

Electropneumatic Positioner Type 3730-3 with HART® communication ESD version

Application

Positioner for early detection of faults in SIS valves with information on predictive maintenance and partial stroke test function. The shutdown function in the event of emergency can also be implemented with the positioner certified acc. to IEC 61508.



Emergency Shutdown (ESD) is a positioner function with extended firmware and partial stroke testing for the predictive, status-oriented detection of malfunctions in pneumatic shut-off valves in safety instrumented systems (SIS).

The testing and diagnostic functions are completely integrated into the positioner.

The positioner is based on the Type 3730-3 Positioner with HART® communication. The basic functions, attachment, and technical data are identical for both positioners (no external position sensor) and are described in Data Sheet T 8384-2/3 EN also containing the ordering specifications.

ESD functions can be parameterized and the test results can be read on site at the positioner and over SSP (SAMSON interface protocol) and HART® communication interfaces.

The user interface is integrated into TROVIS-VIEW software and FDT/ DTM engineering tools, which makes operation easier to learn.

TROVIS-VIEW: Operator interface to configure and parameterize various SAMSON devices

FDT: Field device tool for the manufacturer-independent integration of field devices

DTM: Device type manager to describe the device properties

DD: Device description for integration into process control systems and asset management systems.

Special features

- Local operation over a rotary pushbutton and LC display
- Integration of safety-related limit contact, certified solenoid valve and fault alarm output in the positioner housing
Limit switch to determine the CLOSED valve position or to check the partial stroke test
Integrated solenoid valve for redundant emergency shut-down
- Integrated partial stroke test without disrupting plant operation
- Various cancel conditions to prevent an unwanted large change in stroke caused by the partial stroke test
- ESD lock to prevent unwanted intervention
- ESD mode, control operation or manual mode possible
- Time-controlled, automatic test procedure or manual triggering of the partial stroke test
- Extended EXPERT+ diagnostics already integrated



Fig. 1 · Positioner and pneumatic linear actuator



Fig. 2 · Positioner and pneumatic rotary actuator

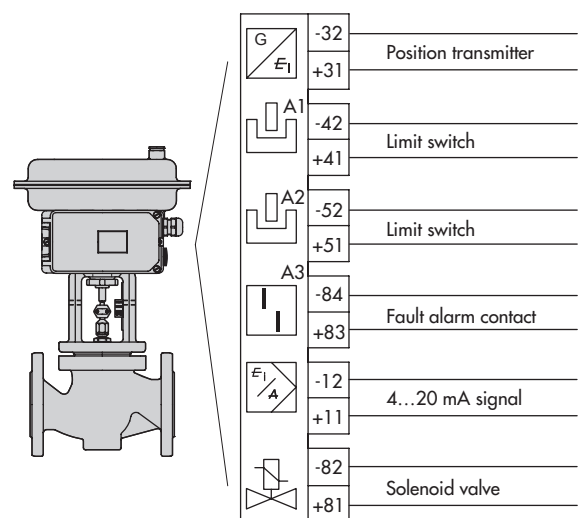


Fig. 3 · Options of the positioner in ESD version

- Diagnostic tests without additional sensors
- Automatic test function start
- Display of classified status and fault alarms
- Condensed status or ESD alarms also displayed on the LCD of the positioner and issued to the fault alarm contact
- Operating hours counter allows data and test results to be sorted by time
- Display of minimum and maximum temperature with details on how long the limits have been exceeded
- Cyclical polling of test data, multiplexer-capable
- Data logger to plot the valve position against time; which can be triggered by the valve position condition and/or the integrated solenoid valve
- Hysteresis test to detect any friction changes

Scope of application

General

In standard cases of application, a shut-off valve in a SIS loop is fitted with a solenoid valve for emergency shutdown and limit switches for position feedback.

Dedicated shut-off valves typically remain static for months or years in normal operating conditions. The use of the Type 3730-3 Positioner in ESD version can prevent problems from occurring in this case.

The following combination of components allows safety and test functions to be merged in one housing (Fig. 3):

- Position feedback
- Certified solenoid valve with a PFD rating (probability of failure on demand) to comply with SIL 3
- Venting of the actuator by the pneumatics in the positioner with certified PFD
- Redundant venting of the positioner pneumatics by the integrated solenoid valve
- Limit switches
- Fault alarm output

The positioner can be mounted on a valve to replace or supplement a solenoid valve. It enables the valve to be moved specifically to a set point within the valve working range.

The partial stroke test function completely integrated into the positioner prevents the valve from becoming stuck, for example, due to corrosion or material disintegration. Maintenance intervals can be scheduled in a more flexible manner and even lengthened in certain cases.

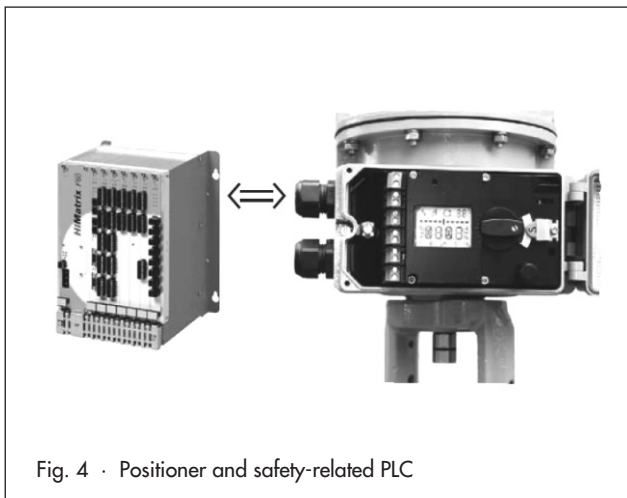


Fig. 4 · Positioner and safety-related PLC

The necessary test validation can be performed simply by using the corresponding combination of instruments and the connection to a customary safety-related PLC (Fig. 4).

The following integrated functions and features are also included in the positioner:

- Data logger to plot the w, x, e and y variables, which can be triggered by the valve position condition and/or the integrated solenoid valve, for example, on emergency shutdown
- Analysis and documenting of the last three partial stroke tests
- Status alarms over the fault alarm output
- Hysteresis test and extensive diagnostic functions
- Direct attachment, attachment according to IEC 60534 (NAMUR) and attachment to rotary actuators (VDI/VDE 3845)

Integration

Various combinations to integrate the positioner into the automation environment are possible.

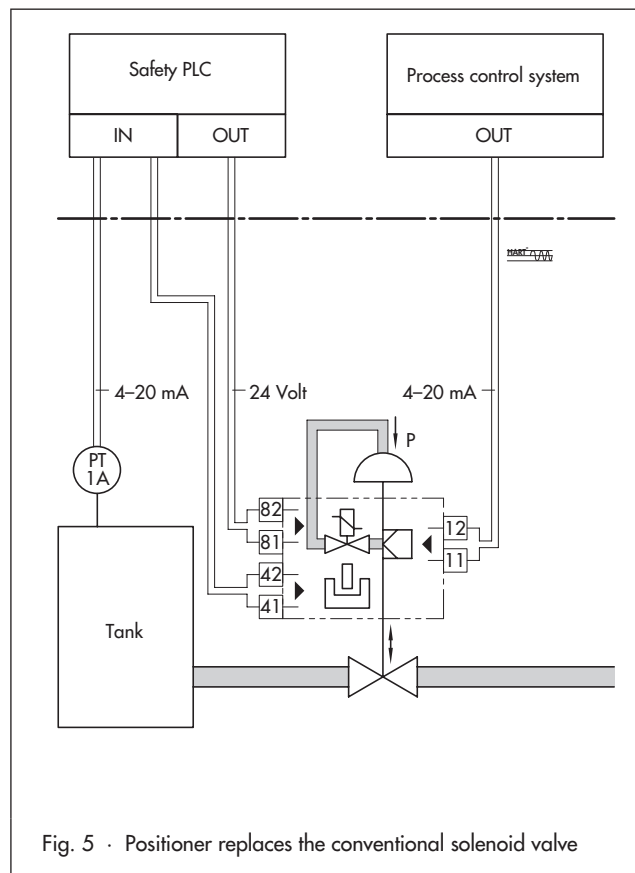


Fig. 5 · Positioner replaces the conventional solenoid valve

The positioner in ESD version replaces the conventional solenoid valve in Fig. 5.

The safety-related PLC controls the safety function with both the solenoid valve and a limit switch connected to it correspondingly.

The integration into the process control system and the asset management system also allows extensive diagnostic information and the set point input to be read.

Fig. 6 shows that the solenoid valve is not required anymore since the positioner in ESD version is certified for reliable shut-down similar to a solenoid valve. An interruption in power supply leads to safe venting of the pneumatic output.

The 4-20 mA signal of the positioner is fed forward to the safety PLC in this combination. HART® protocol is used in this case to integrate the positioner into the asset management system of a process control system.

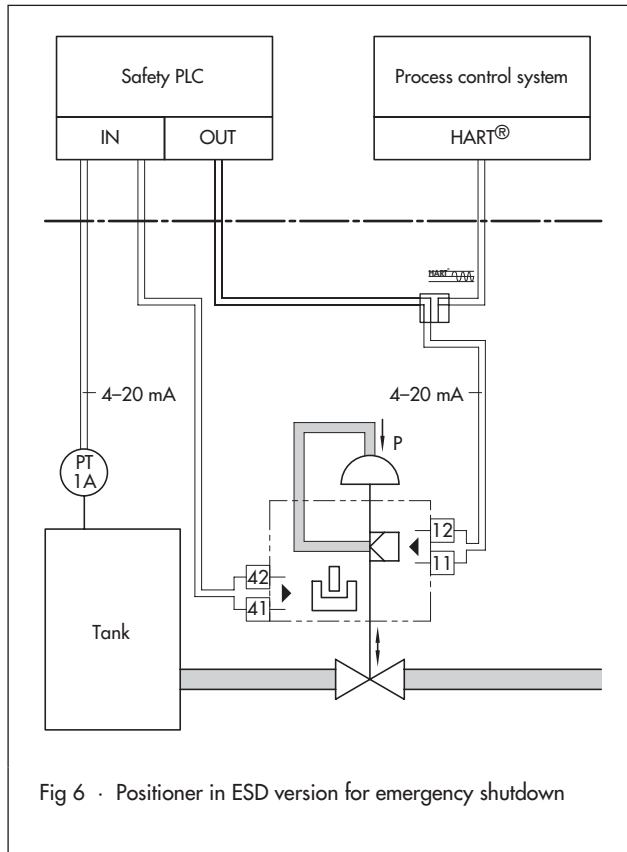


Fig 6 · Positioner in ESD version for emergency shutdown

Scope of functions ESD mode

In ESD mode, the shut-off valve is moved to a set point within the working range of the ESD valve. In the basic setting, the positioner behaves similar to a solenoid valve which keeps the connected valve open. Furthermore, the partial stroke test is triggered for test purposes manually (ESD-MAN) or automatically (ESD-AUTO) according to a time schedule.

Partial stroke test (Fig. 7)

The test is used to confirm that a normally open shut-off valve or a valve in its end position is still able to move and to prevent the valve from seizing up, for example, due to corrosion or material disintegration.

The partial stroke test plotting also allows the dynamic control behavior to be analyzed.

During the test, the valve is moved out of the end position or from a start value in steps or in a ramp function until it reaches a defined final value and then back again in the end position.

The step response is performed, for example, between 10 and 15 % of rated travel starting from the end position while the plant is running, yet without disrupting plant operation.

The following test cancellation conditions provide additional protection against the valve slamming shut and moving past the final value:

- Valve position x
- Drive signal y
- Maximum test time is exceeded
- Tolerance range exceeded.

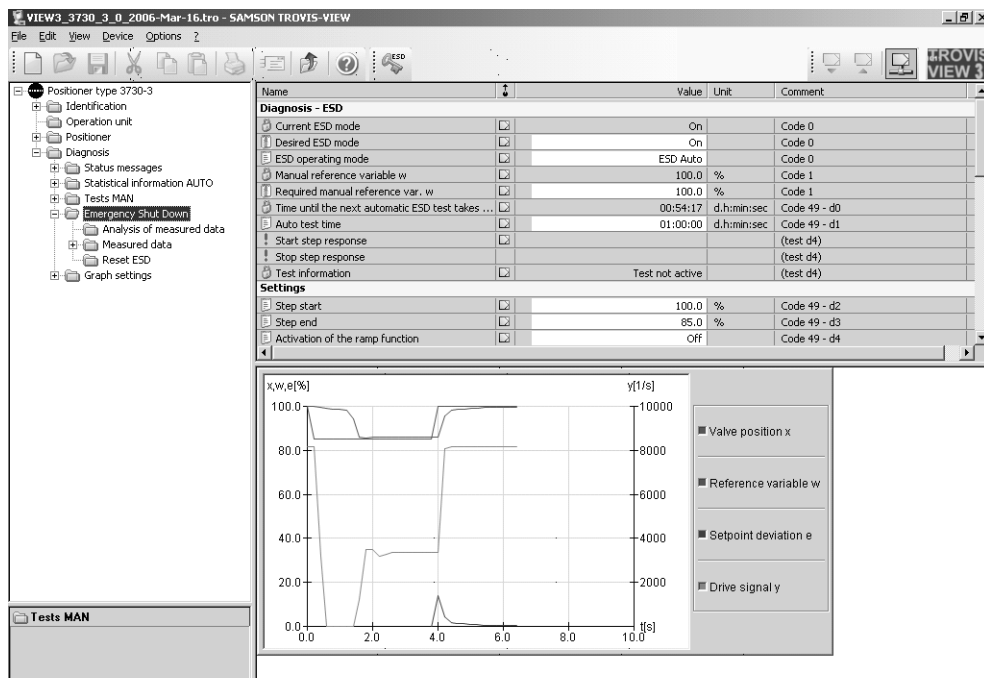


Fig. 7 · Partial stroke test

The course of the controlled variable x , reference variable w , system deviation e and drive signal y are stored in the positioner assigned to details from the operating hour counter.

The dead time, T_{63} , T_{98} , overshooting as well as the rise and response times are analyzed separately for the rising and falling characteristic (Fig. 8).

The analysis of the last three partial stroke tests are stored in the positioner with a time stamp.

Plain test information (Fig. 8)

A test status is assigned to a performed partial stroke test. As a result, it is possible to recognize whether a partial stroke test was successfully completed or not.

In the case that the test was not successfully completed, the possible source of error is specified, too.

In addition to an alarm displayed on the display of the positioner on site or issued to the engineering tool used, the ESD status can also be issued to the fault alarm output.

The states of the last three performed tests are stored in the positioner with a time stamp.

EXPERT/EXPERT+ diagnostics

The diagnostic functions of EXPERT and EXPERT+ are integrated into the positioner. Refer to the Data Sheet T 8388 EN for a summary of the test functions.

The EXPERT+ test functions of the data logger and the hysteresis test to detect friction changes are also included in the ESD mode.

The data logger stores the last x , w , e and y values in an FIFO memory. It can be automatically started by the stroke and/or solenoid valve functioning as the trigger event (see Fig. 9). The ESD version uses the valve position as the valve travel condition.

Viewing and parameterization of the integrated ESD and diagnostic functions

The TROVIS-VIEW or DTM software allow data, test results and alarms collected in the positioner to be conveniently parameterized and displayed in graphs.

Furthermore, the data in the device description (DD) files are also accessible to other engineering tools to allow integration in process control systems and asset management systems from different manufacturers. How the data are viewed depends on the operator interface.

In addition, the ESD functions can also be parameterized completely on site at the positioner.

Alarms are also displayed on the LC display and issued over the fault alarm output.

Graphs

The variables collected from the ESD and diagnostics functions are displayed by the Trend Viewer as graphs in the TROVIS-VIEW and DTM software (Fig. 9).

Name		Value	Unit	Comment
Diagnosis - ESD - Saved analyses				
Current test				
Time stamp for this test	<input checked="" type="checkbox"/>	00:35:07	d,h:min:sec	
Overshoot (increasing)	<input checked="" type="checkbox"/>	0.0	%	
Dead time (increasing)	<input checked="" type="checkbox"/>	0.6	s	
T63 (increasing)	<input checked="" type="checkbox"/>	0.6	s	
T98 (increasing)	<input checked="" type="checkbox"/>	2.0	s	
Rise time (increasing)	<input checked="" type="checkbox"/>	2.0	s	
Settling time (increasing)	<input checked="" type="checkbox"/>	2.2	s	
Overshoot (decreasing)	<input checked="" type="checkbox"/>	0.0	%	
Dead time (decreasing)	<input checked="" type="checkbox"/>	1.2	s	
T63 (decreasing)	<input checked="" type="checkbox"/>	1.6	s	
T98 (decreasing)	<input checked="" type="checkbox"/>	1.6	s	
Rise time (decreasing)	<input checked="" type="checkbox"/>	1.6	s	
Settling time (decreasing)	<input checked="" type="checkbox"/>	1.6	s	
Test status (of current test)				
No test available / Test man. canceled	<input checked="" type="checkbox"/>	OK	No message	Code 49 - F0
x cancellation	<input checked="" type="checkbox"/>	OK	No message	Code 49 - F2
y cancellation	<input checked="" type="checkbox"/>	OK	No message	Code 49 - F3
Tolerance band exceeded	<input checked="" type="checkbox"/>	OK	No message	Code 49 - F4
Max. test time exceeded	<input checked="" type="checkbox"/>	OK	No message	Code 49 - F5
Test start in wrong operating mode	<input checked="" type="checkbox"/>	OK	No message	Code 49 - F6
Measured data storage out of memory	<input checked="" type="checkbox"/>	OK	No message	Code 49 - F7
Aborted by solenoid valve	<input checked="" type="checkbox"/>	OK	No message	Code 49 - F8
Supply pressure / friction	<input checked="" type="checkbox"/>	OK	No message	Code 49 - F9

Fig. 8 · Test information

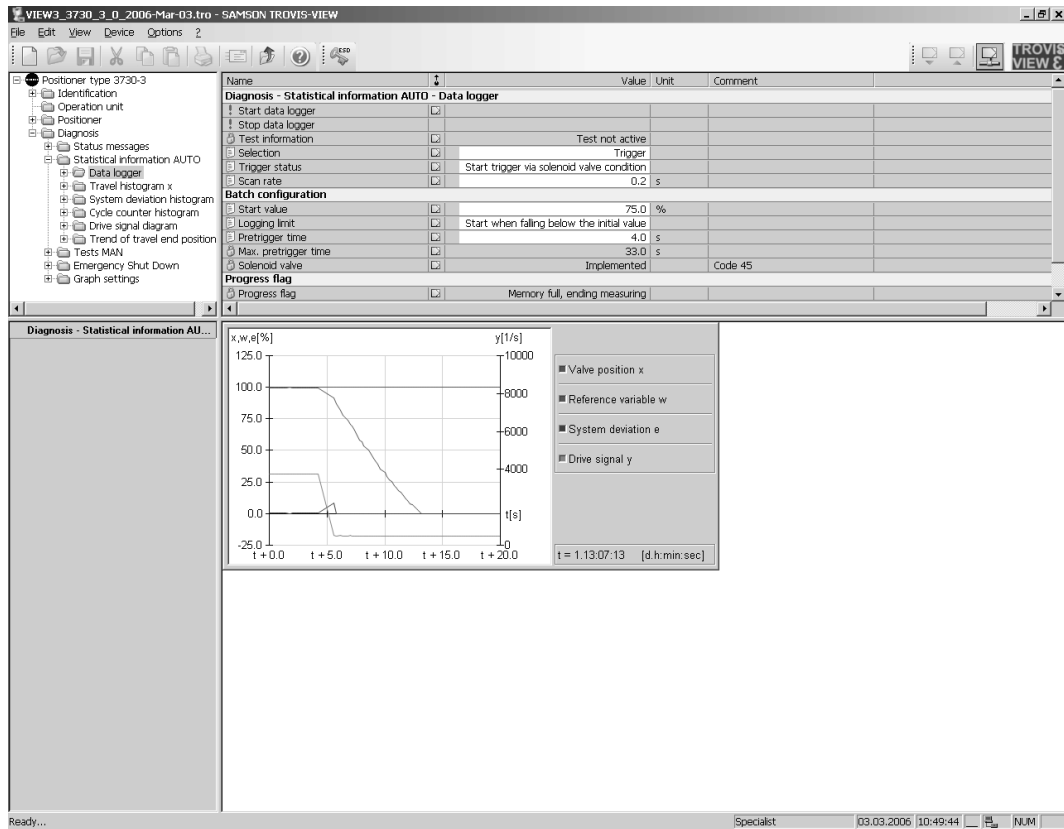


Fig. 9 · Data logger triggered by solenoid valve condition; a drop in solenoid valve voltage causes the valve to move to its fail-safe position

Specifications subject to change without notice.



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