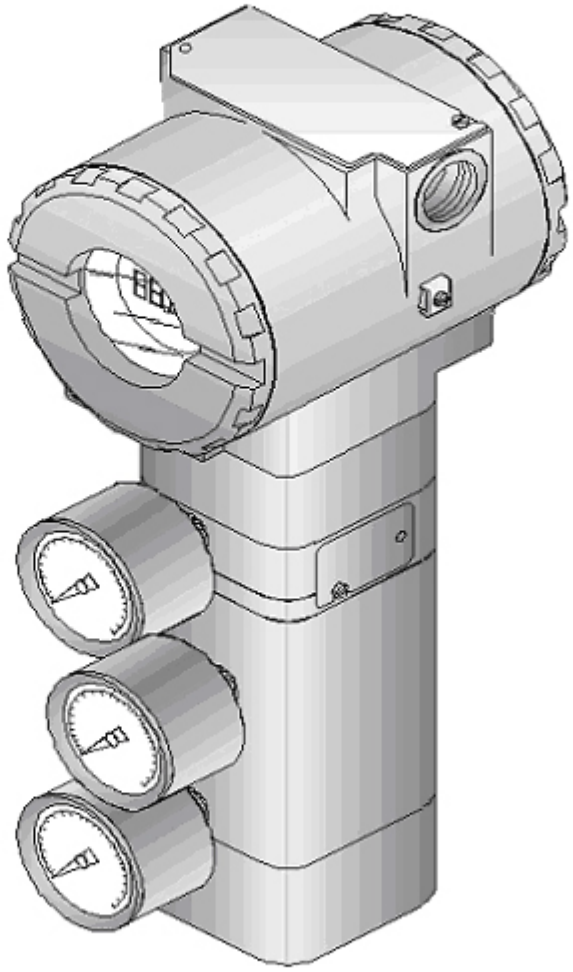
IM-P370-20
CH ISSUE 1

spirax sarco - SP301

OPERATION & MAINTENANCE
INSTRUCTION MANUAL

SMART VALVE POSITIONER



SP301
03.05

INTRODUCTION

The **SP301** is a Spirax Sarco valve positioner for single acting (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, when used 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 **SP301** enabled the choice of several types of flow characterisations, an easy to use interface between the field and the control room, plus several interesting features that considerably reduce the installation, operation and maintenance costs.

The **SP301**includes the following functions:

* **User defined valve characteristic**

* **Local Adjustment** - for travel, flow characterization, tuning, operation mode, indication, set point and PID parameters... and more…..

* **Password protection** - three levels of user security for different functions.

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

* **Self Setup** - automatic calibration of valve travel and other parameters

*** Diagnostic –** continuous monitoring of valve condition for preventive maintenance purposes.

Get the best results from this **SP301** by carefully reading these instructions.

WARNING:
Throughout the operation of the positioner, including self setup, do not touch the moving parts of the valve/actuator/positioner assembly as they may unexpectedly move under automatic control. ALWAYS disconnect supply air before touching any moving parts.

NOTE
This manual is compatible with version 2.XX, where 2 denote software version and XX software release. The indication 2.XX means that this manual is compatible with any release of software version 2.

SAFETY INFORMATION

IMPORTANT
SAFETY INFORMATION:
PLEASE READ CAREFULLY

Hazards to be considered when installing/using/maintaining

1. Access
Ensure safe access and if necessary a safe working platform before attempting to work on the product.
Arrange suitable lifting gear if required.

2. Lighting
Ensure adequate lighting, particularly where detailed or intricate work is required e.g. electrical wiring.

3. Hazardous liquids or gases in the pipeline
Consider what is in the pipeline or what may have been in the pipeline at some previous time.
Consider: flammable materials, substances hazardous to health, extremes of temperature.

4. Hazardous environment around the product
Consider: explosion risk areas, lack of oxygen (e.g. tanks, pits) dangerous gases, extremes of temperature, hot surfaces, fire hazard (e.g. during welding), excessive noise, and moving machinery.
ATEX certifications are available on demand for explosion proof housings (ATEX II2GEExdIICT6) and for intrinsically safe electronic circuits (ATEX II2GEExdIICT6).

5. The system
Consider the effect on the complete system of the work proposed. Will any proposed action (e.g. closing isolating valves, electrical isolation) put any other part of the system or any other workers at risk? Dangers might include isolation of vents or protective devices, or the rendering ineffective of controls or alarms.
Ensure isolation valves are turned on and off in a gradual way to avoid system shocks.

6. Pressure systems
Ensure that any pressure is isolated and safely vented to atmospheric pressure.
Consider double isolation (double block and bleed) and the locking and/or labelling of valve shut.
Do not assume the system is de-pressurized even when the pressure gauge indicates zero.

7. Temperature
Allow time for temperature to normalise after isolation to avoid the risk of burns.

8. Tools and consumables
Before starting work ensure that you have suitable tools and/or consumables available. Use only genuine Spirax Sarco replacement parts.

9. Protective clothing
Consider whether any protective clothing is required, to protect against the hazards of, for example, chemicals, high/low temperature, noise, falling objects, dangers to eyes/face.

10. Permits to work
All works must be carried out or be supervised by a suitable competent person.
Where a formal permit to work system is in force it must be complied with.
Where there is no such system, it is recommended that a responsible person knows what work is going on and where necessary arrange to have an assistant whose primary responsibility is safety. Post warning notices if necessary.

11. Electrical work
Before starting work study the wiring diagram and wiring instructions and note any special requirements. Consider particularly:
mains supply voltage and phase, local mains isolation, fuse requirements, earthing, special cables, cable entries/cable glands, electrical screening.

12. Commissioning
After installation or maintenance ensure that the system is fully functioning.
Carry out tests on any alarms or protective devices.

13. Disposal
Unwanted equipment should be disposed of in a safe manner.

14. Returning products
Customers and stockists are reminded that under EC Health, Safety and Environmental Law, when returning products to Spirax Sarco they must provide information on any hazards and the precautions to be taken due to contamination residues or mechanical damage which may present a health, safety and environmental risk.
This information must be provided in writing including Health and Safety data sheets relating to any substances identified as hazardous.

Note: The products supplied by Spirax Sarco are classified as components and are not generally affected by the Machinery Directive 89/392/EEC.

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Section 1

Installation

General

The overall accuracy of measurement and control depends on several variables. Although the converter has an outstanding performance, proper installation is essential, in order to maximize its performance.

Among all the factors which may affect converter accuracy, environmental conditions are the most difficult to control. There are, however, ways of reducing the effects of temperature, humidity and vibration.

The SP301 has a built-in temperature sensor to compensate for temperature variations. In the field, this feature minimizes the temperature variation effect.

Locating the positioner in areas protected from extreme environmental changes can minimize temperature fluctuation effects.

In warm climates, 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.

Use of sunshades or heat shields to protect the positioner from external heat sources should be considered, if necessary.

Humidity is fatal to electronic circuits. In areas subjected to high relative humidity, the O-rings for the electronics cover must be correctly placed. 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 humidity. A humidity proof coating protects the electronic circuit, but frequent exposure 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. Code approved sealing methods for conduit entering the positioner should be employed.

Although the positioner is virtually insensitive to vibration, installation close to pumps, turbines or other vibrating equipment should be avoided.

The SP301 comes with the option of three built-in pressure sensors continuously monitoring the pressure at the air supply input and the two pneumatic outputs respectively.

Mounting

The mounting of positioner **SP301** will depend on actuator type: single acting (spring return) or double acting, and on actuator movement, if it is linear or rotary. Two supports are required for mounting: one for the magnet and the other for the positioner itself. Spirax Sarco can supply them both since they are specified in the order code (See page 5.2).

Rotary Movement
Install the magnet on the valve stem using the magnet support (See Figure 1.2).

Install the positioner support on the actuator. Should the actuator be in accordance with standard VDI/VDE 5845, all you have to do is tighten the four screws with the lock washers on the standard support.

For special supports, refer to specific instructions. After installing the support on the actuator, it is possible to mount positioner **SP301** on the support by means of the four screws with lock washers.

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

Should the installation of the positioner or magnet be altered, or should there be any other modification, the positioner will require a recalibration.

As to the type of valve action, refer to paragraph “pneumatic connections”.

Linear Movement
Install the magnet on the valve stem using the magnet support (See Figure 1.3).
Install the positioner support on the actuator. The actuator support may be secured in place as per standard NAMUR/IEC 536-4 or in accordance with user specifications. Install the positioner on the support and tighten the four screws in the threaded holes located on the side opposite to the pressure gauges (Figure 1.3). Use lock washers in order to prevent screw slackening.

Make sure that the support is not obstructing the exhaustion outlets.

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

Should the installation of the positioner or magnet be altered, or should there be any other modification, the positioner will require a re-calibration.

Pneumatic Connections

Air supplied to the positioner **SP301** shall be quality instrument air, i.e., dry, clean and non-corrosive. Refer to the Instrument Society of America Standard entitled "Quality Standard for Instrument Air" (ISA S7.3). See "RECOMMENDATIONS FOR AN INSTRUMENT AIR SYSTEM" on page 1.8. It may be possible to provide suitably clean air by use of appropriate air filters – please consult Spirax Sarco for further information.

Air supply pressure to the **SP301** shall be between 1.4 bar (20 psi) and 7 bar (100 psi). In case such requirements cannot be fulfilled, the use of an air pressure regulator is essential.

Use a non-setting sealant on threads. Sealant like PTFE (Teflon) tape shall be avoided because they may fragment and eventually obstruct internal parts.

Positioner **SP301** may be supplied with pressure gauges. There are ports provided for IN, OUT1 and OUT2. Before connecting the pressure lines, make sure that all lines are de-pressurised.
Valve positioner **SP301** has two pneumatic outputs. They work on opposite directions to open or close the valve.

IMPORTANT:
Should the **SP301** fail, for example, because of a power failure, the output identified as OUT1 (output 1) goes to nearly zero, while the output identified as OUT2 (output 2) goes to nearly the air supply pressure.

Pneumatic connections are identified as IN (input) for the air supply, and OUT1 and OUT2 for Output 1 and Output respectively (See Figure 1.1). Use 1/4 NPT connections. Sealant may be used NPT threads. Connect the air supply tubing to the connection identified as IN. Make sure that the air supply pressure does not exceed the maximum rating accepted by the positioner or actuator – 7 bar (100 psi).

The tubing used to connect the positioner **SP301** to the actuator shall be as short as possible.

ATTENTION:
Make sure that sealant does not enter in the positioner.

There are five exhaust outputs in the **SP301**, all of them fitted with filters (See Figure 1.1).
It is very important that such outputs are neither blocked nor obstructed, because the air must circulate freely.

All filters shall be inspected to make sure they will not obstruct the outputs. Refer to Section 4 - Maintenance.

Double Action - Air to Open (Fail Close)
Connect Output 1 (OUT1) of the positioner to the input identified as OPEN in the actuator, and

connect Output 2 (OUT2) of the positioner to the input CLOSE in the actuator (See Figure 1.1).

Double Action - Air to Close (Fail Open)
Connect Output 2 (OUT2) of the positioner to the input identified as OPEN in the actuator, and connect Output 1 (OUT 1) of the positioner to the input CLOSE of the actuator.

Single Action
Connect Output 1 (OUT1) of the positioner to the input of the actuator. Use a plug to block Output 2 (OUT2). Figures 1.2 and 1.3 show the positioner in rotary and linear actuators.

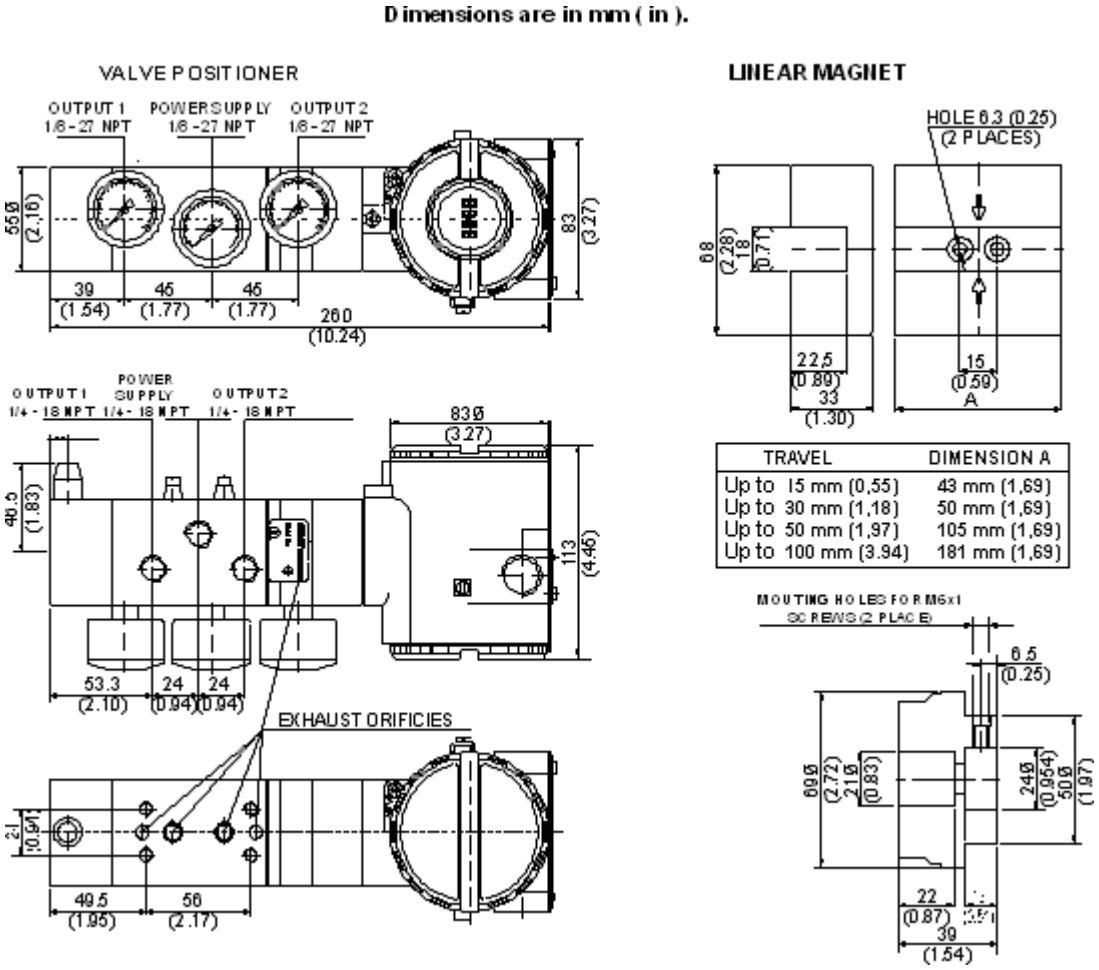


Fig 1.1 – SP301 Dimensional Drawing

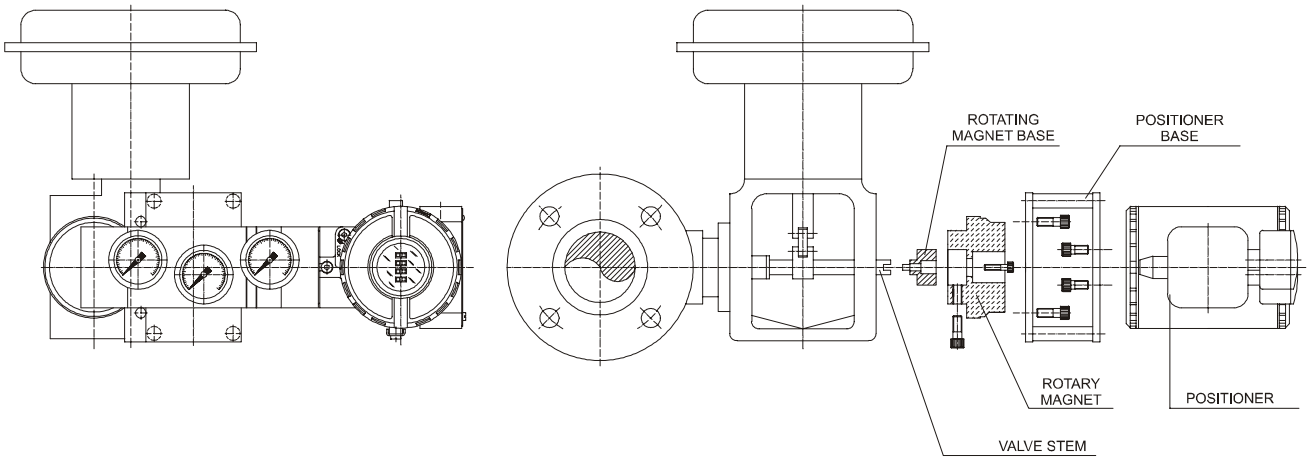


Fig. 1.2 – Positioner on the Rotary Actuator

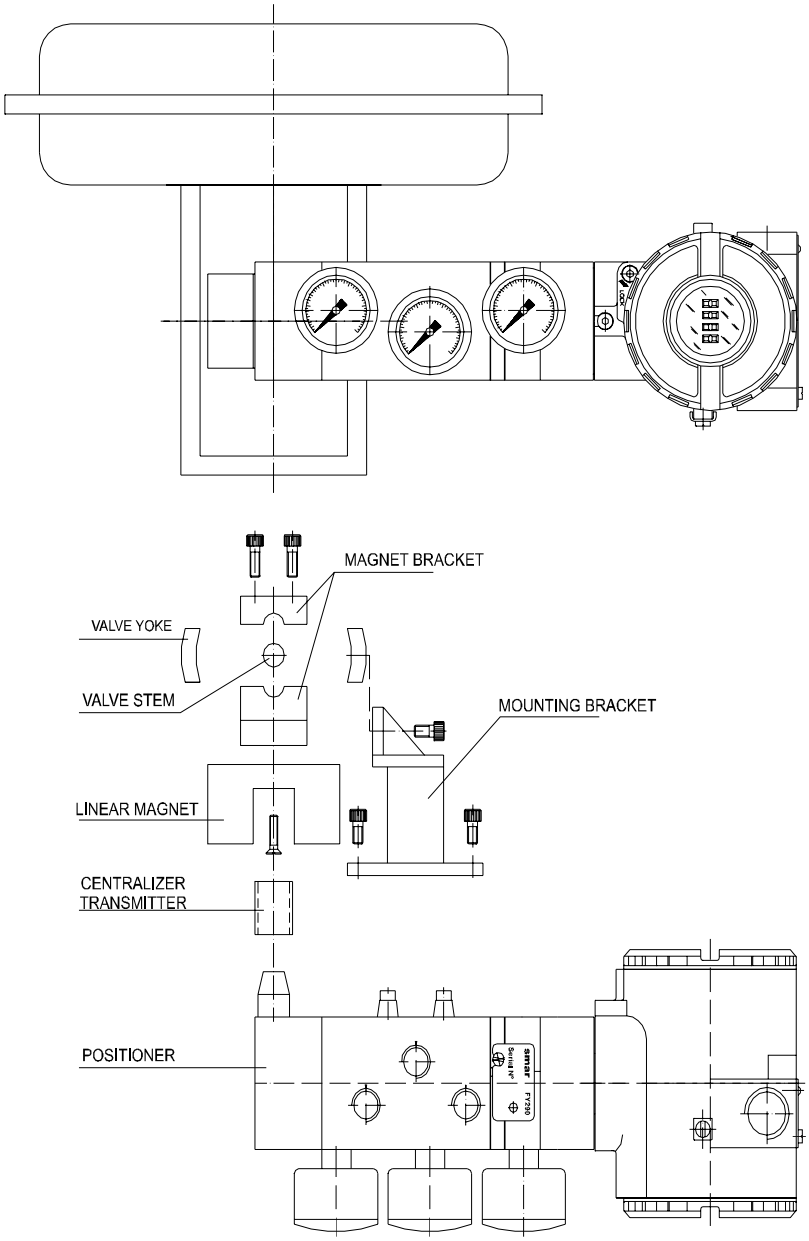


Fig. 1.3 – Positioner on the Linear Actuator

Electronic Housing Rotation

The electronic housing can be rotated 360° in order to re-orientate the digital display. To rotate it, use the Housing Rotation Set Screw, see Figure 1.4.

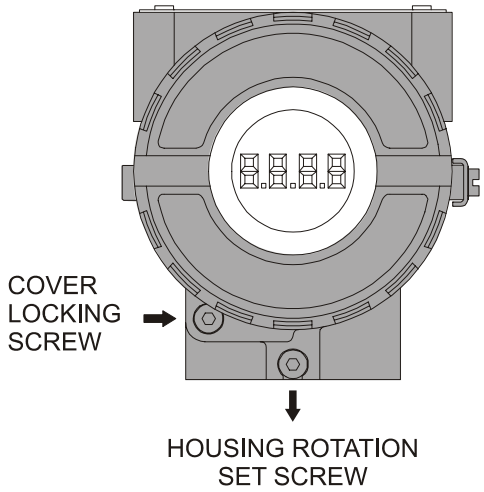


Figure 1.4 - Housing Rotation Set Screw

Access 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 1.5.

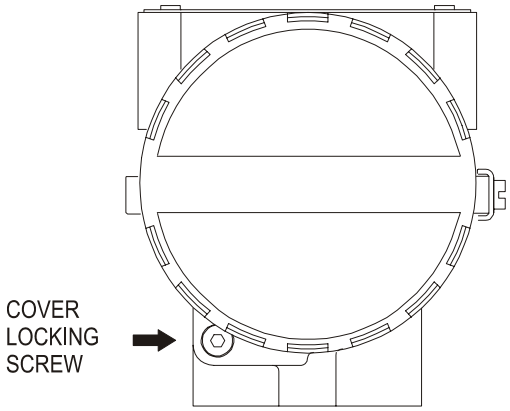


Fig. 1.5 – Cover Locking Screw

The local indicator itself can also be rotated. See Section 5, Figure 5.2.

Electric Wiring

Test terminals allow the user to measure the current in the 4 - 20 mA loop without cutting into the 4-20mA wiring, and communication terminals facilitate communication with the transmitter. To measure the mA signal, connect a multimeter set to read mA to the "**–** " and "**+**" terminals, and to communicate, use a HART configurator in the "**COMM**" and "**–** " terminals.

For convenience there are two ground terminals: one inside the cover and one external, located close to the conduit entries.

The wiring block has screws into which fork or ring-type terminals can be fastened. See Figure 1.6.

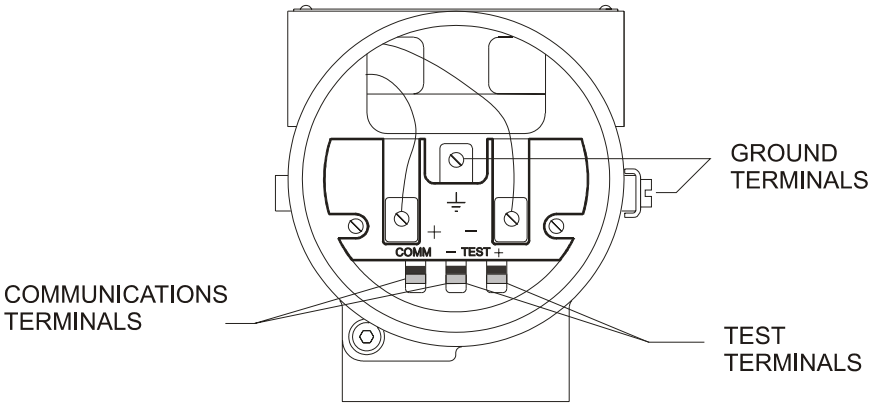


Fig. 1.6 – Wiring Block

HAZARDOUS AREAS
In hazardous areas with explosion proof requirements, the covers must be tightened at least 8 turns. In order to avoid the penetration moisture 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 screw.
In hazardous zones with intrinsically safe or non-incendive requirements, the circuit entity parameters and applicable installation procedures must be observed.
Cable access to wiring connections is obtained by one of the two conduit outlets. Conduit threads should be sealed by means of code-approved sealing methods. The unused outlet connection should be plugged and sealed accordingly.
Explosion proof, non-incendive and intrinsic safety certification are standard for SP301.
Should other certifications be necessary, refer to the certification or specific standard for installation limitations.

The Figure 1.7 – 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
.

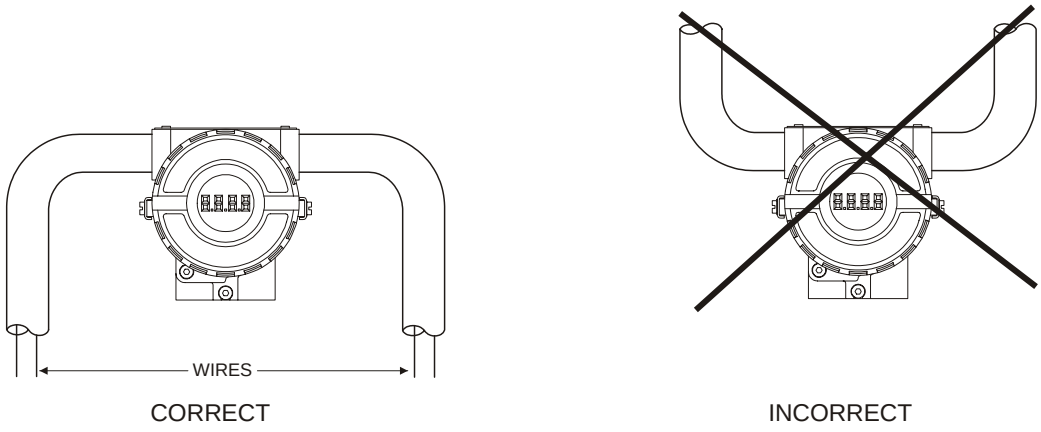


Figure 1.7 - Conduit Installation Diagram.

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

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

The **SP301** is protected against reverse polarity, and can withstand up to 50 mA without damage.

The **SP301** connection may be done according to figures 1.8, 1.9 and 1.10.

The Hand-Held Terminal can be connected to the communication terminals of the transmitter or at any point of the signal line by using the interface IF3 with alligator clips.

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

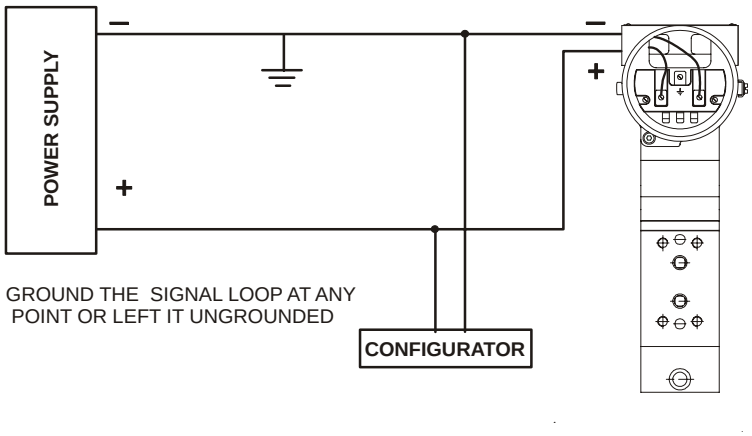


Fig. 1.8 – Wiring Diagram of the SP301

Connection of the **SP301** in multi-drop configuration should be done as in Figure 1.9. Note that a maximum of two positioners can be connected on the same line and that they should be connected in series.

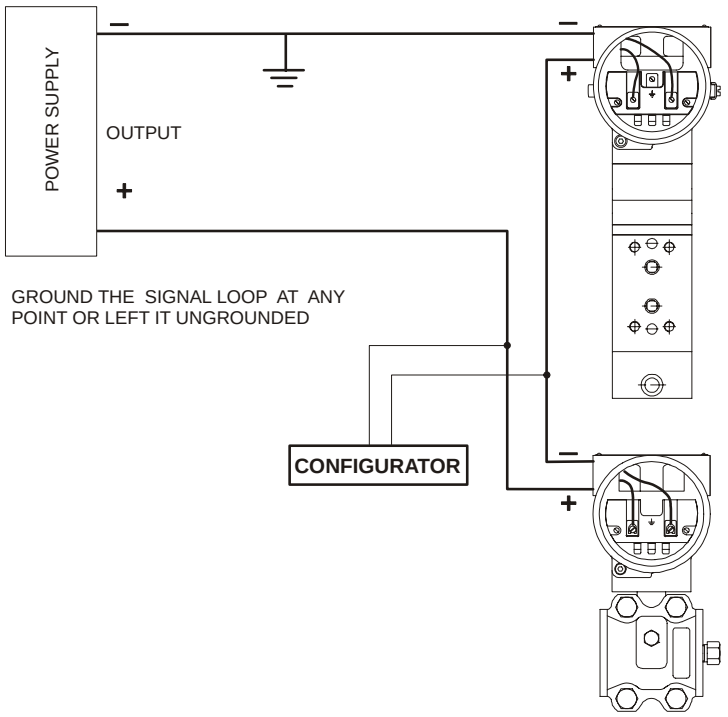


Fig. 1.9 – Wiring Diagram of SP301 Connected in the SPIRAX SARCO Transmitter

The **SP301** has an equivalent impedance of 550 Ohms. Make sure that the analog output (*) powering the positioner is capable to handle a voltage drop of 11 V for each positioner.

If you are using two positioners **in series** as e.g. working in split range, the resulting impedance will be 1100 Ohms. Therefore, the analog output should be capable to handle a voltage drop of 22V.

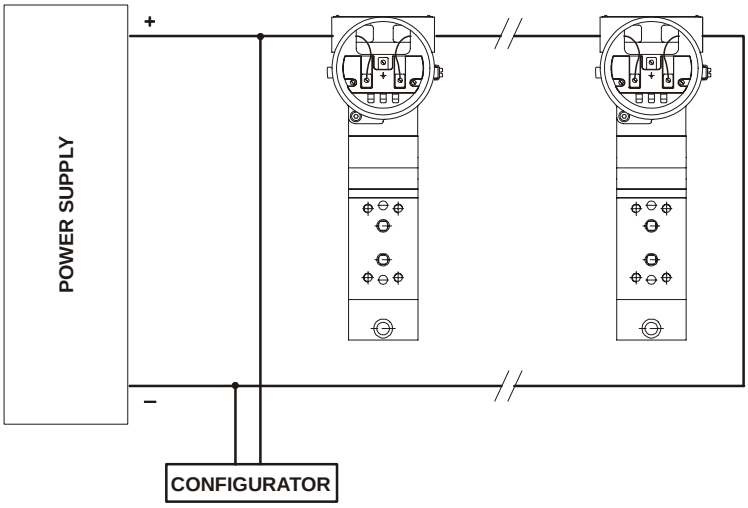


Fig. 1.10 – Wiring Diagram for the SP301 in Multi-drop Configuration

Recommendations for an Instrument Air System

Instrument air quality shall be superior to that of industrial compressed air. Humidity, airborne particles and oil will impair the instrument operation, either temporarily or permanently.
As per standard *ANSI/ISA S7.3 - Quality Standard for Instrument Air*, instrument air shall the following characteristics:

Dew point	10°C below minimum plant temperature
Size of particles (airborne)	3 μm (maximum)
Oil content	1 ppm w/w (maximum)
Contaminants	Free from toxic flammable gases

Standard *ISA RP7.7 - Recommended Practice for Producing Quality Instrument Air* contains general instructions for air production within the quality parameters defined in standard ANSI/ISA S7.3. This standard recommends that the compressor intake be located in an area free from process spills and fitted with and 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 1.11 and 1.12 shows a typical system for Air Supply and Air Quality Conditioning.

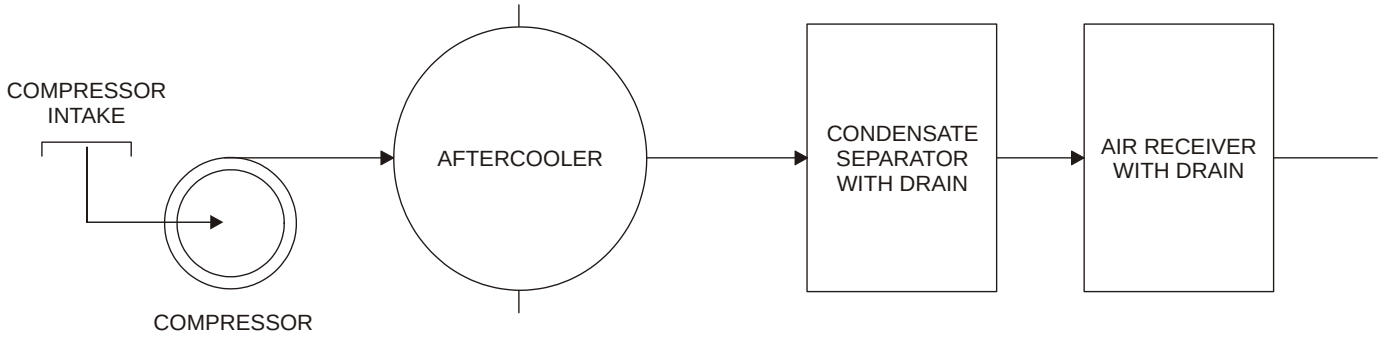


Fig.1.11 – Air Quality Conditioning System

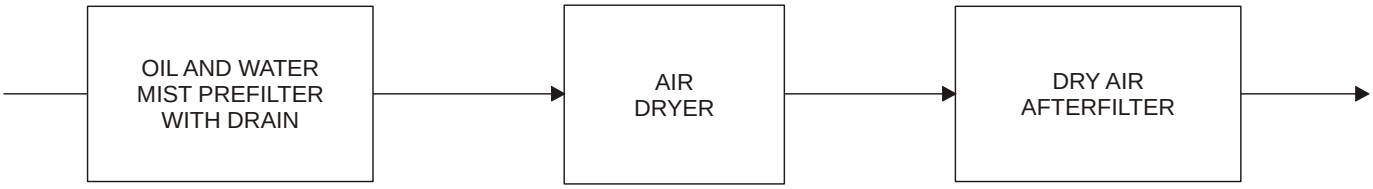


Fig.1.12 - Air Quality Conditioning System

Operation

Functional Description - Transducer

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

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

The pneumatic circuit is based on a well known and widely adopted technology.

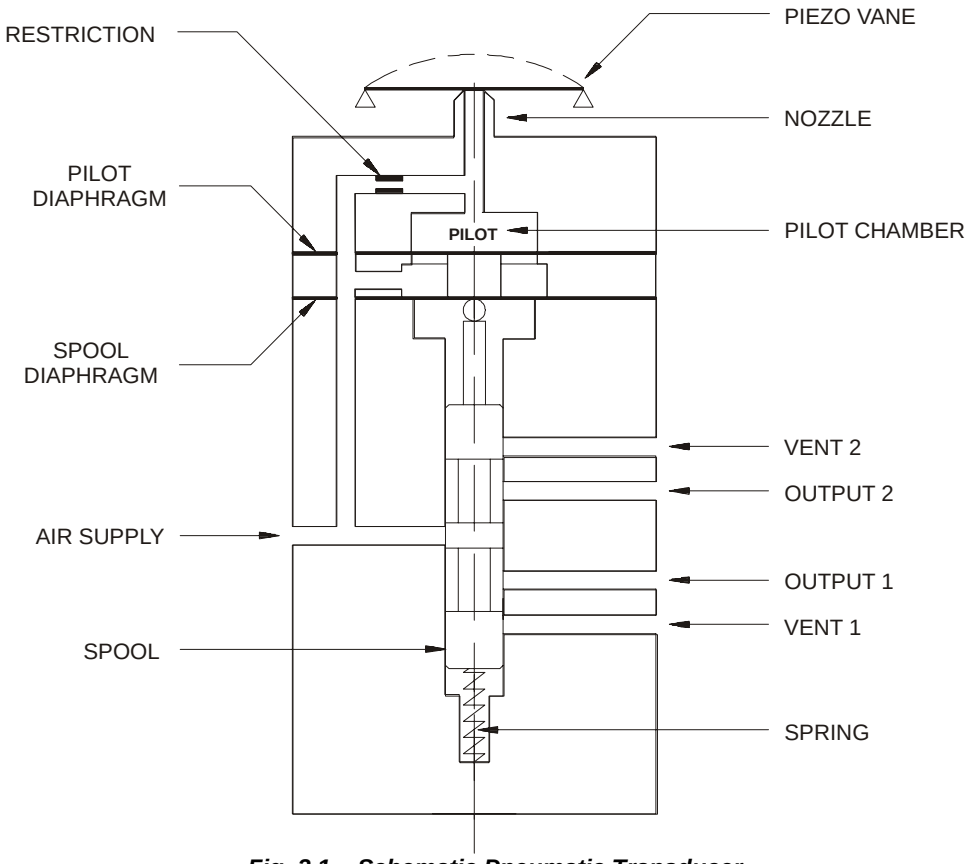


Fig. 2.1 – Schematic Pneumatic Transducer

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 to be used directly, with low air flow rates, 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. 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).

Functional Description-Electronics

Refer to the block diagram (Fig. 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 the desired position, used by the control.

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

Hall Effect Sensor
Measures the actual valve position and feeds back this data to the control and CPU.

Temperature Sensor
Measures the temperature of the Transducer Assembly.

Pressure Sensors
Measure the air supply pressure , and pressure at output 1 and output 2. Available for HART reading.

Isolation
Its function is to isolate the 4 - 20 mA signal from the piezoelectric signal.

EEPROM

A non-volatile memory which stores configuration data as a backup, should the **SP301** main board be replaced

(CPU) Central Processing Unit, 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.

Modem
Modulates and demodulates communication signals 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 of the 4 - 20 mA signal.

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

Display Controller
Receives data from the CPU and drives 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 element 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.

NOTE
The pressure sensor’s circuit board is optional.

Sensor Selector: Select the sensor to be read from.

Sensor IN: Measures air supply pressure.

Sensor OUT1: Changes pressure in Outlet 1

Sensor OUT2: Changes pressure in Outlet 2

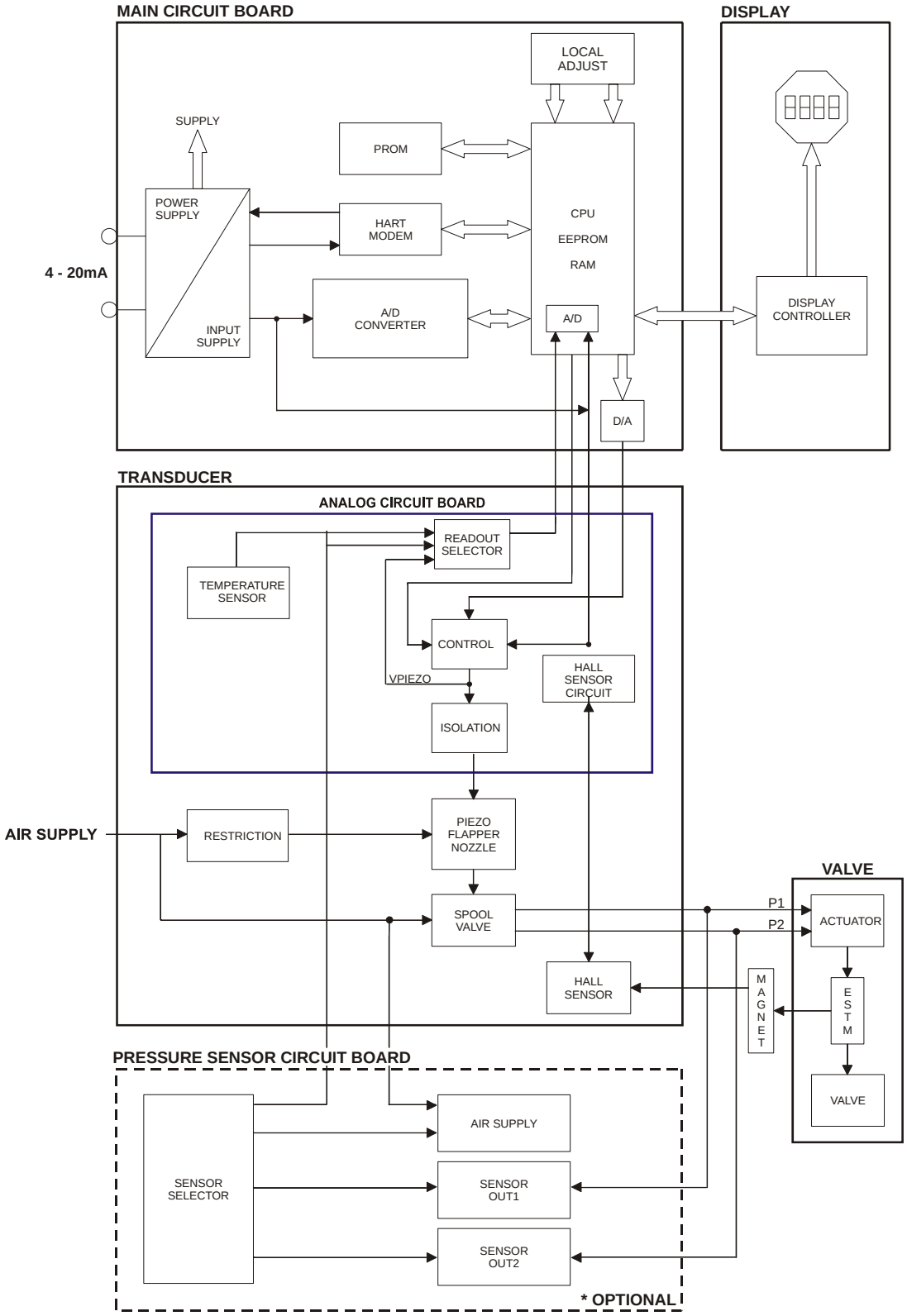


Fig. 2.2 - SP301 Block Diagram

The Local Indicator

The local indicator is required for signaling and operation in local adjustment.

Normal Indicator
During normal operation, the **SP301** 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 **SP301** initializes the position indication on the display, by showing model **SP301** and its software version (X.XX). In case the indication is higher than ±19999 it will be displayed as a two digit and an exponent.

Monitoring
During normal operation, **SP301** remains in the monitoring mode. Figure 2.4 shows the positioning.

The display simultaneously shows the valve position readout and some other information.

Normal display 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.

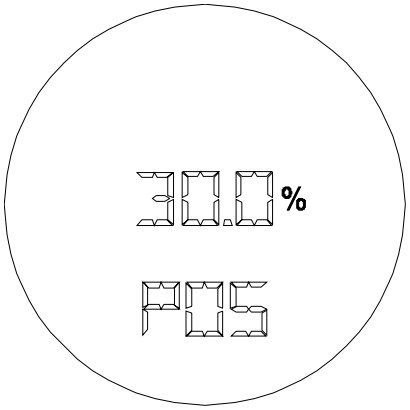


Fig. 2.3 – Typical Normal Indicator

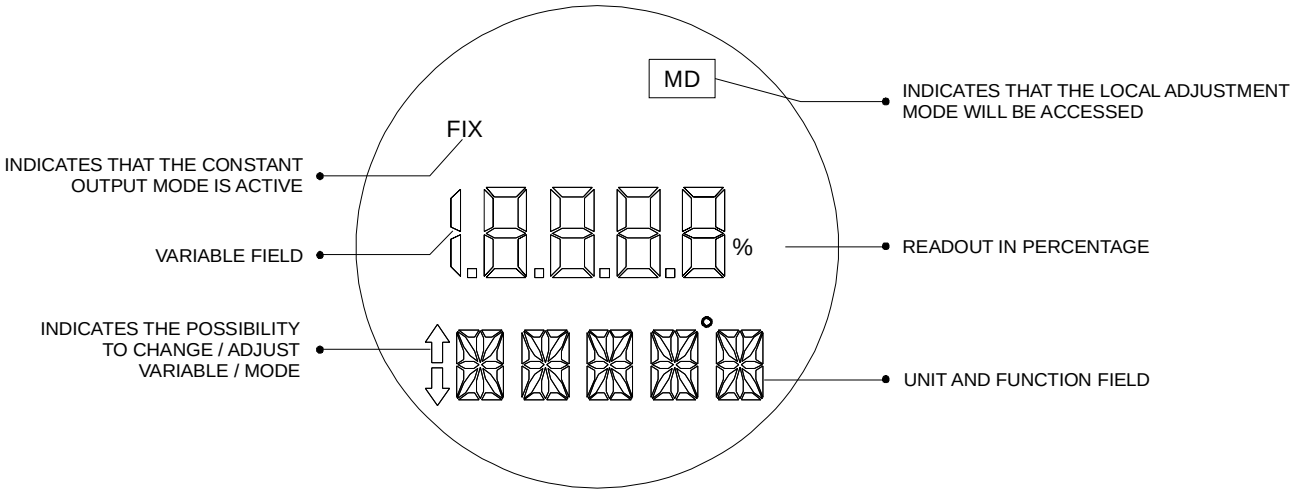


Fig. 2.4 – Local Indicator

Section 3

Programming Using Hand-Held Terminal

HPC HART POCKET CONFIGURATOR

Spirax Sarco SP301 can be configured by hand using a held terminal together withsoftware by SMAR (HPC301).

Introduction

The **HPC301** (HART® Pocket Configurator) is a Palm OS based software that runs in the Palm Operating System version 3.5 and later. The **HPC301 Package** comprises three parts:

1. The communication interface, specifically the **HPI311** (HART® Pocket Interface),
2. The Palm OS based handheld computer, and
3. The configuration software, specifically the **HPC301** (HART® Pocket Configurator).

The HPC301 software is compatible with most Palm handheld versions; this gives the user the flexibility to choose which handheld would be best suited for their purposes. Listed below are the three communication interfaces supported (refer to the *HPI311 Reference Guide*):

HPI311-V - Compatible with Palm V/Vx.

HPI311-III - Compatible with Palm IIIc, and VIIx. (Palm VIIx is available only in the USA.)

HPI311-M5 - Compatible with Palm m125/130, m500/505/515 and i705. (Palm i705 is available only in the USA.)

NOTE
The configuration software is always the same independently of the interface or Palm handheld model chosen.

HPC301 Software Installation

NOTE
If you are unfamiliar with the Palm handheld and it's associated terminology, read the manual that comes with your handheld to become familiar with its terminology and usage. Any Palm terminology used hereafter in this section will be denoted by *italic font*.

To Install/Upgrade the **HPC301** software:

1. Ensure the *cradle* is connected to your computer and the *Palm Desktop software* is installed.
2. Exit all open programs.
3. Start the setup program by double clicking on the **HPC301.EXE** file.
4. When the HPC301 Installer menu appears, click the Next button to begin the installation procedure and follow the on screen instructions.
5. Start the *Hotsync Manager*, if not already started.
6. Insert your handheld in its *cradle* and press the *HotSync* button. The HPC301 application will automatically be installed into your Palm handheld.

Now you should be able to see the HPC301 icon in the Palm Handheld (Figure 1).

Figure 1

Starting the Software

To start the HPC301 software:

1. *Tap* the HPC301 icon. The following screen will appear:

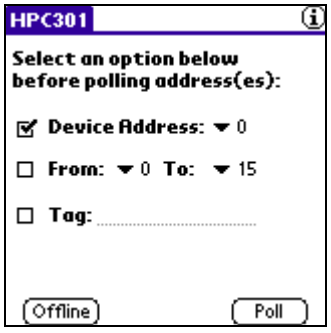


Figure 2

2. Now select the device polling address by choosing an address from 0 to 15. Select a particular device address, a particular device tag, or a range of addresses.

NOTE
Please refer to the field devices' operation manual for connection of the Configurator to the HART® Network.

3. *Tap* the **Poll** button and the HPC301 will poll the network for the desired device. After execution of the Poll function, the list of polled devices found on the bus will be available (Figure 3).

Figure 3

4. Select the device from the list by tapping on it. The HPC301 will provide access to all functions available for this device. For instance, if the selected device is a SP301, the next screen shown would be Figure 4.

Figure 4

5. For further explanation of specific field device procedures, please refer to the instructions provided in the Appendix. If no instructions for the specific device are available, refer to the Generic device section.

Registering the HPC301

To register the HPC301, please send the information below to Spirax Sarco Italy by fax or e-mail. (* Required information.)

To: Spirax Sarco Italy
E-mail: davideradina@it.spiraxsarco.com;
robertogiordano@it.spiraxsarco.com;

Fax: +39 0362 4917 311
User's Information

User Name:
Title:
Company Name:

Address:
City: State: Zip Code:
Phone: Fax:
*E-mail:

HPI311 Information

*HPI311 model and serial number:

NOTE
Registered users receive technical support, early notification of product upgrades, and new product announcements.

Calibrating the Palm handheld screen

Sometimes when you try to *tap* the buttons or icons on your Palm screen, the handheld will activate the wrong feature. When this happens, it usually means that the Palm handheld screen needs to be calibrated. Please refer to the Frequently Asked Questions (tapping and writing problems) section of your Palm manual for calibration instructions.

CONFIGURATION

Introduction

NOTE:
Refer to the SP301's Operation and Maintenance Instruction/Manual for detailed information of the topics described below.

By means of the HART® Configurator, the **SP301** firmware allows the following configuration features to be accessed:

- ✓ Positioner identification and specification data.
- ✓ Remote stroking.
- ✓ Special characterization function according to a configurable 16-point curve.
- ✓ Flow characterization (Linear, Equal Percentage, Quick Opening).
- ✓ Monitoring of all device variables: input, setpoint output, deviation and output module temperature.
- ✓ Diagnostic (Preventive Maintenance).
- ✓ Positioner diagnosis and determining faults
- ✓ PID Controller Configuration.
- ✓ Device Configuration.
- ✓ Equipment Maintenance.

The operations, which take place between the configurator and the positioner do not interrupt the valve positioning, and do not disturb the output signal. The configurator can be connected on the same pair of wires as the 4-20 mA signal, up to 2 km away from the transmitter.

NOTE:
All **HPC301** button sequences provided in this Appendix assume that you are starting from the main **SP301** menu (Figure 1). Refer to **Starting the Software** section of this manual to get to this position.

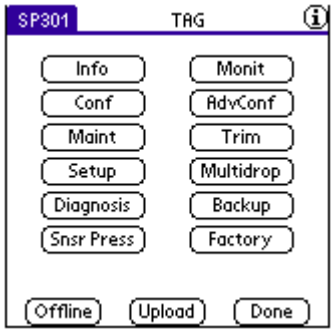


Figure 1

MONITORING - Monit

To Monitor the Positioner variables (Figure 2):

1. From the main **SP301** menu, click the **Monit** button.

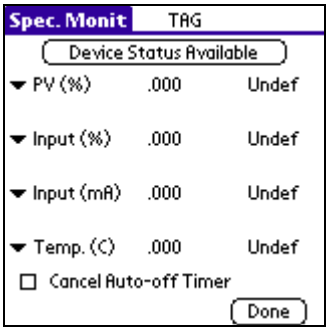


Figure 2

INFORMATION - Info

To configure the **Tag**, **Descriptor**, **Message** and **Date** (Figure 3):

1. From the main **SP301** menu, click the **Info** button.
2. Enter the desired value(s) in the corresponding field(s).
3. Click the **Send** button.

Figure 3

CONFIGURATION - Conf

SAFETY POSITION - *Fail Safe*

The valve position may be programmed to go to either: freeze in *Last Value*, go fully open (*Open*) or go fully closed (*Close*) should the failure occur (in a way that still allows the positioner to manipulate a output). In failure mode FAIL will also be indicated in the display.

FLOW CHARACTERISATION - *Function*

The desired flow characteristics may be changed using this function. E.g. if a valve with linear inherent flow characteristics is used and equal percentage applied flow characteristics is selected, the valve will operate as an equal percentage valve. The adjacent number is the rangeability of the valve. The rangeability of the valve may be found in the manufacturer's documentation.

To configure the ***Fail Safe*** (Safety Position), ***Function*** (Flow Characterization) and ***LCD Indic*** (Figure 4):

1. From the main **SP301** menu, click the **Conf** button.
2. Select the desired value(s).
3. Click the **Send** button.

Figure 4

To configure the ***Table*** points (Figure 5):

1. From the main **SP301** menu, click the **Conf -> Table** button.
2. Select the desired **Number of points** (minimum 2, maximum 16).
3. Enter the desired X(s) and Y(s) values**.**
4. Click the **Send** button.

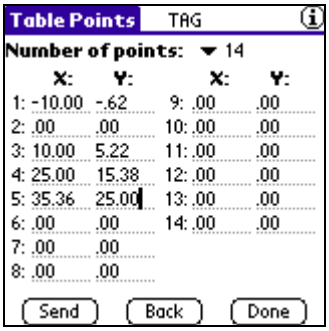


Figure 5

SETUP - Setup

RE-RANGING THE VALVE TRAVEL - *Auto Setup*

To re-range the travel is to change the position values at which the valve is considered fully open and closed. This may also be done using the local adjustment. The SP301 automatically finds the mechanical limitations of valve stroke at fully open and closed positions, but the user may also set a narrower range of operation should this be required. Also, the setpoint limit may be used to limit the travel. Achieving reverse action or split-range operation is a matter of configuring the input, which is done at the **AdvConf** function.

To execute the ***Auto Setup***:

1. From the main **SP301** menu, click the **Setup** -> **Auto Setup** button.

VALVE POSITION - *Lower/Upper Position*

It is possible to perform a fine adjustment for the valve's lower and upper positions, in order to reduce the plug and seat impact. To do this, simply configure "Upper Position" and/or "Lower Position".

To execute the ***Lower Position*** (Figure 6):

1. From the main **SP301** menu, click the **Setup** -> **Lower Position** button.
2. Enter the desired correction value.
3. Click the **Send** button.

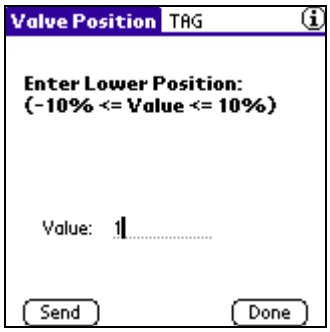


Figure 6

To execute the ***Upper Position*** (Figure 7):

1. From the main **SP301** menu, click the **Setup** -> **Upper Position** button.
2. Enter the desired correction value.
3. Click the **Send** button.

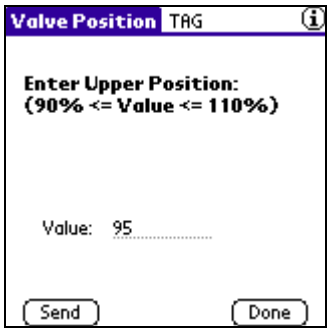


Figure 7

TIME TO CLOSE - *Time_To_Close*
This option allows the valve closing speed to be reduced if the default speed it too fast. The allowed range is 1 ≤ Time ≤ 60.

TIME TO OPEN - *Time_To_Open*

This option allows the valve opening speed to be reduced if the default speed it too fast. . The allowed range is 0.1 ≤ TIME ≤ 60.

SERVO KP - *Servo Kp*

This is the option that provides the gain of the proportional action (**Kp**) of the **PI** control mode. Its value range is as follows: 2 ≤ Kp ≤ 45.

SERVO TR - *Servo Tr*

This option allows the adjustment of the integral action (**Tr**) of the **PI** control. **Tr** valve range is 0 ≤ Tr ≤ 999 min/rep.

To configure the ***Time_To_Close***, ***Time_To_Open***, ***Servo Kp*** and ***Servo Tr*** (Figure 8):

1. From the main **SP301** menu, click the **Setup** button.
2. Enter the desired value(s) in the corresponding field(s).
3. Click the **Send** button.

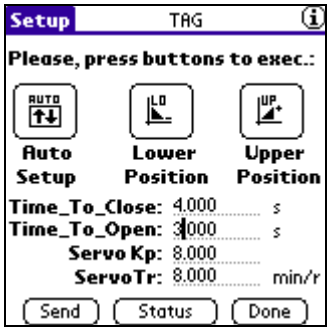


Figure 8

ADVANCED CONFIGURATION - AdvConf

VALVE TYPE - *Valve Type*

The type of actuator motion (i.e. displacement) the actuator has may be configured here. The options are:

Linear - Used with linear valves such as: globe, gate, diaphragm, or pinch/clamp.
Rotary - Used with rotary valves such as: ball, butterfly or plug.

AIR TO - *Air_To*

This function determines if increasing the setpoint the pneumatic output increases (AIR TO OPEN) or decreases (AIR TO CLOSE).

VALVE ACTION - *Valve Action*

An increase in the 4-20mA current input may be set to either open or to close a valve, depending on the valve's flow characteristic. The two control options are:

Direct Action - An increasing input current opens the valve.
Reverse Action - An increasing input current closes the valve.

Please Note this command is directly related with the safety position and the Split Range.

To configure the ***Valve Type***, ***Air_To***, and ***Valve Action*** (Figure 9):

1. From the main **SP301** menu, click the **AdvConf** button.
2. Click on the desired value(s).

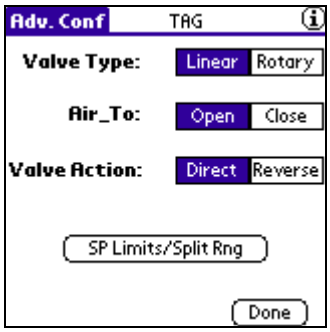


Figure 9

SPLIT RANGE - *Split_Rng_Hi/Split_Rng_Lo*

This option allows the user to split the input current range (4.0 to 20.0 mA) and control two **SP301s** with a single 4-20mA signal. E.g. one **SP301** might be set to respond to a 4.0 a 12.0 mA signal, while another SP301 responds to a 12.0 to 20.0 mA signal.
The adjustment is done by setting “Upper_mA” to 12mA for the first **SP301**, and “Lower_mA” to 12mA for the second **SP301**.

TIGHT SHUT OFF - *TSO_Value*

This feature assigns a setpoint value below which the positioner tightly closes the valve by either full inflation or full venting of the actuator, depending on actuator type.

TIGHT SHUT OFF DEAD BAND - *TSO_D_Band*

The value of this variable creates a tolerance range for TSO_Value. For example, if the Tight Shut Off Value is 4% and the Tight Shut Off Dead Band is 1%, if the SP301 reads that the position of the valve is equal to 5%, SP301 will close the valve immediately. It may be set $0.5 \leq \% \leq 10$.

SETPOINT LIMITS

These two variables mark the limits of the valid **SP** range, and their values, called upper and lower, are the **SP** limits.

UPPER SP LIMIT - *SP_High_Limit*

This is the higher absolute position allowed for the value setpoint, expressed in percentage. The value range is $50 \leq \% \leq 110$.

LOWER SP LIMIT - *SP_Low_Limit*

This is the lowest absolute position allowed for the value setpoint, expressed in percentage. The value range is -10 ≤ % ≤ 50.

INITIAL POSITION - *Pwr_Up_Input*

This function makes it possible to configure an initial position for the valve during initialization. The valve will move from such value to the desired setpoint. The value range for configuration is -10 ≤ % ≤ 110.

DEVIATION DEADBAND - *Dev_D_Band*

This is the magnitude of the valve deviation, in percent of ranged travel.

DEVIATION TIME - *Dev_Time*

This is the time in seconds that the valve must be outside of the Deviation Deadband before the alert is generated.

To configure the ***Split_Rng_Hi***, ***Split_Rng_Lo***, ***TSO_Value***, ***TSO_D_Band***, ***SP_High_Limit***, ***SP_Low_Limit***, ***Pwr_Up_Input***, ***Dev_D_Band***, and ***Dev_Time*** (Figure 10):

1. From the main **SP301** menu, click the **AdvConf** -> **SP Limits/Split Rng** button.
2. Enter the desired value(s) in the corresponding field(s).
3. Click the **Send** button.

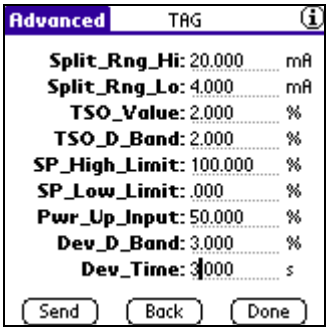


Figure 10

TRIM - Trim

CURRENT TRIM - *Current*

The current trim function is used to calibrate the positioner reading against the actual input current. Trim is NOT used to select the current input or travel ranges. Input trim will result in movement of the valve, so it is therefore good practice to put the valve in Local mode before performing input trim. When the SP301 receives 4 mA it is supposed to read 4.00 mA. If the SP301 receives 20 mA it is supposed to read 20.00 mA. If this is not the case you may use the current trim as follows:

To execute the **4 mA** or **20 mA Trim** (Figure 11):

1. From the main **SP301** menu, click the **Trim** -> **Current** button.
2. Click the **4 mA** or **20 mA** button.
3. Enter the current readout as measured with a precision ammeter.
4. Click the **Send** button.

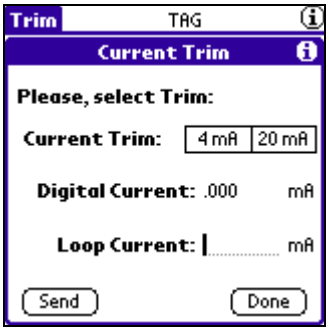


Figure 11

DIAGNOSIS - Diagnosis

TRAVEL DEADBAND - *Dead Band*

This is the amount of valve movement, in percent of ranged travel, necessary to increment the valve travel Mileage counter. Thus the Mileage counter will ignore movements in any one direction if they are smaller than the *Travel* ***Dead Band***.

TRAVEL LENGTH - *Travel Range*

This is the valve movement range. For example: if the length is set to 30 mm, when the valve goes from fully closed to fully open the travel will be increased by 30. The default length is 1.

TRAVEL LIMIT - *Max Mileage*

This is the totalised amount of valve travel which when exceeded, generates an alert. The alert is cleared by entering a new Travel value lower than the Travel Limit.

TRAVEL UNIT - *Eng Unit*

This is the unit of measurement for the valve travel. The default unit is mm.

REVERSAL DEADBAND - *Rvsl Dead Band*

This is the amount of the valve movement, in percent of ranged travel, necessary to increment the reversal counter . Thus reversals smaller than the *Reversal Dead Band* will not be counted.

REVERSAL LIMIT - *Rvsl. Limit*

This is the number of reversals, which, when exceeded, generates an alarm. The alert is cleared by entering a new Reversal value lower than the Reversal Limit.

1. To configure the ***Dead Band***, ***Travel Range***, ***Max Mileage***, ***Eng Unit***, ***Rvsl Dead Band***, and ***Rvsl. Limit*** (Figure 12): From the main **SP301** menu, click the **Diagnosis** button.
2. Enter the desired value(s) in the corresponding field(s).
3. Click the **Send** button.

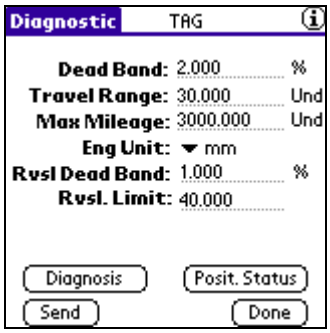


Figure 12

SENSOR PRESSURE - Snsr Press (option actually not included)

The valve positioner SP301, **version 2.12,** has three sensors that work individually to monitor input and output pressures. The input pressure should be within a programmed range in the configuration, or an alarm will be generated by the HART communication.

The **Sensor Pressure** branch is basically divided into three options: **Limits, Pressure Trim**, and **Pressure Unit.**

LIMITS

In this branch the Upper and Lower alarm limits are configured (***High Limit***) (***Low Limit***), in which will be generated whenever an inlet overpressure occurs.

To configure the ***High Limit,*** and ***Low Limit*** (Figure 13).

1. From the main **SP301** menu, click the **Snsr Press** button.
2. Enter the desired value(s) in the corresponding field(s).
3. Click the **Send** button.

Figure 13

PRESSURE TRIM

The **Pressure_Trim** branch allows the user to calibrate the pressure sensors according to a standard. The adjustment options are **Inlet (*Input*), Outlet 1 (*Out 1*) and Outlet 2 (*Out 2*)** (Figure 14). Individually, they all access the options Lower and Upper, in which they allow reading adjustments for each sensor, in a way that the sensor readings coincide with the readings from the standard. To adjust them, access the option **Lower or Upper** in the items **Inlet, Outlet 1 and Outlet 2** and type the readings measured by the standard.

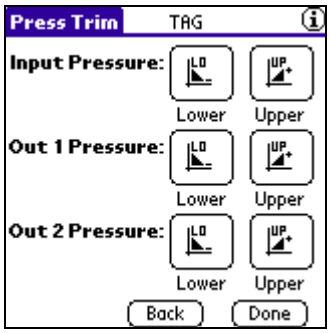


Figure 14

PRESSURE UNIT

In this branch it is possible to configure the desired Engineering pressure units.

To configure the ***Pressure Unit*** (Figure 15):

1. From the main **SP301** menu, click the **Snsr Press** -> **Press Unit** button.
2. Select the desired **Unit.**
3. Click the **Send** button.

Figure 15

MAINTENANCE - Maint

LOCAL OPERATION - ***Local/Remote***

This function makes it possible to locally adjust the valve position to fully open, fully closed, or any value in between. This function is useful for testing of valve performance, and also to manually operate the process in the absence of measurement or other fault preventing closed loop control. To manually set the valve at a desired position, the valve positioner must be set to **Local** mode. In this mode, the valve positioner ignores remote setpoints received over the 4-20 mA input.

To execute the ***Local/Remote*** function (Figure 16):

1. From the main **SP301** menu, click the **Maint** -> **Local/Remote** button.
2. Enter the desired value(s) in the corresponding field(s).
3. Click the **Send** button.

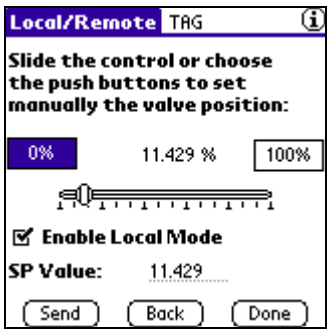


Figure 16

ACTUATOR/VALVE INFORMATION - *Additional Info*
This feature provides information about the actuator and valve model, function and location, and makes it possible to alter them as required. Itaccepts up to 16 characters

To configure the ***Actuator Info***, and ***Valve Info*** (Figure 17):

1. From the main **SP301** menu, click the **Maint** -> **Additional Info** button.
2. Enter the desired value(s) in the corresponding field(s).
3. Click the **Send** button.

Figure 17

OPERATION COUNTER - *Operations Counter*

Every time one of the following items is altered (Figure 18), there is an automatic increment in the corresponding operations counter.

From the main **SP301** menu, click the **Maint** -> **Operations Counter** button.

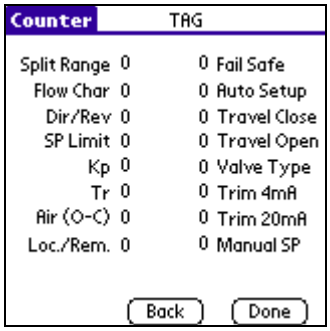


Figure 18

PASSWORD LEVEL - *Passwords*

There are three levels of passwords. They are used to restrict access to certain operations in the programming. A level - 3 password is hierarchically superior to a level - 2 password, which is superior to a level 1 - password. The configuration of the password levels (1 to 3) is stored in the **SP301** EEPROM. Passwords can be configured for CONF, ADVCONF and MAINT branches of the programming tree. The password must be known to enter the CONF, ADVCONF and MAINT branch.

To configure the ***Password Levels*** (Figure 18):

1. From the main **SP301** menu, click the **Maint** -> **Passwords** button.

2. Select the desired **Levels.**
3. Click the **Send** button.

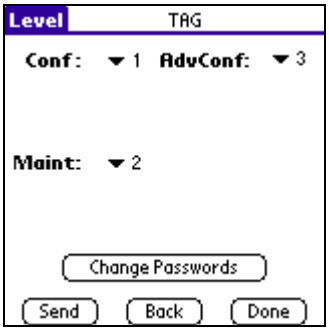


Figure 18

To configure the operation **passwords** (Figure 19):

1. From the main **SP301** menu, click the **Maint** -> **Passwords** -> **Change Passwords** button.
2. Select the password level to be changed.
3. Enter the new password in the corresponding field.
4. Click the **Send** button. Repeat steps 2, 3, and 4 to change other passwords.

Figure 19

MODEL - *Ordering Code*

This feature identifies the model code number (Figure 20).

From the main **SP301** menu, click the **Maint** -> **Ordering Code** button.

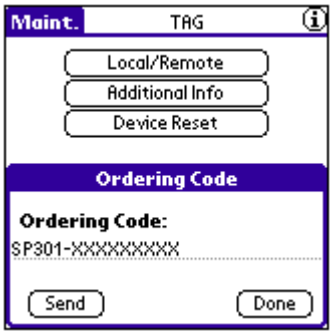


Figure 20

PERFORMANCE

Time Opening/Closing – It is the time in seconds it takes to stroke the valve from fully closed to fully open (***Time Opening***) and from fully open to fully closed (***Time Closing***). It is useful for indication of actuator problems, diaphragm leaks, and pneumatic tubing problems.

To execute the ***Performance Test*** (Figure 21):

1. From the main **SP301** menu, click the **Maint** -> **Performance** button.
2. Click the **Performance Test** button.

Figure 21

MULTIDROP - Multidrop

ADDRESSING - *Multidrop*

To configure the **Polling Address** (Figure 22):

1. From the main **SP301** menu, click the **Multidrop** button.
2. Select the desired value.
3. Click the **Change Polling Address** button.

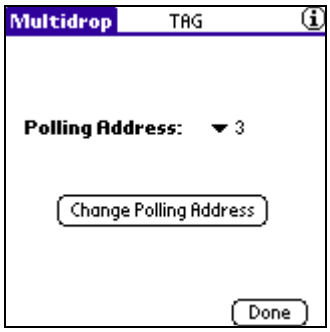


Figure 22

BACKUP - Backup

BACKUP - ***Backup***

When the transducer or main circuit is changed, it is necessary, immediately after the assembly, to transfer the data of the new transducer to the main board. This is done automatically, when the transducer is powered on. If necessary, you can force the transfer using the ***Read From Transducer*** option. In order to transfer data from the transducer to the main board memory, or vice-versa, Option ***Write To Transducer*** of the BACKUP menu may be used to record the modifications performed, for example, in Kp, Tr, etc.

To execute the **Read From Transducer** or **Write To Transducer** (Figure 23):

1. From the main **SP301** menu, click the **Backup** button.
2. Click the desired function button.

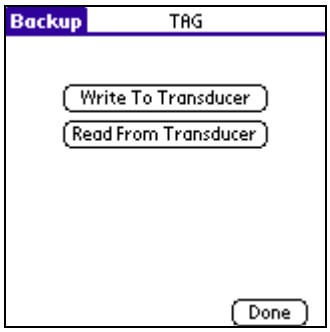


Figure 23

Section 4

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 Fig 4.1).

NOTE
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.

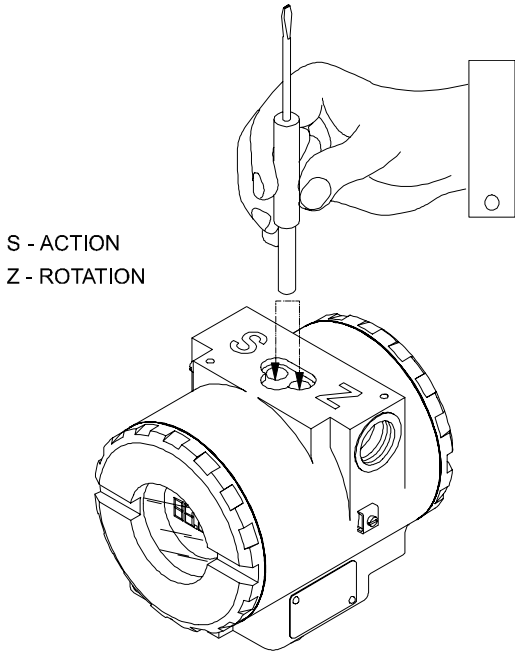


Fig. 4.1 – Local Adjustment Orifices

ORIFICE	ACTION
Z	Function browsing.
S	Selects the displayed function.

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

Local Programming Tree

The programming tree is a tree shaped structure with a menu of all available software functions, as shown on Fig. 4.2.

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 select that particular option.

By keeping the tool in orifice **"S"** it is possible to continuously actuate the selected parameter, since this is a numeric value. To increment the parameter, repeatedly insert and remove the magnetic tool until reaching the desired value.

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

Adjustable Parameters

Type (TYPE)
This parameter enables the user to configure valve type as well as the type of valve action. These are the options:

Lind: Linear and Direct;

Linr: Linear and Reverse;

Rotd: Rotary and Direct;

Rotr: Rotary and Reverse.

Setup (Auto Positioning)

After configuring the valve type by means of parameter TYPE, the AUTO SETUP parameter must be initiated. 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% travel limits are established. This operation lasts approximately 4 minutes. After configuring the valve type as described above, the user must browse up to the parameter SETUP (tool in orifice **Z**) and place the tool in orifice **S** in order to initiate the auto positioning sequence of the valve.

Characterization (CHAR)
This parameter allows the user to configure the valve characterization curve. Options are as follows:

- **Lin:** Linear;
- **EP50:** Equal Percentage 50%;
- **HY:** Hyperbolic.

Mode (MODE)
This parameter allows the user to choose the operation mode. When turning the positioner on, it will always be in automatic mode, but it is possible to switch instead to manual mode.

Automatic (Auto).
During **"Automatic"** mode the positioner responds to the 4 to 20 mA current signal. While in automatic mode, local operation is disabled.

Manual (Man)
During "**Manual"** mode the positioner ignores the setpoint normally determined by the mA input signal. This is the only mode in which the **SP%** parameter can be actuated.

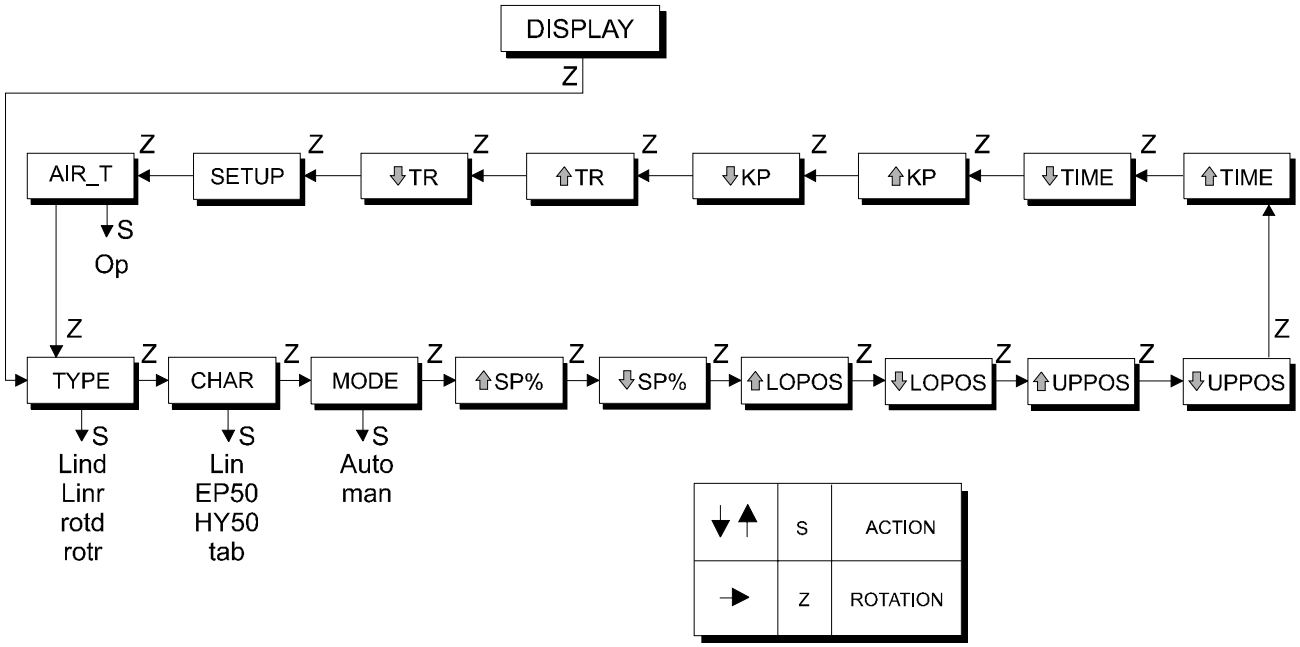


Fig. 4.2 – Local Programming Tree

Set Point (SP %)
This parameter represents the desired valve position. Whilst in "Manual" mode, it is possible to actuate this parameter remotely, independently from the input current. Whilst in automatic, it is calculated from the input current level.

Lower Position (LOPOS)
This parameter defines the lower valve postion with respect to the input signal, usually at 4 mA, unless it is in split range operation.

Upper Position (UPPOS)
This parameter defines the upper valve postion with respect to the input signal, usually at 20 mA, unless it is in split range operation.
Caution!
During automatic calibration, make sure the valve reaches both the upper and lower end stops.If it does not, investigate & take corrective action before proceeding further. Calibration is performed in terms of percentage.

.

Setpoint Variation Time (TIME)
This allows the configuration of the setpoint variation rate. It is expressed in terms of percentage. It is adjustable in the following range: 1 to 60.

Higher values cause the setpoint variation to be faster.

Lower values cause the setpoint variation to be slower.

Proportional Gain (KP)
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** valves are between 35 and 45.

For rotary valves, typical **Kp** valves are around 8.

Integral Time (Tr)
This parameter makes it 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** valves are around 2 minutes/repetition.

For rotary valves, typical **Tr** valves are around 8 minutes/repetition.

Procedure for Calibration of the Valve

STEP 1
Select valve type by means of the menu **TYPE**, browsing at least once through the options (**Lin and Rot**).

STEP 2

SETUP
In order to start self-calibration, browse to 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 valve overshoot (the overshoot will require adjustment after the **RATE** has been adjusted). The lower the **Kp** is, the lower the overshoot will be, but valve positioning will be slower.

Set **Tr** in a valve where the position does not oscillate and control is capable of quickly reaching the final position.

STEP 4

Time Adjustment
Perform **TIME** adjustment for fast moving valves in order to slow down valve movement and decrease the overshoot.

STEP 5

Zero Adjustment by means of loPos (Lower Position).

When making this adjustment the input signal current must be that 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 alter its valve 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 passing beyond the desired valve.

STEP 6

Span Adjustment by means of UpPos (Upper Position).
Whilst setting span adjustment, the mA signal must correspond to 100% as, for example, 20 mA. The procedure is similar to the one described for zero adjustment.

Air to Open or to Close (AIR_T)
This option makes it possible to adjust the positioner indication, so that the value displayed is equal to the actual valve position. Should the actuator be in **"**direct action**"** and **"**air to open**"** or **"**air to close**"**, the positioner shall be configured as **AIR_OPEN** or **AIR_CLOSED**, respectively.

However, should the actuator be in **"**reverse action**"** and **"**air to open**"** or **"**air to close**"**, the positioner must be configured as **AIR_CLOSED** or **AIR_OPEN** respectively.

Section 5

Maintenance Procedures

General

SPIRAX SARCO **SP301** to Valve Positioners are extensively tested and inspected before delivery 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 does not try to repair printed circuit boards. Instead, he should have spare circuit boards, which may be ordered from **SPIRAX SARCO** whenever necessary.

Diagnostic with Hand-Held Terminal

For further informations refer to Section 3 of this manual.

Diagnostics without Hand-Held Terminal

In order to carry out the diagnostics, refer to table 5.2.

DIAGNOSTICS	
SYMPTOM	**PROBABLE ERROR SOURCE:**
POSITION IS NOT DISPLAYED	▪ Positioner Connections • Check wiring polarity and continuity. ▪ Power Supply must be a current source • Check signal input current. Minimum current for positioner operation is 3.8 ma. ▪ Electronic Circuit Failure • Check the boards for malfunctions and faulty boards for spare ones.
NO RESPONSE TO THE INPUT SIGNAL	▪ Pressure Output Connections • Check for air leaks. ▪ Air Supply Pressure • Check the air supply pressure. Input pressure to the SP301 must be between 20 and 100 psi. ▪ Calibration • Check the positioner calibration points. ▪ Obstructed Restriction and/or Blocked Output Connection • Refer to the following procedures described in this Manual: OUTPUT CONNECTION and RESTRICTION CLEANING.
OSCILLATING ACTUATOR	▪ Calibration • Adjust parameter Kp. • Adjust parameter Tr.
SLOW ACTUATOR RESPONSE	▪ Adjustment Parameters are Too Low • Adjust parameter SERVO_KP or Time to Open or Time to Close.
ACTUATOR RESPONDS TOO FAST	▪ Adjustment Parameters are Too High • Adjust parameter SERVO_KP or Time to Open or Time to Close.

Table 5.2 - SP301 Diagnostics without the Programmer

Disassembly Procedure

Refer to Fig. 5.3, "**SP301** Exploded View". Make sure to disconnect power supply and supply air before disassembling the positioner.

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, ensuring that the flat cable is not excessively twisted.

IMPORTANT:
The positioners have a stopper that can be released to allow the transducer to rotate more than one turn. See Fig. 5.1.

CAUTION:
Do not rotate the electronic housing more than 180° without disconnecting the electronic circuit from the power supply.

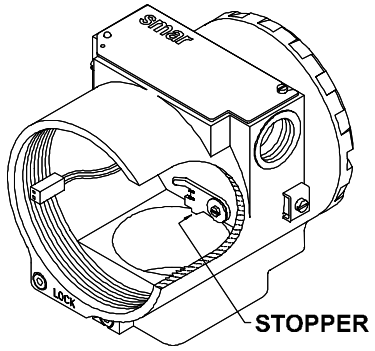


Fig. 5.1 – Transducer Rotation Stopper

Electronic Circuit

To remove the circuit board (**5**) and indicator (**4**), first loosen the cover locking (**6**) on the side not marked "Field Terminals", then unscrew the cover (**1**).

WARNING:
The boards have CMOS components, which may be damaged by electrostatic discharges. Observe correct procedures for handling CMOS components. It is also recommended to store the circuit boards in electrostatic-proof cases.

Loosen the two screws (**3**) that anchor the indicator and the main circuit board. Gently pull out the indicator, and then the main board (**5**).

Reassemble Procedure

TRANSDUCER

Mount the transducer to the housing, turning clockwise until it stops. Then turn it counterclockwise until it faces the square of electronic housing to the square of transducer. Tighten the hex screw (**6**) to lock the housing to the transducer.

CLEANING RESTRICTION

Air is supplied to the nozzle through a restriction. Poor quality instrument air can result in metal chips, dirt, oil, etc, into the restriction.

A regular periodic check should be made to assure high quality performance of **SP301**. Make sure to disconnect supply pressure before removal of the restriction (**20**) from the transducer. Clean by spraying it with a solvent. If necessary, the restriction can be cleaned by inserting a drill with a maximum diameter of 0.011 in.

EXHAUST PORT
Air is vented to the atmosphere through the two exhausts ports located behind the transducer nameplate and 4 outputs on the opposite side from pressure gauges. A foreign object interfering with or blocking the exhaust port will impair performance. Clean it by spraying it with a solvent.

ATTENTION:
Never use oil or grease in the spool, otherwise the positioner performance will be impaired.

ELECTRONIC CIRCUIT
Plug the 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 indicates up position.

Anchor the main board and indicator with their screws (**3**).

After tightening the protective cover (**1**), mounting procedure is complete. The positioner is ready to be energized and tested.

Interchangeability

Main board can be changed and operate with the transducer. There is an EEPROM in the transducer part that keeps the trim.

Returning Materials

Should it become necessary to return the positioner to SPIRAX SARCO, simply contact your local agent or SPIRAX SARCO office and follow their instructions.

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

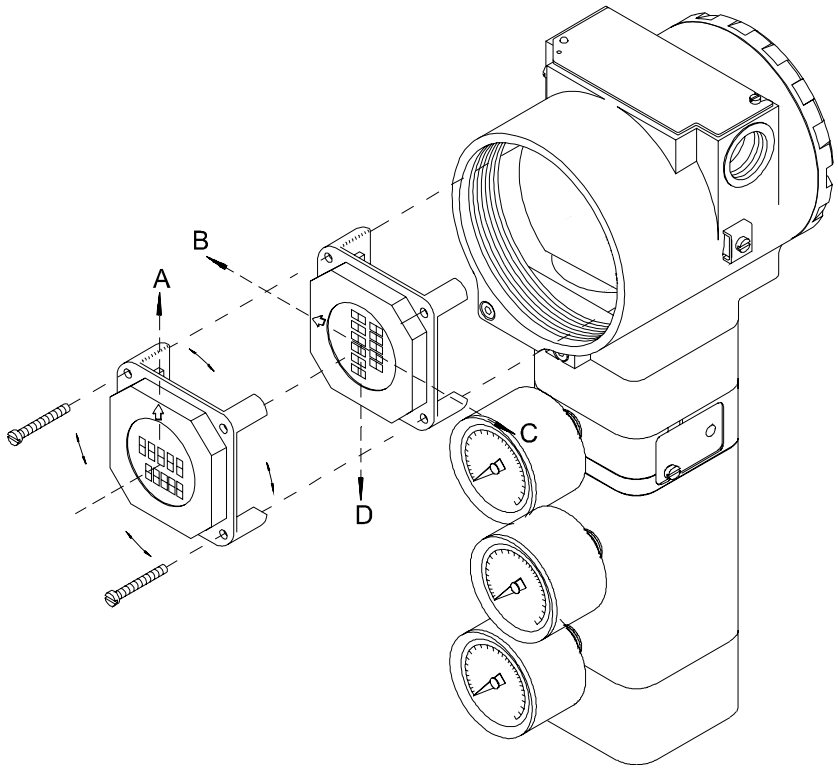


Fig. 5.2 – Four Possible Positions of the Local Indicator

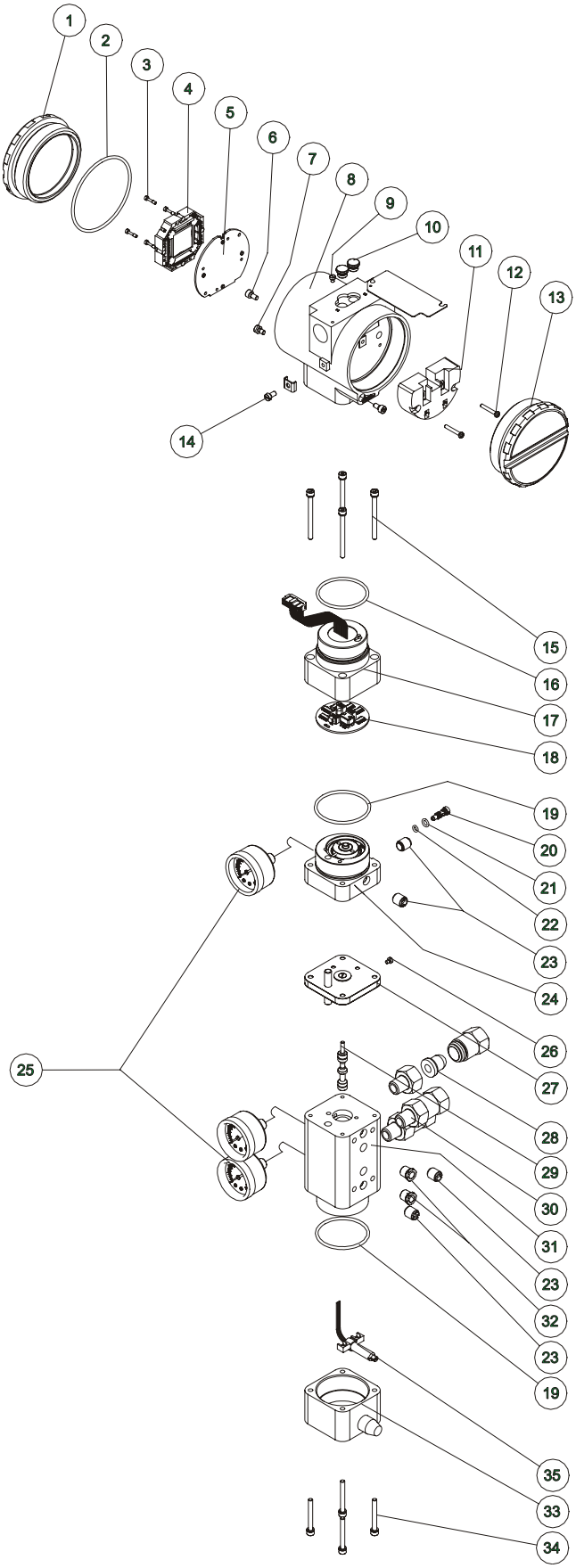


Fig. 5.3 – Exploded View

ACCESSORY	
ODERING CODE	**DESCRIPTION**
SD-1	Magnetic Tool for local adjustment.
PalmZIRE71*	16 Mbytes PalmZIRE71 Handheld, Including HPC301's initialization and installation software.
HPC301*	HART® HPI311-M5P for the PalmZIRE71, including the configuration package for the Spirax Sarco and generic transmitters.
HPI311-M5P*	Just the HART® interface.

SPARE PARTS LIST			
PARTS DESCRIPTION	**POSITION**	**CÓDE**	**CATEGORY (NOTE 4)**
HOUSING, Aluminum (**NOTE 1**)			
. 1/2 - 14 NPT	8		-
. M20 x 1.5	8		-
. PG 13.5 DIN	8		-
HOUSING, 316 SS (**NOTE 1**)			
. 1/2 - 14 NPT	8		-
. M20 x 1.5	8		-
. PG 13.5 DIN	8		-
COVER (INCLUDES O'RING)			
. Aluminum	1 e 13	204-0102	-
. 316 SS	1 e 13	204-0105	-
COVER WITH WINDOW FOR INDICATION (INCLUDES O' RING)			
. Aluminum	1	204-0103	-
. 316 SS	1	204-0106	-
COVER LOCKING BOLT	7		-
SENSOR LOCKING BOLT	6		-
EXTERNAL GROUND BOLT	14		-
IDENTIFICATION PLATE FIXING BOLT	9		-
DIGITAL INDICATOR	4	214-0108	A
TERMINAL INSULATOR	11		A
MAIN ELECTRONIC CIRCUIT BOARD	5	209-0230	A
0-RINGS COVER (**NOTE 2**)			
. Buna-N	2	204-0122	B
TERMINAL HOLDING BOLT HOUSING IN ALUMINUM			
Housing in 316 Stainless Steel	2		B
Housing in 316 Stainless Steel	12		B
MAIN BOARD BOLT HOUSING IN ALUMINUM			
Units with indicator	3		B
Units without indicator	3		B
MAIN BOARD BOLT HOUSING IN 316 STAINLESS STEEL			
Units with indicator	3		B
Units without indicator	3		B
ALUMINUM CONNECTION COVER	15,16,17 and 18		A
316 STAINLESS STEEL CONNECTION COVER	15,16,17 and 18		A
. Connection Cover Bolt	15		-
. Buna N Neck O-ring	16	204-0113	B
. Assembled Connection Cover - Aluminum	17		-
. Assembled Connection Cover - 316 Stainless Steel	17		-
. Analog PC Board GLL 1012	18		-

SPARE PARTS LIST			
PARTS DESCRIPTION	**POSITION**	**CÓDE**	**CATEGORY (NOTE 4)**
PIEZO BASE SET – ALUMINUM	19,20,21,22, 23,24 and 25		A
PIEZO BASE SET – 316 STAINLESS STEEL	19,20,21,22, 23,24 and 25		A
. Base and Block O'ring	19		B
. Restriction	20		B
. Restriction External O-ring	21	344-0155	B
. Restriction Internal O-ring	22	344-0150	B
. Syntherized Bushing	23		B
. Assembled Base – Aluminum	24		A
. Assembled Base – 316 Stainless Steel	24		A
. Analog indicator (Pressure gauge) – Carbon Steel	25		B
. Analog indicator (Pressure gauge) – 316 Stainless Steel	25		B
ALUMINUM INTERMEDIATE SET	26 and 27		A
316 STAINLESS STEEL INTERMEDIATE SET	26 and 27		A
. Identification tag bolt	26		-
. Assembled diaphragm – Aluminum	27		B
. Assembled diaphragm – 316 Stainless Steel	27		B
ALUMINUM BLOCK SET	19,23,25,28,29,30,31 and 32		A
316 STAINLESS STEEL BLOCK SET	19,23,25,28,29,30,31 and 32		A
. Base & Block O-ring	19		-
. Syntherized Bushing	23		-
. Analog indicator (Pressure gauge) – Carbon Steel	25		-
. Analog indicator (Pressure gauge) – 316 Stainless Steel	25		-
. Filtering Element	28		A
. Spool valve	29		-
. 304 Stainless steel Filter- 1/4" NPT	30		B
. Assembled Block– Aluminum	31		-
. Assembled Block – 316 Stainless Steel	31		-
. Vent Plug – Bronze	32		-
. Vent Plug - 316 Stainless Steel	32		-
ALUMINUM HALL COVER SET	33,34 and 35		A
316 STAINLESS STEEL HALL COVER SET	33,34 and 35		A
. Aluminum Hall Cover Set	33		-
. 316 Stainless Steel Hall Cover Set	33		-
. Hall Cover Bolt	34		-
. Hall Support + Hall Sensor + Flat cable	35		B
ALUMINUM TRANSDUCER SET	**NOTE 3**	209-0180	A
316 STAINLESS STEEL TRANSDUCER SET			A
LOCAL ADJUSTMENT PROTECTION COVER.	10		
MAGNETS			
. Linear magnet 15mm.	-	400-0034	
. Linear magnet 30mm.	-	400-0038	-
. Linear magnet 50mm.	-	400-0035	-
. Linear magnet 100mm.	-	400-0036	-
. Rotative magnet.	-	400-0037	-

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 for category **B**, 50.

Section 6

Technical Characteristics

Functional Specifications

Travel

Linear Motion: 3 - 100 mm
Rotary Motion: 30 - 120° Rotation Angle

Input Signal

4 - 20 mA, 2 wire.

Power

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

Voltage Drop

11 Vdc max / 20 mA (equivalent to 550Ω).

Minimum Current

3.8 mA.

Communication

Protocol HART (is superimposed on the current signal).

Reverse Polarity Protection

No damage occurs from reversal of normal supply current (4 - 20 mA) or from misapplication of up 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 ½digit LCD indicator.

Hazardous Location Certification

Explosion proof, weather proof and intrinsically safe to CEPEL, FM, CSA, NEMKO and DMT (pending).

Temperature Limits

Operation:	-40	to	85°C	(-40	to	185°F).
Storage:	-40	to	90°C	(-40	to	194°F).
Display:	-10	to	60°C	(14	to	140°F) operation.
	-40	to	85°C	(-40	to	185°F) without damage.

Humidity Limits

0 to 100% RH.

Flow Characterization

Linear, Equal Percentage, Quick Opening or 16 freely user defined points.

Gain

Through software. Locally adjustable.

Travel Time

Through software. Locally adjustable.

Actual Position Sensing

Magnetic (Non-contact) via Hall Effect.

Performance Specifications

Resolution

≤ 0.1% F.S.

Repeatability

≤ 0.1% F.S.

Hysteresis

≤ 0.2% F.S.

Consumption

0.25 Nm/h (0.15 SCFM) at 1.4 bar (20 psi) supply.
0.70 Nm/h (0.40 SCFM) at 5.6 bar (80 psi) supply.

Output Capacity

46.7 Nm/h (28 SCFM) at 5.6 bar (80 psi) supply.

Ambient Temperature Effect

0.8%/20°C do 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-Magnet Interference Effect

Designed to comply with IEC 801 and European Standards EN50081 and EN50082.

Physical Specifications

Electrical Connection

1/2 -14 NPT, Pg 13.5 or M20 x 1.5.

Pneumatic Connections

Supply and output: 1/4 - 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, IP67).

Weight

Without display and mounting bracket: 2.7 kg.
Add for digital display: 0.1 kg.

SP30	POSITIONER

COD.	Protocol
*1	4-20 mA + Hart
2	Foundation Fieldbus
3	Profibus PA

COD.	Bracket Mounting Kit **
0	Without Kit
*1	With Kit (bracket + magnet)

COD.	Electrical Connections
*0	½ - 14 NPT
A	M20 x 1.5
B	PG 13.5 DIN

COD.	Type of Actuator **
*1	Rotary – Single Action
2	Rotary – Double Action
*3	Linear – Single Action
4	Linear – Double Action
5	Others Specify

COD.	Indication Gauge
0	Without Gauge
1	With Gauge – Input
2	With Gauge - Output 1
*3	With 2 Gauges – Input and Output 1
4	With 2 Gauges – Output 1 and 2
5	With 3 Gauges
Z	Others Specify

COD.	Optional Items
H1	316 SST Housing and body
R1	Remote sensor
I2	Explosion Proof (ATEX)
*I4	Intrinsically Safe (ATEX)
J1	Tag on label
SZ	Specify special application

SP30	-	1	-	1	-	0	3	3	-	I4	**Typical code number**

* STANDARD

** Appropriate magnet to be specified on mounting kit

KMS	BRACKET/MAGNET KIT

COD	Kit
0	Without Positioner Bracket
1	Universal Rotary
2	Universal Linear (Yoke and Pillar)
***3**	Linear Spirax Sarco Valves
4	Rotary Spirax Sarco Valves
Z	Others – Specify

COD	Magnet
0	Rotary
***1**	Linear Up to 15 mm
***2**	Linear Up to 30 mm
***3**	Linear Up to 50 mm
4	Linear Up to 100 mm
Z	Others – Specify

COD	Mounting Bracket Material
***C**	Carbon Steel Bracket
I	316 Stainless Steel Bracket
Z	Others – Specify

COD.	Optional Item
SYZ	Specify Actuator Model / Company

KMS	-	3	2	-	C	/	**

**** Leave it blank for no optional item.**

* STANDARD

Section 7

HAZARDOUS LOCATION INSTALLATION AND APPROVALS

INSTALLATION AND OPERATION

Warning:

General Rule:

- Installation in accordance with IEC 60079-14
- Match the certificate parameters according to the environmental classification

For Ex-d protection application

- Only use Plugs, Adapters and Cable glands certified for Ex d.
- Do not use sealing in the threads of Plugs, Adapters and Cable glands
- Do not open in Hazardous Location when energized

For Ex-i protection application

- Installation in accordance with IEC 60079-14
- The Transmitter must be connected to a barrier
- Match the parameters between barrier and the equipment (Consider the cable parameters)
- Associated apparatus ground bus to 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

Hazardous Location Approvals

FM APPROVAL

Intrinsic Safety Protection (FM Report 3009955)

Class I (Gases and Vapors)
Division 1 (Where ignitable concentrations of flammable gases, vapors or liquids can exist all of time or some of the time under normal conditions)
Groups A (Acetilene), B (Hydrogen), C (Ethylene) and D (Propane)

Class II (Dusts)
Division 1 (Where ignitable concentrations of combustible dusts can exist all of time or some of the time under normal conditions)
Groups E (Metal Dust), F (Coal Dust) and G (Grain Dust)

Class III (Fibers)
Division 1 (Where easily ignitable fibers or materials producing combustible flyings are handled, manufactured or used)

- Temperature Class T4 (Maximum Surface Temperature = 135ºC)
- Maximum Ambient Temperature: 60ºC
- Entity Parameters: Vmax = 30 Vdc Imax = 110 mA Ci = 8 nF Li = 12 uH
- Instalation Drawing: 102A-1013-00
- Valid Options:
  a = Digital Indicator 0 (without indicator) or 1 (with digital indicator)
  b = Mounting bracket 0 or 1
  c = Electrical Connections 0 (1/2-14NPT), A (M20x1/2) or B (Pg 13.5 DIN)
  d = Type of actuator (not included) 1, 2, 3, 4, 5, 6, 7, 8 or Z
  e = Indication gauge 0, 1, 2, 3, 4, 5 or Z
  f = Optional items H1 (316 SST Housing)

Explosion Proof Protection (FM Report 3007267)

Class I (Gases and Vapors)
Division 1 (Where ignitable concentrations of flammable gases, vapors or liquids can exist all of time or some of the time under normal conditions)
Groups A (Acetilene), B (Hydrogen), C (Ethylene) and D (Propane)

- Temperature Class T4 (Maximum Surface Temperature = 135ºC)
- Maximum Ambient Temperature: 60ºC
- Valid Options:
  a = Local Indicator 0 or 1
  b = Mounting bracket 0 or 1
  c = Type of actuator (not part of Approval): single alpha-numeric designation
  d = Indication gauge: 0, 1, 2, 3, 4 or 5
  e = Option H1 or blank

Dust Ignition Proof Protection (FM Report 3009955 and FM Report 3007267)

Class II (Dusts)
Division 1 (Where ignitable concentrations of combustible dusts can exist all of time or some of the time under normal conditions)
Groups E (Metal Dust), F (Coal Dust) and G (Grain Dust)

Class III (Fibers)
Division 1 (Where easily ignitable fibers or materials producing combustible flyings are handled, manufactured or used)

- Temperature Class T4 (Maximum Surface Temperature = 135ºC)
- Maximum Ambient Temperature: 60ºC

Non Incendive Protection (FM Report 3009955)

Class I (Gases and Vapors)
Division 2 (Where ignitable concentrations of flammable gases, vapors or liquids are not likely to exist under normal operating conditions)
Groups A (Acetilene), B (Hydrogen), C (Ethylene) and D (Propane)

- Temperature Class T4 (Maximum Surface Temperature = 135ºC)
- Maximum Ambient Temperature: 60ºC

Degree of Protection (FM Report 3009955 and FM Report 3007267)

Type 4X (Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt, rain, sleet, snow, windblown dust, splashing water, hose-directed water, and corrosion; and that will be undamaged by the external formation of ice on the enclosure. Ref: Nema 250)

CSA APPROVAL

Hazardous Location (CSACertificate 1078546)

Class I (Gases and Vapors),
Division 1 (Where ignitable concentrations of flammable gases, vapors or liquids can exist all of time or some of the time under normal conditions)
Groups B (Hydrogen), C (Ethylene) and D (Propane)

Class II (Dusts)
Division 1 (Where ignitable concentrations of combustible dusts can exist all of time or some of the time under normal conditions)
Groups E (Metal Dust), F (Coal Dust) and G (Grain Dust)

Class III (Fibers)
Division 1 (Where easily ignitable fibers or materials producing combustible flyings are handled, manufactured or used)

- Input Supply 12-42Vdc, 4-20mA;
- Maximum Working Pressure 100psi

Class I (Gases and Vapors)
Division 2 (Where ignitable concentrations of flammable gases, vapors or liquids are not likely to exist under normal operating conditions)
Groups A (Acetilene), B (Hydrogen), C (Ethylene) and D (Propane)

Class II (Dusts)
Division 2 (Where ignitable concentrations of combustible dusts are not likely to exist under normal operating conditions)
Groups E (Metal Dust), F (Coal Dust) and G (Grain Dust)

Class III (Fibers)

- Input Supply 12-42Vdc, 4-20mA;

- Maximum Working Pressure 100psi

Intrinsically Safe Protection (CSACertificate 1078546)

Class I (Gases and Vapors)
Division 1 (Where ignitable concentrations of flammable gases, vapors or liquids can exist all of time or some of the time under normal conditions)
Groups A (Acetilene), B (Hydrogen), C (Ethylene) and D (Propane)

Class II (Dusts)
Division 1 (Where ignitable concentrations of combustible dusts can exist all of time or some of the time under normal conditions)
Groups E (Metal Dust), F (Coal Dust) and G (Grain Dust)

Class III (Fibers)
Division 1 (Where easily ignitable fibers or materials producing combustible flyings are handled, manufactured or used)

- Input Supply12-42V dc, 4-20mA;
- Intrinsically safe with entity parameters: Vmax = 28 V Imax = 110 mA Ci = 5 nF Li = 12 uH when connected through CSA Certified Safety Barriers as per Spirax Sarco Instalation Drawing 102A-1015-00
- Temperature Class T3C (Maximum Surface Temperature = 160 ºC)
- Maximum Ambient Temperature: 40ºC
- Maximum Working Pressure 100psi

Degree of Protection (CSACertificate 1078546)

Type 4X (Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt, rain, sleet, snow, windblown dust, splashing water, hose-directed water, and corrosion; and that will be undamaged by the external formation of ice on the enclosure. Ref: Nema 250)

NEMKO APPROVAL

Explosion Proof Protection (Nemko 00ATEX305)

Group II (Other than mines)
Category 2 (for zone 1: Where igniable concentrations of flamable gases, vapors or liquids are likely to exist under normal operating conditions)
G (Gases, Vapours and Mist)
Method of Protection: EEx d (Explosion Proof)
Group IIC (Acetylene)
Temperature Class: T6 (Maximum Surface Temperature = 85º)

- Vmax = 45 Vdc Imax = 25 mA
- Pressure = 20 – 100 psi
- Maximum Ambient Temperature: 40ºC

Ingress Protection

IP67 (6: Dust-tight; 7: Effects of immersion)

DMT APPROVAL

Intrinsic Safety Protection (DMT 01 ATEX E 012)

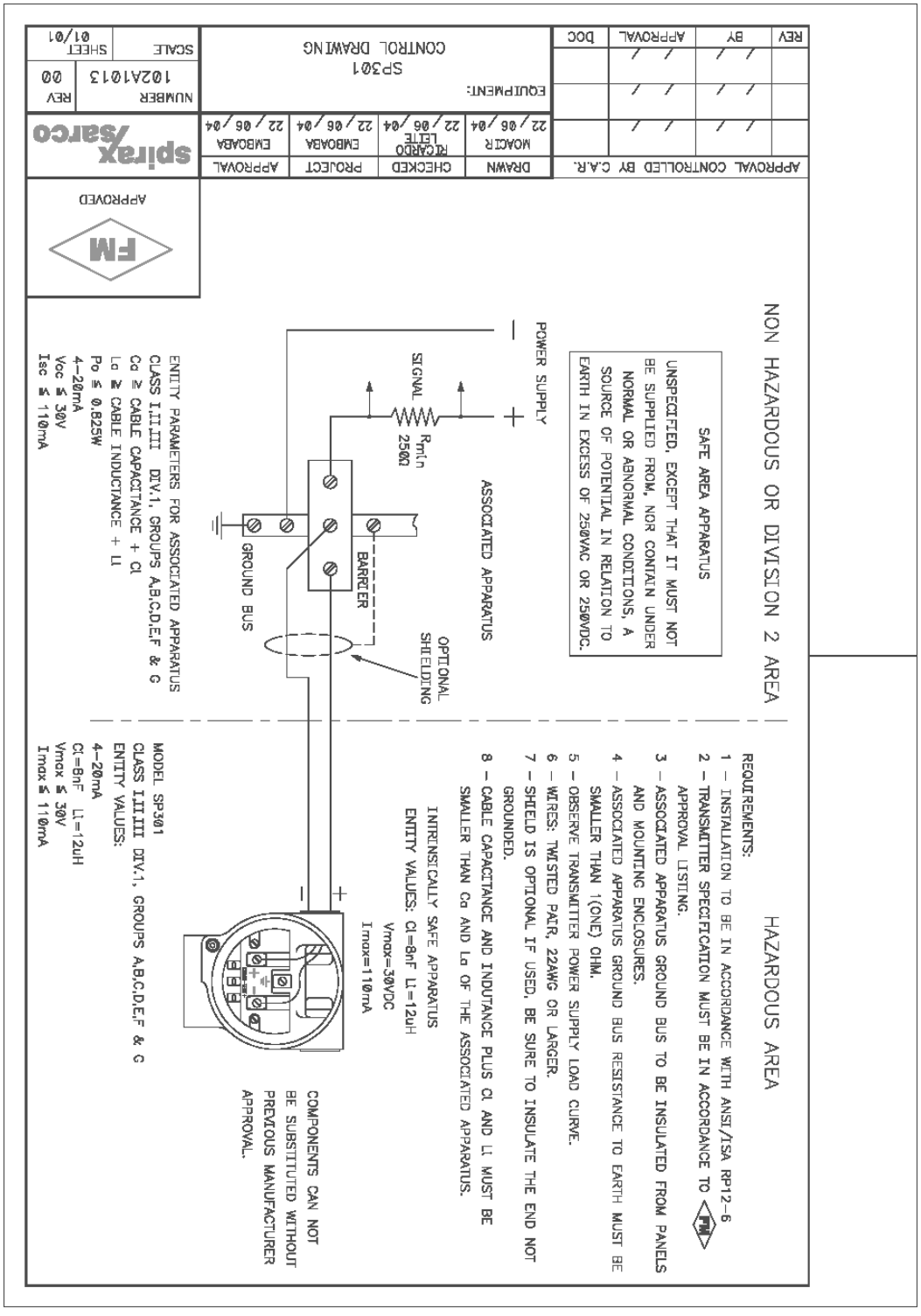
Group II (Other than mines)
Category 2 (for zone 1: Where igniable concentrations of flamable gases, vapors or liquids are likely to exist under normal operating conditions)
G (Gases, Vapours and Mist)
Method of Protection: EEx d [ia] (Intrisic Safety)
Group IIC (Acetylene)
Temperature Class T6 (Maximum Surface Temperature = 85º)

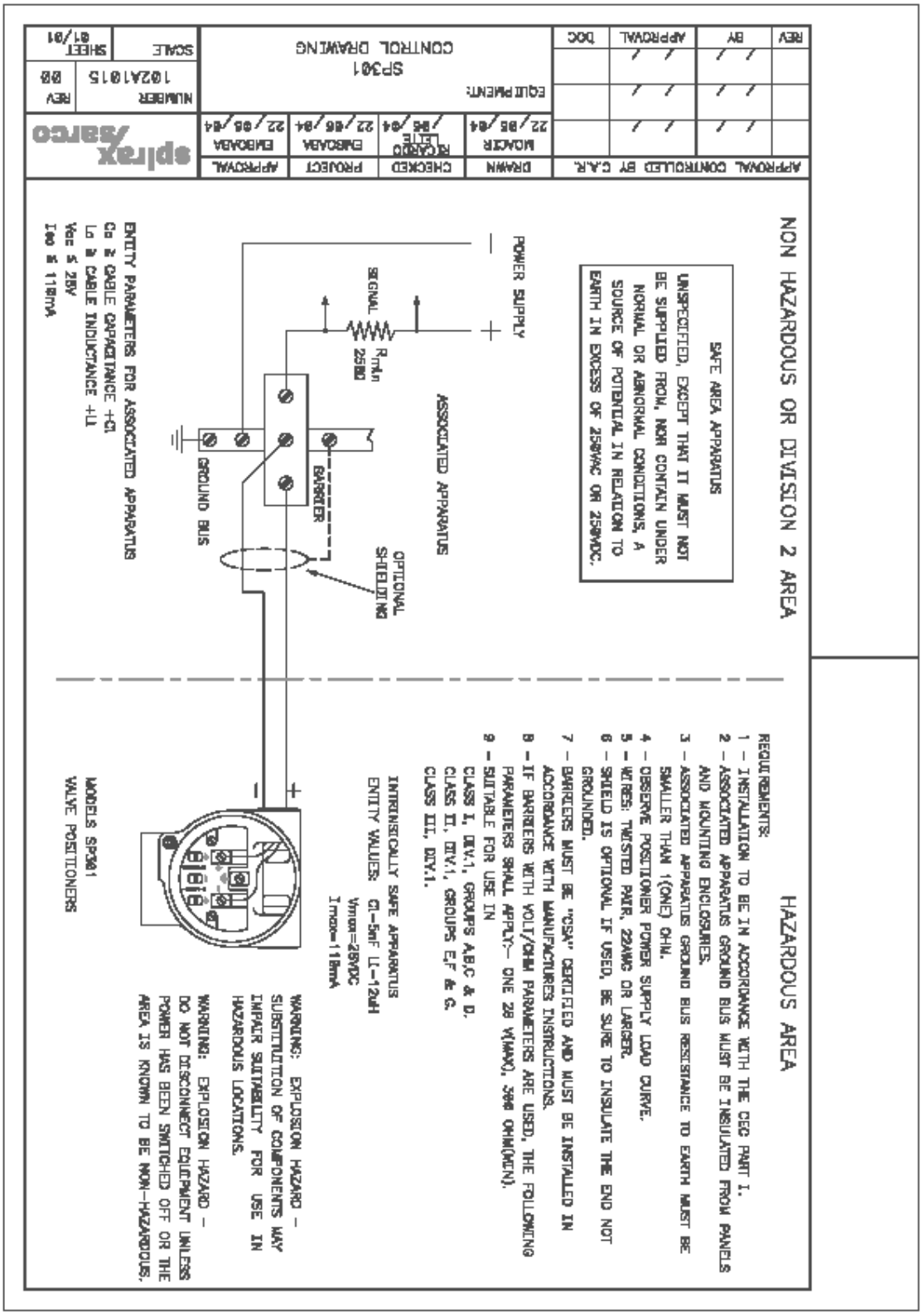
- Entity Parameters: Pi = 700 mW Ui = 28 Vdc Ii = 93 mA Ci ≤ 5 nF Li = 0
- Ambient Temperature: -20º< Ta < 40ºC

Ingress Protection

IP65 (6: Dust-tight; 5: Water jets)

Control Drawings




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.
POWER SUPPLY
SIGNAL
Rmin 250Ω
ASSOCIATED APPARATUS
OPTIONAL SHIELDING
BARRIER
GROUND BUS
ENTITY PARAMETERS FOR ASSOCIATED APPARATUS
Co ≥ CABLE CAPACITANCE +C1
Lo ≥ CABLE INDUCTANCE +L1
Voc ≤ 25V
Isc ≤ 118mA
HAZARDOUS AREA
REQUIREMENTS:
1 – INSTALLATION TO BE IN ACCORDANCE WITH THE CEC PART I.
2 – ASSOCIATED APPARATUS GROUND BUS MUST BE INSULATED FROM PANELS AND MOUNTING ENCLOSURES.
3 – ASSOCIATED APPARATUS GROUND BUS RESISTANCE TO EARTH MUST BE SMALLER THAN 1(ONE) OHM.
4 – OBSERVE POSITIONER POWER SUPPLY LOAD CURVE.
5 – WIRES: TWISTED PAIR, 22AWG 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/OHM PARAMETERS ARE USED, THE FOLLOWING PARAMETERS SHALL APPLY:– ONE 28 V(MAX), 300 OHM(MIN).
9 – SUITABLE FOR USE IN
CLASS I, DIV.1, GROUPS A,B,C & D.
CLASS II, DIV.1, GROUPS E,F & G.
CLASS III, DIV.1.
INTRINSICALLY SAFE APPARATUS
ENTITY VALUES: Ci=5nF Li=12uH
Vmax=28VDC
Imax=118mA
WARNING: EXPLOSION HAZARD – SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR USE IN HAZARDOUS LOCATIONS.
WARNING: EXPLOSION HAZARD – DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.
MODELS SP301
VALVE POSITIONERS
APPROVAL CONTROLLED BY C.A.R.
DRAWN 22/05/04
CHECKED RICARDO ELIE 04/06/04
PROJECT 22/05/04
APPROVAL 22/05/04
EQUIPMENT: SP301
CONTROL DRAWING
NUMBER 1024101S
REV 00
SCALE
SHEET 01/01
REV
BY
APPROVAL
DOC
splrax sarco