FLOWSERVE

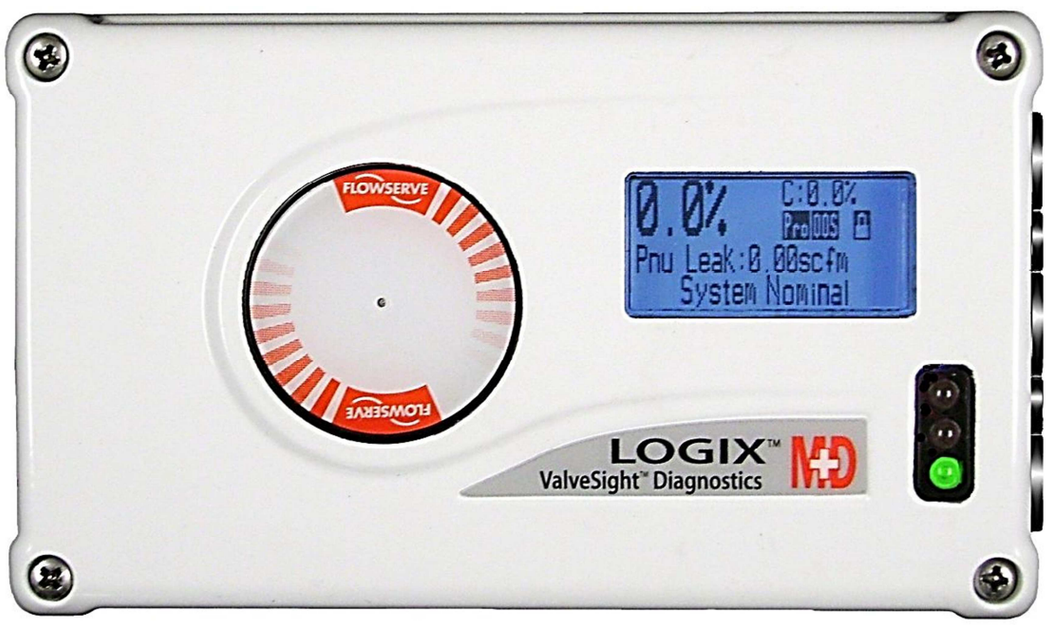
USER INSTRUCTIONS

Logix® 520MD+ Series

Digital Positioner

FCD LGENIM0105-00

Installation
Operation
Maintenance
Safety Manual



Experience In Motion

CONTENTS

1 GENERAL INFORMATION

1.1 Using This Document

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

The following instructions are designed to assist in unpacking, installing and performing maintenance as required on Logix® 500MD+ positioners. Series 500 is the term used for all the positioners herein; however, specific numbers indicate features specific to model (i.e., Logix 520 indicates that the positioner has HART® protocol). See Logix 500MD+ Model Number table in this manual for a breakdown of specific model numbers.

Separate Flow Control Products User Instructions cover the valve (such as IOM 1 or IOM 27) and actuator (such as IOM 2 or IOM 31) 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 valve parts, DANGER, WARNING and CAUTION notes must be strictly followed. Modifying this product, substituting non-factory parts or using maintenance procedures other than outlined could drastically affect performance and be hazardous to personnel and equipment, and may void existing warranties.

1.2 Terms Concerning Safety

The safety terms DANGER, WARNING, 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.*

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

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

Compliance with other, not particularly emphasized notes, with regard to transport, assembly, operation and maintenance and with regard to 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

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

FLOWSERVE products are often used in problematic applications (e.g. extremely high pressures, dangerous, toxic or corrosive mediums). In particular, valves with bellows seals point to such applications. When performing service, inspection or repair operations always ensure, that the valve and actuator are depressurized and that the valve has been cleaned and is free from harmful substances. In such cases pay particular attention to personal protection (protective clothing, gloves, glasses etc.).

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 bulletin 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 Valve and Actuator Installation

DANGER: *Before installation, check the order-no., serial-no. and/or the tag-no. to ensure that the valve/ actuator is correct for the intended application.*

Do not insulate extensions that are provided for hot or cold services. Pipelines must be correctly aligned to ensure that the valve is not fitted under tension. Fire protection must be provided by the user. See specific valve and actuator documentation.

1.7 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 for more information.

1.8 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 520MD+ positioner repair is limited to the replacement of sub-assemblies and circuit boards with FLOWSERVE-manufactured replacements as outlined in this manual.

WARNING: *Substitution of with non-factory positioner components may impair intrinsic safety.*

WARNING: *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.

2 PRINCIPLES OF OPERATION

2.1 Basic Operation

The Logix 520MD+ digital positioner is a two-wire 4-20 mA input digital valve positioner which uses the HART protocol to allow two-way remote communications. The positioner is completely powered by the 4-20 mA input signal. Start-up current must be at least 3.8 mA. The positioner is configurable through the local user interface, hand-held or DTM. The Logix 520MD+ positioner can control both double- and single-acting pneumatic actuators with linear or rotary mountings.

The Logix 520MD+ digital positioner is an electronic and pneumatic closed-loop feedback instrument. Figure 1 shows a schematic of a Logix 520MD+ positioner installed on a double-acting linear actuator for air-to-open action. Figure 2 shows the feedback algorithm.

2.2 HART

The Logix 520MD+ receives power from the two-wire, 4-20 mA input signal. However, since this positioner utilizes HART communications, two sources can be used for the command signal: Analog and Digital. In Analog source, the 4-20 mA signal is used for the command source. In Digital source, the level of the input 4-20 mA signal is ignored (used only for power) and a digital signal, sent via the HART communication protocol, is used as the command source. The command source can be accessed with ValveSight software, the HART 375 communicator, or other host software. See section 11 HART COMMUNICATION for more information.

2.3 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.

2.4 Command Input and Final Command

The Command Input signal (in percent) passes through a characterization/limits modifier block. This function is done in software, which allows for in-the-field customer adjustment. The characterization block can apply no adjustment (Linear), one of several pre-defined characterization curve adjustments (including several Equal Percent), or a 21-point Custom Characterization curve adjustment. In Linear mode, the input signal is passed straight through to the control algorithm in a 1:1 transfer. In Equal Percent (=%) mode, the input signal is mapped to a standard rangeability equal percent curve. If Custom Characterization is enabled, the input signal is mapped to a custom, user-defined 21-point output curve. The custom user-defined 21-point output curve is defined using a handheld or ValveSight software. In addition, two user-defined features, Soft Limits and Tight Shutoff may affect the position. The actual command being used to position the stem after the evaluation of characterization curves and user limits, is called the Final Command.

2.5 Outer Loop

The Logix 520MD+ 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 2, 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.

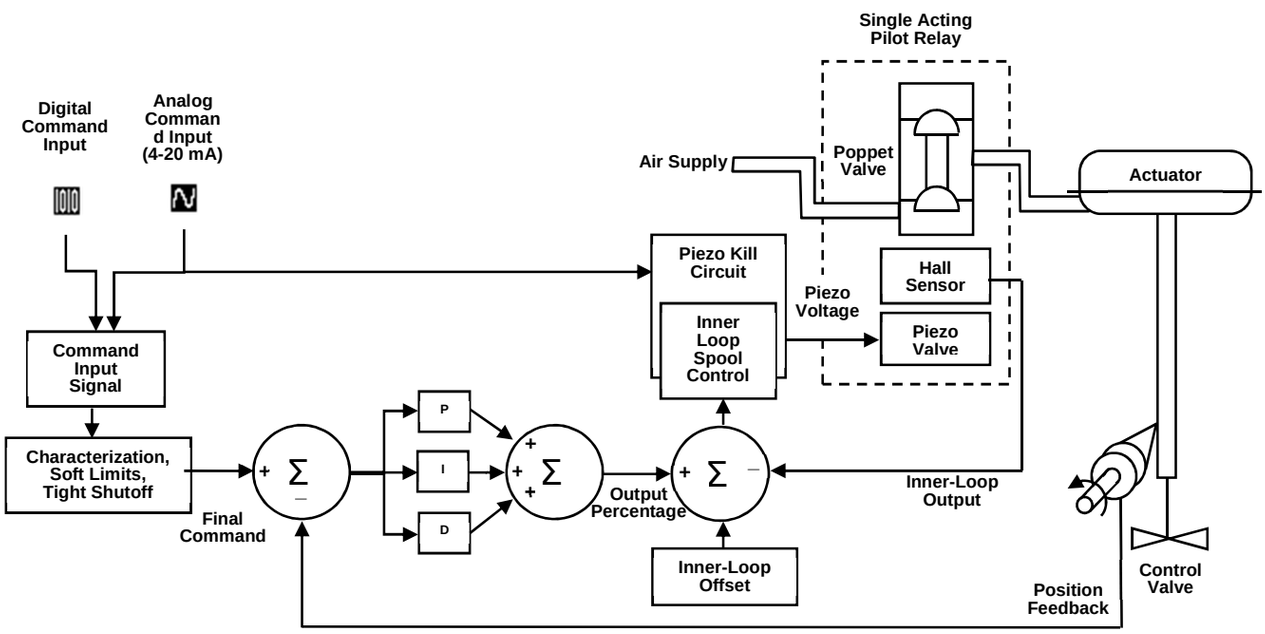


Figure 1: Principles of Operation of Logix 520MD+

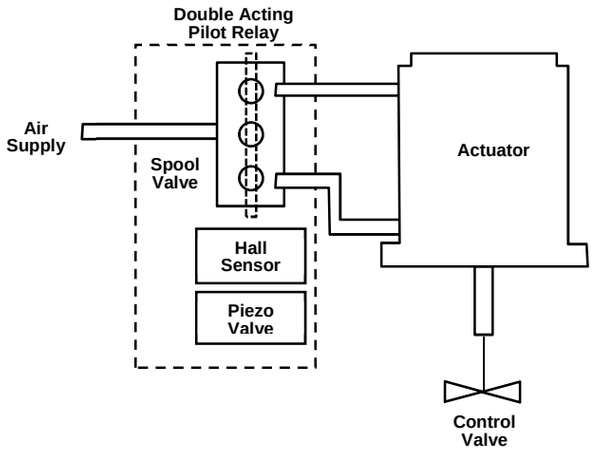


Figure 2: Double Acting Relay Operation

2.6 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.

2.7 Detailed Sequence of Positioner Operations

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

- Unit is in Analog command source.
- Custom characterization is disabled (therefore characterization is Linear).
- No soft limits enabled. No MPC set.
- Valve has zero deviation with a present input signal of
- 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. Custom characterization is disabled so the command source is passed 1:1 to the Final Command. 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. With Linear characterization, the Final Command becomes 75 percent. Deviation is the difference between Final Command and Stem Position: 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.

2.8 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.

**insert physical schematic diagram similar to 3200MD IOM page 6. Show one version with spool and one with poppet.

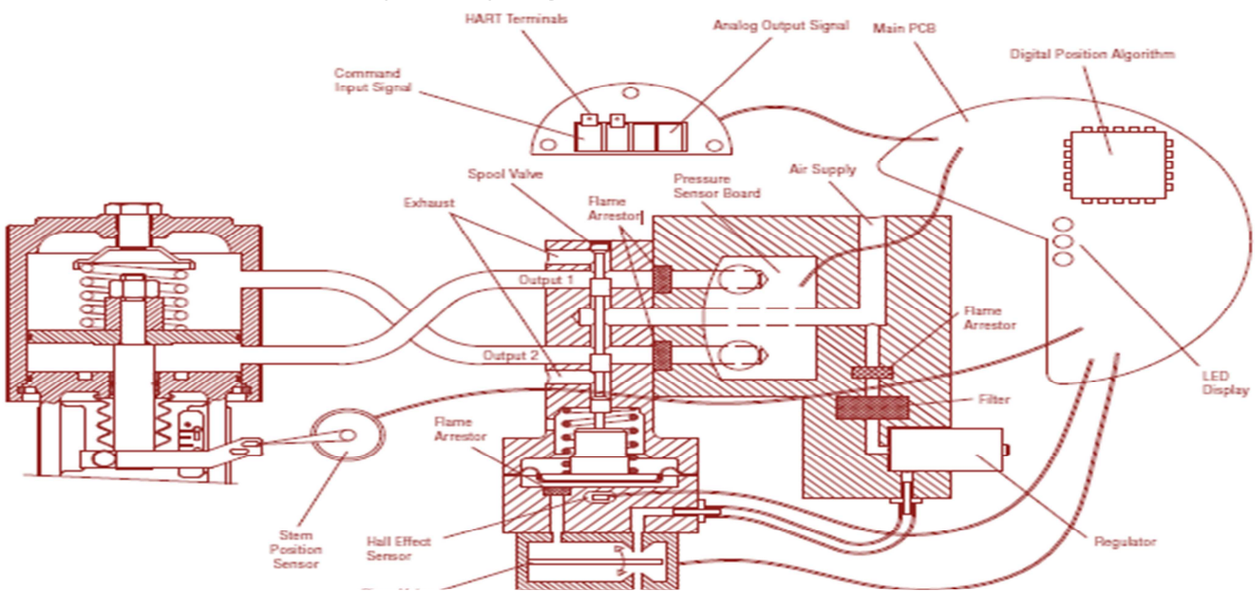


Figure 3: *Logix 520MD+ Digital Positioner Schematic (air-to-open configuration)*

3 SPECIFICATIONS

3.1 Input Signal

Table 1: Input Signal		
	Positioner Alone or with Multi-Function Card	Positioner with Safety Discrete Output Card
Power Supply	Two-wire, 4-20 mA 10,0 VDC plus line losses.	Two-wire, 4-20 mA 13,0 VDC plus line losses.
Input Signal Range	4 - 20 mA (HART)	
Compliance Voltage	10,0 VDC @ 20 mA	13,0 VDC @ 20 mA
Effective Resistance	500 Ω @ 20 mA Typical	650 Ω @ 20 mA Typical
Maximum Supply Voltage	30 VDC	
Minimum Required Operating Current	3,8 mA	
Maximum Shut-down Current	3,6 mA	
Communications	HART protocol	

3.2 Air Supply

Table 2: Air Supply	
Minimum Input Pressure	1,5 Bar (22 PSI)
Maximum Input Pressure	Single Acting Relay – 6,2 Bar (90 PSI) Double Acting Relay – 10,3 Bar (150 PSI) (Set supply pressure as low as possible for maximum relay life.)
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 Gasses	Air, sweet natural gas up to 5 bar, nitrogen and CO2 are acceptable supply gasses. Sour natural gas is not acceptable.
Air Consumption	Single Acting Relay – 0.069 Nm³/h @ 1,5 bar (0.041 SCFM @ 22 PSI) 0.082 Nm³/h @ 4,1 bar (0.048 SCFM @ 60 PSI) 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)

3.3 Pneumatic Output

Table 3: Pneumatic Output	
Output Pressure Range	0 to 100% of air supply pressure.
Output Air Capacity	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) 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)
Primary Output Ports (Port is pressurized in energized state. Port is exhausted upon loss of power.)	Single Acting Relay – Port B Double Acting Relay – Port A

3.4 Stroke Output

Table 4: Stroke Output	
Feedback shaft Rotation	Min 15°, Max 90° 40° recommended for linear applications.

3.5 Analog Output

Table 5: 4 to 20 mA Analog Output Specification	
Potential Range of Rotation	40° to 95°
Power Supply Range	10.0 to 40 VDC, (24 VDC Typical)
Maximum Load Resistance (ohms)	(Supply Voltage - 10.0) / 0.02
Current Signal Output	4-20 mA
Linearity	1.0% F.S.
Repeatability	0.25% F.S.
Hysteresis	1.0% F.S.
Operating Temperature	-40 to 80℃ (-40 to 176℉)

3.6 Safety Discrete Output

Table 6: Safety DO (Switch Function)	
Power Supply Range	10.0 to 40 VDC, (24 VDC Typical)
Maximum Load Resistance (ohms)	TBD
Current Signal Output	TBD
Operating Temperature	-40 to 80℃ (-40 to 176℉)

3.7 Temperature

Table 7: Temperature	
Operating Temperature Range	-52℃* to 80℃ (-61,6° to 176℉)
Transport and Storage Range	-52℃* to 80℃ (-61,6° to 176℉)

*Reduced performance at low temperatures.

3.8 Positioner Performance Characteristics

Table 8: Performance Characteristics	
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%

3.9 Physical Specifications

Table 9: Physical Specifications	
Housing Material	Cast, powder-painted aluminum
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)

3.10 Limit Switch Specifications

Table 10: Limit Switch Specifications	
Switch	Specifications
Mechanical Cherry DG 13-B(X)RA NO and/or NC	Load current: 3/2 AAC/ADC Voltage: 125/30 VAC/VDC Temperature: -25 to +85 ℃ (-13 ℉ to 185 ℉)
Reed Hamlin 59050-030 NO	Load current: 500 mA Voltage: 200VDC Temperature: -40 to +105 ℃ (-40 ℉ to 221 ℉)
Inductive Proximity **P&F SJ2-SN** NAMUR NC	Load current: Plate: ≤ 1 mA; No Plate: ≥ 3 mA Voltage: 5-25 VDC (Nominal 8 VDC) Temperature: -40 ℃ to 100 ℃ (-40 ℉ to 212 ℉)
Inductive Proximity **P&F SJ2-S1N** NAMUR NO	Load current: Plate: ≤ 1 mA; No Plate: ≥ 3 mA Voltage: 5-25 VDC (Nominal 8 VDC) Temperature: -25 ℃ to 100 ℃ (-13 ℉ to 212 ℉)
Inductive Sensor **P&F NJ2-V3-N** NAMUR NC	Load current: Plate: ≤ 1 mA; No Plate: ≥ 3 mA Voltage: Nominal 8.2 VDC Temperature: -25 ℃ to 100 ℃ (-13 ℉ to 212 ℉)
Inductive Sensor **P&F NBB2-V3-E2** PNP NO	Load current: 0…100 mA Voltage: 10...30 VDC Temperature: -25 ℃ to 70 ℃ (-13 ℉ to 158 ℉)

3.11 ValveSight DTM Software Specifications

Table 11: ValveSight DTM Software Specifications	
Computer	Minimum Pentium processor running Windows 95, 98, NT, 2000, XP, 32 MB total memory (64 MB recommended), 30 MB available hard disk space, CD-ROM drive
Ports	1 minimum available with 8 maximum possible. (Can also communicate via serial, PCMCIA and USB connections)
HART Modem	RS-232, PCMCIA card, or USB
HART Filter	May be required in conjunction with some DCS hardware.
HART MUX	MTL 4840/ELCON 2700

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 500MD+ positioner, check the packing list against the materials received. Lists describing the system and accessories are included in each shipping container.

When lifting a valve system from the shipping container, position lifting straps to avoid damage to mounted accessories. Systems with valves up to six inches may be lifted by actuator lifting ring. On larger systems, lift unit using lifting straps or hooks through the yoke legs and outer end of body.

☠ **WARNING:** *When lifting a valve/actuator assembly with lifting straps, be aware the center of gravity may be above the lifting point. Therefore, support must be given to prevent the valve/actuator from rotating. Failure to do so can cause serious injury to personnel or damage to nearby equipment.*

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

If a valve control package has been stored for more than one year, inspect one actuator by disassembling it per the appropriate Installation, Operation, and Maintenance Instructions (IOM) prior to valve installation. If O-rings are out-of-round, deteriorated, or both, they must be replaced and the actuator rebuilt. All actuators must then be disassembled and inspected. If the actuators O-rings are replaced, complete the following steps:

1 Replace the pressure-balance plug O-rings.

2 Inspect the solenoid and positioner soft goods and replace as necessary.

3 Test the control function of the positioner. Do not disassemble to pilot relay module in the positioner.

5 MOUNTING AND INSTALLATION

5.1 Mounting to Mark One Linear Valves

To mount a Logix 520MD+ positioner to a Valtek linear Mark One valve, refer to Figure 4: 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:** *If mounted properly, the follower arm should be horizontal when the valve is at 50% stroke and should move approximately ±30° from horizontal over the full st roke 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.*

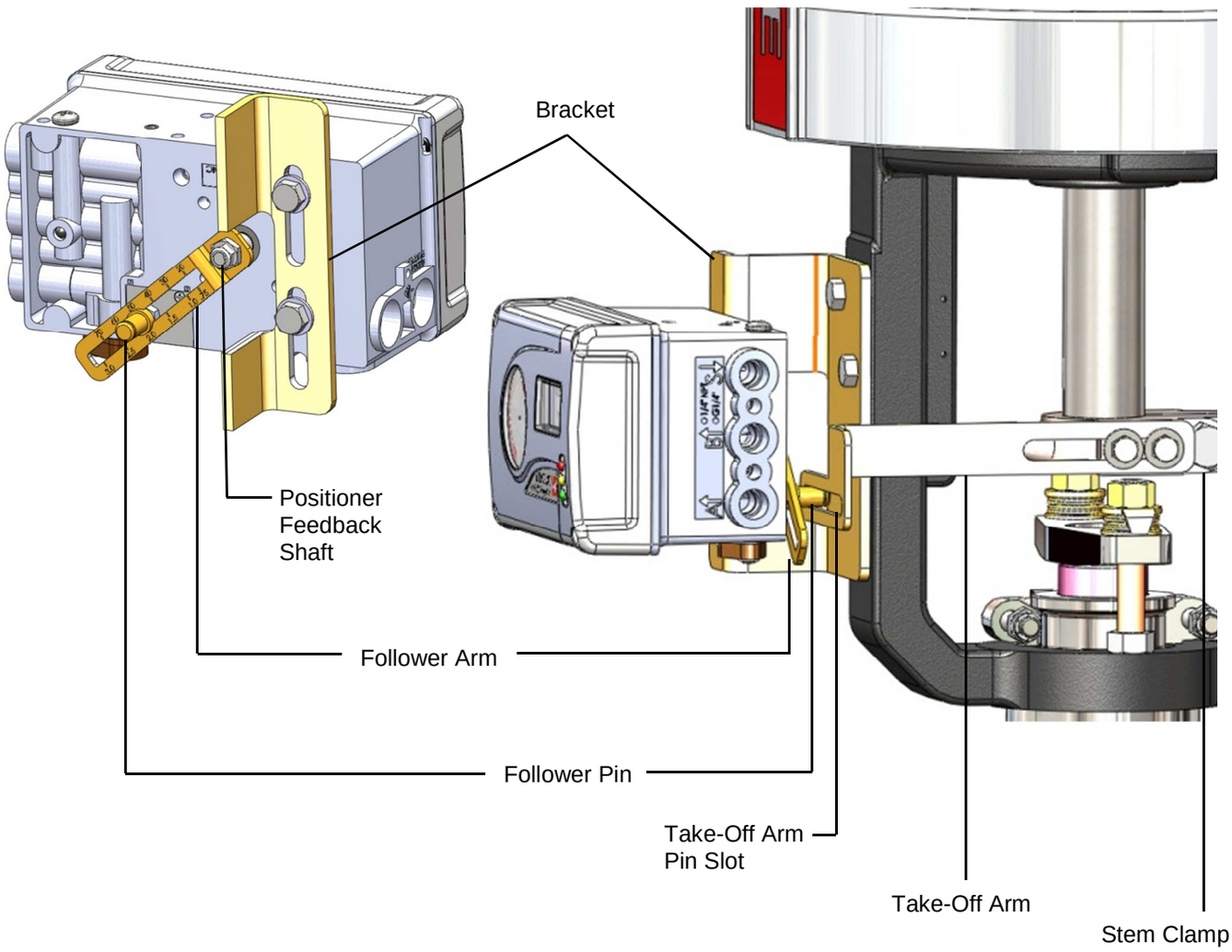


Figure 4: Mounting to Mark I Linear Valves

5.2 Mounting Positioner to Flow-Top Linear Valves

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5.3 Mounting Positioner to Standard Valtek Rotary Valves

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5.4 Mounting Positioner to NAMUR Rotary Valves

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6 TUBING

After mounting has been completed, tube the positioner to the actuator using the appropriate compression fitting connectors.

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: 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. For a linear air-to-close actuator the above configuration is reversed.

Example: Rotary Double-acting Actuators

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

Example: 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, port A can be plugged or may be used for purging. See Purging Single Acting Actuators below.

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 520MD+ 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 Field Service Technician for more information regarding the purging option.

6.4 Vented Design

A standard Logix 520MD+ 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 5: Exhaust Vents.

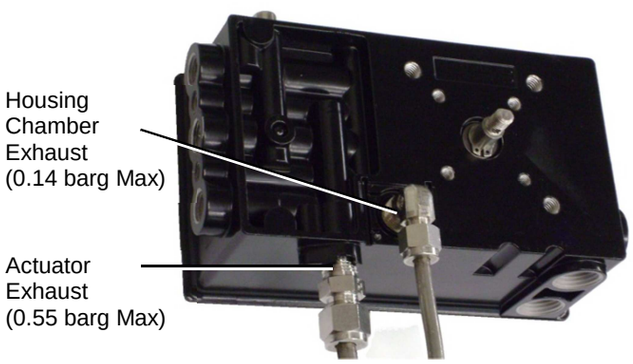


Figure 5: Exhaust Vents

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). For flow rates, see section 3.2 Air Supply.

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 3.3 Pneumatic Output.

WARNING: 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.

6.5 Pneumatic Terminals

Port	Single Acting Poppet Style Relay	Double Acting Spool Style Relay
Supply		
B	Y1	Y2
A		Y1

Figure 6: Pneumatic Connections

7 ELECTRICAL CONNECTIONS

7.1 Electrical Terminals

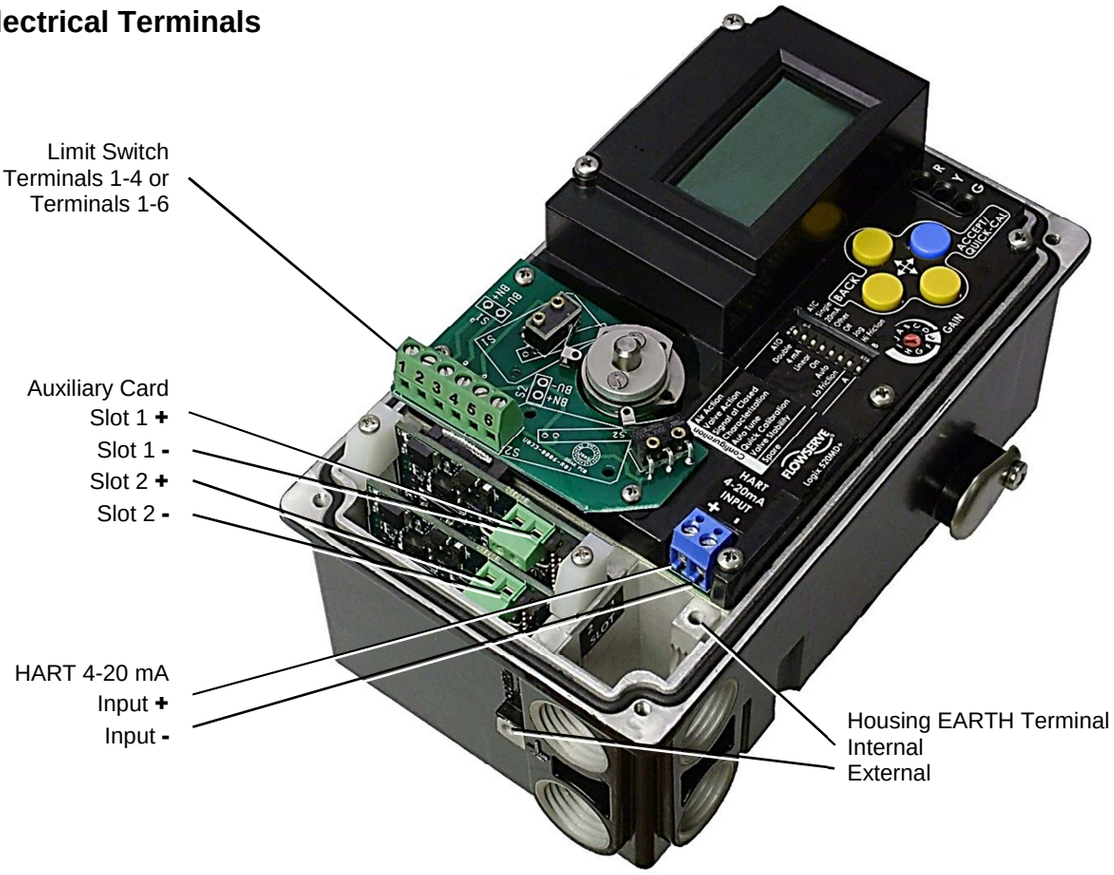


Figure 7: Terminal Diagram

7.2 Command Input (4-20 mA) Connection

The Logix 520MD+ is reverse polarity protected, however, verify polarity when making field termination connection. Wire 4-20 mA current source to the input terminal labeled "HART 4-20mA INPUT". See Figure 7: Terminal Diagram. Depending on the current source, a HART filter may be required. See Figure 8: HART Filter.

7.3 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 520MD impedance.

The Logix 520MD+ requires that the current loop system allow for a **10 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 520MD+, perform the calculation in the following equation. The Available Voltage must be greater than 10VDC in order to support the Logix 520MD. Also, see Table 1: Input Signal.

Equation 1

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

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

$$\text{R}_{\text{barrier}} = 300\Omega$$

$$\text{R}_{\text{wire}} = 25\Omega$$

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

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

The available voltage (12,5 V) is greater than the required voltage (10.0 V) therefore, this system will support the Logix 520MD. The Logix 520MD 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 520MD+ terminals. This could cause permanent circuit board damage*

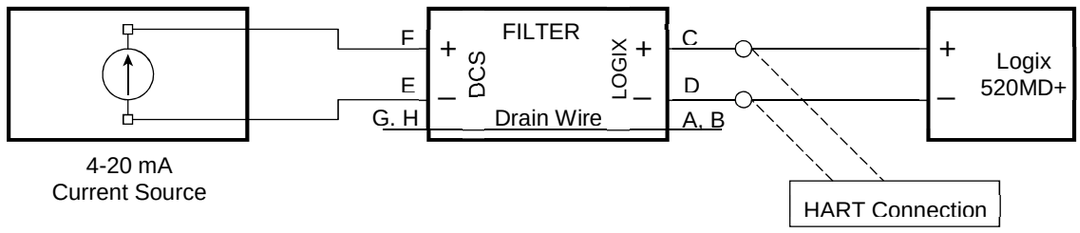


Figure 8: HART Filter

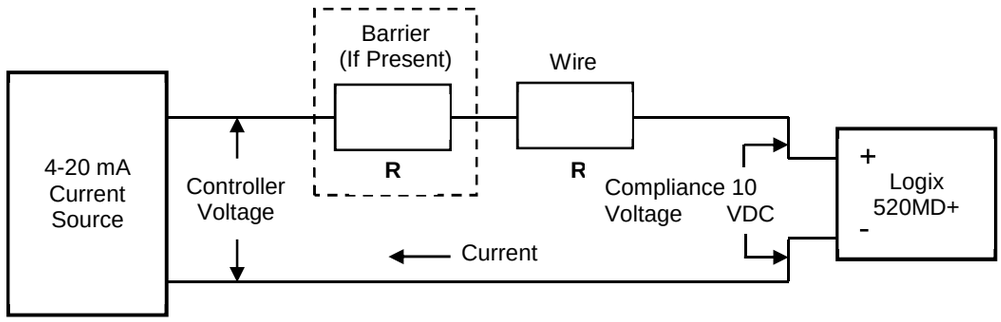


Figure 9: Compliance Voltage

7.4 Cable Requirements

The Logix 520MD+ digital positioner utilizes the HART Communication protocol. This communication signal is superimposed on the 4-20 mA current signal. The two frequencies used by the HART protocol are 1200 Hz and 2200 Hz. In order to prevent distortion of the HART communication signal, cable capacitance and cable length restrictions must be calculated. The cable length must be limited if the capacitance is too high. Selecting a cable with lower capacitance/foot rating will allow longer cable runs. In addition to the cable capacitance, the network resistance also affects the allowable cable length.

In order to calculate the maximum network capacitance, use the following formula:

Equation 2

$$C_{network}\ (\mu F) \leq \frac{650\Omega}{(R_{barrier} + R_{wire} + 390\Omega)} - 0.0032$$

Example:

$R_{barrier} = 300\Omega$ (if present)

$R_{wire} = 50\Omega$

$$C_{network}\ (\mu F) \leq \frac{650\Omega}{(300\Omega + 50\Omega + 390\Omega)} - 0.0032 = 0.08\ \mu F$$

In order to calculate the maximum cable length, use the following formula:

Equation 3

$$\text{Max Cable Length} = \frac{C_{network}}{C_{cable}}$$

Example:

$$C_{cable} = 72\frac{\rho F}{m} = .000072\frac{\mu F}{m}$$

$$\text{Max Cable Length} = \frac{0.08\ \mu F}{.000072\frac{\mu F}{m}}$$

$$\text{Max Cable Length} = 1111\ m$$

To control cable resistance, 24 AWG cable should be used for runs less than 5000 feet. For cable runs longer than 5000 feet, 20 AWG cable should be used.

The input loop current signal to the Logix 3200MD digital positioner should be in shielded cable. Shields must be tied to a ground at only one end of the cable to provide a place for environmental electrical noise to be removed from the cable. In general, shield wire should be connected at the source, not at the positioner.

7.5 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.

The grounded screw must not be used to terminate signal shield wires.

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 10: Conduit and Grounding.

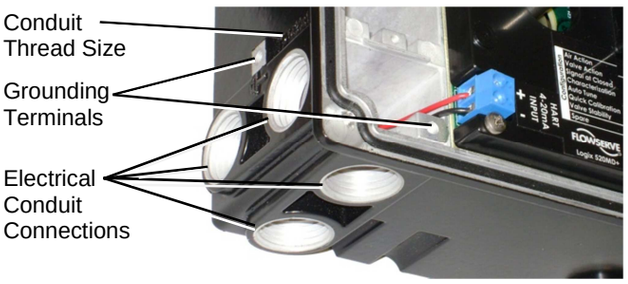


Figure 10: Conduit and Grounding

7.6 Electromagnetic Compatibility

The Logix 520MD+ 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 520MD+ positioner to restore operation.

7.7 Intrinsically Safe Barriers

When selecting an intrinsically safe barrier, make sure the barrier is HART compatible. Although the barrier will pass the loop current and allow normal positioner control, if not compatible, it may prevent HART communication.

7.8 Multi-Function Card (AO, DO, DI)

The Multi-Function Card can act as an Analog Output (AO), a Discrete Output (DO), or a Discrete Input (DI). Connections to the Multi-Function Card are made directly to the card terminals. For detailed information about voltage and current limits, see Table 12: Auxiliary Card Status below.

For AO and DO functions wire the MFC in series with a 10 to 40 VDC power supply, including a method to determine the current. When configured as an AO, the current will follow the valve position. When configured as a DO, current will remain high until the user-defined conditions are met, then drop low when tripped.

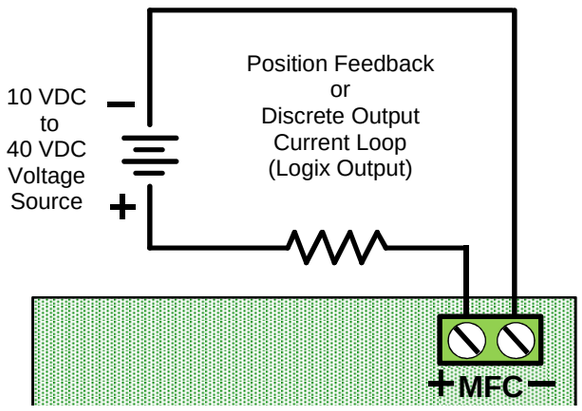


Figure 11: MFC Analog Output or Discrete Output Circuit

For the DI function, wire the MFC in series with a 0 to 40 VDC power supply. Keep the voltage low under normal circumstances. Raise the voltage to indicate a tripped input state.

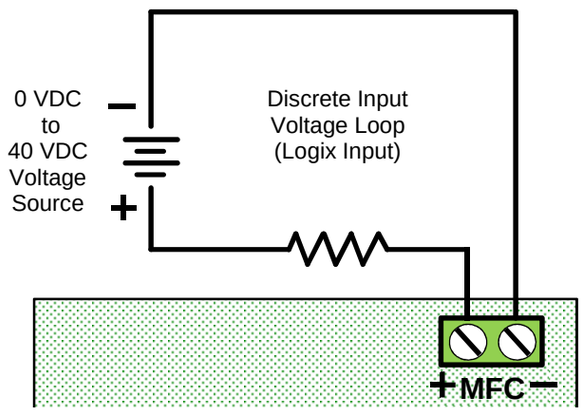


Figure 12: MFC Discrete Input Circuit

Table 12: Auxiliary Card Status

Card	Condition	Status Indication
MFC (AO)	Monitoring Position (typical 4-20mA) < 1.0 mA = Lost Positioner Power	Output (mA)
MFC (DO)	High (output > 2.2 mA, typical 6 mA)	1 - Nominal
	Low (1.0 mA > output > 100 uA, typical 1.1 mA)	0 - Tripped
MFC (DI)	Low (input < 3.0 VDC)	1 - Nominal
	High (input > 10.0 VDC)	0 - Tripped
Safety DO	Circuit Closed (500 mA max)	1 - Nominal
	Circuit Opened (60 VDC max)	0 - Tripped

7.9 Safety Discrete Output (Safety DO)

The Safety Discrete Output (Safety DO) provides a relay-style, open or closed circuit. Connections to the Multi-Function Card are made directly to the card terminals.

Wire the Safety DO in series with a power supply, including a method to determine the current or voltage. The circuit will remain closed until specific conditions are met, then the circuit will open. For detailed information about voltage and current limits, see Table 12: Auxiliary Card Status above.

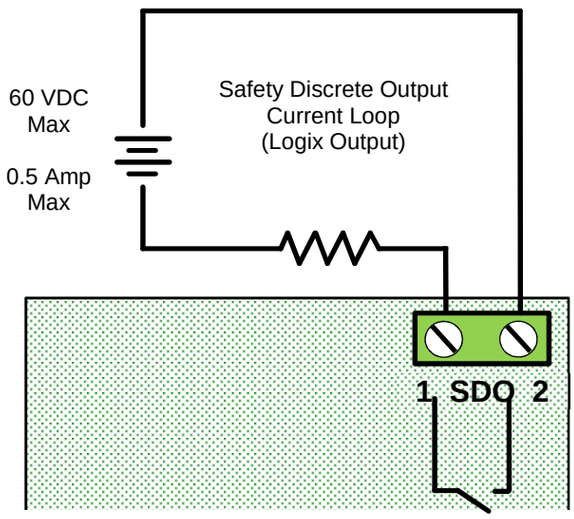
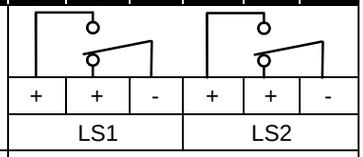
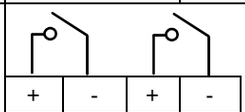
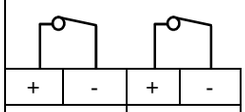
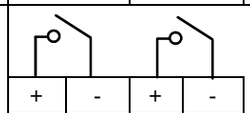
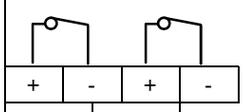
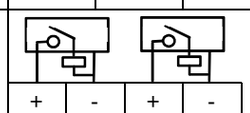


Figure 13: Safety Discrete Output Circuit

7.10 Limit Switches

Limit switches provide an independent verification of the position of the feedback shaft. Wire the limit switches according to the following table. For more information, see table Table 10: Limit Switch Specifications on page 8.

Table 13: Limit Switch Connections

Switch	Terminal (See Figure 14) 1	2	3	4	5	6
Mechanical Cherry DG 13-B2RA 2 & 5 NC						
	+	+	-	+	+	-
	LS1			LS2		
Reed Hamlin 59050-030 NO						
	+	-	+	-		
	LS1		LS2			
Inductive Proximity P&F SJ2-SN NAMUR NC						
	+	-	+	-		
	LS1		LS2			
Inductive Proximity P&F SJ2-S1N NAMUR NO						
	+	-	+	-		
	LS1		LS2			
Inductive Sensor P&F NJ2-V3-N NAMUR NC						
	+	-	+	-		
	LS1		LS2			
Inductive Sensor P&F NBB2-V3-E2 PNP NO						
	+	-	+	-		
	LS1		LS2			

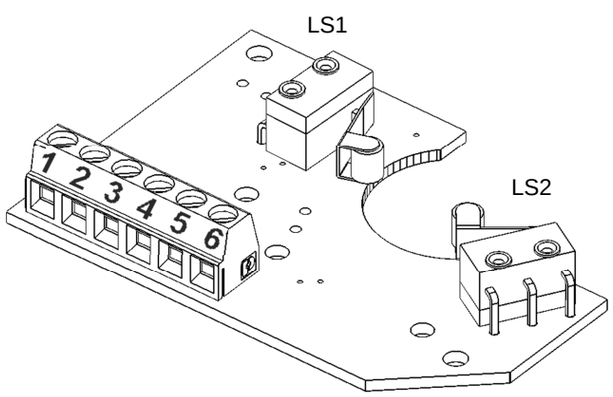


Figure 14: Limit Switch Board

8 STARTUP

8.1 Quick Start Instructions

The DIP switch settings and Quick-Cal function listed below are typically all that are needed to calibrate and tune the positioner for use. This simple procedure takes only seconds for most valves.

1 Using the Configuration Switches, select the desired configuration. See section 8.3 Configuration Switch Settings for details.

2 Hold the Quick-Cal button for 3 seconds. This will initiate a stroke calibration.

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

☠ **WARNING:** *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 3200MD local user interface allows the user to calibrate, configure the basic operation, and tune the response of the positioner without additional tools or configurators. The Local interface consists of:

- Configuration Switches (8) – Used to set basic configuration. See explanations in section 8.3 Configuration Switch Settings.
- Interface Buttons – Used to calibrate the positioner, perform special functions and navigate the display menu.
  - o ►QUICK-CAL / ACCEPT
  - o ▲Up
  - o ▼Down
  - o ◄Back
- Selectable GAIN Switch (Rotary) – Used to manually fine-tune the performance.
- LED Indicators (Red, Yellow, and Green) – Indicate status, alarms and warnings.
- Display (Optional) – Provides a full menu of detailed information and configuration options.

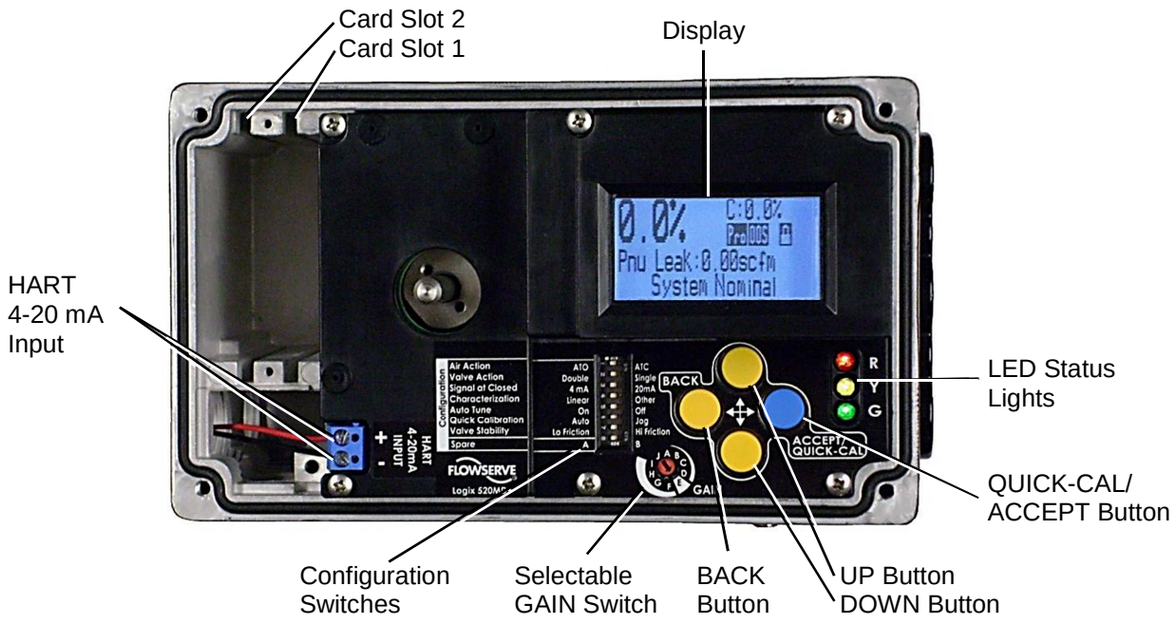


Figure 15: Local User Interface

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). However, the Configuration Switch settings may be edited from the DTM or Handheld at any time.*

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 Valve Action Switch

This must be set to match the configuration of the actuator and is used in some diagnostics.

Double - Select Double when both sides of the actuator are pressurized.

Single - Select Single when only one side of the actuator is pressurized.

8.3.3 Signal at Closed Switch

Normally this will be set to 4 mA for an Air-To-Open actuator configuration, and 20 mA for Air-To-Close.

4 mA - Selecting 4 mA will make the valve close when the signal is low (4 mA) and open when the signal is high (20 mA).
20 mA - Selecting 20 mA will make the valve close when the signal is high (20 mA) and open when the signal is low (4 mA).

➲ **NOTE:** *When using an Analog Output (AO) function of the Multi-Function Card, the AO signal corresponds with the Signal At Closed selection. If the valve closes with a 4 mA signal, the AO will show a 4 mA signal at closed. If the valve closes with a 20 mA signal, the AO will show a 20 mA signal at closed.*

8.3.4 Characterization Switch

The Characterization Switch allows a better match between the input command and the actual fluid flow through the valve. This feature is typically used with valves that have non-linear flow characteristics. The positioner makes a correction by applying an adjustment to the input command according to a characterization curve.

Linear - Select Linear if the actuator position should be directly proportional to the command input signal. (For most rotary valves, this setting gives an =% Cv characteristic due to their inherent =% characteristics.)

Other - Select Other if one of the pre-set characterization curves or a custom curve is desired. The default will be the Custom curve which is populated with a standard 30:1 equal percent rangeability curve which generally opens less than the input command. To select one of the other curve options, use the LCD menu, a Handheld or the ValveSight DTM. To modify the Custom curve, use the DTM. See section 10.3.6 Configuration (Characterization) for more information.

8.3.5 Auto Tune Switch

This switch controls whether the positioner will automatically tune itself during the stroke calibration (Quick-Cal), or use preset tuning parameters.

On - Selecting On enables an auto tune feature that will automatically determine the positioner gain settings. The automatic tuning will be based on response parameters measured during the latest Quick-Cal. The valve response is a combination of these response parameters and the current position of the Selectable GAIN Switch.

Off - Selecting Off forces the positioner to use one of the factory preset tuning sets determined by the Selectable GAIN Switch. Settings “B” through “J” are progressively higher predefined tuning sets.

Selecting “A” on the Selectable Gain Switch during a Quick-Cal allows the user to use and preserve manually adjusted gains.

See section 8.4 Stroke Calibration for more details.

➲ **NOTE:** *The gain switch is live meaning that regardless of the Auto Tune selection, the gain settings can be adjusted at any time during operation by changing the selectable GAIN switch position.*

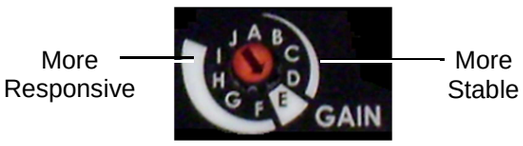


Figure 16: Selectable GAIN Switch

8.3.6 Quick Calibration Switch

This switch selects between Auto and Jog calibration modes.

Auto - Use the Auto setting if the fully opened position of the valve has a mechanical stop. This is typical for most valves. In Auto mode during a stroke calibration (Quick-Cal), the positioner will fully close the valve and register the 0% position, then fully open the valve to register the 100% position.

Jog - Use the Jog setting if the fully opened position of the valve has no hard stop, but needs to be set manually. In Jog mode during a stroke calibration (Quick-Cal), the positioner will fully close the valve and register the 0% position, then wait for the user to move the valve to the 100% open position using the ▲Up and ▼Down buttons. Press the ►ACCEPT/QUICK-CAL button to accept the 100% location.

See section 8.4 Stroke Calibration for more details.

8.3.7 Valve Stability Switch

This switch adjusts the position control algorithm of the positioner for use with low-friction control valves or high-friction automated valves.

Lo Friction - Placing the switch to Lo Friction optimizes the response for low friction, high performance control valves. This setting provides for optimum response times when used with most low friction control valves.

Hi Friction - Placing the switch to the right optimizes the response for valves and actuators with high friction levels. This setting slightly slows the response and will normally stop limit cycling that can occur on high friction valves. See section 10.3.7 Configuration (Pressure Control) for more details.

➲ **NOTE:** *This option is more effective on advanced units with the optional pressure sensors installed.*

8.3.8 Spare Switch

If special features have been purchased they may be controlled by this switch. See associated documentation for more details.

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, first ensure the Quick Calibration Switch is set to Auto or Jog as appropriate. 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 17.3 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.

8.4.1 Quick Calibration Switch – Jog

Set the Quick Calibration Switch to Jog if the valve/actuator assembly has **no** internal mechanical stop at the fully open position. In this case, follow these instructions:

1 Press and hold the ►ACCEPT/QUICK-CAL button for approximately 3 seconds.

This will initiate the jog stroke calibration. The positioner will then close the valve and set the zero position. The zero position is automatically always set at the valve seat. At this point the LED's will flash in a sequence of G-R-R-R (green-red-red-red) which indicates that the user must use the jog keys to manually position the valve to approximately 100%.

2 Use the up and down keys to position the valve at approximately 100% open.
3 Press the ►ACCEPT/QUICK-CAL button to proceed.

No more user actions are required while the calibration process is completed. When the lights return to a sequence that starts with a green light the calibration is complete.

The jog calibration process will only allow the user to set the span. If an elevated zero is needed a handheld or ValveSight DTM are required.

8.4.2 Tuning Options

Quick-Cal Custom Gains **-** This is typically the fastest way to achieve ideal gains. Set the Auto Tune Configuration Switch to On and the Selectable GAIN Switch to "E". Then perform a Quick-Cal. During the Quick-Cal, custom tuning parameters will be determined based on measured response parameters. The gains can then be fine-tuned by adjusting the Selectable GAIN Switch. Selecting "D" "C" or "B" will progressively provide a more stable response. Selecting "F" through "J" will progressively provide a more active response. In most cases selecting "E" will give the best results. This is the default setting for all actuator sizes. Raising or lowering the Selectable GAIN Switch setting is a function of the positioner/valve response to the control signal, and is not actuator size dependent.

Standard Preset Gains - If standard, preset gains are desired, set the Auto Tune Configuration Switch to Off. After performing a Quick-Cal, use the Selectable GAIN switch to the desired level ("B" – "J"). The standard, preset gain settings are not affected by Quick-Cal. It may be necessary to set the gain switch before the Quick Cal. Very fast stroking valves may need to be at lower gains and very slow stroking valves may need to be at higher gains.

It may be necessary to set the gain switch BEFORE the Quick Cal. Very fast stroking valves may need to be at lower gains and very slow stroking valves may need to be at higher gains.

Custom Manual Gains - To set gains manually, set the selectable GAIN switch to "A". Changing the switch from "B" to "A" will write the standard "B" settings into the "A" parameters, allowing a starting point for modification. Similarly, changing the switch from "J" to "A" will write the standard "J" settings into the "A" parameters. Custom tuning values can then be entered using the Display Menu, a Handheld or ValveSight DTM. With the Selectable GAIN Switch set to "A", the tuning will not be modified during a Quick-Cal.

8.4.3 Aborting a Quick-Cal

The Quick-Cal can be aborted at any time by briefly pressing the ►ACCEPT/QUICK-CAL button again. In this case, the previous settings will be retained.

8.4.4 On Line Stroke Calibration Adjustments

At times an adjustment to the calibration is desired, but the process cannot be interrupted. The stroke calibration can be adjusted with minimal valve movement. Contact your local Field Service Technician for more information.

9 POSITIONER FUNCTIONS (No Display Required)

The following features can be performed using the local interface. No display is required for these features. Additional features are offered with the use of a display, Handheld or DTM.

➲ **NOTE:** *In order to prevent unintentional adjustments of the configuration, tuning, or control of the valve, the Tamper Lock feature may be used. This is set in the DTM and disables the buttons and menus except for the ability to view the status of the positioner. When locked, the positioner may be temporarily unlocked by entering a PIN. (An LCD is required to enter the PIN.) Or, the positioner can be unlocked from the DTM.*

9.1 Live Manual Tuning (Adjusting the Gain)

Use the Selectable GAIN Switch to adjust the gain at any time during operation. This adjustment takes effect immediately. For faster response select settings above “E” (F-J). For more stable response, select settings below “E” (B-D). See Figure 16: Selectable GAIN Switch.

9.2 Local Control Of Valve Position

To manually adjust the position of the valve regardless of the input command (analog or digital), press and hold the ▲Up, ▼Down and ◄ BACK buttons for about 3 seconds. The ▲Up, ▼down buttons can then be used to position the valve. While in this mode the LED‘s will flash a GRRY (green-red-red-yellow) sequence. To exit the local control mode and return to normal operation, briefly press the ► ACCEPT/QUICK-CAL button.

☠ **WARNING:** *When operating using local control of the valve, the valve will not respond to external commands. Notify proper personnel that the valve will not respond to remote command changes, and make sure the valve is properly isolated.*

9.3 Command Source Reset

Performing a command source reset will reset the command source to analog if it has been inadvertently left in digital mode. This is done by holding down both the ▲Up and ▼Down buttons, then briefly pressing the ►ACCCEPT/QUICK-CAL button.

9.4 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. Tag names and other user configured limits, alarm settings, and valve information will also be lost and need to be restored. A factory reset will always reset the command source to analog 4-20 mA.

➲ **NOTE:** *Once the Multi-Function Card (MFC) type has been configured, the type selection will still remain after a factory reset.*

☠ **WARNING:** *Performing a factory reset may result in the inability to operate the valve until reconfigured properly. Notify proper personnel that the valve may stroke, and make sure the valve is properly isolated.*

9.5 Viewing Version Numbers

The version number of the embedded code may be checked at any time except during a calibration. To see the major version number, hold the ▲Up button. This will not alter the operation of the unit other than to change the blink sequence to 3 blinks indicating the major version number. Holding the ▼Down button will give the minor version number without affecting operation. The version codes are interpreted by adding up the numbers assigned according to the following table:

Table 14: Viewing Version Numbers

Color	First Blink Value	Second Blink Value	Third Blink Value
Green	0	0	0
Yellow	9	3	1
Red	18	6	2

For example, if holding the ▲Up button gave a G-G-R code, and holding the ▼Down gave a Y-Y-G code then the resulting version number would be (0+0+2).(9+3+0) or version 2.12.

10 POSITIONER FUNCTIONS (LCD Display)

The optional LCD display provides a variety of useful information and functions. The Main View shows important information using icons and scrolling status lines. Using the directional buttons (▼▲►◄) to navigate the menu, the user can view detailed information perform commonly used functions.

➲ **NOTE:** *The LCD backlight may change brightness during use. This is normal. The backlight uses any residual power not used by other functions of the circuitry. When current supply is low (4mA) the light will appear darker. When current supply is high (20mA) the light will appear brighter.*

10.1 Main Display View

The main view provides an instant display of important status parameters: Position, Final Command, Scrolling Status Message, Current Alarm Status and Status Icons.

10.1.1 Position and Command

The current Position and Command are always shown. This shows the Final Command which has been adjusted according to a Characterization Curve, MPC, or Soft Limits that have been applied and should match the Position.

10.1.2 Scrolling Status Messages

The Scrolling Status Message provides the following information as applicable:
Date and Time – The date and time format is adjustable. See Section 10.3.9 Configuration (Set Time and Date) for more information.
Ambient Temperature – This is the temperature inside the positioner.
Supply Pressure – The supply pressure is available with Advanced and Pro upgrades.
Friction – This is calculated when the valve moves. Friction is available with the Pro upgrade.
Actuation Ratio – This is the amount of available force used to move the valve.
Pneumatic Leak – This is leak beyond normal air consumption. Pneumatic Leak is available with the Pro upgrade.
Training Percent Complete – Training tracks key parameters for a period of time. This data can be used to set more meaningful Alarm and Warning limits. Training will begin automatically after 24 hours of continuous operation and end after 90 days of positioner operation. Or use the DTM to initialize this function. The training status will show only if training has occurred.
Training Hours Remaining - This shows the hours left in the training session if training is currently in progress.
Auxiliary Card 1 Status - This shows the type of card in auxiliary card slot 1.
Auxiliary Card 2 Status - This shows the type of card in auxiliary card slot 2.
DIP Switch Override – This indicates that the Configuration (DIP) Switches do not reflect the actual configuration of the positioner. This can happen if a Configuration Switch is changed after a Quick-Cal, or if the configuration is was changed from the DTM. Performing a Quick-Cal will reset the configuration to what the Configuration Switches show, which may not be desirable in this case. Ensure the Configuration Switches are set properly before performing a Quick-Cal.

10.1.3 Current Alarm Status

The Current Alarm Status area shows the highest priority alarm, warning, alert or status indication. This matches the code indicated by the flashing LEDs.

10.1.4 Status Icons

Status icons continuously show the state of the features and modes.

Table 15: Status Icons

Icon Location	Icon	Icon Meaning
Upgrade Level		Standard
		Advanced upgrade
		Pro upgrade
Command Source		Analog command mode
		Digital command mode
		Out of service
Training Mode		Training in progress
		Training complete
	(blank)	Training not started
Pressure Control		Pressure control locked
	(blank)	Pressure control not locked
HART Communications		HART communication currently in progress
		Burst mode in progress
	(blank)	No HART communication currently in progress
Continuous Stroke Test (CST)		CST ramping up
		CST ramping down
		CST holding steady
	(blank)	CST not activated

Upgrade Level Icons - The upgrade levels provide increased functionality beginning at Standard, then Advanced and finally Pro. These levels also correspond to the model numbers 520MD+, 521MD+ and 522MD+ respectively. A Standard (520MD+) positioner has no upgrades. An Advanced (521MD+) positioner includes pressure sensor functions. A Pro (522MD+) positioner includes the pressure sensor functions along with full diagnostic capabilities.

Command Source Icons – The positioner is in Analog Command mode if it is using the 4-20 mA signal to control the location of the valve. In Digital Command mode, the positioner ignores the 4-20 command and responds to the position command given through HART. In Out Of Service mode, the positioner is performing a calibration, signature, partial stroke test or is in a factory reset state.

Training Mode Icons – The positioner can keep track of several key data parameters for a period of time specified by the user. This data can be viewed while setting alarm limits to make them more meaningful. For example, if supply pressure cycles every day from 5 bar to 4 bar in normal operation, this information will be displayed where the supply pressure warning limits are set. Seeing that the supply typically drops to 4 bar, the user can then set the supply pressure low warning to a value below 4 bar. See the DTM User Manual for more information.

Pressure Control – When the position of the valve gets very close to the commanded position, the positioning algorithm will change to pressure control. This means the pressures will be held constant (locked), improving the stability of the valve position. The point at which the pressure control is locked depends on the Valve Stability switch on the positioner. When the switch is set to “Lo Friction”, the locking point is self-adjusting to optimize accuracy. When the switch is set to “Hi Friction” and the deviation is smaller than +/- 1.0%, the pressure “locks”. This value can be adjusted using the Display Menu or DTM. See section 10.3.7 Configuration (Pressure Control).

HART Communications Icons – When the positioner is sending or receiving data via the HART communication protocol, the icon will be displayed. During burst mode, a pulsating heart icon will be displayed.

Continuous Stroke Test (CST) – For valves that are normally held at a constant position for extended periods of time, the Continuous Stroke Test can provide assurance that the valve is still responsive. When CST is on, the positioner will cause a very small amount of valve movement. From this movement, the positioner can find information about the health of the valve, actuator and positioner. This is not recommended for valves intended for high accuracy or stability.

To achieve the CST function, the positioner adds a small deviance to the command. The deviance is ramped at a rate of 0.05%/second up to 5%. However, the instant the valve moves, the ramp reverses and begins to grow in the opposite direction. So, with low friction, the actual movement will be quite small. If the valve does not move by the time the deviance equals 5%, a counter will start. After 5 consecutive failed attempts to move, the CST warning will sound. The ramp rate, maximum limit, and frequency of the CST can be adjusted using the DTM.

10.1.5 Adjusting the Display Contrast

To adjust the display contrast, hold the ◄ Back button for 3 seconds. Use the ▲Up and ▼ Down buttons to adjust the contrast. Use the ►ACCEPT/QUICK-CAL to accept the settings.

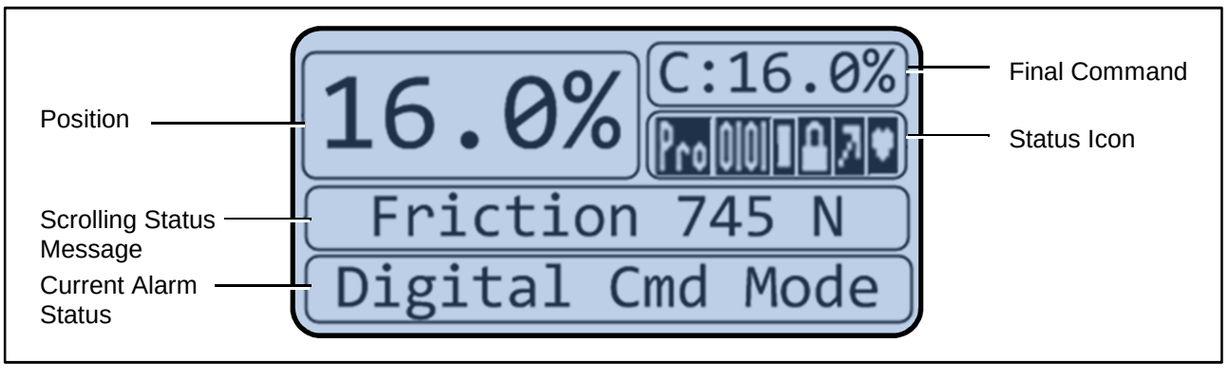


Figure 17: Display Main View

10.2 Menu Overview

Status
- Command (mA)
- Command (%)
- Position (%)
- PS (Supply Pressure)*
- PA (Port A Pressure)*
- PB (Port B Pressure)*
- Friction**
- Actuation Ratio**
- Pneumatic Leak**
- Temperature
- Valve Cycles
- Valve Travel (%)
- Card 1 Value
- Card 2 Value

Alerts and Alarms
- Current Alarms (Prioritized)
- Event History
  - Last Event
  - 2nd Event
  - 3rd Event
    - *
    - *
    - *
  - 32nd Event

Partial Stroke Test
- Start
- Last Result

Calibration
- Stroke/Quick Calibration
- Pressure Sensor Calibration
- Friction Calibration
- Triple Calibration
- Command Input Calibration
- Calibration Dates

Configuration
- Positioner Tuning
- Characterization
- Pressure Control
- Soft Limits & Cutoff
  - *High Soft Limit*
  - *Low Soft Limit*
  - *Upper Position Cutoff*
  - *Lower Position Cutoff*
- Set Date & Time
- User Preferences
  - *All Units*
  - *Pressure Units*
  - *Force Units*
  - *Temperature Units*
  - *Air Flow Units*
  - *Actuator Area Units*
  - *Date Format*
  - *Number Format*
  - *LCD Orientation*
- Burst Mode
  - *ON/OFF*
- Positioner Revs
  - *EC Major Rev*
  - *EC Minor Rev*
  - *EC Build Date and Time*
  - *Universal Rev*
  - *Hardware Rev*
- Factory Reset

Card 1 (or Card 2)
- No Card: “No Card”
- Multi-Function Card
  - *Not Configured*
  - *Set as AO Card*
  - *Set as DO Card*
  - *Set as DI Card*
  - *Config/Cal*
    - If Not Configured – “No Configuration Allowed”
    - If AO
      - Set 0%
      - Set 100%
    - If DO – “Use DTM”
    - If DI
      - Set to No Action
      - Set to Trigger PST
      - Set to Command Override
      - Set Command Point
- Safety Discrete Output

Language
- English
- German
- French
- Spanish
- Portuguese
- Russian
- Turkish
- Italian

* Requires Advanced positioner upgrade.
** Requires Pro positioner upgrade.

10.3 Menu Features

10.3.1 Status

- ►**Status**
  - ►Command (mA)
  - ►Command (%)
  - ►Position (%)
  - ►PS (Supply Pressure)*
  - ►PA (Port A Pressure)*
  - ►PB (Port B Pressure)*
  - ►Friction**
  - ►Actuation Ratio**
  - ►Pneumatic Leak**
  - ►Temperature
  - ►Valve Cycles
  - ►Valve Travel (%)
  - ►Card 1 Value
  - ►Card 2 Value

* Requires Advanced positioner upgrade.
** Requires Pro positioner upgrade.

The Status menu is used to view information about the configuration and operation of the system.

Command displays the final command in mA.
Command displays the final command in %.
Position displays the valve position in %.
PS displays the supply pressure.
PA displays the pressure in port A. This is the primary port if using a poppet-style relay module.
PB displays the pressure in port B. This is the primary port if using a spool-style relay module.
Friction displays the friction of the actuator/valve assembly.
Actuation Ratio displays the force required to actuate the valve as a percentage of the total force available. The value is an estimate of the force that would be required to move the valve to the end of travel, fully compressing the actuator spring(s).
Pneumatic Leak is an estimate of leak in addition to regular air consumption.
Temperature displays the temperature inside the positioner.
Valve Cycles are counted each time the positioner changes direction. The movement must be beyond a dead-band window. This window is set to 0.5% as a default, but can be changed using the DTM.
Valve Travel is counted in small increments every time the valve moves beyond the dead-band window. The travel is displayed in % of full stroke.
Card 1 Value shows the configuration and status of the auxiliary card in slot 1. A tripped state is represented by a 0. A nominal state is represented by a 1.
Card 2 Value shows the configuration and status of the auxiliary card in slot 2. A tripped state is represented by a 0. A nominal state is represented by a 1.

For example, if the Multi-Function Card (MFC) was in slot 1, configured as an analog output (AO), and giving 12.34 mA, the display would show “AO 1 12.34mA”. If no card is in the slot, the display will show “No Card”.

For more information about auxiliary card status, see Table 12: Auxiliary Card Status.

10.3.2 Alerts and Alarms

- ►**Alerts and Alarms**
  - ►Current Alarms (Prioritized)
  - ►Event History
    - ►Last Event
    - ►2nd Event
    - ►3rd Event
      - *
      - *
      - *
    - ►32nd Event

The Alerts and Alarms menu shows current and past alarms, warnings, alerts, and calibrations.

Current Alarms displays all events that are actively sounding.
Event History displays past 32 events including alarms, warnings, alerts, and calibrations. The event that occurred most recently is displayed first (event 32) with later events recorded below. Each event has a time stamp and shows if it was turning on or off.

10.3.3 Partial Stroke Test

- ►**Partial Stroke Test**
  - ►Start
  - ►Last Result

The Partial Stroke Test (PST) menu provides the user the ability to start a PST and see the results of the latest PST.

☠ **WARNING:** *Performing a Partial Stroke Test will result in valve movement and the inability to operate the valve until the test is complete. Notify proper personnel that the valve may stroke, and make sure the valve is properly isolated if required by plant procedures.*

Start allows the user to initialize the (PST).
Last Result shows “Pass” or “Fail” from the last PST attempt.

10.3.4 Calibration

- ►**Calibration**
  - ►Stroke/Quick Calibration
  - ►Pressure Sensor Calibration
  - ►Friction Calibration
  - ►Triple Calibration
  - ►Command Input Calibration
  - ►Calibration Dates

The Calibration menu allows the user to calibrate the positioner’s sensors. The positioner can accurately control with only a Quick-Cal. Typically this is all that is needed. A friction calibration is recommended if the positioner has been upgraded to Pro diagnostics. See section 8 STARTUP for more details.

☠ **WARNING:** *Performing a calibration may result in valve movement and the inability to operate the valve until the calibration is complete. Notify proper personnel that the valve may stroke, and make sure the valve is properly isolated before proceeding.*

Stroke/Quick Calibration starts an automatic calibration of the position feedback sensor. 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. See section 8.4 Stroke Calibration for more information.
Pressure Sensor Calibration starts an automatic calibration of the pressure sensors. The pressure sensors are calibrated at the factory and typically will not need calibration. Use this feature if new pressure sensors are installed. If desired, configure the positioner to use the most recent pressure calibration values after a factory reset. To do this, write a 1 to variable 194 using the Edit Variables page of the ValveSight DTM.
Friction Calibration starts an automatic calculation of total system friction. This also determines the spring rate and other values critical to the Pro diagnostic functions.

➲ **NOTE:** *Friction forces may change quickly when a valve is first placed into service.*

Triple Calibration performs Stoke, Pressure and Friction calibrations in one step.
Command Input Calibration is used to adjust the input range. The default input range is 4 to 20 mA.

Split Range Example:
A split range is easily configured using the Command Input Calibration feature. For example, a 4 to 12 mA signal can be set to correspond to a 0 to 100% stroke. When the display shows "Set 0%", set the command input current to 4 mA. (The display will show a low Analog to Digital Count (ADC) that corresponds to 4 mA.) Then press the ►ACCEPT/QUICK-CAL button to set the value. Press the ▼Down button to move to "Set 100%". Set the command input current to 12 mA. (The display will show a high ADC to correspond to 12 mA.) Again press the ►ACCEPT/QUICK-CAL button to set the value. Select the ◄Back Button to exit.

Calibration Dates lists the most recent date of each calibration.

➲ **NOTE:** *To calibrate the Analog Output, see section 14 MULTI-FUNCTION CARD.*

10.3.5 Configuration (Positioner Tuning)

►**Configuration**
►Positioner Tuning
►*P-Gain Open*
►*I-Gain Open*
►*D-Gain Open*
►*P-Gain Close*
►*I-Gain Close*
►*D-Gain Close*
►*Open Stroke Time*
►*Close Stroke Time*
►*Minimum Open Time*
►*Minimum Close Time*

The Configuration – Positioner Tuning menu allows the user to manually adjust individual tuning parameters. All tuning parameters are automatically set to optimal values during Quick-Cal. Typically a Quick-Cal is all that is needed for positioner tuning. See section 8 STARTUP for more details.

⚠ **CAUTION:** *Adjusting the tuning parameters will affect the responsiveness of the valve and could cause rapid changes to the valve position. Notify proper personnel that the valve may stroke, and make sure the valve is properly isolated before proceeding.*

P-Gain, I-Gain and D-Gain are the proportional, integral, and differential elements of the feedback algorithm. These gains are different for the opening and closing directions because typically responsiveness is different in each direction.

➲ **NOTE:** *Only those with specific training in PID tuning algorithms should attempt to adjust the tuning by manually changing the PID values.*

Open Stroke Time is the fastest time it took the valve to stroke from 0% to 100% during Quick-Cal. Changing this parameter will affect the responsiveness of the valve in the opening direction.

Close Stroke Time is the fastest time it took the valve to stroke from 100% to 0% during Quick-Cal. Changing this parameter will affect the responsiveness of the valve in the closing direction.

Minimum Open Time and Minimum Close Time (Speed Limits) are used to prevent the valve from moving too quickly. This can be used when the process is sensitive to rapid flow or pressure changes. This shows the time (in seconds) that the positioner will allow the valve to travel a full stroke. This speed limit applies to smaller movements of the valve too.

For example, if the Minimum Open Time were set to 20 seconds, and the command was changed from 40% to 50%, the positioner would move the valve at a constant rate, taking 2 seconds to complete the move. If the Minimum Close Time was set to 0, and the command was changed from 50% back to 40%, the positioner would make the move as quickly as possible.

The default values are 0 seconds, meaning the positioner will move the valve as quickly as possible.

10.3.6 Configuration (Characterization)

►**Configuration**
►Characterization
►*MaxFlo Linear*
►*MaxFlo Equal %*
►*Valdisk Linear*
►*Valdisk Equal %*
►*ShearStream Linear*
►*ShearStream Equal %*
►*Custom*

The Configuration – Characterization menu allows the user to change the characterization of the command. This allows a better match between the input command and the actual fluid flow through the valve. This feature is typically used with valves that have non-linear flow characteristics. The positioner makes a correction by applying an adjustment to the input command according to a characterization curve. The table below shows the available characterization curve options. Each point of the Custom curve can be adjusted using the ValveSight DTM.

To view the characterization curve options, set the Characterization switch "Other" before performing a Quick-Cal. Otherwise, the only option available is "Linear". If a Quick-Cal is not possible, use the ValveSight DTM to select the curve.

Select the appropriate curve as required by the process design.

Custom - Select Custom for a standard 30:1 equal percent rangability curve. The curve may be customized point-by point. To modify the Custom curve, use the ValveSight DTM.

⚠ **CAUTION:** *Changing the characterization curve may cause the valve to move suddenly. Notify proper personnel that the valve may stroke and if required, make sure the valve is properly isolated before proceeding.*

Table 16: Characteristic Curve Data

Command Input	Final Command							
	Linear	MaxFlo Linear	MaxFlo =%	Valdisk Linear	Valdisk =%	Shear-Stream Linear	Shear-Stream =%	Custom
0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.0	5.00	6.50	1.00	13.00	4.00	25.00	8.00	0.62
10.0	10.00	11.60	2.00	20.00	6.00	35.00	14.00	1.35
15.0	15.00	16.20	3.00	26.25	7.80	44.00	17.00	2.22
20.0	20.00	20.50	4.40	32.10	9.30	50.20	21.00	3.25
25.0	25.00	24.60	5.80	37.50	11.50	55.50	24.00	4.47
30.0	30.00	28.50	7.40	42.60	14.00	60.20	27.50	5.91
35.0	35.00	32.40	9.30	47.40	16.50	64.30	31.50	7.63
40.0	40.00	36.20	11.20	51.80	19.30	68.00	35.50	9.66
45.0	45.00	40.00	13.50	56.00	22.50	71.50	39.50	12.07
50.0	50.00	43.80	16.10	60.00	26.00	74.70	43.90	14.92
55.0	55.00	47.60	19.10	63.60	30.00	77.70	48.10	18.31
60.0	60.00	51.50	22.40	67.20	34.70	80.50	52.80	22.32
65.0	65.00	55.50	26.20	70.60	39.60	83.20	57.40	27.08
70.0	70.00	59.50	30.60	73.90	45.10	85.90	62.40	32.71
75.0	75.00	63.80	35.70	77.20	51.30	88.40	67.50	39.40
80.0	80.00	68.20	41.70	81.30	57.80	90.80	72.90	47.32
85.0	85.00	73.00	48.90	84.00	64.80	93.20	78.60	56.71
90.0	90.00	78.40	57.70	87.80	72.50	95.50	84.70	67.84
95.0	95.00	85.00	69.20	92.10	81.30	97.80	91.20	81.03
100.0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

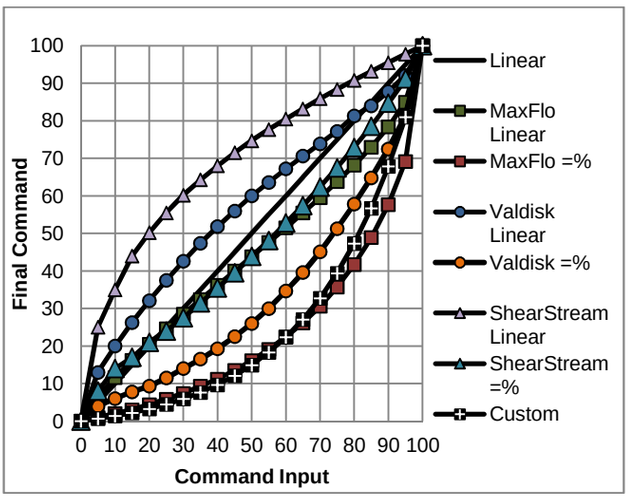


Figure 18: Characterization Curves

10.3.7 Configuration (Pressure Control)

►**Configuration**
►Pressure Control
►*Window*

The Configuration (Pressure Control) menu allows the user to change the size of the pressure control window. This window becomes active when the Valve Stability Switch is set to "Hi". The Valve Stability Switch optimizes the response for valves and actuators with high friction levels. When set to "Hi", it slightly slows the response and will normally stop limit cycling that can occur on high friction valves.

Window - When the position of the valve gets within the pressure control window, the positioning algorithm will change to pressure control. This means the pressures will be held constant (locked), improving the stability of the valve position.

10.3.8 Configuration (Soft Limits and Shutoff)

►**Configuration**
►Soft Limits & Shutoff
►*High Soft Limit*
►*Low Soft Limit*
►*Upper Position Shutoff*
►*Lower Position Shutoff*

Soft Limits allows the user to limit the movement of the valve. Shutoff allows the user to tightly shut the valve with all available force.

High Soft Limit and Low Soft Limit - This feature is used to simulate physical blocks on the valve that restrict movement past a set point. Once the Soft Limit is set, the positioner will not attempt to move the valve position (final command) beyond the set point, regardless of the analog or digital command input signal.

⚠ **CAUTION:** *Changing the Soft Limits may limit the movement of the valve. The valve may not shut or open fully.*

➲ **NOTE:** *Removing power to below 3.6 mA will still cause the valve to move to the de-energized state regardless of the Soft Limits.*

Upper Position Shutoff and Lower Position Shutoff - This feature, (also called Minimum Position Cutoff or MPC) is

used to tightly close or open the valve. It is used when a tight seal is needed or when debris or friction may otherwise interfere with complete closure. When the valve is commanded past the Shutoff points, the pilot relay will direct full supply pressure to the appropriate port, applying all available force to close (or open) the valve. The Shutoff points apply to the Final Command.

⚠ **CAUTION:** *Changing the Shutoff limits may cause the valve to fully open or fully close after the command passes a set limit.*

Though Shutoff and Soft Limit features should not be used together, if both are set, the greater of the two settings will take precedence at the closed end; and the lesser of the two settings will take precedence at the open end.

10.3.9 Configuration (Set Time and Date)

►**Configuration**
►Set Date & Time

The positioner has an internal clock. The clock allows time and date information to be stored with alarms and other events. The clock does not account for daylight savings.

Set Time and Date – Use the ▲Up and ▼Down buttons to set the time and date. The format of the time and date is displayed above the input fields.

10.3.10 Configuration (User Preferences)

►**Configuration**
►User Preferences
►*All Units*
►*Pressure Units*
►*Force Units*
►*Temperature Units*
►*Air Flow Units*
►*Actuator Area Units*
►*Date Format*
►*Number Format*
►*LCD Orientation*

The User Preferences menu allows the user to format how information is displayed.

The following table shows the available options. By default the positioner is set to show information in International System (SI) units. To change all units to North American (English), make the selection under All Units. Each selection can also be changed individually.

Table 17: User Preference Options

Units/Format	International System (SI) (Default)	North American (English)	Other Options
All Units	SI	North American	-
Pressure	bar	PSI	kg/cm2, kPa
Force	N	lbf	kg
Temperature	degrees C	degrees F	-
Air Flow	slph	scfm	slpm, Nm3/hr
Actuator Area	cm^2	in^2	-
Date Format	Day.Mon.Year	Mon/Day/Year	-
Number	Comma	Decimal Point	-

LCD Orientation – Use this selection to turn the turn the display upside down (180 degrees). Use this feature when the positioner is mounted upside down.

10.3.11 Configuration (Burst Mode)

►**Configuration**
►Burst Mode
►*On/Off*

Burst Mode continuously transmits HART information.

On/Off – Use this feature to turn burst mode on and off.

10.3.12 Configuration (Positioner Revs)

►**Configuration**
► Positioner Revs
► *SW Rev*
► *Bld Date*
► *Bld Time*
► *HW Rev*
► *CPU Rev*
► *HART Ver*

Positioner revisions are shown in this menu.

SW Rev –The revision of the embedded software.
Bld Date –The date of the embedded software build.
Bld Time –The time of day of the embedded software build.
HW Rev –The revision of the main board.
CPU Rev – The revision of the CPU.
HART Ver –The revision of the HART protocol (5, 6, or 7).

10.3.13 Configuration (Factory Reset)

►**Configuration**
► Factory Reset

At times, it may be convenient to reset all of the variables to a default state. In this case, perform a Factory Reset.

Factory Reset – Use this feature to reset all variables to their factory default state. All of the internal variables including calibration will be reset to factory defaults. The positioner must be re-calibrated after a factory reset. Tag names and other user configured limits, alarm settings, and valve information will also be lost and will need to be restored. A factory reset will always reset the command source to analog 4-20 mA.

➲ **NOTE:** *Once the Multi-Function Card (MFC) type has been configured, the type selection will still remain after a factory reset.*

☠ **WARNING:** *Performing a factory reset may result in the inability to operate the valve until reconfigured properly. Notify proper personnel that the valve may stroke, and make sure the valve is properly isolated.*

10.3.14 Card 1 (or Card 2)

Two slots are available for auxiliary cards. The Multi-Function Card (MFC) can be configured for analog output (AO), Discrete Input (DI) and Discrete Output (DO). The Safety Discrete Output card (Safety DO) provides highly

reliable annunciation in case of safety critical events. Any combination of cards can be placed in the two slots except two safety DO cards.

►**Card 1 (or Card 2)**
►No Card

No Card – This is displayed when no card is present in the slot.

►**Card 1 (or Card 2)**
►Multi-Function Card
►*Not Configured*
►*Set as AO Card*
►*Set as DO Card*
►*Set as DI Card*
►*Config/Cal*
►If Not Configured – "No Configuration Allowed"
►If AO
►Set 0%
►Set 100%
►If DO – "Use DTM"
►If DI
►Set to No Action
►Set to Trigger PST
►Set to Command Override
►Set Command Point

Multi-Function Card – This is displayed when a Multi-Function Card is present in the slot. Configuration options follow. See section 14 MULTI-FUNCTION CARD for more information.
Not Configured – The MFC is not configured for any function by default. The configuration must be set by using the following functions.
Set as AO Card – Use this feature to set the MFC as an analog output card.
Set as DO Card – Use this feature to set the MFC as a discrete output card.
Set as DI Card – Use this feature to set the MFC as a discrete input card.
Config/Cal – Use this feature to further configure the FMC. The menu items below this level will change according to the MFC configuration type selected.

If Not Configured
No Configuration Allowed – Because the card type has not been selected, no configuration options are available.
If Set As AO Card
Set 0% - Set the current (mA) that will correspond to the 0% (closed) valve position.
Set 100% - Set the current (mA) that will correspond to the 100% (open) valve position.

➲ **NOTE:** *The AO calibration values are required to match the "Signal At Closed" configuration switch on the positioner. For example, if the switch is set to 4 mA, the "Set 0%" current must be less than the "Set 100%" current.*

If Set As DO Card
Use DTM – The DO is highly configurable. Use the ValveSight DTM to set the function of the DO.
If Set As DI Card
Set to No Action – Use this option if **only** an acknowledgement of the DI state is desired.
Set to Trigger PST – Use this option to initiate a partial stroke test when the DI state goes high.
Set to Command Override - Use this option to override the analog or digital command input to move the valve to a set position as long as the DI state remains high.
Set Command Point – Use this feature to set the override position. The position is a final command (not characterized). Tight Shutoff settings and Soft Limits will still apply.

►**Card 1 (or Card 2)**
► Safety Discrete Output

Safety Discrete Output – This is displayed when the card in the slot is a Safety DO card. Configuration is not required. The Safety DO will open its circuit if one of the safety critical conditions occurs. See section 15 SAFETY DO CARD for more information.

10.3.15 Language

► **Language**
►English
►German
►French
►Spanish
►Portuguese
►Russian
►Turkish
►Italian

The display menu is available in several languages.

To navigate directly to the language menu, select the following sequence of buttons: ▲Up , ▲Up, ►QUICK-CAL / ACCEPT.

11 HART COMMUNICATION

The Logix 520MD+ series positioners use the HART communication protocol specified by the HART Communication Foundation.

11.1 ValveSight DTM

Flowserve Corporation has written a custom configuration and diagnostic Device Type Manager (DTM) for the Logix 520MD+ digital positioner called ValveSight. The ValveSight DTM is available from a Flowserve representative.

11.2 HART 375/475 Handheld Communicator

The Logix 520MD+ digital positioner supports and is supported by the HART 375/475 Handheld Communicator. The Device Description (DD) files can be obtained from the HART Communication Foundation or from your Flowserve representative.

11.3 Burst Mode

Burst Mode is available with a handheld device. In the menu of the handheld, select the Burst Mode feature under the Configuration Menu.

11.4 Change from HART 6 to HART 5

The Logix 520MD+ positioner comes standard with the HART 6 communication protocol. Follow this procedure to change to HART 5 by removing the HART jumper.

1 Remove the outer cover.
2 Remove the inner cover by removing the 6 inner cover retaining screws.

⚠ **CAUTION:** *Observe precautions for handling electrostatically sensitive devices.*

3 With a clean, non-conductive instrument, remove the HART jumper. The jumper connectors are located below the left side of the LCD. The HART jumper covers the left pair of pins. After removal of the jumper, the positioner will immediately recognize the HART 5 communication protocol.
4 Replace the covers.

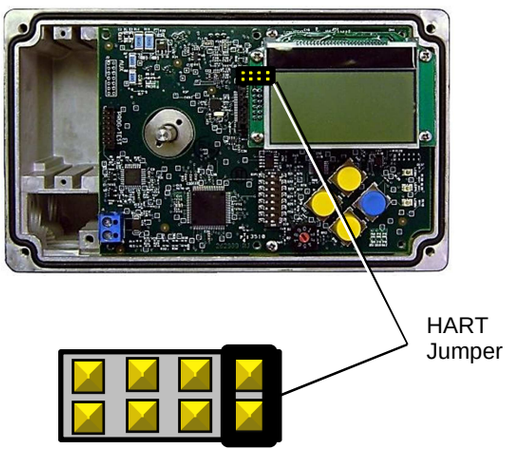


Figure 19: HART Jumper

12 DIAGNOSTIC FEATURES

12.1 Positioner Diagnostic Levels

The Logix 520MD+ digital positioners have three levels of diagnostics, “Standard”, “Advanced”, and “Pro”.

- “**Standard**” diagnostics provide complete position-related diagnostics and data.
- “**Advanced**” diagnostics provide additional pressure data.
- “**Pro**” diagnostics enhance the off-line tests with additional force data, and provide powerful on-line monitoring capabilities including friction, data logging functions, and comprehensive system health information.

12.2 DTM Diagnostic Levels

The DTM is not required for the positioner to function, but the graphical capabilities of the DTM allow for a richer interface and additional functionality, including viewing the dashboard, charts, annunciator panel, test comparisons, and data logs and printing reports.

The DTM also comes in two versions: “Basic” and “Advanced”.

- The “**Basic**” DTM provides an intuitive, easy-to-use user interface to the positioner. It includes calibration, configuration, auxiliary card information and off-line diagnostic tests. A dashboard gives a quick view of important information.
- The “**Advanced**” DTM provides a view of the positioner’s full health analysis and interfaces to all of the positioner’s “Pro” diagnostic functionality.

It is generally wise to use the Advanced DTM with the Advanced and Pro positioners.

Table 15: Upgrade Features

Feature	ValveSight Basic	ValveSight Professional	Logix 520MD+ Standard	Logix 521MD+ Advanced	Logix 522MD+ Pro
Calibration and Configuration	X	X	X	X	X
Auxiliary Cards *(AO, DO, DI)*	X	X	X	X	X
Off-Line Diagnostics *(Ramp Test, Step Test, HDRL, Partial Stroke Test)*	X	X	X	X	X
Pressure Sensor Data *(Supply, Port A, Port B)*	X	X		X	X
Pro Diagnostics *(Force, Actuation, Pneumatic Leak, Continuous Stroke Testing, etc.)*		X			X
Health Evaluation *(Valve, Positioner, Actuator and Control)*		X			X
Training *(Determines Typical Behavior)*		X			X
Data Logging *(Data Monitor and High Speed Capture)*		X			X
Long-Term Trend Logging *(14 factors over 15 years)*		X			X

13 LIMIT SWITCHES

13.1 Limit Switch Principles of Operation

The Logix 520MD+ digital positioner can be equipped with a limit switch unit. The unit has two main parts, the electrical switch board and the vane. The switch board is connected to the Inner cover. The vane connects to the feedback shaft which extends through the positioner and moves with the valve. The vane can hold a cam or ferromagnetic device. As the shaft rotates, the pick-up switch LS1 or LS2 is activated. The switching point can be adjusted.

Four types of Limit Switches can be used with the Logix 520MD+.

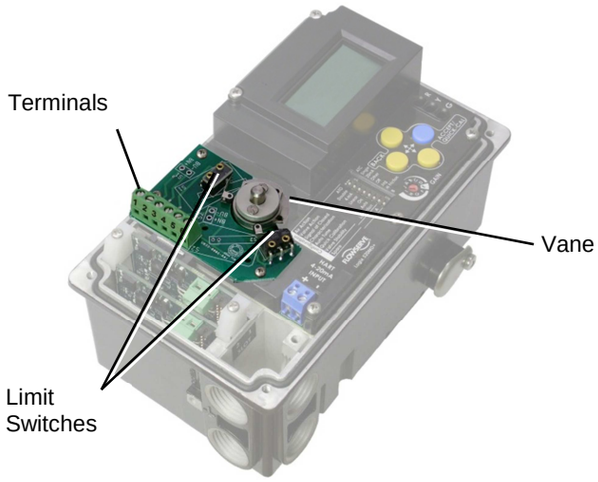


Figure 20: Limit Switches

13.2 Limit Switch Types

Mechanical switches are triggered by the use of a mechanical cam and followers.

Reed switches are triggered by a magnetic force. No physical contact occurs.

Inductive Slot switches are triggered when the sensor detects a ferromagnetic vane inserted between the coils. No physical contact occurs.

Inductive switches are triggered when the sensor detects a ferromagnetic vane approaching the coils in the switch. No physical contact occurs.

Table 18: Limit Switch Cross-References

Information	IOM Section
Electronic Connections	3.10 Limit Switch **Specifications**
Electronic Specifications	7.10 Limit Switches
Install or Adjust the Limit Switch	16.2 Installing a Limit Switch

14 MULTI-FUNCTION CARD

The optional Multi-Function Card (MFC) can be configured to act as an Analog Output, Discrete Output, or Discrete Input. Up to two MFCs may be installed at one time. MFCs are immune to RFI/EMI disturbances.

Table 19: Multi-Function Card Cross-References

Information	IOM Section
Analog Output Specifications	3.5 Analog Output
Electronic Connections	7.8 Multi-Function Card **(AO, DO, DI)**
Configuration	10.3.14 Card 1 (or Card 2)
Status	Table 12: Auxiliary Card Status

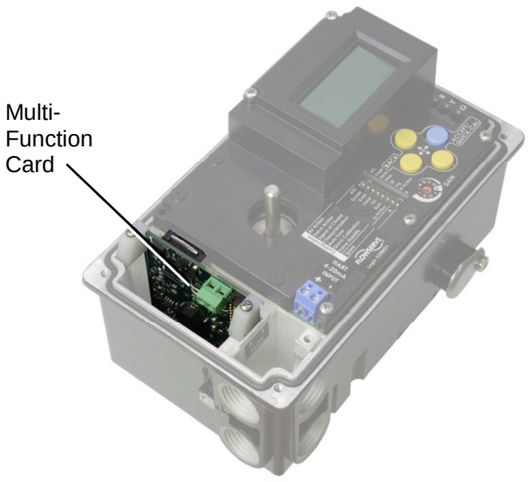


Figure 21: Multi-Function Card

14.1 Analog Output (AO)

Configure the MFC as an Analog Output device to produce a 4-20 mA signal that corresponds to the position of the valve.
Output follows actual position of valve, including all failure modes of positioner except loss of power. An output of < 1.0 mA is transmitted when the positioner loses power.

Calibration of the analog output signal is performed using the display menu, a HART handheld communicator, or the ValveSight DTM .

The MFC configured as an AO does not interfere with positioner operation.

➲ **NOTE:** *The AO signal corresponds with the Signal At Closed configuration switch setting. If the valve closes with a 4 mA signal, the AO will show a 4 mA signal when closed. If the valve closes with a 20 mA signal, the AO will show a 20 mA signal when closed.*

14.2 Discrete Output (DO)

Use the Discrete Output function of the MFC to indicate a variety of conditions such as alarms, warnings, position limits, etc. The current is normally high, and drops low when one of the pre-configured states occurs.

Configuration of the discrete output signal is done using the ValveSight DTM.

The MFC configured as a DO does not interfere with positioner operation.

The MFC DO complies with DIN 19234 standard. For specific current limits, see Table 12: Auxiliary Card Status.

14.3 Discrete Input (DI)

Use the Discrete Input function of the MFC to signal the positioner to begin a partial stroke test, or move to a predefined position as long as the signal remains.

Supply a low voltage (or no voltage) to indicate a normal state. Raise the voltage to indicate the tripped state.

Configuration of the discrete output signal is done using the display menu, a HART handheld Communicator, or the ValveSight DTM .

For specific voltage limits, see Table 12: Auxiliary Card Status.

☠ **WARNING:** *During the use of the Discrete Input function, the valve may stroke unexpectedly. Follow internal procedures, ensuring that the configured movement of the valve (performing a PST or moving to a set-point) is allowed. Notify proper personnel that the valve will stroke, and make sure the valve is properly isolated if required.*

15 SAFETY DO CARD

15.1 Safety DO Function

The optional Safety Discrete Output Card (Safety DO) provides a way for the user to detect errors that are critical to the ability of the system to move to a safe state should there be a failure of power or supply gas to the positioner. One Safety DO may be installed at one time.

Table 20: Safety DO Card Cross-References

Information	IOM Section
Safety DO Specifications	3.6 Safety Discrete Output
Electronic Connections	7.9 Safety Discrete Output (Safety DO)
DO Status	Table 12: Auxiliary Card Status

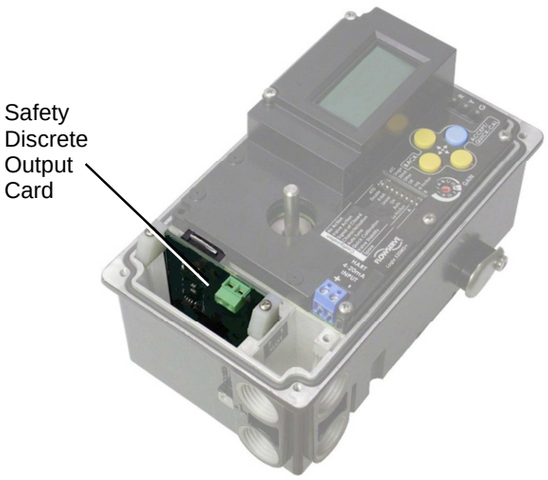


Figure 22: Safety Discrete Output Card

The Safety DO card uses a relay-type circuit which can be closed or open. Normally, the circuit is closed. An open circuit indicates the positioner has detected one of the following errors:

- Position Deviation Alarm
- Pilot Relay Response Alarm
- Driver Module Alarm

The Safety DO requires no positioner configuration.

The Safety DO is immune to RFI/EMI disturbances.

The Safety DO does not interfere with positioner operation.

The Safety DO adds 3 VDC to the terminal voltage.

16 MAINTENANCE AND REPAIR

The kits listed in section 19.2 Spare Parts Kits can be replaced by a technician trained in handling of static sensitive devices and positioner function.

⚠ **CAUTION:** When touching the circuit boards, o*bserve precautions for handling electrostatically sensitive devices.*

16.1 Scheduled Maintainance

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.

16.2 Installing a Limit Switch

The Logix 520MD digital positioner can be equipped with an additional limit switch unit. Part of the switching unit attaches to the feedback shaft. The sensors attach to the inner cover. Connections to the limit switch are independent of other connections to the positioner.

For electrical connection diagrams, see Table 13: Limit Switch Connections. For electrical specifications, see Table 10: Limit Switch Specifications.

☠ **WARNING:** *For units installed in hazardous areas special installation cautions and procedures are required. The installation of hazardous location electrical equipment must comply with the procedures contained in the certificates of conformance. Country specific regulations may apply. Electrical safety is determined only by the power supply device. (Positioner operation with limited voltage only).*

Installation

1 Remove the outer cover.
2 Place the limit switch board (1) onto the Inner cover (2) and secure it with 3 mounting screws (3).
3 Install vane assembly (4) and secure with 2 screws (5).

Adjusting Switches

1 Loosen the two screws on the vane (5).
2 Stroke the valve to the first switching position.
3 Set the switching point of the limit switch by adjusting the lower vane for the lower switch (LS2).
4 Stroke the valve to the second switching position (LS1).
5 Set the switching point of the limit switch by adjusting the vane for the upper switch.
6 Tighten the two screws on the vane (5).
7 Check the two switching points and repeat the adjustment steps 1 to 6, if necessary.

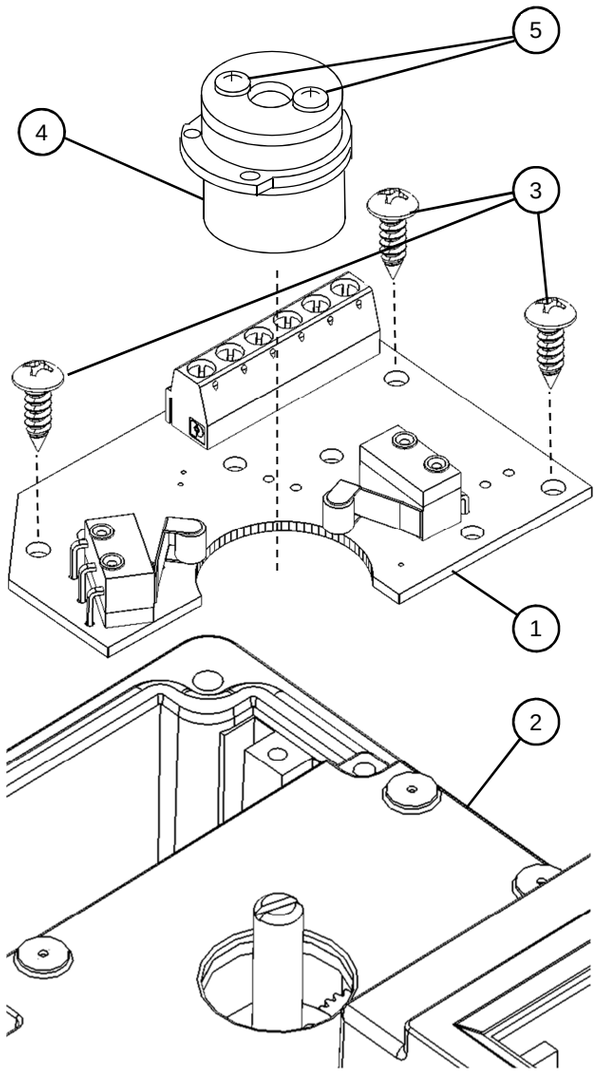


Figure 23: Limit Switch

16.3 Replacing the LCD Board

The LCD board connects to the main board providing additional functionality at the local user interface.

Removal
1 Make sure the valve is bypassed or in a safe condition.
2 Disconnect power to the positioner.
3 Remove the inner cover by removing the 6 inner cover retaining screws.
4 Unscrew the 4 screws holding the LCD Board in place.
5 Gently pry the locking feature on the connector with a small flat screwdriver and separate the connector from the main board. Be careful not to pull the cable, as this may cause damage to the cable.

Installation
1 Connect the LCD Board to the Main Board using the cable. Ensure the connector's locking features engage.
2 Align the LCD Board with the 4 stand-offs on the main board.
3 Screw the LCD Board to the 4 stand-offs.
4 Replace the Inner Cover.

➲ **NOTE:** *The LCD backlight may change brightness during use. This is normal. The backlight uses any residual power not used by other functions of the circuitry. When current supply is low (4mA) the light will appear darker. When current supply is high (20mA) the light will appear brighter.*

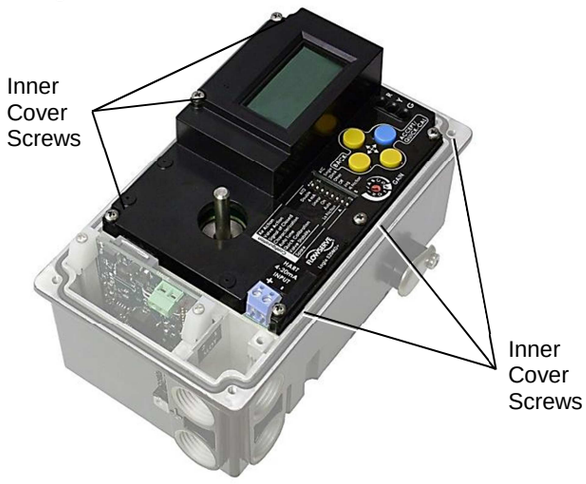


Figure 24: Inner Cover

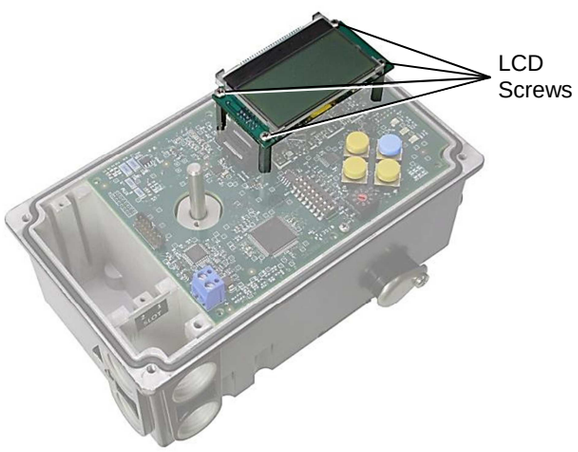


Figure 25: LCD

16.4 Replacing an Auxiliary Card

Up to two auxiliary cards can be installed at a time. Each communicates independently to the main processor, though only one cable is used to connect both cards.

Removal
1 Make sure the valve is bypassed or in a safe condition.
2 Disconnect the power to the positioner.
3 Remove the main cover.
4 Disconnect the two wire connection from the side of the Card.
5 Unscrew and remove the auxiliary card clips.
6 Gently slide the card from the slot. (If two cards are present, remove both cards from the slots.)
7 Gently pry the locking feature on the connector with a small flat screwdriver and separate the connector from the card. Be careful not to pull the cable, as this may cause damage to the cable.
8 Replace the second card (if present) back into the slot.
9 Replace the auxiliary card clips.

Installation
1 Make sure the valve is bypassed or in a safe condition.
2 Disconnect the power to the unit.
3 Remove the main cover.
4 Unscrew and remove the auxiliary card clips.
5 If a card is present, gently slide the card from the slot to access the internal connector.
6 Connect the card to the main board using the internal connector cable. Ensure the connector's locking features engage.
7 Gently slide the card(s) into the slot(s).

⚠ **CAUTION:** *Ensure proper circuitry is used before connecting cables to the auxiliary card. See section 7 ELECTRICAL CONNECTIONS for more information.*

8 Route the external cable through the electrical conduit ports in the base and connect the external cable to the auxiliary card. See Figure 21: Multi-Function Card.
9 Replace the auxiliary card clip.
10 Reinstall the main cover.

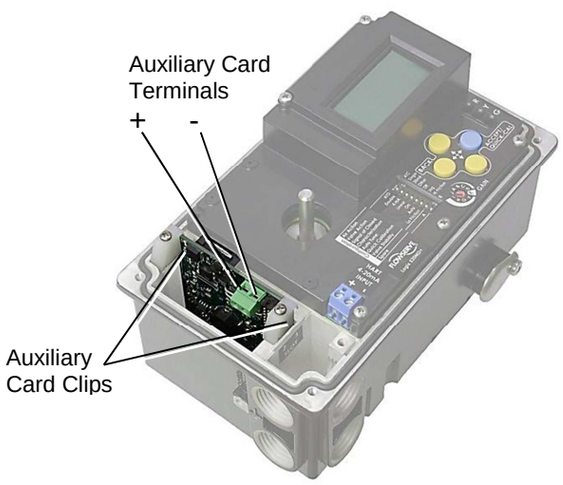


Figure 26: Auxiliary Card

16.5 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. See Figure 24: Inner Cover above.
5 Disconnect the power cable to the Main Board.
6 Disconnect the auxiliary card cable if present. See Figure 26: Auxiliary Card on page38.
7 Disassemble the switch mechanism if present.
8 Remove the inner cover by removing the 6 retaining screws. See Figure 24: Inner Cover.
9 Unscrew the 2 screws holding the main board in place.
10 Gently lift the main board rotating the bottom up while keeping the top in place.
11 Disconnect the Pressure sensor board cable, 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.

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 Calibrate.

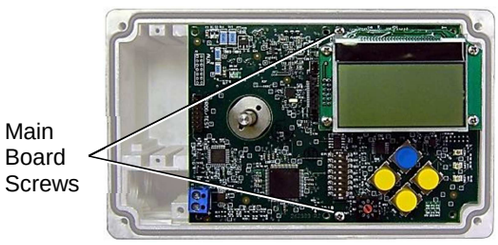


Figure 27: Main Board Screws

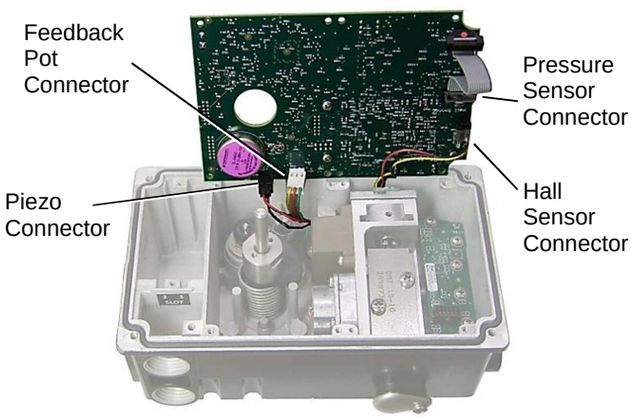


Figure 28: Main Board Connectors

16.6 Replacing the Pressure Sensor Board

Removal

1 Remove the main board. See procedure above. (Disconnecting the hall sensor and feedback cables is not required.)
2 Unscrew the 6 screws holding the pressure sensor board in place.
3 Remove the pressure sensor board.

Installation

1 Place the pressure sensor o-rings in the three holes.
2 Cover the o-rings with the pressure sensor board.
3 Insert the 6 screws. Tighten until the pressure sensor board makes firm contact with the base.
4 Perform a Factory Pressure Sensor Calibration.

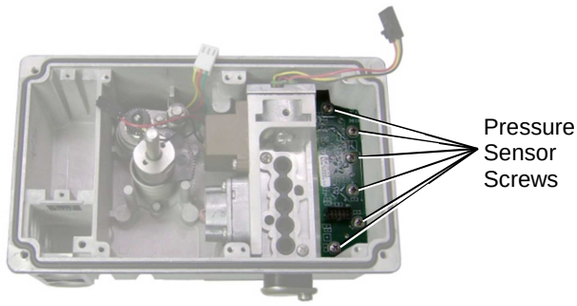


Figure 29: Pressure Sensor Board

16.7 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 pull it straight out. 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.
3 Remove the first manifold gasket.
4 Remove the 2 manifold screws.
5 Remove the manifold assembly.
6 Remove the second manifold gasket and
7 manifold o-ring.

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 clip spring is oriented properly on the spool. Ensure the spool is oriented properly in the block. (See Figure 31: Clip Spring Orientation.) Slide the spool/block/clip spring assembly onto the manifold ensuring the proper placement of the spool and clip spring into the piston slot.
6 Place the 2 spool block screws.
7 Calibrate.

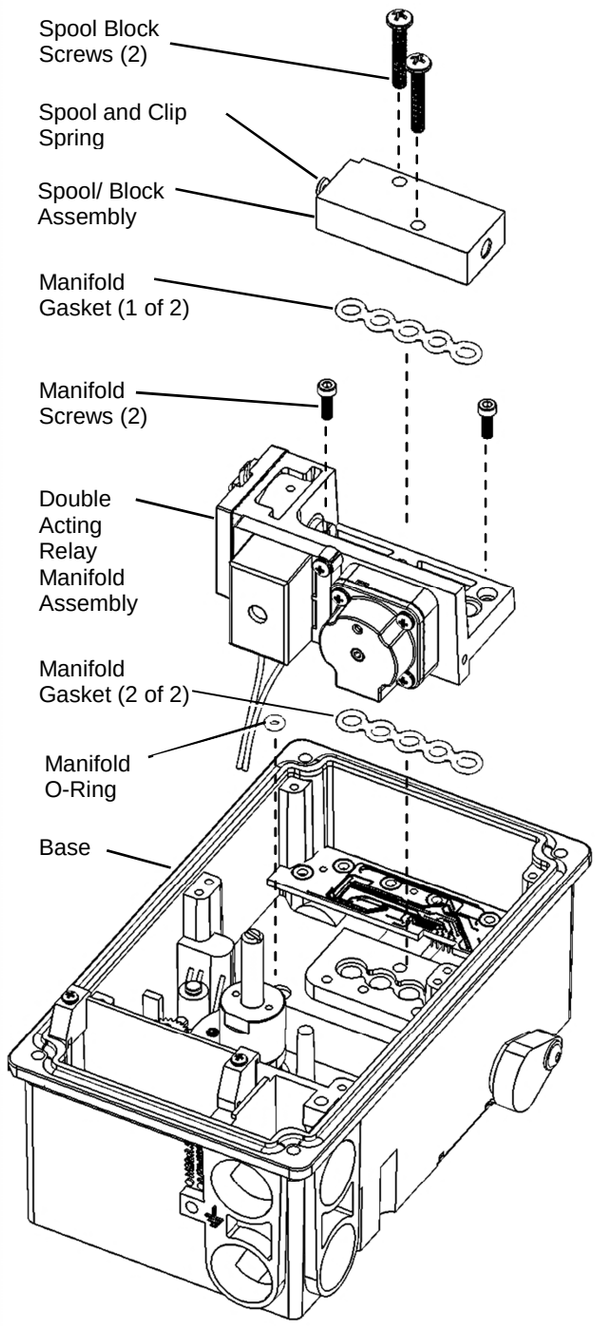


Figure 30: Double Acting Relay Assembly

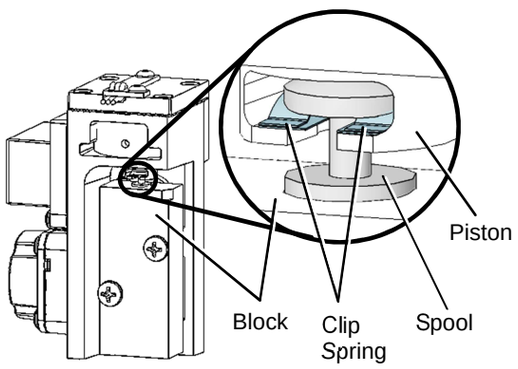


Figure 31: Clip Spring Orientation

16.8 Replacing a Single Acting Pilot Relay

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 Replace other components and calibrate.

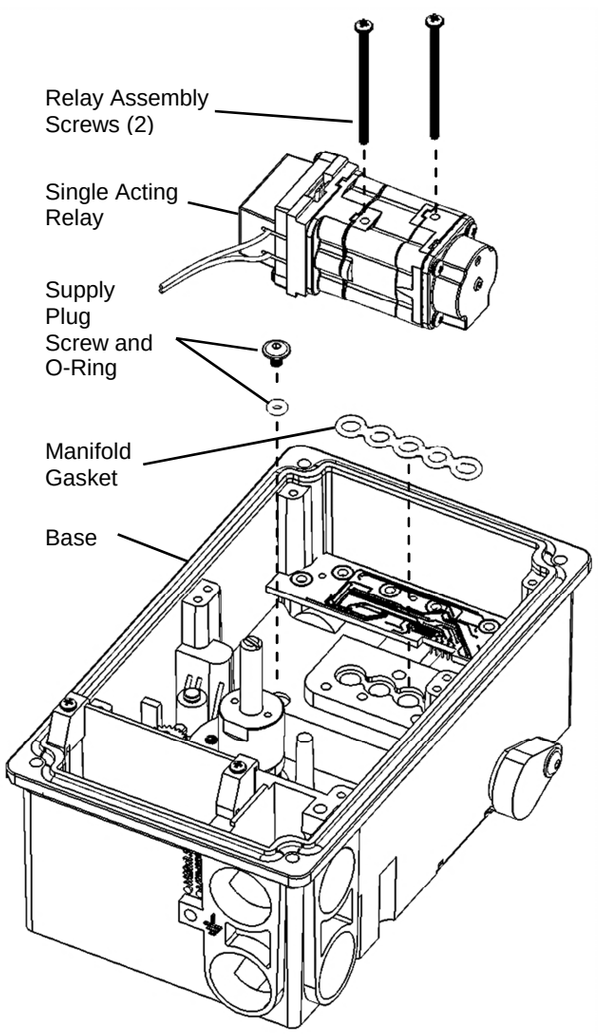
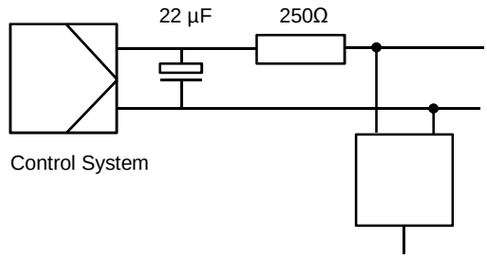


Figure 32: Single Acting Relay Assembly

17 TROUBLESHOOTING

17.1 Troubleshooting Guide

Table 21: Troubleshooting Guide

Failure	Probable Cause	Corrective action
No LED is blinking.	1. Current source too low 2. Voltage of current source is too low 3. Incorrect wiring polarity	1. Verify current source supplies at least 3,8 mA. 2. Verify voltage source supplies at least 10VDC. 3. Check wiring for correct polarity.
Erratic communications.	1. Current source bandwidth not limited to 25Hz 2. Maximum cable length or cable impedance exceeded 3. HART modem connected to PC RS-232 port not receiving enough power 4. Interference with I.S. barrier 5. Current source stripping (filtering) HART signal	1. Maximum allowable current source rate of change is 924 mA per second. 2. Check cable size, length and capacitance. See Section 7 ELECTRICAL CONNECTIONS. 3. Verify laptop battery is not low. 4. Must use HART compatible I.S. barrier. 5. Use the HART filter (VHF) available from Flowserve (FLS part-No. 10156843) See Figure 8: HART Filter on page 17. Alternatively, a 250Ω and a 22 µF capacitor, installed according to the following schematic drawing can be used to establish communication. 
Unit does not respond to analog commands.	1. The positioner is in digital command mode. 2. An error occurred during calibration.	1. Switch to analog command mode using the procedure outlined in Section 9.3 Command Source Reset, use the ValveSight DTM, or use a handheld communicator. 2. Check Status Codes. Correct calibration error. Recalibrate.
Valve position reading is not what is expected.	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.	1. Reposition the sensor. 2. Perform a Stroke calibration (Quick-Cal). 3. Verify Tight Shutoff settings. 4. Verify custom characterization or soft-stop limits.
Position is driven fully open or closed and will not respond to command.	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.	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	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.	1. Check air supply for proper filtering and meeting ISA specifications ISA-7.0.01. 2. Lower proportional gain settings. 3. Enable the stability DIP switch on the local interface and recalibrate. If problem persists, adjust pressure control window with handheld communicator or ValveSight and recalibrate. 4. Disassemble and clean spool valve.
LCD backlight flickering or dim.	1. The backlight uses any residual power not used by other functions of the circuitry.	1. Fluctuations in the LCD backlight are normal. No action required.

17.2 Status Code Index

Table 22: Status Code Index

Description	Status Code
A/O Cal in Prog	GRGY
A/O Range Small	RGYR
Actuation Ratio WRN	YYYY
Actuator Cycles WRN	YGGY
Actuator Travel WRN	YGGY
Air Supply Humid WRN	YYRY
Air Supply Icing WRN	YYRR
Analog In < ADC Range	RGGG
Analog In > ADC Range	RGGG
Analog In Cal Error	RGGG
Analog In Cal in Prog	GRGY
Analog In Range Small	RGGG
Backlash ALM	RRYY
Backlash WRN	YRYY
Bellows Cycles WRN	YGGY
Bellows Travel WRN	YGGY
Calibration in Progress	GRGY
Card 1 Error	RYYR
Card 1 Fail WRN	RYYR
Card 1 No Loop Pwr	RYYR
Card 1 WRN	RYYR
Card 2 Error	RYYY
Card 2 Fail WRN	RYYY
Card 2 No Loop Pwr	RYYY
Card 2 WRN	RYYY
Closed Too Far WRN	YYGY
Cmd Amplitude ALM	RYGY
Cmd Amplitude WRN	YGYR
Cmd Control ALM	RYGY
Cmd Control WRN	YGYR
Cmd Frequency ALM	RYGY
Cmd Frequency WRN	YGYR
CST Failed WRN	YGRY
DI Cmd Override	GRGR
Digital Cmd Mode	GGYY
Driver Module ALM	RRYR
Factory Reset State	RGRR
Feedback Cal Change	RGRY
Feedback Cal Error	RGGY
Friction Cal in Prog	GRGY
Friction Cal Req	GYYY
Friction High ALM	RRGR
Friction High WRN	YRGR
Friction Low ALM	RRGY
Friction Low WRN	YRGY
ILO Time Out	RGGR
Initializing	GGYR
Jog Cal Set 100% Pos	GRRR
Jog Cmd Mode	GRRY
Local Interface Off	GGYG
Low Battery WRN	YRRG
Main Board Fail WRN	RYRR
Memory Error WRN	YYYR
No Motion Time Out	RGYY
Opened Too Far WRN	YYGY
Piezo Volts ALM	RRRY
Piezo Volts High ALM	RRRY
Piezo Volts High WRN	YRRY
Piezo Volts Low ALM	RRRY
Piezo Volts Low WRN	YRRY
Piezo Volts WRN	YRRY
Pilot Cycles WRN	YGGY
Pilot Response ALM	RRGG
Pilot Response WRN	YRGG
Pilot Travel WRN	YGGY
Pneumatic Leak WRN	YRYR
Position < ADC Range	RGGY
Position > ADC Range	RGGY
Position Limit Alert	YGGG
Position Range Small	RGGY
Position Shift WRN	YYGY
Power ON	GGGG
Press Board Fail WRN	RYRY
Pressure Cal in Prog	GRGY
Pressure Cal Req	GYYG
Psn Amplitude ALM	RYGR
Psn Amplitude WRN	YGYY
Psn Control ALM	RYGR
Psn Control WRN	YGYY
Psn Deviation ALM	RRRR
Psn Frequency ALM	RYGR
Psn Frequency WRN	YGYY
Psn High Limit Alert	YGGG
Psn Low Limit Alert	YGGG
Psn Sensor Fail ALM	RYRG
PST Failed WRN	YGRR
PST Scheduled	GYYR
Setting ILO	GRGY
Settle Time Out	RGYG
Signature or PST	GRGG
Soft Stop Alert	GYGY
Soft Stop High Alert	GYGY
Soft Stop Low Alert	GYGY
Software Error WRN	YYRG
Spring Fail WRN	YRRR
Squawk Mode	GGRR
Stiction ALM	RRYG
Stiction WRN	YRYG
Stroke Cal in Prog	GRGY
Stroke Cal Req	RGRG
Stroke Shift	RGRY
Stroke Span Decrease	RGRY
Stroke Span Increase	RGRY
Supply Press Hi WRN	YYGR
Supply Press Lo ALM	RYYG
Supply Press Lo WRN	YYYG
Temperature High WRN	YYGG
Temperature Low WRN	YYGG
Temperature WRN	YYGG
Tight Shut Off Mode	GGGY
Valve Can't Move ALM	RYGG
Valve Can't Open ALM	RYGG
Valve Can't Shut ALM	RYGG
Valve Cycles WRN	YGGY
Valve Cycles WRN	YGGY
Valve Travel WRN	YGGY

17.3 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.

GGYG ●●●●
LOCAL INTERFACE OFF

Description: Control and configuration features are locked at the positioner's local interface. This is to prevent unauthorized or accidental adjustments. The buttons can still be used to view information on the LCD. The status code is only present for a short time when the user attempts to make a change through the display menu.

Possible Solutions: The DTM's Local Interface page is used to unlock the local interface, turn this feature on and off, and to set the PIN. For temporary access, a Personal Identification Number (PIN) can be entered from the positioner if an LCD is installed.

GGYY ●●●●
DIGITAL COMMAND MODE

Description: The input command is set by a digital HART command instead of the 4-20 mA signal.

Possible Solutions: The input command source can be changed back to the 4-20 mA signal by using a handheld, the Dashboard page of the DTM, or performing a manual Command Reset. Perform the Command Reset during a QUICK-CAL by holding both the UP and DOWN buttons and briefly pressing the QUICK-CAL/ACCEPT button. A new QUICK-CAL must be performed after resetting.

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.

GGRR ●●●●
SQUAWK MODE

Description: A user has set the positioner to flash a special sequence so that it can be visually located.

Possible Solutions: This mode is cancelled if one of the following occurs: 1) The QUICK-CAL/ACCEPT button is briefly pressed. 2) The Squawk mode is turned off remotely. 3) More than one hour has passed since the command was issued.

GYGY ●●●●
SOFT STOP HIGH LIMIT ALERT
SOFT STOP LOW LIMIT ALERT

Description: The Final Command would move the valve beyond the user-set Soft Limit, but the internal software is holding the position at the limit. The function is similar to a mechanical limit stop except it is not active if the unit is un-powered.

Possible Solutions: If more travel is needed, reset the Soft Limits. If not, adjust the Final Command signal back into the specified range.

GYYG ●●●●
PRESSURE CALIBRATION REQUIRED

Description: A Factory Pressure Calibration has not been performed. Unlike a regular pressure sensor calibration, a Factory Pressure Calibration saves the calibration values to memory, making them available should a factory reset be performed. Proper pressure sensor calibration is required for proper pressure sensing and diagnostics. Calibration values from a regular pressure sensor calibration will be lost when a factory reset is performed. Typically no pressure calibration is required with a new positioner.

Possible Solutions: After replacing a main board or a pressure sensor board, perform a Factory Pressure Calibration. To do this, see the Pressure Sensor Board Removal and Installation section of the IOM.

GYYY ●●●●
FRICTION CALIBRATION REQUIRED

Description: No friction calibration has been performed since the last factory reset. The friction calibration determines a preliminary friction value, spring forces and direction and other information used for proper diagnostics. If no friction calibration is performed, the positioner will soon determine the operating friction, but other diagnostic information will be missing.

Possible Solutions: Perform a Friction Calibration using the display menu, handheld, or Sensor Calibration page of the DTM. See the Calibration section of the IOM for warnings.

GYYR ●●●●
PARTIAL STROKE TEST SCHEDULED

Description: The schedule established by the user shows that a partial stroke test is due.

Possible Solutions: Follow internal procedures to initiate a partial stroke test (PST). A partial stroke test will cause the valve to move suddenly and the positioner will not respond to commands while the PST is in progress. See the Partial Stroke Test page of the DTM to verify PST settings.

GRGG ●●●●
SIGNATURE OR PARTIAL STROKE TEST IN PROGRESS

Description: The positioner is in Out Of Service (OOS) mode because a test or signature has been initiated. These include Step Test, Ramp Test, or Partial Stroke Test.

Possible Solutions: Signatures and tests can be defined, initiated, and cancelled through the Off-Line Diagnostics pages of the DTM.

GRGY 🟢🔴🟢🟡
STROKE CALIBRATION IN PROGRESS
SETTING INNER LOOP OFFSET
PRESSURE CALIBRATION IN PROGRESS
FRICTION CALIBRATION IN PROGRESS
ANALOG OUTPUT CALIBRATION IN PROGRESS
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: The calibration can be canceled from the corresponding calibration page of the DTM, from the handheld, or by briefly pressing the BACK button.

GRGR 🟢🔴🟢🔴
DI COMMAND OVERRIDE

Description: The Multi-Function Card has been configured as a Discrete Input (DI) and to override the input command, positioning the valve at a preconfigured set point. The DI signal is active and the positioner is attempting to control the valve at the set point.

Possible Solutions: Configure the DI function and set point using the menu, a handheld or the Multi-Function Card Configuration page of the DTM.

GRRY 🟢🔴🔴🟡
JOG COMMAND MODE

Description: The positioner has been placed in a local override mode where the valve can only be stroked using the UP and DOWN buttons. The positioner will not respond to analog or digital input commands from HART.

Possible Solutions: Control the valve using the UP and DOWN buttons. This mode may be cancelled by briefly pushing the QUICK-CAL/ACCEPT button.

GRRR 🟢🔴🔴🔴
JOG CALIBRATION SET 100% POSITION

Description: During a jog calibration, the unit is waiting for the user to manually adjust the valve position to the desired 100% open position.

Possible Solutions: Use the Up and Down buttons on the positioner to adjust the valve to the desired fully open position. The QUICK-CAL/ACCEPT button to accept.

YGGG 🟡🟢🟢🟢
POSITION HIGH LIMIT ALERT
POSITION LOW LIMIT ALERT

Description: The position has reached or is exceeding a user defined position limit. This is similar to a limit switch indicator.

Possible Solutions: Set the limit to a higher (or lower) value if more travel is needed, or adjust the command signal back in the specified range.

YGGY 🟡🟢🟢🟡
ACTUATOR CYCLES WARNING
ACTUATOR TRAVEL WARNING
BELLOWS CYCLES WARNING
BELLOWS TRAVEL WARNING
PILOT RELAY CYCLES WARNING
PILOT RELAY TRAVEL WARNING
VALVE CYCLES WARNING
VALVE TRAVEL WARNING

Description: The cycle or travel limit of the valve, actuator, bellows or pilot relay has been exceeded. Each cycle represents two reversals of the direction of valve movement. The cycle counting criterion and count limit (for the valve, actuator and bellows) are set by the user to track the usage of the valve assembly.

Possible Solutions: Follow routine procedures for maintenance when the limit is reached. For example valve inspection may include checking the packing tightness, and checking linkages for wear, misalignment, and tightness. Bellows inspection may include checking bellows for cracking or leaking. Actuator inspection may include checking the actuator seals and lubrication. Relay inspection may include checking for high air consumption and signs of wear on the spool. After maintenance, reset the travel accumulator.

YGYY 🟡🟢🟡🟡
POSITION AMPLITUDE WARNING
POSITION FREQUENCY WARNING

Description: The amplitude or frequency of the position signal is above the warning limit. The positioner is controlling the position of the valve with large or rapid corrections.

Possible Solutions: Verify the limits are set at an appropriate level. Adjust the selectable Gain switch to a lower setting or use the Hi Friction setting. Perform a QUICK-CAL which sets the gains based on valve response. Check for high friction. If the problem persists replace the relay.

YGYR 🟡🟢🟡🔴
COMMAND AMPLITUDE WARNING
COMMAND FREQUENCY WARNING

Description: The amplitude or frequency of the command signal is above the warning limit. This could mean the control loop has larger swings or is oscillating faster than desirable.

Possible Solutions: Verify the limits are set at an appropriate level. Review the control loop parameters and equipment. Adjust as necessary.

YGRY 🟡🟢🔴🟡
CONTINUOUS STROKE TEST FAILED WARNING

Description: During the continuous stroke test, the valve did not move after 5 consecutive attempts. This could mean the valve has increased friction, a change in process load or inadequate supply pressure.

Possible Solutions: Check friction, supply pressure and other alarms or warnings that would indicate difficulty in moving the valve. Check packing, and air supply. The warning will clear when the CST function is turned off or when a successful attempt to move the valve occurs.

YGRR 🟡🟢🔴🔴
PARTIAL STROKE TEST FAILED WARNING

Description: Measured times or forces during the last partial stroke test did not pass the criteria set by the user. This may be an indication of corrosion build-up on the valve stem or in the actuator, low or restricted supply pressure, or a sticking positioner relay.

Possible Solutions: This warning will clear upon completion of a successful partial stroke test.

YYGG ●●●●
TEMPERATURE HIGH WARNING
TEMPERATURE LOW WARNING

Description: The temperature of the internal electronics has exceeded the manufacturer set limits of -40℃ (-40° F) to 85℃ (176℉). Low temperature may inhibit responsi veness 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.

YYGR ●●●●
SUPPLY PRESSURE HIGH WARNING

Description: The supply pressure is above the user set warning limit. Supply pressure that exceeds the maximum rating on the actuator can become a potential hazard.

Possible Solutions: Regulate the supply pressure at the positioner below the maximum limit recommended for your actuator. Recalibrate pressure sensors. Check the pressure sensor board connections. Replace pressure sensor board if necessary.

YYYG ●●●●
SUPPLY PRESSURE LOW WARNING

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.

YYYY ●●●●
ACTUATION RATIO WARNING

Description: The force required to control the system is close to the maximum available force. Actuation Ratio is based on the ratio of available force to the required force to actuate. Control may be lost if this ratio reaches 100%. It is affected by the process load, friction, spring force, and available supply pressure.

Possible Solutions: Increase the supply pressure. Reduce the friction. Check the actuator spring. Resize the actuator. Adjust user set limits.

YYYR ●●●●
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.

YYRY ●●●●
AIR SUPPLY HUMID WARNING

Description: The supply gas has high relative humidity which can lead to condensation on electronic components and failure of electronic functions.

Possible Solutions: Ensure supply gas is clean and dry. Check and clean the regulator filter.

YYRR ●●●●
AIR SUPPLY ICING WARNING AIR SUPPLY ICING WARNING

Description: The supply gas has high relative humidity and the temperature is close to 0 ℃ (32 ℉). Under th ese conditions ice may form in the pilot relay causing diminished or total loss of position control.

Possible Solutions: Ensure supply gas is clean and dry. Check and clean the regulator filter.

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.

YRGY ●●●●
FRICTION LOW WARNING

Description: The friction has passed below the user set limit. Low friction is an indication of improperly loaded packing

and, in severe cases, can be an indication of the process fluid leaking at the valve stem.

Possible Solutions: Check for packing leak. Tighten or replace the valve packing.

YRGR 🟡🔴🟢🔴
FRICTION HIGH WARNING

Description: The valve and actuator friction has passed the user set limit. High friction can cause loop oscillations, poor position control, jerky motion, or valve sticking. It can be caused by build-up from the process on the stem, trim or seat , by a failing bearing or guides in the valve and actuator, galling of the trim or stem, excessively tightened packing, linkages, or other valve or actuator mechanical issues.

Possible Solutions: Determine if the friction is significantly interfering with the valve control. If not, consider increasing the friction warning limit. Consider the following to reduce friction: Stroke the valve to clear off build-up. Clear any external mechanical obstruction, loosen the packing, clean the stem, repair or replace the actuator. Highly localized friction or very jerky travel can indicate internal galling. Repair or replace internal valve components.

YRYG 🟡🔴🟡🟢
STICTION WARNING

Description: The stiction, or break-away friction, is above the warning limit. This value is typically higher than the friction value. Stiction can cause loop oscillations, poor position control, jerky motion, or valve sticking. It can be caused by build-up from the process on the stem, trim or seat , by a failing bearing or guides in the valve and actuator, galling of the trim or stem, excessively tightened packing, linkages, or other valve or actuator mechanical issues.

Possible Solutions: Determine if the stiction is significantly interfering with the valve control. If not, consider increasing the stiction warning limit. Consider the following to reduce stiction: Stroke the valve to clear off build-up. Clear any external mechanical obstruction, loosen the packing, clean the stem, repair or replace the actuator. Highly localized friction or very jerky travel can indicate internal galling. Repair or replace internal valve components.

YRYY 🟡🔴🟡🟡
BACKLASH WARNING

Description: The amount of detected backlash has passed the user set warning limit. This may affect valve stability.

Possible Solutions: Check the stem and actuator for loose components.

YRYR 🟡🔴🟡🔴
PNEUMATIC LEAK WARNING

Description: The positioner has detected a leak in the actuation assembly. Leakage from the actuator can cause decreased responsiveness and excessive air/gas consumption.

Possible Solutions: Repair pneumatic leaks at the tubing junctions and actuator seals. Check spool valve for excessive wear.

YRRG 🟡🔴🔴🟢
LOW BATTERY WARNING

Description: The battery for the real time clock is low. The battery is designed for a 15+ year life with the positioner unpowered. The battery is not required for the positioner to control properly, but is used only to maintain the time and date upon loss of power. The time and date affect the time stamps of alarms, warnings and other events. This warning could be caused by rapidly power cycling the positioner.

Possible Solutions: The battery is not replaceable. Verify or reset the time and date. Replace the main board if the problem persists for several days.

YRRY 🟡🔴🔴🟡
PIEZO VOLTAGE HIGH WARNING
PIEZO VOLTAGE LOW WARNING

Description: If the voltage to the piezo is to 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.

YRRR 🟡🔴🔴🔴
SPRING UNABLE TO FAIL SAFE WARNING

Description: Upon loss of air supply, the valve may not move to the fail-safe position. The spring alone is not adequate to overcome the friction and process load in the system. The system is relying on pneumatic force to actuate in the direction the spring is pushing. The failsafe spring may have failed, or it was not sized properly for the application. Friction or process load may have increased.

Possible Solutions: Repair or replace actuator spring. Check for high friction. Reduce process load.

RGGG 🔴🟢🟢🟢
COMMAND INPUT BELOW ADC RANGE
COMMAND INPUT ABOVE ADC RANGE
COMMAND INPUT RANGE TOO SMALL

Description: During Command Loop Calibration, the signal was out of the Analog to Digital Converter (ADC) range, or difference between the signal at 0% and the signal at 100% was too small. The system is designed to accept a difference greater than 5 mA and between 10 and 4085 ADC.

Possible Solutions: Recalibrate making sure to use valid command signal values.

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.

RGYR ●●●●
ANALOG OUTPUT RANGE TOO SMALL

Description: During an Analog Output Calibration the difference between the milliamp signal at 0% and the milliamp signal at 100% was too small.

Possible Solutions: Recalibrate making sure to use a larger difference between signal limits. This notification can be cleared by briefly pressing the QUICK-CAL/ACCEPT button.

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.

RYGY ●●●●
COMMAND AMPLITUDE ALARM
COMMAND FREQUENCY ALARM

Description: The amplitude or frequency of the command signal is above the alarm limit. This could mean the control loop has larger or faster swings than desirable.

Possible Solutions: Verify the limits are set at an appropriate level. Review the control loop parameters and equipment. Adjust as necessary.

RYGR ●●●●
POSITION AMPLITUDE ALARM
POSITION FREQUENCY ALARM

Description: The amplitude or frequency of the position signal is above the alarm limit. The positioner is controlling the position of the valve with large or rapid corrections.

Possible Solutions: Verify the limits are set at an appropriate level. Adjust the selectable Gain switch to a lower setting or use the Hi Friction setting. Perform a QUICK-CAL which sets the gains based on valve response. Check for high friction. If the problem persists replace the relay.

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.

RYYY 🔴🟡🟡🟡
AUX CARD 2 ERROR

Description: Auxiliary Card 2 has an electrical problem.

AUX CARD 2 FAILURE WARNING

Description: Auxiliary Card 2 is not communicating.

AUX CARD 2 NO LOOP POWER

Description: Auxiliary Card 2 has no loop current.

Possible Solutions: MFC: Check auxiliary loop wiring and ensure adequate compliance voltage and current. Check auxiliary card connection to the main board. Replace card if condition persists.

RYYR 🔴🟡🟡🔴
AUX CARD 1 ERROR

Description: Auxiliary Card 1 has an electrical problem.

AUX CARD 1 FAILURE WARNING

Description: Auxiliary Card 1 is not communicating.

AUX CARD 1 NO LOOP POWER

Description: Auxiliary Card 1 has no loop current.

Possible Solutions: MFC: Check auxiliary loop wiring and ensure adequate compliance voltage and current. Check auxiliary card connection to the main board. Replace card if condition persists.

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.

RYRY 🔴🟡🔴🟡
PRESSURE SENSOR BOARD FAILURE WARNING

Description: One or more pressure sensors may have failed.

Possible Solutions: Check the supply pressure to ensure it is between 1.3 and 10.3 bar (19 and 150 PSI). Check the pressure sensor board connections. Recalibrate the pressure sensors. If the problem persists, replace the pressure sensor board.

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.

RRGY 🔴🔴🟢🟡
FRICTION LOW ALARM

Description: The friction has passed below the user set limit. Low friction is an indication of improperly loaded packing and, in severe cases, can be an indication of the process fluid leaking at the valve stem.

Possible Solutions: Check for a packing leak. Tighten or replace the valve packing.

RRGR 🔴🔴🟢🔴
FRICTION HIGH ALARM

Description: The valve and actuator friction has passed the user set limit. High friction can cause loop oscillations, poor position control, jerky motion, or valve sticking. It can be caused by build-up from the process on the stem, trim or seat , by a failing bearing or guides in the valve and actuator, galling of the trim or stem, excessively tightened packing, linkages, or other valve or actuator mechanical issues.

Possible Solutions: Determine if the friction is significantly interfering with the valve control. If not, consider increasing the friction warning limit. Consider the following to reduce friction: Stroke the valve to clear off build-up. Clear any external mechanical obstruction, loosen the packing, clean the stem, repair or replace the actuator. Highly localized friction or very jerky travel can indicate internal galling. Repair or replace internal valve components.

RRYG 🔴🔴🟡🟢
STICTION ALARM

Description: The stiction, or break-away friction, is above the warning limit. This value is typically higher than the friction

value. Stiction can cause loop oscillations, poor position control, jerky motion, or valve sticking. It can be caused by build-up from the process on the stem, trim or seat , by a failing bearing or guides in the valve and actuator, galling of the trim or stem, excessively tightened packing, linkages, or other valve or actuator mechanical issues.

Possible Solutions: Determine if the stiction is significantly interfering with the valve control. If not, consider increasing the stiction warning limit. Consider the following to reduce stiction: Stroke the valve to clear off build-up. Clear any external mechanical obstruction, loosen the packing, clean the stem, repair or replace the actuator. Highly localized friction or very jerky travel can indicate internal galling. Repair or replace internal valve components.

RRYY ●●●●
BACKLASH ALARM

Description: The amount of detected backlash has passed the user set alarm limit. This may affect valve stability.

Possible Solutions: Check the stem and actuator for loose components.

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 the user-set limit for longer than a user-set time.

Possible Solutions: Review active alarms and warnings to find root causes of this alarm. The deviation settings can be changed in the Valve Health page of the DTM.

18 POSITIONER DIMENTIONS

18.1 Positioner Dimensions

Figures here…

18.2 Positioner Dimensions with Options

Figures here…

19 HOW TO ORDER

19.1 Positioners

Table 23: 520MD+ Positioner Configurations

Selection	Description	Code	Example
Body	Intrinsically Safe, IP-66	5	5
Communications	HART[1]	2	2
Diagnostics	Standard (Basic Functionality)[2]	0MD+	2MD+
	Advanced (With Pressure Sensing)	1MD+	
	Pro (With Full ValveSight Diagnostics)	2MD+	
Certifications	General Purpose	14	14
Positioner Configuration			-
Housing	Aluminum - Black Base with White Cover	W	B
	Aluminum - Black Base with Yellow Cover	Y	
	Aluminum - Black Base with Black Cover	B	
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	
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	F	
	Domed	D	
Special Options	No special options	0	0
Optional Mechanical Add-Ins			-
Manifold	No Manifold	00	AG
	Gauge Manifold - Aluminum	AG	
	VDI/VDE 3847 Semi-Integrated Manifold - Aluminum	VE	
Gauges	No Gauges	0	2
	Supply, Output, Output, SS with Brass Internals, psi (bar/kPa) (Valtek Standard) (qty 3)	1	
	Supply, Output, Output, SS with Brass Internals. psi (kg/cm2) (qty 3)	2	
	Supply, Output, SS with Brass Internals, psi (bar/kPa) (Valtek Standard) (qty 2)	5	
	Supply, Output, SS with Brass Internals. psi (kg/cm2) (qty 2)	6	
Optional Electronic Add-Ins			-
Add-in Electronic Circuits	No LCD	0	1
	LCD	1	
	Slot 1 - No Card	0	1
	Slot 1 - Multi-Function Card[3]	1	
	Slot 2 - No Card	0	0
	Slot 2 - Multi-Function Card[3]	1	
Switches	No Switches	0	3
	Mechanical Limit Switch	1	
	Reed Switch	2	
	Slot Type NAMUR Sensor, P+F SJ2 SN	3	
	Slot Type NAMUR Sensor, P+F SJ2 S1N	4	
	Namur V3 type proximity switch, P+F NJ2-V3-N	5	
	Namur V3 type proximity switch, P+F NBB2-V3-E2 (2-wire configuration)	6	
	Remote Mount Feedback (Only Available with Certification Option 14)	7	

1 HART 6 standard. Can be configured as HART 5 in the field.
2 Can be upgraded to 521MD+ or 522MD+ in the field.
3 Can be configured as Analog Output, Discrete Output or Discrete Input in the field.

19.2 Spare Parts Kits

Table 24: Spare Parts Kits		
Ref.	Description	Part-no.
	Cover:	
1	Yellow	283450.999.000
2	Black	283451.999.000
3	White	283452.999.000
	Boards:	
4	Main	283453.999.000
5	LCD	283454.999.000
6	Pressure Sensor	283455.999.000
7	Multi-Function Card	283456.999.000
8	Safety Discrete Output Card	283457.999.000
	Pilot Relay Module:	
9	Single Acting (Poppet)	283458.999.000
10	Double or Single Acting (Spool)	283459.999.000
	Switches:	
11	Mechanical Switch	TBD
12	Reed Switch	TBD
13	P&F SJ2-SN	TBD
14	P&F SJ2-S1N	TBD
15	P&F NJ2-V3-N	TBD
16	P&F NBB2-V3-E2 (2-wire configuration)	TBD

19.3 Mounting Kits

Table 25: Mounting Kits	
Description	Part-no.
IEC 534 part 6 *(FloTop, Kämmer KA, Kämmer KP, and standard NAMUR linear valves)*	213619.999.000
Rotary VDI/VDE 3845 *(DIN ISO 5211)*	188151.999.000
Flowserve direct mounting	214004.999.000
Linear VDI / VDE 3847	255242.999.000

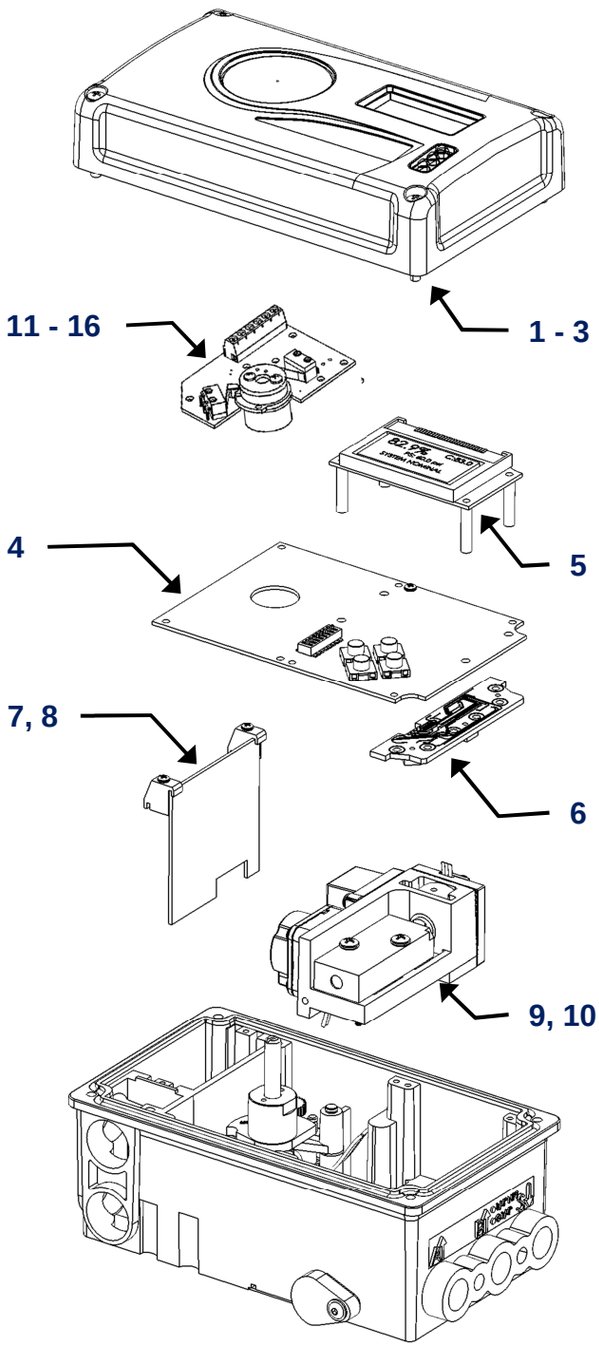


Figure 33: Spare Parts Kits

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