on the board. For details, see *Status LEDs of the DS1103* on page 124.

Problems with Multiple Plug & Play Boards

Objective	Working with more than one dSPACE board in plug & play configuration presents us with two problems. The first is that the logical name of a board as assigned by the software must be associated with a physical board. The second is that under certain conditions, assignment of the names to the boards may change unexpectedly. It is vital to detect this situation, because otherwise an application to be loaded to a certain board might be loaded to another board of the same type by mistake. For example, assume you have one board connected to the engine ECU and another connected to the ESP system of a vehicle. In order to avoid severe damage to the car, you must avoid loading the program intended for the ECU-related board to the ESP-related board, and vice versa.
Affected boards	The problem described always applies to *DS1104* boards (and *MicroAutoBox* via DS815, DS817, DS819 or DS821) because plug & play mode cannot be disabled. MicroAutoBox II ist not affected. It also applies to *DS1103* and *DS1005* boards if they are configured to plug & play mode. Plug & play mode can be used for these boards only if they are installed in a PC directly. This might be the case with an industrial PC with many ISA slots and a built-in PC. However, if you are planning this use case, you must contact dSPACE Support beforehand.
Not affected boards	■ The problem never applies to *DS1006* boards and to *MicroAutoBox II* , because these boards cannot be installed in a host PC. ■ The problem never applies to *DS1103* and *DS1005* boards installed in a dSPACE expansion box independently of the type of interface used to connect the box to the PC, because when they are installed in expansion boxes, the plug & play mode must be disabled.

Handling plug & play boards in ControlDesk

The Platform/Device Manager of ControlDesk Next Generation handles the boards by detecting their type (DS1005, DS1103, DS1104, MicroAutoBox via DS815, DS817, DS819, or DS821) and their actual I/O address. For plug & play boards, the actual I/O address is dynamically assigned by the PC BIOS or the plug & play components of the operating system. If you add hardware components to your host PC or remove them from it, or enable or disable motherboard components, the PC's BIOS and/or the operating system's plug & play components assign new resources such as I/O addresses to all plug & play components, including dSPACE boards in plug & play mode.

ControlDesk Next Generation To avoid the problem described above, select the Assign to identical platform assignment mode when you configure the related platform in ControlDesk Next Generation. This lets you specify the serial number of the platform hardware.

ControlDesk Next Generation assigns the platform to registered dSPACE hardware with a particular serial number, according to the specified connection type. You must specify the serial number of the platform hardware. Optionally you can also specify the Port address as a hexadecimal number.

Refer to *Assignment Properties* (🕮 *ControlDesk Next Generation Reference*).

Method

To restore a consistent dSPACE board configuration

1. On the Platforms ribbon, click Platform Management – Clear System.

   Boards setup in plug & play mode are then reregistered automatically.

2. In the Platform/Device Manager, select the corresponding board icon.

   The Properties controlbar displays detailed information on the currently selected platform.

3 Compare the serial number of each dSPACE board (label on each board's bracket) with the one shown in the Board Details property page of the Platform/Device Manager to make sure that your applications are still loaded to the correct dSPACE boards.

- After using the Clear System command, you must reregister all installed dSPACE boards that do not support plug & play or where plug & play mode is disabled by means of the address switches.
- It is your responsibility to check and ensure that all applications are still loaded to the correct board. Since this is not under complete control of the dSPACE software it might even be necessary to change external connections to the boards! In a subsequent release of the Platform/Device Manager it will be possible to assign board names to the particular boards as needed.

Problems Using an Expansion Box via Bus Connection

Guidelines to avoid problems

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

- When switching on the system, the expansion box should usually be switched on first, followed by the PC.
- Do not switch off the expansion box while the PC is still running. This might lead to unpredictable errors.

Problems Related to the Firmware

Firmware update

If you are prompted to update your firmware when downloading an application to your real-time processor(s), refer to the 🕮 *Firmware Manager Document* for further information.

Problems with the Ethernet Connection

Where to go from here

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General Errors Using Ethernet Connection	214
Restoring BIOS Setup of the Slot CPU	215
Problems When Setting Up the TCP/IP Protocol	216
Problems with Peer-To-Peer Connection	216
Problems with the Integration of an Expansion Box in a Network	217

General Errors Using Ethernet Connection

Objective

The following general errors may occur when you work with an expansion box connected to your host PC via Ethernet.

Expansion box does not boot

The expansion box contains a slot CPU with a built-in network adapter as well as a VGA graphics adapter. A Flash Disk on the slot CPU stores all the necessary software for the network connection on the client side.

If you cannot establish a connection to the expansion box anymore, then the BIOS setup might be missing and the expansion box will not boot.

For restoring the BIOS setup, refer to *Restoring BIOS Setup of the Slot CPU* on page 215.

IP Address lost

During start-up the expansion box beeps several times. The last beep sequence indicates whether the default IP address (192.100.100.98) stored in the Flash Disk is active (three short beeps) or if the IP address has been changed by the user (one long beep).

The host and the expansion box cannot be connected via Ethernet if the IP address of the expansion box is unknown.

To find out the client's IP address, connect a VGA monitor to the slot CPU. The IP address is displayed during power-up. Use this address to connect to the expansion box again.

Wrong IP address	The IP addresses of expansion box and network, or expansion box and host PC (for peer-to-peer connection) must adhere to the following rules: ■ The network part of the IP address must be identical on both systems. Only the workstation part may differ. For details, refer to a definition of IP address classes. ■ The IP address of each node must be unique within the network. ■ The IP address must not be one of the reserved loopback addresses 127.0.0.0 and 127.0.0.1. Additional restrictions may apply.
Wrong subnet mask	The expansion box does not support subnetting. The subnet mask is always adjusted automatically according to the selected IP address class when changing the IP address using the setip utility. Zero subnet bits are set.
Wrong cable	The supplied crossed-over patch cable can only be used for a peer-to-peer connection via Ethernet. It cannot be used to connect the expansion box to an existing network. Use a normal (non crossed-over) cable to integrate the expansion box into an existing network.
Specific problems	In addition, problems to the following specific topics may occur: ■ *Problems When Setting Up the TCP/IP Protocol* on page 216 ■ *Problems with Peer-To-Peer Connection* on page 216 ■ *Problems with the Integration of an Expansion Box in a Network* on page 217

Restoring BIOS Setup of the Slot CPU

Objective	If you cannot establish a connection to the expansion box anymore, then the BIOS setup might be missing and the expansion box will not boot.
Slot CPU	The expansion box contains a slot CPU and a built-in network adapter as well as a VGA graphics adapter. A Flash Disk on the slot CPU stores all the necessary software for the network connection on the client side.

Remedy

To restore the missing BIOS setup of the slot CPU, contact dSPACE Support for further instructions.

Problems When Setting Up the TCP/IP Protocol

Troubleshooting

When you check the installation of the TCP/IP protocol with the ping command, the following error messages may occur.

Error message	Cause	Remedy
Bad command or file name	The TCP/IP protocol has not been installed properly.	Install the TCP/IP protocol again.
The name specified is not recognized as an internal or external command, operable program or batch file	The TCP/IP protocol has not been installed properly.	Install the TCP/IP protocol again.
Unable to contact IP driver, error code x found.	The TCP/IP protocol has not been installed properly.	Install the TCP/IP protocol again.
Pinging 127.0.0.1 with x bytes of data: Request timed out	The TCP/IP protocol has not been configured properly.	Check the configuration of the TCP/IP protocol. If you are uncertain, ask your system administrator.

Problems with Peer-To-Peer Connection

Objective

You may encounter some problems when you set up a peer-to-peer connection between your host PC and an expansion box.

Error message

Pinging 192.100.100.98 with 32 bytes of data:

Request timed out

Remedies

- Check whether the network adapter of the host PC has been installed and configured correctly.
- Make sure that the correct crossed-over patch cable is connected.

  A standard patch cable cannot be used for this type of connection.
- Check whether the expansion box is switched on.
- Check whether the expansion box is configured to a wrong IP address. For details, refer to: *IP Address lost* on page 214.
- Check the IP address of the host PC.

  It should be set to **`192.100.100.1`**. If a different IP address is used, the host might not be able to connect to the client.

Problems with the Integration of an Expansion Box in a Network

Objective

You may encounter some problems when you integrate an expansion box in a network.

Check list

- Check whether the network adapter of the host PC has been installed and configured correctly.
- Check whether the correct standard patch cable is connected and the expansion box is switched on.
- Check whether the expansion box is configured to a wrong IP address: see *IP Address lost* on page 214.
- Check whether the previous TCP/IP configuration of the host PC was restored properly.

Data Sheets

DS1103 and CP1103/CLP1103

Where to go from here

Information in this section

DS1103 Data Sheet	220
CP1103 Data Sheet	224
CLP1103 Data Sheet	225

DS1103 Data Sheet

Technical data

The following table shows the data sheet of the DS1103 PPC Controller Board for different board revisions.

Parameter		Specification	
		As of Board Revision DS1103-09	**Up to Board Revision DS1103-07**
Processor	PowerPC Type	PPC750GX	PPC604e
	CPU clock	1 GHz	400 MHz
	Cache	■ 2 x 32 KB level 1 (L1) (on-chip) ■ 1 MB level 2 (L2)	2 x 32 KB level 1 (L1) (on-chip)
	Bus frequency	133 MHz	66 MHz
	Temperatur sensor	Reads actual temperature at the PPC	
Memory	Local memory (as program memory for application)	32 MB SDRAM	2 MB SRAM
	Global memory (for data storage and data exchange with host)	96 MB SDRAM	128 MB SDRAM

Parameter		Specification	
		As of Board Revision DS1103-09	**Up to Board Revision DS1103-07**
Timer	2 general-purpose timers	■ One 32-bit down counter ■ Reload by software ■ 15 ns resolution	■ 30 ns resolution
		■ One 32-bit up counter with compare register ■ Reload by software ■ 30 ns resolution	■ 60 ns resolution
	1 sample rate timer (decrementer)	■ 32-bit down counter ■ Reload by software ■ 30 ns resolution	■ 60 ns resolution
	1 time base counter	■ 64-bit up counter ■ 30 ns resolution	■ 60 ns resolution
Interrupt controller		Interrupt controller with 20 interrupt sources: ■ 3 timer interrupts ■ 7 incremental encoder index line interrupts ■ 1 UART interrupt ■ 1 CAN interrupt ■ 1 slave DSP interrupt ■ 2 slave DSP PWM interrupts ■ 1 host interrupt ■ 4 external interrupts (user interrupts)	
ADCs (muxed)	Channels	■ 16 muxed channels equipped with 4 sample & hold ADCs (4 channels belong to one ADC. 4 consecutive samplings are necessary to sample all channels belonging to one ADC.) ■ Note: 8 ADC channels (4 x muxed + 4 x parallel) can be sampled simultaneously.	
	Resolution	16 bit	
	Input voltage range	±10 V	
	Overvoltage protection	±15 V	
	Conversion time	1 µs	4 µs
	Offset error	±5 mV	
	Gain error	±0.25%	
	Offset drift	40 µV/K	
	Gain drift	50 ppm/K	
	Signal-to-noise-ratio	>83 dB	>80 dB

Parameter		Specification	
		As of Board Revision DS1103-09	**Up to Board Revision DS1103-07**
ADCs (parallel)	Channels	■ 4 parallel channels each equipped with one sample & hold ADC ■ Note: 8 ADC channels (4 x muxed + 4 x parallel) can be sampled simultaneously	
	Resolution	16 bit	12 bit
	Input voltage range	±10 V	
	Overvoltage protection	±15 V	
	Conversion time	800 ns	
	Offset error	±5 mV	
	Gain error	±0.25%	±0.5%
	Offset drift	40 µV/K	
	Gain drift	50 ppm/K	
	Signal-to-noise-ratio	>83 dB	>65 dB
DACs	Channels	8 channels	
	Resolution	16 bit	14 bit
	Output range	±10 V	
	Settling time	5 µs (14 bit)	5 µs (12 bit)
	Offset error	±1 mV	
	Gain error	±0.5%	
	Offset drift	30 µV/K	
	Gain drift	25 ppm/K	
	Signal-to-noise-ratio	>83 dB	>78 dB
	I_{max}	±5 mA	
	C_{Imax}	10 nF	
Digital I/O	Channels	■ 32-bit parallel I/O ■ Organized in four 8-bit groups ■ Each 8-bit group can be set to input or output (programmable by software)	
	Voltage range	TTL input/output levels	
	I_{outmax}	±10 mA	

Parameter		Specification	
		As of Board Revision DS1103-09	**Up to Board Revision DS1103-07**
Digital Incremental Encoder interface	Channels	■ 6 independent channels ■ Single-ended (TTL) or differential (RS422) input (software programmable for each channel)	
	Position counters	■ 24-bit resolution ■ Max. 1.65 MHz input frequency, i.e. fourfold pulse counts up to 6.6 MHz ■ Counter reset or reload via software	
	Encoder supply voltage	■ 5 V/1.5 A ■ Shared with analog incremental encoder interface	
Analog incremental encoder interface	Channels	■ 1 channel ■ Sinusoidal signals: 1 V_{pp} differential or 11 μA_{pp} differential (software programmable)	
	Position counters	■ < 5° resolution ■ 32-bit loadable position counter ■ Max. 0.6 MHz input frequency, i.e. fourfold pulse counts up to 2.4 MHz	
	ADC performance	■ 6-bit resolution ■ 10 MSPS	
	Encoder supply voltage	■ 5 V/1.5 A ■ Shared with digital incremental encoder interface	
CAN interface	Configuration	■ 1 channel based on SAB 80C164 microcontroller ■ ISO DIS 11898-2 CAN High-speed standard	
	Baud rate	Max. 1 Mbit/s	
Serial interface	Configuration	■ TL16C550C single UART (universal asynchronous receiver and transmitter) with FIFO ■ RS232/RS422 compatibility	
	Baud rate	■ Up to 115.2 kBd (RS232) ■ Up to 1 MBd (RS422)	

Parameter		Specification	
		As of Board Revision DS1103-09	Up to Board Revision DS1103-07
Slave DSP	Type	Texas Instruments TMS320F240 DSP	
	Clock rate	20 MHz	
	Memory	■ 64Kx16 external code memory ■ 28Kx16 external data memory ■ 4Kx16 dual-port memory for communication ■ 32 KB flash memory	
	I/O channels	■ 16 ADC inputs ■ 12 PWM outputs ■ 4 capture inputs ■ 2 serial ports	
	Input voltage range	■ TTL input/output level ■ ADC inputs: 0 … 5 V	
	Output current	Max. ±13 mA	
Host interface		■ Eight 16-bit I/O ports in the 64K host I/O space ■ Processor/host and host/processor interrupts ■ Plug-and-Play support	
Physical size		■ 340 x 125 x 45 mm (13.4 x 4.9 x 1.77 in) ■ The board requires one length PC/AT ISA slot and three brackets	
Ambient temperature		0 … 50 °C (32 … 122 °F)	
Cooling		Passive cooling	Active cooling by fan
Power supply		■ +5 V ±5 %, 4 A ■ +12 V ±5 %, 0.75 A ■ –12 V ±5 %, 0.25 A	■ +5 V ±5 %, 6 A ■ +12 V ±5 %, 0.75 A ■ –12 V ±5 %, 0.25 A

CP1103 Data Sheet

Technical data

The following table shows the data sheet of the CP1103 Connector Panel.

Parameter	Specifications
Grounding	The enclosure and the front panel are not grounded.
Cable length	2 m (6.6 ft) standard
Physical size (with desktop enclosure) (length x depth x height)	433.5 x 142.5 x 70 mm (17.07 x 5.61 x 2.75 in)

Parameter	Specifications
Space needed for 19" rack mount	Height 3 U; width 16.8"
Weight	Approx. 3.8 kg (8.4 lbs); incl. enclosure and shielded ribbon cables

CLP1103 Data Sheet

Technical data

The following table shows the data sheet of the CLP1103 Connector/LED Combi Panel.

Parameter	Specifications
Power consumption	5 V; max. 750 mA (via DS1103 board)
Grounding	The enclosure and the front panel are not grounded.
Cable length	2 m (6.6 ft) standard
Physical size (with desktop enclosure) (length x depth x height)	647 x 142.5 x 70 mm (25.47 x 5.61 x 2.75 in)
Space needed for 19" rack mount	Height 3 U; width 16.8" + height 3 U; width 8.4" (2 slots needed)
Weight	Approx. 4.3 kg (9.5 lbs); incl. enclosure and shielded ribbon cables

Accessories

Where to go from here

Information in this section

Link Boards and Panels	228
dSPACE Expansion Boxes	246
Connector Panel Enclosures	297

Link Boards and Panels

Objective

Several different link boards and link panels are available to connect expansion boxes, for example, to your host PC.

Where to go from here

Information in this section

You can connect an expansion box to your host PC via a bus interface. dSPACE offers several link boards to establish different link types (ISA bus, PCI bus, PCI Express bus, PCMCIA, ExpressCard/54).

DS815 Link Board (PC) 230
Provides a PCMCIA interface.

DS817 Link Board (PC) 233
Provides a PCI interface.

DS819 Link Board (PC) 236
Provides a PCI Express interface.

DS821 Link Board (PC) 239
Provides an ExpressCard/54 interface.

DS814 Link Board (Box) 228
Provides the ISA bus interface required for expansion boxes.

You can connect up to 16 dSPACE boxes (expansion boxes or MicroAutoBoxes) to one host PC with the DS830 MultiLink Panel. In this case you need to install only one link board in the host PC.

DS830 MultiLink Panel 242

DS814 Link Board (Box)

Objective

The DS814 (to be installed in an expansion box) is an *ISA bus interface* and provides the connection to the link boards installed in the host PC (DS815, DS817, DS819, or DS821) or a DS830 Multilink Panel.

Where to go from here

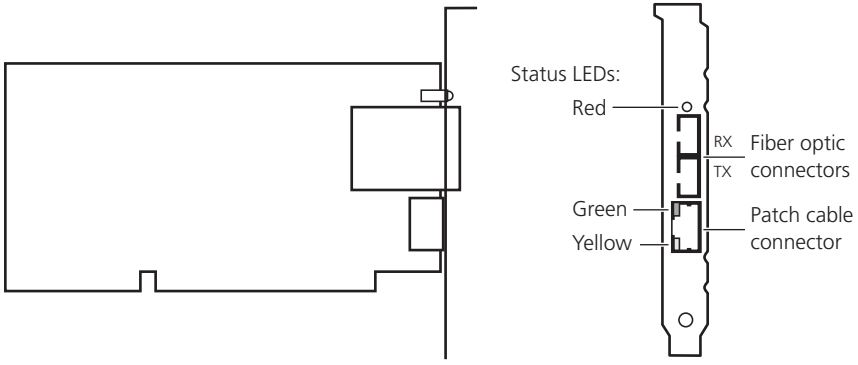
Information in this section

DS814 Board Overview	229
DS814 Data Sheet	230

DS814 Board Overview

Overview illustration

The illustration shows the location of connectors and LEDs on the board. The illustration is not to scale.



Components

The DS814 contains the following board elements:

- *Status LEDs* display the current status of the connection. These LEDs can be used for troubleshooting purposes:
  - A lit *yellow* LEDindicates that the connection between the box and the host PC (or DS830) is ready for communication.
  - A lit *red* LED indicates that the active connection between the box and the host PC (or DS830) uses a fiber-optic cable.
  - A lit *green* LED indicates that data is being sent or received.
- *Fiber optic connectors* are used for the optical link to the link board installed in the host PC or to a DS830 Multilink Panel. The DS814 provides one receiver port (RX) and one transmitter port (TX).
- *Patch cable connector* is an RJ45 connector. It is used for the link via crossed-over patch cable to the link board installed in the host PC or to a DS830 Multilink Panel.

Link cables

Matching link cables (fiber optic or crossed-over patch cable) are delivered with the hardware package. Use only these cables.

DS814 Data Sheet

Technical data

The following table provides the technical characteristics of the DS814 Link Board (Box):

Parameter	Specification
Slave interface	16-bit ISA slot in dSPACE expansion box
Supported link interfaces	DS815, DS817, DS819, DS821, DS830
Physical connection	■ Crossed-over patch cable: twisted pair (CAT5 STP) ■ Fiber-optic cable: multimode (62.5/125 µm)
Cable length per connection	■ Max. 10 m (crossed-over patch cable) ■ Max. 100 m (fiber-optic cable)
Protocol	High-speed serial link (proprietary)
Max. transfer rate	100 MBit/s [1)]
Power supply	+5 V ±5%, 1.0 A
Physical size	158 x 80 x 18 mm (6.3 x 3.1 x 0.7 in.)
Ambient temperature	0 … 70 °C (32 … 158 °F)

[1)] The transfer rate describes 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.

DS815 Link Board (PC)

Objective

The DS815 (to be installed in the host PC) is a PC card and provides a *PCMCIA link* to the DS814 Link Board (Box), a DS830 Multilink Panel or MicroAutoBox. The DS815 always works in Plug & Play mode.

Where to go from here

Information in this section

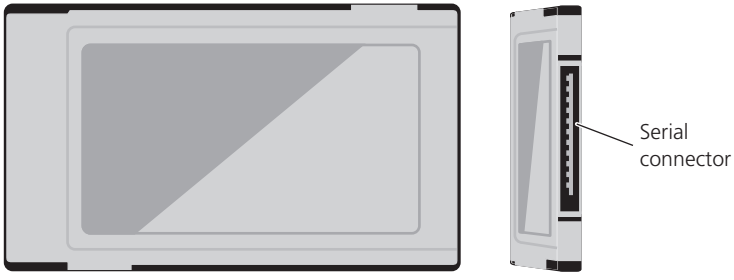
DS815 Board Overview	231
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DS815 Board Overview

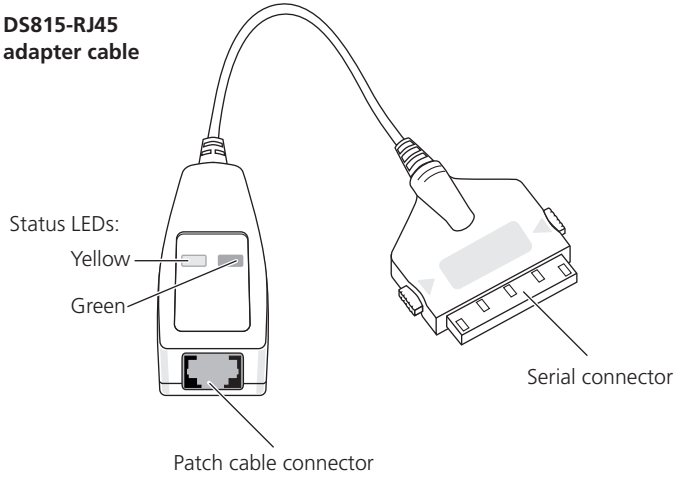
Overview illustration

The illustration shows the DS815 and the DS815-RJ45 adapter cable. The illustration is not to scale.

DS815



DS815-RJ45 adapter cable



DS815 components

The DS815 contains the following element:

- *Serial connector* is used for the serial link to the DS814 Link Board (Box), DS830 or MicroAutoBox. A matching link cable is delivered with the board.

  As of November 2001 the DS815 comes with a new serial connector. These boards have a red label or a blue label with "Vs.2.0". The link cables of DS815 boards delivered before November 2001 are not compatible with the new cables.

  For the DS815 delivered as of November 2001 an adapter cable is available:

  - To adapt the DS815 to a standard patch cable with an RJ45 connector.
  - To identify the current status of the connection by the two LEDs integrated in the shell of the RJ45 connector.

DS815-RJ45 adapter cable components

The adapter cable is labeled "DS815-RJ45 Vs 2.0". It contains the following elements:

- *Status LEDs* display the current status of the connection. These LEDs can be used for troubleshooting purposes:
  - A lit *yellow* LED indicates that the connection between the host PC and a dSPACE box (or DS830) is ready for communication.
  - A lit *green* LED indicates that data is being sent or received.
- *Serial connector* for connection of the DS815 to the host PC.
- *Patch cable connector* is an RJ45 connector. It is used for the link via crossed-over patch cable to the DS814 Link Board (Box), DS830 or MicroAutoBox.

  For the connection between the DS815-RJ45 adapter cable and the dSPACE boxes (or DS830) you must use a crossed-over patch cable.

DS815 Data Sheet

Technical data

The following table provides the technical characteristics of the DS815 Link Board (PC):

Parameter	Specification
Host interface	Type II PCMCIA in host PC (16-bit interface)
Supported link interfaces	DS814, DS830, MicroAutoBox
Physical connection	Crossed-over patch cable: twisted pair (CAT5 STP)
Cable length per connection	Max. 10 m
Protocol	High-speed serial link (proprietary)
Max. transfer rate	100 MBit/s [1)]
Power supply	+5 V ±5%, 150 mA from PC
Physical size	Type II PCMCIA card
Ambient temperature	0 … 70 °C (32 … 158 °F)

[1)] The transfer rate describes 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.

DS817 Link Board (PC)

Objective

The DS817 (to be installed in the host PC) is a *PCI interface* and provides the link to the DS814 Link Board (Box), a DS830 Multilink Panel or MicroAutoBox.

Where to go from here

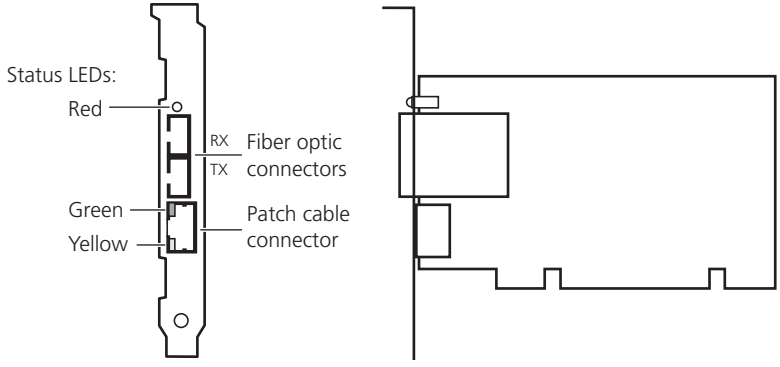
Information in this section

DS817 Board Overview	234
DS817 Data Sheet	235

DS817 Board Overview

Overview illustration

The illustration shows the location of connectors and LEDs on the board (DS817-04 equipped with the standard bracket). The illustration is not to scale.



Components

The DS817 contains the following board elements:

- *Status LEDs* display the current status of the connection. These LEDs can be used for troubleshooting purposes:
  - A lit *yellow* LED indicates that the connection between the host PC and a dSPACE box (or DS830) is ready for communication.
  - A lit *red* LED indicates that the active connection between the host PC and a dSPACE box (or DS830) uses a fiber-optic cable.
  - A lit *green* LED indicates that data is being sent or received.

    Directly after power-up the green LED lights up three times shortly, followed by a longer break. This indicates that the host interface is providing the required 33 MHz PCI clock frequency.
- *Fiber optic connectors* are used for the optical link to the DS814 Link Board (Box) or DS830. The DS817 provides one receiver port (RX) and one transmitter port (TX).
- *Patch cable connector* is an RJ45 connector. It is used for the link via patch cable to the DS814 Link Board (Box), DS830 or MicroAutoBox.

Link cables

Matching link cables (fiber optic or crossed-over patch cable) are delivered with the hardware package. Use only these cables.

Optional bracket

The DS817 comes with an optional bracket for installation in low-profile PCs.

You can use this bracket to install the DS817 in host PCs which support only low-profile cards. Remove the standard bracket and mount the optional low-profile bracket on the link board.



dSPACE does not guarantee that the bracket fits to all low-profile PCs which are available on the market.

DS817 Data Sheet

Technical data

The following table provides the technical characteristics of the DS817 Link Board (PC):

Parameter	Specification	
	Up to board revision DS817-03	**Board revision DS817-04 and later**
Host interface	■ 32-bit PCI host interface ■ 5 V PCI slot ■ 33 MHz ±5 %	■ 32-bit PCI host interface ■ 3.3 V / 5 V Universal PCI slot ■ 33 MHz ±5 %
Supported link interfaces	DS814, DS830, MicroAutoBox	
Physical connection	■ Crossed-over patch cable: twisted pair (CAT5 STP) ■ Fiber-optic cable: multimode (62.5/125 µm)	■ Crossed-over patch cable: twisted pair (CAT5 STP) ■ Standard patch cable ■ Fiber-optic cable: multimode (62.5/125 µm)
Cable length per connection	■ Max. 10 m (patch cable) ■ Max. 100 m (fiber-optic cable)	
Protocol	High-speed serial link (proprietary)	
Max. transfer rate	100 MBit/s [1)]	
Power supply	+5 V ±5%, 1.0 A from PC	+3.3 V ±5%, 1.0 A from PC
Physical size	122 x 72 x 18 mm (4.8 x 2.8 x 0.7 in.)	122 x 64 x 18 mm (4.8 x 2.5 x 0.7 in.)

Parameter	Specification	
	Up to board revision DS817-03	**Board revision DS817-04 and later**
Bracket	■ Standard bracket ■ One optional bracket for installation in low-profile PCs comes with the DS817	
Ambient temperature	0 … 70 °C (32 … 158 °F)	

[1] The transfer rate describes 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.

DS819 Link Board (PC)

Objective

The DS819 (to be installed in the host PC) is a *PCI Express interface* and provides the link to the DS814 Link Board (Box), a DS830 Multilink Panel or MicroAutoBox.

Where to go from here

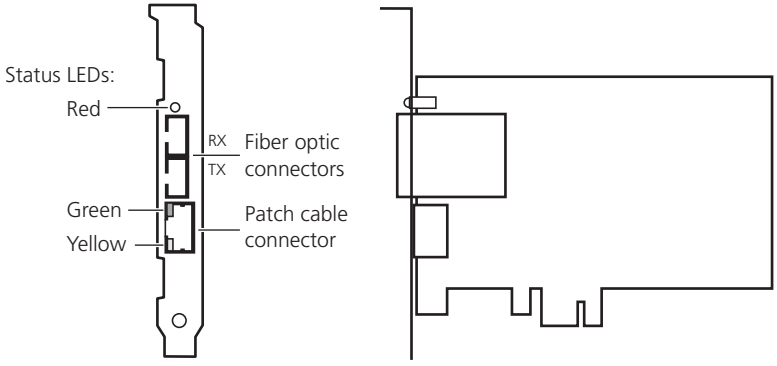
Information in this section

DS819 Board Overview	237
DS819 Data Sheet	238

DS819 Board Overview

Overview illustration

The illustration shows the location of connectors and LEDs on the board. The illustration is not to scale.



Components

The DS819 contains the following board elements:

- *Status LEDs* display the current status of the connection. These LEDs can be used for troubleshooting purposes:
  - A lit *yellow* LED indicates that the connection between the host PC and a dSPACE box (or DS830) is ready for communication.
  - A lit *red* LED indicates that the active connection between the host PC and a dSPACE box (or DS830) uses a fiber-optic cable.
  - A lit *green* LED indicates that data is being sent or received.
- *Fiber optic connectors* are used for the optical link to the DS814 Link Board (Box) or DS830. The DS819 provides one receiver port (RX) and one transmitter port (TX).
- *Patch cable connector* is an RJ45 connector. It is used for the link via crossed-over patch cable to the DS814 Link Board (Box), DS830 or MicroAutoBox.

Link cables

Matching link cables (fiber optic or crossed-over patch cable) are delivered with the hardware package. Use only these cables.

Optional bracket

The DS819 comes with an optional bracket for installation in low-profile PCs.

You can use this bracket to install the DS819 in host PCs which support only low-profile cards. Remove the standard bracket and mount the optional low-profile bracket on the link board.



dSPACE does not guarantee that the bracket fits to all low-profile PCs which are available on the market.

DS819 Data Sheet

Technical data

The following table provides the technical characteristics of the DS819 Link Board (PC):

Parameter	Specification
Host interface	■ PCI Express x1 interface ■ PCI Express slot (x1 ... x32)
Required software	dSPACE Release 5.2 or later
Supported link interfaces	DS814, DS830, MicroAutoBox
Physical connection	■ Crossed-over patch cable: twisted pair (CAT5 STP) ■ Fiber-optic cable: multimode (62.5/125 µm)
Cable length per connection	■ Max. 10 m (crossed-over patch cable) ■ Max. 100 m (fiber-optic cable)
Protocol	High-speed serial link (proprietary)
Max. transfer rate	100 MBit/s [1)]
Power supply	From PC: ■ +3.3 V ±5%, 0.5 A ■ +12 V ±5%, 0.2 A
Physical size	120 x 75 x 18 mm (4.7 x 3.0 x 0.7 in.)
Ambient temperature	0 … 70 °C (32 … 158 °F)

[1)] The transfer rate describes 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.

DS821 Link Board (PC)

Objective

The DS821 (to be installed in the host PC) is an interface card and provides an *ExpressCard/54 link* to the DS814 Link Board (Box), a DS830 Multilink Panel or MicroAutoBox.

Where to go from here

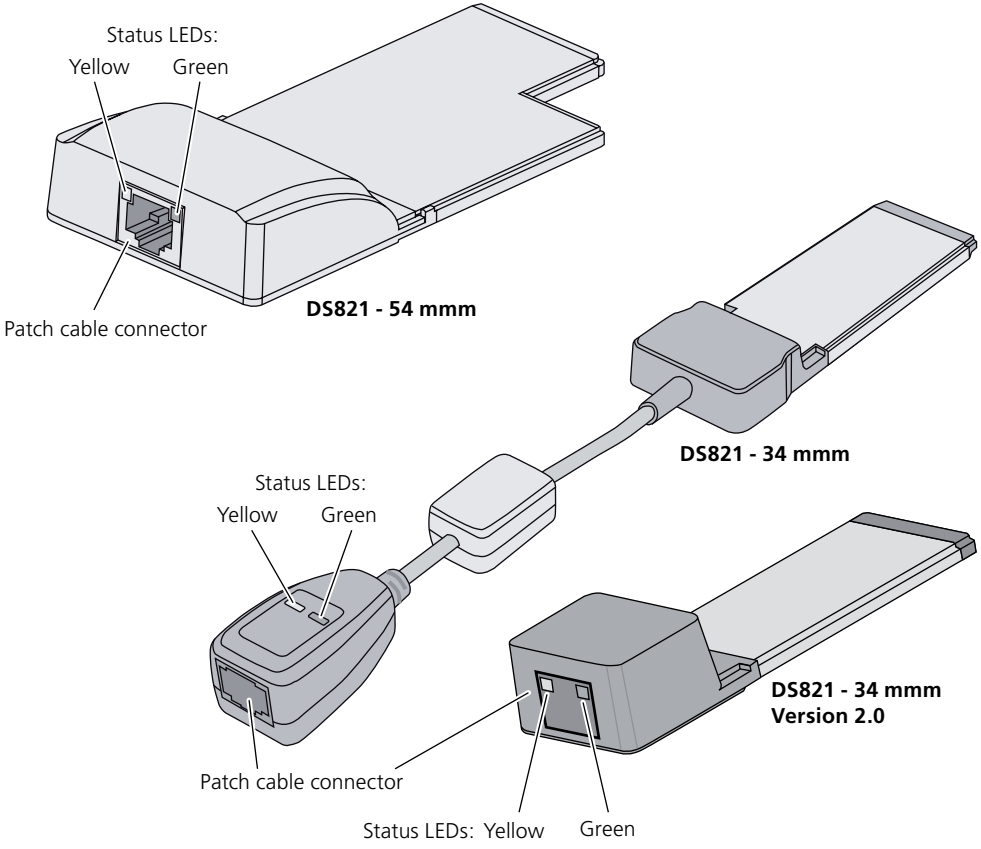
Information in this section

DS821 Board Overview	240
DS821 Data Sheet	241

DS821 Board Overview

Overview illustration

The illustration shows the DS821-54 mm (for ExpressCard/54 notebook slots) and the DS821-34 mm (for ExpressCard/34 notebook slots). The illustration is not to scale.



DS821 components

The DS821 contains the following element:

- *Status LEDs* display the current status of the connection. These LEDs can be used for troubleshooting purposes:
  - A lit *yellow* LED indicates that the connection between the host PC and a dSPACE box (or DS830) is ready for communication.
  - A lit *green* LED indicates that data is being sent or received.
- *Patch cable connector* is an RJ45 connector. It is used for the link via crossed-over patch cable to the DS814 Link Board (Box), DS830 or MicroAutoBox.

DS821 Data Sheet

Technical data

The following table provides the technical characteristics of the DS821 Link Board (PC):

Parameter		Specification
Host interface	DS821-34 mm	ExpressCard/34
	DS821-54 mm	ExpressCard/54
Required software		dSPACE Release 5.2 or later
Supported link interfaces		DS814, DS830, MicroAutoBox
Physical connection		Crossed-over patch cable: twisted pair (CAT5 STP)
Cable length per connection		Max. 10 m
Protocol		High-speed serial link (proprietary)
Max. transfer rate		100 MBit/s [1)]
Power supply		From PC: ■ +3.3 V ±5%, 1.0 A ■ +1.5 V ±5%, 0.5 A
Physical size	DS821-34 mm	112 x 34 x 12 mm (4.4 x 1.3 x 0.5 in.)
	DS821-34 mm (Ver. 2.0)	112 x 34 x 21,5 mm (4.4 x 1.3 x 0.85 in.)
	DS821-54 mm	120 x 54 x 22 mm (4.7 x 2.1 x 0.9 in.)
Ambient temperature		0 … 70 °C (32 … 158 °F)

[1)] The transfer rate describes 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.

DS830 MultiLink Panel

Objective

The DS830 MultiLink Panel allows you to connect several dSPACE boxes (expansion boxes/AutoBoxes and/or MicroAutoBoxes) to one host PC. The panel is available in three variants:

- DS830-4 for up to 4 connections
- DS830-8 for up to 8 connections
- DS830-16 for up to 16 connections

Where to go from here

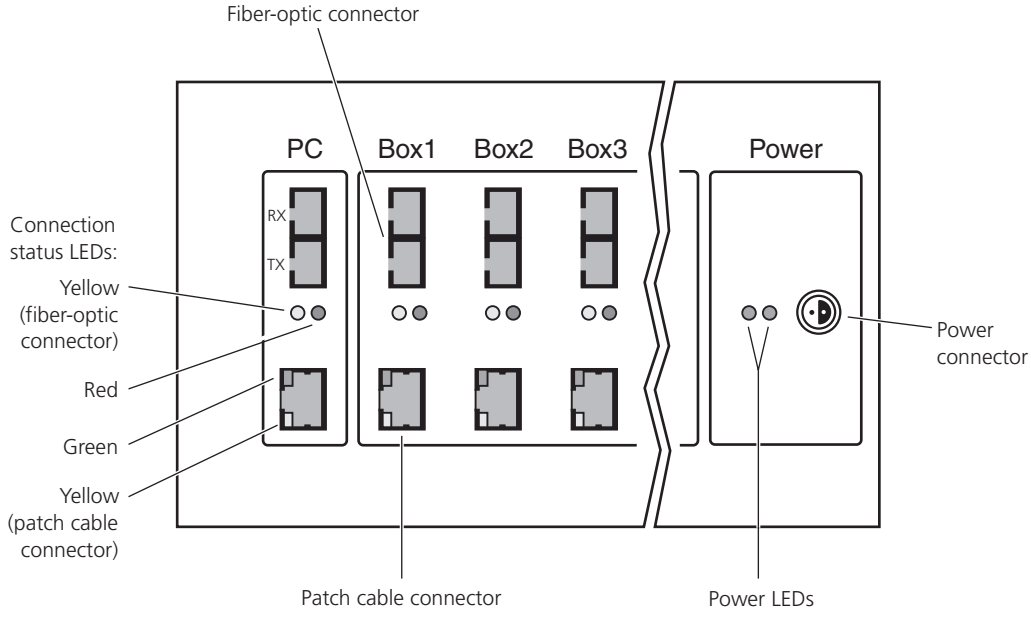
Information in this section

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DS830 Panel Overview

Overview illustration

The illustration shows the location of connectors and LEDs on the panel. The illustration is not to scale.



Components

The DS830 contains the following elements (from left to right):

- *Connection status LEDs* display the current status of the connection. These LEDs can be used for troubleshooting purposes:
  - A lit *yellow* LED (fiber-optic connector) indicates that the connection between host PC and the corresponding dSPACE box is currently being used for communication.
  - A lit *yellow* LED (patch cable connector) indicates that the connection to the host PC or a connected dSPACE box is ready for communication.
  - A lit *red* LED indicates that the corresponding connection to the host PC or a connected dSPACE box uses a fiber-optic cable.
  - A lit *green* LED indicates that data is being sent or received on the corresponding connection.

- *Fiber optic connectors* are used for the optical link to the host PC or a dSPACE box. The panel provides one receiver port (RX) and one transmitter port (TX) for each connection.
- *Patch cable connectors* are RJ45 connectors. They are used for the link via crossed-over patch cable to the host PC or a dSPACE box.
- The *power LEDs* are both lit (green) when power is supplied correctly to the DS830.
- *Power connector* for connection to power supply unit or car battery.

Cables

The following cables are delivered with the DS830 hardware package:

- If ordered: Matching link cables (fiber-optic and crossed-over patch cable)
- The cables required to supply power to the DS830 via a mains socket or a car battery. The cable for the mains socket includes a power supply unit (15.0 V, 4.0 A).

DS830 Data Sheet

Technical data

The following table shows the technical characteristics of the DS830 Multilink Panel.

Parameter	Specification
Enclosure	Aluminium box (not waterproof)
Connectable boxes	Up to 4 (DS830-4), 8 (DS830-8) or 16 (DS830-16) expansion boxes and/or MicroAutoBoxes
Supported link interfaces	DS814, DS815, DS817, DS819, DS821, MicroAutoBox
Physical connection	In any combination: ■ Crossed-over patch cable: twisted pair (CAT5 STP) ■ Fiber-optic cable: multimode (62.5/125 µm)
Cable length per connection	■ Max. 10 m (crossed-over patch cable) ■ Max. 100 m (fiber-optic cable)
Protocol	High-speed serial link (proprietary)
Max. transfer rate	100 MBit/s [1)]
Status LEDs	Various LEDs displaying the current status of each connection and the power supply

Parameter		Specification
Power supply		■ +6 V … +58 V DC ■ Overvoltage protection and protection against reverse polarity (± 80 V) ■ Power supply via mains socket or a car battery (power supply cables are part of the hardware package) ■ Mains socket cable includes a power supply unit (15.0 V, 4.0 A)
Power consumption	DS830-4	16 W
	DS830-8	24 W
	DS830-16	40 W
Physical size (length x depth x height)	DS830-4	201.6 x 56.0 x 108.6 mm (7.9 x 2.2 x 4.3 in.)
	DS830-8	288.0 x 56.0 x 108.6 mm (11.3 x 2.2 x 4.3 in.)
	DS830-16	460.8 x 56.0 x 108.6 mm (18.1 x 2.2 x 4.3 in.)
Approx. weight	DS830-4	0.75 kg (1.65 lb.)
	DS830-8	1.10 kg (2.43 lb.)
	DS830-16	1.70 kg (3.75 lb.)
Ambient temperature		■ 0 … 50 °C (32 … 122 °F) ■ Active cooling (fan)

[1] The transfer rate describes 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.

dSPACE Expansion Boxes

Where to go from here

Information in this section

PX4 Expansion Box	246
PX10 Expansion Box	249
PX20 Expansion Box	259
AutoBox	268
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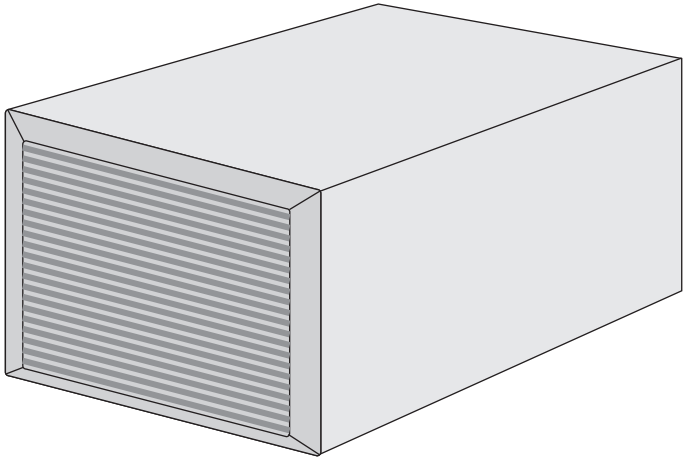
PX4 Expansion Box

Versions

The PX4 Expansion Box is available as desktop version.

Desktop version

The illustration below shows the currently delivered revision of the box.



Where to go from here

Information in this section

PX4 Data Sheet	247
PX4: Ensuring Correct Operating Temperatures	247
PX4 Dimension Drawings	249

PX4 Data Sheet

Technical data

The following table provides the technical characteristics of the PX4:

Parameter	Specification
Chassis	■ Desktop box ■ 4 full-size 16-bit ISA slots ■ 1 slot reserved for Link Board ■ Active cooling with low-noise fan
Power supply	■ Mains voltage 100 … 240 V / 50-60 Hz, autoranging ■ 80 W maximum output power
Maximum output current (The sum of the output power supply rails must not exceed the maximum output power.)	■ 10 A @ +5 V ■ 3 A @ +12 V ■ 0.8 A @ –12 V
Grounding	Circuit ground is connected to the chassis and through that to the power system's protective ground.
Physical size	Refer to *PX4 Dimension Drawings* on page 249
Weight (without boards)	3.5 kg (7.7 lbs)
Ambient temperature[1)]	0 … 50 °C (32 … 122 °F)
Humidity	5 … 95 %, non-condensing

[1)] The ambient temperature specified for boards installed inside the box can limit the stated temperature range.

PX4: Ensuring Correct Operating Temperatures

Objective

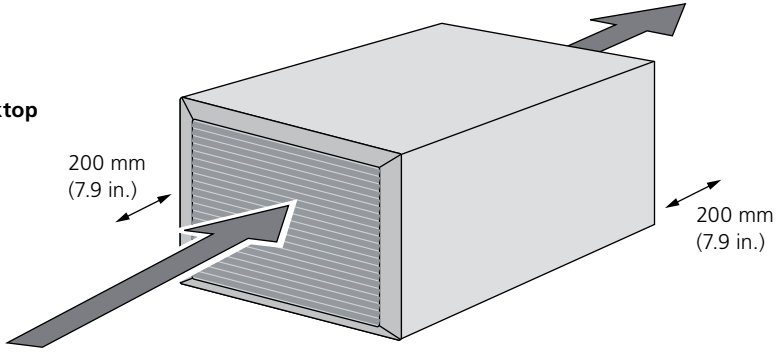
The operating temperatures of hardware devices directly affect their life time and their functionality. To avoid shortening the life times of the hardware components, ensure that the operating temperature of the dSPACE system does not exceed the specified ambient temperature, for example, due to improper installation.

Rules for proper installation

To ensure proper operation within the specified ambient temperature, observe the following rules:

- The temperature of the input airstream must be in the range of the specified min. and max. ambient temperatures (see data sheet).
- Position the box away from heat sources such as radiators, heat registers, power amplifiers, and other hardware that produces heat.
- Do not block the ventilation inlets and outlets. There must be a specified space (normally 200 mm (7.9 in.)) in front of them. For details, see the illustrations below.

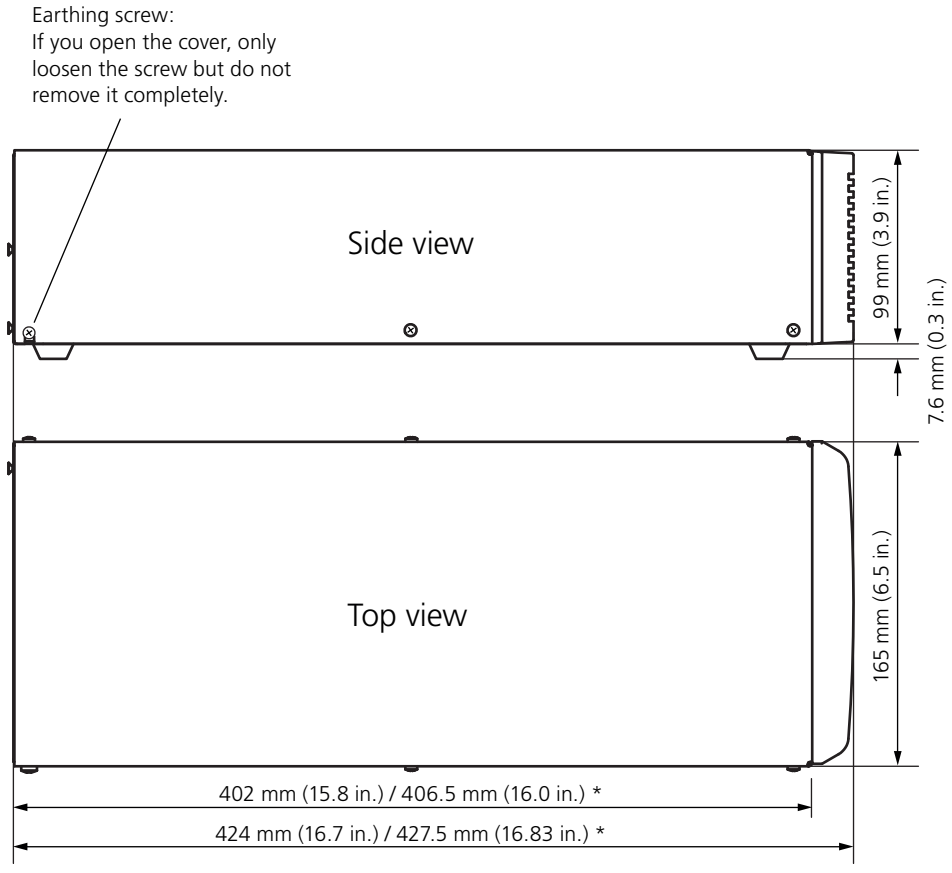
PX4 Desktop



PX4 Dimension Drawings

Desktop version

The illustrations below show the outer dimensions.



* As of version ME9004-xx. The version number is printed on the type plate.

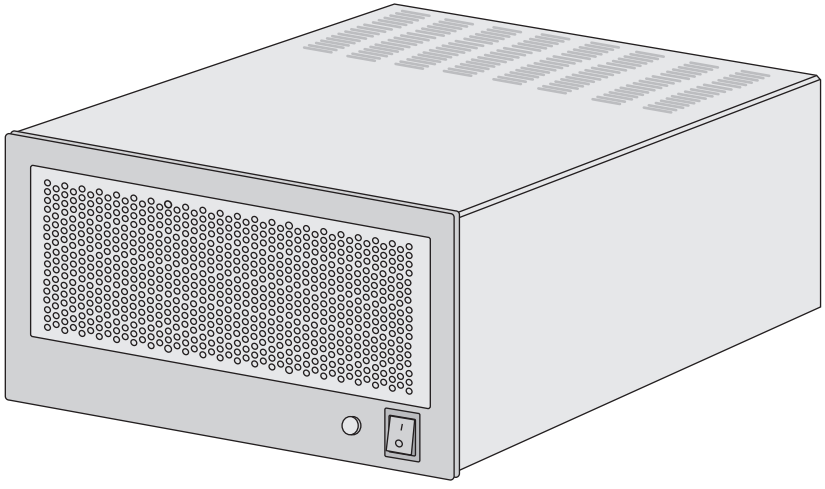
PX10 Expansion Box

Versions

The PX10 Expansion Box is available as desktop version and as 19'' rack version.

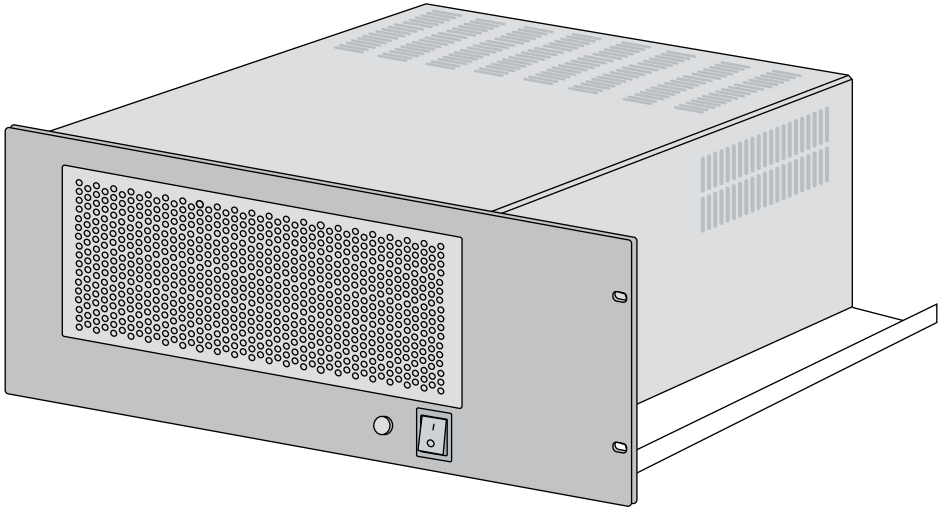
Desktop version

The illustration below shows the currently delivered revision of the box.



19'' rack version

The illustration below shows the currently delivered revision of the box.



Where to go from here

Information in this section

PX10 Data Sheet	251
PX10: Ensuring Correct Operating Temperatures	252
PX10 Dimension Drawings	256

PX10 Data Sheet

Technical data

The following table provides the technical characteristics of the PX10:

Parameter		Specification
Chassis	General	■ Desktop box ■ 19" rack-mount version available
	Slots	■ 10 full-size 16-bit ISA slots ■ 1 slot reserved for Link Board or slot CPU board for Ethernet connection
	Cooling	■ Active cooling with temperature controlled fans (with dust filter) ■ Dust filter: A pack of three replacement filters is available. Order number: FILTER_PAD_PX10
Power supply	General	■ Mains voltage 100 … 240 V / 50-60 Hz ■ As of revision 1.4: active PFC (Power Factor Correction) >= 0.95
	Maximum output power	■ Up to revision 1.2: 200 W ■ As of revision 1.3: 250 W
Maximum output current (The sum of the output currents must not exceed the maximum output power of the supply rails.)	Up to revision 1.2	■ 22 A @ +5 V ■ 7 A @ +12 V ■ 0.7 A @ –12 V
	Up to revision 1.3	■ 33 A @ +5 V ■ 8 A @ +12 V ■ 3 A @ –12 V
	As of revision 1.4	■ 40 A @ +5 V ■ 10 A @ +12 V ■ 1 A @ –12 V

Parameter		Specification
Reset switch (up to revision 3.0)		■ The switch has no function. ■ The lamp in the switch lights up when the expansion box power supply provides +12 V. ■ Approx. 10,000 h life span of the lamp
Grounding		Circuit ground is connected to the chassis and through that to the power system's protective ground.
Physical size		Refer to *PX10 Dimension Drawings* on page 256
Rack-mount version: space needed in a 19" rack	Height	4 U (HE)
	Width	13.5"
Weight (without boards)	Desktop version	■ Up to revision 3.4: 10.8 kg (22 lbs) ■ As of revision 3.5: 11.1 kg (24.5 lbs)
	Rack-mount version	■ Up to revision 3.4:12.8 kg (26.5 lbs) with 19" front plate and mounting plate ■ As of revision 3.5: 13.4 kg (29.5 lbs) with 19" front plate and mounting plate
Ambient temperature (Ta) [1]		0 … 50 °C (32 … 122 °F)
Humidity		20 … 90 %, non-condensing

[1] The ambient temperature specified for boards installed inside the box (for example, the DS1006) can limit the stated temperature range

As of revision 1.3, the revision number is labeled on the chassis and the PX10 is prepared for inserting max. one DS1006 Processor Board. For more details on the different revisions, refer to http://www.dspace.de/goto?pxboxvers.

PX10: Ensuring Correct Operating Temperatures

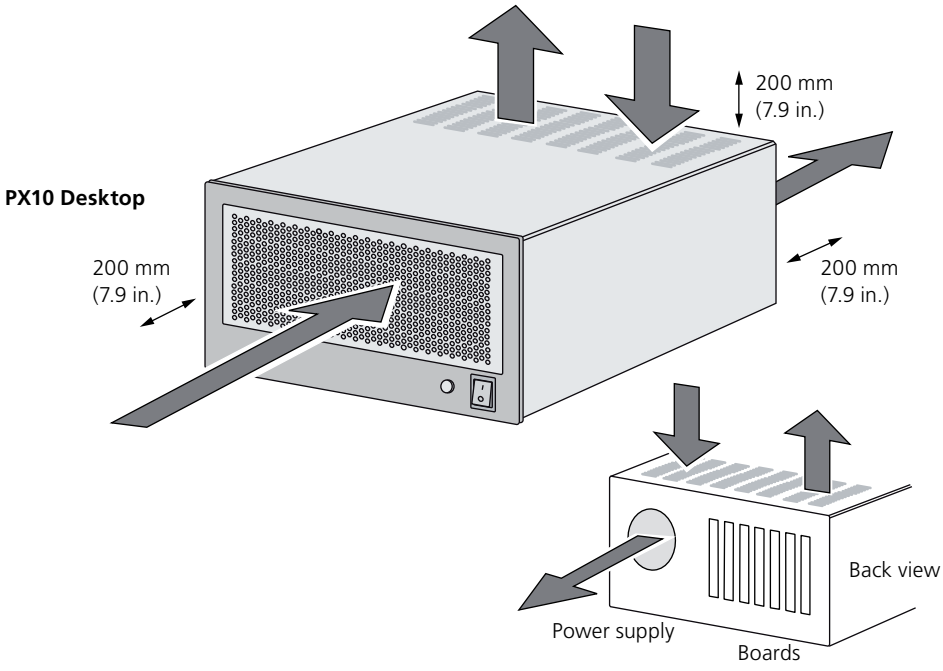
Objective

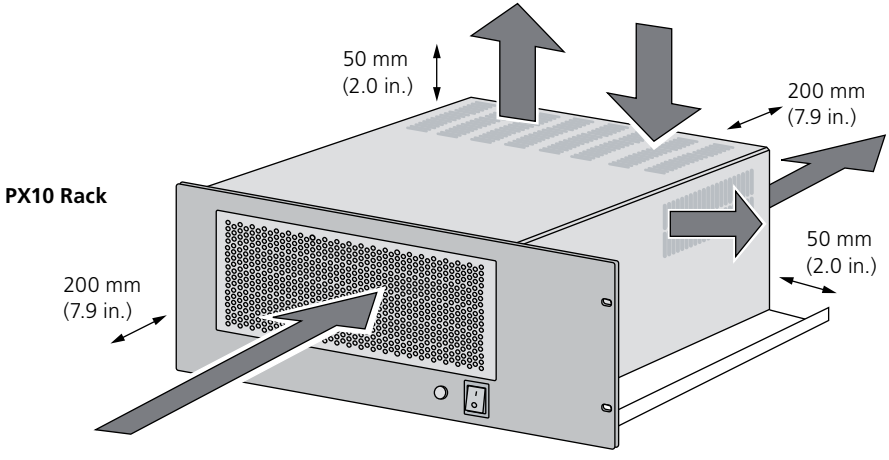
The operating temperatures of hardware devices directly affect their life time and their functionality. To avoid shortening the life times of the hardware components, ensure that the operating temperature of the dSPACE system does not exceed the specified ambient temperature, for example, due to improper installation.

Rules for proper installation

To ensure proper operation within the specified ambient temperature, observe the following rules:

- The temperature of the input airstream must be in the range of the specified min. and max. ambient temperatures (see data sheet).
- Position the box away from heat sources such as radiators, heat registers, power amplifiers, and other hardware that produces heat.
- Do not block the ventilation inlets and outlets. There must be a specified space (normally 200 mm (7.9 in.)) in front of them. In a rack, the space above the box must be at least 50 mm (2.0 in.). For details, see the illustrations below.


PX10 Desktop
200 mm
(7.9 in.)
200 mm
(7.9 in.)
200 mm
(7.9 in.)
Back view
Power supply
Boards


PX10 Rack
50 mm
(2.0 in.)
200 mm
(7.9 in.)
200 mm
(7.9 in.)
50 mm
(2.0 in.)

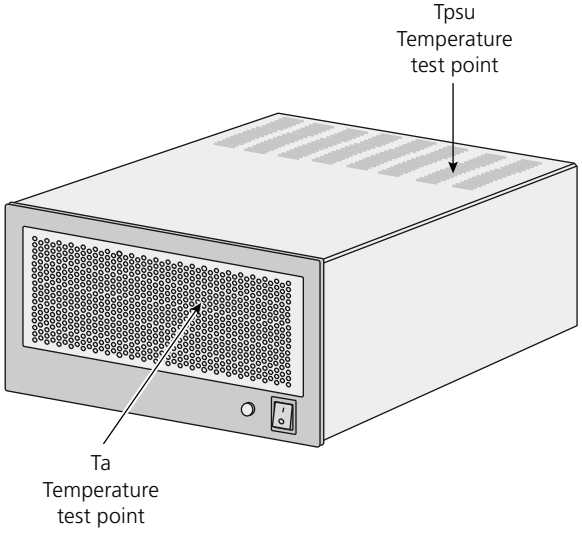
Measures in borderline situations

If you cannot fulfill the space requirement (as typically happens in a rack-mount situation), and if you are not sure whether the ambient temperature can be kept in the specified range while the dSPACE system is running, take the following steps:

1. Measure the temperatures Ta and Tpsu of the output airstream of the uninstalled box marked on the illustration below under operating conditions.

   Measurement condition: Measure the temperatures of the output airstreams after executing a typical real-time application (for example, a dSPACE demo application) on the hardware for at least 15 minutes.

   Temperature sensors must be placed al least 20 mm above the inlets.



2. Use the following formula:

   $Ta + dT_{max}$

   - dT_{max} = 50 °C (122 °F) - Ta_{max}
   - Ta_{max} = Greatest expected ambient temperature

   If the Tpsu temperature exceeds the sum of $Ta + dT_{max}$, you must take suitable measures to improve the rack installation (for example, by using air ducts or external cooling devices) to lower the temperature of the output airstream.

Checking and replacing the dust filter

The fans of the PX10 have a dust filter. You have to check the dust filter for dirt at least once a year. More frequent checks may be necessary depending on the operating conditions. If the dust filter is dirty, you must replace it.

NOTICE

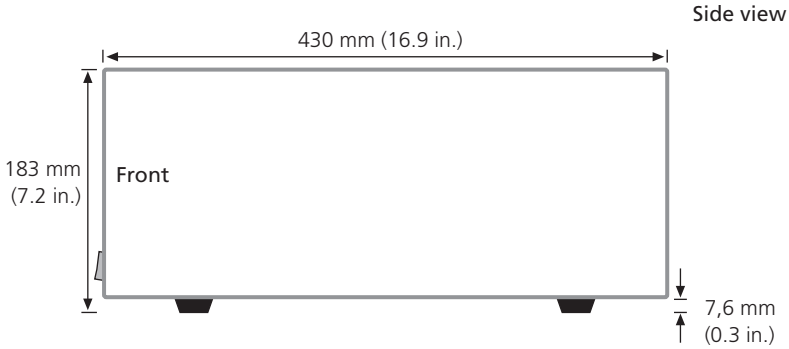
A dirty dust filter blocks the input air stream and increases the temperature in the box, which may shorten the life of the hardware components.

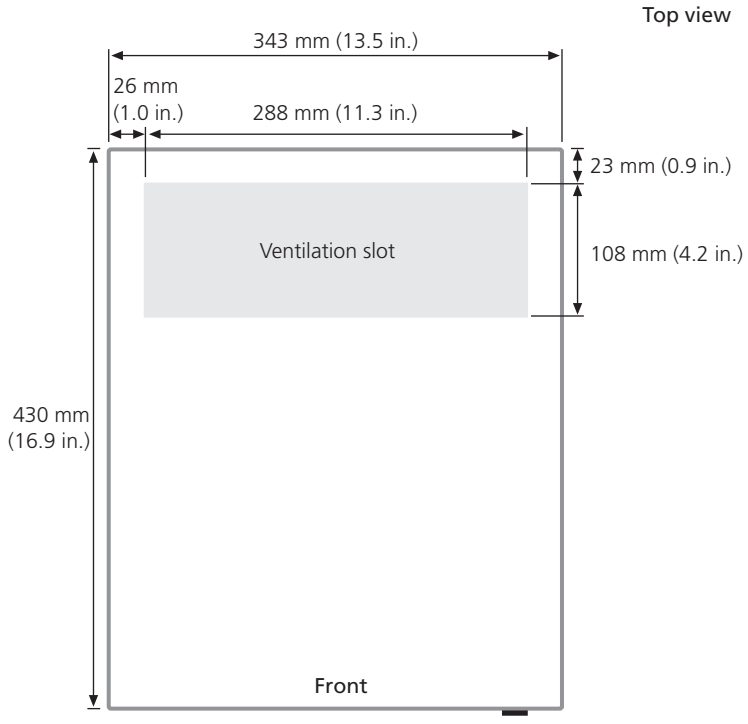
dSPACE provides a pack of three replacement dust filters with the order number: FILTER_PAD_PX10. For instructions, refer to *How to Check and Replace the Dust Filter of an Expansion Box* on page 50.

PX10 Dimension Drawings

Desktop version

The illustrations below show the outer dimensions and the position of ventilation slots of the desktop version.





19" rack version

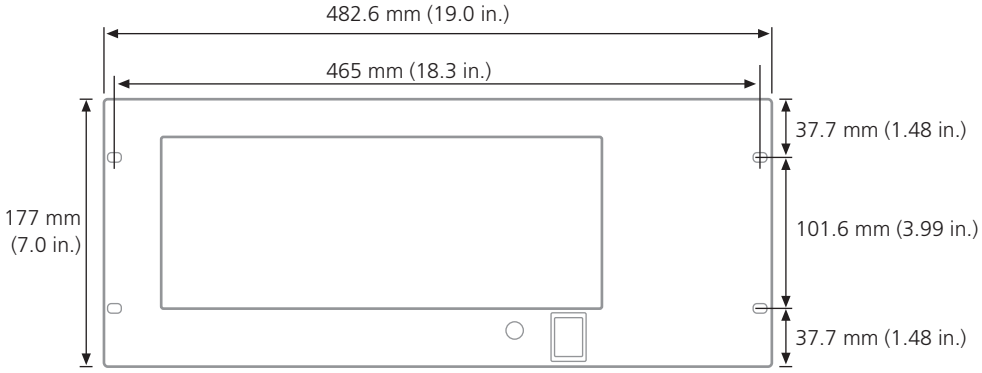
NOTICE

Incorrect mounting of the PX10 in a 19" rack damages the box.

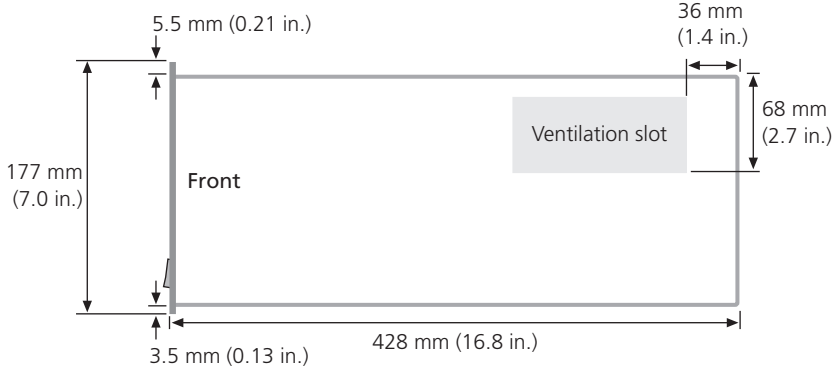
To avoid damage, mount the box in the 19" rack with the mounting plate and not only with the fixing holes at the front plate.

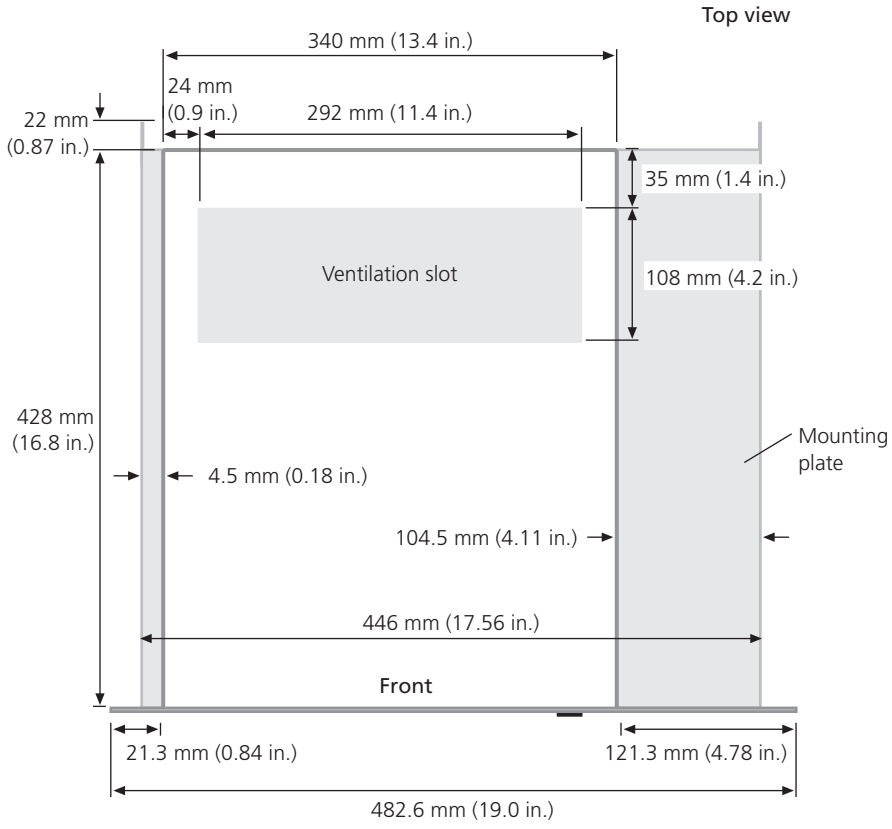
The illustrations below show the outer dimensions and the positions of ventilation slots of the 19" rack version.

Front view



Side view





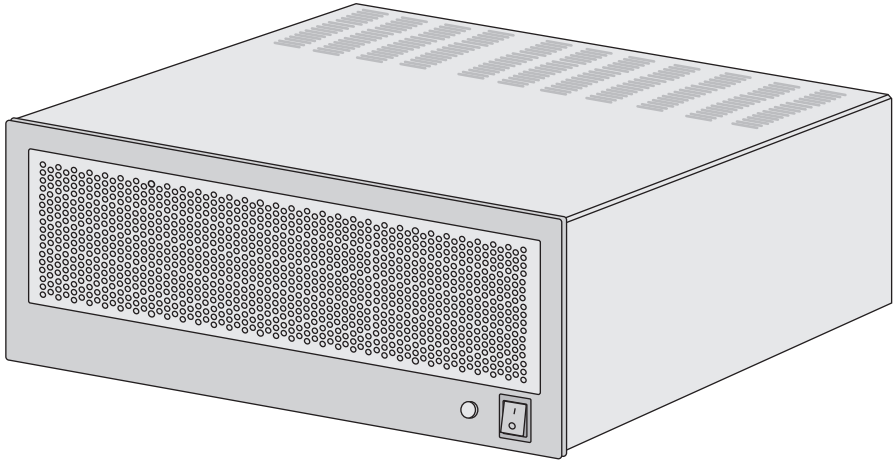
PX20 Expansion Box

Versions

The PX20 Expansion Box is available as desktop version and as 19'' rack version.

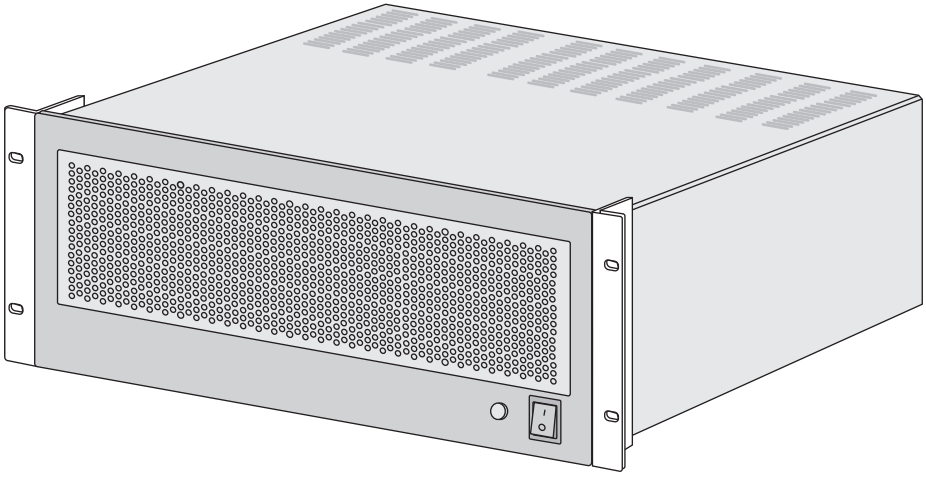
Desktop version

The illustration below shows the currently delivered revision of the box.



19'' rack version

The illustration below shows the currently delivered revision of the box.



Where to go from here

Information in this section

PX20 Data Sheet	261
PX20: Ensuring Correct Operating Temperatures	262
PX20 Dimension Drawings	265

PX20 Data Sheet

Technical data

The following table provides the technical characteristics of the PX20:

Parameter		Specification
Chassis	General	■ Desktop box ■ 19" rack-mount version available
	Slots	■ 20 full-size 16-bit ISA slots ■ 1 slot reserved for Link Board or slot CPU board for Ethernet connection
	Cooling	■ Active cooling with temperature controlled fans (with dust filter) ■ Dust filter: A pack of three replacement filters is available. Order number: FILTER_PAD_PX20
Power supply	Input voltage range	Mains voltage 100 … 240 V / 50-60 Hz
	Maximum output power	Up to board revision 3.1: ■ 350 W @ 100 … 170 VAC
		As of board revision 3.2: ■ 400 W @ 100 … 170 VAC ■ 450 W @ 170 … 240 VAC
Maximum output current (The sum of the output currents must not exceed the maximum output power of the supply rails.)	Up to revision 3.1	■ 50 A @ +5 V ■ 10 A @ +12 V ■ 12 A @ -5 V ■ 5 A @ -12 V
	Revision 3.2	■ 60 A @ +5 V ■ 12 A @ +12 V ■ 10 A @ -5 V ■ 5 A @ -12 V
	Revision 4.1	■ 70 A @ +5 V ■ 12 A @ +12 V ■ 10 A @ -5 V ■ 4 A @ -12 V
	Revision 4.2	■ 75 A @ +5 V ■ 12 A @ +12 V ■ 10 A @ -5 V ■ 4 A @ -12 V
	As of Revision 5.1	■ 75 A @ +5 V ■ 12 A @ +12 V ■ 4 A @ -12 V

Parameter		Specification
Reset switch (up to revision 3.2)		■ The switch has no function. ■ The lamp in the switch lights up when the expansion box power supply provides +12 V. ■ Approx. 10,000 h life span of the lamp
Power LED (as of revision 4.1)		The LED lights up when the expansion box power supply provides +12 V.
Grounding		Circuit ground is connected to the chassis and through that to the power system's protective ground.
Physical size		Refer to *PX20 Dimension Drawings* on page 265.
Rack mount version: space needed in a 19" rack	Height	4 U (HE)
	Width	17.1"
Weight (without boards)	Desktop version	■ 15.6 kg (34.4 lbs) ■ 16.0 kg (35.3 lbs)
	Rack-mount version	■ 14.6 kg (32.2 lbs) ■ 15.0 kg (33 lbs)
Ambient temperature (Ta) [1]		0 … 50 °C (32 … 122 °F)
Humidity		20 … 90 %, non-condensing

[1] The ambient temperature specified for boards installed inside the box (for example, the DS1006) can limit the stated temperature range.

As of revision 3.2, the revision number is labeled on the chassis and the PX20 is prepared for inserting max. two DS1006 Processor Boards. For more details on the different revisions, refer to http://www.dspace.de/goto?pxboxvers.

PX20: Ensuring Correct Operating Temperatures

Objective

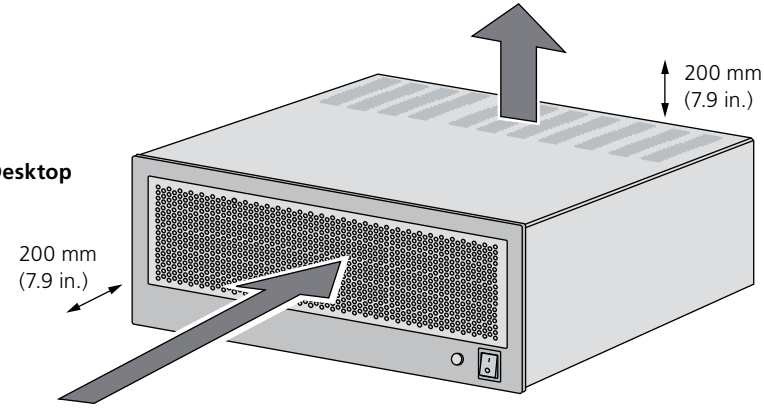
The operating temperatures of hardware devices directly affect their life time and their functionality. To avoid shortening the life times of the hardware components, ensure that the operating temperature of the dSPACE system does not exceed the specified ambient temperature, for example, due to improper installation.

Rules for proper installation

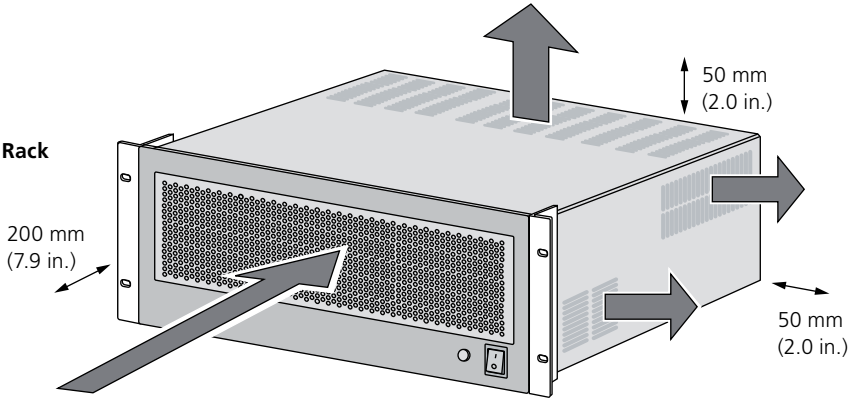
To ensure proper operation within the specified ambient temperature, observe the following rules:

- The temperature of the input airstream must be in the range of the specified min. and max. ambient temperatures (see data sheet).
- Position the box away from heat sources such as radiators, heat registers, power amplifiers, and other hardware that produces heat.
- Do not block the ventilation inlets and outlets. There must be a specified space (normally 200 mm (7.9 in.)) in front of them. In a rack, the space above the box must be at least 50 mm (2.0 in.). For details, see the illustrations below.

PX20 Desktop



PX20 Rack



Measures in borderline situations

If you cannot fulfill the space requirement (as typically happens in a rack-mount situation), and if you are not sure whether the ambient temperature can be kept in the specified range while the dSPACE system is running, take the following steps:

1. Measure the temperature of the output airstream of the uninstalled box and of the box installed in a rack with other devices under operating conditions.

   Measurement condition: Measure the temperature of the output airstream after executing a typical real-time application (for example, a dSPACE demo application) on the hardware for at least 15 minutes.

2. Compare the two measured temperatures. If the difference exceeds 10 °C (18 °F), you must take suitable measures to improve the rack installation (for example, by using air ducts or external cooling devices) to lower the temperature of the output airstream.

Checking and replacing the dust filter

The fans of the PX20 have a dust filter. You have to check the dust filter for dirt at least once a year. More frequent checks may be necessary depending on the operating conditions. If the dust filter is dirty, you must replace it.



NOTICE

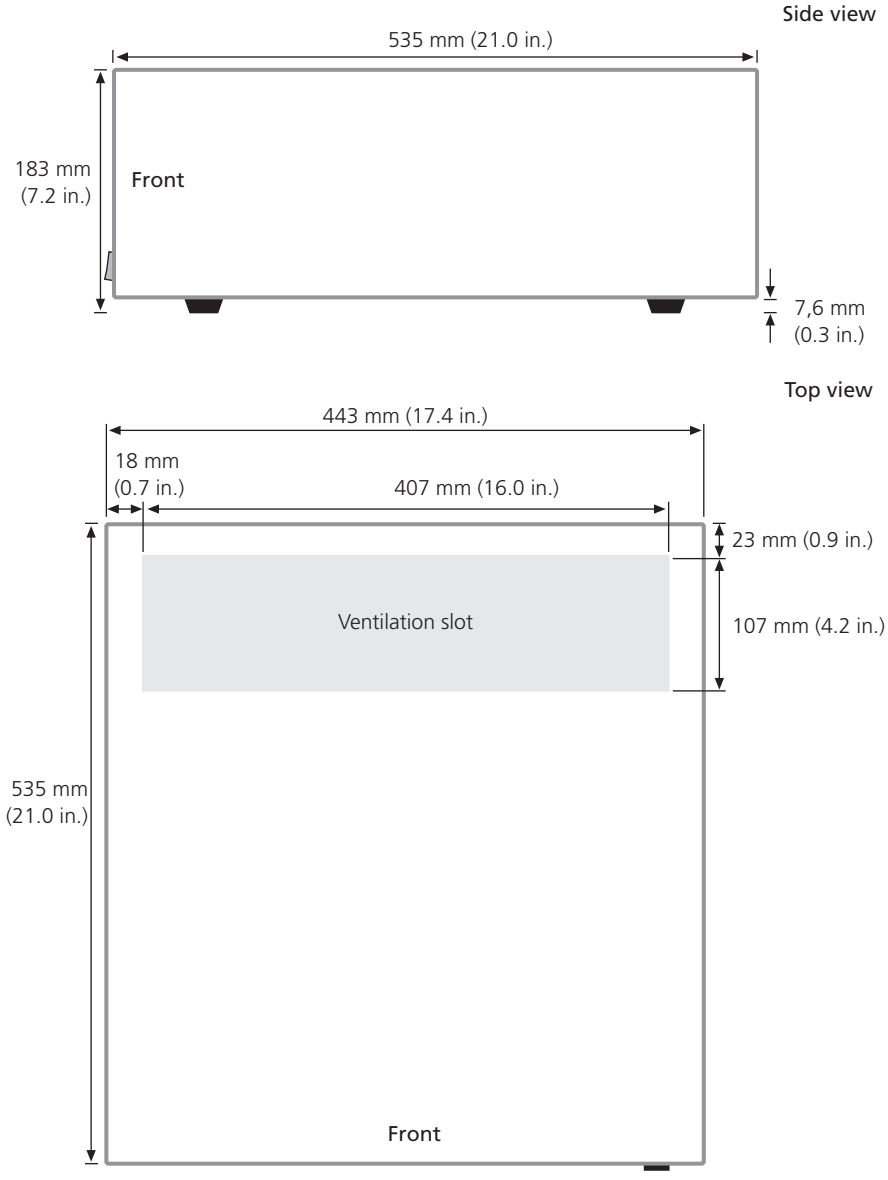
A dirty dust filter blocks the input air stream and increases the temperature in the box, which may shorten the life of the hardware components.

dSPACE provides a pack of three replacement dust filters with the order number: FILTER_PAD_PX20. For instructions, refer to *How to Check and Replace the Dust Filter of an Expansion Box* on page 50.

PX20 Dimension Drawings

Desktop version

The illustrations below show the outer dimensions and the position of ventilation slots of the desktop version.



19'' rack version

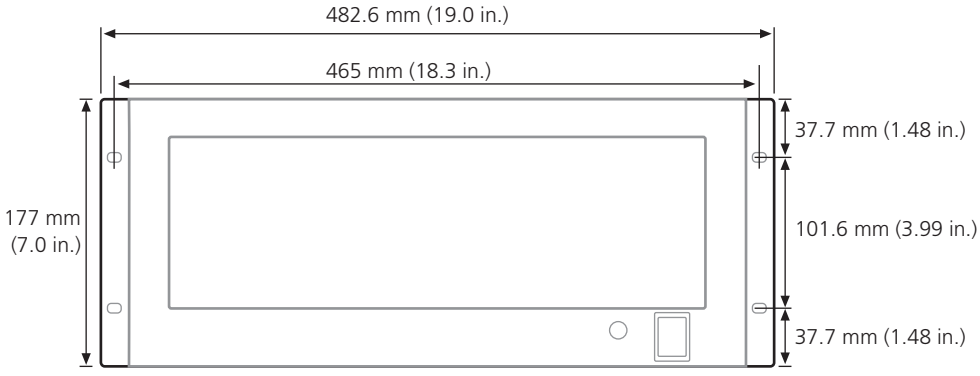
NOTICE

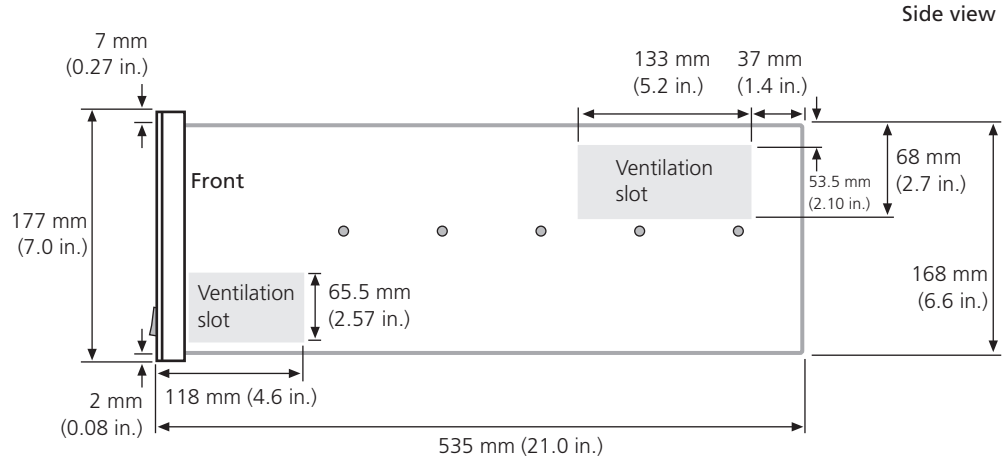
Incorrect mounting of the PX20 in a 19" rack damages the box.

To avoid damage, mount the box in the 19" rack by means of the tapped bore holes in the chassis and not only with the fixing holes at the front plate.

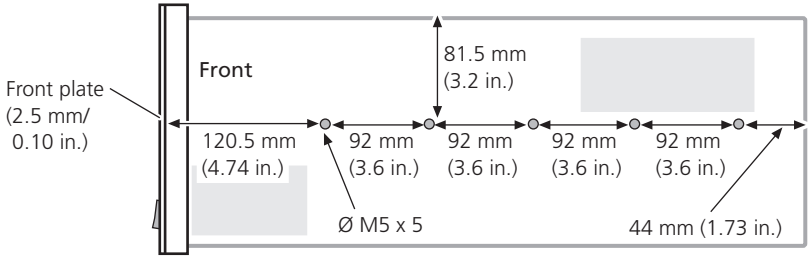
The illustration below show the outer dimensions and the positions of ventilation slots of the 19" rack version.

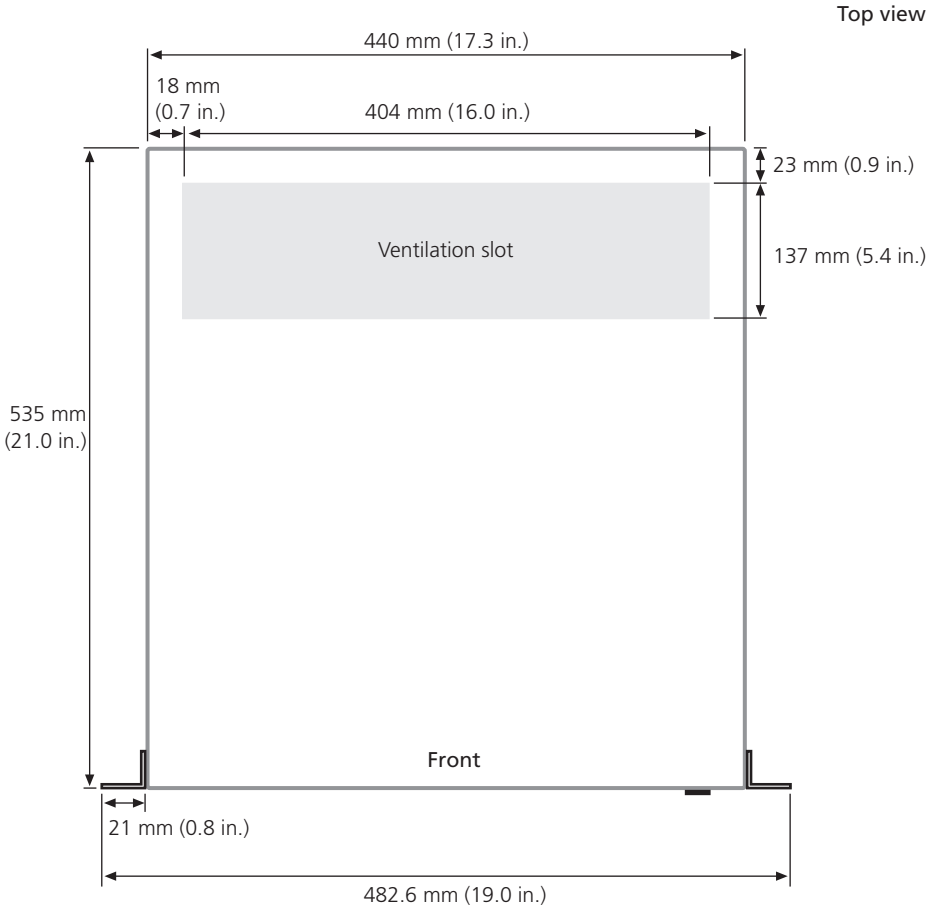
Front view





Positions of tapped holes





AutoBox

Objective

AutoBox is a special expansion box for using your dSPACE real-time hardware for in-vehicle control experiments. It can be mounted anywhere in a vehicle and connected to a car battery.

Where to go from here

Information in this section

AutoBox Data Sheet (AutoBox up to Version 3.0)	269
AutoBox Data Sheet (AutoBox Version 4.0 and later)	272
AutoBox: Ensuring Correct Operating Temperatures	275
AutoBox Dimension Drawings	277
Power Input Connector	279
AutoBox Status LEDs (Integrated as of AutoBox Version 4.0)	281
Lab Power Supply for AutoBox	285

AutoBox Data Sheet (AutoBox up to Version 3.0)

Technical data

The following table provides the technical characteristics of the AutoBox.

Parameter		Specification
General	Chassis	■ Compact aluminum chassis ■ Shock mounts with rubber shoes
	Slots	■ 7 full-size 16-bit ISA slots ■ 1 slot reserved for Link Board or slot CPU board for Ethernet connection (both not required for PHS-bus systems based on DS1007)
	Cooling and heating	■ Temperature-controlled fan with dust filter ■ Heater (optional) ■ Dust filter: A pack of three replacement filters is available. Order number: FILTER_PAD_ABX

Parameter		Specification
Power supply	Input voltage	■ 8 V … 60 V DC normal operating range ■ 10 V … 60 V DC continuous operation (> 30 min., fully equipped at max. ambient temperature) ■ Load-dump protection up to 120 V
	Max. input current	■ 20 A @ 12 V nominal ■ 10 A @ 24 V nominal
	Overcurrent protection	■ 32 A foldback current line ■ 60 A external fuse
	Start-up current	≤ 50 A
	Quiescent current	< 1 mA with remote off
	Maximum output current (The sum of the output currents must not exceed the maximum output power of the supply rails.)	AutoBox version 1.0: ■ 20 A @ +5 V ■ 1.5 A @ +12 V ■ 1.5 A @ –12 V
		AutoBox version 2.0 and 3.0: ■ 20 A @ +5 V ■ 3.5 A @ +12 V ■ 1.5 A @ –12 V
	Maximum output power	135 W @ 12 V nominal input voltage
	Efficiency	60 % @ 12 V nominal input voltage
	Input/output isolation	250 V
Remote control	General	Overvoltage protected remote on/off input. The remote voltage should not exceed the supply voltage. Overvoltage protection of the remote pin is also 100 V. If you connect the remote pin to the car battery directly, the AutoBox will always be turned on, and the car battery will then soon be exhausted if the engine is not running. A switch is therefore highly recommended.
	Input resistance at remote input	47 kΩ tied to GND
	Remote on voltage	> 4 V
	Remote off voltage	< 1 V
Power input connector		■ 7-pin male connector ■ For the pinout, refer to *Power Input Connector* on page 279.

Parameter		Specification
Shock and vibration test	EN 600068-2-6	■ Mechanical test of resistance to vibration ■ Test conditions: Sinusoidal vibration, 3-axis test, 5 … 2000 Hz, up to 9 g, 30 minutes per axis ■ During the test AutoBox continuously executed a program, including I/O without any failures.
	EN 600068-2-27	■ Mechanical test of shock resistance ■ Test conditions: Shock, 3-axis test, 11 ms at 15 g ■ During the test AutoBox continuously executed a program, including I/O without any failures.
Heater (optional)	Operating principle	The heater is a PTC thermistor (PTC = positive temperature coefficient). It regulates the heat output power itself, depending on the temperature of the air flow from the upstreamed fan: ■ Low temperature -> high current -> high heat output ■ High temperature -> low current -> low heat output The PTC is switched on automatically by the AutoBox power supply, if the temperature of the air flow is below 0 °C (32 °F).
	Power consumption	■ 60 W … 200 W, temperature-controlled ■ From car battery
Mounting positions		■ Horizontal position (with shock mounts below) ■ Vertical position ■ Not allowed: upside down position
Grounding		Circuit ground is connected to ground of the backplane, which is isolated from car battery ground.
Physical size		Refer to *AutoBox Dimension Drawings* on page 277.
Weight (without boards)		Approx. 5.3 kg (11.7 lbs)
Ambient temperature		■ 0 … 55 °C (32 … 131 °F) ■ –10 … 55° C (14 … 131 °F) with optional heater

AutoBox Data Sheet (AutoBox Version 4.0 and later)

Technical data

The following table provides the technical characteristics of the AutoBox.

Parameter		Specification
General	Chassis	■ Compact aluminum chassis ■ Shock mounts with rubber shoes
	Slots	■ 7 full-size 16-bit ISA slots ■ 1 slot reserved for Link Board or slot CPU board for Ethernet connection (both not required for PHS-bus systems based on DS1007)
	Cooling and heating	■ Temperature-controlled fan with dust filter ■ No heater option ■ Dust filter: A pack of three replacement filters is available. Order number: FILTER_PAD_ABX

Parameter		Specification
Power supply	Input voltage	■ 10 V … 60 V DC normal operating range ■ 6 V … 10 V DC undervoltage crank condition, time limited (> 10 s @ 6 V DC, measured at input connector)

	Load dump protection [1]	■ 60 V … 70 V DC
		  ■ Fully operational, not time limited
		  ■ Meets transient test case of 48 V car onboard supply system
		■ 70 V … 100 V DC [1]:
		  ■ Delayed shutdown depending on input overvoltage level and load
		■ Reserve protection up to -100 V DC [1]

	Max. input current [2]	■ 30 A @ 12 V input voltage ■ 15 A @ 24 V input voltage ■ 7.5 A @ 48 V input voltage
	Input protection	Adaptive overcurrent/short-circuit protection
	Start-up current	■ Max. 6 A ■ Soft start ■ 230 ms @ 12 V DC start-up time
	Quiescent current	■ < 1 mA with remote off @ 12 V ■ < 3 mA with remote off @ 48 V
	Maximum output current [2] (The sum of the output currents must not exceed the maximum output power of the supply rails.)	■ 40 A @ +5 V ■ 10 A @ +12 V ■ 3 A @ –12 V
	Maximum output power [2]	300 W
	Efficiency	■ > 85% within input voltage operation range ■ Approx. 90 % @ 48V input voltage
	Input/output isolation [1]	100 V

Parameter		Specification
Remote control	General	Overvoltage protected remote on/off input. Overvoltage protection of the remote pin is also 100 V. If you connect the remote pin to the car battery directly, the AutoBox will always be turned on, and the car battery will then soon be exhausted if the engine is not running. A switch is therefore highly recommended.
	Input resistance at remote input	44 kΩ tied to GND
	Remote on voltage	> 4 V
	Remote off voltage	< 1 V
Power input connector		■ 7-pin male connector ■ Max. 20 µH differential mode inductance for the supply cabling ■ For the pinout, refer to *Power Input Connector* on page 279.
Status LEDs		■ 1 multi-color LED on the bracket of the power supply board of the AutoBox. ■ 3 multi-color LEDs on the component side of the power supply board of the AutoBox. ■ For a description of the display, refer to *AutoBox Status LEDs (Integrated as of AutoBox Version 4.0)* on page 281.
Shock and vibration test	EN 600068-2-6	■ Mechanical test of resistance to vibration ■ Test conditions: Sinusoidal vibration, 3-axis test, 5 … 2000 Hz, up to 9 g, 30 minutes per axis ■ During the test AutoBox continuously executed a program, including I/O without any failures.
	EN 600068-2-27	■ Mechanical test of shock resistance ■ Test conditions: Shock, 3-axis test, 11 ms at 15 g ■ During the test AutoBox continuously executed a program, including I/O without any failures.
Mounting positions		■ Horizontal position (with shock mounts below) ■ Vertical position ■ Not allowed: upside down position
Grounding		Circuit ground is connected to ground of the backplane, which is isolated from car battery ground.
Physical size		Refer to *AutoBox Dimension Drawings* on page 277.

Parameter	Specification
Weight (without boards)	Approx. 6.5 kg (14.3 lbs)
Ambient temperature	0 … 55 °C (32 … 131 °F)

[1] Maximum voltage between any input pins or any input pins and output ground must not exceed 100 V.
[2] Cannot be reached in standard AutoBox configuration (DS1005 or DS1007 with various I/O boards).

AutoBox: Ensuring Correct Operating Temperatures

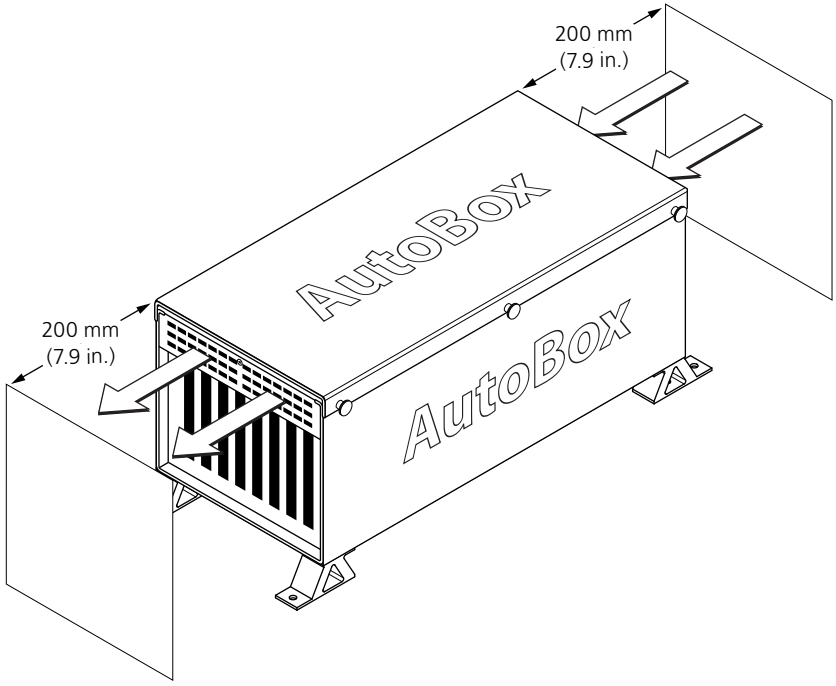
Objective

The operating temperatures of hardware devices directly affect their life time and their functionality. To avoid shortening the life times of the hardware components, ensure that the operating temperature of the dSPACE system does not exceed the specified ambient temperature, for example, due to improper installation.

Rules for proper installation

To ensure proper operation within the specified ambient temperature, observe the following rules:

- The temperature of the input airstream must be in the range of the specified min. and max. ambient temperatures (see data sheet).
- Position the box away from heat sources such as radiators, heat registers, power amplifiers, and other hardware that produces heat.
- Do not block the ventilation inlets and outlets. There must be a specified space (normally 200 mm (7.9 in.)) in front of them. For details, see the illustrations below.



Checking and replacing the dust filter

The fans of AutoBox have a dust filter. You have to check the dust filter for dirt at least once a year. More frequent checks may be necessary depending on the operating conditions. If the dust filter is dirty, you must replace it.



NOTICE

A dirty dust filter blocks the input air stream and increases the temperature in the box, which may shorten the life of the hardware components.

dSPACE provides a pack of three replacement dust filters (order number: FILTER_PAD_ABX). For the Tandem-AutoBox two dust filters are required. For instructions, refer to *How to Check and Replace the Dust Filter of an Expansion Box* on page 50.

AutoBox Dimension Drawings

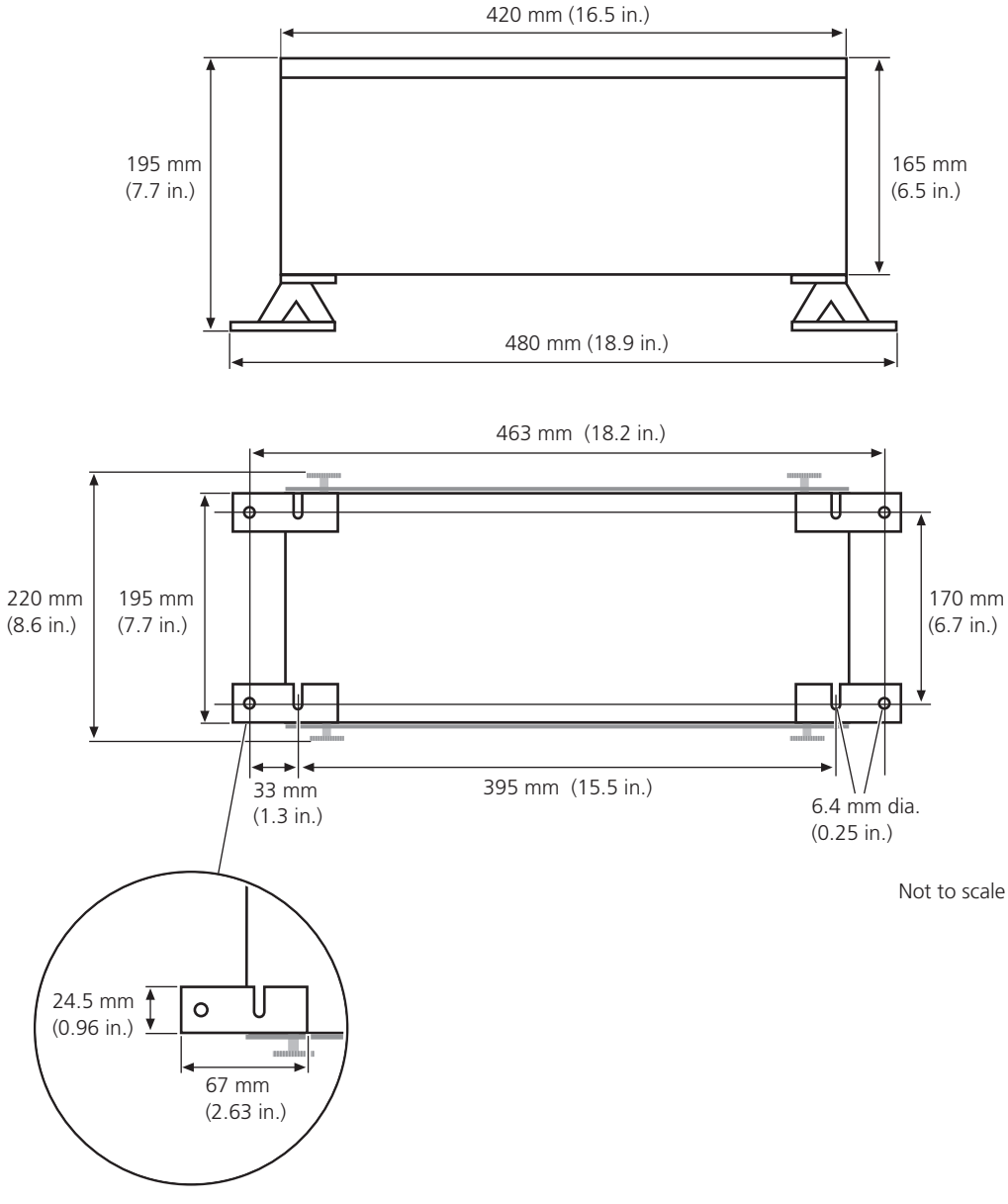
General rule



For mounting you should add approx. 0.1 m (3.9 in.) space to the outer dimensions of the AutoBox. This is to allow the AutoBox to vibrate under extreme conditions without bumping against other devices.

AutoBox without heater

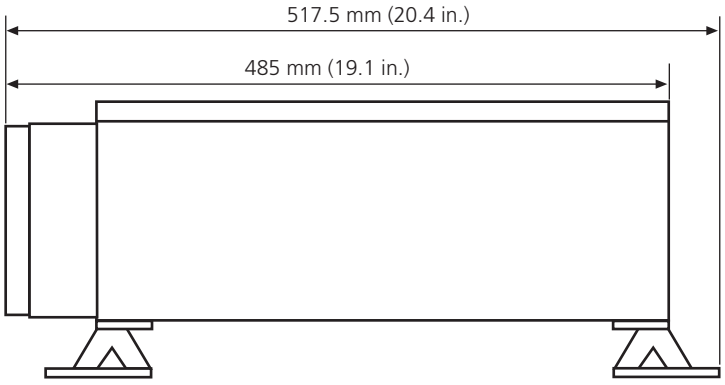
The following diagrams show the physical dimensions of the AutoBox without heater.



Not to scale

AutoBox with heater

The following diagram shows the physical dimensions of the AutoBox with heater that diverge from the one without heater.



Not to scale

Autobox Version 4.0 and later is not available with an optional heater.

Power Input Connector

Objective

Each power supply unit provides a power input connector. It is a 7-pin, male connector with two high-current pins. It is adapted from a 15-pin Sub-D connector.

Matching cable

One mating connector with connecting leads is included in the AutoBox package.

This cable is intended to operate the AutoBox with a laboratory power supply during development. Therefore, pin 4 (remote) is shorted to pin A2 inside the connector in order to save a separate switch. *Do not use this cable in the vehicle. Otherwise, the AutoBox will always be turned on.*

As of March 2009, the VBAT wire (red) contains a melting fuse. The red wire has a cross-section of 10 mm², the black wire of 6 mm². Depending on the AutoBox version, the melting fuse must have the following characteristics:

- AutoBox up to Version 3.0: 60 A/32 V, time lag
- AutoBox Version 4.0 and later: 25 A/32 V, time lag

  The cable for this AutoBox versions is labeled CB402AB.

To avoid damage, do not use a cable with cross-sections less than 6 mm². Note that the cable which is supplied to connect MicroAutoBox 1401/1507 to the power supply provides only 1.5 mm² cross-section wires.

Warnings

WARNING

Hazardous voltages

Even a brief disconnection of the battery while the engine is running results in a load dump of the car generator producing hazardous voltages of more than 100 V.

- Turn off the engine while connecting or disconnecting the car battery.

Not valid for AutoBox Version 4.0 and later:

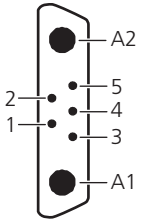
NOTICE

Reverse polarity destroys the AutoBox power supply even if the remote control input is turned off.

- Double check the supply voltage polarity of AutoBox.

Pinout

The following illustration shows the pinout (front view).

Connector	Pin	Signal	Pin	Signal
	A2	Positive supply voltage [1]		
			5	Reserved, do not use
	2	Reserved, do not use	4	Remote control [2]
	1	Reserved, do not use	3	Reserved, do not use
	A1	Negative supply voltage (0 V)		

[1] Up to AutoBox Version 3.0: 8 V … 60 V DC. AutoBox Version 4.0 and later: 6 V … 60 V DC.

[2] If you use the matching cable supplied by dSPACE the remote control line is connected to positive supply voltage within the connector shell. This cable is intended for use with a lab power supply only.

AutoBox Status LEDs (Integrated as of AutoBox Version 4.0)

Objective

As of AutoBox Version 4.0, the AutoBox is equipped with four multi-color LEDs, which display the current status of the power supply of the AutoBox:

- There is one main status LED available on the bracket of the power supply board.
- There are three diagnostic LEDs on the component side of the power supply board.

Possible displays of the LEDs

The multi-color LEDs show states, warnings and errors in different colors and with flashing codes. The frequency of a flashing LED is 1 Hz. In the illustration below the flashing codes are explained in general. The colors are examples.



LED is lit

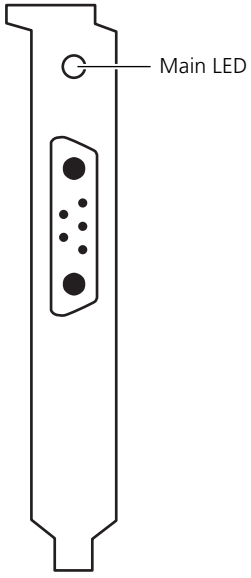
LED flashes with short on-time and long off-time

LED flashes with long on-time and short off-time

LED is lit most of the time and flashes in another color

Main LED

The main LED is located on the bracket as shown below, so that you can check the main state of the AutoBox from the outside.

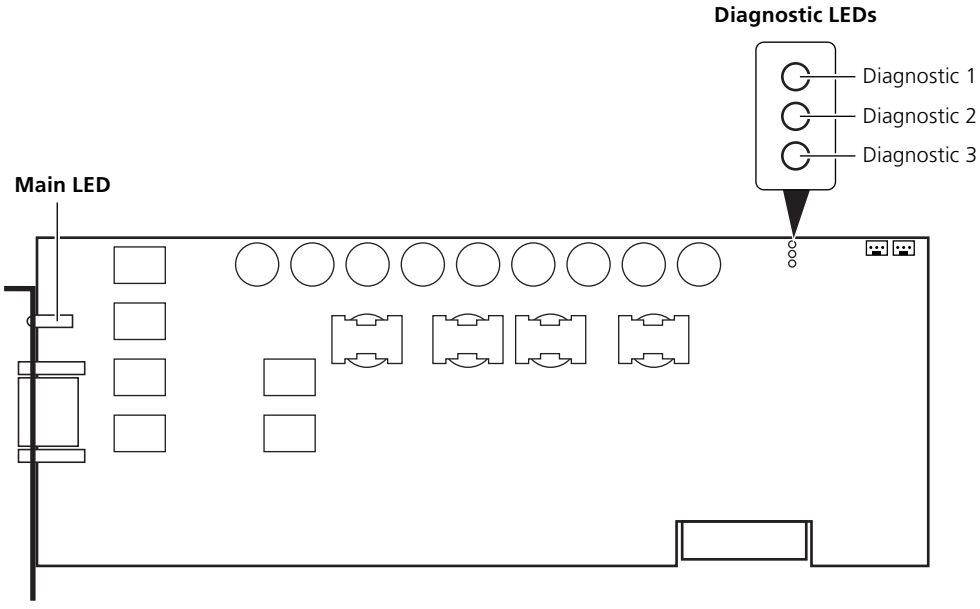


The table below lists the available displays of the main LED and describes the related meanings.

LED State	Description of State
Is not lit.	Power supply is switched off.
Flashes yellow	The start-up sequence has not been executed, because the input voltage is outside the required range. For a detailed fault localization, look at the diagnostic LEDs located inside the AutoBox.
Lit yellow	Start-up sequence is being executed.
Lit green	The power supply of AutoBox is operating without faults.
Lit red	A fault has occurred, and the power supply has been shut down. When troubleshooting, first check the power supply connected to the AutoBox. If you use a laboratory power supply, check whether it can provide sufficient power: ■ Check the setting for current limiting. If necessary increase the limit. ■ Check the power supply for voltage drops. If you cannot find the remedy, look at the diagnostic LEDs located inside the AutoBox.

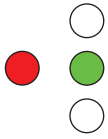
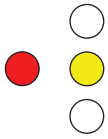
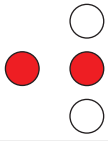
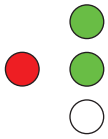
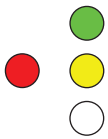
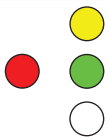
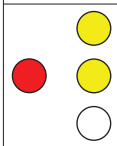
Diagnostic LEDs

The illustration below shows the locations of the three diagnostic LEDs on the component side of the power supply board inside the AutoBox.



The table below lists the states of the LEDs and describes their meanings.

LED Display	Main LED	Diagnostic LED	Description of State	
Legend: Main ○ ○ Diagnostic 1 ○ Diagnostic 2 ○ Diagnostic 3				
○ ◔ ● ○	Flashes yellow	Diagnostic 2 lit green.	Startup problems	Input voltage is too low to start. Startup will be delayed until input voltage reaches valid starting condition.
○ ◔ ● ○	Flashes yellow	Diagnostic 2 lit yellow.		Input voltage is too high to start. Startup will be delayed until input voltage reaches valid starting condition.

LED Display	Main LED	Diagnostic LED	Description of State	
	Lit red	Diagnostic 2 lit green.	Faults related to input voltage	Input undervoltage. AutoBox power supply has been shut down because input voltage too low. Maximum time for a cold crank event exceeded or just too low to operate.
	Lit red	Diagnostic 2 lit yellow.		Input overvoltage. AutoBox power supply has been shut down because input voltage too high. The maximum time for an overvoltage event (for example, load dump) has been exceeded.
	Lit red	Diagnostic 2 lit red.		Load dump overload: The energy of the overvoltage event was too high. AutoBox power supply has been shut down.
	Lit red	■ Diagnostic 1 lit green. ■ Diagnostic 2 lit green.	Faults related to outputs	Output voltage lost: This may happen if an overloadoccurs on one output voltage rail.
	Lit red	■ Diagnostic 1 lit green. ■ Diagnostic 2 lit yellow.		Output overload: Too much output power.
	Lit red	■ Diagnostic 1 lit yellow. ■ Diagnostic 2 lit green.	Temperature or cooling problems	Temperature fault: The measured temperatures on the power supply board are either too high or too low.
	Lit red	■ Diagnostic 1 lit yellow. ■ Diagnostic 2 lit yellow.		Fan failure: One fan is rotating too slowly or not rotating at all.

If the diagnostic LEDs display a pattern which is not shown and explained here, contact dSPACE Support for further help.

Lab Power Supply for AutoBox

Objective

For experiments with the AutoBox in a laboratory, you can use a laboratory power supply instead of the car battery. If you use AutoBox up to Version 3.0 with a lab power supply, note the requirements and information provided below.



These guidelines are not relevant for AutoBox Version 4.0 and later.

Guidelines

- The specified input voltage for the AutoBox power supply (8 V … 60 V DC normal operating range) must not be exceeded.
- Your laboratory power supply must be able to supply approx. 240 W continuous output power. This means, for example if all slots in the AutoBox are filled:
  - At 12 V nominal input voltage your lab power supply must provide 20 A.
  - At 60 V input voltage (max. permissible) your lab power supply must provide 4 A.

  Good results have been optained with 24 V-laboratory power supplies.
- If your lab power supply provides adjustable current limiting: Use always the maximum value.
- The AutoBox needs nearly 50 A start-up current on power-up for a few ms (regardless of the input voltage and the load). If your lab power supply does not provide this current, you can take the following measures:
  - Connect a capacitor parallel to the output pins of the lab power supply. It works like a current reservoir to reduce the load on the lab power supply during turning on the AutoBox.
  - The capacitor should be generously dimensioned and must be certified for the selected input voltage.



The capacitor provides the needed start-up current only if it is charged. Therefore you must switch on the lab power supply long enough before you switch on the AutoBox.

Tandem-AutoBox

Objective

Tandem-AutoBox is a special expansion box for using your dSPACE real-time hardware for in-vehicle control experiments. It can be mounted anywhere in a vehicle and connected to a car battery.

The main differences between AutoBox and Tandem-AutoBox are the following:

- Tandem-AutoBox nearly doubles the space for inserting dSPACE boards.

Where to go from here

Information in this section

Tandem-AutoBox Data Sheet (Tandem-AutoBox up to Version 4.0)	286
Tandem-AutoBox: Ensuring Correct Operating Temperatures	289
Tandem-AutoBox Dimension Drawings	291
Power Input Connector	293
Lab Power Supply for Tandem-AutoBox	295

Tandem-AutoBox Data Sheet (Tandem-AutoBox up to Version 4.0)

Technical data

The following table provides the technical characteristics of the Tandem-AutoBox.

Parameter		Specification
General	Chassis	■ Compact aluminum chassis ■ Shock mounts with rubber shoes
	Slots	■ 14 full-size 16-bit ISA slots ■ 1 slot reserved for Link Board or slot CPU board for Ethernet connection
	Cooling and heating	■ Temperature-controlled fan with dust filter [1)] ■ Heater (optional) [1)] ■ Dust filter: A pack of three replacement filters is available. Order number: FILTER_PAD_ABX

Parameter		Specification
Power supply	Tandem-AutoBox	■ Two power supplies (each identical to the AutoBox power supply). They must both be connected. ■ All specifications stated here are valid for each of the two built-in power supplies.
	Operating principle	Two-stage switching power supply with wide input voltage range and independent output regulation.
	Input voltage	■ 8 V … 60 V DC normal operating range ■ 10 V … 60 V DC continuous operation (> 30 min., fully equipped at max. ambient temperature) ■ Load-dump protection up to 120 V
	Input current	■ 20 A at 12 V nominal ■ 10 A at 24 V nominal
	Overcurrent protection	■ 32 A foldback current line ■ 60 A external fuse
	Start-up current	≤ 50 A
	Quiescent current	< 1 mA with remote off
	Maximum output current (The sum of the output currents must not exceed the maximum output power of the supply rails.)	Up to Tandem-AutoBox Version 2.0: ■ 40 A @ +5 V ■ 3 A @ +12 V ■ 3 A @ –12 V
		Tandem-AutoBox Version 3.0 and 4.0: ■ 40 A @ +5 V ■ 7 A @ +12 V ■ 3 A @ –12 V
	Maximum output power	270 W @ 12 V nominal input voltage
	Efficiency	60 % @ 12 V nominal input voltage
	Input/output isolation	250 V

Parameter		Specification
Power supply	Remote control	Overvoltage protected remote on/off input. The remote voltage should not exceed the supply voltage. Overvoltage protection of the remote pin is also 100 V. If you connect the remote pin to the car battery directly, the AutoBox will always be turned on, and the car battery will then soon be exhausted if the engine is not running. A switch is therefore highly recommended.
	Input resistance at remote input	■ 47 kΩ tied to GND ■ The input resistance also protects the remote input if the remote signal is switched on while the supply voltage is missing due to a blown fuse, for example.
	Remote on voltage	> 4 V
	Remote off voltage	< 1 V
	Power input connector	■ 7-pin male connector ■ For the pinout refer to *Power Input Connector* on page 279.
Shock and vibration test	EN 600068-2-6	■ Mechanical test of resistance to vibration ■ Test conditions: Sinusoidal vibration, 3-axis test, 5 … 2000 Hz, up to 9 g, 30 minutes per axis ■ During the test AutoBox continuously executed a program, including I/O without any failures.
	EN 600068-2-27	■ Mechanical test of shock resistance ■ Test conditions: Shock, 3-axis test, 11 ms at 15 g ■ During the test AutoBox continuously executed a program, including I/O without any failures.
Heater (optional)	Operating principle	The heater is a PTC thermistor (PTC = positive temperature coefficient). It regulates the heat output power itself, depending on the temperature of the air flow from the upstreamed fan: ■ Low temperature -> high current -> high heat output ■ High temperature -> low current -> low heat output The PTC is switched on automatically by the AutoBox power supply, if the temperature of the air flow is below 0 °C (32 °F).
	Power consumption [2)]	■ 60 W … 200 W, temperature-controlled ■ From car battery

Parameter	Specification
Mounting positions	■ Horizontal position (with shock mounts below) ■ Vertical position ■ Not allowed: upside down position
Grounding	Circuit ground is connected to ground of the backplane, which is isolated from car battery ground.
Physical size	Refer to *Tandem-AutoBox Dimension Drawings* on page 291.
Weight (without boards)	Approx. 10.6 kg (21.2 lbs)
Ambient temperature	■ 0 … 55 °C (32 … 131 °F) ■ –10 … 55° C (14 … 131 °F) with optional heater

[1] In a Tandem-AutoBox two fans/two heaters (if this option is used) are installed.
[2] The specification stated is valid only for one heater. Note: If you use Tandem-AutoBox with the heater option, two heaters are installed and therefore the power consumption doubles.

Tandem-AutoBox: Ensuring Correct Operating Temperatures

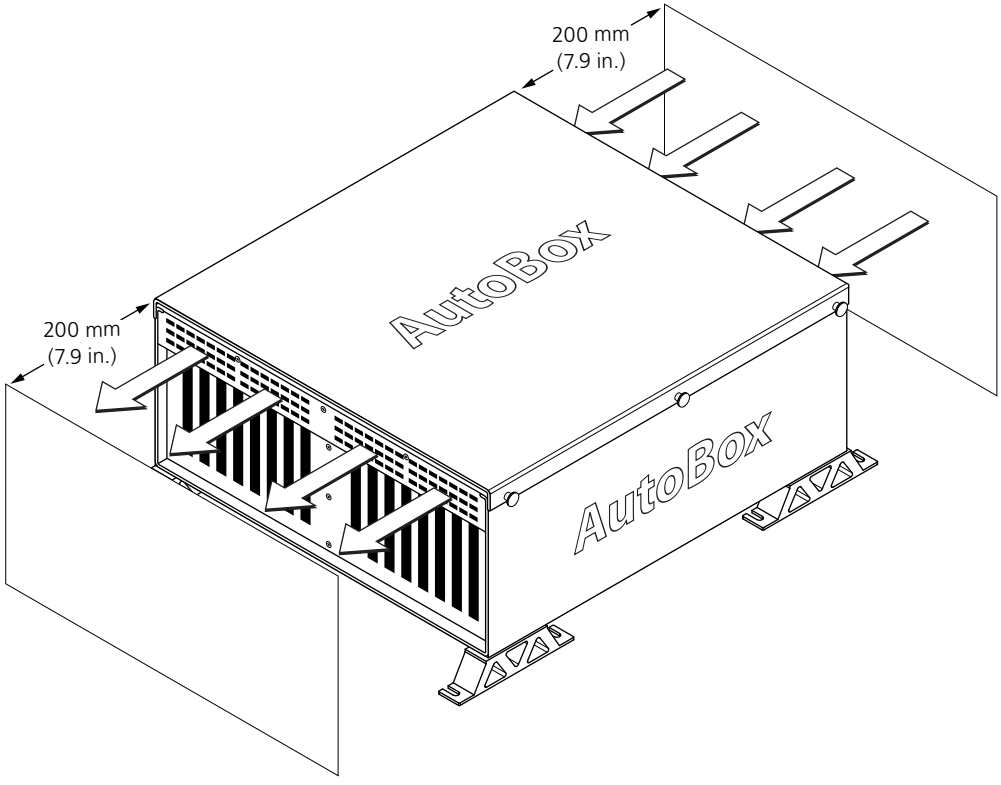
Objective

The operating temperatures of hardware devices directly affect their life time and their functionality. To avoid shortening the life times of the hardware components, ensure that the operating temperature of the dSPACE system does not exceed the specified ambient temperature, for example, due to improper installation.

Rules for proper installation

To ensure proper operation within the specified ambient temperature, observe the following rules:

- The temperature of the input airstream must be in the range of the specified min. and max. ambient temperatures (see data sheet).
- Position the box away from heat sources such as radiators, heat registers, power amplifiers, and other hardware that produces heat.
- Do not block the ventilation inlets and outlets. There must be a specified space (normally 200 mm (7.9 in.)) in front of them. For details, see the illustrations below.



Checking and replacing the dust filter

The fans of Tandem-AutoBox have a dust filter. You have to check the dust filter for dirt at least once a year. More frequent checks may be necessary depending on the operating conditions. If the dust filter is dirty, you must replace it.



NOTICE

A dirty dust filter blocks the input air stream and increases the temperature in the box, which may shorten the life of the hardware components.

dSPACE provides a pack of three replacement dust filters (order number: FILTER_PAD_ABX). For the Tandem-AutoBox two dust filters are required. For instructions, refer to *How to Check and Replace the Dust Filter of an Expansion Box* on page 50.

Tandem-AutoBox Dimension Drawings

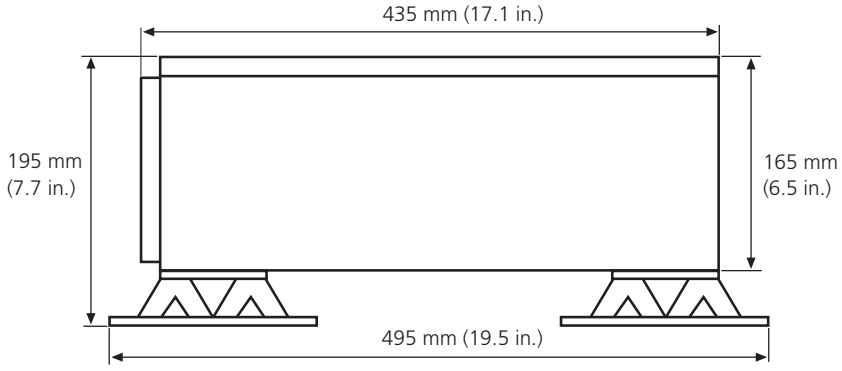
General rule

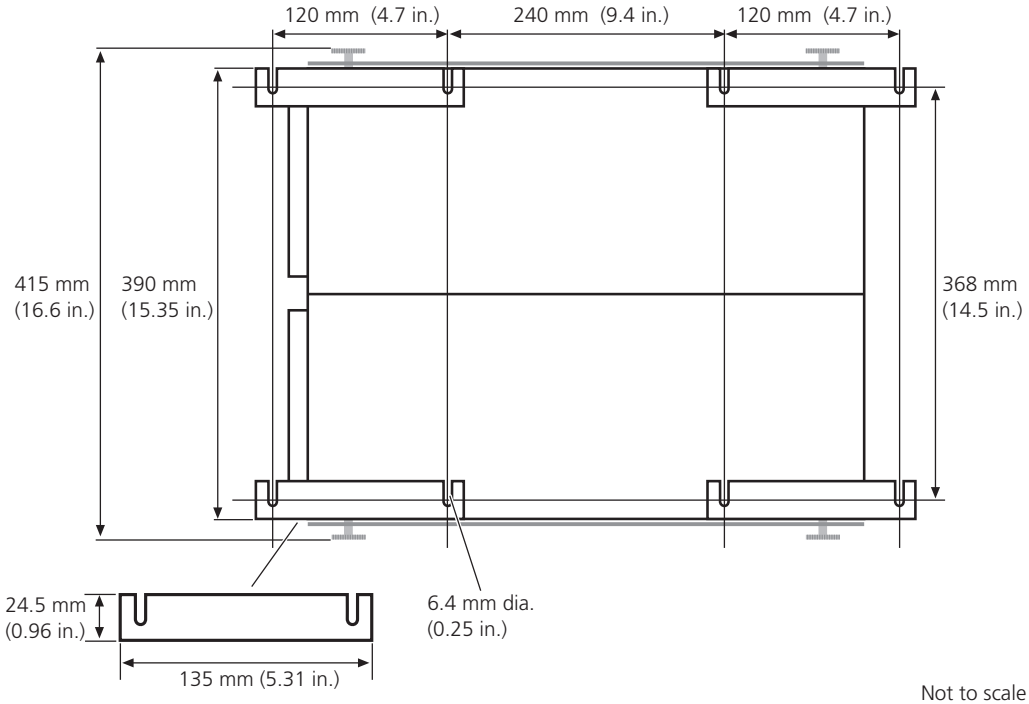


For mounting you should add approx. 0.1 m (3.9 in.) space to the outer dimensions of the Tandem-AutoBox. This is to allow the Tandem-AutoBox to vibrate under extreme conditions without bumping against other devices.

Tandem-AutoBox without heater

The following diagrams show the physical dimensions of the Tandem-AutoBox without heater.

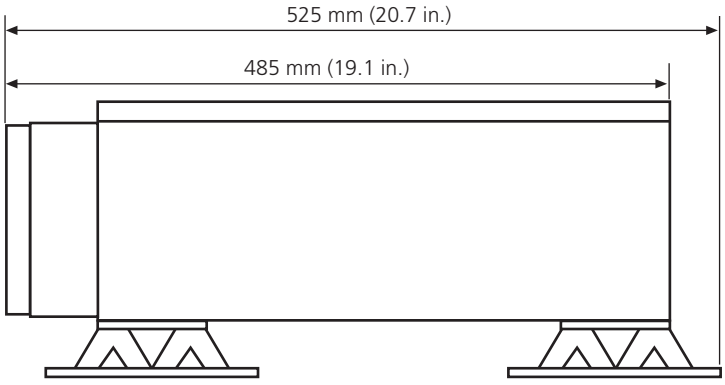




Not to scale

Tandem-AutoBox with heater

The following diagram shows the physical dimensions of the Tandem-AutoBox with heater that diverge from the one without heater.



Not to scale

Power Input Connector

Objective

Each power supply unit provides a power input connector. It is a 7-pin, male connector with two high-current pins. It is adapted from a 15-pin Sub-D connector.

Matching cable

One mating connector with connecting leads is included in the Tandem-AutoBox package (up to TandemAutoBox Version 4.0 = two connectors).

This cable is intended to operate the Tandem-AutoBox with a laboratory power supply during development. Therefore, pin 4 (remote) is shorted to pin A2 inside the connector in order to save a separate switch. *Do not use this cable in the vehicle. Otherwise, the Tandem-AutoBox will always be turned on.*

As of March 2009, the VBAT wire (red) contains a melting fuse. The melting fuse must provide the following characteristics: 60 A/32 V, time lag.

The red wire has a cross-section of 10 mm², the black wire of 6 mm².

To avoid damage, do not use a cable with cross-sections less than 6 mm². Note that the cable which is supplied to connect MicroAutoBox 1401/1507 to the power supply provides only 1.5 mm² cross-section wires.

Warnings



WARNING

Hazardous voltages

Even a brief disconnection of the battery while the engine is running results in a load dump of the car generator producing hazardous voltages of more than 100 V.

- Turn off the engine while connecting or disconnecting the car battery.



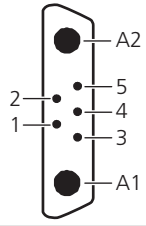
NOTICE

Reverse polarity destroys the Tandem-AutoBox power supply even if the remote control input is turned off.

- Double check the supply voltage polarity of AutoBox.

Pinout

The following illustration shows the pinout (front view).

Connector	Pin	Signal	Pin	Signal
	A2	Positive supply voltage (10 V … 60 V DC)		
			5	Reserved, do not use
	2	Reserved, do not use	4	Remote control [1]
	1	Reserved, do not use	3	Reserved, do not use
	A1	Negative supply voltage (0 V)		

[1] If you use the matching cable supplied by dSPACE the remote control line is connected to positive supply voltage within the connector shell. This cable is intended for use with a lab power supply only.

Lab Power Supply for Tandem-AutoBox

Objective

For experiments with the Tandem-AutoBox in a laboratory, you can use a laboratory power supply instead of the car battery. In this case you should note the requirements and information provided below. The following explanations relate only to the "AutoBox". Therefore the values stated are valid only for one power supply.

Guidelines

- The specified input voltage for the AutoBox power supply (8 V … 60 V DC normal operating range) must not be exceeded.
- Your laboratory power supply must be able to supply approx. 240 W continuous output power. This means, for example if all slots in the AutoBox are filled:
  - At 12 V nominal input voltage your lab power supply must provide 20 A.
  - At 60 V input voltage (max. permissible) your lab power supply must provide 4 A.

  Good results have been optained with 24 V-laboratory power supplies.
- If your lab power supply provides adjustable current limiting: Use always the maximum value.

- The AutoBox needs nearly 50 A start-up current on power-up for a few ms (regardless of the input voltage and the load). If your lab power supply does not provide this current, you can take the following measures:
  - Connect a capacitor parallel to the output pins of the lab power supply. It works like a current reservoir to reduce the load on the lab power supply during turning on the AutoBox.
  - The capacitor should be generously dimensioned and must be certified for the selected input voltage.



The capacitor provides the needed start-up current only if it is charged. Therefore you must switch on the lab power supply long enough before you switch on the AutoBox.

Connector Panel Enclosures

Connector and LED Panels

Objective

The connector and LED panels are installed in a 19" desktop box made from aluminum profiles as standard. They can optionally be mounted in a 19" industry rack.

Where to go from here

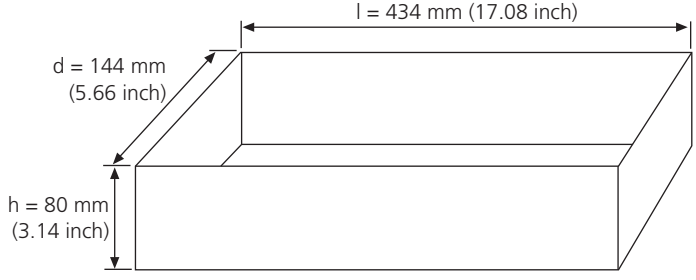
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19" Desktop Enclosure

Dimensions

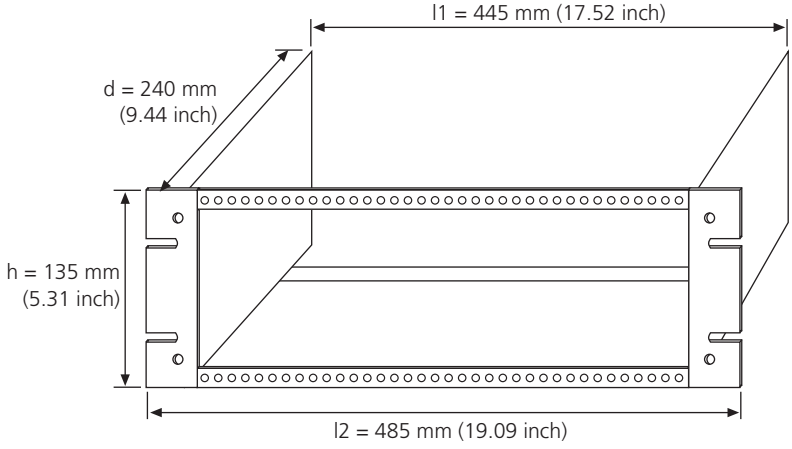
The illustration below shows the outer dimensions of the 19" desktop enclosure for connector and LED panels (CPs, CLPs and LPs).



19" Rack Enclosure

Dimensions

The illustration below shows the outer dimensions of a 19" rack enclosure for alternative installation of connector and LED panels (CPs, CLPs and LPs).



Numerics

19 inch rack (PX20) 49

A

adapter cable
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