BECKHOFF New Automation Technology

Documentation | EN

TwinSAFE Logic FB

TwinCAT function blocks for TwinSAFE logic components

2025-12-03 | Version: 4.3.0

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1 Notes on the documentation

1.1 Disclaimer

Beckhoff products are subject to continuous further development. We reserve the right to revise the documentation at any time and without notice. No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams, and descriptions in this documentation.

In this documentation, we define all permissible use cases whose properties and operating conditions we can guarantee. The use cases we define are fully tested and certified. Any other use cases not described in this documentation, require the approval of Beckhoff Automation GmbH & Co KG.

1.1.1 Trademarks

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1.1.2 Limitation of liability

All components in this product as described in the operating instructions are delivered in a specific configuration of hardware and software, depending on the application regulations. Modifications and changes to the hardware and/or software configuration that go beyond the documented options are prohibited and nullify the liability of Beckhoff Automation GmbH & Co. KG.

The following is excluded from the liability:

- Failure to observe these operating instructions
- Improper use
- Use of untrained personnel
- Use of unauthorized spare parts

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1.1.4 Third-party trademarks

Trademarks of third parties may be used in this documentation. You can find the trademark notices here: https://www.beckhoff.com/trademarks.

1.2 Documentation issue status

Version	Comment
4.3.0	• IFA report added in chapter “References” • New chapter “Safe drive control” • Configuration chapter renamed • Appendix removed
4.2.0	• Corrections in the chapters "Description of the signals", offset values removed • Minor corrections • Chapter "References" corrected • Editorially revised • Function blocks added: ◦ safeCAM ◦ safeLookUpTable ◦ safeSequence
4.1.0	• Function blocks added: ◦ SLI2 ◦ SLP ◦ SBT ◦ ADVPOSMON • Chapter "References" added • Chapter "Function block COUNTER" revised • Editorially revised • Offset values added
4.0.0	• Migration
3.3.0	• FB TON / FB TON2 – extension of the time base
3.2.0	• Texts rendered more precisely • Restart behavior for ESTOP, OPMODE and MON described in detail • FB XOR added • FB TON2 added (saving of timer value) • Document title changed • Note texts updated according to IEC 82079-1 • FB status descriptions amended • Note on FB versions (BLG) added • FB SLI input types changed and *PositionDiff* data types corrected
3.1.0	• Function block Connection Shutdown extended with RUN state • Table 2-6 extended with status 106
3.0.0	• Extension with function blocks of EL6910 / EJ6910 / EK1960 • Change FB: EStop, Mon, Muting, TON and TOF • Adding FB: Add, Sub, Mul, Div, Compare, Limit, Counter, Scale, Speed, LoadSensing, CamMonitor, SLI, Envelope and ViolationCounter • Description of info data added under TC3 • Representation in TwinCAT 3 added for all FBs • TwinSAFE group description extended
2.4.1	• Markings removed
2.4.0	• Company address changed
2.3.0	• Document origin and versions added

Version	Comment
	• EDM extended with standard In • MUTING status+information extended • TwoHand diagnostic information extended
2.2.0	• TwinSAFE Connection info data extended • FB ESTOP info data extended
2.1.0	• FB OPMODE description extended • Service/support information modified
2.0.0	• EL6900 function blocks added
1.1.1	• Corrections during the translation into English
1.1.0	• Adaptations in the application examples
1.0.0	• First released version

Currentness

Check whether you are using the current and valid version of this document. The current version can be downloaded from the Beckhoff homepage at http://www.beckhoff.com/twinsafe. In case of doubt, contact Support and Service.

Origin of the document

This original documentation is written in German. All other languages are derived from the German original.

Product features

The valid product properties are always those specified in the current manual. Further information given on the product pages of the Beckhoff homepage, in emails or in other publications is not authoritative.

1.3 References

In addition to these operating instructions, the following documents form part of the overall documentation, with the exception of the machinery directive:

No.	Issue	Title / description
[1]	4/2018	**Safe drive controls with frequency inverters (IFA Report 4/2018)** The IFA report addresses the use of drive control equipment that implements safety sub-functions at a certain Performance Level according to ISO 13849-1 in consideration of the application and risks. The basic safety sub-functions of drive controls and the requirements for their application are presented. The principles of operation of frequency inverters and DC converters are described, and implementation of the safety sub-functions are explained.
[2]	/	Not used.
[3]	1.4.1 or newer	**Operating instructions for EL6910 TwinSAFE Logic module** The document contains a description of the logic functions of the EL6910.
[4]	/	Not used.
[5]	3.3.0 or newer	**TwinSAFE Application Guide** The Application Guide provides the user with examples for the calculation of safety parameters for safety functions according to the standards DIN EN ISO 13849-1 and EN 62061 or EN 61508:2010, such as are typically used on machines.
[6]	2023/1230	**Regulation (EU) 2023/1230 of the European Parliament and of the Council of June 14, 2023 on machinery and repealing Directive 2006/42/EC of the European Parliament and of the Council and Council Directive 73/361/EEC**

No.	Issue	Title / description
		This regulation, also known as the Machinery Regulation, defines requirements for the placing on the market of machines and machine-like components, such as safety components.
[7]	2017	**EN 61511-1:2017** The standard serves as a basic safety standard for functional safety in the process industry and is tailored to its safety-related systems.

1.4 Staff qualification

These operating instructions are intended exclusively for trained specialists in control technology and automation with the relevant knowledge.

The trained specialist personnel must ensure that the applications and use of the described product meet all safety requirements. This includes all applicable and valid laws, regulations, provisions and standards.

Trained specialists

Trained specialists have extensive technical knowledge from studies, apprenticeships or technical training. Understanding of control technology and automation is available. Trained specialists can:

- Independently identify, avoid and eliminate sources of hazard.
- Apply relevant standards and directives.
- Implement specifications from accident prevention regulations.
- Evaluate, prepare and set up the workplaces.
- Evaluate, optimize and execute work independently.

1.5 Safety and instruction

Read the contents that refer to the activities you have to perform with the product. Always read the chapter For your safety in the operating instructions.

Observe the warnings in the chapters so that you can handle and work with the product as intended and safely.

Explanation of symbols

Various symbols are used for a clear arrangement:

1. The numbering indicates an action that should be taken.
- The bullet point indicates an enumeration.

[…] The square brackets indicate cross-references to other text passages in the document.

[1] The number in square brackets indicates the numbering of a referenced document.

The signal words used in the documentation are classified below.

Signal words

Warning of personal injuries

⚠ DANGER

Hazard with high risk of death or serious injury.

⚠ WARNING

Hazard with medium risk of death or serious injury.

⚠ CAUTION

There is a low-risk hazard that could result in medium or minor injury.

Warning of damage to property or environment

NOTICE

Notes

The environment, equipment, or data may be damaged.

Information on handling the product

This information includes, for example:
Recommendations for action, assistance or further information on the product.

1.6 Beckhoff Support and Service

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Hotline:	+49 5246/963-460
E-mail:	service@beckhoff.com
Web:	www.beckhoff.com/service

Download area

In the download area you can obtain product information, software updates, the TwinCAT automation software, documentation and much more.

Web:	www.beckhoff.com/download

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1.7 Notes on information security

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In addition, the recommendations from Beckhoff regarding appropriate protective measures should be observed. Further information regarding information security and industrial security can be found in our https://www.beckhoff.com/secguide.

Beckhoff products and solutions undergo continuous further development. This also applies to security functions. In light of this continuous further development, Beckhoff expressly recommends that the products are kept up to date at all times and that updates are installed for the products once they have been made available. Using outdated or unsupported product versions can increase the risk of cyber threats.

To stay informed about information security for Beckhoff products, subscribe to the RSS feed at https://www.beckhoff.com/secinfo.

2 For your safety

2.1 Duty of care

Read the entire documentation for the TwinSAFE component

- TwinSAFE Application Guide
- Operating instructions for EL6910 TwinSAFE Logic Terminal

The operator must comply with all the requirements and instructions specified in this documentation in order to fulfill his duty of care. This includes in particular that you

- comply with the provisions defined in the chapter Limitation of liability [▶ 9].
- only operate the TwinSAFE component when it is in perfect working order.
- provide the operating instructions in a legible condition and complete at the place of use of the TwinSAFE component.
- do not remove the safety markings attached to the TwinSAFE component and maintain their legibility.

No disposal in domestic waste
Products marked with a crossed-out waste bin must not be disposed of with domestic waste. The device is considered waste electrical and electronic equipment when it is disposed of. Observe the national regulations for the disposal of waste electrical and electronic equipment.

3 System description

The TwinSAFE system consists of safe inputs, safe outputs and logic modules. The TwinSAFE logic contains function blocks that are parameterized and linked to each other and that form the safety-related logic. Free programming is not possible. In addition to the non-safety-related logic configuration a fieldbus configuration is required for mapping the TwinSAFE data packets. These functions are realized via the TwinCAT System Manager or TwinCAT 3. The safety-relevant TwinSAFE Verifier or TwinCAT 3 loads the TwinSAFE project onto the logic module and checks the project.

The TwinSAFE Logic Terminal can communicate, via the fieldbus-independent and certified TwinSAFE protocol with safe input and output terminals, and also via further logic terminals. The TwinSAFE protocol is the Safety-over-EtherCAT (FSoE) protocol, as disclosed in the EtherCAT Technology Group. For more information please visit www.ethercat.org.

3.1 TwinSAFE Logic Terminals

The configuration of a TwinSAFE Logic Terminal consists of function blocks and connections that are consolidated into one or several TwinSAFE groups. TwinSAFE groups can be started and stopped independently of each other.

Execution order in TwinCAT 3

The execution order of the function blocks corresponds to the order displayed in the project tree in TwinCAT 3 Editor. The execution order of the function blocks in TwinCAT 3 can be changed in the properties of each function block. It is additionally displayed in the upper right corner of the function block diagram. There must be no gaps in the numbering of the execution order.

The function blocks have parameters that you can define for specific applications.

You assign the inputs and outputs of the function blocks to

- the inputs and outputs of TwinSAFE Terminals,
- the inputs and outputs of other function blocks or
- the input variables and output variables of the standard PLC.

A TwinSAFE connection is the unique assignment of a TwinSAFE device to a TwinSAFE group. Only the function blocks belonging to this TwinSAFE group can be linked to the inputs and outputs of an assigned TwinSAFE connection. If additional groups are to access the inputs and outputs, you can use the function block DECOUPLE.

Errors of the TwinSAFE communication within the TwinSAFE group and errors within a function block affect the complete TwinSAFE group. The TwinSAFE group stops all associated function blocks, which then switch their outputs into a safe state (FALSE). Errors in the TwinSAFE Logic lead to the entire TwinSAFE Logic being switched off.

3.1.1 TwinSAFE group

The function blocks are assigned to a TwinSAFE group. All outputs of the group adopt a safe state in the following situations:

- communication error in an assigned TwinSAFE connection,
- error in an assigned function block (e.g. a discrepancy timeout) or
- error in the assigned local outputs.

The safe state is always the non-energized state at the output, which corresponds to logical 0. The data of a TwinSAFE connection (and therefore of a TwinSAFE input terminal or TwinSAFE output terminal) are always assigned to exactly one TwinSAFE group.

A communication error is indicated by the output *ComErr* of the TwinSAFE group and acknowledged via the input *ErrAck*. A function block error is displayed on the output *FbErr* and acknowledged on the same input *ErrAck* as the communication error. An error on the local outputs (only KL6904) is displayed on the third output *OutErr* and once again acknowledged by the same input *ErrAck*. The safe state of the TwinSAFE group outputs is removed once the error is no longer present and has been acknowledged.

In addition, the TwinSAFE group has an input *Run*, which can be used to start and stop the processing of the assigned function blocks. All TwinSAFE group assigned outputs are in a safe state when stopped. For the EL6910 and newer logics the input *Run* must always be linked with a standard signal.

NOTICE

Run and _ErrAck_ of the TwinSAFE group

The error acknowledgement is not automatic, i.e. the input *ErrAck* must always be linked with a standard signal.

For the EL6910 and newer logics, the input *Run* must also always be linked with a standard signal.

3.1.1.1 Inputs and outputs of the TwinSAFE group EL6900/KL6904

Inputs of the TwinSAFE group

Name	Permitted type	Description
RUN	FB-Out Standard-In	TRUE: The function blocks assigned to the TwinSAFE group are executed. FALSE: All function blocks assigned to the TwinSAFE group are in the STOP state and all associated outputs are in the safe state. If the input is not linked, it is in the TRUE state.
ERR ACK	FB-Out Standard-In	All errors in the assigned function blocks and the TwinSAFE connections are acknowledged with the signal sequence FALSE □ TRUE □ FALSE.

Outputs of the TwinSAFE group

Name	Permitted type	Description
FB ERR	TwinSAFE-Out FB-In Standard-Out Local-Out	TRUE: At least one assigned function block has an error. FALSE: All assigned function blocks have no errors.
COM ERR	TwinSAFE-Out FB-In Standard-Out Local-Out	TRUE: At least one TwinSAFE connection of TwinSAFE group has an error. FALSE: All TwinSAFE connections of the TwinSAFE group have no errors.
OUT ERR	TwinSAFE-Out FB-In Standard-Out Local-Out	TRUE: At least one locally assigned output of the TwinSAFE group has an error. FALSE: All local outputs assigned to the TwinSAFE group have no error. This only applies to TwinSAFE components that have local outputs.

3.1.1.2 Inputs and outputs of the TwinSAFE group of the EL6910/EJ6910

The EL6910 offers additional inputs and outputs of the TwinSAFE group. This typically also applies to TwinSAFE components that are based on the logic of the EL6910, such as the EK1960.

Inputs and outputs of the TwinSAFE group EL6910/EJ6910

Group Port	Direction	Description
Err Ack	IN	Error Acknowledge for errors within the group - the signal must be linked to a standard variable

Group Port	Direction	Description
Run/Stop	IN	1 - Run; 0 - Stop - Signal must be linked with a standard variable
Module Fault	IN	Input for an error output of another used module, e.g. with EK1960
Com Err	OUT	Communication error in at least one connection
FB Err	OUT	Error at one or more of the FBs used
Out Err	OUT	not used
Other Err	OUT	ModuleFault or AnalogValueFault or WaitComTimeoutFault
Com Startup	OUT	At least one of the connections in this group is in StartUp.
FB Deactive	OUT	The group has been deactivated (see EL6910 documentation on customization, for example).
FB Run	OUT	All FBs are in the RUN state.
In Run	OUT	The TwinSAFE group is in the RUN state.

The group state and diagnostics (see Group info data [▶ 29]) can be loaded via the group properties in the cyclic process image. The following tables show the possible values.

3.1.2 TwinSAFE connection

Each safe communication path between the TwinSAFE Logic and TwinSAFE inputs, TwinSAFE outputs or other TwinSAFE Logic Terminals are referred to as TwinSAFE connection.

A communication partner is thus always the TwinSAFE master, the other the TwinSAFE slave. The TwinSAFE Logic is always the TwinSAFE master in a TwinSAFE connection to a TwinSAFE input or TwinSAFE output. In the TwinSAFE connection to another TwinSAFE Logic it may be a TwinSAFE slave. This assignment is automatically specified by the TwinCAT System Manager, although it can also be defined by the user.

Both the TwinSAFE master and the TwinSAFE slave have a FSoE address (Safety-over-EtherCAT) that can be set on the respective TwinSAFE terminal via a DIP switch in order to ensure that any mix-up of the TwinSAFE data packets is always detected. These FSoE addresses are checked within the TwinSAFE communication and must be unambiguous in the control system. The TwinSAFE Verifier for each TwinSAFE logic terminal checks that.

If there are several TwinSAFE logic terminals in the control system, the user must ensure that FSoE addresses are not assigned more than once. The TwinSAFE verifier can only check one TwinSAFE logic terminal.

NOTICE

FSoE addresses not assigned more than once

Ensure that unique FSoE addresses are assigned within a configuration.

For each TwinSAFE connection a watchdog time and the corresponding FSoE address for the communication devices must be set. TwinCAT 2 offers the option of setting a SIL level, however this setting is not supported at the moment and has no effects on the safety behavior of the system. In another configuration option a module error (Hardware error or diagnostic message) in the TwinSAFE communication partner can be set to trigger a communication error in the TwinSAFE group.

The EL6910/EJ6910 support activation of a ComErrAck at each connection. If this signal is connected, the respective connection must be reset after a communication error via the signal ComErrAck, in addition to the ErrAck of the TwinSAFE group.

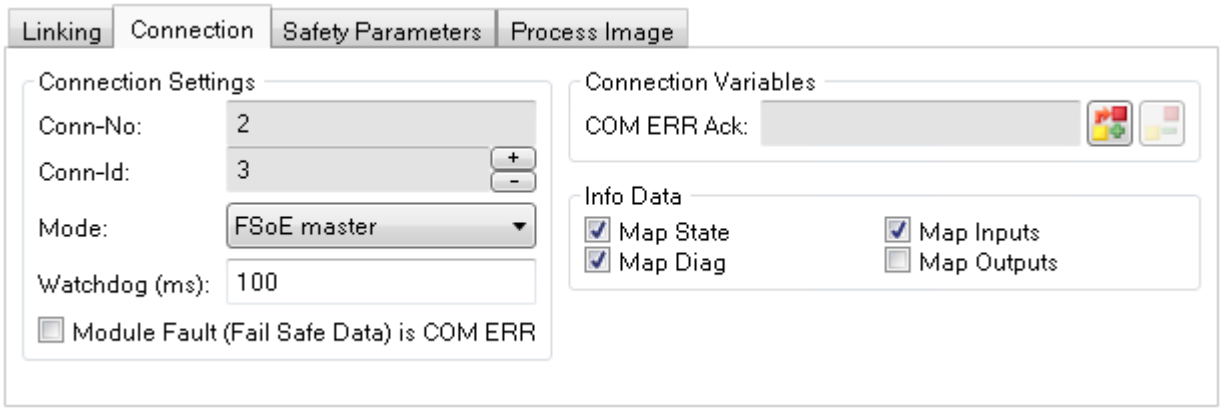

Fig. 1: Connection

3.2 System diagnosis

The states of the TwinSAFE groups, FBs and connections can be checked online in the System Manager. The diagnostic information can be copied into the cyclic process image.

TwinSAFE groups have inputs and outputs that can be assigned offline and viewed online, as illustrated below.

If the checkboxes or the properties ‘Map State’ and ‘Map Diag’ are set, the state and diagnostic data for the group are copied into the cyclic process image and can be linked directly with PLC variables.

The EL6910/EJ6910 additionally reports events in a diag history. It contains events with timestamps. The user can configure which data are to be stored in the history.

NOTICE

KL6904

With the KL6904 copying of the diagnostic information to the cyclic process image is only possible to a limited extent. The checkboxes ‘Map State’ and ‘Map Diag’ are not available.

3.2.1 Diagram showing EL6900/KL6904 diagnostics under TwinCAT 2

3.2.1.1 TwinSAFE group diagnostics

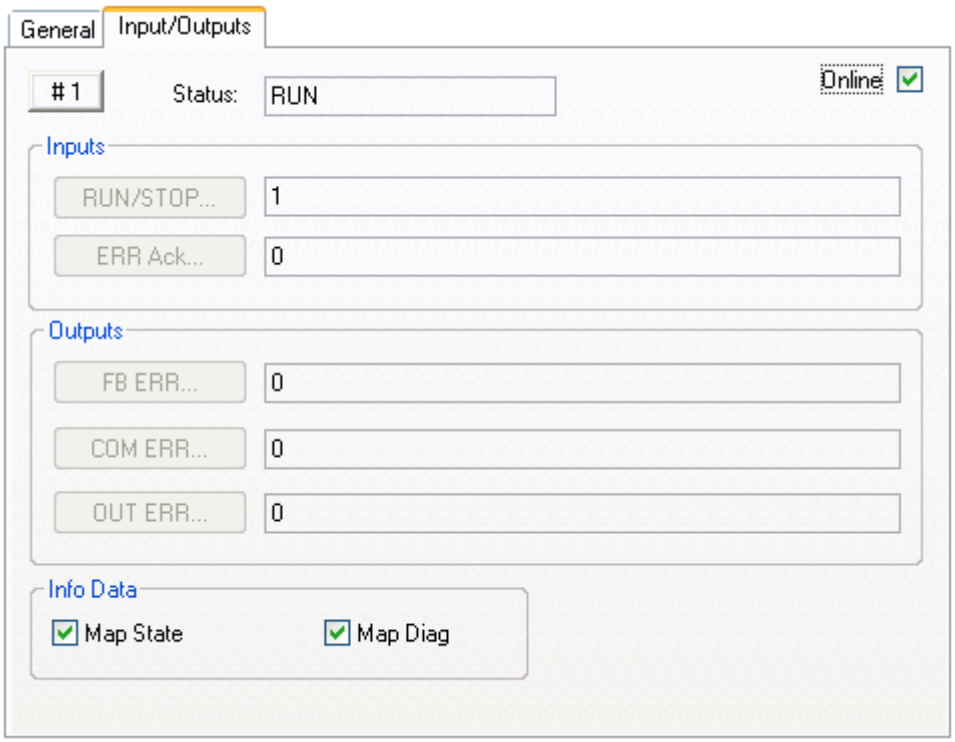

Fig. 2: TwinSAFE group inputs/outputs (online)

Status information KL6904/EL6900

Value	Status	Description
1	RUN	All function blocks and TwinSAFE connections assigned to the TwinSAFE group operate properly, and all TwinSAFE connections assigned to the TwinSAFE group are up and running.
2	STOP	State after initialization
3	SAFE	All function blocks and TwinSAFE connections assigned to the TwinSAFE group operate properly, and at least one of the TwinSAFE connections assigned to the TwinSAFE group is not yet up and running.
4	ERROR	At least one assigned function block or one assigned TwinSAFE connection has reported an error.
5	RESET	A positive edge (FALSE->TRUE) for acknowledgement of a function block or a TwinSAFE connection error was detected on the ERR_ACK input. The system is waiting for the negative edge of the ERR_ACK input.

3.2.1.2 TwinSAFE function block list diagnostics

The status of TwinSAFE FBs is displayed on online summary. The current status data are read from the EL6900/KL6904 via a manual refresh.

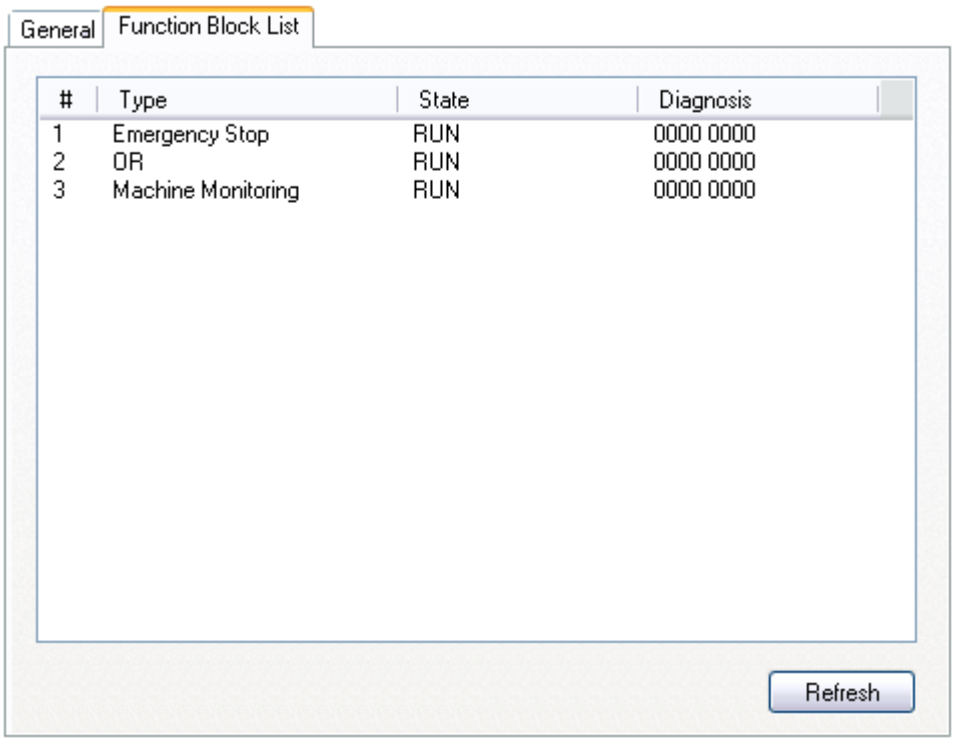

Fig. 3: Function block list online values

If the checkboxes ‘Map State’ and ‘Map Diag’ for the individual TwinSAFE FBs are set, the status and diagnostic data for the FBs are copied into the cyclic process image and can be linked directly with PLC variables. The description of the status and diagnostic values can be found under the respective FBs.

NOTICE

KL6904

With the KL6904 copying of the diagnostic information to the cyclic process image is only possible to a limited extent. The checkboxes ‘Map State’ and ‘Map Diag’ are not available.

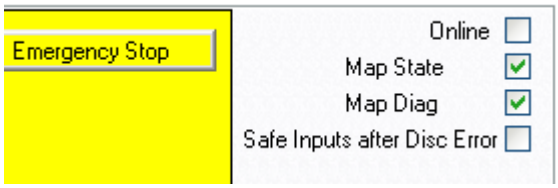

Fig. 4: Emergency Stop

3.2.1.3 TwinSAFE connection diagnostics

The TwinSAFE connections status is displayed on the TwinSAFE connection list summary under the "Connection List" tab. Diagnostics bits are also set in addition to the status.

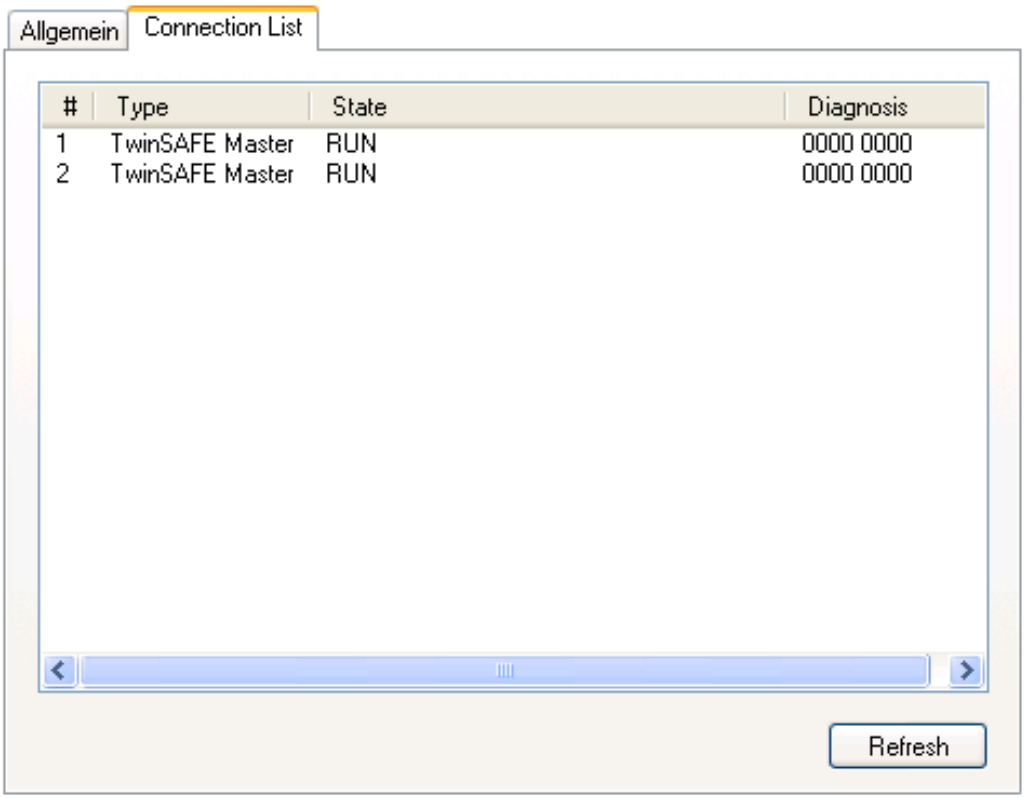

Fig. 5: Connection List

If the checkboxes ‘Map State’ and ‘Map Diag’ for the individual TwinSAFE connections are set, the status and diagnostic data for the connections are copied into the cyclic process image and can be linked directly with PLC variables. In addition, the safe inputs and outputs can be copied into the cyclic process image and used for diagnostic purposes.

NOTICE

KL6904

With the KL6904 copying of the diagnostic information to the cyclic process image is only possible to a limited extent. The checkboxes ‘Map State’, ‘Map Diag’, ‘Map Inputs’ and ‘Map Outputs’ are not available. The button “Com Err Ack” is also not available.

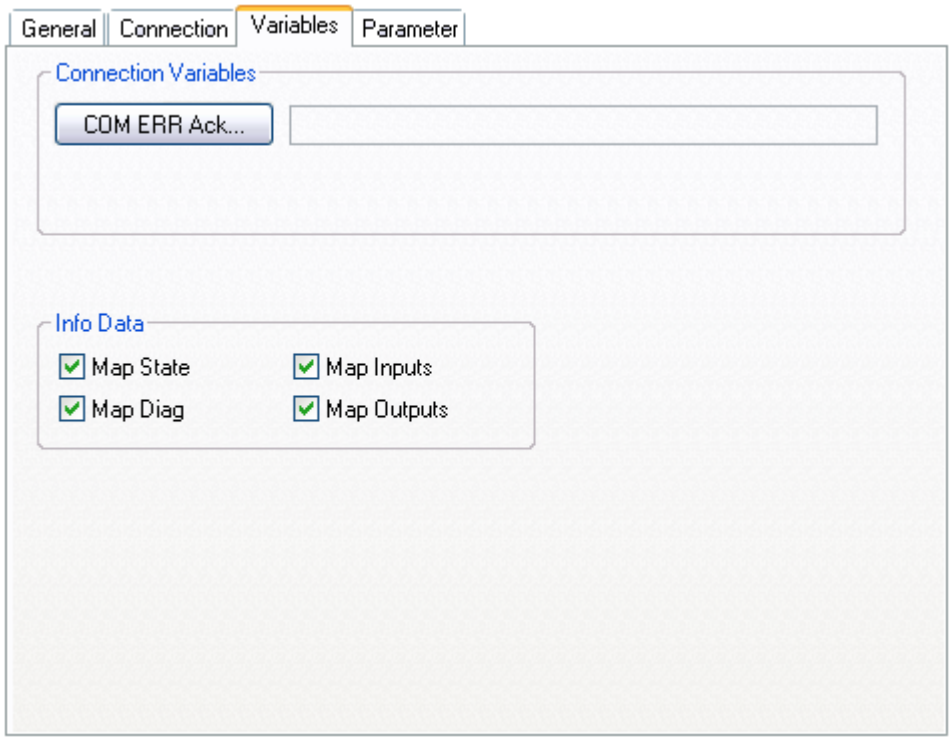

Fig. 6: Variables tab (connection)

Diagnostic information for a connection

Value	Description
xxxx 0001	Invalid command
xxxx 0010	Unknown command
xxxx 0011	Invalid connection ID
xxxx 0100	Invalid CRC
xxxx 0101	Watchdog time elapsed
xxxx 0110	Invalid FSoE address
xxxx 0111	Invalid data
xxxx 1000	Invalid communication parameter length
xxxx 1001	Invalid communication parameters
xxxx 1010	Invalid user parameter length
xxxx 1011	Invalid user parameters
xxxx 1100	FSoE master reset
xxxx 1101	Module error detected on slave, with option "Module error is ComError" activated
xxxx 1110	Module error detected on EL290x, with option "Error acknowledge active" activated
xxxx 1111	Slave not yet started, or unexpected error argument
xxx1 xxxx	FSoE slave error detected
xx1x xxxx	FSoE slave reports Failsafe Value active
x1xx xxxx	StartUp
1xxx xxxx	FSoE master reports Failsafe Value active

Status information for a connection

Value	Description
100 (0x64)	Reset state: The Reset state is used to reinitialize the FSoE connection after power-on or an FSoE communication error.
101 (0x65)	Session state:

Value	Description
	During the transition to or in the Session state, a session ID is transferred from the FSoE master to the FSoE slave, which in turn responds with its own session ID.
102 (0x66)	Connection state: In the Connection state, a connection ID is transferred from the FSoE master to the FSoE slave.
103 (0x67)	Parameter state: In Parameter state safe communication parameters and device-specific application parameters are transferred.
104 (0x68)	Data state: In the Data state, FSoE cycles are transmitted until either a communication error occurs or an FSoE node is stopped locally.
105 (0x69)	Shutdown state: In the Shutdown state the connection was shut down by one of the communication partners. (EL6910 or newer: connection was shut down because a shutdown command was received)
106 (0x6A)	Shutdown-Deactive state: EL6910 or newer: Connection was shut down because the connection was shut down via the Deactivate inputs of the function block.

Further information can be found in the Safety-over-EtherCAT ETG.5100 specification.

3.2.2 Diagram showing EL69x0 diagnostics under TwinCAT 3

The diagnostics is shown in *Safety Project Online View* for the hole safety project. In the event of an error the diagnostic texts are displayed in plain text. Errors are stored in the diag history of the EL/EJ6910, from where they can be read out.

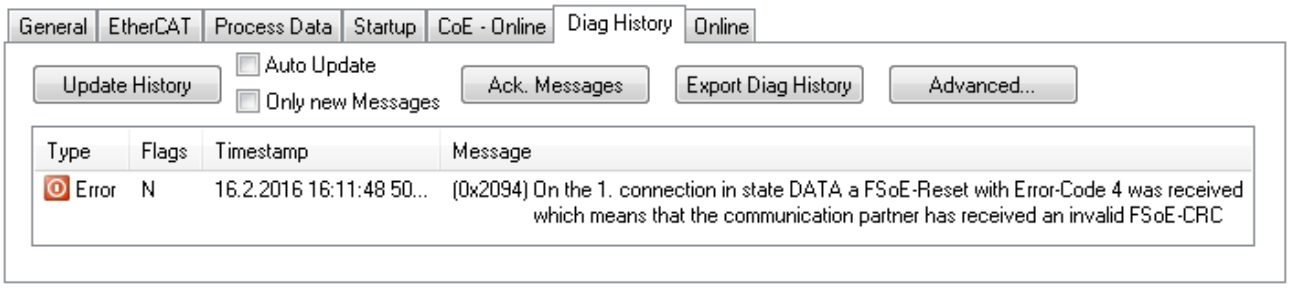

Fig. 7: Diag History of the EL6910 with a Com Error due to a false CRC

Diagnostics in the event of an error via Safety Project Online View

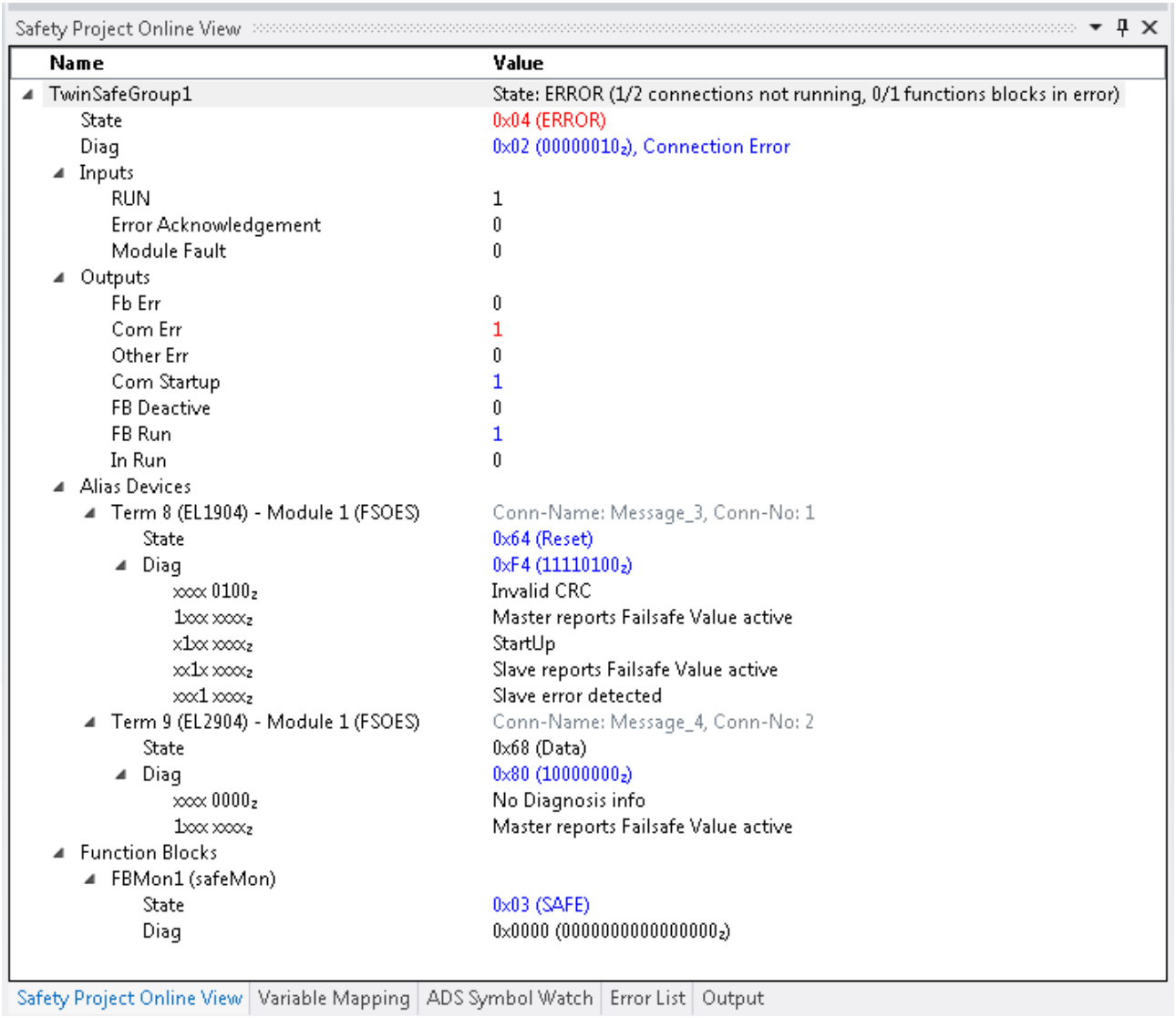

Fig. 8: Safety Project Online View

3.2.3 Info data connection

Info data for TwinSAFE / FSoE connections can be enabled on the *Connection* tab of the alias device.

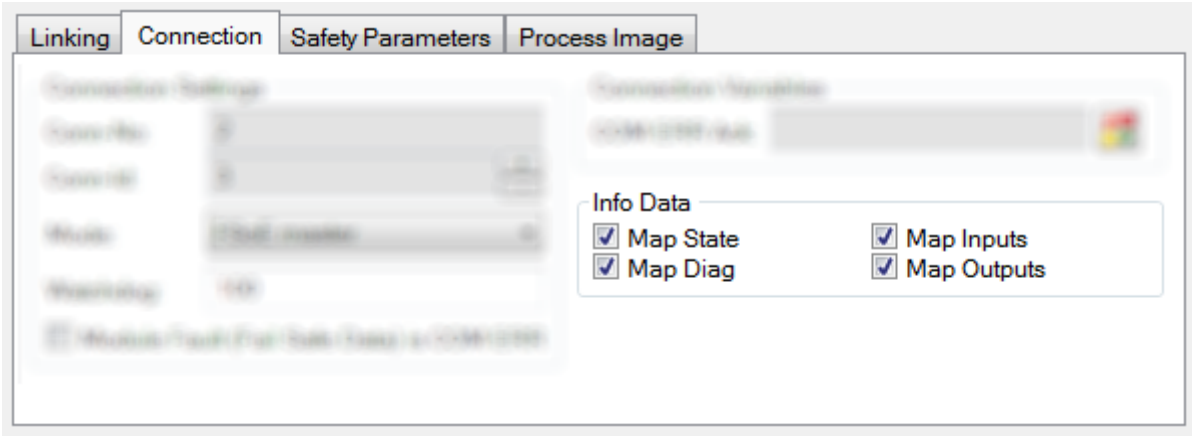

Fig. 9: Info data connection

The Info Data is shown in the I/O tree structure below the TwinSAFE logic in the process image. From here, these signals can be linked with PLC variables.

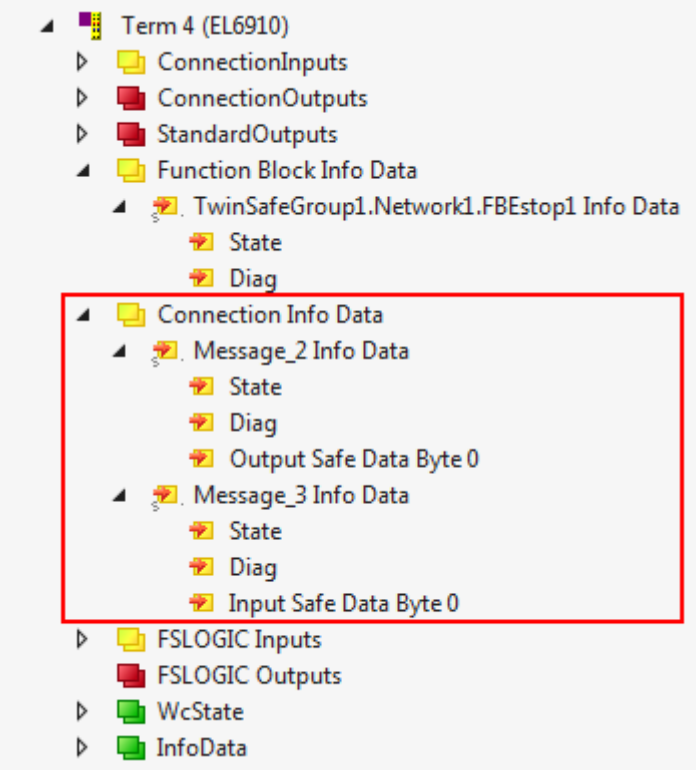

Fig. 10: Connection info data in the I/O tree structure

The status information and diagnostic information contained are identical to the previous description of TwinCAT 2.

3.2.4 Function blocks info data

Info data for function blocks can be enabled in the properties of the function block.

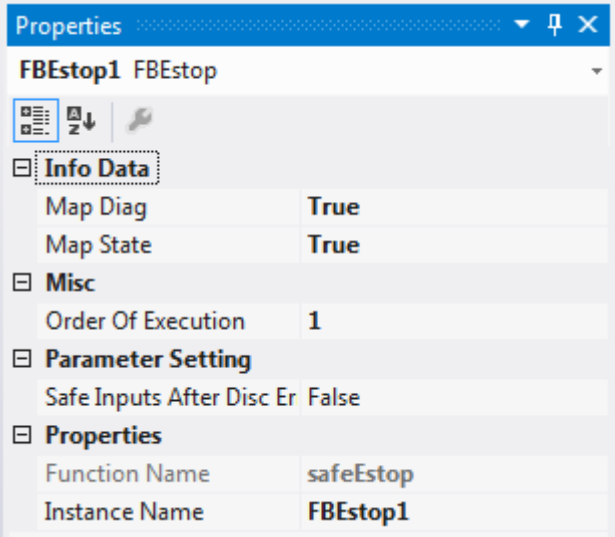

Fig. 11: Function block properties

The Info Data is shown in the I/O tree structure below the TwinSAFE logic in the process image. From here, you can link the signals with PLC variables.

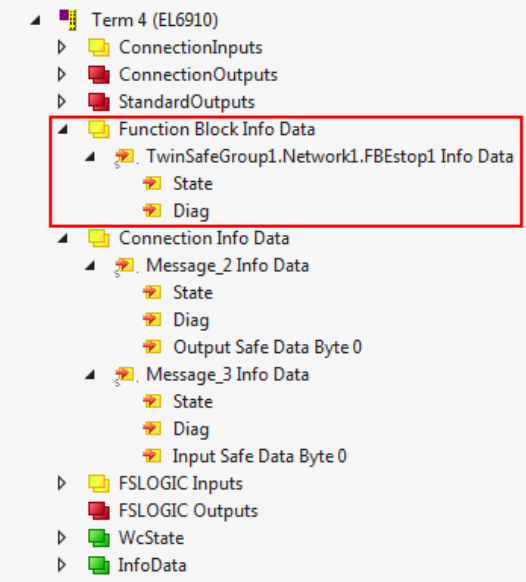

Fig. 12: Function block Info Data in the I/O tree structure

Information on status and diagnostics of the FBs can be found in the respective function block descriptions.

3.2.5 Groups info data

Info data for TwinSAFE groups can be enabled via the properties of the TwinSAFE group. Right-click in an empty area of the worksheet and select Properties to access these parameters.

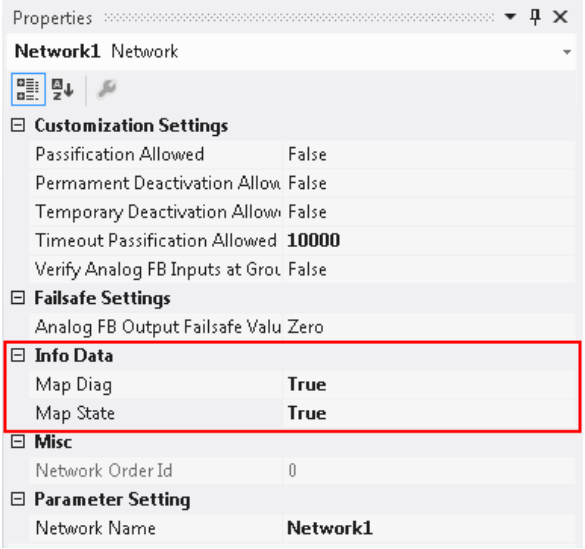

Fig. 13: Access to Info Data via Properties

The Info Data is shown in the I/O tree structure below the TwinSAFE logic in the process image. From here, these signals can be linked with PLC variables.

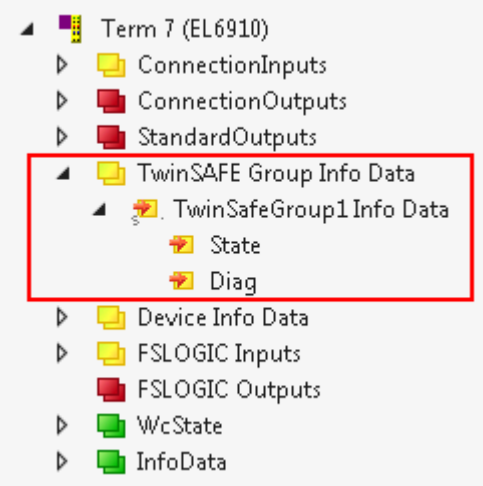

Fig. 14: TwinSAFE group Info Data in the I/O tree structure

Diagnostics information for an EL/EJ69x0 group

Value	State	Description
0	-	No error
1	FBERROR	at least one FB is in ERROR state
2	COMERROR	at least one connection is faulty
3	MODULEERROR	the input ModuleFault is 1
4	CMPERROR	On startup, at least one analog FB input deviates from the last saved value (Power-On Analog Value Check Error)
5	DEACTIVATEERROR	The timeout has elapsed while waiting for the COM error in "passivate" mode of a manual control unit
6	RESTARTERROR	The TwinSAFE logic program was restarted because the EtherCAT connection was restarted or a user logged in without reloading the TwinSAFE logic program (or parts of it).

Status information for an EL/EJ69x0 group

Value	State	Description
1	RUN	Input RUN=1, no error in the group, and all connections have started up without error
2	STOP	Input RUN = 0
4	ERROR	Group is in error, see Diagnostic information
5	RESET	After a group error has occurred, all errors have been rectified and the Err Ack signal is 1
6	START	The group remains in this state as long as not all connections have started up after the start of the group (RUN=1)
7	STOPERROR	When starting or initializing the group, the group assumes the STOPERROR state if TwinSAFE connections are assigned to the group. The group leaves the STOPERROR state to the ERROR state if the Run input is TRUE.
16	DEACTIVE	Group was deactivated via customizing
17	WAITCOMERROR	This state is set when the customizing function “Passivate” is selected and the system waits for ComError of the group

4 Function blocks

The function blocks have a fixed functionality. The function blocks can be configured via parameters or properties. The inputs or outputs of a function block can be inputs or outputs of the local process image, but outputs of function blocks can also be linked with inputs of other function blocks.

4.1 The function block AND

4.1.1 Functional description

With the FB AND several input signals can be linked via AND to one output signal. The input signal of each can be set to represent a break contact or a make contact. A make contact means that the corresponding input signal is negated, before it affects the AND.

The AndIn1 input differs from the AndIn2-AndIn8 inputs in such a way that it can also be linked with a standard input. This makes it possible to switch off a safe output using a standard signal. Outputs cannot be switched on but only released using standard signals, since at least two inputs must always be linked for FB AND (and the second input is a safe one, which prevents switching on).

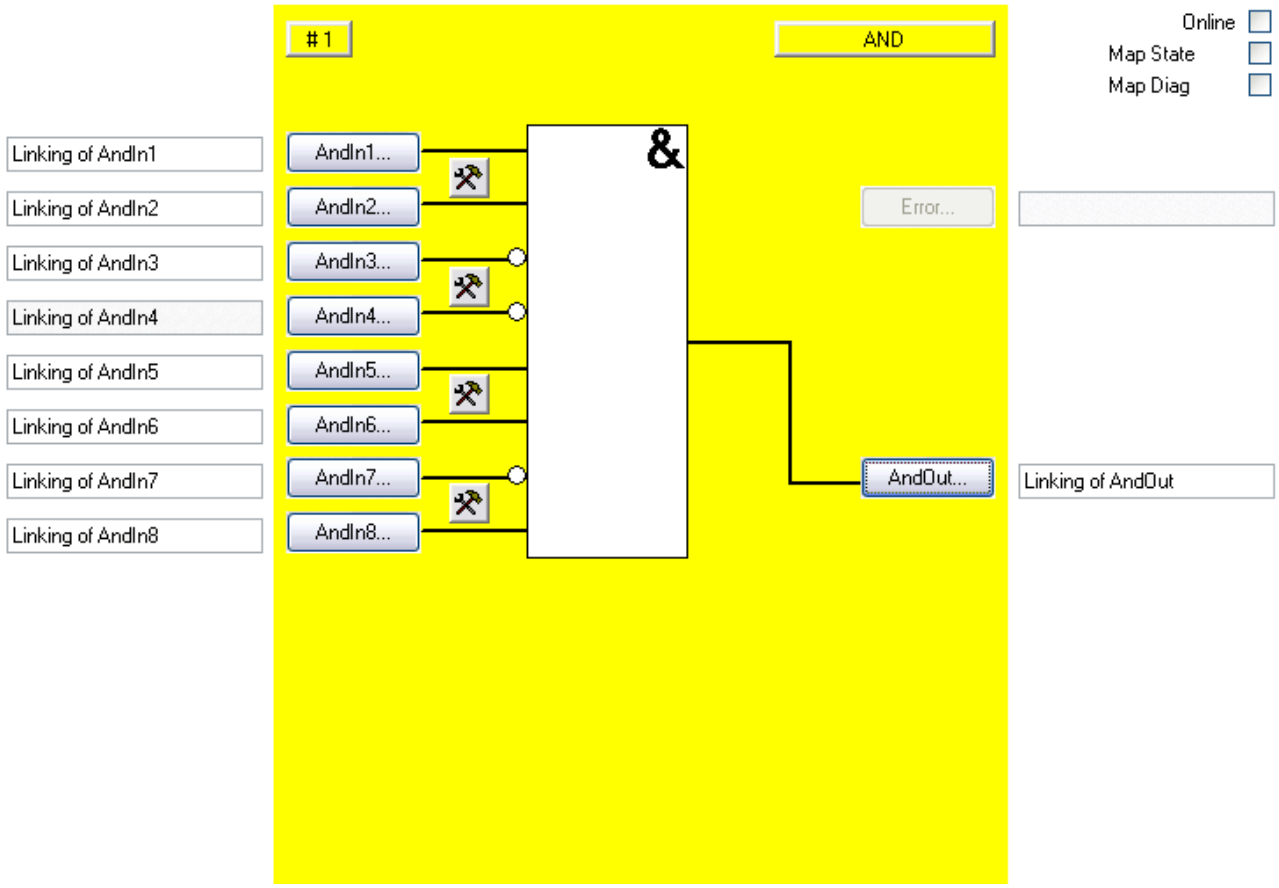

Fig. 15: Function block AND

4.1.2 Signal description

FB AND inputs

Name	Permitted type	Data type	Description
AndIn1	TwinSAFE-In FB-Out Standard-In	BOOL	1st input channel

Name	Permitted type	Data type	Description
AndIn2	TwinSAFE-In FB-Out	BOOL	2nd input channel
AndIn3	TwinSAFE-In FB-Out	BOOL	3rd input channel
AndIn4	TwinSAFE-In FB-Out	BOOL	4th input channel
AndIn5	TwinSAFE-In FB-Out	BOOL	5th input channel
AndIn6	TwinSAFE-In FB-Out	BOOL	6th input channel
AndIn7	TwinSAFE-In FB-Out	BOOL	7th input channel
AndIn8	TwinSAFE-In FB-Out	BOOL	8th input channel

FB AND outputs

Name	Permitted type	Data type	Description
AndOut	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	Output channel

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. on an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. on an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
Local-Out	TwinSAFE output at the KL6904 (not available for EL6900)

Internal identifier of the FB

Type	Description
FB AND	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for the FB AND

Diagnostic information (16-bit value)

Bit	Description
0-15	always 0

Status information (8-bit value)

Value	Description
0	undefined
1	**RUN** If all active inputs AndIn1-AndIn8 are set to 1 (ACTIVE_ANDIN = TRUE), the RUN state is assumed. The output assumes the following value: • AndOut = 1

Value	Description
2	**STOP** If the input FbRun = FALSE, the FB AND assumes the STOP state. The output assumes the following value: • AndOut = 0
3	**SAFE** If at least one of the active inputs AndIn1-AndIn8 is not 1 (ACTIVE_ANDIN = FALSE), the SAFE state is assumed. The output assumes the following value: • AndOut = 0

If the checkboxes 'Map State' and 'Map Diag' are checked, the status and diagnostic data of the FB are copied to the cyclic process image.

NOTICE

KL6904

The Map State and Map Diag checkboxes do not exist in the case of the KL6904.

4.1.3 Configuration in the TwinCAT System Manager

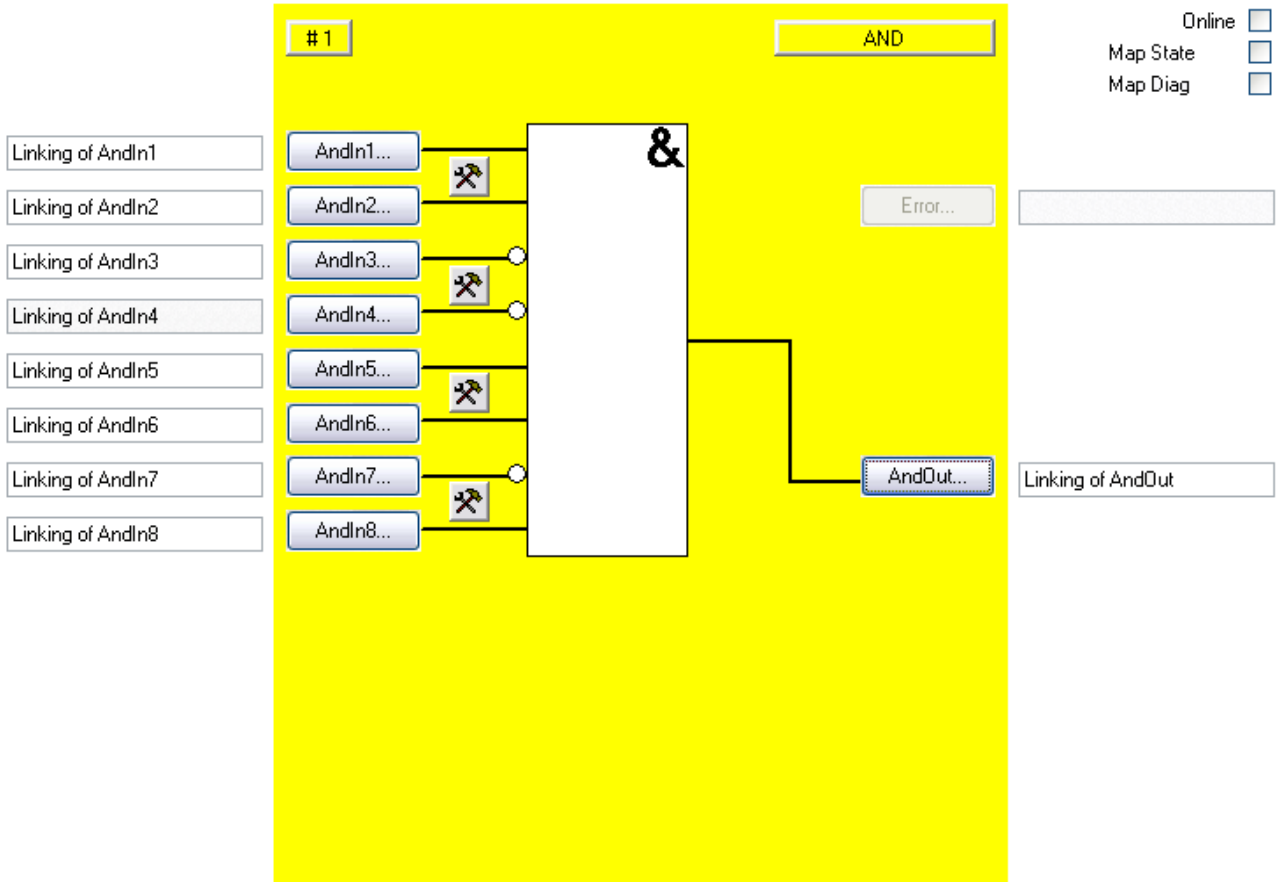

Fig. 16: FB AND configuration

Use the Settings buttons to the right of two AndIn inputs to configure their behavior. The inputs are always single-channel. Discrepancy monitoring cannot be used with the FB AND.

The 'AndIn(x)' buttons can only be selected if the corresponding input has been activated via the Settings button. In the default setting all inputs are disabled.

The FB AND input variables are linked using the 'AndIn(x)' buttons.

The output variable of the FB AND are linked using the 'AndOut' button.

The '"Map State"' and '"Map Diag"' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

The FB AND does not supply any error information and therefore the error button is basically deactivated.

4.1.4 Configuration in TwinCAT 3

Display of the function block and its properties in TwinCAT 3.

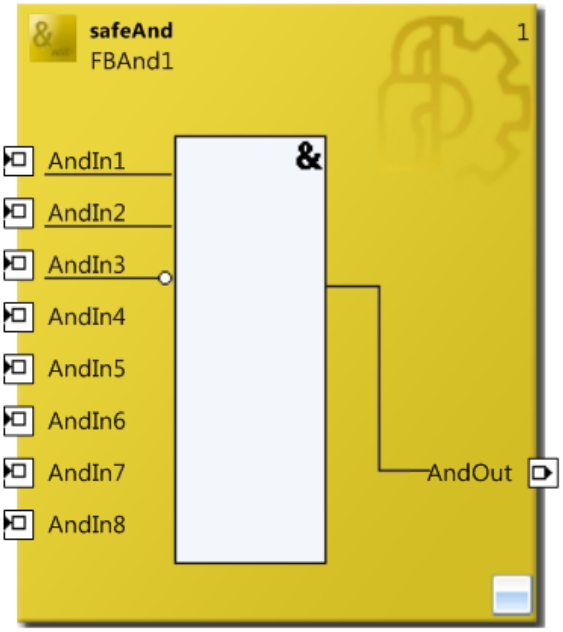

Fig. 17: FB AND in TwinCAT 3

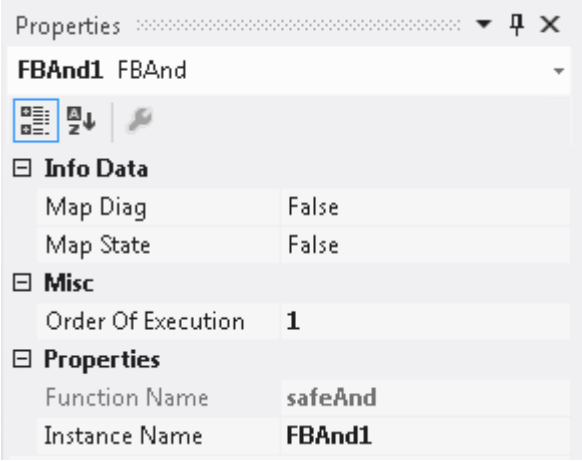

Fig. 18: FB AND properties

4.2 The function block OR

4.2.1 Functional description

With the FB OR several input signals can be linked via OR to one output signal. The input signal of each can be set to represent a break contact or a make contact. A make contact means that the corresponding input signal is negated, before it affects the OR.

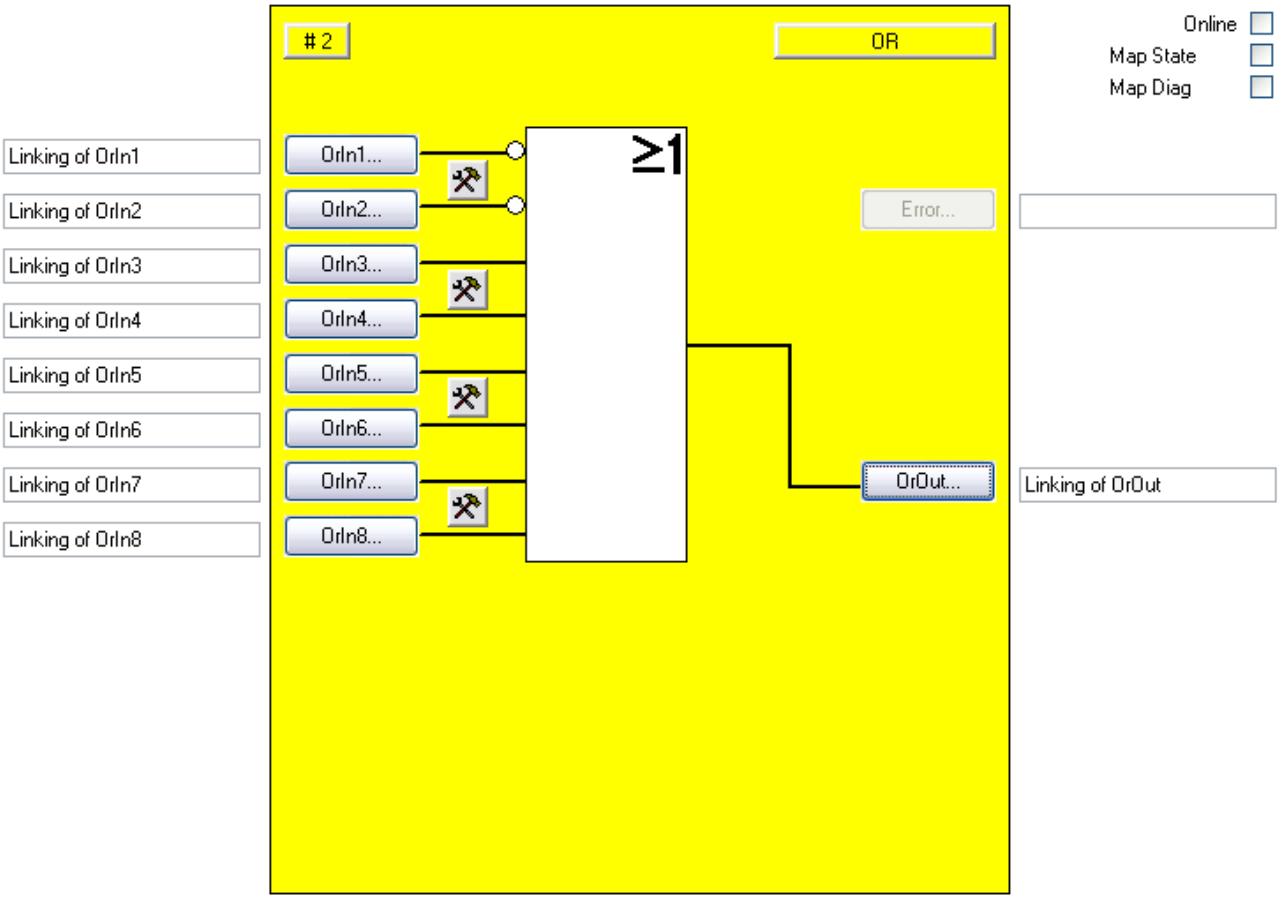

Fig. 19: Function block OR

4.2.2 Signal description

FB OR inputs

Name	Permitted type	Data type	Description
OrIn1	TwinSAFE-In FB-Out	BOOL	1st input channel
OrIn2	TwinSAFE-In FB-Out	BOOL	2nd input channel
OrIn3	TwinSAFE-In FB-Out	BOOL	3rd input channel
OrIn4	TwinSAFE-In FB-Out	BOOL	4th input channel
OrIn5	TwinSAFE-In FB-Out	BOOL	5th input channel
OrIn6	TwinSAFE-In FB-Out	BOOL	6th input channel
OrIn7	TwinSAFE-In FB-Out	BOOL	7th input channel
OrIn8	TwinSAFE-In FB-Out	BOOL	8th input channel

FB OR outputs

Name	Permitted type	Data type	Description
OrOut	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	Output channel

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. on an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. on an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
Local-Out	TwinSAFE output at the KL6904 (not available for EL6900)

Internal identifier of the FB

Type	Description
FB OR	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for FB OR

Diagnostic information (16-bit value)

Bit	Description
0-15	always 0

Status information (8-bit value)

Value	Description
0	undefined
1	**RUN** The RUN state is assumed if one or more of the active inputs OrIn1-OrIn8 is set to 1 (ACTIVE_ORIN=TRUE). The output assumes the following value: • OrOut = 1
2	**STOP** If the input FbRun = FALSE, FB OR switches to the STOP state. The output assumes the following value: • OrOut = 0
3	**SAFE** If all active inputs OrIn1-OrIn8 are equal to 0 (ACTIVE_ORIN = FALSE), the SAFE state is assumed. The output assumes the following value: • OrOut = 0

If the checkboxes 'Map State' and 'Map Diag' are checked, the status and diagnostic data of the FB are copied to the cyclic process image.

NOTICE

KL6904

The Map State and Map Diag checkboxes do not exist in the case of the KL6904.

4.2.3 Configuration in the TwinCAT System Manager

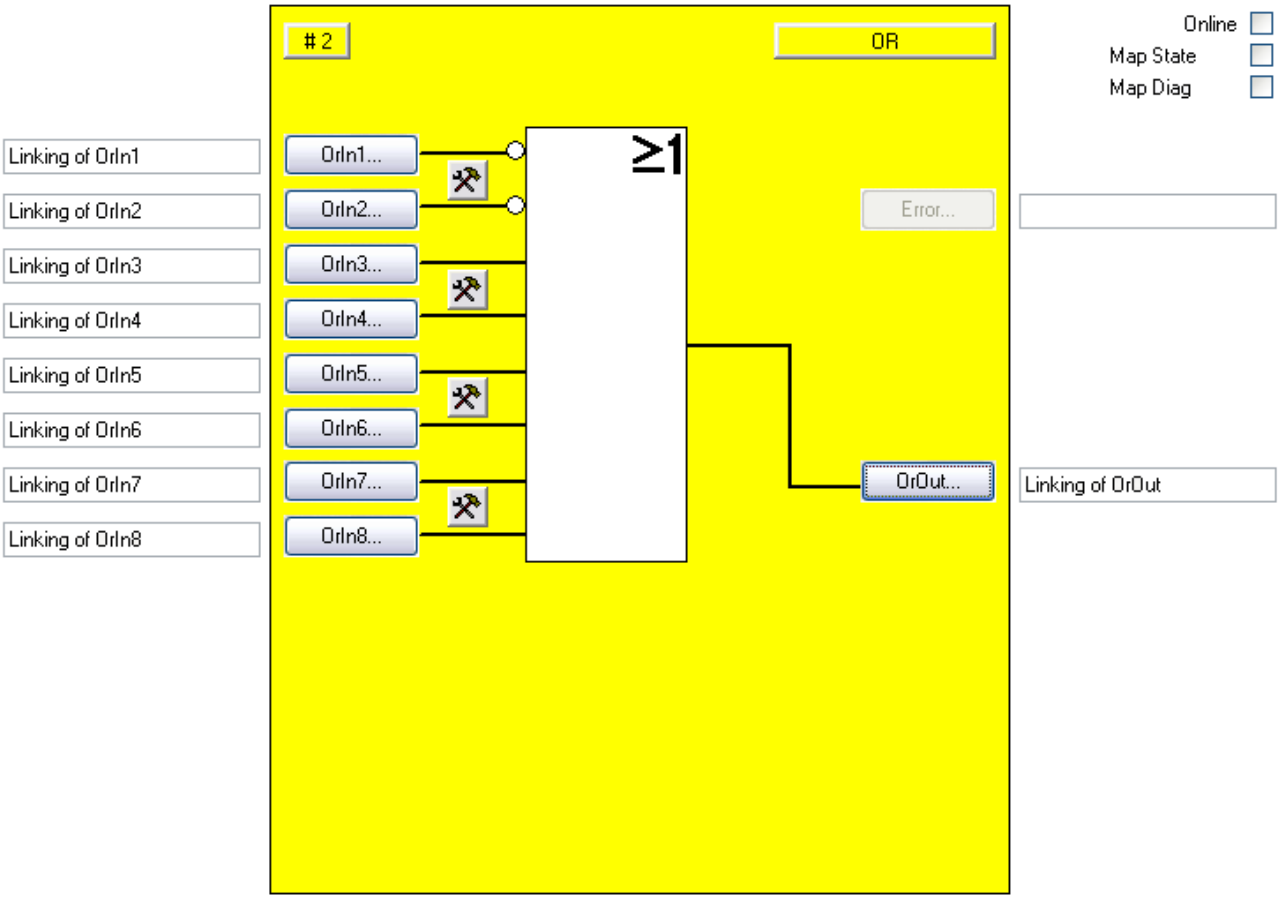

Fig. 20: FB OR configuration

Their characteristics are configured with the setting buttons on the right near the two OrIn inputs, whereby the inputs are always single-channel. A discrepancy monitoring cannot be used for the OR.

The 'OrIn(x)' buttons can only be selected if the corresponding input has been activated via the Settings button. In the default setting all inputs are disabled.

The FB OR input variables are linked using the 'OrIn(x)' buttons.

The output variable of the FB OR are linked using the 'OrOut' button.

The '"Map State"' and '"Map Diag"' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

The FB OR does not supply any error information and therefore the error button is basically deactivated.

4.2.4 Configuration in TwinCAT 3

Display of the function block and its properties in TwinCAT 3.

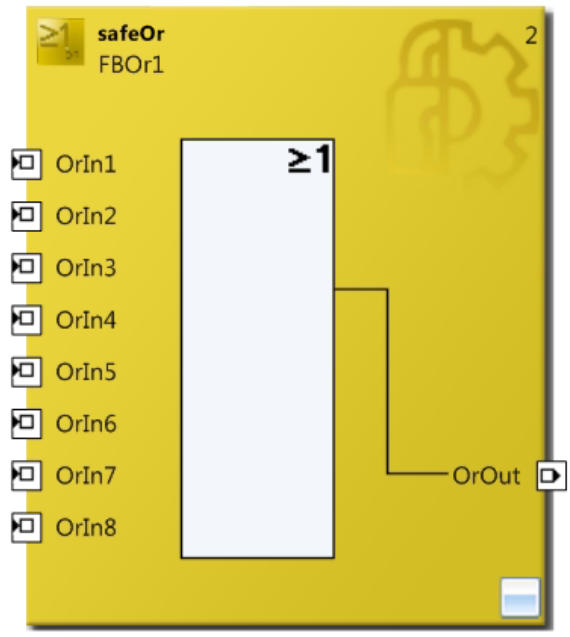

Fig. 21: FB OR in TwinCAT 3

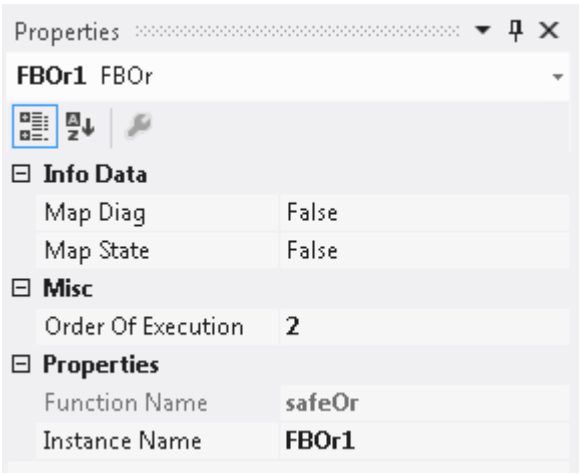

Fig. 22: FB OR properties

4.3 The function block OPMODE

4.3.1 Functional description

Operating mode selectors can be realized with the FB OPMODE. The function block has 8 inputs and 8 outputs, which are looped through one-to-one. Up to 8 different operation modes can be selected.

The FB OPMODE sets the corresponding output only if exactly one input is set ("1"). The other outputs remain in the safe state ("0"). All outputs are in a safe state if there is none or more than one input is set.

If the Restart input is active, the safe state of the outputs is only exited when starting and changing the operation mode by a rising and falling edge on the Restart input (see also chapter 3.3.4 [▶ 42] Restart behavior [▶ 42]). No time monitoring of the restart signal takes place. The output is switched on when the restart signal changes from TRUE to FALSE.

A discrepancy time can be specified to monitor the change from one operation mode to the next.

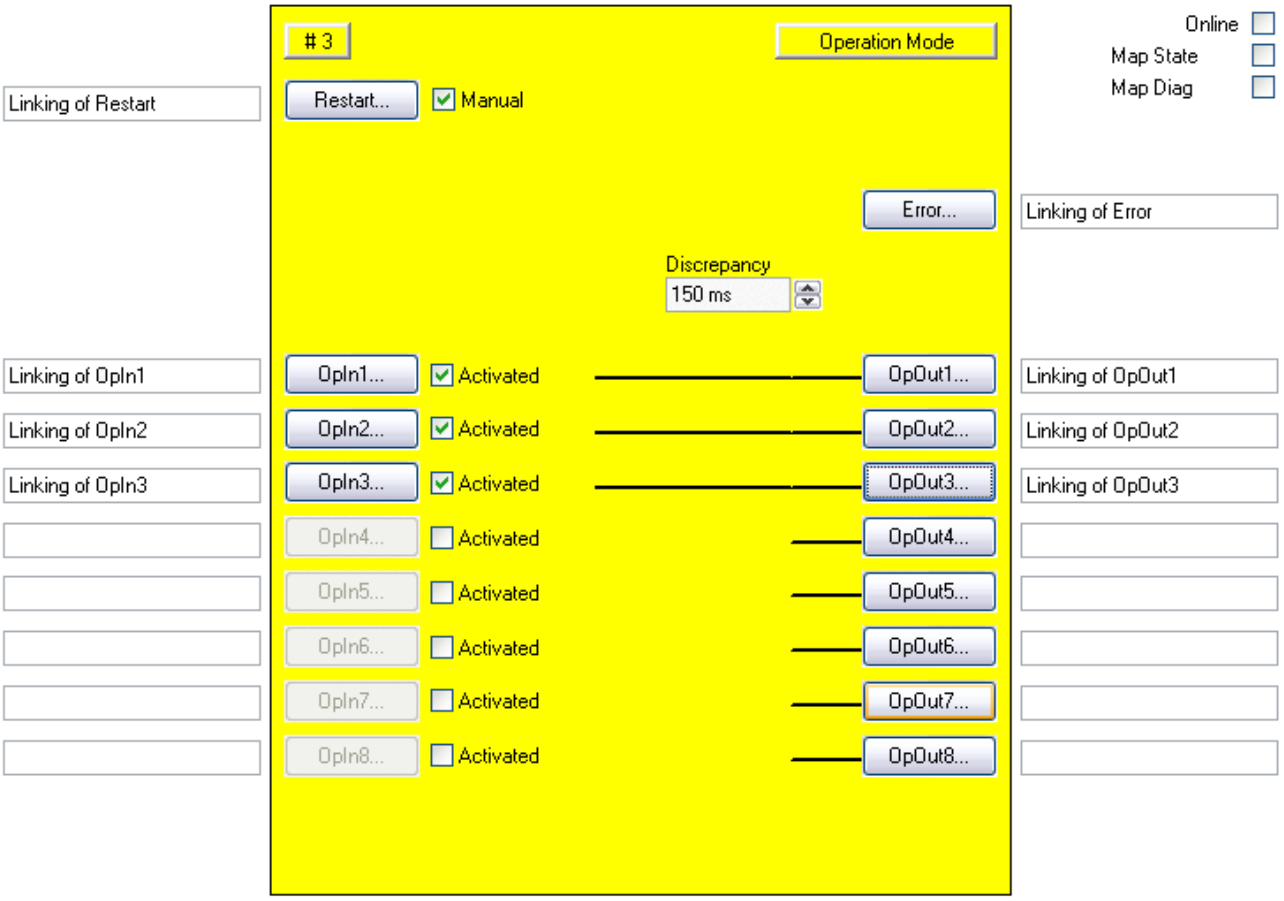

Fig. 23: Function block OPMODE

NOTICE

Number of inputs

At least two inputs of FB OPMODE must be connected.

4.3.2 Signal description

FB OPMODE inputs

Name	Permitted type	Data type	Description
Restart	TwinSAFE-In FB-Out Standard-In	BOOL	The signal sequence 0->1->0 must be detected on the restart input, before the safe state of the outputs can be removed, when starting the FB or when all outputs are switched to the safe state. No time monitoring of the restart signal takes place.
OpIn1	TwinSAFE-In FB-Out	BOOL	1st input channel
OpIn2	TwinSAFE-In FB-Out	BOOL	2nd input channel
OpIn3	TwinSAFE-In FB-Out	BOOL	3rd input channel
OpIn4	TwinSAFE-In FB-Out	BOOL	4th input channel
OpIn5	TwinSAFE-In FB-Out	BOOL	5th input channel
OpIn6	TwinSAFE-In FB-Out	BOOL	6th input channel

Name	Permitted type	Data type	Description
OpIn7	TwinSAFE-In FB-Out	BOOL	7th input channel
OpIn8	TwinSAFE-In FB-Out	BOOL	8th input channel

Outputs of the FB OPMODE

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	TRUE: The discrepancy time monitoring or the input monitoring has found an error. The acknowledgement of the error must be carried out via the ERR_ACK input of the related TwinSAFE group FALSE: No error was found.
OpOut1	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	1st output channel
OpOut2	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	2nd output channel
OpOut3	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	3rd output channel
OpOut4	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	4th output channel
OpOut5	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	5th output channel
OpOut6	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	6th output channel
OpOut7	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	7th output channel
OpOut8	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	8th output channel

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. on an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. on an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input

Type	Description
Local-Out	TwinSAFE output at the KL6904 (not available for EL6900)

Diagnostic information (16-bit value)

Bit	Description
0	Discrepancy monitoring error

Internal identifier of the FB

Type	Description
FB OPMODE	This description applies to BLG 1.0 (internal version number)

Status information (8-bit value)

Value	Description
0	undefined
1	**RUN** The FB OPMODE assumes the RUN state if exactly one input OpInX is equal to TRUE. The outputs assume the following values: • Error = 0 • OpOutX = OpInX (1 ≤ X ≤ 8)
2	**STOP** If the input FbRun = FALSE, FB OPMODE assumes the STOP state. The outputs assume the following values: • Error = 0 • OpOutX = 0 (1 ≤ X ≤ 8)
3	**SAFE** FB OPMODE assumes the SAFE state if not exactly one input OpInX is equal to TRUE. The outputs assume the following values: • Error = 0 • OpOutX = 0 (1 ≤ X ≤ 8)
4	**ERROR** If the FB OPMODE detects an error, FB OPMODE switches to the ERROR state and sends the corresponding Diag message to the GROUP module. The outputs assume the following values: • Error = 1 • OpOutX = 0 (1 ≤ X ≤ 8)
5	**RESET** FB OPMODE assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. The outputs assume the following values: • Error = 0 • OpOutX = 0 (1 ≤ X ≤ 8)
6	**START** FB OPMODE assumes the START state if the restart input is active and equal to TRUE in order to wait for a rising and falling edge of the restart input before assuming the RUN state and setting the corresponding output OpOutX to TRUE. The outputs assume the following values: • Error = 0 • OpOutX = 0 (1 ≤ X ≤ 8)

If the checkboxes 'Map State' and 'Map Diag' are checked, the status and diagnostic data of the FB are copied to the cyclic process image.

NOTICE

KL6904

The 'Map State' and 'Map Diag' checkboxes are not available for the KL6904.

4.3.3 Configuration in the TwinCAT System Manager

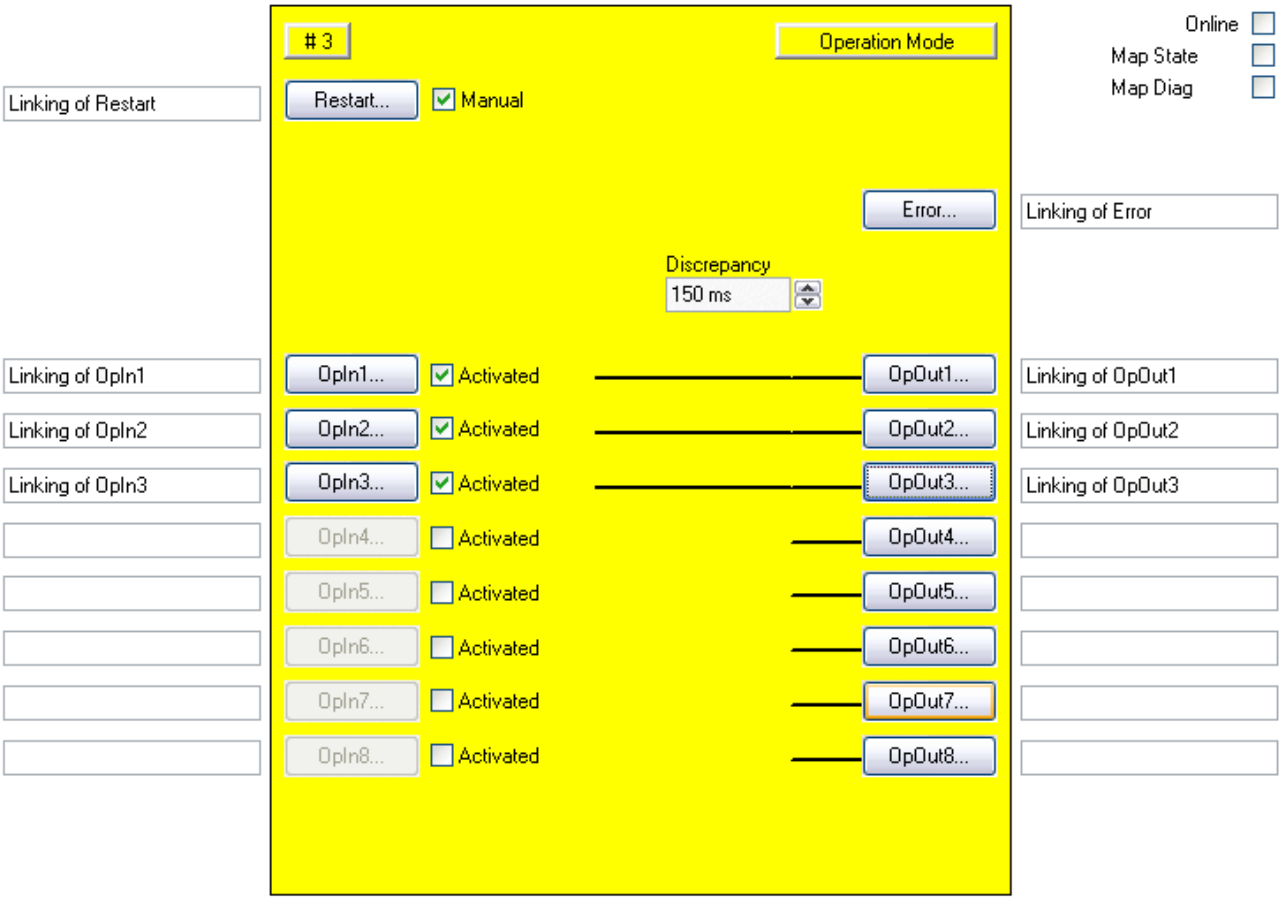

Fig. 24: FB OPMODE configuration

The manual restart is activated using the "'Activated' " checkbox on the right near the 'Restart' button.

The inputs are activated via the 'Activated' check boxes to the right of the 'OpIn (x)' button.

The 'Restart' or 'OpIn(x)' buttons can only be selected, once the corresponding check box has been selected.

The FB OPMODE input variables are linked using the 'Restart' and 'OrIn(x)' buttons.

The FB OPMODE output variables are linked using the 'Error' and 'OpOut(x)' buttons.

The '"Map State"' and '"Map Diag"' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

The discrepancy time is configured using the 'Discrepancy' selection box.

4.3.4 Restart behavior

If exactly one OpIn input is TRUE and the Restart signal is TRUE, Start state (FB State 6) is assumed. The detection of a change of the Restart signal from TRUE to FALSE triggers a check whether exactly one OpIn input is still logical 1. The corresponding output is enabled if these criteria are met and the function block is not in ERROR state.

NOTICE

Restart input

The function block expects a push button with make contact at the restart input.

⚠ CAUTION

Restart

If the risk and hazard analysis indicates that a restart is to be implemented in the safety controller, the restart signal must be applied to a safe input.

Sample 1

The following diagram shows an error-free behavior with a change of the operation mode and subsequent acknowledgement of the OPMODE function block via the restart input.

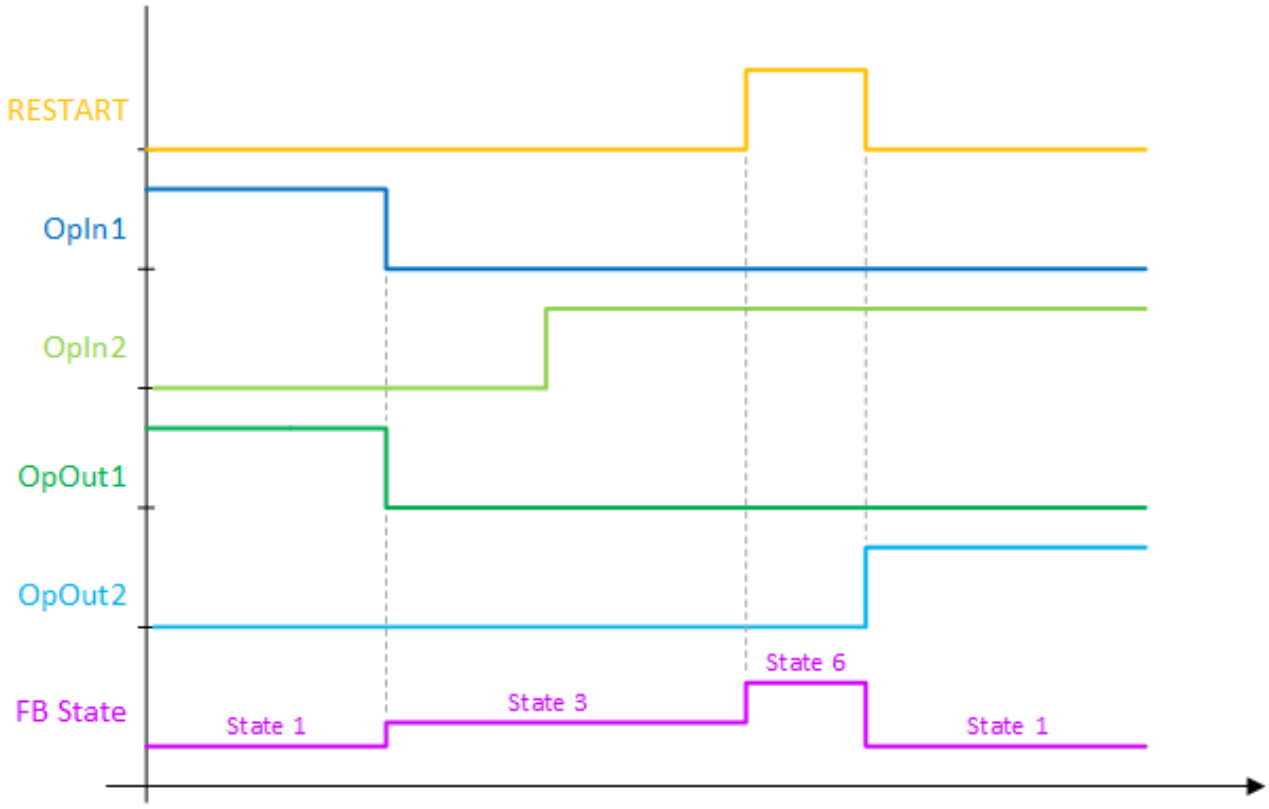

Fig. 25: Restart behavior OPMODE (sample 1)

Sample 2

In the following diagram the Restart is set to TRUE before the operation mode change takes place. Changing the input OpIn1 from TRUE to FALSE results in a switch to state 3. Once operation mode OpIn2 is TRUE, the system changes to the Start state (FB State 6), since the Restart input is already TRUE. The output OpOut2 is activated by changing the Restart input from TRUE to FALSE.

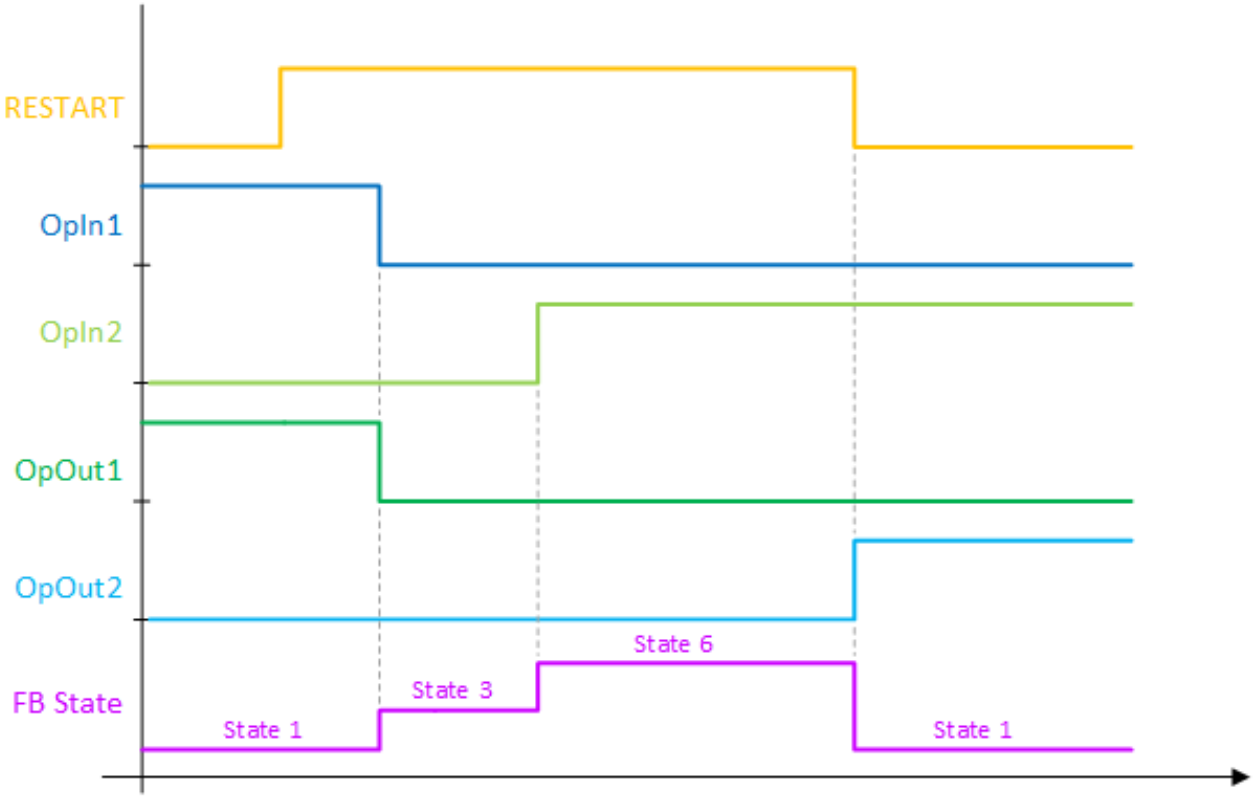

Fig. 26: Restart behavior OPMODE (sample 2)

4.3.5 Configuration in TwinCAT 3

Display of the function block and its properties in TwinCAT 3.

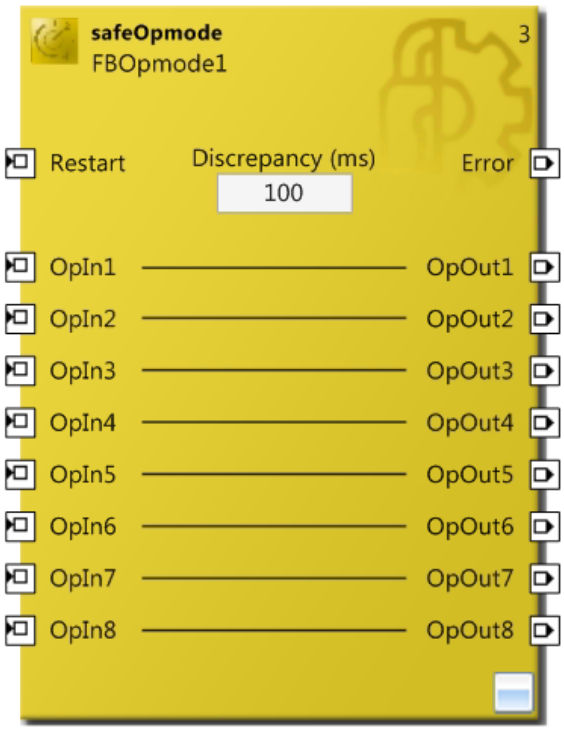

Fig. 27: FB OPMODE in TwinCAT 3

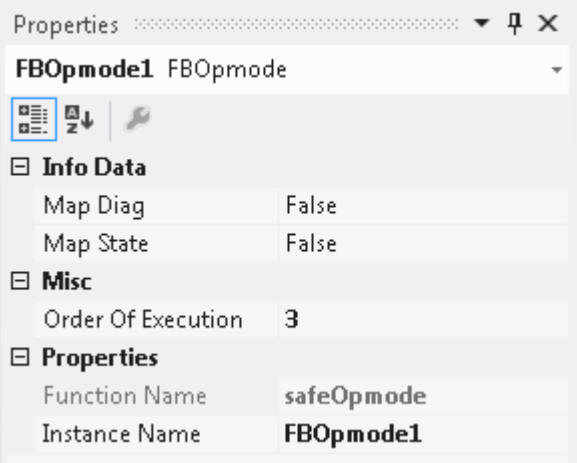

Fig. 28: FB OPMODE properties

4.4 The function block ESTOP

4.4.1 Functional description

An emergency stop circuit with up to eight emergency stop inputs (EStopIn1-EStopIn8) can be realized with the FB ESTOP. Each of the eight inputs can be parameterized as break contact (0 requests the safe state) or make contact (1 request the safe state).

The first output (EStopOut) switches immediately, and the second output (EStopDelOut) after a configurable time delay, into the safe state ("0"), once an input requests the safe state. Each FB output can be linked to several outputs. Therefore, several outputs that switch off immediately (EStopOut) or with a delay (EStopDelOut) can be realized with just one FB ESTOP.

In order to exit the safe state of the outputs, a rising and falling edge must be detected at the Restart input (see also chapter 3.4.4 [▶ 50] Restart behavior [▶ 50]). No time monitoring of the restart signal takes place.

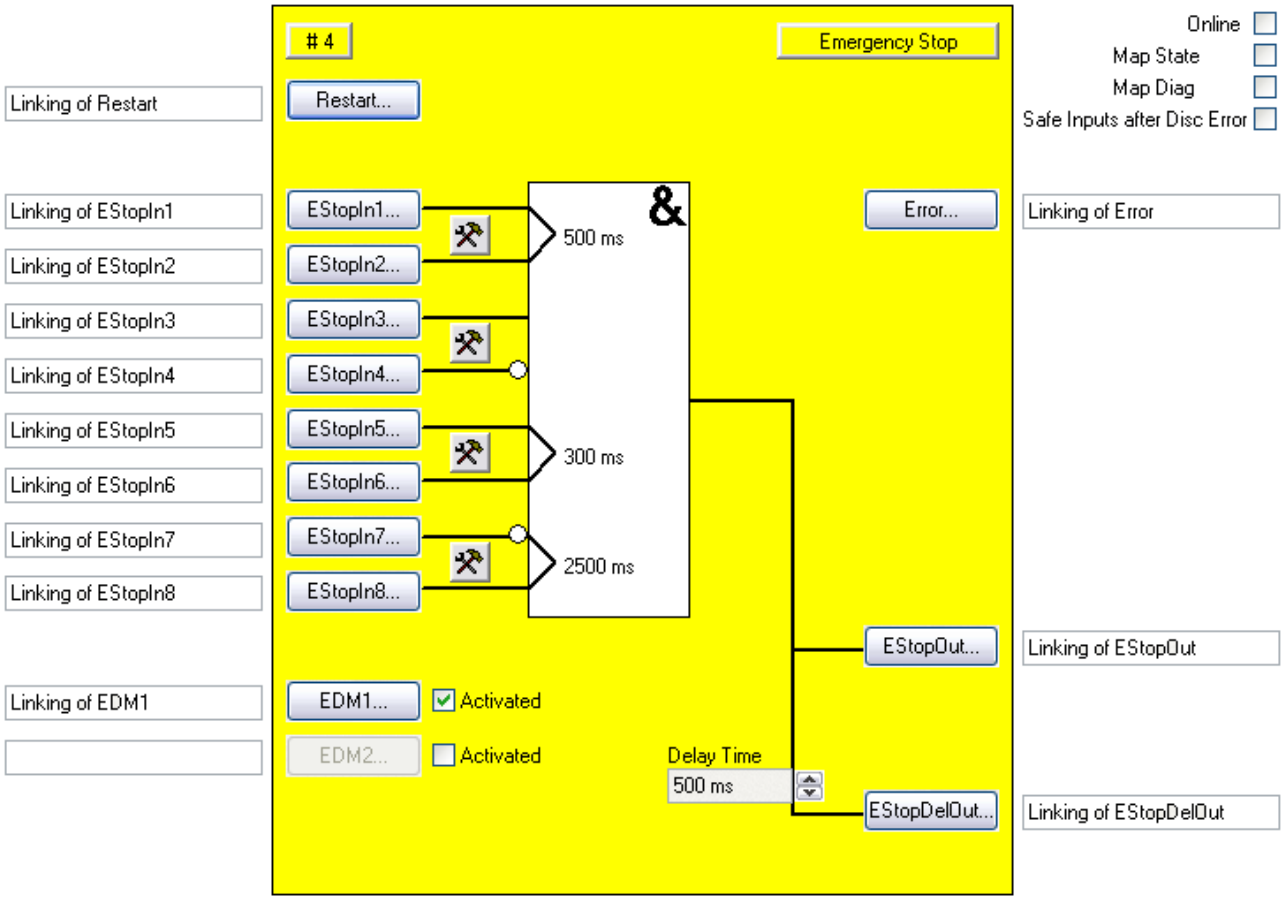

Fig. 29: Function block ESTOP

A feedback loop can be activated for both outputs. The output EStopOut is returned to the input EDM1 and the output EStopDelOut to the input EDM2 through external wiring. The EDM inputs are checked as soon as the FB changes to the START state (6) (see 3.4.4 [▶ 50] Restart behavior [▶ 50]). If the EDM inputs then do not have the signal state "1", the FB ESTOP switches to the error state and sets the Error output to 1. The error state can only be exited again by means of an acknowledgement via the ERR_ACK input of the associated TwinSAFE group.

Furthermore, the following inputs can be combined to pairs: EStopIn1 / EStopIn2, EStopIn3 / EStopIn4, EStopIn5 / EStopIn6, EStopIn7 / EStopIn8. The signal states of the two inputs may only deviate from each other within a configurable discrepancy time. If this discrepancy time is exceeded for an input pair, the FB ESTOP also switches to the error state (FB Error). The error state can only be exited again by acknowledging via the ERR_ACK input of the associated TwinSAFE group.
In the FB error state, the outputs assume the safe state "0", only the Error output is "1".
The characteristics for acknowledging a discrepancy error can be set via the checkbox *Safe Inputs after Disc Error*. If the checkbox is checked, both inputs of the input group that has caused the discrepancy error have to switch to safe state simultaneously before the error can be reset.

4.4.2 Signal description

FB ESTOP inputs

Name	Permitted type	Data type	Description
Restart	TwinSAFE-In FB-Out Standard-In	BOOL	During start-up (when the corresponding TwinSAFE group is started) or a restart (when an input has requested the safe state), a falling edge must be detected at the Restart input before the safe state of the outputs is canceled.
EDM1	TwinSAFE-In FB-Out Standard-In	BOOL	EDM1 is the feedback loop for the non-delayed output channel (EStopOut). If this input is parameterized as active, the safe state of the outputs will only be exited during restart, when the EDM1 supplies the "1" signal.

Name	Permitted type	Data type	Description
EDM2	TwinSAFE-In FB-Out Standard-In	BOOL	EDM2 is the feedback loop for the delayed switching of the output channel (EStopDelOut). If this input is parameterized as active, the safe state of the outputs will only be exited during restart, when the EDM2 supplies the "1" signal.
EStopIn1	TwinSAFE-In FB-Out	BOOL	1st input channel: The parameterization is used to specify whether the input behaves as a break contact (break contact - safe state is requested at logic 0) or as a make contact (make contact - safe state is requested at logic 1).
EStopIn2	TwinSAFE-In FB-Out	BOOL	2nd input channel, behavior like EStopIn1 If the discrepancy time is not equal 0, the 1st and 2nd input channel are considered to be the 1st input pair and a discrepancy time monitoring is carried out between both channels.
EStopIn3	TwinSAFE-In FB-Out	BOOL	3rd input channel or 1st input channel of the 2nd input pair, otherwise corresponds with EStopIn1
EStopIn4	TwinSAFE-In FB-Out	BOOL	4th input channel or 2nd input channel of the 2nd input pair, otherwise corresponds with EStopIn2
EStopIn5	TwinSAFE-In FB-Out	BOOL	5th input channel or 1st input channel of the 3rd input pair, otherwise corresponds with EStopIn1
EStopIn6	TwinSAFE-In FB-Out	BOOL	6th input channel or 2nd input channel of the 3rd input pair, otherwise corresponds with EStopIn2
EStopIn7	TwinSAFE-In FB-Out	BOOL	7th input channel or 1st input channel of the 4th input pair, otherwise corresponds with EStopIn1
EStopIn8	TwinSAFE-In FB-Out	BOOL	8th input channel or 2nd input channel of the 4th input pair, otherwise corresponds with EStopIn2

FB ESTOP outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	TRUE: The discrepancy time monitoring of an input pair, or one of the feedback loops, has found an error. The error reset must be carried out via the ERR_ACK input of the related TwinSAFE group. FALSE: No error was found.
EStopOut	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	1st output channel, the safe state corresponds to a logical 0.
EStopDelOut	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	2nd output channel, the safe state corresponds to a logical 0. The safe state is output with a delay, which corresponds to the parameterized Delay Time.

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. on an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. on an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
Local-Out	TwinSAFE output at the KL6904 (not available for EL6900)

Internal identifier of the FB

Type	Description
FB ESTOP	This description applies to BLG 1.0 / BLG 2.0 (internal version number)

Diagnostic and status information for FB ESTOP

Diagnostic information (16-bit value)

Bit	Description
0	Discrepancy error input group 1
1	Discrepancy error input group 2
2	Discrepancy error input group 3
3	Discrepancy error input group 4
4	EDM monitoring error EDM1
5	EDM monitoring error EDM2
6	-
7	-
8	Discrepancy error input group 1 with activated option "Safe Inputs after Disc Error" (set in addition to bit 0)
9	Discrepancy error input group 2 with activated option "Safe Inputs after Disc Error" (set in addition to bit 1)
10	Discrepancy error input group 3 with activated option "Safe Inputs after Disc Error" (set in addition to bit 2)
11	Discrepancy error input group 4 with activated option "Safe Inputs after Disc Error" (set in addition to bit 3)

Status information (8-bit value)

Value	Description
0	undefined
1	**RUN** The FB ESTOP assumes the RUN state if there are no errors and no active EStopIn input requests a safe state. The outputs assume the following values: • Error = 0 • EStopOut = 1 • EStopDelOut = 1
2	**STOP** If the input FbRun = FALSE, FB ESTOP assumes the STOP state. The outputs assume the following values: • Error = 0 • EStopOut = 0 • EStopDelOut = 0
3	**SAFE** The FB ESTOP assumes the SAFE state as long as at least one of the active EStopIn inputs has requested the safe state. The outputs assume the following values: • Error = 0 • EStopOut = 0 • EStopDelOut = 0
4	**ERROR** If the FB ESTOP detects an error, the FB ESTOP switches to the ERROR state and sends the corresponding Diag message to the GROUP module. The outputs assume the following values:

Value	Description
	• Error = 1 • EStopOut = 0 • EStopDelOut = 0
5	**RESET** FB ESTOP assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. The outputs assume the following values: • Error = 0 • EStopOut = 0 • EStopDelOut = 0
6	**START** The FB ESTOP assumes the START state if the restart input is TRUE in order to wait for a rising and falling edge of the restart input before assuming the RUN state and the outputs exit the safe state. The outputs assume the following values: • Error = 0 • EStopOut = 0 • EStopDelOut = 0
8	**DELAYOUT** The FB ESTOP assumes the DELAYOUT state if at least one of the active EStopIn inputs has requested the safe state, but the delay time for the EStopDelOut output has not yet expired. The outputs assume the following values: • Error = 0 • EStopOut = 0 • EStopDelOut = 1

If the checkboxes 'Map State' and 'Map Diag' are checked, the status and diagnostic data of the FB are copied to the cyclic process image.

NOTICE

KL6904

The checkboxes 'Map State', 'Map Diag' and 'Safe Inputs after Discrepancy Error' are not available in the KL6904.

4.4.3 Configuration in the TwinCAT System Manager

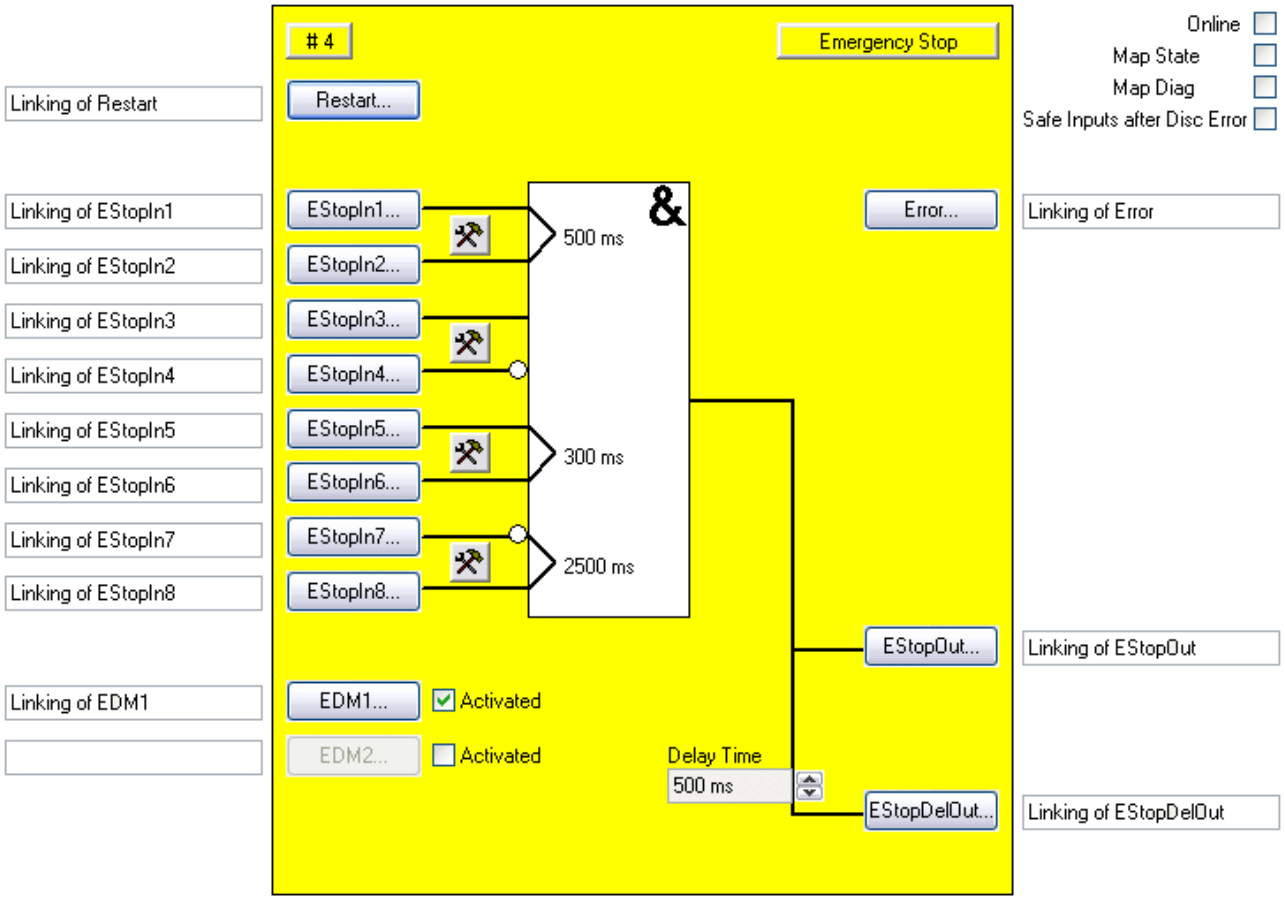

Fig. 30: FB ESTOP configuration

The characteristics of an input pair are configured with the setting buttons on the right near the two EStopIn inputs of this input pair.

The 'EStopIn(x)' buttons can only be selected if the corresponding input has been activated via the Settings button. In the default state all inputs are disabled.

The FB ESTOP input variables are linked using the 'Restart', 'EStopIn(x)' and 'EDM(x)' buttons.

The corresponding feedback loop is activated using the 'Activated' checkbox on the right near the 'EDM(x)' buttons. The 'EDM(x)' button can only be selected, if the associated feedback loop is activated.

The FB ESTOP output variables are linked using the 'Error', 'EStopOut' and 'EStopDelOut' buttons.

The delay time of the 'EStopDelOut' output is configured via the selection box 'Delay-Time'.

The characteristics for acknowledging a discrepancy error can be set via the checkbox ‘Safe Inputs after Disc Error’. If the checkbox is checked, both inputs of the input group that has caused the discrepancy error have to switch to safe state simultaneously before the error can be reset.

The '"Map State"' and '"Map Diag"' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

4.4.4 Restart behavior

If all active EStop-In inputs and all active EDM inputs are TRUE and the Restart signal changes from FALSE to TRUE, the Start state (FB state 6) is assumed. The detection of a change of the Restart signal from TRUE to FALSE triggers a check whether all active EStop-In inputs are still TRUE and whether the EDM signal is still TRUE. The output is enabled if these criteria are met and the function block is not in ERROR state.

NOTICE

Restart input

The function block expects a push button with make contact at the restart input.

⚠ CAUTION

Restart

If the risk and hazard analysis indicates that a restart is to be implemented in the safety controller, the restart signal must be applied to a safe input.

Sample 1

The following diagram shows the behavior when an emergency stop is triggered via Estop-In and subsequent acknowledgement of the ESTOP function block via the Restart input. At least one of the EDM inputs of the FB is active.

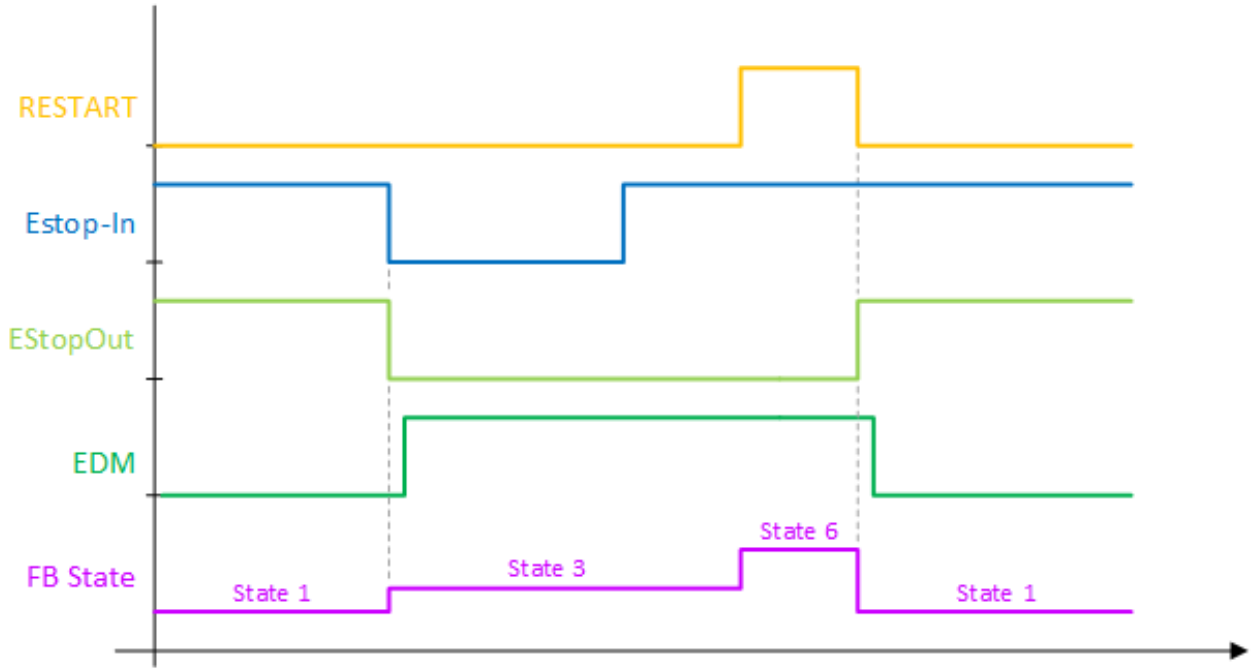

Fig. 31: Restart behavior ESTOP (sample 1)

Sample 2

The following diagram shows the behavior of the ESTOP function block, where the change of the Restart signal from FALSE to TRUE takes place before the change of the EStop inputs from FALSE to TRUE. The Start state (FB state 6) is only assumed if both signals are TRUE. The output is enabled when the Restart input changes from TRUE to FALSE. At least one of the EDM inputs of the FB is active.

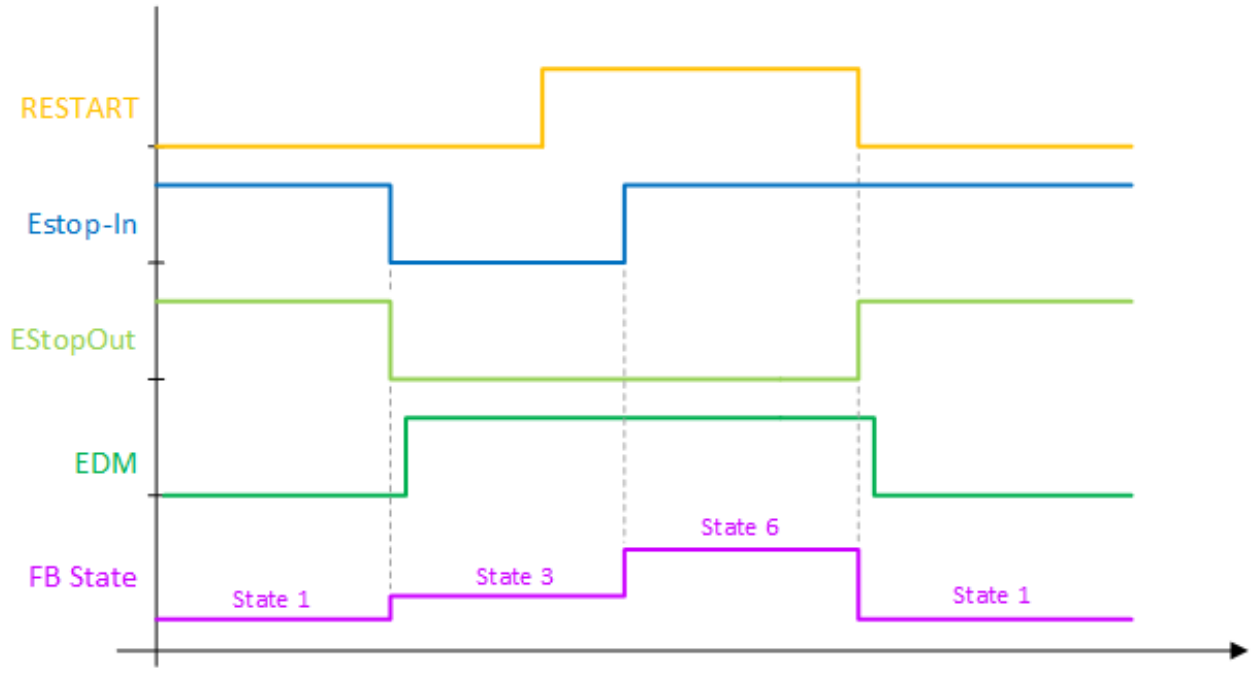

Fig. 32: Restart behavior ESTOP (sample 2)

Sample 3

In the following diagram the Restart input is set to TRUE before the emergency stop event takes place. Due to the Restart input signal, the EDM signal is checked immediately when the EStop-In input changes from TRUE to FALSE. This immediately leads to an EDM error and to the shutdown of the entire TwinSAFE group.

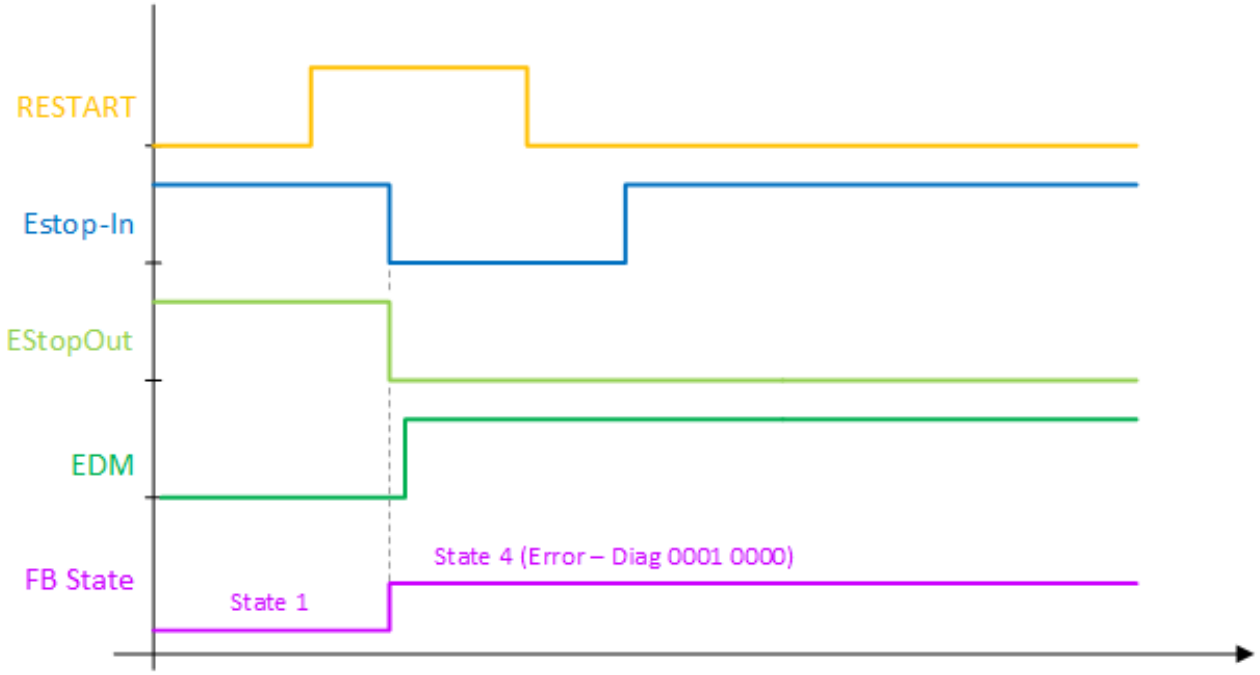

Fig. 33: Restart behavior ESTOP (sample 3)

Sample 4

If the EDM signal of the ESTOP function block is not evaluated, the time when the change from FALSE to TRUE may occur at the Restart input is not monitored. This may also be the case before the emergency stop event. In this case the FB output is enabled when the Restart input changes from TRUE to FALSE.

NOTICE

EDM signal

If the EDM input of the ESTOP function block does not prevent the device from being switched on again in the event of a fault, the user must take further measures to prevent this. (refer also to the TwinSAFE Application Guide, e.g. chapter 2.3).

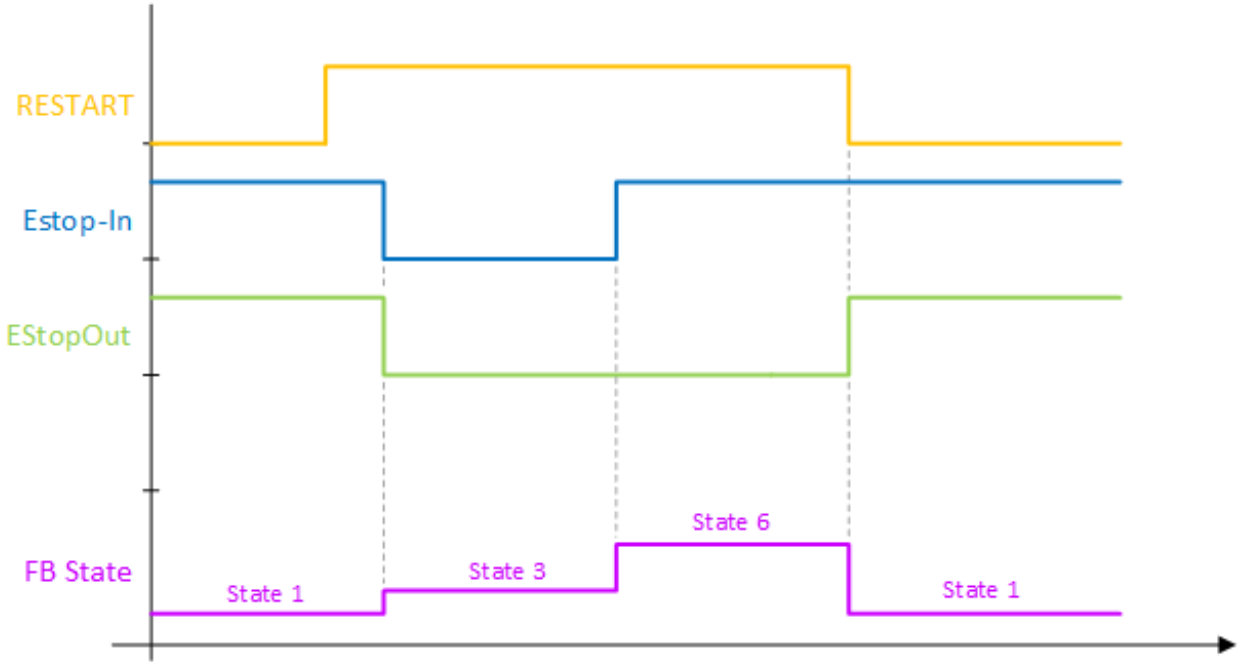

Fig. 34: Restart behavior ESTOP (sample 4)

4.4.5 ESTOP extension

NOTICE

Support

The extensions described below are only available in the EL/EJ6910 or newer terminals. These options cannot be used under the EL6900 and KL6904.

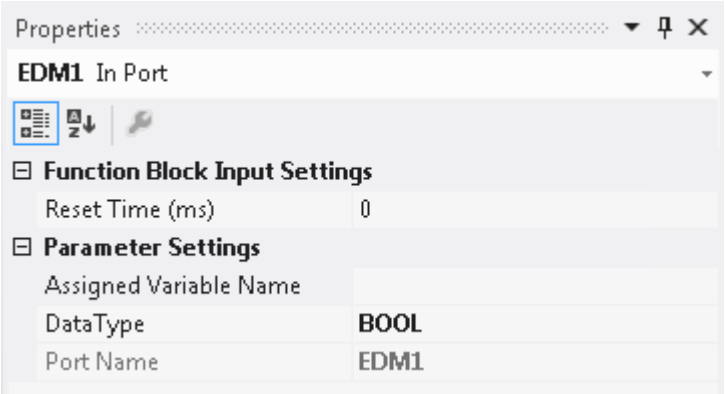

Fig. 35: EDM Reset Time

The FB ESTOP can also be used to monitor the change of the state of the feedback signal (EDMn) when the outputs are switched on.

The inputs *EDM1* and *EDM2* have been assigned a further parameter *Reset Time (ms)*. Open the properties of the EDMx by right-clicking on the EDMx input of the ESTOP function block. If this value is not equal to 0, the timer is started when the output *EStopOut* is activated. If the EDM input does not switch to FALSE within this time, a function block error is set and the outputs are switched off.

This function can be switched off by entering 0 as *Reset Time (ms)*.

4.4.6 Configuration in TwinCAT 3

Display of the function block and its properties in TwinCAT 3.

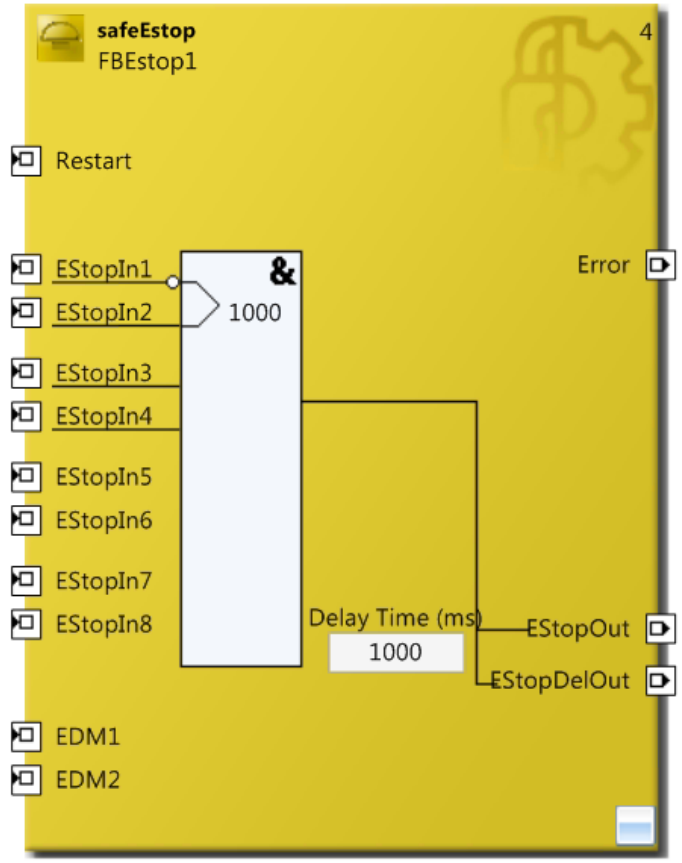

Fig. 36: FB ESTOP in TwinCAT 3

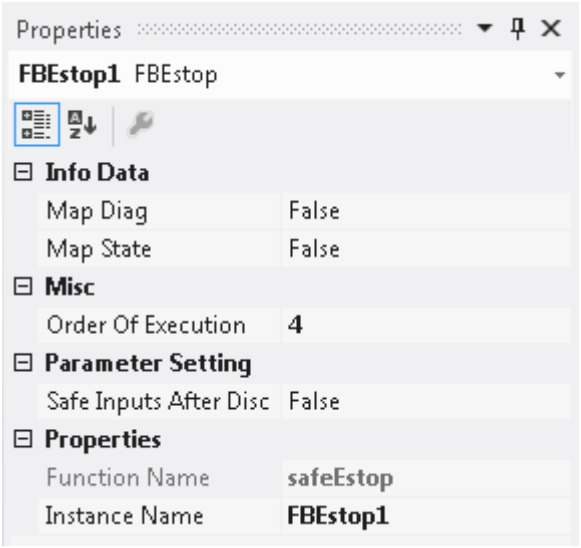

Fig. 37: FB ESTOP properties

The function *Safe Inputs after Disc Error* is activated by default for the ESTOP function block in the EL6910 and cannot be disabled. The display of the corresponding parameter and its value only applies if the function block is used on an EL6900; it can be ignored for the EL6910. A warning is issued if the parameter is set to TRUE under an EL6910.

4.5 The function block MON

4.5.1 Functional description

A safety door circuit with up to four inputs (MonIn(x)) can be realized with the FB MON for example. Each of the four inputs can be parameterized as break contact (0 requests the safe state) or make contact (1 requests the safe state).

When an input requests the safe state, the MonOut output immediately switches to the safe state ("0") and the MonDelOut output switches after a configurable delay. Each FB output can be linked to several outputs. Therefore, several outputs that switch off immediately (MonOut) or with a delay (MonDelOut) can be realized with just one FB MON.

In addition there are two Secure inputs, with which the request of the safe state can be bypassed through the MonIn inputs. The Secure inputs can also be parameterized as break contacts or as make contacts.

The FB restart input can be activated. In order to exit the safe state of the outputs, a rising and falling edge must be detected at the Restart input with restart active (see also chapter 3.5.4 [▶ 60] Restart behavior [▶ 60]). No time monitoring of the restart signal takes place. In case of an inactive restart the safe state is exited once the MonIn or Secure inputs no longer request the safe state.

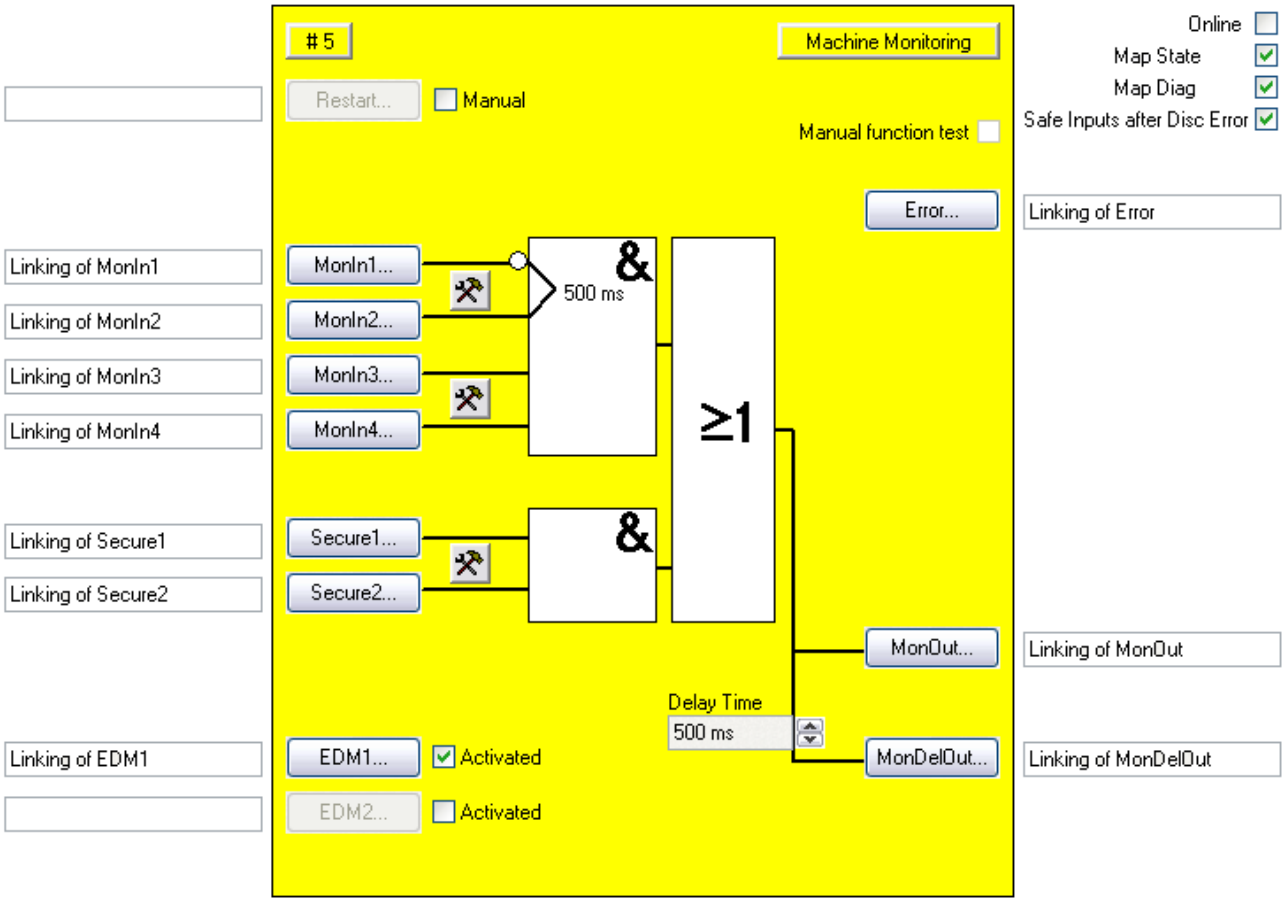

Fig. 38: Function block MON

A feedback loop must be activated for both outputs. The output MonOut is returned to the input EDM1 and the output MonDelOut to the input EDM2 through external wiring. The EDM inputs are checked as soon as the FB changes to the START status (6) (see Restart behavior [▶ 60]).
If Restart is enabled, the FB MON assumes the error state (FB Error) and sets the Error output to 1 if the

EDM inputs do not have the signal state TRUE. The error state can only be exited again by acknowledging via the ERR_ACK input of the associated TwinSAFE group.
If the restart is deactivated, FB MON remains in the safe state if the EDM inputs do not have the signal state "1".
An EDM error can therefore only be detected, when the manual restart is active.

NOTICE

EDM monitoring error

FB MON only reports an EDM error if manual restart is active. If manual restart is not active, the FB MON remains in SAFE state if an EDM error is present.

The following inputs can be combined to pairs: MonIn1 / MonIn2, MonIn3 / MonIn4, Secure1 / Secure2. The signal states of the two inputs may only deviate from each other within a configurable discrepancy time. If this discrepancy time is exceeded for an input pair, the FB MON enters the error state (FB Error).

The error state can only be exited through acknowledgement via the ERR_ACK input of the associated TwinSAFE group

In the FB error state, the outputs assume the safe state "0", only the Error output is "1".

The characteristics for acknowledging a discrepancy error can be set via the checkbox Safe Inputs after Disc Error. If the checkbox is set, both inputs of the input group that has caused the discrepancy error have to return logical zero simultaneously before the error can be reset.

The safe state must have been requested at least once on each active MonIn input after starting the FB MON if the manual function test is active, before an edge of the restart input reacts.

4.5.2 Signal description

FB MON inputs

Name	Permitted type	Data type	Description
Restart	TwinSAFE-In FB-Out Standard-In	BOOL	Manual restart active: When starting the FB or if an input has requested the safe state, the signal sequence 0->1->0 must be detected at the restart input before the safe state of the outputs is exited. Manual restart not active: This input is not used. Both starting and exiting the safe state is carried out automatically, as long as no input requests any longer the safe state.
EDM1	TwinSAFE-In FB-Out Standard-In	BOOL	EDM1 is the feedback loop for the non-delayed output channel (MonOut). If this input is parameterized as active, the safe state of the outputs will only be exited, when the EDM1 supplies the "1" signal.
EDM2	TwinSAFE-In FB-Out Standard-In	BOOL	EDM2 is the feedback loop for the delayed switching of the output channel (MonDelOut). If this input is parameterized as active, the safe state of the outputs will only be exited, when the EDM2 supplies the "1" signal.
MonIn1	TwinSAFE-In FB-Out	BOOL	1st input channel: The parameterization is used to specify whether a break contact (safe state is requested at logic 0) or a make contact (safe state is requested at logic 1) is linked to this input.
MonIn2	TwinSAFE-In FB-Out	BOOL	2nd input channel, behaves like MonIn1 If the discrepancy time is activated or used, the 1st and 2nd input channels are considered to be the 1st input pair and a discrepancy time monitoring is carried out between both channels.
MonIn3	TwinSAFE-In FB-Out	BOOL	3rd input channel or 1st input channel of the 2nd input pair, otherwise corresponds with MonIn1
MonIn4	TwinSAFE-In FB-Out	BOOL	4th input channel or 2nd input channel of the 2nd input pair, otherwise corresponds with MonIn2

Name	Permitted type	Data type	Description
Secure1	TwinSAFE-In FB-Out	BOOL	Secure1 enabled: The evaluation of the MonIn(x) inputs can be switched off. Parameterized as break contact: the inputs MonIn(x) are ignored if Secure1 is "1". Parameterized as make contact: the inputs MonIn(x) are ignored if Secure1 is "0". If the discrepancy time is not 0, Secure1 and Secure2 are considered as input pairs. The discrepancy time between the two channels is monitored.
Secure2	TwinSAFE-In FB-Out	BOOL	Secure2 is the 2nd channel of the input pair and otherwise corresponds to Secure1.

FB MON outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	TRUE: The discrepancy time monitoring of an input pair, or one of the feedback loops, has found an error. The error reset must be carried out via the ERR_ACK input of the related TwinSAFE group. FALSE: No error was found.
MonOut	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	1st output channel, the safe state corresponds to a logical 0.
MonDelOut	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	2nd output channel, the safe state corresponds to a logical 0. The safe state is output with a delay, which corresponds to the parameterized Delay Time.

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. on an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. on an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
Local-Out	TwinSAFE output at the KL6904 (not available for EL6900)

Internal identifier of the FB

Type	Description
FB MON	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for FB MON

Diagnostic information (16-bit value)

Bit	Description
0	Discrepancy error input group 1
1	Discrepancy error input group 2
2	Discrepancy error in Secure input group
4	EDM monitoring error EDM1

Bit	Description
5	EDM monitoring error EDM2
6	-
7	-
8	Discrepancy error input group 1 with activated option "Safe Inputs after Disc Error" (set in addition to bit 0)
9	Discrepancy error input group 2 with activated option "Safe Inputs after Disc Error" (set in addition to bit 1)
10	Discrepancy error input group Secure with activated option "Safe Inputs after Disc Error" (set in addition to bit 2)

Status information (8-bit value)

Value	Description
0	undefined
1	**RUN** The FB MON assumes the RUN state if there are no errors and neither the active MonIn inputs nor the active Secure inputs request a safe state. The outputs assume the following values: • Error = 0 • MonOut = 1 • MonDelOut = 1
2	**STOP** If the input FbRun=FALSE, FB MON assumes the STOP state. The outputs assume the following values: • Error = 0 • MonOut = 0 • MonDelOut = 0
3	**SAFE** The FB MON assumes the SAFE state as long as at least one of the active MonIn inputs and at least one of the active Secure inputs has requested the safe state. The outputs assume the following values: • Error = 0 • MonOut = 0 • MonDelOut = 0
4	**ERROR** If the FB MON detects an error, the FB MON switches to the ERROR state and sends the corresponding Diag message to the GROUP module. The outputs assume the following values: • Error = 1 • MonOut = 0 • MonDelOut = 0
5	**RESET** FB MON assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. The outputs assume the following values: • Error = 0 • MonOut = 0 • MonDelOut = 0
6	**START** FB MON assumes the START state if the Restart input is active and TRUE, in order to wait for a rising and falling edge of the Restart input before entering the RUN state and the outputs exit the safe state. This state can only be assumed if manual restart is active in the configuration data. The outputs assume the following values:

Value	Description
	• Error = 0 • MonOut = 0 • MonDelOut = 0
7	**ERRORDELAY** FB MON assumes the ERRDELAY state if a discrepancy error occurs in the RUN state (DiscError=TRUE), but the delay time for the MonDelOut output has not yet expired. This state can only be assumed if the Output Delay time in the configuration data is not equal to 0. The outputs assume the following values: • Error = 0 • MonOut = 0 • MonDelOut = 1
8	**DELAYOUT** FB MON assumes the DELAYOUT state if at least one of the active MonIn inputs and at least one of the active Secure inputs has requested the safe state and the delay time for the MonDelOut output has not yet expired. This state can only be assumed if the Output Delay time in the configuration data is not equal to 0. The outputs assume the following values: • Error = 0 • MonOut = 0 • MonDelOut = 1
9	**FUNCTEST** The FB MON assumes the FUNCTEST state if the manual function test is enabled in order to test all active MonIn inputs once after startup. This state can only be assumed if the manual function test is active in the configuration data. The outputs assume the following values: • Error = 0 • MonOut = 0 • MonDelOut = 0

If the checkboxes 'Map State' and 'Map Diag' are checked, the status and diagnostic data of the FB are copied to the cyclic process image.

NOTICE

KL6904

The checkboxes 'Map State', 'Map Diag' and 'Safe Inputs after Discrepancy Error' are not available in the KL6904.

4.5.3 Configuration in the TwinCAT System Manager

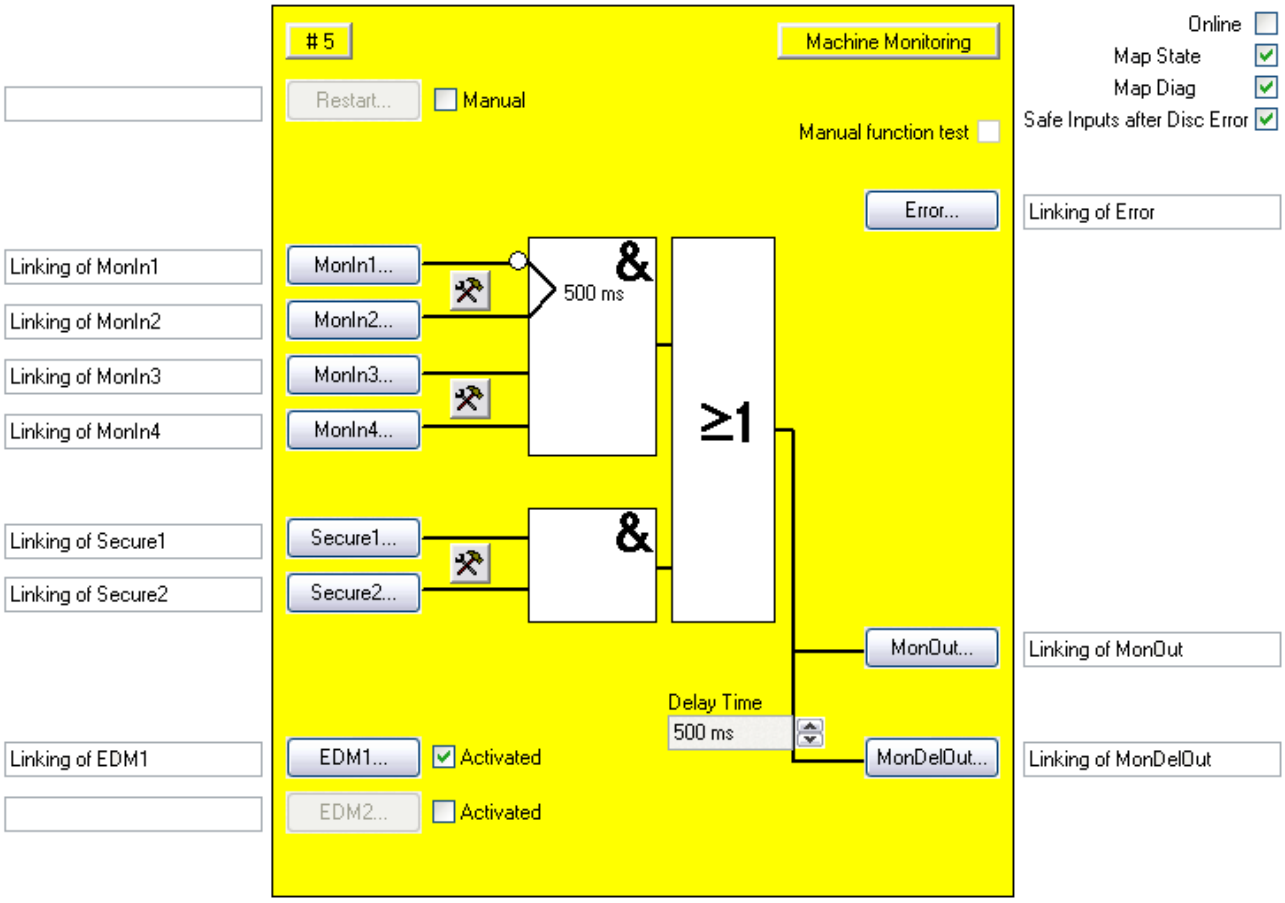

Fig. 39: FB MON configuration

The manual restart is activated using the "Manual" checkbox on the right near the 'Restart' button. The 'Restart' button can only be selected, if the manual restart is activated.
The characteristics of the input pair are configured with the setting buttons on the right near the two MonIn or Secure inputs of an input pair. The 'MonIn(x)' and 'Secure(x)' buttons can only be selected if the corresponding input has been activated via the Settings button. In the default state all inputs are disabled.

The corresponding feedback loop is activated using the 'Activated' checkbox on the right near the 'EDM(x)' buttons. The 'EDM(x)' button can only be selected, if the associated feedback loop is activated.
The FB MON input variables are linked using the 'Restart', 'MonIn(x)', 'Secure(x)' and 'EDM(x)' buttons.
The manual function test is activated using the 'Manual Function Test' checkbox.

The FB MON output variables are linked using the 'Error', 'MonOut' and 'MonDelOut' buttons.
The delay time of the 'MonDelOut' output is configured via the selection box 'Delay-Time'.

The characteristics for acknowledging a discrepancy error can be set via the checkbox ‘Safe Inputs after Disc Error’. If the checkbox is checked, both inputs of the input group that has caused the discrepancy error have to switch to safe state simultaneously before the error can be reset.

The '"Map State"' and '"Map Diag"' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

4.5.4 Restart behavior

If all active MonIn inputs and the active EDM inputs are TRUE and the Restart signal changes from FALSE to TRUE, the Start state (FB state 6) is assumed. The detection of a change of the Restart signal from TRUE to FALSE triggers a check whether all MonIn inputs are still TRUE and whether the EDM signal is still TRUE. The output is enabled if these criteria are met and the function block is not in ERROR state.

NOTICE

Restart input

The function block expects a push button with make contact at the restart input.

⚠ CAUTION

Restart

If the risk and hazard analysis indicates that a restart is to be implemented in the safety controller, the restart signal must be applied to a safe input.

Sample 1

The following diagram shows the behavior when an event is triggered via MonIn and subsequent acknowledgement of the MON function block via the Restart input. At least one of the EDM inputs of the FB is active.

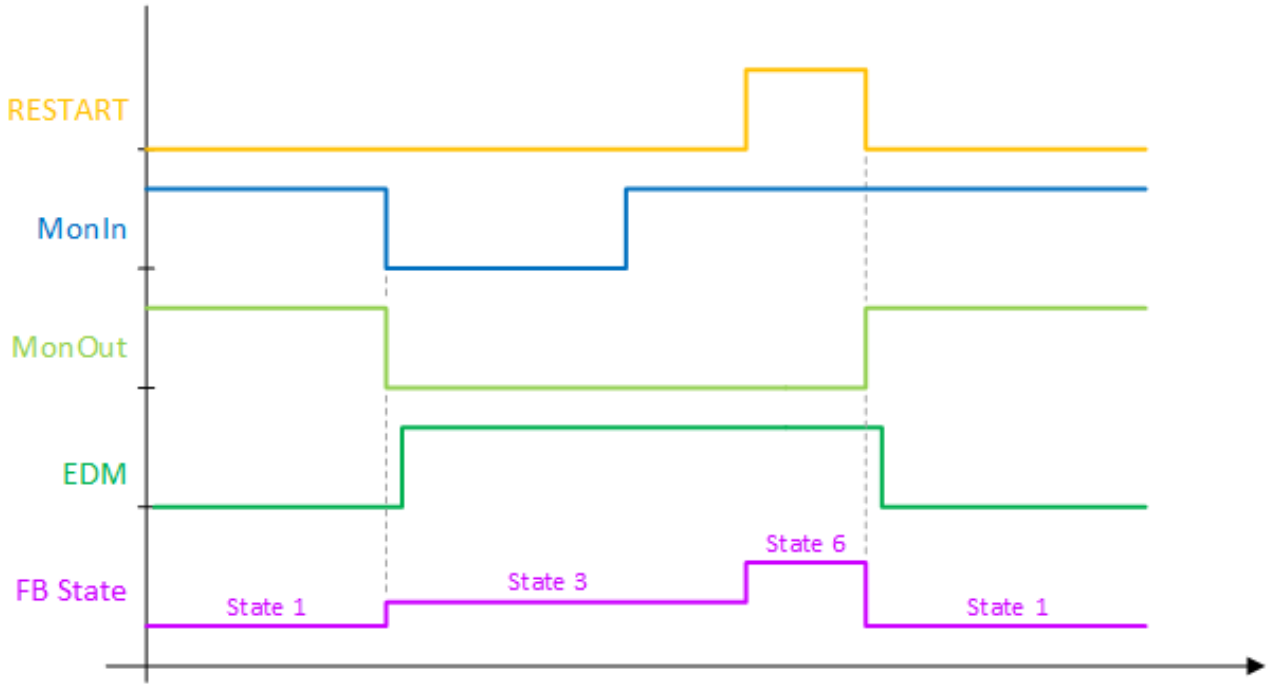

Fig. 40: Restart behavior MON (sample 1)

Sample 2

The following diagram shows the behavior of the MON function block; the rising edge of the Restart occurs before the rising edge of the MonIn inputs. The Start state (FB state 6) is only assumed if both signals are TRUE. The output is enabled with the falling edge at the Restart input. At least one of the EDM inputs of the FB is active.

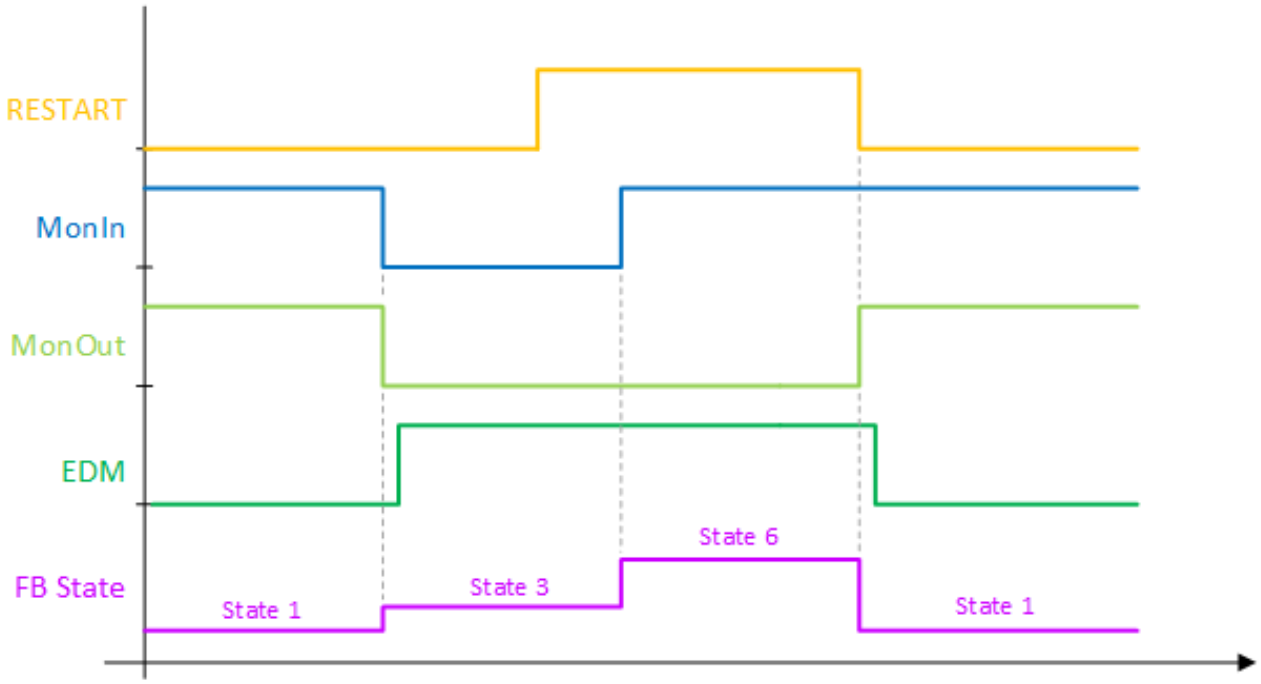

Fig. 41: Restart behavior MON (sample 2)

Sample 3

In the following diagram the Restart is set to TRUE before the MonIn event takes place. With the falling edge of the MonIn input, the EDM signal is immediately checked due to the Restart input signal. This immediately leads to an EDM error and to the shutdown of the entire TwinSAFE group. At least one of the EDM inputs of the FB is active.

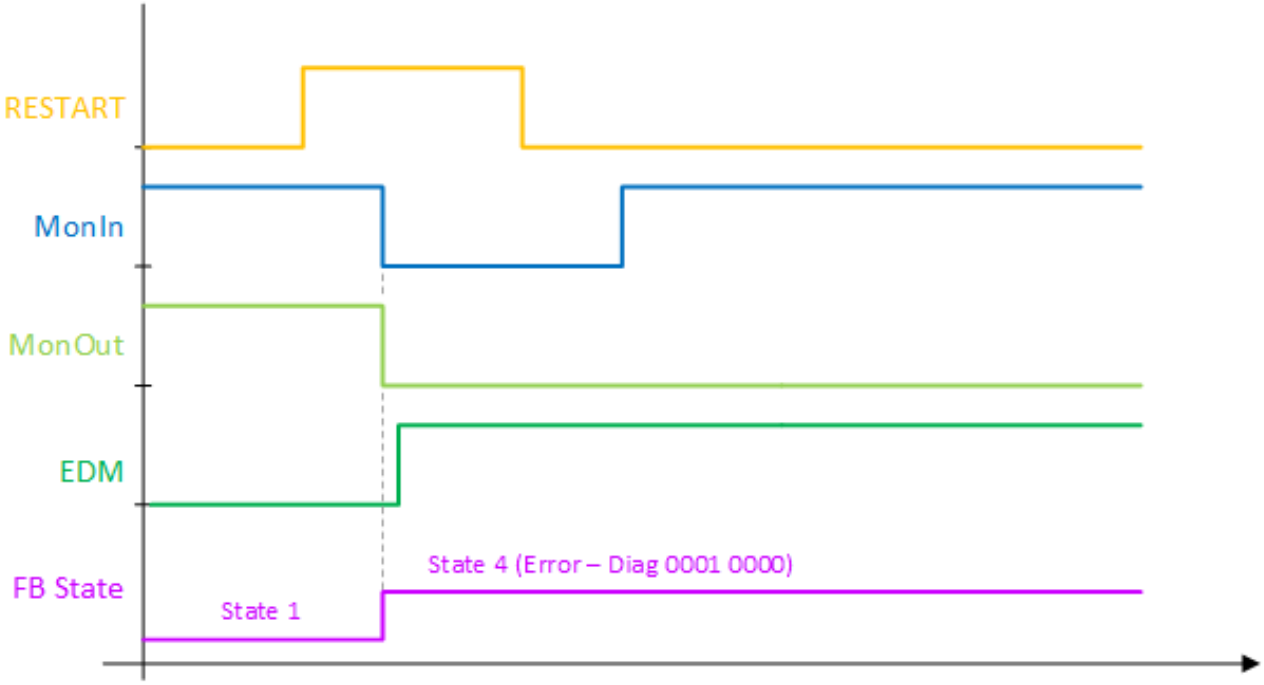

Fig. 42: Restart behavior MON (sample 3)

4.5.5 MON extension

NOTICE

Support

The extensions described below are only available in the EL6910 or newer terminals. These options cannot be used under the EL6900 and KL6904.

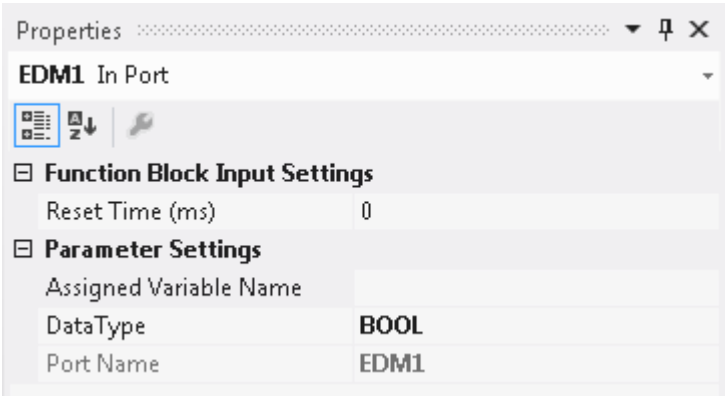

Fig. 43: EDM Reset Time

The FB MON can also be used to monitor the change of the state of the feedback signal (EDMn) when the outputs are switched on.

The inputs *EDM1* and *EDM2* have been assigned a further parameter *Reset Time (ms)*. Open the properties of the EDMx by right-clicking on the *EDMx* input of the *MON* function block. If this value is not equal to 0, the timer is started when the output *MonOut* is activated. If the *EDM* input does not switch to FALSE within this time, a function block error is set and the outputs are switched off.

This function can be switched off by entering 0 as *Reset Time (ms)*.

4.5.6 Configuration in TwinCAT 3

Display of the function block and its properties in TwinCAT 3.

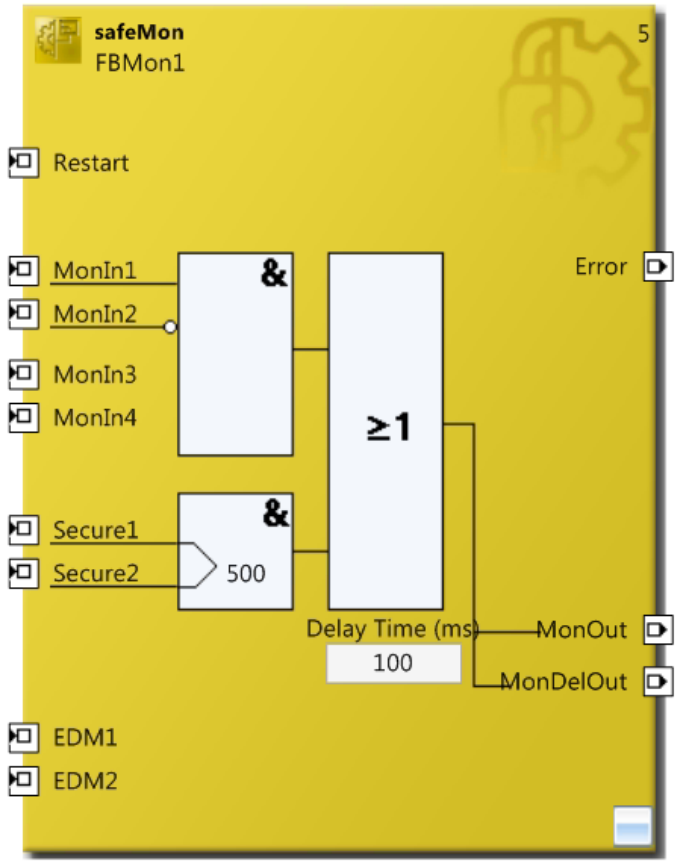

Fig. 44: FB MON in TwinCAT 3

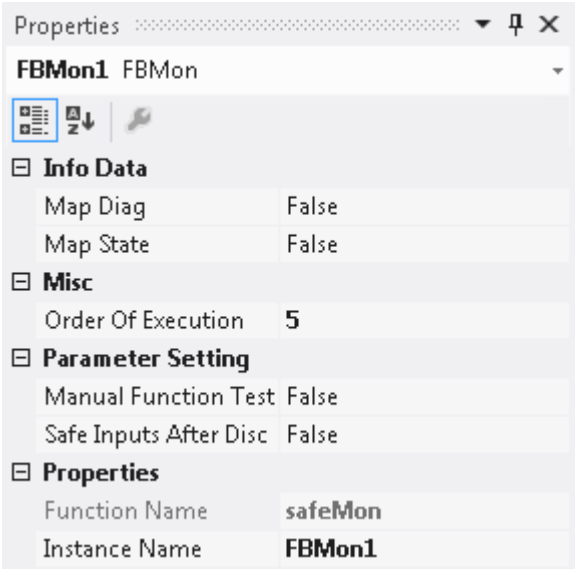

Fig. 45: FB MON properties

The function *Safe Inputs after Disc Error* is activated by default for the MON function block in the EL6910 and cannot be disabled. The display of the corresponding parameter and its value only applies if the function block is used on an EL6900; it can be ignored for the EL6910. A warning is issued if the parameter is set to TRUE under an EL6910.

4.6 The function block DECOUPLE

4.6.1 Functional description

The FB DECOUPLE is for uncoupling of signals from a TwinSAFE connection. The function block has 8 inputs and 8 outputs. The inputs are looped through to the outputs one-to-one. The associated output must be linked as soon as one of the function block inputs is used. The converse is also valid.

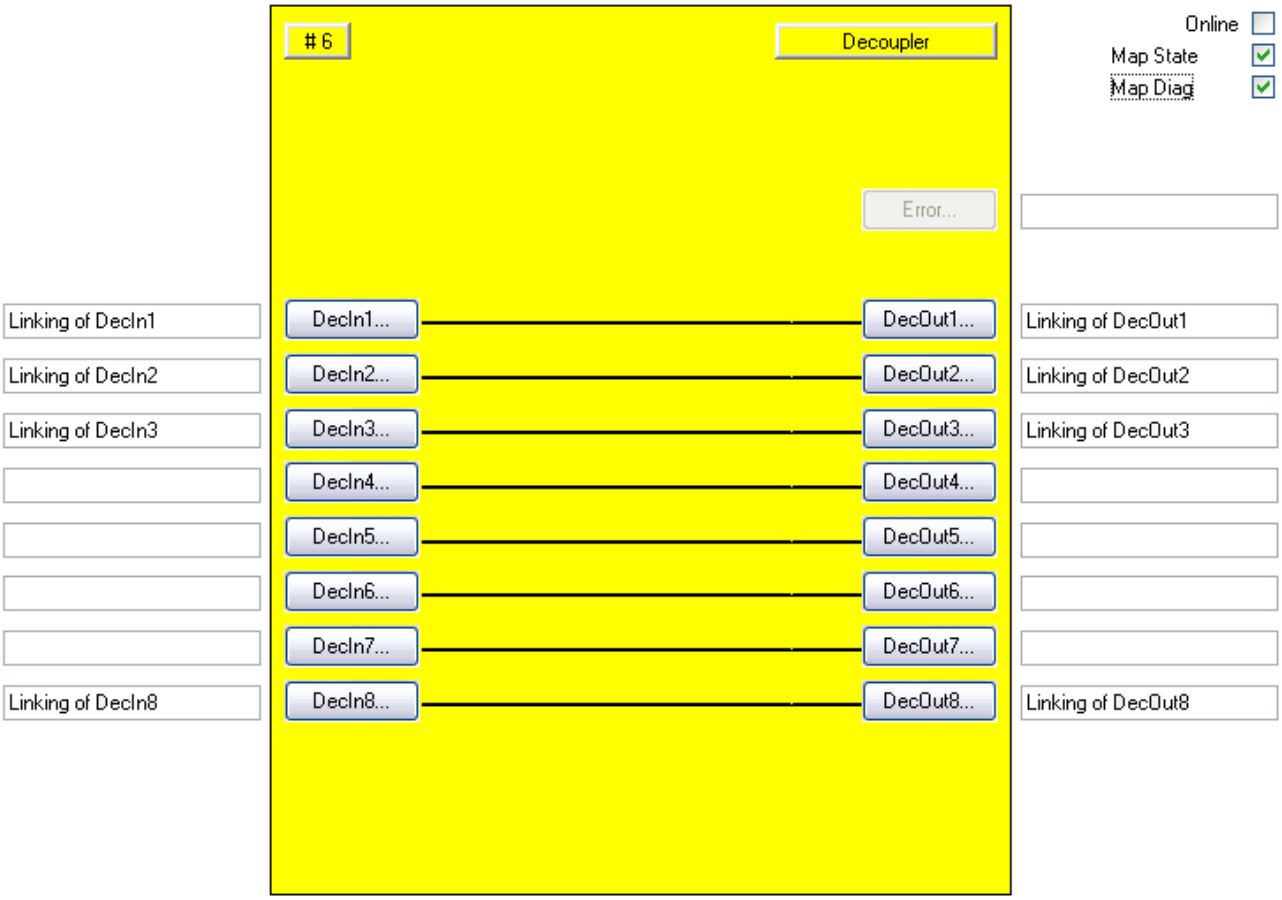

Fig. 46: Function block DECOUPLE

A TwinSAFE connection to a TwinSAFE I/O terminal is always assigned to a TwinSAFE group. Via the FB DECOUPLE it is possible to pass on the signals of a TwinSAFE connection to other TwinSAFE groups and thus decouple them.
The function block within an existing TwinSAFE group can be used to subdivide the signals.

The function block must be used in a separate TwinSAFE group in case the signals should be decoupled, since all used outputs of the TwinSAFE group can be switched off in case of a connection communication error.
The input signals of a TwinSAFE connection can now be linked with the FB DECOUPLE inputs, and the outputs distributed over the different TwinSAFE groups. It operates the same way in the other directions, the outputs of a TwinSAFE connection are linked with the FB DECOUPLE outputs, the FB DECOUPLE inputs can once again come from various TwinSAFE groups.

4.6.2 Signal description

FB DECOUPLE inputs

Name	Permitted type	Data type	Description
DecIn1	TwinSAFE-In FB-Out	BOOL	1st input channel

Name	Permitted type	Data type	Description
DecIn2	TwinSAFE-In FB-Out	BOOL	2nd input channel
DecIn3	TwinSAFE-In FB-Out	BOOL	3rd input channel
DecIn4	TwinSAFE-In FB-Out	BOOL	4th input channel
DecIn5	TwinSAFE-In FB-Out	BOOL	5th input channel
DecIn6	TwinSAFE-In FB-Out	BOOL	6th input channel
DecIn7	TwinSAFE-In FB-Out	BOOL	7th input channel
DecIn8	TwinSAFE-In FB-Out	BOOL	8th input channel

FB DECOUPLE outputs

Name	Permitted type	Data type	Description
DecOut1	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	1st output channel
DecOut2	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	2nd output channel
DecOut3	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	3rd output channel
DecOut4	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	4th output channel
DecOut5	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	5th output channel
DecOut6	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	6th output channel
DecOut7	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	7th output channel
DecOut8	TwinSAFE-Out FB-In Standard-Out Local-Out	BOOL	8th output channel

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. on an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output

Type	Description
TwinSAFE-Out	TwinSAFE output, e.g. on an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
Local-Out	TwinSAFE output at the KL6904 (not available for EL6900)

Internal identifier of the FB

Type	Description
FB DECOUPLE	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for FB DECOUPLE

Diagnostic information (16-bit value)

Bit	Description
0	always 0

Status information (8-bit value)

Value	Description
0	undefined
1	**RUN** If the input FbRun = TRUE, the FB DECOUPLE switches to the RUN state. The output assumes the following value: • DcOutX = DcInX
2	**STOP** If the input FbRun = FALSE, FB DECOUPLE switches to the STOP state. The output assumes the following value: • DcOutX = 0

If the checkboxes 'Map State' and 'Map Diag' are checked, the status and diagnostic data of the FB are copied to the cyclic process image.

NOTICE

KL6904

The 'Map State' and 'Map Diag' checkboxes are not available for the KL6904.

4.6.3 Configuration in the TwinCAT System Manager

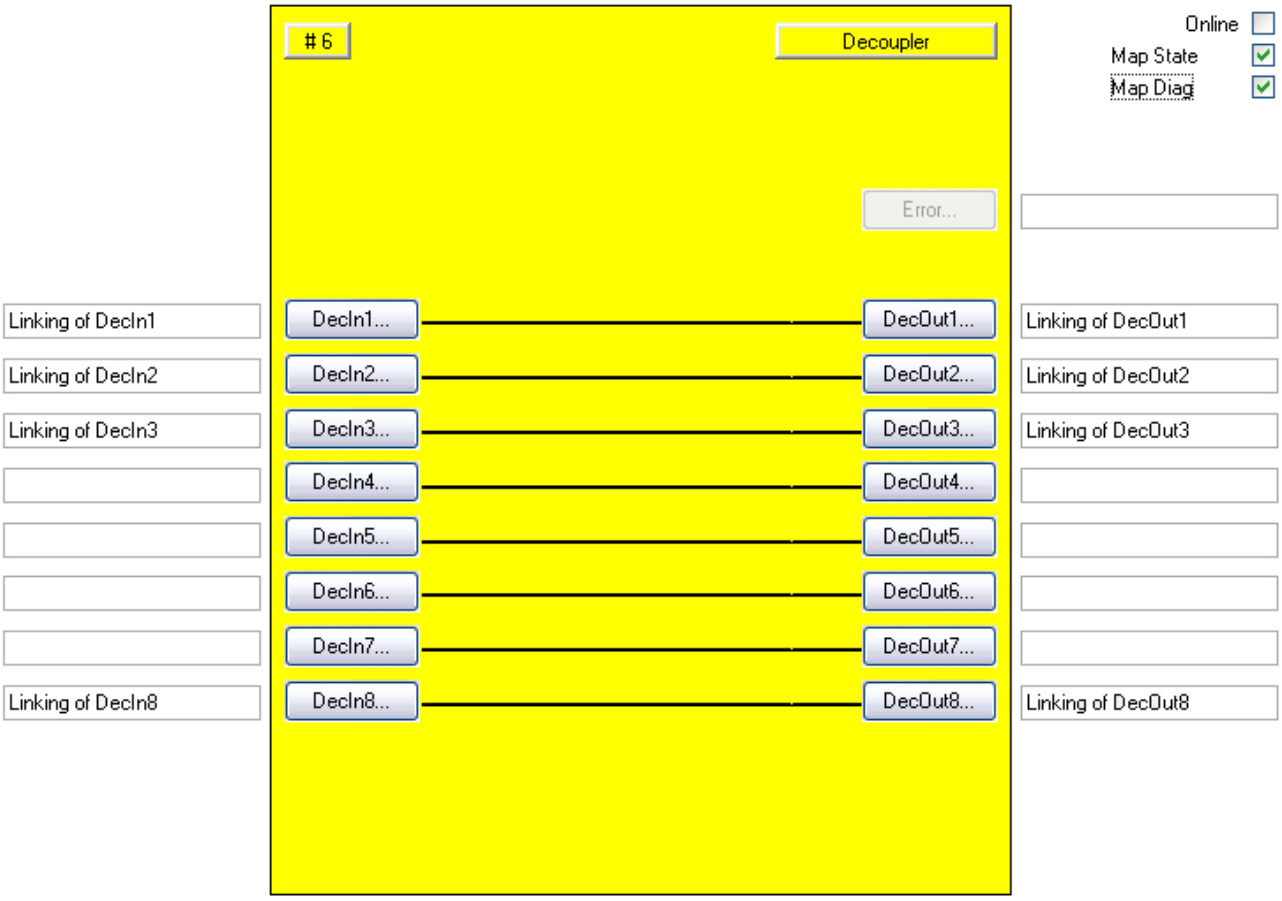

Fig. 47: FB DECOUPLE configuration

The FB DECOUPLE input variables are linked using the 'DecIn(x)' buttons.

The FB DECOUPLE output variables are linked using the 'DecOut(x)' buttons.

The '"Map State"' and '"Map Diag"' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

The FB DECOUPLE does not supply any error information and therefore the error button is basically deactivated.

4.6.4 Configuration in TwinCAT 3

Display of the function block and its properties in TwinCAT 3.

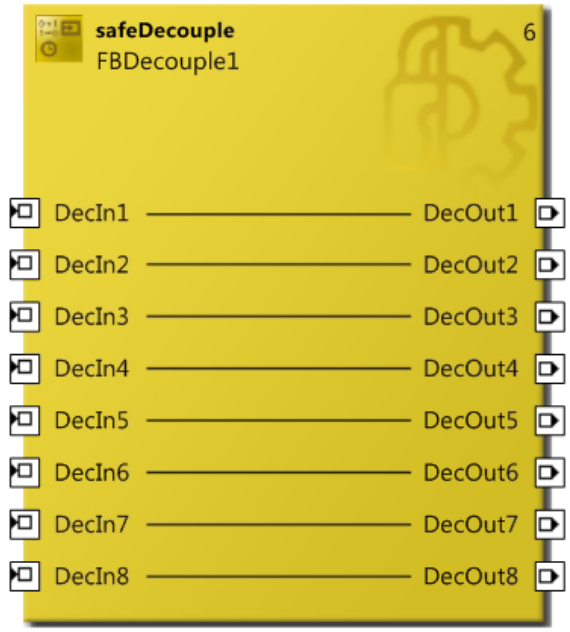

Fig. 48: FB DECOUPLE in TwinCAT 3

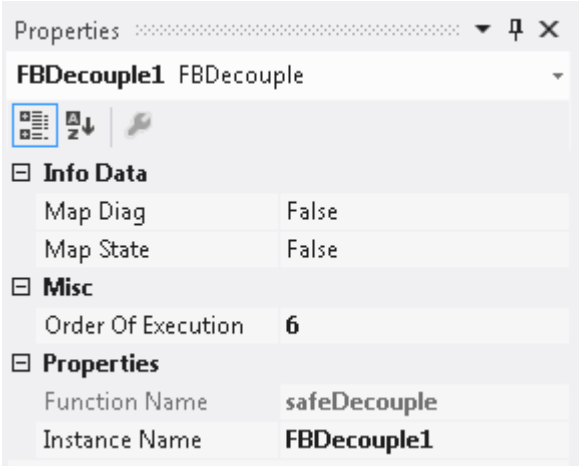

Fig. 49: FB DECOUPLE properties

4.7 The function block TWOHAND

4.7.1 Functional description

The FB TWOHAND implements two-hand control. Both input groups must be actuated simultaneously to switch the output. Repeated setting of the output is only possible if both input groups were not actuated at the same time.

Each input group can be configured as a single-channel input, two-channel input or two-channel input with discrepancy time monitoring. In addition, time monitoring up to 2500 ms between the two input groups can be defined.
Each input can be configured as break contact (NC) or make contact (NO).

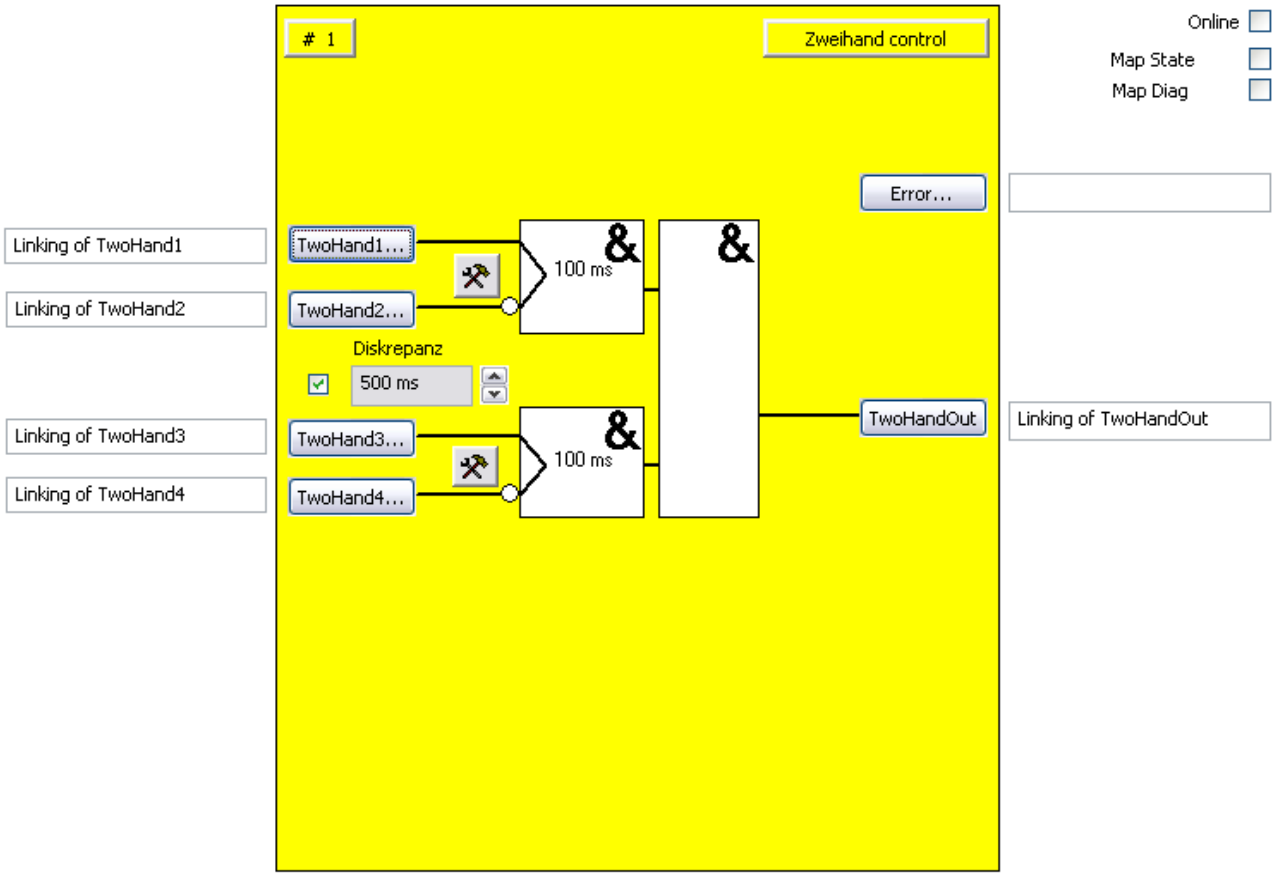

Fig. 50: Function block TWOHAND

NOTICE

KL6904

The TWOHAND function block is not available in the KL6904.

4.7.2 Signal description

FB TWOHAND inputs

Name	Permitted type	Data type	Description
Twohand1	TwinSAFE-In FB-Out	BOOL	1st input channel. The parameterization determines, whether the input is linked to a break contact (safe state will be requested by logical 0) or make contact (safe state will be requested by logical 1).
Twohand2	TwinSAFE-In FB-Out	BOOL	2nd input channel, behavior like Twohand1 If the discrepancy time is not equal to 0, the 1st and 2nd input channels are regarded as the 1st input pair and discrepancy time monitoring is performed between the two channels if one of the two input channels requests the safe state
Twohand3	TwinSAFE-In FB-Out	BOOL	3rd input channel or 1st input channel of the 2nd input pair, otherwise corresponds with Twohand1
Twohand4	TwinSAFE-In FB-Out	BOOL	4th input channel or 2nd input channel of the 2nd input pair, otherwise corresponds with Twohand2

FB TWOHAND outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	TRUE: The discrepancy time monitoring for a two-channel input group has detected an error. The error must be acknowledged via the ERR_ACK input of the corresponding TwinSAFE group FALSE: No error was found
TwoHandOut	TwinSAFE-Out FB-In Standard-Out	BOOL	1st output channel, the safe state corresponds to a logical 0.

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. on an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. on an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input

Internal identifier of the FB

Type	Description
FB Twohand	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for FB TWOHAND

Diagnostic information (16-bit value)

Bit	Description
0	Discrepancy error input pair 1
1	Discrepancy error input pair 2
2	Discrepancy error between the two input pairs
6	Two-hand error - one of the two input pairs is actuated and waiting for the second input pair. The error is output if the second input pair is now actuated and the first input pair is no longer detected as actuated.
8	Discrepancy error input pair 1 with enabled option "Safe Inputs after Disc Error" (set in addition to bit 0) (not EL6900/KL6904)
9	Discrepancy error input pair 2 with enabled option "Safe Inputs after Disc Error" (set in addition to bit 1) (not EL6900/KL6904)
10	Discrepancy error between the input pairs with enabled option "Safe Inputs after Disc Error" (set in addition to bit 2) (not EL6900/KL6904)

Status information (8-bit value)

Value	Description
0	undefined
1	**RUN** The FB TWOHAND assumes the RUN state if all active inputs are TRUE. The FB TWOHAND can only enter the RUN state from either 1BUTTON or 2BUTTON state. The outputs take on the following values: • Error = 0 • TwoHandOut = 1

Value	Description
2	**STOP** If the input FbRun = FALSE, FB TWOHAND assumes the STOP state. The outputs assume the following values: • Error = 0 • TwoHandOut = 0
3	**SAFE** If all active inputs are FALSE, FB TWOHAND assumes the SAFE state. If all active inputs of an input group are TRUE, FB TWOHAND exits the SAFE state. The outputs assume the following values: • Error = 0 • TwoHandOut = 0
4	**ERROR** If the FB TWOHAND detects an error, the FB TWOHAND switches to the ERROR state and sends the corresponding Diag message to the GROUP module. The outputs assume the following values: • Error = 1 • TwoHandOut = 0
5	**RESET** FB TWOHAND assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. The outputs assume the following values: • Error = 0 • TwoHandOut = 0
11	**1BUTTON** If all active inputs of the first input group are TRUE and at least one active input of the second input group is FALSE, FB TWOHAND assumes the 1BUTTON state. The FB TWOHAND only assumes the 1BUTTON state from the SAFE state. The outputs assume the following values: • Error = 0 • TwoHandOut = 0
12	**2BUTTON** If all active inputs of the second input group are TRUE and at least one active input of the first input group is FALSE, FB TWOHAND assumes the 2BUTTON state. The FB TWOHAND only assumes the 2BUTTON state from the SAFE state. The outputs assume the following values: • Error = 0 • TwoHandOut = 0
13	**RELEASE** If at least one active input is FALSE, FB TWOHAND assumes the RELEASE state. If all active inputs are FALSE, the FB TWOHAND module exits the RELEASE state. The outputs assume the following values: • Error = 0 • TwoHandOut = 0

4.7.3 Configuration in the TwinCAT System Manager

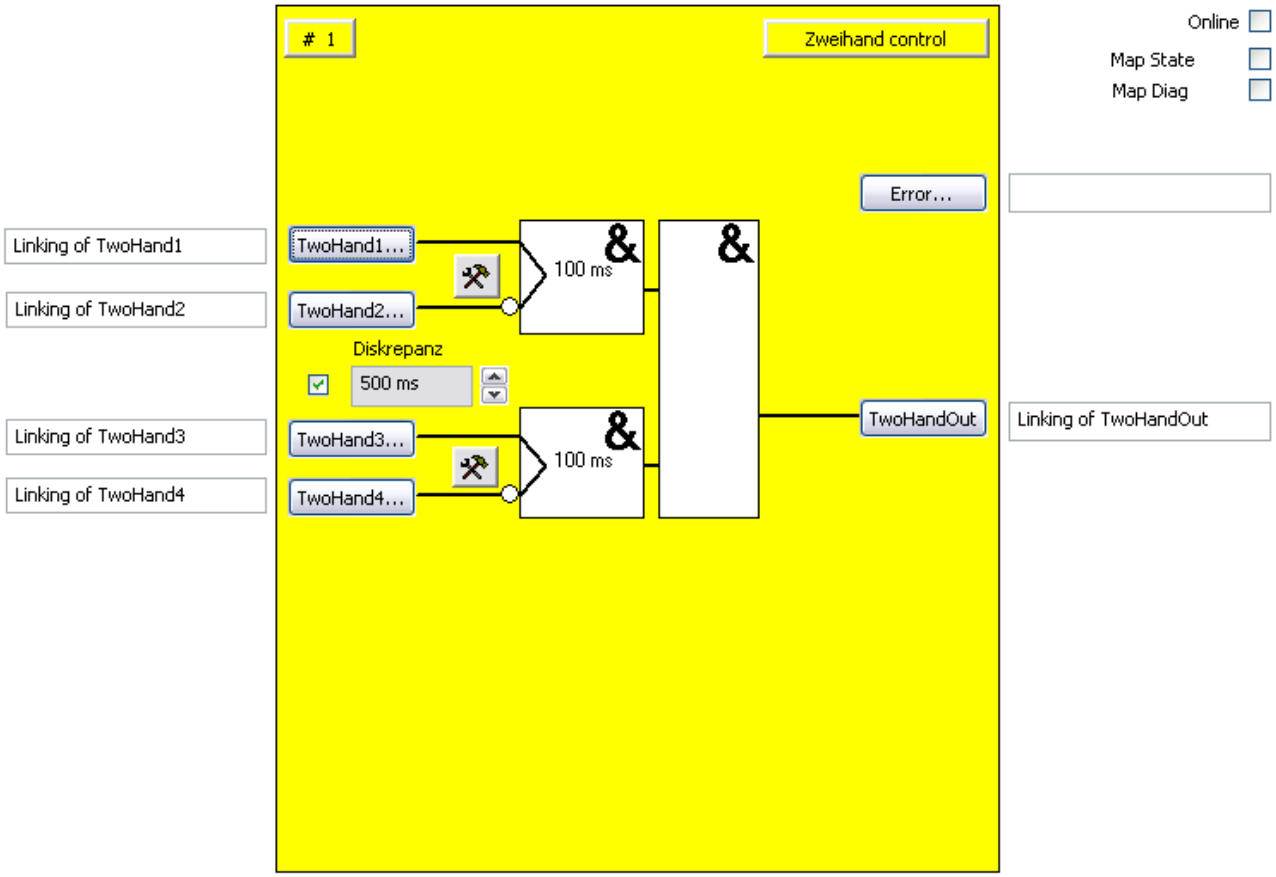

Fig. 51: FB TWOHAND configuration

Discrepancy time monitoring between the two input pairs is activated via the 'Discrepancy' checkbox. The discrepancy time can be set in the selection box next to the checkbox (max. 2500 ms).

The characteristics of the input pair are configured with the setting buttons on the right near the two TwoHand(x) inputs of an input pair. The 'TwoHand(x)' buttons are only available once the corresponding input was activated. In delivery state are all inputs are disabled.

The FB TWOHAND input variables are linked using the 'TwoHand(x)' buttons.

The buttons 'Error' and 'TwoHandOut' are used to link the output variables of FB TWOHAND.

The '"Map State"' and '"Map Diag"' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

4.7.4 Configuration in TwinCAT 3

Display of the function block and its properties in TwinCAT 3.

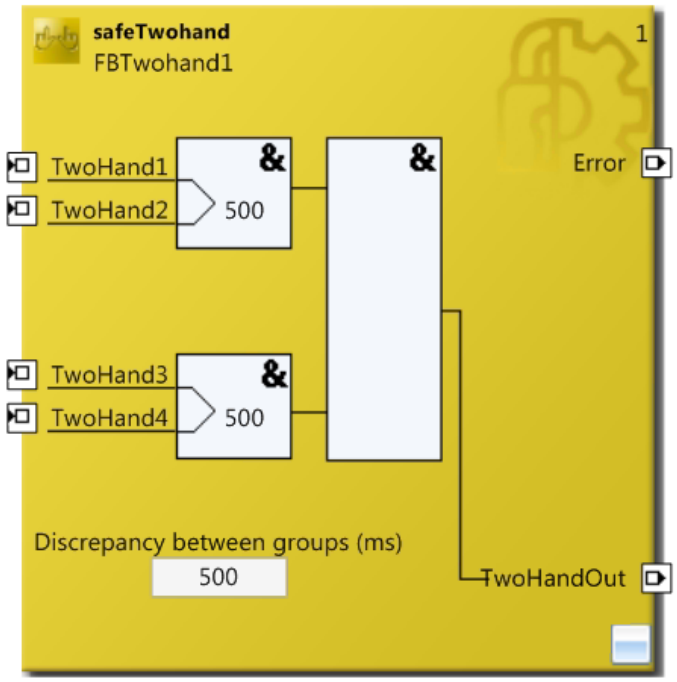

Fig. 52: FB TWOHAND in TwinCAT 3

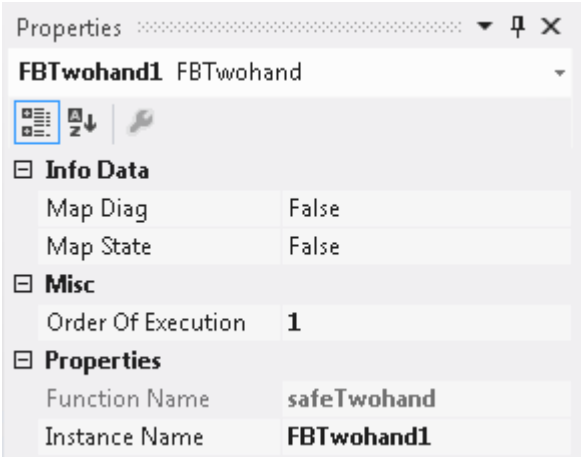

Fig. 53: FB TWOHAND properties

4.8 The function block MUTING

4.8.1 Functional description

FB MUTING is used to realize specified suppression of the protective function, e.g. for transporting material into the protection area. The function block output remains enabled despite the fact that the connected sensor (e.g. light curtain) is interrupted. The process is monitored with the aid of muting sensors. The MUTING inputs are used to verify that they are operated in a defined order.

MUTING can be enabled via the Enable input. If the input is logic 0 an interruption of the protective device results in immediate shutdown of the FB output. If the input is logical 1 the only takes place if the MUTING sequence is violated.
The 'Sequential Inputs' checkbox can be used to specify whether 2 inputs are checked in parallel or whether each input is checked sequentially.
A filter time up to 500 ms can be set for the MUTING inputs in order to prevent bouncing of the MUTING signals and therefore violation of the MUTING sequence.
The maximum duration of the MUTING process can be monitored via the 'Max. MUTINGTime' parameter.
The MUTING process starts with a logic 1 signal of the first MUTING input and ends with the logic 0 signal of

the last MUTING input. The value can be configured to a maximum of 10 minutes. The value 0 disables the monitoring.
The 'MutingActive' output of the function block is set during the MUTING process.
The protective device (AOPD - Active Opto-electronic Protection Device, for example a light curtain), is connected at the OSSDIn(x) inputs.
Feedback signals can be connected at the EDM inputs. In the default setting the inputs are disabled.
Direct outputs are connected via the 'MuteOut' button, outputs that are delayed by up to 30 seconds via the 'MuteDelOut' button.

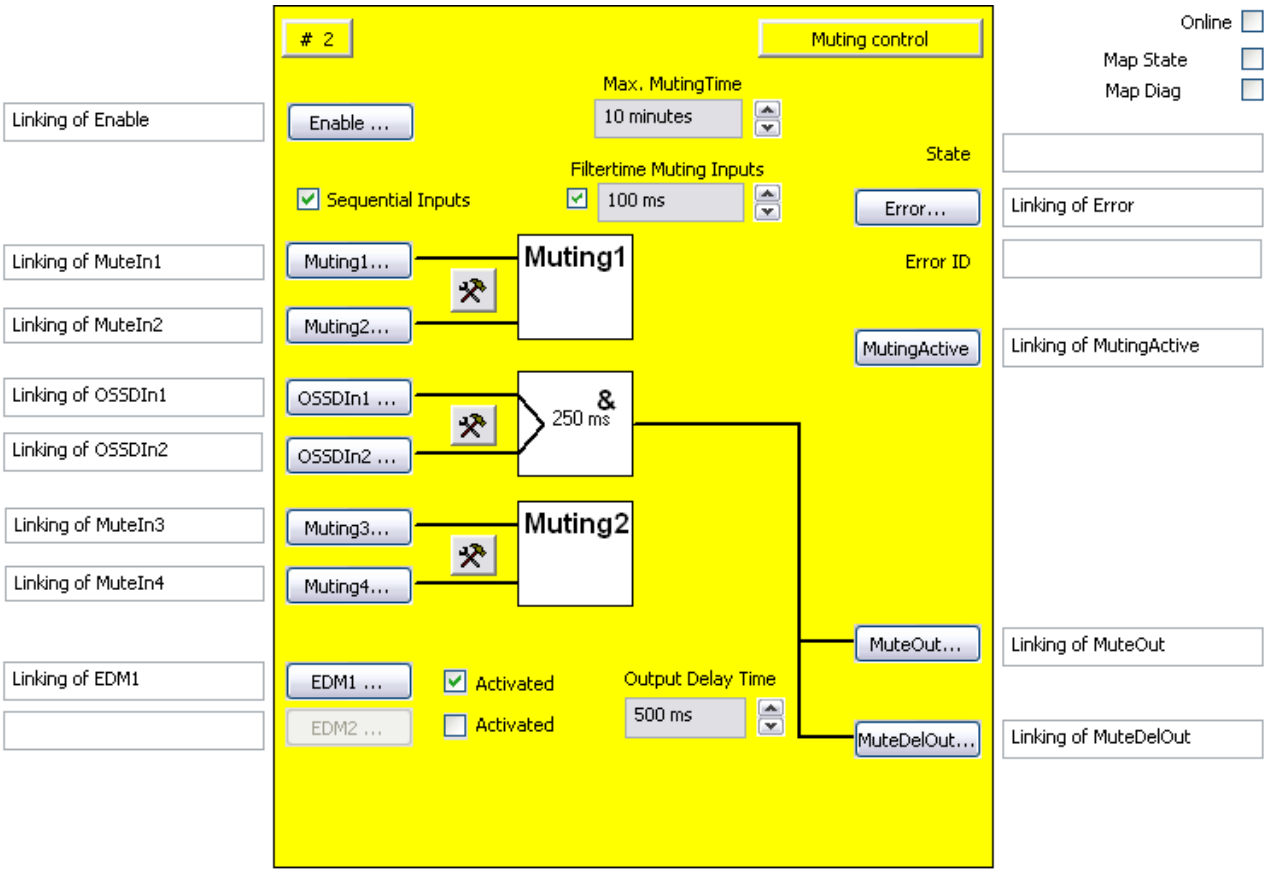

Fig. 54: Function block MUTING

NOTICE

KL6904

The MUTING function block is not available in the KL6904.

4.8.2 Signal description

FB MUTING inputs

Name	Permitted type	Data type	Description
MutingEnable	TwinSAFE-In FB-Out Standard-In	BOOL	Muting can be enabled via the Enable input. If the input is logic 0 an interruption of the protective device results in immediate shutdown of the FB output.
EDM1	TwinSAFE-In FB-Out Standard-In	BOOL	EDM1 is the feedback loop for the output channel (MuteOut), which is switched off immediately. If this input as activated, the safe output state is only exited when EDM1 is set to 1
EDM2	TwinSAFE-In FB-Out Standard-In	BOOL	EDM2 is the feedback loop for the output channel (MuteDelOut), which is switched off with a delay. If this input as activated, the safe output state is only exited when EDM2 is set to 1

Name	Permitted type	Data type	Description
MutingIn1	TwinSAFE-In FB-Out	BOOL	The muting inputs are used to verify that they are operated in a defined order. 1st input channel. The parameterization is used to specify whether the input has to be negated or is used directly.
MutingIn2	TwinSAFE-In FB-Out	BOOL	2nd input channel, behavior like MutingIn1 If the discrepancy time is not equal to 0, the 1st and 2nd input channels are regarded as the 1st input group and discrepancy time monitoring takes place between the two channels if one of the two input channels requests the safe state
OSSDIn1	TwinSAFE-In FB-Out	BOOL	The protective device (AOPD - Active Opto-electronic Protection Device), for example a light curtain, is connected at the 'OSSDIn' inputs. 1st input channel. The parameterization is used to specify whether the input has to be negated or is used directly.
OSSDIn2	TwinSAFE-In FB-Out	BOOL	OSSDIn2 is the 2nd channel for the protective device and otherwise corresponds to OSSDIn1 If the discrepancy time is not 0, the 1st and 2nd OSSD inputs are considered as 1 input pair. Discrepancy time monitoring between the two channels is active if one of the two input channels requests the safe state.
MutingIn3	TwinSAFE-In FB-Out	BOOL	3rd input channel or 1st input channel of the 2nd input group, otherwise corresponds with MutingIn1
MutingIn4	TwinSAFE-In FB-Out	BOOL	4th input channel or 2nd input channel of the 2nd input group, otherwise corresponds with MutingIn2

FB MUTING outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	TRUE: The discrepancy time monitoring of a 2-channel input group has detected an error, the muting sequence was violated or the maximum muting time was exceeded. The error reset must be carried out via the ERR_ACK input of the related TwinSAFE group. FALSE: No error was found
MutingActive	TwinSAFE-Out FB-In Standard-Out	BOOL	1st output channel, indicates the active muting process through logic 1.
MuteOut	TwinSAFE-Out FB-In Standard-Out	BOOL	1st output channel, the safe state corresponds to a logical 0.
MuteDelOut	TwinSAFE-Out FB-In Standard-Out	BOOL	2nd output channel, the safe state corresponds to a logical 0. The safe state is output with a delay, which corresponds to the parameterized Output Delay Time

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. on an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. on an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input

Internal identifier of the FB

Type	Description
FB MUTING	This description applies to BLG 1.0 / BLG 2.0 (internal version number)

Diagnostic and status information for FB MUTING

Diagnostic information (16-bit value)

Bit	Description
0	Discrepancy error in muting input group 1
1	Discrepancy error in the OSSD input group
2	Discrepancy error in muting input group 2
4	EDM monitoring error EDM1
5	EDM monitoring error EDM2
6	Muting sequence was violated
7	Maximum muting time was exceeded
8	Discrepancy error MuteIn1/MuteIn2 has not yet been reset (not EL6900)
9	Discrepancy error OssdIn1/OssdIn2 has not yet been reset (not EL6900)
10	Discrepancy error MuteIn3/MuteIn4 has not yet been reset (not EL6900)

Status information (8-bit value)

Value	Description
0	undefined
1	**RUN** If OssdInActive = TRUE and MutingEnable = FALSE or no muting sequence has been started yet, FB MUTING assumes the RUN state. The outputs assume the following values: • Error = 0 • MutingActive = 0 • MuteOut = 1 • MuteDelOut = 1
2	**STOP** If the input FbRun = FALSE, FB MUTING assumes the STOP state. The outputs assume the following values: • Error = 0 • MutingActive = 0 • MuteOut = 0 • MuteDelOut = 0
3	**SAFE** If OssdInActive = FALSE and MutingEnable = FALSE, the FB MUTING assumes the SAFE state. The outputs assume the following values: • Error = 0 • MutingActive = 0 • MuteOut = 0 • MuteDelOut = 0
4	**ERROR** If the FB MUTING detects an error, FB MUTING switches to the ERROR state and sends the corresponding Diag message to the GROUP module. The outputs assume the following values: • Error = 1 • MutingActive = 0

Value	Description
	• MuteOut = 0 • MuteDelOut = 0
5	**RESET** FB MUTING assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. The outputs assume the following values: • Error = 0 • MutingActive = 0 • MuteOut = 0 • MuteDelOut = 0
6	not used
7	not used
8	**DELAYOUT** The FB MUTING assumes the DELAYOUT state if OssdInActive = FALSE and MutingEnable = FALSE, but the delay time for the MuteDelOut output has not yet expired. If a discrepancy error occurs in the DELAYOUT state, the FB MUTING only assumes the ERROR state after the output delay time has elapsed. The outputs assume the following values: • Error = 0 • MutingActive = 0 • MuteOut = 0 • MuteDelOut = 1
9	**MUTING1** (Figure 3-35 [▶ 80] number 2-3) The outputs assume the following values: • Error = 0 • MutingActive = 1 • MuteOut = 1 • MuteDelOut = 1
10	**MUTING2** (figure 3-35 [▶ 80] number 3-4) Outputs see State 9
11	**MUTING3** (figure 3-35 [▶ 80] number 4-5) Outputs see State 9
12	**MUTING4** (figure 3-35 [▶ 80] number 5-6) Outputs see State 9
13	**MUTING5** (figure 3-35 [▶ 80] number 6-7) Outputs see State 9
14	**MUTING6** (figure 3-35 [▶ 80] number 7-8) Outputs see State 9
15	**MUTING7** (figure 3-35 [▶ 80] number 8-9) Outputs see State 9
16	**MUTING8** (figure 3-35 [▶ 80] number 9-10) Outputs see State 9
17	**MUTING9** (figure 3-35 [▶ 80] number 10-11) Outputs see State 9

4.8.3 Configuration in the TwinCAT System Manager

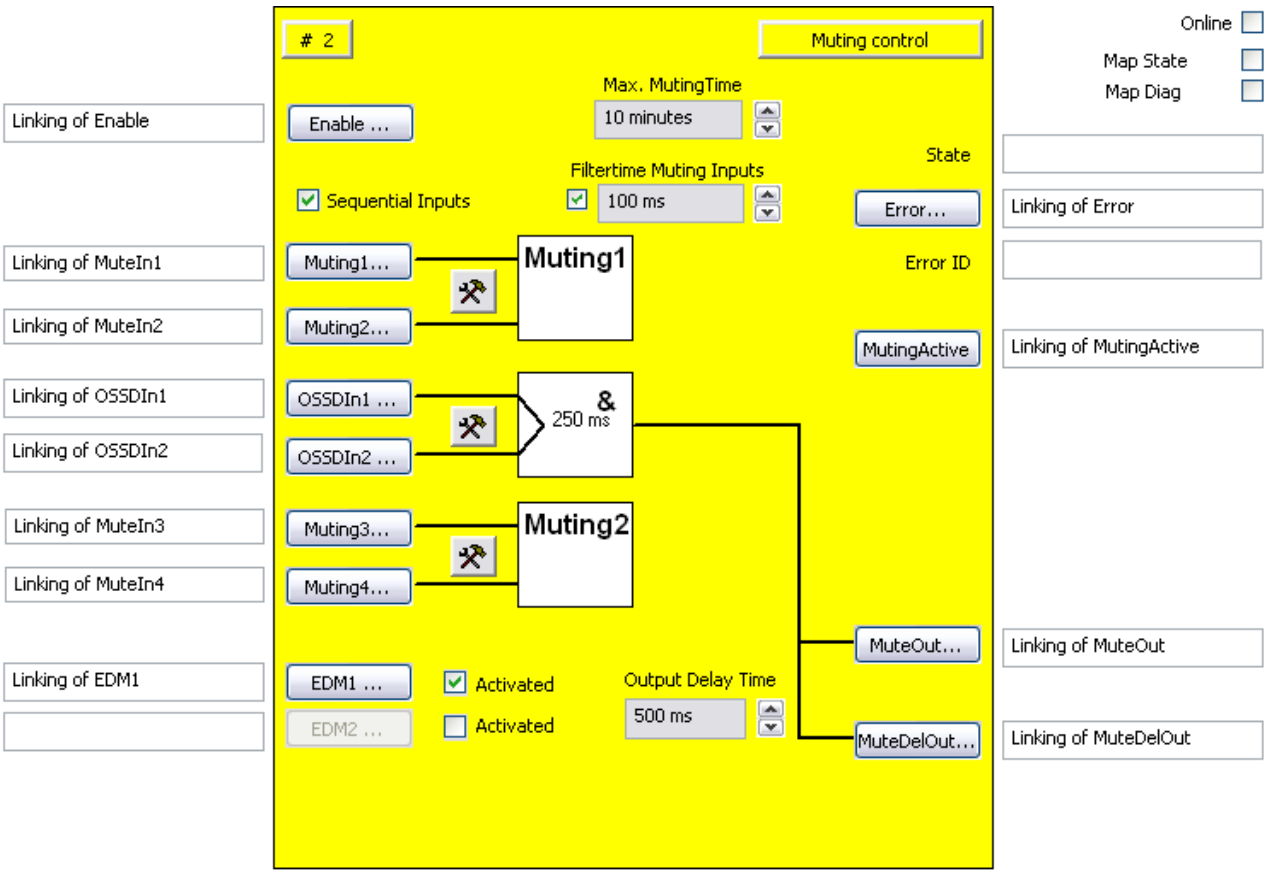

Fig. 55: FB MUTING configuration

An input through which MUTING can be enabled must be connected via the 'Enable' button.

The 'MUTING(x)' buttons are used to connect the MUTING sensors to the function block. Use the Settings buttons to the right of two MUTING inputs to configure them. The 'MUTING (x)' buttons can only be selected when the corresponding input has been activated. All inputs are deactivated in the default setting.

Two-channel evaluation with or without discrepancy time monitoring can be set if the checkbox “Sequential Inputs” is not set. If the "Sequential Inputs" checkbox is set, only single-channel evaluation can be configured via the Settings button. In addition, each input can be configured as a break contact (NC) or as a make contact (NO).

The maximum permitted MUTING period can be set via the 'Max. MUTING Time' text box. If this time exceeded the function block switches to ERROR state. The maximum MUTING period is 10 minutes. It the value is set to 0 minutes, monitoring is disabled.

A filter time up to 500 ms can be activated for the MUTING(x) inputs via the "Filtertime MUTING Inputs" checkbox.

The 'OSSDIn(x)' inputs are connected with the signals from the protective device. Use the Settings button to the right of the OSSDIn inputs to configure them. The setting options include single- or two-channel evaluation or two-channel evaluation with discrepancy time monitoring.

Direct outputs are connected via the 'MuteOut' button, delayed outputs via the 'MuteDelOut' button. The delay time of the 'MuteDelOut' output is configured via the selection box 'Delay-Time'.

The corresponding feedback loop is active using the 'Activated' checkbox on the right near the 'EDM(x)' buttons. The 'EDM(x)' button can only be selected, if the associated feedback loop is activated.

The error state can be connected via the 'Error' button.

NOTICE

Error state

If the MUTING function was interrupted by an error, the user should ensure via the application that the material can be removed from the MUTING area. Only then is an error acknowledgement possible.

Via the 'MutingActive' button a signal can be linked that can be used for a MUTING lamp, for example.

The '"Map State"' and '"Map Diag"' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

4.8.3.1 Configuration example with 4 individual MUTING sensors

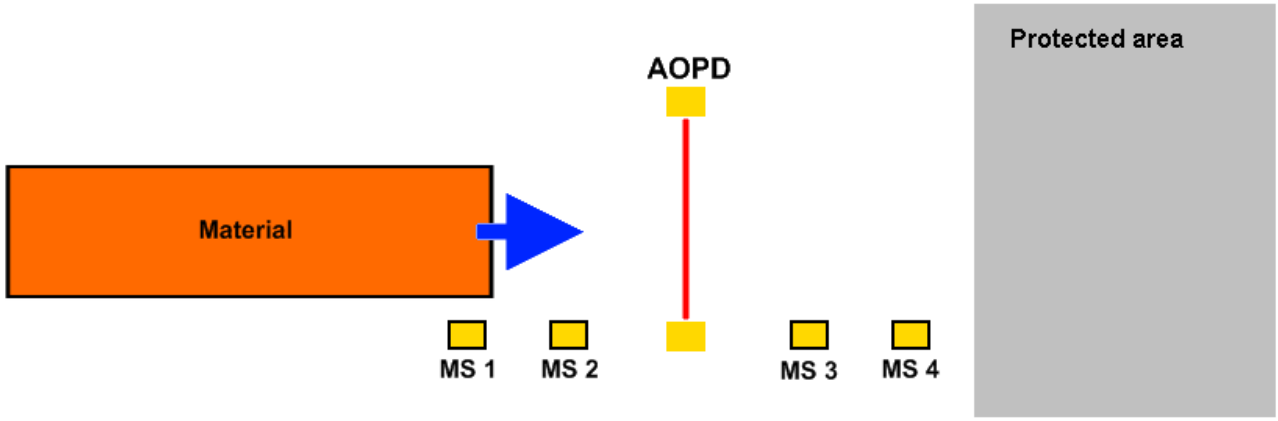

Fig. 56: Configuration example with 4 individual MUTING sensors

The following screenshot shows the parameterization of FB MUTING for this case. The 'Sequential Inputs' checkbox is checked. The 4 MUTING inputs are configured and wired as single-channel inputs.

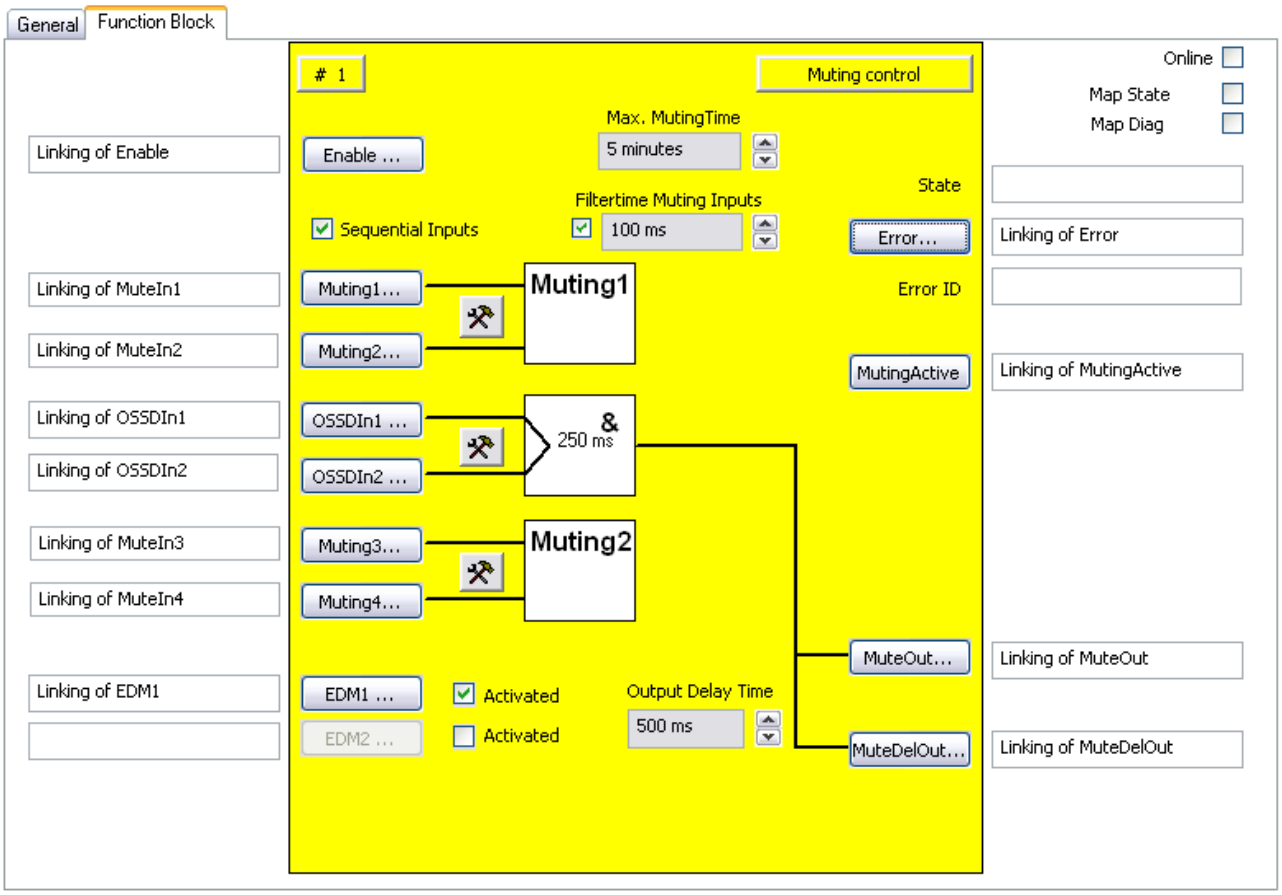

Fig. 57: Parameterization of the FB MUTING for 4 individual MUTING sensors

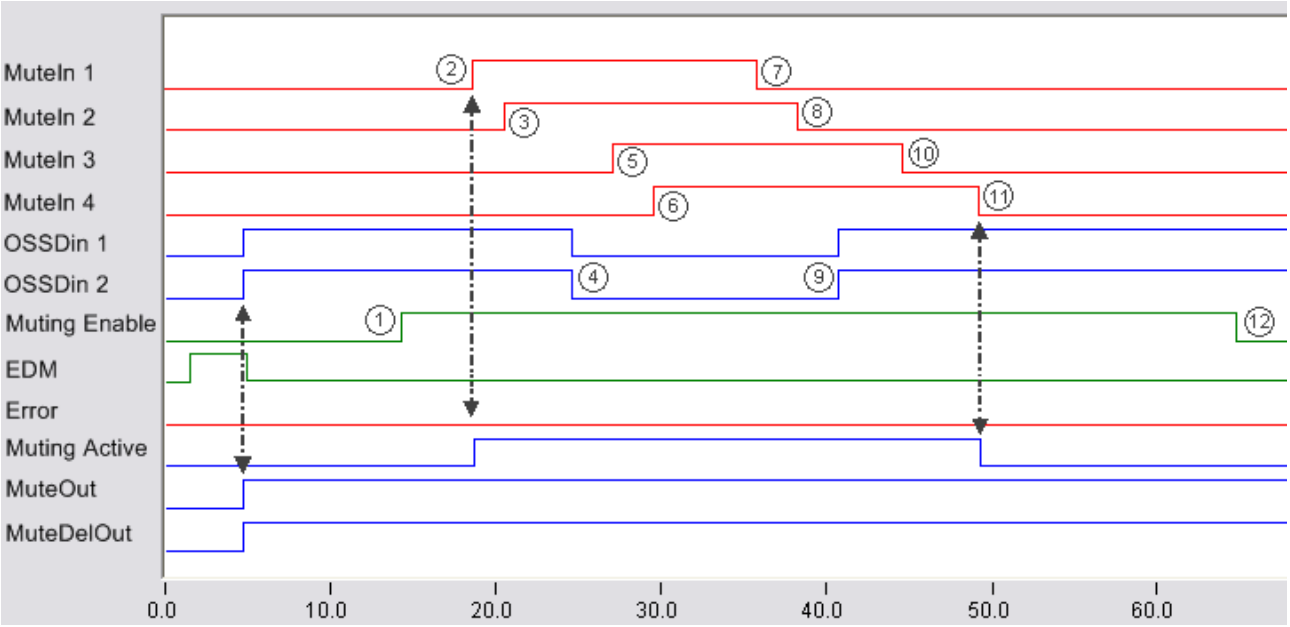

Fig. 58: Sequence for 4 individual MUTING sensors

4.8.3.2 Configuration example with two two-channel MUTING sensors

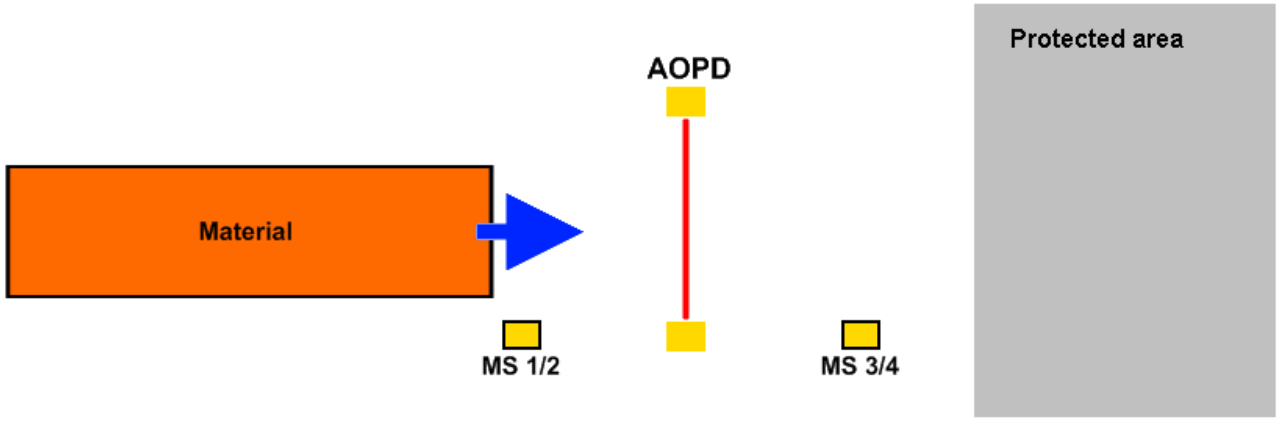

Fig. 59: Configuration example with two two-channel MUTING sensors

The following screenshot shows the parameterization of FB MUTING for this case. The 'Sequential Inputs' checkbox is not checked. The 4 MUTING inputs are configured and wired as two-channel inputs with discrepancy time monitoring.

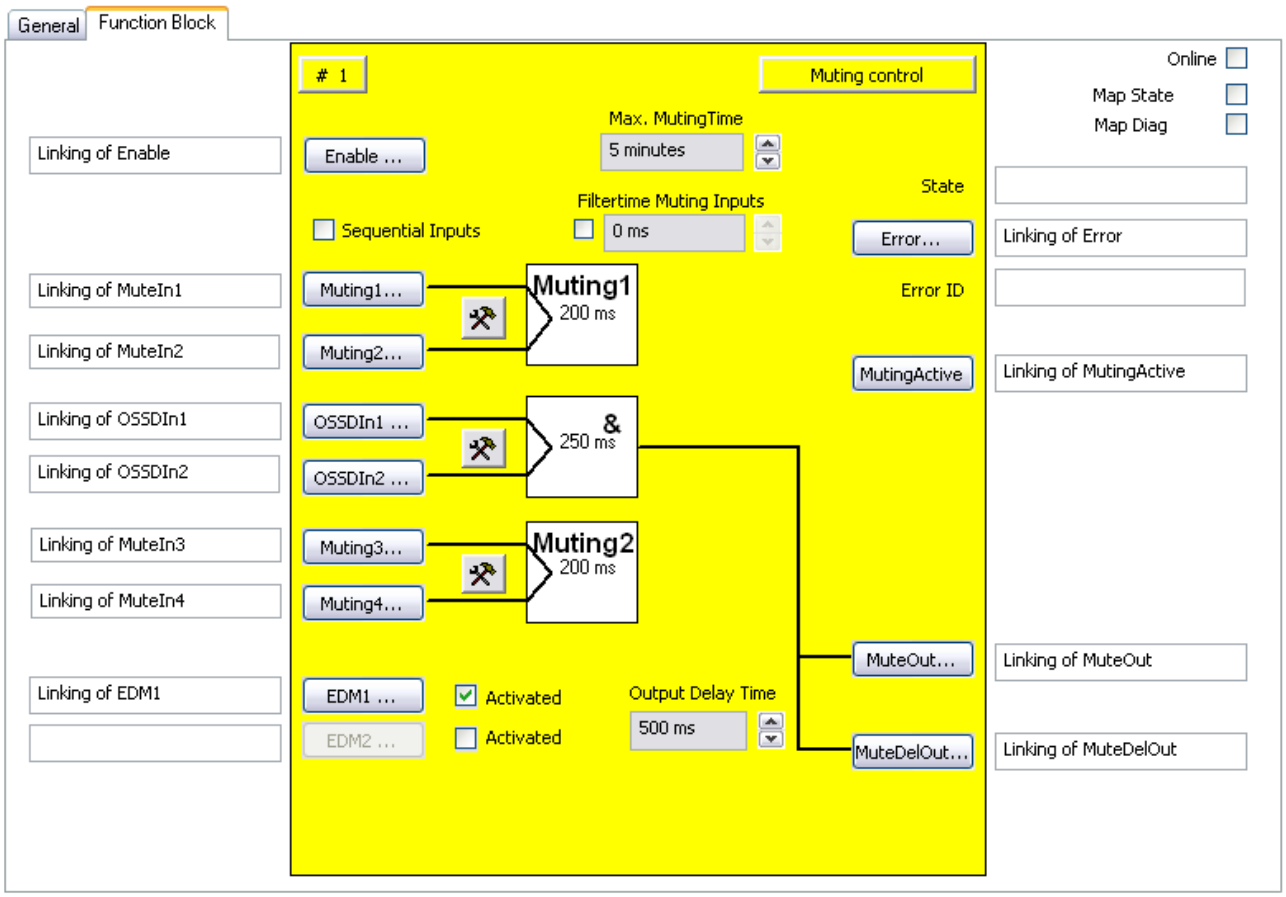

Fig. 60: Parameterization of the FB MUTING for 2 two-channel MUTING sensors

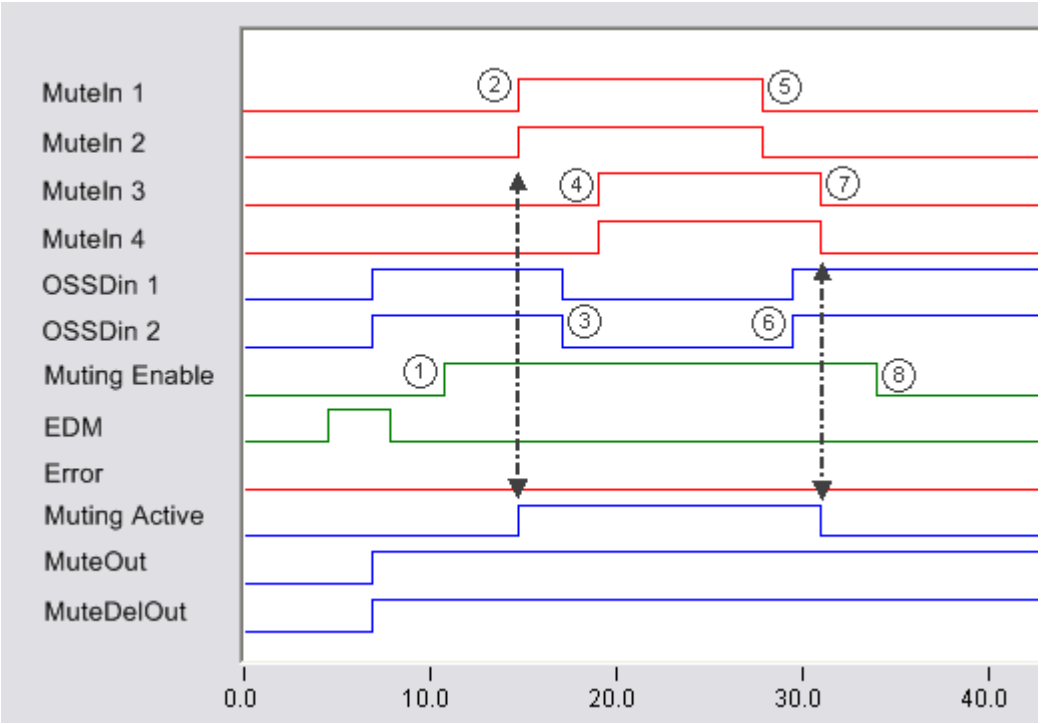

Fig. 61: Parameterization for 2 two-channel MUTING sensors

4.8.4 Extensions FB Muting EL/EJ6910

NOTICE

Support

The extensions described below are only available in the EL6910 or newer terminals. These options cannot be used under the EL6900 and KL6904.

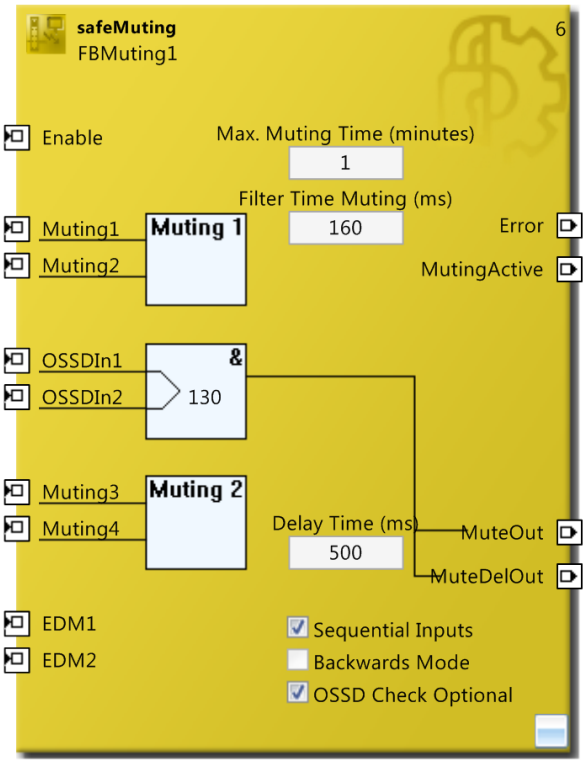

Fig. 62: EL6910 FB MUTING

In addition to existing the options, the following additional functions are now available:

Option *Backwards Mode*:
If the option is active, a MUTING sequence is supported in forward and backward direction. If muting sensor MUTING4 is actuated first, backward direction is assumed, forward direction for MUTING1. A MUTING sequence must be completed before a new sequence (perhaps in the other direction) can be started.

Option *OSSD Check Optional*:
This option is used to remove the light curtain from the sequence check. In this case only the muting sensors *Muting1* to *Muting4* are checked. The light curtain can be operated at any point within the sequence.

Wiring function change:
If the *Sequential Inputs* option is active, it is possible to leave the *MUTING3* and *MUTING4* inputs inactive/ unconnected. Provided the inputs *MUTING*, *MUTING2*, *OSSD1* and *OSSD2* are connected.

Diagnostic and status information for FB MUTING with functional expansion

Diagnostic information (16-bit value)

Bit	Description
0	Discrepancy error in muting input group 1
1	Discrepancy error in the OSSD input group
2	Discrepancy error in muting input group 2
4	EDM monitoring error EDM1
5	EDM monitoring error EDM2
6	Muting sequence was violated

Bit	Description
7	Maximum muting time was exceeded
8	Discrepancy error in muting input group 1 was not yet reset
9	Discrepancy error in OSSD input group was not yet reset
10	Discrepancy error in muting input group 2 was not yet reset

Status information (8-bit value)

Value	Description (see Table 3-48)
1	RUN
2	STOP
3	SAFE
4	ERROR
5	RESET
8	DELAYOUT
9	MUTING1 (figure 3-35 [▶ 80] number 2-3)
10	MUTING2 (figure 3-35 [▶ 80] number 3-4)
11	MUTING3 (figure 3-35 [▶ 80] number 4-5)
12	MUTING4 (figure 3-35 [▶ 80] number 5-6)
13	MUTING5 (figure 3-35 [▶ 80] number 6-7)
14	MUTING6 (figure 3-35 [▶ 80] number 7-8)
15	MUTING7 (figure 3-35 [▶ 80] number 8-9)
16	MUTING8 (figure 3-35 [▶ 80] number 9-10)
17	MUTING9 (figure 3-35 [▶ 80] number 10-11)

4.8.5 Configuration in TwinCAT 3

Display of the function block and its properties in TwinCAT 3.

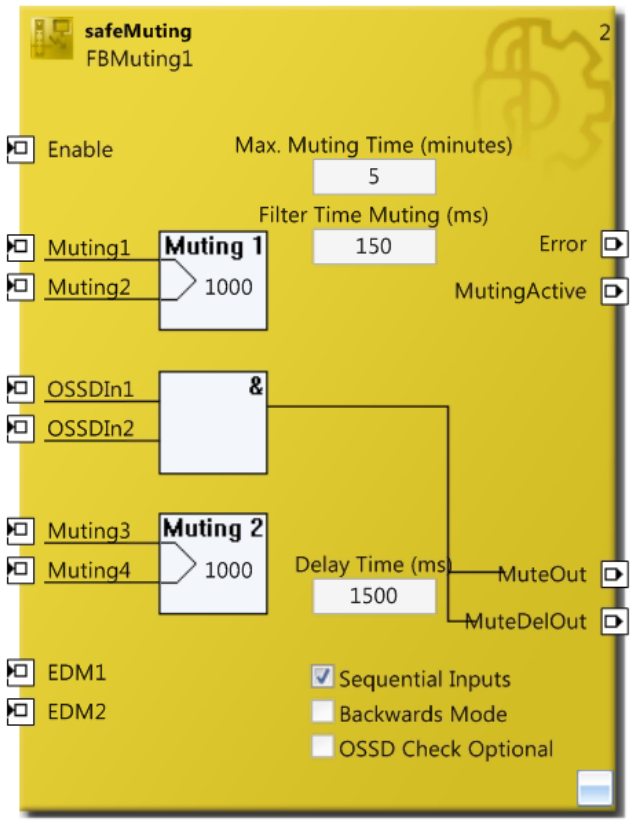

Fig. 63: FB MUTING in TwinCAT 3

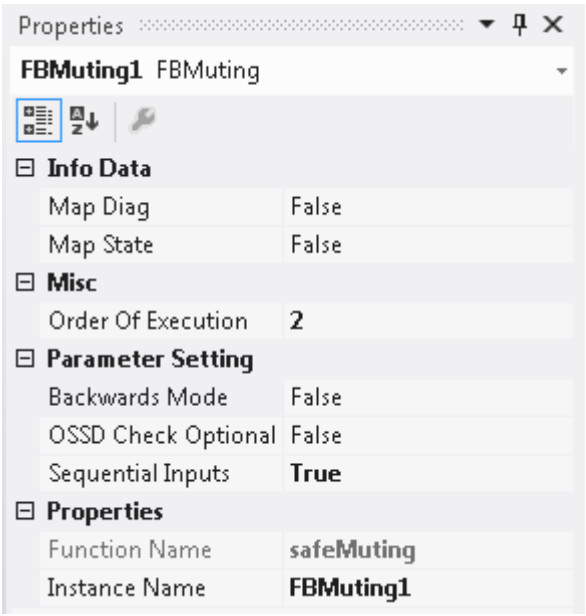

Fig. 64: FB MUTING properties

4.9 The function block EDM

4.9.1 Functional description

The FB EDM (External Device Monitor) is used for time monitoring of signals Mon1 and Mon2. Switch-on and switch-off monitoring can be configured. In default state both monitoring functions are inactive. At least one of the two monitoring functions must be enabled.

Switch-on monitoring checks whether signal Mon2 is set to 0 within the set time (maximum 10000 ms) following a switch from 0 to 1 of signal Mon1.

Switch-off monitoring checks whether signal Mon2 is set to 1 within the set time (maximum 10000 ms) following a switch from 1 to 0 of signal Mon1.

If the set monitoring time is exceeded, the FB EDM enters the error state (FbError) and sets the Error output to 1. The error state can only be exited again by means of an acknowledgement via the ERR_ACK input of the associated TwinSAFE group.

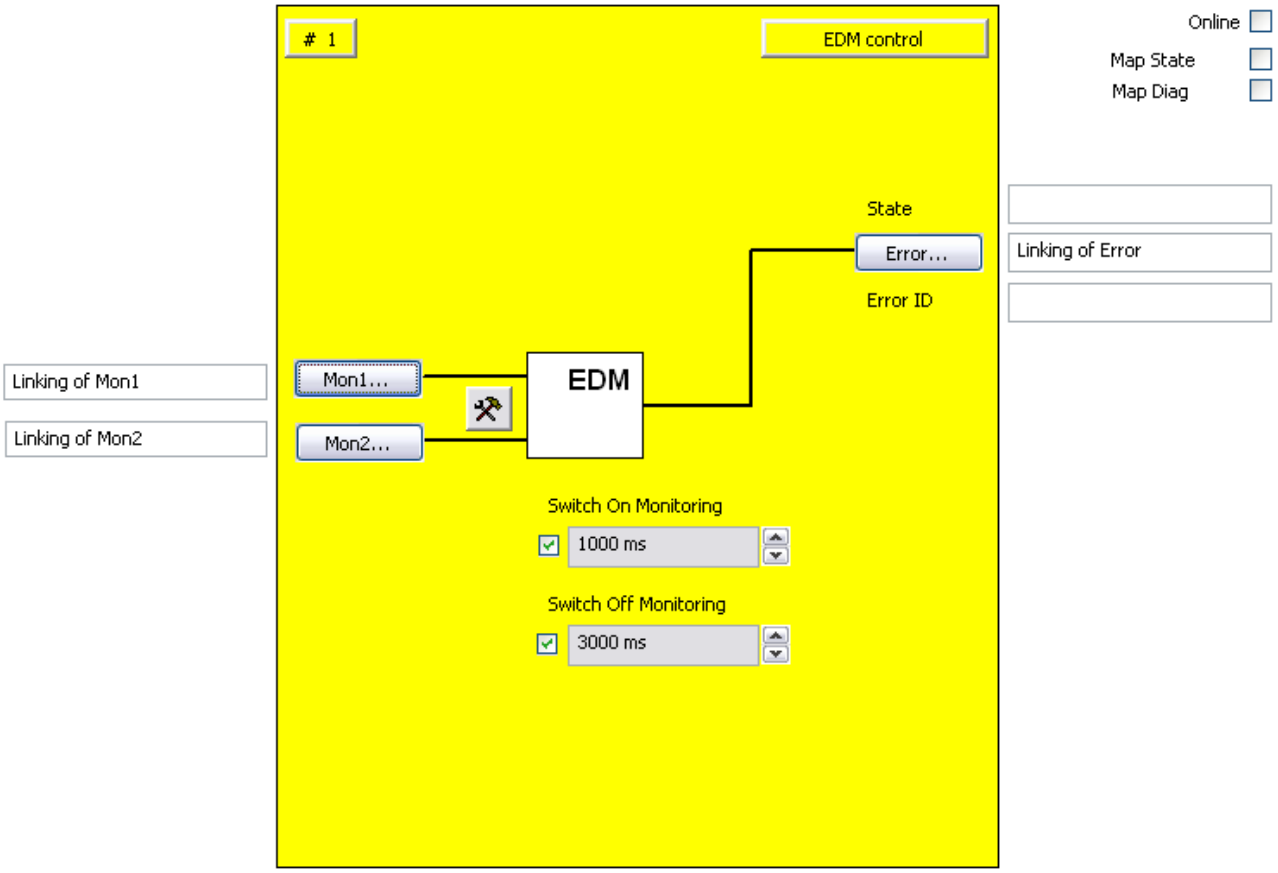

Fig. 65: Function block EDM

NOTICE

KL6904

The EDM function block is not available in the KL6904.

4.9.2 Signal description

FB EDM inputs

Name	Permitted type	Data type	Description
Mon1	TwinSAFE-In FB-Out Standard-In	BOOL	1st input. The input can be parameterized as a break contact or a make contact.
Mon2	TwinSAFE-In FB-Out Standard-In	BOOL	2nd input, which has to assume the value opposite to input 1 within the set times.

FB EDM outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	TRUE: SwitchOn or SwitchOff times were exceeded. FALSE: No error occurred.

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. on an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. on an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input

Internal identifier of the FB

Type	Description
FB EDM	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for FB EDM

Diagnostic information (8-bit value)

Bit	Description
0	Switch-OFF timer elapsed
1	Switch-ON timer elapsed

Status information (8-bit value)

Value	Description
0	undefined
2	**STOP** If the input FbRun = FALSE, FB EDM assumes the STOP state. The output assumes the following value: • Error = 0
4	**ERROR** If the FB EDM detects an error, FB EDM switches to the ERROR state and sends the corresponding Diag message to the GROUP module. The output assumes the following value: • Error = 1
5	**RESET** FB EDM assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. The outputs assume the following values: • Error = 0
14	**MONOFF** If the input MonIn1 = FALSE, the FB EDM switches to the MONOFF state in order to perform switch-off monitoring. The output assumes the following value: • Error = 0

Value	Description
15	**MONON** If the input MonIn1 = TRUE, the FB EDM switches to the MONON state in order to carry out switch-on monitoring. The output assumes the following value: • Error = 0

4.9.3 Configuration in the TwinCAT System Manager

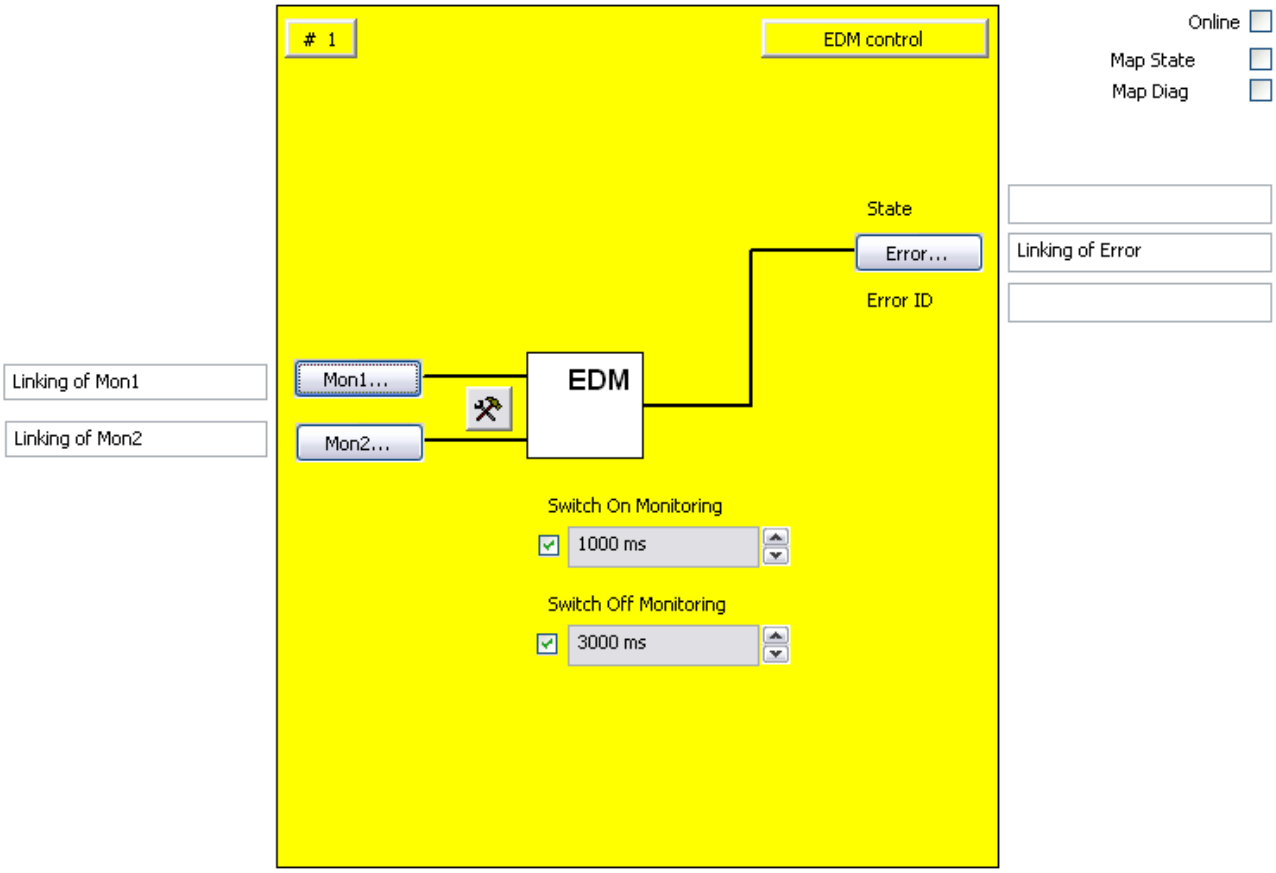

Fig. 66: FB EDM configuration

The FB EDM input variables are linked using the 'Mon1' and 'Mon2' buttons.

Use the Settings button to right or the two Mon inputs to configure them. Only single-channel evaluation is available. In addition the inputs can be configured as make contact (NO) or break contact (NC). In the default state all inputs are disabled.

Use the ‘Switch-On Monitoring’ and ‘Switch-Off Monitoring’ selection boxes to set the switch-on and switch-off delay time. Use the checkboxes to the left of the text fields to activate the corresponding monitoring time. Both are disabled in the default state.

Use the 'Error' button to transfer a function block error to the connected output variable. In online mode the state and error IDs are filled with corresponding information.

The '"Map State"' and '"Map Diag"' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

4.9.4 Configuration in TwinCAT 3

Display of the function block and its properties in TwinCAT 3.

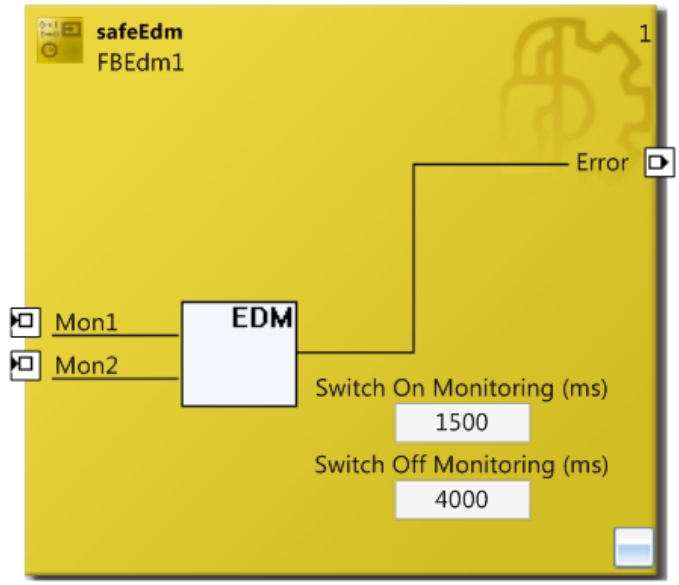

Fig. 67: FB EDM in TwinCAT 3

Fig. 68: FB EDM properties

The 'Switch-On Monitoring' and 'Switch-Off Monitoring' text boxes can be used to set the switch on- and switch-off delay time. Monitoring is disabled if the value is set to 0 ms.

4.10 The function block RS

4.10.1 Functional description

The FB RS realizes a reset / set functionality.
Logic 1 at input Set and logic 0 at input Reset leads to logic 1 at the output.
Logic 0 at input Set and logic 1 at input Reset leads to logic 0 at the output.
If both inputs are set to logic 1, the Reset signal is dominant and leads to logic 0 at the output.
If both inputs are logic 0, the output remains in its current state.

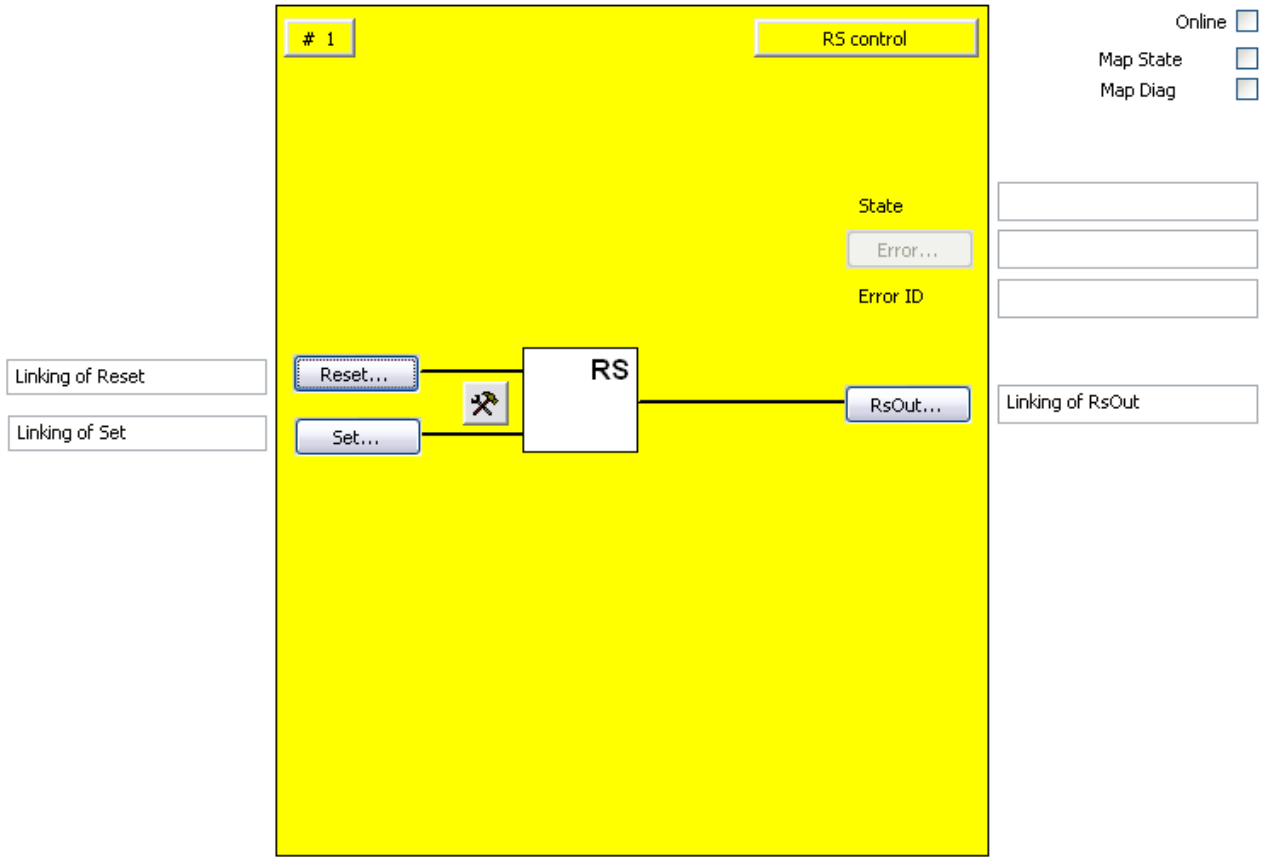

Fig. 69: Function block RS

NOTICE

KL6904

The RS function block is not available in the KL6904.

4.10.2 Signal description

FB RS inputs

Name	Permitted type	Data type	Description
Reset	TwinSAFE-In FB-Out	BOOL	1st input channel; the parameterization indicates whether a break contact or a make contact is linked to this input.
Set	TwinSAFE-In FB-Out	BOOL	2nd input channel; the parameterization indicates whether a break contact or a make contact is linked to this input.

FB RS outputs

Name	Permitted type	Data type	Description
RsOut	TwinSAFE-Out FB-In Standard-Out	BOOL	1st output channel, the safe state corresponds to a logical 0.

FB RS input and output types

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. on an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)

Type	Description
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. on an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input

Internal identifier of the FB

Type	Description
FB RS	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for FB RS

Diagnostic information (16-bit value)

Bit	Description
0-15	always 0

Status information (8-bit value)

Value	Description
0	undefined
2	**STOP** If the input FbRun = FALSE, the FB RS switches to the STOP state. The output assumes the following value: • RsOut = 0
3	**SAFE** If the Reset input is 1, the FB RS switches to the SAFE state. The output assumes the following value: • RsOut = 0
9	**SET** If the Reset input is 0 and the Set input is 1, the FB RS switches to the RUN state. The output assumes the following value: • RsOut = 1

4.10.3 Configuration in the TwinCAT System Manager

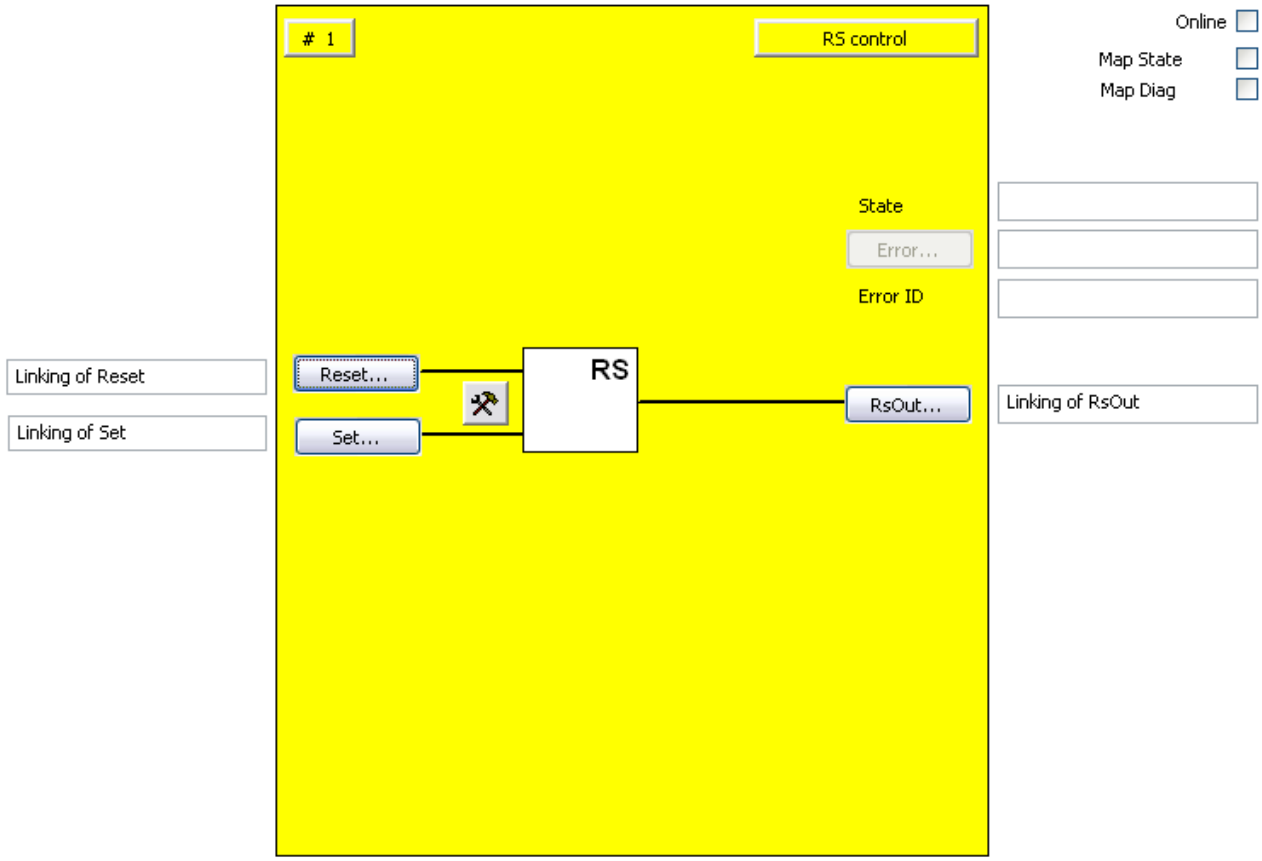

Fig. 70: FB RS configuration

Use the Settings button to the right of the Reset and Set inputs to activate the input signals and configure them as make contact (NO) or break contact (NC). Both inputs are deactivated in the default state.

The 'Reset' and 'Set' buttons can be used to link the input variables of the FB RS.

The 'RsOut' button can be used to link the output variable of the FB RS.

The error output is inactive since FB RS reports no error.

The '"Map State"' and '"Map Diag"' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

4.10.4 Configuration in TwinCAT 3

Display of the function block and its properties in TwinCAT 3.

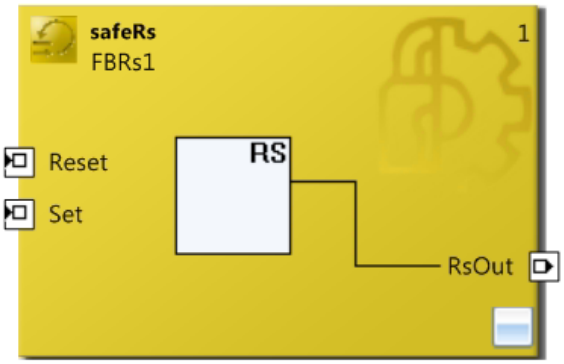

Fig. 71: FB RS in TwinCAT 3

Fig. 72: FB RS properties

4.11 The function block SR

4.11.1 Functional description

The FB SR realizes a set / reset functionality.
Logic 1 at input Set and logic 0 at input Reset leads to logic 1 at the output.
Logic 0 at input Set and logic 1 at input Reset leads to logic 0 at the output.
If both inputs are set to logic 1, the Set signal is dominant and leads to logic 1 at the output.
If both inputs are logic 0, the output remains in its current state.

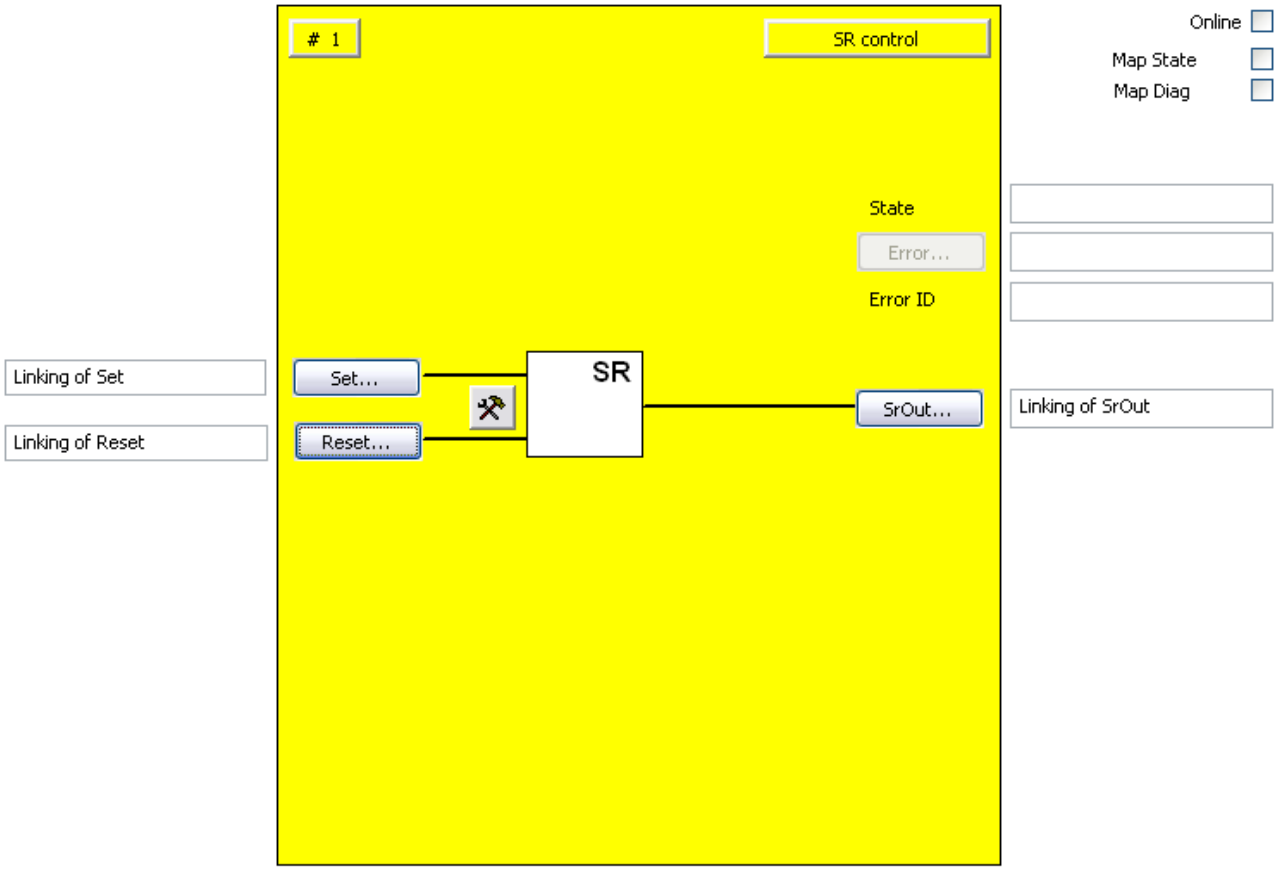

Fig. 73: Function block SR

NOTICE

KL6904

The SR function block is not available in the KL6904.

4.11.2 Signal description

FB SR inputs

Name	Permitted type	Data type	Description
Reset	TwinSAFE-In FB-Out	BOOL	2nd input channel; the parameterization indicates whether a break contact or a make contact is linked to this input.
Set	TwinSAFE-In FB-Out	BOOL	1st input channel; the parameterization indicates whether a break contact or a make contact is linked to this input.

FB SR outputs

Name	Permitted type	Data type	Description
SrOut	TwinSAFE-Out FB-In Standard-Out	BOOL	1st output channel, the safe state corresponds to a logical 0.

FB SR input and output types

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. on an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. on an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input

Internal identifier of the FB

Type	Description
FB SR	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for FB SR

Diagnostic information (16-bit value)

Bit	Description
0-15	always 0

Status information (8-bit value)

Value	Description
0	undefined
2	**STOP** If the input FbRun = FALSE, the FB SR switches to the STOP state. The output assumes the following value: • SrOut = 0

Value	Description
3	**SAFE** If the Reset input is 1 and the Set input is 0, the FB SR switches to the SAFE state. The output assumes the following value: • SrOut = 0
9	**SET** If the Set input is 1, the FB SR switches to the SET state. The output assumes the following value: • SrOut = 1

4.11.3 Configuration in the TwinCAT System Manager

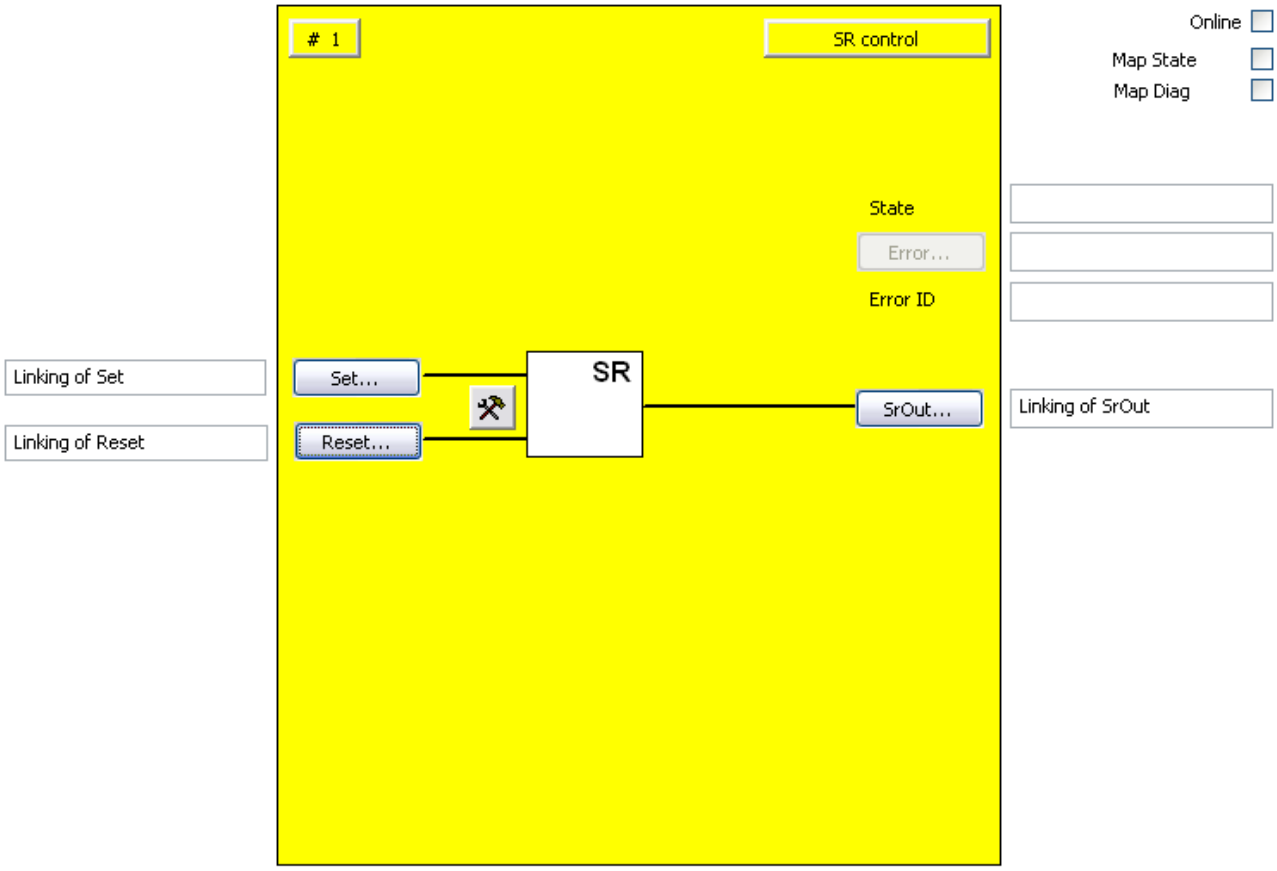

Fig. 74: FB SR configuration

Use the Settings button to the right of the Reset and Set inputs to activate the input signals and configure them as make contact (NO) or break contact (NC). In the default state both inputs are disabled.

The 'Reset' and 'Set' buttons can be used to link the input variables of the FB RS.

The 'SrOut' button can be used to link the output variable of the FB RS.

The error output is inactive since FB SR reports no error.

The '"Map State"' and '"Map Diag"' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

4.11.4 Configuration in TwinCAT 3

Display of the function block and its properties in TwinCAT 3.

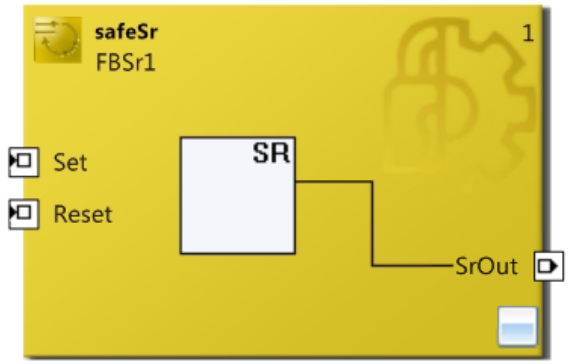

Fig. 75: FB SR in TwinCAT 3

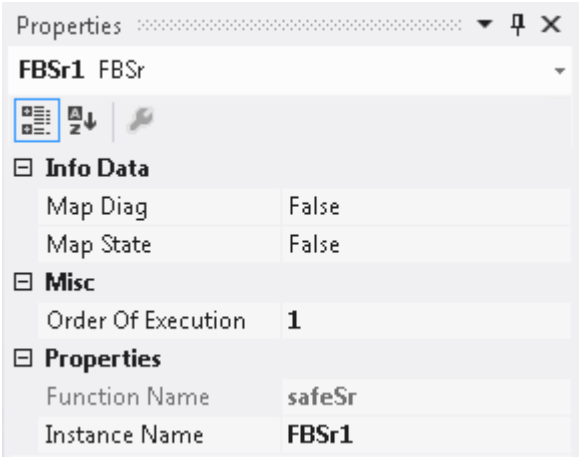

Fig. 76: FB SR properties

4.12 The function block TON

4.12.1 Functional description

FB TON is used to realize a switch-on delay. Logic 1 at input TONIn is transferred to the output with a set delay time. The output is not activated if the input is set to 0 again before the delay time has elapsed. The error output is inactive since the function block sets no errors.

The maximum switch-on delay is 6000 x 100 ms (10 minutes).

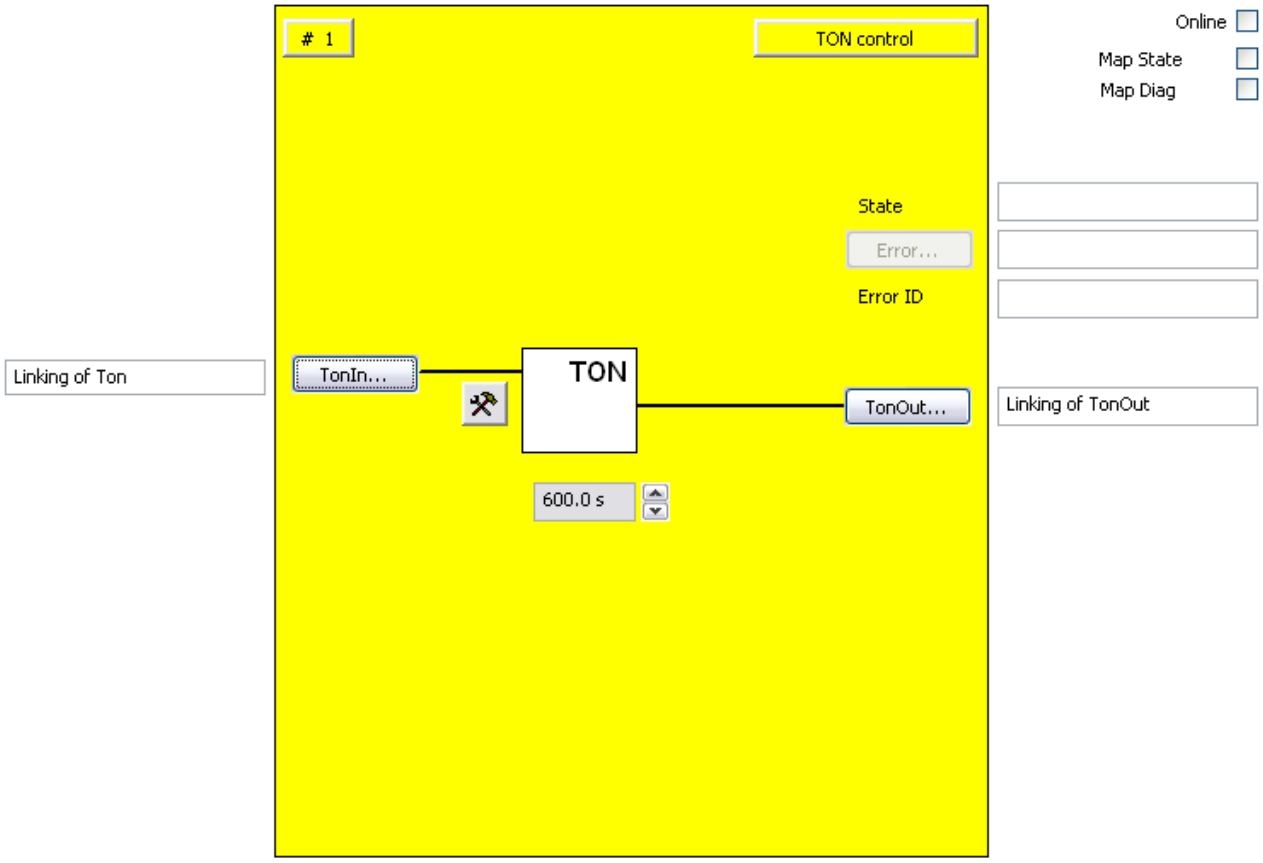

Fig. 77: Function block TON

NOTICE

KL6904

The TON function block is not available in the KL6904.

4.12.2 Signal description

FB TON inputs

Name	Permitted type	Data type	Description
TonIn1	TwinSAFE-In FB-Out	BOOL	1st input channel; the parameterization indicates whether a break contact or a make contact is linked to this input.

FB TON outputs

Name	Permitted type	Data type	Description
TonOut	TwinSAFE-Out FB-In Standard-Out	BOOL	1st output channel, the safe state corresponds to a logical 0.

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. on an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. on an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)

Type	Description
FB-In	TwinSAFE FB input

Internal identifier of the FB

Type	Description
FB TON	This description applies to BLG 3.0 (internal version number)

Diagnostic and status information for FB TON

Diagnostic information (16-bit value)

Bit	Description
0-15	always 0

Status information (8-bit value)

Value	Description
0	undefined
1	**RUN** If the TimerIn input is equal to 1 and the delay time has expired (DelayTimeExpired = TRUE), the FB TON assumes the RUN state. The output assumes the following value: • TimerOut = 1
2	**STOP** If the input FbRun = FALSE, the FB TON assumes the STOP state. The output assumes the following value: • TimerOut = 0
3	**SAFE** If the TimerIn input is equal to 0, FB TON assumes the SAFE state. If, in the SAFE state, the TimerIn becomes equal to 1, the FB TON starts the delay timer with the DelayTime and switches to the DELAYIN state. The output assumes the following value: • TimerOut = 0
9	**DELAYIN** If the TimerIn input is 1 and the delay time has not yet expired (DelayTimeExpired=FALSE), FB TON assumes the DELAYIN state. The outputs assume the following values: • TimerOut = 0

4.12.3 Configuration in the TwinCAT System Manager

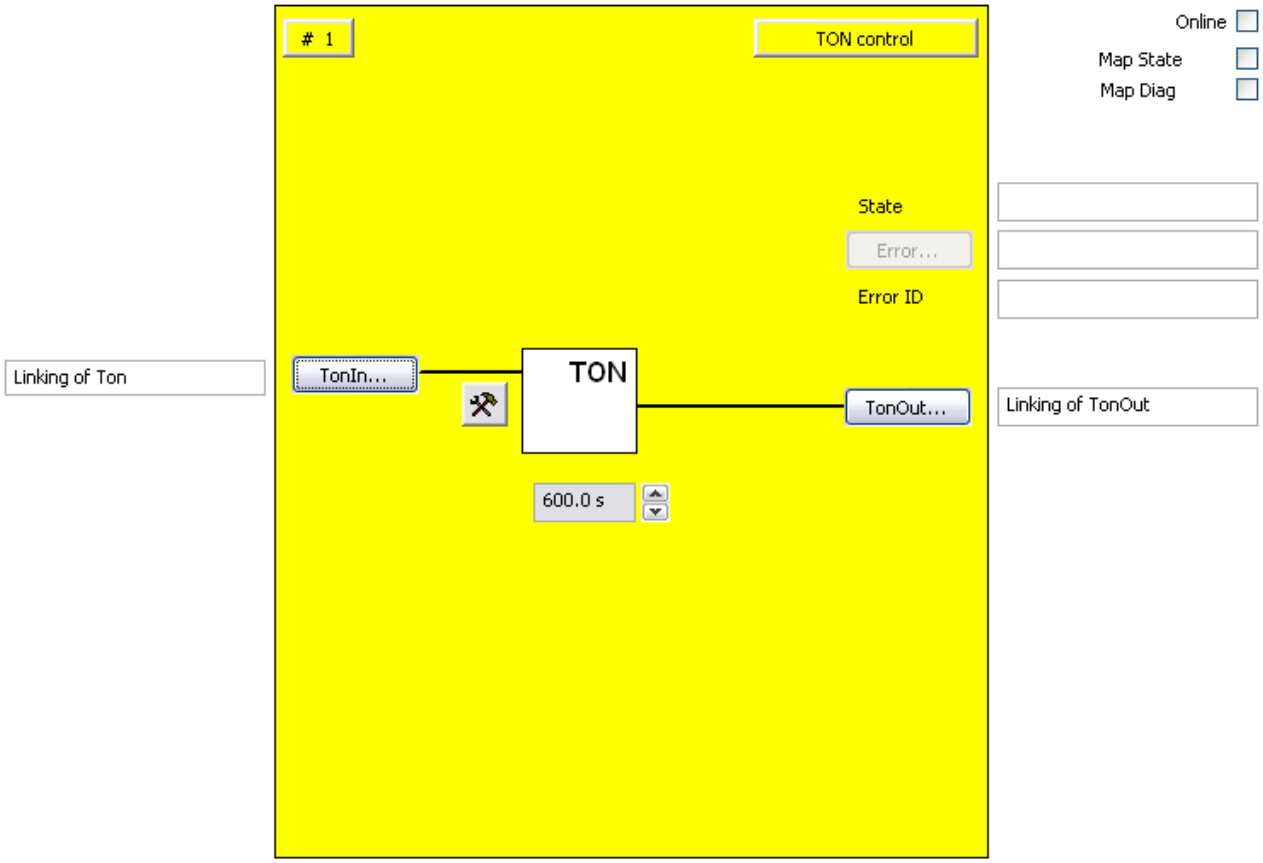

Fig. 78: FB TON configuration

Use the Settings button to the right of the 'TonIn' button to configure the input as make (NO) or break contact (NC). The input is deactivated in the default state.
The 'TonIn' button is used to link the input variable of the FB TON.
The 'TonOut' button is used to link the switch-on-delayed output variable of the FB TON.
Use the text box to set the switch-on delay time. The smallest unit is 0.1 s.

The error output is inactive since FB TON reports no error.

The '"Map State"' and '"Map Diag"' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

4.12.4 TON extension

NOTICE

Support

The extensions described below are only available in the EL6910 or newer terminals. These options cannot be used under the EL6900 and KL6904.

In the EL6910 the FB TON now also supports times between 1 ms and 600 seconds. The function block has two timebases: 1 ms and 10 ms.
With a timebase of 1 ms the maximum time is 60,000 ms in 1 ms steps.
With a timebase of 10 ms the maximum time is 600,000 ms in 10 ms steps.
The timebase is automatically selected in TC3.1 Safety Editor according to the set time.

NOTICE

FB TON and FB TON2 extension (software 04 - EL6910)

From software version 04 of the EL6910 and newer TwinSAFE Logic components, the FB TON also supports the timebases of 100 ms and 1000 ms. Switch-on delays of up to 60,000 s can thus be set.

4.12.5 Configuration in TwinCAT 3

Display of the function block and its properties in TwinCAT 3.

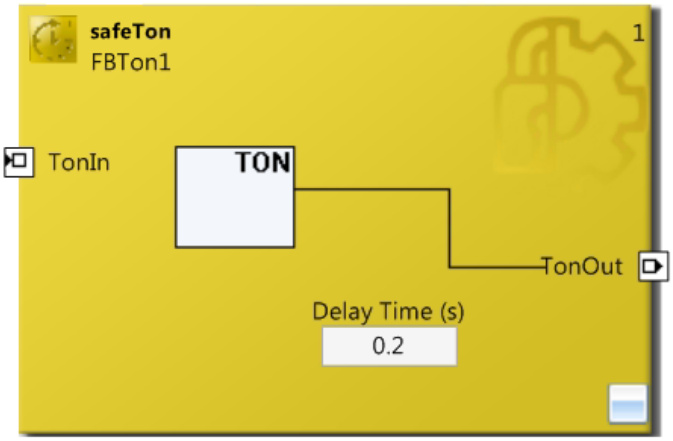

Fig. 79: FB TON in TwinCAT 3

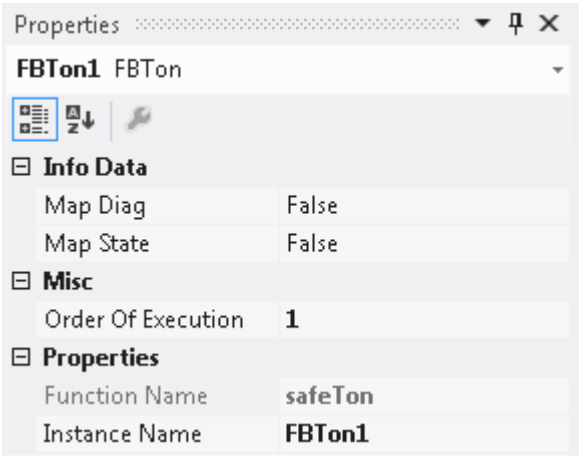

Fig. 80: FB TON properties

4.13 The function block TON2

4.13.1 Functional description

The FB TON2 behaves in the same way as the FB TON (see chapter 3.12) but is extended by a feature which stores the current timer time value on the TwinSafe Logic, so that the logic program can continue running for the remaining time after start-up. In order to use this function, the Enable input must be set during the rising edge at TonIn and the function block must be parameterized accordingly (parameter: *Starts with remaining time* = True).

NOTICE

Support

The function block TON2 is not available in the KL6904, EL6900 and EL6910 (SW ≤ 03).

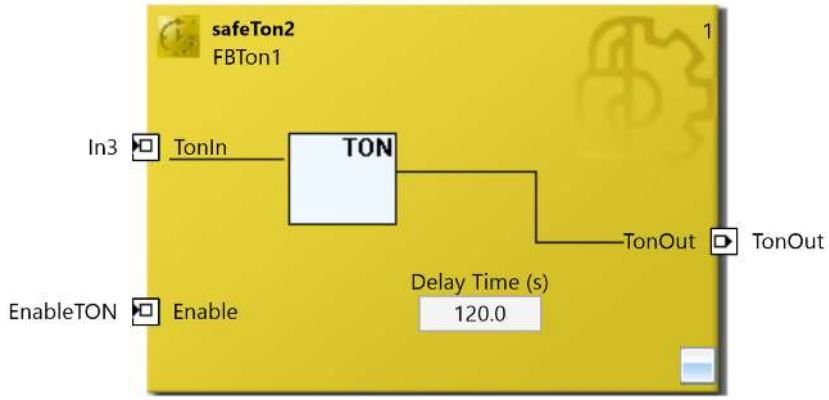

Fig. 81: Function block TON2

In the properties of the FB TON2 the parameter *Starts with remaining time* can be enabled in addition to the diagnostic data.

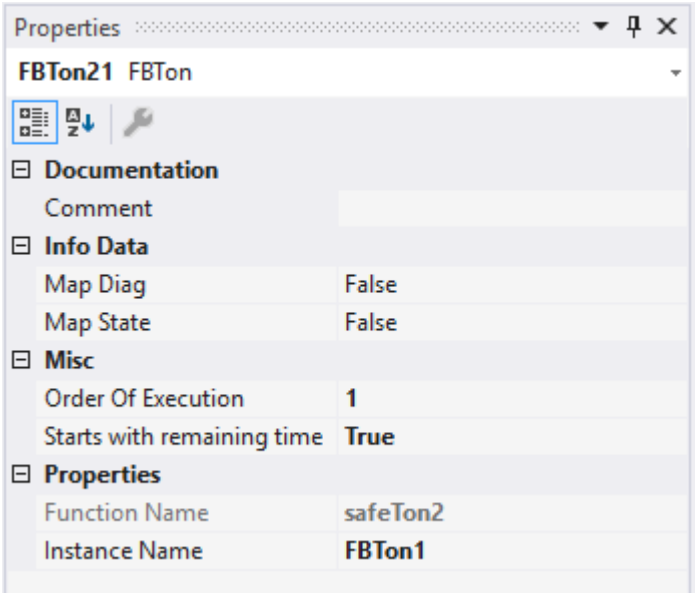

Fig. 82: FB TON2 properties

In the following timing diagram the TON Delay Time is set to 120 seconds. While TonIn is set, the station is switched off (EtherCAT state exits OP (8)) and switched on again after a certain time. After switching on, the logic starts up and starts the active connections. When the TonIn signal is read in again with TRUE within the logic and the Enable signal is also read in with TRUE (in this example after approx. 35 seconds), the TON function block is processed with the remaining time. The TonOut output is set after the parameterized time of 120 seconds has elapsed.

The Enable signal is not shown in the diagram because it is set to TRUE throughout.

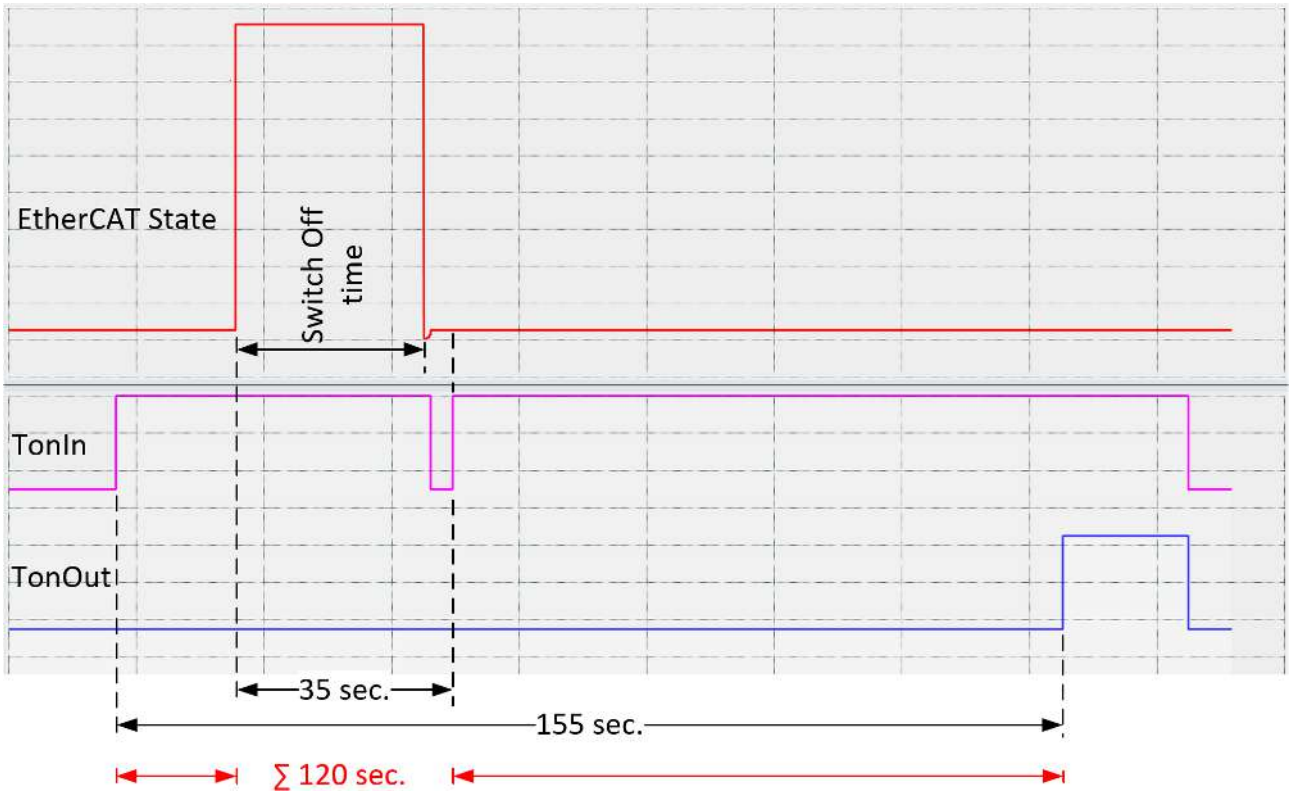

Fig. 83: Timing diagram

4.13.2 Signal description

FB TON2 inputs

Name	Permitted type	Data type	Description	
TonIn1	TwinSAFE-In FB-Out	BOOL	1st input channel; the parameterization indicates whether a break contact or a make contact is linked to this input.	
Enable	TwinSAFE-In FB-Out Standard-In	BOOL	If "Save the timer remaining time" is enabled, the state of the Enable signal is checked when the TonIn signal changes from 0 to 1.	
			Enable	**Description**
			FALSE	The timer is started with the time that is parameterized in the FB
			TRUE	The timer is started with the remaining running time. (If the remaining running time is greater than the time that is parameterized in the FB, the TwinSAFE Logic changes to the *Global Shutdown* state with error code 0x3510)

FB TON2 outputs

Name	Permitted type	Data type	Description
TonOut	TwinSAFE-Out FB-In Standard-Out	BOOL	1st output; the safe state corresponds to logic 0.

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input
Standard-In	Standard PLC variable (output in the PLC %Q*)

Type	Description
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input

Internal identifier of the FB

Type	Description
FB TON2	This description applies to BLG 3.0 (internal version number)

Status information (8-bit value)

Value	Description
0	undefined
1	**RUN** If the TimerIn input is equal to 1 and the delay time has expired (DelayTimeExpired = TRUE), the FB TON assumes the RUN state. The output assumes the following value: • TimerOut = 1
2	**STOP** If the input FbRun = FALSE, the FB TON assumes the STOP state. The output assumes the following value: • TimerOut = 0
3	**SAFE** If the TimerIn input is equal to 0, FB TON assumes the SAFE state. If the input TimerIn changes to 1 in the SAFE state, FB TON starts the delay timer with the DelayTime and changes to the DELAYIN state. If TimerIn changes to 1, "Save remaining time" operation mode is enabled and the Enable input is TRUE in SAFE state, FB TON starts the delay timer with the DelayTime minus the ExpiredTime stored in the FRAM and switches to DELAYIN state. If TimerIn changes to 1, "Save remaining time" operation mode is enabled and the Enable input is FALSE in SAFE state, FB TON starts the delay timer with the DelayTime and switches to DELAYIN state. If TimerIn changes to 1, "Save remaining time" operation mode is enabled, the Enable input is TRUE and the ExpiredTime is greater than the DelayTime in SAFE state, FB TON calls the CTRLCYC so that it assumes the GLOBAL-SHUTDOWN state with error code 0x3510. The output assumes the following value: • TimerOut = 0
9	**DELAYIN** If the TimerIn input is 1 and the delay time has not yet expired (DelayTimeExpired=FALSE), FB TON assumes the DELAYIN state. The outputs assume the following values: • TimerOut = 0

4.14 The function block TOF

4.14.1 Functional description

FB TOF is used to realize a switch-off delay. Logic 1 at input 'TofIn' is transferred to the output with a set delay time. The output remains activated if the input is set to 1 again before the switch-off delay time has elapsed.
The error output is inactive since the function block sets no errors.

The maximum switch-off delay is 6000 x 100 ms (10 minutes).

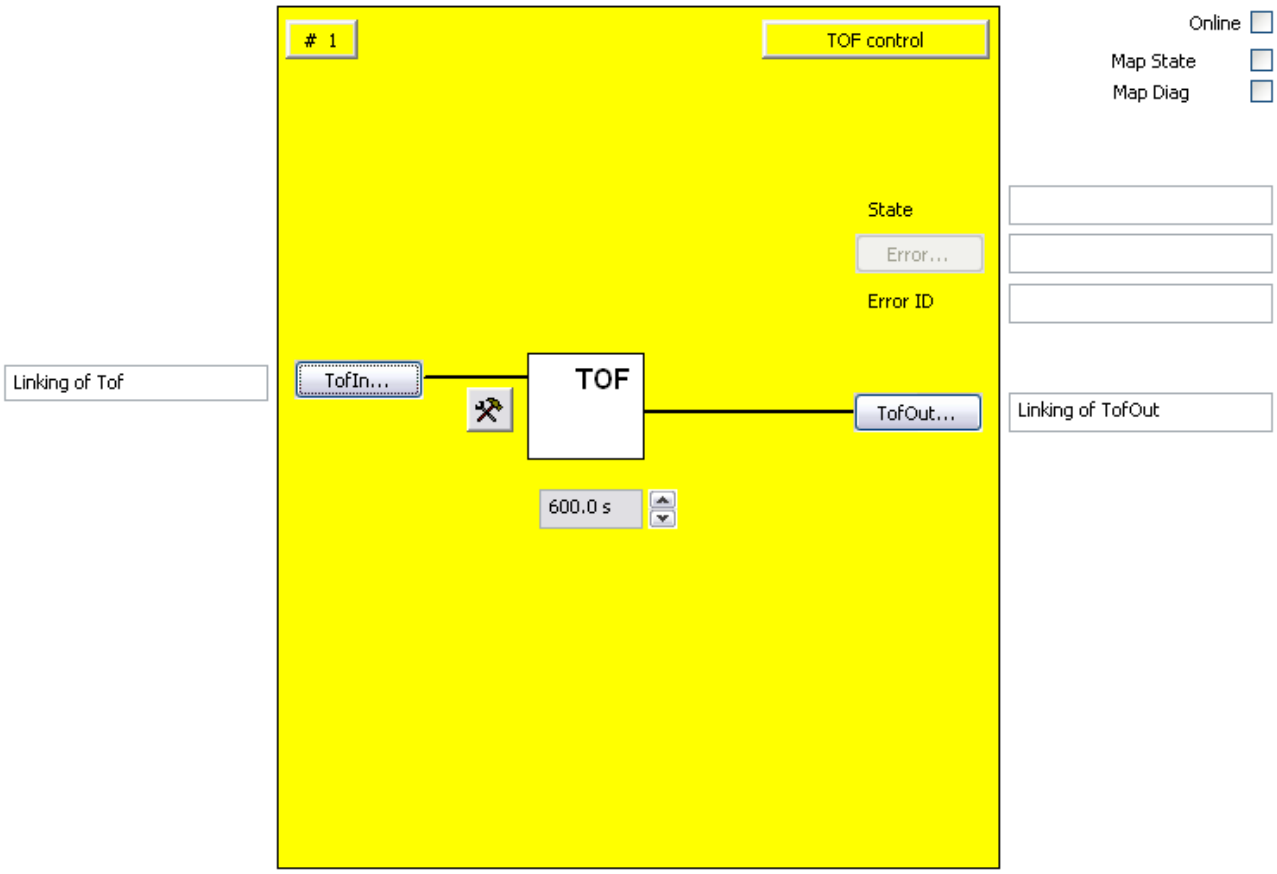

Fig. 84: Function block TOF

NOTICE

KL6904

The TOF function block is not available in the KL6904.

4.14.2 Signal description

Input of FB TOF

Name	Permitted type	Data type	Description
TofIn1	TwinSAFE-In FB-Out	BOOL	1st input channel; the parameterization indicates whether a break contact or a make contact is linked to this input.

Output of FB TOF

Name	Permitted type	Data type	Description
TofOut	TwinSAFE-Out FB-In Standard-Out	BOOL	1st output channel, the safe state corresponds to a logical 0.

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. on an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output

Type	Description
TwinSAFE-Out	TwinSAFE output, e.g. on an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input

Internal identifier of the FB

Type	Description
FB TOF	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for FB TOF

Diagnostic information (16-bit value)

Bit	Description
0-15	always 0

Status information (8-bit value)

Value	Description
0	undefined
1	**RUN** If the TimerIn input is 1, FB TOF assumes the RUN state. If the TimerIn changes to 0 in the RUN state, FB TOF starts the delay timer with the DelayTime and switches to the DELAYOUT state. The output assumes the following value: • TimerOut = 1
2	**STOP** If the input FbRun = FALSE, FB TOF assumes the STOP state. The output assumes the following value: • TimerOut = 0
3	**SAFE** If the TimerIn input is 0 and the DelayTime has expired (DelayTimeExpired = TRUE), FB TOF assumes the SAFE state. The output assumes the following value: • TimerOut = 0
8	**DELAYOUT** If the TimerIn input is equal to 0 and the DelayTime has not yet expired (DelayTimeExpired = FALSE), FB TOF assumes the DELAYOUT state. The output assumes the following value: • TimerOut = 1

4.14.3 Configuration in the TwinCAT System Manager

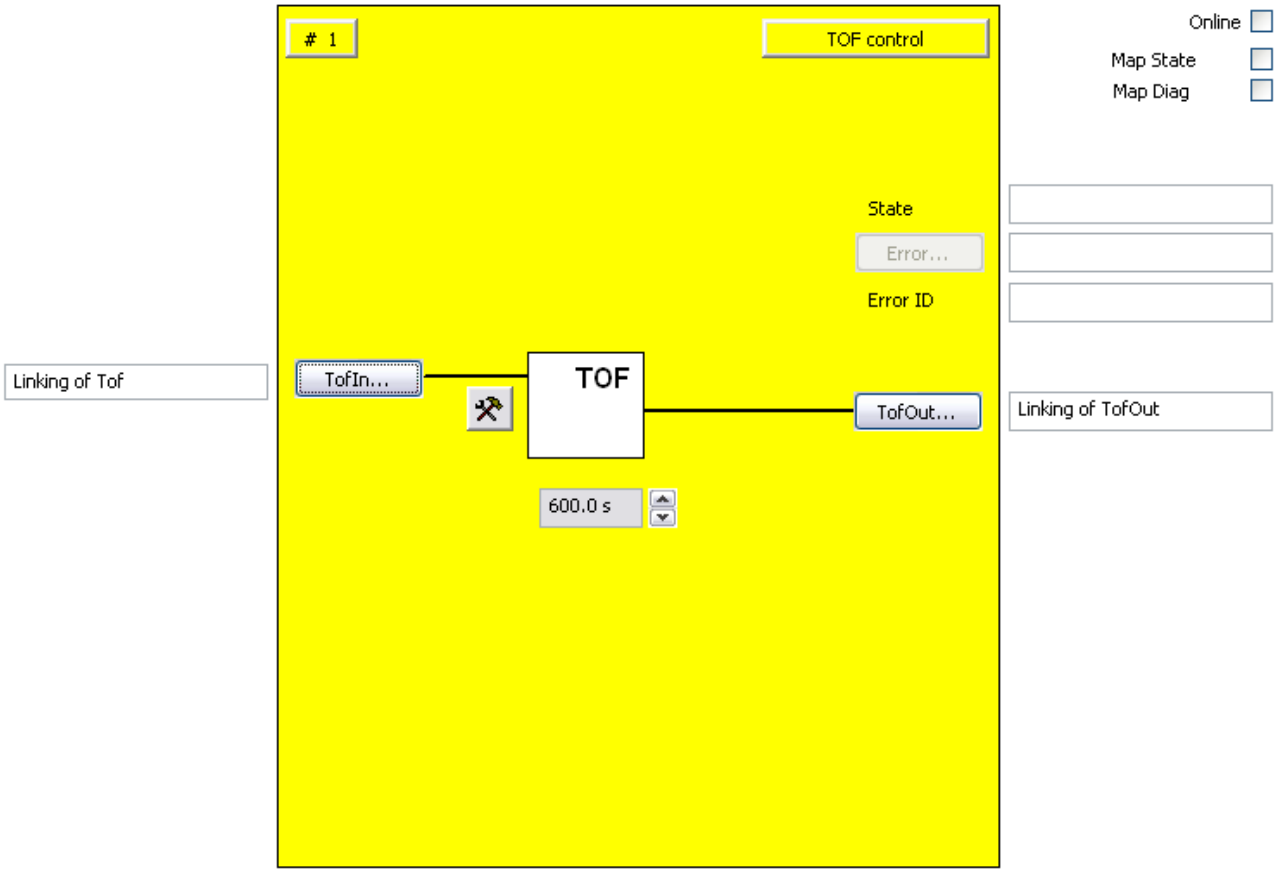

Fig. 85: FB TOF configuration

Use the Settings button to the right of the 'TofIn' button to configure the input as make (NO) or break contact (NC). The input is deactivated in the default state.
The 'TofIn' button is used to link the input variable of the FB TOF.
The 'TofOut' button is used to link the switch-on-delayed output variable of the FB TOF.
Use the text box to set the switch-on delay time. The smallest unit is 0.1 s.
The error output is inactive since FB TOF reports no error.

The '"Map State"' and '"Map Diag"' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

4.14.4 TOF extension

NOTICE

Support

The extensions described below are only available in the EL6910 or newer terminals. These options cannot be used under the EL6900 and KL6904.

In the EL6910 the FB TOF now also supports times between 1 ms and 600 seconds. The function block has two timebases: 1 ms and 10 ms.
With a timebase of 1 ms the maximum time is 60,000 ms in 1 ms steps.
With a timebase of 10 ms the maximum time is 600,000 ms in 10 ms steps.
The timebase is automatically selected in TC3.1 Safety Editor according to the set time.

4.14.5 Configuration in TwinCAT 3

Display of the function block and its properties in TwinCAT 3.

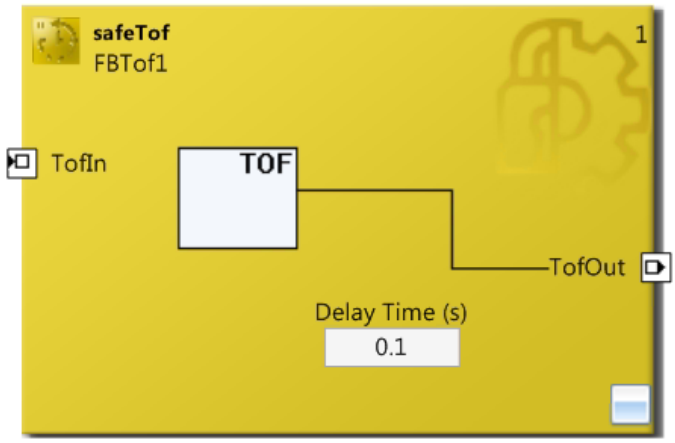

Fig. 86: FB TOF in TwinCAT 3

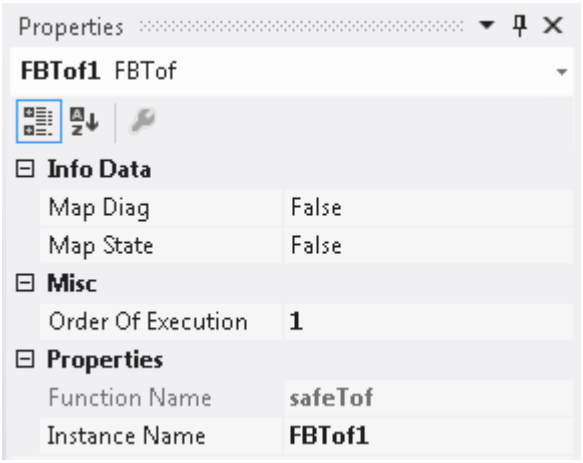

Fig. 87: FB TOF properties

4.15 The function block CONNECTION SHUTDOWN

4.15.1 Functional description

FB CONNECTION SHUTDOWN is used to deactivate a TwinSAFE connection. If the function block input becomes active, the connection is closed, a shutdown command is sent to the FSoE partner, and feedback is sent to the output. The connection is closed and the output is set if the communication partner receives a shutdown command. The output is only reset when the connection to the FSoE partner is in DATA state again.

Once the input of the function block is no longer active, the FSoE master tries to re-establish the connection or the FSoE slave responds to the connection again.

This function block is required for modular safety concepts, in which machine components can be exchanged without stopping the whole safety circuit, e.g. for a tool change. If a modular machine concept is used, which includes machine options such as an optional feeder, these options should be realized in dedicated additional TwinSAFE groups.

⚠ CAUTION

Deactive inputs

Please note that the signal used to shut down the connection must have the same safety level as the signals of the shut-down connection.

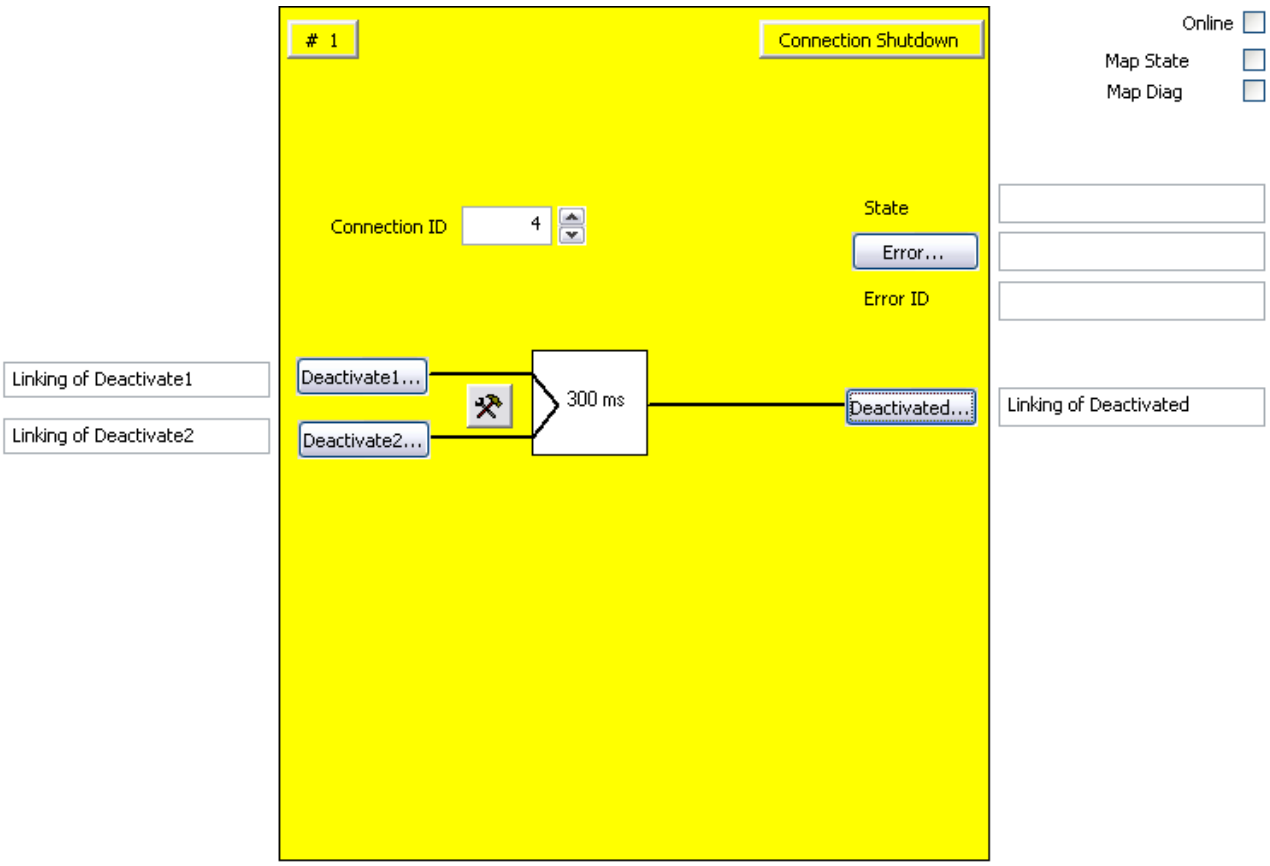

Fig. 88: Function block CONNECTION SHUTDOWN

NOTICE

KL6904

The Connection Shutdown function block is not available in the KL6904.

On the opposite side the function block is called without connected inputs. The output Deactivated is set when the connection is terminated due to a shutdown command from the communication partner.

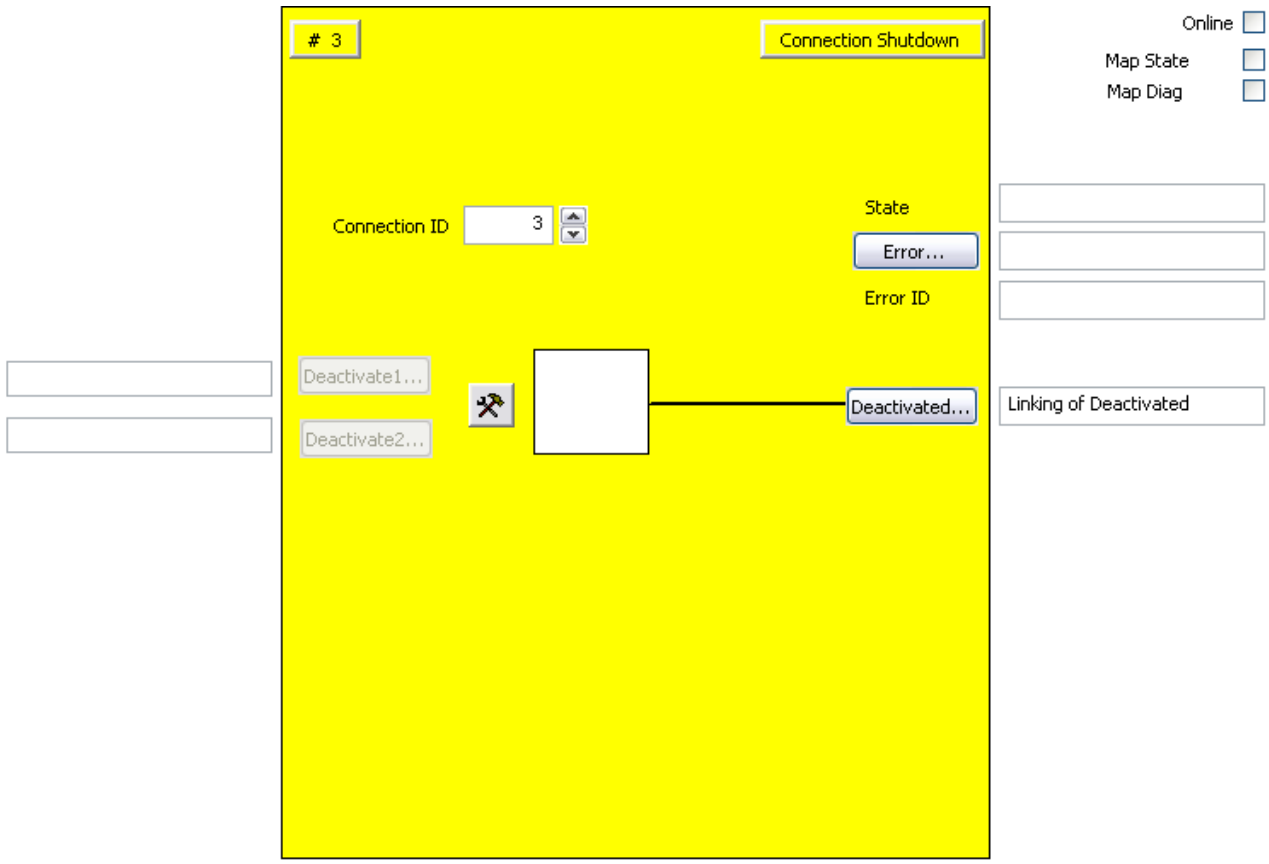

Fig. 89: Function block CONNECTION SHUTDOWN on the opposite side

4.15.2 Signal description

FB CONNECTION SHUTDOWN inputs

Name	Permitted type	Data type	Description
Deactivate1	TwinSAFE-In FB-Out	BOOL	1st input channel. The parameterization determines, whether the input is linked to a break contact (safe state will be requested by logical 0) or make contact (safe state will be requested by logical 1).
Deactivate2	TwinSAFE-In FB-Out	BOOL	2nd input channel, behaves like Deactivate1 If the discrepancy time is not equal 0, the 1st and 2nd input channel are considered to be the 1st input group and a discrepancy time monitoring is carried out between both channels, if one of the two input channels requests the safe state

FB CONNECTION SHUTDOWN outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	TRUE: The discrepancy time monitoring of a 2-channel input group has detected an error. The error reset must be carried out via the ERR_ACK input of the related TwinSAFE group. FALSE: No error was found
Deactivated	TwinSAFE-Out FB-In Standard-Out	BOOL	1st output channel, the safe state corresponds to a logical 0. The output is set when the connection is terminated.

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. on an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. on an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input

Internal identifier of the FB

Type	Description
FB CONNECTION SHUTDOWN	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for FB CONNECTION SHUTDOWN

Diagnostic information (16-bit value)

Bit	Description
0	Discrepancy error input group 1

Status information (8-bit value)

Value	Description
0	undefined
1	**RUN** If the CONNECTION module has received a shutdown command on the assigned Connection, it switches the Connection to the SHUTDOWN state and reports this state to the FB CS, which then assumes the RUN state. If all activated inputs are set to DeactivateX TRUE, the RUN state is assumed, and CONNECTION should send a shutdown command via the assigned Connection to set it to the SHUTDOWN state. The outputs assume the following values: • Error = 0 • Deactivated = 1
2	**STOP** If the input FbRun=FALSE, FB CS assumes the STOP state. The outputs assume the following values: • Error = 0 • Deactivated = 0
3	**SAFE** If not all activated inputs are set to DeactivateX TRUE and the assigned Connection is not in SHUTDOWN state, the FB CS assumes the SAFE state. The outputs assume the following values: • Error = 0 • Deactivated = 0
4	**ERROR** If the FB CS detects an error, FB CS switches to the ERROR state and sends the corresponding Diag message to the GROUP module. The outputs assume the following values: • Error = 1 • Deactivated = 0

Value	Description
5	**RESET** FB CS assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. The outputs assume the following values: • Error = 0 • Deactivated = 0

4.15.3 Configuration in the TwinCAT System Manager

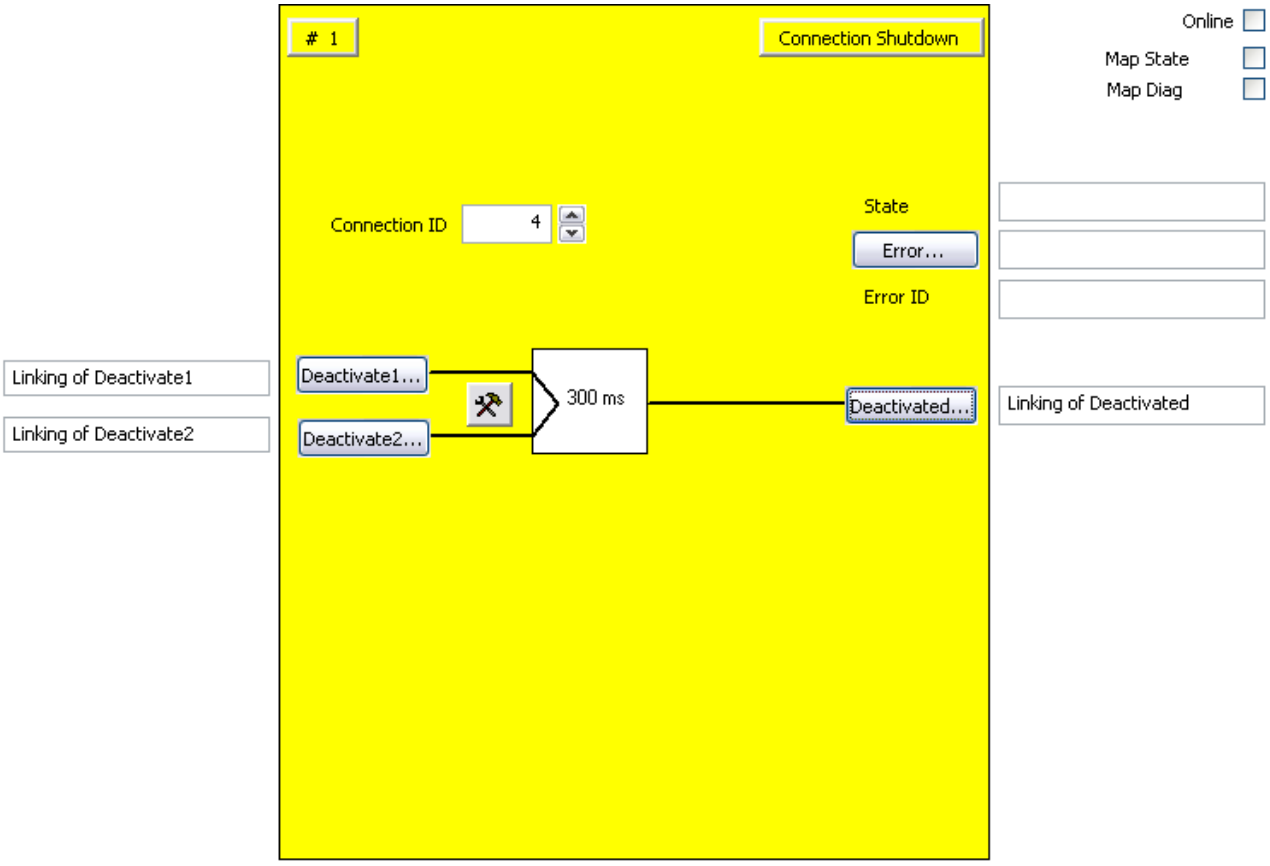

Fig. 90: FB CONNECTION SHUTDOWN configuration

The Settings button to the right of the Deactivate(x) buttons can be used to activate the inputs and configured them as make (NO) or break (NC) contacts. In the default state the inputs are disabled.

The 'Deactivate1' and 'Deactivate2' buttons are used to link the input variables of the FB Connection Shutdown.

The 'Deactivated' button is used to link the output variable of the FB Connection Shutdown. The output signals with a logical 1 that the connection is terminated.

Use the 'Connection ID' selection box to specify the connection ID of the connection to be terminated via the function block. The function block uses the Connection ID, not the Connection No. of the TwinSAFE connection.

The 'Error' button can be used to link the error state to an output variable.

The '"Map State"' and '"Map Diag"' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

4.15.4 Configuration in TwinCAT 3

Display of the function block and its properties in TwinCAT 3.

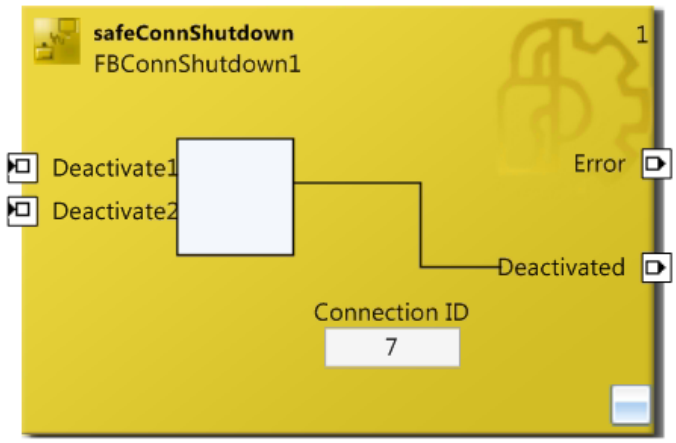

Fig. 91: FB Connection Shutdown in TwinCAT 3

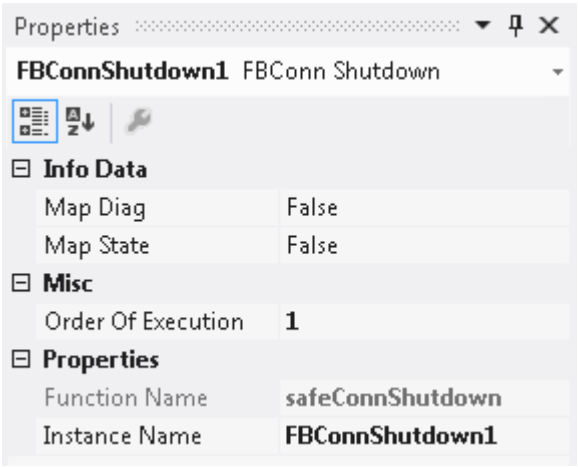

Fig. 92: FB Connection Shutdown properties

NOTICE

Shutdown

Before a connection can be disabled, it must have started up without error and be in DATA state.
For modular machines, where a module is generally not available, for example, this concept should be realized via additional TwinSAFE groups.

4.16 The function block ADD

4.16.1 Functional description

The FB ADD is used to add the two connected analog input values and transfer them to the AnalogOut output. The input data types INT16, INT32, UINT16 and UINT32 are permitted. The output must be selected to match the input types.

If an overflow or underflow occurs during the addition, the ERROR state is assumed. The AnalogOut output is then set to 0, the Error output is set to 1.

Once overflow or underflow no longer occurs after an error, the function block can be set to RUN state again via *ErrAck* of the TwinSAFE group. The RESET state is assumed when the *ErrAck* input of the corresponding group is 1. When the *ErrAck* input of the corresponding group changes to 0 again, the system switches from RESET state to RUN state. In RESET state the AnalogOut output and the Error output are 0.

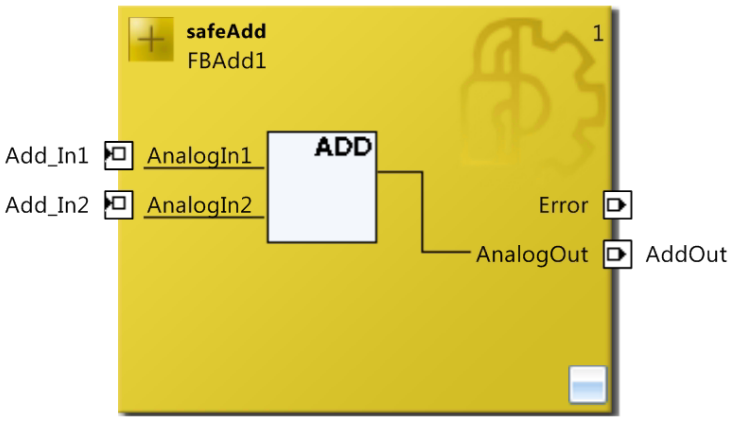

Fig. 93: Function block ADD

NOTICE

KL6904/EL6900

The function block ADD is not available in the KL6904 and the EL6900.

4.16.2 Signal description

FB ADD inputs

Name	Permitted type	Data type	Description
AnalogIn1	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	1st input channel for addition
AnalogIn2	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	2nd input channel for addition

FB ADD outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	Error output (see diagnostic information)
AnalogOut	TwinSAFE-Out FB-In Standard-Out	INT16 UINT16 INT32 UINT32	1st output channel with the addition result

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
TwinSAFE SC	Input of a TwinSAFE connection (TwinSAFE SC technology)

Internal identifier of the FB

Type	Description
FB ADD	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for the FB ADD

Diagnostic information

Bit	Description
0	The output AnalogOut has an underflow (is less than the smallest possible value)
1	The output AnalogOut has an overflow (is greater than the largest possible value)

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
0x4080	An underflow has occurred	FB number	AnalogIn1	AnalogIn2
0x4081	An overflow has occurred	FB number	AnalogIn1	AnalogIn2

Status information

Value	Description
0	undefined
1	**RUN** FB ADD cyclically adds the two analog inputs AnalogIn1 and AnalogIn2. If no overflow and no underflow occur during the addition, FB ADD is in the RUN state. The outputs assume the following values: • Error = 0 • AnalogOut = result of the addition
2	**STOP** If the input FbRun=FALSE, FB ADD assumes the STOP state. The outputs assume the following values: • Error = 0 • AnalogOut = 0
3	not used
4	**ERROR** If FB ADD detects an error when checking the value range of AnalogOut during addition, FB ADD switches to the ERROR state and sends the corresponding Diag message to the GROUP module. The outputs assume the following values: • Error = 1 • AnalogOut = 0
5	**RESET** FB ADD assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. The outputs assume the following values: • Error = 0 • AnalogOut = 0

4.16.3 Configuration in TwinCAT 3

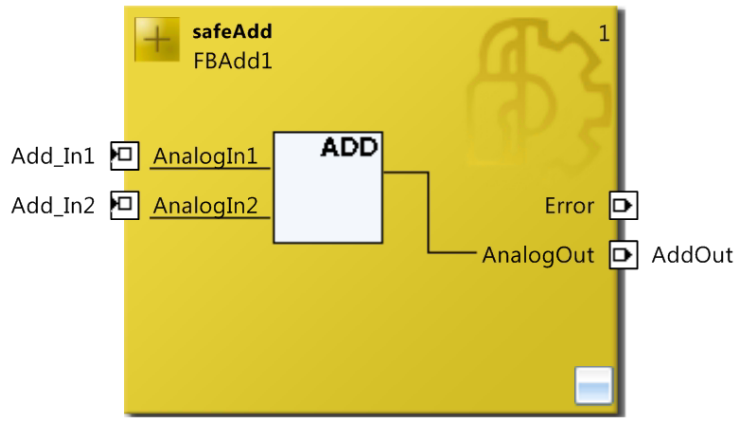

Fig. 94: FB ADD configuration

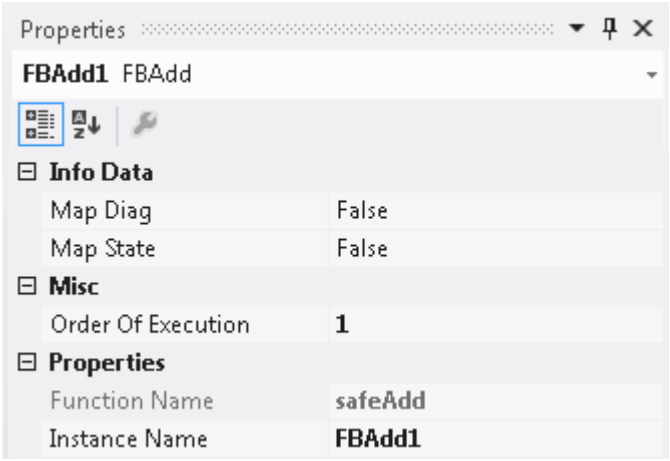

Fig. 95: FB ADD properties

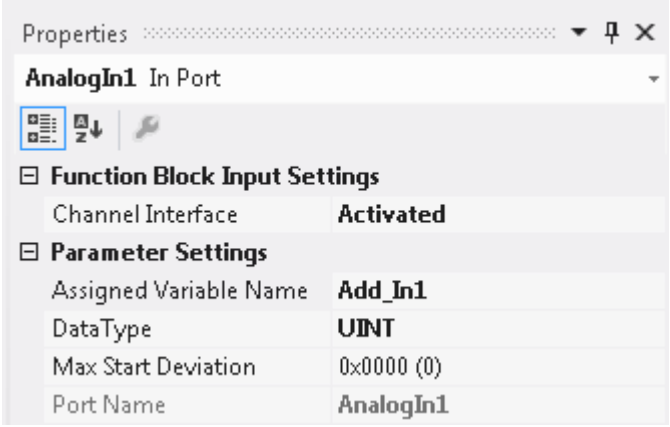

Fig. 96: FB ADD port properties

A mouse click next to the FB port, here *AnalogIn1* and *AnalogIn2*, can be used to create variables that can be linked to input signals. Input settings, such as changing the data type or activation of the input, can be made via the properties of the FB port.

The *"Map State"* and *"Map Diag"* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

4.17 The function block SUB

4.17.1 Functional description

The FB SUB is used to subtract the AnalogIn2 input from the AnalogIn1 input and transfer it to the AnalogOut output. The input data types INT16, INT32, UINT16 and UINT32 are permitted. The output must be selected to match the input types.

If an overflow or underflow occurs during the subtraction, the ERROR state is assumed. The AnalogOut output is then set to 0, the Error output is set to 1.

Once overflow or underflow no longer occurs after an error, the function block can be set to RUN state again via *ErrAck* of the TwinSAFE group. The RESET state is assumed when the *ErrAck* input of the corresponding group is 1. When the *ErrAck* input of the corresponding group changes to 0 again, the system switches from RESET state to RUN state. In RESET state the AnalogOut output and the Error output are 0.

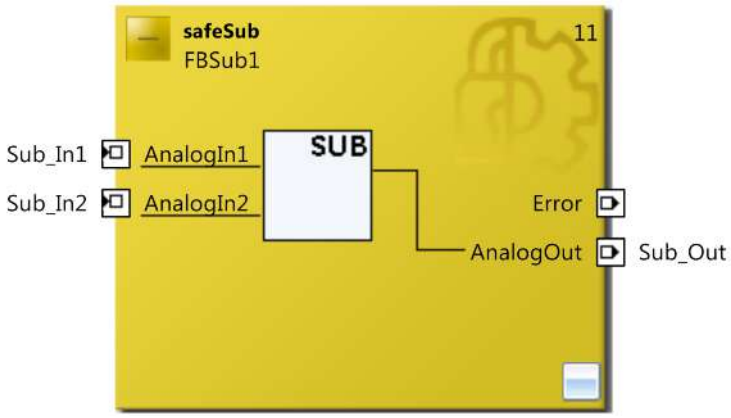

Fig. 97: Function block SUB

NOTICE

KL6904/KL6900

The function block SUB is not available in the KL6904 and the EL6900.

4.17.2 Signal description

FB SUB inputs

Name	Permitted type	Data type	Description
AnalogIn1	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	1st input channel for subtraction
AnalogIn2	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	2nd input channel for subtraction

FB SUB outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	Error output (see diagnostic information)

Name	Permitted type	Data type	Description
AnalogOut	TwinSAFE-Out FB-In Standard-Out	INT16 UINT16 INT32 UINT32	1st output channel with the subtraction result

FB SUB input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
TwinSAFE SC	Input of a TwinSAFE connection (TwinSAFE SC technology)

Internal identifier of the FB

Type	Description
FB SUB	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for the FB SUB

Diagnostic information

Bit	Description
0	The output AnalogOut has an underflow (is less than the smallest possible value)
1	The output AnalogOut has an overflow (is greater than the largest possible value)

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
0x4080	An underflow has occurred	FB number	AnalogIn1	AnalogIn2
0x4081	An overflow has occurred	FB number	AnalogIn1	AnalogIn2

Status information

Value	Description
0	undefined
1	**RUN** FB SUB cyclically subtracts the two analog inputs AnalogIn1 and AnalogIn2. If no overflow or underflow occurs during subtraction, FB SUB is in the RUN state. The outputs assume the following values: • Error = 0 • AnalogOut = result of the subtraction
2	**STOP** If the input FbRun=FALSE, FB SUB assumes the STOP state. The outputs assume the following values: • Error = 0 • AnalogOut = 0
3	not used

Value	Description
4	**ERROR** If FB SUB detects an error when checking the value range of AnalogOut during subtraction, FB SUB switches to the ERROR state and sends the corresponding Diag message to the GROUP module. The outputs assume the following values: • Error = 1 • AnalogOut = 0
5	**RESET** FB ADD assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. The outputs assume the following values: • Error = 0 • AnalogOut = 0

4.17.3 Configuration in TwinCAT 3

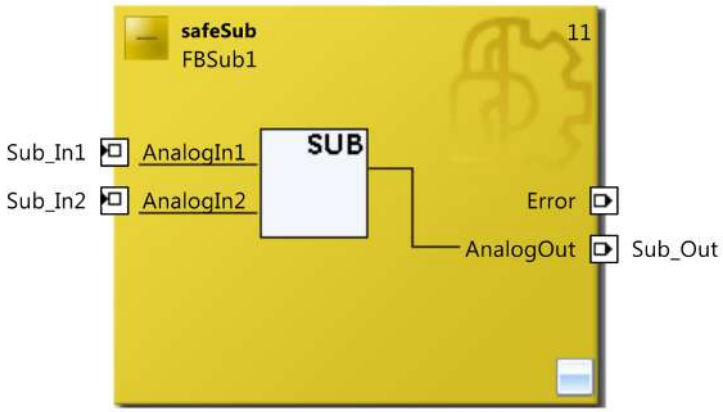

Fig. 98: FB SUB configuration

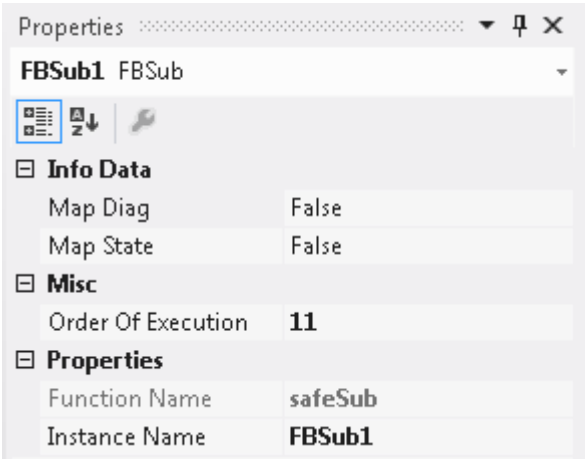

Fig. 99: FB SUB properties

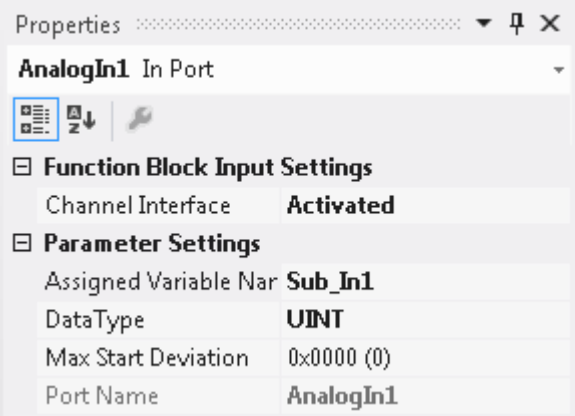

Fig. 100: FB SUB port properties

A mouse click next to the FB port, here *AnalogIn1* and *AnalogIn2*, can be used to create variables that can be linked to input signals. Input settings, such as changing the data type or activation of the input, can be made via the properties of the FB port.

The *"Map State"* and *"Map Diag"* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

4.18 The function block MUL

4.18.1 Functional description

The FB MUL is used to multiply the AnalogIn1 input with the AnalogIn2 input and transfer the result to the AnalogOut output. The input data types INT16, INT32, UINT16 and UINT32 are permitted. The output must be selected to match the input types.

If an overflow or underflow occurs during the multiplication, the ERROR state is assumed. The AnalogOut output is then set to 0, the Error output is set to 1.

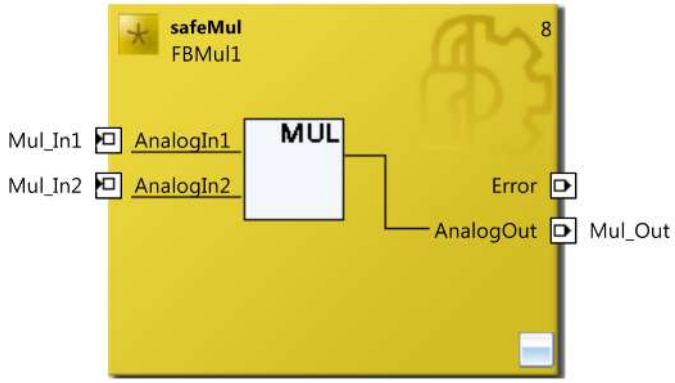

Fig. 101: Function block MUL

NOTICE

KL6904/EL6900

The function block MUL is not available in the KL6904 and the EL6900.

4.18.2 Signal description

FB MUL inputs

Name	Permitted type	Data type	Description
AnalogIn1	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	1st input channel for multiplication
AnalogIn2	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	2nd input channel for multiplication

FB MUL outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	Error output (see diagnostic information)
AnalogOut	TwinSAFE-Out FB-In Standard-Out	INT16 UINT16 INT32 UINT32	1st output channel with the multiplication result

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
TwinSAFE SC	Input of a TwinSAFE connection (TwinSAFE SC technology)

Internal identifier of the FB

Type	Description
FB MUL	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for FB MUL

Diagnostic information

Bit	Description
0	The output AnalogOut has an underflow (is less than the smallest possible value)
1	The output AnalogOut has an overflow (is greater than the largest possible value)

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
0x4080	An underflow has occurred	FB number	AnalogIn1	AnalogIn2
0x4081	An overflow has occurred	FB number	AnalogIn1	AnalogIn2

Status information

Value	Description
0	undefined
1	**RUN** In RUN state, the FB MUL writes the result of the multiplication to the AnalogOut output. The outputs assume the following values: • Error = 0 • AnalogOut = multiplication result
2	**STOP** If the input FbRun=FALSE, FB MUL assumes the STOP state. The outputs assume the following values: • Error = 0 • AnalogOut = 0
3	not used
4	**ERROR** If FB MUL detects an error when checking the value range of AnalogOut, FB MUL switches to the ERROR state and sends the corresponding Diag message to the GROUP module. The outputs assume the following values: • Error = 1 • AnalogOut = 0
5	**RESET** FB MUL assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. The outputs assume the following values: • Error = 0 • AnalogOut = 0

4.18.3 Configuration in TwinCAT 3

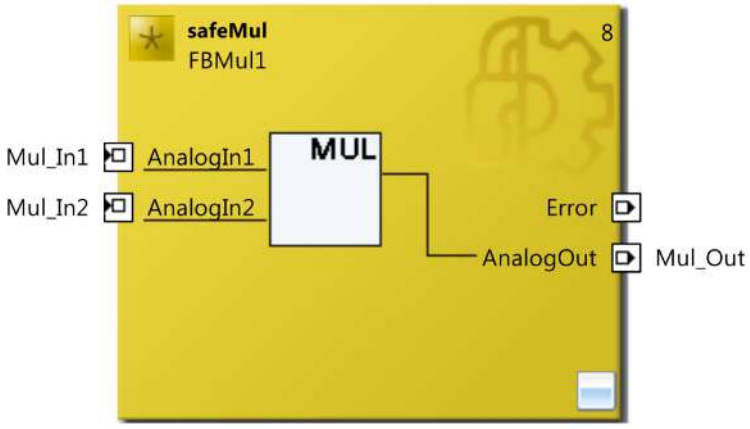

Fig. 102: FB MUL configuration

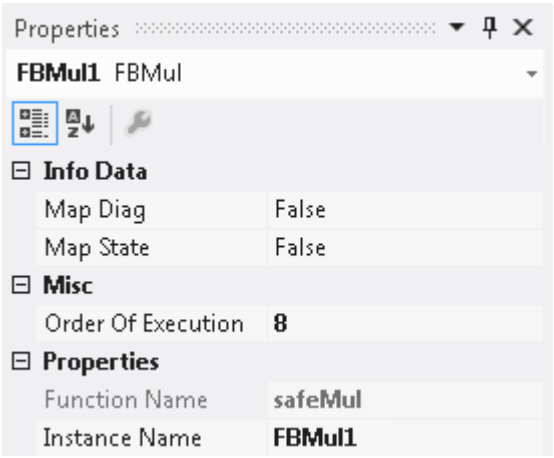

Fig. 103: FB MUL properties

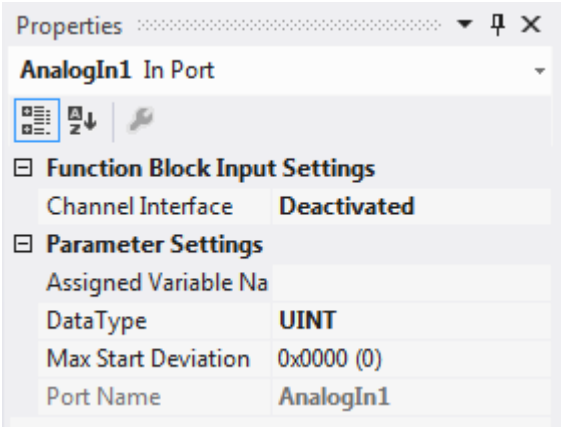

Fig. 104: FB MUL port properties

A mouse click next to the FB port, here *AnalogIn1* and *AnalogIn2*, can be used to create variables that can be linked to input signals. Input settings, such as changing the data type or activation of the input, can be made via the properties of the FB port.

The *"Map State"* and *"Map Diag"* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

4.19 The function block DIV

4.19.1 Functional description

The FB DIV is used to divide the AnalogIn1 input by the AnalogIn2 input and transfer the result to the AnalogOut output. The input data types INT16, INT32, UINT16 and UINT32 are permitted. The output must be selected to match the input types.

If the AnalogIn2 input is 0, the AnalogOut output is set to 0. In this case no error is output.

If an overflow or underflow occurs during the division, the ERROR state is assumed. The AnalogOut output is then set to 0, the Error output is set to 1.

The Division Rounding parameter can be used to specify the rounding method to be used.

Parameter	Rounding method
Floor	Decimal places are truncated
Ceil	The next higher integer is returned as result
Round	Commercial rounding is used (e.g. 2.5 is rounded to 3)

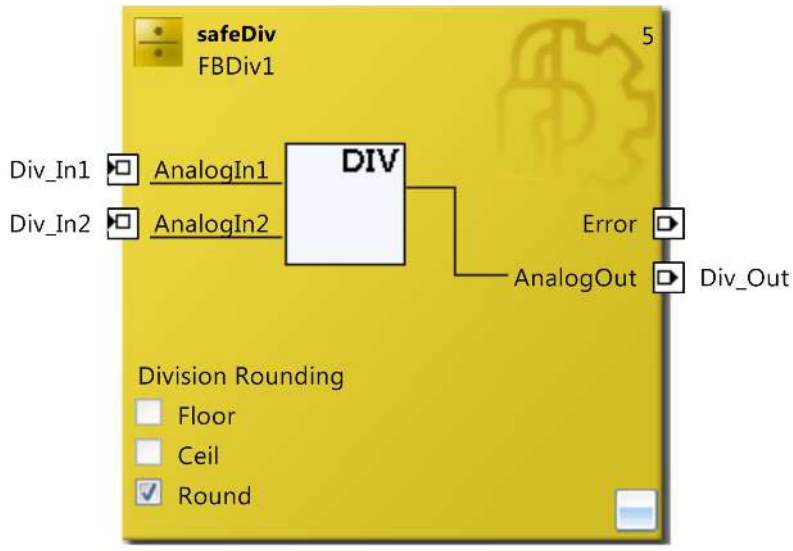

Fig. 105: Function block DIV

NOTICE

KL6904/EL6900

The function block DIV is not available in the KL6904 and the EL6900.

4.19.2 Signal description

FB DIV inputs

Name	Permitted type	Data type	Description
AnalogIn1	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	1st input channel for division
AnalogIn2	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	2nd input channel for division

FB DIV outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	Error output (see diagnostic information)
AnalogOut	TwinSAFE-Out FB-In Standard-Out	INT16 UINT16 INT32 UINT32	1st output channel with the division result

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)

Type	Description
FB-In	TwinSAFE FB input
TwinSAFE SC	Input of a TwinSAFE connection (TwinSAFE SC technology)

Internal identifier of the FB

Type	Description
FB DIV	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for the FB DIV

Diagnostic information

Bit	Description
0	The output AnalogOut has an underflow (is less than the smallest possible value)
1	The output AnalogOut has an overflow (is greater than the largest possible value)

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
0x4080	An underflow has occurred	FB number	AnalogIn1	AnalogIn2
0x4081	An overflow has occurred	FB number	AnalogIn1	AnalogIn2

Status information

Value	Description
0	undefined
1	**RUN** In the RUN state, FB DIV enters the result of the division in the AnalogOut output. The outputs assume the following values: • Error = 0 • AnalogOut = division result
2	**STOP** If the input FbRun=FALSE, FB DIV assumes the STOP state. The outputs assume the following values: • Error = 0 • AnalogOut = 0
3	not used
4	**ERROR** If FB DIV detects an error when checking the value range of AnalogOut, FB DIV switches to the ERROR state and sends the corresponding Diag message to the GROUP module. The outputs assume the following values: • Error = 1 • AnalogOut = 0
5	**RESET** FB DIV assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. The outputs assume the following values: • Error = 0 • AnalogOut = 0

4.19.3 Configuration in TwinCAT 3

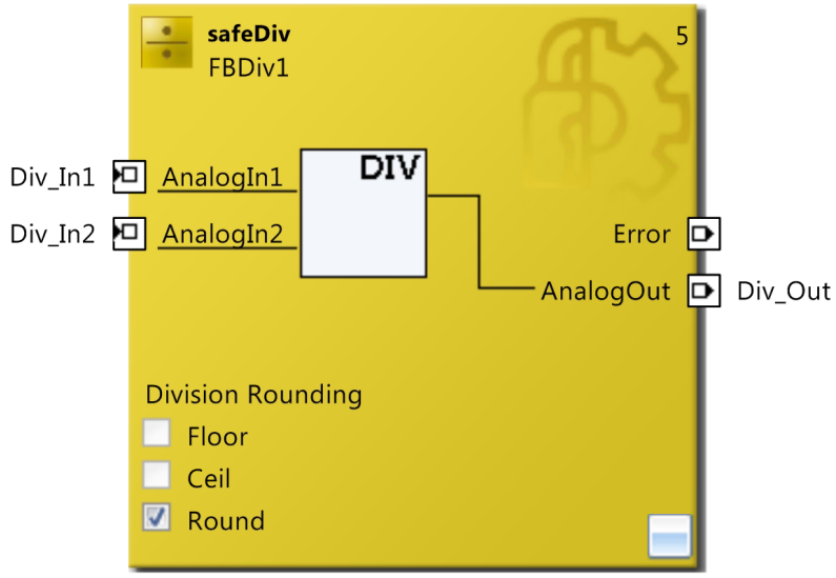

Fig. 106: FB DIV configuration

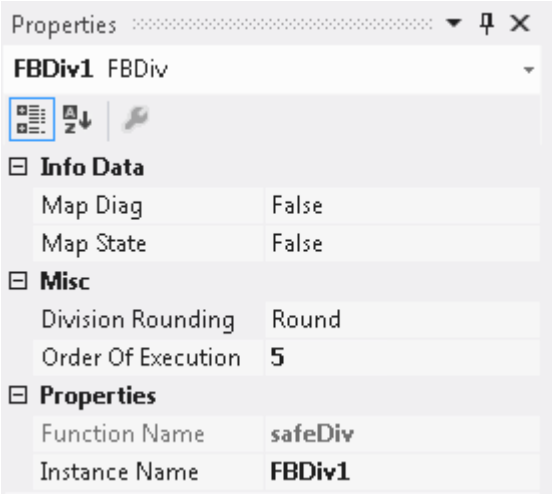

Fig. 107: FB DIV properties

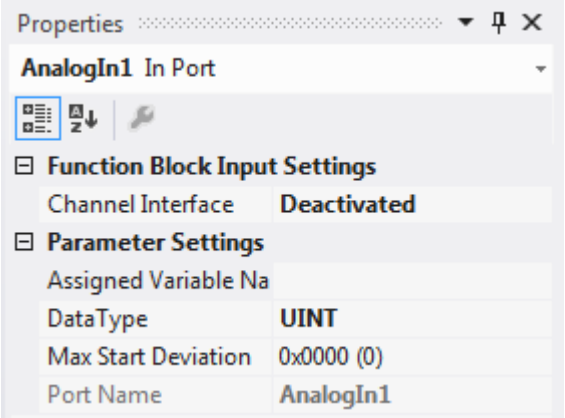

Fig. 108: FB DIV port properties

A mouse click next to the FB port, here *AnalogIn1* and *AnalogIn2*, can be used to create variables that can be linked to input signals. Input settings, such as changing the data type or activation of the input, can be made via the properties of the FB port.

The *"Map State"* and *"Map Diag"* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

4.20 The function block COMPARE

4.20.1 Functional description

The FB COMPARE checks the 2-5 analog inputs CompIn1 to CompIn5 for equality within a time and value tolerance window. The input data types INT16, INT32, UINT16 and UINT32 are permitted. The output CompOut must be selected to match the input types. The *Architecture* option field can be used to select how many inputs are to be evaluated. The parameter *Allowed Deviation* and *Tolerance Time (ms)* can be used to specify which deviations between the input values are permitted during which interval. The *IsValid* output returns a logical 1 if the comparison has a positive result.
The *CompOut* output contains the first analog value that meets the comparison criteria.
The ERROR state is assumed if an overflow or underflow occurs. In this case the CompOut and IsValid outputs are set to 0 and the Error output to 1.

Description of the Architecture radio button

- 1oo2:
  The two input values are compared for equality. If an error is detected, the FB outputs *CompOut* and *IsValid* are set to 0.
- 2oo3:
  The 3 input signals are compared, and the majority result is used (2 out of 3). If all values outside the defined limits are different, the *CompOut* FB output is set to 0 and the *IsValid* output is reset.
- 3oo5:
  The 5 input signals are compared, and the majority result is used (3 out of 5). If fewer than 3 values within the defined limits are equal, the FB output *CompOut* is set to 0 and the output *IsValid* is reset.

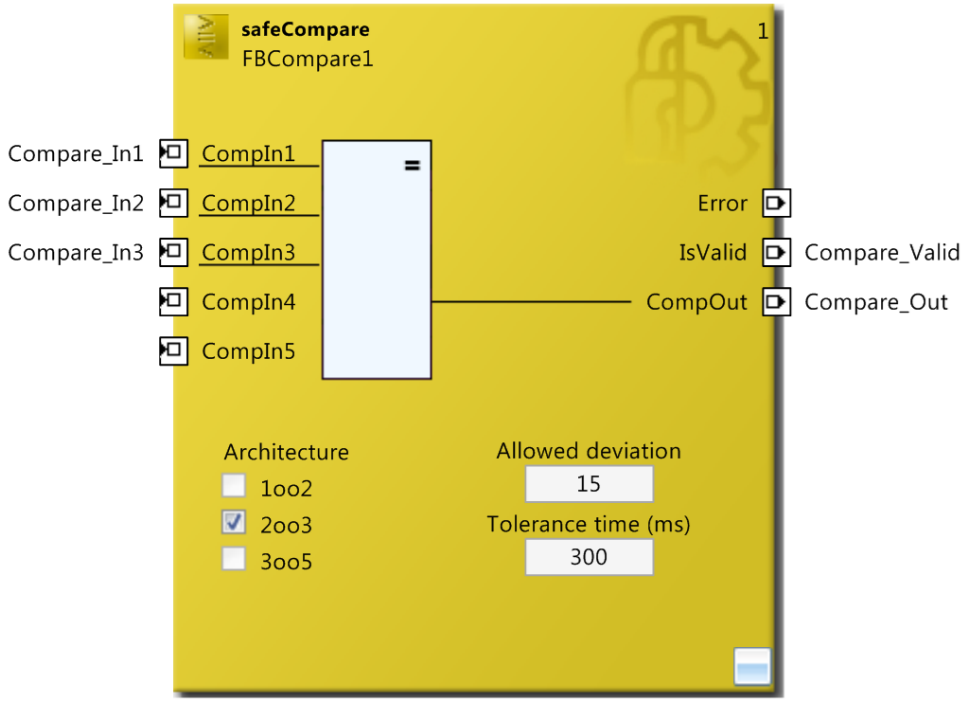

Fig. 109: Function block COMPARE

NOTICE

KL6904/EL6900

The function block COMPARE is not available in the KL6904 and the EL6900.

4.20.2 Signal description

FB COMPARE inputs

Name	Permitted type	Data type	Description
CompIn1	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	1st input channel for the comparison (1oo2, 2oo3, 3oo5)
CompIn2	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	2nd input channel for the comparison (1oo2, 2oo3, 3oo5)
CompIn3	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	3rd input channel for the comparison (2oo3, 3oo5)
CompIn4	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	4th input channel for the comparison (3oo5)
CompIn5	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	5th input channel for the comparison (3oo5)

FB COMPARE outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	Error output (see diagnostic information)
IsValid	TwinSAFE-Out FB-In Standard-Out	BOOL	Output indicating whether the comparison has a positive or negative result (positive=1, negative=0)
CompOut	TwinSAFE-Out FB-In Standard-Out	INT16 UINT16 INT32 UINT32	Output channel with the first CompIn input value that lies within the comparison result

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
TwinSAFE SC	Input of a TwinSAFE connection (TwinSAFE SC technology)

Internal identifier of the FB

Type	Description
FB COMPARE	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for the FB COMPARE

Diagnostic information

Bit	Description
0	The output CompOut has an underflow (is less than the smallest possible value)
1	The output CompOut has an overflow (is greater than the largest possible value)

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
0x4098	An underflow has occurred	FB number	CompOut	Smallest permitted value
0x4099	An overflow has occurred	FB number	CompOut	Largest permitted value

Status information

Value	Meaning
0	undefined
1	**RUN** FB COMPARE assumes the RUN state when sufficient analog inputs deviate from each other by no more than the Allowed Deviation (ValuesEqual = TRUE). The outputs assume the following values: • Error = 0 • IsValid = 1 • CompOut = CompInX (X= smallest input that does not deviate)
2	**STOP** If the input FbRun = FALSE, the FB COMPARE assumes the STOP state. The outputs assume the following values: • Error = 0 • IsValid = 0 • CompOut = 0
3	**SAFE** FB COMPARE assumes the SAFE state if not enough analog inputs deviate from each other by at most the Allowed Deviation (ValuesEqual = FALSE) and the DelayOutTimer has expired (DelayOutExpired=TRUE). The outputs assume the following values: • Error = 0 • IsValid = 0 • CompOut = 0
4	**ERROR** If the FB COMPARE detects an error when checking the value range of CompOut, FB COMPARE switches to the ERROR state and sends the corresponding Diag message to the GROUP module. The outputs assume the following values: • Error = 1 • IsValid = 0 • CompOut = 0
5	**RESET** FB COMPARE assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. The outputs assume the following values: • Error = 0

Value	Meaning
	• IsValid = 0 • CompOut = 0
8	**DELAYOUT** If not enough analog inputs deviate from each other by no more than the allowed deviation (ValuesEqual=FALSE), the DelayOutTimer is started with the ToleranceTime. As long as the DelayOutTimer has not expired (DelayOutExpired = FALSE), FB COMPARE assumes the DELAYOUT state. The outputs assume the following values: • Error = 0 • IsValid = 1 • CompOut = unchanged

4.20.3 Configuration in TwinCAT 3

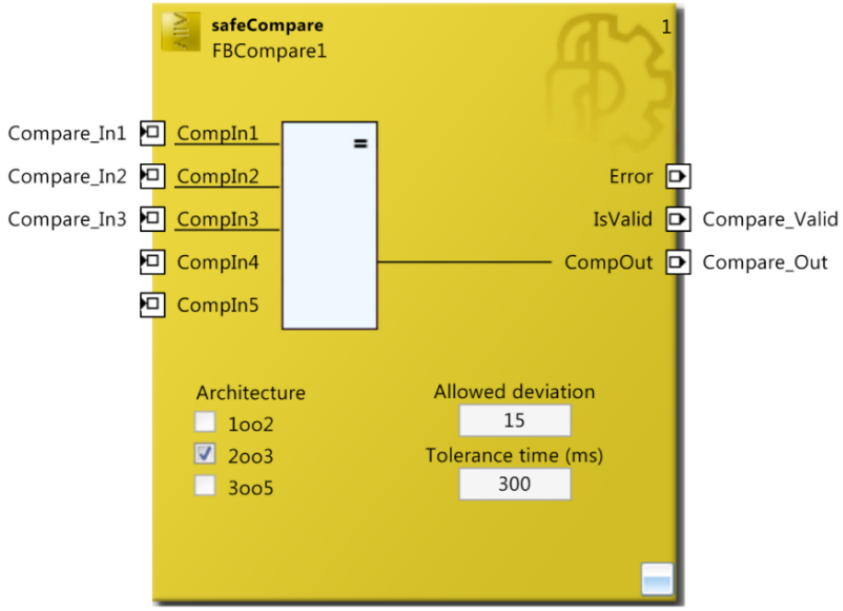

Fig. 110: FB Compare configuration

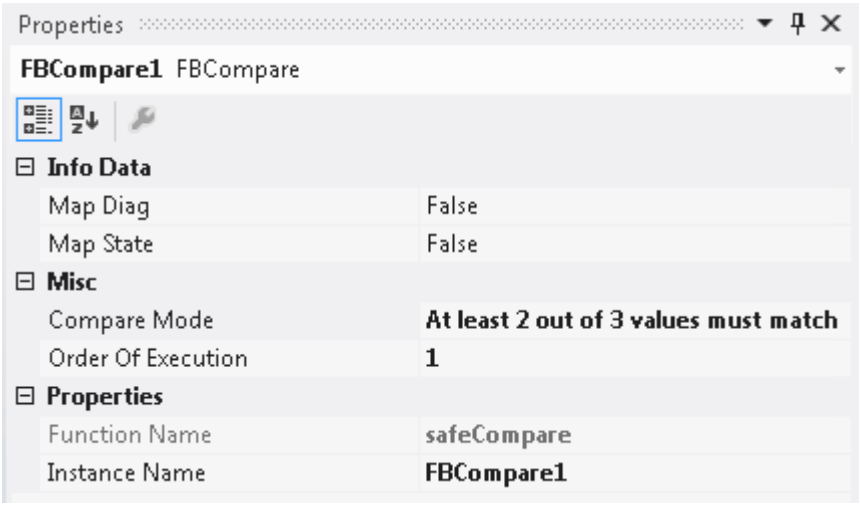

Fig. 111: FB COMPARE properties

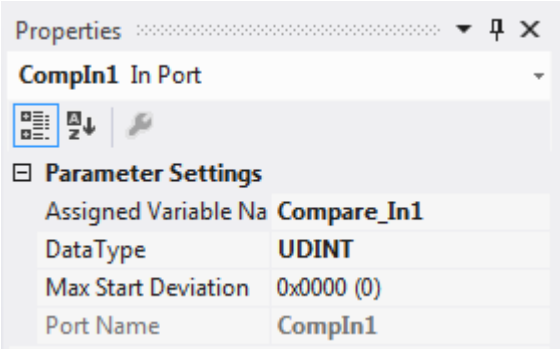

Fig. 112: Properties of the FB COMPARE ports

A mouse click next the FB port, here *CompIn1* to *CompIn5*, can be used to create variables that can be linked to input signals. Input settings, such as changing the data type or activation of the input, can be made via the properties of the FB port.

The *"Map State"* and *"Map Diag"* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

The *Architecture* option field can be used to choose between 1oo2, 2oo3 or 3oo5 evaluation. The parameter field *Allowed Deviation* defines the deviation of the input values from each another. The parameter field *Tolerance time (ms)* defines the time within which a valid result must be present at the inputs, in order to avoid a shutdown.

4.21 The function block LIMIT

4.21.1 Functional description

The FB LIMIT is used to check the *AnalogIn* input for the values linked to *MinValue* and *MaxValue* or the values entered in the parameters *Minimum Value* and *Maximum Value*. The input data types INT16, INT32, UINT16 and UINT32 are permitted. The *In_Limit* output is set if the AnalogIn value is within the *Minimum Value* and *Maximum Value* limits. If the value is above the *AboveMax* limit, it is set below *BelowMin*.

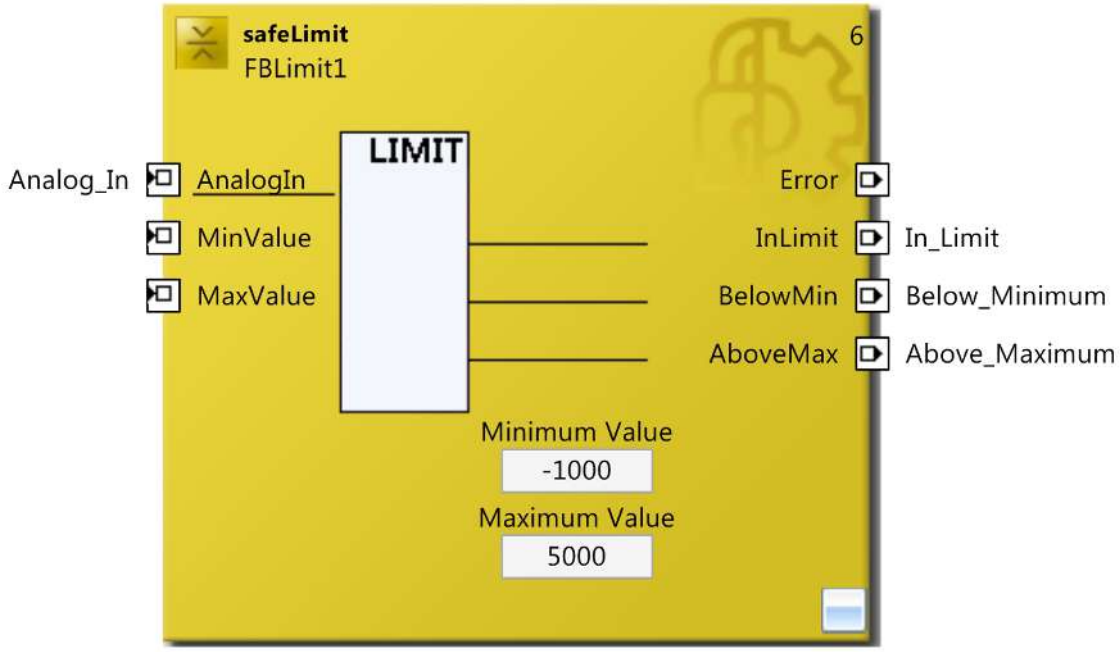

Fig. 113: Function block LIMIT

NOTICE

KL6904/EL6900

The function block LIMIT is not available in the KL6904 and the EL6900.

4.21.2 Signal description

FB LIMIT inputs

Name	Permitted type	Data type	Description
AnalogIn	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	Input channel for limitation
MinValue	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	Minimum value
MaxValue	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	Maximum value

FB LIMIT outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	Error output (see diagnostic information)
InLimit	TwinSAFE-Out FB-In Standard-Out	BOOL	Value is within the minimum/maximum limits
BelowMin	TwinSAFE-Out FB-In Standard-Out	BOOL	Value is below the minimum limit
AboveMax	TwinSAFE-Out FB-In Standard-Out	BOOL	Value is above the maximum limit

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
TwinSAFE SC	Input of a TwinSAFE connection (TwinSAFE SC technology)

Internal identifier of the FB

Type	Description
FB LIMIT	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for the FB LIMIT

Diagnostic information

Bit	Description
0	MinValue is greater than MaxValue

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
0x4090	MinValue is greater than MaxValue	FB number	MinValue	MaxValue

Status information

Value	Description
1	**RUN** If AnalogIn is greater than or equal to MinValue and less than or equal to MaxValue, FB LIMIT assumes the RUN state. The outputs assume the following values: • Error = 0 • InLimit = 1 • BelowMin = 0 • AboveMax = 0
2	**STOP** If the input FbRun = FALSE, FB LIMIT assumes the STOP state. The outputs assume the following values: • Error = 0 • InLimit = 0 • BelowMin = 0 • AboveMax = 0
3	**SAFE** If AnalogIn is less than MinValue or greater than MaxValue, FB LIMIT assumes the SAFE state. The outputs assume the following values: • Error = 0 • InLimit = 0 • BelowMin =(AnalogIn < MinValue) • AboveMax = (AnalogIn > MaxValue)
4	**ERROR** If FB LIMIT detects an error, FB LIMIT switches to into ERROR state and sends the corresponding Diag message to the GROUP module. The outputs assume the following values: • Error = 1 • InLimit = 0 • BelowMin = 0 • AboveMax = 0
5	**RESET** FB LIMIT assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. The outputs assume the following values: • Error = 0 • InLimit = 0 • BelowMin = 0

Value	Description
	• AboveMax = 0

4.21.3 Configuration in TwinCAT 3

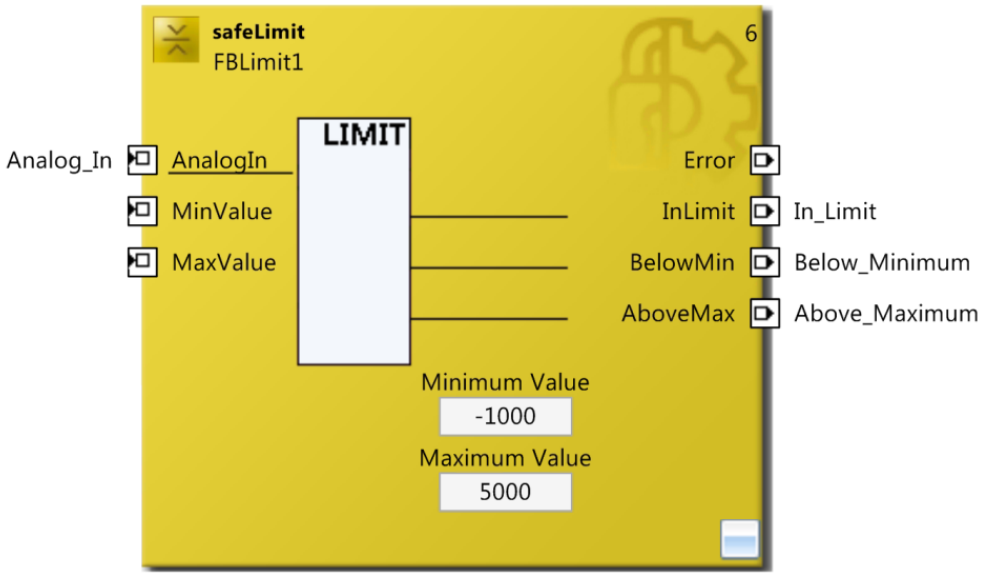

Fig. 114: FB LIMIT configuration

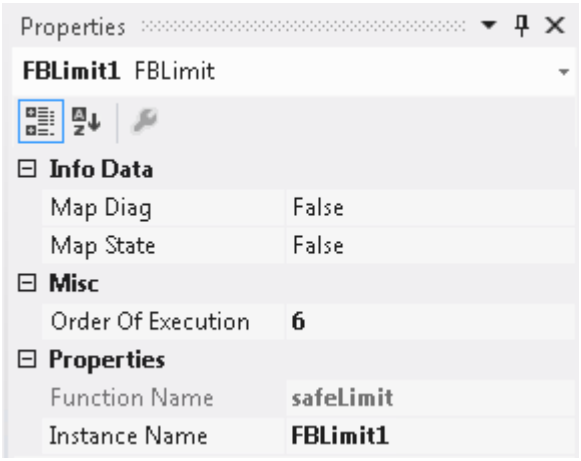

Fig. 115: FB LIMIT properties

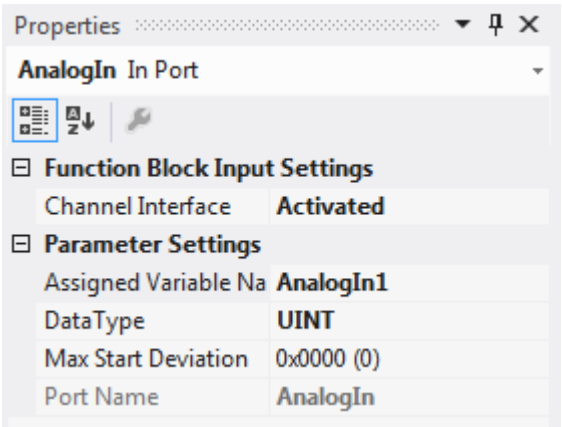

Fig. 116: FB LIMIT port properties

A mouse click next the FB port, here *AnalogIn1, MinValue* und *MaxValue*, can be used to create variables that can be linked to input signals. Input settings, such as changing the data type or activation of the input, can be made via the properties of the FB port. Either the FB inputs *MinValue* and *MaxValue* or the parameters *Minimum Value* and *Maximum Value* can be used. If the FB inputs are active, they are used.

The *"Map State"* and *"Map Diag"* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

4.22 The function block COUNTER

4.22.1 Functional description

The FB Counter is used to realize an up/down counter. The inputs *Reset*, *CountUp* and *CountDown* are of data type BOOL. The outputs *Error*, *CounterOut* and *CounterZero* are also of data type BOOL. The output *ActValue* indicates the current internal counter value and can be of data type INT16, UINT16, INT32 or UINT32. The parameters *Preset Value* and *Counter Limit* can be used to parameterize the counter.

A logical 1 signal at the input *Reset* causes the internal counter value to be set to the value that is parameterized via *Preset Value*. A rising edge at the input *CountUp* increments the internal counter value by 1. A rising edge at the input *CountDown* decrements the internal counter value by 1. Once the counter value specified under *CounterLimit* is reached, the output *CounterOut* is set. Once the counter value 0 is reached, the output *CounterZero* is set.

If the TwinSAFE group is started (Run=1) and the Reset input is TRUE, the output *ActValue* is set to *PresetValue*. When the group is stopped, *ActValue* is set to 0. Further status information can be found in chapter Signal description [▶ 135].

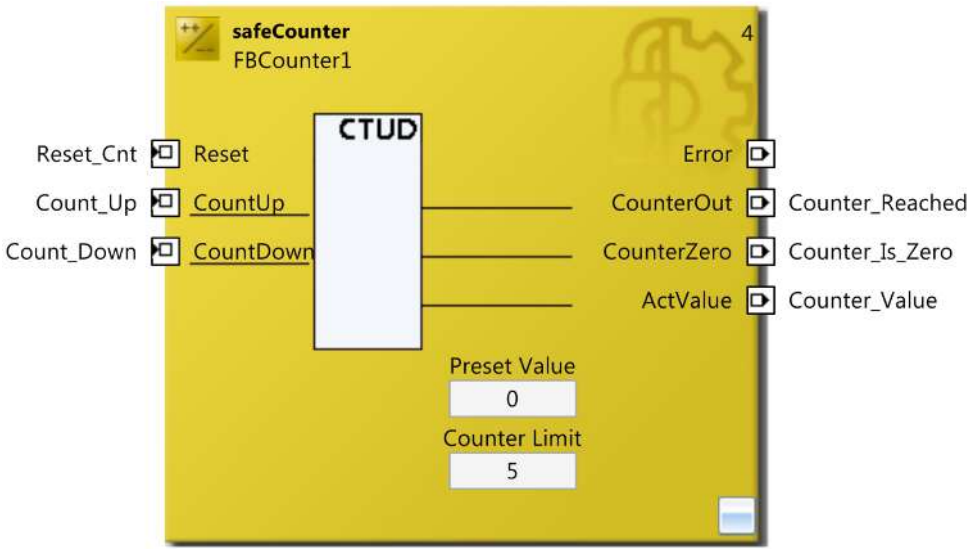

Fig. 117: Function block COUNTER

NOTICE

KL6904/EL6900

The function block Counter is not available in the KL6904 and the EL6900.

4.22.2 Signal description

FB Counter inputs

Name	Permitted type	Data type	Description
Reset	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	BOOL	Reset input for resetting the counter to Preset Value
CountUp	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	BOOL	CountUp input for incrementing the internal counter value by 1
CountDown	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	BOOL	CountDown input for decrementing the internal counter value by 1

FB Counter outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	Error output (see diagnostic information)
CounterOut	TwinSAFE-Out FB-In Standard-Out	BOOL	Output is set when the counter limit is reached
CounterZero	TwinSAFE-Out FB-In Standard-Out	BOOL	Output is set when the internal counter value is 0
ActValue	TwinSAFE-Out FB-In Standard-Out	INT16 UINT16 INT32 UINT32	Current internal counter value

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
TwinSAFE SC	Input of a TwinSAFE connection (TwinSAFE SC technology)

Internal identifier of the FB

Type	Description
FB COUNTER	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for the FB Counter

Diagnostic information

Bit	Description
0	The output ActValue has an underflow (is less than the smallest possible value)
1	The output ActValue has an overflow (is greater than the largest possible value)

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
0x40B8	An underflow has occurred	FB number	ActValue	Smallest permitted value
0x40B9	An overflow has occurred	FB number	ActValue	Largest permitted value

Status information

Value	Description
1	**RUN** In RUN state, FB Counter sets the ActValue output to PresetValue if the input Reset = TRUE. If the Reset input is FALSE, FB Counter increments the ActValue output if a rising edge is detected at the CountUp input and decrements it when a rising edge is detected at the CountDown input (this means that ActValue remains unchanged if both CountUp and CountDown inputs detect a rising edge). The outputs assume the following values: • Error = 0 • CounterOut = (ActValue >= CounterLimit) • CounterZero = (ActValue == 0) • Reset=TRUE: ActValue = PresetValue • Reset=FALSE: ActValue = ActValue + n (-1 <= n <= 1)
2	**STOP** If the input FbRun = FALSE, FB Counter assumes the STOP state. The outputs assume the following values: • Error = 0 • CounterOut = 0 • CounterZero = 0 • ActValue = 0
4	**ERROR** If FB Counter detects an error when checking the value range of CounterOut, FB Counter switches to the ERROR state and sends the corresponding Diag message to the GROUP module. The outputs assume the following values: • Error = 1 • CounterOut = 0 • CounterZero = 0 • ActValue = 0
5	**RESET** FB Counter assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. The outputs assume the following values: • Error = 0 • CounterOut = 0 • CounterZero = 0 • ActValue = 0

4.22.3 Configuration in TwinCAT 3

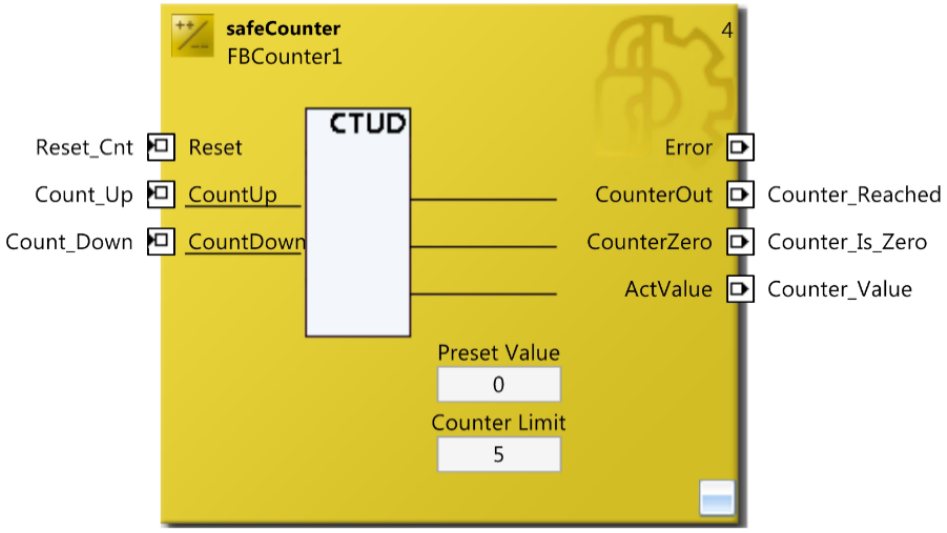

Fig. 118: FB COUNTER configuration

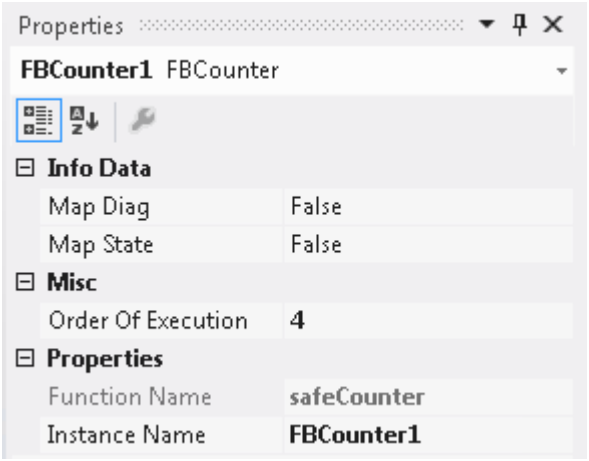

Fig. 119: FB COUNTER properties

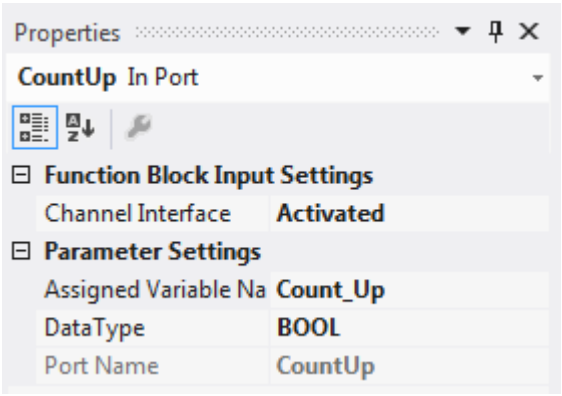

Fig. 120: FB COUNTER port properties

A mouse click next to the FB port, here *Reset, CountUp, CountDown, Error, CounterOut, CounterZero* and *ActValue*, can be used to create variables that can be linked to input or output signals. Input settings, such as changing the data type or activation of the input, can be made via the properties of the FB port.

The *"Map State"* and *"Map Diag"* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

4.23 The function block SCALE

4.23.1 Functional description

The FB SCALE is used to multiply the AnalogIn input with the scaling factor and then divided before the scaling offset is added. The input data types INT16, INT32, UINT16 and UINT32 are permitted. The output must be selected to match the input types. The AnalogIn input can be negated. For data types INT16 and INT32 this corresponds to multiplication with -1, for data types UINT16 and UINT32 it corresponds to an XOR function with 0xFFFF or 0xFFFFFFFF.

The *Division Rounding* parameter can be used to specify the rounding method to be used for the internal division.

Parameter	Rounding method
Floor	Decimal places are truncated
Ceil	The next higher integer is returned as result
Round	Commercial rounding is used (e.g. 2.5 is rounded to 3)

The parameter *Multiplication First* can be used specify whether the first scaling operation after the optional negation should be multiplication (TRUE) or division (FALSE).

In addition, the parameter watchdog (ms) can be used to specify that the AnalogIn input must have changed within the specified time. If the input remains unchanged within the specified time, the StuckAtError output is set to TRUE. If the parameter is set to 0, the check is turned off. The StuckAtError output is not a FB error, which means the TwinSAFE group does not enter an error state. The application program must respond to this.

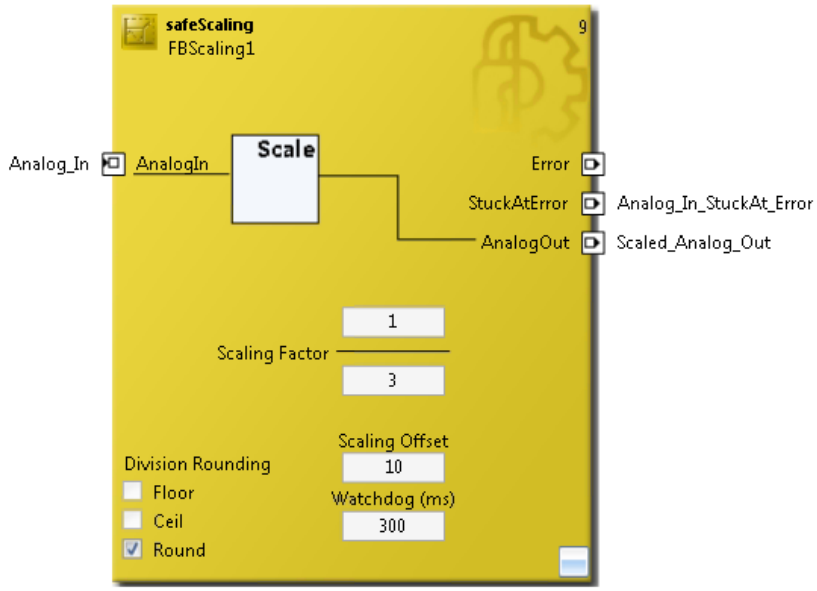

Fig. 121: Function block SCALE

NOTICE

KL6904/EL6900

The function block SCALE is not available in the KL6904 and the EL6900.

4.23.2 Signal description

FB Scale inputs

Name	Permitted type	Data type	Description
AnalogIn1	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	Input for scaling.

FB Scale outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	Error output (see diagnostic information)
StuckAtError	TwinSAFE-Out FB-In Standard-Out	BOOL	Output that is set if the AnalogIn input remains unchanged over the parameterized period.
AnalogOut	TwinSAFE-Out FB-In Standard-Out	INT16 UINT16 INT32 UINT32	Output with the scaled input signal Processing order: AnalogIn negation Nominator multiplication scaling factor (configurable) Denominator division scaling factor (configurable) Addition scaling offset

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
TwinSAFE SC	Input of a TwinSAFE connection (TwinSAFE SC technology)

Internal identifier of the FB

Type	Description
FB SCALE	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for the FB Scale1

Diagnostic information

Value	Description
0	No diagnostic information
1	The output AnalogOut has an underflow (is less than the smallest possible value).
2	The output AnalogOut has an overflow (is greater than the largest possible value).
3	A 32-bit overflow occurred during the multiplication.
4	A 32-bit overflow occurred during the division due to rounding.

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
0x40B0	The output AnalogOut has an underflow (is less than the smallest possible value).	FB number	AnalogIn	-
0x40B1	The output AnalogOut has an overflow (is greater than the largest possible value).	FB number	AnalogIn	-
0x40B2	A 32-bit overflow occurred during the multiplication.	FB number	AnalogIn	-
0x40B3	A 32-bit overflow occurred during the division due to rounding.	FB number	AnalogIn	-

Status information

Value	Description
1	**RUN** In the RUN state, FB SCALE enters the result of the scaling in the AnalogOut output. The outputs assume the following values: • Error = 0 • AnalogOut = result of the scaling • StuckAtError = StuckAtErrorDetected
2	**STOP** If the input FbRun = FALSE, FB SCALE assumes the STOP state. The outputs assume the following values: • Error = 0 • AnalogOut = 0 • StuckAtError = 0
4	**ERROR** If the FB SCALE detects an error when checking the value range of AnalogOut, FB SCALE switches to the ERROR state and sends the corresponding Diag message to the GROUP module. The outputs assume the following values: • Error = 1 • AnalogOut = 0 • StuckAtError = 0
5	**RESET** FB SCALE assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. The outputs assume the following values: • Error = 0 • AnalogOut = 0 • StuckAtError = 0

4.23.3 Configuration in TwinCAT 3

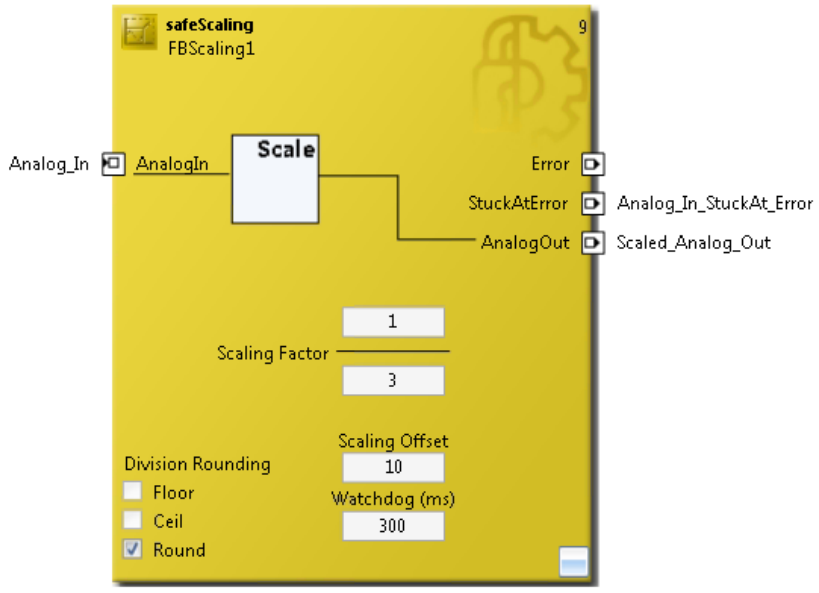

Fig. 122: FB SCALE configuration

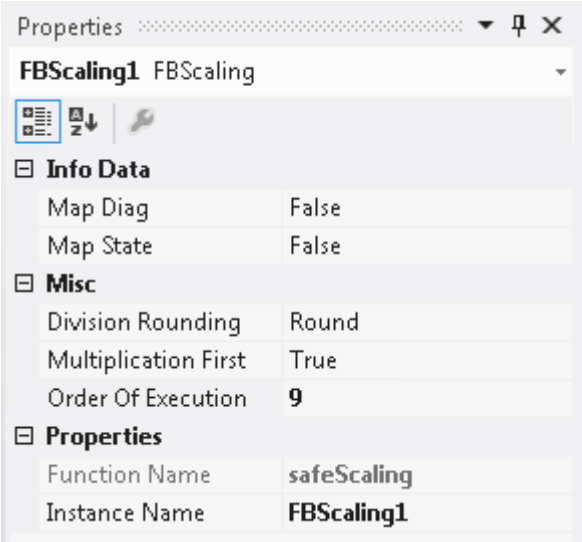

Fig. 123: FB SCALE properties

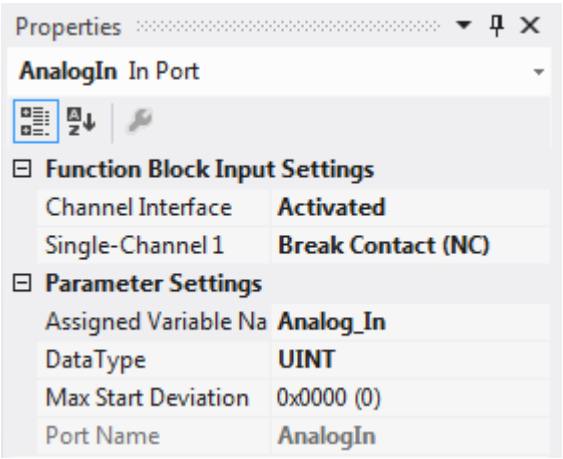

Fig. 124: FB SCALE port properties

A mouse click next to the FB Port, here *AnalogIn, Error, StuckAtError* and *AnalogOut*, can be used to create variables that can be linked to input or output signals. Settings such as changing the data type or activation of the input can be made via the properties of the FB port.

The *"Map State"* and *"Map Diag"* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

4.24 The function block SPEED

4.24.1 Functional description

The FB SPEED is used to store the AnalogIn input and calculate a speed from it, based on the specified time interval. The input data types INT16, INT32, UINT16 and UINT32 are permitted. The output must be selected to match the input types. The speed output is given in increments per time interval.

The parameter *Time Interval* is specified in ms.

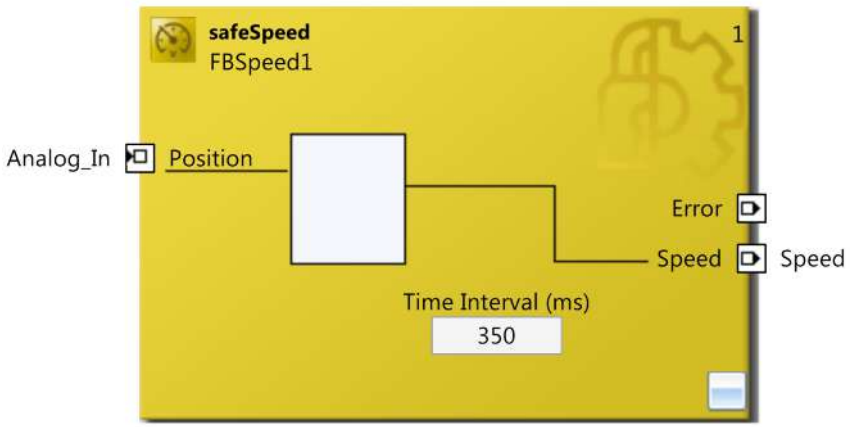

Fig. 125: Function block SPEED

NOTICE

KL6904/EL6900

The function block SPEED is not available in the KL6904 and the EL6900.

4.24.2 Signal description

FB Speed inputs

Name	Permitted type	Data type	Description
Position	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	Input channel for speed calculation

FB Speed outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	Error output (see diagnostic information)
Speed	TwinSAFE-Out FB-In Standard-Out	INT16 UINT16 INT32 UINT32	Output with the calculated speed

FB Speed input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
TwinSAFE SC	Input of a TwinSAFE connection (TwinSAFE SC technology)

Internal identifier of the FB

Type	Description
FB SPEED	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for the FB Speed

Diagnostic information

Bit	Description
0	The output Speed has an underflow (is less than the smallest possible value)
1	The output Speed has an overflow (is greater than the largest possible value)

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
0x4088	An underflow has occurred.	FB number	current position	latched position
0x4089	An overflow has occurred.	FB number	current position	latched position

Status information

Value	Description
1	**RUN** In RUN state, FB SPEED enters the result of the speed calculation into the Speed output. The outputs assume the following values: • Error = 0 • Speed = calculated speed
2	**STOP** If the input FbRun = FALSE, FB SPEED assumes the STOP state. The outputs assume the following values: • Error = 0 • Speed = 0
4	**ERROR** If FB SPEED detects an error when checking the Speed value range, the FB SPEED switches to the ERROR state and sends the corresponding Diag message to the GROUP module. The outputs assume the following values: • Error = 1 • Speed = 0
5	**RESET** FB SPEED assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. The outputs assume the following values: • Error = 0

Value	Description
	• Speed = 0

4.24.3 Configuration in TwinCAT 3

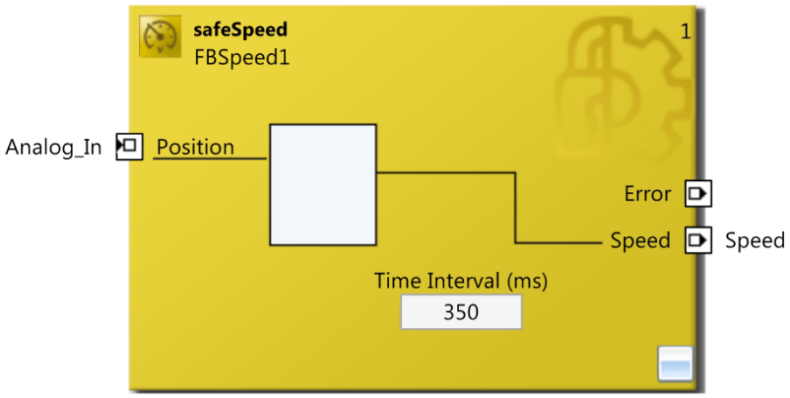

Fig. 126: FB SPEED configuration

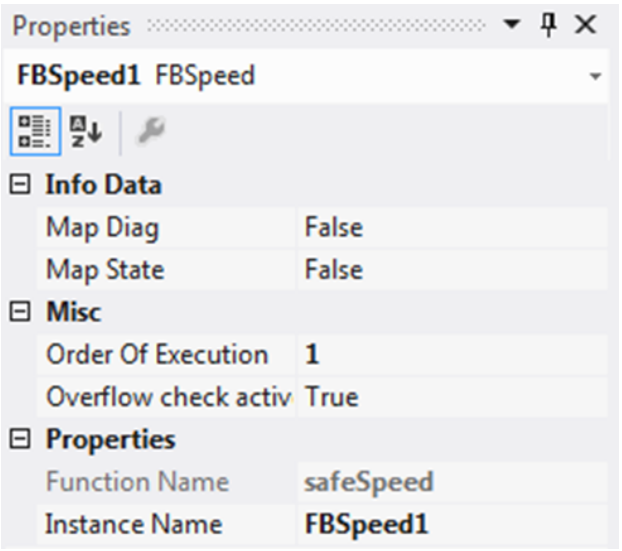

Fig. 127: FB SPEED properties

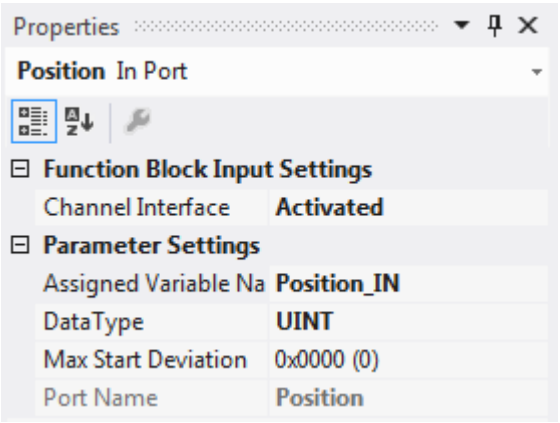

Fig. 128: FB SPEED port properties

A mouse click next to the FB Port, here *Position, Error* and *Speed*, can be used to create variables that can be linked to input or output signals. Settings such as changing the data type or activation of the input can be made via the properties of the FB port.

The *"Map State"* and *"Map Diag"* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

The parameter Overflow Check can be used to specify speed calculation method in the event of an input signal overflow.

4.25 The function block LOADSENSING

4.25.1 Functional description

The FB LoadSensing can be used to check the *AnalogInX* and *AnalogInY* inputs; specifically, whether the *AnalogInY* values are within a certain range at position *AnalogInX*. The input data types INT16, INT32, UINT16 and UINT32 are permitted. For the *AnalogInY* values in the table there is a warning level and a switch-off level. The *Outside* parameter can be used to specify whether the *AnalogInY* value has to be within or outside the defined window.

If Inactive=FALSE, the largest index is determined whose corresponding X-value is still smaller than the AnalogInX input. The system then checks whether the AnalogInY input is within the corresponding switch-off level (Y1, Y2) or within the warning level (WY1, WY2). If the value is within the switch-off level, the *Valid* output is set. If the value is between the Y1 and WY1 or Y2 and WY2, the *Warning* output is set in addition. There can be up to 25 indices.

The Outside parameter can be used to reverse the test, in which case values outside Y1 and Y2 are valid and the output Valid is set. In this case the warning level must be greater than the switch-off level.

The data in the value table are checked based on the following formulas:

Outside = FALSE: Y1[index] <= WY1[index] < WY2[index] <= Y2[index]
Outside = TRUE: WY1[index] <= Y1[index] < Y2[index] <= WY2[index]

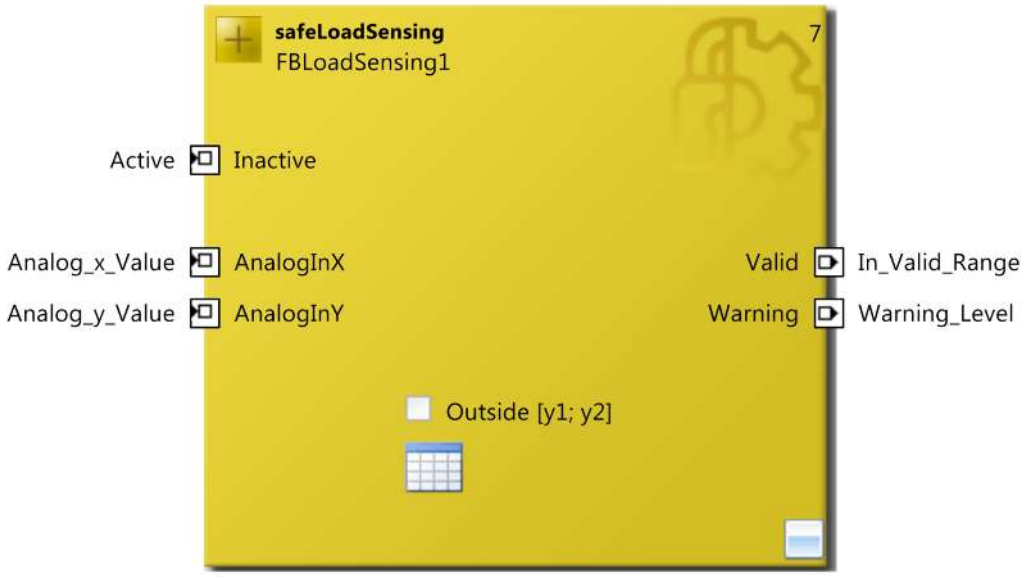

Fig. 129: Function block LOADSENSING

NOTICE

KL6904/EL6900

The function block LOADSENSING is not available in the KL6904 and the EL6900.

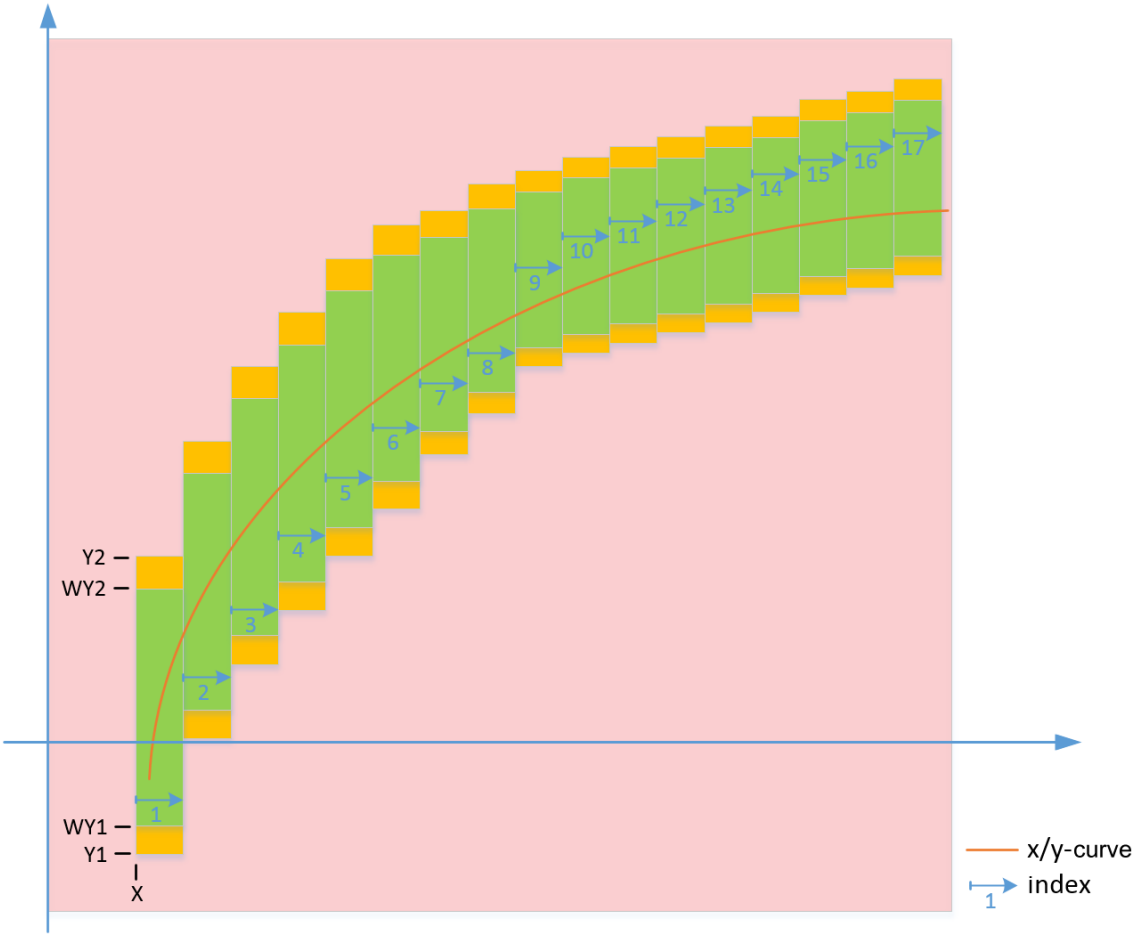

Fig. 130: Illustration of the check of the characteristic curve

4.25.2 Signal description

FB LoadSensing inputs

Name	Permitted type	Data type	Description
Inactive	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	BOOL	Input for activating the FB
AnalogInX	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	Analog x-value
AnalogInY	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	Analog y-value

FB LoadSensing outputs

Name	Permitted type	Data type	Description
Valid	TwinSAFE-Out FB-In Standard-Out	BOOL	This output is set if AnalogInY is within the switch-off level.
Warning	TwinSAFE-Out FB-In Standard-Out	BOOL	This output is set if AnalogInY is between the switch-off level and the warning level.

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
TwinSAFE SC	Input of a TwinSAFE connection (TwinSAFE SC technology)

Internal identifier of the FB

Type	Description
FB LoadSensing	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for the FB LoadSensing

Diagnostic information

Bit	Description
-	No diagnostic information

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
-	-	-	-	-

Status information

Value	Description
1	**RUN** If InActive = FALSE and AreaValid = TRUE, the FB LS assumes the RUN state. The outputs assume the following values: • Valid = 0 • Warning = 0
2	**STOP** If the input FbRun = FALSE, FB LS assumes the STOP state. The outputs assume the following values: • Valid = 0 • Warning = 0
3	**SAFE** If InActive = FALSE, AreaValid = FALSE, and AreaValidButWarning = FALSE, FB LS assumes the SAFE state. The outputs assume the following values: • Valid = 0 • Warning = 0
16	**INACTIVE** If InActive = TRUE, FB LS assumes the INACTIVE state. The outputs assume the following values: • Valid = 0 • Warning = 0

Value	Description
17	**WARNING** If InActive = FALSE and AreaValidButWarning = TRUE, FB LS assumes the WARNING state. The outputs assume the following values: • Valid = 1 • Warning = 1

4.25.3 Configuration in TwinCAT 3

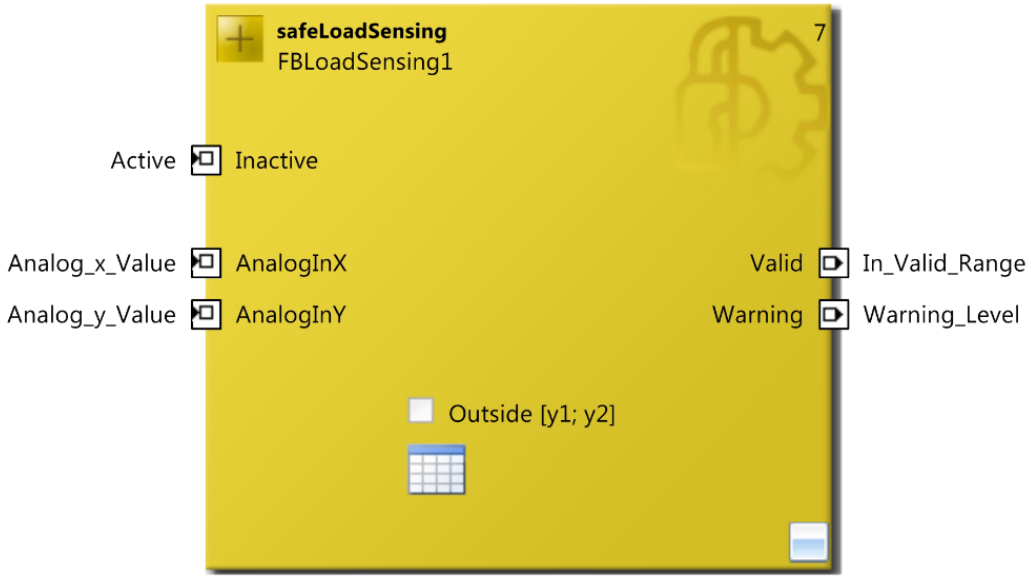

Fig. 131: FB LOADSENSING configuration

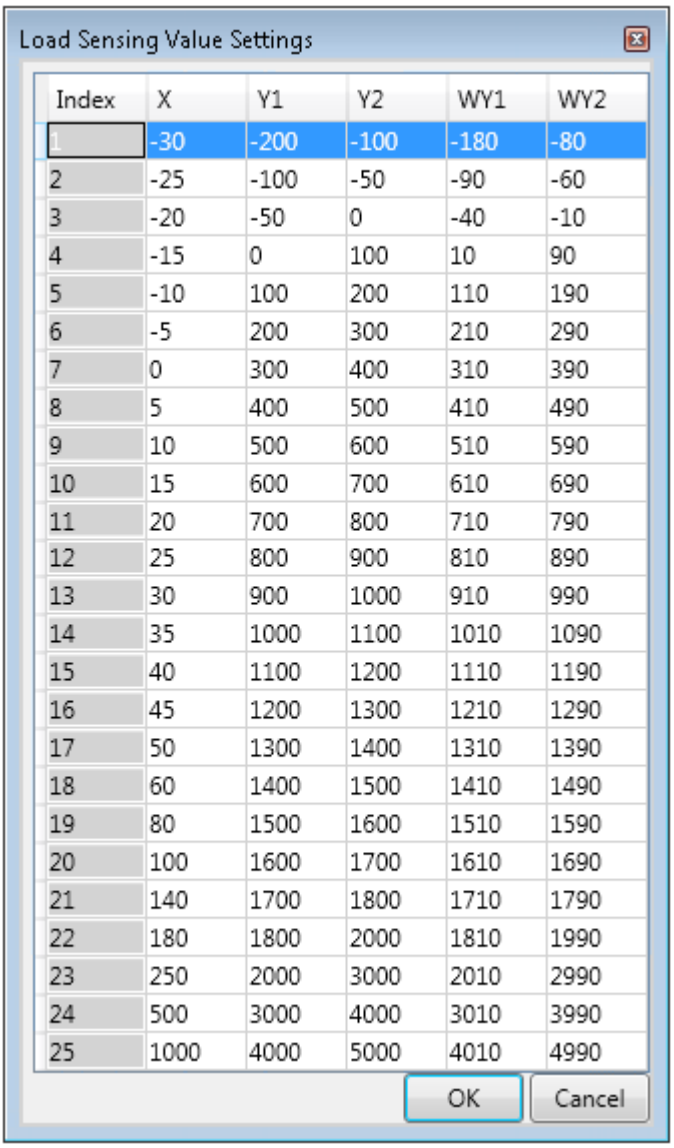

Fig. 132: FB LOADSENSING table

If values for Y1 and Y2 are specified in the table, values for the warning level WY1 and WY2 must also be specified.

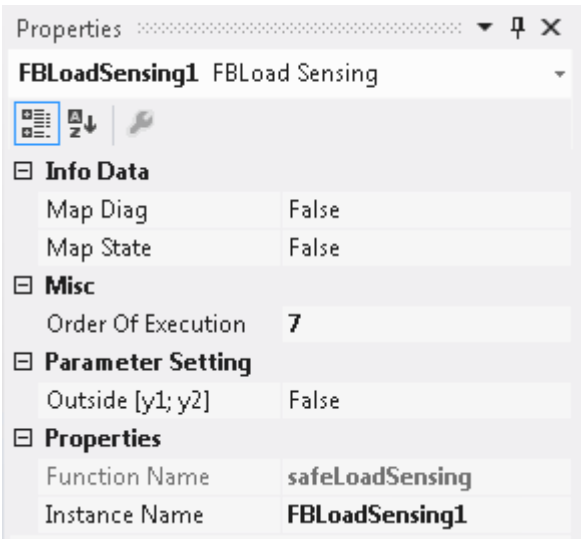

Fig. 133: FB LOADSENSING properties

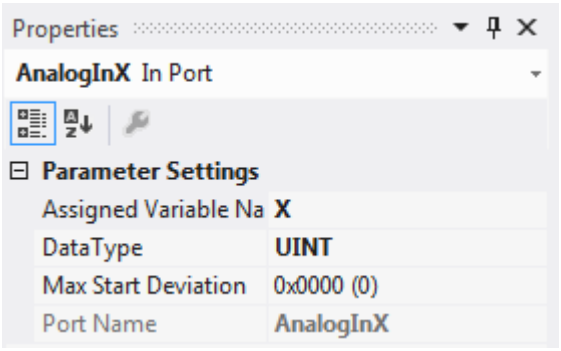

Fig. 134: FB LOADSENSING port properties

A mouse click next to the FB port, here *Inactive, AnalogInX, AnalogInY, Valid* and *Warning*, can be used to create variables that can be linked to input or output signals. Settings such as changing the data type or activation of the input can be made via the properties of the FB port.

The *"Map State"* and *"Map Diag"* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

4.26 The function block CAMMONITOR

4.26.1 Functional description

The FB CamMonitor can be used to realize an electronic cam controller. In addition to excentric mode, pendulum mode should also be supported.

⚠ CAUTION

FB CAMMONITOR

The FB CAMMONITOR provides a safe evaluation function block, which can output the cam data (TDC, BDC, UpwardsMove) according to the set fixed values, depending on the current position.

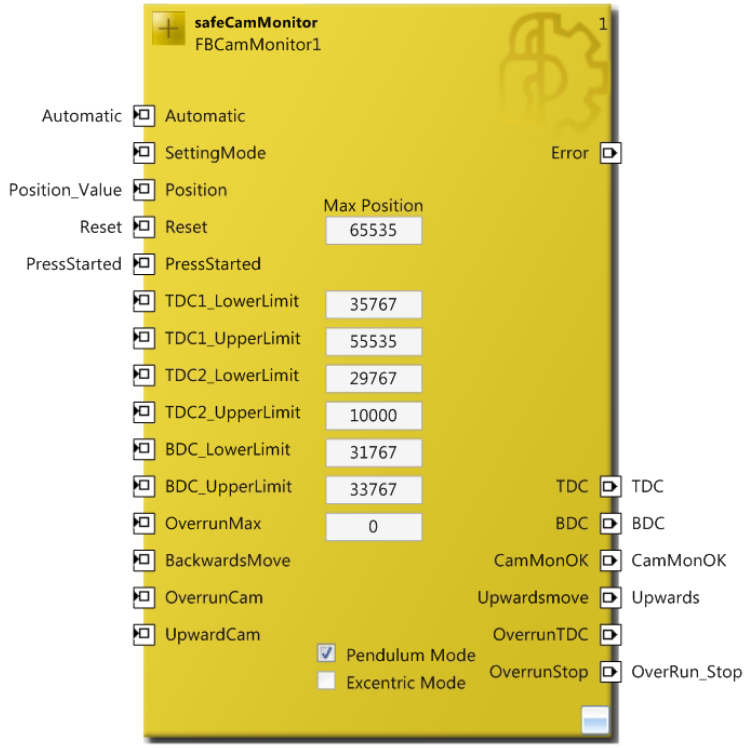

Fig. 135: Function block CAMMONITOR

NOTICE

Function block output UpwardsMove

The output UpwardsMove indicates that the press is in upward motion after passing through BDC. This signal can be used for muting of light curtains or for accepting the control command at the press.

⚠ DANGER

Press position detection!

Position detection must be realized corresponding to the required SIL or performance level. The user or machine manufacturer must verify that this condition is satisfied.

The position value must be verified based on several analog values or made available to the function block by other safe means. The former can be realized via the Compare function block, for example.

In addition, an expectation can be generated via the Press_Started input, by reporting a movement request to the function block. The function block then monitors a change in position within the set parameters.

NOTICE

Excentric/pendulum mode

For excentric mode the Excentric Mode checkbox is set. The inputs TDC2_UpperLimit and TDC2_LowerLimit must be inactive, or the parameters must be 0.

For pendulum mode the Pendulum Mode checkbox will be set. The inputs TDC2_UpperLimit and TDC2_LowerLimit or the parameters are used.

NOTICE

KL6904/EL6900

The function block CAMMONITOR is not available in the KL6904 and the EL6900.

4.26.2 General properties of the FB CAMMONITOR

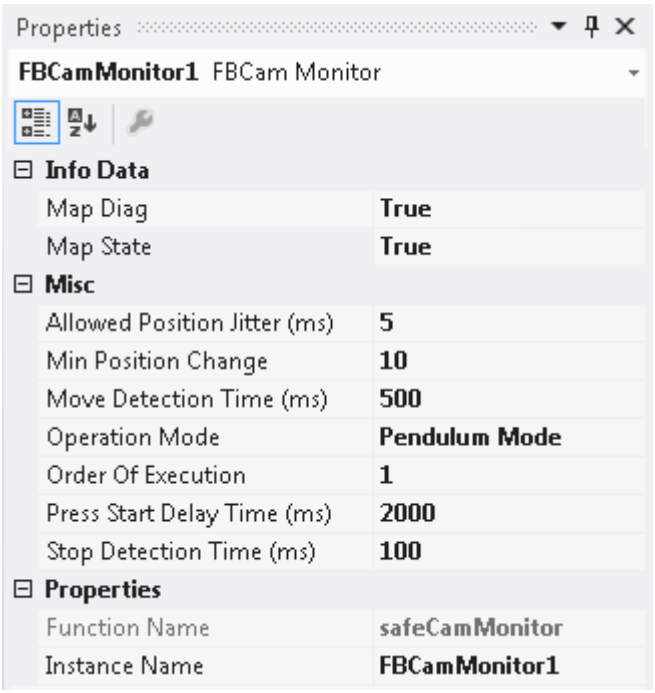

Fig. 136: FB CAMMONITOR properties

Fig. 137: FB CAMMONITOR port properties

A mouse click next to the FB Port can be used to create variables that can be linked with input or output signals. Settings such as changing the data type or activation of the input can be made via the properties of the FB port.

The *"Map State"* and *"Map Diag"* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

Sample position detection

In the following sample position detection takes place via 2 separate encoder systems. Scaling and verification takes place within the TwinSAFE Logic. It is important that the encoder systems use a different procedure for determining the position and are mechanically decoupled. The user should consider shaft breakage detection in the mechanical configuration. One channel (here: sin/cos encoder) is transferred to the EL6910 logic via the TwinSAFE SC technology. The second channel is transferred via the standard EtherCAT communication of the EL6910.

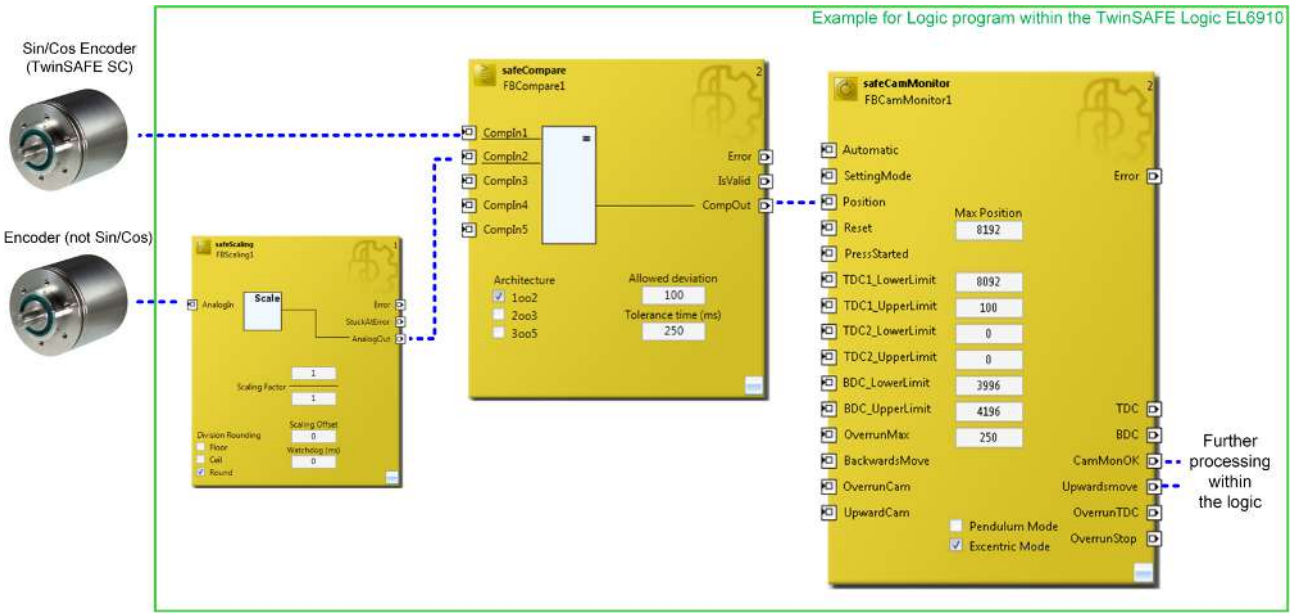

Fig. 138: Structure diagram of the configuration

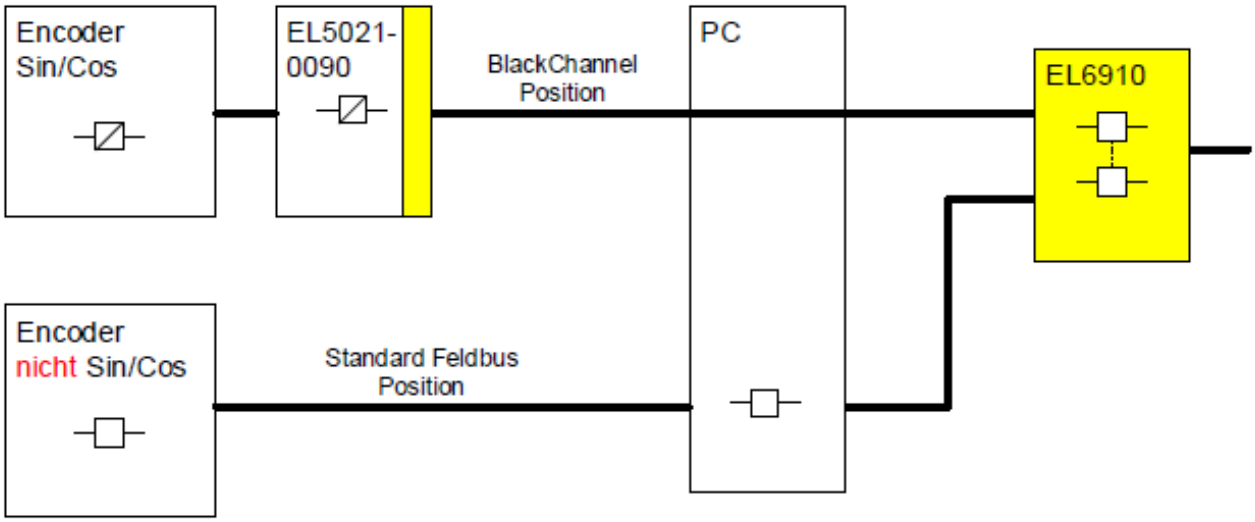

Fig. 139: Schematic diagram of the configuration

4.26.3 Use case excentric mode

In excentric mode, only one direction of rotation is permitted. The FB checks that after a cycle the position stops after TDC (top dead center) plus maximum overrun (OverrunMax). The current overrun or position can be output after TDC (OverrunTDC).

Once standstill is reached, a new cycle is not permitted until a falling edge is detected at the Reset input.

As a further parameter BDC (bottom dead center) is specified with a lower and upper limit (BDC_LowerLimit and BDC_UpperLimit). The output CamMonOK is immediately set to FALSE if the press comes to a standstill without having reached or exceeded TDC, or if the direction of rotation is reversed. If BDC is exceeded the press is in upward movement. This information is output at the UpwardsMove output of the function block.

The BackwardsMove input is used to notify the function block that backward movement of the press is permitted. This is only permitted if the position is between TDC1_UpperLimit and BDC_LowerLimit. The backward movement ends when TDC1_UpperLimit is reached.

4.26.3.1 Schematic diagram of the ranges

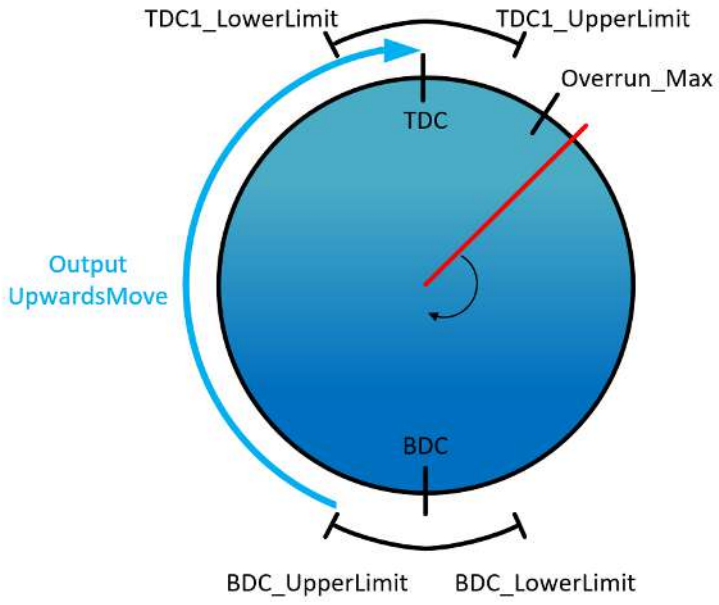

Fig. 140: Excentric mode - schematic diagram of the ranges

4.26.3.2 Inputs

Name	Data type	Description
Automatic	safeBOOL	0: Normal operation 1: Automatic mode (no parameter verification)
BackwardsMove	safeBOOL	The input BackwardsMove can be used to move the press in backward direction in excentric mode. This is possible until TDC1_UpperLimit is reached.
Reset	safeBOOL BOOL	Reset input. Before each press start a falling edge must be detected at the input Reset. Only then may a motion take place or the TDC exited.
Press_Started	safeBOOL BOOL	If the input is active, a motion or change of position is expected when a logical 1 is encountered at the input. To this end the parameter PressStartDelayTime, MoveDetectionTime and MinPositionChange must be set.
OverrunCam	safeBOOL	not used
UpwardCam	safeBOOL	not used
SettingMode	safeBOOL	Parameter transfer in setup mode. Internal parameters can be changed if the input is set to 1.
Position	analog (UINT16/ UINT32)	Press position. The position value must checked for plausibility based on several analog values or made available to the function block by other safe means.
TDC1_LowerLimit	Fixed value (UINT16/ UINT32)	Excentric mode: The input or parameter TDC1_LowerLimit indicates the lower TDC limit (top dead center). It is to the left of TDC.
TDC1UpperLimit	Fixed value (UINT16/ UINT32)	Excentric mode: The input or parameter TDC1_UpperLimit indicates the upper TDC limit (top dead center). It is to the right of TDC.
TDC2_LowerLimit	Fixed value (UINT16/ UINT32)	not used
TDC2UpperLimit	Fixed value (UINT16/ UINT32)	not used
BDC_LowerLimit	Fixed value (UINT16/ UINT32)	The input or parameter BDC_LowerLimit must be less than MaxPosition/2 and greater than OverrunMax.
BDC_UpperLimit	Fixed value (UINT16/ UINT32)	The input or parameter BDC_UpperLimit must be greater than MaxPosition/2 and less than TDC1_LowerLimit.
OverrunMax	Fixed value (UINT16/ UINT32)	OverrunMax indicates the position at which the press must have stopped at the latest in excentric mode. If this value is exceeded without the press stopping, the output CamMonOK is set to FALSE. The input or parameter OverrunMax must be greater than TDC1_UpperLimit and less than BDC_LowerLimit.

4.26.3.3 Outputs

Name	Permitted type	Description
Error	safeBOOL BOOL	Error output
CamMonOK	safeBOOL BOOL	If all internal checks are without error, the output CamMonOK is set. When the group in which the function block is programmed is started, CamMonOK is set for the first time when a falling edge is detected at the Reset input.

Name	Permitted type	Description
UpwardsMove	safeBOOL BOOL	The output UpwardsMove is set to logical 1 between BDC_UpperLimit and 0°.
TDC	safeBOOL BOOL	Boolean output TDC is set if the current position is between TDCx_LowerLimit and TDCx_UpperLimit.
BDC	safeBOOL BOOL	Boolean output BDC is set if the current position is between BDC_LowerLimit and BDC_UpperLimit.
OverrunTDC	analog	Difference between TDC1_LowerLimit and current position
OverrunStop	analog	Difference between position at falling edge at input Press_Started and current position

4.26.3.4 Parameter

Parameter	Description
AllowedPositionJitter	The analog position value may jitter somewhat even at standstill; this jitter is indicated with AllowedPositionJitter.
StopDetectionTime	Since the position is usually received via a TwinSAFE connection, its value will not change in each cycle. For standstill detection the timeframe (StopDetectionTime) must therefore by specified, within which the position must only change around the AllowedPositionJitter.
PressStartDelayTime	If the input PressStarted is active, the time must be specified after which a motion must be detected when PressStarted has a positive edge.
MoveDetectionTime	If the input PressStarted is active, the time must be specified after which the position must change when a motion was detected for the first time.
MinPositionChange	If the input PressStarted is active, a value must be specified to indicate the minimum position change within the MoveDetectionTime
MaxPosition	The parameter MaxPosition is used to set the maximum permitted position value during a 360° movement of the press.
Pendulum Mode	Checkbox for activating pendulum mode
Excentric Mode	Checkbox for activating excentric mode

4.26.3.5 Scope recording of the sequence

Fig. 141: ScopeView display of the signal curve

Color	Signal description
	Current press position (here single-turn resolution 0 to 8192 increments)
	OverrunTDC signal (change in position once TDC_LowerLimit is reached)
	FB input CamReset (rising and falling edge before a motion may start)
	FB input PressStarted (is set to 1 when the press motion is started and set to 0 when the press is stopped.)
	FB output TDC. Press is in top dead center (here set between 8092 and 100 increments). Press 0° is 8192 or 0 increments.
	FB output Upwards. Press is in upward movement. The signal is set when BDC is exited and reset after 0° or 0 increments.

4.26.3.6 Cam Monitor function block excentric mode settings

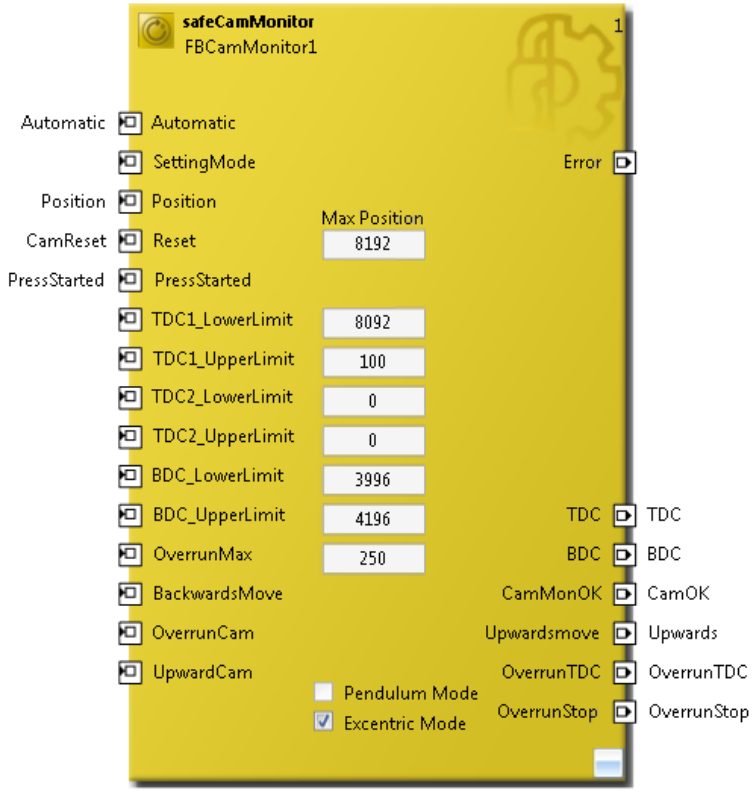

Fig. 142: FB CamMonitor in excentric mode

Description of the fixed values of the sample configuration. The user must adjust these values according to the hardware used.

The MaxPosition of 8192 increments is output in the event of a complete stroke by the encoder system used. All other fixed values are derived from this MaxPosition (see schematic diagram of the ranges).

4.26.4 Use case: pendulum mode

In pendulum mode both directions of rotation are permitted. Two upper reversal points are parameterized here.

Since the curve based on which the press is to be moved can or must be adjusted for each product, the maximum range of the oscillating stroke is set as the limits for the upper reversal points.

The lower reversal point (BDC) is set with an upper and lower limit.

In pendulum mode the system checks that the upper limits (TDC1 and TDC2) are never exceeded. If this happens, the output *CamMonOK* is set to FALSE. At the start of the cycle (falling edge at *Reset* input) the press may start with any motion (pulsating, reverse, ...) until the lower reversal point (BDC) is reached. After this only upward movement is permitted. The upward movement is output as a signal (*UpwardsMove*) at the function block.

A new start is enabled via the *Reset* input. If the press is in downward motion without a falling edge having been detected at the *Reset* input, the system is stopped immediately by setting *CamMonOK* to FALSE.

The optional function block inputs for connecting an upward or overrun cam are not supported in this operation mode. An error is set if they are active erroneously.

4.26.4.1 Schematic diagram of the ranges

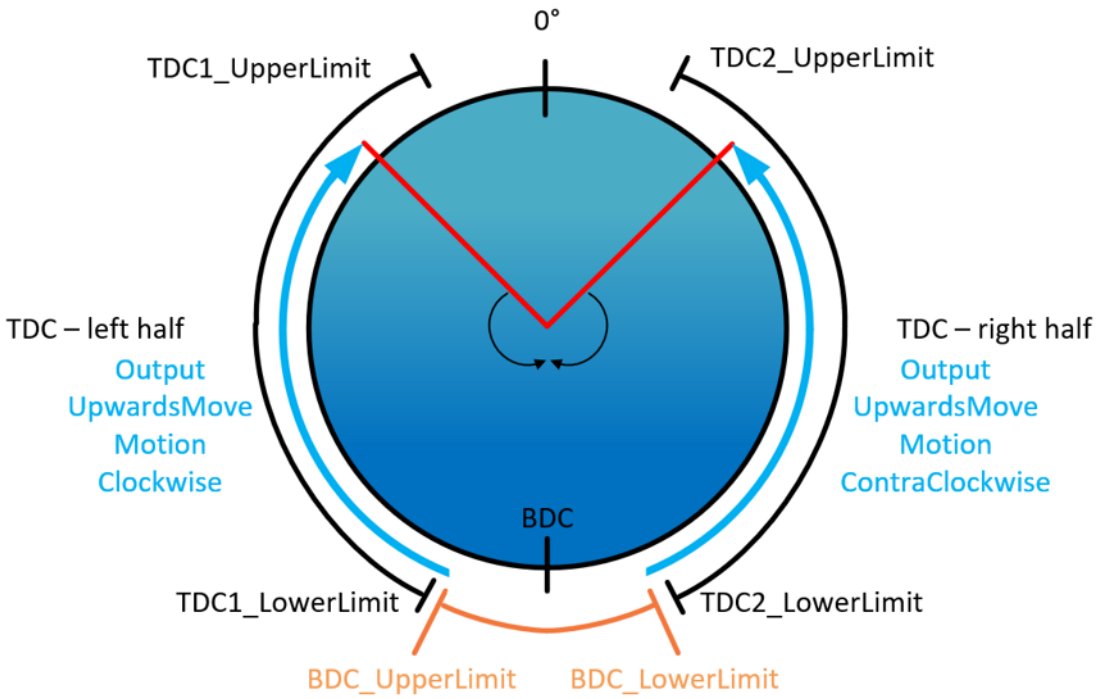

Fig. 143: Pendulum mode - schematic diagram of the ranges

4.26.4.2 Inputs

Name	Data type	Description
Automatic	safeBOOL	0: Normal operation 1: Automatic mode (no parameter verification)
BackwardsMove	safeBOOL	The input must be inactive in pendulum mode.
Reset	safeBOOL BOOL	Reset input. Before each press start a falling edge must be detected at the input Reset. Only then may a motion take place or the TDC exited.
Press_Started	safeBOOL BOOL	If the input is active, a motion or change of position is expected when a logical 1 is encountered at the input. To this end the parameter PressStartDelayTime, MoveDetectionTime and MinPositionChange must be set.
OverrunCam	safeBOOL	The input OverrunCam must be inactive.
UpwardCam	safeBOOL	The input UpwardsCam must be inactive.
SettingMode	safeBOOL	Setup mode. Internal parameters can be changed if the input is set to 1.
Position	analog (UINT16/ UINT32)	Press position. The position value must be checked for plausibility from several analog values or made available to the function block in another safe way, according to the required SIL/performance level.
TDC1_LowerLimit	Fixed value (UINT16/UINT32)	The input or parameter TDC1_LowerLimit indicates the lower limit of the TDC in the “left” half of the press. The value must be greater than the BDC (Bottom Dead Center) and less than TDC1_UpperLimit.
TDC1UpperLimit	Fixed value (UINT16/UINT32)	The input or parameter TDC1_UpperLimit indicates the upper limit of the TDC in the “left” half of the press. The value must greater than TDC1_LowerLimit and less than MaxPosition.
TDC2_LowerLimit	Fixed value (UINT16/UINT32)	The input or parameter TDC2_LowerLimit indicates the lower limit of the TDC in the “right” half of the press. The value must be greater than TDC2_UpperLimit and less than BDC_LowerLimit.
TDC2UpperLimit	Fixed value (UINT16/UINT32)	The input or parameter TDC2_UpperLimit indicates the upper limit of the TDC in the “right” half of the press. The value must be greater than 0 and less than TDC2_LowerLimit.

Name	Data type	Description
BDC_LowerLimit	Fixed value (UINT16/UINT32)	The input or parameter BDC_LowerLimit must be less than MaxPosition/2 and greater than TDC2_LowerLimit.
BDC_UpperLimit	Fixed value (UINT16/UINT32)	The input or parameter BDC_UpperLimit must be greater than MaxPosition/2 and less than TDC1_LowerLimit.
OverrunMax	Fixed value (UINT16/UINT32)	The input or parameter OverrunMax must be disabled or set to 0.

4.26.4.3 Outputs

Name	Permitted type	Description
Error	safeBOOL BOOL	Error output (see diagnostic information)
CamMonOK	safeBOOL BOOL	If all internal checks are without error, the output CamMonOK is set. When the group in which the function block is programmed is started, CamMonOK is set for the first time when a falling edge is detected at the Reset input.
UpwardsMove	safeBOOL BOOL	Depending in which half the motion is started, the output UpwardsMove is set in the other half. The output is set from BDC_UpperLimit or BDC_LowerLimit until press standstill is detected.
TDC	safeBOOL BOOL	Boolean output TDC is set if the current position is between TDCx_LowerLimit and TDCx_UpperLimit.
BDC	safeBOOL BOOL	Boolean output BDC is set if the current position is between BDC_LowerLimit and BDC_UpperLimit.
OverrunTDC	analog	not used
OverrunStop	analog	Difference between position at falling edge at input Press_Started and current position

4.26.4.4 Parameter

Parameter	Description
AllowedPositionJitter	The analog position value may jitter somewhat even at standstill; this jitter is indicated with AllowedPositionJitter.
StopDetectionTime	Since the position is usually received via a TwinSAFE connection, its value will not change in each cycle. For standstill detection the timeframe (StopDetectionTime) must therefore by specified, within which the position must only change around the AllowedPositionJitter.
PressStartDelayTime	If the input PressStarted is active, the time must be specified after which a motion must be detected when PressStarted has a positive edge.
MoveDetectionTime	If the input PressStarted is active, the time must be specified after which the position must change when a motion was detected for the first time.
MinPositionChange	If the input PressStarted is active, a value must be specified to indicate the minimum position change within the MoveDetectionTime
MaxPosition	The parameter MaxPosition is used to set the maximum permitted position value during a 360° movement of the press.
Pendulum Mode	Checkbox for activating pendulum mode
Excentric Mode	Checkbox for activating excentric mode

4.26.4.5 Scope recording of the sequence

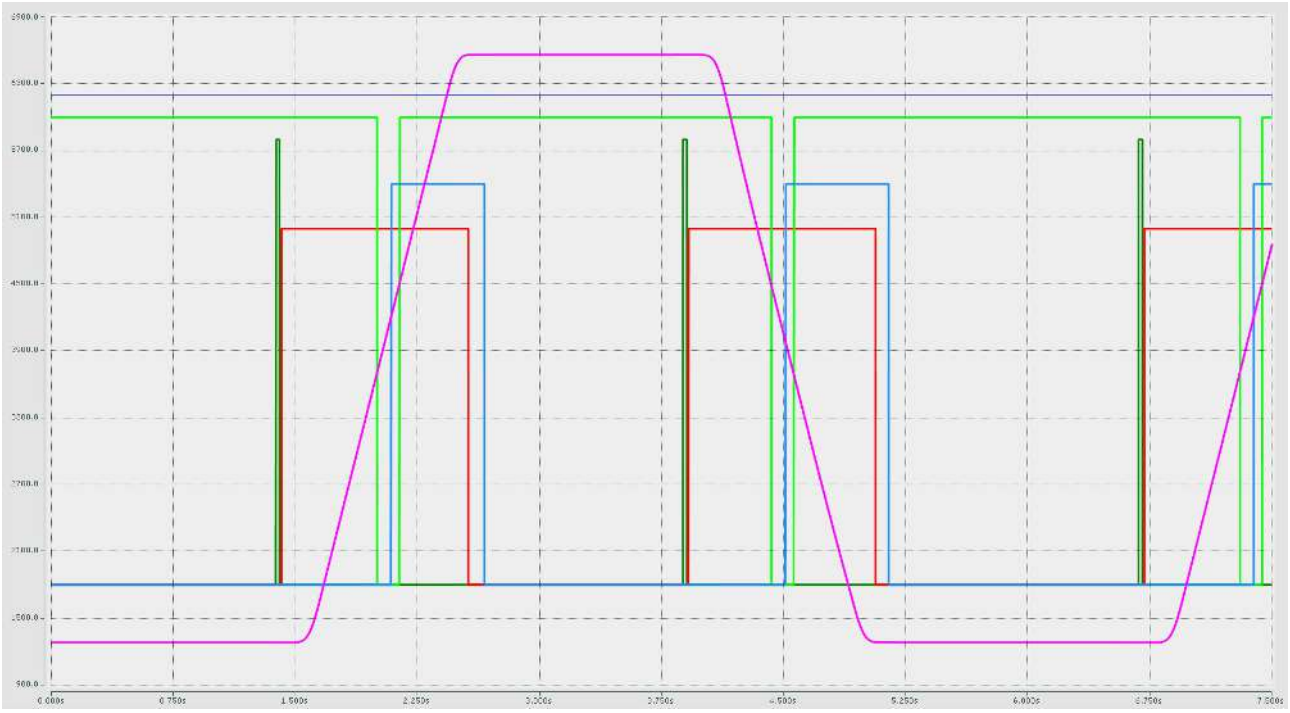

Fig. 144: ScopeView display of the signal curve

Color	Signal description
	Current press position (here single-turn resolution 0 to 8192 increments). Oscillation between approx. 1300 and 6500 increments.
	FB input CamReset (rising and falling edge before a motion may start)
	FB input PressStarted (is set to 1 when the press motion is started and set to 0 when the press is stopped.)
	FB output TDC. Press is in top dead center (here set between 400 and 3696 increments for the right side and between 4496 and 7796 increments for the left side)
	FB output Upwards. Press is in upward movement. The signal is set when BDC is exited and reset when press standstill is detected.

4.26.4.6 CamMonitor function block settings, pendulum mode

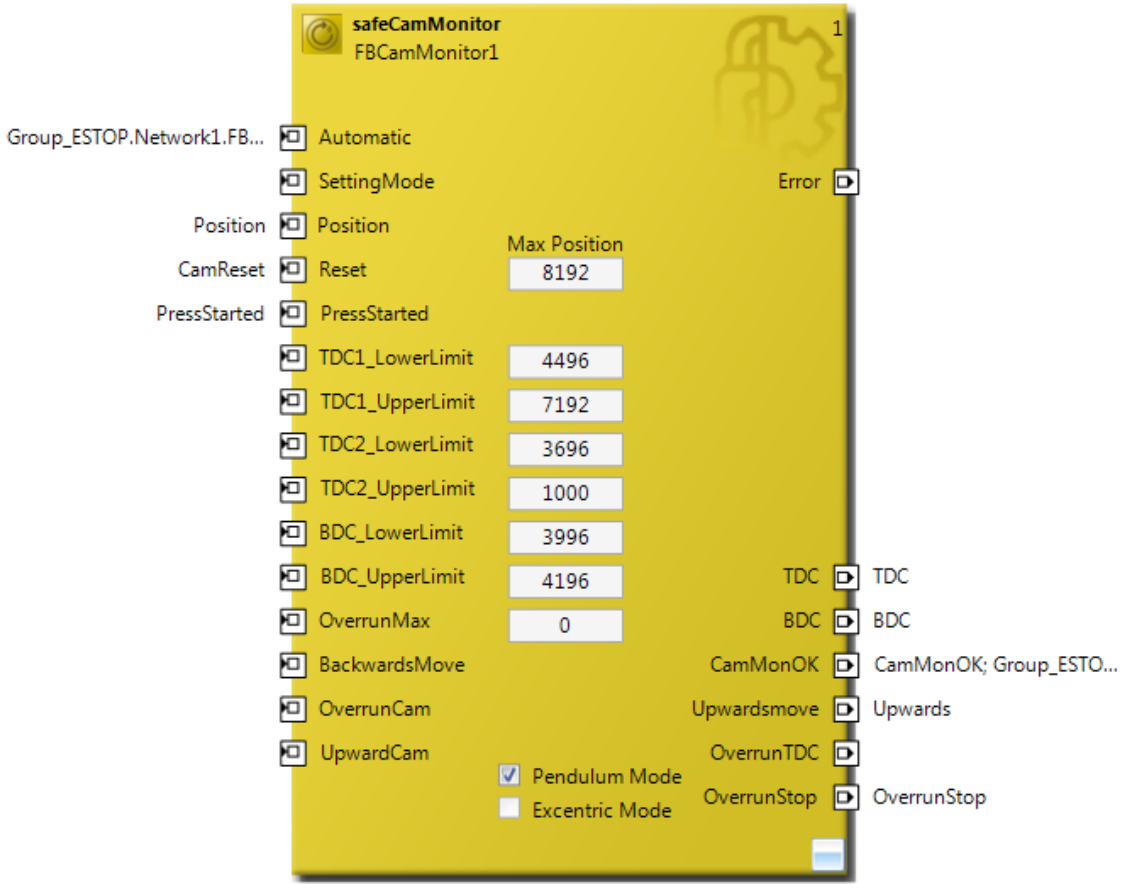

Fig. 145: FB CamMonitor in pendulum mode

Description of the fixed values of the sample configuration. The user must adjust these values according to the hardware used.

The MaxPosition of 8192 increments is output in the event of a complete stroke by the encoder system used. All other fixed values are derived from this MaxPosition (see schematic diagram of the ranges).

4.26.5 Use case: hardware cams

In excentric mode an UpwardCam and an OverrunCam can be connected to the function block as Boolean signals. If these signals are enabled, the system checks that the upward cam is set after BDC (logical 1) and reset at 0°. The overrun cam is checked for logical 1 after TDC1_LowerLimit and must remain set while the press is at standstill. The overrun cam may only be reset when the next cycle starts.

The BackwardsMove input is used to notify the function block that backward movement of the press is permitted. This is only permitted if the UpwardCAM and OverrunCAM inputs are not set. The backward movement ends when OverrunCAM is reached.

4.26.5.1 Inputs

Name	Data type	Description
Automatic	safeBOOL	0: Normal operation 1: Automatic mode (no parameter verification)
BackwardsMove	safeBOOL	The input BackwardsMove can be used to move the press in backward direction in excentric mode. This is possible until TDC1_UpperLimit is reached.
Reset	safeBOOL BOOL	Reset input. Before each press start a falling edge must be detected at the input Reset. Only then may a motion take place or the TDC exited.

Name	Data type	Description
Press_Started	safeBOOL BOOL	If the input is active, a motion or change of position is expected when a logical 1 is encountered at the input. To this end the parameter PressStartDelayTime, MoveDetectionTime and MinPositionChange must be set.
OverrunCam	safeBOOL	The input OverrunCam must be connected to a Boolean input.
UpwardCam	safeBOOL	The input UpwardsCam must be connected to a Boolean input.
SettingMode	safeBOOL	Parameter transfer in setup mode. Internal parameters can be changed if the input is set to 1.
Position	analog (UINT16/ UINT32)	Press position. The position value must checked for plausibility based on several analog values or made available to the function block by other safe means.
TDC1_LowerLimit	Fixed value (UINT16/UINT32)	Excentric mode: The input or parameter TDC1_LowerLimit indicates the lower TDC limit (top dead center). It is to the left of TDC.
TDC1UpperLimit	Fixed value (UINT16/UINT32)	Excentric mode: The input or parameter TDC1_UpperLimit indicates the upper TDC limit (top dead center). It is to the right of TDC.
TDC2_LowerLimit	Fixed value (UINT16/UINT32)	not used
TDC2UpperLimit	Fixed value (UINT16/UINT32)	not used
BDC_LowerLimit	Fixed value (UINT16/UINT32)	The input or parameter BDC_LowerLimit must be less than MaxPosition/2 and greater than OverrunMax.
BDC_UpperLimit	Fixed value (UINT16/UINT32)	The input or parameter BDC_UpperLimit must be greater than MaxPosition/2 and less than TDC1_LowerLimit.
OverrunMax	Fixed value (UINT16/UINT32)	OverrunMax indicates the position at which the press must have stopped at the latest in excentric mode. If this value is exceeded without the press stopping, the output CamMonOK is set to FALSE. The input or parameter OverrunMax must be greater than TDC1_UpperLimit and less than BDC_LowerLimit.

4.26.5.2 Outputs

Name	Permitted type	Description
Error	safeBOOL BOOL	Error output
CamMonOK	safeBOOL BOOL	If all internal checks are without error, the output CamMonOK is set. When the group in which the function block is programmed is started, CamMonOK is set for the first time when a falling edge is detected at the Reset input.
UpwardsMove	safeBOOL BOOL	The output UpwardsMove is set to logical 1 between BDC_UpperLimit and 0°.
TDC	safeBOOL BOOL	Boolean output TDC is set if the current position is between TDCx_LowerLimit and TDCx_UpperLimit.
BDC	safeBOOL BOOL	Boolean output BDC is set if the current position is between BDC_LowerLimit and BDC_UpperLimit.
OverrunTDC	analog	Difference between TDC1_LowerLimit and current position
OverrunStop	analog	Difference between position at falling edge at input Press_Started and current position

4.26.5.3 Parameter

Parameter	Description
AllowedPositionJitter	The analog position value may jitter somewhat even at standstill; this jitter is indicated with AllowedPositionJitter.
StopDetectionTime	Since the position is usually received via a TwinSAFE connection, its value will not change in each cycle. For standstill detection the timeframe (StopDetectionTime) must therefore by specified, within which the position must only change around the AllowedPositionJitter.
PressStartDelayTime	If the input PressStarted is active, the time must be specified after which a motion must be detected when PressStarted has a positive edge.
MoveDetectionTime	If the input PressStarted is active, the time must be specified after which the position must change when a motion was detected for the first time.
MinPositionChange	If the input PressStarted is active, a value must be specified to indicate the minimum position change within the MoveDetectionTime
MaxPosition	The parameter MaxPosition is used to set the maximum permitted position value during a 360° movement of the press.
Pendulum Mode	Checkbox for activating pendulum mode
Excentric Mode	Checkbox for activating excentric mode

4.26.5.4 Scope recording of the sequence

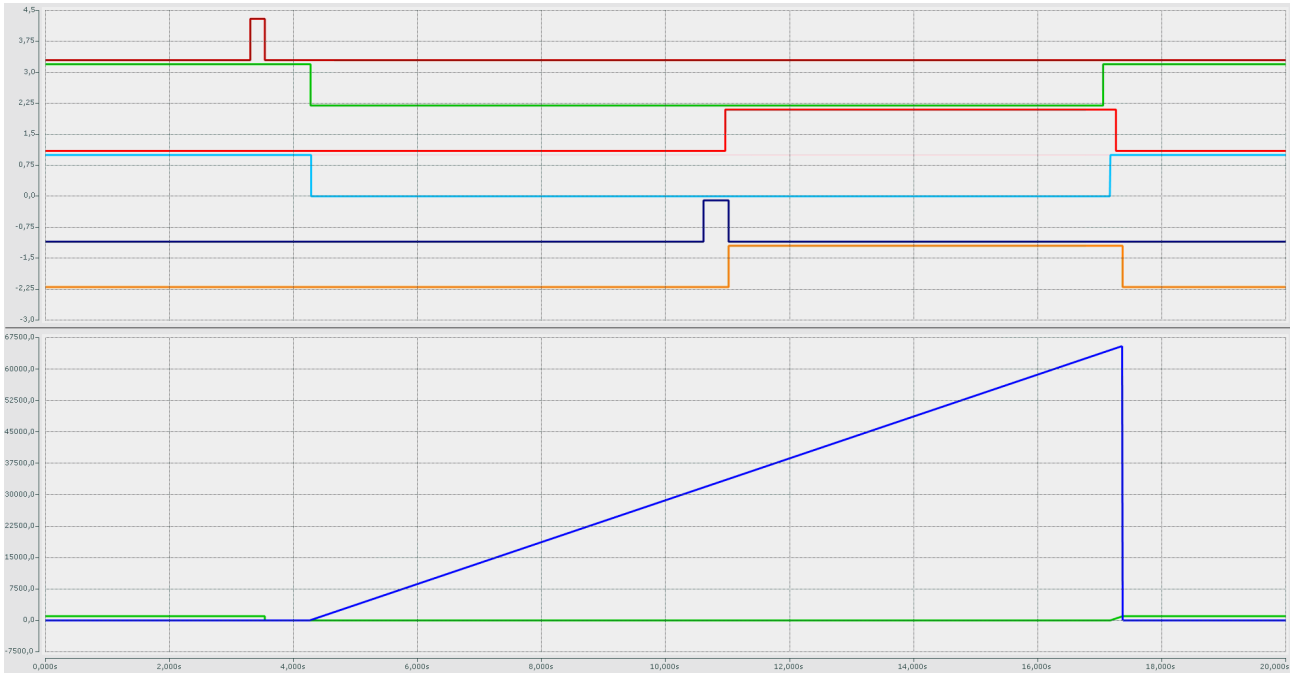

Fig. 146: ScopeView display of the signal curve

Color	Signal description
	FB input CamReset (rising and falling edge before a motion may start)
	OverrunCAM (FB input)
	UpwardCAM (FB input)
	TDC (FB output; here position 64535 to 100)
	BDC (FB output; here position 31767 to 33767)
	Upwards (FB output)

Color	Signal description
	Current press position. Here one revolution: 0 to 65535 increments
	OverrunTDC output. Change in position after TDC1_LowerLimit is reached.

4.26.5.5 CamMonitor function block hardware cam settings

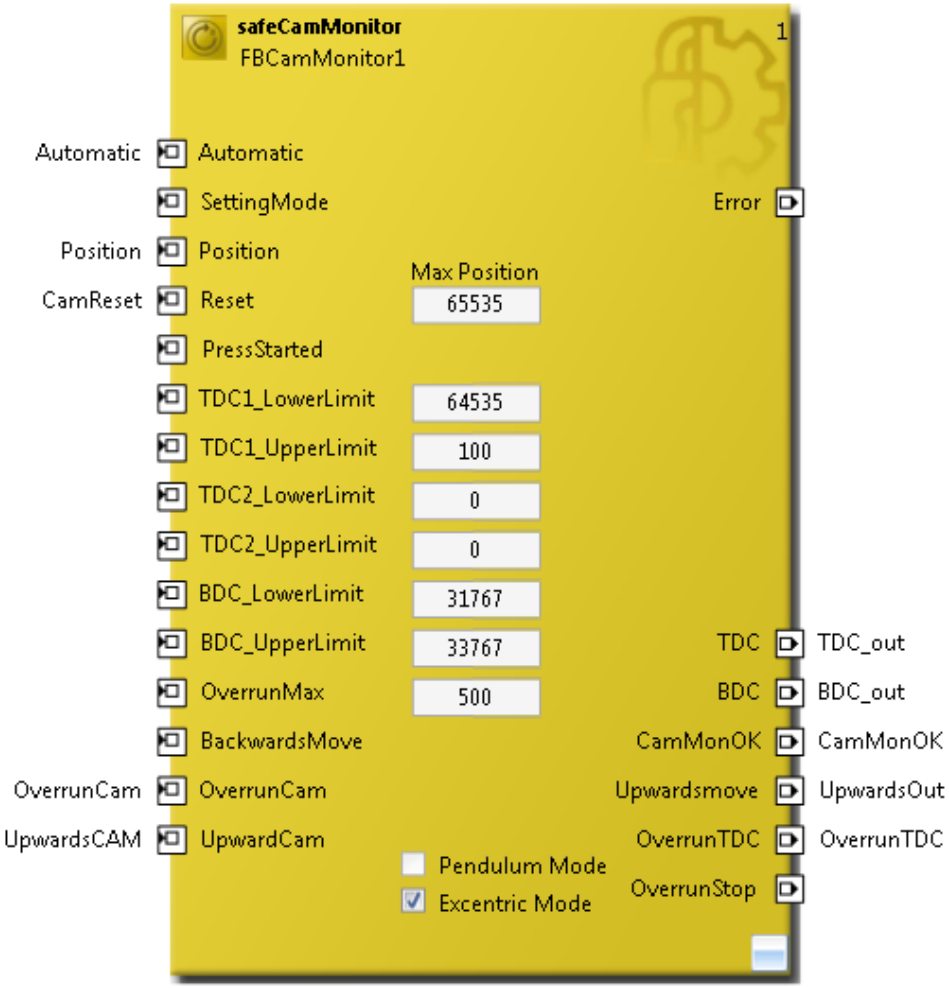

Fig. 147: FB CamMonitor in excentric mode with hardware cams

Description of the fixed values of the sample configuration. The user must adjust these values according to the hardware used.

The MaxPosition of 65535 increments is output in the event of a complete stroke by the encoder system used. All other fixed values are derived from this MaxPosition (see schematic diagram of the ranges excentric mode).

4.26.6 Description of the process

4.26.6.1 Standstill detection

The FB CAMMONITOR detects a standstill (Stopped =TRUE) if the change in position within the StopDetectionTime is less than or equal to the AllowedPositionJitter.

4.26.6.2 Press movement

If the input PressStarted is TRUE, the function block monitors the press for movement.

The FB CAMMONITOR detects a press movement if the change in position at the Position input within the MoveDetectionTime is greater than the MinPositionChange.

The PressStartDelayTimer is started when the PressStarted input changes from FALSE to TRUE. When the PressStartDelayTimer has elapsed, PressStarted is TRUE and no press movement was detected, the function block detects this and sets CamMonOK to FALSE. An error message is issued via the DiagHistory of the EL6910.

4.26.6.3 Direction detection

A backward or counter-clockwise movement (MoveContraClockwise=TRUE) is detected if the position has changed in counter-clockwise direction.

A forward or clockwise movement (MoveClockwise=TRUE) is detected if the position has changed in clockwise direction.

In order for a movement to be detected, the position must change by more than the MaxPositionJitter within the StopDetectionTime.

4.26.6.4 SettingMode

If the input SettingMode is set, in excentric mode the fixed values TDC1_LowerLimit, TDC1_UpperLimit, BDC_LowerLimit, BDC_UpperLimit and OverrunMax are changed retrospectively and saved in a non-volatile manner. In pendulum mode this applies to the set fixed values TDC1_LowerLimit, TDC1_UpperLimit, TDC2_LowerLimit, TDC2_UpperLimit, BDC_LowerLimit and BDC_UpperLimit.

4.26.7 Diagnostics messages excentric mode

4.26.7.1 Parameter error

Text ID	Meaning	Message	Parameter 1	Parameter 2	Parameter 3
In excentric mode the following parameter errors may occur and be reported accordingly.					
0x4025	TDC1UpperLimit <= AllowedPositionJitter	The TDCUpperLimit (%d) is lower or equal than the maximum position jitter (%d)	FB instance	TDC1Upper Limit	Allowed PositionJitter
0x401A	(TDC1UpperLimit + 2*AllowedPositionJitter) >= OverrunMax	The value of TDCUpperLimit (plus twice the maximum position jitter) (%d) is greater than or equal to the value of OverrunMax (%d)	FB instance	TDC1Upper Limit + 2*Allowed PositionJitter	OverrunMax
0x4019	(OverrunMax + 2*AllowedPositionJitter) >= BDCLowerLimit	The value of OverrunMax (plus twice the maximum position jitter) (%d) is greater than or equal to the value of BDCLowerLimit (%d)	FB instance	OverrunMax + 2*Allowed PositionJitter	BDCLower Limit
0x4018	(BDCLowerLimit + AllowedPositionJitter) >= MaxPosition/2	The value of BDCLowerLimit (plus maximum position jitter) (%d) is greater than or equal to the configured value of 180° (%d)	FB instance	BDCLower Limit + Allowed PositionJitter	MaxPosition/2
0x4017	BDCUpperLimit <= (MaxPosition/2 + AllowedPositionJitter)	The value of BDCUpperLimit (%d) is less than or equal to the configured value of 180° (plus maximum position jitter) (%d)	FB instance	BDCUpper Limit	MaxPosition/2 + Allowed PositionJitter

Text ID	Meaning	Message	Parameter 1	Parameter 2	Parameter 3
0x4016	(BDCUpperLimit + 2*AllowedPositionJitter) >= TDC1LowerLimit	The value of BDCUpperLimit (plus twice the maximum position jitter) (%d) is greater than or equal to the value of TDCLowerLimit (%d)	FB instance	BDCUpper Limit + 2*Allowed PositionJitter	TDC1Lower Limit
0x4015	(TDC1LowerLimit + AllowedPositionJitter) > MaxPosition	The value of TDCLowerLimit (plus maximum position jitter) (%d) is greater than or equal to the configured position of 360° (%d)	FB instance	TDC1Lower Limit + Allowed PositionJitter	MaxPosition
0x4002	Position > (MaxPosition +AllowedPositionJitter)	The Position (%d) is greater than the maximum position (plus the maximum position jitter) (%d)	FB instance	Position	MaxPosition+ Allowed PositionJitter

4.26.7.2 Movement errors

Text ID	Meaning	Message	Parameter 1	Parameter 2	Parameter 3
Movement errors reported in function block state ERROR					
0x400E	Automatic = FALSE AND BackwardsMove = FALSE AND MoveContraClockWise =TRUE	The position has been changed negatively	FB instance	-	-
0x4013	Automatic = FALSE AND BackwardsMove = TRUE AND MoveClockWise= TRUE	The BackwardsMove input is TRUE while the movement is clockwise	FB instance	-	-
0x4012	Automatic = FALSE AND BackwardsMove = TRUE AND (LeftArea = TRUE OR TDCLeftArea=TRUE)	The BackwardsMove input is TRUE while the Position is between 180° and 360°, the actual position is %d	FB instance	Position	-

4.26.7.3 Error while OverrunCAM input is active

Text ID	Meaning	Message	Parameter 1	Parameter 2	Parameter 3
OverrunCAM errors reported in function block state ERROR					
0x4005	Automatic = FALSE AND OverrunCAM = TRUE AND BDCRightArea= TRUE	The OverrunCAM input was TRUE in the area between OverrunMax and BDCUpperLimit, the actual position is %d	FB instance	Position	-
0x4003	Automatic = FALSE AND OverrunCAM = FALSE AND TDCArea=TRUE	The OverrunCAM input was FALSE in the top dead center area, the actual position is %d	FB instance	Position	-
0x4004	Automatic = FALSE AND LeftArea = FALSE AND OverrunCAM changes to TRUE	The OverrunCAM input changed from FALSE to TRUE outside the area between BDCUpperLimit and TDCLowerLimit, the actual position is %d	FB instance	Position	-

Text ID	Meaning	Message	Parameter 1	Parameter 2	Parameter 3
0x4006	Automatic = FALSE AND OverrunMaxArea = FALSE AND OverrunCAM changes to FALSE	The OverrunCAM input changed from TRUE to FALSE outside the area between OverrunMax and BDCLowerLimit, the actual position is %d	FB instance	Position	-

4.26.7.4 Error while UpwardsCAM input is active

Text ID	Meaning	Message	Parameter 1	Parameter 2	Parameter 3
UpwardsCAM errors reported in function block state ERROR					
0x400F	Automatic=FALSE AND UpwardsCAM=TRUE AND OverrunMaxRightArea= TRUE	The UpwardsCAM input was TRUE in the area between OverrunMax and BDCLowerLimit	FB instance	Position	-
0x4007	Automatic=FALSE AND UpwardsCAM=FALSE AND LeftArea=TRUE	The UpwardsCAM input was FALSE in the area between BDCUpperLimit and TDCLowerLimit, the actual position is %d	FB instance	Position	-
0x4008	Automatic = FALSE AND BDCArea=FALSE AND UpwardsCAM changes to TRUE	The UpwardsCAM input changed from FALSE to TRUE outside the area between BDCLowerLimit and TDCLowerLimit, the actual position is %d	FB instance	Position	-
0x4009	Automatic = FALSE AND TDCArea = FALSE AND UpwardsCAM changes to FALSE	The UpwardsCAM input changed from TRUE to FALSE outside the area between TDCLowerLimit and OverrunMax, the actual position is %d	FB instance	Position	-

4.26.7.5 Error during starting and stopping in TDC

Text ID	Meaning	Message	Parameter 1	Parameter 2	Parameter 3
Errors during starting or stopping in TDC reported in function block state ERROR					
0x400D	In MOVE-TDC state Stopped does not change to TRUE while TDCArea is TRUE	The Position has left the top dead center while waiting for a stop, the actual position is %d	FB instance	Position	-
0x400A	In MOVE-STOP state Reset is FALSE and Stopped changes to FALSE	The Position was moving while waiting for a rising edge at the Reset input in the MOVE-STOP state	FB instance	-	-
0x400B	In MOVE-START state Reset is TRUE and Stopped changes to FALSE	The Position was moving while waiting for a falling edge at the Reset input in the MOVE-START state	FB instance	-	-
0x400C	In MOVE-UP state LeftArea and TDCAreaMax become FALSE	The Position %d in the area between OverrunMax and BDCLowerLimit was detected in the MOVE-UP state	FB instance	Position	-

Text ID	Meaning	Message	Parameter 1	Parameter 2	Parameter 3
0x4024	In WAIT-FOR-RESET state Reset is FALSE and Stopped changes to FALSE	The Position was moving while waiting for a falling edge on the Reset input in the WAIT-FOR_RESET state	FB instance		

4.26.7.6 Error while PressStarted input is active

Text ID	Meaning	Message	Parameter 1	Parameter 2	Parameter 3
Errors reported in function block state ERROR when input PressStarted is TRUE					
0x401F	If PressStarted is TRUE and Stopped does not change to FALSE within the PressStartedDelayTime	The PressStarted input is TRUE and the position did not move after the PressStartedDelayTime	FB instance	-	-
0x4020	PressStarted is TRUE and Stopped changes to TRUE	The PressStarted input is TRUE and the position has stopped after moving before	FB instance	-	-
0x4021	PressStarted is TRUE and Stopped FALSE and position does not change by at least MinPositionChange within the MoveDetectionTime	The PressStarted input is TRUE and the position has not moved enough, the actual position is %d, the compare position is %d	FB instance	Position	Comparison position

4.26.8 Diagnostic messages pendulum mode

4.26.8.1 Parameter error

Text ID	Meaning	Message	Parameter 1	Parameter 2	Parameter 3
In Pendulum Mode the following parameter errors may occur and be reported accordingly.					
0x4001	TDC2UpperLimit ≤ AllowedPositionJitter	The TDC2UpperLimit (%d) is lower or equal than the maximum position jitter (%d)	FB instance	TDC2UpperLimit	AllowedPositionJitter
0x401E	(TDC2UpperLimit + 2*AllowedPositionJitter) ≥ TDC2LowerLimit	The value of TDC2UpperLimit (plus twice the maximum position jitter) (%d) is bigger or equal the value of TDC2LowerLimit (%d)	FB instance	TDC2UpperLimit+ 2* AllowedPositionJitter	TDC2LowerLimit
0x401D	(TDC2LowerLimit + 2*AllowedPositionJitter) ≥ BDCLowerLimit	The value of TDC2LowerLimit (plus twice the maximum position jitter) (%d) is bigger or equal the value of BDCLowerLimit (%d)	FB instance	TDC2LowerLimit + 2* AllowedPositionJitter	BDCLowerLimit
0x4018	(BDCLowerLimit + AllowedPositionJitter) ≥ MaxPosition/2	The value of BDCLowerLimit (plus maximum position jitter) (%d) is grealer or equal the configured value of 180° (%d)	FB instance	BDCLowerLimit + AllowedPositionJitter	MaxPosition/2

Text ID	Meaning	Message	Parameter 1	Parameter 2	Parameter 3
0x4017	BDCUpperLimit ≤ (MaxPosition/2 + AllowedPositionJitter)	The value of BDCUpperLimit (%d) is smaller or equal the configured value of 180° (plus maximum position jitter) (%d)	FB instance	BDCUpperLimit	MaxPosition/2 + AllowedPositionJitter
0x4016	(BDCUpperLimit + 2*AllowedPositionJitter) ≥ TDC1LowerLimit	The value of BDCUpperLimit (plus twice the maximum position jitter) (%d) is bigger or equal the value of TDCLowerLimit (%d)	FB instance	BDCUpperLimit+ 2*AllowedPositionJitter	TDC1LowerLimit
0x401C	(TDC1LowerLimit + 2*AllowedPositionJitter) ≥ TDC1UpperLimit	The value of TDC1LowerLimit (plus twice the maximum position jitter) (%d) is bigger or equal the value of TDC1UpperLimit (%d)	FB instance	TDC1LowerLimit + 2*AllowedPositionJitter	TDC1UpperLimit
0x401B	(TDC1UpperLimit + AllowedPositionJitter) ≥ MaxPosition	The value of TDC1UpperLimit (plus the maximum position jitter) (%d) is bigger or equal the configured position of 360° (%d)	FB instance	TDC1UpperLimit+ AllowedPositionJitter	MaxPosition
0x4002	Position > (MaxPosition + AllowedPositionJitter)	The Position (%d) is bigger than the maximum position (plus the maximum position jitter) (%d)	FB instance	Position	MaxPosition + AllowedPositionJitter
0x4010	Position overruns MaxPosition	The Position has a circle overflow in Pendulum Mode, actual position = %d, last position = %d	FB instance		

4.26.8.2 Movement errors

Text ID	Meaning	Message	Parameter 1	Parameter 2	Parameter 3
Movement errors reported in function block state ERROR					
0x4022	In MOVE-UP-CLOCKWISE state MoveContraClockwise becomes TRUE	The Position has changed contra clockwise while moving up clockwise (actual Position=%d, old Position=%d)	FB instance	Position	last position
0x4023	In MOVE-UP-CONTRA-CLOCKWISE state MoveClockwise becomes TRUE	The Position has changed clockwise while moving up contra clockwise (actual Position = %d, old Position = %d)	FB instance	Position	last position
0x4011	In MOVE-STOP-TDC state Reset is FALSE and Stopped changes to FALSE	The Position has moved while waiting for a rising edge of the input Reset in Pendulum Mode, actual position = %d, compare position = %d	FB instance	Position	last position
0x4014	In MOVE-START-TDC state Reset is TRUE and Stopped changes to FALSE	The Position has moved while waiting for a falling edge of the input Reset in	FB instance	Position	last position

Text ID	Meaning	Message	Parameter 1	Parameter 2	Parameter 3
		Pendulum Mode, actual position = %d, last position = %d			
0x4024	In WAIT-FOR-RESET state Reset is FALSE and Stopped changes to FALSE	The Position was moving while waiting for a falling edge of the input Reset in the state WAIT-FOR_RESET	FB instance	Position	-

4.26.8.3 Error while PressStarted input is active

Text ID	Meaning	Message	Parameter 1	Parameter 2	Parameter 3
Errors reported in function block state ERROR when input PressStarted is TRUE					
0x401F	If PressStarted is TRUE and Stopped does not change to FALSE within the PressStartedDelayTime	The input PressStarted is TRUE and the position did not move after the PressStartedDelayTime	FB instance	-	-
0x4020	PressStarted is TRUE and Stopped changes to TRUE	The input PressStarted is TRUE and the position has stopped after moving before	FB instance	-	-
0x4021	PressStarted = TRUE and Stopped = FALSE and position does not change by at least MinPositionChange within the MoveDetectionTime	The input PressStarted is TRUE and the position has not moved enough, the actual position is %d, the compare position is %d	FB instance	Position	Comparison position

4.26.9 Status information

The FB CamMonitor can have the following states. They are made available to the user via the diagnostic information.

Value		Name	Description
1	0x01	**RUN** (general)	The function block is in RUN state, the CamMonOK output is 1, and the other outputs are set according to the current position.
2	0x02	**STOP** (general)	The function block is in STOP state, all outputs are FALSE or 0.
3	0x03	**SAFE** (general)	The function block is in SAFE state, i.e. the press motion is not as expected. All outputs are FALSE or 0.
4	0x04	**ERROR** (general)	Function block error (see diagnostic messages table). Error output is TRUE, all other outputs are FALSE.
5	0x05	**RESET** (general)	The function block assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE.
6	0x06	**START** (general)	If the STOP state is exited with RESET = TRUE, the function block assumes the START state.
15	0x0F	**WAIT-FOR-RESET** (general)	The function block switches to the WAIT-FOR-RESET state if Reset is FALSE and ErrAck is set to FALSE in RESET state.
16	0x10	**MOVE-STOP** (Excentric mode)	The function block is in MOVE-STOP state, i.e. no change in position was detected in the TDC range. The press is stopped in the TDC range.

Value		Name	Description
17	0x11	**MOVE-START** (Excentric mode)	The function block assumes the MOVE-START state if the Reset input becomes TRUE in MOVE-STOP state.
18	0x12	**MOVE-DOWN** (Excentric mode)	The function block assumes the MOVE-DOWN state if the Reset input becomes FALSE in MOVE-START state.
19	0x13	**MOVE-UP** (Excentric mode)	The function block assumes the MOVE-UP state if LeftArea becomes TRUE in MOVE-DOWN state.
20	0x14	**MOVE-TDC** (Excentric mode)	The function block assumes the MOVE-TDC state if TDCAreaMax becomes TRUE in MOVE-UP state.
32	0x20	**MOVE-DOWN-CLOCKWISE** (Pendulum mode)	The function block assumes the MOVE-DOWN-CLOCKWISE state when a downward movement starts in clockwise direction.
33	0x21	**MOVE-UP-CLOCKWISE** (Pendulum mode)	The function block assumes the MOVE-UP-CLOCKWISE state if LeftArea becomes TRUE in MOVE-DOWN-CLOCKWISE state.
34	0x22	**MOVE-UP-TDC1** (Pendulum mode)	The function block assumes the MOVE-UP-TDC1 state if TDC1Area or TDC1ExceededArea becomes TRUE in MOVE-DOWN-CLOCKWISE or MOVE-UP-CLOCKWISE state.
35	0x23	**MOVE-STOP-TDC1** (Pendulum mode)	The function block assumes the MOVE-STOP-TDC1 state if the press is stopped in MOVE-UP-TDC1 state.
36	0x24	**MOVE-START-TDC1** (Pendulum mode)	The function block assumes the MOVE-START-TDC1 state if the input Reset becomes TRUE in MOVE-STOP-TDC1 state.
37	0x25	**MOVE-DOWN-CONTRA-CLOCKWISE** (Pendulum mode)	The function block assumes the MOVE-DOWN-CONTRA-CLOCKWISE state when a downward movement starts in counter-clockwise direction.
38	0x26	**MOVE-UP-CONTRA-CLOCKWISE** (Pendulum mode)	The function block assumes MOVE-UP-CONTRA-CLOCKWISE state if RightArea becomes TRUE in MOVE-DOWN-CONTRA-CLOCKWISE state.
39	0x27	**MOVE-UP-TDC2** (Pendulum mode)	The function block assumes the MOVE-UP-TDC2 state if TDC2Area or TDC2ExceededArea becomes TRUE in MOVE-DOWN-CONTRA-CLOCKWISE or MOVE-UP-CONTRA-CLOCKWISE state.
40	0x28	**MOVE-STOP-TDC2** (Pendulum mode)	The function block assumes the MOVE-STOP-TDC2 state if the press is stopped in MOVE-UP-TDC2 state.
41	0x29	**MOVE-START-TDC2** (Pendulum mode)	The function block assumes the MOVE-START-TDC2 state if the input Reset becomes TRUE in MOVE-STOP-TDC2 state.

Internal identifier of the FB

Type	Description
FB CamMonitor	This description applies to BLG 1.0 / BLG 2.0 (internal version number)

4.27 The function block SLI

4.27.1 Functional description

The FB SLI is used to save the *Position* input when a rising edge is encountered at input *SLI* (*LatchPosition*). As long as *SLI* is set to TRUE, the system checks whether the position is within the limits *LatchPosition - Limit neg* and *LatchPosition + Limit pos*. If this is the case the output *SLIActive* is set to TRUE. If the position leaves the defined range, *SLIActive* is set to FALSE. The *PositionDiff* output indicates the current difference between *Position* and *LatchPosition*. A falling edge at *SLIActive* also results in setting of the output *PositionDiff* to 0. The input data types INT16, INT32, UINT16 and UINT32 are permitted for *Position*. The output *PositionDiff* supports the output data types INT16 and INT32.

The parameters *Limit pos* and *Limit neg* are UINT32 values and are therefore always specified positive.

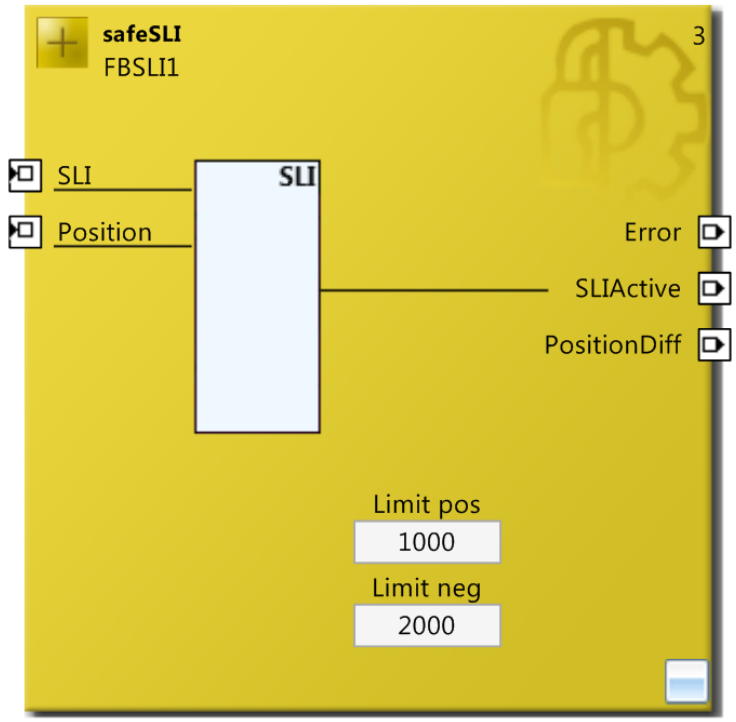

Fig. 148: Function block SLI

NOTICE

KL6904/EL6900

The function block SLI is not available in the KL6904 and the EL6900.

4.27.2 Signal description

FB SLI inputs

Name	Permitted type	Data type	Description
SLI	TwinSAFE-In FB-Out TwinSAFE SC	BOOL	Input for activating the function and saving the current position.
Position	TwinSAFE-In FB-Out TwinSAFE SC	INT16 INT32 UINT16 UINT32	Position value. Is saved with the rising edge at SLI and compared with the saved position as long as SLI remains set and the difference is output at PositionDiff.

FB SLI outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	Error output (see diagnostic information)
SLIActive	TwinSAFE-Out FB-In Standard-Out	BOOL	SLIActive is set if SLI is TRUE and PositionDiff is within the defined limits.
PositionDiff	TwinSAFE-Out FB-In Standard-Out	INT16 INT32	Output of the difference position between the saved (LatchPosition) and current position. PositionDiff is set to 0 if SLIActive is FALSE.

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
TwinSAFE SC	Input of a TwinSAFE connection (TwinSAFE SC technology)

FB SLI parameters

Parameter	Description
Limit pos	Permitted deviation of the saved position (LatchPosition) in positive direction (UINT32)
Limit neg	Permitted deviation of the saved position (LatchPosition) in negative direction (UINT32)

Internal identifier of the FB

Type	Description
FB SLI	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for the FB SLI

Diagnostic information

Bit	Description
0	Underflow (PositionDiff < -NegLimit)
1	Overflow (PositionDiff > PosLimit)

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
0x40C0	An underflow has occurred	FB instance	Position	LatchPosition
0x40C1	An overflow has occurred	FB instance	Position	LatchPosition

Status information

Value	Description
1	**RUN** In RUN state, FB SLI determines the PositionDiff and checks whether -NegLimit ≤ PositionDiff ≤ PosLimit applies. The outputs assume the following values: • Error = 0 • SLIActive = 1 • PositionDiff = Position - LatchPosition
2	**STOP** If the input FbRun=FALSE, FB SLI assumes the STOP state. The outputs assume the following values: • Error = 0 • SLIActive = 0 • PositionDiff = 0

Value	Description
3	**SAFE** If the input SLI=FALSE, FB SLI assumes the SAFE state. The outputs assume the following values: • Error = 0 • SLIActive = 0 • PositionDiff = 0
4	**ERROR** If the FB SLI detects an error when checking the permitted range for the PositionDiff, FB SLI switches to the ERROR state and sends the corresponding Diag message to the GROUP module. The outputs assume the following values: • Error = 1 • SLIActive = 0 • PositionDiff = 0
5	**RESET** FB SLI assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. FB SLI should only exit the RESET state if ErrAck=FALSE and SLI=FALSE. The outputs assume the following values: • Error = 0 • SLIActive = 0 • PositionDiff = 0
7	**EXCEEDED** If ExceededSupport = TRUE and, in RUN state, PositionDiff < NegLimit (underflow) or PositionDiff > PosLimit (overflow), FB SLI2 assumes the EXCEEDED state. The outputs assume the following values: • Error = 0 • SLIActive = 0 • PositionDiff = Position - LatchPosition

4.27.3 Configuration in TwinCAT 3

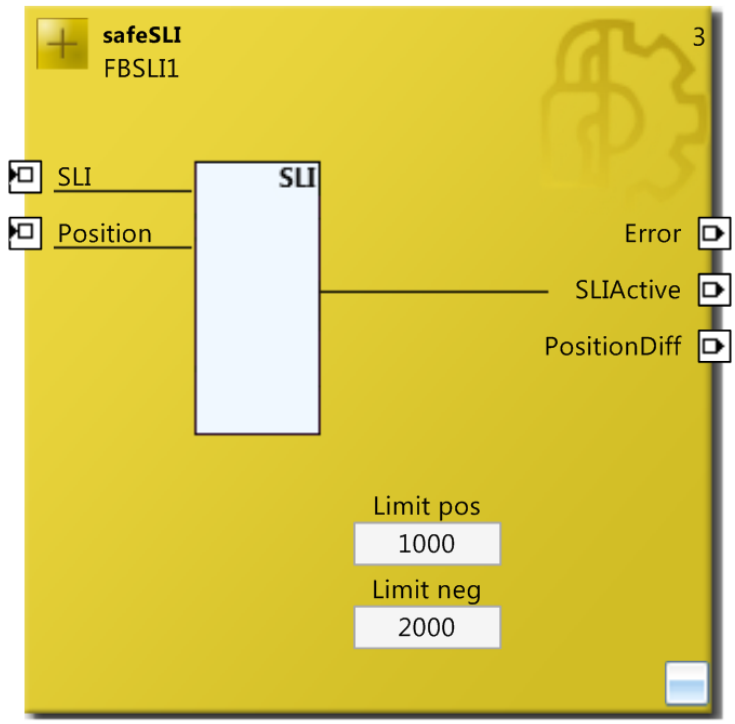

Fig. 149: FB SLI configuration

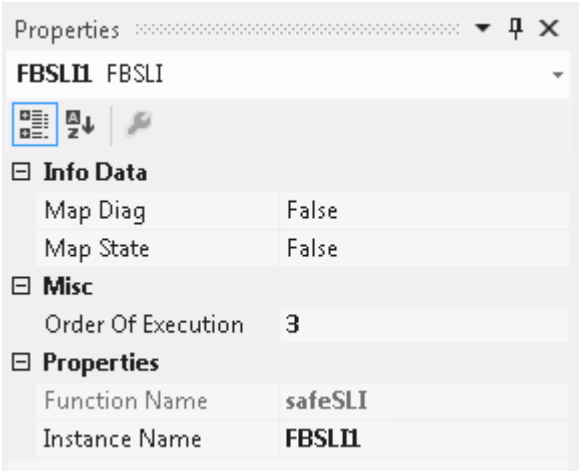

Fig. 150: FB SLI properties

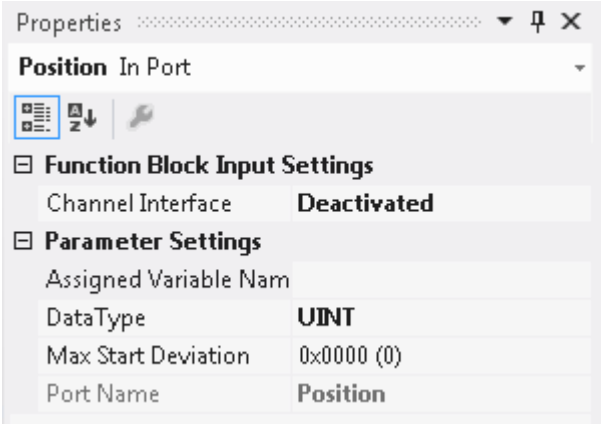

Fig. 151: FB SLI port properties

A mouse click next to the FB Port can be used to create variables that can be linked with input or output signals. Settings such as changing the data type or activation of the input can be made via the properties of the FB port.

The *"Map State"* and *"Map Diag"* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

4.28 The function block SLI2

4.28.1 Functional description

The FB SLI2 corresponds to the function block SLI with the exception of the outputs. SLI2 has two outputs and two more parameters than SLI.

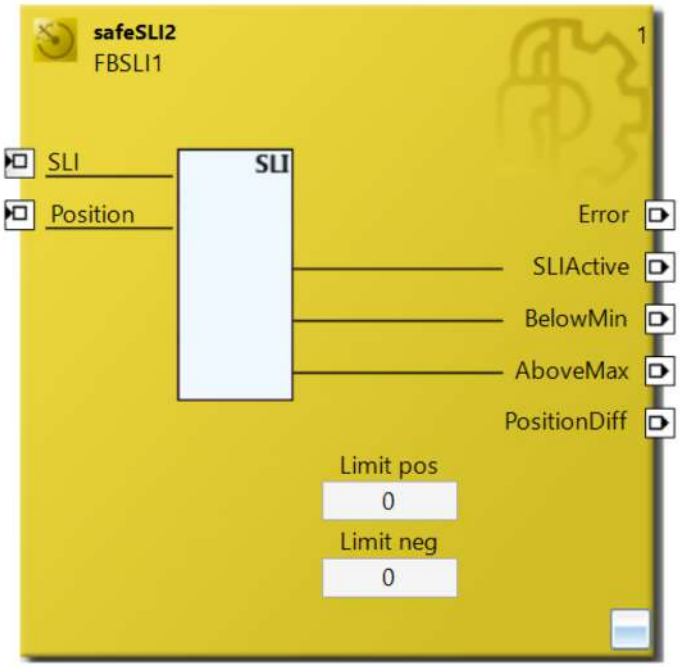

Fig. 152: Function block SLI2

This chapter therefore only describes the outputs, the parameters and the status information. All further information can be found in chapter The function block SLI [▶ 171].

4.28.2 Description of the signals

FB SLI2 outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	Error output (see diagnostic information)
SLIActive	TwinSAFE-Out FB-In Standard-Out	BOOL	SLIActive is set if SLI is TRUE and PositionDiff is within the defined limits.
PositionDiff	TwinSAFE-Out FB-In Standard-Out	INT16 INT32	Output of the difference position between the saved (LatchPosition) and current position. PositionDiff is set to 0 if SLIActive is FALSE.
BelowMin		BOOL	Falling below the latch position
AboveMax		BOOL	Exceeding the latch position

FB SLI2 parameters

Parameter	Description
Limit pos	Permitted deviation of the saved position (LatchPosition) in positive direction (UINT32)
Limit neg	Permitted deviation of the saved position (LatchPosition) in negative direction (UINT32)
OverflowAllowed	Overflow allowed or not allowed
ExceededSupport	If an underflow or overflow occurs in the RUN state, the FB changes to the EXCEEDED state instead of ERROR

Status information of the SLI2 FB

Value	Description
1	**RUN** In RUN state, FB SLI2 determines the PositionDiff and checks whether -NegLimit ≤ PositionDiff ≤ PosLimit applies. The outputs assume the following values: • Error = 0 • SLIActive = 1 • BelowMin = 0 • AboveMax = 0 • PositionDiff = Position - LatchPosition
2	**STOP** If the input FbRun=FALSE, FB SLI2 assumes the STOP state. The outputs assume the following values: • Error = 0 • SLIActive = 0 • BelowMin = 0 • AboveMax = 0 • PositionDiff = 0
3	**SAFE** If the input SLI = FALSE, FB SLI2 assumes the SAFE state. The outputs assume the following values: • Error = 0 • SLIActive = 0 • BelowMin = 0 • AboveMax = 0 • PositionDiff = 0
4	**ERROR** If FB SLI2 detects an error when checking the permitted range for the PositionDiff, FB SLI2 switches to the ERROR state and outputs the corresponding Diag message. The outputs assume the following values: • Error = 1 • SLIActive = 0 • BelowMin = 0 • AboveMax = 0 • PositionDiff = 0
5	**RESET** FB SLI2 assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. FB SLI2 only leaves the RESET state when ErrAck = FALSE and SLI = FALSE. The outputs assume the following values: • Error = 0

Value	Description
	• SLIActive = 0 • PositionDiff = 0
7	**EXCEEDED** If ExceededSupport = TRUE and, in RUN state, PositionDiff < NegLimit (underflow) or PositionDiff > PosLimit (overflow), FB SLI2 assumes the EXCEEDED state. The outputs assume the following values: • Error = 0 • SLIActive = 0 • BelowMin = Underflow • AboveMax = Overflow • PositionDiff = Position - LatchPosition

4.28.3 Configuration in TwinCAT 3

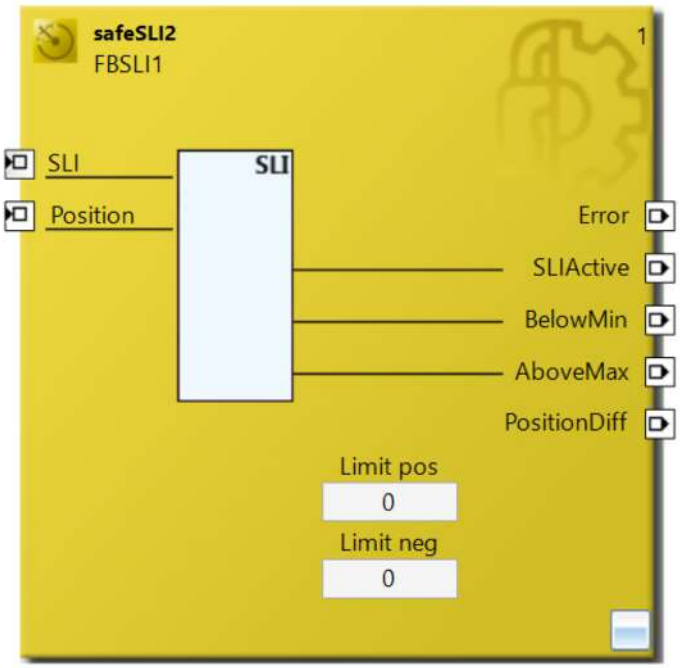

Fig. 153: FB SLI2 configuration

In the function block view, you have the option of defining the permissible deviation of the saved position in the positive and negative direction. By clicking next to the FB port, you can create variables that can be linked to input or output signals.

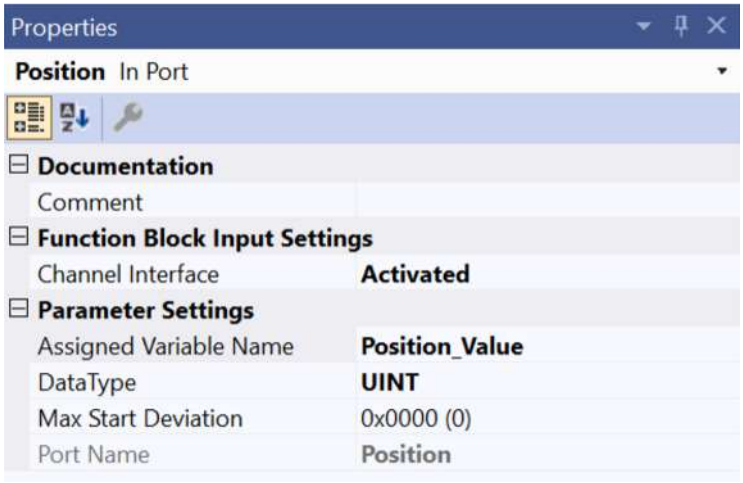

Fig. 154: FB SLI2 port properties

Settings such as changing the data type or activation of the port can be made via the properties of the FB Port.

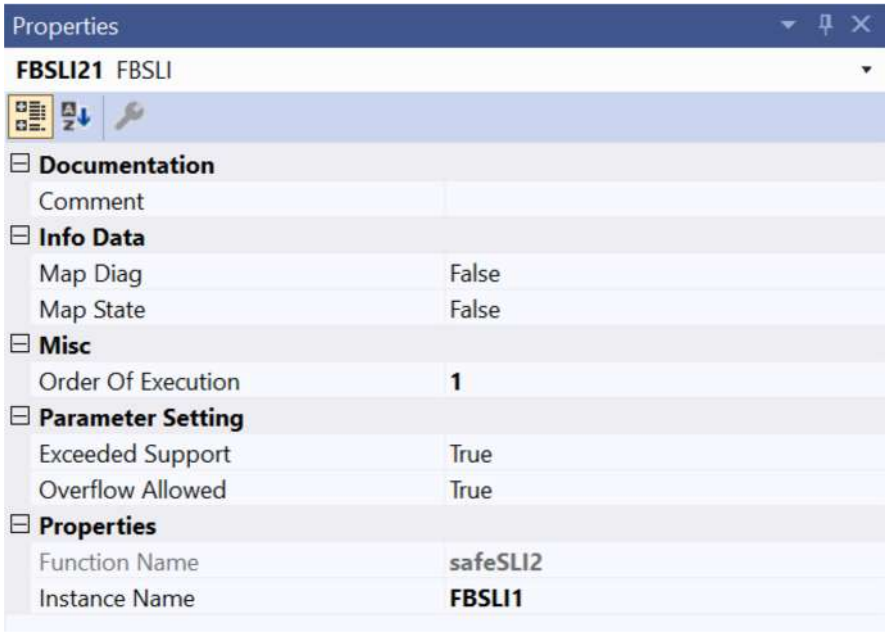

Fig. 155: FB SLI2 properties

The entries "Map Diag" and "Map State" in the properties window of the FB define which diagnostic functions of the FB are mapped in the cyclic process image. In the parameter settings, you can define whether an overflow is allowed or not and whether the FB in the RUN state should switch to the EXCEEDED state in the event of an underflow or overflow.

Under "Misc", you can select the position at which the function block is to be executed in the execution order.

It is possible to change the instance name in both views.

Further information on the parameters can be found in chapter Parameter.

4.29 The function block SLP

4.29.1 Functional description

With a valid position *SafePosionValid*=1, the FB SLP monitors the current position for the specified limits *PositionUpperLimit* and *PositionLowerLimit*.

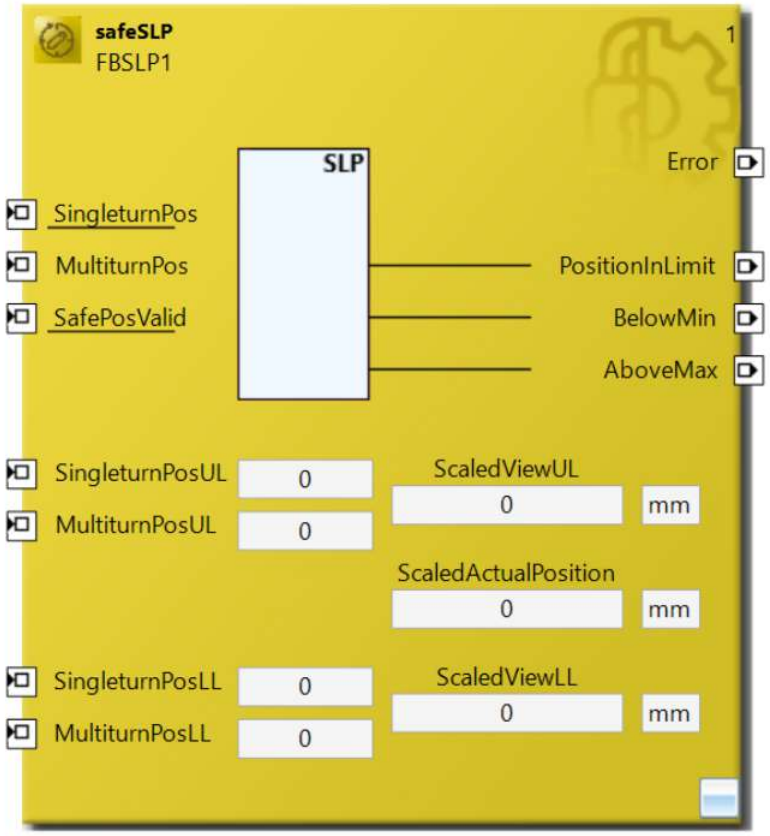

Fig. 156: Function block SLP

4.29.1.1 Multiturn operation mode

In Multiturn mode, the complete 64 bits of SafePosition, SafePositionLowerLimit and SafePositionHigherLimit are used in the comparisons.

SafePosValid = TRUE, SafePositionLowerLimit ≤ SafePosition ≤ SafePositionHigherLimit

FB SLP	TRUE
PositionInLimit	1
BelowMin	0
AboveMax	0

SafePosValid = TRUE and SafePosition < SafePositionLowerLimit

FB SLP	FALSE
PositionInLimit	0
BelowMin	1
AboveMax	0

SafePosValid = TRUE und SafePosition > SafePositionHigherLimit

FB SLP	FALSE

PositionInLimit	0
BelowMin	0
AboveMax	1

4.29.1.2 Singleturn operation mode

In Singleturn mode, only the lower 32 bits of SafePosition, SafePositionLowerLimit and SafePositionHigherLimit are used in the comparisons.

SafePosValid = TRUE and SafePositionLowerLimit ≤ SafePositionHigherLimit

If InLimit = TRUE

PositionInLimit	1
BelowMin	0
AboveMax	0

If InLimit = FALSE

PositionInLimit	0
BelowMin	0
AboveMax	0

SafePosValid = TRUE and SafePositionLowerLimit ≥ SafePositionHigherLimit

If InLimit = TRUE

PositionInLimit	1
BelowMin	0
AboveMax	0

If InLimit = FALSE

PositionInLimit	1
BelowMin	0
AboveMax	0

4.29.2 Description of the signals

FB SLP inputs

Name	Data type	Description
SingleturnPos	UDINT	Current single-turn position
MultiturnPos	DINT	Current multi-turn position
SafePosValid	BOOL	Indicates the validity of the current safe position. 0 = SafePosition invalid 1 = SafePosition valid
SingleturnPosUL	UDINT	Upper limit of the single-turn position
MultiturnPosUL	DINT	Upper limit of the multi-turn position
SingleturnPosLL	UDINT	Lower limit of the single-turn position
MultiturnPosLL	DINT	Lower limit of the multi-turn position

FB SLP outputs

Name	Data type	Description
Error	BOOL	Indicates an error.

Name	Data type	Description
		0 = no error 1 = error
PositionInLimit	BOOL	Indicates whether the current position is within the limits. 0 = Position outside the limits 1 = Position within the limits
BelowMin	BOOL	Indicates whether the current position is within the limits. 0 = Lower limit is adhered to 1 = Lower limit is not reached
AboveMax	BOOL	Indicates whether the current position is within the limits. 0 = Upper limit is adhered to 1 = Lower limit is exceeded

Internal identifier of the FB

Type	Description
FB SLP	This description applies to BLG 1.0 (internal version number)

FB SLP parameters

You can adjust the following parameters both in the function block view and in the "Properties" window:

Parameter	Description
MultiTurn Pos UL	Upper limit of the multi-turn position
SingleTurn Pos UL	Upper limit of the single-turn position
MultiTurn Pos LL	Lower limit of the multi-turn position
SingleTurn Pos LL	Lower limit of the single-turn position
ScaledView UpperLimit	Scaled value from MultiTurn Pos UL and SingleTurn Pos UL
ScaledView LowerLimit	Scaled value from MultiTurn Pos LL and SingleTurn Pos LL

You can adjust the following parameters in the "Properties" window:

Parameter	Description
Scaling Factor Numerator	Numerator value for the NC scaling factor This factor is only used for the display in the editor and is not required for the logic.
Scaling Factor Denominator	Denominator value for the NC scaling factor This factor is only used for the display in the editor and is not required for the logic.
Encoder Mask	Encoder mask from NC configuration
Encoder Sub Mask	Encoder sub mask from NC configuration
Scaling Unit	Textual specification of the unit of the scaled value for the display in the function block view

Diagnostic and status information for the FB SLP

Diagnostic information

Bit	Description
0	The lower limit of the multi-turn position is greater than the upper limit of the multiturn position. (MultiTurn Pos LL > MultiTurn Pos UL)
1	The lower limit of the multi-turn position is the same as the upper limit of the multi-turn position and the lower limit of the single-turn position is greater than the upper limit of the single-turn position. (MultiTurn Pos LL = MultiTurn Pos UL and SingleTurn Pos LL > SingleTurn Pos UL)

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
0x40D0	The multi-turn position lower limit is greater than the multi-turn position upper limit.	FB instance	MultiturnPos_LL	MultiturnPos_UL
0x40D1	The multi-turn position lower limit corresponds to the multi-turn position upper limit. The single-turn position lower limit is greater than the single-turn position upper limit.	FB instance	SingleturnPos_LL	SingleturnPos_UL

Status information

Value	Description
1	**RUN** If SafePosValid = TRUE, FB SLP compares with the lower limit SafePositionLowerLimit and the upper limit SafePositionHigherLimit. If InLimit = TRUE, FB SLP switches to the RUN state. The outputs assume the following values: • Error = 0 • PositionInLimit = 1 • BelowMin = 0 • AboveMax = 0
2	**STOP** If the input FbRun = FALSE, FB SLP switches to the STOP state. The outputs assume the following values: • Error = 0 • PositionInLimit = 0 • BelowMin = 0 • AboveMax = 0
3	**SAFE** If the input SafePosValid = TRUE, the FB SLP compares the SafePosition with the lower limit SafePositionLowerLimit and the upper limit SafePositionHigherLimit. If InLimit = FALSE, FB SLP switches to the SAFE state. The outputs assume the following values: • Error = 0 • PositionInLimit = 0 • BelowMin = according to the comparison results • AboveMax = according to the comparison results
4	**ERROR** When in multi-turn mode • LL_Active = TRUE **or** UL_Active = TRUE **and** • MultiturnPos_LL > MultiturnPos_UL applies (LimitError), FB SLP switches to the ERROR state and outputs the Diag message 0x40D0. When in multi-turn mode • LL_Active = TRUE **or** UL_Active = TRUE **and** • MultiturnPos_LL = MultiturnPos_UL **and** • SingleturnPos_LL > SingleturnPos_UL applies (LimitError), FB SLP switches to the ERROR state and outputs the Diag message 0x40D1. The outputs assume the following values: • Error = 1 • PositionInLimit = 0

Value	Description
	• BelowMin = 0 • AboveMax = 0
5	**RESET** FB SLP switches to the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. The outputs assume the following values: • Error = 0 • PositionInLimit = 0 • BelowMin = 0 • AboveMax = 0
6	**START** If the input SafePosValid = FALSE, FB SLP switches to the START state. The outputs assume the following values: • Error = 0 • PositionInLimit = 0 • BelowMin = 0 • AboveMax = 0

4.29.3 Configuration in TwinCAT 3

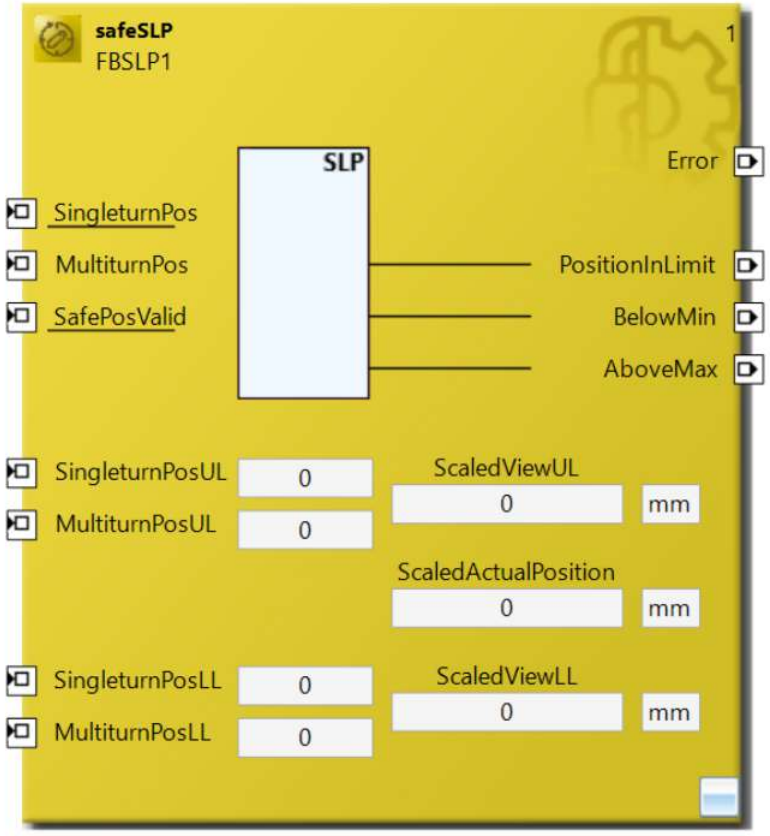

Fig. 157: Function block SLP

In the function block view, you have the option of setting the upper and lower limits of the single-turn and multi-turn position. By clicking next to the FB port, you can create variables that can be linked to input or output signals.

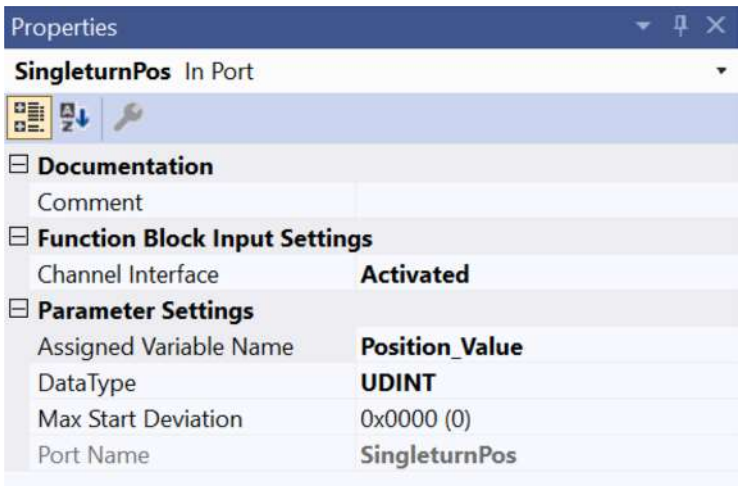

Fig. 158: FB SLP port properties

Settings such as changing the data type or activation of the port can be made via the properties of the FB Port.

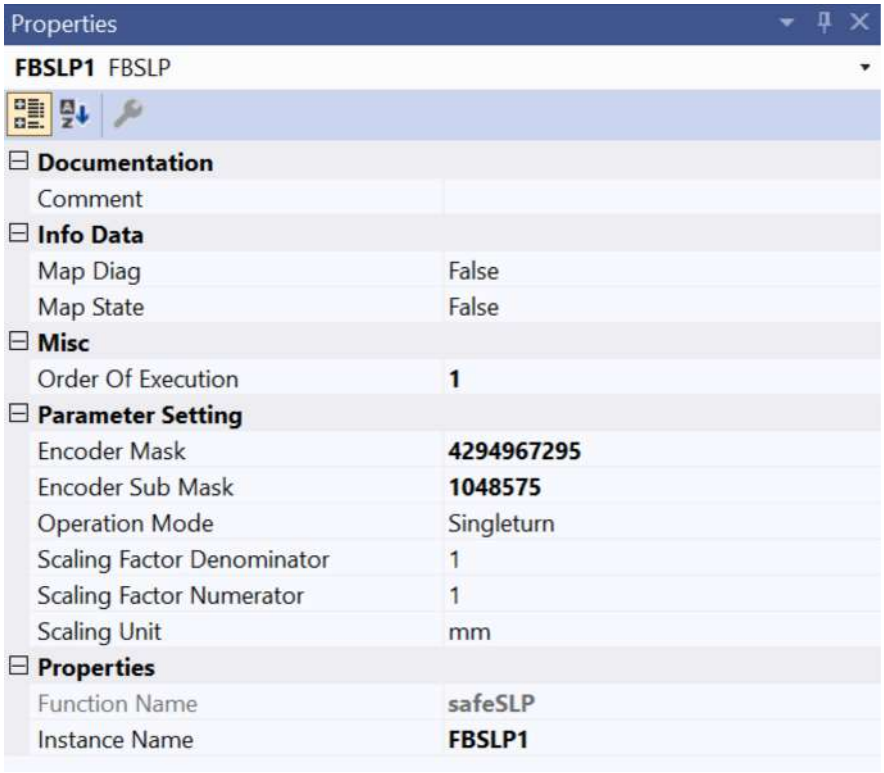

Fig. 159: FB SLP properties

The entries "Map Diag" and "Map State" in the properties window of the FB define which diagnostic functions of the FB are mapped in the cyclic process image.

Under "Misc", you can select the position at which the function block is to be executed in the execution order.

It is possible to change the instance name in both views.

Further information on the parameters can be found in chapter Parameter.

4.30 The function block SBT

4.30.1 Safe drive control

⚠ WARNING

IFA Report 4/2018 mandatory compliance

Only use the function block described here and the associated safety function in compliance with the provisions of the IFA report "Safe drive controls with frequency inverters (IFA Report 4/2018)" (document [1] at References [▶ 11]).

Failure to comply will result in the loss of brake safety.

According to the IFA report, it may be possible to use certain safety functions for brakes. To this end, the report defines requirements and measures that must be fulfilled for the requirement of category 2 of DIN EN ISO 13849-1.

The following table is an excerpt from "Table 2: Examples of measures against unintended descent of gravity-loaded axes (vertical axes) according to DIN EN ISO 13849-1 categories 2 and 3" from document [1] at References [▶ 11].

1 General requirements	
1.1	The mechanical parts of power transmission and the safety devices shall be at least designed to withstand the occurring static and dynamic stresses at double weight load.
1.2	If a brake fault is detected by control means according to DIN EN ISO 13849-1, category 2 or 3, the vertical axis shall immediately approach a safe position if there are protective devices or unlocked protective doors, provided this is still possible. The indications given by the machine control shall request for brake repair. If guards with locked protective doors are present, a safe position shall not be approached until an unlock demand signal has been given.
1.3	One or several warning signs shall be visibly fixed at the machine pointing out to hazards due to vertical axes and suspended loads.
1.4	The operating instructions shall describe measures for fall-down protection. They shall point out to hazards due to vertical axes and suspended loads.
1.5	Measures against unauthorized access to safety-relevant program parts of the control system shall be provided, e.g. by one of the following measures: • write protection for relevant parts of the program • password protection • modification protection by means of a key switch
1.6	In order to prevent unnecessary wear of the brakes, preference should be given to stop category 1 (controlled stopping) − if permitted by the risk assessment − according to EN 60204-1, for operational stop and for emergency stop, instead of stopping with mechanical brakes.
2 Measures according to DIN EN ISO 13849-1, category 2 (cyclic brake test)	
2.1	The brake test shall be carried out in a safe position for the operator, e.g. safe parking position, closed guard.
2.2	The brake test shall become effective automatically during normal operation of the vertical axis, however, after 8 hours or a shift at the latest. For systems to which access is safely prevented, (e.g. by means of protective doors with guard locking), the test may be effected immediately prior to access after unlock demand signal. **Note:** According to DIN EN ISO 13849-1, the test rate for control systems of category 2 (checking) has to be estimated a 100 times more frequent than the demand upon the safety function. Due to the risks of vertical axes, i.e. particularly due to the accident history, such a high test rate is considered to be actually not required. Therefore, a calculation of the Performance Level according to the simplified procedures of DIN EN ISO 13849-1 is not possible and can be omitted in this particular case according to DIN EN ISO 13849-1, clause 6.2.2.

2.3	By the brake test it shall be established, that at least the maximum static weight of the load of the axis occurring in the case of application is held safely. The level of the test torque has to be selected accordingly, i.e. 1.3 times the load torque. If several brakes are applied in a parallel manner, (e.g. two brakes) this is considered to be fulfilled if the braking devices are tested separately one after the other on the simple weight load.
2.4	To ensure its total effectiveness, the test torque shall be applied over a sufficient time period.
2.5	After repair of a defective brake, a brake test shall be forced by the control system and completed successfully prior to further operation.
2.6	As to the effectiveness of the brake test, an acceptance test at the commissioning of the machine shall be carried out and recorded. During this acceptance test, a failure condition of the brake device shall be simulated and the corresponding fault reaction shall be checked. For this acceptance test, the machine manufacturer shall provide a form and prescribe the need for skilled personnel. The acceptance test shall be carried out with a reasonable effort.

4.30.2 Functional description

The function block SBT is used to test the function of a holding brake in one drive direction.

If you want to check both drive directions, you must use 2 instances of the SBT function block and the BrakeValid result from both function blocks within the user logic.

The BrakeValid signal is not set during the brake test and may have to be bypassed with the *SBT* signal for the duration of the brake test.

The function block SBT sets the output BrakeValid=0 on a rising edge (SBT=1). The output *RemainingTime* continues to decrement unchanged and the function block sets the output TestError=0.

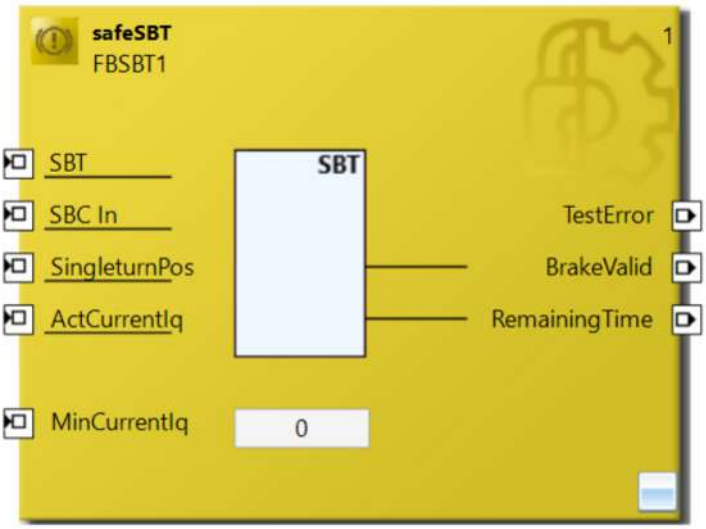

Fig. 160: Function block SBT

As soon as SBT=1 and SBTIn=0, the system checks whether the value of *ActCurrentIq* is equal to or greater than the value of *MinCurrentIq* for the duration of *MinDuration*. A check is also made to ensure that the SingleTurn position does not change more than *MaxPositionDeviation*.

Check position

The SBT function block does not check the position of the shaft before the brake test. The test can therefore be passed and the position is 0, even if the shaft is still moving. Before carrying out a brake test, make sure that the shaft is no longer moving and set the parameters manually accordingly.

If the test is successful

TestError	0
BrakeValid	1

RemainingTime	*BrakeTestInterval* The timer until the next brake test is reset.

SBT=1 after expiry of _BrakeTestInterval_

TestError	1
BrakeValid	0
RemainingTime	0

If the test fails

TestError	1
BrakeValid	0
RemainingTime	continue decrementing unchanged

SBT=0 and no test performed

TestError	0
BrakeValid	unchanged
RemainingTime	continue decrementing unchanged

4.30.3 Description of the signals

Digital inputs of the FB

Name	Data type	Description
SBT	BOOL	Specifies whether a brake test should be started or not. 0 = Brake test not active 1 = Start brake test
SBC In	BOOL	Indicates whether the brake is applied or released. 0 = Brake applied 1 = Brake released

Analog inputs of the FB

Name	Data type	Description
SingleturnPos	UINT32	Indicates the current safe position.
ActCurrentIq	INT32	Indicates the torque-forming current of the axis.
MinCurrentIq	INT32	Specifies the torque-forming current for the minimum required torque of the axis.

Digital outputs of the FB

Name	Data type	Description
TestError	BOOL	Indicates an error during the brake test. 0 = no error 1 = error
BrakeValid	BOOL	Indicates the test result. 0 = last test negative 1 = last test positive

Analog outputs of the FB

Name	Data type	Description
RemainingTime	UINT32	Indicates the remaining time until the next brake test in seconds.

Internal identifier of the FB

Type	Description
FB SBT	This description applies to BLG 1.0 (internal version number)

FB SBT parameters

Parameter	Description
MinCurrentIq	Torque-forming current for the minimum required torque of the axis
BrakeTestInterval	Interval between brake tests in seconds. The preset value is 28800.
MaxPosititionDeviation	Maximum deviation of the position during the brake test
MinDuration	Minimum required test duration for the brake test in tenths of a second The preset value is 10.
MaxDuration	Maximum total duration of the brake test in tenths of a second The preset value is 200.

Diagnostic and status information

Diagnostic information

Bit	Description
-	No diagnostic information

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
0x40DA	The single-turn position exceeds the maximum position deviation.	FB instance	SingleturnPosition Diff	MaxPositionDeviation
0x40D8	The maximum duration of the brake test has expired without the test being successfully completed.	FB instance	FB-State=0x12	LatchPosition
0x40D9	The time remaining for the next brake test has expired and no new brake test has been started.	FB instance	FB-State=0x14	LatchPosition

Status information

Value	Description
1	**RUN** If • SBT=FALSE, • the last brake test was successful and • RemainingTime ≤ BrakeTestInterval, FB SBT switches to the RUN state. The outputs assume the following values: • TestError = 0 • BrakeValid = 0 • RemainingTime = current remaining time
2	**STOP** If

Value	Description
	• FbRun = FALSE FB SBT switches to the STOP state. The outputs assume the following values: • TestError = 0 • BrakeValid = 0 • RemainingTime = 0
3	**SAFE** If • SBT = FALSE, • the last brake test was not successful and • RemainingTime>BrakeTestInterval FB SBT switches to the SAFE state. The outputs assume the following values: • TestError = 0 • BrakeValid = 0 • RemainingTime = current remaining time
18	**TESTING** If • SBT = TRUE the FB SBT switches to the TESTING state and loads the MaxDurationTimer with the MaxDurationTime. The outputs assume the following values: • TestError = 0 • BrakeValid = 0 • RemainingTime = 0 or current remaining time
20	**TEST-OK** If • the brake test was successful and • no falling edge was detected at input SBT FB SBT switches to the TEST-OK state. The outputs assume the following values: • TestError = 0 • BrakeValid = 0 • RemainingTime = current remaining time
21	**TEST-FAILED** If • SBT = TRUE and • TestFailed = TRUE, TestExpired = TRUE or TimerExpired = TRUE FB SBT switches to the TEST-FAILED state. The outputs assume the following values: • TestError = 0 • BrakeValid = 0 • RemainingTime = 0 or current remaining time
16	**MON-ERROR** If • TimerExpired = TRUE and • SBT = FALSE

Value	Description
	FB SBT switches to the MON-ERROR state and sets LastTestResult = FALSE. The outputs assume the following values: • TestError = 0 • BrakeValid = 0 • RemainingTime = 0

4.30.4 Configuration in TwinCAT 3

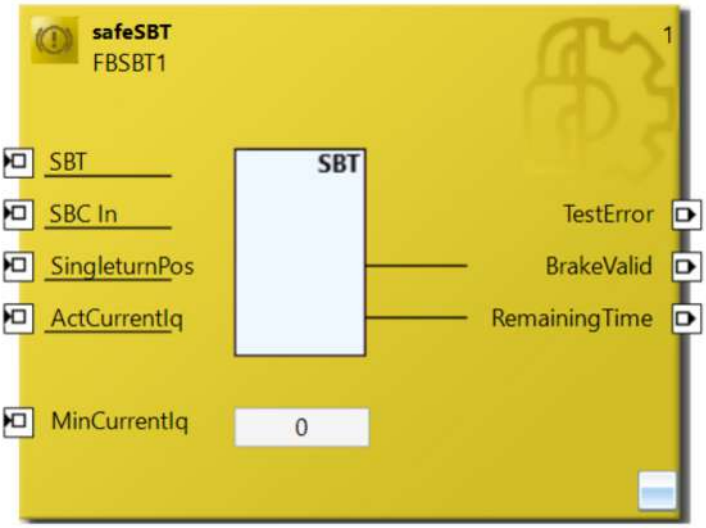

Fig. 161: Function block SBT

In the function block view, you have the option of setting the torque-generating current for the minimum required torque of the axis. By clicking next to the FB port, you can create variables that can be linked to input or output signals.

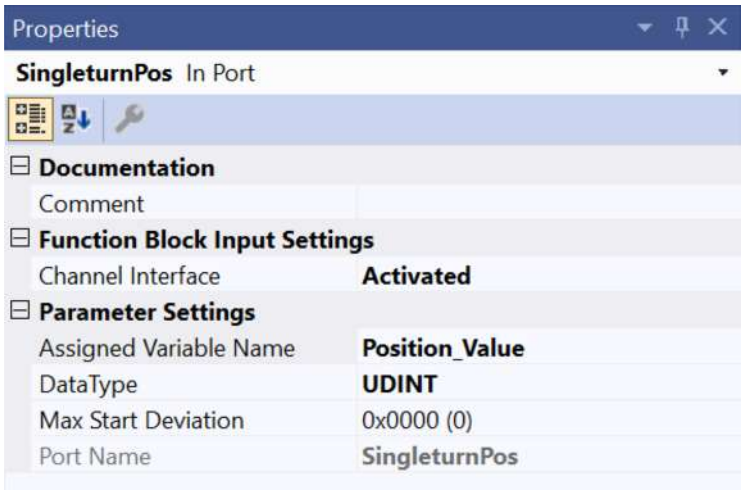

Fig. 162: FB SBT port properties

Settings such as changing the data type or activation of the port can be made via the properties of the FB Port.

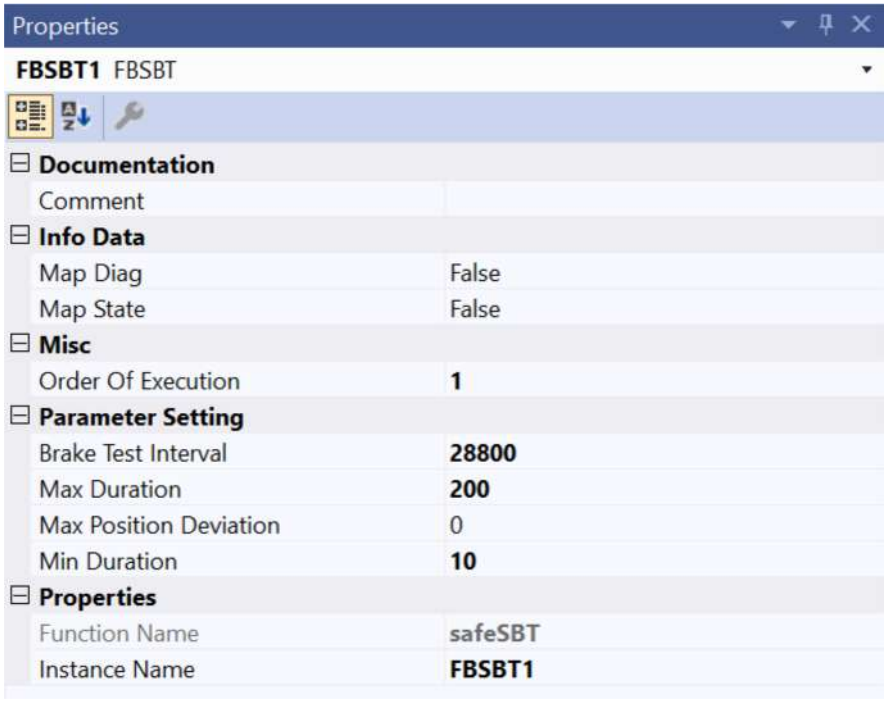

Fig. 163: FB SBT properties

The entries "Map Diag" and "Map State" in the properties window of the FB define which diagnostic functions of the FB are mapped in the cyclic process image.

You can also set the interval between two brake tests and the minimum and maximum duration of a brake test in the parameter settings. Under "Misc", you can select the position at which the function block is to be executed in the execution order.

It is possible to change the instance name in both views.

Further information on the parameters can be found in chapter Parameter.

4.31 The function block ADVPOSMON

4.31.1 Functional description

The FB ADVPOSMON supports the function SIL 3 EnDat 3 jump monitoring.

With an AX8000 with integrated EnDat 3 encoder, a SIL 3 / PL e category 4 can also be achieved with additional measures. For this purpose, the function block "AdvPosMon" must be used for additional monitoring of position and speed.

NOTICE

Integration in Safe Motion functions

You must integrate the additional measures into every Safe Motion function that is to be loaded with SIL 3 / PL e category 4. For more information on integration in Safe Motion functions, see the chapter AdvPosMon with integrated EnDat 3 encoder in document [5] at References [▶ 11].

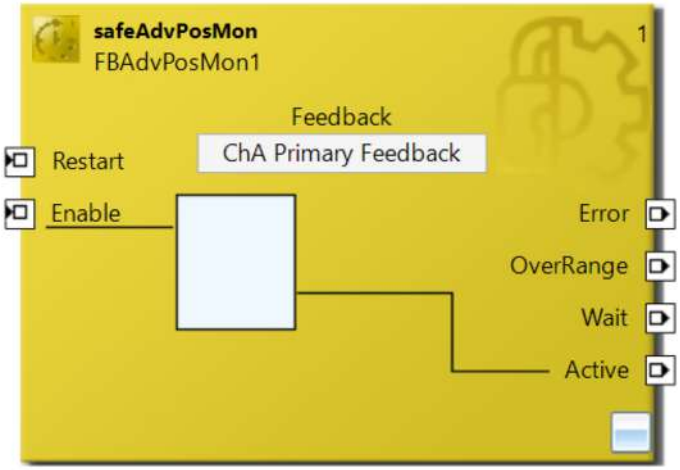

Fig. 164: Function block ADVPOSMON

4.31.2 Description of the signals

FB ADVPOSMON inputs

Name	Data type	Description
Enable	BOOL	Indicates the status of automatic position monitoring. 0 = inactive 1 = active
Restart	BOOL	Restart when the FB is in the OverRange state. This function is optional.

FB ADVPOSMON outputs

Name	Data type	Description
Error	BOOL	Indicates an error. 0 = no error 1 = error, automatic position monitoring is inactive
Active	BOOL	Indicates the status of automatic position monitoring. 0 = inactive 1 = active
Wait	BOOL	Indicates the FB activity.

Name	Data type	Description
		0 = the FB is not activated 1 = the FB is activated, but the parameterized encoder instance is not yet referenced, the extended position monitoring is inactive
OverRange	BOOL	Indicates diagnostic coverage is falling short. 0 = diagnostic coverage is ≥ 99% 1 = the diagnostic coverage is < 99% due to excessive speed, extended position monitoring is inactive

Parameters of the FB ADVPOSMON

You can adjust the following parameters both in the function block view and in the "Properties" window:

Parameter	Description
ChA Primary Feedback	Primary feedback from channel A
ChA Secondary Feedback	Secondary feedback from channel A
ChB Primary Feedback	Primary feedback from channel B
ChB Secondary Feedback	Secondary feedback from channel B

Diagnostic and status information for FB ADVPOSMON

Diagnostic information

Bit	Description
-	No diagnostic information

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
-	-	-	-	-

Status information

Value	Description
1	**RUN** If • ENABLED = TRUE and • the assigned SAFEDRIVEFEEDBACK module is in error mode FB ADVPOSMON switches to the RUN state. The outputs assume the following values • Error = 0 • if POS_REF_OK = TRUE and POS_CHECK_OK = TRUE: Active = 1 • if POS_REF_OK = FALSE: Wait = 1 • if POS_REF_OK = TRUE and POS_CHECK_OK = FALSE: OverRange = 1
2	**STOP** If • FbRun = FALSE FB ADVPOSMON switches to the STOP state. The outputs assume the following values: • Error = 0 • Active = 0 • Wait = 0

Value	Description
	• OverRange = 0
3	**SAFE** If • ENABLED = FALSE and • the assigned SAFEDRIVEFEEDBACK module is in error mode FB ADVPOSMON switches to the SAFE state. The outputs assume the following values: • Error = 0 • Active = 0 • Wait = 0 • OverRange = 0
4	**ERROR** If • SDFB_ERROR = TRUE FB ADVPOSMON switches to the ERROR state and transmits the Diag message 0x38D1 to the Diag History. The outputs assume the following values: • Error = 1 • Active = 0 • Wait = 0 • OverRange = 0
5	**RESET** If in the ERROR state • ErrAck (of the Group) = TRUE and • the assigned SAFEDRIVEFEEDBACK module is in error mode FB ADVPOSMON switches to the RESET state. The outputs assume the following values: • Error = 0 • Active = 0 • Wait = 0 • OverRange = 0
6	**START** If in the WAIT-FOR-RESTART state • Restart = TRUE and • the assigned SAFEDRIVEFEEDBACK module is in error mode FB ADVPOSMON switches to the START state. The outputs assume the following values: • Error = 0 • Active = 0 • Wait = 0 • OverRange = 1
16	**WAIT-FOR-RESTART** If in the RUN state • OverRange = 1 and • RESTART_ACTIVE = TRUE and • the assigned SAFEDRIVEFEEDBACK module is in error mode

Value	Description
	FB ADVPOSMON switches to the WAIT-FOR-RESTART state. The outputs assume the following values: • Error = 0 • Active = 0 • Wait = 0 • OverRange = 1

4.31.3 Configuration in TwinCAT 3

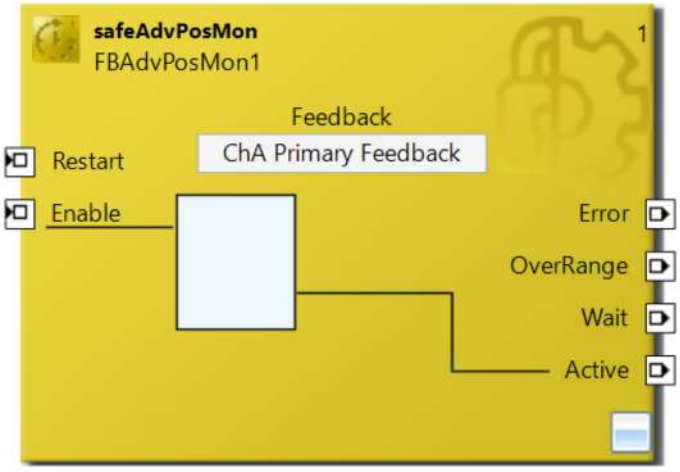

Fig. 165: Function block ADVPOSMON

In the function block view, you have the option of selecting the feedback. By clicking next to the FB port, you can create variables that can be linked to input or output signals.

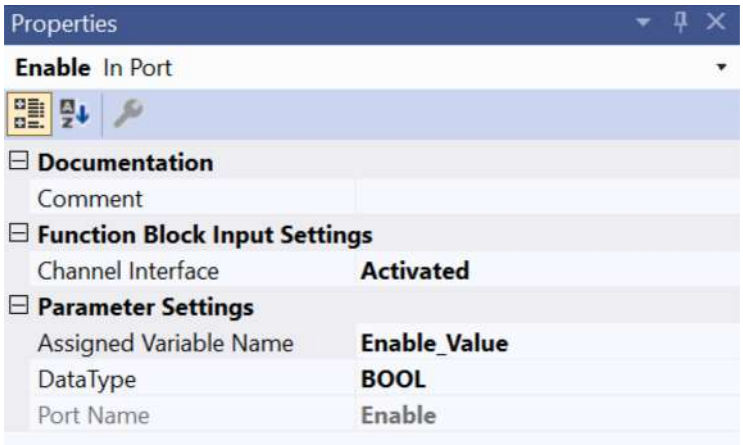

Fig. 166: Properties of the ports of the FB ADVPOSMON

Settings such as changing the data type or activation of the port can be made via the properties of the FB Port.

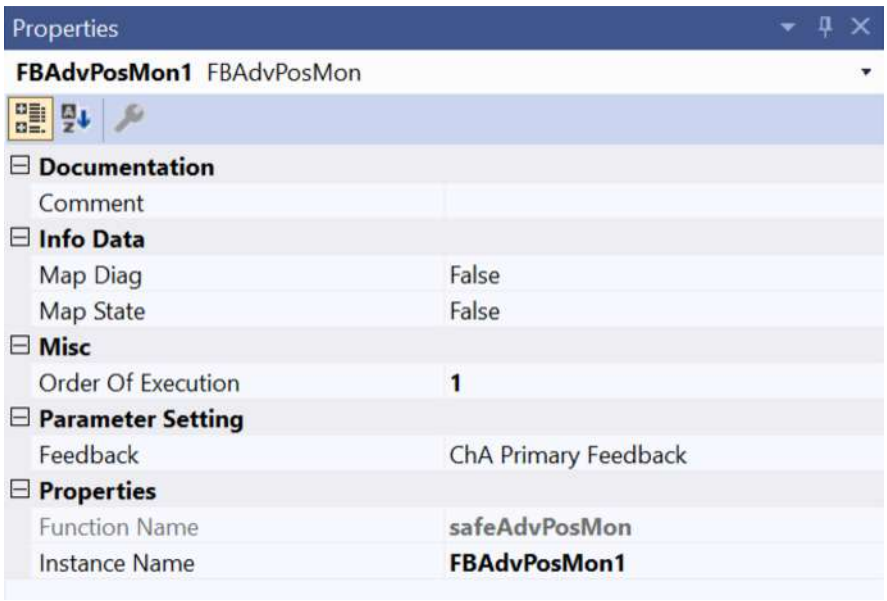

Fig. 167: Properties of the FB ADVPOSMON

The entries "Map Diag" and "Map State" in the properties window of the FB define which diagnostic functions of the FB are mapped in the cyclic process image. You can also choose the feedback in the parameter settings. Under "Misc", you can also select where the function block should be executed in the execution order.

It is possible to change the instance name in both views.

Further information on the parameters can be found in chapter Parameter.

4.32 The function block Envelope

4.32.1 Functional description

The FB Envelope is used to create an envelope from the amount of *InValue* plus the defined *Offset* and to check during each function block call cycle whether *InValue* violates this envelope. The input data types INT16, INT32, UINT16 and UINT32 are permitted for *InValue*. *Time after in Target* starts running when *InValue* reaches the range between -*TargetValue* and +*TargetValue*. The time is reset when *InValue* exits this range and the time has not yet elapsed and restarts if *InValue* enters the range again. If *InValue* remains within the range, the output *SafeFunctionOut* is set to FALSE when *Time after inTarget* has elapsed. The output *SafeFunctionOut* is set to FALSE once *MaxTime* has elapsed at the latest.

This function block can typically be used for SS1 or SS2 safety function, for example.

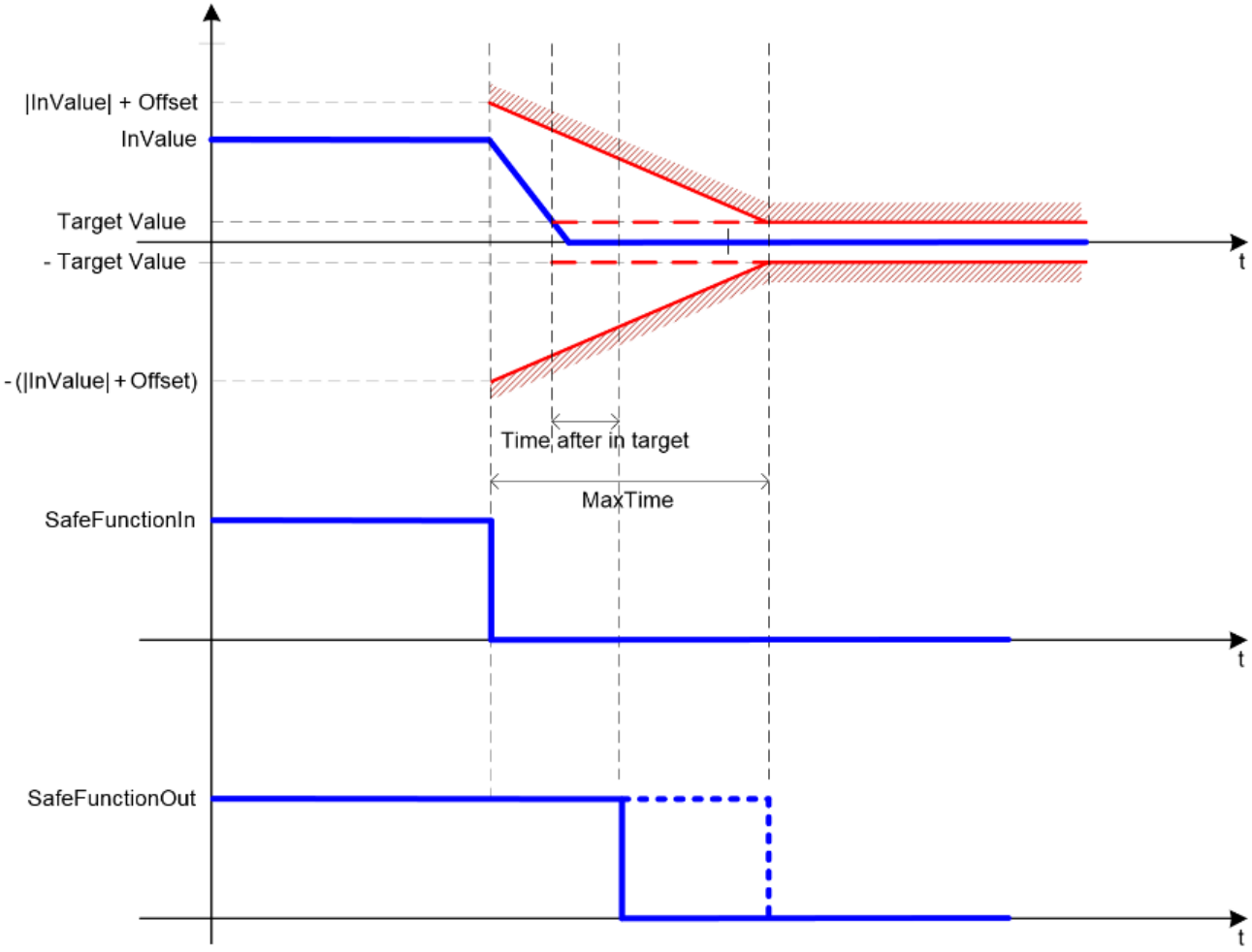

Fig. 168: Time curve of FB Envelope

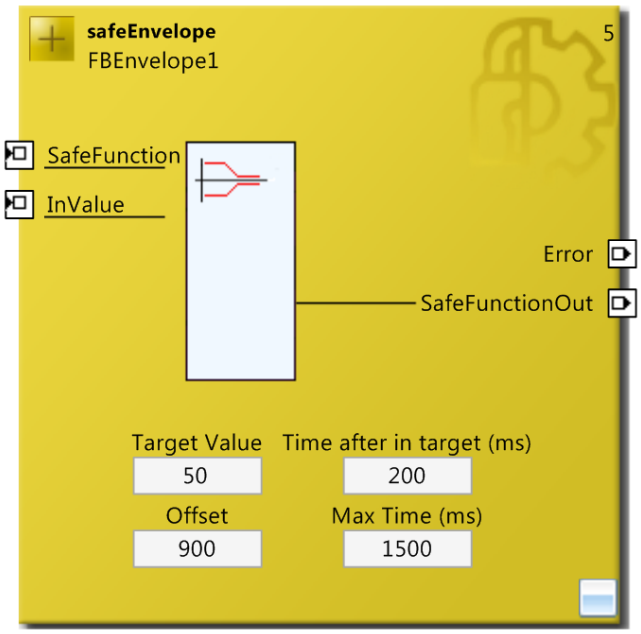

Fig. 169: Function block Envelope

NOTICE

KL6904/EL6900

The function block Envelope is not available in the KL6904 and the EL6900.

4.32.2 Signal description

FB Envelope inputs

Name	Permitted type	Data type	Description
SafeFunction	TwinSAFE-In FB-Out	BOOL	Input for the safety function.
InValue	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 UINT16 INT32 UINT32	Position or analog value to be monitored for deceleration or change in direction of 0 within an envelope curve.

FB Envelope outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	Error output (see diagnostic information)
SafeFunction Out	TwinSAFE-Out FB-In Standard-Out	BOOL	Output with the safety function (delayed and envelope-monitored)

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)

Type	Description
FB-In	TwinSAFE FB input
TwinSAFE SC	Input of a TwinSAFE connection (TwinSAFE SC technology)

FB Envelope parameters

Parameter	Description
Target Value	Target window of InValue, symmetrical around 0
Offset	Offset values, which is added to the amount of InValue and then forms the start point of the envelope as positive and negative value.
Time after in Target (ms)	Time after which the SafeFunctionOut output is switched off, if it is within the TargetValue.
Max Time (ms)	Maximum time, after which the SafeFunctionOut output is switched off.

Internal identifier of the FB

Type	Description
FB Envelope	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for the FB Envelope

Diagnostic information

Value	Description
0	No diagnostic information
1	Underflow (InValue below the envelope)
2	Overflow (InValue above the envelope)
3	InValue Error
4	MaxTimeExpired

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
0x40C8	InValueExpired AND InValue < 0	FB instance	InValue	MinAllowedValue
0x40C9	InValueExpired AND InValue > 0	FB instance	InValue	MaxAllowedValue
0x40CA	InValueError=TRUE	FB instance	InValue	-
0x40CB	MaxTimeExpired=TRUE	FB instance	InValue	-

Status information

Value	Description
1	**RUN** If the input SafeFunction = TRUE, FB Envelope assumes the RUN state. The outputs assume the following values: • Error = 0 • SafeFunctionOut = 1
2	**STOP** If the input FbRun = FALSE, FB Envelope assumes the STOP state. The outputs assume the following values: • Error = 0 • SafeFunctionOut = 0
3	**SAFE** If the input SafeFunction = FALSE, MaxTimeExpired = TRUE or TimeAfterInTargetExpired = TRUE, FB Envelope assumes the SAFE state. The outputs assume the following values:

Value	Description
	• Error = 0 • SafeFunctionOut = 0
4	**ERROR** If FB Envelope detects an error, FB Envelope switches to the ERROR state and sends the corresponding Diag message to the GROUP module. The outputs assume the following values: • Error = 1 • SafeFunctionOut = 0
5	**RESET** FB Envelope assumes the RESET state if no further error is pending after an error has occurred and the ErrAck input of the corresponding group is set to TRUE. The outputs assume the following values: • Error = 0 • SafeFunctionOut = 0
8	**DELAYOUT** If the input SafeFunction = FALSE, InValueInTarget = TRUE, TimeAfterInTargetExpired = TRUE, and MaxTimeExpired = FALSE, FB Envelope assumes the DELAYOUT state. The outputs assume the following values: • Error = 0 • SafeFunctionOut = 0
9	**MONITOR** If the input SafeFunction = FALSE, InValueInTarget = FALSE, and MaxTimeExpired = FALSE, the FB Envelope assumes the MONITOR state and monitors whether the InValue is still within the envelope (InValueExpired = FALSE). To do this, FB Envelope calculates the maximum permissible difference by first multiplying the InValueDec with the elapsed time since the transition to the MONITOR state. This intermediate result is subtracted from InValueLatch (InValue at the time of the state transition to the MONITOR state); the value must not be smaller than the TargetValue. If this difference is less than the amount of the current InValue, InValueExpired is set to TRUE. The outputs assume the following values: • Error = 0 • SafeFunctionOut = 1

4.32.3 Configuration in TwinCAT 3

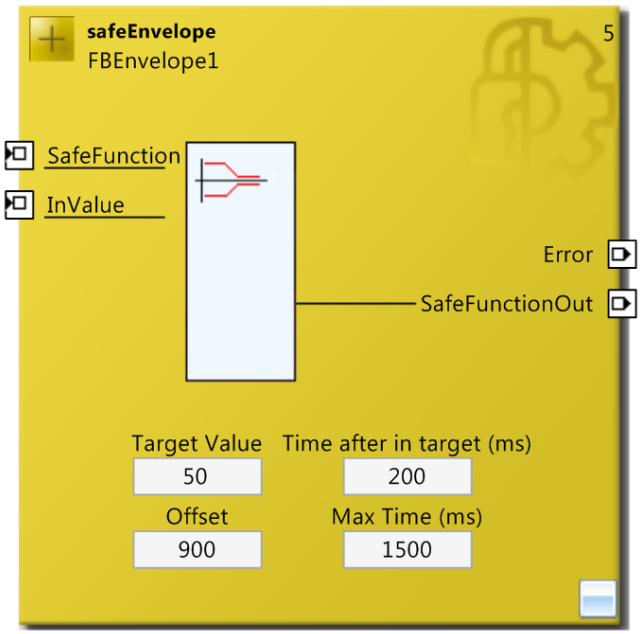

Fig. 170: FB Envelope configuration

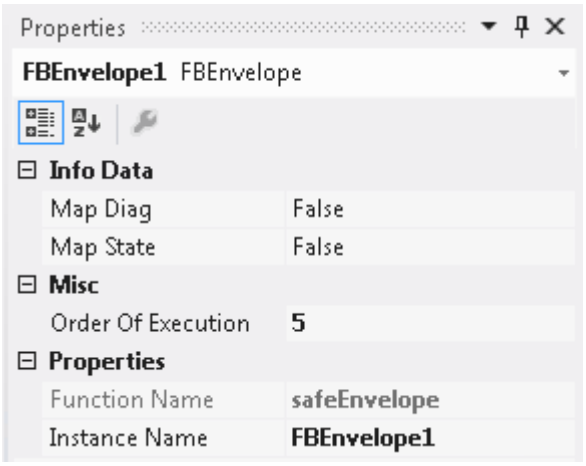

Fig. 171: FB Envelope properties

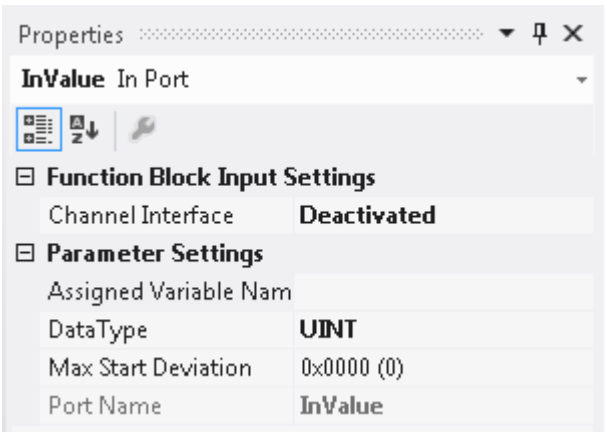

Fig. 172: FB Envelope port properties

A mouse click next to the FB Port can be used to create variables that can be linked with input or output signals. Settings such as changing the data type or activation of the input can be made via the properties of the FB port.

The *"Map State"* and *"Map Diag"* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

4.33 The function block ViolationCounter

4.33.1 Functional description

The FB ViolationCnt can be used to realize a weighted error counter. The counter is enabled (TRUE) or disabled (FALSE) via the *Enable* input. If the counter is disabled, the *InputOK* output is set to FALSE, *ActViolationCnt* is set to 0. If *Enable* is set to TRUE, *Input* is checked whenever the function block is called. If the input is TRUE (in case of negation of *Input*: FALSE), the error counter is decremented by the value *Decrement No Error;* if the input is FALSE (in case of negation of Input: TRUE), the error counter is incremented by *Increment Error*. *InputOK* is set to FALSE when the error counter reaches the *Counter Limit*.

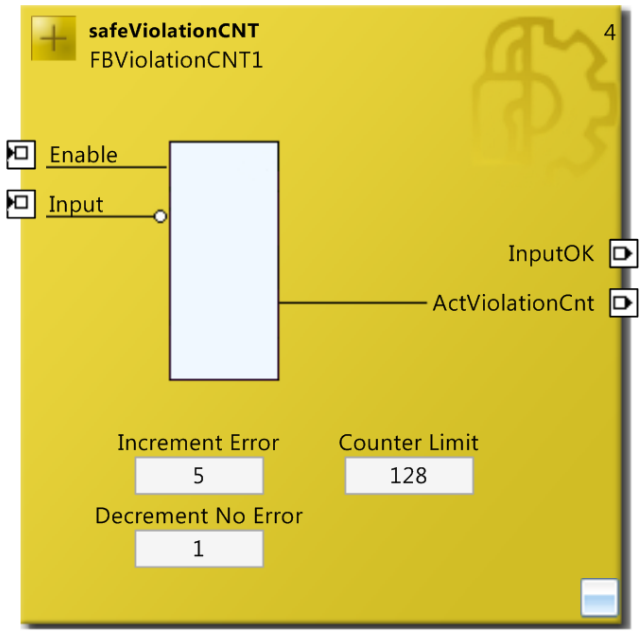

Fig. 173: Function block ViolationCnt

NOTICE

KL6904/EL6900

The function block ViolationCnt is not available in the KL6904 and the EL6900.

4.33.2 Signal description

FB ViolationCnt inputs

Name	Permitted type	Data type	Description
Input	TwinSAFE-In FB-Out Standard-In	BOOL	This value is checked whenever the function block is called. It ensures that the error counter is incremented or decremented. Input not negated: TRUE - counter is decremented FALSE - counter is incremented Input negated: TRUE - counter is incremented FALSE - counter is decremented
Enable	TwinSAFE-In FB-Out Standard-In	BOOL	Input for activating the function.

FB ViolationCnt outputs

Name	Permitted type	Data type	Description
InputOK	TwinSAFE-Out FB-In Standard-Out	BOOL	This output is set to TRUE if Enable is TRUE and the internal error counter is below the counter limit.
ActViolation Cnt	TwinSAFE-Out FB-In Standard-Out	UINT16 UINT32	Indicates the current internal counter value if the input Enable is TRUE, otherwise the output is set to 0.

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
TwinSAFE SC	Input of a TwinSAFE connection (TwinSAFE SC technology)

FB ViolationCnt parameters

Parameter	Description
Increment Error	Number by which the internal counter is incremented
Decrement No Error	Number by which the internal counter is decremented
Counter Limit	Limit for the internal counter. Above the limit, the output InputOK is set to FALSE.

Internal identifier of the FB

Type	Description
FB ViolationCnt	This description applies to BLG 1.0 (internal version number)

Diagnostic and status information for the FB ViolationCnt

Diagnostic information

Bit	Description
-	No diagnostic information

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
-	-	-	-	-

Status information

Value	Description
1	**RUN** If the input Enable = TRUE and LimitOverrun = FALSE, FB ViolationCNT assumes the RUN state and modifies the ActViolationCnt. The outputs assume the following values: • InputOK = 1 • ActViolationCnt = current value
2	**STOP** If the input FbRun = FALSE, FB ViolationCNT assumes the STOP state. The outputs assume the following values:

Value	Description
	• InputOK = 0 • ActViolationCnt = 0
3	**SAFE** If the input Enable = TRUE and LimitOverrun = TRUE, FB ViolationCNT assumes the SAFE state and modifies the ActViolationCnt. The outputs assume the following values: • InputOK = 0 • ActViolationCnt = current value
6	**START** If the input Enable = FALSE, FB ViolationCNT assumes the START state. The outputs assume the following values: • InputOK =0 • ActViolationCnt = 0

4.33.3 Configuration in TwinCAT 3

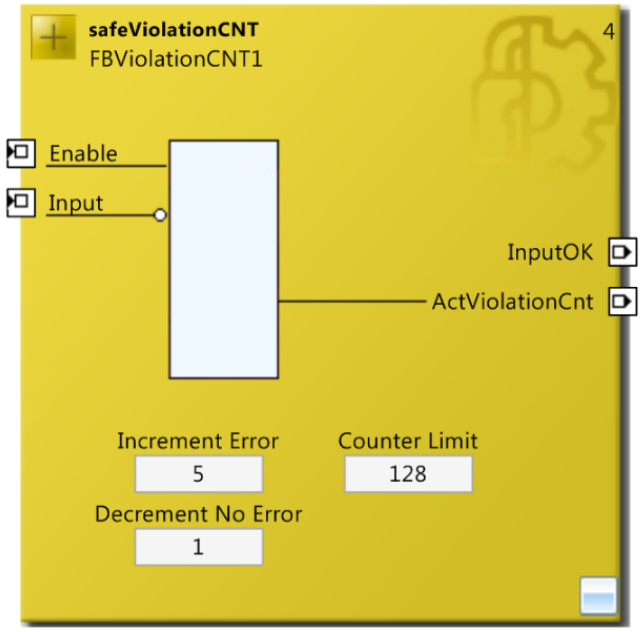

Fig. 174: FB ViolationCnt configuration

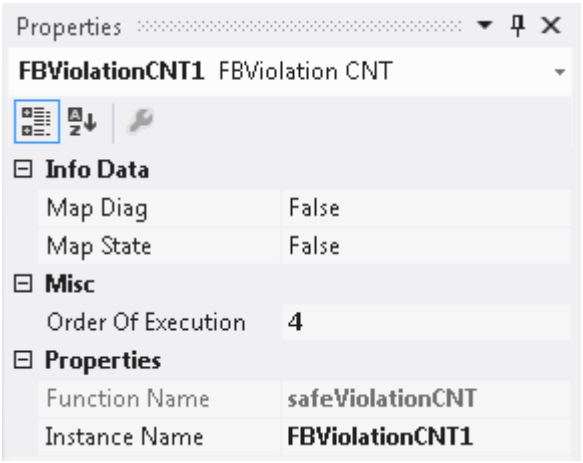

Fig. 175: FB ViolationCnt properties

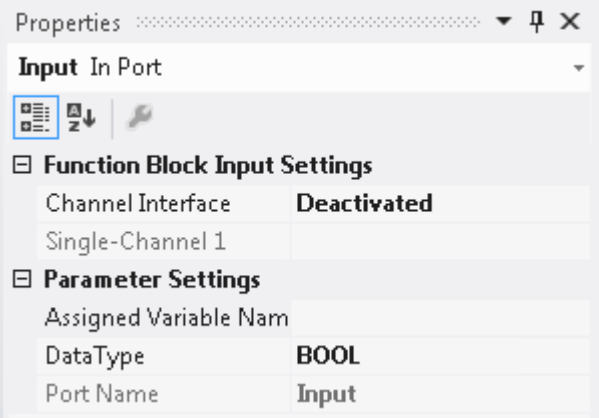

Fig. 176: FB ViolationCnt port properties

A mouse click next to the FB Port can be used to create variables that can be linked with input or output signals. Settings such as changing the data type or activation of the input can be made via the properties of the FB port.

The *"Map State"* and *"Map Diag"* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

4.34 The function block XOR

4.34.1 Functional description

The XOR function block provides the user with up to 8 XOR (exclusive or) functions (XOR1 to XOR8). Two inputs Xor1In(x) and 2 inputs Xor2In(x) are linked in *exclusive or* mode. The result is output at output XorOut(x).

NOTICE

Support

The function block XOR is not available in the KL6904, EL6900 and EL6910 (SW ≤ 03).

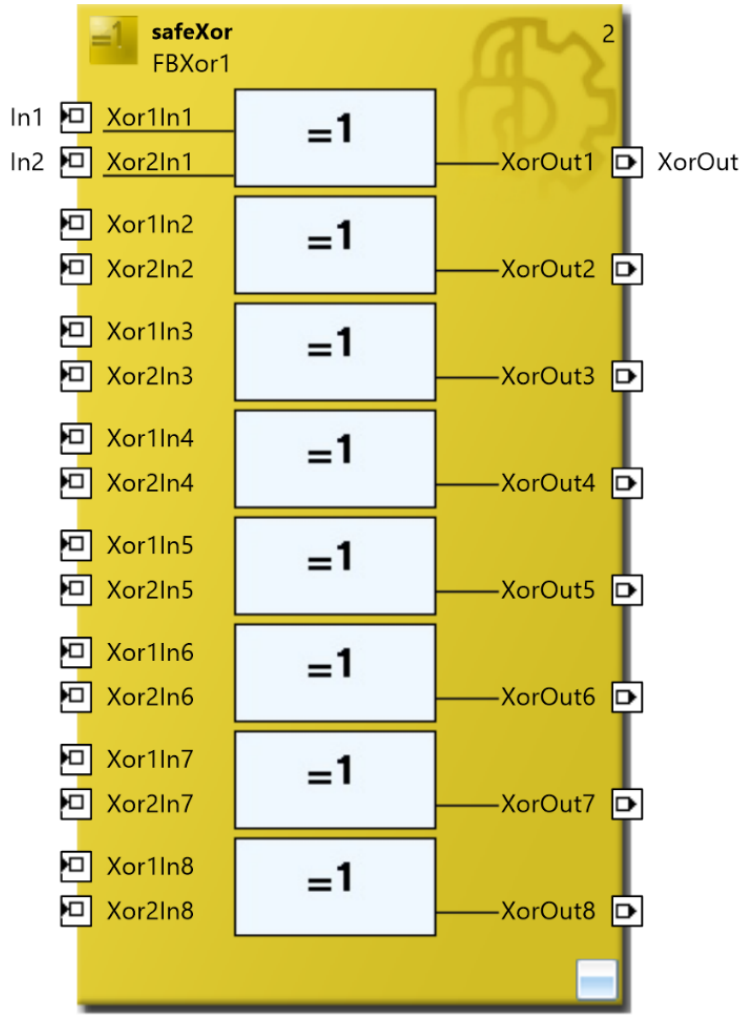

Fig. 177: Configuration of the XOR function block

4.34.2 Signal description

FB XOR inputs

Name	Permitted type	Data type	Description
Xor1In1	TwinSAFE-In FB-Out TwinSAFE SC	BOOL	Input1 of XOR1
Xor2In1	TwinSAFE-In FB-Out TwinSAFE SC	BOOL	Input2 of XOR1
Xor1In2	TwinSAFE-In FB-Out TwinSAFE SC	BOOL	Input1 of XOR2
Xor2In2	TwinSAFE-In FB-Out TwinSAFE SC	BOOL	Input2 of XOR2
Xor1In3	TwinSAFE-In FB-Out TwinSAFE SC	BOOL	Input1 of XOR3
Xor2In3	TwinSAFE-In FB-Out TwinSAFE SC	BOOL	Input2 of XOR3

Name	Permitted type	Data type	Description
Xor1In4	TwinSAFE-In FB-Out TwinSAFE SC	BOOL	Input1 of XOR4
Xor2In4	TwinSAFE-In FB-Out TwinSAFE SC	BOOL	Input2 of XOR4
Xor1In5	TwinSAFE-In FB-Out TwinSAFE SC	BOOL	Input1 of XOR5
Xor2In5	TwinSAFE-In FB-Out TwinSAFE SC	BOOL	Input2 of XOR5
Xor1In6	TwinSAFE-In FB-Out TwinSAFE SC	BOOL	Input1 of XOR6
Xor2In6	TwinSAFE-In FB-Out TwinSAFE SC	BOOL	Input2 of XOR6
Xor1In7	TwinSAFE-In FB-Out TwinSAFE SC	BOOL	Input1 of XOR7
Xor2In7	TwinSAFE-In FB-Out TwinSAFE SC	BOOL	Input2 of XOR7
Xor1In8	TwinSAFE-In FB-Out TwinSAFE SC	BOOL	Input1 of XOR8
Xor2In8	TwinSAFE-In FB-Out TwinSAFE SC	BOOL	Input2 of XOR8

FB XOR outputs

Name	Permitted type	Data type	Description
XorOut1	TwinSAFE-Out FB-In Standard-Out	BOOL	Output of XOR1
XorOut2	TwinSAFE-Out FB-In Standard-Out	BOOL	Output of XOR2
XorOut3	TwinSAFE-Out FB-In Standard-Out	BOOL	Output of XOR3
XorOut4	TwinSAFE-Out FB-In Standard-Out	BOOL	Output of XOR4
XorOut5	TwinSAFE-Out FB-In Standard-Out	BOOL	Output of XOR5
XorOut6	TwinSAFE-Out FB-In Standard-Out	BOOL	Output of XOR6
XorOut7	TwinSAFE-Out FB-In Standard-Out	BOOL	Output of XOR7

Name	Permitted type	Data type	Description
XorOut8	TwinSAFE-Out FB-In Standard-Out	BOOL	Output of XOR8

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
TwinSAFE SC	Input of a TwinSAFE connection (TwinSAFE SC technology)

Internal identifier of the FB

Type	Description
FB XOR	This description applies to BLG 1.0 / BLG 2.0 (internal version number)

Diagnostic and status information for FB XOR

Diagnostic information

Bit	Description
-	No diagnostic information

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
-	-	-	-	-

Status information

Value	Description
1	**RUN** If the input FbRun = TRUE, FB XOR assumes the RUN state. The outputs assume the following values depending on the active input pairs (configuration: FB Input Active): • XorOutY = (Xor1InY XOR Xor2InY) AND FB Input Active(Y) with Y = {1,2 .. 8}
2	**STOP** If the input FbRun = FALSE, FB XOR assumes the STOP state. The outputs assume the following values: • XorOutY = 0 with Y = {1,2 .. 8}

4.34.3 Configuration in TwinCAT 3

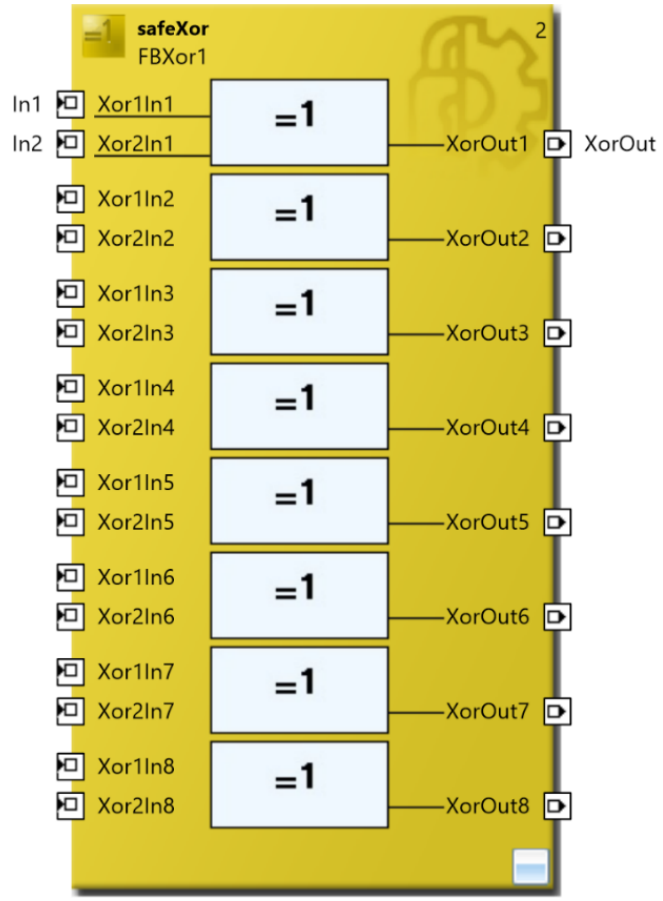

Fig. 178: FB XOR configuration

A mouse click next to the respective FB Port can be used to create variables that can be linked to input or output signals. The properties of the FB Port can be used for settings such as port activation.

The *"Map State"* and *"Map Diag"* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

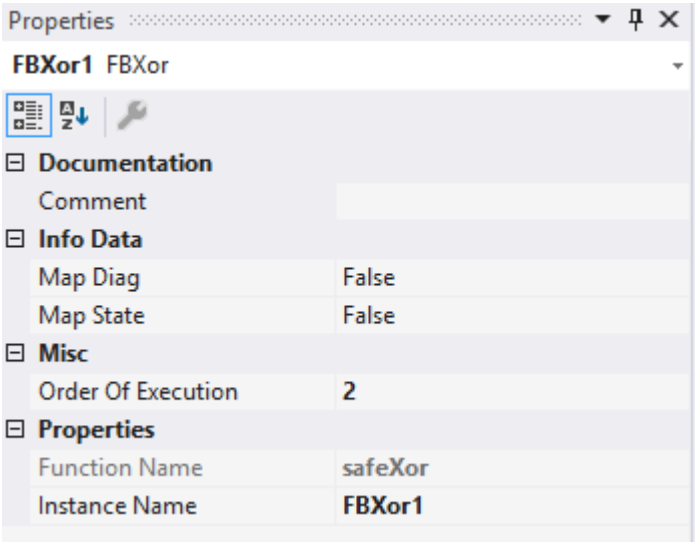

Fig. 179: Properties of the FB XOR

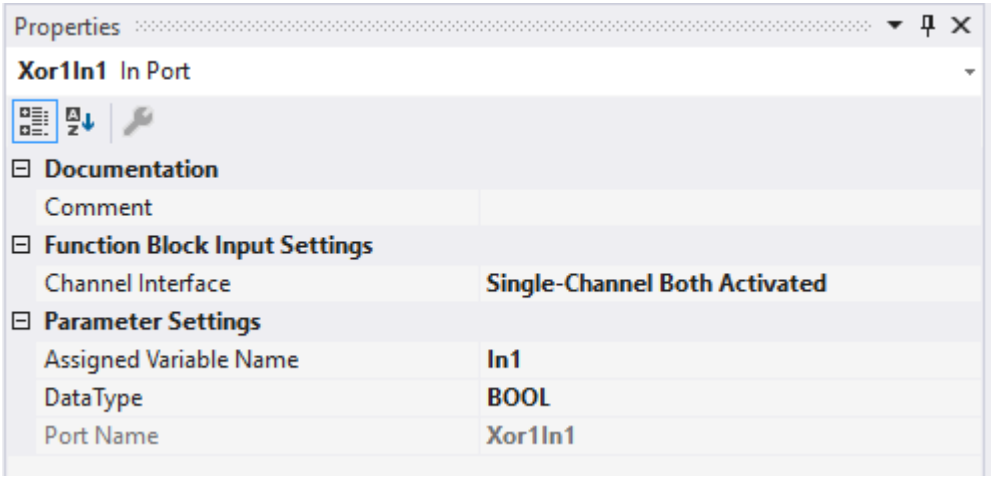

Fig. 180: Port properties of the FB XOR

4.35 The function block safeCAM

4.35.1 Functional description

FB safeCAM is used to implement a cam controller.

NOTICE

Support

The safeCAM function block is available in EJ6910-0001 (firmware 00 (V00.22)). The behavior described here only applies to this version.

Fig. 181: The safeCAM function block

4.35.2 Signal description

FB safeCAM inputs

Name	Permitted type	Data type	Description
AnalogIn	TwinSAFE-In, FB-Out	UDINT, UINT, DINT, INT	Analog input for CAM table

FB safeCAM outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	Error output The error output is set to "TRUE" in the event of an error and can be used in the further logic.
State	TwinSAFE-Out FB-In Standard-Out	BOOL	FB state • STOP • SAFE • RUN • ANALOGIN_EXCEEDED (No CAM active is set)
CAM 01	TwinSAFE-Out FB-In Standard-Out	BOOL	CAM 01 area active

Name	Permitted type	Data type	Description
CAM 02	TwinSAFE-Out FB-In Standard-Out	BOOL	CAM 02 area active
CAM 03	TwinSAFE-Out FB-In Standard-Out	BOOL	CAM 03 area active
CAM 04	TwinSAFE-Out FB-In Standard-Out	BOOL	CAM 04 area active
CAM 05	TwinSAFE-Out FB-In Standard-Out	BOOL	CAM 05 area active
CAM 06	TwinSAFE-Out FB-In Standard-Out	BOOL	CAM 06 area active
CAM 07	TwinSAFE-Out FB-In Standard-Out	BOOL	CAM 07 area active
CAM 08	TwinSAFE-Out FB-In Standard-Out	BOOL	CAM 08 area active
CAM 09	TwinSAFE-Out FB-In Standard-Out	BOOL	CAM 09 area active
CAM 10	TwinSAFE-Out FB-In Standard-Out	BOOL	CAM 10 area active
CAM 11	TwinSAFE-Out FB-In Standard-Out	BOOL	CAM 11 area active
CAM 12	TwinSAFE-Out FB-In Standard-Out	BOOL	CAM 12 area active

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
TwinSAFE SC	Input of a TwinSAFE connection (TwinSAFE SC technology)

Configuration parameters of the FB safeCAM

Parameter	Description
Port active	If an output port on the function block is used in the application, the value is set to active in the configuration parameters (0-inactive, 1-active). When the FB is started, the configuration parameters and the function parameters are checked. In this case, the system checks whether the number of active output ports is ≥ the number of active cams and the position matches the number of the entry in the table (see function parameters).

Function parameters of the FB safeCAM

Parameter	Description
CAM table	12-row table with MinValueOn, MinValueOff, MaxValueOn, MaxValueOff, MinValueOnActive, MaxValueOnActive, CAM-Active (0-inactive, 1-active) The MinValueOnActive and MaxValueOnActive parameters can be used to set a direction-related behavior for the cams.
Max AnalogIn Value	Maximum expected AnalogIn value for checking the plausibility of the analog value
Min AnalogIn Value	Minimum expected AnalogIn value for checking the plausibility of the analog value
Endless Rotation AnalogIn Value	The analog value has an overflow and the maximum value is close to the minimum value. e.g. endless rotation

Diagnostic and status information of the FB safeCAM

Diagnostic information

Bit	Description
-	No diagnostic information

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
-	-	-	-	-

Status information

Value	Description
1	**RUN** The CAM table is checked in the RUN state. In the RUN state, the outputs assume the following values: • Error = FALSE • CAM01..CAM12 = Cam[n] • NoCamActive = TRUE (if all Cam[n] = FALSE, otherwise NoCamActive = FALSE)
2	**STOP** In the STOP state, the associated GROUP has not yet started up (FbRun = FALSE). In the STOP state, the outputs assume the following values: • Error = FALSE • Cam01..Cam12 = FALSE • NoCamActive = FALSE
3	**SAFE** In the SAFE state, the FB parameters are incorrect (bTableConfigOk = FALSE). In the SAFE state, the outputs assume the following values: • Error = FALSE • CAM01..CAM12 = FALSE • NoCamActive = FALSE
16	**ANALOGIN_EXCEEDED** In the ANALOGIN_EXCEEDED state, AnalogIn has exceeded the limits (bExceeded = TRUE). The outputs assume the following values: • Error = FALSE • CAM01..CAM12 = FALSE • NoCamActive = TRUE

4.35.3 Configuration in TwinCAT 3

Fig. 182: FB safeCam configuration

A table can be created within the function block, which consists of 12 lines and therefore 12 areas. A MinimalOn, MinimalOff, MaximalOn and a MaximalOff value are specified in each line, as well as the binary information as to whether the line is active or inactive. The default value is 0 and therefore inactive.

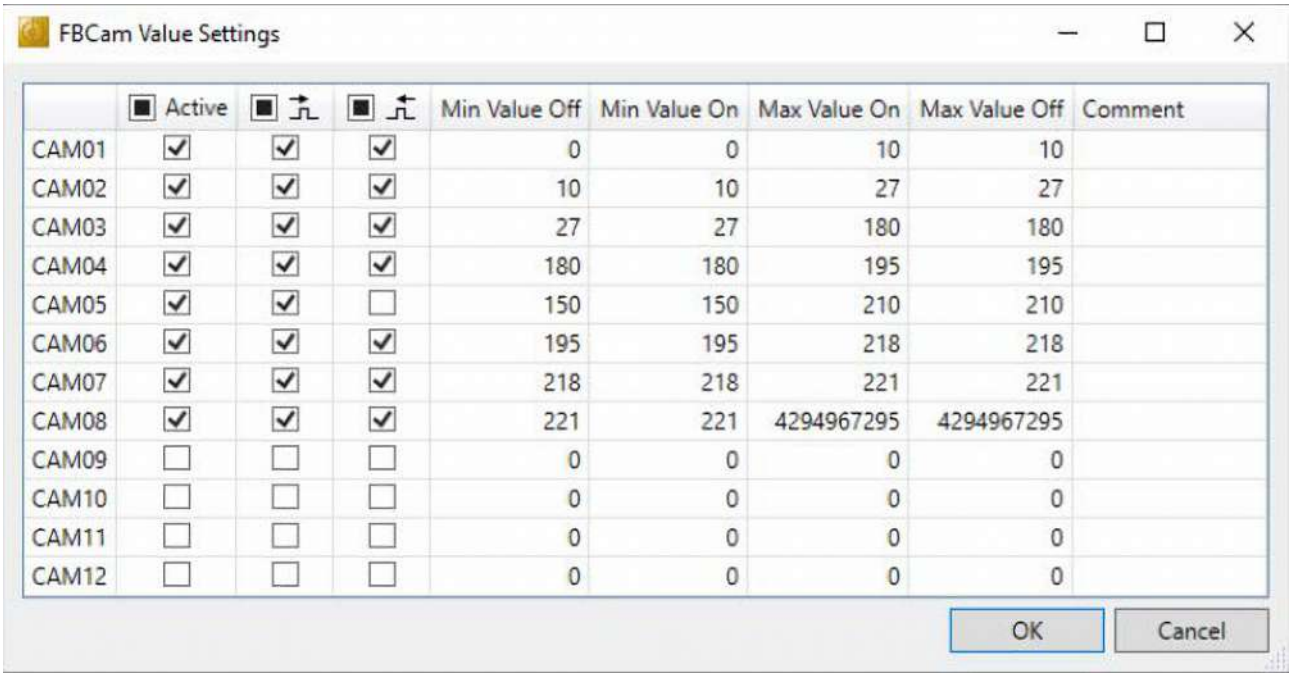

Fig. 183: FB safeCam settings

By specifying the on and off values, the customer can set a separate hysteresis for each range. The module checks the plausibility of the limit values. The minimum on value must be greater than the minimum off value and the maximum on value must be less than the maximum off value. The two minimum values must be less than or equal to the two maximum values.

The ranges of the different cams may also overlap.

If the AnalogIn input is in one of the defined ranges, the digital output associated with the range is set. If none of the defined ranges is active, the "No CAM active" output is set.

The columns 2 (MinValueOnActive) and 3 (MaxValueOnActive) of the table specify whether the cam is to be evaluated based on direction. If only MinValueOnActive is set, the MaxValueOn value of the table is ignored and only MaxValueOff is active, together with MinValueOn and MinValueOff. If only MaxValueOnActive is set, the MinValueOn value of the table is ignored and only MinValueOff is active, together with MaxValueOn and MaxValueOff.

The parameters Min. AnalogIn Value and Max. AnalogIn Value are specified to check the plausibility of the AnalogIn value.

4.36 The function block safeLookUpTable

4.36.1 Functional description

The FB safeLookUpTable is used to implement eight LookUp tables in one function block.

NOTICE

Support

The safeLookUpTable function block is available in EJ6910-0001 (firmware 00 (V00.22)). The behavior described here only applies to this version.

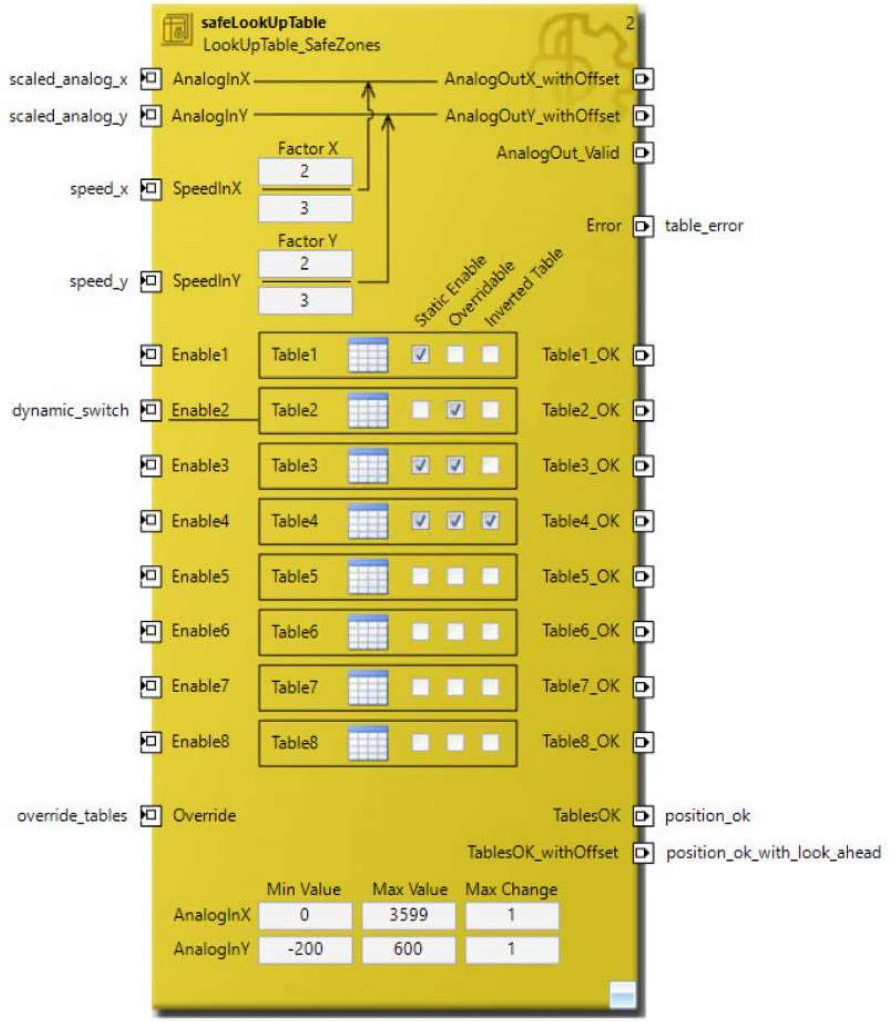

Fig. 184: The function block safeLookUpTable

4.36.2 Signal description

Inputs of the FB safeLookUpTable

Name	Permitted type	Data type	Description
AnalogIn X	TwinSAFE-In FB-Out	DINT, INT, UDINT, UINT	Analog input for the X position
AnalogIn Y	TwinSAFE-In FB-Out	DINT, INT, UDINT, UINT	Analog input for the Y position
Speed X	TwinSAFE-In FB-Out	DINT, INT, UDINT, UINT	Speed value in the X direction
Speed Y	TwinSAFE-In FB-Out	DINT, INT, UDINT, UINT	Speed value in the Y direction
Enable 1	TwinSAFE-In FB-Out	BOOL	Enabling table 1

Name	Permitted type	Data type	Description
Enable 2	TwinSAFE-In FB-Out	BOOL	Enabling table 2
Enable 3	TwinSAFE-In FB-Out	BOOL	Enabling table 3
Enable 4	TwinSAFE-In FB-Out	BOOL	Enabling table 4
Enable 5	TwinSAFE-In FB-Out	BOOL	Enabling table 5
Enable 6	TwinSAFE-In FB-Out	BOOL	Enabling table 6
Enable 7	TwinSAFE-In FB-Out	BOOL	Enabling table 7
Enable 8	TwinSAFE-In FB-Out	BOOL	Enabling table 8
Override	TwinSAFE-In FB-Out	BOOL	Override input with which all tables marked as "overrideable" are set as fulfilled/valid

Outputs of the FB safeLookUpTable

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	Error output of the function block
Status	TwinSAFE-Out FB-In Standard-Out	BOOL	Status output of the function block
AnalogOut X with Offset	TwinSAFE-Out FB-In Standard-Out	BOOL	Analog output for the X position including speed-dependent offset
AnalogOut Y with Offset	TwinSAFE-Out FB-In Standard-Out	BOOL	Analog output for the Y position including speed-dependent offset
AnalogOut Valid	TwinSAFE-Out FB-In Standard-Out	BOOL	Status of the analog outputs
Table1 OK	TwinSAFE-Out FB-In Standard-Out	BOOL	current state at the current X position for table 1
Table2 OK	TwinSAFE-Out FB-In Standard-Out	BOOL	current state at the current X position for table 2
Table3 OK	TwinSAFE-Out FB-In Standard-Out	BOOL	current state at the current X position for table 3
Table4 OK	TwinSAFE-Out FB-In Standard-Out	BOOL	current state at the current X position for table 4
Table5 OK	TwinSAFE-Out FB-In Standard-Out	BOOL	current state at the current X position for table 5
Table6 OK	TwinSAFE-Out FB-In Standard-Out	BOOL	current state at the current X position for table 6
Table7 OK	TwinSAFE-Out FB-In Standard-Out	BOOL	current state at the current X position for table 7

Name	Permitted type	Data type	Description
Table8 OK	TwinSAFE-Out FB-In Standard-Out	BOOL	current state at the current X position for table 8
Enabled Tables OK	TwinSAFE-Out FB-In Standard-Out	BOOL	Output if all enabled tables are in the permitted range.
Enabled Tables with Offset OK	TwinSAFE-Out FB-In Standard-Out	BOOL	Output if all enabled tables including the offsets are within the permitted range.

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
TwinSAFE SC	Input of a TwinSAFE connection (TwinSAFE SC technology)

Parameters of the FB safeLookUpTable

Parameter	Description
Table 1-8	1-row table with 1024 columns + "Enable" information
Factor - Multiplier	Multiplier of the factor X, which is multiplied by the speed X and thus forms the position offset for AnalogIn X.
Factor X - Divisor	Divisor of the factor X, which is divided by the speed X and thus forms the position offset for AnalogIn X.
Factor X Setting	DivBeforeMul and DivisionRounding are selected as FB properties by the user.
Maximal Offset X	Maximum offset that can be added to the AnalogInX value. This must be limited, as otherwise several rotations may be accepted unintentionally with Endless Rotation Analog X = TRUE. The maximum offset must be less than or equal to 1/3 of the maximum values of the X position.
Factor Y - Multiplier	Multiplier of the factor Y, which is multiplied by the speed Y and thus forms the position offset for AnalogIn Y.
Factor Y - Divisor	Divisor of the factor Y, which is divided by the speed Y and thus forms the position offset for AnalogIn Y.
Factor Y Setting	DivBeforeMul and DivisionRounding are selected as FB properties by the user.
Maximal Offset Y	Maximum offset that can be added to the AnalogIn Y value. This must be limited, as otherwise several rotations may be accepted unintentionally with Endless Rotation Analog Y = TRUE. The maximum offset must be less than or equal to 1/3 of the maximum values of the Y position.
Static enable (table 1-8)	The corresponding table can be permanently enabled via the checkbox.
Overrideable (table 1-8)	The checkbox is used to specify whether this table should be set to valid if an override input is set.
Inverted tables	The checkbox is used to specify that the range above the y value leads to a TablesOk = FALSE and below to a TablesOK = TRUE.

Parameter	Description
(table 1-8)	
MaxTableCount X (table 1-8)	Number of table columns used in tables 1 to 8.
Min. analogIn X value	Minimum value of the AnalogIn X input to determine the overflow or check the value range.
Max. AnalogIn X value	Minimum value of the AnalogIn X input to determine the overflow or check the value range.
Endless Rotation Analog X	The analog value X has an overflow and the maximum value is close to the minimum value. e.g. endless rotation.
Min. AnalogIn Y value	Minimum value of the AnalogIn Y input to determine the overflow or check the value range.
Max. AnalogIn Y value	Maximum value of the AnalogIn Y input for determining the overflow or checking the value range.
Endless Rotation Analog Y	The analog value Y has an overflow and the maximum value is close to the minimum value. e.g. endless rotation.

Diagnostic and status information for the FB safeLookUpTable

Diagnostic information

Bit	Description
-	No diagnostic information

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
-	-	-	-	-

Status information

Value	Description
1	**RUN** In the RUN state, all table comparisons are error-free (bCheckOk = TRUE). In the RUN state, the digital outputs assume the following values: • Error = FALSE • TablesOK = TRUE • TablesOK_WithOffset = bCheckOkWithOffset • AnalogOutX_Valid = NOT bAnalogOutXNotValid • AnalogOutY_Valid = NOT bAnalogOutYNotValid • TablesOK[n] = TablesOK AND bEnableCheck[n] In the RUN state, the analog outputs assume the following values: • AnalogOutXwithOffset = AnalogOutX • AnalogOutYwithOffset = AnalogOutY
2	**STOP** In the STOP state, the associated GROUP has not yet started up (FbRun = FALSE). In the STOP state, the digital outputs assume the following values: • Error = FALSE • TablesOK = FALSE • TablesOK_WithOffset = FALSE

Value	Description
	• AnalogOutX_Valid = FALSE • AnalogOutY_Valid = FALSE • TablesOK[n] = FALSE In the STOP state, the analog outputs assume the following values: • AnalogOutXwithOffset = 0 • AnalogOutYwithOffset = 0
3	**SAFE** In the SAFE state, the configuration of the tables is incorrect (bTableConfigOk = FALSE) or the comparison has failed for at least one table (bCheckOk = FALSE). In the SAFE state, the outputs assume the following values: • Error = FALSE • TablesOK = FALSE • TablesOK_WithOffset = FALSE • AnalogOutX_Valid = NOT bAnalogOutXNotValid • AnalogOutY_Valid = NOT bAnalogOutYNotValid • TablesOK[n] = TableCheckOk[n] In the SAFE state, the analog outputs assume the following values: • AnalogOutXwithOffset = 0 • AnalogOutYwithOffset = 0
14	**ANALOGIN_EXCEEDED_X** In the ANALOG_EXCEEDED_X state, AnalogInX has exceeded the corresponding range (bExceededX = TRUE). The outputs assume the following values: • Error = TRUE • TablesOK = FALSE • TablesOK_WithOffset = FALSE • AnalogOutX_Valid = FALSE • AnalogOutY_Valid = FALSE • TablesOK[n] = FALSE In the ANALOG_EXCEEDED_X state, the analog outputs assume the following values: • AnalogOutXwithOffset = AnalogOutX • AnalogOutYwithOffset = AnalogOutY
15	**ANALOGIN_EXCEEDED_Y** In the ANALOG_EXCEEDED_Y state, AnalogInY has exceeded the corresponding range (bExceededY = TRUE). The outputs assume the following values: • Error = TRUE • TablesOK = FALSE • TablesOK_WithOffset = FALSE • AnalogOutX_Valid = FALSE • AnalogOutY_Valid = FALSE • TablesOK[n] = FALSE In the ANALOG_EXCEEDED_Y s state, the analog outputs assume the following values: • AnalogOutXwithOffset = AnalogOutX • AnalogOutYwithOffset = AnalogOutY

4.36.3 Configuration in TwinCAT 3

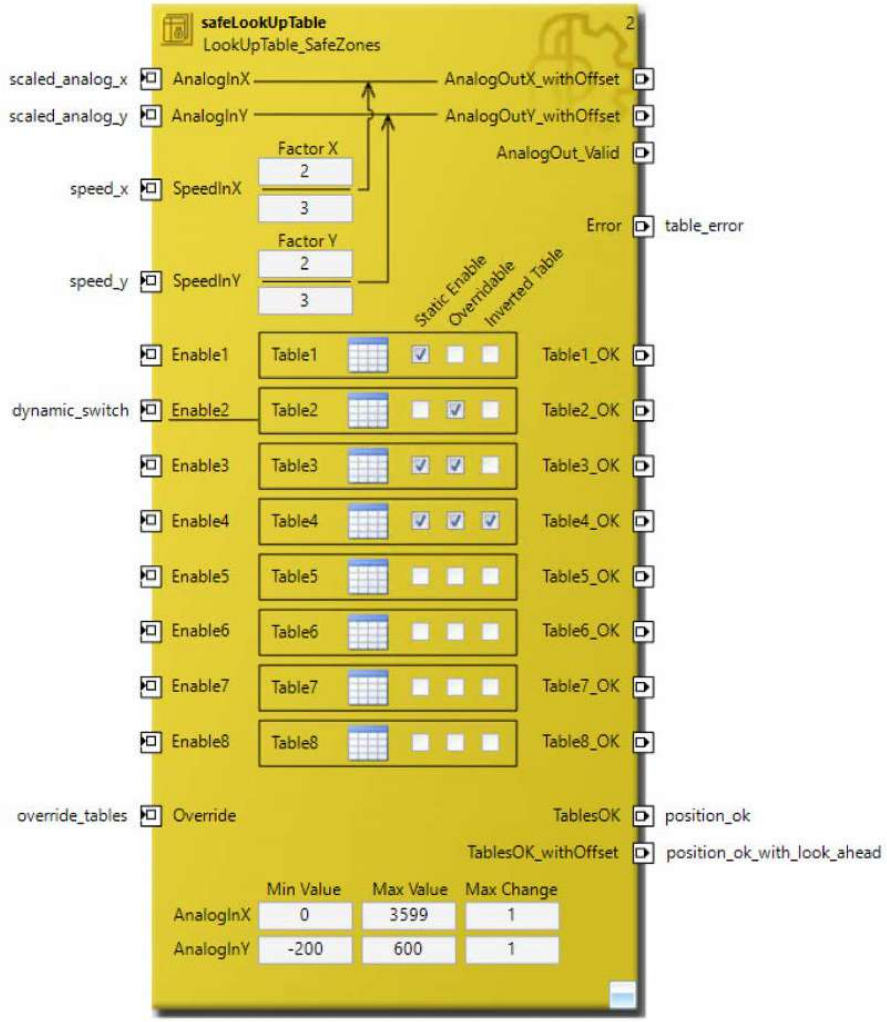

Fig. 185: FB safeLookUpTable configuration

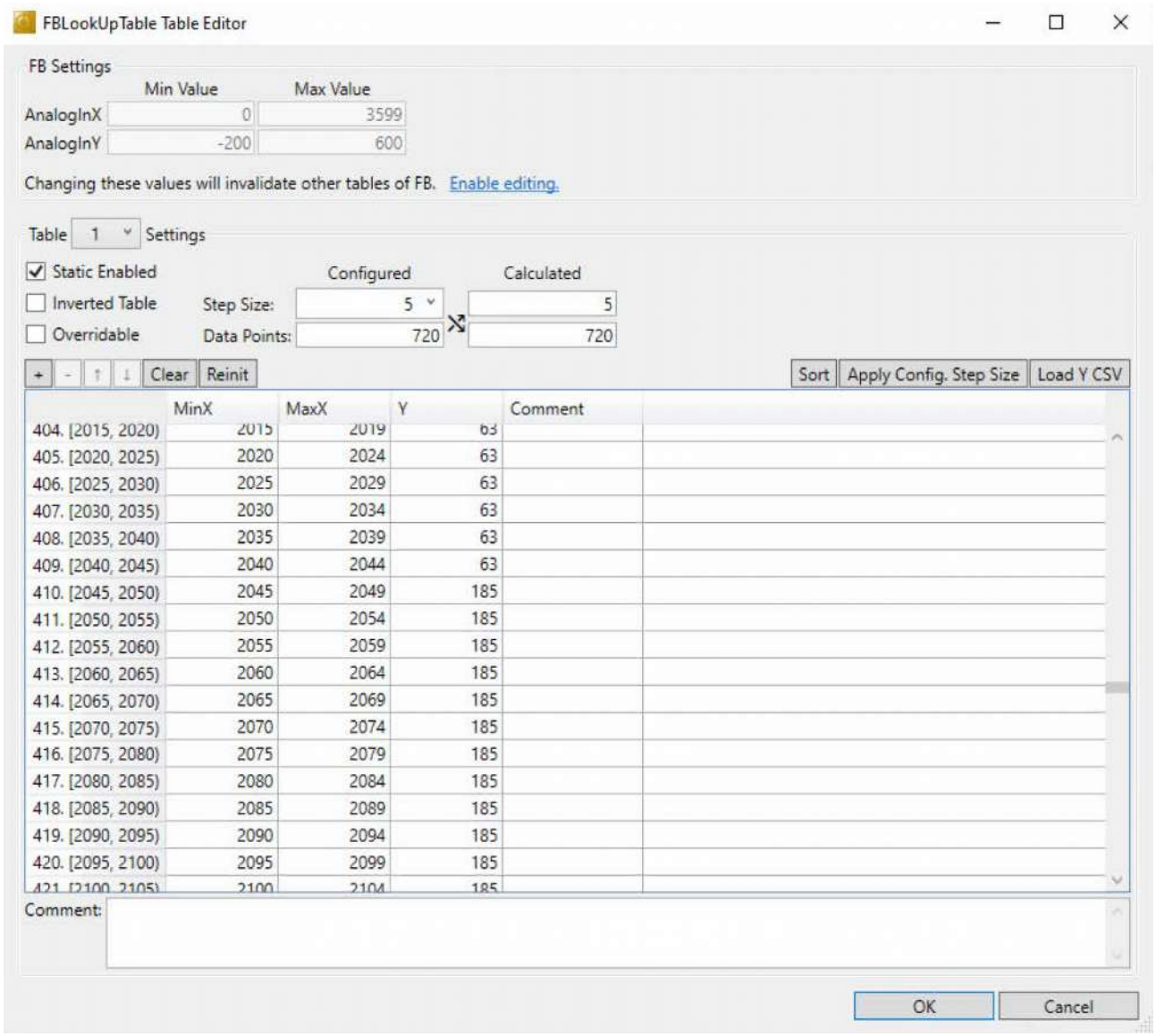

Fig. 186: FB safeLookUpTable table settings

Within the module, the individual tables each consist of one row (Y position) with up to 1024 columns (X position).

The X-position describes interpolation points to which a limit value of the Y-position is assigned. If the current Y-position at the current X-position is less than or equal to the entered limit value, the table outputs the value FALSE. If the current Y position is greater than the limit value, the table is TRUE.

This logic can be inverted for each table using the "Inverted tables" parameter. This means that if the current Y position at the current X position is less than or equal to the entered limit value, the table outputs the value TRUE and otherwise FALSE.

To ensure that there is no need to specify a Y position at certain X values, there should be information for each grid point in the data record of the table as to whether the limit value should be evaluated (enabled) or not (disabled).

All table outputs are logically linked with each other "And" and output on the TablesOK output. The output TablesOK_withOffset is an additional output with the same function as TablesOK, whereby the positions are assigned the speed-dependent offset.

Rapid changes in the analog values for the X position and the Y position can mean that feedforward control or shifting of the interpolation points is necessary to compensate for system reaction times. There are speed inputs for this purpose, which can be used with a factor to determine a position offset. The current position plus the calculated position offset corresponds to the assumed current position after the system dead time.

A minimum value and a maximum value are specified for the X position (analog input). If the permissible ranges are exceeded, the module reports "Error". "Error" is a safe output of the function block and must be evaluated in the application. There is no direct influence on the group error.

The number of interpolation values used must be specified for each table. The value range of the X position is divided evenly between the number of interpolation points used. The step width is specified for each table and must be selected by the user so that it matches the set value range of the table without a remainder. This is checked by the firmware when the function block is started. If the condition is not met, the function block remains in the "SAFE" state.

A minimum value and a maximum value are also specified for the Y position (analog input). If the permissible ranges are exceeded, the function block reports "Error". "Error" is a safe output of the function block and must be evaluated in the application. There is also no direct influence on the group error here.

The maximum values that the position offsets can reach are limited with the parameters Maximum offset X and Maximum offset Y so that the position offsets are less than or equal to 1/3 of the maximum values of the X position and Y position. This is checked by the firmware when the function block is started. If the condition is not met, the function block remains in the "SAFE" state.

Tables can be activated statically via the "static enable" parameter or dynamically via the enable input signal.

The override operating mode is activated via the override input signal. Table outputs that have been provided with the overrideable flag are deactivated with regard to the effect on the TablesOK. This is achieved by setting the corresponding table outputs to TRUE. The override input signal has no effect on the corresponding TablesOK digital outputs (Tables1OK to Tables8OK).

4.37 The function block safeSequence

4.37.1 Functional description

The FB safeSequence supports 4 operation modes.

1. Checking a sequence
2. Two-hand function
3. Save button actuation persistently
4. Do not save button actuation persistently

The respective operation mode can be set in the properties of the FB.

NOTICE

Support

The safeSequence function block is available in EJ6910-0001 (firmware 00 (V00.22)). The behavior described here only applies to this version.

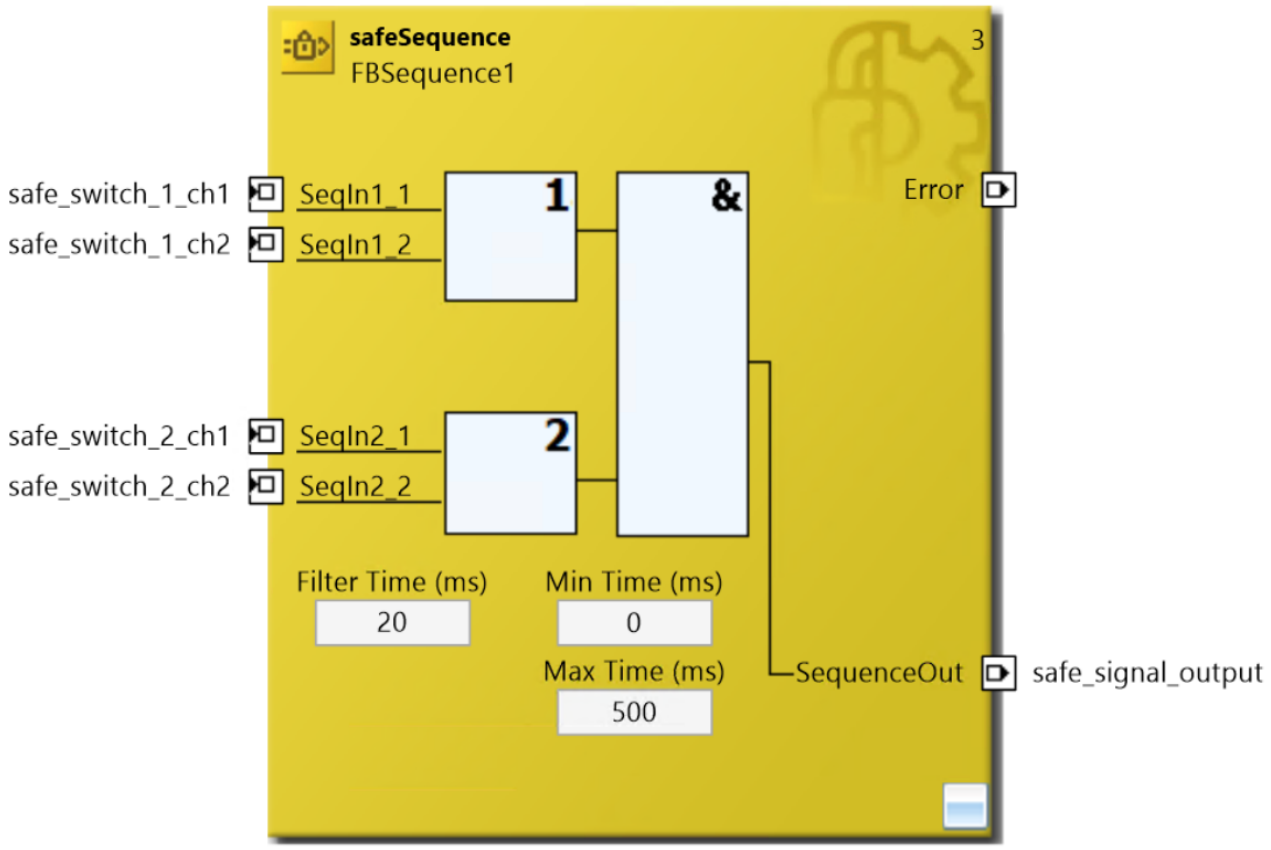

Fig. 187: The safeSequence function block

4.37.2 Signal description

Inputs of the FB safeSequence

Name	Permitted type	Data type	Description
SeqIn1_1	TwinSAFE-In FB-Out	BOOL	Input 1 channel 1
SeqIn1_2	TwinSAFE-In FB-Out	BOOL	Input 1 channel 2
SeqIn2_1	TwinSAFE-In FB-Out	BOOL	Input 2 channel 1
SeqIn2_2	TwinSAFE-In FB-Out	BOOL	Input 2 channel 2

Outputs of the FB safeSequence

Name	Permitted type	Data type	Description
SequenceOut	TwinSAFE-Out FB-In	BOOL	Switching output of the FB
Error	TwinSAFE-Out FB-In	BOOL	Error output
Status	TwinSAFE-Out FB-In	BOOL	Status information of the function block

Input and output types

Type	Description
TwinSAFE-In	TwinSAFE input, e.g. an EL1904/KL1904
Standard-In	Standard PLC variable (output in the PLC %Q*)

Type	Description
FB-Out	TwinSAFE FB output
TwinSAFE-Out	TwinSAFE output, e.g. an EL2904/KL2904
Standard-Out	Standard PLC variable (input in the PLC %I*)
FB-In	TwinSAFE FB input
TwinSAFE SC	Input of a TwinSAFE connection (TwinSAFE SC technology)

Parameters of the FB safeSequence

Parameter	Description
Operation mode	Selection of one of the 4 operation modes. 1. Sequence 2. TwoHand 3. Save button actuation 4. Do not save button actuation
Filter	Filter time of the input signals at the inputs in ms (base time 1 ms). A time of 0 ms means that the filter time is disabled. The maximum value for the filter time is 500 ms.
Discrepancy time SeqIn1	If SeqIn1 is designed as a 2-channel input, a discrepancy time between the two input signals can be parameterized. A time of 0 ms means that the discrepancy time SeqIn1 is disabled. The maximum value for the discrepancy time is 2500 ms.
Discrepancy time SeqIn2	If SeqIn2 is designed as a 2-channel input, a discrepancy time between the two input signals can be parameterized. A time of 0 ms means that the discrepancy time SeqIn2 is disabled. The maximum value for the discrepancy time is 2500 ms.
min. Time between 1/2	The parameter is only active if input 1 and input 2 are active. This parameter contains the minimum time that must elapse between the activation of input 1 and 2 before a change to another input is accepted. A time of 0 ms means that the minimum time is disabled. The minimum value must be smaller than the maximum value.
max. Time between 1/2	The parameter is only active if input 1 and input 2 are active. This parameter contains the maximum time that may elapse between the activation of input 1 and 2. A time of 0 ms means that the maximum time is disabled. The maximum value for the discrepancy time is 5000 ms. The maximum value must be greater than the minimum value.

Diagnostic and status information of the FB safeSequence

Diagnostic information

Bit	Description
-	No diagnostic information

Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
-	-	-	-	-

Status information

Value	Description
1	**RUN** In the RUN state, the configured sequence is completed. In the RUN state, the outputs assume the following values: • SequenceOut = OUTVALUE

Value	Description
	◦ (operation mode 1+2: OUTVALUE = 1, operation mode 3+4: OUTVALUE = current toggle state) • Error = 0
2	**STOP** In the STOP state, the associated GROUP has not yet started up (FbRun = FALSE). In the STOP state, the outputs assume the following values: • SequenceOut = 0 • Error = 0
3	**SAFE** In the SAFE state, the configured sequence has not yet started. In the SAFE state, the outputs assume the following values: • SequenceOut = 0 • Error = 0
11	**SEQUENCE** In the SEQUENCE state, the configured sequence has been started but has not yet been completed. In the SEQUENCE state, the outputs assume the following values: • SequenceOut = OUTVALUE ◦ (Operating mode 1+2: OUTVALUE = 0, operating mode 3+4: OUTVALUE = last toggle state) • Error = 0
13	**RELEASE** In the RELEASE state, one of the two input groups is FALSE; the system waits for the other input group to also become FALSE before a new sequence can begin. The RELEASE state is only available in operation modes 1 and 2. The outputs assume the following values: • SequenceOut = 0 • Error = 0
14	**DISCTIME EXCEEDED** In the DISCTIME_EXCEEDED state, a discrepancy time monitoring error has occurred for at least one input group. The state is exited again if the inputs for the corresponding input groups were both 0. The outputs assume the following values: • SequenceOut = 0 • Error = 0
15	**MAXTIME EXCEEDED** In the MAXTIME_EXCEEDED state, the MaxTime has expired for the started sequence. The state is exited again if both inputs SeqIn1 and SeqIn2 are FALSE. The state is only available in operation modes 1 and 2. The outputs assume the following values: • SequenceOut = 0 • Error = 0

4.37.3 Configuration in TwinCAT 3

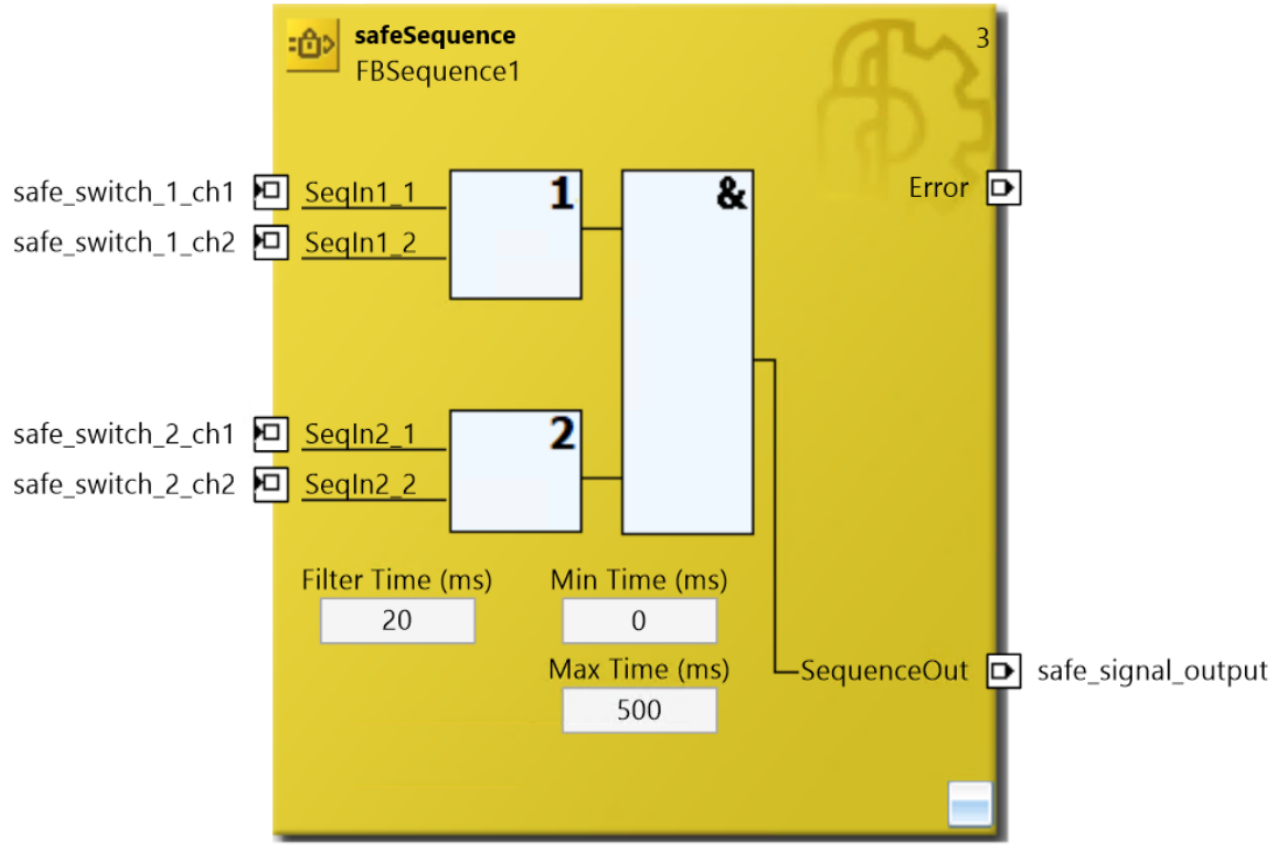

Fig. 188: FB safeSequence configuration

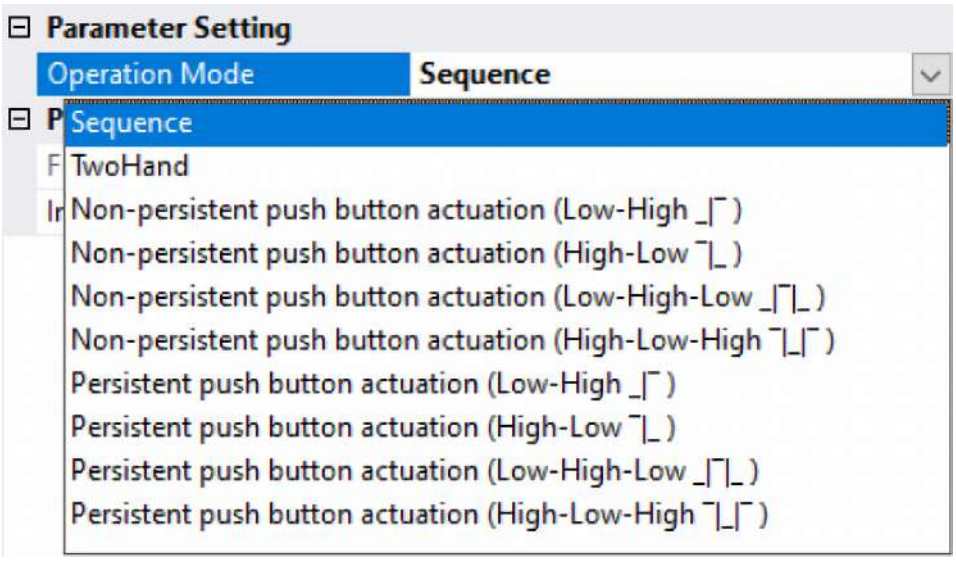

Fig. 189: FB safeSequence parameters

A violation of the sequences or exceeding of times does not lead to an error in the function block but is only reported via the status.

The error output is only set if, for example, it is not possible to save the push-button information.

1. operating mode: Checking a sequence

In this operating mode, the FB safeSequence realizes an output that is set when two inputs are set in the correct sequence. The SeqIn1 input must be set first and then the SeqIn2 input so that the SequenceOut output is set.

The time sequence between the two inputs can be configured with a minimum and maximum time (Min Time (ms), Max Time (ms)). If the time is 0, the respective time monitoring is switched off.

The inputs are each designed as two-channel inputs and can be parameterized differently.

The SequenceOut output can be activated repeatedly via SeqIn2. This means that if input SeqIn1 is set and remains set, input SeqIn2 can be switched on and off to set the output.

The inputs can be designed as 1- or 2-channel signals with or without a discrepancy time. Bouncing of the input signals can be prevented by an optional filter time (Filter Time (ms)) of the input signals.

2. operating mode: Two-hand function

In this operating mode, the FB safeSequence realizes an output that is set when two inputs are set in any sequence. If both inputs are set, the SequenceOut output is set.

The time sequence between the two inputs can be configured with a minimum and maximum time. If the time is 0, the respective time monitoring is switched off.

The inputs are each designed as two-channel inputs and can be parameterized differently.

The SequenceOut output is switched off again when one of the two inputs is no longer set. The output can only be set again when both signals are no longer set.

The inputs can be designed as 1- or 2-channel signals with or without a discrepancy time. Bouncing of the input signals can be prevented by an optional filter time for the input signals.

Rapid alternate actuation of the inputs does not generate an error state on the module.

3. operating mode: Save button actuation persistently

In this operating mode, 1- or 2-channel push-buttons can be used whose switching statuses are saved in the product's persistent memory.

This is only possible if only input SeqIn1 is used. Different sequences can be used for toggling the output signal. Further information can be found in the figure "FB safeSequence parameters".

The filter time can be used to bypass bouncing of the input signals.

4. operating mode: Save button actuation non-persistently

In this operating mode, 1- or 2-channel push-buttons can be used whose switching states are saved in the product's volatile memory. When the product or the logic is restarted, the default state (SequenceOut output = FALSE) is assumed.

This is only possible if only input SeqIn1 is used. Different sequences can be used for toggling the output signal. Further information can be found in the figure "FB safeSequence parameters".

The filter time can be used to bypass bouncing of the input signals.

List of figures

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