RTI Electric Motor Control Blockset

Reference

For RTI Electric Motor Control Blockset 1.4.3

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dSPACE

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Important Notice

Contents

About This Reference

Introduction

This RTI Reference is a complete description of the Real-Time Interface (RTI) blocks and their settings provided by the RTI Electric Motor Control Blockset. You can use this blockset to model electric motor control systems in a Simulink® model.

The blockset can be used with MicroLabBox as hardware platform.

Required knowledge

This reference is primarily for engineers who implement real-time applications by using MATLAB®/Simulink®.

Symbols

dSPACE user documentation uses the following symbols:

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

Naming conventions

dSPACE user documentation uses the following naming conventions:

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

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

Examples:

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

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

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

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

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

Special folders

Some software products use the following special folders:

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

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

or

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

Documents folder A standard folder for user-specific documents.

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

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

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

Accessing dSPACE Help and PDF Files

After you install and decrypt dSPACE software, the documentation for the installed products is available in dSPACE Help and as PDF files.

dSPACE Help (local) You can open your local installation of dSPACE Help:

- On its home page via Windows Start Menu
- On specific content using context-sensitive help via **F1**

dSPACE Help (Web) You can access the Web version of dSPACE Help at www.dspace.com.

To access the Web version, you must have a *mydSPACE* account.

PDF files You can access PDF files via the icon in dSPACE Help. The PDF opens on the first page.

General Information on the RTI Electric Motor Control Blockset

Introduction

Provides basic information on the RTI Electric Motor Control Blockset.

Where to go from here

Information in this section

Overview of the RTI Electric Motor Control Blockset

Introduction

Provides basic information on the RTI Electric Motor Control Blockset's main features, its components and how to access them.

Main features

The RTI Electric Motor Control Blockset is a Simulink® blockset for modeling electric motor controllers.

Note

EMC is used as the short name for Electric Motor Control, for example, for the block names.

The blockset consists of RTI blocks that provide the following features:

- You can configure inputs for a Hall sensor, an incremental encoder, an absolute encoder connected to the EnDat or SSI interface, or a resolver that measure the position of a motor's rotor, its speed, or both.
- You can configure outputs for an electric motor and control it with block-commutated or sine-commutated PWM signals.
- You can combine two sensors to extrapolate the position of the motor's rotor.
- You can configure rotor positions where trigger events or interrupts are generated.

For more information on the features of the RTI Electric Motor Control Blockset, refer to Electric Motor Control (MicroLabBox Features 🕮).

Hardware support The blockset can be used with MicroLabBox as hardware platform.

Note

The features of the RTI Electric Motor Control Blockset are provided by the standard FPGA application of MicroLabBox. If you are using a custom FPGA application with MicroLabBox, you can either not use the RTI Electric Motor Control Blockset at all, or use it only with a reduced number of I/O channels. For more information, refer to General Information on FPGA Support (MicroLabBox Features 🕮).

I/O mapping

You can use the I/O pins of the DIO Class 1 and DIO Class 2 ports to connect Hall and incremental encoder sensors. Absolute encoders connected via EnDat and SSI interface are using the I/O pins of the DIO Class 2 ports. For resolver sensors there are two separate I/O connectors.

You can use the I/O pins of the DIO Class 1 ports to connect the electric motor.

For information on the mapping of channel numbers to the related I/O pins of the MicroLabBox I/O connectors, refer to Digital I/O A Connector (Sub-D) (MicroLabBox Hardware Installation and Configuration 🕮) and Digital I/O B Connector (Sub-D) (MicroLabBox Hardware Installation and Configuration 🕮).

Library access

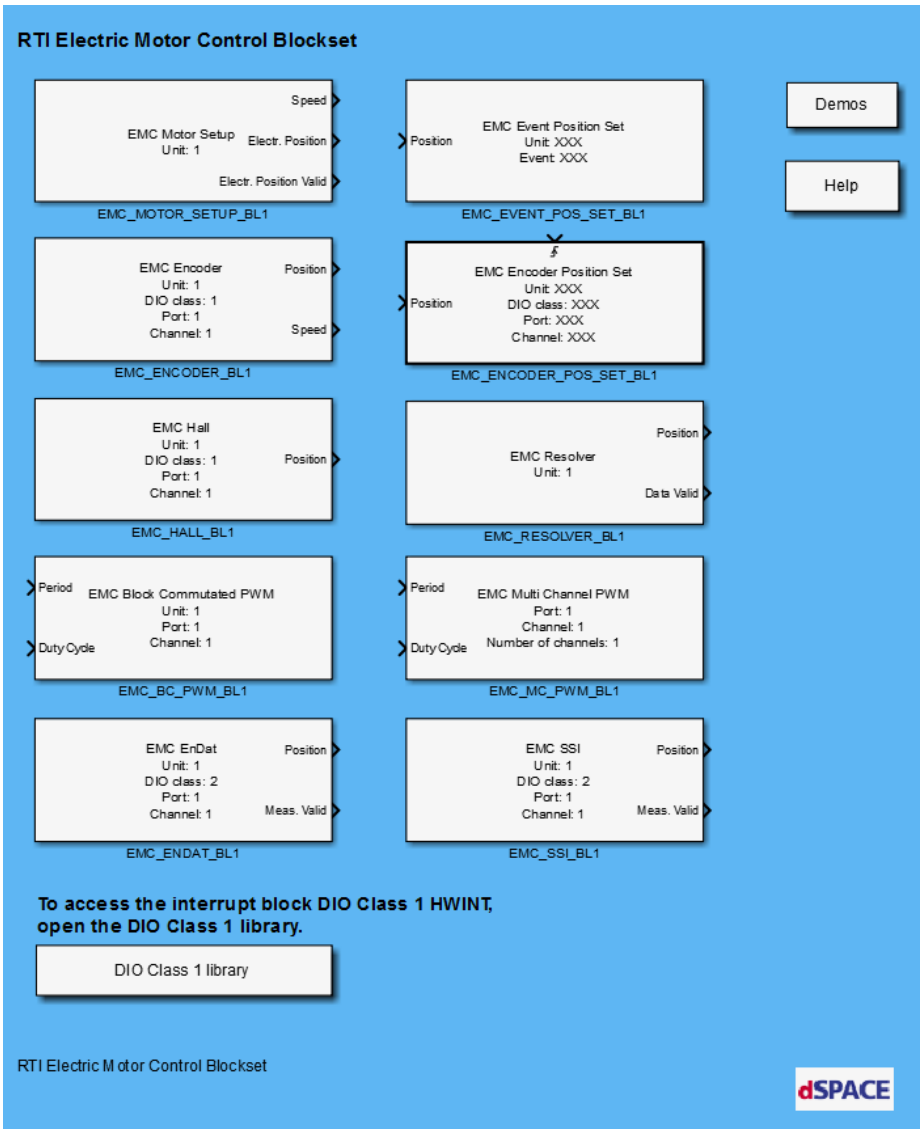
The library can be opened with the following methods:

- Enter `rtiemc` in the MATLAB Command Window.
- Click **Blocksets – RTI EMC Blockset** in the MicroLabBox blockset.
- Navigate to the **dSPACE RTI Electric Motor Control Blockset** folder in the Simulink Library Browser to access the RTI blocks of the library separately.

Note

Choose the platform support before you open the RTI Electric Motor Control Blockset to get the predefined board-specific settings.

When you open the block library, the blockset is displayed.



Library components

The library provides the following RTI blocks:

- To access the input signals from the motor sensors that measure the position of the motor's rotor, its speed, or both.
  - EMC_ENCODER_BLx to access an incremental encoder. With the EMC_ENCODER_POS_SET_BLx you can set a position value at a trigger event.
  - EMC_ENDAT_BLx to access an absolute encoder via EnDat interface.
  - EMC_SSI_BLx to access an absolute encoder via SSI interface.
  - EMC_HALL_BLx to access a Hall sensor.
  - EMC_RESOLVER_BLx to access a resolver.

- To specify PWM signals to control an electric motor.
  - EMC_BC_PWM_BLx to access a block-commutated motor control.
  - EMC_MC_PWM_BLx to access a sine-commutated motor control.
- To set up a configuration of sensors and enable event generation.
  - EMC_MOTOR_SETUP_BLx to combine two sensors and extrapolate the position of the motor's rotor.
  - EMC_EVENT_POS_SET_BLx to configure rotor positions where events are generated.

The library provides a link to the DIO Class1 library in the MicroLabBox blockset for convenient handling of hardware interrupts.

Demo model

For a Simulink® model that shows how to use the RTI Electric Motor Control Blockset, refer to the blockset's Demo library.

This model contains preconfigured blocks that implement an example of an electric motor control.

Handling Hardware Interrupts

Introduction

To provide a short description of using hardware interrupts in the RTI Electric Motor Control (EMC) Blockset.

Generating interrupts by RTI EMC blocks

If an RTI EMC block provides an event that might be relevant for starting another function or synchronizing with other functions, you can configure the block to generate interrupts. All interrupt types of one block can be combined. The interrupt generation is a channel-specific configuration of each block. Other instances of the same block type can be configured differently.

You can specify interrupt generation on the Event page of the following RTI EMC blocks:

- EMC_BC_PWM_BLx and EMC_MC_PWM_BLx

  Interrupts can be generated at:
  - The start of a PWM period.
  - The center of a PWM period.

  For detailed information, refer to Event Page (EMC_BC_PWM_BLx) on page 28 and Event Page (EMC_MC_PWM_BLx) on page 65.
- EMC_MOTOR_SETUP_BLx

  Interrupts can be generated at:
  - Relative equidistant angular positions. The angular distance must be an integer divisor of 360°.
  - Up to four arbitrary absolute positions. These positions are provided by EMC_EVENT_POS_SET_BLx on page 49 blocks.

For detailed information, refer to Event Page (EMC_MOTOR_SETUP_BLx) on page 72 and Unit Page (EMC_EVENT_POS_SET_BLx) on page 50.

The generated interrupts can be used to trigger a subsystem in your Simulink model.

Using the generated interrupts as triggers

You can use a DIO_CLASS1_HWINT_BLx block to make a hardware interrupt available as the trigger source. This block must be in the same Simulink model as the interrupt generating block.

For more information on the MicroLabBox interrupts, refer to Interrupt Handling (MicroLabBox Features 🕮).

Components of the RTI Electric Motor Control Blockset

Introduction

The RTI Electric Motor Control (EMC) Blockset provides RTI blocks that you can use to implement electric motor controllers in the Simulink model.

Where to go from here

Information in this section

Sensor blocks

Actuator blocks

Motor setup blocks

EMC_BC_PWM_BLx

Purpose

To generate block-commutated PWM signals to control an electric motor.

Where to go from here

Information in this section

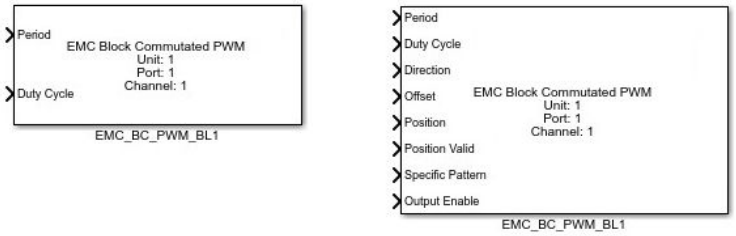
Information in other sections

Block-Commutated PWM Signal Generation (DIO Class 1) (MicroLabBox Features 🕮)

Block Description (EMC_BC_PWM_BLx)

Block

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



Purpose

To generate block-commutated PWM signals to control an electric motor.

I/O mapping

For information on the mapping of channel numbers to the related I/O pins of the MicroLabBox I/O connector, refer to Digital I/O A Connector (Sub-D) (MicroLabBox Hardware Installation and Configuration 🕮).

Description

This block lets you generate block-commutated PWM output signals to control an electric motor.

The block-commutated PWM signals receive their angle information either from the model via the Position input port or from the internal angular computation unit (ACU) if the output function is specified in its EMC_MOTOR_SETUP_BLx block. To provide output signals that are generated independently of the angular position, you can enable the position-independent signal generation.

I/O characteristics

The following table describes the ports of the block:

Port	Description
Input	
Period	Specifies the period of the pulse-width modulated signal in seconds. If the input value exceeds the range, the value is saturated to 100 ns or 1.34 s Range: 100 ns … 1.34 s Resolution: 10 ns Data type: Float64
Duty Cycle	Specifies the duty cycle of the pulse-width modulated signal. If the input value exceeds the range, the value is saturated to 0.0 or 1.0. Range: 0.0 … 1.0 (0 … 100%) Resolution: The resolution of the actual duty cycle depends on the period value it is to be applied to as follows: The resolution for time intervals within the PWM signal generator unit is 10 ns. If the time interval resulting from the chosen duty cycle can not be represented in multiples of 10 ns the actual value is determined by rounding towards the nearest possible value. As a consequence, the shorter the given period is, the poorer the resolution of the duty cycle will be. E.g., if you have specified the

Port	Description
	value 100 ns as the period, which is the minimum value available, you can only obtain actual duty cycles with a step width of 10%. Data type: Float64
Direction	Specifies the direction of the commutation. ▪ 1: Represents forward rotation. ▪ -1: Represents backward rotation. Range: -1, 1 Data type: Int32 The **Direction** port is available only if **Enable Direction input port** is selected.
Offset	Specifies the sector offset angle of the commutation in degrees. This value is added to the sector angles. You can use the sector offset angle for field weakening. Range: -60° … +60° Data type: Float64 The **Offset** port is available only if **Specify sector offset by input port** is selected.
Position	Specifies the electrical angular position of the motor in degrees. Range: 0.0° … (360.0° - Resolution) Resolution: 1.34e-6° Data type: Float64 The **Position** port is available only if **Angle position specified by** is set to **Input port**.
Position Valid	Specifies whether the values that are provided at the **Position** port are valid. ▪ 0: The current value is not valid. ▪ 1: The current value is valid. The **Position Valid** port is available only if **Angle position specified by** is set to **Input port**.
Specific Pattern	Specifies the number of the specific pattern to be used for position-independent signal generation. Range: 0 … 6 ▪ 0: No position-independent signal will be generated. The sector configuration on the **Generation** page is used. This is the default behavior if the port is enabled but not connected. ▪ 1 … 6: The specific pattern with the given number will be used for position-independent signal generation. Data type: UInt32 The **Specific Pattern** port is available only if **Enable Specific Pattern input port** is set on the **Specific Patterns** page.
Output Enable	Specifies the enable state of the digital outputs. Range: 0, 1 ▪ 0: Outputs are disabled, i.e., the outputs are set to high impedance. ▪ 1: Outputs are enabled, i.e., the outputs are driven by the software. Data type: Boolean The **Output Enable** port is available only if **Activate Output Enable input port** is set on the **Advanced** page.

Dialog pages

You can select the dialog settings on the following pages:

- Unit page (refer to Unit Page (EMC_BC_PWM_BLx) on page 20)
- Generation page (refer to Generation Page (EMC_BC_PWM_BLx) on page 21)

- Specific Patterns page (refer to Specific Patterns Page (EMC_BC_PWM_BLx) on page 22)
- Initialization page (refer to Parameters Page (EMC_BC_PWM_BLx) on page 23)
- Termination page (refer to Termination Page (EMC_BC_PWM_BLx) on page 25)
- Advanced page (refer to Advanced Page (EMC_BC_PWM_BLx) on page 26)
- Event page (refer to Event Page (EMC_BC_PWM_BLx) on page 28)

Related RTLib functions

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

- Block-Commutated PWM Generation (MicroLabBox RTLib Reference 🕮)

Unit Page (EMC_BC_PWM_BLx)

Purpose

To specify the output channels of the block-commutated PWM signals.

Description

This block provides six channels of block-commutated signals via the *A*+, *A*-, *B*+, *B*-, *C*+ and *C*- phases.

Dialog settings

Unit number Lets you select a unique unit number for the block commutation unit in the range 1 … 2.

Port number Lets you select the port number to be used in the range 1 … 3.

Channel number Lets you select the first channel number to be used in the range 1 … 11.

Note

Concurrent access to the same DIO Class 1 channel by other blocks or functions is not allowed.

Signal connector pin Displays the range of signal connector pins for the selected channels. The pin assignment is in the order *A*+, *B*+, *C*+, *A*-, *B*-,*C*-.

Reference connector pin Displays the range of reference connector pins for the selected channels.

High level Lets you set the voltage level of *High* on the output channel to 2.5 V, 3.3 V or 5.0 V.

Related topics

References

Generation Page (EMC_BC_PWM_BLx)

Purpose

To specify the sequence of signal patterns of each PWM output channel.

Description

This page lets you configure the sequence of signal patterns of each of the six PWM output signals in six sectors of the same size.

The specified order of the sector configuration is valid for forward rotation. If the direction is set to backward rotation the order of the sequence of signal patterns is changed automatically to get a torque for a backward rotation.

For more information on the block-commutated signal generation, refer to Basics on Electric Motor Control (MicroLabBox Features 🕮).

Dialog settings

Port Displays the port number that you selected on the Unit page.

Channel Displays the range of channels that you selected on the Unit page.

Sector configuration Lets you specify the sequence of signal patterns of each of the PWM output signals to get a torque for a forward rotation.

The settings to do this are ordered as a matrix where each of six columns represent a 60° sector of a full rotation. Each of the six rows of the matrix represent one of the output signals.

For each signal and sector you can select one of the following signal patterns:

Signal Pattern	Meaning
Low	Permanent *low*.
High	Permanent *high*.
PWM (duty cycle)	PWM with the current duty cycle.
Inv. PWM (duty cycle)	Inverted PWM with the current duty cycle.
PWM (1 - duty cycle)	PWM with the inverted current duty cycle.
Inv. PWM (1 - duty cycle)	Inverted PWM with the inverted current duty cycle.

Note

You must make sure that the voltage level of the high side and the low side of the same phase (e.g. of *A+* and *A-*) are never *High* at the same time. This would cause the application to abort with an error.
This is also the case if *A+* is set to permanent high and *A-* is set to PWM.

Update mode Lets you select the PWM update mode for PWM signal generation. You can decide whether to update at the start of the PWM period, in the middle of a period, or at both times.

Dead time Lets you specify the dead time in seconds in the range 0 … 665 µs with a resolution of 10 ns.

Related topics

References

Specific Patterns Page (EMC_BC_PWM_BLx)

Purpose

To specify specific patterns for position-independent signal generation.

Description

This page lets you configure up to six signal patterns, each providing the configuration of the six PWM output signals. These specific patterns can be used to provide a specific behavior of the motor, e.g., an immediate stop independently of the motor position.

The signal generation of each specific pattern can be activated separately by the Specific Pattern input port.

For more information on the block-commutated signal generation, refer to Basics on Electric Motor Control (MicroLabBox Features 🕮).

Dialog settings

Port Displays the port number that you selected on the Unit page.

Channel Displays the range of channels that you selected on the Unit page.

Enable Specific Pattern input port Lets you enable the Specific Pattern input port to control the position-independent signal generation of a specific pattern.

Specific patterns Lets you specify up to six specific patterns for the position-independent signal generation.

For each of the six PWM output signals you can select one of the following signal patterns:

Signal Pattern	Meaning
Low	Permanently *low*.
High	Permanently *high*.
PWM (duty cycle)	PWM with the current duty cycle.
Inv. PWM (duty cycle)	Inverted PWM with the current duty cycle.
PWM (1 - duty cycle)	PWM with the inverted current duty cycle.
Inv. PWM (1 - duty cycle)	Inverted PWM with the inverted current duty cycle.

Note

You must make sure that the voltage level of the high side and the low side of the same phase (e.g., of *A*+ and *A*-) are never *High* at the same time. This causes the application to abort with an error.

This is also the case if *A*+ is set to permanent high and *A*- is set to PWM.

This setting is enabled only if Enable Specific Pattern input port is set.

Related topics

References

Parameters Page (EMC_BC_PWM_BLx)

Purpose

To set the initial output states of the specified channels.

Description

On this page, you can set the initial output states of the specified channels. During the model initialization phase these states are written to all the channels

of the specified digital I/O port to make sure that the output is defined during this simulation phase. This is especially useful if the EMC_BC_PWM_BLx block is used in a triggered or enabled subsystem that is not executed right from the start of the simulation.

Dialog settings

Port Displays the port number that you selected on the Unit page.

Channel Displays the range of channels that you selected on the Unit page.

Initial period Lets you enter the period in seconds at the start of the simulation in the range 100 ns … 1.34 s with a resolution of 10 ns.

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

Signal levels Lets you select *High* or *Low* to specify the signal level during the following situations:

- The Position Valid port indicates an invalid position value.
- If an EMC_MOTOR_SETUP_BLx block is used and the Electric. Position Valid port indicates an invalid position value.

The signal level value can be set separately for each of the six sensor channels *A*+, *A*-, *B*+, *B*-, *C*+ and *C*-.

Note

You must make sure that the voltage level of the high side and the low side of the same phase (e.g., of *A*+ and *A*-) are never *High* at the same time. This would cause the application to abort with an error.

Related topics

References

Termination Page (EMC_BC_PWM_BLx)

Purpose

To specify the termination values for the signal level.

Description

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

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

- All the specified digital outputs are set to high impedance (high-Z).
- Each output is set to a definite output value.

Note

If you want to stop the motor on model termination, you have to note the specific characteristics of your motor. It is usually not sufficient to set the digital outputs to high impedance or a definite output value.

Dialog settings

Port Displays the port number that you selected on the Unit page.

Channel Displays the range of channels that you selected on the Unit page.

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

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

By default, the Termination mode checkbox is disabled.

Termination signal level Lets you select *Low* or *High* to specify the signal level after termination. The value can be set separately for each of the six output channels *A*+, *A*-, *B*+, *B*-, *C*+ and *C*-.

Note

You must make sure that the voltage level of the high side and the low side of the same phase (e.g. of *A*+ and *A*-) are never *High* at the same time. This would cause the six output channels to be set to the signals levels that you specified on the Parameters page.

Related topics

References

Advanced Page (EMC_BC_PWM_BLx)

Purpose

To configure the direction, the sector offset, and the position input.

Dialog settings

Port Displays the port number that you selected on the Unit page.

Channel Displays the range of channels that you selected on the Unit page.

Enable Direction input port Lets you enable the Direction input port to control the direction of rotation at run time.

Initial direction Lets you select *Forward* or *Backward* as the direction at the start of the simulation.

This setting is enabled only if Enable Direction input port is selected.

(Initial) sector offset Lets you specify an offset angle in degrees in the range -60.0° … +60.0°. The meaning of this setting depends on the source of the sector offset that you select in Specify sector offset by input port.

Specify Sector Offset by Input Port	Meaning
Disabled	Sector offset lets you specify a permanent offset angle.
Enabled	Initial sector offset lets you specify an initial offset angle. At run time the offset is provided by the Offset port.

Specify sector offset by input port Lets you enable the Offset port as the source of the offset angle at run time.

Angle position specified by Lets you select the source of the rotor position value.

Angle Position Specified by	Meaning
Input port	The rotor position is provided by the Position input port.
EMC_MOTOR_SETUP	The rotor position is provided by an EMC_MOTOR_SETUP_BLx block. If you select this option, you must add an EMC_MOTOR_SETUP_BLx block to your model and specify this EMC_BC_PWM_BLx block as the Output Function.

Activate Output Enable input port Lets you enable the Output Enable input port to enable or disable the outputs during runtime.

Initial Output Enable state Lets you specify the initial state of the Output Enable input port.

State	Meaning
Enabled	The Output Enable input port is set to *enabled*. The outputs are driven by the software.
Disabled	The Output Enable input port is set to *disabled*. The outputs are set to high impedance.

This setting is enabled only if Activate Output Enable input port is set.

Related topics

References

Event Page (EMC_BC_PWM_BLx)

Purpose

To configure the generation of interrupts and trigger events.

Description

This page lets you configure whether to generate hardware interrupts, trigger signals, or both.

The events can be generated on the specified channel at the start of the PWM period or its middle.

For more information on handling events that are generated by RTI EMC blocks, refer to Basics on Electric Motor Control (MicroLabBox Features 🕮).

Dialog settings

Port Displays the port number that you selected on the **Unit** page.

Channel Displays the range of channels that you selected on the **Unit** page.

Enable event generation Lets you enable the generation of trigger events, interrupt events or both.

If you enable event generation, at least one of the pulse positions (*start position* or *center position*) must be activated.

Event mode Lets you select which events are generated at the activated pulse position.

Event Mode	Meaning
Interrupt	Generate interrupts at the activated pulse position.
Trigger	Generate trigger events at the activated pulse position.
Interrupt and Trigger	Generate both interrupts and trigger events at the activated pulse position.

If you select interrupt generation, your model has to contain a related **DIO_CLASS1_HWINT_BLx** (MicroLabBox RTI Reference 🕮) block configured with the same port and channel number.

Activate event on start position Lets you enable event generation at the start of the period.

Activate event on center position Lets you enable event generation in the middle of the period.

Event delay Lets you specify the delay time in seconds for trigger and interrupt events in the range 0 … 1.34 s.

Note

For periodic events, the event delay should be less than the period. Otherwise, only each first trigger or interrupt event is delayed and becomes effective. The other trigger or interrupt events generated during the event delay are ignored.

Event rate Lets you specify the event rate in the range 1 … 256. It specifies after how many occurrences of any event cause a trigger or interrupt is generated. For example, if you set the event rate to 3, an event will be generated after each third occurrence of an event cause. The value affects the signal of the trigger line as well as the generation of the interrupt.

Trigger line Lets you select a trigger line number to be used for trigger event generation in the range 1 … 16.

Note

It is not allowed to use the same trigger line number in different event-generating blocks.

This setting is enabled only if an event mode with trigger generation is selected.

Related topics

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EMC_ENCODER_BLx

Purpose

To get the rotor's position via an incremental encoder.

Where to go from here

Information in this section

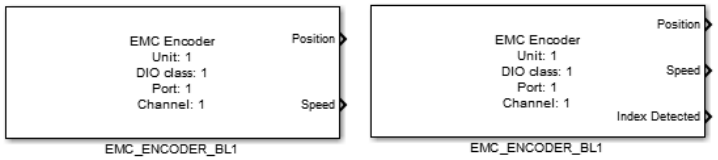
Information in other sections

Incremental Encoder Interface (MicroLabBox Features 🕮)

Block Description (EMC_ENCODER_BLx)

Block

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



Purpose

To provide read access to the position and speed of an incremental encoder interface.

Description

This block lets you access an incremental encoder. With its help you can get the movement of a rotor by counting the number of encoder pulses.

For more information on the operation method of incremental encoders, refer to Incremental Encoder Interface (MicroLabBox Features 🕮).

I/O mapping

For information on the mapping of channel numbers to the related I/O pins of the MicroLabBox I/O connector, refer to Digital I/O A Connector (Sub-D) (MicroLabBox Hardware Installation and Configuration 🕮) and Digital I/O B Connector (Sub-D) (MicroLabBox Hardware Installation and Configuration 🕮).

I/O characteristics

The values of the provided outports depend on the measurement basis that you can specify on the **Parameters** page:

- Position measurement

  The position and speed values are provided on the basis of counted encoder lines. For this behavior, you must select the **Enable position measurement** checkbox.

- Angle measurement

  If you specify the number of lines for a full rotor rotation, the position and speed values can be provided on an angular basis. For this behavior, you must clear the **Enable position measurement** checkbox.

The following table describes the ports of the block:

Port	Description
Output	
Position (Angle measurement)	Provides the current mechanical position as an angle in degrees calculated from the number of lines. Range: 0.0° … <360° Resolution: 360° / (4 · N) (where *N* is the number of encoder lines) Data type: Float64
Speed (Angle measurement)	Provides the angle velocity in revolutions per minute. The direction of rotation is given by a positive or negative value. Range: -6.0e8/N … +6.0e8/N rpm (where *N* is the number of encoder lines) You can specify the minimum angular velocity to be measured on the **Parameters** page. Resolution: 11.19/N rpm Data type: Float64
Position (Position measurement)	Provides the current mechanical position in number of lines. Range: Depends on the upper and lower encoder limits. Resolution: 0.25 [lines] Data type: Float64
Speed (Position measurement)	Provides the current encoder speed in lines per second. The direction of rotation is given by a positive or negative value. Range: -10.0e6 … +10.0e6 [lines per second] You can specify the minimum encoder speed to be measured on the **Parameters** page. Resolution: 0.187 [lines per second] Data type: Float64
Index Detected	Provides whether the index signal has been detected at least once. Range: 0, 1

Port	Description
	Data type: Boolean The **Index Detected** port is available only if the **Enable Index Detected outport** is selected.

Note

The speed value is calculated from the current position. Because the calculation takes some nanoseconds, the speed value might not be updated in the same model step as the position value.

Dialog pages

You can select the dialog settings on the following pages:

- Unit page (refer to Unit Page (EMC_ENCODER_BLx) on page 32)
- Parameters page (refer to Parameters Page (EMC_ENCODER_BLx) on page 34)
- Advanced page (refer to Advanced Page (EMC_ENCODER_BLx) on page 36)

Related RTLib functions

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

- Incremental Encoder Class 1 (MicroLabBox RTLib Reference 🕮)
- Incremental Encoder Class 2 (MicroLabBox RTLib Reference 🕮)

Unit Page (EMC_ENCODER_BLx)

Purpose

To specify the channels used by the incremental encoder.

Description

The EMC_ENCODER_BLx block lets you access an incremental encoder that provides single-ended or differential signals.

Each encoder provides at least the PHI0 and the PHI90 digital signal. Using the index signal (IDX) is optional.

For more information on the signal characteristics of an incremental encoder, refer to Incremental Encoder Interface (MicroLabBox Features 🕮).

Dialog settings

Unit number Lets you select a unique unit number for the incremental encoder unit in the range 1 … 6.

DIO class number Lets you select how the encoder provides the signals.

DIO Class Number	Meaning
1	The encoder provides single-ended signals.
2	The encoder provides differential signals.

Port number Lets you select the port number where the encoder is connected. If single-ended signals are provided the port number is in the range 1 … 3. For differential signals it is always 1.

Channel number Lets you select the first of the channel numbers that are used for the incremental encoder signals. The first input channel is used for the *PHI0* signal, the second for *PHI90* and the optional third for *IDX*. The index input is set on the Parameters page.

DIO Class Number	Channel Range
1	▪ 1 … 15 without index input ▪ 1 … 14 with index input
2	▪ 1 … 11 without index input ▪ 1 … 10 with index input

Note

Concurrent access to the same channel by other blocks or functions is not allowed.

Signal connector pin Displays the range of signal connector pins for the selected channels.

Signal Type	Pin Assignment	
	Pin	**Signal**
Single-ended signals	DIO1 ch<n>	*PHI0*
	DIO1 ch<n+1>	*PHI90*
	DIO1 ch<n+2>	*IDX*
Differential signals	DIO2 ch<n>	*PHI0*, non-inverted signal
	DIO2 ch<n+1>	*PHI90*, non-inverted signal
	DIO2 ch<n+2>	*IDX*, non-inverted signal

Reference connector pin Displays the range of reference connector pins for the selected channels.

Signal Type	Pin Assignment	
	Pin	**Signal**
Single-ended signals	GND	Signal ground
Differential signals	$\overline{\text{DIO2 ch<n>}}$	*PHI0*, inverted signal
	$\overline{\text{DIO2 ch<n+1>}}$	*PHI90*, inverted signal
	$\overline{\text{DIO2 ch<n+2>}}$	*IDX*, inverted signal

Related topics

References

Parameters Page (EMC_ENCODER_BLx)

Purpose

To specify whether the encoder values are provided as angles or as positions.

Description

This page lets you specify how the counted encoder pulses are provided:

- To provide it as an angle measurement in degrees, you can specify the number of lines for one full rotation according to the properties of the connected encoder hardware.
- To provide it as a linear position measurement in number of lines, you can specify the minimum and the maximum position value.

You can also specify the index use and the minimum speed to be detected.

Dialog settings

Port Displays the port number that you selected on the Unit page.

Channel Displays the range of channels that you selected on the Unit page.

Enable position measurement Lets you select whether the sensor measurement is provided in positions or in angles.

Enable Position Measurement	Meaning
Disabled	The sensor measurement is provided in angles. The Position outport provides its values in degrees and the Speed outport provides its values in revolutions per minute. The Angle Measurement settings are enabled.
Enabled	The sensor measurement is provided in positions. The Position outport provides its values in number of lines and the Speed outport provides its values in lines per second. The Position Measurement settings are enabled.

The Enable position measurement checkbox is disabled by default.

Number of lines Lets you specify the number of lines of one full rotation of the incremental encoder in the range 1 … 2^{21}.

This setting is enabled only if Enable position measurement is cleared.

Initial angle Lets you specify the start position of the incremental encoder in the range 0° … <360°.

This setting is enabled only if Enable position measurement is cleared.

Index input (Angle Measurement) Lets you select whether and how the index signal is evaluated.

Index Input	Meaning
Not used	The index signal of the incremental encoder is not used. Only two channels for the PHI0 and PHI90 signals of the encoder are used.
Reset angle value only at the first index transition.	Three channels are used for the PHI0, the PHI90 and IDX signal of the encoder. Only at the first detection of an IDX signal pulse the Position outport is set to the value specified in On index set angle to.
Reset angle value on every index transition.	Three channels are used for the PHI0, the PHI90 and the IDX signal of the encoder. On every detection of an IDX signal pulse the Position outport is set to the value specified in On index set angle to.

This setting is enabled only if Enable position measurement is cleared.

On index set angle to Lets you specify the value the Position output port is set to if an IDX pulse is detected. The value is to be set in degrees in the range 0° … <360°.

This setting is enabled only if Enable position measurement is cleared and Index input (Angle Measurement) is set to process the index signal.

Enable minimum speed specification (angle measurement) Lets you enable the Minimum speed setting to specify the minimum value to be used for angle measurement.

If this setting is disabled the default minimum value of 45 rpm is used.

Minimum speed (angle measurement) Lets you specify the minimum value to be used for angle measurement. When the velocity falls below the specified minimum speed, the measured value of the encoder speed is set to 0 rpm.

The range depends on the specified number of lines according to the following formula.

```
RangeMin = max(0.01 , (60.0 / (1.34 * NumOfLines)))
RangeMax = min(10,000 , (60.0 / (40.0e-9 * NumOfLines)))
```

Minimum position value Lets you specify the lowest value for position in lines that the encoder can provide in the range -2,097,152.00 … +2,097,150.75. This value must be less than the Maximum position value and the difference between the maximum and the minimum position must be in the range 1 … 2,097,151 lines.

This setting is enabled only if Enable position measurement is checked.

Maximum position value Lets you specify the highest value for position in lines that the encoder can provide in the range -2,097,151.00 … +2,097,151.75. This value must be greater than the Minimum position value and the difference between the maximum and the minimum position must be in the range 1 … 2,097,151 lines.

This setting is enabled only if Enable position measurement is checked.

Initial position Lets you specify the start position of the incremental encoder in lines. Its range is defined by Minimum position value and Maximum position value.

This setting is enabled only if Enable position measurement is checked.

Index input (Position Measurement) Lets you select whether and how the index signal is processed.

Index Input	Meaning
Not used	The index signal of the incremental encoder is not used. Only two channels for the PHI0 and PHI90 signals of the encoder are used.
Reset position value only at the first index transition.	Three channels are used for the PHI0, the PHI90 and the IDX signal of the encoder. Only at the first detection of an IDX signal pulse the Position outport is set to the value specified in On index set position to.
Reset position value on every index transition.	Three channels are used for the PHI0, the PHI90 and the IDX signal of the encoder. On every detection of an IDX signal pulse the Position output port is set to the value specified in On index set position to.

This setting is enabled only if Enable position measurement is checked.

On index set position to Lets you specify the value the Position output port is set to if an index pulse occurs. This values is expressed in lines and its range is defined by Minimum position value and Maximum position value.

This setting is enabled only if Enable position measurement is checked and Index input (Angle Measurement) is set to process the index signal.

Enable minimum speed specification (position measurement) Lets you enable the Minimum speed setting to specify the minimum value to be used for position measurement.

Although the position measurement uses lines per second as unit, the default minimum value, which is used if the setting is disabled, is set to 45 rpm.

Minimum speed (position measurement) Lets you specify the minimum value to be used for position measurement in the range 1.0 … 1,000,000 lines per second. When the velocity falls below the specified minimum speed, the measured value of the encoder speed is set to 0 lines per second.

Related topics

References

Advanced Page (EMC_ENCODER_BLx) 36
Block Description (EMC_ENCODER_BLx) 30
EMC_HALL_BLx 52
EMC_MOTOR_SETUP_BLx 67
Unit Page (EMC_ENCODER_BLx) 32

Advanced Page (EMC_ENCODER_BLx)

Purpose

To specify additional options, such as the gated mode or the noise filter.

Dialog settings

Port Displays the port number that you selected on the Unit page.

Channel Displays the range of channels that you selected on the Unit page.

Enable gated mode Lets you enable the gated mode. In gated mode, the index signal is evaluated only if the PHI0 and PHI90 signals are also *high*. If the gated mode is disabled, the index signal is evaluated independently from the PHI0 and PHI90 signals.

Enable noise filter Lets you enable noise filtering for the input signals.

Filter interval Lets you specify the time interval for the noise filter in the range 0 … 10 ms.

For intervals shorter than 650 ns the resolution is 10 ns. For greater intervals, the accuracy is better than 10% of the specified value.

Enable index detected outport Lets you enable the Index Detected outport that indicates the first occurrence of the encoder's IDX signal by rising from *Low* to *High* and retaining this value until the termination of the simulation.

This setting is enabled only if Index input is set to *Reset angle value only at the first index transition* or *Reset angle value on every index transition*.

Related topics

References

EMC_ENCODER_POS_SET_BLx

Purpose

To set the incremental encoder to a specified position.

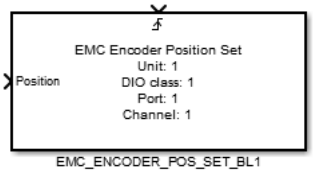
Where to go from here

Information in this section

Block Description (EMC_ENCODER_POS_SET_BLx)

Block

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



Purpose

To set the incremental encoder interface to a specified position.

Description

The encoder position is written to the position count register if the trigger input is set. If the Position inport of the block is not connected to an appropriate block, the block has no effect. The EMC_ENCODER_POS_SET_BLx block requires exactly one EMC_ENCODER_BLx block in the model that is responsible for the encoder configuration.

I/O mapping

For information on the mapping of channel numbers to the related I/O pins of the MicroLabBox I/O connector, refer to Digital I/O A Connector (Sub-D) (MicroLabBox Hardware Installation and Configuration 🕮) and Digital I/O B Connector (Sub-D) (MicroLabBox Hardware Installation and Configuration 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Input	
Trigger input	Input port for the trigger signal.

Position	Updates the value in the position count register of the specified encoder.
	The values that you can provide via this inport depend on the settings of the related **EMC_ENCODER_BLx** block.
	The **Enable position measurement** setting of the related encoder block defines whether to handle the value in lines (for position measurement) or degrees (for angle measurement).
	▪ Position measurement:
	  ▪ Range: **Minimum position value** … (**Maximum position value** - 0.25) lines
	  ▪ Resolution: 0.25 lines
	▪ Angle measurement:
	  ▪ Range: 0 … (360 - Resolution) degrees
	  ▪ Resolution: (360 / **Number of lines**) · 0.25 degrees
	Data type: Double
	If the input value exceeds the range, the value is saturated according to the settings of the related **EMC_ENCODER_BLx** block.

Dialog pages

The dialog settings can be specified on the following page:

- Unit page (refer to Unit Page (EMC_ENCODER_POS_SET_BLx) on page 40)

Related RTLib functions

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

- Incremental Encoder Class 1 (MicroLabBox RTLib Reference 🕮)
- Incremental Encoder Class 2 (MicroLabBox RTLib Reference 🕮)

Unit Page (EMC_ENCODER_POS_SET_BLx)

Purpose

To specify the trigger type for updating the position value.

Description

The EMC_ENCODER_POS_SET_BLx block is used to set a new position for an incremental encoder that you specified by using the EMC_ENCODER_BLx block.

Dialog settings

Encoder Lets you select an encoder that is available in your model. It is uniquely identified by the combination of the unit number, the DIO class number, the port number and the channel number. If you have not specified an encoder, or a specified EMC_ENCODER_BLx block has been deleted from the model or has been modified, the Encoder setting is set to NOT SELECTED.

Trigger type Lets you select the type of the trigger signal the trigger port is listening to. With the trigger signal, the update of the encoder position is started.

Trigger Type	Description
Rising	The block reacts on a rising edge of the trigger signal.
Falling	The block reacts on a falling edge of the trigger signal.
Either	The block reacts on a rising and a falling edge of the trigger signal.
Function-call	The block reacts on a function-call.

Related topics

References

Block Description (EMC_ENCODER_POS_SET_BLx)..... 38
EMC_ENCODER_BLx..... 30

EMC_ENDAT_BLx

Purpose

To get the rotor's position via an absolute encoder connected to the EnDat interface.

Where to go from here

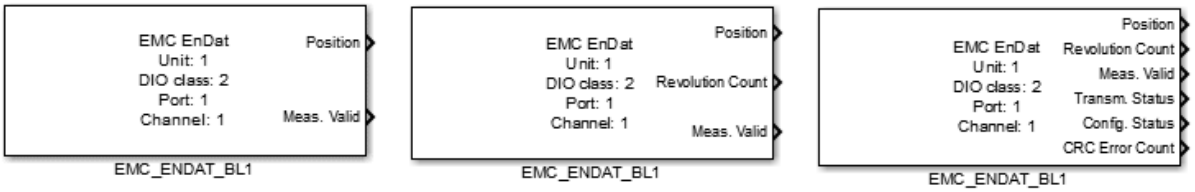
Information in this section

Information in other sections

Block Description (EMC_ENDAT_BLx)

Block

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



Purpose

To provide read access to the position value provided by an absolute encoder connected to the EnDat interface.

Description

This block lets you access an absolute EnDat encoder. The data that is transmitted via the EnDat interface contains information on the absolute angle position and, if you use a multi-turn encoder, the number of revolutions. The measured position value can be modified by an offset before it is output at the **Position** outport. For example, the offset value lets you do the zero balance with the motor.

For more information on the operation method of absolute encoders connected to an EnDat interface, refer to EnDat Interface (MicroLabBox Features 🕮).

I/O mapping

For information on the mapping of channel numbers to the related I/O pins of the MicroLabBox I/O connector, refer to Digital I/O B Connector (Sub-D) (MicroLabBox Hardware Installation and Configuration 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Output	
Position	Provides the current mechanical position as an angle in degrees, optionally modified by an offset specified in the **Position offset** setting. The maximum value of the port range and its resolution depends on the number of positions that is defined by the **Resolution per revolution** setting (`MaxNumberOfPositions = 2^ResolutionPerRevolution`) or the **Specify real number of positions per revolution** setting. Range: 0.0° … (360.0°-Resolution) Resolution: (360/NumberOfPositions)° Data type: Float64
Revolution Count	Provides the number of revolutions determined by a multi-turn encoder. Range: 0 … 2^{28}-1 Data type: UInt32 The **Revolution Count** outport is available only if **Multi-turn encoder** is set on the **Parameters** page.
Meas. Valid	Provides the information on whether the measured position is valid. For multi-turn encoders, the port value is also relevant to the measured revolutions. The validity check includes the following information: ▪ Status of the error bit F1 contained in the EnDat protocol ▪ Status of the CRC checksum contained in the EnDat protocol ▪ Physical connection to an absolute encoder ▪ EnDat configuration parameters were successfully read from the connected encoder Range: 0, 1 ▪ 0: The measured value is not valid. ▪ 1: The measured value is valid. Data type: Boolean
Transm. Status	Provides the transmission error information. The following transmission errors are returned: ▪ Bit 0 (LSB): Reading parameters error

Port	Description
	An error occurred while reading EnDat parameters from the connected encoder. ▪ Bit 1: CRC error The transmitted CRC checksum shows corrupted measurement data. The CRC error bit is set if two successive CRC errors occurred. The CRC error counter records the CRC errors of any transmission and not only the notified CRC errors. The total number of errors in the CRC error counter therefore might differ from the number of notified CRC errors. ▪ Bit 2: Error bit F1 set Error bit F1 of the EnDat protocol was set in the transmission. ▪ Bit 3: No connection No absolute encoder is connected to the EnDat interface, or the connected encoder does not respond. Range: 0, 1 Width: 4 Data type: Boolean The **Transm. Status** outport is available only if **Enable Transmission Status outport** is set on the **Advanced** page.
Config. Status	Provides the configuration error information. For the port to work properly, the configuration of the EnDat interface must match the connected encoder. The consistency check of the configuration requires communication with the connected encoder. These errors can therefore be detected only during run time. The following configuration errors are returned: ▪ Bit 0 (LSB): Configuration check missing The configuration error information is not available, because the parameters could not be read from the connected encoder. ▪ Bit 1: Number of positions error The specified number of positions does not equal the number of positions read from the absolute encoder connected to the EnDat interface. ▪ Bit 2: Resolution per revolution error The specified resolution per revolution does not equal the number of bits representing an angle position according to the property read from the absolute encoder connected to the EnDat interface. ▪ Bit 3: Resolution of revolution counter error The specified resolution of revolutions does not equal the number of bits representing the number of revolutions according to the property read from the absolute encoder connected to the EnDat interface. ▪ Bit 4: Clock frequency error The specified clock signal frequency exceeds the maximum clock signal frequency read from the absolute encoder connected to the EnDat interface. Range: 0, 1 Width: 5 Data type: Boolean The **Config. Status** outport is available only if **Enable Configuration Status outport** is set on the **Advanced** page.
CRC Error Count	Provides the value of the CRC error counter. The counter starts when you start the real-time application. Range: 0 … 65535 Data type: UInt32

Port	Description
	The CRC Error Count outport is available only if Enable CRC Error Count outport is set on the Advanced page.

Dialog pages

The dialog settings can be specified on the following pages:

- Unit page (refer to Unit Page (EMC_ENDAT_BLx) on page 44)
- Parameters page (refer to Parameters Page (EMC_ENDAT_BLx) on page 45)
- Advanced page (refer to Advanced Page (EMC_ENDAT_BLx) on page 47)

Related RTLib functions

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

- EnDat Interface (MicroLabBox RTLib Reference 🕮).

Unit Page (EMC_ENDAT_BLx)

Purpose

To specify the channels used by the absolute encoder connected to the EnDat interface.

Description

This block lets you access an absolute encoder connected to the EnDat interface. Each EnDat interface requires two subsequent channels for the *Clock* and the *Data* signals.

For more information on the signal characteristics of an absolute encoder, refer to EnDat Interface (MicroLabBox Features 🕮).

Dialog settings

Unit number Lets you select a unique unit number for the Endat interface in the range 1 … 2.

Channel number Lets you select the first of the channel numbers that are used for the absolute encoder signals in the range 1 … 11. The first channel is used for the *Clock* output signal and the second for the *Data* signal that is used to read from the EnDat interface and to write to it.

Note

Concurrent access to the same channels by other blocks or functions is not allowed.

Signal connector pin Displays the range of signal connector pins for the selected channels.

Signal Type	Pin Assignment	
	Pin	**Signal**
Single-ended signals	DIO1 ch<n>	*Clock*
	DIO1 ch<n+1>	*Data*
Differential signals	DIO2 ch<n>	*Clock*, non-inverted signal
	DIO2 ch<n+1>	*Data*, non-inverted signal

Reference connector pin Displays the range of reference connector pins for the selected channels.

Signal Type	Signal mapping	
	Pin	**Signal**
Single-ended signals	GND	Signal ground
Differential signals	$\overline{\text{DIO2 ch<n>}}$	*Clock*, inverted signal
	$\overline{\text{DIO2 ch<n+1>}}$	*Data*, inverted signal

Related topics

References

Advanced Page (EMC_ENDAT_BLx)....47
Block Description (EMC_ENDAT_BLx)....41
Parameters Page (EMC_ENDAT_BLx)....45

Parameters Page (EMC_ENDAT_BLx)

Purpose

To configure the EnDat interface for the absolute encoder to be connected.

Description

To guarantee correct measurement data, the EnDat interface contains a consistency check to check whether the specified configuration suits to the connected absolute encoder.

Dialog settings

Channel Displays the range of channels that you selected on the Unit page.

Encoder type Lets you select the type of the absolute encoder connected to the EnDat interface.

Encoder Type	Meaning
Single-turn encoder	For single-turn encoders, the following settings are available: ▪ Resolution per revolution ▪ Specify real number of positions per revolution ▪ Desired frequency
Multi-turn encoder	For multi-turn encoders, the following setting is additionally available: ▪ Resolution of revolution counter By default, the **Specify real number of positions per revolutions** setting is disabled for multi-turn encoders.

Resolution per revolution Lets you specify the number of bits used for providing a measured value of a specific angular position within one revolution in the range 1 … 28.

For multi-turn encoders, the number of positions per revolution is implicitly defined by this setting.

Specify real number of positions per revolution Lets you specify the number of positions the encoder is detecting for one revolution. Usually, the maximum number depends on the **Resolution per revolution** value and is $2^{ResolutionPerRevolution}$. You have to enable this setting if the connected single-turn encoder does not support the full range of the encoder's position resolution.

This setting is enabled only if **Single-turn encoder** is set.

Resolution of revolution counter Lets you specify the number of bits used for providing the number of the current revolution in the range 1 … 28. This implicitly defines the maximum number of revolutions the encoder is able to count.

This setting is enabled only if **Multi-turn encoder** is set.

Desired frequency Lets you specify the desired frequency of the clock signal of the EnDat interface in the range 100 … 16.000 kHz.

The actual frequency might differ. It is displayed in the Message Viewer. For information on how the actual frequency is calculated, refer to EnDat Interface (MicroLabBox Features 🕮).

The default waiting time between two data transmissions (also called recovery time) is in the range 10 … 30 µs. If you specify a clock frequency of 1 MHz or higher for an EnDat 2.2 sensor, the sensor is automatically configured to the shorter waiting time of 1.25 … 3.75 µs. Otherwise, the waiting time might take longer than the time for data transmission. This behavior corresponds to the EnDat 2.2 specification.

Note

The configuration of the shorter waiting time is stored in the sensor's non-volatile memory. After its activation, EnDat 2.2 commands cannot be used with a clock frequency less than 1 MHz.
If you want to use the sensor with another hardware system with a clock frequency less than 1 MHz, you have to clear the shorter waiting time configuration. To do so, specify a clock frequency less than 1 MHz and start the real-time application with the connected sensor once.

Max. cable length Displays the maximum cable length that is recommended for the specified clock frequency.

According to the EnDat 2.2 specification, clock frequencies up to 8 MHz can be used with a maximum cable length of 100 m. At higher clock frequencies, the maximum cable length decreases to up to 20 m.

Clock Frequency	Maximum Cable Length
Up to 8.0 MHz	100 m
8.0 … 8.5 MHz	90 m
8.5 … 9.0 MHz	80 m
9.0 … 10.5 MHz	60 m
10.5 … 11.5 MHz	50 m
11.5 … 12.5 MHz	40 m
12.5 … 14.0 MHz	30 m
14.0 … 16.0 MHz	20 m

Related topics

References

Advanced Page (EMC_ENDAT_BLx)....47
Block Description (EMC_ENDAT_BLx)....41
Unit Page (EMC_ENDAT_BLx)....44

Advanced Page (EMC_ENDAT_BLx)

Purpose

To specify additional options, such as event and outport settings.

Dialog settings

Channel Displays the range of channels that you selected on the Unit page.

Enable transmission synchronization Lets you enable the synchronization mode of the EnDat interface. If selected, the transmission of the measured data

is started if an event on the specified trigger line occurred. If you do not select the synchronization mode, data transmission is continuous.

Trigger line Lets you specify the trigger line the EnDat interface has to listen to for synchronizing the data transmission.

The setting is enabled if **Enable transmission synchronization** is set.

Position offset Lets you specify the offset angle for the measured angular position in degrees in the range -359.9945° … +359.9945° with a resolution of 0.0055°.

Reverse direction Lets you specify whether to reverse the direction of the rotation in the EnDat interface.

With no reversing, the forward rotation is assumed to be the clockwise rotation (with the front view of the motor shaft). If you have activated reversing, the clockwise rotation is measured as backward rotation.

This setting is useful if it is required to install the absolute encoder in inverse orientation.

Enable Transmission Status outport Lets you enable the Transm. Status output port.

Enable Configuration Status outport Lets you enable the Config. Status output port.

Enable CRC Error Count outport Lets you enable the CRC Error Count output port.

Related topics

References

Block Description (EMC_ENDAT_BLx)....41
Parameters Page (EMC_ENDAT_BLx)....45
Unit Page (EMC_ENDAT_BLx)....44

EMC_EVENT_POS_SET_BLx

Purpose

To specify an angular value for event generation.

Where to go from here

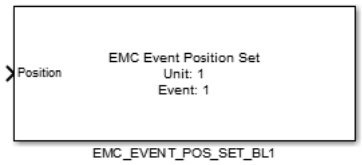
Information in this section

Information in other sections

Block Description (EMC_EVENT_POS_SET_BLx)

Block

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



Purpose

To specify an angular value of an absolute position where an event is generated.

Description

This block lets you specify an angular value of an absolute rotor position where an event is generated.

Before you can use a position in an EMC_EVENT_POS_SET_BLx block, you must activate it via an EMC_MOTOR_SETUP_BLx block. Then you can reference this position by the motor setup unit number and the event number.

You can generate events for different positions by adding separate EMC_EVENT_POS_SET_BLx blocks to your model.

Each EMC_EVENT_POS_SET_BLx block in your model must be unique regarding its motor setup unit number and its event number.

Note

For each absolute position that you activate in an EMC_MOTOR_SETUP_BLx block, you must add an EMC_EVENT_POS_SET_BLx block to your model.

I/O characteristics

The following table describes the ports of the block:

Port	Description
Input	
Position	Specifies the absolute angular position of the rotor where an event will be generated. If the input value exceeds the range, the value is saturated to 0° or (360° - Resolution). Range: 0.0° … (360.0° - Resolution) Resolution: 1.34e-6° Data type: Float64

Dialog pages

You can select the dialog settings on the following pages:

- Unit page (refer to Unit Page (EMC_EVENT_POS_SET_BLx) on page 50)
- Initialization page (refer to Initialization Page (EMC_EVENT_POS_SET_BLx) on page 51)

Unit Page (EMC_EVENT_POS_SET_BLx)

Purpose

To select an activated absolute position of an EMC_MOTOR_SETUP_BLx block.

Description

This page lets you select the event position to specify the angular value for.

Before you can use a position in an EMC_EVENT_POS_SET_BLx block, you must activate it in the corresponding EMC_MOTOR_SETUP_BLx block. Then you can reference the position by the motor setup unit number and the event number.

Dialog settings

Motor setup unit number Lets you select the unit number of an existing EMC_MOTOR_SETUP_BLx block that is used to generate events at absolute positions.

This setting is enabled only if there is at least one **EMC_MOTOR_SETUP_BLx** block in your model where event generation is enabled and at least one absolute position is activated.

The value of this setting is set to *NOT SELECTED* when this block is initially added to the model, or afterwards if the specified **EMC_MOTOR_SETUP_BLx** block has been modified or is deleted.

Event number Lets you select the absolute position number that is used in the specified **EMC_MOTOR_SETUP_BLx** block.

The value of this setting is set to *NOT SELECTED* when this block is initially added to the model, or afterwards if the specified **EMC_MOTOR_SETUP_BLx** block has been modified or is deleted.

Related topics

References

DIO_CLASS1_HWINT_BLx (MicroLabBox RTI Reference 🕮)
EMC_MOTOR_SETUP_BLx 67
Initialization Page (EMC_EVENT_POS_SET_BLx) 51

Initialization Page (EMC_EVENT_POS_SET_BLx)

Purpose

To specify the initial position where an event is generated.

Description

This block lets you use an input port during run time to adjust the position where the events are generated. You can specify an initial value for the position that is used, for example, during the simulation's initialization phase.

Dialog settings

Initial event position Lets you specify the angular position where an event is generated, as long as the **Position** input port has not been evaluated during model initialization. You can specify a value in the range 0.0° … (360.0° - Resolution).

Related topics

References

DIO_CLASS1_HWINT_BLx (MicroLabBox RTI Reference 🕮)
EMC_MOTOR_SETUP_BLx 67
Unit Page (EMC_EVENT_POS_SET_BLx) 50

EMC_HALL_BLx

Purpose

To get the rotor's position via a Hall sensor.

Where to go from here

Information in this section

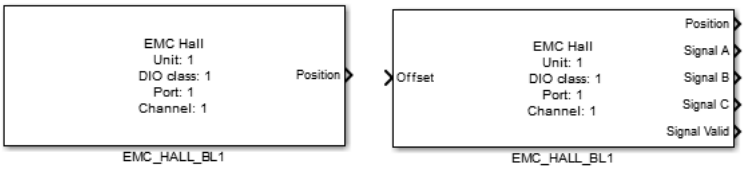
Information in other sections

Hall Sensor Interface (MicroLabBox Features 🕮)

Block Description (EMC_HALL_BLx)

Block

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



Purpose

To get the rotor's position via a Hall sensor.

I/O mapping

For information on the mapping of channel numbers to the related I/O pins of the MicroLabBox I/O connector, refer to Digital I/O A Connector (Sub-D) (MicroLabBox Hardware Installation and Configuration 🕮) and Digital I/O B Connector (Sub-D) (MicroLabBox Hardware Installation and Configuration 🕮).

Description

This block lets you access a three-channel Hall sensor that provides single-ended or differential signals. With its help you can get the current position of a rotor.

For more information on the operation method of Hall sensors, refer to Hall Sensor Interface (MicroLabBox Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Input	
Offset	Specifies the offset angle between the Hall sensor and the rotor position in degrees. This value is added to the electrical position of the Hall sensor. If the input value exceeds the range, the value is saturated to *-60.0*° or *+60.0*°. Range: -60° … +60° Data type: Float64 The **Offset** port is available only if **Specify position offset by input port** is selected.
Output	
Position	Provides the electrical position of the Hall sensor in degrees. Range: 0.0° … (360.0° - Resolution) Resolution: 1.34e-6° Data type: Float64
Signal A Signal B Signal C	Provides the three signals of the Hall sensor. Range: 0, 1 Data type: Boolean These ports are available only if **Enable sensors' signal ports** is selected.
Signal Valid	Specifies whether the combination of the values that are provided in **Signal A**, **Signal B** and **Signal C** is valid. ▪ 0: The combination of the current values is not valid. For most sensors, **Signal Valid** returns 0, for example, if all three signals are *high*. ▪ 1: The combination of the current values is valid. This port is available only if **Enable Signal Valid port** is selected.

Dialog pages

You can select the dialog settings on the following pages:

- Unit page (refer to Unit Page (EMC_HALL_BLx) on page 54)
- Parameters page (refer to Parameters Page (EMC_HALL_BLx) on page 55)
- Advanced page (refer to Advanced Page (EMC_HALL_BLx) on page 56)

Related RTLib functions

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

- Hall Sensor Class 1 (MicroLabBox RTLib Reference 🕮)
- Hall Sensor Class 2 (MicroLabBox RTLib Reference 🕮)

Unit Page (EMC_HALL_BLx)

Purpose

To specify the channels used by the Hall sensor.

Description

This page lets you specify the channels that are used by the Hall sensor. A Hall sensor provides the three signals *A*, *B* and *C*. A combination of the three signals correspond to an angular position of the motor. If the signals are single-ended, the *DIO Class 1* channels can be used. If the signals are differential, the *DIO Class 2* channels can be used.

For more information on the signal characteristics of a Hall sensor, refer to Hall Sensor Interface (MicroLabBox Features 🕮).

Dialog settings

Unit number Lets you select a unique unit number for the Hall sensor unit in the range 1 … 2.

DIO class number Lets you select how the Hall sensor provides the signals.

DIO Class Number	Meaning
1	The Hall sensor provides single-ended signals.
2	The Hall sensor provides differential signals.

Port number Lets you select the port number where the encoder is connected. If single-ended signals are provided the port number is in the range 1 … 3. For differential signals it is always 1.

Channel number Lets you select the first of the three channel numbers that are used for the three Hall sensor signals. The first channel is used for *Signal A*, the second for *Signal B* and the third for *Signal C*.

Note

Concurrent access to the same channel by other blocks or functions is not allowed.

Signal connector pin Displays the range of signal connector pins for the selected channels.

Signal Type	Pin Assignment	
	Pin	**Signal**
Single-ended signals	DIO1 ch<n>	*Signal A*
	DIO1 ch<n+1>	*Signal B*
	DIO1 ch<n+2>	*Signal C*
Differential signals	DIO2 ch<n>	*Signal A*, non-inverted signal
	DIO2 ch<n+1>	*Signal B*, non-inverted signal
	DIO2 ch<n+2>	*Signal C*, non-inverted signal

Reference connector pin Displays the range of reference connector pins for the selected channels.

Signal Type	Pin Assignment	
	Pin	**Signal**
Single-ended signals	GND	Signal ground
Differential signals	$\overline{\text{DIO2 ch<n>}}$	*Signal A*, inverted signal
	$\overline{\text{DIO2 ch<n+1>}}$	*Signal B*, inverted signal
	$\overline{\text{DIO2 ch<n+2>}}$	*Signal C*, inverted signal

Related topics

References

Advanced Page (EMC_HALL_BLx) 56
Block Description (EMC_HALL_BLx) 52
EMC_ENCODER_BLx 30
EMC_MOTOR_SETUP_BLx 67
Parameters Page (EMC_HALL_BLx) 55

Parameters Page (EMC_HALL_BLx)

Purpose

To specify the geometry of the Hall sensor.

Description

This page lets you specify the geometry of a Hall sensor by specifying the angular position of the signal transitions for each sensor.

Dialog settings

Port Displays the port number that you selected on the Unit page.

Channel Displays the range of channels that you selected on the Unit page.

Sensor A rising edge Lets you specify the position where the signal of Hall sensor A changes to *high* in the range 0.0° … (360.0° - Resolution).

Sensor A falling edge Lets you specify the position where the signal of Hall sensor A changes to *low* in the range 0.0° … (360.0° - Resolution).

Sensor B rising edge Lets you specify the position where the signal of Hall sensor B changes to *high* in the range 0.0° … (360.0° - Resolution).

Sensor B falling edge Lets you specify the position where the signal of Hall sensor B changes to *low* in the range 0.0° … (360.0° - Resolution).

Sensor C rising edge Lets you specify the position where the signal of Hall sensor C changes to *high* in the range 0.0° … (360.0° - Resolution).

Sensor C falling edge Lets you specify the position where the signal of Hall sensor C changes to *low* in the range 0.0° … (360.0° - Resolution).

Related topics

References

Advanced Page (EMC_HALL_BLx)

Purpose

To specify additional options, such as the sensor position offset, direction of rotation and noise filtering.

Dialog settings

Port Displays the port number that you selected on the Unit page.

Channel Displays the range of channels that you selected on the Unit page.

(Initial) Position offset Lets you specify an offset angle between the Hall sensor and the rotor position in degrees in the range -60.0° …+60.0°. The meaning of this setting depends on the source of the position offset that you select in Specify position offset by input port.

Specify Position Offset by Input Port	Meaning
Disabled	Position offset lets you specify a permanent offset angle.
Enabled	Initial position offset lets you specify an initial offset angle. At run time the offset is provided by the Offset port.

Specify position offset by input port Lets you enable the Offset input port that allows to specify the offset angle between the Hall sensor and the rotor position dynamically at run time.

Reverse direction Lets you select that the reverse order of sensor signals is interpreted as a forward rotation.

Enable noise filter Lets you enable noise filtering for the input signals.

Filter interval Lets you specify the time interval for the noise filter in the range 0 … 10 ms.

For intervals shorter than 650 ns the resolution is 10 ns. For greater intervals, the accuracy is better than 10% of the specified value.

Enable sensors signal ports Lets you enable the Sensor A, Sensor B and Sensor C output ports with the signals of the single Hall sensors.

Enable signal valid port Lets you enable the Signal valid output port.

Related topics

References

EMC_MC_PWM_BLx

Purpose

To generate a multichannel PWM signal to control an electric motor.

Where to go from here

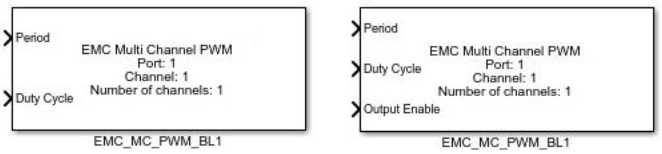
Information in this section

Information in other sections

Block Description (EMC_MC_PWM_BLx)

Block

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



Purpose

To generate PWM signals on the specified number of channels with a common period and individual duty cycles adjustable during run time.

Description

This block lets you specify a number of channels to be used for PWM signal generation within the limits of available channels per port.

If **Inverted channels** is set to *On*, the block automatically reserves the same number of channels for the inverted signals as specified for the non-inverted signals. The first inverted channel is `(ChannelNumber + NumberOfChannels)`.

I/O mapping

For information on the mapping of channel numbers to the related I/O pins of the MicroLabBox I/O connector, refer to Digital I/O A Connector (Sub-D) (MicroLabBox Hardware Installation and Configuration 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Input	
Period	Specifies the common period of all PWM output channels in seconds. If the input value exceeds the range, the value is saturated to the minimum or maximum value. Range: 100 ns … 1.34 s Resolution: 10 ns Data type: Double
Duty Cycle	Specifies a vector of the individual duty cycles for each non-inverted PWM output channel. The vector length equals the number of non-inverted channels. If a duty cycle value exceeds the range, the value is saturated to the minimum or maximum value. Range: 0.0 … 1.0 (0 … 100%) Resolution: The resolution of the actual duty cycle depends on the period value it is to be applied to as follows: The resolution for time intervals within the PWM signal generator unit is 10 ns. If the time interval resulting from the chosen duty cycle can not be represented in multiples of 10 ns the actual value is determined by rounding towards the nearest possible value. As a consequence, the shorter the given period is, the poorer the resolution of the duty cycle will be. E.g., if you have specified the value 100 ns as the period, which is the minimum value available, you can only obtain actual duty cycles with a step width of 10%. Data type: Vector of double values
Output Enable	Specifies the enable state of the digital outputs. Range: 0, 1 ▪ 0: Outputs are disabled, i.e., the outputs are set to high impedance. ▪ 1: Outputs are enabled, i.e., the outputs are driven by the software. Data type: Boolean The **Output Enable** port is available only if **Activate Output Enable input port** is set on the **Parameters** page.

Dialog pages

You can select the dialog settings on the following pages:

- Unit page (refer to Unit Page (EMC_MC_PWM_BLx) on page 60)
- Parameters page (refer to Parameters Page (EMC_MC_PWM_BLx) on page 61)

- Initialization page (refer to Initialization Page (EMC_MC_PWM_BLx) on page 63)
- Termination page (refer to Termination Page (EMC_MC_PWM_BLx) on page 63)
- Event page (refer to Event Page (EMC_MC_PWM_BLx) on page 65)

Related RTLib functions

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

- Multichannel PWM Signal Generation (MicroLabBox RTLib Reference 🕮)

Unit Page (EMC_MC_PWM_BLx)

Purpose

To specify the output channels of the multichannel PWM signals.

Description

This page lets you specify the number of non-inverted signals. If you set Inverted channels to *On*, the same number of channels is automatically allocated for the inverted signals.

Dialog settings

Port number Lets you select the port number to be used in the range 1 … 3.

Channel number Lets you select the first channel number to be used in the range 1 … 16.

Note

Concurrent access to the same DIO Class 1 channel by other blocks or functions is not allowed.

Inverted channels Lets you select whether inverted PWM signals are provided.

Inverted Channels	Meaning
Off	Only the non-inverted PWM signals are provided.
On	Inverted and non-inverted signals are provided. The first inverted channel is `(FirstChannelNumber + NumberOfChannels)`.

If you selected the highest value in **Channel number**, you can only select *Off* in **Inverted Channels**.

Number of channels Lets you select the number of non-inverted PWM signals.

The possible values depend on the number of the first used channel and whether inverted signals are provided:

- Without inverted signals:

```
NumberOfChannels <= 16 - (FirstChannelNumber - 1)
```

- With inverted signals:

```
NumberOfChannels <= (16 - (FirstChannelNumber - 1))/2
```

Note

- The inverted channels are located after the non-inverted channels.
- The pin assignment of the inverted channels is automatically shifted if you change the first channel or the number of channels.

Signal connector pin Displays the range of signal connector pins for the selected channels. The range begins with the connector pin of the first selected channel. The inverted channels are located after the non-inverted channels.

Reference connector pin Displays the range of reference connector pins for the selected channels.

High level Lets you set the voltage level of *High* on the output channel to 2.5 V, 3.3 V or 5.0 V.

Related topics

References

Block Description (EMC_MC_PWM_BLx) 58
Event Page (EMC_MC_PWM_BLx) 65
Initialization Page (EMC_MC_PWM_BLx) 63
Parameters Page (EMC_MC_PWM_BLx) 61
Termination Page (EMC_MC_PWM_BLx) 63

Parameters Page (EMC_MC_PWM_BLx)

Purpose

To configure the multichannel PWM signal generation.

Description

This page lets you specify how the PWM signals are aligned.

- For center-aligned signal generation, you can specify the update mode and the dead time between inverted and non-inverted channels.

- For edge-aligned signal generation, you can select whether to use the synchronous or the asynchronous update mode.

For more information, refer to Multichannel PWM Signal Generation (DIO Class 1) (MicroLabBox Features 🕮).

Dialog settings

Port Displays the port number that you selected on the Unit page.

Channel Displays the range of channels that you selected on the Unit page.

Alignment mode Lets you select whether to generate *center-aligned* or *edge-aligned* multichannel PWM signals.

Update mode (center alignment) Lets you select the PWM update mode for center-aligned PWM signal generation. You can decide whether to update at the start of the PWM period, in the middle of a period, or at both times.

This setting is enabled only if Alignment mode is set to *Center*.

Update mode (edge alignment) Lets you select the PWM update mode for edge-aligned PWM signal generation. You can decide whether to update synchronously or asynchronously.

This setting is enabled only if Alignment mode is set to *Edge*.

Dead time Lets you specify the PWM dead time in seconds in the range 0 … 665 µs with a resolution of 10 ns.

This setting is enabled only if Alignment mode is set to *Center*.

Activate Output Enable input port Lets you enable the Output Enable input port to enable or disable the outputs during runtime.

Initial Output Enable state Lets you specify the initial state of the Output Enable input port.

State	Meaning
Enabled	The Output Enable input port is set to *enabled*. The outputs are driven by the software.
Disabled	The Output Enable input port is set to *disabled*. The outputs are set to high impedance.

This setting is enabled only if Activate Output Enable input port is set.

Related topics

References

Initialization Page (EMC_MC_PWM_BLx)

Purpose

To specify the initial period, duty cycle and signal level for the output signals.

Description

This page lets you specify the initial digital output states of the selected channels. During the model initialization phase, these states are written to all the channels of the specified digital I/O port to ensure a defined output. This is especially useful if the **EMC_MC_PWM_BLx** block is used in a triggered or enabled subsystem that is not executed right from the start of the simulation.

Dialog settings

Port Displays the port number that you selected on the **Unit** page.

Channel Displays the range of channels that you selected on the **Unit** page.

Initial period Lets you enter the period in seconds at the start of the simulation in the range 100 ns … 1.34 s with a resolution of 10 ns.

Initial duty cycle Lets you enter the duty cycle at the start of the simulation in the range 0 … 1. The value can be set separately for each enabled non-inverted channel. The duty cycle values 0 and 1 yield a constant low and constant high output signal, respectively.

Only the channels that you specified at the **Unit** page are enabled.

Related topics

References

Block Description (EMC_MC_PWM_BLx) 58
Event Page (EMC_MC_PWM_BLx) 65
Parameters Page (EMC_MC_PWM_BLx) 61
Termination Page (EMC_MC_PWM_BLx) 63
Unit Page (EMC_MC_PWM_BLx) 60

Termination Page (EMC_MC_PWM_BLx)

Purpose

To specify the termination values for the period and the duty cycle.

Description

This page lets you specify the output states of the specified channels on model termination to drive your external hardware into a safe final condition.

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

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

Note

If you want to stop the motor on model termination, you have to note the specific characteristics of your motor. It is usually not sufficient to set the digital outputs to high impedance or a definite output value.

Dialog settings

Port Displays the port number that you selected on the Unit page.

Channel Displays the range of channels that you selected on the Unit page.

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

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

By default, the Termination mode checkbox is disabled.

Output Lets you select the state of the output channels after termination.

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

Period on termination Lets you enter the period in seconds at the end of the simulation in the range 100 ns … 1.34 s with a resolution of 10 ns.

Duty cycle on termination Lets you enter the duty cycle at the end of the simulation in the range 0 … 1. The value can be set separately for each enabled non-inverted channel. The duty cycle values 0 and 1 yield a constant low and constant high output signal, respectively.

Only the channels that you specified at the Unit page are enabled.

Related topics

References

Block Description (EMC_MC_PWM_BLx) 58
Event Page (EMC_MC_PWM_BLx) 65
Initialization Page (EMC_MC_PWM_BLx) 63
Parameters Page (EMC_MC_PWM_BLx) 61
Unit Page (EMC_MC_PWM_BLx) 60

Event Page (EMC_MC_PWM_BLx)

Purpose

To configure the generation of interrupts and trigger events.

Description

This page lets you configure whether to generate hardware interrupts, trigger signals, or both.

For center-aligned and edge-aligned PWM signals, events can be generated at the start of the PWM period on the specified channel.

For center-aligned PWM signals, events can also be generated at the middle of the PWM period.

For more information on handling events that are generated by RTI EMC blocks, refer to Basics on Electric Motor Control (MicroLabBox Features 🕮).

Dialog settings

Port Displays the port number that you selected on the Unit page.

Channel Displays the range of channels that you selected on the Unit page.

Enable event generation Lets you enable the generation of trigger events, interrupt events or both.

If you enable event generation, at least one of the pulse positions (*start position* or *center position*) must be activated.

Event mode Lets you select which events are generated at the activated pulse position.

Event Mode	Meaning
Interrupt	Generate interrupts at the activated pulse position.
Trigger	Generate trigger events at the activated pulse position.
Interrupt and Trigger	Generate both interrupts and trigger events at the activated pulse position.

If you select interrupt generation, your model has to contain a related DIO_CLASS1_HWINT_BLx (MicroLabBox RTI Reference 🕮) block configured with the same port and channel number.

Activate event on start position Lets you enable event generation at the start of the period.

For edge-aligned PWM signals, you must select this checkbox.

Activate event on center position Lets you enable event generation in the middle of the period.

This setting is enabled only if **Alignment mode** is set to *center-aligned*. For edge-aligned PWM signals, you can only select to generate events at the start of a period.

Event delay Lets you specify the delay time in seconds for trigger and interrupt events in the range 0 … 1.34 s.

Note

For periodic events, the event delay should be less than the period. Otherwise, only each first trigger or interrupt event is delayed and becomes effective. The other trigger or interrupt events generated during the event delay are ignored.

Event rate Lets you specify the event rate in the range 1 … 256. It specifies after how many occurrences of any event cause a trigger or interrupt is generated. For example, if you set the event rate to 3, an event will be generated after each third occurrence of an event cause. The value affects the signal of the trigger line as well as the generation of the interrupt.

Trigger line Lets you select a trigger line number to be used for trigger event generation in the range 1 … 16.

Note

It is not allowed to use the same trigger line number in different event-generating blocks.

This setting is enabled only if an event mode with trigger generation is selected.

Related topics

References

Block Description (EMC_MC_PWM_BLx)..... 58
DIO_CLASS1_HWINT_BLx (MicroLabBox RTI Reference 🕮)
Initialization Page (EMC_MC_PWM_BLx)..... 63
Parameters Page (EMC_MC_PWM_BLx)..... 61
Termination Page (EMC_MC_PWM_BLx)..... 63
Unit Page (EMC_MC_PWM_BLx)..... 60

EMC_MOTOR_SETUP_BLx

Purpose

To configure the computation of the rotor's position and the generation of position-dependent events.

Where to go from here

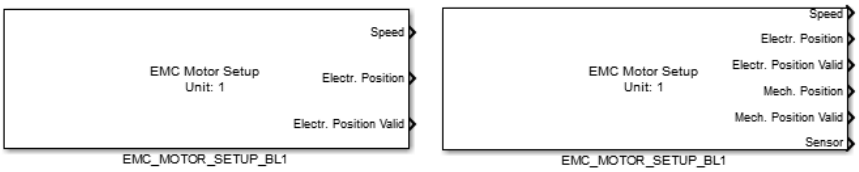
Information in this section

Information in other sections

Block Description (EMC_MOTOR_SETUP_BLx)

Block

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



Purpose

To configure the computation of the rotor's position and speed.

Description

This block lets you configure an angular computation unit (ACU) that calculates and extrapolates the position and speed of the motor's rotor.

You can select sensors that provide the measured input values for the angle computation.

You must add the following blocks for these sensors to your model before:

- EMC_HALL_BLx
- EMC_ENCODER_BLx
- EMC_RESOLVER_BLx
- EMC_ENDAT_BLx
- EMC_SSI_BLx

You can specify that the ACU calls an output function of a block-commutated PWM signal specification immediately to relieve the simulator's calculating node. You must add this signal specification to your Simulink model before via an EMC_BC_PWM_BLx block.

You can specify rotor positions where events are generated.

I/O characteristics

The following table describes the ports of the block:

Port	Description
Output	
Speed	Outputs the current speed that was calculated by the ACU based on the electrical angle position of the motor in revolutions per minute. Range: -262,143.984375 … +262,143.984375 rpm Resolution: 0.015625 rpm (=1/64 rpm) This is the resolution of the output. The resolution of the measured speed decreases with increasing speed. Data type: Float64
Electrical Position	Outputs the current electrical position of the rotor in degrees. The ACU uses the sensor position to calculate the value of the rotor position. The accuracy depends on the resolution of the sensor that is used for calculation. The **Electrical Position** is always available. However, the **Electrical Position Valid** port indicates whether the current position value is valid. Range: 0.0° … (360.0° - Resolution) Resolution: 1.34e-6° Data type: Float64
Electrical Position Valid	Indicates whether the value that is provided in **Electrical Position** is valid. ▪ 0: The current value is not valid. ▪ 1: The current value is valid. Range: 0, 1 Data type: Boolean
Mechanical Position	Outputs the current mechanical position of the rotor in degrees. The accuracy depends on the resolution of the sensor used. The **Mechanical Position Valid** port indicates whether the current position value is valid.

Port	Description
	Range: 0.0° … (360.0° - Resolution) Resolution: 1.34e-6° Data type: Float64 The **Mechanical Position** port is available only if **Enable mechanical position port** on the **Advanced** page is selected.
Mechanical Position Valid	Indicates whether the value that is returned in **Mechanical Position** is valid. ▪ 0: The current value is not valid. ▪ 1: The current value is valid. Range: 0, 1 Data type: Boolean The **Mechanical Position** port is available only if **Enable mechanical position port** on the **Advanced** page is selected.
Sensor	Indicates which sensor is used for angle computation. The motor position and the motor speed are calculated on the basis of this sensor's angle information. ▪ 1: Sensor A is used. ▪ 2: Sensor B is used. Range: 1, 2 Data type: UInt32 The **Sensor** port is available only if **Enable sensor port** on the **Advanced** page is selected.

Note

The speed value is calculated from the current position. Because the calculation takes some nanoseconds, the speed value might not be updated in the same model step as the position value.

Dialog pages

You can select the dialog settings on the following pages:

- Unit page (refer to Unit Page (EMC_MOTOR_SETUP_BLx) on page 70)
- Parameters page (refer to Parameters Page (EMC_MOTOR_SETUP_BLx) on page 70)
- Advanced page (refer to Advanced Page (EMC_MOTOR_SETUP_BLx) on page 72)
- Event page (refer to Event Page (EMC_MOTOR_SETUP_BLx) on page 72)

Related RTLib functions

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

- Angle Computation Unit (ACU) (MicroLabBox RTLib Reference 🕮)

Unit Page (EMC_MOTOR_SETUP_BLx)

Purpose

To select a unit number for this electric motor control configuration.

Dialog settings

Unit number Lets you select a unique unit number for the electric motor control configuration in the range 1 … 4.

Related topics

References

Parameters Page (EMC_MOTOR_SETUP_BLx)

Purpose

To configure the sensors used for position measurement.

Description

This page lets you set up the calculation of the angular position of the rotor. You can configure the sensors in the following ways:

- A Hall or resolver sensor as Sensor A.

  Hall and resolver sensors can immediately provide an absolute electrical position. If the sensor's pole pair number is one the electrical position is equal to the mechanical position.
- An incremental encoder as Sensor B.

  Incremental encoders have a higher resolution than Hall sensors but provide only a relative position until an index pulse occurs that indicates an absolute position. In the worst case, they can not provide an absolute position for the first rotation.
- An absolute encoder connected to the EnDat or SSI interface as Sensor B.

  Absolute encoders are available with high resolutions and can immediately provide an absolute position.
- A combination of a Hall sensor as Sensor A and an incremental or absolute encoder as Sensor B to compensate the specific disadvantages of each sensor type.

  The angular position calculation switches from Sensor A to Sensor B as soon as Sensor B provides a valid angle.

  If Sensor B provides an invalid angle, the angular position calculation is reswitched to Sensor A.

To reduce the CPU load on the real-time processor, you can use the angular computation unit (ACU) to update a block-commutated PWM block directly.

Dialog settings

Unit Displays the unit number of the EMC configuration that you specified on the Unit page.

Sensor A Lets you specify a Hall sensor or a resolver that is used to calculate the angular position of the rotor. You can select it from the list of sensors that provides all the EMC_HALL_BLx and EMC_RESOLVER_BLx blocks that are available in your model.

The value of this setting is set to *NOT SELECTED* when one of these blocks is initially added to the model, or afterwards if the specified Hall sensor or resolver has been modified or is deleted.

Pole pairs sensor A Lets you select the number of pole pairs of Sensor A in the range 1 … 16.

Sensor B Lets you specify an incremental or absolute encoder that is used to calculate the angular position of the rotor. You can select it from the list of incremental and absolute encoders that you added to your model via an EMC_ENCODER_BLx block, an EMC_ENDAT_BLx block, or an EMC_SSI_BLx block.

The value of this setting is set to *NOT SELECTED* when this block is initially added to the model, or afterwards if the specified incremental encoder has been modified or is deleted.

Output function Lets you select a block-commutated PWM block that is directly updated by the ACU. You can select it from the list of block-commutated PWM blocks that you added to your model via EMC_BC_PWM_BLx. In the signal specification, Angle position specified by must be set to *EMC_MOTOR_SETUP*.

The value of this setting is set to *NOT SELECTED* when this block is initially added to the model, or afterwards if the specified block-commutated signal specification has been modified or is deleted.

Pole pairs motor Lets you select the number of pole pairs of the motor in the range 1 … 16.

Related topics

References

Advanced Page (EMC_MOTOR_SETUP_BLx) ... 72
Block Description (EMC_MOTOR_SETUP_BLx) ... 67
EMC_BC_PWM_BLx ... 17
EMC_ENCODER_BLx ... 30
EMC_ENDAT_BLx ... 41
EMC_HALL_BLx ... 52
EMC_RESOLVER_BLx ... 75
EMC_SSI_BLx ... 80
Event Page (EMC_MOTOR_SETUP_BLx) ... 72
Unit Page (EMC_MOTOR_SETUP_BLx) ... 70

Advanced Page (EMC_MOTOR_SETUP_BLx)

Purpose

To output the mechanical position and the currently used sensor.

Dialog settings

Unit Displays the unit number of the EMC configuration that you specified on the Unit page.

Enable mechanical position port Lets you enable the Mechanical Position and Mechanical Position Valid output ports that provide the calculated position on the basis of the active sensor.

Enable sensor port Lets you enable the Sensor output port that indicates which sensor is currently the basis for the angle computation.

Related topics

References

Event Page (EMC_MOTOR_SETUP_BLx)

Purpose

To configure the generation of interrupts and trigger events.

Description

This page lets you configure whether to generate hardware interrupts, trigger signals, or both.

The events can be generated at relative equidistant angular positions or at up to four arbitrary absolute positions.

For more information on handling events that are generated by RTI EMC, refer to Basics on Electric Motor Control (MicroLabBox Features 🕮).

Dialog settings

Unit Displays the unit number of the EMC configuration that you specified on the Unit page.

Enable event generation Lets you enable the generation of trigger events, interrupts, or both.

This setting is enabled only if at least one sensor is selected for Sensor A or Sensor B.

If you enable interrupt generation, at least one type of interrupt must be activated.

Events based on sensor Lets you select which of the sensors that are selected as Sensor A or Sensor B is used as basis for the generation of events.

This setting is available only if Enable event generation is checked.

The value of this setting is set to *NOT SELECTED* when this block is initially added to the model, or afterwards if the specified Sensor A or Sensor B configuration has been modified.

Event angle based on position Lets you select whether the generation of events is based on the electrical or mechanical position.

If you specified Sensor A in Events based on sensor, and this sensor has a number of pole pairs greater than 1, you can select only the electrical position.

This setting is enabled only if you specified a sensor in Events based on sensor.

Event mode Lets you select whether to generate interrupts, trigger events at the activated rotor positions, or both.

If you select interrupt generation, your model has to contain a related DIO_CLASS1_HWINT_BLx (MicroLabBox RTI Reference 🕮) block configured with the same unit number.

This setting is enabled only if you specified a sensor in Events based on sensor.

Activate periodic interrupt Lets you activate the periodical generation of interrupts at positions that you can specify in Angle interval and Offset angle.

This setting is available only if you enabled the generation of interrupts in Event mode.

Activate interrupt on absolute position 1 … 4 Lets you select the generation of interrupts at up to four independent absolute positions. You have to specify each of the activated absolute positions via EMC_EVENT_POS_SET_BLx.

This setting is available only if you enabled the generation of interrupts in Event mode.

Trigger source Lets you select the condition to generate a trigger event.

Trigger Source	Meaning
Periodic	Trigger events are generated at relative positions that you can specify in Angle interval and Offset angle.
Absolute position 1 … 4	An event is generated if the specified absolute position is reached. You have to specify the activated absolute position via EMC_EVENT_POS_SET_BLx.

This setting is available only if you enabled the generation of trigger events in **Event mode**.

Trigger line Lets you select a trigger line number to be used for trigger event generation in the range 1 … 16.

Note

It is not allowed to use the same trigger line number in different event-generating blocks.

This setting is enabled only if an event mode with trigger generation is selected.

Angle interval Lets you specify an angle for relative equidistant periodic positions in the range 0.0° … 360.0°. The value must be an integer divisor of 360°.

For example, an angle interval of *120°* specifies the angular event positions *0°*, *120°* and *240°* if the **Offset angle** is set to *0°*.

Angle interval is enabled only if **Activate periodic interrupt** is activated or *Periodic* is selected for **Trigger source**.

Offset angle Lets you specify an offset for the equidistant relative positions that you specified in **Angle interval**. The **Offset angle** value must be less than the **Angle interval**.

For example, if the **Offset angle** is set to *5°*, an **Angle interval** of *120°* specifies the angular positions *5°*, *125°* and *245°*.

Offset angle is enabled only if **Activate periodic interrupt** is activated or *Periodic* is selected for **Trigger source**.

Related topics

References

Advanced Page (EMC_MOTOR_SETUP_BLx) 72
Block Description (DIO_CLASS1_HWINT_BLx) (MicroLabBox RTI Reference 🕮)
Block Description (EMC_MOTOR_SETUP_BLx) 67
EMC_EVENT_POS_SET_BLx 49
Parameters Page (EMC_MOTOR_SETUP_BLx) 70
Unit Page (EMC_MOTOR_SETUP_BLx) 70

EMC_RESOLVER_BLx

Purpose

To get the rotor's position via a resolver sensor.

Where to go from here

Information in this section

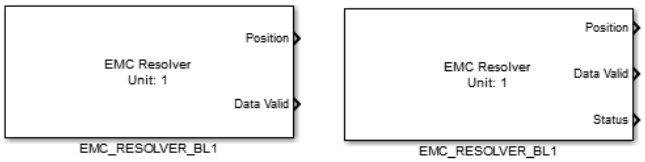
Information in other sections

Resolver Interface (MicroLabBox Features 🕮)

Block Description (EMC_RESOLVER_BLx)

Block

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



Purpose

To get the rotor's position via a resolver sensor.

I/O mapping

For information on the related MicroLabBox I/O connectors, refer to Resolver Connectors (Sub-D) (MicroLabBox Hardware Installation and Configuration 🕮).

Description

This block lets you access a resolver sensor. With its help you can get the current angular position of a rotor.

For more information on the operation method of resolver sensors, refer to Resolver Interface (MicroLabBox Features 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Output	
Position	Provides the electrical position of the resolver sensor in degrees. Range: 0.0° … (360.0° - Resolution) Resolution: 1.34e-6° This is the theoretical maximum resolution. The resolution depends on, for example, the resolver type and the selected speed range. Data type: Float64
Data Valid	Specifies whether the angle position and fault status that are provided by the resolver sensor are valid. Range: 0, 1 ▪ 0: The current values are not valid. ▪ 1: The current values are valid. Data type: Boolean
Status	Provides the fault status of the resolver interface. Range: 0, 1 Each bit in the 6-bit value represents a specific fault: ▪ Bit 0 (LSB): Configuration parity error ▪ Bit 1: Inputs loss of signal ▪ Bit 2: (Not used) ▪ Bit 3: Loss of tracking ▪ Bit 4: Velocity too high ▪ Bit 5: Phase lock error For detailed information on the status information, refer to Resolver Interface (MicroLabBox Features 🕮). Data type: Boolean This port is available only if **Enable Status outport** is selected.

Dialog pages

You can select the dialog settings on the following pages:

- Unit page (refer to Unit Page (EMC_RESOLVER_BLx) on page 77)
- Parameters page (refer to Parameters Page (EMC_RESOLVER_BLx) on page 77)
- Advanced page (refer to Advanced Page (EMC_RESOLVER_BLx) on page 78)

Related RTLib functions

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

- Resolver Interface (MicroLabBox RTLib Reference 🕮)

Unit Page (EMC_RESOLVER_BLx)

Purpose

To specify the resolver unit.

Description

This page lets you specify the resolver unit that corresponds to the **Resolver** connector at MicroLabBox's front connector panel.

For more information on the signal characteristics of a resolver sensor, refer to Resolver Interface (MicroLabBox Features 🕮).

Dialog settings

Unit number Lets you select a unique unit number for the resolver sensor in the range 1 … 2.

Related topics

References

Advanced Page (EMC_RESOLVER_BLx) 78
Block Description (EMC_RESOLVER_BLx) 75
EMC_MOTOR_SETUP_BLx 67
Parameters Page (EMC_RESOLVER_BLx) 77

Parameters Page (EMC_RESOLVER_BLx)

Purpose

To specify the characteristics of the connected resolver sensor.

Description

This page lets you specify the characteristics of the connected resolver sensor. You can configure the excitation and transformation settings of the resolver's coils.

Dialog settings

Desired frequency [2 kHz … 20 kHz] Lets you specify the frequency of the sine signal to be used for the excitation of the resolver rotor in the range 2,000 … 20,000 Hz in steps of 250 Hz.

Resulting frequency Displays the frequency that the resolver driver uses for the excitation of the resolver rotor based on the desired frequency. The resulting frequency is set to '---', if the input value is out of range or contains an undefined variable.

The resulting frequency is calculated as follows:

```
Rest = mod(FreqDesired, 250)
Rest = 0:     FreqResulting = FreqDesired
Rest < 125:  FreqResulting = FreqDesired - Rest
Rest >= 125: FreqResulting = FreqDesired + (250 - Rest)
```

Resolution of frequency Displays the resolution of the resulting frequency value.

RMS voltage (excitation) Lets you specify the RMS voltage that is to be used for the excitation of the resolver coil.

The selectable values are:

- 3.0 V_{RMS}
- 7.0 V_{RMS}
- 10.0 V_{RMS}

Sine/Cosine RMS voltage Lets you specify the RMS voltage that is induced at the non-excited resolver coils.

The selectable values are:

- 1.5 V_{RMS}
- 3.5 V_{RMS}
- 5.0 V_{RMS}

Maximum speed Lets you specify the maximum rotor speed that you expect. The resolution of the measurement, that is specified by the number of bits used, increases with reducing the maximum speed.

The selectable values are:

- 150,000 rpm (10 bit)
- 60,000 rpm (12 bit)
- 30,000 rpm (14 bit)
- 7500 rpm (16 bit)

Related topics

References

Advanced Page (EMC_RESOLVER_BLx) 78
Block Description (EMC_RESOLVER_BLx) 75
EMC_MOTOR_SETUP_BLx 67
Unit Page (EMC_RESOLVER_BLx) 77

Advanced Page (EMC_RESOLVER_BLx)

Purpose

To specify additional options, such as the sensor position offset, direction of rotation and enabling the Status outport.

Dialog settings

Unit Displays the unit number of the resolver that you specified on the Unit page.

Position offset Lets you specify an offset angle between the resolver sensor and the rotor position in degrees in the range -359.9945° …+359.9945° in steps of 0.0055°.

Reverse direction Lets you select that the reverse order of sensor signals is interpreted as a forward rotation.

Enable Status outport Lets you enable the Status outport providing the fault status of the resolver interface. For details on the status information, refer to Block Description (EMC_RESOLVER_BLx) on page 75.

Related topics

References

EMC_SSI_BLx

Purpose

To get the rotor's position via an absolute encoder connected to the SSI interface.

Where to go from here

Information in this section

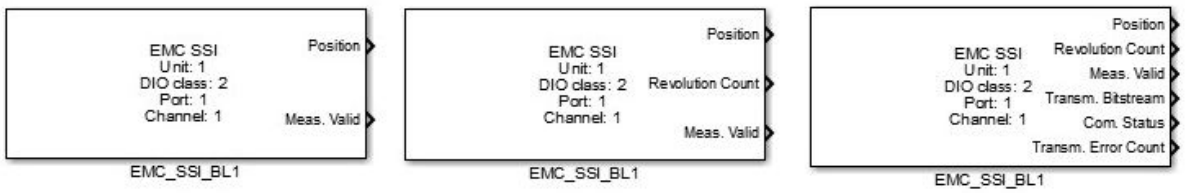
Information in other sections

SSI Interface (MicroLabBox Features 🕮)

Block Description (EMC_SSI_BLx)

Block

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



Purpose

To provide read access to the position value provided by an absolute encoder connected to the SSI interface.

Description

This block lets you access an absolute SSI encoder. The data that is transmitted via the SSI interface contains information on the absolute angle position and, if

you use a multi-turn encoder, the number of revolutions. The measured position value can be modified by an offset before it is output at the **Position** outport. For example, the offset value lets you do the zero balance with the motor.

To access the total number of bits of the serial transmission, the bitstream width of an SSI encoder can be configured. This is required if the SSI encoder is transmitting additional sensor-specific information.

For more information on the operation method of absolute encoders connected to an SSI interface, refer to SSI Interface (MicroLabBox Features 🕮).

I/O mapping

For information on the mapping of channel numbers to the related I/O pins of the MicroLabBox I/O connector, refer to Digital I/O B Connector (Sub-D) (MicroLabBox Hardware Installation and Configuration 🕮).

I/O characteristics

The following table describes the ports of the block:

Port	Description
Output	
Position	Provides the current mechanical position as an angle in degrees, optionally modified by an offset specified in the **Position offset** setting. The maximum value of the port range and its resolution depends on the number of positions that is defined by the **Resolution per revolution** setting (`MaxNumberOfPositions = 2^ResolutionPerRevolution`) or the **Specify real number of positions per revolution** setting. Range: 0.0° … (360.0°-Resolution) Resolution: (360/NumberOfPositions)° Data type: Float64
Revolution Count	Provides the number of revolutions determined by a multi-turn encoder. Range: 0 … 2^{28}-1 Data type: UInt32 The **Revolution Count** outport is available only if **Multi-turn encoder** is set on the **Parameters** page.
Meas. Valid	Indicates whether the measured position is valid. The port value is also relevant for the measured revolutions. The validity check includes the following information: ▪ Transmission error: A transmission error occurs if a data inconsistency was detected twice for two successive read operations. A single detected inconsistency is tolerated. A transmission error occurs only if **Verify transmission data** is set on the **Advanced** page. ▪ Connection error: No absolute encoder is connected to the SSI interface, or the connected encoder does not respond in time. The recognition of a connection error depends on the specified synchronization mode: ▪ Transmission synchronization disabled (the Clock signal is continuously driven) After a data transmission has been completed by generating the last falling edge of the Clock signal, the specified waiting time must be awaited by the SSI interface before the idle state of the data line is actively observed. If the waiting time is exceeded without detecting an idle state, a connection error is assumed.

Port	Description
	▪ Transmission synchronization enabled (the Clock signal is event-triggered) The trigger is ignored and the idle state of the data line is only observed, when the specified event occurs. If there is no idle state detected at this time, a connection error is assumed. Range: 0, 1 ▪ 0: The measured value is not valid. ▪ 1: The measured value is valid. Data type: Boolean
Transm. Bitstream	Provides the entire transmission bitstream as a set of bytes with the most significant bit first. It contains the position data and additional information if available. Range: 0 … 255 Width: Roundup (**Bitstream width** / 8) Data type: UInt8 The **Transm. Bitstream** outport is available only if **Specify total number of transm. bits** is set on the **Parameters** page, and **Enable Transm. Bitstream outport** is set on the **Advanced** page.
Com. Status	Provides the communication error information of the SSI interface. This information describes the reason for an invalid measurement. The outport consists of two signals: ▪ Signal 1 represents the transmission error status indicating a data inconsistency. This error status can only be expected if **Verify transmission data** is set, otherwise it outputs 0. ▪ Signal 2 represents a connection error status indicating a timeout for the communication between the SSI encoder and the SSI interface. The recognition of a connection error depends on the specified synchronization mode, see the description of the **Meas. Valid** port. Range: 0, 1 Width: 2 Data type: Boolean The **Com. Status** outport is available only if **Enable Com. Status outport** is set on the **Advanced** page.
Transmission Error Count	Provides the value of the transmission error counter. The counter is incremented every time a data inconsistency of the transmitted position information is detected. Range: 0 … 65535 Data type: UInt32 The **Transmission Error Count** outport is available only if **Verify Transmission data** and **Enable Transm. Error Count outport** are set on the Advanced page.

Dialog pages

The dialog settings can be specified on the following pages:

- Unit page (refer to Unit Page (EMC_SSI_BLx) on page 83)
- Parameters page (refer to Parameters Page (EMC_SSI_BLx) on page 84)
- Advanced page (refer to Advanced Page (EMC_SSI_BLx) on page 86)

Related RTLib functions

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

- SSI Interface (MicroLabBox RTLib Reference 🕮)

Unit Page (EMC_SSI_BLx)

Purpose

To specify the channels used by the absolute encoder connected to the SSI interface.

Description

This block lets you access an absolute encoder connected to the SSI interface. Each interface requires two subsequent channels for the *Clock* and the *Data* signals.

For more information on the signal characteristics of an absolute SSI encoder, refer to SSI Interface (MicroLabBox Features 🕮).

Dialog settings

Unit number Lets you select a unique unit number for the SSI interface in the range 1 … 2.

Channel number Lets you select the first of the channel numbers that are used for the absolute encoder signals in the range 1 … 11. The first channel is used for the *Clock* output signal and the second for the *Data* input signal.

Note

Concurrent access to the same channels by other blocks or functions is not allowed.

Signal connector pin Displays the range of signal connector pins for the selected channels.

Signal Type	Pin Assignment	
	Pin	**Signal**
Differential signals	DIO2 ch<n>	*Clock*, non-inverted signal
	DIO2 ch<n+1>	*Data*, non-inverted signal

Reference connector pin Displays the range of reference connector pins for the selected channels.

Signal Type	Signal mapping	
	Pin	**Signal**
Differential signals	$\overline{\text{DIO2 ch<n>}}$	*Clock*, inverted signal
	$\overline{\text{DIO2 ch<n+1>}}$	*Data*, inverted signal

Related topics

References

Parameters Page (EMC_SSI_BLx)

Purpose

To configure the SSI interface for the absolute encoder to be connected.

Description

The settings of the SSI interface let you adapt the interface to the specification of the connected absolute encoder. For example, you can configure the encoder type, the width of the serial bitstream, and the clock frequency.

Dialog settings

Channel Displays the range of channels that you selected on the Unit page.

Encoder type Lets you select the type of the absolute encoder connected to the SSI interface.

Encoder Type	Meaning
Single-turn encoder	For single-turn encoders, the following settings are available: ▪ Resolution per revolution ▪ Specify real number of positions per revolution ▪ Desired frequency
Multi-turn encoder	For multi-turn encoders, the following setting is additionally available: ▪ Resolution of revolution counter By default, the Specify real number of positions per revolutions setting is disabled for multi-turn encoders.

Resolution per revolution Lets you specify the number of bits used for providing a measured value of a specific angular position within one revolution in the range 1 … 28.

For multi-turn encoders, the number of positions per revolution is implicitly defined by this setting.

Specify real number of positions per revolution Lets you specify the number of positions the encoder is detecting for one revolution. Usually, the maximum number depends on the Resolution per revolution value and is

$2^{ResolutionPerRevolution}$. You have to enable this setting if the connected single-turn encoder does not support the full range of the encoder's position resolution.

This setting is enabled only if **Single-turn encoder** is set.

Resolution of revolution counter Lets you specify the number of bits used for providing the number of the current revolution in the range 1 … 28. This implicitly defines the maximum number of revolutions the encoder is able to count.

This setting is enabled only if **Multi-turn encoder** is set.

Coding type Lets you specify the coding scheme of the revolution and position data supported by the connected encoder.

Coding Type	Meaning
Gray code	The revolution and position data received from your SSI encoder is interpreted as Gray coded.
Binary code	The revolution and position data received from your SSI encoder is interpreted as binary coded.

Waiting time Lets you specify the waiting time for the clock signal generation in the range 5 µs … 1.0 s in steps of 10 ns.

After a complete serial transmission, the clock signal must pause to let the SSI sensor acquire the next position information. If such a timing pause between two subsequent transmissions has not been ensured, the SSI encoder will not update the position data.

In case of continuous clock signal driving (transmission synchronization disabled) or event-triggered clock signal driving (transmission synchronization enabled), the connection error is assumed when no idle state of the data line is detected after the specified waiting time is exceeded.

Specify total number of transm. bits Lets you specify the size of the serial bitstream providing the position data and additional information transmitted by the connected SSI encoder.

Bitstream width Lets you specify the whole width of the serial bitstream per transmission.

The range depends on the encoder type:

- Single-turn encoder: **Resolution per revolution** … 64 bit
- Multi-turn encoder: (**Resolution per revolution** + **Resolution of revolution counter**) … 64 bit

You have to explicitly specify the bitstream width if the bitstream contains not only the position data but also additional information, such as a parity bit or a CRC checksum. The specified value determines the number of rising edges of the clock signal that the SSI interface has to generate for fetching the entire serial bitstream of the connected encoder.

Index of position first bit Lets you specify the index of the first bit of the position data within the serial bitstream if you set **Specify total number of transm. bits**. If you use a single-turn encoder, this is the first bit of the angular position. If you use a multi-turn encoder, this is the first bit of the revolution number.

The maximum value range for this parameter depends on the encoder type:

- Single-turn encoder:

  1 … (**Bitstream width** - **Resolution per revolution**) + 1

- Multi-turn encoder:

  1 … (**Bitstream width** - (**Resolution per revolution** + **Resolution of revolution counter**) + 1

Desired frequency Lets you specify the desired frequency of the clock signal of the SSI interface in the range 100 … 2.000 kHz.

The actual frequency, which might differ from the specified frequency, is displayed in the Message Viewer. For information on how the actual frequency is calculated, refer to SSI Interface (MicroLabBox Features 🕮).

Refer to the encoder specification for information about the supported maximum clock frequency and the recommended maximum cable length, which depends on the clock frequency.

Related topics

References

Advanced Page (EMC_SSI_BLx)

Purpose

To specify additional options, such as event and outport settings.

Dialog settings

Channel Displays the range of channels that you selected on the **Unit** page.

Enable transmission synchronization Lets you enable the synchronization mode of the SSI interface. If selected, the transmission of the measured data is started if an event on the specified trigger line occurred. If you do not select the synchronization mode, data transmission is continuous.

Trigger line Lets you specify the trigger line the SSI interface has to listen to for synchronizing the data transmission.

The setting is enabled if **Enable transmission synchronization** is set.

Position offset Lets you specify the offset angle for the measured angular position in degrees in the range -359.9945° … +359.9945° with a resolution of 0.0055°.

Reverse direction Lets you specify whether to reverse the direction of the rotation in the SSI interface.

With no reversing, the forward rotation is assumed to be the clockwise rotation (with the front view of the motor shaft). If you have activated reversing, the clockwise rotation is measured as backward rotation.

This setting is useful if it is required to install the absolute encoder in inverse orientation.

Verify transmission data Lets you specify to activate the verification of the encoder transmission data.

If this option is set, the SSI interface checks the transmitted data for data inconsistencies. If you set Enable Com. Status outport, the result is returned by the port's first signal.

If this setting is cleared, the enabled Com. Status output port is always set to 0.

Note

- It is recommended to use this option for encoders that do not provide additional information for verification purposes, such as parity bit or CRC checksum.
- The transmission time doubles with activated data verification.
- The connected encoder must be able to transmit the same position data twice.

Enable Transm. Bitstream outport Lets you enable the Transm. Bitstream output port if Specify total number of transm. bits is set on the Parameters page.

Enable Com. Status outport Lets you enable the Com. Status output port.

Enable Transm. Error Count outport Lets you enable the Transm. Error Count output port if Verify Transmission data is set.

Related topics

References

Block Description (EMC_SSI_BLx) 80
Parameters Page (EMC_SSI_BLx) 84
Unit Page (EMC_SSI_BLx) 83