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Structure and Setup of the Best Practice Control Modules Type Library (BPCM)

SIMATIC PCS 7 V9.0 SP1

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1 Introduction

A control module is used to control individual pieces of equipment, like motors, valves, and controllers, for example. For this purpose, the components required for this job, e.g. for controlling a valve, are combined in a Control Module (CM). If a CM is used several times in a project, e.g. in different versions, a Control Module Type (CMT) is created in PCS 7 and implemented in the master data library. This CMT can be used flexibly as an instance in different forms (versions) in the project.

With this technology, automation projects with the program logic can also be tested without real hardware.

BPCM master data library

The BPCM Type Library offers typical components as a template for building automation solutions. The CMT of the BPCM Type Library contain all necessary function and channel blocks and can be adapted to the project-specific conditions by instantiation.

This chapter gives you detailed information about the structure and mode of operation of the CMTs. All of the CMTs are implemented in the "BPCM_Lib" master data library.

Figure 1-1: Components of the BPCM library

The CMTs are sub-divided as follows:

- Display of analog value "MonAn"
- Display of digital value "MonDi"
- Analog input "OpAn"
- Digital value input "OpDi01"
- PID controller "PIDCon"

- Binary-switched motor "Mot"
- Motor with variable speed "MotSpdC"
- Binary switched valve "Vlv"
- Control valve "VlvAn"

CMTs are of compact structure, i.e. all the relevant blocks are at defined locations. For example, channel blocks are always in chart partition B of a CFC.

Selecting a variant

A variant and the options necessary for solving the automation task are determined in the instance.

1. For this purpose, the technological I/Os are displayed in the CFC,
2. the available variants are displayed in the context menu and
3. the functionality required for the automation task is determined by selecting the options.

Figure 1-2: Selecting a variant in the CFC
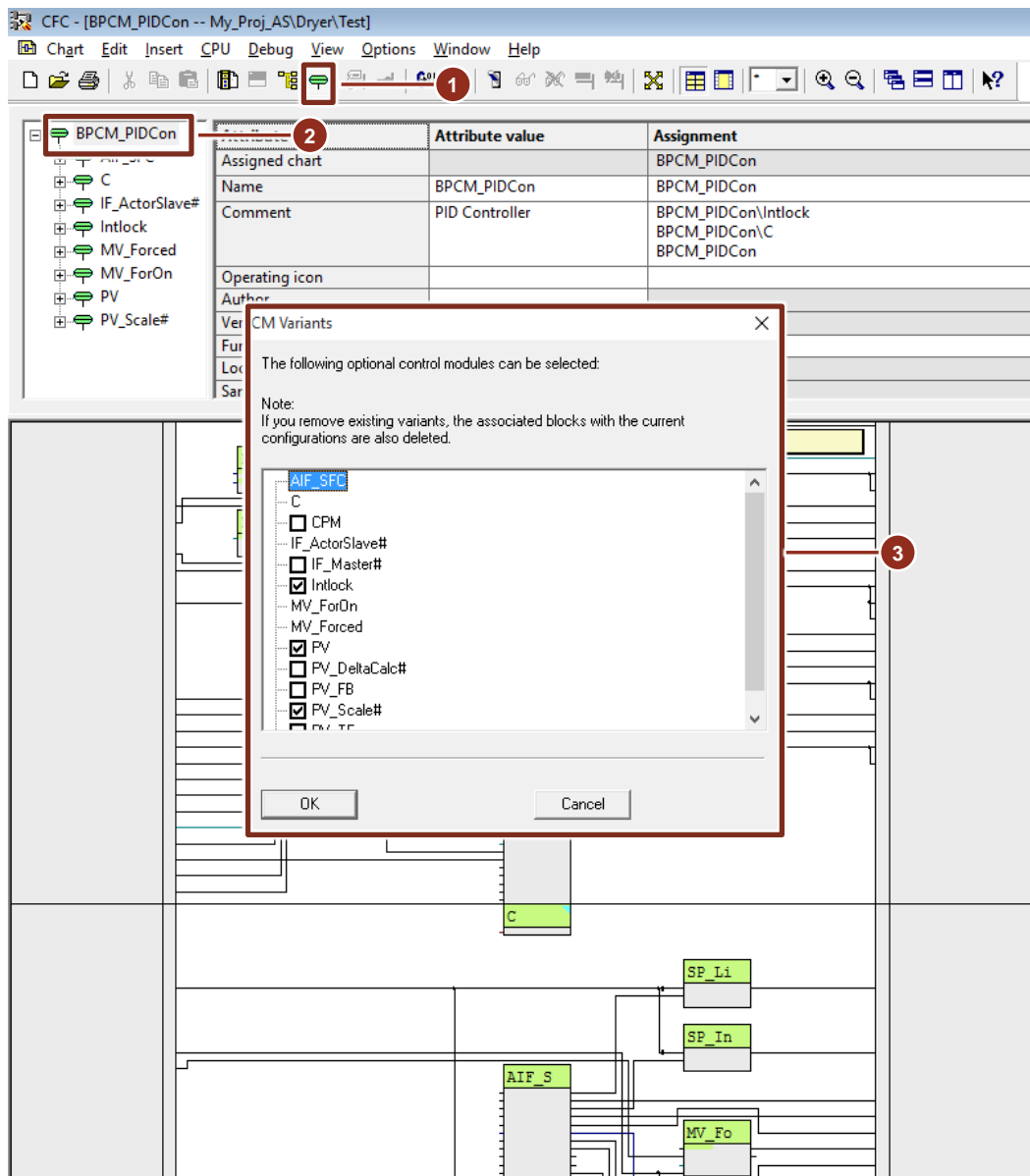
2 Measured value display

The measured value display monitors a measured value, e.g. pressure or limit switch. In addition, you can set up monitoring for the process value.

The CMTs are predesigned for different applications. Using options, you select or deselect the blocks, e.g. channel blocks, that are needed for the application.

The following CMTs are available:

- "MonAn" for display of an analog value
- "MonDi" for display of a digital value

Using variants, the corresponding channel block is selected or deselected based on measured value transfer or the number of available signals (control, servo position, etc.) of the corresponding channel block.

2.1 Analog value display "MonAn"

The analog measured value display monitors a measured value, e.g. pressure or temperature. In addition, you can set up limit monitoring for the process value.

The CMT is pre-configured for different areas of application.

Using variants, the corresponding channel block is selected or deselected based on measured value transfer.

In addition, further functions can be activated on the instance via options without project engineering.

Variants and options are listed and described below.

Variant 1: Measurement for analog measured value (4-20 mA)

Variant 1 is activated by selecting the functions PV and PV_Scale# at the instance.

Variant 2: Measurement for thermocouples

This variant is used for thermocouples that are connected to an analog input module for temperature measurement.

Variant 2 is activated by selecting the functions PV_TE and PV_Scale# at the instance.

Note	Scaling on the channel block has already been preset for the range 0 to 1. For process value scaling, the "PV_Scale#" option of the Control Module is used.

Variant 3: Measurement for digital measured value (fieldbus)

This variant is used if you are using measuring devices with PROFIBUS PA or Fieldbus Foundation (FF).

Variant 3 is activated by selecting the functions PV_FB and PV_Scale# at the instance.

Variant 4: Measurement for software signal

Variant 4 is the default setting without additionally activated functions. In this connection, it is possible to apply the display value by directly interconnecting other process tags. Using the optional PV_DeltaCalc# function, it is possible to carry out difference measurement.

Optional functions for all variants:

- to_Indicate: Link to a controller e.g. a multivariable controller

The table below lists the available options.

Figure 2-1: MonAn Variants

MonAn (CMT Master data library)	PV_Scale#	To_Indicate#	PV_DeltaCalc	PV	PV_FB	PV_TE	
Variants	**Function**			**Channel block**			**Description**
MonAn_Std	x	o		x			Standard analog value display
MonAn_TE	x	o				x	Thermocouples measured value display
MonAn_FB	x	o			x		Fieldbus measured value display
MonAn_SW	o	o					Program logic without channel block
MonAn	o	o	o				Measured value display (no channel blocks)

x = Selection for variant   o = Selectable functions

NOTICE	**When using the Plant Automation Accelerator (PAA) V2.1, the variant "PV_Scale#" should not be used.** The scaling is set in PAA at the respective signal and adopted by the appropriate "Scale" input when exporting to SIMATIC PCS 7.

Parameter assignment

Enter the tolerance, warning, and alarm limits that are to be monitored on block I (MonAnL) on sheet 1. In addition, each limit value at input "xx_xx_En" must be activated.

The system then generates messages in the case of limit violations and outputs them on the operator station.

Note	If a thermocouple is used, you must carry out scaling at channel block "PV_TE" measured value display in addition to scaling at block PV_Scale (process value scaling).

NOTICE	**The channel block for the thermocouple has already been preset for the range 0.0 to 1.0.**

2.1.1 Setup

Figure 2-2: Structure of the analog value display CMT "MonAn"

Chart partition "A"   **Chart partition „B"**
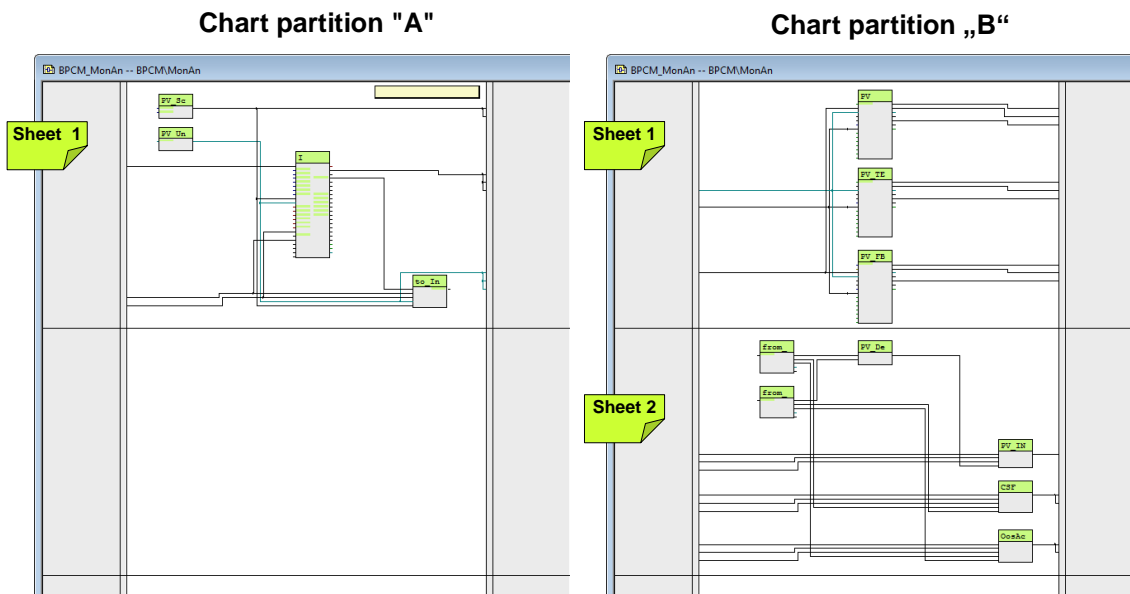
2.1.2 Chart partition "A"

The block below is located on sheet 1:

- PV_Scale: Standardization of the process value for a channel block and measured value display

- PV_Unit: Unit of measured-value display

- I ("MonAnL"): Block for display and monitoring of the analog measured value

- to_Indicate: Communication block for structured transfer of signals (measured value, unit, scaling, and status) to the MPC controller, for example

2.1.3 Chart partition "B"

The channel blocks are located on sheet 1:

- PV ("Pcs7AnIn"): Channel block for signal processing of an analog measured value transfer, e.g. 0/4 to 20w.

- PV_TE ("Pcs7AnIn"): Channel block for signal processing of a thermocouple and use of an analog input module for temperature measurement

- PV_FB ("FbAnIn"): Channel block for signal processing of a digital measured value transfer (PROFIBUS PA or Fieldbus Foundation)

The modules for the difference display are located on sheet 2:

- PV_DeltaCalc ("Sub02"): Formation of a difference value from two process values, e.g. differential pressure

- FromDeltaIn1: Input 1 for the difference value

- FromDeltaIn2: Input 2 for the difference value

- PV_In ("Or04"): Grouping of the input signals (and reporting to the display module

- CSF ("Or04"): Grouping of the "Bad" signals (invalid process value) and reporting to the motor block and the Permit group block
- OosAct ("Or04"): Grouping of the "OosAct" signals (device being maintained) and reporting to the motor block

2.2 Digital display "MonDi"

The digital measured value display monitors a measured value, e.g. limit switch.

The CMT is pre-configured for different areas of application.

Using variants, the corresponding channel block is selected or deselected based on measured value transfer.

In addition, further functions can be activated on the instance via options without project engineering.

Variants and options are listed and described below.

Variant 1: Measured value display for S7-300/400 modules

Variant 1 is activated by selecting the function PV at the instance.

Variant 2: Measurement for digital measured value (fieldbus)

This variant is used if you are using measuring devices with PROFIBUS PA or Fieldbus Foundation (FF).

Variant 2 is activated by selecting the functions PV_FB at the instance.

Variant 3: Measurement for software signal

Variant 3 is the default setting without additionally activated functions. In this connection, it is possible to apply the display value by directly interconnecting other process tags.

The table below lists the available options.

Figure 2-3: MonDi variants

MonDi (CMT Master data library)	PV	PV_FB	
Variants	**Channel block**		**Description**
MonDi_Std	x		Standard digital value display
MonDi_FB		x	Fieldbus measurement value
MonDi	o	o	Measured value display (no channel blocks)

x = Selection for variant   o = Selectable functions

2.2.1 Setup

Figure 2-4: Structure of the digital value display CMT "MonDi"
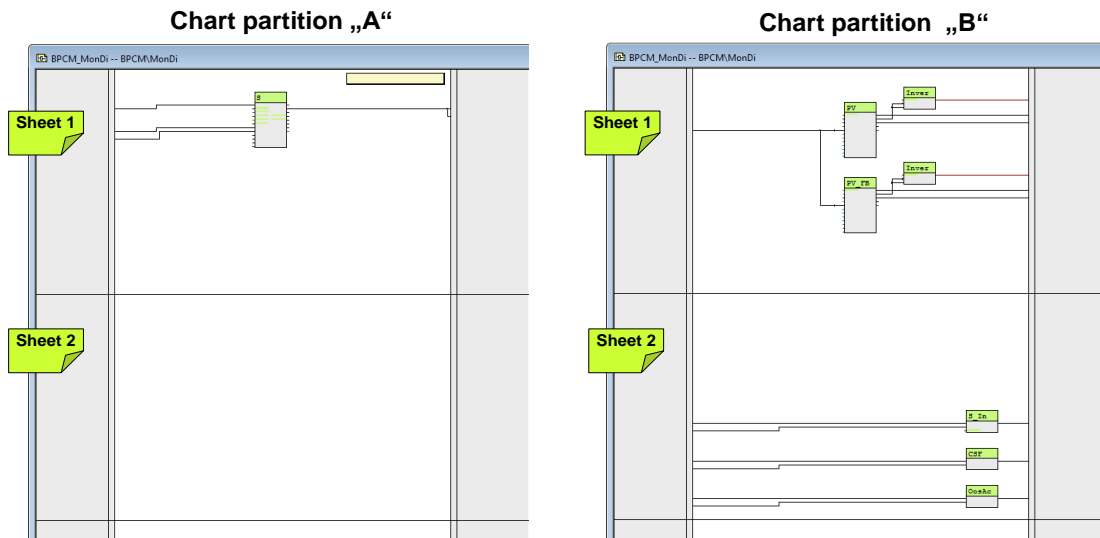
2.2.2 Chart partition "A"

The block below is located on sheet 1:

- S ("MonDiL"): Block for display and monitoring of the digital measured value

2.2.3 Chart partition "B"

The channel blocks are located on sheet 1:

- PV ("Pcs7AnIn"): Channel block for signal processing from an S7-300/400 module
- InvertPV ("SEL_BO"): Parameterizable signal inversion
- PV_FB ("FBAnIn"): Channel block for signal processing of a digital measured value transfer (PROFIBUS PA or Fieldbus Foundation)
- InvertPV_FB ("SEL_BO"): Parameterizable signal inversion

The modules for the difference display are located on sheet 2:

- S_In ("Or04"): Grouping of the "in" signals and reporting to the display module
- CSF ("Or04"): Grouping of the "Bad" signals (invalid process value) and reporting to the motor block and the Permit group block
- OosAct_in ("Or04"): Formation of an OR output signal from the "OosAct" output (device is being maintained) of the input channel blocks.

3 Operating measuring tags

The operating measuring tags are used to enter values from the OS, such as setpoint of pressure or option selection. In addition, the input value is limited to the set limits.

The CMTs are predesigned for different applications. Using options, you select or deselect the blocks, e.g. channel blocks, that are needed for the application.

The following CMTs are available:

- "OpAn" for input of an analog value
- "OpDi01" for input of a digital value

Using variants, the corresponding channel block is selected or deselected based on measured value transfer or the number of available signals (control, servo position, etc.) of the corresponding channel block.

3.1 Analog input "OpAn"

The analog operating measuring tag is used to enter analog values from the OS, such as pressure setpoint. In addition, the input value is limited to the set limits.

The CMT is pre-configured for different areas of application. The use of variants allows the corresponding channel block to be selected or deselected based on measured value transfer.

In addition, further functions can be activated on the instance via options without project engineering.

Variants and options are listed and described below.

Variant 1: Operator input for S7-300/400 modules

Variant 1 is activated by selecting the functions HC and PV_Scale# at the instance.

Variant 2: Operator input for digital measured value (fieldbus)

This variant is used if you are using measuring devices with PROFIBUS PA or Fieldbus Foundation (FF).

Variant 2 is activated by selecting the functions HC_FB and PV_Scale# at the instance.

Variant 3: Operator input for software editing

Variant 3 is the default setting without additionally activated functions. The input value can be transferred by direct interconnection to other measuring tags.

Optional functions for all variants:

- RbkReturn: Return of the manipulated variable as actual value
- HI: Readback values from an analog measuring tag transmission
- HI_FB: Readback values from a digital measuring tag transmission

The table below lists the available options.

Figure 3-1: OpAn variants

OpAn (CMT Master data library)	PV_Scale#	RbkReturn	HC	HC_FB	HI	HI_FB	
Variants	**Function**		**Channel block**				**Description**
OpAn_Std	x	o	x		o	o	Standard analog value input
OpAn_FB	x	o		x	o	o	Analog input for fieldbus value
OpAn	o	o			o	o	Measured value input (no channel blocks)

x = Selection for variant   o = Selectable functions

NOTICE	**When using the Plant Automation Accelerator (PAA) V2.1, the variant "PV_Scale#" should not be used.**
	The scaling is set in PAA at the respective signal and adopted by the appropriate "Scale" input when exporting to SIMATIC PCS 7.

3.1.1 Setup

Figure 3-2: Structure of the analog value display CMT "OpAn"

Chart partition „A"
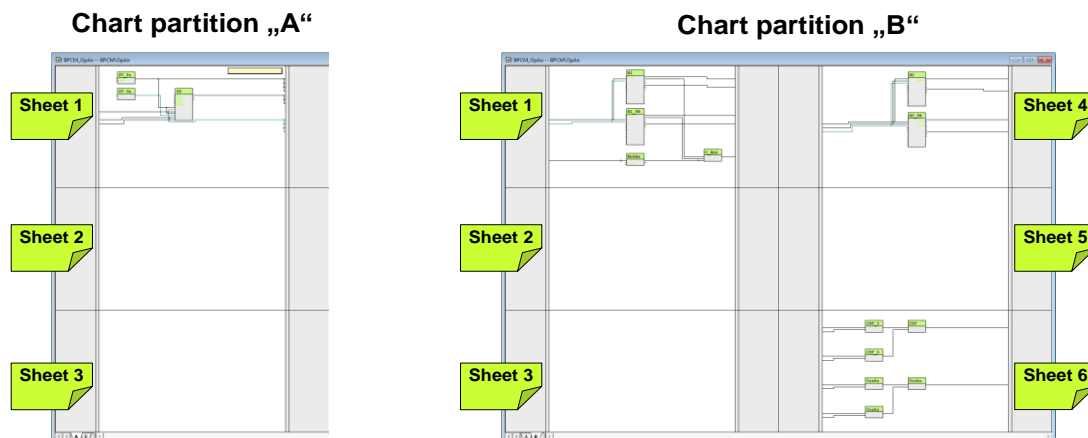
Chart partition „B"

3.1.2 Chart partition "A"

The block below is located on sheet 1:

- PV_Scale: Standardization of the process value for a channel block and measured value display
- PV_Unit: Unit of measured-value display
- SP ("OpAnL"): Block for display and monitoring of the analog measured value

3.1.3 Chart partition "B"

The channel blocks are located on sheet 1:

- HI ("Pcs7AnIn"): Channel block for signal processing of an S7-300/400 module
- HI_FB ("FBAnIn"): Channel block for signal processing of a digital measured value transfer (PROFIBUS PA or Fieldbus Foundation)
- RbkReturn ("SelA02In"): Forwarding the manipulated variable from the MV output to the Rbk input of the valve block (only if no checkback signal from the channel block is present)
- C_Rbk ("Add08"): Grouping of the feedback signals

Sheet 4 contains the blocks for the difference display:

- HC ("Pcs7AnIn"): Channel block for signal transmission for analog measured value, e.g. 0/4 to 20 mA.
- HC_FB ("FBAnIn"): Channel block for signal transmission for digital measured value transmission (PROFIBUS PA or Fieldbus Foundation)

The following blocks are located on sheet 6:

- CSF_In ("Or04"): Formation of an OR output signal from the "Bad" output (process value not valid) of the input channel blocks
- CSF_Out ("Or04"): Formation of an OR output signal from the "Bad" output (process value not valid) of the output channel blocks
- CSF ("Or04"): Grouping of the "Bad" signals (invalid process value) and reporting to the motor block and the Permit group block
- OosAct_in ("Or04"): Formation of an OR output signal from the "OosAct" output (device is being maintained) of the input channel blocks.
- OosAct_Out ("Or04"): Formation of an OR output signal from the "OosAct" output (device is being maintained) of the output channel blocks
- OosAct ("Or04"): Grouping of the "OosAct" signals (device being maintained) and reporting to the motor block

3.2 Digital value input "OpDi01"

The digital operating measuring tag is used to enter digital values from the OS, such as pressure setpoint.

The CMT is pre-configured for different areas of application.

Using variants, the corresponding channel block is selected or deselected based on measured value transfer.

In addition, further functions can be activated on the instance via options without project engineering.

Variants and options are listed and described below.

Variant 1: Operator input for S7-300/400 modules

Variant 1 is activated by selecting the function HS at the instance.

Variant 2: Operator input for software editing

Variant 2 is the default setting without additionally activated functions. In this connection, it is possible to apply the display value by directly interconnecting other process tags.

Optional functions for all variants:

- CSF_OosAct#: Return of the manipulated variable as actual value
- HO: Readback values from a digital measuring tag transmission
- Intlock: Interlock without reset

The table below lists the available options.

Figure 3-3: MonDi variants

OpDi01 (CMT Master data library)	CSF_OosAct#	Intlock	HO	HS	
Variants	**Function**		**Channel block**		**Description**
OpDi01_Std	x	o	x	o	Standard digital value input
OpDi01	o	o		o	Value input (no channel blocks)

x = Selection for variant   o = Selectable functions

3.2.1 Setup

Figure 3-4: Structure of the digital value display CMT "OpDi01"
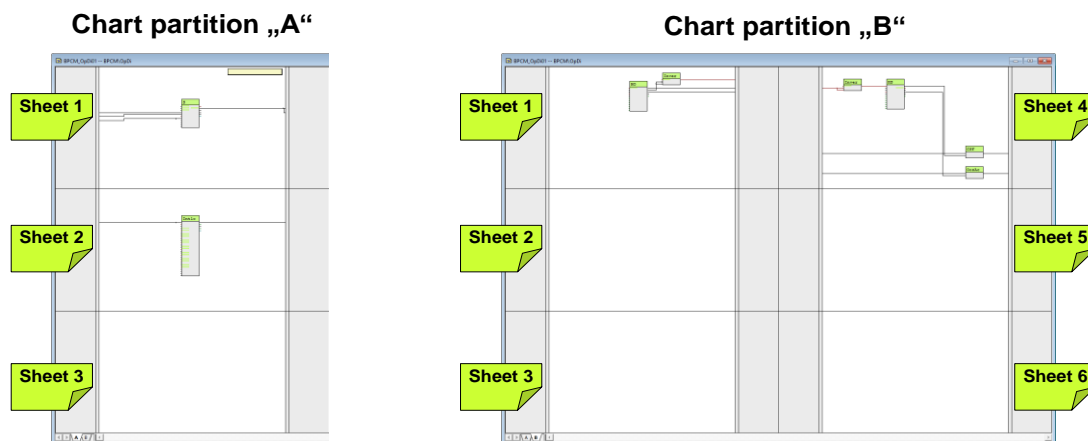
Chart partition „A"

Chart partition „B"

3.2.2 Chart partition "A"

The block below is located on sheet 1:

- S ("OpDi01"): Block for entering a digital measured value

The block below is located on sheet 2:

- Intlock ("Intlk08"): Block for calculating a standardized locking with the option of display on the OS

3.2.3 Chart partition "B"

The modules for the readback value are located on sheet 1:

- HO ("Pcs7DiIn"): Channel block for signal processing of an S7-300/400 SM digital module
- InvertFbkIn („SEL_BO"): Parameterizable signal inversion

Sheet 2 contains the blocks for the output:

- HS ("Pcs7DiOu"): Channel block for signal processing of an S7-300/400 SM digital module
- InvertOut ("SEL_BO"): Parameterizable signal inversion
- CSF ("Or04"): Grouping of the "in" signals and reporting to the display module
- OosAct ("Or04"): Formation of an OR output signal from the "OosAct" output (device is being maintained) of the input channel blocks.

4 Controller "PIDCon"

The CMT controllers contain controller blocks, additional monitoring and interlock functions, link blocks (master/actuator) and the link to a sequence controller.

The "PIDCon" CMT is used for fixed-value and cascade controllers.

Note	In "plant view", you activate master/slave operation by selecting "IF_Master#". After activation, the "to_Master" and "from_Master" link blocks are available.

Using variants, the corresponding channel block is selected or deselected based on measured value transfer.

In addition, further functions can be activated on the instance via options without project engineering.

Variants and options are listed and described below.

Variant 1: Controller for analog measurement and manipulated variable (4-20 mA)

Variant 1 is activated by selecting the functions PV and PV_Scale# at the instance.

Variant 2: Controller for thermocouples

This variant is used for thermocouples that are connected to an analog input module for temperature measurement.

Variant 2 is activated by selecting the function PV_TE at the instance.

Note	Scaling on the channel block has already been preset for the range 0 to 1. For process value scaling, the "PV_Scale#" option of the Control Module is used.

Variant 3: Controller for digital measurement (field bus)

This variant is used if you are using measuring devices with PROFIBUS PA or Fieldbus Foundation (FF).

Variant 3 is activated by selecting the functions PV_FB and PV_Scale# at the instance.

Variant 4: Controller for software signal

Variant 4 is the default setting without additionally activated functions on the instance. In this connection, it is possible to apply the controlled variable by directly interconnecting other process tags. Using the optional PV_DeltaCalc# function, it is possible to carry out difference measurement for the controlled variable.

Optional functions for all variants:

- PV_Scale#: Standardization of the process value including the channel block
- CPM: Monitoring of the control quality
- IF_Master#: Connection to a master controller (cascade)
- PV_DeltaCalc#: Differentiation
- Interlock: Interlocking block

The table below lists the available options.

Figure 4-1: PIDCon variants

PIDCon (CMT Master data library)	PV_Scale#	CPM	IF_Master#	PV_DeltaCalc#	Intlock	PV_In	PV_Fb_In	PV_TE_In	
Variants	Function					Channel block			Description
PIDCon_Std	x	o	o		o	x			Analog measured value
PIDCon_TE	x	o	o	o	o			x	Thermocouple measurement value
PIDCon_Fb	x	o	o		o		x		Fieldbus measurement value
PIDCon_SW	o	o	o	o	o				Controller program logic without channel blocks

x = Selection for variant   o = Selectable functions

Examples of standard controllers include:

- Fill level controller with inflow and outflow
- Temperature control

NOTICE	**When using the Plant Automation Accelerator (PAA) V2.1, the variant "PV_Scale#" should not be used.**
	The scaling is set in PAA at the respective signal and adopted by the appropriate "Scale" input when exporting to SIMATIC PCS 7.

Note	In "plant view", you activate master/slave operation by selecting "IF_Master#". After activation, the "to_Master" and "from_Master" link blocks are available.

Figure 4-2: Status diagram using standard control
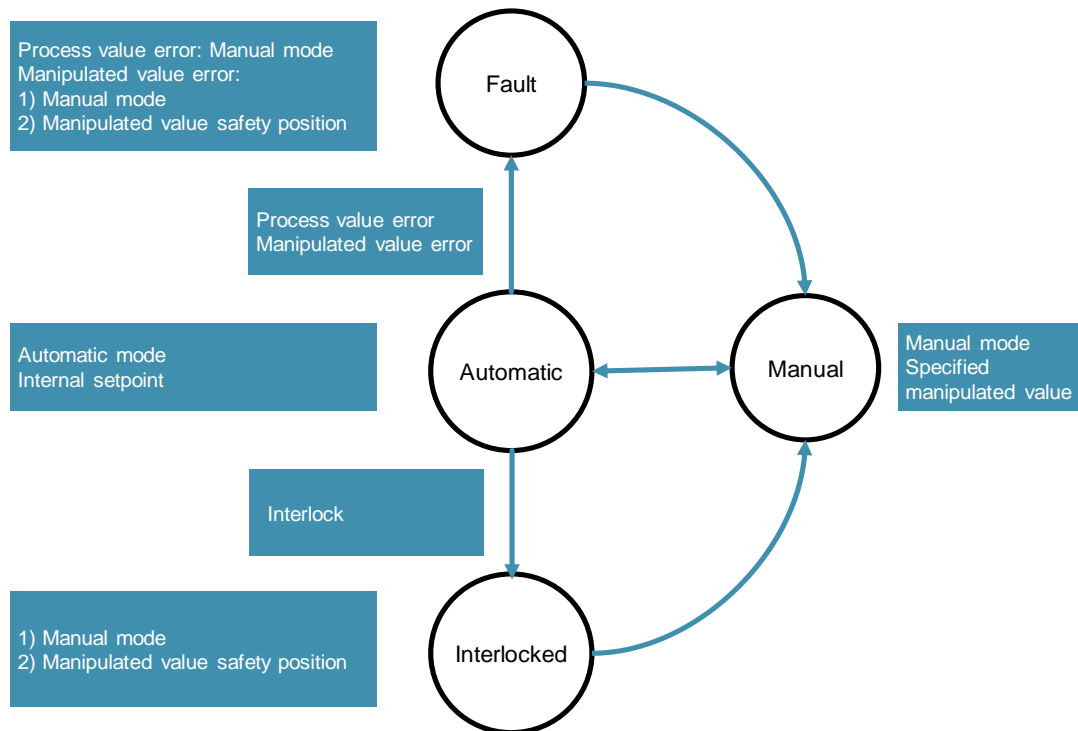
Figure 4-3: Status diagram using cascade control

Faulty master controller process value:
Master controller manual mode
Faulty slave controller process value:
1) Slave controller manual mode
2) Master controller manipulated value "Forced
tracking" with setpoint slave controller
Faulty slave controller manipulated value:
1) Slave controller manual mode
2) Slave controller "Forced tracking" manipulated value
3) Master controller manipulated value "Forced tracking" with setpoint slave controller

Process value error
Manipulated value error

Master controller:
Automatic mode
Internal setpoint
Slave controller:
Automatic mode
External setpoint

Slave controller:
Manual mode
Specified manipulated value
Master controller:
Manual or automatic "Forced tracking" manipulated value

Interlock
Slave controller

Slave controller
1) Manual mode
2) "Forced tracking" manipulated value
Master controller
2) "Forced tracking" manipulated value

Fault

Automatic

Manual

Interlocked

4.1 Setup

Figure 4-4: Design of the controller CMT "PIDCon"

Chart partition „A"

Sheet 1
Sheet 2
Sheet 3
Sheet 4
Sheet 5
Sheet 6

Chart partition „B"

Sheet 1
Sheet 2
Sheet 3
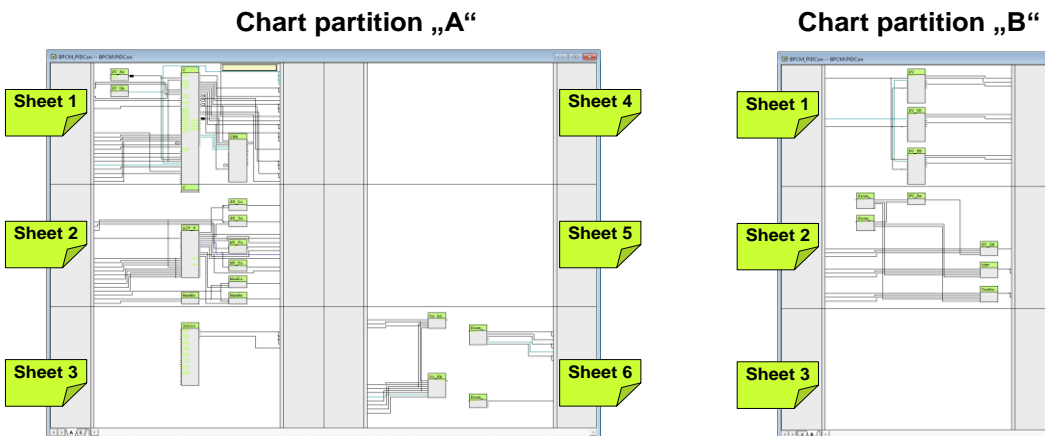
4.2 Chart partition "A"

The following blocks are located on sheet 1:

- PV_Scale: Standardization of the process value for a channel block and measured value display
- PV_Unit: Standardization of the unit for a channel block and displaying measured values
- C ("PIDConL"): PID controller
- CPM ("ConPerMon"): Block for permanent monitoring of control quality
  The outputs, operating mode, setpoint, actual value and manipulated variable of the PID controller are interconnected with the CPM block

The following blocks are located on sheet 2:

- AIF_SFC ("ConnPID"): A free block for SFC linking (not a component of the APL or the standard library)
- Logic blocks for selecting the operating mode and for interlocking
  - SP_LiOp ("Or04"): Setpoint source internal/external
  - SP_IntLi ("Or04"): Internal setpoint via interconnection
  - MV_Forced ("SelA02In"): Forced manipulated variable with selection ("In1" undefined, "In2" SFC link)
  - MV_ForOn ("Or04"): Activates forced manipulated variable "In2" (MV_Forced) on the PID controller
  - ManModOpLi ("Or04"): Formation of an OR output signal from field device in maintenance (channel blocks PV and MV) and invalid process value (channel block PV in chart partition "B", Sheet 1.)
  - ModLiOp ("Or04"): Operating mode selection between operator and interconnection or SFC
  - ManModLi ("Or04"): Manual mode via interconnection or SFC (controlled via ModLiOp = 1)

Using the SFC link, data that is relevant to production is transferred to the PID controlling via the logic blocks. In addition, channel blocks and the interlocking block (chart partition "A", Sheet 3) affect the output signals of the logic blocks.

Sheet 3 contains the "Intlock" interlocking module, which combines signals for standardized interlocking with the option of displaying them on the OS.

The link blocks below, used for rapid engineering, are located on sheet 6.

- to_Actor_Slave ("ComStruIn"): Transfer of the manipulated variable (MV), setpoint value (SP), process value (PV), and the locking status to the actuator or slave (slave in the case of cascade control)
- from_Actor_Slave ("ComStruOu"): Reception of the actuating signal feedback (Rbk), the message with invalid process values, and field device maintenance of channel blocks MV and Rbk, of the out unit and scaling of the actuating display and travel range (ScaleOut) of the actuator or slave (slave in the case of cascade control)
- to_Master ("ComStruIn"): The communication block forms a structure consisting of outputs (setpoint, block is "out of service" message, message for cascade switching, process value), of the PID controller, of the CSF block (message of the channel blocks in the case of an invalid process value), and of channel blocks PV and MV (unit and scaling of the process value).

- from_Master ("ComStruOu"): The communication block receives from the controller process tag of the main component the signals of the CSF block and the setpoint of the PID controller that are relevant to interlocking.

4.3 Chart partition "B"

The channel blocks are located on sheet 1:

- PV ("Pcs7AnIn"): Channel block for signal processing of an analog measured value, e.g. 0/4 to 20mA
- PV_TE ("Pcs7AnIn"): Channel block for signal processing of a resistance thermometer
- PV_FB ("FBAnIn"): Channel block for signal processing of a digitized process value (PA or FF processing unit)

The modules for the difference display are located on sheet 2:

- PV_DeltaCalc ("Sub02"): Formation of a difference value from two process values, e.g. differential pressure
- FromDeltaIn1: Input 1 for the difference value
- FromDeltaIn2: Input 2 for the difference value
- PV_IN ("Add08"): Merging the "PV_In" signals (analog process value)
- CSF ("Or04"): Grouping of the "Bad" signals (invalid process value) and reporting to the motor block and the Permit group block
- OosAct ("Or04"): Grouping of the "OosAct" signals (device being maintained) and reporting to the motor block

Note	If a thermocouple is used, you must carry out scaling at channel block "PV_TE" measured value display in addition to scaling at block PV_Scale (process value scaling).

NOTICE	**The channel block for the thermocouple has already been preset for the range 0.0 to 1.0.**

On sheet 2, the system additionally acquires the messages of the valve process tag channel block at blocks CSF and OosAct and transfers them to the controller.

In the case of a positive "OosAct" signal, the controller switches to manual mode.

5 Valves

The valve CMTs are for controlling and monitoring open/closed valves and control valves. They contain the control block, additional monitoring and interlock functions, and a standardized controller connection (with continuous valves only).

The CMTs are predesigned for different applications. Options are used to select or deselect the blocks required for the application, such as channel blocks.

The following CMTs are available:

- "Vlv" for opening and closing valves
- "VlvAn" for analog control valves

Using variants, the corresponding channel block is selected or deselected based on measured value transfer or the number of available signals (control, servo position, etc.) of the corresponding channel block.

5.1 "Vlv" opening and closing valve

The "Vlv" CMT is used to control and monitor opening and closing valves. Control is via an SFC or by the system operator.

Variants and options are listed and described below.

Variant 1:

Variant 1 is activated by selecting function "1Ctrl#" on the instance and it is used for valves with a single control signal. With this variant, the system starts from the set neutral (de-energized) position and uses a command signal to open or close the valve.

Variant 2:

Variant 2 is activated by selecting function "2Ctrl#" on the instance and it is used for valves with two control signals (open/close). With this variant, the system uses the two command signals to open and close the valve.

Variant 3:

Variant 3 is activated by selecting the function "1Ctrl_FB#" at the instance and is used for valves with a single control signal from one of the encoders with PROFIBUS PA or Fieldbus Foundation (FF). With this variant, the system starts from the set neutral (de-energized) position and uses a command signal to open or close the valve.

Variant 4:

> Variant 4 is activated by selecting the function "2Ctrl_FB#" at the instance and is used for valves with two control signals (Open / Close) of encoders with PROFIBUS PA or Fieldbus Foundation (FF). With this variant, the system uses the two command signals to open and close the valve.

Optional functions for all variants:

- BypassAct: Message with activated bypass
- Intlock: Interlock without reset
- Permit: Activation enable
- Protect: Protective interlock with reset
- FailLock: Neutral position corresponds to command signal
- GSL: Feedback valve closed
- GSL_FB: Feedback valve closed from one of the encoders with PROFIBUS PA or Fieldbus Foundation (FF).
- GSH: Feedback valve open
- GSH_FB: Feedback valve opened by one of the encoders with PROFIBUS PA or Fieldbus Foundation (FF)

The table below lists the available options.

Figure 5-1: Vlv variants

| Vlv (CMT Master data library)	BypassAct	Intlock	Permit	Protect	GSH	GSL	GSH FB	GSL FB	1Ctrl#	2Ctrl#	1Ctrl FB#	2Ctrl FB#	
Variants	**Function**				**Channel block**								**Description**
Vlv_1Ctrl	o	o	o	o	o	o	o	o	x		o		Opening or closing the valve (1 signal)
Vlv_2Ctrl	o	o	o	o	x	x	o	o		x		o	Signals for opening and closing the valve (2 signals)

x = Selection for variant   o = Selectable functions

Application examples include:

- Metering of solid, liquid, and gaseous materials
- Protection device, e.g. forced draining on exceeding fill level
- Venting of containers

5.1.1 Setup

Figure 5-2: Design of the Vlv-CMT

Chart partition „A"
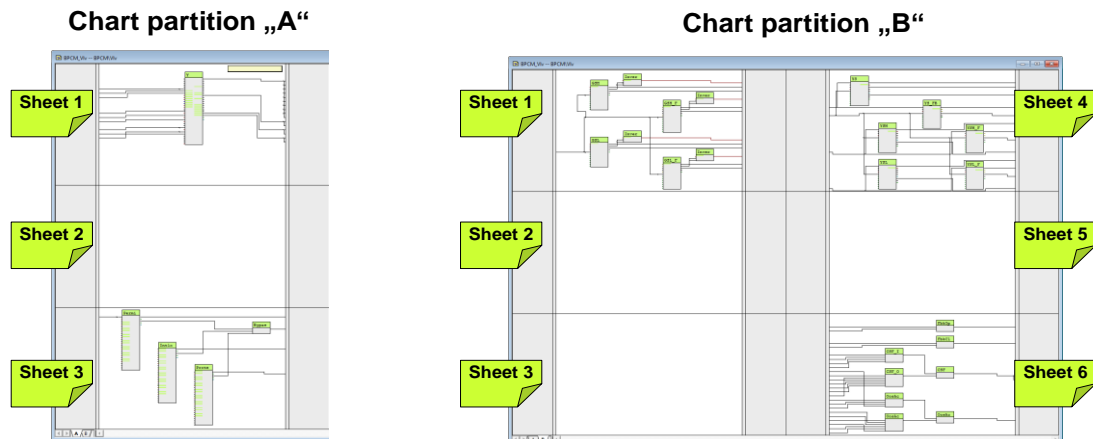
Chart partition „B"

5.1.2 Chart partition "A"

The following blocks are located on sheet 1:

- V ("VlvL"): A valve block for controlling one valve with two positions and a settable neutral position

The following blocks are located on sheet 3:

- Permit ("Intlk08"): Activation enable for the valve ("1"= Enable for opening/closing of the valve from the neutral position)

- Intlock ("Intlk08"): Block for calculating a standardized locking with the option of display on the OS

- Protect ("Intlk08"): Protective interlock that requires resetting of the valve block after the active signal ("0") has gone

- BypassAct ("Or04"): Formation of an OR output signal of the interlock block BypAct outputs (Permit, Intlock, and Protect). With Bypass active ("1"), the valve block outputs a configurable message ("Bypass active").

The "Permit" interlock is activated if the process value of the channel modules Rbk, Fbk and MV is invalid.

5.1.3 Chart partition "B"

The following blocks are located on sheet 1:

- GSH ("Pcs7DiIn"): Channel block for signal processing of the "Open" valve feedback signal

- InvertGSH ("SEL_BO"): Parameterizable signal inversion

- GSL ("Pcs7DiIn"): Channel block for signal processing of the "Close" valve feedback signal

- InvertGSL ("SEL_BO"): Parameterizable signal inversion

- GSH_FB ("Pcs7DiIn"): Channel block for signal processing of the digital measured value transmission (PROFIBUS PA or Fieldbus Foundation) of the valve feedback "Open".

- InvertGSH_FB ("SEL_BO"): Parameterizable signal inversion

- GSL_FB ("Pcs7DiIn"): Channel block for signal processing of the digital measured value transmission (PROFIBUS PA or Fieldbus Foundation) of the valve feedback "Close".

- InvertGSL_FB ("SEL_BO"): Parameterizable signal inversion

The following blocks are located on sheet 4:

- YS ("Pcs7DiOu"): Channel block for signal processing for opening or closing the valve (1 signal)

- YS_FB ("Fb7DiOu"): Channel block for digital signal processing for opening or closing the valve (1 signal)

- YSH ("Pcs7DiIn"): Channel block for signal processing for opening the valve (valve is opened)

- YSH_FB ("Fb7DiIn"): Channel block for digital signal processing for opening the valve (valve is opened)

- YSL ("Pcs7DiIn"): Channel block for signal processing for closing the valve (valve is closed)

- YSL_FB ("Fb7DiIn"): Channel block for digital signal processing for closing the valve (valve is closed)

The following blocks are located on sheet 6:

- FbkOpen_In ("Or04"): Grouping of the feedback signal open

- FbkOpen_In ("Or04"): Grouping of the feedback signal closed

- CSF_In ("Or04"): Formation of an OR output signal from the "Bad" output (process value not valid) of the input channel blocks

- CSF_Out ("Or04"): Formation of an OR output signal from the "Bad" output (process value not valid) of the output channel blocks

- CSF ("Or04"): Grouping of the "Bad" signals (process value not valid) and reporting to the valve block and the Permit group block

- OosAct_In ("Or04"): Formation of an OR output signal from the "OosAct" output (device is being maintained) of the input channel blocks.

- OosAct_Out ("Or04"): Formation of an OR output signal from the "OosAct" output (device is being maintained) of the output channel blocks

- OosAct ("Or04"): Grouping of the "OosAct" signals (device being maintained) and reporting to the valve block

- FbkOpen ("Or04"): Formation of an OR output signal from output "YSH" and "YSH_FB" of the channel blocks and reporting to the valve block

- FbkClose ("Or04"): Formation of an OR output signal from output "YSL" and "YSL_FB" of the channel blocks and reporting to the valve block

5.2 "VlvAn" analog control valve

The "VlvAn" CMT is used to control a proportional valve with or without feedback signal (position feedback). Typically, a controller specifies the manipulated variable. It is possible to generate the control signal via a ramp function.

Variants and options are listed and described below.

Variant 1: Control valve for analog manipulated variable transfer (4-20 mA)

This variant is used for positioners with a 4-20mA signal.

Variant 1 is activated by selecting the functions YC and MV_Scale# at the instance.

Variant 2: Control valve for digital manipulated variable transfer (fieldbus)

This variant is used for positioners with PROFIBUS PA or Fieldbus Foundation (FF).

Variant 2 is activated by selecting the functions YC_FB and MV_Scale# at the instance.

Optional functions:

The following options are available for selection for the variants:

- BypassAct: Message with activated bypass
- GI: GSH: Feedback from the valve
- GSH: Feedback valve open
- GSL: Feedback valve closed
- IF_Ctrl# Link to a controller
- Intlock: Interlock without reset
- MV_Scale#: Standardization of the manipulated variable including the channel block
- Permit: Activation enable
- Protect: Protective interlock with reset
- RbkReturn: Position feedback as measured value of the current valve position, should correspond approximately to the control signal.
- YS: Output of the control signal

The table below lists the available options.

Figure 5-3: VlvAn variants

| VlvAn (CMT Master data library)	BypassAct	Inflock	Permit	Protect	MV_Scale#	IF_Ctrl#	RbkReturn	GSH	GSL	YC_FB	YC	YS	GI	
Variants	Function							Channel block						Description
VlvAn_Std	o	o	o	o	x	x	x		o	o		x	o	Controlling a valve without position feedback (analog signal)
VlvAn_StdRbk	o	o	o	o	o	o			o	o		x	o	x	Controlling a valve with position feedback (analog signal)
VlvAn_FbRbk	o	o	o	o	o	o			o	o	x		o		Controlling a valve with position feedback (fieldbus)

x = Selection for variant   o = Selectable functions

An application example is setting flow rates by adjusting the valve setting for solid, liquid, or gaseous substances.

NOTICE	**When using the Plant Automation Accelerator (PAA) V2.1, the variant "MV_Scale#" should not be used.**
	The scaling is set in PAA at the respective signal and adopted by the appropriate "Scale" input when exporting to SIMATIC PCS 7.

5.2.1 Setup

Figure 5-4: Design of the VlvAn-CMT
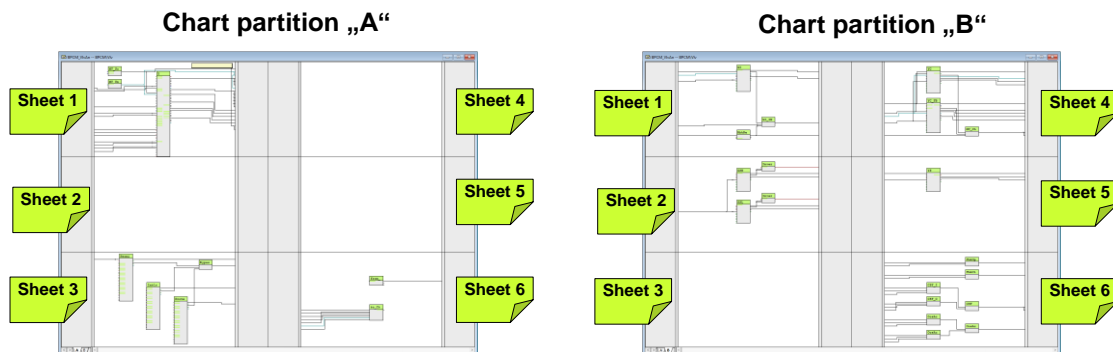
5.2.2 Chart partition "A"

The following blocks are located on sheet 1:

- MV_Scale: Standardization of the manipulated variable for channel blocks and display
- MV_Unit: Determination of the unit for a channel block and display
- V ("VlvAnL"): Valve block for control of an analog control valve and positioner

The valve module receives the external output value from the controller via a communication module (from_Ctrl in chart partition "A", page 6), which is transferred to channel module YC or YC_FB (chart partition "B", page 3) for control. Channel block GI or RbkReturn (chart partition "B", sheet 1) feeds back the manipulated variable.

Note	The lower limit value (MV_LoLim= "0") and the top limit value (MV_HiLim= "100") for limited output of the manipulated variable is pre-parameterized. If the limited external output value is required for other function blocks, switch the output MV_ExtOut.

The following blocks are located on sheet 3:

- Permit ("Intlk08"): Activation enable for the valve ("1"= Enable for opening/closing of the valve from the neutral position)

- Intlock ("Intlk08"): Block for calculating a standardized locking with the option of display on the OS

- Protect ("Intlk08"): Protective interlock that requires resetting of the valve block after the active signal ("0") has gone

- BypassAct ("Or04"): Formation of an OR output signal of the interlock block BypAct outputs (Permit, Intlock, and Protect). With Bypass active ("1"), the valve block outputs a configurable message ("Bypass active").

The "Permit" interlock becomes active if the process value of the channel blocks Rbk, Fbk and MV is invalid.

The link blocks below, used for rapid engineering, are located on sheet 6.

- from_Ctrl ("ComStruOu"): Reception of the manipulated variable (MV) from the control unit.

- to_Ctrl ("ComStruIn"): Transfer of the manipulated variable (Rbk) with the unit and the travel range, cascade interruption (CascaCut), active locking (LockAct), and the messages in the case of invalid process values and field device maintenance of channel blocks MV, Fbk, and Rbk.

5.2.3 Chart partition "B"

The following blocks are located on sheet 1:

- GI ("Pcs7AnIn"): Channel block for signal processing of the position feedback of an analog input value

- RbkReturn ("SelA02In"): Forwarding the manipulated variable from the MV output to the Rbk input of the valve block (only if no checkback signal from the channel block is present)

- C_Rbk ("Add08"): Grouping of the feedback signals

The following blocks are located on sheet 2:

- GSH ("Pcs7DiIn"): Channel block for signal processing of an "Open" valve feedback signal

- InvertGSH ("SEL_BO"): Parameterizable signal inversion

- GSL ("Pcs7DiIn"): Channel block for signal processing of a "Closed" valve feedback signal

- InvertGSH ("SEL_BO"): Parameterizable signal inversion

The following blocks are located on sheet 4:

- YC ("Pcs7AnOu"): Channel block for signal processing of an analog output value
- YC_FB ("FbAnOu"): Channel block for signal processing of a digitized process value (fieldbus)
- MV_ChnSt_IN ("Add08"): Grouping of the signals of the "MV" output

The following blocks are located on sheet 5:

- YS ("Pcs7DiIn"): Channel block for signal processing for opening or closing the valve (binary signal)

The following blocks are located on sheet 6:

- FbkOpen_In ("Or04"): Grouping of the feedback signal open
- FbkOpen_In ("Or04"): Grouping of the feedback signal closed
- CSF_In ("Or04"): Formation of an OR output signal from the "Bad" output (process value not valid) of the input channel blocks
- CSF_Out ("Or04"): Formation of an OR output signal from the "Bad" output (process value not valid) of the output channel blocks
- CSF ("Or04"): Grouping of the "Bad" signals (process value not valid) and reporting to the valve block and the Permit group block
- OosAct_In ("Or04"): Formation of an OR output signal from the "OosAct" output (device is being maintained) of the input channel blocks.
- OosAct_Out ("Or04"): Formation of an OR output signal from the "OosAct" output (device is being maintained) of the output channel blocks
- OosAct ("Or04"): Grouping of the "OosAct" signals (device being maintained) and reporting to the valve block
- FbkOpen ("Or04"): Creating an OR output signal from output "GSH" and "YC_FB" of the channel blocks and signaling to the valve block
- FbkClose ("Or04"): Creating an OR output signal from output "GSL" and "YC_FB" of the channel blocks and signaling to the valve block

6 "Mot" motors

The "MOT" CMT is used to control and monitor a motor starter or a frequency-controlled motor.

The motor CMTs contain the control block, additional monitoring and interlock functions, and a controller connection (with speed-controlled motors only).

The CMTs are predesigned for different applications. Options are used to select or deselect the blocks required for the application, such as channel blocks.

The following CMTs are available:

- "Mot" motor with fixed speed
- "MotSpdC" motor with variable speed

Using variants, the corresponding channel block is selected or deselected based on measured value transfer or the number of available signals (control, local mode, etc.) of the corresponding channel block.

6.1 "Mot" motor with fixed speed

The "Mot" CMT is used to monitor motors with fixed speed. The plant operator or an SFC carry out control.

Variants and options are listed and described below.

Variant 1:

Variant 1 is activated by selecting the "1Fbk#" function on the instance; it monitors the feedback via a signal input.

Variant 2:

Variant 2 is activated by selecting the "2Fbk#" function on the instance; it monitors the feedback via two signal inputs (feedback on and feedback off).

Optional functions for all variants:

- BypassAct: Message with activated bypass
- Intlock: Interlock without reset
- Permit: Activation enable
- Protect: Protective interlock with reset
- Q: Runtime meter
- TRIP: Motor protection active
- MAINT: Maintenance status
- LOCAL: Local mode
- NSH: "Motor started" signal
- NSL: "Motor stopped" signal

The table below lists the available options.

Fig. 6-1: Mot variants

| Mot (Master data library)	BypassAct	Intlock	Permit	Protect	Q	1Fbk#	2Fbk#	TRIP	MAINT	LOCAL	NSH	NSL	
Variants	**Function**					**Channel block**							**Description**
Mot_StdFbk	o	o	o	o	o	x		o	o	o	o	o	Motor operation with simple monitoring
Mot_AdvFbk	o	o	o	o	o		x	o	o	o	o	o	Motor operation with operation monitoring (operation/stop)

x = Selection for variant   o = Selectable functions

Application examples include:

- Stirrer for mixing materials in a container
- Pumps for pumping solid, liquid, and gaseous substances

6.1.1 Setup

Figure 6-2: Format of the Mot CMT

Chart partition „A"   **Chart partition „B"**
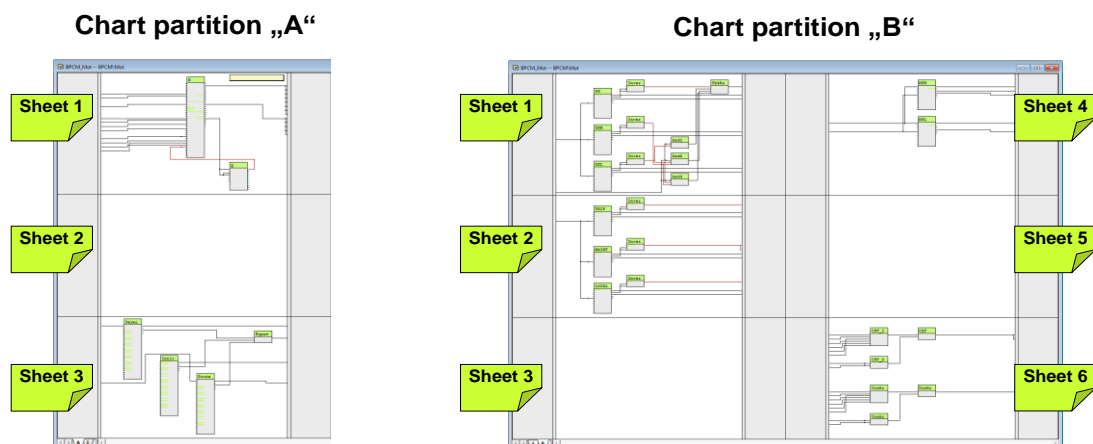
6.1.2 Chart partition "A"

The following blocks are located on sheet 1:

- N ("MotL"): Motor block for controlling a fixed-speed motor via control signals
- Q ("CountOh"): Operating time of the motor since last reset

The motor block is parameterized for different application options. Using interconnections (CFC, SFC), an operating mode is selected (local mode, automatic mode, manual mode and out of service). To control the motor, the "Start" connection of the motor block is interconnected with the Start channel block (chart partition "B", sheet 4). The feedback for a started motor comes from the Fbk or FbkRun channel block.

The following blocks are located on sheet 3:

- Permit ("Intlk08"): Activation enable for the motor ("1" = Enable for opening/closing of the motor from the neutral position)
- Intlock ("Intlk08"): Block for calculating a standardized locking with the option of display on the OS
- Protect ("Intlk08"): Protective interlock that requires resetting of the motor block after the active signal ("0") has gone

- BypassAct ("Or04"): Formation of an OR output signal of the interlock block BypAct outputs (Permit, Intlock, and Protect). With Bypass active ("1"), the motor block outputs a configurable message ("Bypass active").

The outputs of the interlocking block are interconnected with the motor block on sheet 1. Permit locking is activated in the case of an invalid process value of the channel blocks. Protect locking is activated in the case of maintenance messages from the channel blocks.

6.1.3 Chart partition "B"

The following blocks are located on sheet 1:

- GS ("Pcs7DiIn"): Channel block for signal processing of the "motor running" motor checkback signal. This block can also be used for the inverse status. In this case, the system inverts the signal at the InvertGS block at the Mode input.

- InvertGS ("SEL_BO"): Parameterizable signal inversion

- GSH ("Pcs7DiIn"): Channel block for signal processing of the "motor running" motor checkback signal.

- InvertGSH ("SEL_BO"): Parameterizable signal inversion

- GSL ("Pcs7DiIn"): Channel block for signal processing of the motor feedback signal "Motor inactive" or "Motor switched off".

- InvertGSL ("SEL_BO"): Parameterizable signal inversion

- And1 ("And04"): Comparison of whether the motor is not running (motor block) and the motor is not at a standstill (GSL channel block).

- And2 ("And04"): Comparison of whether the motor is not running (motor block), the motor is not at a standstill (GSL channel block), and the motor is running (GSH channel block).

- And3 ("And04"): Comparison of whether the motor is not running (motor block), the motor is at a standstill (GSL channel block), and the motor is running (GSH channel block).

- FbkRun_In ("Or04"): Formation of an OR output to feed back that the motor is running if one of the AND comparisons or the GS channel block returns a positive signal.

Note	Two block combinations (1Fbk# and 2_Fbk#) can be used to feedback whether the motor is running. With the first option, only one checkback signal is available. With the second option, the checkback signal that the motor is at a standstill is used in addition.

The following blocks are located on sheet 2:

- TRIP ("Pcs7DiIn"): Channel block for signal processing of a motor fault

- InvertTRIP ("SEL_BO"): Parameterizable signal inversion

- Maint ("Pcs7DiIn"): Channel block for signal processing of a maintenance procedure (by activation of the locking at the Protect block and triggering of an "ExtMassage1" message at the motor block)

- InvertMAINT ("SEL_BO"): Parameterizable signal inversion

- Local ("Pcs7DiIn"): Channel block for signal processing "local mode"

- InvertLOCAL ("SEL_BO"): Parameterizable signal inversion

The following blocks are located on sheet 4:

- NSH ("Pcs7DiOu"): Channel block for signal processing for starting the motor
- NSL ("Pcs7DiOu"): Channel block for signal processing for stopping the motor

The following blocks are located on sheet 6:

- CSF_In ("Or04"): Formation of an OR output signal from the "Bad" output (process value not valid) of the input channel blocks
- CSF_Out ("Or04"): Formation of an OR output signal from the "Bad" output (process value not valid) of the output channel blocks
- CSF ("Or04"): Grouping of the "Bad" signals (invalid process value) and reporting to the motor block and the Permit group block
- OosAct_in ("Or04"): Formation of an OR output signal from the "OosAct" output (device is being maintained) of the input channel blocks.
- OosAct_Out ("Or04"): Formation of an OR output signal from the "OosAct" output (device is being maintained) of the output channel blocks
- OosAct ("Or04"): Grouping of the "OosAct" signals (device being maintained) and reporting to the motor block

6.2 "MotSpdC" motor with variable speed

The "MotSpdC" CMT is used to monitor motors with variable speed. Typically, control is carried out by means of controllers, SFC, or local mode.

Variant 1:

Variant 1 is used if the setpoint is specified locally at the frequency converter and not by the instrumentation and control technology.

Variant 2:

Variant 2 is activated by selecting functions "SP_Out" and "Rbk" on the instance. With this variant, the instrumentation and control technology controls and acquires the speed of the motor.

Optional functions for all variants:

The following options are available for selection for the variants:

- BypassAct: Message with activated bypass
- GSH_R: Speed feedback
- IF_Ctrl# Speed specification if a controller is used
- Intlock: Interlock without reset
- LOCAL: Local mode
- MAINT: Maintenance status
- NC: Motor speed (setpoint)
- NI: Motor speed (readback value)
- NS_R: Reverse direction of motor rotation
- Permit: Activation enable
- Protect: Protective interlock with reset
- Q: Runtime meter
- RbkReturn: Return of the manipulated variable as actual value
- TRIP: Motor protection active

The table below lists the available options.

Figure 6-3: MotSpdC variants

| MotSpdC (CMT Master data library)	BypassAct	Intlock	Permit	Protect	Q	IF_Ctrl#	RbkReturn	NS_R	NI	TRIP	MAINT	LOCAL	NC	GSH_R	
Variants	**Function**							**Channel block**							**Description**
MotSpdC_Std	o	o	o	o	o	o	o	o	x	o	o	o	o	o	Starting and stopping the motor with fixed speed
MotSpdC_StdRbk	o	o	o	o	o	o	o		o	o	o	o	o	x	x	Starting and stopping the motor with speed specification and feedback

x = Selection for variant   o = Selectable functions

Application examples include:

- Driving a rotary valve
- Driving a pump

6.2.1 Setup

Figure 6-4: Format of the MotSpdC CMT

Chart partition „A"
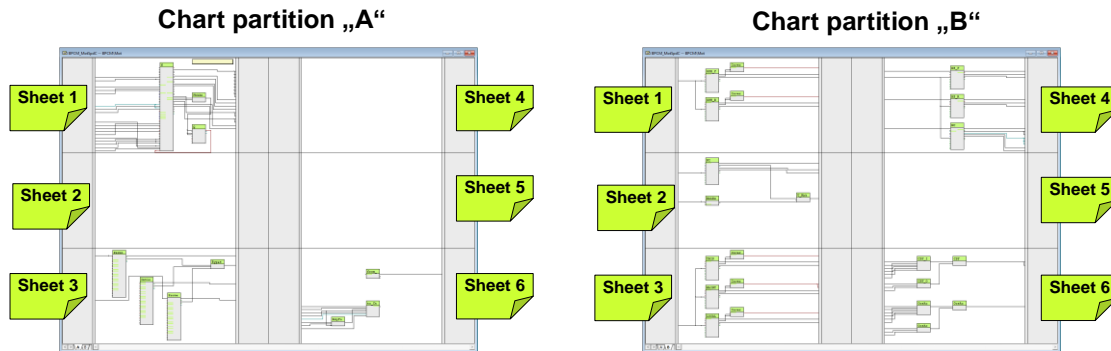
Chart partition „B"

6.2.2 Chart partition "A"

The following blocks are located on sheet 1:

- N ("MotSpdCL"): Controllable motor with variable speed
- FbkAny ("Or04"): Summary of feedback for the operating time
- Q ("CountOh"): Operating time of the motor since last reset

The motor block is parameterized for different application options. Using interconnections (CFC, SFC), an operating mode is selected (local mode, automatic mode, manual mode and out of service). The motor block receives the external manipulated variable from the controller via a communication block (from_Ctrl in chart partition "A", sheet 6) that is transferred to channel block SP_Out (chart partition "B", sheet 4) control. The feedback for a started motor comes from the channel block NI or NS_F.

The following blocks are located on sheet 3:

- Permit ("Intlk08"): Activation enable for the motor ("1" = Enable for opening/closing of the motor from the neutral position)
- Intlock ("Intlk08"): Block for calculating a standardized locking with the option of display on the OS
- Protect ("Intlk08"): Protective interlock that requires resetting of the motor block after the active signal ("0") has gone
- BypassAct ("Or04"): Formation of an OR output signal of the interlock block BypAct outputs (Permit, Intlock, and Protect). With Bypass active ("1"), the motor block outputs a configurable message ("Bypass active").

The outputs of the interlocking block are interconnected with the motor block on sheet 1. Permit locking is activated in the case of an invalid process value of the channel blocks. Protect locking is activated in the case of maintenance messages from the channel blocks.

The link blocks below, used for rapid engineering, are located on sheet 6.

- from_Ctrl ("ComStruOu"): Reception of the manipulated variable (MV) or motor speed from the control.

- to_Ctrl ("ComStruIn"): Transfer of the manipulated variable (Rbk) with the unit and the travel range, cascade interruption, active locking (LockAct), and the messages in the case of invalid process values and field device maintenance of channel blocks MV, Fbk, and Rbk.

- RdyFor_Ctrl ("And04"): Combining the signals "RdyToStart", "OosAct" and "SP_ExtAct" for cascade interruption.

6.2.3   Chart partition "B"

The following blocks are located on sheet 1:

- GSH_F ("Pcs7DiIn"): Channel block for signal processing of the "Direction of rotation forwards" motor checkback signal

- InvertGSH_F ("SEL_BO"): Parameterizable signal inversion

- GSH_R ("Pcs7DiIn"): Channel block for signal processing of the "Direction of rotation backwards" motor checkback signal

- InvertGSH_R ("SEL_BO"): Parameterizable signal inversion

The following blocks are located on sheet 2:

- NI ("Pcs7AnIn"): Channel block for signal processing for motor speed acquisition

- RbkReturn ("SelA02In"): Forwarding the manipulated variable from the SP_Out output to the Rbk input of the motor block

- U_Rbk ("Add08"): Grouping of the feedback signals

The following blocks are located on sheet 3:

- TRIP ("Pcs7DiIn"): Channel block for signal processing of a motor fault

- InvertTRIP ("SEL_BO"): Parameterizable signal inversion

- Maint ("Pcs7DiIn"): Channel block for signal processing of a maintenance procedure (by activation of the locking at the Protect block and triggering of an "ExtMassage1" message at the motor block).

- InvertMAINT ("SEL_BO"): Parameterizable signal inversion

- Local ("Pcs7DiIn"): Channel block for signal processing "local mode"

- InvertLOCAL ("SEL_BO"): Parameterizable signal inversion

The following blocks are located on sheet 4:

- NS_F ("Pcs7DiOu"): Channel block for signal processing for starting the motor in the "Forwards" direction of rotation

- NS_R ("Pcs7DiOu"): Channel block for signal processing for starting the motor in the "Rearwards" direction of rotation

- NC ("Pcs7AnOu"): Channel block for signal processing of the motor speed

The following blocks are located on sheet 6:

- CSF_In ("Or04"): Formation of an OR output signal from the "Bad" output (process value not valid) of the input channel blocks

- CSF_Out ("Or04"): Formation of an OR output signal from the "Bad" output (process value not valid) of the output channel blocks

- CSF ("Or04"): Grouping of the "Bad" signals (invalid process value) and reporting to the motor block and the Permit group block

- OosAct_in ("Or04"): Formation of an OR output signal from the "OosAct" output (device is being maintained) of the input channel blocks.

- OosAct_Out ("Or04"): Formation of an OR output signal from the "OosAct" output (device is being maintained) of the output channel blocks

- OosAct ("Or04"): Grouping of the "OosAct" signals (device being maintained) and reporting to the motor block

7 Appendix

7.1 Change documentation

Table 7-1 Change documentation

Version	Date	Modifications
V1.0	03/2019	First version