


FUNCTIONAL DESCRIPTION

Sequence Control

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Appr. PA/R/ Bengt Persson	Approved	Sequence Control			24
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1 General

The SEQ01 is a functional unit to control several objects in a predefined sequential order. It is important to note that the SEQ01 object is a sequence interface to the PPA. It contains no sequence code and is therefore independent of the programming language used to connect to the control/process objects, although the Sequential Function Charts (SFC) language is preferred. The sequence control, step failures, alarm handling and text handling are all included as part of this object.

2 Configuration

The SEQ01 comprises a function block type, SEQ01 for logic functions in Control^{IT}, a faceplate and an object display in Operate^{IT} for operator functions. SEQ01 is the main function block type to which the sequences control logic in its specific language is connected.

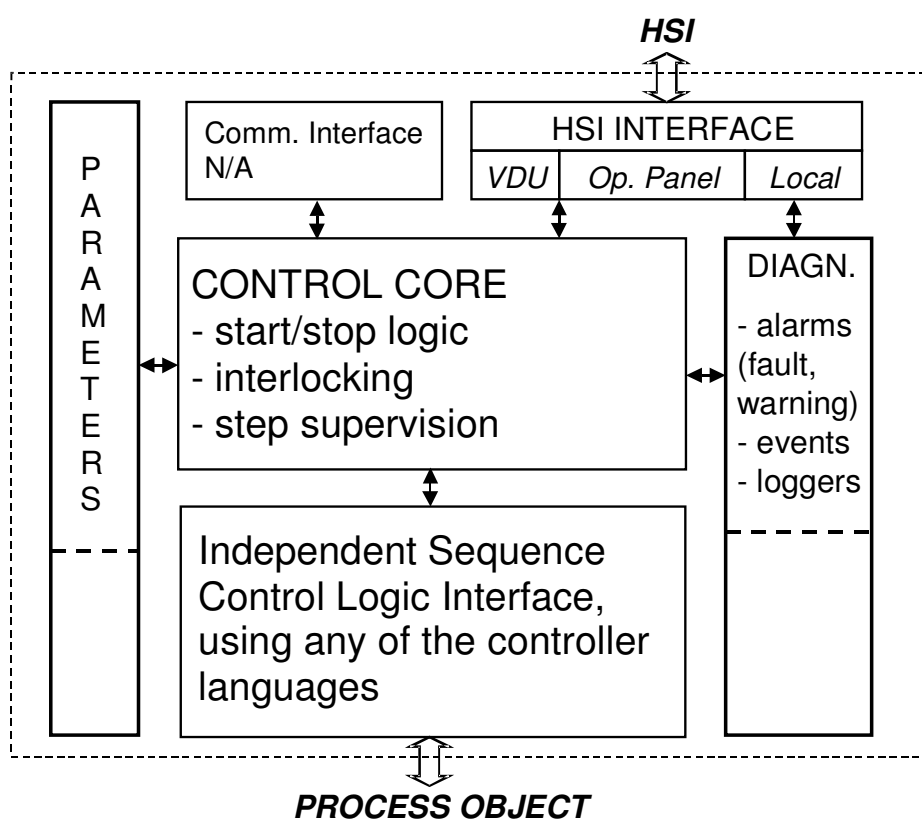


Figure 2-1. The Structure of the Functional Unit

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3 Function Block SEQ01

FUNCTION OF INPUT TERMINALS	SEQ01		FUNCTION OF OUTPUT TERMINALS
Object name	— Name		
Object description	— Description		
Enable object	— Enable		
Communication with HSI	— HSI		Communication with HSI
Start order in E1 mode	— E1Start	NoInt	No Interlocks
Reset	— Reset	RFS	Ready for start
Order mode to Auto	— SeqAuto	Run	Running
Order mode to Man	— SeqMan	Pos	Active step number
Order mode to E1	— SeqE1	AutoInd	Auto mode
Order mode to Hold	— SeqHold	ManInd	Man mode
Process Interlock 1	— IB1	E1Ind	E1 mode
Process Interlock 2	— IB2	HoldInd	Hold mode
Process Interlock 3	— IB3	Seq_Disable	Connection to SFC block, Disable Action
Process Interlock 4	— IB4	Seq_Reset	Connection to SFC block, Reset
Max sequence time	— MaxSeqTime		
Max sequence step time	— MaxStepTime		
Sequence step time	— StepTime		
Sequence step timed out	— StepTimeOut		
Number of sequence cycle	— NoTurns		
Block alarm	— AlcBlk		
Acknowledge alarm	— AlarmAck		
In Parameter	— InPar		
Event name	— EventName		

Figure 3-1. SEQ01 Function Block, Complete symbol

Table 3-1 below illustrates the default properties of each terminal of the SEQ01 function block.

Name	Data Type	Attributes	Direction	FD Port	Initial value	Description
Name	string	coldretain	in	yes	'Seq01'	Object name
Description	string	coldretain	in	yes	'Descr'	Object description
Enable	bool	coldretain	in	yes	true	Enable object
HSI	HSI_Seq		in_out	yes		Communication with HSI
E1Start	bool	retain	in	yes		Start order in E1 mode
Reset	bool	retain	in	yes		Reset
SeqAuto	bool	retain	in	yes		Order mode to Auto
SeqMan	bool	retain	in	yes		Order mode to Man
SeqE1	bool	retain	in	yes		Order mode to E1
SeqHold	bool	retain	in	yes		Order mode to Hold
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
MaxSeqTime	time	coldretain	in	yes	5m	Max sequence time
MaxStepTime	time	retain	in	yes		Max sequence step time
StepTime	time	coldretain	in	yes		Sequence step time
StepTimeOut	bool	retain	in	yes		Sequence step timed out
NoTurns	dint	coldretain	in	yes	1	Number of sequence cycle
AlcBlk	bool	retain	in	yes		Block alarm
AlarmAck	bool	retain	in	yes		Acknowledge alarm
InPar	Seq01_InPar	by_ref	in	yes		In Parameter
EventName	string	coldretain	in	yes	' Seq01_'	Event name
NoInt	bool	retain	out	yes		No Interlocks
RFS	bool	retain	out	yes		Ready for start
Run	bool	retain	out	yes		Running
Pos	dint	retain	out	yes		Active step number
AutoInd	bool	retain	out	yes		Auto mode
ManInd	bool	retain	out	yes		Man mode

Name	Data Type	Attributes	Direction	FD Port	Initial value	Description
E1Ind	bool	retain	out	yes		E1 mode
HoldInd	bool	retain	out	yes		Hold mode
Seq_Disable	bool	retain	out	yes		Connection to SFC block, Disable Action
Seq_Reset	bool	retain	out	yes		Connection to SFC block, Reset
Seq_Hold	bool	retain	out	yes		Connection to SFC block, Hold
OutPar	Seq01_OutPar	by_ref	out	yes		Out Parameter
Opr	Seq01_Opr	by_ref	out	yes		Operator order

4 SEQ01 Datatypes

4.1 Seq01_InPar

Name	Data Type	Attributes	Initial value	ISP value	Description
Class	dint	coldretain	500		AE class
Severity	dint	coldretain	1000		AE severity
InitMode	dint	coldretain	5		Init mode (5 = Man ; 6 = Auto ; 7 = E1)
ManBlk	bool	coldretain	false		Block operator order Man mode
AutoBlk	bool	coldretain	false		Block operator order Auto mode
E1Blk	bool	coldretain	false		Block operator order E1 mode
StartBlk	bool	coldretain	false		Block operator order Start command
ResetBlk	bool	coldretain	false		Block operator order Reset command
HoldBlk	bool	coldretain	false		Block operator order Hold command
StepBlk	bool	coldretain	false		Block operator order Step command
JumpBlk	bool	coldretain	false		Block operator order Jump command
UnCondBlk	bool	coldretain	false		Block operator order Unconditional command
AlcBlkEvBlk	bool	coldretain	true		Block event for AlcBlk
SeqManEvBlk	bool	coldretain	true		Block event for SeqMan
SeqAutoEvBlk	bool	coldretain	true		Block event for SeqAuto
SeqE1EvBlk	bool	coldretain	true		Block event for SeqE1
ResetEvBlk	bool	coldretain	true		Block event for Reset
ExtStartEvBlk	bool	coldretain	true		Block event for ExtStart
SeqHoldEvBlk	bool	coldretain	true		Block event for SeqHold
IB1	IBInParType1	coldretain			Configuration for IB1
IB2	IBInParType1	coldretain			Configuration for IB2
IB3	IBInParType1	coldretain			Configuration for IB3
IB4	IBInParType1	coldretain			Configuration for IB4
AEConfigSeq	dint	coldretain	1		AE configuration for sequence time out alarm
AEConfigStep	dint	coldretain	1		AE configuration for step time out alarm

4.2 Seq01_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)
IB1Ind	bool	retain			IB1 interlocked
IB2Ind	bool	retain			IB2 interlocked
IB3Ind	bool	retain			IB3 interlocked
IB4Ind	bool	retain			IB4 interlocked
Seq	AlarmInd	retain			Alarm indication for sequence time out
Step	AlarmInd	retain			Alarm indication for step time out

4.3 Seq01_Opr

Name	Data Type	Attributes	Initial value	ISP value	Description
BlockAlarm	bool	retain			Operator block alarms
Man	bool	retain			Operator order Manual mode
Auto	bool	retain			Operator order Auto mode
E1	bool	retain			Operator order E1 mode

Name	Data Type	Attributes	Initial value	ISP value	Description
Start	bool	retain			Operator order Start command
Reset	bool	retain			Operator order Reset command
Hold	bool	retain			Operator order Hold command
Step	bool	retain			Operator order Step command
Jump	bool	retain			Operator order Jump command
UnCond	bool	retain			Operator order Uncond 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

5 Function

5.1 Basic Properties

The SEQ01 functional unit is designed for single sequential control. The Process Portal interface does not support parallel sequences.

SEQ01 unit consist of the following basic functions.

- Evaluation of interlocks
- Control of start/stop
- Supervision of sequence and step time
- Supervision of operations via Process Portal A

5.2 Control Modes

SEQ01 is intended for control from Process Portal A, i.e. from a central control room.

All the control modes can be selected from the central operator station.

The different modes of control are as follows:

- Manual
- Auto
- E1
- Hold
- Disabled

All control modes may be selected through the dialog in the Process Portal A.

For the different control modes, SEQ01 is controlled as follows. For a summary of the control modes, see Table 4-1 below, which, shows command signals in priority order and control modes selected (shadowed) under different conditions.

Commands		Mode selected			
Signal	Source	Manual	Auto	Hold	E1
Hold	Operator				
SeqHold	Program				
Man	Operator				
SeqMan	Program				
Auto	Operator				
SeqAuto	Program				
E1	Operator				
SeqE1	Program				

Table 4-1. Control modes selection and priority.

5.2.1 Control Mode HOLD

HOLD control mode is selected from the SEQ01 faceplate on Process Portal A or input terminal SEQHOLD. When this mode is activated the SEQ01 will remain in its current step, completing the activities in its active step. MANUAL, AUTO or E1 modes will then need to be activated to continue the sequence.

5.2.2 Control Mode MANUAL

MAN control mode is selected from the SEQ01 faceplate on Process Portal A or input terminal SEQMAN. The intension with this mode is that the SEQ01 will complete its current step and then wait for the operator to give the STEP command from the object Faceplate.

5.2.3 Control Mode AUTO

AUTO control mode is selected from the SEQ01 faceplate on Process Portal A or Input terminal SEQAUTO. When this mode is selected and the SEQ01 is started by the operator, the sequence after completing it's current step will continue to the next step provided all the user configured transition conditions are met.

5.2.4 Control Mode E1

E1 control mode is selected from the SEQ01 faceplate on Process Portal A or Input terminal SEQE1. This mode is working the same way as AUTO, but the SEQ01 is started thru the input terminal E1START.

5.2.5 Control Mode DISABLED

The SEQ01 is stopped and all orders to it are blocked. Used to take the SEQ01 Out of Service.

DISABLED mode can be selected at the operator station, if a start or stop sequence is not in progress. In this mode the SEQ01 functions are disabled.

5.3 Start-up

An initialization phase begins at start of the system. The result of this becomes:

The outputs are reset (to zero) except for the AutoInd terminal which is set (to 1).

Auto is the default control mode at system initialization. With an additional circuit it is possible to force the control mode to Manual mode at system initialization.

5.4 Interlocks

The SEQ01 control can be interlocked by signals from the process.

Process Interlocks. There are 2 normal process interlocks: IB1 and IB2. Both interlocks can be configured to accept blocking by the operator. Both interlocks can also be configured as start interlocks. A start interlock will prevent the SEQ01 from starting, but does not stop a running SEQ01.

5.5 Start and Reset

Start and Reset command for SEQ01 may originate from dialog with Process Portal A or from Function Block inputs.

When the RESet function is activated all outputs except the mode indication are set to zero. When the sequence is restarted it will start from step 1. The SEQ01 can also be reset from control logic by setting the Reset parameter to TRUE.

When the process interlocks are satisfied the SEQ01 may be started.

If an object doesn't start, the sequence program can put the sequence into HOLD and/or give an alarm thru the SEQ01 function block. Hold can also be ordered by the operator or locally via an input parameter. Hold mode is left with a new start or stop order.

Order RESET interrupts start and stop sequences.

5.5.1 Start and Reset Order at Different Control Modes

The table below describes the commands which can be given at the different control modes of SEQ01.

Order	Manual	Auto	E1
Operator Start	Start	Start	-
Operator Hold	Hold	Hold	Hold
Operator Stop	Res	Res	Res
Input E1Start	-	-	Start
Input SeqHold	Hold	Hold	Hold
Input Reset	Res	Res	Res

Table 4-2. Relation between commands and control modes

5.6 Object connections and interaction

The object connection and interaction will depend on the type of language selected. If Sequential Function Chart (SFC) language is selected then connections to objects are done by the step active parameter, **.X**. For example if the step name is 'S1' then the structured text command in the SFC language will appear as follows:

Seq1.ActSta1 := S1.X; This command activates the text Activity1.

5.7 Interaction Windows

The interaction window is available in 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 Builder.

5.7.1 SEQ01 Interaction Window

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

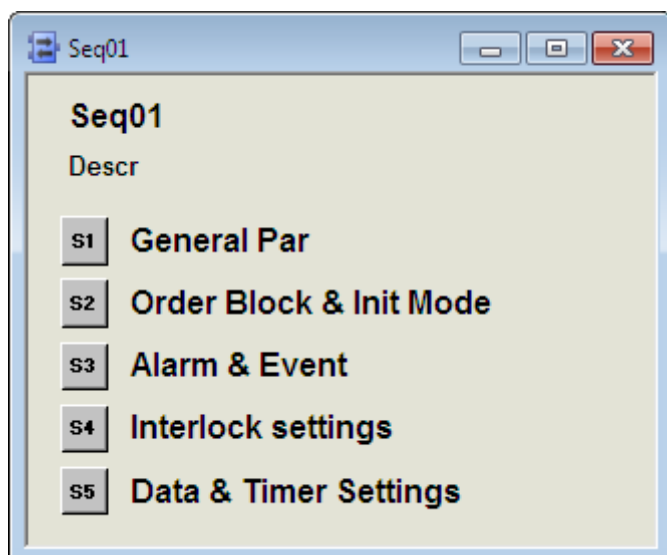


Figure 4-2 Main Interaction Window.

5.7.2 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.

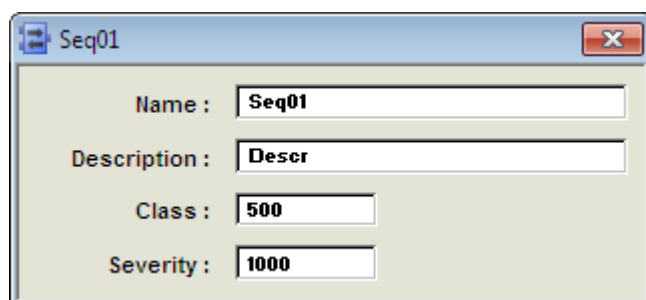


Figure 4-2 General Parameters.

5.7.3 Order Block

Blocking of operator order are entered in this window.

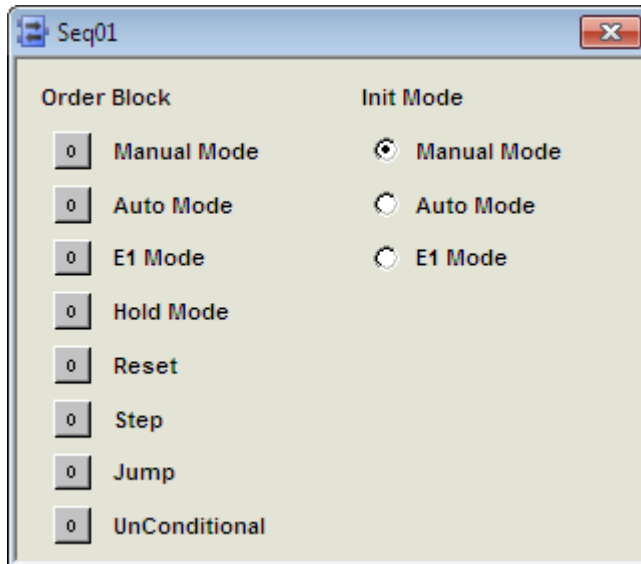


Figure 4-3 Order Block.

5.7.4 Alarm and Event Block

Alarm or Event block may be set in this window or on the extended faceplate.

For Alarm Configuration the following values are valid

- 0 No Alarm or Event are generated
- 1 Alarm and Event are generated
- 2 Event is generated

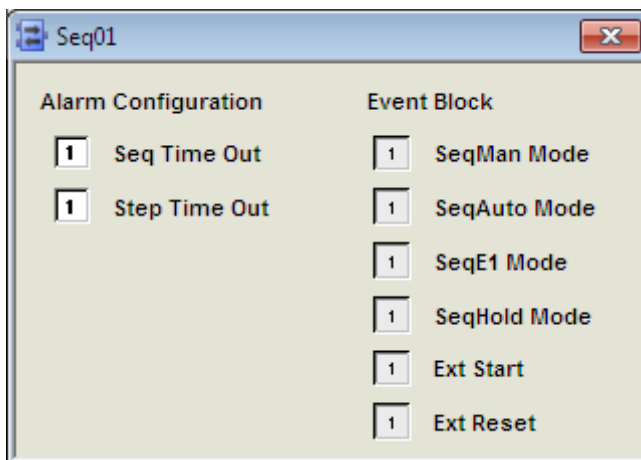


Figure 4-5 Alarm and Event Block.

5.7.5 Interlock Settings

The different settings for interlocks are entered in this window. Permission can also be given to the operator if they are to allowed to override interlocks process interlocks.

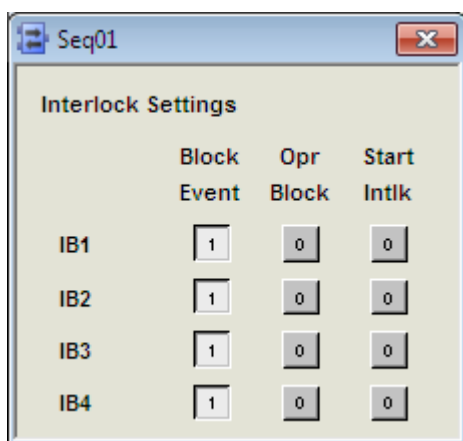


Figure 4-5 Interlock Settings.

5.7.6 Data and Timer Settings

This window gives information about the sequence. Max Seq. Time, Interval Time and No. of Turns. The 'No. of Turns' specifies the amount of times the sequence is to run. A value of '-1' will make the sequence run continuously, repeating from the first step. The 'Interval Time' is the time between each 'turn' of the sequence.

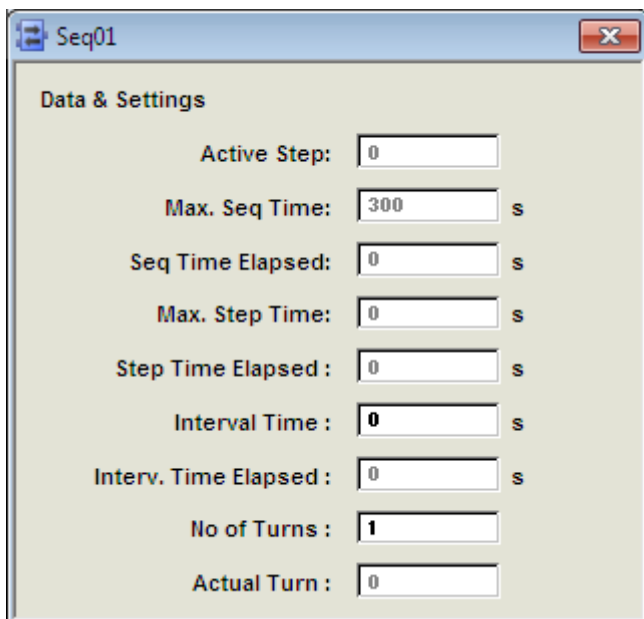


Figure 4-5 Sequence Data and Timer Settings.

5.7.7 Text

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.

The screenshot shows a software dialog box titled "Seq01 : Text Configuration". It contains a table with the following data:

Name	Value	Type	Description	Readable?	R/Permission	Writable?	W/Permission	Deploy Scheme
IB1Text		String	IB1 Interlock Text	Yes		Yes	Configure	Always Repla
IB2Text		String	IB2 Interlock Text	Yes		Yes	Configure	Always Repla
IB3Text		String	IB3 Interlock Text	Yes		Yes	Configure	Always Repla
IB4Text		String	IB4 Interlock Text	Yes		Yes	Configure	Always Repla
Info1Text		String	Info1 Text	Yes		Yes	Configure	Always Repla
Info2Text		String	Info2 Text	Yes		Yes	Configure	Always Repla

At the bottom right of the dialog box, there are three buttons: "Cancel", "Apply", and "Help".

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

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 SEQ01.

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

- Process display
- Object display
- Interlock display

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

6.1.1.1 Process display

If Max Seq Time and Max StepTime parameters on the block is set to 0 the The “Step time” in GE Seq01SG01 will not be red



Figure 5-1 Process Display Elements from the Top, Seq01SG01, CurrStepNumberName01 and Seq01PD01.

6.1.1.2 Object display

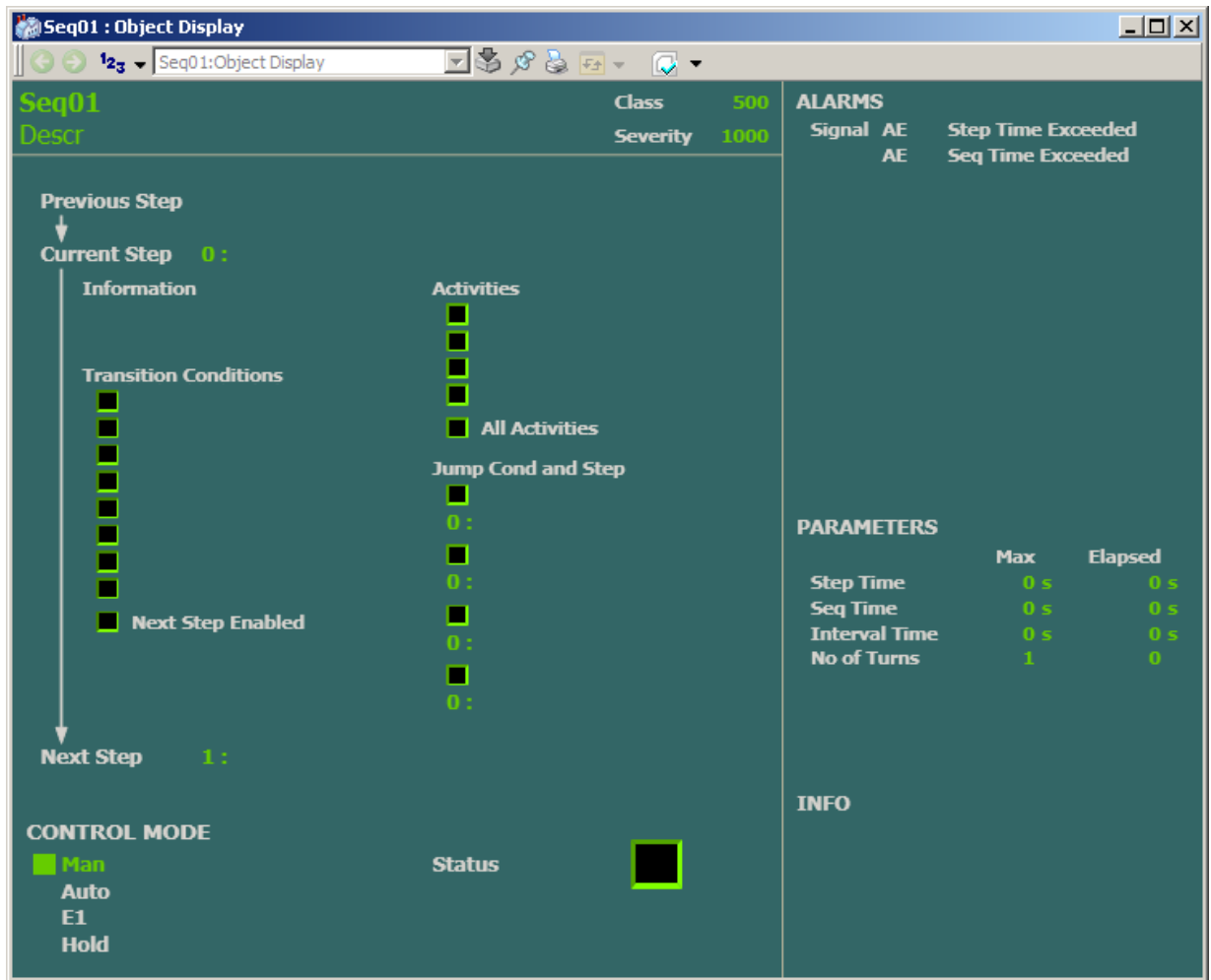


Figure 5-2 Object Display.

If Max Seq Time and Max StepTime parameters on the block is set to 0 not red indication will be activated for Sequence Time Out and Step Time Out

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 override must be set to Blockable. This can be done from this display if the user has permission Configure or from the Interaction Window see chapter 5.7.5.

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.

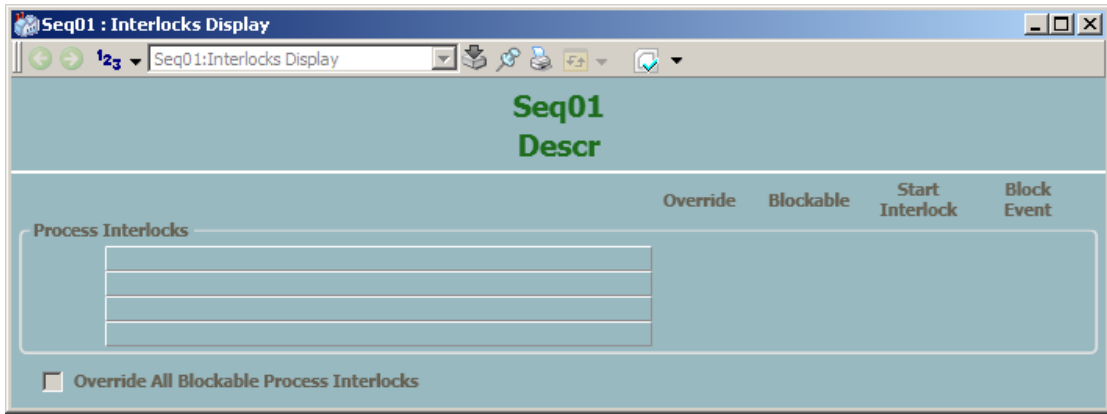


Figure 5-3 Interlock Display.

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 SEQ01 are available to be logged on the trend curves.

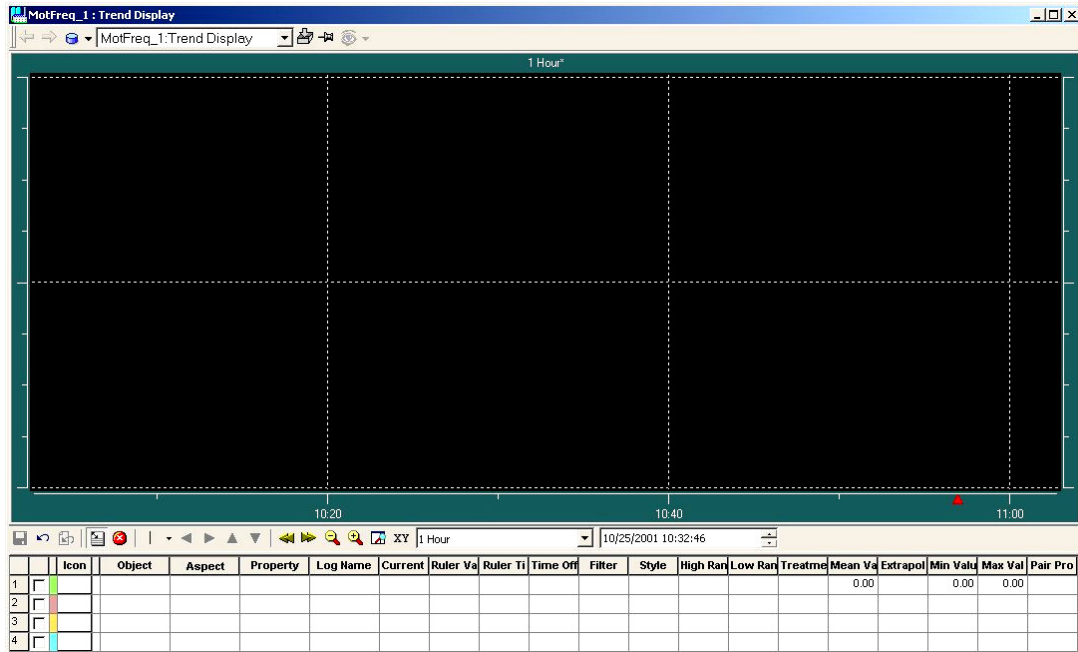


Figure 5-4 Trend Curve

6.2 Faceplate(Dialog)

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

By using Process Portal A 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 5-4 to 5-11 overleaf illustrate the various presentations of the faceplate.

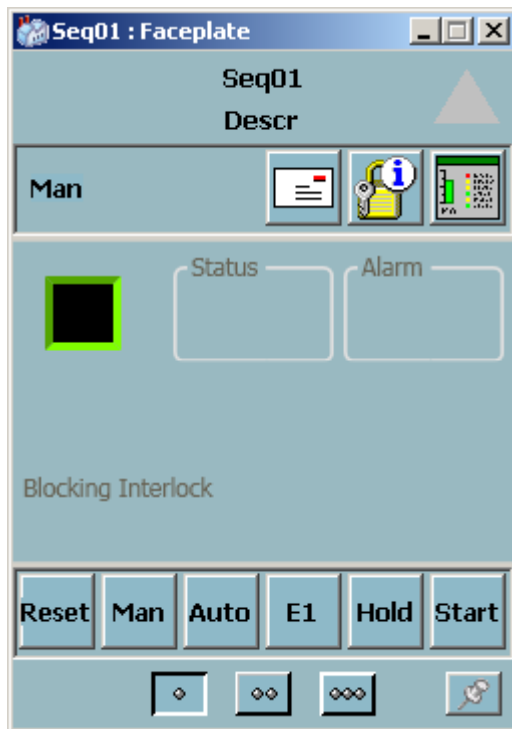


Figure 5-5 Reduced Faceplate

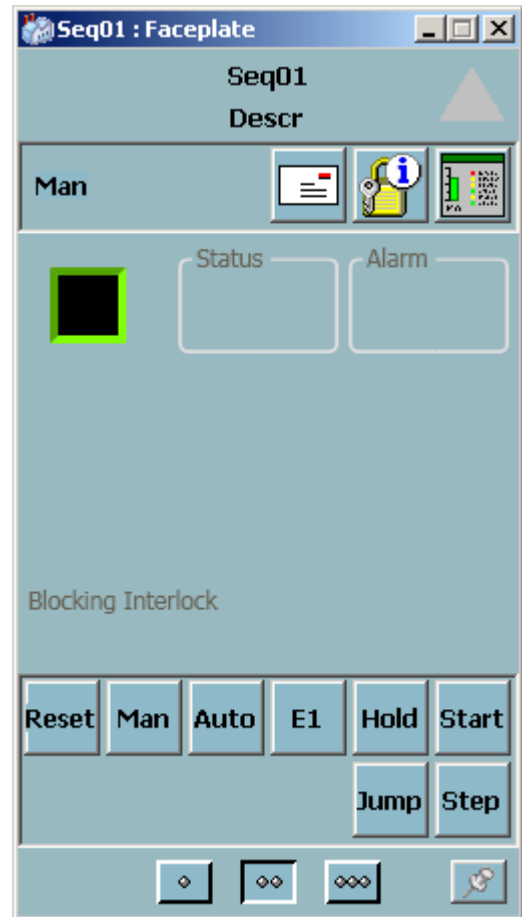


Figure 5-6 Faceplate

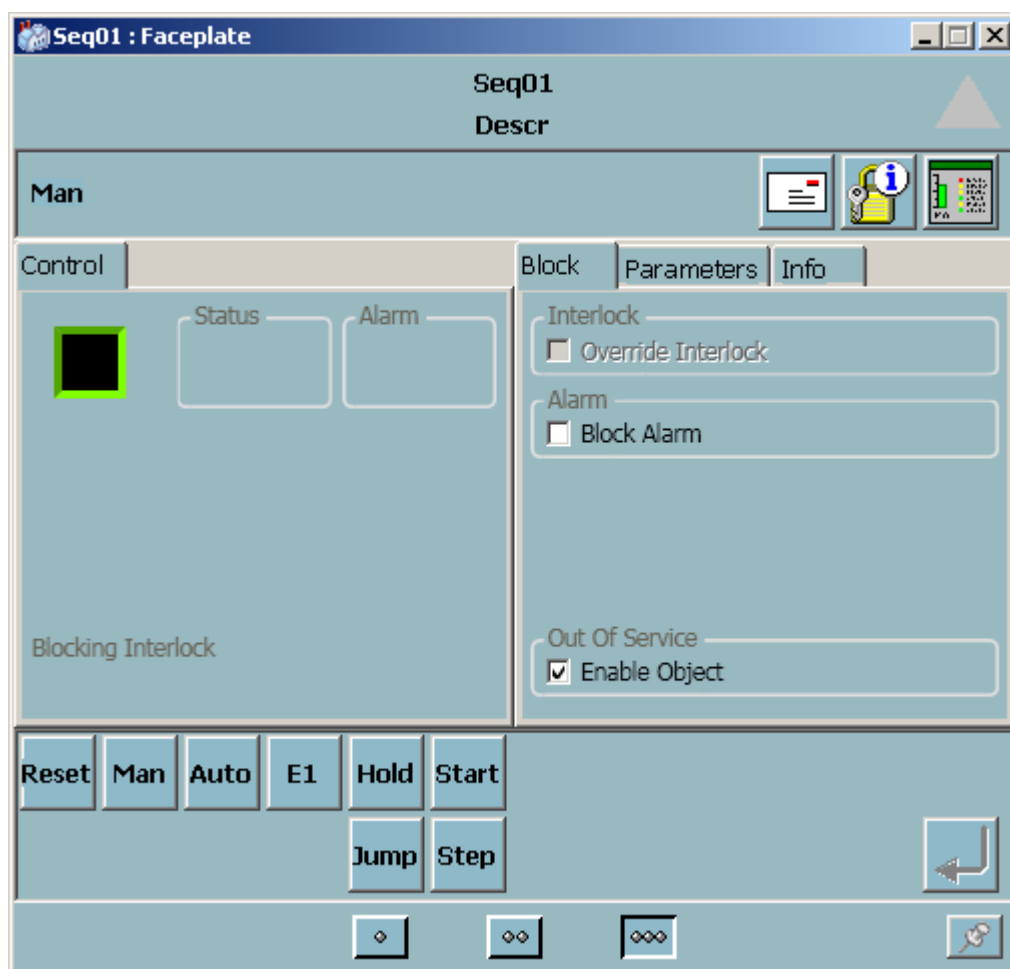


Figure 5-7 Extended Faceplate

6.3 Alarm and Event Handling

6.3.1 General

This section contains a description of all alarms and events in the functional unit SEQ01.

If an object doesn't start, any step or the sequence itself takes to long time, an alarm is generated and can be viewed on the Process Portal A.

6.3.2 Alarm and Event messages

The following alarm texts are generated by the functional unit Seq01. 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>	SeqAlarm	Seq. Time
<Name>	<Description>	StepAlarm	Step Number
<Name>	<Description>	JumpError	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>		SeqMan Mode
<Name>	<Description>		SeqAuto Mode
<Name>	<Description>		SeqHold Mode
<Name>	<Description>		Ext Start On
<Name>	<Description>		IB1 On
<Name>	<Description>		IB1 Off
<Name>	<Description>		IB2 On
<Name>	<Description>		IB2 Off
<Name>	<Description>		Ext Reset On
<Name>	<Description>		Ext Reset Off
<Name>	<Description>		Alarm Acknowledge

6.4 Faceplate tabs

6.4.1 Alarm Blocking

By using the extended faceplate it is possible for the process engineer to block alarms and alarm printouts. When the block alarm and block printout check boxes are active then all alarms are blocked as indicated by dashed yellow frames around the process display elements.

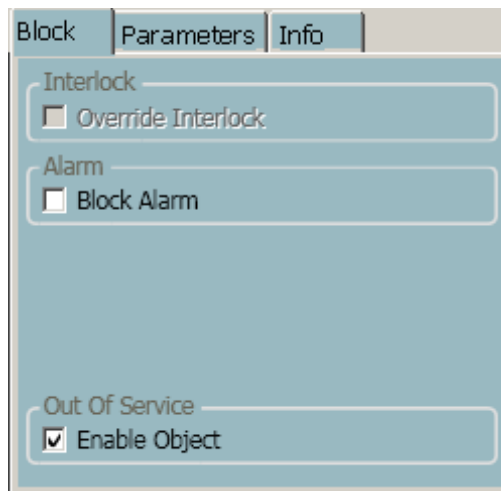


Figure 5-8 Extended Faceplate (Block)

6.4.2 Parameters

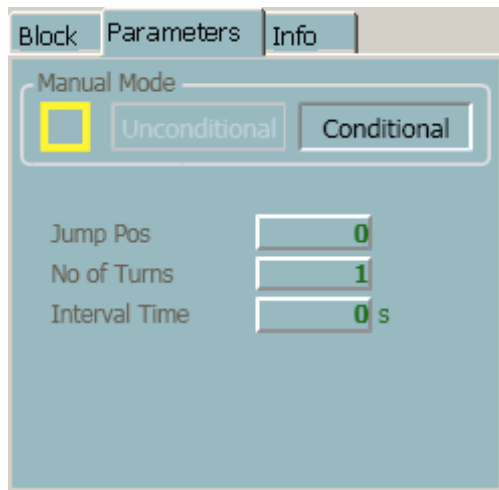


Figure 5-9 Extended Faceplate (Parameters)

6.4.3 Info

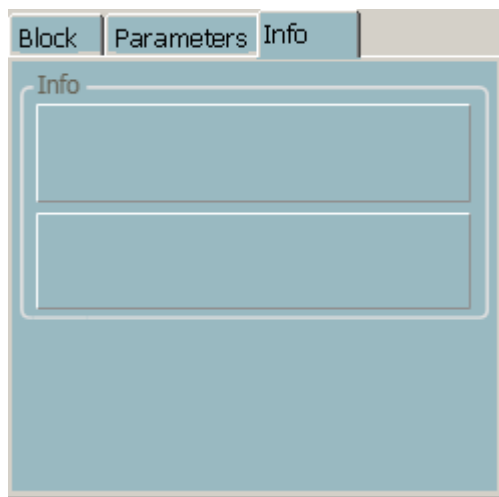


Figure 5-9 Extended Faceplate (Info)

7 Sequence Texts

Texts for Seq01 are entered from the PPA into an aspect of the SEQ01 called 'Step Names Property Translations'. When entering these texts it is useful to look at the Object Display as its layout corresponds with the texts in the Property Translations aspect.

The following texts may be entered for each step:

- 4 Activity texts.
- 8 Condition texts.
- 4 Jump texts.
- 4 Jump Name texts.
- Information text.
- Current Step text.
- Next Step text.
- Previous Step text.

To enter a text a property must first be selected on the property translations aspect, the texts can then be entered on a per step basis for each property. The number of steps is unlimited, even though the number of expressions is 'x=75', just use the TAB key to enter new rows.

The texts are entered into the String Translation Table, columns, Text when true or text when false. In the Expression column, x= a number, indicates the step number when the text is to be active.

The screenshot displays the software's configuration environment. On the left is a project tree for 'Sequence_Test, Control Project'. The central pane shows a list of property translations with columns for Name, Description, and various flags. The 'Property View' dialog is open, showing the configuration for 'Condition_1'. The 'Expression' field is set to 'HSI.PosN'. Below it is the 'String Translation Table' with the following data:

Expression	Text when true	Text when false
x=0		
x=1	Pump Running	
x=2	Tank full	
x=3	Temp	
x=4	Time	
x=5	Tank Empty	
x=6		
x=7		
x=8		
x=9		
x=10		
x=11		
x=12		
x=13		
x=14		

REVISION

Rev.	Page (P) Chapt. (C)	Description	Date Dept./Init.
A	3 - 5	Rev 3.1/2	050319/MP
B	4,5	Event handling is added. Interaction Window updated	050401/BP
C	4, 5	Faceplate, Rev 4.0/1	050902/MP
D	3	Param connection removed rev 4.0/5	070511/BP
E		Rev 5.0-1 Interlock functionality is updated	081204/BP
F		Update Rev5.1/0	101103/BP