



IO-APIS-DIAG (EN)

# APLISENS

MANUFACTURER OF INDUSTRIAL MEASURING  
INSTRUMENTATION AND CONTROL ELEMENTS





## USER'S MANUAL DIAGNOSTICS IN APIS POSITIONERS

Software version X.32

OSTROW WIELKOPOLSKI, MARCH 2024

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## Marking used

Symbol	Description
	Warning to strictly follow information included in the documentation to ensure safety and functionality of the device.
	Information particularly useful during assembly and operation of the device.
	Information particularly useful during assembly and operation of the Ex device.
	Information on procedures for used equipment

## **BASIC REQUIREMENTS AND OPERATIONAL SAFETY**



- The manufacturer shall not be liable for damages resulting from the incorrect installation, not maintaining in adequate condition and misuse of the positioner.
- Assembly works and start-up should be carried out only by the qualified fitters, control engineers or trained personnel under their supervision, in accordance with applicable regulations and recommendations within the scope of control of electrical engineering.
- Incorrect installation or configuration may cause incorrect operation, leading to damage of the equipment or to an accident.
- All safety and protection requirements should be taken into consideration during installation, operation, inspections.
- The device should be disconnected in case of inoperability and sent to the manufacturer or authorized center for repair.



- Systems for intrinsically safe executions should be made with a due care and with strict observations of the standards and regulations applicable for these types of the system.

Amendments introduced in the product manufacturing documentation may be ahead of the user's paper documentation - valid user's manuals are available on the website of the manufacturer: [www.aplisens.pl](http://www.aplisens.pl)

**Scope of application.**

This manual is an extension to the User's Manual for Electropneumatic Positioner Type APIS. Applies to APIS...-IHS-... positioners with software version X.32 or newer, if a new version of the manual has not been released.

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## Diagnostic functions of APIS positioners.

### 1. General information.


The positioners are equipped with a software module that allows you to verify the correct operation and configuration of the positioner-actuator set. Diagnostic messages make it easier to recognize the problem at the stage of starting the positioner and during its operation.


There are two types of diagnostic functions:

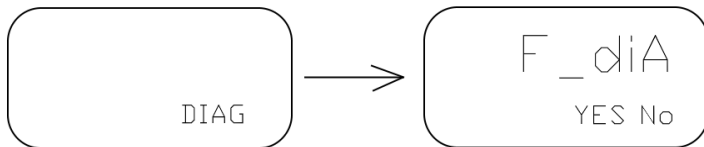
- Manual diagnostics (initiated manually).
- Online diagnostics.

### 2. Manual diagnostics.

This function is useful in case of problems with starting the positioner. It involves the automatic execution of a sequence of pressure changes and actuator movements, based on which conclusions are made regarding the status of important signals and the efficiency of individual modules. You receive the diagnostic result after completing the test procedure.

Diagnostics is started at menu level 3 by pressing the  button under the function name: "DIAG".

Initialization takes place after confirming the "YES / NO" message with the  button.



**After starting, the positioner will perform a sequence of actuator movements.**



**The condition for proper operation of manual diagnostics is a stable supply pressure value within 5% in the steady state during the test.**

The program automatically goes through several points of the diagnostic algorithm. This may take a few minutes. The completion of diagnostics is signaled by a message in accordance with table 1 below:

No	Error name	Description	Tips
1.	OK		
2.	HArdWA	Hardware Error	Perform a power restart, please contact the service
3.	Condit	Extreme outdoor conditions	Try using heat shields
4.	PVSEnS	Position sensor signal	Incorrect PV signal value. Check the position transmitter and its electrical connection (in the case of an external sensor). Check whether the range of actuator movement is within the active range of the potentiometer with a margin of at least 1%.
5.	SPSEnS	Loop current sensor signal	Incorrect SP signal value. Please check the SP loop current value.
6.	CALibr	Calibration error	The device requires factory calibration

7.	EPLoPr	E/P transducer lower pressure range	Check the A channel Electropneumatic transducer.
8.	EPHiPr	E/P transducer upper pressure range	Check the A channel Electropneumatic transducer.
9.	PrESSu	Supply pressure value	Check the supply pressure vaule
10.	PVrAnG	Position sensor active range	Very small movement range of the position sensor. Check the supply pressure, actuator load and mounting point of the lever driver if used.
11.	LEAK	Leakage in the pneumatic system	Check the tightness between the actuator chambers
12.	PVMOVE	Sensor motion error	Check the electrical and mechanical connections of the position sensor and the kinematic system of the actuator.

Table 1. Manual diagnostics messages.

### 3. Online diagnostics.

This is a background diagnostic. The software automatically analyzes the operation of the positioner and valve without disturbing the regulated process. It works automatically after starting the positioner and does not require external initialization. An error message appears when a problem occurs during normal operation of the positioner.

Error messages regarding the actuator/kinematic system or electro-pneumatic transducer allow the user to be alerted to the need to check the system or service before a permanent fault occurs.

Only one highest priority error message can be visible on the LCD at a time.

Diagnostic messages can be checked in menu level 1 under the parameter name "dIA".



Fig.1 Example of the online diagnostics "SUPRSS" message view.

Due to the different nature of the error causes, the messages are divided as follows:

- Messages deleted automatically. They concern faults that can be removed automatically and do not require remembering. For example, "Position sensor operating range". After removing the cause and recalibrating the stroke, the error is automatically deleted.
- Messages deleted manually. They concern problems that we can only observe in specific situations. An example would be the "Supply pressure" error. If the supply pressure is too low, the problem may only manifest itself when attempting to fully actuate the valve. If such a condition occurs, the error is remembered until it is manually reset or the power supply is restarted. The error stored in the non-volatile memory is the "Actuator characteristic hysteresis" error, because its detection requires longer operation of the valve. This error is not removed by restarting the power supply, but only by manual reset.

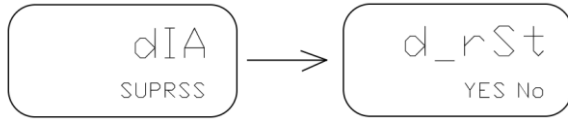
No	Error name	Description	Tips	Man. erase
1.	OK	No errors		
2.	MEMERR	FRAM memory checksum	Perform a power restart and auto-tuning function. If the error still occurs, the non-volatile memory is damaged. Contact service.	YES
3.	PV ADC	Position AD converter	No connection to ADC. Perform a power restart. If the error still occurs, contact the service.	NO
4.	SP ADC	Loop current AD converter		
5.	PP ADC	Pressure AD converter		
6.	TP ADC	Temperature sensor		
7.	PV SEN	Position sensor signal	Incorrect PV signal value. Check the position transmitter and its electrical connection (in the case of an external sensor). Check whether the range of actuator movement is within the active range of the potentiometer with a margin of at least 1%	YES
8.	SP SEN	Loop current sensor signal	Incorrect SP signal value. Please check the SP loop current value.	YES
9.	PP SEN	Pressure sensor signal	Incorrect pressure signal value. Perform a power restart. If the error still occurs, contact the service.	NO
10.	TP SEN	Temperature sensor signal	Incorrect temperature signal value. Perform a power restart. If the error still occurs, contact the service.	NO
11.	SP CAL	Loop current sensor fabric calibration status	Factory calibration required.	NO
12.	PP CAL	Pressure sensor fabric calibration status		
13.	EP MIN	E/P transducer lower pressure range	Check the Electropneumatic transducer.	YES
14.	EP MAX	E/P transducer upper pressure range		
15.	PrESSA	Press A parameter value	Correct the Press A parameter value	YES
16.	SUPRSS	Supply pressure value	Check the supply pressure vaule	YES
17.	SUPrEA	Pneumatic system test	Check in the following order: The supply pressure and the E/P converter	YES
18.	ZERODI	Down valve position	Cannot get down position. Check valve movement.	NO
19.	SPANDI	Up valve position	Cannot get up position. Check valve movement.	NO
20.	VBLOCK	Valve movement	The actuator is mechanically blocked. Check valve movement.	YES
21.	SUBLEb	Reaching the B side pressure position	Check in the following order: supply pressure, kinematics of the system movement for possible blocking of the system and channel B E/P converter	YES

22.	SUBLPb	Reaching the B side pressure position	Check in the following order: supply pressure, kinematics of the system movement for possible blocking of the system and the value of the Press. B parameter	YES
23.	bLEb	Reaching the A side pressure position	Check in the following order: kinematics of the system movement for possible blocking of the system and the E/P converter of channel B	YES
24.	bLPb	Reaching the A side pressure position	Check in the following order: kinematics of the system movement for possible blocking of the system and the value of the Press. B parameter	YES
25.	OVERH	Device temperature	Ambient temperature is too high. Provide a heat shield.	YES
26.	UNDERH		Ambient temperature is too low. Provide a heat shield.	YES
27.	SPuSEr	SP signal calibration by user	The SP range has been set far from the factory settings. Make sure it's intended.	NO
28.	StroEr	Stroke calibration	Range of motion calibration failed. Check the pneumatic supply, PV sensor connections and kinematics of the actuator.	NO
29.	AutoEr	Actuator autotuning	Autocalibration failed. Check the pneumatic supply, PV sensor connections and kinematics of the actuator.	NO
30.	PrESEr	Support pressure autotuning	Pressure calibration failed. Try set the Press A and Press B parameters manually.	NO
31.	PVrAnG	Position sensor active range	Very small movement range of the position sensor. Check the supply pressure, actuator load and mounting point of the lever driver if used.	NO
32.	Frict	Actuator hysteresis	A significant hysteresis (over 25%) was detected in the dependence of the actuator position on the pressure in the chamber. This may be a sign of actuator wear (this problem most often affects rotary actuators) or friction in the system driven by the actuator. Check the actuator and friction in the kinematic system.	YES
33.	LTiME	Work Time	The device has been operating for a long time. Maintenance is recommended.	NO
34.	nCYclE	Number of cycles	The device has performed a large number of work cycles. Maintenance is recommended.	NO
35.	HdCond	Environmental conditions	Difficult environmental conditions. Try using heat shields.	NO
36.	SvRAnG	Valve operating range	The valve operates in a very small range. Check valve compatibility with application.	NO
37.	unStAb	Automatic system stability	The system performs many cycles per unit of time. Check the stability of the external control system and positioner settings. If the positioner works unstable with a constant control signal, lower the Kp parameter value.	NO

Table 2. Online diagnostics messages.

Erasing errors:

The error is cleared by pressing the  $\leftarrow$  button when the online diagnostics view is displayed:



Deleting must be confirmed with the  $\Delta$  button.

#### 4. Diagnostic data available in the "Raport 2" software.

##### 4.1. Information about working with the "Raport 2" software.

The "Raport 2" software is designed to run on a PC with Windows. The connection with the positioner is made via HART communication via a HART modem, e.g. the "HART/USB Converter" modem manufactured by Aplisens S.A.

In addition to connecting via USB, this modem also allows you to connect to a computer/phone via Bluetooth.

It is also possible to run the Raport2 application on a remote computer via the Internet. You should then connect the HART modem to the phone (Bluetooth). The "Aplisens Remote Modem" phone application (for Android, available in the Play Store) connects the modem with Raport2 software on a remote computer via the Internet.

The connection diagram of the HART modem to the positioner can be found in the "User's Manual for Electropneumatic Positioner Type APIS".

The "Raport 2" software, in addition to supporting diagnostic functions, enables full positioner configuration and manual control. It also includes auto-tuning functions with regulation quality analysis.

Tips about using the software can be found in the "Help" menu.

#### 4.2. Online diagnostics.

You also have access to the diagnostic functions described above from the Raport 2 software. The list of control tests is visible and you have access to the status of all list items.

No.	Test name	Status	Result	Tips
1	Position AD converter		OK	No tips.
2	Position sensor signal		OK	No tips.
3	Loop current AD converter		OK	No tips.
4	Loop current sensor signal		OK	No tips.
5	Loop current sensor fabric calibration status		OK	No tips.
6	Pressure AD converter		OK	No tips.
7	Pressure sensor signal		OK	No tips.
8	Pressure sensor fabric calibration status		OK	No tips.
9	Temperature sensor		OK	No tips.
10	Temperature sensor signal		OK	No tips.
11	Device temperature		OK	No tips.
12	FRAM memory checksum		OK	No tips.
13	Stroke calibration		OK	No tips.
14	Actuator autotuning		OK	No tips.
15	E/P transducer lower pressure range		OK	No tips.
16	E/P transducer upper pressure range		OK	No tips.
17	Supply pressure value		OK	No tips.
18	Pneumatic system test		ERROR	Check in the following order: The supply pressure and the E/P converter
19	Down valve position		OK	No tips.
20	Up valve position		OK	No tips.
21	Valve movement		OK	No tips.
22	SP signal calibration by user		OK	No tips.
23	Position sensor active range		OK	No tips.
24	Work Time		OK	No tips.
25	Number of cycles		OK	No tips.
26	Environmental conditions		OK	No tips.
27	Valve operating range		OK	No tips.
28	Automatic system stability		OK	No tips.
29	Actuator hysteresis		0.0%	No tips.

Fig. 2. View of the status of diagnostic signals in the Raport2 software.

### 4.3. Positioner operation history.

During positioner operation, position and temperature histograms are saved in non-volatile memory. Based on this data, we can assess the statistical operating range of the valve and the conditions in the workplace.

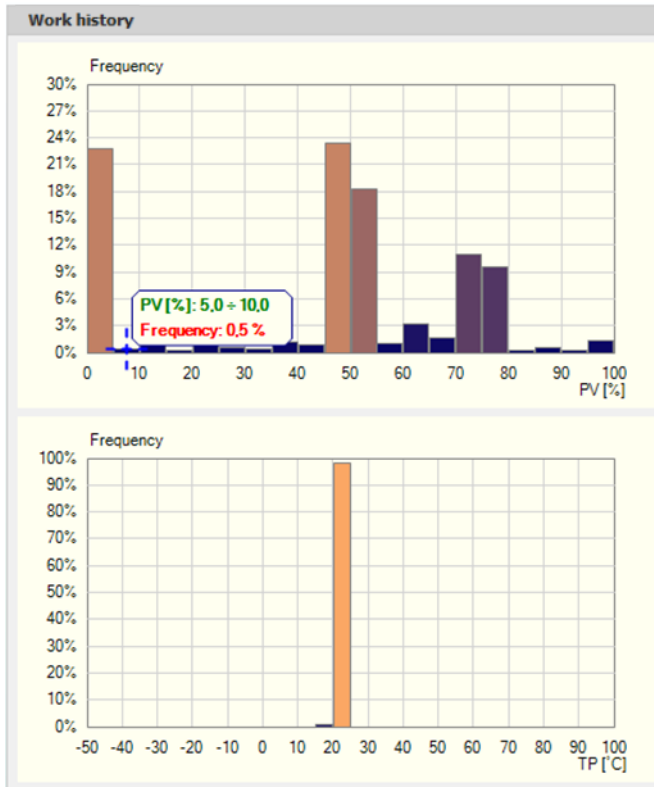


Fig.3 View of work histograms in the Raport2 software.

Data regarding operating time, number of cycles and recorded operating temperature extremes are also available.

No.	Parameter	Status	Result	Tips
1	Total device work time	✓	72,3 h	No tips.
2	PV histogram total work time	✓	72,3 h	No tips.
3	Number of cycles	✓	67	No tips.
4	Minimum work temperature	✓	-20,4 °C	No tips.
5	Maximum work temperature	✓	23,7 °C	No tips.

Fig.4 View of additional data.

#### 4.4. Static characteristics and step response.

Report 2 software allows you to perform an automatic test of static characteristics and step response in order to assess the quality of regulation.

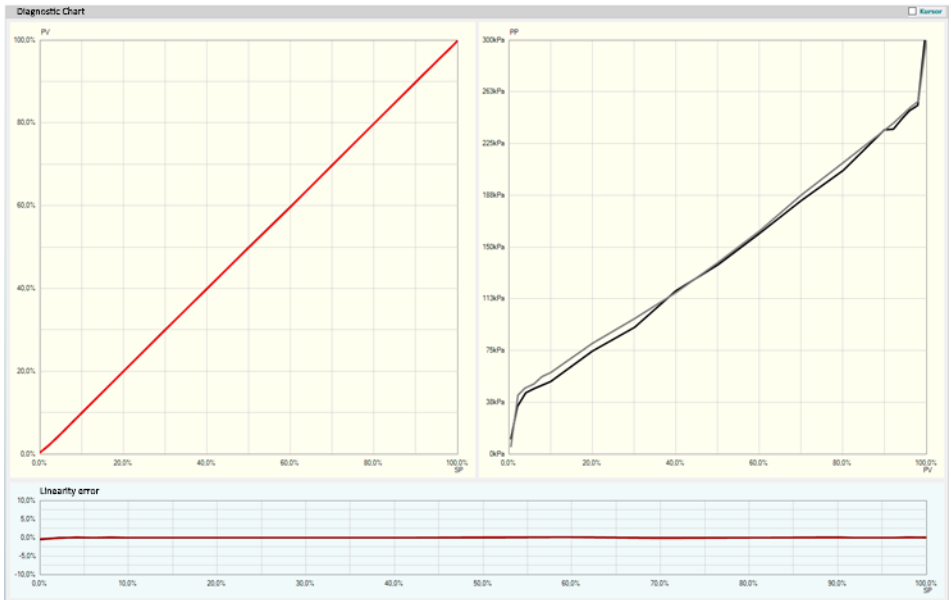


Fig.5 View of an example of static characteristics.

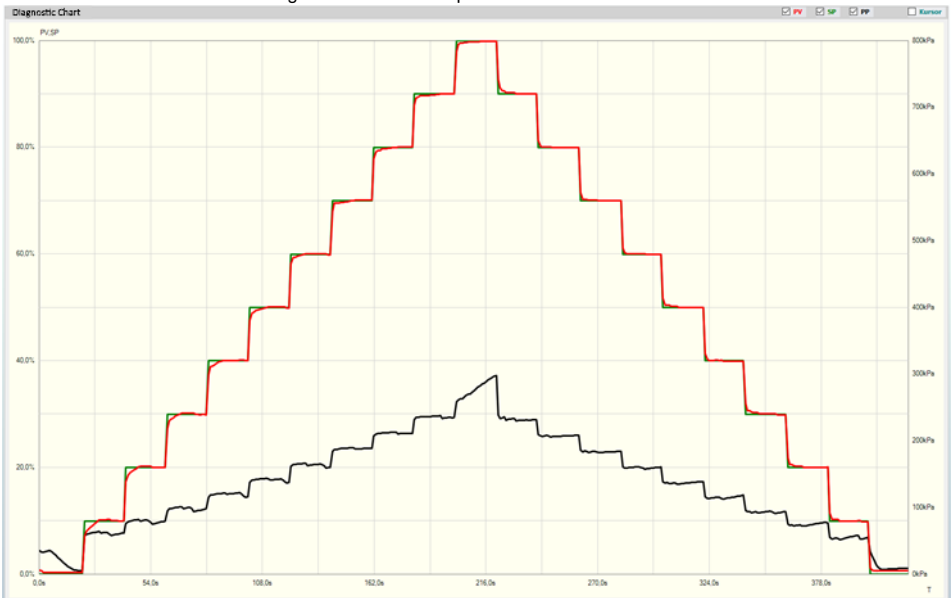


Fig.6 View of an example step response.

#### 4.5. Monitoring of drive operation with the APIS positioner.

In the Report 2 software we can record the operation of the actuator and valve set. Data is transferred via HART communication and recorded in the computer's memory. It is also possible to save them in a file. The data sampling period is approximately 1 second and the maximum recording time is approximately 24 hours.

Waveforms of the set point signal (SP), the actuator position signal (PV) and the pressure in the actuator chamber (PP) are available.



Fig.7 View of an exemplary time chart of the operation of a single-acting drive.

