

GENERAL SPECIFICATION

INSTRUMENTATION

GS EP INS 197

Process Standard Functions

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1. Scope

The purpose of this document is to define a set of Standard Functions for most common process functions.

It includes the following functions with some options:

- PID
- Low voltage and high voltage motor
- Centrifugal pump unit
- Duty/Back-up/Standby unit
- ON/OFF process valve
- ON/OFF manual valve
- Pressure/temperature compensated flow
- Total flow.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
Not applicable	

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP INS 150	Design method for system configuration - Standard functions

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Chapter 1 PID Standard Function

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1. Scope

The purpose of this document is to define the Standard Function of PID controller.

In order to assist in understanding, the document should be read in conjunction with **GS EP INS 150**.

This Standard Function shall be used in conjunction with the AI standard and potentially with the RAI (Redundant analogue inputs) and GCF (Pressure and temperature compensated flow) Standard Functions as well.

The analogue output is part of this Standard Function.

The following options are available:

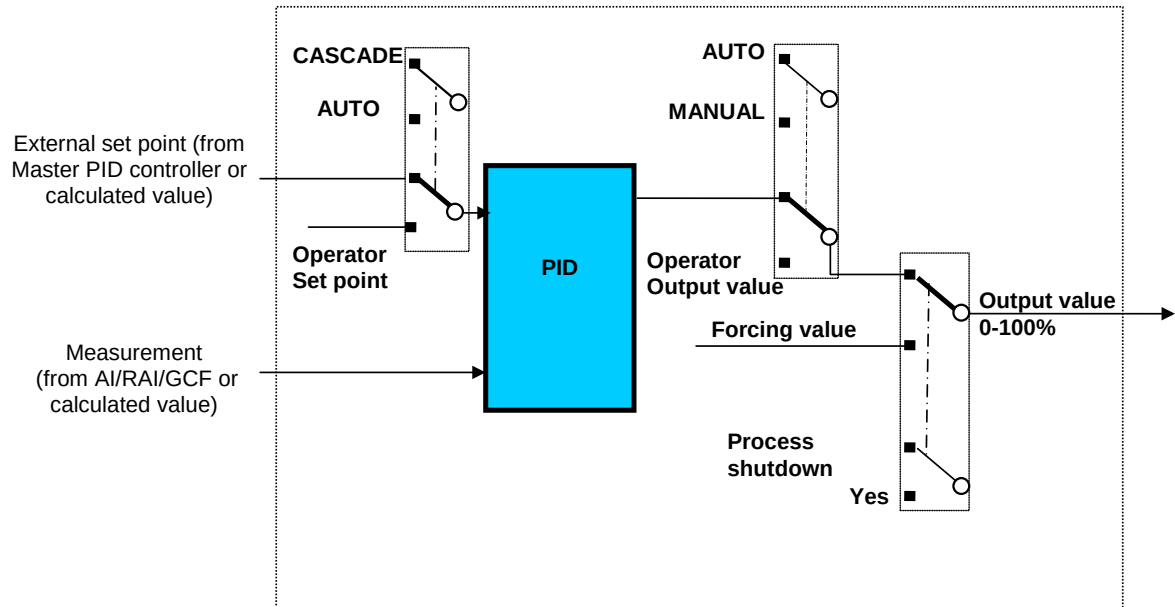
- PID: Standard functions
- PID_MR/PID_SR: Cascaded controllers (Master/Slave)
- PID_RD: PID controller with redundant valves
- PID_SPR: Split range PID controller
- PID_ON/OFF: PID controller with flip/flop analogue output
- PID_1DC: PID controller with digital output

2. General description of functions

2.1 List of main functions

- Control function using PID algorithm
- Process shutdown (in function of associated SDV position)
- Maintenance inhibit of measurement (from AI standard)
- Analogue input and output fault.

2.2 Functional scheme



3. Interfaces description

INPUTS				OUTPUTS				
Field	HMI	Internal		Internal	HMI	Field		
			CASCADE/AUTO/MANUAL commands			CASCADE/AUTO/MANUAL status		
			Set point (in AUTO mode)			Output value (0-100%)		
			Output value (in MANUAL mode)			Output fault status		Alm
			Measurement (in eng. units)			Safety trip status		Alm
			Maintenance inhibit status			MANUAL automatic setting		
			Measurement fault status			Analogue output (4-20 mA)		
			Process shutdown					
			Set point (in CASCADE mode)					
			Slave: Set point from Master controller (in CASCADE mode)			Master: Set point to Slave controller (Slave in cascade)		
			Switching command of Valves (valve 1 / valve 2)			Second analogue output (4-20 mA)		
						2 nd output value (0-100%)		
						Second analogue output (4-20 mA)		
						Digital output instead of analogue output		
						Alm = Alarm		

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4. Detailed description of functions

4.1 CASCADE/AUTO/MANUAL mode

4.1.1 Specific description

4.1.1.1 Definitions

- **MANUAL:** PID algorithm is stopped and the output value is set by the operator
- **AUTO:** PID algorithm runs with an operator set point
- **CASCADE:** PID algorithm runs with the set point set by a higher level automatic control (external set point)

Auto and cascade mode may be interlocked by a higher level standard.

4.1.1.2 Set point handling

The last set point entered by the operator is memorised and displayed (e.g. on a dedicated summary mimic).

When the PID controller is in MANUAL, the set point tracks the measurement.

When the PID controller is in AUTO, the external set point tracks the operator set point.

When the PID controller is in CASCADE, the operator set point tracks the external set point.

4.1.1.3 CASCADE/AUTO ↔ Manual transitions

- **CASCADE/AUTO → MANUAL transition**

The output value does not change because the HMI output value is aligned with the last calculated value.

- **MANUAL → CASCADE/AUTO transition**

The output value does not change because the initial calculated output value is aligned with the HMI value (and set point = measurement).

4.1.1.4 FREE ↔ CASCADE transitions

- **AUTO → CASCADE transition**

The external set point is aligned with the operator set point.

A set point change will be required by the higher level automatic control only after CASCADE mode status checking.

- **CASCADE → AUTO transition**

The operator set point is aligned with the external set point.

4.2 Output value handling

The output value range is from 0 to 100%.

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4.3 Process shutdown

Process shutdown function is performed when the corresponding internal input is initiated (e.g. from the associated SDV closed status).

Upon initiation, actions will be safety trip animation and output value forced to the forcing value.

4.4 Maintenance inhibit of associated measurement

When the corresponding measurement is inhibited, the PID algorithm is stopped and the output value is frozen to the last calculated output value. The operator can not change the set point.

The operator can set the PID controller to MANUAL mode and change the output value.

If the PID controller is switched back to AUTO or CASCADE modes, the output value will not change and is frozen again.

4.5 Analogue output fault status

This status is active when the loop is open-circuit or when the corresponding card is faulty.

4.6 Measurement fault

When the associated measurement is in fault, the CASCADE/AUTO/MANUAL mode is forced to MANUAL.

4.7 Specific features when interlocked with RAI standard

When the switching from PSS measurement to PCS measurement is active, the PCS transmitter inhibit will not affect the PSS transmitter, which is currently utilised by the PCS: the measurement is not frozen.

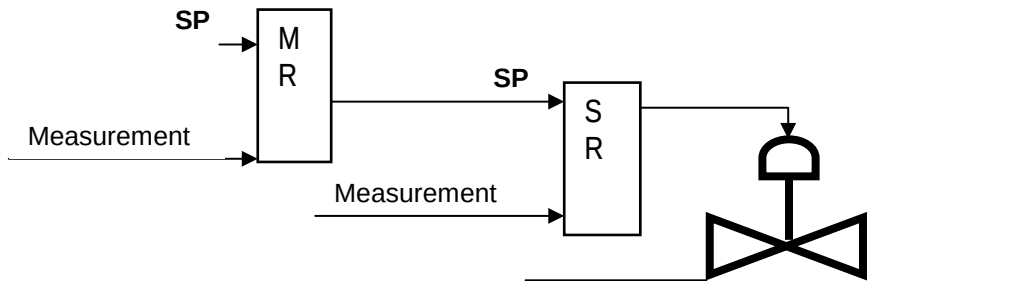
If a discrepancy alarm is active at the switching time, the PID controller will be forced to MANUAL, in order to avoid process upset. In this case, the discrepancy detection has to be considered at time t-1, while the fault detection is considered at time t.

4.8 Status of automatic switching to MANUAL mode

This status is active when the PID controller is forced to MANUAL upon measurement or analogue output fault or upon a situation as defined within the above paragraph; it will be reset after acknowledgement.

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4.9 PID_MR / PID_SR Option: Cascaded controllers (Master/Slave)



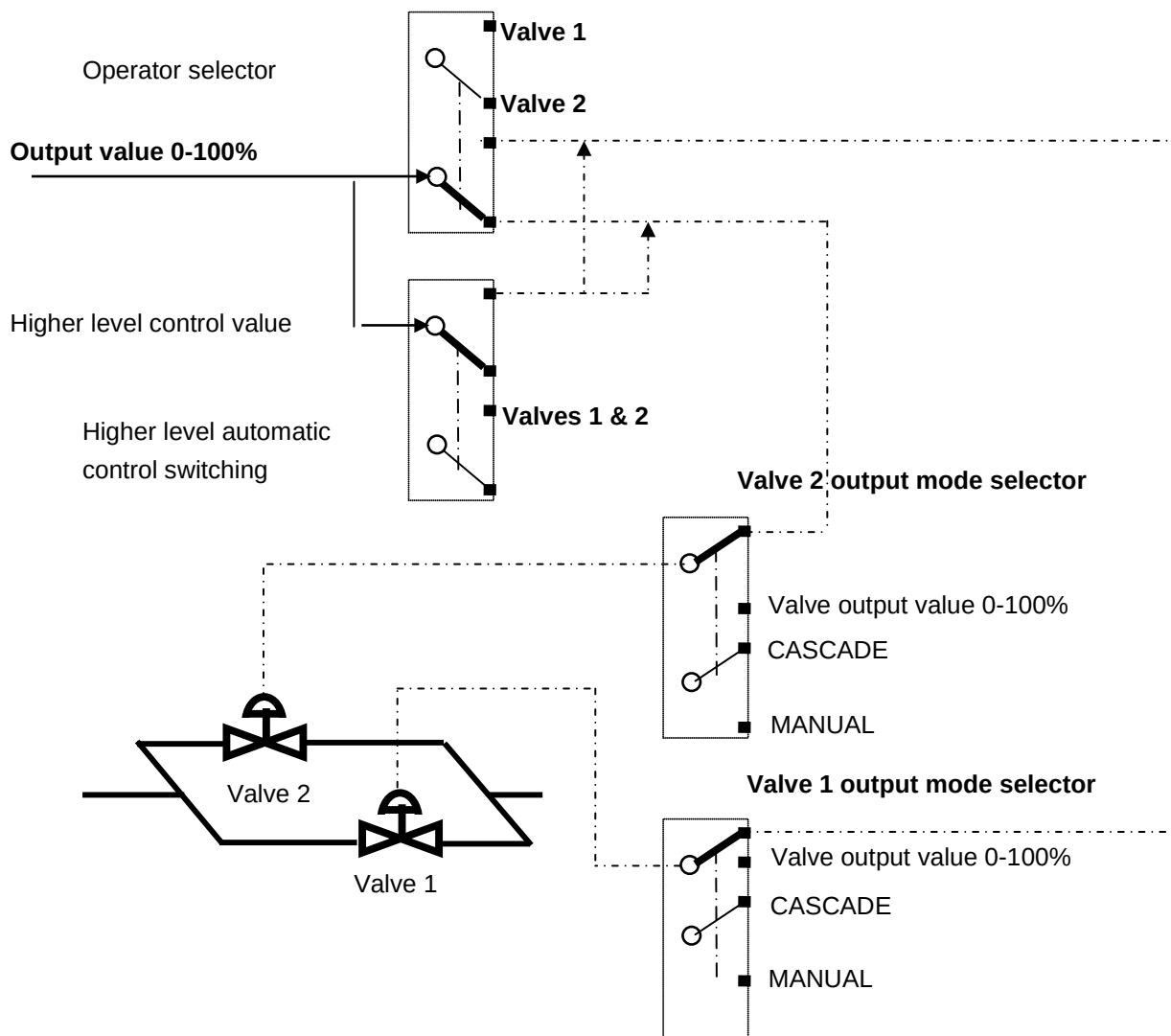
MR: Master PID controller

SR: Slave PID controller

When the Slave controller is set to MANUAL or AUTO mode, the Master controller is forced to MANUAL mode with its output value tracking the operator set point of the Slave regulator. The operator can not change this output value.

The status of the automatic switching to MANUAL mode is active.

4.10 PID_RD Option: PID controller with redundant valves



4.10.1 Normal situation

The operator can select the valve to be operated, the other valve is considered as a backup valve.

The selected valve is controlled by the PID controller output value, while the backup valve is set to 0%.

Upon valves change over, a ramp may be implemented as necessary. Control of both valves by a higher level automatic control is available.

When the higher level control switching is active, both valves are controlled by the output value of the PID controller; the operator can not change the valve selector.

The last position of the manual switch is memorised and the normal control resumes with the last selected valve when the command of the higher level automatic control is no longer active.

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4.10.2 Individual control of both valves in maintenance access

The maintenance operator has the possibility to control individually each valve by means of the output control block no matter the CASCADE/AUTO/MANUAL mode status of the PID. The access will be possible from the corresponding group mimic including both faceplates of the output control blocks. The group mimic is directly linked from the process mimic by means of a "soft key".

Both output control blocks may be set in CASCADE (normal situation) or MANUAL mode. When in MANUAL mode the output value can be changed.

The operator has to switch back output control to CASCADE mode in order to resume PID control.

4.10.2.1 Handling of CASCADE/AUTO/MANUAL mode of PID controller

The PID controller is forced to MANUAL when the output control block of the selected valve is in MANUAL. The operator can set the PID controller in AUTO/CASCADE when the output control block of the selected valve is in CASCADE.

The PID controller is forced to MANUAL when both output control blocks are in MANUAL during the control of both valves by a higher level automatic control. The operator can turn back the PID controller to AUTO/CASCADE when one of the output control blocks is set to CASCADE mode.

4.10.2.2 MANUAL ↔ CASCADE transitions of the output control blocks

4.10.2.2.1 CASCADE → MANUAL transition

The output value of the output control block does not change because the HMI output value is aligned with the last calculated value.

4.10.2.2.2 MANUAL → CASCADE transition

The output value of the PID controller is aligned with the value of the output control block of the selected valve, or with the value of the first output control block turned back to CASCADE mode in the case of control of both valves. Therefore, the output value of the concerned output control block does not change.

Concerning the backup valve, or the second valve in case of control of both valves, the calculated value (0% or output value of the PID controller) may be reached by means of a ramp if necessary (as per § 4.10.1).

4.10.3 Limitation of output value of the PID controller

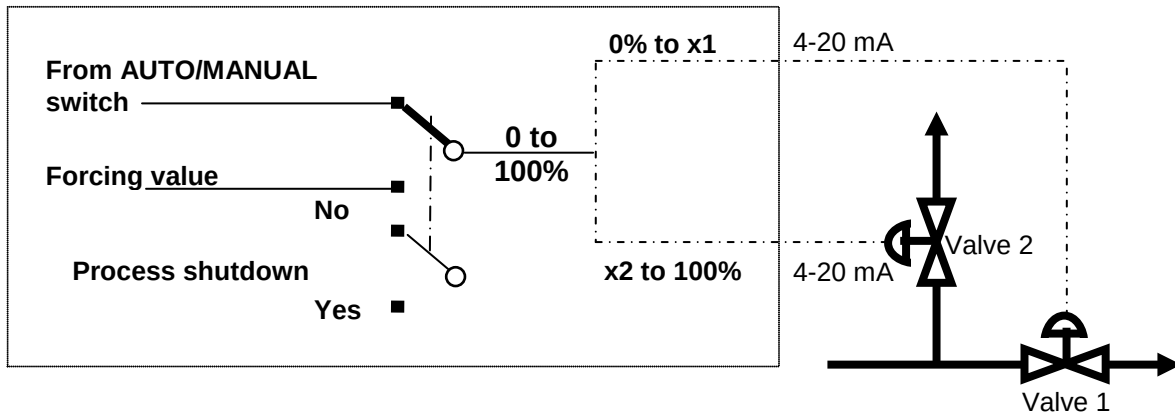
The output value of the PID controller will be limited by thresholds of the output control blocks, effective when PID mode is in AUTO or CASCADE:

- Limited if both output control blocks have reached a limit, when both output control blocks are in CASCADE
- Limited if the remaining output control block in CASCADE has reached a limit.

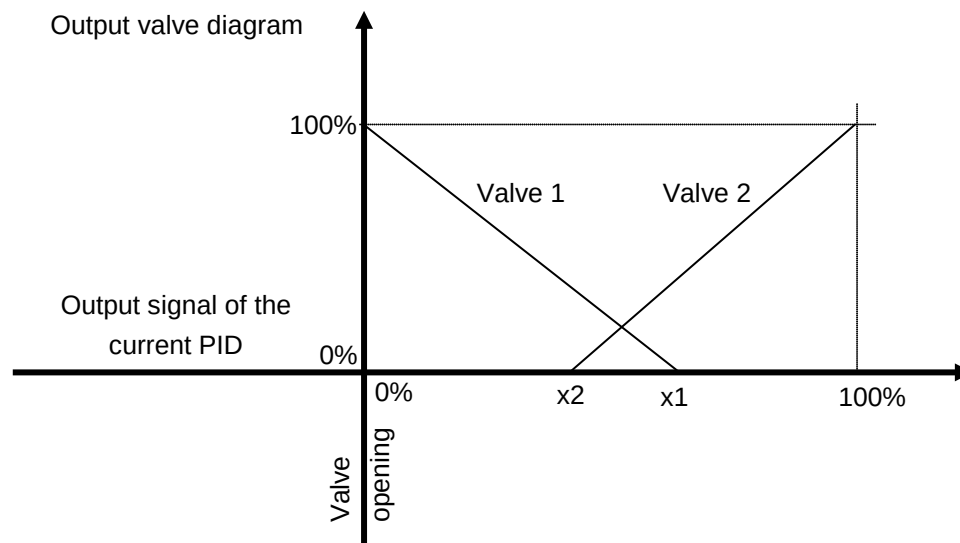
4.10.4 Process shutdown

The mode of the output control blocks (MANUAL/CASCADE) is not locked.

4.11 PID_SPR Option: split range PID controller



Example of a SPLIT RANGE:



4.11.1 General points

The Output value of the PID controller is split to two control valves. Each valve has its own 4-20 mA signal.

4.11.2 Individual control for both valves

The maintenance operator has the possibility to control individually each valve.

4.11.2.1 Access

The maintenance operator has the possibility to control individually each valve by means of the output control block, no matter the CASCADE/AUTO/MANUAL mode status of the PID. The access is possible from the corresponding group mimic including both faceplates of output control blocks. The group mimic is directly linked from the process mimic by means of a "soft key".

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Both output control blocks may be set in CASCADE (normal situation) or MANUAL mode. When in MANUAL mode the output value can be changed.

The operator has to switch back output control block to CASCADE mode in order to resume PID control.

4.11.2.2 Handling of CASCADE / AUTO / MANUAL mode of PID controller

The PID controller is set and locked in MANUAL when the output control block of the selected valve is in MANUAL. The operator can set the PID controller in AUTO/CASCADE when the output control block of the selected valve is in CASCADE.

4.11.2.3 MANUAL $\leftrightarrow$ CASCADE transitions of the output control blocks

4.11.2.3.1 CASCADE $\rightarrow$ MANUAL transition

The output value of the output control block does not change because the HMI output value is aligned with the last calculated value.

4.11.2.3.2 MANUAL $\rightarrow$ CASCADE transition

The output value of the PID controller is aligned with the value of the first output control block turned back to CASCADE mode. Therefore the output value of the concerned output control block does not change.

Concerning the second valve, the calculated value (output value of the PID controller) may be reached by means of a ramp if necessary (as per § 4.10.1).

4.11.3 Limitation of output value of the PID controller

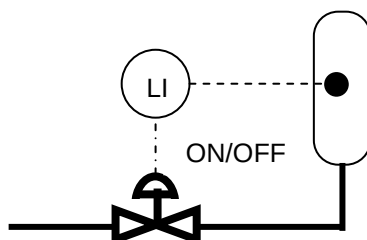
The output value of the PID controller will be limited by thresholds of the output control blocks, effective when PID mode is in AUTO or CASCADE:

- Limited if both output control blocks have reached a limit, when both output control blocks are in CASCADE
- Limited if the remaining output control block in CASCADE has reached a limit.

4.11.4 Process shutdown

The mode of output control blocks (MANUAL/CASCADE) is not locked.

4.12 PID_ON/OFF Option: PID controller with flip/flop analogue output



4.12.1 General points

The regulator modifies its output upon exceeding the maximum allowed deviation between the measurement and the set point (defined by the dead band parameter in engineering units).

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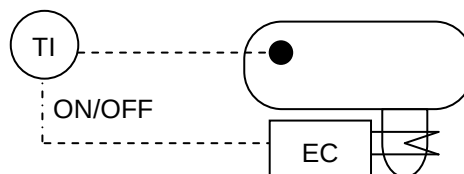
The action of this regulator is configured with an infinite gain, to quickly obtain the minimum or the maximum of the output value of the PID controller.

When the PID controller is in MANUAL, the operator controls the output value in the same way as with a standard PID controller.

4.12.2 MANUAL → CASCADE/AUTO transition

The output value does not change until the deviation (measurement - set point) becomes greater than the dead band.

4.13 PID_1DC Option: PID controller with a digital output



4.13.1 General points

The PID controller operates a digital output instead of an analogue output (e.g. electrical heater start/stop).

The output value turns from 0 (e.g. stop) to 1 (e.g. start) upon exceeding the maximum allowed deviation between the measurement and the set point (defined by the dead band parameter in engineering units).

When the PID controller is in MANUAL, the operator can change the output value.

4.13.2 CASCADE/AUTO → MANUAL transition

The output status does not change because the HMI output value tracks the last calculated value.

4.13.3 MANUAL → CASCADE/AUTO transition

The output value is set to 0 or 1 according to the HMI output value. The output status does not change until the deviation (measurement - set point) exceeds the dead band.

4.13.4 Process shutdown

The output value is forced to 0.

After a process shutdown reset, the output status does not change until the deviation exceeds the dead band.

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5. Standard tuning parameters and variables

Parameters	Access level
Valve type (FC or FO)	Engineer
Direct or Reverse controller	Engineer
P, I, D (parameters of controller)	Maintenance
Set point limits (High and Low) or thresholds	Maintenance
Output limits (High and Low)	Maintenance
Dead band (PID_ON/OFF & PID_1DC)	Maintenance
Set point ramp (if required)	Maintenance
Sampling period	Engineer

6. Representation and animation description (HMI)

6.1 Events and values to be recorded

6.1.1 Events

- CASCADE/AUTO/MANUAL command
- Output fault status
- MANUAL automatic setting status
- CASCADE/MANUAL command of output control blocks (PID_RD, PID_SPR).

6.1.2 Values

- Operator Set point
- Operator output value
- Dead band.

6.2 Alarms handling

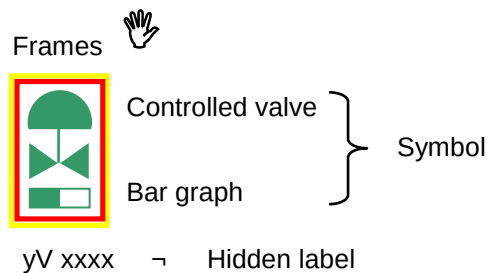
Alarm Description	Priority
Output fault alarm	Level 1
MANUAL automatic setting alarm of PID controller	Level 1
MANUAL automatic setting alarm of valve output control blocks (PID-RD, PID-SPR)	Level 1

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6.3 Control display

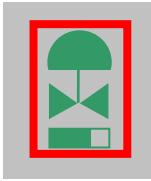
The hereafter description gives examples of representation. However, they may be amended dependant on the DCS features.

6.3.1 Controlled valve representation



- yV xxxx instrument label appears upon operator request (soft key)
- Symbol and yV xxxx instrument label are used as target area for the PID controller faceplate display.

6.3.2 Animation of the controlled valve (Symbol and Frames)

Display description	Display	Valve and bargraph	Frames
Opening > 5%		Fluid colour	NA
Opening ≤ 5%		White	NA
Safety trip		as above	External frame: White
Output fault		as above	Internal frame: Red flashing before acknowledgement Red steady after acknowledgement
Communication or system fault		White	External frame: Magenta

The bar graph represents the opening percentage of the valve. This information is transmitted via the command signal or via the position transmitter if it exists.

The events which drive these frame displays may not be mutually exclusive. Therefore, the precedence on the display, from most to least important, shall be: magenta, white, blue, yellow.

6.3.3 Animation of the “hand” symbol

6.3.3.1 General points

- An empty yellow “hand” symbol appears near the valve when the operator has no access to the set-point (generally when the controller is in AUTO)
- This empty yellow “hand” is not displayed when the associated measurement is in maintenance inhibit
- A full yellow “hand” symbol appears near the valve when output value is available for the operator (generally when the controller is in MANUAL)

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- There is no “hand” symbol displayed during the process shutdown
- PID controller “MANUAL automatic setting” status is shown by means of a yellow frame around the “hand” symbol (with the alarming handling: flashing yellow /steady yellow).

6.3.3.2 Specificity of cascade regulators PID_MR, PID_SR option

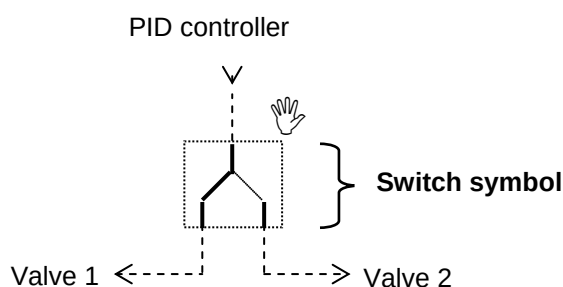
The yellow frame with the “hand” symbol in white is displayed for the Master controller when the Slave controller is not in CASCADE.

6.3.3.3 Specificity of PID_RD & PID_SPR options

A complete “hand” symbol animation with frame is implemented for valve output control blocks. The full yellow “hand” animation is shown when the output control block has been set in MANUAL by the maintenance operator.

6.3.4 Specific animation of PID_RD option: switching display of valves

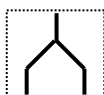
The switching status is displayed on the corresponding process mimic by means of a switch symbol:



This symbol is used as a target area to access the switch selector.

Operator valve switching possibility is shown by a full yellow “hand” symbol displayed near the switch symbol. This “hand” symbol is hidden during the monitoring of both valves by a higher level automatic control.

During the control of both valves by a higher level automatic control, the animation of the switch is:



6.4 Miscellaneous

Specific access to the PID controller faceplate display for cascade regulators PID_MR /PID_SR option:

Symbol and the yV xxxx instrument label are used as target areas to access a group mimic showing a summary of both controllers. The operator can then call up the faceplate of a PID controller by clicking on the corresponding dedicated target (faceplate is directly displayed).

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1. Scope

The purpose of this document is to define the Standard Function used to compensate the gas flow in function of the pressure and temperature.

In order to assist in understanding, this document should be read in conjunction with **GS EP INS 150**.

This Standard Function includes two options:

- GCF: raw flow measured directly by means of a flowmeter
- GCF_SQ: raw Flow measured by means of a differential pressure measurement.

The acquisition of process flow value is achieved directly from corresponding analogue input.

The acquisition of process pressure and temperature numerical values are achieved through AI or RAI Standard Functions.

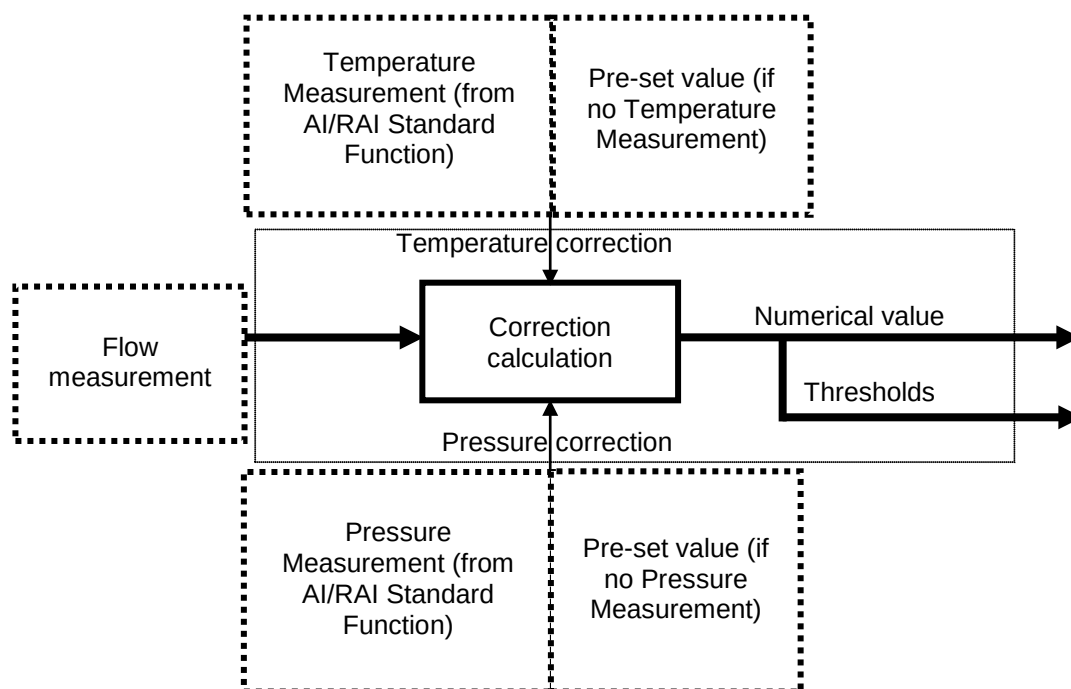
This Standard Function may be used in relationship with other Standard Functions (e.g. PID, TOT (flow totalizer).

2. General Description of Functions

2.1 List of main functions

- Acquisition of the three numerical values
- Calculation of the flow corrected by pressure and temperature measurements
- Input fault detection
- Maintenance inhibit

2.2 Functional scheme



3. Interface description

INPUTS						OUTPUTS		
Field	HMI	Internal				Internal	HMI	Field
				Standard function GCF				
●			Raw Flow value		Value in engineering unit	●	●	
		●	Pressure value		Control thresholds	●	●	
		●	Temperature value		Alarm thresholds		Alm	
		●	Maintenance inhibit status of flow input		Input fault status (corrected flow)	●	Alm	
	Opt	●	Maintenance inhibit status of pressure input		Maintenance inhibit status	●	●	
	Opt	●	Maintenance inhibit status of temperature input					
		●	Flow input fault					
	Opt	●	Pressure input fault					
	Opt	●	Temperature input fault					
	●		Threshold values					
	●		Z/K coefficient					
	Opt	●	Pressure fall-back value					
	Opt	●	Temperature fall-back value					
		Opt	Automatic threshold masking					
					Opt = Optional (if the measure exists, for P & T)			
					Alm = Alarm			

4. Detailed description of functions

4.1 General points

The compensated Flow in pressure/temperature is calculated from three numerical values:

- The raw flow measured from an analogue input (a differential pressure measurement or a flow measurement according to the used analogue value)

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- The pressure from either an analogue input or a pre-set value
- The temperature from either an analogue input or a pre-set value.

Flow, Temperature and Pressure values association shall be specified in functional analysis.

The corrected value will be used instead of the flow measurement by other Standard Functions (e.g. TOT, etc.).

4.2 Instantaneous corrected flow formula for flow measured by vortex system (linear)

The PTZ Flows will be converted by the PCS in accordance with the following formula, in which the PI is indicated in absolute bars and the TI in °K:

$$Q = Q_i \times \frac{PI \times T_0}{P_0 \times TI} \times K$$

- Q_i = measured flow at actual conditions (Am^3/h)
- Q = flow converted to standard conditions (Sm^3/h)
- $K = \frac{Z_0}{Z}$ (K is a coefficient which is entered by method people)
- PI = measured pressure in bara (to convert barg to bara, add 1.01325)
- TI = measured temperature in degrees Kelvin (to convert degC to degK, add 273)
- $T_0 = 288,15 \text{ °K}$ = temperature at standard conditions
- $P_0 = 1,01325 \text{ bar (a)}$ = pressure at standard conditions
- $Z_0 = 1$

Z is the gas average Z value under process condition (modifiable variable on the Flow meter parameter display). This variable may differ depending on the corrected Flow.

Each Z value will be calculated by Method Specialist, taking into account the start up simulation phase data. A default value of "1" will be used during FAT.

4.3 Instantaneous corrected flow formula for flow measured by differential pressure (square root extraction, GCF_sq option)

The flow will be corrected by the DCS as per the following formula, where the differential pressure (PDI) is indicated in Pa, the pressure (PI) in absolute bars and the temperature (TI) indicated in °K:

$$PI = PI \text{ measurement} + 1,01325$$

$$Q = K * \sqrt{PDI} * \sqrt{\frac{PI}{TI}}$$

K is a coefficient which is calculated by Method specialist.

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4.4 Handling of thresholds

Handling of thresholds is similar to threshold handling for one analogue input (AI). The corresponding treatment applies to the corrected flow value.

4.5 Maintenance inhibit of the corrected flow

The corrected flow is considered in maintenance inhibit status when the raw flow measure is in maintenance inhibit.

Numerical value	Control thresholds	Alarm thresholds
HMI shows actual value of the corrected flow (in engineering unit). Used corrected value is the last healthy value (before inhibit). Associated PID controller calculation is stopped with last calculated output. Automatic control sequences still run (with the used corrected value).	xCL and xCH are deactivated and forced to their <i>NORMAL</i> state	xAL and xAH are deactivated and forced to their <i>NORMAL</i> state

The corrected flow input fault is no more alarmed when Maintenance inhibit is active.

4.6 Corrected flow fault

The corrected flow is considered in fault when the flow input is in fault.

Input value	Signal status	Displayed value
Signal < 0.8 mA	<i>In fault</i>	-20%
0.8 mA ≤ signal ≤ 23.2 mA	<i>Healthy</i>	Current value
Signal > 23.2 mA	<i>In fault</i>	120%
Card fault	<i>In fault</i>	Last value

INPUT VALUE is the value of raw flow analogue input.

DISPLAYED VALUE is the value of corrected flow.

-20% and 120% values concerns the corrected flow scale.

4.7 Handling of fall-back values

There is a fall-back value for the Pressure and Temperature measurements.

This value replaces the measurement when the corresponding analogue input is considered in fault or in maintenance inhibit (when pre-set values of pressure and temperature are used, input fault and maintenance inhibit handling for the pressure and temperature do not apply).

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Calculated fall-back values are available to the operator in method access level, who may change them within corresponding sensor scale limits.

4.7.1 Fall-back value of pressure measurement

The fall-back value is the last healthy slide average.

The slide average is normally calculated during one hour, with a sampling period of two minutes (30 value memorised). The slide average is only calculated if the corresponding measurement is healthy and not in maintenance inhibit.

Upon next activation of the healthy status and removal of the maintenance inhibit, the slide average is initialised: all memorised values are loaded with the new healthy measurement.

Note: Number of memorised values and sampling time are adjustable (in method access level).

4.7.2 Fall-back value for temperature

The fall-back value is the last healthy value.

5. Tuning parameters and variables

Parameter	Access level
Alarm threshold FAH in engineering unit	Method
Alarm threshold FAL in engineering unit	Method
Fall-back value for temperature measurement	Method
Fall-back value for pressure measurement	Method
Time duration for pressure slide average	Method
Scale minimum value	Engineer
Scale maximum value	Engineer
Control threshold (FCH) in engineering unit	Method
Control threshold (FCL) in engineering unit	Method
Threshold hysteresis	Engineer
K coefficient (or Z gas coefficient)	Engineer
Pre-set value for temperature (if no available measurement)	Engineer
Pre-set value for pressure (if no available measurement)	Engineer

6. Representation and animation description (HMI)

6.1 Events and values to be recorded

6.1.1 Events

Alarm thresholds

Corrected flow input fault

Maintenance inhibit command.

6.1.2 Analogue values

Corrected value in engineering unit.

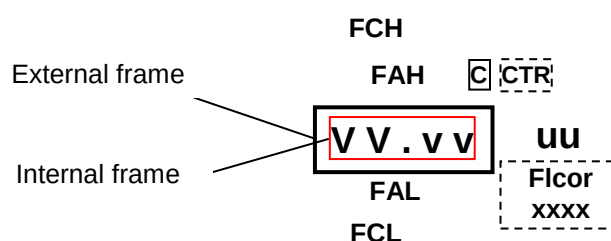
6.2 Alarm handling

Alarm description	Priority
Alarm thresholds (FAH, FAL)	Level 1
Corrected flow input fault	Level 1

6.3 Control display

This description gives examples of representation. However, they may be amended dependant on the DCS features.

6.3.1 Displayed data representation



V V . v v = Numeric value (in engineering unit)

Target area for the corrected flow face plate display (alarm thresholds tuning)

uu = Engineering unit (KSm³/j)

CTR = Process control (only appears on operator request by means of a soft key)

Target area for the corrected flow face plate display (control thresholds tuning)

Flcor xxxx = Corrected flow tag name (only appears on operator request)

Target area for the maintenance inhibit command of flow transmitter

FCH = High control threshold activated

(can be also displayed near the associated equipment)

FAH = High alarm threshold activated

FAL = Low alarm threshold activated

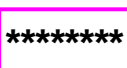
FCL = Low control threshold activated

(can be also displayed near the associated equipment)

As a basis, control thresholds shall not be displayed on process views.

All existing threshold (s) on process views are displayed in white colour on operator request (hidden if not active).

6.3.2 Analogue value display

Internal data	Display	Text	Frame
Symbol  Numeric value = <i>NORMAL</i> Label + CTR Units	 CTR <i>VV.VV</i> uu Flcor	White/hidden Green White/hidden White	NA
Numeric value = <i>ALARM</i>	<i>VV.VV</i> uu	Colour steady (depending on alarm priority level)	NA
Maintenance inhibit = <i>INHIBITED</i>	 uu	As above	External frame: Steady Yellow
Flow input fault = <i>IN FAULT</i> And unacknowledged	 uu	Steady Red	Alarm frame (internal): Flashing Red
Flow input fault = <i>IN FAULT</i> And acknowledged	 uu	Steady Red	Internal frame: Steady Red
Flow input fault occurred after Maintenance inhibit activation	 uu	Steady Red	External frame: Yellow Alarm frame (internal): Red
Communication fault = <i>ACTIVATED</i>	 uu	White	External frame: Steady Magenta

The events which drive these frame displays may not be mutually exclusive. Therefore, the precedence on the display, from most to least important, shall be: magenta, white, blue, yellow.

Symbol  is used as target area for the Detailed display.

6.3.3 Detailed display

Flow measured by Vortex system (linear):

Raw flow	Corrected flow	Correction Pressure	Fall-back pressure	Correction Temperature	Fall-back temperature	Coefficient K/Z
FT xxxx  Km³/j	Ficor xxxx  KSm³/j	PT xxxx  bar		TT xxxx  °C		ZZ.ZZ

Flow measured by differential pressure (GCF_SQ option):

Differential pressure	Corrected flow	Correction pression	Fall-back pressure	Correction temperature	Fall-back temperature	Coefficient K
PDT xxxx  mbar	Ficor xxxx  KSm³/j	PT xxxx  bar		TT xxxx  °C		KK.KK

 Target area on raw value (FT in Km³/j or PDT in mbar) for the loop face plate display of raw measurement (the raw measurement is a differential pressure measurement or a flow measurement).

 Target area on pressure (PT) value for the loop face plate display.

 Target area on pressure fall-back value for changing the fall back value (in method access level).

 Target area on temperature (TT) value for the loop face plate display.

 Target area on temperature fall-back value for changing the fall-back value (in method access level).

The formula coefficient (K) is only displayed (not entered).

6.4 Thresholds displays

6.4.1 Alarm thresholds display

Internal data	Display	Text	Frame
Alarm threshold = <i>NORMAL</i>		Hidden	NA
Alarm threshold = <i>ALARM</i> And unacknowledged		Flashing Yellow	NA
Alarm threshold = <i>ALARM</i> And acknowledged		Steady Yellow	NA

6.4.2 Control thresholds display

Internal data	Display	Text	Frame
Control threshold = <i>NORMAL</i>		Hidden	NA
Control threshold = <i>ACTIVE</i>		Green	NA

6.5 Trend curves and Bar graph

Similar to AI Standard Function.

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1. Scope

The purpose of this document is to define the Standard Function for a **Totalized Flow**, with **Average Flow** as an option.

In order to assist in understanding, this document should be read in conjunction with **GS EP INS 150**.

The acquisition of Flow value is done through the following Standard Functions:

- AI Analogue Input
- RAI Redundant Analogue Input
- GCF Pressure and Temperature compensated Flow

2. General description of functions

2.1 List of main functions

- Acquisition of the flow value
- Totalized flow
- Daily reset
- Input fault of associated flow measurement
- Maintenance inhibit of associated flow measurement.

3. Description of interfaces

3.1 General description

INPUTS						OUTPUTS		
Field	HMI	Internal				Internal	HMI	Field
			Standard Function TOT	Flow value	Totalized Flow			
				Flow input fault	Average flow		Opt	
				Maintenance inhibit status	Fault status			
				Reset of totalizer	Maintenance inhibit status			
					Opt = Option			

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4. Detailed description of functions

4.1 Totalizing formula

$$FQI_{(n)} = FI * \frac{T_s}{T_k} + FQI_{(n-1)}$$

Where:

FI = Value to add up in engineering unit

FQI_(n) = Current adding up value (in totalizing unit)

FQI_(n-1) = Previous adding up value

T_s = Sampling period (in seconds)

T_k = Time scale conversion variable according to engineering unit

4.2 TOT_AV Option: average flow

The average flow formula is:

$$AV = \frac{FQI_{(n)}}{N}$$

Where:

AV = Average flow

FQI_(n) = Current adding up value

N = Adding up of samples

4.3 Reset of totalizer

Automatic report is performed each day and just after, the adding up value is recorded (and averaged if requested) and automatically reset.

The reset of totalizer is also available to the operator in method access level.

4.4 Maintenance inhibit

The totalized flow is considered in maintenance inhibit when the associated flow measurement is in maintenance inhibit.

4.5 Input fault

The totalized flow is considered in fault when the associated flow measure is in fault.

4.6 Maintenance inhibit or input fault handling

When the totalized flow is considered in maintenance inhibit or in fault, the last healthy value of flow and corresponding time are recorded to be restored in a daily report, the current adding up value being frozen.

During this state, the reset of adding up is still possible.

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Upon next activation of the healthy status and removal of maintenance inhibit, the new healthy value of flow and corresponding time are recorded to be restored in a daily report.

5. Tuning parameters and variables

Parameter	Access level
Reset of totalizer	Method

6. Representation and animation description (HMI)

6.1 Values to be recorded

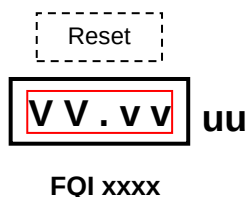
- Last healthy value of low before maintenance inhibit or fault
- Duration of activation of maintenance inhibit or fault status
- New healthy value of flow after maintenance inhibit or fault removal
- Time of activation of healthy status or removal of maintenance inhibit.

6.2 Control display

This description gives examples of representation. However, they may be amended dependant on the DCS features.

6.2.1 Displayed data representation

Adding up and average current values representation are:



V V . v v = Numerical value (in engineering unit)

uu = Engineering unit (m³/km³)

FQI xxxx = Tag name (only appears on operator request)

 Reset symbol is used as a target area for the display of the pop-up dedicated to the reset command

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Chapter 3

6.2.2 Analogue value display

Display description	Display	Text	Frame
Numeric value = <i>NORMAL</i> Units Label	VV.VV uu FQI xxxx	Green White White/Hidden	NA
Maintenance inhibit = INHIBITED	VV.VV uu	Yellow until reset of totalling	External frame: Steady Yellow
Input fault = Alarm (Input fault occurred before maintenance inhibit)	VV.VV uu	Red until reset of totalizer	Internal frame: Red flashing before acknowledgement Red steady after acknowledgement
Communication fault = <i>ACTIVE</i>	***** uu	White	External frame: Steady Magenta

The events which drive these frame displays may not be mutually exclusive. Therefore, the precedence on the display, from most to least important, shall be: magenta, white, blue, yellow.

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