3.568.5275.310

IM-P343-40
CH Issue 1

spirax sarco

# SP500
# Electropneumatic Smart Positioner
A guide to HART® functionality


HART
COMMUNICATION PROTOCOL







Printed in Italy

# 1. Index

# 2. Introduction

The SP500 smart valve positioner with HART® (Highway Addressable Remote Transducer) interface card connects seamlessly with a standard HART® communication network. It provides a wealth of control and feedback capabilities.

SP500 HART® positioners function as slaves to master controllers on the network. The HART® protocol allows commands, position feedback and diagnostics to be sent digitally over the current loop.

HART® is an open standard supported by the HART® Communication Foundation.

The ability to report extensive positioner feedback data as well as network system diagnostic information makes the SP500 electropneumatic smart valve positioner, the first choice for use with HART® communication systems.

# 3. HART® option board

The HART® option board is located inside the positioner housing and interfaces directly with the positioner electronics. Once fitted, the specific commands associated with moving the actuator together with feedback and diagnostics become available on the HART® network.

Feedback information includes signals that are not normally available with conventional wiring. For the correct mounting and wiring procedure reference the SP500 Installation and Maintenance Instructions IM-P343-35.

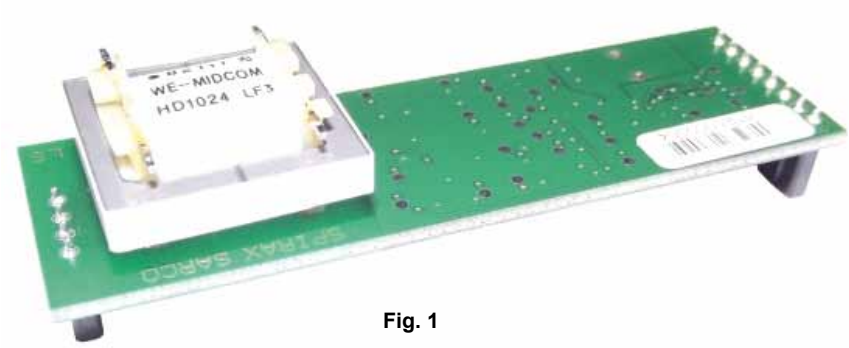



**Fig. 1**

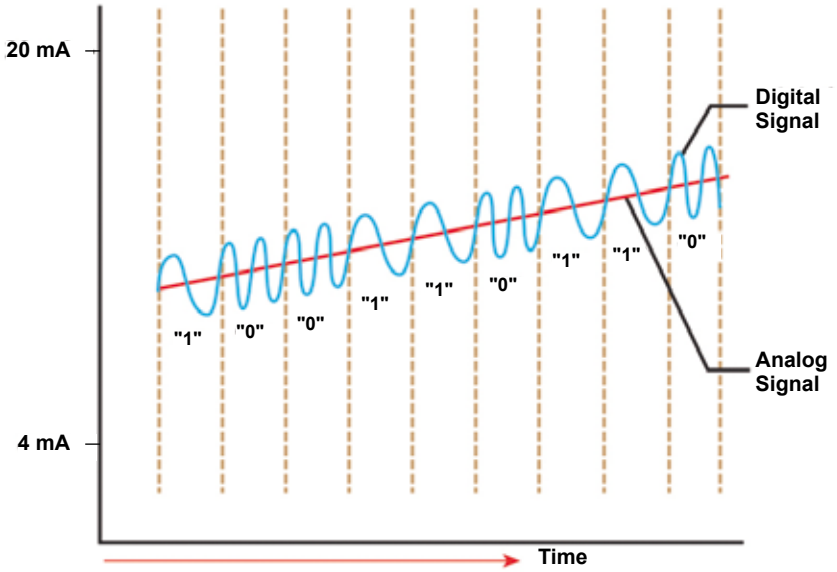
# 4. HART® network

The HART® network uses the existing wiring of the 4 - 20 mA command current loop. The HART® digital data is coupled onto the analog signal by the use of phase continuous, frequency shift keying (FSK) at a fixed baud rate of 1 200 bits per second.

The command input circuitry filters this super-imposed signal so that analogue positioning (in a point-to-point network) is unaffected.

The protocol utilizes technology based on the Bell 202 standard, enabling cable runs of up to 1.5 km while maintaining high noise immunity. The maximum highway length is dependent on cable type, therefore low capacitance, shielded, twisted pair cable is strongly recommended.

Each instrument is configured to have a unique address on the HART® network. A total of two masters may be used, allowing for example a DCS (primary) and handheld (secondary) communicator tool to be used simultaneously.




*FSK Principle (source: HART®)*

**Fig. 2**

# 5. Point-to-point network

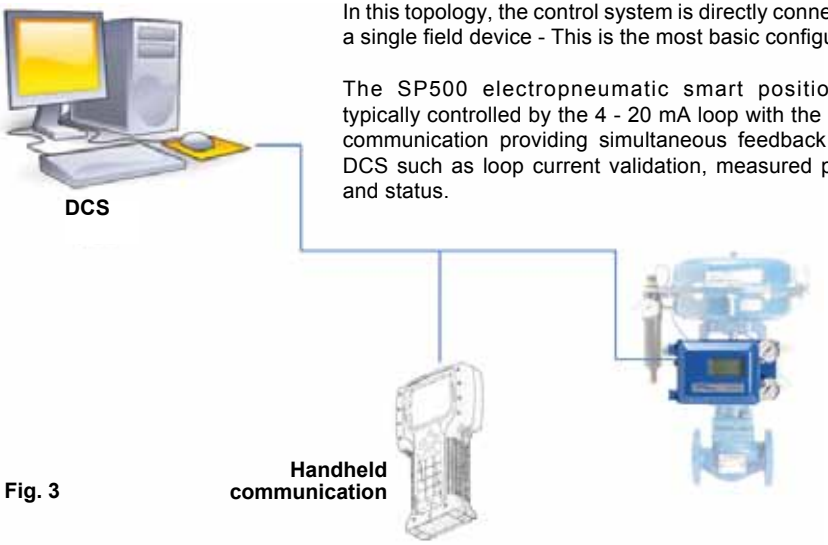



Fig. 3

In this topology, the control system is directly connected to a single field device - This is the most basic configuration.

The SP500 electropneumatic smart positioner is typically controlled by the 4 - 20 mA loop with the HART® communication providing simultaneous feedback to the DCS such as loop current validation, measured position and status.

# 6. Multi drop network

This topology provides the ability for a DCS to communicate with up to 64 HART® devices on a single network. In this configuration, the loop current is set at a fixed value, (typically 4 mA) and the devices are controlled via HART® commands.

The SP500 HART® smart valve positioner may be positioned by writing a desired setpoint to the device.

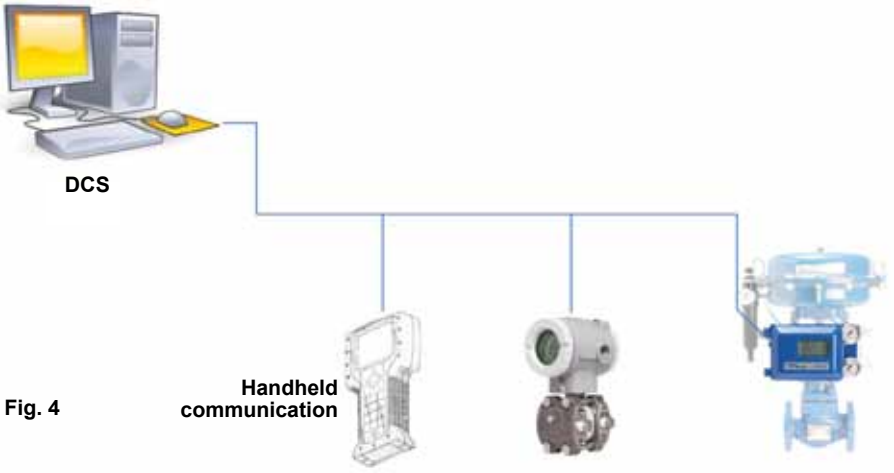



Fig. 4

# 7. HART® device description

DD files have been created specifically for the SP500 HART® smart valve positioner. These files provide access to the complete command set through a user-friendly menu structure, allowing both remote calibration and control of the positioner.

The device description is stored on the host. Once the actuator is identified, the file is automatically loaded and communication with the actuator may commence.

Menu tree and functionalities have been designed to build a similar interface to the one available when access is made locally through the LCD and display.

## 7.1 Menus structure

Menus contain variables and methods. Methods correspond to positioner actions, like: reset the unit, start the autocalibration function, etc…

Variable can be divided in read only variable that are displayed but cannot be changed, and read & write variables. In general to write a variable it is necessary to change its value and then 'send' it to the instrument.

See the example here below:


**Fig. 5**

By double clicking the 'Operation mode' another window will appear allowing you to change the current value.

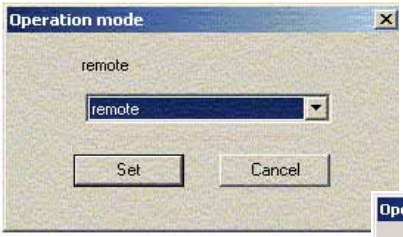



**Fig. 6**


**Fig. 7**

Choose the desired option and confirm by pressing the ‘Set’ button. The new value, see below, will appear highlighted in yellow. In order to send the new value to the positioner, press the ‘Send’ button at the top of the window as shown in the screen shot below.

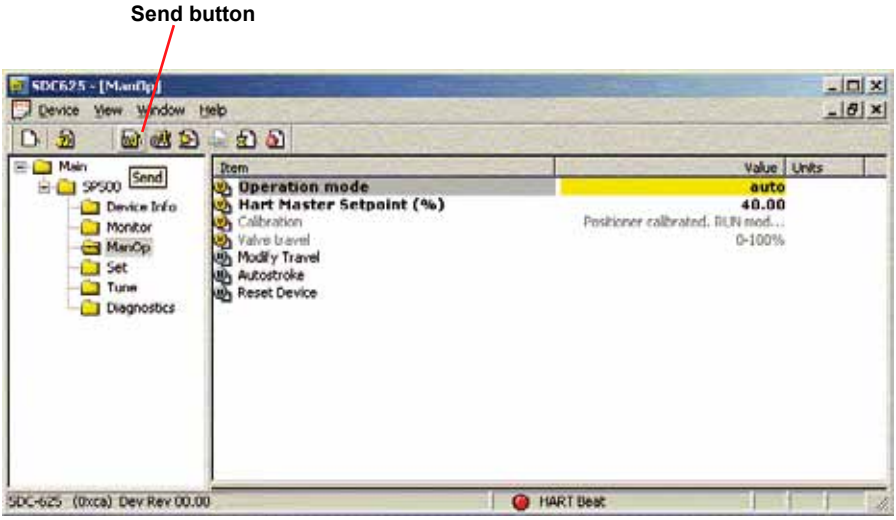



**Fig. 8**

Remote configuration and control are possible thanks to the software configurator running on the host system. Appearance of the menus and access mode may vary depending on the system used, but functionalities and variables implemented by the DD files will remain the same. All HART® functionalities and variables are described in the following screen shots and their explanations.

The software configurator used in the screenshots is the SDC625, Smart Device Configurator from the HART® Communication Foundation, which has been used to develop the DD files.

Details about SP500 variables and functions are provided in the SP500 Installation and Maintenance Instructions IM-P343-35.

## 7.2 Menu 'SP500'

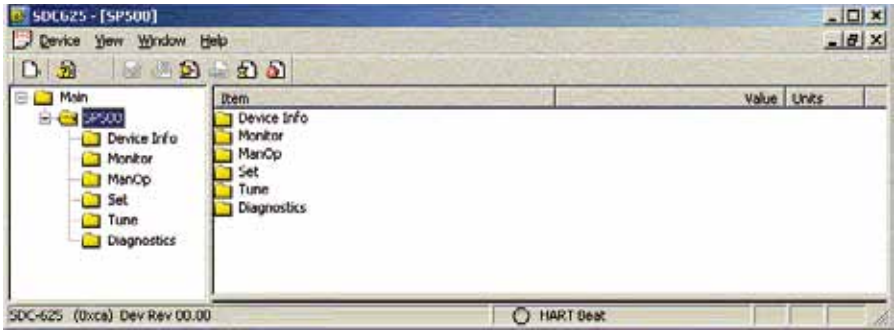



**Fig. 9**

The SP500 menu gives access to the following menus

| Menu | Description |
|---|---|
| Device Info | General data about the instrument |
| Monitor | Real time visualization of the main variables values |
| ManOp | Enables manual control |
| Set | Setting of valve functions |
| Tune | Setting of valve tune functions |
| Diagnostics | Diagnostic functions |

**As a general rule, variables in bold can be overwritten, while the others are read-only variables.**

## 7.3 Menu 'Device Info'

General data from the instrument:


**Fig. 10**

| Variable | Description | |
|---|---|---|
| Manufacturer | Manufacturer name | |
| Model | Instrument model | |
| Serial number | Positioner serial number | |
| Soft rev | Positioner software revision | |
| **Poll addr** | HART® address (default is 0) | |
| **Tag** | Instrument tag | |
| **Description** | Brief description, for example, 'steam control valve' | |
| **Date (MM/DD/YY)** | Any significant date can be stored here e.g. maintenance | |
| **Message** | Any message or comment | |
| Universal commands revision | HART® protocol revision data | |
| Device revision | Hardware version | |
| Travel switch 1 | Travel switch 1 status: | |
| | NOT MOUNTED | option board not mounted |
| | DISABLED | TS1 disabled |
| | ON | TS1 on |
| | OFF | TS1 off |
| Travel switch 2 | Travel switch 2 status: | |
| | NOT MOUNTED | option board not mounted |
| | DISABLED | TS2 disabled |
| | ON | TS1 on |
| | OFF | TS2 off |
| Retransmission | Retransmission status: | |
| | AVAILABLE | RTX board mounted |
| | NOT MOUNTED | RTX board no mounted |
| Valve type | Indicate the positioner valve type | |
| | LINEAR | SP500 rotary positioner |
| | ROTARY | SP500 linear positioner |

## 7.4 Menu 'Monitor'

Real time visualization of the main variables and values:


**Fig. 11**

| Variable | Description |
|---|---|
| Setpoint (%) | Current setpoint in % |
| Valve position (%) | Actual valve position in % |
| Loop current (mA) | Actual input current in mA |
| HART master setpoint (%) | Setpoint value sent from HART master |
| Temperature (ºC) | Temperature sensed inside the positioner housing |
| Travel switch 1 | TS1 current status |
| Travel switch 2 | TS2 current status |

## 7.5 Menu 'ManOp'

This enables manual control and remote HART® master control:

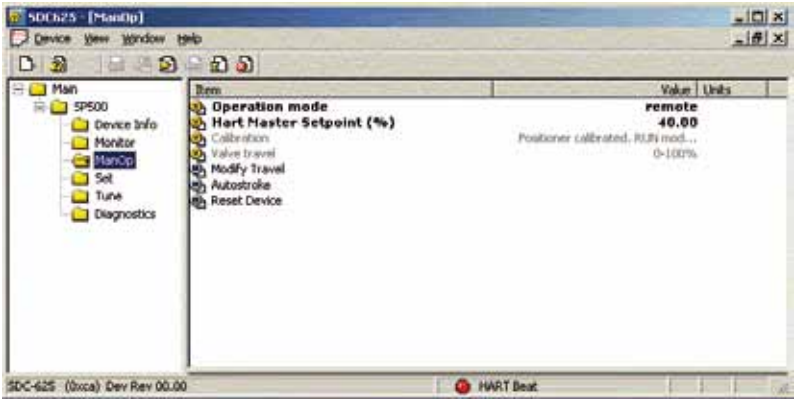



**Fig. 12**

| Variable | Description | |
|---|---|---|
| **Operation mode** | Status of the operation mode: | |
| | **REMOTE** | The positioner will use 'HART® master setpoint' as valve setpoint regardless of the value of the current in the loop |
| | **LOCAL** | This option is not selectable and cannot be changed remotely. It indicates the positioner is driven using a local keyboard through the MCTL local menu |
| | **AUTO** | The positioner is working in automatic mode and the loop current is used as the actual valve setpoint |
| | Selectable values are AUTO and REMOTE | |
| **HART® master setpoint** | Selectable value in %; allowed values are between 0-100%. It becomes the actual setpoint when the 'Operation mode' is set to REMOTE. | |
| Calibration | Positioner status: | |
| | SP500 CALIBRATED | Autostroke executed successfully |
| | SP500 NOT CALIBRATED | Autostroke to be run |
| Valve travel | Shows the valve travel display settings (0-100% or 100-0%) | |
| Modify travel | This is a method that modifies the 'Valve travel' (0 to 100% or 100-0%) | |
| Autostroke | Start the autostroke routine | |
| Reset device | Reset all values to initial factory setting. After reset, 'Autostroke' needs to be rerun. | |

## 7.6 Menu 'Set'

Setting the valve functions:

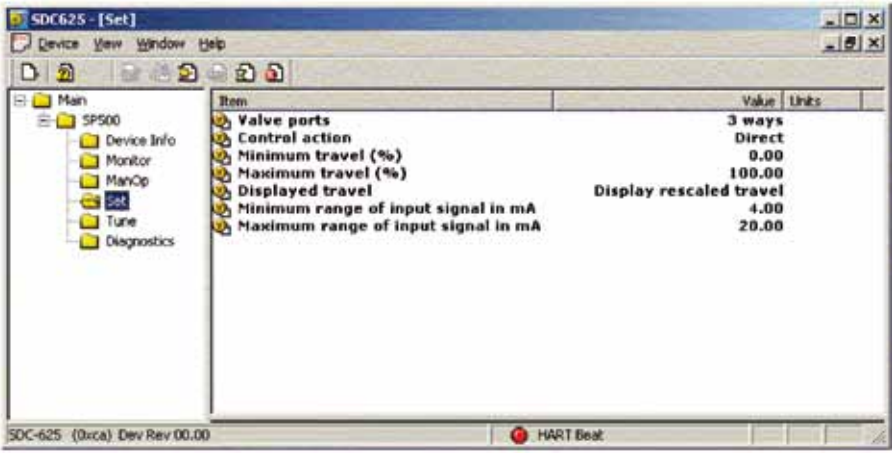



**Fig. 13**

| Variable | Description |
|---|---|
| Valve port | Valve type (2 or 3 way) |
| Control action | Control action (direct or inverse) |
| Minimum travel (%) | Minimum travel settings |
| Maximum travel (%) | Maximum travel settings |
| Displayed travel | Sets the displayed travel percentage option |
| Minimum range mA | Minimum signal span range in mA |
| Maximum range mA | Maximum signal span range in mA |

## 7.7 Menu 'Tune'

Setting the valve tune functions:

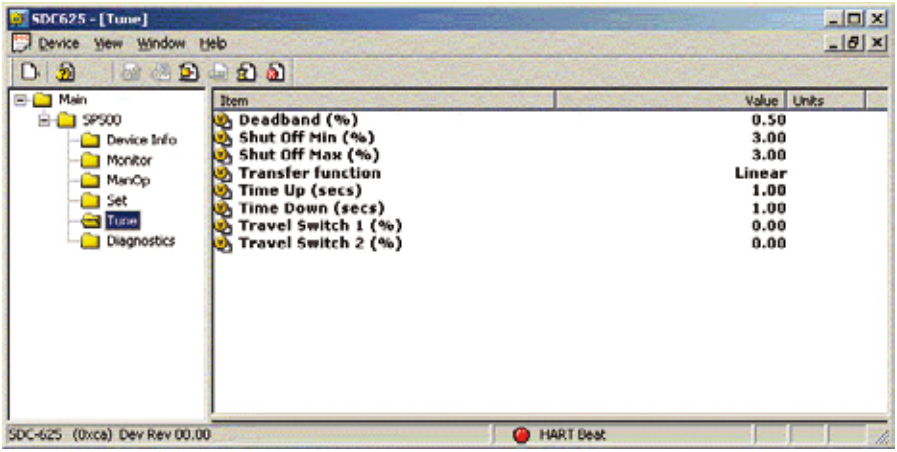



**Fig. 14**

| Variable | Description |
|---|---|
| Deadband (%) | Deadband (%) |
| Shut off min (%) | Valve shut off minimum travel |
| Shut off max (%) | Valve shut off maximum travel |
| Transfer function | Valve characterisation (LINEAR, EQUAL, FAST) |
| Time up (sec) | Sets the displayed travel percentage option |
| Time down (sec) | Slow down valve closing action |
| Travel switch 1 (%) | Threshold value for TS1 |
| Travel switch 2 (%) | Threshold value for TS2 |

## 7.8 Menu 'Diagnostics'

Diagnostic functions:

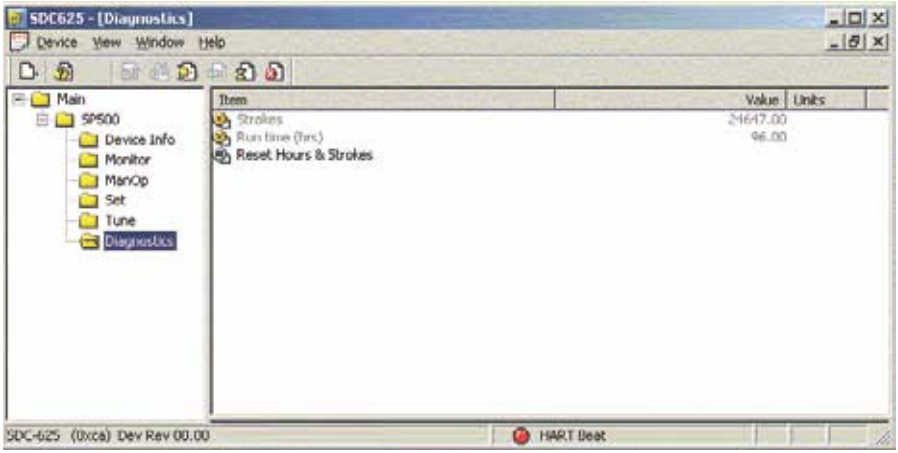



**Fig. 15**

| Variable | Description |
|---|---|
| Strokes | Number of strokes during operation |
| Run time | Operation time |
| Reset hours and strokes | Reset 'Strokes' and 'Run time' |