

DS2001 High-Speed A/D Board

Features

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About This Document

Content This document provides feature-oriented access to the information you need to implement the functions of the DS2001.

Symbols

dSPACE user documentation uses the following symbols:

Symbol	Description
	Indicates a hazardous situation that, if not avoided, will result in death or serious injury.
	Indicates a hazardous situation that, if not avoided, could result in death or serious injury.
	Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.
	Indicates a hazard that, if not avoided, could result in property damage.
	Indicates important information that you should take into account to avoid malfunctions.
	Indicates tips that can make your work easier.
	Indicates a link that refers to a definition in the glossary, which you can find at the end of the document unless stated otherwise.
	Precedes the document title in a link that refers to another document.

Naming conventions

dSPACE user documentation uses the following naming conventions:

%name% Names enclosed in percent signs refer to environment variables for file and path names.

< > Angle brackets contain wildcard characters or placeholders for variable file and path names, etc.

Special folders

Some software products use the following special folders:

Common Program Data folder A standard folder for application-specific configuration data that is used by all users.

%PROGRAMDATA%\dSPACE\<InstallationGUID>\<ProductName>

or

%PROGRAMDATA%\dSPACE\<ProductName>\<VersionNumber>

Documents folder A standard folder for user-specific documents.

%USERPROFILE%\Documents\dSPACE\<ProductName>\<VersionNumber>

Local Program Data folder A standard folder for application-specific configuration data that is used by the current, non-roaming user.

%USERPROFILE%\AppData\Local\dSPACE\<InstallationGUID>\<ProductName>

Accessing dSPACE Help and PDF Files

After you install and decrypt dSPACE software, the documentation for the installed products is available in dSPACE Help and as PDF files.

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

- On its home page via Windows Start Menu
- On specific content using context-sensitive help via **F1**

dSPACE Help (Web) You can access the Web version of dSPACE Help at www.dspace.com.


To access the Web version, you must have a *mydSPACE* account.

PDF files You can access PDF files via the  icon in dSPACE Help. The PDF opens on the first page.

Introduction to the Features of the DS2001

Introduction

The DS2001 High-Speed A/D Board provides five parallel A/D channels that you can use for conversion of analog signals.

For the data sheet of the DS2001 and the connector panel CP2001, refer to [Data Sheets](#) (PHS Bus System Hardware Reference .

Where to go from here

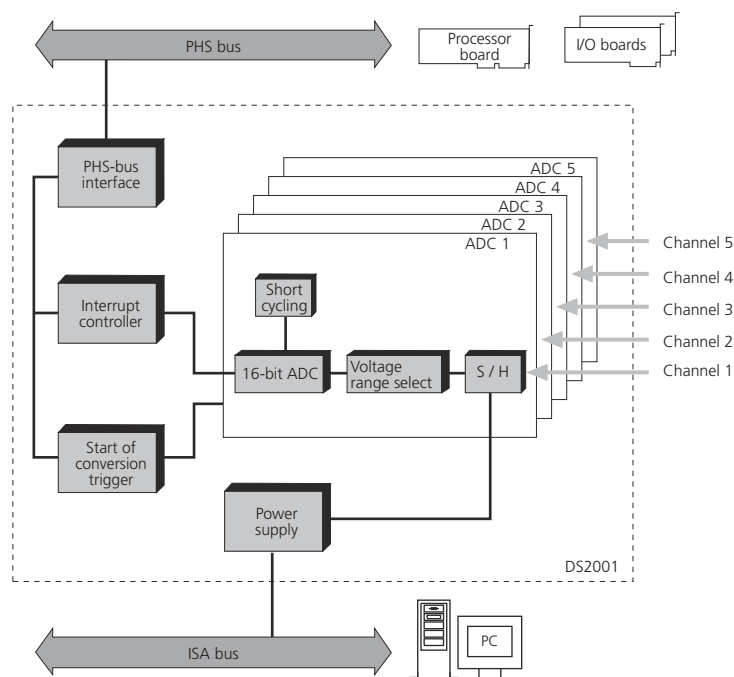
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DS2001 Architecture

Board overview

The following illustration gives an overview of the functional units and architecture of the DS2001:



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Feature Overview

Feature overview

The DS2001 provides the following features.

ADC unit

The ADC unit provides access to 5 input channels, refer to [ADC Unit](#) on page 11.

Interrupt control

The board provides 5 hardware interrupts, refer to [Interrupts Provided by the DS2001](#) on page 15.

Limitations	There are some limitations when you work with the DS2001, refer to Limitations on page 17.
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DS2001 Interfaces

Interfaces	The DS2001 has interfaces for connection to a PHS-bus-based system and external devices.
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Integration into a PHS-bus-based system

To be used, the DS2001 must be integrated into a PHS-bus-based system. While the DS2001 performs the required input tasks, the processor board takes over the calculation of the real-time model. That is, applications using DS2001 I/O features are implemented on the processor board.

Communication between processor board and I/O board is performed via the peripheral high speed bus: That is the PHS bus for connection to a dSPACE processor board.

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

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

The I/O board support depends on the dSPACE software release which you use. For a list of supported I/O boards, refer to [DS802 Data Sheet \(PHS Bus System Hardware Reference !\[\]\(4b7a79268f6ba26c1471d4232fffa85a_img.jpg\)](#)).

Connection to external devices

There are two different ways to connect external devices to the DS2001. To access the I/O units of the DS2001, connect external devices:

- To the 25-pin ADC connector P1 of the DS2001
- To the optional connector panel CP2001
- To the optional Sub-D/BNC adapter cable ADC-BNC5

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ADC Unit

Where to go from here

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Basics on the ADC Unit

Characteristics

The DS2001 controls an ADC unit featuring 5 parallel A/D converters (ADC1 ... ADC5). They have the following characteristics:

- 5 parallel A/D channels
- Simultaneous sample & hold
- ± 5 V or ± 10 V input voltage range (selectable for each of the 5 A/D converters individually)
- 4-, 8-, 12- or 16-bit resolution (selectable for each of the 5 A/D converters individually)

Adjustable ADC resolution

To perform faster conversion, you can lower the resolution to 4, 8 or 12 bits, refer to [Faster A/D Conversion via Short-Cycling](#) on page 12.

Synchronizing start of A/D conversion

You can start A/D conversion on one DS2001 board by using the ds2001_start function. This is possible for any number of channels on the same DS2001 separately or in parallel.

With RTI, A/D conversion is started automatically.

Interrupt on end of A/D conversion

The converters ADC1 ... ADC5 provide an interrupt at the end of an A/D conversion. For information on interrupt handling, refer to [Interrupts Provided by the DS2001](#) on page 15.

RTI/RTLib support

You can access the ADC unit via DS2001 Blockset and RTLib, refer to:

- ADC Unit in the *DS2001 RTI Reference*
- ADC Unit in the *DS2001 RTLib Reference*

Execution times

For details on the execution times and the corresponding measurement setup, refer to [Function Execution Times \(DS2001 RTLib Reference\)](#).

Connecting external devices

For an excerpt from the circuit diagram that shows the I/O circuit and for information on the electrical characteristics and signal conditioning of the ADC unit, refer to [Signal Connection to External Devices \(PHS Bus System Hardware Reference\)](#).

I/O mapping

The following table shows the mapping between the RTI block and RTLib functions and the corresponding pins used by the ADC unit:

Related RTI Block	Ch (RTI)	Related RTLib Functions	Ch (RTLib)	Conn. Pin	Pin on CP	Signal
DS2001_Bx	Ch 1	See ADC Unit	Ch 1	P1 12	P1	ADC1
	Ch 2		Ch 2	P1 22	P2	ADC2
	Ch 3		Ch 3	P1 7	P3	ADC3
	Ch 4		Ch 4	P1 17	P4	ADC4
	Ch 5		Ch 5	P1 2	P5	ADC5

Faster A/D Conversion via Short-Cycling

ADC short-cycling

To perform faster conversion, ADC short-cycling may be used.

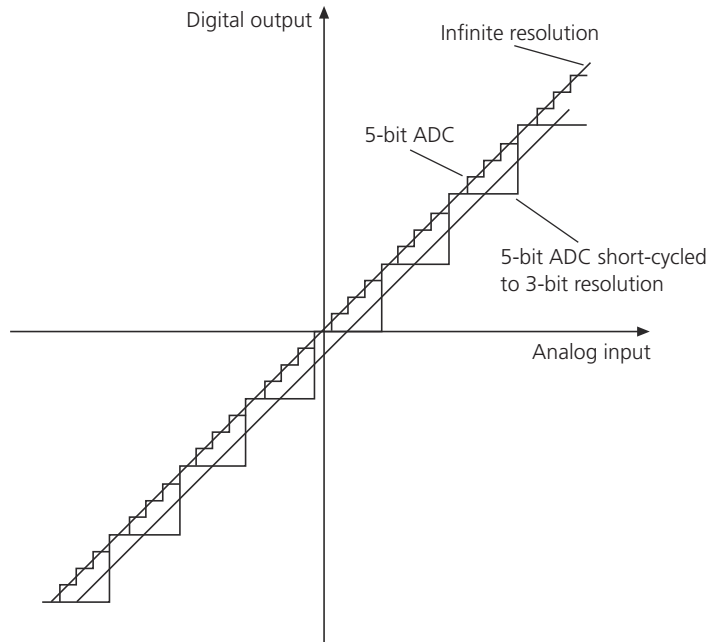
Faster conversion by lowering A/D resolution

The converters ADC1 ... ADC5 use the successive-approximation conversion technique.

The successive-approximation method performs 16 successive comparisons to provide the full 16-bit resolution. Short-cycling terminates the comparison sequence after a programmed number of steps. On a DS2001, you can short-cycle the conversion to 4-, 8- or 12-bit resolution.

Using ADC short-cycling to reduce the conversion time is only possible at the expense of lower resolution.

The following illustration shows the effects of ADC short-cycling:



For information on reducing conversion times, refer to [Function Execution Times \(DS2001 RTLib Reference !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)).

The execution time describes the conversion time (the time needed for conversion itself) plus the time needed for executing the access functions like starting the converter or reading data, for example.

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Interrupts

Interrupts Provided by the DS2001

Characteristics

The DS2001 provides access to 5 hardware interrupts:

Interrupt Type	Description	Refer to
ADC1 ... ADC5 end of conversion	Interrupt on end of A/D conversion (ADC1 ... ADC5)	ADC Unit on page 11

Note

There is a limitation for performing A/D conversion and using hardware interrupts of the DS2001 in the same application. Refer to [A/D Conversion and Interrupt Usage](#) on page 17.

Interrupt processing

Via the interrupt lines of the PHS bus, interrupts from the DS2001 are sent to the interrupt controller of the connected dSPACE processor board. Using RTI, the interrupts of the DS2001 can therefore be used to implement interrupt-driven tasks. For details see [Tasks Driven by Interrupt Blocks \(RTI and RTI-MP Implementation Guide !\[\]\(3cb60d42b10e53f9522bb0b392c1c4cd_img.jpg\)](#)).

RTI/RTLib support

With RTI, you can easily implement interrupt-driven subsystems by means of a specific interrupt block provided by DS2001 Blockset. For handcoded applications, you can use RTLib functions to handle interrupts. Refer to:

- DS2001_HWINT_Bx_Iy in the *DS2001 RTI Reference*
- ADC Unit in the *DS2001 RTLib Reference*

Related topics

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[ADC Unit \(DS2001 RTLib Reference !\[\]\(96cc62f861fdd6e50510c0224a756dff_img.jpg\)\)](#)

[DS2001_HWINT_Bx_jy \(DS2001 RTI Reference !\[\]\(fa6f3af6bfa46c5d4a2d362681095beb_img.jpg\)\)](#)

Limitations

A/D Conversion and Interrupt Usage

Basics	To read converted values from an ADC input channel of the DS2001, you can use RTLib's <code>ds2001_in</code> or <code>ds2001_read</code> function. With RTI, you can work with the DS2001_Bx block, which internally uses the <code>ds2001_in</code> function.
Polling the EOC flag	<p>The board's interrupt control unit holds an end-of-conversion (EOC) flag that indicates whether or not A/D conversion has finished.</p> <p>RTLib's <code>ds2001_in</code> function and RTI's DS2001_Bx block poll the EOC flag, and do not read the converted value until the flag is set. To use the <code>ds2001_in</code> function and the DS2001_Bx block, the interrupt control unit must therefore be initialized to polling mode.</p> <p>With RTLib's <code>ds2001_in</code> function, you have to initialize the interrupt control unit within the processor board's <code>init()</code> macro. With RTI's DS2001_Bx block, this is done automatically.</p>
Limitations	<p>The DS2001 provides several hardware interrupts. To implement them in an application, you have to insert a DS2001_HWINT_Bx_Iy block if you use RTI, or program an interrupt service routine if you use RTLib.</p> <p>However, if you implement one of the DS2001 hardware interrupts in your application, the interrupt control unit is initialized to interrupt mode and cannot be used in polling mode at the same time.</p> <p>As a result, the following limitations apply:</p> <ul style="list-style-type: none"> ▪ With RTI, you cannot use the DS2001_Bx block and the DS2001_HWINT_Bx_Iy block in the same model. ▪ With RTLib, you cannot use the <code>ds2001_in</code> function and implement an interrupt service routine in the same program.

Workaround

To implement one or more DS2001 hardware interrupts and read converted values in the same application, use RTLib's `ds2001_read` function instead of the `ds2001_in` function. The `ds2001_read` function doesn't poll the EOC flag.

Using RTI, you have to program this with RTLib, and incorporate your C code in a Simulink S-function. For details, refer to [Implementing S-Functions \(RTI and RTI-MP Implementation Guide !\[\]\(99f58673407353e96a019fbca558fd72_img.jpg\)](#)).

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