SMART RESOLVER POSITIONER OF PNEUMATIC ACTUATORS

SPIROSTER-07

TECHNICAL SPECIFICATION

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Summary: The present technical specification of the Spiroster-07 positioner (with software v. 3.13) consists of its technical parameters, mounting demands, starting and programming indications, as well as exploitation guidance. This specification does not refer to following models of the positioner: anti-explosive, BUS controlled, and with internal FPD controller.

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❋ Security measures

➢ Application

Spiroster-07 is designed to mount on single-acting pneumatic actuators with pressure input up to 800 kPa. Positioner can not be installed in places running the risk of explosion. Environmental conditions can not exceed these mentioned in nominal data.

➢ Precautions

Positioner maintenance calls for fully trained worker, very familiar with appliance's technical description. The violation of its principles will result in lack of safe and correct performance. It may also lead to breakdown and may be hazardous to personal safety. Please call attention on warning marks !!! within technical description, pointing to crucial safety issues.

!!!

❋ Transport and storage

- The transportation has to be performed in original package.
- Avoid any crashes (shocks, falls, and squeezes).
- Store in dry, dust-free places.

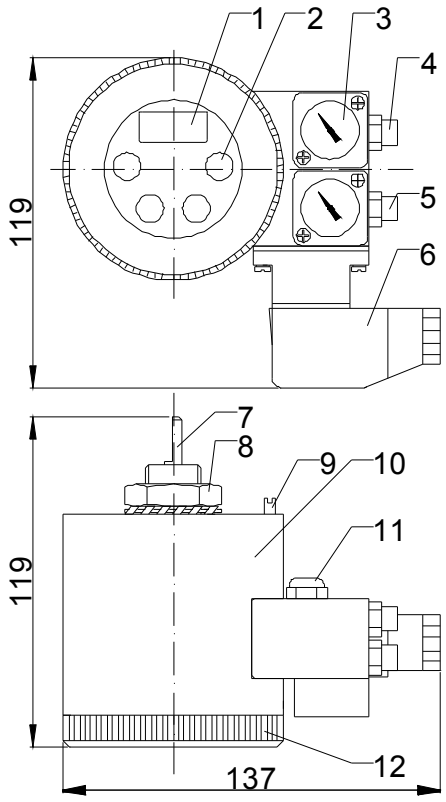
❋ General technical description

➢ Nominal data

Supply pressure	140-800 kPa,	Dry and filtered air
Flow capacity	Up to 300 l/min	
Mass	900 g	
Driving signal	4-20 mA	External feeding
Voltage drop on input	10,5 V	
Analog feedback signal	4-20 mA	External feeding
Feedback signal voltage	12-36 VDC	External feeding, signal is insulated galvanically
Signals of extreme positions	24-48 V DC, 12 mA voltage drop 2 V at the most	Open collector circuits. Positions are related to current inflation or evacuation of the actuator. Signals are galvanically insulated from driving ones.

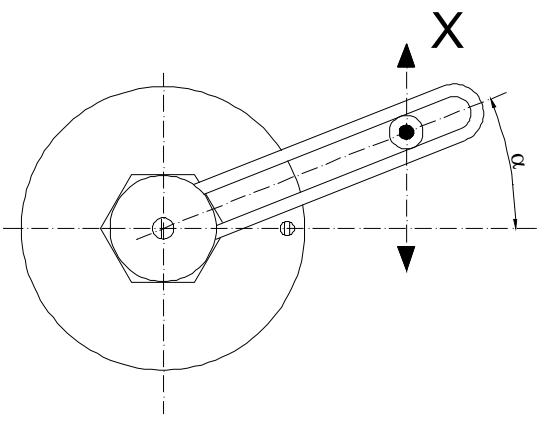
Allowed rotation angle of the positioner's axle	+/- 45° +/- 130°	For linear actuators with lever induced processing of pitch For swinging or linear actuators with gear induced processing of pitch
Relative linearity referred to characteristic's terminal points	+/- 0.5%	
Range of insensibility	0,1%	Do podanej strefy dodaje się nastawiona przez użytkownika strefa nieczułości.
Mounting position	Any	We do suggest not to direct the exhaust damper upward, when the positioner is subjected to water falling
Protection class	IP 67	The exhaust damper has not the defined IP. It is assumed that IP 67 is achieved when the positioner works and overpressure in its case prevents the penetration of water via damper.
Operating temperature	-20 – +70°C	The mentioned range applies also to feeding air
Mechanical durability	Practically unlimited	Contactless resolver evaluation of actuator's position; an axle driven by ball bearing and sealed with fluorinated elastomer; greasing with silicone grease

➢ Case and external dimensions



1) LCD display
2) Buttons
3) Manometers (upper – air pressure for actuator; lower – feeding air pressure).
4) Pneumatic terminal – air for actuator
5) Pneumatic terminal – feeding
6) Connector
7) Axle
8) Nut
9) Position stake
10) Case
11) Exhaust damper
12) Panel's cover

➢ Performance principles



$$X = k \times tg\alpha$$

The Spiroster-07 consists of:
– contactless measurement circuit dedicated to evaluate position of the actuator,
– electropneumatic piezoelctric transducer,
– microprocessor steering system,
– control panel and local control panel.
All appliances are inside stream- and dustproof case. Optionally, the positioner may be equipped with manometers controlling both feeding and steering pressure. According to the type of actuator, different mounting sets are applied (fitting the positioner to a drive's yoke). Detailed description of Spiroster-07 mounting is given in enclosed leaflet.

The evaluation of the actuator's position is achieved by means of resolver (rotational transformer of angular travel). First of all, the resolver guarantees exceptionally precise measurements. Secondly, it is free of environmental failure. As the rotating magnetic field of the resolver is limited to its permalloy core, the measurement circuit rarely suffer of disturbances caused by external electromagnetic interference. Mechanical durability of the device is practically unlimited.

In actuator of linear type its position is calculated directly from the angle of lever, related to its horizontal position. Actuator's position is calculated by specialized chip, accordingly to tangent of an angle. This procedure is very handy as it does not call for the precise evaluation of positioner's starting point (or median one). The top accuracy of measurement is achieved when the full range of positioner's lever movement comprises the horizontal position (best of all around half of lever's travel).

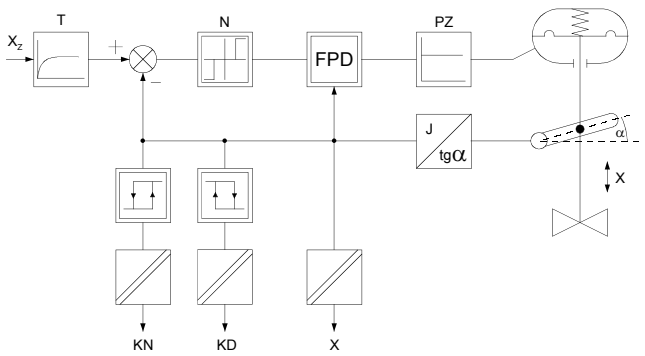
In actuator of rotary type its position is directly described as angular travel of the axle.

The steering system compares assigned position of the actuator with the real one and induces the output signal for electropneumatic piezoelctric transducer. Positioning follows Fuzzy-PID algorithm (variable adjustment of PID regulator induced by position and changing dynamics of the actuator). User himself can:
– introduce the positioner's dynamics (Fuzzy function is off),
– refer to the manufacturer's values, or
– allow for automatic adjustment preformed by the positioner itself (thus, the steering process will follow the criterion of minimum of integral of the square of error).

A control panel and local control panel work as programmer and switch box of local control. Positioner's parameters appear on LCD display, resistant for both high and low temperatures.

Spiroster-07 works in accordance with the rule of inflating of the actuator when the driving signal increases. The manufacturer has excluded the reverse performance of the positioner – the aim was to secure proper action in case of failure: both in sudden loss of assigned input signal and loss of feeding pressure the actuator will move toward position designated by the installation's designer as safe one. On user's request (appliance's special edition) the positioner may also perform the reverse action.

➢ Block diagram



Xz – input signal (assigned one)

T – signal filtering

N – adjustable range of insensibility

FPD – Fuzzy-PID regulator

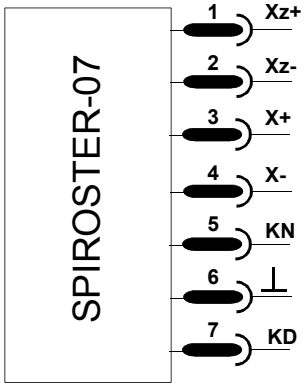
PZ – electropneumatic piezoelctric transducer

X – measured pitch of the actuator

KN – signaling that the actuator is full

KD – signaling that the actuator is empty

➢ Electrical diagram



1. Input of assigned signal 4–20 mA „+”
2. Input of assigned signal 4–20 mA „-”
3. Output of position feedback signal 4–20 mA „+”
4. Output of position feedback signal 4–20 mA „-”
5. Signal that the actuator is full (optional)
6. Common signaling point of KN & KD (optional)
7. Signal that the actuator is empty (optional)

The output of position signal demands the external power supply of 12–36V DC.

The polarization of KN & KD signals in relation to common point is free.

All Xz and X signals are galvanically insulated from themselves, as well as from KN & KD

➢ Control operations

Secure position

!!!

The rule of inflating of the actuator when the driving signal increases secures proper action in case of failure: both in sudden loss of assigned input signal and loss of feeding pressure. Technological installation and direction of actuators' movement would coincide to secure the achievement of safety position in case of the sudden loss of signal or air pressure. Direct (P), reverse (R) actuators or systems maintaining the actuator's feeding pressure (stop-valve) have to be considered in accordance with technological conditions.

Password	Positioner's programming procedures are secured with a password. Only the review of parameters, assigned values, and switching to the local control is available without a password.
Remote control	Spiroster-07 positions the actuator according to assigned signal 4–20 mA, following the rule of inflating of the actuator when the driving signal increases.
Local control	Possible both in slow and fast mode. Switching to local control as well as steering itself go by means of control panel's buttons..
!!!	Local control is possible only when the driving signal is present (this feeds own positioner's electronic signals). The loss of driving signal will exclude local control. If loss and subsequent appearance of driving signal will take place when positioner works in local mode, it automatically will switch back to local control.
Manual selection of extreme positions	Switch the positioner to local control. Put actuator in desired point and accept it by pressing proper button on control panel.
Automatic selection of limit positions (AUTS function)	Spiroster-07 can select limit positions automatically, following the procedure of AUTOTUNING S. The positioner will accept as extreme the position of mechanical limitations of its movement.
!!!	Before starting the AUTOTUNING S make sure that points of mechanical limitation of the actuator's movement are equal to nominal pitch of regulating valve.
Sealing of fittings	Spiroster-07 allows to chose a method of the movement limitation, both during inflation and evacuation of the pneumatic actuator. That possibility is of importance for the durability of steering fittings. Any user may select positional limitation or limitation by force (with pressure).
!!!	Limitation by force (with pressure) calls for precise pairing of valve with actuator and its feeding pressure. Incorrect pairing may result in failure of a valve (e.g. in pivot's bending).
Steering with closed cycle of the air	This option allows to keep the overpressure within positioner's and actuator case, thus for their reliable and durable action in corrosive gas environment.
Split range	The device allows to set the outset and termination of assigned signals to other values than 4-20 mA. Thus, one may want to control the positioner, e.g., within assigned signals 4-12 mA or 12-20 mA.

Forbidden working range	Some fittings demand control signals which omit certain values. Our appliance allows the positioner to omit forbidden working range – e.g. it automatically sends the actuator to its terminal position, thus preventing the activity out of desired, secure parameters.
Inspection of actual parameters	A LCD allows for inspection of the actual state of the positioner (both in remote and local control modes). Please follow detailed procedures described elsewhere in this manual (i.e. programming procedures).
Feedback signal (optional)	Feedback signal is galvanically insulated and follows 4–20 mA standards; it demands an external power supply.
Signals of extreme positions (optional) **!!!**	Signals of extreme positions are galvanically insulated and came from open collector circuit. They inform about completion of inflation or evacuation of the actuator. The loss of driving signals induces the loss of voltage dedicated to manage signaling of extreme position. It results in automatic evacuation of the actuator, thus automatically activates the signaling of evacuation
PID regulator (optional)	Spiroster-07 is solely able to act as PID regulator. To achieve this, user has to follow appropriate programming procedure and supply the positioner (i. e. input of assigned signal) with the signal generated by a transducer of regulated value
Manual adjustment of dynamic parameters	According to the theory of regulation, a positioner is the PID regulator, which performs follow-up control when changeable force put on the actuator's pivot (from the regulating valve side) causes interferences. The user can himself manually tune the PID, basing on his own knowledge and experience. The manual tuning results in switching off the Fuzzy function.
Automatic adjustment of dynamic parameters AUTD **!!!**	AUTOTUNING D allows for fully automatic selection of assigned parameters of the positioner's Fuzzy-PID regulator. Assigned values are stored in the memory and could be displayed on panel's LCD. AUTOTUNING D can be interfered by overresistant pivot, leakages, changeable charge of the valve, and so on. Before starting the AUTOTUNING D make sure that points of mechanical limitation of the actuator's movement are equal to nominal pitch of regulating valve
Adjustment of positioner's insensibility	The user is able to regulate the insensibility zone within 0,1%-5%% of the assigned signal value.

➢ How to order?

SPIROSTER-07 - [ ] - [ ] - [ ] - [ ] - [ ] - [ ] - [ ] - [ ]

Driving signal (input)	
4 ÷ 20 mA	1
MODBUS	2
PROFIBUS PA	3

Feedback signal	
None	0
4 ÷ 20 mA	1

Signaling of extreme positions	
None	0
Of OC type	1

Local manometers	
None	0
Two	1

Pneumatic connections	
Brass connecting piece, ø6	1
łączniki do rurek metalowych ø6 ze stali nierdzewnej	2
Brass connecting piece, ø8	3
Stainless connecting piece, ø8	4
Polyethylene connecting piece ø6	5
Polyethylene connecting piece ø8	6

Mounting stuff	
For actuators P/R – POLNA and for other columnar ones	1
For actuators P1/R1 – POLNA	2
For actuators 37/38 – POLNA	3
For other types – please, specify	4

Mounting stuff materials	
Stainless	1
Zinc coated steel	2

❋ Mounting and installation

It has to be done in compliance with instructions given on a leaflet supplied with appliance's set. In case of cooperation with the actuator of linear type, positioner's lever should be able to cross the horizontal position. Mechanical adjustment of starting and terminal points of the lever's movement can be omitted as long as the mentioned movement falls within angle of +/-45° from symmetry axis given by mutual position of the lever and fixing bolt.

❋ Launching and controlling schemes

!!! **The present description refers to the Spiroster-07 with the software v. 3.13 preinstalled. Before the very beginning of programming procedures it is necessary to check if the installed software's version met the one mentioned in the supplied manual. The method of identification is given elsewhere in this technical description.**

➢ Starting

!!! The positioner launches automatically after appearance of the driving signal and inflating air.

!!! During launching the actuator itself can perform a move. Thus, before launching it is necessary to check if overshoot of the valve will not interfere the technological process.

Input air has to has pressure pointed by the actuator's manufacturer.

➢ Positioner's action after driving signal application

It depends of its state, when the loss of signal appeared:
– when the positioner was in remote mode, it continued in the remote mode;
– when the positioner was in local mode, it continued in the local mode.

➢ Remote mode

In a remote mode the positioner regulates the actuator according to assigned signal. Within this mode is possible:
– to set parameter displayed by LCD,
– to switch to adjustment procedures,
– to switch to local mode,
– to switch to parameters' review.

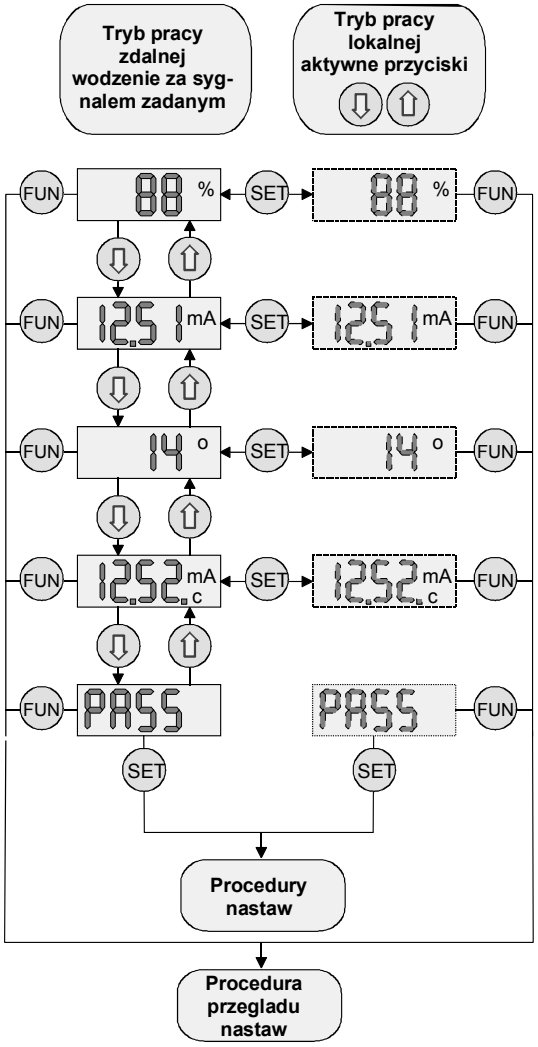
➢ Local mode

This allows for manual steering by means of buttons on the switch box. Button ↑ starts the inflation, ↓ – evacuation. Pressing of the second button shortly after the first one speeds up twice the action defined by the button pressed firstly.
Within the local mode is possible:
– to switch to adjustment procedures,
– to switch to remote mode,
– to switch to parameters' review.

❋ Programming procedures

➢ Software structure

The software consists of two modes and three procedures and subprocedures.



Data displayed on LCD (in local mode LCD blinks):

– signal of the actuator's position [%],

– signal of the actuator's position [mA],

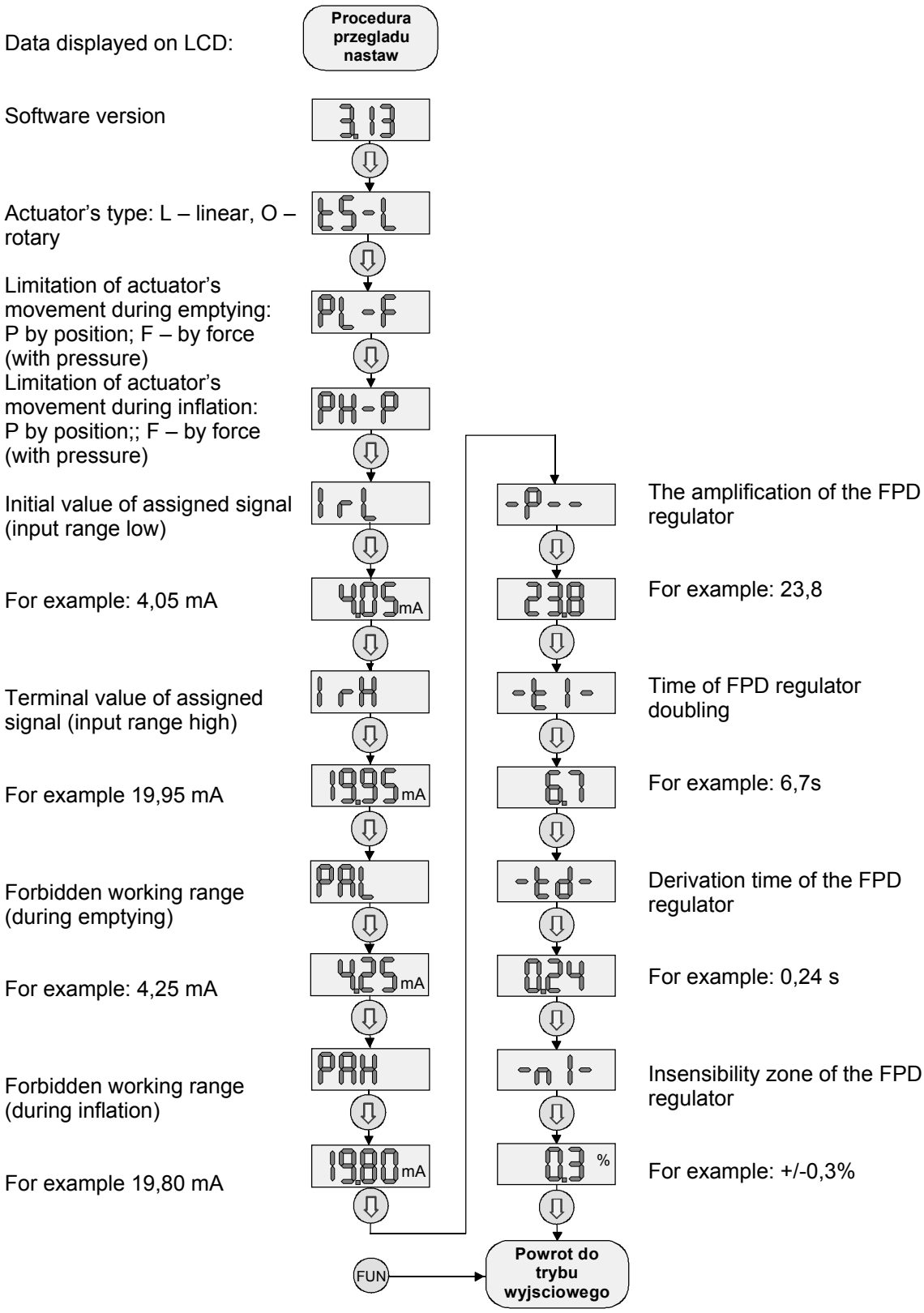
– deviation of the positioner's lever from symmetry axis given by mutual position of the lever and fixing bolt

– driving signal [mA]

– announcement of readiness to programming.

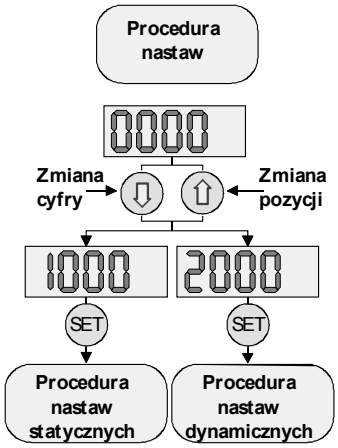
The software follows rules illustrated by the diagram. Buttons ↑ and ↓ in remote mode allow for consecutive change of displayed parameters. In local mode both buttons have active steering functions. When LCD shows one of the parameters, SET button allows to switch the positioner from remote to local mode and vice versa. After that, the LCD displays the current parameter. In local mode LCD blinks. Pressing SET when PASS is displayed moves to adjustment procedure. Any pressing of FUN button results in switching to procedure of parameters' review.

➢ Adjustments' review



The procedure of adjustment's review works independently of remote control mode. The review does not interfere the remote control.

➢ Adjustment procedures

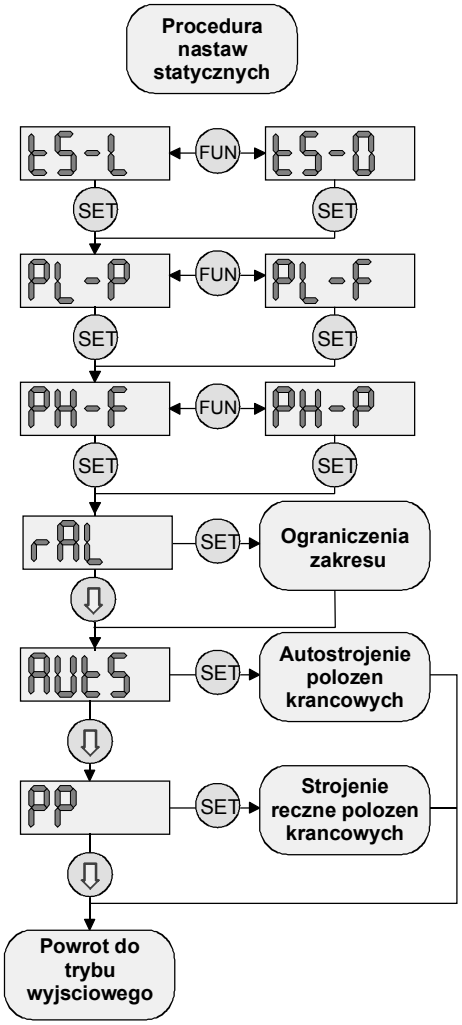


Ready for password introduction

Password displayed after its introduction.

Adjustment consist of two different procedures:
– static assignment (extreme positions), and
– dynamic assignment (parameters of FPD regulator).
Each one must be preceded by introduction of password and pressing SET button. ↓ changes digit, ↑ changes digit's position.

➢ Static parameters adjustment



Selection of actuator's type: L – linear, O – rotary.

Method of limitation of actuator's movement during emptying: P – positional; F – by force (with pressure)

Method of limitation of actuator's movement during filling: P – positional; F – by force (with pressure)

Limitation of range (functions Split Range and Forbidden Working Range)

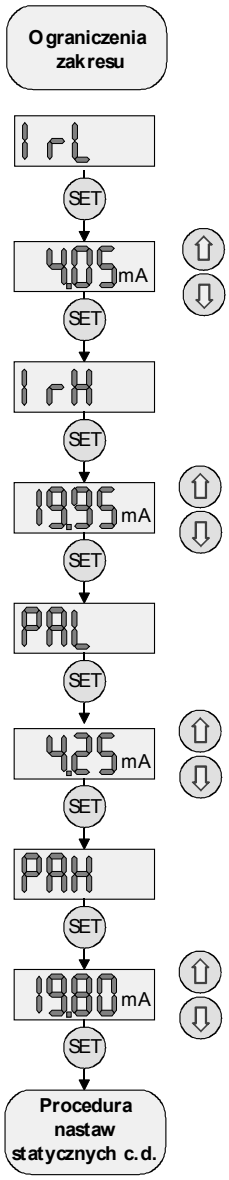
Selection of autotuning of limit positions

Selection of manual tuning of limit positions

Return (to remote or local mode respectively, according to the initial state).

The aim of this procedure is to set limit positions in easy consecutive steps, displayed on LCD. The user has to describe the actuator's type and the method of its movement limitation, both during inflation and evacuation. If the position of linear actuator is transmitted to the positioner by the gear, the actuator is considered as rotary one. In case of regulatory valve with harden seat, its closure would be by force (with pressure), whereas opening – the positional one.

- **Range limitations adjustment (subprocedure)**



Ready for setting the initial value of assigned signal (input range low)

Wyświetlenie wartości minimalnej w mA. Przyciski ↓ i ↑ zmieniają nastawianą wartość.

Ready for setting the terminal value of assigned signal (input range high)

For example 19,95 mA; ↓ & ↑ buttons change the value

Ready for setting the forbidden working range (during emptying)

For example: 4,25 mA; ↓ & ↑ buttons change the value

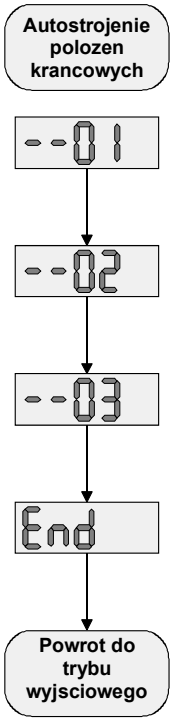
Ready for setting the forbidden working range (during inflation)

For example 19,80 mA; ↓ & ↑ buttons change the value

Powrót do trybu wyjściowego.

Firstly, this subprocedure allows for positioner's work within any range of changes of assigned signal. For example, positioner can be programmed to allow actuator for full working range only with driving signal of 4–12 mA. Secondly, for introduction of forbidden working ranges. If assigned signal drops below, e.g., 4,25 mA, the positioner automatically shuts the valve, eliminating its premature wear. Forbidden working ranges can be defined within 4–5 mA and 19–20 mA of input signal.

- **Limit position autotuning (subprocedure)**



During autotuning, the positioner automatically performs consecutive steps:

Emptying until the actuator stops; when it happens, the position is set in the memory as feedback signal of 4 mA;

Inflating the actuator until it performs any minimal movement; when it happens, the direction of movement is memorized

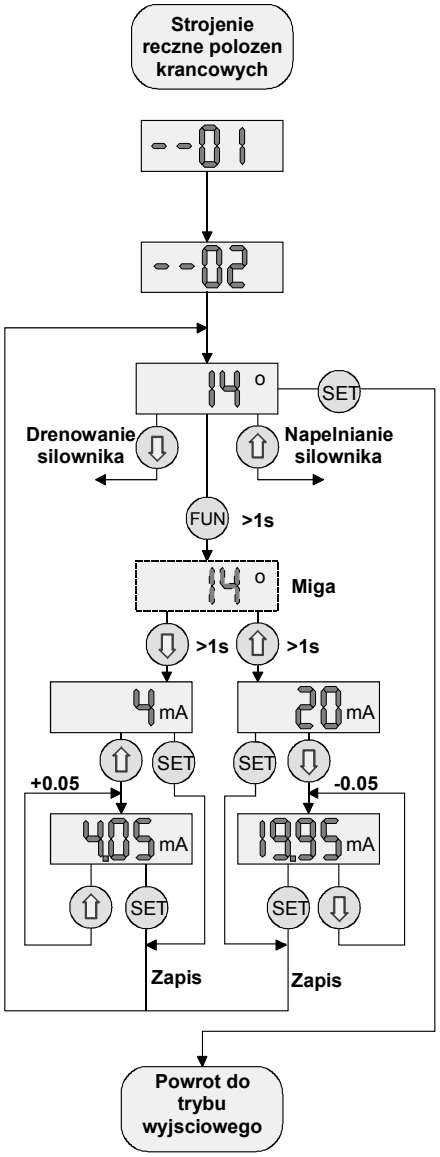
Further inflating until the actuator stops; when it happens, the feedback signal of 20mA is set in the memory;

Autotuning completed.

Return to initial mode (remote or local, respectively, according to the initial state).

Autotuning of extreme positions automatically defines the direction of movement, as well as points characterized by feedback signal 4 and 20 mA. ***The autotuning is effective, only if the mechanical pitch of the coupled valve and actuator is equal to nominal pitch of the valve itself.*** *Mechanical limitations have to work in extreme positions.*

➢ Podprocedura strojenia ręcznego położeń krańcowych



Actuator emptying until it stops (automatically).

Actuator's inflation until it performs any minimal movement; the direction of movement is automatically memorized.

Activation of buttons of the local control. The LCD displays the deviation of the positioner's lever from symmetry axis. **Using the buttons, desired limit position should be set.**

When limit position is reached, press the FUN button for 1 s (it results in LCD blinking).

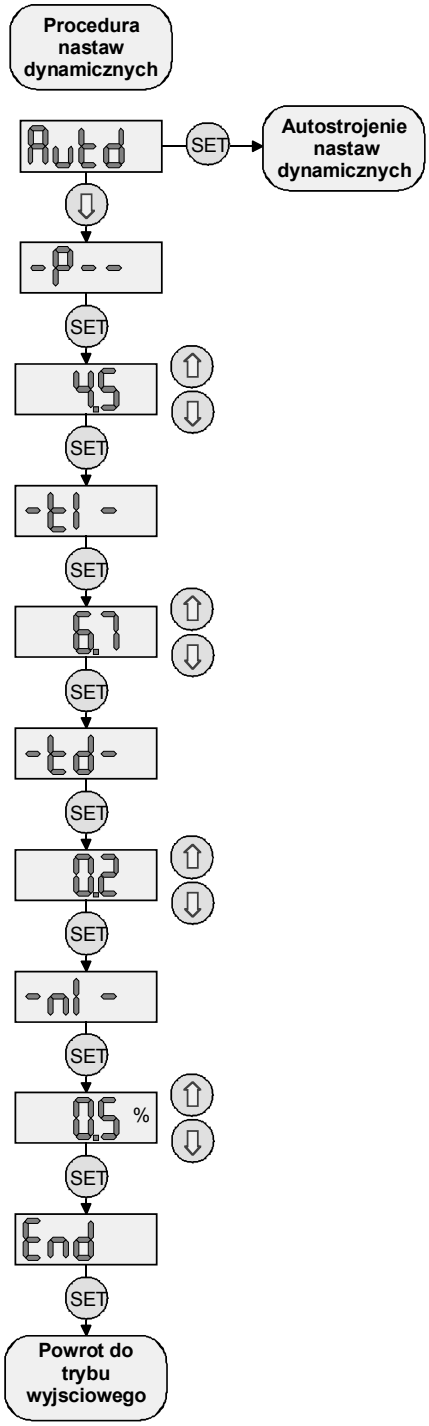
Pressing of respective button for 1 s forces LCD to display the value adequate to one of extreme positions.

The above mentioned position can be accepted (by pressing SET button) or corrected with ↓ & ↑ buttons. LCD will display new value.

Return to initial mode (remote or local, respectively, according to the state present when dynamic assignment started).

Subprocedure allows for manual adjustment of limit positions. It has to be performed if actuator's working range differs of nominal pitch of a valve.

➢ Dynamic parameters adjustment



Selection of autotuning

Ready for setting of the amplification of the FPD regulator

The introduced value of FPD amplification; buttons ↓ & ↑ allow for adjustments.

Ready for setting of doubling time of the FPD regulator

The introduced value (in seconds); buttons ↓ & ↑ allow for adjustments.

Ready for setting of the lead time of the FPD regulator.

The introduced value (in seconds); buttons ↓ & ↑ allow for adjustments.

Ready for setting of the insensibility zone of the FPD regulator.

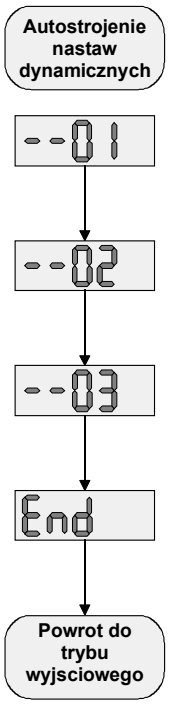
The introduced value (in %); buttons ↓ & ↑ allow for adjustments.

Information about completion of autotuning;

Return to initial mode (remote or local, respectively, according to the initial state).

The procedure allows for programming of parameters of FPD regulator. In manual mode Fuzzy function is off. Autotuning will follow the criterion of minimum of integral of the square of error. Autotuning can be interfered by overresistant pivot, leakages, changeable charge of the valve, and so on. If the interference appears, it is strongly recommended to proceed the manual tuning. It is easy as the microprocessor automatically stores assigned values. Thus, dynamic assignment in manual mode allows for edition and correction of the parameters set during autotuning.

- **Dynamic parameters autotuning (subprocedure)**



During autotuning, the positioner automatically performs consecutive steps:

Emptying until the actuator stops.

Inflating the actuator until it performs any minimal movement.

Further inflation until the actuator stops. Measurement of all the dynamic parameters.

Information about completion of autotuning; calculations and memorizing of parameters.

Return to initial mode (remote or local, respectively, according to the initial state).

Thanks to investigation of parameters of actuator's movement, this subprocedure allows for optimal FPD regulator setting. After the process is completed, settings can be reviewed or edited during manual tuning of dynamic parameters.

Declaration of conformity WE nr 2006/01

Industrial Automatics Enterprise Intec Ultd. Co., ul. Bacciarellego 54, 51-649 Wrocław, Poland declares that the Spiroster-07 is conformed to 89/336/EU directive and the following standards connected to the directive: EN 61000-6-4, EN 61000-6-2.

Rok, w którym naniesiono oznaczenie CE: 2006

WROCŁAW, 23.06.2006

Prezes Zarządu Piotr Czeczenikow

Normy zastosowane do wyrobu, którego dotyczy niniejsza deklaracja zgodności:

- normy zharmonizowane:

Numer	Wydanie	Tytuł
PN-EN 61000-6-4	:2002(U)	Wymagania dotyczące emisyjności w środowisku przemysłowym
PN-EN 61000-6-2	:2002(U)	Wymagania dotyczące odporności w środowisku przemysłowym

- inne normy i dokumentacja techniczna:

PN-EN 60654-1	1996	Urządzenia do pomiarów i sterowania procesami przemysłowymi -- Warunki pracy -- Warunki klimatyczne
PN-EN 60654-2	1999	Warunki pracy urządzeń do pomiarów i sterowania procesami przemysłowymi -- Zasilanie
PN-EN 60654-3	2000	Warunki pracy urządzeń do pomiarów i sterowania procesami przemysłowymi -- Czynniki mechaniczn