Smart Valve Positioner
INTRODUCTION

The FY301 is a smart valve positioner for Single (spring return) or Double acting Linear motion type control valves e.g. Globe, Gate, Diaphragm, Pinch or Clamp and Rotary motion type control valves e.g. Ball, Butterfly or Plug with pneumatic type actuators e.g. Diaphragm, Piston, Vane, or Bellows. It is based on a field-proven piezo flapper and non-contacting Hall-effect position sensor that provides reliable operation and high performance. The digital technology used in the FY301 enabled the choice of several types of flow characterizations, an easy interface between the field and the control room, not to mention several interesting features that considerably reduce the installation, operation and maintenance costs.

The FY301, besides the normal functions offered by other smart positioners, offers the following functions:

* **Table** - on top of the regular valve characterization curves like linear, equal percentage and quick opening (hyperbolic), the valve set point signal may be custom linearized according to a 16 point table, making it possible to achieve flow characterization being a combination of linear and equal percentage etc.

* **Local Adjustment** - not only for travel adjustment, but also flow characterization, tuning, operation mode, indication, set point and PID parameters... as well.

* **Password** - three levels for different functions.

* **Operation Counter** - shows the number of changes in each function.


* **Diagnostic** – permanently valve monitoring condition for preventive maintenance.

Get the best results of the FY301 by carefully reading the instructions of this manual.

WARNING

Throughout the operation of the positioner, including auto setup, do not touch the moving parts of the valve/actuator/positioner ’set as they may unexpectedly move automatically. Make sure to disconnect air supply before touching any moving parts.
NOTE

This manual is compatible with version 3.XX, where 3 indicates software version and XX software release. The indication 3.XX means that this manual is compatible with any release of software version 3.

Waiver of responsibility

The contents of this manual abides by the hardware and software used on the current equipment version. Eventually there may occur divergencies between this manual and the equipment. The information from this document are periodically reviewed and the necessary or identified corrections will be included in the following editions. Suggestions for their improvement are welcome.

Warning

For more objectivity and clarity, this manual does not contain all the detailed information on the product and, in addition, it does not cover every possible mounting, operation or maintenance cases.

Before installing and utilizing the equipment, check if the model of the acquired equipment complies with the technical requirements for the application. This checking is the user’s responsibility.

If the user needs more information, or on the event of specific problems not specified or treated in this manual, the information should be sought from Smar. Furthermore, the user recognizes that the contents of this manual by no means modify past or present agreements, confirmation or judicial relationship, in whole or in part.

All of Smar’s obligation result from the purchasing agreement signed between the parties, which includes the complete and sole valid warranty term. Contractual clauses related to the warranty are not limited nor extended by virtue of the technical information contained in this manual.

Only qualified personnel are allowed to participate in the activities of mounting, electrical connection, startup and maintenance of the equipment. Qualified personnel are understood to be the persons familiar with the mounting, electrical connection, startup and operation of the equipment or other similar apparatus that are technically fit for their work. Smar provides specific training to instruct and qualify such professionals. However, each country must comply with the local safety procedures, legal provisions and regulations for the mounting and operation of electrical installations, as well as with the laws and regulations on classified areas, such as intrinsic safety, explosion proof, increased safety and instrumented safety systems, among others.

The user is responsible for the incorrect or inadequate handling of equipments run with pneumatic or hydraulic pressure or, still, subject to corrosive, aggressive or combustible products, since their utilization may cause severe bodily harm and/or material damages.

The field equipment referred to in this manual, when acquired for classified or hazardous areas, has its certification void when having its parts replaced or interchanged without functional and approval tests by Smar or any of Smar authorized dealers, which are the competent companies for certifying that the equipment in its entirety meets the applicable standards and regulations. The same is true when converting the equipment of a communication protocol to another. In this case, it is necessary sending the equipment to Smar or any of its authorized dealer. Moreover, the certificates are different and the user is responsible for their correct use.

Always respect the instructions provided in the Manual. Smar is not responsible for any losses and/or damages resulting from the inadequate use of its equipments. It is the user’s responsibility to know and apply the safety practices in his country.
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Installation Flowchart

Start

Verify, before installation, the package content. (Section 5)
Proceed with field installation. (Section 1)
Install the valve and the actuator. (Section 1)
Check valve conditions: apply pressure in the actuator and verify if the valve stem travels from 0 to 100%.
Be sure there is no additional friction between magnet and Hall sensor or possibility of movement stop. (Section 1)
Check if there is no leakages at connections or actuator.
Install the magnet bracket. (Section 1)
Install the positioner bracket. (Section 1)
Assemble the positioner and the magnet in the valve. (Section 1)
Place the valve in mid travel. Make sure that the arrow engraved on the magnet coincides with the arrow engraved on the positioner.
Check the distance between the magnet external face and the positioner face. (Recommended: 2 mm to 4 mm) (Section 1)
Verify the most suitable position for local indicator. (Section 5)
Install the positioner. (Section 1)
Check if the cover is correctly closed. (Section 1)
Check area classification and respective practices.
Purge air supply lines before connecting the pressure tubings.
Connect the positioner pneumatic parts to the actuator. (Section 5)
Use sealant on threads. Make sure that the bracket is not obstructing the positioner exhausted ports.
ATTENTION
Do not touch the moving parts of the valve/actuator/positioner assembly as they may unexpectedly move automatically.
Apply pressure in the positioner. (Between 1.4 bar (20 psi) and 7 bar (100 psi)) (Section 5)
Power up the positioner.

NOTE
Get the best results of the FY301 by carefully reading all instructions manual.

Start

Is the positioner pre-configured?
YES

NO
Define action type. (direct / reverse) (Section 3)

Define valve type. (air to open / air to close) (Section 3)

YES

NO
Is the positioner in split range? (Section 1)

Define the current range.

YES

NO
Execute a set up in the positioner. (Section 3)

Define KP, TR (Section 3)

Is the valve working correctly?
YES

OK

NO
Consult Section 5 Maintenance
Section 1

INSTALLATION

General

NOTE

The installation carried out in hazardous areas should follow the recommendations of the IEC60079-14 standard.

The overall accuracy of measuring and control depends on several factors. In spite of the excellent performance, the positioner must be adequately installed so that it may work well.

Among all factors that may affect the positioner accuracy, environmental conditions are the most difficult to control. But there are ways to reduce the effects of temperature, humidity and vibration.

Installing the positioner in areas protected from extreme environmental changes can minimize temperature fluctuation effects. In warm environments, the positioner should be installed to avoid, as much as possible, direct exposure to the sun. Installation close to lines and vessels subjected to high temperatures should also be avoided. If not possible to avoid it, consider using the remote position sensor version.

Use thermal isolation to protect the positioner from external heart sources, if necessary.

Humidity is fatal to electronic circuits. In areas subjected to high relative humidity, the O-rings for the electronic housing covers must be correctly placed and the covers must be completely closed by tighten them by hand until you feel the O-rings being compressed. Do not use tools totight the covers. Removal of the electronics cover in the field should be reduced to the minimum necessary, since each time it is removed; the circuits are exposed to the humidity.

The electronic circuit is protected by a humidity proof coating, but frequent exposures to humidity may affect the protection provided. It is also important to keep the covers tightened in place. Every time they are removed, the threads are exposed to corrosion, since painting cannot protect these parts. Sealing methods should be employed on conduit entering of the positioner.

IMPORTANT

Avoid to use thread sealant tapes on the air input and outputs connections, since small pieces of this type of sealant may block the air flow inside the positioner, affecting the overall equipment performance.

Although the positioner is practically vibration resistant, it is not recommended to install it near pumps, turbines or other equipment producing too much vibration. If not possible to avoid it, consider using of remote position sensor version.

Mounting

The FY301 mounting depends on the type of actuator, its actions, single (with spring return) or double, and the movement characteristic (linear or rotary). It requires two mounting brackets: one for the magnet and another for the positioner. Smar supplies both according to the specified ordering code (see Page 6.4 for mounting bracket ordering code)

Additionally, a great variety of customized mounting brackets is available, covering several control valves models from different manufacturers.

Check the availability and select the most adequate mounting bracket to your need, by visiting our web page on the Internet: http://www.smar.com. Select "Valve Positioner" option to access the product specific page. After enter your login and password, click on the Bracket for FY link and choose the most appropriate mounting bracket to your application.

See below an example showing the Positioner with rotary and linear magnets.

IMPORTANT

Smar web site (www.smar.com) has options of mounting brackets available for several actuators of several manufacturers and models and the related dimensional drawings.
Rotary Movement
Install the magnet on the valve stem using its proper bracket, according to the Figure 1.1.

Figure 1.1 – Positioner with Rotary Actuator

NOTE
Included in the package content the centralizer device of rotary magnet. See figure 1.17.

Figure 1.2 – Positioner on Rotary Actuator with Remote Position

Then, install the positioner bracket on the actuator. Usually, the actuator is designed according to the VDI/VDE 3845 standard, and, in this case, tighten the four screws with their lock washers on the proper bracket.
Make sure that the arrow engraved on the magnet coincides with the arrow engraved on the positioner when the valve is in mid travel.

When mounting the magnet, be sure that:
1. There is no attract between the internal magnet face and the position sensor salience during the travel (rotary or linear), through the magnet.
2. The magnet and the salience of position sensor must not be distant.

A minimum distance of 2 mm and a maximum distance of 4mm are recommended between the magnet external face and the positioner face. For that, a centralizer device (linear or rotary) must be used. The centralizer device is in the positioner packing.

Case the positioner installation or magnet change or if any other modification is done, the positioner will require a re-calibration. See Section 3 (Setup - for Auto Setup procedure).

See item “Pneumatic Connections” as recommended practice to install the positioner to the valve type.

**Linear Movement**

Install the magnet on the valve stem using its proper bracket, according to Figure 1.3.

Install the positioner bracket on the actuator. The fastening of the actuator bracket may follow the NAMUR/IEC 60534-6-1 standard or be in accordance with the user specified boring. Mount the positioner on the bracket by fastening the four screws in the holes of the pressure gauges opposite face. Use lock washers to avoid loosening the screws.

The linear magnet movement must be orthogonal in relation to the main axis of the positioner. For example, if the linear magnet movement is vertical, the positioner main axis must be horizontal, as shown in Figure 1.3.

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**Figure 1.3 - Positioner on the Linear Actuator**

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**NOTE**

Included in the package content the centralizer device of linear magnet. See figure 1.16.
Make sure the bracket does not obstruct the exhaust outputs.

**NOTE**

Make sure that the arrow engraved on the magnet coincides with the arrow engraved on the positioner when the valve is in mid travel.

When mounting the magnet, be sure that:

1. There is no attraction between the internal magnet face and the position sensor salience during the travel (rotary or linear), through the magnet.
2. The magnet and the salience of position sensor must not be distant.

A minimum distance of 2 mm and a maximum distance of 4 mm are recommended between the magnet external face and the positioner face. For that, a centralizer device (linear or rotary) must be used. The centralizer device is in the positioner packing.

Case the positioner installation or magnet change or if any other modification is done, the positioner will require a re-calibration. See Section 3 (Setup - for Auto Setup procedure).

**Pneumatic Connections**

The FY301 requires instrument air quality, following the best practices for pneumatic installations. Consult the American National Standard "Quality Standard for Instrument Air" (ANSI/ISA S7.0.01 - 1996) for detailed information.

The FY301 comes with input and output stainless steel air filters, but these filters do not exclude the preliminary instrument air treatment. Periodical filter cleaning is recommended at every 6 months or less, if the air quality is not good. Please, check the maintenance section for clean the filters.

The FY301 supply air pressure varies from 1.4 bar (20 psi) minimum, to 7.0 bar (100 psi) maximum. The actuator working pressure must follow these limits. Consider the use of boosters, if required. Pressure below this range shall affect the positioner performance. Pressure above this range may damage the positioner.

The two pneumatic outputs, marked as “OUT1” and “OUT2”, work in opposite directions to open or close the valve.

**IMPORTANT**

If a failure occurs on the FY301, such as power loss (4-20 mA input signal), the output marked OUT1 goes to zero pressure and the output marked OUT2 goes to the air supply pressure value.
The positioner can have pressure gages (see the ordering code table) attached to the supply air input and in each output. The indications on gages are references only and does not have the same overall positioner accuracy.

The pneumatic connections are marked with IN for the air supply and OUT1 and OUT2 for Output1 and Output2, respectively. Use 1/4 NPT connections with sealing material for the NPT screw threads. Connect the air supply on the connection marked IN. Be sure the air supply does not exceed the maximum allowed pressure of the positioner or the actuator.

<table>
<thead>
<tr>
<th>IMPORTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>When using tape sealant type on the thread connections, be sure not spread small residues inside, since they may clog the air flow inside the positioner and even impair the equipment efficiency.</td>
</tr>
</tbody>
</table>

The FY381 has five protected exhaust orifices with filters. Do not block any of these exhaust, as the air must circulate freely through them. If painting the positioner block, remove the filters before, to prevent them from being obstructed by paint. The orifices must be inspected on a regular basis to ensure they not blocked, granting the air to flow smoothly.

**Double Action – Air to open (Close on failure)**
Connect the positioner OUT1 output on the actuator connection marked with “OPEN” and connect the positioner OUT2 output on the actuator connection marked with “CLOSE”.

**Double Action – Air to close (Open on failure)**
Connect the positioner OUT2 output on the actuator connection marked with “OPEN” and connect the positioner OUT1 output on the actuator connection marked with “CLOSE”.

**Single Action**
Connect the positioner OUT1 output on the actuator input. Use a plug to block OUT2. Pay attention to the safe logic on the actuator for the specific process. If necessary, invert the connections. Take into consideration that in case of power failure the output marked OUT1 goes to zero pressure and the output marked OUT2 goes to the air supply pressure value.
**Dimensional Drawing**

**VALVE POSITIONER**

- **Input Pressure:** 1/8-27 NPT
- **Output Pressure 1:** 1/8-27 NPT
- **Output Pressure 2:** 1/8-27 NPT

**LINEAR MAGNET**

- **Input Pressure:** 1/4-18 NPT
- **Output Pressure 1:** 1/4-18 NPT
- **Output Pressure 2:** 1/4-18 NPT

**ROTARY MAGNET**

- **MOUNTING HOLES FOR M6x1 SCREWS (2 PLACES)**

All dimensions are in mm (in)

**Note:** Dimensions in mm (in)

- **Up to 100 mm (3.94)**
- **Up to 50 mm (1.97)**
- **Up to 15 mm (0.59)**
- **Up to 30 mm (1.18)**
- **43 mm (1.7)**
- **105 mm (4.13)**
- **181 mm (7.12)**

**Output 2**

**64.5**

**HOLE Ø6.3 (0.25)**

**Rotary Magnet**

- **Exhaust Orifices**
- **Threads for Screws M6x1 (4 Places)**

**Terminal Wiring**

**Electrical Connection**

**Socket Set Plug**

**Input**

**Pressures**

**Leave, at least, a 150mm (5.8 in) space, for zero and span adjustments with the magnetic tool.**
Electronic Housing Rotating

The electronic housing can be rotated in order to offer a better position of the digital display and/or better access to the field connections. To rotate it, release the housing rotation set screw. See figure 1.6. The local indicator itself can also be rotated. See section 5, figure 5.2.
Reach the wiring block by removing the electrical connection cover. This cover can be locked closed by the cover locking screw. To release the cover, rotate the locking screw clockwise. See figure 1.7.

Figure 1.7 - Cover Locking Bolt

**Electric Wiring**

The access to the signal cables to the terminal wiring can be done through one of the electronic housing orifices and can be connected to a conduit. The wiring block has screws on which fork or ring-type terminals can be fastened. See figure 1.8. Use a plug to block the electrical connection not used. Tight it well and use thread sealing tape.

If the user chooses protection against noise induced by atmospheric discharges, overloads, weld machines and machines in general, it will be necessary to install a transient protector (Protector acquired separately).

Test and communication terminals allow, respectively, to measure the current in the 4 - 20 mA loop, without opening it, and to communicate with the transmitter. To measure it, connect a multimeter in the mA scale in the “−” and “+” terminals, and to communicate, use a Hart® configurator in the "COMM" and "−" terminals. For convenience, there are three ground terminals: one inside the cover and two externals, located close to the conduit entries.

Attention to prevent the accidental feeding of the test terminals. This occurrence will cause damages in the equipment.

Figure 1.8 - Wiring Block

<table>
<thead>
<tr>
<th>HAZARDOUS AREAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>In hazardous areas with explosion proof requirements, the covers must be tightened with at least 8 turns. In order to avoid the penetration of humidity or corrosive gases, tighten the o-ring until feeling the o-ring touching the housing. Then, tighten more 1/3 turn (120°) to guarantee the sealing. Lock the covers using the locking bolts.</td>
</tr>
<tr>
<td>Conduit threads should be sealed by means of code-approved sealing methods.</td>
</tr>
<tr>
<td>Explosion proof, non-incendive and intrinsic safety certification are standards for FY301.</td>
</tr>
<tr>
<td>For a complete list of available certificates, please consult <a href="http://www.smar.com">http://www.smar.com</a>.</td>
</tr>
</tbody>
</table>
The figure 1.9 - Conduit installation diagram shows the correct installation of the conduit, in order to avoid penetration of water or other substance, which may cause malfunctioning of the equipment.

![Conduit Installation Diagram](image)

**Figure 1.9 - Conduit Installation Diagram**

Use of twisted pair (22 AWG or greater than) cables is recommended.

Avoid routing signal wiring close to power cables or switching equipment.

The FY301 is protected against reverse polarity, and can withstand up to 50 mA and power supply of ± 60 Vdc without damage.

The FY301 connection could be done according to the figures 1.10, 1.11 and 1.12.

It is also recommended to ground the shield of shielded cables at one end only. The non-grounded end must be carefully isolated.

The configurator can be connected to the communication terminals of the positioner or at any point of the signal line by using the interface HPI311-M5P with “alligator” clips.

![FY301 Wiring Diagram](image)

**Figure 1.10 - FY301 Wiring Diagram**
The FY301 has an equivalent impedance of 550 Ohms. Make sure that the current supply or analog output of DCS, CLP or single loop controller powering the positioner is capable to handle a voltage drop of 11 V for each positioner (550 x 0.02 = 11 Volts).

**NOTE**

If you are using two positioners in series as e.g., working in split range, the resulting impedance will be 1,100 Ohms. Therefore, the analog output should be capable to handle a voltage drop of 22 Volts.

Connection of the FY301 in multidrop configuration should be done as in figure 1.12. Note that a maximum of two positioners can be connected on the same line and that they should be connected in series.
Air Supply Requirements

Before the air supply is connected to the positioner, we recommend the hose is opened freely for 2 to 3 minutes to allow any contamination to be blown out. Direct the air jet into a large paper towel to trap any water, oil, or other foreign materials. If this indicates that the air system is contaminated, it should be properly cleaned.

As soon as the positioner is connected and powered, internal air leakage will provide protection against corrosion and prevent moisture inside. For this reason, it is strongly recommended to keep the positioner pressurized as much as possible.

Recommendations for Instrument Air Supply System

Instrument air quality shall be superior to that of industrial compressed air. Humidity, suspended particles and oil may impair the instrument operation, either temporarily or permanently in case of internal parts wearing.

As per standard ANSI/ISA S7.0.01 - 1996 - Quality Standard for Instrument Air, instrument air shall have the following characteristics:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dew point</td>
<td>10°C below minimum instrument temperature</td>
</tr>
<tr>
<td>Size of particles (airborne)</td>
<td>40 µm (maximum)</td>
</tr>
<tr>
<td>Oil content</td>
<td>1 ppm w/w (maximum)</td>
</tr>
<tr>
<td>Contaminants</td>
<td>free from corrosive flammable gases</td>
</tr>
</tbody>
</table>

This standard recommends that the compressor intake be located in an area free from process spills and fitted with an adequate filter. It also recommends the use of non-lubricated type compressors, in order to prevent air contamination by lubricating oil. Where lubricated type compressors are adopted, there shall be used means to make the air oil free.

Figure 1.13 and 1.14 shows a typical system for air supply and air quality conditioning.

![Figure 1.13 - Air Supply System](image1)

![Figure 1.14 - Air Quality Conditioning System](image2)
Recommendations for mounting Approved Equipments with the IP 66 W certifications (use in saline atmospheres)

**NOTE**

This certification is valid for stainless steel positioners manufactured, approved with the certification IP 66 W. All positioner external material, such as gauge, plugs, connections etc., should be made in stainless steel.

The electrical connection with 1/2” – 14NPT thread must use waterproofing sealant. A non-hardening silicone sealant is recommended.

The instrument modification or replacement parts supplied by other than authorized representative of Smar is prohibited and will void the certification.

**Rotary and Linear Magnet**

Magnet models are linear and rotary, for utilization on linear and rotary actuators.

*Figure 1.15 – Linear and Rotary Magnet Models*
### Magnet Centralizer Device

**Note**

Centralizer device of linear magnet is used for all type of linear bracket.

*Figure 1.16 – Centralizer device of linear magnet*

**Note**

Centralizer device of linear magnet is used only for universal rotary bracket.

*Figure 1.17 - Centralizer device of rotary magnet*

### Remote Hall Sensor

The remote Hall magnetic sensor is an accessory recommended for high temperature and extreme vibration applications. It prevents excessive wear of the equipment and, consequently, the reduction of its useful time.

*Figure 1.18 - Remote Hall Sensor*
The electric signals on the remote sensor’s connection to equipment are of low intensity. Therefore, when installing the cable inside the conduit (maximum limit 20 meters length) keep it away from possible sources of induction and/or magnetic interference. The cable supplied by Smar is shielded for excellent protection against electromagnetic interference, but despite this protection avoid the cable sharing the same conduit with other cables.

The connector for remote Hall sensor is easy handling and simple installation.

See the installation procedure:

![Connecting the Cable to the Remote Hall Sensor](image1)

![Connecting the Cable to the Positioner](image2)

### Installation in Hazardous Areas

**WARNING**

Explosions could result in death or serious injury, besides financial damage. Installation of this instrument in an explosive environment must be in accordance with the national standards and according to the local environmental protection method. Before proceeding with the installation check the certificate parameters according to the environmental classification.

The instrument modification or replaced parts supplied by any other supplier than the authorized representative of Smar Equipamentos Industriais Ltda is prohibited and will void the Certification.

The positioners are marked with options of the protection type. The certification is valid only when the protection type is indicated by the user. Once a particular type of protection is selected, any other type of protection can not be used.

The electronic housing installed in hazardous areas must have a minimum of 6 fully engaged threads. Lock the housing using the locking screw (Figure 1.6).

Tighten the cover with at least 8 turns to avoid the penetration of humidity or corrosive gases.

Tighten the cover until it touches the housing. Then, tighten more 1/3 turn (120°) to guarantee the sealing. Lock the covers using the locking screw (Figure 1.6).

Consult the Appendix A for further information about certification.
**Explosion/Flame Proof**

**WARNING**
The electric connection's entries must be connected or closed using the appropriate Ex-d metal cable gland and/or metal blanking plug with certified IP66 rating.

The standard plugs provided by Smar do not have an Ex-d/XP certification. For Explosion proof applications a certified plug must be used. Consult Smar for certified plugs.

The electrical connection with NPT thread must use waterproofing sealant. A non-hardening silicone sealant is recommended.

Do not remove the positioner covers when power is ON.

**Intrinsically Safe**

**WARNING**
In hazardous zones with intrinsically safe or non-incendive requirements, the circuit entity parameters and applicable installation procedures must be observed.

To protect the application, the positioner must be connected to a barrier. Match the parameters between barrier and the equipment (Consider the cable parameters). Associated apparatus ground bus shall be insulated from panels and mounting enclosures. Shield is optional. If used, be sure to insulate the end not grounded. Cable capacitance and inductance plus Ci and Li must be smaller than Co and Lo of the associated Apparatus (see appendix “A” for Ci and Li values).

For free access to the Hart bus in the explosive environment, ensure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices. Use only Ex Hart communicator approved according to the type of protection Ex-i (IS) or Ex-n (NI).

It is not recommended to remove the positioner cover when the power is ON.
OPERATION

Transducer Functional Description

The main parts of the output module are the pilot, servo, Hall effect position sensor and the output control circuit.

The control circuit receives a digital setpoint signal from the CPU and a feedback signal from the position sensor.

The pneumatic circuit is based on a well-known and widely adopted technology, which is described on item baffle and nozzle and Spool Valve.

A piezoelectric disk is the flapper in the pilot stage. The flapper is deflected when the control circuit applies a voltage. A small stream of air flowing through the nozzle is obstructed causing an increase in pressure in the pilot chamber; this is called the pilot pressure.

The pilot pressure is too low, with a small flowing capacity, and for this reason, it must be amplified in the servo section. The servo section includes a diaphragm in the pilot chamber and a smaller one in the spool chamber. The pilot pressure applies a force at the pilot chamber’s diaphragm, which, in the equilibrium state, will be equal to the force applied by the spool valve at the smaller diaphragm, which is in the spool chamber.

Upon every position change caused by the positioner, the pilot pressure increases or decreases, as explained in the pilot stage section. Such change in pilot pressure causes an upward or downward valve travel, which alters the pressure at Output 1 and Output 2, until a new balance is reached (new valve position).
Electronics Functional Description

Refer to the block diagram (Figure 2.2). The function of each block is described below.

A/D
Receives the 4 - 20 mA signal and converts it in the digital format for the CPU.

D/A
Receives the signal from the CPU and converts it to an analog voltage proportional to the desired position, used by the control.

Control
Controls the valve position according to data received from the CPU and the Hall effect sensor feedback.

Position Sensor
Measures the actual position and feedback to the control and CPU.

Temperature Sensor
Measures the temperature of the Transducer Circuit.

Isolation
Isolates the 4 - 20 mA signal from the piezoelectric signal.

EEPROM
A non-volatile memory that stores configuration data as a backup if the FY301 main board be replaced.

Central Processing Unit (CPU), RAM, PROM and EEPROM
The CPU is the intelligent portion of the positioner, being responsible for the management and operation of block execution, self-diagnostics and communication. The program is stored in PROM. For temporary storage of data there is a RAM. The data in the RAM is lost if the power is switched off, however the device also has a nonvolatile EEPROM where data that must be retained is stored. Examples of such data are calibration and valve configuration.

HART Modem
The function of this system is to make possible the information exchange between Smar programmer and the positioner, over digital communication using Hart® protocol. Modulates and demodulates digital information transmitted by Smar programmer on the current line. A "1" is represented by 1200 Hz and "0" by 2200 Hz. The frequency signal is symmetrical and does not affect the DC-level of the 4 - 20 mA signal.

Power Supply
The positioner circuit receives supply from a 4 - 20 mA power supply or takes power of Loop Line to power the positioner circuit that is limited to 3.8 mA to work properly.

Display Controller
Receives data from the CPU and controls the (LCD) Liquid Crystal Display.

Local Adjustment
Local adjustment is provided by means of two magnetically actuated switches with no external electric or mechanical contact, by using a magnetic screwdriver.

Piezo Flapper Nozzle
The unit flapper nozzle converts the movement of piezoelectric into a pneumatic signal to control pressure in the pilot chamber.

Restriction
The restriction and the nozzle form a pressure-divided circuit. Air is supplied to the nozzle through a restriction.

Spool
The spool ensures a quick valve positioning by providing a greater airflow than one provided by the restriction.
Pressure Sensors
Measure the pressures of air pressure supply, pressure at Output 1 and Output 2. Available for Hart® reading.

NOTE
The pressure sensor’s circuit board is optional. (See request code, session 6, K1 option).

Pressure Sensor Selector
Selects the sensor to be read from:
- **Sensor IN:** Measures air supply pressure.
- **Sensor OUT1:** Changes the pressure in output 1.
- **Sensor OUT2:** Changes the pressure in output 2.

![Figure 2.2 - FY301 Block Diagram](image)
The Local Indicator

The LCD-Local Indicator is required for signaling and for operation in local adjustment.

Normal Indicator

During normal operation, the FY301 remains in the monitoring mode and the display indicates the valve position, either as a percentage or as a current readout. The magnetic tool activates the local programming mode, by inserting it in orifice “Z” on the housing.

The possible configuration and monitoring operation are shown on figure 2.3.

Upon receiving power, the FY301 initializes the position indication on the display, by showing model FY301 and its software version (X.XX).

![Figure 2.3 - Local Indicator](image1)

Monitoring

During normal operation, FY301 remains in the monitoring mode. Figure 2.4 shows the positioning in percentage.

The display simultaneously shows readout and some other information.

Normal displaying is interrupted when the magnetic tool is placed in orifice “Z” (Local Adjustment), entering the programming mode local adjustment.

The above mentioned figure shows the result of tool insertion in orifices Z and S, which inform, respectively, movement and actuation of the selected options.

![Figure 2.4 - Typical Indicator](image2)
Section 3

CONFIGURATION

The FY301 Smart Valve Positioner is a digital instrument with the most up-to-date features a controlling device can possibly have. The Hart® digital communication protocol enables the instrument to be connected to a computer, in order to be configured in a very simple and complete way. Such computers connected to the positioners, are called host computers. They can be either primary or secondary masters. Even though Hart® is a master-slave type of protocol, it is possible to work with up to two masters in a bus. Usually, the primary host, plays the supervisory role and the secondary host plays the configurator role.

The positioners may be connected in a point-to-point or multidrop type network. In a point-to-point connection, the equipment's address must be "0". In a multidrop network, if the devices are recognized by their addresses, the positioners should be configured with a network address between "1" and "15". In this case, the positioners' output current is kept constant, at 4 mA each if the acknowledgement is via Tag, the positioners addresses may be "0", and even in a multidrop configuration.

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>In case of a multidrop network configuration for classified areas, the entity parameters allowed for the area shall be strictly observed. Therefore, the following shall be checked:</td>
</tr>
<tr>
<td>[ Ca \geq \sum C_{ij} + Cc \quad La \geq \sum L_{ij} + Lc ]</td>
</tr>
<tr>
<td>[ Voc \leq \min {V_{maxj}} \quad Isc \leq \min {I_{maxj}} ]</td>
</tr>
<tr>
<td>Where:</td>
</tr>
<tr>
<td>( Ca, La = ) Allowed capacitance and inductance on the bus</td>
</tr>
<tr>
<td>( C_{ij}, L_{ij} = ) Non protected internal capacitance/Inductance of positioner ( j ) (( j = ) up to 15)</td>
</tr>
<tr>
<td>( Cc, Lc = ) Cable capacitance and inductance</td>
</tr>
<tr>
<td>( V_{oc} = ) Barrier open circuit voltage</td>
</tr>
<tr>
<td>( Isc = ) Barrier short circuit current</td>
</tr>
<tr>
<td>( V_{maxj} = ) Maximum allowable voltage to be applied to the instrument ( j )</td>
</tr>
<tr>
<td>( I_{maxj} = ) Maximum allowable current to be applied to the instrument ( j )</td>
</tr>
</tbody>
</table>

The FY301 Smart Valve Positioner includes a very encompassing set of Hart® command functions that make it possible to access the functionality of what has been implemented. Such commands according to the Hart® protocol specifications, are grouped as universal commands, common practice controls commands and specific commands. A detailed description of such commands may be found in the manual entitled Hart® command specification - FY301 Smart Valve Positioner.

Smar developed two types of configurators for its Hart® devices: CONF401 configurator and HPC401 configurator. CONF401 supports Windows platform (95, 98, 2000, XP and NT) and UNIX. It provides a simple configuration, field device monitoring, and ability to analyze data and modify field device performance. The HPC401, is the most up-to-date technology in Palm platform Handheld portable computers.

The operation and use characteristics of each one of the configurators are in their specific manual.

The figures below show the front of the Palm based configurator and CONF401 screen with active advanced configuration.
Figure 3.1 - Smar Configurator

Figure 3.2 - CONF 401 Screen - Active Advanced Configuration
The TSO stands for "Tight Shut Off", which assure the valve is totally closed, avoiding leakage on the valve seat. If the TSO value is 5% the valve will only start moving from the close position (for instance) on 5% of the controller signal. The TSO D stands for "Tight Shut Off Deadband". When the value is 1%, the valve will start to move from the close position on 6%. On 4% the valve shall close totally.

**Configuration Resources**

By means of the Hart® Configurator, the FY301 firmware allows the following configuration features to be accessed:

- Positioner’s Identification and Manufacturing Data;
- Remote movement;
- Special characterization function according to a 16-point configurable curve;
- Flow characterization (Linear, equal percentage and quick opening);
- Monitoring of all device variables: input, setpoint, deviation and modulated output temperature;
- Diagnostic (Preventive maintenance);
- Positioner diagnostic and fail determination;
- PID Controller Configuration;
- Device Configuration;
- Device Maintenance.

The operations between the configurator and the positioner, do not interrupt the valve positioning, and do not disturb the positioner operation. The configurator can be connected to the same pair of wires as the 4-20 mA signal, up to 2 kilometers away from the positioner.

**Identification and Manufacturing Data**

The following information about the FY301 manufacturing and identification data is available:

- **TAG** - 8-character alphanumeric field for identification of the positioner.
- **DESCRIPTION** - 16-character alphanumeric field for additional identification of the positioner. May be used to identify service or location.
- **MESSAGE** - 32-character alphanumeric field for any other information, such as the name of the person who made the last calibration, some special care to be taken, or if a ladder is needed for physical access to the positioner.
- **DATE** - The date may be used to identify a relevant date, such as the last calibration, the next calibration or the installation. The date is presented in the American standard e.g. (Example: Oct 30, 2003) is automatically assumed after the choice of these items.
- **UNIQUE ID** - Used to identify the device and in construction of Hart® long address.
- **DEVICE INFORMATION** - This button allows to read device identification and data recorded in the factory.

**NOTE**

These information items cannot be modified. They are read directly from the circuit memory.

**Monitoring**

This function allows remote monitoring up to 4 different of positioner variables at the same time. The time to start the reading is around 5 seconds. The values are always updated. Altogether, 20 items could be monitored. These items are: valve actual position in percentage, input in percentage of adjusted current range (before the limits and flow linearization), input current in mA or %, device temperature in Celsius and in Fahrenheit degrees, etc..
Device Configuration

Besides the configuration services for equipment operation, the FY301 allows self-configuration. Services from this group are related to: write protection, security position, flow characterization function, local indication and table configuration.

✓ WRITE PROTECTION: The configurator only shows that the writing is authorized if the W2 jumper from main board is connected to the pins under the word DOWN.

✓ CHARACTERIZATION FUNCTION – It changes the valve flow characteristics. For example, if equal percentage flow characterization is applied to a valve with linear flow characteristics, it will work as an equal percentage valve. Manufacturer documentation contains the valve inherent characteristic. The options for applied flow characterization are:

<table>
<thead>
<tr>
<th>LINEAR</th>
<th>UNALTERED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal percentage</td>
<td>1:25</td>
</tr>
<tr>
<td>Equal percentage</td>
<td>1:33</td>
</tr>
<tr>
<td>Equal percentage</td>
<td>1:50</td>
</tr>
<tr>
<td>Quick opening</td>
<td>1:25 (Hyperbolic)</td>
</tr>
<tr>
<td>Quick opening</td>
<td>1:33 (Hyperbolic)</td>
</tr>
<tr>
<td>Quick opening</td>
<td>1:50 (Hyperbolic)</td>
</tr>
<tr>
<td>Table</td>
<td>16 pairs (X, Y)</td>
</tr>
</tbody>
</table>

✓ LOCAL INDICATIONS - The FY301 local indicator has three well-defined fields: information field with icons informing the active status of the configuration, 4 ½ numerical digit field to value indication and alphanumeric field with 5-digit for status information and units.

The FY301 accepts up to two local indicator configurations, showed with a 2 second pause between each one. The parameters that can be selected to visualization are showed below:

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV %</td>
<td>Process variable in percentage.</td>
</tr>
<tr>
<td>PV (mm)</td>
<td>Process variable in mm.</td>
</tr>
<tr>
<td>SP %</td>
<td>Setpoint in percentage.</td>
</tr>
<tr>
<td>SP(mm)</td>
<td>Setpoint in mm.</td>
</tr>
</tbody>
</table>

TABLE CONFIGURATION - Through the Table button, a flow characterization curve with up to 16 points can be configured. This allows the construction of a special flow characterization curve, like linear combinations and equal percentage or other characterizations.

![Table 3.1 - Valve Characteristic Curve](image-url)
Advanced Configuration

This function affects valve advanced configurations. With advanced configuration is possible to configure the valve type, if it is air-to-open or air-to-close, valve action, setpoint limits and split-range.

Device Maintenance

This group includes maintenance services, related to obtainment of necessary information to the device maintenance and performance test. Some of the available services are: position adjustment and valve performance test, general information about the actuator and the valve, operations count, password level, code number model and performance.

Trim

There are two trim operations: Current trim and Temperature trim. Current trim allows to calibrate the positioner input current reading and Temperature trim is the temperature reference to the positioner temperature sensor.

There are two current trims available:

- **4 mA TRIM**: is used to adjust the input current reading correspondent to 0%.
- **20 mA TRIM**: is used to adjust the input current reading correspondent to 100%.

Setup

This function allows to calibrate the value travel automatically (Auto Setup), the points of the totally opened or totally closed travel with higher precision (lower and higher position), to adjust the opening and closing times and the proportional and integral actions of PI control, the state of air supply, the magnet, the sensor Hall, setup and the piezo voltage conditions.

During the setup process, the local display, if installed, will show the setup progress, in which the positioner takes the following steps:

- **10%**: It opens or closes the valve, depending on the initial value of the piezo voltage;
- **20%**: The positioner checks if the flat cable is connected, or if the position sensor is working properly. In case of error, the message "HALL" will appear at local indicator;
- **30%**: The positioner checks whether the magnet is used linear or rotary valve;
- **40%**: At this point, the positioner opens or closes the valve, depending on the initial position. Case the spool is obstructed or if the positioner has no air supply, the message "FAIL MOVE" will appear in the local indicator.
- **50%**: At this moment, the positioner checks if the magnet is connected to the valve. If not, the message "MGNT" will appear in the local indicator;
- **60%**: The positioner places the valve to 50%. The setup process could remain at this step if the Kp value is low;
- **70%**: At this moment, the valve is close to 50%. The setup process could remain at this step, if the Kp value is high;
- **80%**: The positioner adjusts its internal references to place the valve in 50%. The setup process could remain at this step, if the Kp value is high;
- **90%**: The positioner checks if the magnet is correctly mounted (arrow in arrow). If not, the message "MGNT" will appear in the local indicator;
- **100%**: End of setup;

Multidrop Configuration

**ADDRESSING - FY301** contains a variable that define the device address in a Hart® network. Hart® addresses assume values from "0" to "15", the addresses "1" to "15" are specific addresses to multidrop connection. When **FY301** is configured to multidrop, it means that the local indicator is showing "MD" and the address is an value from "1" to "15".

**FY301** is factory configured with address "0".
Diagnostic

This function allows engineering unit configuration, the parameters for diagnostic purposes and shows positioner general conditions. See parameters:
- Dead zone (0 to 100%)
- Odometer Curse (mm/rad)
- Odometer Value Maximum (mm/rad)
- Engineering Unit (mm/rad or %)
- Dead zone Reversal (%)
- Reversal Limit (uni)

Backup

Data transference from transducer to main board must be done immediately after the assembly when there is a transducer or main board substitution.

This process is automatically done when the positioner is powered. If necessary, the user could force transference using the option Read from Sensor.

The option Write on Sensor could be used to record changes previously made, for example, in Kp, Tr, etc., in transducer memory. The previous values for Kp, Tr, etc. will be lost.

Pressure Sensor

This function allows pressure trim adjustment, to view applied pressure status and to configure positioner input pressure in order to activate the alarm via Hart® communication, in case the applied input pressures are not in accordance with configured values.

Factory

This option is used only in the factory, and the user cannot access it.
PROGRAMMING USING LOCAL ADJUSTMENT

Move Jumper “W1” to position “ON” to enable the local adjustment. This jumper is located on top of the main electronic circuit board.

There are two orifices on the positioner, under the nameplate, identified by “S” and “Z” respectively, which provide access to two magnetic switches actuated by means of a magnetic tool (Refer to Figure 4.1).

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>In this section the “Magnetic Tool” will be referred to as “TOOL”, and the orifices identified by “S” and “Z” will be “ORIFICE S” and “ORIFICE Z”, respectively.</td>
</tr>
</tbody>
</table>

**Figure 4.1 - Local Adjustment Orifices**

Table indicates the results for the actions on orifices “Z” and “S” in FY301.

<table>
<thead>
<tr>
<th>ORIFICE</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>Function browsing.</td>
</tr>
<tr>
<td>S</td>
<td>Selects the displayed function.</td>
</tr>
</tbody>
</table>

The digital display is required in order to show the programming performed via local adjustment.

**W1 and W2 Jumpers Connection**

**W1 Jumper connected in ON**
If W1 Jumper is connected in ON, adjustment local enabled, the parameters of the programming tree can be modified.

**W2 Jumper connected in DOWN**
With W2 Jumper connected in this mode, write protected, the positioner protects the configuration against improper modifications.

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing must be enabled during the configuration and after configuration must be disabled again.</td>
</tr>
</tbody>
</table>
Local Programming Tree

The programming tree is a tree shaped structure with a menu of all available software functions, as shown on figure 4.3.

While in local adjustment, it is possible to browse through all configuration options by keeping the magnetic tool in orifice “Z”. Upon choosing the option as described, place the tool in orifice “S” in order to actuate.

By keeping the tool in orifice “S” it is possible to continuously actuate the selected parameter, since this is a numeric value. Actions by increment are performed by repeatedly placing and removing the magnetic tool until reaching the desired valve.

NOTE

The user shall perform every parameter actuation judiciously, since actuation writes configuration parameters on a permanent basis and does not require confirmation. Once an actuation is performed it is assumed to be the desired configuration.
**Adjustable Parameters**

**TYPE - Valve Type**
This parameter enables the user to configure valve type as well as the type of action associate to the valve. These are the options:

- **Lind**: Linear and Direct;
- **Linr**: Linear and Reverse;
- **Rotd**: Rotary and Direct;
- **Rotr**: Rotary and Reverse.

**CHAR - Valve Characterization Curve**
This parameter allows the user to configure the type of valve characterization curve. Options are as follows:

- **Lin**: Linear;
- **EP50**: Equal Percentage 50%;
- **HY**: Hyperbolic.
- **Tab**: 16 points - table (Configurable).

**MODE - Operation Mode**
This parameter allows the user to choose operation mode. Upon turning the positioner on, it will always be in automatic mode, but it is possible to choose the operation mode. During operation there are the following options:

- **Auto - Automatic Mode**
  During automatic mode the positions is set in accordance with the input 4 to 20 mA current signal. While in automatic mode, local actuation in the SP% parameter is not allowed.
- **Man - Manual Mode**
  During manual mode the position is set in accordance with the SP% parameter value, independently from the input current. This is the only mode in which the SP% parameter can be actuated.

**SP % - Set Point**
This parameter represents the desired position value. While in "Manual" mode, it is possible to actuate this parameter remotely, independently from the input current. While in automatic, it is calculated from the input current level.

**LOPOS - Lower Position**
This parameter allows the lower position calibration as per the input current, usually 4 mA unless it is in split range operation. During calibration, notice if the control becomes saturated, that is, if the valve no longer moves in the desired direction. Should such a situation occur, the user shall actuate in the opposite direction to the valves movement. Calibration is performed in terms of percentage.

**UPPOS - Upper Position**
This parameter allows the upper position calibration as per the input current, usually 20 mA unless it is in split range operation. During calibration, notice if the control becomes saturated, that is, if the valve no longer moves in the desired direction. Should such a situation occur, the user shall actuate in the opposite direction to the valves movement. Calibration is performed in terms of percentage.

**TIME - Setpoint Variation Time**
This allows the configuration of the setpoint variation rate. The unit is expressed in seconds. It is adjustable in the following range: 1 to 60.

- TIME close to 60 causes the setpoint variation to be slower.
- TIME close to 1 causes the setpoint variation to be faster.

**KP - Proportional Gain**
This parameter makes it possible to adjust the servo control proportional gain. It is adjustable within the following range: 0.5 to 45.

- For linear valves, typical KP values are between 35 and 45.
- For rotary valves, typical KP values are around 8.

**TR - Integral Time**
This parameter makes possible to adjust the servo control integral time. It is adjustable within the following range: 0 to 999 minutes/repetition.

- For linear valves, typical TR values are around 2 minutes/repetition.
- For rotary valves, typical TR values are around 8 minutes/repetition.
Setup - Auto Positioning
After configuring the valve type by means of parameter TYPE, the AUTO SETUP parameter shall be actuated. During the adjustment procedure the positioner will be in a state of auto positioning and the message "SETUP" will be flashing on the display. During this process the control parameters are determined and the 0% and 100% trim is performed. This operation lasts approximately 4 minutes.
While configuring the valve type as described above, the user shall browse up to parameter SETUP (tool in orifice Z) and place the tool in orifice S in order to initiate the previous auto positioning of the valve.

Air to Close / Air to Open (AIR_T)
This option configures the air pressure effect on the positioner.
If the positioner operates in "direct action":
- It should be configured for AIR_OPEN, if the air is to open the valve
- It should be configured for AIR_CLOSED, if the air is to close the valve
In case the positioner is operating in "reverse action":
- It should be configured for AIR_OPEN, if the air is to close the valve
- It should be configured for AIR_CLOSED, if the air is to open the valve

Procedure for Valve Calibration

STEP 1
Select valve type by means of the menu TYPE, browsing at least once through the options (Lind, Linr, Rotd, and Rotr).

STEP 2
Setup
In order to start self-calibration, browse up to the parameter SETUP and insert the tool in S.

NOTE
In most cases, steps 1 and 2 are sufficient to provide a good calibration.

STEP 3
Set the KP so as to lower the value overshoot (the overshoot will require adjustment after the TIME as adjusted). The lower the KP is, the lower the overshoot will be, but valve positioning will be slower. Set TR in a value where the position does not oscillate and control is capable of quickly reaching the final position.

STEP 4
Time Adjustment (TIME)
Perform TIME adjustment for quick valves in order to increase the time and decrease the overshoot.

STEP 5
Zero Adjustment by means of LOPOS (Lower Position)
At this moment, current shall be in the position which corresponds to 0% as, for example, 4 mA. A more practical way of performing this adjustment is to place the tool in orifice S, thus allowing the parameter to be continually actuated (increased or decreased). Upon noticing the valve action around the desired point, remove the tool from orifice S and slowly change its value on an increment by increment basis, that is, by repeatedly placing and removing the tool in orifice S until reaching the desired point. At a certain point, it is more convenient to perform the adjustment on an increment by increment basis so as to avoid the risk of exceeding beyond the desired value.

STEP 6
Span Adjustment by means of UPPOS (Upper Position)
At this moment, current shall be in the position which corresponds to 100% as, for example, 20 mA. The procedure is similar to the one described for zero adjustment.

STEP 7
Air to Close / Air to Open (AIR_T)
This option configures the air pressure effect on the positioner.
If the positioner operates in "direct action":
- It should be configured for AIR_OPEN, if the air is to open the valve.
- It should be configured for AIR_CLOSED, if the air is to close the valve.
In case the positioner is operating in "reverse action":
- It should be configured for AIR_OPEN, if the air is to close the valve.
- It should be configured for AIR_CLOSED, if the air is to open the valve.
Section 5

MAINTENANCE PROCEDURES

General Information

**NOTE**

Equipment installed in hazardous atmospheres must be inspected in compliance with the IEC60079-17 standard.

FY301 Valve Positioners are extensively tested and inspected before delivered to the end user. Nevertheless, during their design and development, consideration was given to the possibility of repairs by the end user, if necessary.

In general, it is recommended that the end user do not try to repair printed circuit boards. Instead, he should have spare circuit boards, which may be ordered from Smar whenever necessary.

The maintenance procedure is a set of techniques with the purpose to keep the positioners with higher time of use (useful life), to operate in safe conditions and to promote costs reduction. The different maintenance types are described during this section.

**Recommendations for mounting Approved Equipments with the IP66 W certifications (use in saline atmospheres)**

**NOTE**

This certification is valid for stainless steel positioners manufactured, approved with the certification IP66 W. All positioner external material, such as gauge, plugs, connections etc., should be made in stainless steel.

The electrical connection with 1/2” – 14NPT thread must use a sealant. A non-hardening silicone sealant is recommended.

The instrument modification or replacement parts supplied by other than authorized representative of Smar is prohibited and will void the certification.

**Corrective Maintenance for the Positioner**

Maintenance not planned, with the purpose to locate and to repair problems in the positioners operating in continuous work, or either, specifically to suppress defects already presented by the equipment.

The diagnostic are a set of methods to detect, to locate and eventually to correct errors and problems or even verify fail effects in the positioner.

**Diagnostics without Configurator**

In order to carry out the diagnostics, refer to table 5.1.

<table>
<thead>
<tr>
<th>DIAGNOSTICS</th>
<th>SYMPTOM</th>
<th>PROBABLE ERROR SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>POSITION SHOWN ON DISPLAY</td>
<td>Positioner Connections</td>
<td>Check wiring polarity and continuity.</td>
</tr>
<tr>
<td></td>
<td>Power Supply must be a current source</td>
<td>Check signal input current. Minimum current for positioner operation is 3.8 mA.</td>
</tr>
<tr>
<td></td>
<td>Electronics Failure</td>
<td>Check circuit boards for bad connections and replace them for spare boards.</td>
</tr>
<tr>
<td>NO RESPONSE TO INPUT SIGNAL</td>
<td>Pressure Output Connections</td>
<td>Check up on air leaks.</td>
</tr>
<tr>
<td></td>
<td>Air Supply Pressure</td>
<td>Check the air supply pressure. The input pressure to positioner shall be between 20 psi and 100 psi.</td>
</tr>
<tr>
<td></td>
<td>Calibration</td>
<td>Check the positioner calibration points.</td>
</tr>
</tbody>
</table>
5.2

**Table 5.1 - FY301 Diagnostics without the Configurator**

### Diagnostic with Configurator

If the positioner is on and with the communication circuit and the processing unit working, the configurator can be used for diagnostic, in case of problems with the positioner. The configurator should be connected to the positioner according to the wiring diagrams show on Section 1.

### Error Messages

The error messages inform the diagnostic through the self diagnostic of errors and malfunctioning. When the configurator is communicating with the positioner, the user is informed on any problem found, through the self diagnostic. At the **FY301** positioner, the error messages always alternate with the information on the top line of the configurator’s display. Table 5.2 lists the error messages and more details on corrective action.

<table>
<thead>
<tr>
<th>ERROR MESSAGES</th>
<th>POTENTIAL SOURCE OF PROBLEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>PARITY ERROR</td>
<td>- The line resistance is not according to the technical characteristics.</td>
</tr>
<tr>
<td></td>
<td>- Excessive noise or ripple.</td>
</tr>
<tr>
<td>OVERRUN ERROR</td>
<td>- Low level signal.</td>
</tr>
<tr>
<td>CHECK SUM ERROR</td>
<td>- Interface damaged.</td>
</tr>
<tr>
<td>FRAMING ERROR</td>
<td>- Power supply or battery voltage of the configurator lower than 9 V.</td>
</tr>
<tr>
<td>NO RESPONSE</td>
<td>- Positioner line resistance is not according to technical characteristics.</td>
</tr>
<tr>
<td></td>
<td>- Positioner not powered.</td>
</tr>
<tr>
<td></td>
<td>- Positioner not connected or damaged.</td>
</tr>
<tr>
<td></td>
<td>- Positioner configured in multidrop mode being accessed by ON LINE SINGLE UNIT.</td>
</tr>
<tr>
<td></td>
<td>- Positioner reversibly powered (polarity is reversed).</td>
</tr>
<tr>
<td></td>
<td>- Interface damaged.</td>
</tr>
<tr>
<td></td>
<td>- Power supply or battery voltage of the configurator lower than 9 V.</td>
</tr>
<tr>
<td>LINE BUSY</td>
<td>- Other device using the line.</td>
</tr>
<tr>
<td>CMD NOT IMPLEMENTED</td>
<td>- Software version not compatible between configurator and positioner.</td>
</tr>
<tr>
<td>DEVICE BUSY</td>
<td>- Positioner carrying out an important task, e.g., local adjustment.</td>
</tr>
<tr>
<td>POSITIONER MALFUNCTION</td>
<td>- Voltage to pressure transducer disconnected.</td>
</tr>
<tr>
<td></td>
<td>- Voltage to pressure transducer failure.</td>
</tr>
<tr>
<td>COLD START</td>
<td>- Start-up or reset due to power supply failure.</td>
</tr>
<tr>
<td>OUTPUT FIXED</td>
<td>- Operating in local mode with fix position.</td>
</tr>
<tr>
<td></td>
<td>- Connected in burnout.</td>
</tr>
<tr>
<td>OUTPUT SATURATED</td>
<td>- Position out of calibrated span or in fail-safe (Output current in 3.9 or 21 mA).</td>
</tr>
<tr>
<td>2 OUT OF LIMITS</td>
<td>- Temperature out of operating limits.</td>
</tr>
<tr>
<td></td>
<td>- Temperature sensor damaged.</td>
</tr>
<tr>
<td>1 OUT OF LIMITS</td>
<td>- Position out of operation valve range.</td>
</tr>
<tr>
<td></td>
<td>- Voltage to pressure transducer damaged or not connected.</td>
</tr>
<tr>
<td></td>
<td>- Positioner with error configuration.</td>
</tr>
<tr>
<td>LOWER RANGE VALUE TOO HIGH</td>
<td>- The lower range value &gt; (Upper limit of minimum span range).</td>
</tr>
<tr>
<td>LOWER RANGE VALUE TOO LOW</td>
<td>- The lower range value &lt; (Upper limit of range).</td>
</tr>
<tr>
<td>UPPER RANGE VALUE TOO HIGH</td>
<td>- The upper range value &gt; 110 % x (Upper limit of range).</td>
</tr>
<tr>
<td>UPPER RANGE VALUE TOO LOW</td>
<td>- The upper range value &lt; - 10 % (Lower limit of range).</td>
</tr>
</tbody>
</table>
### Table 5.2 – FY301 Diagnostics with the Configurator

<table>
<thead>
<tr>
<th>ERROR MESSAGES</th>
<th>POTENTIAL SOURCE OF PROBLEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPPER AND LOWER RANGE VALUES OUT OF LIMITS</td>
<td>- Both the upper and lower points are outside the positioner range limit.</td>
</tr>
<tr>
<td>SPAN TOO SMALL</td>
<td>- The difference, between the upper and lower points, is less than the allowed by the positioner.</td>
</tr>
<tr>
<td>ACTUAL POSITION</td>
<td>- The actual valve position was above of the upper range limit.</td>
</tr>
<tr>
<td>ACTUAL POSITION</td>
<td>- The actual valve position was below of the lower range limit.</td>
</tr>
<tr>
<td>PASSED PARAMETER TOO LARGE</td>
<td>- Parameter above operating limits.</td>
</tr>
<tr>
<td>PASSED PARAMETER TOO SMALL</td>
<td>- Parameter below operating limits.</td>
</tr>
<tr>
<td>CONTROL LOOP SHOULD BE IN MANUAL</td>
<td>- Indicates that the operation could affect the output.</td>
</tr>
<tr>
<td>CONTROL LOOP MAY BE RETURNED TO AUTO</td>
<td>- After the operation is complete, you are reminded to return the loop to automatic control.</td>
</tr>
</tbody>
</table>

### Disassembly Procedure for Maintenance

1. Apply air pressure in the positioner input, without applying power supply. Verify if there is any air leakage in output 1 (OUT1). In case of air leakage in output 1, it is necessary to check the mechanical parts.

2. Remove the restriction. Verify if the restriction is not obstructed. (See restriction cleaning procedure).

3. Disassemble the equipment as shown:

![Disassembled FY301](image)

### Maintenance – Mechanical Parts

1. Verify if the spool valve is moving freely.

2. Verify if the spool valve is not obstructed with dirty.

3. Verify if there is any obstruction inside the FY pneumatic block and at the exhausts.

4. Verify if the diaphragm integrity.

5. Verify if the nozzle is dirty.

### Maintenance – Electronic Parts

#### Electronic Circuit

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>The numbers indicated between parentheses refer to Figure 5.4 – Exploded View.</td>
</tr>
</tbody>
</table>

To remove the plate of the circuit (5) and the indicator (4), first release the cover locking bolt (6) from the side not marked “Field Terminals”, and after that release the cover (1).
ATTENTION
The circuit boards have CMOS components that can be damaged by electrostatic discharges. Verify the correct procedures to manipulate CMOS components. Also it is recommended to store the circuit boards in packs with electrostatic load proof.

Release the two screws (3) that fix the main board circuit and the indicator. Pull out the indicator, then the main board (5).

Verify the firmware version; must be version 2.12, 2.13 or higher. Mount the equipment; apply pressure supply of 30 PSI and power on the equipment. If the equipment does not initialize and the display does not light on, proceed to the following steps:

1. Disconnect the analog board from the digital board (17);
2. Case the equipment initializes, replace the analog circuit board (18 - part number 400-0060) or the analog circuit board for pressure sensors, if this replacement does not solve the problem, it is necessary to replace the main circuit board (5 - part number 209-0320).

Perform the auto-setup. After the setup, verify if the positioner is working properly. For that, apply 12mA input and be sure that the valve goes to the position correspondent to the 50% travel. If it does not occur, do the following:

1. Connect the Smar configurator to the input electric wires; select "Monitoring" option on the menu screen;
2. Apply 4 mA and verify through the configurator if SP% is equal to 0%;
3. Apply 20 mA and verify through the configurator if SP% is equal to 100%;
4. If the values above were different, execute the 4 mA and 20 mA current trim;
5. Verify the Hall position sensor reading through the configurator. Apply pressure directly to the valve actuator and verify if there is change in the Hall position sensor reading (18 - part number 400-0840), (65000 means that the position sensor is not being read) and the defect can be at the analog circuit board or analog circuit board for pressure sensors (18 - part number 400-0060) or the position sensor set (35 - part number 400-0090); replace the boards and perform the step 2 through step 4 again;
6. Verify the piezo voltage at the configurator;
7. The piezo voltage value must be between 30 and 70 Volts.

To verify the Hall position sensor value and the piezo voltage, do the following:

1. Set the valve in 50% travel;
2. With the configurator, go to the "monitoring" mode and choose two parameters: Hall value and piezo voltage;
3. The piezo voltage values must be the most closed possible to 26000 to 38000;
4. The piezo voltage values must be between 30 and 70 Volts. If the voltage is not between these values, proceed with the piezo calibration by using the FYCAL calibration device (check at www.smar.com for more details on the FYCAL).

Preventive Maintenance for the Positioner
Planned Maintenance, consists in the set of procedures and anticipated actions to keep the device functioning, is effectuate with the special objective to prevent the occurrence of fail. Through adjustments, proves and measures according to the specified values, made before the appearing of defects. The preventive maintenance is recommended in the maximum period of one year, or when the process stops.

Disassembly Procedure
Voltage to Pressure Transducer
To remove the transducer from the electronic housing, the electrical connections (in the field terminal side) and the main board connector must be disconnected.

Loosen the hex screw (6) and carefully unscrew the electronic housing from the transducer, observing that the flat cable is not excessively twisted.
CAUTION

Do not rotate the electronic housing more than 270° without disconnecting the electronic circuit from the power supply.

---

**Figure 5.2 – Transducer Rotation**

---

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>The numbers indicated between parentheses refer to Figure 5.4 – Exploded View.</td>
</tr>
</tbody>
</table>

1. Remove the flat cable cover (17) by releasing the Allen screws (15). When removing this cover (17), take care to do not damage the internal board: disassembly it with care. (This part can not be washed);

2. Remove the analog board (18);

3. Remove the electric piezo base (24) (This part can not be washed);

4. Remove the restriction (20) for cleaning;

5. Remove the intermediate set (27) and check the diaphragms integrity; if necessary, clean the diaphragms with water and neutral detergent; after that, wash them with alcohol, dry before mounting;

6. Remove the spool valve (29); the cleaning is made with water and neutral detergent; after that, wash it with alcohol, dry before mounting. Do not use lubricant of any kind in this part;

7. The pneumatic block (31) can be completely washed with water and neutral detergent, after that, wash it with alcohol and verify if it is completely clean, without dust or any kind of impurity. For that, apply dry compressed air in all block orifices;

8. Verify if the position sensor cover (33) does not have indication of water or humidity. (This part can not be washed);

9. Verify if the position sensor flat cable is damaged, twisted, cut or oxidate.

**Piezo Electric Calibration - FYCAL**

To mount the positioner:

1. Mount the piezoelectric base (24) on the jig;

2. Apply 20 psi at the air pressure input;

3. Apply 0 Volts, then 100 Volts DC and after 0 Volts again (to avoid hysteresis error);

4. Apply 50 Volts DC to the piezoelectric base;
5. Verify the pilot chamber pressure measured in the correspondent FYCAL gauge. The pressure must be between 5.8 and 6.2 psi. In case it is different, make the adjustment rotating the superior disc of piezoelectric base set;

6. Once reached the previous adjustment, apply 0 Volts again and verify that the pressure in the pilot chamber must be between 2 psi. After that, apply 100 Volts and verify that the pressure must be between 12 and 13 psi;

7. Apply 50 Volts AC to the piezoelectric base. Verify the pilot chamber pressure measured in manometer, it must be between 5.8 and 6.2 psi. In case it is different, make the adjustment again and rotating the superior disc of piezoelectric base set and repeating the procedure, to reach the specified values.

8. When these values are reached, the piezoelectric base calibrated;

9. After the piezoelectric base calibration, proceed with the positioner final checking;

10. Re-assembly all positioner set with the calibrated piezoelectric base;

11. Execute the auto-setup for the positioner;

12. If the piezoelectric base voltage is not at indicated range, it means that the piezoelectric base needs a new calibration or it needs to be replaced.

**Restriction Cleaning Procedure**

The air flows to the nozzle through a restriction. Verify the restriction cleaning from time to time to assure a positioner good performance.

1. Be sure that the air supply is not pressurizing the equipment.

2. With an appropriate tool, remove the transducer serial number plate. (New models have the plate placed on the opposite side of the transducer).

3. Remove the restriction screw using an adequate tool;
4. Remove the o-ring’s with an appropriate tool;

5. Dive the part in petroleum base solvent and dry it with dry compressed air (apply the compressed air directly in the smaller orifice for the air to get out through the bigger orifice).

6. Introduce the appropriate tool (PN 400-0726) into the restriction orifice to prevent any possible obstruction;

7. Mount the o-rings again and screw the restriction in the positioner.

8. Apply instrument air into the equipment and it shall work normally.

Change of the Filter Elements

Replace the positioner filter elements (28 - part number 400-0655) with a minimum stated period of 1 (one) year.

The instrument air supply must be clean, dry and non-corrosive, following standards indicated for the American National Standard "Quality Standard for Instrument Air" - (ANSI/ISA S7.0.01 - 1996).

If the instrument air does not comply with the above mentioned standards, the user has to consider replacing the positioner filter elements more frequently.

Exhausts Ports

Air is vented to the atmosphere through the two exhausts ports located behind the transducer nameplate and 4 output of the opposite side from gage. Any strange object interfering or blocking the exhaust port may degrade the positioner performance. Clean the exhausts periodically by spraying it with a solvent.

<table>
<thead>
<tr>
<th>ATTENTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never use oil or grease in the spool valve; lubricants may degrade the positioner performance.</td>
</tr>
</tbody>
</table>
**Electronic Circuit**

Plug transducer connector and power supply connector to main board (5). Attach the display to the main board. Observe the four possible mounting positions (Figure 5.2). The ▲ mark on the display indicates up position.

![Figure 5.3 – Four Possible Positions for Local Indicator](image)

Anchor the main board and indicator with their screws (3). After tightening the protective cover (1), mounting procedure is complete. The positioner is ready for powering and testing.

**Electrical Connections**

The plug must obligatorily be installed in the electric connection not used, preventing the humidity entrance.

**Package Content**

When receiving the equipment, verify the package content. The number for items marked with (*) must be in accordance with the number of positioners delivered.

Positioner
- Adequate mounting brackets
  - For the positioner
  - For the magnet
- Magnetic tool for local adjustment (*)
- Centralizer transmitter device (*)
- Cleaning device for the restriction (*)
- Operation, maintenance and instructions manual (*)
Figure 5.4 – Exploded View
## Accessories

<table>
<thead>
<tr>
<th>ORDERING CODE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD-1</td>
<td>Magnetic tool for local adjustment.</td>
</tr>
<tr>
<td>HPC401*</td>
<td>Hart® HPI311-M5P for the PalmOS platform, including the configuration package for the Smar and generic transmitters.</td>
</tr>
<tr>
<td>HPI311-M5P*</td>
<td>Just the Hart® interface.</td>
</tr>
<tr>
<td>400-0726</td>
<td>Needle cleaning device for the restriction.</td>
</tr>
</tbody>
</table>

* For equipment updates and HPC401 software, just check: http://www.smarresearch.com.

## Spare Parts List

<table>
<thead>
<tr>
<th>SPARE PARTS LIST</th>
<th>PARTS DESCRIPTION</th>
<th>POSITION</th>
<th>CODE</th>
<th>CATEGORY</th>
<th>NOTE (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HOUSING (NOTE 1)</td>
<td>8</td>
<td>400-1314-3 (NOTE 6)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>COVER (INCLUDES O-RING)</td>
<td>1 and 13</td>
<td>400-1307 (NOTE 6)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cover Locking Bolt</td>
<td>6</td>
<td>204-0120</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sensor Locking Bolt (M6 Without Head Screw)</td>
<td>7</td>
<td>400-1121</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>External Ground Bolt</td>
<td>14</td>
<td>204-0124</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Identification Plate Fixing Bolt</td>
<td>9</td>
<td>204-0116</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Orings Cover (NOTE 2)</td>
<td>2</td>
<td>204-0122</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Local Adjustment Protection Cover</td>
<td>10</td>
<td>204-0114</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DIGITAL INDICATOR GLL1438 (for old electronic main board GLL1011)</td>
<td>4</td>
<td>400-1305</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DIGITAL INDICATOR (for new main boards GLL1443 and 1451)</td>
<td>4</td>
<td>400-1310</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TERMINAL INSULATOR</td>
<td>11</td>
<td>400-0058</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TERMINAL INSULATOR FOR 4-20mA POSITION FEEDBACK (packaged with 6 units) (NOTE 7)</td>
<td>12</td>
<td>400-1329</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MAIN ELECTRONIC CIRCUIT BOARD (include digital indicator and mounting kit)</td>
<td>15, 16 and 17</td>
<td>400-1320 (NOTE 6)</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TERMINAL HOLDING BOLT HOUSING</td>
<td>18</td>
<td>400-0060</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MOUNTING KIT FOR MAIN ELECTRONIC BOARD (new boards GLL1443 and 1451), (2 bolts with spacers and retention washers)</td>
<td>19, 20, 21, 22, 23, 24 and 25</td>
<td>400-1318 (NOTE 6)</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ANALOG BOARD without Pressure Sensor GLL1012 (version K0)</td>
<td>19</td>
<td>400-0085</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ANALOG BOARD for Pressure Sensor GLL1204 (version K1)</td>
<td>20</td>
<td>344-0165</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ANALOG BOARD for Position Feedback GLL1456 (version K2)</td>
<td>21</td>
<td>344-0155</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PIEZO BASE SET</td>
<td>22</td>
<td>344-0150</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ASSEMBLED DIAPHRAGM (include hall tube, mechanical part and O-rings)</td>
<td>23</td>
<td>400-0033</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>. Analog indicator (Gage - Stainless Steel and Brass) (NOTE 5)</td>
<td>24</td>
<td>400-1120</td>
<td>B</td>
<td></td>
</tr>
</tbody>
</table>

5.10
### SPARE PARTS LIST

<table>
<thead>
<tr>
<th>PARTS DESCRIPTION</th>
<th>POSITION</th>
<th>CODE</th>
<th>CATEGORY (NOTE 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNEUMATIC BLOCK SET</td>
<td>19,23,25,28,29,30,31 and 32</td>
<td>400-1317 (NOTE 6)</td>
<td>A</td>
</tr>
<tr>
<td>. Base &amp; Block O-ring (NOTE 2)</td>
<td>19</td>
<td>400-0085</td>
<td>-</td>
</tr>
<tr>
<td>. Synthesized Bushing</td>
<td>23</td>
<td>400-0033</td>
<td>-</td>
</tr>
<tr>
<td>. Analog indicator (Gage - Stainless Steel and Brass) (NOTE 5)</td>
<td>25</td>
<td>400-1120</td>
<td>-</td>
</tr>
<tr>
<td>. Filtering Element</td>
<td>28</td>
<td>400-0655</td>
<td>-</td>
</tr>
<tr>
<td>. Spool valve</td>
<td>29</td>
<td>400-0653</td>
<td>A</td>
</tr>
<tr>
<td>. Spool valve Spring</td>
<td>40</td>
<td>400-0787</td>
<td>-</td>
</tr>
<tr>
<td>. Stainless steel Filter- 1/4&quot; NPT - includes filtering element</td>
<td>30</td>
<td>400-1383</td>
<td>-</td>
</tr>
<tr>
<td>. Vent Plug - Stainless Steel</td>
<td>32</td>
<td>400-0654</td>
<td>-</td>
</tr>
<tr>
<td>HALL COVER SET</td>
<td>33 (or 36), 34 and 35</td>
<td>400-1319 (NOTE 6)</td>
<td>-</td>
</tr>
<tr>
<td>. Hall Cover Bolt</td>
<td>34</td>
<td>400-0092</td>
<td>-</td>
</tr>
<tr>
<td>. Hall Support + Hall Sensor + Flat cable</td>
<td>35</td>
<td>400-0090</td>
<td>-</td>
</tr>
<tr>
<td>REMOTE EXTENSION SET</td>
<td>38</td>
<td>400-1322 (NOTE 6)</td>
<td>-</td>
</tr>
<tr>
<td>CABLE SET + CONNECTOR</td>
<td>37</td>
<td>400-1325 (NOTE 6)</td>
<td>-</td>
</tr>
<tr>
<td>1/2&quot; NPT (Ex d) INTERNAL SOCKET SET PLUG IN BICHROMATIZED CARBON STEEL</td>
<td>39</td>
<td>400-0808</td>
<td>-</td>
</tr>
<tr>
<td>1/2&quot; NPT (Ex d) INTERNAL SOCKET SET PLUG IN 304 SST</td>
<td>39</td>
<td>400-0809</td>
<td>-</td>
</tr>
<tr>
<td>1/2&quot; NPT INTERNAL SOCKET SET PLUG IN BICHROMATIZED CARBON STEEL</td>
<td>39</td>
<td>400-0583-11</td>
<td>-</td>
</tr>
<tr>
<td>1/2&quot; NPT INTERNAL SOCKET SET PLUG IN 304 SST</td>
<td>39</td>
<td>400-0583-12</td>
<td>-</td>
</tr>
<tr>
<td>M20 X 1.5 (Ex d) EXTERNAL SOCKET SET PLUG IN 316 SST</td>
<td>39</td>
<td>400-0810</td>
<td>-</td>
</tr>
<tr>
<td>PG13.5 (Ex d) EXTERNAL SOCKET SET PLUG IN 316 SST</td>
<td>39</td>
<td>400-0811</td>
<td>-</td>
</tr>
<tr>
<td>3/4&quot; NPT (Ex d) ADAPTER IN 316 SST</td>
<td>39</td>
<td>400-0812</td>
<td>-</td>
</tr>
<tr>
<td>TRANSDUCER SET</td>
<td>400-1316 (NOTE 6)</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>MAGNETS</td>
<td>400-0748</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>. Linear magnet 30mm</td>
<td>400-0035</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>. Linear magnet 50mm</td>
<td>400-0036</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>. Linear magnet 100mm</td>
<td>400-0037</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>MOUNTING BRACKET SCREW FOR POSITIONER ASSEMBLY (packaged with 12 units)</td>
<td>400-1190</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

**Note**

1) Includes terminal isolator, bolts (cover locking, ground and terminal isolator) and identification plate without certification.
2) O-rings are packaged with 12 units.
3) Includes all transducer's spare parts.
4) For category A it is recommended to keep in stock 25 parts installed for each set and 50 for category B.
5) The pressure gauges for supply pressure, output 1 or output 2, will be supplied with the wet parts in brass.
6) For code detailed, use the tables below.
7) Use only with K2 Positioner version.
**Detailed Code When Ordering of Spare Parts**

<table>
<thead>
<tr>
<th>CODE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>400-1314-3</td>
<td>HOUSING; FY301</td>
</tr>
</tbody>
</table>

**Option | Communication Protocol**

| H | Hart & 4-20 mA |
| R | Hart & 4-20 mA + Position Feedback |

**Option | Electrical Connection**

| 0 | ½ NPT |
| A | M20 X 1,5 |
| B | PG13,5 |

**Option | Material**

| H0 | Aluminum (IP/Type) |
| H1 | Stainless Steel (IP/Type) |
| H2 | Aluminum - for saline atmospheres (IPW/Type X) |
| H4 | Aluminum Copper Free (IPW/Type X) |

**Option | Painting**

| P0 | Gray Munsell N 6,5 |
| P8 | Without Painting |
| P9 | Safety Blue Epoxy - Electrostatic Painting |

**Typical Ordering Code**

* Choose the desired option

---

<table>
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<th>CODE</th>
<th>DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>400-1307</td>
<td>Cover</td>
</tr>
</tbody>
</table>

**Option | Type**

| 0 | Without window for display |
| 1 | With window for display |

**Option | Material**

| H0 | Aluminum (IP/TYPE) |
| H1 | Stainless Steel (IP/TYPE) |

**Option | Painting**

| P0 | Gray Munsell N 6,5 |
| P8 | Without Painting |
| P9 | Safety Blue Epoxy - Electrostatic Painting |

**Typical Ordering Code**

* Choose the desired option.
## DETAILED CODE WHEN ORDERING OF SPARE PARTS

<table>
<thead>
<tr>
<th>CODE</th>
<th>DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>400-1316</td>
<td><strong>Transducer Set; FY30X</strong></td>
</tr>
</tbody>
</table>

**Option Indication Gage**
- 0: Without Gage
- 6: 01 Gage - Input
- 7: 01 Gage – Output 1
- 8: 02 Gage – Input and Output 1
- 9: 02 Gage – Output 1 and 2
- A: 03 Gage

**Option Action of Positioner**
- C: Single Action
- D: Double Action

**Option Material**
- H0: Aluminum (IP/TYP)
- H1: Stainless Steel (IP/TYP)

**Option Painting**
- P0: Gray Munsell N 6,5
- P8: Without Painting
- P9: Safety Blue Epoxy - Electrostatic Painting

**Option Standard of Manufacture**
- S0: Smar

**Option Hall Remote Sensor**
- R0: Standard Mounting (Without Hall Remote Sensor)
- R9: Remote Mounting (adapted for Remote Sensor)

**Option Special Sensor**
- K0: Without Special Sensor (compatible w/ main board until version 4)
- K1: With Pressure Sensors for Diagnostic (compatible w/ main board until version 3)
- K2: With 4-20mA Position Feedback (compatible w/ main board version 5)

*Choose the desired option.*

## DETAILED CODE WHEN ORDERING OF SPARE PARTS

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<th>CODE</th>
<th>DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>400-1317</td>
<td><strong>Pneumatic Block Set; FY30X</strong></td>
</tr>
</tbody>
</table>

**Option Indication Gage**
- 0: Without Gage
- 7: 01 Gage – Output 1
- 9: 02 Gage – Output 1 and 2

**Option Action of Positioner**
- C: Single Action
- D: Double Action

**Option Material**
- H0: Aluminum (IP/TYP)
- H1: Stainless Steel (IP/TYP)

**Option Painting**
- P0: Gray Munsell N 6,5
- P8: Without Painting
- P9: Safety Blue Epoxy - Electrostatic Painting

**Option Standard of Manufacture**
- S0: Smar

**Option Special Sensor**
- K0: Without Special Sensor
- K1: With Pressure Sensor for Diagnostic (compatible w/ main board version 3, besides analog board GLL1204)

*Choose the desired option.*

---

TYPICAL ORDERING CODE

* Choose the desired option.
### DETAILED CODE WHEN ORDERING OF SPARE PARTS

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<tbody>
<tr>
<td><strong>400-1318</strong></td>
<td>Piæzo Base Set; FY30X</td>
<td><strong>Option Indication Gage</strong></td>
<td><strong>Option Material</strong></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 Without Gage</td>
<td>H0 Aluminum (IP/TYPE)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>6 01 Gage – Input</td>
<td>H1 Stainless Steel (IP/TYPE)</td>
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<td></td>
</tr>
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<td></td>
<td></td>
<td><strong>Option Painting</strong></td>
<td></td>
<td>P0 Gray Munsell N 6,5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P8 Without Painting</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P9 Safety Blue Epoxy - Electrostatic Painting</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td><strong>Option Standard of Manufacture</strong></td>
<td></td>
<td>S0 Smar</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Option Hall Remote Sensor</strong></td>
<td></td>
<td>R0 Standard Mounting (Without Hall Remote Sensor)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R9 Remote Mounting (adapted for Remote Sensor)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td><strong>Option Special Sensor</strong></td>
<td></td>
<td>KA For Pneumatic Block without Pressure Sensors</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>KB For Pneumatic Block with Pressure Sensors</td>
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* Choose the desired option.

### TYPICAL ORDERING CODE

### DETAILED CODE WHEN ORDERING OF SPARE PARTS

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<td><strong>Option Material</strong></td>
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<tr>
<td></td>
<td></td>
<td>H0 Aluminum (IP/TYPE)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>H1 Stainless Steel (IP/TYPE)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Option Painting</strong></td>
<td></td>
<td>P0 Gray Munsell N 6,5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P8 Without Painting</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P9 Safety Blue Epoxy - Electrostatic Painting</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Option Standard of Manufacture</strong></td>
<td></td>
<td>S0 Smar</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Option Hall Remote Sensor</strong></td>
<td></td>
<td>R0 Standard Mounting (Without Hall Remote Sensor)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R9 Remote Mounting (adapted for Remote Sensor)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td><strong>Option Special Sensor</strong></td>
<td></td>
<td>KA For Pneumatic Block without Pressure Sensors</td>
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<td></td>
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<td></td>
<td>KB For Pneumatic Block with Pressure Sensors</td>
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* Choose the desired option.

### TYPICAL ORDERING CODE

### DETAILED CODE WHEN ORDERING OF SPARE PARTS

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<tr>
<td><strong>400-1320</strong></td>
<td>Connection Cover; FY30X</td>
<td><strong>Option Material</strong></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>H0 Aluminum (IP/TYPE)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>H1 Stainless Steel (IP/TYPE)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td><strong>Option Painting</strong></td>
<td></td>
<td>P0 Gray Munsell N 6,5</td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>P8 Without Painting</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P9 Safety Blue Epoxy - Electrostatic Painting</td>
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<td></td>
<td><strong>Option Standard of Manufacture</strong></td>
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<td>S0 Smar</td>
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* Choose the desired option.

### TYPICAL ORDERING CODE
### DETAILED CODE WHEN ORDERING OF SPARE PARTS

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<tr>
<th>CODE</th>
<th>DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>400-1321</td>
<td>Assembled Diaphragm; FY30X</td>
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<tr>
<td></td>
<td><strong>Option</strong> Material</td>
</tr>
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<td>H0 Aluminum (IP/TYP)</td>
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<tr>
<td></td>
<td>H1 Stainless Steel (IP/TYP)</td>
</tr>
<tr>
<td></td>
<td><strong>Option</strong> Painting</td>
</tr>
<tr>
<td></td>
<td>P0 Gray Munsell N 6.5</td>
</tr>
<tr>
<td></td>
<td>P8 Without Painting</td>
</tr>
<tr>
<td></td>
<td>P9 Safety Blue Epoxy - Electrostatic Painting</td>
</tr>
<tr>
<td></td>
<td><strong>Option</strong> Standard of Manufacture</td>
</tr>
<tr>
<td></td>
<td>S0 Smar</td>
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**TYPICAL ORDERING CODE**

* Choose the desired option.

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<tr>
<th>CODE</th>
<th>DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>400-1322</td>
<td>Remote Extension Set; FY30X</td>
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<td><strong>Option</strong> Material</td>
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<td>H0 Aluminum (IP/TYP)</td>
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<td></td>
<td>H1 Stainless Steel (IP/TYP)</td>
</tr>
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<td></td>
<td><strong>Option</strong> Painting</td>
</tr>
<tr>
<td></td>
<td>P0 Gray Munsell N 6.5</td>
</tr>
<tr>
<td></td>
<td>P8 Without Painting</td>
</tr>
<tr>
<td></td>
<td>P9 Safety Blue Epoxy - Electrostatic Painting</td>
</tr>
<tr>
<td></td>
<td><strong>Option</strong> Standard of Manufacture</td>
</tr>
<tr>
<td></td>
<td>S0 Smar</td>
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**TYPICAL ORDERING CODE**

* Choose the desired option.

<table>
<thead>
<tr>
<th>CODE</th>
<th>DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>400-1325</td>
<td>Cable Set and Connectors for Hall Remote Sensor; FY30X</td>
</tr>
<tr>
<td></td>
<td><strong>Option</strong> Cable Length</td>
</tr>
<tr>
<td></td>
<td>1 5 m</td>
</tr>
<tr>
<td></td>
<td>2 10 m</td>
</tr>
<tr>
<td></td>
<td>3 15 m</td>
</tr>
<tr>
<td></td>
<td>4 20 m</td>
</tr>
<tr>
<td></td>
<td>Z Special</td>
</tr>
</tbody>
</table>

**TYPICAL ORDERING CODE**

* Choose the desired option.
Section 6

TECHNICAL CHARACTERISTICS

Functional Specifications

Travel
Linear Motion: 3 - 100 mm
Rotary Motion: 30° - 120°

Input Signal
4 - 20 mA, 2 wires.

Power
Supplied by the 4-20 mA current loop. No external supply required.

Input Impedance
550 Ω.

Minimum Current
3.8 mA.

Communication Protocol
Hart® Communication Protocol (is superimposed on the current signal).

Protection against Reverse Polarity
No damage occurs from reversal of normal supply current (4 - 20 mA) or from misapplication of up to 50 mA.

Output
Output to actuator 0 -100% supply air pressure. Single or double-action.

Pressure Supply
1.4 - 7 bar (20-100 psi). Free of oil, dust and water.

Indication
4 ½ numerical digits and 5 alphanumerical digits (Liquid Cristal Display).

Hazardous Area Certifications
See appendix "A".

European Directive Information
See appendix "A".

Temperature Limits
Operation: -40 to 85°C (-40 to 185°F).
Storage: -40 to 90°C (-40 to 194°F).
Display: -10 to 75°C (-14 to 167°F) operation.
Remote Sensor: -40 to 85°C (-40 to 185°F) without damage.

Humidity Limits
0 to 100% RH.

Flow Characterization
Linear, Equal Percentage, Quick Opening, 16 freely selectable points.

Gain
Through software. Locally adjustable.

Travel Time
Through software. Locally adjustable.

Actual Position Sensing
Magnet (Non-contact), via Hall Effect.
Performance Specifications

Resolution
≤ 0.1% F.S.

Repeatability
≤ 0.1% F.S.

Hysteresis
≤ 0.1% F.S.

Consumption
0.35 Nm³/h (0.20 SCFM) at 1.4 bar (20 psi) supply.
1.10 Nm³/h (1.65 SCFM) at 5.6 bar (80 psi) supply.

Output Capacity
13.6 Nm³/h (8 SCFM) at 5.6 bar (80 psi) supply.

Ambient Temperature Effect
0.8%/20°C of span

Supply Pressure Effect
Negligible

Vibration Effect
±0.3%/g of span during the following conditions:
• 5 - 15 Hz at 4 mm constant displacement.
• 15 - 150 Hz at 2g.
• 150 - 2000 Hz at 1g.
Reference SAMA PMC 31.1 - 1980, Sec. 5.3, Condition 3, Steady State.

Electro-Magnetic Interference Effect
Designed to comply with IEC 801 and European Standards EN50081 and EN50082.

Physical Specifications

Electrical Connection
½ - 14 NPT, Pg 13.5 or M20 x 1.5.

Pneumatic Connections
Supply and output: ¼ - 18 NPT
Gage: 1/8 - 27 NPT

Material of Construction
Injected low copper aluminum with polyester painting or 316 Stainless Steel housing, with Buna-N O-rings on covers (NEMA 4X, IP66).

Weight
Without display and mounting bracket: 2.7 kg. (Aluminum)
5.8 kg. (Stainless Steel)
Add for digital display: 0.1 kg.
Remote Sensor: 550 g.
Cable: 100 g. (For connectors plus 45 g/m)
### Technical Characteristics

#### Ordering Code

<table>
<thead>
<tr>
<th>MODEL</th>
<th>SMART VALVE POSITIONER</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY301</td>
<td>HART® &amp; 4 to 20 mA</td>
</tr>
</tbody>
</table>

**COD. Local Indicator**
- 0: Without Indicator
- 1: With Digital Indicator

**COD. Mounting Bracket**
- 0: Without Bracket
- 1: With Bracket

**COD. Electrical Connections**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>0</td>
<td>1/2&quot; - 14 NPT (4)</td>
</tr>
<tr>
<td>1</td>
<td>1/2&quot; - 14 NPT X 3/4 NPT (316 SS) - with adapter (5)</td>
</tr>
<tr>
<td>2</td>
<td>1/2&quot; - 14 NPT X 3/4 BSP (316 SS) - with adapter (3)</td>
</tr>
</tbody>
</table>

**COD. Type of Actuator**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Rotary - Single Action</td>
</tr>
<tr>
<td>2</td>
<td>Rotary - Double Action</td>
</tr>
<tr>
<td>3</td>
<td>Linear Stroke Up to 15 mm. - Single Action</td>
</tr>
<tr>
<td>4</td>
<td>Linear Stroke Up to 15 mm. - Double Action</td>
</tr>
<tr>
<td>5</td>
<td>Linear Stroke Up to 50 mm. - Single Action</td>
</tr>
<tr>
<td>6</td>
<td>Linear Stroke Up to 50 mm. - Double Action</td>
</tr>
<tr>
<td>7</td>
<td>Linear Stroke Up to 100 mm. - Single Action</td>
</tr>
<tr>
<td>8</td>
<td>Linear Stroke Up to 100 mm. - Double Action</td>
</tr>
</tbody>
</table>

**COD. Indication Gage**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>Without Gage</td>
</tr>
<tr>
<td>6</td>
<td>With 1 Gage (Acrylic, Stainless steel and wetted parts in brass) - Input</td>
</tr>
<tr>
<td>7</td>
<td>With 1 Gage (Acrylic, Stainless steel and wetted parts in brass) - Output 1</td>
</tr>
<tr>
<td>8</td>
<td>With 2 Gage (Acrylic, Stainless steel and wetted parts in brass) - Input and Output 1</td>
</tr>
</tbody>
</table>

**SPECIAL OPTIONS** (Leave it blank for no optional items)

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<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>HI</td>
<td>Aluminum (IP/Type)</td>
</tr>
<tr>
<td>H1</td>
<td>316 Stainless Steel (IP/Type)</td>
</tr>
<tr>
<td>H2</td>
<td>Aluminum for saline atmosphere (IP/Type X) (2)</td>
</tr>
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</table>

**COD. Identification Plate**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>I1</td>
<td>FM: XP, IS, NI, DI</td>
</tr>
<tr>
<td>I3</td>
<td>CSA: XP, IS, NI, DI</td>
</tr>
<tr>
<td>I4</td>
<td>EXAM (DMT): EX-IA, NEMKO: EX-D</td>
</tr>
<tr>
<td>I5</td>
<td>CEPEL: EX-D, EX-IA</td>
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</table>

**COD. Housing**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>H0</td>
<td>Gray Munsell N 6.5 Polyester</td>
</tr>
<tr>
<td>H1</td>
<td>Without Painting</td>
</tr>
<tr>
<td>H2</td>
<td>Blue Safety Epoxy – Electrostatic Painting</td>
</tr>
<tr>
<td>H3</td>
<td>Blue smooth diamond RAL5010 - Epoxy</td>
</tr>
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**COD. TAG Plate**

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<td>With TAG</td>
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<td>J1</td>
<td>Blank</td>
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<td>J2</td>
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**COD. Sensor Mounting (1)**

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<tbody>
<tr>
<td>R0</td>
<td>Full Mounting</td>
</tr>
<tr>
<td>R1</td>
<td>Remote sensor - 5 m cable</td>
</tr>
<tr>
<td>R2</td>
<td>Remote sensor - 10 m cable</td>
</tr>
<tr>
<td>R3</td>
<td>Remote sensor - 15 m cable</td>
</tr>
<tr>
<td>R4</td>
<td>Remote sensor - 20 m cable</td>
</tr>
<tr>
<td>R5</td>
<td>Remote Mounting (adapted for Remote Sensor, without cable and remote extension set)</td>
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<tr>
<td>R6</td>
<td>Specify (*)</td>
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**COD. Special Sensor**

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<td>K0</td>
<td>Without special sensor</td>
</tr>
<tr>
<td>K1</td>
<td>With pressure sensors for diagnostic</td>
</tr>
<tr>
<td>K2</td>
<td>With 4-20 mA Position Feedback (open collector)</td>
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</table>

**COD. Special**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>ZZ</td>
<td>Leave it blank for no optional items</td>
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**Typical Model Number**

FY301 1 0 0 1 0 * * * * * * * * * *

**NOTES**

1. Consult Smar for applications in classified areas.
2. IPW/TYPEX tested for 200 hours according to NBR 8094 / ASTM B 117 standard.
3. Options not certified for Hazardous Locations.
<table>
<thead>
<tr>
<th>CODE</th>
<th>Positioner Mounting Bracket (2)</th>
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<tbody>
<tr>
<td>0</td>
<td>Without Bracket</td>
</tr>
<tr>
<td>1</td>
<td>Universal Rotary</td>
</tr>
<tr>
<td>2</td>
<td>Universal Linear - Yoke and Pillar Type</td>
</tr>
<tr>
<td>3</td>
<td>Linear - Yoke Type</td>
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<tr>
<td>4</td>
<td>Linear - Pillar Type</td>
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<tr>
<td>Z</td>
<td>Others - Specify</td>
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<tr>
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<td>1</td>
<td>Rotary</td>
</tr>
<tr>
<td>2</td>
<td>Linear up to 15 mm / 30 mm</td>
</tr>
<tr>
<td>3</td>
<td>Linear up to 50 mm</td>
</tr>
<tr>
<td>4</td>
<td>Linear up to 100 mm</td>
</tr>
<tr>
<td>Z</td>
<td>Others - Specify</td>
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<table>
<thead>
<tr>
<th>CODE</th>
<th>Positioner Mounting Bracket Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Carbon Steel Bracket and Accessories in SST</td>
</tr>
<tr>
<td>C</td>
<td>Carbon Steel Bracket</td>
</tr>
<tr>
<td>I</td>
<td>Stainless Steel Bracket</td>
</tr>
<tr>
<td>N</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Z</td>
<td>Others - Specify</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>C</td>
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</tr>
<tr>
<td>I</td>
<td>Stainless Steel Bracket</td>
</tr>
<tr>
<td>N</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Z</td>
<td>Others - Specify</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CODE</th>
<th>Optional Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZZ</td>
<td>Leave it blank for no optional items</td>
</tr>
</tbody>
</table>

**BFY** - **BRACKET (1)**

(1) When choosing the remote sensor version, an additional "L" shape bracket is included, for 2" tube mounting.

(2) For customized mounting bracket, for different brands and models, please, consult www.smar.com.
Appendix A

CERTIFICATIONS INFORMATION

European Directive Information

Consult www.smar.com for the EC declarations of conformity for all applicable European directives and certificates.

ATEX Directive (94/9/EC) – “Electrical equipment and protective system intended for use in potential explosive atmospheres”
The EC-Type Examination Certificate had been released by Nemko AS (CE0470) and/or DEKRA EXAM GmbH (CE0158), according to European Standards.
The certification body for Production Quality Assurance Notification (QAN) and IECEx Quality Assessment Report (QAR) is Nemko AS (CE0470).

Hazardous Locations General Information

Ex Standards:
IEC 60079-0 General Requirements
IEC 60079-1 Flameproof Enclosures “d”
IEC 60079-11 Intrinsic Safety “i”
IEC 60079-26 Equipment with equipment protection level (EPL) Ga
IEC 60529 Classification of degrees of protection provided by enclosures (IP Code)

Customer responsibility:
IEC 60079-10 Classification of Hazardous Areas
IEC 60079-14 Electrical installation design, selection and erection
IEC 60079-17 Electrical Installations, Inspections and Maintenance

Warning:
Explosions could result in death or serious injury, besides financial damage. Installation of this instrument in an explosive environment must be in accordance with the national standards and according to the local environmental protection method. Before proceeding with the installation match the certificate parameters according to the environmental classification.

General Notes:
Maintenance and Repair
The instrument modification or replaced parts supplied by any other supplier than authorized representative of Smar Equipamentos Industriais Ltda is prohibited and will void the Certification.

Marking Label
Once a device labeled with multiple approval types is installed, do not reinstall it using any other approval types. Scratch off or mark unused approval types on the approval label.

For Ex-i protection application
- Connect the instrument to a proper intrinsically safe barrier.
- Check the intrinsically safe parameters involving the barrier, equipment including the cable and connections.
- Associated apparatus ground bus shall be insulated from panels and mounting enclosures.
- When using shielded cable, isolate the not grounded cable end.
- Cable capacitance and inductance plus C_i and L_i must be smaller than C_o and L_o of the Associated Apparatus.

For Ex-d protection application
- Only use Explosion Proof/Flameproof certified Plugs, Adapters and Cable glands.
- In an Explosion-Proof/Flame-Proof installation, do not remove the instrument housing covers when powered on.

Electrical Connection
In Explosion-Proof installations the cable entries must be connected through conduit with sealed unit or closed using metal cable gland or closed using metal blanking plug, all with at least IP66 and Ex-d certification. For enclosure with saline environment protection (W) and ingress protection (IP) applications, all NPT thread parts must apply a proper water-proof sealant (a non-hardening silicone group sealant is recommended).
For Ex-d and Ex-i protection application
- The transmitter has a double protection. In this case the transmitter shall be fitted with appropriate certified cable entries Ex-d and the electric circuit supplied by a certified diode safety barrier as specified for the protection Ex-ia.

Environmental Protection
- Enclosure Types (Type X): Supplementary letter X meaning special condition defined as default by Smar the following: Saline Environment approved - salt spray exposed for 200 hours at 35ºC. (Ref: NEMA 250).
- Ingress protection (IP W): Supplementary letter W meaning special condition defined as default by Smar the following: Saline Environment approved - salt spray exposed for 200 hours at 35ºC. (Ref: IEC60529).
- Ingress protection (IP x8): Second numeral meaning continuous immersion in water under special condition defined as default by Smar the following: 1 Bar pressure during 24 hours. (Ref: IEC60529).

**Hazardous Locations Approvals**

<table>
<thead>
<tr>
<th>CSA (Canadian Standards Association)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class 2258 02 – Process Control Equipment – For Hazardous Locations</strong> (CSA1078546)</td>
</tr>
<tr>
<td>Class I, Division 1, Groups B, C and D</td>
</tr>
<tr>
<td>Class II, Division 1, Groups E, F and G</td>
</tr>
<tr>
<td>Class III, Division 1</td>
</tr>
<tr>
<td>Class I, Division 2, Groups A, B, C and D</td>
</tr>
<tr>
<td><strong>Class 2258 04 – Process Control Equipment – Intrinsically Safe Entity – For Hazardous Locations</strong> (CSA 1078546)</td>
</tr>
<tr>
<td>Class I, Division 1, Groups A, B, C and D</td>
</tr>
<tr>
<td>Class II, Division 1, Groups E, F and G</td>
</tr>
<tr>
<td>Class III, Division 1</td>
</tr>
<tr>
<td>Model FY301 Valve Positioners: input supply 12-42 V dc, 4-20mA; Enclosure Type 4/4X; intrinsically safe with entity parameters: Vmax = 28 V, Imax = 110 mA, Ci = 5 nF, Li = 12uH, when connected through CSA Certified Safety Barriers as per Smar Installation Drawing 102A0833; T Code T3C @ Max Ambient 40 Deg C; MWP 100 psi. Note: Only models with stainless steel external fittings are Certified as Type 4X.</td>
</tr>
<tr>
<td><strong>Special conditions for safe use:</strong></td>
</tr>
<tr>
<td>Temperature Class T3C</td>
</tr>
<tr>
<td>Maximum Ambient Temperature: 40ºC (-20 to 40 ºC)</td>
</tr>
<tr>
<td>Maximum Working Pressure: 100 psi</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FM Approvals (Factory Mutual)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intrinsic Safety</strong> (FM 3009955)</td>
</tr>
<tr>
<td>IS Class I, Division 1, Groups A, B, C and D</td>
</tr>
<tr>
<td>IS Class II, Division 1, Groups E, F and G</td>
</tr>
<tr>
<td>IS Class III, Division 1</td>
</tr>
<tr>
<td><strong>Explosion Proof</strong> (FM 3007267)</td>
</tr>
<tr>
<td>XP Class I, Division 1, Groups A, B, C and D</td>
</tr>
<tr>
<td><strong>Dust Ignition Proof</strong> (FM 3009955)</td>
</tr>
<tr>
<td>DIP Class II, Division 1, Groups E, F and G</td>
</tr>
<tr>
<td>DIP Class III, Division 1</td>
</tr>
<tr>
<td><strong>Non Incendive</strong> (FM 3009955)</td>
</tr>
<tr>
<td>NI Class I, Division 2, Groups A, B, C and D</td>
</tr>
<tr>
<td><strong>Environmental Protection</strong> (FM 3009955)</td>
</tr>
<tr>
<td>Option: Type 4X or Type 4</td>
</tr>
<tr>
<td><strong>Special conditions for safe use:</strong></td>
</tr>
<tr>
<td>Entity Parameters:</td>
</tr>
</tbody>
</table>
Vmax = 30 Vdc, Imax = 110 mA, Ci = 8 nF, Li = 12 uH
Temperature Class T4
Maximum Ambient Temperature: 60°C (-20 to 60 ºC)

**NEMKO (Norges Elektriske MaterielKontroll)**

**Explosion Proof** (NEMKO 00ATEX305X)
Group II, Category 2 G, Ex d, Group IIIC, Temperature Class T6, EPL Gb

Ambient Temperature: -20ºC ≤ Ta ≤ +60ºC
Working Pressure: 20-100 psi

**Environmental Protection** (NEMKO 00ATEX305X)
Options: IP66W or IP66

**Special conditions for safe use:**
Repairs of the flameproof joints must be made in compliance with the structural specifications provided by the manufacturer. Repairs must not be made on the basis of values specified in tables 1 and 2 of EN/IEC 60079-1.

The Essential Health and Safety Requirements are assured by compliance with:
- EN 60079-0:2012 General Requirements
- EN 60079-1:2007 Flameproof Enclosures “d”

**EXAM (BBG Prüf - und Zertifizier GmbH)**

**Intrinsic Safety** (DMT 01 ATEX E 012)
Group II, Category 2 G, Ex d ia, Group IIIC, Temperature Class T6, EPL Gb

Supply and signal circuit for the connection to an intrinsically safe 4-20mA current loop
Ui = 28 Vdc, li = 93 mA, Pi = 700 mW, Ci ≤ 5 nF, Li = Neg

Ambient Temperature: -20ºC ≤ Ta ≤ +60ºC

The Essential Health and Safety Requirements are assured by compliance with:
- EN 60079-0:2012 +A11:2013 General Requirements
- EN 60079-1:2007 Flameproof Enclosures “d”
- EN 60079-11:2012 Intrinsic Safety “i”

**CEPEL (Centro de Pesquisa de Energia Elétrica)**

**Intrinsic Safety** (CEPEL 00.0017)
Ex d ia, Group IIIC, Temperature Class T5/T6, EPL Gb

Entity Parameters:
Pi = 0.7 W, Ui = 30 V, li = 100 mA, Ci = 6.4 nF, Li = Neg

Ambient Temperature:
-20 to 65 ºC for T5
-20 to 40 ºC for T6

**Protection by enclosure** (CEPEL 00.0017)
Ex tb, Group IIIIC, Temperature Class T100ºC/T85ºC, EPL Db

Ambient Temperature:
-20 to 65 ºC for T100ºC
-20 to 40 ºC for T85ºC

**Explosion Proof** (CEPEL 98.0008)
Ex d, Group IIC, Temperature Class T6, EPL Gb

Maximum Ambient Temperature: 40ºC (-20 to 40 ºC)

**Protection by enclosure** (CEPEL 98.0008)
Ex tb, Group IIIIC, Temperature Class T85ºC, EPL Db
Maximum Ambient Temperature: 40ºC (-20 to 40 ºC)

**Environmental Protection** (CEPEL 00.0017 AND CEPEL 98.0008)
Options: IP66W or IP66

The Essential Health and Safety Requirements are assured by compliance with:
- ABNT NBR IEC 60079-0:2008 General Requirements
- ABNT NBR IEC 60079-1:2009 Flameproof Enclosures “d”
- ABNT NBR IEC 60079-11:2009 Intrinsic Safety “i”
- ABNT NBR IEC 60529:2009 Classification of degrees of protection provided by enclosures (IP Code)
- ABNT NBR IEC 60079-31:2011 Explosive atmospheres - Part 31: Equipment dust ignition protection by enclosure "t"
Identification Plate

CSA (Canadian Standards Association)

**smar FY301 Positioner**

- **BR - 14160**
- **Type 4X**
- **Seal not required (conduit)**
- **Temp Class: T4**
- **Tamb: 60°C max.**
- **Vmax: 110 VDC**
- **I max: 110 mA**
- **Ci: 8 mF**
- **Li: 12 µH**
- **Per Inst. Dwg: 102A0833**

**smar FY301 Positioner**

- **BR - 14160**
- **Type 4**
- **Temp Class: T4**
- **Tamb: 60°C max.**
- **Vmax: 110 VDC**
- **I max: 110 mA**
- **Ci: 8 mF**
- **Li: 12 µH**
- **Per Inst. Dwg: 102A0833**

FM Approvals (Factory Mutual)

**smar FY301 Positioner**

- **BR - 14160**
- **Type 4X**
- **Seal not required (conduit)**
- **Temp Class: T4**
- **Tamb: 60°C max.**
- **Vmax: 110 VDC**
- **I max: 110 mA**
- **Ci: 8 mF**
- **Li: 12 µH**
- **Per Inst. Dwg: 102A0439**

**smar FY301 Positioner**

- **BR - 14160**
- **Type 4**
- **Temp Class: T4**
- **Tamb: 60°C max.**
- **Vmax: 110 VDC**
- **I max: 110 mA**
- **Ci: 8 mF**
- **Li: 12 µH**
- **Per Inst. Dwg: 102A0439**

NEMKO (Norges Elektriske MaterielKontroll) / EXAM (BBG Prüf - und Zertifizier GmbH)

**smar FY301 Positioner**

- **BR - 14160**
- **Sertãozinho, Brazil**
- **Temp Class: T4**
- **Tamb: -20°C to 60°C**
- **Pt: 700 mV**
- **I k: 28 VDC**
- **I l: 65 mA**
- **(DO NOT OPEN WHEN ENERGIZED)**
- **U: 12 VDC**
- **Nemko No ATEX III X ( )**
- **Pressure: 20 - 100 psi**

**smar FY301 Positioner**

- **BR - 14160**
- **Sertãozinho, Brazil**
- **Temp Class: T4**
- **Tamb: -20°C to 60°C**
- **Pt: 700 mV**
- **I k: 28 VDC**
- **I l: 65 mA**
- **(DO NOT OPEN WHEN ENERGIZED)**
- **U: 12 VDC**
- **Nemko No ATEX III X ( )**
- **Pressure: 20 - 100 psi**
CEPEL (Centro de Pesquisa de Energia Elétrica)
NON HAZARDOUS OR DIVISION 2 AREA

SAFE AREA APPARATUS
UNSPECIFIED, EXCEPT THAT IT MUST NOT
BE SUPPLIED FROM, NOR CONTAIN UNDER
NORMAL OR ABNORMAL CONDITIONS, A
SOURCE OF POTENTIAL IN RELATION TO
EARTH IN EXCESS OF 250VAC OR 250VDC.

HAZARDOUS AREA

REQUIREMENTS:
1. INSTALLATION TO BE IN ACCORDANCE WITH THE CEC PART 1.
2. ASSOCIATED APPARATUS GROUND BUS TO BE INSULATED FROM PANELS
   AND MOUNTING ENCLOSURES.
3. ASSOCIATED APPARATUS GROUND BUS RESISTANCE TO EARTH MUST BE
   SMALLER THAN 1(O ONE) OHM.
4. OBSERVE POSITIONER POWER SUPPLY LOAD CURVE.
5. WIRES: TWISTED PAIR, 28AWG OR LARGER.
6. SHIELD IS OPTIONAL IF USED, BE SURE TO INSULATE THE END NOT
   GROUNDED.
7. BARRIERS MUST BE "CSA" CERTIFIED AND MUST BE INSTALLED IN
   ACCORDANCE WITH MANUFACTURES INSTRUCTIONS.
8. IF BARRIERS WITH VOLT/OMH PARAMETERS ARE USED, THE FOLLOWING
   PARAMETERS SHALL APPLY: ONE 28 V(MAX), 300 OHM(MIN).
9. INTRINSICALLY SAFE, ExIA FOR USE IN
   CLASS I, DIV. 1, GROUPS A, B, C, D;
   CLASS II, DIV. 1, GROUPS E, F, G;
   CLASS III, DIV. 1, WITH ENTITY INPUT PARAMETERS AS LISTED BELOW.
10. NON-INCENDIVE FOR
    CLASS I, DIV. 2, GROUPS A, B, C, D. WITH NON-INCENDIVE FIELD WIRING
     INPUT PARAMETERS AS LISTED BELOW.

INTRINSICALLY SAFE APPARATUS AND NON-INCENDIVE APPARATUS
ENTITY VALUES:

CAUTION: EXPLOSION HAZARD -
SUBSTITUTION OF COMPONENTS MAY
IMPACT SUITABILITY FOR USE IN
HAZARDOUS LOCATIONS.

CAUTION: EXPLOSION HAZARD -
DO NOT DISCONNECT FOR CLASS I, DIV. 2
EQUIPMENT THAT IS NOT CONNECTED TO BARRIERS.

MODEL FY290 & FY301 - SERIES
VALVE POSITIONERS
## Appendix B

### SRF – Service Request Form

**FY Positioner**

### GENERAL DATA

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<thead>
<tr>
<th>Model</th>
<th>Firmware Version:</th>
<th>Model</th>
<th>Firmware Version:</th>
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<td>FY301</td>
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<tr>
<td>FY302</td>
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<td>FY303</td>
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<tr>
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<table>
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<th>TAG:</th>
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<thead>
<tr>
<th>Remote Position Sensor?</th>
<th>Yes ( )</th>
<th>No ( )</th>
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<tbody>
<tr>
<td>Pressure Sensor?</td>
<td>Yes ( )</td>
<td>No ( )</td>
</tr>
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</table>

| Action: | | |
|---------| | |
| Travel: | | |

<table>
<thead>
<tr>
<th>Configuration:</th>
<th>Magnetic Tool ( )</th>
<th>Palm ( )</th>
<th>Psion ( )</th>
<th>PC ( )</th>
<th>Software:</th>
<th>Version:</th>
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### FINAL CONTROL ELEMENT DATA

| Type: | | |
|-------| | |
| Size: |

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<table>
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<table>
<thead>
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### AIR SUPPLY

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<tr>
<th>Conditions:</th>
<th>Dry and Clean ( )</th>
<th>Oil ( )</th>
<th>Water ( )</th>
<th>Other:</th>
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<tr>
<td>Work Pressure:</td>
<td>20 PSI ( )</td>
<td>60 PSI ( )</td>
<td>100 PSI ( )</td>
<td>Other:</td>
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### PROCESS DATA

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<tr>
<th>Hazardous Area Classification</th>
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<th>Chemical ( )</th>
<th>Explosive ( )</th>
<th>Other:</th>
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<tbody>
<tr>
<td>Interference Types</td>
<td>Vibration ( )</td>
<td>Temperature ( )</td>
<td>Electromagnetic ( )</td>
<td>Others:</td>
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</table>

### SITUATION DESCRIPTION

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**SERVICE SUGGESTION**

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<tr>
<th>Adjustment ( )</th>
<th>Cleaning ( )</th>
<th>Preventive Maintenance ( )</th>
<th>Update / Up-grade ( )</th>
</tr>
</thead>
</table>

Other:

### USER INFORMATION

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<thead>
<tr>
<th>Company:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact:</td>
</tr>
<tr>
<td>Title:</td>
</tr>
<tr>
<td>Section:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phone:</th>
<th>Extension:</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-mail:</td>
<td>Date: ______/ ______/ ______</td>
</tr>
</tbody>
</table>

For warranty or non-warranty repair, please contact your representative.
Further information about address and contacts can be found on www.smar.com/contactus.asp.
Returning Materials

Should it become necessary to return the positioner and/or configurator to SMAR, simply contact our office, informing the defective instrument serial number, and return it to our factory.

In order to speed up analysis and solution of the problem, the defective item should be returned with a description of the failure observed, with as much details as possible. Other information concerning the instrument operation, such as service and process conditions, is also helpful.

Instruments returned or to be revised outside the guarantee term should be accompanied by a purchase order or a quote request.
SMAR WARRANTY CERTIFICATE

1. SMAR guarantees its products for a period of 24 (twenty four) months, starting on the day of issuance of the invoice. The guarantee is valid regardless of the day that the product was installed.

2. SMAR products are guaranteed against any defect originating from manufacturing, mounting, whether of a material or manpower nature, provided that the technical analysis reveals the existence of a quality failure liable to be classified under the meaning of the word, duly verified by the technical team within the warranty terms.

3. Exceptions are proven cases of inappropriate use, wrong handling or lack of basic maintenance compliant to the equipment manual provisions. SMAR does not guarantee any defect or damage caused by an uncontrolled situation, including but not limited to negligence, user imprudence or negligence, natural forces, wars or civil unrest, accidents, inadequate transportation or packaging due to the user's responsibility, defects caused by fire, theft or stray shipment, improper electric voltage or power source connection, electric surges, violations, modifications not described on the instructions manual, and/or if the serial number was altered or removed, substitution of parts, adjustments or repairs carried out by non-authorized personnel; inappropriate product use and/or application that cause corrosion, risks or deformation on the product, damages on parts or components, inadequate cleaning with incompatible chemical products, solvent and abrasive products incompatible with construction materials, chemical or electrolytic influences, parts and components susceptible to decay from regular use, use of equipment beyond operational limits (temperature, humidity, etc.) according to the instructions manual. In addition, this Warranty Certificate excludes expenses with transportation, freight, insurance, all of which are the customer’s responsibility.

4. For warranty or non-warranty repair, please contact your representative.

Further information about address and contacts can be found on www.smar.com/contactus.asp

5. In cases needing technical assistance at the customer’s facilities during the warranty period, the hours effectively worked will not be billed, although SMAR shall be reimbursed from the service technician’s transportation, meals and lodging expenses, as well dismounting/mounting costs, if any.

6. The repair and/or substitution of defective parts do not extend, under any circumstance, the original warranty term, unless this extension is granted and communicated in writing by SMAR.

7. No Collaborator, Representative or any third party has the right, on SMAR's behalf, to grant warranty or assume some responsibility for SMAR products. If any warranty would be granted or assumed without SMAR's written consent, it will be declared void beforehand.

8. Cases of Extended Warranty acquisition must be negotiated with and documented by SMAR.

9. If necessary to return the equipment or product for repair or analysis, contact us. See item 4.

10. In cases of repair or analysis, the customer must fill out the Revision Requisition Form (FSR) included in the instructions manual, which contains details on the failure observed on the field, the circumstances it occurred, in addition to information on the installation site and process conditions. Equipments and products excluded from the warranty clauses must be approved by the client prior to the service execution.

11. In cases of repairs, the client shall be responsible for the proper product packaging and SMAR will not cover any damage occurred in shipment.
12. In cases of repairs under warranty, recall or outside warranty, the client is responsible for the correct packaging and packing and SMAR shall not cover any damage caused during transportation. Service expenses or any costs related to installing and uninstalling the product are the client’s sole responsibility and SMAR does not assume any accountability before the buyer.

13. It is the customer’s responsibility to clean and decontaminate products and accessories prior to shipping them for repair, and SMAR and its dealer reserve themselves the right to refuse the service in cases not compliant to those conditions. It is the customer’s responsibility to tell SMAR and its dealer when the product was utilized in applications that contaminate the equipment with harmful products during its handling and repair. Any other damages, consequences, indemnity claims, expenses and other costs caused by the lack of decontamination will be attributed to the client. Kindly, fill out the Declaration of Decontamination prior to shipping products to SMAR or its dealers, which can be accessed at www.smar.com/doc/declarationofcontamination.pdf and include in the packaging.

14. This warranty certificate is valid only when accompanying the purchase invoice.
1 – Attach the magnet to the magnet bracket support before connect them to the valve stem.

2 - The stem nuts should be used to fasten the magnet bracket.

3 – Mount the magnet assembly using the nuts of the valve stem. The mounting bracket has two parts that should be mounted to the stem.
4 – Tighten the hex screw that join the two parts of the magnet bracket. It will avoid sliding of the two parts of the bracket during the fastening of the stem nuts.

5 – Tighten the stem nuts.

6 – Attach the “clamps” to the positioner bracket.
If your actuator is pillar type, go to step 15 to see the instructions.
7 – Adjust the clamps according to the width of the yoke and tighten the bolts finger tight.

8 – Mount the positioner back plate. Tighten the nuts finger tight.

9 – Use the plate as a guidance to adjust the position of the positioner so that the back plate is about 1 mm apart from the magnet.
10 – Fasten the nuts to fix the positioner bracket to the yoke. If the actuator is pillar type, fasten the U-clamp nuts.

11 – Mount the positioner to the plate and tighten the hex screws. You can take the back plate apart to facilitate the assembling.

12 – Move the positioner as to adjust the Hall sensor tip in the center of the magnet. Tighten the nuts after the adjustment.

ATTENTION:
A minimum distance of 2mm and a maximum distance of 4mm is recommended between the magnet external face and the positioner face. For that, a centralizer device (linear or rotary) must be used. The centralizer device is in the positioner packing.
13 – Put the pressure equivalent to the half of the stem travel and adjust the height of the bracket assembly to have the arrows matching.

14 - Tighten the bolts to fasten the clamps to the yoke.

If the actuator is pillar type, fasten the U-clamp nuts.
MOUNTING DETAILS FOR THE PILLAR TYPE ACTUATOR

15 - This is the mounting bracket using U-clamps to be mounted on pillar type actuators.

16 – After assembling the U-clamps, follow the steps 8 to 13.
1- Attach the clamps to the threaded orifices existent on the actuator. Do not tight them completely.

The bolts are not supplied with the mounting bracket and they must be in accordance with size and thread of the actuator holes.

2- Attach the magnet bracket to the Actuator extremity (NAMUR).

The end the valve shaft must comply with Namur Standard.
 Mounting Instructions

3 – Fasten the hex screw.

4 – Attach the magnet to the NAMUR adapter. Do not fasten the bolts completely, allowing the magnet rotation.

5 – Mounting the positioner bracket through the threaded rods.
6 – Use the centralizer gadget to get the bracket centralized with the magnet.

7 – Adjust the positioner bracket using the centralizer gadget and the nuts to get the height.

8 – Place the nut and washers. Do not fasten the nuts completely.
9 – Tighten the clamp bolts to fasten them to the actuator.

10 – Fasten the positioner bracket bolts to the clamps fastening.

11 – Remove the centralizer gadget and fasten the positioner to the positioner bracket.
12 – Put the pressure equivalent to the half of the stem and adjust the magnet position to have the arrows matching.

13 – Tighten the bolts to fasten the magnet to the magnet bracket.