FUNCTIONAL DESCRIPTION
Pid01A
Closed Loop Controller with Auto Tuner

Contents

1 General

Pid01A is a functional unit for closed loop process control in Control^{IT}, to be operated from Operate^{IT}, Operator Station. A Pid01A normally performs a complete function independently.

Pid01A has the following functions and properties:

- P-, PI-, PD- and PID-algorithm.
- Control parameters can be set from the operator station or by control logic.
- Different control modes, set by operator or by control logic.
- Controllable rate of change of setpoints and output signals.
- Limiting of setpoints and output signals.
- Function for bumpless change between different control modes.
- Alarm and event handling of important control signals.
- Autotuner of relay type

2 Configuration

Pid01A comprises a function block type for control and logic functions in Control^{IT}, a faceplate and an object display in Operate^{IT} for operator functions and control parameters.

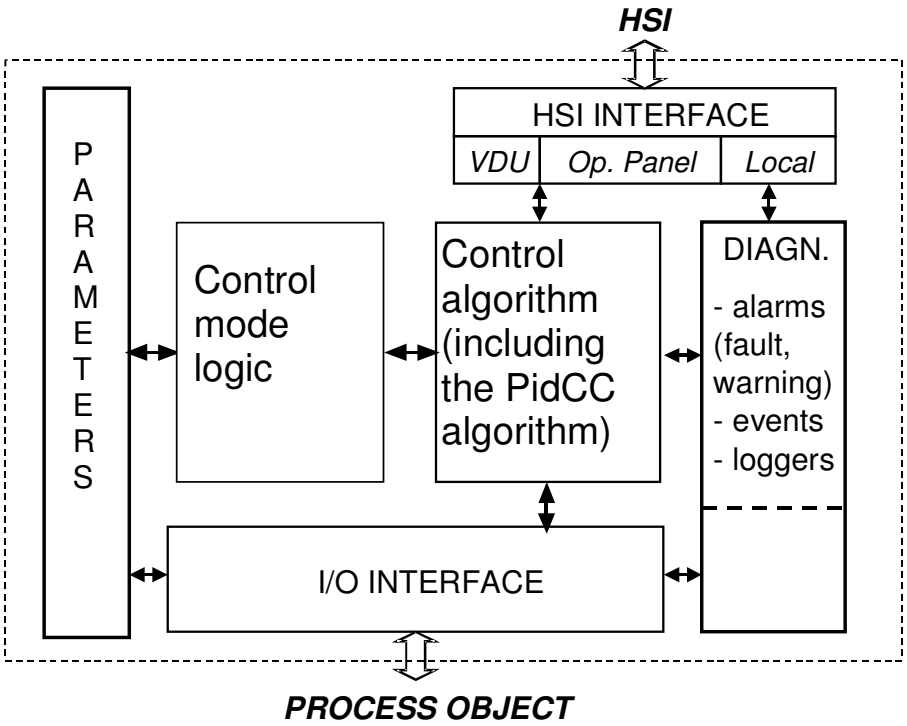


Figure 1. The Structure of the Functional Unit

3 Function Block Pid01A

FUNCTION OF INPUT TERMINALS		PID01A			FUNCTION OF OUTPUT TERMINALS
Object name		Name	AutoSP		Auto setpoint
Object description		Description	WSP		Working setpoint
Enable object		Enable	Dev		Deviation
Selection of tracking reference		TrackA	OutP		Output
Selection of how to track		TrackB	Bal		Balance mode
Selection of tracking reference for external setpoint		TrackC	Man		Man mode
Reverse control action		RevAct	ManFd		Man Forced mode
Selection of derivation		Deriv	Auto		Auto mode
Added output value for feedforward		FeedFwd	E1		E1 mode
Measured Value		MV	E2		E2 mode
MV status		AIErr	E3		E3 mode
Max setpoint change rate in Auto mode (unit/s)		Speed1	BalOut		Balance Out
Max output change rate (unit/s)		Speed4	OutEqLL		Output less than or equal to Low Limit
Enable Man mode		ManEnbl	OutEqHL		Output greater than or equal to High Limit
Enable Auto mode		AutoEnbl	SpEqLL		SP less than or equal to Low Limit
Enable E1 mode		E1Enbl	SpEqHL		SP greater than or equal to High Limit
Enable E2 mode		E2Enbl	MV_GT_H2		MV greater than or equal to High High Limit (H2)
Enable E3 mode		E3Enbl	MV_GT_H1		MV greater than or equal to High Limit (H1)
External reference setpoint in E1 mode		ExtRef1	MV_LT_L1		MV less than or equal to Low Limit (L1)
External reference setpoint in E2 mode		ExtRef2	MV_LT_L2		MV less than or equal to Low Low Limit (L2)
External reference setpoint in E3 mode		ExtRef3	Dev_GT_H		Deviation greater than or equal to High Limit
Max setpoint change rate in E1 mode (unit/s)		Speed2	Dev_LT_L		Deviation less than or equal to Low Limit
Max setpoint change rate in E2 mode (unit/s)		Speed3	OLimErr		Output Low Limit is greater than Output High Limit
Order mode to E1		SeqE1	NoInt		No Interlocks
Order mode to E2		SeqE2	Err		Error
Order mode to E3		SeqE3	ExtParOut		Control data for supervisory control
Order mode to Local		Local	OutPar		Out Parameter
Order mode to Balance		BalIn	Opr		Operator order
Order mode to Man		SeqMan			
Order mode to Auto		SeqAuto			
Balance Reference		BalRef			
Order mode to Clamp		Clamp			
Clamp Reference		ClampRef			
Enable external output limit		EOLim			
External Output Low Limit		EOLL			
External Output High Limit		EOHL			
Process Interlock 1		IB1			
Process Interlock 2		IB2			
Process Interlock 3		IB3			
Process Interlock 4		IB4			
Reference for Process Interlock 1		IB1Ref			
Reference for Process Interlock 2		IB2Ref			
Reference for Process Interlock 3		IB3Ref			
Reference for Process Interlock 4		IB4Ref			
Actuator position		ActPos			
Block alarm		AlcBlk			
Acknowledge alarm		AlarmAck			
External control		ExtCtrl			

MV alarm configuration		MVAlarms			
Deviation alarm configuration		DevAlarms			
In Parameter		InPar			
Event name		EventName			

Figure 3-1. Function Block Type, Complete symbol

Table 3-1 below illustrates the default properties of each terminal of the Pid01A function block.

Name	Data Type	Attributes	Direction	FD Port	Initial value	Description
Name	string	coldretain	in	yes	'PID01A'	Object name
Description	string	coldretain	in	yes	'Descr'	Object description
Enable	bool	coldretain	in	yes	true	Enable object
TrackA	dint	coldretain	in	yes	1	Selection of tracking reference
TrackB	dint	coldretain	in	yes	1	Selection of how to track
TrackC	dint	coldretain	in	yes	0	Selection of tracking reference for external setpoint
RevAct	dint	coldretain	in	yes	1	Reverse control action
Deriv	dint	coldretain	in	yes	0	Selection of derivation
FeedFwd	real	retain	in	yes		Added output value for feedforward
MV	real	retain	in	yes		Measured Value
AIErr	dword	retain	in	yes	16#C0	MV status
Speed1	real	coldretain	in	yes	2.0	Max setpoint change rate in Auto mode (unit/s)
Speed4	real	coldretain	in	yes	20.0	Max output change rate (unit/s)
ManEnbl	bool	coldretain	in	yes	true	Enable Man mode
AutoEnbl	bool	coldretain	in	yes	true	Enable Auto mode
E1Enbl	bool	coldretain	in	yes		Enable E1 mode
E2Enbl	bool	coldretain	in	yes		Enable E2 mode
E3Enbl	bool	coldretain	in	yes		Enable E3 mode
ExtRef1	real	retain	in	yes		External reference setpoint in E1 mode
ExtRef2	real	retain	in	yes		External reference setpoint in E2 mode
ExtRef3	real	retain	in	yes		External reference setpoint in E3 mode
Speed2	real	coldretain	in	yes	2.0	Max setpoint change rate in E1 mode (unit/s)
Speed3	real	coldretain	in	yes	2.0	Max setpoint change rate in E2 mode (unit/s)
SeqE1	bool	retain	in	yes		Order mode to E1
SeqE2	bool	retain	in	yes		Order mode to E2
SeqE3	bool	retain	in	yes		Order mode to E3
Local	bool	retain	in	yes		Order mode to Local
BalIn	bool	retain	in	yes		Order mode to Balance
SeqMan	bool	retain	in	yes		Order mode to Man
SeqAuto	bool	retain	in	yes		Order mode to Auto
BalRef	real	coldretain	in	yes	0.0	Balance Reference
Clamp	bool	retain	in	yes		Order mode to Clamp
ClampRef	real	coldretain	in	yes	0.0	Clamp Reference
EOLim	bool	retain	in	yes		Enable external output limit
EOLL	real	coldretain	in	yes	0.0	External Output Low Limit
EOHL	real	coldretain	in	yes	100.0	External Output High Limit
IB1	bool	retain	in	yes	true	Process Interlock 1
IB2	bool	retain	in	yes	true	Process Interlock 2
IB3	bool	retain	in	yes	true	Process Interlock 3
IB4	bool	retain	in	yes	true	Process Interlock 4
IB1Ref	real	coldretain	in	yes	0.0	Reference for Process Interlock 1
IB2Ref	real	coldretain	in	yes	0.0	Reference for Process Interlock 2
IB3Ref	real	coldretain	in	yes	0.0	Reference for Process Interlock 3
IB4Ref	real	coldretain	in	yes	0.0	Reference for Process Interlock 4
ActPos	real	retain	in	yes		Actuator position
AlcBlk	bool	retain	in	yes		Block alarm

Name	Data Type	Attributes	Direction	FD Port	Initial value	Description
AlarmAck	bool	retain	in	yes		Acknowledge alarm
ExtCtrl	Ext_Control	by_ref	in	yes		External control
MVAlarms	Alarm4Limit	by_ref	in	yes		MV alarm configuration
DevAlarms	Alarm2Limit	by_ref	in	yes		Deviation alarm configuration
InPar	PID01A_InPar	by_ref	in	yes		In Parameter
EventName	string	coldretain	in	yes	'||PID01A_'	Event name
AutoSP	real	retain	out	yes		Auto setpoint
WSP	real	retain	out	yes		Working setpoint
Dev	real	retain	out	yes		Deviation
OutP	real	retain	out	yes		Output
Bal	bool	retain	out	yes		Balance mode
Man	bool	retain	out	yes		Man mode
ManFd	bool	retain	out	yes		Man Forced mode
Auto	bool	retain	out	yes		Auto mode
E1	bool	retain	out	yes		E1 mode
E2	bool	retain	out	yes		E2 mode
E3	bool	retain	out	yes		E3 mode
BalOut	bool	retain	out	yes		Balance Out
OutEqLL	bool	retain	out	yes		Output less than or equal to Low Limit
OutEqHL	bool	retain	out	yes		Output greater than or equal to High Limit
SpEqLL	bool	retain	out	yes		SP less than or equal to Low Limit
SpEqHL	bool	retain	out	yes		SP greater than or equal to High Limit
MV_GT_H2	bool	retain	out	yes		MV greater than or equal to High High Limit (H2)
MV_GT_H1	bool	retain	out	yes		MV greater than or equal to High Limit (H1)
MV_LT_L1	bool	retain	out	yes		MV less than or equal to Low Limit (L1)
MV_LT_L2	bool	retain	out	yes		MV less than or equal to Low Low Limit (L2)
Dev_GT_H	bool	retain	out	yes		Deviation greater than or equal to High Limit
Dev_LT_L	bool	retain	out	yes		Deviation less than or equal to Low Limit
OLimErr	bool	retain	out	yes		Output Low Limit is greater than Output High Limit
NoInt	bool	retain	out	yes		No Interlocks
Err	bool	retain	out	yes		Error
ExtParOut	Ctrl_Data	by_ref	out	yes		Control data for supervisory control
OutPar	PID01A_OutPar	by_ref	out	yes		Out Parameter
Opr	PID01A_Opr	by_ref	out	yes		Operator order

Table 3-1. Terminal properties.

4 PID01A Datatypes

4.1 PID01A_InPar

Name	Data Type	Attributes	Initial value	ISP value	Description
Class	dint	coldretain	500		AE class
Severity	dint	coldretain	1000		AE severity
MVRange	RangeReal	coldretain			MV Range
OUTRange	RangeReal	coldretain			OUT Range
SPLimit	RangeLimit	coldretain			SP limit
OUTLimit	RangeLimit	coldretain			OUT limit
InitMode	dint	coldretain	5		Init mode (5 = Man ; 6 = Auto ; 7 = E1 ; 8 = E2 ; 9 = E3)
ManFdBlk	bool	coldretain	false		Block operator order Man Forced mode
SeqManEvBlk	bool	coldretain	true		Block event for SeqMan
SeqAutoEvBlk	bool	coldretain	true		Block event for SeqAuto
SeqE1EvBlk	bool	coldretain	true		Block event for SeqE1
SeqE2EvBlk	bool	coldretain	true		Block event for SeqE2
SeqE3EvBlk	bool	coldretain	true		Block event for SeqE3
AlcBlkEvBlk	bool	coldretain	true		Block event for AlcBlk
EOLimEvBlk	bool	coldretain	true		Block event for EOLim
LocalEvBlk	bool	coldretain	true		Block event for Local
BalInEvBlk	bool	coldretain	true		Block event for BalIn
ClampEvBlk	bool	coldretain	true		Block event for Clamp
IB1	IBInParType3	coldretain			Configuration for IB1
IB2	IBInParType3	coldretain			Configuration for IB2
IB3	IBInParType3	coldretain			Configuration for IB3
IB4	IBInParType3	coldretain			Configuration for IB4
ErrCtrl	bool	coldretain			No error at overflow
AEConfigAIErr	dint	coldretain	1		AE configuration for AI Error
AlarmDelay	time	coldretain	0s		Alarm Delay
ShowActPos	bool	coldretain	false		Show actuator position
OUTIncDec	real	coldretain	2.0		Increase/Decrease step of output (In percentage of range)
SPIncDec	real	coldretain	1.0		Increase/Decrease step of setpoint (In percentage of range)
Gain	real	coldretain	0.5		Gain
TI	real	coldretain	15		Integration Time
TD	real	coldretain	0.0		Derivative Time
TF	real	coldretain	0.0		Filter Time
ControllerType	dint	coldretain	2		Controller Type
Beta	real	coldretain	1.0		Beta
BetaDisc	real	coldretain	0.0		Beta Disc
DeadZone	real	coldretain	0.0		DeadZone

4.2 PID01A_OutPar

Name	Data Type	Attributes	Initial value	ISP value	Description
AlarmBlk	bool	retain			Alarm blocked
IntlkBlk	bool	retain			Interlock blocked
IntlkBlkActive	bool	retain			Interlock blocked active
EnOverrideAll	bool	retain			Override All button enabled
Mode	dint	retain			Active mode
NormalMode	bool	retain			Normal mode (Active mode = Init mode)
AIErr	bool	retain			MV error
Forced	bool	retain			MV forced
IB1Ind	bool	retain			IB1 interlocked
IB2Ind	bool	retain			IB2 interlocked
IB3Ind	bool	retain			IB3 interlocked

Name	Data Type	Attributes	Initial value	ISP value	Description
IB4Ind	bool	retain			IB4 interlocked
MVH2	real	retain			Active High High MV alarm limit
MVH1	real	retain			Active High MV alarm limit
MVL1	real	retain			Active Low MV alarm limit
MVL2	real	retain			Active Low Low MV alarm limit
DevH	real	retain			Active High Deviation alarm limit
DevL	real	retain			Active Low Deviation alarm limit
ALB_H2	bool	retain			High High MV alarm blocked
ALB_H1	bool	retain			High MV alarm blocked
ALB_L1	bool	retain			Low MV alarm blocked
ALB_L2	bool	retain			Low Low MV alarm blocked
ALB_DevH	bool	retain			High Deviation alarm blocked
ALB_DevL	bool	retain			Low Deviation alarm blocked
AU_MVH2	bool	retain			UnAcknowledge alarm for MV > H2
AU_MVH1	bool	retain			UnAcknowledge alarm for MV > H1
AU_MVL1	bool	retain			UnAcknowledge alarm for MV < L1
AU_MVL2	bool	retain			UnAcknowledge alarm for MV < L2
AU_DevH	bool	retain			UnAcknowledge alarm for Dev > H
AU_DevL	bool	retain			UnAcknowledge alarm for Dev < L
AU_AIErr	bool	retain			UnAcknowledge alarm for AI Error
Direction	bool	retain			Direction (0 = direct ; 1 = reverse)
HWStatus	HwStatus	retain			Hardware status
SubStatus	dint	retain			Hardware substatus
IOStatus	dint	retain			Hardware I/O status quality
Gain	real	retain			Active Gain
TI	real	retain			Active Integration Time
TD	real	retain			Active Derivative Time
TF	real	retain			Active Filter Time
ControllerType	dint	retain			Active Controller Type
Beta	real	retain			Active Beta
BetaDisc	real	retain			Active Beta Disc
DeadZone	real	retain			Active DeadZone

4.3 PID01A_Opr

Name	Data Type	Attributes	Initial value	ISP value	Description
BlockAlarm	bool	retain			Operator block alarms
ALB_H2	bool	retain			Operator block alarm limit H2
ALB_H1	bool	retain			Operator block alarm limit H1
ALB_L1	bool	retain			Operator block alarm limit L1
ALB_L2	bool	retain			Operator block alarm limit L2
ALB_DevH	bool	retain			Operator block alarm deviation H
ALB_DevL	bool	retain			Operator block alarm deviation L
ManFd	bool	retain			Operator order Manual Forced mode
Man	bool	retain			Operator order Manual mode
Auto	bool	retain			Operator order Auto mode
E1	bool	retain			Operator order E1 mode
E2	bool	retain			Operator order E2 mode
E3	bool	retain			Operator order E3 mode
Incr	real	retain			Operator order Increase SP command
Decr	real	retain			Operator order Decrease SP command
OverrideAll	bool	retain			Operator override all interlocks
IB1Override	bool	retain			Operator override IB1 interlock
IB2Override	bool	retain			Operator override IB2 interlock
IB3Override	bool	retain			Operator override IB3 interlock
IB4Override	bool	retain			Operator override IB4 interlock
AutoSP	real	coldretain	0.0		Operator enter Auto Setpoint
ManOUT	real	coldretain	0.0		Operator enter Man OUT

5 Function

5.1 Basic Properties

The Pid01A functional unit is designed for regulatory control in different processes.

Pid01A normally performs all control functions independently, however there are situations where Pid01A's functionality needs to be supplemented. Such cases can include

- Ratio Control, where a Ratio Station RATIO01 supplements the Pid01A.
- Increase/Decrease control, where a three state controller CON-PU1 supplements the Pid01A.
- For special control applications additional logic can be used to supplement Pid01A.

Pid01A has the following basic functions.

- P, PI, PD or PID control algorithm.
- External control parameters, which can be useful when applying i.e., gain scheduling.
- External control data, which can be useful for supervisory control.
- Feed Forward
- Control modes: BAL, Man, Auto and different cascade alternatives.
- Logic for allocation of priority in the selection of control mode.
- Different versions of setpoint tracking.
- Rate of change limiting of the different setpoints and of the output signal.
- The possibility to limit setpoints and output signals.
- Functions for bumpless transfers between the different control modes.
- Possibility to Forced the control of the output signal.
- Alarm and event handling.
- Autotuning

5.2 Control Algorithm

The algorithm is based on the PidCC control module.

The algorithm consists of a controller with optional P-, PI-, PD- or PID-characteristics. The different parameters can be set from the operator station or by control logic.
Derivation can be performed on measured value or deviation.
Direct or reversed control action is selectable.

The PID controller algorithms used are of ideal type. The controller input from the process Pv and the setpoint Sp are regularly read by the controller. A reading is also called a sample, and the time between two samples is called the sampling time. The required output signal value is calculated for each sample by comparing samples of the input and

setpoint values. The sample time is equal to the task cycle time of the current task. The process value may be filtered before it enters the derivative part of the control algorithm by a first-order, low-pass filter.

For more details please refer to **Ref1**.

5.2.1 Control Deviation

Control deviation is the difference between the working setpoint and the measured value from the process. This is processed in accordance with the control parameters given to the P-, PI-, PD- or PID- algorithms. The result of this processing is applied to the output signal.

Calculation of Control Deviation

The control deviation is calculated with the following equation:

DEV = MV - WSP

DEV = control deviation

MV = measured value

WSP = working setpoint

5.2.2 Transfer Function

The transfer function for a PID controller consists of the sum of the different transfer functions for PI-controller and derivator.

$$G(s) = Gain \left(1 + \frac{1}{s \cdot T\,1} + \frac{s \cdot TD}{1 + s \cdot TF} \right)$$

GAIN = gain constant

TI = integration time constant

TD = derivation time constant

TF = filter time constant.

The PID algorithm in the software performs the following tests:

- If $\frac{TS}{TI} > 1$, then $\frac{TS}{TI}$ is set = 1
- $Abs(Dev) > IntegralDeadband$, otherwise no integration change.

TS = the sampling time for the controller.

5.2.3 External control parameters

With the input “ExtCtrl” the control and alarm parameters can be externally controlled, which can be useful when applying i.e., gain scheduling. The input is a structured data type with the following components, which can be individually utilized.

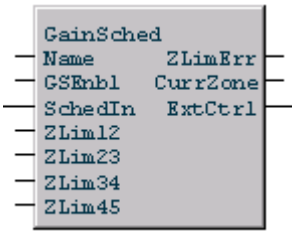
Index No.	Name	Data Type	Attributes	Initial Value	Description
1	GainEnbl	bool	retain	FALSE	External Gain Enable
2	Gain	real	retain	0.5	External Gain
3	TIEnbl	bool	retain	FALSE	External IntegrationTime Enable
4	TI	real	retain	30	External Integration Time
5	TDEnbl	bool	retain	FALSE	External DerivationTime Enable
6	TD	real	retain	0	External DerivationTime
7	TFEnbl	bool	retain	FALSE	External Filter Time Enable
8	TF	real	retain	0	External Filter Time
9	IntBlkEnbl	bool	retain	FALSE	External Integration Block Enable
10	IntBlk	bool	retain	FALSE	External Integration Block
11	DerBlkEnbl	bool	retain	FALSE	External Derivation Block Enable
12	DerBlk	bool	retain	FALSE	External Derivation Block
13	SPLimEnbl	bool	retain	FALSE	External Setpoint Limit Enable
14	SPH	real	retain	100	External Setpoint High Limit
15	SPL	real	retain	0	External Setpoint Low Limit
16	En_H2	bool	retain		Enable HH Limit
17	MVH2	real	retain	100	High Limit 2
18	ALB_H2	bool	retain		Blocking of alarm limit H2
19	En_H1	bool	retain		Enable H Limit
20	MVH1	real	retain	100	High Limit 1
21	ALB_H1	bool	retain		Blocking of alarm limit H1
22	En_L1	bool	retain		Enable L Limit
23	MVL1	real	retain	0	Low Limit 1
24	ALB_L1	bool	retain		Blocking of alarm limit L1
25	En_L2	bool	retain		Enable LL Limit
26	MVL2	real	retain	0	Low Limit 2
27	ALB_L2	bool	retain		Blocking of alarm limit L2
28	En_DevH	bool	retain		Enable Dev High Limit
29	DevH	real	retain	100	Deviation High Limit
30	ALB_DevH	bool	retain		Blocking of alarm Dev High limit
31	En_DevL	bool	retain		Enable Dev Low Limit
32	DevL	real	retain	-100	Deviation Low Limit
33	ALB_DevL	bool	retain		Blocking of alarm Dev Low limit
34	SetpStationModeEnbl	bool	retain	FALSE	Enable QCS Setpoint Station Mode
35	Bal	bool	retain	FALSE	Balance Mode (Used when SetpStationModeEnbl is True and PID Enable is False)
36	Man	bool	retain	FALSE	Manual Mode (Used when SetpStationModeEnbl is True and PID Enable is False)
37	Auto	bool	retain	FALSE	Auto Mode (Used when SetpStationModeEnbl is True and PID Enable is False)
38	E1	bool	retain	FALSE	E1 Mode (Used when SetpStationModeEnbl is True and PID Enable is False)
39	AI_Error_Override	bool	retain	FALSE	Bypass AI Error check (used when SetpStationModeEnbl is True)
40	On_Off_Ctrl_Enbl	bool	retain	FALSE	Enable On Off Ctrl
41	On_Off_Ctrl	bool	retain	FALSE	On Off Ctrl
42	ManOut_Enbl	bool	retain	false	External Entered Output Enable
43	ManOut	real	retain		External Entered Output

Index No.	Name	Data Type	Attributes	Initial Value	Description
44	SP_Enbl	bool	retain	false	External Entered Setpoint Enable
45	SP	real	retain		External Entered Setpoint
46	WSP_Enbl	bool	retain	false	External Working Setpoint Enable
47	WSP	real	retain		External Working Setpoint

Table 4-1. ExtCtrl Terminal properties of Pid01A

5.2.4 Gain scheduling

Gain scheduling can be accomplished by connecting the output “ExtCtrl” of the element “GainSched” to the input “ExtCtrl” of the Pid01A. If GSEnbl is not active the values from Zone 1 will be used.



Name	Data Type	Attributes	Direction	FD Port	Initial value	Description
Name	string	coldretain	in	yes	'GainSched'	Object name
GSEnbl	bool	coldretain	in	yes	false	Enable gain scheduling
SchedIn	real	coldretain	in	yes	0.0	Scheduling Input
ZLim12	real	coldretain	in	yes	20.0	Zone 1 to 2 Limit
ZLim23	real	coldretain	in	yes	40.0	Zone 2 to 3 Limit
ZLim34	real	coldretain	in	yes	60.0	Zone 3 to 4 Limit
ZLim45	real	coldretain	in	yes	80.0	Zone 4 to 5 Limit
ZLimErr	bool	retain	out	yes		Zone limit error
CurrZone	dint	retain	out	yes		Current zone
ExtCtrl	Ext_Control	by_ref	out	yes		External control

5.2.5 External control data

With the output “ExtParOut” internal data from the control can be used by e.g. supervisory control. The output is a structured data type with the following components, which can be individually utilized.

Index No.	Name	Data Type	Attributes	Initial Value	Description
1	Name	string	retain	'Pid01'	Object Tag Name
2	Description	string	retain	'Descr'	Object Description
3	MV	real	retain		Measured Value
4	WSP	real	retain		Working Setpoint
5	OutP	real	retain		Output signal
6	ActPos	real	retain		Actuator Position
7	Max	real	retain		Max Range, MV
8	Min	real	retain		Min Range, MV
9	SPH	real	retain		Setpoint High Limit
10	SPL	real	retain		Setpoint Low Limit
11	OHL	real	retain		Output High Limit
12	OLL	real	retain		Output Low Limit
13	Gain	real	retain		Gain

Index No.	Name	Data Type	Attributes	Initial Value	Description
14	TI	real	retain		Integration Time
15	TD	real	retain		Derivative Time
16	DeadZ	real	retain		Deadzone
17	RevAct	dint	retain		Reverse Control Action
18	NoInt	bool	retain		No Interlock
19	SpEqLL	bool	retain		Setpoint equal to low limit
20	SpEqHL	bool	retain		Setpoint equal to high limit
21	OutEqLL	bool	retain		Output equal to low limit
22	OutEqHL	bool	retain		Output equal to high limit
23	Mode	dint	retain		Control Mode, -1=Bal, 0=Man, 1=Auto, 2=E1, 3=E2, 4=E3, 5=ManFd
24	TopMode	dint	retain		Highest Control Mode, 0=Man, 1=Auto, 2=E1, 3=E2

Table 4-2. ExtParOut Terminal properties of Pid01A

5.2.6 Feed Forward

In automatic modes, the output of the controller is generated by the control algorithm, with the value of the input :FeedFwd added. The result is checked against high and low limits and rate limit, as described

The feed forward signal is used to compensate for measurable disturbances to achieve faster and smoother control of a process. Feed forward means that a signal is either added to or subtracted from the output signal of the controller. The feed forward signal may also be amplified or reduced. The feed forward process accelerates the controller's response by anticipating changes and acting to neutralize any disturbance before it occurs. Feed forward can also be used to suppress changes in the input signal that must not be allowed to influence the controller output. Feed forward is selected as a positive (+) or a negative (–) value of FFGain in the algorithm.

For more details please refer to **Ref1**

5.3 Autotuning

5.3.1 Introduction

Auto tuning is a simple way to obtain suitable controller parameters. You are thus recommended to use the Autotuner function, otherwise, a great deal of time can be spent in manual tuning of many controllers in large process plants. Manual tuning time can be increased even more when retuning becomes necessary due to changes in the process conditions.

When the process is in steady state, the user starts the Autotuner. It then identifies the dynamic parameters of the process automatically, and from these the Autotuner calculates and suggests appropriate PID parameters. When autotuning is complete the controller goes back to the mode it was in before. It uses the old controller parameters, but suggests the new autotuned parameters and you have the choice to apply them. If you do not apply the new values, and then close the tuning interaction window, the autotuning values will be lost.

Auto tuning is based on a relay (ON/OFF) identification method with feedback measurements.

Note: Perform auto tuning only when the process is in steady state.

5.3.2 Auto tuning with the Relay Method

When the system is in steady state and the Autotuner has been started, the PID controller is temporarily disconnected.

First the Autotuner measures the noise of the process value.

Secondly, the output is generated and changed by the relay, with a hysteresis function, to implement a disturbance in the process, of a small amplitude.The effect of the relay function is an ON/OFF control which, by means of a square wave signal, generates a controlled and stable oscillation in the process value. The response is observed and the amplitude of the oscillation is automatically controlled to a minimum value by adjustment of the relay amplitude. From the period and amplitude of the process value oscillation, suitable P, I and D parameters are calculated. The controller is then ready to operate and the PID algorithm is reintroduced into the control loop.

5.3.3 Auto tuning Process

Auto tuning can be started with the controller in Manual, Auto, E1 or E2 mode. During the auto tuning process the Autotuner controls the output. The following two conditions must be fulfilled before starting auto tuning.

• The process must be in steady state. It is not possible to start the Autotuner during a load disturbance or a setpoint change.

• It is also important that no major load disturbance occurs during the auto tuning process.

• The control deviation (Sp – Pv) must be less than 5% of the actual Pv range.

When these conditions are fulfilled, you can start the Autotuner.

If the process is not in steady state auto tuning may fail. Auto tuning is interrupted by a load disturbance.

For more details on the Auto tuning process please refer to **Ref1.**

5.4 Control Modes

5.4.1 Control Mode Command Signals and Priority

The signals for control mode change are placed in order of priority. LOCAL has the highest priority and SEQE3 has the lowest priority. The current control mode is determined by the active inputs with the highest priority by a pulse. The inputs are of three different types; static, set-reset and dynamic.

- The static input must be activated for the corresponding control mode to be applied. If the signal at the input disappears, the control mode changes over to MAN, provided no static input with a lower priority takes over the selection of the control mode.

- Set-Reset means that the control mode is selected when the input is activated. If the input is reset to zero, the control mode remains in effect until some other input is activated. If the SR-input is kept active, only inputs with a higher priority can assume the selection of control mode.

- The dynamic input is only initiating. The control mode is selected when a change from 0 to 1 occurs at the input.

The control mode can be enabled individually. Input terminals ManEnbl, AutoEnbl, E1Enbl, E2Enbl and E3Enbl can be set in the function block with constants or by application logic. By enabling a single control mode under certain conditions it is possible to lock the control mode to prevent switching to another control mode.

Table 4-2 illustrates control mode activation and priority when selected from either an application program or from the operator station.

Commands		**Mode selected**					
Signal	**Source**	**Balance**	**Manual**	**Auto**	**E1**	**E2**	**E3**
Local (1)	Program	■					
BalIn (1)	Program	■					
Clamp (1)	Program		■				
Manual Forced (2)	Operator		■				
Interlocks	Program		Remains unchanged				
AI-error	AI-channel		■				
Man	Operator		■				
SeqMan ↑ (3)	Program		■				
Auto	Operator			■			
SeqAuto ↑ (3)	Program			■			
E1	Operator				■		
E2	Operator					■	
E3	Operator						■
SeqE1 ↑ (3)	Program				■		
SeqE2 ↑ (3)	Program					■	
SeqE3 ↑ (3)	Program						■

Table 4-2. Control modes selection and priority.

(1) On leaving mode Balance or Manual Clamped (i. e. when the command signal returns to zero), mode Manual is always obtained, unless any signal commands another mode.

(2) The mode MAN Forced is temporarily left while a command signal with higher priority is active. The mode is not left finally, until the operator gives a command for another mode. All other commands of lower priority are blocked.

(3) The arrow ↑ indicates that only the positive transition of the signal is relevant for commanding a mode change.

The purpose and function of each control mode is described below.

5.4.2 Balance

Balance control mode is used to force the controller output to a value present at the input terminal BalRef. The operator cannot override this mode.

When the controller is operating in Balance mode the output signal follows the balance reference signal. This mode is used when the control signal is disconnected and the controller is balanced for a bumpless return to control.

Control mode BAL is activated by:

- The activation of input terminal LOcCAL. An indication of BAL LOCAL is presented on the object display and Bal on the Faceplate mode indicator.

- The activation of input terminal BALIN. An indication of BAL is presented on the object display and Bal on the Faceplate mode indicator.

Examples of use can be as follows:

- Manual emergency control, which has the highest priority. An operator, working centrally at the display screen cannot take over control from a local backup station located adjacent to the process function.

- When another function block or other logic other than the process controller is to take over the control. An example is cascade coupling of several process controllers.

5.4.3 Manual

Manual is the initial control mode of the controller. In this mode the operator directly sets the output value from the operator station. The rate of output value is limited by the value at terminal Speed4. Manual mode is enabled by input terminal ManEnbl.

The control mode MAN is activated by:

- Input terminal CLAMP gives the indication MAN CLAMP in the object display.

- Changeover to manual forced mode by using the MFd button on the operator's faceplate. Indication MFd on the object display.

- Input terminal AIERR <> 1 changes the control mode to MAN. "No error at overflow" can be selected from the interaction window. Overflow will then not generate AIERR, while Underflow still will.

- By clicking on the Man button on the operator's faceplate. Man is indicated on the object display and Faceplate.

Examples of use:

- Manual control of an actuator under abnormal operation conditions e.g. in connection with a malfunction.

- Manual control at start and stop.

- Man Clamp can be used to let an interlock signal force the outpot to a specific value. When the interlock is gone, the control mode is MAN. Either application logic or the operator has to decide how to return to normal operating mode.

5.4.4 Manual Forced

Manual Forced is a non-regulatory control mode, like the manual mode, where the operator sets the output. This mode overrides the Interlocks, but not the external output limitations (EOLim) or operator entered limitations.

The control mode MANFd is activated by:

- Changeover to manual forced mode by using the MFd button on the operator's faceplate. Indication MFd on the object display.

Examples of use:

- During a plant stop interlocks could prevent opening of the valve. ManFd enables the operator to still use the valve for ie. testing etc.

5.4.5 Auto

Auto is the automatic control mode, where the operator sets the setpoint. The rate of change of the setpoint value is limited by the value at terminal Speed1. Auto mode is enabled by input terminal AutoEnbl.

The control mode AUTO is activated by:

- By clicking on the Auto button on the operator's faceplate. Auto is indicated on the object display and Faceplate.
- Input terminal SEQAUTO when activated by a pulse.

5.4.6 E1 and E2

E1 and E2 are automatic control modes, where the setpoint is obtained from an external source. The rate of setpoint values is limited by the value at terminals Speed2 and respectively Speed3. E1 and E2 modes are enabled by input terminals E1Enbl and E2Enabl.

With control mode E1 (External 1) the setpoint consists of a signal received from an external source at input terminals ExtRef1 and ExtRef2. The control mode E1 and E2 can be commanded from the operator's keyboard, from another application logic or from an external control device.

The control mode E1 or E2 is activated by:

- By clicking on the E1 or E2 buttons on the operator's faceplate. Ext1 or Ext2 is indicated on the object display and Faceplate.
- Input terminal SEQE1 or SEQE2 when activated by a pulse.

Examples of use:

- Cascade control.
- Setpoint control from an optimizing function.
- Local setting of setpoint.
- Recipe-controlled setpoint.

5.4.7 E3

E3 is the non-regulatory control mode, where the setpoint is derived from program logic and directly applied to the output. It has the same functionality as Manual mode excepting that the setpoint to the output comes from program logic and not the operator. The output signal is forced to follow an external reference. E3 mode is enabled by input terminal E3Enbl.

The control mode E3 is activated by:

- By clicking on the E3 button on the operator's faceplate. Ext3 is indicated on the object display and Faceplate.
- Input terminal SEQE3 when activated by a pulse.

Examples of use:

- When it is desirable to control the output signal with low priority e.g. from a local operator's station or from a PC. The responsibility for the control can then always be taken over at a central operator's station.
- In connection with traditionally named DDC (Direct Digital Control).

5.5 Start-up

An initialisation phase begins at start of the AC800M system. Manual is the default control mode at system initialisation or after a download. It is possible to force the control mode to other modes at system initialisation.

The input terminal HOTINIT: controls the selection of the control mode and output with respect to the status, which was present before the initialization.

0 Control mode and output unchanged.
1 Control mode changed to Manual, output unchanged.
2 Control mode changed to Manual, output = 0 or = OLL

5.6 Process connections

The Pid01A is connected to the process via the following two input terminals.

- MV Connection for measured value e.g. a level transmitter.
- OUTP Control output to e.g. a control valve.

5.7 Reverse Action

The following control functions are activated when the REVACT: input terminal is enabled with the values as shown below.

- 0 Direct action in "PI" and "D" sections. (INC/INC)
- 1 Reverse action in "PI" and "D" sections. (INC/DEC)
- 2 Direct action in "PI" section. Reverse action in "D" section.
- 3 Reverse action in "PI" section. Direct action in "D" section.

5.8 Ramp Functions

Ramp functions are introduced into the signal paths to determine the maximum permitted rate of change of certain signals. These are designated RAMP and are located in the function block and used for CONTROL DEVIATION, SETPOINT SELECTION and FORCED CONTROL. The maximum permitted rate of change is determined by the operational parameter SPEED (X) and is specified in process-related variables/second or percentage units/second, depending on the signal.

5.9 Setpoint Selection, Mode transitions and Tracking

The term “working setpoint” is the setpoint that the controller uses in its algorithm in all modes. The “auto setpoint” is the setpoint that the operator enters in auto mode. In auto mode the auto setpoint is transferred to the working setpoint.

SETPOINT SELECTION contains the following functions:

- Selection of external reference (1 or 2)
- Tracking
- Ramp functions
- Limitations

5.9.1 Selection of External Reference

The working setpoint is external reference 1(E1) in control mode Ext1 or external reference 2(E2) in control mode Ext2.

5.9.2 Tracking

The tracking functions are intended to eliminate abrupt changes of the setpoint on return to the different control modes. Tracking functions are available for both auto and external modes and are activated during mode transfers.

During a mode transfer the working setpoint will ramp to selected setpoint if TrackA (Auto SP Track Reference) and TrackC (External SP Track Reference) are enabled.

The auto setpoint can be set to follow the process value and/or the external setpoints by means of TrackB (SP Track Selection).

5.9.2.1 Tracking of AUTO setpoint

Two tracking functions are included for the AUTO setpoint (AUTOSP). The tracking functions can be activated with other control modes than AUTO. Their purpose is to permit bumpless connection of the AUTO setpoint or connection with constant signal value.

The function is selected with two parameters, TRACKA and TRACKB.

- TRACK A: Selection of tracking reference.
  - 0 No tracking.
  - 1 Tracking on "MV" if TRACK B not = 0.
  - 2 Tracking on "External setpoint" if TRACK B not = 0.
- TRACK B: Selection of how to track.
  - 0 No tracking.
  - 1 Working setpoint tracks signal according to TRACK A.
  - 2 Working setpoint and Auto setpoint tracks signal according to TRACK A.

TrackA	**TrackB**	**Description**
0	0	No tracking.
X	0	No tracking.

1	1	AutoSp is not affected. The working setpoint, WSP, is tracking the measured value, MV, when not in Auto mode. The WSP is ramped to equal AutoSp with a speed that is determined by Speed1.
2	1	AutoSp is not affected. The working setpoint, WSP, is tracking the value of ExtRef1 or ExtRef2, depending on whether operating mode E1 or E2 applies. The WSP is ramped to equal AutoSp with a speed that is determined by Speed1. ”Tracking” takes place in the operating modes E1 and E2.
1	2	AutoSp and Working setpoint tracks the measured value, MV when not in Auto mode. Changeover to Auto takes place both without bumps and changes
2	2	AutoSp and Working setpoint tracks the external setpoint ExtRef1 or ExtRef2, depending on whether operating mode E1 or E2 applies. Changeover to Auto takes place both without bumps and changes. Tracking takes place in the operating modes E1 and E2.

Table 4-3. Selection for tracking function of AutoSp.

5.9.2.2 Tracking of External setpoints

The tracking functions are intended to eliminate abrupt changes of the setpoint on return to the control modes E1 and E2 respectively. The tracking functions are controlled with a function parameter TRACKC.

Two tracking functions below are integrated in Track C.

- External reference 1 can follow the measured value or the working setpoint with a control mode other than E1.
- External reference 2 can follow the measured value or the the working setpoint with a control mode other than E2.

Table 4-4 below describes the changeover for each function.

TrackC	**Description**
0	No tracking
1	The external setpoints ExtRef1 and ExtRef2 are tracking the measured value, MV, when not in mode E1 or E2. The internal setpoint, Extref, is thereafter ramped to equal ExtRef1 or ExtRef2 as applicable with a speed that is determined by Speed2 or Speed3 respectively. ExtRef1 is tracking in all control modes but E1, while ExtRef2 is tracking in the all modes but E2.
2	The external setpoints ExtRef1 and ExtRef2 are tracking the working setpoint, WSP, when not in mode E1 or E2. The internal setpoint, Extref, is thereafter ramped to equal ExtRef1 or ExtRef2 as applicable with a speed that is determined by Speed2 or Speed3 respectively. ExtRef1 is tracking in all control modes but E1, while ExtRef2 is tracking in the all modes but E2.

Table 4-4. Selection of tracking function for ExtRef.

5.9.3 Setpoint Ramp Functions

The input terminals described below determine the maximum permitted rate of change as follows:

- Speed 1 Auto setpoint speed. Specified in engineering units/second.
- Speed 2 Ext1 setpoint speed. Specified in engineering units/second.
- Speed 3 Ext2 setpoint speed Specified in engineering units/second.

5.9.4 Setpoint Limitations

The limiting values SPH and SPL apply for both AUTO setpoint and the external references E1 and E2. The setpoint limits are set in the Extended Faceplate on the faceplate element “Limits2”.

5.10 Forced Control

Forced control may also be initiated to a reference value i.e. on receiving an incorrect signal from an analog input (AI), the output signal for example ramps down to zero.

The function block contains the following functions:

- Selection of control signal
- Tracking
- Ramp functions
- Limitations

5.10.1 Selection of Control Signal

There are three forms to force the control of the output signal:

- Manual is selected with the control mode MAN
- External references are selected with the control mode E3
- Clamping is selected with the clamping function (control mode MAN)

The following inputs are be used for forced control.

Speed4 Highest permitted rate of change of the output signal.

Clamp Command signal for clamping. The mode changes to MAN. When the Clamp signal is released the mode will still be MAN.

ClampRef Clamping reference value when terminal Clamp is activated.

ExtRef3 External reference value for the output signal in mode E3

5.10.2 Tracking

Tracking functions are integrated to eliminate abrupt output signal changes at change-over to and from the control modes MAN, Clamp (MAN) and E3.

5.10.3 Output Ramp Functions

The input terminals described below determine the maximum permitted rate of change as follows:

- Speed 4 Output ramp speed. Specified in percent units/second.

5.10.4 Output Limitations

The limiting values Out H and Out L limit the value of the output signal. The output limits are set in the Extended Faceplate on the faceplate element “Limits1”.

5.11 Output Signal Control

Output signal control includes the following functions.

- Selection of output signal
- Output signal limitation

5.11.1 Selection of Output Signal

The output signal is selected in accordance with the control mode as follows:

- AUTO, E1, E2 output control signal
- MAN, Clamp (MAN), E3 output control signal
- BAL control signal, the value of balance reference is transferred to the output.

The following input terminals are beeing used for output control.

FEEDFWD	Feed Forward
BALREF	Balance reference
BALIN	Signal for selection of BALREF
EOHL	Upper external limiting value
EOLL	Lower external limiting value
EOLIM	Signal for selection of external limitation
IB1REF	IB1 reference
IB2REF	IB2 reference
IB1	Signal for selection of IB1REF
IB2	Signal for selection of IB2REF

OUTP	Output signal
OLIMERR	Crossed external limiting value

5.11.2 Output Limiting

The controller output signal is normally limited to Max and Min values of the Real IO signal, connected to the output but limiting values on this signal can be determined either from the operator's station or externally.

The limiting upper and lower values Out H and Out L limit the value of the output signal. The output limits are set in the Extended Faceplate on the faceplate element "Limits1".

The activation of input terminal EOLim determines whether the external limits EOLL and EOHL or internal limits Out H and Out L are applied to the output limitation. The operator-entered limiting values are not affected when external limits are used. The limiting values currently active are presented on the faceplate and object display.

The limiting values from the operator Out H and Out L can be set equal but Out L cannot be set greater than Out H. If the external limiting value EOLL is greater than EOHL then only the upper value EOHL applies. The output signal can thereby be force controlled to the value for EOHL. The crossing of the limiting values causes a fault indication (OLimErr).

5.11.3 Interlocks

The controller can be interlocked by using IB1 and IB2 input terminals. Deactivation of these terminals set the output value to a fixed value, which is present at the IB1Ref and IB2Ref input terminals.

- These interlocks do not change the current control mode, but can be overridden by Manual Forced, when selected by the operator.
- IB1 has higher priority than IB2.
- Both have higher priority than EOLim.
- EOLim, however, can not be overridden by Manual Forced.

5.12 Scaling and Units

The process controller works internally with process-related units up to the calculation of the control deviation where there is a changeover to percentage units. This means that measured values and setpoints, both internal and external are specified in process-related units and other signals in percentage units.

The deviation is expressed in percent of the measured value range (MAX-MIN). The PI-block and the D and output signal have a default range of -100% to +100%. Scaling is possible. The output signal (OUTP) scaling is possible except in the Operator Station bargraph which shows 0 - 100%.

5.13 Alarm and Alarm Limitation Functions

The following alarms are monitored in the function block:

- Measured value MV with two upper and two lower alarm limits
- Control deviation DEV with one upper and one lower alarm limit

When an alarm limit is exceeded, an alarm, which must be acknowledged, is transmitted to the operator station (and printer, if provided). Alarms are also available as outputs on the Function Block.

The time stamping of the alarm is done when the function block is executed.

5.13.1 Alarm Limits

When determining the MV alarm limits, the following equation applies:

$$H2 \geq H1 \geq L1 \geq L2$$

If an attempt is made to cross the alarm limits with each other, the operator is notified that the operation is not permitted. There is no change of the limit.

5.13.2 Alarm Blocking

Supervision of the measured value (MV) and control deviation (DEV) is blocked by activating the input connection ALCBLK.

Automatic alarm blocking can be suitable in connection with start and stop and with anticipated events, the so-called sequential fault blocking. The signal outputs are also affected by this blocking (as to differentiate from operator's blockings which are only blocked on the operator's station and printer).

The event handling function makes it possible to block all alarms from the operator's station or from the function block.

The following errors can be blocked:

$$MV \geq H2$$

$$MV \geq H1$$

$$MV \leq L1$$

$$MV \leq L2$$

$$DEV \geq H1$$

$$DEV \leq L1$$

Using Event handling to block alarms means that the printer and operator's station and updating of the error list are blocked. The PC outputs are not affected.

The following terminals are used for alarm handling.

ALCBLK	Blocking of alarm on MV and DEV
MV_GT_H2	Measured value exceeds H2
MV_GT_H1	Measured value exceeds H1
MV_LT_L1	Measured value less than L1
MV_LT_L2	Measured value less than L2
DEV_GT_H	Deviation exceeds H1
DEV_LT_L	Deviation less than L1
SP=HL	Setpoint limit, high
SP=LL	Setpoint limit, low
OUT=HL	Output signal limit, high

OUT=LL Output signal limit low

5.14 Event Handling

Event are generated for status change on the signals defined in interaction window in chapter 5.15.6 Alarm & Event handling.

The layout of the event is described in chapter 6.3 Alarm and Event Handling.

All Operator Events are reported by Audit Trail Functionality and not included in the FunctionBlock.

The individual text string for each event is stored in the Alarm and Event Translator aspect. This text can be NLS handled.

5.15 Interaction Window

The interaction window is available in the Control^{IT} Control Builder. The interaction window is an engineering aid used to simplify configuration and blocking of signals not available on the faceplates. Changes to values in the Interaction window are only available in 'Online' mode in Control ^{IT}.

5.15.1 Pid01A Interaction Window

Interaction window overview. Name and description are shown. The buttons are links to sub-windows.

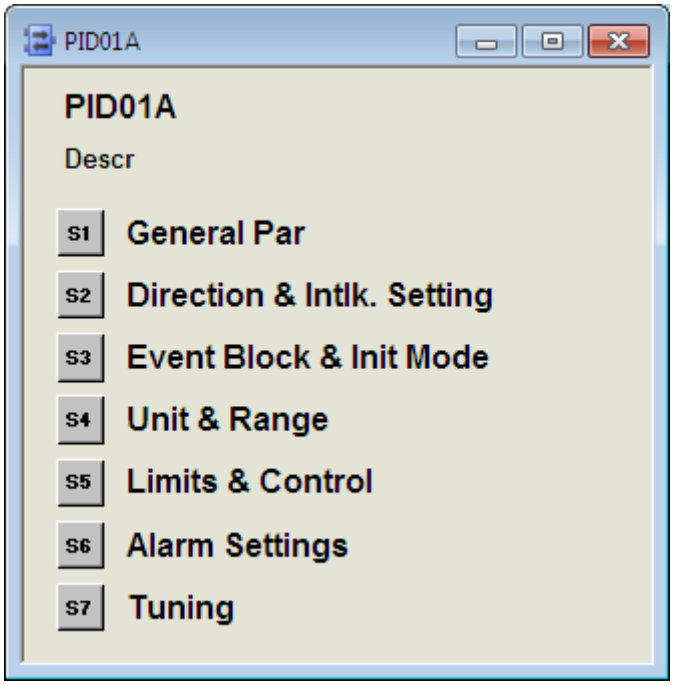


Figure 4-1 Main Interaction Window.

5.15.2 General Parameters

"Class" defines the process section or area in which alarms are grouped. By utilizing class the alarms can be filtered. Valid values are user defined. A suggestion would be to use mill area numbers as class values.

"Severity defines the alarm priority for general alarms. The severity for MV-alarms is entered in window "Alarm & Event". Valid values are 1 –1000 where 1000 is the highest priority.

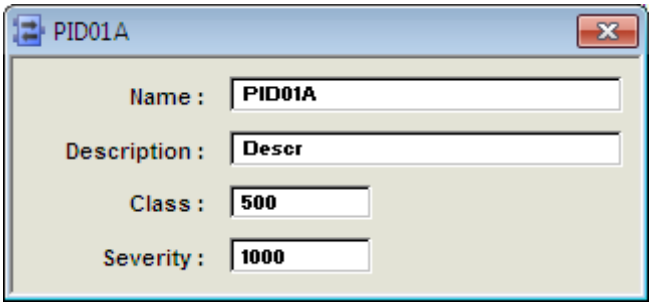


Figure 4-2 General Parameters.

5.15.3 Direction & Intl. Blockings

Control Action (Incr/Incr, Incr/Decr) – indication of direct or reverse control action.

MV Direction (Incr/Decr) – indication of MV response to operator increasing to output.

Actuator Direction (Op/Cls) – indication of actuator response to operator increasing the output.

On/Off Control – indication of actuator feedback in Faceplate and Object Display.

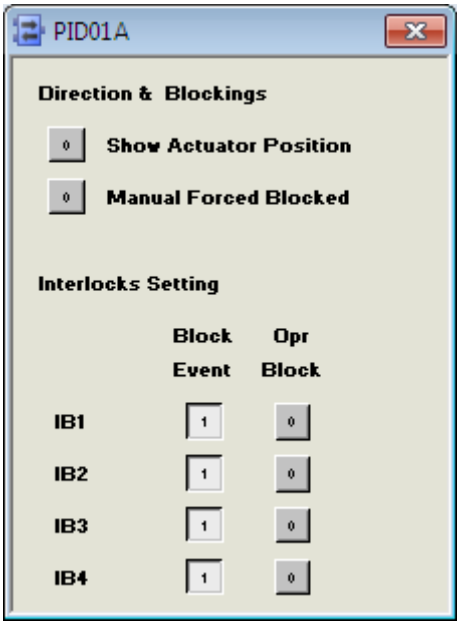


Figure 4-3 Direction & Intl. Blockings.

5.15.4 Units and Range

Measured Value and output (PO), minimum, maximum, units and decimals are entered in this interaction window. The step change for operator increase/decrease buttons is also set in this window.

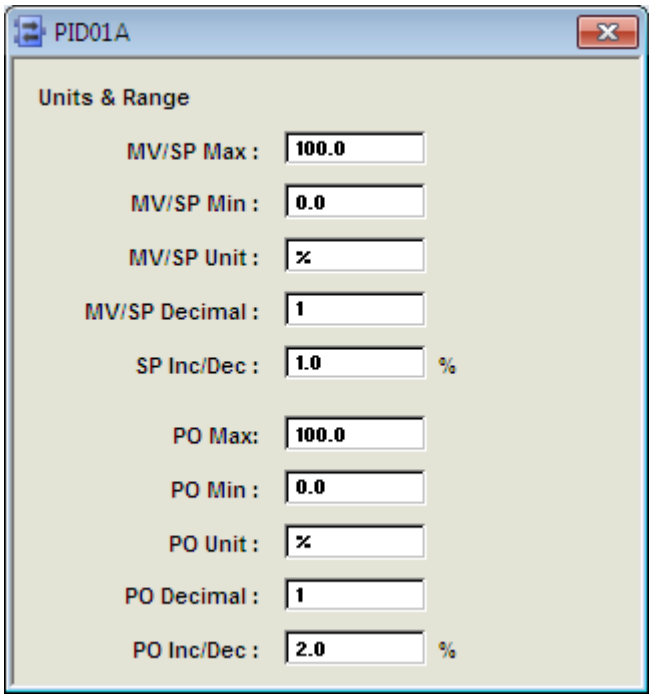


Figure 4-4 Units & Range.

5.15.5 Limits & Control

Limits for output signal and possibilit to set output and/or setpoint.

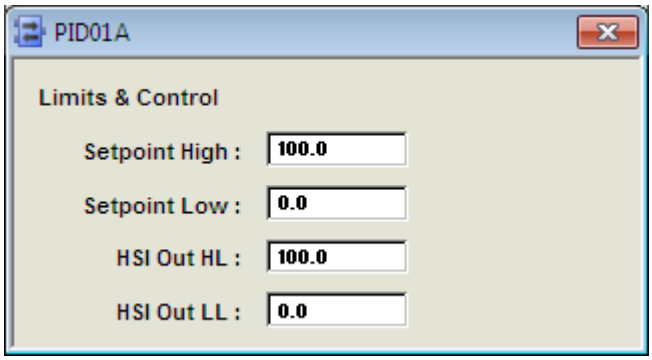


Figure 4-5 Limits & Control.

5.15.6 Alarm & Event handling

Alarm limits, Severity and Enabling of the alarms for measured value and deviation as well as hysteresis and alarm delay time is entered in this window.

For AE config the following values are valid

0 No Alarm or Event are generated

1 Alarm and Event are generated

2 Event is generated

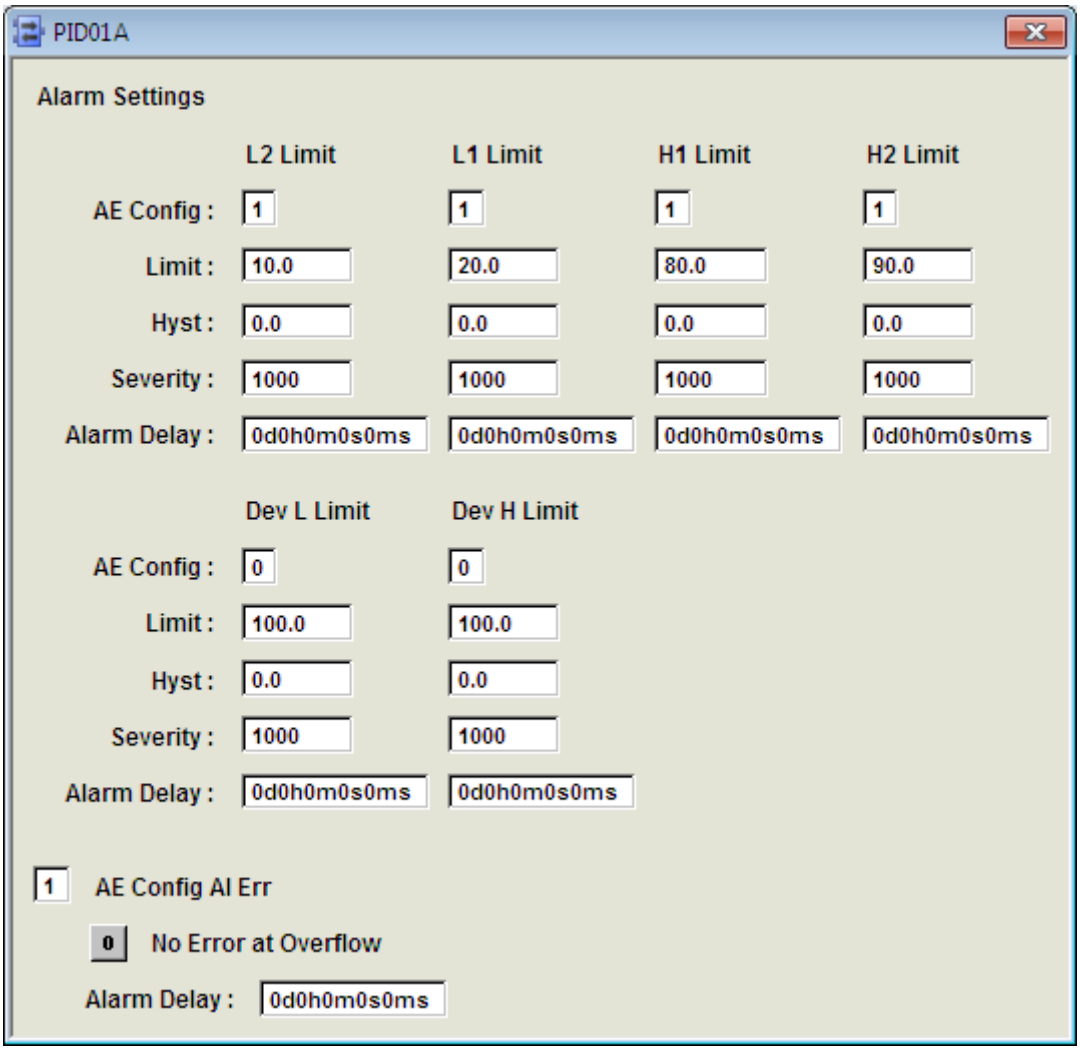


Figure 4-6 Alarm & Event Handling.

5.15.7 Texts

The different interlock and information texts are entered in the aspect Text Properties. The length of the text is limited to about 60 characters, by the size of presentation element in the Interlock Display.

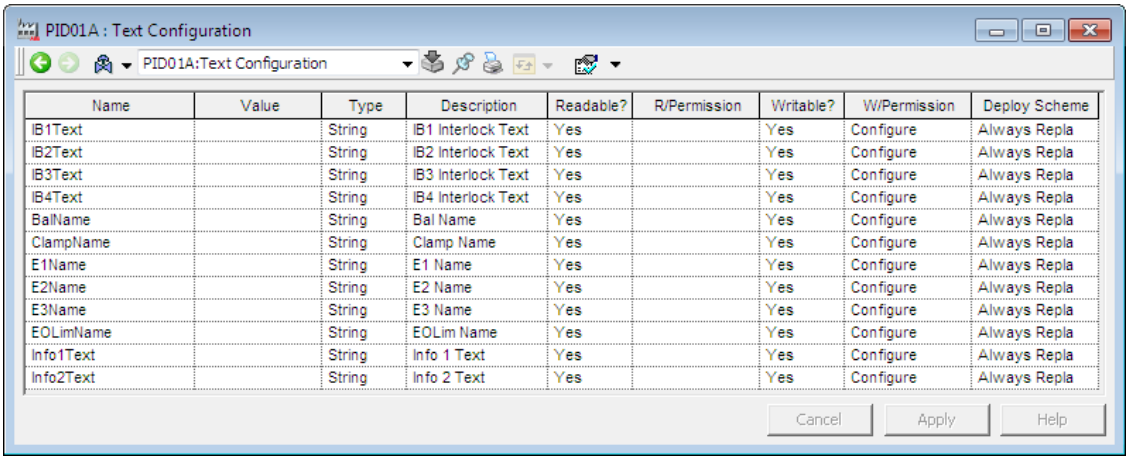
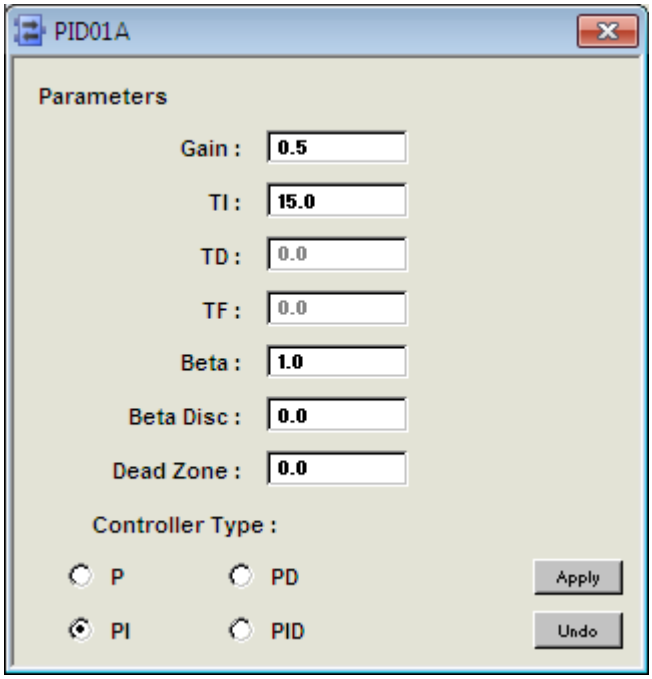


Figure 4-7 Texts.

5.15.8 Parameters



Tuning

This is PidCC Interaction Window on top level. Values can not be modified. Sp is the Working Setpoint.

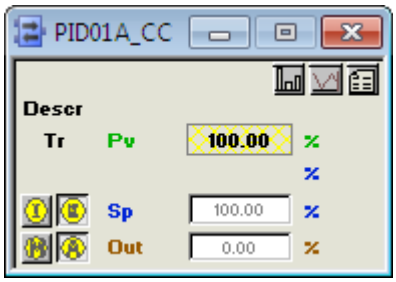


Figure 4-8 PidCC Main Window

5.15.9 Parameters

In this window the control parameters are presented and adjusted.

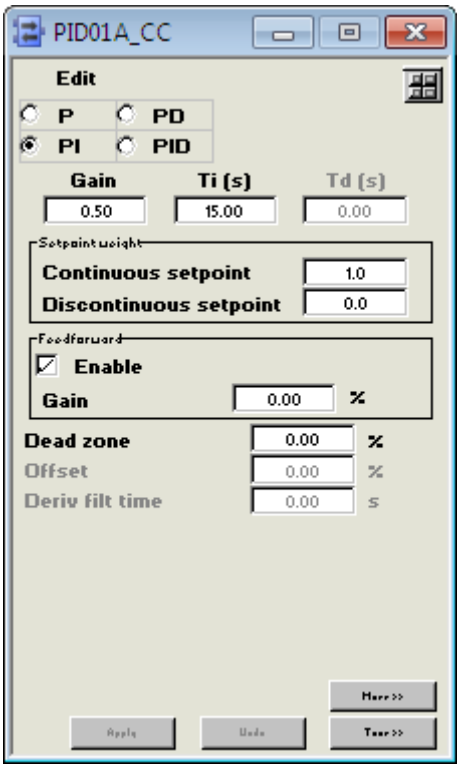


Figure 4.9 PidCC Edit Window

Autotuning is done from this window. Apply will transfer the parameters to the Edit window.

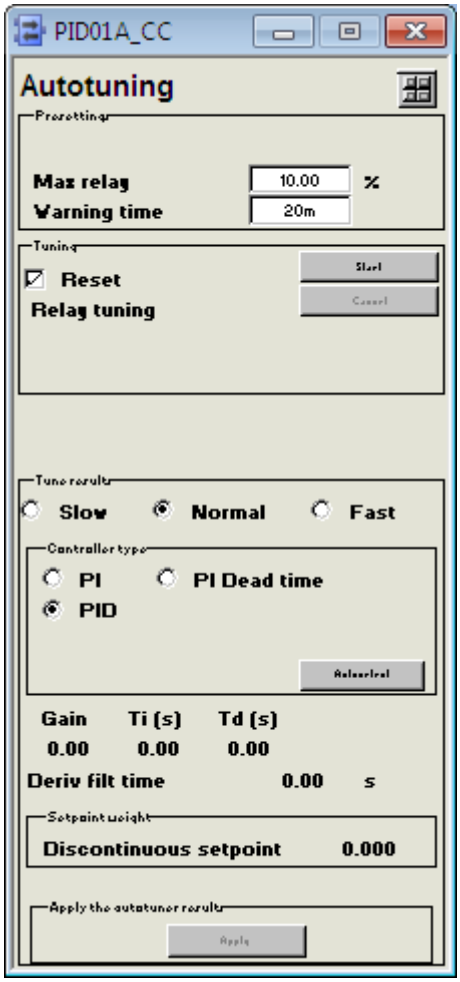


Figure 4-10 PidCC Autotuning Window

This window is for presentation only.

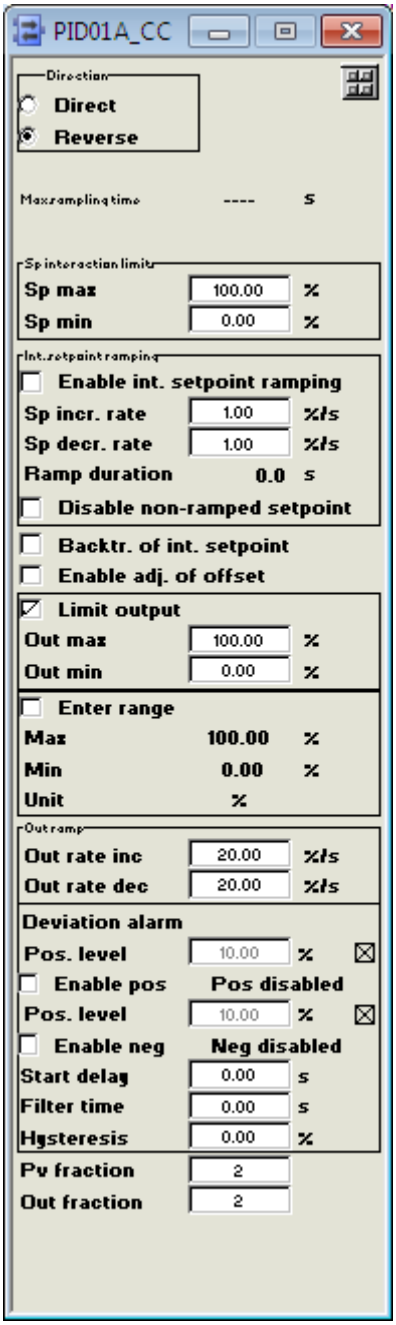


Figure 4-11 PidCC Extra Window

5.15.10 Event Handling

The blocking of Events are entered in this Interaction Window

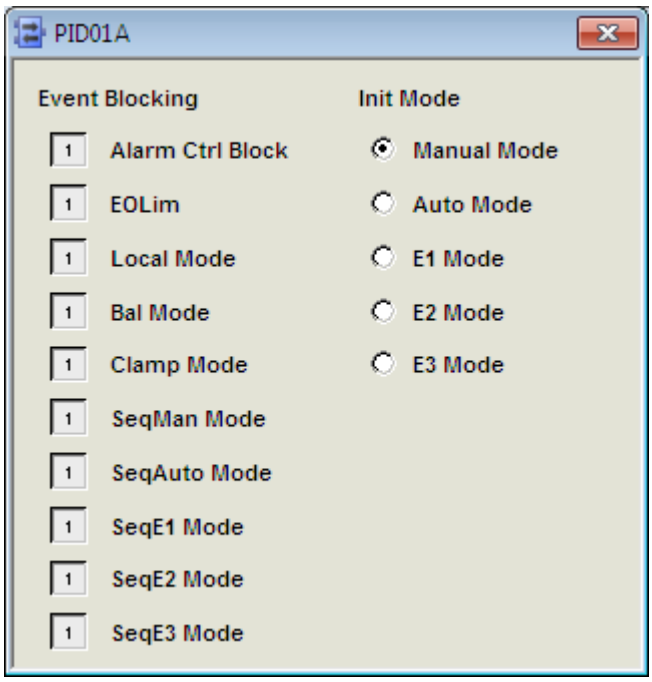


Figure 4-9 Event Blocking.

5.15.11 Gain Scheduling

In this window the control parameters for the different zones are entered.

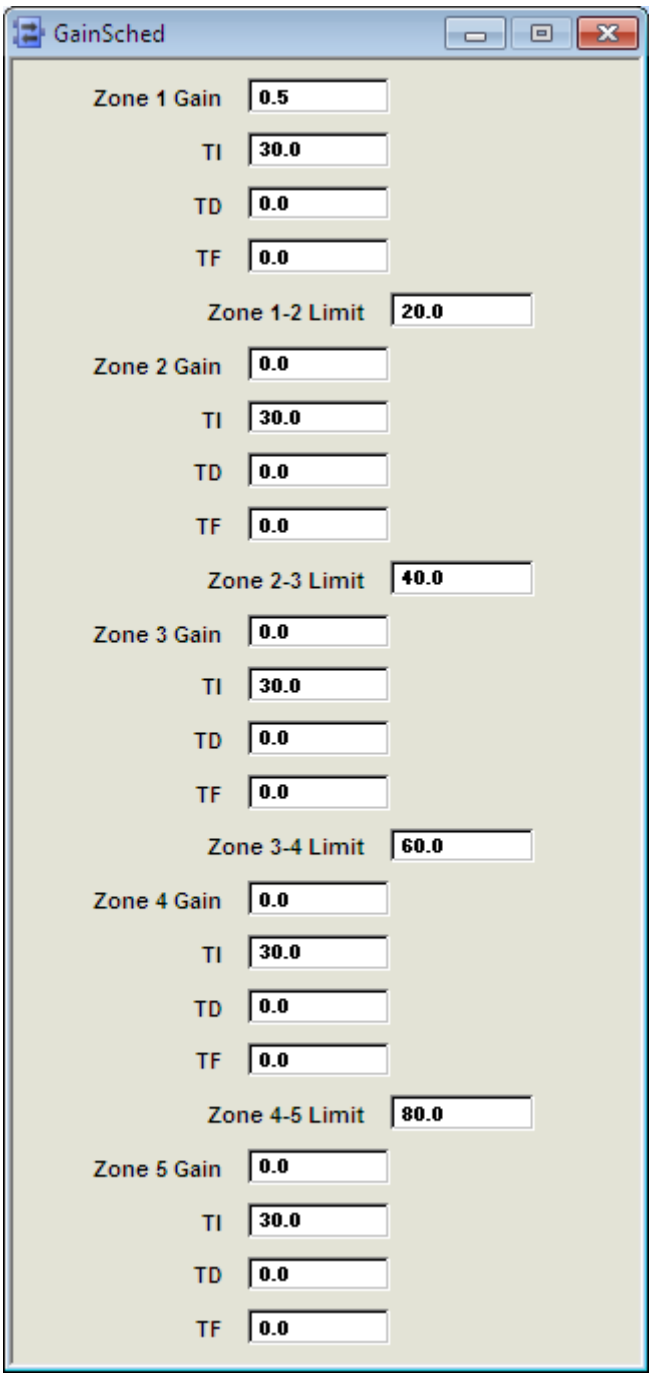


Figure 4-12 Gain Scheduling.

6 Operator Functions

The Operator functions are divided in principle into 4 parts:

- Presentation (Display elements, Time logged properties)
- Faceplate (Dialog)
- Alarm and Event handling
- Text handling

6.1 Presentation

6.1.1 Display Elements

Display elements, which can be used for different display types, are available for use in the functional unit Pid01A.

The display elements show the status and the controls of the process with different degrees of detail and are intended for the following displays:

- Object display
- Process display
- Interlock display

Examples of different display elements which could be used are given in the following sections.

6.1.1.1 Object Display

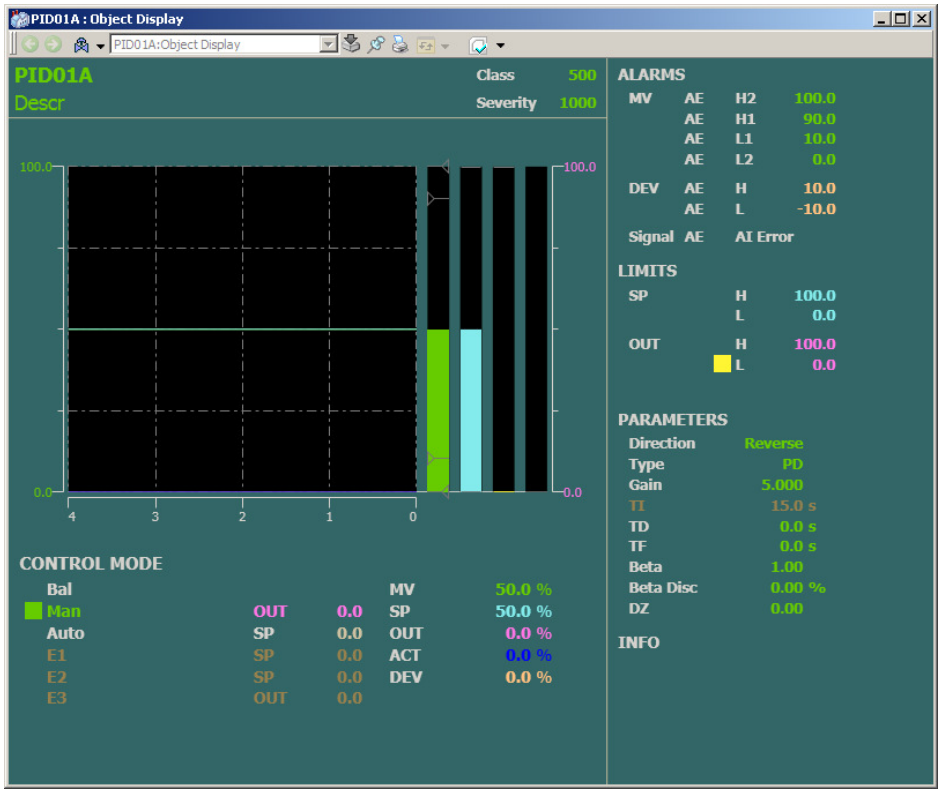


Figure 5-1 Object Display.

6.1.1.2 Process Display

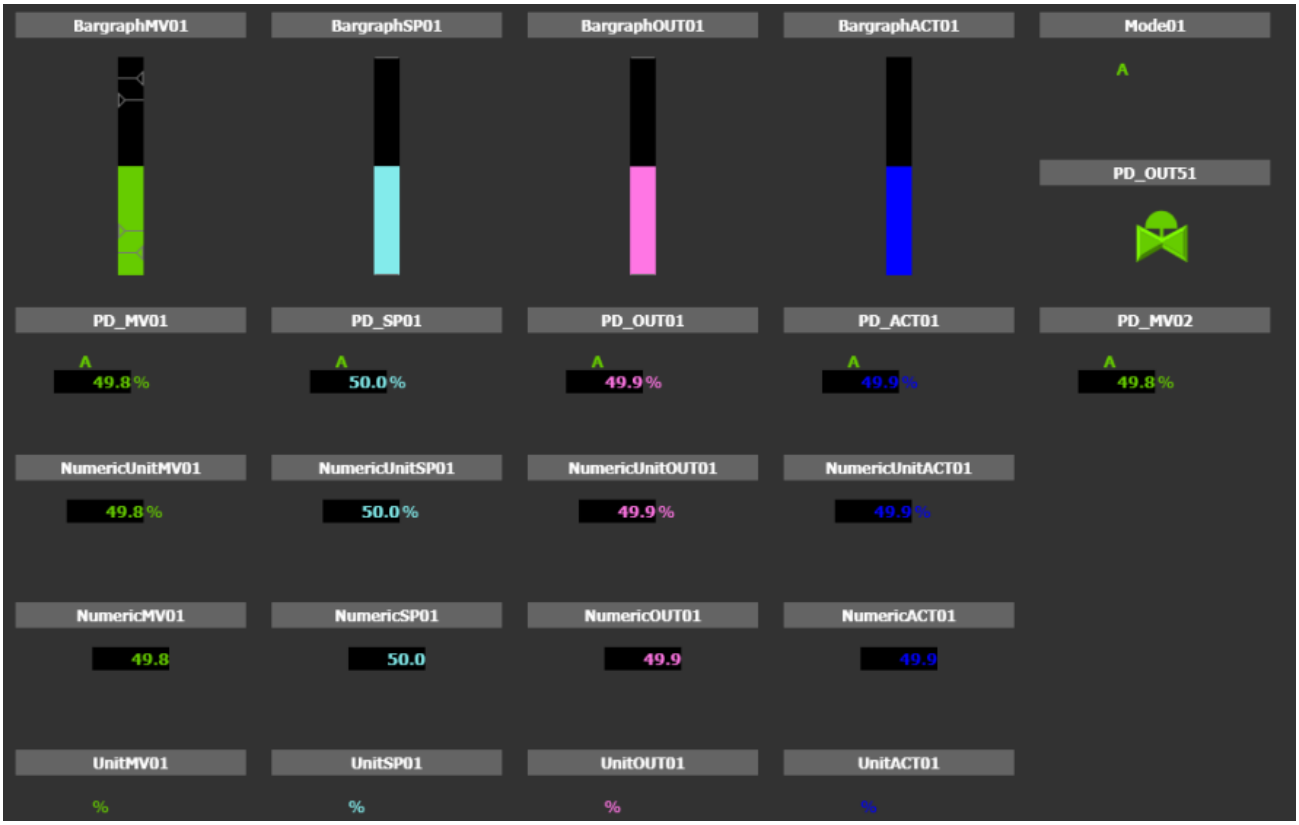


Figure 5-2 Process Display Elements.

6.1.1.3 Interlock display

This display shows the actual status of all Interlock. The operator can override individual interlocks or all interlock.

Interlocks that can be overrided must be set to Blockable. This can be done from this display it the user has permission Configure or from the Interaction Window see chapter 5.15.3.

Start Interlock, Block Event and IA Blocked when no in E1 or E2 mode are parameters that can be set from this display if the user has Permission Configure or from Interaction Window.

6.1.2 Time-logged Properties

Measured values stored can be presented graphically in the form of curves on the display screen. Such a display, a **Trend displa**y, can consist of 1- 4 curves. All properties for the object Pid01A are available to be logged on the trend curves.

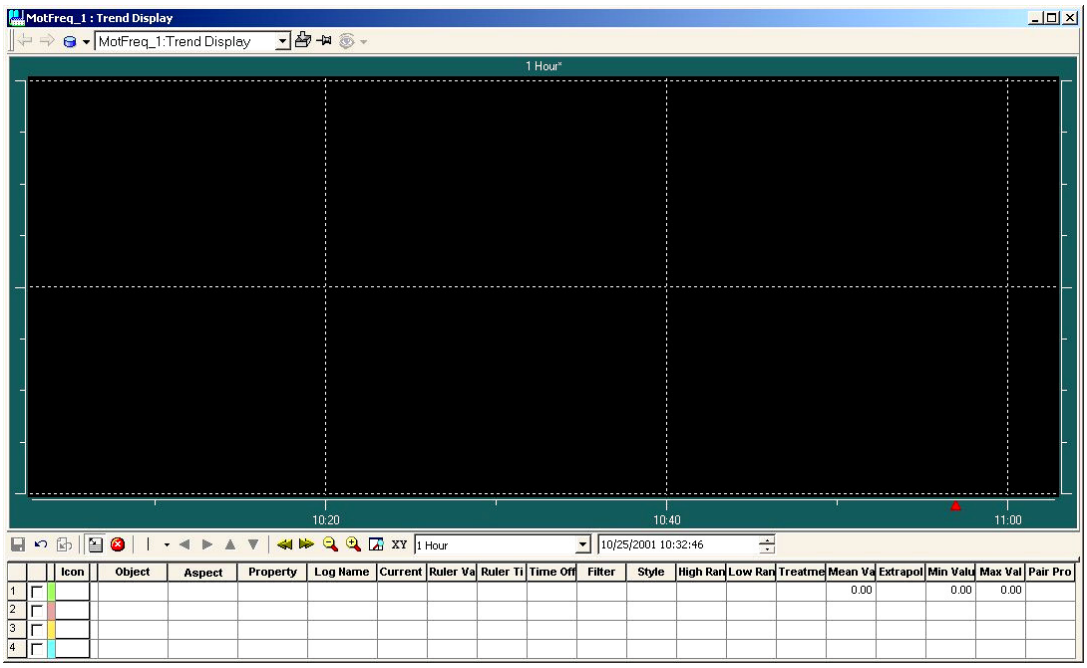


Figure 5-3 Trend Curve

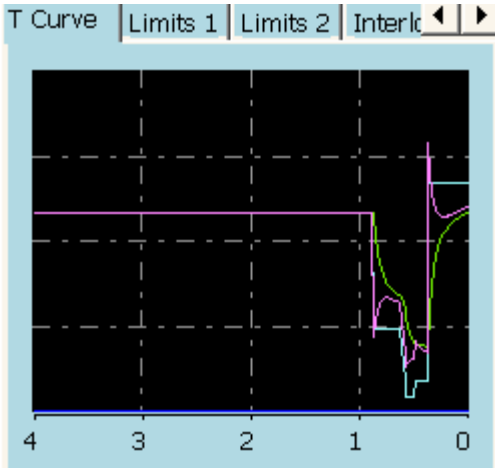


Figure 5-4 Extended Faceplate (T Curve)

6.2 Faceplate(Dialog)

The display screen is supplemented with a mouse and keyboard for operator communication with the functional unit/object.

By using Operate^{IT} Operator Station the operator can view and control the process through faceplates. The dialogue consists of buttons, indicators and graphic presentations within a Faceplate. A faceplate has three levels of dialogue, which are presented by the following three runtime views:

- Reduced Faceplate, where the size and contents typically have been optimized to cover most of the normal process operator actions. Minimum dialogue. This is the default view.
- Faceplate, which typically covers all normal process operator actions. This view is disabled as default.
- Extended Faceplate, with functions and information intended for the process engineer or the advanced operator. Maximum dialogue.

The figures 5-5 to 5-7 below and overleaf illustrate the various presentations of the faceplate.

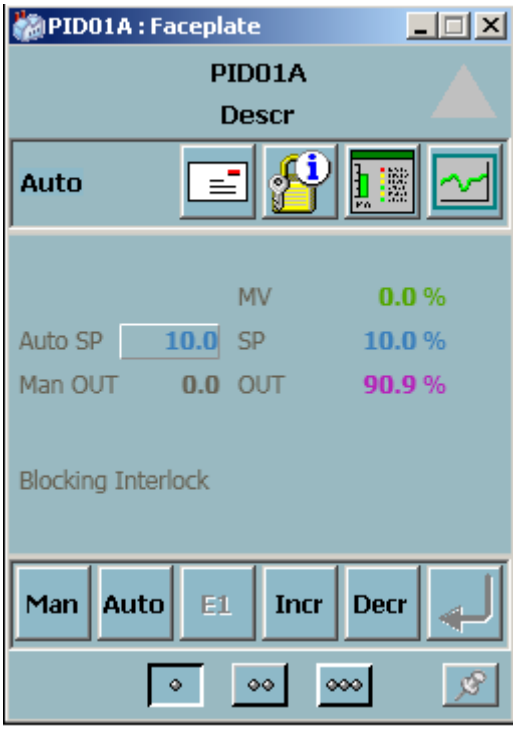


Figure 5-5 Reduced Faceplate.

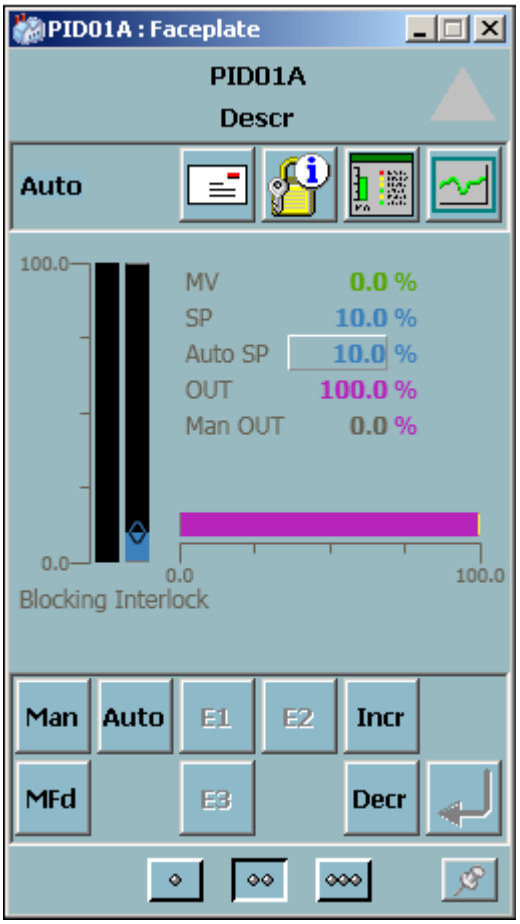


Figure 5-6 Faceplate.

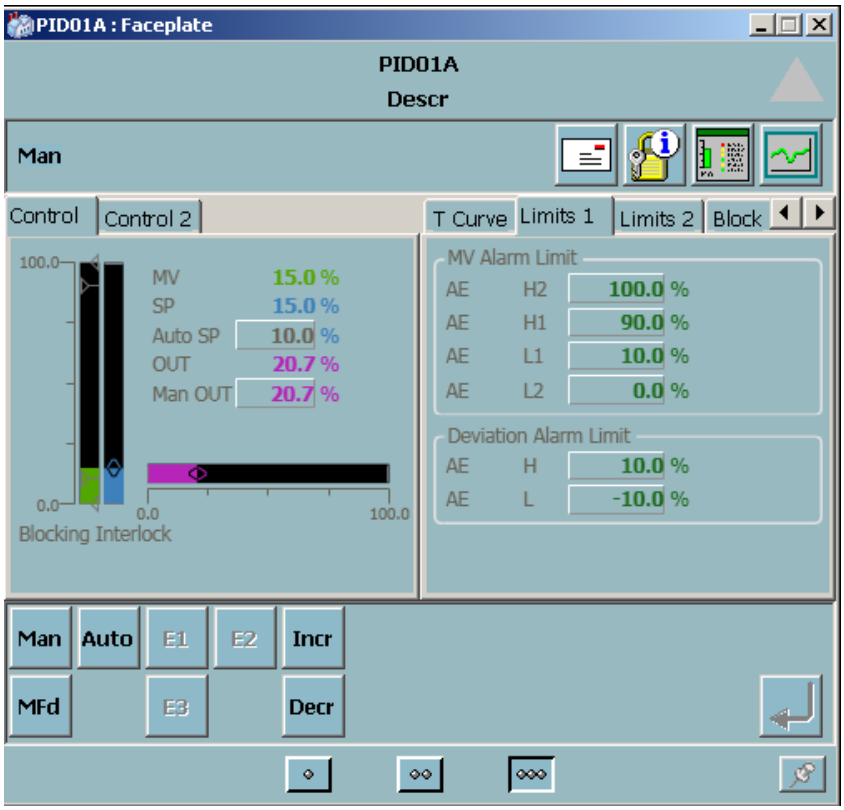


Figure 5-7 Extended Faceplate

6.3 Alarm and Event Handling

6.3.1 General

This section contains a description of all alarms and events in the functional unit Pid01A.

When a measured value deviates from the controllers limits or fails an alarm and an event is generated and can be viewed on the Operate^{IT} Operator Station. The alarms are indicated in the faceplate, object display and in the alarm and event list.

The possibilities of the operator to block alarms are shown under the heading ‘Event and alarm blocking’ below.

The alarm limits for Pid01A can be controlled individually

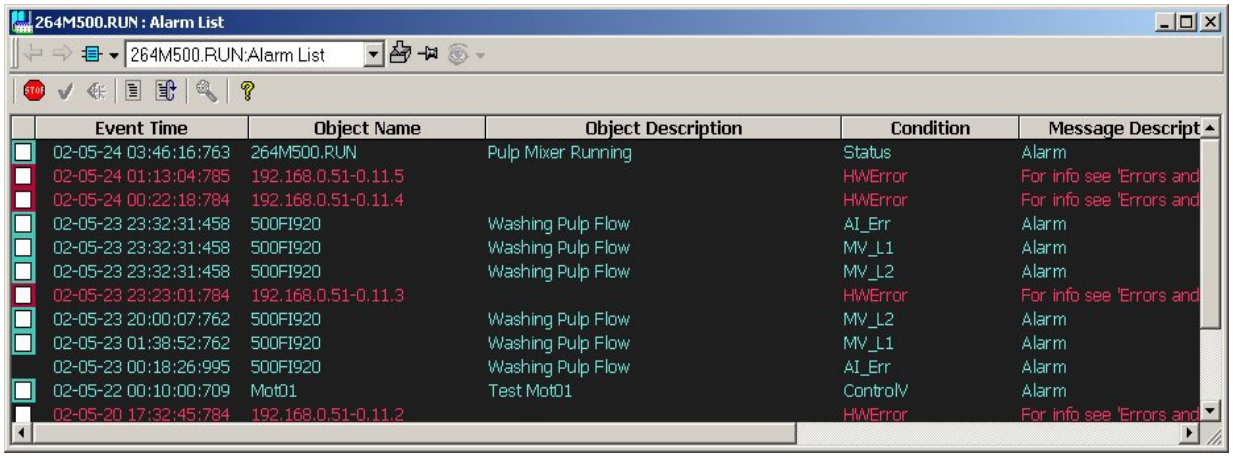


Figure 5-8 Alarm List

6.3.2 Alarm and Event Message

The following alarm texts are generated by the functional unit Pid01A. The “Condition” text are stored in the Alarm and Event Translator aspect and can be NLS handeled.

Object Name	**Object Description**	**Condition**	**Message Description**
<Name>	<Description>	AIError	Alarm
<Name>	<Description>	DevHigh	Alarm
<Name>	<Description>	DevLow	Alarm
<Name>	<Description>	MV > H1	Alarm
<Name>	<Description>	MV > H2	Alarm
<Name>	<Description>	MV < L1	Alarm
<Name>	<Description>	MV < L2	Alarm

The “Message Description” text are stored in the Alarm and Event Translator aspect and can be NLS handled.

SourceName	**ObjectDescription**	**Condition**	**Message Description**
<Name>	<Description>		SeqE1 Mode
<Name>	<Description>		SeqE2 Mode
<Name>	<Description>		SeqE3 Mode
<Name>	<Description>		SeqAuto Mode
<Name>	<Description>		SeqMan Mode
<Name>	<Description>		Bal Mode On
<Name>	<Description>		Bal Mode Off
<Name>	<Description>		Clamp Mode On
<Name>	<Description>		Clamp Mode Off
<Name>	<Description>		Local Mode On
<Name>	<Description>		Local Mode Off
<Name>	<Description>		EoLim On
<Name>	<Description>		EoLim Off
<Name>	<Description>		IB1 On
<Name>	<Description>		IB1 Off
<Name>	<Description>		IB2 On
<Name>	<Description>		IB2 Off
<Name>	<Description>		Alarm Acknowledge
<Name>	<Description>		Alarm P Blk

6.4 Faceplate tabs

6.4.1 Alarm Blocking.

By using the extended faceplate it is possible for the process engineer to block alarms.

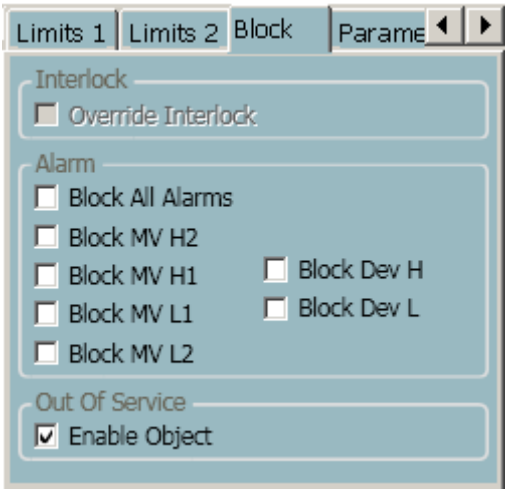


Figure 5-9 Extended Faceplate (Block1)

6.4.2 Limits

By using the extended faceplate it is possible to adjust the limits for the measured value, the setpoint, the deviation and the output. The faceplate elements in the extended faceplate below illustrate this.

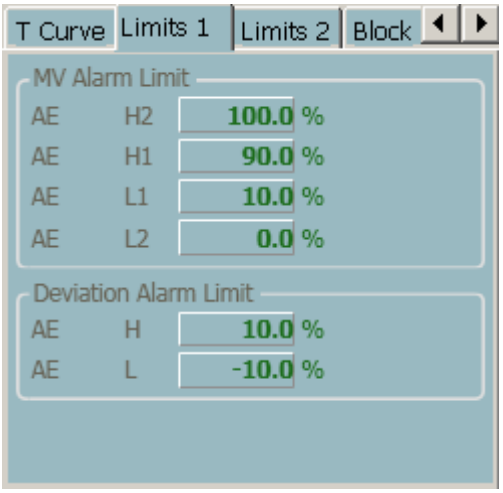


Figure 5-10 Extended Faceplate (Limits1)

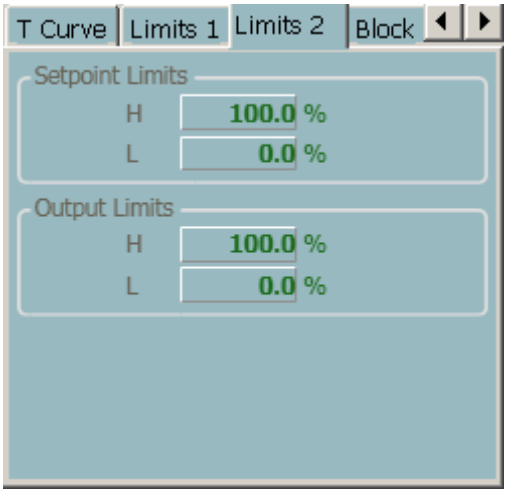


Figure 5-11 Extended Faceplate (Limits2)

6.4.3 Controller Parameters

The “Param” faceplate element in the extended faceplate below illustrates where it is possible to adjust the gain, integral time, derivation time and filter time for the controller. The scan time, control action and controller type is also indicated here.

The feed forward gain is used to compensate for measurable disturbances to achieve faster and smoother control of a process.

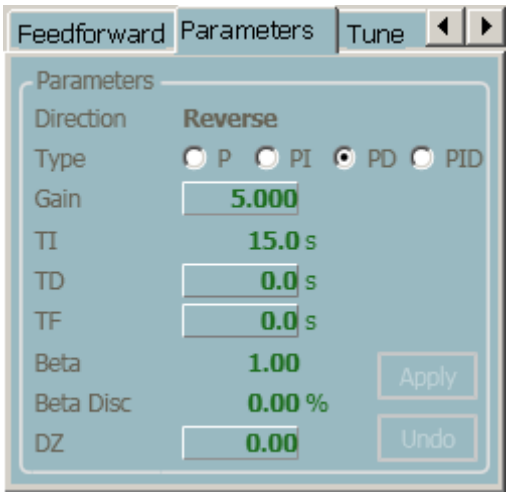


Figure 5-12 Extended Faceplate (Param)

Figure 5-13 Extended Faceplate (Feed Forward)

6.4.4 Autotuning

Two faceplate elements deals with Autotuning:

- Tune is where the tuning is started from
- Tune Result is where the resulting parameters are presented

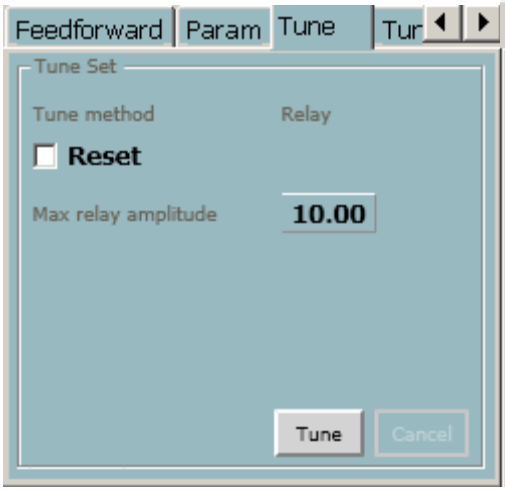


Figure 5-14 Extended Faceplate (Tune)

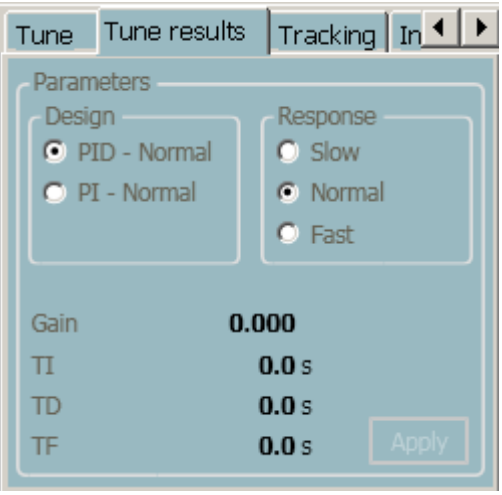


Figure 5-15 Extended Faceplate (TuneResult)

By setting the Reset parameter, the values of the noise level and the relay amplitude saved by the Autotuner from the previous autotuning are rejected. A new estimate of the noise level is then made. Reset is recommended when a condition of the process, such as dynamics or noise properties, has changed. It should also be used when earlier autotuning has failed.

6.4.5 Info Text

6.4.6 Tracking

Tracking setup is presented in text.

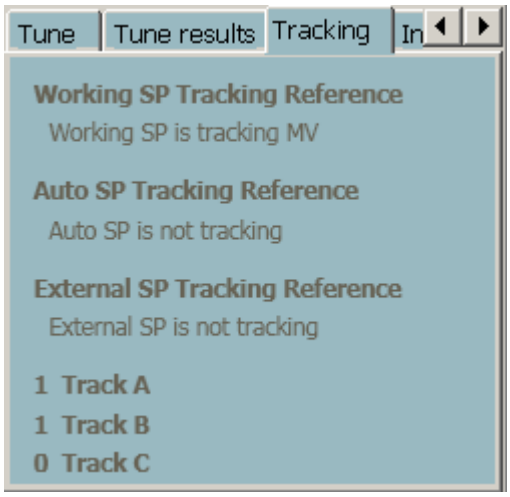


Figure 5-17 Extended Faceplate (Tracking)

6.4.7 Status IO

The “Status” tab is showing the type of device and it’s status for the measured value.

If the signal is connected via a Profibus PA link the extended status from the device is showed in this tab. For more information see document *Integration of PA instruments 3AST001 792 D0090.*

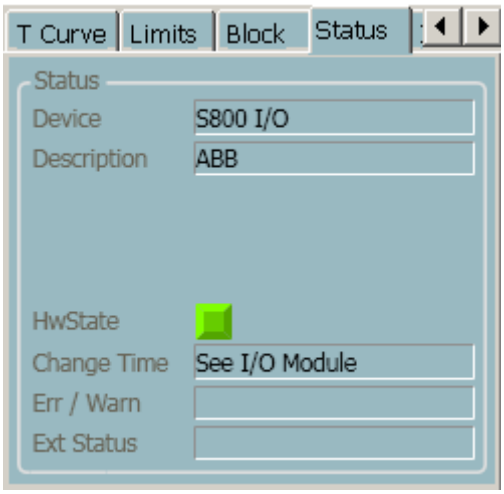


Figure 5-18 Extended Faceplate (Status IO))

7 References

Ref1.:

3BSE 028 809 R101 Rev B Control^{IT} AC 800M/C Version 3.2 Analog Process Control Objects and Design

REVISION

Rev.	Page (P) Chapt. (C)	Description	Date Dept./Init.
-		New document	2005-02-22/HE
A	4, 5	Interaction Window & Faceplate. Rev 4.0/1	050902/MP
B	3	Param connection removed rev 4.0/5	070511/BP
C	4.2.5	External control data updated	080623/BP
D		5.0-1 Interlock functionality updated	081203/BP
E		5.0-2 Update of External control data, faceplate element and Interaction window elements	090909/BP
F		Updated Rev 5.1/0	101103/BP