DS4004 HIL Digital I/O Board

RTI Reference

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dSPACE

How to Contact dSPACE

Mail:	dSPACE GmbH Rathenaustraße 26 33102 Paderborn Germany
Tel.:	+49 5251 1638-0
Fax:	+49 5251 16198-0
E-mail:	info@dspace.de
Web:	http://www.dspace.com

How to Contact dSPACE Support

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

- Local dSPACE companies and distributors: http://www.dspace.com/go/locations
- For countries not listed, contact dSPACE GmbH in Paderborn, Germany.
  Tel.: +49 5251 1638-941 or e-mail: support@dspace.de

You can also use the support request form: http://www.dspace.com/go/supportrequest. If you are logged on to mydSPACE, you are automatically identified and do not need to add your contact details manually.

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

Software Updates and Patches

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

Important Notice

Contents

About This Reference

Contents

This RTI Reference provides a full description of the Real-Time Interface (RTI) software support for the DS4004 HIL Digital I/O Board.

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.

Examples:

- Where you find terms such as `rti<XXXX>` replace them by the RTI platform support you are using, for example, `rti1007`.
- Where you find terms such as `<model>` or `<submodel>` in this document, replace them by the actual name of your model or submodel. For example, if the name of your Simulink model is `smd_1007_sl.slx` and you are asked to edit the `<model>_usr.c` file, you actually have to edit the `smd_1007_sl_usr.c` file.

RTI block name conventions All I/O blocks have default names based on dSPACE's board naming conventions:

- Most RTI block names start with the board name.
- A short description of functionality is added.
- Most RTI block names also have a suffix.

Suffix	Meaning
B	Board number (for PHS-bus-based systems)
M	Module number (for MicroAutoBox II)
C	Channel number
G	Group number
CON	Converter number
BL	Block number
P	Port number
I	Interrupt number

A suffix is followed by the appropriate number. For example, DS2201IN_B2_C14 represents a digital input block located on a DS2201 board. The suffix indicates board number 2 and channel number 14 of the block. For more general block naming, the numbers are replaced by variables (for example, DS2201IN_Bx_Cy).

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.

General Information on the DS4004 Blockset

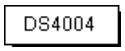
Introduction

To get basic information on the DS4004 blockset.

Overview of the DS4004 Blockset

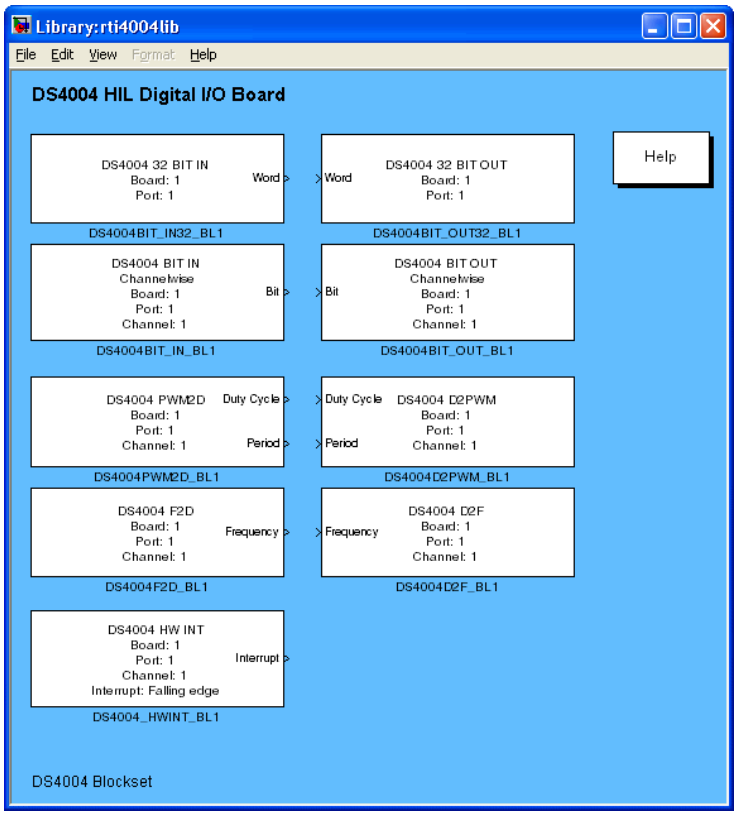
Introduction

The rti4004lib Real-Time Interface (RTI) board library provides the RTI blocks to implement the functionality and I/O capabilities of the DS4004 HIL Digital I/O Board in Simulink models. The RTI blocks are designed to specify the hardware setup for real-time applications.



Library access

Double-click the DS4004 board library button in the rtilibm window to open the Library:rti4004lib window.



Library components

The following components are available in the rti4004lib board library:

Digital I/O Blocks to access the board's digital I/O channels:

- DS4004BIT_IN_BLx
- DS4004BIT_OUT_BLx
- DS4004BIT_IN32_BLx
- DS4004BIT_OUT32_BLx

Timing I/O Blocks to access the board's timing I/O unit:

- DS4004PWM2D_BLx
- DS4004D2PWM_BLx
- DS4004F2D_BLx
- DS4004D2F_BLx

Interrupt Blocks

- DS4004_HWINT_BLx

Related topics

References

Digital I/O Blocks

Introduction

To access the board's digital I/O ports.

Note

Before operating the output channels, you must connect an external power supply (VBAT) to at least one of the two supply rails (VBAT1 or VBAT2) of the port.

Where to go from here

Information in this section

DS4004BIT_IN_BLx

Purpose

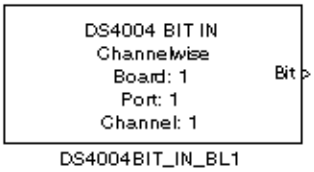
To provide channel-wise read access to a single bit of a digital I/O port.

Where to go from here

Information in this section

Block Description (DS4004BIT_IN_BLx)

Illustration



Purpose

To provide channel-wise read access to a single bit of a digital I/O port.

Description

The block provides channel-wise read access to a single bit of a digital I/O port. You can specify the threshold level on which the input signal is interpreted as logical 0 or 1. The block's output is a binary value representing the state of the digital input channel.

Use the **DS4004BIT_IN32_BLx** block to read all the 32 channels (bits) of the input port at the same time.

I/O mapping

For information on the I/O mapping, refer to Basics on Standard I/O (DS4004 Features 🕮).

I/O characteristics

The following table shows the relationship between the digital input and the block's output variable (binary representation relating to one channel) in Simulink:

Digital Input	Simulink Output
High	1
Low	0

The following table shows the characteristics of the block's output in Simulink:

Characteristic	Value
Data type	Boolean
Range	0, 1

Dialog pages

The dialog settings can be specified on the following dialog pages:

- To specify the board number, the port number, and the channel number, refer to the **Unit Page** (refer to Unit Page (DS4004BIT_IN_BLx) on page 15).
- To specify the threshold level for the selected digital input channel, refer to the **Electrical Interface Page** (refer to Electrical Interface Page (DS4004BIT_IN_BLx) on page 16).

Related RTLib functions

`ds4004_init`, `ds4004_digin_init`, `ds4004_bit_in`

Related topics

Basics

Basics on Standard I/O (DS4004 Features 🕮)

HowTos

How to Read a Single Digital Input via RTI (DS4004 Features 🕮)

Unit Page (DS4004BIT_IN_BLx)

Purpose

To specify the board number, the port number, and the channel number.

Dialog settings

Board Number Lets you select the DS4004 board number in the range 1 … 16.

Port Number Lets you select the port number of the board in the range 1 … 3.

Channel Number Lets you select a channel of the port in the range 1 … 32.

Related topics

Basics

Basics on Standard I/O (DS4004 Features 🕮)

HowTos

How to Read a Single Digital Input via RTI (DS4004 Features 🕮)

Electrical Interface Page (DS4004BIT_IN_BLx)

Purpose

To set the threshold level for the selected input channel.

Description

For detailed information on the electrical specifications of digital inputs, refer to I/O Circuits and Electrical Characteristics (PHS Bus System Hardware Reference 🕮).

Dialog settings

Port Displays the selected port number.

Channel Displays the selected channel.

Threshold level digital I/O in Lets you specify the threshold level for the selected input channel in the range 1.0 … 23.8 V. The default threshold level is 2.5 V.

Related topics

Basics

Basics on Standard I/O (DS4004 Features 🕮)

HowTos

How to Read a Single Digital Input via RTI (DS4004 Features 🕮)

DS4004BIT_IN32_BLx

Purpose

To provide word-wise read access to the 32 bits of a digital I/O port.

Where to go from here

Information in this section

Block Description (DS4004BIT_IN32_BLx)

Illustration

Purpose

To provide word-wise read access to the 32 bits of a digital I/O port.

Description

The block provides word-wise read access to the 32 channels (bits) of a digital I/O port. You can specify the threshold level on which an input signal is interpreted as logical 0 or 1 for each channel individually. The block's output is a decimal value in the range 0 ... 4294967295 (0 … 2^{32}-1). The single bits of this value correspond directly to the related channels, i.e., the LSB corresponds to the state of channel 1 and the MSB corresponds to the state of channel 32.

Use the DS4004BIT_IN_BLx block to read a single digital input channel of a port.

I/O mapping

For information on the I/O mapping, refer to Basics on Standard I/O (DS4004 Features 🕮).

I/O characteristics

The following shows the relationship between the block's digital input and block's Simulink output in the range 0 … 4294967295 (0 … 2^{32}-1):

Digital Input	Simulink Output
0000 0000 0000 0000 0000 0000 0000 0000	0
…	…
0000 0000 0000 0000 0000 0000 1111 1101	253
…	…
0000 0000 0000 0000 1111 1111 0000 0010	65282
…	…
0000 0000 0000 0000 1111 1111 1111 1111	65535
…	…
0000 0000 0001 1010 1110 0110 1010 1000	1762984
…	…
1111 1111 1111 1111 1111 1111 1111 1111	4294967295

The following table shows the characteristics of the block's output in Simulink:

Characteristic	Value
Data type	Uint32
Range	0 … 4294967295

Dialog pages

The dialog settings can be specified on the following dialog pages:

- To specify the board number and the port number, refer to the **Unit Page** (refer to Unit Page (DS4004BIT_IN32_BLx) on page 19).
- To specify the threshold level for all the 32 digital input channels, refer to the **Electrical Interface Page** (refer to Electrical Interface Page (DS4004BIT_IN32_BLx) on page 19).

Related RTLib functions

`ds4004_init`, `ds4004_digin_init`, `ds4004_bit_in32`

Related topics

Basics

Basics on Standard I/O (DS4004 Features 🕮)

HowTos

How to Read all the 32 Digital Inputs of a Port via RTI (DS4004 Features 🕮)

Unit Page (DS4004BIT_IN32_BLx)

Purpose

To specify the board number and the port number.

Dialog settings

Board Number Lets you select the DS4004 board number in the range 1 … 16.

Port Number Lets you select the port number of the board in the range 1 … 3.

Related topics

Basics

Basics on Standard I/O (DS4004 Features 🕮)

HowTos

How to Read all the 32 Digital Inputs of a Port via RTI (DS4004 Features 🕮)

Electrical Interface Page (DS4004BIT_IN32_BLx)

Purpose

To set the threshold level for all the 32 digital input channels of the selected port.

Description

For detailed information on the electrical specifications of digital inputs, refer to I/O Circuits and Electrical Characteristics (PHS Bus System Hardware Reference 🕮).

Dialog settings

Port Displays the selected port number.

Threshold level digital I/O in Lets you set the threshold level for each single digital input channel in the range 1.0 … 23.8 V. The default threshold level is 2.5 V.

Set all Lets you set the threshold level for all the 32 digital input channels identically and at once in the in 1.0 … 23.8 V. The default threshold level is 2.5 V.

Related topics

Basics

Basics on Standard I/O (DS4004 Features 🕮)

HowTos

How to Read all the 32 Digital Inputs of a Port via RTI (DS4004 Features 🕮)

DS4004BIT_OUT_BLx

Purpose

To provide channel-wise write access to a single bit of a digital I/O port.

Where to go from here

Information in this section

Block Description (DS4004BIT_OUT_BLx)

Illustration

DS4004BIT_OUT_BL1

Purpose

To provide channel-wise write access to a single bit of a digital I/O port.

Description

The block provides channel-wise write access to a single bit of a digital I/O port. The block's input is a binary value.

Use the DS4004BIT_OUT32_BLx block to write to all the 32 bits of the digital output port at the same time.

I/O mapping

For information on the I/O mapping, refer to Basics on Standard I/O (DS4004 Features 🕮).

I/O characteristics

The following table shows the relationship between the block's input variable (binary representation relating to one channel) in Simulink and the digital output:

Simulink Input	Digital Output
1	High
0	Low

The following table shows the characteristics of the block's input in Simulink:

Characteristic	Value
Data type	Boolean
Range	0, 1

Dialog pages

The dialog settings can be specified on the following dialog pages:

- To specify the board number, the port number, and the channel number, refer to the **Unit Page** (refer to Unit Page (DS4004BIT_OUT_BLx) on page 22).
- To set the high-side and low-side switches of the connected supply rails, refer to the **Electrical Interface Page** (refer to Electrical Interface Page (DS4004BIT_OUT_BLx) on page 23).
- To set the initial output state and the termination output state, refer to the **Parameters Page** (refer to Parameters Page (DS4004BIT_OUT_BLx) on page 25).

Related RTLib functions

`ds4004_init`, `ds4004_digout_mode_set`, `ds4004_digout_init`, `ds4004_bit_out`

Related topics

Basics

Basics on Standard I/O (DS4004 Features 🕮)

HowTos

How to Write to a Single Digital Output via RTI (DS4004 Features 🕮)

Unit Page (DS4004BIT_OUT_BLx)

Purpose

To specify the board number, the port number, and the channel number.

Dialog settings

Board Number Lets you select the DS4004 board number in the range 1 … 16.

Port Number Lets you select the port number of the board in the range 1 … 3.

Channel Number Lets you select a channel of the port in the range 1 … 32.

Related topics

Basics

Basics on Standard I/O (DS4004 Features 🕮)

HowTos

How to Write to a Single Digital Output via RTI (DS4004 Features 🕮)

Electrical Interface Page (DS4004BIT_OUT_BLx)

Purpose

To set the high-side and low-side switches of the connected supply rails for the selected output channel.

Description

The output state of each I/O channel depends on its individual settings for the low-side switch and the high-side switches. You can use the supply rails L (GND), H1 (VBAT1), and H2 (VBAT2).

- If you set the low-side switch L (GND), the digital output channel is set to low-side switch mode.
- If you set the high-side switch H1 (VBAT1) *or* H2 (VBAT2), the digital output channel is actively driven in high-side switch mode.
- If you set the high-side switches H1 (VBAT1) *and* H2 (VBAT2), the digital output channel is also actively driven in high-side switch mode, but the output voltage is driven to the highest supply voltage (VBAT1 or VBAT2).
- If you set low-side switch L (GND) and the high-side switches H1 (VBAT1) *and/or* H2 (VBAT2), the digital output channel is actively driven in push-pull mode. Push-pull driver mode means that the output source is actively driven to both high and low level.

Switch Settings [1]			**Input of the Output Circuit** [2]	**Output Px_IO1 ... Px_IO32** [2], [3]	**Description** [3]
L (GND)	**H1 (VBAT1)**	**H2 (VBAT2)**			
0	0	0	0 or 1	High-Z	Individual output disabled.[4]
1	0	0	0	GND	Low-side switch

Switch Settings [1]			Input of the Output Circuit [2]	Output Px_IO1 ... Px_IO32 [2], [3]	Description [3]
L (GND)	H1 (VBAT1)	H2 (VBAT2)			
1	0	0	1	High-Z	Low-side switch
0	1	0	0	High-Z	High-side switch set to Px_VBAT1
0	1	0	1	Px_VBAT1	High-side switch set to Px_VBAT1
0	0	1	0	High-Z	High-side switch set to Px_VBAT2
0	0	1	1	Px_VBAT2	High-side switch set to Px_VBAT2
0	1	1	0	High-Z	High-side switch set to maximum value (Px_VBAT1 or Px_VBAT2)
0	1	1	1	max. value (Px_VBAT1 or Px_VBAT2)	High-side switch set to maximum value (Px_VBAT1 or Px_VBAT2)
1	1	0	0	GND	Push-pull output set to Px_VBAT1
1	1	0	1	Px_VBAT1	Push-pull output set to Px_VBAT1
1	0	1	0	GND	Push-pull output set to Px_VBAT2
1	0	1	1	Px_VBAT2	Push-pull output set to Px_VBAT2
1	1	1	0	GND	Push-pull output set to maximum value (Px_VBAT1 or Px_VBAT2)
1	1	1	1	max. value (Px_VBAT1 or Px_VBAT2)	Push-pull output set to maximum value (Px_VBAT1 or Px_VBAT2)

[1] 0 = switch disabled, 1 = switch enabled
[2] Refer to Digital Outputs (PHS Bus System Hardware Reference 🕮)
[3] x is a placeholder for port/connector number 1 ... 3
[4] With RTLib functions, the channel can be used as digital input or PWM input.

For more details, refer to I/O Circuits and Electrical Characteristics (PHS Bus System Hardware Reference 🕮).

Dialog settings

Port Displays the selected port number.

Channel Displays the selected channel.

Setup of supply rails Lets you enable/disable the supply rails defined by the parameters L, H1 and H2.

Parameter	Meaning
L	Enables/disables the low-side switch for the selected digital output channel.
H1	Enables/disables the high-side switch to H1 (VBAT1) for the selected digital output channel.
H2	Enables/disables the high-side switch to H2 (VBAT2) for the selected digital output channel.

L and H1 are enabled by default (push-pull output set to VBAT1).

Related topics

Basics

Basics on Standard I/O (DS4004 Features 🕮)

HowTos

How to Write to a Single Digital Output via RTI (DS4004 Features 🕮)

Parameters Page (DS4004BIT_OUT_BLx)

Purpose

To set the initial output state and the termination output state.

Description

Initialization During the model initialization phase, the Initial output state is written to the selected channel (bit) to ensure a defined output during this simulation phase. This is especially useful if the channel is used in a triggered or enabled subsystem that is not executed right from the start of the simulation.

Termination With the block's Termination settings, you can specify an output state of the channel on termination to drive your external hardware into a safe final condition.

The possible termination states at the end of the simulation are:

- The output is set to high impedance (high-Z) state.
- The output holds its last output value.
- The output is set to a definite output value.

The specified termination values of I/O channels are set when the simulation executes its termination function by setting the `simState` variable to STOP. If you stop the real-time application by using ControlDesk's Stop RTP command, the processor resets immediately without executing termination functions. The current values of the I/O channels are kept and the specified termination values are not set.

Dialog settings

Port Displays the selected port number.

Channel Displays the selected channel.

Initial output state Lets you select the initial output state *Low(0)* or *High(1)* at the start of the simulation.

The default state is *Low(0)*.

Termination To enable or disable the setting of a definite output value at the end of the simulation.

Termination Mode Checkbox	Meaning
Disabled	The digital output channel is set to high impedance (high-Z) state at the end of the simulation.
Enabled	The channel's output behavior is determined by the **Output** settings (see below) at the end of the simulation.

The termination mode checkbox is disabled by default.

Output To set a definite output value at the end of the simulation.

Option Button	Meaning
Last output state	The channel holds its last digital output value at the end of the simulation.
Value	Lets you set the output value to *Low(0)* or *High(1)* at the end of the simulation.

Related topics

Basics

Basics on Standard I/O (DS4004 Features 🕮)

HowTos

How to Write to a Single Digital Output via RTI (DS4004 Features 🕮)

References

simState (RTI and RTI-MP Implementation Reference 🕮)
Stop RTP (ControlDesk Platform Management 🕮)

DS4004BIT_OUT32_BLx

Purpose

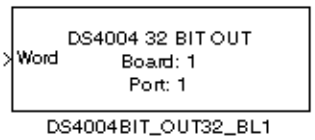
To provide word-wise write access to the 32 bits of a digital I/O port.

Where to go from here

Information in this section

Block Description (DS4004BIT_OUT32_BLx)

Illustration



Purpose

To provide word-wise write access to the 32 bits of a digital I/O port.

Description

The block provides word-wise write access to the 32 channels (bits) of a digital I/O port. The block's input is a decimal value in the range 0 ... 4294967295 (0 … 2^{32}-1). The single bits of this value correspond directly to the related channels, i.e., the LSB corresponds to the setting for channel 1 and the MSB corresponds to the setting for channel 32.

Use the **DS4004BIT_OUT_BLx** block to write to a single bit of the digital output port.

I/O mapping

For information on the I/O mapping, refer to Basics on Standard I/O (DS4004 Features 🕮).

I/O characteristics

The following table shows the relationship between the block's Simulink input and block's digital output:

Simulink Input	Digital Output
0	0000 0000 0000 0000 0000 0000 0000 0000
…	…
253	0000 0000 0000 0000 0000 0000 1111 1101
…	…
65282	0000 0000 0000 0000 1111 1111 0000 0010
…	…
65535	0000 0000 0000 0000 1111 1111 1111 1111
…	…
1762984	0000 0000 0001 1010 1110 0110 1010 1000
…	…
4294967295	1111 1111 1111 1111 1111 1111 1111 1111

The following table shows the characteristics of the block's input in Simulink:

Characteristic	Value
Data type	Uint32
Range	0 … 4294967295

Dialog pages

The dialog settings can be specified on the following dialog pages:

- To specify the board number, the port number, and the channel number, refer to the **Unit Page** (refer to Unit Page (DS4004BIT_OUT32_BLx) on page 29).
- To set the high and low side switches of the connected supply rails, refer to the **Electrical Interface Page** (refer to Electrical Interface Page (DS4004BIT_OUT32_BLx) on page 29).
- To set the initial output state and the termination output state, refer to the **Parameters Page** (refer to Parameters Page (DS4004BIT_OUT32_BLx) on page 31).

Related RTLib functions

`ds4004_init`, `ds4004_digout_mode_set`, `ds4004_digout_init`, `ds4004_bit_out`

Related topics

Basics

Basics on Standard I/O (DS4004 Features 🕮)

HowTos

How to Write to all the 32 Digital Outputs of a Port via RTI (DS4004 Features 🕮)

Unit Page (DS4004BIT_OUT32_BLx)

Purpose

To specify the board number and the port number.

Dialog settings

Board Number Lets you select the DS4004 board number in the range 1 … 16.

Port Number Lets you select the port number of the board in the range 1 … 3.

Related topics

Basics

Basics on Standard I/O (DS4004 Features 🕮)

HowTos

How to Write to all the 32 Digital Outputs of a Port via RTI (DS4004 Features 🕮)

Electrical Interface Page (DS4004BIT_OUT32_BLx)

Purpose

To set the high-side and low-side switches of the connected supply rails for all the 32 digital output channels.

Description

The output state of each I/O channel depends on its individual settings for the low-side switch and the high-side switches. You can use the supply rails L (GND), H1 (VBAT1), and H2 (VBAT2).

- If you set the low-side switch L (GND), the digital output channel is set to low-side switch mode.
- If you set the high-side switch H1 (VBAT1) *or* H2 (VBAT2), the digital output channel is actively driven in high-side switch mode.
- If you set the high-side switches H1 (VBAT1) *and* H2 (VBAT2), the digital output channel is also actively driven in high-side switch mode, but the output voltage is driven to the highest supply voltage (VBAT1 or VBAT2).
- If you set low-side switch L (GND) and the high-side switches H1 (VBAT1) *and/or* H2 (VBAT2), the digital output channel is actively driven in push-pull mode. Push-pull driver mode means that the output source is actively driven to both high and low level.

Switch Settings [1]			Input of the Output Circuit [2]	Output Px_IO1 ... Px_IO32 [2], [3]	Description [3]
L (GND)	H1 (VBAT1)	H2 (VBAT2)			
0	0	0	0 or 1	High-Z	Individual output disabled.[4]
1	0	0	0	GND	Low-side switch
1	0	0	1	High-Z	Low-side switch
0	1	0	0	High-Z	High-side switch set to Px_VBAT1
0	1	0	1	Px_VBAT1	High-side switch set to Px_VBAT1
0	0	1	0	High-Z	High-side switch set to Px_VBAT2
0	0	1	1	Px_VBAT2	High-side switch set to Px_VBAT2
0	1	1	0	High-Z	High-side switch set to maximum value (Px_VBAT1 or Px_VBAT2)
0	1	1	1	max. value (Px_VBAT1 or Px_VBAT2)	High-side switch set to maximum value (Px_VBAT1 or Px_VBAT2)
1	1	0	0	GND	Push-pull output set to Px_VBAT1
1	1	0	1	Px_VBAT1	Push-pull output set to Px_VBAT1
1	0	1	0	GND	Push-pull output set to Px_VBAT2
1	0	1	1	Px_VBAT2	Push-pull output set to Px_VBAT2
1	1	1	0	GND	Push-pull output set to maximum value (Px_VBAT1 or Px_VBAT2)
1	1	1	1	max. value (Px_VBAT1 or Px_VBAT2)	Push-pull output set to maximum value (Px_VBAT1 or Px_VBAT2)

[1] 0 = switch disabled, 1 = switch enabled
[2] Refer to Digital Outputs (PHS Bus System Hardware Reference 🕮)
[3] x is a placeholder for port/connector number 1 ... 3
[4] With RTLib functions, the channel can be used as digital input or PWM input.

For more details, refer to I/O Circuits and Electrical Characteristics (PHS Bus System Hardware Reference 🕮).

Dialog settings

Port Displays the selected port number.

Set up of supply rails Lets you enable/disable the supply rails defined by the parameters L, H1 and H2 for each single digital output channel individually.

Parameter	Meaning
L	Enables/disables the low-side switch for a channel.
H1	Enables/disables the high-side switch to H1 (VBAT1) for a channel.
H2	Enables/disables the high-side switch to H2 (VBAT2) for a channel.

L and H1 are enabled by default (push-pull output set to VBAT1).

Set all Lets you enable/disable the supply rails for all the 32 digital output channels identically and at once.

Related topics

Basics

Basics on Standard I/O (DS4004 Features 🕮)

HowTos

How to Write to all the 32 Digital Outputs of a Port via RTI (DS4004 Features 🕮)

Parameters Page (DS4004BIT_OUT32_BLx)

Purpose

To set the initial output state and the termination output state.

Description

Initialization During the model initialization phase, the initial digital output states specified by the **Initial output** settings are written to the 32 channels to ensure a defined output during this simulation phase. This is especially useful if the channels are used in a triggered or enabled subsystem that is not executed right from the start of the simulation.

Termination With the block's **Termination** settings, you can specify the output states of the 32 channels on termination to drive your external hardware into a safe final condition.

The possible termination states at the end of the simulation are:

- All digital outputs are set to high impedance (high-Z) state.
- Each output holds its last output value.
- Each output is set to a definite output value.

The specified termination values of I/O channels are set when the simulation executes its termination function by setting the `simState` variable to STOP. If you stop the real-time application by using ControlDesk's **Stop RTP** command, the processor resets immediately without executing termination functions. The current values of the I/O channels are kept and the specified termination values are not set.

Dialog settings

Port Displays the selected port number.

Initial output Lets you set the output state "low" (binary 0) or "high" (binary 1) for each channel (bit) at the start of the simulation.

You have to specify the **Initialization value** as a decimal value in the range 0 ... 4294967295 (0 … 2^{32}-1). The initialization value will also be displayed in hexadecimal and binary format. The single bits of this value correspond directly

to the related channels, i.e., the LSB corresponds to the setting for channel 1 and the MSB corresponds to the setting for channel 32.

The default value is 0.

Termination To enable or disable the setting of definite output values at the end of the simulation.

Termination Mode Checkbox	Meaning
Disabled	The digital outputs of all the 32 channels are set to high impedance (high-Z) state at the end of the simulation.
Enabled	The output behavior of the 32 channels is determined by the **Output** settings (see below) at the end of the simulation.

The termination mode checkbox is disabled by default.

Output To set all the 32 digital output channels to definite output values at the end of the simulation.

Option Button	Meaning
Last output state	Each output channel holds its last digital output value at the end of the simulation.
Value	Lets you specify the output values for the channels by a decimal value in the range 0 … 4294967295 (0 … 2^{32}-1). The decimal value is also displayed in hexadecimal and binary format. The single bits of this value correspond directly to the related channels, i.e., the LSB corresponds to the setting for channel 1 and the MSB corresponds to the setting for channel 32. The default value is 0.

Related topics

Basics

Basics on Standard I/O (DS4004 Features 🕮)

HowTos

How to Write to all the 32 Digital Outputs of a Port via RTI (DS4004 Features 🕮)

References

simState (RTI and RTI-MP Implementation Reference 🕮)
Stop RTP (ControlDesk Platform Management 🕮)

Timing I/O Blocks

Introduction

To access the board's timing I/O ports.

Note

Before operating the output channels, you must connect an external power supply (VBAT) to at least one of the two supply rails (VBAT1 or VBAT2) of the port.

Where to go from here

Information in this section

DS4004PWM2D_BLx

Purpose

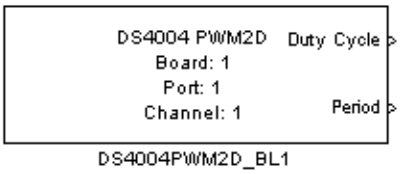
To measure the period and duty cycle of a PWM input signal.

Where to go from here

Information in this section

Block Description (DS4004PWM2D_BLx)

Illustration



Purpose

To measure the period and duty cycle of a PWM input signal.

Description

In a Simulink model, the block provides channel-wise read access to the duty cycle and period of a PWM signal. You can specify the threshold level on which the input signal is interpreted as logical 0 or 1.

I/O mapping

For information on the I/O mapping, refer to Basics on PWM Signal Measurement (PWM2D) (DS4004 Features 🕮).

I/O characteristics

The following table shows the scaling between the duty cycle of the measured signal and the block's output in Simulink:

Duty Cycle	Simulink Output
0 … 100%	0 … 1

The following table shows the characteristics of the block's output in Simulink:

Variable	Characteristic	Value
Duty Cycle	Data type	Double
	Range	0 … 1
Period	Data type	Double
	Range	Depends on the selected period range

The period of the measured signal is given in seconds.

The period of the input signal must remain in the specified measurement range, otherwise the measured values are not correct.

For further information, refer to Basics on PWM Signal Measurement (PWM2D) (DS4004 Features 🕮).

Dialog pages

The dialog settings can be specified on the following dialog pages:

- To specify the board number, the port number, and the channel number, refer to the **Unit Page** (refer to Unit Page (DS4004PWM2D_BLx) on page 36).
- To specify the threshold level for the selected input channel, refer to the **Electrical Interface Page** (refer to Electrical Interface Page (DS4004PWM2D_BLx) on page 36).
- To specify the PWM update mode and the PWM period range, refer to the **Measurement Page** (refer to Measurement Page (DS4004PWM2D_BLx) on page 37).

Related RTLib functions

`ds4004_init`, `ds4004_pwm2d_init`, `ds4004_pwm2d`

Related topics

Basics

Basics on PWM Signal Measurement (PWM2D) (DS4004 Features 🕮)

HowTos

How to Measure a Frequency via RTI (DS4004 Features 🕮)

Unit Page (DS4004PWM2D_BLx)

Purpose

To specify the board number, the port number, and the channel number.

Dialog settings

Board Number Lets you select the DS4004 board number in the range 1 … 16.

Port Number Lets you select the port number of the board in the range 1 … 3.

Channel Number Lets you select a channel of the port in the range 1 … 32.

Related topics

Basics

Basics on PWM Signal Measurement (PWM2D) (DS4004 Features 🕮)

HowTos

How to Measure a Frequency via RTI (DS4004 Features 🕮)

Electrical Interface Page (DS4004PWM2D_BLx)

Purpose

To set the threshold level for the selected input channel.

Description

For detailed information on the electrical specifications of digital inputs, refer to I/O Circuits and Electrical Characteristics (PHS Bus System Hardware Reference 🕮).

Dialog settings

Port Displays the selected port number.

Channel Displays the selected channel.

Threshold level digital I/O in Lets you specify the threshold level for the selected input channel in the range 1.0 … 23.8 V. The default threshold level is 2.5 V.

Related topics

Basics

Basics on PWM Signal Measurement (PWM2D) (DS4004 Features 🕮)

HowTos

How to Measure a Frequency via RTI (DS4004 Features 🕮)

Measurement Page (DS4004PWM2D_BLx)

Purpose

To specify the PWM update mode and the PWM period range.

Dialog settings

Port Displays the selected port number.

Channel Displays the selected channel.

Update mode Lets you select the update mode of the PWM measurement:

Mode	Description
Asynchronous	The measured values are updated at the end of each T_{high} and T_{low} period of the PWM signal. The update is asynchronous to the period.
Synchronous	The measured values are updated at the end of each T_{low} period of the PWM signal only. The update is synchronous to the period.

Range of period Lets you select the measurement range for the input PWM period.

Note

The measurement resolution depends on the selected period range.
Due to quantization effects, you will encounter considerable deviations between the input PWM period and the measured PWM period, especially for higher PWM frequencies. To avoid poor measurement resolution, you should therefore select the period range with the best possible resolution (resolution values as small as possible). Refer to Basics on PWM Signal Measurement (PWM2D) (DS4004 Features 🕮).

Range of frequency Displays the corresponding frequency range.

Resolution of period Displays the measurement resolution for the selected period range.

Related topics

Basics

Basics on PWM Signal Measurement (PWM2D) (DS4004 Features 🕮)

HowTos

How to Measure a Frequency via RTI (DS4004 Features 🕮)

DS4004D2PWM_BLx

Purpose

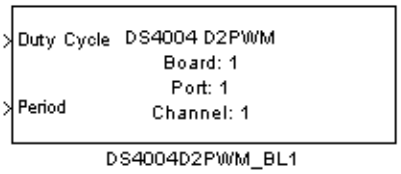
To generate a PWM signal with the period and duty cycle adjustable during run time.

Where to go from here

Information in this section

Block Description (DS4004D2PWM_BLx)

Illustration



Purpose

To generate a PWM signal with the period and duty cycle adjustable during run time.

Description

The block's Simulink inputs – the period and the duty cycle – can be changed during run time. To avoid saturation effects when generating the PWM signal, the input value for the period must remain in the selected period range.

I/O mapping

For information on the I/O mapping, refer to Basics on PWM Signal Generation (D2PWM) (DS4004 Features 🕮).

I/O characteristics

The following table shows the scaling between the duty cycle and the block's Simulink input:

Simulink Input	Duty Cycle
0 … 1	0 … 100%

The following table shows the characteristics of the block's Simulink input:

Variable	Characteristic	Value
Duty Cycle	Data type	Double
	Range	0 … 1
Period	Data type	Double
	Range	Depends on the selected period range

The period must be given in seconds.

For further information, refer to Basics on PWM Signal Generation (D2PWM) (DS4004 Features 🕮).

Dialog pages

The dialog settings can be specified on the following dialog pages:

- To specify the board number, the port number, and the channel number, refer to the **Unit Page** (refer to Unit Page (DS4004D2PWM_BLx) on page 41).
- To set the high-side and low-side switches of the connected supply rails, refer to the **Electrical Interface Page** (refer to Electrical Interface Page (DS4004D2PWM_BLx) on page 41).
- To specify the PWM update mode and the PWM period range, refer to the **Generation Page** (refer to Generation Page (DS4004D2PWM_BLx) on page 43).
- To set the initial output state and the termination output state, refer to the **Parameters Page** (refer to Parameters Page (DS4004D2PWM_BLx) on page 44).

Related RTLib functions

`ds4004_init`, `ds4004_d2pwm_init`, `ds4004_d2pwm`

Related topics

Basics

Basics on PWM Signal Generation (D2PWM) (DS4004 Features 🕮)

HowTos

How to Generate a PWM Signal via RTI (DS4004 Features 🕮)

Unit Page (DS4004D2PWM_BLx)

Purpose

To specify the board number, the port number, and the channel number.

Dialog settings

Board Number Lets you select the DS4004 board number in the range 1 … 16.

Port Number Lets you select the port number of the board in the range 1 … 3.

Channel Number Lets you select a channel of the port in the range 1 … 32.

Related topics

Basics

Basics on PWM Signal Generation (D2PWM) (DS4004 Features 🕮)

HowTos

How to Generate a PWM Signal via RTI (DS4004 Features 🕮)

Electrical Interface Page (DS4004D2PWM_BLx)

Purpose

To set the high-side and low-side switches of the connected supply rails for the selected output channel.

Description

The output state of each I/O channel depends on its individual settings for the low-side switch and the high-side switches. You can use the supply rails L (GND), H1 (VBAT1), and H2 (VBAT2).

- If you set the low-side switch L (GND), the digital output channel is set to low-side switch mode.
- If you set the high-side switch H1 (VBAT1) *or* H2 (VBAT2), the digital output channel is actively driven in high-side switch mode.
- If you set the high-side switches H1 (VBAT1) *and* H2 (VBAT2), the digital output channel is also actively driven in high-side switch mode, but the output voltage is driven to the highest supply voltage (VBAT1 or VBAT2).
- If you set low-side switch L (GND) and the high-side switches H1 (VBAT1) *and/or* H2 (VBAT2), the digital output channel is actively driven in push-pull mode. Push-pull driver mode means that the output source is actively driven to both high and low level.

Switch Settings [1]			Input of the Output Circuit [2]	Output Px_IO1 ... Px_IO32 [2], [3]	Description [3]
L (GND)	H1 (VBAT1)	H2 (VBAT2)			
0	0	0	0 or 1	High-Z	Individual output disabled.[4]
1	0	0	0	GND	Low-side switch
1	0	0	1	High-Z	Low-side switch
0	1	0	0	High-Z	High-side switch set to Px_VBAT1
0	1	0	1	Px_VBAT1	High-side switch set to Px_VBAT1
0	0	1	0	High-Z	High-side switch set to Px_VBAT2
0	0	1	1	Px_VBAT2	High-side switch set to Px_VBAT2
0	1	1	0	High-Z	High-side switch set to maximum value (Px_VBAT1 or Px_VBAT2)
0	1	1	1	max. value (Px_VBAT1 or Px_VBAT2)	High-side switch set to maximum value (Px_VBAT1 or Px_VBAT2)
1	1	0	0	GND	Push-pull output set to Px_VBAT1
1	1	0	1	Px_VBAT1	Push-pull output set to Px_VBAT1
1	0	1	0	GND	Push-pull output set to Px_VBAT2
1	0	1	1	Px_VBAT2	Push-pull output set to Px_VBAT2
1	1	1	0	GND	Push-pull output set to maximum value (Px_VBAT1 or Px_VBAT2)
1	1	1	1	max. value (Px_VBAT1 or Px_VBAT2)	Push-pull output set to maximum value (Px_VBAT1 or Px_VBAT2)

[1] 0 = switch disabled, 1 = switch enabled
[2] Refer to Digital Outputs (PHS Bus System Hardware Reference 🕮)
[3] x is a placeholder for port/connector number 1 ... 3
[4] With RTLib functions, the channel can be used as digital input or PWM input.

For more details, refer to I/O Circuits and Electrical Characteristics (PHS Bus System Hardware Reference 🕮).

Dialog settings

Port Displays the selected port number.

Channel Displays the selected channel.

Setup of supply rails Lets you enable/disable the supply rails defined by the parameters L, H1 and H2.

Parameter	Meaning
L	Enables/disables the low-side switch for the selected digital output channel.
H1	Enables/disables the high-side switch to H1 (VBAT1) for the selected digital output channel.
H2	Enables/disables the high-side switch to H2 (VBAT2) for the selected digital output channel.

L and H1 are enabled by default (push-pull output set to VBAT1).

Related topics

Basics

Basics on PWM Signal Generation (D2PWM) (DS4004 Features 🕮)

HowTos

How to Generate a PWM Signal via RTI (DS4004 Features 🕮)

Generation Page (DS4004D2PWM_BLx)

Purpose

To specify the PWM update mode and the PWM period range.

Dialog settings

Update mode Lets you select the PWM update mode for the new values of the period and/or the duty cycle:

Update Mode	Description
Asynchronous	New values for T_{high} and T_{low} are updated immediately. An update can happen anywhere during the PWM period. **Note** For PWM signal generation with *asynchronous* update, it is possible that a high or low pulse is cut off. This occurs when the new T_{high} or T_{low} value is shorter than the current one and exceeds the time which has elapsed in the current T_{high} or T_{low} period, respectively. The result is a non-constant PWM period during update (i.e. actual T_{high} + T_{low}). If this is not desirable, use the synchronous mode instead.
Synchronous	New values for T_{high} and T_{low} are updated at the next rising edge of the PWM output signal. The output period is constant if T = T_{high} + T_{low} is constant.

Range of period Lets you select the period range for the PWM signal to be generated.

Note

The resolution of the period to be generated depends on the selected period range.
Due to quantization effects, you might encounter considerable deviations between the desired PWM period and the generated PWM period, especially for higher PWM frequencies. To avoid poor frequency resolution, you should therefore select the period range with the best possible resolution (resolution values as small as possible). Refer to Basics on PWM Signal Generation (D2PWM) (DS4004 Features 🕮).

Range of frequency Displays the corresponding frequency range.

Resolution of period Displays the resolution for the selected period range.

Related topics

Basics

Basics on PWM Signal Generation (D2PWM) (DS4004 Features 🕮)

HowTos

How to Generate a PWM Signal via RTI (DS4004 Features 🕮)

Parameters Page (DS4004D2PWM_BLx)

Purpose

To specify the initial output behavior and the termination output behavior.

Description

Initialization During the model initialization phase, the PWM output signal is either generated with an initial period or set to constant low or high potential. This is especially useful if a channel is used in a triggered or enabled subsystem that is not executed at the start of the simulation. With **Initial period** and **Initial duty cycle**, the channel has a defined output during this simulation phase.

Termination With the block's **Termination** settings, you can specify an output behavior of the channel on termination to drive your external hardware into a safe final condition.

The possible output behaviors at the end of the simulation are:

- The output is set to high impedance (high-Z) state.
- The output holds the last duty cycle and period.
- The output is set to a definite duty cycle and period.

The specified termination values of I/O channels are set when the simulation executes its termination function by setting the `simState` variable to STOP. If you stop the real-time application by using ControlDesk's **Stop RTP** command, the processor resets immediately without executing termination functions. The current values of the I/O channels are kept and the specified termination values are not set.

Dialog settings

Port Displays the selected port number.

Channel Displays the selected channel.

Initial duty cycle Lets you enter the duty cycle at the start of the simulation in the range 0 … 1. The duty cycle values 0 and 1 yield a constant low and constant high output signal respectively.

Range Displays the selected period range and the corresponding frequency range.

Resolution Displays the resolution for the selected period.

Initial period Lets you enter the period at the start of the simulation. The value must be given in seconds and should remain in the stated period range.

Termination To enable or disable the setting of a definite output behavior at the end of the simulation.

Termination Mode Checkbox	Meaning
Disabled	The output channel is set to high impedance (high-Z) state at the end of the simulation.
Enabled	The channel's output behavior is determined by the **Output** settings (see below) at the end of the simulation.

The termination mode checkbox is disabled by default.

Output To set a definite output behavior at the end of the simulation.

Option Button	Meaning
Last output values	The channel holds the last duty cycle and period when the simulation terminates.
Specific output values	Lets you set a definite duty cycle and period at the end of the simulation.

Duty cycle Lets you set the duty cycle at the end of the simulation in the range 0 … 1. The duty cycle values 0 and 1 yield a constant low and constant high output signal respectively.

Period Lets you set the period at the end of the simulation. The value must be given in seconds and should remain in the stated period range.

Related topics

Basics

Basics on PWM Signal Generation (D2PWM) (DS4004 Features 🕮)

HowTos

How to Generate a PWM Signal via RTI (DS4004 Features 🕮)

References

simState (RTI and RTI-MP Implementation Reference 🕮)
Stop RTP (ControlDesk Platform Management 🕮)

DS4004F2D_BLx

Purpose

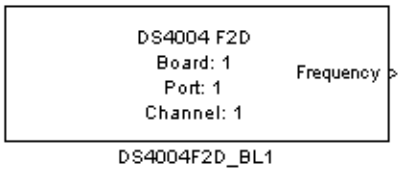
To measure the frequency of a square-wave signal.

Where to go from here

Information in this section

Block Description (DS4004F2D_BLx)

Illustration



Purpose

To measure the frequency of a square-wave signal.

Description

In a Simulink model, the block provides channel-wise read access to the frequency of a square-wave signal. You can specify the threshold level on which the input signal is interpreted as logical 0 or 1.

I/O mapping

For information on the I/O mapping, refer to Basics on Frequency Measurement (F2D) (DS4004 Features 🕮).

I/O characteristics

The following table shows the characteristics of the block's output in Simulink:

Variable	Characteristic	Value
Frequency	Data type	Double
	Range	Depends on the selected frequency range

The frequency of the measured signal is given in Hz.

The frequency of the input signal must remain in the specified measurement range, otherwise the measured value is not correct.

- If the frequency is less than the lower limit, the measured frequency is detected as a 0 Hz signal.
- If the frequency is higher than the upper limit, the measurement is faulty due to undersampling effects.

For further information, refer to Basics on Frequency Measurement (F2D) (DS4004 Features 🕮).

Dialog pages

The dialog settings can be specified on the following dialog pages:

- To specify the board number, the port number, and the channel number, refer to the **Unit Page** (refer to Unit Page (DS4004F2D_BLx) on page 48).
- To specify the threshold level for the selected input channel, refer to the **Electrical Interface Page** (refer to Electrical Interface Page (DS4004F2D_BLx) on page 49).
- To specify the frequency range, refer to the **Measurement Page** (refer to Measurement Page (DS4004F2D_BLx) on page 50).

Related RTLib functions

`ds4004_init`, `ds4004_f2d_init`, `ds4004_f2d`

Related topics

Basics

Basics on Frequency Measurement (F2D) (DS4004 Features 🕮)

HowTos

How to Measure a Frequency via RTI (DS4004 Features 🕮)

Unit Page (DS4004F2D_BLx)

Purpose

To specify the board number, the port number, and the channel number.

Dialog settings

Board Number Lets you select the DS4004 board number in the range 1 … 16.

Port Number Lets you select the port number of the board in the range 1 … 3.

Channel Number Lets you select a channel of the port in the range 1 … 32.

Related topics

Basics

Basics on Frequency Measurement (F2D) (DS4004 Features 🕮)

HowTos

How to Measure a Frequency via RTI (DS4004 Features 🕮)

Electrical Interface Page (DS4004F2D_BLx)

Purpose

To set the threshold level for the selected input channel.

Description

For detailed information on the electrical specifications of digital inputs, refer to I/O Circuits and Electrical Characteristics (PHS Bus System Hardware Reference 🕮).

Dialog settings

Port Displays the selected port number.

Channel Displays the selected channel.

Threshold level digital I/O in Lets you specify the threshold level for the selected input channel in the range 1.0 … 23.8 V. The default threshold level is 2.5 V.

Related topics

Basics

Basics on Frequency Measurement (F2D) (DS4004 Features 🕮)

HowTos

How to Measure a Frequency via RTI (DS4004 Features 🕮)

Measurement Page (DS4004F2D_BLx)

Purpose

To specify the frequency range.

Dialog settings

Range of frequency Lets you select the frequency range.

Note

The measurement resolution depends on the selected frequency range. To get the best possible resolution of the measured square-wave signal, you should select the frequency range with the best possible resolution (the frequency range with the lowest possible range number). For example, if your desired frequency is 100 Hz, you should use frequency range 1 (9.54 Hz … 150 kHz) rather than frequency range 2 (4.77 Hz … 150 kHz). Refer to Basics on Frequency Measurement (F2D) (DS4004 Features 🕮).

Resolution of frequency Displays the measurement resolution for the selected frequency range.

Related topics

Basics

Basics on Frequency Measurement (F2D) (DS4004 Features 🕮)

HowTos

How to Measure a Frequency via RTI (DS4004 Features 🕮)

DS4004D2F_BLx

Purpose

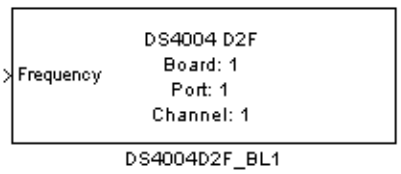
To generate a square-wave signal with the frequency adjustable during run time.

Where to go from here

Information in this section

Block Description (DS4004D2F_BLx)

Illustration



DS4004D2F_BL1

Purpose

To generate a square-wave signal with the frequency adjustable during run time.

Description

The block's Simulink input – the frequency – can be changed during run time. To avoid saturation effects when generating the square-wave signal, the input value for the frequency must remain in the selected frequency range.

I/O mapping

For information on the I/O mapping, refer to Basics on Square-Wave Signal Generation (D2F) (DS4004 Features 🕮).

I/O characteristics

The following table shows the characteristics of the block's input in Simulink:

Variable	Characteristic	Value
Frequency	Data type	Double
	Range	Depends on the selected frequency range

The frequency must be given in Hz.

If the specified frequency range is exceeded, square-wave signal generation will be faulty:

- If the frequency is higher than the upper range limit, the frequency saturates to f_{max}.
- If the frequency is less than the lower range limit, the frequency is set to 0 Hz, and the output voltage level is set to the value specified by **Set output channel**, refer to the **Generation Page (DS4004D2F_BLx)** on page 55.

For further information, refer to Basics on Square-Wave Signal Generation (D2F) (DS4004 Features 🕮).

Dialog pages

The dialog settings can be specified on the following dialog pages:

- To specify the board number, the port number, and the channel number, refer to the **Unit Page** (refer to Unit Page (DS4004D2F_BLx) on page 53).
- To set the high-side and low-side switches of the connected supply rails, refer to the **Electrical Interface Page** (refer to Electrical Interface Page (DS4004D2F_BLx) on page 53).
- To specify the frequency range and the zero frequency mode, refer to the **Generation Page** (refer to Generation Page (DS4004D2F_BLx) on page 55).
- To set the initial output state and the termination output state, refer to the **Parameters Page** (refer to Parameters Page (DS4004D2F_BLx) on page 56).

Related RTLib functions

`ds4004_init`, `ds4004_d2f_init`, `ds4004_d2f`

Related topics

Basics

Basics on Square-Wave Signal Generation (D2F) (DS4004 Features 🕮)

HowTos

How to Generate a Square-Wave Signal via RTI (DS4004 Features 🕮)

Unit Page (DS4004D2F_BLx)

Purpose

To specify the board number, the port number, and the channel number.

Dialog settings

Board Number Lets you select the DS4004 board number in the range 1 … 16.

Port Number Lets you select the port number of the board in the range 1 … 3.

Channel Number Lets you select a channel of the port in the range 1 … 32.

Related topics

Basics

Basics on Square-Wave Signal Generation (D2F) (DS4004 Features 🕮)

HowTos

How to Generate a Square-Wave Signal via RTI (DS4004 Features 🕮)

Electrical Interface Page (DS4004D2F_BLx)

Purpose

To set the high-side and low-side switches of the connected supply rails for the selected output channel.

Description

The output state of each I/O channel depends on its individual settings for the low-side switch and the high-side switches. You can use the supply rails L (GND), H1 (VBAT1), and H2 (VBAT2).

- If you set the low-side switch L (GND), the digital output channel is set to low-side switch mode.
- If you set the high-side switch H1 (VBAT1) *or* H2 (VBAT2), the digital output channel is actively driven in high-side switch mode.
- If you set the high-side switches H1 (VBAT1) *and* H2 (VBAT2), the digital output channel is also actively driven in high-side switch mode, but the output voltage is driven to the highest supply voltage (VBAT1 or VBAT2).
- If you set low-side switch L (GND) and the high-side switches H1 (VBAT1) *and/or* H2 (VBAT2), the digital output channel is actively driven in push-pull mode. Push-pull driver mode means that the output source is actively driven to both high and low level.

Switch Settings [1]			Input of the Output Circuit [2]	Output Px_IO1 ... Px_IO32 [2], [3]	Description [3]
L (GND)	H1 (VBAT1)	H2 (VBAT2)			
0	0	0	0 or 1	High-Z	Individual output disabled.[4]
1	0	0	0	GND	Low-side switch
1	0	0	1	High-Z	Low-side switch
0	1	0	0	High-Z	High-side switch set to Px_VBAT1
0	1	0	1	Px_VBAT1	High-side switch set to Px_VBAT1
0	0	1	0	High-Z	High-side switch set to Px_VBAT2
0	0	1	1	Px_VBAT2	High-side switch set to Px_VBAT2
0	1	1	0	High-Z	High-side switch set to maximum value (Px_VBAT1 or Px_VBAT2)
0	1	1	1	max. value (Px_VBAT1 or Px_VBAT2)	High-side switch set to maximum value (Px_VBAT1 or Px_VBAT2)
1	1	0	0	GND	Push-pull output set to Px_VBAT1
1	1	0	1	Px_VBAT1	Push-pull output set to Px_VBAT1
1	0	1	0	GND	Push-pull output set to Px_VBAT2
1	0	1	1	Px_VBAT2	Push-pull output set to Px_VBAT2
1	1	1	0	GND	Push-pull output set to maximum value (Px_VBAT1 or Px_VBAT2)
1	1	1	1	max. value (Px_VBAT1 or Px_VBAT2)	Push-pull output set to maximum value (Px_VBAT1 or Px_VBAT2)

[1] 0 = switch disabled, 1 = switch enabled
[2] Refer to Digital Outputs (PHS Bus System Hardware Reference 🕮)
[3] x is a placeholder for port/connector number 1 ... 3
[4] With RTLib functions, the channel can be used as digital input or PWM input.

For more details, refer to I/O Circuits and Electrical Characteristics (PHS Bus System Hardware Reference 🕮).

Dialog settings

Port Displays the selected port number.

Channel Displays the selected channel.

Setup of supply rails Lets you enable/disable the supply rails defined by the parameters L, H1 and H2.

Parameter	Meaning
L	Enables/disables the low-side switch for the selected digital output channel.
H1	Enables/disables the high-side switch to H1 (VBAT1) for the selected digital output channel.
H2	Enables/disables the high-side switch to H2 (VBAT2) for the selected digital output channel.

L and H1 are enabled by default (push-pull output set to VBAT1).

Related topics

Basics

Basics on Square-Wave Signal Generation (D2F) (DS4004 Features 🕮)

HowTos

How to Generate a Square-Wave Signal via RTI (DS4004 Features 🕮)

Generation Page (DS4004D2F_BLx)

Purpose

To specify the frequency range and the zero frequency mode.

Dialog settings

Range of frequency Lets you select the frequency range.

Note

The resolution of the square-wave signal to be generated depends on the selected frequency range.
To get the best signal resolution, you should select the frequency range with the best possible resolution (the frequency range with the lowest possible range number). For example, if your desired frequency is 100 Hz, you should use frequency range 1 (9.54 Hz … 150 kHz) rather than frequency range 2 (4.77 Hz … 150 kHz).

Resolution of frequency Displays the frequency resolution for the selected frequency range.

Set output channel Lets you select the Zero frequency mode (the behavior of the output channel if the frequency falls below the lower limit of the frequency range). The following settings are available:

Output Level	Meaning
Low	The output is set to low (default).
High	The output is set to high.
Hold	The output holds its last signal level (low or high).

Related topics

Basics

Basics on Square-Wave Signal Generation (D2F) (DS4004 Features 🕮)

HowTos

How to Generate a Square-Wave Signal via RTI (DS4004 Features 🕮)

Parameters Page (DS4004D2F_BLx)

Purpose

To set the initial output behavior and the termination output behavior.

Description

Initialization During the model initialization phase, the output signal is either generated with an initial frequency or set to zero. This is especially useful if a channel is used in a triggered or enabled subsystem that is not executed at the start of the simulation. With **Initial frequency**, the channel has a defined output during this simulation phase.

Termination With the block's **Termination** settings, you can specify an output behavior of the channel on termination to drive your external hardware into a safe final condition.

The possible output behaviors at the end of the simulation are:

- The output is set to high impedance (high-Z) state.
- The output holds the last frequency.
- The output is set to a definite frequency.

The specified termination values of I/O channels are set when the simulation executes its termination function by setting the `simState` variable to STOP. If you stop the real-time application by using ControlDesk's **Stop RTP** command, the processor resets immediately without executing termination functions. The current values of the I/O channels are kept and the specified termination values are not set.

Dialog settings

Port Displays the selected port number.

Channel Displays the selected channel.

Initial frequency Lets you enter the initial frequency at the start of the simulation.

The frequency should remain in the stated frequency range. Otherwise, it is saturated to f_{max} or set to 0 Hz.

Termination To enable or disable the setting of a definite output behavior at the end of the simulation.

Termination Mode Checkbox	Meaning
Disabled	The output channel is set to high impedance (high-Z) state at the end of the simulation.
Enabled	The channel's output behavior is determined by the **Output** settings (see below) at the end of the simulation.

The termination mode checkbox is disabled by default.

Output To set a definite output behavior at the end of the simulation.

Option Button	Meaning
Last output values	The channel holds the last frequency when the simulation terminates.
Specific output values	Lets you set a definite frequency at the end of the simulation. The frequency should remain in the stated frequency range. Otherwise, it is saturated to f_{max} or set to 0 Hz.

Related topics

Basics

Basics on Square-Wave Signal Generation (D2F) (DS4004 Features 🕮)

HowTos

How to Generate a Square-Wave Signal via RTI (DS4004 Features 🕮)

References

simState (RTI and RTI-MP Implementation Reference 🕮)
Stop RTP (ControlDesk Platform Management 🕮)

Interrupt Blocks

Introduction To manage the interrupt handling of the DS4004 board.

DS4004_HWINT_BLx

Purpose

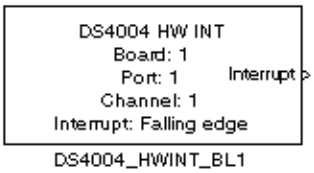
To make the hardware interrupts of the DS4004 board available as trigger sources in a Simulink® model.

Where to go from here

Information in this section

Block Description (DS4004_HWINT_BLx)

Illustration



Purpose

To make the hardware interrupts of the DS4004 board available as trigger sources in a Simulink® model.

Description

The block manages the interrupt handling for the DS4004 board. It makes the interrupt of the DS4004 board available as a trigger source.

Channels 1 and 2 of each port can be used for interrupt generation. You can specify the threshold level and the edge type for an external input signal which is used for interrupt generation.

Note

There must not be several interrupt blocks in the same model which are identically configured regarding the board number, the port number, and the channel number.

I/O mapping

For information on the I/O mapping, refer to Basics on DS4004 Interrupts (DS4004 Features 🕮).

Dialog pages

The dialog settings can be specified on the following dialog pages:

- To specify the board number, the port number, and the channel number, refer to the **Unit Page** (refer to Unit Page (DS4004_HWINT_BLx) on page 61).
- To specify the threshold level and the edge type for an external input signal which is used for interrupt generation, refer to **Interrupt Page** (refer to Interrupt Page (DS4004_HWINT_BLx) on page 62).

Related RTLib functions

`ds4004_init`, `ds4004_digin_init`, `ds4004_int_mode_set`

Related topics

Basics

Basics on DS4004 Interrupts (DS4004 Features 🕮)

HowTos

How to Specify Interrupt Generation via RTI (DS4004 Features 🕮)

Unit Page (DS4004_HWINT_BLx)

Purpose

To specify the board number, the port number, and the channel number.

Dialog settings

Board Number Lets you select the DS4004 board number in the range 1 … 16.

Port Number Lets you select the port number of the board in the range 1 … 3.

Channel Number Lets you select a channel of the port in the range 1 … 2.

Related topics

Basics

Basics on DS4004 Interrupts (DS4004 Features 🕮)

HowTos

How to Specify Interrupt Generation via RTI (DS4004 Features 🕮)

Interrupt Page (DS4004_HWINT_BLx)

Purpose

To specify the edge type for an external input signal which is used for interrupt generation.

Description

For detailed information on the electrical specifications of digital inputs, refer to I/O Circuits and Electrical Characteristics (PHS Bus System Hardware Reference 🕮).

Dialog settings

Port Displays the selected port number.

Channel Displays the selected channel.

Threshold level Lets you enter the threshold level which is used for interrupt generation in the range 1.0 … 23.8 V.

The default threshold level is 2.5 V.

Edge type Lets you select the edge type which is used for interrupt generation.

The possible settings are:

- Falling edge
- Rising edge
- Both edges

The default edge type is *Falling edge*.

Related topics

Basics

Basics on DS4004 Interrupts (DS4004 Features 🕮)

HowTos

How to Specify Interrupt Generation via RTI (DS4004 Features 🕮)