


# FUNCTIONAL DESCRIPTION

## FLOW01

### Temp & Pressure Compensation of Flow Measurements

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## 1. General

FLOW is a functional unit for temperature and pressure compensation of flow measurements using differential pressure flow elements. The output will be displayed on the OperateIT, Operator Station and/or can be used for control of other objects. An FLOW01 normally performs a complete function independently.

FLOW01 has the following functions and properties:

- Different control modes, set by operator or by control logic.
- Limiting of output signal.
- Function for bumpless change between different control modes.
- Alarm and event handling of important control signals.

## 2. Configuration

FLOW01 comprises a function block type for control and logic functions in Control<sup>IT</sup>, a faceplate and an object display in Operate<sup>IT</sup> for operator functions and control parameters.

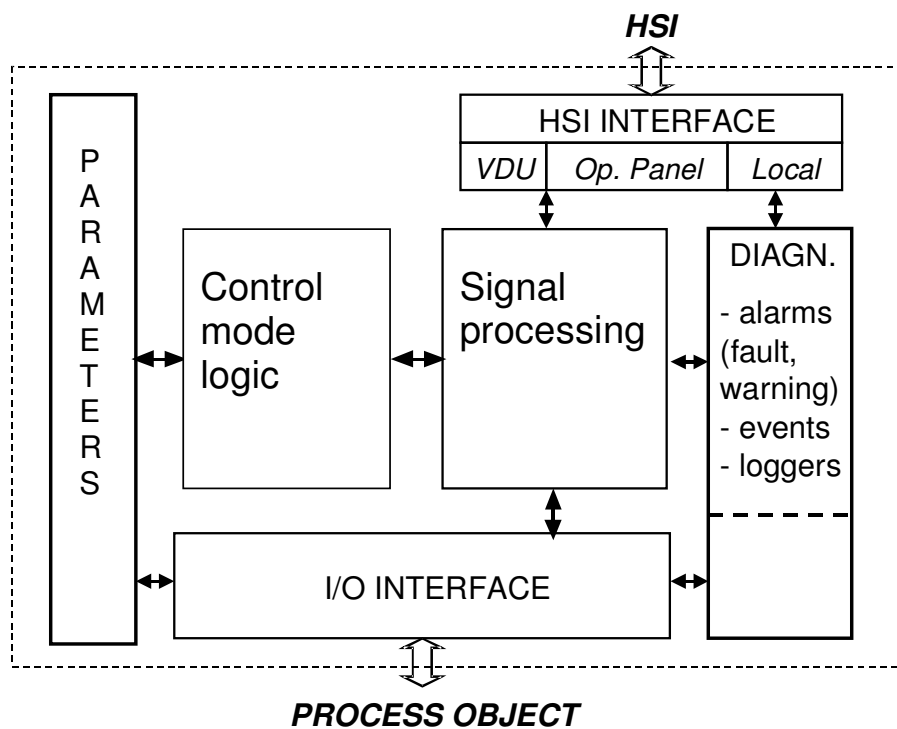


Figure 1. The Structure of the Functional Unit

### 3. Function Block FLOW01

FUNCTION OF INPUT TERMINALS	FLOW01		FUNCTION OF OUTPUT TERMINALS
Object name	Name	Out	Output
Object description	Description	MV_Err	Error
Enable object	Enable	Err_Type	Error type
Measured Value from dp-cell	MV	Man	Man mode
Temperature measurement	Temp	E1	E1 mode
Temperature measurement error	Temp_Err	Forced	Channel is forced
Pressure measurement	Press	MV_GT_H2	MV greater than or equal to High High Limit (H2)
Pressure measurement error	Press_Err	MV_GT_H1	MV greater than or equal to High Limit (H1)
Dimensioning temperature (in deg. C)	CalcTemp	MV_LT_L1	MV less than or equal to Low Limit (L1)
Dimensioning pressure (in MPa)	CalcPress	MV_LT_L2	MV less than or equal to Low Low Limit (L2)
Block alarm	AL_P_Blk	OutPar	Out Parameter
Acknowledge alarm	AlarmAck	Opr	Operator order
Profibus device status	Status		
External control	ExtCtrl		
MV alarm configuration	MVAlarms		
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 **FLOW01** function block.

Name	Data Type	Attributes	Direction	FD Port	Initial value	Description
Name	string	coldretain	in	yes	'Flow01'	Object name
Description	string	coldretain	in	yes	'Descr'	Object description
Enable	bool	coldretain	in	yes	true	Enable object
MV	RealIO	by_ref	in	yes		Measured Value from dp-cell
Temp	real	retain	in	yes	20.0	Temperature measurement
Temp_Err	dword	retain	in	yes	16#C0	Temperature measurement error
Press	real	retain	in	yes	1.0	Pressure measurement
Press_Err	dword	retain	in	yes	16#C0	Pressure measurement error
CalcTemp	real	coldretain	in	yes	150.0	Dimensioning temperature (in deg. C)
CalcPress	real	coldretain	in	yes	0.1	Dimensioning pressure (in MPa)
AL_P_Blk	bool	retain	in	yes		Block alarm
AlarmAck	bool	retain	in	yes		Acknowledge alarm
Status	PB_Status	by_ref	in	yes		Profibus device status
ExtCtrl	Ext_Analog	by_ref	in	yes		External control
MVAlarms	Alarm4Limit	by_ref	in	yes		MV alarm configuration
InPar	Flow01_InPar	by_ref	in	yes		In Parameter
EventName	string	coldretain	in	yes	'  Flow01_'	Event name
Out	real	retain	out	yes		Output
MV_Err	bool	retain	out	yes		Error
Err_Type	string[20]	retain	out	yes		Error type
Man	bool	retain	out	yes		Man mode
E1	bool	retain	out	yes		E1 mode
Forced	bool	retain	out	yes		Channel is forced
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)

Name	Data Type	Attributes	Direction	FD Port	Initial value	Description
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)
OutPar	Flow01_OutPar	by_ref	out	yes		Out Parameter
Opr	Flow01_Opr	by_ref	out	yes		Operator order

Table 3-1. Terminal properties.

## 4. FLOW01 Datatypes

### 4.1 FLOW01\_InPar

Name	Data Type	Attributes	Initial value	ISP value	Description
Class	dint	coldretain	500		AE class
Severity	dint	coldretain	1000		AE severity
Range	RangeReal	coldretain			Range
InitMode	dint	coldretain	7		Init mode (5= Man, 7=E1)
ManBlk	bool	coldretain	false		Block operator order Man mode
E1Blk	bool	coldretain	false		Block operator order E1 mode
AlcBlkEvBlk	bool	coldretain	true		Block event for AlcBlk
ErrCtrl	bool	coldretain	false		No error at overflow
AEConfigAIErr	dint	coldretain	1		AE configuration for AI Error
AEConfigPressErr	dint	coldretain	1		AE configuration for Pressure Error
AEConfigTempErr	dint	coldretain	1		AE configuration for Temperature Error
AlarmDelay	time	coldretain	0s		Alarm Delay
FilterP	time	coldretain	0s		Signal filter time

### 4.2 FLOW01\_OutPar

Name	Data Type	Attributes	Initial value	ISP value	Description
AlarmBlk	bool	retain			Alarm blocked
Mode	dint	retain			Active mode
NormalMode	bool	retain			Normal mode (Active mode = Init mode)
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
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
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_AIErr	bool	retain			UnAcknowledge Alarm for AI Error
TempErr	AlarmInd	retain			Alarm Indication for Temperature Error
PressErr	AlarmInd	retain			Alarm Indication for Pressure Error
HWStatus	HwStatus	retain			Hardware status
SubStatus	dint	retain			Hardware substatus
TypeStrLength	dint	retain			Hardware str length
IOStatus	dint	retain			Hardware I/O status quality

### 4.3 FLOW01\_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
Man	bool	retain			Operator order Manual mode
E1	bool	retain			Operator order E1 mode
ManOut	real	coldretain	0.0		Operator enter value

## 5. Function

### 5.1 Basic Properties

The FLOW01 functional unit is designed for a analog input signal from a differential pressure transmitter.

FLOW01 has the following basic functions:

- Control Modes and Updating
- Filtering
- Linearization
- Scaling and Units
- Limit Check
- Error Handling
- Alarm and event handling.
- Operator Functions

### 5.2 Function

The inputs for temp and pressure are first converted to absolut temperature (deg K) and pressure (Mpa). The compensated flow measurement is then calculated according to the following formula.

$$\text{Flow} = k * \sqrt{dp * \frac{P1 * T0}{T1 * P0}} .$$

Where;

$k$  is the Range max defined in Interaction window ( see chapter 5.11.4)

$dp$  is the MV input parameter / MV max value.

$P1$  is the measured pressure.

$P0$  is the design pressure of the flow element.

$T1$  is the measured temperature.

$T0$  is the design temperature of the flow element.

If an signal error occurs in the temp or pressure measurements the faulty signal is excluded from the square root extraction. When the differential signal goes below 5 % the output is switched to 0 (zero).

### 5.2.1 External control parameters

With the input “ExtCtrl” the alarm parameters can be externally controlled, which can be useful to temporarily block alarms i.e., start-up. 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	En_H2	bool	retain		Enable HH Limit
2	MVH2	real	retain	100	High Limit 2
3	ALB_H2	bool	retain		Blocking of alarm limit H2
4	En_H1	bool	retain		Enable H Limit
5	MVH1	real	retain	100	High Limit 1
6	ALB_H1	bool	retain		Blocking of alarm limit H1 and Dev High
7	En_L1	bool	retain		Enable L Limit
8	MVL1	real	retain	0	Low Limit 1
9	ALB_L1	bool	retain		Blocking of alarm limit L1 and Dev Low
10	En_L2	bool	retain		Enable LL Limit
11	MVL2	real	retain	0	Low Limit 2
12	ALB_L2	bool	retain		Blocking of alarm limit L2

Table 4-1. ExtCtrl Terminal properties of FLOW01

### 5.3 Control Modes and Updating

The analog signal is read at intervals determined by the controllers task scan-time. You should set scan time to the requirements of your system.

The control modes can individually be blocked for operator access.

#### 5.3.1 E1

E1 is the initial control mode of the FLOW01, where the value is obtained from the I/O-module at input terminal :IOSignal. The control mode E1 can be commanded from the operator’s keyboard.

- The control mode E1 is activated by clicking on the E1 button on the operator’s faceplate. Ext1 is indicated on the object display and Faceplate.

#### 5.3.2 Manual

In this mode the operator directly sets the output value from the operator station.

The control mode MAN is activated by:

- Clicking on the Man button on the operator’s faceplate activates the control mode MAN. Man is indicated on the object display and Faceplate. A dialog entry window becomes available for the operator to enter the required value.
- Enabling the Forced check box in the I/O Hardware section of the controller activates the control mode FORCED.

## 5.4 Filtering

You may select software filtering of the process value in addition to the hardware board filter. The Filter Parameter time constant is entered directly in time format. Filter\_P=0 disables the software filter. A filter time >0 but less than the task scan-time (TS) will be set equal to TS. The filter corresponds to a one-pole low-pass filter.

## 5.5 Scaling and Units

All values are used in the system as engineering units.

### 5.5.1 Nominal input range

With "Signal range" on the hardware unit you select the measuring range, using the nominal limits for the physical signal expressed in volts or mA.

See the manuals *S800 I/O User's Guide*, for setting the hardware for voltage or current.

### 5.5.2 Engineering units

The FLOW01 function block automatically reads the Max, Min, Unit and Fraction (Decimal) entered in the I/O-modules configuration. Using the Control IT offline editor on the hardware module itself will change the engineering values.

## 5.6 Limit check

In the Limit check part of the function block you determine whether and how a limit check will be performed. The result is stored in the output terminals and is thus available to other programs, even if the operator blocks a limit.

## 5.7 Fieldbus Device Status

The status of fieldbus devices can be indicated of the faceplate of the FLOW01 object. A separate FB, with the decoding of fieldbus data, is connected to the input "Status".

## 5.8 Error handling

The control function of an AI signal indicates errors via Err and Err\_Type. Different types of errors can occur, that are caused by the system.

This occurs if the I/O-module function is determined non-functional. Typical causes of this type of error are:

- Missing or faulty hardware
- Incorrectly installed hardware or software
- Error in the bus communication.
- Out of range values

Errors in the AI-module are copied to the error handling function of the FLOW01 and the error flag Err is set to 1 and the type of error can be read at terminal Err\_Type.

"Overflow" or "underflow" will occur if the A/D converter is given values out of its range.

Detection of out-of-range signals can give indirect information about various errors, e.g. disconnected transducers, cut electrical connections, loss of power supply or other hardware and system errors on signal level.

The Err and Err\_Type terminals of the FLOW01 function block can be connected to programs where the desired function may be built.

## 5.9 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
- Signal error for Temperature and Pressure

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.

### 5.9.1 Alarm Limits

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

$$H\ 2 \geq H\ 1 \geq L\ 1 \geq L\ 2$$

The different alarm limit can be enabled individually from the Interaction Window. 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.

### 5.9.2 Alarm Blocking

The Alarm Block function disables alarm Supervision of the measured value (MV).

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:

$$MV \geq H\ 2$$

$$MV \geq H\ 1$$

$$MV \leq L\ 1$$

$$MV \leq L\ 2$$

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.

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

### 5.9.3 Event handling

Event are generated for status change on the signals defined in interaction window in chapter 5.11.5.

The layout of the event is described in chapter 5.4.2

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.

### 5.10 Process connections

The FLOW01 is connected to the process via the following input terminals.

- MV Connection for measured value e.g. a level transmitter.
- Temp Temperature of media.
- Press Pressure of media.

### 5.11 Interaction Window

The interaction window is available in the Control<sup>IT</sup> 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<sup>IT</sup>.

#### 5.11.1 FLOW01 Interaction Window

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

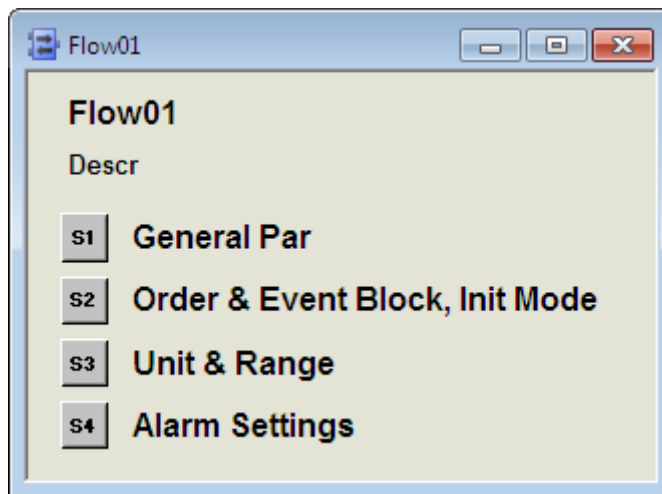


Figure 4-1 Main Interaction Window.

#### 5.11.2 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.

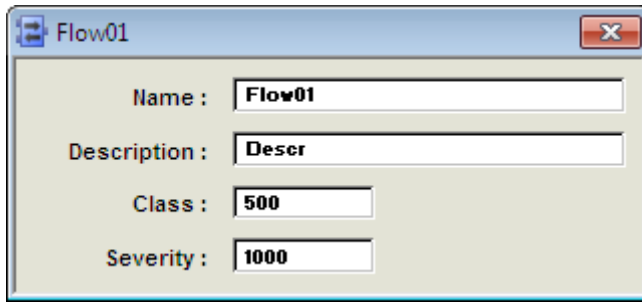


Figure 4-2 General Parameters.

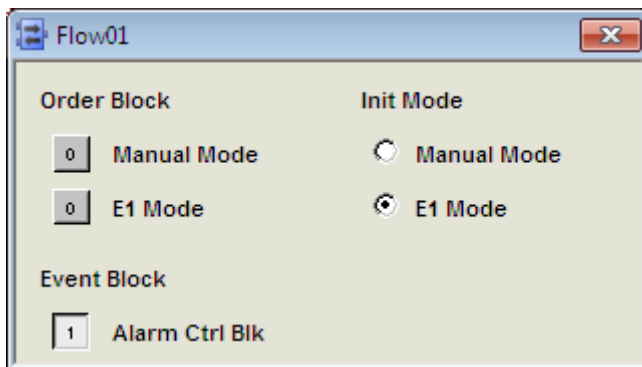
### 5.11.3 Orders and Events

“Order Manual” blocks the input signal. A value can then be entered from faceplate. Mode is Man.

“Order E1” removes the block function. The IOSignal is then read and displayed on the faceplate. Mode is E1

Init Mode define the mode when the object is cold started

Event Block block the event message if the value is set to 1.



### 5.11.4 Units and Range

Decimal resolution, engineering units and minimum and maximum range are shown and filter time entered in this window.

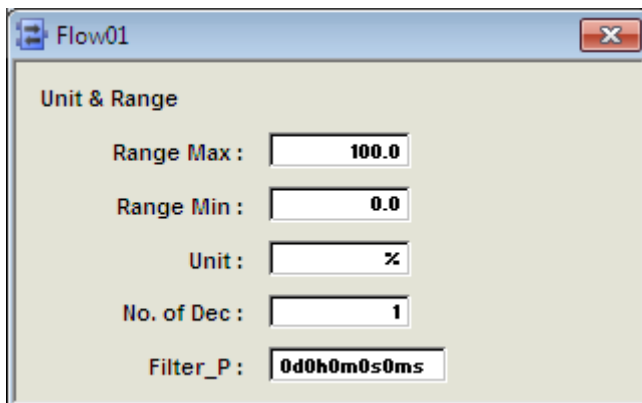


Figure 4-3 Units & Range.

5.11.5 Alarm & Event handling

Alarm limits, Severity and Enabling of the alarms for measured value 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

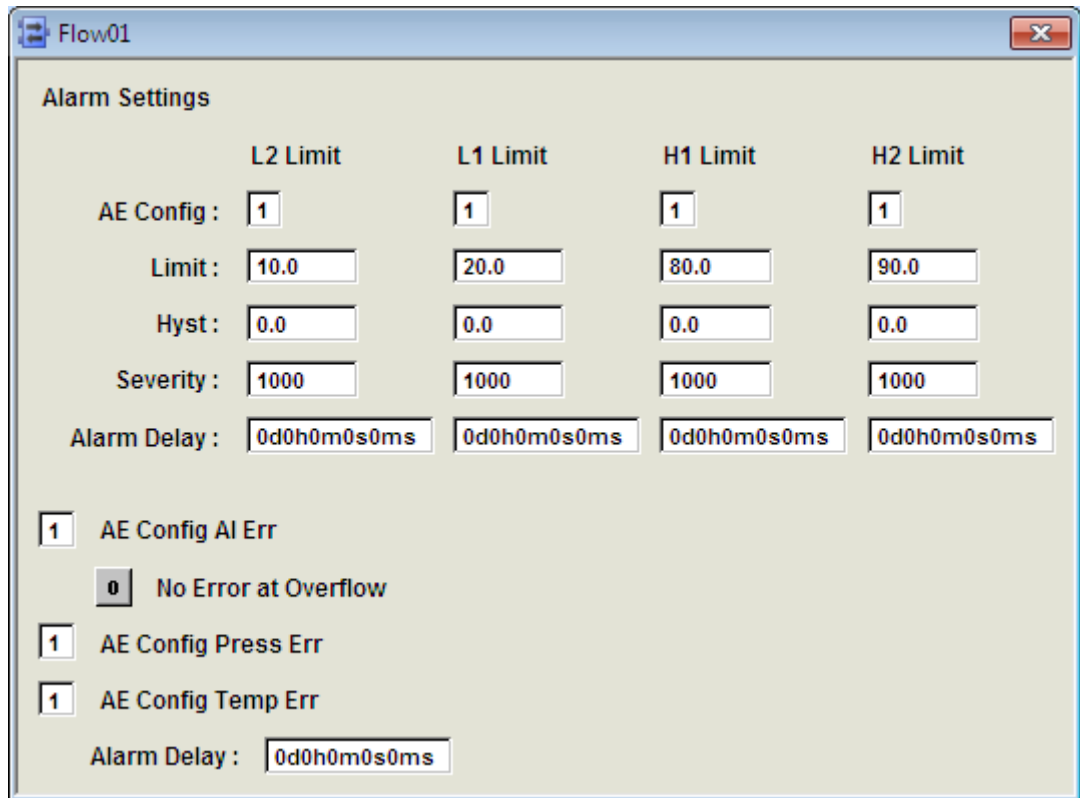


Figure 4-4 Alarm & Event.

5.11.6 Text

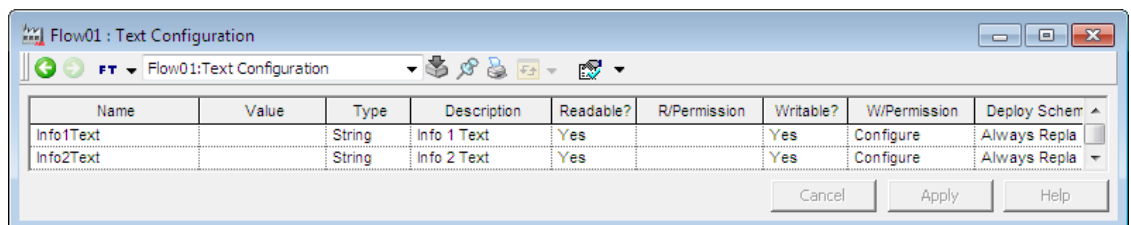


Figure 4-6 Text

## 6. Operator Functions

The Operator functions are divided in principle into 3 parts:

- Presentation (Display elements, Time logged properties)
- Faceplate (Dialog)
- Alarm and Event 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 FLOW01.

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

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

##### 6.1.1.1 Object Display

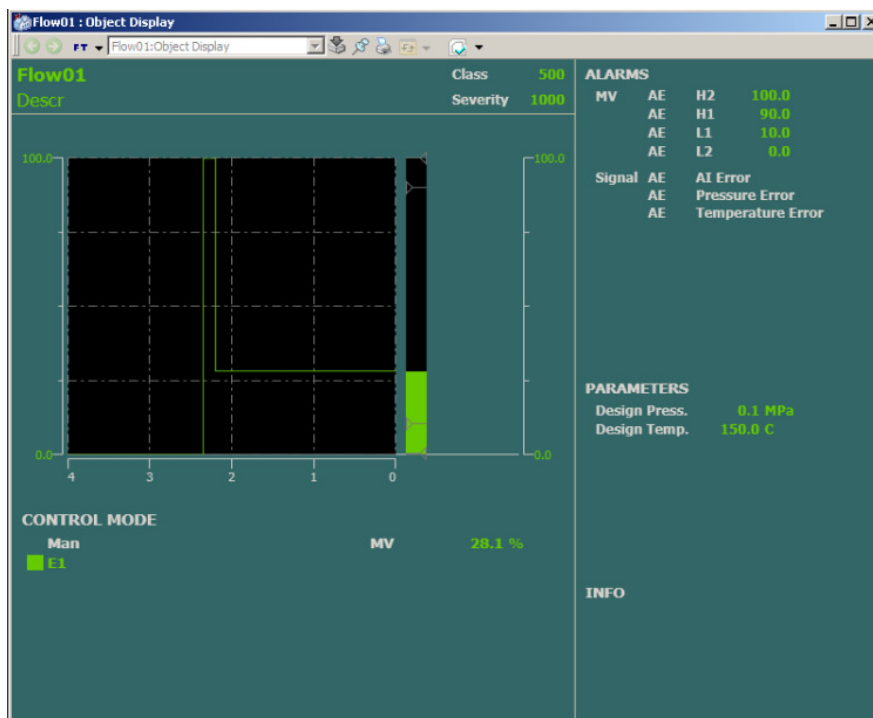


Figure 5-1 Object Display.

6.1.1.2 Process Display

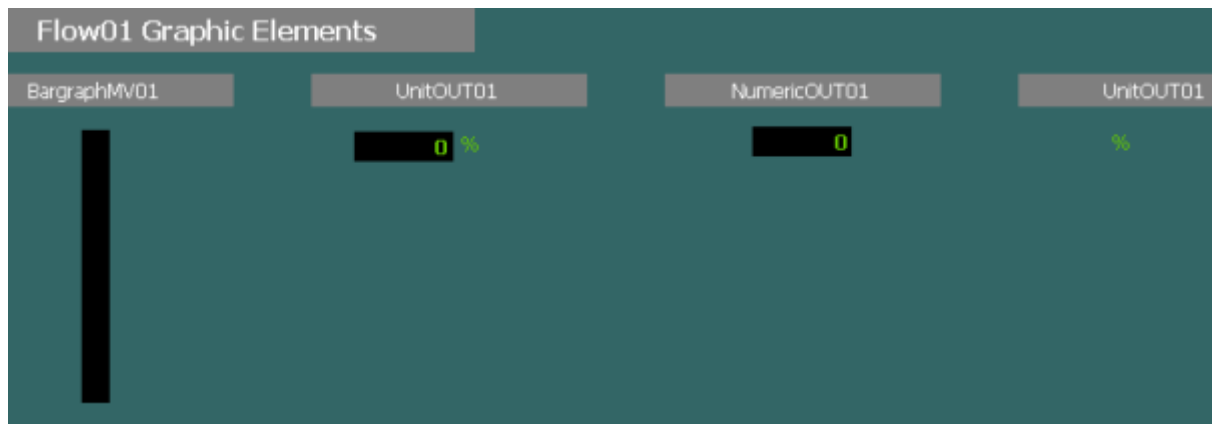
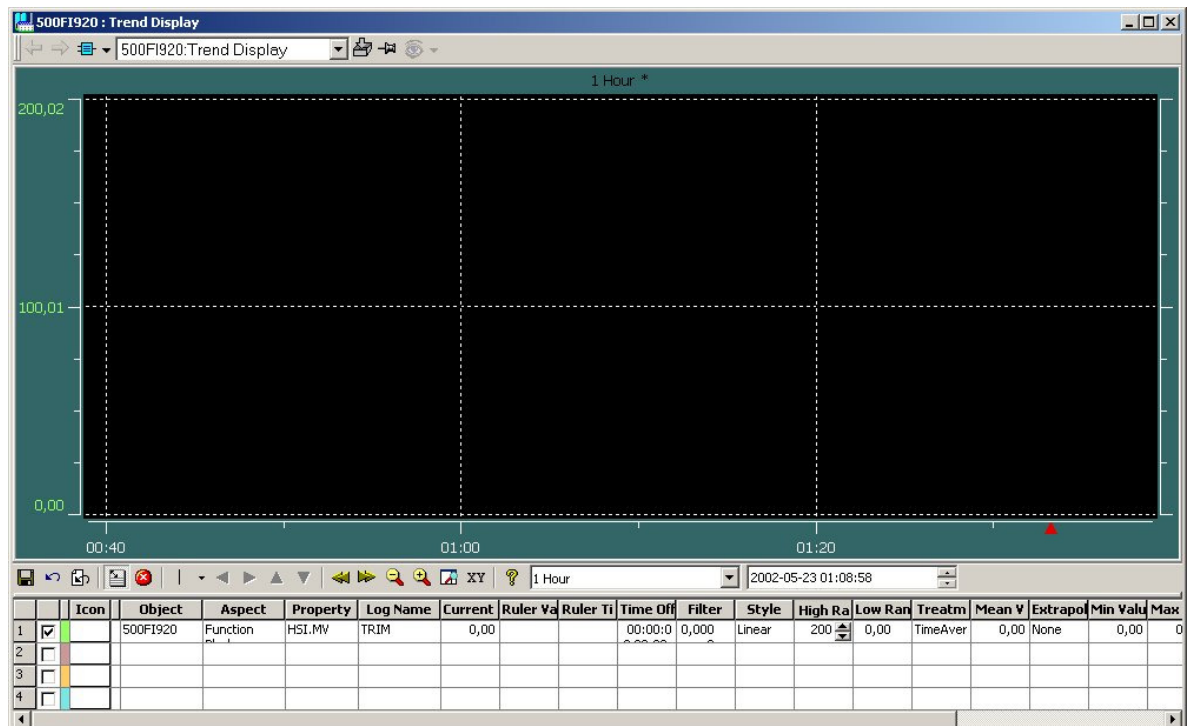


Figure 5-2 Process Display Elements.

6.1.2 Time-logged Properties

Measured values stored can be presented graphically in the form of curves on the display screen. Such a display, a **Trend display**, can consist of 1- 4 curves. All properties for the object FLOW01 are available to be logged on the trend curves.



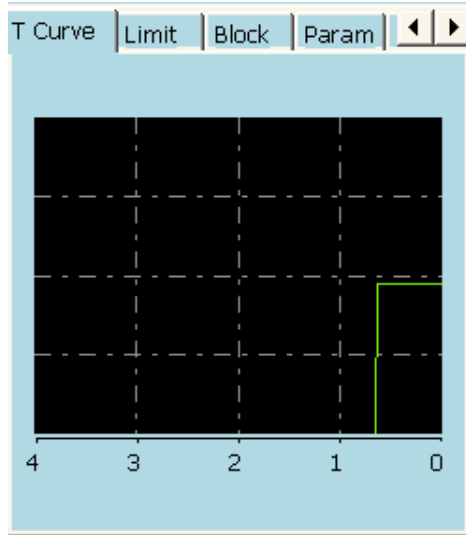


Figure 5-4 Extended Faceplate (T Curve)

## 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<sup>IT</sup> 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.

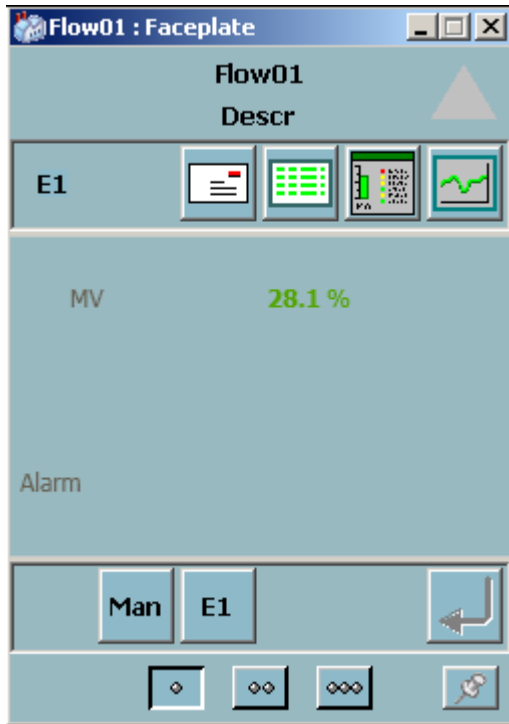


Figure 5-5 Reduced Faceplate.

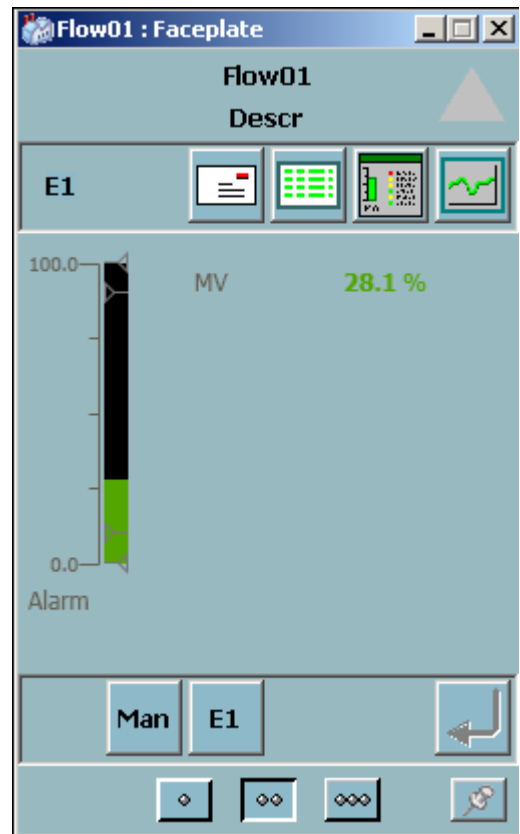


Figure 5-6 Faceplate.

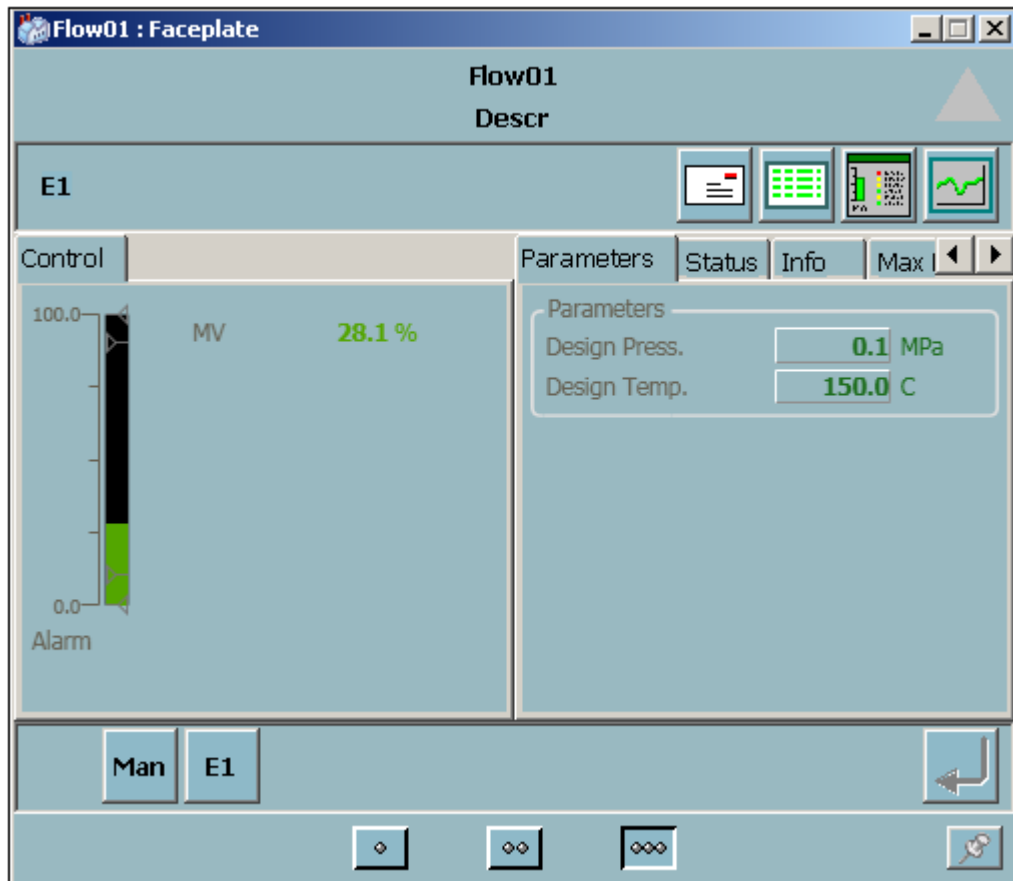


Figure 5-7 Extended Faceplate

## 6.3 Alarm and Event Handling

### 6.3.1 General

This section contains a description of all alarms and events in the functional unit FLOW01.

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<sup>IT</sup> Operator Station. The alarms are indicated in the faceplate, object display and in the alarm and event list.

The alarm limits for FLOW01 can be controlled individually

Event Time	Object Name	Object Description	Condition	Message Description
02-05-24 03:46:16:763	264M500.RUN	Pulp Mixer Running	Status	Alarm
02-05-24 01:13:04:785	192.168.0.51-0.11.5		HWError	For info see 'Errors and
02-05-24 00:22:18:784	192.168.0.51-0.11.4		HWError	For info see 'Errors and
02-05-23 23:32:31:458	500FI920	Washing Pulp Flow	AI_Err	Alarm
02-05-23 23:32:31:458	500FI920	Washing Pulp Flow	MV_L1	Alarm
02-05-23 23:32:31:458	500FI920	Washing Pulp Flow	MV_L2	Alarm
02-05-23 23:23:01:784	192.168.0.51-0.11.3		HWError	For info see 'Errors and
02-05-23 20:00:07:762	500FI920	Washing Pulp Flow	MV_L2	Alarm
02-05-23 01:38:52:762	500FI920	Washing Pulp Flow	MV_L1	Alarm
02-05-23 00:18:26:995	500FI920	Washing Pulp Flow	AI_Err	Alarm
02-05-22 00:10:00:709	Mot01	Test Mot01	ControlV	Alarm
02-05-20 17:32:45:784	192.168.0.51-0.11.2		HWError	For info see 'Errors and

Figure 5-8 Alarm List

### 6.3.2 Alarm and Event Message

The following alarm texts are generated by the functional unit FLOW01. The “Message Description” is “hard coded” in the function block and can not be modified.

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

Object Name	Object Description	Condition	Message Description
<Name>	<Description>	AI Error	Alarm
<Name>	<Description>	MV>H1	Alarm
<Name>	<Description>	MV>H2	Alarm
<Name>	<Description>	MV<L1	Alarm
<Name>	<Description>	MV<L2	Alarm
<Name>	<Description>	Temp Error	Alarm
<Name>	<Description>	Press Error	Alarm

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

ObjectName	ObjectDescription	Condition	Message Description
<Name>	<Description>		Alarm P Blk
<Name>	<Description>		Acknowledge Alarm

## 6.4 Faceplate tabs

### 6.4.1 Alarm and Event Blocking

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

The check box “Enable Object”, is used to set the object out of service.

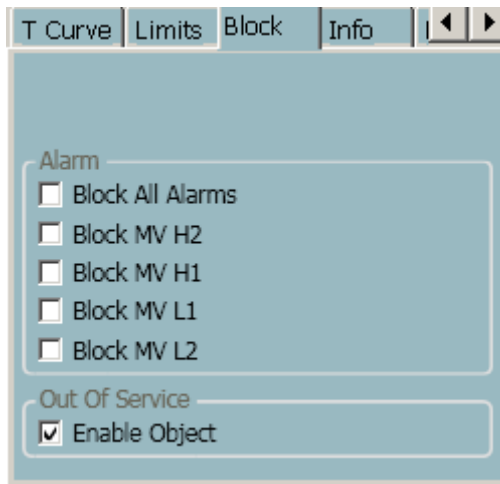


Figure 5-9 Extended Faceplate (Block)

### 6.4.2 Limits

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

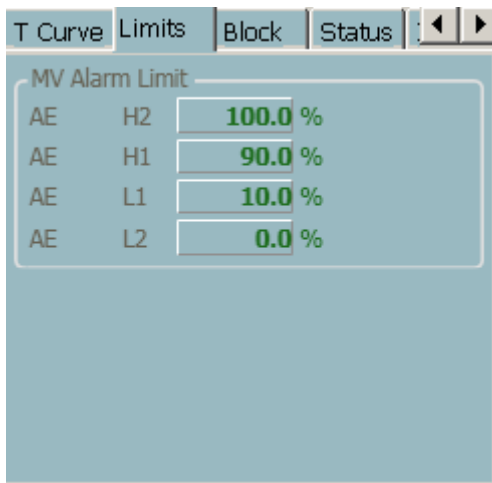


Figure 5-10 Extended Faceplate (Limits)

### 6.4.3 Parameters

By using the extended faceplate it is possible to adjust the parameters for the design temperature and pressure for the measuring device. The faceplate elements in the extended faceplate below illustrate this.

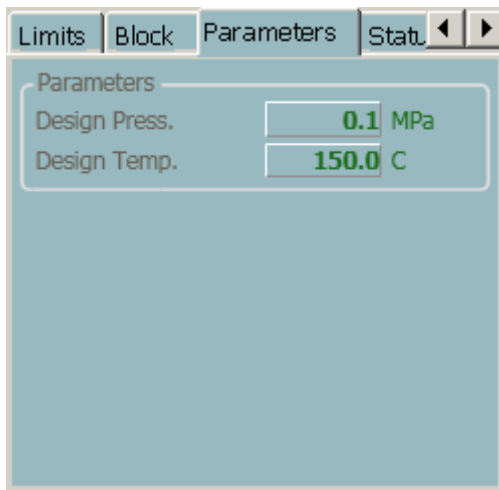


Figure 5-11 Extended Faceplate (Param)

#### 6.4.4 Max Dialog

By using the extended faceplate it is possible to block the selection of control mode for the operator. The faceplate elements in the extended faceplate below illustrate this.

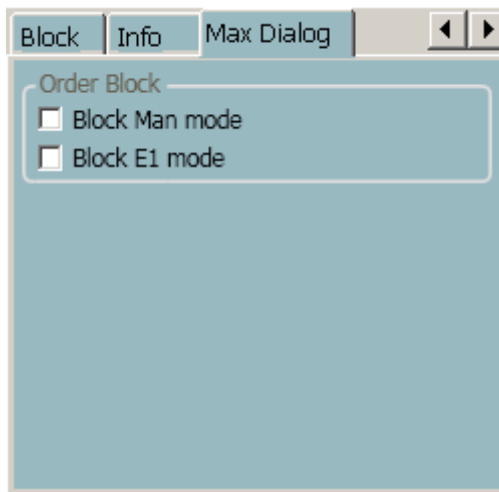


Figure 5-12 Extended Faceplate (Max Dialog)

6.4.5 Info

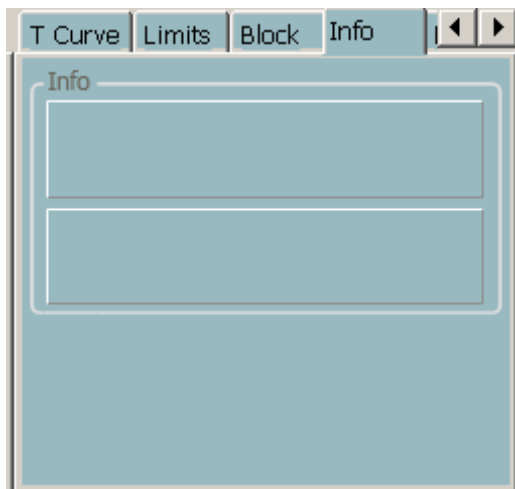


Figure 5-13 Extended Faceplate (Info)

6.4.6 Status

The “Status” tab of the extended faceplate is showing the type of device and its status for the measured value. The faceplate elements in the extended faceplate below illustrate this.

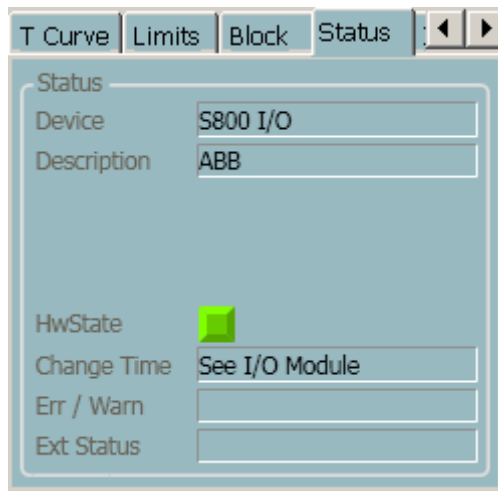


Figure 5-14 Extended Faceplate (Max Dialog)

**REVISION**

Rev. ind.	Page (P) Chapt. (C)	Description	Date Dept./Init.
-		First version	050320 /MP
F	4, 5	Faceplate Eventhandling added, Rev 4.0/1	050902/MP
G		Rev 4.0/5 Interaction window changes. Alarm Ack added	070627
H		Updated for rel 5.0-1	081230/BP
I	5.1.1.2	Update of Process display	090909/BP
J		Update rev 5.1/0	101102/BP