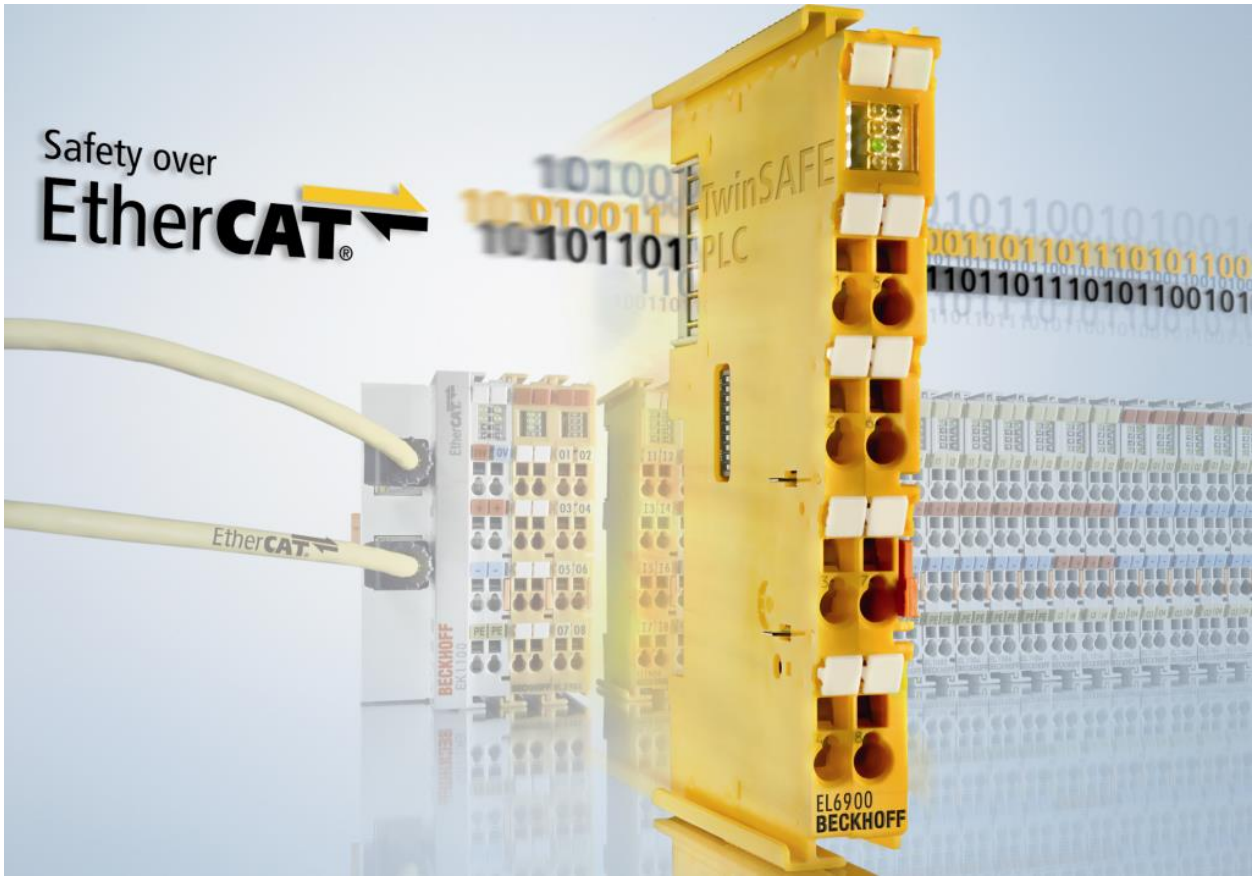

Documentation

TwinSAFE logic FB

TwinCAT function blocks for TwinSAFE logic components

Version: 3.3.0
Date: 2019-08-29

BECKHOFF

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1 Foreword

1.1 Notes on the documentation

1.1.1 Target group

This description is aimed specifically at trained qualified persons with a control and automation technology background, who are familiar with the current national and international standards and guidelines.
The following instructions and explanations must be followed during installation and commissioning of the components.

The qualified personnel must ensure that the application of the described products meets all safety requirements, including all applicable laws, specifications, regulations and standards.

1.1.2 Origin of the document

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

1.1.3 Currentness

Please 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/english/download/twinsafe.htm . If in doubt, please contact the technical support (see chapter 4.1 Beckhoff Support and Service).

1.1.4 Product features

Only the product features specified in the current user documentation are valid. Further information given on the product pages of the Beckhoff homepage, in emails or in other publications is not authoritative.

1.1.5 Disclaimer

The documentation has been prepared with care. The products described in this document are subject to cyclical revision. For that reason the documentation is not in every case checked for consistency with performance data, standards or other characteristics. We reserve the right to revise and change the documentation at any time and without prior announcement. 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.

1.1.6 Trademarks

Beckhoff®, TwinCAT®, EtherCAT®, EtherCAT G®, EtherCAT G10®, EtherCAT P®, Safety over EtherCAT®, TwinSAFE®, XFC®, XTS® and XPlanar® are registered and licensed trademarks of Beckhoff Automation GmbH.
Other designations used in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owners.

1.1.7 Patents

The EtherCAT technology is patent protected, in particular by the following applications and patents: EP1590927, EP1789857, DE102004044764, DE102007017835 with the corresponding applications and registrations in various other countries.

The TwinCAT technology is patent protected, in particular by the following applications and patents: EP0851348, US6167425 with corresponding applications or registrations in various other countries.

EtherCAT® and Safety over EtherCAT® are registered trademarks and patented technologies, licensed by Beckhoff Automation GmbH, Germany.

1.1.8 Copyright

1.1.9 Delivery conditions

In addition, the general delivery conditions of the company Beckhoff Automation GmbH & Co. KG apply.

1.2 Safety instructions

1.2.1 Delivery state

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

1.2.2 Operator's obligation to exercise diligence

The operator must ensure that

- the TwinSAFE products are only used as intended (see chapter Product description);
- the TwinSAFE products are only operated in sound condition and in working order.
- the TwinSAFE products are operated only by suitably qualified and authorized personnel.
- the personnel is instructed regularly about relevant occupational safety and environmental protection aspects, and is familiar with the operating instructions and in particular the safety instructions contained herein.
- the operating instructions are in good condition and complete, and always available for reference at the location where the TwinSAFE products are used.
- none of the safety and warning notes attached to the TwinSAFE products are removed, and all notes remain legible.

1.2.3 Explanation of notes

The following notes are used in this document. They must be read carefully and strictly followed!

⚠ DANGER

Serious risk of injury!

Failure to observe these safety instructions can result in immediate danger to life and health!

⚠ WARNING

Risk of injury!

Failure to observe these safety instructions can result in danger to life and health!

⚠ CAUTION

Personal injuries!

Failure to observe these safety instructions can result in personal injury!

NOTE

Damage to environment/equipment or loss of data

Failure to observe this note may result in environmental damage, equipment damage or loss of data.

Tip or pointer

This symbol indicates information that contributes to better understanding.

1.2.4 Documentation issue status

Version	Comment
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 EL6910 / EJ6910 / EK1960 function blocks • FBs modified: EStop, Mon, Muting, TON and TOF • FBs added: 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 • EDM extended with standard In • MUTING status information expanded • TwoHand diagnostic information expanded
2.2.0	• TwinSAFE connection info data expanded • FB ESTOP info data expanded
2.1.0	• FB OPMODE description expanded • Service/support information modified
2.0.0	• EL6900 function blocks added
1.1.1	• Corrections during the translation into English
1.1.0	• Amendments in the application examples
1.0.0	• First released version

2 System description

The TwinSAFE system consists of safe inputs (EL/KL1904), safe outputs (EL/KL2904) and logic modules (KL6904/EL6900/EL6910/EJ6910). The TwinSAFE logic terminal (KL6904/EL6900/EL6910/EJ6910) contains function blocks, which can be parameterized and connected to each other and 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 handles loading and checking of the TwinSAFE project on the EL69x0/KL6904/EJ6910.

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 (www.ethercat.org).

2.1 TwinSAFE logic terminals EL69x0/KL6904/EJ6910

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.

The order of execution of the function blocks corresponds to the order shown in the project tree of the TwinCAT 2 System Manager or in the TwinCAT 3 editor. This order can be changed in the System Manager via drag & drop or in TwinCAT 3 via an FB property.

NOTE
Order of execution in TwinCAT 3 The order of execution 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. The order of execution must have no gaps in the numbering.

The function blocks have parameters which must be configured by the user.

The inputs and outputs of the function blocks are assigned to the inputs and outputs of the TwinSAFE terminals, to other function blocks or to the input and output variable of the standard PLC by the user.

A TwinSAFE connection involves unambiguous assignment of a TwinSAFE device (EL/KL1904, EL/KL2904, EL6900/KL6904/EL69x0/EJ6910) to TwinSAFE group. Only function blocks which belong to this TwinSAFE group can be linked with the input and outputs of an assigned TwinSAFE connection. The DECOUPLE function block can be used if it is necessary for other groups to access the inputs and outputs (see chapter 3.6).

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

Errors in the TwinSAFE Logic result in it switching off completely.

2.1.1 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)
- 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 or TwinSAFE output terminal) are always assigned to exactly one TwinSAFE group.

A communication error is indicated by the output (COM ERR) of the TwinSAFE group and acknowledged via the ERR ACK input. A function block error is displayed on the output FB ERR and acknowledged on the same input ERR ACK as the communication error. An error on the local outputs (only KL6904) is displayed on the third output OUT ERR and once again acknowledged by the same input ERR ACK. The secure state of the TwinSAFE group outputs is removed once the error is no longer present and has been acknowledged.

Apart from this the TwinSAFE group has an input (RUN), with which the processing of the assigned function blocks can be stopped and started. All TwinSAFE group assigned outputs are in a safe state when stopped. For the EL6910 and newer logics the RUN input must always be linked with a standard signal.

NOTE
Run and ErrACK in the TwinSAFE group The error acknowledgement is not automatic, i.e. the input ERR ACK must always be linked with a standard signal. For the EL6910 and newer logics, the RUN input must also always be linked with a standard signal.

2.1.1.1 Inputs and outputs of the TwinSAFE group EL6900/KL6904

Table 2-1: 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 of the TwinSAFE group assigned function blocks are at a STOP state and thus all associated outputs are in a safe state When the input is not linked it is in the TRUE state
ERR ACK	FB-Out Standard-In	The signal sequence FALSE->TRUE->FALSE acknowledges all errors in the assigned function blocks and the TwinSAFE connections.

Table 2-2: 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 of the locally assigned outputs of the TwinSAFE group have no errors Only for TwinSAFE components with local outputs.

2.1.1.2 Inputs and outputs of the TwinSAFE group of the EL/EJ6910

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

Table 2-3: Inputs and outputs of the TwinSAFE group EL/EJ6910

Group Port	Direction	Description
Err Ack	IN	Error Acknowledge for errors within the group - Signal must be linked with a standard variable
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 module that is used, e.g. EK1960
Com Err	OUT	Communication error in one or more connections
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 of this group is in startup
FB Deactive	OUT	The group was disabled (see EL6910 documentation for customization, for example)
FB Run	OUT	All FBs are in RUN state
In Run	OUT	TwinSAFE group is in RUN state

The group status and the diagnostics (see 2.2.5 Groups info data) can be loaded into the cyclic process image via the group properties. The following tables show the possible values.

2.1.2 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 in a TwinSAFE connection to a TwinSAFE input or TwinSAFE output is always TwinSAFE master. 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 (Safety-over-EtherCAT) address 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/ editor can only check one TwinSAFE logic terminal.

NOTE

Multiple FSoE addresses must be avoided

The user must ensure that FSoE addresses are unique 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.

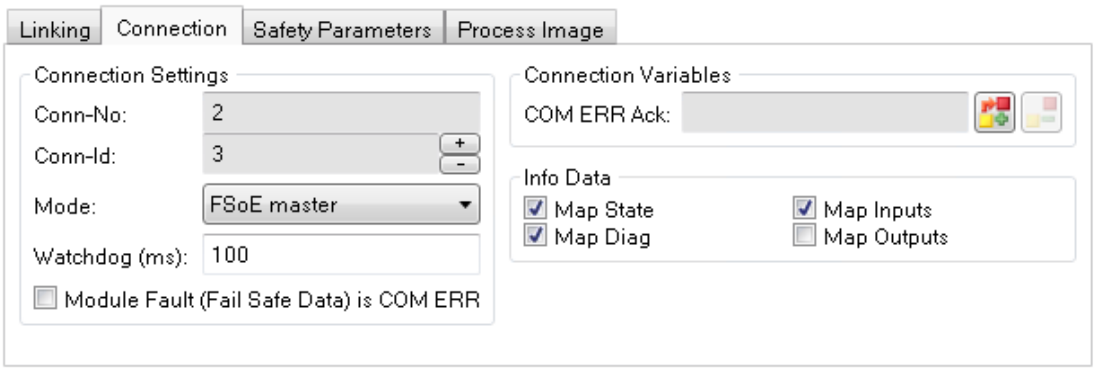


Figure 2-1:Connection

2.2 System diagnosis

The states of TwinSAFE groups, FBs and connections can be checked online in the System Manager / Solution. 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 EL/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.

NOTE
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.

2.2.1 Diagram showing EL6900/KL6904 diagnostics under TwinCAT 2

2.2.1.1 TwinSAFE group diagnostics

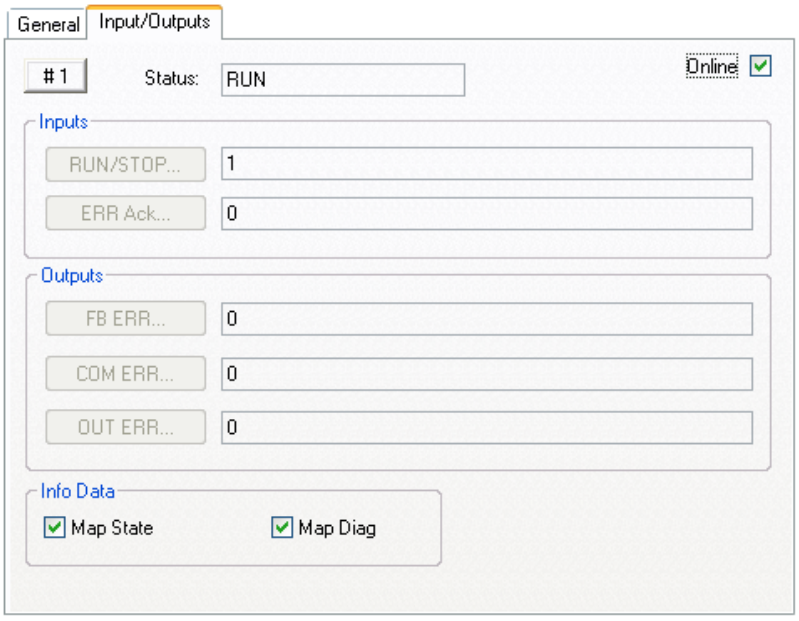


Figure 2-2: TwinSAFE group inputs/outputs (online)

Table 2-4: State information KL6904/EL6900

Value	State	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

2.2.1.2 TwinSAFE function block list diagnostics

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

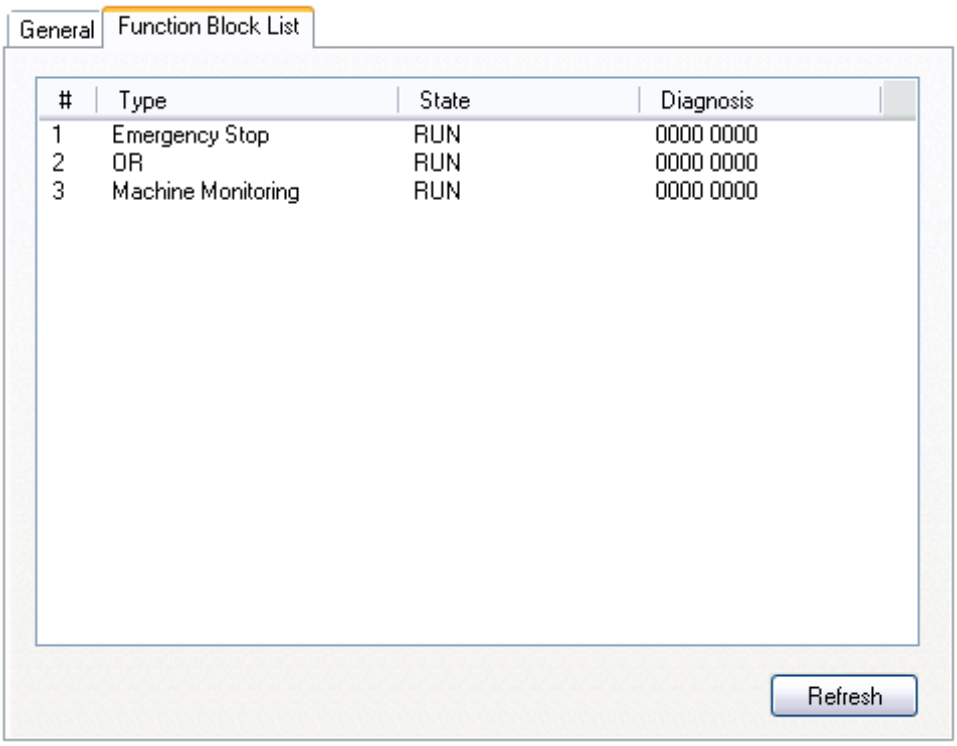


Figure 2-3: Function block list online values

If the checkboxes 'Map State' and 'Map Diag' for the individual TwinSAFE FBs are set, the state 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 state and diagnostic values can be found under the respective FBs.

NOTE
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.

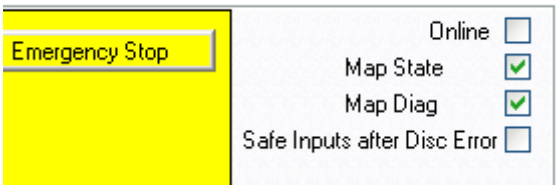


Figure 2-4: Emergency Stop

2.2.1.3 TwinSAFE connection diagnostics

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

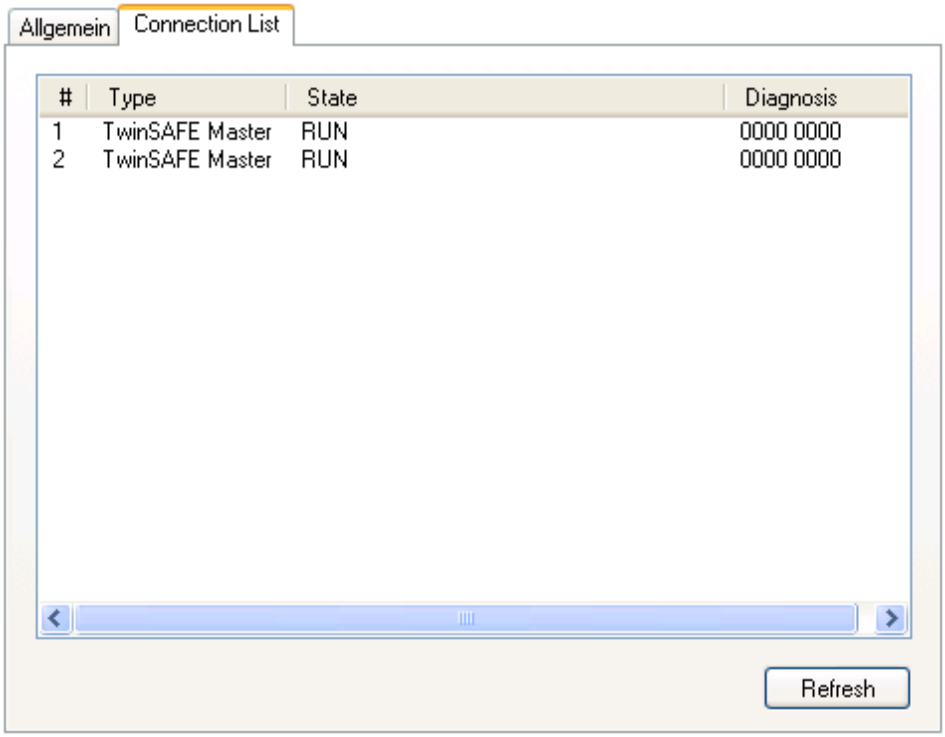


Figure 2-5: Connection List

If the checkboxes 'Map State' and 'Map Diag' for the individual TwinSAFE connections are set, the state 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.

NOTE
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.

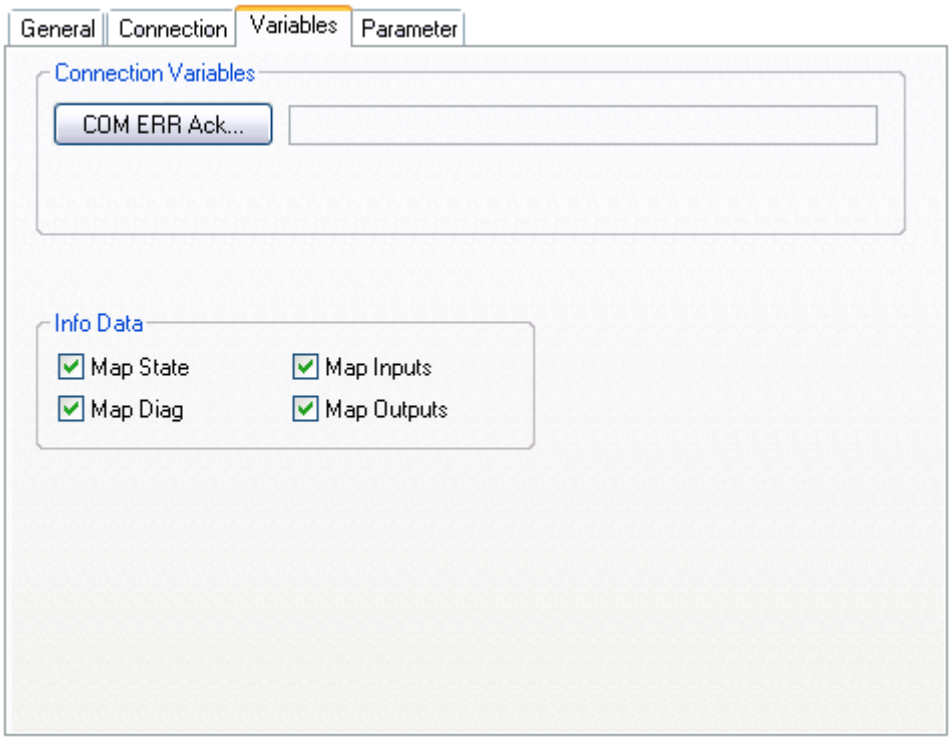


Figure 2-6: Variables tab (connection)

Table 2-5: 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

Table 2-6: State information for a connection

Value	Description
100 (0x64)	Reset state: The reset state is used to re-initialize the Safety over EtherCAT connection after the power-on or a Safety over EtherCAT communication error.
101 (0x65)	Session state: During the transition to or in the session state a session ID is transferred from the Safety over EtherCAT master to the Safety over EtherCAT 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 Safety over EtherCAT master to the Safety over EtherCAT slave.
103 (0x67)	Parameter state: In Parameter state safe communication and device-specific application parameters are transferred.
104 (0x68)	Data state: In Data state Safety over EtherCAT cycles are transferred until either a communication error occurs or a Safety over EtherCAT 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 later: connection was shut down because a shutdown command was received)
106 (0x6A)	Shutdown-Deactive state: EL6910 or later: 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.

2.2.2 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.

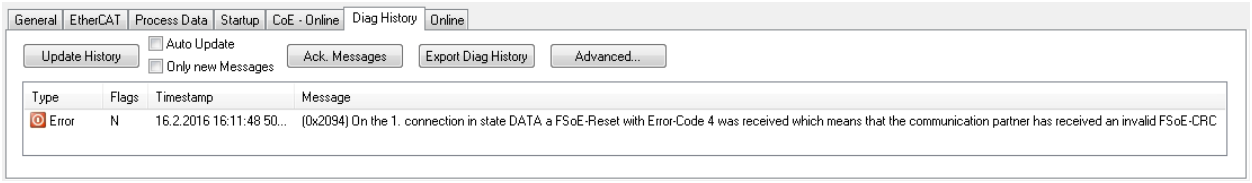


Figure 2-7 Diag history of the EL6910 with a Com Error due to an incorrect CRC

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

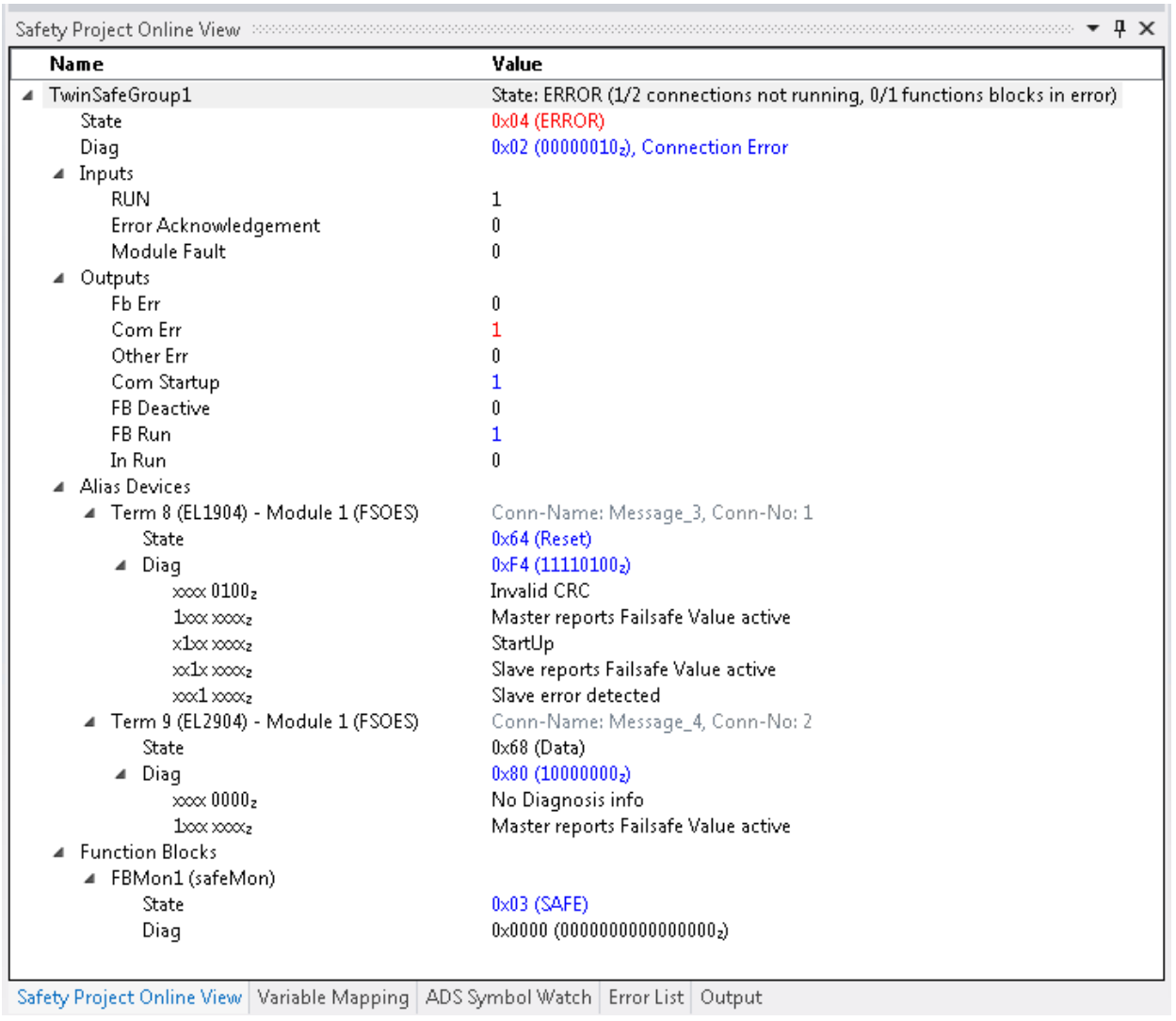


Figure 2-8: Safety Project Online View

2.2.3 Info data connection

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

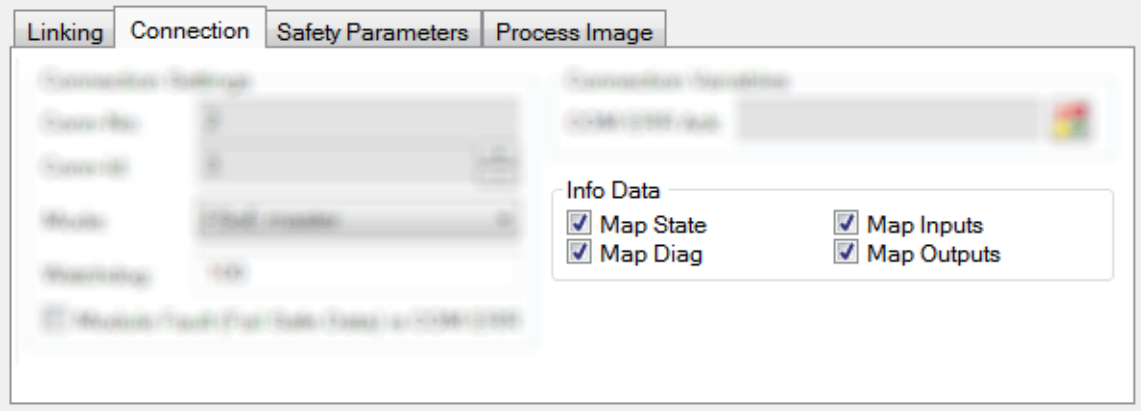


Figure 2-9: Info data connection

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.

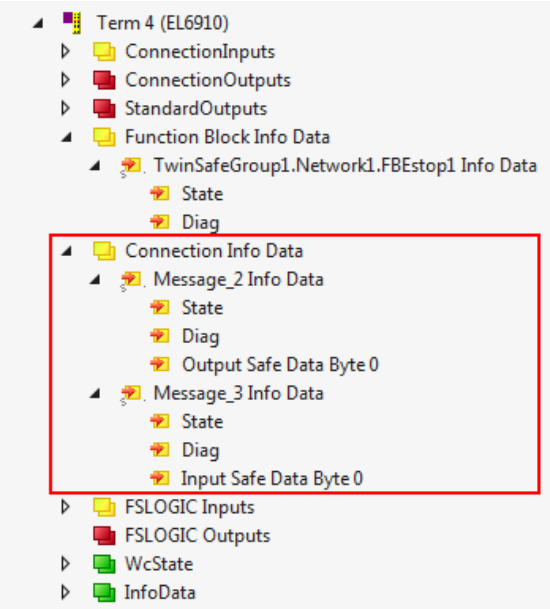


Figure 2-10: Connection info data in the I/O tree structure

The state and diagnostic information is as described above for TwinCAT 2.

2.2.4 Function blocks info data

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

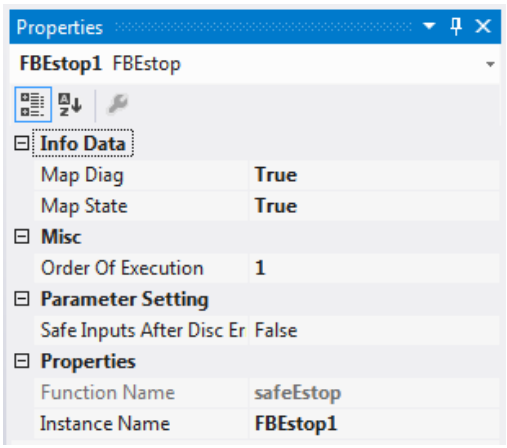


Figure 2-11: Function block properties

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

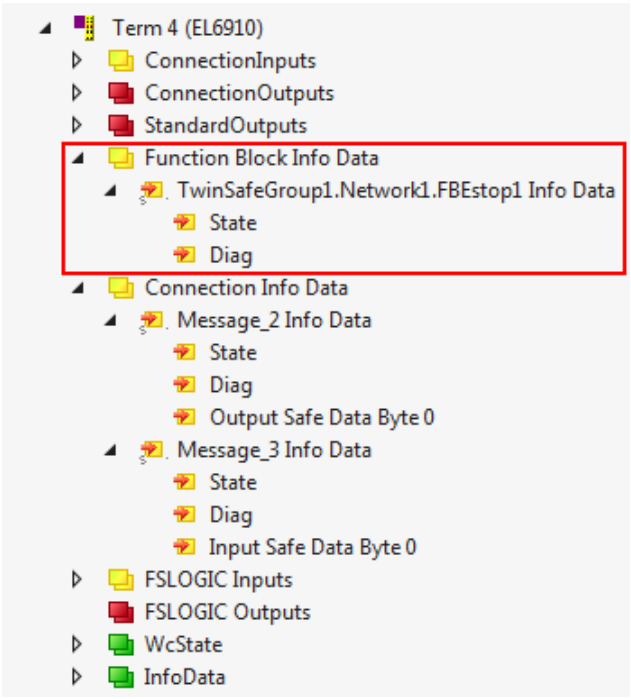


Figure 2-12: Function block info data in the I/O tree structure

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

2.2.5 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.

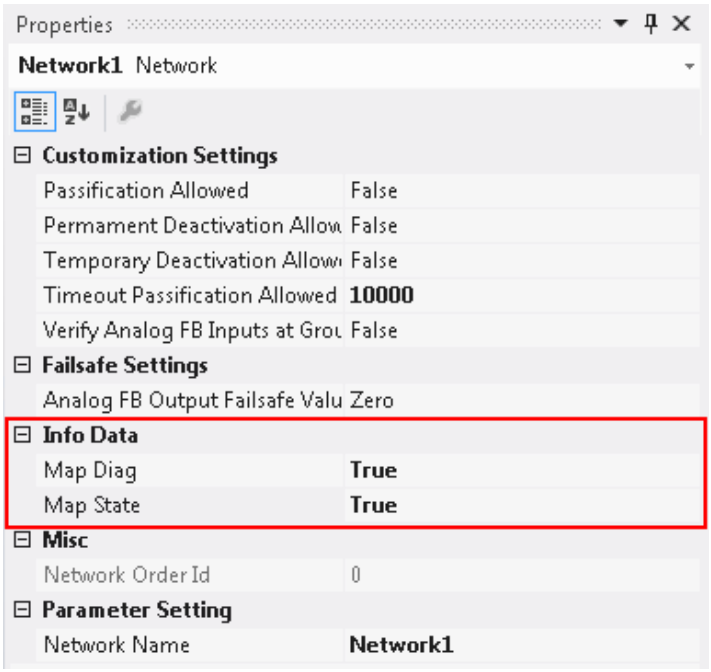


Figure 2-13: Access to info data via Properties

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.

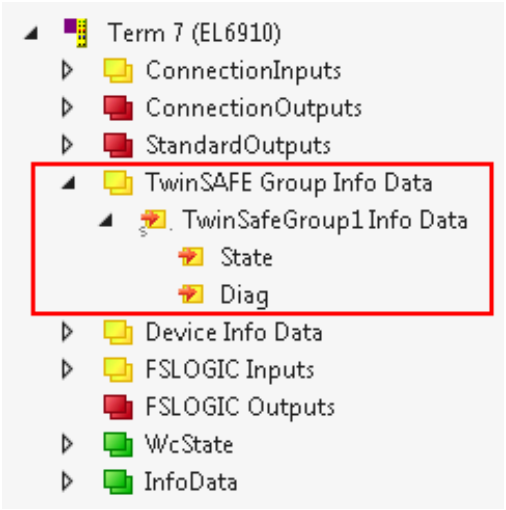


Figure 2-14: TwinSAFE group info data in the I/O tree structure

Table 2-7: State 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 the group is started or initialized, it assumes the STOPERROR status if the TwinSAFE connections are assigned to the group. The group switches from STOPERROR state into 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

Table 2-8: 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).

3 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.

3.1 The function block AND

3.1.1 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).

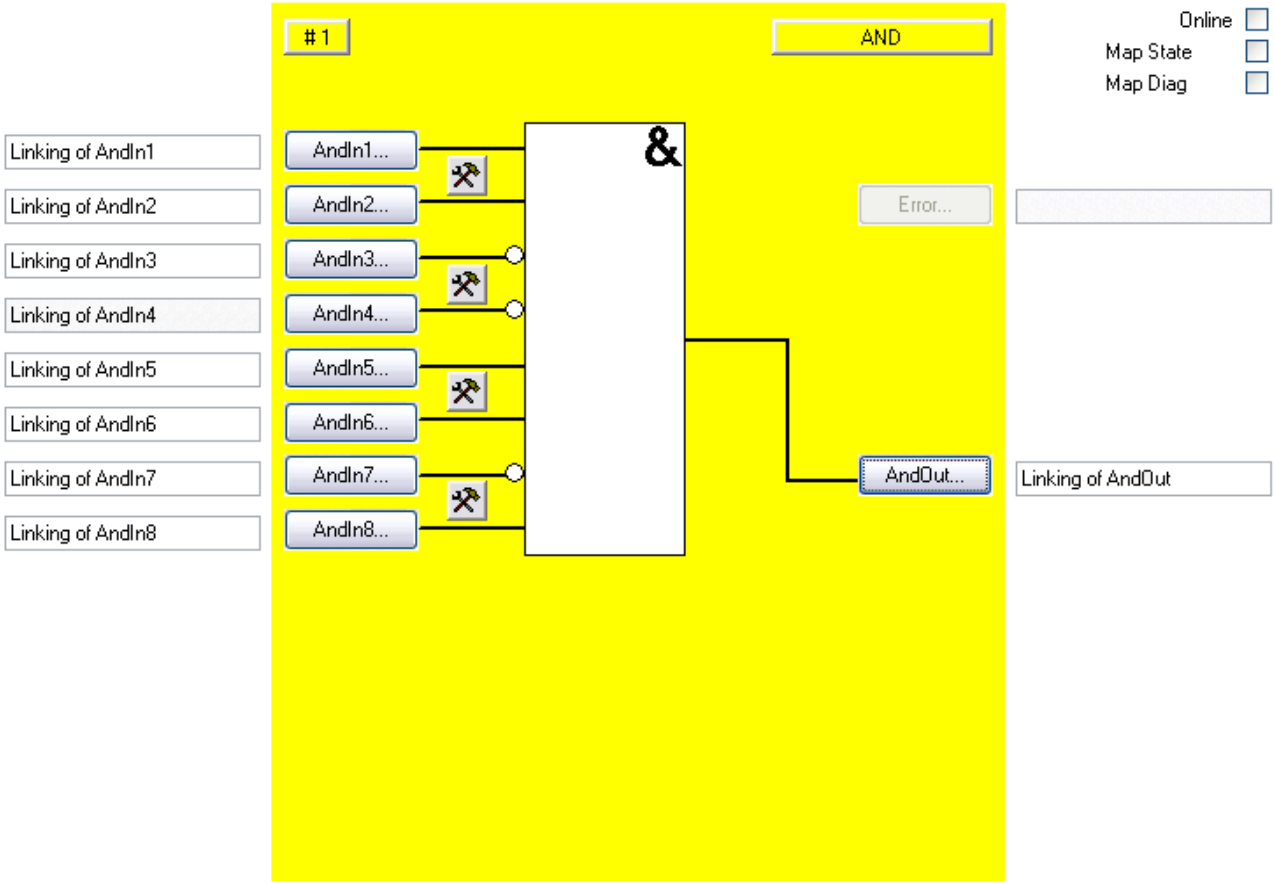


Figure 3-1: AND function block

3.1.2 Signal description

Table 3-1: FB AND inputs

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

Table 3-2: FB AND outputs

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

Table 3-3: Input and output types

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

Table 3-4: Internal identifier of the FB

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

3.1.2.1 Diagnostic and state information for the FB AND

Table 3-5: Diagnostic information (16-bit value)

Bit	Description
0-15	always 0

Table 3-6: State information (8-bit value)

Value	Description
0	undefined
1	RUN The RUN state is assumed once all active inputs AndIn1-AndIn8 are set to 1 (ACTIVE_ANDIN=TRUE). The outputs assume the following values: AndOut=1
2	STOP The FB AND module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: AndOut=0
3	SAFE The SAFE state is assumed if one or more of the active inputs AndIn1-AndIn8 is not 1 (ACTIVE_ANDIN=FALSE). The outputs assume the following values: AndOut=0

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

NOTE

KL6904

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

3.1.3 FB AND configuration in the TwinCAT System Manager

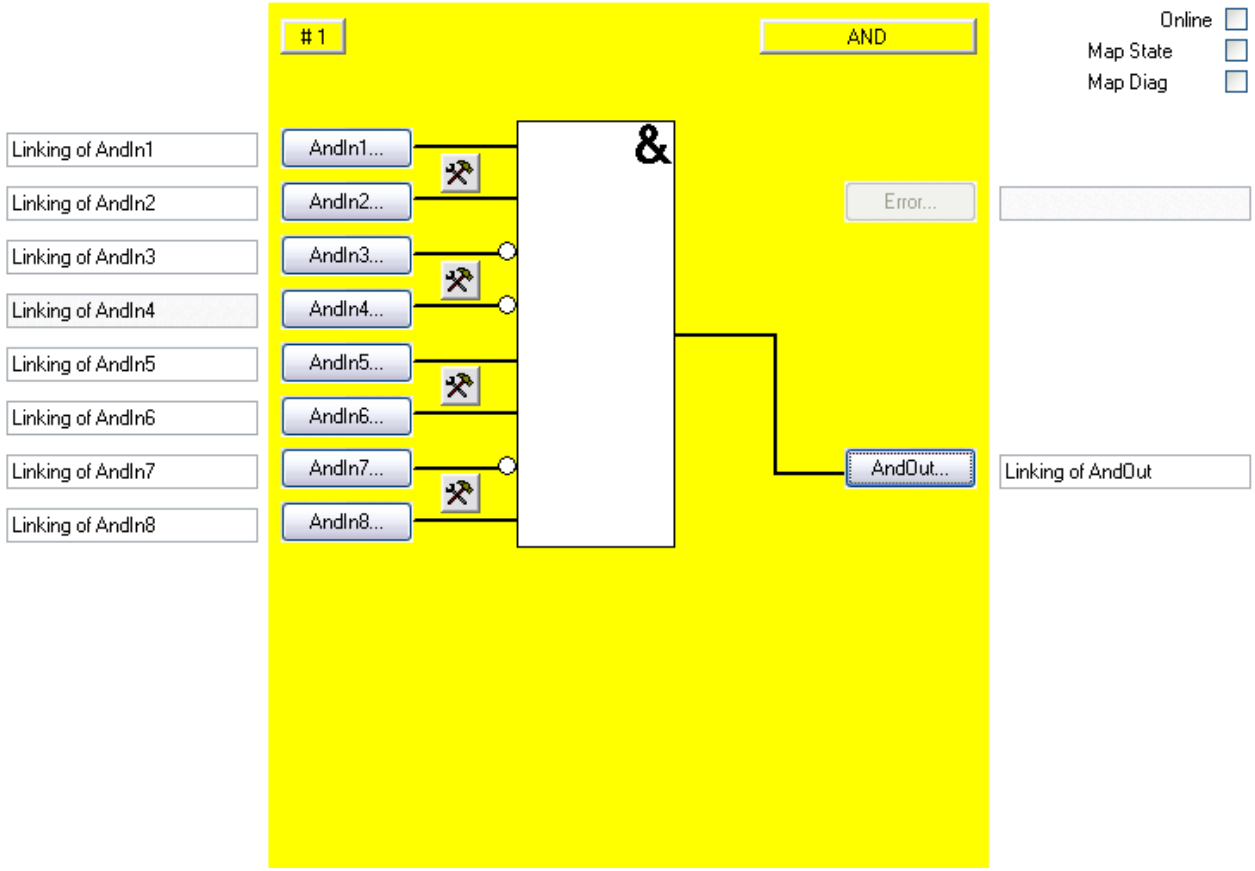


Figure 3-2: FB AND configuration

Use the Settings buttons to the right of two AndIn inputs to configure their behavior. The inputs are always single-channel. A discrepancy monitoring cannot be used for 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 'MapState' and 'MapDiag' 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.

3.1.4 Display in TwinCAT 3

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

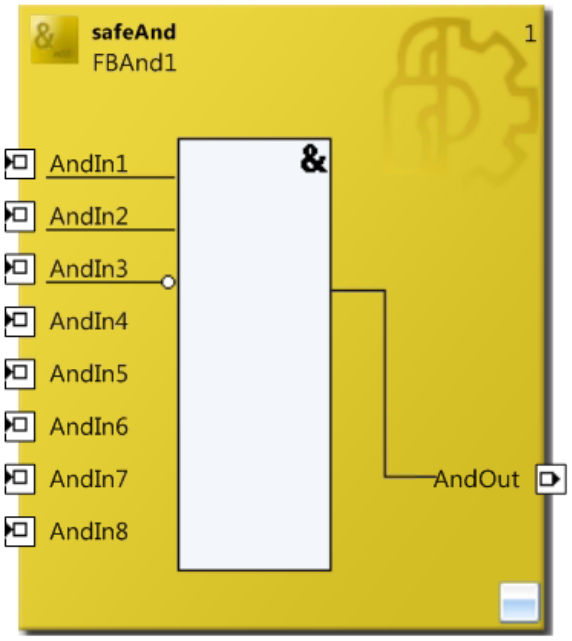


Figure 3-3 FB AND in TwinCAT 3

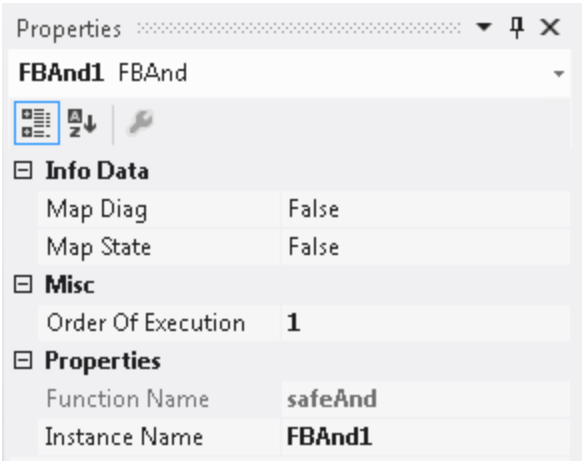


Figure 3-4 FB AND properties

3.2 The function block OR

3.2.1 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.

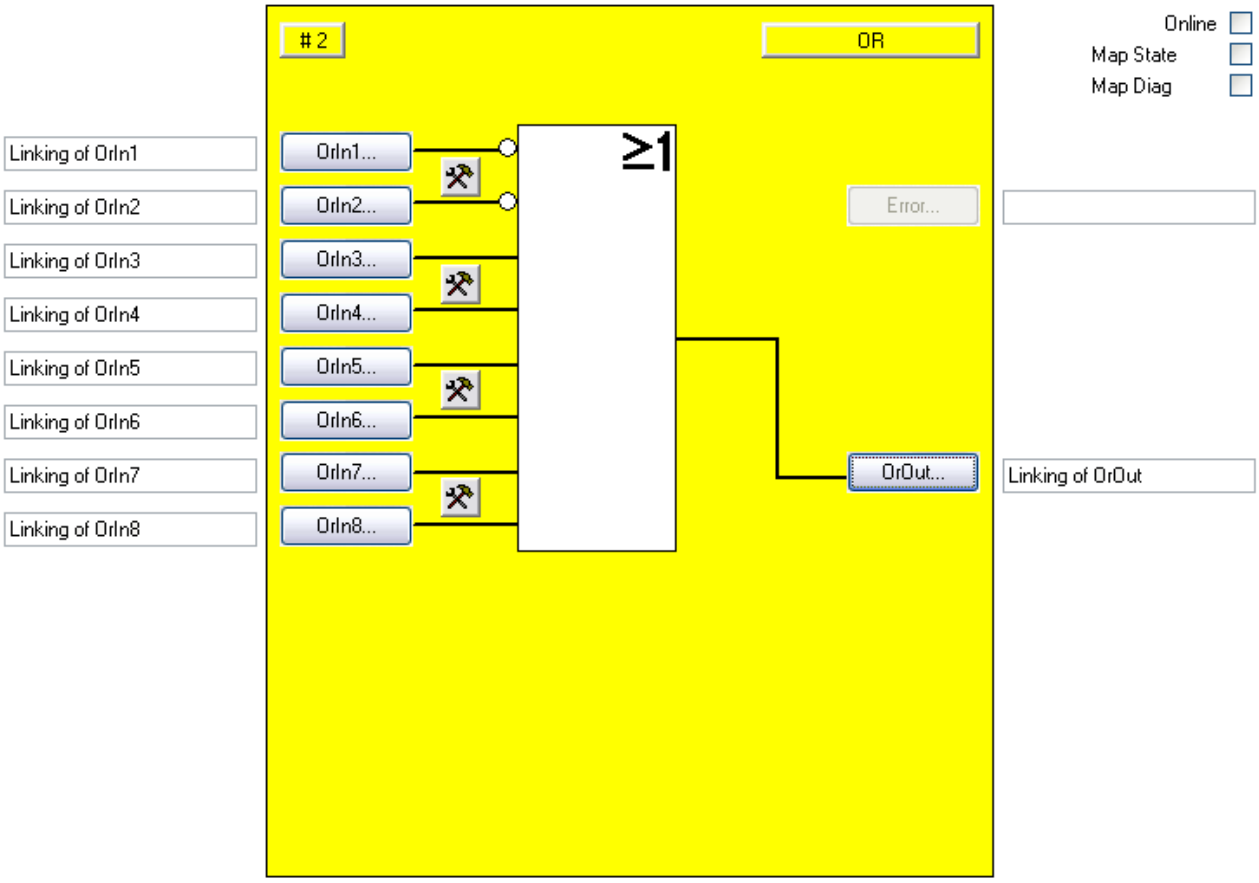


Figure 3-5: OR function block

3.2.2 Signal description

Table 3-7: 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

Table 3-8: FB OR outputs

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

Table 3-9: Input and output types

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

Table 3-10: Internal identifier of the FB

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

3.2.2.1 Diagnostic and state information for FB OR

Table 3-11: Diagnostic information (16-bit value)

Bit	Description
0-15	always 0

Table 3-12: State 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 outputs assume the following values: OrOut=1
2	STOP The FB OR module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: OrOut=0
3	SAFE The SAFE state is assumed if all active inputs OrIn1-OrIn8 are 0 (ACTIVE_ORIN=FALSE). The outputs assume the following values: OrOut=0

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

NOTE

KL6904

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

3.2.3 FB OR configuration in the TwinCAT System Manager

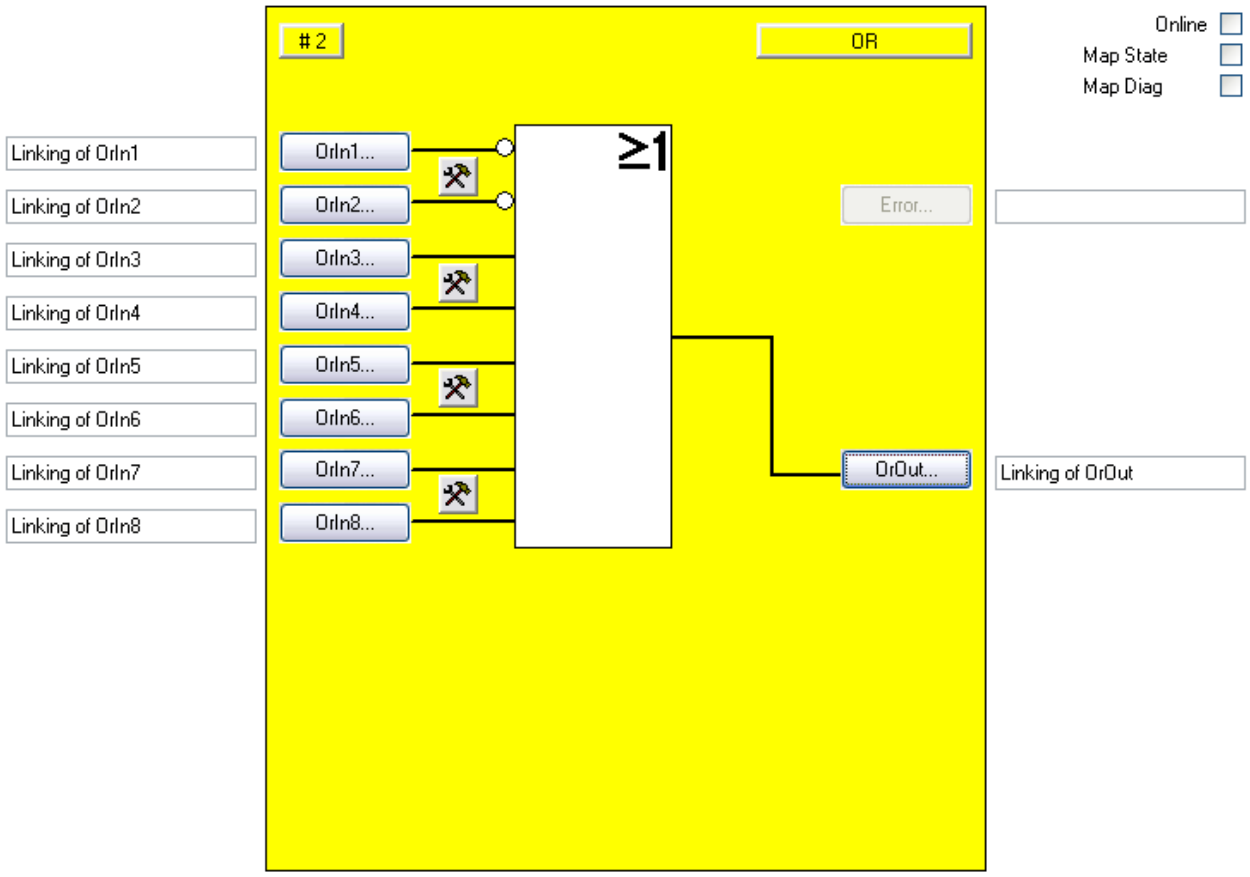


Figure 3-6: FB OR configuration

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 'MapState' and 'MapDiag' 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.

3.2.4 Display in TwinCAT 3

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

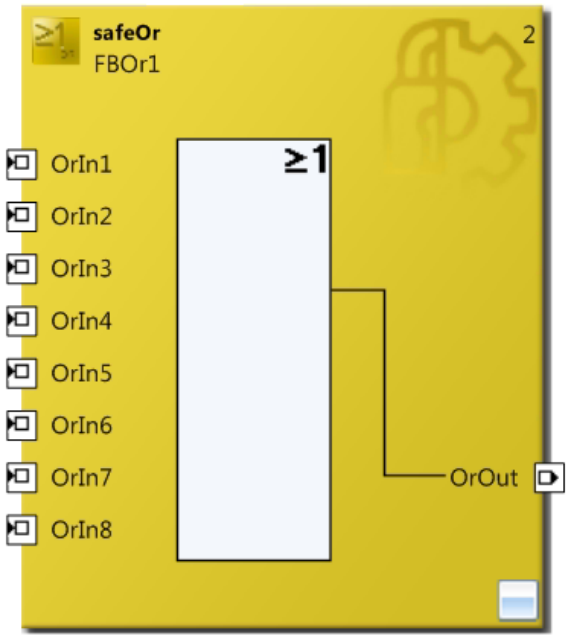


Figure 3-7 FB OR in TwinCAT 3

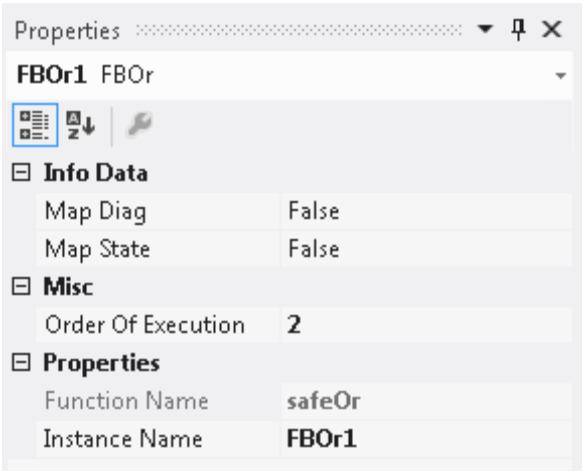


Figure 3-8 FB OR properties

3.3 The function block OPMODE

3.3.1 Functional description

Operation 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 enabled, the safe state of the outputs is only exited by a rising and falling edge at the restart input during startup and when the operation mode changes (see also chapter 3.3.4 Restart behavior). 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.

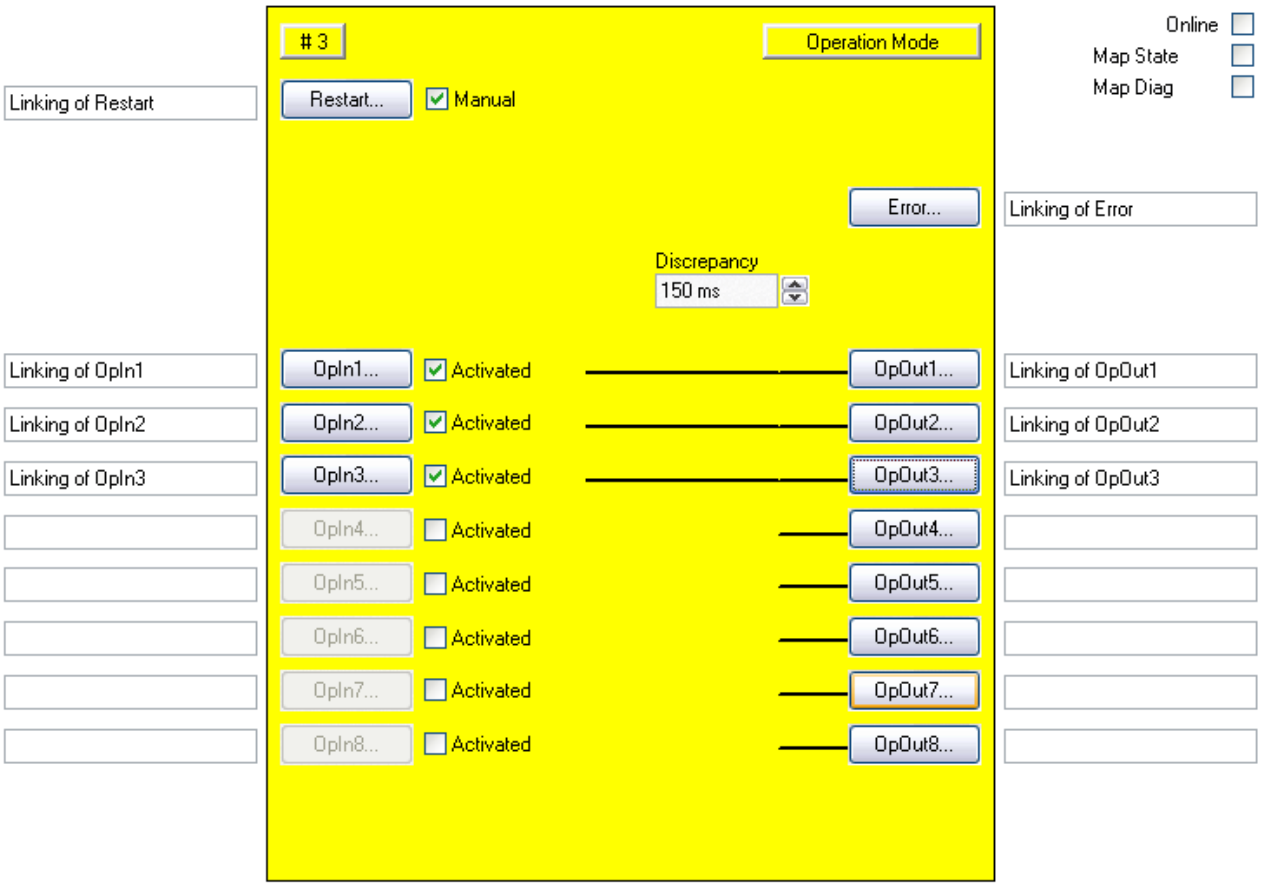


Figure 3-9: Function block OPMODE

NOTE
Number of inputs At least two inputs of FB OPMODE must be connected.

3.3.2 Signal description

Table 3-13: FB OPMODE inputs

Name	Permitted type	Data type	Description
Restart	TwinSAFE-In FB-Out Standard-In	BOOL	The 0->1->0 signal sequence 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
OpIn7	TwinSAFE-In FB-Out	BOOL	7th input channel
OpIn8	TwinSAFE-In FB-Out	BOOL	8th input channel

Table 3-14: 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

Table 3-15: Input and output types

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

3.3.2.1 Diagnostic and state information for FB OPMODE

Table 3-16: Diagnostic information (16-bit value)

Bit	Description
0	Discrepancy monitoring error

Table 3-17: Internal identifier of the FB

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

Table 3-18: State information (8-bit value)

Value	Description
0	undefined
1	RUN The FB OPMODE module assumes the RUN state if exactly one OpInX input is TRUE. The outputs assume the following values: Error=0 OpOutX=OpInX (1<=X<=8)
2	STOP The FB OPMODE module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: Error=0 OpOutX=0 (1<=X<=8)
3	SAFE The FB OPMODE module assumes the SAFE state if not exactly one OpInX input is TRUE. The outputs assume the following values: Error=0 OpOutX=0 (1<=X<=8)
4	ERROR If the FB OPMODE module detects an error, the FB OPMODE module assumes the ERROR state and transmits the corresponding Diag message to the GROUP module. The outputs assume the following values: Error=1 OpOutX=0 (1<=X<=8)
5	RESET The FB OPMODE module 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 The FB OPMODE module 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 corresponding output OpOutX becomes 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 state and diagnostic data of the FB are copied to the cyclic process image.

NOTE

KL6904

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

3.3.3 Configuration of the FB OPMODE in the TwinCAT System Manager

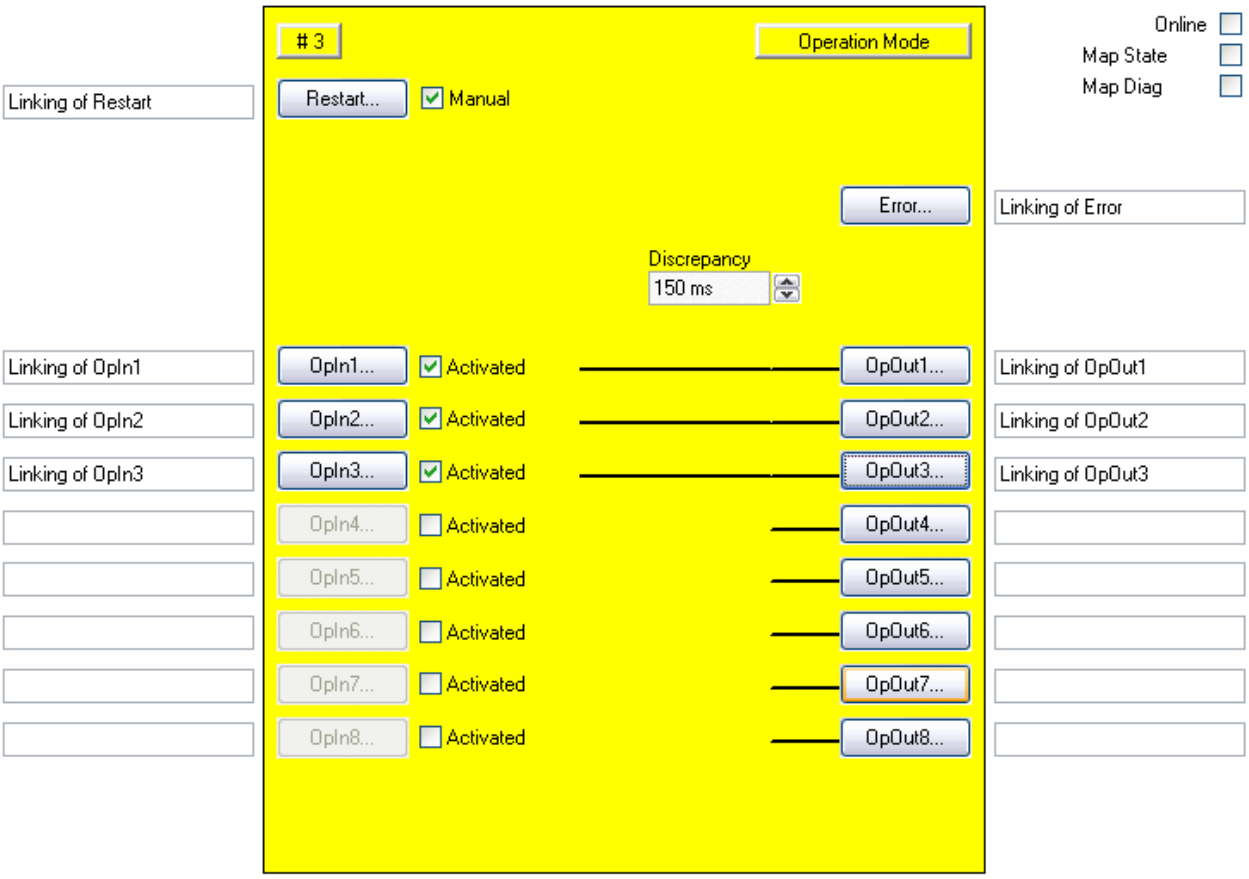


Figure 3-10: FB OPMODE configuration

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 'MapState' and 'MapDiag' 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.

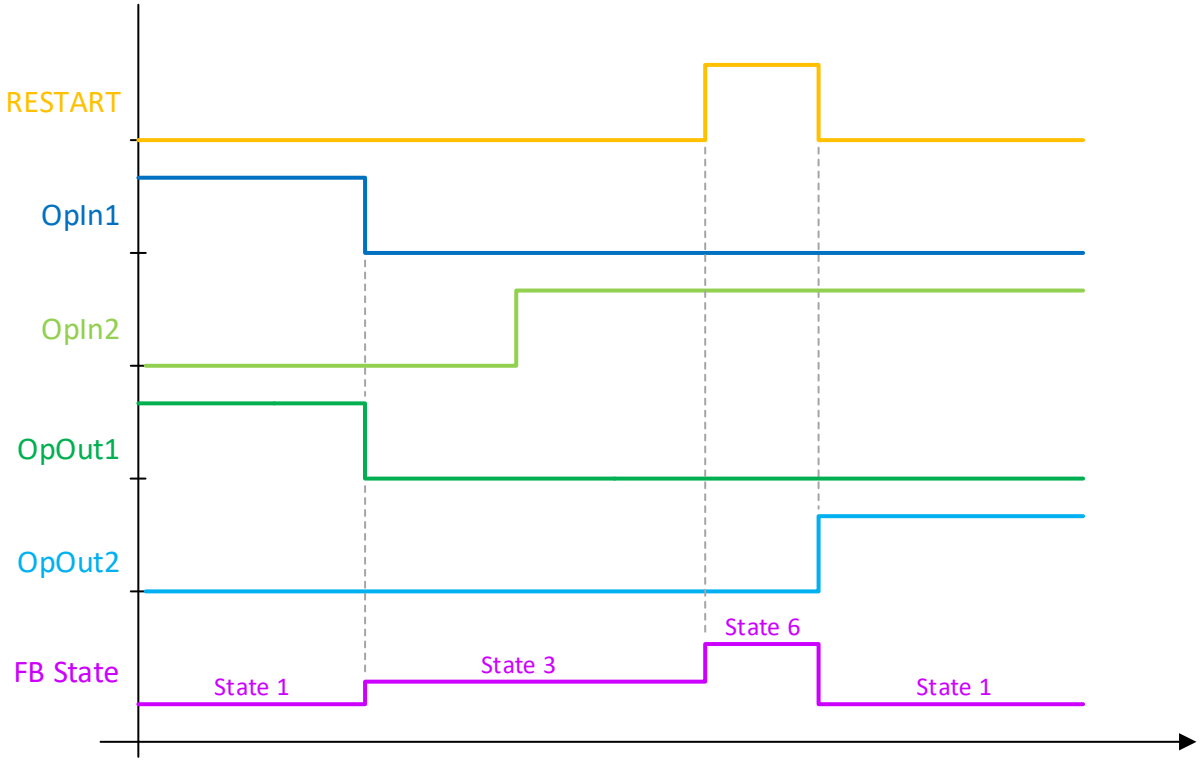
3.3.4 Restart behavior

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.

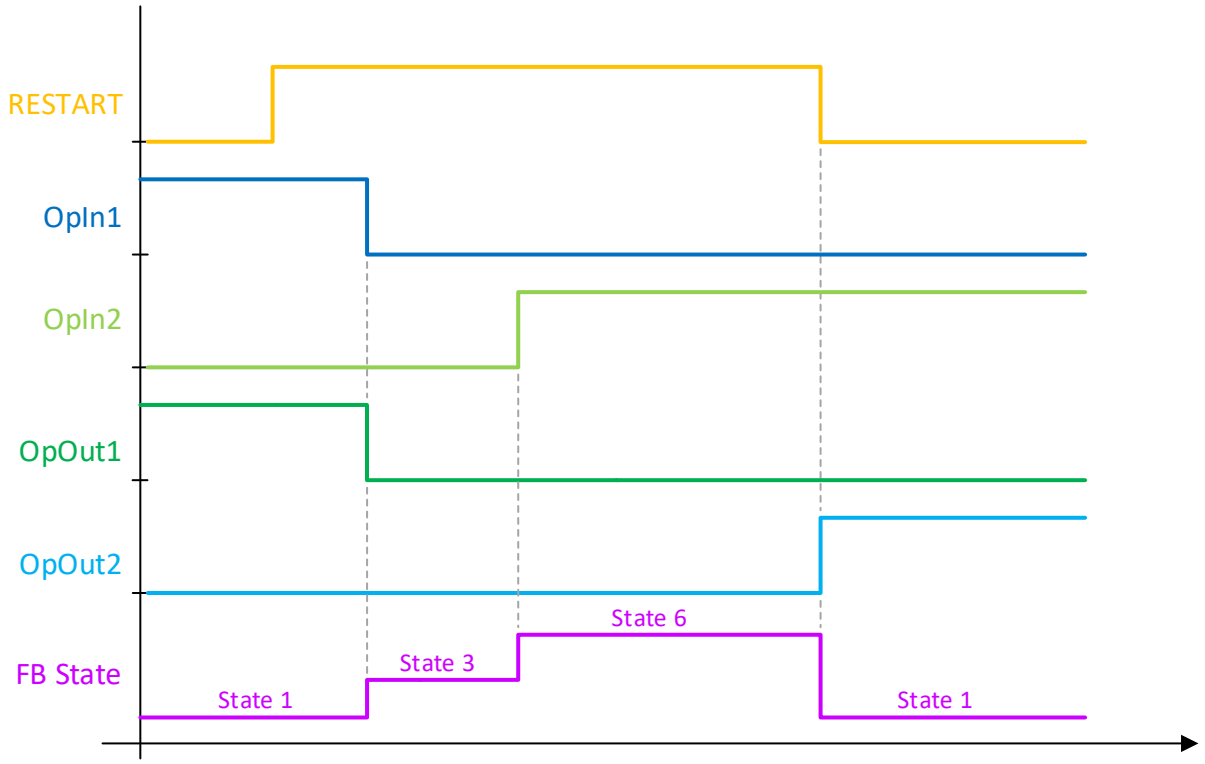
NOTE
Restart input The function block expects a button with make contact at the restart input.

⚠ 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.

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.



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.



3.3.5 Display in TwinCAT 3

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

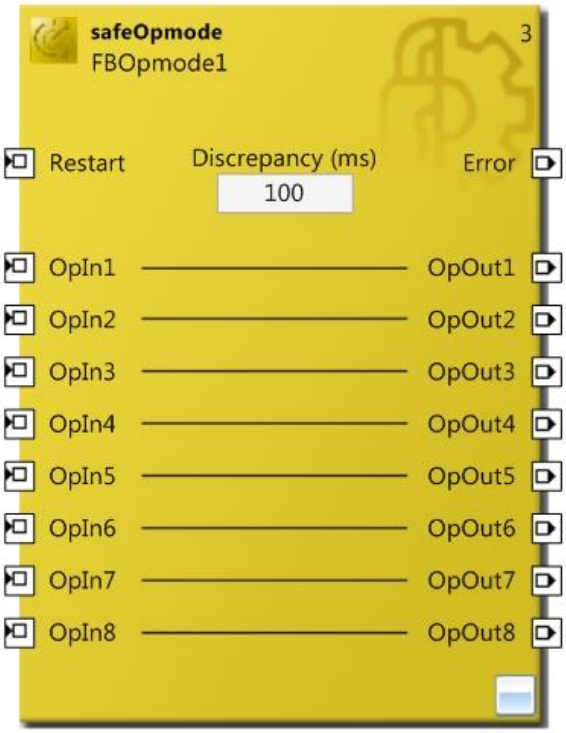


Figure 3-11 FB OPMODE in TwinCAT 3

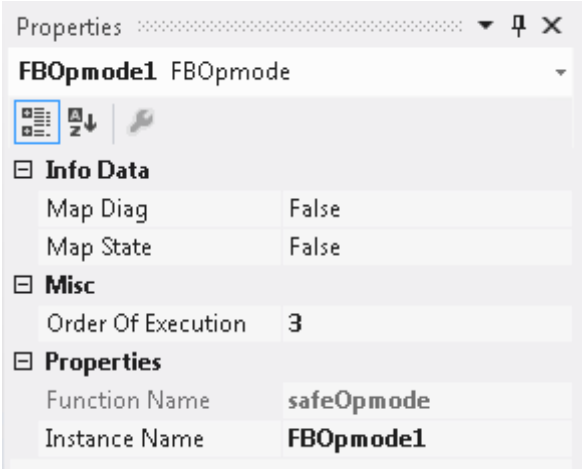


Figure 3-12 FB OPMODE properties

3.4 The function block ESTOP

3.4.1 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) goes 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.

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 Restart behavior). No time monitoring of the restart signal takes place.

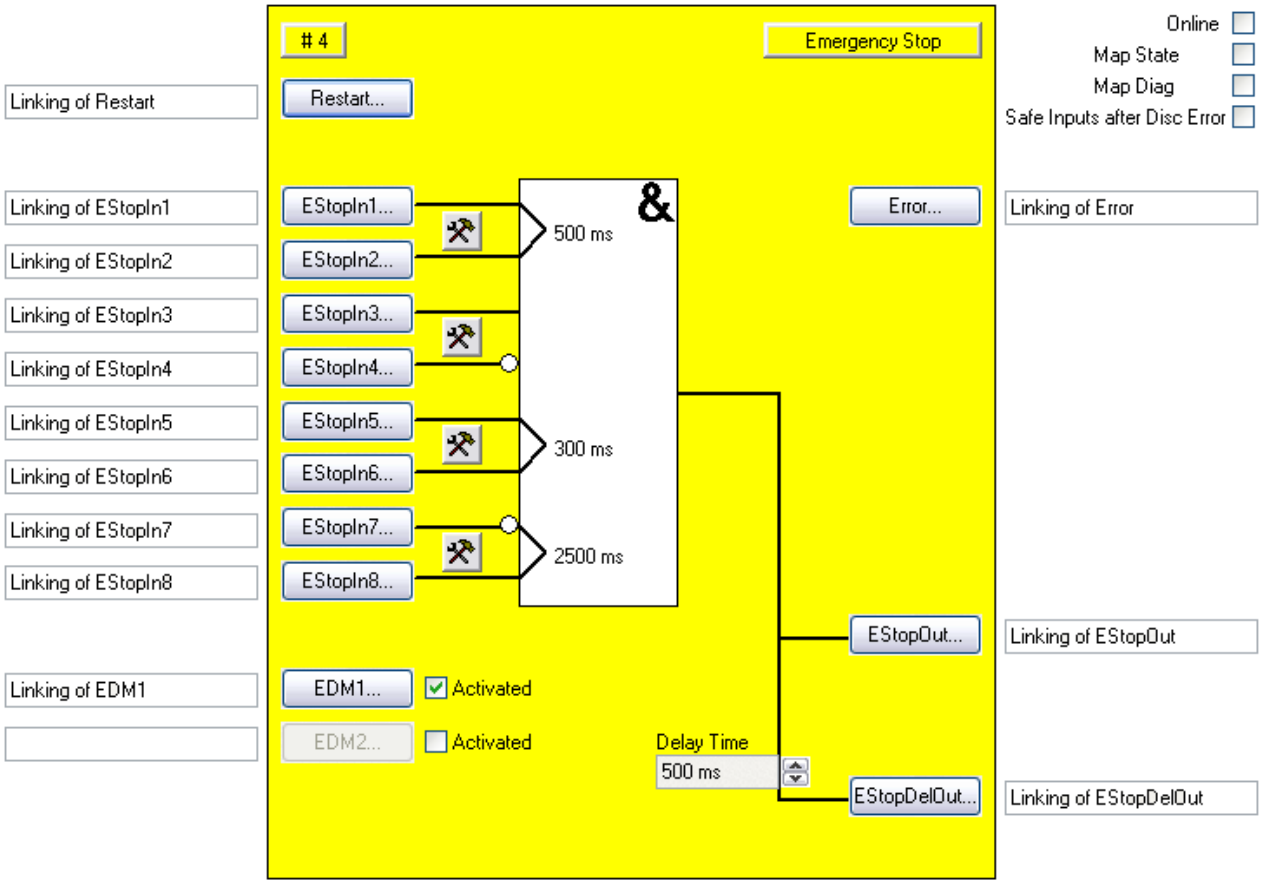


Figure 3-13: Function block ESTOP

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 when the FB changes to the START state (6) (see 3.4.4 Restart behavior). If the EDM inputs don't have the "1" signal state, the FB ESTOP goes into error state and sets the output error to 1. The error state can only be exited through 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 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 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.

3.4.2 Signal description

Table 3-19: 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.
EStopIn1	TwinSAFE-In FB-Out	BOOL	1st input channel: The parameterization determines, whether the input will be a break contact (safe state will be requested by logical 0) or make contact (safe state will be requested by logical 1).
EStopIn2	TwinSAFE-In FB-Out	BOOL	2nd input channel, behaves 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
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.
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.

Table 3-20: 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.

Table 3-21: Input and output types

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

Table 3-22: Internal identifier of the FB

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

3.4.2.1 Diagnostic and state information for FB ESTOP

Table 3-23: 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)

Table 3-24: State information (8-bit value)

Value	Description
0	undefined
1	RUN The FB ESTOP module assumes the RUN state if no error is present and no active EStopIn input requests a safe state. The outputs assume the following values: Error=0 EStopOut=1 EStopDelOut=1
2	STOP The FB ESTOP module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: Error=0 EStopOut=0 EStopDelOut=0
3	SAFE The FB ESTOP module 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 module detects an error, the FB ESTOP module assumes the ERROR state and transmits the corresponding Diag message to the GROUP module. The outputs assume the following values: Error=1 EStopOut=0 EStopDelOut=0

Value	Description
5	RESET The FB ESTOP module 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 module 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 entering the RUN state and the outputs leave the safe state. The outputs assume the following values: Error=0 EStopOut=0 EStopDelOut=0
8	DELAYOUT The FB ESTOP module assumes the DELAYOUT state if at least one of the active EStopIn inputs has requested the safe state and 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 state and diagnostic data of the FB are copied to the cyclic process image.

NOTE

KL6904

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

3.4.3 FB ESTOP configuration in the TwinCAT System Manager

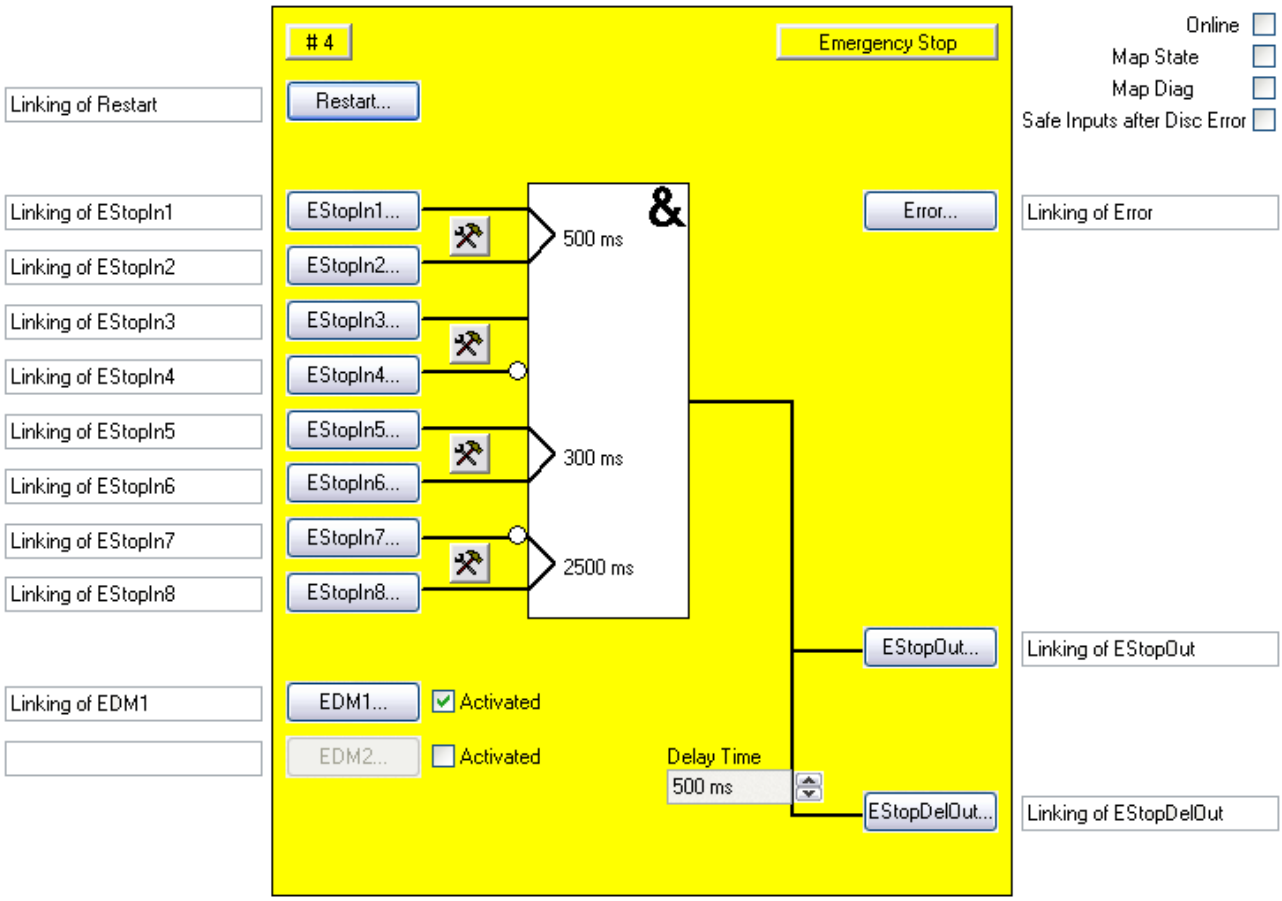


Figure 3-14: FB ESTOP configuration

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 'MapState' and 'MapDiag' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

3.4.4 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.

NOTE

Restart input

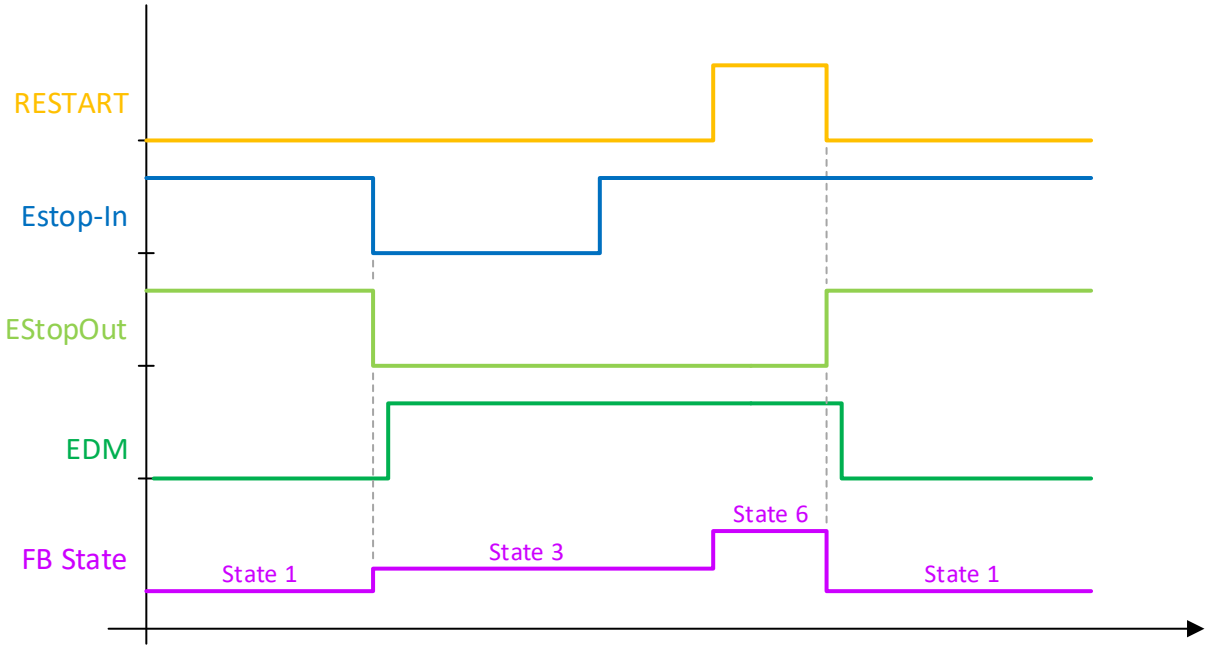
The function block expects a button with make contact at the restart input.

⚠ CAUTION

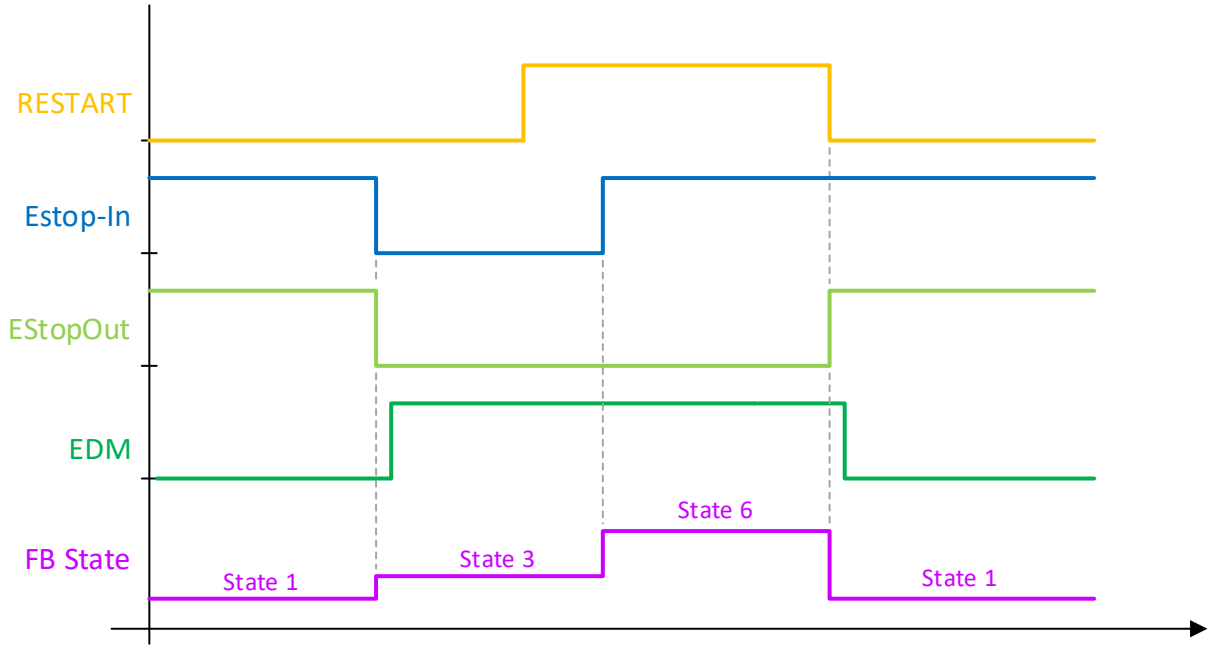
Restart

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.

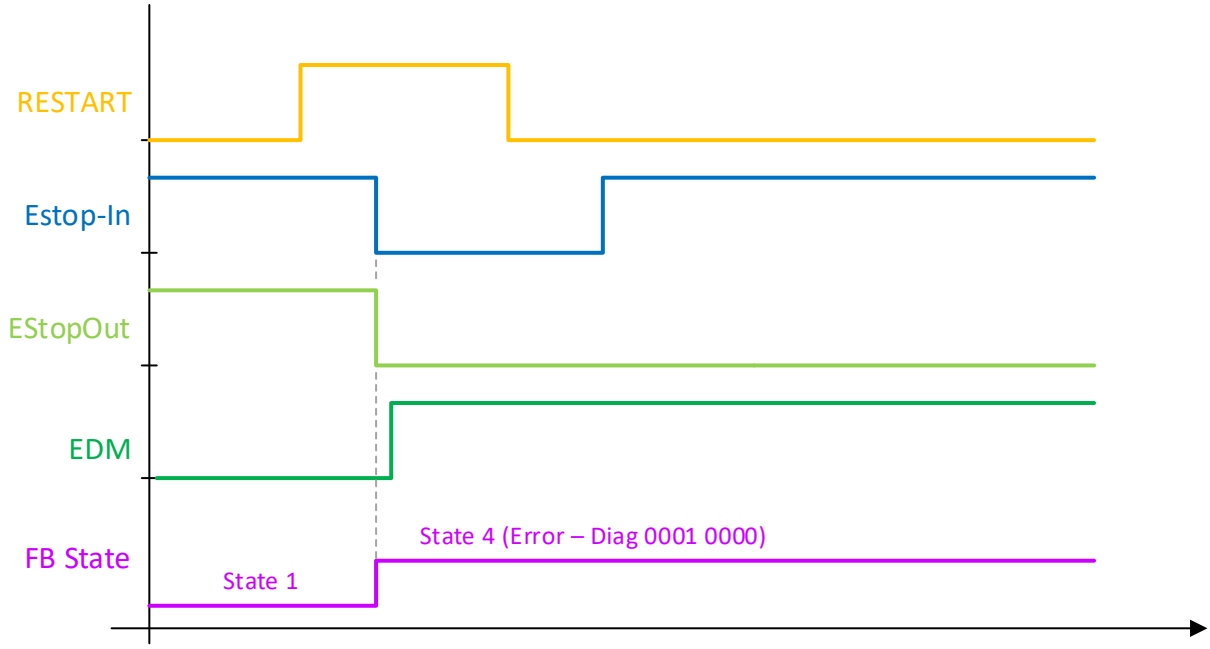
The following diagram shows the behavior when an emergency stop is triggered via Estop-In and subsequent acknowledgement of the ESTOP function block via the Restart input. At least one of the EDM inputs of the FB is active.



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.

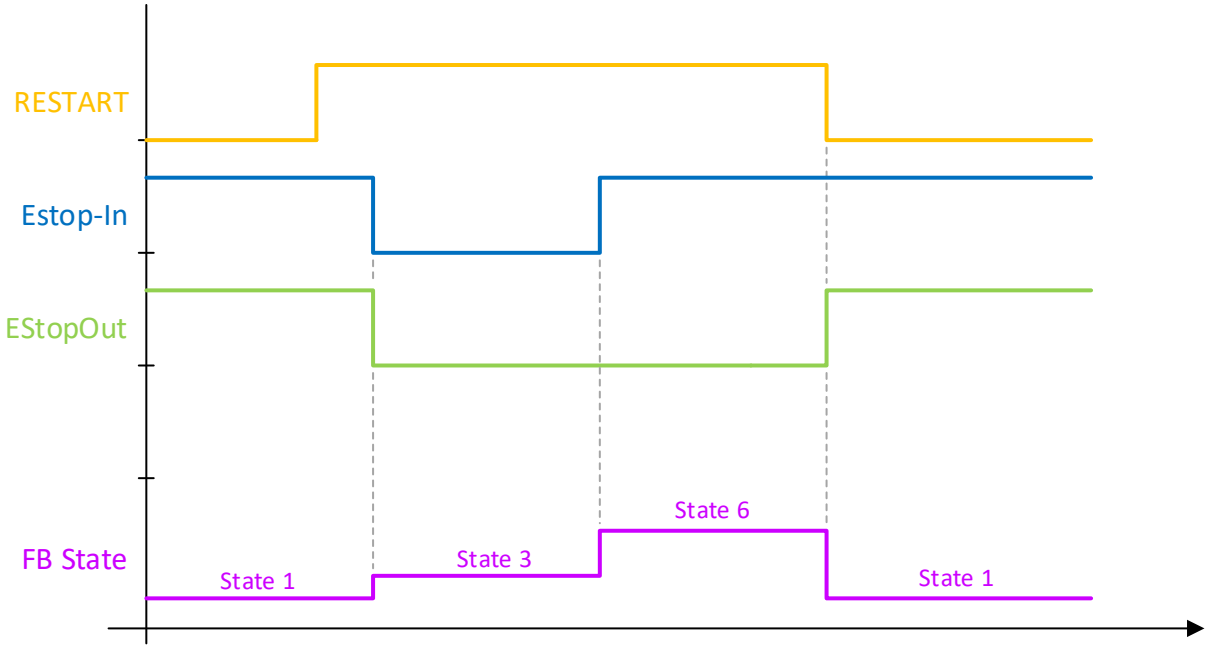


In the following diagram the Restart input is set to TRUE before the emergency stop event takes place. Due to the Restart input signal, the EDM signal is checked immediately when the EStop-In input changes from TRUE to FALSE. This immediately leads to an EDM error and to the shutdown of the entire TwinSAFE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



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.

NOTE
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. (see also TwinSAFE Application Guide, e.g. chapter 2.3).



3.4.5 ESTOP extension

NOTE

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.

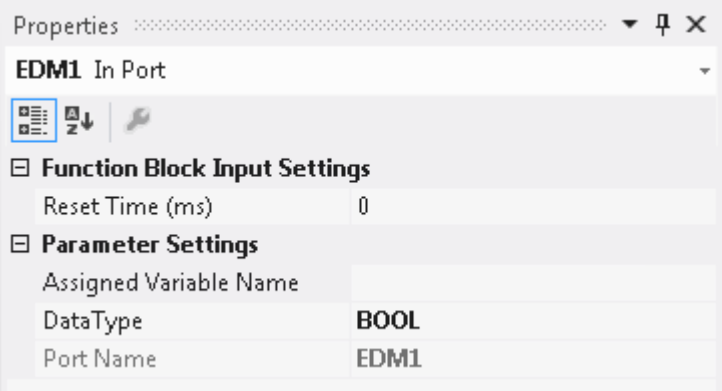


Figure 3-15 EDM Reset Time

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)*.

3.4.6 Display in TwinCAT 3

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

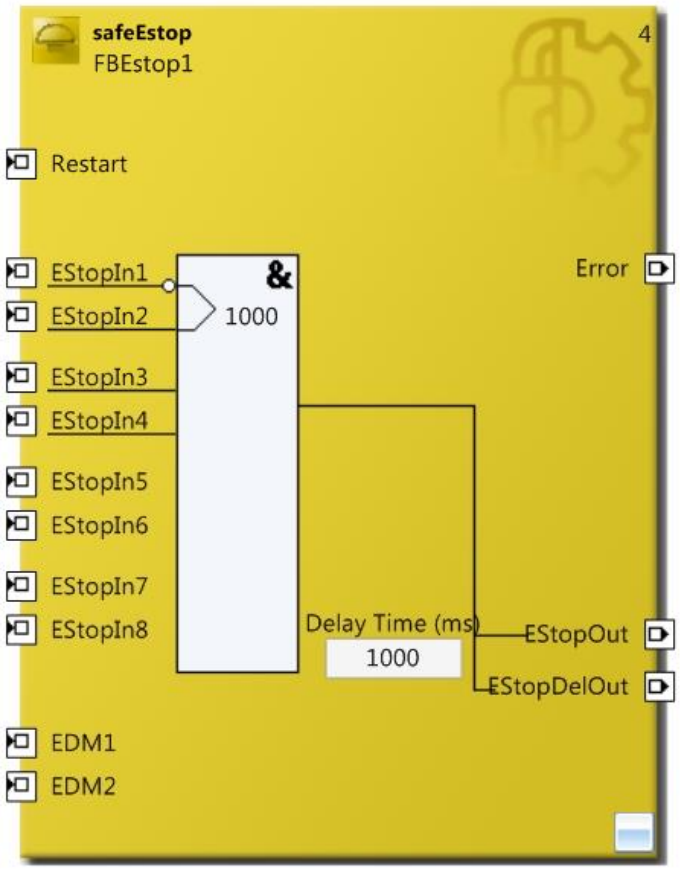


Figure 3-16 FB ESTOP in TwinCAT 3

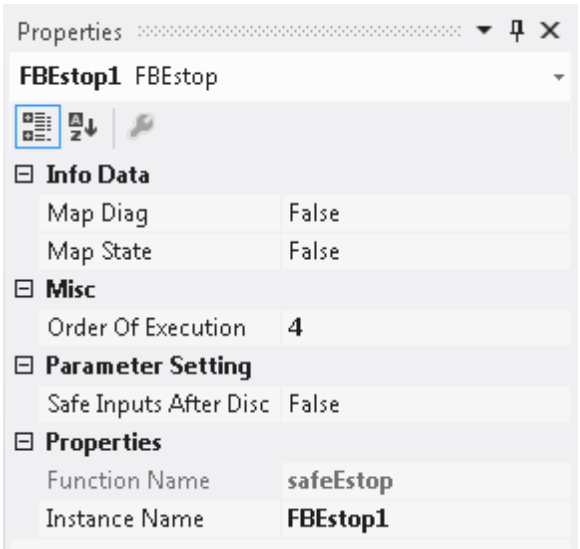


Figure 3-17 FB ESTOP properties

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.

3.5 The function block MON

3.5.1 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 request 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. To exit the safe state of the outputs, a rising and falling edge must be detected at the Restart input when Restart is active (see also chapter 3.5.4 Restart behavior). 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.

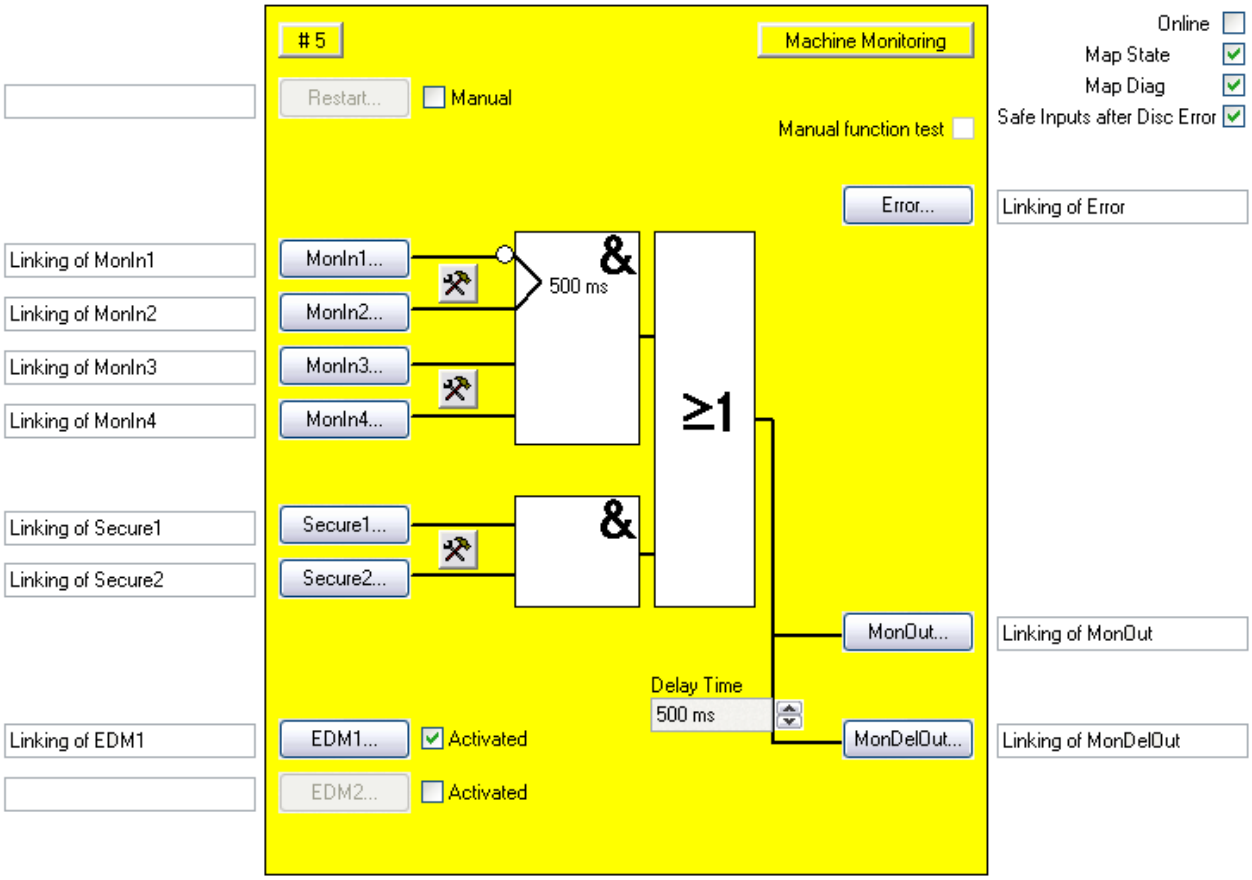


Figure 3-18: MON function block

A feedback loop can 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 when the FB changes to the START state (6) (see 3.5.4 Restart behavior).
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 through acknowledgement via the ERR_ACK input of the associated TwinSAFE group.

If Restart is disabled, the 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.

NOTE
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.

3.5.2 Signal description

Table 3-25: FB MON inputs

Name	Permitted type	Data type	Description
Restart	TwinSAFE-In FB-Out Standard-In	BOOL	Manual restart active: When the FB is started 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.
MonIn1	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).
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
Secure1	TwinSAFE-In FB-Out	BOOL	Secure1 enabled: Evaluation of the inputs MonIn(x) can be disabled. 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.
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.

Table 3-26: 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.

Table 3-27: Input and output types

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

Table 3-28: Internal identifier of the FB

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

3.5.2.1 Diagnostic and state information for FB MON

Table 3-29: 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
5	EDM monitoring error EDM2
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)

Table 3-30: State information (8-bit value)

Value	Description
0	undefined
1	RUN The FB MON module assumes the RUN state if no error is present 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 The FB MON module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: Error=0 MonOut=0 MonDelOut=0
3	SAFE The FB MON module 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 module detects an error, the FB MON module assumes the ERROR state and transmits the corresponding Diag message to the GROUP module. The outputs assume the following values: Error=1 MonOut=0 MonDelOut=0
5	RESET The FB MON module 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 The FB MON module 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 leave the safe state. This state can only be assumed if manual restart is enabled in the configuration data. The outputs assume the following values: Error=0 MonOut=0 MonDelOut=0

Value	Description
7	ERRORDELAY The FB MON module assumes the ERRDELAY state if a discrepancy error occurs in the RUN state (DiscError=TRUE) 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 0. The outputs assume the following values: Error=0 MonOut=0 MonDelOut=1
8	DELAYOUT The FB MON module 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 0. The outputs assume the following values: Error=0 MonOut=0 MonDelOut=1
9	FUNCTEST The FB MON module 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 enabled 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 state and diagnostic data of the FB are copied to the cyclic process image.

NOTE

KL6904

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

3.5.3 FB MON configuration in the TwinCAT System Manager

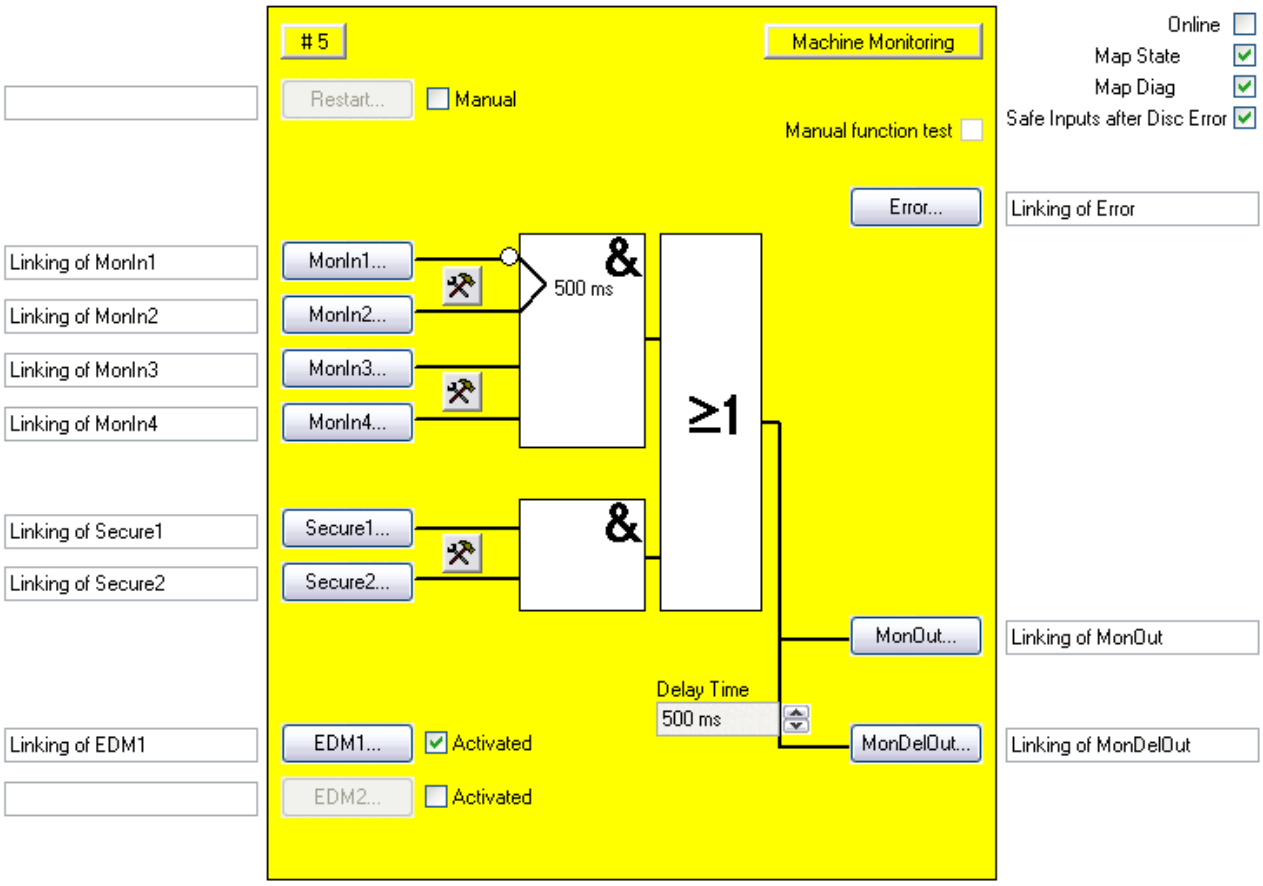


Figure 3-19: FB MON configuration

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 'MapState' and 'MapDiag' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

3.5.4 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.

NOTE

Restart input

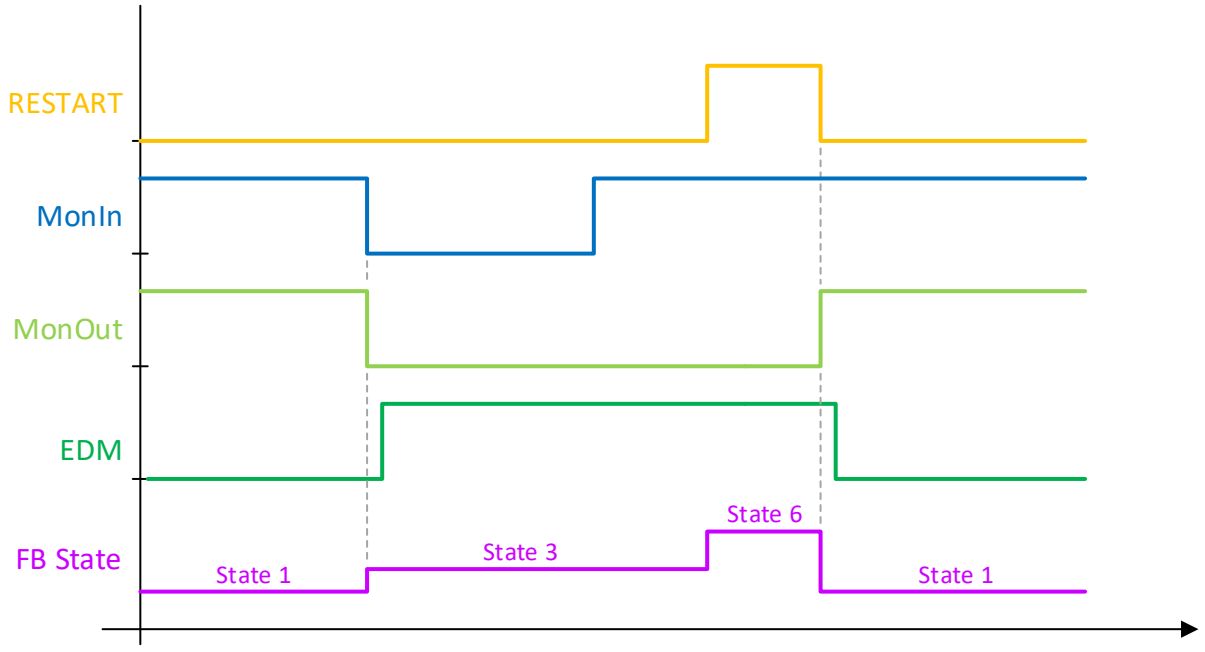
The function block expects a button with make contact at the restart input.

⚠ CAUTION

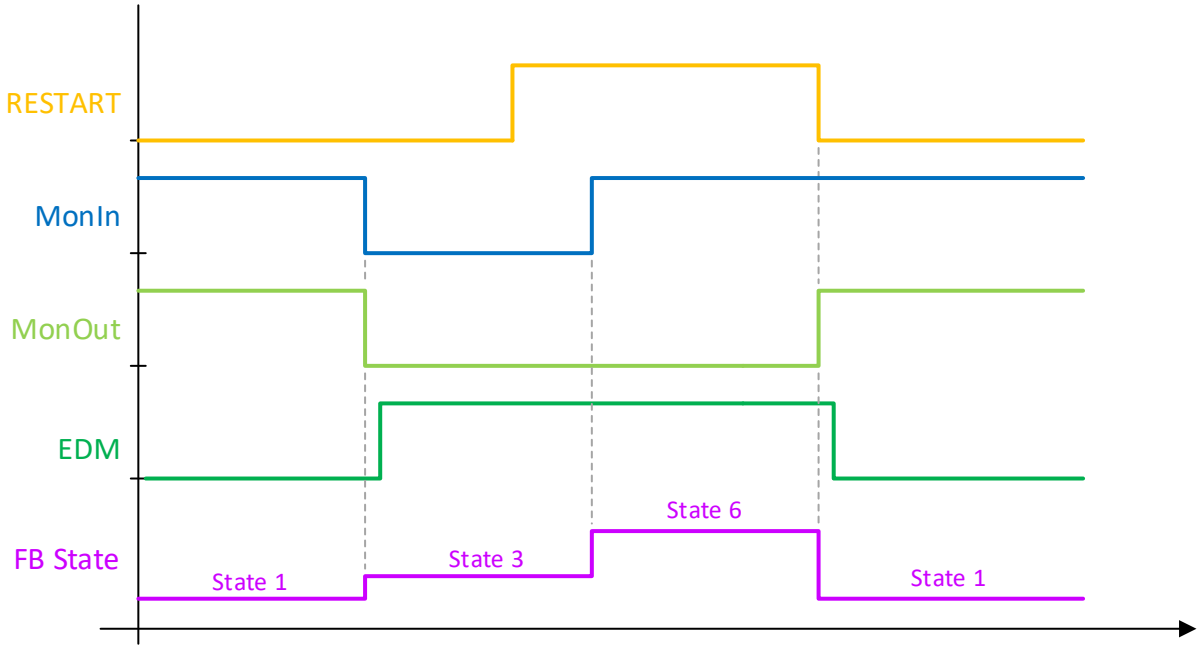
Restart

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.

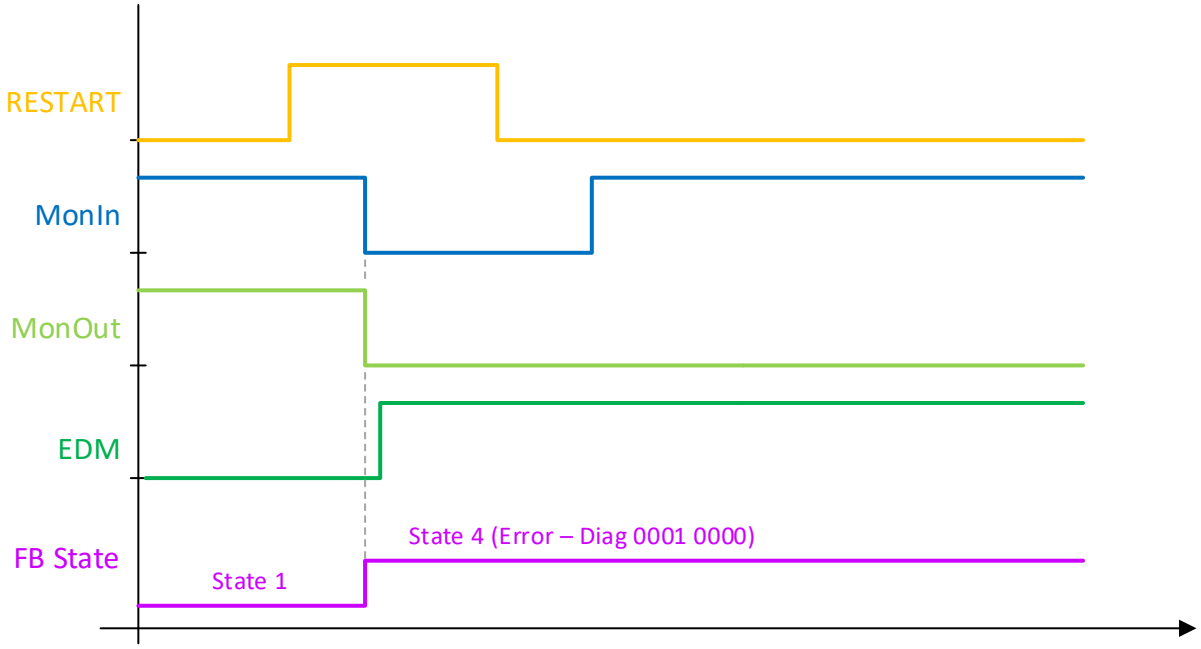
The following diagram shows the behavior when an event is triggered via MonIn and subsequent acknowledgement of the MON function block via the Restart input. At least one of the EDM inputs of the FB is active.



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.



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.



3.5.5 MON extension

NOTE

Support

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

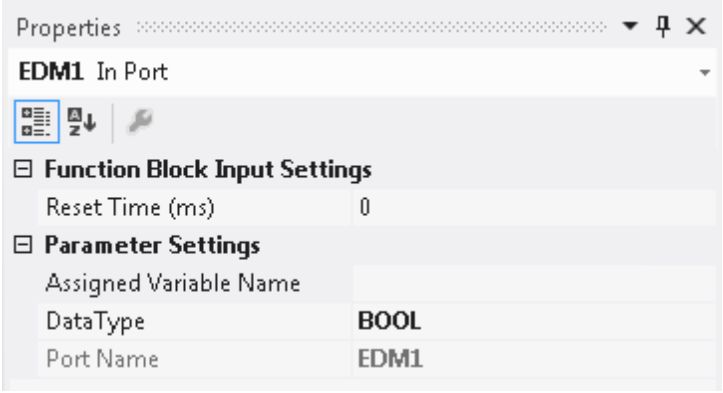


Figure 3-20 EDM Reset Time

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)*.

3.5.6 Display in TwinCAT 3

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

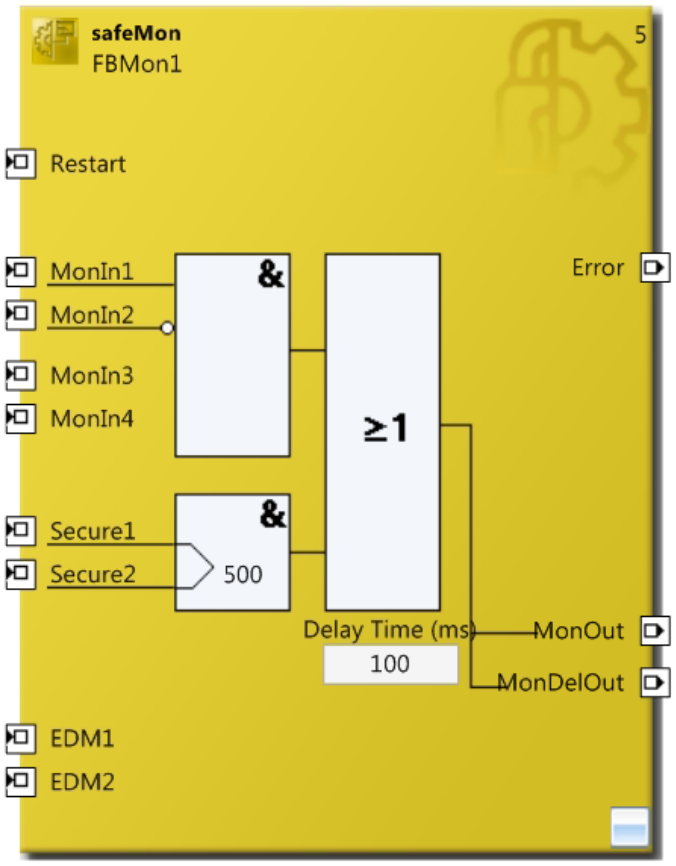


Figure 3-21 FB MON in TwinCAT 3

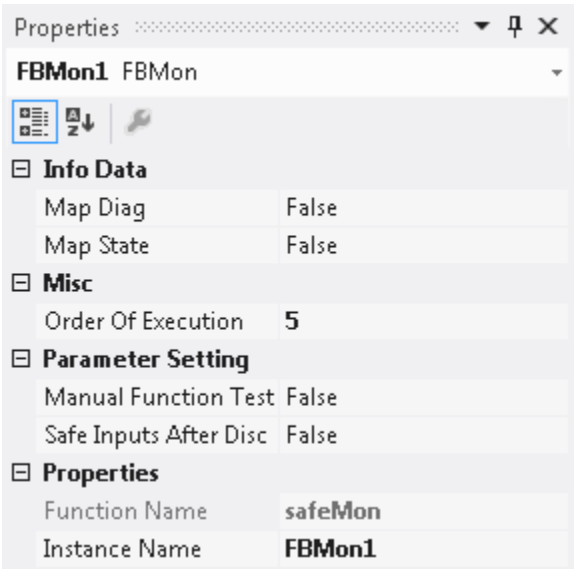


Figure 3-22 FB MON properties

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.

3.6 The function block DECOUPLE

3.6.1 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.

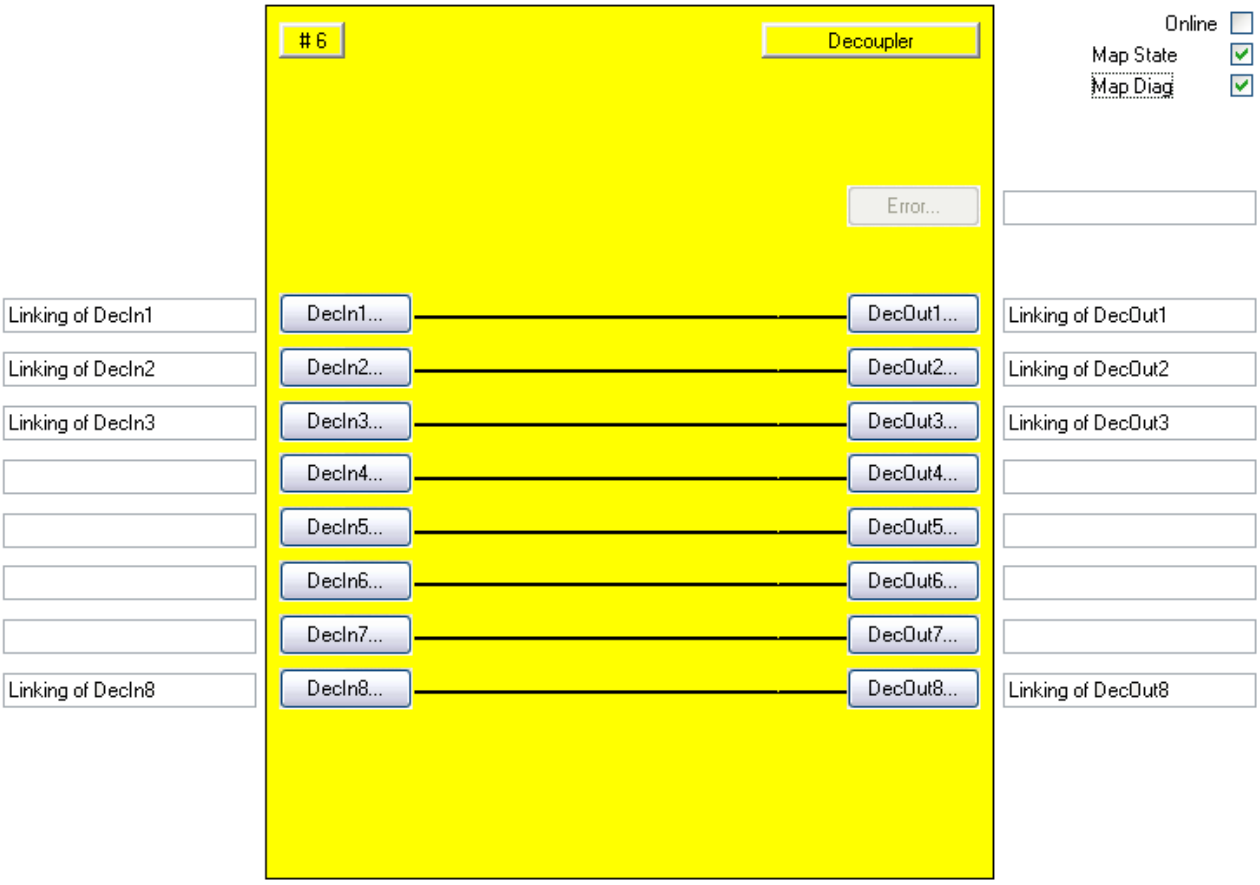


Figure 3-23: DECOUPLE function block

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.

3.6.2 Signal description

Table 3-31: FB DECOUPLE inputs

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

Table 3-32: 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

Table 3-33: Input and output types

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

Table 3-34: Internal identifier of the FB

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

3.6.2.1 Diagnostic and state information for FB DECOUPLE

Table 3-35: Diagnostic information (16-bit value)

Bit	Description
0	always 0

Table 3-36: State information (8-bit value)

Value	Description
0	undefined
1	RUN The FB DECOUPLE module assumes the RUN state if the input FbRun is TRUE. The outputs assume the following values: DcOutX=DcInX
2	STOP The FB DECOUPLE module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: DcOutX=0

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

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

3.6.3 FB DECOUPLE configuration in the TwinCAT System Manager

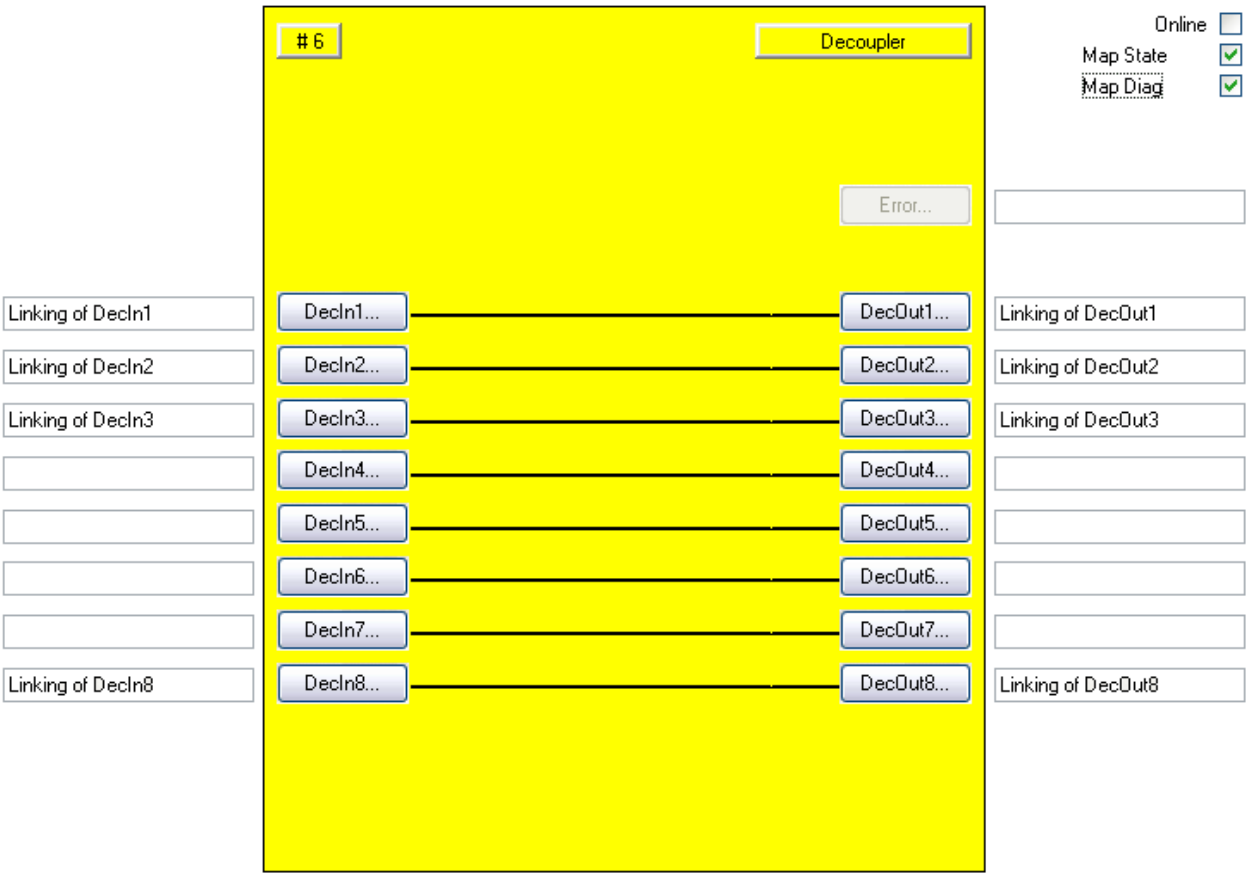


Figure 3-24: FB DECOUPLE configuration

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 'MapState' and 'MapDiag' 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.

3.6.4 Display in TwinCAT 3

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

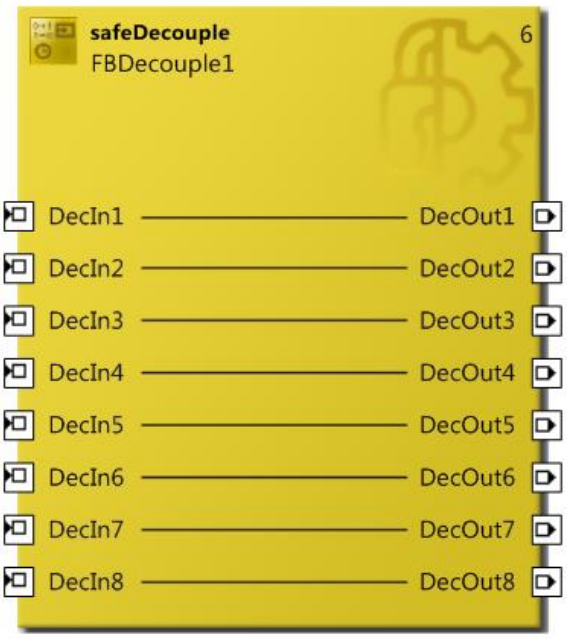


Figure 3-25 FB DECOUPLE in TwinCAT 3

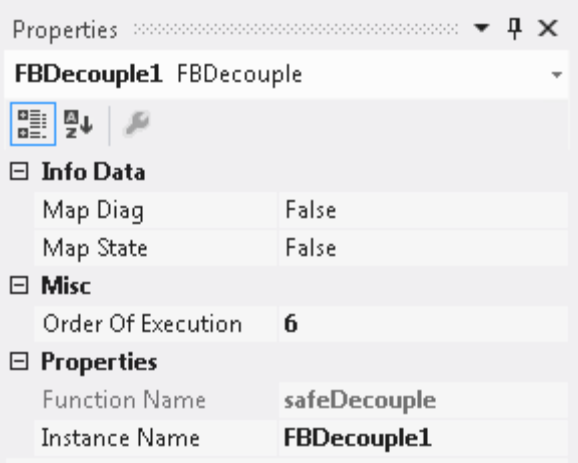


Figure 3-26 FB DECOUPLE properties

3.7 The function block TWOHAND

3.7.1 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).

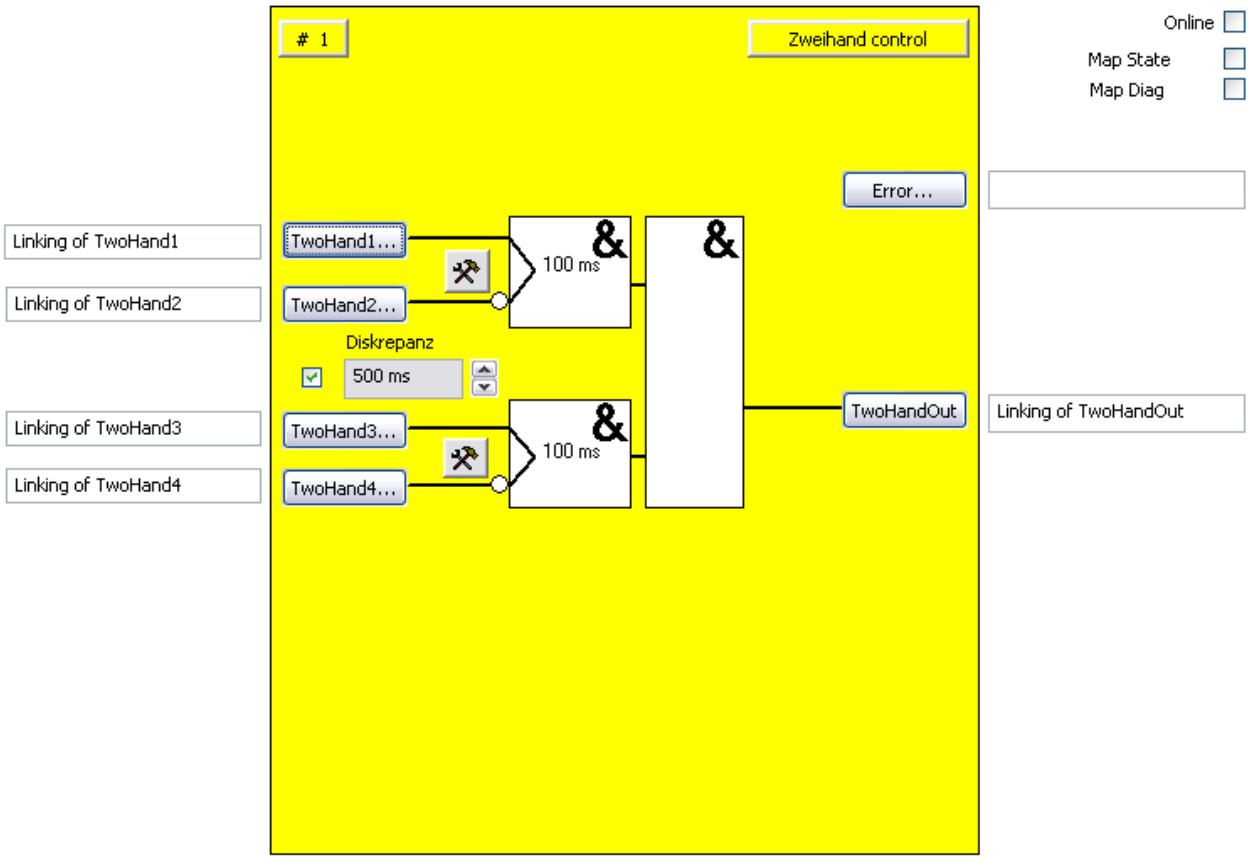


Figure 3-27: TWOHAND function block

NOTE
KL6904 The TwoHand function block is not available in the KL6904.

3.7.2 Signal description

Table 3-37: 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, behaves like Twohand1 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.
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

Table 3-38: 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.

Table 3-39: Input and output types

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

Table 3-40: Internal identifier of the FB

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

3.7.2.1 Diagnostic and state information for FB TWOHAND

Table 3-41: 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 issued 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)

Table 3-42: State information (8-bit value)

Value	Description
0	undefined
1	RUN The FB TWOHAND module assumes the RUN state if all active inputs are TRUE. The FB TWOHAND module can only assume the RUN state from one of the states 1BUTTON or 2BUTTON. The outputs assume the following values: Error=0 TwoHandOut=1
2	STOP The FB TWOHAND module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: Error=0 TwoHandOut=0
3	SAFE The FB TWOHAND module assumes the SAFE state if all active inputs are FALSE. The FB TWOHAND module exits the SAFE state if all active inputs of an input group are TRUE. The outputs assume the following values: Error=0 TwoHandOut=0
4	ERROR If the FB TWOHAND module detects an error, the FB TWOHAND module assumes the ERROR state and transmits the corresponding Diag message to the GROUP module. The outputs assume the following values: Error=1 TwoHandOut=0

Value	Description
5	RESET The FB TWOHAND module 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, the module FB TWOHAND assumes the 1BUTTON state. The FB TWOHAND module 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, the module FB TWOHAND assumes the 2BUTTON state. The FB TWOHAND module 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, the FB TWOHAND module 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

3.7.3 FB TWOHAND configuration in the TwinCAT System Manager

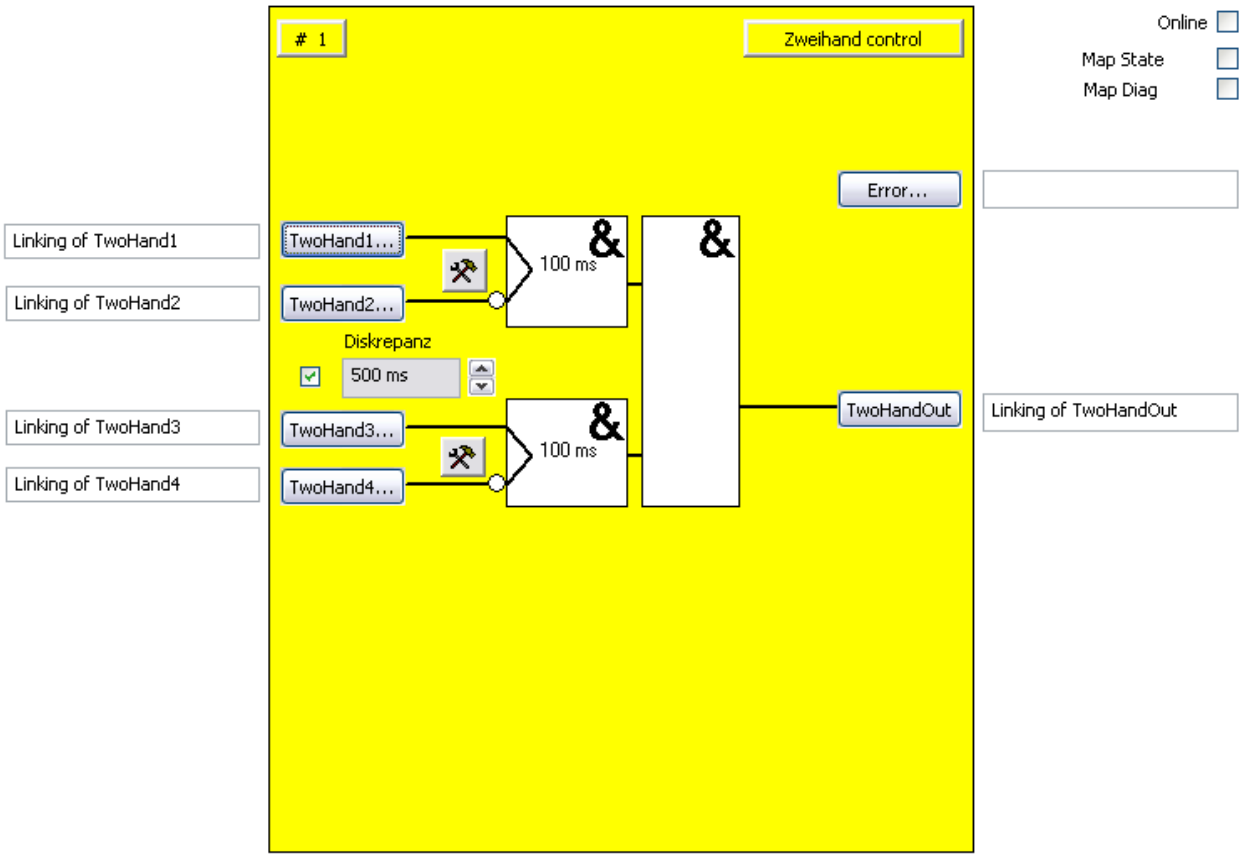


Figure 3-28: FB TWOHAND configuration

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 'MapState' and 'MapDiag' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

3.7.4 Display in TwinCAT 3

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

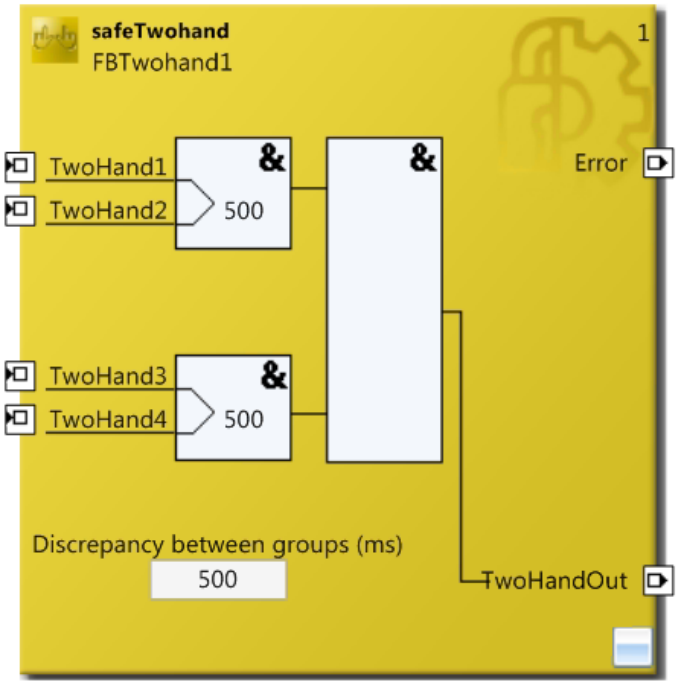


Figure 3-29 FB TWOHAND in TwinCAT 3

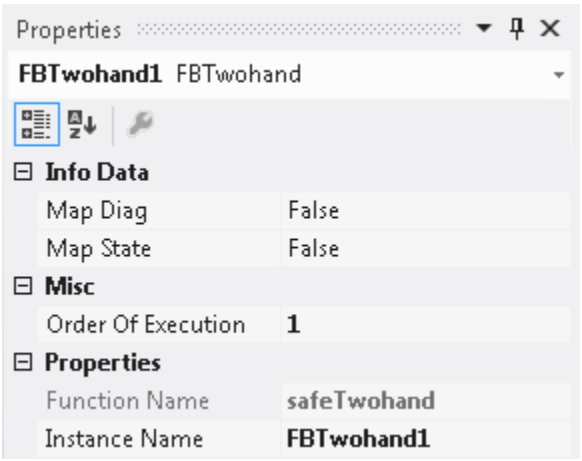


Figure 3-30 FB TWOHAND properties

3.8 The function block MUTING

3.8.1 Functional description

FB MUTING is used to realize specified suppression of the protective function, e.g. for transporting material into the protection zone. 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.

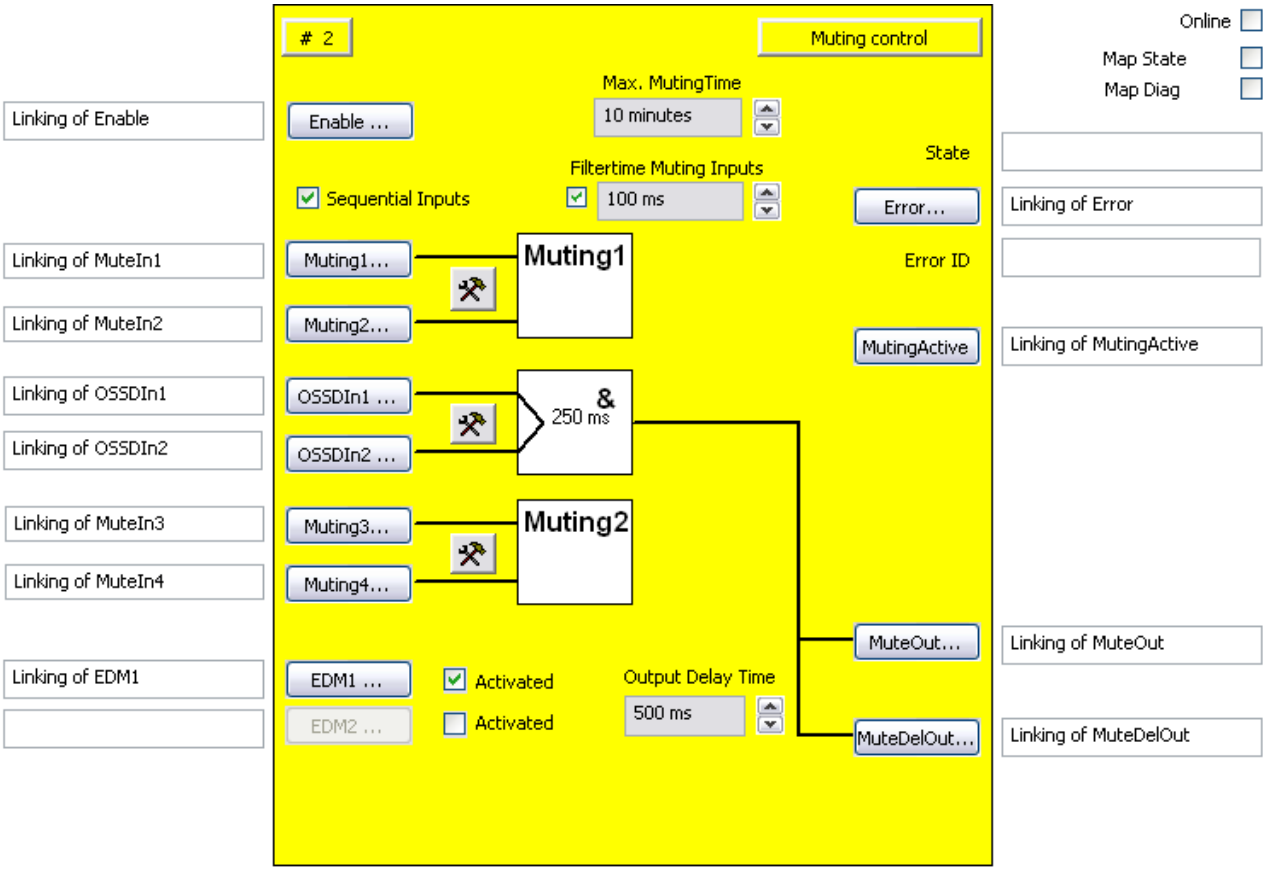


Figure 3-31: MUTING function block

NOTE
KL6904 The Muting function block is not available in the KL6904.

3.8.2 Signal description

Table 3-43: FB MUTING inputs

Name	Permitted type	Data type	Description
Enable	TwinSAFE-In FB-Out Standard-In	BOOL	Muting can be activated via the Enable input. If the input is logic 0 an interruption of the protective device results in immediate shutdown of the FB output.
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, behaves like MutingIn1 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
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
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.
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 matches OSSDIn1 If the discrepancy time is not 0, the 1st and 2nd OSSD inputs are considered as an input pair. Discrepancy time monitoring between the two channels is active if one of the two input channels requests the safe state.

Table 3-44: FB MUTING outputs

Name	Permitted type	Data type	Description
Error	TwinSAFE-Out FB-In Standard-Out	BOOL	TRUE: The discrepancy time monitoring of a two-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 output is delayed based on the parameterized Output Delay time.

Table 3-45: Input and output types

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

Table 3-46: Internal identifier of the FB

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

3.8.2.1 Diagnostic and state information for FB MUTING

Table 3-47: 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)

Table 3-48: State information (8-bit value)

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

Value	Description
5	RESET The FB MUTING module 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 module assumes the DELAYOUT state if OssdInActive is FALSE and MutingEnable is FALSE and the delay time for the MuteDelOut output has not yet expired. If a discrepancy error occurs in the DELAYOUT state, the FB MUTING module does not assume the ERROR state until 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 number 2-3) The outputs assume the following values: Error=0 MutingActive=1 MuteOut=1 MuteDelOut=1
10	MUTING2 (Figure 3-35 number 3-4) Outputs see state 9
11	MUTING3 (Figure 3-35 number 4-5) Outputs see state 9
12	MUTING4 (Figure 3-35 number 5-6) Outputs see state 9
13	MUTING5 (Figure 3-35 number 6-7) Outputs see state 9
14	MUTING6 (Figure 3-35 number 7-8) Outputs see state 9
15	MUTING7 (Figure 3-35 number 8-9) Outputs see state 9
16	MUTING8 (Figure 3-35 number 9-10) Outputs see state 9
17	MUTING9 (Figure 3-35 number 10-11) Outputs see state 9

3.8.3 FB MUTING configuration in the TwinCAT System Manager

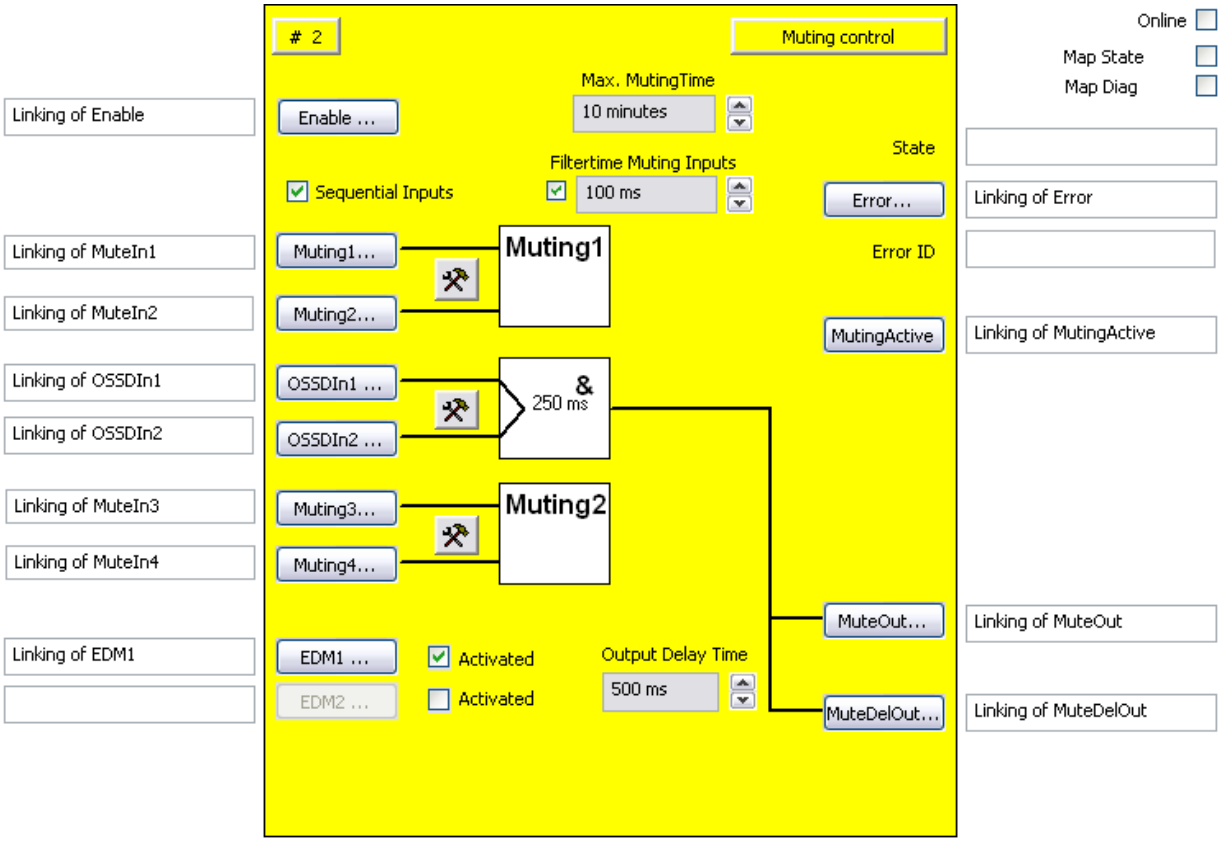


Figure 3-32: FB MUTING configuration

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.

NOTE
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 'MapState' and 'MapDiag' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

3.8.3.1 Configuration example with 4 individual muting sensors

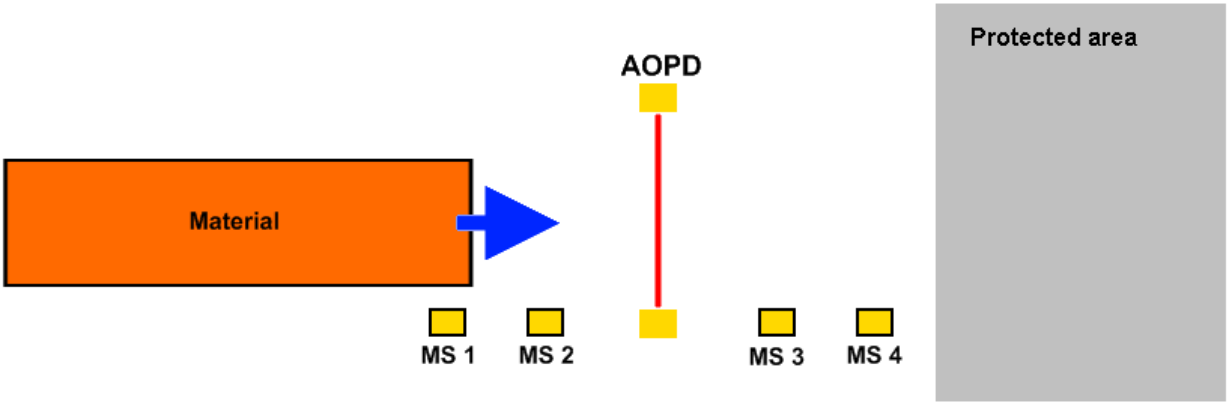


Figure 3-33: Configuration example with FB MUTING

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.

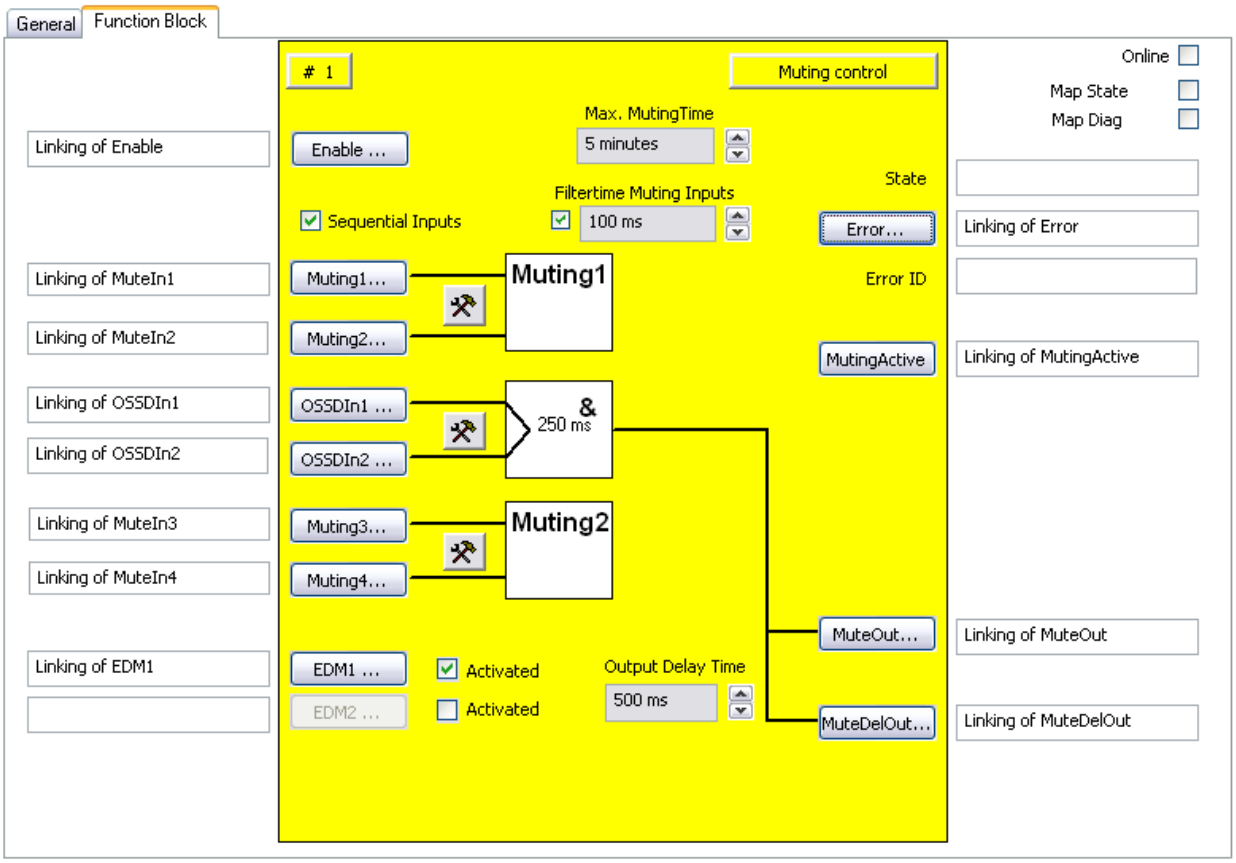


Figure 3-34: Muting example

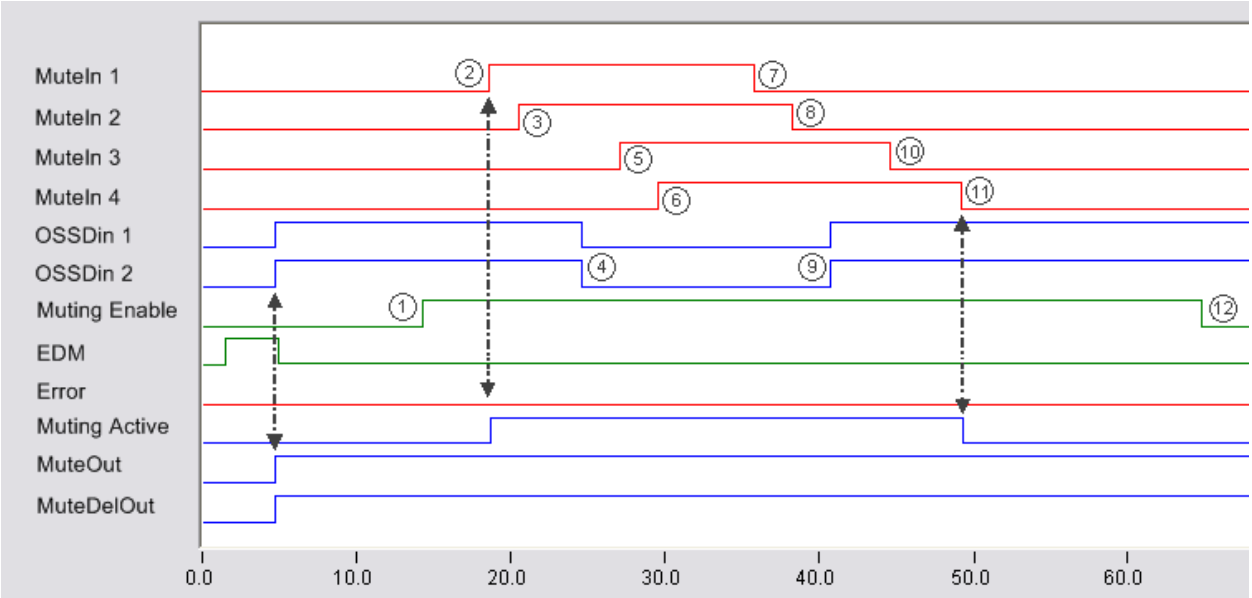


Figure 3-35: Muting FB sequence

3.8.3.2 Configuration example with two two-channel muting sensors

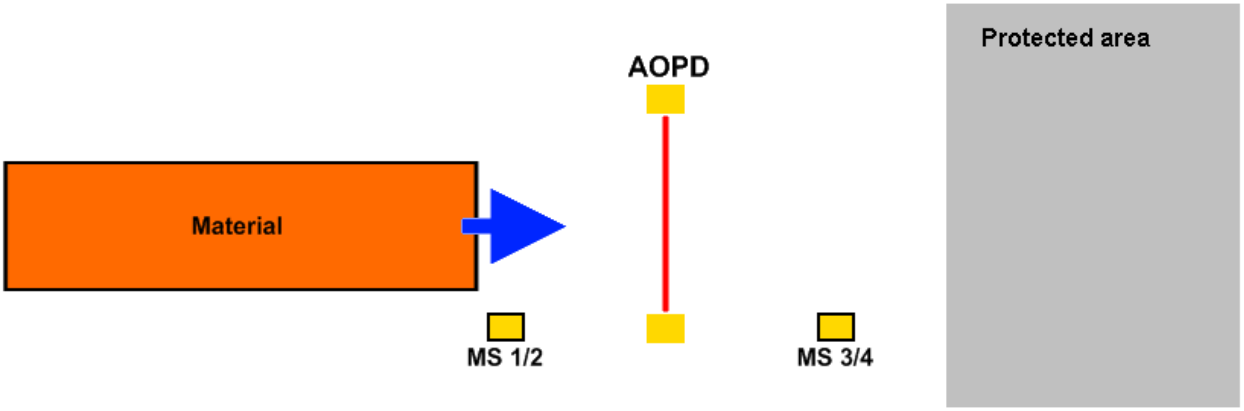


Figure 3-36: Configuration example with two two-channel muting sensors

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.

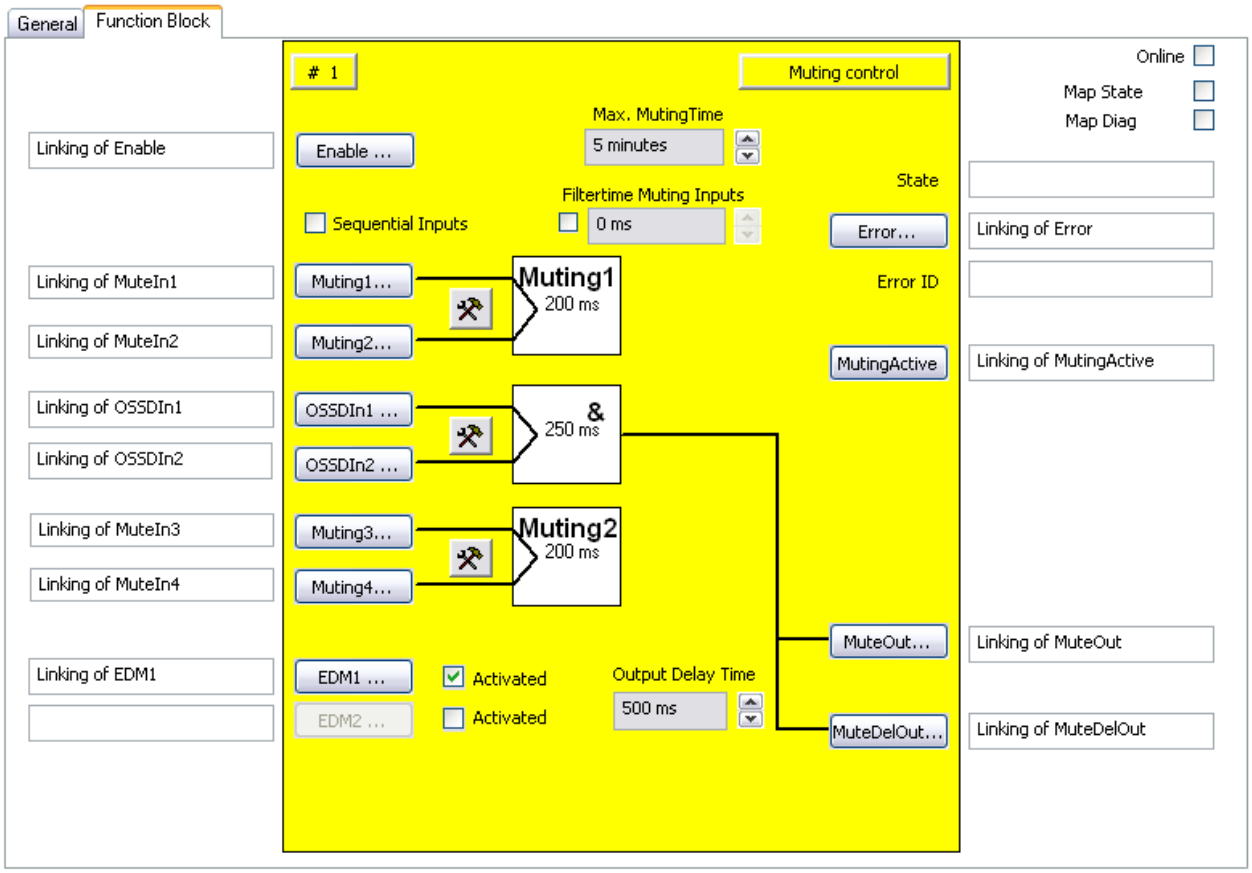


Figure 3-37: Muting example

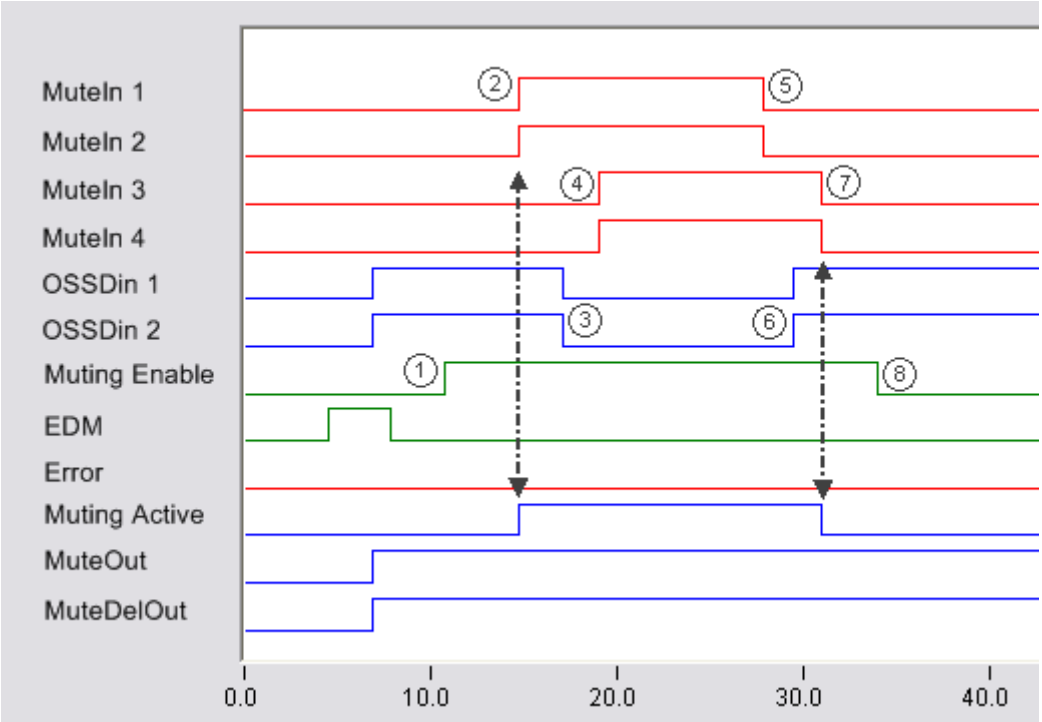


Figure 3-38: Muting FB sequence

3.8.4 Extensions FB Muting EL/EJ6910

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

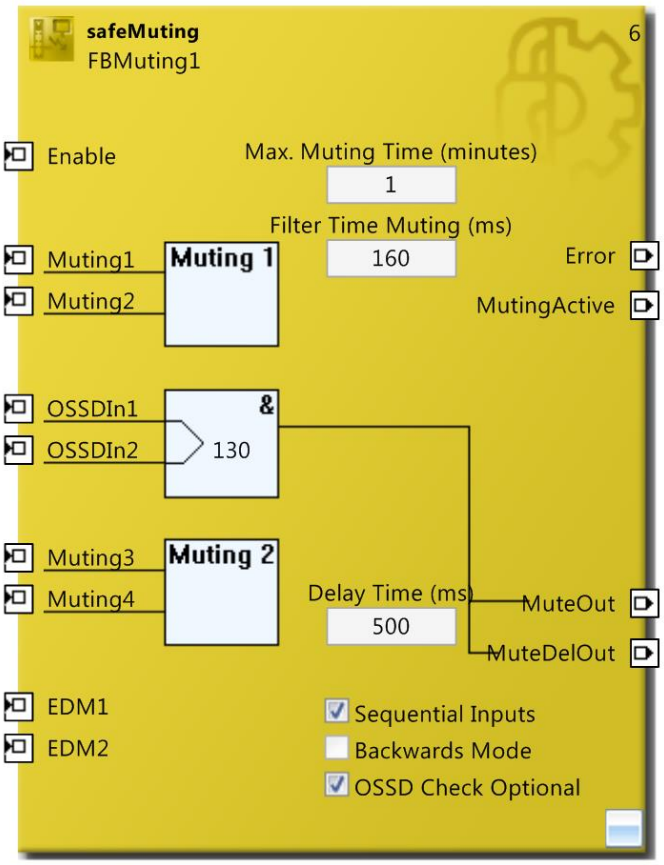


Figure 3-39 FB Muting EL6910

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 *Muting1*, *Muting2*, *OSSD1* and *OSSD2* are connected.

3.8.4.1 Diagnostic and state information for FB MUTING with functional expansion

Table 3-49: 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 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

Table 3-50: State information (8-bit value)

Value	Description (see Table 3-48)
0	undefined
1	RUN
2	STOP
3	SAFE
4	ERROR
5	RESET
6	not used
7	not used
8	DELAYOUT
9	MUTING1 (Figure 3-35 number 2-3)
10	MUTING2 (Figure 3-35 number 3-4)
11	MUTING3 (Figure 3-35 number 4-5)
12	MUTING4 (Figure 3-35 number 5-6)
13	MUTING5 (Figure 3-35 number 6-7)
14	MUTING6 (Figure 3-35 number 7-8)
15	MUTING7 (Figure 3-35 number 8-9)
16	MUTING8 (Figure 3-35 number 9-10)
17	MUTING9 (Figure 3-35 number 10-11)

3.8.5 Display in TwinCAT 3

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

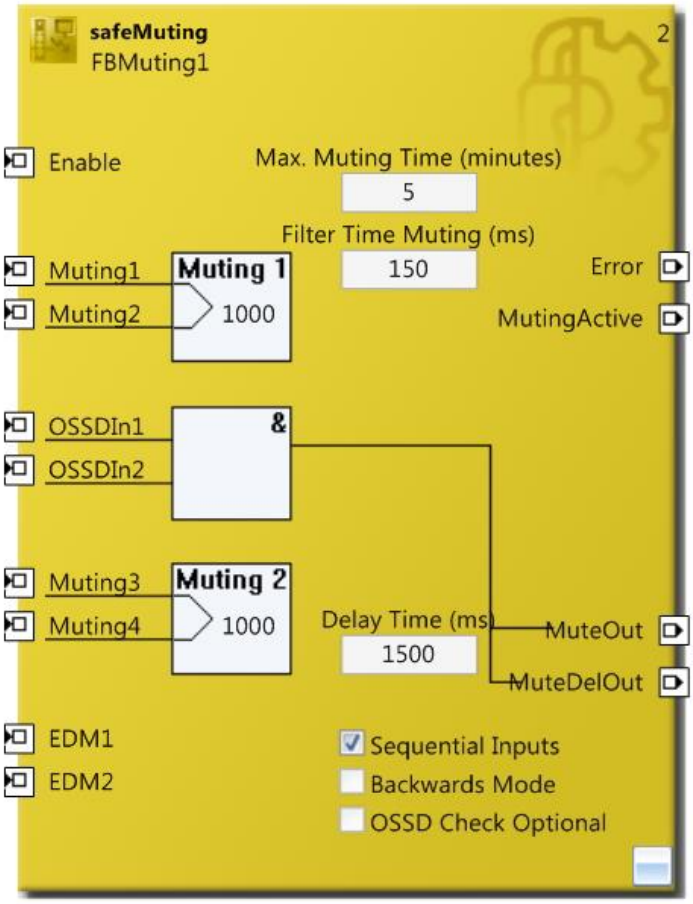


Figure 3-40 FB MUTING in TwinCAT 3

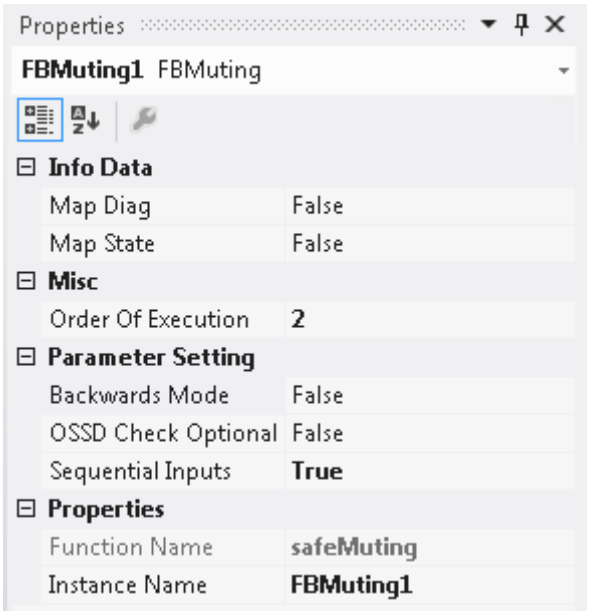


Figure 3-41 FB MUTING properties

3.9 The function block EDM

3.9.1 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 through acknowledgement via the ERR ACK input of the associated TwinSAFE group.

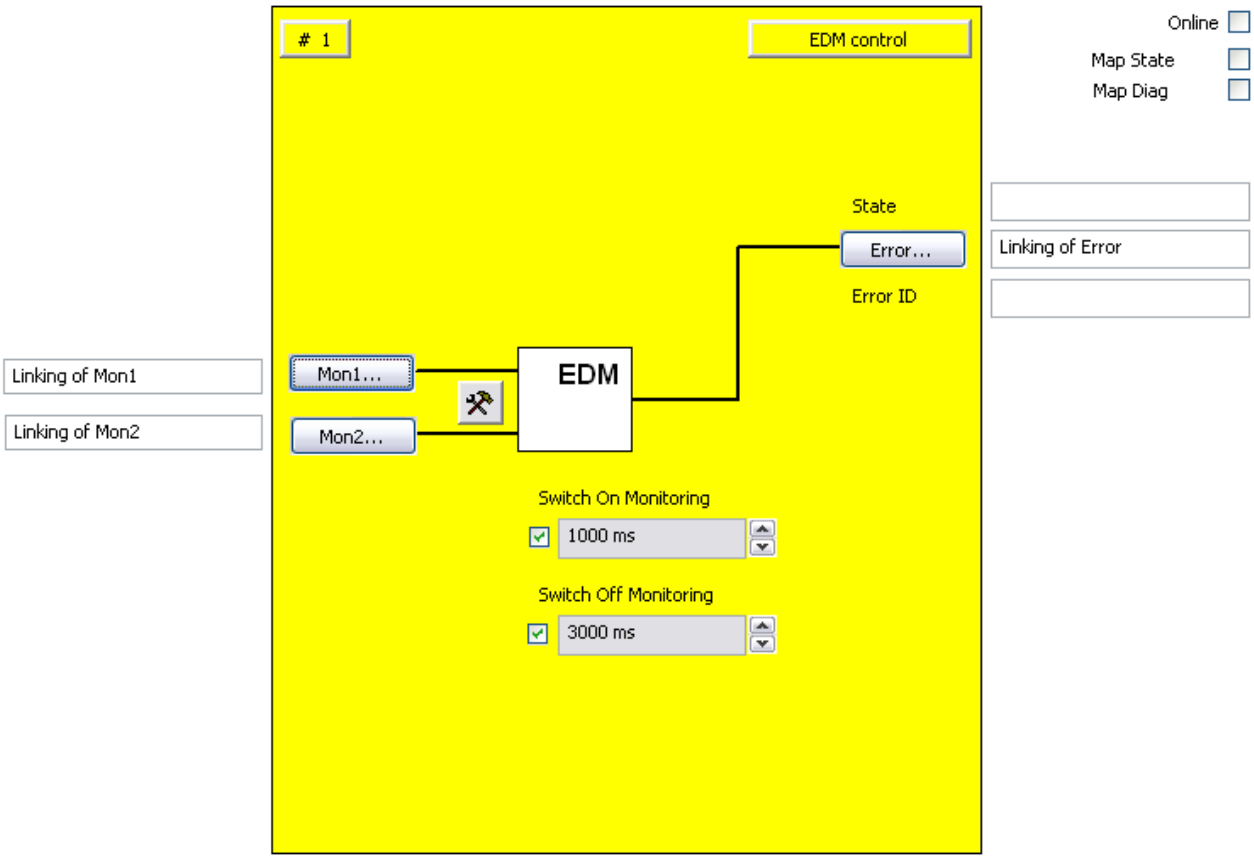


Figure 3-42: EDM function blocks

NOTE
KL6904 The EDM function block is not available in the KL6904.

3.9.2 Signal description

Table 3-51: 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.

Table 3-52: 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.

Table 3-53: Input and output types

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

Table 3-54: Internal identifier of the FB

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

3.9.2.1 Diagnostic and state information for FB EDM

Table 3-55: Diagnostic information (16-bit value)

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

Table 3-56: State information (8-bit value)

Value	Description
0	undefined
2	STOP The FB EDM module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: Error=0
4	ERROR If the FB EDM module detects an error, the FB EDM module assumes the ERROR state and transmits the corresponding Diag message to the GROUP module. The outputs assume the following values: Error=1
5	RESET The FB EDM module 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	MON_OFF If the input MonIn1 is FALSE, the FB EDM module assumes the MONOFF state in order to perform switch-off monitoring. The outputs assume the following values: Error=0
15	MON_ON If the input MonIn1 is TRUE, the FB EDM module assumes the MONON state in order to perform switch-on monitoring. The outputs assume the following values: Error=0

3.9.3 FB EDM configuration in the TwinCAT System Manager

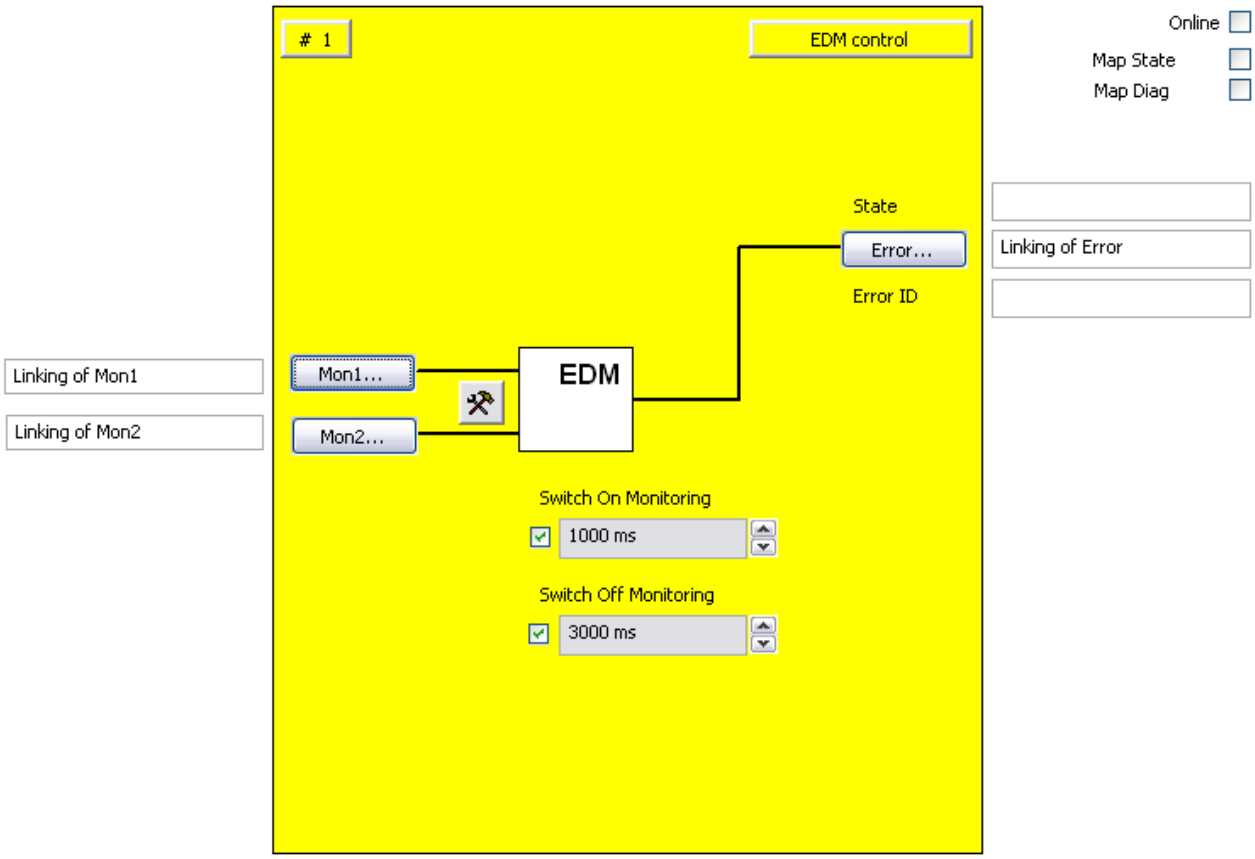


Figure 3-43: FB EDM configuration

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 'MapState' and 'MapDiag' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

3.9.4 Display in TwinCAT 3

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

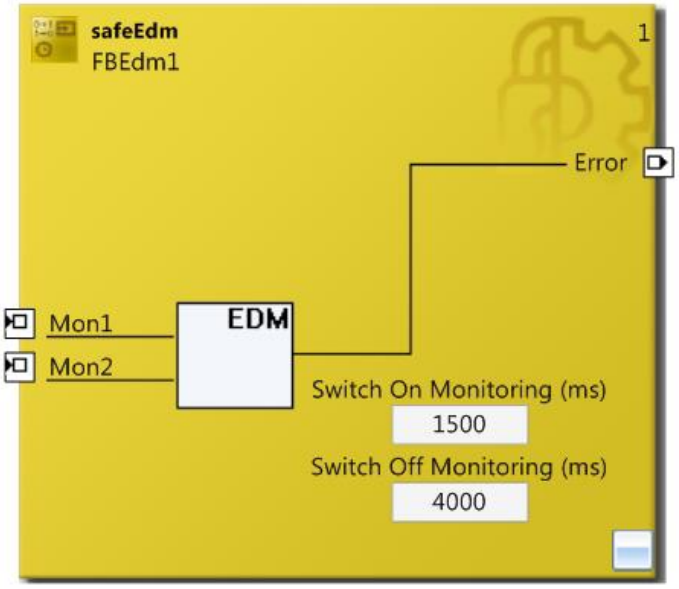


Figure 3-44: FB EDM in TwinCAT 3

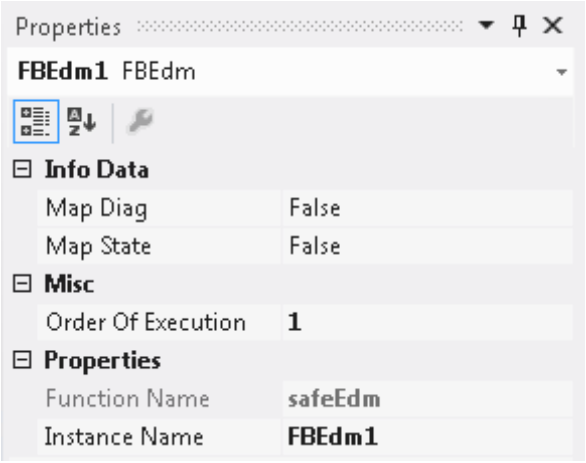


Figure 3-45: FB EDM properties

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.

3.10 The function block RS

3.10.1 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.

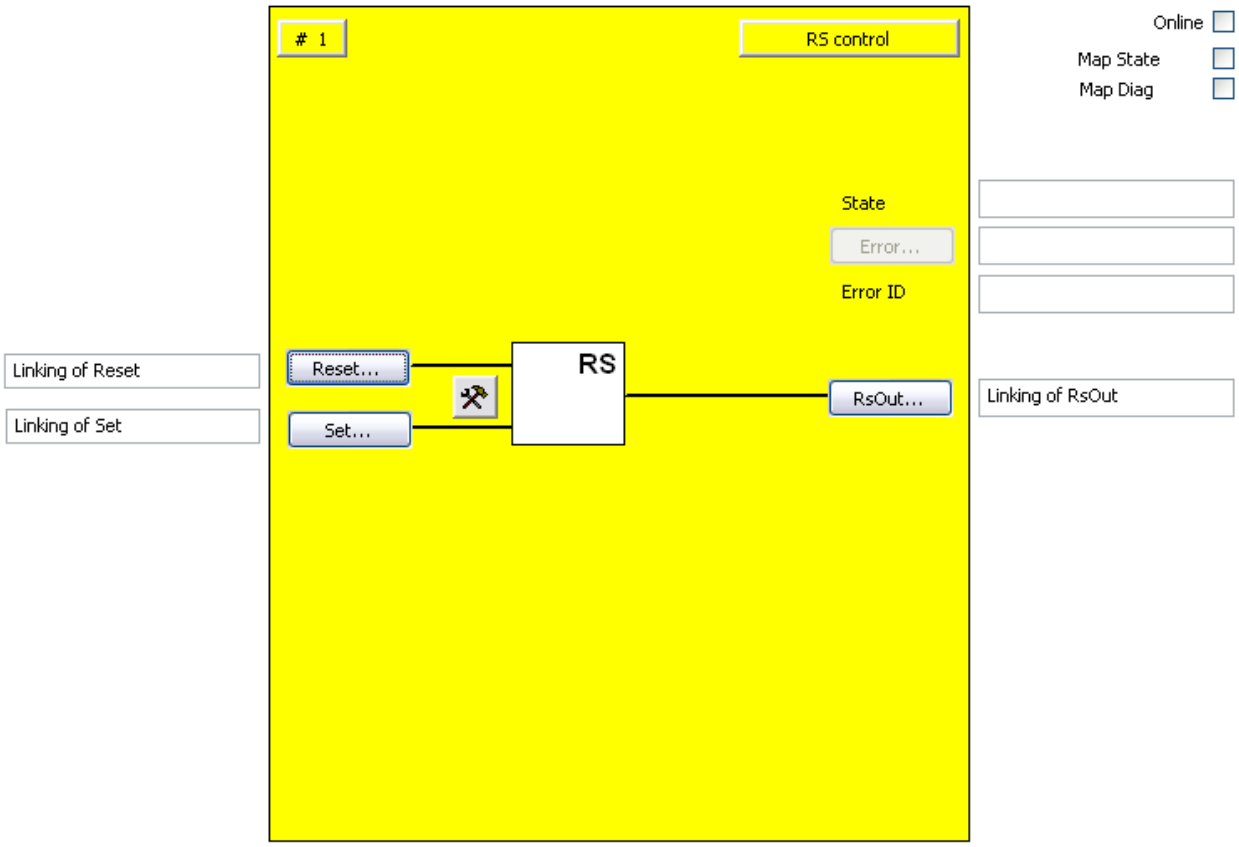


Figure 3-46: RS function block

NOTE
KL6904 The RS function block is not available in the KL6904.

3.10.2 Signal description

Table 3-57: 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.

Table 3-58: 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.

3.10.2.1 FB RS input and output types

Table 3-59: Input and output types

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

Table 3-60: Internal identifier of the FB

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

3.10.2.2 Diagnostic and state information for FB RS

Table 3-61: Diagnostic information (16-bit value)

Bit	Description
0-15	always 0

Table 3-62: State information (8-bit value)

Value	Description
0	undefined
2	STOP The FB RS module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: RsOut=0
3	SAFE If the Reset input is 1, the FB RS module assumes the SAFE state. The outputs assume the following values: RsOut=0

Value	Description
9	SET If the Reset input is 0 and the Set input is 1, the FB RS module assumes the RUN state. The outputs assume the following values: RsOut=1

3.10.3 FB RS configuration in the TwinCAT System Manager

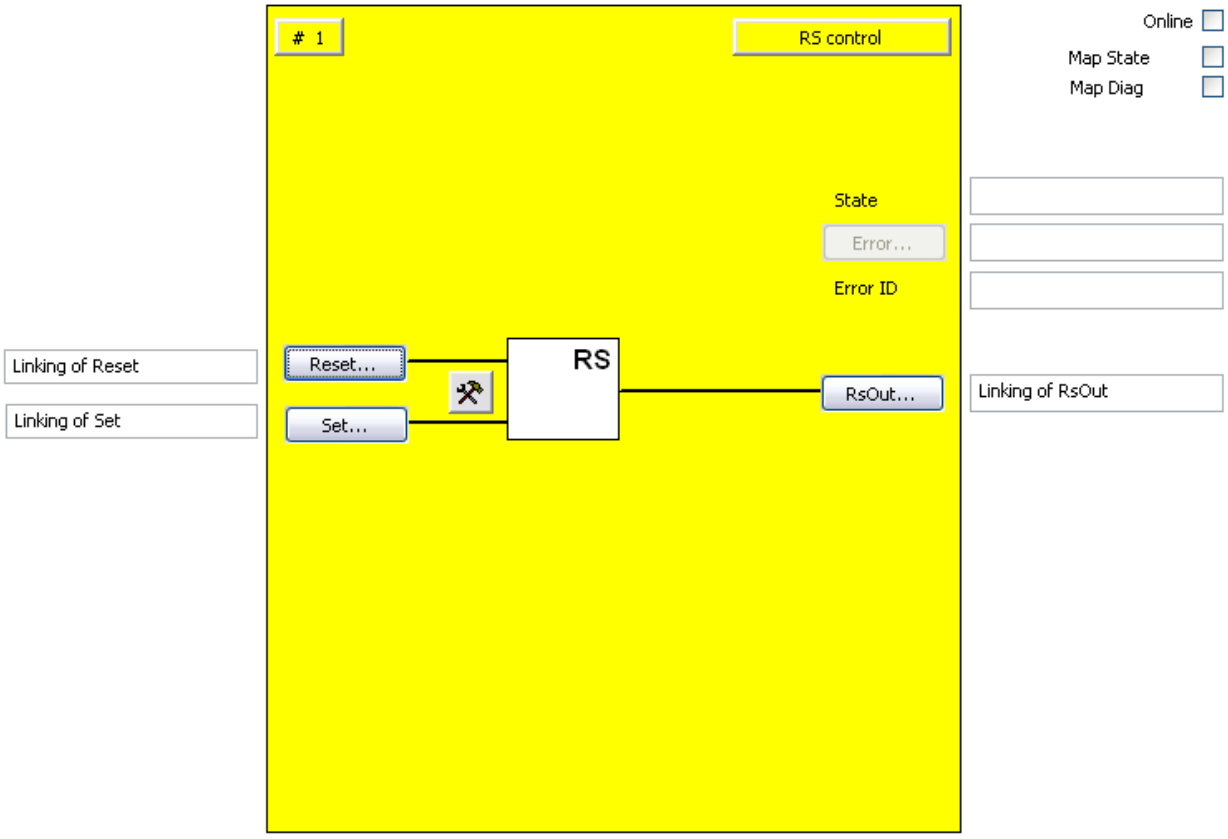


Figure 3-47: FB RS configuration

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). 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 '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 'MapState' and 'MapDiag' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

3.10.4 Display in TwinCAT 3

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

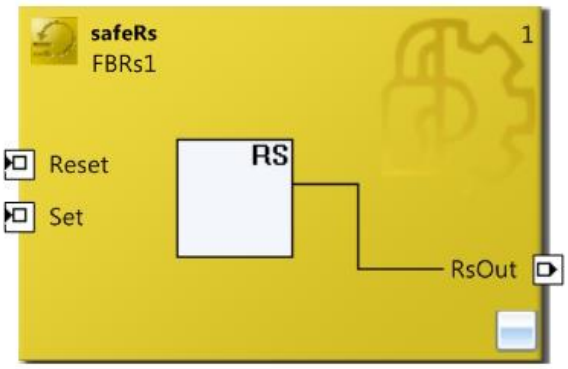


Figure 3-48: FB RS in TwinCAT 3

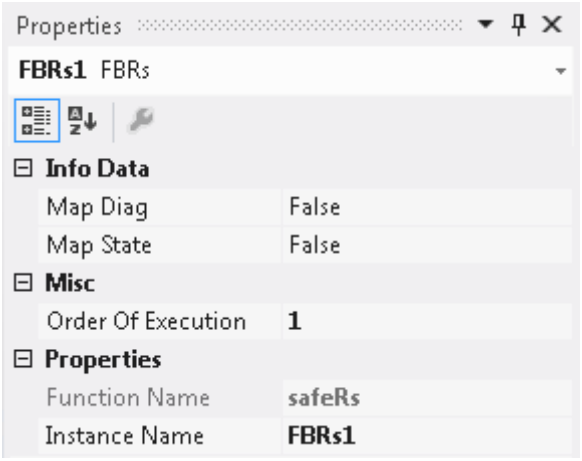


Figure 3-49: FB RS properties

3.11 The function block SR

3.11.1 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.

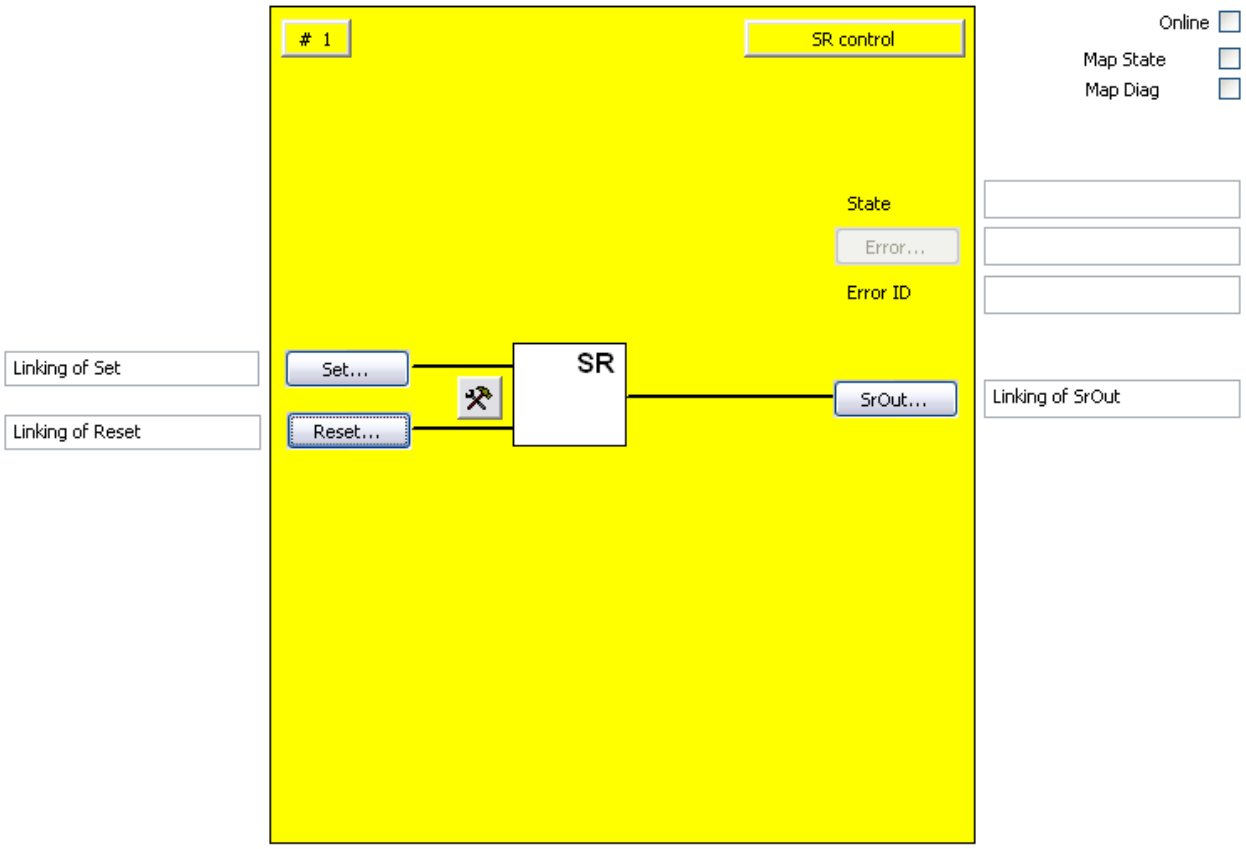


Figure 3-50: SR function block

NOTE
KL6904 The SR function block is not available in the KL6904.

3.11.2 Signal description

Table 3-63: FB SR inputs

Name	Permitted type	Data type	Description
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.
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.

Table 3-64: 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.

3.11.2.1 FB SR input and output types

Table 3-65: Input and output types

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

Table 3-66: Internal identifier of the FB

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

3.11.2.2 Diagnostic and state information for FB SR

Table 3-67: Diagnostic information (16-bit value)

Bit	Description
0-15	always 0

Table 3-68: State information (8-bit value)

Value	Description
0	undefined
2	STOP The FB SR module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: SrOut=0

Value	Description
3	SAFE If the Reset input is 1 and the Set input is 0, the FB SR module assumes the SAFE state. The outputs assume the following values: SrOut=0
9	SET If the Set input is 1, the FB SR module assumes the SET state. The outputs assume the following values: SrOut=1

3.11.3 FB SR configuration in the TwinCAT System Manager

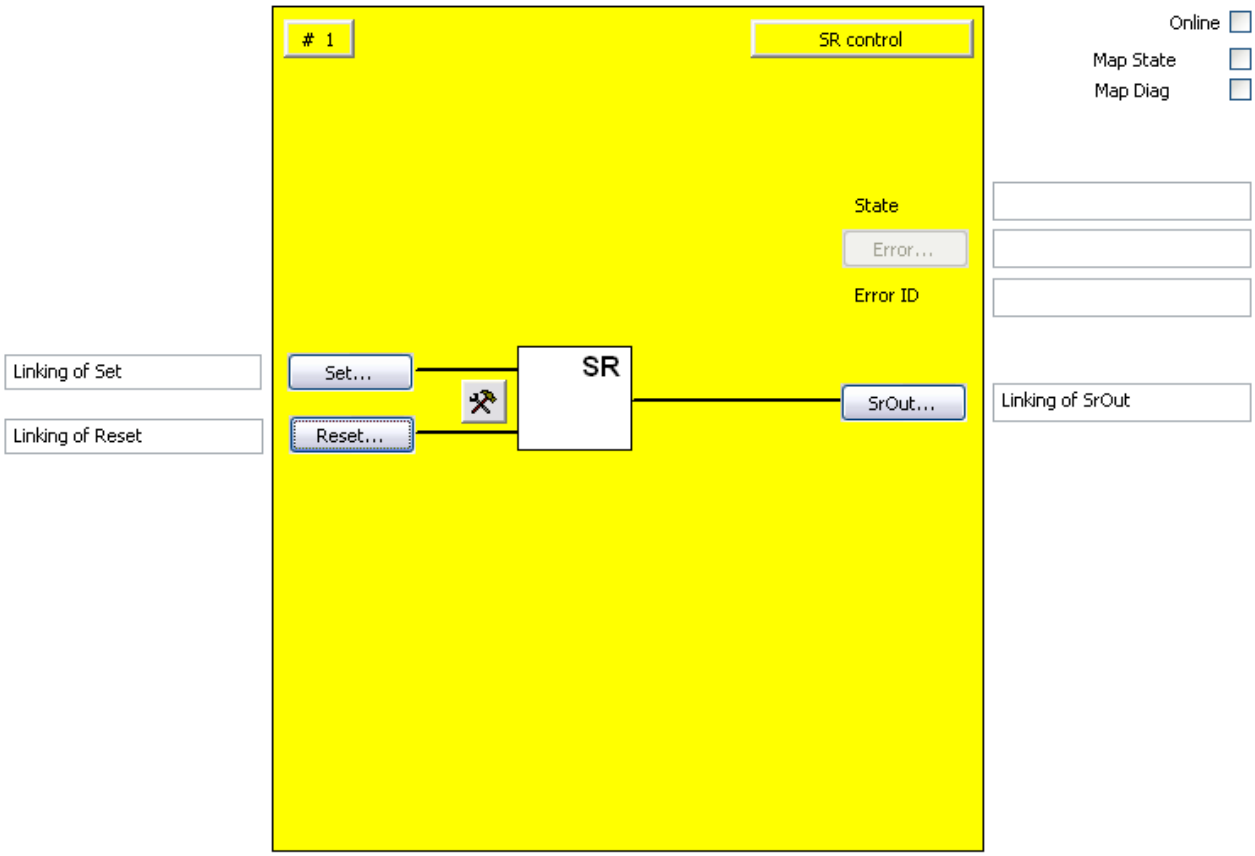


Figure 3-51: FB SR configuration

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 'MapState' and 'MapDiag' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

3.11.4 Display in TwinCAT 3

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

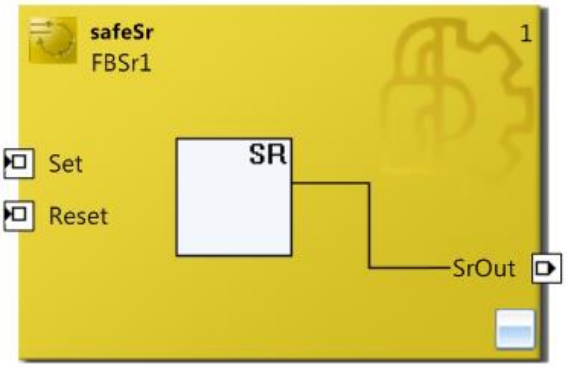


Figure 3-52: FB SR in TwinCAT 3

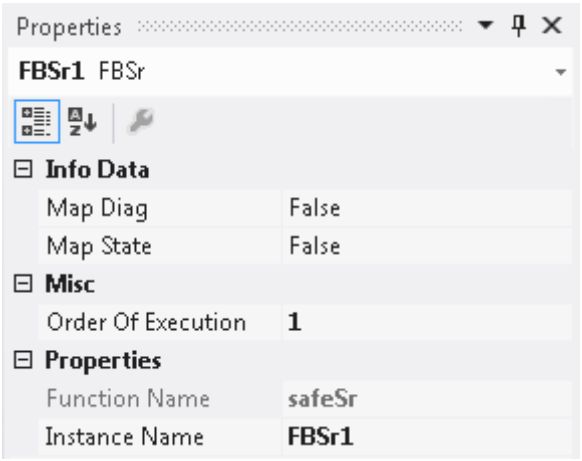


Figure 3-53: FB SR properties

3.12 The function block TON

3.12.1 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 6 000 x 100 ms (10 minutes).

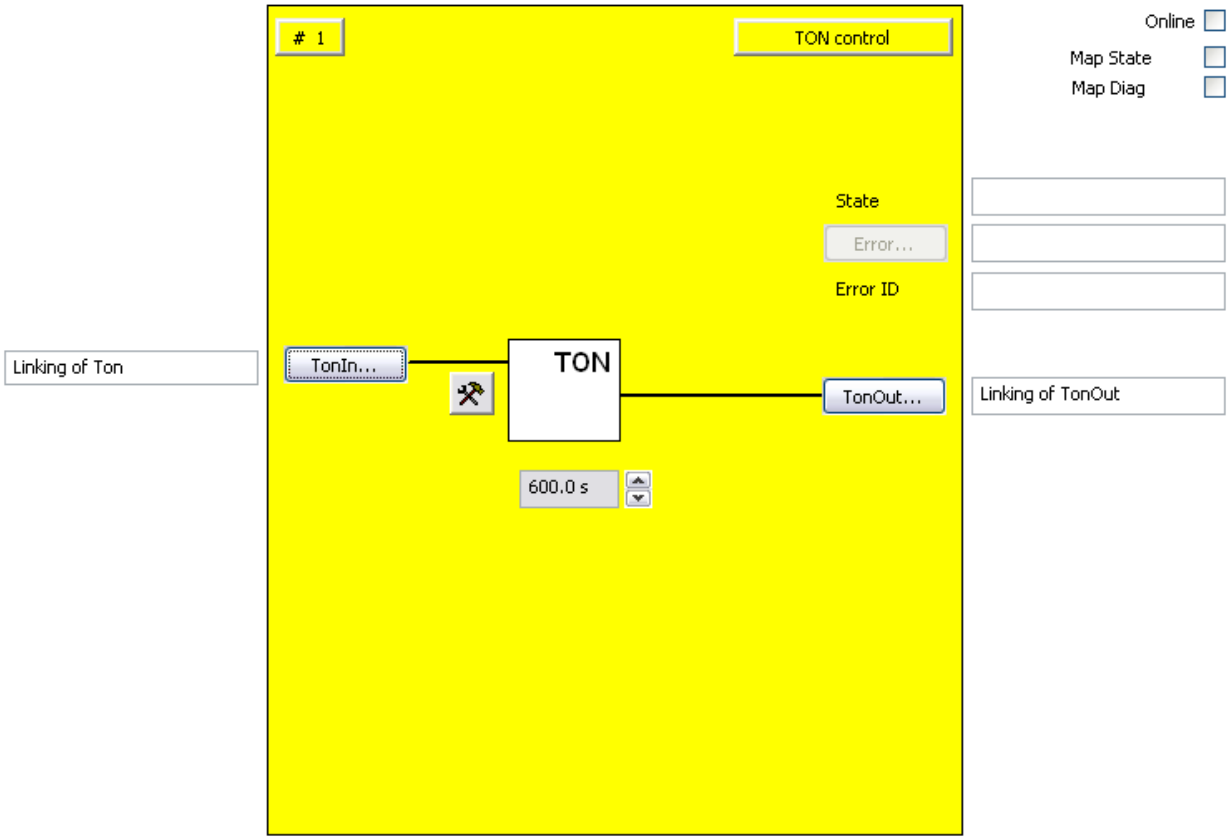


Figure 3-54: TON function blocks

NOTE
KL6904 The TON function block is not available in the KL6904.

3.12.2 Signal description

Table 3-69: 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.

Table 3-70: 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.

Table 3-71: Input and output types

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

Table 3-72: Internal identifier of the FB

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

3.12.2.1 Diagnostic and state information for FB TON

Table 3-73: Diagnostic information (16-bit value)

Bit	Description
0-15	always 0

Table 3-74: State information (8-bit value)

Value	Description
0	undefined
1	RUN If the TimerIn input is 1 and the delay time has expired (DelayTimeExpired=TRUE), the FB TON module assumes the RUN state. The outputs assume the following values: TimerOut=1
2	STOP The FB TON module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: TimerOut=0

Value	Description
3	SAFE If the TimerIn input is 0, the FB TON module assumes the SAFE state. If the TimerIn input changes to 1 in the SAFE state, the FB TON module starts the delay timer with the DelayTime and changes to the DELAYIN state. The outputs assume the following values: TimerOut=0
9	DELAY_IN If the TimerIn input is 1 and the delay time has not yet expired (DelayTimeExpired=FALSE), the FB TON module assumes the DELAYIN state. The outputs assume the following values: TimerOut=0

3.12.3 FB TON configuration in the TwinCAT System Manager

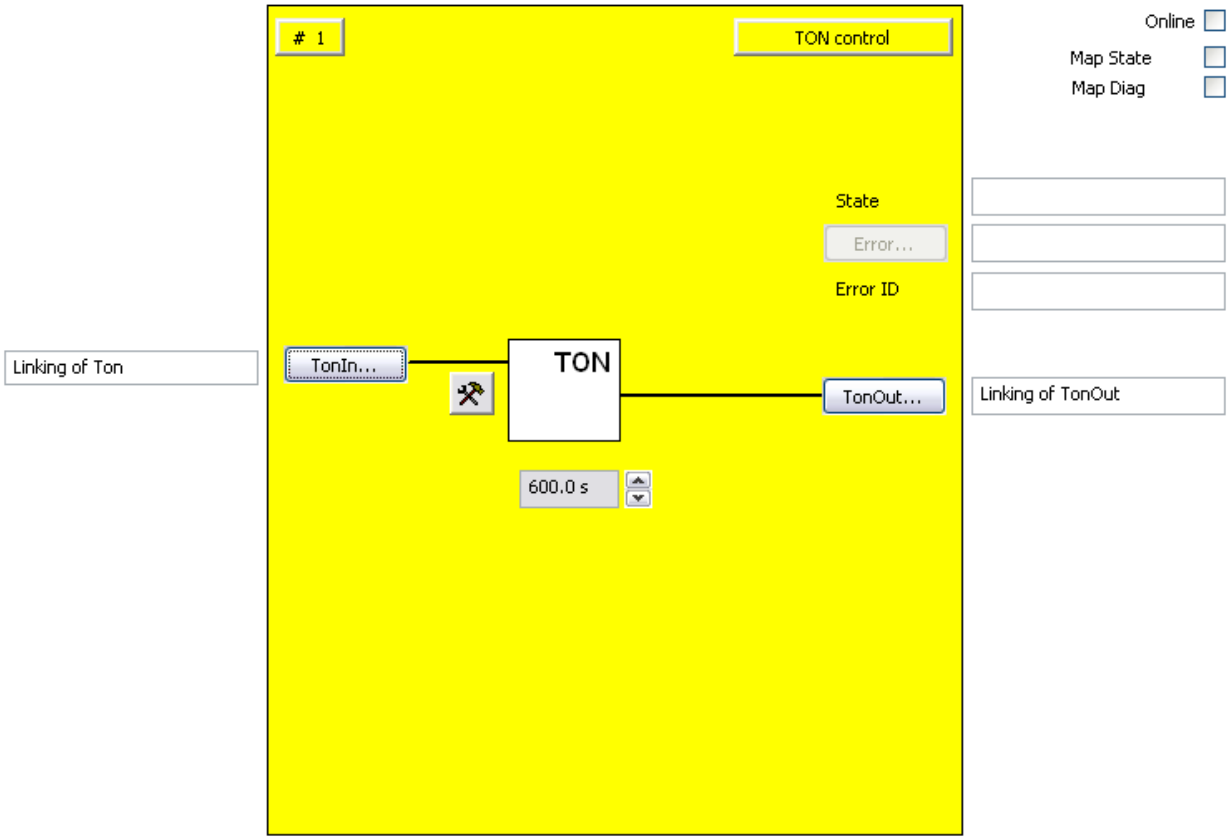


Figure 3-55: FB TON configuration

Use the Settings button to the right of the TonIn button to configure the input as make (NO) or break contact (NC). In the default state the input is disabled.
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 'MapState' and 'MapDiag' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

3.12.4 TON extension

NOTE
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.

NOTE
Extension FB TON and FB TON2 (Software 04 - EL6910) As of software version 04 of the EL6910 and newer TwinSAFE logic components, the FB TON also supports the time base of 100 ms and 1000 ms. This allows switch-on delays of up to 60,000 s to be set.

3.12.5 Display in TwinCAT 3

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

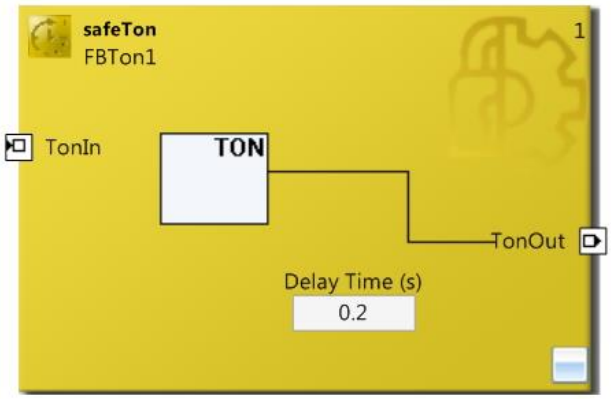


Figure 3-56: FB TON in TwinCAT 3

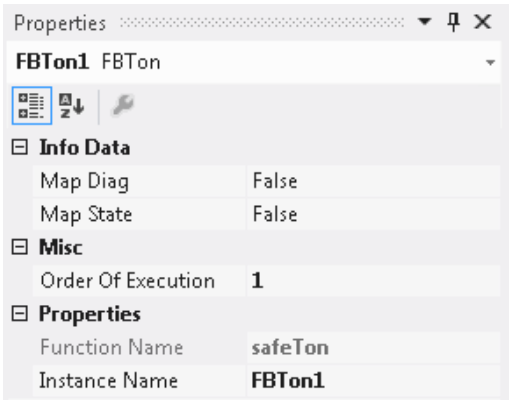


Figure 3-57: FB TON properties

3.13 The function block TON2

3.13.1 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).

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

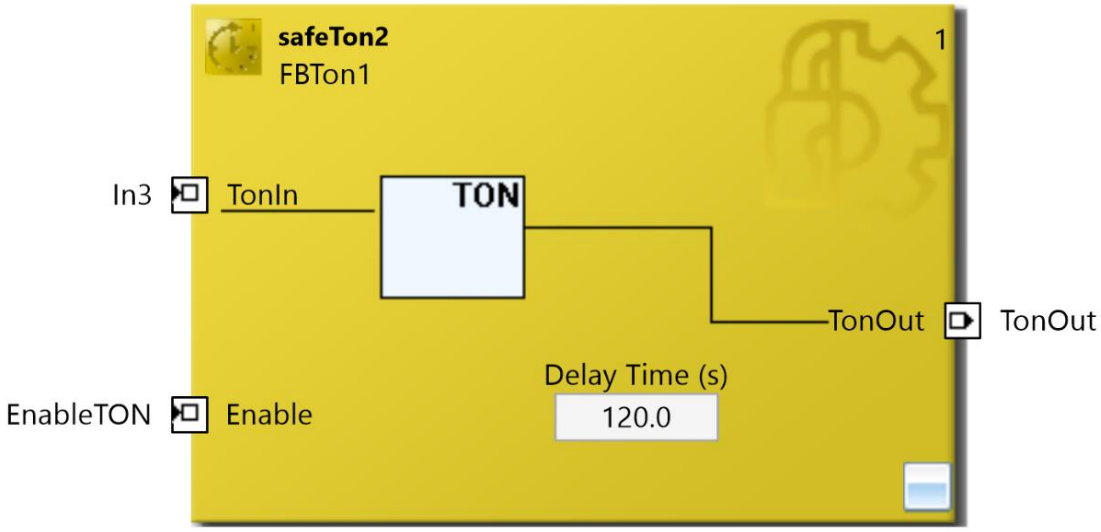
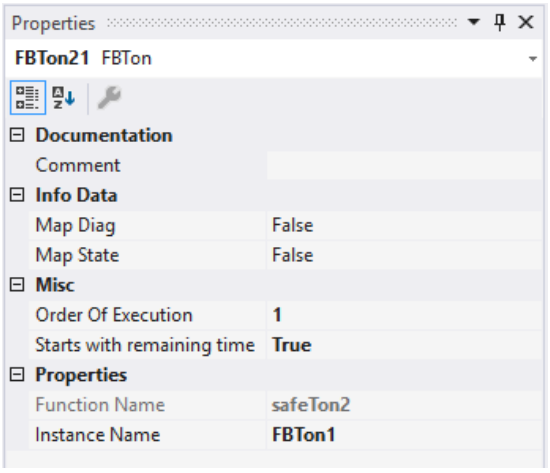


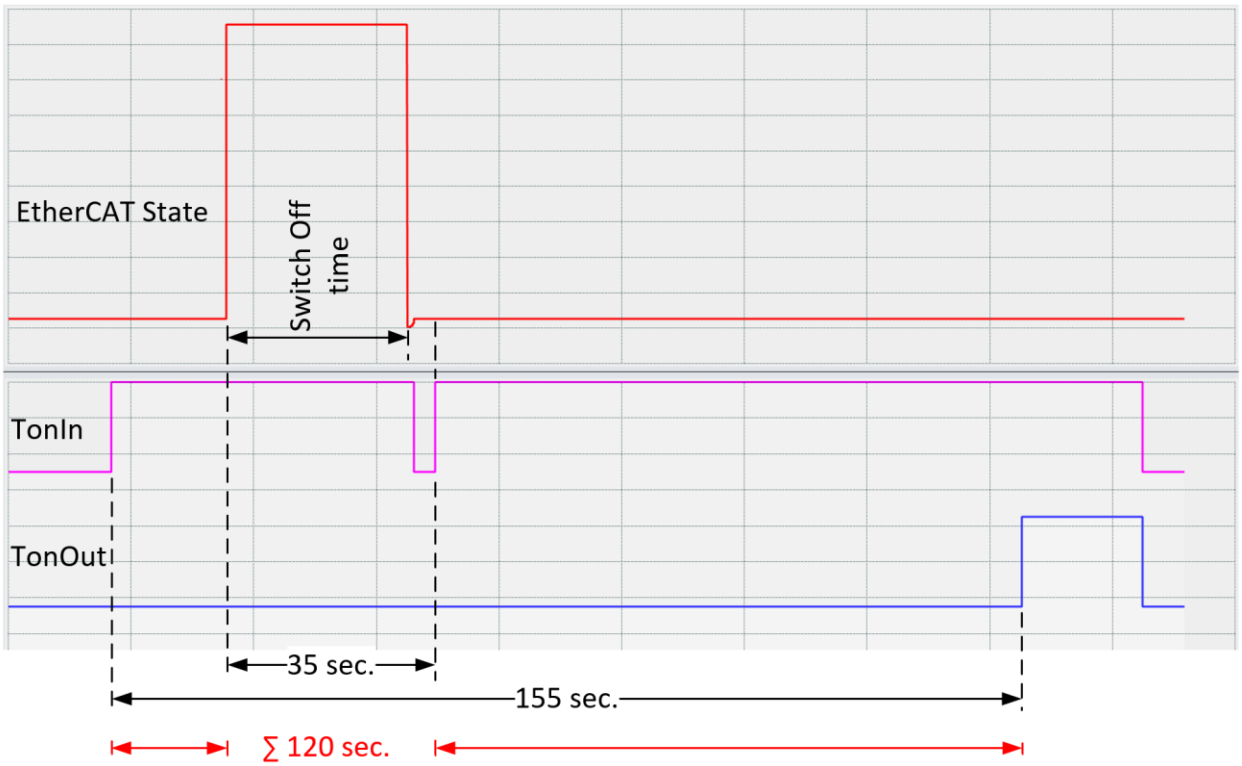
Figure 3-58: TON2 function block

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



In the following time 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.



3.13.2 Signal description

Table 3-75: Inputs of the FB TON2

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)

Table 3-76: Outputs of the FB TON2

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

Table 3-77: Input and output types

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

Table 3-78: Internal identifier of the FB

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

Table 3-79: State information (8-bit value)

Value	Description
0	undefined
1	RUN If the TimerIn input is 1 and the delay time has expired (DelayTimeExpired=TRUE), the FB TON module assumes the RUN state. The outputs assume the following values: TimerOut=1
2	STOP The FB TON module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: TimerOut=0
3	SAFE - If the TimerIn input is 0, the FB TON module assumes the SAFE state. If the TimerIn input changes to 1 in the SAFE state, the FB TON module 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, the FB TON module 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, the FB TON module 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 mode, the FB TON module calls the module CTRLCYC so that it assumes the state GLOBAL-SHUTDOWN with error code 0x3510. The outputs assume the following values: TimerOut=0
9	DELAY_IN If the TimerIn input is 1 and the delay time has not yet expired (DelayTimeExpired=FALSE), the FB TON module assumes the DELAYIN state. The outputs assume the following values: TimerOut=0

3.14 The function block TOF

3.14.1 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).

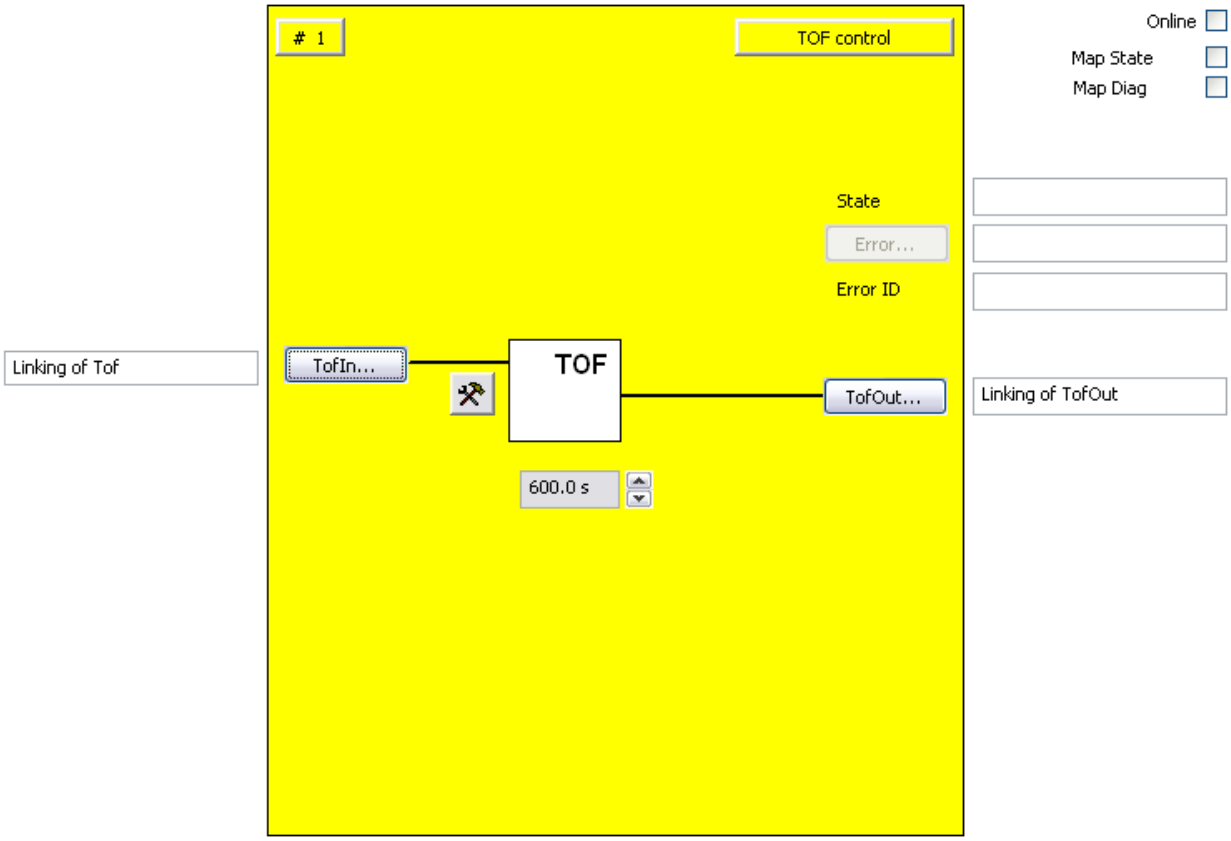


Figure 3-59: TOF function block

NOTE
KL6904 The TOF function block is not available in the KL6904.

3.14.2 Signal description

Table 3-80: FB TOF inputs

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.

Table 3-81: FB TOF outputs

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.

Table 3-82: Input and output types

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

Table 3-83: Internal identifier of the FB

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

3.14.2.1 Diagnostic and state information for FB TOF

Table 3-84: Diagnostic information (16-bit value)

Bit	Description
0-15	always 0

Table 3-85: State information (8-bit value)

Value	Description
0	undefined
1	RUN If the TimerIn input is 1, the FB TOF module assumes the RUN state. If the TimerIn changes to 0 in the RUN state, the FB TOF module starts the delay timer with the DelayTime and changes to the DELAYOUT state. The outputs assume the following values: TimerOut=1
2	STOP The FB TOF module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: TimerOut=0

Value	Description
3	SAFE If the TimerIn input is 0 and the DelayTime has expired (DelayTimeExpired=TRUE), the FB TOF module assumes the SAFE state. The outputs assume the following values: TimerOut=0
8	DELAY_OUT If the TimerIn input is 0 and the DelayTime has not yet expired (DelayTimeExpired=FALSE), the FB TOF module assumes the DELAYOUT state. The outputs assume the following values: TimerOut=1

3.14.3 FB TOF configuration in the TwinCAT System Manager

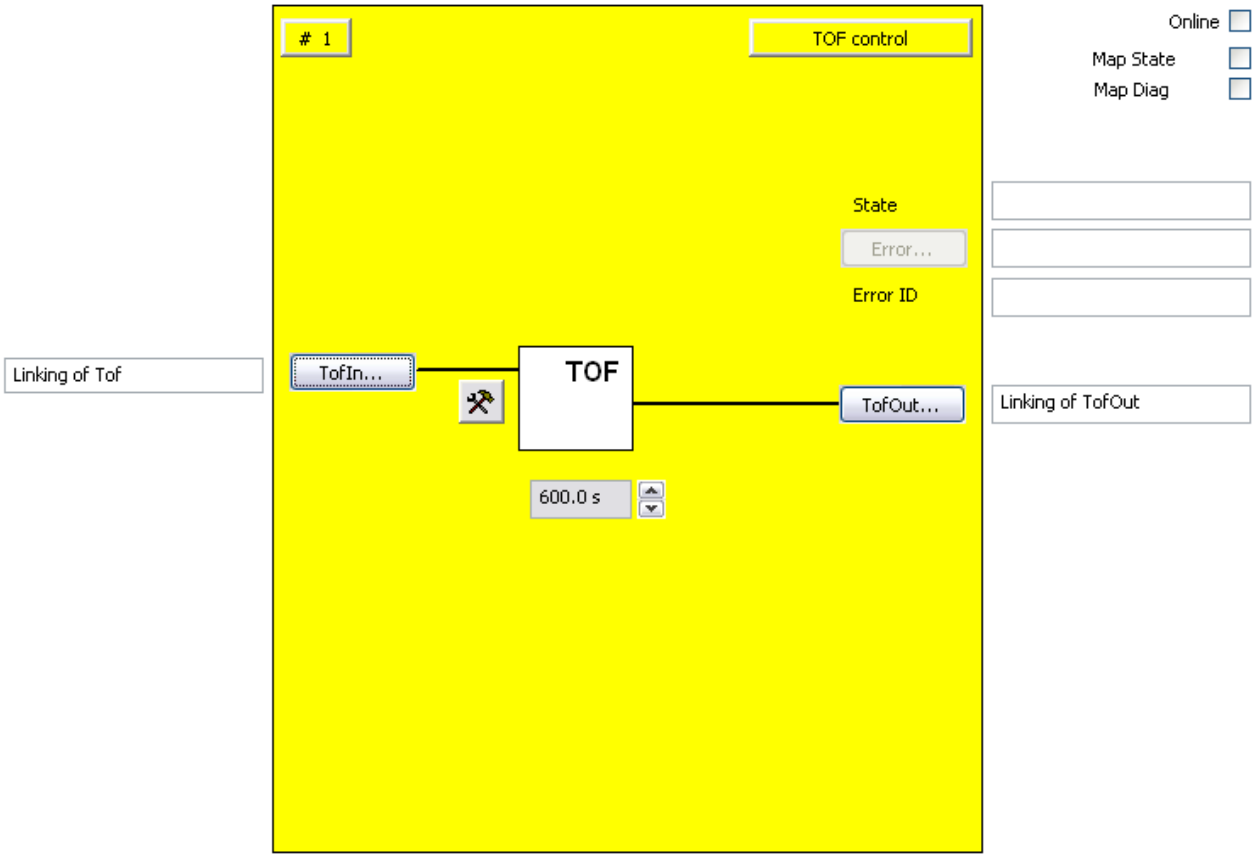


Figure 3-60: FB TOF configuration

Use the Settings button to the right of the TofIn button to configure the input as make (NO) or break contact (NC). In the default state the input is disabled.
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 'MapState' and 'MapDiag' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

3.14.4 TOF extension

NOTE
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.

3.14.5 Display in TwinCAT 3

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

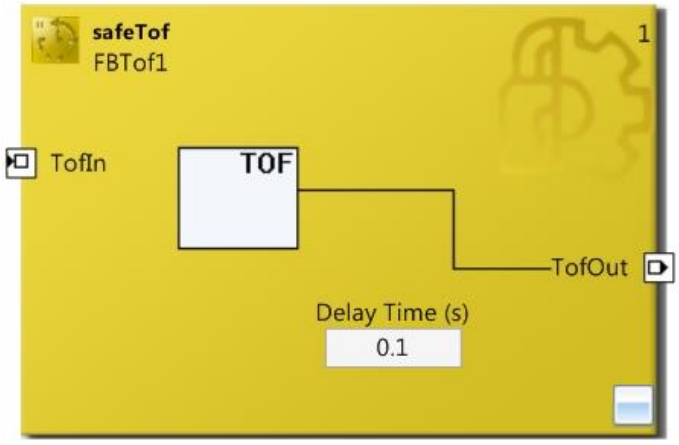


Figure 3-61: FB TOF in TwinCAT 3

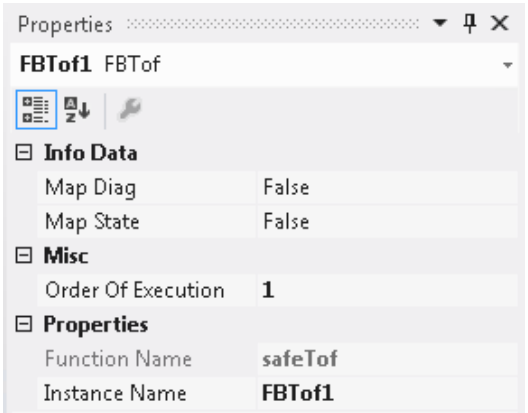


Figure 3-62: FB TOF properties

3.15 The function block CONNECTION SHUTDOWN

3.15.1 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.

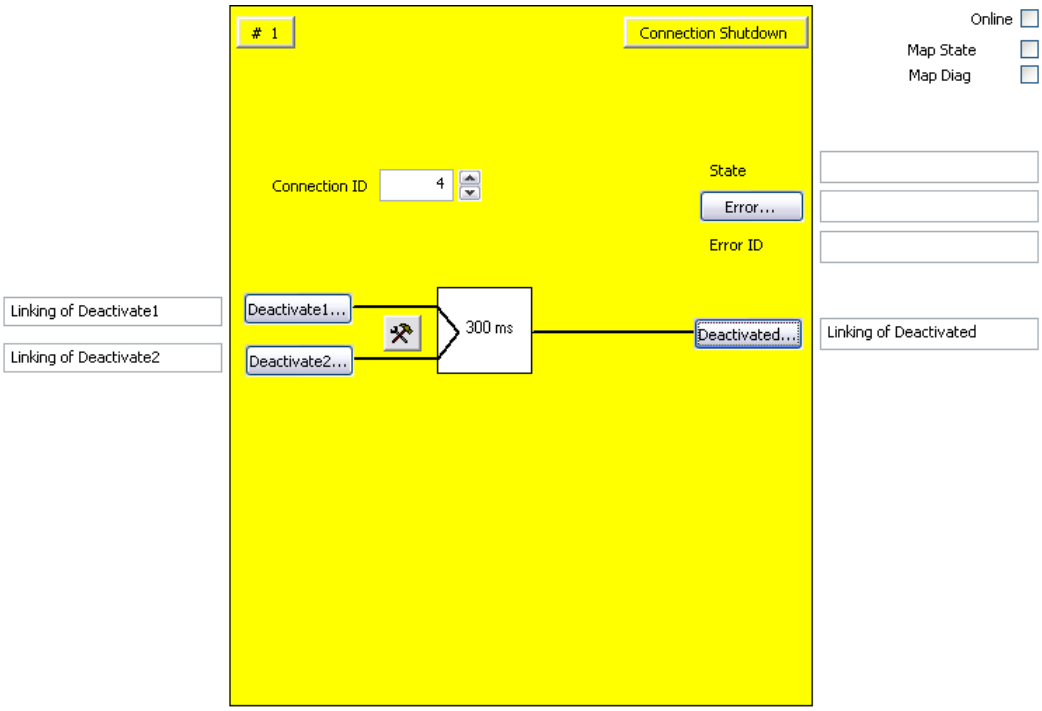


Figure 3-63: Function block CONNECTION SHUTDOWN

NOTE

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.

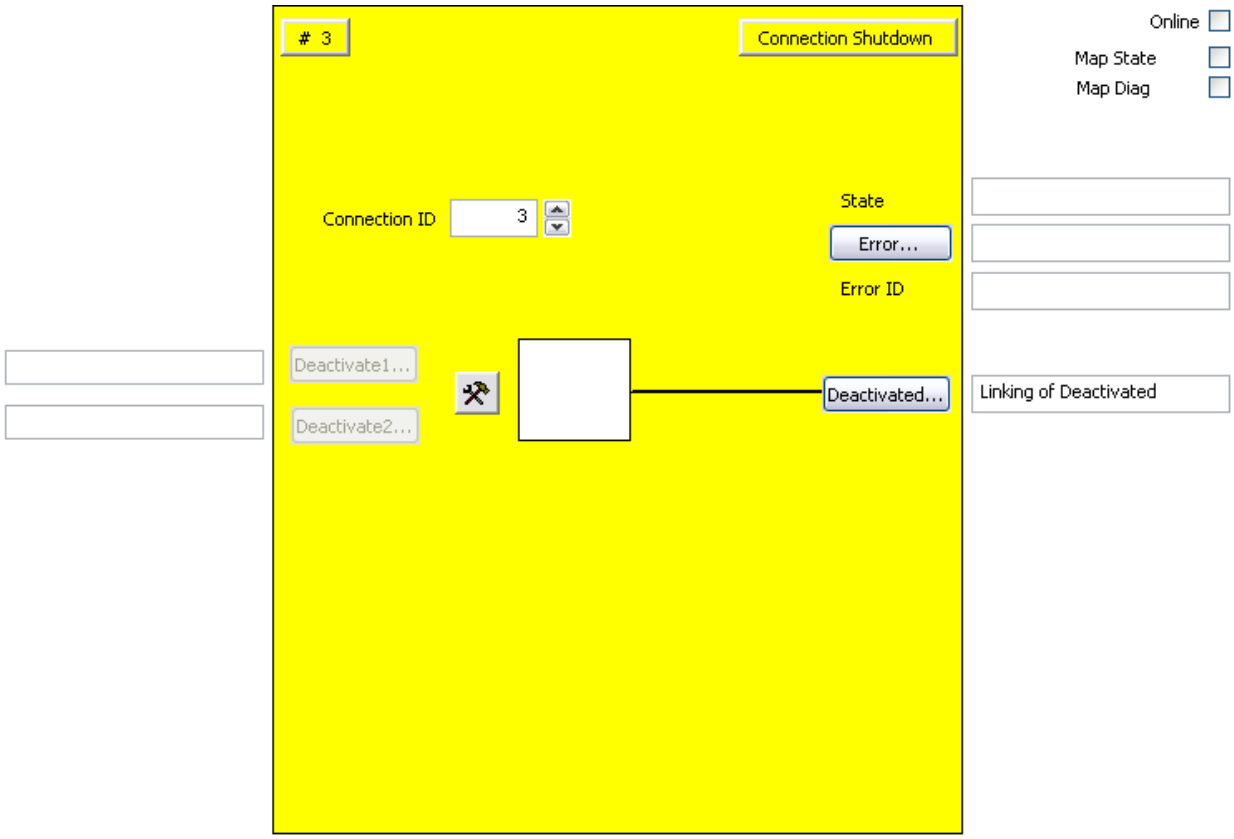


Figure 3-64: Function block CONNECTION SHUTDOWN on the opposite side

3.15.2 Signal description

Table 3-86: 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

Table 3-87: 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 once the connection is terminated.

Table 3-88: Input and output types

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

Table 3-89: Internal identifier of the FB

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

3.15.2.1 Diagnostic and state information for FB CONNECTION SHUTDOWN

Table 3-90: Diagnostic information (16-bit value)

Bit	Description
0	Discrepancy error input group 1

Table 3-91: State 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 SHUTDOWN state and reports this state to the FB CS module, which then assumes the RUN state. If all activated DeactivateX inputs are TRUE, the module switches to the RUN state and instructs the CONNECTION module to send a shutdown command via the assigned connection and to set it to SHUTDOWN state. The outputs assume the following values: Error=0 Deactivated=1
2	STOP The FB CS module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: Error=0 Deactivated=0
3	SAFE If not all activated DeactivateX inputs are TRUE and the assigned connection is not in SHUTDOWN state, the FB CS module assumes the SAFE state. The outputs assume the following values: Error=0 Deactivated=0
4	ERROR If the FB CS module detects an error, the FB CS module assumes the ERROR state and transmits the corresponding Diag message to the GROUP module. The outputs assume the following values: Error=1 Deactivated=0
5	RESET The FB CS module 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

3.15.3 FB ConnectionShutdown configuration in the TwinCAT System Manager

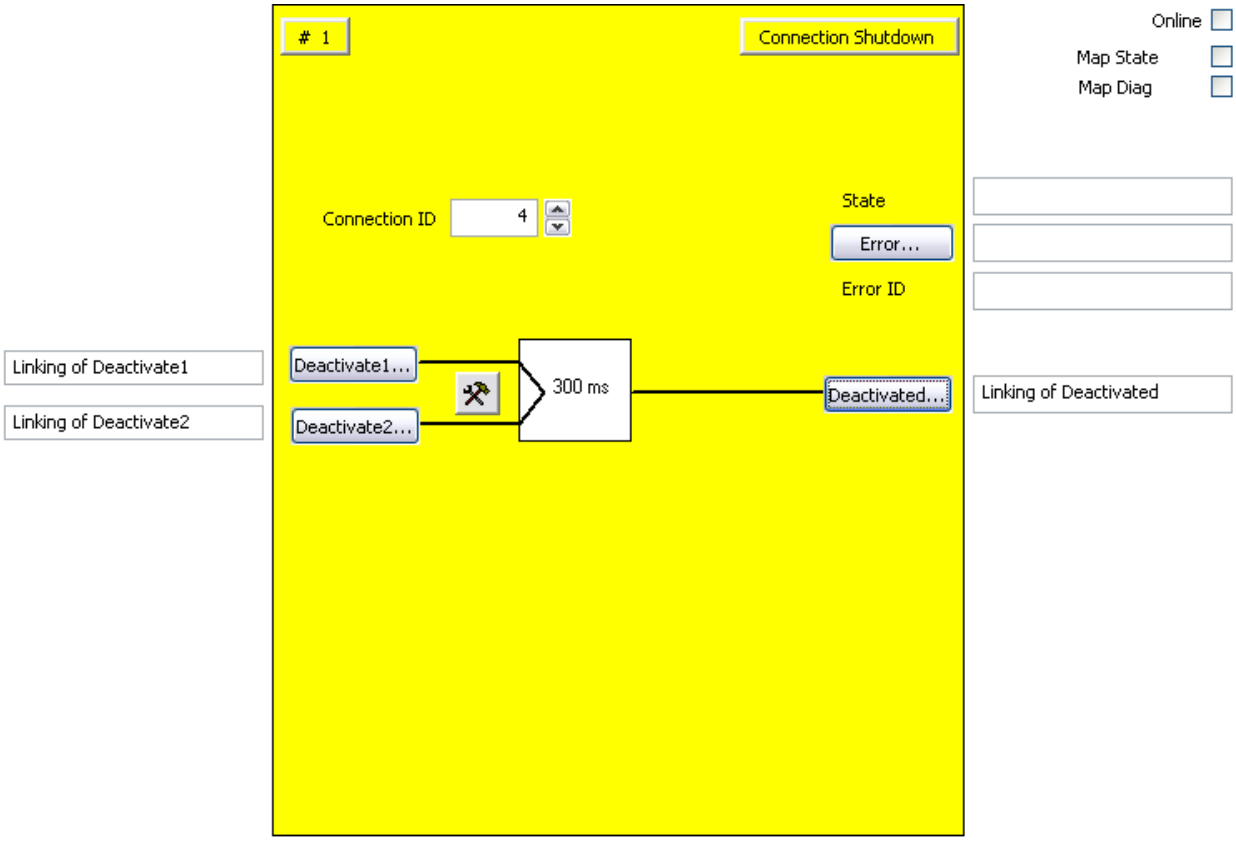


Figure 3-65: FB CONNECTION SHUTDOWN configuration

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 status to an output variable.

The 'MapState' and 'MapDiag' checkboxes are used to specify which FB diagnostic functions are mapped to the cyclic process image.

3.15.4 Display in TwinCAT 3

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

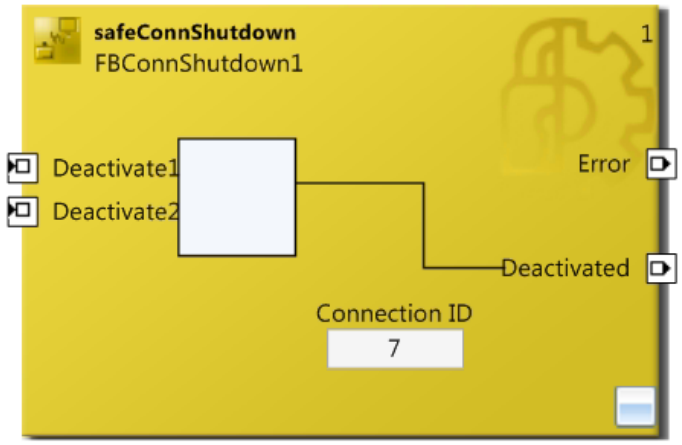


Figure 3-66: FB Connection Shutdown in TwinCAT 3

Figure 3-67: FB Connection Shutdown properties

NOTE
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.

3.16 The function block ADD

3.16.1 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.

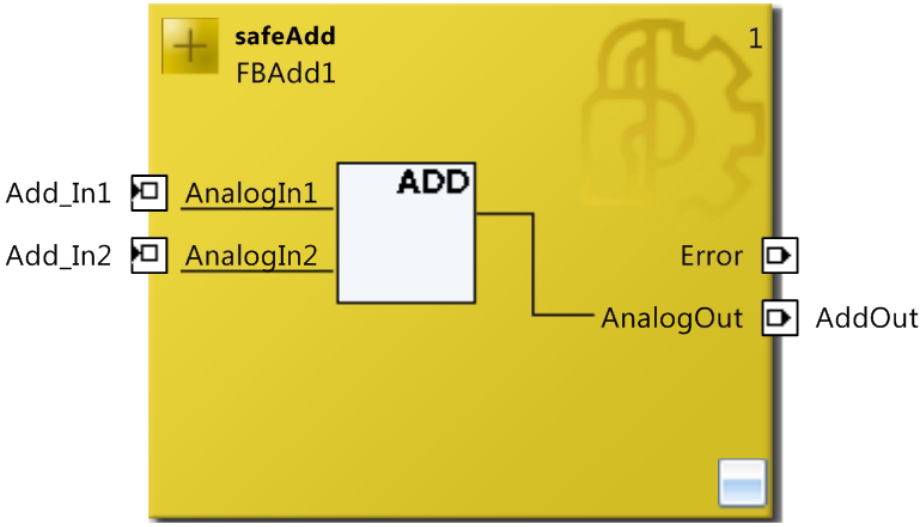


Figure 3-68: Function block ADD

NOTE

KL6904/EL6900

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

3.16.2 Signal description

Table 3-92: FB ADD inputs

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

Table 3-93: 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 INT32 UINT16 UINT32	1st output channel with the addition result

Table 3-94: Input and output types

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

Table 3-95: Internal identifier of the FB

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

3.16.2.1 Diagnostic and state information for the FB ADD

Table 3-96: Diagnostic information

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

Table 3-97: 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

Table 3-98: State information

Value	Description
0	not used
1	RUN The FB ADD module cyclically adds the two analog inputs AnalogIn1 and AnalogIn2. If no overflow or underflow occurs during the addition, the FB ADD module is in the RUN state. The outputs assume the following values: Error=0 AnalogOut = result of the addition
2	STOP The FB ADD module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: Error=0 AnalogOut=0
3	not used
4	ERROR If the FB ADD module detects an error when checking the value range of AnalogOut during the addition, the FB ADD module switches to the ERROR state and transmits the corresponding Diag message to the GROUP module. The outputs assume the following values: Error=1 AnalogOut=0
5	RESET The FB ADD module 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

3.16.3 FB ADD configuration in TwinCAT 3

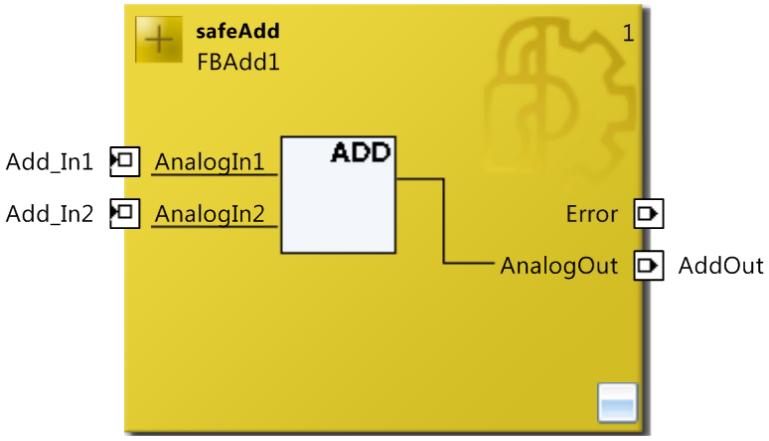


Figure 3-69: FB ADD configuration

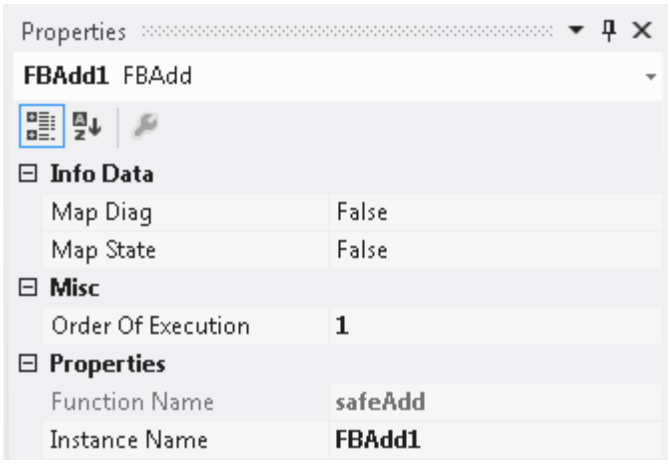


Figure 3-70: FB ADD properties

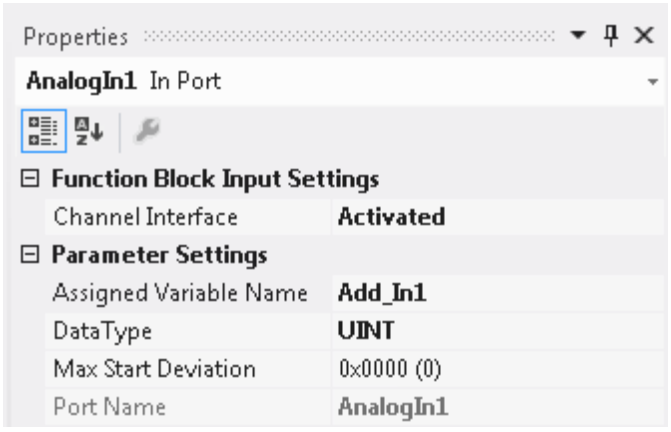


Figure 3-71: FB ADD port properties

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 *MapState* and *MapDiag* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

3.17 The function block SUB

3.17.1 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.

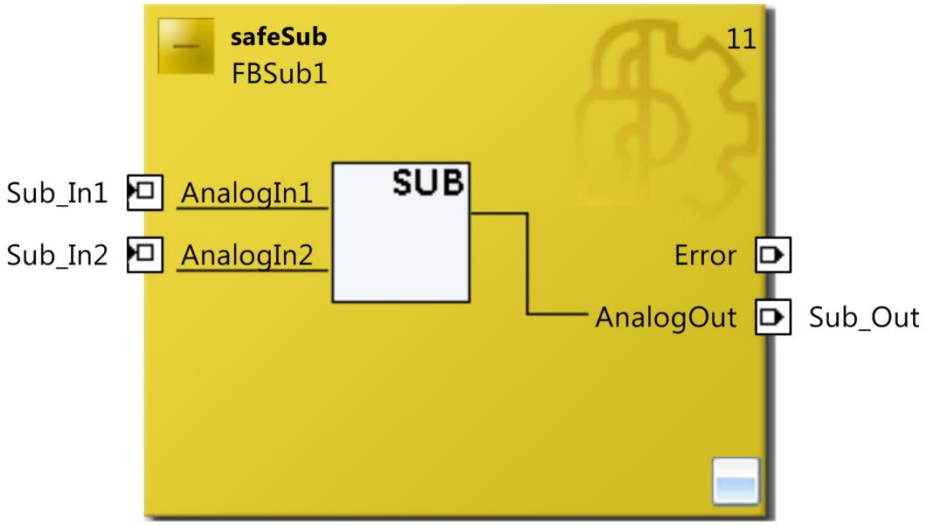


Figure 3-72: Function block SUB

NOTE

KL6904/EL6900

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

3.17.2 Signal description

Table 3-99: FB SUB inputs

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

Table 3-100: FB SUB 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 INT32 UINT16 UINT32	1st output channel with the subtraction result

Table 3-101: FB SUB input and output types

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

Table 3-102: Internal identifier of the FB

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

3.17.2.1 Diagnostic and state information for the FB SUB

Table 3-103: Diagnostic information

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

Table 3-104: 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

Table 3-105: State information

Value	Description
0	not used
1	RUN The FB SUB module cyclically subtracts the two analog inputs AnalogIn1 and AnalogIn2. If no overflow or underflow occurs during the subtraction, the FB SUB module is in the RUN state. The outputs assume the following values: Error=0 AnalogOut = result of the subtraction
2	STOP The FB SUB module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: Error=0 AnalogOut=0
3	not used
4	ERROR If the FB SUB module detects an error when checking the value range of AnalogOut during subtraction, the FB SUB module switches to the ERROR state and transmits the corresponding Diag message to the GROUP module. The outputs assume the following values: Error=1 AnalogOut=0
5	RESET The FB ADD module 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

3.17.3 FB SUB configuration in TwinCAT 3

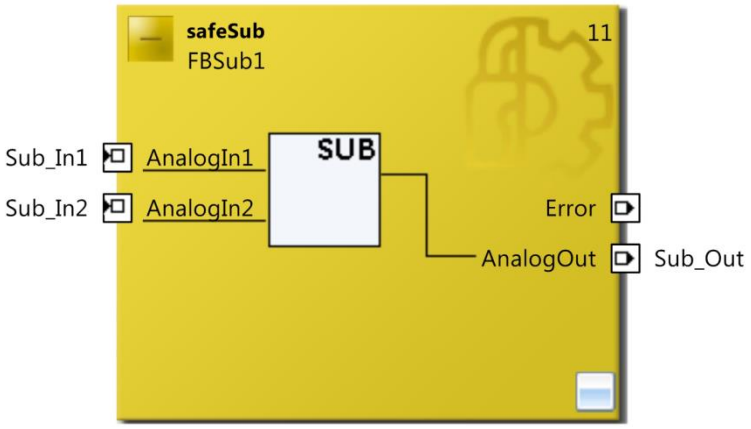


Figure 3-73: FB SUB configuration

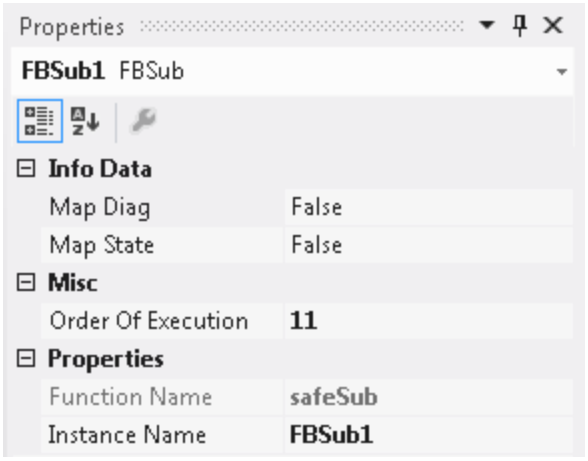


Figure 3-74: FB SUB properties

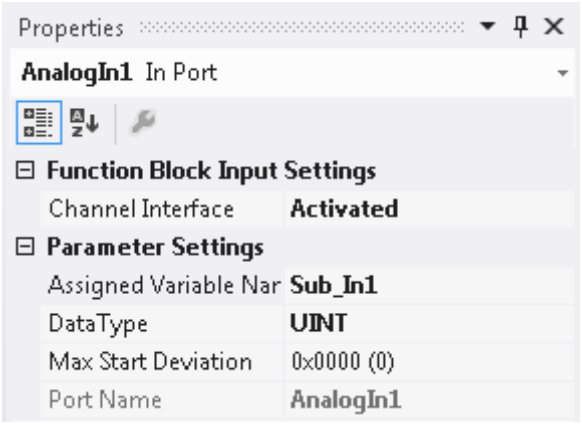


Figure 3-75: FB SUB port properties

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 *MapState* and *MapDiag* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

3.18 The function block MUL

3.18.1 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.

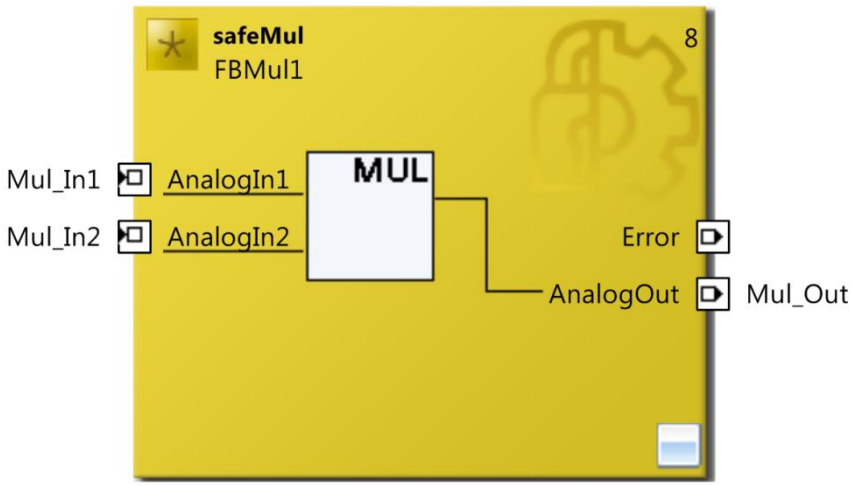


Figure 3-76: Function block MUL

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

3.18.2 Signal description

Table 3-106: FB MUL inputs

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

Table 3-107: 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 INT32 UINT16 UINT32	1st output channel with the multiplication result

Table 3-108: Input and output types

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

Table 3-109: Internal identifier of the FB

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

3.18.2.1 Diagnostic and state information for FB MUL

Table 3-110: Diagnostic information

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

Table 3-111: 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

Table 3-112: State information

Value	Description
0	not used
1	RUN In RUN state the FB MUL module enters the result of the multiplication in the AnalogOut output. The outputs assume the following values: Error=0 AnalogOut = multiplication result
2	STOP The FB MUL module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: Error=0 AnalogOut=0
3	not used
4	ERROR If the FB MUL module detects an error when checking the value range of AnalogOut, the FB MUL module switches to the ERROR state and transmits the corresponding Diag message to the GROUP module. The outputs assume the following values: Error=1 AnalogOut=0
5	RESET The FB MUL module 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

3.18.3 FB MUL configuration in TwinCAT 3

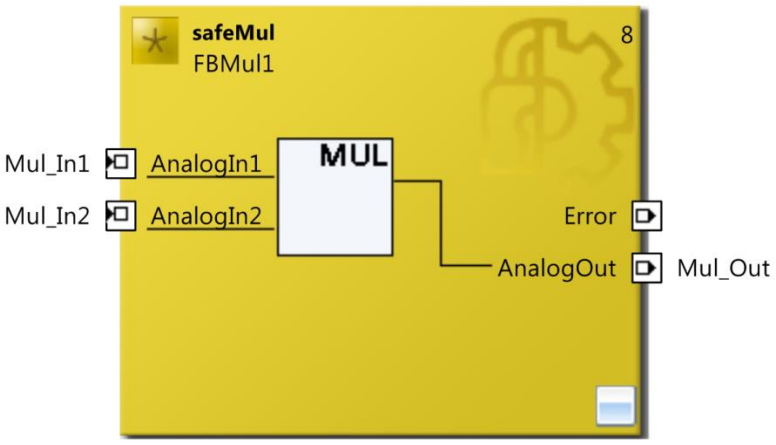


Figure 3-77: FB MUL configuration

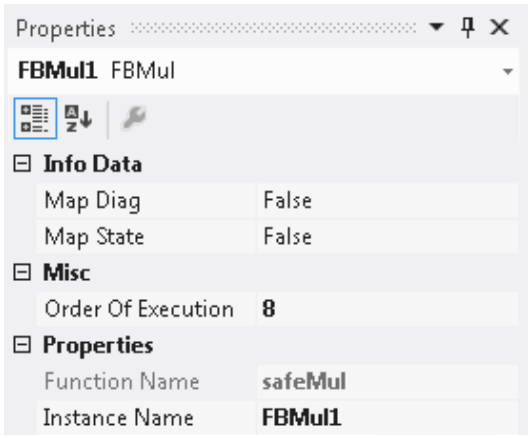


Figure 3-78: FB MUL properties

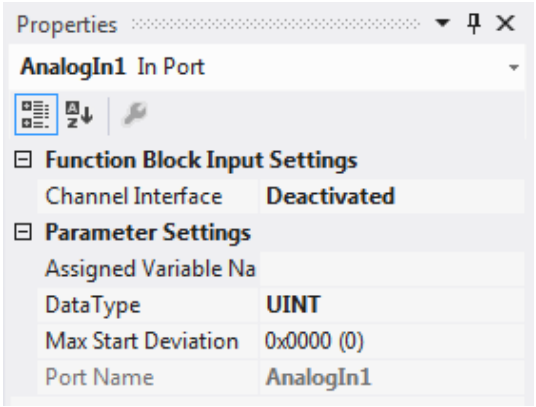


Figure 3-79: FB MUL port properties

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 *MapState* and *MapDiag* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

3.19 The function block DIV

3.19.1 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)

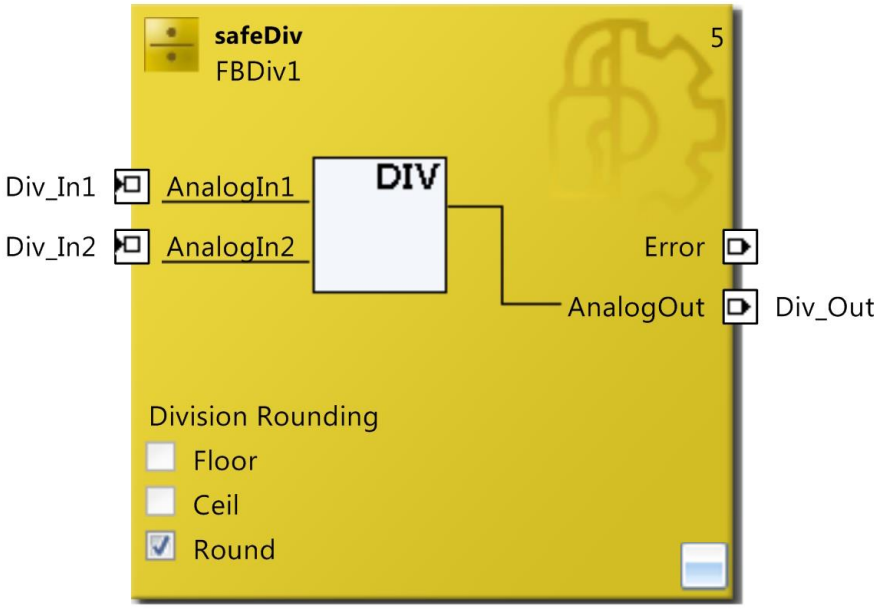


Figure 3-80: Function block DIV

NOTE

KL6904/EL6900

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

3.19.2 Signal description

Table 3-113: FB DIV inputs

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

Table 3-114: 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 INT32 UINT16 UINT32	1st output channel with the division result

Table 3-115: Input and output types

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

Table 3-116: Internal identifier of the FB

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

3.19.2.1 Diagnostic and state information for the FB DIV

Table 3-117: Diagnostic information

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

Table 3-118: 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

Table 3-119: State information

Value	Description
0	not used
1	RUN In the RUN state, the FB DIV module enters the result of the division in the AnalogOut output. The outputs assume the following values: Error=0 AnalogOut = division result
2	STOP The FB DIV module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: Error=0 AnalogOut=0
3	not used
4	ERROR If the FB DIV module detects an error when checking the value range of AnalogOut, the FB DIV module switches to the ERROR state and transmits the corresponding Diag message to the GROUP module. The outputs assume the following values: Error=1 AnalogOut=0
5	RESET The FB DIV module 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

3.19.3 FB DIV configuration in TwinCAT 3

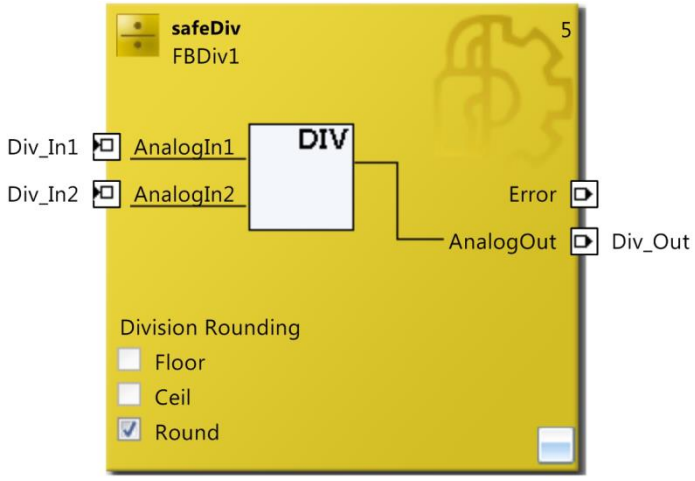


Figure 3-81: FB DIV configuration

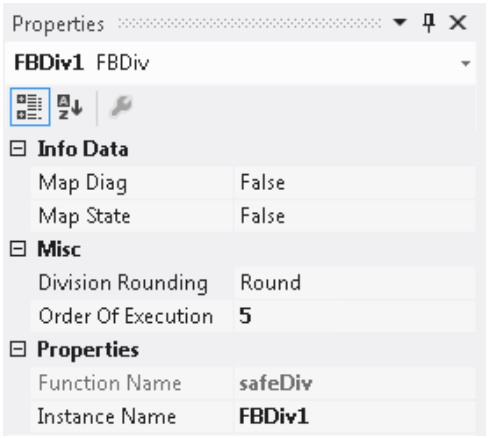


Figure 3-82: FB xxx properties

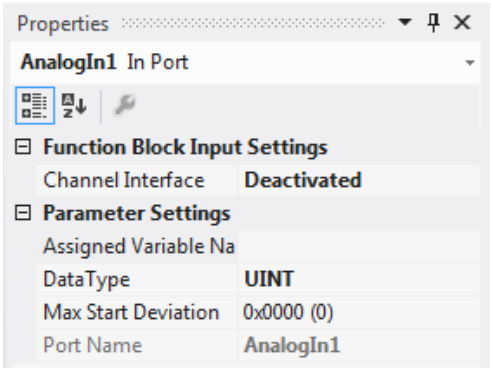


Figure 3-83: FB xxx port properties

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 *MapState* and *MapDiag* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

3.20 The function block COMPARE

3.20.1 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* option field
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.

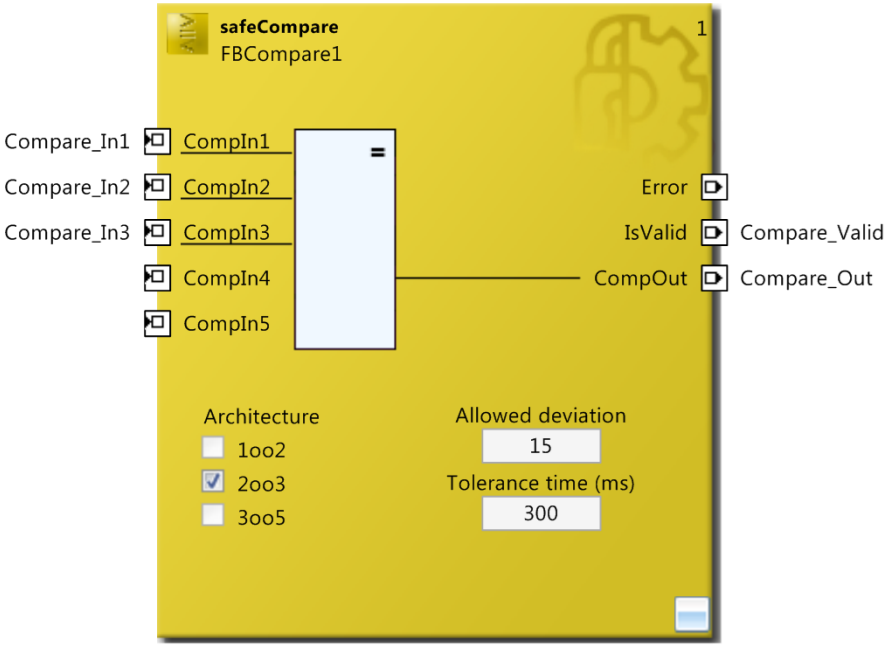


Figure 3-84: Function block COMPARE

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

3.20.2 Signal description

Table 3-120: FB COMPARE inputs

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

Table 3-121: 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 INT32 UINT16 UINT32	Output channel with the first CompIn input value that lies within the comparison result

Table 3-122: Input and output types

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

Table 3-123: Internal identifier of the FB

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

3.20.2.1 Diagnostic and state information for the FB COMPARE

Table 3-124: Diagnostic information

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

Table 3-125: 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

Table 3-126: State information

Value	Meaning
0	undefined
1	RUN The FB COMPARE module assumes the RUN state if a sufficient number of 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 The FB COMPARE module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: Error=0 IsValid=0 CompOut=0
3	SAFE The FB COMPARE module assumes the SAFE state if not enough analog inputs deviate from each other by no more than 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 module detects an error while checking the value range of CompOut, the FB COMPARE module switches to the ERROR state and transmits the corresponding Diag message to the GROUP module. The outputs assume the following values: Error=1 IsValid=0 CompOut=0
5	RESET The FB COMPARE module 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 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. The FB COMPARE module assumes the DELAYOUT state as long as the DelayOutTimer has not expired (DelayOutExpired=FALSE). The outputs assume the following values: Error=0 IsValid=1 CompOut = unchanged

3.20.3 FB COMPARE configuration in TwinCAT 3

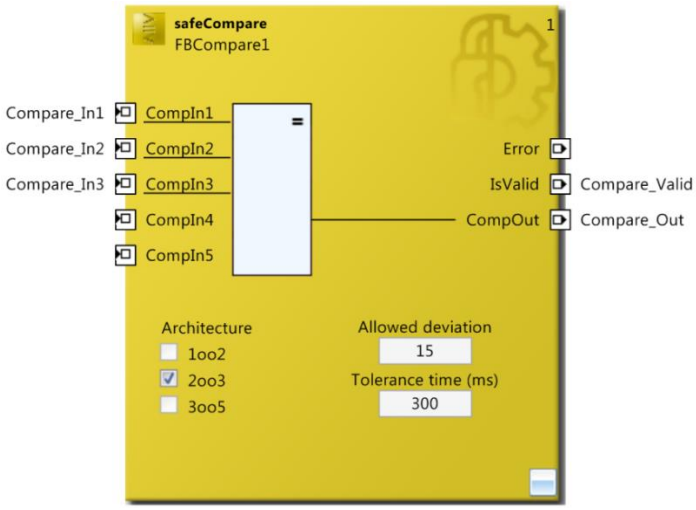


Figure 3-85: FB Compare configuration

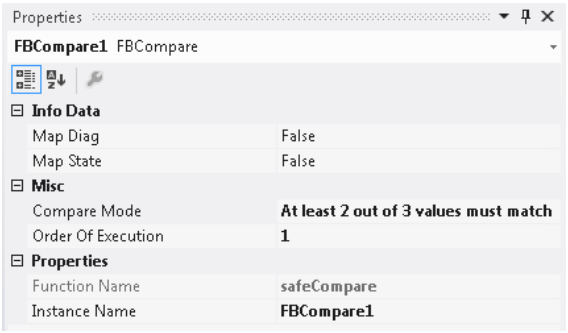


Figure 3-86: FB Compare properties

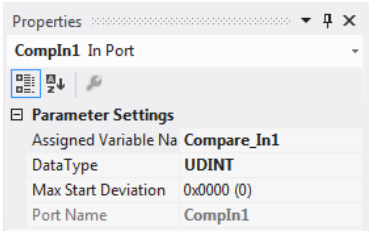


Figure 3-87: FB Compare port properties

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 *MapState* and *MapDiag* 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.

3.21 The function block LIMIT

3.21.1 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*.

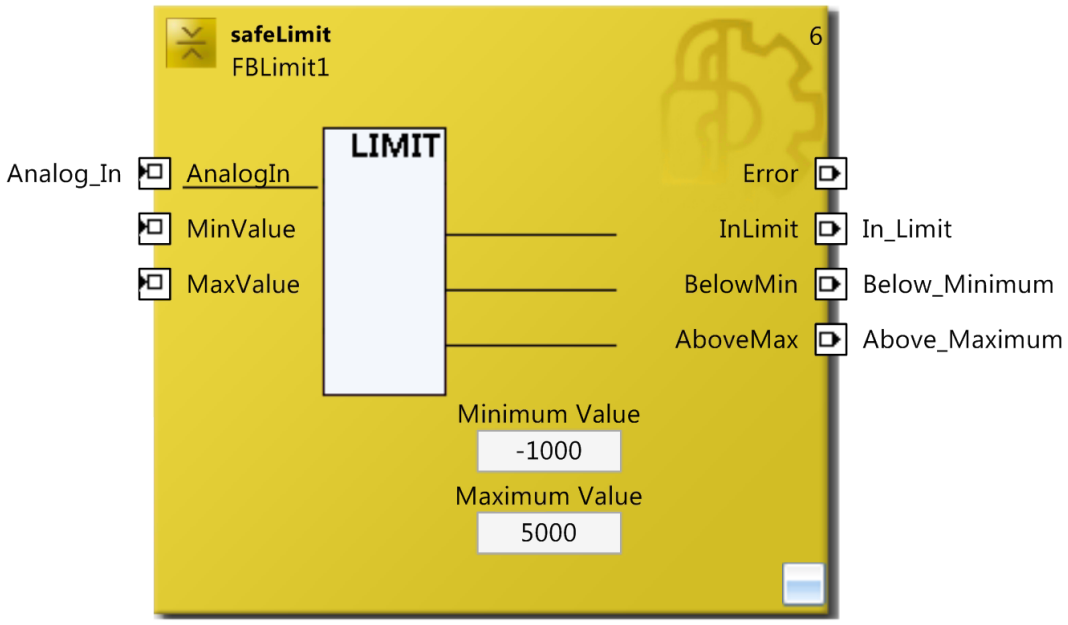


Figure 3-88: Function block LIMIT

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

3.21.2 Signal description

Table 3-127: FB LIMIT inputs

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

Table 3-128: FB xxx 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

Table 3-129: Input and output types

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

Table 3-130: Internal identifier of the FB

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

3.21.2.1 Diagnostic and state information for the FB LIMIT

Table 3-131: Diagnostic information

Value	Description
0	No diagnostic information
1	MinValue is greater than MaxValue

Table 3-132: Diag Message

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

Table 3-133: State information

Value	Description
1	RUN If AnalogIn is greater than or equal to MinValue and less than or equal to MaxValue, the FB LIMIT module assumes the RUN state. The outputs assume the following values: Error=0 InLimit=1 BelowMin=0 AboveMax=0
2	STOP If the input FbRun is FALSE, the FB LIMIT module 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, the FB LIMIT module assumes the SAFE state. The outputs assume the following values: Error=0 InLimit=0 BelowMin=(AnalogIn<MinValue) AboveMax=(AnalogIn>MaxValue)
4	ERROR If the FB LIMIT module detects an error, the FB LIMIT module switches to the ERROR state and transmits the corresponding Diag message to the GROUP module. The outputs assume the following values: Error=1 InLimit=0 BelowMin=0 AboveMax=0
5	RESET The FB LIMIT module 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 AboveMax=0

3.21.3 FB LIMIT configuration in TwinCAT 3

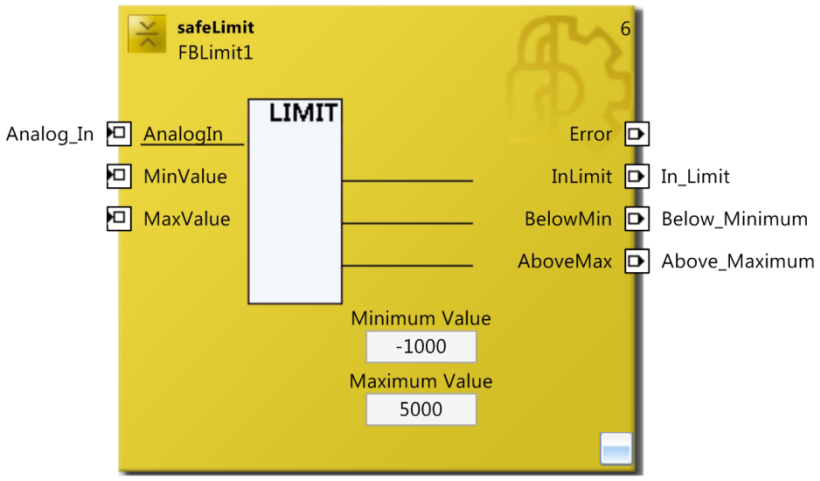


Figure 3-89: FB Limit configuration

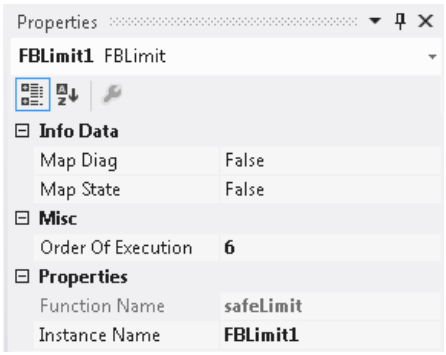


Figure 3-90: FB Limit properties

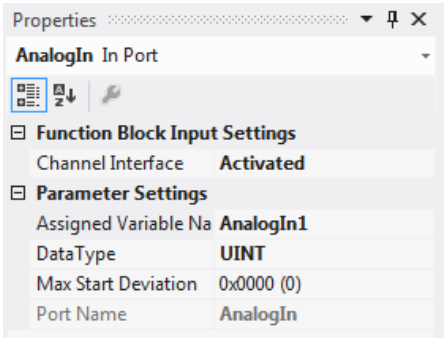


Figure 3-91: FB Limit port properties

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 *MapState* and *MapDiag* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

3.22 The function block COUNTER

3.22.1 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 *Reset* input causes the internal counter value to be set to the value that is parameterized via *Preset Value*. A rising edge at the *CountUp* input increments the internal counter value by 1. A rising edge at the *CountDown* input 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.

When the TwinSAFE group is started (Run=1), *ActValue* is set to *PresetValue*. When the group is stopped, *ActValue* is set to 0.

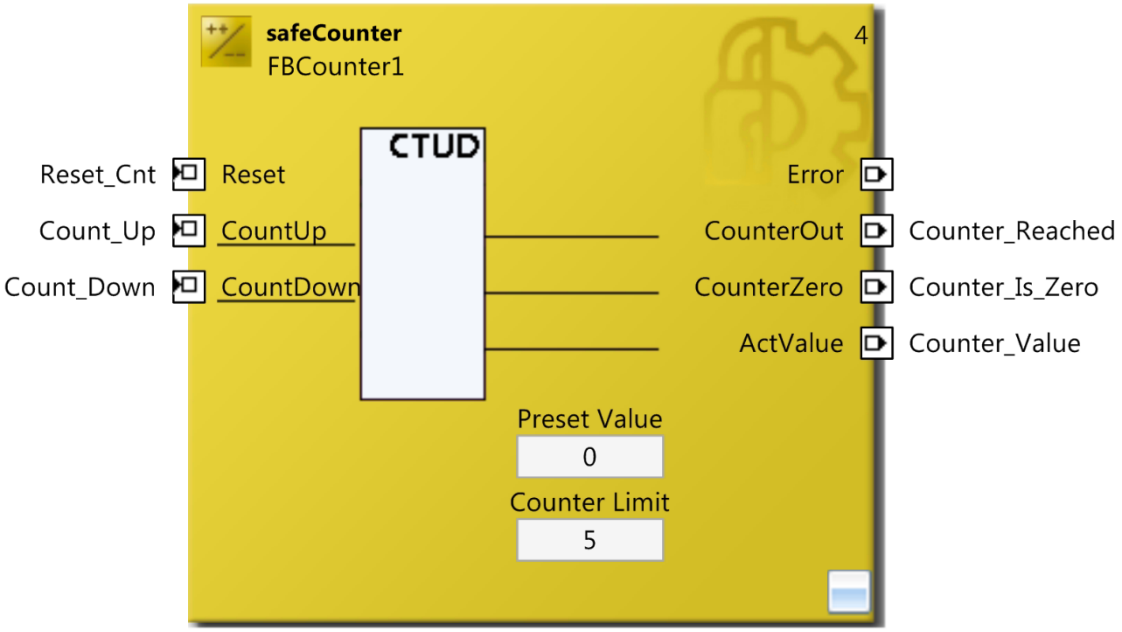


Figure 3-92: Function block COUNTER

NOTE
KL6904/EL6900 The function block COUNTER is not available in the KL6904 and the EL6900.

3.22.2 Signal description

Table 3-134: 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

Table 3-135: 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 INT32 UINT16 UINT32	Current internal counter value

Table 3-136: Input and output types

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

Table 3-137: Internal identifier of the FB

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

3.22.2.1 Diagnostic and state information for the FB Counter

Table 3-138: Diagnostic information

Value	Description
0	No diagnostic information
1	The ActValue output has an underflow (is less than the smallest possible value)
2	The ActValue output has an overflow (is greater than the largest possible value)

Table 3-139: 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

Table 3-140: State information

Value	Description
1	RUN In the RUN state the FB COUNT module sets the ActValue output to PresetValue if the Reset input is TRUE. If the Reset input is FALSE, the FB COUNT module increments the ActValue output when a rising edge is detected at the CountUp input and decrements it when a rising edge is detected at the CountDown input (this means ActValue remains unchanged when 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 The FB COUNT module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: Error=0 CounterOut=0 CounterZero=0 ActValue=0
4	ERROR If the FB COUNT module detects an error while checking the value range of CounterOut, the FB COUNT module switches to the ERROR state and transmits the corresponding Diag message to the GROUP module. The outputs assume the following values: Error=1 CounterOut=0 CounterZero=0 ActValue=0
5	RESET The FB COUNT module 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

3.22.3 FB Counter configuration in TwinCAT 3

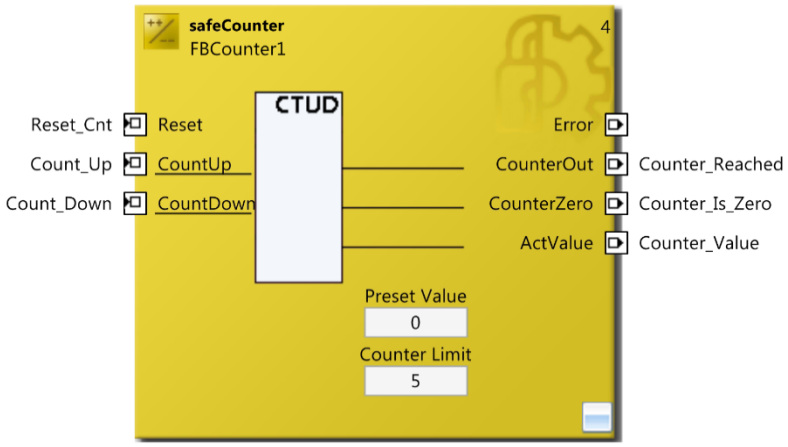


Figure 3-93: FB Counter configuration

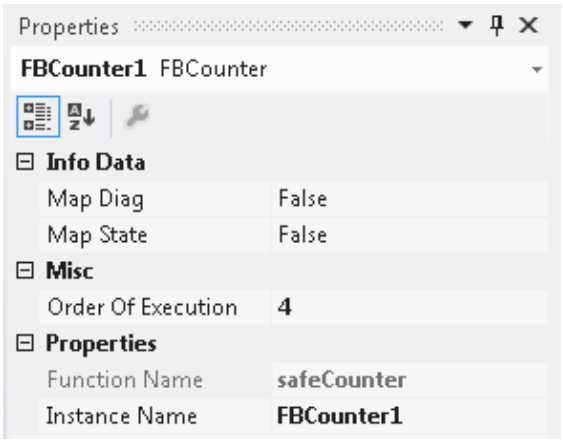


Figure 3-94: FB Counter properties

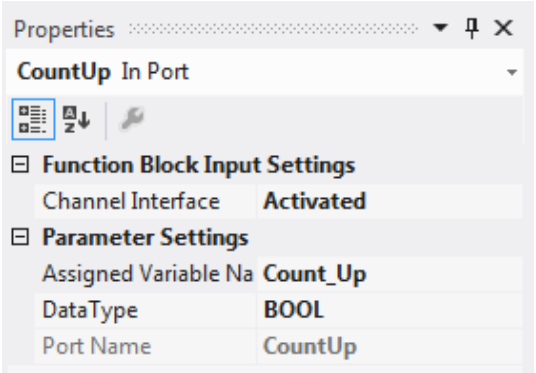


Figure 3-95: FB Counter port properties

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 *MapState* and *MapDiag* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

3.23 The function block SCALE

3.23.1 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.

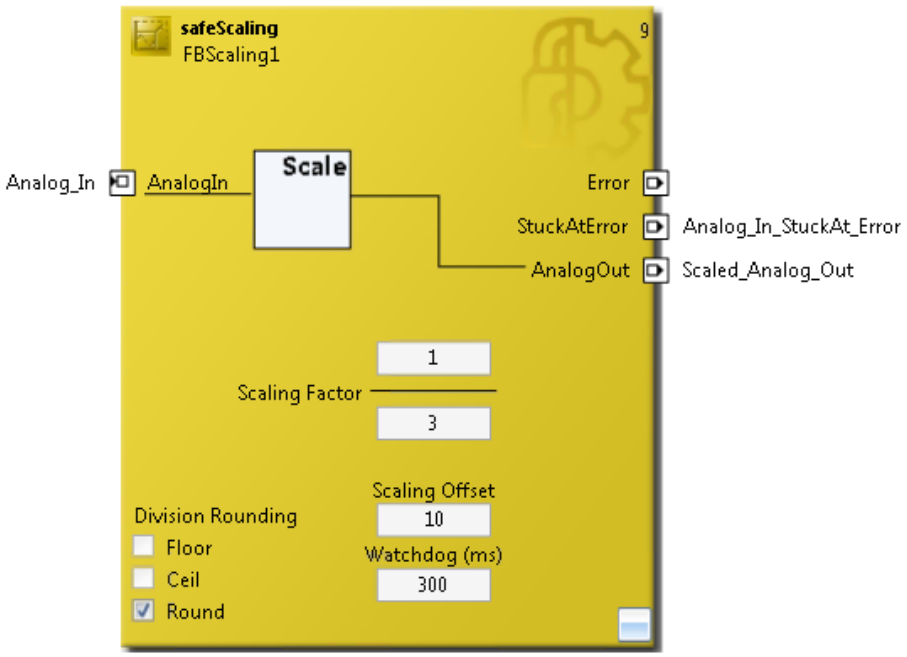


Figure 3-96: Function block SCALE

NOTE

KL6904/EL6900

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

3.23.2 Signal description

Table 3-141: FB Scale inputs

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

Table 3-142: 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 INT32 UINT16 UINT32	Output with the scaled input signal Processing order: • AnalogIn negation • Nominator multiplication scaling factor (configurable) • Denominator division scaling factor (configurable) • Addition scaling offset

Table 3-143: Input and output types

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

Table 3-144: Internal identifier of the FB

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

3.23.2.1 Diagnostic and state information for the FB Scale1

Table 3-145: Diagnostic information

Value	Description
0	No diagnostic information
1	The AnalogOut output has an underflow (is less than the smallest possible value)
2	The AnalogOut output 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.

Table 3-146: Diag Message

Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
0x40B0	The AnalogOut output has an underflow (is less than the smallest possible value)	FB number	AnalogIn	-
0x40B1	The AnalogOut output 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	-

Table 3-147: State information

Value	Description
1	RUN In the RUN state the FB SCALE module enters the scaling result in the AnalogOut output. The outputs assume the following values: Error=0 AnalogOut = result of the scaling StuckAtError=StuckAtErrorDetected
2	STOP The FB SCALE module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: Error=0 AnalogOut=0 StuckAtError=0
4	ERROR If the FB SCALE module detects an error when checking the value range of AnalogOut, the FB SCALE module switches to the ERROR state and transmits the corresponding Diag message to the GROUP module. The outputs assume the following values: Error=1 AnalogOut=0 StuckAtError=0
5	RESET The FB SCALE module 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

3.23.3 FB Scale configuration in TwinCAT 3

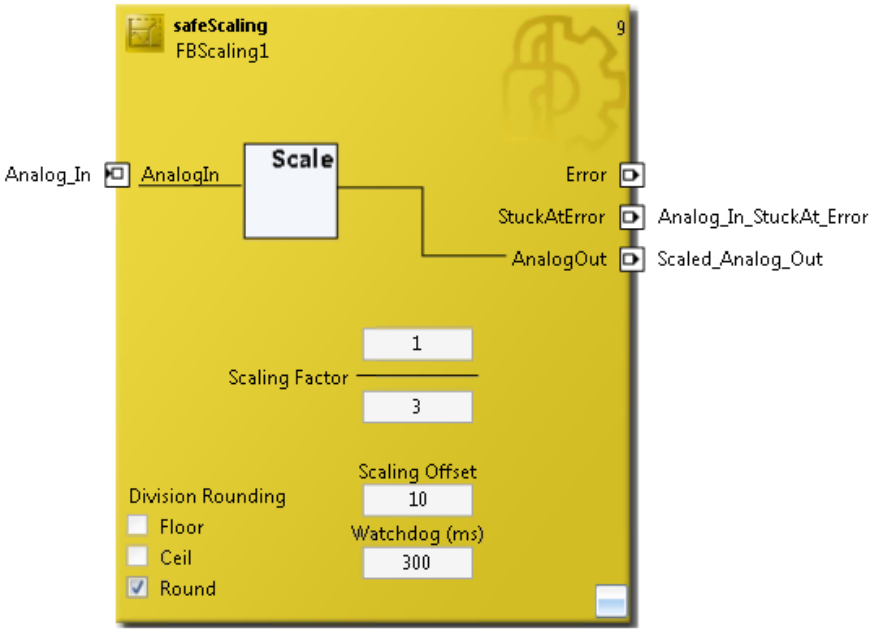


Figure 3-97: FB Scale configuration

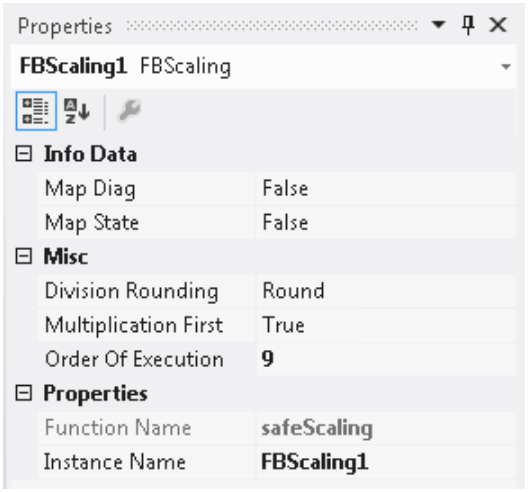


Figure 3-98: FB Scale properties

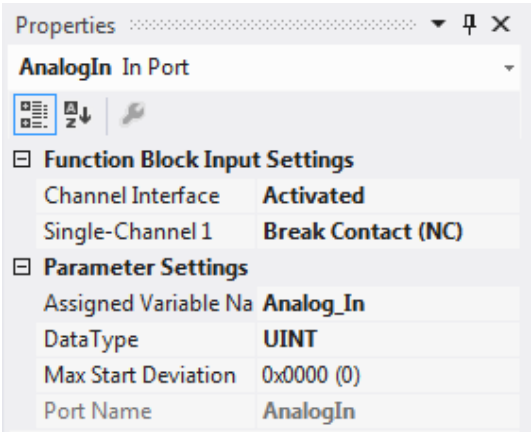


Figure 3-99: FB Scale port properties

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 *MapState* and *MapDiag* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

3.24 The function block SPEED

3.24.1 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 is output in increments per time interval.

The parameter *Time Interval* is specified in ms

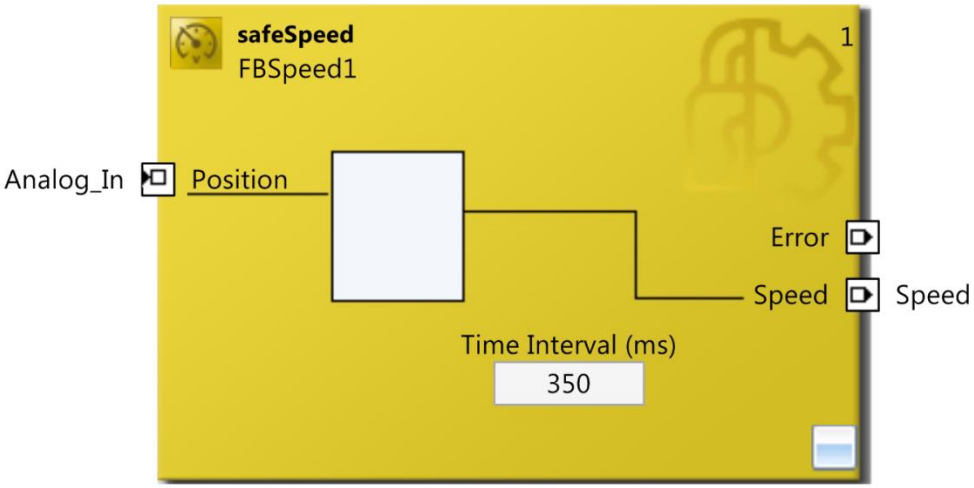


Figure 3-100: Function block SPEED

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

3.24.2 Signal description

Table 3-148: FB Speed inputs

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

Table 3-149: 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 INT32 UINT16 UINT32	Output with the calculated speed

Table 3-150: FB Speed input and output types

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

Table 3-151: Internal identifier of the FB

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

3.24.2.1 Diagnostic and state information for the FB Speed

Table 3-152: Diagnostic information

Value	Description
0	No diagnostic information
1	The Speed output has an underflow (is less than the smallest possible value)
2	The Speed output has an overflow (is greater than the largest possible value)

Table 3-153: 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

Table 3-154: State information

Value	Description
1	RUN In the RUN state the FB SPEED module enters the result of the speed calculation in the Speed output. The outputs assume the following values: Error=0 Speed = calculated speed
2	STOP The FB SPEED module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: Error=0 Speed=0
4	ERROR If the FB SPEED module detects an error when checking the value range of Speed, the module FB SPEED switches to the ERROR state and transmits the corresponding Diag message to the GROUP module. The outputs assume the following values: Error=1 Speed=0
5	RESET The FB SPEED module 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 Speed=0

3.24.3 FB Speed configuration in TwinCAT 3

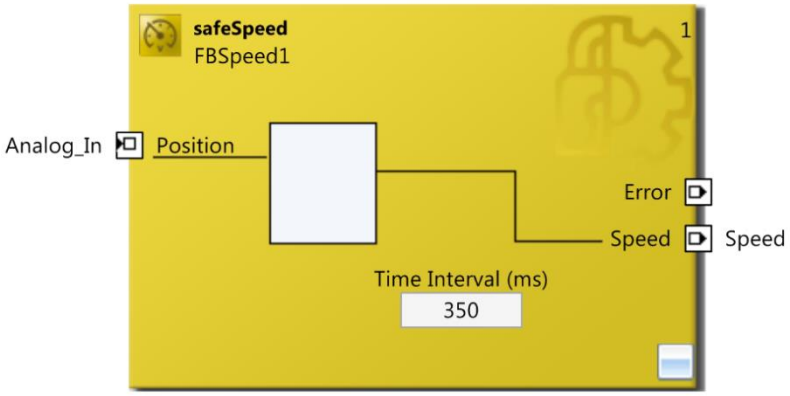


Figure 3-101: FB Speed configuration

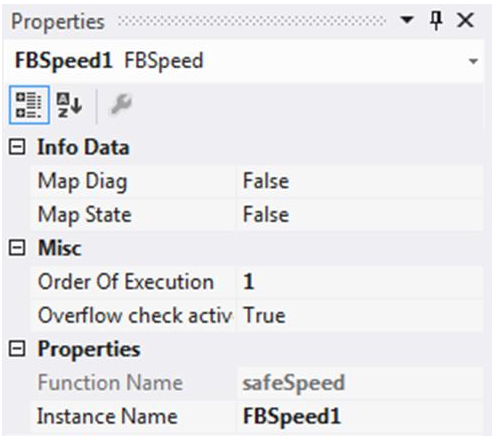


Figure 3-102: FB Speed properties

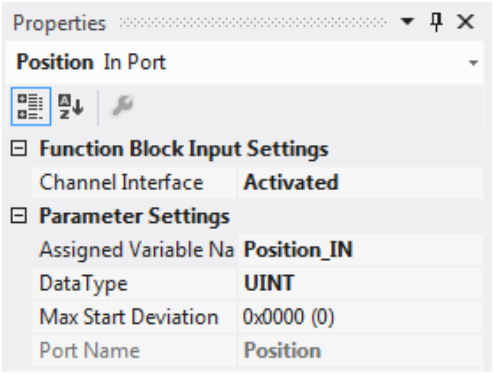


Figure 3-103: FB Speed port properties

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 *MapState* and *MapDiag* 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.

3.25 The function block LOADSENSING

3.25.1 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]

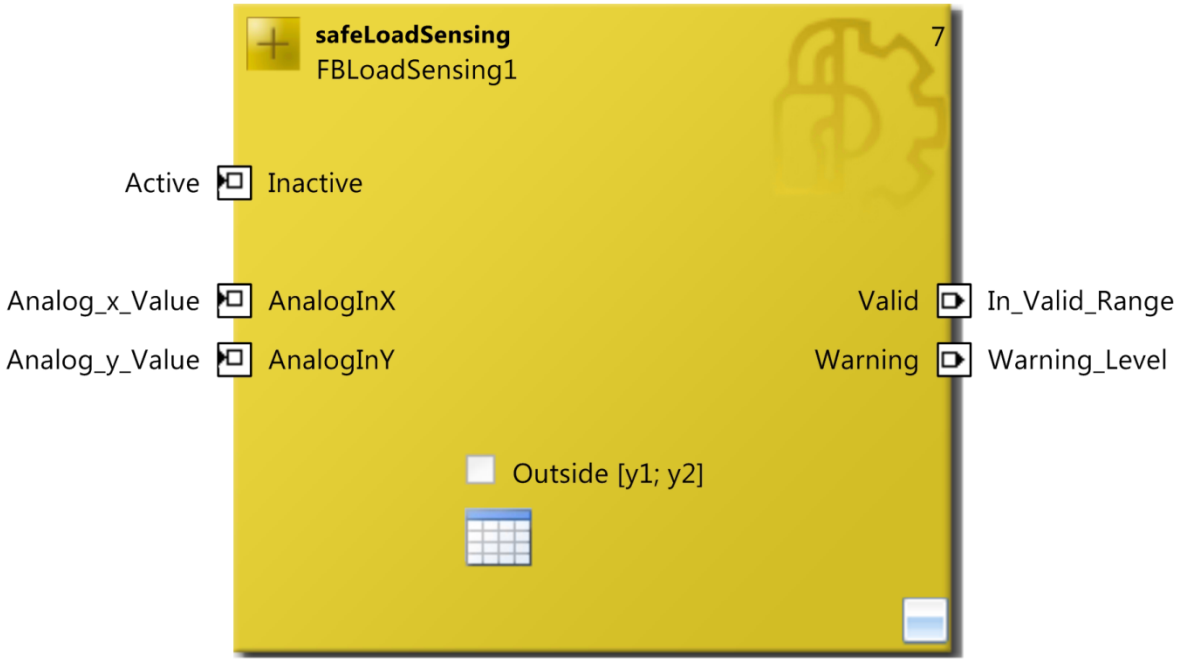


Figure 3-104: Function block LOADSENSING

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

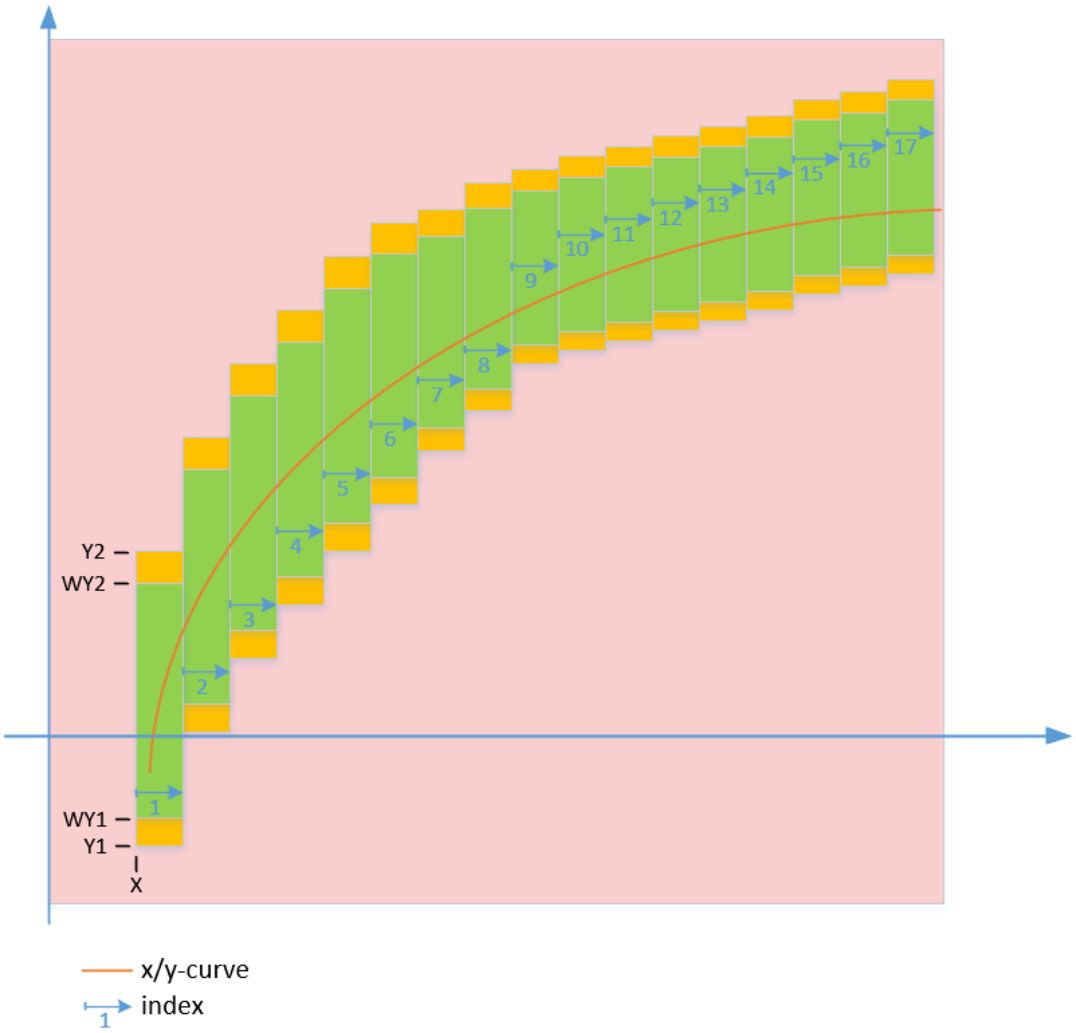


Figure 3-105 - Diagram showing verification of the characteristic curve

3.25.2 Signal description

Table 3-155: 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 INT32 UINT16 UINT32	Analog x-value
AnalogInY	TwinSAFE-In FB-Out Standard-In TwinSAFE SC	INT16 INT32 UINT16 UINT32	Analog y-value

Table 3-156: 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.

Table 3-157: Input and output types

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

Table 3-158: Internal identifier of the FB

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

3.25.2.1 Diagnostic and state information for the FB LoadSensing

Table 3-159: Diagnostic information

Value	Description
-	No diagnostic information

Table 3-160: Diag Message

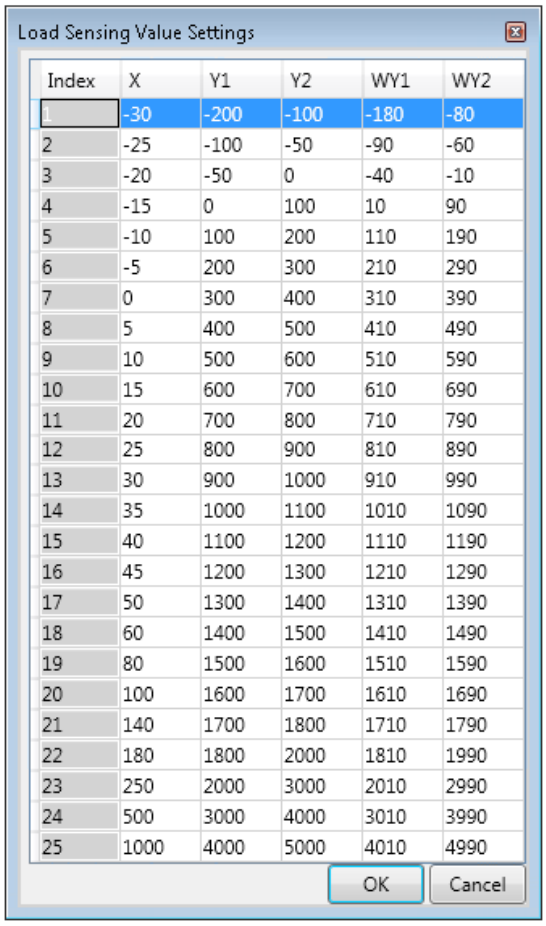
Text ID	Meaning	Parameter 1	Parameter 2	Parameter 3
-	-	-	-	-

Table 3-161: State information

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

3.25.3 FB LOADSENSING configuration in TwinCAT 3

Figure 3-106: FB LOADSENSING configuration



Index	X	Y1	Y2	WY1	WY2
1	-30	-200	-100	-180	-80
2	-25	-100	-50	-90	-60
3	-20	-50	0	-40	-10
4	-15	0	100	10	90
5	-10	100	200	110	190
6	-5	200	300	210	290
7	0	300	400	310	390
8	5	400	500	410	490
9	10	500	600	510	590
10	15	600	700	610	690
11	20	700	800	710	790
12	25	800	900	810	890
13	30	900	1000	910	990
14	35	1000	1100	1010	1090
15	40	1100	1200	1110	1190
16	45	1200	1300	1210	1290
17	50	1300	1400	1310	1390
18	60	1400	1500	1410	1490
19	80	1500	1600	1510	1590
20	100	1600	1700	1610	1690
21	140	1700	1800	1710	1790
22	180	1800	2000	1810	1990
23	250	2000	3000	2010	2990
24	500	3000	4000	3010	3990
25	1000	4000	5000	4010	4990

Figure 3-107: 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.

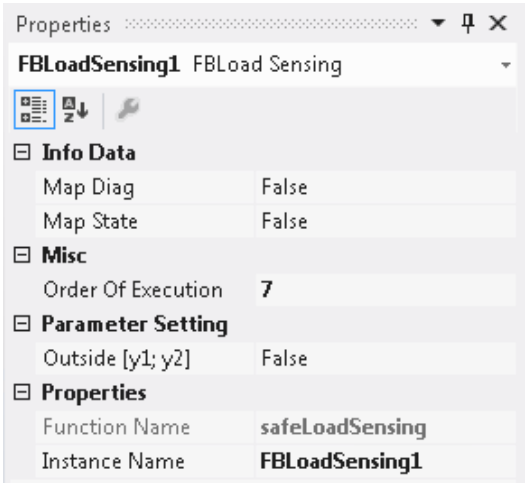


Figure 3-108: FB LOADSENSING properties

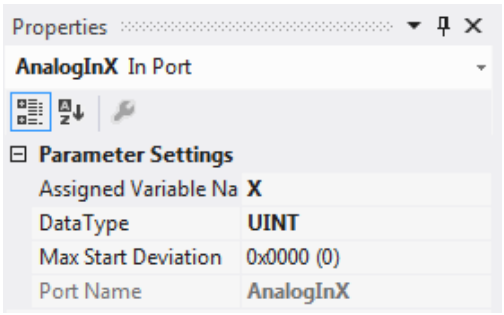


Figure 3-109: FB LOADSENSING port properties

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 *MapState* and *MapDiag* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

3.26 The function block CAMMONITOR

3.26.1 Functional description

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

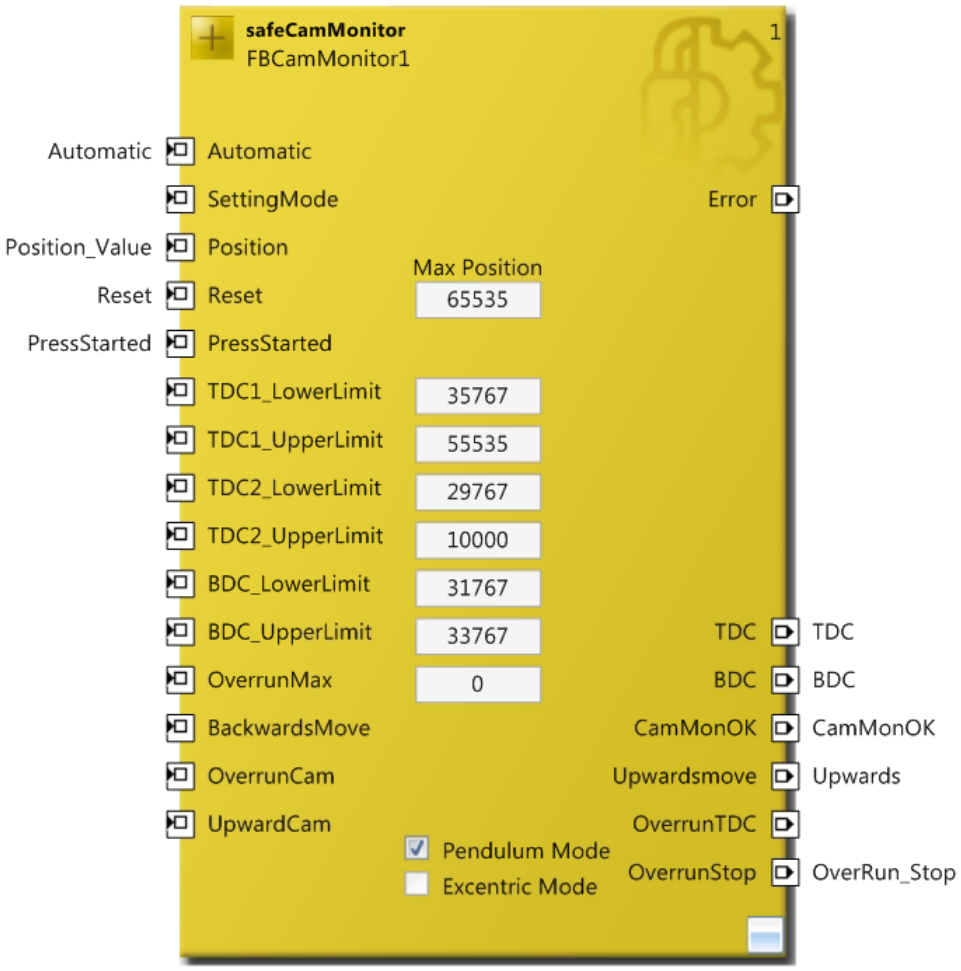


Figure 3-110: Function block CAMMONITOR

NOTE
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 sensing!

Position sensing 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.

NOTE

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.

NOTE

KL6904/EL6900

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

3.26.2 General properties of the FB CAMMONITOR

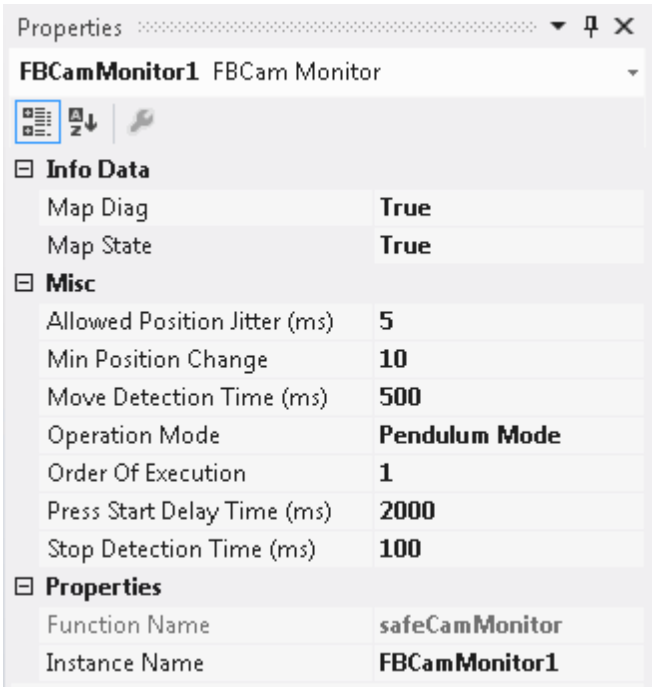


Figure 3-111: FB CAMMONITOR properties

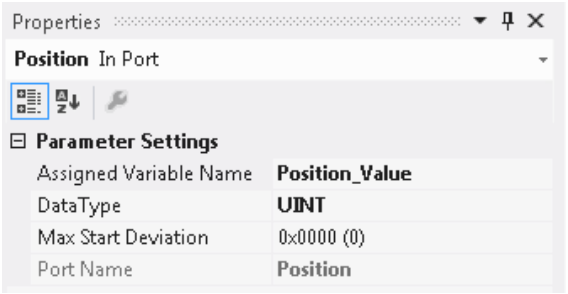


Figure 3-112: FB CAMMONITOR port properties

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 *MapState* and *MapDiag* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

Sample position sensing

In the following sample position sensing 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.

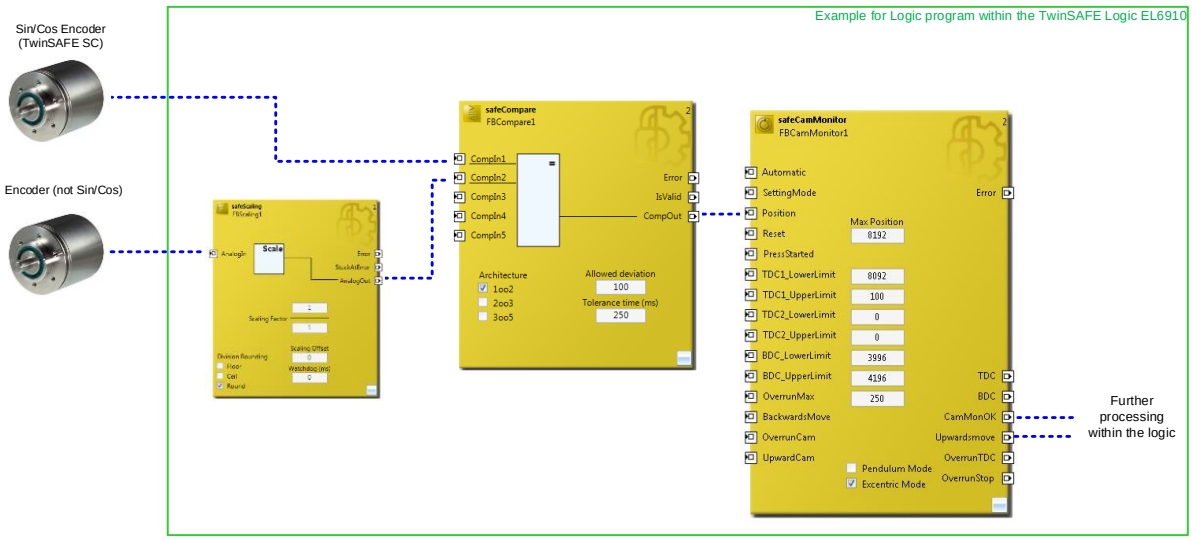


Figure 3-113: Schematic diagram of the configuration

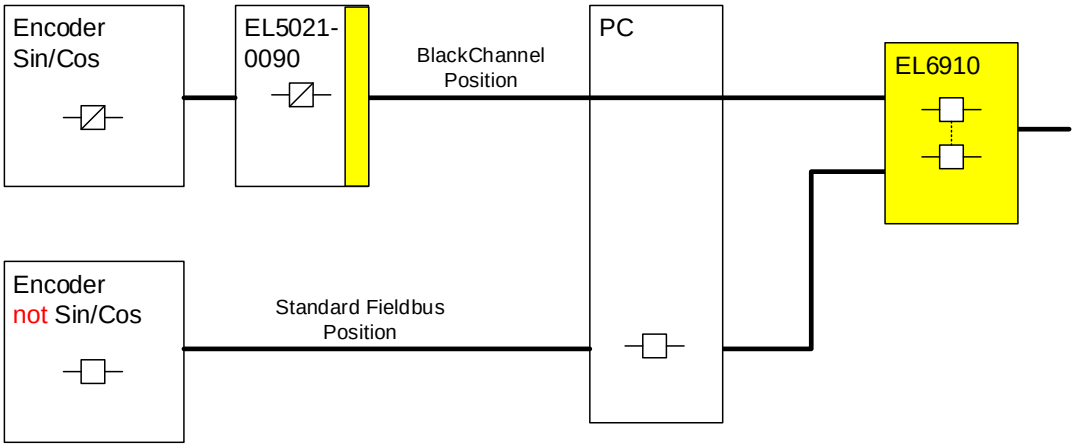


Figure 3-114: Schematic diagram of the configuration

3.26.3 Application 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.

3.26.3.1 Schematic diagram of the ranges

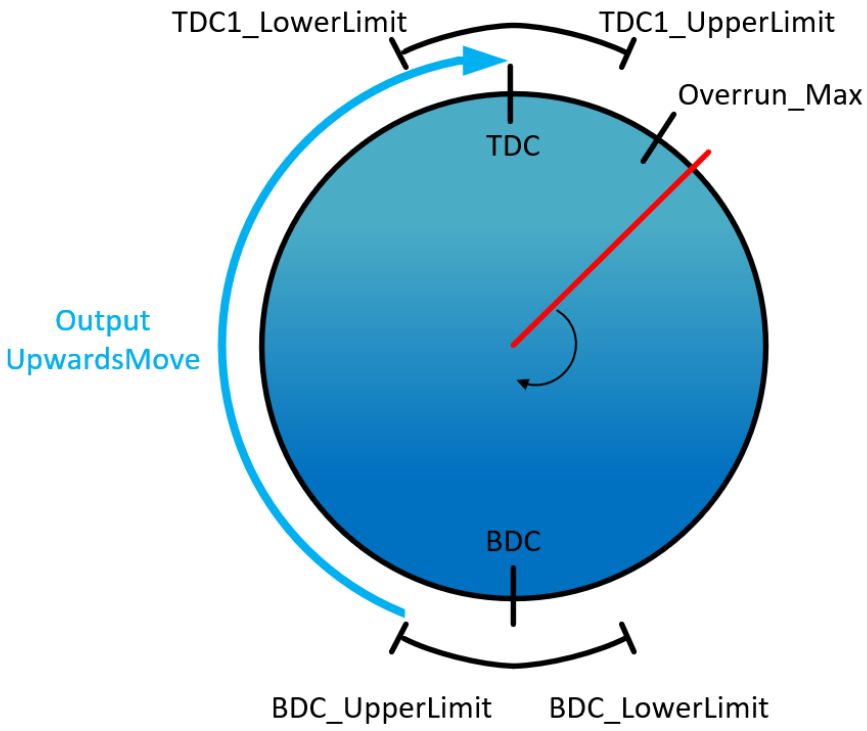


Figure 3-115: Excentric mode - schematic diagram of the ranges

3.26.3.2 Inputs

Name	Data type	Description
Automatic	safeBOOL	0: Normal operation 1: Automatic mode (no parameter verification)
SettingMode	safeBOOL	Parameter transfer in setting-up mode. Internal parameters can be changed if the input is set to 1.
Position	analog (UINT16/UINT32)	Press position. The position value must be verified reliably from several analog values or made available to the function block by another other safe method, according to the required SIL/performance level.
Reset	safeBOOL BOOL	Reset input. Before each press start a falling edge must be detected at the Reset input. 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.
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.
TDC1_UpperLimit	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
TDC2_UpperLimit	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.
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.
OverrunCam	safeBOOL	not used
UpwardCam	safeBOOL	not used

3.26.3.3 Outputs

Name	Permitted type	Description
Error	safeBOOL BOOL	Error output
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.
CamMonOK	safeBOOL BOOL	If all internal checks are without error, the CamMonOK output 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°.
OverrunTDC	analog	Difference between TDC1_LowerLimit and current position
OverrunStop	analog	Difference between position at falling edge at input Press_Started and current position

3.26.3.4 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

3.26.3.5 Scope recording of the sequence

Figure 3-116: ScopeView display of the signal sequence

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.

3.26.3.6 Cam Monitor function block excentric mode settings

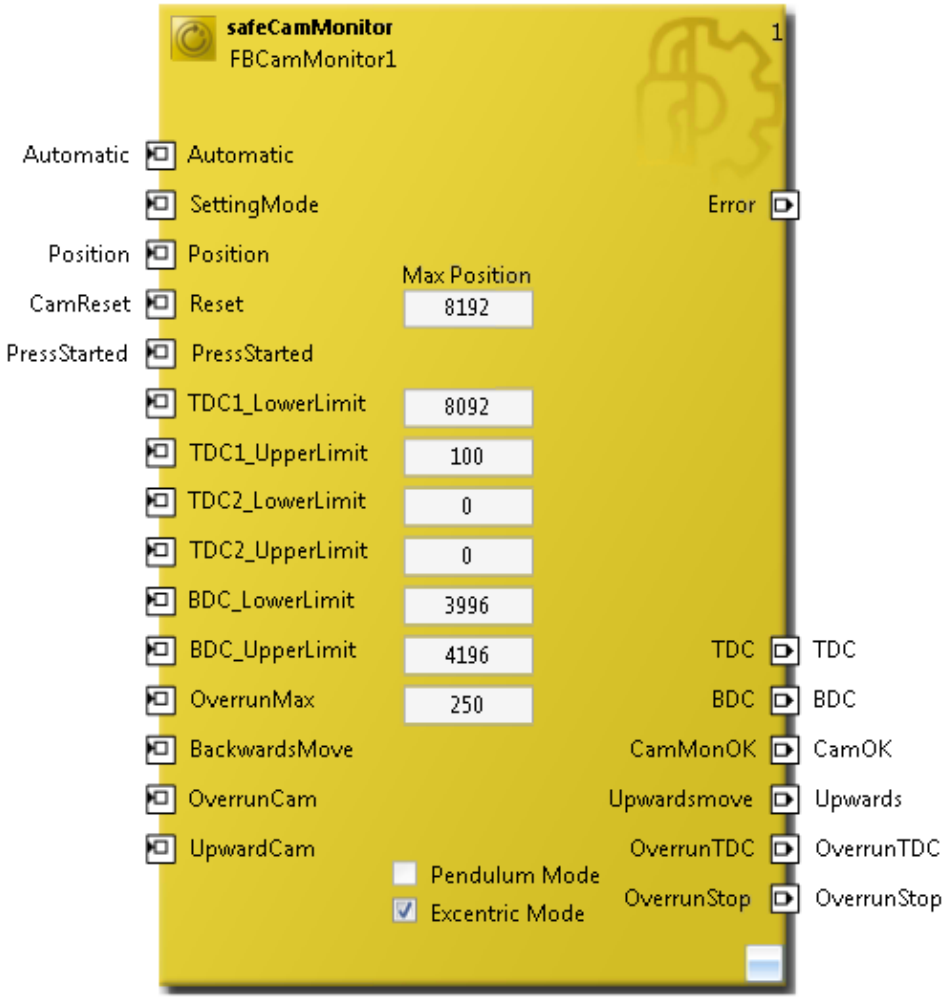


Figure 3-117: FB CamMonitor in excentric mode

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).

3.26.4 Application: 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.

3.26.4.1 Schematic diagram of the ranges

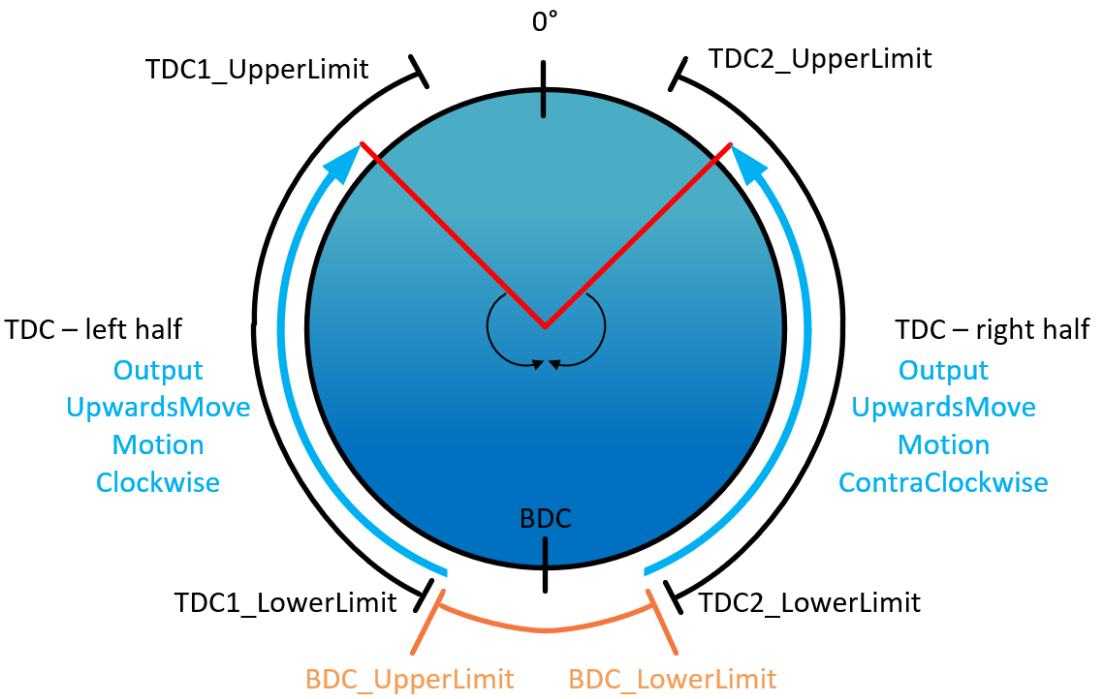


Figure 3-118: Pendulum mode - schematic diagram of the ranges

3.26.4.2 Inputs

Name	Permitted type	Description
Automatic	safeBOOL	0: Normal operation 1: Automatic mode (no parameter verification)
SettingMode	safeBOOL	Setting-up mode. Internal parameters can be changed if the input is set to 1.
Position	analog (UINT16/UINT32)	Press position. The position value must be verified reliably from several analog values or made available to the function block by another other safe method, according to the required SIL/performance level.
Reset	safeBOOL BOOL	Reset input. Before each press start a falling edge must be detected at the Reset input. 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.
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.
TDC1_UpperLimit	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.
TDC2_UpperLimit	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.
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.
BackwardsMove	safeBOOL	In pendulum mode the input must be inactive.
OverrunCam	safeBOOL	The input OverrunCam must be inactive.
UpwardCam	safeBOOL	The input UpwardsCam must be inactive.

3.26.4.3 Outputs

Name	Permitted type	Description
Error	safeBOOL BOOL	Error output (see diagnostic information)
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.
CamMonOK	safeBOOL BOOL	If all internal checks are without error, the CamMonOK output 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 UpwardsMove output is set in the other half. The output is set from BDC_UpperLimit or BDC_LowerLimit until press standstill is detected.
OverrunTDC	analog	not used
OverrunStop	analog	Difference between position at falling edge at input Press_Started and current position

3.26.4.4 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

3.26.4.5 Scope recording of the sequence

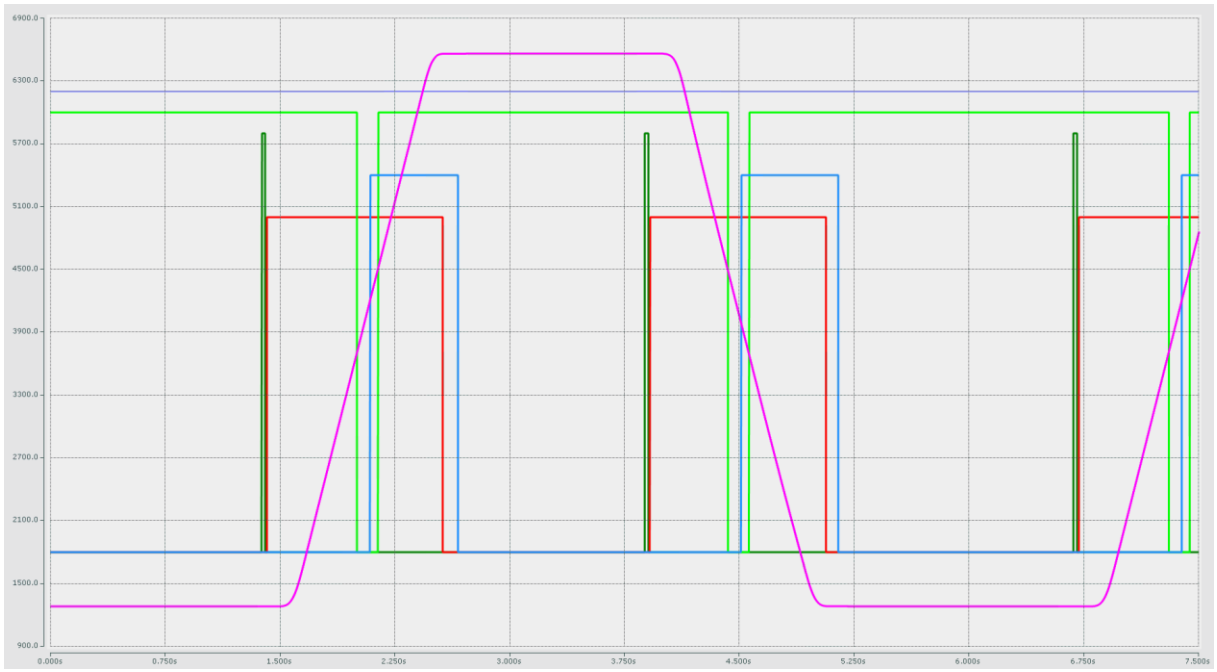


Figure 3-119: ScopeView display of the signal sequence

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.

3.26.4.6 CamMonitor function block settings, pendulum mode

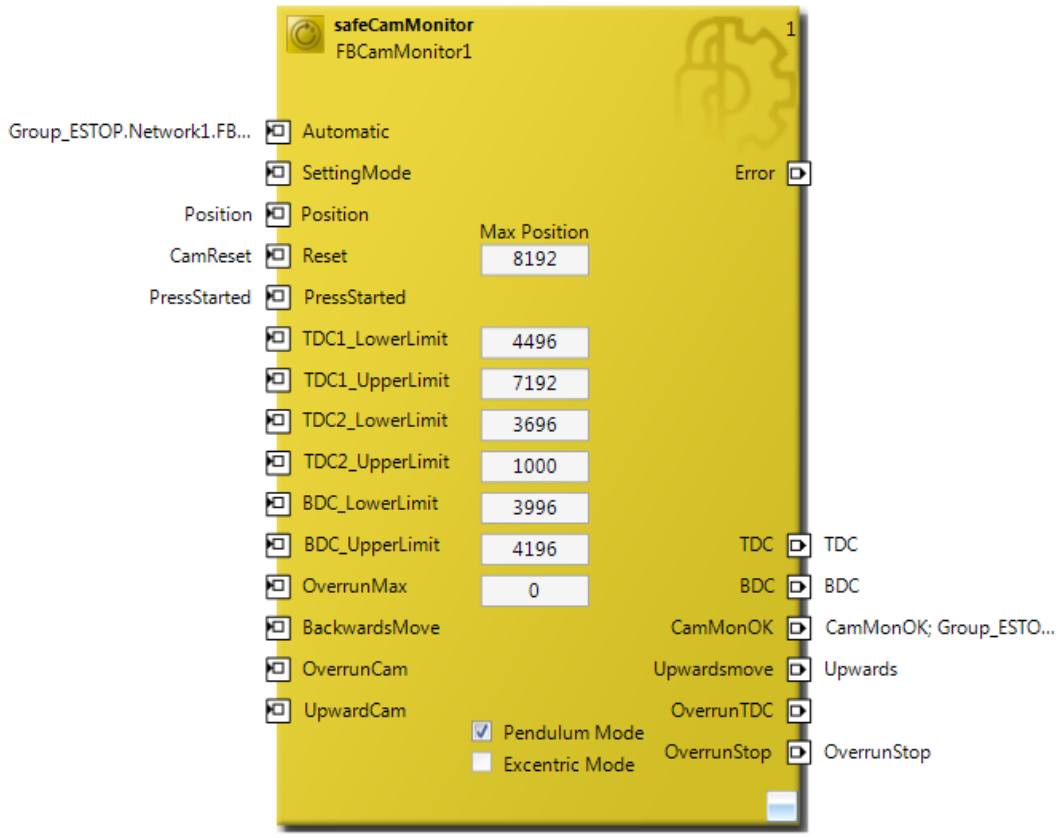


Figure 3-120: FB CamMonitor in pendulum mode

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).

3.26.5 Application: 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.

3.26.5.1 Inputs

Name	Data type	Description
Automatic	safeBOOL	0: Normal operation 1: Automatic mode (no parameter verification)
SettingMode	safeBOOL	Parameter transfer in setting-up mode. Internal parameters can be changed if the input is set to 1.
Position	analog (UINT16/UINT32)	Press position. The position value must be verified based on several analog values or made available to the function block by other safe means.
Reset	safeBOOL BOOL	Reset input. Before each press start a falling edge must be detected at the Reset input. 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.
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.
TDC1_UpperLimit	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
TDC2_UpperLimit	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.
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.
OverrunCam	safeBOOL	The OverrunCam input must be connected to a Boolean input.
UpwardCam	safeBOOL	The UpwardsCam input must be connected to a Boolean input.

3.26.5.2 Outputs

Name	Permitted type	Description
Error	safeBOOL BOOL	Error output
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.
CamMonOK	safeBOOL BOOL	If all internal checks are without error, the CamMonOK output 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°.
OverrunTDC	analog	Difference between TDC1_LowerLimit and current position
OverrunStop	analog	Difference between position at falling edge at input Press_Started and current position

3.26.5.3 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

3.26.5.4 Scope recording of the sequence

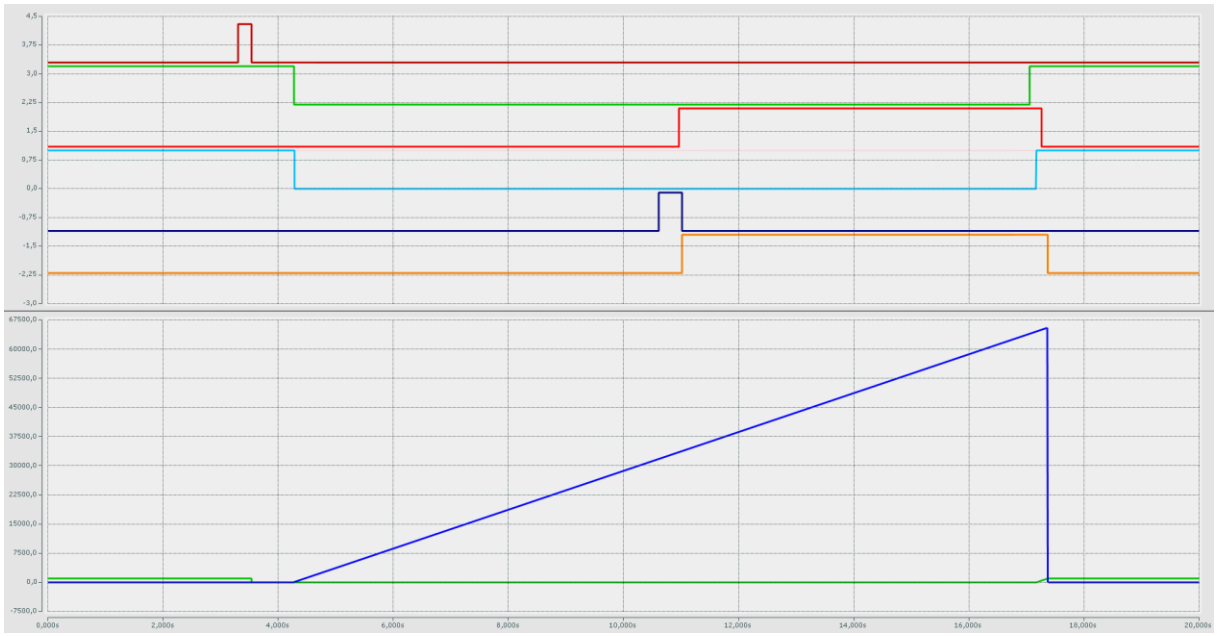


Figure 3-121: ScopeView display of the signal sequence

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

3.26.5.5 CamMonitor function block hardware cam settings

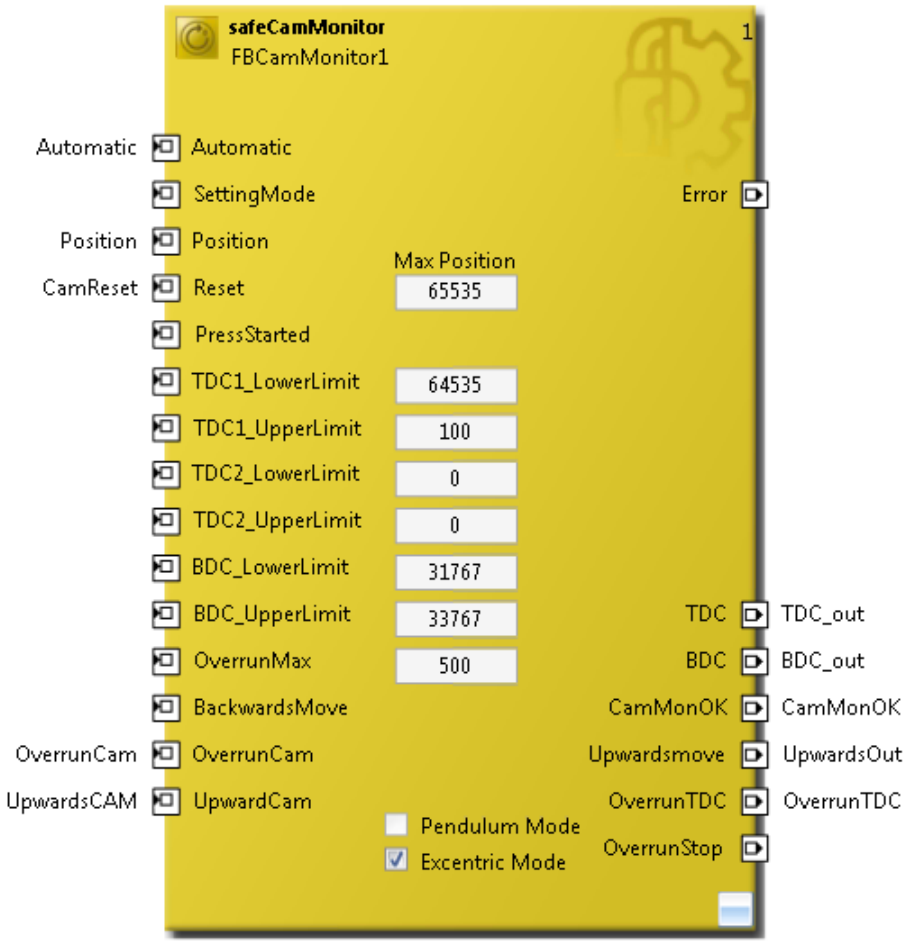


Figure 3-122: FB CamMonitor in excentric mode with hardware cams

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).

3.26.6 Description of the process

3.26.6.1 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.

3.26.6.2 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.

3.26.6.3 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.

3.26.6.4 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.

3.26.7 Diagnostics messages excentric mode

3.26.7.1 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 bigger or equal 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 bigger or equal 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 or equal 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 smaller or equal the configured value of 180° (plus maximum position jitter) (%d)	FB instance	BDCUpper Limit	MaxPosition/2 + Allowed PositionJitter
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	BDCUpper Limit + 2*Allowed PositionJitter	TDC1Lower Limit
0x4015	(TDC1LowerLimit + AllowedPositionJitter) > MaxPosition	The value of TDCLowerLimit (plus maximum position jitter) (%d) is bigger or equal the configured position of 360° (%d)	FB instance	TDC1Lower Limit + Allowed PositionJitter	MaxPosition
0x4002	Position > (MaxPosition +AllowedPositionJitter)	The Position (%d) is bigger than the maximum position (plus the maximum position jitter) (%d)	FB instance	Position	MaxPosition+ Allowed PositionJitter

3.26.7.2 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 negative	FB instance	-	-
0x4013	Automatic = FALSE AND BackwardsMove = TRUE AND MoveClockWise= TRUE	The Input BackwardsMove is TRUE while the moving is clockwise	FB instance	-	-
0x4012	Automatic = FALSE AND BackwardsMove = TRUE AND (LeftArea = TRUE OR TDCLeftArea=TRUE)	The Input BackwardsMove is TRUE while the Position is between 180° and 360°, the actual position is %d	FB instance	Position	-

3.26.7.3 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 input OverrunCAM 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 input OverrunCAM 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 input OverrunCAM changed from FALSE to TRUE outside the area between BDCUpperLimit and TDCLowerLimit, the actual position is %d	FB instance	Position	-
0x4006	Automatic = FALSE AND OverrunMaxArea = FALSE AND OverrunCAM changes to FALSE	The input OverrunCAM changed from TRUE to FALSE outside the area between OverrunMax and BDCLowerLimit, the actual position is %d	FB instance	Position	-

3.26.7.4 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 input UpwardsCAM was TRUE in the area between OverrunMax and BDCLowerLimit	FB instance	Position	-
0x4007	Automatic=FALSE AND UpwardsCAM=FALSE AND LeftArea=TRUE	The input UpwardsCAM 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 input UpwardsCAM 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 input UpwardsCAM changed from TRUE to FALSE outside the area between TDCLowerLimit and OverrunMax, the actual position is %d	FB instance	Position	-

3.26.7.5 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 of the input Reset in the state MOVE-STOP	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 of the input Reset in the state MOVE-START	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 state MOVE-UP	FB instance	Position	-
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		

3.26.7.6 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 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 is 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

3.26.8 Diagnostic messages pendulum mode

3.26.8.1 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
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		

3.26.8.2 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 Pendulum Mode, actual position=%d, last position=%d	FB instance	Position	last position
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	-

3.26.8.3 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 is 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

3.26.9 State 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 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 assumes 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.
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 Reset input 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.

Value		Name	Description
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 Reset input becomes TRUE in MOVE-STOP-TDC2 state.

Table 3-162: Internal identifier of the FB

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

3.27 The function block SLI

3.27.1 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.

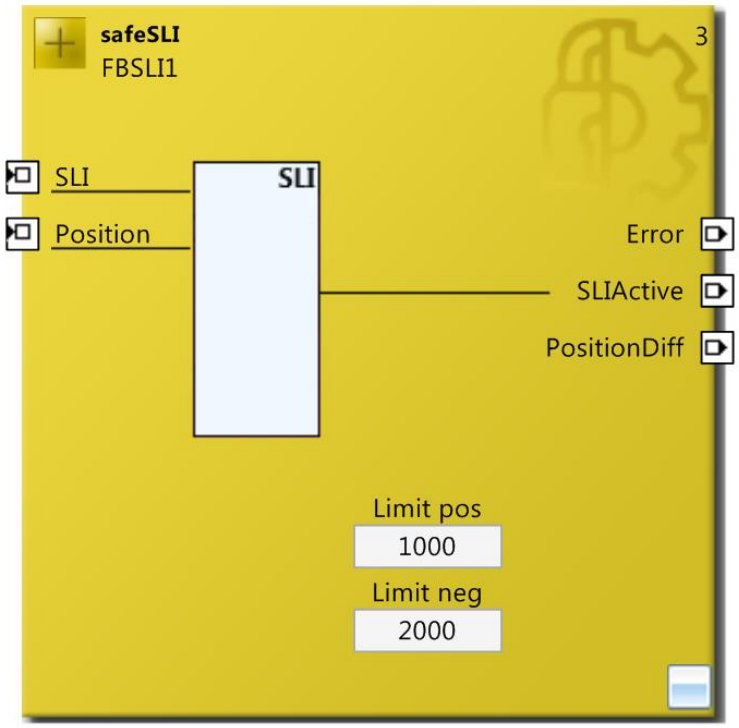


Figure 3-123: Function block SLI

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

3.27.2 Signal description

Table 3-163: 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 set with a rising edge at SLI stored and compared with the saved position as long as SLI remains set. The difference is output at PositionDiff.

Table 3-164: 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	The difference between the saved position (LatchPosition) and the current position is output. PositionDiff is set to 0 if SLIActive is FALSE.

Table 3-165: Input and output types

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

Table 3-166: 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)

Table 3-167: Internal identifier of the FB

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

3.27.2.1 Diagnostic and state information for the FB SLI

Table 3-168: Diagnostic information

Value	Description
0	no diagnostic information
1	Underflow (PositionDiff < -NegLimit)
2	Overflow (PositionDiff > PosLimit)

Table 3-169: 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

Table 3-170: State information

Value	Description
1	RUN In RUN state the FB SLI module 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 The FB SLI module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: Error=0 SLIActive=0 PositionDiff = 0
3	SAFE If the SLI input is FALSE, the FB SLI module assumes the SAFE state. The outputs assume the following values: Error=0 SLIActive=0 PositionDiff = 0
4	ERROR If the FB SLI module detects an error when checking the permitted range for the PositionDiff, the FB SLI module switches to the ERROR state and transmits the corresponding Diag message to the GROUP module. The outputs assume the following values: Error=1 SLIActive=0 PositionDiff = 0
5	RESET The FB SLI module 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 FB SLI module should not exit the RESET state until ErrAck is FALSE and SLI is FALSE. The outputs assume the following values: Error=0 SLIActive=0 PositionDiff = 0

3.27.3 FB SLI configuration in TwinCAT 3

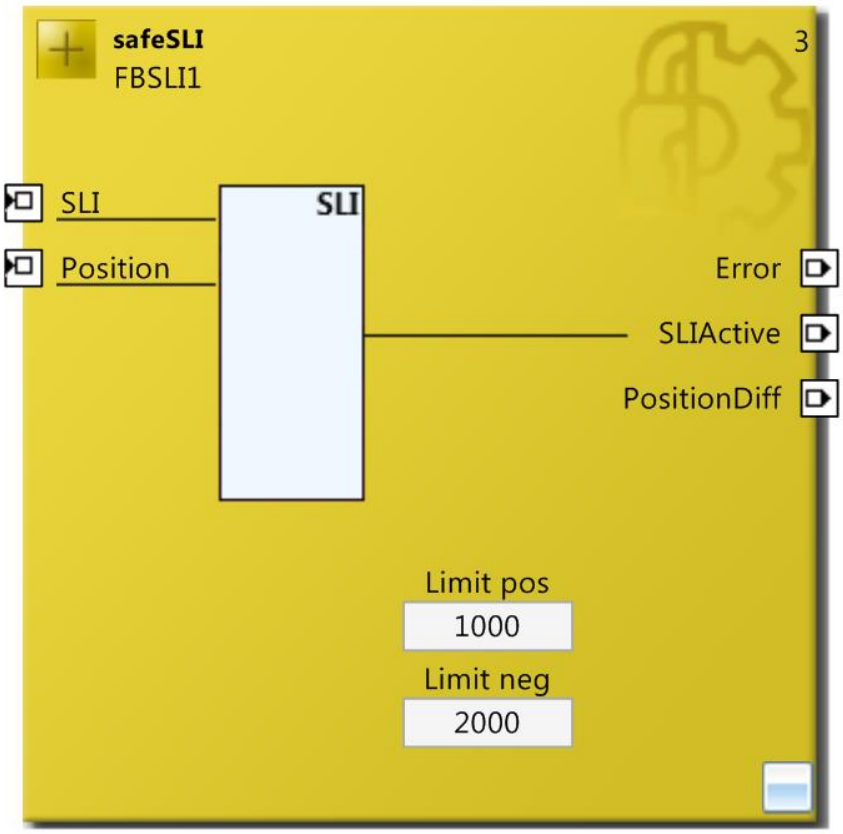


Figure 3-124: FB SLI configuration

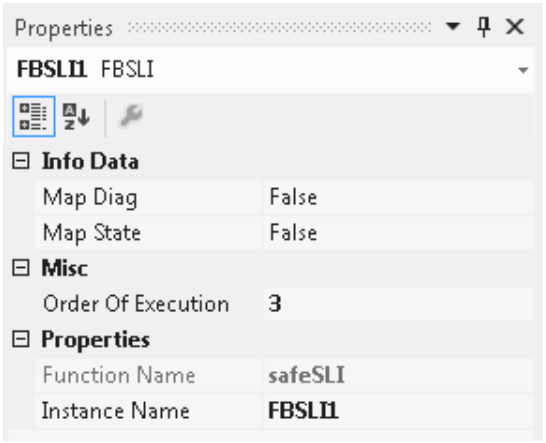


Figure 3-125: FB SLI properties

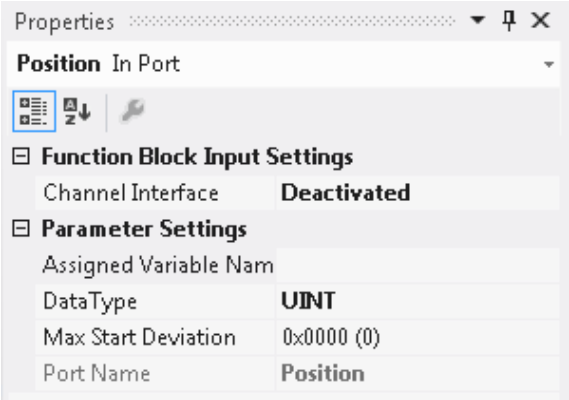


Figure 3-126: FB SLI port properties

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 *MapState* and *MapDiag* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

3.28 The function block Envelope

3.28.1 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.

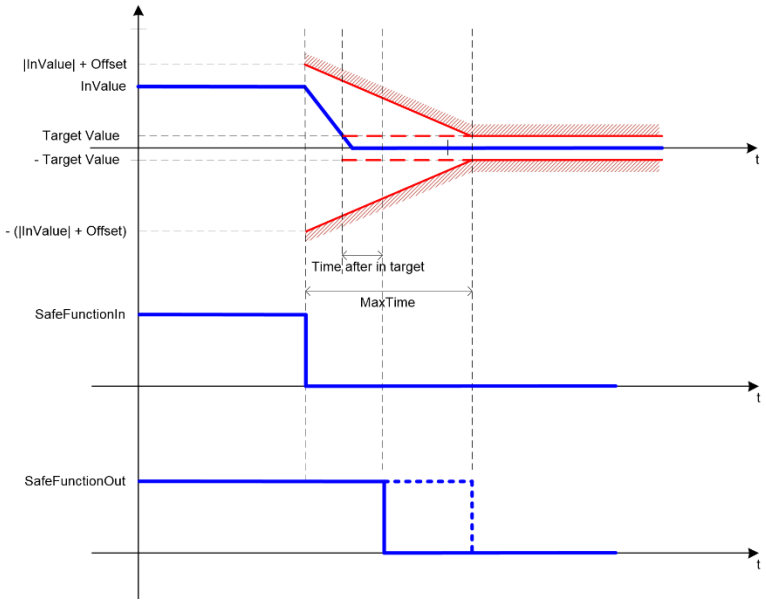


Figure 3-127 - Diagram showing FB Envelope over time

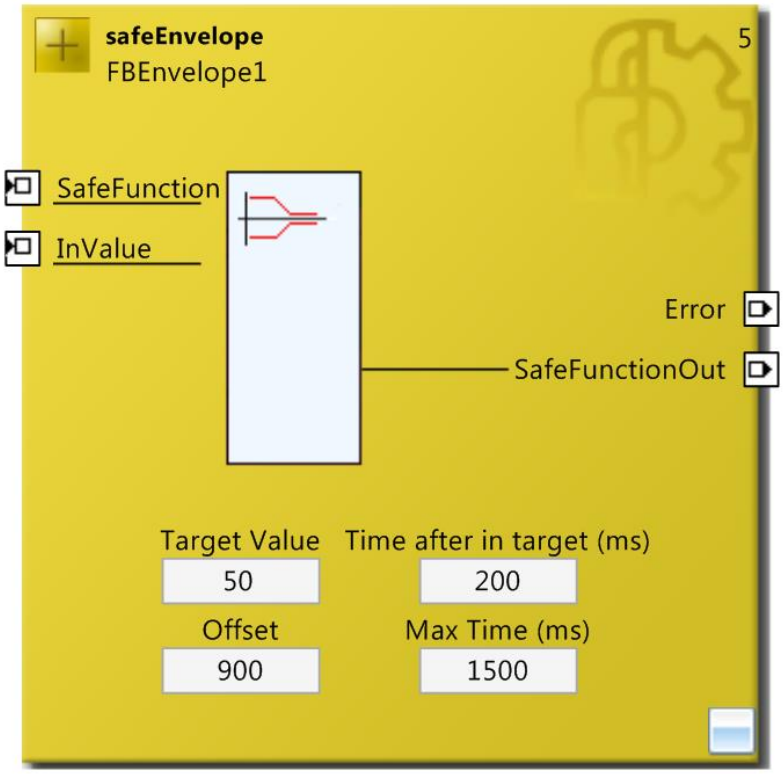


Figure 3-128: Function block Envelope

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

3.28.2 Signal description

Table 3-171: 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 INT32 UINT16 UINT32	Position or analog value to be monitored for deceleration or change in direction of 0 within an envelope curve.

Table 3-172: 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 curve-monitored)

Table 3-173: Input and output types

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

Table 3-174: 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 starting point of the envelope curve as positive and negative value.
Time after in target (ms)	Time after which the SafeFunctionOut output switched off, if it is within the TargetValue range
Max Time (ms)	Maximum time, after which the SafeFunctionOut output is switched off.

Table 3-175: Internal identifier of the FB

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

3.28.2.1 Diagnostic and state information for the FB Envelope

Table 3-176: Diagnostic information

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

Table 3-177: 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	-

Table 3-178: State information

Value	Description
1	RUN The FB ENV module assumes the RUN state if the input SafeFunction is TRUE. The outputs assume the following values: Error=0 SafeFunctionOut=1
2	STOP The FB ENV module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: Error=0 SafeFunctionOut=0
3	SAFE The FB ENV module assumes the SAFE state if the input SafeFunction is FALSE, MaxTimeExpired is TRUE or TimeAfterInTargetExpired is TRUE. The outputs assume the following values: Error=0 SafeFunctionOut=0
4	ERROR If the FB ENV module detects an error, the FB ENV module assumes the ERROR state and transmits the corresponding Diag message to the GROUP module. The outputs assume the following values: Error=1 SafeFunctionOut=0
5	RESET The FB ENV module 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 The FB ENV module assumes the DELAYOUT state if the input SafeFunction is FALSE, InValueInTarget is TRUE, TimeAfterInTargetExpired is TRUE and MaxTimeExpired is FALSE. The outputs assume the following values: Error=0 SafeFunctionOut=1
9	MONITOR If the input SafeFunction is FALSE, InValueInTarget is FALSE and MaxTimeExpired is FALSE, the FB ENV module assumes the MONITOR state and monitors whether the InValue is still within the envelope (InValueExpired=FALSE). The FB ENV module 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 current InValue, InValueExpired is set to TRUE. The outputs assume the following values: Error=0 SafeFunctionOut=1

3.28.3 FB Envelope configuration in TwinCAT 3

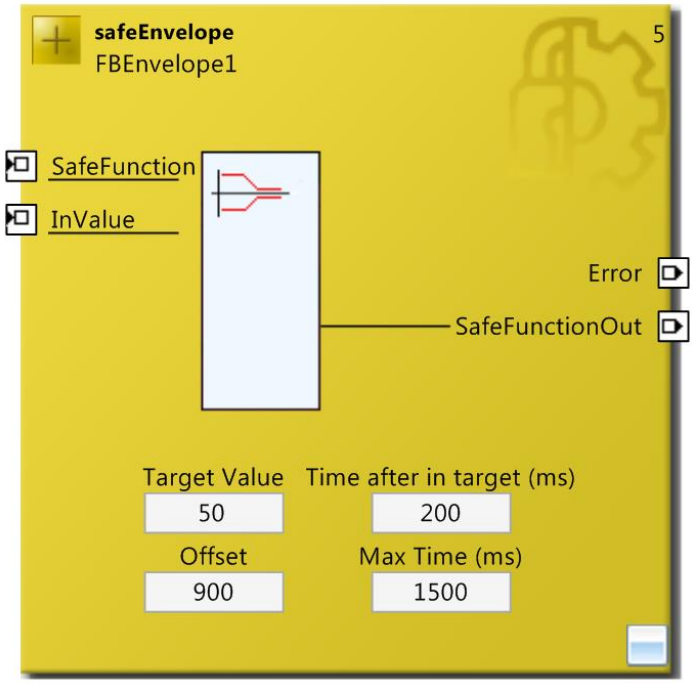


Figure 3-129: FB Envelope configuration

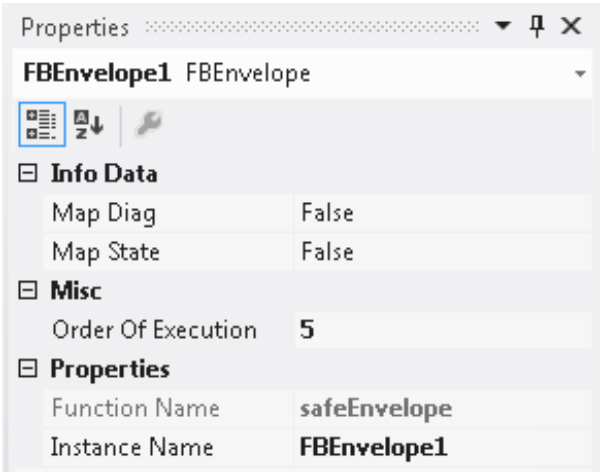


Figure 3-130: FB Envelope properties

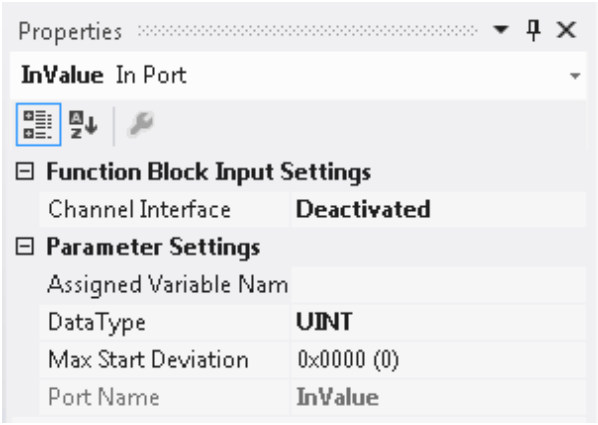


Figure 3-131: FB Envelope port properties

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 *MapState* and *MapDiag* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

3.29 The function block ViolationCounter

3.29.1 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 (*Input*: FALSE if negated), the error counter is decremented by the value *Decrement No Error*; if the input is FALSE (Input: TRUE if negated), the error counter is incremented by *Increment Error*. *InputOK* is set to FALSE when the error counter reaches the *Counter Limit*.

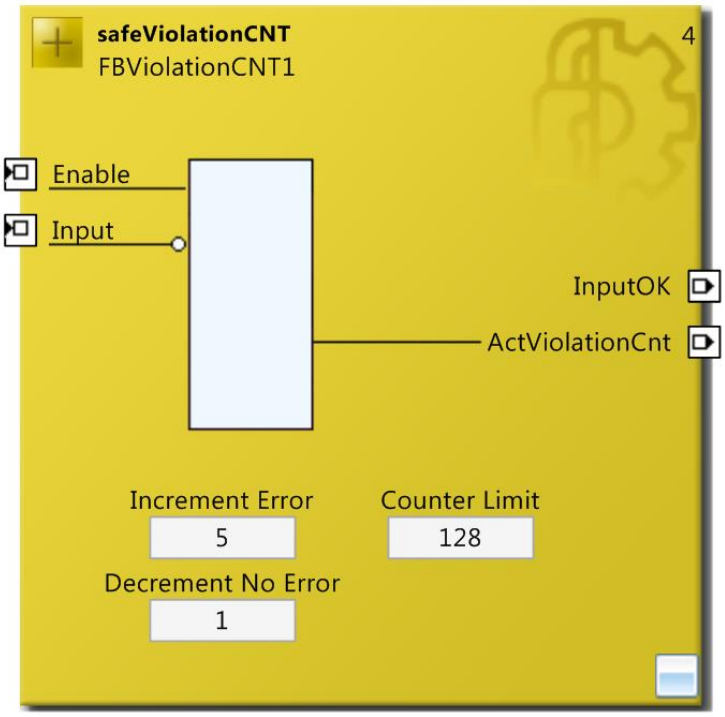


Figure 3-132: Function block ViolationCnt

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

3.29.2 Signal description

Table 3-179: FB ViolationCnt inputs

Name	Permitted type	Data type	Description
Enable	TwinSAFE-In FB-Out Standard-In	BOOL	Input for activating the function.
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

Table 3-180: 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.
ActViolationCnt	TwinSAFE-Out FB-In Standard-Out	UINT16 UINT32	Indicates the current internal counter value if the Enable input is TRUE, otherwise the output is set to 0.

Table 3-181: Input and output types

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

Table 3-182: 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.

Table 3-183: Internal identifier of the FB

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

3.29.2.1 Diagnostic and state information for the FB ViolationCnt

Table 3-184: Diagnostic information

Value	Description
0	no diagnostic information

Table 3-185: Diag Message

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

Table 3-186: State information

Value	Description
1	RUN If the input Enable is TRUE and LimitOverrun is FALSE, the FB VIOCNT module assumes the RUN state and modifies the ActViolationCnt value. The outputs assume the following values: InputOK=1 ActViolationCnt = current value
2	STOP The FB VIOCNT module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: InputOK=0 ActViolationCnt = 0
3	SAFE If the input Enable is TRUE and LimitOverrun is TRUE, the FB VIOCNT module assumes the SAFE state and modifies the ActViolationCnt value. The outputs assume the following values: InputOK=0 ActViolationCnt = current value
6	START If the input Enable is FALSE, the FB VIOCNT module assumes the START state. The outputs assume the following values: InputOK=0 ActViolationCnt = 0

3.29.3 FB ViolationCnt configuration in TwinCAT 3

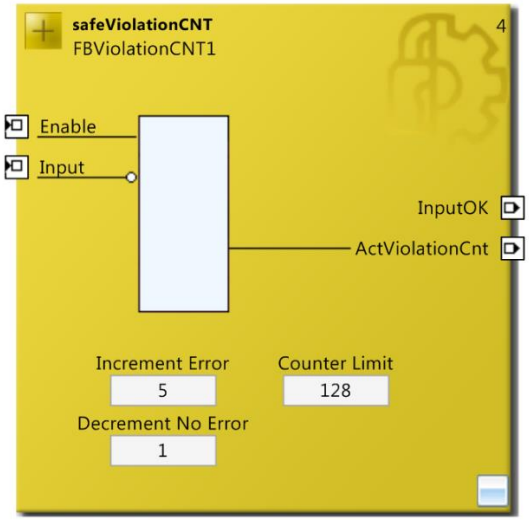


Figure 3-133: FB ViolationCnt configuration

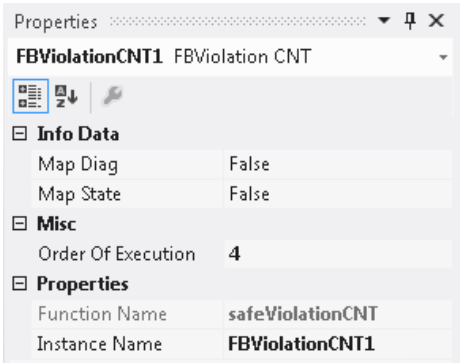


Figure 3-134: FB ViolationCnt properties

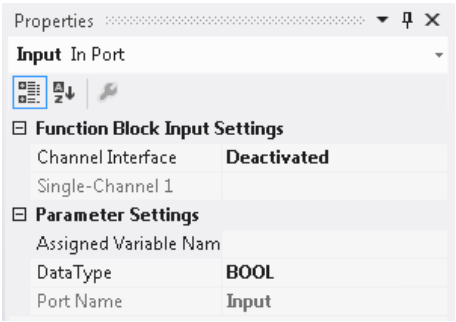


Figure 3-135: FB ViolationCnt port properties

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 *MapState* and *MapDiag* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

3.30 The function block XOR

3.30.1 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).

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

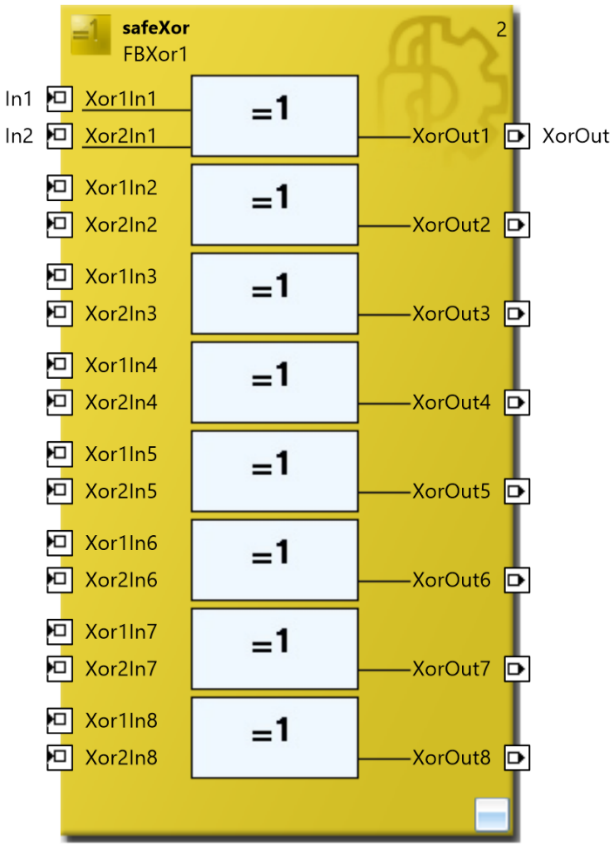


Figure 3-136: Configuration of the XOR function block

3.30.2 Signal description

Table 3-187: FB OR 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
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

Table 3-188: 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
XorOut8	TwinSAFE-Out FB-In Standard-Out	BOOL	Output of XOR8

Table 3-189: Input and output types

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

Table 3-190: Internal identifier of the FB

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

3.30.2.1 Diagnostic and state information for FB XOR

Table 3-191: Diagnostic information

Value	Description
0	no diagnostic information

Table 3-192: Diag Message

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

Table 3-193: State information

Value	Description
1	RUN The FB XOR module assumes the RUN state if the input FbRun is TRUE. 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 The FB XOR module assumes the STOP state if the input FbRun is FALSE. The outputs assume the following values: XorOutY = 0 with Y = {1,2 .. 8}

3.30.3 Configuration of the FB XOR in TwinCAT 3

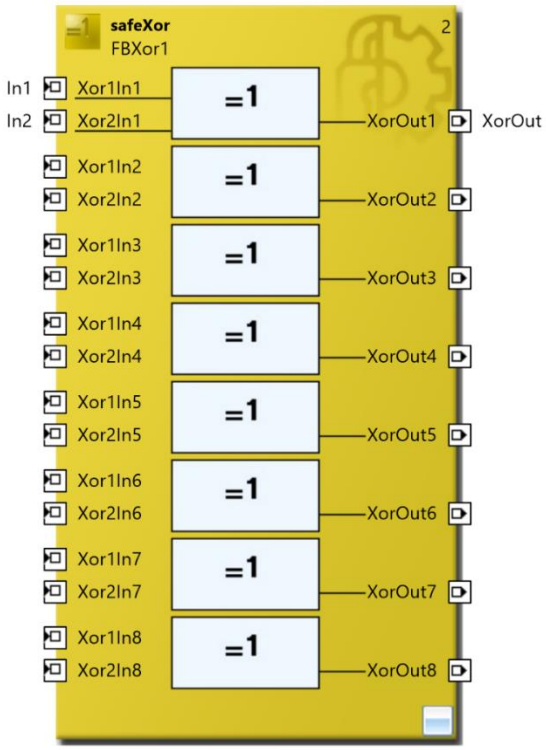


Figure 3-137: FB XOR configuration

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 *MapState* and *MapDiag* entries define which diagnostic functions of the FB are mapped to the cyclic process image.

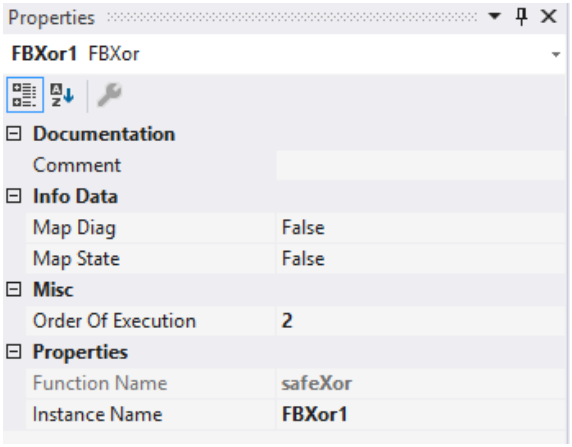


Figure 3-138: Properties of the FB XOR

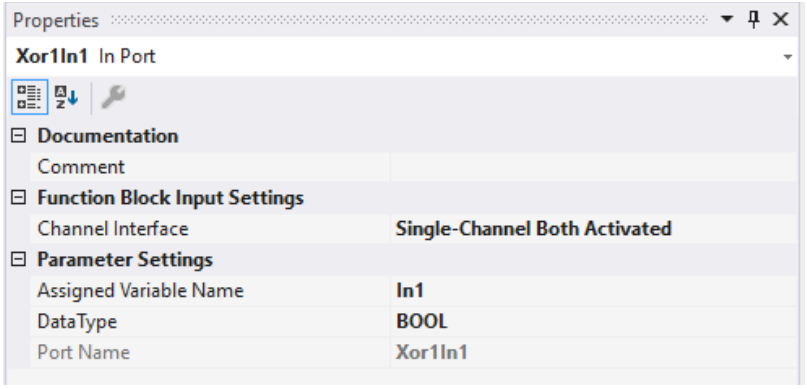


Figure 3-139: Port properties of the FB XOR

4 Appendix

4.1 Beckhoff Support and Service

Beckhoff and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to Beckhoff products and system solutions.

Beckhoff Support and Service is available to you wherever you are in the world, and can be reached by telephone, fax or e-mail. The contact addresses for your country can be found in the list of Beckhoff branches and partner firms.

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Fax: + 49 (0) 5246/963-9157
E-mail: support@beckhoff.com

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- repair service
- spare parts service
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