RapidPro System – I/O Subsystem

MPC565 RTI Reference

For RTI RapidPro Control Unit Blockset

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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

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About This Reference

Contents

This document provides concise information on the RTI block library of dSPACE's RapidPro Control Unit that is used as an I/O subsystem (slave processor MPC565) to complement a rapid control prototyping (RCP) system from dSPACE, such as MicroAutoBox II or a DS1007 modular system (PHS-bus-based system with a DS1007 processor board). For each block, the I/O ports and dialog pages (parameters) are described.

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 RapidPro Control Unit Blockset

Overview of the RTI RapidPro Control Unit Blockset

About this board

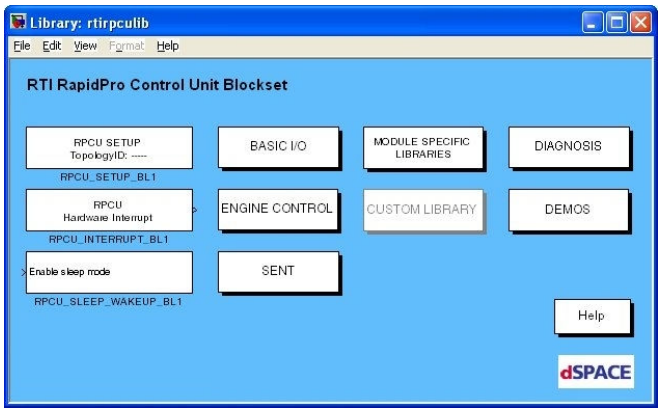
The RapidPro Control Unit with its MPC565 microprocessor can be used to add I/O functionality to your RCP system. The RapidPro Control Unit has to contain signal conditioning (SC) modules that provide the required I/O functionality.

RTI blockset

The Real-Time Interface (RTI) board library for the RapidPro system, the **rtirpculib**, provides the RTI blocks that implement the I/O capabilities of the RapidPro hardware in Simulink models. These RTI blocks are based on RTLib functions and used to specify the hardware-specific code for real-time applications. The **rtirpculib** also provides additional RTI blocks, demo models, and useful information.

Access

Entering **`rtirpcu`** in the MATLAB Command Window displays the RTI board library for the RapidPro Control Unit.



The following components are available in the **Library: rtirpculib** window:

Component	Description
RTI blocks	
RPCU_SETUP_BLx on page 18	To specify the basic settings of the RapidPro system and initialize master-slave communication. Additionally, to measure the CPU load of the slave processor (MPC565).
RPCU_INTERRUPT_BLx on page 226	To make the interrupts of the RapidPro system available as trigger sources.
RPCU_SLEEP_WAKEUP_BLx on page 230	To manage the sleep mode functions of a RapidPro Control Unit.
RTI sublibraries	
Basic I/O	Contains RTI blocks for: ▪ A/D Conversion on page 27 ▪ Bit I/O on page 35 ▪ Timing I/O on page 53
Engine Control on page 127	Contains RTI blocks for engine control.
Single Edge Nibble Transmission (SENT) on page 115	Contains RTI block for data transfer based on the SENT protocol.
Module-specific libraries	Contains sublibraries for module-specific engine control: ▪ Measuring Exhaust Gas Oxygen with the SC-EGOS 2/1 Module on page 188 ▪ Measuring Preignitions with the SC-KNOCK 4/1 Module on page 192
Custom Library (available only if custom software is installed)	Contains custom blocks.
Diagnosis	Contains RTI blocks for: ▪ Reading the diagnostic data of a module: RPCU_DIAGNOSIS_BLx on page 212 ▪ Checking whether a carrier board is alive: RPCU_DIAGNOSIS_ALIVE_BLx on page 216 ▪ Resetting the diagnosis data of a module: RPCU_DIAG_MODULE_RESET_BLx on page 219 ▪ Resetting the diagnosis data of all modules of a RapidPro system: RPCU_DIAG_GLOBAL_RESET_BLx on page 222
DEMOS	Contains examples of RTI models.
Help	To display this reference information.

Setup

Where to go from here

Information in this section

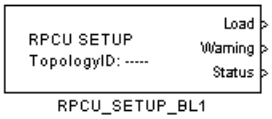
RPCU_SETUP_BLx

Where to go from here

Information in this section

RPCU_SETUP_BLx Block Description

Block



Purpose

To specify the basic settings of the RapidPro system and initialize master-slave communication. Additionally, to measure the CPU load of the MPC565 processor (slave).

Description

An RPCU_SETUP_BLx block initializes the master-slave communication to a specific RapidPro Control Unit.

When you select a hardware topology file (`HWT`) in the **Select topology file** dialog and click the **Open** button, the file is parsed and its information on the signal routing of the I/O modules is read and stored in the RPCU_SETUP_BLx block. This makes the RapidPro hardware topology available to the RTI model.

Note

A model must have at least one RPCU_SETUP_BLx block. However, only one RPCU_SETUP_BLx block can address a specific ECU interface, that is, only one RPCU_SETUP_BLx block with the same board/module and ECU channel numbers is allowed in a model.

For basic information, refer to Specifics of the RapidPro System (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

After successful initialization of the RapidPro system, the CPU load (in %) of the MPC565 is measured every 100 ms, and the results are sent to the RCP system via the ECU interface. The CPU load is evaluated relative to a shutdown threshold

and (optionally) to a warning threshold. Depending on this evaluation, your RapidPro system can have three operating states: Normal, warning, and shutdown. For details, refer to CPU Load Measurement of the Slave Processor (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

Enter `rtirpcu` in the MATLAB Command Window.

TopologyID

If the hardware of a RapidPro system is modified, an updated hardware topology file `(*.hwt)` is needed. The TopologyID number can change depending on the extent of modification. The TopologyID number is affected If you perform one of the following actions:

- Add or remove a module
- Replace a module with one of another type
- Insert a module in another slot
- Add or remove a unit
- Rebuild a stack with the units in a different order

Refer to Effects of Changing Components of a RapidPro System (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

⚠ WARNING

If an HWT file with a new TopologyID number is opened, the Inport/Output Driver settings of all the blocks in the model are treated according to the hardware modification, as shown in the table below.

Hardware Modification	Driver Settings
Number of layers in the RapidPro stack did not change and the module used is still on the same place	Update: All drivers remain selected
Number of layers in the RapidPro stack changed	Reset: All drivers are set to <NOT SELECTED>
Layer, slot, or channel changed or Module has been substituted or I/O routing has changed	Reset: The drivers of the blocks concerned are set to <NOT SELECTED>

I/O characteristics

The following table describes the ports of the block:

Port	Description
Load	Outputs the current load of the MPC565 processor in percent. Available only if the **Enable CPU load port** checkbox is selected, refer to Parameter Page (RPCU_SETUP_BLx) on page 21. Data type: Double Range: 0 ... 100
Warning	Outputs the load status of the MPC565 processor. Available only if the **Enable CPU load warning threshold** checkbox is selected, refer to Parameter Page (RPCU_SETUP_BLx) on page 21. Data type: Boolean 1: Warning 0: Normal
Status	Represents the reading status. Available only if the **Enable outport Status** checkbox is selected, refer to Parameter Page (RPCU_SETUP_BLx) on page 21. Data type: UInt8 1: Inport state has been updated since last read access 0: Inport state has not been updated since last read access

Related RTLib functions

- dsrpcu_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_init_cmd_finished (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- DSRPCU_BACKGROUND (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- DSRPCU_ERROR_READ (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_cpu_load_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_cpu_load_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_SETUP_BLx)

Purpose

To address the related RapidPro hardware and the topology file.

Unit specification

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which unambiguously identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded.

The parsing process is always started when a topology file has been selected in the file browser.

Note

All other block dialogs that display the Topology ID must be closed if a new HWT file is loaded.

RPCU topology file Displays the name of the hardware topology file (*.hwt).

Browse Opens a dialog that lets you browse HWT files.

Parameter Page (RPCU_SETUP_BLx)

Purpose

To measure the CPU load of the slave processor and provide status information.

CPU Load Measurement

Shut-down threshold [50% ... 95%] Lets you specify the value of the shut-down threshold in percent. If the CPU load of the slave processor exceeds this value the simState variable is set to STOP. Range: 50 ... 95 (default: 95).

Enable CPU load port Indicates whether the block has a port that outputs the current CPU load in percent.

Note

Regardless of whether this port exists the RPCU_SETUP_BLx block measures the CPU load permanently during model execution.

Enable CPU load warning threshold Indicates whether a warning threshold is active, in addition to the shut-down threshold. If this checkbox is selected the block has a port that outputs 0 or 1 (0: "Normal" state, 1: "Warning" state).

Warning threshold [50% ... <shut-down threshold>] Lets you specify the value of the warning threshold in percent. Range: 50 ... <Shut-down threshold> (default: 80).

Note

The RapidPro system switches from "Warning" state back to "Normal" state not before the CPU load becomes less than *WarningTreshold - 5%* (hysteresis).

Outport setting

Enable outport Status Indicates whether the block has a "Status" output port for status information about the data in the DPMEM. See the I/O characteristics of the block.

Related topics

References

simState (RTI and RTI-MP Implementation Reference 🕮)

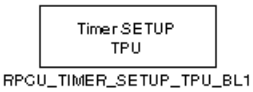
RPCU_TIMER_SETUP_TPU_BLx

Where to go from here

Information in this section

RPCU_TIMER_SETUP_TPU_BLx Block Description

Block



Purpose

To configure the timer settings of a time processor unit (TPU).

Description

Using an RPCU_TIMER_SETUP_TPU_BLx block, you can configure the timer resolutions of TPU A, B, and C. Each TPU has two timers. You have to specify the timer resolutions of both of them. Refer to Timer Setup (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

If a block in a model refers to a TPU, the model must contain an RPCU_TIMER_SETUP_TPU_BLx block assigned to a specific board/module and ECU interface channel. However, only one RPCU_TIMER_SETUP_TPU_BLx block can address a specific ECU interface, that is, only one RPCU_TIMER_SETUP_TPU_BLx block with the same board/module number and ECU interface channel number is allowed in a model.

For TPU, the timer resolution is found by the equation:

$\text{Timer resolution}_{TPU} = (1 / 56\ \text{MHz}) * \text{Prescaler\_value}$

The TPU timer settings influence the range specification of TPU blocks. As an example, see Period range on page 61 of the RPCU_PWM_TPU_BLx block. For TPU, the range specification results from the timer resolution as follows:

$\text{Range}_{TPU} = [\text{Limit}_{lower}; \text{Limit}_{upper}]$

$Limit_{lower}$ = Timer $resolution_{TPU}$ * 0x0018

$Limit_{upper}$ = Timer $resolution_{TPU}$ * 0x7FFF

For basic information, refer to General Characteristics of a TPU (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the **Basic I/O** or the **Engine Control** button.

Other RTI blocks

The following RTI blocks must reside in the model, too, with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18

Related RTLib functions

- dsrpcu_tpu_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_tpu_prescaler_set (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_tpu_start (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_TIMER_SETUP_TPU_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Related topics

References

Unit Page (RPCU_SETUP_BLx)..... 20

Parameters Page (RPCU_TIMER_SETUP_TPU_BLx)

Purpose

To specify the TPU timer resolution and the timer for engine control.

Description

The RapidPro Control Unit has three time processing units (TPU A, B, and C). You can select the resolution of the related timers (timer 1, timer 2) for each TPU. For detailed TPU information, refer to Timer Setup (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

TPU A/B/C

"TPU A/B/C timer" is an abbreviation for the "TPU A timer", "TPU B timer", and "TPU C timer"settings.

TPU A/B/C timer 1 resolution Specifies the resolution of TPU timer 1. The range is 35.71 ns … 8 µs.

Use TPU A/B/C timer 2 for engine control Indicates whether TPU timer 2 is used for engine control. If the TPU is used for engine control, you have to select this checkbox. Refer also to RPCU_CRANK_SETUP_TPU_BLx on page 128.

TPU A/B/C timer 2 resolution Specifies the resolution of TPU timer 2. The range is 142.9 ns … 2.143 ms. If the TPU is used for engine control, this setting is disabled and is not evaluated.

A/D Conversion

Introduction

The RapidPro Control Unit RTI blockset provides a block that you can use for converting analog signals.

Where to go from here

Information in this section

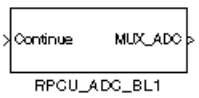
RPCU_ADC_BLx

Where to go from here

Information in this section

RPCU_ADC_BLx Block Description

Block



Purpose

To provide read access to one of the two queued A/D converters (QADC).

Description

One RPCU_ADC_BLx block controls one QADC. The RapidPro Control Unit provides two QADCs, thus, up to two RPCU_ADC_BLx blocks are allowed in one model. The two QADCs provide together 40 A/D conversion channels. The channels are connected in parallel to the two QADCs and, thus, can be used by both QADCs. One QADC can use up to 20 A/D conversion channels.

For basic information, refer to Basics on A/D Conversion (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮) and Technical Details of the RapidPro Control Unit (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the **Basic I/O** button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port		Description
Input		
	Continue	Controls A/D conversion. Available only if Conversion mode on page 32 is set to "Continuous". Data type: Boolean 1: Continuous A/D conversions are activate. 0: Continuous A/D conversions are deactivated.
Output		
	Status	Represents the current status of the output: 1: New value available 0: Old value available Available only if the Enable outport Status on page 34 checkbox is selected. Data type: UInt8
	MUX_ADC	Outputs the current results of the A/D conversions for all ADC channels as listed in the MC Channel selection field. The output is a vector whose number of elements equals Number of ADC Channels multiplied by the Number of buffered conversion results. The vector's elements are sorted as follows: 1. By channel 2. By conversion For example, if 3 channels were used and 2 conversions were buffered, the vector would look like this: ($Value_{Ch1,Conv1}$; $Value_{Ch1,Conv2}$; $Value_{Ch2,Conv1}$;$Value_{Ch2,Conv2}$; $Value_{Ch3,Conv1}$; $Value_{Ch3,Conv2}$) If the **Enable burst mode** checkbox is selected, the output comprises the A/D conversion results for the last conversion burst of the current channel. Refer to Enable burst mode on page 33. Data type: Double Range: 0 … 1
	Channel Idx	Indexes the A/D conversion channel (see ADC channel list) for which the last conversion burst was performed. Available only if the Enable burst mode on page 33 checkbox is selected. Data type: UInt8 Range: 1 … 20

Related RTLib functions

- dsrpcu_qadc_init2 (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_qadc_start (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_qadc_stop (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_qadc_request (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_qadc_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_qadc_burst_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_qadc_burst_start (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_qadc_burst_stop (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_qadc_burst_request (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_qadc_burst_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_ADC_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related RPCU_SETUP_BLx on page 18 block.

Parameters Page (RPCU_ADC_BLx)

Purpose

To specify A/D conversion options.

Basic settings

ADC unit Lets you choose one of the two A/D converters.

Available ADC channel Lists all channels that can be addressed for A/D conversion.

Number of ADC channels Lets you choose the total number of channels for which A/D conversion is performed:

- ≤20, if the Buffer conversion results checkbox is cleared
- ≤12, if the Buffer conversion results checkbox is selected

MC Channel selection Lets you specify an array ($size_{max}$ = 20 or 12, see Number of ADC channels) of channel numbers (range: 1 … 40), for which A/D conversion is performed. The order of the channel numbers (from left to right) reflects the processing order.

If Enable burst mode is selected and Conversion mode is set to "Continuous", only one channel can be specified.

Note

If you use the continuous mode, you should specify at least 10 A/D channels in the queue to avoid a task overrun on the RapidPro Control Unit.

Trigger source Lets you choose the kind of trigger that invokes an A/D conversion.

- Sample base rate: The A/D converter is triggered by the model. The Sample time parameter determines the frequency of the trigger.
- External trigger: The A/D converter is triggered by an external trigger signal. The Edge polarity parameter determines the edge polarity of the signal. The channels ADCTrig1 and ADCTrig2 must be routed on a digital input module.
- TPU PWM mode: The A/D converter is triggered by a PWM interrupt. The PWM interrupt is triggered at the rising edge of the PWM signal. Thus, an RPCU_PWM_TPU_BLx block must be allocated to the RPCU_ADC_BLx block (RPCU_PWM_TPU_BLx on page 59). Refer to the TPU PWM channel on page 32 parameter.

- Engine mode: The A/D converter is triggered by an RPCU_ANGLE_INT_BLx block. Thus, an RPCU_ANGLE_INT_BLx block must be allocated to the RPCU_ADC_BLx block (RPCU_ANGLE_INT_BLx on page 182). The **Angle index** on page 32 parameter specifies the angle interrupt used.

Note

Dependent on the selection of the trigger source, one of the following options is available (Conversion mode, PWM channel, Angle index, or Edge polarity):

Conversion mode Lets you choose the conversion mode to be used as the trigger source. Possible values are single or continuos. If you use the continuous mode, you should specify at least 4 A/D channels in the queue to avoid a task overrun on the RapidPro Control Unit. Refer to A/D Conversion (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮). Enabled only if Trigger source is set to "Sample base rate".

– or –

TPU PWM channel Lets you choose a PWM channel to be used as the trigger source. Refer to A/D Conversion (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮). Enabled only if Trigger source is set to "PWM mode".

– or –

Angle index Lets you choose an angle interrupt to be used as the trigger source. Refer to Angle-Based Interrupt (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮). Enabled only if Trigger source is set to "Engine mode".

– or –

Edge polarity Lets you choose the edge polarity of the external trigger to be used as the trigger source. Refer to A/D Conversion (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮). Enabled only if Trigger source is set to "External trigger".

Buffer conversion results (Disabled if **Enable burst mode** checkbox is selected, or if **Trigger source** is set to "Sample base rate" and **Conversion mode** is set to "Continuous") Indicates whether the results of several conversions are buffered on the slave (RapidPro system) before they are sent as a whole to the master (RCP system).

Number of buffered conversion results Lets you choose the number of conversions whose results are buffered.

Converter settings

Enable burst mode Indicates whether the A/D converter works in burst mode.

> **Note**
>
> A/D burst conversions are performed with the fastest sample rate (conversion time), which is typically 4 µs (refer to MC-MPC565 1/1 Module (RapidPro System Hardware Reference 🕮)). However, the signal frequency must not exceed the module-specific limit (cutoff or input frequency), refer to SC-AI 4/1 Module (RapidPro System Hardware Reference 🕮) and SC-AI 10/1 Module (RapidPro System Hardware Reference 🕮).

For information on burst mode, refer to Comparison of Standard and Burst A/D Conversion (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Burst size Lets you choose the number of A/D conversions during a complete conversion burst. Possible values are 64 or 128. Disabled if the Enable burst mode checkbox is cleared. Disabled and set to 64 if Conversion mode is set to "Continuous".

Read Mode Lets you choose how the channels related to A/D conversion are accessed:

- Read current value (default): The RCP system requests the RapidPro system to write a new result to the dual-port memory (DPMEM) but simultaneously reads the data that is currently available from the DPMEM.
- Read new value: The RCP system requests the RapidPro system to write a new result to the DPMEM and waits for the requested data. The RapidPro system writes the requested data to the DPMEM. The RCP system reads the requested data from the DPMEM.

Enabled only if Trigger source is set to "Sample base rate", Conversion mode is set to "Single", and the Enable burst mode checkbox is cleared.

> **Note**
>
> If the Read Mode parameter is disabled, the default option is active (Read current value).

For further information, refer to Basics on A/D Conversion (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Related topics

Basics

Comparison of Standard and Burst A/D Conversion (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

References

RPCU_ANGLE_INT_BLx..... 182

Advanced Page (RPCU_ADC_BLx)

Purpose

To specify advanced block options.

Trigger setting

Trigger delay Lets you choose the time delay in seconds between the trigger and the start of A/D conversion. The range is 45.71 ns … 46.81 µs. Disabled and set to "no delay" if **Trigger source** on page 31 is set to "External trigger" or "Engine mode", or **Conversion mode** on page 32 is set to "Continuous".

For further information, refer to Basics on A/D Conversion (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Interrupt setting

Enable interrupt Indicates whether end-of-conversion interrupts (EOC interrupts) are generated. Refer to RPCU_INTERRUPT_BLx on page 226.

Disabled and cleared if Conversion mode is set to "Continuous".

Note

If Trigger source is set to "Sample base rate", the RPCU_ADC_BLx block must not reside in a subsystem that is triggered by the block's own EOC interrupt.

Tip

EOC interrupts can be used to trigger, for example, a Simulink® subsystem.

Sample time

Sample time Lets you specify the block's sample time in seconds (range: >=0). If -1 is specified, the sample time of the Simulink subsystem is adopted. Enabled only if **Trigger source** on page 31 is set to "Sample base rate".

Outport setting

Enable outport Status Indicates whether the block has a "Status" output port for status information about the data in the DPMEM. See the I/O characteristics of the block.

Bit I/O

Introduction

The RapidPro Control Unit RTI blockset provides blocks that you can use for reading/writing digital signals.

Where to go from here

Information in this section

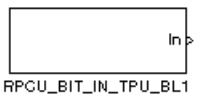
RPCU_BIT_IN_TPU_BLx

Where to go from here

Information in this section

RPCU_BIT_IN_TPU_BLx Block Description

Block



Purpose

To provide bit-wise read access to the digital input via a TPU channel. Interrupts can be generated when the value of the digital input changes.

Description

An RPCU_BIT_IN_TPU_BLx block performs a read access to one digital TPU input channel. Interrupts can be generated when the value of the digital input changes.

For basic information, refer to Basics of Bit I/O (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the **Basic I/O** button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O

mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
In	Current value (low/high) of the BIT IN channel. Data type: Boolean 1: High 0: Low
Status	Represents the reading status. Available only if the Enable outport Status on page 38 checkbox is selected. Data type: UInt8 1: Inport state has been updated since last read access 0: Inport state has not been updated since last read access

Related RTLib functions

- dsrpcu_tpu_digin_init2 (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_tpu_digin_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_BIT_IN_TPU_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration	**TopologyID** Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related RPCU_SETUP_BLx on page 18 block.
Input port selection	**Input port selection** Lets you choose an input channel for signal capture. The channels offered are referenced from the hardware topology file (*.hwt). Channels that are used by the block are marked with "+", channels that are used by other blocks are marked with "*". For information on the HWT file, refer to RPCU_SETUP_BLx on page 18.

Parameters Page (RPCU_BIT_IN_TPU_BLx)

Purpose	To specify interrupt and status options.
Interrupt settings	**Enable interrupt** Indicates whether interrupts are generated as soon as new values exist. Refer to RPCU_INTERRUPT_BLx on page 226. **Edge polarity** Lets you choose the kind of edge polarity for interrupt generation. Possible values are Either edge, Rising edge or Falling edge. Disabled if the Enable interrupt checkbox is cleared.
Outport setting	**Enable outport Status** Indicates whether the block has a "Status" output port for status information about the data in the DPMEM. See the I/O characteristics of the block.

Advanced Page (RPCU_BIT_IN_TPU_BLx)

Purpose	To specify read options and sample time.
Read settings	**Enable request-read** Indicates whether the RCP system triggers the RapidPro system to write the most up-to-date measurement values to the DPMEM (dual-port memory). If this checkbox is cleared, the RapidPro system updates the results in the DPMEM as soon as new measurement values are available.

Note

If the frequency of the measured signal is high, it is helpful to let the RCP system trigger the RapidPro system (enable request-read), as it avoids an unnecessary load on the CPU of the RapidPro system. On the contrary, if the frequency of the measured signal is low, it does not make sense to trigger the RapidPro system (disable request-read).

Read mode (Disabled and set to default if the **Enable request-read** checkbox is cleared) Lets you choose how the master retrieves the measurement results from the DPMEM:

- Read current value (default): The RCP system requests the RapidPro system to write a new result to the DPMEM but simultaneously reads the data that is currently available from the DPMEM.
- Read new value: The RCP system requests the RapidPro system to write a new result to the DPMEM and waits for the requested data. The RapidPro system writes the requested data to the DPMEM. The RCP system reads the requested data from the DPMEM.

Sample time

Sample time Lets you enter the sample time for the block in seconds:

- -1 : The sample time is inherited from the blocks that the block is connected to. If the block resides in a triggered subsystem, this setting must be selected.
- 0: The block uses the discrete sample time of the Simulink model.
- >0: The block is executed with the sample time as specified.

Related topics

Basics

Basics of PWM Signal Measurement (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

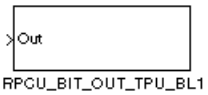
RPCU_BIT_OUT_TPU_BLx

Where to go from here

Information in this section

RPCU_BIT_OUT_TPU_BLx Block Description

Block



Purpose

To provide bit-wise write access to the digital output via a TPU channel.

Description

An RPCU_BIT_OUT_TPU_BLx block performs a write access to one digital TPU input channel.

For basic information, refer to Basics of Bit I/O (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the **Basic I/O** button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Out	Current value (low/high) of the BIT OUT channel. Data type: Boolean 1: High 0: Low

Related RTLib functions

- dsrpcu_tpu_digout_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_tpu_digout_write (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_BIT_OUT_TPU_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Output port selection

Output port selection Lets you choose a channel for signal output. The channels offered are referenced from the hardware topology file (*.hwt), refer to

RPCU_SETUP_BLx on page 18. Channels that are used by the block are marked with "+", channels that are used otherwise are marked with "*".

Parameters Page (RPCU_BIT_OUT_TPU_BLx)

Purpose

To specify the digital output at initialization and termination.

Initialization

During the model initialization phase, an initial digital output value is written to the output channel. This is especially useful if the channel is used within a triggered or enabled subsystem that is not executed right from the start of the simulation. With the initial state value, the channel has a defined output during this simulation phase.

Initial output value To specify the digital output at initialization. Possible values are Low or High.

Termination

When the simulation terminates, the output channel holds its last digital output value by default. You can specify a user-defined output value on termination, and use these settings to drive your external hardware into a safe final condition.

The specified termination value is set when the simulation executes its termination function by setting the simState variable to STOP. If the real-time process is stopped by using ControlDesk's Stop RTP command, the processor resets immediately without executing termination functions. The specified termination values are not set.

⚠ WARNING

Applying ControlDesk's Stop RTP command can lead to unpredictable results.

Risk of injury and material damage!

- Before applying ControlDesk's Stop RTP command, think through the effects of the command.
- Ensure that no one is in the potential danger zone of the device (machine, etc.) when the command is applied.

Termination state Indicates whether the following parameter is evaluated when the termination function is executed.

Output value on termination To specify the digital output at termination. Possible values are Low or High.

Related topics

References

simState (RTI and RTI-MP Implementation Reference 🕮)

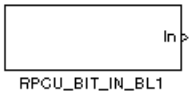
RPCU_BIT_IN_BLx

Where to go from here

Information in this section

RPCU_BIT_IN_BLx Block Description

Block



Purpose

To provide multi-channel read access to the digital input of one group.

Description

Digital input and output channels make up a group. There can be up to five groups. A group comprises eight channels (8-bit group). A group can comprise both input and output channels. The hardware topology file (*.hwt) specifies which channels of a group are used for input or output (the RPCU_BIT_IN_BLx block displays only input channels). A group can be assigned to several blocks, but a channel can be addressed only once.

For example:

Group	Channel	Block
1	1 (In)	A
1	3 (In)	B
1	4 (In)	B
1	8 (Out)	C

For basic information, refer to Basics of Bit I/O (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter `rtirpcu` in the MATLAB Command Window.
2. Click the **Basic I/O** button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
In	Vector of current values (low/high) of the BIT_IN channels. The number of elements depends on the number of channels selected. Refer to Channel list on page 46. Data type: Boolean 1: High 0: Low
Status	Represents the reading status. Available only if the Enable outport Status on page 47 checkbox is selected. Data type: UInt8 1: Inport state has been updated since last read access 0: Inport state has not been updated since last read access

Related RTLib functions

- dsrpcu_bio_init2 (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_bio_req_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Related topics

Basics

Basics of Bit I/O (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Unit Page (RPCU_BIT_IN_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Parameters Page (RPCU_BIT_IN_BLx)

Purpose

To specify a group for digital input.

Input port selection

Group number Lets you choose one out of five 8-bit groups. When the group number is changed, the block output labels are updated.

Channel list Indicates whether a channel is configured as digital input. The channel's name is referenced from the related hardware topology file (*.hwt). Disabled, if this channel is not a "BIT_IN" type, and if the channel is not routed at all.

Advanced Page (RPCU_BIT_IN_BLx)

Purpose	To specify advanced block options.
Read setting	**Read mode** Lets you choose how the digital input pins are accessed: ▪ Read current value (default): The RCP system requests the RapidPro system to write a new result to the dual-port memory (DPMEM) but simultaneously reads the data that is currently available from the DPMEM. ▪ Read new value: The RCP system requests the RapidPro system to write a new result to the DPMEM and waits for the requested data. The RapidPro system writes the requested data to the DPMEM. The RCP system reads the requested data from the DPMEM.
Outport setting	**Enable outport Status** Indicates whether the block has a "Status" output port for status information about the data in the DPMEM. See the I/O characteristics of the block.

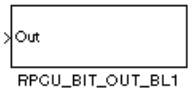
RPCU_BIT_OUT_BLx

Where to go from here

Information in this section

RPCU_BIT_OUT_BLx Block Description

Block



Purpose

To provide multi-channel write access to the digital output.

Description

Digital input and output channels make up a group. There can be up to five groups. A group comprises eight channels (8-bit group). A group can comprise both input and output channels. The hardware topology file (*.hwt) specifies which channels of a group are used for input or output (the RPCU_BIT_OUT_BLx block displays only output channels). A group can be assigned to several blocks, but a channel can be addressed only once.

For example:

Group	Channel	Block
1	1 (In)	A
1	3 (In)	B
1	4 (In)	B
1	8 (Out)	C

For basic information, refer to Basics of Bit I/O (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter **rtirpcu** in the MATLAB Command Window.
2. Click the Basic I/O button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Out	Vector of current values (0/1) of the BIT_OUT channels. The number of elements depends on the number of ports selected. Data type: Boolean 1: High 0: Low

Related RTLib functions

- dsrpcu_bio_init2 (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_bio_write (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_BIT_OUT_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related RPCU_SETUP_BLx on page 18 block.

Parameters Page (RPCU_BIT_OUT_BLx)

Purpose

To specify digital outputs within a group.

Output port selection

Group number Lets you choose one out of five 8-bit groups. When the group number is changed, the block output labels are updated.

Channel list Indicates whether a channel is configured as digital output. The channel's name is referenced from the related hardware topology file (*.hwt). Disabled, if this channel is not a "BIT_OUT" type, and if the channel is not routed at all.

Initialization Page (RPCU_BIT_OUT_BLx)

Purpose

To specify the digital output at initialization.

Description

During the model initialization phase, an initial digital output value is written to each channel. This is especially useful if a channel is used within a triggered or enabled subsystem that is not executed right from the start of the simulation. With the initial state value, all channels have defined outputs during this simulation phase.

Initialization settings

Group number Displays the group used for digital output.

Channel list Lets you choose an initial state value. Possible values are Low or High. Disabled if the related <Channel_Out> checkbox on the Parameters page is cleared.

Set all Sets all <Initial_value> settings to the value selected in the popup list on the left, which may help you editing the channel list. Possible values are Low or High.

Termination Page (RPCU_BIT_OUT_BLx)

Purpose

To specify the digital output at termination.

Description

When the simulation terminates, all channels hold their last digital output values by default. You can specify a user-defined output value on termination, and use these settings 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 the real-time process is stopped by using ControlDesk's Stop RTP command, the processor resets immediately without executing termination functions. The specified termination values are not set.

⚠ WARNING

Applying ControlDesk's Stop RTP command can lead to unpredictable results.

Risk of injury and material damage!

- Before applying ControlDesk's Stop RTP command, think through the effects of the command.
- Ensure that no one is in the potential danger zone of the device (machine, etc.) when the command is applied.

Termination settings

Group number Displays the group used for digital output.

Termination state Indicates whether the digital output is set to <Termination_value> when the simulation terminates. Otherwise, the current digital output value is kept.

Channel list Lets you choose a termination value. Possible values are Low or High. Disabled if Termination state is cleared, and if the related <Channel_Out> checkbox on the Parameters page is cleared.

Set all Sets all <Termination_value> settings to the value selected in the popup list on the left, which may help you editing the channel list. Possible values are Low or High.

Related topics

References

simState (RTI and RTI-MP Implementation Reference 🕮)

Timing I/O

Introduction

The RapidPro Control Unit RTI blockset provides blocks that you can use for generating and measuring signals.

PWM signals

In the following descriptions, the expression *PWM signals* means pulse width modulated square-wave signals.

Where to go from here

Information in this section

PWM Signal Generation (PWM)

Introduction

To generate single, edge-aligned, and center-aligned PWM signals.

MIOS and TPU

PWM signal generation is possible via MIOS and TPU. For the characteristics of these two methods, refer to Comparing TPU and MIOS (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Where to go from here

Information in this section

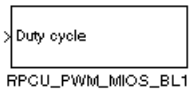
RPCU_PWM_MIOS_BLx

Where to go from here

Information in this section

RPCU_PWM_MIOS_BLx Block Description

Block



Purpose

To generate a single PWM signal on a MIOS channel.

Description

The RPCU_PWM_MIOS_BLx block is used to generate a single PWM signal on a specific output driver connected to the MIOS module of the microprocessor on the RapidPro Control Unit. The period and duty cycle of the PWM signal can be specified via inports and changed during run time. The **Period** and **Duty cycle** ports are updated at the beginning of a new PWM period. The polarity of the PWM signal is active high.

Note

Consider possible external signal inversion (SC/Power modules).

For basic information, refer to PWM Signal Generation (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the **Basic I/O** button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Duty cycle	Specifies the duty cycle of the PWM signal.
	Data type: Double Range: 0 … 1
Period	Specifies the period of the PWM signal. Must fit the **Period range** specified on the Unit page of the block's dialog. Available only if the **Enable inport Period** on page 59 checkbox is selected.
	Data type: Double Unit: Seconds [s]

Related RTLib functions

- dsrpcu_mios_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_mios_pwm_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_mios_pwm_start (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_mios_pwm_fp_update (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_mios_pwm_vp_update (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_PWM_MIOS_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related RPCU_SETUP_BLx on page 18 block.

Output port selection

Output port selection Lets you choose a channel for signal output. The channels offered are referenced from the hardware topology file (*.hwt), refer to RPCU_SETUP_BLx on page 18. Channels that are used by the block are marked with "+", channels that are used otherwise are marked with "*".

Range specification

Period range Lets you choose the period's range of the PWM signal. The range depends on the specified global prescaler value, refer to Frequency Ranges for 1-Phase PWM Signal Generation (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

The period ranges are theoretical values. In practice, the values are limited by the SC and Power modules used. For further information, refer to the module data sheet.

Parameters Page (RPCU_PWM_MIOS_BLx)

Purpose

To specify predefined PWM signals to be used during initialization and termination.

Description

During the model initialization phase, an initial digital output value is written to each channel. This is especially useful if a channel is used within a triggered or enabled subsystem that is not executed right from the start of the simulation. With the initial state value, all channels have defined outputs during this simulation phase.

When the simulation terminates, all channels hold their last digital output values by default. You can specify a user-defined output value on termination, and use these settings 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 the real-time process is stopped by using ControlDesk's Stop RTP command, the processor resets immediately without executing termination functions. The specified termination values are not set.

⚠ WARNING

Applying ControlDesk's Stop RTP command can lead to unpredictable results.

Risk of injury and material damage!

- Before applying ControlDesk's Stop RTP command, think through the effects of the command.
- Ensure that no one is in the potential danger zone of the device (machine, etc.) when the command is applied.

Initialization settings

Initial period [107.2 ns … 3.510 ms] Lets you specify the initial period range of the PWM signal at the start of a simulation.

Initial duty cycle [0 … 1] Lets you specify the initial duty cycle of the PWM signal at the start of a simulation. The duty cycle must fit 0 … 1.

Termination settings

Termination state Indicates whether the digital output is set to a predefined PWM signal when a simulation terminates. Otherwise, the current digital output value is kept.

Period on termination [107.2 ns … 3.510 ms] Lets you specify the period of the output signal when a simulation terminates. The entered value must fit the given Period range on page 57 on the Unit page. If the Enable inport Period on page 59 parameter on the Advanced page is set to off, the default value equals the value of Initial period [107.2 ns … 3.510 ms] on page 58 parameter. Disabled, if the Termination state checkbox is cleared.

Duty cycle on termination [0 … 1] Lets you specify the duty cycle of the output when the simulation terminates. The duty cycle must fit 0 … 1. Disabled, if the Termination state checkbox is cleared.

Related topics

References

simState (RTI and RTI-MP Implementation Reference 🕮)

Advanced Page (RPCU_PWM_MIOS_BLx)

Purpose

To enable synchronous start with the other MIOS-based PWM signals and enable a Period inport.

Advanced specification

Enable synchronous start Indicates whether all MIOS-based PWM signals contained in the application model start synchronously. All the synchronized PWM signals start at the first falling edge. Refer to PWM Signal Generation (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

The Enable synchronous start checkboxes of all RPCU_PWM_MIOS_BLx blocks in an application model are linked. Thus, all these checkboxes have the same status.

Inport setting

Enable inport Period Indicates whether the block has a period inport to update the period value during run-time.

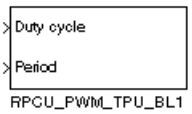
RPCU_PWM_TPU_BLx

Where to go from here

Information in this section

RPCU_PWM_TPU_BLx Block Description

Block



Purpose

To generate a single PWM signal on a TPU channel. In addition, interrupts can be generated at the rising edge of the PWM signal.

Description

The RPCU_PWM_TPU_BLx block is used to generate a single PWM signal on a specific output driver of the microprocessor on the RapidPro Control Unit. The period and duty cycle of the PWM signal can be specified via inports and changed during run time. The Period and duty cycle are updated at the beginning of a new PWM period. In addition, interrupts can be generated at the rising edge of the PWM signal. The polarity of the PWM signal is active high.

Note

Consider possible external signal inversion (SC/Power modules).

For basic information, refer to PWM Signal Generation (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the **Basic I/O** button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Duty cycle	Specifies the duty cycle of the PWM signal. Data type: Double Range: 0 … 1
Period	Specifies the period of the PWM signal. Must fit the **Period range** specified on the Unit page of the block's dialog. The range depends on the timer resolution settings, refer to Parameters Page (RPCU_TIMER_SETUP_TPU_BLx) on page 25. Data type: Double Unit: Seconds [s]

Related RTLib functions

- dsrpcu_tpu_pwm_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_tpu_pwm_update (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_PWM_TPU_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Output port selection

Output port selection Lets you choose a channel for signal output. The channels offered are referenced from the hardware topology file (*.hwt), refer to RPCU_SETUP_BLx on page 18. Channels that are used by the block are marked with "+", channels that are used otherwise are marked with "*".

Range specification

Period range Lets you choose the period's range of the PWM signal. The range depends on the timer resolution settings, refer to Parameters Page (RPCU_TIMER_SETUP_TPU_BLx) on page 25. The Timer 2 option is available only if the **Use TPU A/B/C timer 2 for engine control** checkbox on the Parameters page of the RPCU_TIMER_SETUP_TPU_BLx block is cleared.

For details on possible ranges, refer to Frequency Ranges for 1-Phase PWM Signal Generation (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

The period ranges are theoretical values. In practice, the values are limited by the SC modules used. For further information, refer to the module data sheet.

Parameters Page (RPCU_PWM_TPU_BLx)

Purpose

To specify predefined PWM signals to be used during initialization and termination.

Description

During the model initialization phase, an initial digital output value is written to each channel. This is especially useful if a channel is used within a triggered or enabled subsystem that is not executed right from the start of the simulation. With the initial state value, all channels have defined outputs during this simulation phase.

When the simulation terminates, all channels hold their last digital output values by default. You can specify a user-defined output value on termination, and use these settings 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 the real-time process is stopped by using ControlDesk's Stop RTP command, the processor resets immediately without executing termination functions. The specified termination values are not set.

⚠ WARNING

Applying ControlDesk's Stop RTP command can lead to unpredictable results.

Risk of injury and material damage!

- Before applying ControlDesk's Stop RTP command, think through the effects of the command.
- Ensure that no one is in the potential danger zone of the device (machine, etc.) when the command is applied.

Initialization settings

Initial period [<Period range>] Lets you specify the initial period of the PWM signal at the start of a simulation. The entered value must fit the given Period range on page 61.

Initial duty cycle [0 … 1] Lets you specify the initial duty cycle of the PWM signal at the start of a simulation. The duty cycle must fit 0 … 1.

Termination settings

Termination state Indicates whether the digital output is set to a predefined PWM signal when a simulation terminates. Otherwise, the current digital output value is kept.

Period on termination [<Period range>] Lets you specify the period when a simulation terminates. The entered value must fit the given Period range on page 61. Disabled, if the Termination state checkbox is cleared.

Duty cycle on termination [0 … 1] Lets you specify the duty cycle of the output when the simulation terminates. The duty cycle must fit 0 … 1. Disabled, if the Termination state checkbox is cleared.

Related topics

References

simState (RTI and RTI-MP Implementation Reference 🕮)

Advanced Page (RPCU_PWM_TPU_BLx)

Purpose

To specify the interrupt settings.

Interrupt settings

Enable interrupt Indicates whether PWM interrupts are generated. Refer to RPCU_INTERRUPT_BLx on page 226.

Interrupt number Lets you specify the number of PWM periods after which an interrupt is periodically generated. The range is 1 … 256. The interrupt is triggered at the rising edge of the PWM signal.

Note

If you invert the signal externally, the interrupt is triggered at the falling edge of the PWM signal.

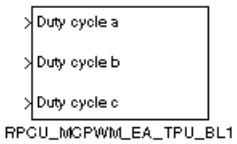
RPCU_MCPWM_EA_TPU_BLx

Where to go from here

Information in this section

RPCU_MCPWM_EA_TPU_BLx Block Description

Block



Purpose

To generate edge-aligned PWM signals with variable duty cycles on a TPU channel. Interrupts can be additionally generated.

Description

The RPCU_MCPWM_EA_TPU_BLx block is used to generate three edge-aligned PWM signals. Each signal is generated on an output driver connected to a TPU channel of the microprocessor on the RapidPro Control Unit. The signals are synchronized to their rising edges (same frequency). The duty cycles of the three PWM signals can be changed separately at run time, and are updated at the beginning of a new PWM period.

Interrupts (fixed and variable) can be additionally generated within a PWM period. If a fixed position interrupt is selected, the interrupt is triggered at the rising edge of the PWM signals. If a variable position interrupt is selected, the **Interrupt delay** on page 69 setting defines the delay between the rising edge of the PWM signals and the time when the interrupt is triggered.

Tip

If the interrupt channel is routed as a digital output channel (TPU), you can use it as an external trigger source for A/D conversion.

For basic information, refer to PWM Signal Generation (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter `rtirpcu` in the MATLAB Command Window.
2. Click the Basic I/O button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Duty cycle a	Specifies the duty cycle of the PWM signal of channel a. Data type: Double Range: 0 … 1
Duty cycle b	Specifies the duty cycle of the PWM signal of channel b. Data type: Double Range: 0 … 1
Duty cycle c	Specifies the duty cycle of the PWM signal of channel c. Data type: Double Range: 0 … 1

Related RTLib functions

- dsrpcu_tpu_mcpwm_ea_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_tpu_mcpwm_ea_update (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_MCPWM_EA_TPU_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Output port selection

Output port selection Displays the available TPU channels, as referenced from the hardware topology file (*.hwt), refer to RPCU_SETUP_BLx on page 18. Channels that are used by the block are marked with "+", channels that are used otherwise are marked with "*".

The TPU channels CH02, CH03, and CH04 must be displayed in the list (that is, they are routed as output channels) and not be used by other blocks ("*"). If displayed in the list (that is routed), the TPU channel CH01 must also not be used by other blocks ("*"), too.

Whether an additional TPU channel (CH05) is used for interrupt generation depends on the **Enable interrupt** on page 68 parameter. The interrupt channel does not need to be routed.

MC PWM generated on Lets you choose the TPU to be used. Only TPUs that are able to generate the required PWM signals due to an appropriate routing of the TPU channels are available.

For details on the routing, refer to RapidPro System Hardware Reference 🕮.

Period specification

Period range Lets you choose the period's range of the PWM signal. The range depends on the Timer resolution settings, refer to Parameters Page (RPCU_TIMER_SETUP_TPU_BLx) on page 25. The Timer 2 option is available only

if the **Use TPU A/B/C timer 2 for engine control** checkbox on the Parameters Page of the RPCU_TIMER_SETUP_TPU_BLx block is cleared.

For details on possible ranges, refer to Frequency Ranges for Edge-Aligned Multi-Channel PWM Signal Generation (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

The period ranges are theoretical values. In practice, the values are limited by the SC modules used. For further information, refer to the module data sheet.

Period Lets you specify the PWM period, which must fit the period range.

Parameters Page (RPCU_MCPWM_EA_TPU_BLx)

Purpose

To specify predefined PWM signals to be used during initialization and termination.

Description

During the model initialization phase, an initial digital output value is written to each channel. This is especially useful if a channel is used within a triggered or enabled subsystem that is not executed right from the start of the simulation. With the initial state value, all channels have defined outputs during this simulation phase.

When the simulation terminates, all channels hold their last digital output values by default. You can specify a user-defined output value on termination, and use these settings 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 the real-time process is stopped by using ControlDesk's Stop RTP command, the processor resets immediately without executing termination functions. The specified termination values are not set.

⚠ WARNING

Applying ControlDesk's Stop RTP command can lead to unpredictable results.

Risk of injury and material damage!

- Before applying ControlDesk's Stop RTP command, think through the effects of the command.
- Ensure that no one is in the potential danger zone of the device (machine, etc.) when the command is applied.

Initialization settings

Initial duty cycle a [0 … 1] Lets you specify the initial duty cycle of the PWM signal of channel a at the start of a simulation. The duty cycle must fit 0 … 1.

Initial duty cycle b [0 … 1] Lets you specify the initial duty cycle of the PWM signal of channel b at the start of a simulation. The duty cycle must fit 0 … 1.

Initial duty cycle c [0 … 1] Lets you specify the initial duty cycle of the PWM signal of channel c at the start of a simulation. The duty cycle must fit 0 … 1.

Termination settings

Termination state Indicates whether the digital output is set to a predefined PWM signal when a simulation terminates. Otherwise, the current digital output value is kept.

Duty cycle on termination a [0 … 1] Lets you specify the duty cycle of the output of channel a when the simulation terminates. The duty cycle must fit 0 … 1. Disabled if the Termination state checkbox is cleared.

Duty cycle on termination b [0 … 1] Lets you specify the duty cycle of the output of channel b when the simulation terminates. The duty cycle must fit 0 … 1. Disabled if the Termination state checkbox is cleared.

Duty cycle on termination c [0 … 1] Lets you specify the duty cycle of the output of channel c when the simulation terminates. The duty cycle must fit 0 … 1. Disabled if the Termination state checkbox is cleared.

Related topics

References

simState (RTI and RTI-MP Implementation Reference 🕮)

Advanced Page (RPCU_MCPWM_EA_TPU_BLx)

Purpose

To specify interrupt properties.

Interrupt specification

Enable interrupt Indicates whether PWM interrupts are generated. Refer to RPCU_INTERRUPT_BLx on page 226.

Interrupt number Lets you specify the number of PWM periods after which an interrupt is periodically generated. The range is 1 … 256.

Interrupt at fixed position Indicates whether the interrupt is triggered at the rising edge of the PWM signal.

Note

If you invert the signal externally, the interrupt is actually triggered at the falling edge of the PWM signal.

Interrupt at variable position Indicates whether the interrupt is triggered at a specific position of the PWM signal (refer to Interrupt delay below).

Note

For the use of variable interrupts, an additional PWM signal PWM_int is generated which is specified as follows (for details, refer to Basics of Edge-Aligned Multi-Channel PWM Signal Generation (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)):

- Rising edge at the same position as the variable interrupt
  By specifying the number of PWM periods after which a variable interrupt is periodically generated (see IntRate parameter), you also specify the number of PWM periods after which the additional PWM signal is periodically generated.
- Falling edge at the middle of the period of the edge-aligned multi-channel PWM signal

Due to the master-slave communication it might happen that an interrupt reaches the master processor a few micro seconds later than specified. The actual delay depends on your application.

Tip

If the interrupt channel (TPU channel 5) is routed as a digital output channel, you can use PWM_int as external trigger source for A/D conversion, for example.

Interrupt delay Lets you specify the delay (in seconds) from the beginning of a PWM period (rising edge of PWM signal) until the time when the interrupt is triggered. The range is 0 s … 0.0005 s. The possible range depends on the upper limit of the Period range on page 66 and the Period on page 67 itself.

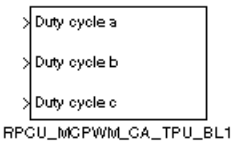
RPCU_MCPWM_CA_TPU_BLx

Where to go from here

Information in this section

RPCU_MCPWM_CA_TPU_BLx Block Description

Block



Purpose

To generate center-aligned PWM signals with variable duty cycles on a TPU channel. Interrupts can be additionally generated.

Description

The RPCU_MCPWM_CA_TPU_BLx block is used to generate either three center-aligned non-inverted PWM signals or six center-aligned PWM signals (three inverted and three non-inverted). Each signal is generated on an output driver connected to a TPU channel of the microprocessor on the RapidPro Control Unit. The signals are synchronized to the center positions of their high and low times. The duty cycles of the signals can be changed separately at run time, and are simultaneously updated at the beginning of a new PWM period.

You can specify dead times for the non-inverted PWM signals of the six center-aligned PWM signals.

Note

Simultaneous updating of all three duty cycles is possible down to a period of about 50 µs. If faster periods are desired, simultaneous updating cannot be guaranteed.

Interrupts (fixed and variable) can be additionally generated within a PWM period. The PWM periods for all channels start with the center position of the low times. If a fixed position interrupt is selected, the interrupt is triggered at the

center positions of the high times of the PWM periods. If a variable position interrupt is selected, the Interrupt delay setting defines the delay between the start of the PWM periods and the point in time when the interrupt is triggered.

Tip

If the interrupt channel is routed as a digital output channel (TPU), you can use it as an external trigger source for A/D conversion.

For basic information, refer to PWM Signal Generation (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter `rtirpcu` in the MATLAB Command Window.
2. Click the Basic I/O button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Duty cycle a	Specifies the duty cycle of the PWM signal of channel a. Data type: Double Range: 0 … 1
Duty cycle b	Specifies the duty cycle of the PWM signal of channel b. Data type: Double Range: 0 … 1
Duty cycle c	Specifies the duty cycle of the PWM signal of channel c. Data type: Double Range: 0 … 1

Related RTLib functions

- dsrpcu_tpu_mcpwm_ca_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

- dsrpcu_tpu_mcpwm_ca_update (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_MCPWM_CA_TPU_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Output port selection

Output port selection Displays the available TPU channels, as referenced from the hardware topology file (*.hwt), refer to RPCU_SETUP_BLx on page 18. Channels that are used by the block are marked with "+", channels that are used otherwise are marked with "*".

The following TPU channels must be displayed (that is, they are routed as output channels), and also not be used by other blocks ("*"):

- CH02, CH04, CH06

  (PWM 3 phase signal generation)

  – or –

- CH02, CH04, CH06, CH08, CH10, CH12

  (PWM 6 phase signal generation)

If displayed in the list (that is, they are routed as output channels) the following TPU channels must not be used by other blocks ("*"), too:

- CH01, CH03, CH05, CH07, CH08

  (PWM 3 phase signal generation)

  – or –

- CH01, CH03, CH05, CH07, CH09, CH11, CH13, CH14

  (PWM 6 phase signal generation)

Whether an additional TPU channel (CH09/CH15) is used for interrupt generation depends on the **Enable interrupt** parameter. The interrupt channel does not need to be routed.

MC PWM generated on Lets you choose the TPU to be used. Only TPUs that are able to generate the required PWM signals due to an appropriate routing of the TPU channels are available.

For details on the routing, refer to RapidPro System Hardware Reference 🕮.

Parameters Page (RPCU_MCPWM_CA_TPU_BLx)

Purpose

To specify predefined PWM signals to be used during initialization and termination.

Description

During the model initialization phase, an initial digital output value is written to each channel. This is especially useful if a channel is used within a triggered or enabled subsystem that is not executed right from the start of the simulation. With the initial state value, all channels have defined outputs during this simulation phase.

When the simulation terminates, all channels hold their last digital output values by default. You can specify a user-defined output value on termination, and use these settings 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 the real-time process is stopped by using ControlDesk's Stop RTP command, the processor resets immediately without executing termination functions. The specified termination values are not set.

⚠ WARNING

Applying ControlDesk's Stop RTP command can lead to unpredictable results.

Risk of injury and material damage!

- Before applying ControlDesk's Stop RTP command, think through the effects of the command.
- Ensure that no one is in the potential danger zone of the device (machine, etc.) when the command is applied.

Period specification

PWM signal mode Lets you choose whether the three PWM signals are also available as inverted signals ("PWM 6 phase signal generation").

Period range Lets you choose the period's range of the PWM signal. The range depends on the Timer resolution settings, refer to Parameters Page (RPCU_TIMER_SETUP_TPU_BLx) on page 25. The Timer 2 option is available only if the **Use TPU A/B/C timer 2 for engine control** checkbox on the Parameters Page of the RPCU_TIMER_SETUP_TPU_BLx block is cleared.

For details on possible ranges, refer to Frequency and Dead Time Ranges for Center-Aligned Multi-Channel PWM Signal Generation (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

The period ranges are theoretical values. In practice, the values are limited by the SC modules used. For further information, refer to the module data sheet.

Period Lets you specify the period value, which must fit the period range.

PWM deadband Lets you specify the dead time of the non-inverted PWM signals.

For details on possible ranges, refer to Frequency and Dead Time Ranges for Center-Aligned Multi-Channel PWM Signal Generation (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

This parameter is disabled if **PWM signal mode** on page 74 is set to "PWM 3 phase signal generation".

Initialization

Initial duty cycle a [0 … 1] Lets you specify the initial duty cycle of the PWM signal of channels a+ and a- at the start of a simulation. The duty cycle must fit 0 … 1.

Initial duty cycle b [0 … 1] Lets you specify the initial duty cycle of the PWM signal of channels b+ and b- at the start of a simulation. The duty cycle must fit 0 … 1.

Initial duty cycle c [0 … 1] Lets you specify the initial duty cycle of the PWM signal of channels c+ and c- at the start of a simulation. The duty cycle must fit 0 … 1.

Termination

Termination state Indicates whether the digital output is set to a predefined PWM signal when a simulation terminates. Otherwise, the current digital output value is kept.

Duty cycle on termination a [0 … 1] Lets you specify the duty cycle of the output of channels a+ and a- when the simulation terminates. The duty cycle must fit 0 … 1. Disabled if the Termination state checkbox is cleared.

Duty cycle on termination b [0 … 1] Lets you specify the duty cycle of the output of channels b+ and b- when the simulation terminates. The duty cycle must fit 0 … 1. Disabled if the Termination state checkbox is cleared.

Duty cycle on termination c [0 … 1] Lets you specify the duty cycle of the output of channels c+ and c- when the simulation terminates. The duty cycle must fit 0 … 1. Disabled if the Termination state checkbox is cleared.

Related topics

References

simState (RTI and RTI-MP Implementation Reference 🕮)

Advanced Page (RPCU_MCPWM_CA_TPU_BLx)

Purpose

To specify interrupt properties.

Interrupt specification

Enable interrupt Indicates whether PWM interrupts are generated. Refer to RPCU_INTERRUPT_BLx on page 226.

Interrupt number Lets you specify the number of PWM periods after which an interrupt is periodically generated. The range is 1 … 256.

Interrupt at fixed position Indicates whether the interrupt is triggered at the center position of the high time of the PWM signal.

Note

If you invert the signal externally, the interrupt is actually triggered at the center position of the low time of the PWM signal.

Interrupt at variable position Indicates whether the interrupt is triggered at a specific position of the PWM signal (refer to Interrupt delay below).

Note

For the use of variable interrupts, an additional PWM signal PWM_int is generated which is specified as follows (for details, refer to Basics of Center-Aligned Multi-Channel PWM Signal Generation (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)):

- Rising edge at the same position as the variable interrupt
  By specifying the number of PWM periods after which a variable interrupt is periodically generated (see IntRate parameter), you also specify the number of PWM periods after which the additional PWM signal is periodically generated.
- Falling edge at the middle of the period of the center-aligned multi-channel PWM signal

Due to the master-slave communication it might happen that an interrupt reaches the master processor a few micro seconds later than specified. The actual delay depends on your application.

Tip

If the interrupt channel (PWM3: TPU channel 8, PWM6: TPU channel 14) is routed as digital output channel, you can use PWM_int as external trigger source for A/D conversion, for example.

Interrupt delay Lets you specify the delay (in seconds) from the beginning of a PWM period, that is, from the center position of the low time of the PWM signal, until the time when the interrupt is triggered. The range is 0 s … 0.0005 s. The possible range depends on the upper limit of the Period range on page 74 and the Period on page 74 itself.

PWM Signal Measurement (PWM2D)

Introduction

To measure the frequency and duty cycle of a single PWM signal.

Where to go from here

Information in this section

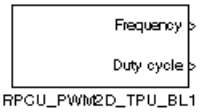
RPCU_PWM2D_TPU_BLx

Where to go from here

Information in this section

RPCU_PWM2D_TPU_BLx Block Description

Block



Purpose

To measure the frequency and duty cycle of a single PWM signal on a specified TPU channel.

Description

The RPCU_PWM2D_TPU_BLx block is used to measure the frequency and duty cycle of a PWM characteristic signal on a specific input driver connected to a TPU channel.

For basic information, refer to PWM Signal Measurement (PWM2D) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the **Basic I/O** button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Frequency	The measured frequency of the PWM signal. Data type: Double Unit: Hz
Duty cycle	The measured duty cycle of the PWM signal. Data type: Double Range: 0 … 1
Status	Represents the status of the measurement. Available only if the **Enable outport Status** on page 81 checkbox is selected. Data type: UInt8 1: Result value has been updated since last read access 0: Result value has not been updated since last read access

Related RTLib functions

- dsrpcu_tpu_pwm2d_init2 (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_tpu_pwm2d_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_tpu_pwm2d_request (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_tpu_pwm2d_req_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_PWM2D_TPU_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Input port selection Lets you choose an input channel for signal capture. The channels offered are referenced from the hardware topology file (*.hwt). Channels that are used by the block are marked with "+", channels that are used by other blocks are marked with "*".

For information on the HWT file, refer to **RPCU_SETUP_BLx** on page 18.

Period range Lets you choose the period's range of the PWM signal. The range depends on the Timer resolution settings, refer to Parameters Page (RPCU_TIMER_SETUP_TPU_BLx) on page 25. The Timer 2 option is available only if the **Use TPU A/B/C timer 2 for engine control** checkbox on the Parameters Page of the RPCU_TIMER_SETUP_TPU_BLx block is cleared.

For details on possible ranges, refer to Frequency Ranges for PWM Signal Measurement (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

The period ranges are theoretical values. In practice, the values are limited by the SC modules used. For further information, refer to the module data sheet.

Input port selection

Input port selection Lets you choose an input channel for signal capture. The channels offered are referenced from the hardware topology file (*.hwt). Channels that are used by the block are marked with "+", channels that are used by other blocks are marked with "*".

For information on the HWT file, refer to **RPCU_SETUP_BLx** on page 18.

Range specification

Period range Lets you choose the period's range of the PWM signal. The range depends on the Timer resolution settings, refer to Parameters Page (RPCU_TIMER_SETUP_TPU_BLx) on page 25. The Timer 2 option is available only if the **Use TPU A/B/C timer 2 for engine control** checkbox on the Parameters Page of the RPCU_TIMER_SETUP_TPU_BLx block is cleared.

For details on possible ranges, refer to Frequency Ranges for PWM Signal Measurement (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

The period ranges are theoretical values. In practice, the values are limited by the SC modules used. For further information, refer to the module data sheet.

Parameters Page (RPCU_PWM2D_TPU_BLx)

Purpose

To specify edge polarity and enable access to status information.

Capture setting

Edge polarity Lets you choose the edge polarity of the measurement. The possible values are Rising edge or Falling edge.

Note

Consider possible external signal inversion (SC modules).

Interrupt setting

Enable interrupt (Disabled, if the Enable request-read checkbox on the Advanced page is selected) Indicates whether interrupts are generated as soon as new measurement values exist. Refer to RPCU_INTERRUPT_BLx on page 226.

Outport setting

Enable outport Status Indicates whether the block has a "Status" output port for status information about the data in the DPMEM. See the I/O characteristics of the block.

Advanced Page (RPCU_PWM2D_TPU_BLx)

Purpose

To specify read options and sample time.

Read settings

Enable request-read Indicates whether the RCP system triggers the RapidPro system to write the most up-to-date measurement values to the DPMEM (dual-port memory). If this checkbox is cleared, the RapidPro system updates the results in the DPMEM as soon as new measurement values are available.

Note

If the frequency of the measured signal is high, it is helpful to let the RCP system trigger the RapidPro system (enable request-read), as it avoids an unnecessary load on the CPU of the RapidPro system. On the contrary, if the frequency of the measured signal is low, it does not make sense to trigger the RapidPro system (disable request-read).

Read mode (Disabled and set to default if the Enable request-read checkbox is cleared) Lets you choose how the master retrieves the measurement results from the DPMEM:

- Read current value (default): The RCP system requests the RapidPro system to write a new result to the DPMEM but simultaneously reads the data that is currently available from the DPMEM.
- Read new value: The RCP system requests the RapidPro system to write a new result to the DPMEM and waits for the requested data. The RapidPro system writes the requested data to the DPMEM. The RCP system reads the requested data from the DPMEM.

Sample time

Sample time Lets you enter the sample time for the block in seconds:

- -1 : The sample time is inherited from the blocks that the block is connected to. If the block resides in a triggered subsystem, this setting must be selected.
- 0: The block uses the discrete sample time of the Simulink model.
- >0: The block is executed with the sample time as specified.

Related topics

Basics

Basics of PWM Signal Measurement (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Pulse Width Measurement (PW2D)

Introduction

To measure the pulse width of a square-wave signal.

MIOS and TPU

Pulse width measurement is possible via MIOS and TPU. For the characteristics of these two methods, refer to Comparing TPU and MIOS (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Where to go from here

Information in this section

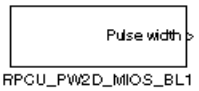
RPCU_PW2D_MIOS_BLx

Where to go from here

Information in this section

RPCU_PW2D_MIOS_BLx Block Description

Block



Purpose

To read the pulse width of a square-wave signal.

Description

The RPCU_PW2D_MIOS_BLx block is used to measure the pulse width of two square-wave signal on a specific input driver connected to the MIOS module of the microprocessor on the RapidPro Control Unit.

For basic information, refer to Pulse-Width Measurement (PW2D) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the **Basic I/O** button.

Other RTI blocks

The following RTI block must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block. The port width is always two (two channels)

Port	Description
Pulse width	The measured pulse width of the square-wave signal. If a measured pulse width is larger than the Maximum pulse width on page 86 defined, the output value equals infinity. Data type: Double Range: Depends on the Pulse width range on page 85.
Status	Represents the status of the measurement. Available only if the Enable outport Status on page 86 checkbox is selected. Data type: UInt8 1: Result value has been updated since last read access 0: Result value has not been updated since last read access

Related RTLib functions

- dsrpcu_mios_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_mios_pw2d_init2 (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_mios_pw2d_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

- dsrpcu_mios_pw2d_request (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_mios_pw2d_req_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_PW2D_MIOS_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Input port selection

Input port selection Lets you choose two input channels for signal capture: You have to specify the first, odd one, and the second, even one is chosen automatically. The channels offered are referenced from the hardware topology file (*.hwt). Channels that are used by the block are marked with `"+"`, channels that are used by other blocks are marked with `"*"`.

For information on the HWT-file, refer to RPCU_SETUP_BLx on page 18.

Range specification

Pulse width range Lets you choose the pulse width range of the square-wave signals. The range depends on the specified global prescaler value, refer to Pulse-Width Ranges for Pulse-Width Measurement (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

The pulse width ranges are theoretical values. In practice, the values are limited by the SC modules used. For further information, refer to the module data sheet.

Parameters Page (RPCU_PW2D_MIOS_BLx)

Purpose

To specify capture, interrupt, and outport settings.

Capture settings

Edge polarity Lets you choose the edge polarity of the measurement. Possible values are Rising edge or Falling edge.

Note

Consider possible external signal inversion (SC modules).

Maximum pulse width Lets you specify the maximum pulse width. The entered value must fit the given Pulse width range on page 85. If a measured pulse width is larger than the Maximum pulse width, the Pulse width outport signal equals infinity.

Refer to Pulse-Width Measurement (PW2D) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Interrupt setting

Enable interrupt (Disabled, if the Enable request-read checkbox on the Advanced page is selected) Indicates whether interrupts are generated for each of the selected two channels as soon as new measurement values exist. Refer to RPCU_INTERRUPT_BLx on page 226.

Outport setting

Enable outport Status Indicates whether the block has a "Status" output port for status information about the data in the DPMEM. See the I/O characteristics of the block.

Advanced Page (RPCU_PW2D_MIOS_BLx)

Purpose

To specify read options and sample time.

Read settings

Enable request-read Indicates whether the RCP system triggers the RapidPro system to write the most up-to-date measurement values to the DPMEM (dual-port memory). If this checkbox is cleared, the RapidPro system updates the results in the DPMEM as soon as new measurement values are available.

Note

If the frequency of the measured signal is high, it is helpful to let the RCP system trigger the RapidPro system (enable request-read), as it avoids an unnecessary load on the CPU of the RapidPro system. On the contrary, if the frequency of the measured signal is low, it does not make sense to trigger the RapidPro system (disable request-read).

Read mode (Disabled and set to default if the **Enable request-read** checkbox is cleared) Lets you choose how the master retrieves the measurement results from the DPMEM:

- Read current value (default): The RCP system requests the RapidPro system to write a new result to the DPMEM but simultaneously reads the data that is currently available from the DPMEM.
- Read new value: The RCP system requests the RapidPro system to write a new result to the DPMEM and waits for the requested data. The RapidPro system writes the requested data to the DPMEM. The RCP system reads the requested data from the DPMEM.

Sample time

Sample time Lets you enter the sample time for the block in seconds:

- -1 : The sample time is inherited from the blocks that the block is connected to. If the block resides in a triggered subsystem, this setting must be selected.
- 0: The block uses the discrete sample time of the Simulink model.
- >0: The block is executed with the sample time as specified.

Related topics

Basics

Basics of PWM Signal Measurement (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

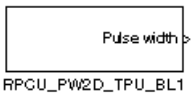
RPCU_PW2D_TPU_BLx

Where to go from here

Information in this section

RPCU_PW2D_TPU_BLx Block Description

Block



Purpose

To read the pulse width of a square-wave signal.

Description

The RPCU_PW2D_TPU_BLx block is used to measure the pulse width of one square-wave signal on a specific input driver connected to the TPU module of the microprocessor on the RapidPro Control Unit.

For basic information, refer to Pulse-Width Measurement (PW2D) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the Basic I/O button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in

ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Pulse width	The measured pulse width of the square-wave signal. If a measured pulse width is larger than the **Maximum pulse width** on page 91 defined, the output value equals infinity. Data type: Double Range: Depends on the **Pulse width range** on page 90.
Status	Represents the status of the measurement. Available only if the **Enable outport Status** on page 91 checkbox is selected. Data type: UInt8 1: Result value has been updated since last read access 0: Result value has not been updated since last read access

Related RTLib functions

- dsrpcu_tpu_pw2d_init2 (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_tpu_pw2d_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_PW2D_TPU_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related RPCU_SETUP_BLx on page 18 block.

Input port selection

Input port selection Lets you choose an input channel for signal capture. The channels offered are referenced from the hardware topology file (*.hwt). Channels that are used by the block are marked with "+", channels that are used by other blocks are marked with "*".

For information on the HWT file, refer to RPCU_SETUP_BLx on page 18.

Range specification

Pulse width range Lets you choose the pulse width range of the square-wave signals. The range depends on the Timer resolution settings, refer to Parameters Page (RPCU_TIMER_SETUP_TPU_BLx) on page 25. The Timer 2 option is available only if the **Use TPU A/B/C timer 2 for engine control** checkbox on the Parameters Page of the RPCU_TIMER_SETUP_TPU_BLx block is cleared.

For details on possible ranges, refer to Pulse-Width Ranges for Pulse-Width Measurement (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

The pulse width ranges are theoretical values. In practice, the values are limited by the SC modules used. For further information, refer to the module data sheet.

Parameters Page (RPCU_PW2D_TPU_BLx)

Purpose

To specify capture, interrupt, and outport settings.

Capture settings

Edge polarity Lets you choose the edge polarity of the measurement. Possible values are Rising edge or Falling edge.

Note

Consider possible external signal inversion (SC modules).

Number of periods Lets you specify the number of signal periods which the average pulse width is calculated for. The range is 1 … 256.

Maximum pulse width Lets you specify the maximum pulse width. The entered value must fit the given Pulse width range on page 90. If a measured pulse width is larger than the Maximum pulse width, the Pulse width outport signal equals infinity.

Refer to Pulse-Width Measurement (PW2D) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Interrupt setting

Enable interrupt (Disabled, if the Enable request-read checkbox on the Advanced page is selected) Indicates whether interrupts are generated as soon as new measurement values exist. Refer to RPCU_INTERRUPT_BLx on page 226.

Outport setting

Enable outport Status Indicates whether the block has a "Status" output port for status information about the data in the DPMEM. See the I/O characteristics of the block.

Advanced Page (RPCU_PW2D_TPU_BLx)

Purpose

To specify read options and sample time.

Read settings

Enable request-read Indicates whether the RCP system triggers the RapidPro system to write the most up-to-date measurement values to the DPMEM (dual-port memory). If this checkbox is cleared, the RapidPro system updates the results in the DPMEM as soon as new measurement values are available.

Note

If the frequency of the measured signal is high, it is helpful to let the RCP system trigger the RapidPro system (enable request-read), as it avoids an unnecessary load on the CPU of the RapidPro system. On the contrary, if the frequency of the measured signal is low, it does not make sense to trigger the RapidPro system (disable request-read).

Read mode (Disabled and set to default if the **Enable request-read** checkbox is cleared) Lets you choose how the master retrieves the measurement results from the DPMEM:

- Read current value (default): The RCP system requests the RapidPro system to write a new result to the DPMEM but simultaneously reads the data that is currently available from the DPMEM.
- Read new value: The RCP system requests the RapidPro system to write a new result to the DPMEM and waits for the requested data. The RapidPro system writes the requested data to the DPMEM. The RCP system reads the requested data from the DPMEM.

Sample time

Sample time Lets you enter the sample time for the block in seconds:

- -1 : The sample time is inherited from the blocks that the block is connected to. If the block resides in a triggered subsystem, this setting must be selected.
- 0: The block uses the discrete sample time of the Simulink model.
- >0: The block is executed with the sample time as specified.

Related topics

Basics

Basics of PWM Signal Measurement (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Frequency Measurement (F2D)

Introduction

To measure the frequency of a square-wave signal.

MIOS and TPU

Frequency measurement is possible via MIOS and TPU. For the characteristics of these two methods, refer to Comparing TPU and MIOS (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Where to go from here

Information in this section

RPCU_F2D_MIOS_BLx

Where to go from here

Information in this section

RPCU_F2D_MIOS_BLx Block Description

Block

Purpose

To read the frequency of a square-wave signal.

Description

The RPCU_F2D_MIOS_BLx block is used to measure the frequency of two square-wave signals on a specific input driver connected to the MIOS module on the microprocessor of the RapidPro Control Unit.

For basic information, refer to Frequency Measurement (F2D) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the **Basic I/O** button.

Other RTI blocks

The following RTI block must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block. The port width is always two (two channels)

Port	Description
Frequency	The measured frequency of the square-wave signal. If a measured frequency is smaller than the Minimum frequency on page 96, the output value equals zero. Data type: Double Range: Depends on the Frequency range on page 95.
Status	Represents the status of the frequency measurement. Available only if the Enable outport Status on page 96 checkbox is selected. Data type: UInt8 1: Result value has been updated since last read access 0: Result value has not been updated since last read access

Related RTLib functions

- dsrpcu_mios_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_mios_f2d_init2 (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_mios_f2d_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_mios_f2d_request (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

- dsrpcu_mios_f2d_req_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_F2D_MIOS_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Input port selection

Input port selection Lets you choose two input channels for signal capture: You have to specify the first, odd one, and the second, even one is chosen automatically. The channels offered are referenced from the hardware topology file (*.hwt). Channels that are used by the block are marked with `"+"`, channels that are used by other blocks are marked with `"*"`.

For information on the HWT-file, refer to RPCU_SETUP_BLx on page 18.

Range specification

Frequency range Lets you choose the frequency range of the square-wave signals. The range depends on the specified global prescaler value, refer to Frequency Ranges for Frequency Measurement (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

The frequency ranges are theoretical values. In practice, the values are limited by the SC modules used. For further information, refer to the module data sheet.

Parameters Page (RPCU_F2D_MIOS_BLx)

Purpose

To specify capture, interrupt, and outport settings.

Capture settings

Edge polarity Lets you choose the edge polarity of the measurement. Possible values are rising edge or falling edge.

Note

Consider possible external signal inversion (SC modules).

Minimum frequency Lets you specify the minimum frequency. The entered value must fit the given Frequency range on page 95. If a measured frequency is smaller than the minimum frequency, the frequency outport signal equals zero.

Interrupt setting

Enable interrupt (Disabled, if the Enable request-read checkbox on the Advanced page is selected) Indicates whether interrupts are generated for each of the selected two channels as soon as new measurement values exist. Refer to RPCU_INTERRUPT_BLx on page 226.

Outport setting

Enable outport Status Indicates whether the block has a "Status" output port for status information about the data in the DPMEM. See the I/O characteristics of the block.

Advanced Page (RPCU_F2D_MIOS_BLx)

Purpose

To specify read options and sample time.

Read settings

Enable request-read Indicates whether the RCP system triggers the RapidPro system to write the most up-to-date measurement values to the DPMEM (dual-

port memory). If this checkbox is cleared, the RapidPro system updates the results in the DPMEM as soon as new measurement values are available.

Note

If the frequency of the measured signal is high, it is helpful to let the RCP system trigger the RapidPro system (enable request-read), as it avoids an unnecessary load on the CPU of the RapidPro system. On the contrary, if the frequency of the measured signal is low, it does not make sense to trigger the RapidPro system (disable request-read).

Read mode (Disabled and set to default if the **Enable request-read** checkbox is cleared) Lets you choose how the master retrieves the measurement results from the DPMEM:

- Read current value (default): The RCP system requests the RapidPro system to write a new result to the DPMEM but simultaneously reads the data that is currently available from the DPMEM.
- Read new value: The RCP system requests the RapidPro system to write a new result to the DPMEM and waits for the requested data. The RapidPro system writes the requested data to the DPMEM. The RCP system reads the requested data from the DPMEM.

Sample time

Sample time Lets you enter the sample time for the block in seconds:

- -1 : The sample time is inherited from the blocks that the block is connected to. If the block resides in a triggered subsystem, this setting must be selected.
- 0: The block uses the discrete sample time of the Simulink model.
- >0: The block is executed with the sample time as specified.

Related topics

Basics

Basics of PWM Signal Measurement (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

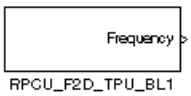
RPCU_F2D_TPU_BLx

Where to go from here

Information in this section

RPCU_F2D_TPU_BLx Block Description

Block



Purpose

To read the frequency of a square-wave signal.

Description

The RPCU_F2D_TPU_BLx block is used to measure the frequency of one square-wave signal on a specific input driver connected to the TPU module of the microprocessor on the RapidPro Control Unit.

For basic information, refer to Frequency Measurement (F2D) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the **Basic I/O** button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Frequency	The measured frequency of the square-wave signal. If a measured frequency is smaller than the **Minimum frequency** on page 101, the output value equals zero. Data type: Double Range: Depends on the Frequency range on page 100.
Status	Represents the status of the frequency measurement. Available only if the **Enable outport Status** on page 101 checkbox is selected. Data type: UInt8 1: Result value has been updated since last read access 0: Result value has not been updated since last read access

Related RTLib functions

- dsrpcu_tpu_f2d_init2 (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_tpu_f2d_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_F2D_TPU_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related RPCU_SETUP_BLx on page 18 block.

Input port selection

Input port selection Lets you choose an input channel for signal capture. The channels offered are referenced from the hardware topology file (*.hwt). Channels that are used by the block are marked with "+", channels that are used by other blocks are marked with "*".

For information on the HWT file, refer to RPCU_SETUP_BLx on page 18.

Range specification

Frequency range Lets you choose the frequency range of the square-wave signals. The range depends on the timer resolution settings, refer to Parameters Page (RPCU_TIMER_SETUP_TPU_BLx) on page 25. The Timer 2 option is available only if the **Use TPU A/B/C timer 2 for engine control** checkbox on the Parameters Page of the RPCU_TIMER_SETUP_TPU_BLx block is cleared.

For details on possible ranges, refer to Frequency Ranges for Frequency Measurement (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

The frequency ranges are theoretical values. In practice, the values are limited by the SC modules used. For further information, refer to the module data sheet.

Parameters Page (RPCU_F2D_TPU_BLx)

Purpose

To specify capture, interrupt, and outport settings.

Capture settings

Edge polarity Lets you choose the edge polarity of the measurement. Possible values are Rising edge or Falling edge.

Note

Consider possible external signal inversion (SC modules).

Number of periods Lets you specify the number of signal periods which the average frequency is calculated for. The range is 1 … 256.

Minimum frequency Lets you specify the minimum frequency. The entered value must fit the given Frequency range on page 100. If a measured frequency is smaller than the minimum frequency, the frequency outport signal equals zero.

Interrupt setting

Enable interrupt (Disabled, if the Enable request-read checkbox on the Advanced page is selected) Indicates whether interrupts are generated as soon as new measurement values exist. Refer to RPCU_INTERRUPT_BLx on page 226.

Outport setting

Enable outport Status Indicates whether the block has a "Status" output port for status information about the data in the DPMEM. See the I/O characteristics of the block.

Advanced Page (RPCU_F2D_TPU_BLx)

Purpose

To specify read options and sample time.

Read settings

Enable request-read Indicates whether the RCP system triggers the RapidPro system to write the most up-to-date measurement values to the DPMEM (dual-port memory). If this checkbox is cleared, the RapidPro system updates the results in the DPMEM as soon as new measurement values are available.

Note

If the frequency of the measured signal is high, it is helpful to let the RCP system trigger the RapidPro system (enable request-read), as it avoids an unnecessary load on the CPU of the RapidPro system. On the contrary, if the frequency of the measured signal is low, it does not make sense to trigger the RapidPro system (disable request-read).

Read mode (Disabled and set to default if the Enable request-read checkbox is cleared) Lets you choose how the master retrieves the measurement results from the DPMEM:

- Read current value (default): The RCP system requests the RapidPro system to write a new result to the DPMEM but simultaneously reads the data that is currently available from the DPMEM.
- Read new value: The RCP system requests the RapidPro system to write a new result to the DPMEM and waits for the requested data. The RapidPro system writes the requested data to the DPMEM. The RCP system reads the requested data from the DPMEM.

Sample time

Sample time Lets you enter the sample time for the block in seconds:

- -1 : The sample time is inherited from the blocks that the block is connected to. If the block resides in a triggered subsystem, this setting must be selected.
- 0: The block uses the discrete sample time of the Simulink model.
- >0: The block is executed with the sample time as specified.

Related topics

Basics

Basics of PWM Signal Measurement (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Incremental Encoder Interface

Introduction

To measure the position and the rotation speed of an incremental encoder.

Where to go from here

Information in this section

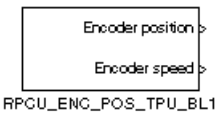
RPCU_ENC_POS_TPU_BLx

Where to go from here

Information in this section

RPCU_ENC_POS_TPU_BLx Block Description

Block



Purpose

To read the position and the rotation speed of an incremental encoder.

Description

The RPCU_ENC_POS_TPU_BLx block is used to read the position and rotation speed of an incremental encoder via SC modules connected to a TPU module of the microprocessor on the RapidPro Control Unit.

Two or three TPU channels are used, depending on whether an index input is used. Refer to Index input on page 106. The channel usage is as follows:

Channel	With Index Input	Without Index Input
Channel x	Index signal	0°-Phase signal
Channel x+1	0°-Phase signal	90°-Phase signal
Channel x+2	90°-Phase signal	Not used (free)

For basic information, refer to Incremental Encoder Interface (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter `rtirpcu` in the MATLAB Command Window.
2. Click the Basic I/O button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Encoder position	The actual encoder position. An overflow of a positive number results in a negative number, and vice versa. Data type: Double Range: -8192 … 8191.75
Encoder speed	The actual encoder speed and direction. Data type: Double Unit: 1/s The encoder speed is set to zero, if one of the following conditions applies: ▪ The measured pulse width is larger than the **Max. edge distance** on page 106. ▪ The time between two consecutive measurements is larger than the upper limit of the **Pulse width range** on page 106. ▪ Two consecutive measurements return the same encoder position. For details, refer to Conditions forcing encoder speed to zero (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Port	Description
Status	Represents the status of the encoder measurement. Available only if the Enable outport Status on page 107 checkbox is selected. Data type: UInt8 1: Result value has been updated since last read access 0: Result value has not been updated since last read access

Related RTLib functions

- dsrpcu_tpu_enc_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_tpu_enc_request (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_tpu_enc_req_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_ENC_POS_TPU_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Input port selection

Input port selection Lets you choose three input channels for signal capture: You have to specify the first one, two successive ones are chosen automatically.

The channels offered are referenced from the hardware topology file (*.hwt), refer to RPCU_SETUP_BLx on page 18. Channels used by the block are marked with "+", channels used otherwise are marked with "*".

Range specification

Pulse width range Lets you choose the pulse width range for the maximum edge distance. The range depends on the timer resolution settings, refer to Parameters Page (RPCU_TIMER_SETUP_TPU_BLx) on page 25. The Timer 2 option is available only if the **Use TPU A/B/C timer 2 for engine control** checkbox on the Parameters Page of the RPCU_TIMER_SETUP_TPU_BLx block is cleared.

For details on possible ranges, refer to Encoder Pulse-Width Ranges (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

The pulse width ranges are theoretical values. In practice, the values are limited by the SC modules used. For further information, refer to the module data sheet.

Parameters Page (RPCU_ENC_POS_TPU_BLx)

Purpose

To specify the read parameters for an incremental encoder

Capture settings

For detailed information on the parameters, refer to Incremental Encoder Interface (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Max. edge distance Lets you specify the maximum edge distance (in seconds) between two consecutive signal edges, that is, the maximal edge distance after which a time-out is detected. The entered value must fit the given **Pulse width range** on page 106. If the distance between two consecutive encoder positions is larger than the Max. edge distance, the encoder speed equals zero.

Index input Lets you choose the index mode:

- Not used: No index signal pulse is evaluated.
- Reset position value only at the first index transition: Only the first index signal pulse is evaluated and used to update the position register of the incremental encoder (see parameter **On index set position to**).
- Reset position value every index transition: Each index signal pulse is evaluated. The position register of the incremental encoder is consecutively updated (see parameter **On index set position to**).

Independently of the index mode chosen, three consecutive TPU channels are always reserved.

On index set position to Lets you specify the index position of the incremental encoder. The range is -8192 … 8191.75. This is the position that is written to the position register when an index signal pulse has been detected. The entered value must fit the given Pulse width range on page 106.

Enable interrupt on index transition Indicates whether interrupts are generated when an index signal pulse has been detected. Refer to RPCU_INTERRUPT_BLx on page 226.

Read mode Lets you choose how the encoder position and speed are accessed:

- Read current value (default): The RCP system requests the RapidPro system to write a new result to the dual-port memory (DPMEM) but simultaneously reads the data that is currently available from the DPMEM.
- Read new value: The RCP system requests the RapidPro system to write a new result to the DPMEM and waits for the requested data. The RapidPro system writes the requested data to the DPMEM. The RCP system reads the requested data from the DPMEM.

Initial position Lets you specify the value of the position register of the incremental encoder at start. The range is -8192 … 8191.75. The entered value must fit the given Pulse width range on page 106.

Outport setting

Enable outport Status Indicates whether the block has a "Status" output port for status information about the data in the DPMEM. See the I/O characteristics of the block.

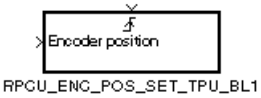
RPCU_ENC_POS_SET_TPU_BLx

Where to go from here

Information in this section

RPCU_ENC_POS_SET_TPU_BLx Block Description

Block



Purpose

To provide write access to the position register of an incremental encoder.

Description

The RPCU_ENC_POS_SET_TPU_BLx block is used to update the position register of an incremental encoder. It always references an RPCU_ENC_POS_TPU_BLx block, via choosing the first input port (TPU channel) of the RPCU_ENC_POS_TPU_BLx block.

For basic information, refer to Incremental Encoder Interface (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the Basic I/O button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23
- RPCU_ENC_POS_TPU_BLx on page 103

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Trigger input	Input port for the trigger signal.
Encoder position	Position which the incremental encoder is set to when the trigger signals occurs, that is, the current position value is updated. Data type: Double Range: -8192 … 8191.75

Related RTLib functions

dsrpcu_tpu_enc_write (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_ENC_POS_SET_TPU_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Note

An RPCU_ENC_POS_SET_TPU_BLx block requires an RPCU_ENC_POS_TPU block with corresponding Input driver settings.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Input port selection

Select 1st encoder input port Lets you choose an incremental encoder by choosing the first input port (TPU channel) of the corresponding RPCU_ENC_POS_TPU_BLx block. Channels that are used by the block are marked with "+".

Stepper Motor Control

Introduction

To control the actuating signal of a stepper motor.

Where to go from here

Information in this section

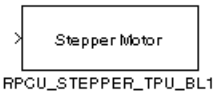
RPCU_STEPPER_TPU_BLx

Where to go from here

Information in this section

RPCU_STEPPER_TPU_BLx Block Description

Block



Purpose

To control the actuating signal of a stepper motor.

Description

The RPCU_STEPPER_TPU_BLx block is used to control the actuating signal of a stepper motor via Power modules connected to a TPU module of the microprocessor on the RapidPro Control Unit. The position of the stepper motor can be changed at run time.

For basic information, refer to Stepper Motor Control (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter `rtirpcu` in the MATLAB Command Window.
2. Click the Basic I/O button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
<Inport>	Current position of the stepper motor. Data type: Int16 Range: -32768 … Limit. Limit = (32767-Acceleration steps-1), refer to Acceleration steps on page 113.

Related RTLib functions

- dsrpcu_tpu_sm_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_tpu_sm_position_set (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_STEPPER_TPU_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related RPCU_SETUP_BLx on page 18 block.

Output port selection

Output port selection Lets you choose the first channel for signal output. The second one (same TPU) is chosen automatically. The channels offered are referenced from the hardware topology file (*.hwt), refer to RPCU_SETUP_BLx on page 18. Channels that are used by the block are marked with "+", channels that are used otherwise are marked with "*".

Range specification

Period range Lets you choose the period's range of the stepper motor. The range depends on the Timer resolution settings, refer to Parameters Page (RPCU_TIMER_SETUP_TPU_BLx) on page 25. The Timer 2 option is available only if the **Use TPU A/B/C timer 2 for engine control** checkbox on the Parameters Page of the RPCU_TIMER_SETUP_TPU_BLx block is cleared.

For details on possible ranges, refer to Step Period Ranges (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

The period ranges are theoretical values. In practice, the values are limited by the Power modules used. For further information, refer to the module data sheet.

Parameters Page (RPCU_STEPPER_TPU_BLx)

Purpose

To specify the stepper motor parameters, including initialization and termination values.

Description

During the model initialization phase, an initial digital output value is written to each channel. This is especially useful if a channel is used within a triggered or enabled subsystem that is not executed right from the start of the simulation. With the initial state value, all channels have defined outputs during this simulation phase.

When the simulation terminates, all channels hold their last digital output values by default. You can specify a user-defined output value on termination, and use these settings 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 the real-time process is stopped by using ControlDesk's Stop RTP command, the processor resets immediately without executing termination functions. The specified termination values are not set.

⚠ WARNING

Applying ControlDesk's Stop RTP command can lead to unpredictable results.

Risk of injury and material damage!

- Before applying ControlDesk's Stop RTP command, think through the effects of the command.
- Ensure that no one is in the potential danger zone of the device (machine, etc.) when the command is applied.

Acceleration/deceleration

For detailed information on the parameters, refer to Stepper Motor Control (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Acceleration steps Lets you choose the number of steps for accelerating and decelerating the stepper motor. The range is 0 … 13.

Maximal step period Lets you specify the maximum period between two subsequent steps. The entered value must fit the given Period range on page 112.

Period difference Lets you specify the time interval between the acceleration and deceleration steps. The entered value must fit the given Period range on page 112.

Initialization

Initial position value Lets you specify the initial stepper motor position at the start of a simulation. Range: -32768 … Limit. Limit = (32767-Acceleration steps-1), refer to Acceleration steps.

Termination

Termination state Indicates whether the digital output is set to a predefined stepper motor position when a simulation terminates. Otherwise, the current digital output value is kept.

Position value on termination Lets you specify the stepper motor position at termination. Range: -32768 … Limit. Limit = (32767-Acceleration steps-1), refer to Acceleration steps. Disabled, if the Termination state checkbox is cleared.

Related topics

References

simState (RTI and RTI-MP Implementation Reference 🕮)

Single Edge Nibble Transmission (SENT)

Introduction

SENT is a protocol used between sensors and ECUs to transmit data of high-resolution sensors as an alternative to an analog interface.

The RapidPro Control Unit RTI blockset provides blocks that you can use to implement *SENT receivers* on the RapidPro system.

Note

The RapidPro Control Unit RTI blockset does not yet provide blocks for you to use the RapidPro system as a SENT transmitter.

Basic information

For basics on the SENT protocol and the implementation on a RapidPro system, refer to Basics on the SENT Protocol (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

RPCU_SENT_RX_TPU_BLx

Purpose

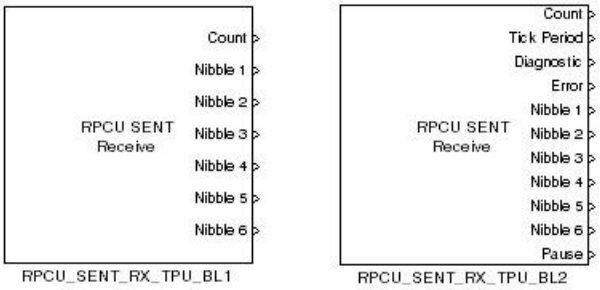
To receive data using the SENT protocol.

Where to go from here

Information in this section

RPCU_SENT_RX_TPU_Blx Block Description

Block



Purpose

To receive data using the SENT protocol.

Description

The block reads the messages from a receive FIFO of the RapidPro hardware. A SENT receiver allocates two consecutive channels on the same TPU. To receive messages and nibbles, you must specify the number of expected messages and the number of nibbles to be received. The blocks gets one outport for each nibble which is specified. The outports provide vectors with the nibbles of several messages.

To specify the properties of the SENT signal, all the relevant parameters (for example, the number of ticks which defines a low pulse, a zero nibble high pulse, and a sync high pulse) are available on the **RX Parameters** page.

Pause pulses are recognized and measured if you enable the **Enable pause mode** block parameter. The pause pulse values then can be used for diagnostic purposes.

The block supports two read modes: It can read all new messages received since the last read operation or it can read the last recent complete message. During run time, your application can read the received messages stored in the receive FIFO when triggered periodically by a timer task or when triggered asynchronously by an interrupt. The block provides interrupt generation to support asynchronous reading. If this feature is enabled, an interrupt is generated on the master system (MicroAutoBox II/DS1007) after receiving a certain number of SENT messages, specified by the **Number of messages to trigger interrupt** parameter.

The block has four outputs to provide information on the read operation. Most of them are optional and must be enabled on the **Advanced** page. For a detailed description of the outports, see below.

I/O characteristics

The table shows the block outport:

Simulink Output	Range	Simulink Data Type	Description
Count	0 ... 256	UInt32	Number of messages that were received since the last read operation. This information can also be used to detect a too long model cycle time, when the number of received messages approaches the maximum FIFO message depth (specified by **Expected number of messages** parameter on the **RX Parameters** page). The maximum value of **Count** cannot be higher than the value specified by the **Expected number of messages** parameter.
Tick Period[1)]	▪ TP_{min} ... TP_{max} ▪ For concrete range values, refer to Tick Period Ranges for SENT Messages (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)	Double	Current tick period in seconds. The tick period is extracted from the last received valid synchronization pulse when SENT messages are read. This also applies if several messages are received. The value is updated with every read operation, so it is constant until the next call of the block. If no message has been read, a tick period of 0 is returned.
Diagnostic[1)]	0 ... 255	UInt32	Diagnostic information for each received SENT message (UInt32 value for each received SENT message). The diagnostic vector must hold at least as many UInt32 values as specified by the **Expected number of messages** parameter (see **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, refer to Diagnostics flags on page 119.
Error[1)]	0 ... 4	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. The number of received messages did not exceed the expected

Simulink Output	Range	Simulink Data Type	Description
			number of received messages set by the **Expected number of messages** parameter. ▪ 1: Data loss. Not all messages could be read from the receive FIFO. The number of received messages exceeded the expected number of messages set by the **Expected number of messages** parameter. The FIFO runs full and the oldest messages stored in the FIFO are lost, because they are overwritten by new input data. You can use the **Count** outport to get the number of messages which are currently stored in the receive FIFO. ▪ 2: Data loss due to an overload on the RapidPro I/O subsystem. The CPU workload is too high. For tips on reducing the CPU workload, refer to Using the SENT Protocol on the RapidPro System (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮). ▪ 4: The length of a SENT pulse is longer than the maximum pulse length which can be measured by the SENT receiver.
Nibble (1 ... **Number of nibbles**) [2)]	0 ... 127, -128	Int8	Contains the nibble values which are read from the receive FIFO. If the number of received messages between two subsequent calls is higher than the specified number of expected messages, the returned vector is filled from the first element up to the number of expected messages and the most recent messages are rejected. If the number of received messages is lower than the number of expected messages, the vector is filled from the first element up to the received number of messages. The unused elements are set to -128. When a nibble value outside the allowed range of 0 ... 15 is received, the nibble is saved to the message anyway and the diagnostic parameter reports a nibble which is outside the valid range.
Pause[1)]	0 ... 32767, -32768	Int16	Pause pulse value (Int16 value) for each received SENT message. The pause vector must hold at least as many Int16 values as specified by the

Simulink Output	Range	Simulink Data Type	Description
			Expected number of messages parameter (see Parameters page). The number of values matches the number of returned messages indicated by the Count outport. The returned values correspond to nibble values. Example: A complete pulse duration of `LowTics` + `ZeroNibbleHighTics` results in a pause value of 0. If no message has been read or no pause pulse inside the message was generated, a value of -32768 is returned.

[1] The port is only available if it is enabled on the Advanced Page (RPCU_SENT_RX_TPU_Blx) on page 125.
[2] Specifies the number of nibbles included in every SENT message. The maximum number of nibbles is 217.

Diagnostics flags

The SENT receiver generates a diagnostic information for every received SENT message. The following diagnostic information is evaluated and reported via flags in a single diagnostic word for each received SENT message. The diagnostic information for all received SENT messages since the last read operation is stored in a vector of UInt32. The number of diagnostic words always matches the number of returned messages.

The following table shows the values and descriptions of the flags of the Diagnostic outport:

Bit (Flag)	Value	Description
0	1	Too many nibbles in message When too many nibbles are received in a message, the excess nibbles are ignored and the diagnostic flag reports too many nibbles. The system ensures that every message is saved to the data buffer with the number of nibbles specified by the Number of nibbles (incl. status, CRC) block parameter.
1	2	Too few nibbles in message When a message with too few nibbles is received, the missing nibbles are marked with the value "-128" and the diagnostic flag reports missing nibbles. The system ensures, that every message is saved to the data buffer with the number of nibbles specified by the Number of nibbles (incl. status, CRC) block parameter.
2	4	Nibble value out of range [0...15] When a nibble with a value of <0 or >15 is received, this nibble is saved to the data buffer anyway, and the diagnostic flag for a nibble out of the valid range is set.
3	8	Synchronization pulse too long. When a synchronization pulse exceeds the valid range (upper limit) of the expected tick period specified by the Tick period and Tick

Bit (Flag)	Value	Description
		period tolerance block parameters, this is reported by the diagnostic flag. The nibble values are evaluated anyway.
4	16	Synchronization pulse too short. When a synchronization pulse exceeds the valid range (lower limit) of the expected tick period specified by the Tick period and Tick period tolerance block parameters, this is reported by the diagnostic flag. The nibble values are evaluated anyway.
5	32	When two consecutive synchronization pulses differ by more than 1/64 of the current synchronization pulse, this is reported by the diagnostic flag.
6	64	Measured message length differs from expected (fixed) message length in tick periods. If the tick periods in a received message differ from the value specified by Expected message length block parameter, this is reported by the diagnostic flag. The message length includes the low and high ticks of all pulses of a message, including the sync pulse, the pause pulse and all nibble pulses. As preconditions for evaluation, the Enable pause mode block parameter must be enabled and the value specified by the Expected message length block parameter must be set unequal to 0.
7	128	The ratio of sync pulse length to complete message length is different to the expected value. When the ratio of sync pulse length to complete message length differs by more than 1/64 (approx. 1.5 %) between the expected value (= specified via relevant timing parameters) and the current measured value, this is reported by the diagnostic flag. This lets you observe the clock drift of a SENT transmitter while it is transmitting a SENT message. As preconditions for evaluation, the Enable pause mode parameter must be enabled and the value specified by the Expected message length block parameter must be set unequal to 0.

It is possible that several diagnostic flags are generated simultaneously for the same SENT message. 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.

Dialog pages

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

- To specify the related RapidPro hardware, refer to the Unit Page (RPCU_SENT_RX_TPU_Blx) on page 121.
- To specify the parameters for receiving SENT messages, refer to the Parameters Page (RPCU_SENT_RX_TPU_Blx) on page 122.
- To disable or enable output ports, refer to the Advanced Page (RPCU_SENT_RX_TPU_Blx) on page 125.

Related RTLib functions

`dsrpcu_tpu_sent_rx_init2` (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮), `dsrpcu_tpu_sent_rx_receive_all2` (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮), `dsrpcu_tpu_sent_rx_receive_most_recent2` (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮), `dsrpcu_tpu_sent_get_rx_tic_period2` (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Related topics

Basics

Single Edge Nibble Transmission (SENT) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Unit Page (RPCU_SENT_RX_TPU_Blx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx).

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related RPCU_SETUP_BLx on page 18 block.

Input port selection

Input port selection Lets you choose an input channel for signal capture. The channels offered are referenced from the hardware topology file (*.hwt).

Channels that are used by the block are marked with "+", channels that are used by other blocks are marked with "*".

For information on the HWT file, refer to RPCU_SETUP_BLx on page 18.

Range specification

Tick period range Lets you choose the range of the tick period. The range depends on the timer resolution settings, refer to Parameters Page (RPCU_TIMER_SETUP_TPU_BLx). The Timer 2 option is available only if the **Use TPU A/B/C timer 2 for engine control** checkbox on the **Parameters** page of the RPCU_TIMER_SETUP_TPU_BLx block is cleared.

For concrete values, refer to Tick Period Ranges for SENT Messages (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

The period ranges are theoretical values. In practice, the values are limited by the SC modules used. For further information, refer to the module data sheet.

Parameters Page (RPCU_SENT_RX_TPU_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 to 256 by the hardware, but the limit can be reduced via the **Expected number of messages (FIFO size)** parameter.

If the receive FIFO runs full, the oldest messages stored in the FIFO are lost, because they are overwritten by new input data. In addition an appropriate error flag is set.

SENT setting

Number of nibbles (incl. status, CRC) Lets you specify the number of nibbles included in every SENT message in the range 1 ... 217. The number includes the status nibble and the CRC nibble.

Expected number of messages (FIFO size) Lets you specify the expected number of SENT messages which can be stored in the receive FIFO in the range 1 ... 256.

The specified value also defines:

- The FIFO size. The maximum possible value (= 256) is a hardware limit.
- The maximum value of the **Number of messages to trigger interrupt** parameter.

Note

The memory of the FIFO which is not used by the SENT functionality can be used by other RapidPro functions. Therefore the specified FIFO size should be as large as required but also as small as possible.

Number of ticks for low state Lets you select the number of tick periods used for a SENT low pulse in the range 1 ... 15.

Number of ticks for high state of zero nibble Lets you select the number of tick periods used for a SENT nibble high pulse with a value of 0 in the range 1 ... 15.

Number of ticks for high state of sync pulse Lets you specify the number of tick periods used for a synchronization high pulse in the range 1 ... 255.

Tick period Lets you specify the expected pulse length of a tick period within a SENT pulse in seconds. This is the base clock every SENT pulse is generated with.

The tick period (TP) must fit the period range: $TP_{min} < TP < TP_{max}$. The range is specified via the Tick period range parameter on the Unit Page (RPCU_SENT_RX_TPU_Blx) on page 121.

The specified value also is used to calculate diagnostic information (see I/O characteristics on page 117).

Tick period tolerance Specifies the maximum allowed tolerance (clock drift) of the measured tick period that the SENT receiver accepts as the valid tick period. Synchronization pulses and nibble pulses are recognized as valid pulses within this range. Pulses outside this specified tolerance are recognized as invalid synchronization pulses or nibble pulses with an invalid value (< 0; > 15).

In addition the tolerance between two synchronization pulses must not exceed a factor of 1/64.

Related diagnostic information is returned during run time. If an invalid synchronization pulse is received, the current message is cut and the receiver searches for the next valid synchronization pulse.

The value is specified in the range 0.0 … 0.5, which is a percentage of the tick period, for example:

- 0: 0% tolerance
- 0.1: 10% tolerance
- 0.5: 50% tolerance

Note

It is not recommended to use a tolerance of 0, because:

- Every transmitter and receiver has a minimum drift, so the measured pulse length can fluctuate around a mean value.
- If a nibble pulse is longer than the maximum, it is recognized as a synchronization pulse. Thus, with a Tick period tolerance of 0, some fluctuating nibble pulses with a value of 15 could be interpreted as synchronization pulses.

The maximum possible nibble length can be calculated as follows:

Maximum nibble pulse	= `TP` * (`ZeroNibbleHighPulse` + 15 + `LowTicks`) * (1 + `TP tolerance`)
`TP`	Tick period
`ZeroNibbleHighPulse`	Number of ticks for high state of nibble pulse with the value of 0
`LowTicks`	Number of ticks for low state
`TP tolerance`	Tick period tolerance

Read mode Lets you choose the mode for reading messages.

Read Mode	Description
All messages	The block reads all new complete received messages and diagnostic information from the receive FIFO since the last read operation. If no complete new message is available, the **Count** outport is 0 and the **Nibble** outports are filled with the value '-128' (= missing nibble).
Most recent message	The block reads the most recent message and diagnostic information from the receive FIFO. In addition, the receive FIFO is cleared completely. If no complete message is available, a message is returned whose nibbles have the value '-128' (see **Diagnostic** port in I/O characteristics on page 117) and the **Count** outport is 0.

SENT pause

Enable pause mode Lets you enable (or disable) the pause pulse mode.

If you enable the mode, pause pulses are recognized and measured. The values can be used for diagnostic purposes, for example, as follows: If you enable the **Enable pause mode** block parameter and specify a non-zero value for the **Expected message length** block parameter, the receiver uses this expected message length for evaluation. If the message does not match the specified value, diagnostic information is generated.

Range of pause pulse length Displays the possible range of the pause pulse length in ticks. The range is automatically calculated from the values specified for SENT block parameters.

Expected message length Lets you specify the expected length of each message in the range 0 … $Message_{max}$ in ticks. The possible upper value (Message $_{max}$) is automatically calculated from the values specified for SENT block parameters and displayed after the parameter name.

If you specify a non-zero value for this block parameter, the receiver uses this expected message length for evaluation and generates diagnostic information. If

the value is set to 0 the pause pulse is expected but it is not checked whether the message has a fixed length. In this case you must consider that the maximum expected pause pulse lenght suits to the related value range.

This parameter takes effect only if you enable the **Enable pause mode** block parameter.

Interrupt settings

Enable interrupt Lets you enable (or disable) interrupt generation on the master system (MicroAutoBox II/DS1007), for example, to read and transfer messages to the model when triggered by an interrupt:

- Enabled: An interrupt is generated on the master system after receiving a certain number of SENT messages, specified via the **Number of messages to trigger interrupt** block parameter.
- Disabled: No interrupt is generated on the master system after receiving a SENT message.

Number of messages to trigger interrupt Lets you specify the number of messages which are received and stored in the receive FIFO before an interrupt is triggered on the master system (MicroAutoBox II/DS1007) in the range 1 … **Expected number of messages (FIFO size)**. For example: If the number is set to 6, one interrupt is triggered on the master system after every 6th message (that is received).

The range (max. value) of the parameter is limited by the **Expected number of messages (FIFO size)** block parameter.

This parameter takes effect only if interrupt generation is enabled via the **Enable interrupt** block parameter.

Advanced Page (RPCU_SENT_RX_TPU_Blx)

Purpose

To disable or enable output ports and to specify the sample time.

Output setting

Enable Tick Period port Lets you disable or enable the **Tick Period** port.

The **Tick Period** outport provides the current tick period of the specified SENT receiver in seconds. The tick period is extracted from the last received synchronization pulse when SENT messages are read. For details on the outport, refer to I/O characteristics on page 117.

Enable Diagnostic port Lets you disable or enable the **Diagnostic** port.

The **Diagnostic** outport provides a diagnostic word for each received SENT message. The diagnostic word consists of flags for different message-specific status and diagnostic information.

For details on the outport, refer to I/O characteristics on page 117. For information on the meanings of the flags, refer to Diagnostics flags on page 119.

Enable Error port Lets you disable or enable the Error port.

The Error outport provides information on the current read operation. The values have the following meanings:

- 0: No data loss
- 1: Data loss, more messages were received than expected (causing an overflow in the block's receive FIFO)
- 2: Data loss due to overload on the RapidPro I/O subsystem

For details on the outport, refer to I/O characteristics on page 117.

Sample time

Sample time Lets you enter the sample time for the block in seconds:

- -1 : The sample time is inherited from the blocks that the block is connected to. If the block resides in a triggered subsystem, this setting must be selected.
- 0: The block uses the discrete sample time of the Simulink model.
- >0: The block is executed with the sample time as specified.

Engine Control

Where to go from here

Information in this section

Crankshaft Signal Measurement

Where to go from here

Information in this section

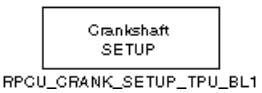
RPCU_CRANK_SETUP_TPU_BLx

Where to go from here

Information in this section

RPCU_CRANK_SETUP_TPU_BLx Block Description

Block



Purpose

To configure the crankshaft wheel measurement.

Description

The RPCU_CRANK_SETUP_TPU_BLx block initializes the crankshaft wheel for engine control.

Note

The RPCU_CRANK_SETUP_TPU_BLx block must be part of the model if any engine control is to be performed. However, only one RPCU_CRANK_SETUP_TPU_BLx block with the same module and ECU channel numbers is allowed in a model.
The **Use TPU A/B/C timer 2 for engine control** on page 25 checkbox of the related TPU (A, B, C) in the related RPCU_TIMER_SETUP_TPU_BLx block must be selected.

For basic information, refer to Setting Up Crankshaft and Camshaft Signal Measurement (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the **Engine Control** button.

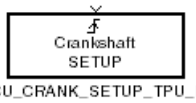
Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23

I/O characteristics

The following table describes the ports of the block:

Port	Description
<Trigger inport>  	Forces resynchronization of the engine position. Available only if the crankshaft wheel is specified via wave table, and if the **Resynchronization trigger type** on page 133 parameter is set to Rising/Falling/Either or Function-call.

Related RTLib functions

- TPU-related RTLib functions (crank wheel parameters):
  dsrpcu_tpu_crank_pm_init2 (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
  dsrpcu_tpu_crank_od_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- I/O PLD-related RTLib functions (crank wheel wave table):
  dsrpcu_crank_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_crank_reset (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_CRANK_SETUP_TPU_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Input port selection

Input port selection Lets you choose an input channel for signal capture. The channels offered are referenced from the hardware topology file (*.hwt), refer to RPCU_SETUP_BLx on page 18. Channels that are used by the block are marked with "+", channels that are used otherwise are marked with "*".

Note

If a TPU (A, B, or C) is used for engine control (refer to the **Use TPU A/B/C timer 2 for engine control** on page 25 parameter in the dialog of the RPCU_TIMER_SETUP_TPU_BLx block) its Ch01 channel is used internally, and thus not available. In addition, the RPCU_CRANK_SETUP_TPU_BLx uses the Ch02 channel for the period measurement. Thus, the Ch02 channel is not available, too. However, both channels do not need to be routed.

Note

The incoming crankshaft signal must be connected to an SC module. The SC module must be mounted on the RapidPro Control Unit, not on a RapidPro SC Unit mounted on top of the RapidPro Control Unit.

Related topics

HowTos

How to Set Up Crankshaft Signal Processing (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Parameters Page (RPCU_CRANK_SETUP_TPU_BLx)

Purpose

To specify the crankshaft wheel, either via entering the wheel parameters manually or via referencing a wave table.

Description

For all angle values to be specified, the angle resolution is 0.1°.

Note

For the angle values of all other engine control blocks, the angle resolution is 0.1°, too.

Engine settings

Specify crankshaft wheel by wave table Indicates whether the crankshaft wheel is to be specified via referencing a wave table. For details on wheel wave tables, refer to Basics on Crankshaft Wheel Specification (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

The wavetable specification approach requires a RapidPro Control Unit with MPC565 not older than board revision DS1601-12.

Wheel parameters

The following parameters are available only, if the Specify crankshaft wheel by wave table checkbox is cleared.

Number of crankshaft teeth Lets you specify the absolute number of teeth corresponding to 360°. The range is 1 … 3600.

Missing teeth per gap Lets you specify the number of missing teeth in a gap. The range is 0 … 6.

Number of gaps Lets you specify the number of gaps of the crankshaft wheel corresponding to 360°. The range is 0 … 10.

Note

If the crankshaft wheel does not have a gap, refer to the note concerning the Camshaft pulse number on page 156 parameter.

Wave table

The following parameters are available only, if the Specify crankshaft wheel by wave table checkbox is selected.

Model directory Displays the folder which the Simulink model is saved to.

Use path relative to the model directory Indicates whether the path of the wave table file is defined relative to the Simulink model.

Note

This checkbox is not enabled until the Simulink model is saved.

Wave table file Lets you specify the path of the wave table file (*.mat). Use the Browse button to select an existing wave table file.

Note

If this field is empty, the Browse button opens the folder that contains the ready-to-use wave table files, refer to Basics on Crankshaft Wheel Specification (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Number of crankshaft teeth Displays the number of teeth as specified in the wave table.

Number of gaps Displays the number of gaps as specified in the wave table.

Enable reverse crank Indicates whether a crank sensor with direction detection is used. A so-called reverse crank sensor can detect forward as well as reverse crankshaft rotation.

Pulse duration forward Lets you specify the pulse length that indicates a forward rotation of the crankshaft. The possible range is [1 µs … 255 µs], the default is 45 µs. This parameter is available only, if the Enable reverse crank checkbox is selected.

Pulse duration reverse Lets you specify the pulse length that indicates a reverse rotation of the crankshaft. The possible range is [1 µs … 255 µs], the default is 90 µs. This parameter is available only, if the Enable reverse crank checkbox is selected.

Resynchronization trigger type Lets you choose the edge polarity of the resynchronization trigger signal which forces the resynchronization of the engine position. This parameter is enabled only if the **Specify crankshaft wheel by wave table** checkbox is selected.

Note

Resynchronization of the engine position is necessary if the engine status value reads 15, refer to RPCU_ENG_SPEED_TPU_BLx on page 139.

The possible values are:

- None (default):
  The inport for the resynchronization trigger signal is not available.
- Rising:
  The rising edge is the trigger.
- Falling:
  The falling edge is the trigger.
- Either:
  Both rising and falling edges are the triggers.
- Function-call:
  A function call is the trigger. Select this option if you want to use, for example, the **RPCU_INTERRUPT_BLx** on page 226 block as the trigger source.

Related topics

Basics

Basics on Crankshaft Wheel Specification (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

HowTos

How to Set Up Crankshaft Signal Processing (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Crank Speed Measurement Page (RPCU_CRANK_SETUP_TPU_BLx)

Purpose

To configure the measurement of the crankshaft speed.

Description

For all angle values to be specified, the angle resolution is 0.1°.

Note

For the angle values of all other engine control blocks, the angle resolution is 0.1°, too.

Basic settings

Tooth period ratio Lets you specify the region of valid tooth periods. The possible range is [0< … 4]. Tooth periods are valid if they are either

- Smaller than "PreviousPeriod" * PeriodRatio,
- Or greater than "PreviousPeriod" / PeriodRatio.

Refer to Basics on Speed Measurement (Crank Parameters) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Edge polarity Lets you choose the matching edge of the crankshaft signal. Possible values are Rising edge or Falling edge (default: Rising edge).

Note

An external inversion of the crankshaft signal, for example, by ConfigurationDesk for RapidPro, does not have an effect on its polarity.

Start angle Lets you specify the start value of the angle counter at initialization. Each angle must fit the range [0° … 719.999°].

Note

If Start angle differs from 0°, the 0°-position changes analogously. You must take this into account for the specification of any other absolute angle values, for example, camshaft angles, TDCs, and interrupts.

Specified by wheel parameters

This parameter is available only, if the Specify crankshaft wheel by wave table checkbox is cleared on the Parameters Page (RPCU_CRANK_SETUP_TPU_BLx).

Period measurement interval Lets you specify an angle range to evaluate the crankshaft signal for speed measurement, if the crankshaft wheel is specified via parameters. The period measurement angle defines the angle distance after which speed measurement is repeatedly performed. It must fit the range [1° …

120°]. The period measurement angle must be an integer N multiplied by the teeth spacing:

Period measurement angle = N * (360° / No. of crankshaft teeth)

Tip

A high value for N smooths the speed measurement and hides high-frequency speed variations.

For details on speed measurement, refer to Basics on Speed Measurement (Crank Parameters) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

This parameter corresponds to the Period measurement interval parameter that is related to a wheel wave table (see below).

Specified by wave table

The following parameters are available only, if the Specify crankshaft wheel by wave table checkbox is selected on the Parameters Page (RPCU_CRANK_SETUP_TPU_BLx).

Direct measurement Indicates that the result is made up by averaging a sequence of consecutive measurement values. The result is output at the end of the sequence. A subsequent sequence follows contiguously the previous but does not overlap. For details on the direct speed measurement, refer to Basics on Speed Measurement (Crank Parameters) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Period measurement interval Lets you specify a signal interval to evaluate the crankshaft signal for speed measurement, if the crankshaft wheel is specified via wave table. The period measurement interval defines the number of relevant signal edges after which speed measurement is repeatedly performed. It must fit the range [Number of crankshaft teeth /360 … Number of crankshaft teeth /3].

Tip

A high value for N smooths the speed measurement and hides high-frequency speed variations.

For details on speed measurement, refer to Basics on Speed Measurement (Crank Parameters) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

This parameter corresponds to the Period measurement interval parameter that is related to wheel parameters (see above).

Recursive measurement Indicates that the result is made up by combining the new measurement value and the last result. For details on the recursive speed measurement, refer to Basics on Speed Measurement (Crank Parameters) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Output interval Lets you specify the number of signal edges that must have evaluated until the next result is output. The possible range is [1 … Number of crankshaft teeth /3]

Recursion weighting factor Lets you specify the weight of the last result in comparison to the new measurement value. The possible range is [Output interval … Number of crankshaft teeth /3].

Note

The following condition must be met:
Recursion weighting factor ≥ Output interval

For details on the recursion weighting factor, refer to Basics on Speed Measurement (Crank Parameters) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Related topics

Basics

Basics on Speed Measurement (Crank Parameters) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Advanced Page (RPCU_CRANK_SETUP_TPU_BLx)

Purpose

To specify a periodic pulse sequence that can be used as external trigger signal.

Description

The trigger signal is represented by a sequence of periodically generated pulses. The Bit I/O channel 1 must be used a output channel.

The trigger signal is only generated in a synchronous state. For details on synchronization, refer to Synchronization Details on Parameter-Based Crankshaft Wheel Specifications (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

For all angle values to be specified, the angle resolution is 0.1°.

Note

For the angle values of all other engine control blocks, the angle resolution is 0.1°, too.

External trigger signal settings

Enable external trigger signal (Disabled if Bit I/O channel 1 is not routed as BIT_OUT or is used by another block) Indicates whether an external trigger signal is generated by the I/O PLD (periodic angle-based pulses).

Note

An external trigger signal can be generated only with I/O PLD firmware version 1.3 or later. To check and update your I/O PLD firmware version, refer to How to Update RapidPro Firmware (RapidPro System Hardware Installation Guide 🕮).

Period trigger angle (Disabled if the Enable external trigger signal checkbox is cleared) Lets you specify the distance between the rising edges of subsequent pulses. Range is [0.1° ... 720.0°].

Note

The value must divide 720° without any remainder (Period trigger angle * N = 720°).
Depending on the period trigger angle, the engine speed must not exceed specific upper limits:

- 0.1°: 5000 rpm
- 0.2°: 10000 rpm (maximum possible engine speed, if the crankshaft wheel is specified via a wave table)
- 0.3°: 15000 rpm
- 0.4°: 20000 rpm

Higher engine speed is basically possible if you decrease pulse duration. However, you must take the specification of the digital output module into account.

Start angle (Disabled if the Enable external trigger signal checkbox is cleared) Lets you specify the start angle of the first trigger pulse. Range is [0° ... 719.9°].

Note

The start angle must be less than the period trigger angle.

Pulse duration (Disabled if the Enable external trigger signal checkbox is cleared) Lets you specify the duration of a single pulse of the generated trigger signal. Range is [0.0000000178 s ... 0.00000455 s], that is, [1/56 MHz ... 255/56 MHz].

Speed calculation suppression settings

Note

Speed calculation suppression is only possible if the following applies: Period measurement interval on page 134 = 360° / No. of crankshaft teeth.

Enable speed calculation suppression following a gap Indicates whether speed calculation suppression is enabled.

Number of teeth Lets you select the number of teeth that pass by after a gap until speed is calculated, again. The possible range is [1 … 4].

Related topics

Basics

Generating Periodic Angle-Based Trigger Pulses (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

HowTos

How to Set Up Crankshaft Signal Processing (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Engine Speed and Status

Where to go from here

Information in this section

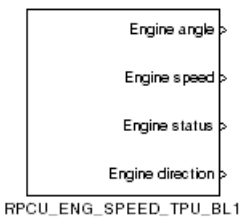
RPCU_ENG_SPEED_TPU_BLx

Where to go from here

Information in this section

RPCU_ENG_SPEED_TPU_BLx Block Description

Block



Purpose

To read the angle, speed, status, and rotation direction of the engine.

Description

The RPCU_ENG_SPEED_TPU_BLx block reads the engine speed and the angle of the crankshaft detection as well as the engine status (specific status codes) at run-time.

An RPCU_ENG_SPEED_TPU_BLx block is related to the RPCU_CRANK_SETUP_TPU_BLx that references the same RapidPro hardware (see Unit page). For basic information, refer to Measuring Engine Speed, Position, and Status (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter `rtirpcu` in the MATLAB Command Window.
2. Click the **Engine Control** button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23
- RPCU_CRANK_SETUP_TPU_BLx on page 128

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Engine angle	The measured engine angle. Data type: Double Range: 0° … 719.9° Resolution: 0.1°
Engine speed	The measured engine speed. Data type: Double The range depends on the crankshaft wheel specification (wavetable or parameters). ▪ Using a wavetable: Range is 5 … 10000 rpm ▪ Using parameters: Range is 40 … 20000 rpm Resolution: Depends on the TPU prescaler setting, refer to RPCU_TIMER_SETUP_TPU_BLx on page 23.

Port	Description	
Engine status	Represents the status of the engine. Data type: UInt8	
	If the crank wheel is specified by wheel parameters, the following engine status values are possible:	
	0	Crankshaft angle measurement and period measurement have not been started. Crankshaft and camshaft signals are not synchronized.
	1	Speed measurement and evaluation of the camshaft signal have been started.
	2	Synchronization algorithm has been started. Logging of the camshaft signal is finished.
	3	Crankshaft angle measurement is being adjusted (update of the angle counter TCR2).
	4	Generation of injection and ignition pulses is being started.
	5	Crankshaft and camshaft signals are synchronized. Angle values are being returned.
	6	(only possible if no camshaft signal exists) Period measurement has been started.
	If the crank wheel is specified by a wave table, the following engine status values are possible:	
	0	Crankshaft angle measurement and speed measurement have not been started. Crankshaft and camshaft signals are not synchronized.
	1	Speed measurement is enabled. Evaluation of the crankshaft and camshaft signal has been started to achieve the synchronization of these signals.
	2	The Time Counter Register (TCR2) is synchronized with the 0.1° pulses sent by the Angular Computation Unit (ACU). For details on TCR2 and ACU, refer to Processing the Crankshaft Signal (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).
	3	Crankshaft and camshaft signals are synchronized. Angle measurement is enabled. Generation of injection and ignition signals is still disabled.
	4	Same as status 3, but the generation of injection and ignition signals is enabled as speed has increased above **SpeedUpperThreshold**.
	5	Speed measurement is enabled. Angle measurement is not possible. **Note** Status 5 only occurs, if no RPCU_CAM_TPU_BLx on page 152 block exists in the model.
	15	A cam signal error occurred during synchronization (e.g., due to cable disruption), or speed is greater than the maximum possible speed. All the engine control functions are disabled (pulse generation, speed and angle measurement).

Port	Description
	Note You must restart the application, or call the **dsrpcu_crank_reset** function, refer to **dsrpcu_crank_reset** (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮).
Engine direction	The direction of the engine rotation. Data type: UInt16 ▪ 0 means undefined. ▪ 1 means forward. ▪ 2 means reverse.
Status	Represents the status of the engine speed and engine angle measurement. Available only if the Enable outport Status on page 143 checkbox is selected. Data type: UInt8 1: Result value has been updated since last read access 0: Result value has not been updated since last read access

Related RTLib functions

- TPU-related RTLib functions (crank wheel parameters):
  dsrpcu_tpu_crank_pm_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- I/O PLD-related RTLib functions (crank wheel wave table):
  dsrpcu_crank_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_ENG_SPEED_TPU_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related RPCU_SETUP_BLx on page 18 block.

Parameters Page (RPCU_ENG_SPEED_TPU_BLx)

Purpose

To enable status information.

Outport setting

Enable outport Status Indicates whether the block has a "Status" output port for status information about the data in the DPMEM. See the I/O characteristics of the block.

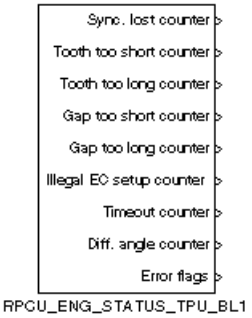
RPCU_ENG_STATUS_TPU_BLx

Where to go from here

Information in this section

RPCU_ENG_STATUS_TPU_BLx Block Description

Block



Note

The RPCU_ENG_STATUS_TPU_BLx block can only be used if the crankshaft wheel is specified via parameters, refer to Parameters Page (RPCU_CRANK_SETUP_TPU_BLx) on page 131.

Purpose

To count the occurrence of specific synchronization errors.

Description

The RPCU_ENG_STATUS_TPU_BLx counts the occurrence of specific synchronization errors at run time. This is additional status data, supplementing the status data of the RPCU_ENG_SPEED_TPU_BLx on page 139.

Tip

The block should be part of a task that is not that dominant, for example, only executed every 100 ms. This helps reducing the CPU load.

An RPCU_ENG_STATUS_TPU_BLx block is related to the RPCU_CRANK_SETUP_TPU_BLx that references the same RapidPro hardware (see Unit page).

For basic information, refer to Measuring Engine Speed, Position, and Status (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the **Engine Control** button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23
- RPCU_CRANK_SETUP_TPU_BLx on page 128

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Sync. lost counter	Number of lost synchronizations Data type: UInt16 Range: 0 … 65535
Tooth too short counter	Number of "Too short tooth distance" errors. For the definition of "Too short tooth distance", refer to Limitation of the Speed Measurement (Crank Parameters) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮). Data type: UInt16 Range: 0 … 65535
Tooth too long counter	Number of "Too long tooth distance" errors. For the definition of "Too long tooth distance", refer to Limitation of the Speed Measurement (Crank Parameters) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮). Data type: UInt16 Range: 0 … 65535
Gap too short counter	Number of "Too short gap distance" errors. For the definition of "Too short gap distance", refer to Limitation of the Speed Measurement (Crank Parameters) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮). Data type: UInt16 Range: 0 … 65535
Gap too long counter	Number of "Too long gap distance" errors. For the definition of "Too long gap distance", refer to Limitation of the Speed Measurement (Crank Parameters) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮). Data type: UInt16 Range: 0 … 65535

Port	Description
Illegal EC setup counter	Number of "Illegal engine control setup" errors. The counter increments if the engine control for the crankshaft or camshaft wheel is initialized with invalid parameters. Data type: UInt16 Range: 0 … 65535
Timeout counter	Number of "Timeout" errors caused by a missing signal. The counter increments when a timeout is detected for the crankshaft signal input. Data type: UInt16 Range: 0 … 65535
Diff. angle counter	Number of errors due to inconsistent angle values of the TPUs (A, B, C). The angle counters of the TPUs that perform engine control are checked for ACU synchronicity every second revolution. If they are not synchronous, the firmware starts resynchronization and increments this counter. Data type: UInt16 Range: 0 … 65535
Error flags	Indicates for each counter port whether a new error occurred during the last sample time. This is a vector (width=8, requires a **Demux** block) with the following elements, sorted by index: ▪ 0: Sync. lost counter ▪ 1: Tooth too short counter ▪ 2: Tooth too long counter ▪ 3: Gap too short counter ▪ 4: Gap too long counter ▪ 5: Illegal EC setup counter ▪ 6: Timeout counter ▪ 7: Diff. angle counter Data type (vector element): Boolean 1: New count 0: No count
Status	Represents the status of the engine status measurement. Available only if the Enable outport Status on page 147 checkbox is selected. Data type: UInt8 1: Result value has been updated since last read access 0: Result value has not been updated since last read access

Related RTLib functions dsrpcu_tpu_eng_status_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_ENG_STATUS_TPU_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Parameters Page (RPCU_ENG_STATUS_TPU_BLx)

Purpose

To enable status information.

Outport setting

Enable outport Status Indicates whether the block has a "Status" output port for status information about the data in the DPMEM. See the I/O characteristics of the block.

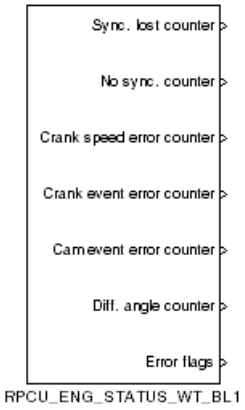
RPCU_ENG_STATUS_WT_BLx

Where to go from here

Information in this section

RPCU_ENG_STATUS_WT_BLx Block Description

Block



Note

The RPCU_ENG_STATUS_WT_BLx block can only be used if the crankshaft wheel is specified via a wave table, refer to Parameters Page (RPCU_CRANK_SETUP_TPU_BLx) on page 131.

Purpose

To count the occurrence of specific synchronization errors.

Description

The RPCU_ENG_STATUS_WT_BLx counts the occurrence of specific synchronization errors at run time. This is additional status data, supplementing the status data of the RPCU_ENG_SPEED_TPU_BLx on page 139.

Tip

The block should be part of a task that is not that dominant, for example, only executed every 100 ms. This helps reducing the CPU load.

An RPCU_ENG_STATUS_WT_BLx block is related to the RPCU_CRANK_SETUP_TPU_BLx that references the same RapidPro hardware (see Unit page).

For basic information, refer to Measuring Engine Speed, Position, and Status (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter `rtirpcu` in the MATLAB Command Window.
2. Click the **Engine Control** button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23
- RPCU_CRANK_SETUP_TPU_BLx on page 128

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Sync. lost counter	Number of lost synchronizations The counter increments up if crankshaft angle measurement loses its reference position, i.e., the 0° position. Data type: UInt16 Range: 0 … 65535
No sync. counter	Number of engine cycles during which synchronization cannot be achieved. Data type: UInt16 Range: 0 … 65535
Crank speed error counter	Number of times which speed exceeds the maximum speed limit. For details, refer to Basics on Speed Measurement (Crank Parameters) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮). Data type: UInt16 Range: 0 … 65535

Port	Description
Crank event error counter	Number of times which an unexpected crankshaft signal edge is detected. For details, refer to Basics on Speed Measurement (Crank Parameters) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮). Data type: UInt16 Range: 0 … 65535
Cam event error counter	Number of times which ▪ an unexpected or missing camshaft signal edge is detected during the synchronization process. ▪ no cam signal edge is detected during the last 720° (e.g., due to cable disruption). In addition, the **Status** outport of the RPCU_CAM_TPU_BLx on page 152 block is set to value 4 (only Bit 2 is set).. Detection is only possible if synchronization is already achieved. Data type: UInt16 Range: 0 … 65535
Diff. angle counter	Number of errors due to inconsistent angle values of the TPUs (A, B, C). The angle counters of the TPUs that perform engine control are checked for ACU synchronicity every second revolution. If they are not synchronous, the firmware starts resynchronization and increments this counter. Data type: UInt16 Range: 0 … 65535
Error flags	Indicates for each counter port whether a new error occurred during the last sample time. This is a vector (width=6, requires a **Demux** block) with the following elements, sorted by index: ▪ 0: Sync. lost counter ▪ 1: No sync. counter ▪ 2: Crank speed error counter ▪ 3: Crank event error counter ▪ 4: Cam event error counter ▪ 5: Diff. angle counter Data type (vector element): Boolean 1: New count 0: No count
Status	Represents the status of the engine status measurement. Available only if the Enable outport Status on page 151 checkbox is selected. Data type: UInt8 1: Result value has been updated since last read access 0: Result value has not been updated since last read access

Related RTLib functions dsrpcu_crank_status_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Related topics

Basics

Basics on Speed Measurement (Crank Parameters) (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Unit Page (RPCU_ENG_STATUS_WT_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Parameters Page (RPCU_ENG_STATUS_WT_BLx)

Purpose

To enable status information.

Outport setting

Enable outport Status Indicates whether the block has a "Status" output port for status information about the data in the DPMEM. See the I/O characteristics of the block.

Camshaft Signal Measurement

Where to go from here

Information in this section

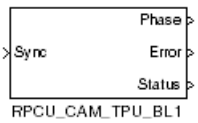
RPCU_CAM_TPU_BLx

Where to go from here

Information in this section

RPCU_CAM_TPU_BLx Block Description

Block



Purpose

To initialize a camshaft wheel for engine control.

Description

The RPCU_CAM_TPU_BLx block specifies a camshaft pattern. This block is also used to measure a camshaft phase shift.

Note

A maximum of four RPCU_CAM_TPU_BLx blocks with the same board/module and ECU channel numbers are allowed in a model.
The **Use TPU A/B/C timer 2 for engine control** on page 25 checkbox of the related TPU (A, B, C) in the related RPCU_TIMER_SETUP_TPU_BLx block must be selected.

For basic information, refer to Setting Up Crankshaft and Camshaft Signal Measurement (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter `rtirpcu` in the MATLAB Command Window.
2. Click the Engine Control button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23
- RPCU_CRANK_SETUP_TPU_BLx on page 128

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port		Description
Input		
	Sync	Actual status of the camshaft wheel. Indicates whether the wheel is in initial position. Available only if the **Enable phase measurement** on page 158 checkbox is selected and **Synchronization mode** on page 158 is set to "Lock position". Data type: Boolean 0: Camshaft wheel is not in initial position 1: Camshaft wheel is in initial position

Port		Description
Output		
	Phase	The phase of the camshaft wheel at run time, refer to **Camshaft start position** on page 159. Until angle measurement is synchronized, 0° is returned as result, refer to Synchronization With Camshaft Phase Shift (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮). Available only if the **Enable phase measurement** on page 158 checkbox is selected. Data type: Double Range: -360.0° … +359.9° The **Phase** signal is negative if the camshaft marker is detected earlier than expected, i.e., at a smaller angle value. For a phase shift example, refer to Example of Synchronization With Camshaft Phase Shift (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).
	Error	Reads the error counter of the camshaft phase shift measurement. This counter is incremented each time an invalid camshaft phase shift is measured, for example, caused by erroneous edges in the camshaft signal due to noise. A measurement value is invalid if it exceeds the phase shift validity range [**Minimum phase shift angle** on page 158 ... **Maximum phase shift angle** on page 158]. Available only if the **Enable outport Error** on page 159 checkbox is selected. Data type: UInt32
	Status	Represents the status of the camshaft measurement. Available only if the **Enable outport Status** on page 159 checkbox is selected. Data type: UInt8 The meaning of the bit numbers depends on the crankshaft wheel specification: ▪ Specification via parameters: 2: Measurement is suspended and it is being resynchronized to the angle counter (TCR2). 1: Result value has been updated since last read access. 0: Result value has not been updated since last read access. ▪ Specification via a wave table: 4: No cam signal is detected during the last 720°, for example, due to cable disruption. Subsequently, the **Cam event error counter** of the **RPCU_ENG_STATUS_WT_BLx** on page 148 block is incremented (+1). 2: Measurement is suspended and it is being resynchronized to the angle counter (TCR2). 1: Result value has been updated since last read access. 0: Result value has not been updated since last read access.

Related RTLib functions

- TPU-related RTLib functions (crank wheel parameters):
  dsrpcu_tpu_cam_init3 (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

dsrpcu_tpu_cam_phase_read2 (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

dsrpcu_tpu_cam_phase_status_write (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

- I/O PLD-related RTLib functions (crank wheel wave table):

  dsrpcu_cam_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

  dsrpcu_cam_phase_shift_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

  dsrpcu_cam_phase_shift_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

  dsrpcu_cam_phase_shift_status_write (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_CAM_TPU_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Input port selection

Input port selection Lets you choose an input channel for signal capture. The channels offered are referenced from the hardware topology file (*.hwt), refer to RPCU_SETUP_BLx on page 18. Channels that are used by the block are marked with "+", channels that are used otherwise are marked with "*".

Note

The Ch01 channel of the related TPU is used internally if not already assigned by the RPCU_CRANK_SETUP_TPU_BLx on page 128.

Note

The incoming camshaft signal must be connected to an SC module.
If the crankshaft wheel does not have a gap, the SC module must be mounted on the RapidPro Control Unit, not on a RapidPro SC Unit mounted on top of the RapidPro Control Unit.

Related topics

HowTos

How to Set Up Camshaft Signal Processing (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Parameters Page (RPCU_CAM_TPU_BLx)

Purpose

To specify the camshaft parameters.

Camshaft specification

Camshaft pulse number Lets you choose the size of the vector of camshaft start/end angles (see below), that is, the number of pulses. The range is 1 … 16.
This parameter is set to 1, by default, if the Number of gaps on page 132 parameter of the RPCU_CRANK_SETUP_TPU_BLx block is set to 0.

Vector of camshaft start angles Lets you specify the start angles of the camshaft pulses. Angles must be entered in ascending order. Each angle must fit the range [0° … 719.999°]. Disabled if the Edge polarity parameter (see below) is set to "Falling Edge".

Vector of camshaft end angles Lets you specify the end angles of the camshaft pulses. Angles must be entered in ascending order. Each angle must fit the range [0° … 719.999°]. Disabled if the Edge polarity parameter (see below) is set to "Rising Edge".

Camshaft tolerance Lets you specify the standard tolerance for all angles of the camshaft pulse pattern. Range is [0° … 180°]. This parameter is necessary because of production tolerances. In addition, if synchronization needs to be

possible for any camshaft position (see Synchronization mode on page 158), this parameter limits the range of the camshaft phase shift.

Edge polarity Lets you choose the edge polarity. Possible values are Either edge, Rising edge or Falling edge.

Note

An external inversion of the camshaft signal, for example, by ConfigurationDesk for RapidPro, is not allowed. Inversion is only allowed via the RTI RapidPro Control Unit Blockset.
If set to Either edge, there must be at least one relevant crank signal edge between the signal edges of each cam marker.

Signal polarity before first transition Lets you choose the signal polarity of the camshaft signal before the first edge occurs, i.e., signal polarity at 0° position. The possible values are Low and High. (Only evaluated if edge polarity is "Either edge").

Segment specification

Note

Segment specification is required only, if the crankshaft wheel is specified via parameters.

Segment start angle Lets you specify the start angle of the camshaft evaluation segment. The angle must fit the range [0° … 719.999°].

The Segment start angle must equal the sum of the Start angle on page 134 and an integer multiple N of the Period measurement interval on page 134 parameters (refer to the Crank Speed Measurement Page (RPCU_CRANK_SETUP_TPU_BLx)):

```
Segment start angle = Start angle + N * Period measurement angle
```

To achieve quick synchronization, the segment start angle should read as follows:

Start angle ≤ Segment start angle ≤ Minimum relevant camshaft angle

Segment end angle Lets you specify the end angle of the camshaft evaluation segment. The angle must fit the range [0° … 719.999°]. The Segment end angle must cover the maximum camshaft end angle that is relevant for synchronization (taking the crankshaft wheel segmentation into account):

```
Maximum relevant camshaft angle ≤ Segment end angle
```

The segment end angle should read as follows:

- As small as possible, as otherwise synchronization takes longer than actually necessary.
- Large enough for all the relevant camshaft angle values to be logged, even if the camshaft is shifted.

Note

If you evaluate multiple camshaft wheels, they must all have the same Segment start/end angles specified.

Refer to Logging the Camshaft Signal Within the Evaluation Segment (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Related topics

Basics

Logging the Camshaft Signal Within the Evaluation Segment (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

HowTos

How to Set Up Camshaft Signal Processing (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

CAM Phase Measurement Page (RPCU_CAM_TPU_BLx)

Purpose

To specify camshaft phase measurement.

Measurement setting

Enable phase measurement Indicates whether the measurement of a camshaft phase shift is enabled.

Minimum phase shift angle Specifies the minimum possible camshaft phase shift. The range is [-120°... 119.999].

Maximum phase shift angle Specifies the maximum possible camshaft phase shift. The range is [-119.999° ... 120°]. The following rule applies:

Note

Maximum phase shift angle > Minimum phase shift angle

Synchronization

Synchronization mode Lets you choose the synchronization mode:

- Lock position: Synchronization is possible only if there is no camshaft phase shift during initialization.
- Always: Synchronization is even possible if there is a camshaft phase shift during initialization. However, there are some general limitations, refer to Synchronization Details on Parameter-Based Crankshaft Wheel Specifications (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

- Ignore: The camshaft wheel position is ignored in synchronization. It is still possible to measure the camshaft phase shift.

Note

If Synchronization mode is set to "Always" and the Number of gaps parameter is set to 0 (see RPCU_CRANK_SETUP_TPU_BLx on page 128), an error occurs.

Camshaft start position Lets you choose the camshaft start position at initialization:

- Init: The camshaft phase shift is zero.
- Shifted: There is a camshaft phase shift, which has to be offset before synchronization can take place.

Interrupt setting

Enable interrupt Indicates whether CAM interrupts are generated. Refer to RPCU_INTERRUPT_BLx on page 226. Interrupt generation depends on the selected Edge polarity on page 157:

- Rising edge: Interrupt is generated on each rising edge
- Falling edge: Interrupt is generated on each falling edge
- Either edge: Interrupt is generated on each rising and each falling edge

Disabled if the Enable phase measurement checkbox is cleared. Disabled and cleared if Synchronization mode is set to "Lock position".

Note

If Synchronization mode is set to "Lock position" the RPCU_CAM_TPU_BLx block must not reside in a subsystem that is triggered by the block's own interrupt.

Outport setting

Enable outport Error Indicates whether the block has an "Error" output port for status information about the error counter. This counter is incremented each time an invalid camshaft phase shift is measured. See the I/O characteristics of the block.

Enable outport Status Indicates whether the block has a "Status" output port for status information about the data in the DPMEM. See the I/O characteristics of the block.

Advanced Page (RPCU_CAM_TPU_BLx)

Purpose

To specify the extended synchronization settings.

Extended synchronization settings

NOTICE

Risk of damage of the combustion engine

When using Force synchronization without camshaft signal edge detection, this could lead to a synchronization failure, if any wiring harness is defect or an improper synchronization segment was selected.
Check the wiring harness and the Segment specification on page 157.

Force synchronization without camshaft signal edge detection Indicates whether synchronization of the angle counter is possible without the detection of a camshaft signal edge.

Note

This option is not supported, if the crankshaft wheel is specified via wave table.

Related topics

HowTos

How to Set Up Camshaft Signal Processing (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Examples

Example of Synchronization Without Camshaft Signal (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Injection and Ignition Pulse Generation

Where to go from here

Information in this section

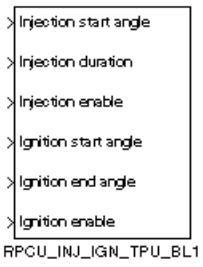
RPCU_INJ_IGN_TPU_BLx

Where to go from here

Information in this section

RPCU_INJ_IGN_TPU_BLx Block Description

Block



Purpose

To configure injection and ignition signal generation of one cylinder.

Description

The RPCU_INJ_IGN_TPU_BLx block initializes the injection and ignition pulse patterns for a specific cylinder. Injection and ignition pulses can overlap into the next 720° cycle, but must not overlap the next pulse pattern. The edge polarity of the signals is always "active high".

Note

Consider possible external signal inversion (SC/Power modules).

Refer to Injection and Ignition Reference Data (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

Only one RPCU_INJ_IGN_TPU_BLx block referencing the same hardware (cylinder) is allowed in a model.
The **Use TPU A/B/C timer 2 for engine control** on page 25 checkbox of the related TPU (A, B, C) in the related RPCU_TIMER_SETUP_TPU_BLx block must be selected.

For basic information, refer to Generating Injection and Ignition Pulses (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the **Engine Control** button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23
- RPCU_CRANK_SETUP_TPU_BLx on page 128
- RPCU_CAM_TPU_BLx on page 152
- RPCU_INJ_IGN_ENABLE_TPU_BLx on page 172

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Injection start angle	Vector of start angles before TDC for the injection pulse. Data type: Double Range: -360.0° ... +359.9°
Injection duration	Vector of duration values for the injection pulse. Each value specifies the complete duration including peak A and peak B durations. Data type: Double Range: 0 … 0.5 s
Injection enable	Enables/disables injection for the related cylinder. Data type: Boolean
Ignition start angle	Vector of start angles before TDC for the ignition pulses. Data type: Double Range: -360.0° ... +359.9°
Ignition end angle	Vector of end angles before TDC for the ignition pulses. Data type: Double Range: -360.0° ... +359.9°
Ignition enable	Enables/disables ignition for the related cylinder. Data type: Boolean
Injection peak A duration	Value for the peak A subpulse. Data type: Double Range: 0.0000032 … 0.002 s This inport is enabeld, if the following checkboxes are selected: ▪ **Enable injection**(Injection Page), and ▪ **Enable inport for injection peak A duration**(Advanced Page)
Injection peak B duration	Value for the peak B subpulse. Data type: Double Range: 0 … 0.002 s This inport is enabeld, if the following checkboxes are selected: ▪ **Enable injection**(Injection Page), and ▪ **Enable inport for injection peak B duration**(Advanced Page)

Related RTLib functions

- dsrpcu_tpu_inj_ign_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_tpu_inj_ign_update (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Related topics

References

Injection and Ignition Reference Data (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Unit Page (RPCU_INJ_IGN_TPU_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Engine parameters

Cylinder number Lets you choose the cylinder for which injection and ignition are to be configured. The range is 1 … 12.

Top dead center angle Lets you specify the top dead center angle (TDC) for the cylinder chosen. Each angle must fit the range [0° … 719.999°].

Injection Page (RPCU_INJ_IGN_TPU_BLx)

Purpose

To configure the injection signal.

Injection settings

The following settings address the cylinder chosen on the Unit page, refer to Cylinder number on page 164.

Enable injection Indicates whether injection signal generation is enabled.

Output driver selection (Disabled and set to <NOT SELECTED> if Enable injection checkbox is cleared) Lets you choose two TPU output channels for

injection pulse generation: You have to specify the first, even one, and the second, odd one is chosen automatically. For details on the channel usage, refer to the **Enable gate mode** option below. The channels offered are referenced from the hardware topology file (*.hwt), refer to RPCU_SETUP_BLx on page 18. Channels that are used by the block are marked with "+", channels that are used otherwise are marked with "*".

The Ch01 channel of the related TPU is used internally and thus not available.

Note

If the **Enable gate mode** checkbox (see below) is selected, the second, odd TPU channel does not need to be routed.

Number of pulses (Disabled if Enable injection checkbox is cleared) Lets you choose the number (max. 15) of injection pulses per camshaft revolution (0° … <720°).

Overlap mode (Disabled if Enable injection checkbox is cleared) Lets you choose the injection behavior if two or more injection pulses overlap.

- Merge: The pulses are merged, that is, one new pulse is specified:
  - Start angle = Start angle of the pulse that started first
  - End angle = End angle of the pulse that started last
- Remove: From left to right (ascending angle values), if a pulse overlaps the preceding pulse it is removed.

Enable gate mode (Disabled if the **Enable injection** checkbox is cleared) Indicates whether the GATE mode is enabled. The GATE mode affects the output of the injection subpulses via the two module output channels as follows:

GATE Mode	First Channel	Second Channel
ON	Peak A + Peak B + Hold	$[\text{Peak A + Peak B + Hold}]_{\text{inverted}}$
OFF	Peak A + Peak B	Peak B + Hold

Note

If you use the RPCU_INJ_IGN_TPU_BLx block in combination with a PS-DINJ 2/1 module, you must clear the **Enable gate mode** checkbox to get the full functionality. For further information on this module, refer to Module Components and Functionality (RapidPro System Hardware Reference 🕮).

For details on the composition of injection pulses, refer to Parts of an injection pulse (refer to Specification of Injection and Ignition Pulse Patterns (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)).

Related topics

Basics

Specification of Injection and Ignition Pulse Patterns (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Injection Pulses Page (RPCU_INJ_IGN_TPU_BLx)

Purpose

To configure an injection pulse pattern.

Description

An injection pulse is characterized by its start angle and duration. It consists of several subpulses: The peak A subpulse is used to generate a high-voltage signal that activates the injection nozzle. The peak B subpulse is used to generate a middle-voltage signal that quickly opens the nozzle. The hold subpulse is used to generate a low-voltage signal that keeps the nozzle open. For details, refer to Specification of Injection and Ignition Pulse Patterns (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

During the model initialization phase, an initial digital output value is written to each channel. This is especially useful if a channel is used within a triggered or enabled subsystem that is not executed right from the start of the simulation. With the initial state value, all channels have defined outputs during this simulation phase.

When the simulation terminates, all channels hold their last digital output values by default. You can specify a user-defined output value on termination, and use these settings 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 the real-time process is stopped by using ControlDesk's Stop RTP command, the processor resets immediately without executing termination functions. The specified termination values are not set.

⚠ WARNING

Applying ControlDesk's Stop RTP command can lead to unpredictable results.

Risk of injury and material damage!

- Before applying ControlDesk's Stop RTP command, think through the effects of the command.
- Ensure that no one is in the potential danger zone of the device (machine, etc.) when the command is applied.

The following settings address the cylinder chosen on the Unit page, refer to Cylinder number on page 164.

Note

The following rules apply to all vectors on this page (and to the input signals as well):
The number of vector elements must equal the Number of pulses on page 165 parameter. The start angle vector elements must be strictly monotonic decreasing, all angle values are related to the TDC ("Before TDC").
Refer to Specification of Injection and Ignition Pulse Patterns (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Initialization

Initial peak A duration (Disabled if Enable injection checkbox is cleared) Lets you specify the initial time period of the first injection pre-pulse (high voltage). The range is 0.0000032 … 0.002 s.

Initial peak B duration (Disabled if Enable injection checkbox is cleared) Lets you specify the initial time period of the second injection pre-pulse (middle voltage). The range is 0 … 0.002 s.

Initial start angle before TDC (Disabled if Enable injection checkbox is cleared) Lets you specify the initial values for the start angle of the injection pulses. Each angle must fit the range [-360° … 359.999°]. The sequence of the pulses must be arranged in such a way that all pulses are in one engine revolution beginning with the start angle of the first pulse.

Initial duration (Disabled if Enable injection checkbox is cleared) Lets you specify the initial values for the duration of the injection pulses. The range is 0 … 1 s.

Termination

Termination state (Disabled if Enable injection checkbox is cleared) Indicates whether the digital output is set to the termination values when the simulation terminates. Otherwise, the current digital output value is kept.

Note

There is only one Termination state option for both injection and ignition pulses. If you change one option, the other is automatically changed, too.

Peak A duration on termination (Disabled if Enable injection checkbox or Termination state checkbox is cleared) Lets you specify the time period of the first injection pre-pulse (high voltage) on termination. The range is 0.0000032 … 0.002 s.

Peak B duration on termination (Disabled if Enable injection checkbox or Termination state checkbox is cleared) Lets you specify the time period of the second injection pre-pulse (middle voltage) on termination. The range is 0 … 0.002 s.

Start angle on termination before TDC (Disabled if Enable injection checkbox or Termination state checkbox is cleared) Lets you specify the values for the start angle of the injection pulses when a simulation terminates. Each angle must fit the range [-360° … 359.999°]. The sequence of the pulses must be such that all pulses are in one engine revolution beginning with the start angle of the first pulse.

Duration on termination (Disabled if Enable injection checkbox or Termination state checkbox is cleared) Lets you specify the values for the duration of the injection pulses when a simulation terminates. The range is 0 … 1 s.

Related topics

References

simState (RTI and RTI-MP Implementation Reference 🕮)

Ignition Page (RPCU_INJ_IGN_TPU_BLx)

Purpose

To configure the ignition signal.

Ignition settings

The following settings address the cylinder chosen on the Unit page, refer to Cylinder number on page 164.

Enable ignition Indicates whether ignition signal generation is enabled.

Output driver selection (Disabled and set to <NOT SELECTED> if Enable ignition checkbox is cleared) Lets you choose a TPU channel for ignition generation. The channels offered are referenced from the hardware topology file (*.hwt), refer to RPCU_SETUP_BLx on page 18. Channels that are used by the block are marked with "+", channels that are used otherwise are marked with "*".

The Ch01 channel of the related TPU is internally used and, thus, not available.

Number of pulses (Disabled if Enable ignition checkbox is cleared) Lets you choose the number (max. 15) of ignition pulses per camshaft revolution (0° … <720°).

Overlap mode (Disabled if Enable ignition checkbox is cleared) Lets you choose the ignition behavior if two or more ignition pulses overlap.

- Merge: The pulses are merged, that is, one new pulse is specified:
  Start angle = Start angle of the pulse that started first
  End angle = Largest end angle
- Remove: From left to right (ascending angle values), if a pulse overlaps the preceding pulse it is removed.

For details refer to Specification of Injection and Ignition Pulse Patterns (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Related topics

Basics

Specification of Injection and Ignition Pulse Patterns (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Ignition Pulses Page (RPCU_INJ_IGN_TPU_BLx)

Purpose

To configure an ignition pulse pattern.

Description

An ignition pulse is characterized by its start and end angles.

During the model initialization phase, an initial digital output value is written to each channel. This is especially useful if a channel is used within a triggered or enabled subsystem that is not executed right from the start of the simulation. With the initial state value, all channels have defined outputs during this simulation phase.

When the simulation terminates, all channels hold their last digital output values by default. You can specify a user-defined output value on termination, and use these settings 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 the real-time process is stopped by using ControlDesk's Stop RTP command, the processor resets immediately without executing termination functions. The specified termination values are not set.

⚠ WARNING

Applying ControlDesk's Stop RTP command can lead to unpredictable results.

Risk of injury and material damage!

- Before applying ControlDesk's Stop RTP command, think through the effects of the command.
- Ensure that no one is in the potential danger zone of the device (machine, etc.) when the command is applied.

The following settings address the cylinder chosen on the Unit page, refer to Cylinder number on page 164.

Note

The following rules apply to all vectors on this page (and to the input signals as well):

The number of vector elements must equal the Number of pulses on page 165 parameter. The start angle vector elements must be strictly monotonic decreasing, all angle values are related to the TDC ("Before TDC").

Refer to Specification of Injection and Ignition Pulse Patterns (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Initialization

Initial start angle before TDC (Disabled if Enable ignition checkbox is cleared) Lets you specify the initial values for the start angle of the ignition pulses. Each angle must fit the range [-360° … 359.9°]. The vector elements must be strictly monotonic decreasing, refer to Specification of Injection and Ignition Pulse Patterns (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮). The sequence of the pulses must be such that all pulses are in one engine revolution beginning with the start angle of the first pulse.

Initial end angle before TDC (Disabled if Enable ignition checkbox is cleared) Lets you specify the initial values for the end angle of the ignition pulses. Each angle must fit the range [-360° … 359.9°].

Termination

Termination state (Disabled if Enable ignition checkbox is cleared) Indicates whether the digital output is set to the termination values when the simulation terminates. Otherwise, the current digital output value is kept.

Note

There is only one Termination state option for both injection and ignition pulses. If you change one option, the other is automatically changed, too.

Start angle before TDC on termination (Disabled if Enable ignition checkbox or Termination state checkbox is cleared) Lets you specify the values for the start angle of the ignition pulses when a simulation terminates. Each angle must fit the range [-360° … 359.9°]. The vector elements must be strictly monotonic decreasing, refer to Specification of Injection and Ignition Pulse Patterns (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮). The sequence of the pulses must be such that all pulses are in one engine revolution beginning with the start angle of the first pulse.

End angle before TDC on termination (Disabled if Enable ignition checkbox or Termination state checkbox is cleared) Lets you specify the values for the end angle of the ignition pulses when a simulation terminates. Each angle must fit the range [-360° … 359.9°].

Related topics

Basics

Specification of Injection and Ignition Pulse Patterns (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

References

simState (RTI and RTI-MP Implementation Reference 🕮)

Advanced Page (RPCU_INJ_IGN_TPU_BLx)

Purpose

To enable inports for injection peak A and peak B durations.

Inport settings

Enable inport for injection peak A duration (Disabled if Enable injection checkbox is cleared) Lets you enable an inport for the peak A duration.

Enable inport for injection peak B duration (Disabled if Enable injection checkbox is cleared) Lets you enable an inport for the peak B duration.

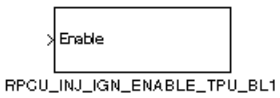
RPCU_INJ_IGN_ENABLE_TPU_BLx

Where to go from here

Information in this section

RPCU_INJ_IGN_ENABLE_TPU_BLx Block Description

Block



Purpose

To switch injection and ignition on/off for all cylinders centrally.

Description

The RPCU_INJ_IGN_ENABLE_TPU block is used to enable and disable injection and ignition for all cylinders.

Note

Only one RPCU_INJ_IGN_ENABLE_TPU Block with the same module and ECU channel numbers is allowed in one model.

For basic information, refer to Generating Injection and Ignition Pulses (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the **Engine Control** button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23
- RPCU_CRANK_SETUP_TPU_BLx on page 128
- RPCU_CAM_TPU_BLx on page 152
- RPCU_INJ_IGN_TPU_BLx on page 161

I/O mapping

None

I/O characteristics

The following table describes the ports of the block:

Port	Description
Enable	Controls the injection and ignition generation for all cylinders. Data type: Boolean 1: Enabled 0: Disabled

Related RTLib functions

- dsrpcu_tpu_inj_ign_start (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_tpu_inj_ign_stop (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_INJ_IGN_ENABLE_TPU)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Angle-Angle-Based Pulse Generation

Where to go from here

Information in this section

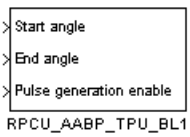
RPCU_AABP_TPU_BLx

Where to go from here

Information in this section

RPCU_AABP_TPU_BLx Block Description

Block



Purpose

To configure angle-angle-based pulse generation.

Description

The RPCU_AABP_TPU_BLx block initializes the angle-angle based pulse patterns. Pulses can overlap into the next 720° cycle, but must not overlap the next pulse pattern. The edge polarity of the signals is always "active high".

Note

Up to 12 RPCU_AABP_TPU_BLx blocks and up to 4 **RPCU_SCKNOCK41_SETUP Block** on page 192 blocks are allowed in one model, but they must not exceed an overall total of 12.
Consider possible external signal inversion (SC/Power modules).

For basic information, refer to Generating Angle-Angle-Based Pulses (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter `rtirpcu` in the MATLAB Command Window.
2. Click the Engine Control button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23
- RPCU_CRANK_SETUP_TPU_BLx on page 128
- RPCU_CAM_TPU_BLx on page 152
- RPCU_AABP_ENABLE_TPU_BLx on page 179

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Start angle	Vector of start angles before TDC for the angle-angle based pulses. Data type: Double Range: -360.0° ... +359.9°
End angle	Vector of end angles before TDC for the angle-angle based pulses. Data type: Double Range: -360.0° ... +359.9°
Pulse generation enable	Enables/disables pulse generation for this block. Data type: Boolean

Related RTLib functions

- dsrpcu_tpu_aabp_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

- dsrpcu_tpu_aabp_update (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_AABP_TPU_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Output port selection

Output driver selection Lets you choose a TPU channel for angle-angle based pulse generation. The channels offered are referenced from the hardware topology file (*.hwt), refer to RPCU_SETUP_BLx on page 18. Channels that are used by the block are marked with "+", channels that are used otherwise are marked with "*".

The Ch01 channel of the related TPU is internally used and, thus, not available.

Parameters Page (RPCU_AABP_TPU_BLx)

Purpose

To configure an angle-angle based pulse pattern.

Description

An angle-angle based pulse is characterized by its start and end angles.

During the model initialization phase, an initial digital output value is written to each channel. This is especially useful if a channel is used within a triggered or enabled subsystem that is not executed right from the start of the simulation. With the initial state value, all channels have defined outputs during this simulation phase.

When the simulation terminates, all channels hold their last digital output values by default. You can specify a user-defined output value on termination, and use these settings 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 the real-time process is stopped by using ControlDesk's Stop RTP command, the processor resets immediately without executing termination functions. The specified termination values are not set.

⚠ WARNING

Applying ControlDesk's Stop RTP command can lead to unpredictable results.

Risk of injury and material damage!

- Before applying ControlDesk's Stop RTP command, think through the effects of the command.
- Ensure that no one is in the potential danger zone of the device (machine, etc.) when the command is applied.

Note

The following rules apply to all vectors on this page (and to the input signals as well):
The number of vector elements must equal the Number of pulses on page 165 parameter. The start angle vector elements must be strictly monotonic decreasing, all angle values are related to the TDC ("Before TDC").
Refer to Basics on the Generation of Angle-Angle-Based Pulses (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Pulse settings

Top dead center angle Lets you specify the top dead center angle (TDC) . The angle must fit the range [0° … 719.999°].

Number of pulses Lets you choose the number (max. 15) of angle-angle based pulses per camshaft revolution (0° … <720°).

Overlap mode Lets you choose the generation behavior if two or more angle-angle based pulses overlap.

- Merge: The pulses are merged, that is, one new pulse is specified:
  Start angle = Start angle of the pulse that started first
  End angle = Largest end angle
- Remove: From left to right (ascending angle values), if a pulse overlaps the preceding pulse it is removed.

For details refer to Basics on the Generation of Angle-Angle-Based Pulses (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Initialization

Initial start angle before TDC Lets you specify the initial values for the start angle of the angle-angle based pulses. Each angle must fit the range [-360° … 359.999°]. The vector elements must be strictly monotonic decreasing. The sequence of the pulses must be such that all pulses are in one engine revolution beginning with the start angle of the first pulse.

Initial end angle before TDC Lets you specify the initial values for the end angle of the angle-angle based pulses. Each angle must fit the range [-360° … 359.999°].

Termination

Termination state Indicates whether the digital output is set to the termination values when the simulation terminates. Otherwise, the current digital output value is kept.

Start angle before TDC on termination (Disabled if Enable ignition checkbox or Termination state checkbox is cleared) Lets you specify the values for the start angle of the angle-angle based pulses when a simulation terminates. Each angle must fit the range [-360° … 359.999°]. The vector elements must be strictly monotonic decreasing. The sequence of the pulses must be such that all pulses are in one engine revolution beginning with the start angle of the first pulse.

End angle before TDC on termination (Disabled if Enable ignition checkbox or Termination state checkbox is cleared) Lets you specify the values for the end angle of the angle-angle based pulses when a simulation terminates. Each angle must fit the range [-360° … 359.999°].

Related topics

References

simState (RTI and RTI-MP Implementation Reference 🕮)

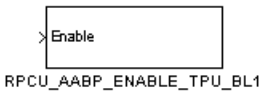
RPCU_AABP_ENABLE_TPU_BLx

Where to go from here

Information in this section

RPCU_AABP_ENABLE_TPU_BLx Block Description

Block



Purpose

To switch generation of angle-angle based pulses on/off for all channels centrally.

Description

The RPCU_AABP_ENABLE_TPU_BLx block is used to enable and disable angle-angle-based pulse generation for all channels.

Note

Only one RPCU_AABP_ENABLE_TPU_BLx block with the same module and ECU channel numbers is allowed in one model.
This block also affects knock signal measurement. Enabling/disabling angle-angle-based pulse generation also enables/disables knock signal measurement.

For basic information, refer to Basics on the Generation of Angle-Angle-Based Pulses (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the **Engine Control** button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23

- RPCU_CRANK_SETUP_TPU_BLx on page 128
- RPCU_CAM_TPU_BLx on page 152
- RPCU_AABP_TPU_BLx on page 174

I/O mapping

None

I/O characteristics

The following table describes the ports of the block:

Port	Description
Enable	Controls the angle-angle-based pulse generation for all channels. Data type: Boolean 1: Enabled 0: Disabled

Related RTLib functions

- dsrpcu_tpu_aabp_start (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_tpu_aabp_stop (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_AABP_ENABLE_TPU)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related RPCU_SETUP_BLx on page 18 block.

Angle-Synchronized Task Triggers

Where to go from here

Information in this section

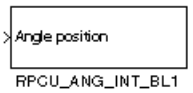
RPCU_ANGLE_INT_BLx

Where to go from here

Information in this section

RPCU_ANGLE_INT_BLx Block Description

Block



Purpose

To define interrupts generated at user-specific angle positions.

Description

The RPCU_ANGLE_INT_BLx block initializes the angle-based interrupt generation. One of the following interrupt types can be specified by means of this block:

- Fixed angle-based interrupts: Up to 16 different single angles are possible. The angle values can be changed during run time.
- Periodical angle-based interrupts: You have to define a start angle and a period to specify one angle period. Up to 6 different periodical angle-based interrupts are possible.

Note

Each angle-based interrupt needs its own RPCU_ANGLE_INT_BLx block. Only one RPCU_ANGLE_INT_TPU_BLx block with the same board/module, ECU channel and interrupts is allowed in a model.

For basic information, refer to Generating Angle-Based Interrupts (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

1. Enter `rtirpcu` in the MATLAB Command Window.
2. Click the Engine Control button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23
- RPCU_CRANK_SETUP_TPU_BLx on page 128
- RPCU_CAM_TPU_BLx on page 152
- RPCU_INTERRUPT_BLx on page 226

I/O mapping

None

I/O characteristics

The following table describes the ports of the block:

Port	Description
Angle position	Angle related to the engine's position at which an interrupt is to be triggered. Not available if periodic angle-based interrupts are specified, refer to Angle index on page 184. Data type: Double Range: 0° … 719.9°

Related RTLib functions

- dsrpcu_per_angle_int_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_angle_int_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_angle_int_update (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_ANGLE_INT_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Parameters Page (RPCU_ANGLE_INT_BLx)

Purpose

To specify the angle positions.

Initialization

Angle index Lets you choose the ID number of the angle-based interrupt. The range is 1 … 16 and Periodic 1 … Periodic 6.

Angle Lets you specify the angle at which a fixed angle-based interrupt is triggered. The range is 0° … <720°. Disabled if the Angle index parameter addresses a periodic angle-based interrupt.

Start angle Lets you specify the initial angle at which the periodic angle-based interrupt generation starts. The range is 0° … <720°. Disabled if the Angle index parameter addresses a fixed angle-based interrupt.

Period angle Lets you specify the period, that is, the angular distance between neighboring interrupt positions. The range is 0° … <720°. Disabled if the Angle index parameter addresses a fixed angle-based interrupt.

Related topics

Basics

Angle-Based Interrupts (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

HowTos

How to Implement a Periodic Interrupt (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)
How to Implement a Position Interrupt (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

References

Angle-Based Interrupts Reference Data (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Extended Engine Control

Where to go from here

Information in this section

Information in other sections

Extended Engine Control (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Measuring Exhaust Gas Oxygen with the SC-EGOS 2/1 Module

Where to go from here

Information in this section

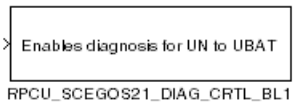
RPCU_SCEGOS21_DIAG_CTRL_BLx

Where to go from here

Information in this section

RPCU_SCEGOS21_DIAG_CTRL_BLx Block Description

Block



Purpose

To control the short circuit detection from UN to UBAT on the SC-EGOS 2/1 module during run time.

Description

A short circuit from the module's front connector pin UN to UBAT might be detected erroneously, if the internal resistance Ri of the lambda probe is high (cold probe), and you have set the pump reference current IP to ≠ 0 A in ConfigurationDesk for RapidPro.

Each time a short circuit is detected, erroneously or not, a specific diagnostic message is thrown in ConfigurationDesk for RapidPro, and the channel concerned is set to shutdown mode.

To prevent erroneous detection of a short circuit from the module's front connector pin UN to UBAT, you can enable and disable this type of short circuit detection at run time and outside run time. The setting chosen at run time overwrites the setting chosen outside run time.

1. At run time (prio 1): Via RPCU_SCEGOS21_DIAG_CTRL_BLx block
2. Outside run time (prio 2): Via ConfigurationDesk for RapidPro

For details, refer to Diagnostics for the SC-EGOS 2/1 Module (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Note

If an application using an RPCU_SCEGOS21_DIAG_CTRL_BLx block stops, the setting for short circuit detection chosen via ConfigurationDesk for RapidPro becomes the active one again.
All the settings that you can specify in ConfigurationDesk for RapidPro are stored on the module.

Access

Enter **`rtirpcu`** in the MATLAB Command Window, click the Module-specific libraries button, and click the SC EGOS21 Blockset button.

Enter **`rtirpcu_scegos21_lib`** in the MATLAB Command Window.

Other RTI blocks

The following RTI blocks must also reside in the model with the same module number (board and ECU channel numbers):

- RPCU_SETUP_BLx on page 18

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the inport of the block:

Inport	Description
Enables diagnosis for UN to UBAT	Lets you control the short circuit detection from UN to UBAT at run time. Data type: Boolean 0: Detection is disabled 1: Detection is enabled

Unit Page (RPCU_SCEGOS21_DIAG_CTRL_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Parameters Page (RPCU_SCEGOS21_DIAG_CTRL_BLx)

Purpose

To select the EGOS module/channel and specify the behavior of the short circuit detection on initialization and termination.

Module selection

Module selection Lets you choose the EGOS module and the channel which the lambda probe is connected to.

Initialization

Short circuit detection on initialization Lets you enable/disable the UN to UBAT short circuit detection on initialization.

Termination

Termination state Indicates whether the Short circuit detection on termination parameter is evaluated when the termination function is executed.

Note

The simulation executes its termination function when the simState variable is set to STOP. If the real-time process is stopped by using ControlDesk's Stop RTP command, the processor resets immediately without executing termination functions. In this case, the Short circuit detection on termination parameter is not evaluated, but the setting of the corresponding ConfigurationDesk for RapidPro parameter is applied.

Short circuit detection on termination Lets you enable/disable the UN to UBAT short circuit detection on termination.

For details on the I/O circuit and the hardware configuration of the SC-EGOS 2/1 module, refer to SC-EGOS 2/1 Module (RapidPro System Hardware Reference 🕮).

Related topics

References

simState (RTI and RTI-MP Implementation Reference 🕮)

Measuring Preignitions with the SC-KNOCK 4/1 Module

Where to go from here

Information in this section

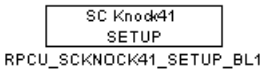
RPCU_SCKNOCK41_SETUP Block

Where to go from here

Information in this section

RPCU_SCKNOCK41_SETUP_BLx Block Description

Block



Purpose

To make a SC-KNOCK 4/1 module available for knock signal measurement.

Description

An RPCU_SCKNOCK41_SETUP block addresses and reserves a certain SC-KNOCK 4/1 module. This is a preparatory step, so that the module can be referenced by RPCU_SCKNOCK41_CTRL and RPCU_SCKNOCK41_DATA blocks.

Note

Up to 4 RPCU_SCKNOCK41_SETUP Block blocks and up to 12 RPCU_AABP_TPU_BLx on page 174 blocks are allowed in one model, but they must not exceed an overall total of 12.

Access

Enter `rtirpcu` in the MATLAB Command Window, click the Module-specific libraries button, and click the SC KNOCK41 Blockset button.

Other RTI blocks

The following RTI blocks must also reside in the model with the same board/module number:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23(the Use TPU A/B/C timer 2 for engine control checkbox of the TPU used must be selected)
- RPCU_CRANK_SETUP_TPU_BLx on page 128
- RPCU_CAM_TPU_BLx on page 152

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

None

Unit Page (RPCU_SCKNOCK41_SETUP_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related RPCU_SETUP_BLx on page 18 block.

Module selection

Module selection Lets you choose a SC-KNOCK 4/1 module. The modules offered are referenced from the hardware topology file (*.hwt), refer to RPCU_SETUP_BLx on page 18. Modules that are used by the block are marked with "+", modules that are used otherwise are marked with "*", for example, a channel routed to a SC-KNOCK 4/1 module is used by another block.

Note

If no SC-KNOCK 4/1 module is displayed, check the following:
- Module is not correctly inserted in the carrier board, or
- Routing does not correspond to the hardware.

For details on installation and routing, refer to the RapidPro System Hardware Installation Guide 🕮.

Parameters Page (RPCU_SCKNOCK41_SETUP_BLx)

Purpose

To specify the measurement settings for initialization and termination.

Description

The following parameters are crucial to the specification of knock signal measurement:
- Channel selection (knock sensor)
- TDC (top dead center angle)
- MW start angle (relative to "before TDC")
- MW end angle (relative to "before TDC")

The resolution of TDC, MW start angle, and MW end angle is 0.1°.

The parameters are accessible during run time via the RPCU_SCKNOCK41_CTRL Block on page 196. Their initialization and termination values can be specified via the RPCU_SCKNOCK41_SETUP_BLx block.

Initialization

Initial top dead center angle Lets you specify the top dead center angle (TDC) on initialization. The range is [0° … <720°].

Initial channel selection Lets you choose the channel of the SC-KNOCK 4/1 module that is used for measuring and reading the knock signal on initialization. Selecting a channel means selecting a knock sensor.

Initial measurement window start angle before TDC Specifies the angle value at which measurement starts, that is, the start angle of the measurement window. The angle value must be specified relative to "before TDC". The range is [-360° … <360°].

Initial measurement window end angle before TDC Specifies the angle value at which measurement ends, that is, the end angle of the measurement window. The angle value must be specified relative to "before TDC". The range is [-360° … <360°].

Termination

Termination state Indicates whether the following parameters are evaluated when the termination function is executed.

Top dead center angle on termination Lets you specify the top dead center angle (TDC) on termination. The range is [0° … <720°].

Channel selection on termination Lets you choose the channel of the SC-KNOCK 4/1 module that is used for measuring and reading the knock signal on termination. Selecting a channel means selecting a knock sensor.

Measurement window start angle on termination before TDC Specifies the angle value at which measurement starts, that is, the start angle of the measurement window. The angle value must be specified relative to the TDC. The range is [-360° … <360°].

Measurement window end angle on termination before TDC Specifies the angle value at which measurement ends, that is, the end angle of the measurement window. The angle value must be specified relative to the TDC. The range is [-360° … <360°].

Advanced Page (RPCU_SCKNOCK41_SETUP_BLx)

Purpose

To specify interrupt properties.

Interrupt setting

Enable interrupt Indicates whether an interrupt is generated as soon as the resulting data of the current measurement window has been completely received by the serial receiver on the RapidPro Control Unit.

In addition, you need an RPCU_INTERRUPT_BLx block for interrupt generation. For details on this block, refer to page RPCU_INTERRUPT_BLx on page 226.

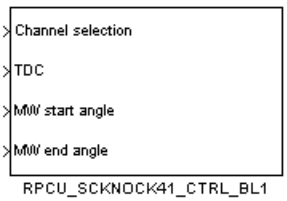
RPCU_SCKNOCK41_CTRL Block

Where to go from here

Information in this section

RPCU_SCKNOCK41_CTRL_BLx Block Description

Block



Purpose

To specify the measurement of knock signals at run time.

Description

The RPCU_SC_KNOCK_CONTROL_BLx block enables you to change the knock sensor (channel), the top dead center angle (TDC), and the measurement window (MW start angle, MW stop angle) at run time.

Note

A RPCU_SCKNOCK41_CTRL_BLx block must reside in an angle-triggered subsystem (Simulink Function-Call Subsystem). Only one RPCU_SCKNOCK41_CTRL_BLx block can reference one SC-KNOCK 4/1 module in a subsystem. However, multiple RPCU_SC_KNOCK_CONTROL_BLx blocks can be in the same subsystem if they reference different SC-KNOCK 4/1 modules.
In addition, some timing restrictions must be met, refer to Restrictions.

Access

Enter `rtirpcu` in the MATLAB Command Window, click the Module-specific libraries button, and click the SC KNOCK41 Blockset button.

Other RTI blocks

The following RTI blocks must also reside in the model with the same board/module number:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23(the Use TPU A/B/C timer 2 for engine control checkbox of the TPU used must be selected)
- RPCU_CRANK_SETUP_TPU_BLx on page 128
- RPCU_CAM_TPU_BLx on page 152
- RPCU_SCKNOCK41_SETUP Block on page 192

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Channel selection	Channel of the SC-KNOCK 4/1 module that is used for reading the knock signal. Selecting a channel means selecting a knock sensor. Data type: UInt8 Range: 1 … 4
TDC	Top dead center angle (TDC), refer also to Initial top dead center angle on page 195. Data type: Double Range: 0° … 719.9°
MW start angle	Angle value at which measurement starts, that is, the start angle of the measurement window. The angle value must be specified relative to "before TDC", refer to Initial top dead center angle on page 195.

Port	Description
MW end angle	Data type: Double Range: -360° … 359.9° Angle value at which measurement ends, that is, the stop angle of the measurement window. The angle value must be specified relative to "before TDC". Data type: Double Range: -360° … 359.9°

Unit Page (RPCU_SCKNOCK41_CTRL_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Module selection

Module selection Lets you choose a SC-KNOCK 4/1 module. Only modules that are referenced from the RPCU_SCKNOCK41_SETUP Block on page 192 are offered. Modules that are used by the block are marked with "+".

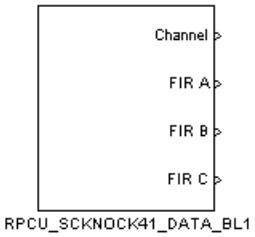
RPCU_SCKNOCK41_DATA Block

Where to go from here

Information in this section

RPCU_SCKNOCK41_DATA_BLx Block Description

Block



Purpose

To read the result of the knock signal measurement.

Description

The result of the knock signal measurement (totals of the three FIR filters) is stored in the buffer of a serial receiver on the RapidPro Control Unit. You can read the buffer using the RPCU_SCKNOCK41_DATA_BLx block.

Note

A RPCU_SCKNOCK41_DATA_BLx block must reside in an event-triggered subsystem (Simulink Function-Call Subsystem). You can have multiple RPCU_SCKNOCK41_DATA_BLx blocks in a subsystem referencing the same SC-KNOCK 4/1 module.

Access

Enter `rtirpcu` in the MATLAB Command Window, click the Module-specific libraries button, and click the SC KNOCK41 Blockset button.

Other RTI blocks

The following RTI blocks must also reside in the model with the same board/module number:

- RPCU_SETUP_BLx on page 18
- RPCU_TIMER_SETUP_TPU_BLx on page 23(the **Use TPU A/B/C timer 2 for engine control** checkbox of the TPU used must be selected)
- RPCU_CRANK_SETUP_TPU_BLx on page 128
- RPCU_CAM_TPU_BLx on page 152
- RPCU_SCKNOCK41_SETUP Block on page 192
- RPCU_SCKNOCK41_CTRL Block on page 196

I/O mapping

None

I/O characteristics

The following table describes the ports of the block:

Port	Description
Channel	Return value which indicates the channel (knock sensor: Ch1 … Ch4) where the data outputs FIR A, FIR B, and FIR C are assigned to. Data type: UInt8 Range: 1 … 4
FIR A	Total of FIR filter A[1]. Data type: UInt32 Range: 0 … 2^{18}-1 (262143)
FIR B	Total of FIR filter B[1]. Data type: UInt32 Range: 0 … 2^{18}-1 (262143)
FIR C	Total of FIR filter C[1]. Data type: UInt32 Range: 0 … 2^{18}-1 (262143)
Status	Represents the status of the resulting data in the buffer of the serial receiver on the RapidPro Control Unit. Available only if the **Enable outport Status** on page 201 checkbox is selected. Data type: UInt8 1: Resulting data has been updated since last read access 0: Resulting data has not been updated since last read access

[1] Refer to *Signal processing* in Basics of Knock Signal Measurement (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Unit Page (RPCU_SCKNOCK41_DATA_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Module selection

Module selection Lets you choose a SC-KNOCK 4/1 module. Only modules that are referenced from the RPCU_SCKNOCK41_CTRL Block on page 196 are offered. Modules that are used by the block are marked with `"+"`.

Parameters Page (RPCU_SCKNOCK41_DATA_BLx)

Purpose

To enable/disable a Status outport.

Outport setting

Enable outport Status Indicates whether the block has a `"Status"` output port for status information about the data in the DPMEM. See the I/O characteristics of the block.

Measuring Temperatures with the SC-TC 8/1 Module

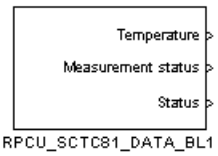
RPCU_SCTC81_Data_BLx

Where to go from here

Information in this section

RPCU_SCTC81_DATA_BLx Block Description

Block



Purpose

To configure temperature measurement performed with the SC-TC 8/1 module and to provide read access to the results.

Description

You can measure temperatures in run time by using up to 8 thermocouples connected to the SC-TC 8/1 module.

The RPCU_SCTC81_Data_BLx block allows you:

- To configure temperature measurement with the SC-TC 8/1 module
- To access the measurement result (vector output comprises results of all channels used)
- To monitor the measurement status (vector output comprises states of all channels used)
- To monitor the status of the dual-port memory (DPMEM), which is used for master-slave communication, for example, result transfer from the RapidPro system to the RCP system.

RPCU_SCTC81_DATA blocks can be used in applications running on MicroAutoBox II or DS1007 (RCP systems). Whenever such a block is executed, it reads the result that is currently available in the DPMEM. You can use multiple RPCU_SCTC81_DATA_BLx blocks in one Simulink model referencing the same SC-TC 8/1 module. However, the blocks must have identical dialog settings.

Tip

To have access to the most recent measurement result, the RPCU_SCTC81_DATA block must reside in a Simulink function-call subsystem that is triggered by the block's serial data interrupt (SC-TC 8/1 SERDAT).

For details on the block's functionality, refer to Measuring Temperatures with the SC-TC 8/1 Module (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

Enter **`rtirpcu_sctc81_lib`** in the MATLAB Command Window.

Other RTI blocks

The following RTI blocks must also reside in the model – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18

I/O mapping

The I/O mapping between the specified signals and the I/O connector pins depends on the installed modules and the connected RapidPro units. The I/O mapping information is specific to your RapidPro system and can be displayed in ConfigurationDesk for RapidPro. For further information, refer to Signal Mapping to I/O Pins (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Temperature	Measurement results of the SC-TC 8/1 module. The output is a vector, whose width (max. 8) depends on the number of selected conversion channels. If the connection of a thermocouple and the SC-TC 8/1 module is disrupted, the output of the channel concerned is set to FLOAT_MAX. Data type: Double Resolution: 0.1 °C (is equivalent to 0.18 °F)
Measurement status	Represents the channel-wise validity of the measurement data coming from SC-TC 8/1 module. The output is a vector, whose width (max. 8) depends on the number of selected input channels. ▪ 0: No measurement data available for the channel since master application was started ▪ 1: Valid measurement data available for the channel ▪ 2: No valid measurement data available for the channel due to a channel-specific error, for example, broken cable Data type: UInt8

Port	Description
Status	Represents the status of the resulting data in the DPMEM. Available only if the **Enable outport Status** on page 208 checkbox on the **Parameters** page is selected. 1: Resulting data has been updated since last read access 0: Resulting data has not been updated since last read access Data type: UInt8

Unit Page (RPCU_SCTC81_DATA_BLx)

Purpose

To reference the related RapidPro hardware.

Tip

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Unit specification

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Module selection

Module selection Lets you choose an SC-TC 8/1 module. Modules that are used by the block are marked with "+".

Related topics

HowTos

How to Implement Temperature Measurement with the SC-TC 8/1 Module (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Parameters Page (RPCU_SCTC81_DATA_BLx)

Purpose

To configure measurement and result transfer with the SC-TC 8/1 module.

Note

The configuration of the SC-TC 8/1 module cannot be modified during run time.

Channel selection

1 ... 8 A selected checkbox indicates whether the channel is used for temperature measurement. The SC-TC 8/1 module provides 8 input channels at maximum. At least one channel must be selected.

All Selects all checkboxes (channels).

None Clears all checkboxes (channels).

Conversion settings

Conversion modes Lets you specify how temperature measurement is performed:

- Triggered conversion mode with auto transfer

  After the SC-TC 8/1 module is triggered by the master application (RCP system), one measurement starts with a delay of 3 sampling steps (3 / conversion rate). The result is automatically returned (written to the DPMEM of the RCP system).
- Continuous conversion mode with triggered transfer

  Measurements are performed continuously (see the **Conversion rate** setting below). After the SC-TC 8/1 module is triggered by the master application (RCP system), the result of the most recently finished measurement is returned (written to the DPMEM of the RCP system).
- Continuous conversion mode with auto transfer

  Measurements are performed continuously (see the **Conversion rate** setting below). After a measurement is finished, the result is automatically returned (written to the DPMEM of the RCP system).

This parameter is disabled and set to **Continuous conversion mode with auto transfer**, if no digital output channel (**SC-TC 8/1 ADCCTRL**) is routed to the SC-TC 8/1 module.

For details on the conversion modes, refer to Basics on Temperature Measurement with the SC-TC 8/1 Module (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Edge polarity Lets you choose the edge polarity of the trigger signal.

- Rising edge (default): The rising edge is the trigger.
- Falling edge: The falling edge is the trigger.
- Either edge: Both rising and falling edges are the triggers.

This parameter is disabled if **Conversion mode** is set to **Continuous conversion mode with auto transfer**.

Note

The trigger signal must be generated by an appropriate block of the RPCU blockset, for example, the RPCU_PWM_TPU_BLx on page 59 block. The signal must be mapped to the SC-TC 8/1 ADCCTRL channel.

Conversion rate Lets you specify the sampling rate of continuously performed measurements. The range is 0.1 Hz ... 60 Hz (resolution: 0.1 Hz). Default: 10 Hz.

Though the **Conversion rate** resolution is limited to 0.1 Hz, you can enter more fractional digits. However, the RapidPro system does not make use of the unnecessary fractional digits but uses rounded numbers, for example: 2.25 → 2.3, 3.34615 → 3.3.

If **Conversion mode** is set to **Triggered conversion mode with auto transfer**, the lower range limit is 7.6 Hz, instead of 0.1 Hz.

Due to implementation reasons, the actual conversion rate slightly differs from the value entered:

- Conversion rate < 55 Hz: Deviation ≤ ±0.05 Hz
- Conversion rate ≥ 55 Hz: Deviation ≤ ±0.064 Hz

Interrupt setting

Enable interrupt Indicates whether a serial SC-TC 8/1 SERDAT interrupt is generated after new measurement data is available in the DPMEM.

Tip

To have access to the most recent measurement result, the RPCU_SCTC81_DATA block must reside in a Simulink function-call subsystem triggered by the block's SC-TC 8/1 SERDAT interrupts.

You need to implement an RPCU_INTERRUPT_BLx on page 226 to make the interrupt available as a trigger source.

Outport setting

Enable outport Status Indicates whether the block has a "Status" output port for status information about the data in the DPMEM. See the I/O characteristics of the block.

Related topics

Basics

Basics on Temperature Measurement with the SC-TC 8/1 Module (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

HowTos

How to Implement Temperature Measurement with the SC-TC 8/1 Module (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮)

Diagnostic

Where to go from here

Information in this section

RPCU_DIAGNOSIS_BLx

Where to go from here

Information in this section

RPCU_DIAGNOSIS_BLx Block Description

Block

Purpose

To read the diagnostic data of a module.

Description

The number of output ports of the RPCU_DIAGNOSIS_BLx block, and their name and width, depends on the module selected. Each port name reflects a diagnostic data type. You can resize the block's height so that all ports can easily be identified. A port may be module-specific or channel-specific. If it is channel-specific, the port name has the prefix "Ch_".

Note

Only one RPCU_DIAGNOSIS_BLx block with the same settings for the Layer type, Layer number and Module selection parameters is allowed in a model.

For basic information, refer to Basics on Diagnostics (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

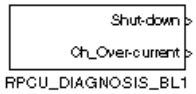
1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the **Diagnosis** button.

Example

Suppose you have selected a module and the following diagnostic data types have to be evaluated for it:

- Shut-down
- Ch_Over-current

The RPCU_DIAGNOSIS_BLx block would be configured as follows:



Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18

I/O mapping

None

I/O characteristics

The following table describes the ports of the block:

Port	Description
<Port>	Represents the diagnosis data for each channel or for complete module. The names and number of output ports depend on the module. Data type: Boolean Only available, if a module is selected.
Status	Represents the status of diagnostic data. Data type: UInt8 1: Diagnostic state has been updated since last read access 0: Diagnostic state has not been updated since last read access

Related RTLib functions

- dsrpcu_diag_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_diag_request (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_diag_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_DIAGNOSIS_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related RPCU_SETUP_BLx on page 18 block.

Parameters Page (RPCU_DIAGNOSIS_BLx)

Purpose

To address the module for which diagnosis data is to be read.

Note

Other RPCU_DIAGNOSIS_BLx blocks in the model must not address the same module.

Layer selection

Layer type Lets you choose the type of carrier board for which diagnosis data is to be read.

Layer number Lets you choose the layer number at which the desired carrier board is placed.

Module selection Lets you choose the module on the desired carrier board for which diagnosis data is to be read. Only modules that provide diagnostic data are available. The number of output ports (and their name and size) depends on the type of module selected.

Note

The selection takes no effect until the Apply button has been clicked.

Outport setting

Enable outport Status Indicates whether the block has a "Status" output port for status information about the data in the DPMEM. See the I/O characteristics of the block.

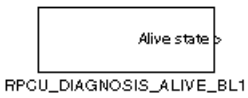
RPCU_DIAGNOSIS_ALIVE_BLx

Where to go from here

Information in this section

RPCU_DIAGNOSIS_ALIVE_BLx Block Description

Block



Purpose

To check whether a carrier board is alive.

Note

Only one RPCU_DIAGNOSIS_ALIVE_BLx block with the same settings for the Layer type and Layer number parameters is allowed in one model.

Description

This block performs a read access to the alive state of a RapidPro carrier board.

In addition, if the RapidPro system detects a malfunction of the master system (MicroAutoBox II), the RapidPro system deactivates it's output drivers (tristate) and remains in this state until the master system's real time application is restarted. This feature requires at least one RPCU_DIAGNOSIS_ALIVE_BLx block in the Simulink model, addressing an arbitrary RapidPro Unit board.

Note

When using the RPCU_DIAGNOSIS_ALIVE block, you must ensure, that the time span between it's simulation steps is always smaller than one second. Otherwise, an error occurs.

Access

1. Enter **rtirpcu** in the MATLAB Command Window.
2. Click the **Diagnosis** button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18

I/O mapping

None

I/O characteristics

The following table describes the ports of the block:

Port	Description
Alive state	Represents the alive state for the diagnosis of the related carrier board. Data type: Boolean 0: Alive 1: Not alive
Status	Represents the status of the alive counter. Data type: UInt8 1: Status has been updated since last read access 0: Status has not been updated since last read access

Related RTLib functions

- dsrpcu_diag_alive_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_diag_alive_request (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_diag_alive_read (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_DIAGNOSIS_ALIVE_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related RPCU_SETUP_BLx on page 18 block.

Parameters Page (RPCU_DIAGNOSIS_ALIVE_BLx)

Purpose

To address the carrier board.

Note

Other RPCU_DIAGNOSIS_ALIVE_BLx blocks in the model must not address the same carrier board.

Layer selection

Layer type Lets you choose the type of carrier board for which diagnosis data is to be read.

Layer number Lets you choose the layer number at which the desired carrier board is placed. "1" means bottom (RapidPro Control Unit).

Outport setting

Enable outport Status Indicates whether the block has a "Status" output port for status information about the data in the DPMEM. See the I/O characteristics of the block.

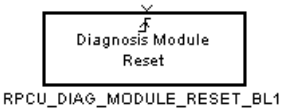
RPCU_DIAG_MODULE_RESET_BLx

Where to go from here

Information in this section

RPCU_DIAG_MODULE_RESET_BLx Block Description

Block



Purpose

To reset the diagnosis data of a module.

Note

Only one RPCU_DIAG_MODULE_RESET_BLx block with the same settings for the Layer type, Layer number, and Module selection is allowed in one model.

Description

When the block is triggered during simulation by a rising edge signal, the RCP system sends a reset command to the RapidPro system, and the diagnosis data of the addressed RapidPro module is cleared.

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the Diagnosis button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18

I/O mapping

None

I/O characteristics

The following table describes the ports of the block:

Port	Description
Trigger input	Input port for the trigger signal.

Related RTLib functions

- dsrpcu_diag_module_reset_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_diag_module_reset (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_DIAG_MODULE_RESET_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Parameters Page (RPCU_DIAG_MODULE_RESET_BLx)

Purpose

To address the RapidPro module.

Note

Other RPCU_DIAG_MODULE_RESET_BLx blocks in the model must not address the same module.

Layer selection

Layer type Lets you choose the type of the carrier board that holds the module.

Layer number Lets you choose the layer number at which the desired carrier board is placed. "1" means bottom (RapidPro Control Unit).

Module selection Lets you choose the module for which diagnosis data is to be reset. Only modules that provide diagnostic data are available.

RPCU_DIAG_GLOBAL_RESET_BLx

Where to go from here

Information in this section

RPCU_DIAG_GLOBAL_RESET_BLx Block Description

Block

Purpose

To reset the diagnosis data of all modules of a RapidPro system.

Note

Only one RPCU_DIAG_GLOBAL_RESET_BLx block is allowed in one model.

Description

When the block is triggered during simulation by a rising edge signal, the RCP system sends a reset command to the RapidPro system, and the diagnosis data of all RapidPro modules is cleared.

Access

1. Enter **`rtirpcu`** in the MATLAB Command Window.
2. Click the Diagnosis button.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18

I/O mapping

None

I/O characteristics

The following table describes the ports of the block:

Port	Description
Trigger input	Input port for the trigger signal.

Related RTLib functions

- dsrpcu_diag_global_reset_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_diag_global_reset (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_DIAG_GLOBAL_RESET_BLx)

Purpose

To reference the related RapidPro hardware.

Unit specification

The data to be entered here can be looked up on the Unit page of the related RPCU_SETUP_BLx block. Refer to Unit Page (RPCU_SETUP_BLx) on page 20.

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.

Interrupt Handling

Introduction

To make interrupts of the RapidPro system available as trigger sources.

Where to go from here

Information in this section

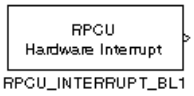
RPCU_INTERRUPT_BLx

Where to go from here

Information in this section

RPCU_INTERRUPT_BLx Block Description

Block



Purpose

To make the interrupts of the RapidPro system available as trigger sources.

Description

Interrupts that are triggered by the RapidPro Control Unit are handled by means of this block. You can choose any interrupt source that is activated by any other block of the used model.

Access

Enter `rtirpcu` in the MATLAB Command Window.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18
- All RTI blocks used for interrupt generation

I/O mapping

None

I/O characteristics

The following table describes the ports of the block:

Port	Description
<No label>	Trigger output Data type: Function call

Related RTLib functions	None

Unit Page (RPCU_INTERRUPT)

Purpose	To reference the related RapidPro hardware and choose an interrupt trigger source.
Unit specification	**Board/module number** Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them. If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮). **ECU interface channel number** Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board. (This parameter is only available if you work with a DS1007 modular system containing DS4121.)
Configuration	**TopologyID** Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related **RPCU_SETUP_BLx** on page 18 block.
Interrupt selection	**Interrupt selection** Lets you choose an interrupt trigger source. Each block of the model that provides an interrupt trigger source is represented by its related device. Devices that are used by the block are marked with "+", devices that are used by other interrupt blocks are marked with "*". For detailed information on interrupt trigger sources, refer to Interrupts Provided by the RapidPro Control Unit (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

System

Where to go from here

Information in this section

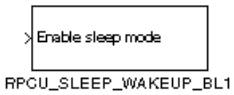
RPCU_SLEEP_WAKEUP_BLx

Where to go from here

Information in this section

RPCU_SLEEP_WAKEUP_BLx Block Description

Block



Purpose

To manage the sleep mode functions of a RapidPro Control Unit.

Description

A RapidPro system can be put into sleep mode, that is, the software execution on the RapidPro Control Unit is stopped. In addition, the outputs of all SC and Power Units in the RapidPro stack are disabled. This state is similar to the PAUSE simulation state, except that here initialization values for the output devices of the RTI I/O blocks are not applied.

When wake-up is performed the block resumes software execution on the RapidPro Control Unit that was put in sleep mode. In addition, the outputs of all SC and Power Units in the RapidPro stack are enabled again.

You can choose between two different power sleep modes for the microprocessor of the RapidPro Control Unit. In addition, the outputs of existing SC and Power Units can be optionally switched off.

Note

If a RapidPro Control Unit has been set into sleep mode, the blocks of the RTI model must not be triggered (any longer). Otherwise, the RapidPro Control Unit might awake, or a task overrun might occur.

For basic information, refer to Basics on System Functions (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Access

Enter `rtirpcu` in the MATLAB Command Window.

Other RTI blocks

The following RTI blocks must reside in the model, too – with the same board/module and ECU channel numbers:

- RPCU_SETUP_BLx on page 18

I/O mapping

None

I/O characteristics

The following table describes the ports of the block:

Port	Description
Enable sleep mode	Sets the RapidPro Control Unit in sleep mode or wakes it up. Data type: Boolean 0: RapidPro Control Unit is not set to sleep mode 1: RapidPro Control Unit is set to sleep mode

Related RTLib functions

- dsrpcu_sleep_init (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_sleep (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)
- dsrpcu_wake_up (RapidPro System – I/O Subsystem MPC565 RTLib Reference 🕮)

Unit Page (RPCU_SLEEP_WAKEUP_BLx)

Purpose

To address the related RapidPro hardware.

Unit specification

Board/module number Lets you choose the board/module number. The range is 1 … 16. If your system contains several boards/modules of the same type, RTI uses this number to distinguish between them.

If your RapidPro system is connected to a dSPACE MicroAutoBox, the module number must match the number of the MicroAutoBox's ECU interface channel (IFx). Refer to *ECU interface channels* in Hardware (MicroAutoBox II Features 🕮).

ECU interface channel number Lets you select the number of the ECU interface channel. The ECU interface channel enables communication between the RapidPro Control Unit and the master processor board.

(This parameter is only available if you work with a DS1007 modular system containing DS4121.)

Configuration

TopologyID Displays the TopologyID which uniquely identifies the RapidPro hardware. The TopologyID is stored in the hardware topology file (`*.hwt`). If no TopologyID is displayed, no HWT file is loaded in the related RPCU_SETUP_BLx on page 18 block.

Power Mode Page (RPCU_SLEEP_WAKEUP_BLx)

Purpose

To specify the power mode of the RapidPro Control Unit.

MPC565 unit

Sleep Indicates whether the power sleep mode for the microprocessor of the RapidPro Control Unit is "Sleep".

Deepsleep Indicates whether the power sleep mode for the microprocessor of the RapidPro Control Unit is "Deepsleep".

For detailed information on the parameters, refer to Basics on System Functions (RapidPro System – I/O Subsystem MPC565 Implementation Features 🕮).

Power- and IO- units

Switch off power supply Indicates whether the power supply of existing SC and Power Units is switched off.

Note

The outputs of all modules in the RapidPro stack are disabled when the sleep mode is active, regardless of the setting of the Power- and IO- units parameter.