



USER INSTRUCTIONS

Logix® 505+ Digital Positioners

FCD LGENIM0109-03-A4 – (09/15)

*Installation
Operation
Maintenance*



Contents

Quick Start Instruction	25	8 Startup	25
1. General Information	4	8.1 Quick Start Instructions	25
1.1 Using This Document	4	8.2 Local User Interface Overview	25
1.2 Terms Concerning Safety	4	8.3 Configuration Switch Settings	26
1.3 Protective Clothing	4	8.4 Stroke Calibration	26
1.4 Qualified Personnel	4	8.5 Factory Reset	26
1.5 Valve And Actuator Variations	4	9 Maintenance And Repair	27
1.6 Spare Parts	4	9.1 Scheduled Maintenance	27
1.7 Service / Repair	4	9.2 Required Tools And Equipment	27
1.8 Basic Operation	5	9.3 Torque Specification For Screws	27
1.9 Position Definition	5	9.4 Replacing A Main Board	28
1.10 Tight Shutoff	6	9.5 Cleaning And Replacing A Double Acting Pilot Relay	29
1.11 Outer Loop	6	9.6 Replacing A Single Acting Pilot Relay	30
1.12 Inner Loop	6	10 Troubleshooting	31
1.13 Detailed Sequence Of Positioner Operations	6	10.1 Troubleshooting Guide	31
1.14 Inner Loop Offset	6	10.2 Status Code Descriptions	32
2 Specifications	8	10.3 Help From Flowserve	36
2.1 Input Signal	8	11 Positioner Dimensions	37
2.2 Pneumatic Output	8	11.1 Positioner Dimensions	37
2.3 Air Supply	8	12 How To Order	38
2.4 Stroke Output	8	12.1 Positioners	38
2.5 Positioner Performance Characteristics	9	12.2 Spare Parts Kits	39
2.6 Physical Specifications	9	12.3 Gage Blocks	40
2.7 Temperature	9	12.4 VDI/VDE 3847 Mounting Blocks	41
3 Hazardous Area Certifications	10	12.5 Mounting Kits	41
4 Storage And Unpacking	11		
4.1 Storage	11		
4.2 Unpacking	11		
4.3 Pre-Installation Inspection	11		
4.4 Labels	11		
5 Mounting And Installation	12		
5.1 Mounting To Mark One Linear Valves	12		
5.2 Mounting To Flowtop Linear Valves	13		
5.3 Mounting To Standard Valtek Rotary Valves	15		
5.4 Mounting To Maxflo Rotary Valves	17		
5.5 Mounting To Rotary Namur (Automax) Valves	18		
5.6 Mounting To A Linear Namur Pneumatic Actuator	19		
6 Tubing	20		
6.1 Determine Air Action	20		
6.2 Connect Supply Port	21		
6.3 Purging Single Acting Actuators	21		
6.4 Vented Design	21		
7 Electrical Connections	23		
7.1 Electrical Terminals	23		
7.2 Command Input (4-20 Ma) Connection	23		
7.3 Connections For Intrinsically Safe Operation	24		

Figures

Figure 1: Principles Of Operation Of Logix 505+	5
Figure 2: Principles Of Operation Of Logix 505+	6
Figure 3: Logix 505+ Digital Positioner Schematic	7
Figure 4: Certification Label	11
Figure 5: Model Code Label	11
Figure 6: Mounting To Mark I Linear Valves	12
Figure 7: Flowtop Mounting Bracket	13
Figure 8: Flowtop Mounting	14
Figure 9: Valtek Rotary Follower Arm	15
Figure 10: Valtek Rotary Take-Off Arm	15
Figure 11: Valtek Rotary Mounting	15
Figure 12: Valtek Rotary Final Orientation	16
Figure 13: Maxflo Take-Off Arm	17
Figure 14: Maxflo Follower Arm	17
Figure 15: Maxflo Assembly	17
Figure 16: Maxflo Connection	17
Figure 17: Automax Bracket	18
Figure 18: Automax Assembly	18
Figure 19: Mounting To A Linear Actuator	19
Figure 20: Linear, Double Acting, Air To Open	20
Figure 21: Rotary, Double Acting, Air To Open	20
Figure 22: Linear, Single Acting, Air To Open	21
Figure 23: Exhaust Vents	21
Figure 24: Pneumatic Connections	22
Figure 25: Terminal Diagram	23
Figure 26: Compliance Voltage	24
Figure 27: Conduit And Grounding	24
Figure 28: Local User Interface	25
Figure 29: Display Main View	26
Figure 30: Tools For Positioner Maintenance	27
Figure 31: Inner Cover	28
Figure 32: Main Board Screws	28
Figure 33: Main Board Connectors	28
Figure 34: Clip Spring Orientation	29
Figure 35: Double Acting Relay Assembly	29
Figure 36: Inserting The Double Acting Block Assembly	29
Figure 37: Single Acting Relay Assembly	30
Figure 38: Spare Parts Kits	39

General Information

1.1 Using This Document

Product users and maintenance personnel should thoroughly review this manual prior to installing, operating, or performing any maintenance on the positioner.

The following instructions are designed to assist in unpacking, installing and performing maintenance as required on Logix® 505+ positioners.


Separate Flow Control Products User Instructions cover the valve, actuator, or portions of the system and other accessories. Refer to the appropriate instructions when this information is needed. In most cases Flowserve valves, actuators and accessories are designed for specific applications with regard to medium, pressure and temperature. For this reason they should not be used in other applications without first contacting the manufacturer.


To avoid possible injury to personnel or damage to positioner parts, **DANGER** and **CAUTION** notes must be strictly followed.

1.2 Terms Concerning Safety

The safety terms **DANGER**, **CAUTION** and **NOTE** are used in these instructions to highlight particular dangers and/or to provide additional information on aspects that may not be readily apparent.

NOTE: Indicates and provides additional technical information, which may not be very obvious even to qualified personnel.


 **CAUTION:** Indicates that minor personal injury and/or property damage can occur if proper precautions are not taken.

 **DANGER:** Indicates that death, severe personal injury and/or substantial property damage can occur if proper precautions are not taken.

Compliance with other, not particularly emphasized notes, with regard to assembly, operation and maintenance and technical documentation (e.g., in the operating instruction, product documentation or on the product itself) is essential in order to avoid faults, which in themselves might directly or indirectly cause severe personal injury or property damage.

1.3 Protective Clothing

Flowserve positioners use high pressure gas to operate. Use eye protection when working around pressurized equipment. Follow proper procedures for working with natural gas if it is used.

 **DANGER:** Standard industry safety practices must be adhered to when working on this or any process control product. Specifically, personal protective equipment must be used as warranted.

1.4 Qualified Personnel

Qualified personnel are people who, on account of their training, experience, instruction and their knowledge of relevant standards, specifications, accident prevention regulations and operating conditions, have been authorized by those responsible for the safety of the plant to perform the necessary work and who can recognize and avoid possible dangers.

In unpacking, installing and performing maintenance as required on Flowserve products, product users and maintenance personnel should thoroughly review this manual prior to installing, operating or performing any maintenance.

1.5 Valve and Actuator Variations

These instructions cannot claim to cover all details of all possible product variations, nor can they provide information for every possible example of installation, operation or maintenance. This means that the instructions normally include only the directions to be followed by qualified personal where the product is being used for its defined purpose. If there are any uncertainties in this respect particularly in the event of missing product-related information, clarification must be obtained via the appropriate Flowserve sales office.

1.6 Spare Parts

Use only Flowserve original spare parts. Flowserve cannot accept responsibility for any damages that occur from using spare parts or fastening materials from other manufactures. If Flowserve products (especially sealing materials) have been in storage for longer periods check these for corrosion or deterioration before using these products. See section 4 STORAGE AND UNPACKING more information.

1.7 Service / Repair

To avoid possible injury to personnel or damage to products, safety terms must be strictly adhered to. Modifying this product, substituting non-factory parts, or using maintenance procedures other than outlined in this instruction could drastically affect performance and be hazardous to personnel and equipment, and may void existing warranties.

Between actuator and valve there are moving parts. To avoid injury Flowserve provides pinch-point-protection in the form of cover plates, especially where side-mounted positioners are fitted. If these plates are removed for inspection, service or repair special attention is required. After completing work the cover plates must be refitted.

Logix 505+ positioner repair is limited to the replacement of sub-assemblies and circuit boards with Flowserve-manufactured replacements as outlined in this manual.

⚠ DANGER: Substitution of with non-factory positioner components may impair intrinsic safety.

⚠ CAUTION: Before products are returned to Flowserve for repair or service, Flowserve must be provided with a certificate which confirms that the product has been decontaminated and is clean. Flowserve will not accept deliveries if a certificate has not been provided (a form can be obtained from Flowserve).

Apart from the operating instructions and the obligatory accident prevention directives valid in the country of use, all recognized regulations for safety and good engineering practices must be followed.

Principles Of Operation

1.8 Basic Operation

The Logix 505+ digital positioner is a two-wire 4-20 mA input digital valve positioner. The positioner is completely powered by the 4-20 mA input signal. Start-up current must be at least 3.8 mA. The Logix 505+ positioner can control both double- and single-acting pneumatic actuators with linear or rotary mountings.

The Logix 505+ digital positioner is an electronic and pneumatic closed-loop feedback instrument. Figure 1 shows a schematic of a Logix 505+ positioner installed on a single-acting linear actuator for air-to-open action. Figure 2 shows the double acting option.

1.9 Position Definition

Whether in Analog or Digital Source, The position at 0% is always defined as the valve in a closed position and 100% is always defined as the valve in an open position. In Analog Source, the 4-20 mA signal is converted to a position (in percent). During loop calibration, the signals corresponding to 0% and 100% are defined.

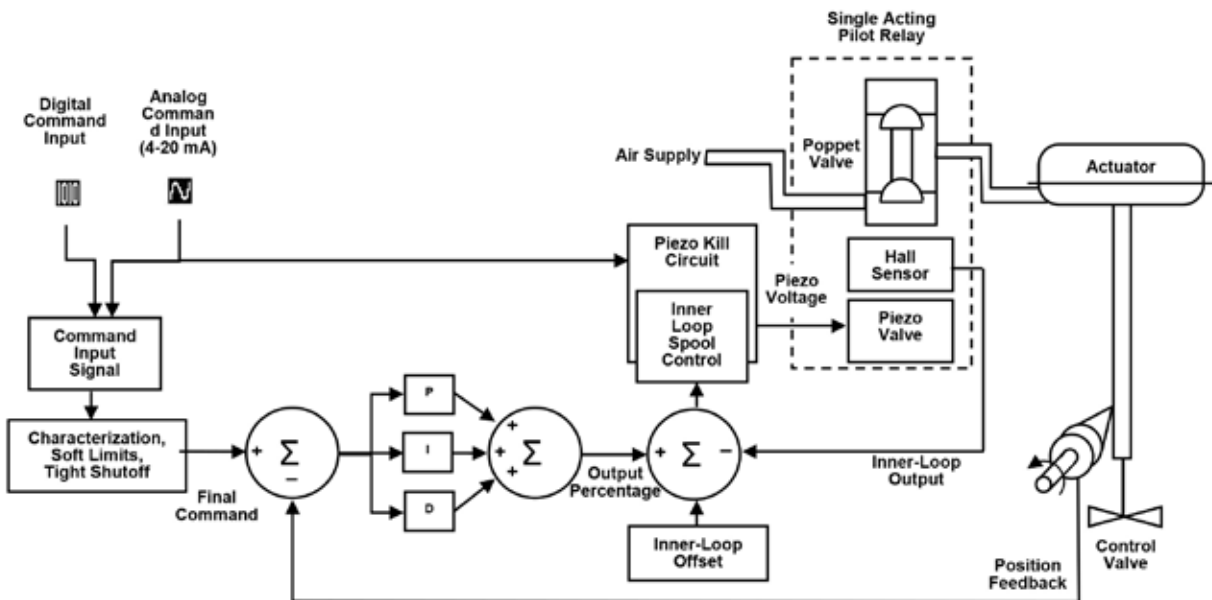


Figure 1: Principles of Operation of Logix 505+

1.10 Tight Shutoff

When the command signal is below 1.0%, the positioner will apply full effort to close the valve. In this case, the Input Command could be 0.9%, and the Final Command would be 0%.

1.11 Outer Loop

The Logix 505+ uses a two-stage, stem-positioning algorithm. The two stages consist of an inner-loop (pilot relay control) and an outer-loop (stem position control). Referring again to Figure 1, a stem position sensor provides a measurement of the stem movement. The Final Command is compared against the Stem Position. If any deviation exists, the control algorithm sends a signal to the inner-loop control to move the relay in a direction, depending upon the deviation. The inner-loop then quickly adjusts the spool position. The actuator pressures change and the stem begins to move. The stem movement reduces the deviation between Final Command and Stem Position. This process continues until the deviation goes to zero.

1.12 Inner Loop

The inner-loop controls the position of the relay valve by means of a driver module. The driver module consists of a temperature-compensated hall-effect sensor and a Piezo valve pressure modulator. The Piezo valve pressure modulator controls the air pressure under a diaphragm by means of a Piezo beam bender. The Piezo beam deflects in response to an applied voltage from the inner-loop electronics. As the voltage to the Piezo valve increases, the Piezo beam bends, closing off against a nozzle causing the pressure under the diaphragm to increase. As the pressure under the diaphragm increases or decreases, the spool or poppet valve moves up or down respectively. The Hall Effect sensor transmits the position of the spool or poppet back to the inner-loop electronics for control purposes.

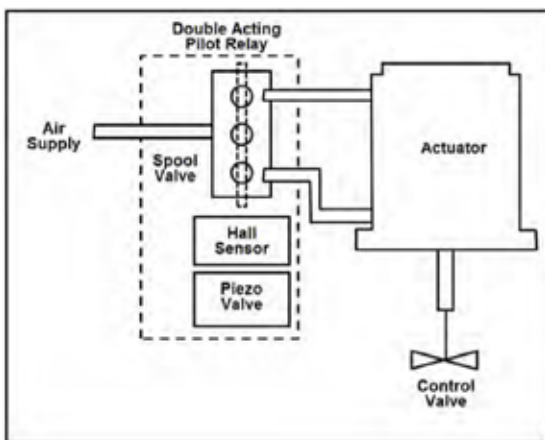


Figure 2: Principles of Operation of Logix 505+

1.13 Detailed Sequence of Positioner Operations

A more detailed example explains the control function. See Figure 3. Assume the unit is configured as follows:

- Valve has zero deviation with a present input signal of 12 mA.
- Loop calibration: 4 mA = 0% command, 20 mA = 100% command.
- Actuator is tubed and positioner is configured air-to-open.

Given these conditions, 12 mA represents a Command source of 50 percent. Since zero deviation exists, the stem position is also at 50 percent. With the stem at the desired position, the spool valve will be at a middle position that balances the pressures above and below the piston in the actuator. This is commonly called the null or balanced spool position.

Assume the input signal changes from 12 mA to 16 mA. The positioner sees this as a command source of 75 percent. The Final Command becomes 75 percent. Deviation is the difference between Final Command and Stem Position: $\text{Deviation} = 75\% - 50\% = +25\%$, where 50 percent is the present stem position. With this positive deviation, the control algorithm sends a signal to move the spool up from its present position. As the spool moves, the supply air is applied to the bottom of the actuator and air is exhausted from the top of the actuator. This new pressure differential causes the stem to start moving towards the desired position of 75 percent. As the stem moves, the Deviation begins to decrease. The control algorithm begins to reduce the spool opening. This process continues until the Deviation goes to zero. At this point, the spool will be back in its null or balanced position. Stem movement will stop and the desired stem position is now achieved.

1.14 Inner Loop Offset

The position of the spool (or poppet) at which the pressures are balanced, holding the valve position in a steady state, is called the Inner Loop Offset. The controlling algorithm uses this value as a reference in determining the Piezo voltage. This parameter is important for proper control and is optimized and set automatically during stroke calibration.

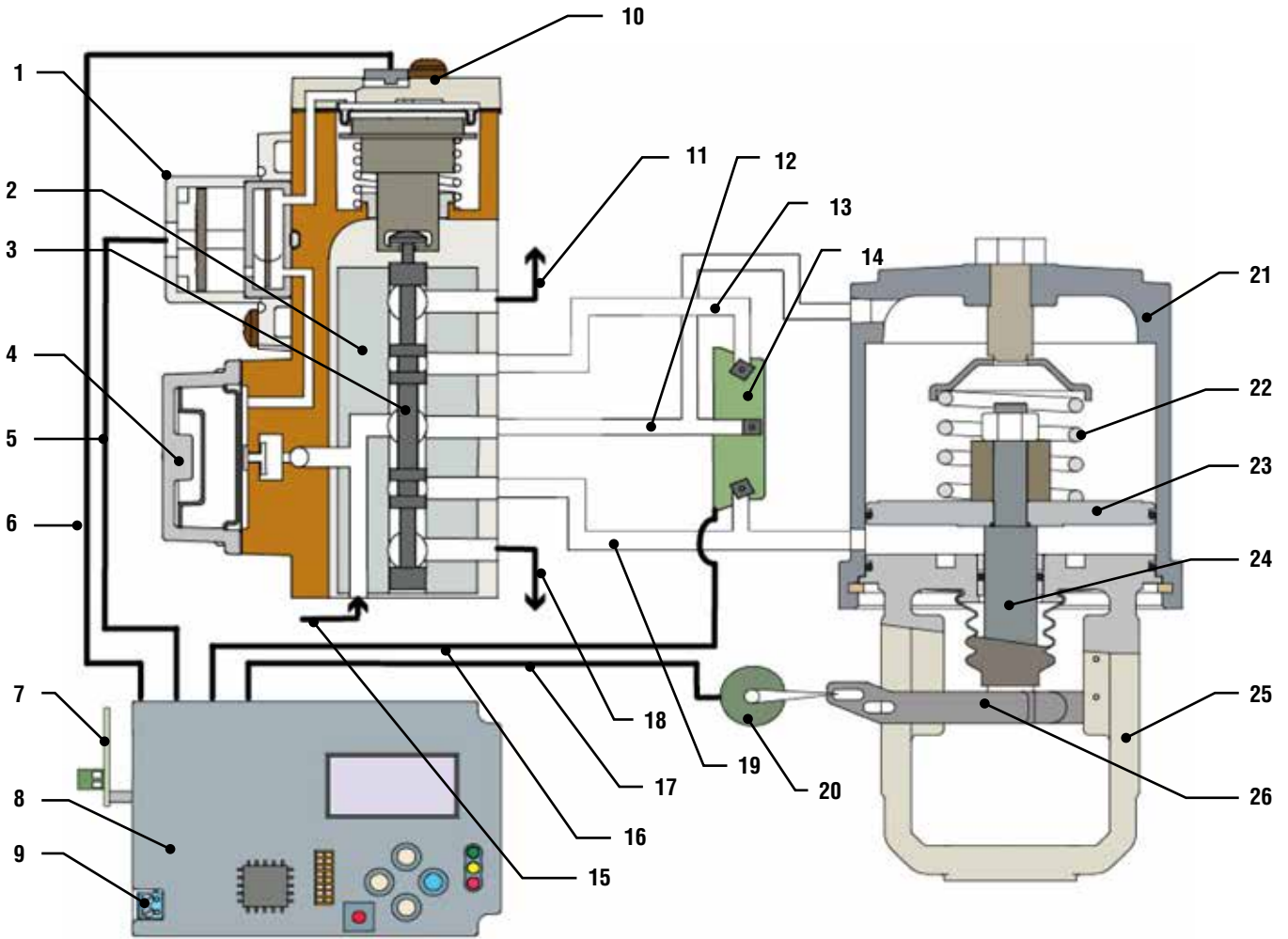


Figure 3: Logix 505+ Digital Positioner Schematic (Double Acting Relay - Air To Open)

1	Piezo Assembly	14	Pressure Sensor Board
2	Block	15	Supply In
3	Spool	16	Pressure Sensor Cable
4	Regulator Assembly	17	Feedback Cable
5	Piezo Cable	18	Exhaust
6	Hall Sensor Cable	19	Port A
7	Auxiliary Card	20	Feedback Potentiometer
8	Main Board	21	Actuator Housing
9	4-20 mA Input	22	Spring
10	Hall Sensor Assembly	23	Piston
11	Exhaust	24	Stem
12	Port B	25	Yoke
13	Supply Pressure	26	Take-Off Arm

2 Specifications

2.1 Input Signal

Table 1: Input Signal

	Positioner Alone or with Multi-Function Card
Power Supply	Two-wire, 4-20 mA 6.0 VDC plus line losses.
Input Signal Range	4 - 20 mA (HART)
Compliance Voltage	6.0 VDC @ 20 mA
Effective Resistance	300 Ω @ 20 mA Typical
Minimum Required Operating Current	3.8 mA
Maximum Shut-down Current	3.6 mA
Power Interruption Time Limit	After power has been applied for at least 10 seconds, a 60 ms power interruption will not cause the positioner to reset.
Power-up time	Time from application of power to begin controlling valve < 1.0 second.

2.2 Pneumatic Output

Table 2: Pneumatic Output

Output Pressure Range	0 to 100% of air supply pressure.
Output Air Capacity	<p>Single Acting Relay – 9.06 Nm³/h @ 1.5 bar (5.33 SCFM @ 22 PSI) 20.8 Nm³/h @ 4.1 bar (12.2 SCFM @ 60 PSI)</p> <p>Double Acting Relay – 14.3 Nm³/h @ 1.5 bar (8.44 SCFM @ 22 PSI) 30.6 Nm³/h @ 4.1 bar (18.0 SCFM @ 60 PSI)</p>
Primary Output Ports (Port is pressurized in energized state. Port is exhausted upon loss of power.)	<p>Single Acting Relay – Port B</p> <p>Double Acting Relay – Port A</p>

2.3 Air Supply

Table 3: Air Supply

Minimum Input Pressure	1.5 Bar (22 PSI)
Maximum Input Pressure	<p>Single Acting Relay – 6.2 Bar (90 PSI)</p> <p>Double Acting Relay – 10.3 Bar (150 PSI)</p>
Air Supply Quality	The air supply must be free from moisture, oil and dust by conforming to the ISA 7.0.01 standard. (A dew point at least 18 degrees Fahrenheit below ambient temperature, particle size below five microns—one micron recommended—and oil content not to exceed one part per million).
Operating Humidity	0 - 100% non-condensing
Acceptable Supply Gases	Air, sweet natural gas, nitrogen and CO ₂ are acceptable supply gasses. Sour natural gas is not acceptable. For Type nA and Type tb installation only air or inert gas may be connected to the air supply inlet.
Air Consumption	<p>Single Acting Relay – 0.069 Nm³/h @ 1.5 bar (0.041 SCFM @ 22 PSI) 0.082 Nm³/h @ 4.1 bar (0.050 SCFM @ 60 PSI)</p> <p>Double Acting Relay – 0.297 Nm³/h @ 1.5 bar (0.175 SCFM @ 22 PSI) 0.637 Nm³/h @ 4.1 bar (0.375 SCFM @ 60 PSI)</p>

2.4 Stroke Output

Table 4: Stroke Output

Feedback Shaft Rotation	<p>Min 15°, Max 90°</p> <p>45° recommended for linear applications.</p>
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2.5 Positioner Performance Characteristics

Table 5: Performance Characteristics

Better than or equal to the following values on a 25 square inch Mark I actuator.	
Resolution	± 0.25%
Linearity	+/-1.25%
Repeatability	± 0.25%
Hysteresis	± 1.0%
Deadband	± 0.3%
Sensitivity	± 0.25%
Stability	± 0.4%
Long term drift	± 0.5%
Supply Pressure Effect	± 0.2%

NOTE: Performance tested according to ISA 75.13.

2.6 Physical Specifications

Table 6: Physical Specifications

NOTE: For dimensions, see section 11 Positioner Dimensions.

Housing Material	Cast, powder-painted aluminum EN AC-AISI12(Fe)
Soft Goods	Fluorosilicone
Weight of Base Positioner Without Accessories	With Single Acting Relay 1.76 kg (3.88 lb) With Double Acting Relay 1.88 kg (4.14 lb)

2.7 Temperature

Table 7: Temperature

Operating Temperature Range	-52 to 85°C (-61.6 to 185°F)
Transport and Storage Range	-52 to 85°C (-61.6 to 185°F)

NOTE: Reduced performance possible at low temperatures.

3 Hazardous Area Certifications

DANGER: Certifications listed on the positioner are correct for that positioner. Before using the information on this page, ensure the certifications on the positioner label match the certifications on this page.

Table 8: Logix 505+ Series Hazardous Locations Information

ATEX	North America (cFMus)																								
<p>Intrinsically Safe FM12ATEX0009X II 1 G Ex ia IIC T4/T6 Ga IP66 T4 Tamb = -20°C ≤ Ta ≤ +85°C T6 Tamb = -52°C ≤ Ta ≤ +45°C</p> <p>Type 'n' ATEX FM15ATEX0002X II 3 G Ex nA IIC T4/T6 Gc IP65 T4 Tamb = -52°C ≤ Ta ≤ +85°C T6 Tamb = -52°C ≤ Ta ≤ +45°C</p> <p>Type 't' FM12ATEX0009X II 2 D Ex tb IIIC T100°C Db IP65 Tamb = -52°C ≤ Ta ≤ +85°C</p> <table border="1"> <thead> <tr> <th>Entity Parameters</th> <th>4-20 Input</th> </tr> </thead> <tbody> <tr> <td>Ui (Vdc)=</td> <td>30</td> </tr> <tr> <td>Ii (mA)=</td> <td>100</td> </tr> <tr> <td>Pi (mW)=</td> <td>800</td> </tr> <tr> <td>Ci (nF)=</td> <td>0</td> </tr> <tr> <td>Li (µH)=</td> <td>47</td> </tr> </tbody> </table> <p>Assessed to the following standards: EN 60079-0:2012, EN 60079-11:2012, EN 60079-15:2010, EN 60079-26:2007, EN 60079-31:2014, EN60529:1991+A1:2000</p>	Entity Parameters	4-20 Input	Ui (Vdc)=	30	Ii (mA)=	100	Pi (mW)=	800	Ci (nF)=	0	Li (µH)=	47	<p>Intrinsically Safe Class I, Div 1, Groups A,B,C,D Class I, Zone 0, AEx ia IIC T4/T6 Ga Class I, Zone 0, Ex ia IIC T4/T6 Ga T4 Tamb = -20°C ≤ Ta ≤ +85°C T6 Tamb = -52°C ≤ Ta ≤ +45°C NEMA Type 4X, IP66</p> <p>Non-Incendive Class I, Div 2, Groups A,B,C,D, T4 Tamb = -20°C ≤ Ta ≤ +85°C T6 Tamb = -52°C ≤ Ta ≤ +45°C NEMA Type 4X, IP65</p> <p>Type 't' Zone 21, AEx tb IIIC T100°C Db IP65 Tamb = -52°C ≤ Ta ≤ +85°C</p> <table border="1"> <thead> <tr> <th>Entity Parameters</th> <th>4-20 Input</th> </tr> </thead> <tbody> <tr> <td>Ui (Vdc)=</td> <td>30</td> </tr> <tr> <td>Ii (mA)=</td> <td>100</td> </tr> <tr> <td>Pi (mW)=</td> <td>800</td> </tr> <tr> <td>Ci (nF)=</td> <td>0</td> </tr> <tr> <td>Li (µH)=</td> <td>47</td> </tr> </tbody> </table> <p>Assessed to the following US standards: Class 3600 :2011, Class 3610 :2010, FM 3611, Class 3810 :2005, ANSI/NEMA 250 :2008, ANSI/IEC 60529 :2004, ANSI/ISA 60079-0 :2013 ANSI/ISA 60079-1 :2009, ANSI/ISA, 60079-11:2011, 60079-15:2012, ANSI/ISA 60079-31:2013</p> <p>Assessed to the following CAN standards: CSA C22.2 No.0.4, CSA C22.2 No. 0.5, CSA C22.2 No.60529, CSA C22.2 60079-0, CSA C22.2 60079-1, CSA C22.2 No. 157, CSA C22.2 No.213, CSA No. 60079-11, CSA C22.2 No. 60529</p>	Entity Parameters	4-20 Input	Ui (Vdc)=	30	Ii (mA)=	100	Pi (mW)=	800	Ci (nF)=	0	Li (µH)=	47
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<p>Conditions spéciales pour une utilisation en toute sécurité:</p> <ul style="list-style-type: none"> Le matériel doit être installé de sorte à réduire au minimum le risque de choc ou de frottement avec d'autres surfaces métalliques. Pour éviter les risques de décharge d'électricité statique Nettoyez uniquement avec un chiffon humide Pour les installations en sécurité intrinsèque, le positionneur doit être connecté à un équipement sécurité intrinsèque convenablement qualifié, et doit être installé conformément aux normes d'installation sécurité intrinsèque applicables. La substitution de composants peut compromettre la sécurité intrinsèque. Utiliser une isolation appropriée du câble à des températures plus élevées. 																									

4 Storage and Unpacking

4.1 Storage

Flowserve Control valve packages (a control valve and its instrumentation) are typically well protected from corrosion. Nevertheless Flowserve products must be stored in a clean, dry environment such as an enclosed building that affords environmental protection. Heating is not required. Control valve packages must be stored on suitable skids, not directly on the floor. The storage location must also be free from flooding, dust, dirt, etc. Plastic caps are fitted to protect the flange faces and positioner ports to prevent the ingress of foreign materials. These caps should not be removed until the valve or positioner is actually mounted into the system.

If Flowserve products (especially sealing materials) have been in storage for longer periods check these for corrosion or deterioration before using these products. Fire protection for Flowserve products must be provided by the end user.

4.2 Unpacking

While unpacking the valve and/or Logix 505+ positioner, check the packing list against the materials received. Lists describing the system and accessories are included in each shipping container.

In the event of shipping damage, contact the shipper immediately. Should any problems arise, contact a Flowserve Flow Control Division representative.

4.3 Pre-Installation Inspection

When installing a positioner, verify the shaft has not been damaged and that the plugs and cover are in place. The plugs keep debris and moisture from damaging the internal components of the positioner. If the positioner has been contaminated, clean the positioner components gently with a soft damp cloth. Some components may be removed for better access. See section 9 MAINTENANCE AND REPAIR. When cleaning a Double Acting Relay (Spool and Block) take care not to bend or force the spool. A Single Acting Relay may be removed, but do not disassembled the relay. Check connectors to ensure that no debris is present. Port screens can be removed with a flat screwdriver for access to internal passages.

4.4 Labels

Verify that the labels match the intended application.

NOTE: Mark checkbox next to hazardous area information for protection method Logix 505+ positioner is installed to.



Figure 4: Certification Label

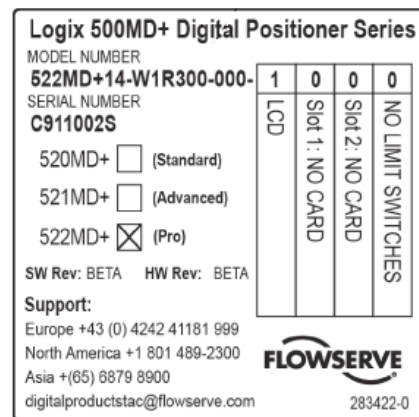


Figure 5: Model Code Label

5 Mounting and Installation

5.1 Mounting to Mark One Linear Valves

To mount a Logix 505+ positioner to a Valtek linear Mark One valve, refer to Figure 6: Mounting to Mark I Linear Valves and proceed as outlined below.

1. Remove washer and nut from follower pin assembly. Insert pin into the appropriate hole in follower arm, based on stroke length. The stroke lengths are stamped next to their corresponding holes in the follower arms. Make sure the unthreaded end of the pin is on the stamped side of the arm. Reinstall lock washer and tighten nut to complete follower arm assembly.
2. Slide the slot in the follower arm assembly over the flats on the position feedback shaft in the back of the positioner. Make sure the arm is pointing toward the side of the positioner with ports A, B, and Supply. Slide the lock washer over the threads on the shaft and tighten down the nut.
3. Align the bracket with the three outer mounting holes on the positioner. Fasten with 1/4" bolts.
4. Screw one mounting bolt into the hole on the yoke mounting pad nearest the cylinder. Stop when the bolt is approximately 3/16" from being flush with mounting pad.
5. Slip the large end of the teardrop shaped mounting hole in the back of the positioner/bracket assembly over the mounting bolt. Slide the small end of the teardrop under the mounting bolt and align the lower mounting hole.

6. Insert the lower mounting bolt and tighten the bolting.
7. Position the take-off arm mounting slot against the stem clamp mounting pad. Apply Loctite 222 to the take-off arm bolting and insert through washers into stem clamp. Leave bolts loose.
8. Slide the appropriate pin slot of the take-off arm, based on stroke length, over the follower arm pin. The appropriate stroke lengths are stamped by each pin slot.
9. Center the take-off arm on the rolling sleeve of the follower pin.
10. Align the take-off arm with the top plane of the stem clamp and tighten bolting. Torque to 120 in-lb.

NOTE: The feedback shaft has a clutch mechanism that allows for over-rotation of the shaft for easy adjustments.

NOTE: If mounted properly, the follower arm should be horizontal when the valve is at 50% stroke and should move approximately $\pm 30^\circ$ from horizontal over the full stroke of the valve. If mounted incorrectly, a stroke calibration error will occur and the indicator lights will blink a RGGY code indicating the position sensor has gone out of range on one end of travel or the travel is too small. Reposition the feedback linkage or rotate the position sensor to correct the error.

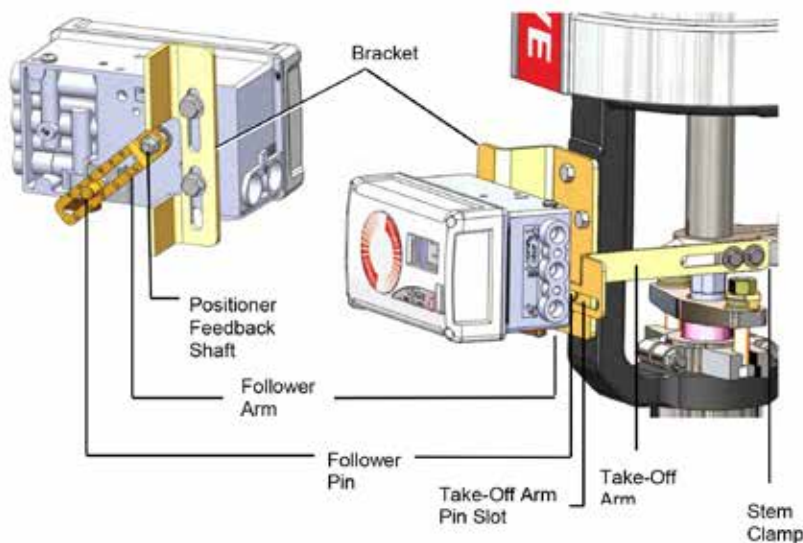


Figure 6: Mounting to Mark I Linear Valves

5.2 Mounting to FlowTop Linear Valves

To mount a Logix 505+ positioner to a FlowTop linear actuator and valve (with direct mounting / integrated tubing), refer to Figure 7 and proceed as outlined below.

NOTE: Because the integral mounting uses the alternate pneumatic port, the positioner must have a poppet style, single acting relay. This is indicated in the model code with a “1” in the highlighted location:

505+14-W1ED1F0-GM2-000

1. Remove the FlowTop port plug screw. Plug port B.
2. Ensure positioner O-ring surface is clean. Then install the O-ring, and FlowTop mounting block using the positioner screws.
3. Attach the follower arm to the feedback shaft using the follower arm nut.

Refer to Figure 8: FlowTop Mounting.

4. Assemble the take-off pin to the take-off plate and mount the take-off plate to the valve stem using the two screws. Adjust the follower pin to match the correct location as indicated on the follower arm’s embossed scale.
5. Place the actuator O-ring.
6. Place the positioner on the actuator, ensuring the take-off pin is inside the follower arm slot. Adjust the follower arm as needed.

NOTE: The feedback shaft has a clutch mechanism that allows for over-rotation of the shaft for easy adjustments.

7. Use the actuator screws to secure the positioner in place.
8. Connect regulated air supply to appropriate port in manifold. See section 6 TUBING.
9. Connect the power to the 4-20 mA terminals. See section 7 ELECTRICAL CONNECTIONS.
10. Remove main cover and locate DIP switches and QUICK-CAL/ ACCEPT button.

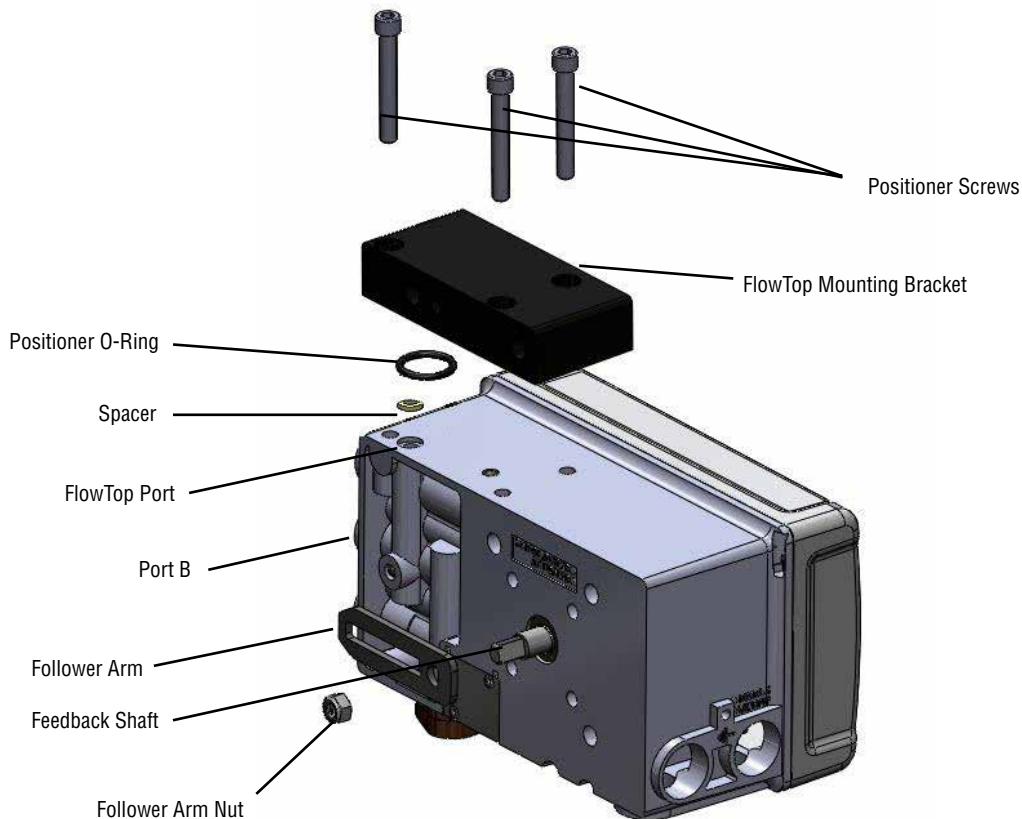


Figure 7: FlowTop Mounting Bracket

11. Refer to sticker on main board cover and set DIP switches accordingly. See section 8 STARTUP.
12. Press the QUICK-CAL/ACCEPT button for three to four seconds or until the positioner begins to move. The positioner will now perform a stroke calibration.
13. If the calibration was successful the green LED will blink GGGG or GGGY and the valve will be in control mode.
14. If calibration fails, as indicated by a RGGY blink code, retry the calibration. If it still fails, the feedback values were exceeded and the arm must be adjusted away from the positioner's limits. Rotate the feedback shaft so that the full free travel of the feedback shaft is in the range of the actuator movement. Optionally, continue to attempt the calibration. Each calibration attempt adjusts the acceptable limits and it should pass eventually.

CAUTION: Remember to remove the air supply before re-adjusting take-off arm.

NOTE: If mounted properly, the follower arm should be horizontal when the valve is at 50% stroke and should move approximately $\pm 30^\circ$ from horizontal over the full stroke of the valve.

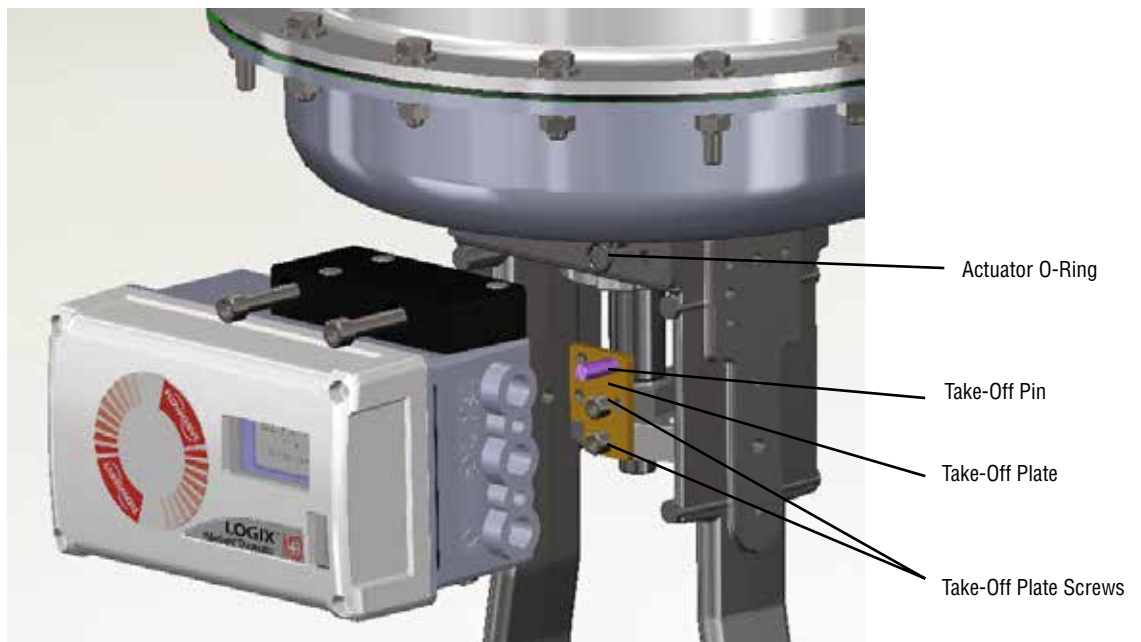


Figure 8: FlowTop Mounting

5.3 Mounting to Standard Valtek Rotary Valves

The standard rotary mounting applies to Valtek valve/actuator assemblies that do not have mounted volume tanks or hand-wheels. The standard mounting uses a linkage directly coupled to the valve shaft. This linkage has been designed to allow for minimal misalignment between the positioner and the actuator. Refer to Figure 10 through Figure 12.

1. Fasten the spline lever adapter to the splined lever using two 6 x 1/2" self-tapping screws.
2. Slide the take-off arm onto the spline lever adapter shaft, orienting the arm to the current valve position. Insert the screw with star washer through the take-off arm and add the second star washer and nut and tighten.

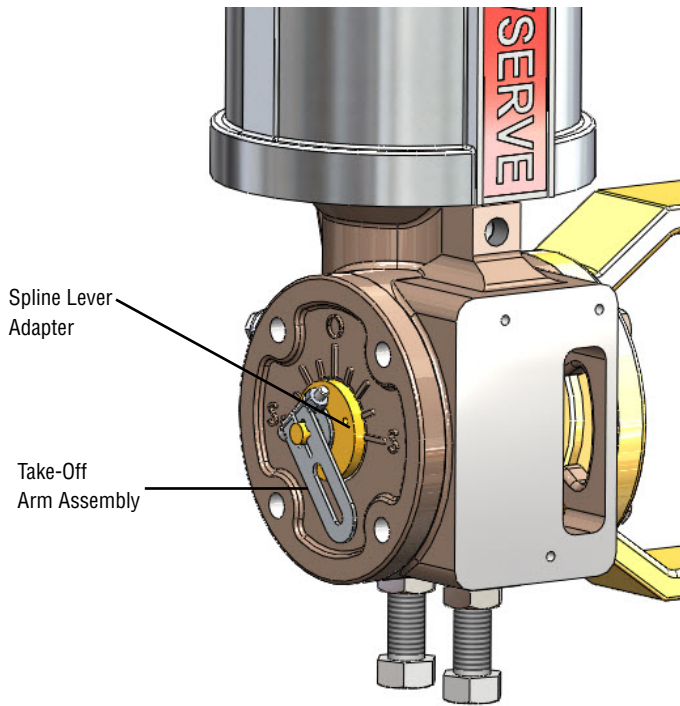


Figure 9: Valtek Rotary Take-Off Arm

3. Attach follower arm to positioner feedback shaft using the star washer and 10-32 nut.
4. Rotate the follower arm so the follower pin will slide into the slot on the take-off arm. Adjust the bracket position as needed noting the engagement of the follower pin and the take-off arm slot. The pin should extend approximately 2 mm past the take-off arm. When properly adjusted, securely tighten the bracketing bolts
5. Using four 1/4-20 x 1/2" bolts, fasten positioner to universal bracket using appropriate hole pattern (stamped on bracket).
6. Using a 1/2" end wrench and two 5/16-18 X 1/2" bolts, attach bracket to actuator transfer case pad. Leave these bolts slightly loose until final adjustments are made.

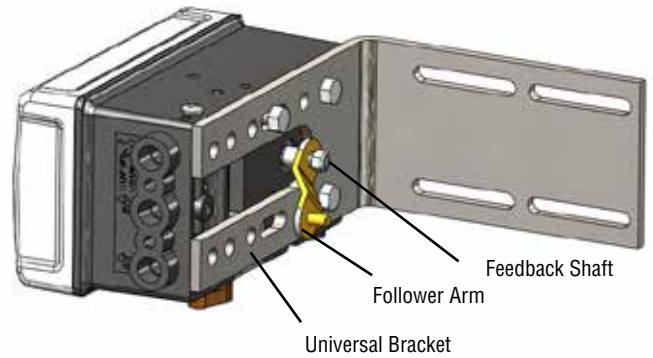


Figure 9: Valtek Rotary Follower Arm

7. Rotate follower arm so the follower pin will slide into the slot on the take-off arm. Over-rotate the follower arm if needed so the arm moves freely through the intended travel.

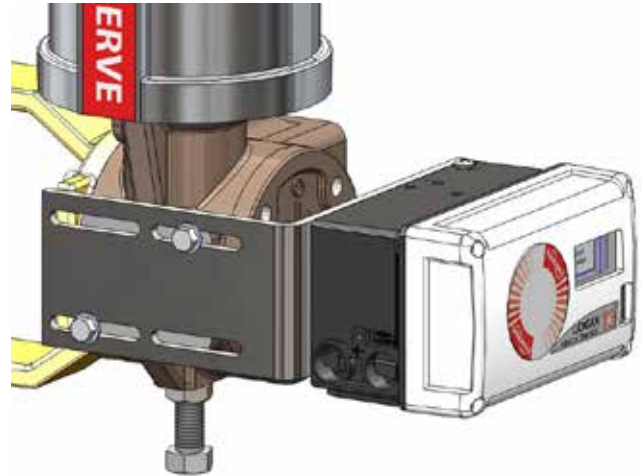


Figure 11: Valtek Rotary Mounting

NOTE: The feedback shaft has a clutch mechanism that allows for over-rotation of the shaft for easy adjustments.

8. Adjust the bracket position as needed noting the engagement of the follower pin and the take-off arm slot. The pin should extend approximately 1/16" past the take-off arm. When properly adjusted, securely tighten the bracketing bolts.
9. Connect regulated air supply to appropriate port in manifold. See section 6 TUBING.
10. Connect the power to the 4-20 mA terminals. See section 7 ELECTRICAL CONNECTIONS.
11. Remove main cover and locate DIP switches and QUICK-CAL/ACCEPT button.
12. Refer to sticker on main board cover and set DIP switches accordingly. See section 8 STARTUP.
13. Press the QUICK-CAL/ACCEPT button for three to four seconds or until the positioner begins to move. The positioner will now perform a stroke calibration.
14. If the calibration was successful the green LED will blink GGGG or GGGY and the valve will be in control mode.
15. If calibration fails, as indicated by a RGGY blink code, retry the calibration. If it still fails, the feedback values were exceeded and the arm must be adjusted away from the positioner's limits. Rotate the feedback shaft so that the full free travel of the feedback shaft is in the range of the actuator movement. Optionally, continue to attempt the calibration. Each calibration attempt adjusts the acceptable limits and it should pass eventually.

▲ CAUTION: Remember to remove the air supply before re-adjusting take-off arm.

NOTE: If mounted properly, the follower arm should be horizontal when the valve is at 50% stroke and should move approximately $\pm 30^\circ$ from horizontal over the full stroke of the valve.

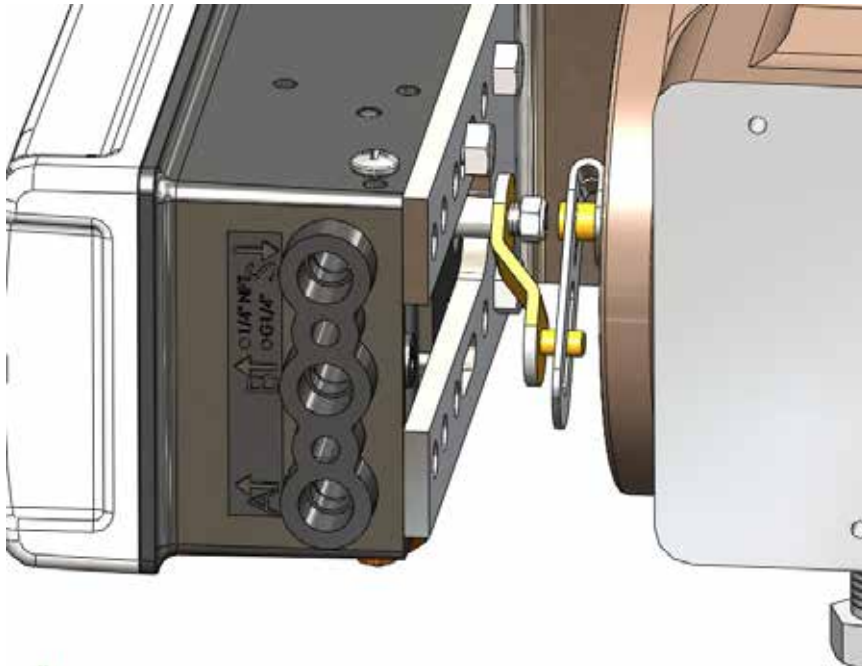


Figure 12: Valtek Rotary Final Orientation

5.4 Mounting to MaxFlo Rotary Valves

1. Slide the take-off arm onto the shaft. Insert the screw with star washer through the take-off arm and add the second star washer and nut. Tighten nut with socket so arm is lightly snug on the shaft but still able to rotate. This will be tightened after linkage is correctly oriented. Refer to figures Figure 13 through Figure 16.

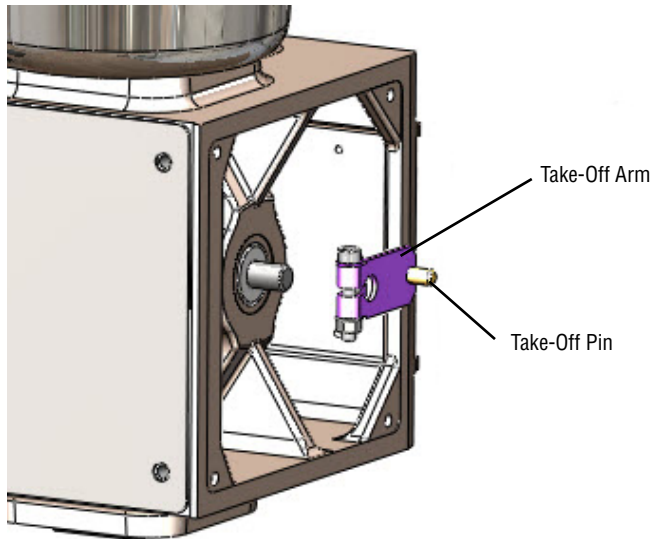


Figure 13: MaxFlo Take-Off Arm

2. Attach the mounting plate to the positioner using 4 screws.
3. Attach follower arm to positioner feedback shaft.

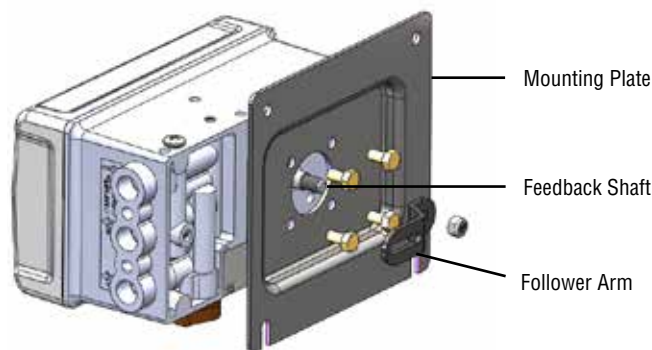


Figure 14: MaxFlo Follower Arm

4. Rotate the follower arm so the take-off pin will slide into the slot on the follower arm. Adjust the bracket position as needed noting the engagement of the follower pin and the take-off arm slot. The pin should extend approximately 2 mm past the take-off arm. When properly adjusted, securely tighten the bracketing bolts.

NOTE: The feedback shaft has a clutch mechanism that allows for over-rotation of the shaft for easy adjustments.

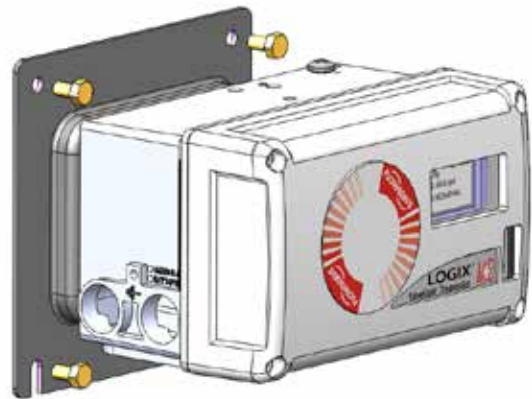


Figure 15: MaxFlo Assembly

NOTE: The feedback shaft has a clutch mechanism that allows for over-rotation of the shaft for easy adjustments.

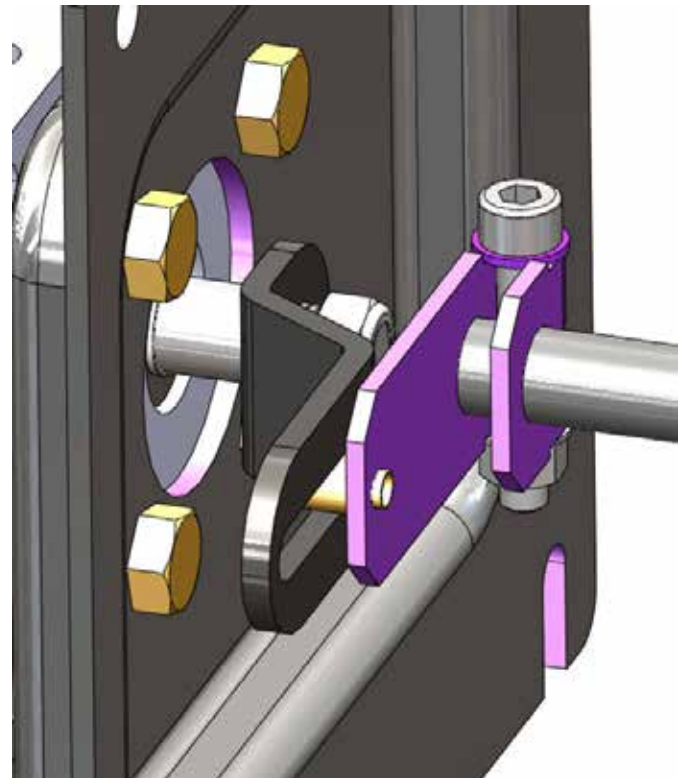


Figure 16: MaxFlo Connection

5. Connect regulated air supply to appropriate port in manifold. See section 6 TUBING.
6. Connect the power to the 4-20 mA terminals. See section 7 ELECTRICAL CONNECTIONS.
7. Remove main cover and locate DIP switches and QUICK-CAL/ ACCEPT button.

8. Refer to sticker on main board cover and set DIP switches accordingly. See section 8 STARTUP.
9. Press the QUICK-CAL/ACCEPT button for three to four seconds or until the positioner begins to move. The positioner will now perform a stroke calibration.
10. If the calibration was successful the green LED will blink GGGG or GGGY and the valve will be in control mode.
11. If calibration fails, as indicated by a RGGY blink code, retry the calibration. If it still fails, the feedback values were exceeded and the arm must be adjusted away from the positioner's limits. Rotate the feedback shaft so that the full free travel of the feedback shaft is in the range of the actuator movement. Optionally, continue to attempt the calibration. Each calibration attempt adjusts the acceptable limits and it should pass eventually.

▲ CAUTION: Remember to remove the air supply before re-adjusting take-off arm.

5.5 Mounting to Rotary NAMUR (AutoMax) Valves

1. Attach the mounting plate to the positioner using 4 screws. See Figure 17.
2. Rotate the feedback shaft to match the orientation of the receiver on the actuator.

NOTE: The feedback shaft has a clutch mechanism that allows for over-rotation of the shaft for easy adjustments.

3. Mount the positioner onto the actuator using the washers and nuts. See Figure 18.
4. Connect regulated air supply to appropriate port in manifold. See section 6 TUBING.
5. Connect the power to the 4-20 mA terminals. See section 7 ELECTRICAL CONNECTIONS.
6. Remove main cover and locate DIP switches and QUICK-CAL/ACCEPT button.
7. Refer to sticker on main board cover and set DIP switches accordingly. See section 8 STARTUP.
8. Press the QUICK-CAL/ACCEPT button for three to four seconds or until the positioner begins to move. The positioner will now perform a stroke calibration.
9. If the calibration was successful the green LED will blink GGGG or GGGY and the valve will be in control mode.
10. If calibration fails, as indicated by a RGGY blink code, retry the calibration. If it still fails, remove power from the positioner, disconnect the air, and remove the positioner from the actuator.

Rotate the feedback shaft so that the full free travel of the feedback shaft is in the range of the actuator movement. Optionally, continue to attempt the calibration. Each calibration attempt adjusts the acceptable limits and it should pass eventually.

▲ CAUTION: Remember to remove the air supply before re-adjusting take-off arm.

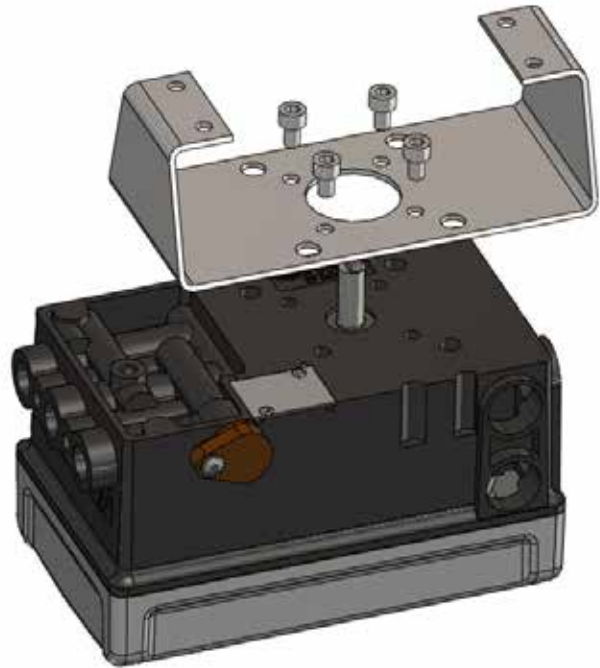


Figure 17: AutoMax Bracket



Figure 18: AutoMax Assembly

5.6 Mounting to a Linear NAMUR Pneumatic Actuator

The mounting of a rod actuator kit and actuator (according to IEC 534 part 6) is described in the following example. Refer to Figure 19.

1. Mount the follower arm by unscrewing the lock nut for the follower arm attachment. Place the follower arm on the shaft at the back of the positioner and fasten it with the lock nut. The follower pin should point away from the positioner.
2. Attach the stem clamp bracket to the stem clamp and fasten it with two hexagon socket screws and lock washers.
3. Attach the take-off arm to the stem clamp bracket and fasten it with a hexagon socket caps crew and a washer.

▲ CAUTION: Maximum torque 0,25 Nm (0,18 ft-lbs).

4. To mount the positioner, adjust the actuator to mid-stroke.
5. Pre-assemble the mounting bracket on the left actuator leg and hand-tighten the two U-bolts, nuts and lock-washers.
6. Attach the positioner to the pre-assembled mounting bracket and fasten it with two hexagon screws and two lock washers. Check that the follower pin is inserted in the slot of the take-off arm and the follower arm is positioned parallel to the take-off arm.
7. Tighten all screws and nuts.

NOTE: The feedback shaft has a clutch mechanism that allows for over-rotation of the shaft for easy adjustments.

NOTE: A slight unsymmetrical mounting increases the linearity deviation but does not affect the performance of the device.

NOTE: Depending on the actuator size and stroke it may be necessary to flip the take-off arm (Figure 3) by 180° and attach it to the opposite side of the stem clamp bracket.

8. Connect regulated air supply to appropriate port in manifold. See section 6 TUBING.
9. Connect the power to the 4-20 mA terminals. See section 7 ELECTRICAL CONNECTIONS.
10. Remove main cover and locate DIP switches and QUICK-CAL/ACCEPT button.
11. Refer to sticker on main board cover and set DIP switches accordingly. See section 8 STARTUP.
12. Press the QUICK-CAL/ACCEPT button for three to four seconds or until the positioner begins to move. The positioner will now perform a stroke calibration.
13. If the calibration was successful the green LED will blink GGGG or GGGY and the valve will be in control mode.

14. If calibration fails, as indicated by a RGGY blink code, retry the calibration. If it still fails, remove power from the positioner, disconnect the air, and remove the positioner from the actuator. Rotate the feedback shaft so that the full free travel of the feedback shaft is in the range of the actuator movement. Optionally, continue to attempt the calibration. Each calibration attempt adjusts the acceptable limits and it should pass eventually.

▲ CAUTION: Remember to remove the air supply before re-adjusting take-off arm.

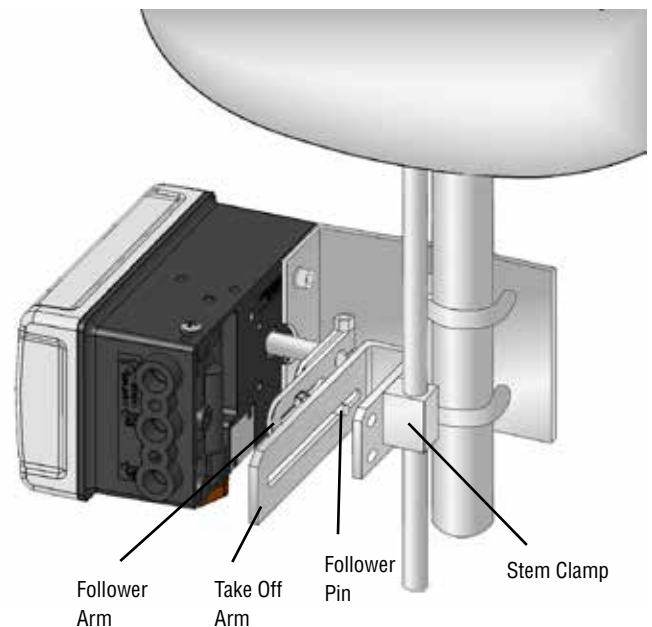


Figure 19: Mounting to a Linear Actuator

6 Tubing

After mounting has been completed, tube the positioner to the actuator using the appropriate compression fitting connectors. For best performance, use 10 mm (3/8 inch) tubing for 645 square cm (100 square inch) actuators or larger. See Figure 24 below.

6.1 Determine Air Action

The port labeled “Y1” delivers air when an air supply is present and the relay is energized. (For positioners with double acting relays, this is port A. For positioners with single acting relays, this is port B.) Typically, the port labeled “Y1” should be tubed to the pneumatic side of the actuator (the side that would result in the air compressing the actuator spring). When tubed this way, the spring is designed to return the valve to the fail safe state should supply air or power to the unit fail.

Tube the port labeled “Y1” to the side of the actuator that must receive air to begin moving away from the fail safe state.

If air from “Y1” should open the valve, set the Air Action configuration switch on the positioner to Air-to-Open, otherwise set it to Air-to-Close.

The Air-to-Open and Air-to-Close selection is determined by the actuator tubing, not the software. When air action selection is made during configuration, the selection tells the control which way the actuator has been tubed.

If the valve is double acting, port the valve labeled “Y2” to the other side of the actuator.

⚠ DANGER: Proper tubing orientation is critical for the positioner to function correctly and have the proper failure mode.

Example: Tubing Linear Double-Acting Actuators

For a linear air-to-open actuator, the “Y1” port of the positioner is tubed to the bottom side of the actuator (closest to the valve). The “Y2” port of the positioner is tubed to the top side of the actuator. See Figure 20. For a linear air-to-close actuator the tubing configuration is reversed.

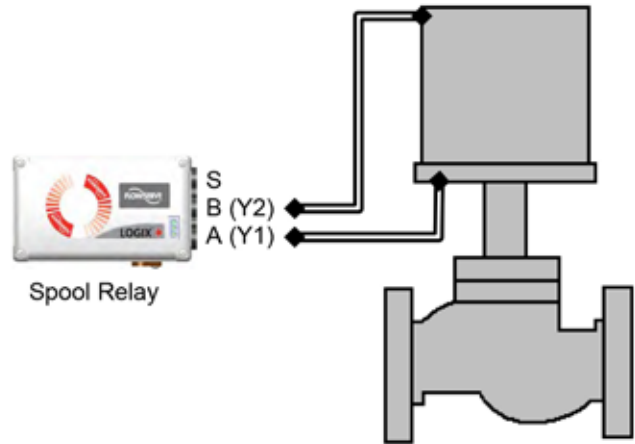


Figure 20: Linear, Double Acting, Air to Open

Example: Rotary Double-Acting Actuators

For a rotary actuator, the “Y1” port of the positioner manifold is tubed to the far side of the actuator. The “Y2” port of the positioner manifold is tubed to the side of the actuator closer to the transfer case. This tubing convention is followed regardless of air action. On rotary actuators, the transfer case orientation determines the air action. See Figure 21.

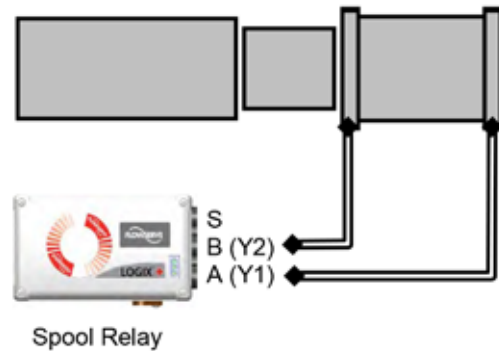


Figure 21: Rotary, Double Acting, Air to Open

Example: Tubing Single-acting Actuators

For single-acting actuators, the “Y1” port is always tubed to the pneumatic side of the actuator regardless of air action. If a double acting (spool style) relay is installed in the positioner, plug port B (Y2). If a single acting - poppet style relay is installed, plug port A (Y2) as in Figure 22. Or, port A may be used for purging. See Purging Single Acting Actuators below.

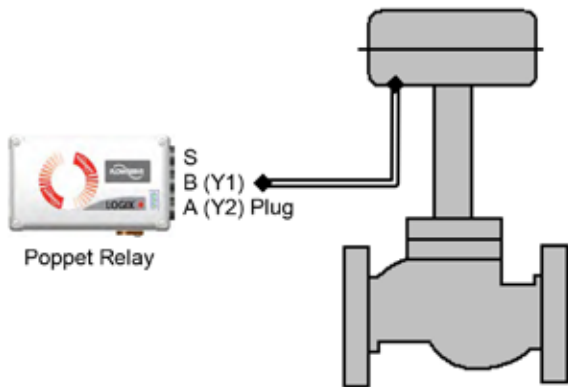


Figure 22: Linear, Single Acting, Air to Open

6.2 Connect Supply Port

The positioner ports are threaded with either G ¼ or ¼ NPTF as indicated on the housing.

In order to maintain the recommended air quality, a coalescing filter should always be installed in the supply gas line. An air filter is highly recommended for all applications where dirty air is a possibility. The positioner passage ways are equipped with small filters, which remove medium and coarse size dirt from the pressurized air. If necessary, they are easily accessible for cleaning.

A supply regulator is recommended if the customer will be using the diagnostic features of the Logix 505+ but is not required. In applications where the supply pressure is higher than the maximum actuator pressure rating a supply regulator is required to lower the pressure to the actuator's maximum rating.

6.3 Purging Single Acting Actuators

Purging allows the non-pressurized side of a single acting actuator to fill with exhaust gas instead of atmospheric air. This configuration helps prevent corrosion of actuator components in harsh environments. When a single acting relay is used, a special procedure can be performed to configure the positioner to purge properly using port A. Contact your local Flowserve Representative for more information regarding the purging option.

6.4 Vented Design

A standard Logix 505+ positioner is vented directly to the atmosphere. When supply air is substituted with sweet natural gas, piping must be used to route the exhausted natural gas to a safe environment.

The housing chamber exhaust port is located on the backside of the positioner. The actuator exhaust port is located on the bottom of the positioner. Both ports are tapped with either ¼ NPTF or G ¼ threads and covered with a protective cap. To control vented gas, remove the caps and connect the necessary tubing/piping to these ports. See Figure 23: Exhaust Vents.

This piping system may cause some positioner back pressure. Back pressure in the housing chamber is from the modulator and regulator. Back pressure in the exhaust port is from the actuator.

The maximum allowable back pressure from the housing chamber is 0.14 barg (2.0 PSIG).

The maximum allowable back pressure from the exhaust port is 0.55 barg (8.0 PSIG) for double acting relays and is 0.14 barg (2.0 PSIG) for single acting relays. Higher pressure may result in decreased performance. For output flow rates, see section 2.2 Pneumatic Output.

▲ CAUTION: The back pressure in the main housing must never rise above 0.14 barg (2.0 PSIG). This could cause the positioner to become unresponsive under some circumstances

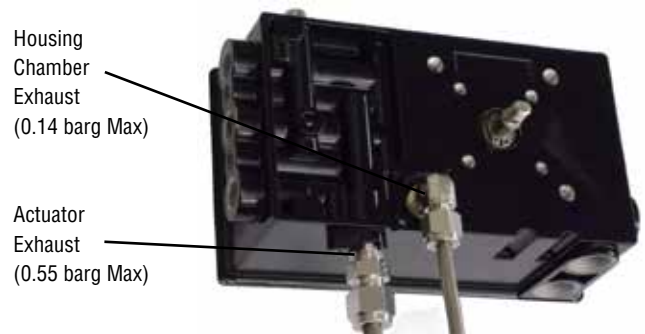


Figure 23: Exhaust Vents

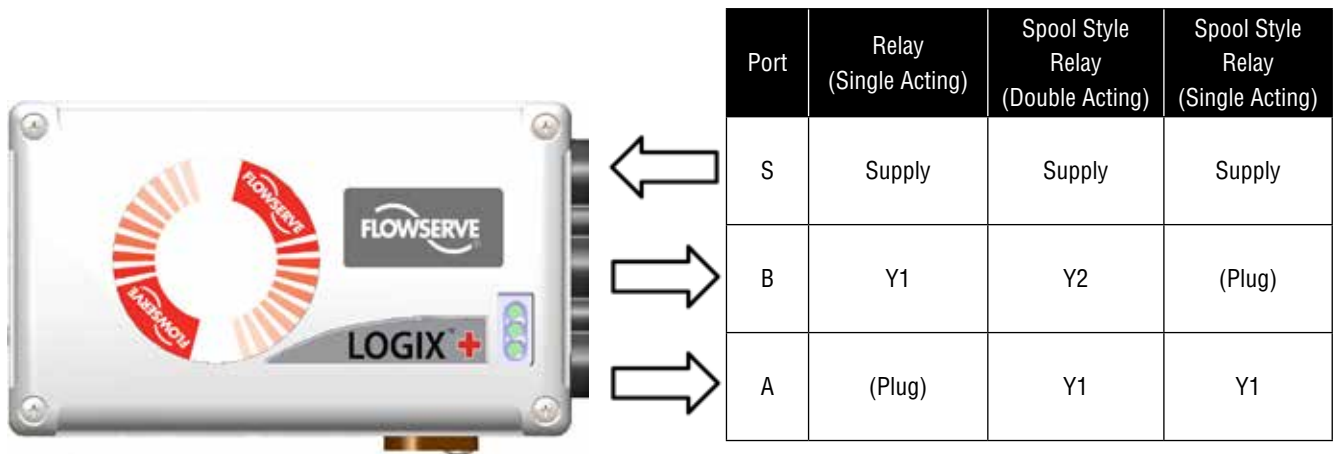


Figure 24: Pneumatic Connections

7 ELECTRICAL CONNECTIONS

7.1 Electrical Terminals



Note: Tighten all terminals 0.5 - 0.6 Nm

Figure 25: Terminal Diagram

7.2 Command Input (4-20 mA) Connection

The Logix 505+ is reverse polarity protected, however, verify polarity when making field termination connection. Wire 4-20 mA current source to the input terminal labeled “4-20mA INPUT”. Tighten terminals 0.5 to 0.6 Nm torque. See Figure 25: Terminal Diagram.

7.2.1 Compliance Voltage

Output compliance voltage refers to the voltage limit the current source can provide. A current loop system consists of the current source, wiring resistance, barrier resistance (if present), and the Logix 505+ impedance.

The Logix 505+ requires that the current loop system allow for a 6 VDC drop across the positioner at maximum loop current. The operating current range is from 3.8 to 24 mA.

In order to determine if the loop will support the Logix 505+, perform the calculation in the following equation. The Available Voltage must be greater than 6 VDC in order to support the Logix 505+. Also, see Table 1: Input Signal.

Equation 1

$$\text{Available Voltage} = \text{Controller Voltage} (\text{Current}_{\text{max}}) - \text{Current}_{\text{max}} \times (R_{\text{barrier}} + R_{\text{wire}})$$

$$\text{Current}_{\text{max}} = 20\text{mA}$$

$$R_{\text{barrier}} = 300\Omega$$

$$R_{\text{wire}} = 25\Omega$$

$$\text{Available Voltage} = 19\text{ V} - 0.020\text{ A} \times (300\Omega + 25\Omega)$$

$$\text{Available Voltage} = 12.5\text{ V}$$

The available voltage (12.5 V) is greater than the required voltage (6.0 V) therefore; this system will support the Logix 505+. The Logix 505+ has an input resistance equivalent to 500 Ω at a 20 mA input current.

▲ CAUTION: The current must always be limited for 4-20 mA operation. Never connect a voltage source directly across the Logix 505+ terminals. This could cause permanent circuit board damage.

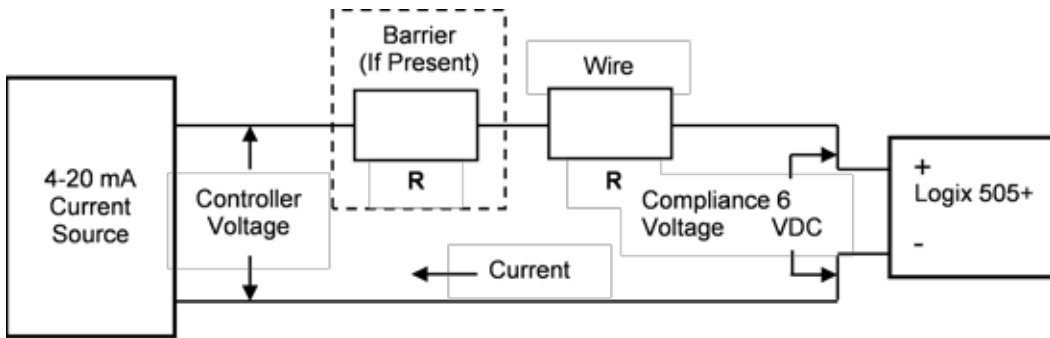


Figure 26: Compliance Voltage

7.2.2 Grounding and Conduit

The grounding terminals, located by the electrical conduit ports should be used to provide the unit with an adequate and reliable earth ground reference. This ground should be tied to the same ground as the electrical conduit. Additionally, the electrical conduit should be earth grounded at both ends of its run.

NOTE: The grounded screw must not be used to terminate signal shield wires. Shield wires should be terminated only at the signal source.

This product has electrical conduit connections in either thread sizes 1/2" NPTF or M20x1.5 which appear identical but are not interchangeable. The thread size is indicated on the side of the positioner near the conduit connections. Conduit fittings must match equipment housing threads before installation. If threads do not match, obtain suitable adapters or contact a Flowserve representative. See Figure 27.



Figure 27: Conduit and Grounding

7.2.3 Electromagnetic Compatibility

The Logix 505+ digital positioner has been designed to operate correctly in electromagnetic (EM) fields found in typical industrial environments. Care should be taken to prevent the positioner from being used in environments with excessively high EM field strengths (greater than 10 V/m).

Portable EM devices such as hand-held two-way radios should not be used within 30 cm of the device.

Ensure proper wiring and shielding techniques of the control lines, and route control lines away from electromagnetic sources that may cause unwanted electrical noise. An electromagnetic line filter can be used to further eliminate noise (FLOWSERVE Part Number 10156843).

In the event of a severe electrostatic discharge near the positioner, the device should be inspected to ensure correct operability. It may be necessary to recalibrate the Logix 500+505+ positioner to restore operation.

7.3 Connections for Intrinsically Safe Operation

See section 3 HAZARDOUS AREA CERTIFICATIONS for entity parameters and control drawing reference.

8 Startup

8.1 Quick Start Instructions

Once the positioner is installed, adjusting the DIP switch settings and performing a Quick-Cal function will typically get the positioner working properly. This simple procedure takes only seconds for most valves.

1. Using the Configuration Switches, select the desired configuration.
2. Hold the Quick-Cal button for 3 seconds. This will initiate a stroke calibration.

After the stroke calibration is complete, the positioner is ready for control.

⚠ CAUTION: During the QUICK-CAL operation the valve may stroke unexpectedly. Notify proper personnel that the valve will stroke, and make sure the valve is properly isolated.

8.2 Local User Interface Overview

The Logix 505+ local user interface allows the user to calibrate, configure the basic operation, and tune the response of the positioner without additional tools or configurators. See Figure 28.

The Logix 505+ local interface has the following features:

- Configuration Switches (4) – Used to set basic configuration. See explanations in section 8.3.Configuration Switch Settings
- QUICK-CAL button – Used to calibrate the positioner.
- LED Indicators (Red, Yellow, and Green) – Indicate status, alarms and warnings.

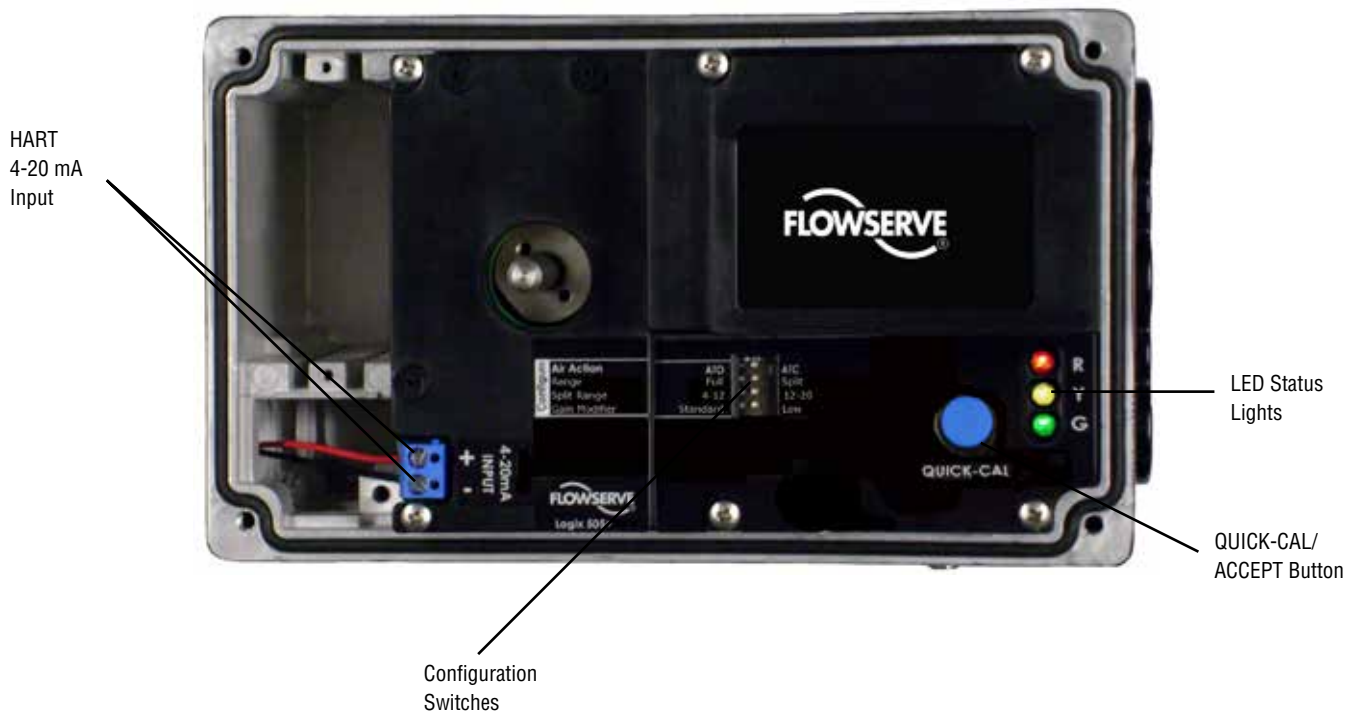


Figure 28: Local User Interface

8.3 Configuration Switch Settings

Before placing the unit in service, set the Configuration Switches to the desired control options.

NOTE: The Configuration Switch settings are activated only by performing a Stroke calibration (pressing the “QUICK-CAL” button for 3 seconds).

8.3.1 Air Action Switch

This must be set to match the configuration of the valve/actuator mechanical tubing connection since the tubing determines the air action of the system.

If Single Acting (Poppet) Relay

ATO - Increasing pressure from Port B (labeled “Y1”) causes the valve to open.

ATC - Increasing pressure from Port B (labeled “Y1”) causes the valve to close.

If Double Acting (Spool) Relay

ATO - Increasing pressure from Port A (labeled “Y1”) causes the valve to open.

ATC - Increasing pressure from Port A (labeled “Y1”) causes the valve to close.

8.3.2 Split Range Switch

The Split Range feature allows the valve to move the full length of travel with either a 4-12mA signal or a 12-20mA signal.

Off - Select Off to disable the split range feature.

On - Select On to enable the split range feature.

8.3.3 Range Select Switch

If the Split Range switch is On, the Range Select Switch designates which input range will control the positioner.

4-12 - Selecting 4-12 will cause the valve to travel from 0 to 100% over a 4 to 12 mA input range.

12-20 - Selecting 12-20 will cause the valve travel from 0 to 100% over a 12 to 20 mA input range.

8.3.4 Gain Switch

The Gain switch changes the tuning parameters. Changes to this switch take effect immediately. (Other DIP switches take effect only during a QUICK-CAL.

Normal – The Normal selection is typically suitable for most applications.

Low – The Low selection can be used to increase the stability of the valve control.

8.4 Stroke Calibration

The ►ACCEPT/QUICK-CAL button is used to initiate an automatic stroke calibration. The stroke calibration determines the closed (0%) and open (100%) positions of the valve and gathers information about the response of the valve (such as valve stroke time) in order to determine the gains. The gains are then set automatically. After a stroke calibration, the positioner is ready to control.

To perform a Quick-Cal, press and hold the ►ACCEPT/QUICK-CAL button for approximately 3 seconds. This will initiate the automatic stroke calibration. While the calibration is in progress, the LED lights will flash status codes indicating the calibration progress. See section 10.2 Status Code Descriptions for an explanation of the status code sequences.

The initial calibration of extremely large or very small actuators may require several calibration attempts. The positioner adapts to the actuator performance and begins each calibration where the last attempt ended. On an initial installation it is recommended that after the first successful calibration that one more calibration be completed for optimum performance.

8.5 Factory Reset

To perform a factory reset, hold ►ACCEPT/QUICK-CAL button while applying power. All of the internal variables including calibration will be reset to factory defaults. The positioner must be re-calibrated after a factory reset.

▲ CAUTION: Performing a factory reset may result in the inability to operate the valve until reconfigured properly. Notify proper personnel that the valve may stroke

9 Maintenance and Repair

The kits listed in section 12.2 Spare Parts Kits can be replaced by a technician trained in positioner function and handling of static sensitive devices.

CAUTION: Depressurize the positioner before servicing.

CAUTION: Use eye protection.

CAUTION: When touching the circuit boards, observe precautions for handling electrostatically sensitive devices.

9.1 Scheduled Maintenance

The supply gas filter(s) should be scheduled for regular maintenance as required to maintain supply gas quality. If contamination is found in the filter, the inside of the positioner should be visually inspected for contamination. If contamination is found in the positioner, the positioner should be replaced.

9.2 Required Tools and Equipment

The Logix 505+ digital positioner has modular components that can be replaced using the tools shown in Figure 30.

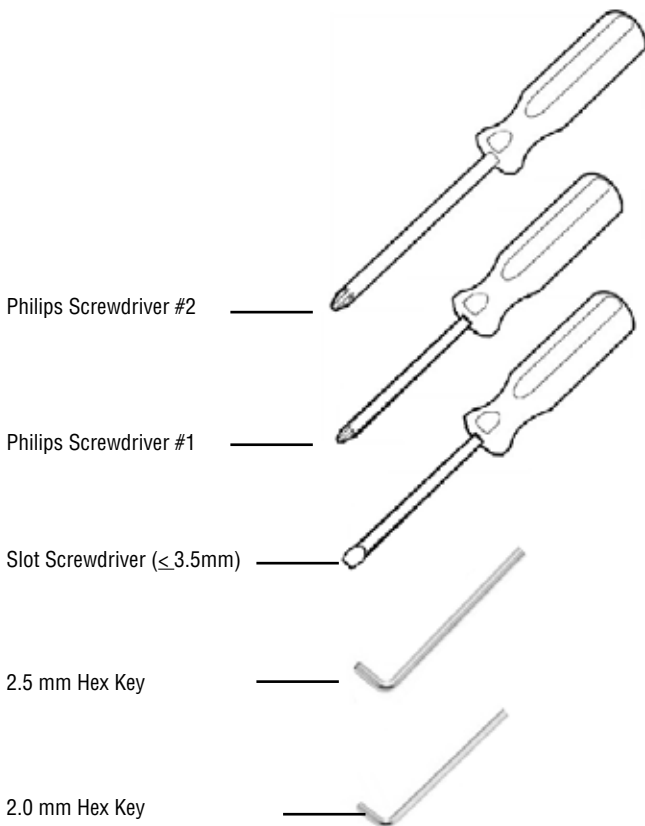


Figure 30: Tools for Positioner Maintenance

9.3 Torque Specification for Screws

Table 9: Torque Specification for Screws

Outer Cover (4 Screws)	1.7 N-m (15 in-lb)
Limit Switch (3 Screws)	0.56 N-m (5 in-lb)
Limit Switch Vane (2 Screws)	0.34 N-m (3 in-lb)
Inner Cover (6 Screws)	0.34 N-m (3 in-lb)
LCD (4 Screws)	0.34 N-m (3 in-lb)
Main Board (2 Screws)	0.34 N-m (3 in-lb)
Pressure Board (6 Screws)	0.68 N-m (6 in-lb)
Double Acting Relay Block (2 Screws)	0.56 N-m (5 in-lb)
Double Acting Relay manifold (2 Screws)	0.56 N-m (5 in-lb)
Single Acting Relay (2 Screws)	0.56 N-m (5 in-lb)

9.4 Replacing a Main Board

Removal

1. Make sure the valve is bypassed or in a safe condition.
2. Remove the outer cover.
3. Disconnect the power to the positioner.
4. Remove the inner cover by removing the 6 retaining screws. See Figure 31: Inner Cover.
5. Remove the screws from the main circuit board. See Figure 32: Main Board Screws.
6. Gently lift the main board rotating the bottom up while keeping the top in place.
7. Disconnect the hall sensor cable, the piezo cable and the feedback cable. (Use a small flat screwdriver to pry the locking features and carefully separate the connector from the main board. Be careful not to pull the cable, as this may cause damage to the cable.) See Figure 33: Main Board Connectors.

Installation

1. Place the main board on the positioner base with the 4-20 mA input on the same side as the electronic access ports.
2. Lift the main board rotating the bottom (configuration switches) upwards while keeping the top in place.
3. Connect the pressure sensor board cable, the hall sensor cable, and the feedback cable. Ensure the connector's locking features engage.
4. Place the main board on the positioner base, ensuring the cables are clear of the feedback gears. Insert the two retaining screws.
5. Replace the inner cover by inserting the 6 retaining screws.
6. Connect power.
7. Calibrate.

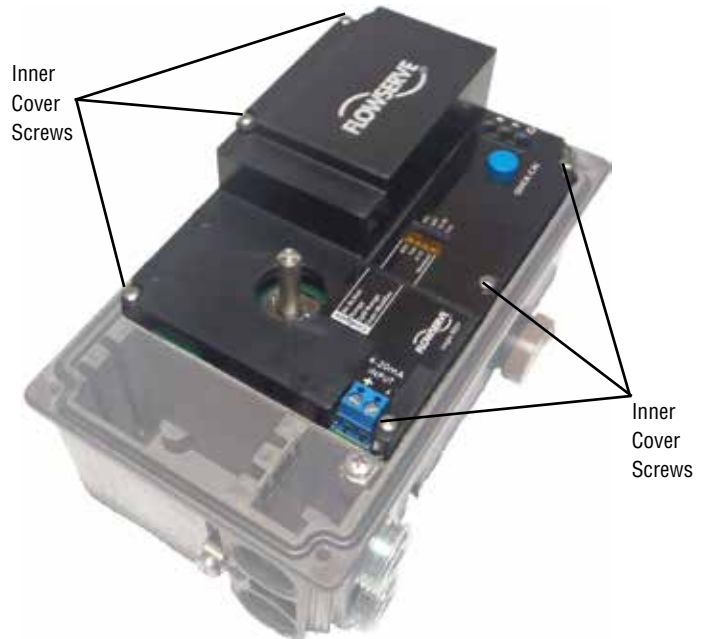


Figure 31: Inner Cover



Figure 32: Main Board Screws

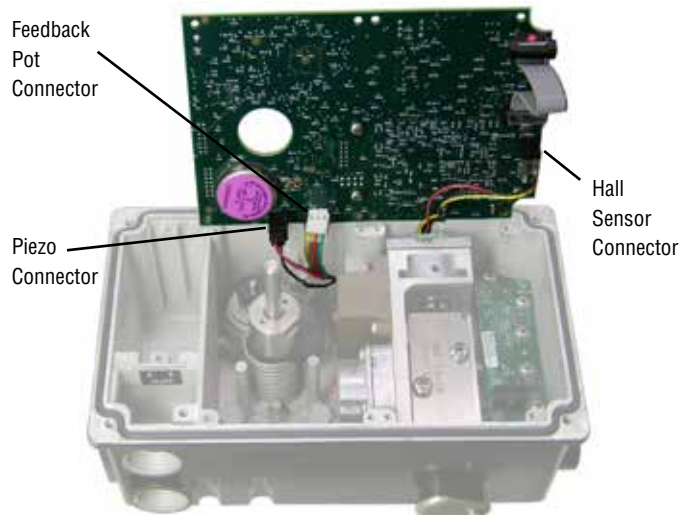


Figure 33: Main Board Connectors

9.5 Cleaning & Replacing a Double Acting Pilot Relay

Removal

1. Remove the Main Board. See procedure above.
2. Fully loosen the 2 spool block screws. By squeezing the two screws toward each other, grip the spool block and slide the spool from the piston. Take care to slide the spool straight out of the spool seat to avoid bending the spool or damaging the clip spring. The small clip spring should remain attached to the spool. See Figure 34: Clip Spring Orientation
3. Remove the first manifold gasket.
4. Remove the 2 manifold screws.
5. Remove the manifold assembly.
6. Remove the second manifold gasket and manifold O-ring. See Figure 35: Double Acting Relay Assembly.

Cleaning

1. Using acetone and a cotton cloth wipe down the block and manifold.
2. Use cotton swabs to reach inside air passage ways.
3. Dry components thoroughly.

⚠ CAUTION: Follow precautions on acetone label and MSDS.

Installation

1. Place the manifold gasket and manifold O-ring into the base.
2. Place the manifold assembly.
3. Place the 2 manifold screws.
4. Place the manifold gasket.
5. Ensure the spool is oriented properly in the block. Ensure the clip spring is oriented properly on the spool. See Figure 36: Inserting the Double Acting Block Assembly. Holding the block level, slide the spool/block/clip spring assembly onto the manifold ensuring the proper placement of the spool and clip spring into the piston slot and tighten the 2 spool block screws.
6. Reassemble the main board and covers and calibrate.

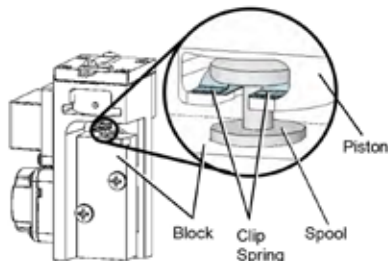


Figure 34: Clip Spring Orientation

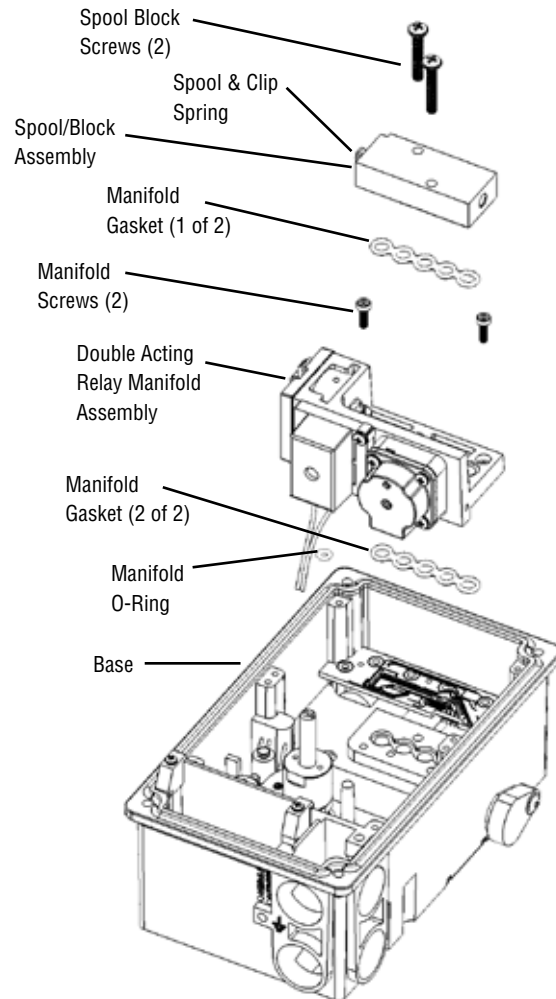


Figure 35: Double Acting Relay Assembly

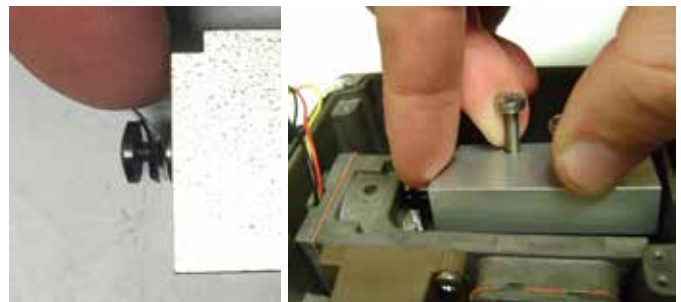


Figure 36: Inserting the Double Acting Block Assembly

9.6 Replacing a Single Acting Pilot Relay

Refer to Figure 37.

Removal

1. Remove the Main Board. See procedure above.
2. Remove the two relay assembly screws.
3. Remove the single acting relay.
4. Remove the supply plug screw and O-ring.
5. Remove the Manifold gasket.

Installation

1. Place the Manifold gasket.
2. Place the supply plug O-ring and screw.
3. Place the single acting relay.
4. Place the two relay assembly screws.
5. Reassemble the main board and covers and calibrate.

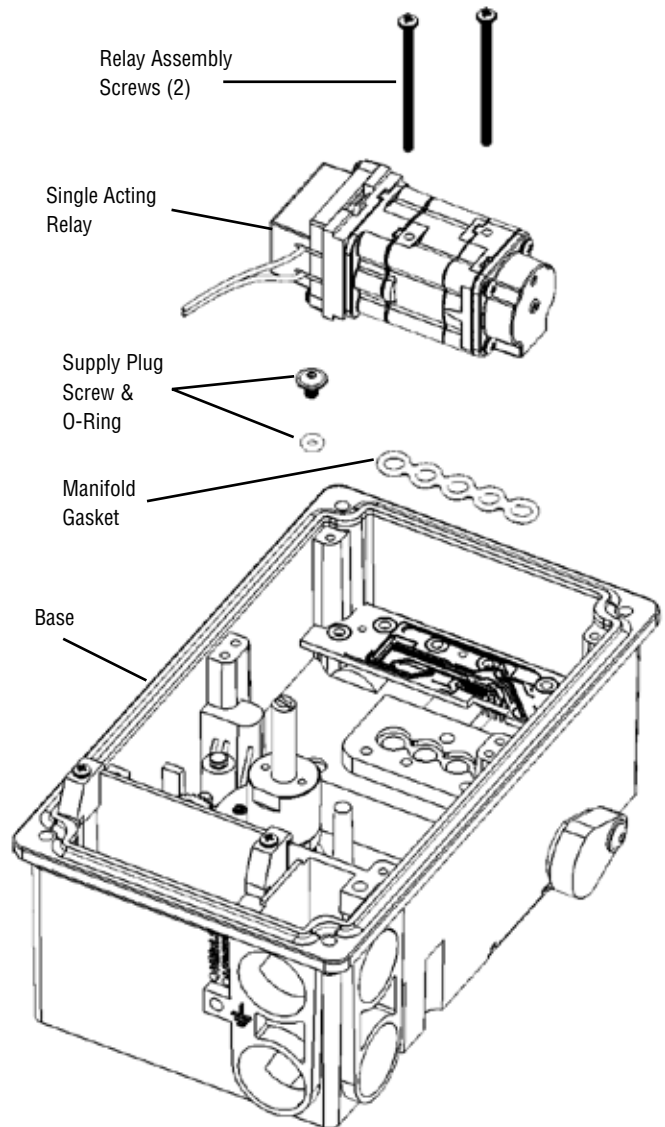


Figure 37: Single Acting Relay Assembly

10 Troubleshooting

10.1 Troubleshooting Guide

Table 10: Troubleshooting Guide

Failure	Probable Cause	Corrective action
No LED is blinking.	<ol style="list-style-type: none"> 1. Current source too low. 2. Voltage of current source is too low. 3. Incorrect wiring polarity. 	<ol style="list-style-type: none"> 1. Verify current source supplies at least 3,8 mA. 2. Verify voltage source supplies at least 6 VDC. 3. Check wiring for correct polarity.
Unit does not respond to analog commands.	<ol style="list-style-type: none"> 1. An error occurred during calibration. 	<ol style="list-style-type: none"> 1. Check Status Codes. Correct calibration error. Recalibrate.
Valve position reading is not what is expected.	<ol style="list-style-type: none"> 1. Stem position sensor mounting is off 180 degrees. 2. Stroke not calibrated 3. Tight shutoff MPC (Minimum position cutoff) is active. 4. Custom characterization or soft stops are active 	<ol style="list-style-type: none"> 1. Reposition the sensor. 2. Perform a Stroke calibration (Quick-Cal). 3. Command above 1.0% if full valve closure is not desired. 4. Verify custom characterization or soft-stop limits.
Position is driven fully open or closed and will not respond to command.	<ol style="list-style-type: none"> 1. Stroke is not calibrated. 2. Inner-loop hall sensor is not connected. 3. Wrong air action was entered in software. 4. Actuator tubing is backward. 5. Electro-pneumatic converter is malfunctioning. 6. Control parameter inner-loop offset is too high/low. 	<ol style="list-style-type: none"> 1. Perform stroke calibration (Quick-Cal) 2. Verify hardware connections. 3. Check ATO (Air-to-open) and ATC (Air-to-Close) settings. Recalibrate using Quick-Cal to apply settings. 4. Verify ATO/ATC actuator tubing. 5. Replace electro-pneumatic converter. 6. Adjust inner-loop and see if proper control resumes.
Sticking or hunting operation of the positioner	<ol style="list-style-type: none"> 1. Contamination of the electro-pneumatic converter. 2. Control tuning parameters not correct. 3. Packing friction is high. 4. Spool valve is corroded or dirty. 	<ol style="list-style-type: none"> 1. Check air supply for proper filtering and meeting 2. ISA specifications ISA-7.0.01. 3. Lower proportional gain settings. 4. Adjust packing. 5. Disassemble and clean spool valve.

10.2 Status Code Descriptions

GGGG ●●●●

POWER ON

Description: No issues.

Possible Solutions: Not applicable.

GGGY ●●●●

TIGHT SHUT OFF MODE

Description: (Also called MPC.) The Final Command is beyond the user set limit for the tight shutoff feature and the positioner is applying full actuator pressure to close (or open) the valve. This is a normal condition for all valves when closed. The factory default setting triggers this at command signals below 1%. This indication may also occur on 3 way valves at both ends of travel if the upper Tight Shut Off value has been set.

Possible Solutions: If tight shutoff is not desired reset the tight shutoff limits or adjust the command signal inside of the specified Tight Shut Off values.

GGYR ●●●●

INITIALIZING

Description: The positioner has powered up and is displaying a blink sequence 3 times.

Possible Solutions: Wait for 3 blink sequences to complete.

GRGY ●●●●

STROKE CALIBRATION IN PROGRESS

SETTING INNER LOOP OFFSET

COMMAND INPUT CALIBRATION IN PROGRESS

Description: A calibration sequence is in progress. The inner loop offset is an important step of the stroke calibration.

Possible Solutions: Wait for calibration sequences to complete.

YYGG ●●●●

TEMPERATURE HIGH WARNING

TEMPERATURE LOW WARNING

Description: The temperature of the internal electronics has exceeded the manufacturer set limits of -40°C (-40°F) to 85°C (176°F). Low temperature may inhibit responsiveness and accuracy. High temperature may affect performance or limit the life of the positioner.

Possible Solutions: Regulate the temperature of the positioner by shading or cooling supply gas. Heat the positioner if needed. If the temperature reading is in error, replace the main board.

YYGY ●●●●

VALVE CLOSED TOO FAR WARNING

VALVE OPENED TOO FAR WARNING

Description: While the valve was in use, it closed or opened farther than it did at the last calibration by 0.5%.

Possible Solutions: Check the feedback arm linkage and ensure the valve stem connection is tight. Recalibrate the stroke. If the process cannot be interrupted a service technician may be able to adjust the calibration.

YYR ●●●●

MEMORY ERROR WARNING

Description: The microprocessor's memory has a problem.

Possible Solutions: Error may clear with time. If error persists, cycle power and complete a QUICK-CAL. If the error still persists, perform a factory reset, reprogram or replace the main circuit board.

YYRG ●●●●

SOFTWARE ERROR WARNING

Description: There has been a watch dog time out, stack overflow warning, or CPU usage warning.

Possible Solutions: If the problem persists, perform a factory reset. If it still persists, reprogram or replace the main board.

YRGG ●●●●

PILOT RELAY RESPONSE WARNING

Description: The pilot relay is sticking or slow to respond. This affects the responsiveness, increases the chance of limit cycling and excessive air consumption. The pilot relay is part of the inner loop and consists of the driver module assembly with piezo (I-P relay) which is coupled to the spool valve or poppet. The value of this indicator corresponds with inner loop lag. Delayed response can be caused by a partially clogged piezo or debris, oil, corrosion, or ice on the spool, or low supply pressure.

Possible Solutions: Check response of the valve. If OK, adjust Pilot Relay Response limits. Check supply pressure. Check the spool or poppet for debris, oil, corrosion, ice on the spool. Clean or replace the spool or poppet assembly. Replace the piezo or driver module assembly. Maintain a clean, water-free air/gas supply.

YRRY ●●●●

PIEZO VOLTAGE HIGH WARNING
PIEZO VOLTAGE LOW WARNING

Description: If the voltage to the piezo is too high, this could indicate an error with the relay or the main board. This may result from an extended period of inactivity, but in this case should not persist for more than 30 minutes when the valve is controlling. The positioner may still be functioning, but have reduced performance under some circumstances. If the voltage to the piezo is too low, the piezo may be damaged. This may prevent the proper failure position upon loss of signal/power. This condition may occur briefly on an air-to-close valve that is held for long periods of time in the closed position, or an air-to-open valve held in the open position.

Possible Solutions: Ensure the supply pressure is not low. If alarm persists for more than 30 minutes, the Piezo assembly is damaged. Replace the pilot relay.

RGGY ●●●●

POSITION RANGE TOO SMALL
POSITION SENSOR ABOVE ADC RANGE
POSITION SENSOR BELOW ADC RANGE

Description: During calibration, the range of motion of the position feedback arm was too small for optimum performance or the feedback sensor moved beyond its range of operation.

Possible Solutions: Check for loose linkages. Adjust the positioner mounting. Adjust the feedback pin back into range. Adjust the feedback pin to a position closer to the follower arm pivot to create a larger angle of rotation and recalibrate. The minimum angle of rotation should be greater than 15 degrees. Briefly pressing the QUICK-CAL/ACCEPT button acknowledges a small range and the positioner will operate using the short stroke calibration if otherwise a good calibration.

RGGR ●●●●

INNER LOOP OFFSET TIME OUT

Description: During calibration the Inner Loop Offset (ILO) value did not settle. This could result in less accurate positioning.

Possible Solutions: Repeat the stroke calibration to get a more accurate ILO value. To proceed using the less accurate ILO value, this error may be cleared by briefly pushing the QUICK-CAL/ACCEPT button. Lowering the setting on the gain selection switch may help if the actuator is unstable during the calibration.

RGYG ●●●●

SETTLE TIME OUT

Description: During calibration, the position feedback sensor showed movement, but did not settle.

Possible Solutions: Check for loose linkages or a loose positioner sensor. This error may appear on some very small actuators during the initial calibration. Recalibrating may clear the problem, or this error may be cleared by briefly pushing the QUICK-CAL/ACCEPT button.

RGYY ●●●●

NO MOTION TIME OUT

Description: During a stroke calibration, there was no valve motion detected. Because some valves are quite large, this indicator can take up to 9 minutes to detect an error.

Possible Solutions: Check linkages and air supply to make sure the system is properly connected. If the time out occurred because the actuator is very large then simply retry the QUICK-CAL and the positioner will automatically adjust for a larger actuator by doubling the time allowed for movement. This error may be cleared by briefly pushing the QUICK-CAL/ACCEPT.

RGRG ●●●●

STROKE CALIBRATION REQUIRED

Description: A factory reset was performed and the positioner has not yet been calibrated. The unit will not respond to commands and will remain in the failsafe position until a calibration is successfully completed.

Possible Solutions: Perform a Stroke Calibration (QUICK-CAL) by holding the QUICK-CAL/ACCEPT button down for 3 seconds, or perform a Pressure or Friction calibration if desired. See the Calibration section of the IOM for warnings.

RGRY ●●●●
STROKE SHIFT

Description: The 0% and 100% valve positions have both shifted in the same direction since the last stroke calibration. This may be related to a bent or adjusted feedback linkage, loose positioner mounting, or an over rotated feedback potentiometer.

STROKE SPAN DECREASE

Description: The 0% and 100% valve positions are closer together compared to the last stroke calibration. This could indicate debris or build up at valve seat.

STROKE SPAN INCREASE

Description: The 0% and 100% valve positions are farther apart compared to the last stroke calibration. This could indicate seat wear.

Possible Solutions: Ensure the feedback linkage is not bent and the positioner is mounted securely. If the feedback potentiometer is over-rotated, repeat the stroke calibration until the Stroke Shift error is no longer present. Inspect valve or schedule valve for inspection. This notification can be cleared by briefly pressing the QUICK-CAL/ACCEPT button.

RGRR ●●●●
FACTORY RESET STATE

Description: The positioner is in factory reset state. Calibration is required to enable control.

Possible Solutions: Perform a Stroke Calibration (QUICK-CAL).

RYGG ●●●●
VALVE CAN'T OPEN ALARM
VALVE CAN'T SHUT ALARM

Description: Pressure has been applied (or removed) to open or shut the valve, but the valve is not moving. This may be caused by excessive friction.

Possible Solutions: Verify adequate supply pressure is applied. Verify the feedback linkage is connected. View the friction trends if available. Consider the following: Clear any external or internal mechanical obstruction, loosen the packing, clean the stem, repair or replace the actuator, repair the valve if galling is suspected.

RYYG ●●●●
SUPPLY PRESSURE LOW ALARM

Description: The supply pressure is below the user set warning limit. Low supply pressure can cause poor valve response or positioner failure. The minimum recommended supply pressure for proper operation is 1.3 bar (19 PSI).

Possible Solutions: Regulate the supply pressure at the positioner above 1.3 bar (19 PSI). Ensure system air/gas supply is adequate. Repair kinked or restricted supply tubing. Check for pneumatic leaks in the actuator and actuator tubing. Recalibrate pressure sensors. Check the pressure sensor board connections and replace pressure sensor board if necessary.

RYRG ●●●●
POSITION SENSOR FAILURE ALARM

Description: The feedback arm may be disconnected from the valve assembly or the sensor has failed.

Possible Solutions: Check the feedback arm linkage. Recalibrate. If the problem persists return the unit for repair.

RYRR ●●●●
MAIN BOARD ELECTRONIC FAILURE WARNING

Description: There has been an oscillator fault, position sensor ADC failure, supply voltage error, reference voltage error, shunt voltage error, or piezo voltage error.

Possible Solutions: This may be caused by transient conditions. If the error persists, replace the main board.

RRGG ●●●●
PILOT RELAY RESPONSE ALARM

Description: The pilot relay is sticking or extremely slow to respond. This affects the responsiveness, increases the chance of limit cycling and excessive air consumption. The pilot relay consists of the driver module assembly with piezo (I-P relay) which is coupled to the spool valve or poppet. Delayed response can be caused by a partially clogged piezo or debris, oil, corrosion, or ice on the spool, or low supply pressure.

Possible Solutions: Check response of the valve. If OK, adjust Pilot Relay Response limits. Check the supply pressure. Check the spool or poppet for debris, oil, corrosion, ice on the spool. Clean or replace the spool assembly. Replace the piezo or driver module assembly. Maintain a clean, water-free air/gas supply.

RRYG ●●●●

FEEDBACK LINKAGE ALARM

Description: The feedback linkage is broken or the position feedback POT is out of range.

Possible Solutions: Fix broken linkage or adjust feedback arm until full motion is within the range of the POT.

RRYR ●●●●

DRIVER MODULE ALARM

Description: The pilot relay can't open, the pilot relay can't shut, or the Hall sensor circuit has failed.

Possible Solutions: Check the internal wiring connections. Replace the pilot relay.

RRRY ●●●●

PIEZO VOLTAGE HIGH ALARM

Description: The voltage driving the piezo is above the alarm limit. This could indicate an error with the relay or the main board. The positioner may still be functioning, but have reduced performance under some circumstances.

PIEZO VOLTAGE LOW ALARM

Description: The voltage to the piezo is too low. The piezo may be damaged. This may prevent the proper failure position upon loss of signal/power. This condition may occur briefly on an air-to-close valve that is held for long periods of time in the closed position, or an air-to-open valve held in the open position.

Possible Solutions: Ensure the supply pressure is not low. If alarm persists for more than 30 minutes, the Piezo assembly is damaged. Replace the pilot relay.

RRRR ●●●●

POSITION DEVIATION ALARM

Description: The difference between the command and the actual position has been greater than 10% for longer than 60 seconds.

Possible Solutions: Check air supply. Check feedback linkage. Check valve for blockage.

10.3 Help From Flowserve

10.3.1 Phone Support

Over-the-phone troubleshooting is often available for positioner issues. Should your positioner be experiencing problems, or if you have questions that are not answered by this manual, feel free to call your local sales representative or a Quick Response Center (QRC). See the back cover of this manual for contact details.

10.3.2 Returning the 505+ Positioner for Service

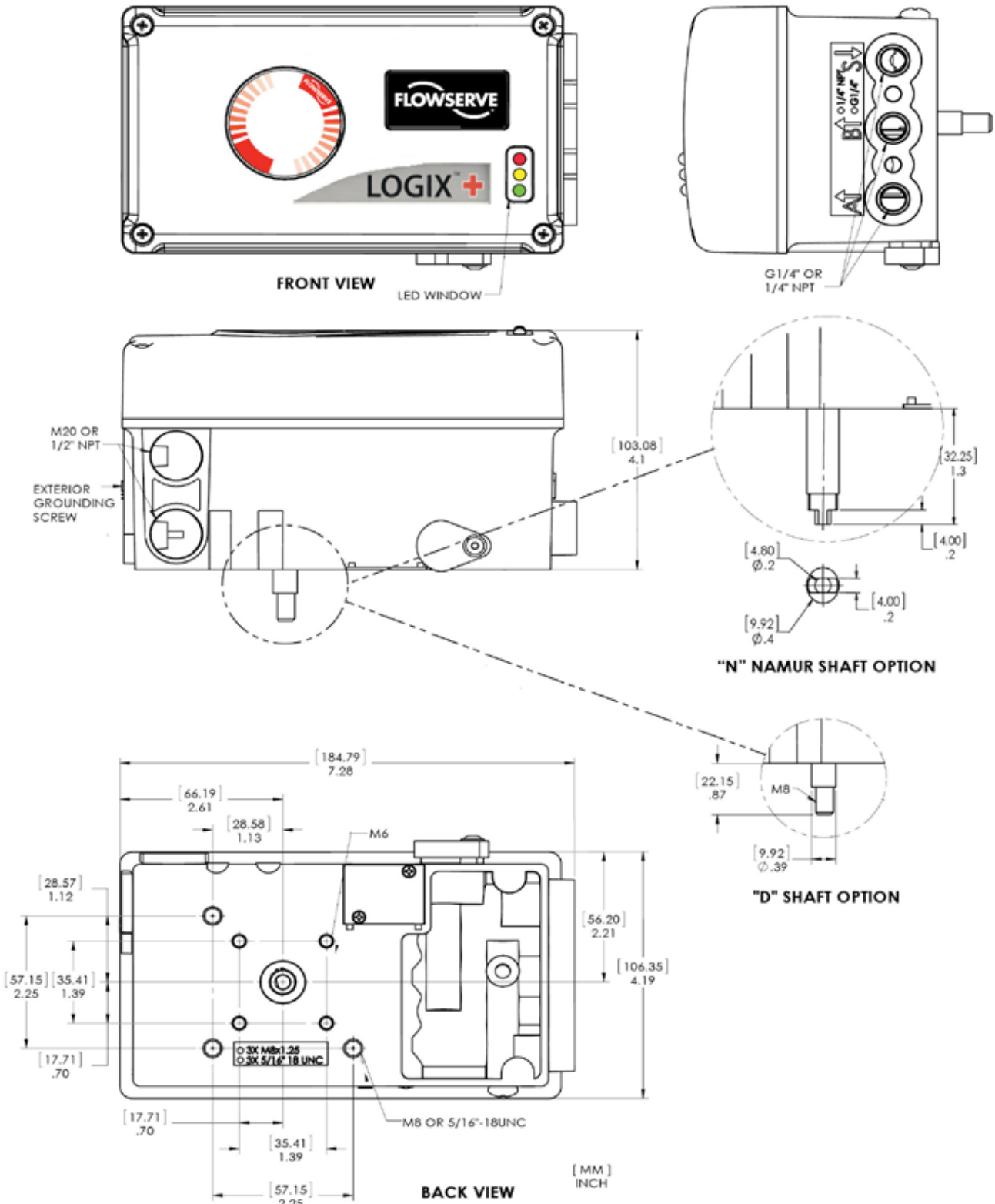
If troubleshooting is unable to solve the problem, the unit may be returned. Please follow the steps below.

1. Request a Return Goods Authorization (RGA) form. An RGA form will be e-mailed to you to accompany the unit being returned.
2. Remove all fittings, brackets, filters, feedback arms, etc. from the unit before packaging.
3. If the unit was operated with a gas other than clean air, please include the related MSDS with the return.
4. Complete the RGA form. Write any specific issues with the positioner you would like us to evaluate. Please include the customer name and contact information
5. When packaging, please secure the unit in a method that will insure it will reach our facility undamaged (the weight of positioners will often settle through packing peanuts and pop large air packets).
6. Please insert a copy of the completed RGA form inside the package and write the RGA number on the outside of the package. Send the unit to the address at the bottom of the form.

If the cause of the unit failure is found to be a manufacturing defect and the unit is within the warranty period (18 months from manufacture) it will be repaired free of charge. If no problem is found with the unit and the unit is still under warranty, a fee for the evaluation will be required. If the cause of the unit failure is not covered under the warranty a fee will be charged for the evaluation and a quote will be provided showing the cost of the repair. If the customer decides to purchase a new positioner, the evaluation fee will be waved.

11 Positioner Dimensions

11.1 Positioner Dimensions



12 How To Order

12.1 Positioners

Table 11: 505+ Positioner Configurations

Selection	Description	Code	Example
Base Model	Logix 500+ Series	5	5
Type	Analog Only; 4-DIP Set-Up; Limited Diagnostics	05+	05+
Certifications	General Purpose	14	37
	Intrinsically Safe, North America, IP66, Class I, Div 1 Groups A-D T4/T6	37	
	Intrinsically Safe, North America, IP66, Class I, Zone 0, AEx ia IIC T4/T6 Ga		
	Intrinsically Safe, North America IP66, Class I, Zone 0, Ex ia IIC T4/T6 Ga		
	Non-Incendive, North America, IP65, Class I, Div 2, Groups A-D T4/T6		
	Non-Sparking, North America, IP65, Class I, Zone 2 AEx nA IIC T4/T6 Gc		
	Non-Sparking, North America, IP65, Class I, Zone 2 Ex nA IIC T4/T6 Gc (T4@Ta=-20°C to +85°C, T6@Ta=-52°C to +45°C)		
	Dust Ignition, North America, IP65, Zone 21, AEx tb IIIC T100°C Db (Ta=-52°C to +85°C) NEMA Type 4X		
	IECEX FMG 12.0001X, IP66, Ex ia IIC T4/T6 Ga		
	IECEX FMG 12.0001X, IP65, Ex nA IIC T4/T6 Gc (T4@Ta=-20°C to +85°C, T6@Ta=-52°C to +45°C)		
	IECEX FMG 12.0001X, IP65, Ex tb IIIC T100°C Db (Ta=-52°C to +85°C)		
	ATEX FM15ATEX0002X II 3 G, IP65, Ex nA IIC T4/T6 Gc (T4@Ta=-20°C to +85°C, T6@Ta=-52°C to +45°C)		
	ATEX FM12ATEX0009X II 1 G, IP66, Ex ia IIC T4/T6 Ga (T4@Ta=-20°C to +85°C, T6@Ta=-52°C to +45°C)		
	ATEX FM12ATEX0009X II 2 D, IP65, Ex tb IIIC T 100°C Db (Ta=-52°C to +85°C)		
TR CU, Russia, IP66, Ex ia IIC T4/T6: T4@Ta=-52°C to +85°C, T6@Ta=-52°C to +45°C)	44		
Positioner Configuration			
Housing	Aluminum - Black Base with White Cover	W	W
	Aluminum - Black Base with Yellow Cover	Y	
	Aluminum - Black Base with Black Cover (Automax)	B	
	Aluminum - Black Base with Black Cover (Accord)	A	
Threaded Connections	Mounting: 5/16" 18 UNC, Pneumatics: 1/4" NPTF, Conduit: 1/2" NPTF, Vents 1/4" NPTF	1	1
	Mounting: M8 x 1.25, Pneumatics: 1/4" NPTF, Conduit: M20 x 1.5, Vents 1/4" NPTF	2	
	Mounting: M8 x 1.25, Pneumatics: G1/4", Conduit: M20 x 1.5, Vents G1/4"	3	
Feedback Shaft	D - 316 Stainless Steel Shaft (Valtek Standard)	D	D
	NAMUR - 316 Stainless Steel Shaft (VDI/VDE 3845)	R	
Action	Three-way (Single-Acting), Poppet Style Relay	1	1
	Three-way (Single-Acting), Spool Style Relay	2	
	Four-way (Double-Acting), Spool Style Relay	3	
Position Indicator	No Indicator	0	F
	Flat Indicator	F	
	Domed Indicator	D	
Special Options	No special options	0	0
Optional Mechanical Add-Ins			
Manifold	No Manifold	0	GM
	Gauge Manifold - Aluminum (required for gauges)	GM	
Pressure Gauges	No Gauges	0	1
	Nickel Plated with Brass Internals, psi (bar/kPa)	1	
	Nickel Plated with Brass Internals, psi (kg/cm2)	2	
	SS with SS Internals, psi (bar/kPa)	3	
	SS with SS Internals, psi (kg/cm2)	4	
	UCC Press Test Plug, 1/8" NPT	A	
Valve, Tank, Schrader 645A	B		
Optional Electronic Add-Ins			
Display	No LCD	0	0
Auxiliary Card Slot 1	Slot 1 - No Card	0	0
Auxiliary Card Slot 2	Slot 2 - No Card	0	0
Limit Switches or Remote Mount	No Switches	0	0

12.2 Spare Parts Kits

Table 12: Spare Parts Kits

Ref.	Description	Part-no.
Cover:		
1	Yellow	283450.999.000
1	Black	283451.999.000
1	White	283452.999.000
Board:		
2	505+ Main	331624.999.000
Pilot Relay Module:		
3	Single Acting (Poppet)	283458.999.000
3	Double or Single Acting (Spool)	283459.999.000
4	Pneumatic Restrictor	291750.999.000

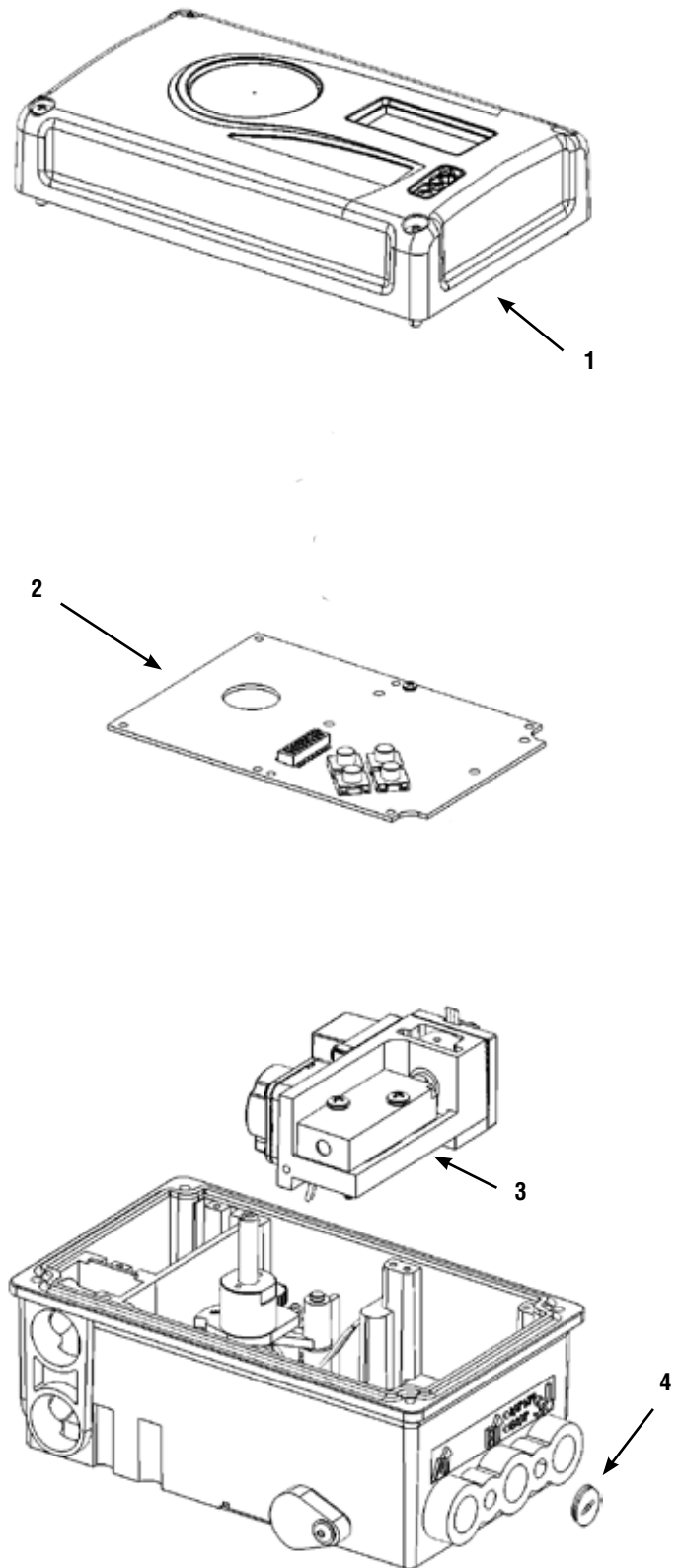


Figure 38: Spare Parts Kits

12.3 Gage Blocks

Table 13: Gage Block (Aluminum - ¼ NPT)

Gage Internal Material	Pressure Units	Relay	No. Gages	Part-no.	
N/A	N/A	N/A	0	291759.999.000	
Brass	PSI (Bar/kPa)	Single Acting Poppet	2	307318.999.000	
		Single Acting Spool	2	325205.999.000	
		Double Acting Spool	3	291760.999.000	
	PSI (kg/cm2)	Single Acting Poppet	2	307319.999.000	
		Single Acting Spool	2	325206.999.000	
		Double Acting Spool	3	291761.999.000	
	Stainless Steel	PSI (Bar/kPa)	Single Acting Poppet	2	307320.999.000
			Single Acting Spool	2	325207.999.000
			Double Acting Spool	3	291762.999.000
PSI (kg/cm2)		Single Acting Poppet	2	307321.999.000	
		Single Acting Spool	2	325208.999.000	
		Double Acting Spool	3	291763.999.000	
UCC Pressure Test Plug			0	325211.999.000	
Schrader 645A			0	325212.999.000	

Table 14: Gage Block (Aluminum - ¼ G)

Gage Internal Material	Pressure Units	Relay	No. Gages	Part-no.	
N/A	N/A	N/A	2	325070.999.000	
Brass	PSI (Bar/kPa)	Single Acting Poppet	2	325209.999.000	
		Single Acting Spool	3	325213.999.000	
		Double Acting Spool	2	325214.999.000	
	PSI (kg/cm2)	Single Acting Poppet	2	325215.999.000	
		Single Acting Spool	3	325216.999.000	
		Double Acting Spool	2	325071.999.000	
	Stainless Steel	PSI (Bar/kPa)	Single Acting Poppet	2	325210.999.000
			Single Acting Spool	3	325217.999.000
			Double Acting Spool	2	325218.999.000
PSI (kg/cm2)		Single Acting Poppet	2	325219.999.000	
		Single Acting Spool	3	325220.999.000	
		Double Acting Spool	0	325221.999.000	
UCC Pressure Test Plug			0	325222.999.000	
Schrader 645A			0	325212.999.000	

12.4 VDI/VDE 3847 Mounting Blocks

Table 15: VDI/VDE 3847 Mounting Block (Aluminum)

Relay Type	No. Gages	Gage Internal Material	Pressure Units	Part-no.
Poppet	0	N/A	N/A	307308.999.000
Poppet	2	Brass	PSI (Bar/kPa)	307309.999.000
Poppet	2	Brass	PSI (kg/cm ²)	307310.999.000
Poppet	2	Stainless	PSI (Bar/kPa)	307311.999.000
Poppet	2	Stainless	PSI (kg/cm ²)	307312.999.000
Spool	0	N/A	N/A	307313.999.000
Spool	3	Brass	PSI (Bar/kPa)	307314.999.000
Spool	3	Brass	PSI (kg/cm ²)	307315.999.000
Spool	3	Stainless	PSI (Bar/kPa)	307316.999.000
Spool	3	Stainless	PSI (kg/cm ²)	307317.999.000

12.5 Mounting Kits

Table 16: Mounting Kits

Description	Part-no.
Shaft Converter - D to NAMUR	314586.999.000
Direct Mount – 500MD+ (IEC 534 part 6 FlowTop, Kämmer KA, Kämmer KP, and standard NAMUR linear valves)	307303.999.000

INDEX

A

- Air Action Switch • 26
- Air Supply • 8

C

- Calibration • 33, 34
- Characterization • 26
- Compliance Voltage • 23
- Configuration Switch Settings • 26

D

- Double Acting Relay • 22, 29

E

- Electrical Connections • 23

F

- Factory Reset • 26
- FloTop Linear Valves • 13
- Friction • 33

H

- HART • 8
- Hazardous Area Certifications • 10

I

- Inner Loop • 6
- Installation • 12

L

- Limit Switch • 24
- Local User Interface • 25

M

- Main Board • 28
- Maintenance • 11, 27
- Mark One Linear Valves • 12
- MaxFlo Rotary Valves • 17, 19
- Mounting • 12
- Mounting Kits • 41

N

- NAMUR AutoMax Valves • 18

O

- Outer Loop • 6

P

- Performance • 9
- Positioner Dimensions • 37

Q

- Quick-Cal • 25

R

- Repair • 27

S

- Safety • 4
- Single Acting Relay • 22, 30
- Spare Parts • 4, 39
- Specifications • 8
- Stroke Calibration • 25, 26

T

- Temperature • 9
- Troubleshooting • 31
- Tubing • 20

V

- Valtek Rotary Valves • 15
- Valve Action Switch • 26
- Vented Design • 21





Flowserve Headquarters
5215 N. O'Connor Blvd. Suite 2300
Irving, Tx. 75039
Phone: +1 972 443 6500

Flowserve Corporation
1350 N. Mt. Springs Parkway
Springville, UT 84663 USA
Phone: +1 801 489 8611
Fax: +1 801 489 3719

Flowserve S.A.S.
12, avenue du Quebec B.P. 645 91965
Courtaboeuf Cedex France
Phone: +33 (0) 1 60 92 32 51
Fax: +33 (0) 1 60 92 32 99

Flowserve Pte Ltd.
12 Tuas Avenue 20
Singapore 638824 Singapore
Phone: +65 6868 4600
Fax: +65 6862 4940

Flowserve Australia Pty Ltd.
14 Dalmore Drive Scoresby,
Victoria 3179 Australia
Phone: +61 7 32686866
Fax: +61 7 32685466

Flowserve Ltda .
Rua Tocantins
128 São Caetano do Sul,
SP 09580-130 Brazil
Phone: +55 11 2169 6300
Fax: +55 11 2169 6313

Flowserve Control Valves gmbH
Control Valves - Villach Operation
Kasernengasse 6 9500
Villach Austria
Phone: +43 (0)4242 41181 0
Fax: +43 (0)4242 41181 50

Flowserve (China)
585, Hanwei Plaza
7 Guanghau Road
Beijing, China 100004
Phone: +86 10 6561 1900

Flowserve India Controls
Pvt. Ltd Plot # 4, 1A, E.P.I.P,
Whitefield Bangalore Kamataka
India 560 066
Phone: +91 80 284 10 289
Fax: +91 80 284 10 286

Flowserve Essen GmbH
Schederhofstr. 71
45145 Essen Germany
Phone: +49 (0)201 8919 5
Fax: +49 (0)201 8919 600

Kämmer Valves inc.
1300 Parkway View Drive
Pittsburgh, Pa 15205 USA
Tel.: +1 412 787 8803
Fax: +1 412 787 1944

NAF Ab Gelbgjutaregatan
2 SE-581 87
Linköping Sweden
Phone: +46 (0)13 31 61 00
Fax: +46 (0)13 13 60 54

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