

## **Function description**

DCS System

Project K70101

ASU No. 9 Kosice

## Table of contents

1.1	<u>Overview</u>
1.1	<u>System description</u>
1.1.1	<u>System architecture</u>
1.1.2	<u>System Software</u>
1.2.	<u>Remote Control</u>
2.1	<u>DCS Functions</u>
2.2	<u>Graphic displays</u>
2.2.1	<u>Group display</u>
2.2.2	<u>Faceplate</u>
2.2.3	<u>System Display</u>
2.2.4	<u>Graphics Display</u>
2.2.4.1	<u>Color specification</u>
2.3	<u>Alarm strategy</u>
2.3.1	<u>Alarm Priority</u>
2.3.2	<u>Discrete sensor alarms</u>
2.3.3	<u>Process Value alarms</u>
2.4	<u>Logs</u>
2.4.1	<u>Signal sequence log</u>
2.4.2	<u>Daily report</u>
2.4.3	<u>Monthly report</u>
2.4.4	<u>Snapshot report</u>
2.5	<u>Security Lock</u>
2.6	<u>Trend server</u>
2.7	<u>Trip logic</u>
2.8	<u>Function Blocks</u>
2.8.1	<u>Analog monitoring</u>
2.8.1.1	<u>Typical of an analog monitoring</u>
2.8.1.2	<u>Typical of a binary monitoring</u>
2.8.1.3	<u>Representation of a Binary value in the graphic</u>
2.8.2	<u>Closed loop control</u>
2.8.2.1	<u>Typical of an universal continuous controller</u>
2.8.2.2	<u>Representation of a closed loop control</u>
2.8.3	<u>Open loop control for valves</u>
2.8.3.1	<u>Typical of an open loop control for valves</u>
2.8.3.2	<u>Representation of an open loop control for valves</u>
2.8.4	<u>Open loop control for electric motors</u>
2.8.4.1	<u>Typical of an open loop control for motors</u>
2.8.4.2	<u>Representation of an open loop control for motors</u>
2.8.5	<u>Trip logic</u>
2.8.5.1	<u>Typical of a trip logic</u>
2.8.6	<u>Analysis measuring</u>
2.8.6.1	<u>Representation of an analysis measuring</u>

## 1.1 Overview

This document describes the basic of the application software which confirm to Air Liquide AGS Standard.

### 1.1 System description

Control IT AC800F is the process control system from ABB for the automation of process engineering and production processes. Control IT AC800F combines the advantages of PLC –based automation solutions for the manufacturing industry, such as low hardware costs and finely graded systems, with the advantages of PLC-based features for the processing industry such as reliable process control, user friendly operation and visualization, and powerful engineering tools.

Control Builder F is the tool for configuring, commissioning and documenting the user programs and displays in a Freelance 2000 system. Configuration using *Control Builder F* is based on the IEC 61131-3 standard.

The software running on the PC operator station in the *Freelance 2000 system* is known as *DigiVis*. It offers a user-friendly graphical user interface in accordance with the MS-Windows standard.

For process operation *DigiVis* offers following features:

Standard displays such as overview display, group display, faceplate, trend display, system display, time scheduler display, SFC display, Customized graphic displays, Customized faceplates for user-defined function blocks, Simple process operation with mouse and keyboard. Quick and direct access to tags for operation, Comprehensive and wide-ranging message management, Trend displaying and trend archiving, Logging, System diagnostics in the system display.

#### 1.1.1. System architecture

*Control IT AC800F* is based on the following HW components:

- Industrial IT Controller AC800F
- Operator stations (DigiVis) based on Windows standard
- System bus based on the Ethernet standard with the TCP/IP communications protocol
- Profibus DP I/O's based S800 I/O modules

System Layout see Appendix A

### 1.1.2. System Software

*Control IT AC800F* offers system wide and plant wide engineering for all components of the process control system: operator stations, automation system and distributed I/Os.

*Control IT AC800F* is based on the following SW components:

- Control Builder F V 7.2
- DigiVis V 7.2
- DigiLock
- OPC-Server F
- Trend-Server F

### 1.2. Remote Control

For remote control a ISDN Router is installed.

For remote control *PCanywhere* Version 11.0 is used.

## 2.1 DCS Functions

### 2.2 Graphic displays

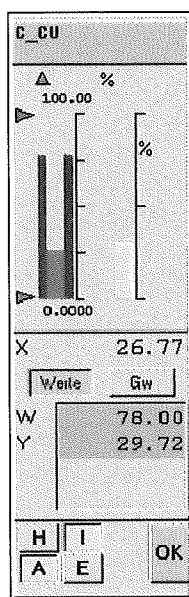
#### 2.2.1 Group display

A group display is a configured collection of several faceplates. It offers the user the possibility of presenting related functions in one display. Following the selection of one of the faceplates, the corresponding function can be operated.

### 2.2.2 Faceplate

Faceplates are used for operation and observation of tags. They show the current state of the associated process point. A faceplate can be superimposed on all other displays on the screen. A selected tag is always operable via its faceplate.

For operations every typical has its own standard faceplate.



Example of a continuous controller faceplate

### 2.2.3 System Display

The current state of hardware and software throughout the control IT AC800 F system is shown in the customized DigiVis system display. The current state can be ascertained from the colors used for displaying the process station components.

A DigiVis operator station has one system display.

### 2.2.4 Graphics Display













In addition to standard displays such as group displays each part of the plant is generated on one or more graphic picture (basis of the P&I diagram).

Current process data and process state information are presented in digital or analog form (e.g. bar graph, fill level or trend) in the required position as a dynamic foreground display.

The motors, valves and sensors are displayed as simple typicals.

#### 2.2.4.1

#### Color specification

<u>COLOR DEFINITION</u>		
	GREY 48	AIR
	YELLOW	NITROGEN
	DARK YELLOW	BASIC NITROGEN
	BLUE	OXYGEN
	DARK BLUE	BASIC OXYGEN
	BRIGHT PURPUR	H2 / N2 MIXTURE
	MAGENTA	ARGON
	DARK MAGENTA	BASIC ARGON
	PURPUR	HYDROGEN
	DARK GREEN	STEAM
	MEDIUM GREEN	WATER
	RED 19	OIL

#### 2.3

#### Alarm strategy

The operator is kept informed constantly of disturbances or certain state either in the process or in the Control IT system by optical and acoustic messages.

All alarms are generated by the controllers and displayed and archived in DigiVis. When appropriate, alarm conditions are dynamically evaluated, an alarm is not be generated for a given process condition, if that part (sequence) is not active. All alarms are reported in an alarm list and event logs with all states as incoming time, outgoing time and acknowledged by the operator.

In the system, messages are divided into the following types according to their importance to the process:

- **System messages**  
System messages have the highest priority level and are subdivided into three message groups S1 to S3. System messages are used to indicate fault states of the system itself.

- **Alarm messages**  
Alarm messages have the priority levels 1 .Messages of this type are used to indicate e.g. motor failures being violated, and cause e.g. trips, switch off.
- **Warning messages**  
Alarm messages have the priority levels 3 .Messages of this type are used to indicate e.g. alarm limit settings being violated and cause e.g. interlocks.
- **Switch messages** Switch messages are at priority level 5. Messages of this type are used to indicate switch events, e.g. valve open/closed.

### 2.3.1 Alarm Priority

<u>Priority level</u>	<u>Message type</u>	<u>Display color</u>
S0 to S3	System message	blue
1	Fault message	red
3	Fault message	yellow
5	Switch message	-

The same color is used to indicate the priority level of a message in the message line, message list and faceplates.

### 2.3.2 Discrete sensor alarms

Discrete input signals include instrumentation such as pressure, temperature, level, and flow transmitter and proximity switches. In most cases, the discrete sensor is configured in the fail-safe state (i.e. closed contact is normal and open contact for an alarm). These signals generate an alarm dependent upon the real world input state as follow:

- The PLC digital input signal equal to 1 (high) is the normal state.(no internal alarming)
- The PLC digital input signal equal to 0 (low) is the alarm state (control system generates alarm)

Discrete switches inputs are maintained for adjustable time duration to eliminate nuisance alarming

This type of feedback –based discrete alarm may be specified to cause a device fault. In cases where the condition is critical to the operation of a sequential process, the process generates a critical alarm and either stops or transitions to next appropriate step.

### 2.3.3 Process Value alarms

All analog input values (i.e. pressure, temperature, flow, speed,O2, ....) interfacing to the PLC have the ability to have multiple alarms,. These alarms may be high, low, highhigh, lowlow. Based upon predefined operating values the alarm limits are configured for each analog point.

All critical analog input signals are monitored in the PLC for overrange and underrange values. In some cases these alarms cause to enter the trip logic.

## 2.4 Logs

The logs are printed automatically (24 hours or every month). If it is necessary the operator could start the print manually.

### 2.4.1 Signal sequence log

These are used for logging events such as messages, faults, switching actions and operator interventions. Logging is performed spontaneously when the event takes place.

### 2.4.2 Daily report

The daily report shows all integrated values of the flowmeters and powermeters. The Values from the day and the day before are displayed.

### 2.4.3 Monthly report

The monthly report shows all integrated values of the flowmeters and powermeters. The Values from the month and the month before are displayed.

### 2.4.4 Snapshot report

The snapshot report shows the actual process value include date and time. The signals are defined by the process engineers.

## 2.5 Security Lock

The Security Lock (DigiLock) provides access control for engineering with Control Builder F and for operation and observation with DigiTool.

In the system users are required to login before using Control Builder F or DigiVis.

A total of 1000 users can be administered in up to 16 groups.

In the system, groups are divided into the following types:

- Group 1: supervisor
  - ◆ start/stop motors, pumps, sequence, etc
  - ◆ open/close valves
  - ◆ switch auto/manual mode of controller, discrete device
  - ◆ change constant, limit values of analog signals
- Group 2: operator
  - ◆ start/stop motors, pumps, sequence, etc
  - ◆ open/close valves



- ◆ switch auto/manual mode of controller, discrete device
- Group 3: engineer
  - ◆ start/stop motors, pumps, sequence, etc
  - ◆ open/close valves
  - ◆ switch auto/manual mode of controller, discrete device
  - ◆ change constant, limit values of analog signals
  - ◆ start the engineering tool,
  - ◆ configure and edit the system
- Group 4: Guest
  - ◆ only observation

## 2.6 Trend server

The trend server is used to supply DigiVis with process data for use in trend displays. A trend display can be used to show the time curve of analog process variables. A graphical representation of up to 6 process variables can be shown simultaneously in a trend display. The trend display allows curves to be zoomed, removed and transposed. The standard scanning time is one second.

The curve data is archived for minimum 14 days, the maximum time depends on the size of the harddisk.

Each analog signal is represented in a trend display.

## 2.7 Trip logic

Each part of the plant has its own trip logic. All critical alarms or failures are collected by the trip logic. If one of these alarms is active, the trip logic causes different devices and valves to enter the fail-safe state. If it is necessary to trip another part of the plant, the trip logic will do this (i.e. cold box trip causes entry into the GOX product trip).

If the alarm or failure after shutdown is OK again, then it is allowed to reset the trip logic.

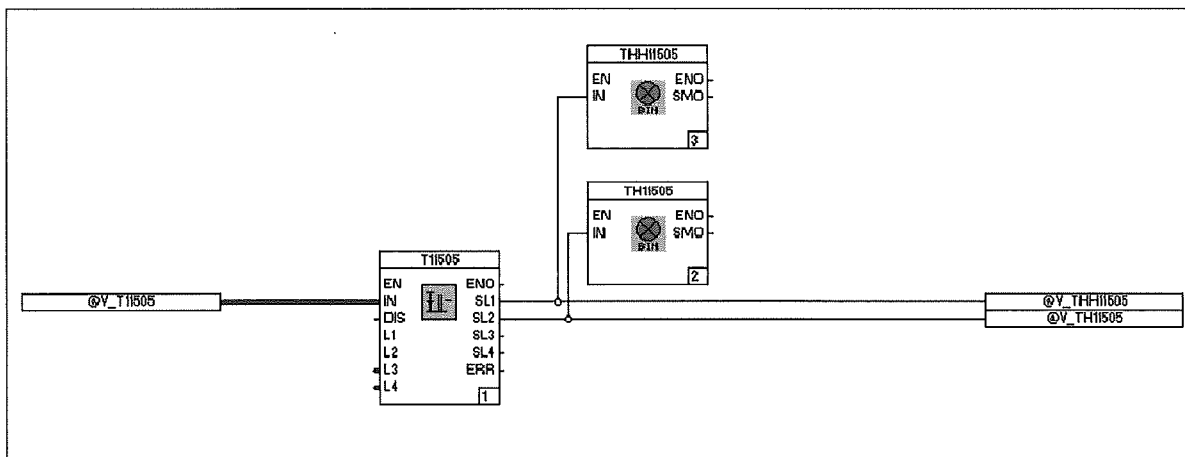
Each trip logic is shown in detail in the function diagram.

## 2.8 Function Blocks

### 2.8.1 Analog monitoring

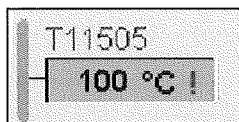
Analog monitoring is used to represent an analog input and monitoring of this signal for up to 4 limit values.

#### 2.8.1.1 Typical of an analog monitoring

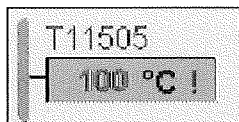


Example of a temperature measuring with two high limits

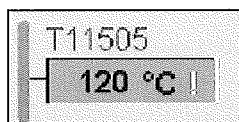
#### 2.8.1.2 Representation of an analog value



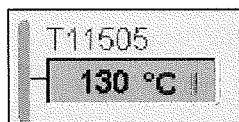
Representation of an analog value without faults



Representation of an analog value with an active I/O failure



Representation of an analog value with an active warning

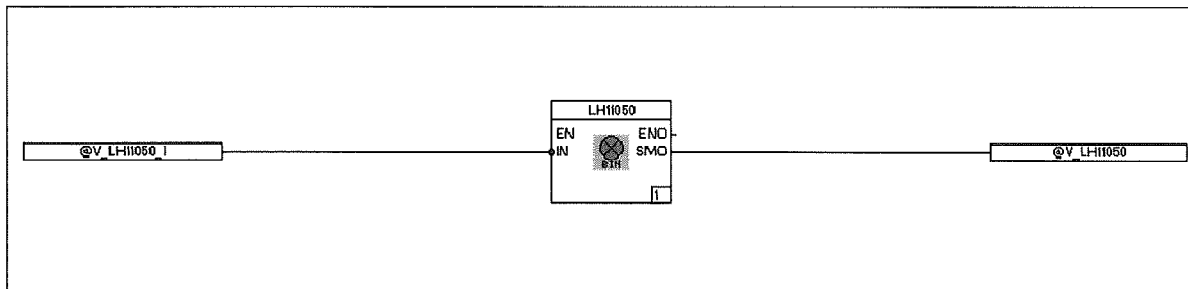


Representation of an analog value with an active alarm

## 2.8.2 Binary Monitoring

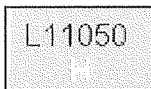
Binary monitoring is used to indicate the state of binary input.

### 2.8.2.1 Typical of a binary monitoring

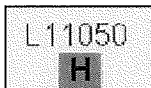


Example of a high level switch

### 2.8.2.2 Representation of a Binary value in the graphic



Representation of a binary value without an active alarm



Representation of a binary value with an active alarm

## 2.8.3 Closed loop control

The control algorithm (PID) will manipulate the output in order to maintain the process variable equal to the set point. An external set point may be introduced.

A monitoring of 4 limit values is possible. The limits refer to the controlled variable or the control difference.

In **automatic** and **internal mode** the user provides a set point.

In **automatic** and **external mode** a lead controller or a sequence provides a set point.

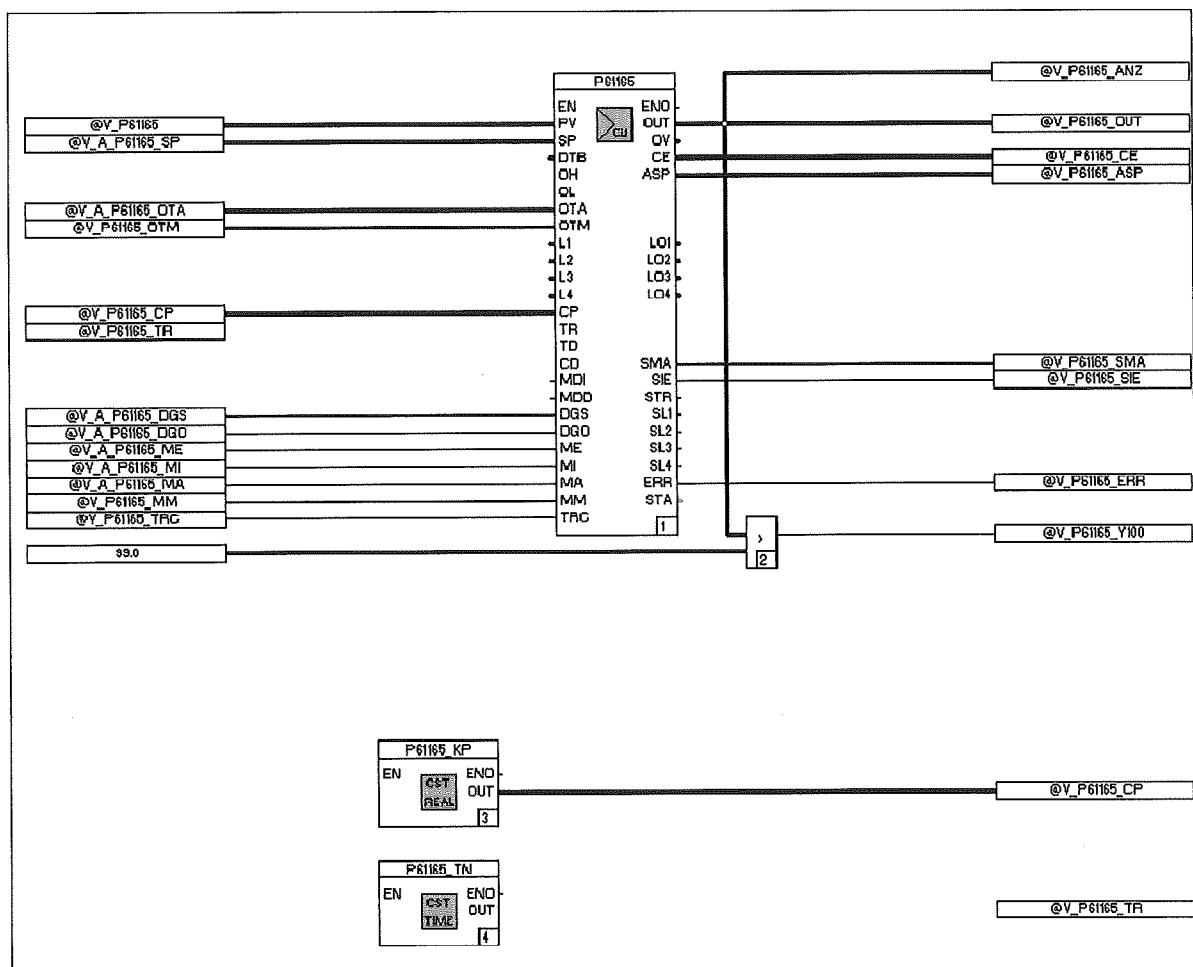
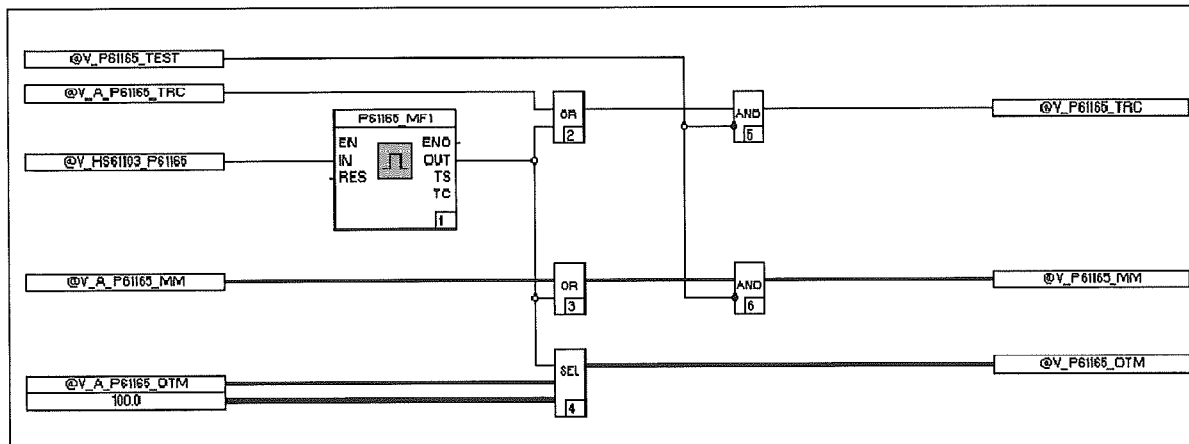
In **manual mode**, the output is manipulated directly by the operator.

In manual and automatic mode the safety interventions can cause to enter the fail-safe state.

In the **testing mode**, the output is manipulated directly by the operator. No interlock and no safety intervention are active. It is possible to enter this mode only by a supervisor.

### 2.8.3.1

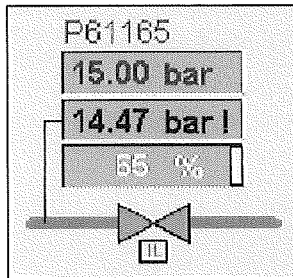
### Typical of an universal continuous controller



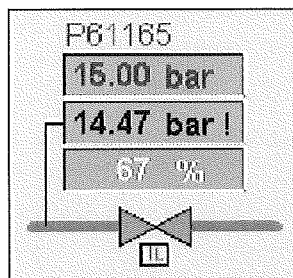
Example of a pressure controller

### 2.8.3.2 Representation of a closed loop control

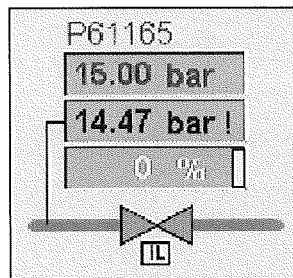
The Representation of the process value with its faults and limits is the same as the analog monitoring.



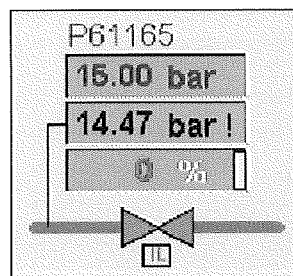
Representation of a controller in manual mode



Representation of a controller in automatic mode



Representation of a controller in manual mode and active interlock



Representation of a controller in manual mode and internal error

## 2.8.4 Open loop control for valves

The individual drive function relays a control command to technical control equipment (valve) in the process. This command can come from a higher ranking control (**automatic mode**) or take place manually (**manual mode**).

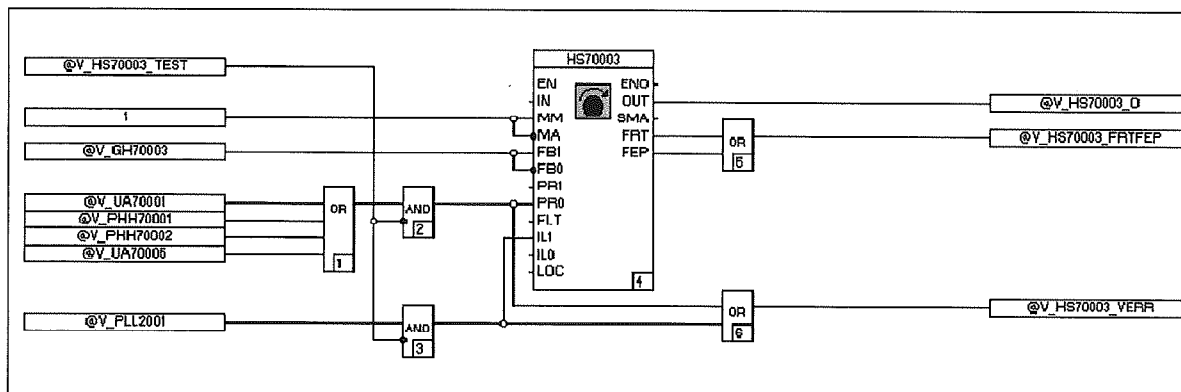
In manual and automatic mode the safety interventions can cause to enter the fail-safe state.

In the **testing mode**, the output is manipulated directly by the operator. No interlock and no safety intervention are active. It is possible to enter this mode only by an engineer.

After the control command has changed, the time is monitored as **run time** until feedback occurs (end position reached). If the run time is exceeded an error message (**run time error**) appears.

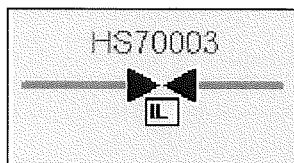
Leaving the end position without control command is signalled as an **end position error**.

### 2.8.4.1 Typical of an open loop control for valves

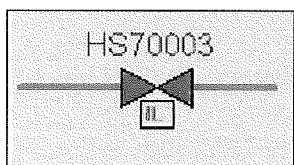


Example for a valve in only manual mode with one feedback

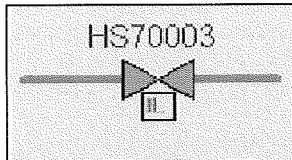
### 2.8.4.2 Representation of an open loop control for valves



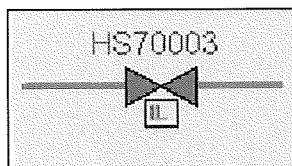
Representation of a valve, closed with an active interlock



Representation of a valve, opened



Representation of a valve, not opened and not closed



Representation of a valve with an active failure

## 2.8.5 Open loop control for electric motors

The individual drive function relays a control command to technical control equipment (motor) in the process. This command can come from a higher ranking control (**automatic mode**) or take place manually (**manual mode**).

In manual and automatic mode the safety interventions can cause to enter the fail-safe state.

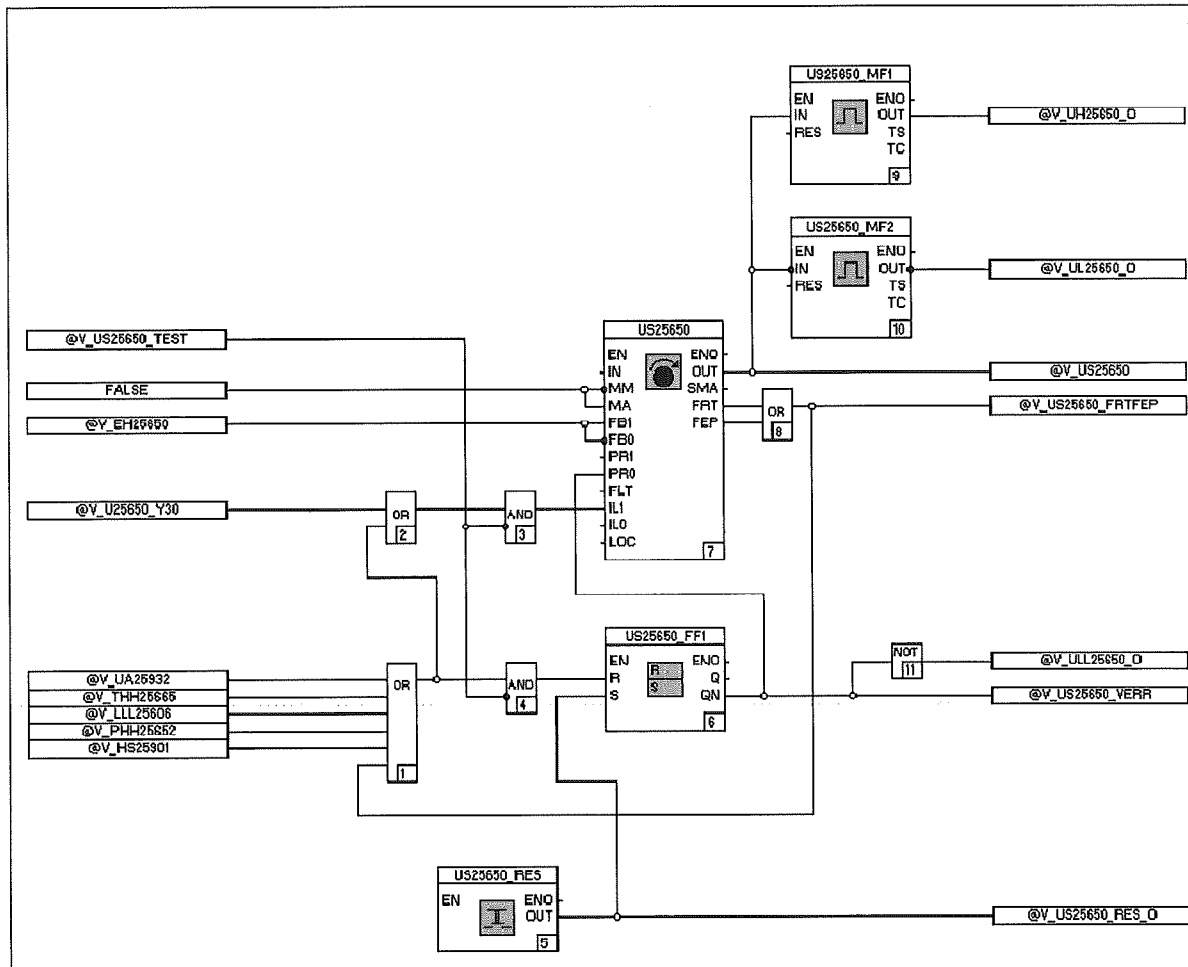
In the **testing mode**, the output is manipulated directly by the operator. No interlock and no safety intervention are active. It is possible to enter this mode only by an engineer.

After the control command has changed, the time is monitored as **run time** until feedback occurs (end position reached). If the run time is exceeded an error message (**run time error**) appears.

Leaving the end position without control command is signalled as an **end position error**.

If a fault appears, then this one must become resetet.

### 2.8.5.1 Typical of an open loop control for motors

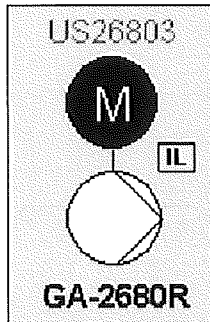


Example for a motor in only manual mode

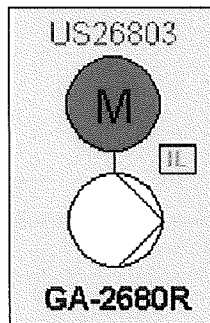


## 2.8.5.2

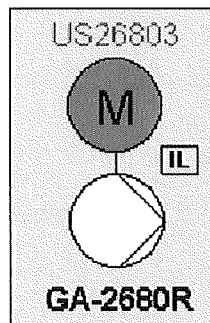
## Representation of an open loop control for motors



Representation of a motor, off with an active interlock



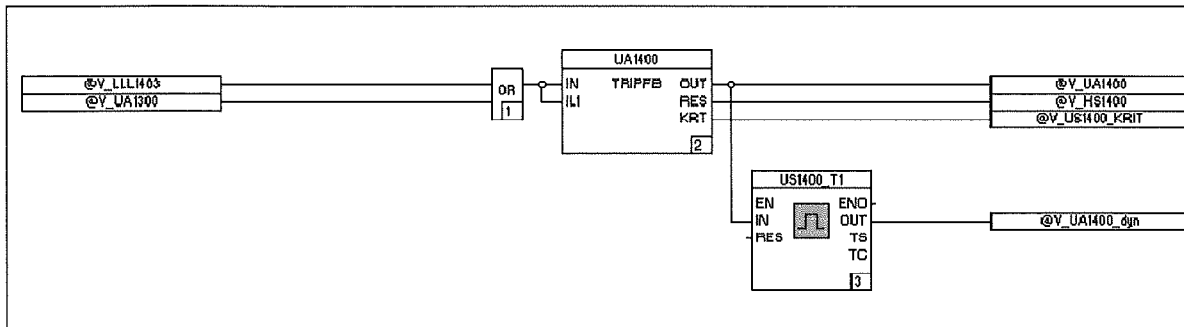
Representation of a motor, on



Representation of a motor with an active failure and interlock (If the yellow symbol is flashing it's possible to reset the block,)

## 2.8.6 Trip logic

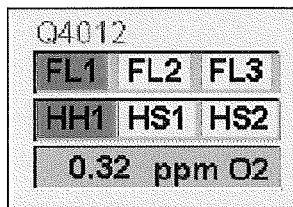
### 2.8.6.1 Typical of a trip logic



Example for trip logic with two trip criterion

## 2.8.7 Analysis measuring

### 2.8.7.1 Representation of an analysis measuring



Representation of an analysis measuring