DS2211 HIL I/O 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

Contents

This RTI reference provides a full description of the Real-Time Interface (RTI) software for the DS2211 HIL 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/go/help.

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 DS2211 Blockset

Introduction

Here you get basic information on the DS2211 blockset.

Overview of the DS2211 Blockset

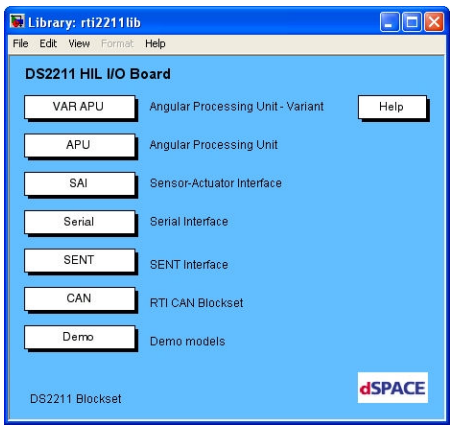
Introduction

The Real-Time Interface (RTI) board library for the DS2211 – rti2211lib – provides RTI blocks that implement the functionality and I/O capabilities of the DS2211 HIL I/O Board.

The RTI blocks are designed to specify the hardware setup for real-time applications.

Access

After you double-click the DS2211 button the rti2211lib window is displayed.



Library components

The following rti2211lib components are available in the Library: rti2211lib window:

VAR APU The sublibrary comprises RTI blocks for the angular processing unit - variant. This sublibrary provides access to crankshaft sensor signal generation and ignition signal capturing, for example. This sublibrary supports the simulation of engine variants. Refer to Angular Processing Unit - Variant on page 153.

APU The sublibrary comprises RTI blocks for the angular processing unit. This sublibrary provides access to crankshaft sensor signal generation and ignition signal capturing, for example. Refer to Angular Processing Unit on page 73.

SAI The sublibrary comprises RTI blocks for the sensor and actuator interface. This sublibrary provides access to A/D conversion, digital I/O and PWM signal measurement, for example. Refer to Sensor and Actuator Interface on page 17.

SERIAL The sublibrary comprises RTI blocks for the serial interface. Refer to Serial Interface on page 205.

SENT The sublibrary comprises RTI blocks for implementing a communication using the single edge nibble transmission (SENT) protocol. Refer to Single Edge Nibble Transmission (SENT) Protocol on page 231.

CAN The sublibrary comprises RTI blocks for CAN access. Refer to Basics on the RTI CAN Blockset (RTI CAN Blockset Reference 🕮).

Demo Shows example models.

Sensor and Actuator Interface

Where to go from here

Information in this section

General Information

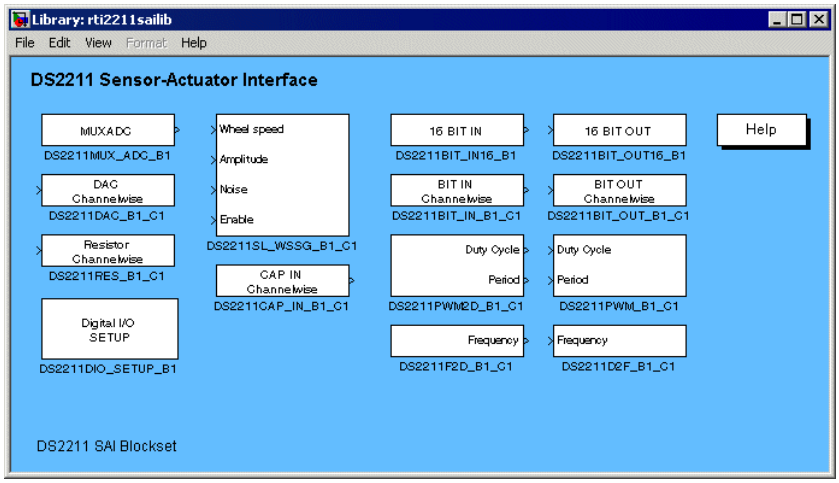
Overview of the Sensor and Actuator Interface

Introduction

The sensor and actuator interface (SAI) provides standard I/O components and timing I/O components.

Access

After you double-click the SAI button in the Library: rti2211lib, the Library: rti2211sailib window is displayed.



The buttons of this library provide access to the RTI I/O blocks of the sensor and actuator interface (SAI).

Library components

The library contains the following components:

- ADC Unit on page 20
- DAC Unit on page 22
- Digital I/O Set Up on page 25
- Bit I/O Unit on page 35
- D/R Converter on page 46
- PWM Signal Measurement on page 49
- PWM Signal Generation on page 52
- Frequency Measurement on page 57
- Square-Wave Signal Generation on page 60
- Wheel Speed Sensor Simulation on page 65
- Digital Capture of Event Capture Input on page 69

Related topics

Basics

Sensor and Actuator Interface (DS2211 Features 🕮)

ADC Unit

DS2211MUX_ADC_Bx

Purpose

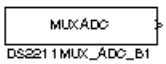
To read from up to 16 A/D channels.

Where to go from here

Information in this section

Block Description (DS2211MUX_ADC_Bx)

Illustration



Purpose

To read from up to 16 A/D channels.

I/O mapping

For information on the I/O mapping, refer to ADC Unit (DS2211 Features 🕮).

Depending on your selection, A/D conversion will be started for channels 1 … 4, 1 … 8, 1 … 12, or 1 … 16. To speed up conversion time use low channel numbers.

I/O characteristics

This table shows the scaling between the differential analog input voltage and the output of the block:

Input Voltage Range	Simulink Output
0 V … 60 V	0 … 1

Dialog pages

The dialog settings can be specified on the **Unit Page** (refer to Unit Page (DS2211MUX_ADC_Bx) on page 21).

Related RTLib functions

`ds2211_adc_block_init`, `ds2211_adc_block_start`, `ds2211_adc_block_in`

Related topics

Basics

ADC Unit (DS2211 Features 🕮)

Unit Page (DS2211MUX_ADC_Bx)

Purpose

To specify the board number and select the channel to be used.

Dialog settings

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

Channel selection Lets you choose a set of up to 16 A/D channels. Use the **None** button to clear an obsolete selection.

Note

You have to select at least one channel.

Related topics

References

DS2211MUX_ADC_Bx 20

DAC Unit

DS2211DAC_Bx_Cy

Purpose

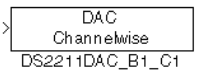
To write to a single D/A channel.

Where to go from here

Information in this section

Block Description (DS2211DAC_Bx_Cx)

Illustration



Purpose

To write to a single D/A channel.

I/O mapping

For information on the I/O mapping, refer to DAC Unit (DS2211 Features 🕮).

I/O characteristics

- This table shows the scaling between the input of the block and the analog output voltage:

Simulink Input	Output Voltage Range
0 … 1	0 … V_{REF}

For information on V_{REF}, refer to DAC Unit (DS2211 Features 🕮).

- The following table shows the characteristics of the block input:

Characteristic	Value
Data type	Double
Range	0 … 1

- The block provides its outputs in unlatched mode, which means that the channel is converted and output immediately.

Dialog pages

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

- **Unit Page** (refer to Unit Page (DS2211DAC_Bx_Cx) on page 23)
- **Parameters Page** (refer to Parameters Page (DS2211DAC_Bx_Cx) on page 24)

Related RTLib functions

`ds2211_dac_out`

Related topics

Basics

DAC Unit (DS2211 Features 🕮)

Unit Page (DS2211DAC_Bx_Cx)

Purpose

To specify the board number and select the channel to be used.

Dialog settings

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

Channel selection Lets you select a single channel in the range 1 … 20.

Related topics

References

DS2211DAC_Bx_Cy....22

Parameters Page (DS2211DAC_Bx_Cx)

Purpose

To specify the initialization and termination.

Description

Initialization With the initialization value, the D/A channel has a defined output during the initialization phase. This is especially useful if a channel is used in a triggered or enabled subsystem that is not executed right from the start of the simulation.

Termination When the simulation terminates, the D/A channel holds the last output value by default. Using the parameters **Termination mode** and **Termination value**, you can specify a user-defined output value on termination and use this setting to drive your external hardware into a safe final condition.

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

Initial output Lets you enter the initial value for the output voltage at the start of the simulation. The value in the range 0 … 100% corresponds to the DAC output voltage range (0 … V_{REF}).

Termination value Lets you enter the output value at the end of the simulation. The value in the range 0 … 100% corresponds to the DAC output voltage range (0 … V_{REF}).

Related topics

References

DS2211DAC_Bx_Cy.....22
simState (RTI and RTI-MP Implementation Reference 🕮)
Stop RTP (ControlDesk Platform Management 🕮)

Digital I/O Set Up

Introduction To set up all digital I/O ports.

DS2211DIO_SETUP_Bx

Purpose To set up digital I/O.

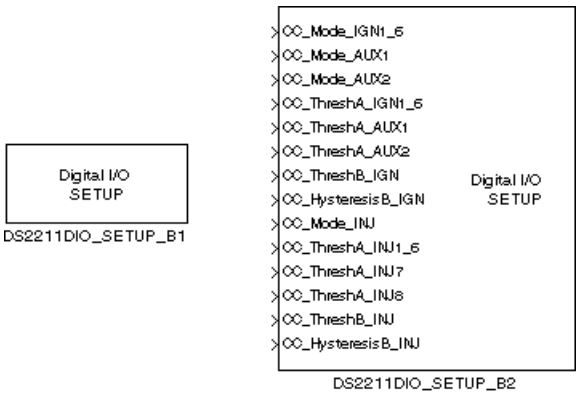
Where to go from here

Information in this section

Block Description (DS2211DIO_SETUP_Bx)

Illustration

The block's different representations depend on how you configure the tunable parameters of the block.



Purpose

To set up digital I/O.

Description

To set the basic parameters of the digital I/O blocks, the sensor and actuator interface (rti2211sailib) and the angular processing unit (rti2211apulib and rti2211varapulib) provide a common block that affects the bit I/O unit, PWM generation, PWM measurement, spark event capture, injection pulse position and fuel amount measurement and the digital outputs of camshaft and crankshaft sensor signal generation.

You can configure the following parameters of the digital I/O:

- To configure the threshold level for digital inputs
- To set the termination mode for all digital outputs
- To configure the complex comparators
- To set the supply voltage for the output drivers (driver behavior configuration)

For information on digital I/O, refer to Signal Connection to External Devices (PHS Bus System Hardware Reference 🕮).

Note

This block is part of the sensor and actuator interface (`rti2211sailib`) and the angular processing unit (`rti2211apulib` and `rti2211varapulib`).

Dialog pages

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

- **Unit Page** (refer to Unit Page (DS2211DIO_SETUP_Bx) on page 27)
- **DIG IN Page** (refer to DIG_IN Page (DS2211DIO_SETUP_Bx) on page 28)
- **DIG OUT Page** (refer to DIG_OUT Page (DS2211DIO_SETUP_Bx) on page 28)

- **PWM IN Page** (refer to PWM_IN Page (DS2211DIO_SETUP_Bx) on page 29)
- **PWM OUT Page** (refer to PWM_OUT Page (DS2211DIO_SETUP_Bx) on page 30)
- **Waveform Outputs Page** (refer to Waveform Outputs Page (DS2211DIO_SETUP_Bx) on page 31)
- **IGN Page** (refer to IGN Page (DS2211DIO_SETUP_Bx) on page 32)
- **INJ Page** (refer to INJ Page (DS2211DIO_SETUP_Bx) on page 33)

Related RTLib functions

`ds2211_digout_mode_set`, `ds2211_digin_threshold_set`, `ds2211_apu_ignition_cc_setup`, `ds2211_apu_injection_cc_setup`, `ds2211_digout_ls_write`, `ds2211_digout_hs_vbat1_write`, `ds2211_digout_hs_vbat2_write`

Related topics

Basics

Bit I/O Unit (DS2211 Features 🕮)

Unit Page (DS2211DIO_SETUP_Bx)

Purpose

To configure the threshold level and the termination mode for all digital I/O as well as the complex comparators of the event capture units.

Dialog settings

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

Termination mode Lets you select the termination mode. Possible values are *disable* and *enable*. If you set the termination mode to *disable*, all digital outputs will be set to high-impedance when the simulation terminates. If you set the termination mode to *enable*, the output on termination will be determined by the block-specific settings. This parameter affects the following blocks:

- DS2211BIT_OUT16_Bx on page 37,
- DS2211BIT_OUT_Bx_Cy on page 42,
- DS2211PWM_Bx_Cy on page 52,
- DS2211APU_CRANK_Bx on page 77,
- DS2211APU_CAM_Bx_Cy on page 84,

- DS2211D2F_Bx_Cy on page 60,
- DS2211VARAPU_CRANK_Bx on page 156.

Related topics

References

DS2211DIO_SETUP_Bx..... 25

DIG_IN Page (DS2211DIO_SETUP_Bx)

Purpose

To set up the parameters for the digital inputs.

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

Threshold level BIT I/O in Lets you enter the threshold level value for digital inputs for one or more of the 16 channels in the range 1 ... 23.8 V.

Set All Lets you enter the threshold level value for digital inputs for all 16 channels in the range 1 ... 23.8 V.

Related topics

References

ds2211_digin_threshold_set (DS2211 RTLib Reference 🕮)
DS2211DIO_SETUP_Bx..... 25

DIG_OUT Page (DS2211DIO_SETUP_Bx)

Purpose

To set up the parameters for the digital outputs.

Description

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

Normally, the low-side switch must be closed to avoid a voltage drift of the digital output. You must connect a pulldown resistor to avoid the voltage drift if

the low-side switch is opened. For example, you can use several digital outputs in a wired OR relation using a common pulldown resistor and opening their low-side switches.

Dialog settings

Setup of supply rails Lets you set the supply rails defined by the parameters LOW, VBAT1 and VBAT2.

Parameter	Meaning
LOW	Set the low-side switch for the bit I/O output channel 1 ... 16.
VBAT1	Set the high-side switch to VBAT1 for the bit I/O output channel 1 ... 16.
VBAT2	Set the high-side switch to VBAT2 for the bit I/O output channel 1 ... 16.

Set All Lets you set the supply rails defined by the parameters LOW, VBAT1 and VBAT2 for all channels.

Related topics

References

ds2211_digout_hs_vbat1_write (DS2211 RTLib Reference 🕮)
ds2211_digout_hs_vbat2_write (DS2211 RTLib Reference 🕮)
ds2211_digout_ls_write (DS2211 RTLib Reference 🕮)
ds2211_digout_mode_set (DS2211 RTLib Reference 🕮)
DS2211DIO_SETUP_Bx..... 25

PWM_IN Page (DS2211DIO_SETUP_Bx)

Purpose

To set up the parameters for the PWM signal inputs.

Dialog settings

Threshold level PWM in Lets you set the threshold level in the range 1 ... 23.8 V for the PWM input channel 1 ... 8.

Set All Lets you set the threshold level in the range 1 ... 23.8 V for all PWM input channels.

Note

The PWM input channel 9 … 24 and the bit I/O input channel 1 … 16 share the same input pins. The parameters for these channels must be set on the DIG_IN page (see DIG_IN Page (DS2211DIO_SETUP_Bx) on page 28).

Related topics

References

ds2211_digin_threshold_set (DS2211 RTLib Reference 🕮)
DS2211DIO_SETUP_Bx..... 25

PWM_OUT Page (DS2211DIO_SETUP_Bx)

Purpose

To set up the parameters for the PWM signal outputs.

Dialog settings

Setup of supply rails Lets you set the supply rails defined by the parameters LOW, VBAT1 and VBAT2.

Parameter	Meaning
LOW	Set the low-side switch for the PWM output channel 1 ... 9.
VBAT1	Set the high-side switch to VBAT1 for the PWM output channel 1 ... 9.
VBAT2	Set the high-side switch to VBAT2 for the PWM output channel 1 ... 9.

Set All Lets you set the supply rails defined by the parameters LOW, VBAT1 and VBAT2 for all channels.

Related topics

References

ds2211_digout_hs_vbat1_write (DS2211 RTLib Reference 🕮)
ds2211_digout_hs_vbat2_write (DS2211 RTLib Reference 🕮)
ds2211_digout_ls_write (DS2211 RTLib Reference 🕮)
ds2211_digout_mode_set (DS2211 RTLib Reference 🕮)
DS2211DIO_SETUP_Bx..... 25

Waveform Outputs Page (DS2211DIO_SETUP_Bx)

Purpose

To set up the parameters for the waveform outputs.

Dialog settings

Setup of supply rails Lets you set the supply rails defined by the parameters LOW, VBAT1 and VBAT2 for the digital APU output channels CRANK_DIG (channel 1), CAM1_DIG (channel 2) and CAM2_DIG (channel 3).

Parameter	Meaning
LOW	Set the low-side switch for the digital APU output channel 1 ... 3.
VBAT1	Set the high-side switch to VBAT1 for the digital APU output channel 1 ... 3.
VBAT2	Set the high-side switch to VBAT2 for the digital APU output channel 1 ... 3.

Set All Lets you set the supply rails defined by the parameters LOW, VBAT1 and VBAT2 for all digital APU outputs.

Note

The digital camshaft channel 3 and 4 and the bit I/O output channel 15 and 16 share the same output ports. The parameters for these channels must be set on the DIG_OUT page (see DIG_OUT Page (DS2211DIO_SETUP_Bx) on page 28).

Related topics

References

ds2211_digout_hs_vbat1_write (DS2211 RTLib Reference 🕮)
ds2211_digout_hs_vbat2_write (DS2211 RTLib Reference 🕮)
ds2211_digout_ls_write (DS2211 RTLib Reference 🕮)
ds2211_digout_mode_set (DS2211 RTLib Reference 🕮)
DS2211DIO_SETUP_Bx.....25

IGN Page (DS2211DIO_SETUP_Bx)

Purpose

To set up the parameters for the ignition capture inputs.

Description

This dialog sets the parameters of the complex comparator. For more information on the complex comparator, refer to Complex Comparators (DS2211 Features 🕮).

Dialog settings

All parameters are tunable. Select **by input port** to set the parameter by the block input port or select **by block parameter** to set the parameter value by the block parameter using the corresponding edit field.

Complex comparator mode Lets you set the signal capture mode of the complex comparator for the ignition capture inputs **IGN1 … 6**, **AUXCAP1** and **AUXCAP2**. For a description of the modes, refer to Complex Comparators (DS2211 Features 🕮).

Channel	Mode
IGN1..6	A leading to A trailing B leading to B trailing B leading to A trailing B trailing to A trailing
AUXCAP1	A leading to A trailing B leading to B trailing B leading to A trailing B trailing to A trailing
AUXCAP1	A leading to A trailing B leading to B trailing B leading to A trailing B trailing to A trailing

Complex comparator setup Lets you specify the threshold level and the hysteresis for the complex comparators of the ignition capture.

Comparator A Lets you set the threshold level of **Comparator A** for the ignition capture inputs **IGN1 … 6**, **AUXCAP1** and **AUXCAP2** (channelwise) in the range 1 … 23.8 V. The hysteresis is always 0.2 V. It cannot be changed.

Comparator B Lets you set the threshold level (1 … 22.65 V) and hysteresis (0.2 … 2.4 V) of **Comparator B** for the ignition capture inputs **IGN1 … 6**, **AUXCAP1** and **AUXCAP2** (all together).

Related topics

References

ds2211_apu_ignition_cc_setup (DS2211 RTLib Reference 🕮)
DS2211DIO_SETUP_Bx.....25

INJ Page (DS2211DIO_SETUP_Bx)

Purpose

To set up the parameters for the injection capture inputs.

Description

This dialog sets the parameters of the complex comparator. For more information on the complex comparator, refer to Complex Comparators (DS2211 Features 🕮).

Dialog settings

All parameters are tunable. Select **by input port** to set the parameter by the block input port or select **by blockparameter** to set the parameter value by the block parameter using the corresponding edit field.

Complex comparator mode Lets you set the signal capture mode of the complex comparator for the injection capture inputs **INJ1…6, INJ7(PWM_IN7)** and **INJ8(PWM_IN8)**. For a description of the modes, refer to Complex Comparators (DS2211 Features 🕮).

Channel	Mode
INJ1..6, INJ7(PWM_IN7), INJ8(PWM_IN8)	A leading to A trailing B leading to B trailing B leading to A trailing B trailing to A trailing

Complex comparator setup Lets you specify the threshold level and hysteresis for the complex comparators of the injection capture.

Comparator A Lets you set the threshold level of **Comparator A** for the ignition capture inputs **INJ1 … 6, INJ7(PWM_IN7)** and **INJ8(PWM_IN8)** in the range 1 … 23.8 V.

Comparator B Lets you set the threshold level (1 … 22.65 V) and hysteresis (0.2 … 2.4 V) of **Comparator B** for the injection capture inputs **INJ1 … 6, INJ7 (PWM_IN7)** and **INJ8 (PWM_IN8)**.

Related topics

References

ds2211_apu_injection_cc_setup (DS2211 RTLib Reference 🕮)
DS2211DIO_SETUP_Bx..... 25

Bit I/O Unit

Introduction

To access the digital I/O ports.

Note

Before operating the digital outputs of the bit I/O unit, an external power supply (V_{Bat}) must be connected.

Where to go from here

Information in this section

DS2211BIT_IN16_Bx

Purpose

To read from the 16 bits from the digital input.

Where to go from here

Information in this section

Block Description (DS2211BIT_IN16_Bx)

Illustration

Purpose

To read from the 16 bits from the digital input.

Description

- Use DS2211BIT_IN_Bx_Cy to read from a single bit of the input port.
- Use DS2211DIO_SETUP_Bx to set the threshold level for digital inputs. If you do not include this block in your model the default threshold level of 2.5 V is valid.

I/O mapping

For information on the I/O mapping, refer to Bit I/O Unit (DS2211 Features 🕮).

I/O characteristics

This table shows the relationship between the block input and block output in the range 0 … 65535:

Digital Input	Simulink Output
0000 0000 0000 0000	0
…	…
0000 0000 1111 1101	253
…	…
1111 1111 0000 0010	65282
…	…
1111 1111 1111 1111	65535

The following table shows the characteristics of the block output:

Characteristic	Value
Data type	Uint16
Range	0 … 65535

Dialog pages

The dialog settings can be specified on the Unit Page (refer to Unit Page (DS2211BIT_IN16_Bx) on page 37).

Related RTLib functions	`ds2211_bit_io_in`
Related topics	Basics Bit I/O Unit (DS2211 Features 🕮)

Unit Page (DS2211BIT_IN16_Bx)

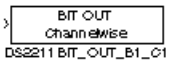
Purpose	To specify the board number.
Dialog settings	**Board number** Lets you select the board number in the range 1 … 16.
Related topics	References DS2211BIT_IN16_Bx 35

DS2211BIT_OUT16_Bx

Purpose	To write to the 16 bits of the digital output.
Where to go from here	Information in this section

Block Description (DS2211BIT_OUT16_Bx)

Illustration



Purpose

To write to the 16 bits of the digital output.

Description

- Use DS2211BIT_OUT_Bx_Cy to write to a single bit of the output port.
- Use DS2211DIO_SETUP_Bx to configure the digital outputs.

I/O mapping

For information on the I/O mapping, refer to Bit I/O Unit (DS2211 Features 🕮).

I/O characteristics

This table shows the relationship between the block input and block output:

Simulink Input	Digital Output
0	0000 0000 0000 0000
…	…
253	0000 0000 1111 1101
…	…
65282	1111 1111 0000 0010
…	…
65535	1111 1111 1111 1111

The following table shows the characteristics of the block input:

Characteristic	Value
Data type	Uint16
Range	0 … 65535

Dialog pages

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

- **Unit Page** (refer to Unit Page (DS2211BIT_OUT16_Bx) on page 39)
- **Parameters Page** (refer to Parameters Page (DS2211BIT_OUT16_Bx) on page 39)

Related RTLib functions `ds2211_bit_io_out`

Related topics

References

DS2211BIT_OUT_Bx_Cy 42
DS2211DIO_SETUP_Bx 25

Unit Page (DS2211BIT_OUT16_Bx)

Purpose To specify the board number.

Dialog settings

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

Related topics

References

DS2211BIT_OUT16_Bx 37

Parameters Page (DS2211BIT_OUT16_Bx)

Purpose To set the initial output and termination output.

Description

Initialization During the model initialization phase the initial output specified with **Initialization value** is written to each channel (bit) to ensure a defined output during this simulation phase. This is especially useful if a channel is used in a triggered or enabled subsystem that is not executed right from the start of the simulation.

Termination When the simulation terminates, all channels hold their last digital output values by default. With **Output on termination** you can specify an output value on termination and use this setting to drive your external hardware into a safe final condition. Use DS2211DIO_SETUP_Bx on page 25 to enable or disable the termination mode for all digital outputs.

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

Initial output Lets you enter the initial output value at the start of the simulation. The value must remain in the range 0 … 65535. According to the corresponding binary value, the bits will be set.

Termination output Lets you set the output value specified by Output on termination or keep the current output value when the simulation terminates.

Related topics

References

DS2211BIT_OUT16_Bx.....37
simState (RTI and RTI-MP Implementation Reference 🕮)
Stop RTP (ControlDesk Platform Management 🕮)

DS2211BIT_IN_Bx_Cy

Purpose

To read channelwise from a single bit of the digital input.

Where to go from here

Information in this section

Block Description (DS2211BIT_IN_Bx_Cy).....40
To describe the purpose and function of the block.

Unit Page (DS2211BIT_IN_Bx_Cy).....42
To specify the board number and the channel number.

Block Description (DS2211BIT_IN_Bx_Cy)

Illustration

Purpose

To read channelwise from a single bit of the digital input.

Description

- Use DS2211BIT_IN16_Bx to access all 16 bits of the input port at the same time.
- Use DS2211DIO_SETUP_Bx to set the threshold level for digital inputs. If you do not include this block in your model the default threshold level of 2.5 V is valid.

I/O mapping

For information on the I/O mapping, refer to Bit I/O Unit (DS2211 Features 🕮).

I/O characteristics

This table shows the relationship between the digital input and the output variable (binary representation related to one channel) of the block:

Digital Input	Simulink Output
High	1
Low	0

The following table shows the characteristics of the block output:

Characteristic	Value
Data type	Boolean
Range	0, 1

Dialog pages

The dialog settings can be specified on the Unit Page (refer to Unit Page (DS2211BIT_IN_Bx_Cy) on page 42).

Related RTLib functions

`ds2211_bit_io_in`

Related topics

References

DS2211BIT_IN16_Bx 35
DS2211DIO_SETUP_Bx 25

Unit Page (DS2211BIT_IN_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.

Channel number Lets you select a channel (bit) in the range 1 … 16.

Related topics

References

DS2211BIT_IN_Bx_Cy.....40

DS2211BIT_OUT_Bx_Cy

Purpose

To write channelwise to a single bit of the digital output.

Where to go from here

Information in this section

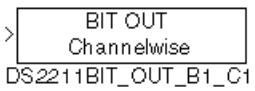
Block Description (DS2211BIT_OUT_Bx_Cy).....42
To describe the purpose and function of the block.

Unit Page (DS2211BIT_OUT_Bx_Cy).....44
To specify the board number and the channel number.

Parameters Page (DS2211BIT_OUT_Bx_Cy).....44
To set the initial output state and the termination output state.

Block Description (DS2211BIT_OUT_Bx_Cy)

Illustration



Purpose

To write channelwise to a single bit of the digital output.

Description

- Use DS2211BIT_OUT16_Bx to access all 16 bits of the output port at the same time.
- Use DS2211DIO_SETUP_Bx to configure the digital outputs.

I/O mapping

For information on the I/O mapping, refer to Bit I/O Unit (DS2211 Features 🕮).

I/O characteristics

This table shows the relationship between the block input and block output:

Simulink Input	Digital Output
1	High
0	Low

The following table shows the characteristics of the block input:

Characteristic	Value
Data type	Boolean
Range	0, 1

Dialog pages

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

- Unit Page (refer to Unit Page (DS2211BIT_OUT_Bx_Cy) on page 44)
- Parameters Page (refer to Parameters Page (DS2211BIT_OUT_Bx_Cy) on page 44)

Related RTLib functions

`ds2211_bit_io_set`, `ds2211_bit_io_clear`

Related topics

Basics

Bit I/O Unit (DS2211 Features 🕮)

Unit Page (DS2211BIT_OUT_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.

Channel number Lets you select a channel (bit) in the range 1 … 16.

Related topics

References

DS2211BIT_OUT_Bx_Cy....42

Parameters Page (DS2211BIT_OUT_Bx_Cy)

Purpose

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

Description

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

Termination When the simulation terminates, all channels hold their last digital output state by default. With the **Termination output state** you can specify an output state on termination and use this setting to drive your external hardware into a safe final condition. Use DS2211DIO_SETUP_Bx on page 25 to enable or disable the termination mode for all digital outputs.

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

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

Termination output state Lets you select the output state "Low(0)" or "High(1)" at the end of the simulation.

Related topics

References

DS2211BIT_OUT_Bx_Cy....42
DS2211DIO_SETUP_Bx....25
simState (RTI and RTI-MP Implementation Reference 🕮)
Stop RTP (ControlDesk Platform Management 🕮)

D/R Converter

DS2211RES_Bx_Cy

Purpose

To set a single resistance output.

Where to go from here

Information in this section

Block Description (DS2211RES_Bx_Cy)

Illustration

Purpose

To set a single resistance output.

I/O mapping

For information on the I/O mapping, refer to D/R Converter (DS2211 Features 🕮).

Description

The resistance value can only be set to the discrete values 1 MΩ / x (x in the range 1 … 65535) or to infinity. If you specify a resistance that does not match one of these discrete values the next matching value will be set.

Note

Resolution decreases with growing resistance due to the reciprocal relationship between the output code and resistance.

I/O characteristics

The following table shows the characteristics of the block input:

Characteristic	Value
Data type	Double
Range	15.26 Ω … 1 MΩ, infinity

Dialog pages

The dialog settings can be specified on the following pages:

- Unit Page (refer to Unit Page (DS2211RES_Bx_Cy) on page 47)
- Parameters Page (refer to Parameters Page (DS2211RES_Bx_Cy) on page 48)

Related RTLib functions

`ds2211_resistance_out`

Related topics

Basics

D/R Converter (DS2211 Features 🕮)

Unit Page (DS2211RES_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.

Channel number Lets you select a resistor channel in the range 1 … 10.

Related topics

References

DS2211RES_Bx_Cy.....46

Parameters Page (DS2211RES_Bx_Cy)

Purpose

To specify the initialization and the termination.

Description

Initialization During the model initialization phase the initial resistance specified with **Initial resistance** is adjusted for each channel to ensure a defined output during this simulation phase. This is especially useful if a channel is used in a triggered or enabled subsystem that is not executed right from the start of the simulation.

Termination When the simulation terminates, all channels hold their last resistance by default. With the **Termination resistance**, you can specify an output resistance on termination and use this setting to drive your external hardware into a safe final condition.

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

Initial resistance Lets you enter the initial resistance value at the start of the simulation. The value must remain in the range 15.26 … 1000000 Ω. If you enter values greater than 1 MΩ, the resistance will be set to infinity.

Termination resistance Lets you set the output resistance specified by **Output on termination** or keep the current output resistance when the simulation terminates.

Output on termination Lets you enter the termination resistance value at the end of the simulation. The value must remain in the range 15.26 … 1000000 Ω. If you enter values greater than 1 MΩ, the resistance will be set to infinity.

Related topics

References

DS2211RES_Bx_Cy.....46
simState (RTI and RTI-MP Implementation Reference 🕮)
Stop RTP (ControlDesk Platform Management 🕮)

PWM Signal Measurement

DS2211PWM2D_Bx_Cy

Purpose

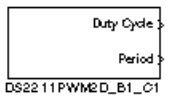
To measure the period and duty cycle of the specified PWM input signal.

Where to go from here

Information in this section

Block Description (DS2211PWM2D_Bx_Cy)

Illustration



Purpose

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

Description

Use DS2211DIO_SETUP_Bx on page 25 to set the threshold level for digital inputs. If you do not include this block in your model, the default threshold level of 2.5 V is valid.

I/O mapping

For information on the I/O mapping, refer to PWM Signal Measurement (DS2211 Features 🕮).

Note

It is not possible to use the same channels for frequency and PWM signal measurement.

I/O characteristics

- This table shows the scaling between the duty cycle of the measured signal and the output of the block:

Duty Cycle	Simulink Output
0 … 100%	0 … 1

- The following table shows the characteristics of the block output:

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

- The period of the measured signal is given in seconds.
- The period of the input signal should remain within the specified range, otherwise the measured values will not be correct.

Dialog pages

The dialog settings can be specified on the **Unit Page** (refer to Unit Page (DS2211PWM2D_Bx_Cy) on page 50).

Related RTLib functions

`ds2211_timing_in_mode_set`, `ds2211_pwm_in`

Related topics

References

DS2211DIO_SETUP_Bx 25

Unit Page (DS2211PWM2D_Bx_Cy)

Purpose

To specify the board number, the channel number and the range period.

Dialog settings

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

Channel number Lets you select a channel in the range 1 … 24.

Update mode Lets you select the update mode:

Mode	Description
Asynchronous	The measured values are updated at the end of each T_{high} and T_{low} period of the PWM signal.
Synchronous	Update of the block output is performed synchronous to the period (at each rising edge of the input signal).

Range of period Lets you select the period range. Note that the resolution depends on the selected period range (for further information, refer to PWM Signal Measurement (DS2211 Features 🕮)).

Range of frequency States the range of frequency.

Resolution of period States the current resolution of period.

Tip

To optimize the resolution of the measurement, you should always choose the period range with the lowest possible range number. For example, if your desired period is 10 ms, you should use period range 3 (10 µs … 13.1 ms) rather than period range 4 (10 µs … 26.2 ms), refer to Quantization Effects (DS2211 Features 🕮).

Related topics

References

DS2211PWM2D_Bx_Cy.....49

PWM Signal Generation

DS2211PWM_Bx_Cy

Purpose

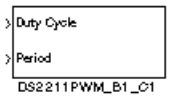
To generate a square-wave signal with the variable period and variable duty cycle adjustable during run time.

Where to go from here

Information in this section

Block Description (DS2211PWM_Bx_Cy)

Illustration



Purpose

To generate a square-wave signal with the variable period and variable duty cycle adjustable during run time.

Note

- It is not possible to use the same channels for square-wave signal and PWM signal generation.
- Before operating the digital outputs for square-wave or PWM signal generation, you must connect an external power supply (VBat).

Description

Use DS2211DIO_SETUP_Bx to configure the digital outputs.

I/O mapping

For information on the I/O mapping, refer to PWM Signal Generation (DS2211 Features 🕮).

I/O characteristics

- The block inputs – Period and Duty Cycle – can be changed during run time. The Period input values should remain within the specified range.
- The block input Period is given in seconds.
- This table shows the scaling between the duty cycle and the input of the block:

Simulink Input	Duty Cycle
0 … 1	0 … 100%

The following table shows the characteristics of the block input:

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

Dialog pages

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

- Unit Page (refer to Unit Page (DS2211PWM_Bx_Cy) on page 53)
- Initialization Page (refer to Initialization Page (DS2211PWM_Bx_Cy) on page 55)
- Termination Page (refer to Termination Page (DS2211PWM_Bx_Cy) on page 55)

Related RTLib functions

`ds2211_timing_out_mode_set`, `ds2211_pwm_out`

Related topics

References

DS2211DIO_SETUP_Bx 25

Unit Page (DS2211PWM_Bx_Cy)

Purpose

To specify the board number, the channel number and the range of period.

Dialog settings

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

Channel number Lets you select the output channel in the range 1 … 9.

Update mode Lets you select the update mode:

Update Mode	Description
Asynchronous	The new values 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	Update of the input parameters is performed synchronous to the period. Changes take effect in the next period (at each rising edge). **Note** For PWM signal generation with *synchronous* update, the output period should be constant. It is constant if $T = T_{high} + T_{low}$ is constant. If you change the period during run time, synchronous PWM update cannot be ensured.

Range of period Lets you select the period range for the PWM signal to be generated. Note that the resolution depends on the selected period range. Refer to PWM Signal Generation (DS2211 Features 🕮).

Range of frequency States the range of frequency.

Resolution of period States the current resolution of period.

Related topics

References

DS2211PWM_Bx_Cy 52

Initialization Page (DS2211PWM_Bx_Cy)

Purpose

To specify the initialization values to be set.

Description

Initialization During the model initialization phase, the output signal is either generated with an initial period or is 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 period** and **Initial duty cycle**, the channel has a defined output during this simulation phase.

Dialog settings

Initial duty cycle Lets you enter the duty cycle at the start of the simulation in the range 0 … 1 (by default: 0).

Initial period Lets you enter the period at the start of the simulation in the range 10 µs … 107.3 s (by default: 50 µs). The value should remain in the selected period range and must be given in seconds.

Related topics

References

DS2211PWM_Bx_Cy 52

Termination Page (DS2211PWM_Bx_Cy)

Purpose

To specify the termination values to be set.

Description

Termination When the simulation terminates, the signal generation is continued with the last period and duty cycle by default. If you want to stop signal generation during this simulation phase, set the duty cycle to 0. Otherwise, select one above the lower range limit. Use these settings to drive your external hardware into a safe final condition. Use DS2211DIO_SETUP_Bx on page 25 to enable or disable the termination mode for all digital outputs.

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

Termination Lets you set the values specified by Duty cycle on termination and Period on termination or keep the current duty cycle and period when the simulation terminates.

Duty cycle on termination Lets you enter the duty cycle at the end of the simulation in the range 0 … 1.

Period on termination Lets you enter the period at the end of the simulation in the range 10 µs … 107.3 s (by default: 50 µs). The values should remain within the selected period range and must be given in seconds.

Related topics

References

DS2211PWM_Bx_Cy 52
simState (RTI and RTI-MP Implementation Reference 🕮)
Stop RTP (ControlDesk Platform Management 🕮)

Frequency Measurement

DS2211F2D_Bx_Cy

Purpose

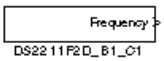
To measure the frequency of a square-wave input signal.

Where to go from here

Information in this section

Block Description (DS2211F2D_Bx_Cy)

Illustration



Purpose

To measure the frequency of a square-wave input signal.

Description

For frequency measurement, 24 independent channels are available.

I/O mapping

For information on the I/O mapping, refer to Frequency Measurement (F2D) (DS2211 Features 🕮).

Note

It is not possible to use the same channels for frequency and PWM signal measurement.

I/O characteristics	The frequency of the input signal specified in Hz corresponds to the output of the block. ▪ 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 quantization effects.
Dialog pages	The dialog settings can be specified on the **Unit Page** (refer to Unit Page (DS2211F2D_Bx_Cy) on page 58).
Related RTLib functions	`ds2211_init`, `ds2211_timing_in_mode_set`, `ds2211_f2d`
Related topics	Basics Frequency Measurement (F2D) (DS2211 Features 🕮)

Unit Page (DS2211F2D_Bx_Cy)

Purpose	To specify the board number, the channel number and the range of frequency.

Dialog settings

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

Channel number Lets you select the input channel in the range 1 … 24.

Range of frequency Lets you select the frequency range and the resolution.

Note

To optimize the resolution of the measurement, you should always choose 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 … 100 kHz) rather than frequency range 2 (4.77 Hz … 100 kHz).

Resolution of frequency States the resolution of the selected frequency range.

Related topics

References

DS2211F2D_Bx_Cy..... 57

Square-Wave Signal Generation

DS2211D2F_Bx_Cy

Purpose

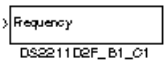
To generate a square-wave signal for the specified output channel. For square-wave signal generation, 9 independent channels are available.

Where to go from here

Information in this section

Block Description (DS2211D2F_Bx_Cy)

Illustration



Purpose

To generate a square-wave signal for the specified output channel. For square-wave signal generation, 9 independent channels are available.

Note

- It is not possible to use the same channels for square-wave signal and PWM signal generation.
- Before operating the digital outputs for square-wave or PWM signal generation, you must connect an external power supply (VBat).

I/O mapping

For information on the I/O mapping, refer to Square-Wave Signal Generation (D2F) (DS2211 Features 🕮).

I/O characteristics

The frequency of the output signal specified in Hz corresponds to the input of the block.

If the frequency is higher than the upper limit, the frequency saturates to f_{max}.

If the frequency is less than the lower limit, the frequency is set to 0 Hz and the output voltage level is set to the value specified by **Set output channel**.

Dialog pages

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

- **Unit Page** (refer to Unit Page (DS2211D2F_Bx_Cy) on page 61)
- **Initialization Page** (refer to Initialization Page (DS2211D2F_Bx_Cy) on page 62)
- **Termination Page** (refer to Termination Page (DS2211D2F_Bx_Cy) on page 63)

Related RTLib functions

`ds2211_init`, `ds2211_digout_mode_set`, `ds2211_timing_out_mode_set`, `ds2211_d2f`

Related topics

Basics

Square-Wave Signal Generation (D2F) (DS2211 Features 🕮)

Unit Page (DS2211D2F_Bx_Cy)

Purpose

To specify the board number, the channel number, the range of frequency and the Zero frequency mode.

Dialog settings

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

Channel number Lets you select the output channel in the range 1 … 9.

Range of frequency Lets you select the frequency range and the resolution.

Note

To optimize the resolution of the generated square-wave signal, you should always choose 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 … 100 kHz) rather than frequency range 2 (4.77 Hz … 100 kHz).

Resolution of frequency Displays the resolution of the selected frequency range (read-only).

Set output channel Lets you select the behavior of the output if the output 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 keeps the current signal level (low or high).

Related topics

References

DS2211D2F_Bx_Cy.....60

Initialization Page (DS2211D2F_Bx_Cy)

Purpose

To specify the initialization values to be set.

Dialog settings

Initial frequency Lets you enter the initial frequency at the start of the simulation. The values of the initial frequency must remain within the selected range. If a frequency below the lower limit is chosen, the signal generation starts with frequency 0.

Related topics

References

DS2211D2F_Bx_Cy....60

Termination Page (DS2211D2F_Bx_Cy)

Purpose

To specify the termination values to be set.

Description

Initialization During the model initialization phase, the output signal is either generated with an initial frequency or is 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 When the simulation terminates, the signal generation continues with the last frequency by default. If you want to stop signal generation during this simulation phase, specify a frequency below the lower limit. The frequency is set to 0 Hz, but the signal voltage level may not be 0 V (if **Set output channel** is set to **High**). Otherwise, select a frequency above the lower limit. Use these settings to drive your external hardware into a safe final condition. Use DS2211DIO_SETUP_Bx on page 25 to enable or disable the termination mode for all digital outputs.

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

Termination Lets you set the values specified by **Frequency on termination** or keep the frequency when the simulation terminates. Values must remain within the selected range. If a frequency below the lower limit is chosen, the frequency is set to 0 Hz, but the signal voltage level may not be 0 V (if **Set output channel** is set to **High**).

Related topics

References

DS2211D2F_Bx_Cy....60
DS2211DIO_SETUP_Bx....25

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

Wheel Speed Sensor Simulation

DS2211SL_WSSG_Bx_Cy

Purpose

To generate wheel speed sensor signals.

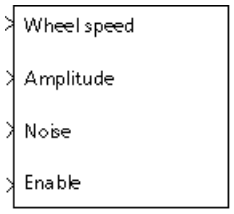
Where to go from here

Information in this section

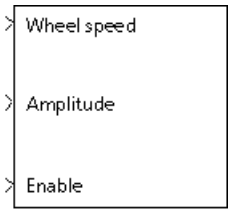
Block Description (DS2211SL_WSSG_Bx_Cy)

Illustration

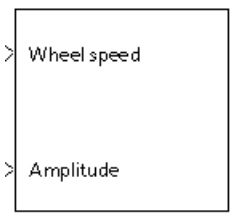
The block's different representations depend on how you configure the tunable parameters of the block.



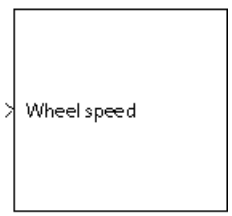
DS2211SL_WSSG_B1_C1



DS2211SL_WSSG_B1_C4



DS2211SL_WSSG_B1_C3



DS2211SL_WSSG_B1_C2

Purpose

To generate wheel speed sensor signals.

Note

The block uses tunable parameters. These parameters can be updated *either* by their block input *or* by block parameters that are accessible by experiment software, for example, ControlDesk. The different representations of the block depend on your selection. Tunable parameters that are defined as block parameters will be removed from the RTI block layout. For detailed information, refer to Model Parameter Configuration Dialog (RTI and RTI-MP Implementation Reference 🕮).

I/O mapping

For information on the I/O mapping, refer to Wheel Speed Sensor Simulation (DS2211 Features 🕮).

I/O characteristics

- The *Wheel speed* input must be given in revolutions per minute (rpm).
- The *Amplitude* input is available if **input port** is selected in the **Set amplitude** parameter. The value must be given in the range 0 … 40 V_{PP}.
- The *Noise* input is available if input port is selected in the **Set noise** parameter. The value must be given in the range 0 … 40 V_{PP}.
- The *Enable* input is available if input port is selected by the **Enable channel** parameter. The value must be given as follows.

Simulink Input	Purpose
0	To disable the wheel speed signal.
1	To enable the wheel speed signal.

- The following table shows the characteristics of the block inputs:

Variable	Characteristic	Value
Wheel speed	Data type	Double
	Range	(1/60) · Wheel speed · Number of wheel teeth < (1/2) · 50.000
Amplitude	Data type	Double
	Range	0 … 40
Noise	Data type	Double
	Range	0 … 40
Enable	Data type	Boolean
	Range	0, 1

Dialog pages

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

- **Unit Page** (refer to Unit Page (DS2211SL_WSSG_Bx_Cy) on page 67)
- **Parameters Page** (refer to Parameters Page (DS2211SL_WSSG_Bx_Cy) on page 67)

Related RTLib functions

`ds2211_slave_dsp_signal_enable`, `ds2211_slave_dsp_channel_enable`, `ds2211_slave_dsp_wheel_init`, `ds2211_slave_dsp_wheel_update`

Related topics

Basics

Wheel Speed Sensor Simulation (DS2211 Features 🕮)

Unit Page (DS2211SL_WSSG_Bx_Cy)

Purpose

To specify the board number, the channel number and the sample time.

Dialog settings

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

Channel number Lets you select a channel in the range 1 … 4.

Sample time Lets you enter the sample time of the WSSG block in seconds. Enter -1 to keep the model's base sample time (inherited).

Related topics

References

DS2211SL_WSSG_Bx_Cy.....65

Parameters Page (DS2211SL_WSSG_Bx_Cy)

Purpose

To specify the wheel and the signal parameters.

Dialog settings

Number of wheel teeth Lets you enter the number of wheel teeth in the range 0 … 2^{31}-1. You have to take care of the following relation:

(1/60) · Wheel speed · Number of wheel teeth < (1/2) · 50.000

Set amplitude This is a tunable parameter. Select the radio button by input port to set the amplitude value of the wheel speed signal by the block input port or enter the initial amplitude in the range 0 … 40 V_{PP}.

Set noise This is a tunable parameter. Select the radio button by input port to set the noise value of the wheel speed signal by the block input port or enter the noise value in the range 0 … 40 V_{PP}.

Enable channel This is a tunable parameter. Select the radio button by input port to enable the wheel speed signal by the block input port or select "enable" in the by block parameter selection list.

Related topics

References

DS2211SL_WSSG_Bx_Cy..... 65

Digital Capture of Event Capture Input

DS2211CAP_IN_Bx_Cy

Purpose

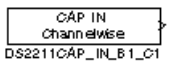
To read the digital capture input channelwise (according to threshold of comparator A).

Where to go from here

Information in this section

Block Description (DS2211CAP_IN_Bx_Cy)

Illustration



Purpose

To read the digital capture input channelwise (according to threshold of comparator A).

Description

- The threshold level of comparator A can be adjusted in the range 1 … 23.8 V via the **DS2211DIO_SETUP_Bx** block.
- **DS2211CAP_IN_Bx_Cy** needs no other block to run within a Simulink model. If you do not use the **DS2211_SETUP_Bx** block, the threshold is set to 2.5 V.
- The block is also linked to the rti2211apulib and rti2211varapulib.

I/O mapping

For information on the I/O mapping, refer to Spark Event Capture (DS2211 Features 🕮) and Injection Pulse Position and Fuel Amount Measurement (DS2211 Features 🕮).

I/O characteristics

The digital signal (high/low) of the binary signal is defined by a threshold level of comparator A that can be configured via DS2211DIO_SETUP_Bx. If no setup block is selected, the default threshold (2.5 V) is valid.

Dialog pages

The dialog settings can be specified on the Unit Page (refer to Unit Page (DS2211CAP_IN_Bx_Cy) on page 70).

Related RTLib functions

`ds2211_init`, `ds2211_injection_status_read`, `ds2211_injection_status_read`

Related topics

References

DS2211DIO_SETUP_Bx.....25
Injection Pulse Position and Fuel Amount Measurement (DS2211 Features 🕮)
Spark Event Capture (DS2211 Features 🕮)

Unit Page (DS2211CAP_IN_Bx_Cy)

Purpose

To specify the board number and the channel-wise read access to the capture input.

Dialog settings

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

Capture input Lets you select the capture input channel. You can use the channels to capture either ignition or injection data. The following channels can be selected:

Channel Number	Signal
1	IGN1
2	IGN2
3	IGN3
4	IGN4
5	IGN5
6	IGN6
7	AUXCAP1
8	AUXCAP2
9	INJ1
10	INJ2

Channel Number	Signal
11	INJ3
12	INJ4
13	INJ5
14	INJ6
15	INJ7 (PWM_IN7)
16	INJ8 (PWM_IN8)

Related topics

References

DS2211CAP_IN_Bx_Cy..... 69

Angular Processing Unit

Where to go from here

Information in this section

General Information

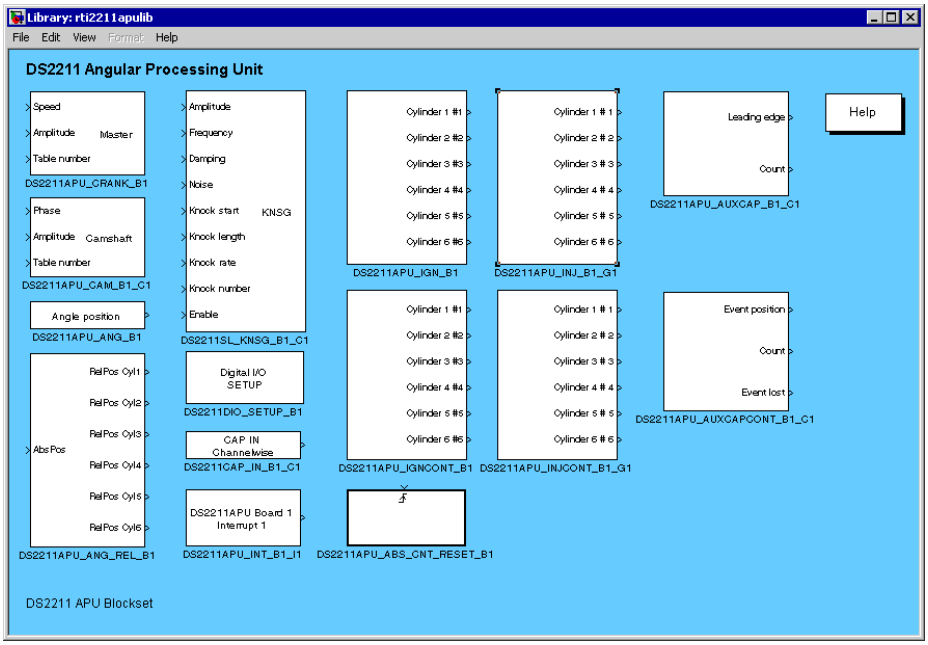
Overview of the Angular Processing Unit

Introduction

The angular processing unit (APU) is designed to simulate core engine processing functions, for example, crankshaft signal generation, or capturing spark events.

Access

If you double-click the APU button in the Library: rti2211lib window, the Library: rti2211apulib window opens.



The Library: rti2211apulib provides access to the angular processing unit (APU).

Note

Do not mix blocks of the VAR APU and APU blockset in one model. Only blocks which are shared can be used with both blocksets. For details, refer to Building a Simulink Model for Engine Variants (DS2211 Features 🕮).

Libray components

The library contains the following RTI blocks:

- DS2211APU_CRANK_Bx on page 77
- DS2211APU_CAM_Bx_Cy on page 84

- DS2211APU_ANG_Bx on page 89
- DS2211APU_ANG_REL_Bx on page 91
- DS2211APU_IGN_Bx on page 94
- DS2211APU_IGNCONT_Bx on page 101
- DS2211APU_INJ_Bx_Gy on page 109
- DS2211APU_ABS_CNT_RESET_Bx on page 120
- DS2211APU_INJCONT_Bx_Gy on page 123
- DS2211APU_AUXCAP_Bx_Cy on page 131
- DS2211APU_AUXCAPCONT_Bx_Cy on page 137
- DS2211APU_INT_Bx_Iy on page 143
- DS2211SL_KNSG_Bx_Cy on page 146
- Digital Capture of Event Capture Input on page 69
- Digital I/O Set Up on page 25

Related topics

References

Angular Processing Unit (DS2211 Features 🕮)

DS2211APU_CRANK_Bx

Purpose

To set up the angular processing unit, generate the engine position information, and define the crankshaft output signal.

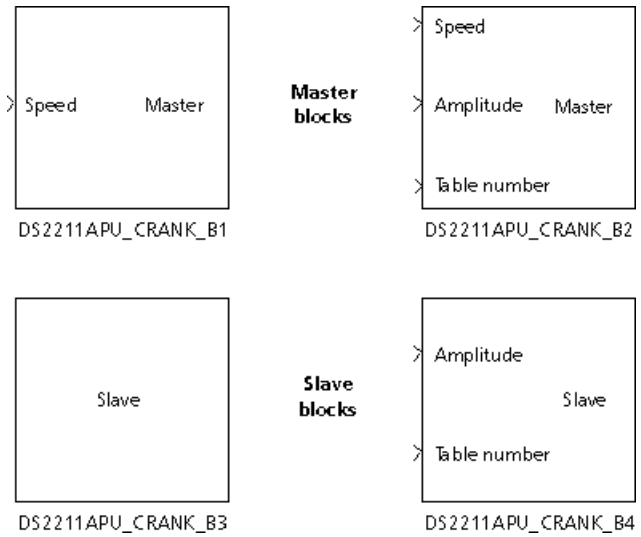
Where to go from here

Information in this section

Block Description (DS2211APU_CRANK_Bx)

Illustration

The block's appearance varies according to your settings.



Purpose

To set up the angular processing unit, generate the engine position information, and define the crankshaft output signal.

I/O mapping

For information on the I/O mapping, refer to Crankshaft Sensor Signal Generation (DS2211 Features 🕮).

Note

If several DS2211 boards are connected to different PHS buses of a multiprocessor system, identical board numbers are assigned to these boards. For the moment, RTI-MP does not allow you to configure a multiprocessor system using identical board numbers on different processors. If you encounter this problem, contact dSPACE Support (www.dspace.com/go/supportrequest).

Description

The block input ports are specified in I/O characteristics on page 79.

You can cascade I/O boards of the following type: DS2211, DS2210, DS5203. Cascading means, that their APUs are connected to the engine position bus to get the same time base. One board must be configured as master, all other boards are slave boards.

For each DS2211 master or slave board you need an own DS2211APU_CRANK_Bx block. You have to define the master board on the Unit page first.

If another board is configured as master, for example, a DS5203, you have to reconfigure the DS2211 master manually via the following source code. You cannot reconfigure the master in the RTI block because a slave configuration requires a master configuration in the model.

1. Start a build process for your model to generate the `<ModelName>_usr.c` file.
2. Add the following lines to the file.

```
static void usr_initialize(void)
{
   2211ds_mode_set(DS2211_1_BASE, DS2211_SLAVE_MODE);
}
...
static void usr_terminate(void)
{
   ds2211_apu_stop(DS2211_1_BASE);
}
```

3. Restart the build process.
4. Load the model to your real-time hardware.

The engine position is derived from the Speed input. For cascaded boards, only the master board gets a Speed input port to generate the engine position. The

slave boards get the engine position information from the master board via the time base connector.

Note

- The DS2211APU_CRANK_Bx block must always be in your model if you want to use any of the other APU blocks.
- Use DS2211DIO_SETUP_Bx to configure the digital outputs and to enable or disable the termination mode for all digital outputs.
- The block uses tunable parameters. These parameters can be updated *either* by their block input *or* by block parameters that are accessible by experiment software, for example, ControlDesk. The different representations of the block depend on your selection. Tunable parameters that are defined as block parameters will be removed from the RTI block layout. For detailed information, refer to Model Parameter Configuration Dialog (RTI and RTI-MP Implementation Reference 🕮).

The block can be used for signal generation for reverse crankshaft rotation but this is not supported by all board revisions. For details, refer to Reverse Crankshaft Rotation (DS2211 Features 🕮).

I/O characteristics

- The *Speed* input is only available for the master block and must be given in revolutions per minute (rpm). The parameter is saturated to its limits.
- The *Amplitude* input is available if **input port** is selected in the **Set amplitude** parameter.
- The *Table number* input is available if **input port** is selected in the **Set table number** parameter. The parameter is saturated to its limits.
- The following table shows the characteristics of the block inputs:

Variable	Characteristic	Value
Speed	Data type	Double
	Range	–29297 … 29297
Amplitude	Data type	Double
	Range	0 … 40 V_{pp}
Table number	Data type	UInt8
	Range	1 … 8

Dialog pages

The following pages are available:

- Unit Page (DS2211APU_CRANK_Bx) on page 80 for master/slave selection
- TDC Page (DS2211APU_CRANK_Bx) on page 81 only for the master board's engine setup
- Parameters Page (DS2211APU_CRANK_Bx) on page 81 for crankshaft signal definition and to define the digital output mode of crankshaft and camshaft signals
- Wave Tables Page (DS2211APU_CRANK_Bx) on page 82 for wave table assignment

Related RTLib functions

`ds2211_mode_set`, `ds2211_digout_mode_set`, `ds2211_digwform_mode_set`, `ds2211_apu_transformer_mode_set`, `ds2211_apu_position_write`, `ds2211_apu_start`, `ds2211_apu_stop`, `ds2211_apu_velocity_write`, `ds2211_crank_output_ampl_set`, `ds2211_crank_table_load`, `ds2211_crank_table_select`, `ds2211_reverse_crank_setup`, `ds2211_crank_mode`

Related topics

References

DS2211DIO_SETUP_Bx 25

Unit Page (DS2211APU_CRANK_Bx)

Purpose

To specify the board number and select master/slave mode.

Dialog settings

Board number Lets you select the DS2211 board number in the range 1 … 16.

Master/Slave selection Lets you define the board as the master or the slave board. If you choose **Master** you can specify the **Initial position** at the start of the simulation within the engine cycle range 0 … <720° with a resolution of 0.011°. If you choose **Slave**, you have to select the board number of the already defined master board in the range 1 … 16 and the board type (DS2210 or DS2211).

Related topics

Basics

Setting Up I/O Boards (DS1006 Hardware Installation and Configuration Guide 🕮)
Setting Up I/O Boards (DS1007 Hardware Installation and Configuration Guide 🕮)

References

DS2211APU_CRANK_Bx 77

TDC Page (DS2211APU_CRANK_Bx)

Purpose

To specify the top dead center (TDC).

Dialog settings

The TDC page is enabled only if you chose Master in the Master/Slave selection. Use this page to set up the engine to be simulated, that is the TDC positions for the selected number of cylinders. The TDC page provides the following parameters:

Number of cylinders Lets you select the number of cylinders of the engine to be simulated in the range 1 … 96. The I/O blocks (for example, DS2211APU_IGN_Bx on page 94, DS2211APU_INJ_Bx_Gy on page 109 and DS2211SL_KNSG_Bx_Cy on page 146) allow you to use up to 8 of the defined cylinders.

Cylinder sequence Lets you edit the ignition sequence, for example: [1 3 2 4]. This setting affects ignition and injection capturing as well as knock signal generation.

First TDC Lets you enter the TDC for the first cylinder of the sequence you have specified above. The engine position has to be given in the range 0 … <720° with a resolution of 0.011°.

Example

The following table shows how the TDC values are calculated for the cylinder sequence [1 3 2 4]:

Cylinder	TDC
1	First TDC
3	First TDC + 720° / Number of cylinders
2	First TDC + (2 · 720°) / Number of cylinders
4	First TDC + (3 · 720°) / Number of cylinders

Related topics

References

DS2211APU_CRANK_Bx.....77

Parameters Page (DS2211APU_CRANK_Bx)

Purpose

To enable the specify the digital output and the signal parameters.

Dialog settings

Digital output mode Clears automatically the digital crankshaft and camshaft outputs (CRANK_DIG, CAM1_DIG … CAM4_DIG) when the angular processing unit is stopped or when the Speed input becomes 0.

Set amplitude This is a tunable parameter. Select the radio button **input port** to set the amplitude of the analog crankshaft output by the block input port or enter the initial amplitude value in the range 0 … 40 V_{PP}. This parameter allows you to scale the values defined in your wave table.

Set table number This is a tunable parameter. Select the radio button **input port** to update the wave table to be used by the block input port or select an initial wave table in the **block parameter table number** selection list. For the wave table numbering, refer to the Wave Tables Page (DS2211APU_CAM_Bx_Cy) on page 87.

Related topics

References

DS2211APU_CRANK_Bx 77

Wave Tables Page (DS2211APU_CRANK_Bx)

Purpose

To assign MAT wave table files to up to eight crankshaft wave tables.

Description

Each MAT wave table file defines a single wave table. For information on wave tables, refer to Wave Table Generation (DS2211 Features 🕮).

Use the **Add** button to browse through the file system and collect up to eight MAT wave table files in the selection list. Use the **Remove** button to remove a wave table file from the selection list. The files in the selection list are internally numbered consecutively, starting with 1 at the top. These numbers identify the wave tables.

You can modify the sequence with the **Up** and **Down** buttons.

Dialog settings

Model directory Displays the directory of your model. If you copy the model to another directory while the **Wave tables** page is still open, click the **Refresh** button to display the current model directory.

Use path relative to the model directory Displays the file names with a path relative to the current model directory.

Enable reverse crank Lets you enable the simulation of a reverse crank sensor signal. If selected, you can specify the signal settings (time delay and pulse

durations) in the edit fields (see below). For general information on the reverse crank sensor signal, refer to Reverse Crankshaft Rotation (DS2211 Features 🕮).

Note

- For the simulation of a reverse crank sensor signal, you must (create and) select a special wave table for reverse crankshaft signals. You cannot use a "normal" crankshaft wave table.
- The reverse crank signal is generated as a digital signal. However, the analog crankshaft output is not automatically disabled and might generate an irrelevant analog signal.

Time delay (Available only if Enable reverse crank is activated) Lets you specify the time between a trigger event of a timing wheel tooth and the beginning of the corresponding sensor pulse in the range 1 … 8191.75 µs with a resolution of 0.25 µs (the default value is 5 µs). The specified time is also used as the forced minimum inactive time between two active pulses of the same rotation direction.

Pulse duration forward (Available only if Enable reverse crank is activated) Lets you specify the pulse duration that indicates a forward rotation of the crankshaft in the range 1 … 8191.75 µs with a resolution of 0.25 µs (the default value is 45 µs).

Pulse duration reverse (Available only if Enable reverse crank is activated) Lets you specify the pulse duration that indicates a reverse rotation of the crankshaft in the range 1 … 8191.75 µs with a resolution of 0.25 µs (the default value is 90 µs).

Forced pulse duration (Available only if Enable reverse crank is activated) Lets you specify the forced minimum inactive time between two pulses of different rotation directions in the range 1 … 8191.75 µs with a resolution of 0.25 µs (the default value is 5 µs).

Polarity (Available only if Enable reverse crank is activated) Lets you select whether to use active high or active low crank sensor pulses.

Related topics

References

DS2211APU_CRANK_Bx 77

DS2211APU_CAM_Bx_Cy

Purpose

To define the amplitude, phase and wave table of the selected camshaft output signal.

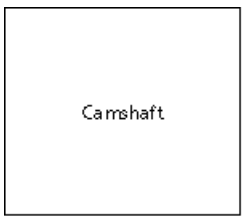
Where to go from here

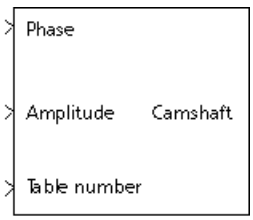
Information in this section

Block Description (DS2211APU_CAM_Bx_Cy)

Illustration

The block's appearance varies according to how you configure its tunable parameters.





Purpose

To define the amplitude, phase and wave table of the selected camshaft output signal.

Description

The block input ports are specified in I/O characteristics on page 85.

Use DS2211APU_CRANK_Bx to set the digital output mode for the digital camshaft outputs.

Note

- The DS2211APU_CRANK_Bx block must be in your model.
- Use DS2211DIO_SETUP_Bx to configure the digital outputs and to enable or disable the termination mode for all digital outputs.
- The block uses tunable parameters. These parameters can be updated *either* by their block input *or* by block parameters that are accessible by experiment software, for example, ControlDesk. The different representations of the block depend on your selection. Tunable parameters that are defined as block parameters will be removed from the RTI block layout. For detailed information, refer to Model Parameter Configuration Dialog (RTI and RTI-MP Implementation Reference 🕮).

I/O mapping

For information on the I/O mapping, refer to Camshaft Sensor Signal Generation (DS2211 Features 🕮).

I/O characteristics

- The *Phase* input, which sets the phase between the crankshaft and the camshaft signal, is available if **by input port** is selected in the **Set phase** parameter. A positive angle leads to a shift to the left of the camshaft signal in relation to the crankshaft signal. The value must be given in the range –720° … <720° with a resolution of 0.011°.
- The *Amplitude* input is available if **by input port** is selected in the **Set amplitude** parameter. The amplitude can only be defined for channel 1 and channel 2.
- The *Table number* input is available if **by input port** is selected in the **Set table number** parameter. The value must be given in the range 1 … 8. The parameter is saturated to its limits.
- The following table shows the characteristics of the block inputs:

Variable	Characteristic	Value
Phase	Data type	double
	Range	–720 … <720°
Amplitude	Data type	double
	Range	0 … 40 V_{PP}
Table number	Data type	uint8
	Range	1 … 8

Dialog pages

The following pages are available:

- Unit Page (DS2211APU_CAM_Bx_Cy) on page 86 for camshaft output channel selection

- Parameters Page (DS2211APU_CAM_Bx_Cy) on page 86 for camshaft signal definition
- Wave Tables Page (DS2211APU_CAM_Bx_Cy) on page 87 for wave table assignment

Related RTLib functions

`ds2211_cam_phase_write`, `ds2211_cam_output_ampl_set`, `ds2211_cam_phase_offset_update_mode`, `ds2211_cam_table_load`, `ds2211_cam_table_select`

Related topics

References

Camshaft Sensor Signal Generation (DS2211 Features 🕮)
DS2211APU_CRANK_Bx 77

Unit Page (DS2211APU_CAM_Bx_Cy)

Purpose

To specify the board and channel number.

Dialog settings

Board number Lets you select the DS2211 board number of the board to be defined by this block in the range 1 … 16. This board may be the master board itself.

Channel number Lets you select the camshaft output channel number in the range 1 … 4. Channel 3 and channel 4 have only digital outputs (DIG_OUT15, DIG_OUT16).

Related topics

References

DS2211APU_CAM_Bx_Cy 84

Parameters Page (DS2211APU_CAM_Bx_Cy)

Purpose

To specify the phase between crankshaft and camshaft signal and set the signal parameters.

Dialog settings

Set phase This is a tunable parameter. Either select the radio button by input port to set the phase between crankshaft and camshaft signal by the block input port or enter the initial phase value within the engine cycle range – 720 … <720° with a resolution of 0.011°. A positive angle leads to a shift to the left of the camshaft signal in relation to the crankshaft signal.

Enable smooth phase update Lets you enable/disable a smooth camshaft phase update to suppress undesired spikes when updating the phase offset. If you update the camshaft phase according to the direction of engine rotation (for example, 20° to 40° during forward rotation), the phase is updated with a maximum of double engine speed. If you update the camshaft phase in the opposite direction to engine rotation (for example, 40° to 20° during forward rotation), the phase is updated with a maximum equal to the engine speed. This ensures that the position of the camshaft does not move back to a pulse that was already processed. It also ensures that no unprocessed pulse is skipped. Smooth phase updating is not applied with offsets greater than 180° crankshaft or a nonrotating engine.

Set amplitude This is a tunable parameter. Either select the radio button by input port to set the amplitude by the block input port or enter the initial amplitude value in the range 0 … 40 V_{PP}. This parameter allows you to scale the values defined in your wave table. It is only available if channel 1 and 2 are selected.

Set table number This is a tunable parameter. Either select the radio button by input port to update the wave table to be used by the block input port or select an initial wave table in the by blockparameter table number selection list. For the wave table numbering, refer to the Wave Tables Page (DS2211APU_CAM_Bx_Cy) on page 87.

Related topics

References

DS2211APU_CAM_Bx_Cy 84

Wave Tables Page (DS2211APU_CAM_Bx_Cy)

Purpose

To assign MAT wave table files to up to eight camshaft wave tables.

Description

Each MAT wave table file defines a single wave table. For information on wave tables, refer to Wave Table Generation (DS2211 Features 🕮).

Use the Add button to browse through the file system and collect up to eight MAT wave table files in the selection list. Use the Remove button to remove a

wave table file from the selection list. The files in the selection list are internally numbered consecutively, starting with 1 at the top. These numbers identify the wave tables.

You can modify the sequence with the Up and Down buttons.

Dialog settings

Model directory Displays the directory of your model. If you copy the model to another directory while the Wave tables page is still open, click the Refresh button to display the current model directory.

Use relative path Displays the filenames with a path relative to the current model directory.

Related topics

References

DS2211APU_CAM_Bx_Cy..... 84
Wave Table Generation (DS2211 Features 🕮)

DS2211APU_ANG_Bx

Purpose

To read the current engine position (angle) of the angular processing unit.

Where to go from here

Information in this section

Block Description (DS2211APU_ANG_Bx)

Illustration

Purpose

To read the current engine position (angle) of the angular processing unit.

Description

For information on angle position (engine position) processing, refer to Engine Position Phase Accumulator (DS2211 Features 🕮).

Note

- If you model using the APU blockset and you want to use the DS2211APU_ANG_Bx block, the Simulink model must contain the DS2211APU_CRANK_Bx block.
- If you model using the VAR APU blockset and you want to use the DS2211APU_ANG_Bx block, the Simulink model must contain the DS2211VARAPU_CRANK_Bx block.
- Only one DS2211APU_ANG_Bx block must be used in a model.
- If you use more than one DS2211APU_ANG_Bx block for cascaded DS2211 master and slave boards within the same timer task, the engine positions may differ from one another. It is recommended to use only one DS2211APU_ANG_Bx block in a DS2211 master/slave system.

I/O characteristics

- The *Angle position* output is given in the range –720 … <720° with a resolution of 0.011°.
- The following table shows the characteristics of the block output:

Variable	Data Type	Range
Angle position	Double	0 … 719.989°

Dialog pages

The dialog settings can be specified on the **Unit page** (refer to Unit Page (DS2211APU_ANG_Bx) on page 90).

Related RTLib functions

`ds2211_apu_position_read`

Related topics

References

DS2211APU_CRANK_Bx 77
DS2211VARAPU_CRANK_Bx 156

Unit Page (DS2211APU_ANG_Bx)

Purpose

To select the board number.

Dialog settings

Board number Lets you select the DS2211 board number of the board to be defined by this block in the range 1 … 16. This board may be the master board itself.

Related topics

References

DS2211APU_ANG_Bx 89

DS2211APU_ANG_REL_Bx

Purpose

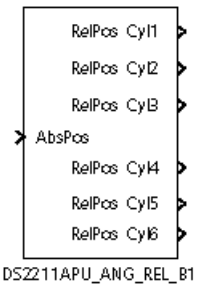
To convert the absolute angle position of the APU to a relative angle related to the top dead center of the selected cylinder or related to a specified reference position.

Where to go from here

Information in this section

Block Description (DS2211APU_ANG_REL_Bx)

Illustration



Purpose

To convert the absolute angle position of the APU to a relative angle related to the top dead center of the selected cylinder or related to a specified reference position.

Description

For information on angle position (engine position) processing, refer to Engine Position Phase Accumulator (DS2211 Features 🕮).

Note

- If you model using the APU blockset and you want to use the DS2211APU_ANG_REL_Bx block, the Simulink model must contain the DS2211APU_CRANK_Bx block.
- If you model using the VAR APU blockset and you want to use the DS2211APU_ANG_REL_Bx block, the Simulink model must contain the DS2211VARAPU_CRANK_Bx block.
- The input value must be an absolute angle position as output by DS2211APU_ANG_Bx, for example.

I/O characteristics

- The relative *Angle position* output depends on the absolute angle's value that was input and on the specified reference angle.
- The following table shows the characteristics of the block output:

Output Variable	Data Type	Range
RelPos Cyl x	Double	–719.989° … 719.989°

Dialog pages

The following pages are available:

- Unit Page (DS2211APU_ANG_REL_Bx) on page 92
- Parameter Page (DS2211APU_ANG_REL_Bx) on page 93

Related topics

References

DS2211APU_ANG_Bx....89
DS2211APU_CRANK_Bx....77
DS2211VARAPU_CRANK_Bx....156

Unit Page (DS2211APU_ANG_REL_Bx)

Purpose

To specify the board number.

Dialog settings

Board number Lets you select the DS2211 board number of the board to be defined by this block in the range 1 … 16. This board may be the master board itself.

Related topics

References

DS2211APU_ANG_REL_Bx.....91

Parameter Page (DS2211APU_ANG_REL_Bx)

Purpose

To specify the number and sequence of the cylinders to be used.

Dialog settings

Number of selected cylinders Lets you select the number of cylinders in the range 1 … 8. The parameter defines the size of the **Selected cylinders** vector.

Selected cylinders Lets you enter the cylinder sequence for which the angles should be converted in the range 1 … 96. The size of the array is specified by the number of selected cylinders (see above). The values of the array elements specify the cylinders which are converted. The maximum number of cylinders is specified in the **DS2211APU_CRANK_Bx** block. For example, to convert the angles of the 1, 3, and 6 cylinder, you must specify [1, 3, 6].

Set reference Lets you select the reference the absolute angles are related to. The table shows the possibilities:

Setting	Meaning
from master crank block	The angle positions are related to the TDCs defined in the **DS2211APU_CRANK_Bx** block.
by block parameter	If you select this option the input field is enabled. Enter the reference position for each selected cylinder into the vector, for example [0 120 240 360 480 600].

Note

The number of angle positions to be specified in the vector must be equal to the number of selected cylinders.

Related topics

References

DS2211APU_CRANK_Bx.....77

DS2211APU_IGN_Bx

Purpose

To read the positions of the ignition pulses that occurred in the last one or two event capture windows.

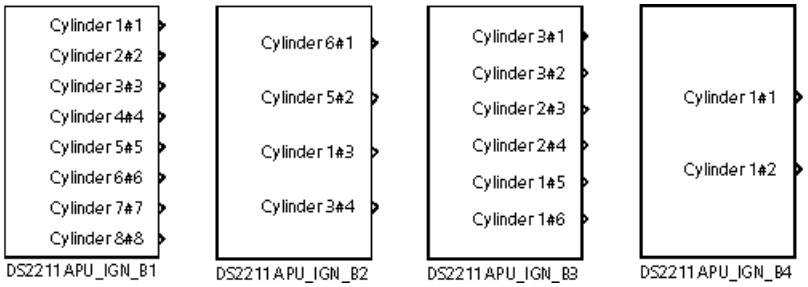
Where to go from here

Information in this section

Block Description (DS2211APU_IGN_Bx)

Illustration

The block's appearance varies according to the selected cylinders.



Purpose

To read the positions of the ignition pulses that occurred in the last one or two event capture windows.

Description

You can define one or two event capture windows for up to eight cylinders. For capturing ignition pulses for eight cylinders, the two auxiliary capture channels are used for channel 7 and 8.

The block can operate in two modes:

Single event capture mode The block provides the leading edge position of the first ignition in each defined event capture windows.

Multiple event capture mode The block provides the leading and trailing edge positions of all ignitions (up to 64) in each defined event capture windows.

For both modes, the measured values are returned via an output array, see below.

Note

When using this block, you have to consider the following:

- The DS2211APU_CRANK_Bx block must be in your model.
- Use DS2211DIO_SETUP_Bx to set the threshold level for digital inputs. If you do not include this block in your model the default threshold level of 2.5 V is valid.
- This block cannot be used together with the following blocks:
  - DS2211APU_INJ_Bx_G2
  - DS2211APU_INJCONT_Bx_G2
  - DS2211APU_AUXCAPCONT_Bx_Cx
  - DS2211APU_IGNCONT_Bx
  - DS2211APU_AUXCAP_Bx_C1 (if you use channel 7 of DS2211APU_IGN_Bx).
  - DS2211APU_AUXCAP_Bx_C2 (if you use channel 8 of DS2211APU_IGN_Bx).

I/O mapping

For information on the I/O mapping, refer to Spark Event Capture (DS2211 Features 🕮).

I/O characteristics

The ports are named Cylinder x # y. X is the number of the selected cylinder and y the port number that corresponds to the appropriate ignition input line.

The format of the *Cylinder x # y* block outputs depends on the capture mode. Position values are given relative to the TDC in the range –720 … 720° with a resolution of 0.011°. The position values are output as an array of data type Double. If two event capture windows are defined, the output array starts with the position values of the first event capture window.

In the single capture event mode, the output array is defined as follows:

Array Index	Parameter	Event Window
1	Leading edge	1
2	Pulse count	1
3	Leading edge	2
4	Pulse count	2

In the multiple event capture mode, the output array is defined as follows:

Array Index[1), 2)]	Parameter	Number of Elements	Event Window
1 … NoS1	Leading edge	NoS1[1)]	1
NoS1 + 1 … 2 · NoS1	Trailing edge	NoS1	1
2 · NoS1 + 1	Pulse count	1	1
2 · NoS1 + 2	Pulse state	1	1
2 · NoS1 + 3 … 2 · NoS1 + 2 + NoS2	Leading edge	NoS2[2)]	2
2 · NoS1 + 2 + NoS2 + 1 … 2 · NoS1 + 2 + 2 · NoS2	Trailing edge	NoS2	2
2 · NoS1 + 2 + 2 · NoS2 + 1	Pulse count	1	2
2 · NoS1 + 2 + 2 · NoS2 + 2	Pulse state	1	2

[1)] NoS1: Number of expected sparks in the event capture window 1
[2)] NoS2: Number of expected sparks in the event capture window 2

The output array contains different parameters:

Leading edge The `leading edge` parameter is the position of the first leading edge in single event capture mode or the positions of up to 64 leading edges in multiple event capture mode. The following rules apply to both modes:

- The values are given in degrees.
- Before the first leading edge after the start of the simulation is captured, the output is the default value as specified on the Capture page.
- If no leading edge was detected in the last event capture window, the old values will remain.

The following additionally rules apply to the multiple event capture mode:

- The number of position values is defined by the number of expected sparks as specified on the Parameters page.
- If the number of measured leading edges is smaller than the number of expected sparks, the missing position values are set to the default value as specified on the Capture page.
- If the leading edge of the first pulse occurred before the event capture window, the position value is set to the start position of the event capture window.

Trailing edge The `trailing edge` parameter contains the positions of up to 64 trailing edges.

- The values are given in degrees.
- The number of position values is defined by the number of expected sparks as specified on the Parameters page.
- If the number of measured trailing edges is smaller than the number of expected events, the missing position values are set to the default value as specified on the Capture page.
- If no trailing edge was detected in the last event capture window, the old values will remain.
- If the trailing edge of the last pulse occurs after the event capture window, the position value is set to the end position of the event capture window.
- Before the first trailing edge after the start of the simulation is captured, the output is the default value as specified on the Capture page.

Pulse count The `pulse count` parameter specifies the number of actually captured pulses.

Pulse state The `pulse state` parameter is defined as follows:

Pulse State	Meaning
0	All pulses occurred in the event capture window.
1	The leading edge of the first pulse occurred before the event capture window.
2	The trailing edge of the last pulse occurred after the event capture window.
3	The leading edge of the first pulse occurred before the event capture window and the trailing edge of the last pulse occurred after the event capture window.

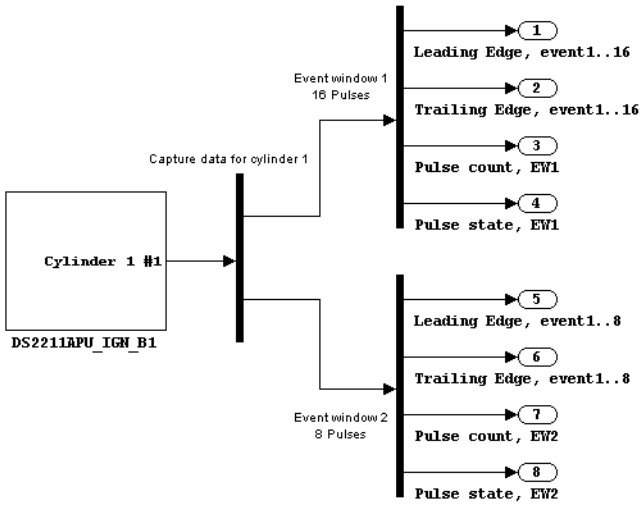
Dialog pages

The following dialog pages are available:

- Unit Page (DS2211APU_IGN_Bx) for board selection
- Capture Page (DS2211APU_IGN_Bx) for capture mode setting
- Parameters Page (DS2211APU_IGN_Bx) for cylinder selection and definition of event capture windows

Example

The following illustration shows the relationship between the block outputs and the captured values for 16 pulses in the first event capture window and 8 pulses in the second event window.



Related RTLib functions

`ds2211_multi_eventwin_set`, `ds2211_ign_capture_mode_setup`, `ds2211_multiwin_ign_cap_read`

Related topics

References

DS2211APU_CRANK_Bx 77
DS2211DIO_SETUP_Bx 25

Unit Page (DS2211APU_IGN_Bx)

Purpose

To specify the board number.

Dialog settings

Board number Lets you select the DS2211 board number of the board to be defined by this block in the range 1 … 16. This board may be the master board itself.

Related topics

References

DS2211APU_IGN_Bx 94

Capture Page (DS2211APU_IGN_Bx)

Purpose

To specify the trigger and capture mode.

Dialog settings

Trigger mode Lets you select whether ignition pulses are active high or active low.

Capture mode Lets you select the capture mode. In single event capture mode, the position of the leading edge of the first input pulse in the event capture window is captured. In multiple event capture mode, the positions of all leading and trailing edges of up to 64 pulses are captured. For more detailed information, see the I/O characteristics on page 95.

Position default value Lets you specify the default value for missing position values in the range -999 … 999 deg. If the number of measured pulses is smaller than the number of expected pulses, the missing positions are set to this value.

Related topics

References

DS2211APU_IGN_Bx.....94

Parameters Page (DS2211APU_IGN_Bx)

Purpose

To specify the number of cylinders and the event capture window to be used.

Dialog settings

Number of selected cylinders Lets you select the number of cylinders for which ignition pulses will be captured in the range 1 … 8. This number can be smaller than the number of cylinders simulated by the specified DS2211 board.

Selected cylinders Lets you enter the cylinders for which ignition pulses will be captured. The cylinder sequence in this field determines the I/O mapping of the ignition input lines. The first cylinder is mapped to the I/O signal IGN1, the second one to IGN2, and so on. For example, if you specify [8 12 10], cylinder 8 is mapped to IGN1, cylinder 12 to IGN2, and cylinder 10 to IGN3. The size of the array is specified by the number of selected cylinders (see above). The values of the array elements specify the cylinders which are mapped. The maximum number of cylinders is specified in the DS2211APU_CRANK_Bx block.

Number of event windows Lets you select the number of event capture windows (1 or 2).

The following parameters must be specified for each event window.

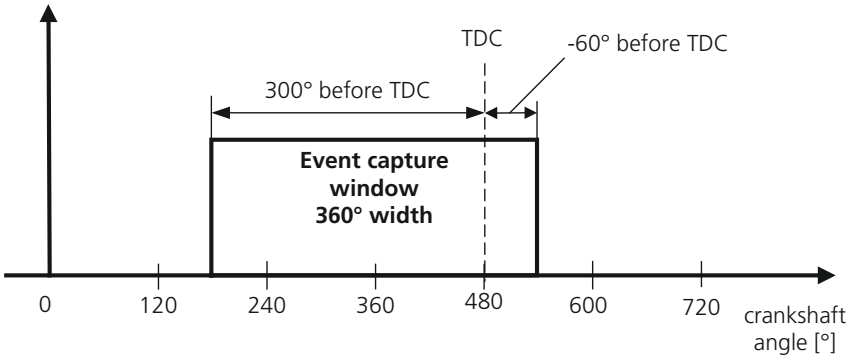
Number of expected sparks Lets you select the number of expected pulses within an event capture window (available only if multiple event capture mode is selected). This parameter defines the number of position values in the block's output. You cannot differentiate between the cylinders, the same number is valid for each of them. For more detailed information, see the I/O characteristics on page 95.

Start position Lets you enter the start positions of the event capture windows in the range –720 … 720° (719.82°) with a resolution of 0.011°. Note that the maximum size of the defined event capture window is 720° (719.82°). The values are assigned to the cylinders following the sequence you specified for the Selected cylinders parameter. The start positions are defined relative to the TDCs, which are specified by the First TDC parameter of the DS2211APU_CRANK_Bx / DS2210APU_CRANK_Bx block of the master board.

End position Lets you enter the end positions of the event capture windows in the range –720 … 720° (719.82°) with a resolution of 0.011°. Note that the maximum size of the defined event capture window is 720° (719.82°). The values are assigned to the cylinders following the same sequence that you have specified for the Selected cylinders parameter. The end positions are defined relative to the TDCs, which are specified by the First TDC parameter of the DS2211APU_CRANK_Bx / DS2210APU_CRANK_Bx block of the master board.

Before TDC

Angles before TDC are positive values. Thus, the Start position is always greater than the End position. The following illustration shows an event capture window (width 360°, Start position = +300°, End position = –60°):



Related topics

References

DS2211APU_CRANK_Bx....77
DS2211APU_IGN_Bx....94

DS2211APU_IGNCONT_Bx

Purpose

To read continuously the positions of the ignition pulses.

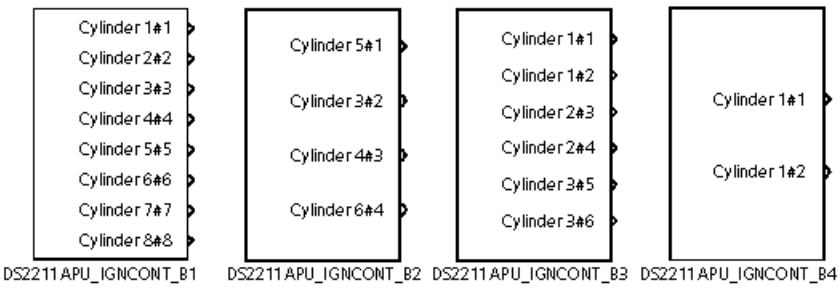
Where to go from here

Information in this section

Block Description (DS2211APU_IGNCONT_Bx)

Illustration

The block's appearance varies according to the selected cylinders.



Purpose

To read continuously the positions of the ignition pulses.

Description

You can define one or two event capture windows for up to eight cylinders. For capturing events of eight cylinders, the two auxiliary capture channels are used for channel 7 and 8. The values are captured continuously that means, the block output is updated immediately at the next sample step.

The block can operate in two modes:

Single capture event mode The block provides the leading edge position of the first event in each defined event capture window. The block provides several first events (up to 64) if the sample time is greater than the turnaround time of several motor cycles.

Multiple capture event mode The block provides the position and state of all events in each defined event capture window. The state indicates whether the events are leading or trailing edges.

For both modes, the measured values are returned via an output array, see below.

Note

When using this block, you have to consider the following:

- The DS2211APU_CRANK_Bx block must be in your model.
- Use DS2211DIO_SETUP_Bx to set the threshold level for digital inputs. If you do not include this block in your model, the default threshold level of 2.5 V is valid.
- This block cannot be used together with the following blocks:
  - DS2211APU_AUX_Bx_Cx
  - DS2211APU_IGN_Bx
  - DS2211APU_INJ_Bx_G2
  - DS2211APU_INJCONT_Bx_G2
  - DS2211APU_AUXCAPCONT_Bx_C1 (if you use channel 7 of DS2211APU_IGNCONT_Bx).
  - DS2211APU_AUXCAPCONT_Bx_C2 (if you use channel 8 of DS2211APU_IGNCONT_Bx).

I/O mapping

For information on the I/O mapping, refer to Spark Event Capture (DS2211 Features 🕮).

I/O characteristics

The ports are named Cylinder x # y. X is the number of the selected cylinder and y the port number that corresponds to the appropriate ignition input line.

The format of the *Cylinder x # y* block outputs depends on the capture mode. The position values are output as an array of data type Double. If two event capture windows are defined, the output array starts with the position values of the first event capture window.

Output array in single capture event mode In the single capture event mode, the output array is defined as follows:

Array Index[1), 2)]	Parameter	Number of Elements	Event Window
1 … NoE1	Position value	NoE1[1)]	1

Array Index[1), 2)]	Parameter	Number of Elements	Event Window
NoE1 + 1	Event count	1	1
NoE1 + 2	Lost events	1	1
NoE1 + 3 … NoE1 + 2 + NoE2	Position value	NoE2[2)]	2
NoE1 + 2 + NoE2 + 1	Event count	1	2
NoE1 + 2 + NoE2 + 2	Lost events	1	2

1) NoE1: Number of expected events in the event capture window 1
2) NoE2: Number of expected events in the event capture window 2

Output array in multiple capture event mode In the multiple capture event mode, the output array is defined as follows:

Array Index[1), 2)]	Parameter	Number of Elements	Event Window
1 … NoE1	Position value	NoE1[1)]	1
NoE1 + 1 … 2 · NoE1	Event state	NoE1	1
2 · NoE1 + 1	Event count	1	1
2 · NoE1 + 2	Lost events	1	1
2 · NoE1 + 3 … 2 · NoE1 + 2 + NoE2	Position value	NoE2[2)]	2
2 · NoE1 + 2 + NoE2 + 1 … 2 · NoE1 + 2 + 2 · NoE2	Event state	NoE2	2
2 · NoE1 + 2 + 2 · NoE2 + 1	Event count	1	2
2 · NoE1 + 2 + 2 · NoE2 + 2	Lost events	1	2

1) NoE1: Number of expected events in the event capture window 1
2) NoE2: Number of expected events in the event capture window 2

The output array contains different parameters:

Position value The position value parameter contains the position of the event relative to the TDC in the range –720 … 720° with a resolution of 0.011°. The events are the first leading edges in single event capture mode, or leading and trailing edges in multiple event capture mode. The following rules apply to both modes:

- The position values are given in degrees.
- The number of position values is defined by the number of expected events as specified on the Parameters page.

- If no leading edge was detected in the last sample hit, the old value are kept.
- Before the first leading edge after the start of the simulation is captured, the value is the default value as specified on the **Capture** page.

The following additionally rules apply to the multiple event capture mode:

- The event is either a leading (Event state = 1) or a trailing edges (Event state = 0).
- If the number of measured events is less than the number of expected events, the missing position values are set to the default value as specified on the **Capture** page.

Event state The `Event state` parameter specifies the kind of the captured event:

Event state	Meaning
1	Event is a leading edge
0	Event is a trailing edge

Event count The `event count` parameter specifies the number of actually captured pulses in the range 0 … 64.

Lost events The `lost events` parameter specifies whether data is lost or all events are read. Up to 64 events are stored in a temporary internal buffer (FIFO). Events that are not read remain in the FIFO. If they are not read fast enough, a buffer overflow with a loss of pulses occurs.

Lost events	Meaning
0	No event is lost or left in the FIFO
1 … 64	Number of events left in the FIFO
–1	A FIFO overflow occurred, one or more events are lost.

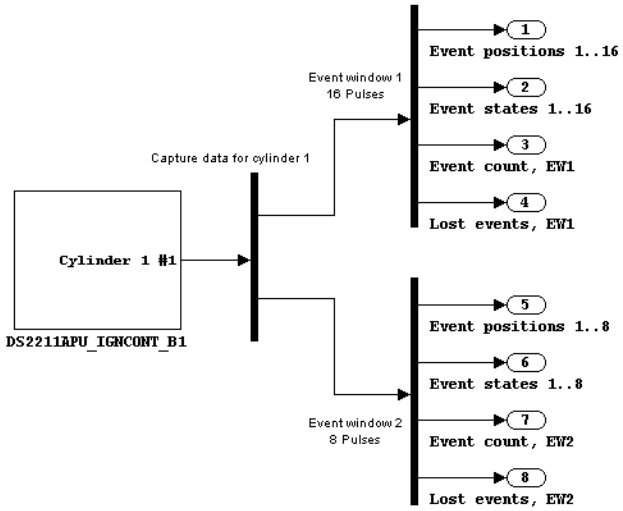
Dialog pages

The following pages are available:

- **Unit Page (DS2211APU_IGNCONT_Bx)** for board selection
- **Capture Page (DS2211APU_IGNCONT_Bx)** for capture mode setting
- **Parameters Page (DS2211APU_IGNCONT_Bx)** for cylinder selection and definition of event capture windows

Example

The following illustration shows the relationship between the block outputs and the captured values for 16 pulses in the first event window and 8 pulses in the second event window.



Related RTLib functions

`ds2211_init`, `ds2211_multiwin_ign_fifo_read`, `ds2211_multi_eventwin_set`, `ds2211_ign_capture_mode_setup`

Related topics

References

DS2211APU_CRANK_Bx 77
DS2211DIO_SETUP_Bx 25

Unit Page (DS2211APU_IGNCONT_Bx)

Purpose

To specify the board number.

Dialog settings

Board number Lets you select the DS2211 board number of the board to be defined by this block in the range 1 … 16. This board may be the master board itself.

Related topics

References

DS2211APU_IGNCONT_Bx 101

Capture Page (DS2211APU_IGNCONT_Bx)

Purpose

To specify the trigger and capture mode.

Dialog settings

Trigger mode Lets you select whether ignition pulses are active high or active low.

Capture mode Lets you select the capture mode. In single event capture mode, only the position of the leading edge of the first input pulse within the sample hit is captured.

In multiple event capture mode, up to 64 position values of all leading and trailing edges can be captured in each sample hit. For more detailed information, see the I/O characteristics on page 102.

Position default value Lets you specify the default value for missing position values in the range -999 … 999 deg. If the number of measured pulses is smaller than the number of expected pulses, the missing positions are set to this value.

Related topics

References

DS2211APU_IGNCONT_Bx..... 101

Parameters Page (DS2211APU_IGNCONT_Bx)

Purpose

To specify the number of cylinders and the event capture window to be used.

Dialog settings

Number of selected cylinders Lets you select the number of cylinders for which ignition pulses will be captured in the range 1 … 8. This number can be smaller than the number of cylinders simulated by the specified DS2211 board.

Selected cylinders Lets you enter the cylinders for which ignition pulses will be captured.

The cylinder sequence in this field determines the I/O mapping of the ignition input lines. The first cylinder is mapped to the I/O signal IGN1, the second one to IGN2, and so on. For example, if you specify [8 12 10], cylinder 8 is mapped to IGN1, cylinder 12 to IGN2, and cylinder 10 to IGN3.

The size of the array is specified by the number of selected cylinders (see above). The values of the array elements specify the cylinders which pulses are captured. The maximum number of cylinders is specified in the DS2211APU_CRANK_Bx block.

Number of event windows Lets you select the number of event capture windows (1 or 2).

The following parameters must be specified for each event window.

Number of expected events Lets you select the number of expected events within one sample hit. You cannot differentiate between the cylinders, the same number is valid for each of them. It is possible to capture multiple events in single event capture mode, for example, if the sample time is greater than the turnaround time of the engine cycle.

Start position Lets you enter the start positions of the event capture windows in the range –720 … 720° with a resolution of 0.011°. Note that the maximum size of the defined event capture window is 720°. The values are assigned to the cylinders in the sequence that you specified for the Selected cylinders parameter. The start positions are defined relative to the TDCs, which are specified by the First TDC parameter of the DS2211APU_CRANK_Bx / DS2210APU_CRANK_Bx block of the master board.

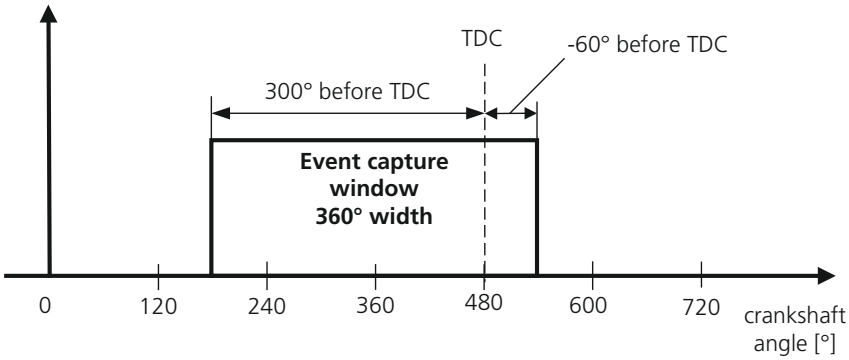
End position Lets you enter the end positions of the event capture windows in the range –720 … 720° with a resolution of 0.011°. Note that the maximum size of the defined event capture window is 720°. The values are assigned to the cylinders in the sequence that you specified for the Selected cylinders parameter. The end positions are defined relative to the TDCs, which are specified by the First TDC parameter of the DS2211APU_CRANK_Bx / DS2210APU_CRANK_Bx block of the master board.

Note

- With the DS2211APU_IGNCONT_Bx block in *multiple event capture mode* you can use the whole 720° event capture window, while DS2211APU_IGN_Bx subtracts 0.18° from 720°.
- In *single event capture mode*, the event window must not span the whole 720°. The event window must be in the range 0 … 719.82°.

Before TDC

Angles before TDC are positive values. Thus, the Start position is always greater than the End position. The following illustration shows an event capture window (width 360°, Start position = +300°, End position = -60°):



Related topics

References

DS2210APU_CRANK_Bx (DS2210 RTI Reference 🕮)
DS2211APU_CRANK_Bx 77
DS2211APU_IGNCONT_Bx 101

DS2211APU_INJ_Bx_Gy

Purpose

To read the positions and durations of the injection pulses that occurred in the last one or two event capture windows.

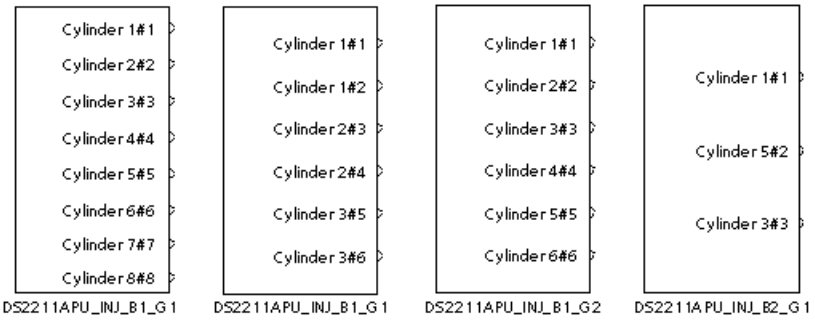
Where to go from here

Information in this section

Block Description (DS2211APU_INJ_Bx_Gy)

Illustration

The block's appearance varies according to the selected cylinders.



Purpose

To read the positions and durations of the injection pulses that occurred in the last one or two event capture windows.

Description

The block measures the positions of the leading and trailing edges of the injection pulses and/or the durations (fuel amount) of the pulses for up to 16 channels.

One block supports a group of up to 8 channels. The group number specifies the injection capture unit (group 1) and the ignition capture unit (group 2). You can define one or two event capture windows for each group.

The block can operate in four modes:

Position mode The block provides the positions of the leading and trailing edges of all injection pulses (up to 64) that occurred in each defined event capture window.

Duration mode The block provides the positions of the leading edges and the durations (fuel amount) of all injection pulses (up to 64) that occurred in each defined event capture window.

Position and duration mode The block provides the positions of the leading and trailing edges and the durations (fuel amount) of all injection pulses (up to 64) that occurred in each defined event capture window. This mode can be used starting from board revision 3 and FPGA revision 3 (for details, refer to DS2211 Board Revision (DS2211 Features 🕮)).

Absolute mode The block provides the positions and the time stamps of the leading and trailing edges of all injection pulses (up to 64) that occurred in each defined event capture window as absolute values. This mode can be used starting from board revision 3 and FPGA revision 3 (for details, refer to DS2211 Board Revision (DS2211 Features 🕮)).

The measured values for all modes are returned via an output array, see below.

Note

When using this block, you have to consider the following:

- The DS2211APU_CRANK_Bx block must be in your model.
- Use DS2211DIO_SETUP_Bx to set the threshold level for digital inputs. If you do not include this block in your model, the default threshold level of 2.5 V is valid.
- DS2211APU_INJ_Bx_G1 cannot be used with DS2211APU_INJCONT_Bx_G1
- DS2211APU_INJ_Bx_G2 cannot be used with
  - DS2211APU_INJCONT_Bx_G2
  - DS2211APU_AUXCAPCONT_Bx_Cy
  - DS2211APU_IGN_Bx
  - DS2211APU_IGNCONT_Bx
  - DS2211APU_AUXCAP_Bx_C1 (if you use channel 7 of the DS2211APU_INJ_Bx_G2).
  - DS2211APU_AUXCAP_Bx_C2 (if you use channel 8 of the DS2211APU_INJ_Bx_G2).

I/O mapping

For information on the I/O mapping, refer to Injection Pulse Position and Fuel Amount Measurement (DS2211 Features 🕮).

I/O characteristics

The ports are named Cylinder x # y. X is the number of the selected cylinder and y the port number that corresponds to the appropriate injection input line.

The format of the *Cylinder x # y* block outputs depends on the capture mode.

- In all capture modes except for the absolute mode, the position values are given relative to the TDC in the range –720 … 720° with a resolution of 0.011°.
- In the absolute mode, the position values are absolute values relative to a user-defined starting point. The default starting point is the start of the angular processing unit. You can define a new starting point using the DS2211APU_ABS_CNT_RESET_Bx block at run time. The position values are measured with a resolution of 0.011°, the time stamps have a resolution of 250 ns.

The block outputs an array of Double data type.

In the duration mode, the output array is defined as follows:

Array Index[1), 2)]	**Parameter**	**Number of Elements**	**Event Window**
1 … NoP1	Leading edge	NoP1[1)]	1
NoP1 + 1 … 2 · NoP1	Duration	NoP1	1
2 · NoP1 + 1	Pulse count	1	1
2 · NoP1 + 2 … 2 · NoP1 + 2 + NoP2	Leading edge	NoP2[2)]	2
2 · NoP1 + 2 + NoP2 +1 … 2 · NoP1 + 2 + 2 · NoP2	Duration	NoP2	2
2 · NoP1 + 2 + 2 · NoP2 + 1	Pulse count	1	2

[1)] NoP1: Number of expected pulses in the event capture window 1
[2)] NoP2: Number of expected pulses in the event capture window 2

In the position mode, the output array is defined as follows:

Array Index[1), 2)]	**Parameter**	**Number of Elements**	**Event Window**
1 … NoP1	Leading edge	NoP1[1)]	1
NoP1 + 1 … 2 · NoP1	Trailing edge	NoP1	1

Array Index[1), 2)]	Parameter	Number of Elements	Event Window
2 · NoP1 + 1	Pulse count	1	1
2 · NoP1 + 2	Leading edge	NoP2[2)]	2
…			
2 · NoP1 + 2 + NoP2			
2 · NoP1 + 2 + NoP2 +1	Trailing edge	NoP2	2
…			
2 · NoP1 + 2 + 2 · NoP2			
2 · NoP1 + 2 + 2 · NoP2 + 1	Pulse count	1	2

1) NoP1: Number of expected pulses in the event capture window 1
2) NoP2: Number of expected pulses in the event capture window 2

In the position and duration mode (can be used starting from board revision 3 and FPGA revision 3), the output array is defined as follows:

Array Index[1), 2)]	Parameter	Number of Elements	Event Window
1	Leading edge	NoP1[1)]	1
…			
NoP1			
NoP1 + 1	Trailing edge	NoP1	1
…			
2 · NoP1			
2 · NoP1 + 1	Duration	NoP1	1
…			
3 · NoP1			
3 · NoP1 + 1	Pulse count	1	1
3 · NoP1 + 2	Leading edge	NoP2[2)]	2
…			
3 · NoP1 + 2 + NoP2			
3 · NoP1 + 2 + NoP2 +1	Trailing edge	NoP2	2
…			
3 · NoP1 + 2 + 2 · NoP2			
3 · NoP1 + 2 + 2 · NoP2 + 1	Duration	NoP2	2
…			
3 · NoP1 + 2 + 3 · NoP2			
3 · NoP1 + 2 + 3 · NoP2 + 1	Pulse count	1	2

1) NoP1: Number of expected pulses in the event capture window 1
2) NoP2: Number of expected pulses in the event capture window 2

In the absolute mode (starting from board revision 3 and FPGA revision 3), the output array is defined as follows:

Array Index[1), 2)]	**Parameter**	**Number of Elements**	**Event Window**
1 … NoP1	Leading edge	NoP1[1)]	1
NoP1 + 1 … 2 · NoP1	Trailing edge	NoP1	1
2 · NoP1 + 1 … 3 · NoP1	Start timestamp	NoP1	1
3 · NoP1 + 1 … 4 · NoP1	End timestamp	NoP1	1
4 · NoP1 + 1	Pulse count	1	1
4 · NoP1 + 2 … 4 · NoP1 + 2 + NoP2	Leading edge	NoP2[2)]	2
4 · NoP1 + 2 + NoP2 + 1 … 4 · NoP1 + 2 + 2 · NoP2	Trailing edge	NoP2	2
4 · NoP1 + 2 + 2 · NoP2 +1 … 4 · NoP1 + 2 + 3 · NoP2	Start timestamp	NoP2	2
4 · NoP1 + 2 + 3 · NoP2 +1 … 4 · NoP1 + 2 + 4 · NoP2	End timestamp	NoP2	2
4 · NoP1 + 2 + 4 · NoP2 + 1	Pulse count	1	2

1) NoP1: Number of expected pulses in the event capture window 1
2) NoP2: Number of expected pulses in the event capture window 2

The output array contains different parameters:

Leading edge The leading edge parameter contains the positions of up to 64 leading edges in degrees. The number of position values is defined by the number of expected pulses as specified on the Parameters page. The following rules apply to this parameter:

- If the number of measured leading edges is smaller than the number of expected pulses, the missing position values are set to the default value as specified on the Capture page.
- If no leading edge was detected in the last event capture window the old values will remain.

- If the leading edge of the first pulse occurred before the event capture window the position value is set to the start position of the event capture window.
- Before the first leading edge after the start of the simulation is captured, the output is the default value as specified on the Capture page.

Duration The duration parameter contains up to 64 pulses within the last event capture window in seconds. The number of duration values is defined by the number of expected pulses as specified on the Parameters page. The following rules apply to this parameter:

- If the number of measured pulses is smaller than the number of expected pulses, the missing duration values will be set to the default value as specified on the Capture page.
- If no pulse was detected in the last event capture window, the old duration values will remain.
- If the leading edge of the first pulse occurred before the event capture window, the duration measurement begins at the start position of the event capture window.
- If the trailing edge of the last pulse occurred after the event capture window, the duration measurement ends at the end position of the event capture window.
- Before the first pulse after the start of the simulation is captured, the output is the default value as specified on the Capture page.

Trailing edge The trailing edge parameter contains the positions of trailing edges in degrees. The number of position values is defined by the number of expected pulses as specified on the Parameters page. The following rules apply to this parameter:

- If the number of measured trailing edges is smaller than the number of expected pulses, the missing position values are set to the default value as specified on the Capture page.
- If no trailing edge was detected in the last event capture window, the old values will remain.
- If the trailing edge of the last pulse occurs after the event capture window, the position value is set to the end position of the event capture window.
- Before the first trailing edge after the start of the simulation is captured, the output is the default value as specified on the Capture page.

Start timestamp The Start timestamp parameter contains the absolute time stamps of up to 64 leading edges in seconds. The number of time stamps is defined by the number of expected pulses as specified on the Parameters page. The following rules apply to this parameter:

- If the number of measured leading edges is smaller than the number of expected pulses, the missing time stamps are set to the default value as specified on the Capture page.
- If no leading edge was detected in the last event capture window the old values will remain.
- If the leading edge of the first pulse occurred before the event capture window, the time stamp is set to the start position of the event capture window.

- Before the first leading edge after the start of the simulation is captured, the output is the default value as specified on the Capture page.

End timestamp The end timestamp parameter contains the absolute time stamps of trailing edges in seconds. The number of time stamps is defined by the number of expected pulses as specified on the Parameters page. The following rules apply to this parameter:

- If the number of measured trailing edges is smaller than the number of expected pulses, the missing time stamps are set to the default value as specified on the Capture page.
- If no trailing edge was detected in the last event capture window, the old values will remain.
- If the trailing edge of the last pulse occurs after the event capture window, the time stamp is set to the end position of the event capture window.
- Before the first trailing edge after the start of the simulation is captured, the output is the default value as specified on the Capture page.

Pulse count The Pulse count parameter specifies the number of actually captured pulses.

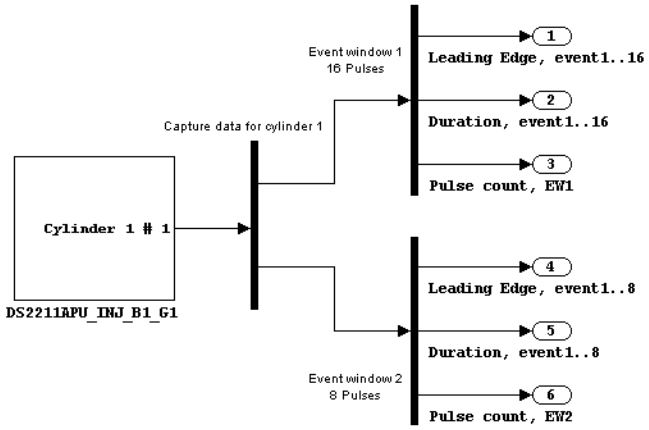
Dialog pages

The following pages are available:

- Unit Page (DS2211APU_INJ_Bx_Gy) for board selection
- Capture Page (DS2211APU_INJ_Bx_Gy) for capture mode setting
- Parameters Page (DS2211APU_INJ_Bx_Gy) for cylinder selection and definition of event capture windows

Example

The following illustration shows the relationship between the block outputs and the captured values for 16 pulses in the first event window and for 8 pulses in the second event window.



Related RTLib functions

`ds2211_multi_eventwin_set`, `ds2211_inj_capture_mode_setup`, `ds2211_multiwin_inj_cap_read`

Related topics

Basics

DS2211 Board Revision (DS2211 Features 🕮)

References

Unit Page (DS2211APU_INJ_Bx_Gy)

Purpose

To specify the board number.

Dialog settings

Board number Lets you select the DS2211 board number of the board to be defined by this block in the range 1 … 16. This board may be the master board itself.

Group number Lets you select the group number. Group 1 can be used for injection capture on channels INJ1 … INJ6, INJ7 (PWM7), INJ8 (PWM8) and group 2 for injection capture on channels IGN1 … IGN6, (AUXCAP1, AUXCAP2).

Related topics

References

Capture Page (DS2211APU_INJ_Bx_Gy)

Purpose

To specify the trigger and capture mode.

Dialog settings

Trigger mode Lets you select whether ignition pulses are active high or active low.

Capture mode Lets you select the capture mode. Up to 64 pulses are measured in each event capture window. The selected capture mode determines the measurement values as shown in the following table.

Capture Mode	Measurement Values
Position	Positions of the leading and trailing edges (relative to the TDC)
Duration	Positions of the leading edges and the pulse durations (relative to the TDC, default capture mode)
Position and duration	Positions of the leading and trailing edges and the pulse durations (relative to the TDC)
Absolute	Absolute positions and absolute time stamps of the leading and trailing edges (relative to a user-defined starting point)

Note

The position and duration mode and the absolute mode can be used starting from board revision 3 and FPGA revision 3 (for details, refer to DS2211 Board Revision (DS2211 Features 🕮)).

For more information on the capture modes, refer to Injection Event Capture Unit (DS2211 Features 🕮).

The measured values for all modes are returned via an output array, see I/O characteristics on page 111.

Position default value Lets you specify the default value for missing position values in the range -999 … 999 deg. If the number of measured pulses is smaller than the number of expected pulses, the missing positions are set to this value.

Duration default value Lets you specify the default value for missing duration values in the range -999 … 999 s. If the number of measured pulses is smaller than the number of expected pulses, the missing durations are set to this value. In absolute capture mode this value is used as a default time stamp value. You can use negative values to differentiate between missing and invalid values.

Related topics

Basics

DS2211 Board Revision (DS2211 Features 🕮)

References

DS2211APU_INJ_Bx_Gy 109

Parameters Page (DS2211APU_INJ_Bx_Gy)

Purpose

To specify the number of cylinders and the event capture window to be used.

Dialog settings

Number of selected cylinders Lets you select the number of cylinders for which injection pulses will be captured in the range 1 … 8. This number can be smaller than the number of cylinders simulated by the specified DS2211 board.

Selected cylinders Lets you enter the cylinders for which injection pulses will be captured. The size of the array is specified by the number of selected cylinders (see above). The values of the array elements specify the cylinders which pulses are captured. The maximum number of cylinders is specified in the DS2211APU_CRANK_Bx block.

The cylinder sequence in this field determines the I/O mapping of the injection input lines. The first cylinder is mapped to the I/O signal INJ1, the second one to INJ2, and so on. For example, if you specify [8 12 10] then cylinder 8 is mapped to INJ1, cylinder 12 to INJ2, and cylinder 10 to INJ3.

Number of events windows Lets you select the number of event capture windows (1 or 2).

The following parameters must be specified for each event window.

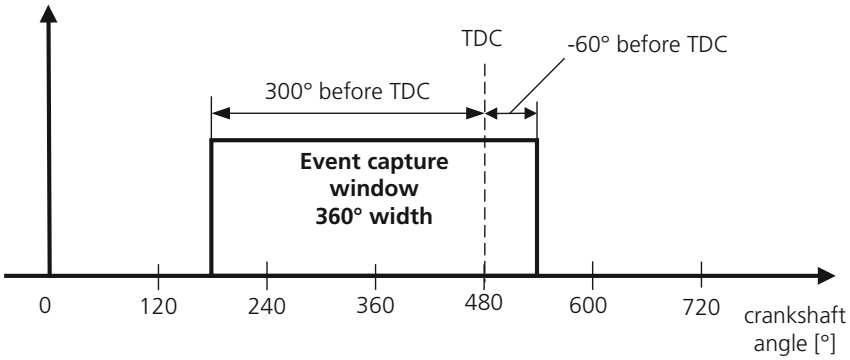
Number of expected pulses Lets you select the number of expected pulses in each event capture window. This parameter defines the number of position values in the block's output. You cannot differentiate between the cylinders, the same number is valid for each of them. For more detailed information, see the I/O characteristics on page 111.

Start position Lets you enter the start positions of the event capture windows in the range –720 … 720° (719.82°) with a resolution of 0.011°. The maximum size of the defined event capture window is 720° (719.82°). The values are assigned to the cylinders following the same sequence that you specified for the Selected cylinders parameter. The start positions are defined relative to the TDCs, which are specified by the First TDC parameter of the DS2211APU_CRANK_Bx / DS2210APU_CRANK_Bx block of the master board.

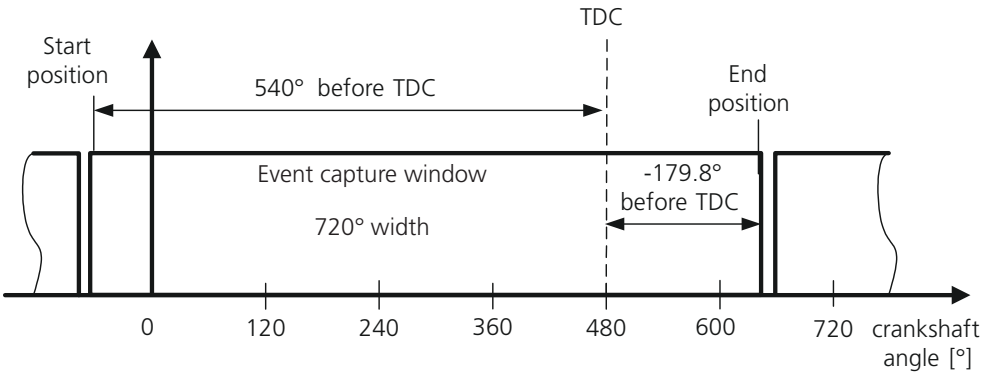
End position Lets you enter the end positions of the event capture windows in the range –720 … 720° (719.82°) with a resolution of 0.011°. The maximum size of the defined event capture window is 720° (719.82°). The values are assigned to the cylinders following the same sequence that you specified for the Selected cylinders parameter. The end positions are defined relative to the TDCs, which are specified by the First TDC parameter of the DS2211APU_CRANK_Bx / DS2210APU_CRANK_Bx block of the master board.

Before TDC

Angles before TDC are positive values. The following illustration shows an event capture window (width 360°, Start position = +300°, End position = –60°):



The following illustration shows an event capture window with the maximum width of 719.8° (Start position = +540°, End position = –179.8°). Note that the event capture window must not cover the whole engine cycle of 720° and that Start and End position have to be defined in the range –720 … 720°.



Related topics

References

DS2210APU_CRANK_Bx (DS2210 RTI Reference 🕮)
DS2211APU_CRANK_Bx 77
DS2211APU_INJ_Bx_Gy 109

DS2211APU_ABS_CNT_RESET_Bx

Purpose

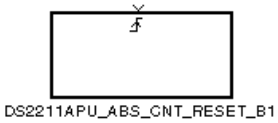
To define a new starting point when using the absolute capture mode.

Where to go from here

Information in this section

Block Description (DS2211APU_ABS_CNT_RESET_Bx)

Illustration



Purpose

To define a new starting point when using the absolute capture mode.

Description

If you use the absolute capture mode, the absolute values (time stamps and angle positions) are related to a user-defined starting point. The default starting point is the start of the APU. To get a new definite starting point, you can use the DS2211APU_ABS_CNT_RESET_Bx block.

Dialog pages

The following pages are available:

- Unit Page (DS2211APU_ABS_CNT_RESET_Bx) on page 121 for board selection
- Options Page (DS2211APU_ABS_CNT_RESET_Bx) on page 121 for capture mode setting

Related topics

Basics

APU Overview (DS2211 Features 🕮)

Unit Page (DS2211APU_ABS_CNT_RESET_Bx)

Purpose

To specify the board number.

Dialog settings

Board number Lets you select the DS2211 board number of the board in the range 1 … 16.

Description

The board must be the time-base master. For details, refer to Cascading I/O Boards (DS2211 Features 🕮).

Related topics

References

DS2211APU_INJ_Bx_Gy..... 109

Options Page (DS2211APU_ABS_CNT_RESET_Bx)

Purpose

To specify the trigger type of the block.

Description

The block is realized as a triggered subsystem which allows you to define various trigger types.

Dialog settings

Trigger type Lets you select the trigger type of the block.

- If the trigger type is set to **Rising**, **Falling**, or **Either**, the trigger port of the subsystem requires a Simulink signal and cannot be used with hardware or software interrupts. This type of conditionally executed subsystem does not form a separate task in the real-time program but is part of its parent subsystem's task.

- If the trigger type is set to **Function-call**, the trigger port of the subsystem accepts only function-call connections (for example, from RTI's Interrupt blocks, or the Simulink Function-Call Generator block) and no standard Simulink signals.
- If the trigger type is set to **None**, the trigger port is switched off.

Related topics

References

DS2211APU_INJ_Bx_Gy..... 109

DS2211APU_INJCONT_Bx_Gy

Purpose

To measure continuously the injection position and duration (fuel amount).

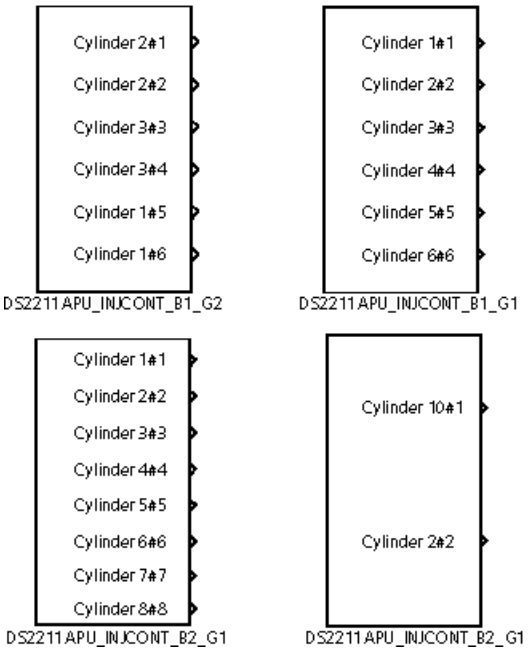
Where to go from here

Information in this section

Block Description (DS2211APU_INJCONT_Bx_Gy)

Illustration

The block's appearance varies according to the selected cylinders.



Purpose

To measure continuously the injection position and duration (fuel amount).

Description

The block measures the positions of leading and trailing edges or leading edges and durations (proportional to the fuel amount) of injection pulses for up to 16 channels. The values are measured continuously, that mean, they are updated at each sample hit. One block supports a group of up to 8 channels. The group number specifies the injection capture unit (group 1) and the ignition capture unit (group 2). You can define one or two event capture windows for each group.

This block can operate in two modes:

Duration mode The block provides the positions of the leading edges and duration (fuel amount) of all injection pulses (up to 64) that occurred in each defined event capture window.

Position mode The block provides the positions of the leading and trailing edges of all injection pulses (up to 64) that occur in each defined event capture window.

For both modes, the measured values are returned via an output array, see below.

Note

When using this block, you have to consider the following:

- The DS2211APU_CRANK_Bx block must be in your model.
- Use DS2211DIO_SETUP_Bx to set the threshold level for digital inputs. If you do not include this block in your model, the default threshold level of 2.5 V is used.
- DS2211APU_INJCONT_Bx_G1 cannot be used with DS2211APU_INJ_Bx_G1.
- DS2211APU_INJCONT_Bx_G2 cannot be used with
  - DS2211APU_INJ_Bx_G2
  - DS2211APU_AUXCAP_Bx_Cy
  - DS2211APU_IGN_Bx
  - DS2211APU_IGNCONT_Bx
  - DS2211APU_AUXCAPCONT_Bx_C1 (if you use channel 7 of DS2211APU_INJCONT_Bx_G2).
  - DS2211APU_AUXCAPCONT_Bx_C2 (if you use channel 8 of DS2211APU_INJCONT_Bx_G2).

I/O mapping

For information on the I/O mapping, refer to Injection Pulse Position and Fuel Amount Measurement (DS2211 Features 🕮).

I/O characteristics

The ports are named Cylinder x # y. X is the number of the selected cylinder and y the port number that corresponds to the appropriate injection input line.

The format of the *Cylinder x # y* block outputs depends on the capture mode. Position values are given relative to the TDC in the range –720 … 720° with a resolution of 0.011°. The position values are output as an array of data type Double that is defined as follows:

Array Index[1), 2)]	**Parameter**	**Number of Elements**	**Event Window**
1 … NoE1	Event value	NoE1[1)]	1
NoE1 + 1 … 2 ·NoE1	Event state	NoE1	1
2 · NoE1 + 1	Event count	1	1
2 · NoE1 + 2	Lost events	1	1
2 · NoE1 + 3 … 2 · NoE1 + 2 + NoE2	Event value	NoE2[2)]	2
2 · NoE1 + 2 + NoE2 + 1 … 2 · NoE1 + 2 + 2 · NoE2	Event state	NoE2	2
2 · NoE1 + 2 + 2 · NoE2 + 1	Event count	1	2
2 · NoE1 + 2 + 2 · NoE2 + 2	Lost events	1	2

[1)] NoE1: Number of expected events within in event capture window 1
[2)] NoE2: Number of expected events within in event capture window 2

The output array contains different parameters:

Event value The `Event value` parameter contains the position of the leading or trailing edge or duration of the event. The `Event state` parameter indicates which kind of event it is. Up to 64 events are evaluated in each capture window and in the last sample hit. The following rules apply to this parameter:

- The leading and trailing edges are given in degrees.
- The durations are given in seconds.
- The number of event values is defined by the number of expected events as specified on the Parameters page.
- If the number of measured events is less than the number of expected events, the missing position values are set to the default value as specified on the Capture page.
- If no event was detected during the last sample hit, the old values are kept.
- In front of the first event after the start of the simulation is captured, the output is the default value as specified on the Capture page.

Event state The `Event state` parameter and the selected mode indicates which kind of event/value the `Event value` parameter is.

Event state	Mode	Kind of Event/Value
1	Duration mode	Leading edge
1	Position mode	Leading edge
0	Duration mode	Duration
0	Position mode	Trailing edge

- If no event was measured, the states are kept.
- If the number of measured events is less than the number of expected events, the missing state values are set to the default value as specified on the Capture page.

Event count The `Event count` parameter specifies the number of actually captured events in the range 0 … 64.

Lost events Up to 64 events (32 pulses with two events each) are stored in a temporary internal buffer (FIFO). Pulses that are not read remain in the FIFO. If they are not read fast enough, a buffer overflow with a loss of pulses occurs. The `Lost events` parameter specifies whether data is lost or all events are read.

Lost Events	Meaning
0	No event is lost or left in the FIFO.
1 … 64	Number of events left in the FIFO.
–1	A FIFO overflow occurred, one or more events are lost.

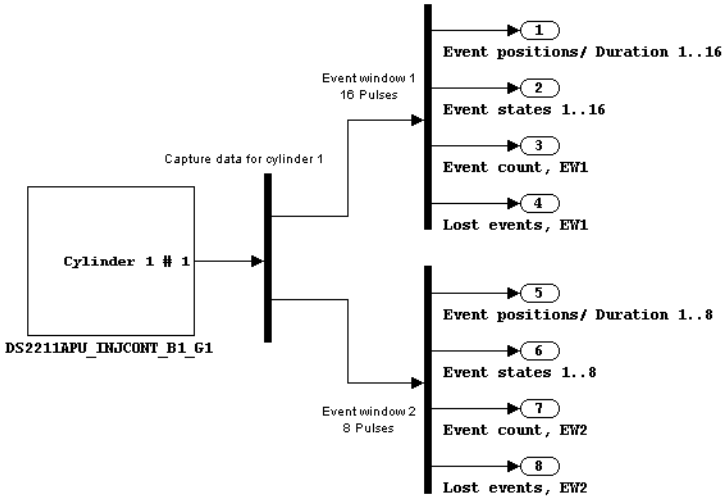
Dialog pages

The following pages are available:

- Unit Page (DS2211APU_INJCONT_Bx_Gy) on page 127 for board selection
- Capture Page (DS2211APU_INJCONT_Bx_Gy) on page 128 for capture mode setting
- Parameters Page (DS2211APU_INJCONT_Bx_Gy) on page 128 for cylinder selection and definition of event capture windows

Example

The following illustration shows the relationship between the block outputs and the captured values for 16 pulses in the duration mode.



Related RTLib functions

`ds2211_init`

Group 1 `ds2211_inj_capture_mode_setup`, `ds2211_multiwin_inj_fifo_read`

Group 2 `ds2211_ign_capture_mode_setup`, `ds2211_aux1_capture_mode_setup`, `ds2211_aux2_capture_mode_setup`, `ds2211_multiwin_ign_fifo_read`

Related topics

References

DS2211APU_CRANK_Bx....77
DS2211DIO_SETUP_Bx....25

Unit Page (DS2211APU_INJCONT_Bx_Gy)

Purpose

To specify the board and group number.

Dialog settings

Board number Lets you select the DS2211 board number of the board to be defined by this block in the range 1 … 16. This board may be the master board itself.

Group number Lets you select the group number. Group 1 can be used for injection capture on channels INJ1 … INJ6, INJ7 (PWM7), INJ8 (PWM8) and group 2 for injection capture on channels IGN1 … IGN6, (AUXCAP1, AUXCAP2).

Related topics

References

DS2211APU_INJCONT_Bx_Gy..... 123

Capture Page (DS2211APU_INJCONT_Bx_Gy)

Purpose

To specify the trigger and capture mode.

Dialog settings

Trigger mode Lets you select whether injection pulses are active high or active low.

Capture mode Lets you select the capture mode. If you select **duration mode** (start position/fuel amount capture mode), the positions of the leading edges and the pulse durations of up to 64 events (32 pulses with 2 events each) in the last sample hit are measured. If you select **position mode** (start/end position capture mode), the positions of leading and trailing edges of up to 64 events (32 pulses with 2 events each) are captured. For more information, see the I/O characteristics on page 124.

Default value Lets you specify the default value for missing position or duration values in the range -999 … 999. The default value is specified in degree for position values and in seconds for duration values. If the number of measured pulses is smaller than the number of expected pulses, the missing positions or durations are set to this value.

Related topics

References

DS2211APU_INJCONT_Bx_Gy..... 123

Parameters Page (DS2211APU_INJCONT_Bx_Gy)

Purpose

To specify the number of cylinders and the event capture window to be used.

Dialog settings

Number of selected cylinders Lets you select the number of cylinders for which injection pulses will be captured in the range 1 … 8. This number can be less than the number of cylinders simulated by the specified DS2211 board.

Selected cylinders Lets you enter the cylinders for which injection pulses will be captured. The size of the array is specified by the number of selected cylinders (see above). The values of the array elements specify the cylinders which pulses are captured. The maximum number of cylinders is specified in the DS2211APU_CRANK_Bx block.

The cylinder sequence in this field determines the I/O mapping of the injection input lines. The first cylinder is mapped to the I/O signal INJ1, the second one to INJ2, and so on. For example, if you specify [8 12 10], cylinder 8 is mapped to INJ1, cylinder 12 to INJ2, and cylinder 10 to INJ3.

Number of event windows Lets you select the number of event capture windows (1 or 2).

The following parameters must be specified for each event window.

Number of expected events Lets you select the number of expected events in each sample hit. This parameter defines the number of position values in the block's output. You cannot differentiate between the cylinders, the same number is valid for each of them. For more information, see the I/O characteristics on page 124.

Start position Lets you enter the start positions of the event capture windows in the range –720 … 720° with a resolution of 0.011°. Note that the maximum size of the defined event capture window is 720°. The values are assigned to the cylinders following the same sequence that you specified for the Selected cylinders parameter. The start positions are defined relative to the TDCs, which are specified by the First TDC parameter of the DS2211APU_CRANK_Bx / DS2210APU_CRANK_Bx block of the master board.

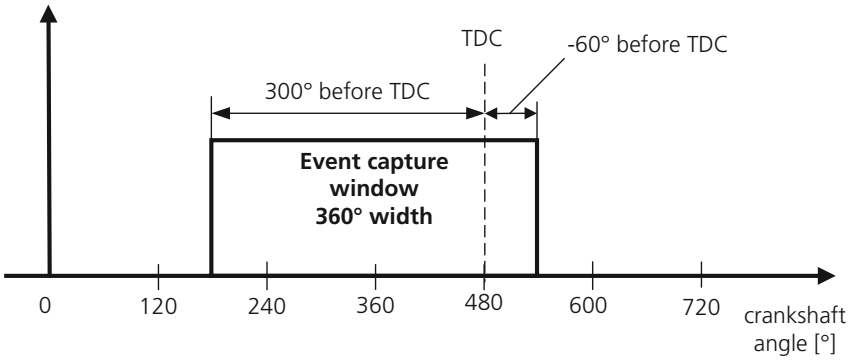
End position Lets you enter the end positions of the event capture windows in the range –720 … 720° with a resolution of 0.011°. Note that the maximum size of the defined event capture window is 720°. The values are assigned to the cylinders following the same sequence that you specified for the Selected cylinders parameter. The end positions are defined relative to the TDCs, which are specified by the First TDC parameter of the DS2211APU_CRANK_Bx or DS2210APU_CRANK_Bx block of the master board.

Note

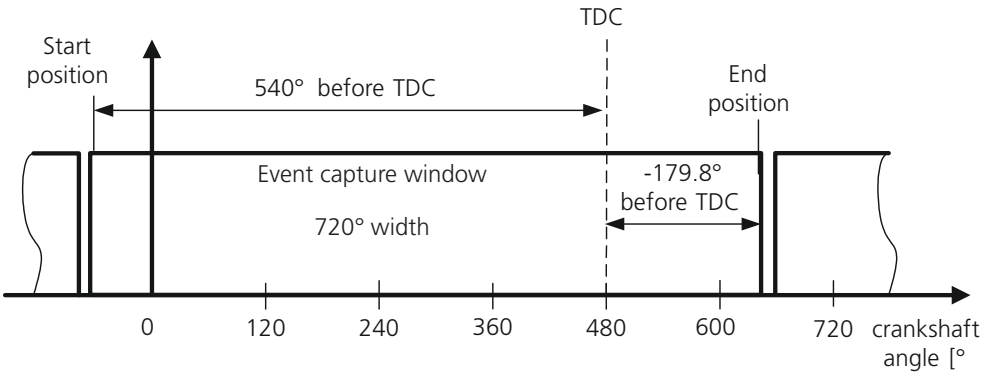
With the DS2211APU_INJCONT_Bx_Gy block you can use the whole 720° event capture window, while the DS2211APU_INJ_Bx_Gy subtract 0.18° from 720°.

Before TDC

Angles before TDC are positive values. The following illustration shows an event capture window (width 360°, Start position = +300°, End position = -60°):



The following illustration shows an event capture window with the maximum width of 719.8° (Start position = +540°, End position = -179.8°). Note that the event capture window must not cover the whole engine cycle of 720° and that Start and End position have to be defined in the range -720 … 720°.



Related topics

References

DS2211APU_CRANK_Bx 77
DS2211APU_INJCONT_Bx_Gy 123

DS2211APU_AUXCAP_Bx_Cy

Purpose

To read the positions of pulses that occurred in the last one or two event capture window of the specified auxiliary capture input.

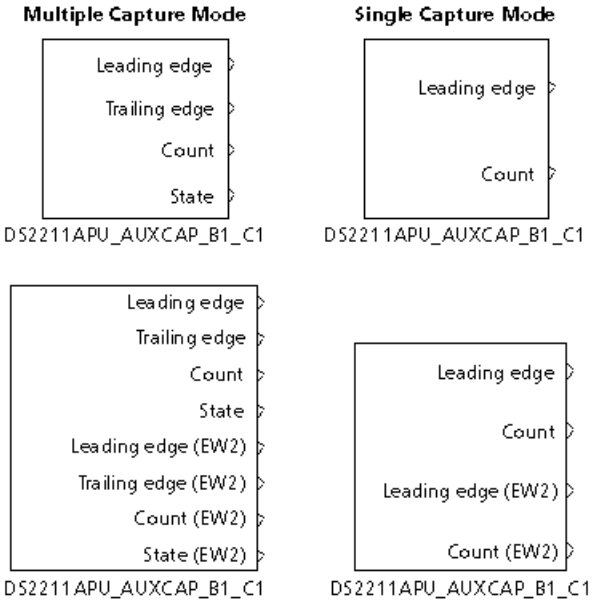
Where to go from here

Information in this section

Block Description (DS2211APU_AUXCAP_Bx_Cy)

Illustration

The block's appearance varies according to the selected capture mode and number of event capture windows.



Purpose

To read the positions of pulses that occurred in the last one or two event capture window of the specified auxiliary capture input.

Description

The block reads the position of pulses that occurred at one of the auxiliary capture lines within event capture windows. You can define one or two event capture windows. The block can operate in two modes:

Single event capture mode The block provides the position of the first leading edge within the defined event capture window.

Multiple event capture mode The block provides all (up to 64) positions of the pulses (leading and trailing edges) within the defined event capture windows.

For information on the block output ports, see below.

Note

When using this block, you have to consider the following:
- The DS2211APU_CRANK_Bx block must be in your model.
- Use DS2211DIO_SETUP_Bx to set the threshold level for digital inputs. If you do not include this block in your model the default threshold level of 2.5 V is valid.

You cannot use this block together with the following blocks
- DS2211APU_AUXCAPCONT_Bx_Cy
- DS2211APU_IGNCONT_Bx
- DS2211APU_INJCONT_Bx_G2
- DS2211APU_IGN_Bx (if you use channel 7 or 8)
- DS2211APU_INJ_Bx_G2 (if you use channel 7 or 8)

I/O mapping

For information on the I/O mapping, refer to Spark Event Capture (DS2211 Features 🕮).

I/O characteristics (single event capture mode)

In single event capture mode the block has the following output ports for each event capture window.

Output Port[1)]	Simulink Output	Data Type
Leading edge	0 … 719.91°	double
Count	0 … 255	UInt8

1) To identify the output ports for event capture window 2, the string "(EW2)" is added to their names.

Leading edge The Leading edge port provides the position of the first leading edge:

- The position is given in degrees.
- If no leading edge was detected in the last event capture window the old value will remain.
- Before the first leading edge after the start of the simulation is captured, the output is the default value as specified on the Capture page.

Count The count port is defined as follows:

Count	Meaning
0	No pulse captured within the last event capture window.
1	At least one pulse captured within the last event capture window.

I/O characteristics (multiple event capture mode)

In multiple event capture mode the block has the following output ports for each event capture window.

Output Port[1)]	Simulink Output	Data Type
Leading edge	0 … 719.91°	double
Trailing edge	0 … 719.91°	double
Count	0 … 255	UInt8
State	0 … 3	UInt8

1) To identify the output ports for event capture window 2, the string "(EW2)" is added to their names.

Leading edge The Leading edge port provides up to 64 positions of the leading edges:

- The positions are given in degrees.
- The number of position values is defined by the number of expected pulses as specified on the Event Window page.
- If the number of measured leading edges is smaller than the number of expected pulses, the missing position values are set to the default value as specified on the Capture page.
- If no pulse was detected in the last event capture window, the old values will remain.
- If the leading edge of the first pulse occurred before the event capture window, the position value is set to the start position of the event capture window.
- Before the first leading edge after the start of the simulation is captured, the output is the default value as specified on the Capture page.

Trailing edge The Trailing edge port provides up to 64 position of the trailing edges:

- The positions are given in degrees.
- The number of position values is defined by the number of expected pulses as specified on the Event Window page.

- If the number of measured trailing edges is smaller than the number of expected pulses, the missing position values are set to the default value as specified on the Capture page.
- If no pulse was detected in the last event capture window, the old values will remain.
- If the trailing edge of the last pulse occurs after the event capture window, the position value is set to the end position of the event capture window.
- Before the first trailing edge after the start of the simulation is captured, the output is the default value as specified on the Capture page.

Count The Count port provides the number of actually captured pulses in the range 0, 1, … 255.

State The State is defined as follows:

State	Meaning
0	All pulses occurred in the event capture window.
1	The leading edge of the first pulse occurred before the event capture window.
2	The trailing edge of the last pulse occurred after the event capture window.
3	The leading edge of the first pulse occurred before the event capture window, and the trailing edge of the last pulse occurred after the event capture window.

Dialog pages

The following pages are available:

- Unit Page (DS2211APU_AUXCAP_Bx_Cy) for board and channel selection
- Capture Page (DS2211APU_AUXCAP_Bx_Cy) for capture mode setting
- Event Window Page (DS2211APU_AUXCAP_Bx_Cy) to define the event capture window

Related RTLib functions

`ds2211_multi_eventwin_set`, `ds2211_aux1_capture_mode_setup`, `ds2211_aux2_capture_mode_setup`, `ds2211_multiwin_ign_cap_read`

Related topics

References

DS2211APU_CRANK_Bx 77
DS2211DIO_SETUP_Bx 25

Unit Page (DS2211APU_AUXCAP_Bx_Cy)

Purpose

To specify the board and channel number.

Dialog settings

Board number Lets you select the DS2211 board number of the board to be defined by this block in the range 1 … 16. This board may be the master board itself.

Channel number Lets you select the auxiliary capture input to be defined by this block (1 or 2).

Related topics

References

DS2211APU_AUXCAP_Bx_Cy..... 131

Capture Page (DS2211APU_AUXCAP_Bx_Cy)

Purpose

To specify the trigger and capture mode.

Dialog settings

Trigger mode Lets you select whether ignition pulses are active high or active low.

Capture mode Lets you select the capture mode. In single event capture mode, the position of the leading edge of the first input pulse in the event capture window is captured (see I/O characteristics (single event capture mode) on page 132). In multiple event capture mode, the positions of all leading and trailing edges of up to 64 pulses are captured (see I/O characteristics (multiple event capture mode) on page 133).

Position default value Lets you specify the default value for missing position values -999 … 999 deg. If the number of measured pulses is smaller than the number of expected pulses, the missing positions are set to this value.

Related topics

References

DS2211APU_AUXCAP_Bx_Cy..... 131

Event Window Page (DS2211APU_AUXCAP_Bx_Cy)

Purpose

To specify the event windows.

Dialog settings

Number of event windows Lets you select the number of event capture windows (1 or 2).

The following parameters must be specified for each event window.

Number of expected sparks Lets you select the number of expected pulses within an event capture window (available only if multiple event capture mode is selected). This parameter defines the number of position values in the block's output. You cannot differentiate between the cylinders, the same number is valid for each of them. For more information, see the I/O characteristics (multiple event capture mode) on page 133.

Start position Lets you enter the start position of the event capture window in the range 0 … <720° (719.82°) with a resolution of 0.011°. The value is not relative to the TDC.

End position Lets you enter the end position of the event capture window in the range 0 … <720° (719.82°) with a resolution of 0.011°. The value is not relative to the TDC.

Related topics

References

DS2211APU_AUXCAP_Bx_Cy..... 131

DS2211APU_AUXCAPCONT_Bx_Cy

Purpose

To read continuously the positions of pulses of the specified auxiliary capture input on up to two channels. The captured data for each channel is read in each sample hit.

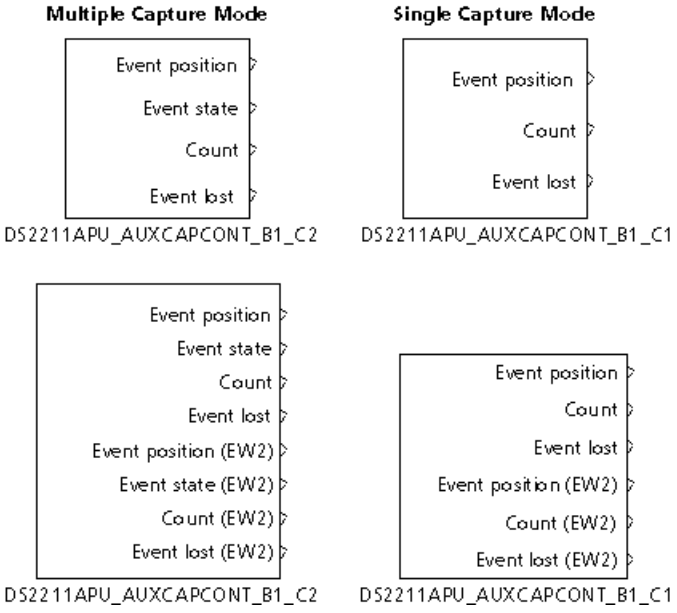
Where to go from here

Information in this section

Block Description (DS2211APU_AUXCAPCONT_Bx_Cy)

Illustration

The block's appearance varies according to the selected capture mode.



Purpose

To read continuously the positions of pulses of the specified auxiliary capture input on up to two channels. The captured data for each channel is read in each sample hit.

Description

Note

- The DS2211APU_CRANK_Bx block must be in your model.
- Use DS2211DIO_SETUP_Bx to set the threshold level for digital inputs. If you do not include this block in your model, the default threshold level of 2.5 V is valid.

For information on the block outport, see below.

I/O mapping

For information on the I/O mapping, refer to Spark Event Capture (DS2211 Features 🕮).

I/O characteristics (single event capture mode)

In single event capture mode the block has the following output ports for each event capture window.

Output Port[1)]	Simulink Output	Data Type
Leading edge	0 … 719.91°	double
Count	0 … 64	UInt8
Event lost	–1, 0 … 64	UInt8

1) To identify the output ports for event capture window 2, the string "(EW2)" is added to their names.

Leading edge The Leading edge port provides the position of the first leading edge within the last sample hit.

- The position is given in degrees.
- If no leading edge was detected during the last sample hit, the old value is kept.
- After the start of the simulation the output is default value until the first leading edge is captured. The default value is specified on the Capture page.

Count The Count port provides the number of actually captured events in the range 0 … 64.

Event lost Up to 64 events (32 pulses with two events each) are stored in a temporary internal buffer (FIFO). Pulses that are not read remain in the FIFO. If they are not read fast enough, a buffer overflow with a loss of pulses occurs. The Event lost port specifies whether data is lost or all events are read.

Lost Events	Meaning
0	No event is lost or left in the FIFO
1 … 64	Number of events left in the FIFO

Lost Events	Meaning
–1	A FIFO overflow occurred, one or more events are lost.

I/O characteristics (multiple event capture mode)

In *multiple event capture mode* the block has the following output ports for each event capture window:

Output Port[1)]	Simulink Output	Data Type
Event position	0 … 719.91°	double
Event state	0, 1	UInt32
Count	0 … 64	UInt8
Event lost	–1, 0 … 64	UInt8

1) To identify the output ports for event capture window 2, the string "(EW2)" is added to their names.

Event position The Event position port provides the position of the events. Which kind of event it is (leading or trailing edge), is given by the Event state port.

- The positions are given in degrees.
- Up to 64 position values can be provided. The number of position values is defined by the number of expected events as specified on the Capture page.
- If the number of measured events is less than the number of expected pulses, the missing position values are set to the default value as specified on the Capture page.
- If no event was detected during the last sample hit, the old values are kept.

Event state The Event state is defined as follows:

Event State	Meaning
1	The captured positions are leading edges.
0	The captured positions are trailing edges.

Count The Count port provides the number of events actually read.

Event lost Up to 64 events (32 pulses with two events each) can be stored in a temporary internal buffer (FIFO). Pulses that are not read remain in the FIFO. If the stored pulses are not read fast enough, a buffer overflow occurs and pulses are lost. The Event lost port is defined as follows:

Lost Events	Meaning
0	No pulse is lost or left in the FIFO
1 … 64	Number of pulses in the FIFO
–1	FIFO overflow occurred, one or more pulses are lost.

Dialog pages

The following pages are available:

- Unit Page (DS2211APU_AUXCAPCONT_Bx_Cy) for board and channel selection
- Capture Page (DS2211APU_AUXCAPCONT_Bx_Cy) for capture mode setting
- Event Window Page (DS2211APU_AUXCAPCONT_Bx_Cy) to define the event capture window

Related RTLib functions

`ds2211_init`, `ds2211_multiwin_ign_fifo_read`, `ds2211_multi_eventwin_set`, `ds2211_aux1_capture_mode_setup`, `ds2211_aux2_capture_mode_setup`

Related topics

References

DS2211APU_CRANK_Bx 77
DS2211DIO_SETUP_Bx 25

Unit Page (DS2211APU_AUXCAPCONT_Bx_Cy)

Purpose

To specify the board and channel number.

Board number Lets you select the DS2211 board number of the board to be defined by this block in the range 1 … 16. This board may be the master board itself.

Channel number Lets you select the auxiliary capture input to be defined by this block in the range 1 … 2.

Related topics

References

DS2211APU_AUXCAPCONT_Bx_Cy 137

Capture Page (DS2211APU_AUXCAPCONT_Bx_Cy)

Purpose

To specify the trigger and capture mode.

Dialog settings

Trigger mode Lets you select whether ignition pulses are active high or active low.

Capture mode Lets you select the capture mode. In single event capture mode, the position of the leading edge of the first event in each capture window is captured (see I/O characteristics (single event capture mode) on page 138). In multiple event capture mode, the positions of all leading and trailing edges of up to 64 events are captured (see I/O characteristics (multiple event capture mode) on page 139).

Position default value Lets you specify the default value for missing position values in the range -999 … 999 deg. If the number of measured pulses is smaller than the number of expected pulses, the missing positions are set to this value.

Related topics

References

DS2211APU_AUXCAPCONT_Bx_Cy..... 137

Event Window Page (DS2211APU_AUXCAPCONT_Bx_Cy)

Purpose

To specify the event window.

Dialog settings

Number of event windows Lets you select the number of event capture windows (1 or 2).

The following parameters must be specified for each event window.

Number of expected sparks Lets you select the number of expected pulses in an event capture window (available only if multiple event capture mode is selected). This parameter defines the number of position values in the block's output. You cannot differentiate between the cylinders, the same number is valid

for each of them. For more information, see the I/O characteristics (multiple event capture mode) on page 139.

Start position Lets you enter the start position of the event capture window in the range 0 … 720° with a resolution of 0.011°. The value is not relative to the TDC.

End position Lets you enter the end position of the event capture window in the range 0 … 720° with a resolution of 0.011°. The value is not relative to the TDC.

Note

- With the DS2211APU_AUXCAPCONT_Bx_Cy block in *multiple event capture mode* you can use the whole 720° event capture window, while the DS2211APU_AUXCAP_Bx_Cy always subtract 0.18° from 720°.
- In *single event capture mode*, the event window must not span the whole 720°. The event window must be in the range 0 … 719.82°.

Related topics

References

DS2211APU_AUXCAPCONT_Bx_Cy..... 137

DS2211APU_INT_Bx_Iy

Purpose

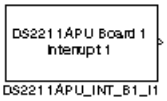
To define up to 6 angle position interrupts and make them available as trigger sources in your model.

Where to go from here

Information in this section

Block Description (DS2211APU_INT_Bx_Iy)

Illustration



Purpose

To define up to 6 angle position interrupts and make them available as trigger sources in your model.

Description

For information on interrupt handling, refer to Interrupt Handling (DS2211 Features 🕮).

For the specified angle position interrupt, you can define up to 2048 angle positions (engine positions) for which interrupts are generated.

Note

- The DS2211APU_CRANK_Bx block must be in your model.
- The interrupt position has a fixed offset error.
  If a DS2211 is the APU master, the offset error is 0.022° in forward engine rotation direction and 0.033° in reverse engine rotation direction.
  If a DS2210 is the APU master, the offset error is 0.088° in forward engine rotation direction and 0.099° in reverse engine rotation direction.

Dialog pages

The following pages are available:

- Unit Page (DS2211APU_INT_Bx_Iy) on page 144 for board and interrupt selection
- Parameters Page (DS2211APU_INT_Bx_Iy) on page 144 to define angle (engine) positions

Related topics

Basics

Interrupt Handling (DS2211 Features 🕮)

References

DS2211APU_CRANK_Bx 77

Unit Page (DS2211APU_INT_Bx_Iy)

Purpose

To specify the board and interrupt number.

Dialog settings

Board number Lets you select the DS2211 board number of the board to be defined by this block in the range 1 … 16. This board may be the master board itself.

Interrupt number Lets you select the angle position interrupt to be defined by this block in the range 1 … 6.

Related topics

References

DS2211APU_INT_Bx_Iy 143

Parameters Page (DS2211APU_INT_Bx_Iy)

Purpose

To specify the angle parameters of the interrupts to be used.

Dialog settings

Set angle position Lets you select how to define the angle positions for which interrupts will be generated. Select by automatic generation to define

angular positions based on a fixed step size. Select **by array field** to define interrupts only for the positions given in the array.

First angle Lets you enter the angle (engine position) for which the first interrupt in each engine cycle is to be generated. The value must remain in the range 0 … <720° with a resolution of 0.011°.

Step size Lets you enter the step size in the range 0 … <720° with a resolution of 0.011°. Based on the first angle, the step size defines the following interrupt occurrences within an engine cycle. For example, if you specify a first angle of 270° and a step size of 200°, interrupts will be generated at the angle positions of 270°, 470° and 670°.

Number of angles Lets you enter the number of angle positions to be specified in the **Angle position** array in the range 1 … 6. This number defines the length of the array.

Angle positions Lets you enter the angle positions within the array, for example: [80 210 690], meaning that interrupts will be generated at the angle positions of 80°, 210° and 690°. The position values must remain in the range 0 … <720° with a resolution of 0.36°.

Related topics

References

DS2211APU_INT_Bx_Iy..... 143

DS2211SL_KNSG_Bx_Cy

Purpose

To generate knock signals.

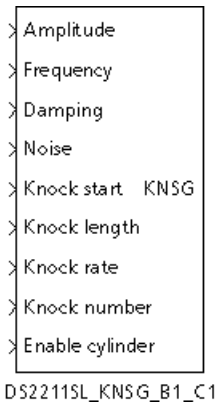
Where to go from here

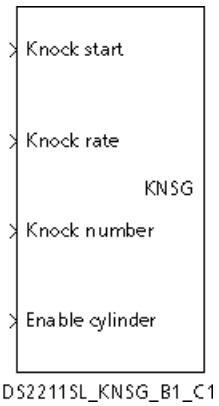
Information in this section

Block Description (DS2211SL_KNSG_Bx_Cy)

Illustration

The block's appearance varies according to how you configure the tunable parameters of the block.





Purpose

To generate knock signals.

Description

The block input ports are specified in I/O characteristics on page 147.

Note

- The DS2211APU_CRANK_Bx on page 77 block must be in your model.
- The block uses tunable parameters. These parameters can be updated *either* by their block input *or* by block parameters that are accessible by experiment software, for example, ControlDesk. The different representations of the block depend on your selection. Tunable parameters that are defined as block parameters will be removed from the RTI block layout. For detailed information, refer to Model Parameter Configuration Dialog (RTI and RTI-MP Implementation Reference 🕮).

I/O mapping

For information on the I/O mapping, refer to Knock Sensor Simulation (DS2211 Features 🕮).

I/O characteristics

The cylinder sequence as defined by the **Selected cylinders** parameter on the **Parameters** page determines the cylinder sequence and the length of the arrays used by the following block input parameters, except for the *Noise* parameter.

- The *Amplitude* input is available if **by input port** is selected for the **Set amplitude** parameter. The values in the array of amplitudes must be given in the range 0 … 40 V_{PP}.
- The *Frequency* input is available if **by input port** is selected for the **Set frequency** parameter. The values in the array of frequencies must be given in the range 0 … 12000 Hz.
- The *Damping* input is available if **by input port** is selected for the **Set damping** parameter. The values in the array of damping factors must be given in the range 0 … 1.
- The *Noise* input is available if **by input port** is selected for the **Set noise** parameter. The noise amplitude must be given in the range 0 … 40 V_{PP}. The noise is common for all cylinders.
- The *Knock start* input is available if **by input port** is selected for the **Set angle position of knock pulse before TDC** parameter. The values in the array of angle positions must be given in the range –90 … 90° relative to TDC with a resolution of 0.011°.
- The *Knock length* input is available if **by input port** is selected for the **Set length of knock pulse** parameter. The values in the array of angle positions must be given in the range 0 … 359° with a resolution of 0.011°.
- The *Knock rate* input is available if **by input port** is selected for the **Set knock rate** parameter. The values in the array of knock rates must be given in the range 0 … 2^{31}–1.
- The *Knock number* input is available if **by input port** is selected for the **Set number of knocks** parameter. The values in the array of numbers must be given in the range 0 … 2^{31}–1.

- The *Enable* input is available if **by input port** is selected for the **Enable cylinder** parameter. The values in the array are defined as follows.

Simulink Input	Purpose
0	To disable knock signal generation for a cylinder.
1	To enable knock signal generation for a cylinder.

- The following table shows the characteristics of the block inputs:

Variable	Characteristic	Value
Amplitude	Data type	Double
	Range	0 … 40 V_{PP}
Frequency	Data type	Double
	Range	0 … 12000 Hz
Damping	Data type	Double
	Range	0 … 1
Noise	Data type	Double
	Range	0 … 40 V_{PP}
Knock start	Data type	double
	Range	–90 … 90°
Knock length	Data type	double
	Range	0 … 359°
Knock rate	Data type	int32
	Range	0 … 2^{31}–1
Knock number	Data type	int32
	Range	0 … 2^{31}–1
Enable cylinder	Data type	boolean
	Range	0, 1

Dialog pages

The following pages are available:

- Unit Page (DS2211SL_KNSG_Bx_Cy) on page 149 for board and channel selection
- Parameters Page (DS2211SL_KNSG_Bx_Cy) on page 149 to define the cylinders and knock signal
- Knock Control Page (DS2211SL_KNSG_Bx_Cy) on page 150 to define the knock signal

Related RTLib functions

`ds2211_slave_dsp_signal_enable`, `ds2211_slave_dsp_channel_enable`, `ds2211_slave_dsp_knock_init`, `ds2211_slave_dsp_knock_update`, `ds2211_slave_dsp_knock_noise`, `ds2211_int_position_set`

Related topics

Basics

Knock Sensor Simulation (DS2211 Features 🕮)

Unit Page (DS2211SL_KNSG_Bx_Cy)

Purpose

To specify the board number, channel number and the sample time.

Dialog settings

Board number Lets you select the DS2211 board number of the board to be defined by this block in the range 1 … 16. This board may be the master board itself.

Channel number Lets you select the output channel to be defined by this block in the range 1 … 4.

Sample time Lets you enter the sample time for this DS2211SL_KNSG_Bx_Cy block in seconds. Enter –1 to keep the model's base sample time (inherited). The sample time determines how often the block's functions are executed. Use this parameter to minimize the execution time.

Related topics

References

DS2211SL_KNSG_Bx_Cy..... 146

Parameters Page (DS2211SL_KNSG_Bx_Cy)

Purpose

To specify the number of cylinders and the signal parameters.

Dialog settings

Number of selected cylinders Lets you select the number of cylinders in the range 1 … 8 for which knock signals will be generated.

Selected cylinders Lets you enter the cylinder numbers of the cylinders for which knock signals are generated, for example: [1 3 5]. The size of the array is specified by the number of selected cylinders (see above). The values of the array elements specify the cylinders for which knock signals are generated. The maximum number of cylinders is specified in the DS2211APU_CRANK_Bx block.

Note

The cylinder sequence within this array determines the cylinder sequence within the other parameter arrays.

Set amplitude This is a tunable parameter. Either select the radio button by input port to set the amplitudes for the selected cylinders by the block input port "Amplitude" or select by block parameter and enter the initial amplitude values for the selected cylinders in the range 0 … 40 V_{PP}.

Set noise This is a tunable parameter. Either select the radio button by input port to set the noise by the block input port "Noise" or select by block parameter and enter the initial noise value in the range 0 … 40 V_{PP}. The noise signal is common for all cylinders.

Set frequency This is a tunable parameter. Either select the radio button by input port to set the frequencies for the selected cylinders by the block input port "Frequency" or select by block parameter and enter the initial frequency values for the selected cylinders in the range 0 … 12000 Hz.

Set damping coefficient This is a tunable parameter. Either select the radio button by input port to set the damping coefficients for the selected cylinders by the block input port "Damping" or select by block parameter and enter the initial damping coefficient values for the selected cylinders in the range 0 … 1.

Related topics

References

DS2211APU_CRANK_Bx 77
DS2211SL_KNSG_Bx_Cy 146

Knock Control Page (DS2211SL_KNSG_Bx_Cy)

Purpose

To specify the cylinders and the knock pulse parameters.

Dialog settings

Selected cylinders Displays the sequence of selected cylinder numbers as specified on the Parameters Page (DS2211SL_KNSG_Bx_Cy) on page 149.

Note

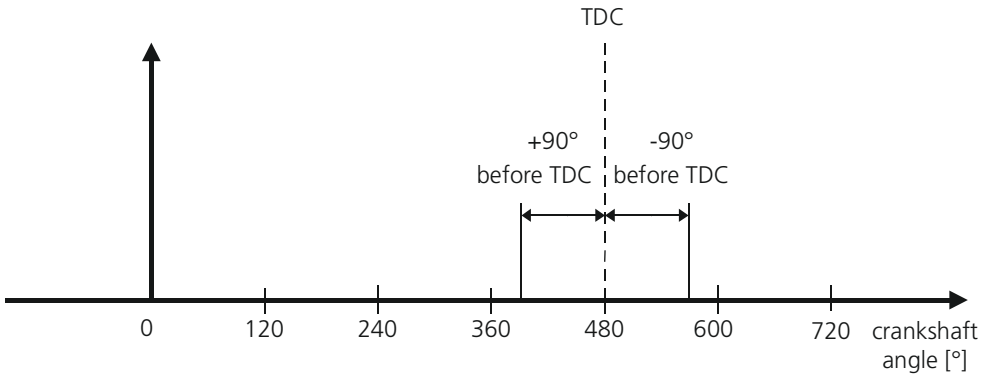
The cylinder sequence within this array determines the cylinder sequence within the other parameter arrays.

Set angle position of knock pulse before TDC This is a tunable parameter. Either select the radio button by input port to set the angle positions for the

selected cylinders by the block input port "Knock start" or select **by block parameter** and enter the initial angle position values for the selected cylinders in the range –90 … 90° relative to TDC with a resolution of 0.011°.

Before TDC

Angles before TDC are positive values. The following illustration shows the allowed range relative to a TDC of 480°:



Set length of knock pulse This is a tunable parameter. Either select the radio button **by input port** to set the knock pulse lengths for the selected cylinders by the block input port "Knock length" or select **by block parameter** and enter the initial knock length values for the selected cylinders in the range 0 … 359° with a resolution of 0.011°.

Enable cylinder This is a tunable parameter. Either select the radio button **by input port** to enable knock signal generation for the selected cylinders by the block input port "Enable cylinder" or mark the checkboxes in the **by block parameter** frame to enable knock signal generation for the selected cylinders. To disable knock signal generation for a selected cylinder do not mark the checkbox.

Set knock rate This is a tunable parameter. Either select the radio button **by input port** to set the knock rates for the selected cylinders by the block input port "Knock rate" or select **by block parameter** and enter the initial knock rate values for the selected cylinders in the range 0 … 2^{31}–1. For information on knock signal parameters, refer to Knock Sensor Simulation (DS2211 Features 🕮).

Note

The product of (knock rate · number of knocks) must not exceed 2^{31}–1.

Set number of knocks This is a tunable parameter. Either select the radio button **by input port** to set the number of knocks for the selected cylinders by the block input port "Knock number" or select **by block parameter** and enter the initial numbers of knocks for the selected cylinders in the range 0 … 2^{31}–1.

For information on knock signal parameters, refer to Knock Sensor Simulation (DS2211 Features 🕮).

Related topics

References

DS2211SL_KNSG_Bx_Cy..... 146

Angular Processing Unit - Variant

Where to go from here

Information in this section

General Information

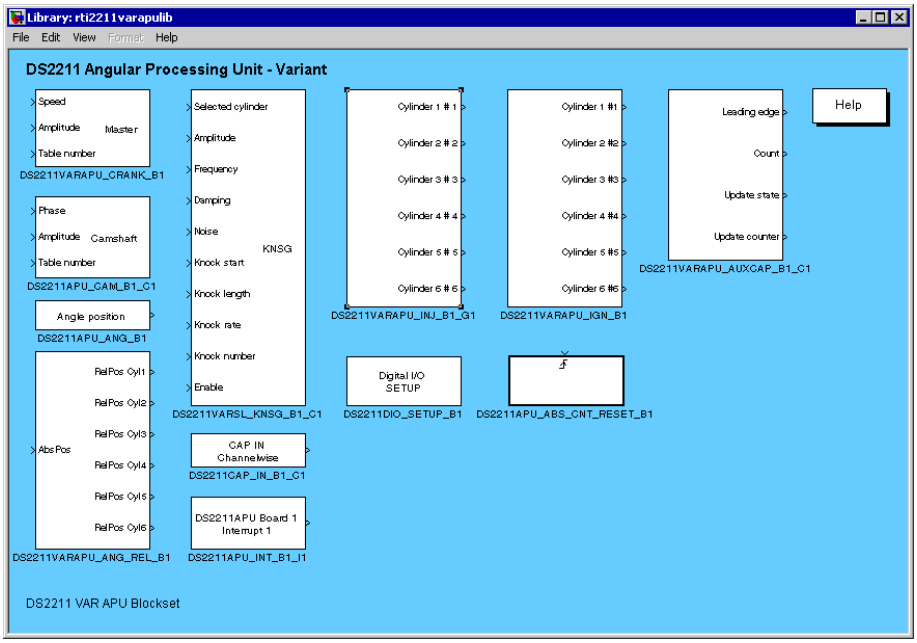
Overview of the Angular Processing Unit - Variant - DS2211RTI

Introduction

The angular processing unit (APU) is designed to simulate core engine processing functions, for example, crankshaft signal generation, or capturing spark events. If you use the VAR APU blockset, you can change the engine variant without the need to rebuild and download the real-time application. All relevant parameters can be changed via the experiment software.

Access

If you double-click the VAR APU button in the Library: rti2211lib window, the Library: rti2211varapulib window opens.



The Library: rti2211varapulib provides access to the angular processing unit - variant (VARAPU).

You can use the blocks of the library to simulate different engine variants. You can change the engine variant without the need to rebuild and download the real-time application. All relevant parameters can be changed via the experiment software.

Note

Do not mix blocks of the VAR APU and APU blockset in one model. Only blocks which are shared can be used with both blocksets. For details, refer to Building a Simulink Model for Engine Variants (DS2211 Features 🕮).

Library components

The library contains the following RTI blocks:

- DS2211VARAPU_CRANK_Bx on page 156
- DS2211VARAPU_ANG_REL_Bx on page 163
- DS2211VARAPU_IGN_Bx on page 166
- DS2211VARAPU_INJ_Bx_Gy on page 175
- DS2211VARAPU_AUXCAP_Bx_Cy on page 188
- DS2211VARSL_KNSG_Bx_Cy on page 197
- DS2211APU_CAM_Bx_Cy on page 84
- DS2211APU_ANG_Bx on page 89
- DS2211APU_ABS_CNT_RESET_Bx on page 120
- DS2211APU_INT_Bx_Iy on page 143
- Digital Capture of Event Capture Input on page 69
- Digital I/O Set Up on page 25

Related topics

Basics

Angular Processing Unit - Variant (DS2211 Features 🕮)

DS2211VARAPU_CRANK_Bx

Purpose

To set up the angular processing unit, generate the engine position information, and define the crankshaft output signal.

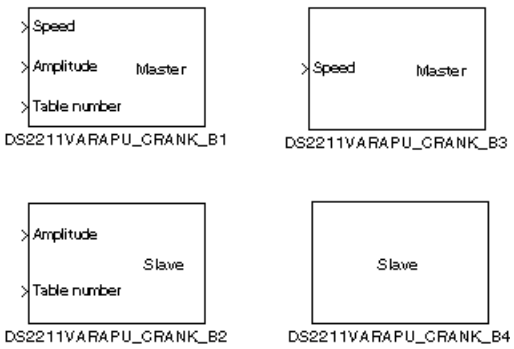
Where to go from here

Information in this section

Block Description (DS2211VARAPU_CRANK_Bx)

Illustration

The block's different representations depend on your settings.



Purpose

To set up the angular processing unit, generate the engine position information, and define the crankshaft output signal.

I/O mapping

For information on the I/O mapping, refer to Crankshaft Sensor Signal Generation (DS2211 Features 🕮).

Note

If several DS2211 boards are connected to different PHS buses of a multiprocessor system, identical board numbers are assigned to these boards. For the moment, RTI-MP does not allow you to configure a multiprocessor system using identical board numbers on different processors. If you encounter this problem, contact dSPACE support.

Description

The block input ports are specified in I/O characteristics on page 158.

You can cascade DS2211 boards. Cascading means, that their APUs are connected to the engine position bus to get the same time base. One board must be configured as master, all other boards are slave board. For each DS2211 master or slave board you need an own **DS2211VARAPU_CRANK_Bx** block. You have to define the master board on the **Unit** page first. In contrast to the **DS2211APU_CRANK_Bx** block, the **DS2211VARAPU_CRANK_Bx** block can not be used for cascading DS2211 and DS2210 boards because the DS2210 software does not support the VAR APU blockset.

The engine position is derived from the Speed input. For cascaded boards, only the master board gets a Speed input port to generate the engine position. The slave boards get the engine position information from the master board via the time-base connector.

Note

- The **DS2211VARAPU_CRANK_Bx** block must always be in your model if you want to use any of the other VARAPU blocks.
- Use **DS2211DIO_SETUP_Bx** to configure the digital outputs and to enable or disable the termination mode for all digital outputs.
- This block supports the simulation of engine variants. You can specify other engine parameters without generating the code again. For details, refer to Angular Processing Unit - Variant.
- This block cannot be used together with the blocks of the APU library, for example, **DS2211APU_CRANK_Bx**, **DS2211APU_IGN_Bx**.
- The block uses tunable parameters. These parameters can be updated *either* by their block input *or* by block parameters that are accessible by experiment software, for example, ControlDesk. The different representations of the block depend on your selection. Tunable parameters that are defined as block parameters will be removed from the RTI block layout. For detailed information, refer to Model Parameter Configuration Dialog (RTI and RTI-MP Implementation Reference 🕮).

I/O characteristics

- The *Speed* input is only available for the master block and must be given in revolutions per minute (rpm). The parameter is saturated to its limits.
- The *Amplitude* input is available if **input port** is selected in the **Set amplitude** parameter.
- The *Table number* input is available if **input port** is selected in the **Set table number** parameter. The parameter is saturated to its limits.
- The following table shows the characteristics of the block inputs:

Variable	Characteristic	Value
Speed	Data type	Double
	Range	–29297 … 29297
Amplitude	Data type	Double
	Range	0 … 40 V_{pp}
Table number	Data type	UInt8
	Range	1 … 8

Dialog pages

The following pages are available:

- **Unit Page** (refer to Unit Page (DS2211VARAPU_CRANK_Bx) on page 159) for master/slave selection
- **TDC Page** (refer to TDC Page (DS2211VARAPU_CRANK_Bx) on page 159) only for the master board's engine setup
- **Parameters Page** (refer to Parameters Page (DS2211VARAPU_CRANK_Bx) on page 161) for crankshaft signal definition and to define the digital output mode of crankshaft and camshaft signals
- **Wave Tables Page** (refer to Wave Tables Page (DS2211VARAPU_CRANK_Bx) on page 161) for wave table assignment

Related RTLib functions

`ds2211_mode_set`, `ds2211_digout_mode_set`, `ds2211_digwform_mode_set`, `ds2211_apu_transformer_mode_set`, `ds2211_apu_position_write`, `ds2211_apu_start`, `ds2211_apu_stop`, `ds2211_apu_velocity_write`, `ds2211_crank_output_ampl_set`, `ds2211_crank_table_load`, `ds2211_crank_table_select`

Related topics

References

Crankshaft Sensor Signal Generation (DS2211 Features 🕮)

Unit Page (DS2211VARAPU_CRANK_Bx)

Purpose

To specify the board number and select master/slave mode.

Dialog settings

Board number Lets you select the DS2211 board number in the range 1 … 16.

Master/Slave selection Lets you define the board as the master or the slave board. If you choose **Master** you can specify the **Initial position** at the start of the simulation within the engine cycle range 0 … <720° with a resolution of 0.011°. If you choose **Slave**, you have to select the board number of the already defined master board in the range 1 … 16 and the board type (DS2210 or DS2211).

Related topics

Basics

Setting Up I/O Boards (DS1006 Hardware Installation and Configuration Guide 🕮)
Setting Up I/O Boards (DS1007 Hardware Installation and Configuration Guide 🕮)

References

DS2211VARAPU_CRANK_Bx..... 156

TDC Page (DS2211VARAPU_CRANK_Bx)

Purpose

To specify the top dead center (TDC).

Dialog settings

The TDC page is enabled only if you chose Master in the Master/Slave selection. Use this page to set up the engine to be simulated, that is the TDC positions for the selected number of cylinders. These parameters can be modified after download to simulate engine variants. Refer to Angular Processing Unit - Variant (DS2211 Features 🕮).

The TDC page provides the following parameters:

Number of cylinders Lets you specify the number of cylinders of the engine to be simulated in the range 1 … 96. The I/O blocks (for example, DS2211VARAPU_IGN_Bx, DS2211VARAPU_INJ_Bx_Gy and DS2211VARSL_KNSG_Bx_Cy) allow you to use up to 8 of the defined cylinders.

Set TDC positions Lets you select the method how you want to specify the TDC positions.

Method	Descriptions
by automatic generation	Use this method if the TDC positions are equidistant. The TDC positions are calculated depending on the **Cylinder sequence** and **First TDC** (see the example below).
by array field	Use this method if the TDC positions are not equidistant. The **Firing sequence** parameter specifies the TDC positions in the order of the cylinder.

Cylinder sequence Lets you specify the ignition sequence, for example: [1 3 2 4]. This setting affects ignition and injection capturing as well as knock signal generation.

First TDC Lets you specify the TDC for the first cylinder of the sequence you have specified above in degree. The engine position has to be in the range 0 … <720° with a resolution of 0.011°.

Firing sequence Lets you specify the TDC positions in degree. The TDC positions must be specified in the physical order.

Example

The following example shows how the TDC positions are calculated when **by automatic generation** is selected:

Number of cylinders: 4

Cylinder sequence: [1 3 2 4]

First TDC: 0°

Cylinder	TDC
1	First TDC
3	First TDC + 720° / Number of cylinders
2	First TDC + (2 · 720°) / Number of cylinders
4	First TDC + (3 · 720°) / Number of cylinders

The calculated TDC positions are: [0°, 180°, 360°, 540°]

To specify the same TDC positions when **by array field** is selected, you must specify the firing sequence: [0°, 360°, 180°, 540°].

Related topics

References

DS2211VARAPU_CRANK_Bx 156
DS2211VARAPU_IGN_Bx 166
DS2211VARAPU_INJ_Bx_Gy 175
DS2211VARSL_KNSG_Bx_Cy 197

Parameters Page (DS2211VARAPU_CRANK_Bx)

Purpose

To enable the specify the digital output and the signal parameters.

Dialog settings

Digital output mode Clears automatically the digital crankshaft and camshaft outputs (CRANK_DIG, CAM1_DIG … CAM4_DIG) when the angular processing unit is stopped or when the Speed input becomes 0.

Set amplitude This is a tunable parameter. Select **input port** to set the amplitude of the analog crankshaft output by the block input port or enter the initial amplitude value in the range 0 … 40 V_{PP}. This parameter allows you to scale the values defined in your wave table.

Set table number This is a tunable parameter. Select **input port** to update the wave table to be used by the block input port or select an initial wave table in the **blockparameter table number** selection list. For the wave table numbering, refer to the Wave Tables Page (DS2211APU_CAM_Bx_Cy) on page 87.

Related topics

References

DS2211VARAPU_CRANK_Bx 156

Wave Tables Page (DS2211VARAPU_CRANK_Bx)

Purpose

To assign MAT wave table files to up to eight crankshaft wave tables.

Description

Each MAT wave table file defines a single wave table. For information on wave tables, refer to Wave Table Generation (DS2211 Features 🕮).

Use the **Add** button to browse through the file system and collect up to eight MAT wave table files in the selection list. Use the **Remove** button to remove a wave table file from the selection list. The files in the selection list are internally numbered consecutively, starting with 1 at the top. These numbers identify the wave tables.

You can modify the sequence with the **Up** and **Down** buttons.

Dialog settings

Model directory Displays the directory of your model. If you copy the model to another directory while the Wave tables page is still open, click the **Refresh** button to display the current model directory.

Use path relative to the model directory Displays the file names with a path relative to the current model directory.

Enable reverse crank Lets you enable the simulation of a reverse crank sensor signal. If selected, you can specify the signal settings (time delay and pulse durations), in the edit fields (see below). For general information on the reverse crank sensor signal, refer to Reverse Crankshaft Rotation (DS2211 Features 🕮).

Note

For the simulation of a reverse crank sensor signal, you must (create and) select a special wave table for reverse crankshaft signals. You cannot use a "normal" crankshaft wave table.

The reverse crank signal is generated as a digital signal. However, the analog crankshaft output is not automatically disabled and might generate an irrelevant analog signal.

Time delay (Available only if Enable reverse crank is activated) Lets you specify the time between a trigger event of a timing wheel tooth and the beginning of the corresponding sensor pulse in the range 1 … 8191.75 µs with a resolution of 0.25 µs (the default value is 5 µs). The specified time is also used as the forced minimum inactive time between two active pulses of the same rotation direction.

Pulse duration forward (Available only if Enable reverse crank is activated) Lets you specify the pulse duration that indicates a forward rotation of the crankshaft in the range 1 … 8191.75 µs with a resolution of 0.25 µs (the default value is 45 µs).

Pulse duration reverse (Available only if Enable reverse crank is activated) Lets you specify the pulse duration that indicates a reverse rotation of the crankshaft in the range 1 … 8191.75 µs with a resolution of 0.25 µs (the default value is 90 µs).

Forced pulse duration (Available only if Enable reverse crank is activated) Lets you specify the forced minimum inactive time between two pulses of different rotation directions in the range 1 … 8191.75 µs with a resolution of 0.25 µs (the default value is 5 µs).

Polarity (Available only if Enable reverse crank is activated) Lets you select whether to use active high or active low crank sensor pulses.

Related topics

References

DS2211VARAPU_CRANK_Bx..... 156
Wave Table Generation (DS2211 Features 🕮)

DS2211VARAPU_ANG_REL_Bx

Purpose

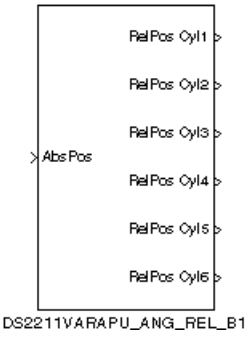
To convert the absolute angle position of the APU to a relative angle related to the top dead center of the selected cylinder or related to a specified reference position.

Where to go from here

Information in this section

Block Description (DS2211VARAPU_ANG_REL_Bx)

Illustration



Purpose

To convert the absolute angle position of the APU to a relative angle related to the top dead center of the selected cylinder or related to a specified reference position.

Description

This block supports the simulation of engine variants.

For information on angle position (engine position) processing, refer to Engine Position Phase Accumulator (DS2211 Features 🕮).

Note

- The DS2211VARAPU_CRANK_Bx block must be in your model.
- The input value must be an absolute angle position as output by DS2211APU_ANG_Bx, for example.
- This block cannot be used together with the blocks of the APU library, for example, DS2211APU_CRANK_Bx, DS2211APU_IGN_Bx.

I/O characteristics

- The relative *Angle position* output depends on the absolute angle's value that was input and on the specified reference angle.
- The following table shows the characteristics of the block output:

Output Variable	Data Type	Range
RelPos Cyl x	Double	–719.989° … 719.989°

Dialog pages

The following pages are available:

- **Unit Page** (refer to Unit Page (DS2211VARAPU_ANG_REL_Bx) on page 164)
- **Parameters Page** (refer to Parameter Page (DS2211VARAPU_ANG_REL_Bx) on page 165)

Related topics

Basics

Engine Position Phase Accumulator (DS2211 Features 🕮)

Unit Page (DS2211VARAPU_ANG_REL_Bx)

Purpose

To specify the board number.

Dialog settings

Board number Lets you select the DS2211 board number of the board to be defined by this block in the range 1 … 16. This board may be the master board itself.

Related topics

References

DS2211VARAPU_ANG_REL_Bx 163

Parameter Page (DS2211VARAPU_ANG_REL_Bx)

Purpose

To specify the number and sequence of the cylinders to be used.

Dialog settings

Number of selected cylinders Lets you select the number of cylinders in the range 1 … 8. The parameter defines the size of the Selected cylinders vector.

Selected cylinders Lets you specify the cylinder sequence for which the angles should be converted in the range 1 … 96. The size of the array is specified by the number of selected cylinders (see above). The values of the array elements specify the cylinders which are converted. The maximum number of cylinders is specified in the DS2211VARAPU_CRANK_Bx block. For example, to convert the angles of the 1, 3, and 6 cylinder, you must specify [1, 3, 6].

Set reference Lets you select the reference the absolute angles are related to. The table shows the possibilities:

Setting	Meaning
from master crank block	The angle positions are related to the TDCs defined in the DS2211VARAPU_CRANK_Bx on page 156 block.
by block parameter	If you select this option the input field is enabled. Enter the reference position for each selected cylinder into the vector, for example [0 120 240 360 480 600].

Note

The number of angle positions to be specified in the vector must be equal to the number of selected cylinders.

Related topics

References

DS2211VARAPU_ANG_REL_Bx 163
DS2211VARAPU_CRANK_Bx 156

DS2211VARAPU_IGN_Bx

Purpose

To read the positions of the ignition pulses that occurred in the last one or two event capture windows.

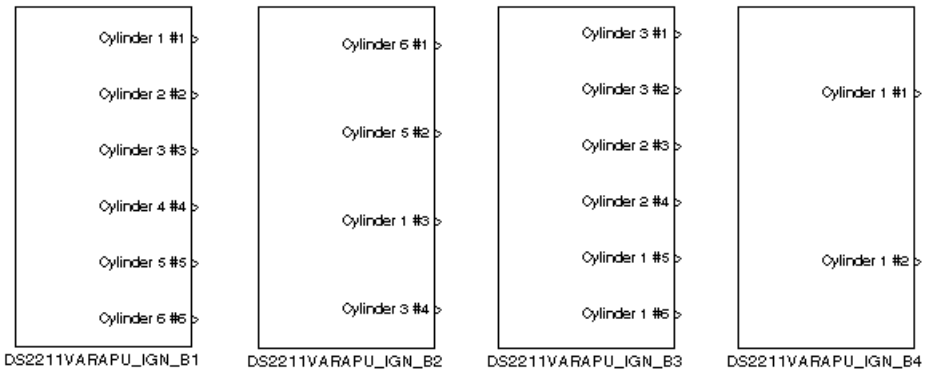
Where to go from here

Information in this section

Block Description (DS2211VARAPU_IGN_Bx)

Illustration

The block's different representations depend on the selected cylinders.



Purpose

To read the positions of the ignition pulses that occurred in the last one or two event capture windows.

Description

You can define one or two event capture windows for up to eight cylinders. For capturing ignition pulses for eight cylinders, the two auxiliary capture channels are used for channel 7 and 8.

The block can operate in two modes:

Single event capture mode The block provides the leading edge position of the first ignition within each defined event capture windows.

Multiple event capture mode The block provides the leading and trailing edge positions of all ignitions (up to 64) within each defined event capture windows.

For both modes, the measured values are returned via an output array, see below.

Note

When using this block, you have to consider the following:

- The DS2211VARAPU_CRANK_Bx block must be in your model.
- Use DS2211DIO_SETUP_Bx to set the threshold level for digital inputs. If you do not include this block in your model, the default threshold level of 2.5 V is valid.
- This block supports the simulation of engine variants. You can specify other engine parameters without generating the code again. For details, refer to Angular Processing Unit - Variant.
- This block cannot be used together with the following blocks of the VARAPU library:
  - DS2211VARAPU_INJ_Bx_G2
  - DS2211VARAPU_AUXCAP_Bx_C1 (if you use channel 7 of DS2211VARAPU_IGN_Bx).
  - DS2211VARAPU_AUXCAP_Bx_C2 (if you use channel 8 of DS2211VARAPU_IGN_Bx).
- This block cannot be used together with the blocks of the APU library, for example, DS2211APU_CRANK_Bx, DS2211APU_IGN_Bx.

I/O mapping

For information on the I/O mapping, refer to Spark Event Capture (DS2211 Features 🕮).

I/O characteristics

The ports are named Cylinder x # y. X is the number of the selected cylinder and y the port number that corresponds to the appropriate ignition input line.

The format of the *Cylinder x # y* block outputs depends on the capture mode. Position values are given relative to the TDC in the range –720 … 720° with a resolution of 0.011°. The position values are output as an array of data type Double. If two event capture windows are defined, the output array starts with the position values of the first event capture window. If only one event capture window is defined, the elements of the second event capture window are omitted.

In the single capture event mode, the output array is defined as follows (for details of the parameters, see below the tables):

Array Index	Parameter	Event Window
1	Leading edge	1
2	Edge count	1
3	Update state	1
4	Update counter	1
5	Leading edge	2
6	Edge count	2
7	Update state	2
8	Update counter	2

In the multiple event capture mode, the output array is defined as follows (for details of the parameters, see below the table):

Array Index[1), 2)]	Parameter	Number of Elements	Event Window
1 … NoS1	Leading edge	NoS1[1)]	1
NoS1 + 1 … 2 · NoS1	Trailing edge	NoS1	1
2 · NoS1 + 1	Pulse count	1	1
2 · NoS1 + 2	Pulse state	1	1
2 · NoS1 + 3	Update state	1	1
2 · NoS1 + 4	Update counter	1	1
2 · NoS1 + 5 … 2 · NoS1 + 2 + NoS2	Leading edge	NoS2[2)]	2
2 · NoS1 + 4 + NoS2 + 1 … 2 · NoS1 + 4 + 2 · NoS2	Trailing edge	NoS2	2
2 · NoS1 + 4 + 2 · NoS2 + 1	Pulse count	1	2
2 · NoS1 + 4 + 2 · NoS2 + 2	Pulse state	1	2
2 · NoS1 + 4 + 2 · NoS2 + 3	Update state	1	2
2 · NoS1 + 4 + 2 · NoS2 + 4	Update counter	1	2

[1)] NoS1: Number of expected sparks within the event capture window 1
[2)] NoS2: Number of expected sparks within the event capture window 2

The output array contains different parameters:

Leading edge The `leading edge` parameter is the position of the first leading edge in single event capture mode or the positions of up to 64 leading edges in multiple event capture mode. The following rules apply to both modes:

- The values are given in degrees.
- Before the first leading edge after the start of the simulation was captured, the output is the default value as specified on the Capture page.
- If no leading edge was detected in the last event capture window, the old values will remain.

The following additionally rules apply to multiple event capture mode:

- The number of position values is defined by the number of expected sparks as specified on the Parameters page.
- If the number of measured leading edges is smaller than the number of expected sparks, the missing position values are set to the default value as specified on the Capture page.
- If the number of leading edges is smaller than the number of leading edges of the previous measurement, the output array keeps the old values at the superflous positions.
- If the leading edge of the first pulse occurred before the event capture window, the position value is set to the start position of the event capture window.

Edge count The `edge count` parameter is defined as follows:

Edge Count	Meaning
0	No ignition pulse captured within the last event capture window.
1	At least one pulse captured within the last event capture window.

Trailing edge The `trailing edge` parameter contains the positions of up to 64 trailing edges.

- The values are given in degrees.
- The number of position values is defined by the number of expected sparks as specified on the Parameters page.
- If the number of measured trailing edges is smaller than the number of expected events the missing position values are set to the default value as specified on the Capture page.
- If the number of trailing edges is smaller than the number of trailing edges of the previous measurement, the output array keeps the old values at the superflous positions.
- If no trailing edge was detected in the last event capture window, the old values will remain.
- If the trailing edge of the last pulse occurs after the event capture window, the position value is set to the end position of the event capture window.
- Before the first trailing edge after the start of the simulation was captured, the output is the default value as specified on the Capture page.

Pulse count The `pulse count` parameter specifies the number of actually captured pulses.

Pulse state The `pulse state` parameter is defined as follows:

Pulse State	Meaning
0	All pulses occurred within the event capture window.
1	The leading edge of the first pulse occurred before the event capture window.
2	The trailing edge of the last pulse occurred after the event capture window.
3	The leading edge of the first pulse occurred before the event capture window and the trailing edge of the last pulse occurred after the event capture window.

Update state The update state is defined as follows:

Value	Description
0	The update of data within current event capture window is still running. The `update counter` parameter is still updated. The `leading edge` and `trailing edge` parameters may contain a mix of old and new data.
1	Data within current event capture window is not updated any longer. The `update counter` parameter is not updated. The `leading edge` and `trailing edge` parameters contain only new data (Exception: In the current event capture window no or less pulses occurred referred to the previous event capture window).

The state is set to 0 when the first event of each event capture window occurs. The state is set to 1 when the number of expected pulses is reached or at the end of each event capture window (then the number of expected pulses was not reached within the event capture window). After initialization the value is 0.

Update counter The counter counts every occurring edge within the current event capture window until the number of expected pulses is reached. Additional edges are ignored. During counting, the counter alternates its sign to distinguish between leading and trailing edges.

Sign	Description
Negative	A leading edge is detected. The count value is incremented.
Positive	A trailing edge is detected. The count value is not incremented.

Dialog pages

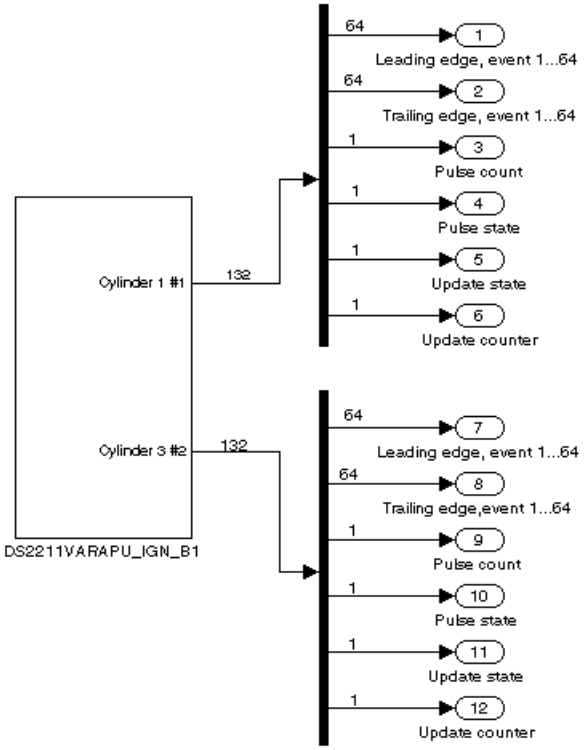
The following dialog pages are available:

- Unit Page for board selection
- Capture Page for capture mode setting

- **Parameters Page** for cylinder selection and definition of event capture windows

Example

The following illustration shows the relationship between the block outputs and the captured values for 64 pulses in the multiple event capture mode.



Related RTLib functions

`ds2211_multi_eventwin_set`, `ds2211_ign_capture_mode_setup`, `ds2211_multiwin_ign_cap_read`

Related topics

References

Spark Event Capture (DS2211 Features 🕮)

Unit Page (DS2211VARAPU_IGN_Bx)

Purpose

To specify the board number.

Dialog settings

Board number Lets you select the DS2211 board number of the board to be defined by this block in the range 1 … 16. This board may be the master board itself.

Related topics

References

DS2211VARAPU_IGN_Bx..... 166

Capture Page (DS2211VARAPU_IGN_Bx)

Purpose

To specify the trigger and capture mode.

Dialog settings

Capture mode Lets you select the capture mode. In single event capture mode, the position of the leading edge of the first input pulse within the event capture window is captured. In multiple event capture mode, the positions of all leading and trailing edges of up to 64 pulses are captured. For more detailed information, see the I/O characteristics on page 167.

Trigger mode Lets you specify whether ignition pulses are active high (1) or active low (0). The trigger mode can be modified by a block parameter from within ControlDesk. Changes take effect only during Stop/Run or Stop/Pause transitions of the model.

Position default value Lets you specify the default value for missing position values in the range -999 … 999 deg. If the number of measured pulses is smaller than the number of expected pulses, the missing positions are set to this value.

Related topics

References

DS2211VARAPU_IGN_Bx..... 166

Parameters Page (DS2211VARAPU_IGN_Bx)

Purpose

To specify the number of cylinders and the event capture window to be used.

Dialog settings

Number of selected cylinders Lets you select the number of cylinders for which ignition pulses will be captured in the range 1 … 8. This number can be smaller than the number of cylinders simulated by the specified DS2211 board.

Selected cylinders Lets you enter the cylinders for which ignition pulses will be captured. The cylinder sequence in this field determines the I/O mapping of the ignition input lines. The first cylinder is mapped to the I/O signal IGN1, the second one to IGN2, and so on. For example, if you specify [8 12 10], cylinder 8 is mapped to IGN1, cylinder 12 to IGN2, and cylinder 10 to IGN3. The size of the array is specified by the number of selected cylinders (see above). The values of the array elements specify the cylinders which are mapped. The maximum number of cylinders is specified in the DS2211VARAPU_CRANK_Bx block.

Number of event windows Lets you select the number of event capture windows (1 or 2).

Number of expected sparks Lets you select the number of expected pulses within an event capture window in the range 1 … 64 (available only if multiple event capture mode is selected). This parameter defines the number of position values given in the block's output. You cannot differentiate between the cylinders, the same number is valid for each of them. For more detailed information, see the I/O characteristics on page 167.

Start position Lets you enter the start positions of the event capture windows in the range –1440 … 1440° with a resolution of 0.011°. Note that the maximum size of the defined event capture window is 720° (719.82°). The values are assigned to the cylinders following the sequence you specified for the Selected cylinders parameter. The start positions are defined relative to the TDCs, which are specified on the TDC page of the DS2211VARAPU_CRANK_Bx block of the master board (see TDC Page (DS2211VARAPU_CRANK_Bx) on page 159).

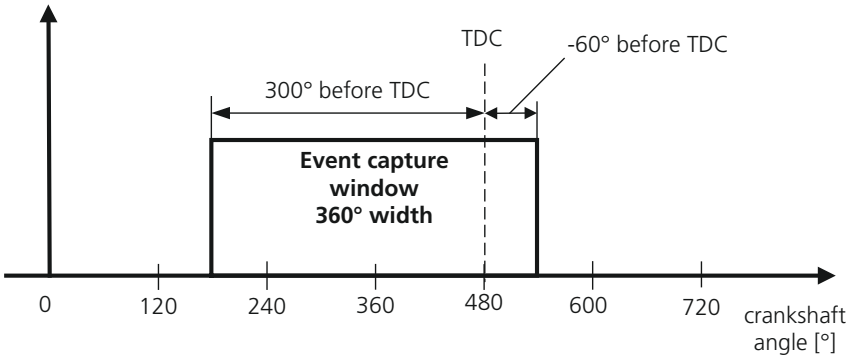
The start positions can be modified by a block parameter from within ControlDesk. Changes take effect only during Stop/Run or Stop/Pause transitions of the model.

End position Lets you enter the end positions of the event capture windows in the range –1440 … 1440° with a resolution of 0.011°. Note that the maximum size of the defined event capture window is 720° (719.82°). The values are assigned to the cylinders following the same sequence that you have specified for the Selected cylinders parameter. The end positions are defined relative to the TDCs, which are specified on the TDC page of the DS2211VARAPU_CRANK_Bx block of the master board (see TDC Page (DS2211VARAPU_CRANK_Bx) on page 159).

The end positions can be modified by a block parameter from within ControlDesk. Changes take effect only during Stop/Run or Stop/Pause transitions of the model.

Before TDC

Angles before TDC are positive values. Thus, the Start position is always greater than the End position. The following illustration shows an event capture window (width 360°, Start position = +300°, End position = –60°):



Related topics

References

DS2211VARAPU_CRANK_Bx..... 156
DS2211VARAPU_IGN_Bx..... 166

DS2211VARAPU_INJ_Bx_Gy

Purpose

To read the positions and durations of the injection pulses that occurred in the last one or two event capture windows.

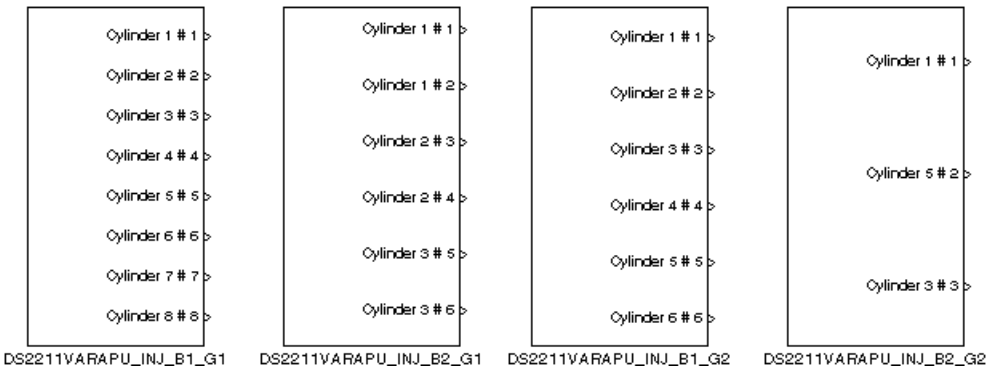
Where to go from here

Information in this section

Block Description (DS2211VARAPU_INJ_Bx_Gy)

Illustration

The block's different representations depend on the selected cylinders.



Purpose

To read the positions and durations of the injection pulses that occurred in the last one or two event capture windows.

Description

The block measures the positions of the leading and trailing edges of the injection pulses and/or the durations (fuel amount) of the pulses for up to 16 channels.

One block supports a group of up to 8 channels. The group number specifies the injection capture unit (group 1) and the ignition capture unit (group 2). You can define one or two event capture windows for each group.

This block can operate in four modes:

Position mode The block provides the positions of the leading and trailing edges of all injection pulses (up to 64) that occurred in each defined event capture window.

Duration mode The block provides the positions of the leading edges and duration (fuel amount) of all injection pulses (up to 64) that occurred in each defined event capture window.

Position and duration mode The block provides the positions of the leading and trailing edges and the duration (fuel amount) of all injection pulses (up to 64) that occurred in each defined event capture window. This mode can be used starting from board revision 3 and FPGA revision 3 (for details, refer to DS2211 Board Revision (DS2211 Features 🕮)).

Absolute mode The block provides the positions and the time stamps of the leading and trailing edges of all injection pulses (up to 64) that occurred in each defined event capture window as absolute values. This mode can be used starting from board revision 3 and FPGA revision 3 (for details, refer to DS2211 Board Revision (DS2211 Features 🕮)).

For all modes, the measured values are returned via an output array, see below.

Note

When using this block, you have to consider the following:

- The DS2211VARAPU_CRANK_Bx block must be in your model.
- Use DS2211DIO_SETUP_Bx to set the threshold level for digital inputs. If you do not include this block in your model, the default threshold level of 2.5 V is valid.
- This block supports the simulation of engine variants. You can specify other engine parameters without generating the code again. For details, refer to Angular Processing Unit - Variant (DS2211 Features 🕮).
- DS2211VARAPU_INJ_Bx_G2 cannot be used with
  - DS2211VARAPU_IGN_Bx
  - DS2211VARAPU_AUXCAP_Bx_C1 (if you use channel 7 of the DS2211VARAPU_INJ_Bx_G2).
  - DS2211VARAPU_AUXCAP_Bx_C2 (if you use channel 8 of the DS2211VARAPU_INJ_Bx_G2).
- This block cannot be used together with the blocks of the APU library, for example, DS2211APU_CRANK_Bx, DS2211APU_INJ_Bx_Gy.

I/O mapping

For information on the I/O mapping, refer to Injection Pulse Position and Fuel Amount Measurement (DS2211 Features 🕮).

I/O characteristics

The ports are named Cylinder x # y. X is the number of the selected cylinder and y the port number that corresponds to the appropriate injection input line.

The format of the Cylinder x # y block outputs depends on the capture mode.

- In all capture modes except for the absolute mode, the position values are given relative to the TDC in the range –1440 … 1440° with a resolution of 0.011°.
- In the absolute mode, the position values are absolute values relative to a defined starting point. The default starting point is the start of the angular processing unit. At run time, you can define a new starting point using the DS2211APU_ABS_CNT_RESET_Bx block. This block sets the time stamp counter and the engine-cycle counter to 0. The position values are measured with a resolution of 0.011°, the time stamps have a resolution of 250 ns.

The block outputs an array of Double data type.

In the *duration mode*, the output array is defined as follows:

Array Index[1), 2)]	Parameter	Number of Elements	Event Window
1 … NoP1	Leading edge	NoP1[1)]	1
NoP1 + 1 … 2 · NoP1	Duration	NoP1	1
2 · NoP1 + 1	Pulse count	1	1
2 · NoP1 + 2	Update state	1	1
2 · NoP1 + 3	Update counter	1	1
2 · NoP1 + 4 … 2 · NoP1 + 4 + NoP2	Leading edge	NoP2[2)]	2
2 · NoP1 + 4 + NoP2 +1 … 2 · NoP1 + 4 + 2 · NoP2	Duration	NoP2	2
2 · NoP1 + 4 + 2 · NoP2 + 1	Pulse count	1	2
2 · NoP1 + 4 + 2 · NoP2 + 2	Update state	1	2
2 · NoP1 + 4 + 2 · NoP2 + 3	Update counter	1	2

1) NoP1: Number of expected pulses within the event capture window 1
2) NoP2: Number of expected pulses within the event capture window 2

In the *position mode*, the output array is defined as follows:

Array Index[1), 2)]	Parameter	Number of Elements	Event Window
1 … NoP1	Leading edge	NoP1[1)]	1
NoP1 + 1 … 2 · NoP1	Trailing edge	NoP1	1
2 · NoP1 + 1	Pulse count	1	1
2 · NoP1 + 2	Update state	1	1
2 · NoP1 + 3	Update counter	1	1
2 · NoP1 + 4 … 2 · NoP1 + 4 + NoP2	Leading edge	NoP2[2)]	2
2 · NoP1 + 4 + NoP2 +1 … 2 · NoP1 + 4 + 2 · NoP2	Trailing edge	NoP2	2
2 · NoP1 + 4 + 2 · NoP2 + 1	Pulse count	1	2
2 · NoP1 + 4 + 2 · NoP2 + 2	Update state	1	2
2 · NoP1 + 4 + 2 · NoP2 + 3	Update counter	1	2

[1)] NoP1: Number of expected pulses within the event capture window 1
[2)] NoP2: Number of expected pulses within the event capture window 2

In the *position and duration mode* (starting from board revision 3 and FPGA revision 3), the output array is defined as follows:

Array Index[1), 2)]	Parameter	Number of Elements	Event Window
1 … NoP1	Leading edge	NoP1[1)]	1
NoP1 + 1 … 2 · NoP1	Trailing edge	NoP1	1
2 · NoP1 + 1 … 3 · NoP1	Duration	NoP1	1
3 · NoP1 + 1	Pulse count	1	1
3 · NoP1 + 2	Update state	1	1
3 · NoP1 + 3	Update counter	1	1
3 · NoP1 + 4 … 3 · NoP1 + 4 + NoP2	Leading edge	NoP2[2)]	2

Array Index[1), 2)]	Parameter	Number of Elements	Event Window
3 · NoP1 + 4 + NoP2 +1 … 3 · NoP1 + 4 + 2 · NoP2	Trailing edge	NoP2	2
3 · NoP1 + 4 + 2 · NoP2 +1 … 3 · NoP1 + 4 + 3 · NoP2	Duration	NoP2	2
3 · NoP1 + 4 + 3 · NoP2 + 1	Pulse count	1	2
3 · NoP1 + 4 + 3 · NoP2 + 2	Update state	1	2
3 · NoP1 + 4 + 3 · NoP2 + 3	Update counter	1	2

1) NoP1: Number of expected pulses within the event capture window 1
2) NoP2: Number of expected pulses within the event capture window 2

In the *absolute mode* (starting from board revision 3 and FPGA revision 3), the output array is defined as follows:

Array Index[1), 2)]	Parameter	Number of Elements	Event Window
1 … NoP1	Leading edge	NoP1[1)]	1
NoP1 + 1 … 2 · NoP1	Trailing edge	NoP1	1
2 · NoP1 + 1 … 3 · NoP1	Start timestamp	NoP1	1
3 · NoP1 + 1 … 4 · NoP1	End timestamp	NoP1	1
4 · NoP1 + 1	Pulse count	1	1
4 · NoP1 + 2	Update state	1	1
4 · NoP1 + 3	Update counter	1	1
4 · NoP1 + 4 … 4 · NoP1 + 4 + NoP2	Leading edge	NoP2[2)]	2
4 · NoP1 + 4 + NoP2 +1 … 4 · NoP1 + 4 + 2 · NoP2	Trailing edge	NoP2	2
4 · NoP1 + 4 + 2 · NoP2 + 1 … 4 · NoP1 + 4 + 3 · NoP2	Start timestamp	NoP1	1
4 · NoP1 + 4 + 3 · NoP2 + 1 …	End timestamp	NoP1	1

Array Index[1), 2)]	Parameter	Number of Elements	Event Window
4 · NoP1 + 4 + 4 · NoP2			
4 · NoP1 + 4 + 4 · NoP2 + 1	Pulse count	1	2
4 · NoP1 + 4 + 4 · NoP2 + 2	Update state	1	2
4 · NoP1 + 4 + 4 · NoP2 + 3	Update counter	1	2

1) NoP1: Number of expected pulses within the event capture window 1
2) NoP2: Number of expected pulses within the event capture window 2

The output array contains different parameters:

Leading edge The `leading edge` parameter contains the positions of up to 16 leading edges are given in degrees. The number of position values is defined by the number of expected pulses as specified on the Parameters page. The following rules apply to this parameter:

- If the number of measured leading edges is smaller than the number of expected pulses, the missing position values are set to the default value as specified on the Capture page.
- If the number of leading edges is smaller than the number of leading edges of the previous measurement, the output array keeps the old values at the superflous positions.
- If no leading edge was detected in the last event capture window the old values will remain.
- If the leading edge of the first pulse occurred before the event capture window the position value is set to the start position of the event capture window.
- Before the first leading edge after the start of the simulation was captured, the output is the default value as specified on the Capture page.

Duration The `duration` parameter contains up to 64 pulses within the last event capture window in seconds. The number of duration values is defined by the number of expected pulses as specified on the Parameters page. The following rules apply to this parameter:

- If the number of measured pulses is smaller than the number of expected pulses, the missing duration values will be set to the default value as specified on the Capture page.
- If the number of pulses is smaller than the number of pulses of the previous measurement, the output array keeps the old values at the superflous positions.
- If no pulse was detected in the last event capture window, the old duration values will remain.
- If the leading edge of the first pulse occurred before the event capture window, the duration measurement begins at the start position of the event capture window.
- If the trailing edge of the last pulse occurred after the event capture window, the duration measurement ends at the end position of the event capture window.

- Before the first duration value after the start of the simulation was captured, the output is the default value as specified on the Capture page.

Trailing edge The Trailing edge parameter contains the positions of trailing edges in degrees. The number of position values is defined by the number of expected pulses as specified on the Parameters page. The following rules apply to this parameter:

- If the number of measured trailing edges is smaller than the number of expected pulses, the missing position values are set to the default value as specified on the Capture page.
- If the number of trailing edges is smaller than the number of trailing edges of the previous measurement, the output array keeps the old values at the superflous positions.
- If no trailing edge was detected in the last event capture window, the old values will remain.
- If the trailing edge of the last pulse occurs after the event capture window, the position value is set to the end position of the event capture window.
- Before the first trailing edge after the start of the simulation was captured, the output is the default value as specified on the Capture page.

Start timestamp The Start timestamp parameter contains the absolute time stamps of up to 64 leading edges in seconds. The number of time stamps is defined by the number of expected pulses as specified on the Parameters page. The following rules apply to this parameter:

- If the number of measured leading edges is smaller than the number of expected pulses, the missing time stamps are set to the default value as specified on the Capture page.
- If the number of leading edges is smaller than the number of leading edges of the previous measurement, the output array keeps the old values of time stamps at the superflous positions.
- If no leading edge was detected in the last event capture window the old values will remain.
- If the leading edge of the first pulse occurred before the event capture window, the time stamp is set to the start position of the event capture window.
- Before the first leading edge after the start of the simulation was captured, the output is the default value as specified on the Capture page.

End timestamp The `end timestamp` parameter contains the absolute time stamps of trailing edges in seconds. The number of time stamps is defined by the number of expected pulses as specified on the Parameters page. The following rules apply to this parameter:

- If the number of measured trailing edges is smaller than the number of expected pulses, the missing time stamps are set to the default value as specified on the Capture page.
- If the number of leading edges is smaller than the number of leading edges of the previous measurement, the output array keeps the old values of time stamps at the superflous positions.
- If no trailing edge was detected in the last event capture window, the old values will remain.

- If the trailing edge of the last pulse occurs after the event capture window, the time stamp is set to the end position of the event capture window.
- Before the first trailing edge after the start of the simulation was captured, the output is the default value as specified on the Capture page.

Pulse count The `Pulse count` parameter specifies the number of actually captured pulses in the range 0, 1, … 256.

Update state The update state is defined as follows:

Value	Description
0	The update of data within the current event capture window is still running. The `update counter` parameter is still being updated. The `leading edge`, `duration`, `trailing edge`, `start timestamp`, and `end timestamp` parameters may contain a mix of old and new data.
1	Data in the current event capture window is no longer being updated. The `update counter` parameter is not being updated. The `leading edge`, `duration`, `trailing edge`, `start timestamp`, and `end timestamp` parameters contain only new data (Exception: In the current event capture window, no pulses occurred, or fewer pulses than in the previous event capture window).

The state is set to 0 when the first event of each event capture window occurs. The state is set to 1 when the number of expected pulses is reached or at the end of each event capture window (then the number of expected pulses was not reached within the event capture window). The state remains 1 until the first event of the following event capture window is captured. A value of 1 means that no data is currently updated, the block output data is complete for the last event capture window. After initialization the value is 0.

For details, refer to Multiple Event Capture Mode of the VAR APU Blockset (DS2211 Features 🕮).

Update counter The counter counts every occurring edge within the current event capture window until the number of expected pulses is reached. Additional edges are ignored. During counting, the counter alternates its sign to distinguish leading and trailing edges.

Sign	Description
Negative	A leading edge is detected. The count value is incremented.
Positive	A trailing edge is detected. The count value is not incremented.

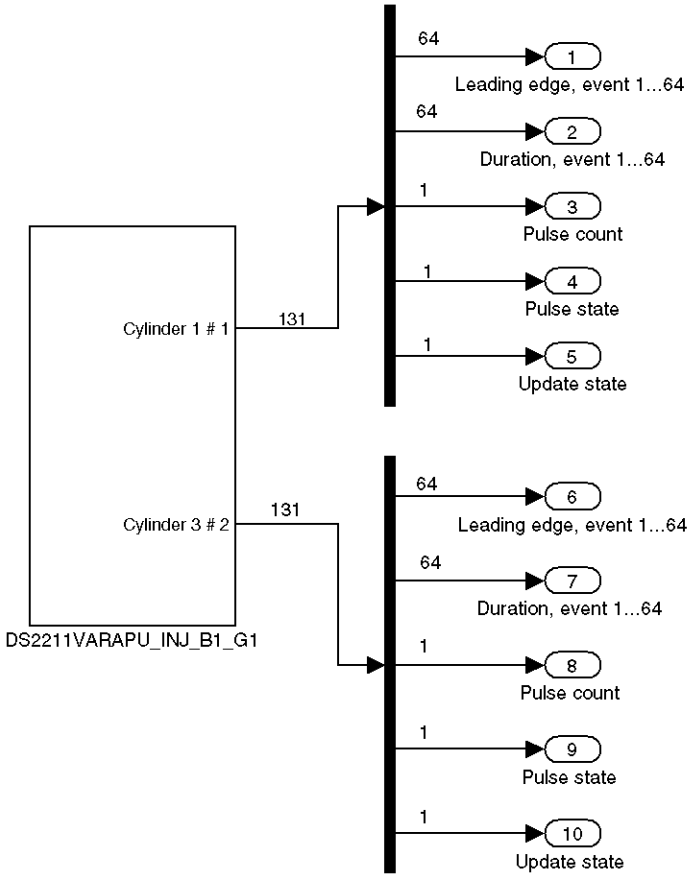
Dialog pages

The following pages are available:

- Unit Page for board selection
- Capture Page for capture mode setting
- Parameters Page for cylinder selection and definition of event capture windows

Example

The following illustration shows the relationship between the block outputs and the captured values for 64 pulses in the duration mode.



Related RTLib functions

`ds2211_multi_eventwin_set`, `ds2211_inj_capture_mode_setup`, `ds2211_multiwin_inj_cap_read`

Related topics

Basics

DS2211 Board Revision (DS2211 Features 🕮)

References

DS2211DIO_SETUP_Bx..... 25
DS2211VARAPU_CRANK_Bx..... 156

Unit Page (DS2211VARAPU_INJ_Bx_Gy)

Purpose

To specify the board number.

Dialog settings

Board number Lets you select the DS2211 board number of the board to be defined by this block in the range 1 … 16. This board may be the master board itself.

Group number Lets you select the group number. Group 1 can be used for injection capture on channels INJ1 … INJ6, INJ7 (PWM7), INJ8 (PWM8) and group 2 for injection capture on channels IGN1 … IGN6, AUXCAP1, AUXCAP2.

Related topics

References

DS2211VARAPU_INJ_Bx_Gy..... 175

Capture Page (DS2211VARAPU_INJ_Bx_Gy)

Purpose

To specify the trigger and capture mode.

Dialog settings

Capture mode Lets you select the capture mode. Up to 64 pulses can be measured in each event capture window. The selected capture mode determines the measurement values as shown in the following table.

Capture Mode	Measurement Values
Position	Positions of the leading and trailing edges (relative to the TDC)
Duration	Positions of the leading edges and the pulse durations (relative to the TDC, default capture mode)
Position and duration	Positions of the leading and trailing edges and the pulse durations (relative to the TDC)
Absolute	Absolute positions and absolute timestamps of the leading and trailing edges (relative to a user-defined starting point)

Note

The position and duration mode and the absolute mode can be used starting from board revision 3 and FPGA revision 3 (for details, refer to DS2211 Board Revision (DS2211 Features 🕮)).

For more detailed information, refer to I/O characteristics on page 177.

Trigger mode Lets you specify whether ignition pulses are active high (1) or active low (0). The trigger mode can be modified by a block parameter from within ControlDesk. Changes take effect only during Stop/Run or Stop/Pause transitions of the model.

Position default value Lets you specify the default value for missing position values in the range -999 … 999 deg. If the number of measured pulses is smaller than the number of expected pulses, the missing positions are set to this value.

Duration default value Lets you specify the default value for missing duration values in the range -999 … 999 s. If the number of measured pulses is smaller than the number of expected pulses, the missing durations are set to this value. In absolute capture mode this value is used as a default time stamp value. You can use negative values to differentiate between missing and invalid values.

Related topics

Basics

DS2211 Board Revision (DS2211 Features 🕮)

References

DS2211VARAPU_INJ_Bx_Gy 175

Parameters Page (DS2211VARAPU_INJ_Bx_Gy)

Purpose

To specify the number of cylinders and the event capture window to be used.

Dialog settings

Number of selected cylinders Lets you select the number of cylinders for which injection pulses will be captured in the range 1 … 8. This number can be smaller than the number of cylinders simulated by the specified DS2211 board.

Selected cylinders Lets you enter the cylinders for which injection pulses will be captured. The size of the array is specified by the number of selected cylinders (see above). The values of the array elements specify the cylinders which pulses are captured. The maximum number of cylinders is specified in the DS2211VARAPU_CRANK_Bx block.

The cylinder sequence in this field determines the I/O mapping of the injection input lines. The first cylinder is mapped to the I/O signal INJ1, the second one to

INJ2, and so on. For example, if you specify [8 12 10] then cylinder 8 is mapped to INJ1, cylinder 12 to INJ2, and cylinder 10 to INJ3.

Number of event windows Lets you select the number of event capture windows (1 or 2).

Number of expected pulses Lets you select the number of expected pulses within each event capture window in the range 1 … 64. This parameter defines the number of position values in the block's output. For more information, see the I/O characteristics on page 177.

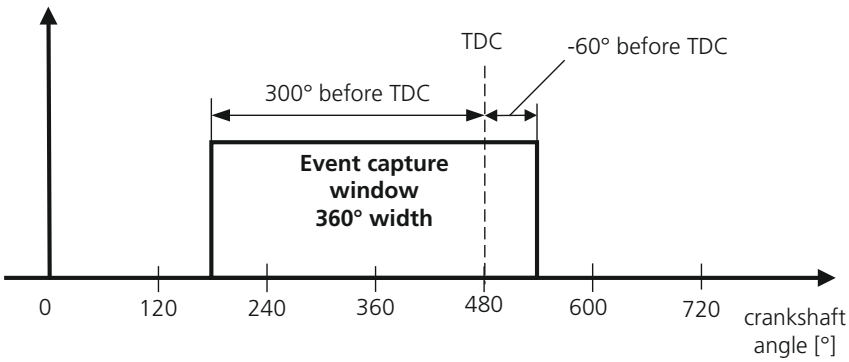
Start position Lets you enter the start positions of the event capture windows in the range –1440 … 1440° with a resolution of 0.011°. Note that the maximum size of the defined event capture window is 720° (719.82°). The values are assigned to the cylinders following the same sequence that you specified for the **Selected cylinders** parameter. The start positions are defined relative to the TDCs, which are specified on the **TDC** page of the **DS2211VARAPU_CRANK_Bx** block of the master board (see TDC Page (DS2211VARAPU_CRANK_Bx) on page 159).

The start positions can be modified by a block parameter from within ControlDesk. Changes take effect only during Stop/Run or Stop/Pause transitions of the model.

End position Lets you enter the end positions of the event capture windows in the range –1440 … 1440° with a resolution of 0.011°. Note that the maximum size of the defined event capture window is 720° (719.82°). The values are assigned to the cylinders following the same sequence that you specified for the **Selected cylinders** parameter. The end positions are defined relative to the TDCs, which are specified on the **TDC** page of the **DS2211VARAPU_CRANK_Bx** block of the master board (see TDC Page (DS2211VARAPU_CRANK_Bx) on page 159).

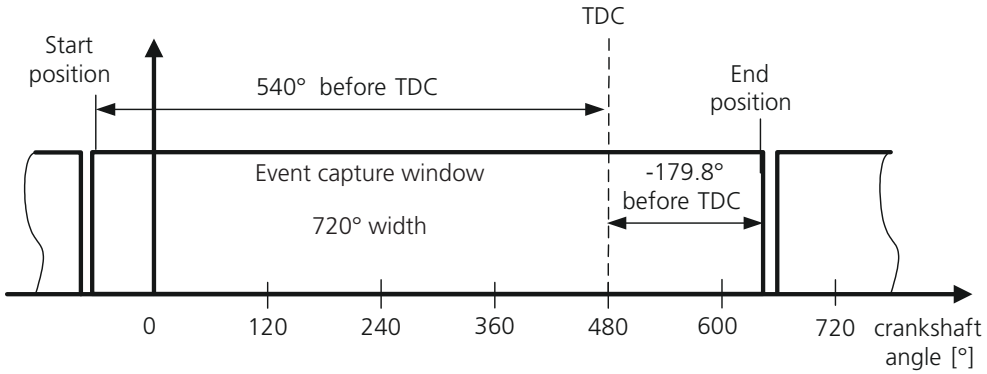
The end positions can be modified by a block parameter from within ControlDesk. Changes take effect only during Stop/Run or Stop/Pause transitions of the model.

Example Angles before TDC are positive values. The following illustration shows an event capture window (width 360°, Start position = +300°, End position = –60°):



Example The following illustration shows an event capture window with the maximum width of 719.8° (Start position = +540°, End position = –179.8°). Note

that the event capture window must not cover the whole engine cycle of 720° and that Start and End position have to be defined in the range –1440 … 1440°.



Related topics

References

DS2211VARAPU_CRANK_Bx 156
DS2211VARAPU_INJ_Bx_Gy 175

DS2211VARAPU_AUXCAP_Bx_Cy

Purpose

To read the positions of pulses that occurred in the last one or two event capture window of the specified auxiliary capture input.

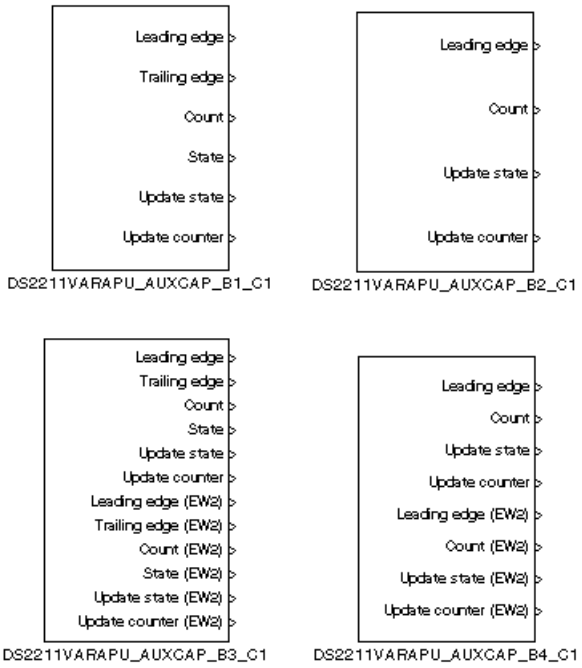
Where to go from here

Information in this section

Block Description (DS2211VARAPU_AUXCAP_Bx_Cy)

Illustration

The block's different representations depend on the selected capture mode and number of event capture windows.



Purpose

To read the positions of pulses that occurred in the last one or two event capture window of the specified auxiliary capture input.

Description

The block reads the position of pulses that occurred at one of the auxiliary capture lines within event capture windows. You can define one or two event capture windows. The block can operate in two modes:

Single event capture mode The block provides the position of the first leading edge within the defined event capture window. The block output ports are specified in I/O characteristics (single event capture mode).

Multiple event capture mode The block provides all (up to 64) positions of the pulses (leading and trailing edges) within the defined event capture windows. The block output ports are specified in I/O characteristics (multiple event capture mode).

Note

When using this block, you have to consider the following:

- The DS2211VARAPU_CRANK_Bx block must be in your model.
- Use DS2211DIO_SETUP_Bx to set the threshold level for digital inputs. If you do not include this block in your model, the default threshold level of 2.5 V is valid.
- This block supports the simulation of engine variants. You can specify other engine parameters without generating the code again. For details, refer to Angular Processing Unit - Variant (DS2211 Features 🕮).
- You cannot use this block together with the following blocks
  - DS2211VARAPU_IGN_Bx (if you use channel 7 or 8)
  - DS2211VARAPU_INJ_Bx_G2 (if you use channel 7 or 8)
- This block cannot be used together with the blocks of the APU library, for example, DS2211APU_CRANK_Bx, DS2211APU_AUXCAP_Bx_Cy.

I/O mapping

For information on the I/O mapping, refer to Spark Event Capture (DS2211 Features 🕮).

I/O characteristics (single event capture mode)

In single event capture mode the block has the following output ports for each event capture window.

Output Port[1)]	Simulink Output	Data Type
Leading edge	0 … 719.91°	Double
Count	0, 1	UInt8
Update state	0, 1	UInt8
Update counter	-64 … 64	Int8

1) To identify the output ports for event capture window 2, the string "(EW2)" is added to their names.

Leading edge The Leading edge port provides the position of the first leading edge:

- The position is given in degrees.
- If no leading edge was detected in the last event capture window the old value will remain.
- Before the first leading edge after the start of the simulation was captured, the output is set to the default value as specified on the Capture page.

Count The count port is defined as follows:

Count	Meaning
0	No pulse captured within the last event capture window.
1	At least one pulse captured within the last event capture window.

Update state The update state is defined as follows:

Value	Description
0	The update of data within current event capture window is still running. The `update counter` parameter is still updated. The `leading edge` and `trailing edge` parameters may contain a mix of old and new data.
1	Data within current event capture window is not updated any longer. The `update counter` parameter is not updated. The `leading edge` and `trailing edge` parameters contain only new data (Exception: In the current event capture window no or less pulses occurred referred to the previous event capture window).

The state is set to 0 when the first event of each event capture window occurs. The state is set to 1 when the number of expected pulses is reached or at the end of each event capture window (then the number of expected pulses was not reached within the event capture window). After initialization the value is 0.

Update counter The counter counts every occurring edge within the current event capture window until the number of expected pulses is reached. Additional edges are ignored. During counting, the counter alternates its sign to distinguish leading and trailing edges.

Sign	Description
Negative	A leading edge is detected, the count value is incremented.
Positive	A trailing edge is detected, the count value is not incremented.

I/O characteristics (multiple event capture mode)

In multiple event capture mode the block has the following output ports for each event capture window.

Output Port[1)]	Simulink Output	Data Type
Leading edge	0 … 719.91°	Double
Trailing edge	0 … 719.91°	Double
Count	0 … 255	UInt8
State	0 … 3	UInt8

Output Port[1)]	Simulink Output	Data Type
Update state	0, 1	UInt8
Update counter	-64 … 64	Int8

1) To identify the output ports for event capture window 2, the string "(EW2)" is added to their names.

Leading edge The Leading edge port provides up to 64 positions of the leading edges:

- The positions are given in degrees.
- The number of position values is defined by the number of expected pulses as specified on the Event Window page.
- If the number of measured leading edges is smaller than the number of expected pulses, the missing position values are set to the default value as specified on the Capture page.
- If the number of leading edges is smaller than the number of leading edges of the previous measurement, the output array keeps the old values at the superflous positions.
- If no pulse was detected in the last event capture window, the old values will remain.
- If the leading edge of the first pulse occurred before the event capture window, the position value is set to the start position of the event capture window.
- Before the first leading edge after the start of the simulation was captured, the output is set to the default value as specified on the Capture page.

Trailing edge The Trailing edge port provides up to 64 position of the trailing edges:

- The positions are given in degrees.
- The number of position values is defined by the number of expected pulses as specified on the Event Window page.
- If the number of measured trailing edges is smaller than the number of expected pulses, the missing position values are set to the default value as specified on the Capture page.
- If the number of trailing edges is smaller than the number of trailing edges of the previous measurement, the output array keeps the old values at the superflous positions.
- If no pulse was detected in the last event capture window, the old values will remain.
- If the trailing edge of the last pulse occurs after the event capture window, the position value is set to the end position of the event capture window.
- Before the first trailing edge after the start of the simulation was captured, the output is set to the default value as specified on the Capture page.

Count The Count port provides the number of actually captured pulses in the range 0 … 255.

State The State is defined as follows:

State	Meaning
0	All pulses occurred within the event capture window.
1	The leading edge of the first pulse occurred before the event capture window.
2	The trailing edge of the last pulse occurred after the event capture window.
3	The leading edge of the first pulse occurred before the event capture window, and the trailing edge of the last pulse occurred after the event capture window.

Update state The update state is defined as follows:

Value	Description
0	The update of data within current event capture window is still running. The `update counter` parameter is still updated. The `leading edge` and `trailing edge` parameters may contain a mix of old and new data.
1	Data within current event capture window is not updated any longer. The `update counter` parameter is not updated. The `leading edge` and `trailing edge` parameters contain only new data (Exception: In the current event capture window no or less pulses occurred referred to the previous event capture window).

The state is set to 0 when the first event of each event capture window occurs. The state is set to 1 when the number of expected pulses is reached or at the end of each event capture window (then the number of expected pulses was not reached within the event capture window). After initialization the value is 0.

Update counter The counter counts every occurring edge within the current event capture window until the number of expected pulses is reached. Additional edges are ignored. During counting, the counter alternates its sign to distinguish leading and trailing edges.

Sign	Description
Negative	A leading edge is detected. The count value is incremented.
Positive	A trailing edge is detected. The count value is not incremented.

Dialog pages

The following pages are available:

- Unit Page for board and channel selection
- Capture Page for capture mode setting
- Event Window Page to define the event capture window

Related RTLib functions	`ds2211_multi_eventwin_set`, `ds2211_aux1_capture_mode_setup`, `ds2211_aux2_capture_mode_setup`, `ds2211_multiwin_ign_cap_read`
Related topics	References Spark Event Capture (DS2211 Features 🕮)

Unit Page (DS2211VARAPU_AUXCAP_Bx_Cy)

Purpose	To specify the board and channel number.
Dialog settings	**Board number** Lets you select the DS2211 board number of the board to be defined by this block in the range 1 … 16. This board may be the master board itself. **Channel number** Lets you select the auxiliary capture input to be defined by this block (1 or 2).
Related topics	References DS2211VARAPU_AUXCAP_Bx_Cy..... 188

Capture Page (DS2211VARAPU_AUXCAP_Bx_Cy)

Purpose	To specify the trigger and capture mode.
Dialog settings	**Capture mode** Lets you select the capture mode. In single event capture mode, the position of the leading edge of the first input pulse within the event capture window is captured (see I/O characteristics (single event capture mode) on page 190). In multiple event capture mode, the positions of all leading and

trailing edges of up to 64 pulses are captured (see I/O characteristics (multiple event capture mode) on page 191).

Trigger mode Lets you specify whether ignition pulses are active high (1) or active low (0). The trigger mode can be modified by a block parameter from within ControlDesk. Changes take effect only during Stop/Run or Stop/Pause transitions of the model.

Position default value Lets you specify the default value for missing position values in the range -999 … 999 deg. If the number of measured pulses is smaller than the number of expected pulses, the missing positions are set to this value.

Related topics

References

DS2211VARAPU_AUXCAP_Bx_Cy..... 188

Event Window Page (DS2211VARAPU_AUXCAP_Bx_Cy)

Purpose

To specify the event capture windows.

Dialog settings

Number of event windows Lets you select the number of event capture windows (1 or 2).

The following parameters must be specified for each event window.

Number of expected sparks Lets you select the number of expected pulses within an event capture window (available only if multiple event capture mode is selected). This parameter defines the number of position values in the block's output. You cannot differentiate between the cylinders, the same number is valid for each of them. For more information, see the I/O characteristics (multiple event capture mode) on page 191.

Start position Lets you enter the start position of the event capture window in the range 0 … <720° (719.82°) with a resolution of 0.011°. The value is not relative to the TDC.

The start positions can be modified by a block parameter from within ControlDesk. Changes take effect only during Stop/Run or Stop/Pause transitions of the model.

End position Lets you enter the end position of the event capture window in the range 0 … <720° (719.82°) with a resolution of 0.011°. The value is not relative to the TDC.

The end positions can be modified by a block parameter from within ControlDesk. Changes take effect only during Stop/Run or Stop/Pause transitions of the model.

Related topics

References

DS2211VARAPU_AUXCAP_Bx_Cy..... 188

DS2211VARSL_KNSG_Bx_Cy

Purpose

To generate knock signals.

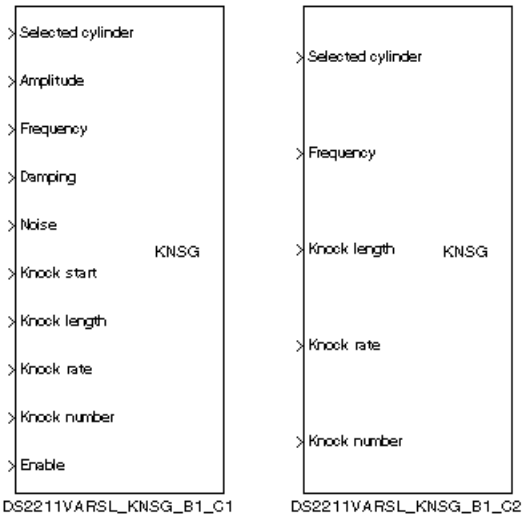
Where to go from here

Information in this section

Block Description (DS2211VARSL_KNSG_Bx_Cy)

Illustration

The block's different representations depend on how you configure the tunable parameters of the block.



Purpose

To generate knock signals.

Description

This block generates knock sensor signals at certain engine positions. For details on knock sensor simulation, refer to Knock Sensor Simulation (DS2211 Features 🕮).

To simulate different engine variant, the **Selected cylinder** parameter can be changed during run time.

The block considers changes to the TDC positions during run time. For example, if it is configured to generate knock signals for the cylinder 1 and the TDC position of this cylinder has been changed via the **DS2211VARAPU_CRANK_Bx** block, the knock signal position corresponds to the modified TDC position.

The number of cylinders is not tunable. If you change the number of cylinders in the model, you have to enable the added cylinders or disable the redundant cylinders via the **Enable cylinder** parameter.

I/O mapping

For information on the I/O mapping, refer to Knock Sensor Simulation (DS2211 Features 🕮).

Note

- The **DS2211VARAPU_CRANK_Bx** block must be in your model.
- This block supports the simulation of engine variants. You can specify other engine parameters without generating the code again. For details, refer to Angular Processing Unit - Variant (DS2211 Features 🕮).
- This block cannot be used together with the blocks of the APU library, for example, **DS2211APU_CRANK_Bx**, **DS2211SL_KNSG_Bx_Cy**.
- The block uses tunable parameters. These parameters can be updated *either* by their block input *or* by block parameters that are accessible by experiment software, for example, ControlDesk. The different representations of the block depend on your selection. Tunable parameters that are defined as block parameters will be removed from the RTI block layout. For detailed information, refer to Model Parameter Configuration Dialog (RTI and RTI-MP Implementation Reference 🕮).

I/O characteristics

The cylinder sequence as defined by the **Selected cylinders** parameter on the **Parameters** page determines the cylinder sequence and the length of the arrays used by the following block input parameters, except for the *Noise* parameter.

- The *Selected cylinder* input is available if **by input port** is selected for the **Set cylinders** parameter. The values in the array of cylinder numbers must be given in the range 1 … 18.
- The *Amplitude* input is available if **by input port** is selected for the **Set amplitude** parameter. The values in the array of amplitudes must be in the range 0 … 40 V_{PP}.
- The *Frequency* input is available if **by input port** is selected for the **Set frequency** parameter. The values in the array of frequencies must be in the range 0 … 12000 Hz.

- The *Damping* input is available if **by input port** is selected for the **Set damping** parameter. The values in the array of damping factors must be in the range 0 … 1.
- The *Noise* input is available if **by input port** is selected for the **Set noise** parameter. The noise amplitude must be in the range 0 … 40 V_{PP}. The noise is common for all cylinders.
- The *Knock start* input is available if **by input port** is selected for the **Set angle position of knock pulse before TDC** parameter. The values in the array of angle positions must be in the range –90 … 90° relative to TDC with a resolution of 0.011°.
- The *Knock length* input is available if **by input port** is selected for the **Set length of knock pulse** parameter. The values in the array of angle positions must be in the range 0 … 359° with a resolution of 0.011°.
- The *Knock rate* input is available if **by input port** is selected for the **Set knock rate** parameter. The values in the array of knock rates must be in the range 0 … 2^{31}–1.
- The *Knock number* input is available if **by input port** is selected for the **Set number of knocks** parameter. The values in the array of numbers must be in the range 0 … 2^{31}–1.
- The *Enable* input is available if **by input port** is selected for the **Enable cylinder** parameter. The values in the array are defined as follows.

Simulink Input	Purpose
0	To disable knock signal generation for a cylinder.
1	To enable knock signal generation for a cylinder.

- The following table shows the characteristics of the block inputs:

Variable	Characteristic	Value
Selected cylinder	Data type Range	UInt32 1 … 18
Amplitude	Data type Range	Double 0 … 40 V_{PP}
Frequency	Data type Range	Double 0 … 12000 Hz
Damping	Data type Range	Double 0 … 1
Noise	Data type Range	Double 0 … 40 V_{PP}
Knock start	Data type Range	Double –90 … 90°
Knock length	Data type Range	Double 0 … 359°

Variable	Characteristic	Value
Knock rate	Data type	Int32
	Range	0 … 2^{31}–1
Knock number	Data type	Int32
	Range	0 … 2^{31}–1
Enable cylinder	Data type	Boolean
	Range	0, 1

Dialog pages

The following pages are available:

- **Unit Page** (refer to Unit Page (DS2211VARSL_KNSG_Bx_Cy) on page 200) for board and channel selection
- **Parameters Page** (refer to Parameters Page (DS2211VARSL_KNSG_Bx_Cy) on page 201) to define the cylinders and knock signal
- **Knock Control Page** (refer to Knock Control Page (DS2211VARSL_KNSG_Bx_Cy) on page 202) to define the knock signal

Related RTLib functions

`ds2211_slave_dsp_signal_enable`, `ds2211_slave_dsp_channel_enable`, `ds2211_slave_dsp_knock_init`, `ds2211_slave_dsp_knock_update`, `ds2211_slave_dsp_knock_noise`, `ds2211_int_position_set`

Related topics

References

DS2211VARAPU_CRANK_Bx 156

Unit Page (DS2211VARSL_KNSG_Bx_Cy)

Purpose

To specify the board number, channel number and the sample time.

Dialog settings

Board number Lets you select the DS2211 board number of the board to be defined by this block in the range 1 … 16. This board may be the master board itself.

Channel number Lets you select the output channel to be defined by this block in the range 1 … 4.

Sample time Lets you enter the sample time for this DS2211VARSL_KNSG_Bx_Cy block in seconds. Enter –1 to keep the model's

base sample time (inherited). The sample time determines how often the block's functions are executed. Use this parameter to minimize the execution time.

Related topics

References

DS2211VARSL_KNSG_Bx_Cy..... 197

Parameters Page (DS2211VARSL_KNSG_Bx_Cy)

Purpose

To specify the number of cylinders and the signal parameters.

Dialog settings

In the dialog you can specify the parameters for knock signal generation. For details on the parameters, refer to Knock Sensor Simulation (DS2211 Features 🕮).

Number of selected cylinders Lets you select the number of cylinders in the range 1 … 8 for which knock signals will be generated.

Set cylinders This is a tunable parameter. Either select the radio button **by input port** to set the cylinder numbers by the block input port "Selected cylinder" or select **by block parameter** and enter the initial cylinder numbers. The cylinder numbers specifies for which cylinders knock signals are generated, for example: [1 3 5]. The size of the array is specified by the number of selected cylinders (see above). The values of the array elements specify the cylinders for which knock signals are generated. The maximum number of cylinders is specified in the **DS2211VARAPU_CRANK_Bx** block.

Note

The cylinder sequence within this array determines the cylinder sequence within the other parameter arrays.

Set amplitude This is a tunable parameter. Either select the radio button **by input port** to set the amplitudes for the selected cylinders by the block input port "Amplitude" or select **by block parameter** and enter the initial amplitude values for the selected cylinders in the range 0 … 40 V_{PP}.

Set frequency This is a tunable parameter. Either select the radio button **by input port** to set the frequencies for the selected cylinders by the block input port "Frequency" or select **by block parameter** and enter the initial frequency values for the selected cylinders in the range 0 … 12000 Hz.

Set noise This is a tunable parameter. Either select the radio button **by input port** to set the noise by the block input port "Noise" or select **by block**

parameter and enter the initial noise value in the range 0 … 40 V_{pp}. The noise signal is common for all cylinders.

Set damping coefficient This is a tunable parameter. Either select the radio button **by input port** to set the damping coefficients for the selected cylinders by the block input port "Damping" or select **by block parameter** and enter the initial damping coefficient values for the selected cylinders in the range 0 … 1.

Related topics

References

DS2211VARAPU_CRANK_Bx 156
DS2211VARSL_KNSG_Bx_Cy 197

Knock Control Page (DS2211VARSL_KNSG_Bx_Cy)

Purpose

To specify the cylinders and the knock pulse parameters.

Dialog settings

In the dialog you can specify the parameters for knock signal generation. For details on the parameters, refer to Knock Sensor Simulation (DS2211 Features 🕮).

Selected cylinders Displays the sequence of selected cylinder numbers as specified on the **Parameters Page (DS2211VARSL_KNSG_Bx_Cy)**.

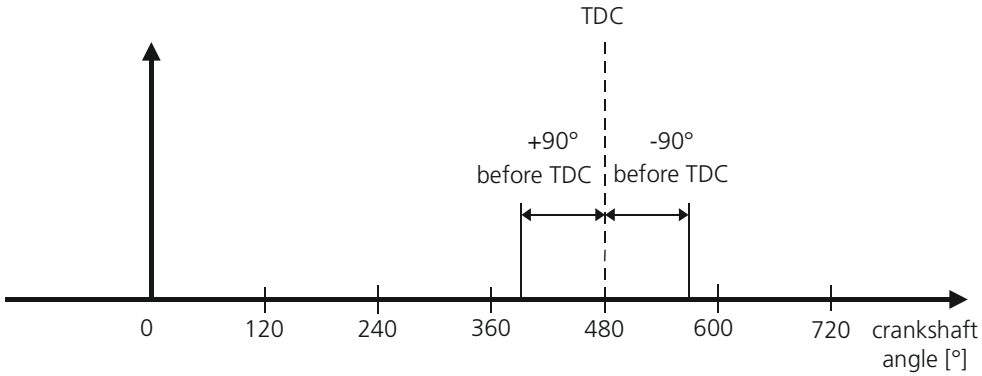
Note

The cylinder sequence within this array determines the cylinder sequence within the other parameter arrays.

Set angle position of knock pulse before TDC This is a tunable parameter. Either select the radio button **by input port** to set the angle positions for the selected cylinders by the block input port "Knock start" or select **by block parameter** and enter the initial angle position values for the selected cylinders in the range –90 … 90° relative to TDC with a resolution of 0.011°.

Before TDC

Angles before TDC are positive values. The following illustration shows the allowed range relative to a TDC of 480°:



Set length of knock pulse This is a tunable parameter. Either select the radio button **by input port** to set the knock pulse lengths for the selected cylinders by the block input port "Knock length" or select **by block parameter** and enter the initial knock length values for the selected cylinders in the range 0 … 359° with a resolution of 0.011°.

Enable cylinder This is a tunable parameter. Either select the radio button **by input port** to enable knock signal generation for the selected cylinders by the block input port "Enable cylinder" or mark the checkboxes in the **by block parameter** frame to enable knock signal generation for the selected cylinders. To disable knock signal generation for a selected cylinder do not mark the checkbox.

Set knock rate This is a tunable parameter. Either select the radio button **by input port** to set the knock rates for the selected cylinders by the block input port "Knock rate" or select **by block parameter** and enter the initial knock rate values for the selected cylinders in the range 0 … 2^{32}.

Note

The product of (knock rate · number of knocks) must not exceed 2^{32}–1.

Set number of knocks This is a tunable parameter. Either select the radio button **by input port** to set the number of knocks for the selected cylinders by the block input port "Knock number" or select **by block parameter** and enter the initial numbers of knocks for the selected cylinders in the range 0 … 2^{32}.

Related topics

References

DS2211VARSL_KNSG_Bx_Cy..... 197
Parameters Page (DS2211VARSL_KNSG_Bx_Cy)..... 201

Serial Interface

Where to go from here

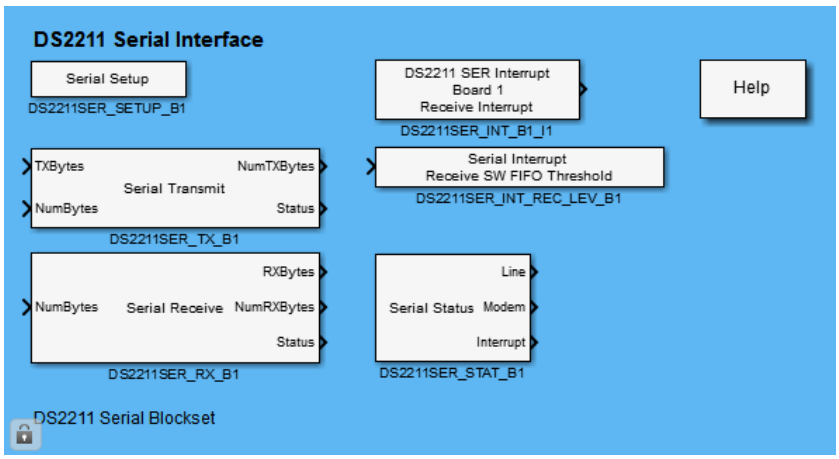
Information in this section

General Information on the Serial Interface

Overview of the Serial Interface

Introduction

After you double-click the SERIAL button in the Library: rti2211lib window, the Library: rti2211serlib is displayed.



The Serial Interface blocks can be used to implement serial communication.

Basic principles

Refer to Serial Interface (DS2211 Features 🕮).

Note

Although the serial blocks of different boards are almost the same, you must always use the board-specific serial blocks.

Library components

The library contains the following RTI blocks:

- DS2211SER_SETUP_Bx on page 208
- DS2211SER_STAT_Bx on page 213
- DS2211SER_TX_Bx on page 217
- DS2211SER_RX_Bx on page 221

- DS2211SER_INT_Bx_Iy on page 225
- DS2211SER_INT_REC_LEV_Bx on page 228

Related topics

Basics

Serial Interface (DS2211 Features 🕮)

DS2211SER_SETUP_Bx

Where to go from here

Information in this section

Block Description (DS2211SER_SETUP_Bx)

Block

Purpose

To set the global parameters for the serial interface.

Note

- This block has to be placed in the model if any of the other serial blocks is used for the corresponding board.
- This block must not be used more than once per channel.
- If several DS2211 boards are connected to different PHS buses of a multiprocessor system, identical board numbers are assigned to these boards. For the moment, RTI-MP does not allow you to configure a multiprocessor system using identical board numbers on different processors. If you encounter this problem, contact dSPACE support.

I/O mapping

For information on the I/O mapping, refer to Serial Interface (DS2211 Features 🕮).

Dialog pages

The dialog settings can be specified on the following pages:

- **Unit Page** (refer to Unit Page (DS2211SER_SETUP_Bx) on page 209)
- **UART Page** (refer to UART Page (DS2211SER_SETUP_Bx) on page 210)
- **FIFO Page** (refer to FIFO Page (DS2211SER_SETUP_Bx) on page 211)
- **Advanced Page** (refer to Advanced Page (DS2211SER_SETUP_Bx) on page 212)

Related RTLib functions

This RTI block is implemented using the following RTLib functions:

- dsser_init
- dsser_config
- dsser_set

Related topics

References

Advanced Page (DS2211SER_SETUP_Bx)..... 212
dsser_config (DS2211 RTLib Reference 🕮)
dsser_init (DS2211 RTLib Reference 🕮)
dsser_set (DS2211 RTLib Reference 🕮)
FIFO Page (DS2211SER_SETUP_Bx)..... 211
UART Page (DS2211SER_SETUP_Bx)..... 210
Unit Page (DS2211SER_SETUP_Bx)..... 209

Unit Page (DS2211SER_SETUP_Bx)

Purpose

To select the board number and channel number.

Dialog settings

Board number Lets you choose the board number in the range 1 … 16.

Related topics

References

Advanced Page (DS2211SER_SETUP_Bx)..... 212
Block Description (DS2211SER_SETUP_Bx)..... 208
FIFO Page (DS2211SER_SETUP_Bx)..... 211
UART Page (DS2211SER_SETUP_Bx)..... 210

UART Page (DS2211SER_SETUP_Bx)

Purpose

To specify the UART parameters.

Dialog settings

Transceiver Lets you select the transceiver mode:

Transceiver Mode	Meaning
RS232	RS232 mode
RS422	RS422 mode

Baud rate Lets you specify the baud rate in bits per second.

Mode	Baud Rate Range
RS232	300 … 115,200 baud
RS422	300 … 1,000,000 baud

For further information, refer to Specifying the Baud Rate of the Serial Interface (DS2211 Features 🕮).

Data bits Lets you choose the number of data bits. The valid values are: 5, 6, 7, 8.

Stop bits Lets you choose the number of stop bits. The valid values are: 1, 1.5 or 2. If you select 1.5 or 2, the number of stop bits depends on the number of specified data bits: For 5 data bits there are 1.5 stop bits; for 6, 7 and 8 data bits there are 2 stop bits.

Parity Lets you choose the parity mode:

Parity Mode	Meaning
No	No parity bits
Odd	Parity bit is set so that there is an odd number of "1" bits in the byte, including the parity bit
Even	Parity bit is set so that there is an even number of "1" bits in the byte, including the parity bit
Forced parity one	Parity bit is forced to a logical 1

Copy data to RX SW FIFO after reception of <value> byte(s) at latest Lets you choose the UART threshold at which data is copied from the UART to the receive buffer. Values are: 1, 4, 8, 14.

Note

Use the highest UART threshold possible to generate fewer interrupts, i.e., to decrease the UART's workload.

Related topics

References

Advanced Page (DS2211SER_SETUP_Bx) 212
Block Description (DS2211SER_SETUP_Bx) 208
FIFO Page (DS2211SER_SETUP_Bx) 211
Unit Page (DS2211SER_SETUP_Bx) 209

FIFO Page (DS2211SER_SETUP_Bx)

Purpose

To specify the software FIFO buffer.

Dialog settings

SW FIFO size Lets you specify the size of the software buffer. The size must be a power of two (2^n) and at least 64 bytes great. The maximum size depends on the available memory.

Overwrite mode Lets you choose the behavior of the receive buffer when an overrun occurs:

Overwrite Mode	Meaning
Discard new data	If the receive buffer is full, the new data is discarded.
Replace old data with FIFO method	If the receive buffer is full, the new data replaces the oldest data in the buffer. The number of bytes that are replaced is defined by Block size.

Block size Lets you specify the number of bytes that are deleted in RX SW FIFO overrun (see table above). Use this parameter to set up the appropriate data consistency for your model. Value range: 1 … (`SW FIFO size`-1)

Related topics

References

Advanced Page (DS2211SER_SETUP_Bx) 212
Block Description (DS2211SER_SETUP_Bx) 208
UART Page (DS2211SER_SETUP_Bx) 210
Unit Page (DS2211SER_SETUP_Bx) 209

Advanced Page (DS2211SER_SETUP_Bx)

Purpose

To specify the behavior on model termination.

Dialog settings

Disable UART on termination Lets you choose the UART behavior on model termination. If the UART is disabled, data is neither transmitted nor received. No interrupts are generated in this case.

Related topics

References

Block Description (DS2211SER_SETUP_Bx)..... 208
FIFO Page (DS2211SER_SETUP_Bx)..... 211
UART Page (DS2211SER_SETUP_Bx)..... 210
Unit Page (DS2211SER_SETUP_Bx)..... 209

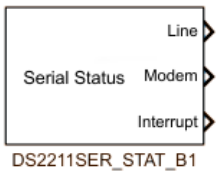
DS2211SER_STAT_Bx

Where to go from here

Information in this section

Block Description (DS2211SER_STAT_Bx)

Block



Purpose

To read the contents of the UART status register.

Note

This block can only be used in interrupt-driven subsystems (see DS2211SER_INT_Bx_Iy on page 225).

- The Line status delivers correct results only if the block resides in a subsystem driven by the Line status interrupt.
- The Modem status delivers correct results only if the block resides in a subsystem driven by the Modem status interrupt.
- The Interrupt status is non-functional at the moment.

Description

The block reads the line, modem and interrupt statuses and writes the values to the outports. If you do not want to evaluate a status register, you can disable its outport with the block dialog.

I/O mapping

For information on the I/O mapping, refer to Serial Interface (DS2211 Features 🕮).

I/O characteristics

The outports show the values of the UART's register.

- The **Line** port outputs the 8 bits of the line status register. The following table shows the meanings of the individual bits:

Index	Meaning
1	Data ready (DR) indicator
2	Overrun error (OE) indicator
3	Parity error (PE) indicator
4	Framing error (FE) indicator
5	Break interrupt (BI) indicator
6	Transmitter holding register empty (THRE) indicator
7	Transmitter empty (TEMT) indicator
8	Error in receiver FIFO

- The **Modem** port outputs the 8 bits of the modem status register. The following table shows the meanings of the individual bits:

Index	Meaning
1	Clear-to-send (CTS) changed state
2	Data-set-ready (DSR) changed state
3	Ring-indicator (RI) changed state
4	Data-carrier-detect (DCD) changed state
5	Complement of CTS
6	Complement of DSR
7	Complement of RI
8	Complement of DCD

- The **Interrupt** port outputs the 8 bits of the interrupt status register. The following table shows the meanings of the individual bits:

Index	Meaning
1	Interrupt status: 0 if interrupt pending
2	Interrupt ID bit 1
3	Interrupt ID bit 2
4	Interrupt ID bit 3
5	Not relevant
6	Not relevant
7	FIFOs enabled (bit 0)
8	FIFOs enabled (bit 1)

- The following table shows the characteristics of the block outputs:

Port	Characteristics	Value
Line	Datatype	Boolean
	Range	0, 1
	Size	8
Modem	Datatype	Boolean
	Range	0, 1
	Size	8
Interrupt	Datatype	Boolean
	Range	0, 1
	Size	8

Dialog pages

The dialog settings can be specified on the following pages:

- **Unit Page** (refer to Unit Page (DS2211SER_STAT_Bx) on page 215)
- **Status Page** (refer to Status Page (DS2211SER_STAT_Bx) on page 216)

Related RTLib functions

This RTI block is implemented using the following RTLib function:

- dsser_status_read

Related topics

References

dsser_status_read (DS2211 RTLib Reference 🕮)
Status Page (DS2211SER_STAT_Bx)..... 216
Unit Page (DS2211SER_STAT_Bx)..... 215

Unit Page (DS2211SER_STAT_Bx)

Purpose

To specify the board number used for reading the status.

Dialog settings

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

Related topics

References

Block Description (DS2211SER_STAT_Bx)..... 213

Status Page (DS2211SER_STAT_Bx)

Purpose

To enable the status registers to be read.

Dialog settings

Enable Line status port Lets you enable the line status output of the UART.

Enable Modem status port Lets you enable the modem status output of the UART.

Enable Interrupt status port Lets you enable the interrupt status output of the UART.

Related topics

References

Block Description (DS2211SER_STAT_Bx)..... 213
Unit Page (DS2211SER_STAT_Bx)..... 215

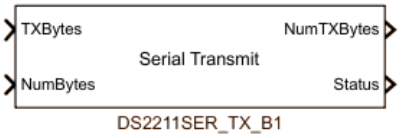
DS2211SER_TX_Bx

Where to go from here

Information in this section

Block Description (DS2211SER_TX_Bx)

Block



Purpose

To send data via the serial interface.

Description

The block sends the bytes of the TXBytes input via the serial interface during one sample step. The number of bytes to be sent can be either fixed or variable. If the number of bytes to be sent is fixed, you have to specify it with a block parameter. If the number of bytes to be sent is variable, you can specify it with either a block parameter or an inport. The status and the number of bytes that were sent are returned via outports.

You can disable the NumBytes input, NumTXBytes output and Status output with the block dialog.

I/O mapping

For information on the I/O mapping, refer to Serial Interface (DS2211 Features 🕮).

I/O characteristics

- The TXBytes input must be the stream of bytes to be written to the software buffer within one sample step.

- The **NumBytes** input must be the number of bytes to be sent within one sample step. The value must be less than or equal to the **Maximum number of bytes** block parameter. If it is less, only the specified number of bytes is sent.
- The **NumTXBytes** port outputs the number of bytes that could be written to the software buffer within the current sample step. You can use this output value and the **NumTXBytes** input to verify whether all the data could be sent.
- The **Status** port outputs the status of writing data to the software buffer within the current sample step. One of the following values is returned:

Return Value	Meaning
0	No error
202	The FIFO is filled or not all data could be copied to the FIFO

- The following table shows the characteristics of the block inputs and outputs:

Port	Characteristics	Value
TXBytes	Datatype	UInt8
	Range	0 … 255
	Size	1 … (SW FIFO size - 1)
NumBytes	Datatype	UInt32
	Range	1 … (SW FIFO size - 1)
NumTXBytes	Datatype	UInt32
	Range	1 … (SW FIFO size - 1)
Status	Datatype	Int32
	Range	int32

SW FIFO size is a block parameter. For further information, refer to DS2211SER_SETUP_Bx on page 208.

Dialog pages

The dialog settings can be specified on the following pages:

- **Unit Page** (refer to Unit Page (DS2211SER_TX_Bx) on page 219)
- **Tx Parameters Page** (refer to TX Parameters Page (DS2211SER_TX_Bx) on page 219)
- **Advanced Page** (refer to Advanced Page (DS2211SER_TX_Bx) on page 220)

Related RTLib functions

This RTI block is implemented using the following RTLib function:

- dsser_transmit

Related topics

References

Unit Page (DS2211SER_TX_Bx)

Purpose

To specify the board number used for sending data.

Dialog settings

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

Related topics

References

TX Parameters Page (DS2211SER_TX_Bx)

Purpose

To specify the transmitting parameters.

Dialog settings

Transmission SW FIFO mode Lets you specify how to react if there is not enough free space in the transmit buffer:

Data Handling	Meaning
Discard all new data	All data in the sample step is discarded. Data consistency is ensured but you have to repeat the complete data from this sample step.
Write as much data as possible	The transmit buffer is filled until it is full. You only have to repeat bytes which did not fit into the transmit buffer.

Parameter flexibility Lets you specify whether the number of bytes to be sent is fixed (non-tunable) or variable (tunable).

Number of bytes Lets you specify the number of bytes to be sent within one sample step.

Maximum number of bytes Lets you specify the maximum number of bytes that can be sent within one sample step. The valid value range is: 1 … (SW FIFO size-1) (SW FIFO size is a block parameter, see DS2211SER_SETUP_Bx on page 208).

Specify the number of bytes Lets you specify whether to set the number of bytes to be sent within one sample step via the **NumBytes** inport or the block parameter.

Related topics

References

Advanced Page (DS2211SER_TX_Bx)

Purpose

To specify the output.

Dialog settings

Enable TXBytes port Lets you specify whether to output the number of bytes that could be sent or not.

Enable Status port Lets you specify whether to output the transmission status or not.

Related topics

References

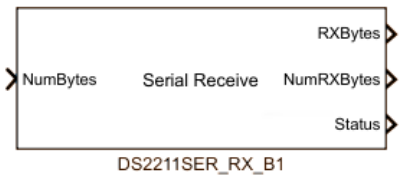
DS2211SER_RX_Bx

Where to go from here

Information in this section

Block Description (DS2211SER_RX_Bx)

Block



Purpose

To read bytes from the serial interface.

Description

The block receives bytes via a serial interface and writes them to the RXBytes output. The number of bytes to be received can be either fixed or variable. If the number of bytes to be received is fixed, you have to specify it with a block parameter. If the number of bytes to be received is variable, you can specify it with either a block parameter or an inport. The status and the number of received bytes are returned via outports.

You can disable the NumBytes input, NumRXBytes output and Status output with the block dialog.

I/O mapping

For information on the I/O mapping, refer to Serial Interface (DS2211 Features 🕮).

I/O characteristics

- The **NumBytes** input must be the number of bytes to be read from the software buffer within one sample step.
- The **RXBytes** port outputs the stream of data that could be read from the software buffer within one sample step. If fewer than the expected number of bytes could be received, the last bytes of the output still contain the data from the previous sample step.
- The **NumRXBytes** port outputs the number of bytes that could be read from the software buffer within one sample step.
- The **Status** port outputs the reception status. One of the following values is returned:

Return Value	Meaning
0	No error
4	The operation failed with no effect on the input or output data. No data is written to or read from the FIFO.
5	No new data is read from the FIFO.
202	The FIFO is filled or not all data could be copied to the FIFO.

- The following table shows the characteristics of the block input and outputs:

Port	Characteristics	Value
NumBytes	Datatype	UInt32
	Range	1 … (SW FIFO size - 1)
RXBytes	Datatype	UInt8
	Range	0 … 255
	Size	1 … (SW FIFO size - 1)
NumRXBytes	Datatype	UInt32
	Range	1 … (SW FIFO size - 1)
Status	Datatype	Int32
	Range	Int32

SW FIFO size is a block parameter. For further information, refer to DS2211SER_SETUP_Bx on page 208.

Dialog pages

The dialog settings can be specified on the following pages:

- **Unit Page** (refer to Unit Page (DS2211SER_RX_Bx) on page 223)
- **RX Parameters Page** (refer to RX Parameters Page (DS2211SER_RX_Bx) on page 223)
- **Advanced Page** (refer to Advanced Page (DS2211SER_RX_Bx) on page 224)

Related RTLib functions

This RTI block is implemented using the following RTLib functions:

- dsser_receive
- dsser_receive_term

Related topics

References

Advanced Page (DS2211SER_RX_Bx)..... 224
DS2211SER_SETUP_Bx..... 208
dsser_receive (DS2211 RTLib Reference 🕮)
dsser_receive_term (DS2211 RTLib Reference 🕮)
RX Parameters Page (DS2211SER_RX_Bx)..... 223
Unit Page (DS2211SER_RX_Bx)..... 223

Unit Page (DS2211SER_RX_Bx)

Purpose

To specify the board number used for reading data.

Dialog settings

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

Related topics

References

Advanced Page (DS2211SER_RX_Bx)..... 224
Block Description (DS2211SER_RX_Bx)..... 221
RX Parameters Page (DS2211SER_RX_Bx)..... 223

RX Parameters Page (DS2211SER_RX_Bx)

Purpose

To specify the receiving parameters.

Dialog settings

Reception mode Lets you specify how to react if there are fewer than the expected number of bytes in the receive buffer:

Data Handling	Meaning
Skip read operation	The new data is left in the receive buffer. The received data is collected in the receive buffer until the specified number of bytes is reached. Then it is copied to the RXBytes output.
Read available data anyway	All the available data is copied from the receive buffer to the RXBytes output.

Parameter flexibility Lets you specify whether the number of bytes to be received is fixed (non-tunable) or variable (tunable).

Number of bytes Lets you specify the number of bytes to be received within one sample step.

Maximum number of bytes Lets you specify the maximum number of bytes that can be received within one sample step. Value range: 1 … (SW FIFO size-1) (SW FIFO size is a block parameter, see DS2211SER_SETUP_Bx on page 208).

Specify the number of bytes Lets you specify whether to set the number of bytes to be received within one sample step via the **NumBytes** input or the block parameter.

Related topics

References

Advanced Page (DS2211SER_RX_Bx)..... 224
Block Description (DS2211SER_RX_Bx)..... 221
Unit Page (DS2211SER_RX_Bx)..... 223

Advanced Page (DS2211SER_RX_Bx)

Purpose

To specify the output.

Dialog settings

Enable NumRXBytes port Lets you specify whether to output the number of bytes that could be received or not.

Enable Status port Lets you specify whether to output the transmission status or not.

Related topics

References

Block Description (DS2211SER_RX_Bx)..... 221
RX Parameters Page (DS2211SER_RX_Bx)..... 223
Unit Page (DS2211SER_RX_Bx)..... 223

DS2211SER_INT_Bx_Iy

Where to go from here

Information in this section

Block Description (DS2211SER_INT_Bx_Iy)

Block

Purpose

To make the interrupts of the serial interface available as trigger sources in the model.

I/O mapping

For information on the I/O mapping, refer to Serial Interface (DS2211 Features 🕮).

I/O characteristics

The output triggers a function call to a subsystem if it is connected.

Dialog pages

The dialog settings can be specified on the following pages:

- **Unit Page** (refer to Unit Page (DS2211SER_INT_Bx_Iy) on page 226)
- **Interrupt Page** (refer to Interrupt Page (DS2211SER_INT_Bx_Iy) on page 226)

Related RTLib functions

This RTI block is implemented using the following RTLib functions:

- dsser_subint_handler_inst
- dsser_subint_enable
- dsser_subint_disable

Related topics

References

dsser_subint_disable (DS2211 RTLib Reference 🕮)
dsser_subint_enable (DS2211 RTLib Reference 🕮)
dsser_subint_handler_inst (DS2211 RTLib Reference 🕮)
Interrupt Page (DS2211SER_INT_Bx_Iy)..... 226
Unit Page (DS2211SER_INT_Bx_Iy)..... 226

Unit Page (DS2211SER_INT_Bx_Iy)

Purpose

To specify the board on which an interrupt will be made available.

Dialog settings

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

Related topics

References

Block Description (DS2211SER_INT_Bx_Iy)..... 225
Interrupt Page (DS2211SER_INT_Bx_Iy)..... 226

Interrupt Page (DS2211SER_INT_Bx_Iy)

Purpose

To specify the interrupt source.

Dialog settings

Interrupt source Lets you choose the interrupt type. The following table shows the available interrupt types:

Interrupt Type	Meaning
RX SW FIFO	Interrupt triggered when the number of bytes in the receive buffer reaches the specified threshold (see Initial RX SW FIFO threshold)
TX SW FIFO	Interrupt triggered when the transmit buffer is empty
Line status	Line status interrupt of the UART
NOT SELECTED	For other platforms, this option represents the modem status interrupt. The DS2211 does not support the modem status interrupt, so specifying this option has no effect on the model.

Initial RX SW FIFO threshold Lets you specify the RX SW FIFO threshold for the receive interrupt in the range 1 … (SW FIFO size -1) . The value should be a multiple of the UART threshold (see DS2211SER_SETUP_Bx on page 208).

The RX SW FIFO threshold can be changed during run time by using the block DS2211SER_INT_REC_LEV_Bx on page 228.

Related topics

References

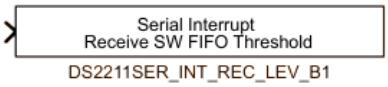
DS2211SER_INT_REC_LEV_Bx

Where to go from here

Information in this section

Block Description (DS2211SER_INT_REC_LEV_Bx)

Block



Purpose

To change the RX SW FIFO threshold during run time.

Description

The block changes the RX SW FIFO threshold that is initially specified by the DS2211SER_INT_Bx_Iy block (see DS2211SER_INT_Bx_Iy on page 225).

I/O mapping

For information on the I/O mapping, refer to Serial Interface (DS2211 Features 🕮).

I/O characteristics

- The Receive SW FIFO Threshold input sets a new RX SW FIFO threshold.
- The following table shows the characteristics of the block input:

Port	Characteristics	Value
Receive SW FIFO Threshold	Datatype	UInt32
	Range	1 … (SW FIFO size - 1)

SW FIFO size is a block parameter. For further information, refer to DS2211SER_SETUP_Bx on page 208.

Dialog pages

The dialog settings can be specified on the following page:

- Unit page (refer to Unit Page (DS2211SER_INT_REC_LEV_Bx) on page 229)

Related RTLib functions

This RTI block is implemented using the following RTLib functions:

- dsser_config
- dsser_fifo_reset
- dsser_transmit_fifo_level
- dsser_receive_fifo_level

Related topics

References

DS2211SER_INT_Bx_Iy..... 225
DS2211SER_SETUP_Bx..... 208
dsser_config (DS2211 RTLib Reference 🕮)
dsser_fifo_reset (DS2211 RTLib Reference 🕮)
dsser_receive_fifo_level (DS2211 RTLib Reference 🕮)
dsser_transmit_fifo_level (DS2211 RTLib Reference 🕮)
Unit Page (DS2211SER_INT_REC_LEV_Bx)..... 229

Unit Page (DS2211SER_INT_REC_LEV_Bx)

Purpose

To specify the board on which the RX SW FIFO threshold will be changed.

Dialog settings

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

Related topics

References

Block Description (DS2211SER_INT_REC_LEV_Bx)..... 228

Single Edge Nibble Transmission (SENT) Protocol

Where to go from here

Information in this section

General Information

Overview of the DS2211 SENT Interface

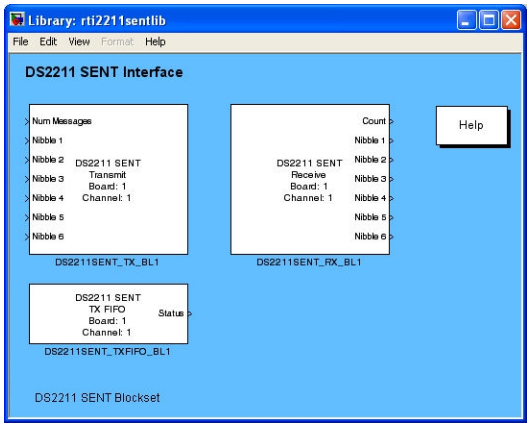
Introduction

SENT (Single Edge Nibble Transmission) is a protocol used between sensors and ECUs. It is defined in the SAE J2716 standard defined by the Society of Automotive Engineers (SAE). It is used to transmit data of high-resolution (10 bits or more) sensors as an alternative to an analog interface. The sensor signal is transmitted as a series of pulses with data measured as falling to falling edge times.

The DS2211 supports SENT in version SAE J2716 JAN2010 and earlier.

Access

After you double-click the **SENT** button in the **Library: rti2211lib** window, the **Library: rti2211sentlib** is displayed.



Basic principles

For basic information on the SENT protocol and information on implementing the SENT receiver and SENT transmitter, refer to Single Edge Nibble Transmission (SENT) Support (DS2211 Features 🕮).

Library components

The library contains the following RTI blocks:

- DS2211SENT_TX_BLx on page 234
- DS2211SENT_TXFIFO_BLx on page 240
- DS2211SENT_RX_BLx on page 242

Related topics

Basics

Single Edge Nibble Transmission (SENT) Support (DS2211 Features 🕮)

DS2211SENT_TX_BLx

Purpose

To send data using the SENT protocol.

Where to go from here

Information in this section

Block Description (DS2211SENT_TX_BLx)

Illustration

Purpose

To send data using the SENT protocol.

Description

The block writes the messages to a transmit FIFO of a specified channel. Data in the transmit FIFO is transmitted sequentially, from the first nibble of the first message to the last nibble of the last message.

The size of the transmit FIFO is limited so that the number of messages and the included number of nibbles are also limited. The maximum number of messages and nibbles is specified on the **TX Parameters** page. The number of messages currently due to be transmitted is specified at the **Num Messages** block inport. If it is larger than the maximum specified, it is reduced to the maximum. The

nibbles to be sent are specified at block inports. Each **Nibble** *n* inport must be connected to a vector with the size of the specified maximum number of messages.

You can set the **Num Messages** inport to 0. In this case no new messages are written to the transmit buffer in the current simulation step. This is can be used to prevent the transmit FIFO overrunning due to its limited size. The fill level of the transmit FIFO can be read using the **DS2211SENT_TXFIFO_BLx** block.

The block has two outports to give information on the write operation. The **Count** outport provides the number of messages that were successfully written to the transmit FIFO. The **Error** outport provides status information (0: write operation successful, 1: write operation not successful). Both outports are optionally and must be enabled on the **Advanced** page.

The tick period can be specified at a block inport or as a block parameter on the **Advanced** page.

The number of ticks which defines a low pulse, a zero nibble high pulse, and a sync high pulse can be specified on the **TX Parameters** page. These parameters can be modified during run time via the experiment software.

The block can append pause pulse to every message. You can enable the pause pulse mode on the **TX Parameters** page. If the pause pulse mode is enabled, the block gets a **Pause** inport to specify the pause pulses for each message.

I/O mapping

For information on the I/O mapping, refer to Using the SENT Protocol on a DS2211 (DS2211 Features 🕮).

Note

It is not possible to use the same channels for digital out.

I/O characteristics

The table shows the block inport:

Simulink Input	Range	Simulink Data Type	Description
Num Messages	1 ... 31 or 63	UInt32	Number of messages to be written to the transmit FIFO. The maximum number of messages is specified on the **TX Parameters** page. If pause pulse mode is disabled, the maximum value is 63, otherwise 31.
Tick Period[1)]	$0.5 \cdot 10^{-6}$ ... $51.1875 \cdot 10^{-6}$ or $204.787 \cdot 10^{-6}$ [2)]	Double	Tick period of the SENT transmitter in seconds. The resulting SENT pulse length of the specified tick period must not exceed the range of the allowed pulse length of minimum 2 µs. These pulses are not correctly detected.

Simulink Input	Range	Simulink Data Type	Description
Nibble 1 ... Nibble *nibble_count*[3]	0 … 15, -128	Int8	Data to be written to the transmit FIFO. The inport must be connected to a vector with the size of the maximum number of messages (specified as block parameter on the **TX Parameters** page). To simulate a missing nibble, specify a value of -128.
Pause[4]	0 … 32767, -32768	Int16	A vector containing pause pulses in ticks for each message. The inport must be connected to a vector with the size of the maximum number of messages (specified as block parameter on the **TX Parameters** page). To simulate a missing pause pulse, specify a value of -32768.

[1] The port is only available if it is enabled on the **Advanced** page.
[2] The maximum value depends on the board/FPGA revision of the DS2211, see Using the SENT Protocol on a DS2211 (DS2211 Features 🕮).
[3] *nibble_count* is the number of nibbles per message. The maximum number of nibbles is 217.
[4] The port is only available if the pause pulse mode is enabled on the **TX Parameters** page.

The table shows the block outport:

Simulink Output	Range	Simulink Data Type	Description
Count[1]	0 ... 31 or 63	UInt32	Number of messages which were successfully written to the transmit FIFO. If pause pulse mode is disabled, the maximum value is 63, otherwise 31.
Error[1]	0, 1	UInt32	State of the write operation of the messages to the transmit FIFO: ▪ 0: Write operation was successful. All messages were written to the transmit FIFO. ▪ 1: Not all messages could be written to the transmit FIFO because the transmit FIFO is full. You can use the **Count** outport to get the number of messages which were successfully written.

[1] The port is only available if it is enabled on the **Advanced** page.

Dialog pages

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

- To specify the board number and the channel number, refer to the Unit Page (DS2211SENT_TX_BLx) on page 237.
- To specify parameters for sending SENT messages, refer to the TX Parameters Page (DS2211SENT_TX_BLx) on page 238.
- To specify the tick period and disable or enable output ports, refer to the Advanced Page (DS2211SENT_TX_BLx) on page 239.

Related RTLib functions

`ds2211_sent_tx_init`, `ds2211_sent_tx_config`, `ds2211_sent_set_tx_tic_period`, `ds2211_sent_tx_transmit_pause`

Related topics

Basics

Implementing SENT Transmitters in Simulink (DS2211 Features 🕮)
Using the SENT Protocol on a DS2211 (DS2211 Features 🕮)

References

DS2211SENT_TXFIFO_BLx 240

Unit Page (DS2211SENT_TX_BLx)

Purpose

To specify the board number and the number of the channel used for sending SENT messages.

Dialog settings

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

Channel number Lets you select the number of the channel which is used for sending SENT messages in the range 1 ... 5.

TX Parameters Page (DS2211SENT_TX_BLx)

Purpose

To specify parameters for sending SENT messages.

Description

The messages are written to a transmit FIFO. The number of messages (`FIFO_Entries`) that can be maximally buffered in the transmit FIFO between two write operations depends on the number of nibbles (`Num_Nibbles`):

If pause pulse mode is disabled:

```
FIFO_Entries = RoundDown(63 / RoundUp(Num_Nibbles / 7))
```

If pause pulse mode is enabled:

```
FIFO_Entries = RoundDown(63 / (RoundUp(Num_Nibbles / 7) + 1))
```

Some parameters of the dialog are run-time-tuneable. The values of run-time-tunable parameters can be modified during run time via the experiment software. The changed values take effect immediately. This makes it possible to simulate a SENT transmitter that does not comply with the specification.

Dialog settings

Channel Displays the channel number which is selected for sending messages.

Number of nibbles (incl. status, CRC) Lets you specify the number of nibbles in a message in the range 1 ... 217 (without pause pulse) or 1 ... 210 (with pause pulse). The number includes the status nibble and the CRC nibble.

Max. number of messages Lets you specify the maximum number of messages in the range 1 ... 63 (without pause pulse) or 1 ... 31 (with pause pulse). The maximum value depends on the Number of nibbles parameter.

Number of ticks for low state Lets you select the number of tick periods which specify a low pulse.

The parameter is run-time-tuneable.

Number of ticks for high state of zero nibble Lets you select the number of tick periods which specify the zero nibble high pulse and a pause pulse with a value of 0.

The parameter is run-time-tuneable.

Number of ticks for high state of sync pulse Lets you specify the number of tick periods which specify a sync high pulse.

The parameter is run-time-tuneable.

Enable autorepeat Lets you enable or disable the automatic repeat mode of the SENT transmitter.

If the automatic repeat mode is enabled, the message written last is repeated when the transmit FIFO runs empty. This message is repeated until a new message is written to the transmit FIFO.

If the automatic repeat mode is disabled, the messages in the transmit FIFO are transmitted once. If the transmit FIFO runs empty, the transmission stops and the output stays high until the next message is written to the transmit FIFO. As the SENT specification requires continuous transmission of messages without any interruption, you must ensure that the **DS2211SENT_TX_BLx** block is called regularly and the transmit FIFO does not run empty.

The parameter is run-time-tuneable.

Enable pause mode Lets you enable or disable the pause pulse mode of the SENT transmitter.

If the pause pulse is enabled, the transmitter appends a pause pulse at the end of every message. The pause pulse length is defined for each message.

Advanced Page (DS2211SENT_TX_BLx)

Purpose

To specify the tick period and disable or enable output ports.

Dialog settings

Channel Displays the channel number which is selected for sending messages.

Specify tick period Indicates whether the tick period is set by an input port or by a block parameter. The value of the tick period must be specified in seconds.The range depends on the board/FPGA revision of the DS2211: 500 ns ... 51.1875 µs or 500 ns ... 204.787 µs (for details of the board/FPGA revision, refer to Using the SENT Protocol on a DS2211 (DS2211 Features 🕮)).

Enable Count port Indicates whether the Count port is enabled or disabled. For details on the outport, refer to I/O characteristics on page 235.

Enable Error port Indicates whether the Error port is enabled or disabled. For details on the outport, refer to I/O characteristics on page 235.

Related topics

Basics

Using the SENT Protocol on a DS2211 (DS2211 Features 🕮)

DS2211SENT_TXFIFO_BLx

Purpose

To get the fill level of the transmit FIFO.

Where to go from here

Information in this section

Block Description (DS2211SENT_TXFIFO_BLx)

Illustration

Purpose

To get the fill level of the transmit FIFO.

Description

The block outputs the number of messages in the transmit FIFO. You can use this information to prevent writing more messages to the transmit FIFO than allowed.

I/O mapping

For information on the I/O mapping, refer to Using the SENT Protocol on a DS2211 (DS2211 Features 🕮).

I/O characteristics

The table shows the block outport:

Simulink Output	Range	Simulink Data Type	Description
Status	0 ... 63	UInt32	Indicates the number of messages in the transmit FIFO

Dialog pages

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

- To specify the board number and the channel number, refer to the **Unit Page (DS2211SENT_TXFIFO_BLx)** on page 241.

Related RTLib functions

`ds2211_sent_tx_fifo_state`

Related topics

Basics

Implementing SENT Transmitters in Simulink (DS2211 Features 🕮)

Unit Page (DS2211SENT_TXFIFO_BLx)

Purpose

To specify the board number and the number of the channel used for sending SENT messages.

Dialog settings

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

Channel number Lets you select the number of the channel which is used for sending SENT messages in the range 1 ... 5.

DS2211SENT_RX_BLx

Purpose

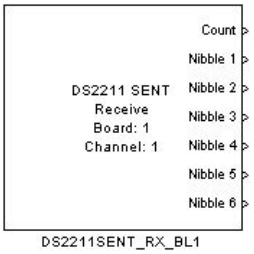
To receive data using the SENT protocol.

Where to go from here

Information in this section

Block Description (DS2211SENT_RX_BLx)

Illustration



Purpose

To receive data using the SENT protocol.

Description

The block reads the messages from a receive FIFO of a specified channel. The number of nibbles to be received must be specified on the **RX Parameters** page. The block gets one outport for each nibble which is specified. The outports provide vectors with the nibble of several messages. The expected number of messages must be specified on the **RX Parameters** page.

Parameters for specifying the SENT settings are specified on the **RX Parameters** page. Some parameters of them are stop-run-tuneable. The values of stop-run-tuneable parameters can be modified during run time via the experiment

software. The changed values take effect when the simulation state of the model changes from STOP to RUN or PAUSE. Stop-run-tuneable parameters are:

- Number of ticks for low state
- Number of ticks for high state of zero nibble
- Number of ticks for high state of sync pulse
- Tick period
- Tick period tolerance

You can specify a timing range for pulse length measurement on the **RX Parameters** page. You can use this to adapt the range of measurable pulse length to the transmitter clock and pulse length. Choosing higher timing ranges leads to a reduced resolution, but allow measuring longer pulse length. The parameter is stop-run-tuneable.

You can enable the pause mode on the **RX Parameters** page. If it is enabled, the receiver accepts a pause pulse at the end of every message, between the last nibble and the sync pulse of the next message. If you specify an expected message length, this value is compared with the actual received message length. If these values differ, a flag is set in the diagnostic outport (see Diagnostics flags on page 245). The **Expected message length** parameter is stop-run-tuneable.

The block has two read modes. It can read all new messages received since the last read operation or it can read the newest complete message. The mode is set on the **RX Parameters** page.

Outports of the block provide information on the read operation:

- **Count**: Number of complete messages
- **Tick period**: Current tick period in seconds (optional, it can be enabled on the **Advanced** page)
- **Diagnostic**: Diagnostic information for each received message (optional, it can be enabled on the **Advanced** page)
- **Error**: State of the read operation (optional, it can be enabled on the **Advanced** page)
- **Pause**: Pause pulse value for each received message (available if the pause pulse mode is enabled)

I/O mapping

For information on the I/O mapping, refer to Using the SENT Protocol on a DS2211 (DS2211 Features 🕮).

Note

It is not possible to use the same channels for digital in (channels 1 ... 4), square-wave and PWM signal measurement (channels 9 ... 12).

I/O characteristics

The table shows the block outports:

Simulink Output	Range	Simulink Data Type	Description
Count	0 ... 128	UInt32	Number of complete messages that are received since the last read operation.
Tick Period[1)]	0.0 ... 23.4e-3	Double	Current tick period in seconds. The tick period is measured from the last received valid synchronization pulse. If no message has been read, a tick period of 0 is returned. The pulse length of low pulses and high pulses must not exceed the range of the defined by **Range of pulse length** (see **Rx Parameters Page** (refer to RX Parameters Page (DS2211SENT_RX_BLx) on page 247)).
Diagnostic[1)]	0 ... 255	UInt32	Diagnostic information on the received messages. It is a vector with the size of the expected number of messages (see **RX Parameters** page). The diagnostic information is reported via flags (UInt32 words). The number of words matches the number of returned messages indicated by the **Count** outport. For information on the meanings of the flags, see Diagnostics flags on page 245.
Error[1)]	0 ... 3	UInt32	State of the read operation of the messages from the receive FIFO: ▪ 0: No data loss. All messages were read from the receive FIFO. ▪ Bit 0 (value 1): Data loss. Not all messages could be read from the receive FIFO because the number of received messages exceeds the expected number of messages. Superfluous messages are discarded. You can use the **Count** outport to get the number of messages which were currently received. ▪ Bit 1 (value 2): Timeout occurred. At least one pulse length exceeded the maximum measurable pulse length of the specified timing range. The receiver discards the message with a timeout and searches for the next sync pulse. The timout information is active for one read operation only.

Simulink Output	Range	Simulink Data Type	Description
Nibble 1 ... Nibble *nibble_count*[2]	0 ... 15, -128	Int8	Contains the nibble values which are read from the receive FIFO.
Pause[3]	0 ... 32767, -32768	Int16	Contains the pulse pause values which are read from the receive FIFO in ticks. It is a vector with the size of the expected number of messages (see **RX Parameters** page). The range depends on the settings for SENT. The value is -32768 if no pause pulse is received.

[1] The port is only available if it is enabled on the **Advanced Page** (refer to Advanced Page (DS2211SENT_RX_BLx) on page 250).

[2] *nibble_count* is the number of nibbles per message. The maximum number of nibbles is 217 (without pause pulse) or 210 (with pause pulse).

[3] The port is only available if the pause pulse mode is enabled on the **Rx Parameters Page** (refer to RX Parameters Page (DS2211SENT_RX_BLx) on page 247).

Diagnostics flags

The following table shows the values and descriptions of the flags of the Diagnostic outport:

Bit	Value	Description
0	1	Too many nibbles in message. This value is returned when too many nibbles are received in a message. The superfluous nibbles are ignored. Each message is stored with the number of nibbles as specified by the **Number of nibbles (incl. status, CRC)** block parameter.
1	2	Too few nibbles in message. This value is returned when a message with too few nibbles is received. The missing nibbles are marked with a value of "-128". Each message is stored with the number of nibbles as specified by the **Number of nibbles (incl. status, CRC)** block parameter.
2	4	Nibble value is out of range [0 … 15]. This value is returned when a nibble with a value <0 or >15 is received. The nibble is saved to the data buffer anyway.
3	8	Synchronization pulse too long. This value is returned when a synchronization pulse is larger than the upper limit of the expected tick period specified by the **Tick period** and **Tick period**

Bit	Value	Description
		tolerance block parameters. The nibble values are evaluated despite this.
4	16	Synchronization pulse too short. This value is returned when a synchronization pulse is shorter than the lower limit of the expected tick period specified by the **Tick period** and **Tick period tolerance** block parameters. The nibble values are evaluated despite this.
5	32	The current synchronization pulse differs from the last synchronization pulse by a factor of more than 1/64.
6	64	Measured message length does not match the specified expected length in tick periods. This value is returned when the pause pulse mode is enabled and an **Expected message length** unequal 0 is specified. The diagnostic information occurs if the lenght of the received message differs from the specified expected message length in tick periods.
7	128	Deviation of sync pulse to message length ratio too high. This value is returned when the pause pulse mode is enabled and an **Expected message length** unequal 0 is specified. The diagnostic information occurs if the ratio from sync pulse to fixed message length differs by a factor of more than 1/64.

For example, if a message has a nibble out of range (flag 2, value 4) and the synchronization pulse is too short (flag 4, value 16), the Diagnostic word value is 20. To get the information, you must evaluate the returned Diagnostic word. Nibble diagnostic information is evaluated for every nibble in a message, even for ignored excess nibbles when exceeding the configured number of nibbles per message.

Dialog pages

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

- To specify the board number and the channel number, refer to the **Unit Page** (refer to Unit Page (DS2211SENT_RX_BLx) on page 247).
- To specify the parameters for receiving SENT messages, refer to the **Rx Parameters Page** (refer to RX Parameters Page (DS2211SENT_RX_BLx) on page 247).
- To disable or enable output ports, refer to the **Advanced Page** (refer to Advanced Page (DS2211SENT_RX_BLx) on page 250).

Related RTLib functions

`ds2211_sent_rx_init`, `ds2211_sent_rx_config_pause`, `ds2211_sent_rx_receive_all_pause`, `ds2211_sent_rx_receive_most_recent_pause`, `ds2211_sent_get_rx_tic_period`

Related topics

Basics

Implementing SENT Receivers in Simulink (DS2211 Features 🕮)

Unit Page (DS2211SENT_RX_BLx)

Purpose

To specify the board number and the number of the channel used for receiving SENT messages.

Dialog settings

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

Channel number Lets you select the number of the channel which is used for receiving SENT messages in the range 1 ... 4.

RX Parameters Page (DS2211SENT_RX_BLx)

Purpose

To specify parameters for receiving SENT messages.

Description

The messages are read from a receive FIFO. The size of the receive FIFO is limited. The number of messages (`Max_Messages`) that can be maximally buffered between two read operation depends on the number of nibbles in a message (`Num_Nibble`):

If the pause pulse mode is disabled:

```
Max_Messages = RoundDown(128 / (Num_Nibble + 1))
```

If the pause pulse mode is enabled:

```
Max_Messages = RoundDown(128 / (Num_Nibble + 2))
```

When the receive FIFO runs full, all new received pulses get lost until the next read operation is executed. This leads to a loss of nibbles or messages and the Count outport is set to the maximum FIFO size.

Some parameters of the dialog are stop-run-tuneable. The values of stop-run-tuneable parameters can be modified during run time via the experiment software. The changed values take effect when the simulation state of the model changes from STOP to RUN or PAUSE.

To adapt the receiver clock to different pulse length and transmitter clocks, different timing ranges can be specified. This is realized by a clock prescaler and reduces the resolution of the receiver clock while increasing the measurable pulse length. For information on the relevant time information of the different timing ranges, refer to Range of pulse length on page 248.

Note

The resulting pulse length must not exceed the range of allowed pulse length of the selected timing range. Otherwise, pulses gets lost or are measured with a wrong value.
If a pulse length exceeds the measurable pulse length, a timeout is reported by the read function. The timeout detection depends on the board/FPGA revision. For details of the required board/FPGA revisions, refer to Using the SENT Protocol on a DS2211 (DS2211 Features 🕮).
The maximum resulting nibble pulse under consideration of the specified clock drift must be shorter than the minimum resulting synchronization pulse under consideration of the clock drift.

Dialog settings

Channel Displays the channel number which is selected for receiving messages.

Range of pulse length Lets you specify a timing range for pulse length measurement. You can use this to adapt the range of measurable pulse length to the transmitter clock and pulse length. Choosing higher timing ranges leads to a reduced resolution, but allow measuring longer pulse length, see the following table.

Range	Resolution
2 µs ... 819 µs	50 ns
2 µs ... 1.64 ms	100 ns
2 µs ... 3.28 ms	200 ns
2.4 µs ... 6.55 ms	400 ns
4.8 µs ... 13.1 ms	800 ns
9.6 µs ... 26.2 ms	1.6 µs
19.2 µs ... 52.4 ms	3.2 µs
38.4 µs ... 105 ms	6.4 µs
76.8 µs ... 210 ms	12.8 µs

Resolution Displays the resolution of the measurement.

Number of nibbles (incl. status, CRC) Lets you specify the number of nibbles included in a message in the range 1 ... 217. The number includes the

status nibble and the CRC nibble. The number of nibbles (Num_Nibble) affects the maximum number of messages (Max_Messages) that can be buffered between two read operation (see above).

Expected number of messages Lets you specify the expected number of messages in the range 1 ... 128.

Number of ticks for low state Lets you select the number of tick periods which specify a low pulse. The parameter is stop-run-tuneable.

Number of ticks for high state of zero nibble Lets you select the number of tick periods which specify the zero nibble high pulse. The parameter is stop-run-tuneable.

Number of ticks for high state of sync pulse Lets you specify the number of tick periods which specify a sync high pulse. The parameter is stop-run-tuneable.

Tick period Lets you specify the expected tick period in the range 0.5 µs ... 200 µs in seconds. This value is used to calculate diagnostic information (refer to I/O characteristics on page 244). The parameter is stop-run-tuneable.

Tick period tolerance Lets you specify the maximum allowed tolerance of the tick period in the range 0.0 ... 0.5. The value is the percentage of the expected tick period, for example, 0.3 is 30% of the expected tick period.

It is not recommended to use a tolerance of `0`. Every transmitter and receiver has a minimum tolerance or clock drift, so the measured tick period varies.

The parameter is stop-run-tuneable.

Read mode Lets you choose the mode for reading messages.

Read Mode	Description
All messages	The block reads all new messages received since the last read operation. If no complete new message is available, the **Count** outport is 0 and the **Nibble** outports keep their values of the last read operation.
Most recent message	The block block reads the newest complete message. If no complete message is available, a message is returned which nibbles have the value "-128" (refer to **Diagnostic** port in I/O characteristics on page 244) and the **Count** outport is 0.

Enable pause mode Indicates whether the pause pulse mode is enabled or disabled. If the pause pulse mode is enabled, the receiver expects a pause pulse at the end of every message, between the last nibble and the sync pulse of the next message. If the pause pulse mode is disabled and pause pulses receive, they are handled like additional nibbles. This means, the flag 0 of the diagnostic word (value: 1, "To many nibble in message") is set as long as no timeout occurs.

Expected message length Lets you specify an expected message length if the pause pulse mode is enabled. This value must include all low and high ticks of synchronization pulse, nibble pulses and pause pulse. If the lenght of the received message differs from the specified expected message length, a flag is set at the **Diagnostic** outport (refer to I/O characteristics on page 244). If you

specify an expected message length of 0, the additional fixed message length diagnostic is disabled.

Related topics

Basics

Using the SENT Protocol on a DS2211 (DS2211 Features 🕮)

Advanced Page (DS2211SENT_RX_BLx)

Purpose

To disable or enable output ports.

Dialog settings

Channel Displays the channel number which is selected for receiving messages.

Enable Tick Period port Indicates whether the Tick Period port is enabled or disabled. For details on the outport, refer to I/O characteristics on page 244.

Enable Diagnostic port Indicates whether the Diagnostic port is enabled or disabled. For details on the outport, refer to I/O characteristics on page 244.

Enable Error port Indicates whether the Error port is enabled or disabled. For details on the outport, refer to I/O characteristics on page 244.