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Document Title	**NORSOK - PLC library**	

Project Number	**0001**	
Customer Reference		
Customer	**Dynamic Engineering**	
Project No	**0001**	
Document Type	**Standard**	
Document Number		

Rev.	Stat.	Date	Revision memo	Issued by	Checked by	Approved by
01A	IFR	01.05.2019	Issued for review	DVL	EAN	OAB
02	L1	22.07.2019	As built	EAN	EAN	EAN

DOCUMENT APPROVAL & CUSTOMER APPROVAL BOX

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The signature-box is located on the front-page.

Revision history

Rev	Description
02	QA - Added

Reference and third party documentation

Rev.	Utgiver	Dato	Kommentarer

Attachments

Nr	Beskrivelse

Content

1   Abbreviations

Short	Meaning
OB	Organization Block
FB	Function Block
FC	Function
DB	Data Base
PLC	Programmable Logical Controller
TIA	Totally Integrated Automation
DI	Digital Input
DO	Digital Output
AD	Analog to Digital
DA	Digital to Analog
OS	Operator Station

2   Background

Process automation is entering more and more industries and will have a more central role in the years to come. Many existing installations are based of outdated and ad-hoc solutions, making systems expensive to troubleshoot, maintain and update.

2.1   Purpose

This document describes the industry independent standard for factory and process automation purposed by Dynamic Engineering AS. The standard utilizes industry leading systems for automation logic and visualization; Siemens TIA and Copa-Data Zenon.

The standard describes PLC software structure and standard function blocks for automation objects with associated faceplates in Zenon. The tested structure, function blocks and face plates all enables the supplier to deliver a fault free and user-friendly system on schedule.

PLC Software: Siemens TIA Portal V15.1

Standard: IEC 63131:2017

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3   Program structure TIA

The following structure shall be used for all PLC software delivered in accordance with this standard. The system is tested and carefully planned to account for all aspects of an automation deliverance.

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3.1   HA – Analog input value from HMI

According to Norsok I-005 "HA function"

The HA function template shall be used for entering an analogue value from the HMI. This analogue value can be used in logic, calculations etc. It is possible to follow an external value by set ting the block in auto (LA). The operator can disable this function by setting the block in manual (LM).
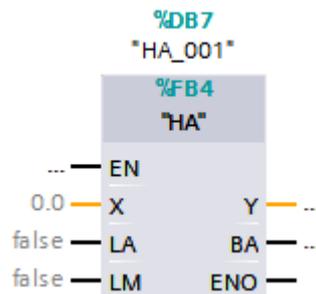
3.1.1   Datatypes

3.1.1.1   Inputs and Outputs

Port	Name	DataType	Comment
Input	X	Real	External Value Analog value tracked in Auto mode
	LA	Bool	Lock Auto Locks the template to auto mode, overruling the operator. After signal disappears, template keeps in auto mode.
	LM	Bool	Lock Manual Locks the template to man mode. After signal disappears, template keeps in manual mode.
Output	Y	Real	Normal function output Manual/ auto selected analogue output to be used in logic.
	BA	Bool	Status auto/man mode (1=auto, 0=man)
Static	OS_Param	HA_OS_Param	Block parameters
	OS_CTW	HA_OS_CTW	Commands from HMI
	OS_STW	HA_OS_STW	Status signals to HMI

3.1.1.2   OS_CTW

Name	DataType	Comment
Auto_on	Bool	Switch to auto mode
Manual_on	Bool	Switch to manual mode
X	Real	Set value in manual mode

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3.1.1.3   OS_Param

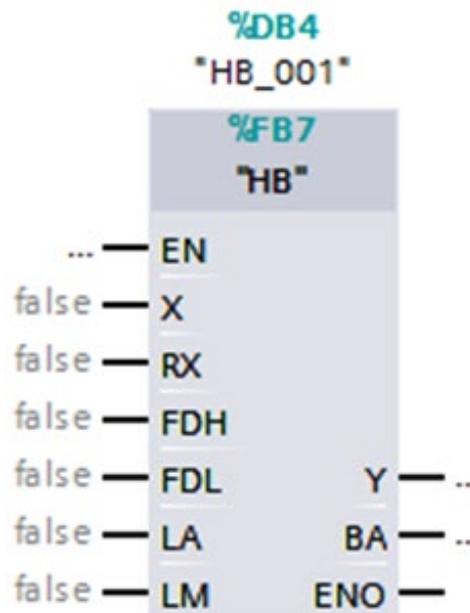| Name	DataType	Range	Comment
Ramp_time	*Real*	-	Specifies the ramping of the external value when switched from manual to auto mode. The ramp time is specified in engineering unit per second. If the ramp time is set to zero, this means the ramping is disabled.
Maximum_input_value	*Real*	Min – 32767	Defining the highest allowed input value, default 100
Minimum_input_value	*Real*	-32768 – Max	Defining the lowest allowed input value, default 0

3.1.1.4   OS_STW

Name	DataType	Offset	Comment
auto_manual_state	*Int*	-	Auto/manual state: 1= Lock auto, 2=Auto, 3=Manual, 4=Lock Manual
LA	*Bool*	-	Status Lock Auto input
LM	*Bool*	-	Status Lock Manual Input
X	*Real*	-	Status Input
Y	*Real*	-	Status Output

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3.2 HB – Binary input command from HMI

According to Norsok I-005 "HB function"

The HB function template shall be used for entering a binary value from the HMI. This binary value can be used in logic, calculations etc. It is possible to follow an external value by setting the function in auto (LA). The operator can disable this function by setting the function in manual (LM).

3.2.1 Datatypes

3.2.1.1 Inputs and Outputs

Port	Name	DataType	Comment
Input	X	*Bool*	External Value Binary value tracked in Auto mode
	RX	*Bool*	Reset latched input Resets the output Y when RX goes High
	FDH	*Bool*	Force disable transition High Permissive to set output on when FDH=0 and prevents transition to on when FDH=1
	FDL	*Bool*	Force disable transition Low when pulsed output is disabled. Permissive to set output off when FDL=0 and prevents transition to off when FDL=1
	LA	*Bool*	Lock Auto Locks the template to auto mode, overruling the operator. After signal disappears, template keeps in auto mode.
	LM	*Bool*	Lock Manual

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			Locks the template to man mode. Overrides LA. After signal disappears, template keeps in manual mode.
Output	Y	*Bool*	Normal function output -If the template is set not to latch, Y = X. Dependent on parameter selection, the output can be pulsed. -If the template is set to latch, Y is set then X goes high, and reset when RX goes high.
	BA	*Bool*	Status auto/man mode (1=auto, 0=man)
Static	OS_Param	*HB_OS_Param*	Block parameters
	OS_CTW	*HB_OS_CTW*	Control from HMI
	OS_STW	*HB_OS_STW*	Status to HMI

3.2.1.2   HB_OS_CTW

Name	DataType	Comment
Auto_on	*Bool*	Switch to automatic mode
Manual_on	*Bool*	Switch to manual mode
Set_on	*Bool*	Set output to high
Set_off	*Bool*	Set output to low

3.2.1.3   HB_OS_Param

Name	DataType	Range	Comment
Latched output	*Bool*	-	If the parameter is set the Y output is latched.
Pulsed output	*Bool*	-	If the parameter is set an on-pulse is generated on the output Y when the input is set high. This parameter will have no effect when latched output is selected.
Pulse time output	*Time*	T#50ms – T#5m	Pulse length for Y when pulsed output selected.

3.2.1.4   HB_OS_STW

Name	DataType	Reaction matrix	Comment
X	*Bool*		Status Input
Y	*Bool*		Status Output
BA	*Bool*		
auto_manual_state	*Int*	Norsok_mode_auto_manual	Auto/manual state: 1= Lock auto, 2=Auto, 3=Manual, 4=Lock Manual
transition_state	*Int*	Norsok_mode_disable_transition	Transition state: 1 = Enabled, 2= Disable Transition Low, 3 = Disable Transition High, 4 = FDL & FDH

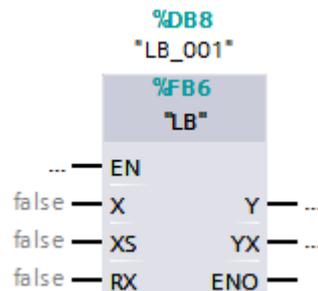For more information, see user manual

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PLC and SCADA/HMI Standard Library	Rev.: 04 Rev. Date : 14-Dec-17
	Status: IC Document Type : Standard
Contract no : Project: Internal	Project no : Page **14** of **37**

3.3   LB – Safeguarding shutdown level

According to IEC 63131:2017 "LB functional description"

This template has latched and/or unlatched inputs. The unlatched input (XS) shall be used when the shutdown originates from a higher shutdown level. The latched input (X) shall be used for causes with input to this level. This latched input (X) can be configured as unlatched by a parameter. Latch can be reset by operator or logic (RX). If a shutdown is initiated from operator (I.e. not from higher shutdown level), RX cannot reset the shutdown.

Conflict and fault from the shutdown devices should be grouped into the LB. The same should be done for status blocked from the primary shutdown initiators. The group status can be displayed on the LB HMI object. This is as repeated information in addition to the individual alarms on the shutdown objects. The grouping into the LB shall not be shown on the SCD diagram.

```
                %DB8
               "LB_001"
                %FB6
                 "LB"
      --- ─── EN
  false ─── X        Y ─── ---
  false ─── XS      YX ─── ---
  false ─── RX     ENO ───
```

3.3.1   Datatypes

3.3.1.1   Inputs and Outputs

Port	Name	DataType	Comment
Input	X	Bool	Normal function input (latched) - Action signal from shutdown initiators (eg MA or MB.Y)
	XS	Bool	External shutdown input (unlatched) - Action signal YX from higher level shutdown blocks
	RX	Bool	Reset latched output Y – does not reset stops triggered from OS
Output	Y	Bool	Normal function output - Connected to shutdown input on shutdown devices
	YX	Bool	External shutdown output - Connected to external shutdown input XS on lower shutdown level blocks
Static	OS_Param	HB_OS_Param	Block parameters
	OS_CTW	HB_OS_CTW	Control from HMI
	OS_STW	HB_OS_STW	Status to HMI

3.3.1.2   LB_OS_CTW

Name	DataType	Comment
Set_safeguard	Bool	Set block to shutdown mode
Reset_safeguard	Bool	Force reset shutdown mode
Block_XS_on	Bool	Start blocking chain input

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Block_XS_off	Bool	Stop blocking chain input
Block_YX_on	Bool	Start blocking chain output
Block_YX_off	Bool	Stop blocking chain output

3.3.1.3   LB_OS_Param

Name	DataType	Default	Comment
Latched_output	Bool	true	Latches the input X (not XS)

3.3.1.4   LB_OS_STW

Name	DataType	Comment
Level_released	Bool	
External_level_released	Bool	
Group_fault_status	Bool	
Group_conflict_status	Bool	
Blocked_XS	Bool	Chain input blocked
Blocked_XS_state	Int	Chain input block state (1 = not blocked, 2 = blocked)
Blocked_YX	Bool	Chain output blocked
Blocked_YX_state	Int	Chain output block state (1 = not blocked, 2 = blocked)

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3.4 MA – Monitor analogue

The MA function template shall be used for scaling, display (indication) and monitoring (alarming) of process variable or control variable. The template comprises handling of field instrument and signalling faults.

```
                    %DB8
                  "MA_001"

                    %FB36
                     "MA"

                        Y —— 0.0
                       YF —  false
                      AHH —  false
                      BHH —  false
                       WH —  false
                       WL —  false
                      ALL —  false
                      BLL —  false
                     BBHH —  false
      ... — EN       BBLL —  false
     0.0 — X           BA —  false
   false — XF          BU —  false
   false — FBHH        BB —  false
   false — FBLL      BXHH —  false
   false — FUHH       BXH —  false
   false — FUWH       BXL —  false
   false — FUWL      BXLL —  false
   false — FULL       ENO —
```

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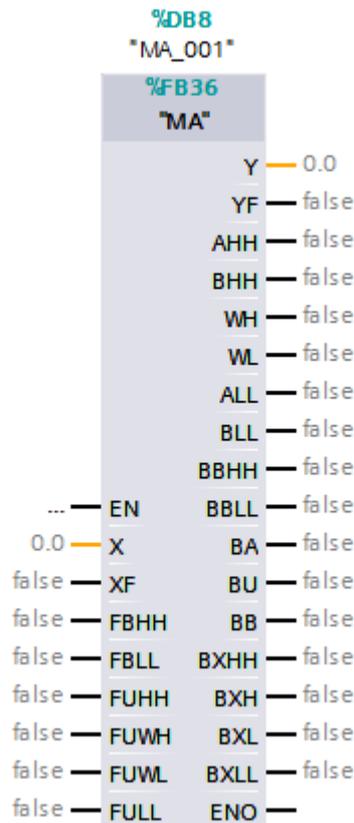
3.4.1 Datatypes

3.4.1.1 Input and outputs

Port	Name	DataType	Comment
Input	X	Bool	Analogue input signal from procell
	XF	Bool	Fault indication from outside the template
	FBHH	Bool	Logic input: Alarm HH action is blocked as long asinput signal is true.
	FBLL	Bool	Logic input: Alarm LL action is blocked as long asinput signal is true.
	FUHH	Bool	Logic input: Alarm HH action and annuciation is suppressed as long as input is true.
	FUWH	Bool	Logic input: Alarm WH action and annuciation is suppressed as long as input is true.
	FUWL	Bool	Logic input: Alarm WL action and annuciation is suppressed as long as input is true.
	FULL	Bool	Logic input: Alarm LL action and annuciation is suppressed as long as input is true.
Output	Y	Real	Analogue output signal from function template
	YF	Bool	YF = 1 if XF = 1 or if an internal error has been detected in the template or if an error is detected on the input x
	AHH	Bool	True when X-value > AHH limit. Subject to blocking and suppression
	BHH	Bool	Status alarm annuciation HH without blocking logic. Subject to suppression.
	WH	Bool	True when X-value > WH limit. Subject to blocking and suppression
	WL	Bool	True when X-value < WL limit. Subject to blocking and suppression
	ALL	Bool	True when X-value < ALL limit. Subject to blocking and suppression
	BLL	Bool	Status alarm annuciation LL without blocking logic. Subject to suppression.
	BBHH	Bool	True if FBHH or OS blocking is active
	BBLL	Bool	True if FBLL or OS blocking is active.
	BA	Bool	Auto/Manual mode
	BU	Bool	True if the template is in suppressed mode.
	BB	Bool	True if the template is in blocked mode.
	BXHH	Bool	"True if the template is in blocked mode.True when X-Value > Event High-High Limit.
	BXH	Bool	No Alarm annuciation, event only"
	BXL	Bool	"True if the template is in blocked mode.True when X-Value > Event High Limit.
	BXLL	Bool	No Alarm annuciation, event only"
Static	OS_CTW	MA_OS_CTW	
	OS_Param	MA_OS_Param	
	OS_STW	MA_OS_STW	

3.4.1.2 MA_OS_CTW

Name	DataType	Comment
Auto_set	Bool	Set function to Auto
Manual_set	Bool	Set function to Manual
Block_HH_set	Bool	Turn ON blocking of HH
Block_HH_reset	Bool	Turn OFF blocking of HH
Block_LL_set	Bool	Turn ON blocking of LL
Block_LL_reset	Bool	Turn OFF blocking of LL
Suppression_set	Bool	Turn ON suppression
Suppression_reset	Bool	Turn OFF suppression
X	Real	Simulate value, to be used instead of Input X when simulation is active.

3.4.1.3 MA_OS_Param

Name	DataType	Comment
Limit_AHH	Real	Alarm limit for AHH
Limit_WH	Real	Alarm limit for WH
Limit_WL	Real	Alarm limit for WL
Limit_ALL	Real	Alarm limit for ALL
Limit_BXHH	Real	Event limit for BXHH
Limit_BXH	Real	Event limit for BXH
Limit_BXL	Real	Event limit for BXL
Limit_BXLL	Real	Event limit for BXLL
Time_delay_AHH	Time	Delay before (AHH) alarm and action is raised after limit has been reached.
Time_delay_ALL	Time	Delay before (ALL) alarm and action is raised after limit has been reached.
Time_delay_WH	Time	Delay before (WH) alarm is raised after limit has been reached.
Time_delay_WL	Time	Delay before (WL) alarm is raised after limit has been reached.
Hysteresis_value	Real	The hysteresis is in % of display range and is common for all limits. The hysteresis only affect the return of alarms/events, not initiation.
Maximum_range	Real	Maximum display range value
Minimum_range	Real	Minimum display range value
Fault_function	Int	1 - X = Freeze value (lastgood value), 2 - X = Show current measured value, 3 - X = Substitute value
Substitute_value	Real	Value for fall back situation. Only possible to enter value within range
Dead_band	Real	Threshold value to avoid calculation whe X is close to zero (Worn out transmitters)

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3.4.1.4   MA_OS_STW

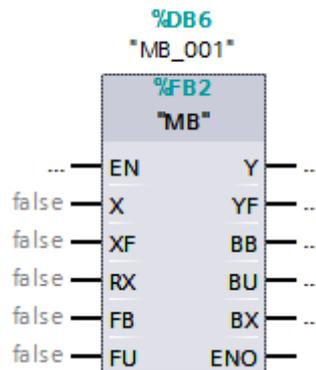| Name	DataType	Comment
X	Real	Normal function input
Y	Real	Normal function output
Auto_manual_mode	Int	Status auto/manual mode
Suppress_mode_HH	Int	Status suppress mode - HH
Suppress_mode_LL	Int	Status suppress mode – LL
Suppress_mode_WH	Int	Status suppress mode – WH
Suppress_mode_WL	Int	Status suppress mode – WL
Blocked_mode_HH	Int	Status block mode – HH
Blocked_mode_LL	Int	Status block mode - LL
YF	Bool	YF = 1 if XF = 1 or if an internal error has been detected in the template or if an error is detected on the input x
AHH	Bool	True when X-value > AHH limit. Subject to blocking and suppression
BHH	Bool	Status alarm annuciation HH without blocking logic. Subject to suppression.
WH	Bool	True when X-value > WH limit. Subject to blocking and suppression
WL	Bool	True when X-value < WL limit. Subject to blocking and suppression
ALL	Bool	True when X-value < ALL limit. Subject to blocking and suppression
BLL	Bool	Status alarm annuciation LL without blocking logic. Subject to suppression.
BXHH	Bool	True if the template is in blocked mode.True when X-Value > Event High-High Limit. BXH Bool false True False True False No Alarm annuciation, event only
BXL	Bool	True if the template is in blocked mode.True when X-Value > Event High Limit. BXLL Bool false True False True False No Alarm annuciation, event only

3.5 MB – Monitoring of binary (digital) process variables.

According to Norsok I-005 "MB function"

The MB function template shall be used for automatic monitoring (alarming), display and latching of binary process variables.

```
              %DB6
            "MB_001"
              %FB2
               "MB"
    ...  ─── EN        Y  ─── ...
  false ─── X         YF  ─── ...
  false ─── XF        BB  ─── ...
  false ─── RX        BU  ─── ...
  false ─── FB        BX  ─── ...
  false ─── FU       ENO
```

3.5.1 Datatypes

3.5.1.1 Inputs and Outputs

Port	Name	DataType	Comment
Input	X	*Bool*	Normal function input Binary input signal from process
	XF	*Bool*	External fault Fault indication from outside the template
	RX	*Bool*	Reset latched input Resets the output Y when RX goes High
	FB	*Bool*	Force blocking If FB is true, Y is set to 0
	FU	*Bool*	Force suppression If FU is true, Y is set to 0, YF is set to 0 and OS Alarm is set to 0.
Output	Y	*Bool*	Normal function output -If the template is set not to latch, Y = X -If the template is set to latch, Y is set when X goes high, and reset when RX goes high. Subjected to blocking and suppression. It shall be possible to generate a warning or action alarm on this output. In these cases the letter W (warning) or A (action) shall be used as the terminal name on the SCD diagram.

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	YF	*Bool*		Function failed YF = 1 if XF = 1 or if an internal error has been detected in the template. Subjected to suppression.
	BB	*Bool*		Status blocked True if the template is in blocked mode (FB = 1 or Blocking set from OS).
	BU	*Bool*		Status suppressed True if template is in suppress mode (FU = 1 or Suppression sett from OS).
	BX	*Bool*		Status function input
Static	OS_Param	*MB_OS_Param*		Block parameters
	OS_CTW	*MB_OS_CTW*		Control from HMI
	OS_STW	*MB_OS_STW*		Status signals to HMI

3.5.1.2   MB_OS_CTW

Name	DataType	Comment
Blocking On	*Bool*	Set blocking on
Blocking Off	*Bool*	Set blocking off
Suppression On	*Bool*	Set suppression on
Suppression Off	*Bool*	Set suppression off
Reset latched output	*Bool*	Resets latched output

3.5.1.3   MB_OS_Param

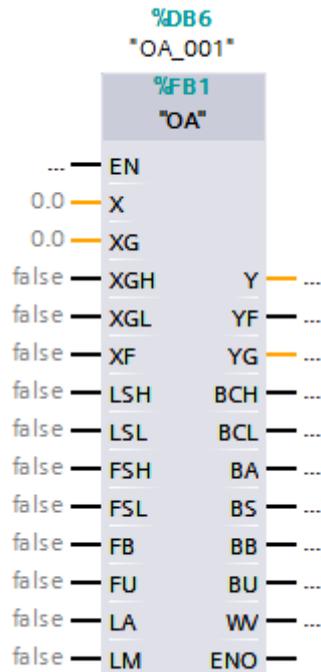| Name	DataType	Range	Comment
Invert input	*Bool*	-	If the parameter is set the X input is inverted.
Latched output	*Bool*	-	If the parameter is set the Y output is latched.
Time delay alarm	*Time*	T#0s – T#120s	Delay before alarm is raised an Y output is set after X input goes high.

3.5.1.4   MB_OS_STW

Name	DataType	Reaction matrix	Comment
block_mode	*Int*	MB_Blocked	Status of blocked mode
suppress_mode	*Int*	MB_Suppressed	Status of suppressed mode
Alarm	*Bool*	MB_Alarm	Same as Y except not affected by blocking. Should be used for display in the HMI.
YF	*Bool*	MB_YF	Function failed
Y	*Bool*	MB_Y	Alarm output

For more information, see user manual

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3.6   OA – Output analog

The OA function template shall be used for analogue control of flow device of medium (electricity, heat or fluid) where the CA block do not represent required functionality, e.g. split range output. The controlled element is a unit such as motor, pump, heater, fan etc.

```
            %DB6
          "OA_001"

            %FB1
            "OA"

    ---  ── EN
    0.0  ── X
    0.0  ── XG
   false ── XGH        Y  ──  ---
   false ── XGL       YF  ──  ---
   false ── XF        YG  ──  ---
   false ── LSH      BCH  ──  ---
   false ── LSL      BCL  ──  ---
   false ── FSH       BA  ──  ---
   false ── FSL       BS  ──  ---
   false ── FB        BB  ──  ---
   false ── FU        BU  ──  ---
   false ── LA        WV  ──  ---
   false ── LM       ENO  ──
```

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3.6.1 Datatypes

3.6.1.1 Inputs and Outputs

Port	Name	DataType	Comment
Inputs	X	Real	External value that will control the output Y by means of a ramp function.
	XG	Real	Position feedback
	XGH	Bool	Position high feedback
	XGL	Bool	Position low feedback
	XF	Bool	External fault
	LSH	Bool	Lock safeguarding high.
	LSL	Bool	Lock safeguarding low.
	FSH	Bool	Force safeguarding high
	FSL	Bool	Force safeguarding low
	FB	Bool	Force blocked
	FU	Bool	Force suppression
	LA	Bool	Lock auto
	LM	Bool	Lock manual
Outputs	Y	Real	Normal function output
	YF	Bool	Function failed
	YG	Real	Output valve position
	BCH	Bool	Output position high confirmed
	BCL	Bool	Output position low confirmed
	BA	Bool	Status auto/man
	BS	Bool	Status safeguarding
	BB	Bool	Status blocked
	BU	Bool	Status suppressed
	WV	Bool	Warning deviation on feedback
Static	OS_CTW	OA_OS_CTW	Control from HMI
	OS_Param	OA_OS_Param	Block parameters
	OS_STW	OA_OS_STW	Status to HMI

3.6.1.2 OA_OS_CTW

Name	DataType	Comment
Auto_set	Bool	Set function to Auto mode
Manual_set	Bool	Set function to Manual mode
Block_set	Bool	Activate block mode
Block_reset	Bool	Deactivate block mode

Suppression_set	Bool	Activate suppression mode
Suppression_reset	Bool	Deactivate suppression mode
Output_value_set	Real	Set output value (Manual value)

3.6.1.3   OA_OS_Param

Name	DataType	Default	Comment
Max_input	Real	100	Maximum range value in
Min_input	Real	0.0	Minimum range value in
Max_output	Real	100	Maximum range value out
Min_output	Real	0.0	Minimum range value out
Max_operating	Real	100	Maximum allowed output value. This value is less or equal to maximum range out.
Min_operating	Real	0.0	Minimum allowed output value. This value is greater or equal to minimum range out.
Alarm_delay	Time	T#30s	Deviation alarm XG compared to Y
Deviation_limit	Real	2.0	Deviation in % of output range between Y and XG
Fail_safe_position	Bool	False	1 = High, 0 = Low
Limit_confirmed_state	Real	2.0	Compared to operating range high or low. The % value is calculated in relation to the full range.
Manual_limited_by_range	Bool	True	1 = Manual output limited by operating range. 0 = No limit for manual
Feedback_configuration	Int	0	0 =No feedback, 1 = XGL, 2 = XGH, 3 = XGH and XGL, 4 = XG, 5 = XG and XGL, 6 = XG and XGH, 7 = XG and XGH and XGL
Y_ramp_to_X_switch_to_auto	Time	T#0s	Ramp time while switch to auto. Y ramp to X.Time to travel the whole range.
Y_ramp_to_X_in_auto	Time	T#0s	Ramp time while in auto. Y ramp to X.Time to travel the whole range.
Substitute_value_if_XF	Bool	False	1 = Substitute value to be used as Y if XF. 0 = Freeze (to manual and keep last valid value).
Substitute_value	Real	0.0	Value to be used.
Reaction_if_X_outside_range	Bool	False	0 – No reaction (Y= operating limit)1 – YF and reaction as XF=1.
Restart_options	Int	0	0 = Enter manual mode and substitute value, 1 = Enter manual mode and failsafe position, 2 = Enter auto mode Y = XG

3.6.1.4   OA_OS_STW

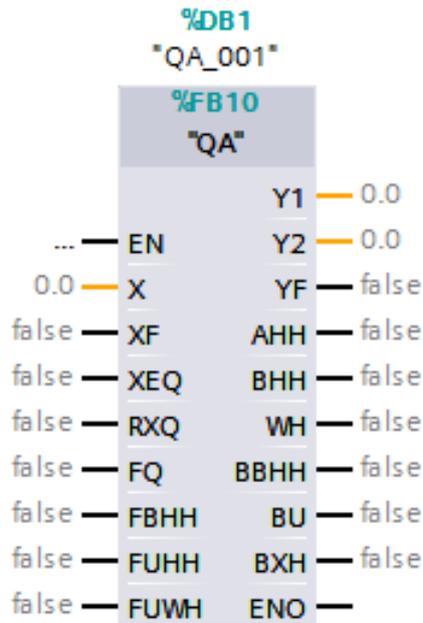| Name	DataType	Comment
Y	Real	Y (Output) value
X	Real	X (Input) value
XG	Real	XG (Feedback) value
Mode_auto_manual	Int	
Mode_block	Int	
Mode_suppressed	Int	
Conflict	Bool	Conflict, both safeguarding and blocked is active
XF	Bool	Fault: External Fault (Loop fail / IO card)

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YF	*Bool*	Fault: Function failed (XF = 1)
WV	*Bool*	Warning: Feedback deviation

3.7 QA – Totalizer

The QA function template shall be used for accumulation (totalizing) of process values based on time intervals.

```
                    %DB1
                  "QA_001"
                   %FB10
                    "QA"

                           Y1 —— 0.0
        ··· —— EN          Y2 —— 0.0
        0.0 —— X           YF —— false
      false —— XF         AHH —— false
      false —— XEQ        BHH —— false
      false —— RXQ         WH —— false
      false —— FQ        BBHH —— false
      false —— FBHH        BU —— false
      false —— FUHH       BXH —— false
      false —— FUWH       ENO ——
```

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3.7.1   Datatypes

3.7.1.1   Inputs and Outputs

Port	Name	DataType	Comment
Inputs	X	Real	Normal function input
	XF	Bool	External fault
	XEQ	Bool	External enabling totalizing
	RXQ	Bool	External reset totalizing
	FQ	Bool	Force totalizing
	FBHH	Bool	Force blocking alarm AHH
	FUHH	Bool	Force suppression alarm HH
	FUWH	Bool	Force suppression alarm WH
Outputs	Y1	Real	Previous total
	Y2	Real	Current total
	YF	Bool	Function failed
	AHH	Bool	Action alarm HH
	BHH	Bool	Status alarm HH
	WH	Bool	Warning alarm H
	BBHH	Bool	Status blocked alarm HH
	BU	Bool	Status suppressed
	BXH	Bool	Status event H
Static	OS_CTW	QA_OS_CTW	Control from HMI
	OS_Param	QA_OS_Param	Block parameters
	OS_STW	QA_OS_STW	Status to HMI

3.7.1.2   QA_OS_CTW

Name	DataType	Comment
On_Off	Bool	Totalizing On
Reset	Bool	Reset totalizer
Block_set	Bool	Activate block mode
Block_reset	Bool	Deactivate block mode
Suppression_set	Bool	Activate suppression mode
Suppression_reset	Bool	Deactivate suppression mode

3.7.1.3   QA_OS_Param

Name	DataType	Default	Comment
Count_negative	Bool	FALSE	If set to 1 the totalizer shoould allow for negative counting
Scaling_factor	Real	1	Optional scaling factor to obtain requires output
Initial_value	Real	0	Defines the real value totalizer will start counting with after reset operation
Maximum_value	Real	999999	Defines max real value totalizer will allow (owerflow). Passing this limit will result in a fault state initiating the YF output
Limit_AHH	Real	0	Alarm limit for AHH
Limit_WH	Real	0	Alarm limit for WH
Limit_BXH	Real	0	Event limit for BXH
Hysteresis_value	Real	0	Affects the return of alarms/events
Fault_function	Int	0	1, Y2=freeze accumulation - 2, Y2=0

3.7.1.4   QA_OS_STW

Name	DataType	Comment
Y1	Real	Previous total
Y2	Real	Current total
On_Off	Bool	Totalizing on/off (1= on)
AHH	Bool	Action Alarm HH
WH	Bool	Warning Alarm H
BXH	Bool	Event H
Mode_suppress_HH	Int	Status suppress mode - HH
Mode_suppress_WH	Int	Status suppress mode - WH
Mode_suppress_OS	Int	Status suppress mode – OS
Mode_blocked_HH	Int	Status block mode – HH
XF	Bool	Fault: External Fault (Loop fail / IO card)
YF	Bool	Fault: Function failed (XF = 1)
Reset_timestamp	Date_And_Time	Date and time for last reset
XEQ	Bool	Totalizing enabled
FQ	Bool	Totalizing forced

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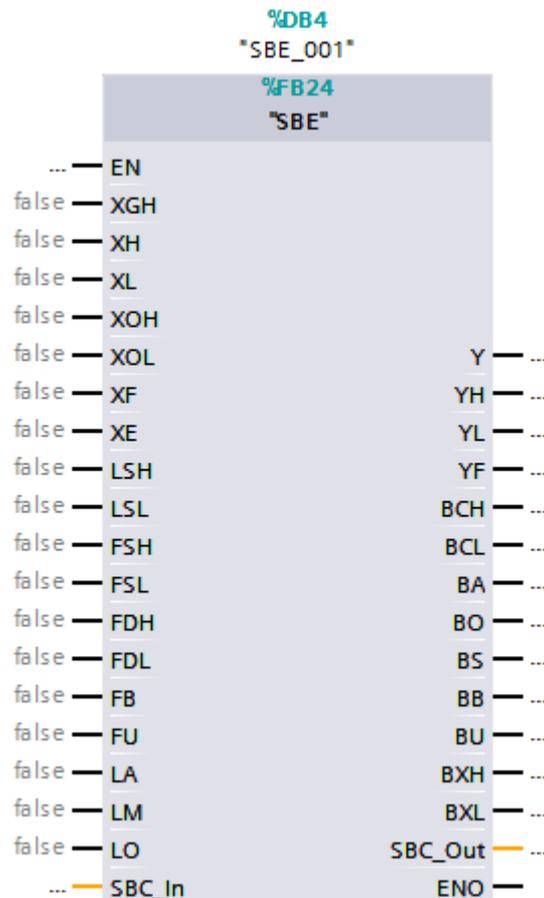
3.8 SBE – Control of electrical equipment

The SBE function template shall be used for binary (on/off) control of flow element of medium /(electricity, heat or fluid). The controlled element is a unit, e.g. motor, pump, heater, fan etc.

The following operation mode optiuons shall be made available selected by parameter:
- Manual operation + automatic control + outside control
- Manual operation + automatic control
- Manual operation + outside control
- Locked in outside control (CCR indication only)
- Locked in manual operation (controlled from HMI in CCR)

The function template can be configured to operate with several options according to the type of application restricting the possibilities for changing modes.

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3.8.1   Datatypes

3.8.1.1   Inputs and Outputs

Port	Name	DataType	Comment
Inputs	XGH	*Bool*	Signal from MCC, running status high (XGH = 1 is motor running)
	XH	*Bool*	External set high – XH = 1 (positive edge) set Y to 1 in auto mode
	XL	*Bool*	External set low – XL = 1 (positive edge) set Y to 0 in auto mode. XL is dominant over XH.
	XOH	*Bool*	External outside set high – XOH = 1 set Y to 1 in outside mode
	XOL	*Bool*	External outside set low – XOL = 1 set Y to 0 in outside mode
	XF	*Bool*	External Fault – Loop failure, e.g. I/O card broken
	XE	*Bool*	Externally enabled (MCC) – XE = 1 is required for a start. The effect on Y when XE goes low while running will be defined by parameter.
	LSH	*Bool*	Lock safeguarding high – Safeguarding – LSH = 1. Overrule operator possibility to operate start/stop and auto/manual. Locks template in manual mode an Y to 1 regardless of failure state. Input is subject to blocking. When signal goes low, the template remains in manual mode and Y = 1.
	LSL	*Bool*	Lock safeguarding low – Safeguarding – LSL = 1 Overrule operator possibility to operate start/stop and auto/manual. Locks template to manual mode and Y to 0 regardless of failure state. Input is subject to blocking. When the signal goes low, the template remains in manual mode and Y = 0.
	FSH	*Bool*	Force safeguarding low – Safeguarding FSH = 0 Overrule operator possibility to operate start/stop. Sets Y to 1 regardless of failure state. When signal is reset, the template will react to actual terminal statuses again. Signal is subject to blocking. If in Manual mode, the output (Y) remains 1 after signal returns to normal.
	FSL	*Bool*	Force safeguarding low – Safeguarding FSH = 0 Overrule operator possibility to operate start/stop. Sets to 0 regardless of faulilure state. When signal is reset, the template will react to actual terminal statuses again. Signal is subject to blocking. If in manual mode, the output (Y) remains 0 after signal returns to normal.
	FDH	*Bool*	Force Force disable transition high – Permissive to start when DFH = 0 and prevents equipment from being started when FDH = 1. Signal is subject to blocking.
	FDL	*Bool*	Force disable transition low – Permissive to stop when FDL = 0 and prevents equipment from being stopped when FDL = 1. Signal is subject to blocking.
	FB	*Bool*	Force blocking – FB = 1. Safeguarding action LSH, LSL, FSH, FSL and FDH and FDL will be blocked.

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	FU	Bool	Force suppression. – FU = 1. Alarm annunciation is suppressed. YF = 0 and statuses XF, XE and XGH are neglected.
	LA	Bool	Lock auto – Locks the template in auto mode.- When LA is reset, the template remains in auto mode.
	LM	Bool	Locks the template in manual mode. When LM is reset, the template remains in manual mode.
	LO	Bool	Lock outside – Locks the template in outside mode. When LO goes low the template will be set to manual mode.
Outputs	Y	Bool	Normal function output – Command to flow element. Start Y = 1 and stop Y = 0.
	YH	Bool	Pulsed normal function output high – Pulse start command YH = 1 (one pulse)
	YL	Bool	Pulsed normal function output low – Pulse stop command YL = 1 (one pulse)
	YF	Bool	Function failed – Set YF = 1 if XF = 1 or feedback time exceeded or change in feedback while in run or stop or XE = 0.
	BCH	Bool	Output position high confirmed – Output Y compared to feedback position high limit switch and validated as true (set BCH = 1 if Y = 1 and XGH = 1). XF has no impact on BCH.
	BCL	Bool	Output position low confirmed – Output Y compared to feedback position low limit switch and validated as true (set BCL = 1 if Y = 0 and XGH = 0). XF has no impact on BCL.
	BS	Bool	Status safeguarding – BS = 1 if any safeguarding input is active.
	BB	Bool	Status blocked – BB = 1 when block from operator station is true or FB = 1.
	BU	Bool	Status suppressed – BU = 1 when suppressed from operator station is true or FB = 1.
	BU	Bool	Status suppressed – BU = 1 when suppressed from operator station is true or FU = 1.
	BA	Bool	Status auto/man – BA = 1 when in auto mode
	BO	Bool	Status outside – BO = 1 when outside mode set from operator station or LO = 1
	BXH	Bool	Status external set high – BXH = 1 when SBE is in auto and XH = 1 or start signal from SBC
	BXL	Bool	Status external set low – BXL = 1 when SBE is in auto and XL = 1 or stop signal from SBC
Static	OS_CTW	SBE_OS_CTW	
	OS_Param	SBE_OS_Param	
	OS_STW	SBE_OS_STW	

3.8.1.2   SBE_OS_CTW

Name	DataType	Comment
Auto_set	Bool	
Manual_set	Bool	
Outside_set	Bool	
Outside_reset	Bool	
Block_set	Bool	

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Block_reset	Bool	
Suppression_set	Bool	
Suppression_reset	Bool	
H_set	Bool	
L_set	Bool	

3.8.1.3   SBE_OS_Param

Name	DataType	Default	Comment
Feedback_time	Time	T#2s	Maximum allowed time from start/stop command is given (Y set to 1) to flow element running/stop feedback (XGH) is set/reset
Feedback_time_delay	Time	T#2s	Time before action when loss of feedback – Time from XGH is lost until actions are performed. Dependent of parameter that select if there shall be action on loss of XGH.
Pulse_time_high	Time	T#2s	Pulse time high – Pulse length for YH
Pulse_time_low	Time	T#2s	Pulse time low – Pulse length for YL
Template_startup_setting	Int	2	0: undefined 1: Manual and run 2: Manual and stop 3: As previous state
Operation_mode_options	Int	2	0: undefined 1: Possible to switch between outside, manual and automatic mode 2: Possible to switch between manual and automatic mode 3: Possible to switch between manual and outside mode 4: Locked in manual mode 5: Locked in outside mode
Outside_mode_type	Int	2	0: undefined 1: Outside: Output controlled by SAS 2: Local: Output controlled locally
External_fault_action	Bool	False	0: Stop motor 1: Keep running
Available_loss_action	Bool	False	Action on loss of XE while running – 0: Stop motor 1: Keep running
Feedback_loss_action	Bool	False	Action on loss of run feedback (XGH) – 0: Stop motor 1: Keep running
Restart_option	Bool	False	Restart controller options – 0: Manual mode and stopped 1: Auto mode and follow XH/XL – stopped if both are 0

3.8.1.4   SBE_OS_STW

Name	DataType	Comment
State	Int	0 = Not available, 1 = Stopped, 2 = Starting, 3 = Running, 4 = Stopping, 5 = Error

Mode_auto_manual	Int	As described by Norsok standard
Mode_outside	Int	As described by Norsok standard
Mode_transition	Int	As described by Norsok standard
Mode_safeguarding	Int	As described by Norsok standard
Mode_block	Int	As described by Norsok standard
Mode_suppress	Int	As described by Norsok standard
Priority	Int	
Conflict	Bool	If the block is both suppressed and in safeguarding mode or both FSH and FSL is active the conflict fault will be triggered
Disabled	Bool	
External_fault	Bool	Set YF = 1 if XF = 1 or feedback time exceeded or change in feedback while in run or stop or XE = 0.
Loss_of_XE	Bool	XE (externally enabled) is required for a start. The effect on Y when XE goes low while running will be defined by parameter.
Feedback_failure	Bool	Feedback time exceeded or change in feedback while in run or stop
Safeguarding_failure	Bool	Dedicated alarm when feedback failure has been obtained and safeguarding is set.

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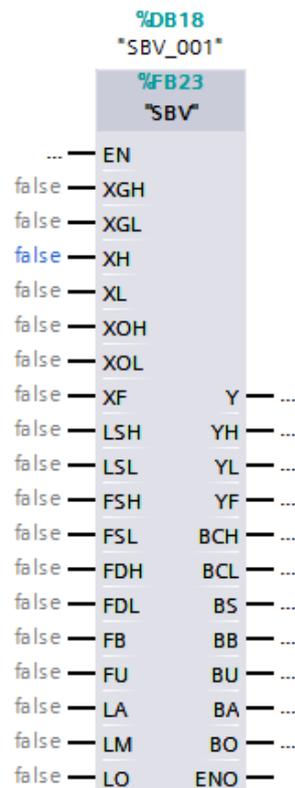### 3.9 SBV – Control of pneumatic/hydraulic equipment

According to IEC 63131:2017 "SBV functional description"

The following control options shall be made available selected by parameter:
- Manual operation + automatic control + outside control
- Manual operation + automatic control
- Manual operation + outside control
- Locked in outside control (CCR indication only)
- Locked in manual operation (Controlled from HMI in CCR)

The function template can be configured to operate with several options according to the type of application restricting the possibilities for changing modes. These options are fixed during run-time, but selected when structuring the control logic and thus called control options.

Duty/standby configurations for valves are not used.

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3.9.1 Datatypes

3.9.1.1 Inputs and Outputs

Port	Name	DataType	Comment
Input	XGH	*Bool*	Signal from limit switch high (XGH = 1 is open flow device).
	XGL	*Bool*	Signal from limit switch low (XGL = 1 is closed flow device)
	XH	*Bool*	From process or logic to function template which set high signal (Y = 1) to flow device in auto mode
	XL	*Bool*	External set low – From process or logic to function template which set high signal (Y = 0) to flow device in auto mode.
	XOH	*Bool*	External outside set high – Set high signal (positive edge) to open flow device in outside mode.
	XOL	*Bool*	External outside set low – Set low signal (positive edge) to close flow device in outside mode.
	XF	*Bool*	External fault – Loop failure – e.g. I/O card broken
	LSH	*Bool*	Lock safeguarding high – LSH = 1 overrules operator inputs. Locks the template in manual mode with Y = 1. Input is subject to blocking. When signal is reset, the template remains in manual mode and Y = 1.
	LSL	*Bool*	Lock safeguarding low – LSL = 1 overrules operator inputs. Locks the template in manual mode with Y = 0. Input is subject to blocking. When signal is reset, the template remains in manual mode and Y = 0.
	FSH	*Bool*	Foce safeguarding low – Signal overrules the operator inputs forces the Y to 1. When signal goes low, the template will react to actual terminal status again if in auto mode. Signal is subject to blocking. If in manual mode, the output (Y) remains high after signal returns to normal.
	FSL	*Bool*	Force safeguarding low – Signal overrules operator inputs. Forces the template Y to 0. When signal goes low, the template will react to actual terminal status again if in auto mode. Signal is subject to blocking. If in manual mode, the output(Y) remains low after signal returns to normal.
	FDH	*Bool*	Force disable transition high – Permissive to open when FDH = 0 and prevents element from being opened when FDH = 1. Signal is subject to blocking.
	FDL	*Bool*	Permissive to close when FDL = 0 and prevents element from being closed when FDL = 1. Signal is subject to blocking.
	FB	*Bool*	Force blocking – FB = 1. Safeguarding action LSH, LSL, FSH, FSL and disable transition function FDH, FDL will be blocked.
	FU	*Bool*	Force suppression – Alarm annunciation is suppressed, YF = 0 and status XGL, XGH and XF are neglected as long as FU = 1.
	LA	*Bool*	Lock auto – Locks the template in auto mode. When LA goes low, the template remains in auto mode.

	LM	*Bool*	Lock manual – Locks the template in manual mode. When LM does low, the template remains in manual mode.
	LO	*Bool*	Lock outside – Locks the template to outside mode, and sets the template to manual mode. When LO goes low, the template remains in manual mode.
Output	Y	*Bool*	Normal function output – Command to flow device, Open Y = 1 and close Y = 0.
	YH	*Bool*	Pulsed normal function output high – Pulse open command YH = 1 (one pulse)
	YL	*Bool*	Pulsed normal function output low – Pulse close command YL = 1 (one pulse).
	YF	*Bool*	Function failed – YF = 1 if XF = 1 ref. error handling definition.
	BCH	*Bool*	Output position high confirmed – Output Y compared to feedback position high limit switch and validated as true (BCH = 1 iuf Y = 1 and XGH = 1).
	BCL	*Bool*	Output position low confirmed – Output Y compared to feedback position low limit switch and validated as true (BCL = 1 if Y = 0 and BCL = 1).
	BS	*Bool*	Status safeguarding – BS = 1 if any safeguarding input is active.
	BB	*Bool*	Status blocked – BB = 1 if blocking from operator station is true or FU = 1.
	BA	*Bool*	Status auto/man – BA = 1 when in auto mode.
	BO	*Bool*	Status outside – BO = 1 when set outside from operator station or LO = 1.
Static	SBV_OS_CTW	*SBV_OS_CTW*	OS Control struct
	SBV_OS_Param	*SBV_OS_Param*	OS Parameter struct
	SBV_OS_STW	*SBV_OS_STW*	OS status struct

3.9.1.2   SBV_OS_CTW

Name	DataType	Comment
Auto_set	*Bool*	
Manual_set	*Bool*	
Outside_set	*Bool*	
Outside_reset	*Bool*	
Blocking_set	*Bool*	
Blocking_reset	*Bool*	
Suppression_set	*Bool*	
Suppression_reset	*Bool*	
H_set	*Bool*	
L_set	*Bool*	

3.9.1.3   SBV_OS_Param

Name	DataType	Default	Comment
Travel_time_open	*Time*	T#30s	Maximum allowed time from open command is given to process element (Y set to 1) to opened feedback (XGH) is set.
Travel_time_close	*Time*	T#30s	Maximum allowed time from close command is given to process element (Y set to 0) to closed feedback (XGL) is set.

Pulse_time_open	*Time*	T#2s	Pulse length for YH
Pulse_time_close	*Time*	T#2s	Pulse length for YL
Template_startup_state	*Int*	1	1: Closed 2: Open 3: Based on feedback
Template_startup_mode	*Int*	1	1: Manual 2: Auto 3: As previous state
Operation_mode_options	*Int*	1	1: Possible to switch between outside, manual and automatic mode. 2: Possible to switch between manual and automatic mode 3: Possible to switch between manual and outside mode 4: Locked in manual mode 5: Locked in outside mode
Outside_mode_type	*Int*	2	1: Outside – Output controlled by SAS 2: Local – Output controlled locally
Feedback_type	*Int*	4	1: No limit-switch feedback. 2: Position high limit-switch feedback only. 3: Position low limit-switch feedback only. 4: Position high and low limit switches feedback.
Action_on_fault	*Int*	1	1: No action 2: Close 3: Open
Tag	*String*	'Tag'	

3.9.1.4 SBV_OS_STW

Name	DataType	Comment
State	*Int*	0 = Open, 1 = Opening, 2 = Closed, 3 = Closing
Mode_auto_manual	*Int*	As described by Norsok standard
Mode_outside	*Int*	As described by Norsok standard
Mode_transition	*Int*	As described by Norsok standard
Mode_safeguarding	*Int*	As described by Norsok standard
Mode_block	*Int*	As described by Norsok standard
Mode_suppress	*Int*	As described by Norsok standard
Conflict	*Bool*	If the block is both suppressed and in safeguarding mode the conflict fault will be triggered
Deviation_error	*Bool*	Alarm is generated when there is a discrepancy between output command and feedback from valve.
Safeguarding_failure	*Bool*	Dedicated alarm when feedback failure (Deviation error) has been obtained and safeguarding is set.

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