ELDATEX
POWER SYSTEMS GMBH
SWITCHBOARDS AND CONTROL

(E)LDATEX(S)TEAM(T)URBINE(C)ONTROLLER

Operation instruction V1.05

Content

1.0 Introduction

The ESTC is a steam turbine controller that can control steam turbines with up to 4 extraction/Admissioning stages.

1.1 Construction

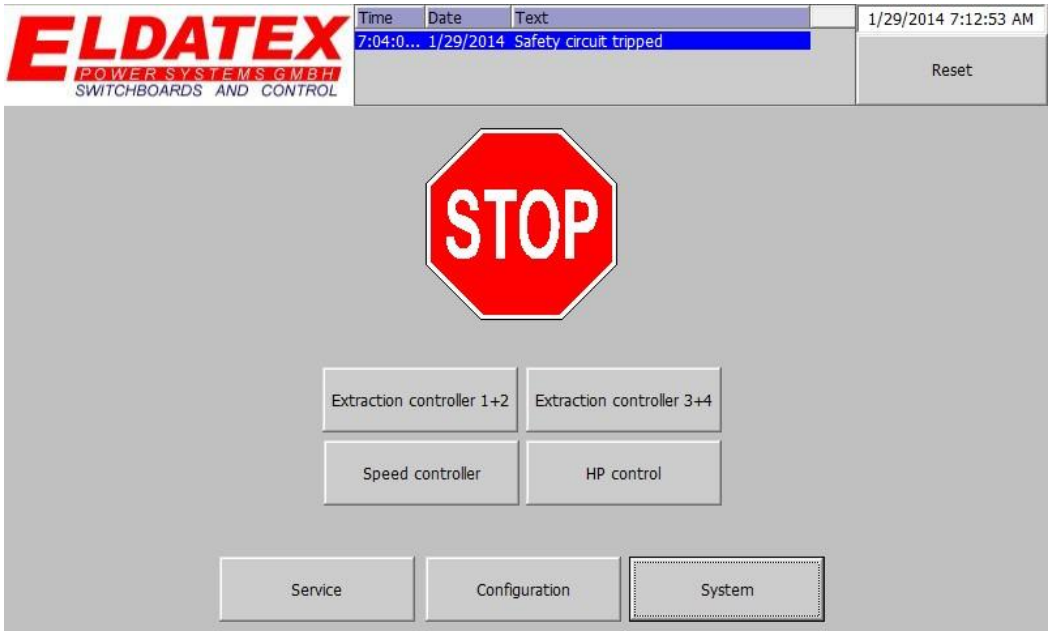
The ESTC is based on a Siemens S7 and is operated through a Siemens "Comfort Panel" HMI. Additionally it is possible to configure and control the ESTC with the "PC Configurator Software" with a normal windows based pc.

A detailed hardware construction overview is available in the operator manual "ESTC Construction".

The following connections are available:

- **USB Connection:** Can be used to save and restore the configuration with a USB drive.
- **Ethernet Connection:** Can be used to save and restore the configuration with the "ESTC PC Configurator Software" and a windows based PC. Additionally the Ethernet connection can be used to set up a data communication to another PLC.

1.2 Overview



Overview picture

The overview page is the start page of the ESTC. From here you can navigate through all 4 levels of the controller. The following levels can be reached:

- System
- Configuration
- Service
- Control

Levels

The System level can be reached by the button "System".

The Configuration level can be reached by the button "Configuration".

The Service level can be reached by the button "Service".

The Control levels can be reached by the following buttons:

- Speed controller
- HP controller
- Extraction controller 1+2
- Extraction controller 3+4
- Alarms, trips and messages (The Alarm window is working like a button)

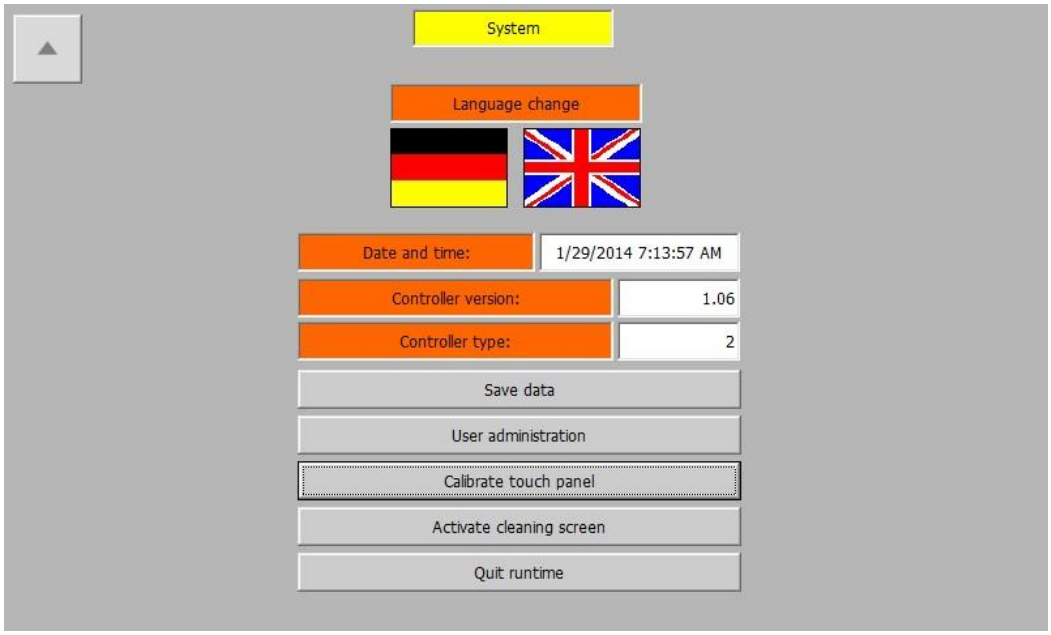
Reset

The overview page allows the operator to reset alarms and trips. The reset can be done by pressing the button "Reset".

Overview picture – Stop function

The overview page allows the operator to stop the controller and send out a trip from the ESTC. To do that, the button "STOP" must be pressed. Than a popup will appear which will ask you if you really want to Trip the controller and stop the turbine. By pressing the button "No" the window will close and the controller will stay in operation. By pressing the button "Yes" the safety circuit of the ESTC will trip and the turbine will stop. Additionally a Trip will be send out from the ESTC.

2.0 System configuration



System

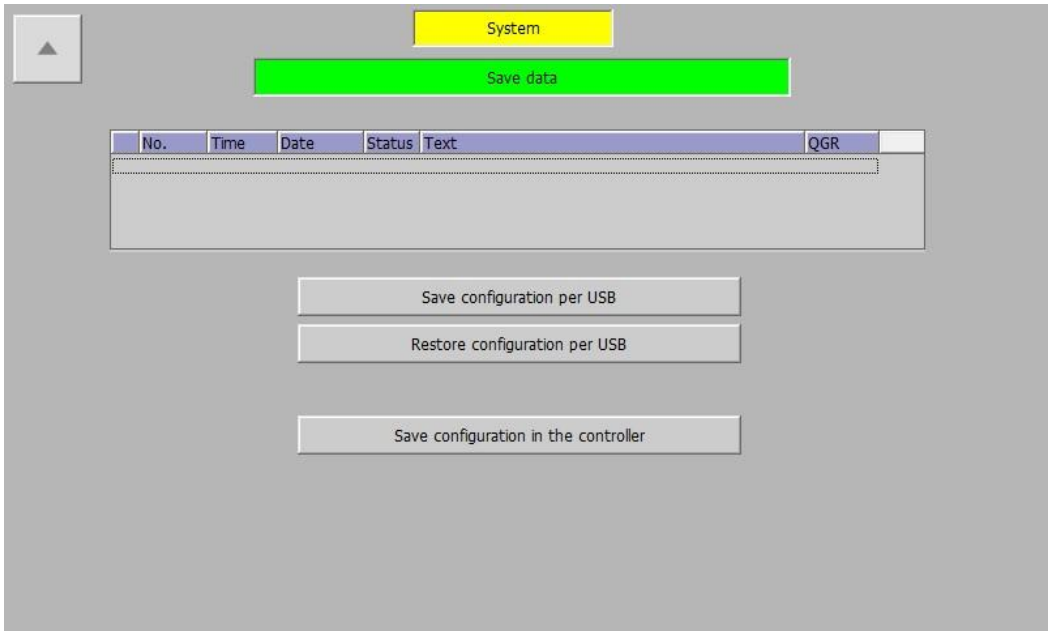
The System level includes all system parameters of the ESTC. Additionally it is possible to save and restore the configuration. The following under levels are available:

- Save data
- User administration

The following parameters are available in the system configurations:

- **Date and time:** Sets the date and time.
- **Language change:** Changes the language of the controller runtime.
- **Controller version:** Shows the software version of the ESTC.
- **Controller type:** Shows the actual type of the ESTC. The following types are available:
  - 1: 4 free configurable analog control outputs
  - 2: 8 free configurable analog control outputs
  - 3= 12 free configurable analog control outputs
  - 4= 16 free configurable analog control outputs
- **Calibrate touch panel:** Activates the system calibration of the HMI. This can be used if the accuracy of the touch input of the HMI is not perfect.
- **Quit:** Stops the ESTC Runtime and opens up the system internal configuration. This option is only possible for an operator that has the safety class "Administrator".

2.1 Save data

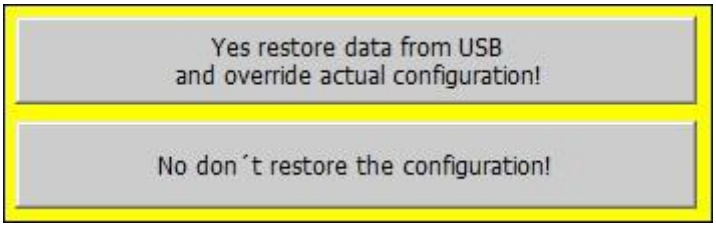


System – Save data

The save level allows to save and restore the complete configuration of the ESTC. The following functions are available:

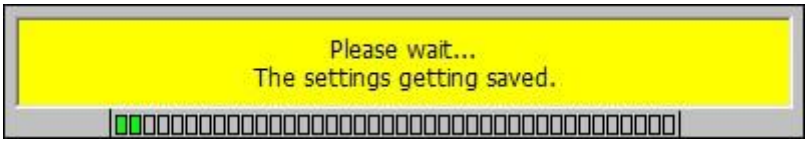
- **Save configuration per USB:** If a USB drive is connected to the ESTC, this function allows it to save the actual configuration of the ESTC into a file in the USB drive. The name of the file is "ESTC_Data.ELD" and will be saved in the folder "ESTC". If the folder does not exist, the ESTC controller will create a new folder.
- **Restore configuration per USB:** All data on the ESTC will be overwritten. The data will be loaded from a file named "ESTC_Data.ELD" in the folder "ESTC". If this file does not exist, the restore of the configuration will be cancelled. Before the data of the ESTC will be overwritten, the system will ask you a second time if you are sure you want to overwrite the settings(See picture "System-Save data - Restore configuration per USB")
- **Save configuration in the controller:** Saves the actual configuration in the ROM of the controller. By doing this, it is sure that the parameters of the controller cannot get lost, even if somebody does a Memory reset at the PLC. The saving of the configuration should be made at the end of the configuration. The actual status of the saving is shown as a bar graph (See picture "System-Save data-Save configuration in controller")

The message window will diagnose messages appear, that will inform the operator about the status of the saving and restoring of the USB configuration.



System – Save data – Restore configuration per USB

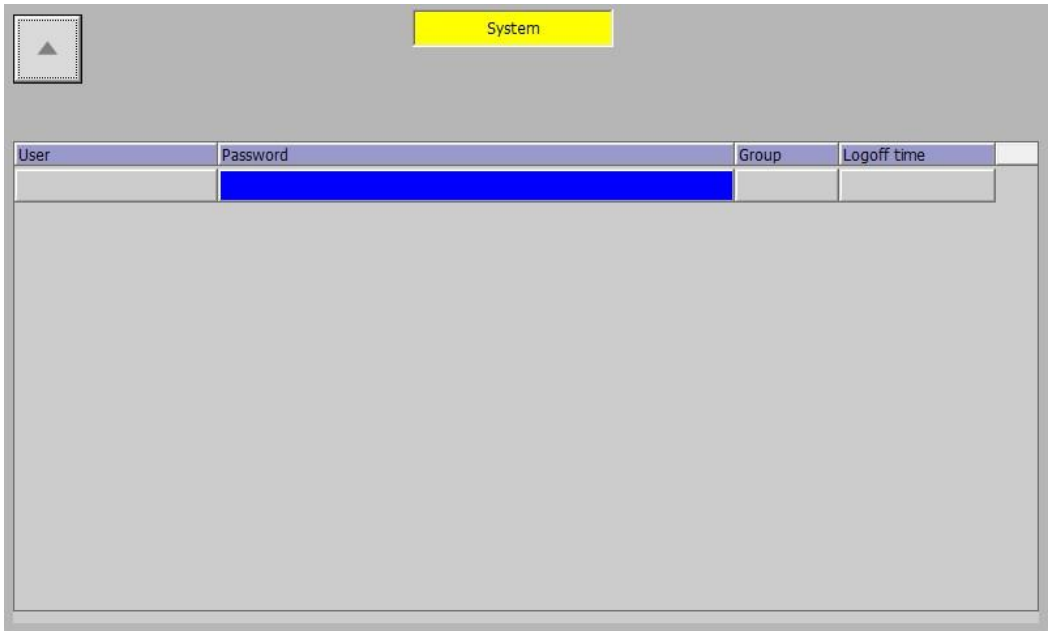
By selecting the Restore configuration per USB, this window will appear to ask again of the actual configuration should really be overwritten.



System – Save data – Save configuration in the controller

The save configuration in the controller can take a little time. The bar graph shows the actual status of the saving.

2.2 User administration



System – User administration

The user administration allows the operator to set up new users and change existing users. By a press on to the user administration mask, the configuration will be started. Each user can only add or change another user that has the same or a lower security level. The following information's are available:

- User: Sets up the User name.
- Password: Sets up the password.
- Group: Sets up one of the following groups:
  - Administrator: Can change settings in all levels.
  - Configuration: Can change settings in the service, configuration and control level. Only the internal panel configuration is not accessible.
  - Service: Can only change settings in the service and in the control level.
  - Unauthorized: Has no rights to change settings that are password protected.
- Logoff time: Sets up the time for the automatic logout if the users are not active anymore.

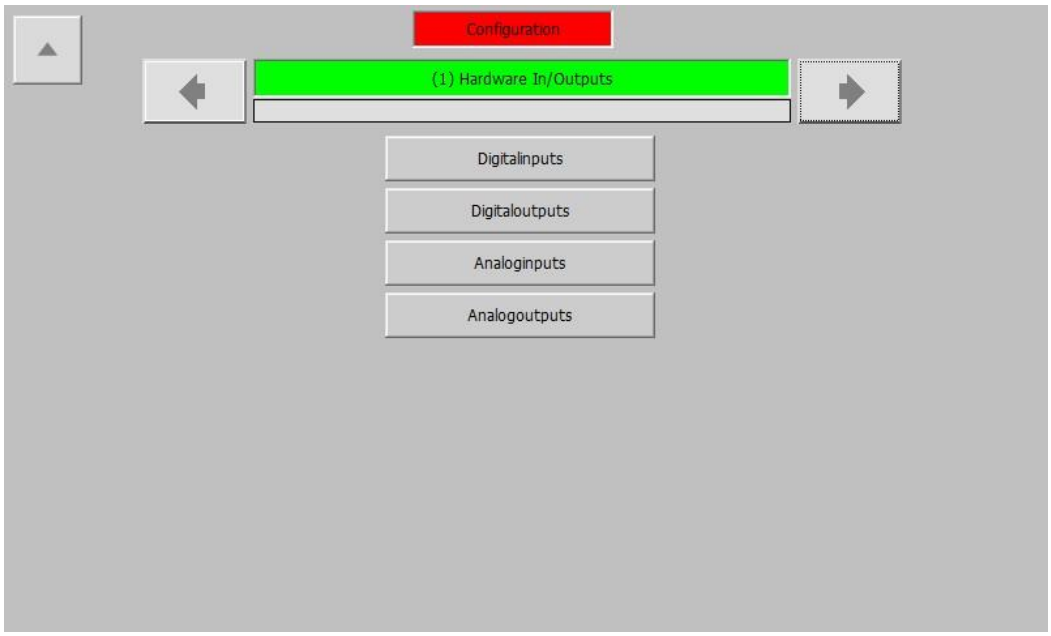
The following standard users are configured:

- Username: Service Password: ****
- Username: Konfiguration Password:****

3.0 Configuration

The configuration level of the ESTC includes the basic configurations for the machine and the setup of the controller. The configurations in the configuration level can only be changed when the turbine has not been started. All configurations require a security level for the configuration level.

3.1 Hardware In/Outputs



Configuration – (1) HardwareIn/Outputs

In the Hardware In/Outputs level the configuration for the digital and analog inputs and outputs of the ESTC can be configured. The following under levels are available:

- Digital inputs
- Digital outputs
- Analog inputs
- Analog inputs

3.1.1 Digital inputs

Configuration – (1) Hardware In/Outputs –Digital inputs 1-8

Configuration – (1) Hardware In/Outputs –Digital inputs 9-16

The digital input level includes the parameters for the digital inputs of the ESTC. The ESTC has 16 digital inputs, from which 15 are free configurable. The first digital input is fixed to the function "Safety circuit".

For the 15 free configurable inputs can be configured by a drop down menu with one of the following functions:

- **Reset:**Resets the alarms and trip of the ESTC.
- **Start turbinesite 1:**Starts at a positive edge the control of the 1. Turbine site.

- **Stop turbinesite1:**Starts the stop ramp at a positive edge of the 1. Turbine site.
- **Start turbinesite 2:**Starts at a positive edge the control of the 2. Turbine site.
- **Stop turbinesite 2:**Starts the stop ramp at a positive edge of the 2. Turbine site.
- **Increase speed turbine site 1:**Increases the speed set point for the 1. Turbine site.
- **Decrease speed turbine site 1:** Decreases the speed set point for the 1. Turbine site.
- **Increase speed turbine site 2:** Increases the speed set point for the 2. Turbine site.
- **Decrease speed turbine site 3:** Decreases the speed set point for the 3. Turbine site.
- **Generator C.B. closed:**Gives the feedback to the ESTC that the generator circuit breaker of the machine is closed.
- **Main C.B. closed:**Gives the feedback to the ESTC that the main circuit breaker of the machine is closed. If the main circuit breaker is not is not configured, the ESTC will behave like it is closed.
- **LP turbine online:**Can be used to change the 2. Turbine site from offline to online speed control with extraction steam pressure control.
- **Active EVU step 1:**Activates the 1. Limit of the EVU limitation according to the configuration in the power limitation (See part 3.3.5)
- **Active EVU step 2:**Activates the 2. Limit of the EVU limitation according to the configuration in the power limitation (See part 3.3.5)
- **Active EVU step 3:**Activates the 3. Limit of the EVU limitation according to the configuration in the power limitation (See part 3.3.5)
- **Active EVU step 4:**Activates the 4. Limit of the EVU limitation according to the configuration in the power limitation (See part 3.3.5)
- **Activate inlet pressure controller:**Activates the inlet steam pressure controller if it is configured and available(See part 3.3.2)
- **Activate exhaust pressure controller:**Activates the exhaust steam pressure controller if it is configured and available (See part 3.3.3)
- **Activate power controller:**Activates the power controller if it is configured and available (See part 3.3.5)
- **Activate auxiliary controller:**Activates the auxiliary controller is it is configured and available (See part 3.3.4)
- **Activate extraction controller 1:**Activates the extraction controller 1 at an edge at the digital input if the extraction controller 1 is configured and available. A negative edge at the digital input will deactivate the extraction controller 1.(See part 3.4.2)
- **Activate extraction controller 2:**Activates the extraction controller 2 at an edge at the digital input if the extraction controller 2 is configured and available. A negative edge at the digital input will deactivate the extraction controller 2. (See part 3.4.3)
- **Activate extraction controller 3:**Activates the extraction controller 3 at an edge at the digital input if the extraction controller 3 is configured and available. A negative edge at the digital input will deactivate the extraction controller 3. (See part 3.4.4)
- **Activate extraction controller 4:**Activates the extraction controller 4 at an edge at the digital input if the extraction controller 4 is configured and available. A negative edge at the digital input will deactivate the extraction controller 4. (See part 3.4.5)

- **Activate external speed set point turbine site 1:**Activates the external Speed set point for the 1. Turbine site if it is configured and released.
- **Activate external speed set point turbine site 2:**Activates the external Speed set point for the 2. Turbine site if it is configured and released.
- **Activate external inlet pressure set point:**Activates the external inlet pressure set point for the HP control.
- **Activate external exhaust pressure set point:**Activates the external exhaust pressure set point for the HP control.
- **Activate external power set point:**Activates the external power set point for the HP control.
- **Activate external auxiliary set point:**Activates the external auxiliary set point for the HP control.
- **Activate External minimum power limitation set point:**Activates the external minimum power set point.
- **Activate External maximum power limitation set point:** Activates the external maximum power set point.
- **Activate external hp auxiliary limiter 1 set point:**Activates the external set point for the HP auxiliary limiter 1.
- **Activate external hp auxiliary limiter 2 set point:** Activates the external set point for the HP auxiliary limiter 2.
- **Activate external extraction controller 1set point:**Activates the external set point for the extraction controller 1.
- **Activate external extraction controller 2 set point:** Activates the external set point for the extraction controller 2.
- **Activate external extraction controller 3 set point:** Activates the external set point for the extraction controller 3.
- **Activate external extraction controller 4 set point:** Activates the external set point for the extraction controller 4.
- **Activate extraction limiter 1 external set point:**Activates the external set point for the extraction limiter 1.
- **Activate extraction limiter 2 external set point:** Activates the external set point for the extraction limiter 2.
- **Activate extraction limiter 3 external set point:** Activates the external set point for the extraction limiter 3.
- **Activate extraction limiter 4 external set point:** Activates the external set point for the extraction limiter 4.
- **Activate condensate middle temperature controller:**Activates the condensate middle temperature controller at an edge at the digital input.
- **Activate condensate outlet temperature controller**: Activates the condensate outlet temperature controller at an edge at the digital input.
- **Activate condensate middle temperature external set point**: Activates the external set point for the condensate middle temperature controller.
- **Activate condensate outlet temperature external set point**: Activates the external set point for the condensate outlet temperature controller.

- **Activate over speed test turbine site 1**: Activates the over speed test for the 1. Turbine site.
- **Activate over speed test turbine site 2**: Activates the over speed test for the 2. Turbine site.

3.1.2 Digital outputs

Configuration – (1) Hardware In/Outputs – Digital outputs 1-8

Configuration – (1) Hardware In/Outputs – Digital outputs 9-16

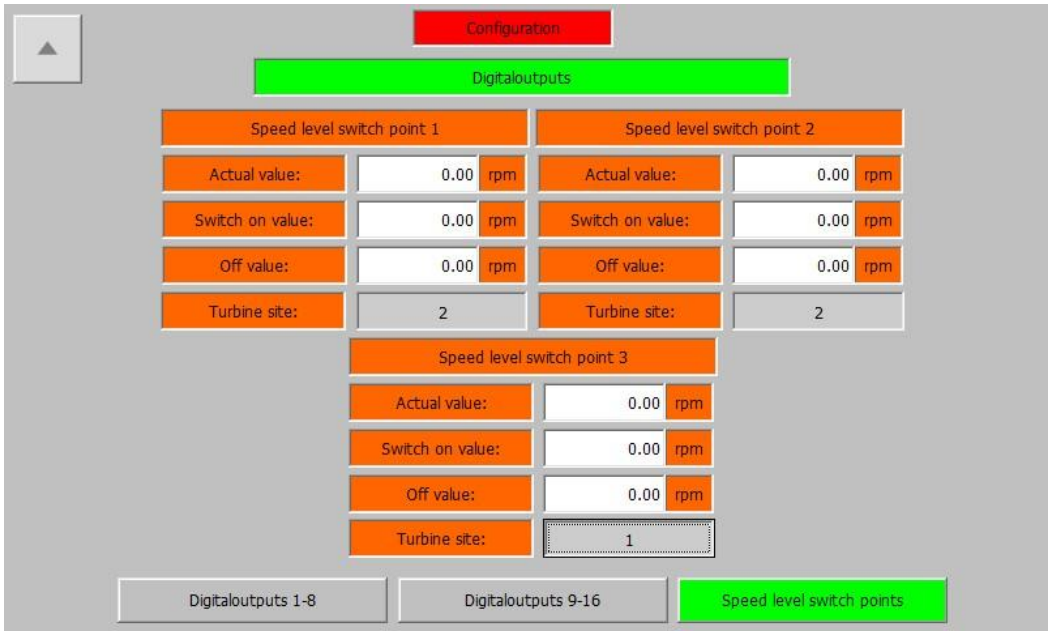
The digital input level includes the parameters for the digital inputs of the ESTC. The ESTC has 16 digital outputs, from which 15 are free configurable. The first digital output is fixed to the function "Trip".

For the 15 free configurable outputs can be configured by a drop down menu with one of the following functions:

- **Warning:**Indicates that at least 1 warning is active or not resetted at the ESTC.
- **Controller ready:**Indicates that the ESTC is ready to be started.

- **Controller started:** Indicates that the ESTC has been started.
- **HP controller online:**Indicates that the speed controller of the turbine site 1 is in "online" mode.
- **LP controller online:**Indicates that the speed controller of the turbine site 2 is in "online" mode.
- **Over speed test active:**Indicates that the overspeedtest for turbine site 1 or 2 is active.
- **Overspeedtrip HP:**Indicates that the overspeedprotection of turbine site 1 has tripped.
- **Over speed trip LP:**Indicates that the over speed protection of turbine site 2 has tripped.
- **Level switch 1:**Indicates the status of the 1. Speedlevelswitch.
- **Level switch 2:**Indicates the status of the 1. Speed level switch.
- **Level switch 3:**Indicates the status of the 1. Speed level switch.
- **HP turbine sensor difference:**Indicates that a difference between the speed sensors of turbine site 1 has been noticed.
- **HPturbine sensor fault:**Indicates that the speed sensors of turbine site 1 have failed.
- **LP turbine sensor difference:**Indicates that a difference between the speed sensors of turbine site 2 has been noticed.
- **LP turbine sensor fault:**Indicates that the speed sensors of turbine site 2 have failed.
- **Inlet pressure controller is active:**Indicates that the inlet pressure controller of the HP controller is active.
- **Exhaust pressure controller is active:**Indicates that the exhaustpressure controller if the HP controller is active.
- **Power controller is active:**Indicates that the power controller of the HP controller is active.
- **Auxiliary controller is active:**Indicates that the auxiliary controller of the HP controller is active.
- **Extraction controller 1 is active:**Indicates that the extraction controller 1 is active.
- **Extraction controller 2 is active:**Indicates that the extraction controller 2 is active.
- **Extraction controller 3 is active:**Indicates that the extraction controller 3 is active.
- **Extraction controller 3 is active:**Indicates that the extraction controller 4 is active.
- **Minimum power limiter is in control:**Indicates that the minimum power limiter is influencing the HP controller.
- **Maximum power limiter is in control:**Indicates that the maximum power limiter is influencing the HP controller.
- **HP auxiliary limiter 1 is in control:**Indicates that the auxiliary limiter 1 is influencing the HP controller.
- **HP auxiliary limiter 2 is in control:**Indicates that the auxiliary limiter 2 is influencing the HP controller.
- **Extraction limiter 1 is in control:**Indicates that the extraction limiter 1 is influencing theextraction controller 1.
- **Extraction limiter 2 is in control:**Indicates that the extraction limiter 2 is influencing theextraction controller 2.
- **Extraction limiter 3 is in control:**Indicates that the extraction limiter 3 is influencing theextraction controller 3.

- **Extraction limiter 4 is in control:**Indicates that the extraction limiter 4 is influencing theextraction controller 4.



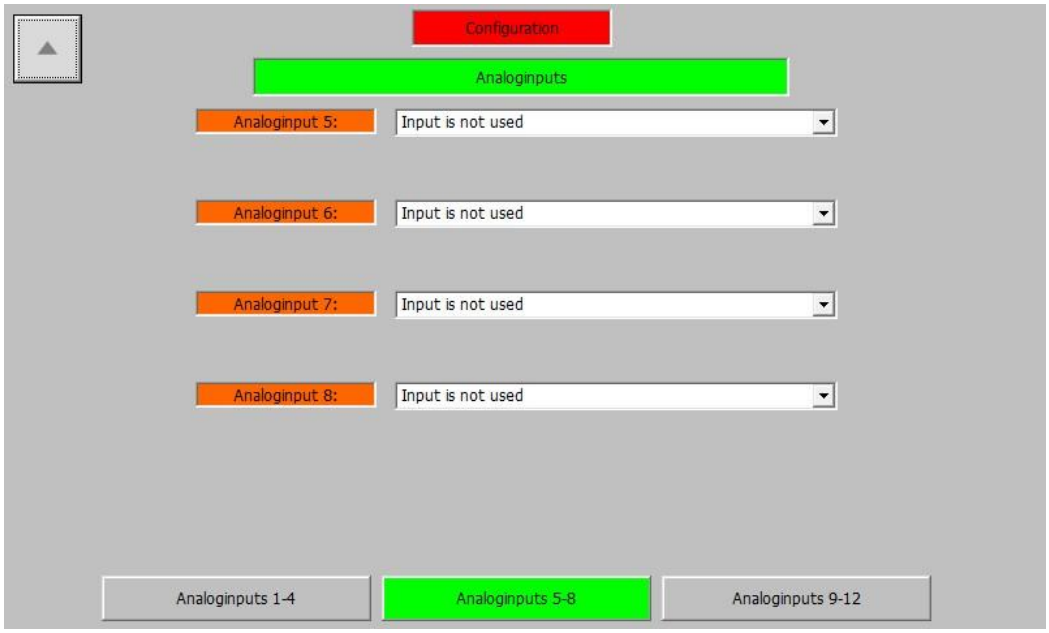
Konfiguration – (1) Hardware In/Outputs – Speed level switch points

If at least 1 of the 15 free configurable digital outputs of the ESTC has been configured at 1 of the 3 level switches, the speed level witch point page is accessible. The following parameters are available:

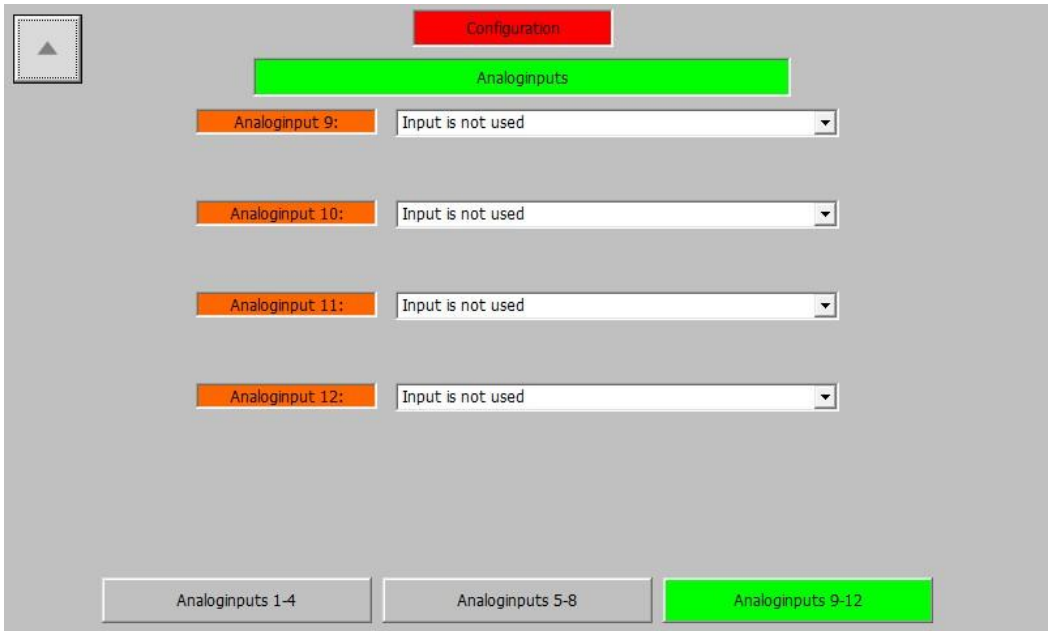
- **Actual value:**Indicates the actual measured speed value for the level switch.
- **Switch on value:**The limit for switching on the level switch. If the actual speed value is higher than the configured value, the level switch will be switched on.
- **Off value:**The limit for switching off the level switch. If the actual speed value is lower than the configuredvalue, the level switch will be switched off.
- **Turbine site (1/2):**Specifieswhich turbine site (1 or 2) will be used for the level switch.

3.1.3 Analog inputs

Konfiguration – (1) Hardware In/Outputs– Analog inputs 1-4



Konfiguration – (1) Hardware In/Outputs– Analog inputs 5-8



Konfiguration – (1) Hardware In/Outputs– Analog inputs 9-12

The analog input level includes the parameters for the analog inputs of the ESTC. The ESTC has 12 analog inputs, from which the inputs 1-9 are 4-20mA and the inputs 10-12 are PT100.

For the Inputs 1-9 is a scaling availablewhich allows it to tell the controller what kind of sensors is connected, and what the range of the measured value for 4-20mA is. The following units are available, and will be accessible depending on the configured kind of input:

- -
- KW
- MW
- Bar
- Psi
- kPa
- MPa
- Atm
- °C
- °F
- t/h
- kg/h
- g/h
- &
- -1/min

The Inputs 1-9 (4-20mA) can be configured by using a drop down menu which allows it to select one of the following functions:

- **Inlet steam pressure:** Actual value of the inlet steam of the turbine.
- **Exhaust steam pressure:** Actual value of the exhaust steam pressure of the turbine.
- **Power:** Actual value of the produced electrical power.
- **Auxiliary value:** Actual value of the auxiliary(Can be anything for example steam flow)
- **Extraction steam pressure 1:** Actual value of the extraction steam pressure 1.
- **Extraction steam pressure 2:** Actual value of the extraction steam pressure 2.
- **Extraction steam pressure 3:** Actual value of the extraction steam pressure 3.
- **Extraction steam pressure 4:** Actual value of the extraction steam pressure 4.
- **Turbine site 1 speed set point:** External set point for the speed controller of turbine site 1.
- **Turbine site 2 speed set point:** External set point for the speed controller of turbine site 2.
- **Inlet steam pressure set point:** External set point for the inlet pressure controller of the HP controller.
- **Exhaust steam pressure set point:** External set point for the exhaust pressure controller of the HP controller.
- **Power controller set point:** External set point for the power controller of the HP controller.
- **Auxiliary set point:** External set point for the auxiliary controller of the HP controller.
- **Minimum power limiter set point:** External set point for the minimum power limiter.
- **Maximum power limiter set point:** External set point for the maximum power limiter.
- **HP auxiliary limiter 1 set point:** External set point for the HP auxiliary limiter 1.
- **HP auxiliary limiter 2 set point:** External set point for the HP auxiliary limiter 2.
- **Extraction set point 1:** External set point for the extraction controller 1.
- **Extraction set point 2:** External set point for the extraction controller 2.
- **Extraction set point 3:** External set point for the extraction controller 3.
- **Extraction set point 4:** External set point for the extraction controller 4.
- **Extraction limiter set point 1:** External set point for the extraction limiter 1.
- **Extraction limiter set point 2:** External set point for the extraction limiter 2.
- **Extraction limiter set point 3:** External set point for the extraction limiter 3.
- **Extraction limiter set point 4:** External set point for the extraction limiter 4.
- **HP stage minimum output:** External limit for the minimum controller output of the HP stage.
- **HP stage maximum output:** External limit for the maximum controller output of the HP stage.
- **LP stage 1 minimum output:** External limit for the minimum controller output of the LP stage 1.
- **LP stage 1 maximum output:** External limit for the maximum controller output of the LP stage 1.
- **LP stage 2 minimum output:** External limit for the minimum controller output of the LP stage 2.
- **LP stage 2 maximum output:** External limit for the maximum controller output of the LP stage 2.
- **LP stage 3 minimum output:** External limit for the minimum controller output of the LP stage 3.
- **LP stage 3 maximum output:** External limit for the maximum controller output of the LP stage 3.

- **LP stage 4 minimum output:** External limit for the minimum controller output of the LP stage 4.
- **LP stage 4 maximum output:** External limit for the maximum controller output of the LP stage 4.
- **Condensate inlet temperature:** Actual value of the incoming cooling water temperature of the condensator.
- **Condensate middle temperature:** Actual value of the middle cooling water temperature of the condensator
- **Condensate outlet temperature:** Actual value of the outcoming cooling water temperature of the condensator.
- **Extraction value 1:** Actual value for the extraction controller 1, if it is not controlling the pressure.
- **Extraction value 2:** Actual value for the extraction controller 2, if it is not controlling the pressure.
- **Extraction value 3:** Actual value for the extraction controller 3, if it is not controlling the pressure.
- **Extraction value 4:** Actual value for the extraction controller 4, if it is not controlling the pressure.
- **Condensate middle temperature set point:** External set point for the condensate middle temperature controller.
- **Condensate outlet temperature set point:** External set point for the condensate outlet temperature controller.

The Inputs 10-12 (PT100) can be configured by using a drop down menu which allows it to select one of the following functions:

- **Auxiliary value:** Actual value of the auxiliary(Can be anything for example water temperature)
- **Condensate inlet temperature:** Actual value of the incoming cooling water temperature of the condensator.
- **Condensate middle temperature:** Actual value of the middle cooling water temperature of the condensator
- **Condensate outlet temperature:** Actual value of the out coming cooling water temperature of the condensator.
- **Extraction value 1:** Actual value for the extraction controller 1, if it is not controlling the pressure.
- **Extraction value 2:** Actual value for the extraction controller 2, if it is not controlling the pressure.
- **Extraction value 3:** Actual value for the extraction controller 3, if it is not controlling the pressure.
- **Extraction value 4:** Actual value for the extraction controller 4, if it is not controlling the pressure.

3.1.4 Analog outputs

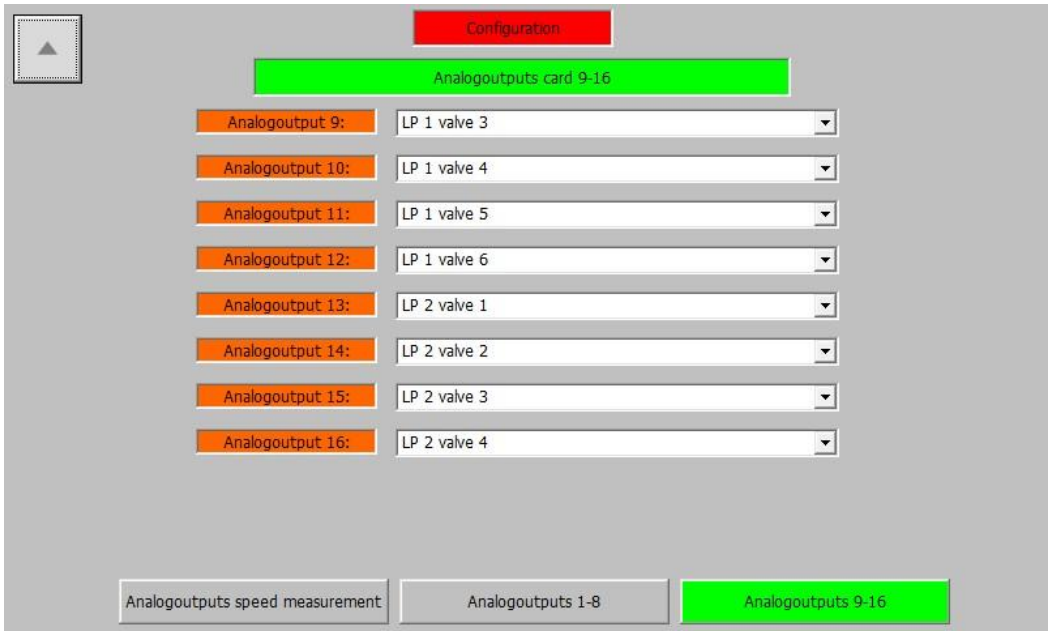
Konfiguration – (1) Hardware In/Outputs – Analog outputs speed measurement

The analog output level includes the parameters for the analog outputs of the ESTC. The ESTC has 12 analog inputs, from which the inputs 1-9 are 4-20mA and the inputs 10-12 are PT100. The ESTC has up to 18 analog outputs, fromwhich 16 are free to configure. The other 2 analog outputs are fixed to the actual speed of turbine site 1 and 2.

For the Inputs 1-9 is a scaling availablewhich allows it to tell the controller what kind of sensors is connected, and what the range of the measured value for 4-20mA is. The following units are available, and will be accessible depending on the configured kind of input:

- **HPSpeed:**Scales the actual speed of turbine site 1 as a 4-20mA Signal. With the parameter "Upper limit :(20mA)" it is possible to set up the actual speed that is according to 20mA at the analog output. With the parameter "Lower limit :(4mA)" it is possible to set up the actual speed that is according to 4mA at the analog output.
- **LP Speed:**Scales the actual speed of turbine site 2 as a 4-20mA Signal. With the parameter "Upper limit :(20mA)" it is possible to set up the actual speed that is according to 20mA at the analog output. With the parameter "Lower limit :(4mA)" it is possible to set up the actual speed that is according to 4mA at the analog output.

Konfiguration – (1) Hardware In/Outputs – Analog outputs 1-8



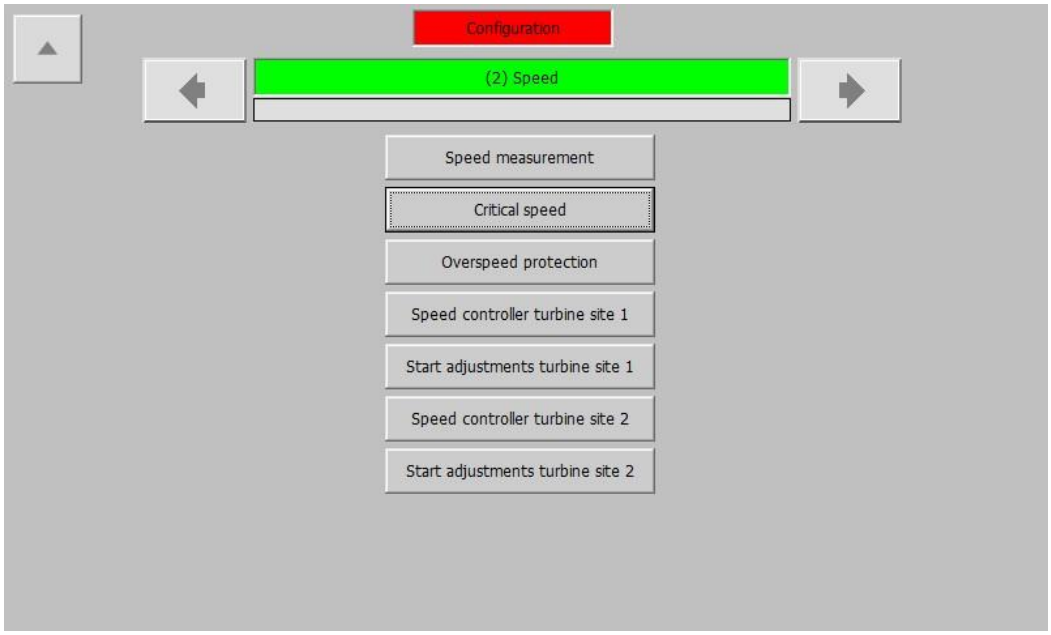
Konfiguration – (1) Hardware In/Outputs – Analog outputs 9-16

The Outputs 1-16 can be free configured with one of the following functions:

- **HP Valve 1:**Controller output for the 1. Valve of the HP stage.
- **HP Valve 2:** Controller output for the 2. Valve of the HP stage.
- **HP Valve 3:** Controller output for the 3. Valve of the HP stage.
- **HP Valve 4:** Controller output for the 4. Valve of the HP stage.
- **HP Valve 5:** Controller output for the 5. Valve of the HP stage.
- **HP Valve 6:** Controller output for the 6. Valve of the HP stage.
- **LP1 Valve 1:** Controller output for the 1. Valve of the LP stage 1.

- **LP 1 Valve 2:** Controller output for the 2. Valve of the LP stage 1.
- **LP 1 Valve 3:** Controller output for the 3. Valve of the LP stage 1.
- **LP 1 Valve 4:** Controller output for the 4. Valve of the LP stage 1.
- **LP 1 Valve 5:** Controller output for the 5. Valve of the LP stage 1.
- **LP 1 Valve 6:** Controller output for the 6. Valve of the LP stage 1.
- **LP 2 Valve 1:** Controller output for the 1. Valve of the LP stage 2.
- **LP 2 Valve 2:** Controller output for the 2. Valve of the LP stage 2.
- **LP 2 Valve 3:** Controller output for the 3. Valve of the LP stage 2.
- **LP 2 Valve 4:** Controller output for the 4. Valve of the LP stage 2.
- **LP 2 Valve 5:** Controller output for the 5. Valve of the LP stage 2.
- **LP 2 Valve 6:** Controller output for the 6. Valve of the LP stage 2.
- **LP 3 Valve 1:** Controller output for the 1. Valve of the LP stage 3.
- **LP 3 Valve 2:** Controller output for the 2. Valve of the LP stage 3.
- **LP 3 Valve 3:** Controller output for the 3. Valve of the LP stage 3.
- **LP 3 Valve 4:** Controller output for the 4. Valve of the LP stage 3.
- **LP 3 Valve 5:** Controller output for the 5. Valve of the LP stage 3.
- **LP 3 Valve 6:** Controller output for the 6. Valve of the LP stage 3.
- **LP 4 Valve 1:** Controller output for the 1. Valve of the LP stage 4.
- **LP 4 Valve 2:** Controller output for the 2. Valve of the LP stage 4.
- **LP 4 Valve 3:** Controller output for the 3. Valve of the LP stage 4.
- **LP 4 Valve 4:** Controller output for the 4. Valve of the LP stage 4.
- **LP 4 Valve 5:** Controller output for the 5. Valve of the LP stage 4.
- **LP 4 Valve 6:** Controller output for the 6. Valve of the LP stage 4.

3.2 Speed

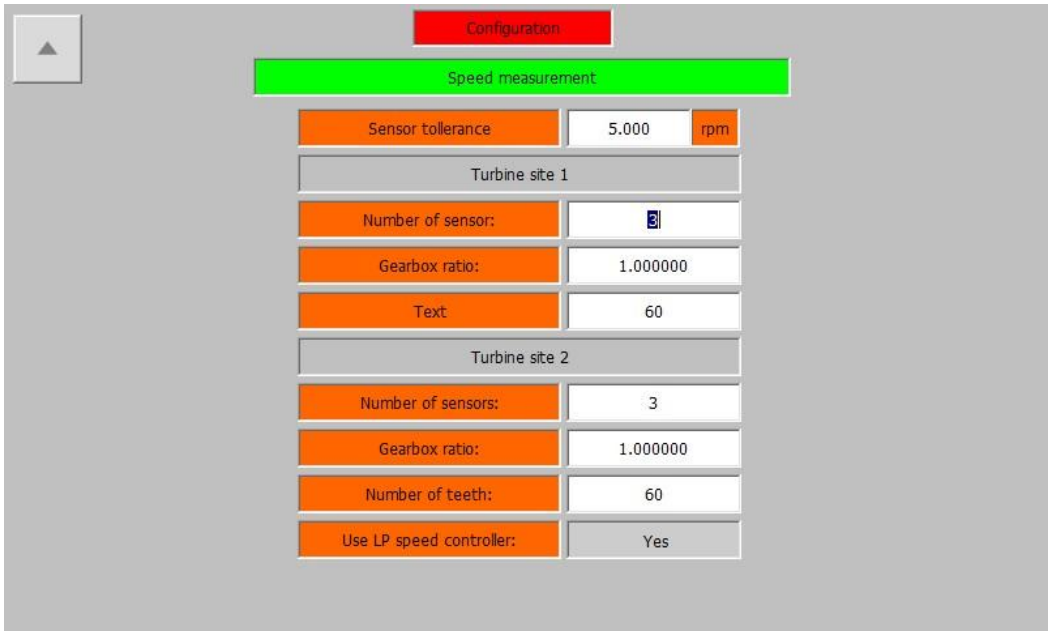


Configuration – (2) Speed

In the speed level the configuration for the speed sensing and the speed control of the turbine can be made. The following under levels are available:

- Speed measurement
- Critical speed
- Over speed protection
- Speed controller turbine site 1
- Start adjustments turbine site 1
- Speed controller turbine site 2
- Start adjustments turbine site 2

3.2.1 Speed measurement



Configuration – (2) Speed–Speed measurement

The speed measurement level includes the settings for the detection and calculation of the actual speed of turbine site 1 and 2.

The following parameters are available:

- **Sensor tolerance (Min 0):**The limit for the difference between the single sensors to trigger an alarm.
- **Turbine site 1 number of sensors (1-3):**The number of speed sensors at the 1. Turbine site.
- **Turbine site 1 gearbox ratio (Min 0, 000001):**The gearbox ratio of the 1. Turbine site. When no gearbox is used or the turbine speed should be used, than the gearbox ratio must be set to 1,0.
- **Turbine site 1 number of teeth (Min 1):**The number of teeth at the pulse wheel of turbine site 1. When the ESTC counted that number of pulses, it means that the turbine site 1 has rotated 1 round.
- **Turbine site 2 number of sensors (1-3):** The number of speed sensors at the 2. Turbine site.
- **Turbine site 2 gearbox ratio (Min 0,000001):** The gearbox ratio of the 2. Turbine site. When no gearbox is used or the turbine speed should be used, than the gearbox ratio must be set to 1,0.
- **Turbine site 2 number of teeth (Min 1):** The number of teeth at the pulse wheel of turbine site 1. When the ESTC counted that number of pulses, it means that the turbine site 1 has rotated 1 round.
- **Use LP speed controller(Yes/No):**Adjusts if the turbine site 2 is using a speed controller.

3.2.2 Critical speed

Configuration – (2) Speed – Critical speed

The critical speed level includes the settings for the critical speed bands of the turbine during the startup ramp.

The following parameters are available:

- **Use(Yes/No):** Defines if the critical speed band is used.
- **Begin(0-End):**The speed at which the critical speed band begins.
- **End(Begin - Rated speed):**The speed at which the critical speed band ends.
- **Accell.(Min 0):**The acceleration of the speed set point while the critical speed band is active.

Function

The critical speed band can be used to increase the acceleration of the speed set point between specified speed points. While the speed set point is higher than the begin value and lower than the end value, the speed set point will be increase by the adjusted acceleration to avoid getting a vibration trip during the critical speed of the turbine.

3.2.3 Over speed protection

Configuration – (2) Speed – Over speed protection

The over speed protection level includes the parameters for the over speed protection of the turbine and the over speed test procedure. The settings will be set separately for each turbine site.

The following parameters are available:

- **Test Limit:**The value to which the speed set point will be increased during the over speed protection test.
- **Trip Limit:**The value at which the ESTC stops if the actual speed of the turbine is higher than this value. During the over speed protection trip, this protection is deactivated. It will flash red if the actual speed is higher than this value, but not stop the turbine.
- **Test rate of rise:**The rate if rise of the speed set point during activated over speed test.

3.2.4 Speed controller turbine site 1

Configuration – (2) Speed – Speed controller turbine site 1

The speed controller of turbine site 1 includes the parameters for the control of the speed, and the protection of the turbine in case of faulty speed pickups.

The following parameters are available:

- **Blockage speed (Min 0):**The minimum speed set points that enables the speed controller. Speed set points that are lower than this value will be ignored. Additionally these parameters is also used for enabling the detection of speed difference between the speed sensors.
- **Sensor fault with valve position(Yes/No):** If activated, the fault of speed sensors will be checked by the actual output of the controller. If the controller output is bigger than the adjusted limit, the speed must be at least 20 rpm.
- **Valve position (1-99%):**The limit for detection a speed sensor fault by using the controller output.
- **Sensor fault with time(Yes/No):**If activated, the fault of speed sensors will be checked by the time after getting the start command. When the configured time has been finished, the speed must be at least 20 rpm.
- **Delay:**The time delay for the detection of a speed sensor fault.
- **Sensor fault with generator c.b. (Yes/No):**If activated, the fault of speed sensors will be checked by the feedback of the generator circuit breaker. If the feedback indicates that the generator circuit breaker is closed, the actual speed must be at least 20 rpm.
- **Number of sensor faults for trip (0-Number of sensors):**Sets how many sensors must be faulty to cause a trip of the ESTC. If the value is 0, no trip will appear.

3.2.5 Start adjustments turbine site 1

Configuration – (2) Speed –Start adjustments turbine site 1 - Start selection

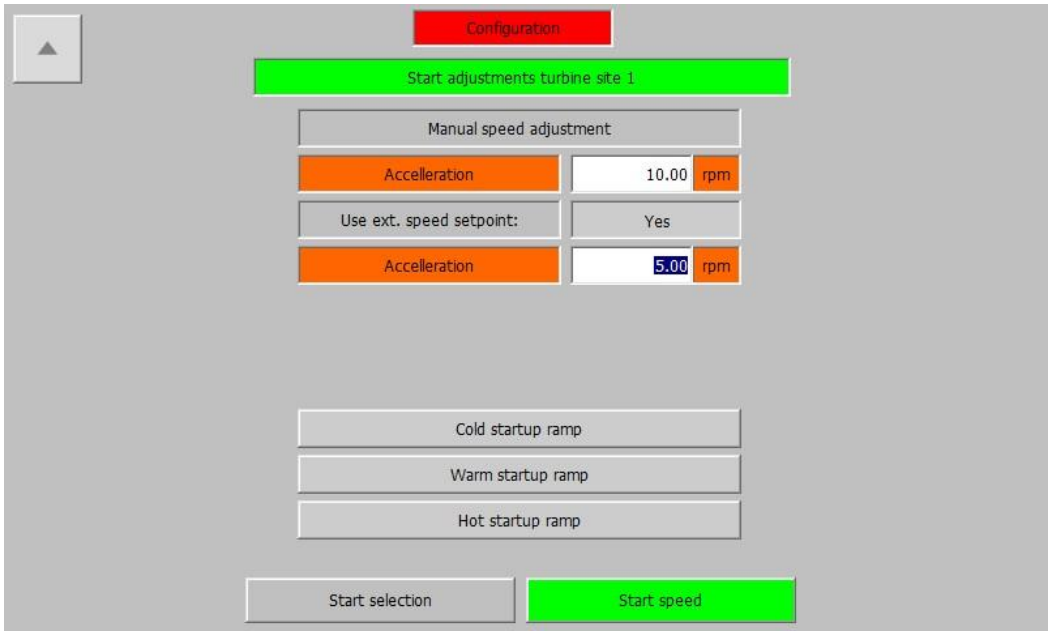
The start adjustments level of turbine site 1 includes the parameters for the startup phase of the speed control. The start adjustments level is separated into 2 areas.

The following parameters are available on the "Start selection" level of the start adjustments level of turbine site 1:

- **Rated speed:**Sets the rated speed of the machine. This value is according to the controller speed. if a gearbox is used, it will be the speed after it.
- **Max speed set point:**Sets the maximum allowed speed set point during operation.
- **Min speed set point:**Sets the minimum allowed speed set point during operation. The limitation of the speed set point begins when the speed set point exceeded the limit. Until the next stop of the turbine, it is not possible to set a lower value than this limit.
- **Start type selection:**Sets the type of startup ramp. The following start types areavailable:
  - **Manuel Start:**At manual start, the speed set point must be manually set. When the turbine is started in manual mode the speed set point will be 0 at the beginning.
  - **Direct Start:**There are 2 different versions of the direct start:
    - **Acceleration:**The speed set point will be increased to rated speed by the configuredacceleration rate.
    - **Time:**The speed set point will be increased within the configured time to rated speed.
  - **Ramp Start:**When ramp start is chosen, up to 6 holding points can be approached until the turbine reaches the rated speed. Up to 3 different start up ramps can be set according to the time since the turbine stopped.
    - **Cold startup ramp**
    - **Warm startup ramp**
    - **Hot startup ramp**

- **External set point:**If external set point is configured, the ESTC must get either an 4-20mA input or a set point over Ethernet communication.

- **Use cold startup ramp:**If "Ramp start" is chosen, the cold start up ramp is automatically activated.
- **Use warm startup ramp:**If "Ramp start" is chosen, the warm startup ramp can be used to set a 2. Startup ramp.
- **Use hot startup ramp:**If "Ramp stat" is chosen and the warm startup ramp is used, the hot startup ramp can be used as 3. startup ramp.



Configuration – (2) Speed –Start adjustments turbine site 1 - Start speed

The following parameters are available on the "Start speed" level of the start adjustments level of turbine site 1:

- **Manual speed adjustment acceleration:**Sets the acceleration for an manually set speed set point.
- **Use ext. speed set point:**If activated, it is possible to set an external speed set point.
- **Acceleration:** Sets the acceleration for an externally set speed set point.
- **Direct start type(Acceleration/Time):**Sets if the direct start should be controlled by a set acceleration or by a set time to rated speed.
- **Acceleration/Time:**Depending on the configured "Direct start type", this parameter sets the acceleration or the needed time to rated speed.
- **Cold startup ramp:**Opens the cold startup ramp level.
- **Warm startup ramp:**Opens the warm startup ramp level.
- **Hot startup ramp:**Opens the hot startup ramp level.

Configuration – (2) Speed –Start adjustments turbine site 1 - Cold startup ramp

The cold startup ramp level of turbine site 1 includes the parameters for the startup phase when the cold startup ramp is activated. The cold startup ramp is active when either warm and hot startup ramp are finished or not used. The cold startup ramp includes up to 6 holding points and the acceleration to rated speed. the following parameters are available:

- **Use:**Sets if the holding point is used or not.
- **Speed:**Sets the speed set point for the holding point.
- **Holding time:**Sets the time that the speed set point will stay at the holding point before accelerating to the next holding point or to rated speed.
- **Acceleration:**Sets the acceleration of the speed set point to reach the holding point or the rated speed.

Additionally the following parameters are available for the cold startup ramp:

- **Theoretical start time:**Shows the calculated time that is needed from the start of the turbine until it will reach the rated speed.

Configuration – (2) Speed –Start adjustments turbine site 1 - Warm startup ramp

The warm startup ramp level of turbine site 1 includes the parameters for the startup phase when the warm startup ramp is activated. The warm startup ramp is active when the hot startup ramp is finished or not used. The warm startup ramp includes up to 6 holding points and the acceleration to rated speed. the following parameters are available:

- **Use:** Sets if the holding point is used or not.
- **Speed:** Sets the speed set point for the holding point.
- **Holding time:** Sets the time that the speed set point will stay at the holding point before accelerating to the next holding point or to rated speed.
- **Acceleration:** Sets the acceleration of the speed set point to reach the holding point or the rated speed.

Additionally the following parameters are available for the warm startup ramp:

- **Theoretical start time:** Shows the calculated time that is needed from the start of the turbine until it will reach the rated speed.
- **Time after stop:**Sets the time for the warm startup ramp to be active after the stop of the turbine and a finished or not used hot startup ramp. To activate the warm startup ramp, the turbine must have reached rated speed at the last start, otherwise the time will not be started again.
- **Left:**Shows the left time of the warm startup ramp. When the time is over, the warm startup ramp will be deactivated and the cold startup ramp is activated.

Configuration – (2) Speed –Start adjustments turbine site 1 - Hot startup ramp

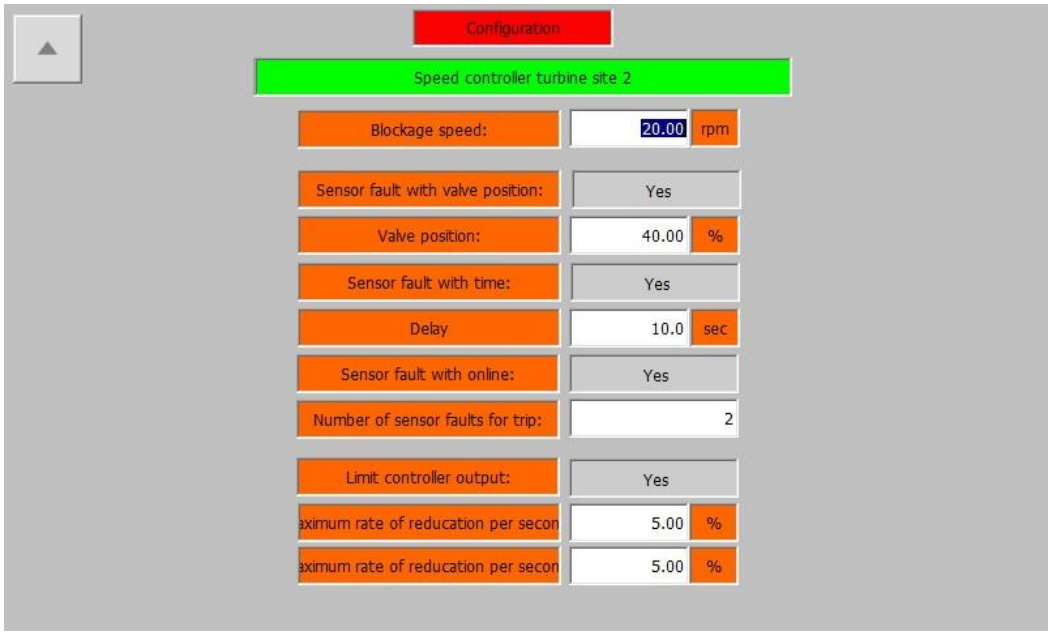
The hot startup ramp level of turbine site 1 includes the parameters for the startup phase when the hot startup ramp is activated. The hot startup ramp is active after the turbine has been stopped. The hot startup ramp includes up to 6 holding points and the acceleration to rated speed. the following parameters are available:

- **Use:** Sets if the holding point is used or not.
- **Speed:** Sets the speed set point for the holding point.
- **Holding time:** Sets the time that the speed set point will stay at the holding point before accelerating to the next holding point or to rated speed.
- **Acceleration:** Sets the acceleration of the speed set point to reach the holding point or the rated speed.

Additionally the following parameters are available for the hot startup ramp:

- **Theoretical start time:** Shows the calculated time that is needed from the start of the turbine until it will reach the rated speed.
- **Time after stop:** Sets the time for the got startup ramp to be active after the stop of the. To activate the hot startup ramp, the turbine must have reached rated speed at the last start, otherwise the time will not be started again.
- **Left:** Shows the left time of the hot startup ramp. When the time is over, the hot startup ramp will be deactivated and the warm startup ramp is activated.

3.2.6 Speed controller turbine site 2



Configuration – (2) Speed –Speed controller turbine site 2

The speed controller of turbine site 2 includes the parameters for the control of the speed, and the protection of the turbine in case of faulty speed pickups.

The following parameters are available:

- **Blockage speed (Min 0):** The minimum speed set points that enables the speed controller. Speed set points that are lower than this value will be ignored. Additionally this parameters is also used for enabling the detection of speed difference between the speed sensors.
- **Sensor fault with valve position(Yes/No):** If activated, the fault of speed sensors will be checked by the actual output of the controller. If the controller output is bigger than the adjusted limit, the speed must be at least 20 rpm.
- **Valve position (1-99%):** The limit for detection a speed sensor fault by using the controller output.
- **Sensor fault with time(Yes/No):** If activated, the fault of speed sensors will be checked by the time after getting the start command. When the configured time has been finished, the speed must be at least 20 rpm.
- **Delay:** The time delay for the detection of a speed sensor fault.
- **Sensor fault with generator c.b. (Yes/No):** If activated, the fault of speed sensors will be checked by the feedback of the generator circuit breaker. If the feedback indicates that the generator circuit breaker is closed, the actual speed must be at least 20 rpm.
- **Number of sensor faults for trip (0-Number of sensors):** Sets how many sensor must be faulty to cause a trip of the ESTC. If the value is 0, no trip will appear.

3.2.7 Start adjustments turbine site 2

Configuration – (2) Speed – Start adjustments turbine site 2 - Start selection

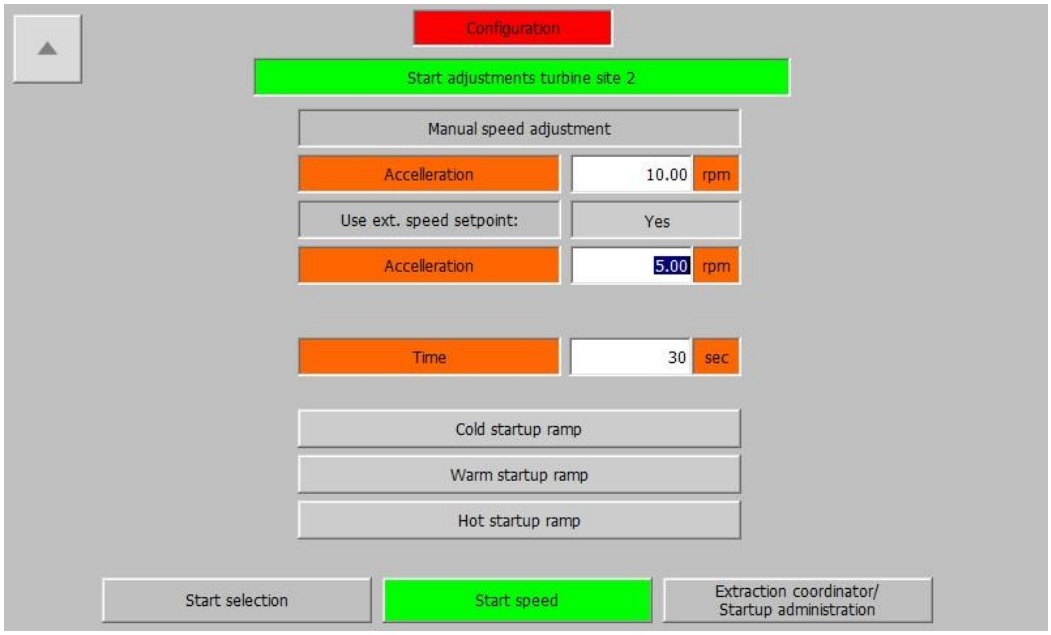
The start adjustments level of turbine site2 includes the parameters for the startup phase of the speed control. The start adjustments level is separated into 2 areas.

The following parameters are available on the "Start selection" level of the start adjustments level of turbine site 2:

- **Rated speed:** Sets the rated speed of the machine. This value is according to the controller speed. if a gearbox is used, it will be the speed after it.
- **Max speed set point:** Sets the maximum allowed speed set point during operation.
- **Min speed set point:** Sets the minimum allowed speed set point during operation. The limitation of the speed set point begins when the speed set point exceeded the limit. Until the next stop of the turbine, it is not possible to set a lower value than this limit.
- **Start type selection:** Sets the type of startup ramp. The following start types areavailable:
  - **Manuel Start:** At manual start, the speed set point must be manually set. When the turbine is started in manual mode the speed set point will be 0 at the beginning.
  - **Direct Start:** There are 2 different versions of the direct start:
    - **Acceleration:** The speed set point will be increased to rated speed by the configuredacceleration rate.
    - **Time:** The speed set point will be increased within the configured time to rated speed.
  - **Ramp Start:** When ramp start is chosen, up to 6 holding points can be approached until the turbine reaches the rated speed. Up to 3 different start up ramps can be set according to the time since the turbine stopped.
    - **Cold startup ramp**
    - **Warm startup ramp**
    - **Hot startup ramp**

- **External set point:** If external set point is configured, the ESTC must get either an 4-20mA input or a set point over Ethernet communication.

- **Use cold startup ramp:** If "Ramp start" is chosen, the cold start up ramp is automatically activated.
- **Use warm startup ramp:** If "Ramp start" is chosen, the warm startup ramp can be used to set a 2. Startup ramp.
- **Use hot startup ramp:** If "Ramp stat" is chosen and the warm startup ramp is used, the hot startup ramp can be used as 3. startup ramp.



Configuration – (2) Speed – Start adjustments turbine site 2 - Start speed

The following parameters are available on the "Start speed" level of the start adjustments level of turbine site 2:

- **Manual speed adjustment acceleration:** Sets the acceleration for an manually set speed set point.
- **Use ext. speed set point:** If activated, it is possible to set an external speed set point.
- **Acceleration:** Sets the acceleration for an externally set speed set point.
- **Direct start type(Acceleration/Time):** Sets if the direct start should be controlled by a set acceleration or by a set time to rated speed.
- **Acceleration/Time:** Depending on the configured "Direct start type", this parameter sets the acceleration or the needed time to rated speed.
- **Cold startup ramp:** Opens the cold startup ramp level.
- **Warm startup ramp:** Opens the warm startup ramp level.
- **Hot startup ramp:** Opens the hot startup ramp level.

Configuration – (2) Speed - Start adjustments turbine site 2 - Cold startup ramp

The cold startup ramp level of turbine site 2 includes the parameters for the startup phase when the cold startup ramp is activated. The cold startup ramp is active when either warm and hot startup ramp are finished or not used. The cold startup ramp includes up to 6 holding points and the acceleration to rated speed. the following parameters are available:

- **Use:** Sets if the holding point is used or not.
- **Speed:** Sets the speed set point for the holding point.
- **Holding time:** Sets the time that the speed set point will stay at the holding point before accelerating to the next holding point or to rated speed.
- **Acceleration:** Sets the acceleration of the speed set point to reach the holding point or the rated speed.

Additionally the following parameters are available for the cold startup ramp:

- **Theoretical start time:** Shows the calculated time that is needed from the start of the turbine until it will reach the rated speed.

Configuration – (2) Speed – Start adjustments turbine site 2 - Warm startup ramp

The warm startup ramp level of turbine site 2 includes the parameters for the startup phase when the warm startup ramp is activated. The warm startup ramp is active when the hot startup ramp is finished or not used. The warm startup ramp includes up to 6 holding points and the acceleration to rated speed. the following parameters are available:

- **Use:** Sets if the holding point is used or not.
- **Speed:** Sets the speed set point for the holding point.
- **Holding time:** Sets the time that the speed set point will stay at the holding point before accelerating to the next holding point or to rated speed.
- **Acceleration:** Sets the acceleration of the speed set point to reach the holding point or the rated speed.

Additionally the following parameters are available for the warm startup ramp:

- **Theoretical start time:** Shows the calculated time that is needed from the start of the turbine until it will reach the rated speed.
- **Time after stop:** Sets the time for the warm startup ramp to be active after the stop of the turbine and a finished or not used hot startup ramp. To activate the warm startup ramp, the turbine must have reached rated speed at the last start, otherwise the time will not be started again.
- **Left:** Shows the left time of the warm startup ramp. When the time is over, the warm startup ramp will be deactivated and the cold startup ramp is activated.

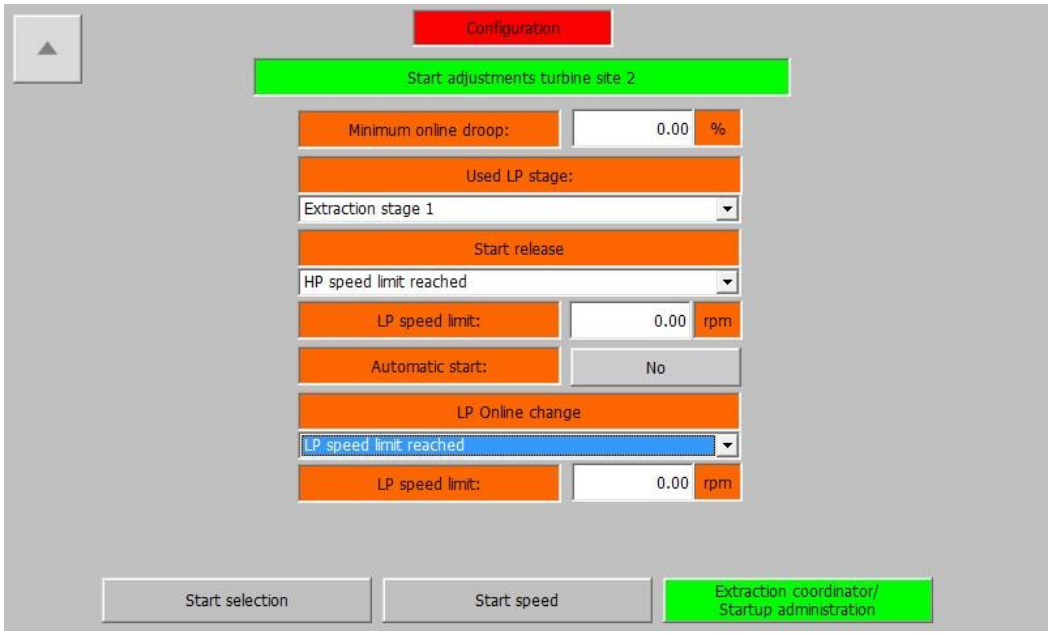
Configuration – (2) Speed – Start adjustments turbine site 2 - Hot startup ramp

The hot startup ramp level of turbine site 2 includes the parameters for the startup phase when the hot startup ramp is activated. The hot startup ramp is active after the turbine has been stopped. The hot startup ramp includes up to 6 holding points and the acceleration to rated speed. the following parameters are available:

- **Use:** Sets if the holding point is used or not.
- **Speed:** Sets the speed set point for the holding point.
- **Holding time:** Sets the time that the speed set point will stay at the holding point before accelerating to the next holding point or to rated speed.
- **Acceleration:** Sets the acceleration of the speed set point to reach the holding point or the rated speed.

Additionally the following parameters are available for the hot startup ramp:

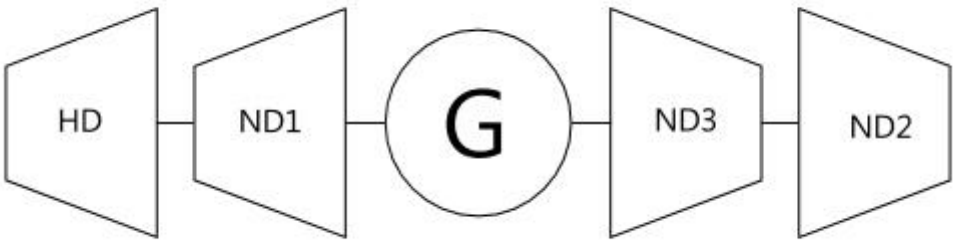
- **Theoretical start time:** Shows the calculated time that is needed from the start of the turbine until it will reach the rated speed.
- **Time after stop:** Sets the time for the got startup ramp to be active after the stop of the. To activate the hot startup ramp, the turbine must have reached rated speed at the last start, otherwise the time will not be started again.
- **Left:** Shows the left time of the hot startup ramp. When the time is over, the hot startup ramp will be deactivated and the warm startup ramp is activated.



Configuration – (2) Speed – Start adjustments turbine site 2 - Extraction coordinator

The Extraction coordinator/Startup administration level of the 2.turbine site includes the parameters for the startup of the 2. turbine site in relation to different factors. The control of the 2.turbine site can be interlocked, so that it is not possible to start the 2. turbine site too early. The following parameters are available:

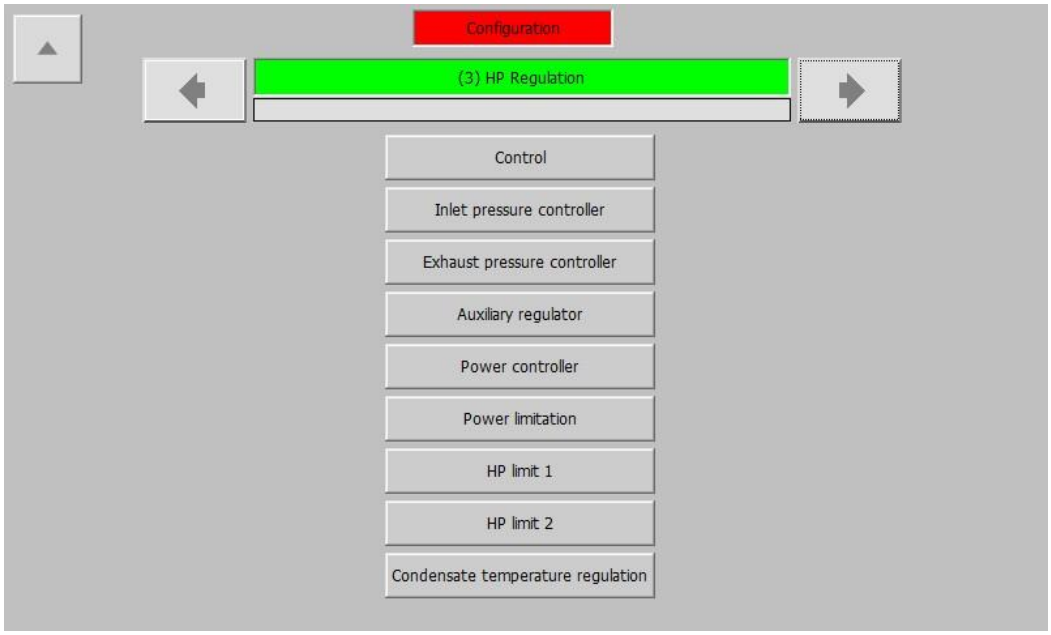
- **Minimum online droop:**Sets the minimum increase of the controller output when the speed controller of turbine site 2 changes from offline to online mode. When the regulator output was 5% before changing from offline to online mode, and the Minimum online droop if 3%, the controller output will be increase to 8%. While the speed controller of turbine site 2 is in online mode, the controller output cannot be lower than the calculated value (Example8%). This function is used to make sure that turbine site 2 does get enough steam, and does not slip out of the coupling.
- **Used LP stage:**Sets the used LP Stage that is used for the 2. turbine site as speed control. This is need only if the turbine has more than 1 extraction stage. All extraction stages that are before the adjusted stage (lower number) will be assigned to turbine site 2. All extractions that are behind the selected stage (higher number) will be assigned to turbine site 2. Example with the parameter "Used LP Stage: Extraction stage 2"



Example drawing for extraction stage 2 as "used LP Stage"

- **Start release:**Sets the release for starting up the 2. turbine site. The selected parameters must be satisfied to allow the start of the 2. turbine site. The following parameters can be selected:
  - **HP Start:**Turbine site 1 must be started.
  - **HPreached rated speed:**Turbine site 1 must have reached rated speed.
  - **HP Online:**Turbine site 1 must be in online mode.
  - **HPreached speed limit:**Turbine site 1 must have reached a configured speed limit.
  - **Reached power limit:**The power output must be higher than the configured limit.
- **Power limit/Speed limit:**Sets the power or speed limit if selected at "Start release".
- **Automatic start:**Sets if the 2. turbine site should start automatically as soon as it is ready to start.
- **LP Online change:**Because the 2. turbine site has no separate generator and generator circuit breaker, there are different options to change the speed control of turbine site 2 from offline to online mode. The following parameters are available:
  - **LP Online input:**A digital input named "LP Online" can be used to change the turbine site 1 from offline to online mode.
  - **LP reached rated speed:**Turbine site 2 will change from offline to online mode as soon as it has reached rated speed.
  - **LP reached speed limit:**Turbine site 2 will change from offline to online mode as soon as a configured limit has been exceeded.
- **LP speed limit:**Sets the speed limit for changing turbine site 2 from offline to online mode if set at "LP Online change" to "LP reached speed limit".

3.3 HP Regulation



Configuration - (3) HP Regulation

The HP Regulation Level has all parameters according to the control modes of the HP Stage. The following levels are available:

- Control
- Inlet pressure controller
- Exhaust pressure controller
- Auxiliary regulator
- Power controller
- Power limitation
- HP Limit 1
- HP Limit 2
- Condensate temperature regulation

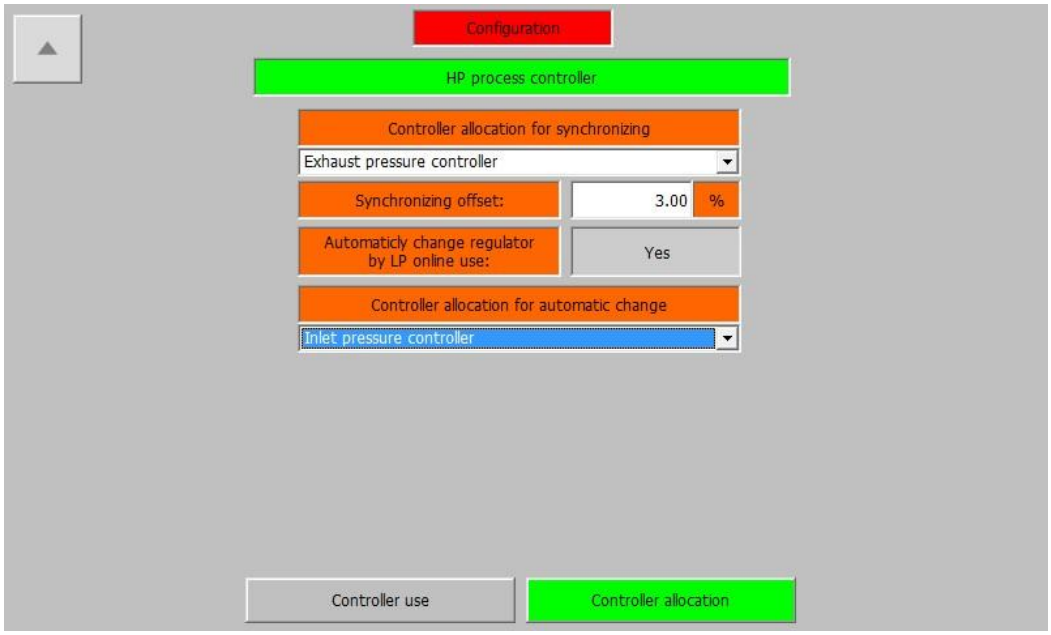
3.3.1 HP Controls

Configuration - (3) HP Regulation - Regulation - Controller use

The Regulation level of the HP Regulation includes the parameters for selecting the control and limitation modes of the HP controller, and also the automatic change of control modes. The Regulation level is separated into the 2 levels "Controller use" and "Controller allocation".

"Controller use" includes the parameters to select which regulations and limitations are used. The following parameters are available:

- **Use inlet pressure controller:**If activated, an inlet pressure controller is used.
- **Use exhaust pressure controller:**If activated, an exhaust pressure controller is used.
- **Use auxiliary regulation:** If activated, an auxiliary controller is used.
- **Use power controller:** If activated, a power controller is used.
- **Use power limitation:** If activated, a power limitation is used.
- **Use condensate temperature controller:**If activated, a temperature regulation for 2 condensate stages is used.
- **HP limit 1:** If activated and selected, HP limitation 1 is used for the selected value.
- **HD limit 2:**If activated and selected, HP limitation 2 is used for the selected value.



Configuration - (3) HP Regulation - Regulation - Controller allocation

"Controller allocation" includes the parameters for the automatic activation of controllers. The following parameters are available:

- **Controller allocation for synchronizing:**If more than 1 controller selected is, it is needed to select a start regulation. When turbine site 1 changes from offline to online mode, this regulation will be activated.
- **Synchronizing offset:**Sets how many % regulator output will be added to the HP controller when it changes from Offline to Online mode.
- **Automatically change regulator by LP online use:**If more than 1 controller and a turbine site 2 speed controller selected is, is it possible to selected a HP regulator change trigger by turbine site 2 changing from offline to online mode.
- **Controller allocation for automatic change:**Sets the regulator that will be activated for the HP stage when the turbine site 2 changes from Offline to Online mode.

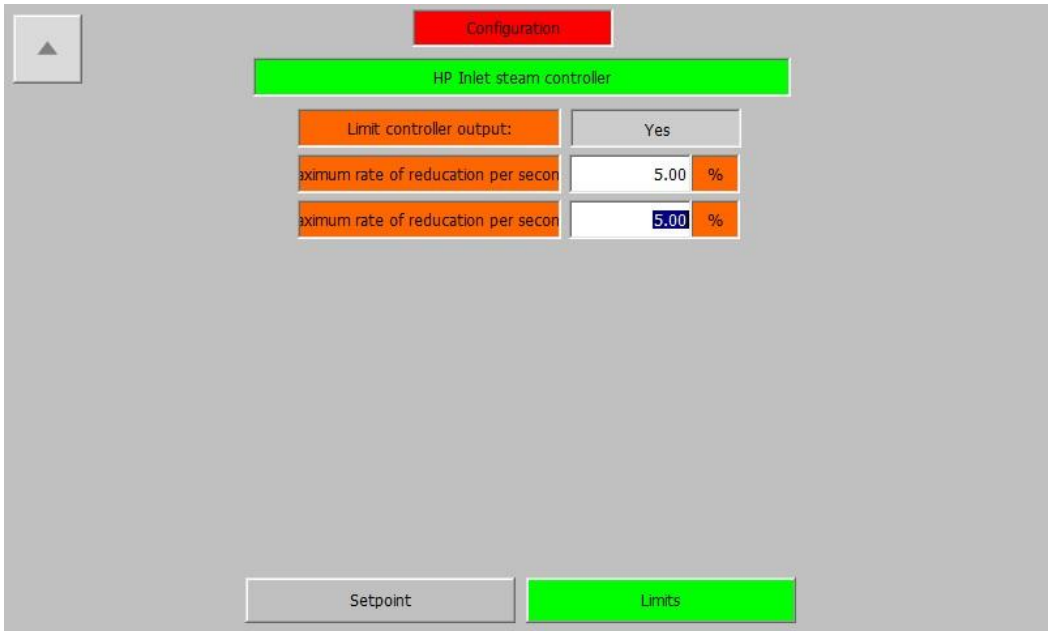
3.3.2 Inlet steam controller

Configuration - HP Regulation - HP inlet steam controller - Set point

The Inlet steam controller level of the HP controller includes the parameters for the inlet pressure control. It is separated into 2 levels "Set point" and "Limits". The Inlet pressure controller is regulating the inlet steam pressure of the turbine in online mode.

The Level "Set points" includes the parameters for limiting the setpoint. The following parameters are available:

- **Max set point:** Sets the maximum allowed set point.
- **Min set point:** Sets the minimum allowed set point.
- **Set point rate of rise per second:**Sets the maximum rate of rice for changing a set point.
- **Set point rate of reduction per second:**Sets the maximum rate of reduction for changing a Set point.
- **Set point tracking:**Sets if the Set point should be tracked with the actual value while the controller is not active.
- **Tracking offset:**If the Set point is tracked by the actual value, this parameter sets an offset to the actual value. Example:
  - **Actual value:** 10,0Bar
  - **Offset:** -0,1Bar
  - **Set point:** 9,9Bar
- **Initial Set point:**Sets if a specifiedSet point should be set before the turbine is started. As soon as the turbine is started, the Set point can be changed. It is not necessary that the controller is active, it is enough if the turbine is in offline speed control.
- **Initial Set point:**If the Initial Set point is activated, this value sets the Set point that is set before the turbine is started.



Configuration - HP Regulation - HP inlet steam controller - Limits

The level "Limits" includes the parameters for limiting the rate of change of the controller output. The following parameters are available:

- **Limit controller output:**If activated, the limitation for the change of the controller output is activated.
- **Maximum rate of reduction per second:**Sets the maximum allowed rate of reduction of the controller output. If the controller tries to reduce the controller output more than the adjusted rate of reduction, it will be limited.
- **Maximum rate of rise per second:**Sets the maximum allowed rate of rise for the controller output. If the controller tries to rise the controller output more than the adjusted rate of rice, it will be limited.

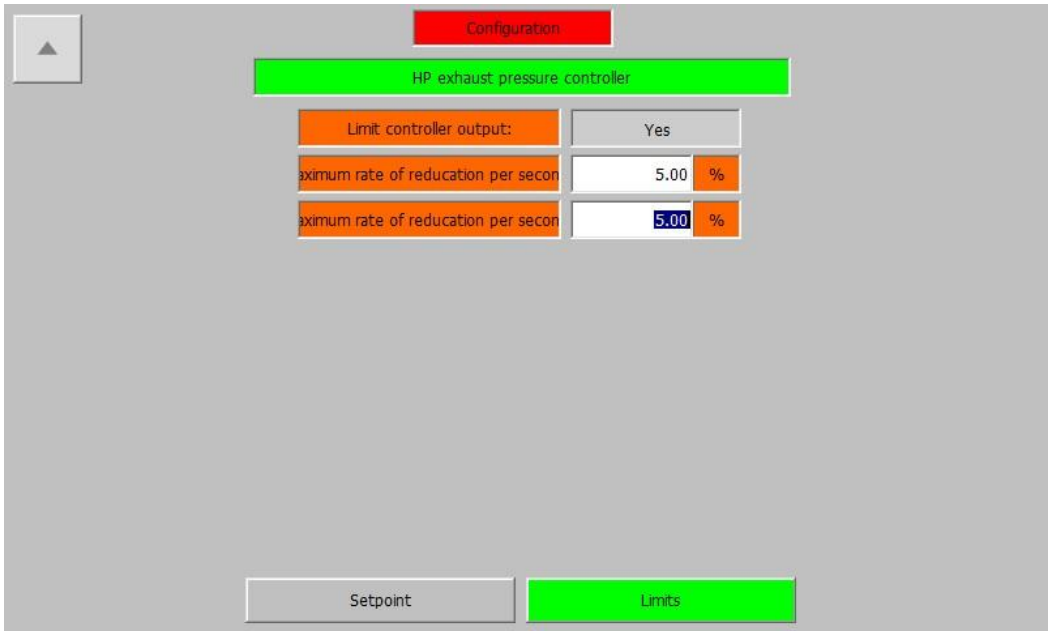
3.3.3 Exhaust pressure controller

Configuration - HP Regulation - HP exhaust steam controller - Set point

The exhaust steam controller level of the HP controller includes the parameters for the exhaust pressure control. It is separated into 2 levels "Set point" and "Limits". The exhaust pressure controller is regulating the exhaust steam pressure of the turbine in online mode.

The Level "Set points" includes the parameters for limiting the set point. The following parameters are available:

- **Max Set point:** Sets the maximum allowed Set point.
- **Min Set point:** Sets the minimum allowed Set point.
- **Set point rate of rise per second:** Sets the maximum rate of rice for changing a Set point.
- **Set point rate of reduction per second:** Sets the maximum rate of reduction for changing a Set point.
- **Set point tracking:** Sets if the Set point should be tracked with the actual value while the controller is not active.
- **Tracking offset:** If the Set point is tracked by the actual value, this parameter sets an offset to the actual value. Example:
  - **Actual value:** 10,0Bar
  - **Offset:** -0,1Bar
  - **Set point:** 9,9Bar
- **Initial Set point:** Sets if a specifiedSet point should be set before the turbine is started. As soon as the turbine is started, the Set point can be changed. It is not necessary that the controller is active, it is enough if the turbine is in offline speed control.
- **Initial Set point:** If the Initial Set point is activated, this value sets the Set point that is set before the turbine is started.



Configuration - HP Regulation - HP exhaust steam controller - Limits

The level "Limits" includes the parameters for limiting the rate of change of the controller output. The following parameters are available:

- **Limit controller output:** If activated, the limitation for the change of the controller output is activated.
- **Maximum rate of reduction per second:** Sets the maximum allowed rate of reduction of the controller output. If the controller tries to reduce the controller output more than the adjusted rate of reduction, it will be limited.
- **Maximum rate of rise per second:** Sets the maximum allowed rate of rise for the controller output. If the controller tries to rise the controller output more than the adjusted rate of rice, it will be limited.

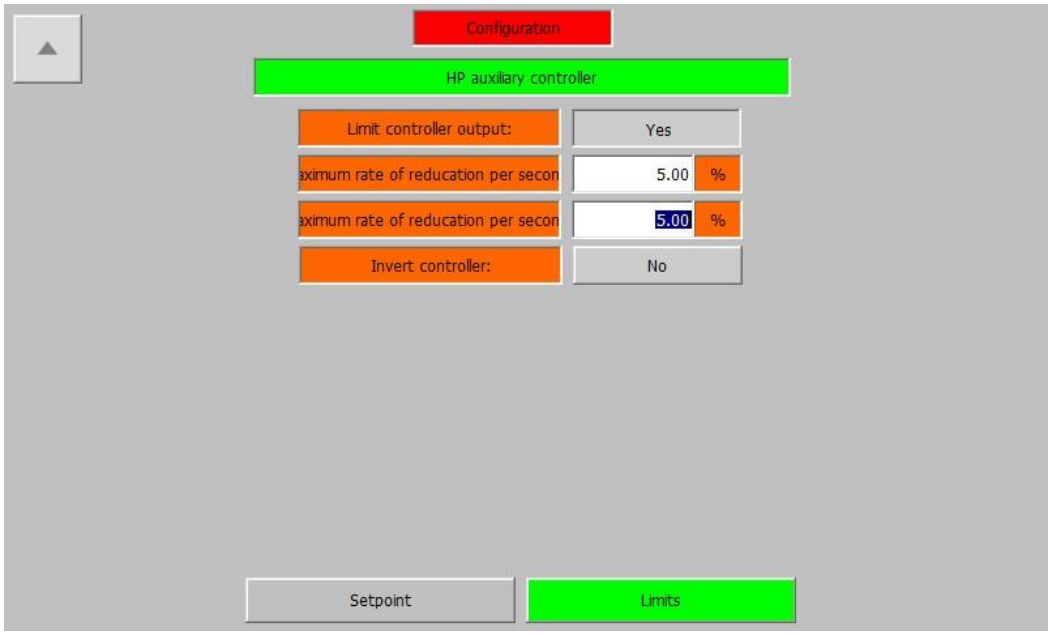
3.3.4 Auxiliary controller

Configuration - HP Regulation - HP auxiliary controller - Set point

The auxiliary controller level of the HP controller includes the parameters for the auxiliary control. It is separated into 2 levels "Set point" and "Limits". The auxiliary controller is regulating the auxili9ary value of the turbine in online mode.

The Level "Set points" includes the parameters for limiting the set point. The following parameters are available:

- **Max Set point:** Sets the maximum allowed Set point.
- **Min Set point:** Sets the minimum allowed Set point.
- **Set point rate of rise per second:** Sets the maximum rate of rice for changing a Set point.
- **Set point rate of reduction per second:** Sets the maximum rate of reduction for changing a Set point.
- **Set point tracking:** Sets if the Set point should be tracked with the actual value while the controller is not active.
- **Tracking offset:** If the Set point is tracked by the actual value, this parameter sets an offset to the actual value. Example:
  - **Actual value:** 10,0Bar
  - **Offset:** -0,1Bar
  - **Set point:** 9,9Bar
- **Initial Set point:** Sets if a specifiedSet point should be set before the turbine is started. As soon as the turbine is started, the Set point can be changed. It is not necessary that the controller is active, it is enough if the turbine is in offline speed control.
- **Initial Set point:** If the Initial Set point is activated, this value sets the Set point that is set before the turbine is started.

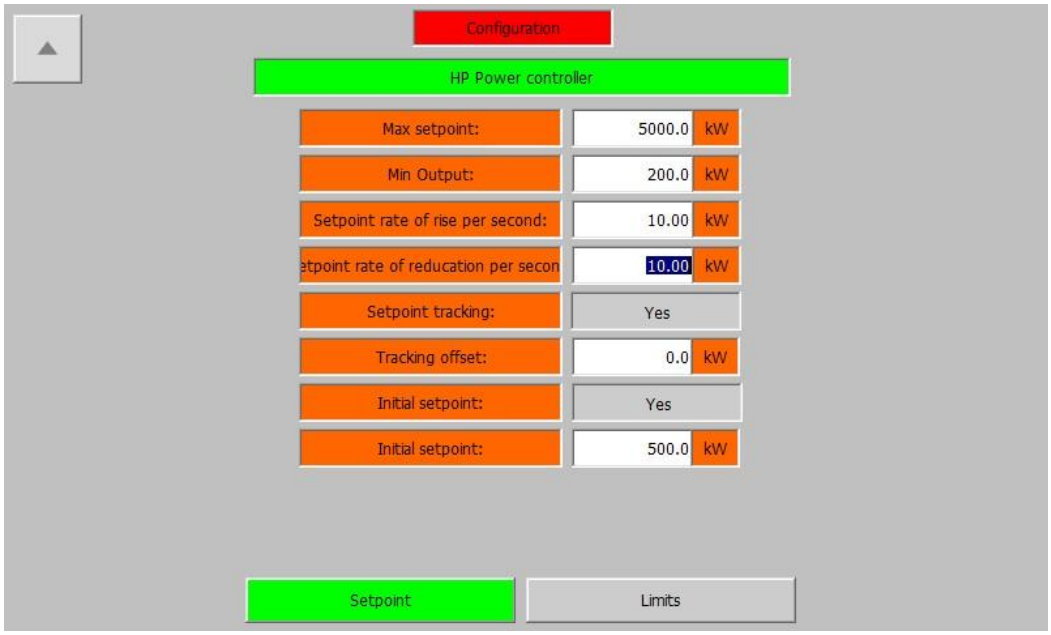


Configuration - HP Regulation - HP auxiliary controller - Limits

The level "Limits" includes the parameters for limiting the rate of change of the controller output. The following parameters are available:

- **Limit controller output:** If activated, the limitation for the change of the controller output is activated.
- **Maximum rate of reduction per second:** Sets the maximum allowed rate of reduction of the controller output. If the controller tries to reduce the controller output more than the adjusted rate of reduction, it will be limited.
- **Maximum rate of rise per second:** Sets the maximum allowed rate of rise for the controller output. If the controller tries to rise the controller output more than the adjusted rate of rice, it will be limited.
- **Invert controller:**Sets of the controller should work inverted. The parameters is needed, cause the controller does not know which value is used for the regulation and where it is in the steam system. Example:
  - **Yes:**If the actual value is increasing compared to the Set point, the controller output will increase. (see inlet pressure control)
  - **No:**If the actual value is increasing compared to the Set point, the controller output will decrease. (see power control)

3.3.5 Power controller

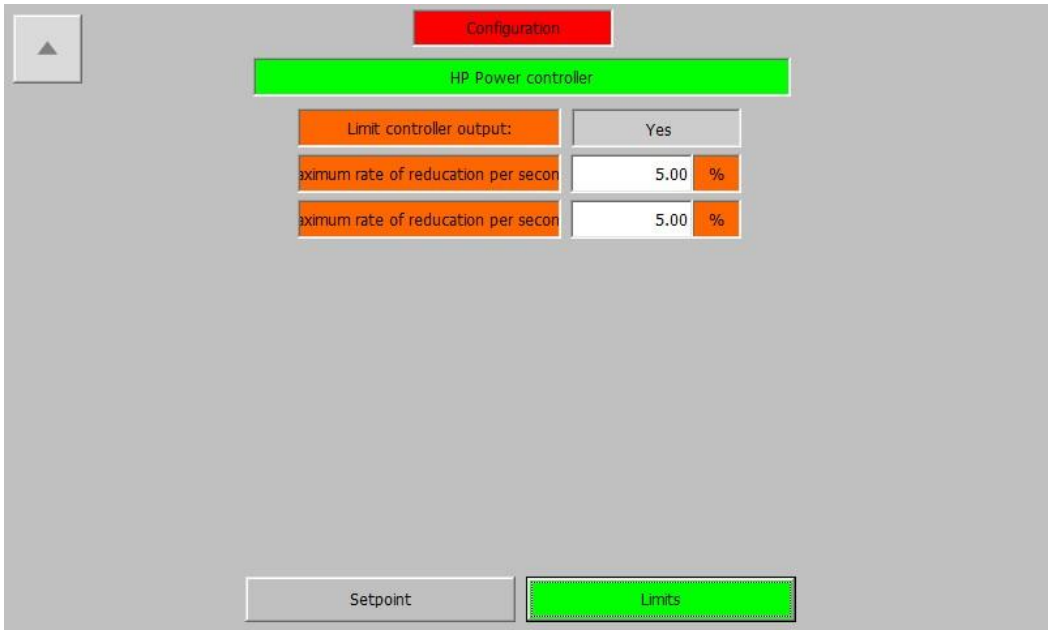


Configuration - HP Regulation - HP Power controller - Set point

The power controller level of the HP controller includes the parameters for the power control. It is separated into 2 levels "Set point" and "Limits". The power controller is regulating the power output of the turbine in online mode.

The Level "Set points" includes the parameters for limiting the set point. The following parameters are available:

- **Max Set point:** Sets the maximum allowed Set point.
- **Min Set point:** Sets the minimum allowed Set point.
- **Set point rate of rise per second:** Sets the maximum rate of rice for changing a Set point.
- **Set point rate of reduction per second:** Sets the maximum rate of reduction for changing a Set point.
- **Set point tracking:** Sets if the Set point should be tracked with the actual value while the controller is not active.
- **Tracking offset:** If the Set point is tracked by the actual value, this parameter sets an offset to the actual value. Example:
  - **Actual value:**1000KW
  - **Offset:** 200KW
  - **Set point:** 1200KW
- **Initial Set point:** Sets if a specifiedSet point should be set before the turbine is started. As soon as the turbine is started, the Set point can be changed. It is not necessary that the controller is active, it is enough if the turbine is in offline speed control.
- **Initial Set point:** If the Initial Set point is activated, this value sets the Set point that is set before the turbine is started.



Configuration - HP Regulation - HP Power controller - Limits

The level "Limits" includes the parameters for limiting the rate of change of the controller output. The following parameters are available:

- **Limit controller output:** If activated, the limitation for the change of the controller output is activated.
- **Maximum rate of reduction per second:** Sets the maximum allowed rate of reduction of the controller output. If the controller tries to reduce the controller output more than the adjusted rate of reduction, it will be limited.
- **Maximum rate of rise per second:** Sets the maximum allowed rate of rise for the controller output. If the controller tries to rise the controller output more than the adjusted rate of rice, it will be limited.

3.3.6 Power limitation

Configuration - HP Regulation - Power limitation - Set point

The power limitation level of the HP Controller includes the parameters for the limitation of the power output. It is separated into 4 Levels "Set point", "Limits", "Ramp" and "EVU". The power limitation imitates the power output of the turbine with HP and LP stages for minimum and maximum power.

The Level "Set points" includes the parameters for limiting the set point. The following parameters are available:

- **Max Set point:** Sets the maximum allowed Set point.
- **Min Set point:** Sets the minimum allowed Set point.
- **Set point rate of rise per second:** Sets the maximum rate of rice for changing a Set point.
- **Set point rate of reduction per second:** Sets the maximum rate of reduction for changing a Set point.
- **Set point tracking:** Sets if the Set point should be tracked with the actual value while the controller is not active.
- **Tracking offset:** If the Set point is tracked by the actual value, this parameter sets an offset to the actual value. Example:
  - **Actual value:** 1000KW
  - **Offset:** 200KW
  - **Set point:** 1200KW
- **Initial Set point:** Sets if a specifiedSet point should be set before the turbine is started. As soon as the turbine is started, the Set point can be changed. It is not necessary that the controller is active, it is enough if the turbine is in offline speed control.
- **Initial Set point:** If the Initial Set point is activated, this value sets the Set point that is set before the turbine is started.

Configuration - HP Regulation - Power limitation - Limits

The level "Limits" includes the parameters for limiting the rate of change of the limiter output. The following parameters are available:

- **Limit controller output:** If activated, the limitation for the change of the limiter output is activated.
- **Maximum rate of reduction per second:** Sets the maximum allowed rate of reduction of the limiter output. If the controller tries to reduce the limiter output more than the adjusted rate of reduction, it will be limited.
- **Maximum rate of rise per second:** Sets the maximum allowed rate of rise for the limiter output. If the limiter tries to rise the limiter output more than the adjusted rate of rice, it will be limited.

Configuration - HP Regulation - Power limitation - ramp

The level "Ramp" include the parameters for the automatic ramps. The following parameters are available:

- **Use deload ramp:**If activated, it is possible to stop the turbine with an automatically deload of the turbine starting from the actual power output.
- **Deload ramp Set point:**Sets the value to which Set point the turbine load should be decreased.
- **Rate of deload per second:**Sets the rate of deload for the stop ramp. As lower the rate is, as smoother the turbine will stop.
- **Save stop signal:**If activated, if the stop ramp can be cancelled or not. Save stop ramp is set to "Yes" it is not possible to cancel the deload ramp anymore. If it is set to "No", the deload ramp will stop as soon as the stop input is off.
- **Use power limitation release curve:**If activated, it is possible to set an automatic power limitation release curve. This function can be used to avoid the turbine to increase the load too quickly after changing from offline to online mode.
- **Time until increasing of the load:**The time after synchronizing that the controller will hold the turbine on minimum load. When this time has finished, the release curve will start.
- **Time to maximum load first time:**The time after the start of the release curve until the released power is at maximum. This time is only active after the first synchronizing after a turbine start.
- **Time to maximum load every time:**The time after the start of the release curve until the released power is at maximum. this parameter is active after every synchronizing and also after island mode condition.
- **Maximum power lead:**The maximum allowed difference between the release curve Set point and the actual power output. If the power output is not increasing and the difference

between the release curve Set point and the power output is higher than this value, the release curve Set point will not increase more.

Configuration - HP Regulation - Power limitation - EVU

The level "EVU" includes the parameters for the automatic load decreasing from the network operators. The following parameters are available:

- **EVU limiting use:**If activated, it is possible to decrease the maximum power output of the turbine with digital inputs.
- **EVU limiting step 0:**Shows the maximum released power output when no EVU limiting step is active. The maximum released power output is the according to the maximum Set point of the power limitation.
- **EVU limiting step 1:**If step 1 of the EVU limiting is activated, and step 2-4 are not active, the power will be limited to the set value.
- **EVU limiting step 2:**If step 2 of the EVU limiting is activated and step 3 and 4 are not active, the power will be limited to the set value.
- **EVU limiting step 3:**If step 3 of the EVU limiting is activated and step 4 is not active, the power will be limited to the set value.
- **EVU limiting step 4:**If step 4 of the EVU limiting is activated, the power will be limited to the set value.

Configuration - HP Regulation - Power limitation - Primary control

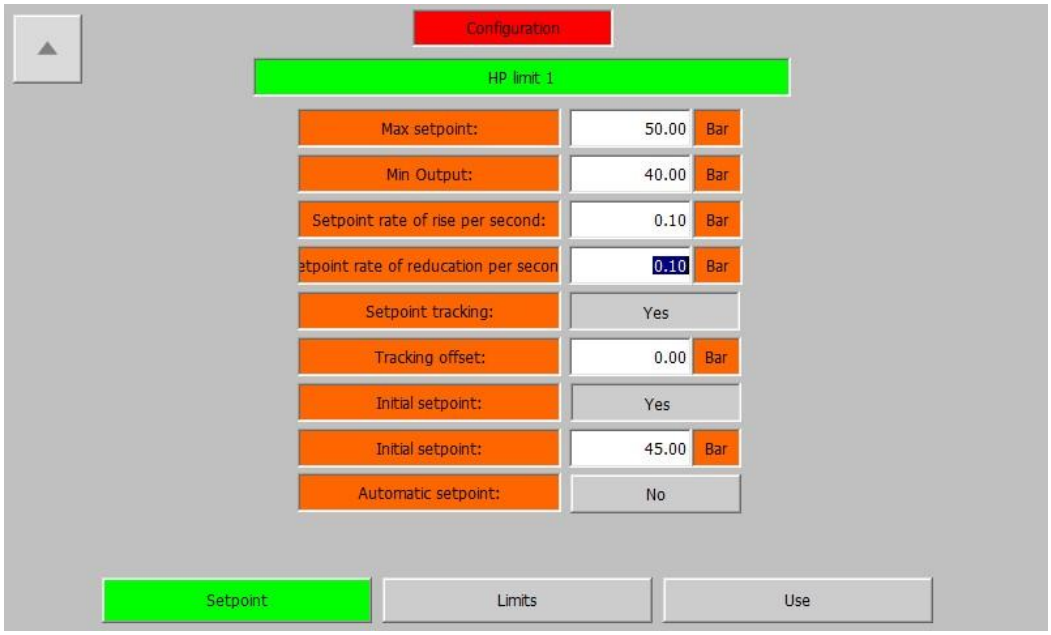
(ESTC Version 1.09 and higher) The level "Primary control" includes the parameters for the automatic load decreasing depending on the actual frequency. The parameters can be set automatically according to "BDEW". The primary control calculates the actual frequency from the turbine speed. If the actual frequency is higher than the start frequency, the primary control will be activated. While the primary control is activated, the actual power value will be saved. The saved power value will than depending on the actual frequency minus the rated frequency multiplied with the value "Power reduction per Hz" reduced. Example:

Saved power value:	1000KW
Rated frequency:	50,00Hz
Actual frequency:	50,25Hz
Power reduction per Hz:	40%
Power limitation to:	900KW

The following parameters are available:

- **Use primary control:** If activated, the primary control will reduce the power in case of a high frequency.
- **According to BDEW:** If activated, the values for detecting a high frequency and reducing of the power output will be according to the BDEW.
- **Frequency at rated speed:** Sets the frequency at the rated speed of the turbine. This value will be used to calculate the actual frequency from the actual speed.
- **Start frequency:** Sets the Start frequency for the primary control.
- **Stop frequency:** Sets the Stop frequency for the primary control.
- **Power reduction per Hz:** Sets the multiplication value for reducing the power while the primary control is active.

3.3.7 HP limit 1



Configuration - (3) HP Regulation - HP Limit 1 - Set point

The HP Limiter 1 level of the HP regulator includes the parameters for the first limiter. The parameters are separated into 3 levels "Set point", "Limits" and "Use". The HP Limiter 1 is limiting a free configurable value. The HP Limiter 1 is manipulating the controller output of the active process controller to insure a bumbles change between limitation and control.

The Level "Set points" includes the parameters for limiting the set point. The following parameters are available:

- **Max Set point:** Sets the maximum allowed Set point.
- **Min Set point:** Sets the minimum allowed Set point.
- **Set point rate of rise per second:** Sets the maximum rate of rice for changing a Set point.
- **Set point rate of reduction per second:** Sets the maximum rate of reduction for changing a Set point.
- **Set point tracking:** Sets if the Set point should be tracked with the actual value while the controller is not active.
- **Tracking offset:** If the Set point is tracked by the actual value, this parameter sets an offset to the actual value. Example:
  - **Actual value:** 45.0Bar
  - **Offset:** 0.1Bar
  - **Set point:** 45.1Bar
- **Initial Set point:** Sets if a specified Set point should be set before the turbine is started. As soon as the turbine is started, the Set point can be changed. It is not necessary that the controller is active, it is enough if the turbine is in offline speed control.
- **Initial Set point:** If the Initial Set point is activated, this value sets the Set point that is set before the turbine is started.

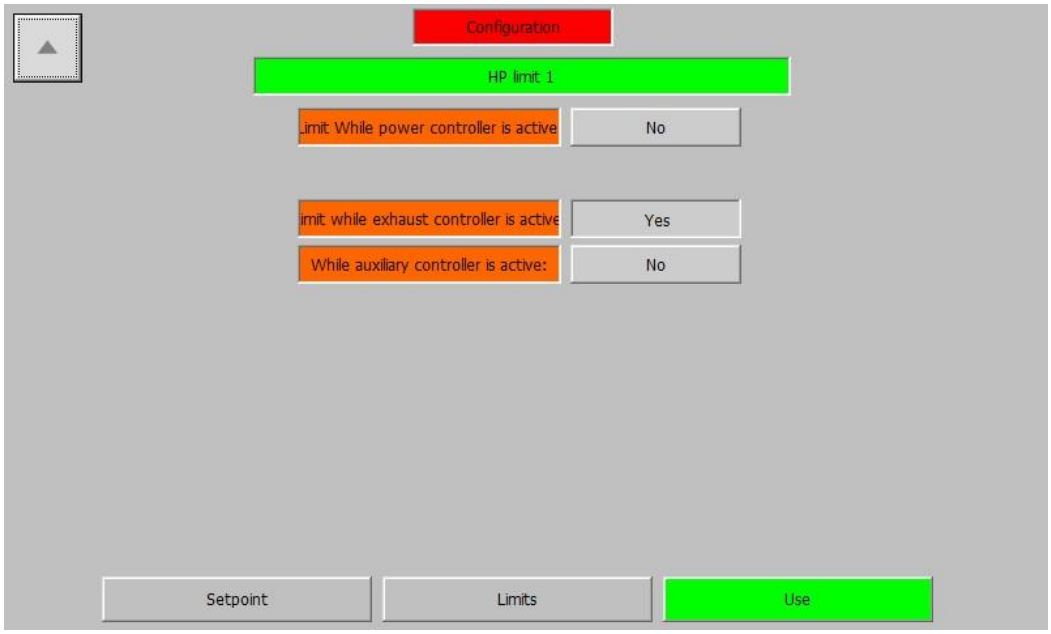
- **Automatic Set point:**If the selected limitation value is also used in an regulator, it is possible to use the actual Set point of the controller. This is useful to take the controller Set point as a limitation value when the control mode has been changed to another controller.
- **Automatic Set point offset:**If an automatic Set point is selected, the automaticSet point offset will be added to the actual controller Set point and be used as the limiter Set point.

Configuration - (3) HP Regulation - HP Limit 1 - Limits

The level "Limits" includes the parameters for limiting the rate of change of the limiter output. The following parameters are available:

- **Limit controller output:** If activated, the limitation for the change of the limiter output is activated.
- **Maximum rate of reduction per second:** Sets the maximum allowed rate of reduction of the limiter output. If the controller tries to reduce the limiter output more than the adjusted rate of reduction, it will be limited.
- **Maximum rate of rise per second:** Sets the maximum allowed rate of rise for the limiter output. If the limiter tries to rise the limiter output more than the adjusted rate of rice, it will be limited.
- **Type of limit:**Selects if the limitation value should be limited to a minimum or a maximum limit.
- **Invert controller:**Selects of the limiter is working invers. The parameters is needed, cause the controller does not know which value is used for the regulation and where it is in the steam system. Example:
    - **Yes:** If the actual value is increasing compared to the Set point, the limiter output will increase. (see inlet pressure control)

- **No:** If the actual value is increasing compared to the Set point, the limiter output will decrease. (see power control)

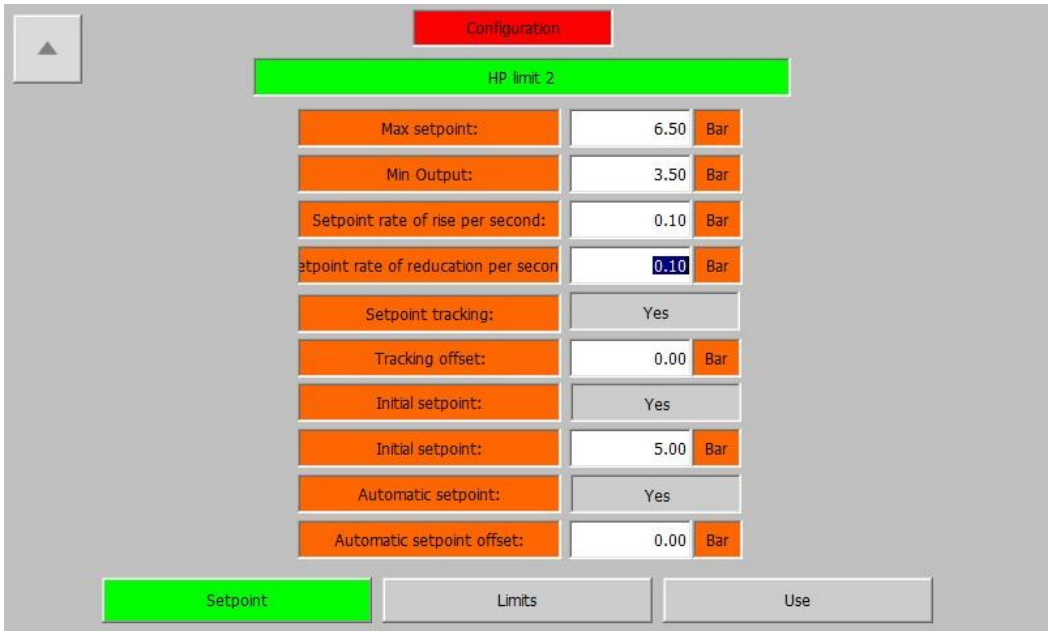


Configuration - (3) HP Regulation - HP Limit 1 - Use

The level "Use" includes the parameters about the activation of the limiter. The limiter can be configured to only work with certain active controllers. The following parameters are available:

- **Limit while power controller is active:** If activated, the limitation will work while the power controller is active.
- **Limit while inlet pressure controller is active:** If activated, the limitation will work while the inlet pressure controller is active.
- **Limit while exhaust controller is active:**If activated, the limitation will work while the exhaust steam pressure controller is active.
- **Limit while auxiliary controller is active:**If activated, the limitation will work while the auxiliary controller is active.

3.3.8 HP limit 2



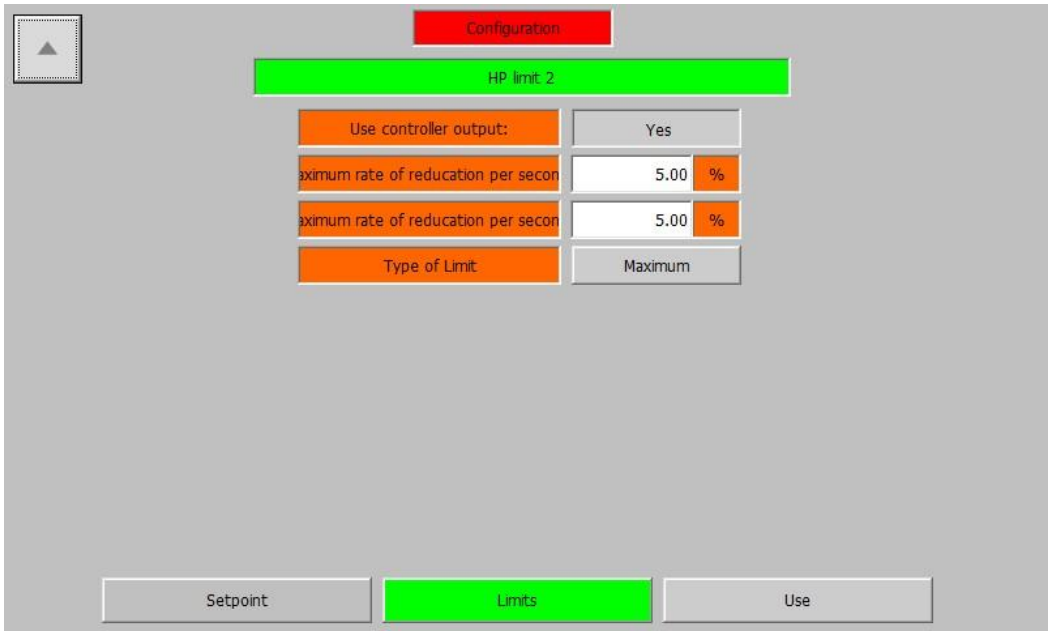
Configuration - (3) HP Regulation - HP Limit 2 - Set point

The HP Limiter 2 level of the HP regulator includes the parameters for the first limiter. The parameters are separated into 3 levels "Set point", "Limits" and "Use". The HP Limiter 2 is limiting a free configurable value. The HP Limiter 2 is manipulating the controller output of the active process controller to insure a bumbles change between limitation and control.

The Level "Set points" includes the parameters for limiting the set point. The following parameters are available:

- **Max Set point:** Sets the maximum allowed Set point.
- **Min Set point:** Sets the minimum allowed Set point.
- **Set point rate of rise per second:** Sets the maximum rate of rice for changing a Set point.
- **Set point rate of reduction per second:** Sets the maximum rate of reduction for changing a Set point.
- **Set point tracking:** Sets if the Set point should be tracked with the actual value while the controller is not active.
- **Tracking offset:** If the Set point is tracked by the actual value, this parameter sets an offset to the actual value. Example:
  - **Actual value:** 4.0Bar
  - **Offset:** 0.1Bar
  - **Set point:** 4.1Bar
- **Initial Set point:** Sets if a specifiedSet point should be set before the turbine is started. As soon as the turbine is started, the Set point can be changed. It is not necessary that the controller is active, it is enough if the turbine is in offline speed control.
- **Initial Set point:** If the Initial Set point is activated, this value sets the Set point that is set before the turbine is started.

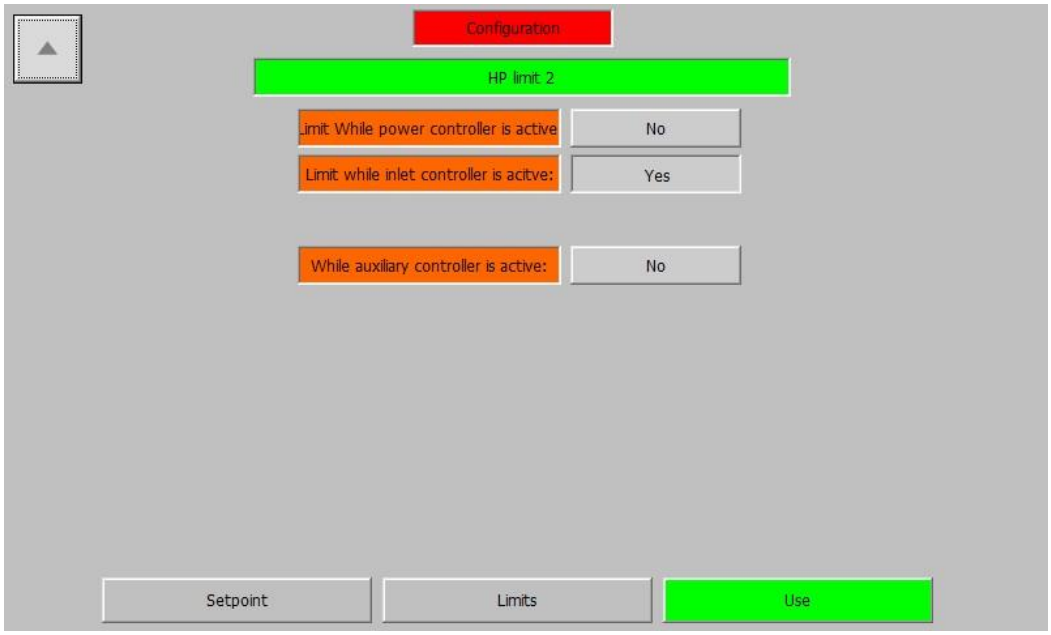
- **Automatic Set point:** If the selected limitation value is also used in an regulator, it is possible to use the actual Set point of the controller. This is useful to take the controller Set point as a limitation value when the control mode has been changed to another controller.
- **Automatic Set point offset:** If an automatic Set point is selected, the automaticSet point offset will be added to the actual controller Set point and be used as the limiter Set point.



Configuration - (3) HP Regulation - HP Limit 2 - Limits

The level "Limits" includes the parameters for limiting the rate of change of the limiter output. The following parameters are available:

- **Limit controller output:** If activated, the limitation for the change of the limiter output is activated.
- **Maximum rate of reduction per second:** Sets the maximum allowed rate of reduction of the limiter output. If the controller tries to reduce the limiter output more than the adjusted rate of reduction, it will be limited.
- **Maximum rate of rise per second:** Sets the maximum allowed rate of rise for the limiter output. If the limiter tries to rise the limiter output more than the adjusted rate of rice, it will be limited.
- **Type of limit:** Selects if the limitation value should be limited to a minimum or a maximum limit.
- **Invert controller:** Sets of the controller should work inverted. The parameters is needed, cause the controller does not know which value is used for the regulation and where it is in the steam system. Example:
    - **Yes:** If the actual value is increasing compared to the Set point, the controller output will increase. (see inlet pressure control)
    - **No:** If the actual value is increasing compared to the Set point, the controller output will decrease. (see power control)

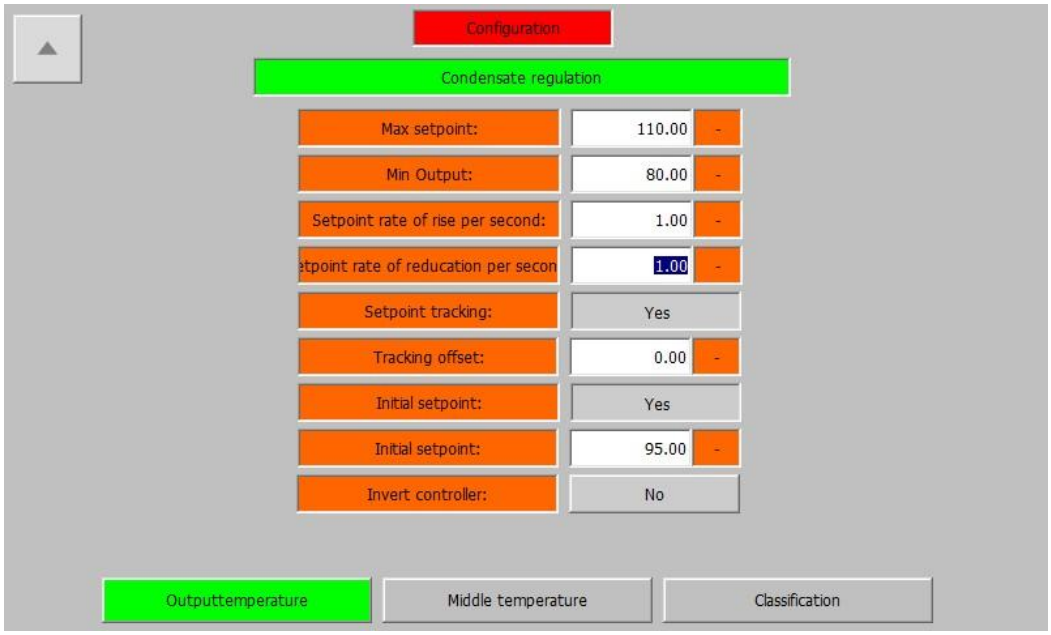


Configuration - (3) HP Regulation - HP Limit 2 - Use

The level "Use" includes the parameters about the activation of the limiter. The limiter can be configured to only work with certain active controllers. The following parameters are available:

- **Limit while power controller is active:** If activated, the limitation will work while the power controller is active.
- **Limit while inlet pressure controller is active:** If activated, the limitation will work while the inlet pressure controller is active.
- **Limit while exhaust controller is active:** If activated, the limitation will work while the exhaust steam pressure controller is active.
- **Limit while auxiliary controller is active:** If activated, the limitation will work while the auxiliary controller is active.

3.3.9 Condensate temperature regulation



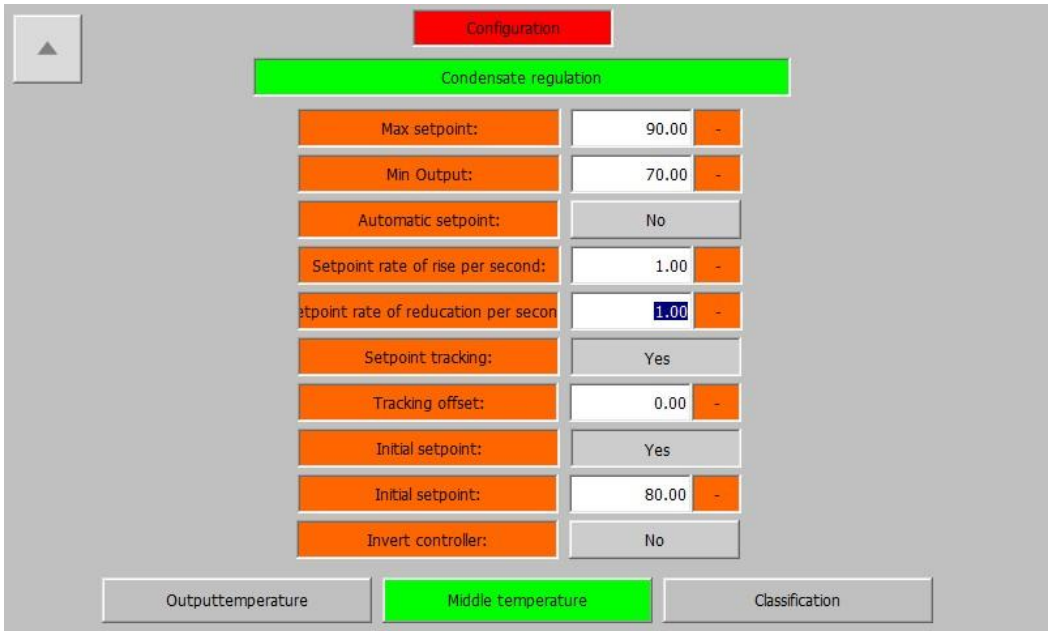
Configuration – (3) HP Control – Condensate regulation–Output temperature

The Condensate regulation level includes the parameters for the regulation of the condensate cooling temperature. The level is separated into 3 sections "Output temperature", "Middle temperature" and "Classification". The condensate temperature controller is controller the temperature of a 2 stage condensate by changing the Set point of the active regulation.

The level "Output temperature" includes the parameters for controlling the temperature at the outlet of the condensator. The following parameters are available:

- **Max Set point:** Sets the maximum allowed Set point.
- **Min Set point:** Sets the minimum allowed Set point.
- **Set point rate of rise per second:** Sets the maximum rate of rice for changing a Set point.
- **Set point rate of reduction per second:** Sets the maximum rate of reduction for changing a Set point.
- **Set point tracking:** Sets if the Set point should be tracked with the actual value while the controller is not active.
- **Tracking offset:** If the Set point is tracked by the actual value, this parameter sets an offset to the actual value. Example:
  - **Actual value:** 90°C
  - **Offset:** 5°C
  - **Set point:** 95°C
- **Initial Set point:** Sets if a specifiedSet point should be set before the turbine is started. As soon as the turbine is started, the Set point can be changed. It is not necessary that the controller is active, it is enough if the turbine is in offline speed control.
- **Initial Set point:** If the Initial Set point is activated, this value sets the Set point that is set before the turbine is started.

- **Invert controller:** Sets of the controller should work inverted. The parameters is needed, cause the controller does not know which value is used for the regulation and where it is in the steam system. Example:
    - **Yes:** If the actual value is increasing compared to the Set point, the controller output will increase. (see inlet pressure control)
    - **No:** If the actual value is increasing compared to the Set point, the controller output will decrease. (see power control)



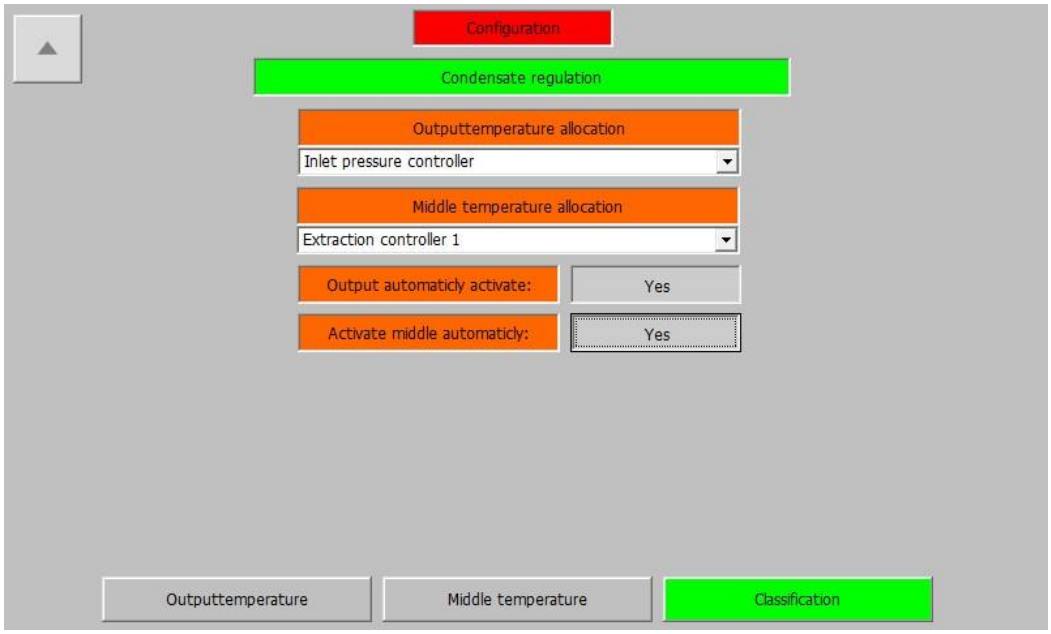
Configuration – (3) HP Control – Condensate regulation – Middle temperature

The level "Middle temperature" includes the parameters for controlling the temperature at the middle of the condensator between HP and LP stage. The following parameters are available:

- **Max Set point:** Sets the maximum allowed Set point.
- **Min Set point:** Sets the minimum allowed Set point.
- **Automatic Set point:**If activated, the controller will automatically calculate the temperature for the middle controller. The middle controller will always try to keep the middle temperature between the inlet and the outlet temperature of the condensator.
- **Set point rate of rise per second:** Sets the maximum rate of rice for changing a Set point.
- **Set point rate of reduction per second:** Sets the maximum rate of reduction for changing a Set point.
- **Set point tracking:** Sets if the Set point should be tracked with the actual value while the controller is not active.
- **Tracking offset:** If the Set point is tracked by the actual value, this parameter sets an offset to the actual value. Example:

- **Actual value:** 90°C
- **Offset:** 5°C
- **Set point:** 95°C

- **Initial Set point:** Sets if a specifiedSet point should be set before the turbine is started. As soon as the turbine is started, the Set point can be changed. It is not necessary that the controller is active, it is enough if the turbine is in offline speed control.
- **Initial Set point:** If the Initial Set point is activated, this value sets the Set point that is set before the turbine is started.
- **Invert controller:** Sets of the controller should work inverted. The parameters is needed, cause the controller does not know which value is used for the regulation and where it is in the steam system. Example:
  - **Yes:** If the actual value is increasing compared to the Set point, the controller output will increase. (see inlet pressure control)
  - **No:** If the actual value is increasing compared to the Set point, the controller output will decrease. (see power control)



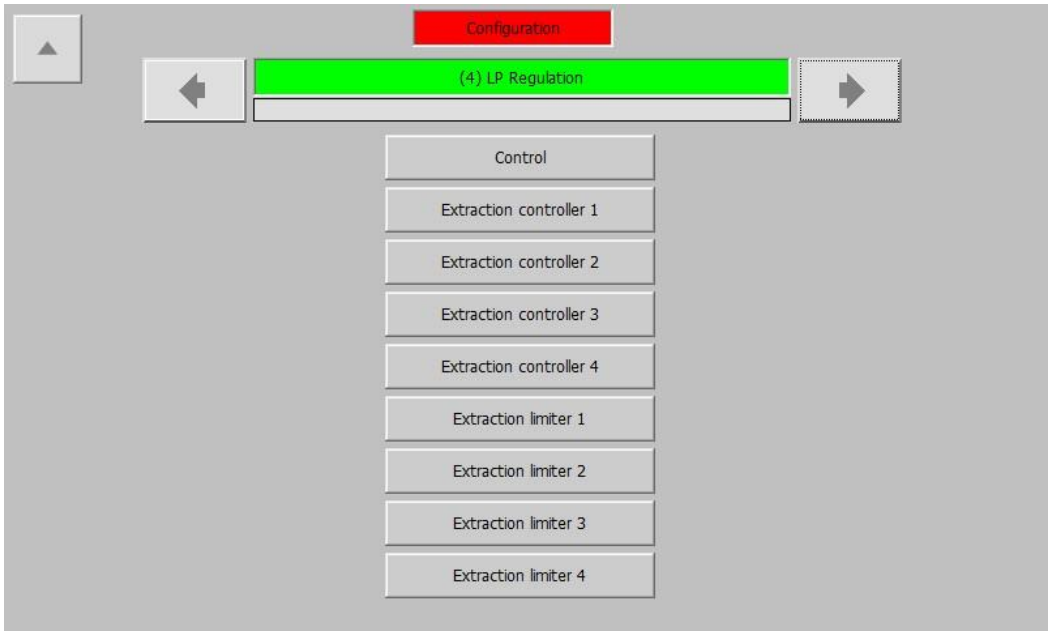
Configuration – (3) HP Control – Condensate regulation– Classification

The Level "Classification" includes the parameters for the assignment of the temperature controller to the active controller. The following parameters are available:

- **Output temperature allocation:**Sets which process controllerSet point will be changed by the condensator output temperature controller. The following controllers are available:
  - Inlet pressure controller
  - Exhaust pressure controller
  - Power controller
  - Auxiliary controller

    - Extraction controller 1
    - Extraction controller 2
    - Extraction controller 3
    - Extraction controller 4
- **Middle temperature allocation:**Sets which process controllerset point will be changed by the condensator middle temperature controller. The following controllers are available:
    - Inlet pressure controller
    - Exhaust pressure controller
    - Power controller
    - Auxiliary controller
    - Extraction controller 1
    - Extraction controller 2
    - Extraction controller 3
    - Extraction controller 4
- **Output automatically activate:**If activated, the condensate output temperature controller will be automatically activated as soon as the allocated process controller is active.
- **Middle automatically activate:**If activated, the condensate middle temperature controller will be automatically activated as soon as the allocated process controller is active.

3.4 LP Regulation

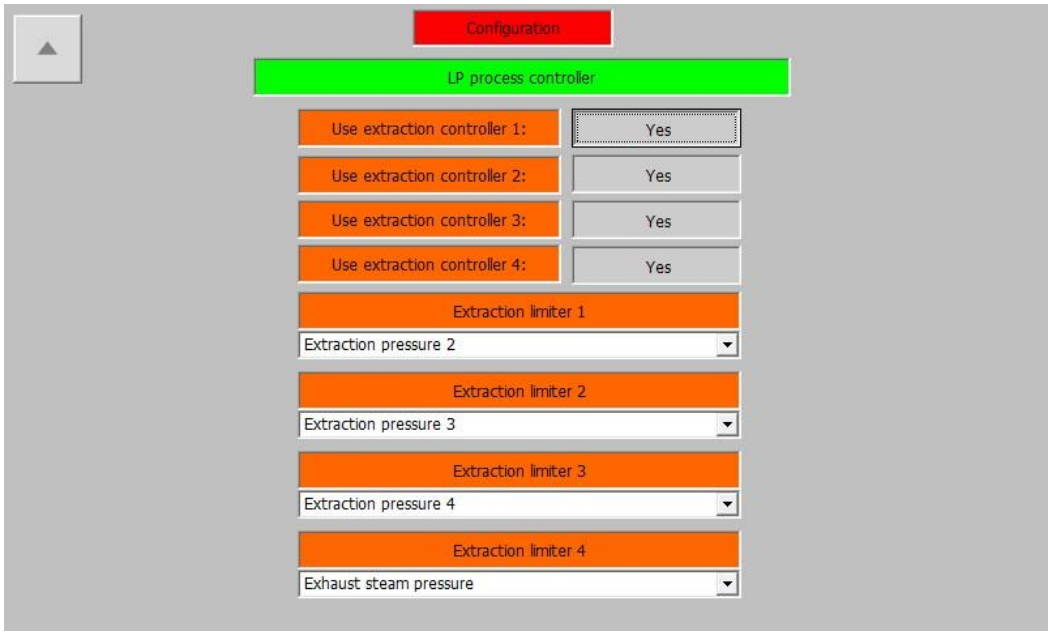


Configuration – (4) LP Regulation

The LP Regulation level includes all parameters for the LP Stages 1-4. The following Levels are available:

- Control
- Extraction controller 1
- Extraction controller 2
- Extraction controller 3
- Extraction controller 4
- Extraction limiter 1
- Extraction limiter 2
- Extraction limiter 3
- Extraction limiter 4

3.4.1 Control

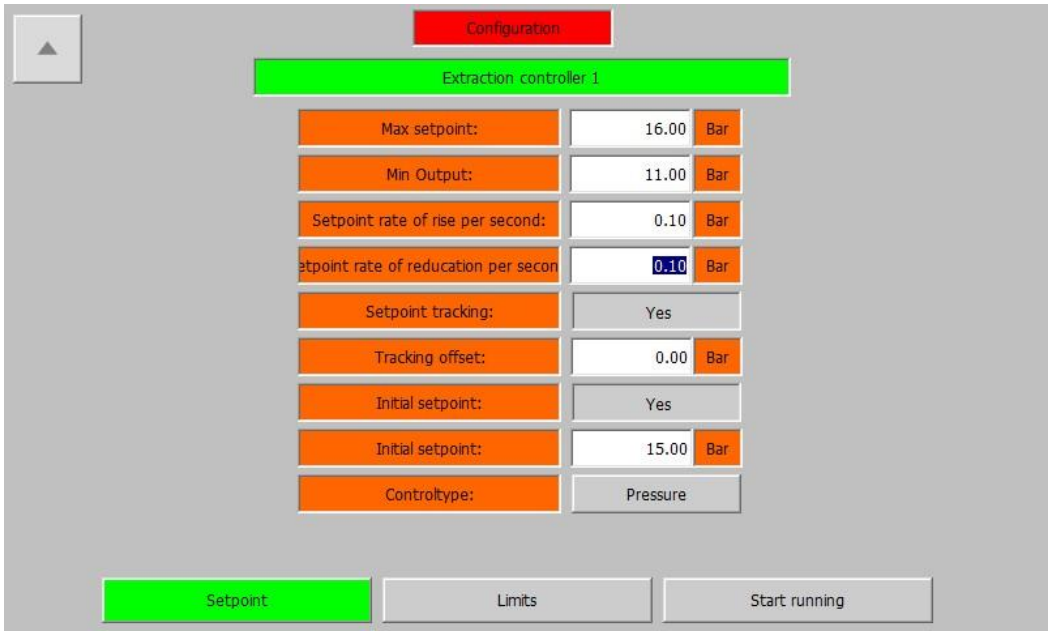


Configuration – (4) LP Regulation – process controller

The level LP control includes the parameters for selecting the used controls and limits. The following parameters are available:

- **Use extraction controller 1:**If activated, the 1. extraction stage is used.
- **Use extraction controller 2:** If activated, the 2. extraction stage is used.
- **Use extraction controller 3:** If activated, the 3. extraction stage is used.
- **Use extraction controller 4:** If activated, the 4. extraction stage is used.
- **Extraction limiter 1:** Selects the value that is used to limitate the 1. extraction controller.
- **Extraction limiter 2:** Selects the value that is used to limitate the 2. extraction controller.
- **Extraction limiter 3:** Selects the value that is used to limitate the 3. extraction controller.
- **Extraction limiter 4:** Selects the value that is used to limitate the 4. extraction controller.

3.4.2 Extraction controller 1



Configuration – (4) LP Control – Extraction controller 1 – Set point

The Extraction controller 1 level of the LP process controller includes the parameters for the extraction controller 1. The parameters are separated into 3 levels "Set point", "Limits" and "Start running". The extraction controller 1 can control the extraction pressure or the extraction value.

The level "Set point" includes the parameters for limiting the Set points. The following parameters are available:

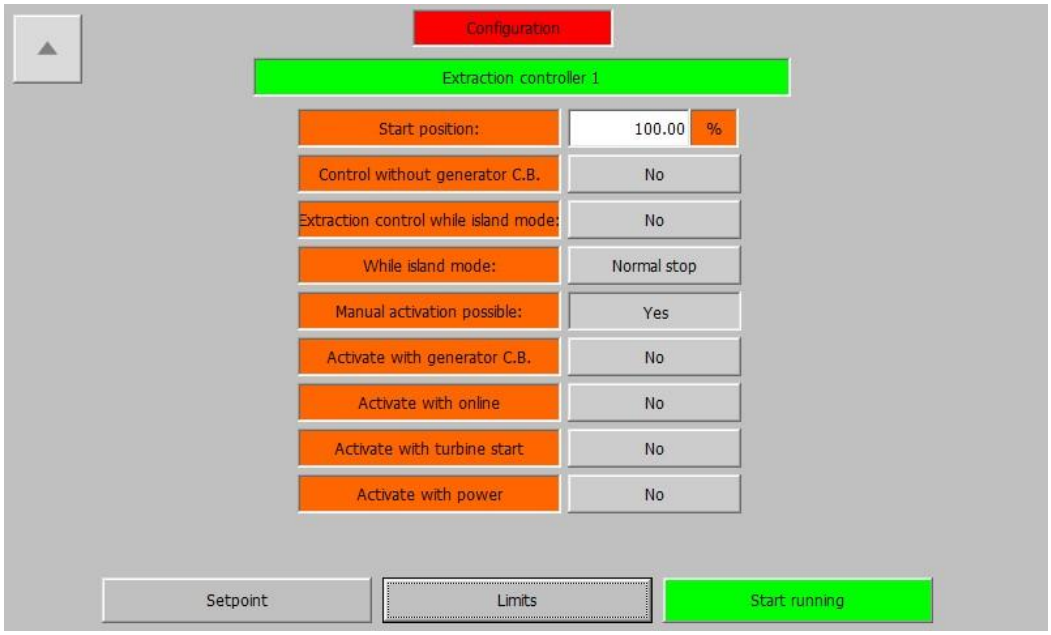
- **Max Set point:** Sets the maximum allowed Set point.
- **Min Set point:** Sets the minimum allowed Set point.
- **Set point rate of rise per second:** Sets the maximum rate of rice for changing a Set point.
- **Set point rate of reduction per second:** Sets the maximum rate of reduction for changing a Set point.
- **Set point tracking:** Sets if the Set point should be tracked with the actual value while the controller is not active.
- **Tracking offset:** If the Set point is tracked by the actual value, this parameter sets an offset to the actual value. Example:
  - **Actual value:** 10,0Bar
  - **Offset:** -0,1Bar
  - **Set point:** 9,9Bar
- **Initial Set point:** Sets if a specifiedSet point should be set before the turbine is started. As soon as the turbine is started, the Set point can be changed. It is not necessary that the controller is active, it is enough if the turbine is in offline speed control.
- **Initial Set point:** If the Initial Set point is activated, this value sets the Set point that is set before the turbine is started.

- **Control type:**Selects if "Extraction pressure 1" or "Extraction value 1" should be used as control value. This function allows to control an external pressure and limitate an internal pressure at the same time.

Configuration – (4) LP Control – Extraction controller 1 – Limits

The level "Limits" includes the parameters for limiting the rate of change of the controller output and the use of power limitation. The following parameters are available:

- **Limit controller output:** If activated, the limitation for the change of the controller output is activated.
- **Maximum rate of reduction per second:** Sets the maximum allowed rate of reduction of the controller output. If the controller tries to reduce the controller output more than the adjusted rate of reduction, it will be limited.
- **Maximum rate of rise per second:** Sets the maximum allowed rate of rise for the controller output. If the controller tries to rise the controller output more than the adjusted rate of rice, it will be limited.
- **Use max power limiter:** If a power limitation is used, this parameter allows the max power limitation to limitate the extraction stage as well as the HP stage.
- **Use min power limiter:**If a power limitation is used, this parameter allows the min power limitation to limitate the extraction stage as well as the HP stage.
- **Off speed per second:**Sets the speed of the controller output when the controller is switched off and the output goes back to the start value. This value inhibits an too quick opening of the extraction steam values that could case changes in the pressure of the machine and the steam system.



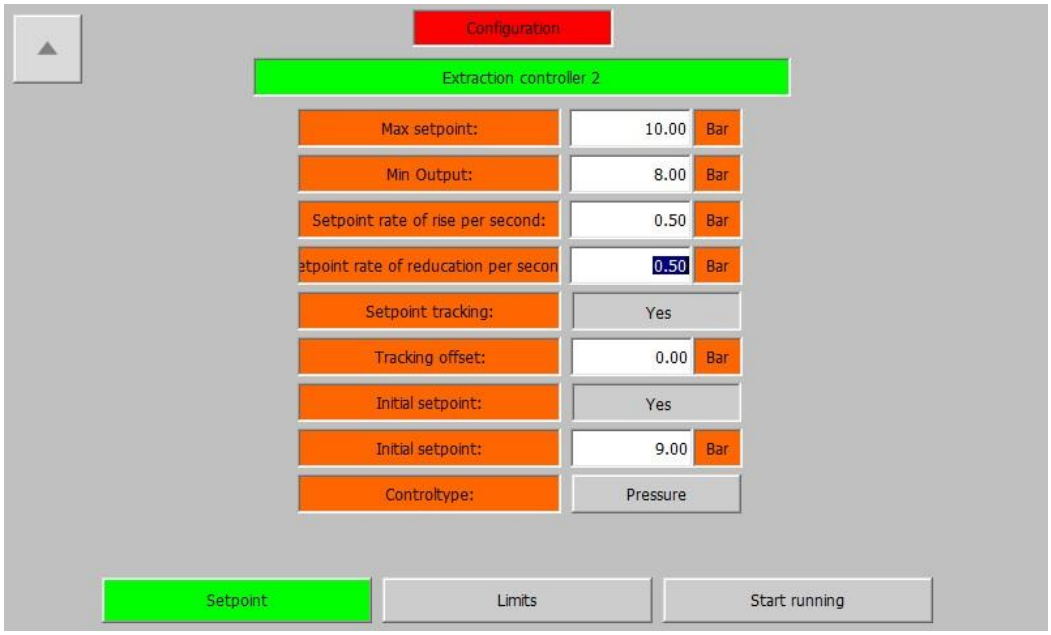
Configuration – (4) LP Control – Extraction controller 1 – Start running

The "Start running" level includes the parameters for the start and stop of the extraction controller 1. The following parameters are available:

- **Startposition:**Sets the controller output position while the controller is switches off
- **Control without generator C.B.:**If activated, it is possible to start the extraction without getting a closed feedback of the generator C.B.
- **Extraction control while island mode:**If activated, the extraction control is possible while the turbine is in island mode.
- **While island mode:**If the parameter "Extraction control while island mode" is configured to "No", this parameter define the way of stopping the extraction. The following selection is possible:
  - **Normal stop:**The extraction stops with the normal stop speed that is set at the level "Limits".
  - **Quick Stopp:** Stopp die Entnahmeregelung direkt, so dass der Regelausgang direkt auf die Startposition wechselt.The extraction stops immediately and the control output will change to the start position.
- **Manual activation possible:**If activated, it is possible to start and stop the extraction from the control level.
- **Activate with generator C.B.:**If activated, the extraction controller will automatically start as soon as the closed feedback of the generator C.B. appears. As soon as the closed feedback of the generator C.B. disappears, the controller will automatically stop.
- **Activate with online:**If activated, the extraction controller will automatically start as soon as the allocated turbine site has switches to "Online" mode. As soon as the allocated turbine site has switched back to "Offline" mode, the extraction controller will automatically stop.
- **Activate with turbine start:**If activated, the extraction controller will start as soon as the allocated turbine site has been started.

- **Activate with power:**If activated, the extraction controller will start as soon as a power limit has been reached. As soon as the closed feedback of the generator circuit breaker disappears, the extraction controller will automatically stop.
- **Start:**If the parameter "Activate with power" is set to "Yes", this parameter is the power limit that has to be reached to start the extraction controller. As soon as the closed feedback of the generator circuit breaker disappears, the extraction controller will automatically stop. If the produced power will go below the start limit, the extraction controller will not stop.

3.4.3 Extraction controller 2



Configuration – (4) LP Control – Extraction controller 2 – Set point

The Extraction controller 2 level of the LP process controller includes the parameters for the extraction controller 2. The parameters are separated into 3 levels "Set point", "Limits" and "Start running". The extraction controller 2 can control the extraction pressure or the extraction value.

The level "Set point" includes the parameters for limiting the Set points. The following parameters are available:

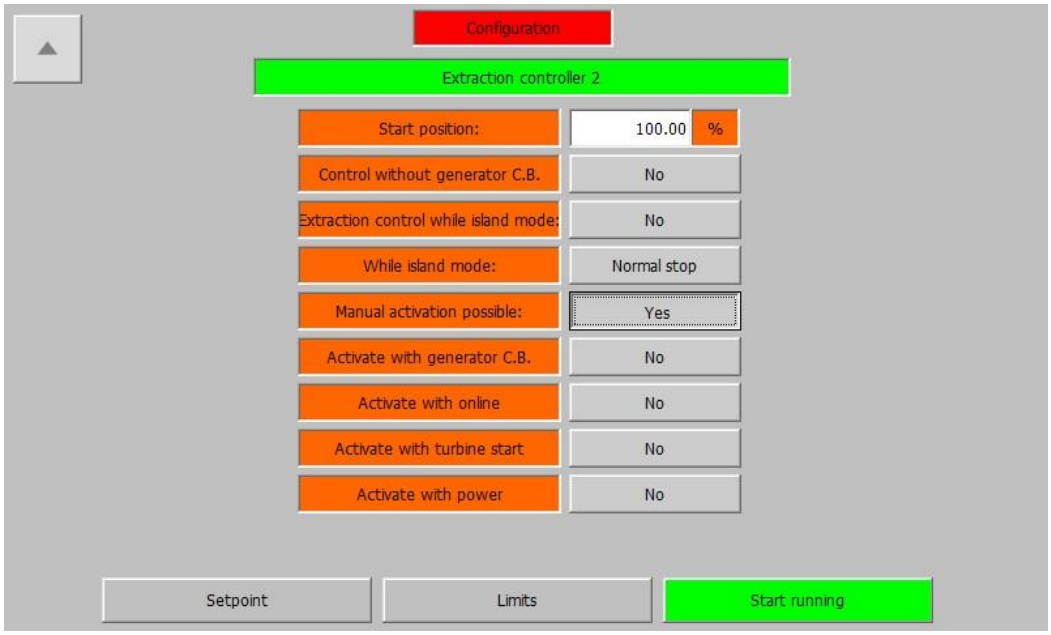
- **Max Set point:** Sets the maximum allowed Set point.
- **Min Set point:** Sets the minimum allowed Set point.
- **Set point rate of rise per second:** Sets the maximum rate of rice for changing a Set point.
- **Set point rate of reduction per second:** Sets the maximum rate of reduction for changing a Set point.
- **Set point tracking:** Sets if the Set point should be tracked with the actual value while the controller is not active.
- **Tracking offset:** If the Set point is tracked by the actual value, this parameter sets an offset to the actual value. Example:
  - **Actual value:** 10,0Bar
  - **Offset:** -0,1Bar
  - **Set point:** 9,9Bar
- **Initial Set point:** Sets if a specifiedSet point should be set before the turbine is started. As soon as the turbine is started, the Set point can be changed. It is not necessary that the controller is active, it is enough if the turbine is in offline speed control.
- **Initial Set point:** If the Initial Set point is activated, this value sets the Set point that is set before the turbine is started.

- **Control type:** Selects if "Extraction pressure 2" or "Extraction value 2" should be used as control value. This function allows to control an external pressure and limitate an internal pressure at the same time.

Configuration – (4) LP Control – Extraction controller 2 – Limits

The level "Limits" includes the parameters for limiting the rate of change of the controller output and the use of power limitation. The following parameters are available:

- **Limit controller output:** If activated, the limitation for the change of the controller output is activated.
- **Maximum rate of reduction per second:** Sets the maximum allowed rate of reduction of the controller output. If the controller tries to reduce the controller output more than the adjusted rate of reduction, it will be limited.
- **Maximum rate of rise per second:** Sets the maximum allowed rate of rise for the controller output. If the controller tries to rise the controller output more than the adjusted rate of rice, it will be limited.
- **Use max power limiter:** If a power limitation is used, this parameter allows the max power limitation to limitate the extraction stage as well as the HP stage.
- **Use min power limiter:** If a power limitation is used, this parameter allows the min power limitation to limitate the extraction stage as well as the HP stage.
- **Off speed per second:** Sets the speed of the controller output when the controller is switched off and the output goes back to the start value. This value inhibits an too quick opening of the extraction steam values that could case changes in the pressure of the machine and the steam system.



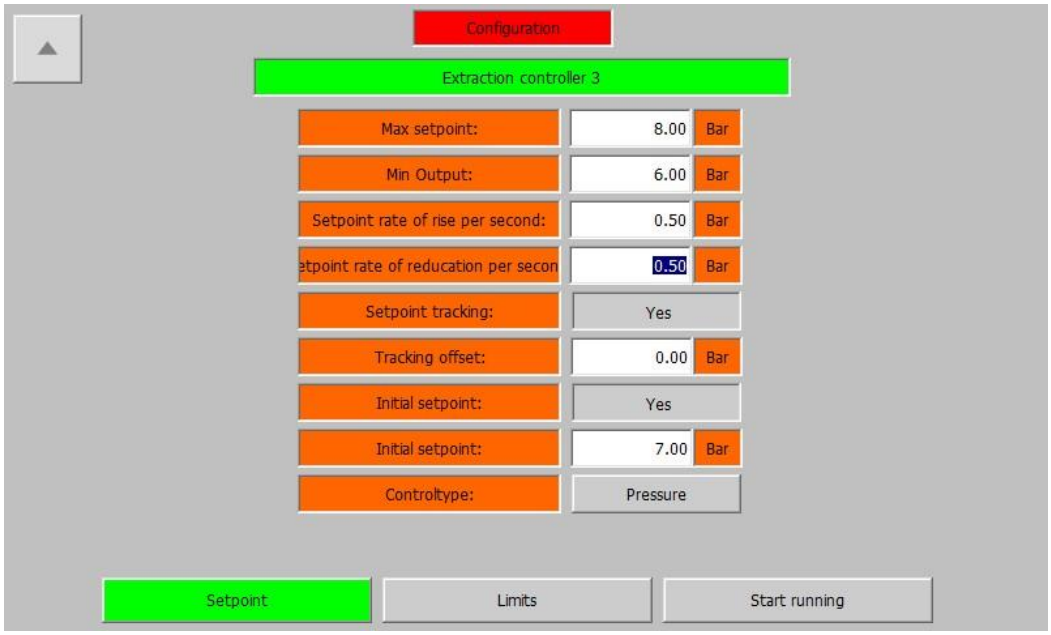
Configuration – (4) LP Control – Extraction controller 2 – Start running

The "Start running" level includes the parameters for the start and stop of the extraction controller 2. The following parameters are available:

- **Start position:** Sets the controller output position while the controller is switches off
- **Control without generator C.B.:** If activated, it is possible to start the extraction without getting a closed feedback of the generator C.B.
- **Extraction control while island mode:** If activated, the extraction control is possible while the turbine is in island mode.
- **While island mode:** If the parameter "Extraction control while island mode" is configured to "No", this parameter define the way of stopping the extraction. The following selection is possible:
  - **Normal stop:** The extraction stops with the normal stop speed that is set at the level "Limits".
  - **Quick Stopp:** Stopp die Entnahmeregelung direkt, so dass der Regelausgang direkt auf die Startposition wechselt. The extraction stops immediately and the control output will change to the start position.
- **Manual activation possible:** If activated, it is possible to start and stop the extraction from the control level.
- **Activate with generator C.B.:** If activated, the extraction controller will automatically start as soon as the closed feedback of the generator C.B. appears. As soon as the closed feedback of the generator C.B. disappears, the controller will automatically stop.
- **Activate with online:** If activated, the extraction controller will automatically start as soon as the allocated turbine site has switches to "Online" mode. As soon as the allocated turbine site has switched back to "Offline" mode, the extraction controller will automatically stop.
- **Activate with turbine start:** If activated, the extraction controller will start as soon as the allocated turbine site has been started.

- **Activate with power:** If activated, the extraction controller will start as soon as a power limit has been reached. As soon as the closed feedback of the generator circuit breaker disappears, the extraction controller will automatically stop.
- **Start:** If the parameter "Activate with power" is set to "Yes", this parameter is the power limit that has to be reached to start the extraction controller. As soon as the closed feedback of the generator circuit breaker disappears, the extraction controller will automatically stop. If the produced power will go below the start limit, the extraction controller will not stop.

3.4.4 Extraction controller 3



Configuration – (4) LP Control – Extraction controller 3 – Set point

The Extraction controller 3 level of the LP process controller includes the parameters for the extraction controller 3. The parameters are separated into 3 levels "Set point", "Limits" and "Start running". The extraction controller 3 can control the extraction pressure or the extraction value.

The level "Set point" includes the parameters for limiting the Set points. The following parameters are available:

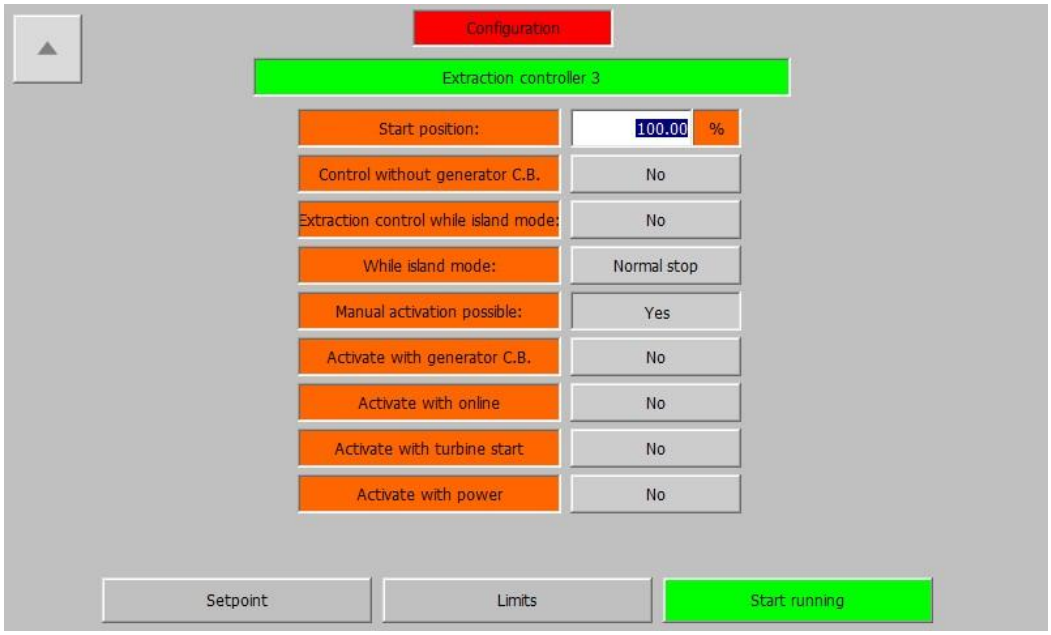
- **Max Set point:** Sets the maximum allowed Set point.
- **Min Set point:** Sets the minimum allowed Set point.
- **Set point rate of rise per second:** Sets the maximum rate of rice for changing a Set point.
- **Set point rate of reduction per second:** Sets the maximum rate of reduction for changing a Set point.
- **Set point tracking:** Sets if the Set point should be tracked with the actual value while the controller is not active.
- **Tracking offset:** If the Set point is tracked by the actual value, this parameter sets an offset to the actual value. Example:
  - **Actual value:** 10,0Bar
  - **Offset:** -0,1Bar
  - **Set point:** 9,9Bar
- **Initial Set point:** Sets if a specifiedSet point should be set before the turbine is started. As soon as the turbine is started, the Set point can be changed. It is not necessary that the controller is active, it is enough if the turbine is in offline speed control.
- **Initial Set point:** If the Initial Set point is activated, this value sets the Set point that is set before the turbine is started.

- **Control type:** Selects if "Extraction pressure 3" or "Extraction value 3" should be used as control value. This function allows to control an external pressure and limitate an internal pressure at the same time.

Configuration – (4) LP Control – Extraction controller 3 – Limits

The level "Limits" includes the parameters for limiting the rate of change of the controller output and the use of power limitation. The following parameters are available:

- **Limit controller output:** If activated, the limitation for the change of the controller output is activated.
- **Maximum rate of reduction per second:** Sets the maximum allowed rate of reduction of the controller output. If the controller tries to reduce the controller output more than the adjusted rate of reduction, it will be limited.
- **Maximum rate of rise per second:** Sets the maximum allowed rate of rise for the controller output. If the controller tries to rise the controller output more than the adjusted rate of rice, it will be limited.
- **Use max power limiter:** If a power limitation is used, this parameter allows the max power limitation to limitate the extraction stage as well as the HP stage.
- **Use min power limiter:** If a power limitation is used, this parameter allows the min power limitation to limitate the extraction stage as well as the HP stage.
- **Off speed per second:** Sets the speed of the controller output when the controller is switched off and the output goes back to the start value. This value inhibits an too quick opening of the extraction steam values that could case changes in the pressure of the machine and the steam system.



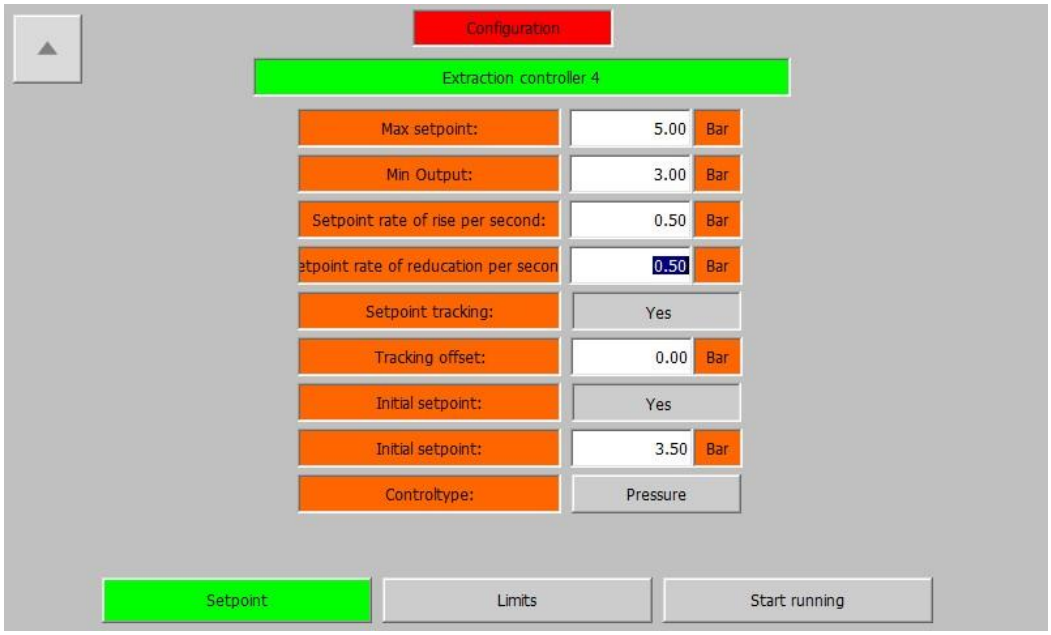
Configuration – (4) LP Control – Extraction controller 3 – Start running

The "Start running" level includes the parameters for the start and stop of the extraction controller 3. The following parameters are available:

- **Start position:** Sets the controller output position while the controller is switches off
- **Control without generator C.B.:** If activated, it is possible to start the extraction without getting a closed feedback of the generator C.B.
- **Extraction control while island mode:** If activated, the extraction control is possible while the turbine is in island mode.
- **While island mode:** If the parameter "Extraction control while island mode" is configured to "No", this parameter define the way of stopping the extraction. The following selection is possible:
  - **Normal stop:** The extraction stops with the normal stop speed that is set at the level "Limits".
  - **Quick Stopp:** Stopp die Entnahmeregelung direkt, so dass der Regelausgang direkt auf die Startposition wechselt. The extraction stops immediately and the control output will change to the start position.
- **Manual activation possible:** If activated, it is possible to start and stop the extraction from the control level.
- **Activate with generator C.B.:** If activated, the extraction controller will automatically start as soon as the closed feedback of the generator C.B. appears. As soon as the closed feedback of the generator C.B. disappears, the controller will automatically stop.
- **Activate with online:** If activated, the extraction controller will automatically start as soon as the allocated turbine site has switches to "Online" mode. As soon as the allocated turbine site has switched back to "Offline" mode, the extraction controller will automatically stop.
- **Activate with turbine start:** If activated, the extraction controller will start as soon as the allocated turbine site has been started.

- **Activate with power:** If activated, the extraction controller will start as soon as a power limit has been reached. As soon as the closed feedback of the generator circuit breaker disappears, the extraction controller will automatically stop.
- **Start:** If the parameter "Activate with power" is set to "Yes", this parameter is the power limit that has to be reached to start the extraction controller. As soon as the closed feedback of the generator circuit breaker disappears, the extraction controller will automatically stop. If the produced power will go below the start limit, the extraction controller will not stop.

3.4.5 Extraction controller 4



Configuration – (4) LP Control – Extraction controller 4 – Set point

The Extraction controller 4 level of the LP process controller includes the parameters for the extraction controller 4. The parameters are separated into 3 levels "Set point", "Limits" and "Start running". The extraction controller 4 can control the extraction pressure or the extraction value.

The level "Set point" includes the parameters for limiting the Set points. The following parameters are available:

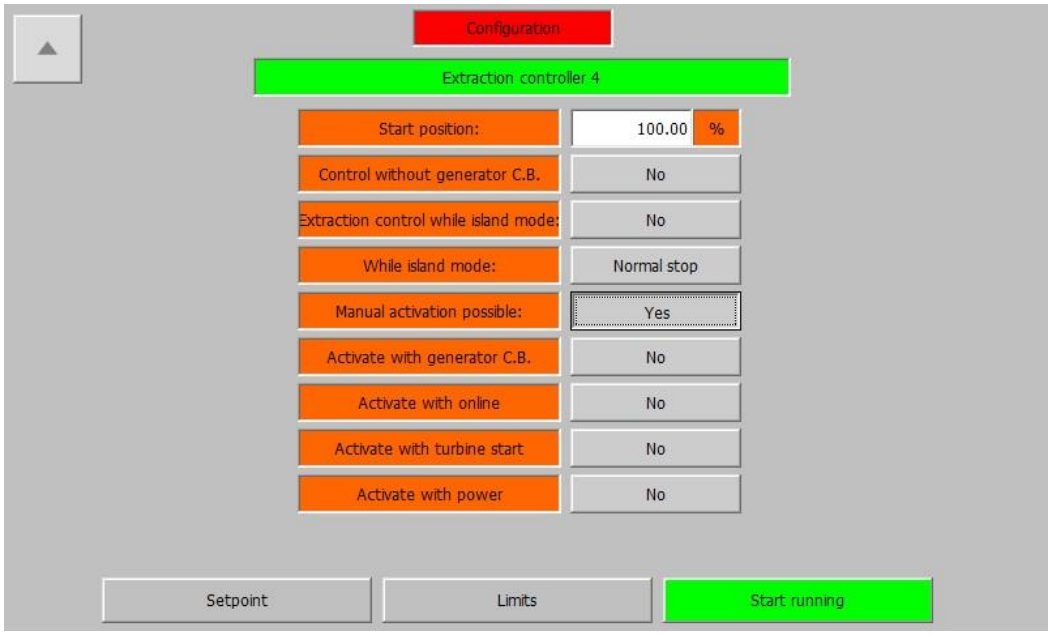
- **Max Set point:** Sets the maximum allowed Set point.
- **Min Set point:** Sets the minimum allowed Set point.
- **Set point rate of rise per second:** Sets the maximum rate of rice for changing a Set point.
- **Set point rate of reduction per second:** Sets the maximum rate of reduction for changing a Set point.
- **Set point tracking:** Sets if the Set point should be tracked with the actual value while the controller is not active.
- **Tracking offset:** If the Set point is tracked by the actual value, this parameter sets an offset to the actual value. Example:
  - **Actual value:** 10,0Bar
  - **Offset:** -0,1Bar
  - **Set point:** 9,9Bar
- **Initial Set point:** Sets if a specifiedSet point should be set before the turbine is started. As soon as the turbine is started, the Set point can be changed. It is not necessary that the controller is active, it is enough if the turbine is in offline speed control.
- **Initial Set point:** If the Initial Set point is activated, this value sets the Set point that is set before the turbine is started.

- **Control type:** Selects if "Extraction pressure 4" or "Extraction value 4" should be used as control value. This function allows to control an external pressure and limitate an internal pressure at the same time.

Configuration – (4) LP Control – Extraction controller 4 – Limits

The level "Limits" includes the parameters for limiting the rate of change of the controller output and the use of power limitation. The following parameters are available:

- **Limit controller output:** If activated, the limitation for the change of the controller output is activated.
- **Maximum rate of reduction per second:** Sets the maximum allowed rate of reduction of the controller output. If the controller tries to reduce the controller output more than the adjusted rate of reduction, it will be limited.
- **Maximum rate of rise per second:** Sets the maximum allowed rate of rise for the controller output. If the controller tries to rise the controller output more than the adjusted rate of rice, it will be limited.
- **Use max power limiter:** If a power limitation is used, this parameter allows the max power limitation to limitate the extraction stage as well as the HP stage.
- **Use min power limiter:** If a power limitation is used, this parameter allows the min power limitation to limitate the extraction stage as well as the HP stage.
- **Off speed per second:** Sets the speed of the controller output when the controller is switched off and the output goes back to the start value. This value inhibits an too quick opening of the extraction steam values that could case changes in the pressure of the machine and the steam system.



Configuration – (4) LP Control – Extraction controller 4 – Start running

The "Start running" level includes the parameters for the start and stop of the extraction controller 4. The following parameters are available:

- **Start position:** Sets the controller output position while the controller is switches off
- **Control without generator C.B.:** If activated, it is possible to start the extraction without getting a closed feedback of the generator C.B.
- **Extraction control while island mode:** If activated, the extraction control is possible while the turbine is in island mode.
- **While island mode:** If the parameter "Extraction control while island mode" is configured to "No", this parameter define the way of stopping the extraction. The following selection is possible:
  - **Normal stop:** The extraction stops with the normal stop speed that is set at the level "Limits".
  - **Quick Stopp:** Stopp die Entnahmeregelung direkt, so dass der Regelausgang direkt auf die Startposition wechselt. The extraction stops immediately and the control output will change to the start position.
- **Manual activation possible:** If activated, it is possible to start and stop the extraction from the control level.
- **Activate with generator C.B.:** If activated, the extraction controller will automatically start as soon as the closed feedback of the generator C.B. appears. As soon as the closed feedback of the generator C.B. disappears, the controller will automatically stop.
- **Activate with online:** If activated, the extraction controller will automatically start as soon as the allocated turbine site has switches to "Online" mode. As soon as the allocated turbine site has switched back to "Offline" mode, the extraction controller will automatically stop.
- **Activate with turbine start:** If activated, the extraction controller will start as soon as the allocated turbine site has been started.

- **Activate with power:** If activated, the extraction controller will start as soon as a power limit has been reached. As soon as the closed feedback of the generator circuit breaker disappears, the extraction controller will automatically stop.
- **Start:** If the parameter "Activate with power" is set to "Yes", this parameter is the power limit that has to be reached to start the extraction controller. As soon as the closed feedback of the generator circuit breaker disappears, the extraction controller will automatically stop. If the produced power will go below the start limit, the extraction controller will not stop.

3.4.6 Extraction limiter 1

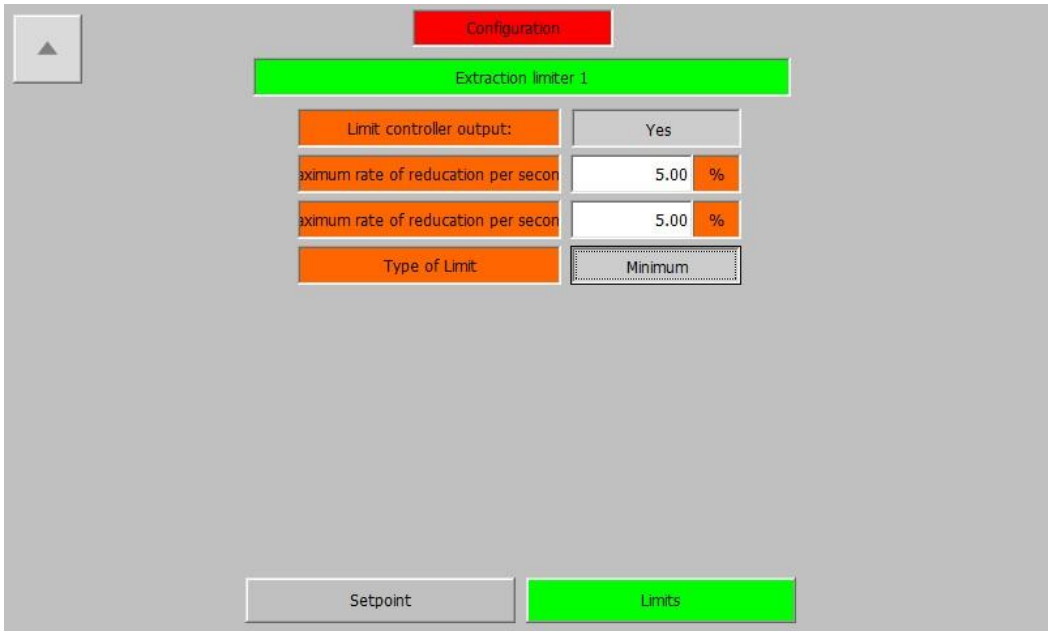
Configuration – (4) LP Control –Extraction limiter 1 – Set point

The Extraction limiter 1 level includes the parameters of the extraction limiter 1. The parameters are separated into "Set point" and "Limits". The Extraction limiter 1 is manipulating the controller output of the Extraction controller 1 to insure a bumbles change between limitation and control.

The Level "Set points" includes the parameters for limiting the set point. The following parameters are available:

- **Max Set point:** Sets the maximum allowed Set point.
- **Min Set point:** Sets the minimum allowed Set point.
- **Set point rate of rise per second:** Sets the maximum rate of rice for changing a Set point.
- **Set point rate of reduction per second:** Sets the maximum rate of reduction for changing a Set point.
- **Set point tracking:** Sets if the Set point should be tracked with the actual value while the controller is not active.
- **Tracking offset:** If the Set point is tracked by the actual value, this parameter sets an offset to the actual value. Example:
  - **Actual value:** 4.0Bar
  - **Offset:** 0.1Bar
  - **Set point:** 4.1Bar
- **Initial Set point:** Sets if a specifiedSet point should be set before the turbine is started. As soon as the turbine is started, the Set point can be changed. It is not necessary that the controller is active, it is enough if the turbine is in offline speed control.
- **Initial Set point:** If the Initial Set point is activated, this value sets the Set point that is set before the turbine is started.

- **Automatic Set point:** If the selected limitation value is also used in an regulator, it is possible to use the actual Set point of the controller. This is useful to take the controller Set point as a limitation value when the control mode has been changed to another controller.
- **Automatic Set point offset:** If an automatic Set point is selected, the automaticSet point offset will be added to the actual controller Set point and be used as the limiter Set point.

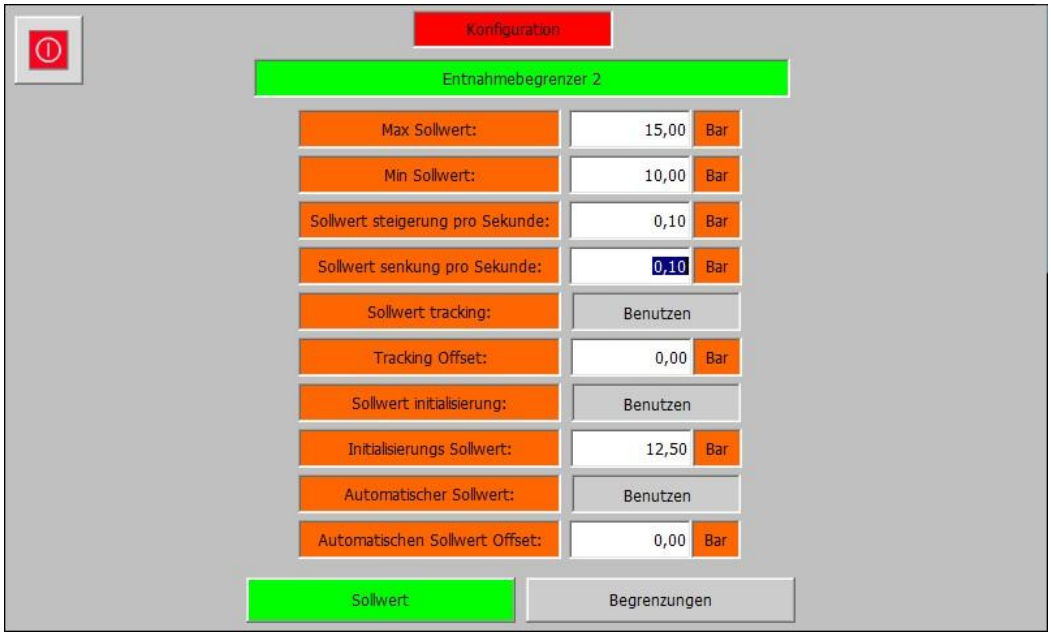


Configuration – (4) LP Control –Extraction limiter 1 – Limits

The level "Limits" includes the parameters for limiting the rate of change of the limiter output. The following parameters are available:

- **Limit controller output:** If activated, the limitation for the change of the limiter output is activated.
- **Maximum rate of reduction per second:** Sets the maximum allowed rate of reduction of the limiter output. If the controller tries to reduce the limiter output more than the adjusted rate of reduction, it will be limited.
- **Maximum rate of rise per second:** Sets the maximum allowed rate of rise for the limiter output. If the limiter tries to rise the limiter output more than the adjusted rate of rice, it will be limited.
- **Type of limit:** Selects if the limitation value should be limited to a minimum or a maximum limit.

3.4.7 Extraction limiter 2



Configuration – (4) LP Control –Extraction limiter 2 – Set point

The Extraction limiter 2 level includes the parameters of the extraction limiter 2. The parameters are separated into "Set point" and "Limits". The Extraction limiter 2 is manipulating the controller output of the Extraction controller 2 to insure a bumbles change between limitation and control.

The Level "Set points" includes the parameters for limiting the set point. The following parameters are available:

- **Max Set point:** Sets the maximum allowed Set point.
- **Min Set point:** Sets the minimum allowed Set point.
- **Set point rate of rise per second:** Sets the maximum rate of rice for changing a Set point.
- **Set point rate of reduction per second:** Sets the maximum rate of reduction for changing a Set point.
- **Set point tracking:** Sets if the Set point should be tracked with the actual value while the controller is not active.
- **Tracking offset:** If the Set point is tracked by the actual value, this parameter sets an offset to the actual value. Example:
    - **Actual value:** 4.0Bar
    - **Offset:** 0.1Bar
    - **Set point:** 4.1Bar
- **Initial Set point:** Sets if a specifiedSet point should be set before the turbine is started. As soon as the turbine is started, the Set point can be changed. It is not necessary that the controller is active, it is enough if the turbine is in offline speed control.
- **Initial Set point:** If the Initial Set point is activated, this value sets the Set point that is set before the turbine is started.

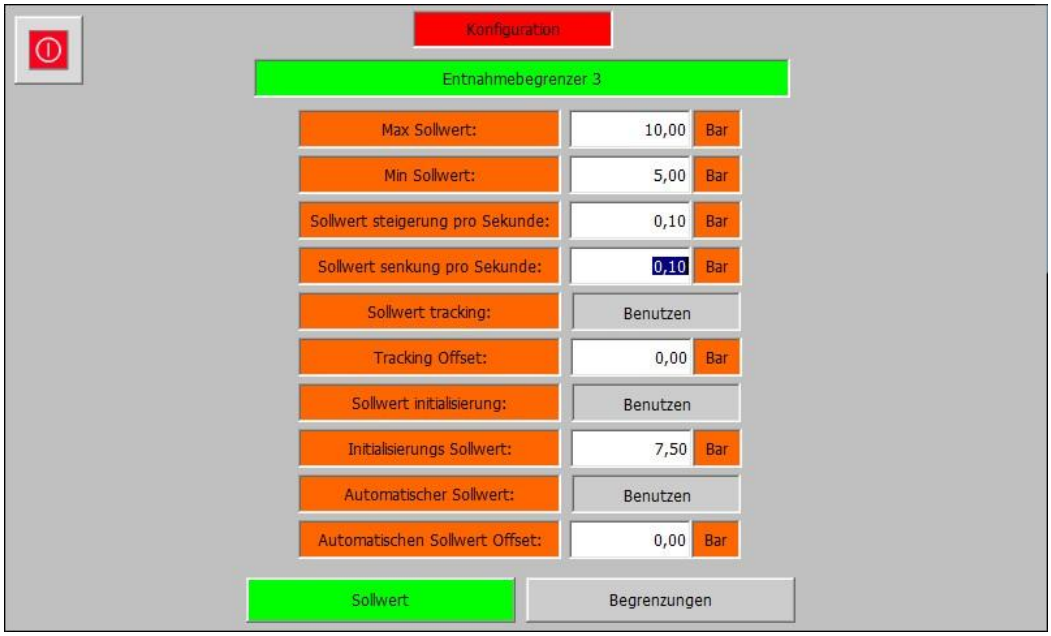
- **Automatic Set point:** If the selected limitation value is also used in an regulator, it is possible to use the actual Set point of the controller. This is useful to take the controller Set point as a limitation value when the control mode has been changed to another controller.
- **Automatic Set point offset:** If an automatic Set point is selected, the automaticSet point offset will be added to the actual controller Set point and be used as the limiter Set point.

Configuration – (4) LP Control –Extraction limiter 2 – Limits

The level "Limits" includes the parameters for limiting the rate of change of the limiter output. The following parameters are available:

- **Limit controller output:** If activated, the limitation for the change of the limiter output is activated.
- **Maximum rate of reduction per second:** Sets the maximum allowed rate of reduction of the limiter output. If the controller tries to reduce the limiter output more than the adjusted rate of reduction, it will be limited.
- **Maximum rate of rise per second:** Sets the maximum allowed rate of rise for the limiter output. If the limiter tries to rise the limiter output more than the adjusted rate of rice, it will be limited.
- **Type of limit:** Selects if the limitation value should be limited to a minimum or a maximum limit.

3.4.8 Extraction limiter 3



Configuration – (4) LP Control –Extraction limiter 3 – Set point

The Extraction limiter 3 level includes the parameters of the extraction limiter 3. The parameters are separated into "Set point" and "Limits". The Extraction limiter 3 is manipulating the controller output of the Extraction controller 3 to insure a bumbles change between limitation and control.

The Level "Set points" includes the parameters for limiting the set point. The following parameters are available:

- **Max Set point:** Sets the maximum allowed Set point.
- **Min Set point:** Sets the minimum allowed Set point.
- **Set point rate of rise per second:** Sets the maximum rate of rice for changing a Set point.
- **Set point rate of reduction per second:** Sets the maximum rate of reduction for changing a Set point.
- **Set point tracking:** Sets if the Set point should be tracked with the actual value while the controller is not active.
- **Tracking offset:** If the Set point is tracked by the actual value, this parameter sets an offset to the actual value. Example:
    - **Actual value:** 4.0Bar
    - **Offset:** 0.1Bar
    - **Set point:** 4.1Bar
- **Initial Set point:** Sets if a specifiedSet point should be set before the turbine is started. As soon as the turbine is started, the Set point can be changed. It is not necessary that the controller is active, it is enough if the turbine is in offline speed control.
- **Initial Set point:** If the Initial Set point is activated, this value sets the Set point that is set before the turbine is started.

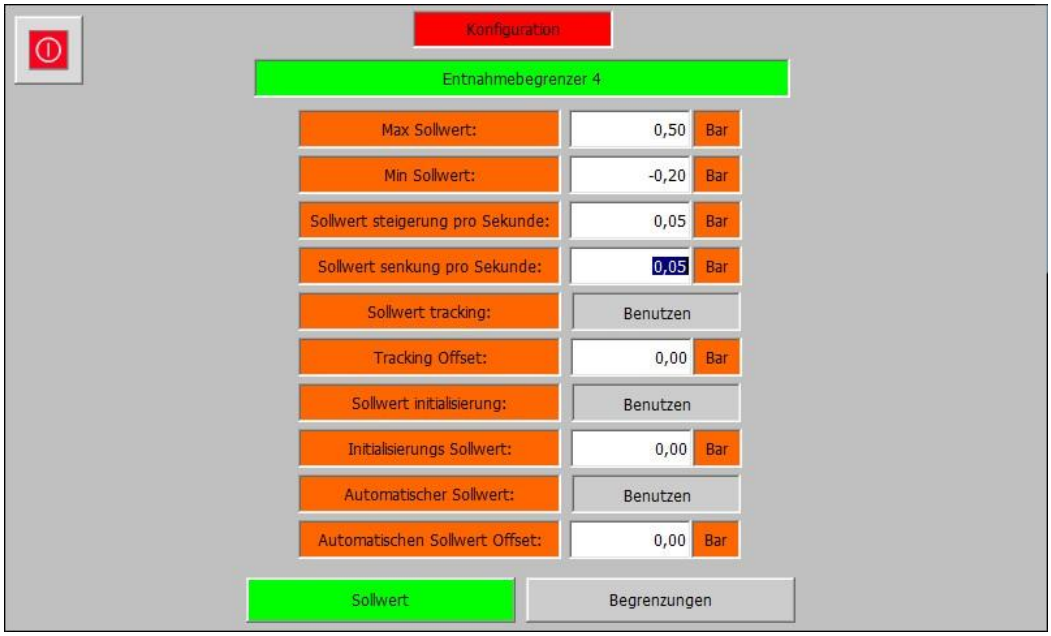
- **Automatic Set point:** If the selected limitation value is also used in an regulator, it is possible to use the actual Set point of the controller. This is useful to take the controller Set point as a limitation value when the control mode has been changed to another controller.
- **Automatic Set point offset:** If an automatic Set point is selected, the automaticSet point offset will be added to the actual controller Set point and be used as the limiter Set point.

Configuration – (4) LP Control –Extraction limiter 3 – Limits

The level "Limits" includes the parameters for limiting the rate of change of the limiter output. The following parameters are available:

- **Limit controller output:** If activated, the limitation for the change of the limiter output is activated.
- **Maximum rate of reduction per second:** Sets the maximum allowed rate of reduction of the limiter output. If the controller tries to reduce the limiter output more than the adjusted rate of reduction, it will be limited.
- **Maximum rate of rise per second:** Sets the maximum allowed rate of rise for the limiter output. If the limiter tries to rise the limiter output more than the adjusted rate of rice, it will be limited.
- **Type of limit:** Selects if the limitation value should be limited to a minimum or a maximum limit.

3.4.9 Extraction limiter 4



Configuration – (4) LP Control –Extraction limiter 4 – Set point

The Extraction limiter 4 level includes the parameters of the extraction limiter 4. The parameters are separated into "Set point" and "Limits". The Extraction limiter 4 is manipulating the controller output of the Extraction controller 4 to insure a bumbles change between limitation and control.

The Level "Set points" includes the parameters for limiting the set point. The following parameters are available:

- **Max Set point:** Sets the maximum allowed Set point.
- **Min Set point:** Sets the minimum allowed Set point.
- **Set point rate of rise per second:** Sets the maximum rate of rice for changing a Set point.
- **Set point rate of reduction per second:** Sets the maximum rate of reduction for changing a Set point.
- **Set point tracking:** Sets if the Set point should be tracked with the actual value while the controller is not active.
- **Tracking offset:** If the Set point is tracked by the actual value, this parameter sets an offset to the actual value. Example:
  - **Actual value:** 4.0Bar
  - **Offset:** 0.1Bar
  - **Set point:** 4.1Bar
- **Initial Set point:** Sets if a specifiedSet point should be set before the turbine is started. As soon as the turbine is started, the Set point can be changed. It is not necessary that the controller is active, it is enough if the turbine is in offline speed control.
- **Initial Set point:** If the Initial Set point is activated, this value sets the Set point that is set before the turbine is started.

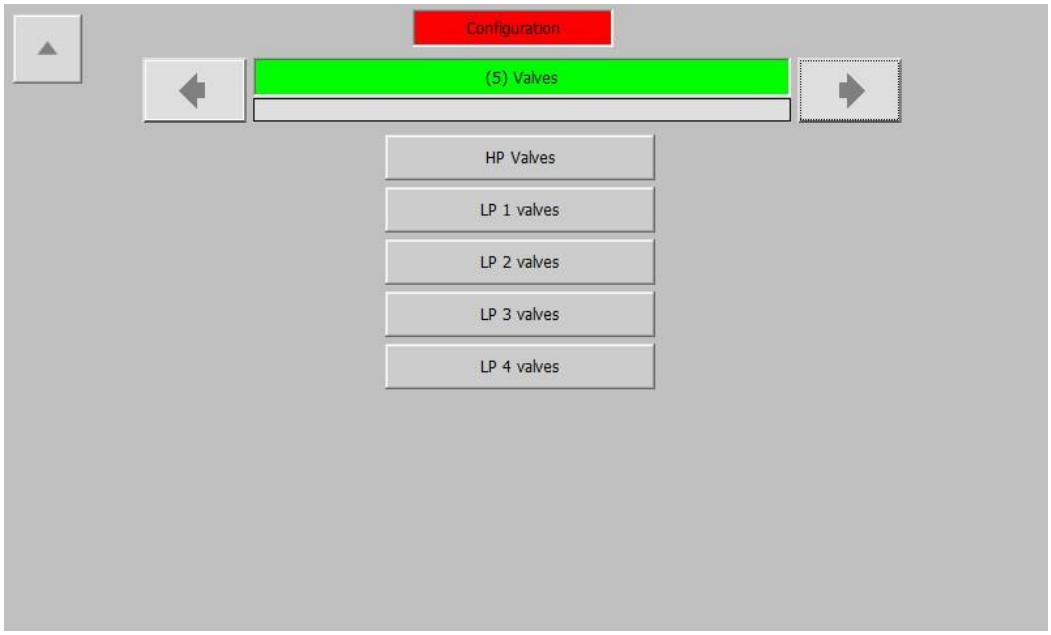
- **Automatic Set point:** If the selected limitation value is also used in an regulator, it is possible to use the actual Set point of the controller. This is useful to take the controller Set point as a limitation value when the control mode has been changed to another controller.
- **Automatic Set point offset:** If an automatic Set point is selected, the automaticSet point offset will be added to the actual controller Set point and be used as the limiter Set point.

Configuration – (4) LP Control –Extraction limiter 4 – Limits

The level "Limits" includes the parameters for limiting the rate of change of the limiter output. The following parameters are available:

- **Limit controller output:** If activated, the limitation for the change of the limiter output is activated.
- **Maximum rate of reduction per second:** Sets the maximum allowed rate of reduction of the limiter output. If the controller tries to reduce the limiter output more than the adjusted rate of reduction, it will be limited.
- **Maximum rate of rise per second:** Sets the maximum allowed rate of rise for the limiter output. If the limiter tries to rise the limiter output more than the adjusted rate of rice, it will be limited.
- **Type of limit:** Selects if the limitation value should be limited to a minimum or a maximum limit.

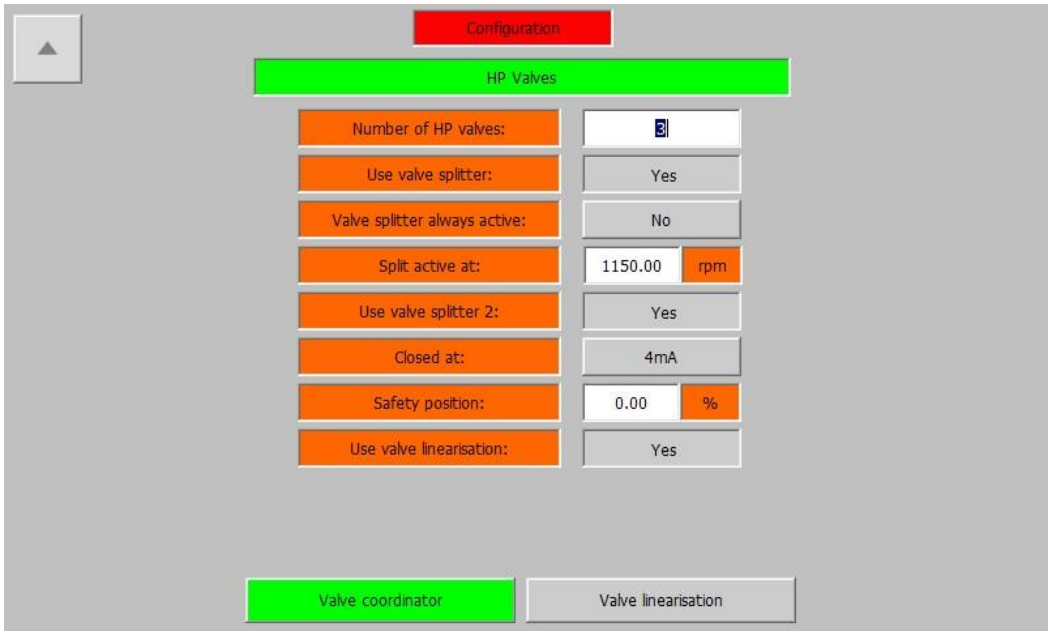
3.5 Valves



The valve level includes all parameters for the control of the valve outputs. The following levels are available:

- HP Valves
- LP 1 Valves
- LP 2 Valves
- LP 3 Valves
- LP 4 Valves

3.5.1 HP Valves



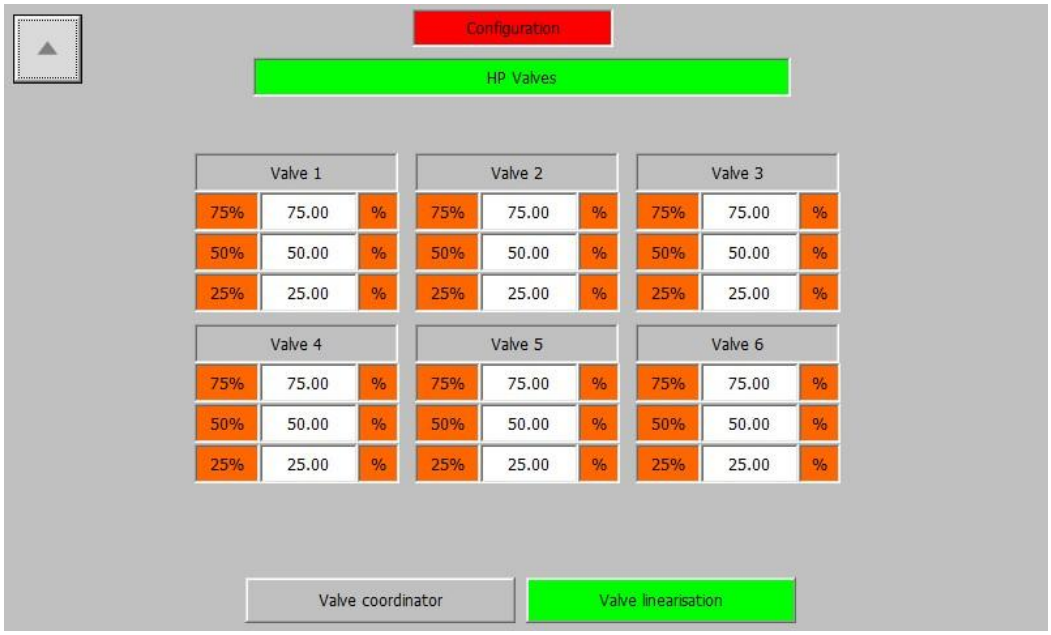
Configuration – (5) Valves – HP Valves - Valve coordinator

The HP valve level includes the parameters for the HP control valves. The parameters are in 2 levels "Valve coordinator" and "Valve linearization". The level "Valve linearization" is only available if the valve linearization is used.

The following parameters are available:

- **Number of HP valves (1-6):**The number of valves controlled by the HP control stage.
- **Use valve splitter (Yes/No):**If activated, a valve splitter is used. This option is only available when more than 1 valve controlled is. IF the valve splitter activated is, the control output of the HP controller will be splitter to the HP valve outputs according to the split values that are configured in theservice level.
- **Valve splitter always active (Yes/No):**If activated, the valve splitter is always after the controller has been started. If it is not activated, the split will be activated after reaching the speed limit configured at „Split active at".
- **Split active at (0 – Rated speed):**Sets the speed limit for the activation of the split function if "Valve splitter always active" is configured to "No".
- **Use valve splitter 2 (Yes/No):**If activated, a 2. valve splitter is used. This option allows a floating change between 2 separate adjusted splitters. This can be used to achieve a better efficiency at part load. A signal received via Ethernet can be used to activate and deactivate the 2. splitter.
- **Closed at (4mA/20mA):**Sets the type of valve that is connected at the valve outputs. The ESTC is calculating the controller output according to the type of valve to make sure it is always in the right position.
- **Safety position(0-100%):**Sets the position for the valve that will be reached when the safety chain of the ESTC has been tripped. This position is more important than the start position of the control groups.

- **Use valve linearization (Yes/No):**If activated, the control valves can be adjusted to a 4 zone linearization curve to insure a linear behavior of the turbine.



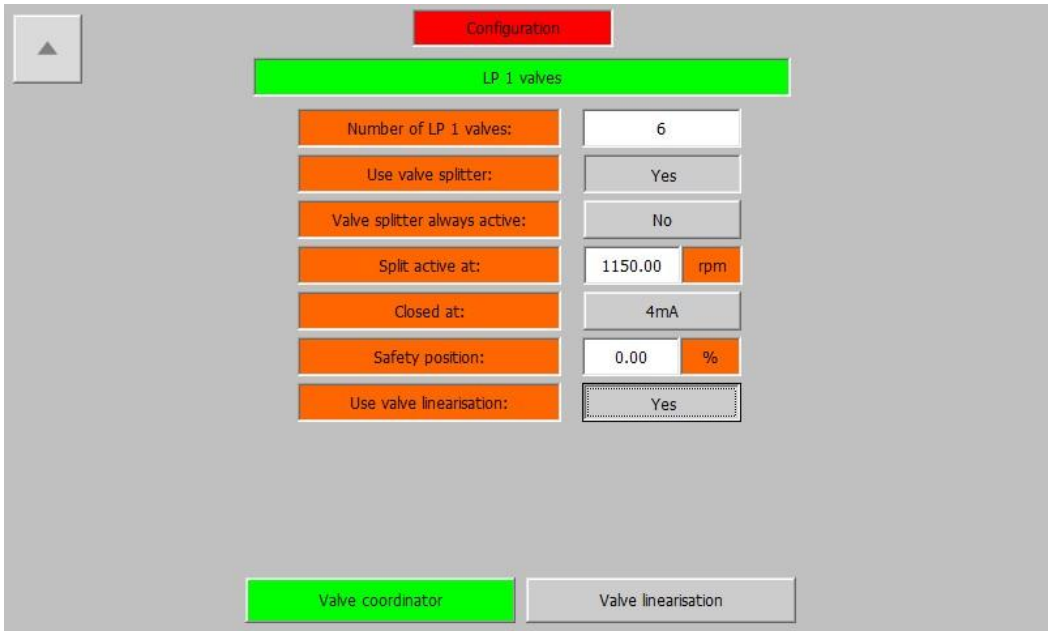
Configuration – (5) Valves – HP Valves - Valve linearization

The valve linearization can be used to tune the linearization curve of the control valves. Because every valve has a slightly different characteristic through put curve, this function can be used to insure a linear valve efficiency. To calculate this curve, 5 points between 0-100% will be set according to the control outputs values of 0%, 25%, 50%, 75% and 100%. This values will be used to calculate the curve and manipulate the control output to the valve output. The fixed values are according to the control output and the configurable values are according to the valve output.

The following parameters are available for every single valve:

- **Valve 75% (0-100% but bigger than valve 50%):**Sets the valve output according to a control output of 75%.
- **Valve 50% (0-100% but bigger than valve25% and smaller than valve 75%):**Sets the valve output according to a control output of 50%.
- **valve 25% (0-100% but smaller than valve 50%):**Sets the valve output according to a control output of 75%.

3.5.2 LP 1 valves

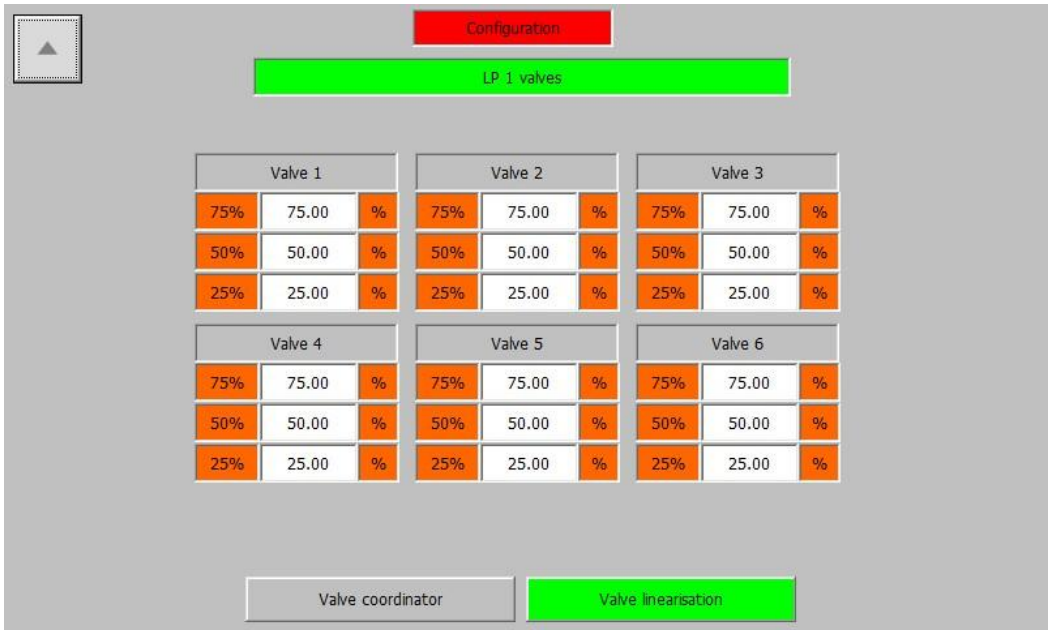


Configuration – (5) Valves – LP 1 Valves - Valve coordinator

The LP 1 valve level includes the parameters for the LP 1 control valves. The parameters are in 2 levels "Valve coordinator" and "Valve linearization". The level "Valve linearization" is only available if the valve linearization is used.

The following parameters are available:

- **Number of LP 1 valves (1-6):** The number of valves controlled by the LP 1 control stage.
- **Use valve splitter (Yes/No):** If activated, a valve splitter is used. This option is only available when more than 1 valve controlled is. IF the valve splitter activated is, the control output of the LP 1 controller will be splitter to the LP 1 valve outputs according to the split values that are configured in this service level.
- **Valve splitter always active (Yes/No):** If activated, the valve splitter is always after the controller has been started. If it is not activated, the split will be activated after reaching the speed limit configured at „Split active at".
- **Split active at (0 – Rated speed):** Sets the speed limit for the activation of the split function if "Valve splitter always active" is configured to "No".
- **Closed at (4mA/20mA):** Sets the type of valve that is connected at the valve outputs. The ESTC is calculating the controller output according to the type of valve to make sure it is always in the right position.
- **Safety position(0-100%):** Sets the position for the valve that will be reached when the safety chain of the ESTC has been tripped. This position is more important than the start position of the control groups.
- **Use valve linearization (Yes/No):** If activated, the control valves can be adjusted to a 4 zone linearization curve to insure a linear behavior of the turbine.



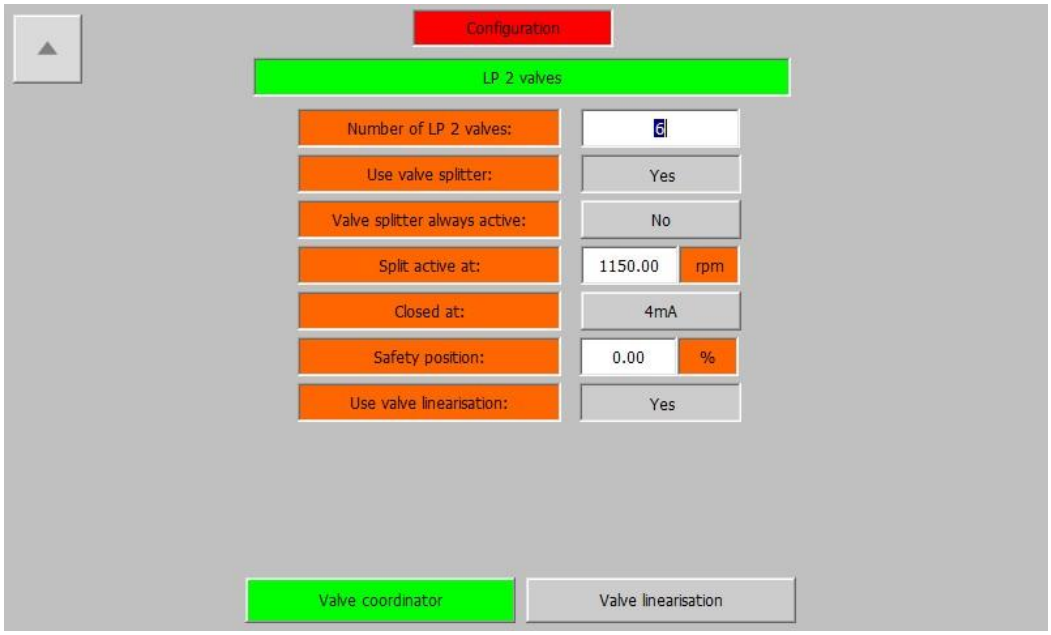
Configuration – (5) Valves – LP 1 Valves - Valve linearization

The valve linearization can be used to tune the linearization curve of the control valves. Because every valve has a slightly different characteristic through put curve, this function can be used to insure a linear valve efficiency. To calculate this curve, 5 points between 0-100% will be set according to the control outputs values of 0%, 25%, 50%, 75% and 100%. This values will be used to calculate the curve and manipulate the control output to the valve output. The fixed values are according to the control output and the configurable values are according to the valve output.

The following parameters are available for every single valve:

- **Valve 75% (0-100% but bigger than valve 50%):** Sets the valve output according to a control output of 75%.
- **Valve 50% (0-100% but bigger than valve 25% and smaller than valve 75%):** Sets the valve output according to a control output of 50%.
- **valve 25% (0-100% but smaller than valve 50%):** Sets the valve output according to a control output of 75%.

3.5.3 LP 2 valves

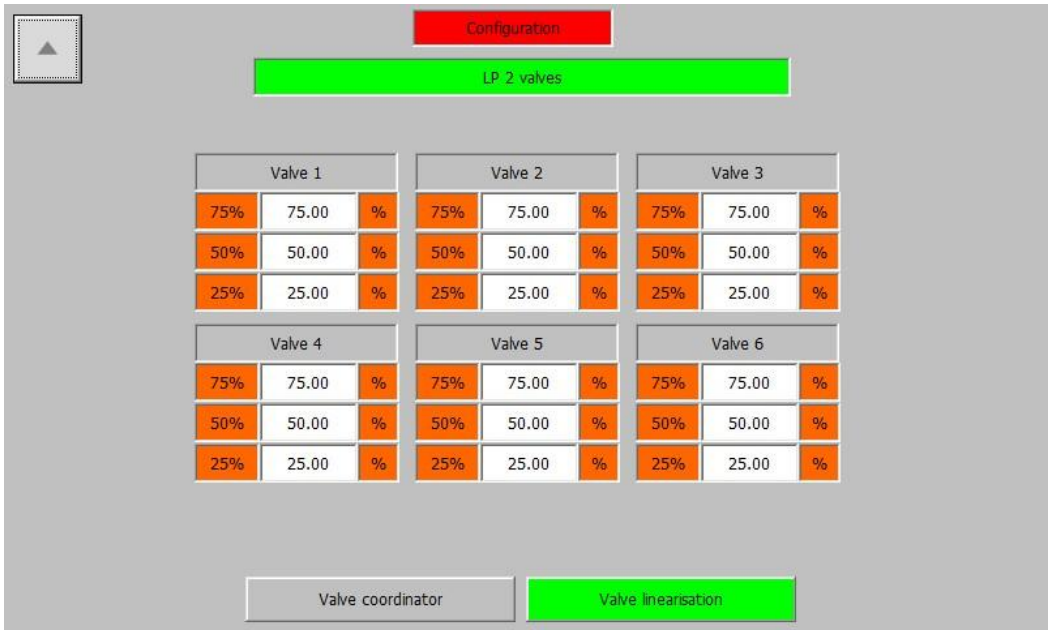


Configuration – (5) Valves – LP 2 Valves - Valve coordinator

The LP 2 valve level includes the parameters for the LP 2 control valves. The parameters are in 2 levels "Valve coordinator" and "Valve linearization". The level "Valve linearization" is only available if the valve linearization is used.

The following parameters are available:

- **Number of LP 2 valves (1-6):** The number of valves controlled by the LP 2 control stage.
- **Use valve splitter (Yes/No):** If activated, a valve splitter is used. This option is only available when more than 1 valve controlled is. IF the valve splitter activated is, the control output of the LP 2 controller will be splitter to the LP 2 valve outputs according to the split values that are configured in this service level.
- **Valve splitter always active (Yes/No):** If activated, the valve splitter is always after the controller has been started. If it is not activated, the split will be activated after reaching the speed limit configured at „Split active at".
- **Split active at (0 – Rated speed):** Sets the speed limit for the activation of the split function if "Valve splitter always active" is configured to "No".
- **Closed at (4mA/20mA):** Sets the type of valve that is connected at the valve outputs. The ESTC is calculating the controller output according to the type of valve to make sure it is always in the right position.
- **Safety position(0-100%):** Sets the position for the valve that will be reached when the safety chain of the ESTC has been tripped. This position is more important than the start position of the control groups.
- **Use valve linearization (Yes/No):** If activated, the control valves can be adjusted to a 4 zone linearization curve to insure a linear behavior of the turbine.



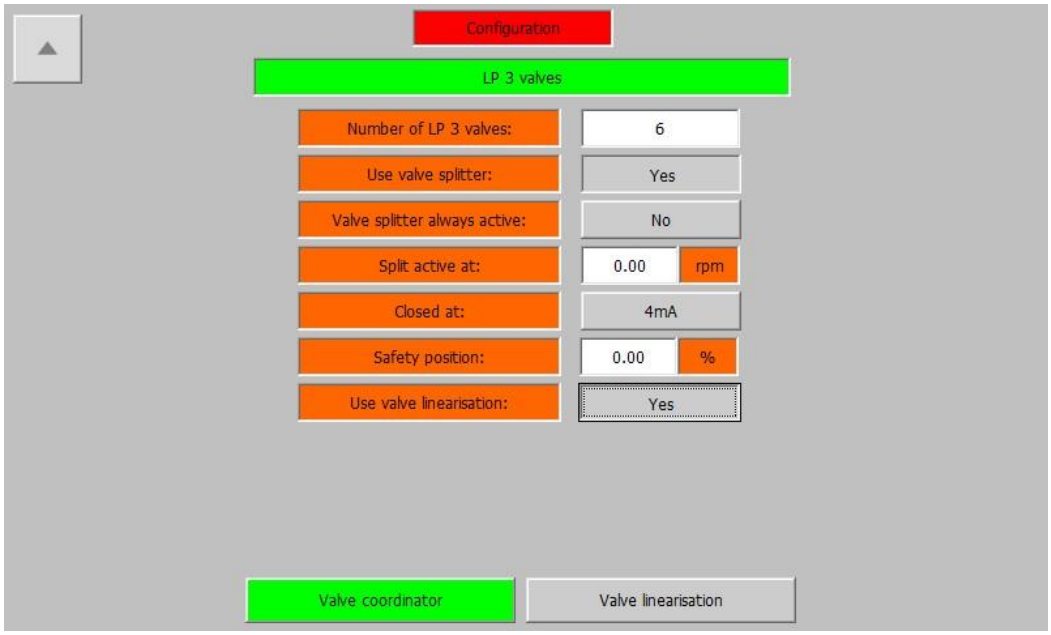
Configuration – (5) Valves – LP 2 Valves - Valve linearization

The valve linearization can be used to tune the linearization curve of the control valves. Because every valve has a slightly different characteristic through put curve, this function can be used to insure a linear valve efficiency. To calculate this curve, 5 points between 0-100% will be set according to the control outputs values of 0%, 25%, 50%, 75% and 100%. This values will be used to calculate the curve and manipulate the control output to the valve output. The fixed values are according to the control output and the configurable values are according to the valve output.

The following parameters are available for every single valve:

- **Valve 75% (0-100% but bigger than valve 50%):** Sets the valve output according to a control output of 75%.
- **Valve 50% (0-100% but bigger than valve 25% and smaller than valve 75%):** Sets the valve output according to a control output of 50%.
- **valve 25% (0-100% but smaller than valve 50%):** Sets the valve output according to a control output of 75%.

3.5.4 LP 3 valves

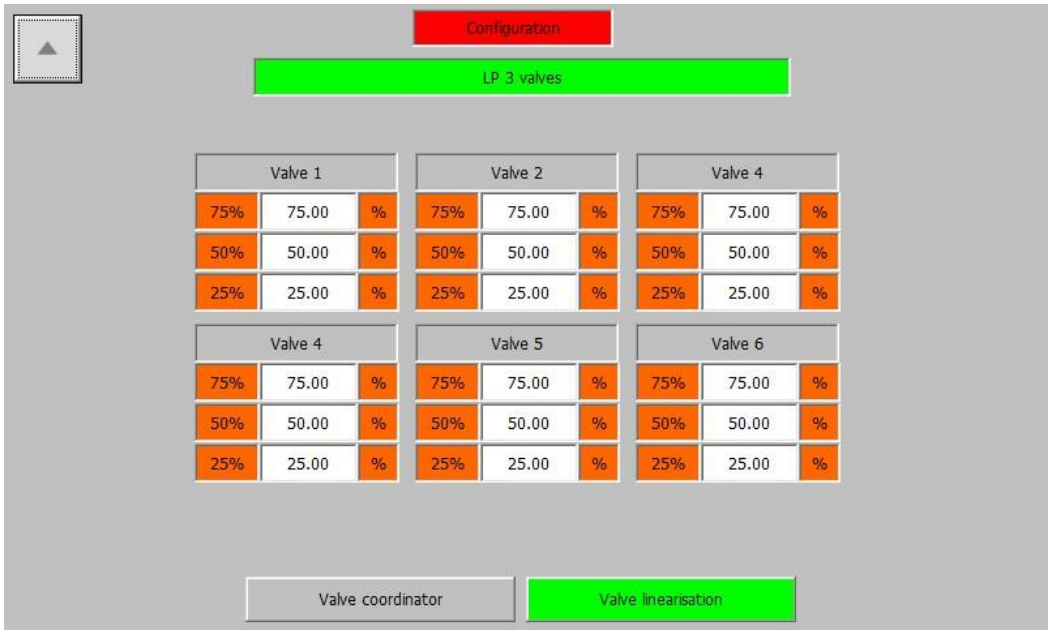


Configuration – (5) Valves – LP 3 Valves - Valve coordinator

The LP 3 valve level includes the parameters for the LP 3 control valves. The parameters are in 2 levels "Valve coordinator" and "Valve linearization". The level "Valve linearization" is only available if the valve linearization is used.

The following parameters are available:

- **Number of LP 3 valves (1-6):** The number of valves controlled by the LP 3 control stage.
- **Use valve splitter (Yes/No):** If activated, a valve splitter is used. This option is only available when more than 3 valve controlled is. IF the valve splitter activated is, the control output of the LP 3 controller will be splitter to the LP 3 valve outputs according to the split values that are configured in this service level.
- **Valve splitter always active (Yes/No):** If activated, the valve splitter is always after the controller has been started. If it is not activated, the split will be activated after reaching the speed limit configured at „Split active at".
- **Split active at (0 – Rated speed):** Sets the speed limit for the activation of the split function if "Valve splitter always active" is configured to "No".
- **Closed at (4mA/20mA):** Sets the type of valve that is connected at the valve outputs. The ESTC is calculating the controller output according to the type of valve to make sure it is always in the right position.
- **Safety position(0-100%):** Sets the position for the valve that will be reached when the safety chain of the ESTC has been tripped. This position is more important than the start position of the control groups.
- **Use valve linearization (Yes/No):** If activated, the control valves can be adjusted to a 4 zone linearization curve to insure a linear behavior of the turbine.



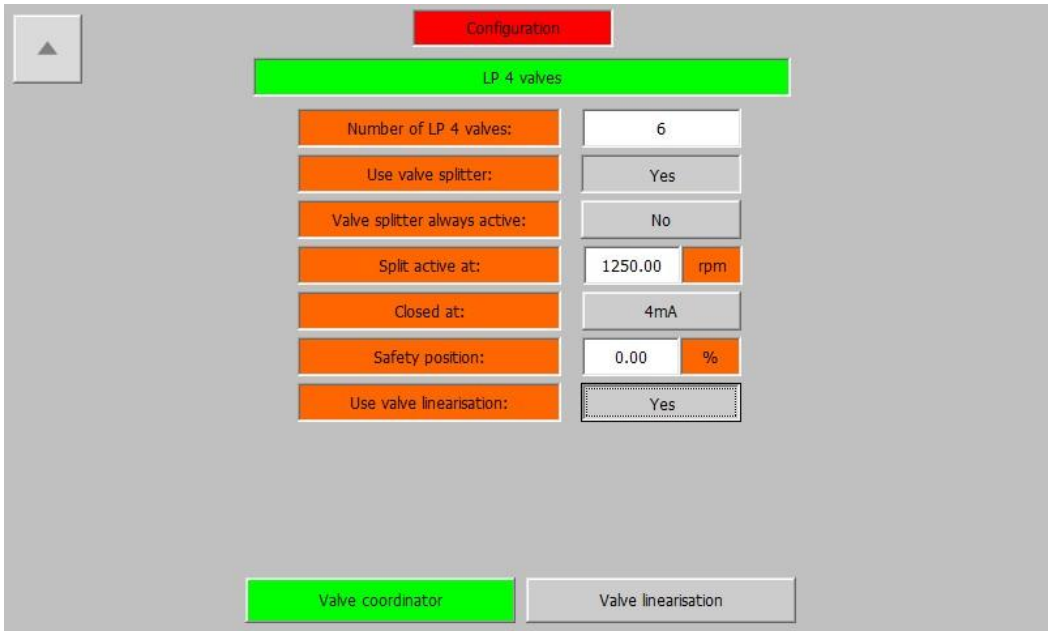
Configuration – (5) Valves – LP 3 Valves - Valve linearization

The valve linearization can be used to tune the linearization curve of the control valves. Because every valve has a slightly different characteristic through put curve, this function can be used to insure a linear valve efficiency. To calculate this curve, 5 points between 0-100% will be set according to the control outputs values of 0%, 25%, 50%, 75% and 100%. This values will be used to calculate the curve and manipulate the control output to the valve output. The fixed values are according to the control output and the configurable values are according to the valve output.

The following parameters are available for every single valve:

- **Valve 75% (0-100% but bigger than valve 50%):** Sets the valve output according to a control output of 75%.
- **Valve 50% (0-100% but bigger than valve 25% and smaller than valve 75%):** Sets the valve output according to a control output of 50%.
- **valve 25% (0-100% but smaller than valve 50%):** Sets the valve output according to a control output of 75%.

3.5.5 LP 4 valves

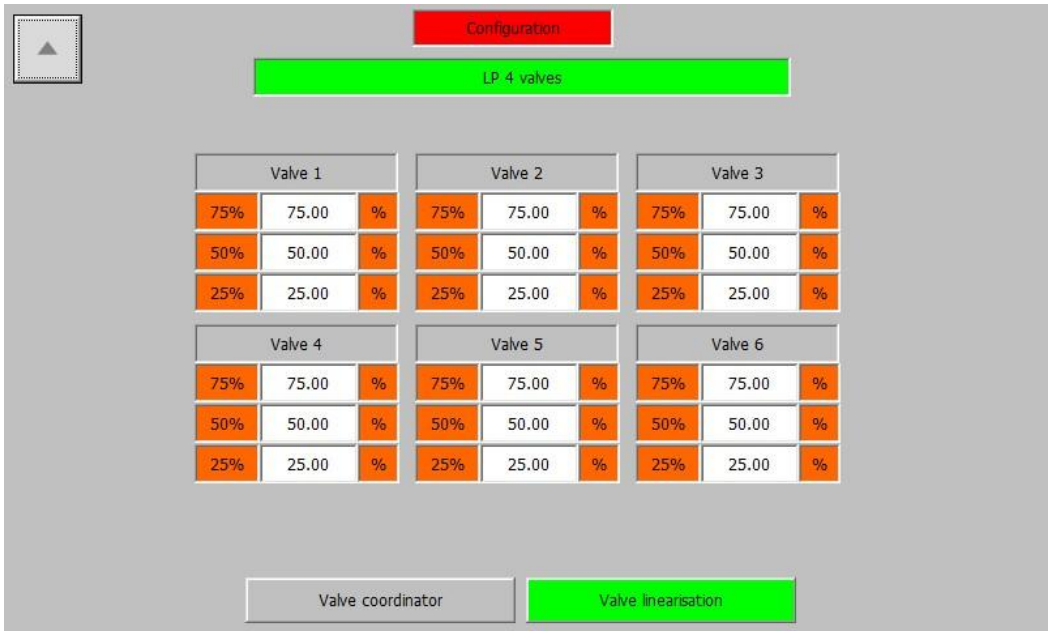


Configuration – (5) Valves – LP 4 Valves - Valve coordinator

The LP 4 valve level includes the parameters for the LP 4 control valves. The parameters are in 4 levels "Valve coordinator" and "Valve linearization ". The level "Valve linearization " is only available if the valve linearization is used.

The following parameters are available:

- **Number of LP 4 valves (1-6):** The number of valves controlled by the LP 4 control stage.
- **Use valve splitter (Yes/No):** If activated, a valve splitter is used. This option is only available when more than 1 valve controlled is. IF the valve splitter activated is, the control output of the LP 4 controller will be splitter to the LP 4 valve outputs according to the split values that are configured in this service level.
- **Valve splitter always active (Yes/No):** If activated, the valve splitter is always after the controller has been started. If it is not activated, the split will be activated after reaching the speed limit configured at „Split active at".
- **Split active at (0 – Rated speed):** Sets the speed limit for the activation of the split function if "Valve splitter always active" is configured to "No".
- **Closed at (4mA/20mA):** Sets the type of valve that is connected at the valve outputs. The ESTC is calculating the controller output according to the type of valve to make sure it is always in the right position.
- **Safety position(0-100%):** Sets the position for the valve that will be reached when the safety chain of the ESTC has been tripped. This position is more important than the start position of the control groups.
- **Use valve linearization (Yes/No):** If activated, the control valves can be adjusted to a 4 zone linearization curve to insure a linear behavior of the turbine.



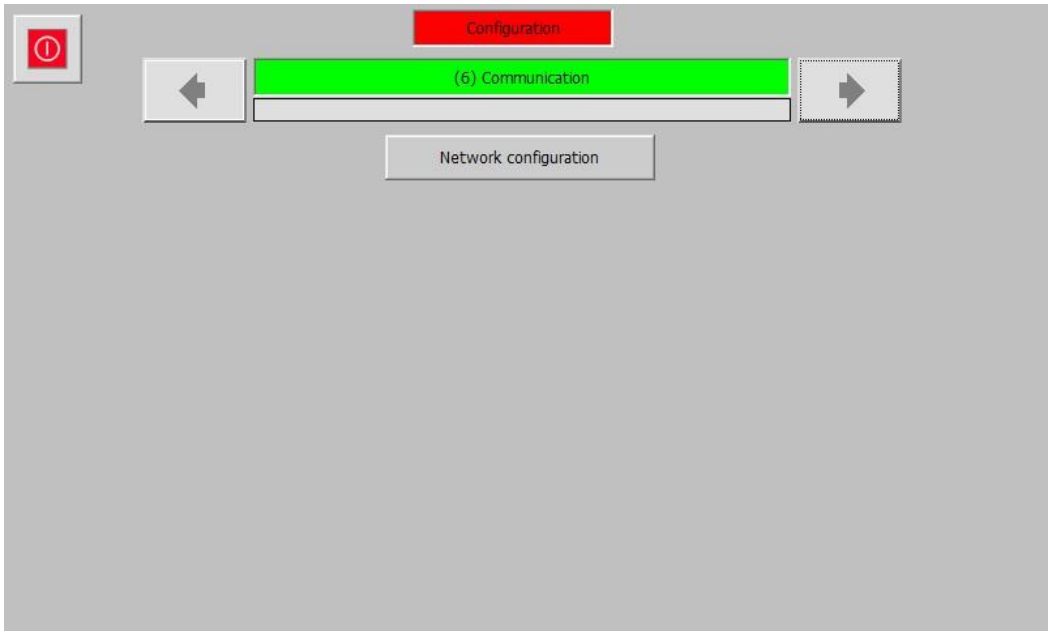
Configuration – (5) Valves – LP 4 Valves - Valve linearization

The valve linearization can be used to tune the linearization curve of the control valves. Because every valve has a slightly different characteristic through put curve, this function can be used to insure a linear valve efficiency. To calculate this curve, 5 points between 0-100% will be set according to the control outputs values of 0%, 25%, 50%, 75% and 100%. This values will be used to calculate the curve and manipulate the control output to the valve output. The fixed values are according to the control output and the configurable values are according to the valve output.

The following parameters are available for every single valve:

- **Valve 75% (0-100% but bigger than valve 50%):** Sets the valve output according to a control output of 75%.
- **Valve 50% (0-100% but bigger than valve 25% and smaller than valve 75%):** Sets the valve output according to a control output of 50%.
- **valve 25% (0-100% but smaller than valve 50%):** Sets the valve output according to a control output of 75%.

3.6 Communication



Configuration – (6) Communication

The communication level includes the configuration for communication with other PLC´s and the IP settings. The following levels are available:

- Network configuration

3.6.1 Network configuration

Configuration – (6) Communication- Network configuration

The network configuration allows the adjustment of the Ethernet connection. The connection can be used for remote access and for data exchange to PLCs.

The following parameters are only available of the communication of the ESTC to the HMI is via Profibus. When the connection is used via Ethernet, the following parameters are not available:

- **IP Address:** Sets the IP-Address of the ESTC.
- **Subnet mask:** Sets the Subnet mask of the ESTC.
- **Gateway:** Sets the Standard gateway of the ESTC. This is necessary when a communication through different network areas is used.
- **Take data:** Activates the configured IP configuration.

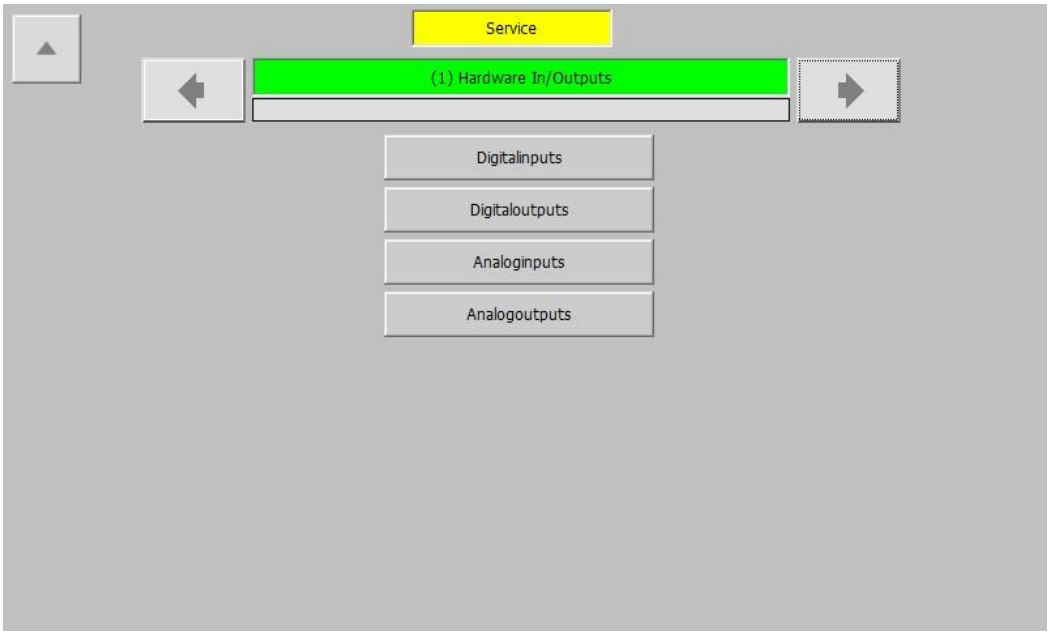
The following parameters are always available:

- **Use Ethernet communication:** If activated, it is possible to get commands and Set points over Ethernet from another PLC.

4.0 Service

The Service level of the ESTC includes the parameters for the control of the Turbine. These parameters can also be changed during the operation of the turbine. All parameters need a user level that does at least allow changes to the service level.

4.1 Hardware In/Outputs



Service – (1) Hardware In/Outputs

The Hardware In/Output level shows the actual status of all Digital and Analog In and Outputs. The following levels are available:

- Digital inputs
- Digital outputs
- Analog inputs
- Analog outputs

4.1.1 Digital inputs

Service – (1) Hardware In/Outputs – Digital Inputs 1-8

Service – (1) Hardware In/Outputs – Digital Inputs 9-16

The Digital input level shows the actual status of the digital inputs of the ESTC. For the first and fixed input „Safety circuit“, the background color shows the actual status according to the following colors:

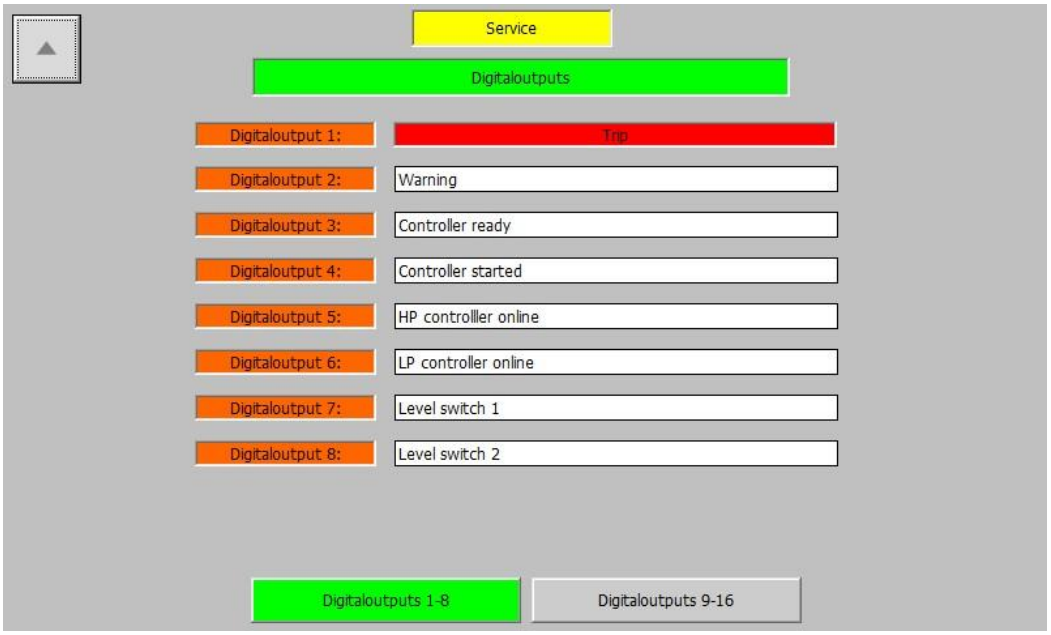
- **Gray:** The Input „Safety circuit“ has the status „1“ and the safety chain is ok.
- **Red:** The Input „Safety circuit“ has the status „0“ and the safety chain is not ok.

For the free configurable inputs 2-16, the background color shows the actual status according to the following colors:

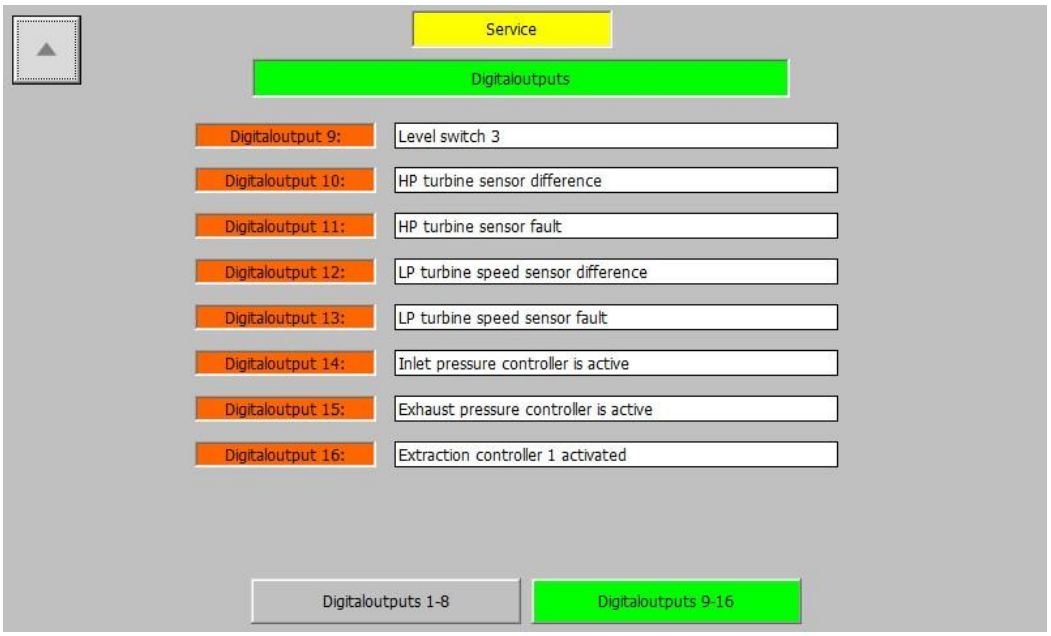
- **Gray:** The input has the status „0“.
- **Green:** the input has the status „1“.

The Background color is always indicating the status of the Input. It does not say if the input is ok or not.

4.1.2 Digital outputs



Service – (1) Hardware In/Outputs – Digital outputs 1-8



Service – (1) Hardware In/Outputs – Digital outputs 9-16

The digital output level shows the actual status of the digital outputs of the ESTC. For the first and fixed output „Trip“, the background color shows the status according to the following colors:

- **Gray:** The Status „Trip“ is ok and has the status „1“.
- **Red:** The Status „Trip“ is not ok and the status is „0“.

For the free configurable outputs 2-16, the background color is indicating the status according to the following colors:

- **Gray:** The Output has the status „0“.
- **Green:** The Output has the status „1“.

The Background color is indicating the status of the output. It is not indicating if the output is ok or not.

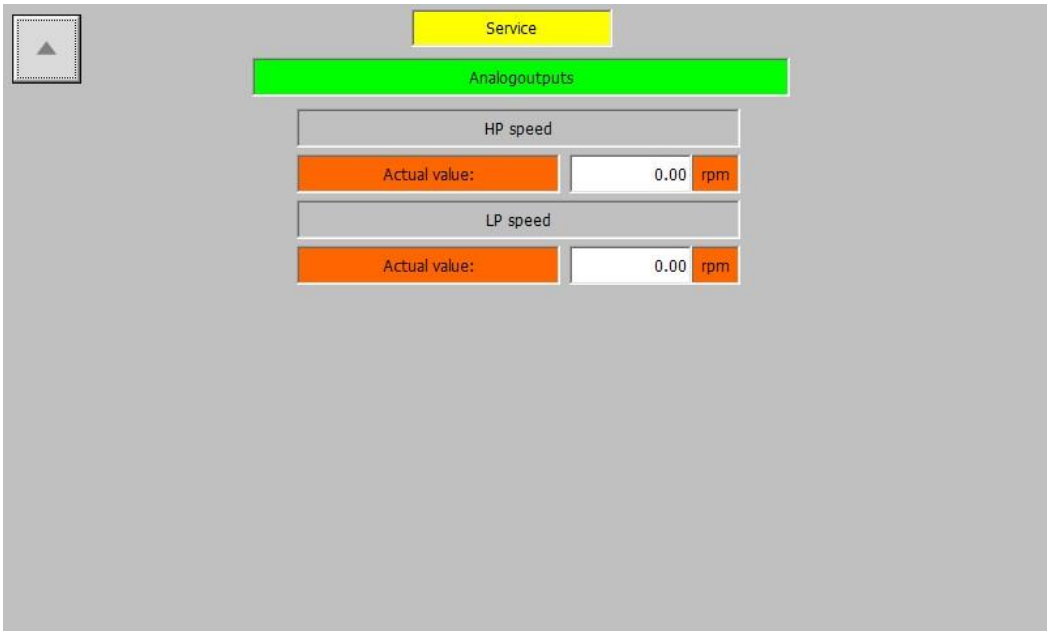
4.1.3 Analog inputs

Service – (1) Hardware In/Outputs – Analog Inputs

The Analog inputs level shows the actual inputs of the analog inputs 1-12. Beyond this, the following parameters can be set:

- **Factor:** The measured analog input will be multiplied with this value and is increasing or decreasing the complete band. This can be used to correct the measured value.
- **Offset:** After the measured value has been multiplied with the factor, it will be added with the „Offset“ value. This can be used to correct the measured value.

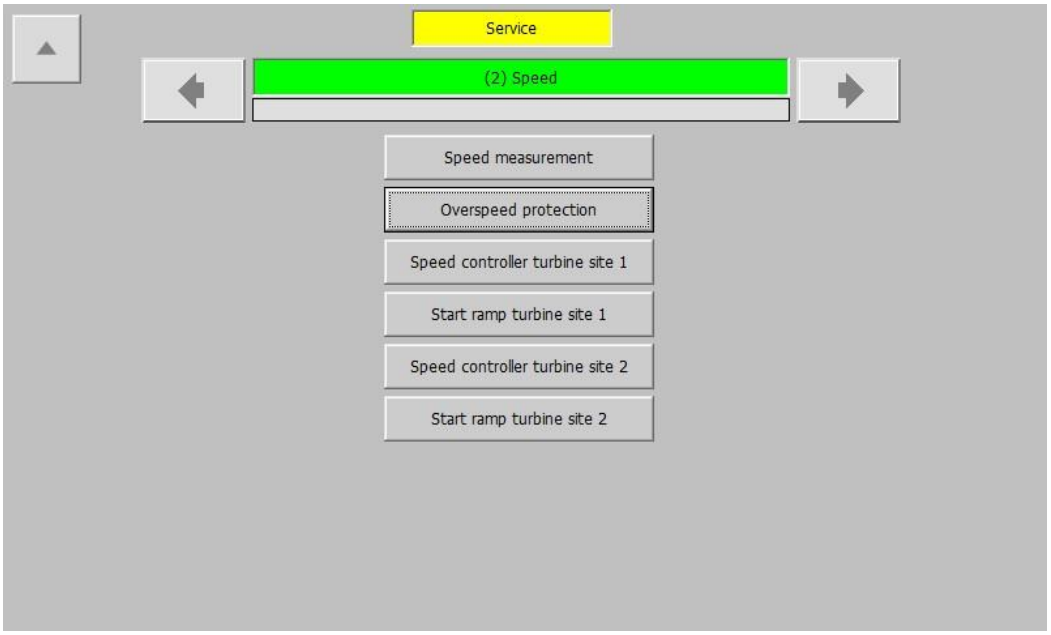
4.1.4 Analog outputs



Service – (1) Hardware In/Outputs – Analog outputs

The analog outputs level shows the actual speed values that are used for the scaling of the 4-20mA outputs.

4.2 Speed

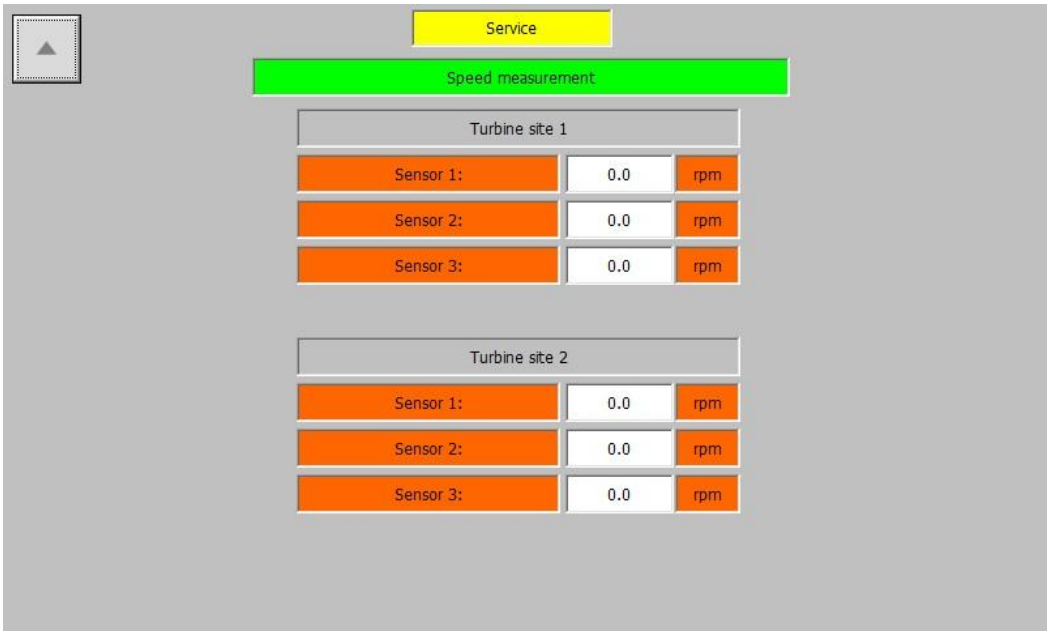


Service – (2) Speed

The Speed level shows all parameters and control functions for the control and monitoring of the turbine speed. The following levels are available:

- Speed measurement
- Over speed protection
- Speed controller turbine site 1
- Start ramp turbine site 1
- Speed controller turbine site 2
- Start ramp turbine site 2

4.2.1 Speed measurement



Service – (2) Speed – speed measurement

The speed measurement level shows the actual measured speed values. All speed sensor can be checked separately to find a problem with a not working speed sensor.

4.2.2 Over speed protection

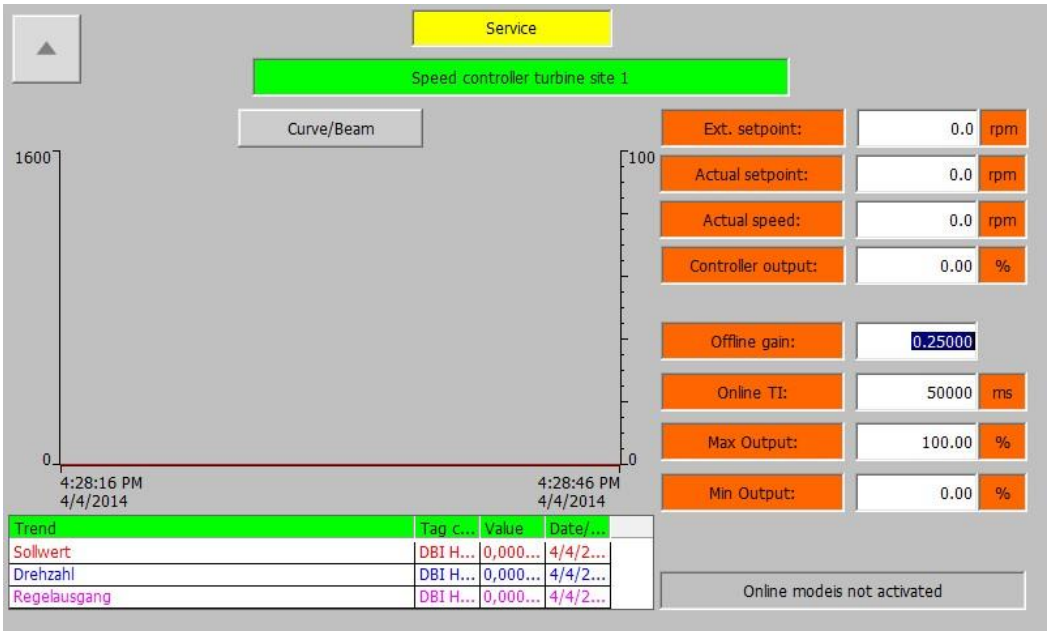
Service – (2) Speed – Over speed protection

The Over speed protection level shows the highest measured speed value and allows the operator to start a over speed protection procedure to test an external over speed protection. The following parameters are available:

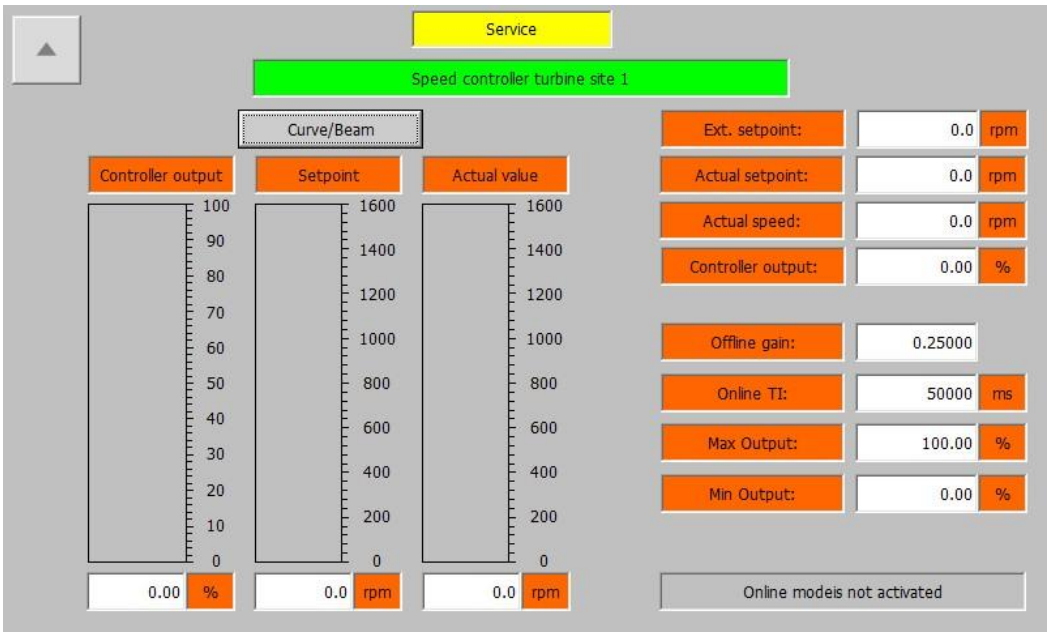
- **Highest speed value of turbine site 1:**Shows the highest measured value of the turbine site 1 speed.
- **Reset highest speed value of turbine site 1:**Sets the parameter „Highest speed value of turbine site 1“ to the value 0. With this function it is possible to reset this value for the next over speed test.
- **Speed turbine site 1:**Shows the actual measured speed of turbine site 1. When the actual measured speed is above the configured over speed protection limit, the background color begins to flash in red and black.
- **Actual speed Set point site 1:**Shows the actual speed Set point of turbine site 1.
- **Start over speed test turbine site 1:**Activates the over speed protection test procedure of turbine site 1. The function is only active while the button is pushed down. If the button is released, the over speed protection test procedure will be stopped. While the procedure is active, the internal over speed protection is blocked to allow a test of an external over speed test without getting a trip of the ESTC over speed protection.
- **Highest speed value of turbine site 2:** Shows the highest measured value of the turbine site 2 speed.
- **Reset highest speed value of turbine site 2:** Sets the parameter „Highest speed value of turbine site 1“ to the value 0. With this function it is possible to reset this value for the next over speed test.

- **Speed turbine site 2:** Shows the actual measured speed of turbine site 2. When the actual measured speed is above the configured over speed protection limit, the background color begins to flash in red and black.
- **Actual speed Set point site 2:** Shows the actual speed Set point of turbine site 2.
- **Start over speed test turbine site 2:** Activates the over speed protection test procedure of turbine site 2. The function is only active while the button is pushed down. If the button is released, the over speed protection test procedure will be stopped. While the procedure is active, the internal over speed protection is blocked to allow a test of an external over speed test without getting a trip of the ESTC over speed protection.

4.2.3 Speed controller turbine site 1



Service – (2) Speed – Speed controller turbine site 1 „Curve“

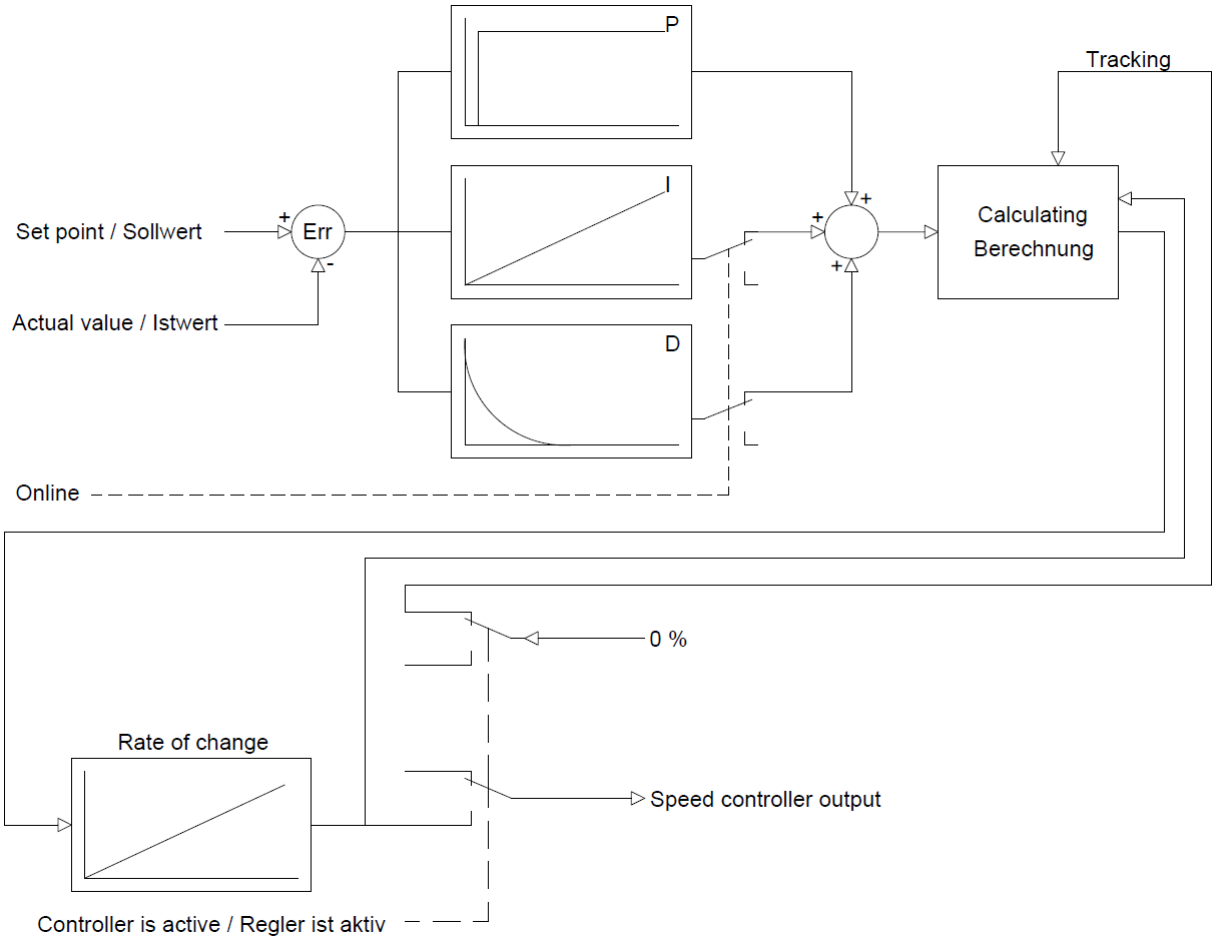


Service – (2) Speed – Speed controller turbine site 1 „Beam“

The speed controller turbine site 1 level includes the measurements and parameters for the speed controller of turbine site 1. 2 Different views are available for the speed controller turbine site 1. The button “Curve/Beam” can be used to switch between the “Curve” and “Beam” view. The following parameters are available:

- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.

- **Actual speed:** Shows the actual measured speed of turbine site 1.
- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Offline Gain:** Sets the Gain Part of the PI-Controller in offline mode.
- **Offline Twi**nsets the TI Part of the PI-Controller in offline mode.
- **Max Output:** Sets the maximum output of the PI-Controller.
- **Min Output:** Sets the minimum output of the PI-Controller.
- **Online mode is deactivated/activated:** Shows if the PI-Controller is on offline or online mode.



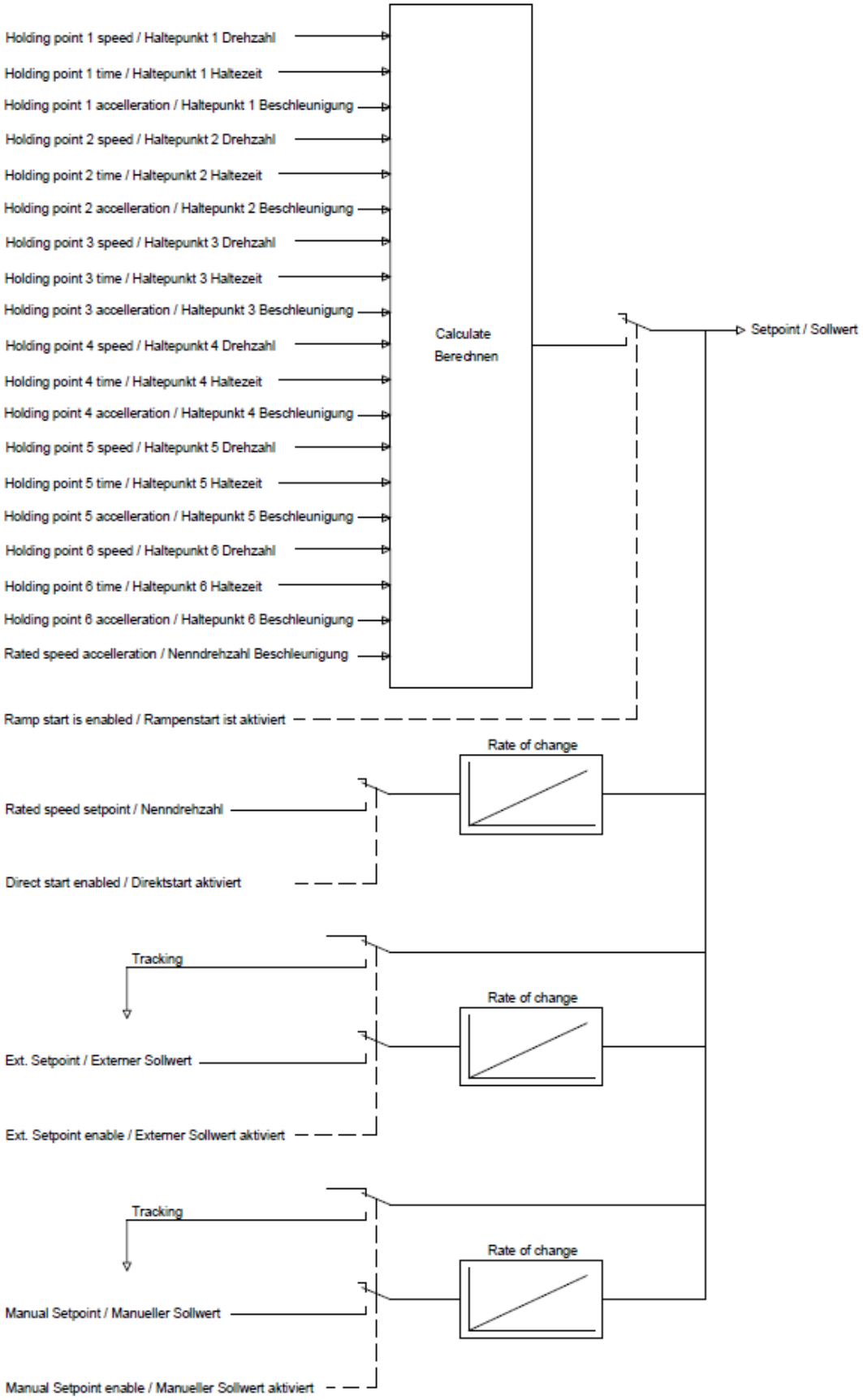
Service – (2) Speed – Speed controller turbine site 1 Controller

4.2.4 Start ramp turbine site 1

Service – (2) Speed – Start ramp turbine site 1

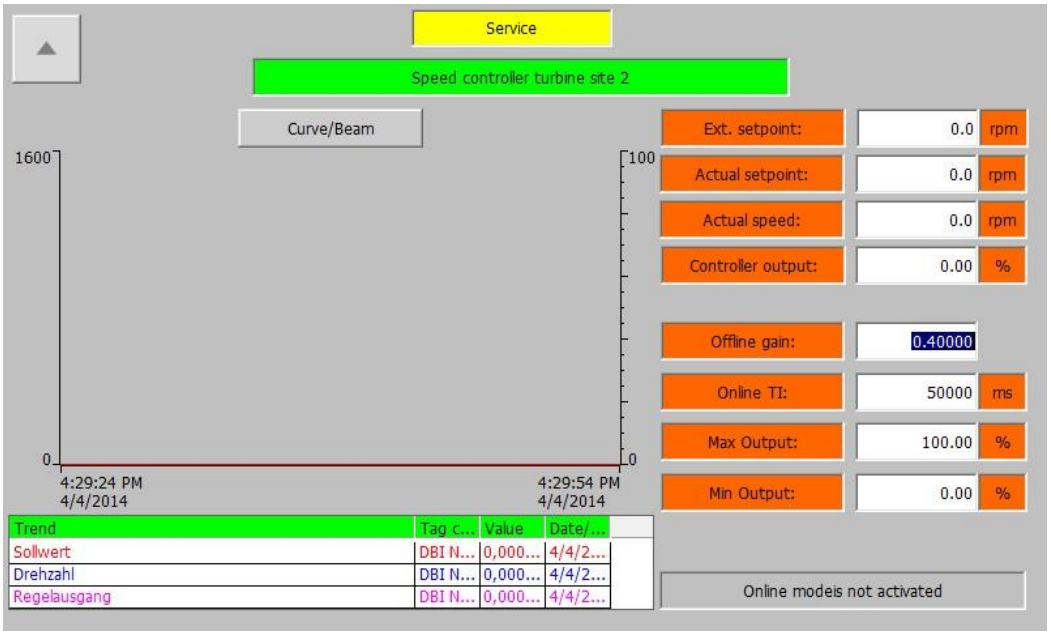
The start ramp turbine site 1 shows the measurements and parameters of the start ramp of turbine site 1. According to the active start ramp, different parameters are available. The following parameters are available:

- **Actual start type:** Shows the active type of start ramp.
- **Set point:** Shows the actual internal speed Set point of turbine site 1.
- **Start ramp:** Shows the active start ramp and the associated ramp steps.
- **Acceleration:** Shows the actual acceleration of the speed Set point of turbine site 1.
- **Time:** Shows the remaining time of the actual ramp step that needs to pass before the next ramp step will be reached.
- **Stop start ramp:** stops the active start ramp at the actual speed Set point. After stopping the start ramp, it is possible to manually set a new speed Set point. After pressing the button again, the start ramp will start again from the holding point where it was stopped.

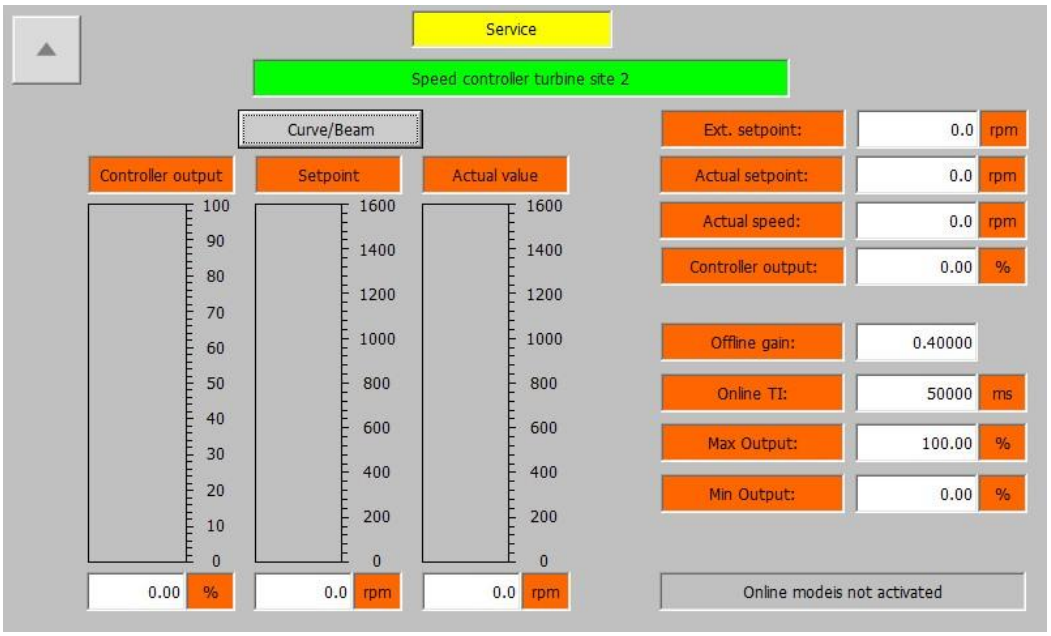


Service – (2) Speed – Start ramp turbine site 1 calculation

4.2.5 Speed controller turbine site 2



Service – (2) Speed – Speed controller turbine site 2 „Curve“

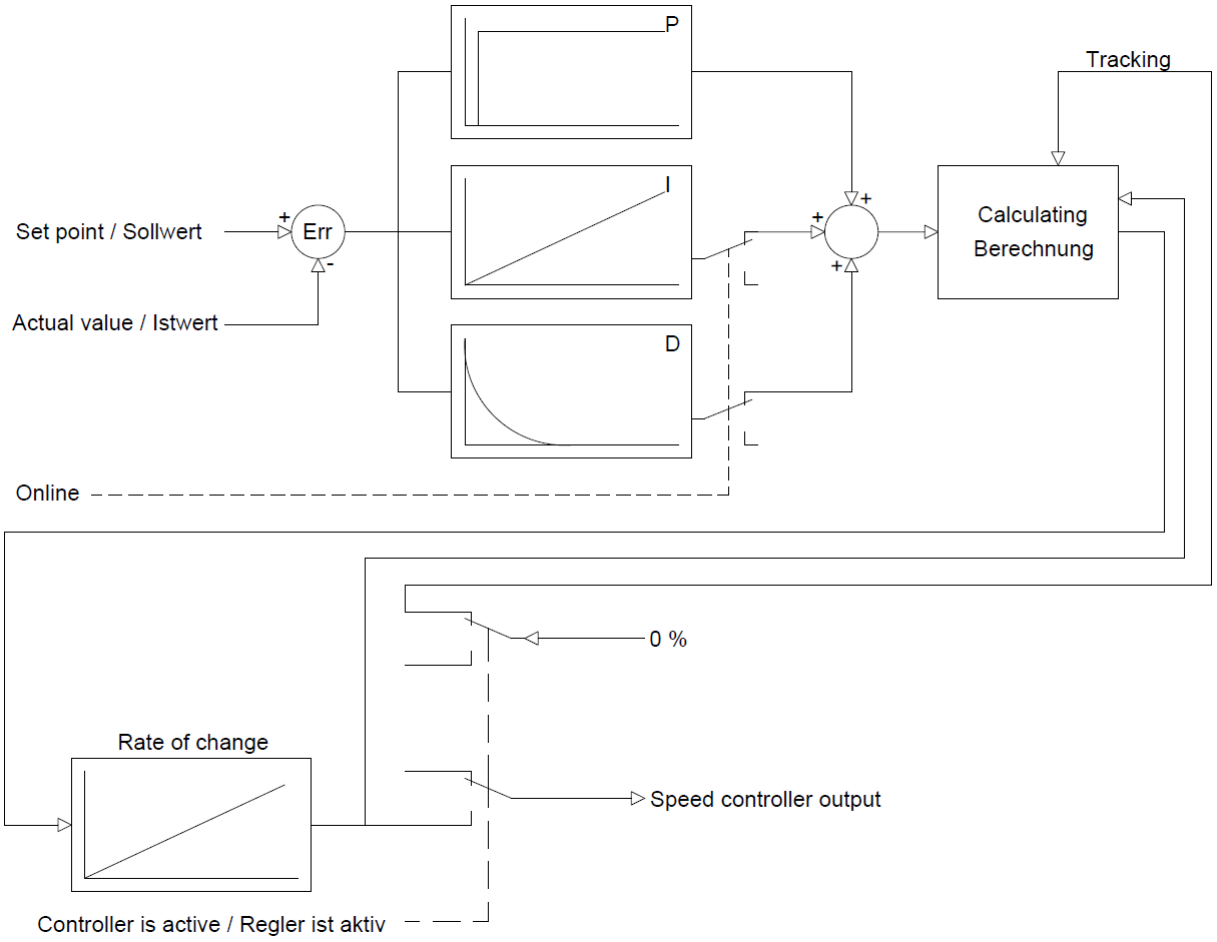


Service – (2) Speed - Speed controller turbine site 2 „Beam“

The speed controller turbine site 2 level includes the measurements and parameters for the speed controller of turbine site 2. 2 Different views are available for the speed controller turbine site 2. The button “Curve/Beam” can be used to switch between the “Curve” and “Beam” view. The following parameters are available:

- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.

- **Actual speed:** Shows the actual measured speed of turbine site 2.
- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Offline Gain:** Sets the Gain Part of the PI-Controller in offline mode.
- **Offline TI:** Sets the TI Part of the PI-Controller in offline mode.
- **Max Output:** Sets the maximum output of the PI-Controller.
- **Min Output:** Sets the minimum output of the PI-Controller.
- **Online mode is deactivated/activated:** Shows if the PI-Controller is on offline or online mode.



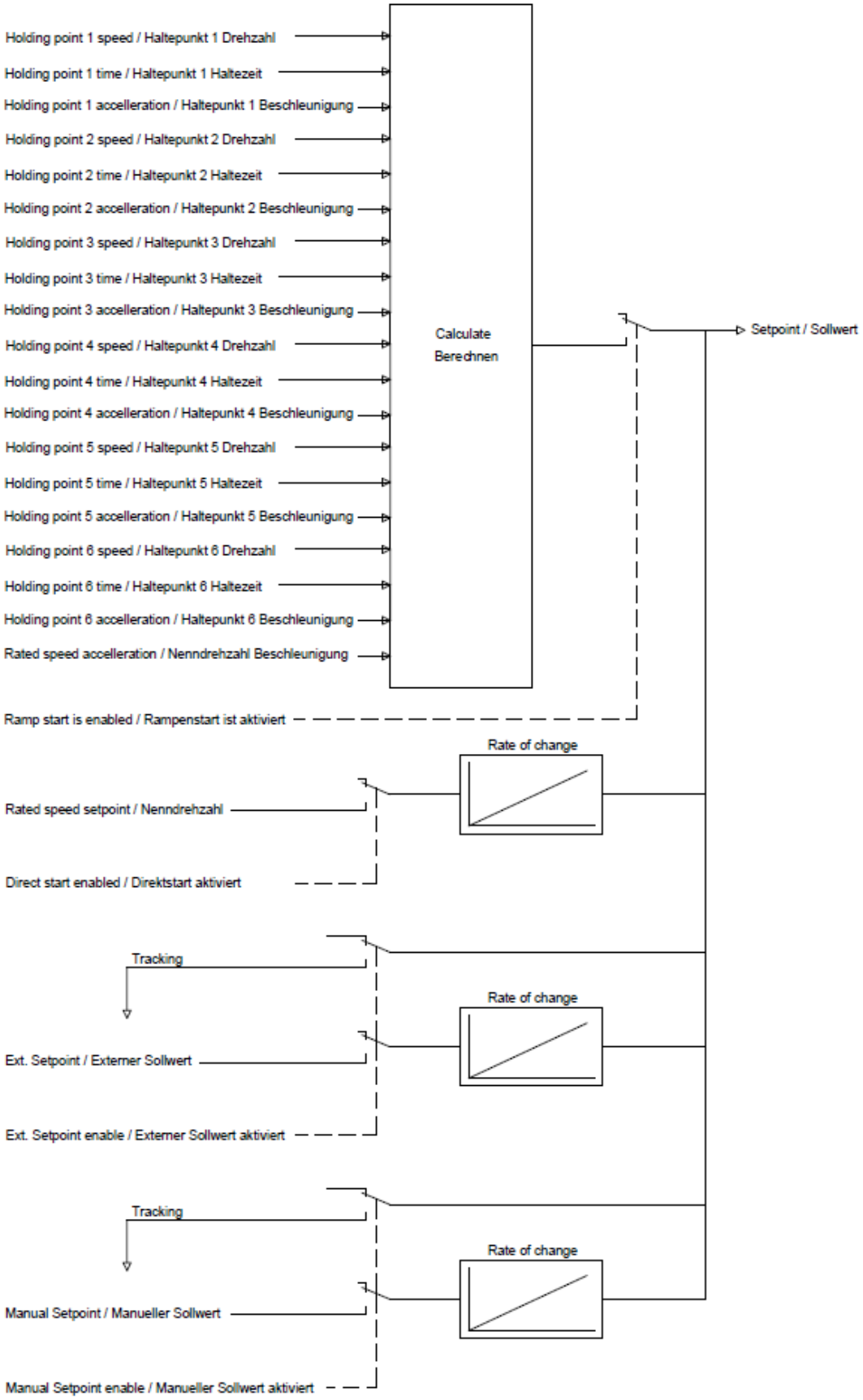
Service – (2) Speed – Speed controller turbine site 2 Controller

4.2.6 Start ramp turbine site 2

Service – (2) Speed – Start ramp turbine site 2

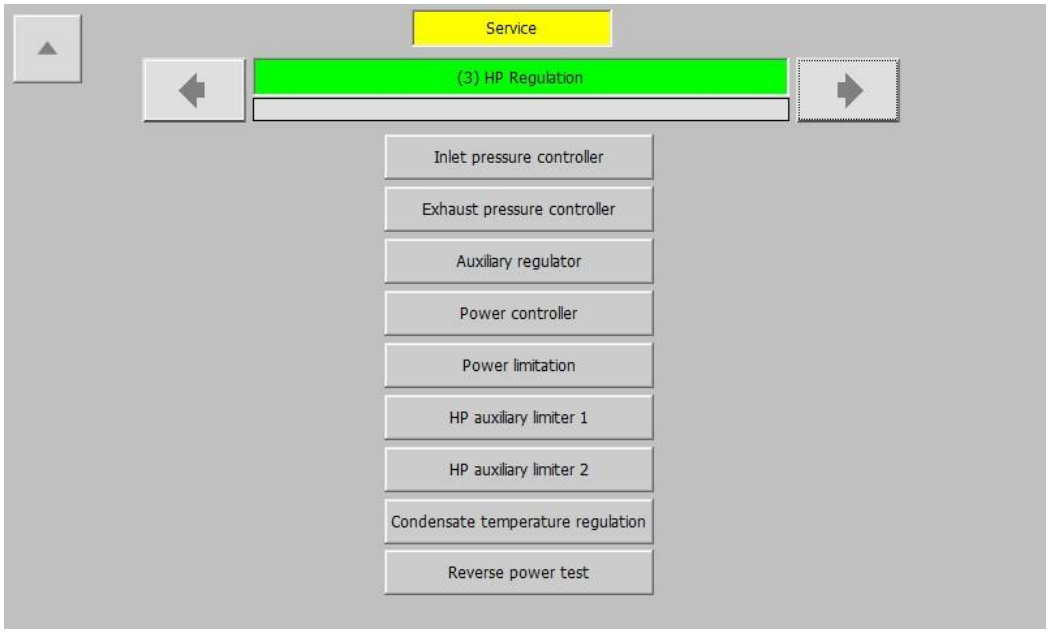
The start ramp turbine site 2 shows the measurements and parameters of the start ramp of turbine site 1. According to the active start ramp, different parameters are available. The following parameters are available:

- **Actual start type:** Shows the active type of start ramp.
- **Set point:** Shows the actual internal speed Set point of turbine site 2.
- **Start ramp:** Shows the active start ramp and the associated ramp steps.
- **Acceleration:** Shows the actual acceleration of the speed Set point of turbine site 2.
- **Time:** Shows the remaining time of the actual ramp step that needs to pass before the next ramp step will be reached.
- **Stop start ramp:** stops the active start ramp at the actual speed Set point. After stopping the start ramp, it is possible to manually set a new speed Set point. After pressing the button again, the start ramp will start again from the holding point where it was stopped.



Service – (2) Speed – Start ramp turbine site 2 calculation

4.3 HP Regulation

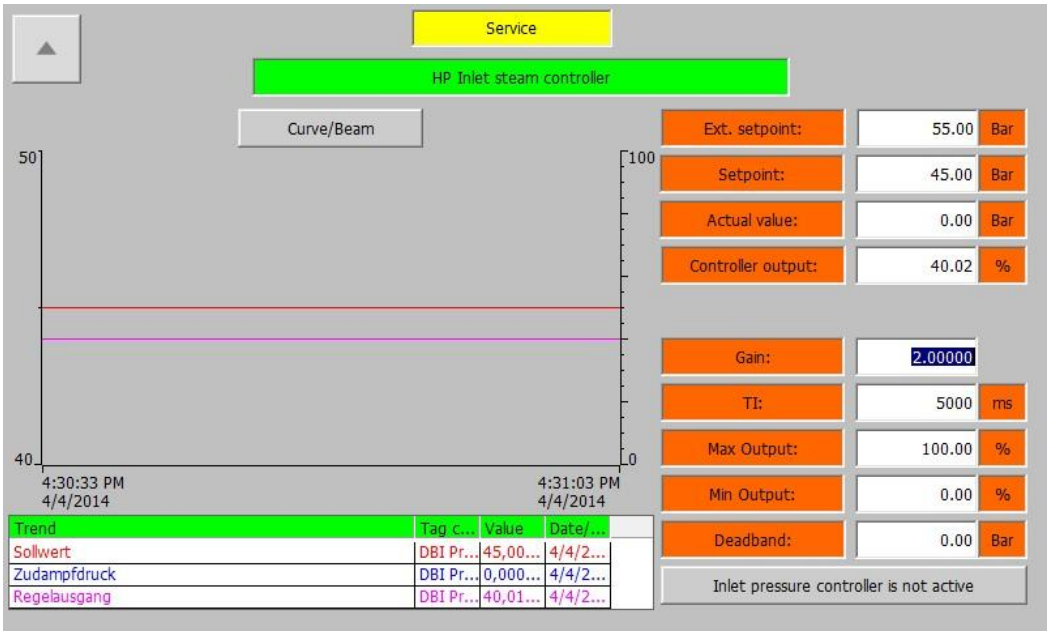


Service – (3) HP Regulation

The HP Regulation level includes the parameters for the process controllers and limiters for the HP control stage.

- Inlet pressure controller
- Exhaust pressure controller
- Auxiliary regulator
- Power controller
- Power limitation
- HP auxiliary limiter 1
- HP auxiliary limiter 2
- Condensate temperature regulation
- Reverse power test

4.3.1 Inlet steam controller



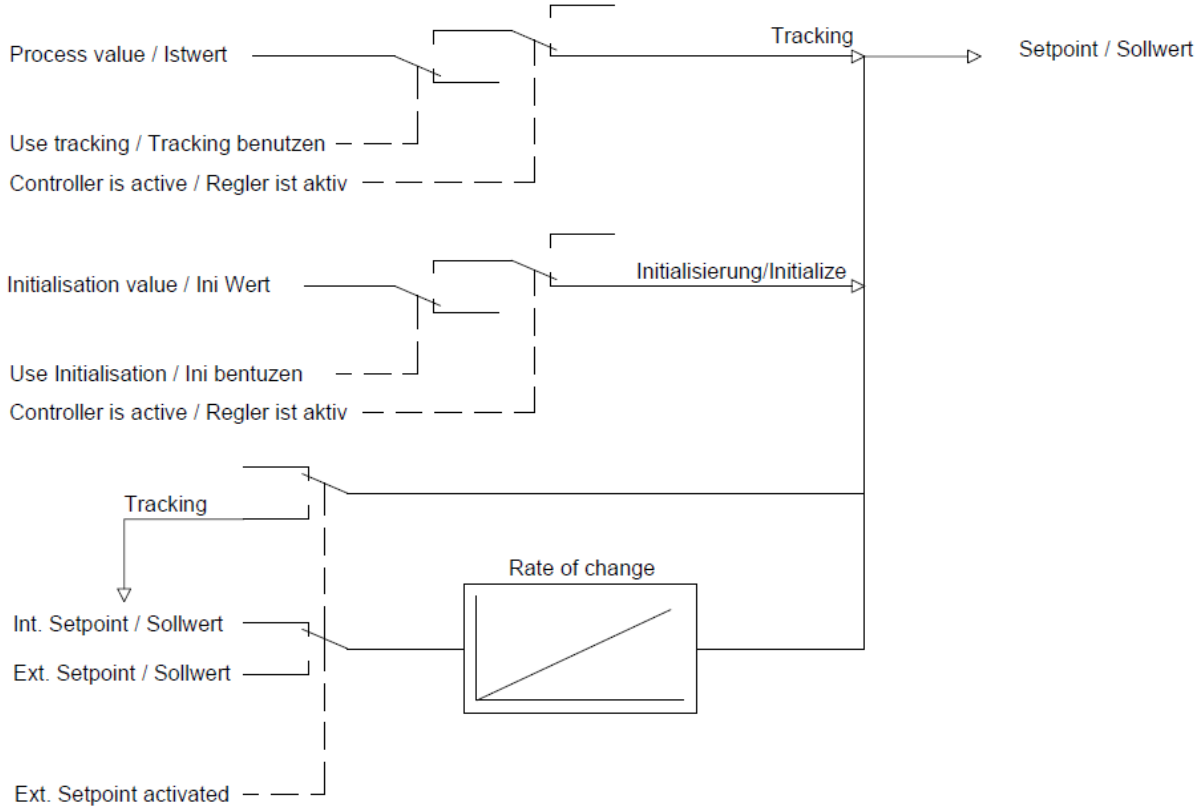
Service – (3) HP Regulation – Inlet steam controller „Curve“

Service – (3) HP Regulation – Inlet steam controller „Beam“

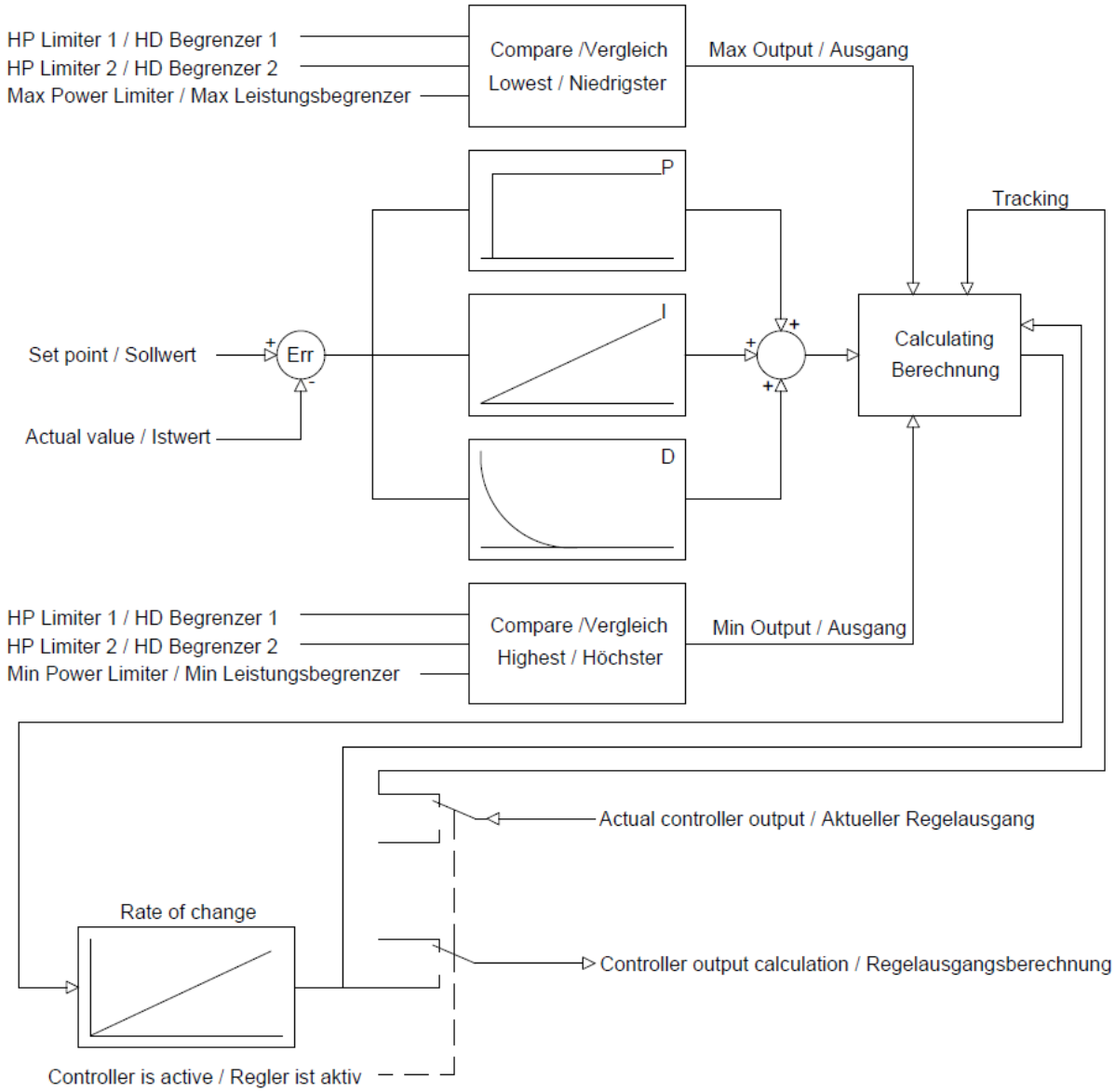
The Inlet steam controller level includes the measured values and parameters for the inlet pressure of the HP Stage. 2 Different views are available for the inlet pressure controller. The button “Curve/Beam” can be used to switch between the “Curve” and “Beam” view. The following parameters are available:

- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.

- **Actual value:** Shows the actual measured control value.
- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Gain:** Sets the Gain Part of the PI-Controller.
- **TI:** Sets the TI Part of the PI-Controller.
- **Max Output:** Sets the maximum output of the PI-Controller.
- **Min Output:** Sets the minimum output of the PI-Controller.
- **Dead band:** Sets the Dead band for the PI-Controller. A control difference that is smaller than this value will be ignored and the controller output will not change.
- **Inlet pressure controller is not active/active:** Shows if the inlet pressure controller is active or not. The background color indicated a grey color (Controller is off) or a green color (Controller is on). If the inlet pressure controller is not active, but the turbine site 1 is in online mode, the button can be used to activate the inlet pressure controller.

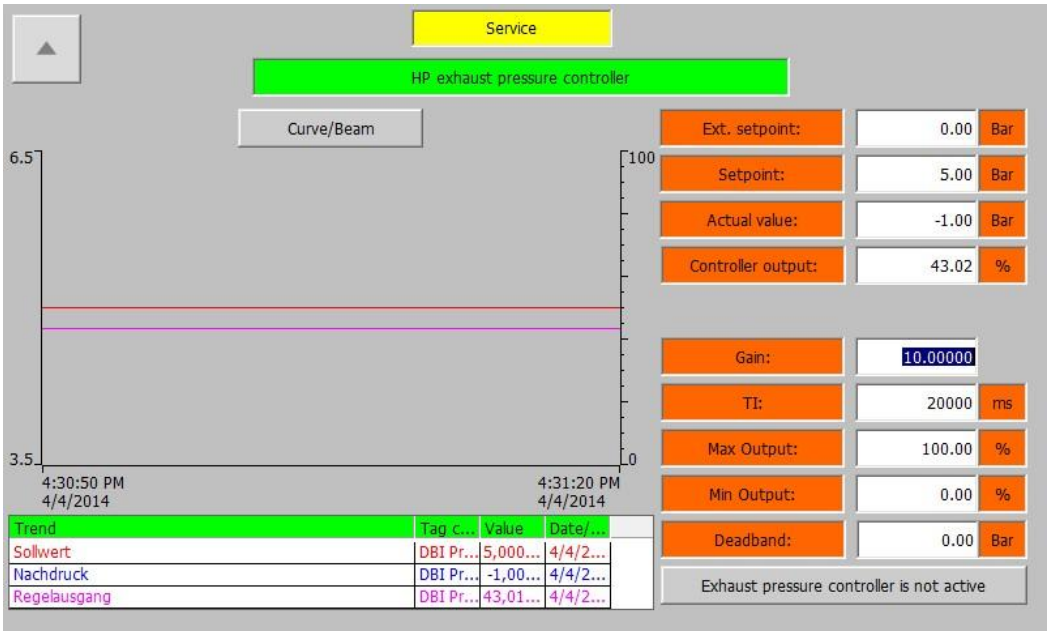


Service – (3) HP Regulation – Inlet steam controller set point calculation

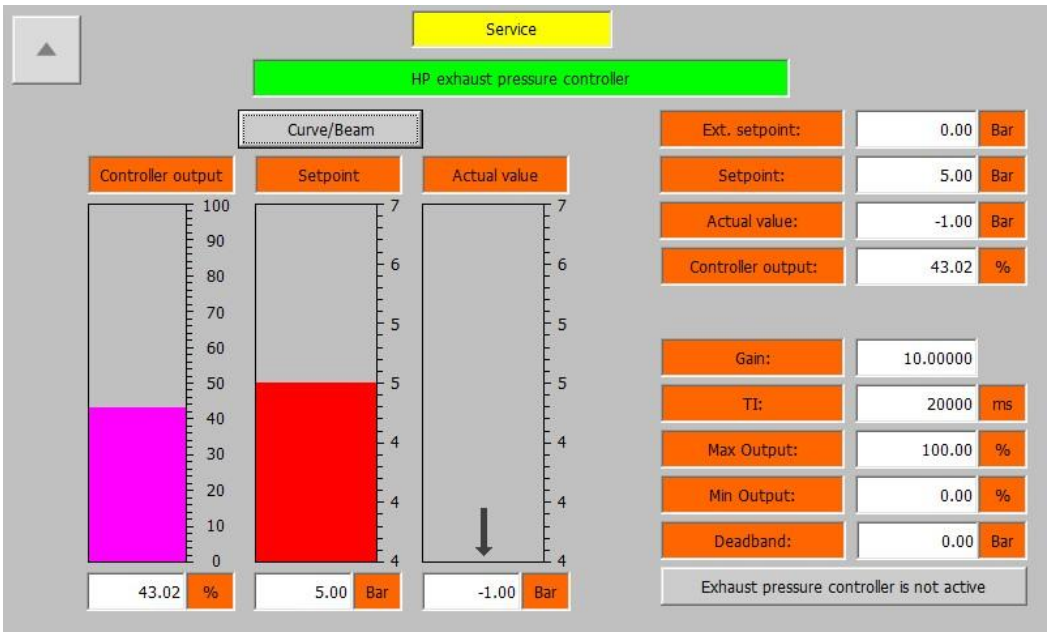


Service – (3) HP Regulation – Inlet steam controller

4.3.2 Exhaust pressure controller



Service – (3) HP Regulation – Exhaust pressure controller „Curve“

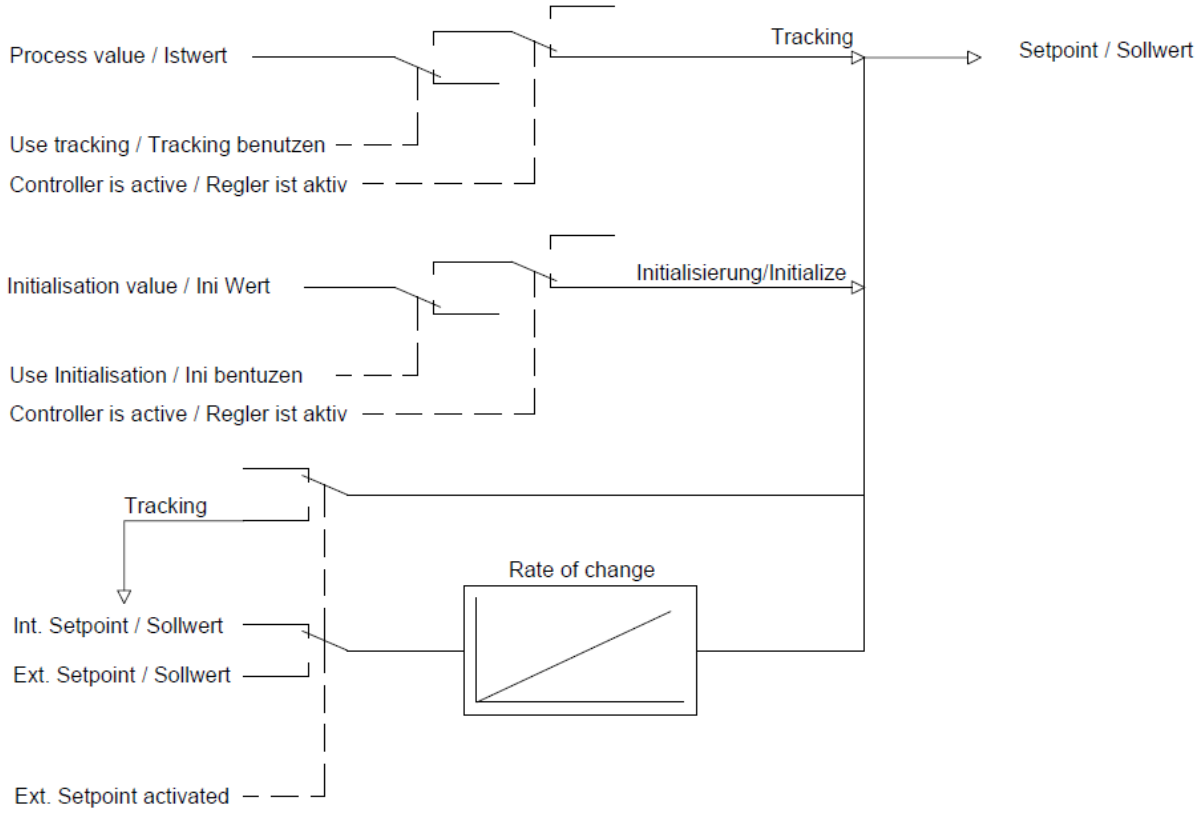


Service – (3) HP Regulation – Exhaust pressure controller „Beam“

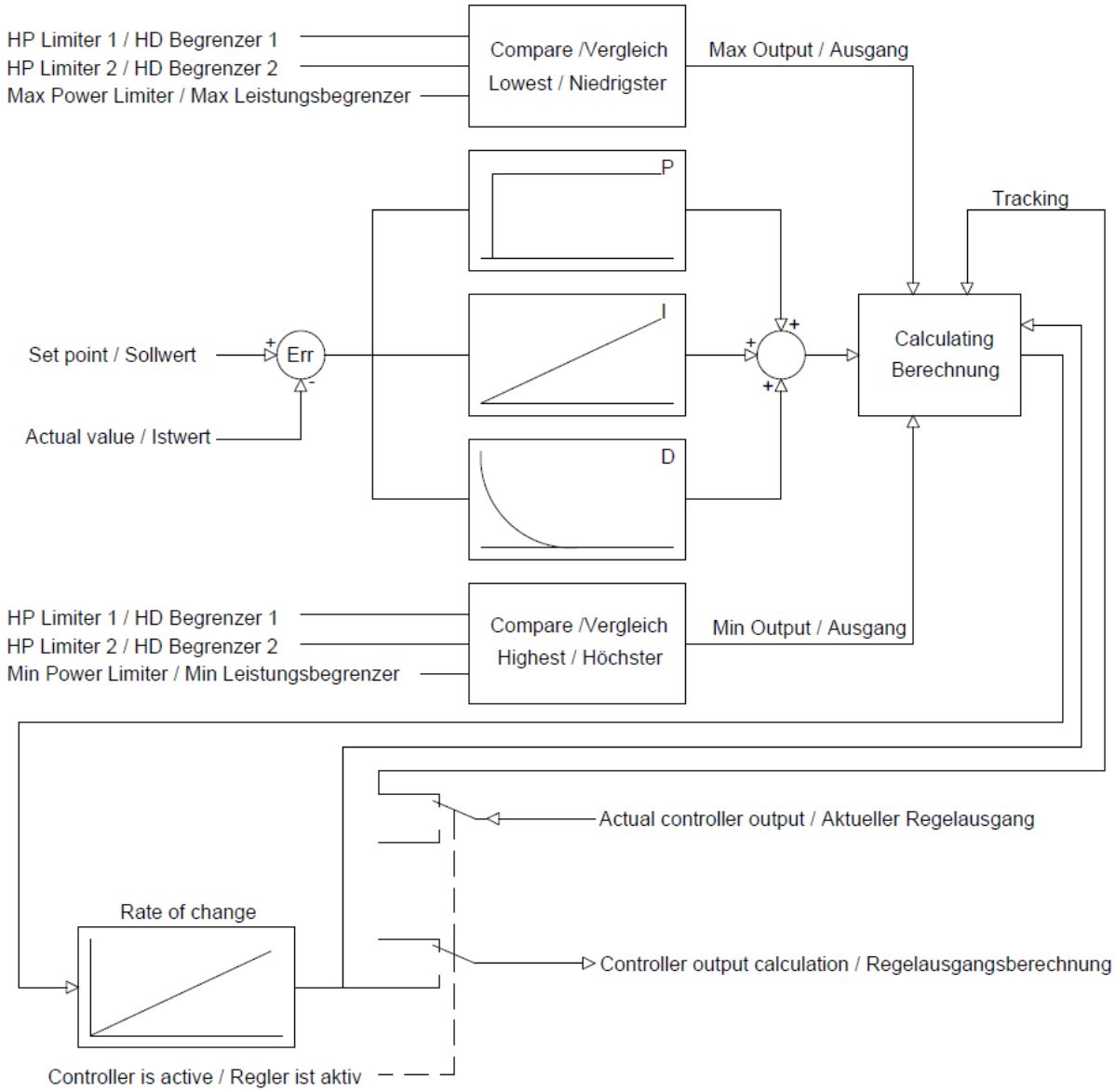
The exhaust steam controller level includes the measured values and parameters for the exhaust pressure of the HP Stage. 2 Different views are available for the exhaust pressure controller. The button “Curve/Beam” can be used to switch between the “Curve” and “Beam” view. The following parameters are available:

- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.

- **Actual Set point:** Shows the actual internal Set point.
- **Actual value:** Shows the actual measured control value.
- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Gain:** Sets the Gain Part of the PI-Controller.
- **TI:** Sets the TI Part of the PI-Controller.
- **Max Output:** Sets the maximum output of the PI-Controller.
- **Min Output:** Sets the minimum output of the PI-Controller.
- **Dead band:** Sets the Dead band for the PI-Controller. A control difference that is smaller than this value will be ignored and the controller output will not change.
- **Exhaust pressure controller is not active/active:** Shows if the exhaust pressure controller is active or not. The background color indicated a grey color (Controller is off) or a green color (Controller is on). If the exhaust pressure controller is not active, but the turbine site 1 is in online mode, the button can be used to activate the exhaust pressure controller.

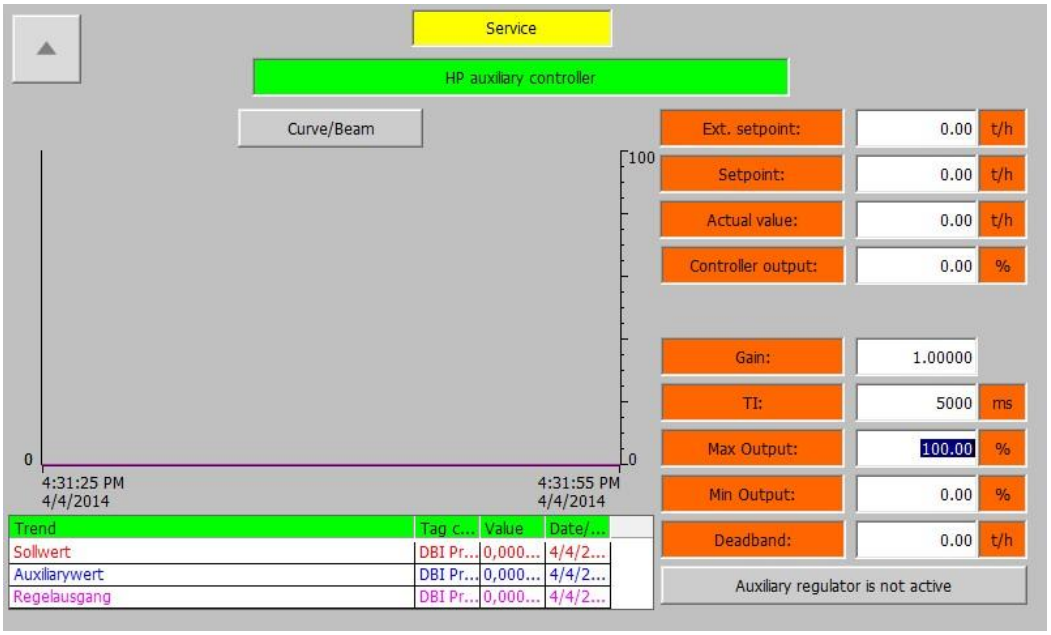


Service – (3) HP Regulation – Exhaust steam controller set point calculation

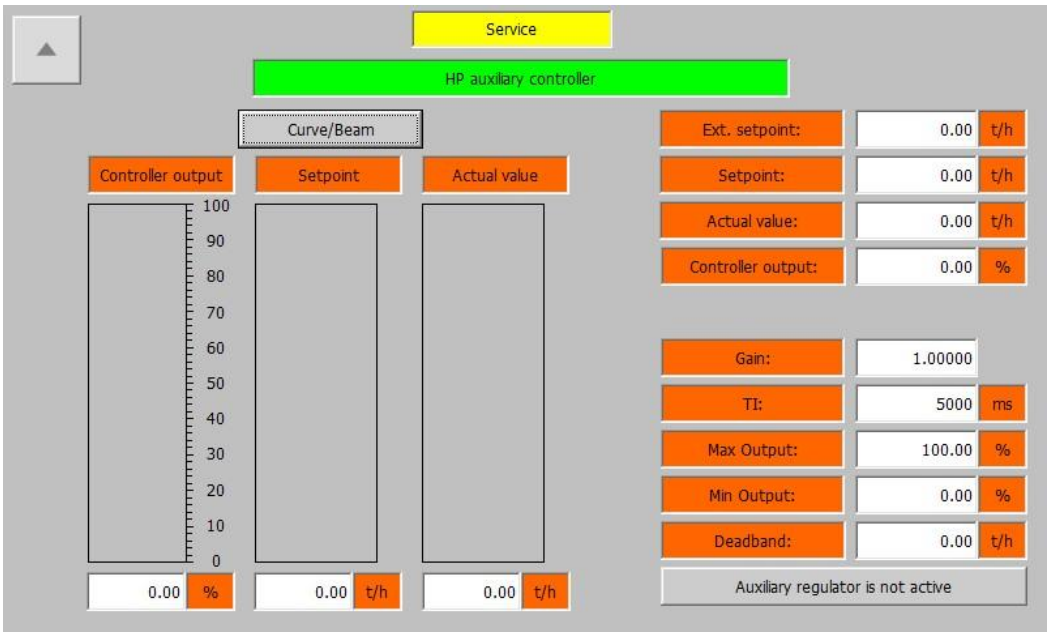


Service – (3) HP Regulation – Exhaust steam controller

4.3.3 Auxiliary controller



Service – (3) HP Regulation – Auxiliary controller „Curve“

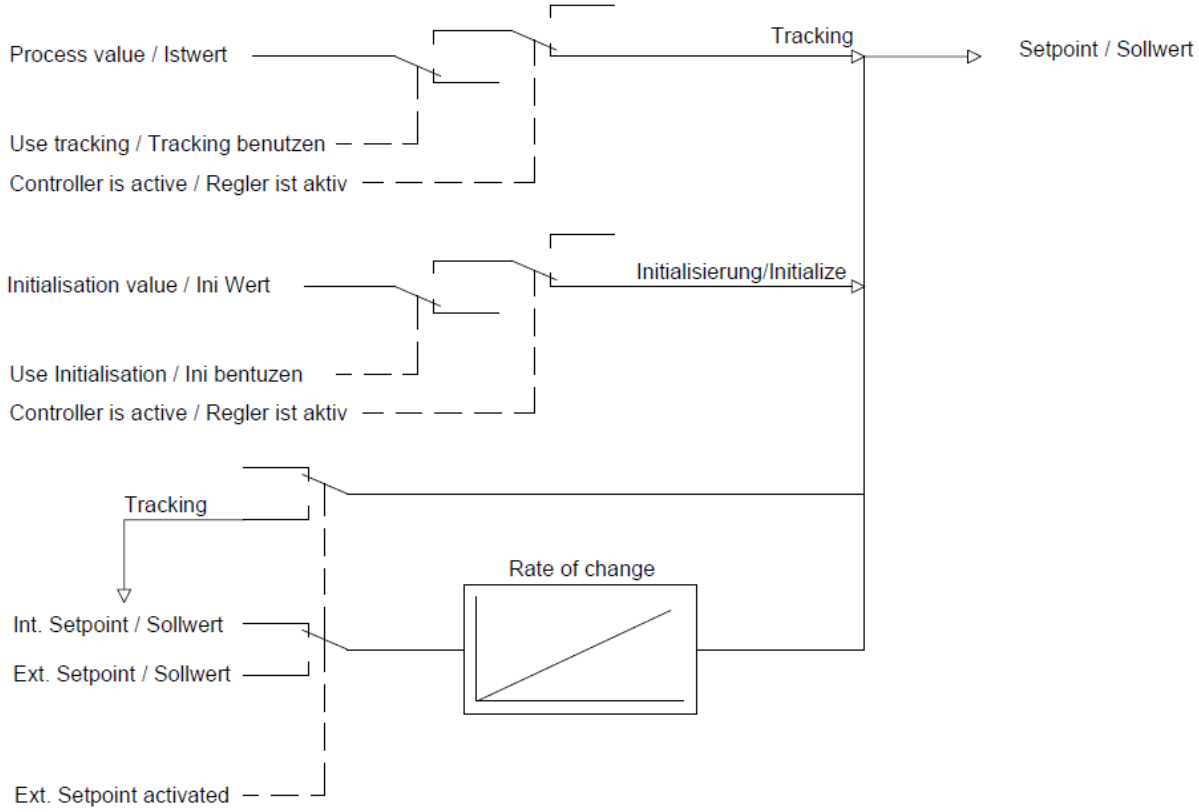


Service – (3) HP Regulation – Auxiliary controller „Beam“

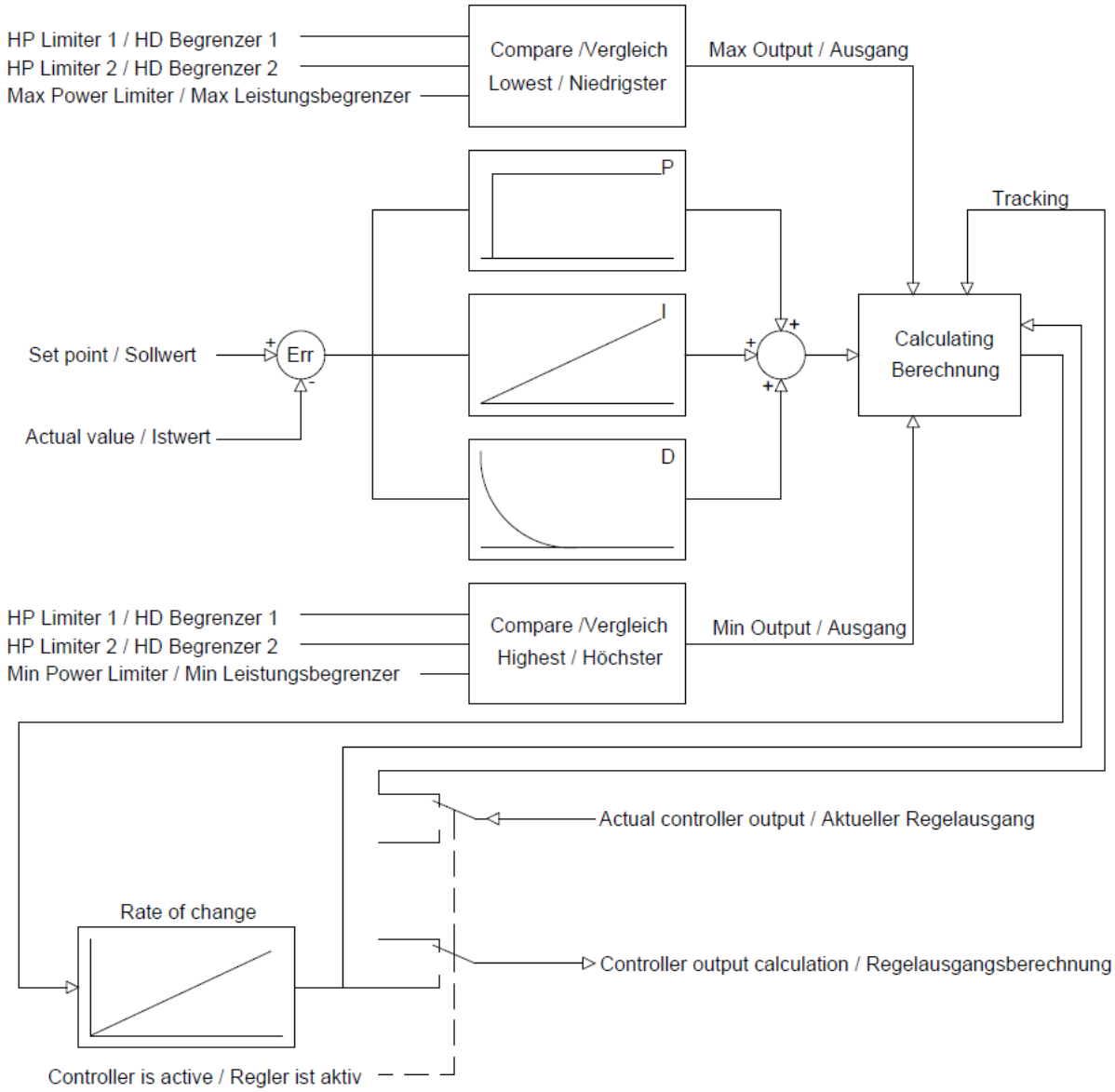
The Auxiliary controller level includes the measured values and parameters for the Auxiliary value. 2 Different views are available for the Auxiliary controller. The button “Curve/Beam” can be used to switch between the “Curve” and “Beam” view. The following parameters are available:

- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.

- **Actual value:** Shows the actual measured control value.
- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Gain:** Sets the Gain Part of the PI-Controller.
- **TI:** Sets the TI Part of the PI-Controller.
- **Max Output:** Sets the maximum output of the PI-Controller.
- **Min Output:** Sets the minimum output of the PI-Controller.
- **Dead band:** Sets the Dead band for the PI-Controller. A control difference that is smaller than this value will be ignored and the controller output will not change.
- **Auxiliary controller is not active/active:** Shows if the Auxiliary controller is active or not. The background color indicated a grey color (Controller is off) or a green color (Controller is on). If the Auxiliary controller is not active, but the turbine site 1 is in online mode, the button can be used to activate the Auxiliary controller.

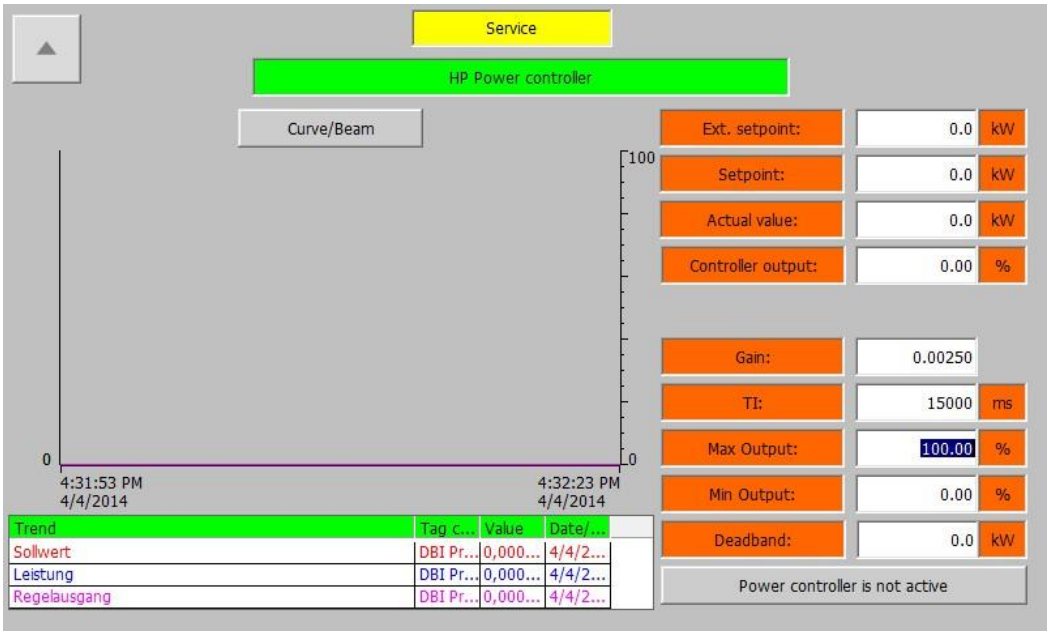


Service – (3) HP Regulation – Auxiliary controller set point calculation

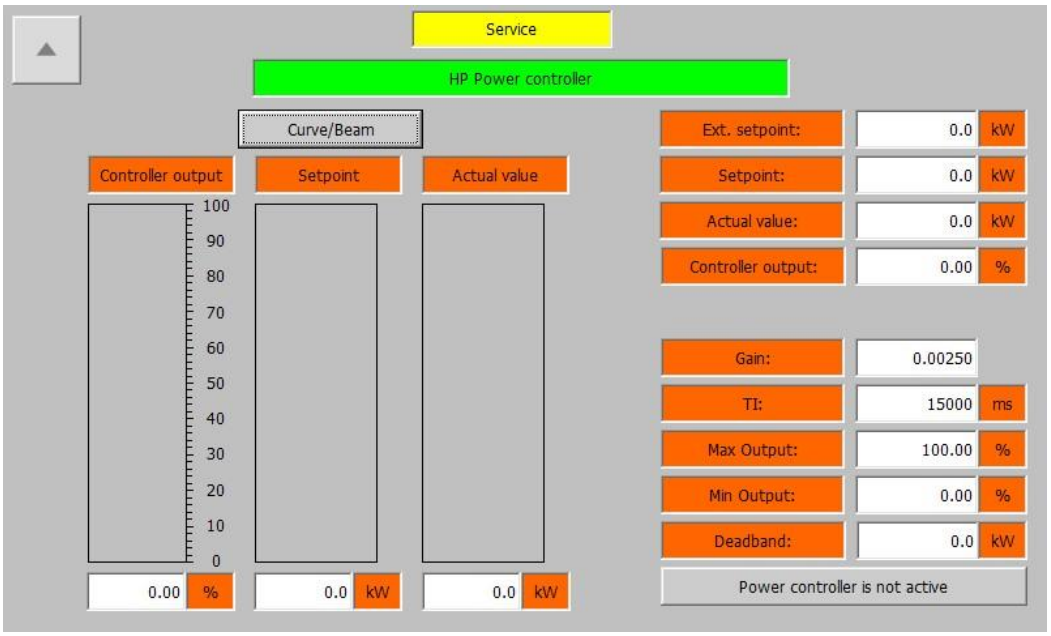


Service – (3) HP Regulation – Auxiliary controller

4.3.4 Power controller



Service – (3) HP Regulation – Power controller „Curve“

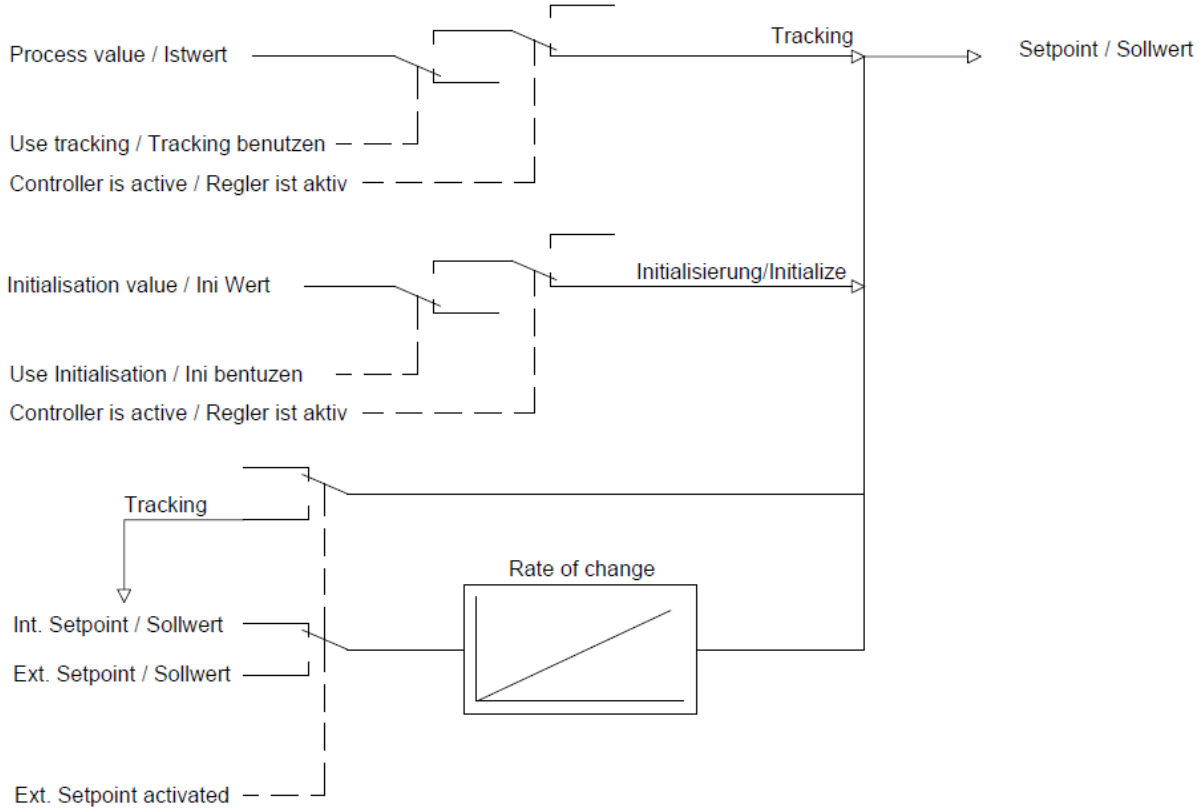


Service – (3) HP Regulation – Power controller „Beam“

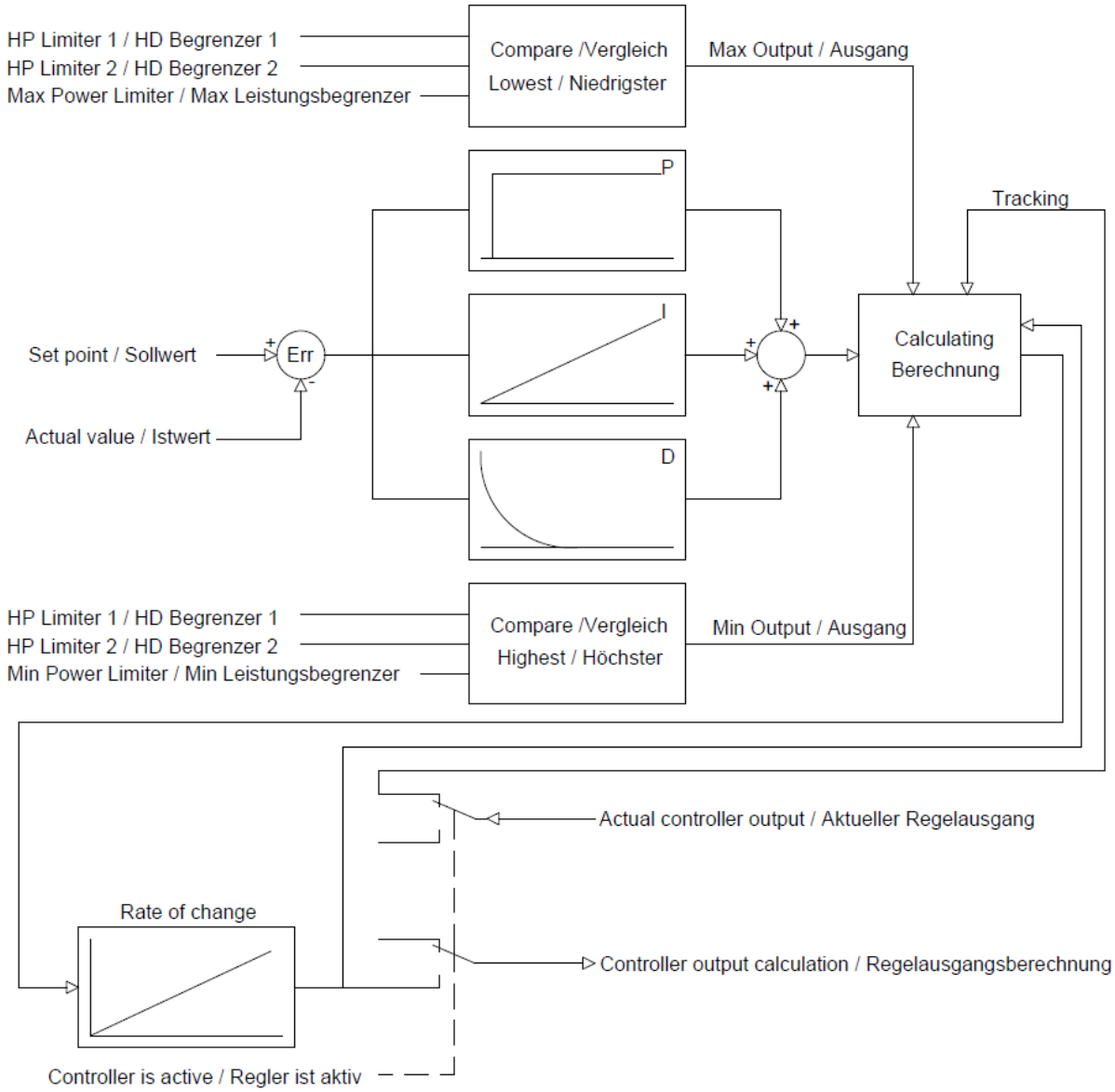
The Power controller level includes the measured values and parameters for the Power value. 2 Different views are available for the Power controller. The button “Curve/Beam” can be used to switch between the “Curve” and “Beam” view. The following parameters are available:

- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.

- **Actual value:** Shows the actual measured control value.
- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Gain:** Sets the Gain Part of the PI-Controller.
- **TI:** Sets the TI Part of the PI-Controller.
- **Max Output:** Sets the maximum output of the PI-Controller.
- **Min Output:** Sets the minimum output of the PI-Controller.
- **Dead band:** Sets the Dead band for the PI-Controller. A control difference that is smaller than this value will be ignored and the controller output will not change.
- **Power controller is not active/active:** Shows if the Power controller is active or not. The background color indicated a grey color (Controller is off) or a green color (Controller is on). If the Power controller is not active, but the turbine site 1 is in online mode, the button can be used to activate the Power controller.

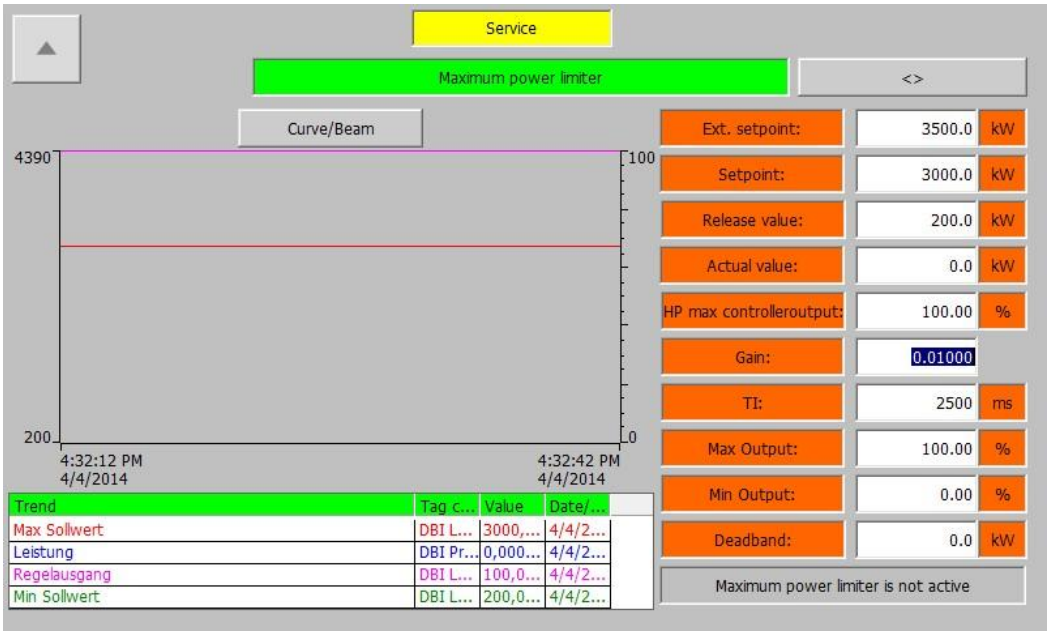


Service – (3) HP Regulation – Power controller set point calculation

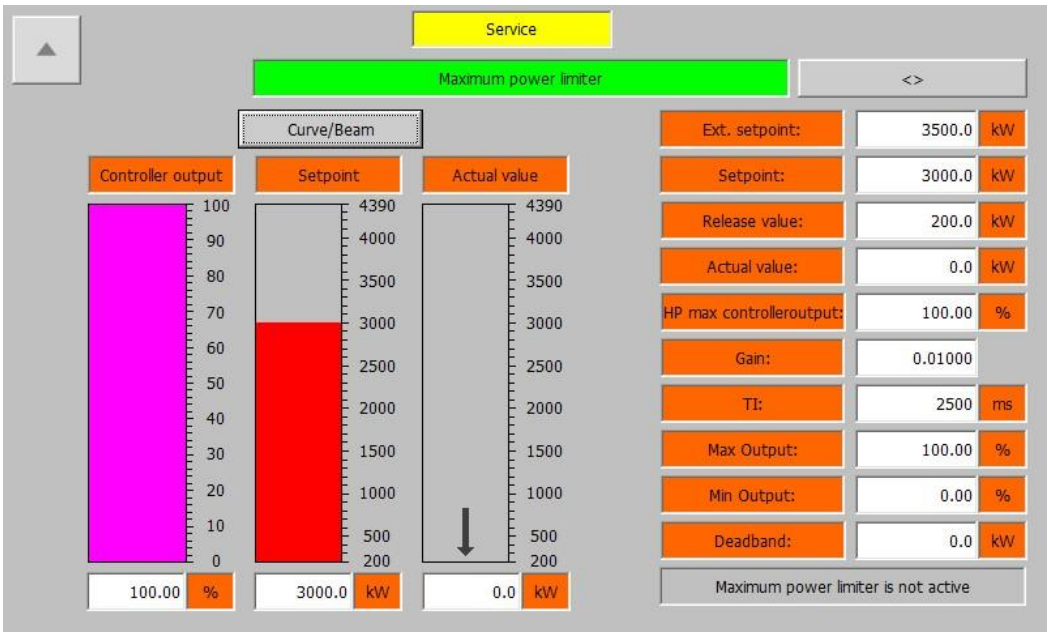


Service – (3) HP Regulation – Power controller

4.3.5 Maximum power limiter



Service – (3) HP Regulation – Maximum power limiter „Curve“

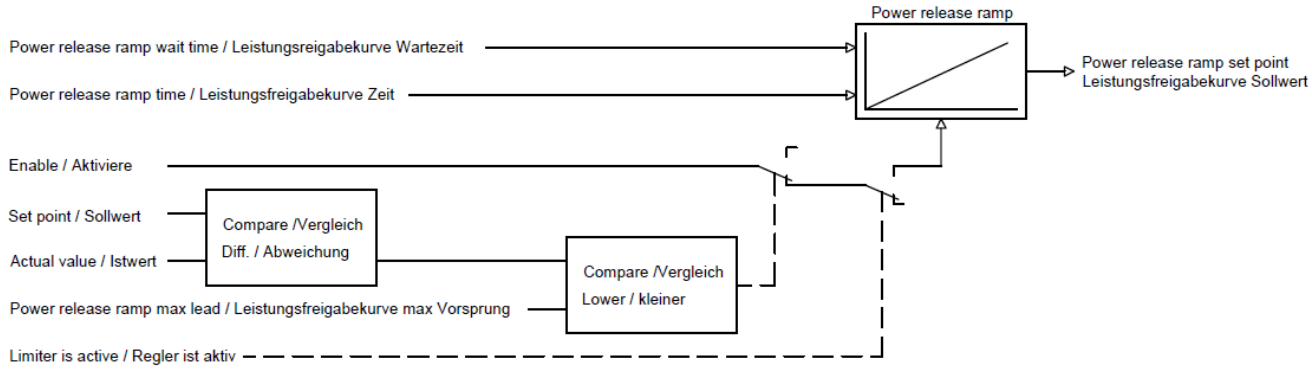


Service – (3) HP Regulation – Maximum power limiter „Beam“

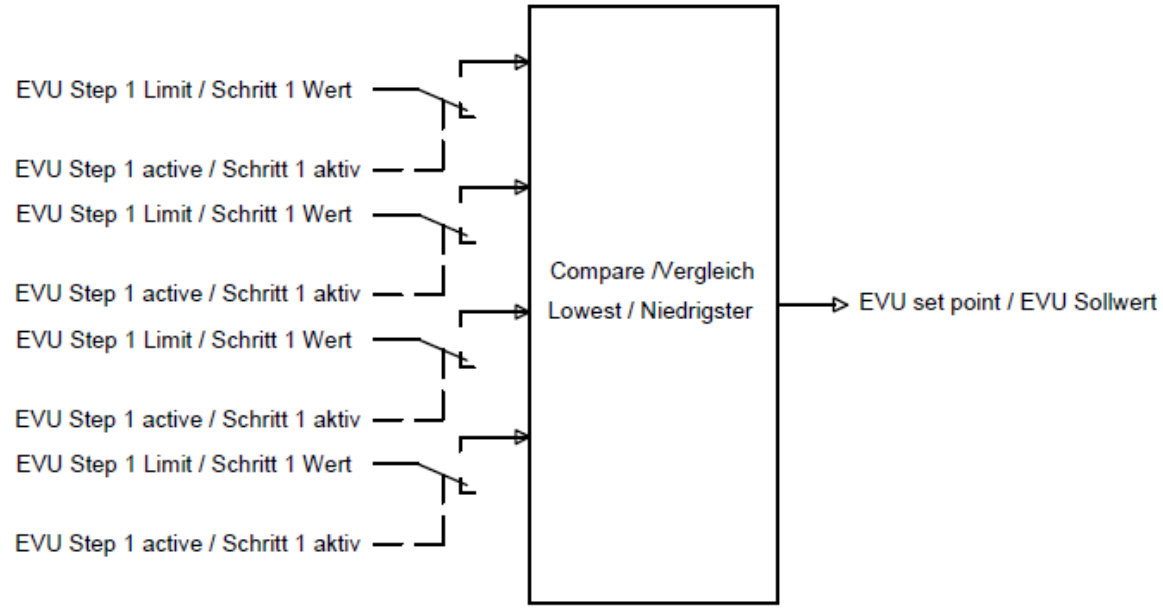
The power limitation level includes the measured values and parameters for the maximum and minimum power limitation. The parameters are separated into 2 parts, „Maximum power limitation“ and „minimum power limitation“. The Button „<>“ can be used to switch between this 2 parts. For both parts, 2 views are available. The button “Curve/Beam” can be used to switch between the “Curve” and “Beam” view.

The part “Maximum power limitation” includes the parameters for the limitation of the maximum power output. The following parameters are available:

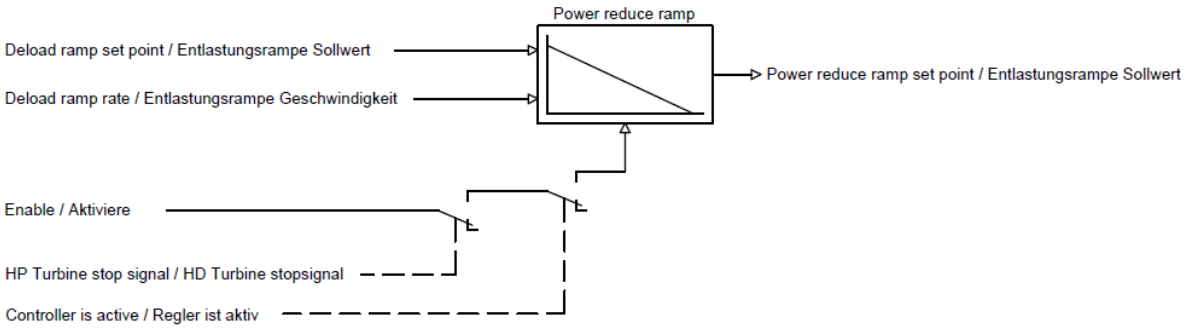
- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.
- **Release value:** Shows the released power output calculated by the power release curve.
- **Actual value:** Shows the actual measured control value.
- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Gain:** Sets the Gain Part of the PI-Controller.
- **TI:** Sets the TI Part of the PI-Controller.
- **Max Output:** Sets the maximum output of the PI-Controller.
- **Min Output:** Sets the minimum output of the PI-Controller.
- **Dead band:** Sets the Dead band for the PI-Controller. A control difference that is smaller than this value will be ignored and the controller output will not change.
- **Maximum power limiter is not active/active:** Indicates if the maximum power limiter is active or not. Additionally it is showing if the maximum power limiter is in control, which means that it manipulates the output of the active process controller. This will be indicated by the background color, which changes between gray (Not in control) and green (In control).



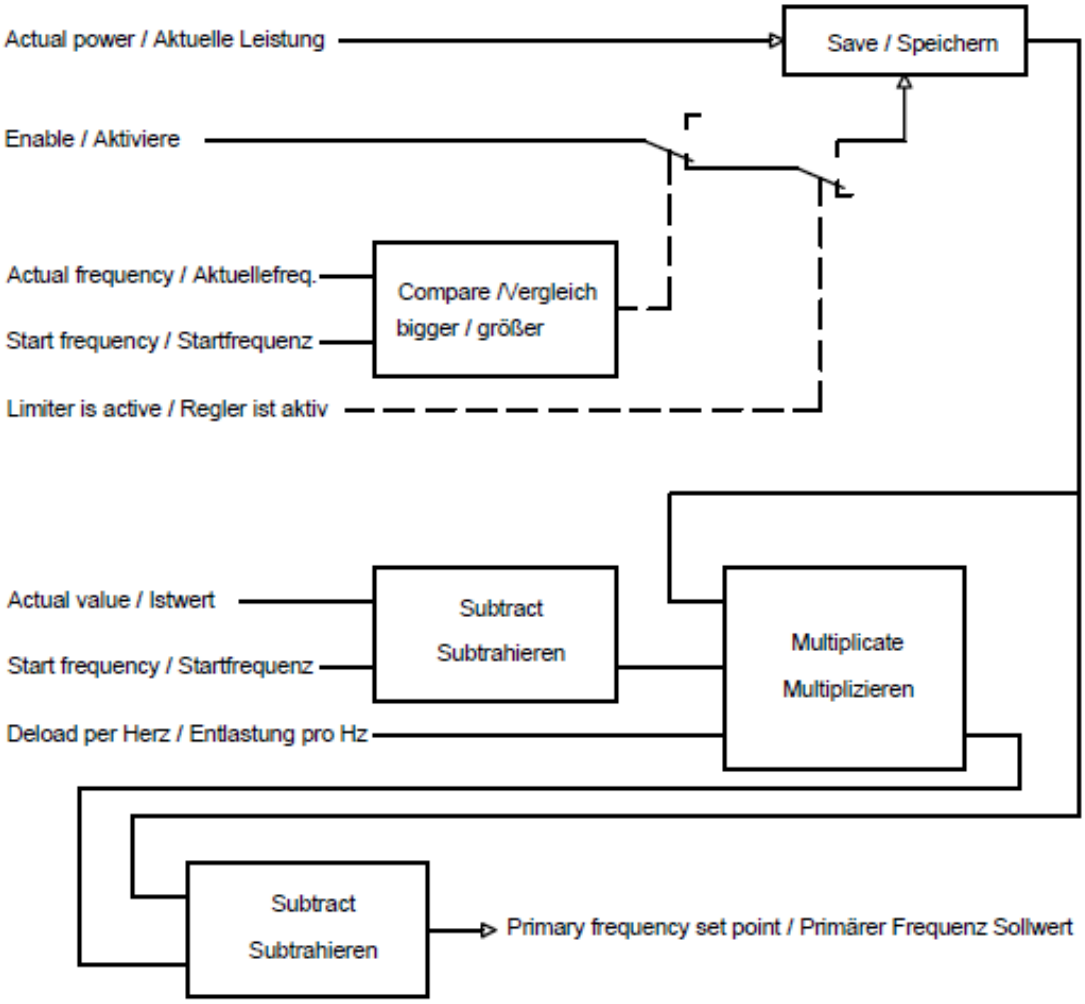
Service – (3) HP Regulation – Maximum power limiter power release ramp



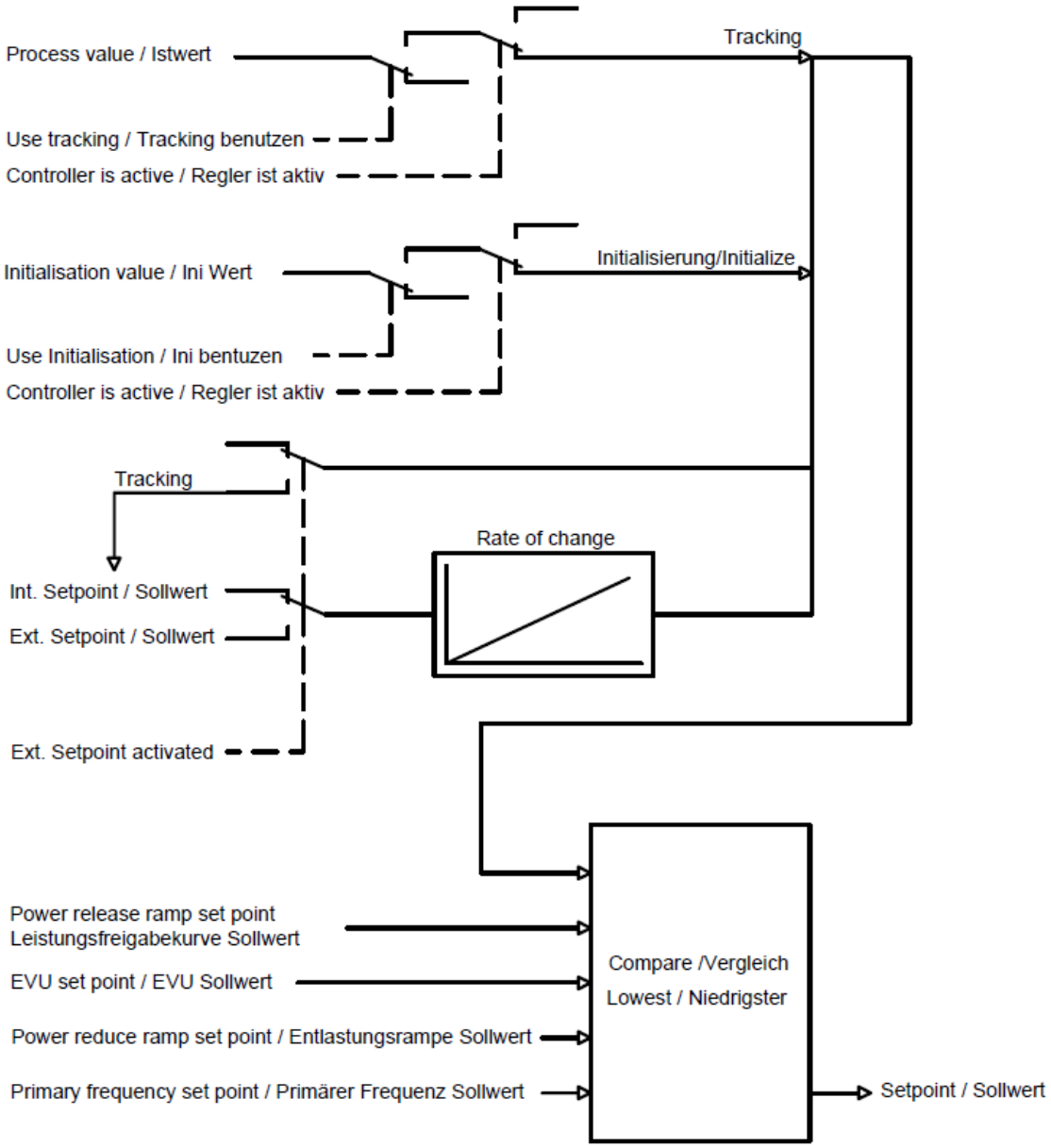
Service – (3) HP Regulation – Maximum power limiter EVU



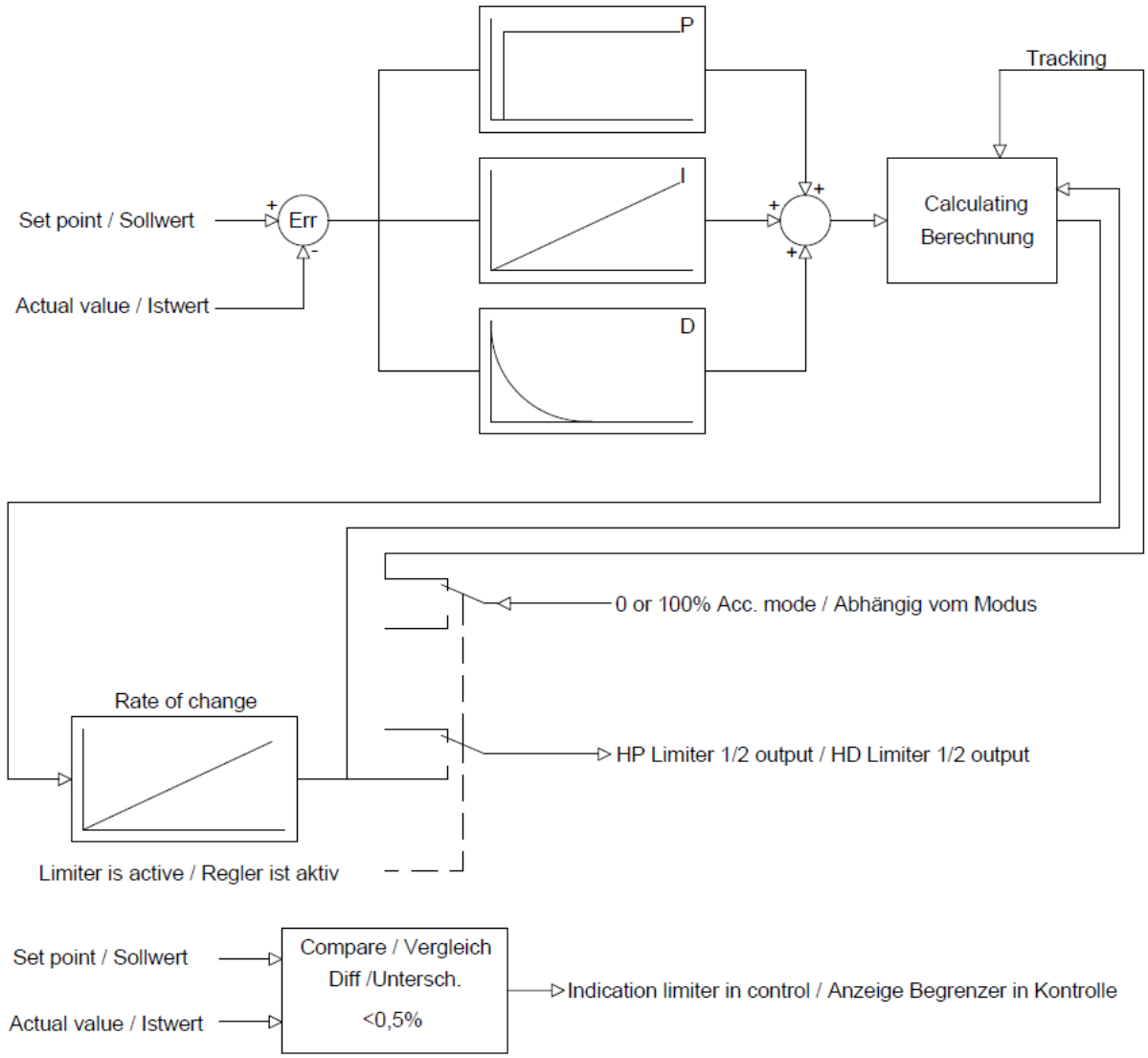
Service – (3) HP Regulation – Maximum power limiter deload ramp



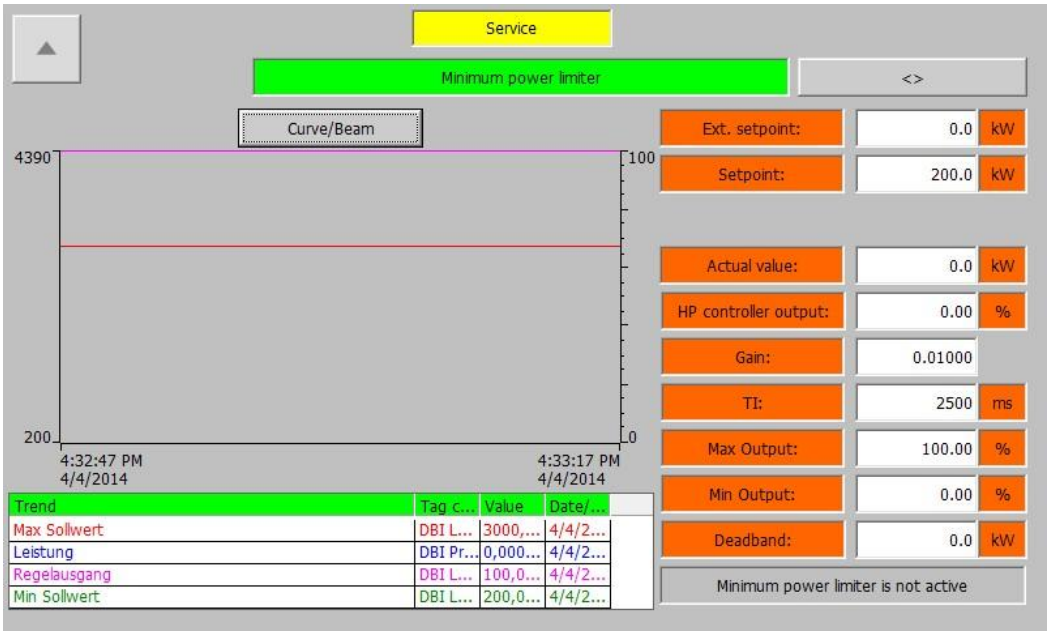
Service – (3) HP Regulation – Maximum power limiter primary frequency control



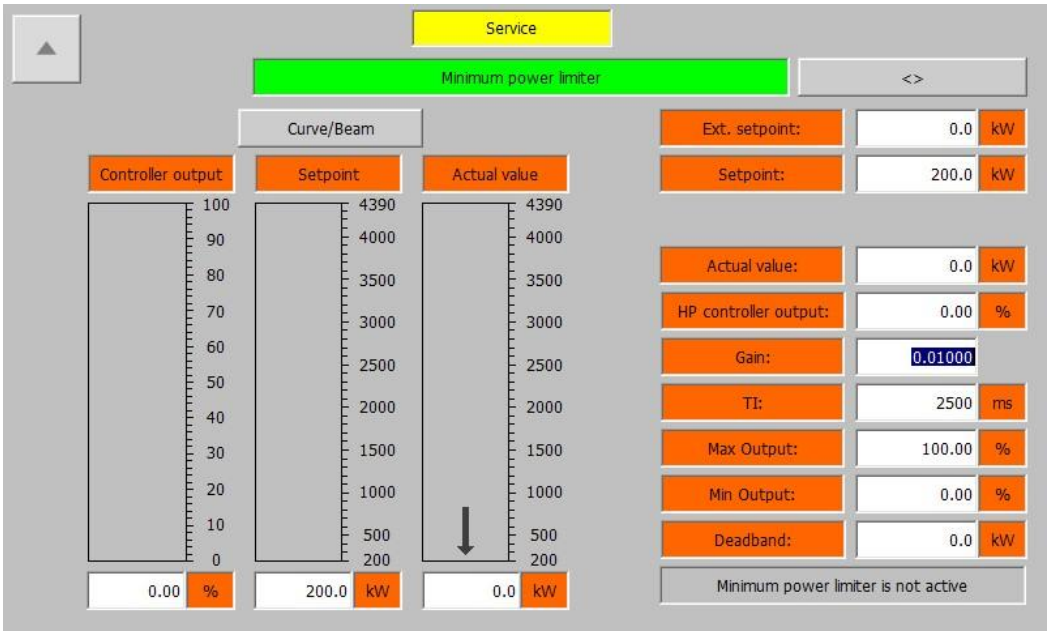
Service – (3) HP Regulation – Maximum power limiter set point calculation



Service – (3) HP Regulation – Maximum power limiter



Service – (3) HP Regulation – Minimum power limiter „Curve“

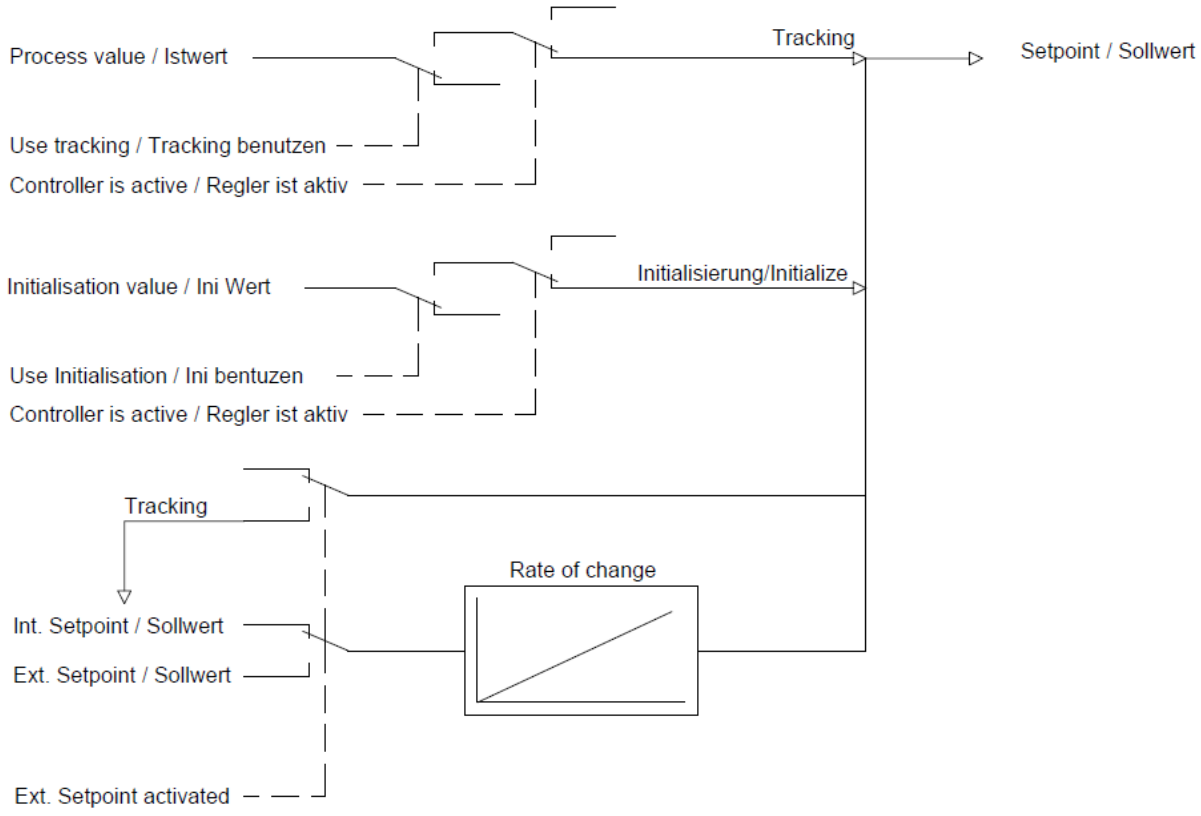


Service – (3) HP Regulation – Minimum power limiter „Beam“

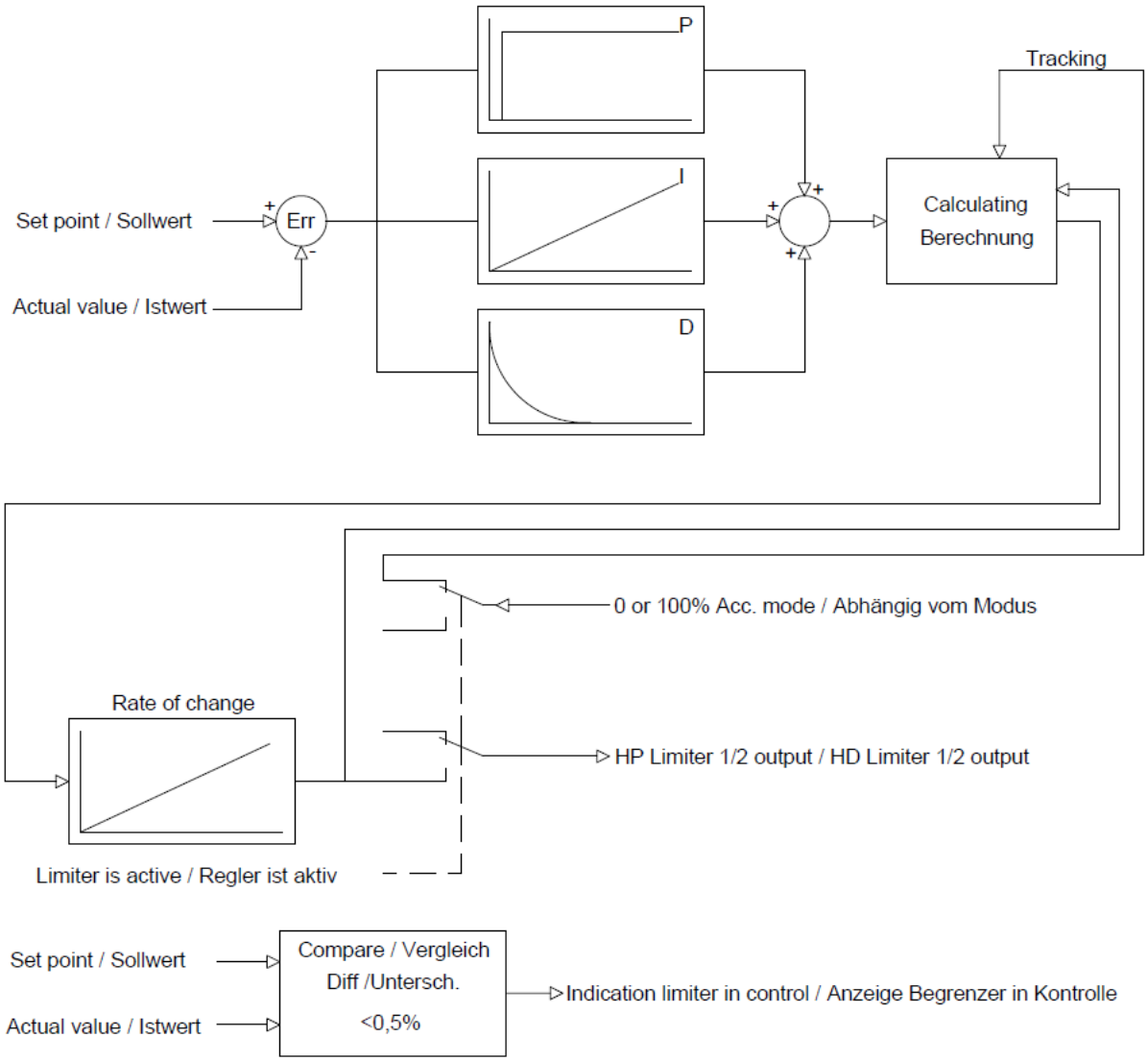
The part “Minimum power limitation” includes the parameters for the limitation of the minimum power output. The following parameters are available:

- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.
- **Actual value:** Shows the actual measured control value.
- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Gain:** Sets the Gain Part of the PI-Controller.

- **TI:** Sets the TI Part of the PI-Controller.
- **Max Output:** Sets the maximum output of the PI-Controller.
- **Min Output:** Sets the minimum output of the PI-Controller.
- **Dead band:** Sets the Dead band for the PI-Controller. A control difference that is smaller than this value will be ignored and the controller output will not change.
- **Minimum power limiter is not active/active:** Indicates if the minimum power limiter is active or not. Additionally it is showing if the minimum power limiter is in control, which means that it manipulates the output of the active process controller. This will be indicated by the background color, which changes between gray (Not in control) and green (In control).

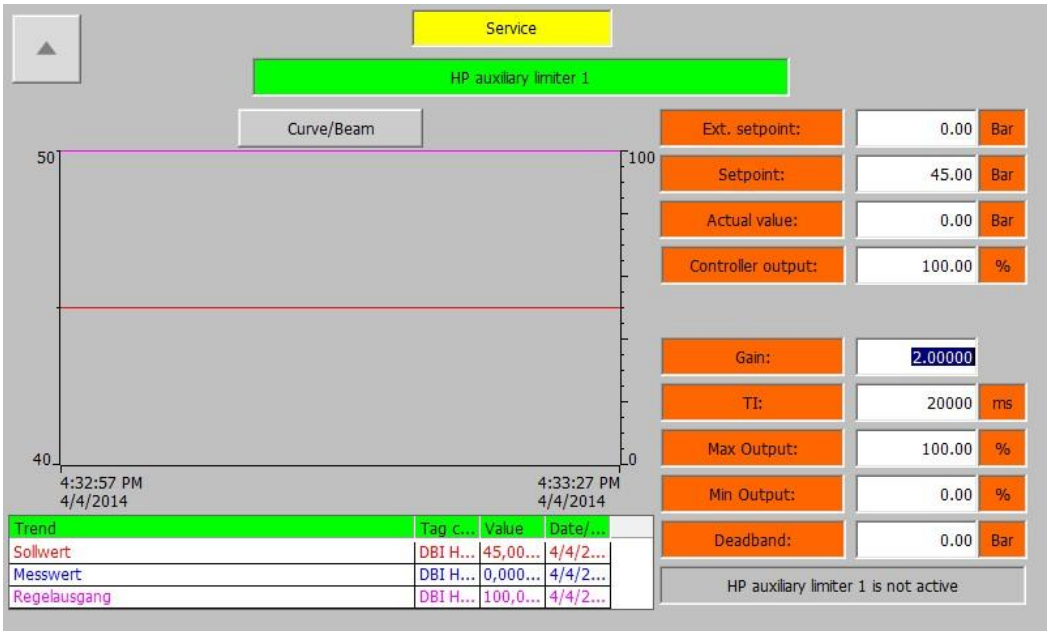


Service – (3) HP Regulation – Minimum power limiter set point calculation



Service – (3) HP Regulation – Minimum power limiter

4.3.6 HP auxiliary limiter 1



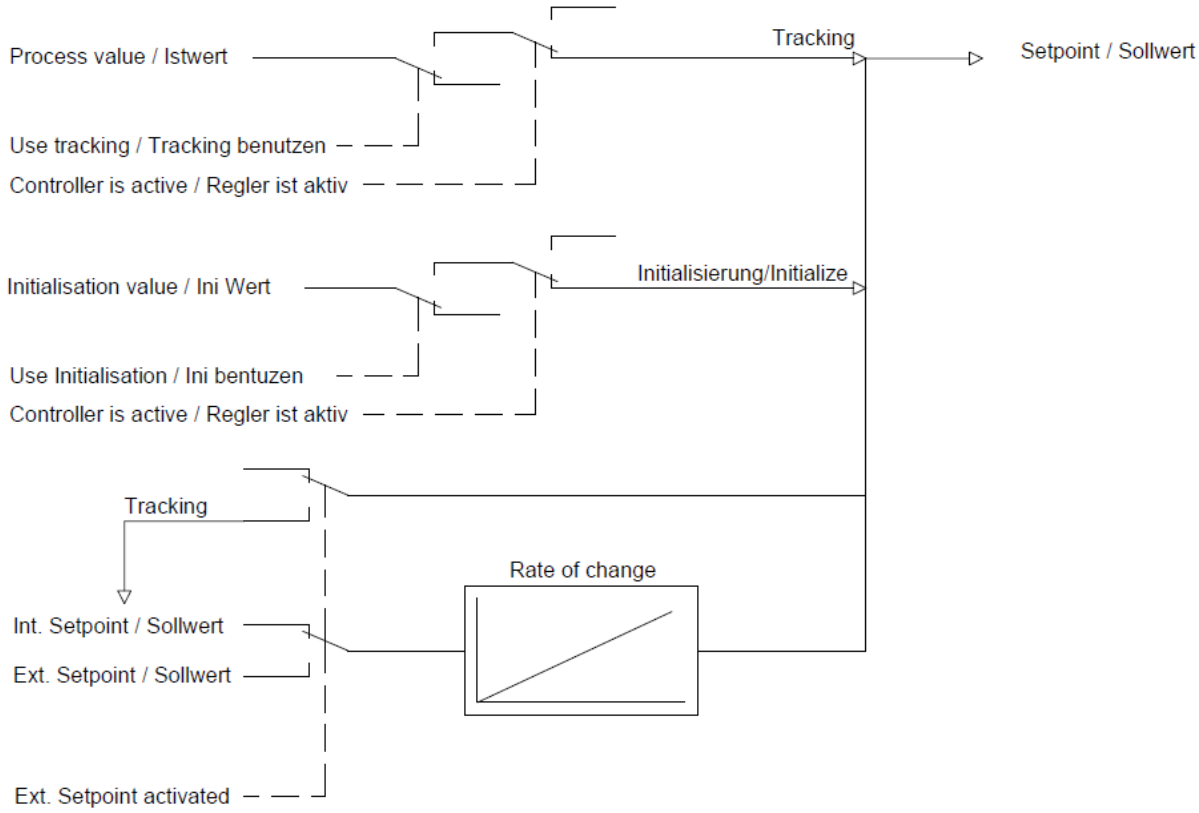
Service – (3) HP Regulation – Auxiliary limiter 1 „Curve“

Service – (3) HP Regulation – Auxiliary limiter 1 „Beam“

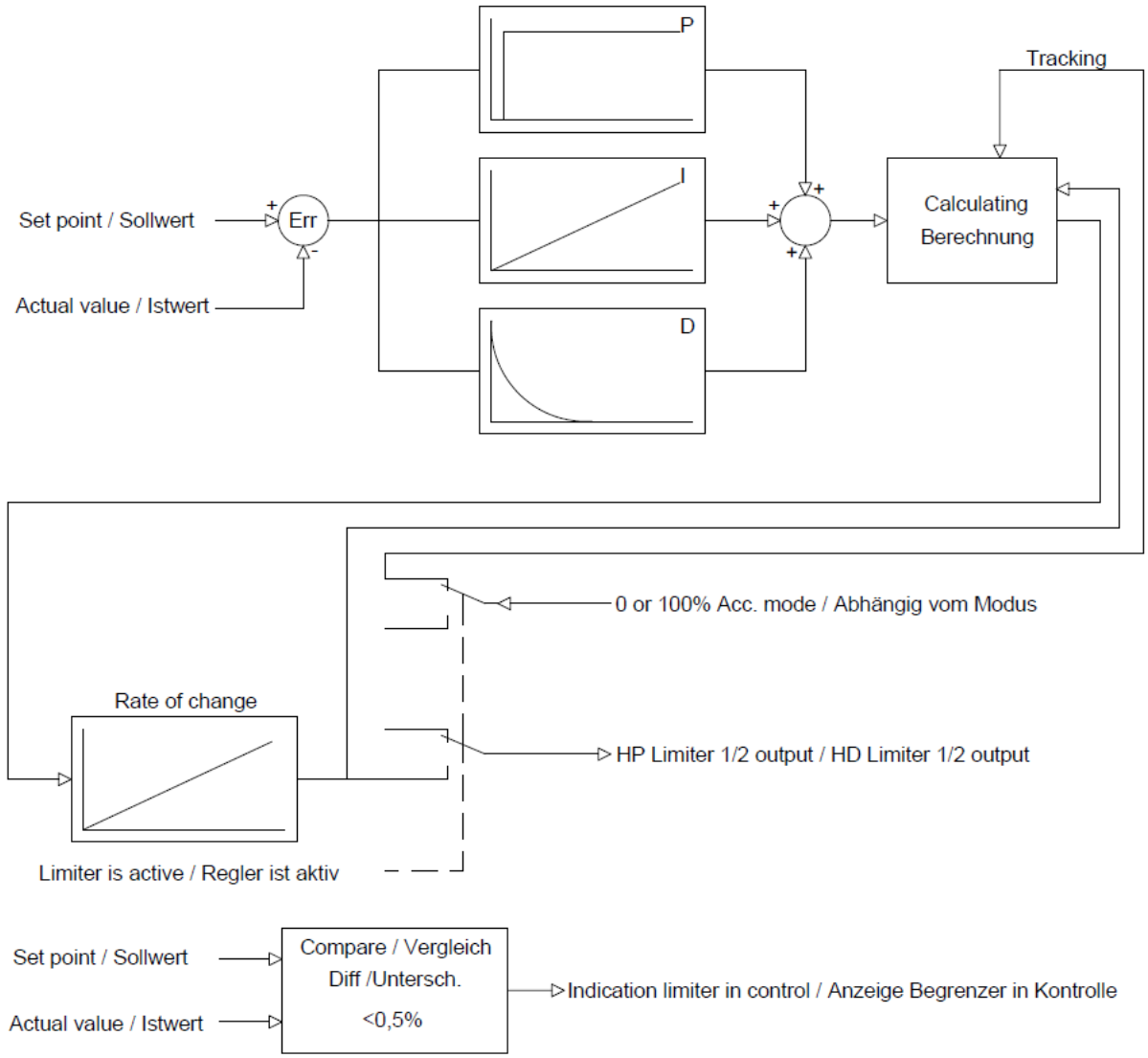
The auxiliary limiter 1 level includes the measured values and parameters for the auxiliary limiter 1. 2 views are available. The button “Curve/Beam” can be used to switch between the “Curve” and “Beam” view. The following parameters are available:

- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.
- **Actual value:** Shows the actual measured control value.

- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Gain:** Sets the Gain Part of the PI-Controller.
- **TI:** Sets the TI Part of the PI-Controller.
- **Max Output:** Sets the maximum output of the PI-Controller.
- **Min Output:** Sets the minimum output of the PI-Controller.
- **Dead band:** Sets the Dead band for the PI-Controller. A control difference that is smaller than this value will be ignored and the controller output will not change.
- **HP auxiliary limiter 1 is not active/active:** Indicates if the HP auxiliary limiter 1 is active or not. Additionally it is showing if the HP auxiliary limiter 1 is in control, which means that it manipulates the output of the active process controller. This will be indicated by the background color, which changes between gray (Not in control) and green (In control).

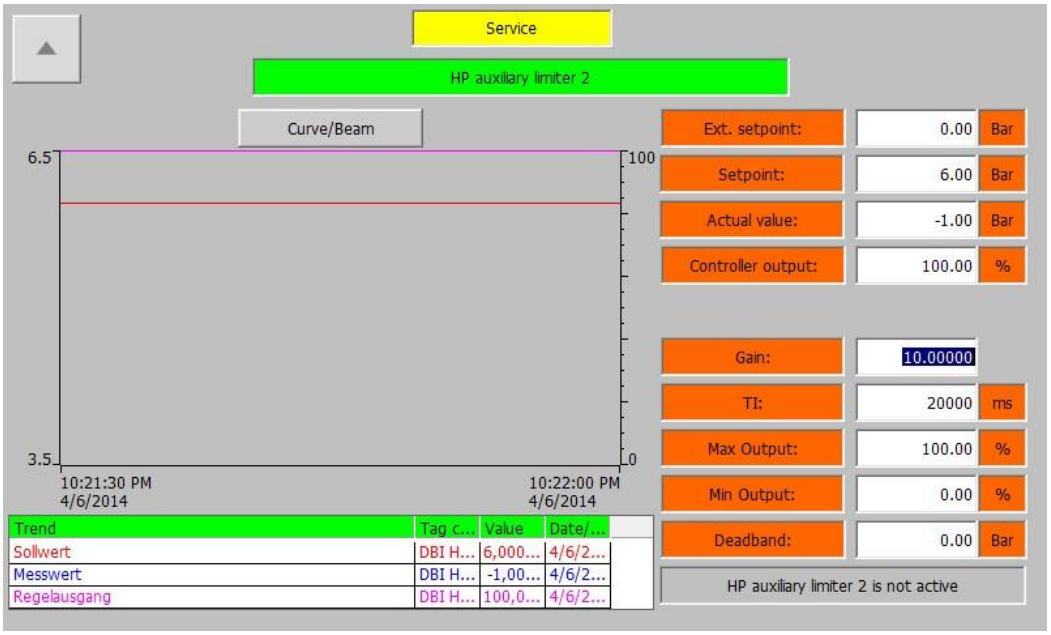


Service – (3) HP Regulation – Auxiliary limiter 1 set point calculation

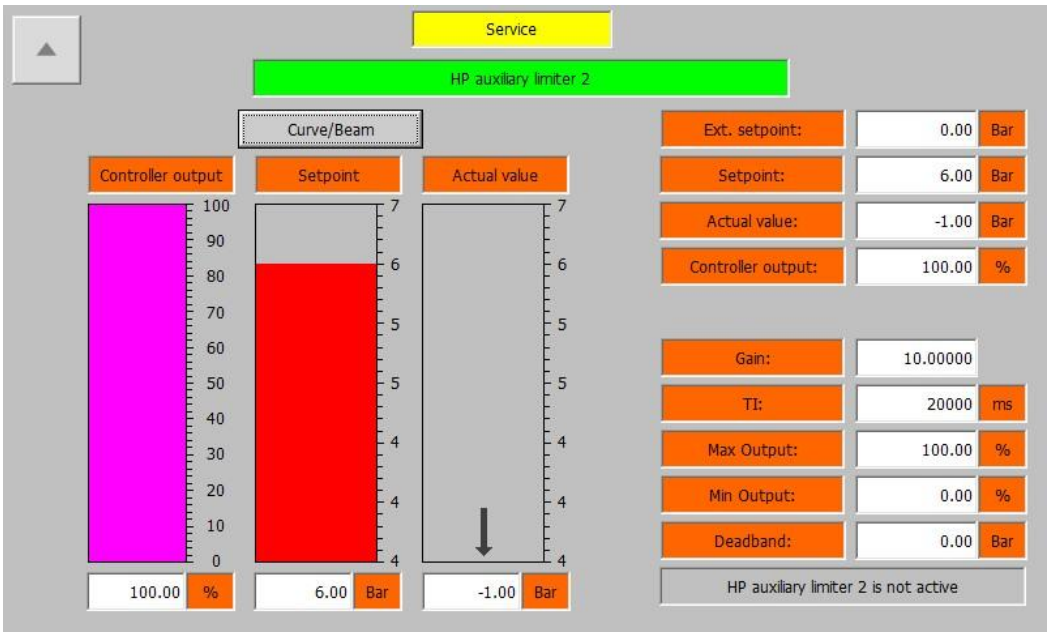


Service – (3) HP Regulation – Auxiliary limiter 1

4.3.7 HP Limiter 2



Service – (3) HP Regulation – Auxiliary limiter 2 „Curve“

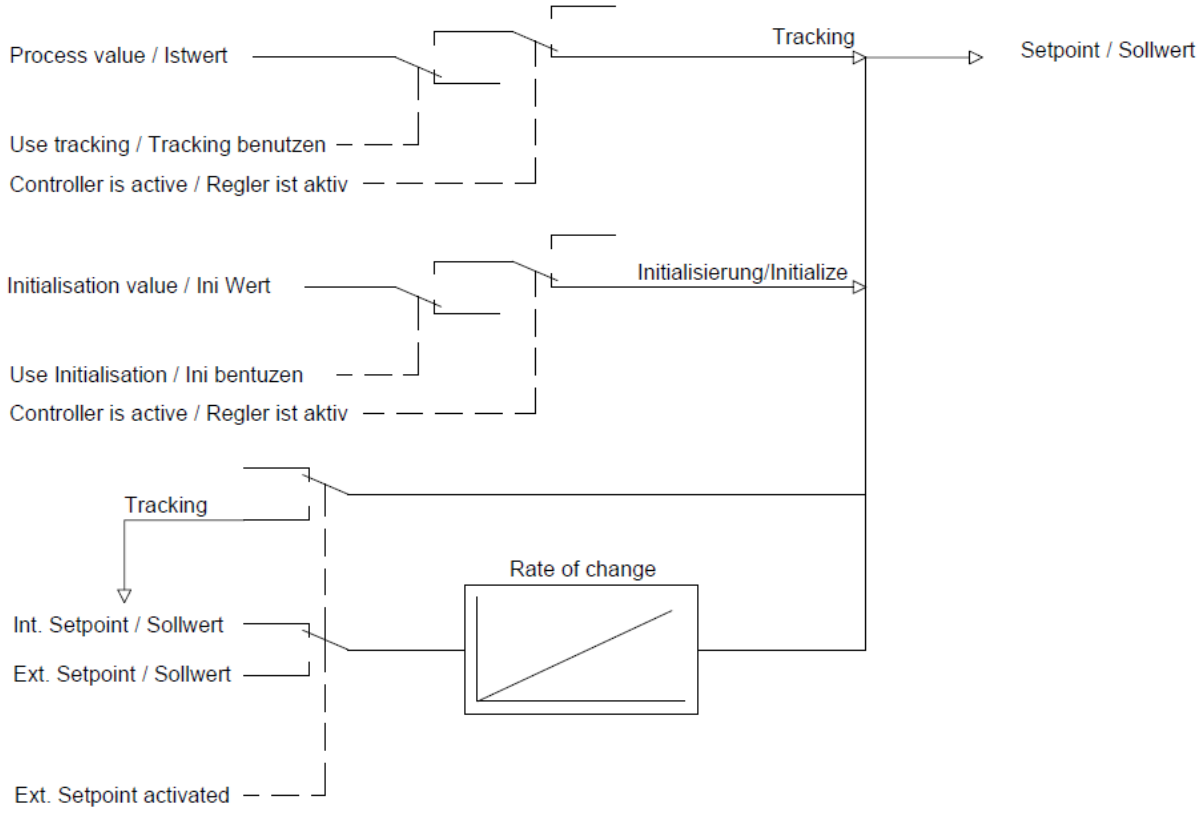


Service – (3) HP Regulation – Auxiliary limiter 2 „Beam“

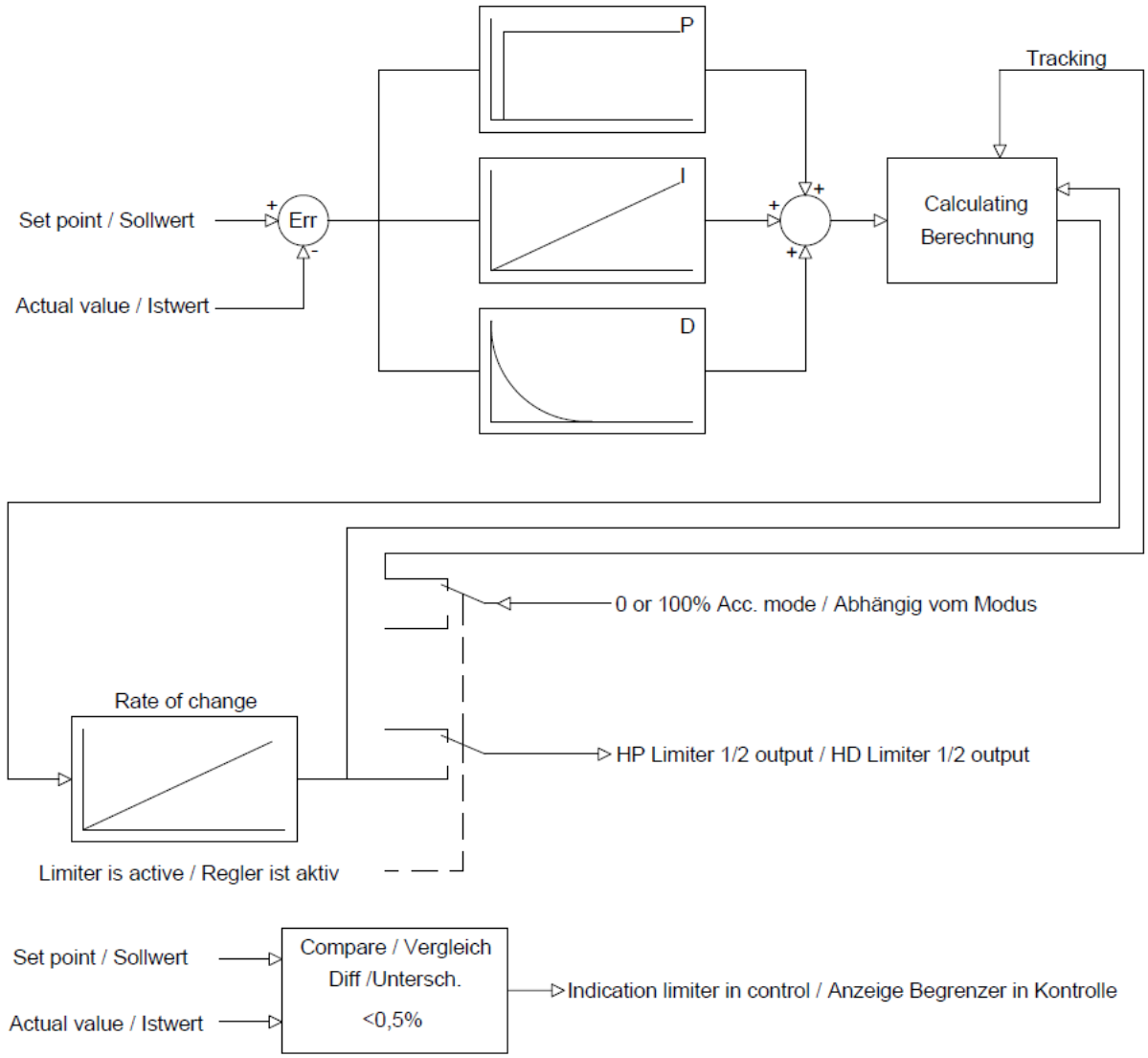
The auxiliary limiter 2 level includes the measured values and parameters for the auxiliary limiter 2. 2 views are available. The button “Curve/Beam” can be used to switch between the “Curve” and “Beam” view. The following parameters are available:

- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.
- **Actual value:** Shows the actual measured control value.

- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Gain:** Sets the Gain Part of the PI-Controller.
- **TI:** Sets the TI Part of the PI-Controller.
- **Max Output:** Sets the maximum output of the PI-Controller.
- **Min Output:** Sets the minimum output of the PI-Controller.
- **Dead band:** Sets the Dead band for the PI-Controller. A control difference that is smaller than this value will be ignored and the controller output will not change.
- **HP auxiliary limiter 2 is not active/active:** Indicates if the HP auxiliary limiter 2 is active or not. Additionally it is showing if the HP auxiliary limiter 2 is in control, which means that it manipulates the output of the active process controller. This will be indicated by the background color, which changes between gray (Not in control) and green (In control).

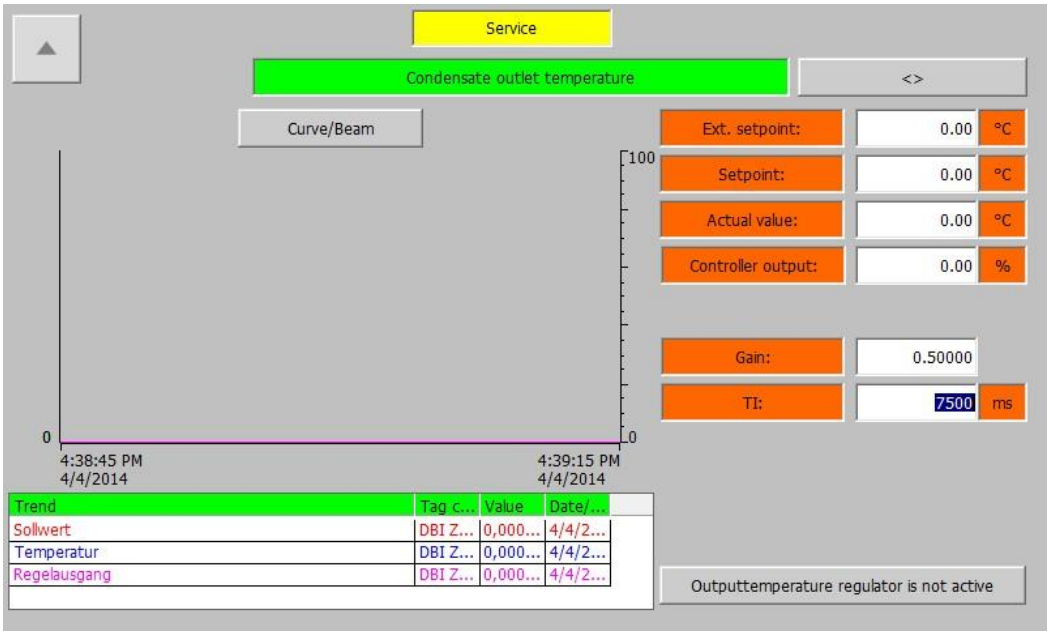


Service – (3) HP Regulation – Auxiliary limiter 2 set point calculation

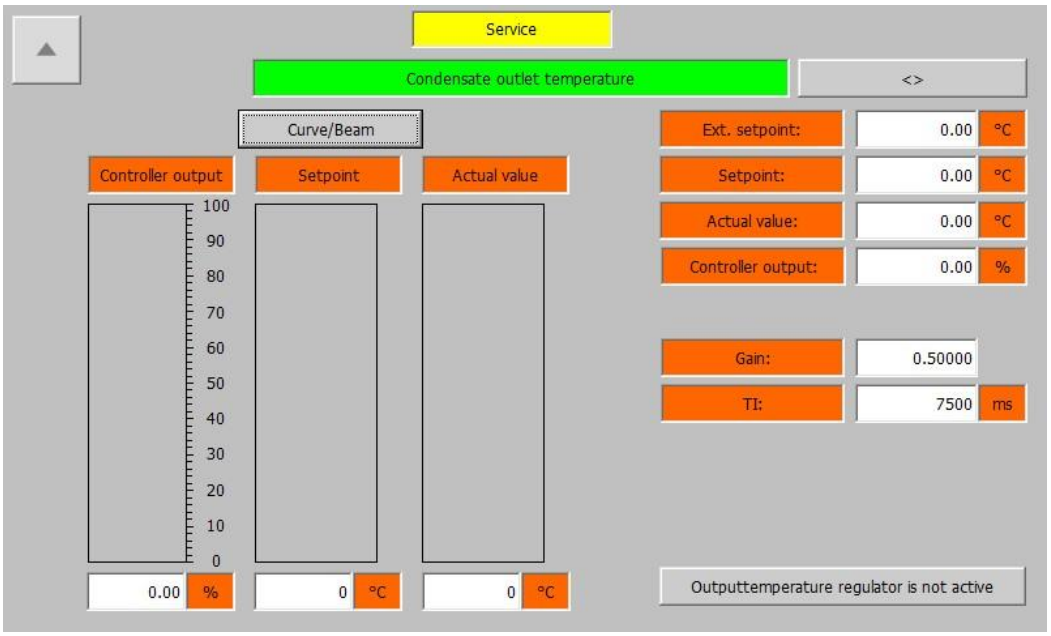


Service – (3) HP Regulation – Auxiliary limiter 2

4.3.8 Condensate outlet temperature controller



Service – (3) HP Regulation – Condensate outlet temperature „Curve“

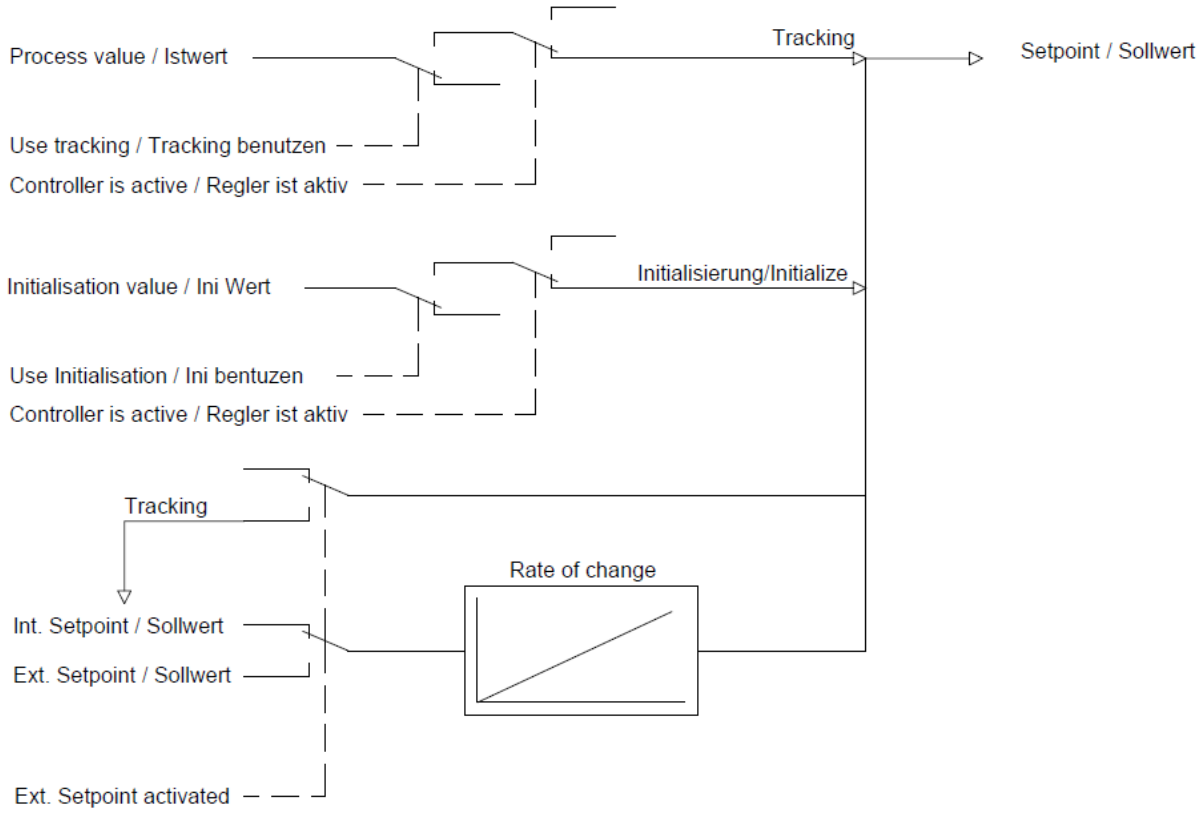


Service – (3) HP Regulation – Condensate outlet temperature „Beam“

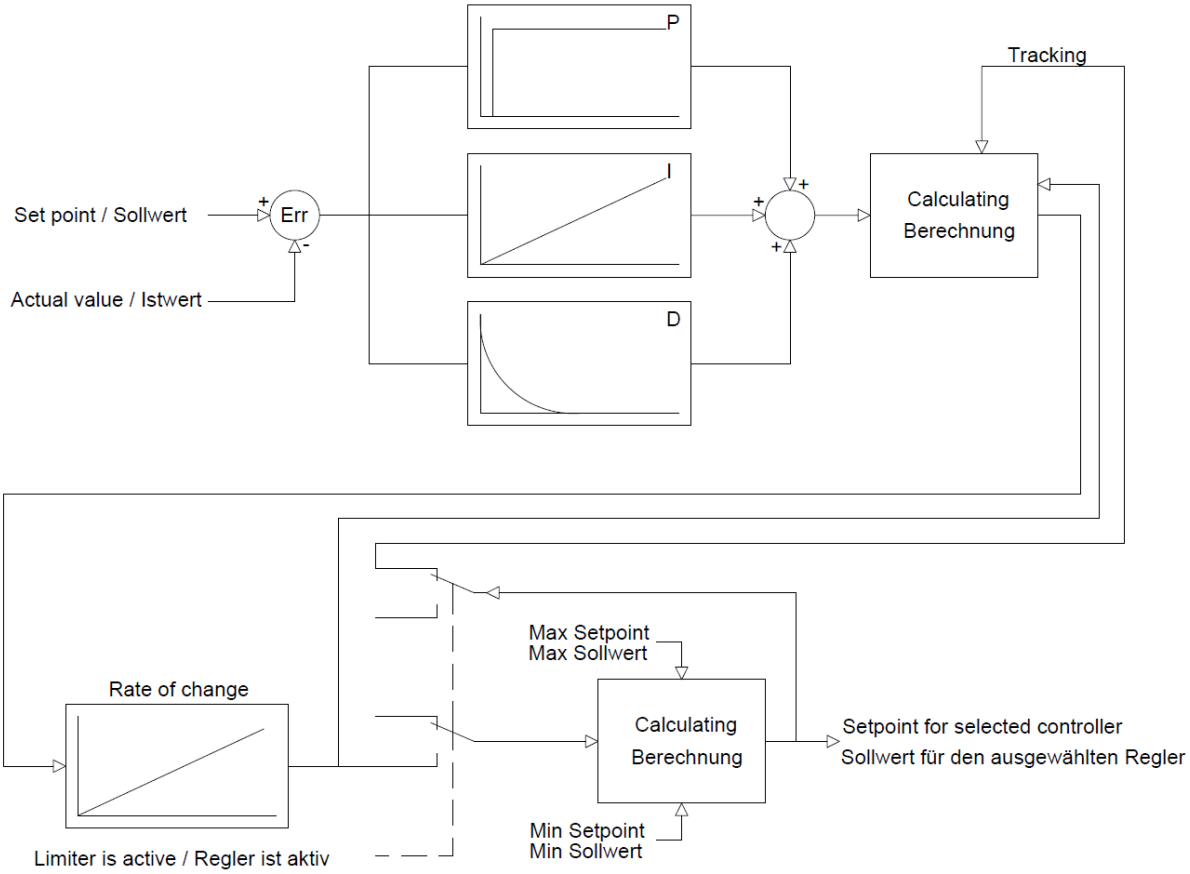
The Condensate temperature level includes the measured values and parameters for the outlet and middle temperature control of the Condensator. The parameters are separated into 2 parts, „Condensate outlet temperature“ and „Condensate middle temperature“. The Button „<>“ can be used to switch between this 2 parts. For both parts, 2 views are available. The button “Curve/Beam” can be used to switch between the “Curve” and “Beam” view.

The part „Output temperature regulator“ includes the parameters for the control of the outlet temperature of the Condensator. The following parameters are available:

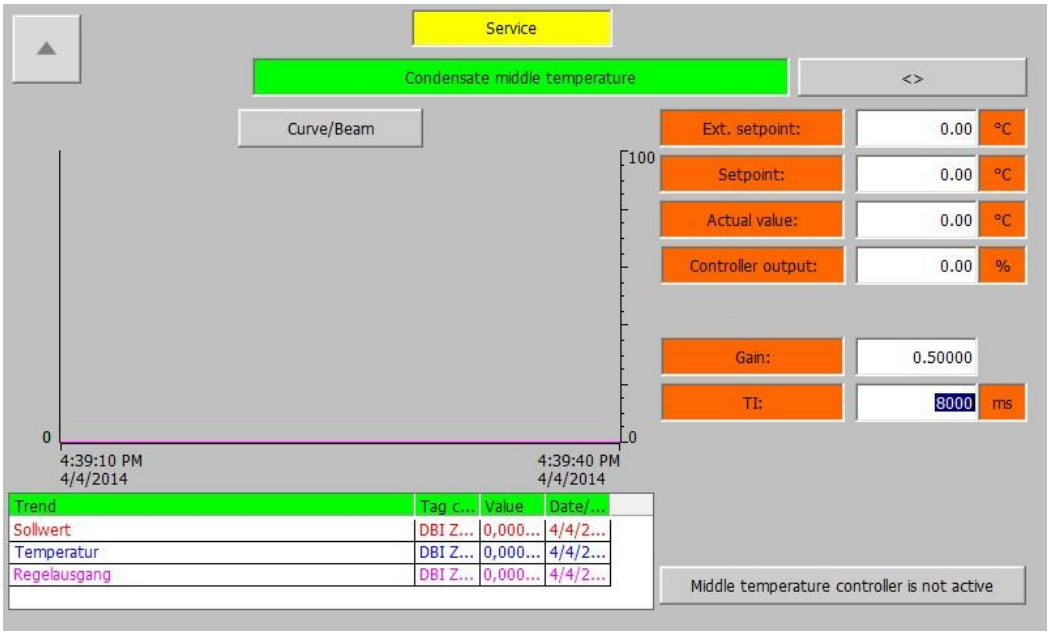
- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.
- **Actual value:** Shows the actual measured control value.
- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Gain:** Sets the Gain Part of the PI-Controller.
- **TI:** Sets the TI Part of the PI-Controller.
- **Output temperature regulator is not active/active:** Shows if the Output temperature regulator is active or not. The background color indicated a grey color (Controller is off) or a green color (Controller is on). If the Power controller is not active, but associated process controller is active, the button can be used to activate the Power controller.



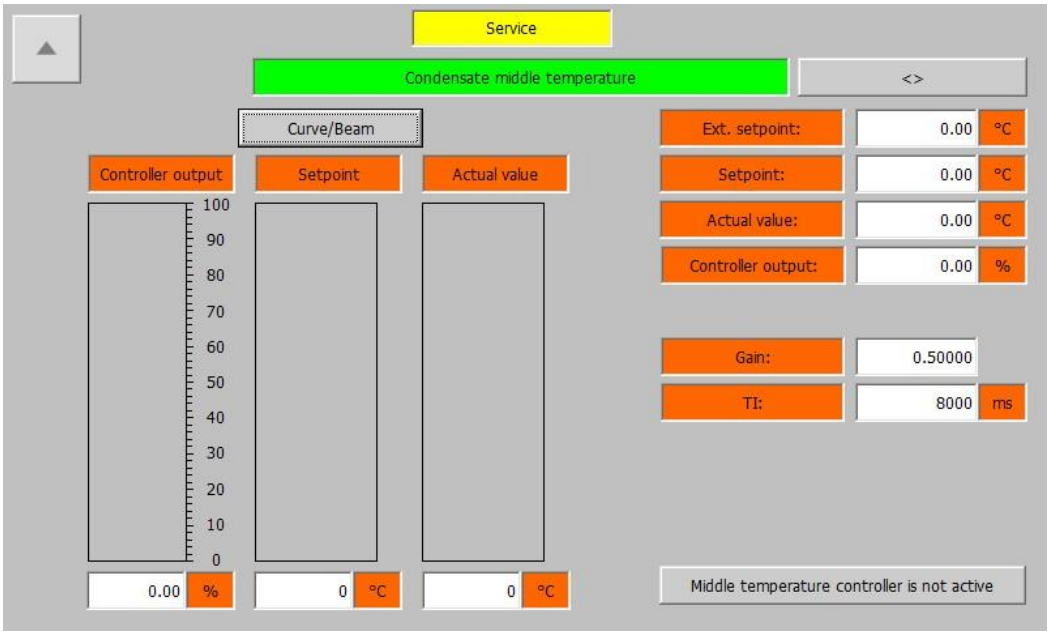
Service – (3) HP Regulation – Condensate outlet temperature set point calculation



Service – (3) HP Regulation – Condensate outlet temperature controller



Service – (3) HP Regulation – Condensate middle temperature „Curve“

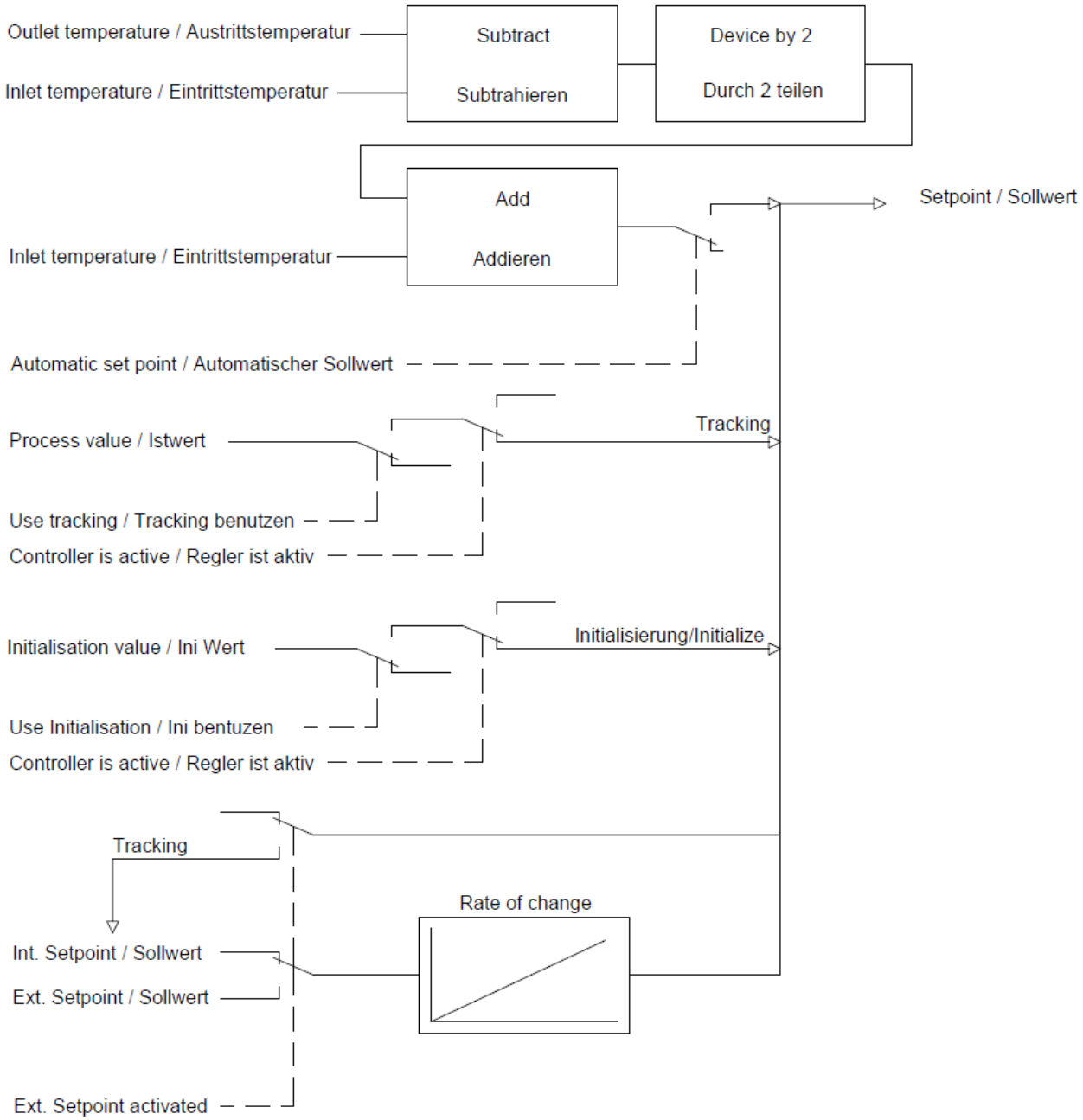


Service – (3) HP Regulation – Condensate middle temperature „Beam“

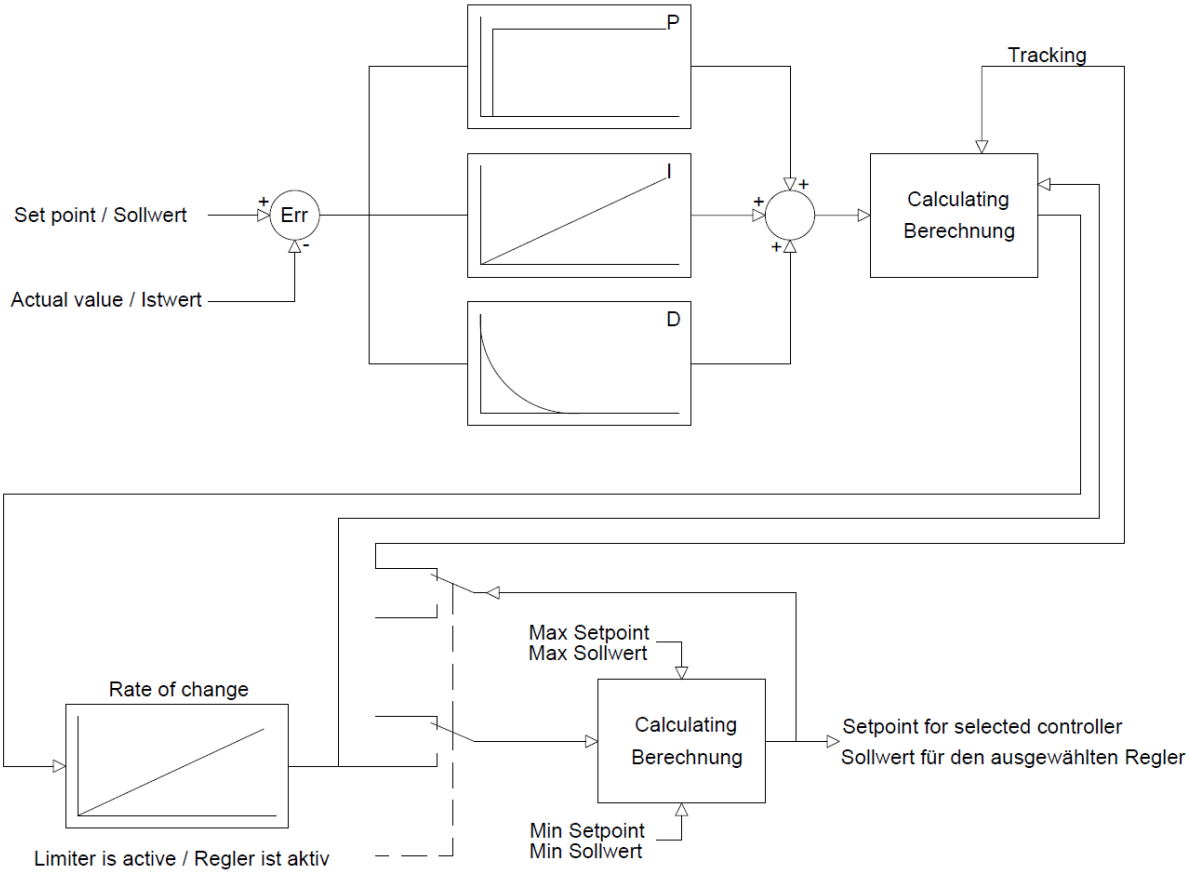
The part „middle temperature regulator“ includes the parameters for the control of the middle temperature of the Condensator.. The following parameters are available:

- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.
- **Actual value:** Shows the actual measured control value.
- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Gain:** Sets the Gain Part of the PI-Controller.

- **TI:** Sets the TI Part of the PI-Controller.
- **Middle temperature regulator is not active/active:** Shows if the Middle temperature regulator is active or not. The background color indicated a grey color (Controller is off) or a green color (Controller is on). If the Power controller is not active, but associated process controller is active, the button can be used to activate the Power controller.

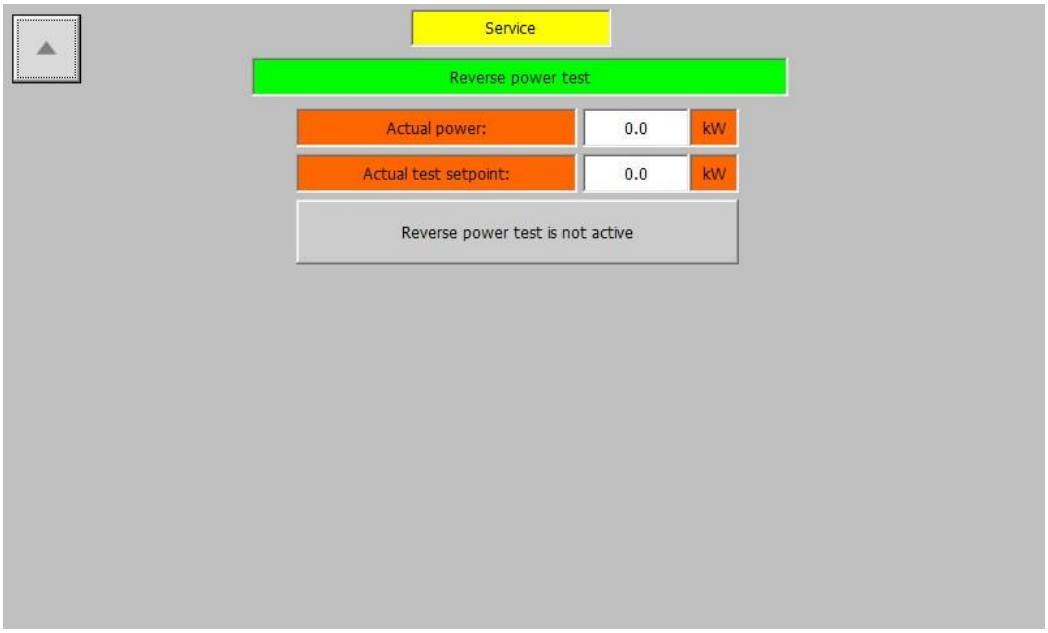


Service – (3) HP Regulation – Condensate middle temperature set point calculation



Service – (3) HP Regulation – Condensate middle temperature controller

4.3.9 Reverse power test



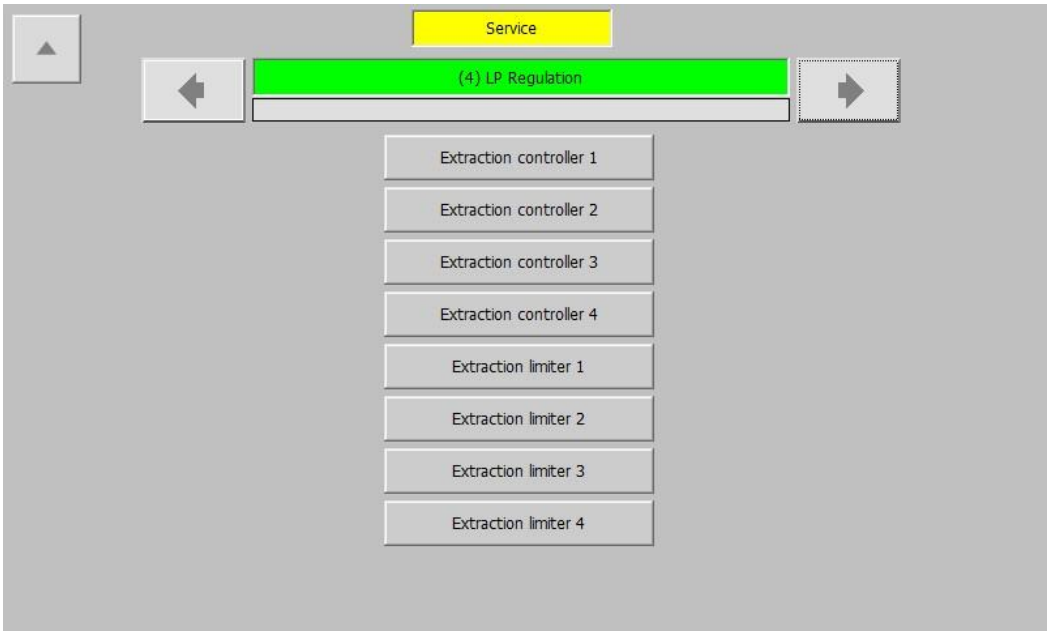
Service – (3) HP Regulation – Reverse power test

The Reverse power test level of the HP Regulation, allows a controlled test of the reverse power protection of the generator. The following parameters are available:

- **Actual power:** Shows the actual produced power.
- **Actual test Set point:** Shows the actual Set point for the activated reverse power test.
- **Reverse power test is not active/active:** Activates or deactivates the reverse power test.

When the reverse power test is activated, the power output will be limited starting from the actual power and decrease according to the configured speed. Unlike when the start ramp is active, the Set point will not stop at the stop set point, but will go on decreasing until the test is stopped or the reverse power protection is tripped the turbine and stopped the ESTC.

4.4 LP Regulation

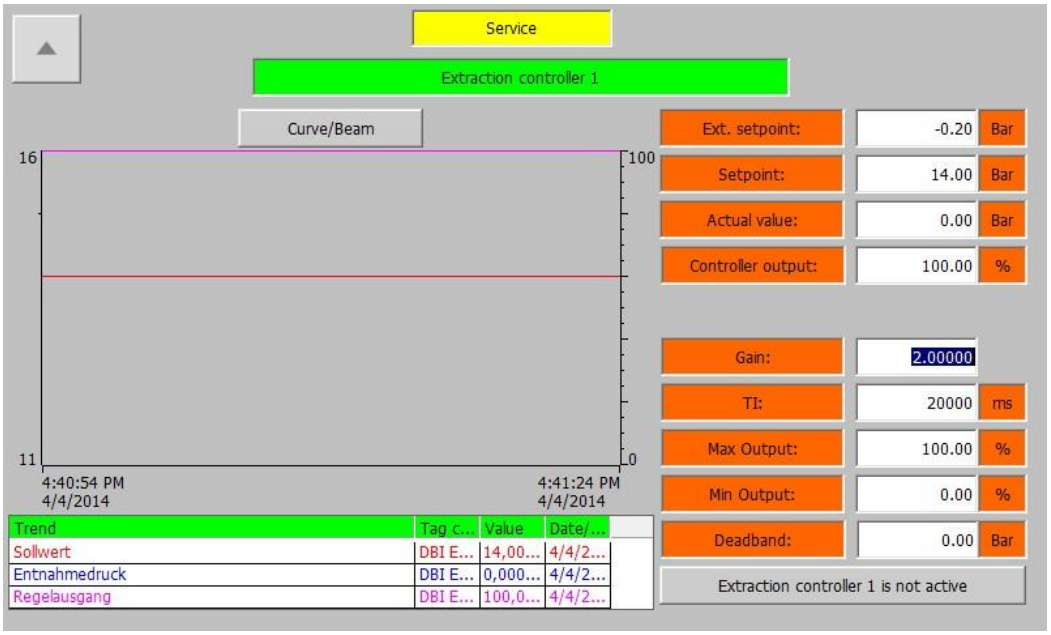


Service – (4) LP Regulation

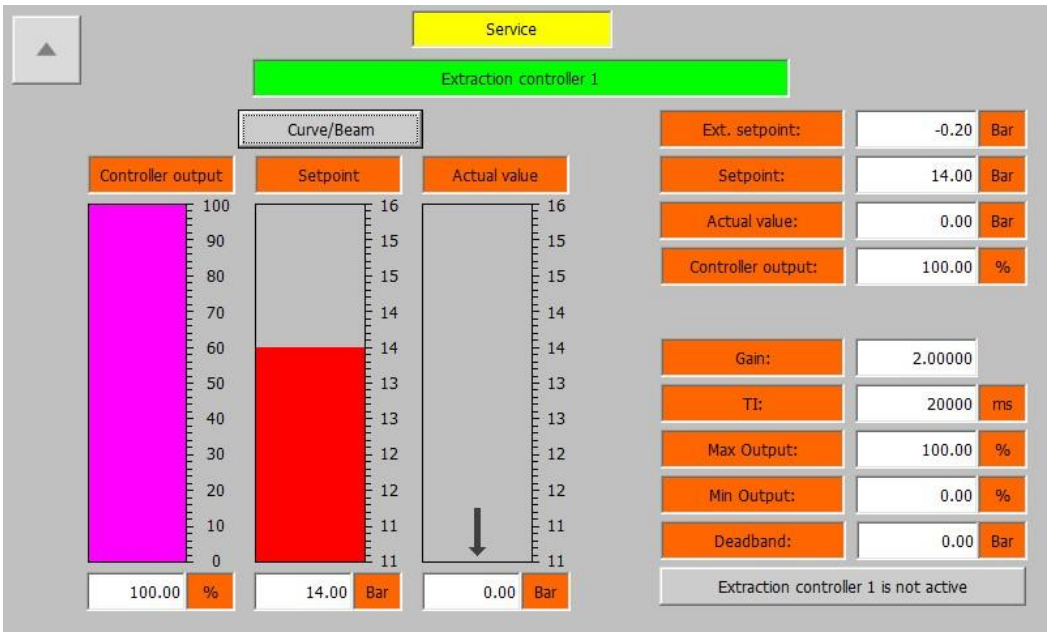
The LP Regulation level includes the controller and limiter of the extraction stages 1-4. The following levels are available:

- Extraction controller 1
- Extraction controller 2
- Extraction controller 3
- Extraction controller 4
- Extraction limiter 1
- Extraction limiter 2
- Extraction limiter 3
- Extraction limiter 4

4.4.1 Extraction controller 1



Service – (4) LP Regulation – Extraction controller 1 „Curve“

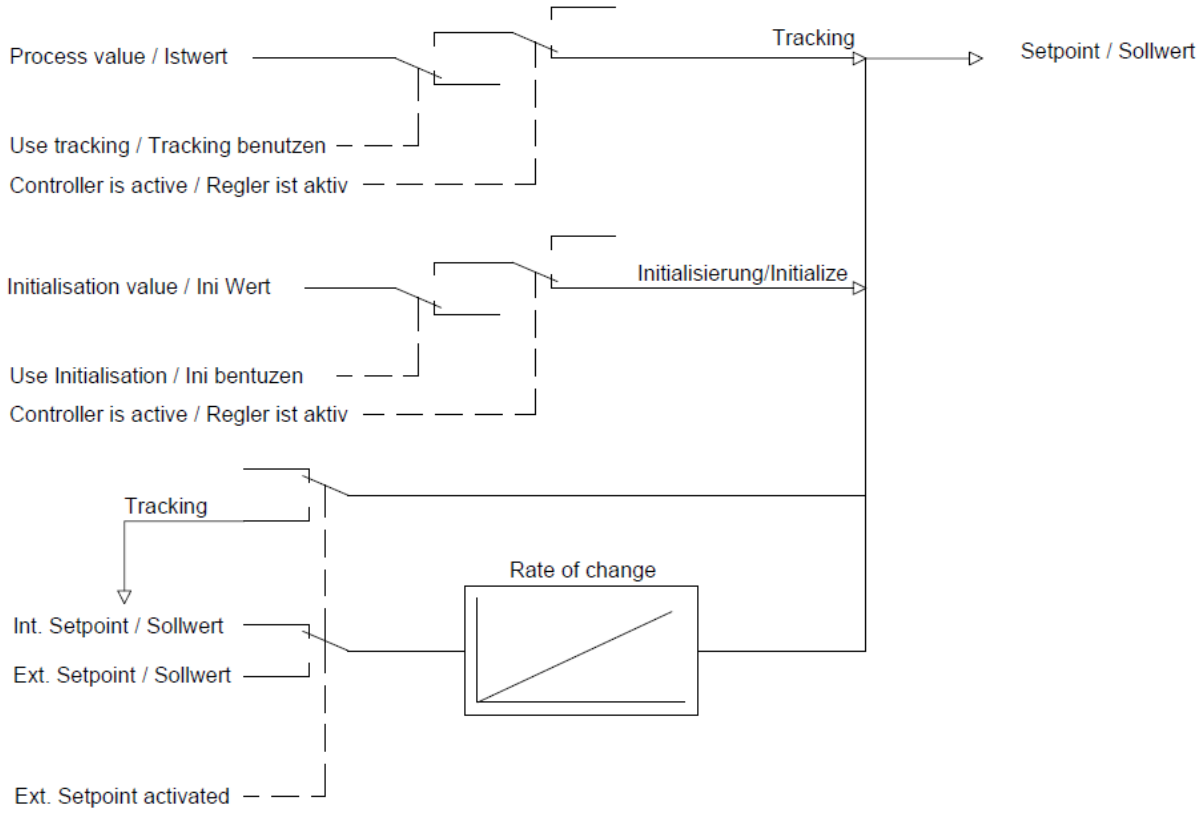


Service – (4) LP Regulation – Extraction controller 1 „Beam“

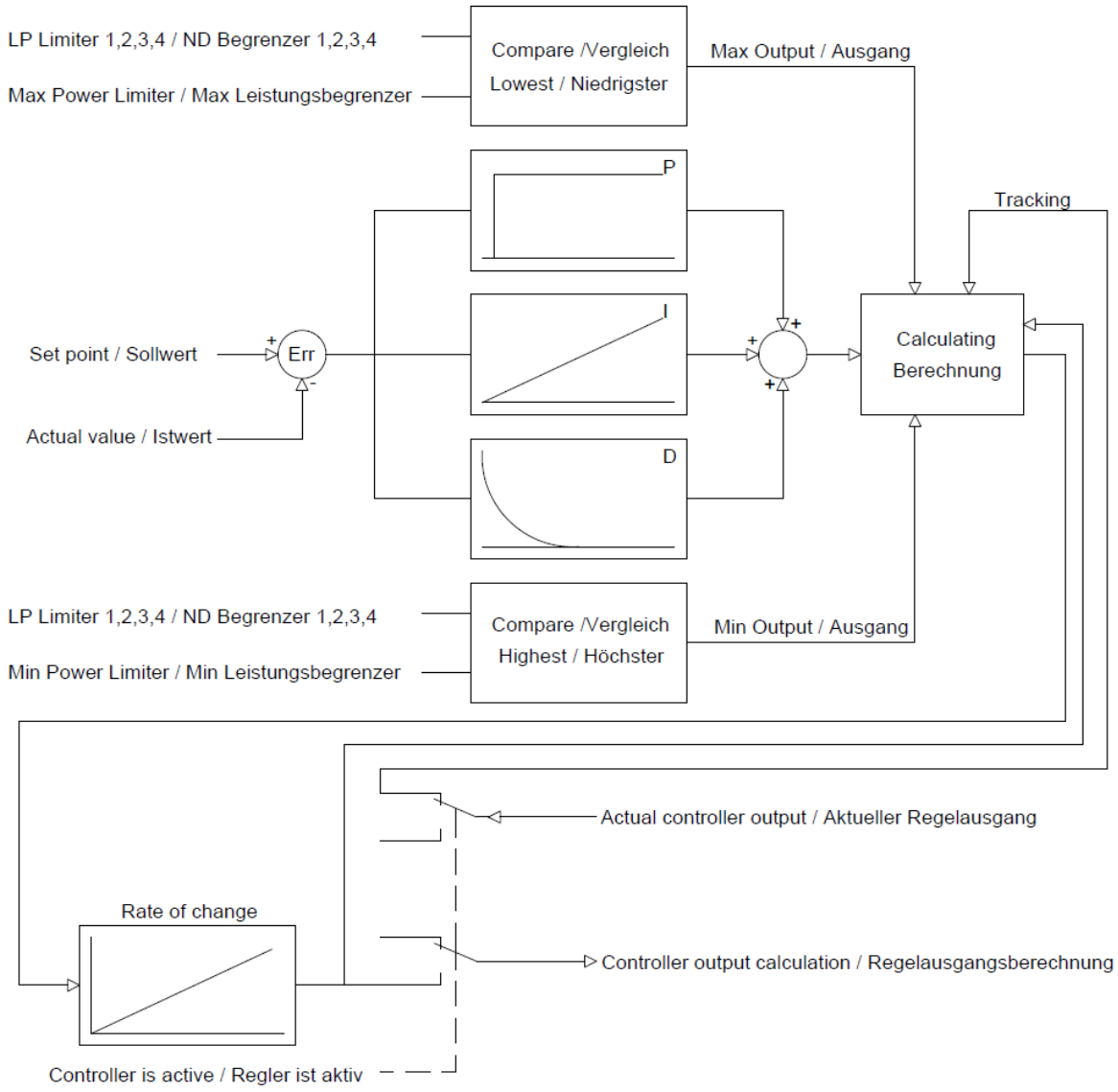
The Extraction controller 1 level includes the measured values and parameters for the extraction controller 1.2 views are available. The button “Curve/Beam” can be used to switch between the “Curve” and “Beam” view.

- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.
- **Actual value:** Shows the actual measured control value.

- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Gain:** Sets the Gain Part of the PI-Controller.
- **TI:** Sets the TI Part of the PI-Controller.
- **Max Output:** Sets the maximum output of the PI-Controller.
- **Min Output:** Sets the minimum output of the PI-Controller.
- **Dead band:** Sets the Dead band for the PI-Controller. A control difference that is smaller than this value will be ignored and the controller output will not change.
- **Extraction controller is 1 not active/active:** Shows if the extraction controller 1 is active or not. The background color indicated a grey color (Controller is off) or a green color (Controller is on). If the Extraction controller 1 is not active, but the release is there, the button can be used to activate the extraction controller 1. By Re-pressing the button, the extraction controller 1 will be deactivated.

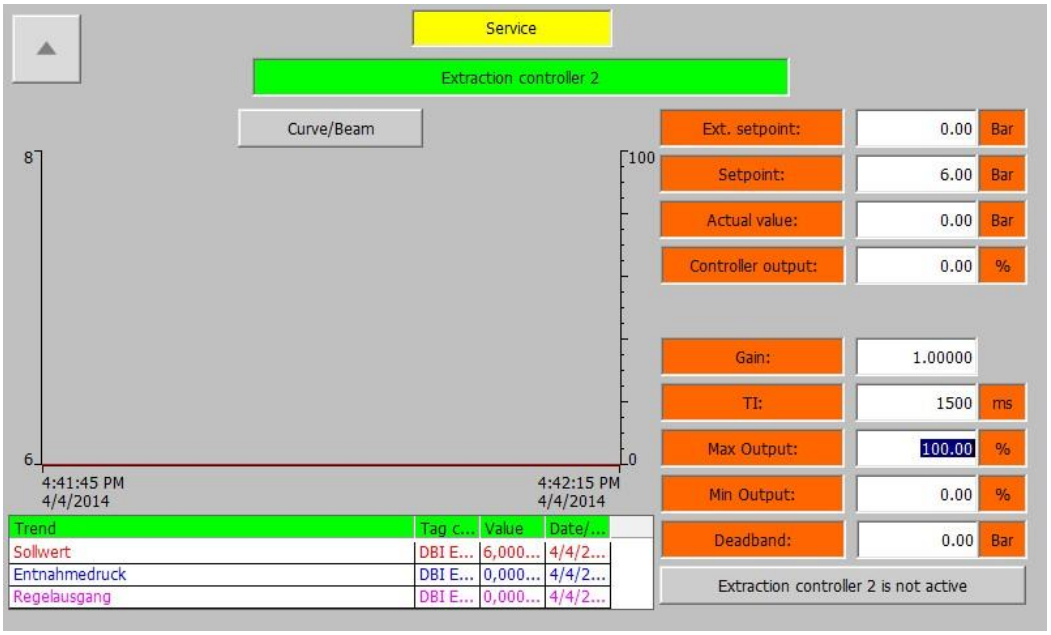


Service – (4) LP Regulation – Extraction controller 1 set point calculation

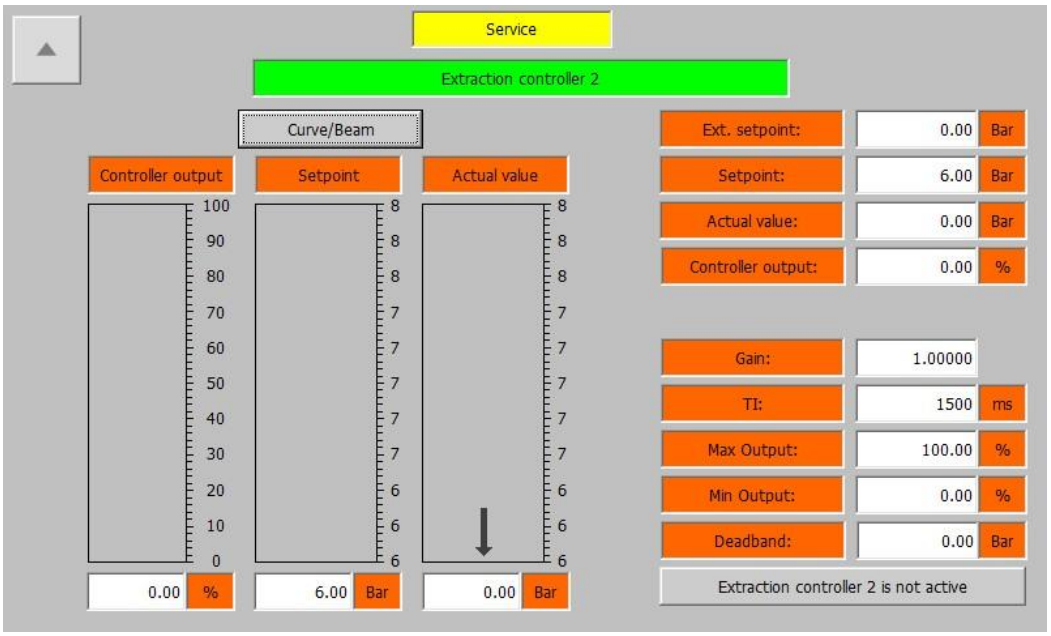


Service – (4) LP Regulation – Extraction controller 1

4.4.2 Extraction controller 2



Service – (4) LP Regulation – Extraction controller 2 „Curve“

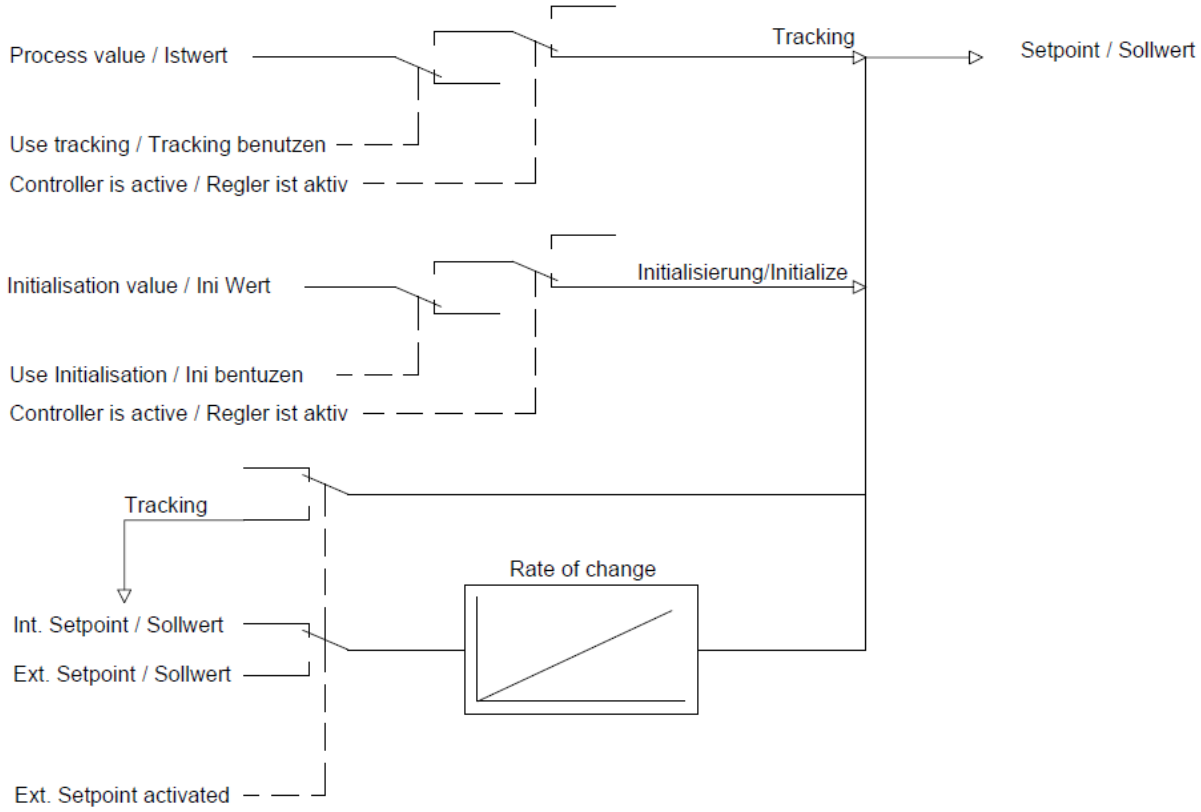


Service – (4) LP Regulation – Extraction controller 2 „Beam“

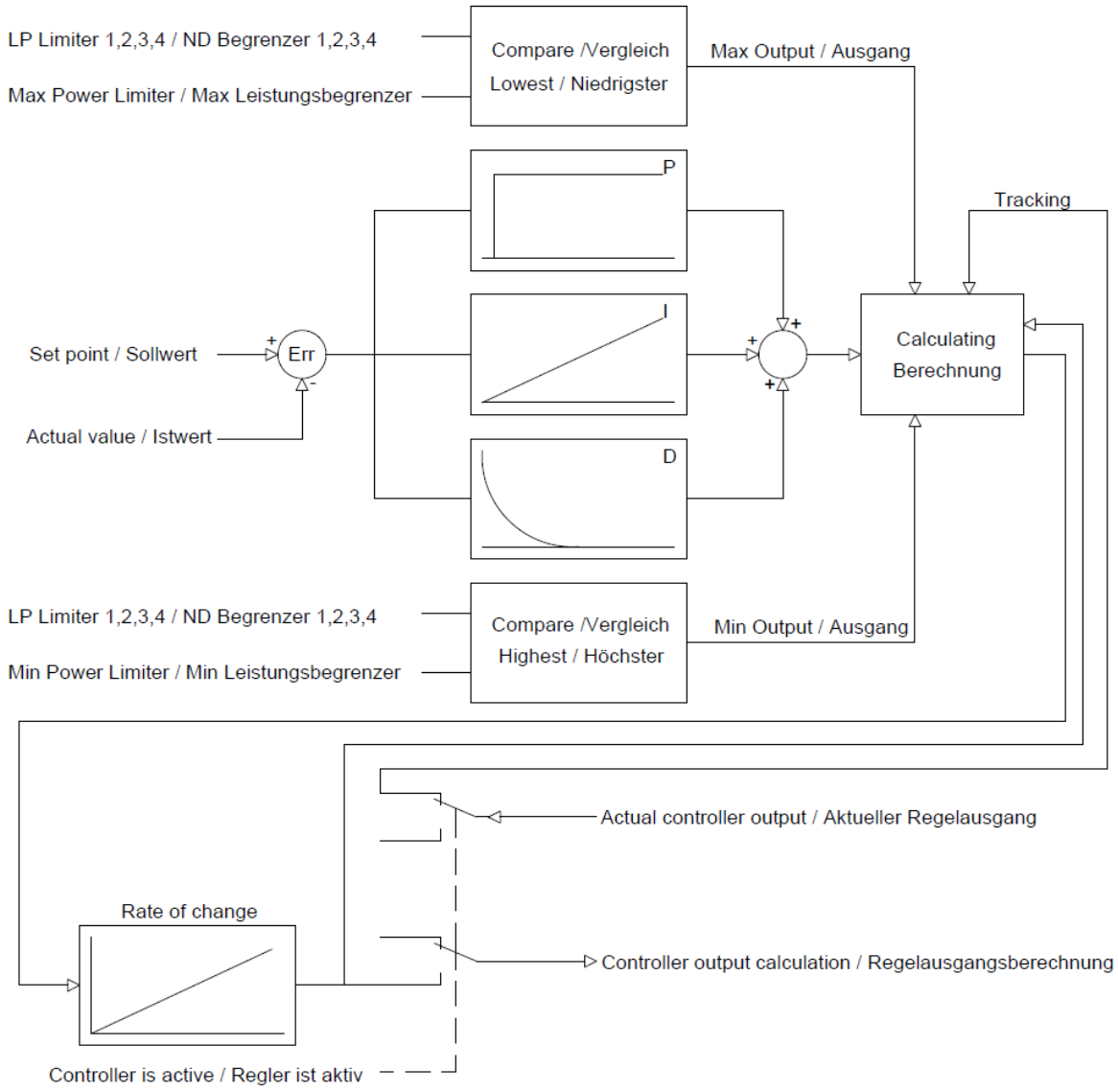
The Extraction controller 2 level includes the measured values and parameters for the extraction controller 2.2 views are available. The button “Curve/Beam” can be used to switch between the “Curve” and “Beam” view.

- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.
- **Actual value:** Shows the actual measured control value.

- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Gain:** Sets the Gain Part of the PI-Controller.
- **TI:** Sets the TI Part of the PI-Controller.
- **Max Output:** Sets the maximum output of the PI-Controller.
- **Min Output:** Sets the minimum output of the PI-Controller.
- **Dead band:** Sets the Dead band for the PI-Controller. A control difference that is smaller than this value will be ignored and the controller output will not change.
- **Extraction controller is 2 not active/active:** Shows if the extraction controller 2 is active or not. The background color indicated a grey color (Controller is off) or a green color (Controller is on). If the Extraction controller 2 is not active, but the release is there, the button can be used to activate the extraction controller 2. By Re-pressing the button, the extraction controller 2 will be deactivated.

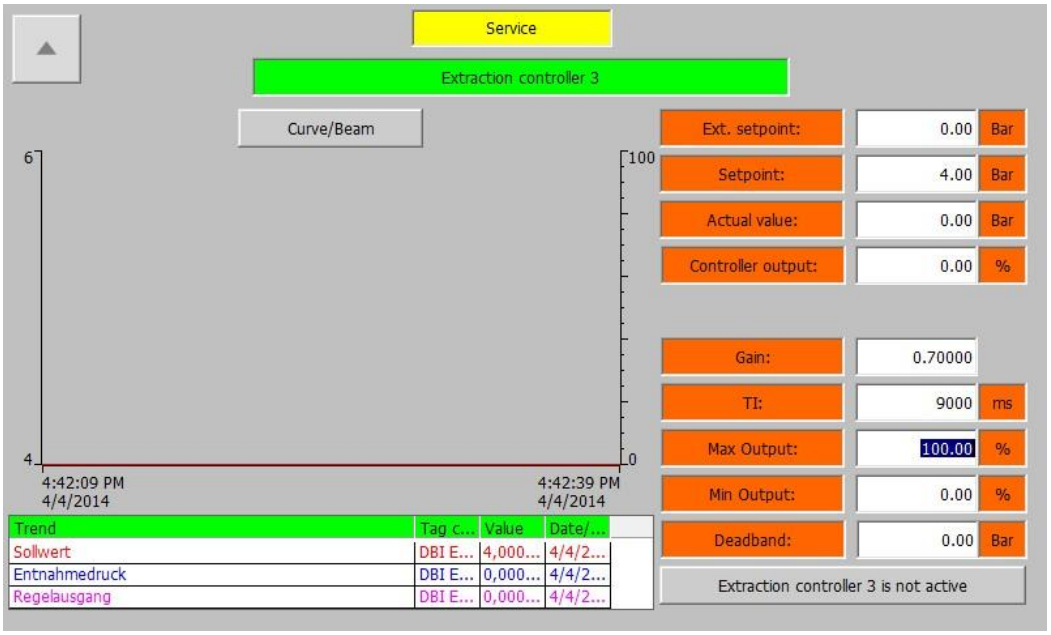


Service – (4) LP Regulation – Extraction controller 2 set point calculation

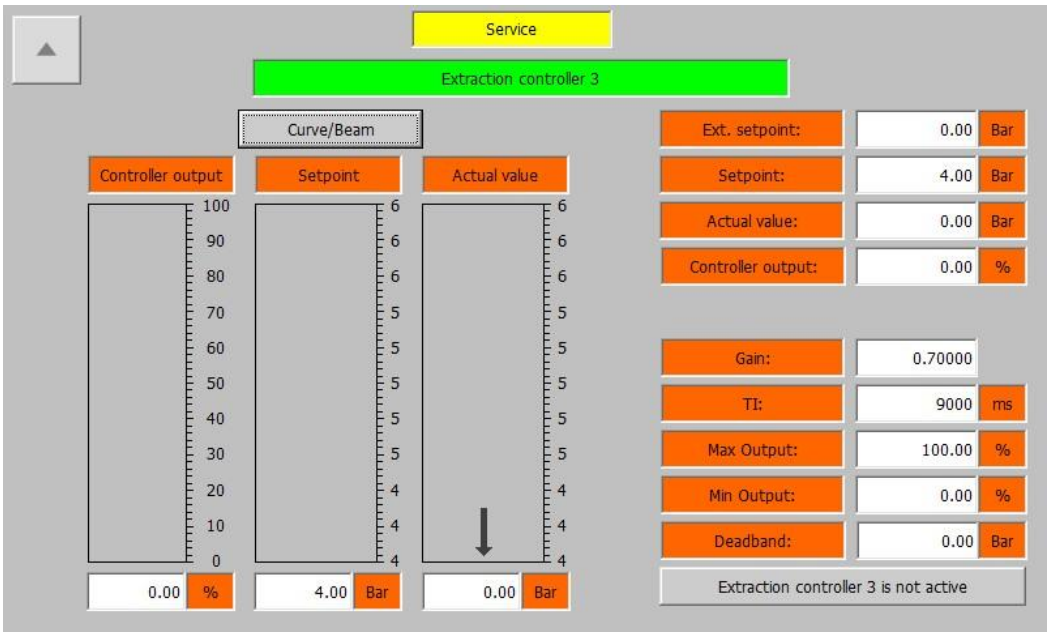


Service – (4) LP Regulation – Extraction controller 2

4.4.3 Extraction controller 3



Service – (4) LP Regulation – Extraction controller 3 „Curve“

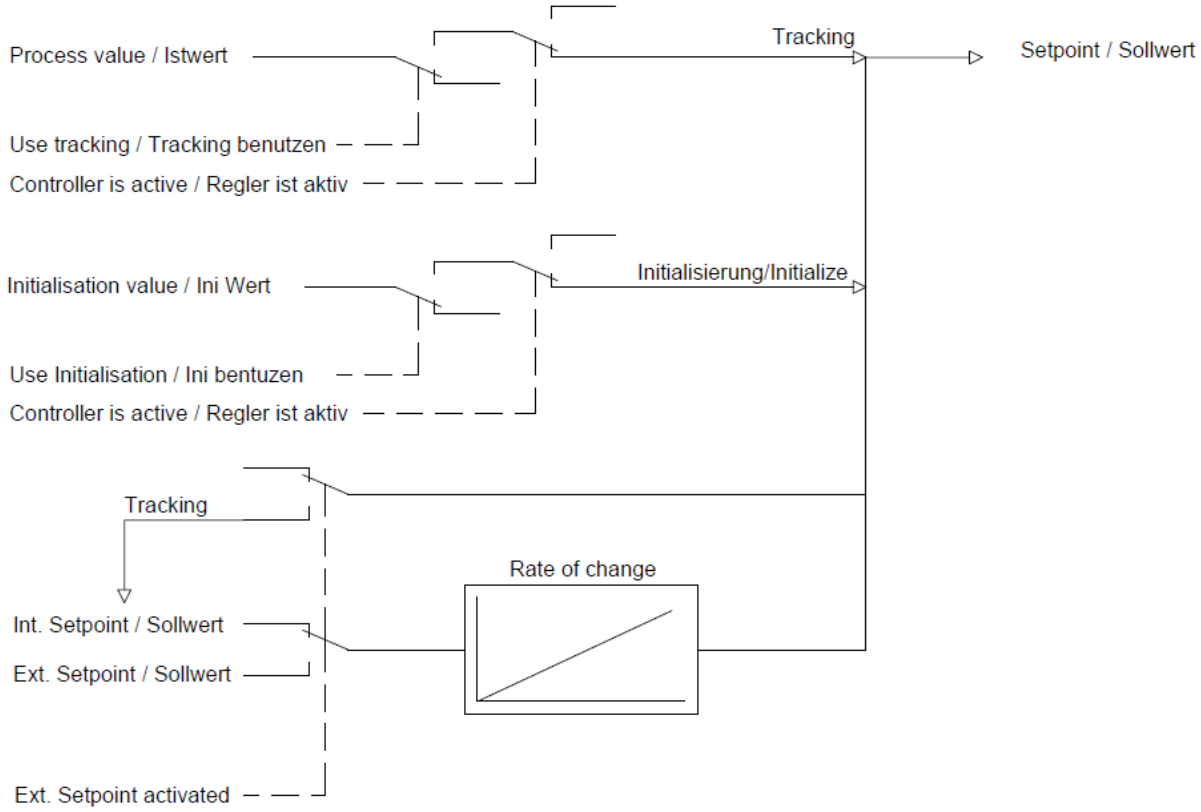


Service – (4) LP Regulation – Extraction controller 3 „Beam“

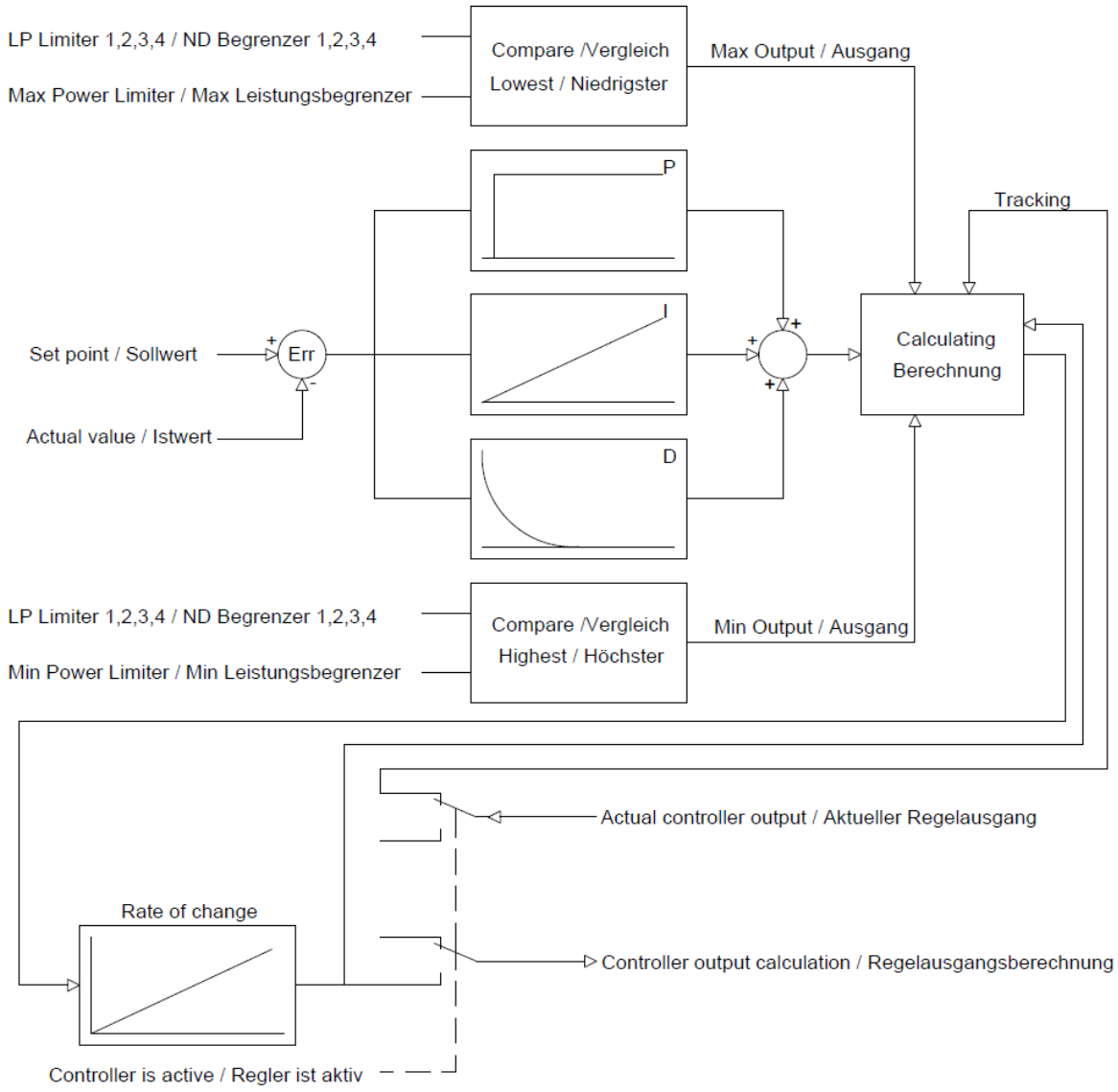
The Extraction controller 3 level includes the measured values and parameters for the extraction controller 3.2 views are available. The button “Curve/Beam” can be used to switch between the “Curve” and “Beam” view.

- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.
- **Actual value:** Shows the actual measured control value.

- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Gain:** Sets the Gain Part of the PI-Controller.
- **TI:** Sets the TI Part of the PI-Controller.
- **Max Output:** Sets the maximum output of the PI-Controller.
- **Min Output:** Sets the minimum output of the PI-Controller.
- **Dead band:** Sets the Dead band for the PI-Controller. A control difference that is smaller than this value will be ignored and the controller output will not change.
- **Extraction controller is 3 not active/active:** Shows if the extraction controller 3 is active or not. The background color indicated a grey color (Controller is off) or a green color (Controller is on). If the Extraction controller 3 is not active, but the release is there, the button can be used to activate the extraction controller 3. By Re-pressing the button, the extraction controller 3 will be deactivated.

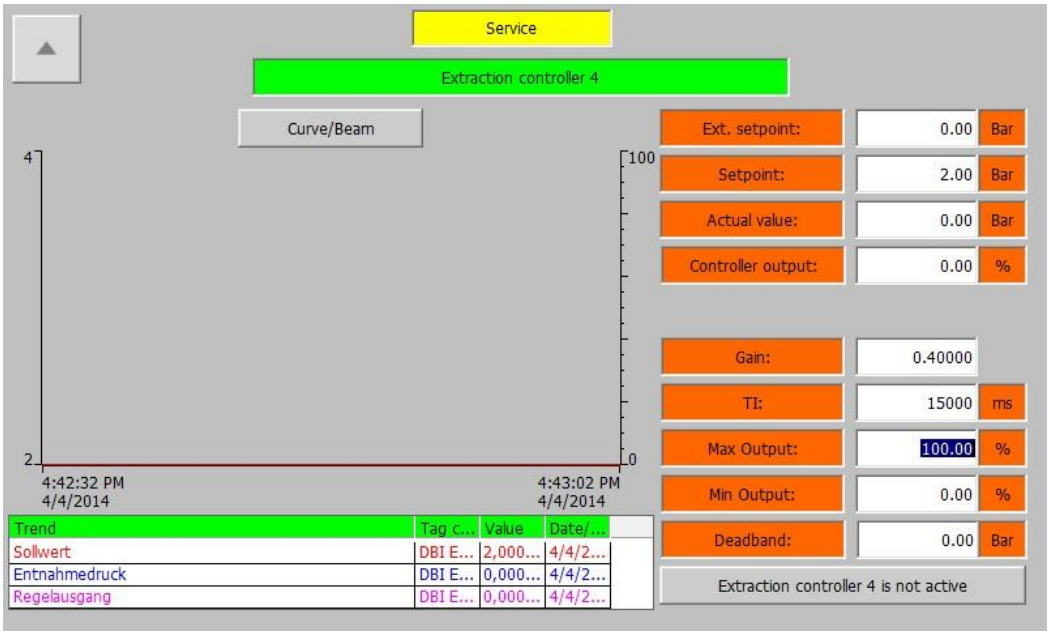


Service – (4) LP Regulation – Extraction controller 3 set point calculation

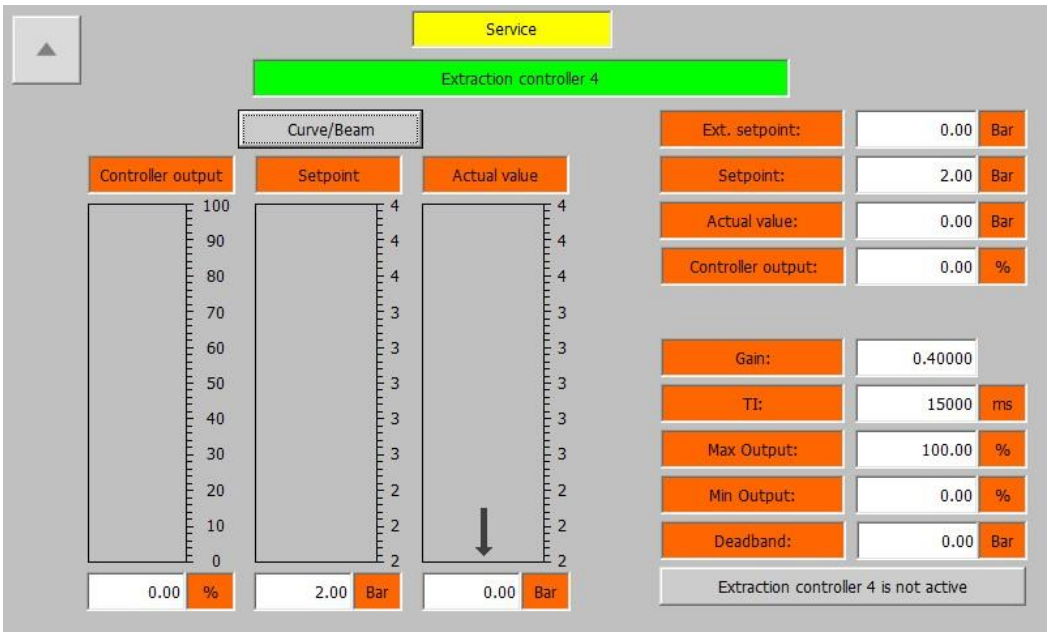


Service – (4) LP Regulation – Extraction controller 3

4.4.4 Extraction controller 4



Service – (4) LP Regulation – Extraction controller 4 „Curve“

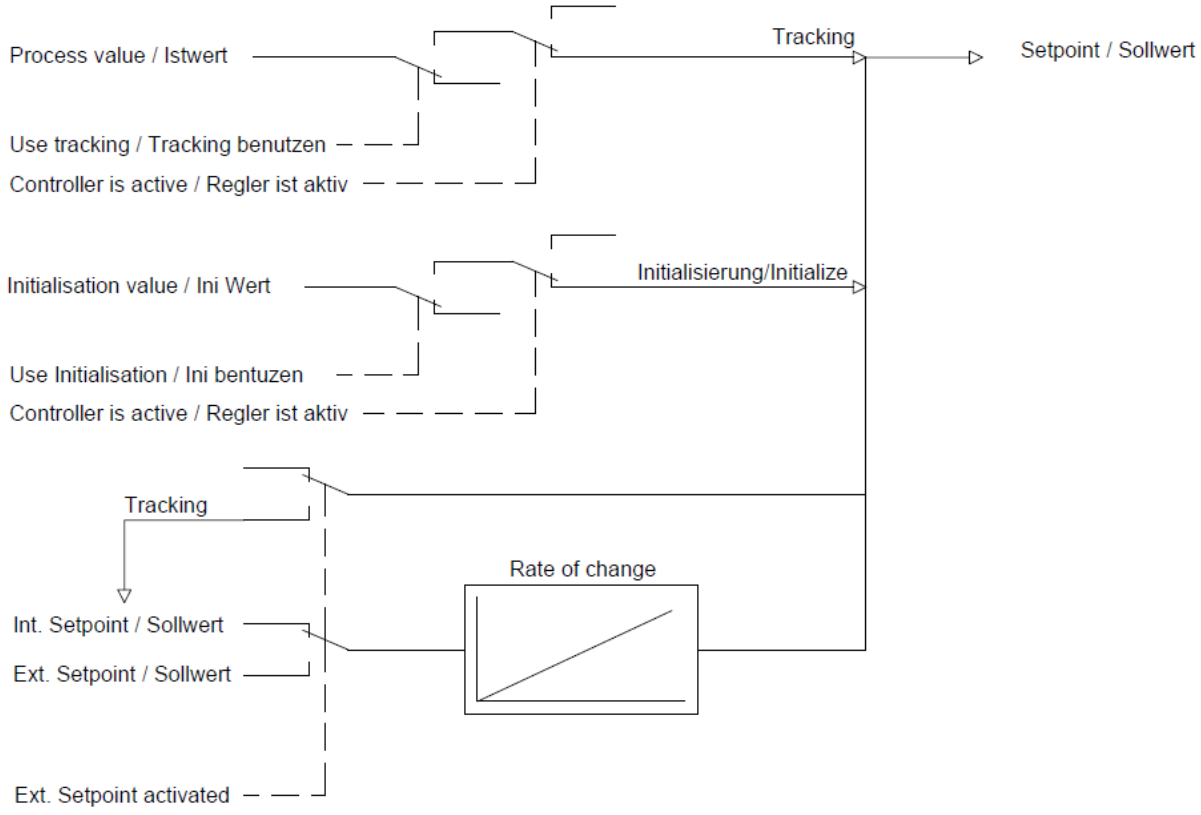


Service – (4) LP Regulation – Extraction controller 4 „Beam“

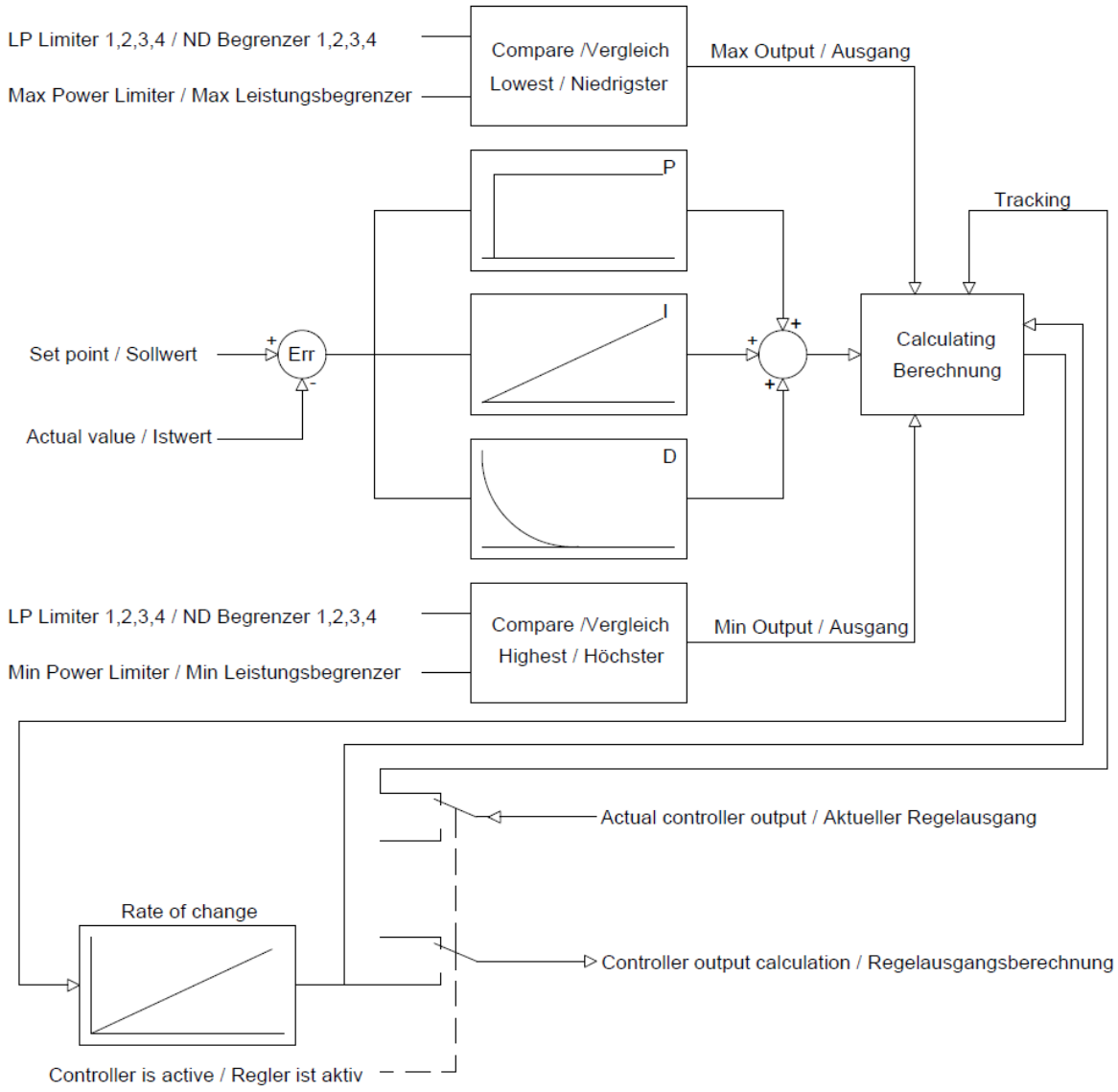
The Extraction controller 4 level includes the measured values and parameters for the extraction controller 4.2 views are available. The button “Curve/Beam” can be used to switch between the “Curve” and “Beam” view.

- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.
- **Actual value:** Shows the actual measured control value.

- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Gain:** Sets the Gain Part of the PI-Controller.
- **TI:** Sets the TI Part of the PI-Controller.
- **Max Output:** Sets the maximum output of the PI-Controller.
- **Min Output:** Sets the minimum output of the PI-Controller.
- **Dead band:** Sets the Dead band for the PI-Controller. A control difference that is smaller than this value will be ignored and the controller output will not change.
- **Extraction controller is 4 not active/active:** Shows if the extraction controller 4 is active or not. The background color indicated a grey color (Controller is off) or a green color (Controller is on). If the Extraction controller 4 is not active, but the release is there, the button can be used to activate the extraction controller 4. By Re-pressing the button, the extraction controller 4 will be deactivated.

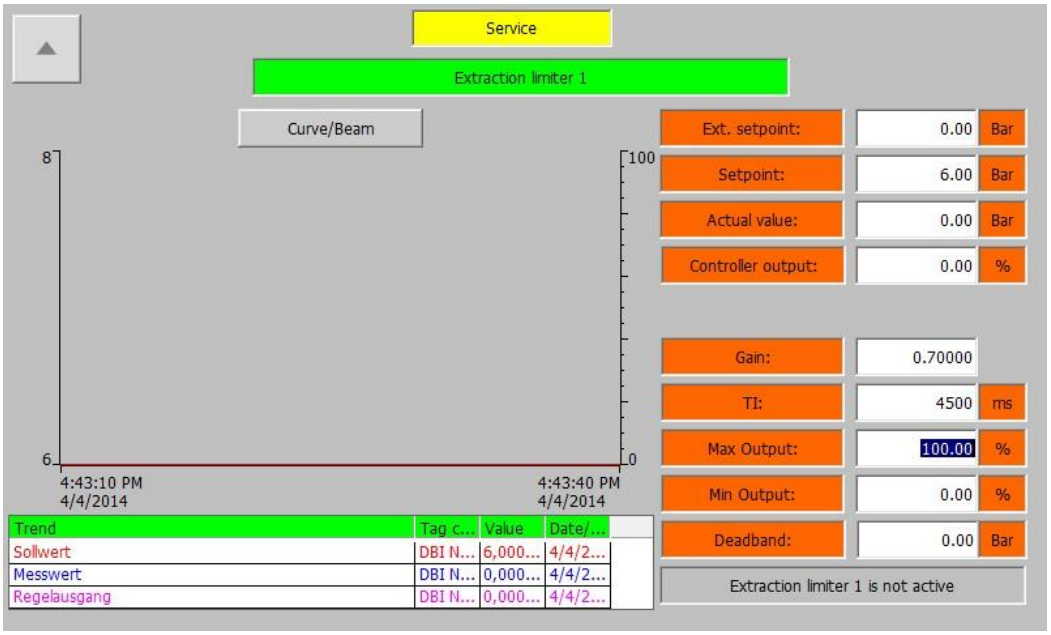


Service – (4) LP Regulation – Extraction controller 4 set point calculation

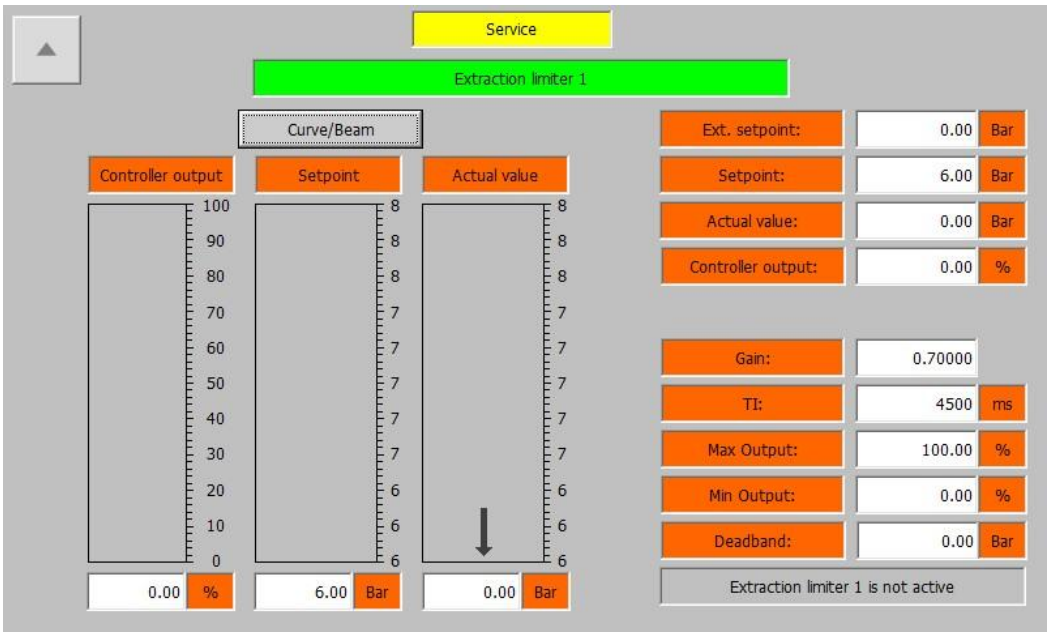


Service – (4) LP Regulation – Extraction controller 4

4.4.5 Extraction limiter 1



Service – (4) LP Regulation – Extraction limiter 1 „Curve“

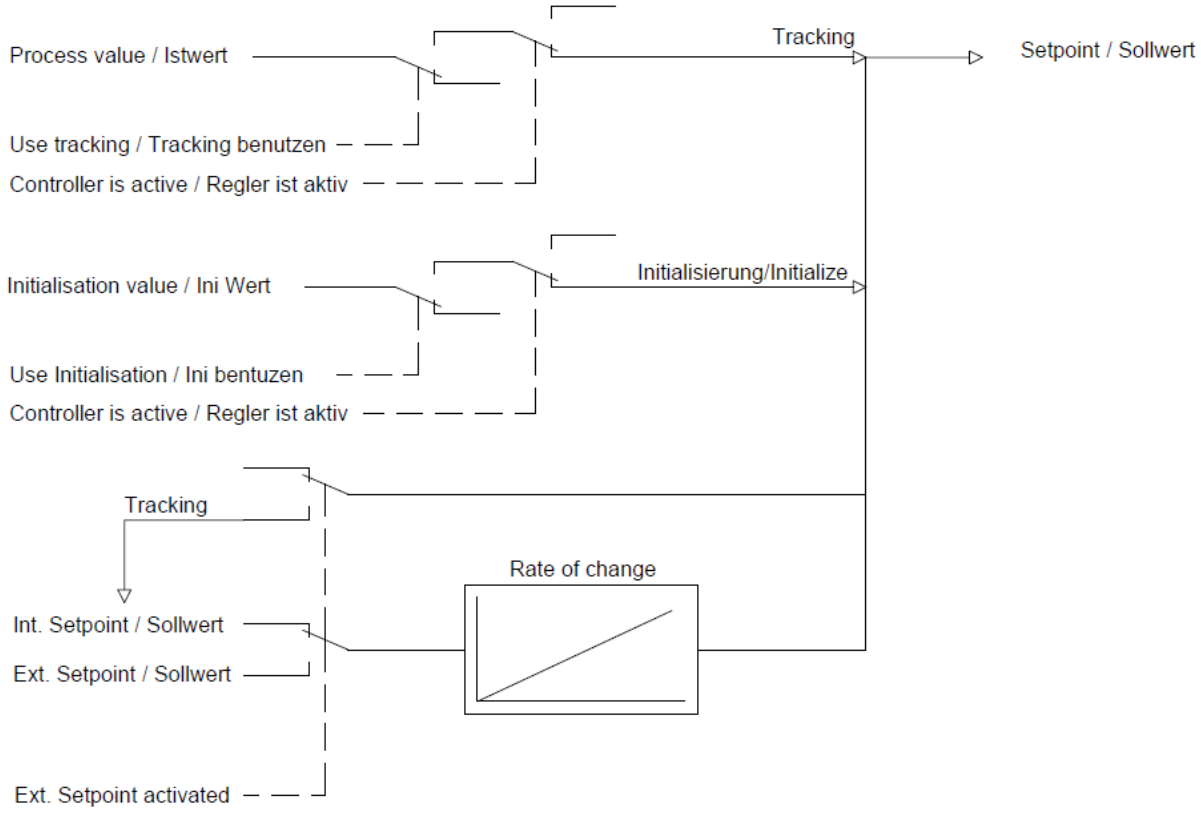


Service – (4) LP Regulation – Extraction limiter 1 „Beam“

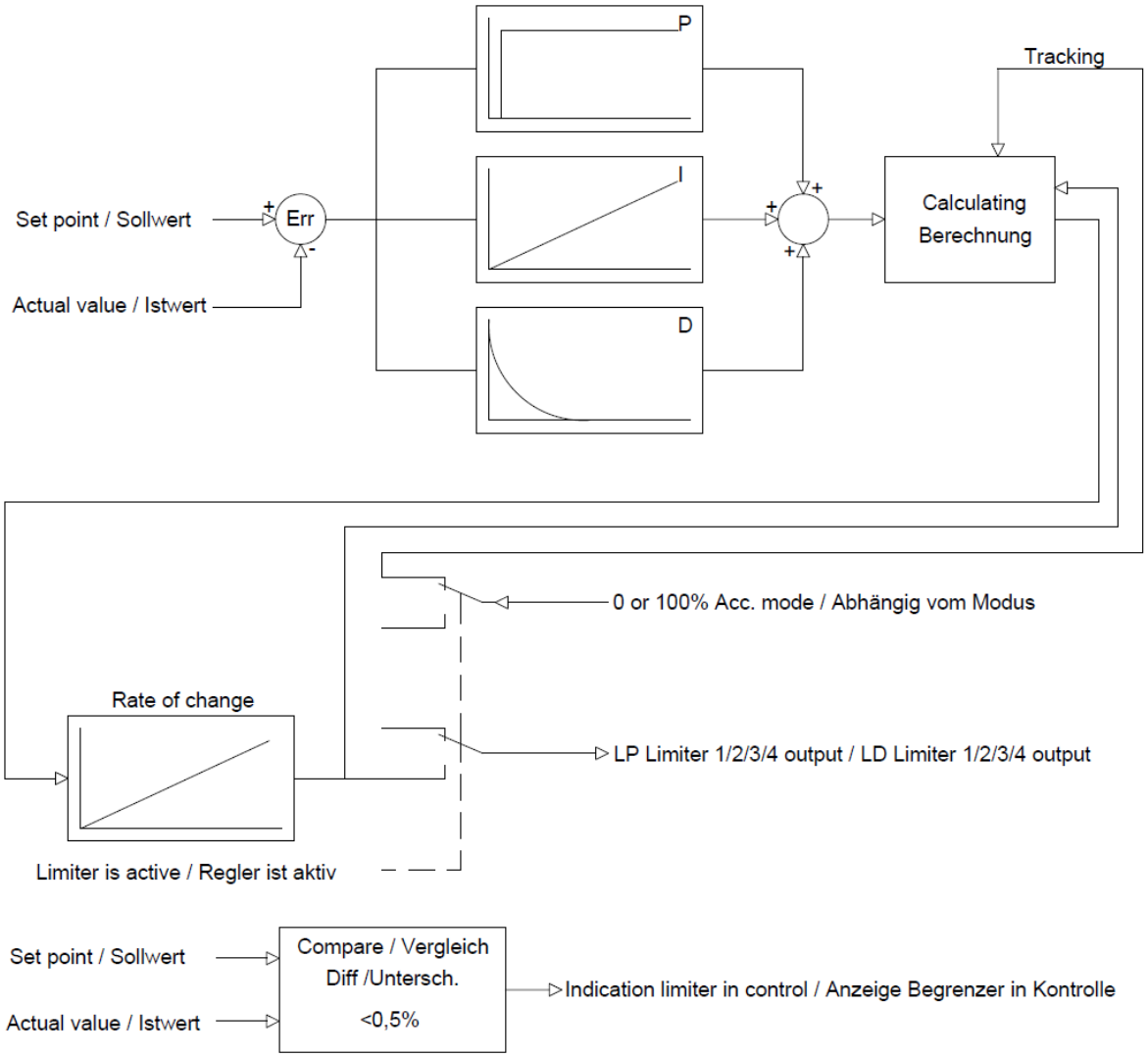
The Extraction limiter 1 level includes the measured values and parameters for the extraction limiter 1.2 views are available. The button “Curve/Beam” can be used to switch between the “Curve” and “Beam” view.

- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.
- **Actual value:** Shows the actual measured control value.

- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Gain:** Sets the Gain Part of the PI-Controller.
- **TI:** Sets the TI Part of the PI-Controller.
- **Max Output:** Sets the maximum output of the PI-Controller.
- **Min Output:** Sets the minimum output of the PI-Controller.
- **Dead band:** Sets the Dead band for the PI-Controller. A control difference that is smaller than this value will be ignored and the controller output will not change.
- **Extraction limiter 1 is not active/active:** Indicates if the Extraction limiter 1 is active or not. Additionally it is showing if the Extraction limiter 1 is in control, which means that it manipulates the output of the extraction controller 1. This will be indicated by the background color, which changes between gray (Not in control) and green (In control).

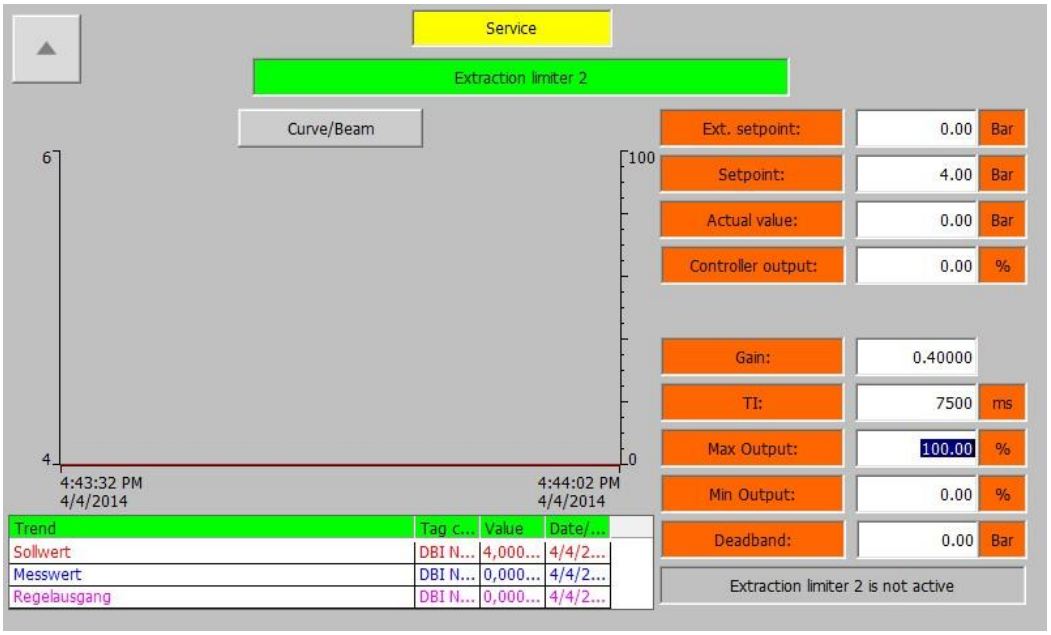


Service – (4) LP Regulation – Extraction limiter 1 set point calculation

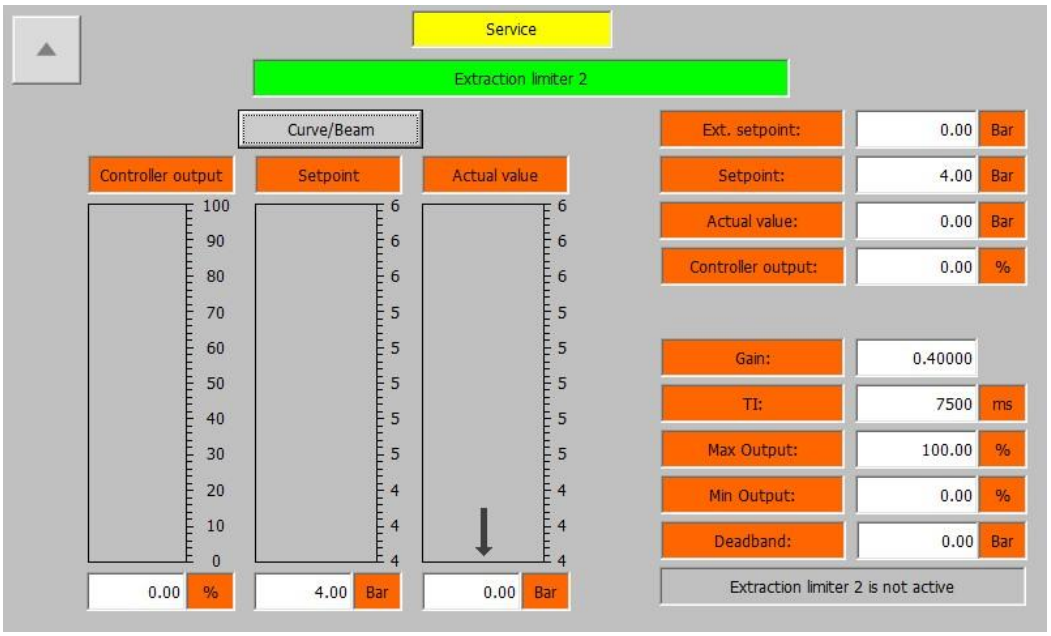


Service – (4) LP Regulation – Extraction limiter 1

4.4.6 Extraction limiter 2



Service – (4) LP Regulation – Extraction limiter 2 „Curve“

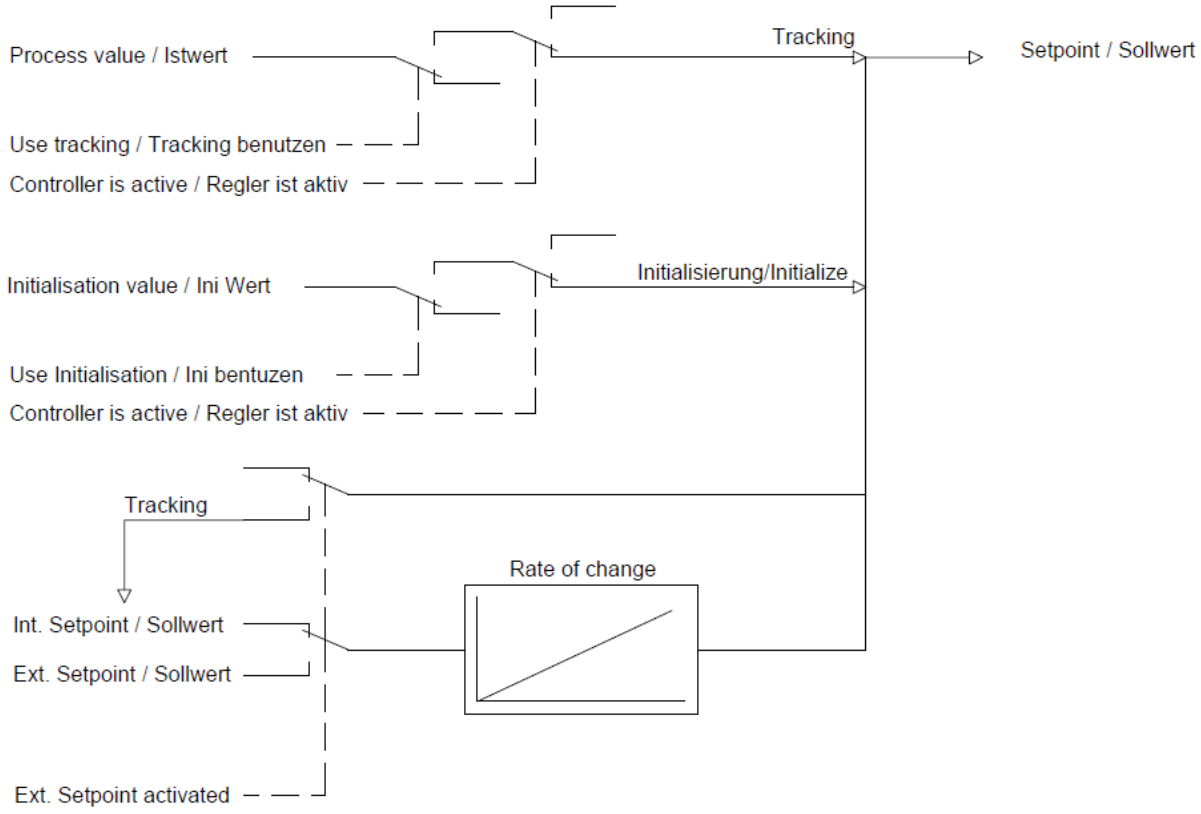


Service – (4) LP Regulation – Extraction limiter 2 „Beam“

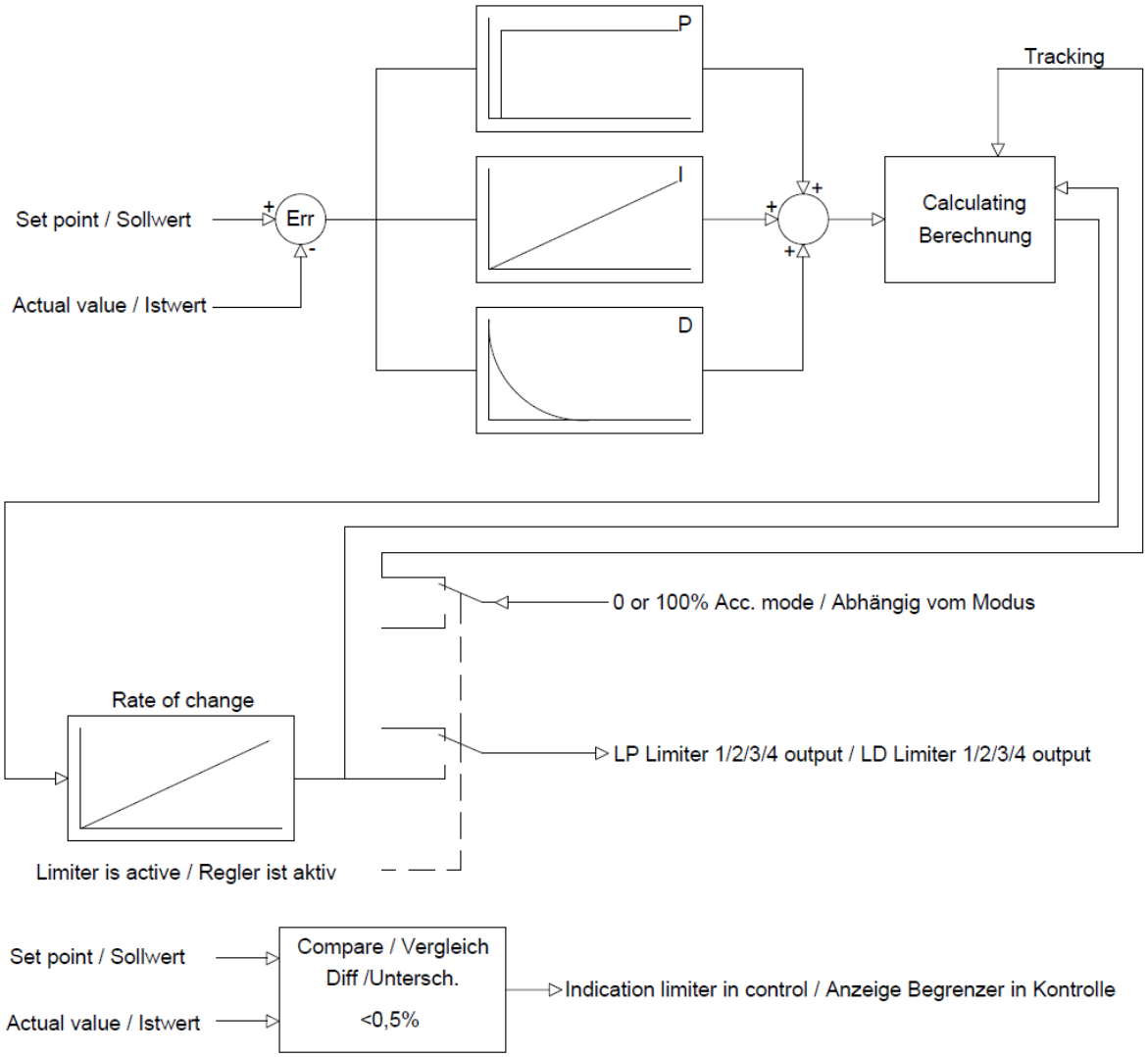
The Extraction limiter 2 level includes the measured values and parameters for the extraction limiter 2.2 views are available. The button “Curve/Beam” can be used to switch between the “Curve” and “Beam” view.

- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.
- **Actual value:** Shows the actual measured control value.

- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Gain:** Sets the Gain Part of the PI-Controller.
- **TI:** Sets the TI Part of the PI-Controller.
- **Max Output:** Sets the maximum output of the PI-Controller.
- **Min Output:** Sets the minimum output of the PI-Controller.
- **Dead band:** Sets the Dead band for the PI-Controller. A control difference that is smaller than this value will be ignored and the controller output will not change.
- **Extraction limiter 2 is not active/active:** Indicates if the Extraction limiter 2 is active or not. Additionally it is showing if the Extraction limiter 2 is in control, which means that it manipulates the output of the extraction controller 2. This will be indicated by the background color, which changes between gray (Not in control) and green (In control).

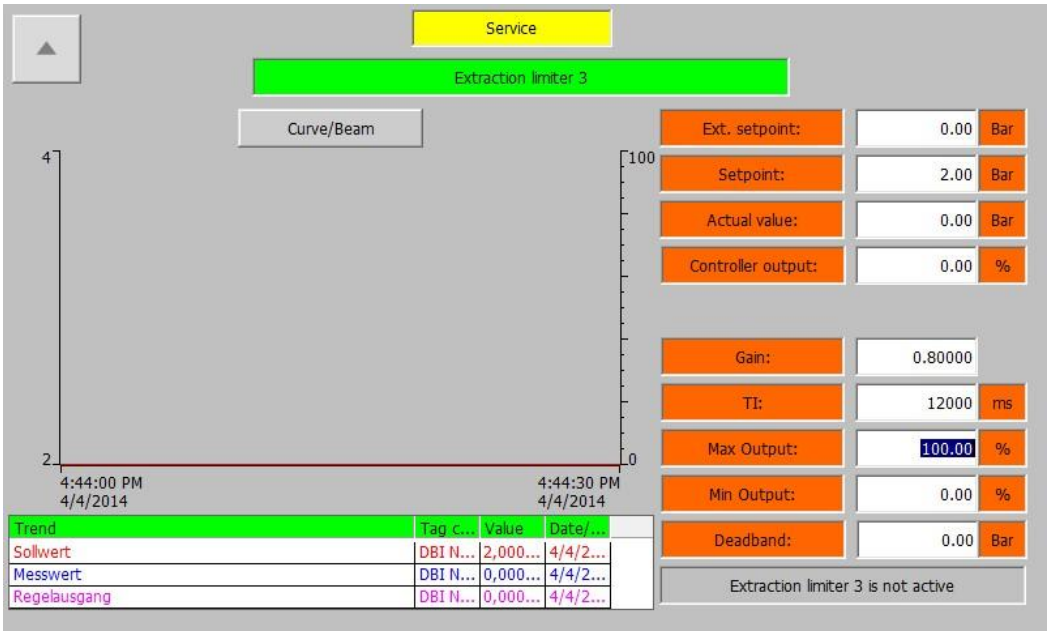


Service – (4) LP Regulation – Extraction limiter 2 set point calculation

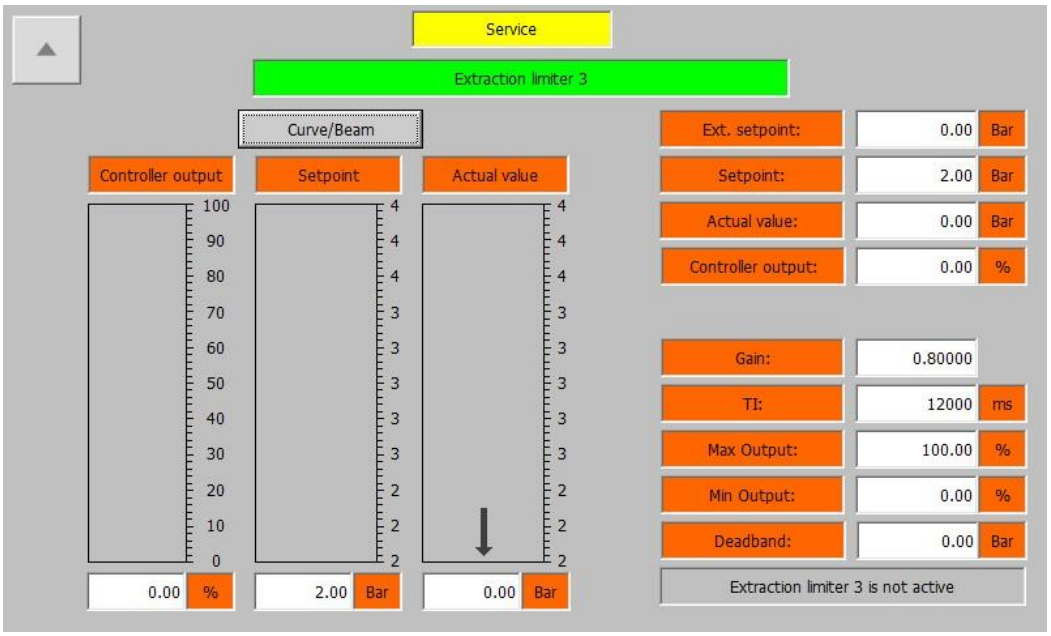


Service – (4) LP Regulation – Extraction limiter 2

4.4.7 Extraction limiter 3



Service – (4) LP Regulation – Extraction limiter 3 „Curve“

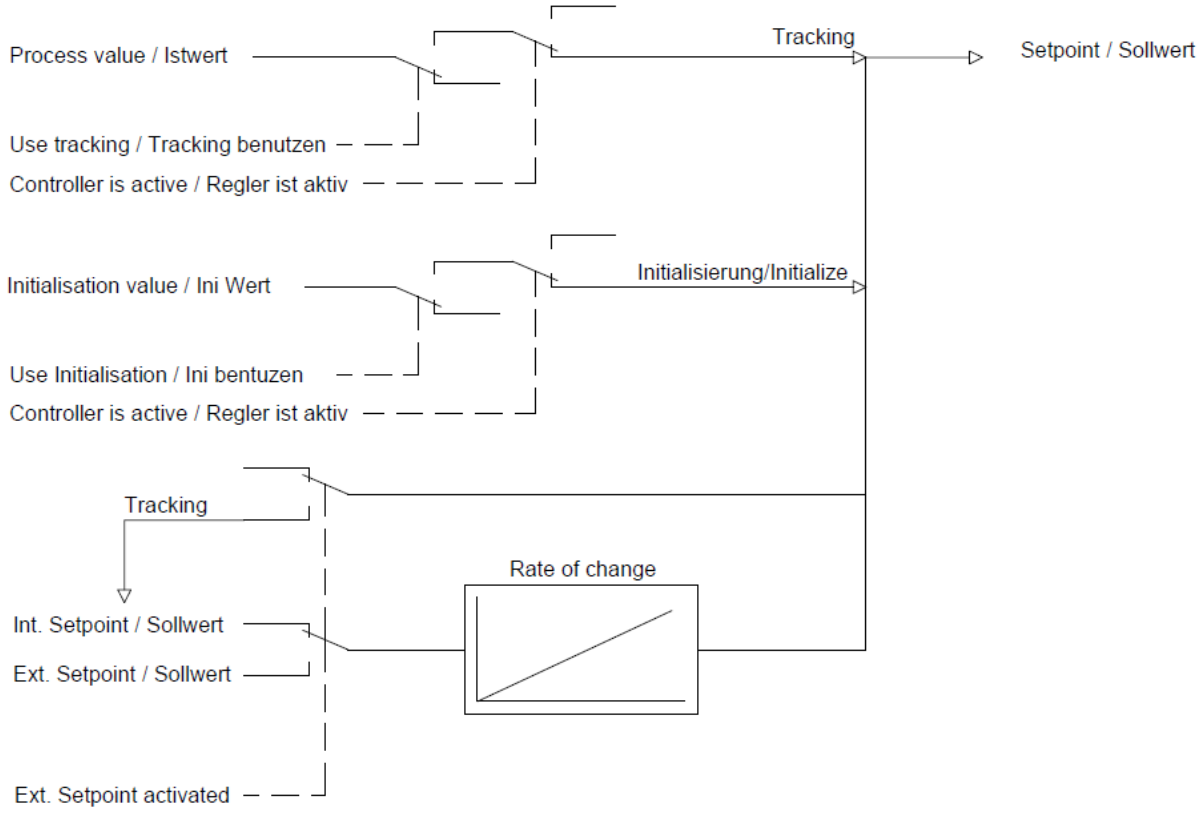


Service – (4) LP Regulation – Extraction limiter 3 „Beam“

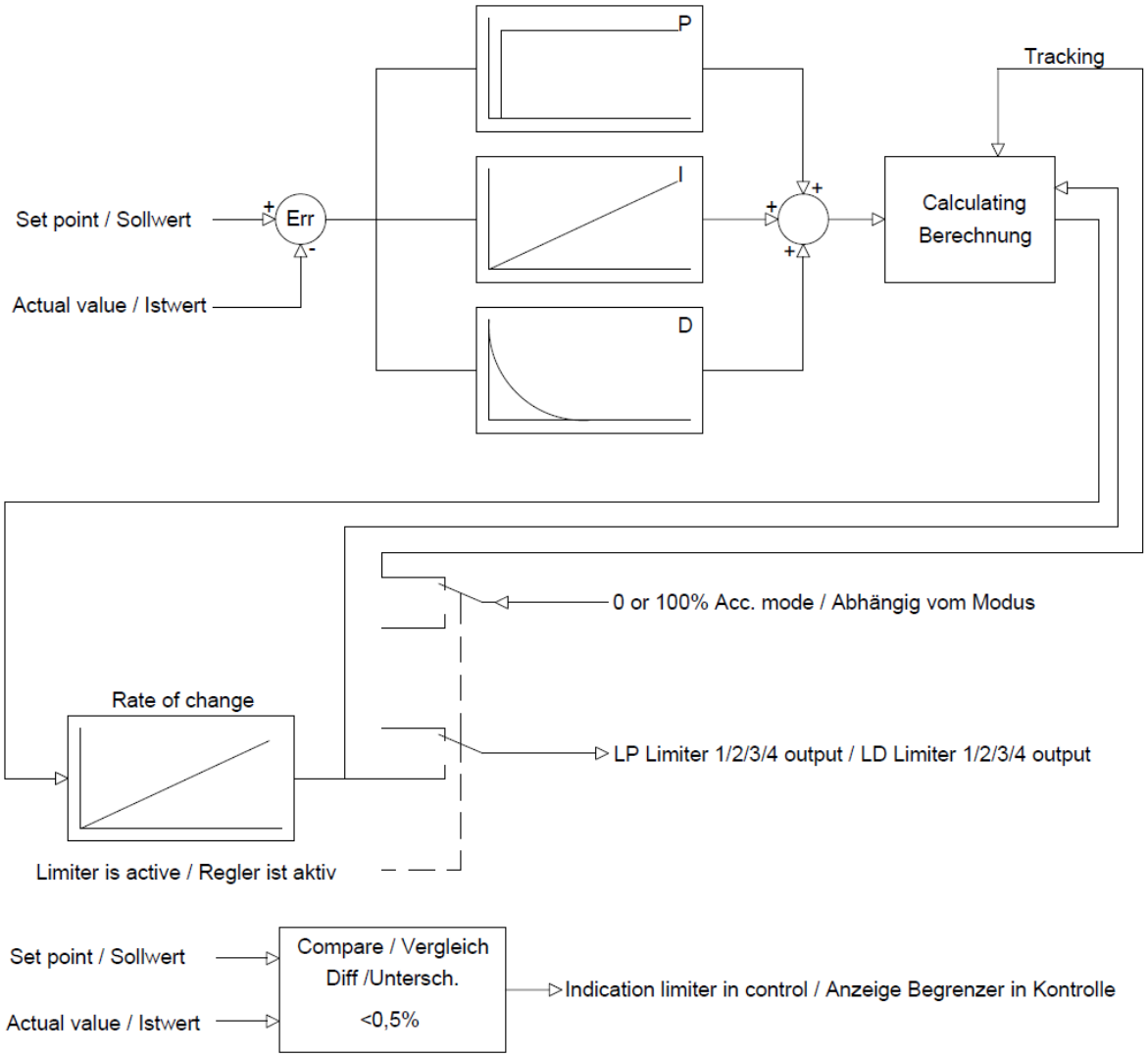
The Extraction limiter 3 level includes the measured values and parameters for the extraction limiter 3.2 views are available. The button “Curve/Beam” can be used to switch between the “Curve” and “Beam” view.

- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.
- **Actual value:** Shows the actual measured control value.

- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Gain:** Sets the Gain Part of the PI-Controller.
- **TI:** Sets the TI Part of the PI-Controller.
- **Max Output:** Sets the maximum output of the PI-Controller.
- **Min Output:** Sets the minimum output of the PI-Controller.
- **Dead band:** Sets the Dead band for the PI-Controller. A control difference that is smaller than this value will be ignored and the controller output will not change.
- **Extraction limiter 3 is not active/active:** Indicates if the Extraction limiter 3 is active or not. Additionally it is showing if the Extraction limiter 3 is in control, which means that it manipulates the output of the extraction controller 3. This will be indicated by the background color, which changes between gray (Not in control) and green (In control).

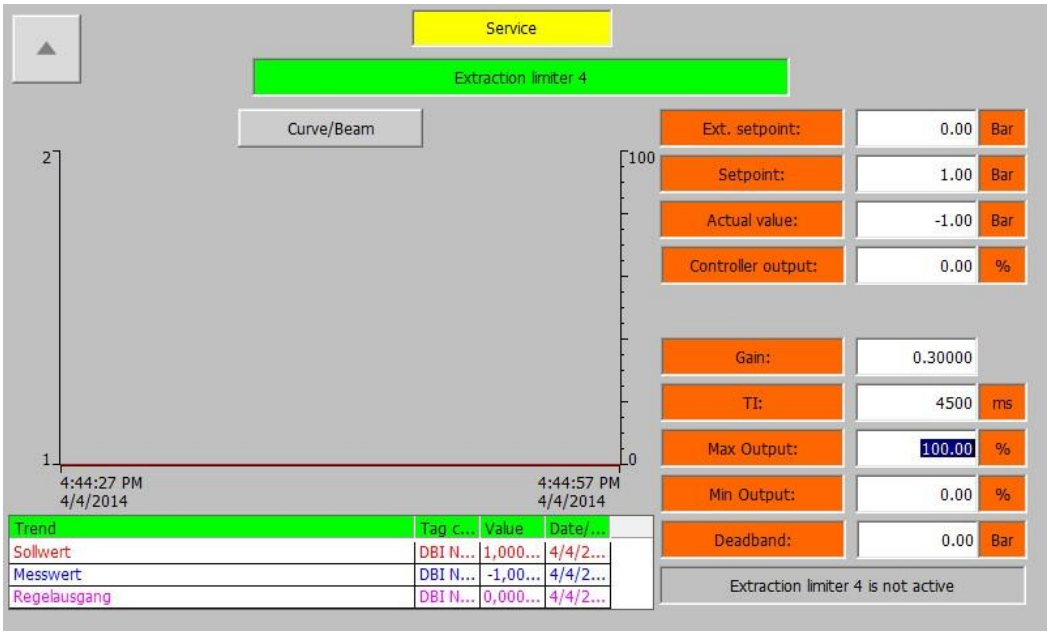


Service – (4) LP Regulation – Extraction limiter 3 set point calculation

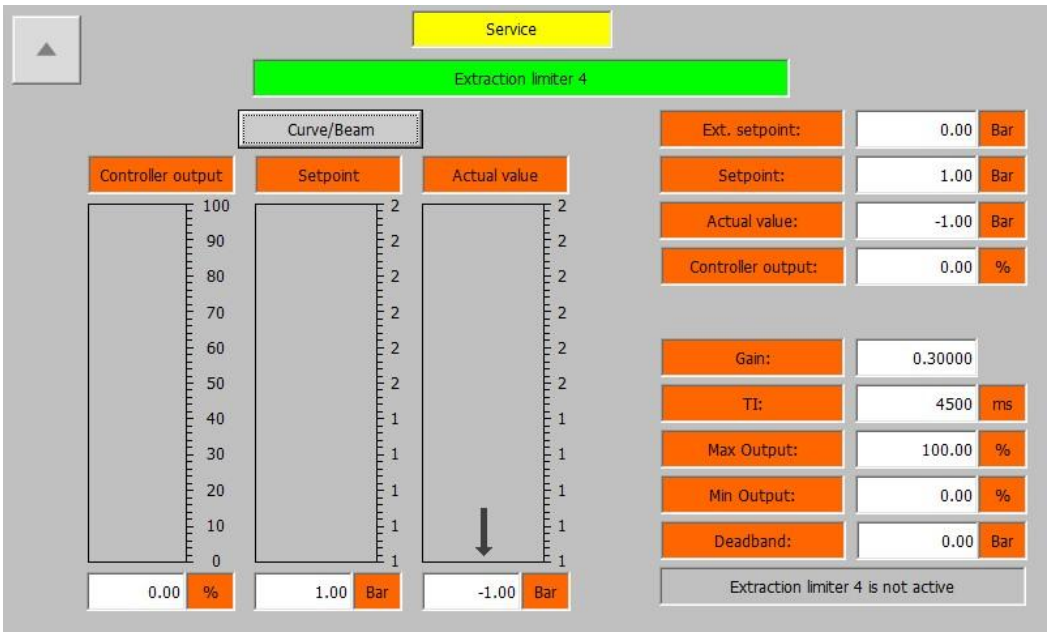


Service – (4) LP Regulation – Extraction limiter 3

4.4.8 Extraction limiter 4



Service – (4) LP Regulation – Extraction limiter 4 „Curve“

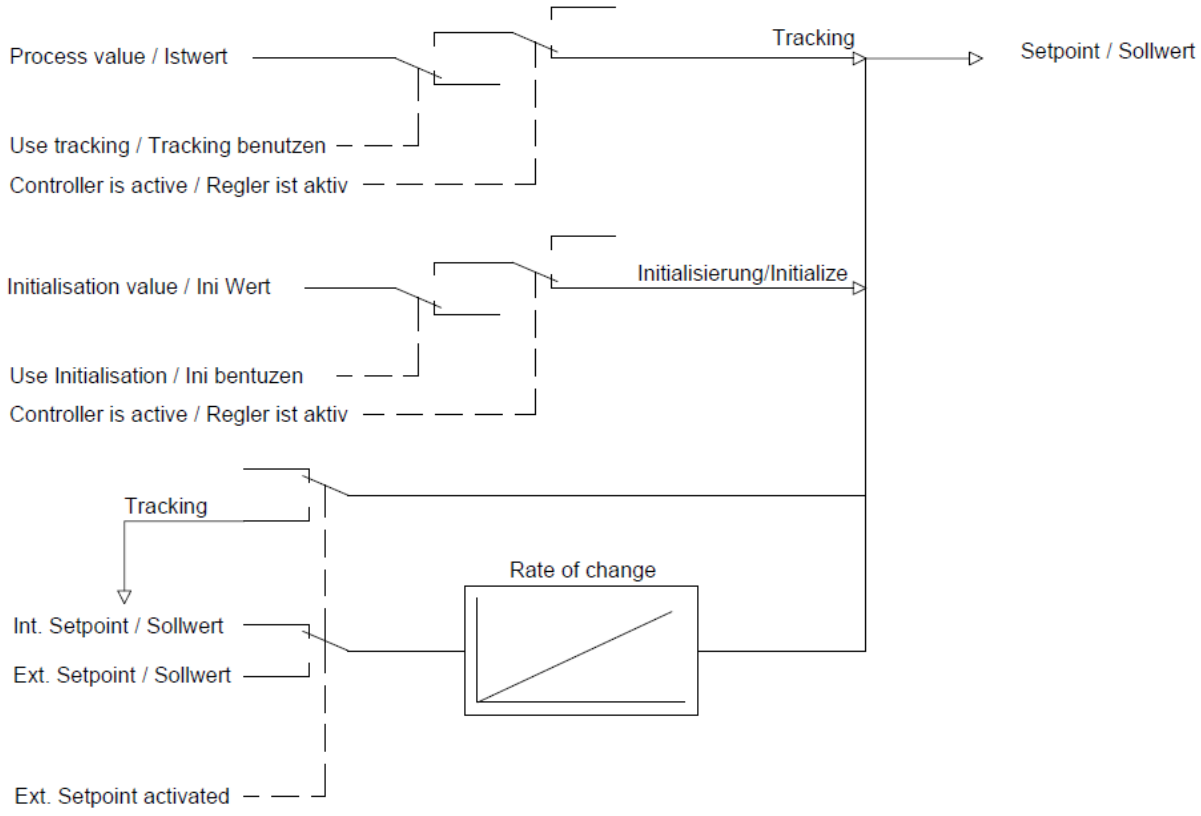


Service – (4) LP Regulation – Extraction limiter 4 „Beam“

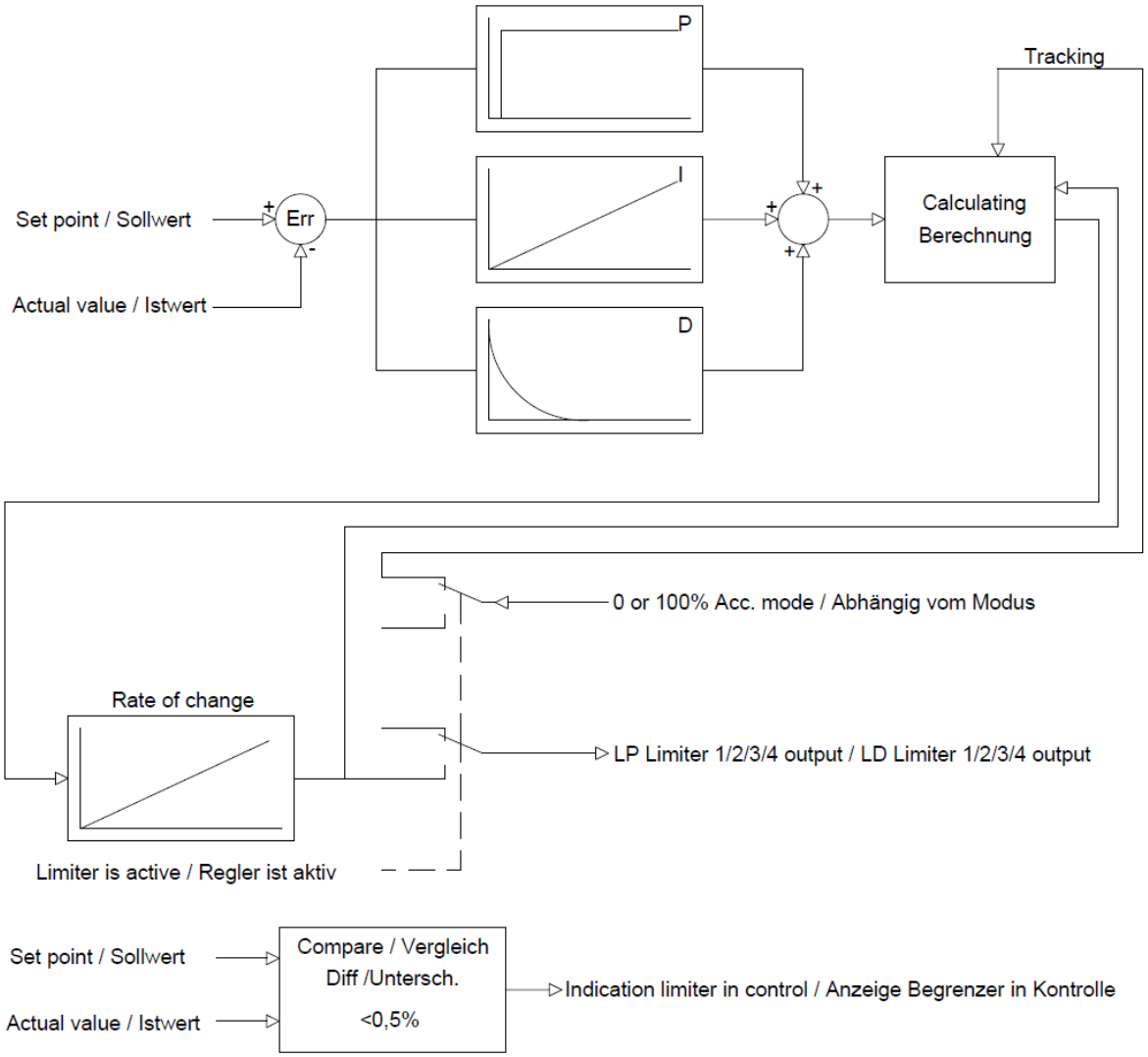
The Extraction limiter 4 level includes the measured values and parameters for the extraction limiter 4.2 views are available. The button “Curve/Beam” can be used to switch between the “Curve” and “Beam” view.

- **Ext. Set point:** Shows the actual external Set point. The background color is indicating that the Set point is active while it is green.
- **Actual Set point:** Shows the actual internal Set point.
- **Actual value:** Shows the actual measured control value.

- **Controller output:** Shows the actual controller output of the PI-Controller.
- **Gain:** Sets the Gain Part of the PI-Controller.
- **TI:** Sets the TI Part of the PI-Controller.
- **Max Output:** Sets the maximum output of the PI-Controller.
- **Min Output:** Sets the minimum output of the PI-Controller.
- **Dead band:** Sets the Dead band for the PI-Controller. A control difference that is smaller than this value will be ignored and the controller output will not change.
- **Extraction limiter 4 is not active/active:** Indicates if the Extraction limiter 4 is active or not. Additionally it is showing if the Extraction limiter 4 is in control, which means that it manipulates the output of the extraction controller 4. This will be indicated by the background color, which changes between gray (Not in control) and green (In control).

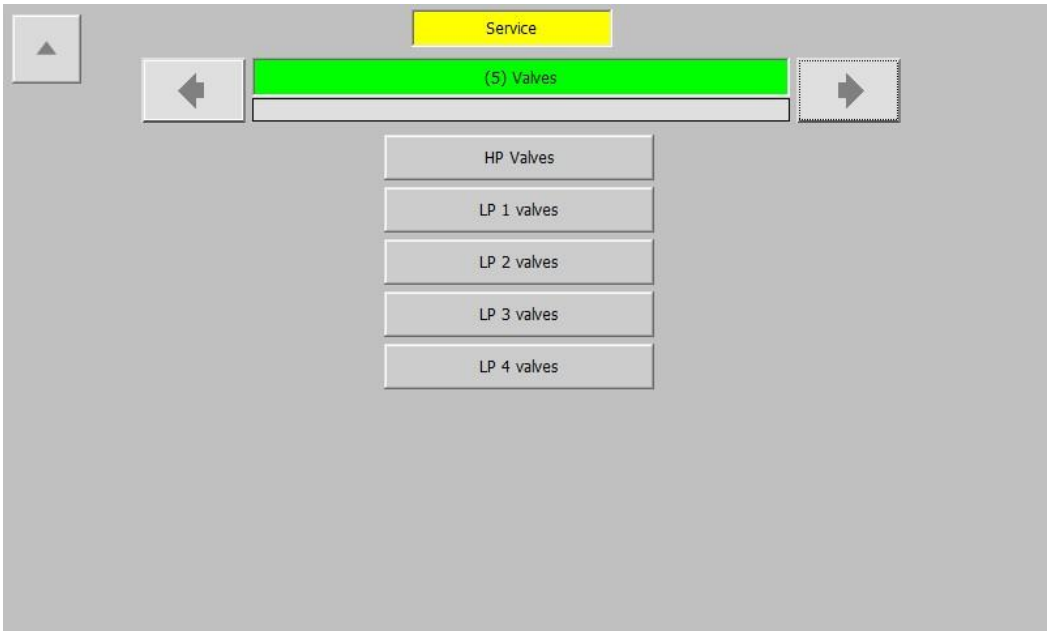


Service – (4) LP Regulation – Extraction limiter 4 set point calculation



Service – (4) LP Regulation – Extraction limiter 4

4.6 Valves

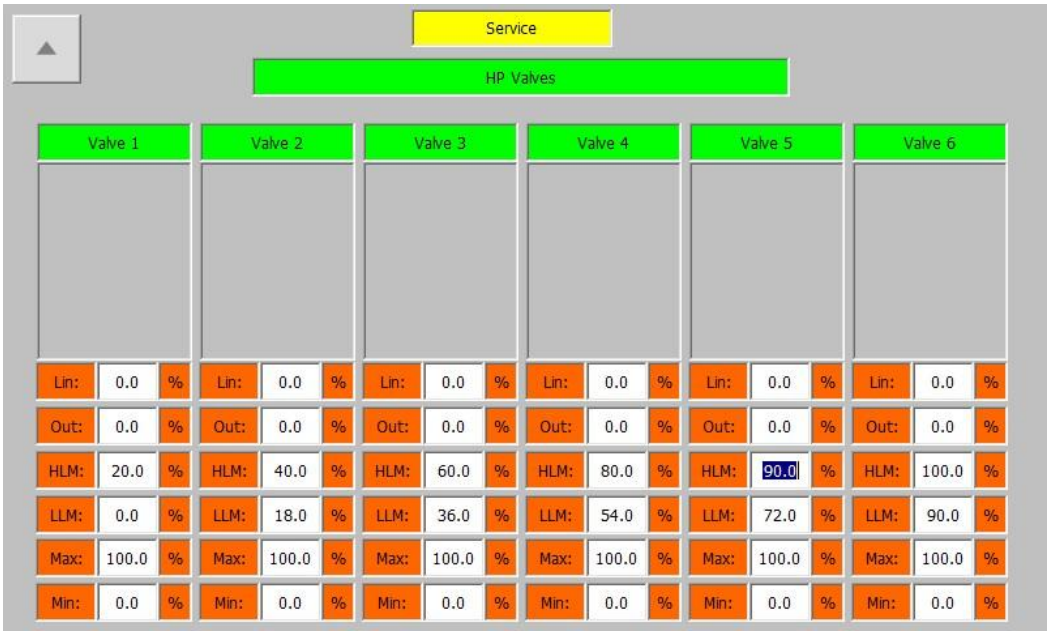


Service – (5) Valves

The Valve level includes the parameters for the limitation and the scaling of the valve outputs. The following levels are available:

- HP Valves
- LP 1 Valves
- LP 2 Valves
- LP 3 Valves
- LP 4 Valves
- LP 5 Valves

4.6.1 HP valves



Service – (5) Valves – HP valves

The HP valve level includes the parameters for the HP control valves. The limiting, scale and split parameters are set in this level. The HP level automatically adjusts the valve overview according to the number of valves.

The following parameters are available for the HP valves:

- **Lin:** Shows the actual output of the control valves after the linearization of the valve. This value is only available if „Use Linearization " is selected. If the value „Use Linearization " is not selected, the value „Out" will be directed forwarded to the valve output.
- **Out:** Shows the actual output of the valve calculation that is forwarded to the valve linearization . If the parameter „Use split" is not selected, the HP controller output will be directly forwarded to the „Out" value. If the parameter „Use split" is selected, the HP controller output will be scaled to the Min/Max limitation and the HLM and LLM split range.
- **HLM(0-100% but bigger than LLM):**The upper end of the split range which is according to the maximum valve output configured at „Max". This value is only available if „Use split" is selected.
- **LLM(0-100% but smaller than HLM):**The lower end of the split range which is according to the minimum valve output configured at „Min". This value is only available if „Use split" is selected.
- **Max(0-100% but bigger than Min):**The maximum output of the control valve when it is in control. When the safety position is triggered, and the configured position is above this value, this value will be ignored.
- **Min(0-100% but smaller than Max):**The minimum output of the control valve when it is in control. When the safety position is triggered, and the configured position is below this value, this value will be ignored.

Valve split:

When the parameter „Use split“ is selected, the controller output will be calculated and splitter o several valves. Therefore every valve gets a begin (LLM) and an end (HLM) point. The valve movement is according to the Values Min and Max scaled to the controller output from LLM to HLM.

Example of a split setting

Controller output = 30%

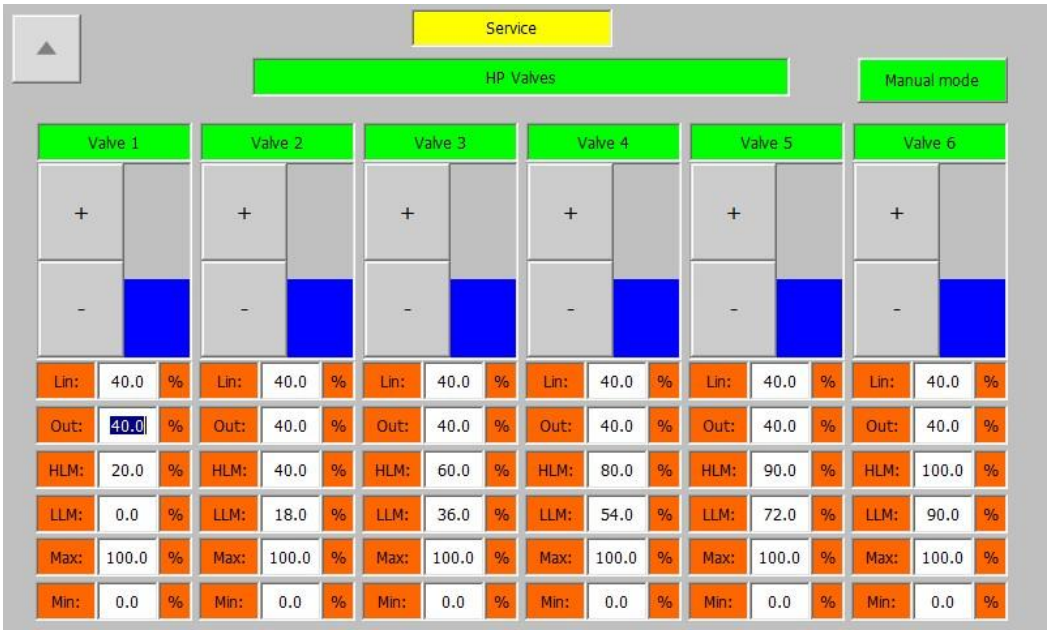
LLM Valve 1 = 0%	LLM Valve 2 = 20%
HLM Valve 2 = 40%	HLM Valve 2 = 60%
Valve output= 75%	Valve output =25%

Valve travelling limitation:

To optimize the regulation, the calculated split value will be scaled to the configured valve way. Example:

Example with complete travelling:	Example with limited travelling:
Controller output = 10%	Controller output= 10%
Travelling way = 0-100%	Travelling way = 0-90%
Valve output= 10%	Valve output = 9%

This insures that the valve opened 90% when the split calculated 100% valve travelling.

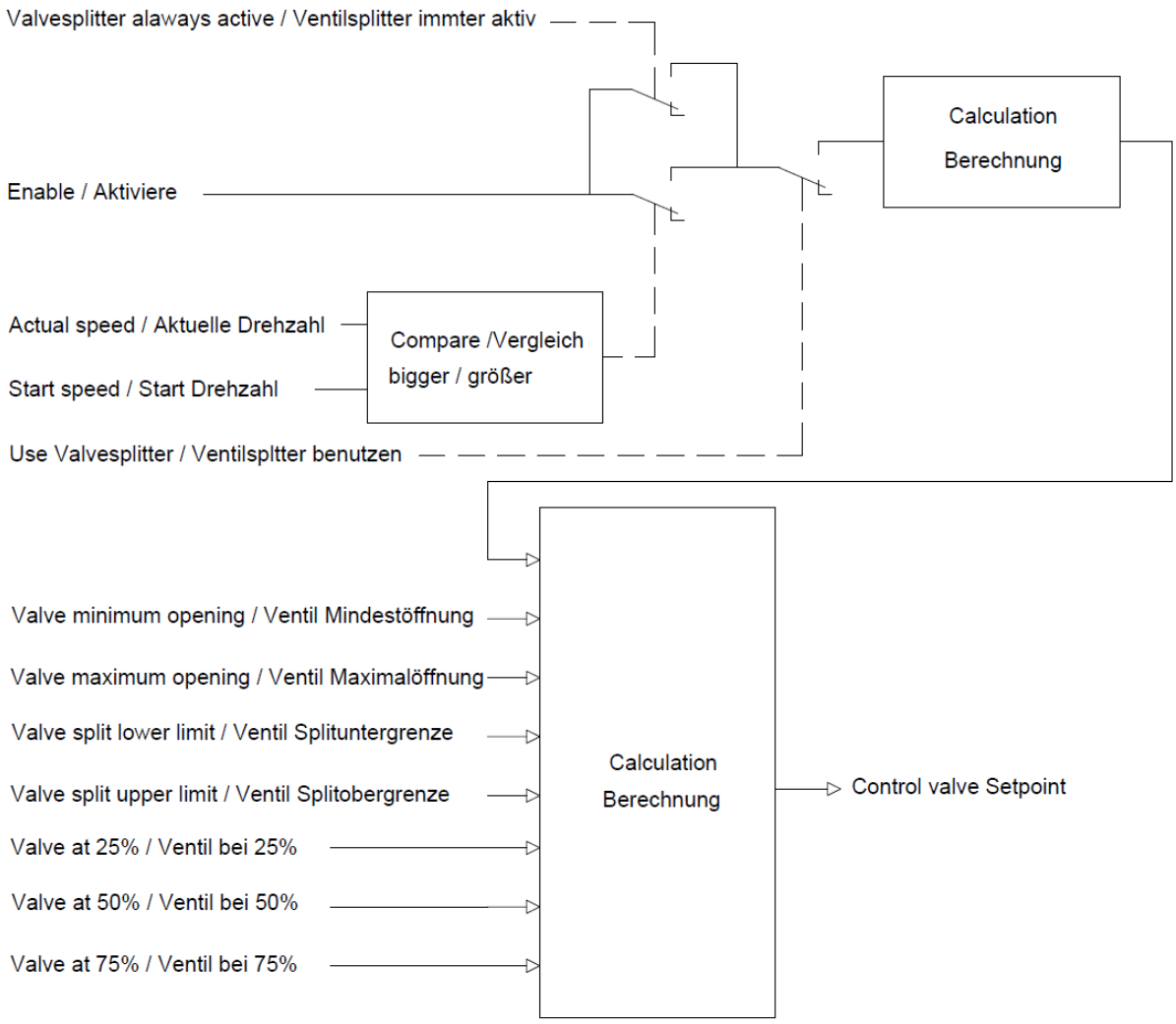


Service – (5) Valves – HP Valves manual mode

The HP Valve level includes a manual mode that allows testing the valves while the turbine has not been started. While the hand mode is active, the trip output of the ESTC will trip to avoid an higher-level system to start the turbine. After switching off the manual mode, a reset is needed to set the ESTC safety chain again. The criteria for the manual mode are:

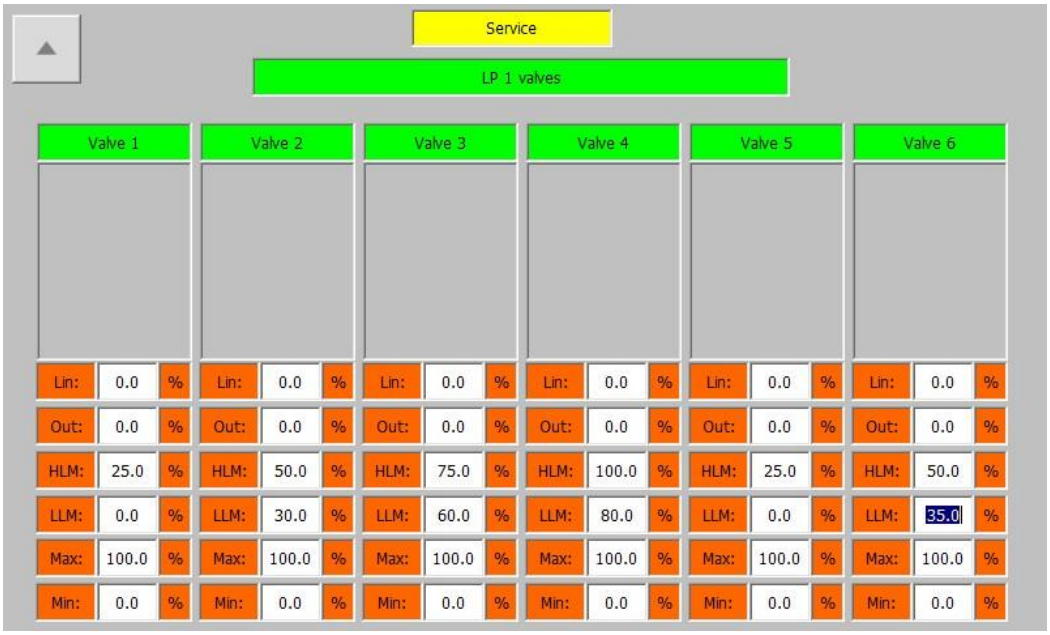
- Safety circuit ok
- Speed at turbine site 1 < parameter „blockage speed“ (see Part 3.2.4)
- Speed at turbine site 2 < parameter „blockage speed“ (see Part 3.2.6)
- Control has not been started

When all criteria for the manual mode are ok, the button „Manual mode“ will appear. By pressing this button, the manual mode will be activated and change the color to green to indicate that the manual mode is not active. When one of the criteria disappears while the manual mode is active, the manual mode will automatically be deactivated. When the manual mode is activated, the buttons „+“ and „-„ will appear and can be used to open and close the valve. Beyond this function, it is also possible to set a valve output directly at the value „Out“ while the manual mode is activated. The valve output is also in manual mode limited by the values „Max“ and „Min“.



Service – (5) Valves – HP Valves calculation

4.6.2 LP 1 valves



Service – (5) Valves – LP 1 valves

The HP valve level includes the parameters for the LP 1 control valves. The limiting, scale and split parameters are set in this level. The LP 1 level automatically adjusts the valve overview according to the number of valves.

The following parameters are available for the LP 1 valves:

- **Lin:** Shows the actual output of the control valves after the linearization of the valve. This value is only available if „Use Linearization " is selected. If the value „Use Linearization " is not selected, the value „Out" will be directed forwarded to the valve output.
- **Out:** Shows the actual output of the valve calculation that is forwarded to the valve linearization . If the parameter „Use split" is not selected, the LP 1 controller output will be directly forwarded to the „Out" value. If the parameter „Use split" is selected, the LP 1 controller output will be scaled to the Min/Max limitation and the HLM and LLM split range.
- **HLM(0-100% but bigger than LLM):** The upper end of the split range which is according to the maximum valve output configured at „Max". This value is only available if „Use split" is selected.
- **LLM(0-100% but smaller than HLM):** The lower end of the split range which is according to the minimum valve output configured at „Min". This value is only available if „Use split" is selected.
- **Max(0-100% but bigger than Min):** The maximum output of the control valve when it is in control. When the safety position is triggered, and the configured position is above this value, this value will be ignored.
- **Min(0-100% but smaller than Max):** The minimum output of the control valve when it is in control. When the safety position is triggered, and the configured position is below this value, this value will be ignored.

Valve split:

When the parameter „Use split“ is selected, the controller output will be calculated and split to several valves. Therefore every valve gets a begin (LLM) and an end (HLM) point. The valve movement is according to the Values Min and Max scaled to the controller output from LLM to HLM.

Example of a split setting

Controller output = 30%

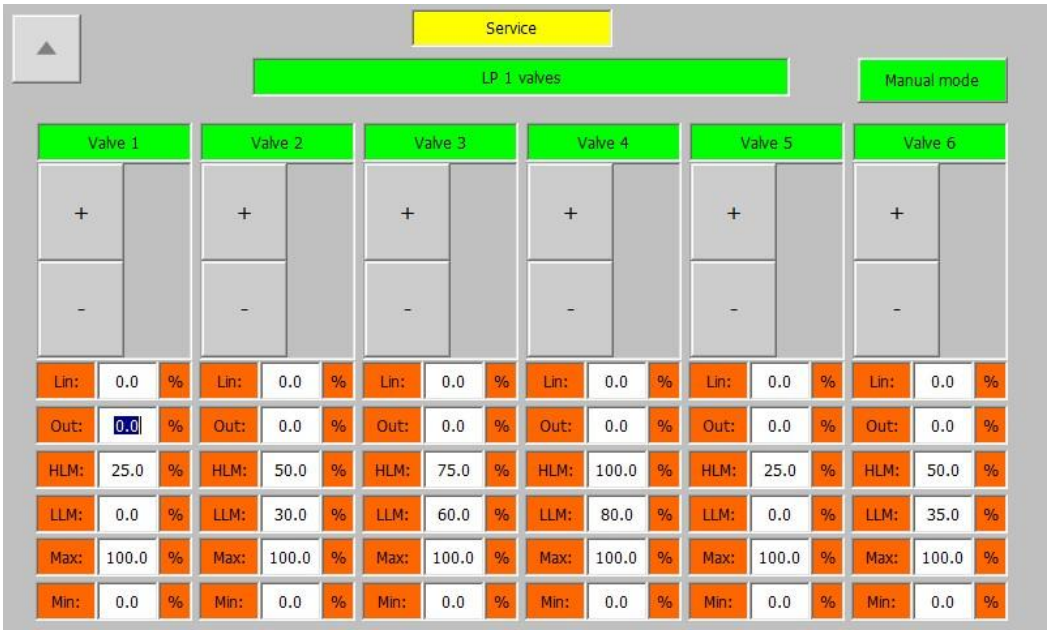
LLM Valve 1 = 0%	LLM Valve 2 = 20%
HLM Valve 2 = 40%	HLM Valve 2 = 60%
Valve output= 75%	Valve output =25%

Valve travelling limitation:

To optimize the regulation, the calculated split value will be scaled to the configured valve way.
Example:

Example with complete travelling:	Example with limited travelling:
Controller output = 10%	Controller output= 10%
Travelling way = 0-100%	Travelling way = 0-90%
Valve output= 10%	Valve output = 9%

This insures that the valve opened 90% when the split calculated 100% valve travelling.

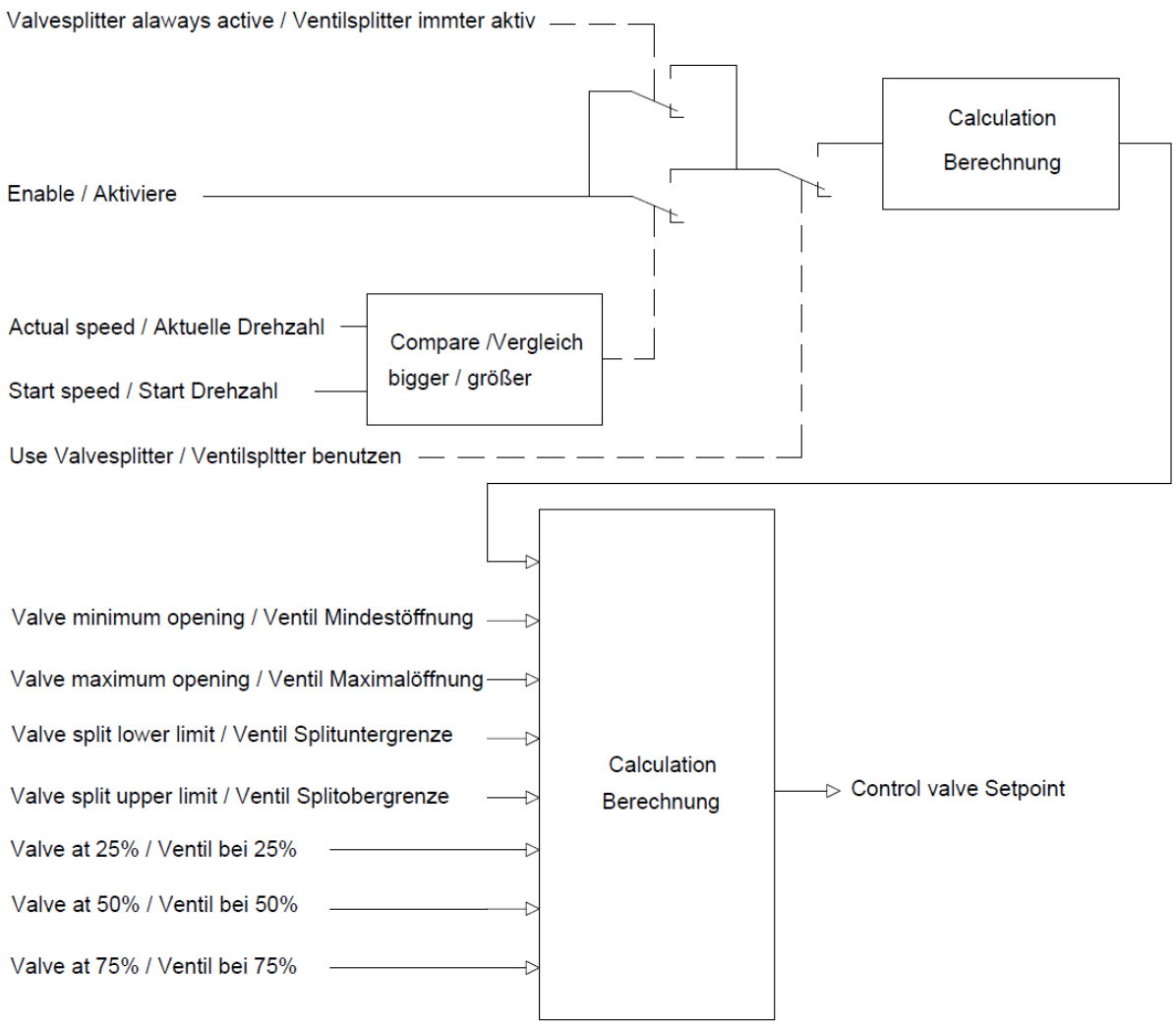


Service – (5) Valves – LP 1 valves manual mode

The LP 1 Valve level includes a manual mode that allows testing the valves while the turbine has not been started. While the hand mode is active, the trip output of the ESTC will trip to avoid an higher-level system to start the turbine. After switching off the manual mode, a reset is needed to set the ESTC safety chain again. The criteria for the manual mode are:

- Safety circuit ok
- Speed at turbine site 1 < parameter „blockage speed“ (see Part 3.2.4)
- Speed at turbine site 2 < parameter „blockage speed“ (see Part 3.2.6)
- Control has not been started

When all criteria for the manual mode are ok, the button „Manual mode“ will appear. By pressing this button, the manual mode will be activated and change the color to green to indicate that the manual mode is not active. When one of the criteria disappears while the manual mode is active, the manual mode will automatically be deactivated. When the manual mode is activated, the buttons „+“ and „-„ will appear and can be used to open and close the valve. Beyond this function, it is also possible to set a valve output directly at the value „Out“ while the manual mode is activated. The valve output is also in manual mode limited by the values „Max“ and „Min“.



Service – (5) Valves – LP 1 Valves calculation

4.6.3 LP 2 valves

Service – (5) Valves – LP 2 valves

The LP 2 valve level includes the parameters for the LP 2 control valves. The limiting, scale and split parameters are set in this level. The LP 2 level automatically adjusts the valve overview according to the number of valves.

The following parameters are available for the LP 2 valves:

- **Lin:** Shows the actual output of the control valves after the linearization of the valve. This value is only available if „Use Linearization " is selected. If the value „Use Linearization " is not selected, the value „Out" will be directly forwarded to the valve output.
- **Out:** Shows the actual output of the valve calculation that is forwarded to the valve linearization . If the parameter „Use split" is not selected, the LP 2 controller output will be directly forwarded to the „Out" value. If the parameter „Use split" is selected, the LP 2 controller output will be scaled to the Min/Max limitation and the HLM and LLM split range.
- **HLM(0-100% but bigger than LLM):** The upper end of the split range which is according to the maximum valve output configured at „Max". This value is only available if „Use split" is selected.
- **LLM(0-100% but smaller than HLM):** The lower end of the split range which is according to the minimum valve output configured at „Min". This value is only available if „Use split" is selected.
- **Max(0-100% but bigger than Min):** The maximum output of the control valve when it is in control. When the safety position is triggered, and the configured position is above this value, this value will be ignored.
- **Min(0-100% but smaller than Max):** The minimum output of the control valve when it is in control. When the safety position is triggered, and the configured position is below this value, this value will be ignored.

Valve split:

When the parameter „Use split“ is selected, the controller output will be calculated and split to several valves. Therefore every valve gets a begin (LLM) and an end (HLM) point. The valve movement is according to the Values Min and Max scaled to the controller output from LLM to HLM.

Example of a split setting

Controller output = 30%

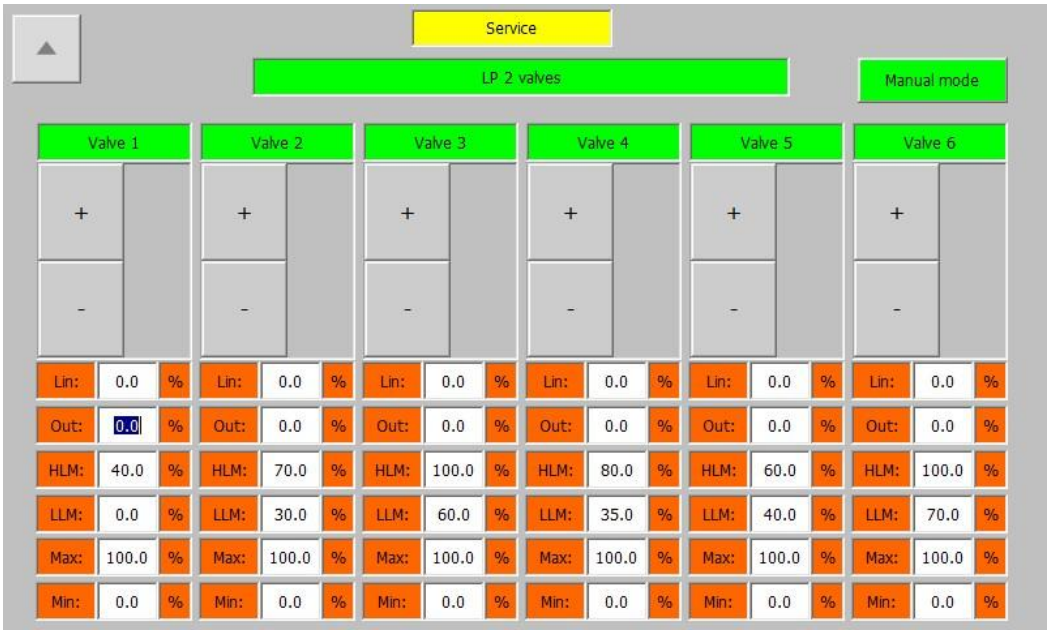
LLM Valve 1 = 0%	LLM Valve 2 = 20%
HLM Valve 2 = 40%	HLM Valve 2 = 60%
Valve output= 75%	Valve output =25%

Valve travelling limitation:

To optimize the regulation, the calculated split value will be scaled to the configured valve way.
Example:

Example with complete travelling:	Example with limited travelling:
Controller output = 10%	Controller output= 10%
Travelling way = 0-100%	Travelling way = 0-90%
Valve output= 10%	Valve output = 9%

This insures that the valve opened 90% when the split calculated 100% valve travelling.

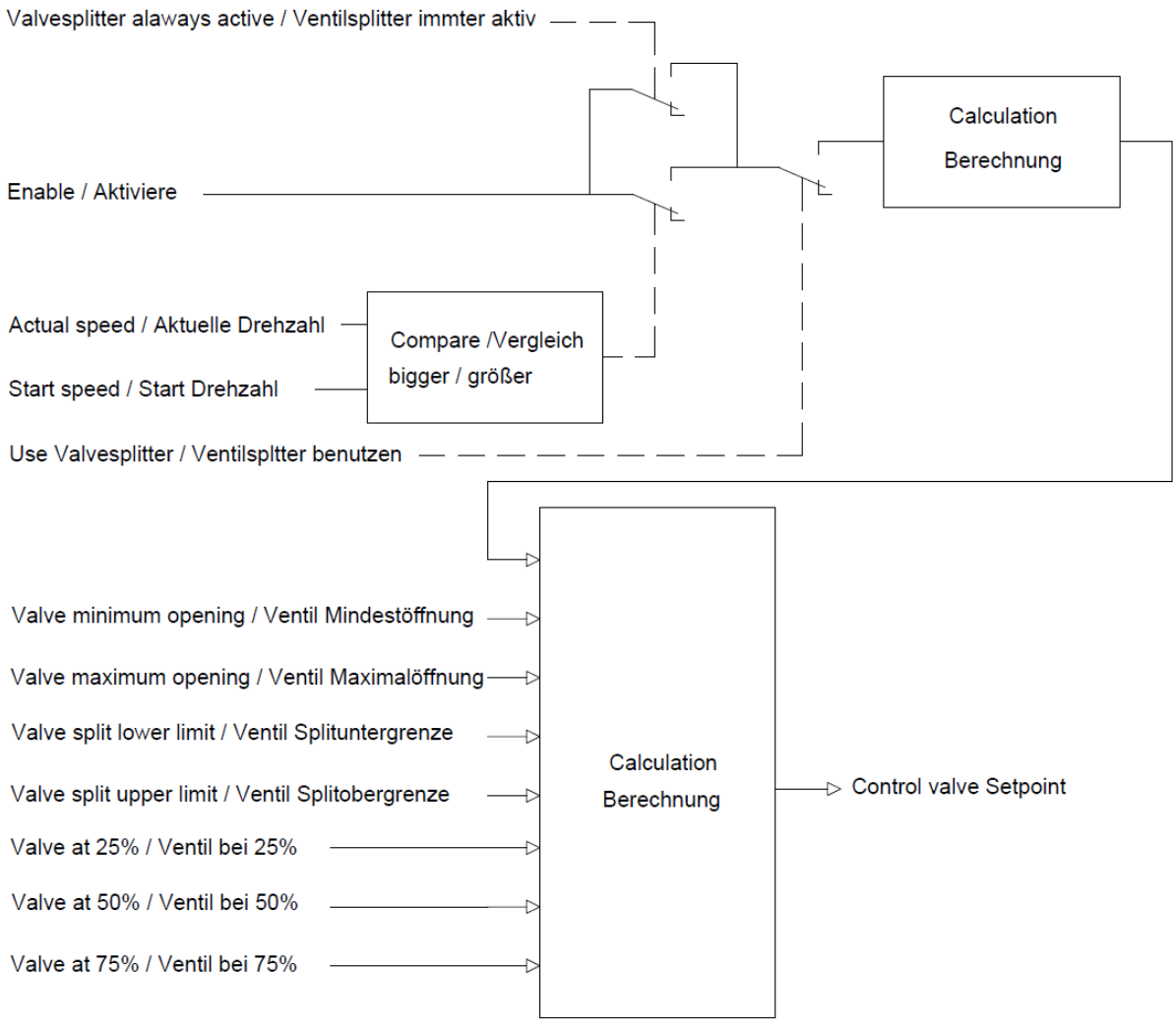


Service – (5) Valves – LP 2 valves manual mode

The LP 2 Valve level includes a manual mode that allows testing the valves while the turbine has not been started. While the hand mode is active, the trip output of the ESTC will trip to avoid an higher-level system to start the turbine. After switching off the manual mode, a reset is needed to set the ESTC safety chain again. The criteria for the manual mode are:

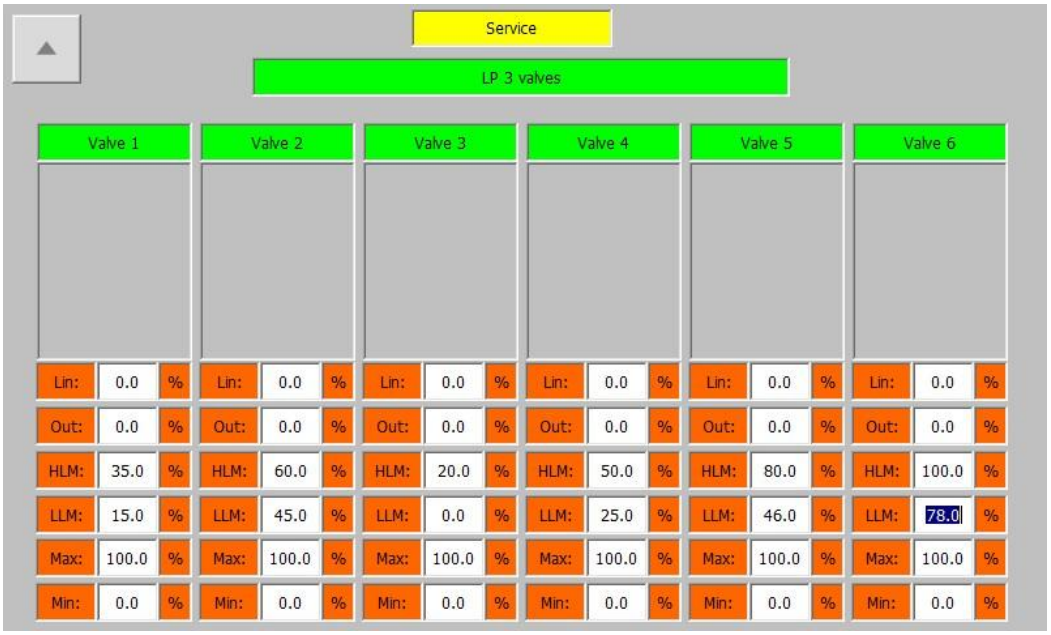
- Safety circuit ok
- Speed at turbine site 1 < parameter „blockage speed“ (see Part 3.2.4)
- Speed at turbine site 2 < parameter „blockage speed“ (see Part 3.2.6)
- Control has not been started

When all criteria for the manual mode are ok, the button „Manual mode“ will appear. By pressing this button, the manual mode will be activated and change the color to green to indicate that the manual mode is not active. When one of the criteria disappears while the manual mode is active, the manual mode will automatically be deactivated. When the manual mode is activated, the buttons „+“ and „-„ will appear and can be used to open and close the valve. Beyond this function, it is also possible to set a valve output directly at the value „Out“ while the manual mode is activated. The valve output is also in manual mode limited by the values „Max“ and „Min“.



Service – (5) Valves – LP 2 Valves calculation

4.6.4 LP 3 valves



Service – (5) Valves – LP 3 valves

The LP 3 valve level includes the parameters for the LP 3 control valves. The limiting, scale and split parameters are set in this level. The LP 3 level automatically adjusts the valve overview according to the number of valves.

The following parameters are available for the LP 3 valves:

- **Lin:** Shows the actual output of the control valves after the linearization of the valve. This value is only available if „Use Linearization “ is selected. If the value „Use Linearization “ is not selected, the value „Out“ will be directly forwarded to the valve output.
- **Out:** Shows the actual output of the valve calculation that is forwarded to the valve linearization . If the parameter „Use split“ is not selected, the LP 3 controller output will be directly forwarded to the „Out“ value. If the parameter „Use split“ is selected, the LP 3 controller output will be scaled to the Min/Max limitation and the HLM and LLM split range.
- **HLM(0-100% but bigger than LLM):** The upper end of the split range which is according to the maximum valve output configured at „Max“. This value is only available if „Use split“ is selected.
- **LLM(0-100% but smaller than HLM):** The lower end of the split range which is according to the minimum valve output configured at „Min“. This value is only available if „Use split“ is selected.
- **Max(0-100% but bigger than Min):** The maximum output of the control valve when it is in control. When the safety position is triggered, and the configured position is above this value, this value will be ignored.
- **Min(0-100% but smaller than Max):** The minimum output of the control valve when it is in control. When the safety position is triggered, and the configured position is below this value, this value will be ignored.

Valve split:

When the parameter „Use split“ is selected, the controller output will be calculated and split to several valves. Therefore every valve gets a begin (LLM) and an end (HLM) point. The valve movement is according to the Values Min and Max scaled to the controller output from LLM to HLM.

Example of a split setting

Controller output = 30%

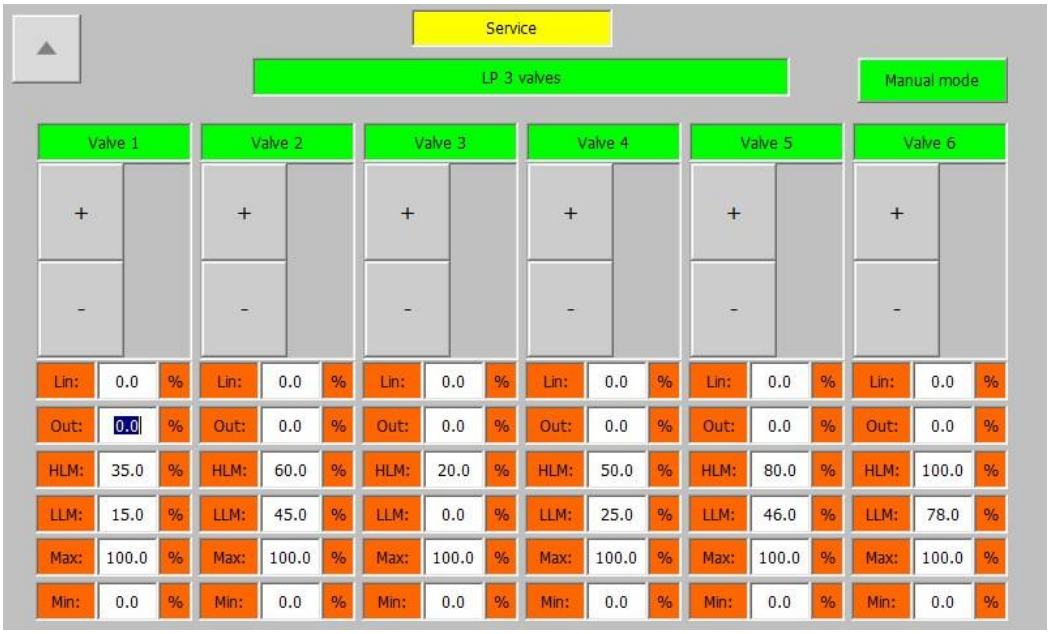
LLM Valve 1 = 0%	LLM Valve 2 = 20%
HLM Valve 2 = 40%	HLM Valve 2 = 60%
Valve output= 75%	Valve output =25%

Valve travelling limitation:

To optimize the regulation, the calculated split value will be scaled to the configured valve way.
Example:

Example with complete travelling:	Example with limited travelling:
Controller output = 10%	Controller output= 10%
Travelling way = 0-100%	Travelling way = 0-90%
Valve output= 10%	Valve output = 9%

This insures that the valve opened 90% when the split calculated 100% valve travelling.

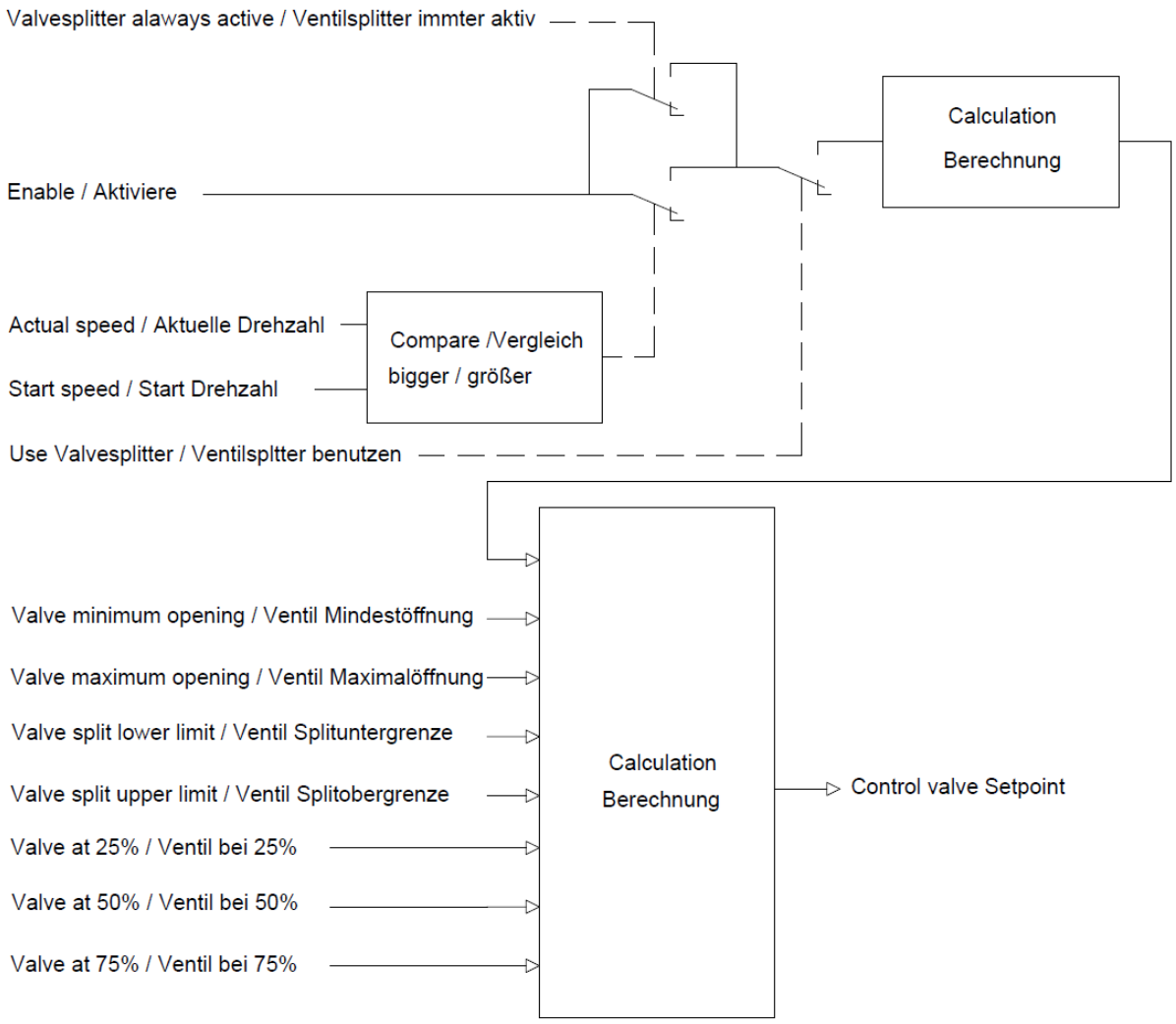


Service – (5) Valves – LP 3 valves manual mode

The LP 3 Valve level includes a manual mode that allows testing the valves while the turbine has not been started. While the hand mode is active, the trip output of the ESTC will trip to avoid an higher-level system to start the turbine. After switching off the manual mode, a reset is needed to set the ESTC safety chain again. The criteria for the manual mode are:

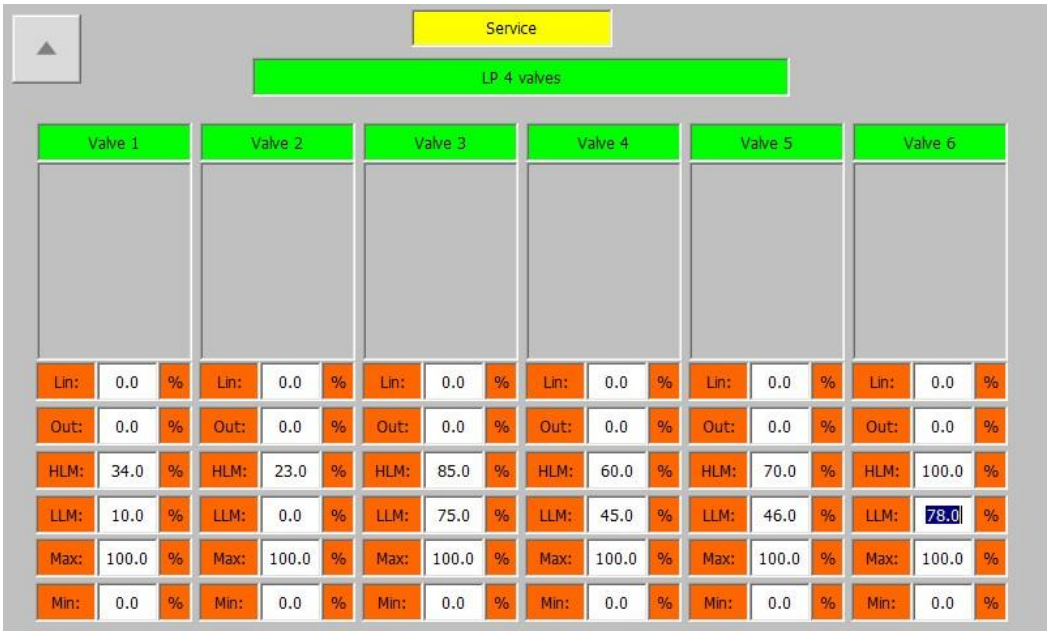
- Safety circuit ok
- Speed at turbine site 1 < parameter „blockage speed“ (see Part 3.2.4)
- Speed at turbine site 2 < parameter „blockage speed“ (see Part 3.2.6)
- Control has not been started

When all criteria for the manual mode are ok, the button „Manual mode“ will appear. By pressing this button, the manual mode will be activated and change the color to green to indicate that the manual mode is not active. When one of the criteria disappears while the manual mode is active, the manual mode will automatically be deactivated. When the manual mode is activated, the buttons „+“ and „-„ will appear and can be used to open and close the valve. Beyond this function, it is also possible to set a valve output directly at the value „Out“ while the manual mode is activated. The valve output is also in manual mode limited by the values „Max“ and „Min“.



Service – (5) Valves – LP 3 Valves calculation

4.6.5 LP 4 valves



Service – (5) Valves – LP 4 valves

The LP 4 valve level includes the parameters for the LP 4 control valves. The limiting, scale and split parameters are set in this level. The LP 4 level automatically adjusts the valve overview according to the number of valves.

The following parameters are available for the LP 4 valves:

- **Lin:** Shows the actual output of the control valves after the linearization of the valve. This value is only available if „Use Linearization " is selected. If the value „Use Linearization " is not selected, the value „Out" will be directly forwarded to the valve output.
- **Out:** Shows the actual output of the valve calculation that is forwarded to the valve linearization . If the parameter „Use split" is not selected, the LP 1 controller output will be directly forwarded to the „Out" value. If the parameter „Use split" is selected, the LP 4 controller output will be scaled to the Min/Max limitation and the HLM and LLM split range.
- **HLM(0-100% but bigger than LLM):** The upper end of the split range which is according to the maximum valve output configured at „Max". This value is only available if „Use split" is selected.
- **LLM(0-100% but smaller than HLM):** The lower end of the split range which is according to the minimum valve output configured at „Min". This value is only available if „Use split" is selected.
- **Max(0-100% but bigger than Min):** The maximum output of the control valve when it is in control. When the safety position is triggered, and the configured position is above this value, this value will be ignored.
- **Min(0-100% but smaller than Max):** The minimum output of the control valve when it is in control. When the safety position is triggered, and the configured position is below this value, this value will be ignored.

Valve split:

When the parameter „Use split“ is selected, the controller output will be calculated and split to several valves. Therefore every valve gets a begin (LLM) and an end (HLM) point. The valve movement is according to the Values Min and Max scaled to the controller output from LLM to HLM.

Example of a split setting

Controller output = 30%

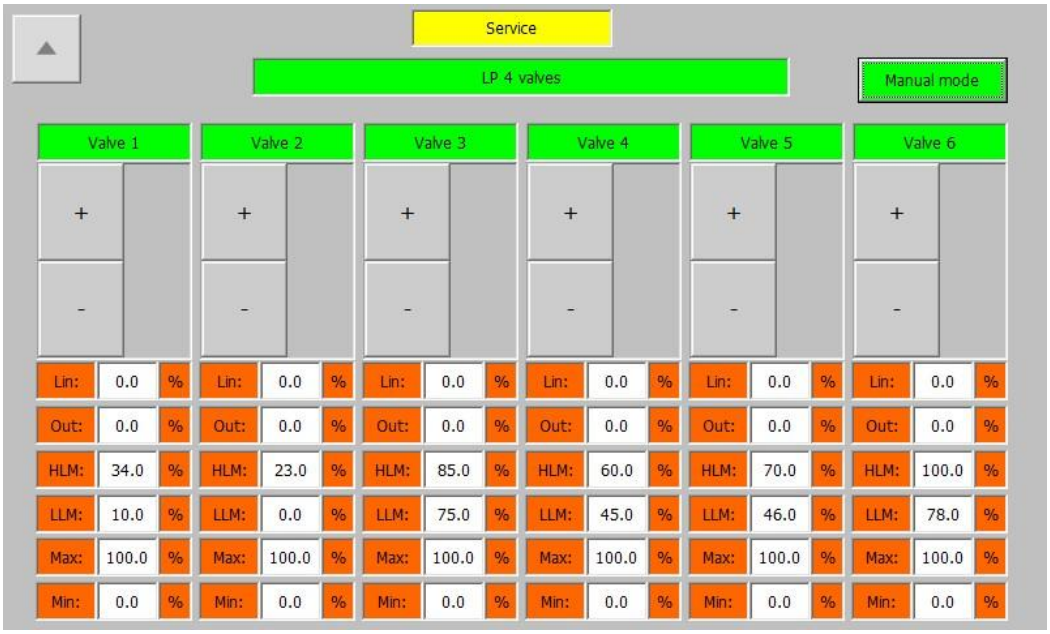
LLM Valve 1 = 0%	LLM Valve 2 = 20%
HLM Valve 2 = 40%	HLM Valve 2 = 60%
Valve output= 75%	Valve output =25%

Valve travelling limitation:

To optimize the regulation, the calculated split value will be scaled to the configured valve way.
Example:

Example with complete travelling:	Example with limited travelling:
Controller output = 10%	Controller output= 10%
Travelling way = 0-100%	Travelling way = 0-90%
Valve output= 10%	Valve output = 9%

This insures that the valve opened 90% when the split calculated 100% valve travelling.

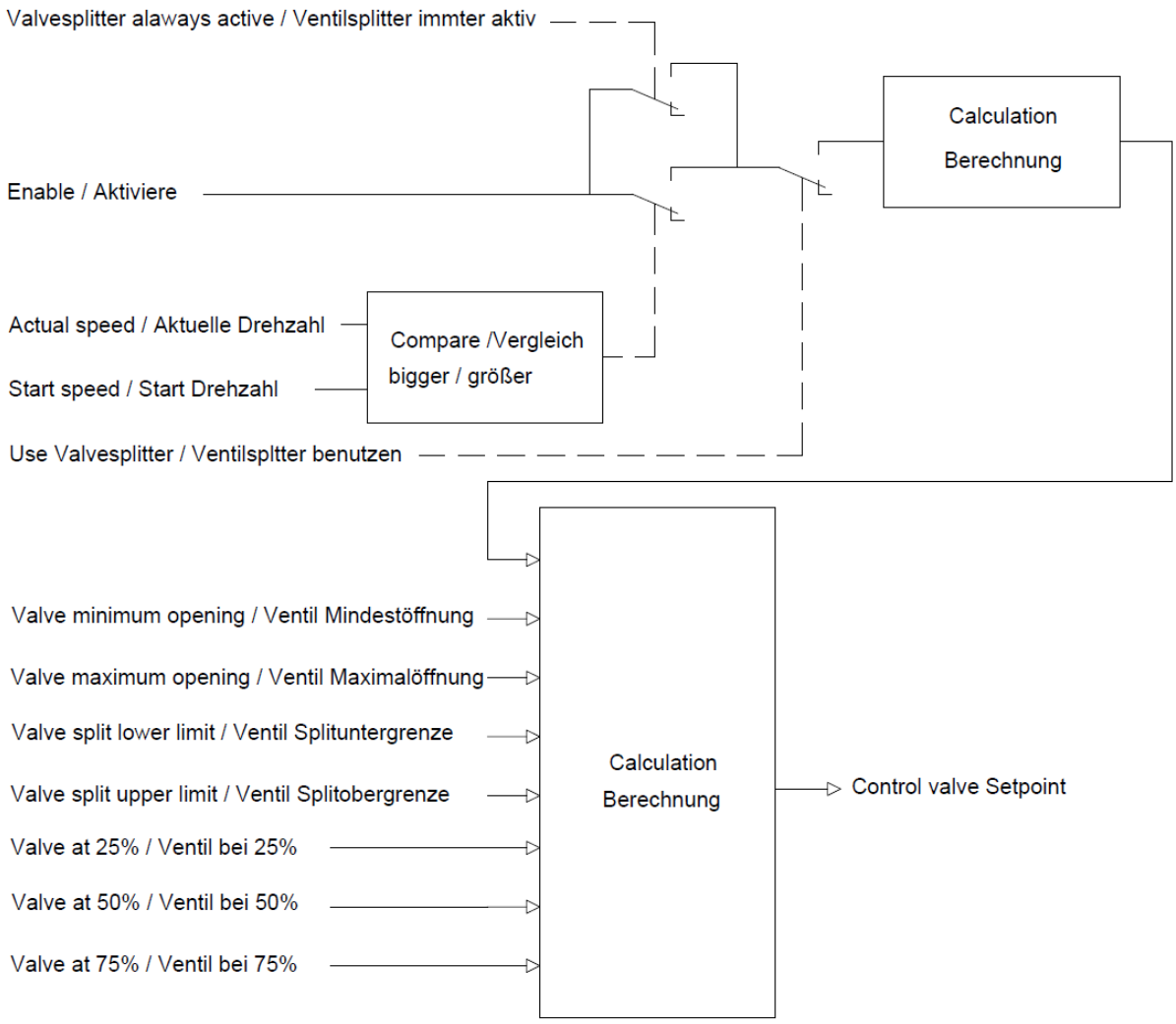


Service – (5) Valves – LP 4 valves manual mode

The LP 4 Valve level includes a manual mode that allows testing the valves while the turbine has not been started. While the hand mode is active, the trip output of the ESTC will trip to avoid an higher-level system to start the turbine. After switching off the manual mode, a reset is needed to set the ESTC safety chain again. The criteria for the manual mode are:

- Safety circuit ok
- Speed at turbine site 1 < parameter „blockage speed“ (see Part 3.2.4)
- Speed at turbine site 2 < parameter „blockage speed“ (see Part 3.2.6)
- Control has not been started

When all criteria for the manual mode are ok, the button „Manual mode“ will appear. By pressing this button, the manual mode will be activated and change the color to green to indicate that the manual mode is not active. When one of the criteria disappears while the manual mode is active, the manual mode will automatically be deactivated. When the manual mode is activated, the buttons „+“ and „-„ will appear and can be used to open and close the valve. Beyond this function, it is also possible to set a valve output directly at the value „Out“ while the manual mode is activated. The valve output is also in manual mode limited by the values „Max“ and „Min“.



Service – (5) Valves – LP 4 Valves calculation

4.6.6 HP redundant split

Service – (5) Valves – HP Redundant split

The HP valve level includes the parameters for the hp valves if a redundant split is used. The scale values for both splits are configured in this level. If the redundant split is used, the scale values at page "Service - (5) Valves- HP Valves" are only indication for the actual calculated split through the redundant split. The HP level automatically adjusts the valve overview according to the number of valves.

The following parameters are available for the HP valves at split 1:

- **HLM(0-100% but bigger than LLM):** Sets the upper end of the split range.
- **LLM(0-100% but smaller than HLM):** Sets the lower end of the split range.

The following parameters are available for the HP valves at split 2:

- **HLM(0-100% but bigger than LLM):** Sets the upper end of the split range.
- **LLM(0-100% but smaller than HLM):** Sets the lower end of the split range.

The following parameters are available:

- **Transition time:** Sets the transition time for the switch between split 1 and split 2. In this time the scaling values for the split is calculated in 100ms and interpolated between split1 and split 2. The time is used for the switch from split 1 to split 2 as well as the switch from split 2 to split 1.

The activation and deactivation of split 2 is done by a signal received via the communication port. As soon as the signal is set, the automatic transition between split 1 and split 2 starts. If the signal is resetted the automatic transition back from split 2 to split 1 starts.

5.0 Monitoring

The monitoring level is used to give an overview about the actual situation of the controller and to allow the operator to change between control modes and to change Set points. The controller and limiter are display in the way they work together. The control level is separated into up to 5 sublevels. The levels are:

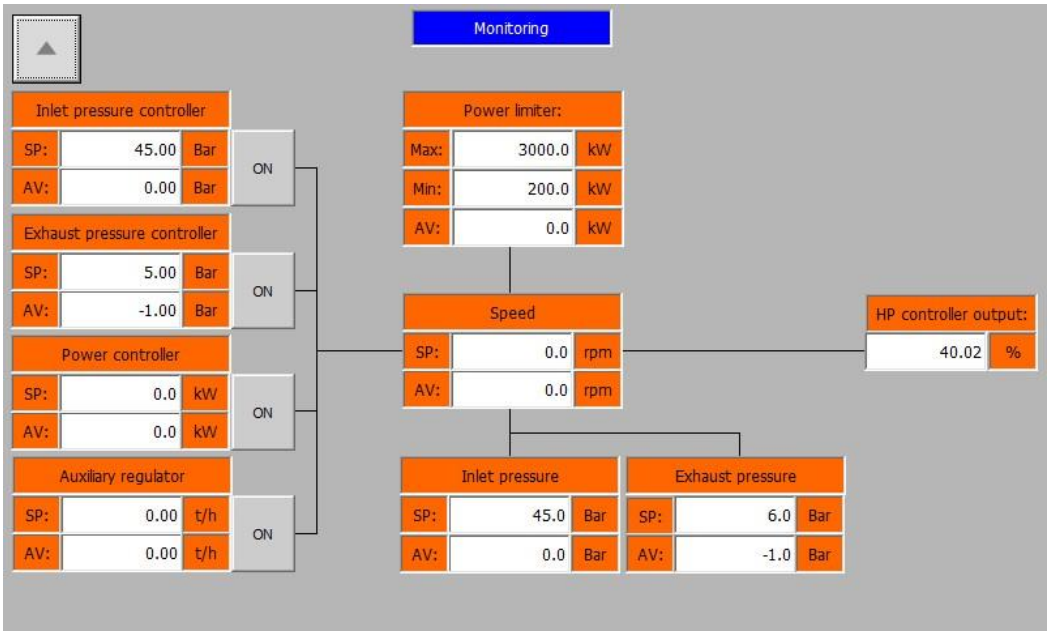
- Speed control
- HP control
- Extraction control 1+2
- Extraction control 3+4
- Alarms, Trips and messages

5.1.0 Speed control

Monitoring – Speed control

The speed controller level shows the speed controller of turbine site 1 and 2. A change of the speed Set point is not possible at this page. If a manual start up ramp is selected, or the automatic start ramp has been stopped, it is necessary to enter he service mode to change the speed Set point.

5.2 HP Control



Monitoring – HP control

The HP Control level shows the controller and limiter for the HP control stage. The following controllers and limiter are displayed:

- Speed controller turbine site 1
- Inlet pressure controller
- Exhaust pressure controller
- Power controller
- Auxiliary controller
- Power limiter
- HP Auxiliary limiter 1 (In this example it is named „Inlet pressure“. The name changes automatically according to the selected process value that should be limited)
- HP Auxiliary limiter 2 (In this example it is named „Exhaust pressure“. The name changes automatically according to the selected process value that should be limited)

Activate controller

If more than 1 process controller is selected, it is possible to switch between them while the turbine is in control. The button next to the process controller needs to be pressed. The back color of the process controller Set point indicates if the controller is active(Gray = inactive, Green = active)

Change Set point

It is possible to change the Set point of the controllers and Set points in the monitoring page. To do this, the Set point field (labeled with „SP:“) must be selected. After selecting the field, the new Set point can be entered and confirm by pressing the „Enter“ button. After confirming the new Set point, the actual Set point will change according to the configured change speed. A change of the speed Set

point is not possible at this page. If a manual start up ramp is selected, or the automatic start ramp has been stopped, it is necessary to enter he service mode to change the speed Set point.

Power limiter in control

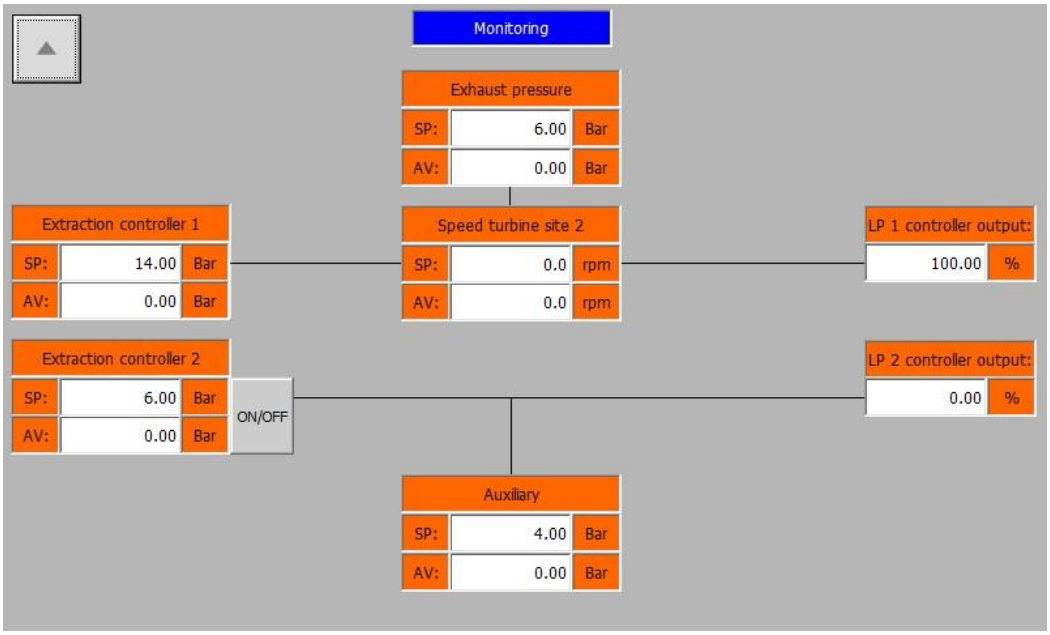
The minimum and maximum power limitation indicates a manipulation of the process controller output. The back color of the Set point will indicate the actual status (Gray = not in control, Green = in control). The limiter does not need to be activated, it will be automatically activates as soon as the associated controller is active.

HP auxiliary limiter 1 + 2

The HP auxiliary limiter 1 + 2indicates a manipulation of the process controller output. The back color of the Set point will indicate the actual status (Gray = not in control, Green = in control). The limiter does not need to be activated, it will be automatically activates as soon as the associated controller is active.

5.3 Extraction controller

5.3.1 Extraction controller 1+2



Monitoring – Extraction controller 1+2

The extraction controller 1 + 2 level shows all controllers and limiter for LP stages 1 + 2. The following controllers and limiters can be displayed:

- Speed controller turbine site 2
- Extraction controller 1
- Extraction controller 2
- Extraction limiter 1 (In this example it is named „Exhaust pressure“. The name changes automatically according to the selected process value that should be limited)
- Extraction limiter 2 (In this example it is named „Auxiliary“. The name changes automatically according to the selected process value that should be limited)

Speed controller turbine site 2

If a speed controller for turbine site 2 is configured, and LP stage 1 or 2 is associated, this will be displayed at this level.

Activate controller

It is possible to start and stop the extraction controller separately. This is only possible if no speed controller is associated to the extraction controller. To do that, the button behind the extraction controller must be pressed. The back color of the Set point indicates if the extraction controller is switched on or off (Gray = Off, Green = on). Pressing the button another time, the extraction controller will be switched off again.

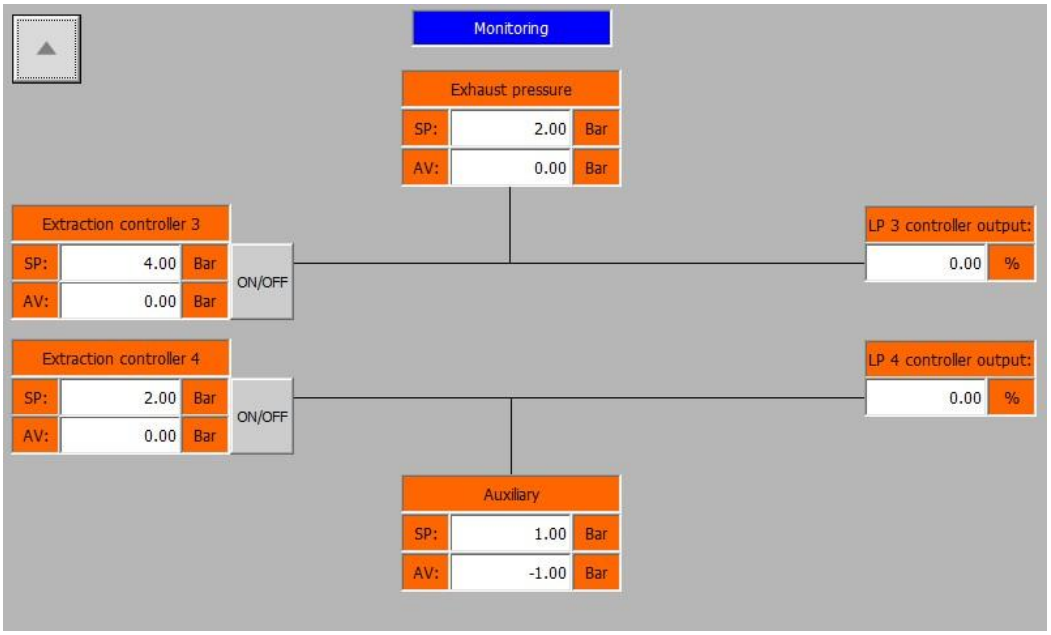
Change Set point

It is possible to change the Set point of the controllers and Set points in the monitoring page. To do this, the Set point field (labeled with „SP:“) must be selected. After selecting the field, the new Set point can be entered and confirm by pressing the „Enter“ button. After confirming the new Set point, the actual Set point will change according to the configured change speed. A change of the speed Set point is not possible at this page. If a manual start up ramp is selected, or the automatic start ramp has been stopped, it is necessary to enter he service mode to change the speed Set point.

Extraction limiter 1 + 2

The extraction controller 1 + 2indicates a manipulation of the process controller output. The back color of the Set point will indicate the actual status (Gray = not in control, Green = in control). The limiter does not need to be activated, it will be automatically activates as soon as the associated controller is active.

5.3.2 Extraction controller 3+4



Monitoring – Extraction controller 3+4

The extraction controller 3+4 level shows all controllers and limiter for LP stages 3 + 4. The following controllers and limiters can be displayed:

- Speed controller turbine site 2
- Extraction controller 3
- Extraction controller 4
- Extraction limiter 3 (In this example it is named „Exhaust pressure“. The name changes automatically according to the selected process value that should be limited)
- Extraction limiter 4 (In this example it is named „Auxiliary“. The name changes automatically according to the selected process value that should be limited)

Speed controller turbine site 2

If a speed controller for turbine site 2 is configured, and LP stage 3 or 4 is associated, this will be displayed at this level.

Activate controller

It is possible to start and stop the extraction controller separately. This is only possible if no speed controller is associated to the extraction controller. To do that, the button behind the extraction controller must be pressed. The back color of the Set point indicates if the extraction controller is switched on or off (Gray = Off, Green = on). Pressing the button another time, the extraction controller will be switched off again.

Change Set point

It is possible to change the Set point of the controllers and Set points in the monitoring page. To do this, the Set point field (labeled with „SP:“) must be selected. After selecting the field, the new Set point can be entered and confirm by pressing the „Enter“ button. After confirming the new Set point, the actual Set point will change according to the configured change speed. A change of the speed Set point is not possible at this page. If a manual start up ramp is selected, or the automatic start ramp has been stopped, it is necessary to enter he service mode to change the speed Set point.

Extraction limiter 3 + 4

The extraction controller 3 + 4 indicates a manipulation of the process controller output. The back color of the Set point will indicate the actual status (Gray = not in control, Green = in control). The limiter does not need to be activated, it will be automatically activates as soon as the associated controller is active.

5.4 Alarms, Trips and Messages

Alarms, Trips and Messages

The alarms, trips and messages level shows the actual alarms, trips and messages of the ESTC. Each of this 3 groups has different background colors, to easily find out the type of message. The colors are:

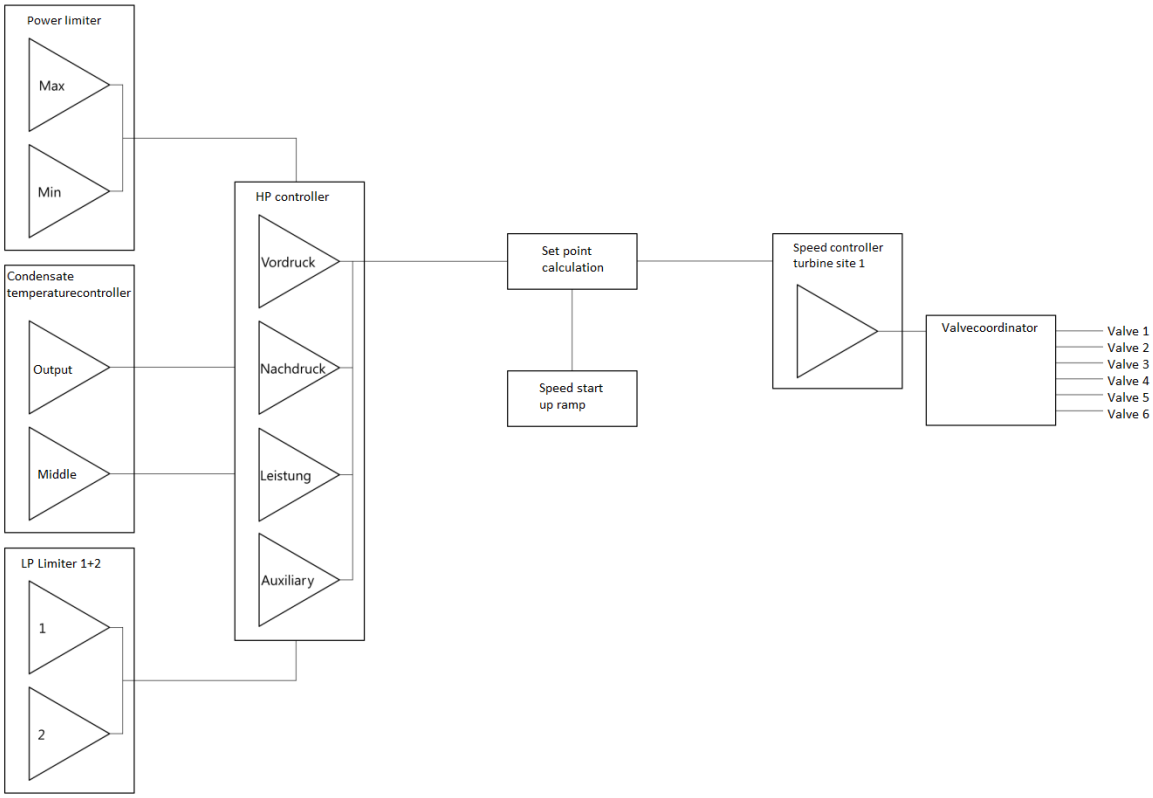
- **Alarms:** Yellow
- **Trips:** Red
- **Messages:** Green

The alarms and messages are just signals that indicate information's fort h operator, but don't stop the controller. The Trips automatically stops the controller and gives out a trip.

6.0 Function

The following drawings show the controller concept of the HP and the Extraction stages. The extraction stages are separated into 2 types:

- Extraction stage with speed control
- Extraction stage without speed control



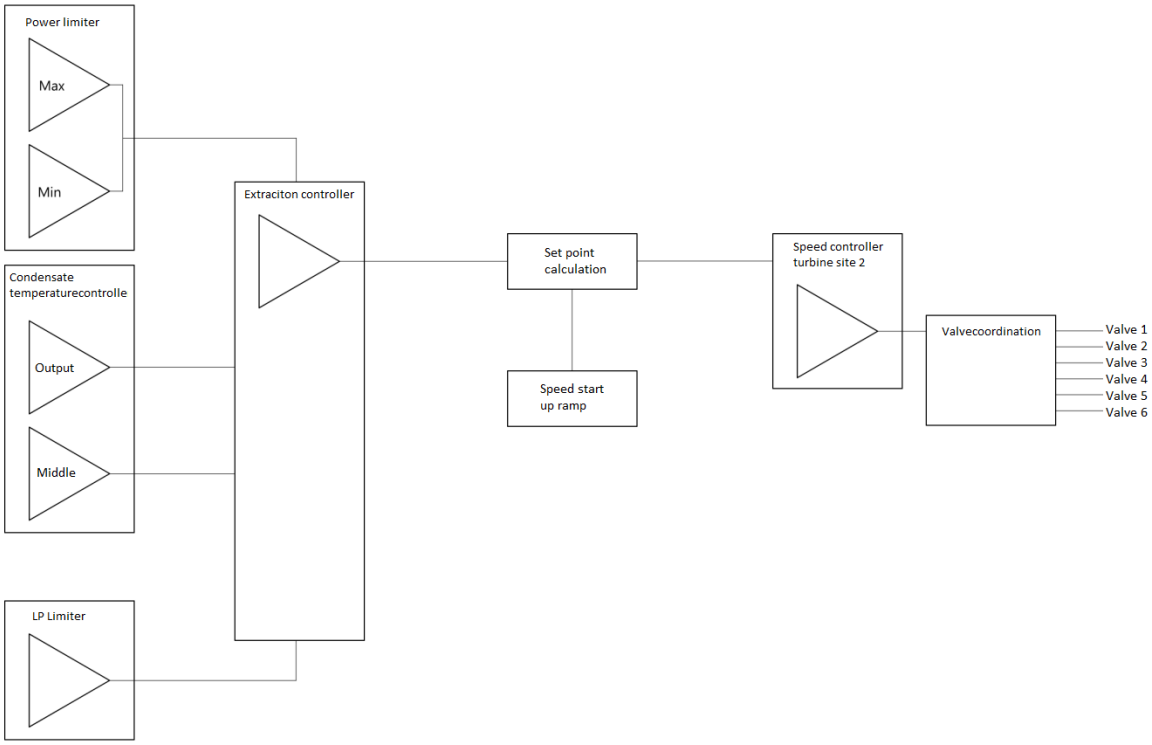
Drawing of the HP controller concept

All controllers of the HP control stage work together with the speed controller of turbine site 1. While the turbine is in offline or island mode, the speed start up ramp calculates the speed Set point. This controller is done with up to 6 valve outputs parallel or individual by using a split function. Additionally a 4 stage valve linearization can be used to optimize the control valve travelling.

As soon as the generator is connected to the grid, the speed controller will change from offline to online mode. Up to 4 HP process controller can be configured and switched during operation. The active process controller is calculating a speed Set point according to the actual speed, and transfers it to the speed controller in online mode.

Additionally a power limitation and 2 auxiliary limitations can be configured. This limitations manipulate the controller output of the active process controller to influence the calculated speed Set point. Because the controllers and limiters are working together and are not switching on and off, controller output will change bump less.

Additionally a condensate temperature controller can be configured and used to control the temperature of a district heating system together with a 2 stage Condensator. To do this, the condensate temperature controller changes the Set point of the associated process controller between the configured minimum and maximum range.



Drawing of the LP controller concept with speed control (Is valid for the LP stages 1 -4)

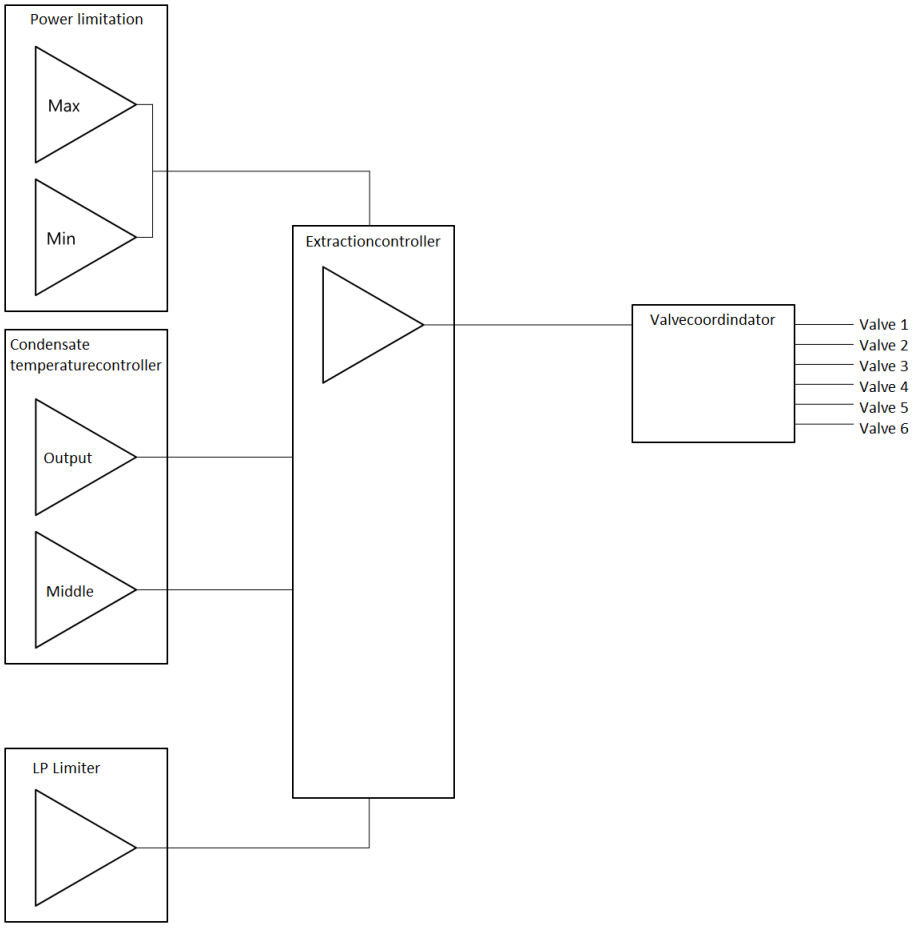
If extraction controller is configured with the speed controller of turbine site 2, the extraction controller and extraction limiter will work together with the speed controller of turbine site 2. While the turbine is in offline or island mode, the speed start up ramp calculates the speed Set point. This controller is done with up to 6 valve outputs parallel or individual by using a split function. Additionally a 4 stage valve linearization can be used to optimize the control valve travelling.

As soon as the configured criteria's are satisfied, the speed controller will change from offline to online mode. The process controller is calculating a speed Set point according to the actual speed, and transfers it to the speed controller in online mode.

Additionally a power limitation and an auxiliary limitation can be configured. This limitations manipulate the controller output of the active process controller to influence the calculated speed Set point. Because the controllers and limiters are working together and are not switching on and off, controller output will change bump less.

Additionally a condensate temperature controller can be configured and used to control the temperature of a district heating system together with a 2 stage Condensator. To do this, the

condensate temperature controller changes the Set point of the associated process controller between the configured minimum and maximum range.



Drawing of the LP controller concept without speed control (Valid for the LP stages 1-4=

If a extraction controller is configured without the speed controller of turbine site 2, the extraction controller and the extraction limiter are working directly together. This controller is done with up to 6 valve outputs parallel or individual by using a split function. Additionally a 4 stage valve linearization can be used to optimize the control valve travelling.

Additionally a power limitation and an auxiliary limitation can be configured. This limitations manipulate the controller output of the active process controller to influence the calculated speed Set point. Because the controllers and limiters are working together and are not switching on and off, controller output will change bump less.

Additionally a condensate temperature controller can be configured and used to control the temperature of a district heating system together with a 2 stage Condensator. To do this, the condensate temperature controller changes the Set point of the associated process controller between the configured minimum and maximum range.

7.0 Communication

The ESTC allows a communication to another PLC using S7-Connection. To allow the communication, the following functions and data blocks can be provided.:

- **FB160 "ESTC Communication":**This function block handles the send and receive functions for the communication between the ESTC and an external PLC.
- **DB160 "DBI ESTC Communication":**This Instance data block is used by the FB160 so handle the sub functions.
- **DB60 "Datenvom ESTC":**This Data block includes the data'ssend from the ESTC to the external PLC.
- **DB61 "Datenzum ESTC":**This Data block includes the data'ssend from an external PLC to the ESTC.

Followingdata's ca will be send from the ESTC to the external PLC.

Datenvom ESTC			
Name	type	Offset	Description
Sicherheitskette	Bool	0.0	The actual status of the Safety chain. 1=OK
Notaus_HMI	Bool	0.1	The actual status of the internal emergency stop. 1=OK
Reserve_1	Bool	0.2	
Reserve_2	Bool	0.3	
Reserve_3	Bool	0.4	
Reserve_4	Bool	0.5	
Reserve_5	Bool	0.6	
HD_gestartet	Bool	0.7	Turbine site 1 has been started.
HD_Nenndrehzahl_erreicht	Bool	1.0	Turbine site 1 has reached the rated speed.
HD_Online	Bool	1.1	Turbine site 1 is in online mode.
HD_Ueberdreh_test_aktiv	Bool	1.2	The overspeed procedure of turbine site 1 has been activated.
HD_Ueberdrehzahltrip	Bool	1.3	The overspeed protection of turbine site 1 has tripped.
HD_Stoprampe_Aktiv	Bool	1.4	The controlled stop of turbine site 1 is active.
HD_Sensorfehler	Bool	1.5	The speed pick ups of turbine site 1 failed.
HD_Sensorabweichung	Bool	1.6	The speed pick ups of turbine site 1 indicate different speeds.
ND_gestartet	Bool	1.7	Turbine site 2 has been started.
ND_Nenndrehzahl_erreicht	Bool	2.0	Turbine site 2 has reached the rated speed.
ND_Online	Bool	2.1	Turbine site 2 is in online mode.
ND_Ueber_test_aktiv	Bool	2.2	The overspeed procedure of turbine site 2 has been activated.
ND_Ueber_trip	Bool	2.3	The overspeed protection of turbine site 2 has tripped.
ND_Stoprampe_Aktiv	Bool	2.4	The controller stop of turbine site 2 is active.
ND_Sensorfehler	Bool	2.5	The speed pick ups of turbine site 2 failed.

ND_Sensorabweichung	Bool	2.6	The speed pick ups of turbine site 2 indicate different speeds.
HD_Kaltstartrampe_aktiv	Bool	2.7	The cold start up ramp of turbine site 1 is active.
HD_Warmstartrampe_aktiv	Bool	3.0	The warm start up ramp of turbine site 1 is active.
HD_Heissstartrampe_aktiv	Bool	3.1	The hot start up ramp of turbine is 1 is active.
HD_Rampenstufe_1	Bool	3.2	The 1. Holding point oft he start ramp of turbine site 1 has been reached.
HD_Rampenstufe_2	Bool	3.3	The 2. Holding point oft he start ramp of turbine site 1 has been reached.
HD_Rampenstufe_3	Bool	3.4	The 3. Holding point oft he start ramp of turbine site 1 has been reached.
HD_Rampenstufe_4	Bool	3.5	The 4. Holding point oft he start ramp of turbine site 1 has been reached.
HD_Rampenstufe_5	Bool	3.6	The 5. Holding point oft he start ramp of turbine site 1 has been reached.
HD_Rampenstufe_6	Bool	3.7	The 6. Holding point oft he start ramp of turbine site 1 has been reached.
HD_Rest_Haltezeit	Time	4.0	The Remaining time for t he active holding point of turbine site 1.
ND_Kaltstartrampe_aktiv	Bool	8.0	The cold start up ramp of turbine is 2 is active.
ND_Warmstartrampe_aktiv	Bool	8.1	The warm start up ramp of turbine site 2 is active.
ND_Heisstartrampe_aktiv	Bool	8.2	The hot start up ramp of turbine site 2 is active.
ND_Rampenstufe_1	Bool	8.3	The 1. Holding point oft he start ramp of turbine site 2 has been reached.
ND_Rampenstufe_2	Bool	8.4	The 2. Holding point oft he start ramp of turbine site 2 has been reached.
ND_Rampenstufe_3	Bool	8.5	The 3. Holding point oft he start ramp of turbine site 2 has been reached.
ND_Rampenstufe_4	Bool	8.6	The 4. Holding point oft he start ramp of turbine site 2 has been reached.
ND_Rampenstufe_5	Bool	8.7	The 5. Holding point oft he start ramp of turbine site 2 has been reached.
ND_Rampenstufe_6	Bool	9.0	The 6. Holding point oft he start ramp of turbine site 2 has been reached.
ND_Rest_Haltezeit	Time	10.0	TheRemaining time for t he active holding point of turbine site 2.
HD_Drehzahl_Aktiv	Bool	14.0	The speed control of turbine site 1 is active.
ND_Drehzahl_Aktiv	Bool	14.1	The speed control of turbine site 2 is active.
Vordruckregler_Aktiv	Bool	14.2	The inlet pressure controller is active.
Nachdruckregler_Aktiv	Bool	14.3	The exhaust pressure controller is active.
Leistungsregler_Aktiv	Bool	14.4	The power controller is active.
Auxiliaryregler_Aktiv	Bool	14.5	The auxiliary controller is active.
Entnahmeregler_1_Aktiv	Bool	14.6	The extractioncontroller 1 is active.
Entnahmeregler_2_Aktiv	Bool	14.7	The extractioncontroller 2 is active.
Entnahmeregler_3_Aktiv	Bool	15.0	The extractioncontroller 3 is active.
Entnahmeregler_4_Aktiv	Bool	15.1	The extractioncontroller 4 is active.

Leistung_Min_Kontrolle	Bool	15.2	The minimum power limitation is in control.
Leistung_Max_Kontrolle	Bool	15.3	The maximum power limitation is in control.
HD_Begrenzung_1_Kontr	Bool	15.4	The HP Auxiliary limiter 1 is in control.
HD_Begrenzung_2_Kontr	Bool	15.5	The HP Auxiliary limiter 2 is in control.
ED_Begr_1_in_Kontrolle	Bool	15.6	The Extraction limitation 1 is in control.
ED_Begr_2_in_Kontrolle	Bool	15.7	The Extraction limitation 2 is in control.
ED_Begr_3_in_Kontrolle	Bool	16.0	The Extraction limitation 3 is in control.
ED_Begr_4_in_Kontrolle	Bool	16.1	The Extraction limitation 4 is in control.
Kondensator_Austritt_akt	Bool	16.2	The Condensate outputtemperature controller is active.
Kondensator_Mittel_akt	Bool	16.3	The Condensate middletemperature controller is active.
Info_Reserve_3	Bool	16.4	
Info_Reserve_4	Bool	16.5	
Info_Reserve_5	Bool	16.6	
Info_Reserve_6	Bool	16.7	
Info_Reserve_7	Bool	17.0	
Info_Reserve_8	Bool	17.1	
Info_Reserve_9	Bool	17.2	
Info_Reserve_10	Bool	17.3	
Info_Reserve_11	Bool	17.4	
Info_Reserve_12	Bool	17.5	
Info_Reserve_13	Bool	17.6	
Info_Reserve_14	Bool	17.7	
HD_Drehzahl_vor_Getriebe	Real	18.0	The actual measured speed of turbine site 1 without the gearbox ratio.
ND_Drehzahl_vor_Getriebe	Real	22.0	The actual measured speed of turbine site 2 without the gearbox ratio.
HD_Drehzahlregler_SW	Real	26.0	The actual speed Set point of turbine site 1.
HD_Drehzahlregler_IW	Real	30.0	The actual measured speed of turbine site 1.
ND_Drehzahlregler_SW	Real	34.0	The actual speed Set point of turbine site 2.
ND_Drehzahlregler_IW	Real	38.0	The actual measured speed of turbine site 2.
Vordruckregler_SW	Real	42.0	The actual Set point of the inlet pressure controller.
Vordruckregler_IW	Real	46.0	The actual value of the inlet pressure controller.
Nachdruckregler_SW	Real	50.0	The actual Set pointoft he exhaust pressure controller.
Nachdruckregler_IW	Real	54.0	The actual value of the exhaust pressure controller.
Leistungsregler_SW	Real	58.0	The actual Set point of the power controller.
Leistungsregler_IW	Real	62.0	The actual value of the power controller.
Auxiliaryregler_SW	Real	66.0	The actual Set point of the auxiliary controller.
Auxiliaryregler_IW	Real	70.0	The actual value oft he auxiliary controller.
Entnahmeregler_1_SW	Real	74.0	The actual Set point of the extractioncontroller 1.
Entnahmeregler_1_IW	Real	78.0	The actual value of the extractioncontroller 1.

Entnahmeregler_2_SW	Real	82.0	The actual Set point of the extractioncontroller 2.
Entnahmeregler_2_IW	Real	86.0	The actual value of the extractioncontroller 2.
Entnahmeregler_3_SW	Real	90.0	The actual Set point of the extractioncontroller 3.
Entnahmeregler_3_IW	Real	94.0	The actual value of the extractioncontroller 3.
Entnahmeregler_4_SW	Real	98.0	The actual Set point of the extractioncontroller 4.
Entnahmeregler_4_IW	Real	102.0	The actual value of the extractioncontroller 4.
Leistung_Max_SW	Real	106.0	The actual Set point of the maximum power limitation.
Leistung_Min_SW	Real	110.0	The actual Set point of the minimum power limitation.
HD_Begrenzer_1_SW	Real	114.0	The actual Set point of the HP auxiliary limiter 1.
HD_Begrenzer_1_IW	Real	118.0	The actual value of the HP auxiliary limiter 1.
HD_Begrenzer_2_SW	Real	122.0	The actual Set point of the HP auxiliary limiter 2.
HD_Begrenzer_2_IW	Real	126.0	The actual value of the HP auxiliary limiter 2.
Entnahmebegrenzer_1_SW	Real	130.0	The actual Set point of the extraction limiter 1.
Entnahmebegrenzer_1_IW	Real	134.0	The actual value of the extraction limiter 1.
Entnahmebegrenzer_2_SW	Real	138.0	The actual Set point of the extraction limiter 2.
Entnahmebegrenzer_2_IW	Real	142.0	The actual value of the extraction limiter 2.
Entnahmebegrenzer_3_SW	Real	146.0	The actual Set point of the extraction limiter 3.
Entnahmebegrenzer_3_IW	Real	150.0	The actual value of the extraction limiter 3.
Entnahmebegrenzer_4_SW	Real	154.0	The actual Set point of the extraction limiter 4.
Entnahmebegrenzer_4_IW	Real	158.0	The actual value of the extraction limiter 4.
HD_Regelausgang	Real	162.0	The actual output of the HP controller.
ND_1_Regelausgang	Real	166.0	The actual output of the extractioncontroller 1.
ND_2_Regelausgang	Real	170.0	The actual output of the extractioncontroller 2.
ND_3_Regelausgang	Real	174.0	The actual output of the extractioncontroller 3.
ND_4_Regelausgang	Real	178.0	The actual output of the extractioncontroller 4.
SW_Reserve_6	Real	182.0	
HD_Ventil_1	Real	186.0	The actual output of the HP Valve 1.
HD_Ventil_2	Real	190.0	The actual output of the HP Valve 2.
HD_Ventil_3	Real	194.0	The actual output of the HP Valve 3.
HD_Ventil_4	Real	198.0	The actual output of the HP Valve 4.
HD_Ventil_5	Real	202.0	The actual output of the HP Valve 5.
HD_Ventil_6	Real	206.0	The actual output of the HP Valve 6.
ND_1_Ventil_1	Real	210.0	The actual output of the LP 1 Valve 1.
ND_1_Ventil_2	Real	214.0	The actual output of the LP 1 Valve 2.
ND_1_Ventil_3	Real	218.0	The actual output of the LP 1 Valve 3.
ND_1_Ventil_4	Real	222.0	The actual output of the LP 1 Valve 4.
ND_1_Ventil_5	Real	226.0	The actual output of the LP 1 Valve 5.
ND_1_Ventil_6	Real	230.0	The actual output of the LP 1 Valve 6.
ND_2_Ventil_1	Real	234.0	The actual output of the LP 2 Valve 1.
ND_2_Ventil_2	Real	238.0	The actual output of the LP 2 Valve 2.
ND_2_Ventil_3	Real	242.0	The actual output of the LP 2 Valve 3.

ND_2_Ventil_4	Real	246.0	The actual output of the LP 2 Valve 4.
ND_2_Ventil_5	Real	250.0	The actual output of the LP 2 Valve 5.
ND_2_Ventil_6	Real	254.0	The actual output of the LP 2 Valve 6.
ND_3_Ventil_1	Real	258.0	The actual output of the LP 3 Valve 1.
ND_3_Ventil_2	Real	262.0	The actual output of the LP 3 Valve 2.
ND_3_Ventil_3	Real	266.0	The actual output of the LP 3 Valve 3.
ND_3_Ventil_4	Real	270.0	The actual output of the LP 3 Valve 4.
ND_3_Ventil_5	Real	274.0	The actual output of the LP 3 Valve 5.
ND_3_Ventil_6	Real	278.0	The actual output of the LP 3 Valve 6.
ND_4_Ventil_1	Real	282.0	The actual output of the LP 4 Valve 1.
ND_4_Ventil_2	Real	286.0	The actual output of the LP 4 Valve 2.
ND_4_Ventil_3	Real	290.0	The actual output of the LP 4 Valve 3.
ND_4_Ventil_4	Real	294.0	The actual output of the LP 4 Valve 4.
ND_4_Ventil_5	Real	298.0	The actual output of the LP 4 Valve 5.
ND_4_Ventil_6	Real	302.0	The actual output of the LP 4 Valve 6.
Kondensator_Austritt_IW	Real	306.0	The actual value of the condensate output controller.
Kondensator_Austritt_SW	Real	310.0	The actual Set point of the condensate output controller.
Kondensator_Mittel_IW	Real	314.0	The actual value of the condensate middle controller.
Kondensator_Mittel_SW	Real	318.0	The actual Set point of the condensate middle controller.
Kondensator_Eintritt_IW	Real	322.0	The actual value of the condensate inlet.
Platzhalter	Array [1 .. 9] Of Byte	326.0	

Data from ESTC

Datenzum ESTC			
Name	Type	Offset	Description
Befehl_VD_regler_akt	Bool	0.0	Activates the inlet pressure controller.
Befehl_ND_regler_akt	Bool	0.1	Activates the exhaust pressure controller.
Befehl_LT_regler_akt	Bool	0.2	Activates the power controller.
Befehl_AX_regler_akt	Bool	0.3	Activates the auxiliary controller.
Befehl_ED_1_akt	Bool	0.4	Activates the extraction controller 1.
Befehl_ED_2_akt	Bool	0.5	Activates the extraction controller 2.
Befehl_ED_3_akt	Bool	0.6	Activates the extraction controller 3.
Befehl_ED_4_akt	Bool	0.7	Activates the extraction controller 4.
Befehl_Kon_Mittel_akt	Bool	1.0	Activates the condensate middle temperature controller.
Befehl_Kon_Aus_akt	Bool	1.1	Activates the condensate outlet temperature controller.

Befehl_SW_HD_DR_ben	Bool	1.2	Allows the communication Set point for the speed controller of turbine site 1.
Befehl_SW_HD_DR_akt	Bool	1.3	Activates the communication Set point for the speed controller of turbine site 1.
Befehl_SW_ND_DR_Ben	Bool	1.4	Allows the communication Set point for the speed controller of turbine site 2.
Befehl_SW_ND_DR_akt	Bool	1.5	Activates the communication Set point for the speed controller of turbine site 2.
Befehl_SW_VD_Ben	Bool	1.6	Allows the communication Set point for the inlet pressure controller.
Befehl_SW_VD_akt	Bool	1.7	Activates the communication Set point for the inlet pressure controller.
Befehl_SW_ND_Ben	Bool	2.0	Allows the communication Set point for the exhaust pressure controller.
Befehl_SW_ND_akt	Bool	2.1	Activates the communication Set point for the inlet pressure controller.
Befehl_SW_LT_Ben	Bool	2.2	Allows the communication Set point for the power controller.
Befehl_SW_LT_akt	Bool	2.3	Activates the communication Set point for the power controller.
Befehl_SW_AX_Ben	Bool	2.4	Allows the communication Set point for the auxiliary controller.
Befehl_SW_AX_akt	Bool	2.5	Activates the communication Set point for the auxiliary controller.
Befehl_SW_ED_1_Ben	Bool	2.6	Allows the communication Set point for the extraction controller 1.
Befehl_SW_ED_1_akt	Bool	2.7	Activates the communication Set point for the extraction controller 1.
Befehl_SW_ED_2_Ben	Bool	3.0	Allows the communication Set point for the extraction controller 2.
Befehl_SW_ED_2_akt	Bool	3.1	Activates the communication Set point for the extraction controller 2.
Befehl_SW_ED_3_Ben	Bool	3.2	Allows the communication Set point for the extraction controller 3.
Befehl_SW_ED_3_akt	Bool	3.3	Activates the communication Set point for the extraction controller 3.
Befehl_SW_ED_4_Ben	Bool	3.4	Allows the communication Set point for the extraction controller 4.
Befehl_SW_ED_4_akt	Bool	3.5	Activates the communication Set point for the extraction controller 4.
Befehl_SW_LT_max_Ben	Bool	3.6	Allows the communication Set point for the maximum power limitation.
Befehl_SW_LT_max_akt	Bool	3.7	Activates the communication Set point for the maximum power limitation.
Befehl_SW_LT_min_Ben	Bool	4.0	Allows the communication Set point for the minimum power limitation.
Befehl_SW_LT_min_akt	Bool	4.1	Activates the communication Set point for the minimum power limitation.

Befehl_SW_HD_Begr_1_Ben	Bool	4.2	Allows the communication Set point for the HP auxiliary limiter 1.
Befehl_SW_HD_Begr_1_akt	Bool	4.3	Activates the communication Set point for the HP auxiliary limiter 1.
Befehl_SW_HD_Begr_2_Ben	Bool	4.4	Allows the communication Set point for the HP auxiliary limiter 2.
Befehl_SW_HD_Begr_2_akt	Bool	4.5	Activates the communication Set point for the HP auxiliary limiter 2.
Befehl_SW_ED_Begr_1_Ben	Bool	4.6	Allows the communication Set point for the extraction limiter 1.
Befehl_SW_ED_Begr_1_akt	Bool	4.7	Activates the communication Set point for the extraction limiter 1.
Befehl_SW_ED_Begr_2_Ben	Bool	5.0	Allows the communication Set point for the extraction limiter 2.
Befehl_SW_ED_Begr_2_akt	Bool	5.1	Activates the communication Set point for the extraction limiter 2.
Befehl_SW_ED_Begr_3_Ben	Bool	5.2	Allows the communication Set point for the extraction limiter 3.
Befehl_SW_ED_Begr_3_akt	Bool	5.3	Activates the communication Set point for the extraction limiter 3.
Befehl_SW_ED_Begr_4_Ben	Bool	5.4	Allows the communication Set point for the extraction limiter 4.
Befehl_SW_ED_Begr_4_akt	Bool	5.5	Activates the communication Set point for the extraction limiter 4.
Befehl_SW_Kon_Mittel_Ben	Bool	5.6	Allows the communication Set point for the condensate middle temperature controller.
Befehl_SW_Kon_Mittel_akt	Bool	5.7	Activates the communication Set point for the condensate middle temperature controller.
Befehl_SW_Kon_Aus_Ben	Bool	6.0	Allows the communication Set point for the condensate output temperature controller.
Befehl_SW_Kon_Aus_akt	Bool	6.1	Activates the communication Set point for the condensate output temperature controller.
Befehl_Stop_HD_Turbine_ben	Bool	6.2	Select the controller stop ramp of turbine site 1 from communication. If it is selected, the digital input for controller stop ramp of turbine site 1 will be ignored.
Befehl_Stop_HD_Turbine_Akt	Bool	6.3	Activates the controller stop ramp of turbine site 1 if it is selected.
Befehl_Stop_ND_Turbine_ben	Bool	6.4	Select the controller stop ramp of turbine site 2 from communication. If it is selected, the digital input for controller stop ramp of turbine site 2 will be ignored.
Befehl_Stop_ND_Turbine_Akt	Bool	6.5	Activates the controller stop ramp of turbine site 2 if it is selected.
Befehl_Aktiviere_HD_Splitt_2	Bool	6.6	Activates the switch from HP splitter 1 to HP Splitter 2.
Befehl_Reserve_02	Bool	6.7	
Befehl_Reserve_03	Bool	7.0	

Befehl_Reserve_04	Bool	7.1	
Befehl_ED_1_IW_benutzen	Bool	7.2	Activates the extraction controller 1 process value transferred over communication.
Befehl_ED_2_IW_benutzen	Bool	7.3	Activates the extraction controller 2 process value transferred over communication.
Befehl_ED_3_IW_benutzen	Bool	7.4	Activates the extraction controller 3 process value transferred over communication.
Befehl_ED_4_IW_benutzen	Bool	7.5	Activates the extraction controller 4 process value transferred over communication.
Befehl_Reserve_13	Bool	7.6	
Befehl_Reserve_14	Bool	7.7	
SW_HD_Drehzahl	Real	8.0	Set point for the speed control of turbine site 1.
SW_ND_Drehzahl	Real	12.0	Set point for the speed control of turbine site 2.
SW_Vordruck	Real	16.0	Set point for the inlet pressure controller.
SW_Nachdruck	Real	20.0	Set point for the exhaust pressure controller.
SW_Leistungsregler	Real	24.0	Set point for the power controller.
SW_Auxiliaryregler	Real	28.0	Set point for the auxiliary controller.
SW_Entnahmeregler_1	Real	32.0	Set point for the extraction controller 1.
SW_Entnahmeregler_2	Real	36.0	Set point for the extraction controller 2.
SW_Entnahmeregler_3	Real	40.0	Set point for the extraction controller 3.
SW_Entnahmeregler_4	Real	44.0	Set point for the extraction controller 4.
SW_LT_Max	Real	48.0	Set point for the maximum power limitation.
SW_LT_Min	Real	52.0	Set point for the minimum power limitation.
SW_HD_Begrenzer_1	Real	56.0	Set point for the HP auxiliary limiter 1.
SW_HD_Begrenzer_2	Real	60.0	Set point for the HP auxiliary limiter 2.
SW_ED_Begr_1	Real	64.0	Set point for the extraction limiter 1.
SW_ED_Begr_2	Real	68.0	Set point for the extraction limiter 2.
SW_ED_Begr_3	Real	72.0	Set point for the extraction limiter 3.
SW_ED_Begr_4	Real	76.0	Set point for the extraction limiter 4.
SW_Kon_Mittel	Real	80.0	Set point for the condensate middle temperature controller.
SW_Kon_Aus	Real	84.0	Set point for the condensate output temperature controller.
IW_ED_Reg_1	Real	88.0	Process value for the extraction controller 1.
IW_ED_Reg_2	Real	92.0	Process value for the extraction controller 2.
IW_ED_Reg_3	Real	96.0	Process value for the extraction controller 3.
IW_ED_Reg_4	Real	100.0	Process value for the extraction controller 4.
Reserve_Wert_7	Real	104.0	
IW_AD_Reg	Real	108.0	Process value for the exhaust pressure controller.
Reserve_Wert_9	Real	112.0	
Reserve_Wert_10	Real	116.0	
Reserve_Wert_11	Real	120.0	
Reserve_Wert_12	Real	124.0	
Reserve_Wert_13	Real	128.0	

Reserve_Wert_14	Real	132.0	
Reserve_Wert_15	Real	136.0	
Reserve_Wert_16	Real	140.0	
Reserve_Wert_17	Real	144.0	
Reserve_Wert_18	Real	148.0	
Reserve_Wert_19	Real	152.0	
Reserve_Wert_20	Real	156.0	

Data to ESTC

8.0 ESTC PC Configurator

ESTC PC Configurator

The ESTC PC Configurator allows to read and configure all settings of the ESTC from a windows PC. The manual for this PC Configurator can be found in a separate manual.