DS3002 Incremental Encoder Interface Board

RTI Reference

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dSPACE

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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/patches for software updates and patches.

Important Notice

Contents

About This Reference

Content

This RTI Reference provides a full description of the Real-Time Interface (RTI) software support for the DS3002 Incremental Encoder Interface Board, which can be controlled by the DS1006 Processor Board and DS1007 PPC Processor 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 DS3002 Blockset

Objective

Here you get basic information on the DS3002 blockset.

Where to go from here

Information in this section

Overview of the DS3002 Blockset

About this board

The DS3002 board supports incremental encoders with 2 different sensor signal types:

- Analog, with either sinusoidal 1 V_{pp} or 11 μA_{pp}
- Digital, with either RS422 (differential) or single-ended TTL

Before you start using the DS3002 board you have to set the channel jumpers of your DS3002 board according to the encoder type you are using. By default, all channels are set to work with digital encoders in single-ended TTL mode. The pin connection depends on the encoder type. For the setting of the channel jumpers as well as information on pin connections refer to DS3002 Incremental Encoder Interface Board (PHS Bus System Hardware Reference 🕮).

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 🕮).

Basic principles

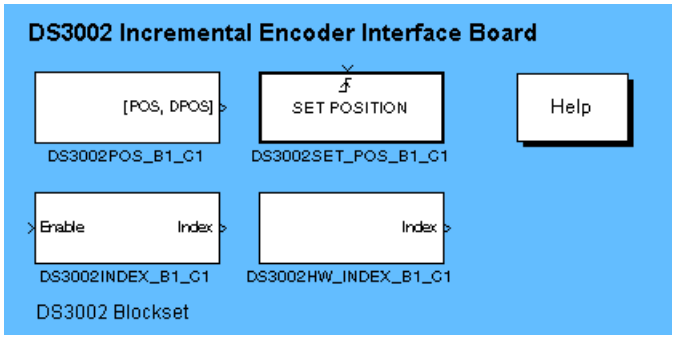
For basic principles working with incremental encoder, refer to Basic Terms on page 10.

RTI blockset

The Real-Time Interface (RTI) board library for the DS3002 Incremental Encoder Interface Board provides the RTI blocks that implement the functionality and I/O capabilities of the DS3002 board in Simulink models.

DS3002

After you double-click this board library icon in the RTI library of the DS1006 or DS1007, the board library of the DS3002 opens.



The following I/O unit can be accessed by the RTI blockset for the DS3002:

- Incremental Encoder Interface on page 13

Related topics

References

Basic Terms

Basic terms

These are the basic terms used in connection with incremental encoders.

Encoder type Sensor signal type of the incremental encoder, either analog (sinusoidal 1 V_{pp} or 11 μA_{pp}) or digital (RS422 / differential or single-ended TTL).

Encoder lines Number of physical encoder lines of the incremental encoder. Refer to your encoder manual for the correct value.

Line subdivision Number of subdivisions measured from one physical encoder line. A higher line subdivision results in a more accurate position measurement.

Increment Size of the fraction for the position value. It is the reciprocal of the line subdivision.

Position value For all block outputs and dialog entries the position value is interpreted as the number of encoder lines counted. The result of the line subdivision is reflected as a fraction.

Delta position value The difference of the position value from the last to the current sample step, measured in encoder lines. To compute the velocity from this value you need to divide the delta position value by the sample time that the DS3002POS block is executed with.

Position range Number of physical encoder lines to be counted without wrap around of the position value.

Wrap around If the position range is exceeded, the position value wraps around from the positive to the negative limit range, or vice versa. The delta position value is not affected by one wrap around of the position value when the position range is exceeded.

Position computation For single-processor and multiprocessor PHS-bus-based systems, the position computation is performed with the full position information (32 bits for a digital, and 42 bits for an analog encoder).

Incremental Encoder Interface

Objective

This section gives you concise information on how to use the Incremental Encoder Interface of the DS3002.

Hardware and software settings must match

NOTICE

The encoder type (analog or digital) displayed in the dialogs does not affect the channel jumper settings of the DS3002 board. RTI cannot check these settings. Thus you need to make sure that the dialog settings and jumper settings match for each channel. By default all channels are set to work with digital encoders in single-ended TTL mode.

For further information on the jumper settings, refer to Jumpers for Encoder Signal Type Selection (PHS Bus System Hardware Reference 🕮).

Where to go from here

Information in this section

DS3002POS_Bx_Cy

Objective

To read the positions of the encoder input channels.

Where to go from here

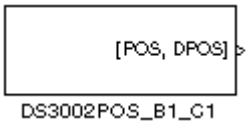
Information in this section

Information in other sections

Block Description (DS3002POS_Bx_Cy)

Block

Gives you information on the appearance and purpose of the block.



Purpose

To provide read access to the position value and delta position value of one of the 6 encoder channels. The position values are measured in encoder lines.

Description

When an application is loaded to the processor board, the position values of the employed channels are initialized to 0.

- The number of increments can be calculated as follows:

  $n_{increments} = line\_subdivision \cdot position\_value$

- The radian angle φ can be calculated according to:

  $\varphi = position\_value \cdot 2 \cdot \frac{\pi}{encoder\_lines}$

- The maximum number of encoder revolutions to be measured without wrap around of the position value is:

$$max\_revolutions = \frac{positions\_range}{encoder\_lines}$$

I/O characteristics

- The block output is a vector containing both the position value and the delta position value. Use a Simulink **Demux** block to access them separately.
- The relationship between the measured incremental encoder lines and the output (position and delta position value) of the block is:

Encoder Signal Type	Simulink Output
Digital	±536,870,912.25
Analog	±536,870,912.00

- The increment of the Simulink output always is 0.25 (4-fold subdivision) or 1/4096 (4096-fold subdivision). The required encoder type is **digital or analog** (4-fold subdivision), or **analog** (4096-fold subdivision).
- If the position range is exceeded, the position value wraps around from the positive to the negative range limit, or vice versa.
- If reset-on-index is set for the specified encoder channel, you have to regard the following situation: When an index has occurred between the actual and the last evaluation of the delta position, the previously read position is set either to 0 or to the specified position value. This causes a deviation between the real and the calculated delta position.

Dialog pages

The dialog settings can be specified on the following pages:

- Unit Page (DS3002POS_Bx_Cy) on page 16
- Settings Page (DS3002POS_Bx_Cy) on page 16

Related RTLib functions

This RTI block is implemented by using the RTLib functions, which are described in the *DS3002 RTLib Reference*.

- ds3002_init
- ds3002_start
- ds3002_read_count
- ds3002_read_line_count
- ds3002_write_line_count

Unit Page (DS3002POS_Bx_Cy)

Purpose

To specify the board number and channel number.

Dialog settings

Board number Lets you select the board number in the range 1 … 16. If your system contains several boards of the same type, RTI uses the board number to distinguish between them.

Channel number Lets you select a single channel within the range 1 … 6.

Related topics

References

Block Description (DS3002POS_Bx_Cy)..... 14
Settings Page (DS3002POS_Bx_Cy)..... 16

Settings Page (DS3002POS_Bx_Cy)

Purpose

To specify the position measurement.

Dialog settings

Line subdivision Number of subdivisions measured from one encoder line. Selectable values are 4 or 4096. The default is a 4-fold subdivision. This setting is valid for the position measurement and the delta position measurement.

Required encoder type Displays the sensor signal type required for the selected Line subdivision value.

Position range Displays the position range according to the selected Line subdivision value.

Related topics

References

Block Description (DS3002POS_Bx_Cy)..... 14
Unit Page (DS3002POS_Bx_Cy)..... 16

DS3002INDEX_Bx_Cy

Objective

To poll the encoder index of a selected encoder input channel.

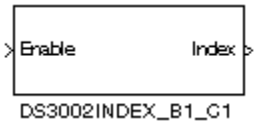
Where to go from here

Information in this section

Block Description (DS3002INDEX_Bx_Cy)

Block

Gives you information on the appearance and purpose of the block.



Purpose

To poll the encoder index line to perform an index search. At the end of the search the position can be set to a specific value. After the search the block output can either be kept high or follow the current index signal.

Description

- When an application is loaded to the processor board, the position value of the employed channels are initialized to 0.
- The increment of the position value to be set is 0.25. The required encoder type is "digital or analog." The position range that can be covered is ±536,870,912 encoder lines.
- The DS3002INDEX block refers to the S-function file `ds3002_index_s_t2.c` that is available from the directory `<RCP_HIL_InstallationPath>\MATLAB\RTI\RTI<ProcessorBoard>\SFcn`.
- If a different functionality is required for your application, a copy of the S-function's source code can be customized accordingly.

Note

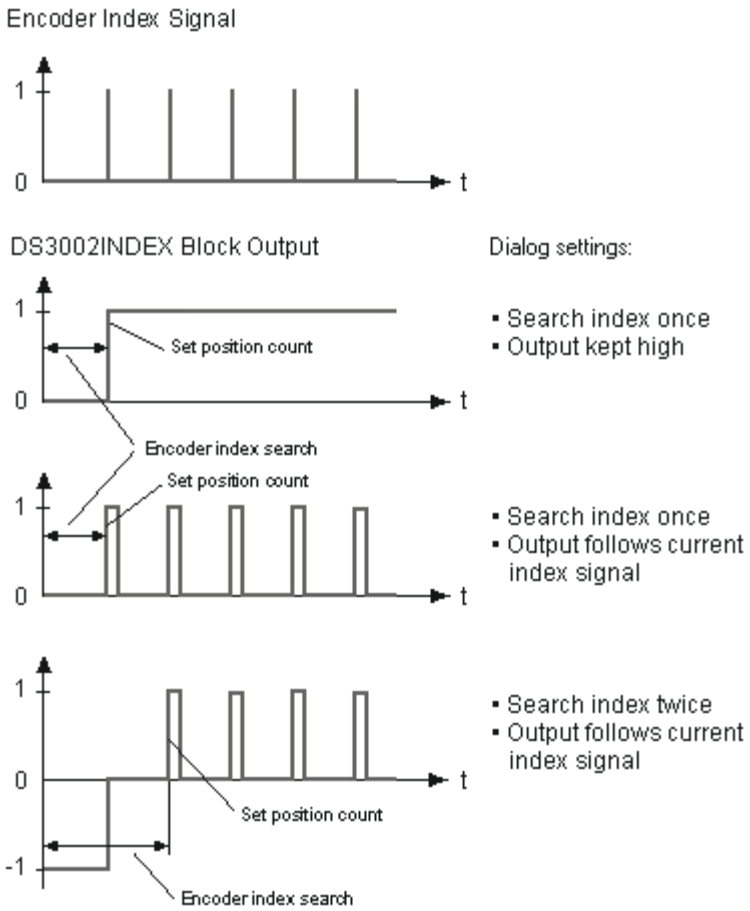
The DS3002INDEX_Bx_Cy block and the DS3002HW_INDEX_Bx_Cy block cannot be used simultaneously.

I/O mapping

For information on the I/O mapping, refer to Mapping of I/O Signals (PHS Bus System Hardware Reference 🕮).

I/O characteristics

- An input value > 0 enables the index search for the respective interface channel. The output will be of the type double.
- The block output depends on the selected settings for Type of index search and Output after search in the Settings page. The following figure displays the relationship.



If current index signal is selected for the block output in the Settings page, the block output will be high for at least one execution step of the block.

- The following tables show the datatype of the block output. The Block output on the Settings page has been set to kept high.

If Search index twice for speed-up has not been selected:

State	Simulink Output
Index has not been found once	0 (int8)
Index has been found	1 (int8)

If the Search index twice for speed-up has been selected:

State	Simulink Output
Index has not been found yet	–1 (int8)
Index has been found once	0 (int8)
Index has been found for the second time	1 (int8)

Dialog pages

The dialog settings can be specified on the following pages:

- Unit Page (DS3002INDEX_Bx_Cy) on page 19
- Settings Page (DS3002INDEX_Bx_Cy) on page 20
- Options Page (DS3002INDEX_Bx_Cy) on page 20

Related RTLib functions

This RTI block is implemented by using the RTLib functions, which are described in the *DS3002 RTLib Reference*.

- ds3002_init
- ds3002_write_line_count
- ds3002_clear_index
- ds3002_test_index

Unit Page (DS3002INDEX_Bx_Cy)

Purpose

To specify the board number and channel number.

Dialog settings

Board number Lets you select the board number in the range 1 … 16. If your system contains several boards of the same type, RTI uses the board number to distinguish between them.

Channel number Lets you select a single channel within the range 1 … 6.

Related topics

References

Settings Page (DS3002INDEX_Bx_Cy)

Purpose

To specify the position measurement.

Dialog settings

Search index twice for speed-up If enabled, the search is performed in 2 steps. Otherwise the encoder index is searched once.

Set position count If enabled, the position is set to the specified value.

Required encoder type Displays the required sensor signal type.

Position value When the index search is finished the position is set to the specified value (measured in encoder lines). This value is restricted to the Position range and Increment as displayed.

Position range Displays the accessible range.

Increment Displays the increment valid for the setting of the position value. Always 0.25 encoder lines.

Block output The block output can either be kept high or follows the current index signal.

Related topics

References

Options Page (DS3002INDEX_Bx_Cy)

Purpose

To specify the sample time and underlying S-function.

Dialog settings

Sample time The sample time of the task the DS3002INDEX block should be executed in. Valid values are –1 (inherited) or any multiple of the Fixed step size chosen on the Simulation Parameters page of the current model. As an alternative, you may also state a valid MATLAB expression, meaning a mathematical expression containing numbers and variables that you defined in MATLAB's workspace beforehand.

Solving S-function The underlying C-code S-function for the encoder index search.

Related topics

References

DS3002HW_INDEX_Bx_Cy

Objective

To reset the position counter if a hardware index was detected.

Where to go from here

Information in this section

Block Description (DS3002HW_INDEX_Bx_Cy)

Block

Gives you information on the appearance and purpose of the block.

Purpose

To reset the position counter and to specify the output signal if the encoder index was detected by hardware.

Description

The reset will be done immediately after the index detection. It can be performed never, once or always on detection on each of the 6 encoder channels independently. The block output after index detection can be set to follow the current index signal or to keep the high level signal.

Note

The DS3002HW_INDEX_Bx_Cy block and the DS3002INDEX_Bx_Cy blocks cannot be used simultaneously.

I/O mapping

For information on the I/O mapping, refer to Mapping of I/O Signals (PHS Bus System Hardware Reference 🕮).

I/O characteristics

The block outputs 1 if an index was detected. If no index was detected, the block output is 0.

Dialog pages

The dialog settings can be specified on the following pages:

- Unit Page (DS3002HW_INDEX_Bx_Cy) on page 23
- Parameter Page (DS3002HW_INDEX_Bx_Cy) on page 23

Related RTLib functions

This RTI block is implemented by using the RTLib functions, which are described in the *DS3002 RTLib Reference*.

- ds3002_init
- ds3002_set_counter_reset_mode
- ds3002_test_index

Unit Page (DS3002HW_INDEX_Bx_Cy)

Purpose

To specify board and channel on which the index detection should be performed.

Dialog settings

Board number Lets you select the board number in the range 1 … 16. If your system contains several boards of the same type, RTI uses the board number to distinguish between them.

Channel number Lets you specify a channel within the range 1 … 6.

Related topics

References

Parameter Page (DS3002HW_INDEX_Bx_Cy)

Purpose

To specify the reset mode and output signal for the index detection.

Dialog settings

Reset position count Lets you specify the reset mode on index detection:

Reset Mode	Meaning
Never	No reset will be performed.
Once	The position counter will be reset to 0 only the first time if an encoder index was detected.
Always	The position counter will be reset to 0 each time if an encoder index was detected.

Block output Lets you specify the output signal after the encoder index was detected:

Block Output	Meaning
Current	The block output follows the current index signal after index detection.
Kept high	The block output remains on high level after index detection.

Related topics

References

Block Description (DS3002HW_INDEX_Bx_Cy)..... 22
Unit Page (DS3002HW_INDEX_Bx_Cy)..... 23

DS3002SET_POS_Bx_Cy

Objective

To set the position of an encoder channel.

Where to go from here

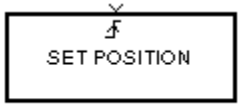
Information in this section

Information in other sections

Block Description (DS3002SET_POS_Bx_Cy)

Block

Gives you information on the appearance and purpose of the block.



Purpose

To provide channel-wise write access to the position value. When the block is triggered, the specified position is set.

Description

- Due to the integer representation of the position count the positive range limits are one resolution step below the given range. This has been omitted to keep the representation simple. For example, the positive range for 4-fold line subdivision is by ¼ = 0.25 below.
- Since the 10-bit fine count cannot be set to a specific value, the increment is limited by the 4-fold line count, which is ¼ encoder line.

I/O characteristics

- A trigger value > 0 forces the DS3002SET_POS_Bx_Cy block to set the specified position value.
- The increment of the position value to be set is 0.25. The required encoder type is **digital or analog**. The position range that can be covered is ±536,870,912 encoder lines.

Dialog pages

The dialog settings can be specified on the following pages:

- Unit Page (DS3002SET_POS_Bx_Cy) on page 26
- Settings Page (DS3002SET_POS_Bx_Cy) on page 27

Related RTLib functions

This RTI block is implemented by using the RTLib functions, which are described in the *DS3002 RTLib Reference*.

- ds3002_init
- ds3002_write_line_count

Unit Page (DS3002SET_POS_Bx_Cy)

Purpose

To specify the board number and the channel number.

Dialog settings

Board number Lets you select the board number in the range 1 … 16. If your system contains several boards of the same type, RTI uses the board number to distinguish between them.

Channel number Lets you select a single channel within the range 1 … 6.

Related topics

References

Block Description (DS3002SET_POS_Bx_Cy)..... 25
Settings Page (DS3002SET_POS_Bx_Cy)..... 27

Settings Page (DS3002SET_POS_Bx_Cy)

Purpose

To specify the position measurement.

Dialog settings

Required encoder type Displays the required sensor signal type.

Position value When the block is triggered, the position is set to the specified value (measured in encoder lines). This value is restricted to the current Position range and Increment as displayed.

Position range Displays the accessible range.

Increment Displays the increment valid for the setting of the position value. Always 0.25 encoder lines.

Related topics

References

C

D

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P