



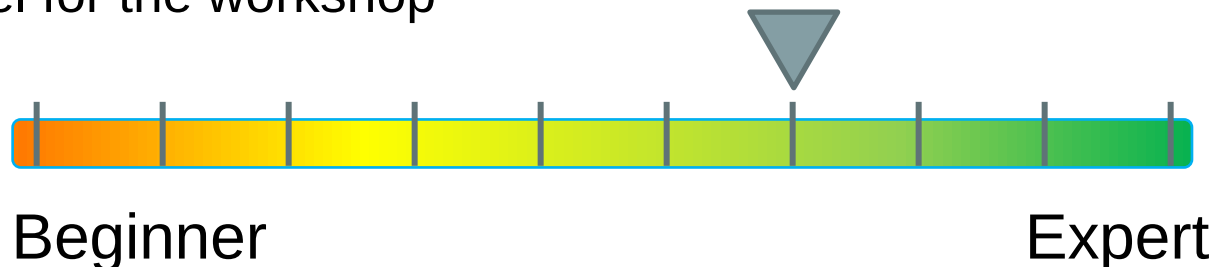
Training module TM861 PAL



PAL

Time	Topic	Presenter
Day 1 – AM	Intention, Availability, Editions, Internationalization, Documentation, Basic concepts	Marböck Wolfgang
Day 1 – PM	PAL control modules in detail + workshop	Marböck Wolfgang
Day 2	PAL control modules in detail + workshop	Marböck Wolfgang

Aimed level for the workshop



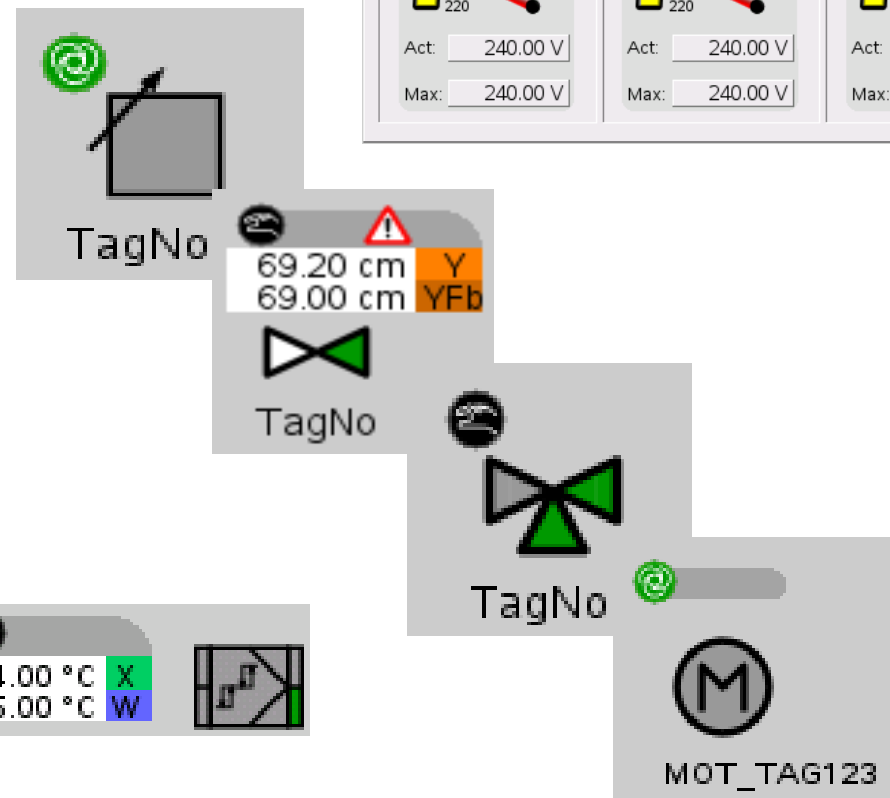
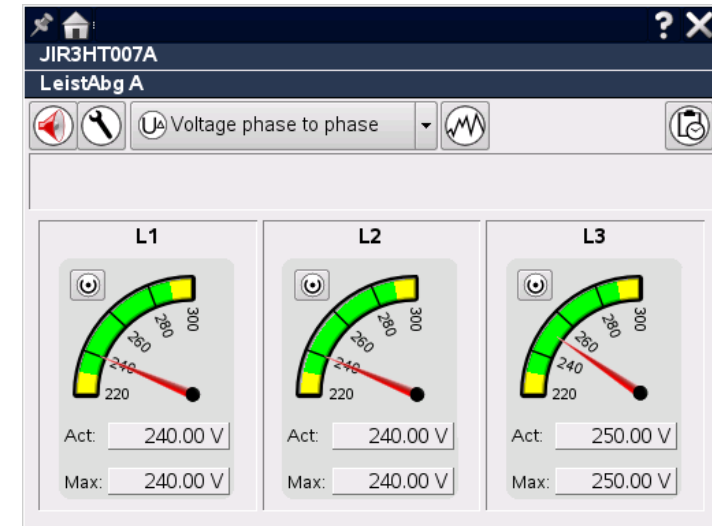


PAL

Process Automation Library



- Intention
- Availability
- APROL Solutions and PAL Editions
- Documentation
- Internationalization
- Basic Concepts
- Components
- Control Modules Overview
- Control Modules in Detail

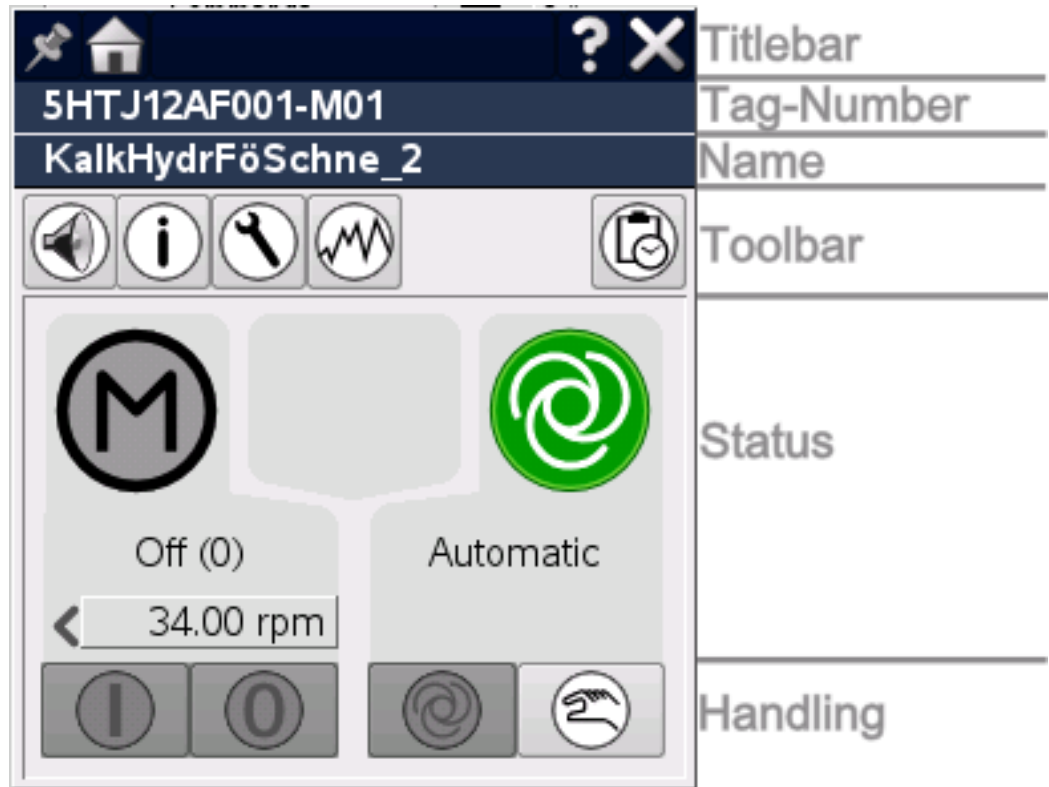




PAL Intention



- Standard Library
- Fits all industries
- Minimizing Engineering Cost & Effort
- Intuitive operation
- Faceplates with clear, modern svg icons
- Integrated system functions (Alarming, Trending, ShiftLogbook)
- Extensive functionalities (Operating Modes, Priority Commands, Interlocking, Exclusive operator access, ...)

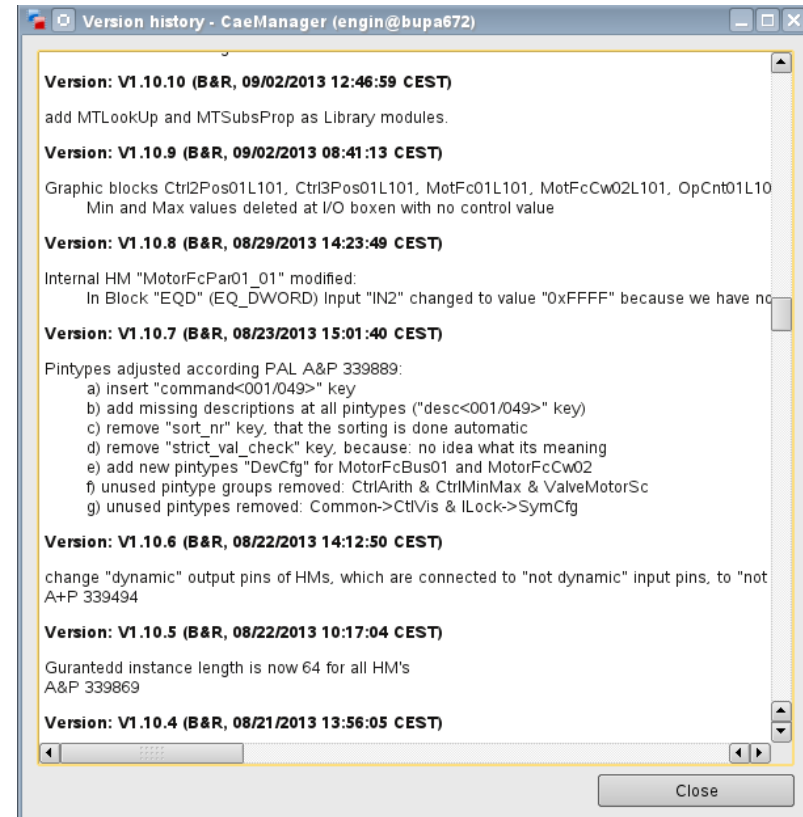
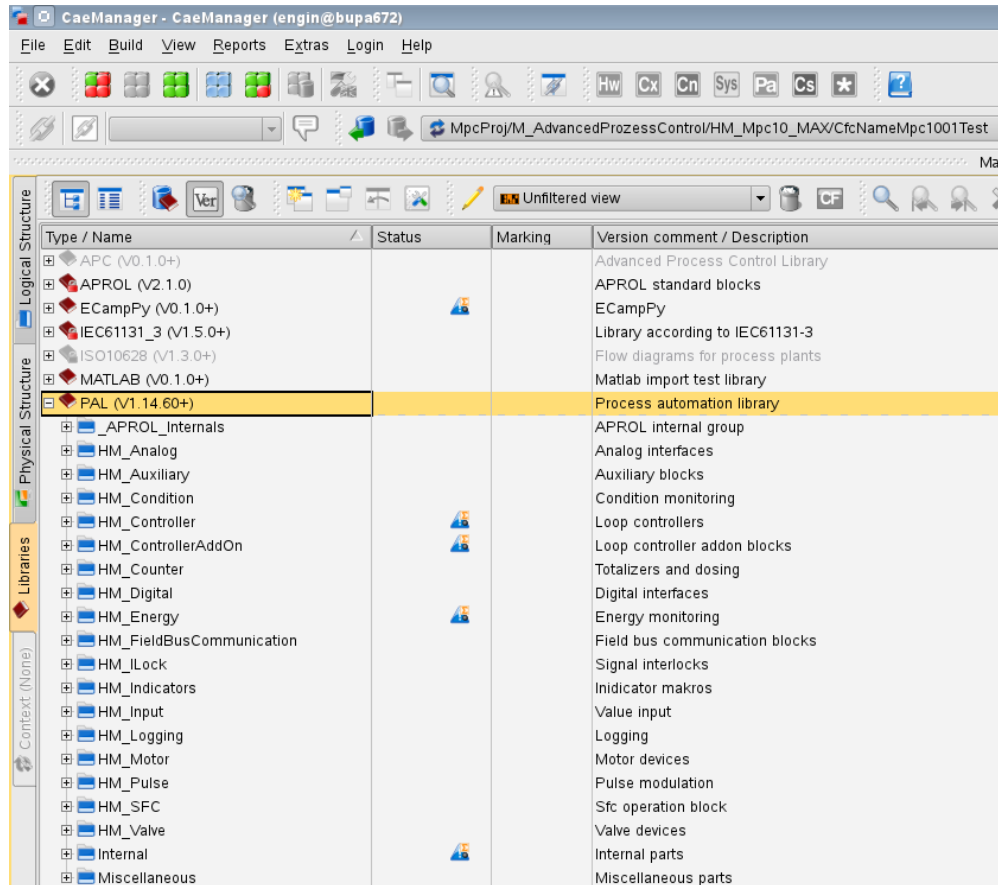




PAL Availability

PAL Availability

PERFECTION IN AUTOMATION
www.br-automation.com



- Comes with the APROL Setup
- Check version history for last changes
- Can easily be added to your project



PAL Editions

APROL Solutions



- Universal standard library
PAL
= **P**rocess **A**utomation **L**ibrary
for process control system APROL

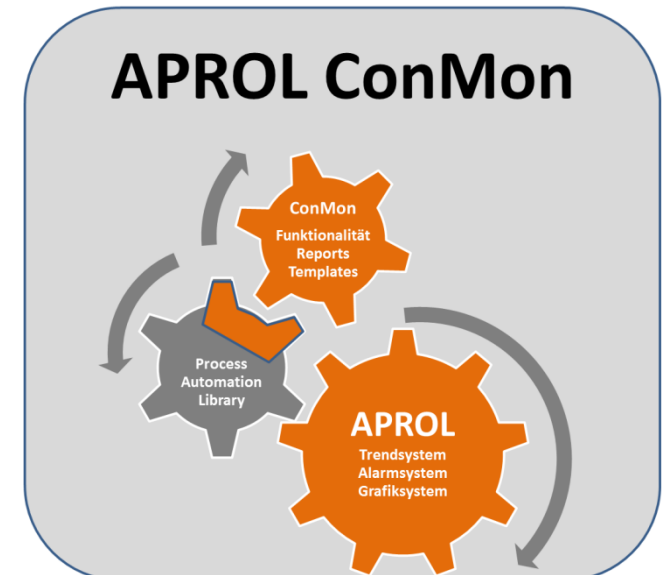
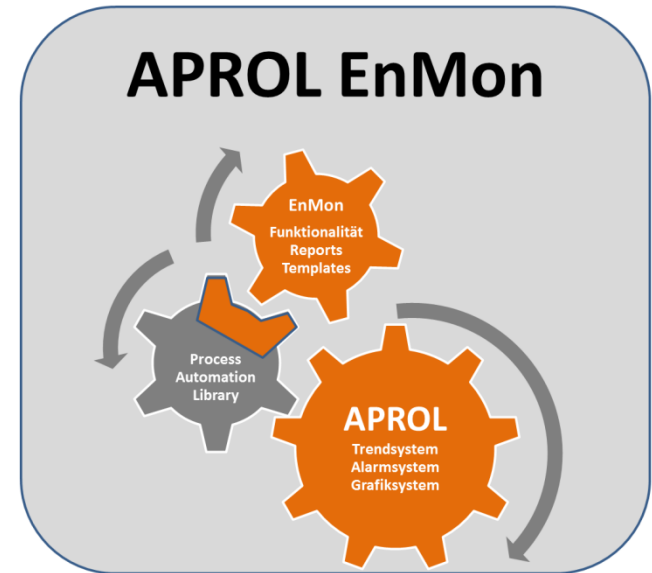
- To keep down costs
there are different PAL **Editions**
for the different APROL Solutions

e.g.:

PAL Edition EnMon
AP.LIB-ENM-CNT-NEW

PAL Edition ConMon
AP.LIB-COM-CNT-NEW

- Always the original version of PAL
is installed on the APROL systems.
But depending on
the purchased (=licensed) edition
there is only a subset of the
PAL control modules available.





PAL Documentation



- PAL Documentation is integrated in Setup since R3.6-08
 - Languages German/English
 - In product documentation – chapter L1 (Help->Product Documentation)
 - Divided in engineering part (engineers view) and operating part (operators view)
 - AsBuilt-Documentation: no documentation, only description of the pins available

- PAL Documentation was not integrated in APROL < R3.6-08
 - separate HTML- Files
 - Download from download servers
 - Folder structure



PAL Internationalization



- Internationalization based on GNU gettext mechanism
- Available languages
 - English
 - German
 - Further languages at request
- Create the translation for a new language by yourself
- Edit the existing translation





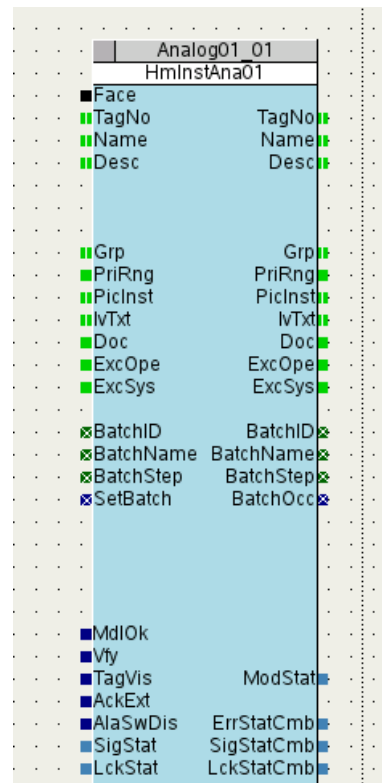
PAL

Basic concepts



➤ APROL Hypermacro concept

- Includes **logic** functionality (C- FUBs , ST- FUBs, SFC- FUBs)
- Includes **visualization** parts (graphic macros, faceplates)
- Includes **control system blocks** (alarm, trend)
- **One block** per typical, **everything inside**





Logic



Graphic Macro



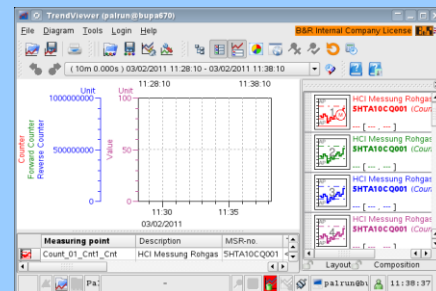
Faceplate



Alarm

3	→ 03/02/2011 11:36:29 CET	0	FQ 1027	RA	NOT ACKNOWLEDGED	Group	Operations counter interval 1	PV	OpCh_R4_S5201_AVP1_C.ABCH
2	→ 03/02/2011 11:36:37 CET	0	FQ 1028	RA	NOT ACKNOWLEDGED	Group	Operations counter interval 1	PV	OpCh_R4_S5202_AVP1_C.ABCH
1	→ 03/02/2011 11:36:30 CET	0	FQ 1029	RA	NOT ACKNOWLEDGED	Group	Operations counter interval 1	PV	OpCh_R4_S5203_AVP1_C.ABCH

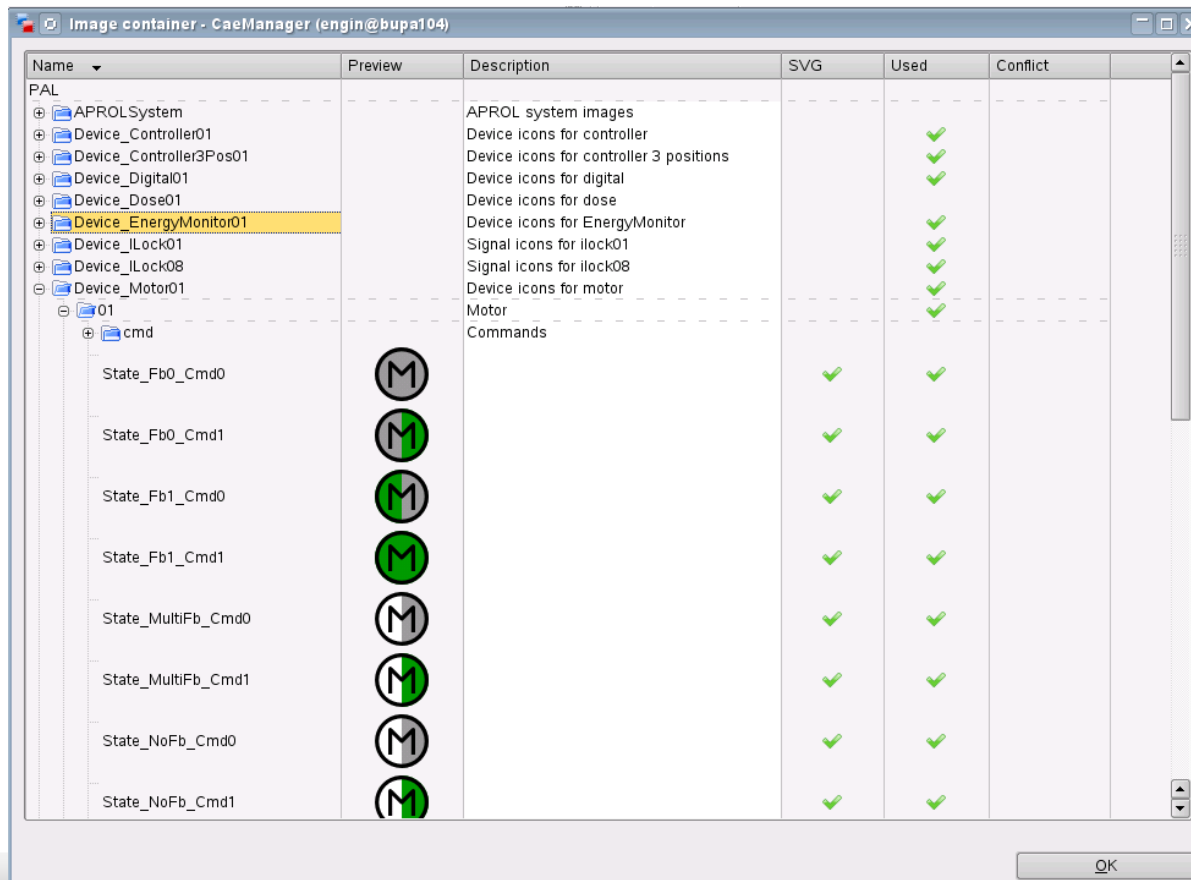
Trend





➤ Image Container

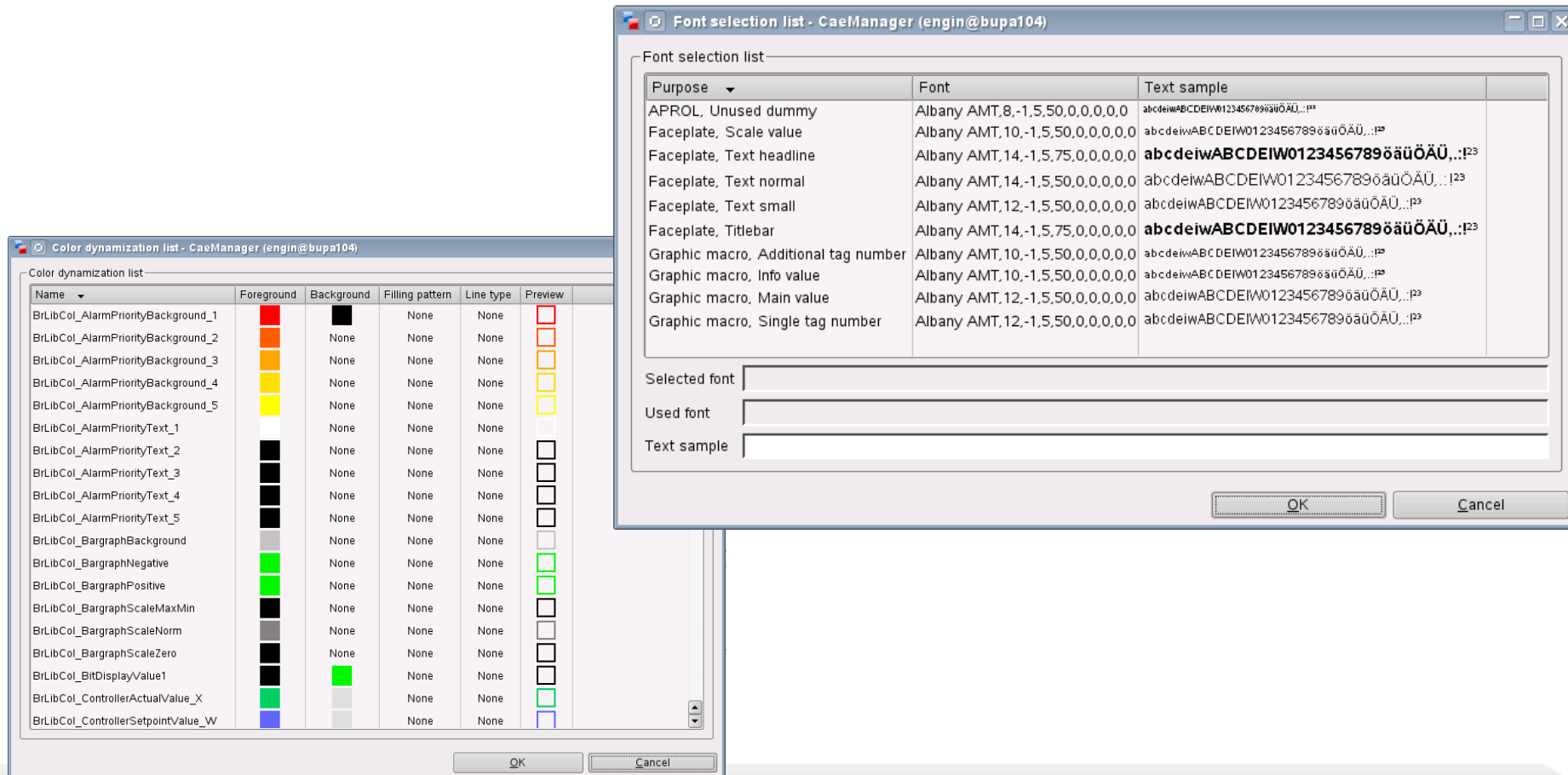
- clear, **modern SVG-Icons**
- icons are saved in the library
- standard- icons can be replaced by customer icons





 Color list, Font list

- are saved in the library
- can be customized





➤ Faceplate classification

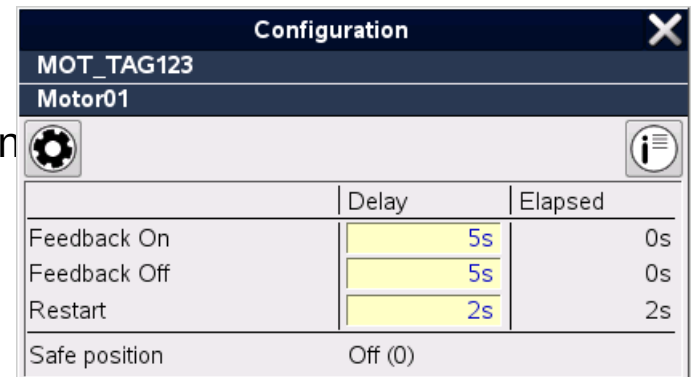
- Graphic macro
 - graphic symbols which are directly placed in the process graphic



- Faceplate (level 1–faceplate, first-level-faceplate)
 - main faceplate of a device
 - pops up when you click on a graphic macro
 - contains most important information + interaction (status, buttons,...)
 - Is displayed with dark-grey background when inhibit is active



- Sub- faceplate(s) (level n-faceplate)
 - contain further information + interaction status, buttons ...
 - Pop up when you click on a button in a faceplate one level higher up
 - used for parameter input





➤ Operating mode

- Control Modules work with operating modes
(not each control module provides all modes)

- Available modes are:

- **Automatic**
- **Manual**
- **Local**
- **Maintenance**

(=kind of manual mode where Priority Commands and Locks are inactive)

- **Inhibit**

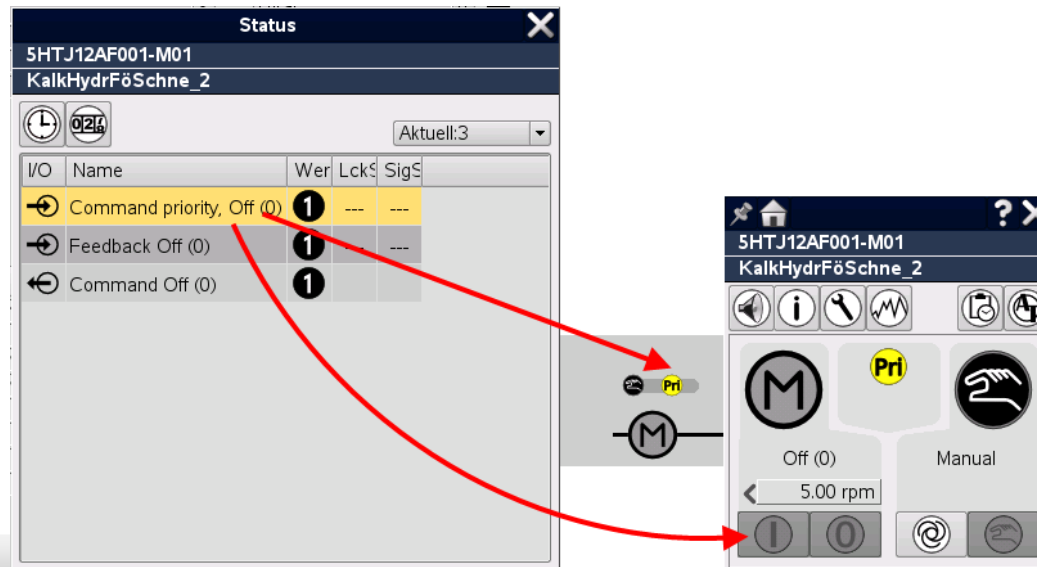
- See [Bausteindoku\02_common\modi_eng.htm](#)





➤ Priority Commands

- Control Modules can be controlled by
 - Commands from the operator via the **faceplate** in mode **manual**
 - **Automatic commands** from logic, only active in mode **automatic**
 - **Priority Commands**, active in **manual and automatic** mode
- Priority commands have higher priority than automatic commands
- While Priority Command is active, setting commands via faceplate is locked
- See [Bausteindoku\02_common\cmdpri_eng.htm](#)





➤ Interlocking

- Means you can do a **manipulation** on some signal
- Access via Sub- Faceplate Status
- For example to set priority commands during project startup or FAT

The screenshot displays the 'Status' window for the device '5HTJ12AF001-M01' and the sub-faceplate 'KalkHydrFöSchne_2'. The window shows a list of I/O signals with their current status. The 'Command priority, On (1)' signal is highlighted in yellow. A red arrow points from this signal to the 'Eingang' (Input) faceplate, which shows a '0' in a circle. Another red arrow points from the '0' in the 'Eingang' faceplate to the '1' in a circle in the 'Eingang' faceplate, indicating a change in status. The 'Eingang' faceplate also shows a green checkmark and a red circle around the '0' and '1' buttons.

I/O	Name	Wer	LckS	SigS
⏸	Command priority manual, Off (0)	0	---	---
⏸	Command priority manual, On (1)	0	---	---
⏸	Command priority, Off (0)	0	---	---
⏸	Command priority, On (1)	0	---	---
⏸	Lock Off (0)	0	---	---
⏸	Lock On (1)	0	---	---
⏸	Set manual	0	---	---
⏸	Set automatic	0	---	---
⏸	Local	0	---	---
⏸	Command automatic	0	---	---

Command priority, On (1)
5HTJ12AF001-M01
KalkHydrFöSchne_2

Input 0 0

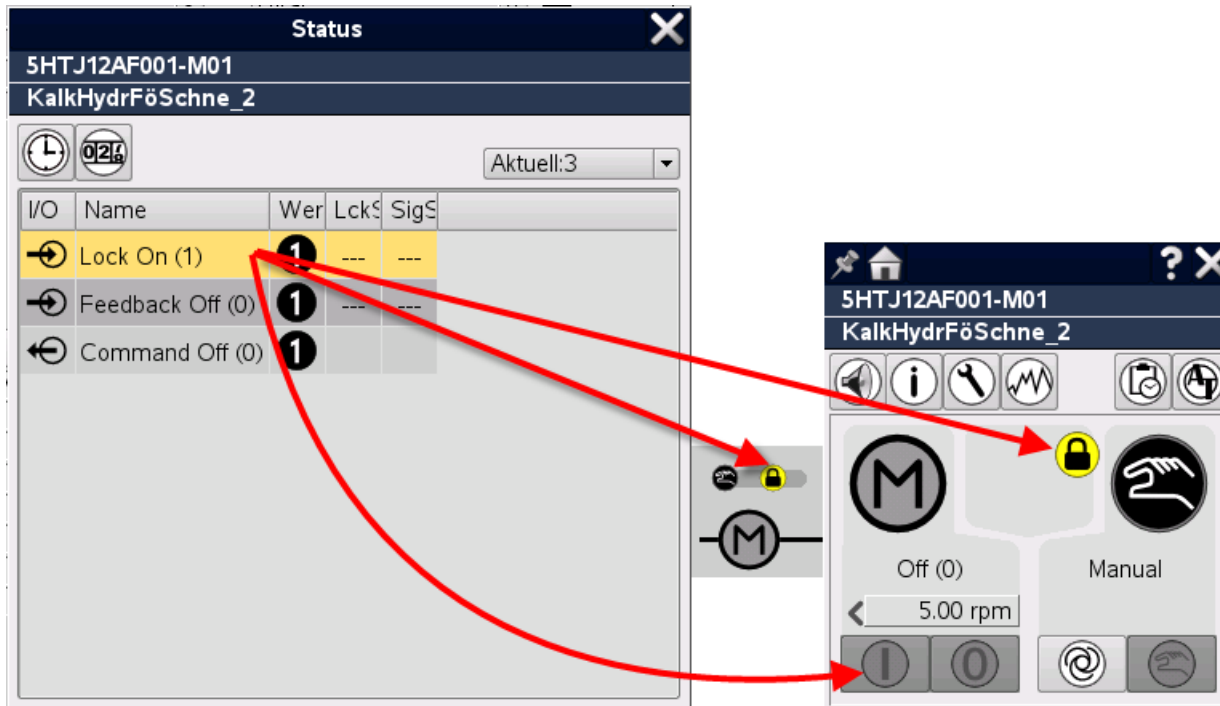
Eingang
5HTJ12AF001-M01
KalkHydrFöSchne_2

✓ 0 1



➤ Locking

- With locking you can **prevent** Control Modules from **accepting commands**
- e.g. you can prevent a motor from accepting commands for a movement in direction 1
- See [Bausteindoku\02_common\lck_eng.htm](#)





➤ Lock State

- Control Modules have a lock state
- Gives information about **signal manipulation** state
 - Signal **okay**
 - Signal **manipulated**
- Manipulations are:
 - Bridge set, alarm locked, dummy value active,...
- Is displayed
- Can be handed over to a following block
- See [Bausteindoku\02_common\lckstat_eng.htm](#)





➤ Signal State

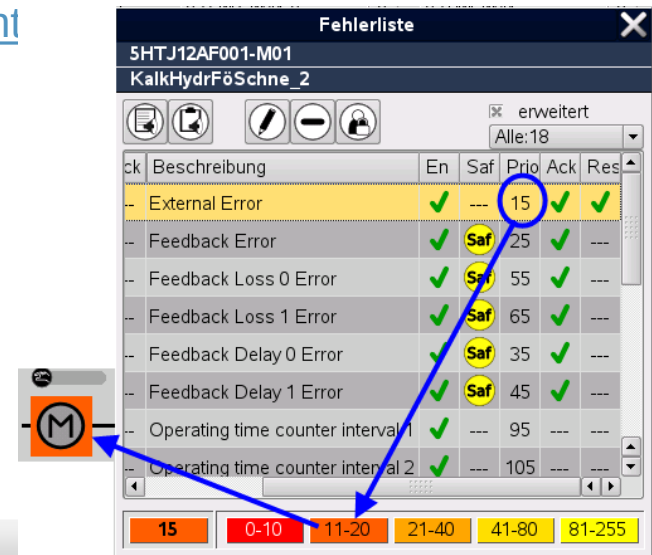
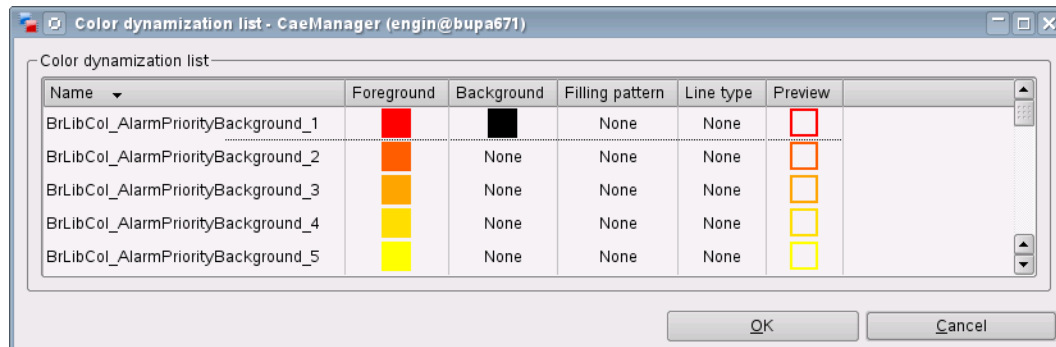
- Control Modules have a signal state
- Gives information about **signal's quality**
 - Signal quality **good**
 - Signal quality **bad**
- Reasons for a bad signal state:
 - Broken wire, configuration error, life signal error,...
- Is displayed
- Can be handed over to a following block
- See [Bausteindoku\02_common\sigstat_eng.htm](#)





➤ Alarm

- Control Modules are fitted with alarms
 - (runtime violation, operating hours,...)
- Any alarm is logged in the **alarm system** (AprCcAlarm)
- Alarm configuration:
 - Alarm/message, acknowledgement, reset, safety-related
- Any alarm needs to have a defined priority (0-255)
- Any instance of a Typical needs a **priority range**
- Definition of the **alarm color** for a specific priority range
- See [Bausteindoku\02_common\alarms_eng.ht](#)





➤ Operator rights

- APROL standard; operator rights are assigned to operators, groups of operators with **OperatorManager**
- All Control Modules are fitted with some **operator rights**. These can be assigned / not assigned

The screenshot shows a software window titled "Edit Group - OperatorManager (paleng@bupa670)". The window has a tabbed interface with four tabs: "Master data", "Operator Rights", "Alarm Groups", and "Application Rights". The "Operator Rights" tab is selected. The window displays a table of operator rights for the group "GroupTuner1". The table has four columns: "Rights", "Status", "Changes", and "Description". The "Rights" column is expanded to show a list of rights under the "Library[PAL_V003]" section. The "Status" column shows green checkmarks for most rights, indicating they are assigned. The "Changes" column is empty. The "Description" column provides details for each right.

Rights	Status	Changes	Description
Library[PAL_V003]			Process Automation Library
AlarmSummary01_Acknowledge	✓		Acknowledge selected alarm
AlarmSummary01_Lock	✓		Lock/Unlock selected alarm
AlarmSummary01_Reset	✓		Reset selected alarm
Analog01_Bargraph	✓		Configure bargraph
Analog01_Dummy	✓		Set dummy value
Analog01_Filter	✓		Configure filter
Analog01_Internal_External	—		Switch between internal and external
Analog01_Limits	✓		Configure limits



➤ Exclusive Access

- An operator can ensure **exclusive access to an instance**
- The exclusive access is only about operation via DisplayCenter, but has no effect on the logic
- See [Bausteindoku\02_common\exc_eng.htm](#)

The screenshot displays the PAL DisplayCenter interface with three main panels: a main control panel on the left, a 'Configuration' panel in the center, and a 'Special modes' panel on the right. The 'Configuration' panel contains a table with settings for feedback loops and transitions. The 'Special modes' panel shows the current user and exclusive access status.

Configuration Panel:

TagNo	Name	Delay	Elapsed
	Feedback 0	10s	0s
	Feedback 1	10s	0s
	Feedback 2	10s	0s
	Restart	6s	6s1ms
	Change over 1->2	5s	0s
	Change over 2->1	5s	0s
	Safe Position	Off (0)	

Special modes Panel:

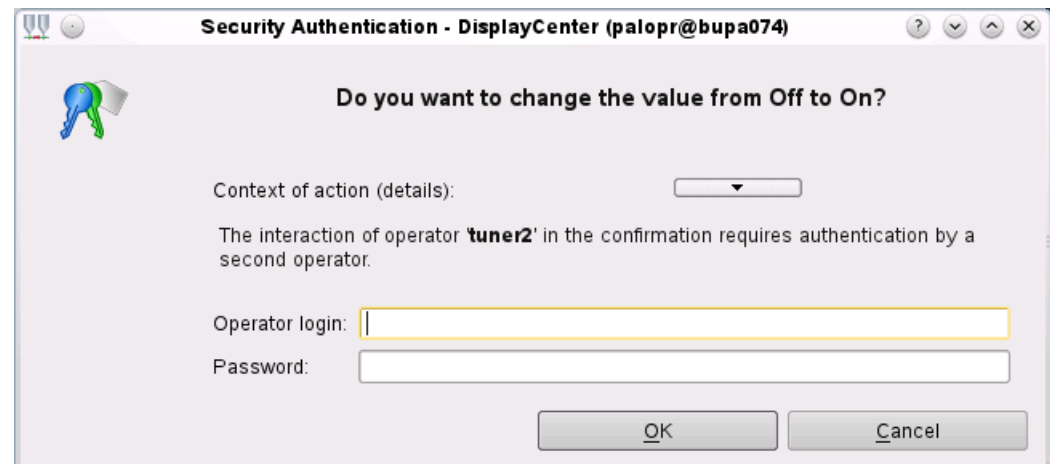
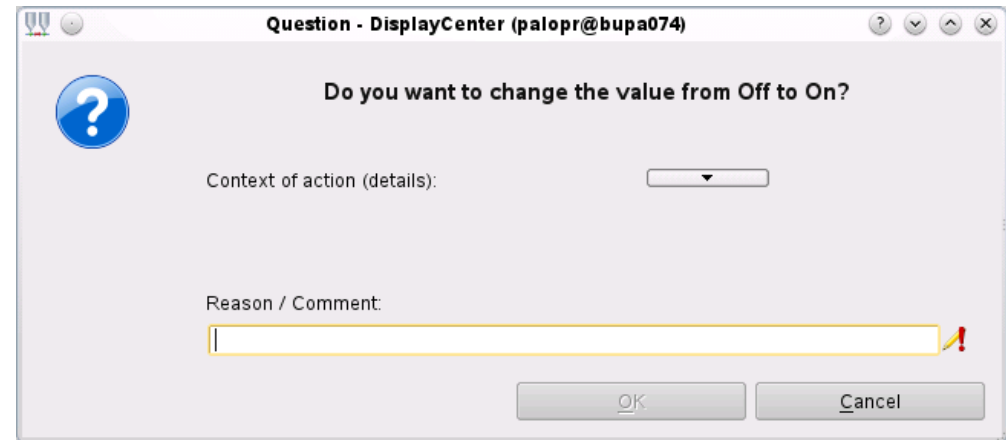
You are: tuner palrun

Exclusive: tuner PalNotExc



➤ Verification, Authentication

- Verify switching operations
 - Without comment
 - Comment possible
 - Comment necessary
- Authentication necessary
 - No
 - Yes
 - Yes, additional with second operator

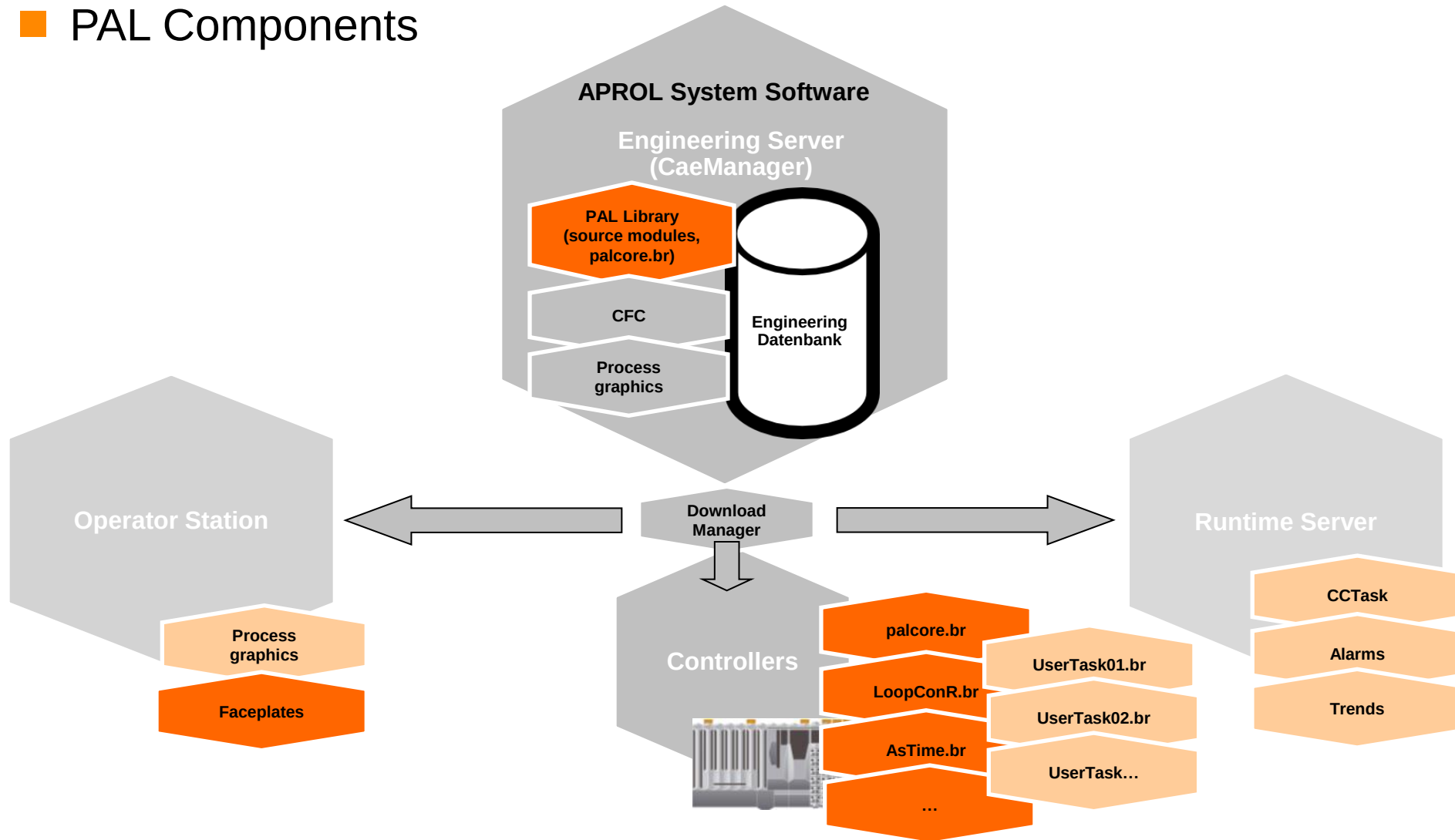




PAL Components



■ PAL Components





PAL

Control modules overview



- PAL Control Modules
 - Analog blocks
 - Analog01_01: Analog inputs or values (transmitter, ...)
 - Analog02_01: Analog inputs or values (transmitter, ...)
usage without Controller possible
 - AnalogHart01_01: Analog inputs of HART-modules
 - Bargraph01_01: Bargraph
 - Digital blocks
 - Digital01_01: Digital inputs or values
 - DigitalSeqOfEvt01_01 Fast digital inputs or values
 - Interlock blocks:
 - ILock01_01: Interlocking, 1 digital signal
 - ILock08_01: Interlocking, 8 digital signals
 - Input blocks
 - InputDINT01_01: Input block for signed integers
 - InputUDINT01_01: Input block for unsigned integers
 - InputLREAL01_01: Input block for decimal values



➤ PAL Control Modules

➤ Counter blocks

- Totalizer01_01: Counter UDINT (analog integrator or dig. pulses)
- Totalizer02_01: Counter LREAL (analog integrator or dig. Pulses)
- Totalizer03_01: Counter LREAL (count increments)
- Dose01_01: Dosing quantities
- OperationCouner01_01: Operations- and Operating time counter

➤ Energy Monitoring blocks

- EngyMonX20AP31XX01_02: Support of B&R X20-module for energy measurement (X20AP31xx)
- EngyMon01_01: Energy monitoring using signals from various sources
- TimeOfUseRate01_01: Time of use, tariff
- TimeOfUseRateSel01_01: Select rate from TimeOfUseRate
- LoadShed01_01: load shedding
- EnergyToPower01_01: Calculate power out of energy
- DegreeDay01_01: Heating degree days / Cooling degree days
- MetaDataInput01_01: Input of meta data for EnMon-Reports
- PowerCalculation01_01: Calculation of the enthalpy of water
- FlowCalculation01_01: Flow calculation according EN ISO 5167-1/2/3/4



➤ PAL Control Modules

➤ Motor blocks:

- Motor01_01: Motor, 1 direction (on, off)
- Motor02_01: Motor, 2 directions or 2 speeds
- MotorFcCw02_01: Motor, Frequency Converter, conv. Wiring
- MototFcBusPB01_01: Motor, Frequency Converter, PROFIBUS
- MototFcBusPLK01_01: Motor, Frequency Converter, POWERLINK
- MototFcBusPN01_01: Motor, Frequency Converter, PROFINET
- MotorScPB01_01: Motor, Simocode, 1 direction, PROFIBUS
- MotorScPN01_01: Motor, Simocode, 1 direction, PROFINET
- MotorScPB02_01: Motor, Simocode, 2 directions or 2 speeds, PROFIBUS
- MotorScPN02_01: Motor, Simocode, 2 directions or 2 speeds, PROFINET



➤ PAL Control Modules

➤ Valve blocks

- Valve01_01: Valve (open, close)
- Valve02_01: Valve (open, stop, close)
- ValveAnalog01_01: Analog valve (1x ana out, 1x ana in)
- ValveMotor01_01: Motor controlled valve (3x dig out, 1x ana in)
- ValveScPB01_01: Valve, Simocode (open, close), PROFIBUS
- ValveScPN01_01: Valve, Simocode (open, close), PROFINET
- ValveScPB02_01: Valve, Simocode (open, stop, close), PROFIBUS
- ValveScPN02_01: Valve, Simocode (open, stop, close), PROFINET



➤ PAL Control Modules

➤ Controller blocks

- Controller01_01: PID controller, algorithm B&R LoopConR
- Controller2Pos01_01: Controller, 2 positions, discontinuous
- Controller3Pos01_01: Controller, 3 positions, discontinuous
- Mpc01_01: Model based predictive control 1x1x1
- Mpc10_01: Model based predictive control 10x10x10

➤ Advanced control blocks

- AutoTunePID01_01: Autotuning for PID controller
- ControlSmithPredict01_01: Smith predictor
- ControlPerformanceMonitor01_01: Controller performance monitoring
- LookUpTable01_01: Interpolation of a table of values
- GainSched01_01: Gain scheduling
- SignalFilter01_01: Apply different kinds of filters on signals
- SignalGenerator01_01: Generate different kinds of signal (sinus, rect. ...)
- SplitRange01_01: Split range (one input -> 2 outputs)



➤ PAL Control Modules

➤ Controller add on blocks

- ControlArithmetics01_01: Arithmetic calculation
- ControlCompare01_01: Compare
- ControlComplement01_01: Complement
- ControlDeadTime01_01: Dead time
- ControlMultiplex01_01: Multiplex
- ControlDemultiplex01_01: Demultiplex
- ControlLatch01_01: Latch
- ControlLeadLag01_01: Lead lag
- ControlMinMax01_01: Min/Max-selector
- ControlTransferFct01_01: Transfer function



- PAL Control Module
 - Auxiliary blocks
 - NavigationBar01_01: Navigation in process graphics
 - Sequential Flow Charts
 - SfcOperate01_01: block for operation with SFCs
 - Fieldbus communication
 - MbusMaster01_01: block for operation of an M-Bus master
 - MbusSlave01_01: block for operation of M-Bus slaves
 - Condition Monitoring
 - ConditionMonitor01_01: support of B&R X20 module for vibration measurement (X20CM4810))
 - Pulses
 - PulseFrequencyModulation01_01: PFM
 - PulseWidthModulation01_01: PWM



PAL

Control modules

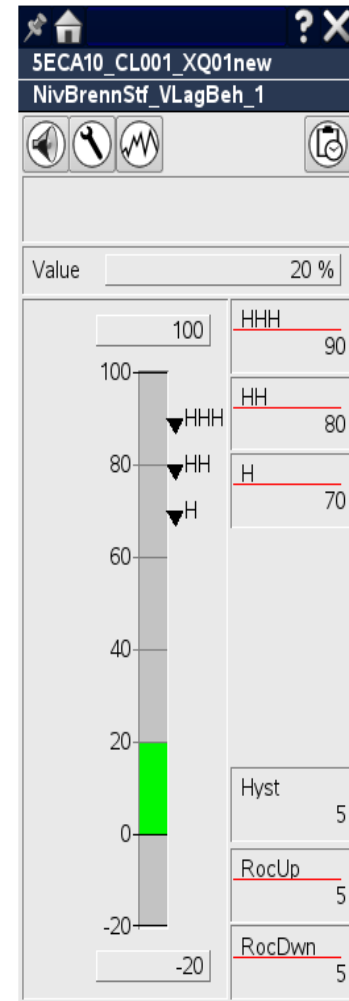
in detail



Analog

➤ Analog01_01, Analog02_01

- **Analog inputs, analog values**
- Limit monitoring
- Scaling
- Filter (only Analog01_01)
- Dummy
- Visualization, Bargraph, Trends
- Alarms
- See Bausteindoku/analog01_01/analog01_01_eng.htm
- Exercise :
 - Use the block according documentation
 - Connect hardware analog input to the block
 - Connect the output value to a hardware analog output
 - Add the hypermacro Bargraph01_01 to your project

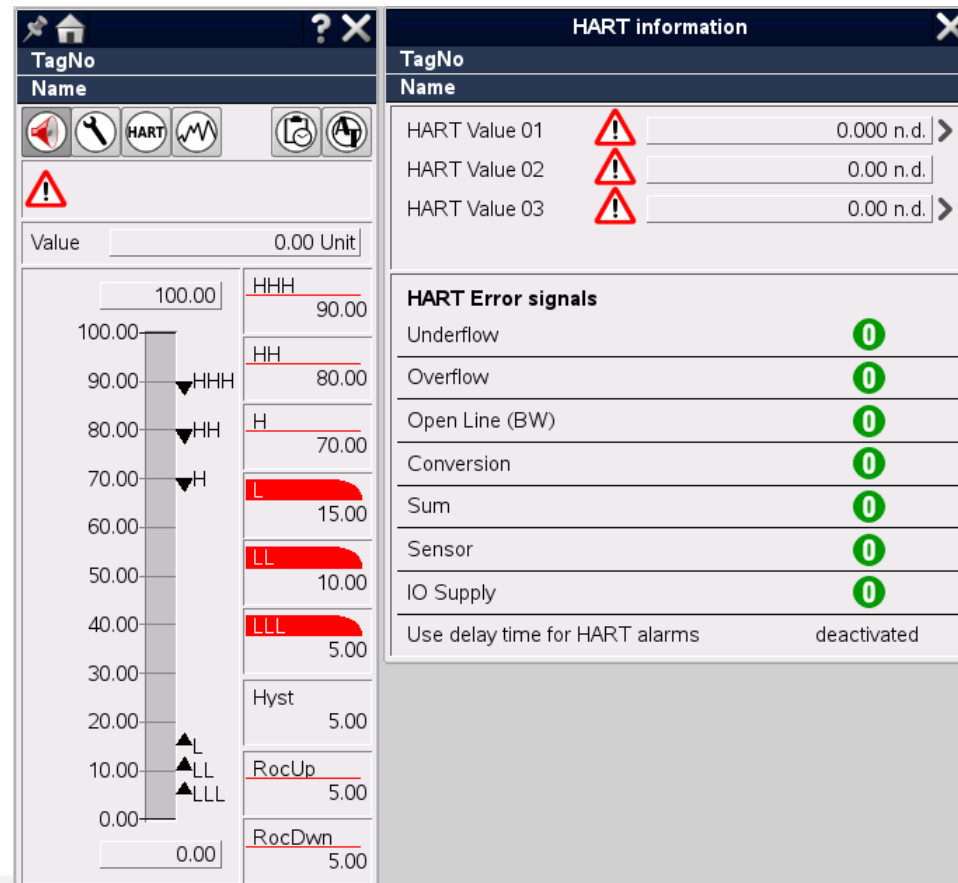




Analog

➤ AnalogHart01_01

- Analog inputs, analog values, additional HART-values
- Standard features like Analog01_01
- Additional display up to 4 HART values

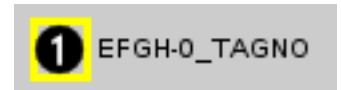




Digital

➤ Digital01_01

- **Digital inputs, digital values**
- Normalization
- Time Delay
- Latch
- Bridge
- Visualization, Trends
- Alarms
- See [Bausteindoku\digital01\digital01_eng.htm](#)
- Exercise:
 - Use the block according documentation
 - Connect hardware digital input to the block
 - Connect the output value to a hardware digital output
 - Test the features





Digital

➤ DigitalSeqOfEvt01_01

- **Fast digital inputs, digital values**
- Support X20DS4389
(Fast input scanner 250µs)
- See also Digital01_01
- See [Bausteindoku\digitalsoe01\digitalsoe01_eng.htm](#)

1 EFGH-0_TAGNO

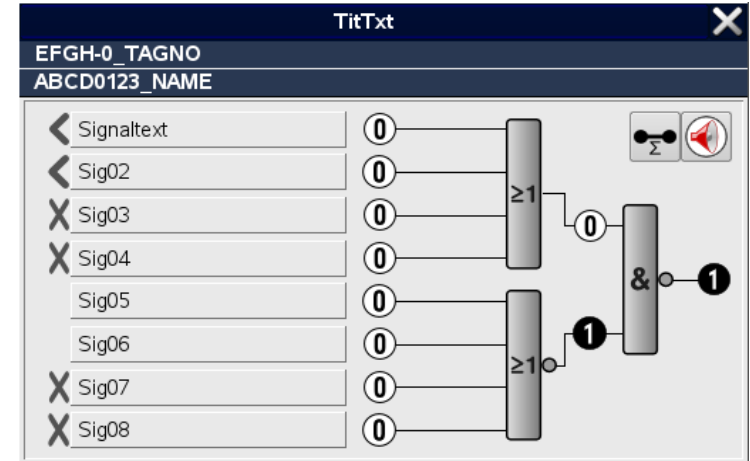




Interlock

➤ ILock08_01

- **Interlocking** of 8 digital signals
- Bridge
- Logical combinations
- Bridge
- Visualization
- Alarms
- See Bausteindoku/ilock08/ilock08_eng.htm
- Exercise:
 - Use the block according documentation
 - Connect hardware digital inputs to the block
 - Connect the output value to a hardware digital output
 - Test the features



1 EFGH-0_TAGNO

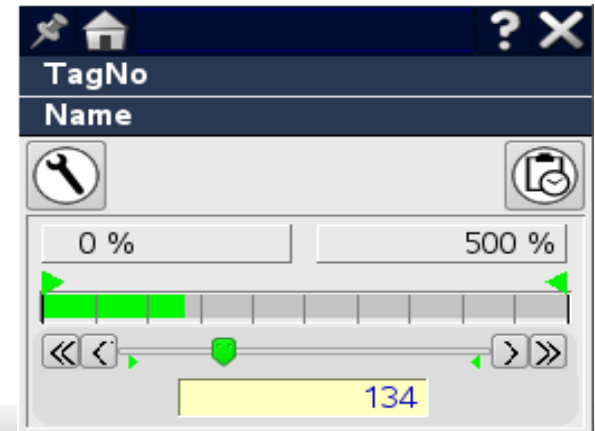


Input

➤ InputUDINT01_01 (InputLREAL01_01, InputDINT01_01)

- **Input** of an UDINT value (unsigned integer)
- Range limiting
- Input via Slider or IOBox
- Visualization, Bargraph
- Further implemented:
 - InputLREAL01_01 for floating point values
 - InputDINT01_01 für signed integer values
- Exercise:
 - Use the block according documentation
 - Connect the output value to a hardware analog output
 - Test the features

134 %
TagNo

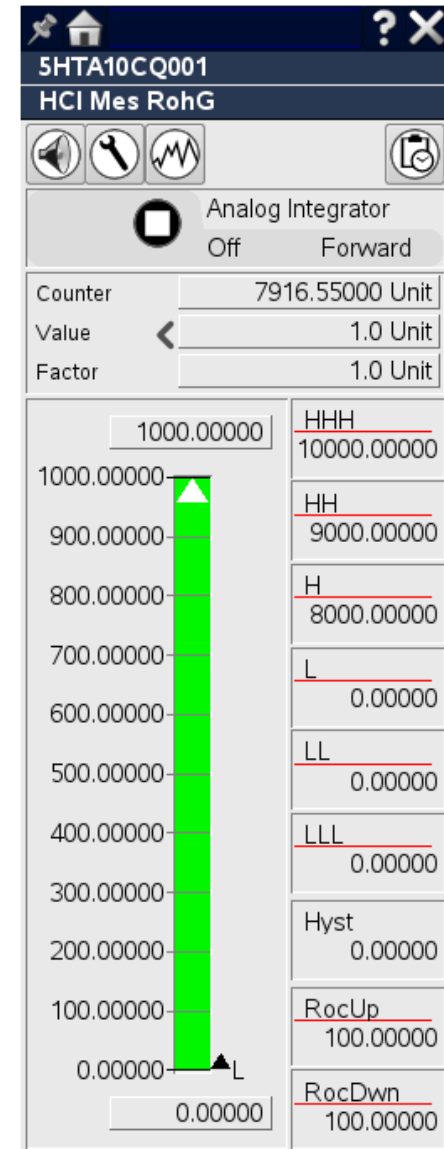




Counter

➤ Totalizer02_01

- **Counter (analog integrator, pulse counter)**
- Limit monitoring
- Scaling
- Dummy
- Visualization, Bargraph, Trends
- Alarms
- See Bausteindoku/totalizer01/totalizer01_eng.htm
- Exercise :
 - Use the block according documentation
 - Configure the block as analog integrator
 - Connect hardware analog input to the block
 - Test the features

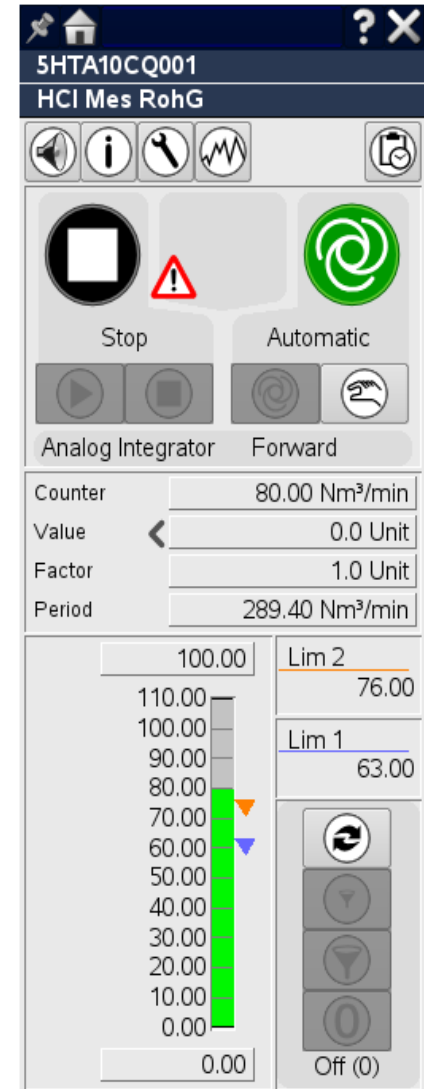




Counter

➤ Dose01_01

- **Dosing of quantities**
- Counter (analog integrator, pulse counter)
- Control of dig. Outputs: Coarse dosing / Fine dosing
- Leakage monitoring
- Dummy
- Visualization, Bargraph, Trends
- Alarms
- See Bausteindoku/dose01/dose01_eng.htm
- Exercise :
 - Use the block according documentation
 - Configure the block as pulse counter
 - Connect hardware digital input to the block
 - Test the features





Counter

➤ OperationCounter01_01

- **Operation- and Operating time counter**
 - Monitoring of operations for command 0, command 1 and the sum
 - Monitoring of operating time for command 0, command 1 and the sum
 - Display of remaining operations and remaining operating time

Operating time counters	
TagNo	Name
Command 0 Command 1 Sum	
Reset all operating time counter ✓	
Operations counters	
TagNo	Name
Command 0 Command 1 Sum	
Reset all operations counter ✓	
limit 1 12.00 h	
Remaining time limit 2 24.00 h	
limit 3 48.00 h	
Remaining operations 20	
Time Cmd0 to Fb0 0s	
Command 1 limit 1 12.00 h	
Remaining time limit 2 24.00 h	
limit 3 48.00 h	
Remaining operations 20	
Time Cmd1 to Fb1 0s	
Sum limit 1 12.00 h	
Remaining time limit 2 24.00 h	
limit 3 48.00 h	
Remaining operations 20	

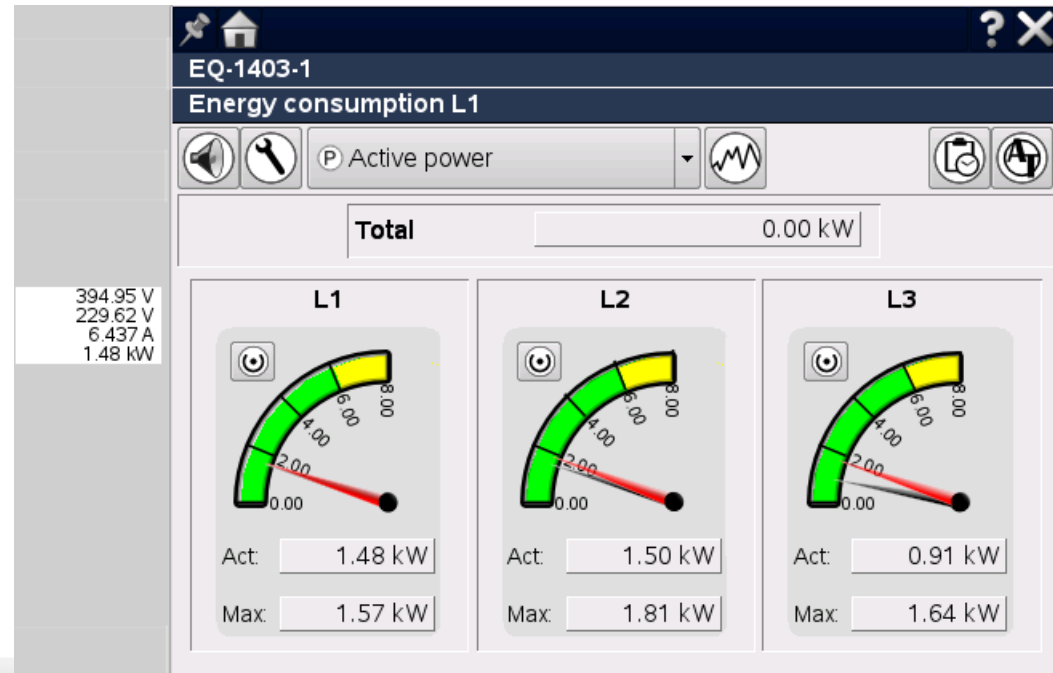
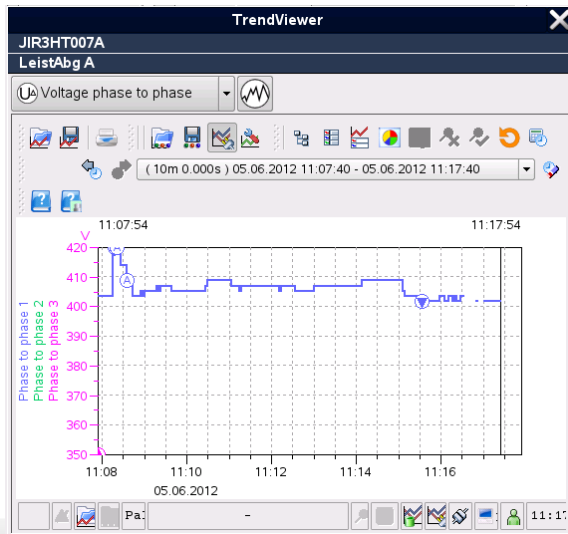
Configuration Command 0	
TagNo	Name
✓ Absolute Open (1) Set counter 0 ✓	
✓ Interval Open (1) Set counter 0 ✓	
Limit	Internal 0 External 0
Configuration Command 1 TagNo Name	
✓ Absolute Set counter 0.00 h ✓	
✓ Interval 1 Set counter 0.00 h ✓	
Limit	Internal 12.00 h External 0.00 h
✓ Interval 2 Set counter 0.00 h ✓	
Limit	Internal 24.00 h External 0.00 h
✓ Interval 3 Set counter 0.00 h ✓	
Limit	Internal 48.00 h External 0.00 h



EnergyMon

➤ EngyMonX20AP31XX01_01

- support of **B&R** energy measurement module X20AP31xx
- 1-3 phases, 480VAC
- voltage, current, active power, reactive power, apparent power, power factor, frequency, ...
- configurable alarm limits
- trailing pointer (maximum value display)
- set / reset counters
- trends

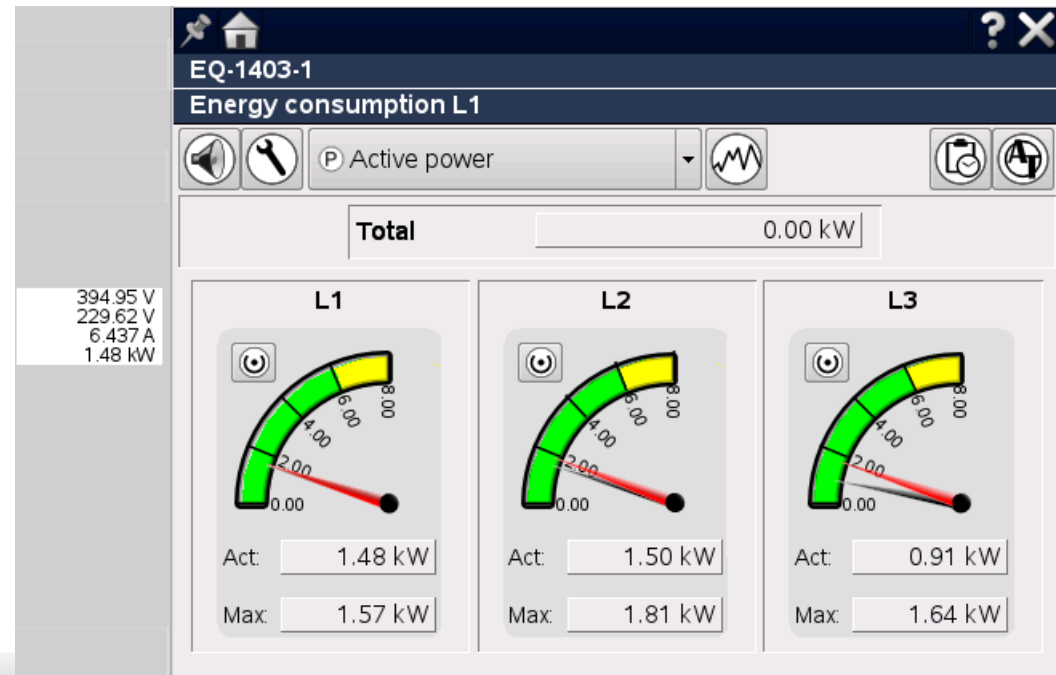
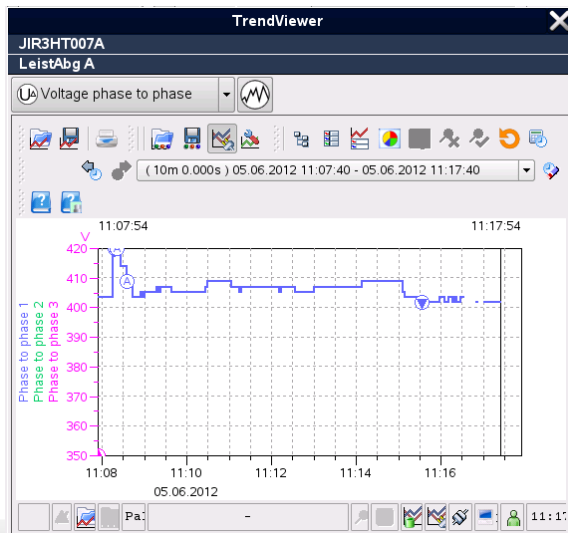




EnergyMon

➤ EngyMon01_01

- support external modules and bus systems
- 1-3 phases, 480VAC
- voltage, current, active power, reactive power, apparent power, power factor, frequency, ...
- configurable alarm limits
- trailing pointer (maximum value display)
- set / reset counters
- trends





EnergyMon

➤ TimeOfUseRate01_01

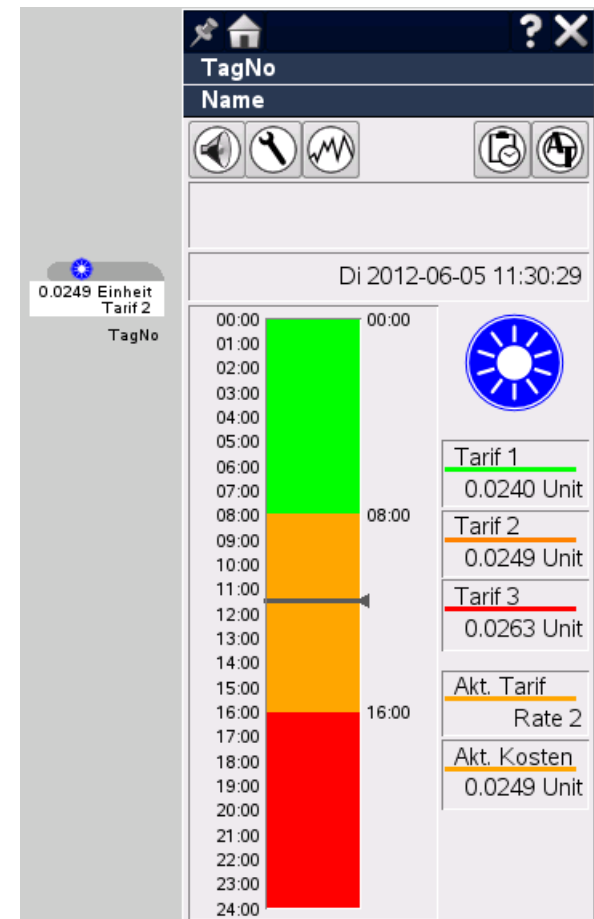
- Time of use rate
- selection of the actual tariff depending on:
 - summer/winter season
 - holiday
 - time

Parameter Konfiguration

TagNo	Name	Icon
Tarif 1	[Unit] 0.0240	☒ Intern ☐ Extern 0.0000
Tarif 2	[Unit] 0.0249	☒ Intern ☐ Extern 0.0000
Tarif 3	[Unit] 0.0263	☒ Intern ☐ Extern 0.0000
Start Sommersaison	☒ Intern ☐ Extern 0000	1 April
Start Wintersaison	☒ Intern ☐ Extern 0000	1 October

Configuration Summer

Von	To	Rate
00:00	08:00	Tarif 1
08:00	16:00	Tarif 2
16:00	24:00	Tarif 3





EnergyMon

- DegreeDay01_01
 - Calculation heating degree day, cooling degree days
 - Used for energy monitoring

The screenshot displays two overlapping windows from the PAL Control Modules software. The background window is titled 'DGDYW305 DegreeDay' and features a toolbar with icons for home, help, and various data visualization functions. It shows a 'Hdd' button and a table with 8 rows of data. The foreground window is titled 'Temperatures' and displays 'Average temperature' as -68.65 °C, 'Average calculation method' as 24 values, and 'Actual temperature' as -24.40 °C. It also includes a table with 4 columns: Time, yesterday[°C], and today[°C], showing hourly temperature data for the last 24 hours.

No	Parameter[°C]	Hdd[K]
01	19.0	87.65
02	19.0	87.65
03	19.0	87.65
04	19.0	87.65
05	19.0	87.65
06	21.0	89.65
07	20.0	88.65
08	20.0	88.65

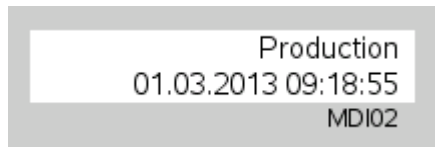
Time	yesterday[°C]	today[°C]
00:00	75.55	-68.65
01:00	-29.38	-89.93
02:00	-50.65	-28.92
03:00	10.35	-72.84
04:00	-94.57	70.45
05:00	84.15	49.17
06:00	-7.08	-77.03
07:00	-29.26	-98.31
08:00	-50.54	-3.23



EnergyMon

➤ MetaDataInput01_01

- **Input** of meta data for historical saved values
- Range limiting
- Save to pins by pressing button
- Restore old values after wrong input



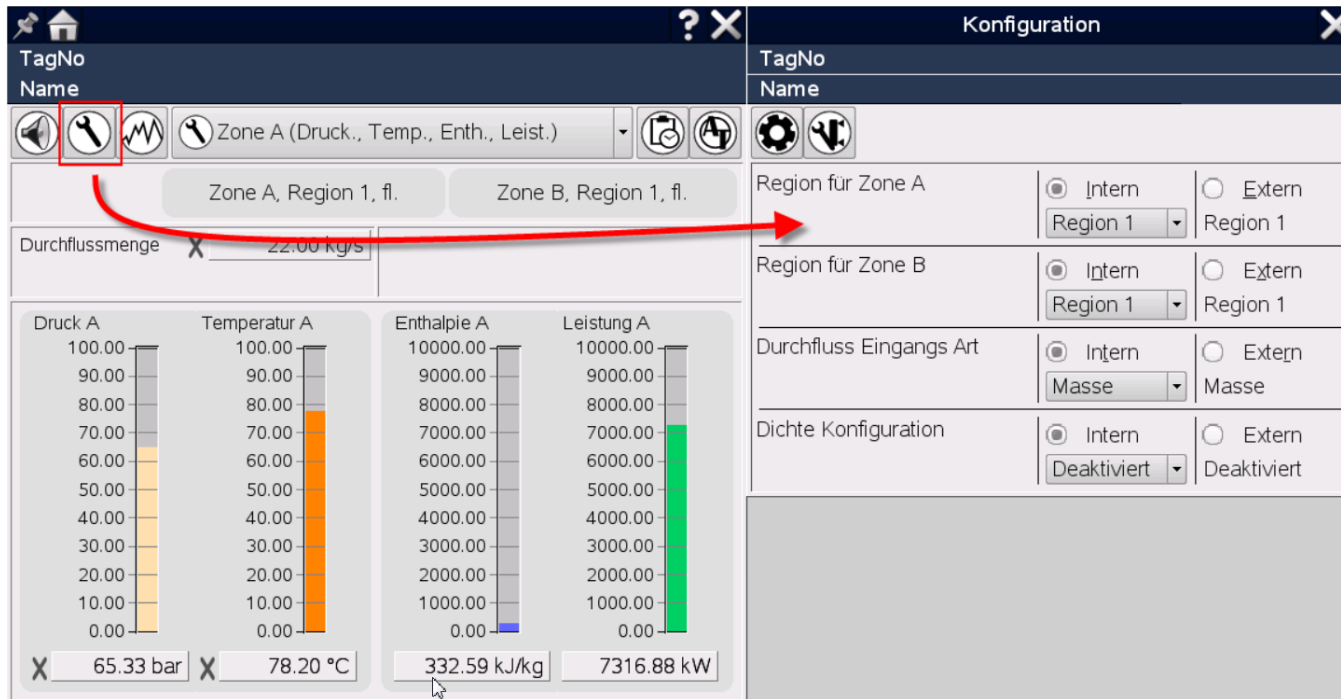
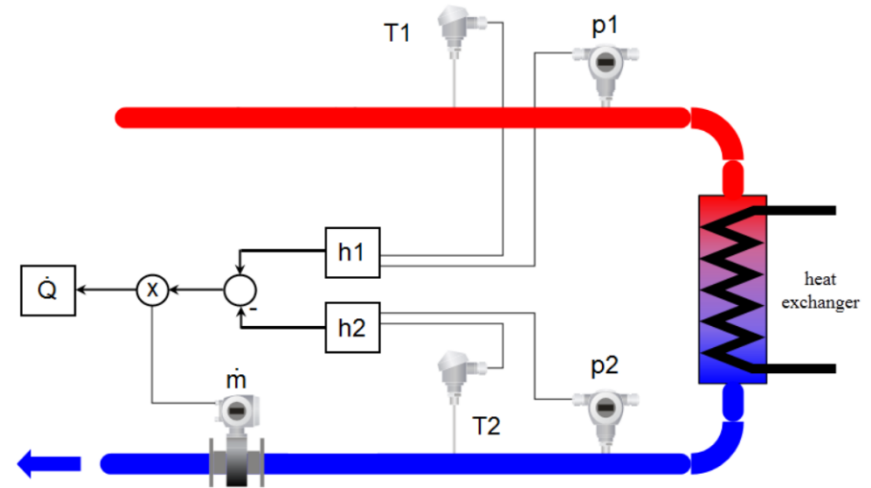
Name	Wert	Status
CntNo	CntNo	
ObjDesc	ObjDesc	
ObjCmnt	ObjCmnt	
ObjPers	ObjPers	
ObjPersCnt	0	
ObjArea	0.0	
ObjAreaUnit	ObjAreaUnit	
ObjDir	ObjDir	



EnergyMon

➤ PowerCalculation01_01

- Enthalpy of water steam
- According IAPWS-IF97

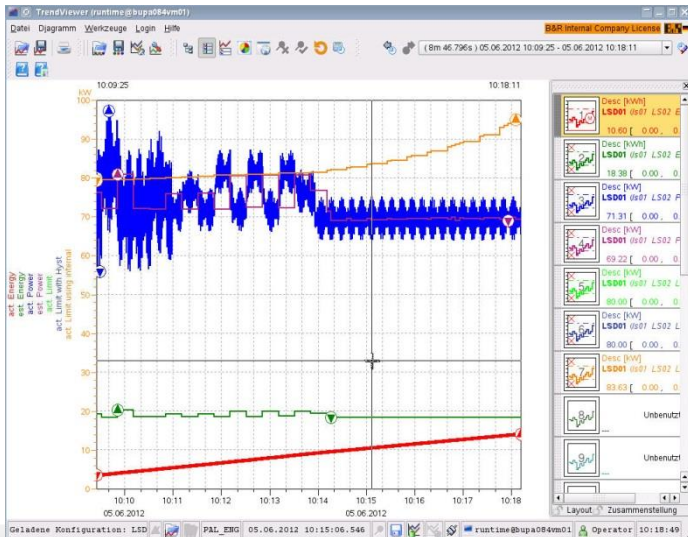




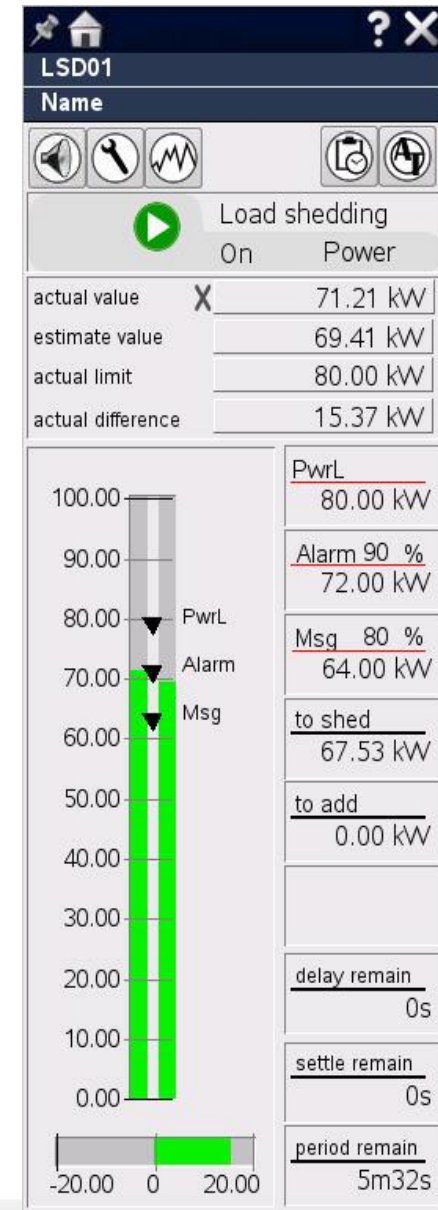
EnergyMon

➤ LoadShed01_01

- load shedding
- monitor power or energy
- switch off /on according priority list
- max. 10 loads
- possible to cascade
- alarms
- trends



Analog configuration									
LSD01									
Name									
actuell value	67.84 kW	actual limit	80.00 kW	estimate value	69.63 kW				
	enable Shed	Cmd	On	actual Power	nominal	Prio	Roll		
Csr01Name	☐ Internal disabled	☒ External enabled	1	1	5.00 kW	5.00 kW	1	0	
Csr02Name	☐ Internal enabled	☒ External enabled	1	1	4.90 kW	5.00 kW	2	0	
Csr03Name	☐ Internal enabled	☒ External enabled	0	1	2.15 kW	5.00 kW	3	0	
Csr04Name	☐ Internal enabled	☒ External enabled	0	1	2.20 kW	5.00 kW	4	0	
Csr05Name	☐ Internal enabled	☒ External enabled	1	1	3.54 kW	5.00 kW	5	0	
Csr06Name	☐ Internal enabled	☒ External enabled	1	0	-0.15 kW	10.00 kW	6	0	
Csr07Name	☐ Internal enabled	☒ External enabled	1	1	11.60 kW	10.00 kW	6	1	
Csr08Name	☐ Internal enabled	☒ External enabled	1	1	11.20 kW	10.00 kW	6	2	
Csr09Name	☐ Internal enabled	☒ External enabled	1	1	13.90 kW	10.00 kW	9	0	
Csr10Name	☐ Internal disabled	☒ External enabled	1	1	13.50 kW	10.00 kW	10	0	





Motor

➤ Motor01_01

- **Motor control, 1 directions or 1 speed**
- Digital Feedbacks
- Feedback monitoring
- Safe position
- Visualization, Trends
- Alarms
- See Bausteindoku/motor01/motor01_eng.htm
- Exercise :
 - Use the block according documentation
 - Connect hardware digital inputs to the feedback inputs
 - Connect block output to hardware digital output
 - Test the features





Motor

➤ Motor02_01

- **Motor control, 2 directions or 2 speeds**
- Digital Feedbacks
- Feedback monitoring
- Safe position
- Visualization, Trends
- Alarms
- See Bausteindoku/motor02/motor02_eng.htm
- Exercise :
 - Use the block according documentation
 - Connect hardware digital inputs to the feedback inputs
 - Connect block output to hardware digital output
 - Test the features





Motor

➤ MotorFcCw02_01

- Motor control with **frequency converter**
- connected via **conventional wiring**
- Set value for rpm
- Digital Feedbacks
- Feedback monitoring
- Safe position
- Visualization, Trends
- Alarms

Configuration

34A502.13.XA-1
Entleer.Pump.Austr.Kam

	Delay	Elapsed
Feedback 0	5m5s	0s
Feedback 1	5m5s	0s
Feedback 2	5m5s	0s
Restart	4ms	52ms

Safe position Off (0)

W configuration

34A502.13.XA-1
Entleer.Pump.Austr.Kam

W max	☐ Internal	☒ External
[U/min]	1230	1200
W min	☐ Internal	☒ External
[U/min]	23	100

34A502.13.XA-1
Entleer.Pump.Austr.Kam

Internal Manual

Ext Int

1500

X
0 U/min

W
100 U/min

W internal
0 U/min

W external
23 U/min

0

Off (0) 37 A

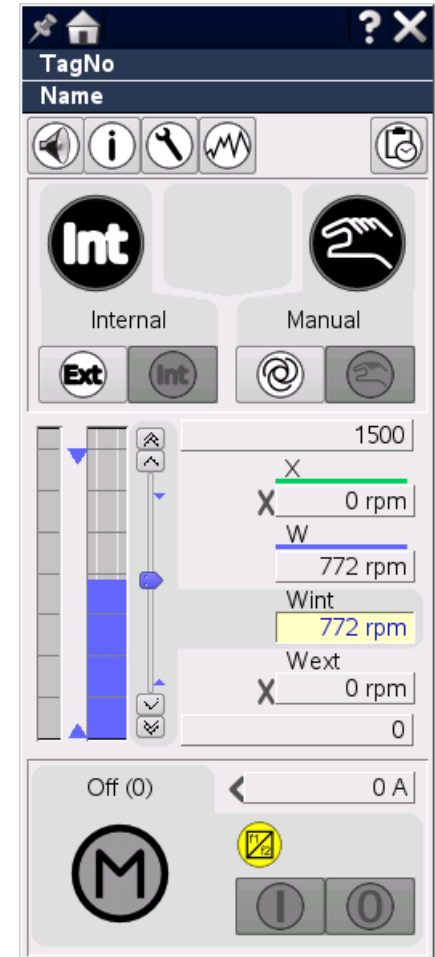
M

0



Motor

- MotorFcBusPLK01_01
- MotorFcBusPB01_01
- MotorFcBusPN01_01
 - Motor control with **frequency converter**
 - **POWERLINK, PROFIBUS DP, PROFINET**
 - PROFIdrive profile
 - 2 directions or 2 speeds
 - Parameter transfer via DP-V1
 - Set value for rpm
 - Digital feedbacks
 - Feedback monitoring
 - Operation time counter, operations counter
 - Safe position
 - Visualization, Trends
 - Alarms





Motor

- MotorScPB01_01
- MotorScPN01_01
 - **Motor control, 1 directions or 1 speeds**
 - **Simocode** motor control functions
(direct starter, star/delta starter, circuit breaker)
 - connected via **PROFIBUS DP, PROFINET**
 - Digital Feedbacks
 - Feedback monitoring
 - Safe position
 - Visualization, Trends
 - Alarms





Motor

- MotorScPB02_01
- MotorScPN02_01
 - **Motor control, 2 directions or 2 speeds**
 - **Simocode** motor control functions
(reversing starter, star/delta reversing dahlander, pole-changing starter)
 - connected via **PROFIBUS DP, PROFINET**
 - Digital Feedbacks
 - Feedback monitoring
 - Safe position
 - Visualization, Trends
 - Alarms





Valves

➤ Valve01_01

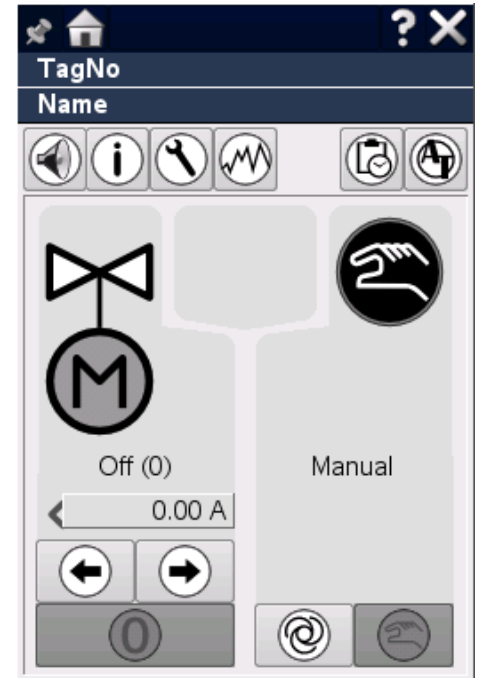
- **Valve control** (open, close)
- 4 digital Feedbacks
- Feedback monitoring
- Safe position
- Visualization, Trends
- Alarms
- See Bausteindoku/valve01/valve01_eng.htm
- Exercise :
 - Use the block according documentation
 - Connect hardware digital inputs to the feedback inputs
 - Connect block output to hardware digital output
 - Test the features





Valves

- Valve02_01
 - **Valve control** (open, stop, close)
 - 4 digital Feedbacks for the end position
 - 3 digital Feedbacks for the operation
 - Feedback monitoring
 - Safe position
 - Visualization, Trends
 - Choose different device symbols
(Valve + Motor, Valve only, Motor only)
 - Alarms
 - See Bausteindoku/valve02/valve02_eng.htm

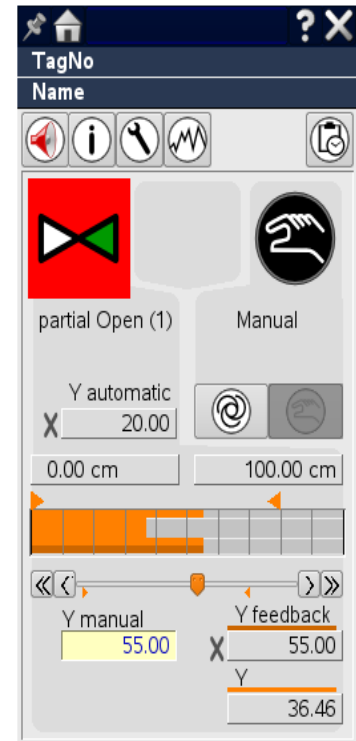




Valves

➤ ValveAnalog01_01

- Valve control (analog output)
- Analog adjuster
- Analog and digital Feedbacks
- Feedback monitoring
- Switch between automatic and manual control value
- Safe position
- Control value ramp
- Control value deviation monitoring
- Visualization, Bargraph, Trends
- Alarms
- See Bausteindoku/valveanalog01/valveanalog01_eng.htm
- Exercise :
 - Use the block according documentation
 - Connect hardware analog input to the feedback input
 - Connect block output to hardware analog output
 - Test the features

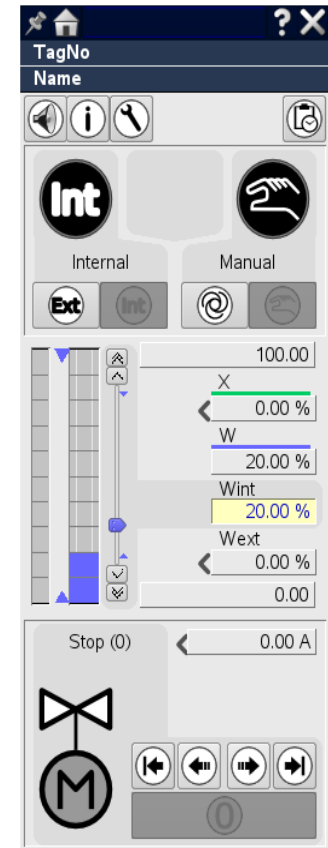
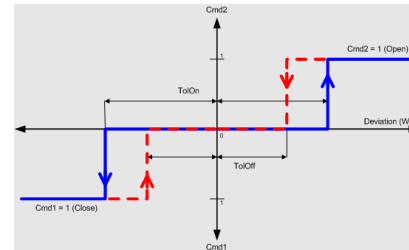




Valves

➤ ValveMotor01_01

- **Valve control (via motor and digital outputs)**
- Analog and digital Feedbacks
- Feedback monitoring
- **Three position control**
- Safe position
- Visualization, Bargraph, Trends
- Alarms
- See Bausteindoku/valvemotor01/valvemotor01_eng.htm
- Exercise :
 - Use the block according documentation
 - Connect hardware analog input to the feedback input
 - Connect block output to hardware digital output
 - Test the features





Valves

- ValveScPB01_01
- ValveScPN01_01
 - **Valve control** (open, close)
 - **Simocode** motor control functions (Valve)
 - connected via **PROFIBUS DP, PROFINET**
 - Digital Feedbacks
 - Feedback monitoring
 - Safe position
 - Visualization, Trends
 - Alarms
 - See Bausteindoku/valvesc01/valvesc01_eng.htm





Valves

- ValveScPB02_01
- ValveScPN02_01
 - **Valve control** (open, stop, close)
 - **Simocode** motor control functions (Positioner)
 - connected via **PROFIBUS DP, PROFINET**
 - Digital Feedbacks for the end position
 - Digital Feedbacks for the operation
 - Feedback monitoring
 - Safe position
 - Visualization, Trends
 - Choose different device symbols (Motor, Valve only, Motor only)
 - Alarms
 - See Bausteindoku/valvesc02/valvesc02_eng.htm



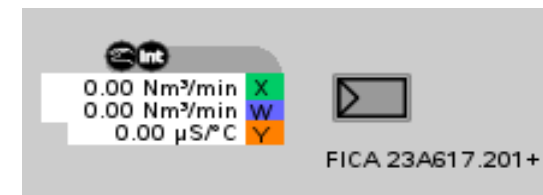
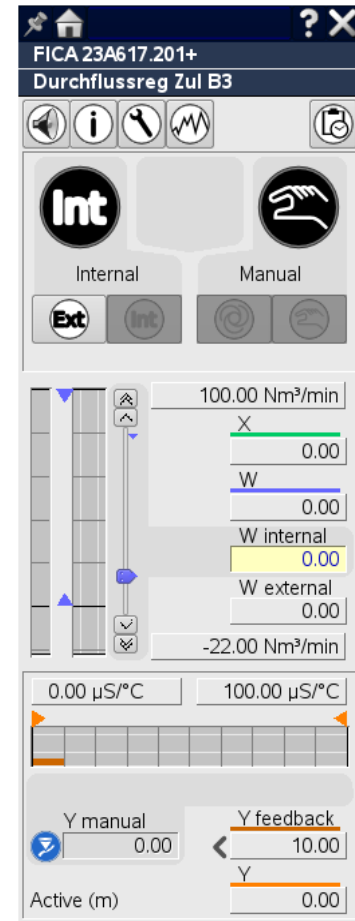
(Valve +



Control

➤ Controller01_01

- **PID controller**
- algorithm from B&R LoopConR
- Safe position
- Set value ramp
- Control value ramp
- Deviation monitoring
- Cascading functionality
- Tracking of Y to YMan
- Tracking of WExt to WInt
- Visualization, Bargraph, Trends
- Alarms
- See Bausteindoku/controller01/controller01_eng.htm
- Exercise :
 - Use the block according documentation
 - Test the features

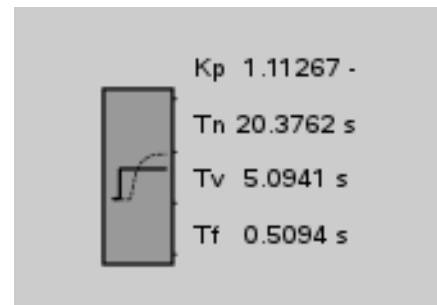
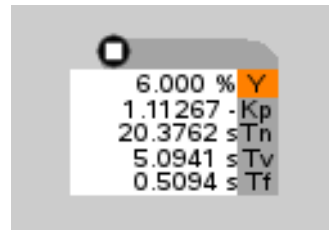




Control

➤ AutoTunePID01_01

- Automatic tuning for PID controller
- Calculation of the PID control parameter
- 2 different tuning methods implemented
 - Oscillating tuning
 - Step tuning



TagNo
Name

Step

Play button

X 74.8 %
W 89.8 %
Y 45.000 %

Tuning quality 0.00000 %

Tuning results	Outputs
Proportional gain 0.00000 -	1.11267 -
Integration time 0.0000 s	20.3762 s
Derivative time 0.0000 s	5.0941 s
Filter time 0.0000 s	0.5094 s

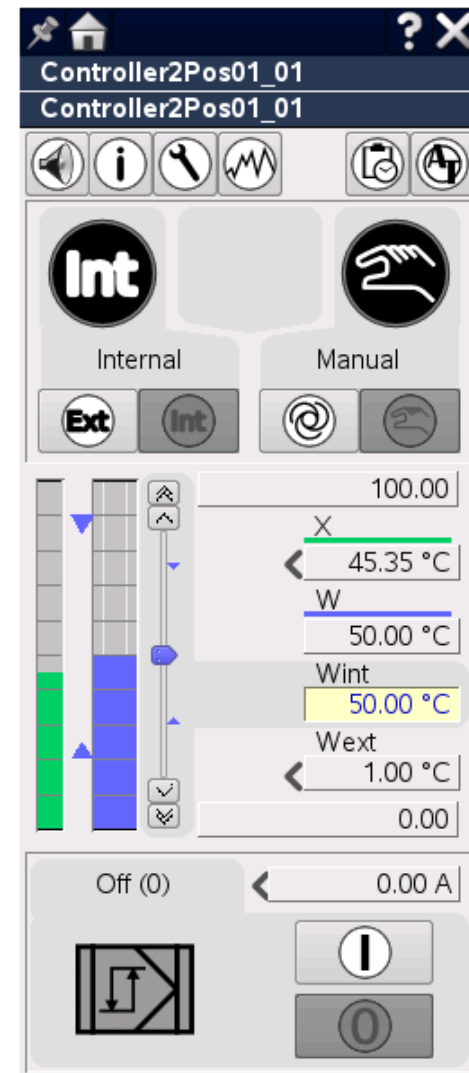
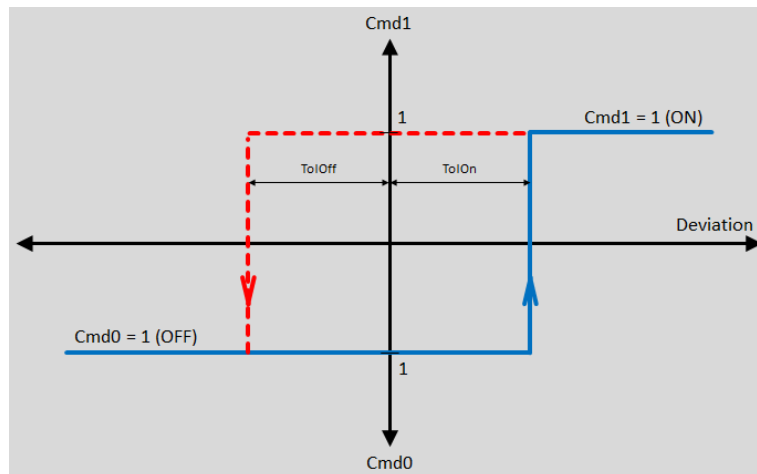
Checkmark button



Control

➤ Controller2Pos01_01

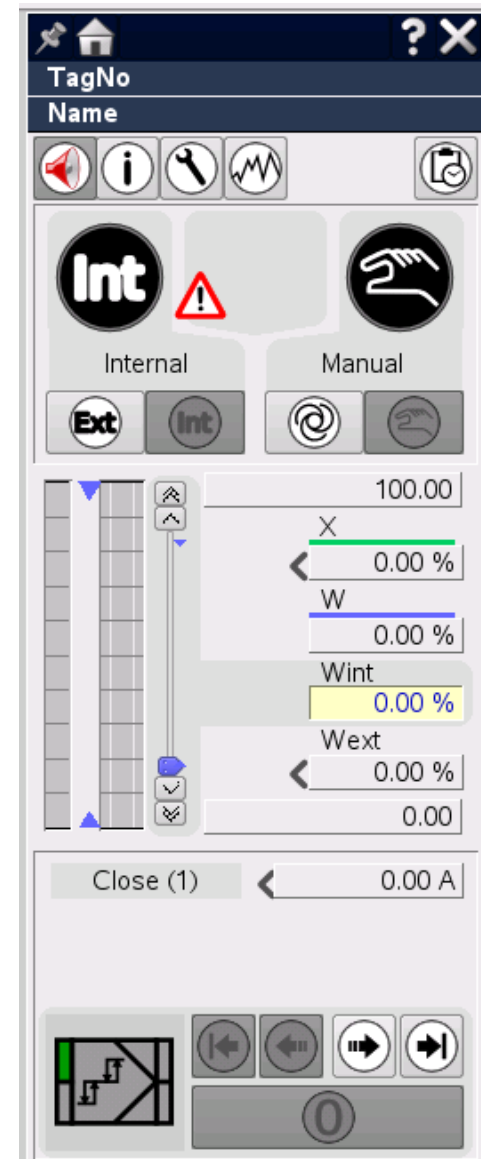
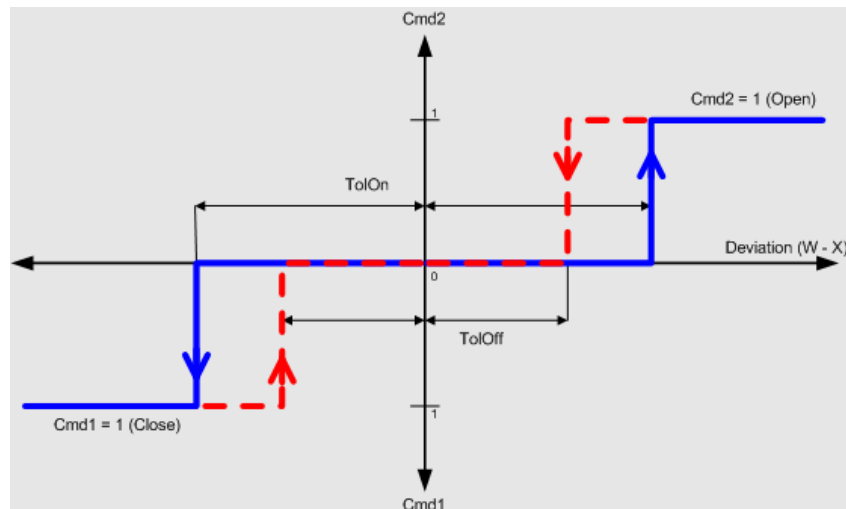
- 2 position controller
- Safe position
- Deviation monitoring
- Visualization, Bargraph, Trends
- Alarms





Control

- **Controller3Pos01_01**
 - **3 position controller**
 - Safe position
 - Deviation monitoring
 - Visualization, Bargraph, Trends
 - Alarms
 - Exercise :
 - Use the block according documentation
 - Test the features

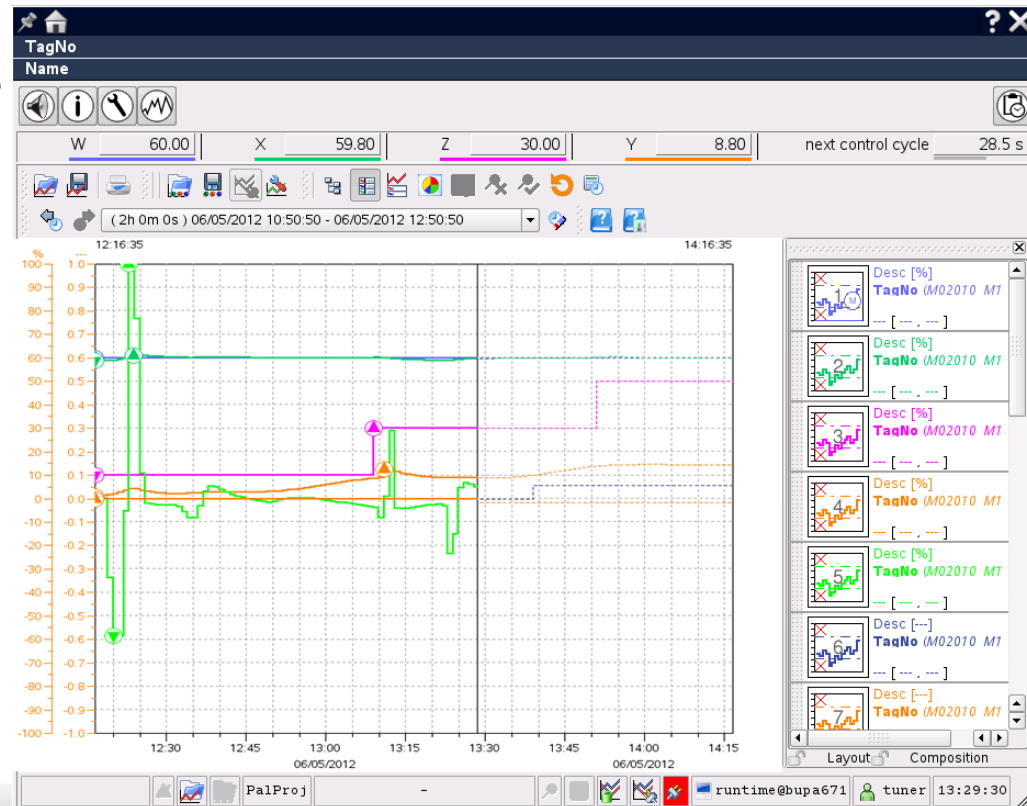
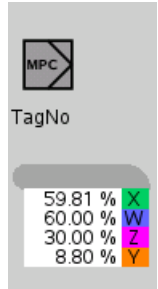




Control

➤ Mpc01_01

- **Model based predictive control**
- Input system dynamics via trajectories for Y,Z step responses
- MPC1x1x1
 - 1 control value
 - 1 disturbance value
 - 1 manipulated variable
- input
 - Set value trajectory
 - Disturbance value
- prediction
 - Manipulated var. traj.
 - Actual value trajectory

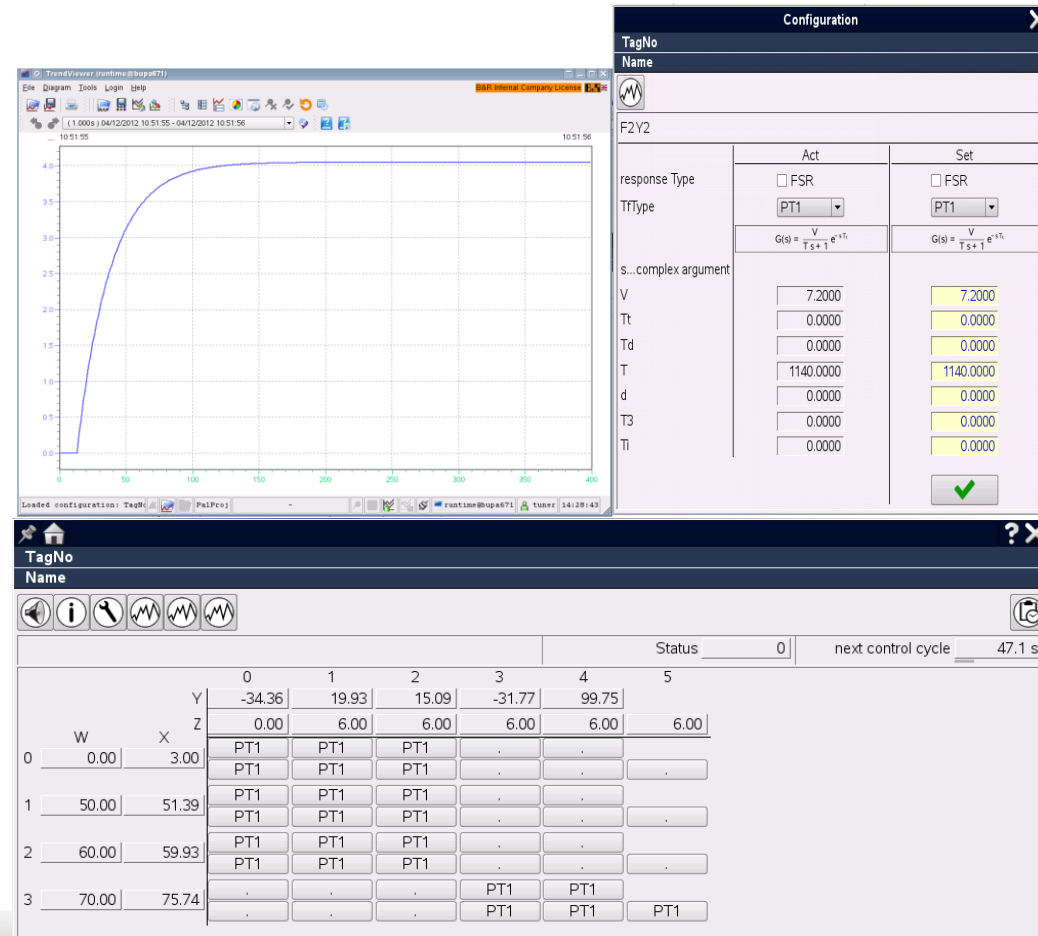
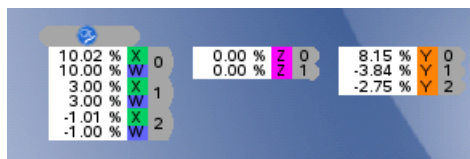




Control

➤ Mpc10_01

- **Model based predictive control**
- Input system dynamics with transfer functions
- MPC10x10x10
 - max. 10 control values
 - max. 10 disturbances
 - max. 10 manipulated var.
- input
 - Set value trajectories
 - Disurbance trajectories
- prediction
 - Manipulated var. Traj.
 - Actual val. trajectories

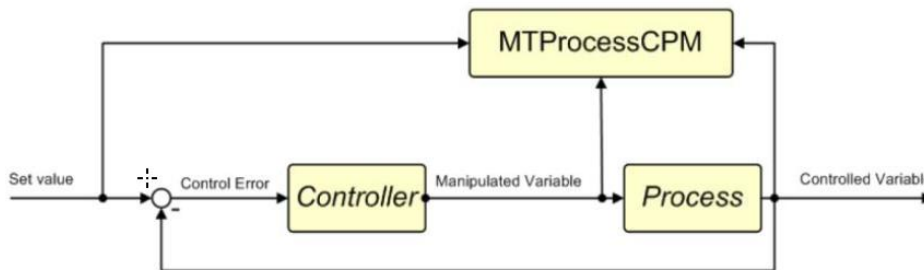




Control APC

➤ ControlPerformanceMonitor01_01

- **Control quality measurement**
- Calculate characteristic data



TagNo
Name

active Data collection 100 %

PID controller mode Automatic Set value (W) 30.000 %
Manipulated value (Y) 0.000 %
Controlled value (X) 0.072 %

Performance

Item	Value	Unit
MVI	✓ 0.965	
CPI reference	0.000	
CPI	✓ 0.000	

30.000
0.000
0.072

CPM

0.965



Control APC

➤ LookUpTable01_01

- Linear interpolation of a table of values
- 1 dimension

Configuration

TagNo: [] Name: []

Calculation mode out of range: Linear extrapolator

Number of nodes: 7

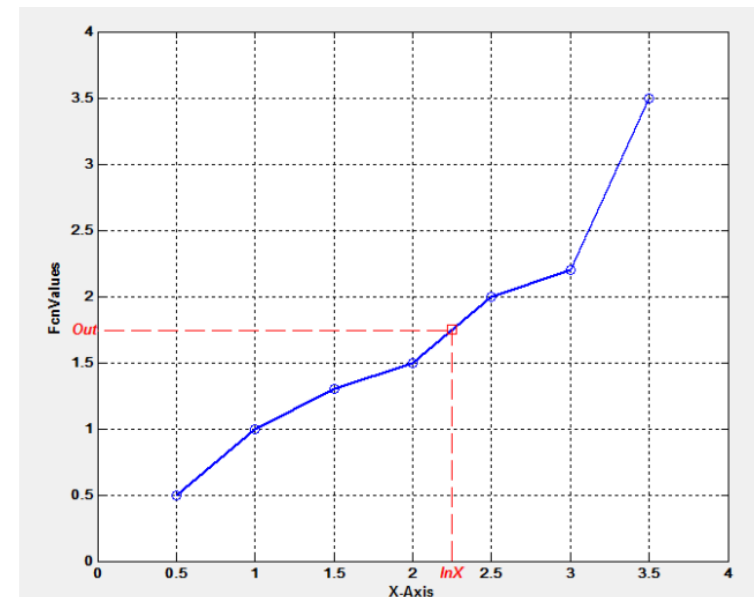
Node	NodeVector	FunctionValue
1	0.5	0.5
2	1.0	1.0
3	1.5	1.3
4	2.0	1.5
5	2.5	2.0
6	3.0	2.25
7	3.5	3.5

Value IN: 3.00 °C

Manual OUT: 2.44 mBar

Auto OUT: 2.25 mBar

Value OUT: 2.25 mBar





Control APC

➤ GainSched01_01

- Continuous adjustment of PID parameter values
- PID parameter sets that are dependent on working points can be used to control systems with non-linearity

Configuration

TagNoGainSched
NameGainSched

Number of nodes: 3

Node	Input	Kp [1]	Tn [s]	Tv [s]
1	0.0	1.0	200.0	90.0
2	50.0	1.2	180.0	100.0
3	100.0	1.6	175.0	100.0

Input: 24.55 mBar

Auto

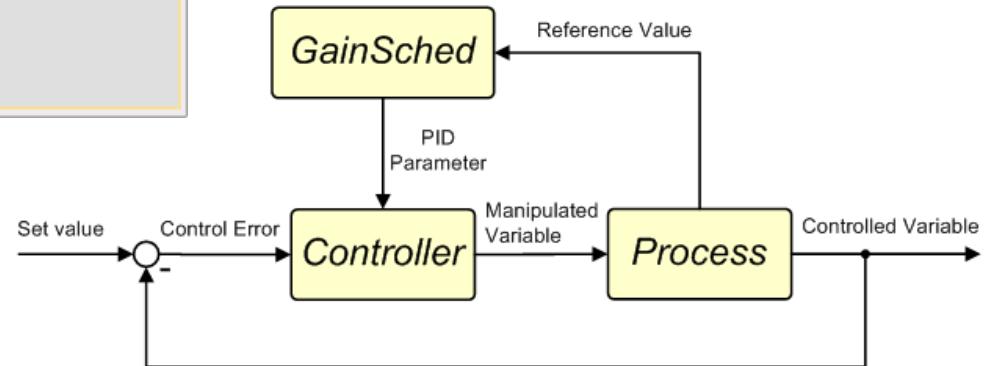
Kp [1]: 1.10
Tn [s]: 190.18
Tv [s]: 94.91

Manual

Kp [1]: 1.00
Tn [s]: 0.00
Tv [s]: 0.00

Output

Kp [1]: 1.10
Tn [s]: 190.18
Tv [s]: 94.91





Control APC

➤ SplitRange01_01

- Splits an input signal into two output signals
- Two reference points are defined for each output signal *Out1* or *Out2*

Configuration

Output 1

Parameter	Input	Output
Start	0.0	100.0
End	50.0	0.0

Output 2

Parameter	Input	Output
Start	50.0	0.0
End	100.0	100.0

Input: 29.00 °C

Auto

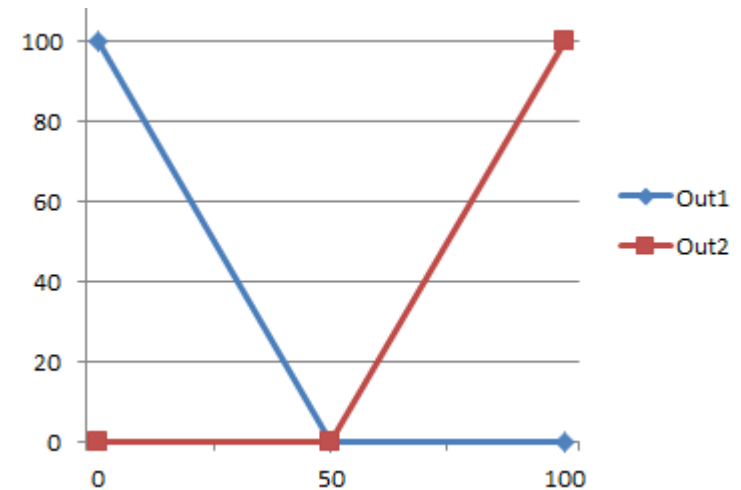
Output 1: 42.00 %

Output 2: 0.00 %

Manual

Output 1: 0.00 %

Output 2: 0.00 %





Control APC

➤ SignalFilter01_01

- **Signal filter**
- High pass, Low pass
- Band pass, Band stop
- BiQuad filter
- Notch filter
- Moving average
- Trends
- Alarme

Parameter	Unit	Value
Window length	--	100.000

Filter Configuration

High pass Band stop Notch

Low pass Moving average

Band pass BiQuad



Control APC

➤ SignalGenerator01_01

➤ **Signalgenerator**

➤ Distributuin function

➤ Uniform

➤ Exponential

➤ Cauchy

➤ Weibull

➤ Triangula

➤ Normal

➤ automatic-mode / manual-mode

➤ Trends

➤ Alarme

➤ Signal

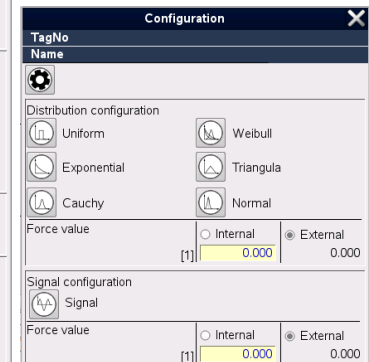
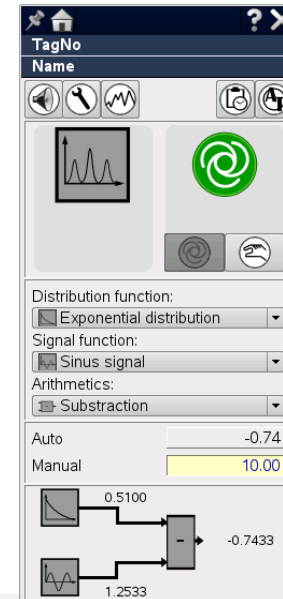
➤ Sinus

➤ Rectangle

➤ Triangle

➤ Sawtooth

➤ Rectangle with $\sin^2$

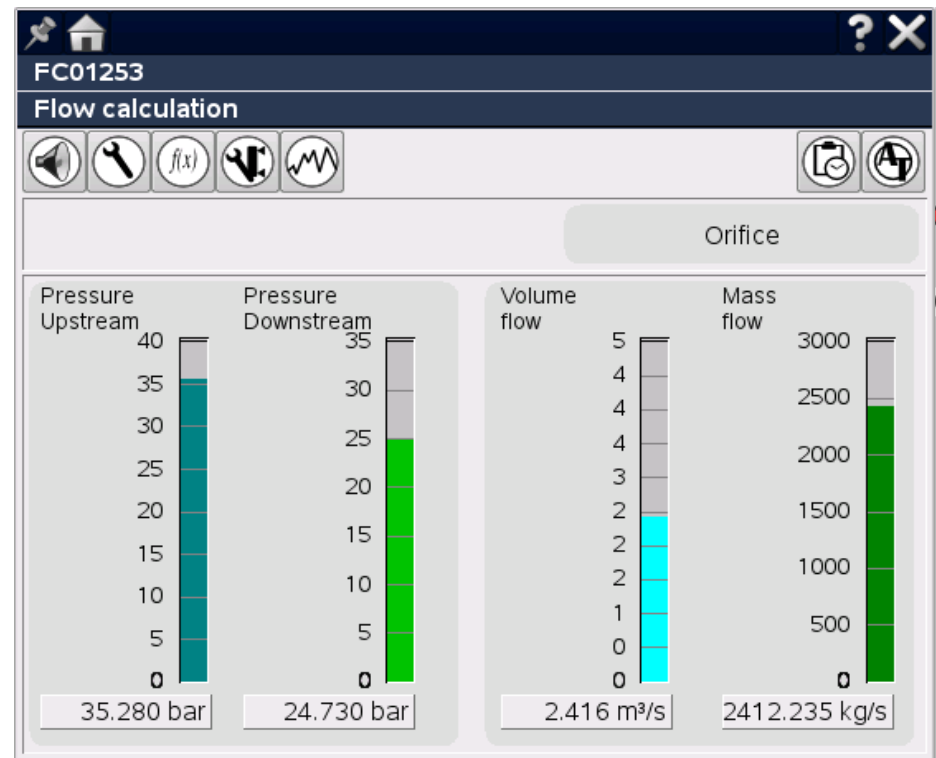




Control APC

➤ FlowCalculation01_01

- **Flow measurement**
- Orifice (EN ISO 5167-2)
- Nozzles (EN ISO 5167-3)
- Venturi (EN ISO 5167-4)
- Trends
- Alarme

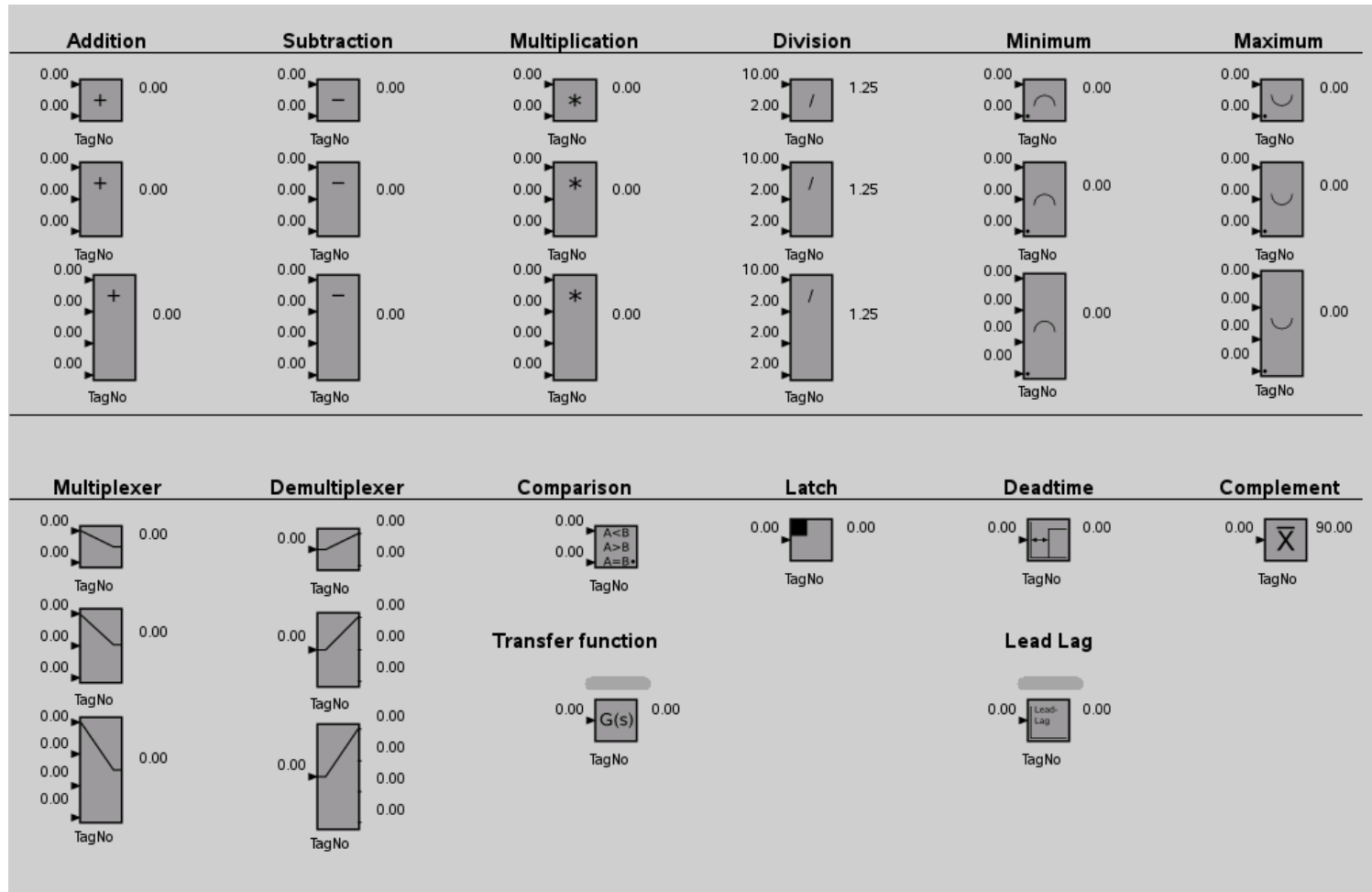




Control AddOn

➤ Advanced Controller Modules

➤ Use for control schemes

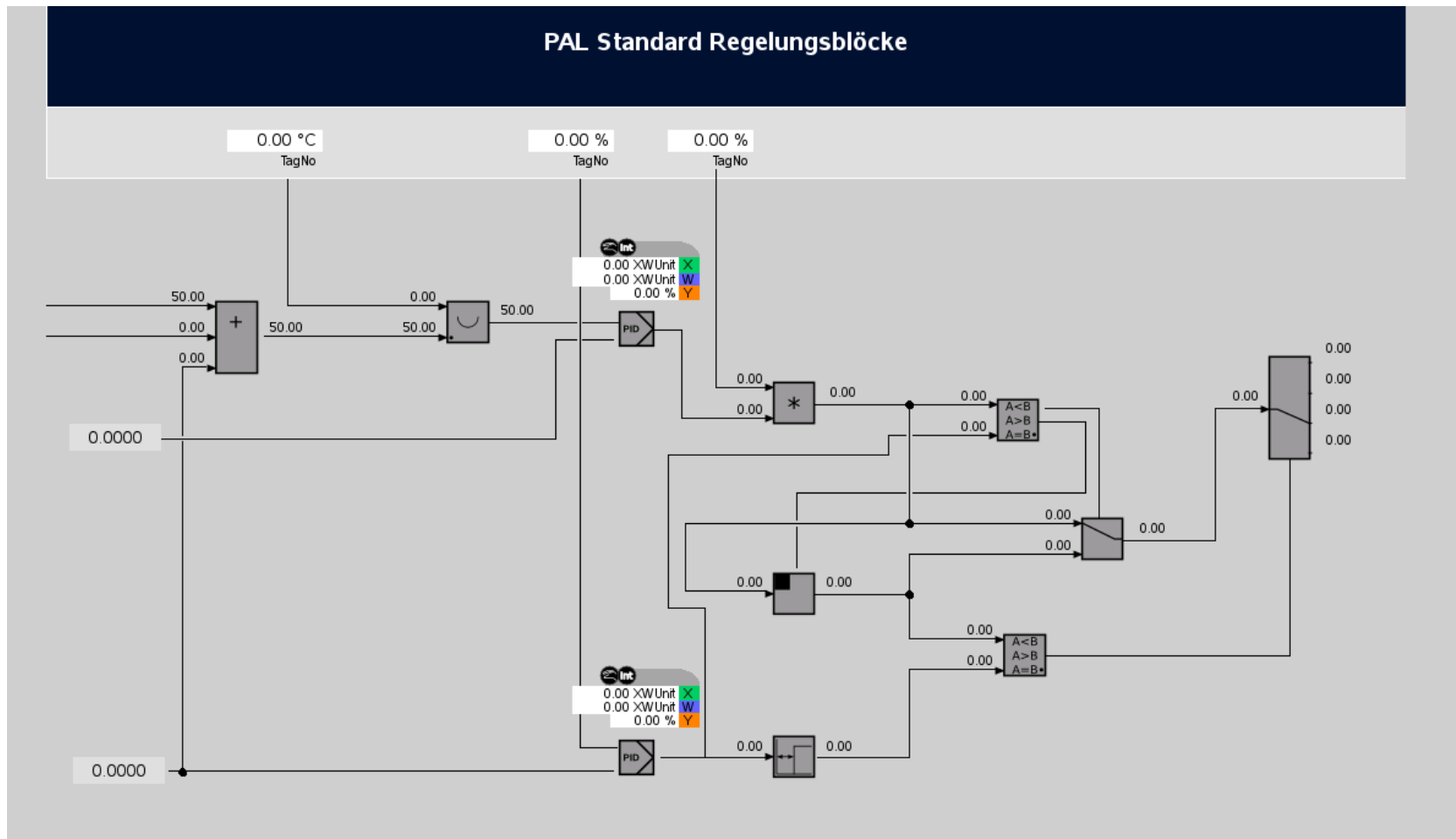




Control AddOn

➤ Advanced Controller Modules

➤ Use for control schemes





Auxiliary

- **NavigationBar01_01**
 - **navigation** in process graphics
 - navigation via Buttons
 - navigation via structured list
 - Shows **information**
about operator, date, time, ...





SFC

- SfcOperate01_01
 - Sequential Flow Chart operation
 - SFC stop/start/init
 - manual/automatic
 - tip mode
 - display actual sequence
 - embedded SFC-Viewer
 - alarms

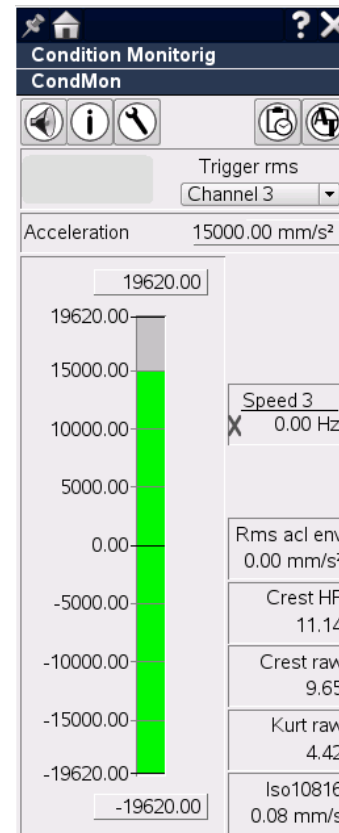
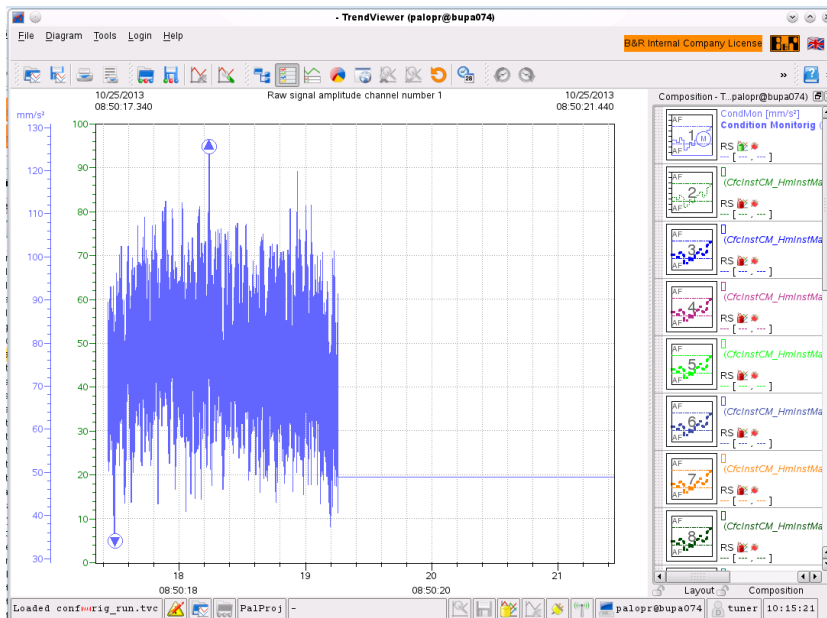




ConMon

➤ ConditionMonitor01_01

- support of **B&R Condition Monitoring module X20CM4810**
- **vibration measurement** (velocity, acceleration,...)
- live values, statistical values
- 32 frequency spectrums
- trends
- spectrums



Characteristic data			
Condition Monitoring			
CondMon			
Channel 3			
Characteristic data	Value	Unit	Overflow
Peak high frequency	73.20	mm/s²	×
Rms high frequency	6.29	mm/s²	×
Crest factor high frequency	11.64	---	×
Vdi3832kt high frequency	0.00	---	×
Rms acceleration envelope	0.00	mm/s²	×
Rms velocity envelope	0.01	mm/s	×
Rms acceleration raw	9.81	mm/s²	×
Rms velocity raw	0.10	mm/s	×
Peak raw	9.28	mm/s²	×



Bus

➤ MbusMaster01_01

- support of **B&R M-Bus-Master module X20CS1012**
- manages the automatic refresh of the slaves
- additionally a manual refresh via the visualization possible
- overview of all slaves



The screenshot shows the M-Bus Master configuration window. It includes fields for TagNo and Name, a speaker icon, and a refresh button. Below these are fields for 'Configured slaves' (5) and 'Invalid slaves' (0). A dropdown menu shows 'All slaves'. At the bottom is a table with columns for State, Addr., and Last valid sync.

State	Addr.	Last valid sync
1	1	10/11/2013 09:45:07
1	2	10/11/2013 09:45:10
1	5	10/11/2013 09:45:13
1	30	10/11/2013 09:45:16
1	63	10/11/2013 09:45:19



Bus

➤ MbusSlave01_01

- only in combination with the MbusMaster01_01 block
- general slave information
- up to 16 free configurable datapoints per slave possible
- monitoring of the status byte

0.92 kWh
TagNo

Status byte		
MbusSI01		
EMH MIZ		
Status byte		
Bit Δ	Description	Value
0	Counter coding (signed binary or BCD)	0
1	Counter storage (fixed date or actual)	0
2	Power low	0
3	Permanent error	0
4	Temporary error	0
5	Device-specific	0
6	Device-specific	0
7	Device-specific	0

M-Bus
Slave

Slave adress

Data valid **1**

Last valid sync
10/11/2013 09:45:07

Ident number

Medium

Name	Value	Unit
Energy	0.00	kWh
Power	0.0	W
Voltage	0.00	V
Current	0.000	A
Frequency	0.0	Hz
Hours	0	h
Powerfactor	0.000	-

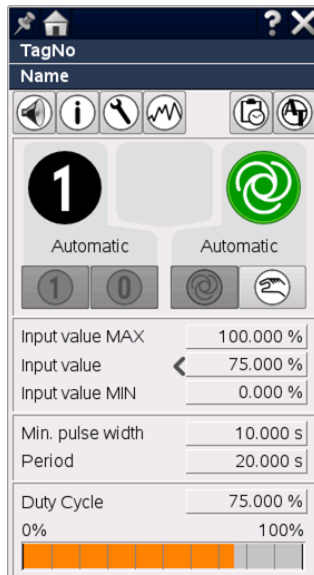




Pulses

➤ PulseWidhtModulation01_01

- **Pulse width modulation**
- automatic-mode / manual-mode
- scaling of input value
- operation- and operating time counter for pulse output
- trending
- alarming



Pulse width modulation configuration		
TagNo		
Name		
Value	☐ Dummy	☒ Live
%	50.000	75.000
Min pulse width	☒ Internal	☐ External
[s]	10.000	20.000
Period	☒ Internal	☐ External
[s]	20.000	30.000
Cycle time	[s]	0.100
Duty cycle steps	[%]	0.500
Pulse mode	☒ Internal	☐ External
Pulse position in period	Middle	Beginning



Pulses

➤ PulseFrequencyModulation01_01

- **Pulse frequency modulation**
- automatic-mode / manual-mode
- scaling of input value
- operation- and operating time counter for pulse output
- trending
- alarming

TagNo
Name

1
Automatic Automatic

Input value MAX 100.000 %
Input value 50.000 %
Input value MIN 0.000 %

Pulse width 20.000 s
Minimum pause 50.000 s

Duty Cycle 50.000 %
0% 100%

Pulse frequency modulation configuration

TagNo
Name

Value % ☐ Dummy ☒ Live 50.000 50.000

Pulse width [s] ☐ Internal ☒ External 20.000 20.000

Minimum pause [s] ☐ Internal ☒ External 50.000 50.000

Cycle time [s] 0.100

t on [s] 20.000

t off (Δ duty cycle) [s] 120.000



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