DS2002 Multi-Channel A/D Board

Features

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dSPACE

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

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Important Notice

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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 DS2002.

Symbols

dSPACE user documentation uses the following symbols:

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

Naming conventions

dSPACE user documentation uses the following naming conventions:

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

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

Special folders

Some software products use the following special folders:

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

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

or

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

Documents folder A standard folder for user-specific documents.

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

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

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

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 DS2002

Introduction

The DS2002 Multi-Channel A/D Board provides two independent A/D converters with 16 multiplexed inputs each that you can use for conversion of analog signals.

For the data sheet of the DS2002 and the connector panel CP2002, refer to Data Sheets (PHS Bus System Hardware Reference 🕮).

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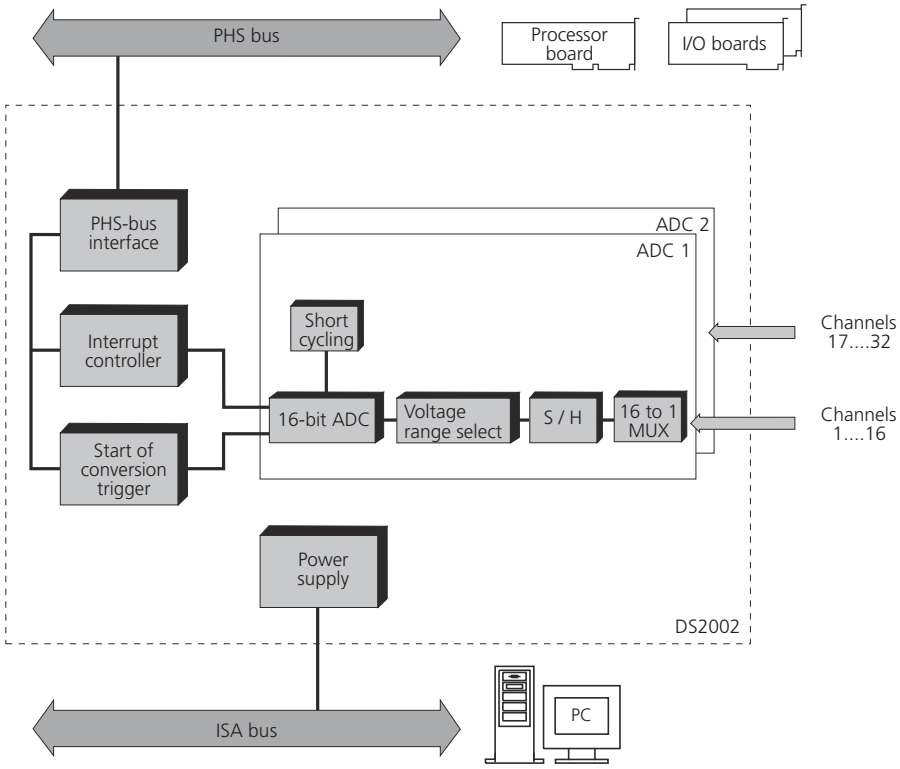
Board Architecture

Board overview

The following illustration gives an overview of the functional units and architecture of the DS2002:



Integration Into a PHS-Bus-Based System

Basics

To be used, the DS2002 must be integrated into a PHS-bus-based system. While the DS2002 performs the required input tasks, the processor board takes over the calculation of the real-time model. That is, applications using DS2002 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 🕮).

Connection to External Devices

Basics

There are two different ways to connect external devices to the DS2002. To access the I/O units of the DS2002, connect external devices:

- To the 50-pin ADC connector P1 of the DS2002.
- To the optional connector panel CP2002, equipped with BNC connectors CP1 … CP33.

ADC Unit

Where to go from here

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Basics on the ADC Unit

Characteristics

The DS2002 provides an ADC unit featuring 2 parallel A/D converters (ADC1, ADC2) multiplexed to 16 channels each (signals VIN1 … VIN16 and VIN17 … VIN32). The A/D converters have the following characteristics:

- 4-, 8-, 12- or 16-bit resolution (selectable for each of the 2 A/D converters individually)
- ±5 V or ±10 V input voltage range (selectable for each of the 2 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 14.

Interrupt on end of A/D conversion

The converters ADC1/ADC2 provide an interrupt at the end of an A/D conversion. For information on interrupt handling, refer to Interrupts on page 15.

RTI/RTLib support

You can access the ADC unit via DS2002 Blockset and RTLib. For details, refer to:

- ADC Unit in the *DS2002 RTI Reference*
- ADC Unit in the *DS2002 RTLib Reference*

Execution times

For details on the conversion times and the corresponding measurement setup, refer to Function Execution Times (DS2002 RTLib Reference 🕮).

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.

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
DS2002_Bx	Ch 1	See ADC Unit	Ch 1 (group 1)	P1 1	P1	VIN1
	Ch 2		Ch 2 (group 1)	P1 34	P2	VIN2
	Ch 3		Ch 3 (group 1)	P1 2	P3	VIN3
	Ch 4		Ch 4 (group 1)	P1 35	P4	VIN4
	Ch 5		Ch 5 (group 1)	P1 3	P5	VIN5
	Ch 6		Ch 6 (group 1)	P1 36	P6	VIN6
	Ch 7		Ch 7 (group 1)	P1 4	P7	VIN7
	Ch 8		Ch 8 (group 1)	P1 37	P8	VIN8
	Ch 9		Ch 9 (group 1)	P1 5	P9	VIN9
	Ch 10		Ch 10 (group 1)	P1 38	P10	VIN10
	Ch 11		Ch 11 (group 1)	P1 6	P11	VIN11
	Ch 12		Ch 12 (group 1)	P1 39	P12	VIN12
	Ch 13		Ch 13 (group 1)	P1 7	P13	VIN13
	Ch 14		Ch 14 (group 1)	P1 40	P14	VIN14
	Ch 15		Ch 15 (group 1)	P1 8	P15	VIN15
	Ch 16		Ch 16 (group 1)	P1 41	P16	VIN16
	Ch 17		Ch 17 (group 2)	P1 9	P17	VIN17
	Ch 18		Ch 18 (group 2)	P1 42	P18	VIN18
	Ch 19		Ch 19 (group 2)	P1 10	P19	VIN19
	Ch 20		Ch 20 (group 2)	P1 43	P20	VIN20
	Ch 21		Ch 21 (group 2)	P1 11	P21	VIN21
	Ch 22		Ch 22 (group 2)	P1 44	P22	VIN22
	Ch 23		Ch 23 (group 2)	P1 12	P23	VIN23
	Ch 24		Ch 24 (group 2)	P1 45	P24	VIN24
	Ch 25		Ch 25 (group 2)	P1 13	P25	VIN25
	Ch 26		Ch 26 (group 2)	P1 46	P26	VIN26
	Ch 27		Ch 27 (group 2)	P1 14	P27	VIN27
	Ch 28		Ch 28 (group 2)	P1 47	P28	VIN28
	Ch 29		Ch 29 (group 2)	P1 15	P29	VIN29
	Ch 30		Ch 30 (group 2)	P1 48	P30	VIN30
	Ch 31		Ch 31 (group 2)	P1 16	P31	VIN31
	Ch 32		Ch 32 (group 2)	P1 49	P32	VIN32

Faster A/D Conversion via Short-Cycling

ADC short-cycling

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

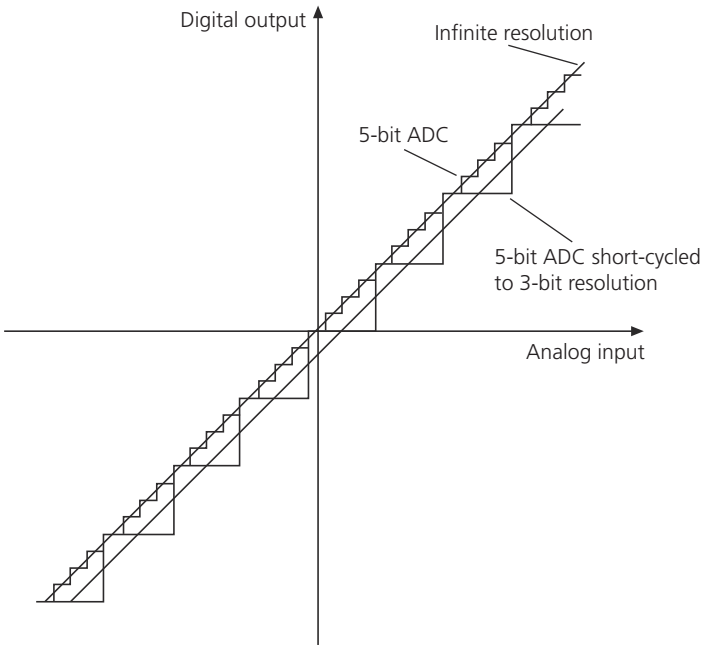
Faster conversion by lowering A/D resolution

The converters ADC1/ADC2 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 DS2002, 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 (DS2002 RTLib Reference 🕮).

Related topics

Basics

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Interrupts

Interrupts Provided by the DS2002

Characteristics

The DS2002 provides access to two hardware interrupts:

Interrupt Type	Description	See Also
ADC1 and ADC2 end of conversion	Interrupt on end of A/D conversion (multiplexed converters ADC1 and ADC2)	ADC Unit on page 11

Note

There is a limitation for performing A/D conversion and using hardware interrupts of the DS2002 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 DS2002 are sent to the interrupt controller of the connected dSPACE processor board. Using RTI, the interrupts of the DS2002 can therefore be used to implement interrupt-driven tasks. For details see Tasks Driven by Interrupt Blocks (RTI and RTI-MP Implementation Guide 🕮).

RTI/RTLib support

With RTI, you can easily implement interrupt-driven subsystems by means of a specific interrupt block provided by DS2002 Blockset. For handcoded applications, you can use RTLib functions to handle interrupts. For details, see:

- DS2002_HWINT_Bx_Iy in the *DS2002 RTI Reference*
- ADC Unit in the *DS2002 RTLib Reference*

Limitations

A/D Conversion and Interrupt Usage

Basics

To read converted values from an ADC input channel of the DS2002, you can use RTLib's ds2002_in or ds2002_read function. With RTI, you can work with the DS2002_Bx block, which internally uses the ds2002_block_in function.

Polling the EOC flag

The board's interrupt control unit holds an end-of-conversion (EOC) flag that indicates whether or not A/D conversion has finished.

RTLib's ds2002_in function and RTI's DS2002_Bx block poll the EOC flag, and do not read the converted value until the flag is set. To use the ds2002_in function and the DS2002_Bx block, the interrupt control unit must therefore be initialized to polling mode.

With RTLib's ds2002_in function, you have to initialize the interrupt control unit within the processor board's `init()` macro. With RTI's DS2002_Bx block, this is done automatically.

Limitations

The DS2002 provides several hardware interrupts. To implement them in an application, you have to insert a DS2002_HWINT_Bx_Iy block if you use RTI, or program an interrupt service routine if you use RTLib.

However, if you implement one of the DS2002 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.

As a result, the following limitations apply:

- With RTI, you cannot use the DS2002_Bx block and the DS2002_HWINT_Bx_Iy block in the same model.
- With RTLib, you cannot use the ds2002_in function and implement an interrupt service routine in the same program.

Workaround

To implement one or more DS2002 hardware interrupts and read converted values in the same application, use RTLib's ds2002_read function instead of the ds2002_in function. The ds2002_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 🕮).

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