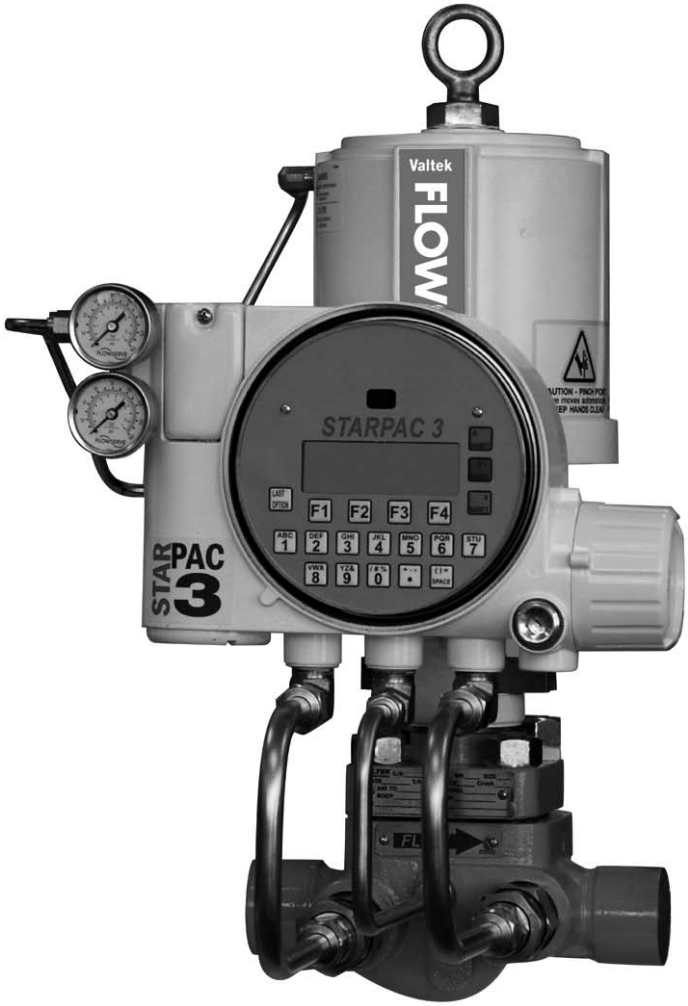
FLOWSERVE

USER INSTRUCTIONS

StarPac 3
Intelligent Control System

FCD VLENIM0066-01

Installation
Operation
Maintenance



Experience In Motion

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1 General Information

1.1 Using

The following instructions are designed to assist in unpacking, installing and performing maintenance as required on Flowserve products. Product users and maintenance personnel should thoroughly review this bulletin prior to unpacking, installing, operating, or performing any maintenance. In most cases, Flowserve valves, actuators and accessories are designed for specific applications (e.g. with regard to medium, pressure, and temperature). For this reason, they should not be used in other applications without first contacting the manufacturer. The product Installation, Operation, and Maintenance Instructions provides important additional safety information.

1.2 Applicability

The following instructions are applicable to the maintenance and installation of Flowserve control valves with the StarPac 3 control system. 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 using the product 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. All Flowserve User Instruction Manuals are available at www.flowserve.com.

1.3 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.

DANGER: Indicates that death, severe personal injury and/or substantial property damage will 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.

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

NOTE: Indicates and provides additional technical information, which may not be obvious, even to qualified personnel. Compliance with other notes, which may not be particularly emphasized, with regard to transport, assembly, operation and maintenance and with regard to technical documentation (e.g. in the operating instructions, product documentation, or on the product itself) is essential, in order to avoid faults, which can directly or indirectly cause severe personal injury or property damage.

1.4 Personal Protective Equipment

Flowserve products are often used in problematic applications (e.g. under extremely high pressures with dangerous, toxic or corrosive mediums). When performing service, an inspection or repair operation 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 (e.g. protective clothing, gloves, glasses etc.).

1.5 Qualified Personnel

Qualified personnel are people who, on account of their training, experience and 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.

1.6 Spare Parts

Use only Flowserve original spare parts. Flowserve cannot accept responsibility for any damages that occur from using spare parts or fastening materials from other manufactures. If Flowserve products (especially sealing materials) have been on store for long periods of time check them for corrosion or deterioration before putting them into use.

1.7 Service / Repair

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

WARNING: Before products are returned to Flowserve for repair or service, Flowserve must be provided with a certificate that 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).

1.8 Storage

In most cases, Flowserve products are manufactured from stainless steel. Products not manufactured from stainless steel are provided with an epoxy resin coating. This means that Flowserve products are well protected from corrosion. Nevertheless, Flowserve products must be stored adequately in a clean, dry environment. Heating is not required. Control valve packages must be stored on suitable skids, not directly on the floor. Plastic caps are fitted to protect the flange faces and prevent the ingress of foreign materials. These caps should not be removed until the valve is actually mounted into the system.

Long Term Storage of StarPac 3 Positioner in Humid Locations

The StarPac 3 positioners are designed to operate in humid environments when connected to a proper instrument air supply. There are some occasions when valves and positioners are stored at job sites or installed and commissioned and then left without instrument air for months. To make startup easier for units that are left without instrument air and insure that the positioners will be ready to operate, it is recommended that the vent assembly of the positioner be sealed preferably with a desiccant pouch sealed with the vent assembly.

The vent assembly is located in the upper left side of the positioner. The gaps around the assembly as noted by the arrows should be sealed for long storage.

A small desiccant package as shown can be included under the sealing tape to insure proper protection.

All of the edges around the vent assembly should be sealed similar to picture below.

The sealing tape and desiccant should be removed when instrument air is permanently applied to the positioner

2 Unpacking

1. While unpacking the StarPac 3 Intelligent Control System, check the packing list against the materials received. Lists describing the system and accessories are included in each shipping container.

2. When lifting the control system from the shipping container, use straps through the yoke legs, or the lifting lugs attached to the yoke bolting. Take care to position lifting straps to avoid damage to the tubing and mounted accessories.

WARNING: When lifting a control system, be aware that the center of gravity may be above the lifting point. Therefore, support must be given to prevent the valve from rotating. Failure to do so can cause serious injury to personnel and damage to the valve and nearby equipment.

3. Contact your shipper immediately if there is shipping damage.

4. Should any problems arise, call your Flowserve representative.

3 Installation

DANGER: Before installation check the order number, serial number, and/or the tag number to ensure that the valve and actuator being installed are correct for the intended application.

CAUTION: Do not insulate extensions that are provided for hot or cold services. Do not insulate the StarPac 3 electronics housing or remote-mounted pressure or temperature sensors; otherwise excessive heat may build up and affect operation.

CAUTION: If the StarPac 3 is being installed in an insulated process line, do not place more than four inches of insulation around the pressure or temperature sensors.

CAUTION: On valves equipped with air filters, the air filter must point down to perform properly.

NOTE: In some rare cases, the air supply must be limited to less than 150 psi (10.3 bar). This is indicated on a sticker found near the upper air port on the actuator cylinder. An air regulator should be installed to ensure the supply pressure does not exceed the line pressure indicated on the sticker.

1. Pipelines must be correctly aligned to ensure that the valve is not fitted under tension.

2. Fire protection must be provided by the user.

3. Before installing the valve, clean the line of dirt, welding chips, scale and other foreign material.

4. Whenever possible, the valve should be installed in an upright position. Vertical installation permits easier valve maintenance.

5. Be sure to provide proper overhead clearance for the actuator to allow for disassembly of the plug from the valve body. Refer to the appropriate actuator User Instructions for proper clearances. Actuator User Instructions are available at www.flowserve.com.

6. Double-check flow direction to be sure the valve is installed correctly. Flow direction is indicated by the arrow attached to the body.

7. If welding the valve into the line, use extreme care to avoid excess heat build up in the valve.

8. Connect the air supply and instrument signal lines.

4 Quick-check

Prior to start-up, check the control valve by following these steps:

1. Stroke the valve and observe the plug position indicator on the stem clamp compared to the stroke indicator plate. The plug should change position in a smooth, linear fashion.

NOTE: Due to excessive friction, graphite packing can cause the plug stem to move in a jerky fashion.

2. Check for full stroke by making appropriate instrument signal changes.

3. Check all air connections for leaks.

4. Check packing box bolting for the correct adjustment. Refer to the packing installation manual for specific details on maintaining the style of packing supplied.

CAUTION: Do not over-tighten packing. This can cause excessive packing wear and high stem friction that may impede plug movement.

5. Make sure the valve fails in the correct direction in case of air failure. This is done by turning off the air supply and observing the failure direction.

6. After a temperature excursion has occurred, bonnet flange bolting should be re-torqued to ensure bonnet seals do not leak.

5 Valve Maintenance

At least once every six months, check for proper operation by following the preventative maintenance steps outlined below. These steps can be performed while the valve is in-line and, in some cases, without interrupting service. If an internal problem is suspected, refer to the Valve Disassembly and Inspection in the Installation, Operation and Maintenance (IOM) instructions of the valve that the StarPac 3 system is mounted to.

1. Look for signs of gasket leakage through the end flanges and bonnet. Re-torque flange and bonnet bolting (if required).

2. Examine the valve for damage caused by corrosive fumes or process drippings.

3. Clean valve and repaint areas of severe oxidation.

4. Check packing box bolting for proper tightness. Refer to the Installation, Operation and Maintenance (IOM) instructions for the valve for specific details on maintaining the style of packing supplied.

CAUTION: Do not over-tighten packing. This can cause excessive packing wear and high stem friction that may impede stem movement.

5. If possible, stroke the valve and check for smooth, full-stroke operation. Unsteady stem movement could indicate an internal valve problem.

NOTE: Due to excessive friction, graphite packing can cause the plug stem to move in a jerky fashion.

WARNING: Keep hands, hair and clothing away from all moving parts when operating the valve. Failure to do so can cause serious injury.

6. Make sure positioner linkage and stem clamp are securely fastened. If the stem clamp is loose, check plug thread engagement (refer to the "Reassembly and Installation" section for the correct procedure on aligning the plug with the seat). Tighten stem clamp nut.

7. Ensure all accessories, bolting and brackets are securely fastened.

8. If possible, remove air supply and observe actuator for correct fail-safe action.

9. Check rubber actuator bellows for splits, cuts or wear.

10. Spray a soap solution around the actuator cylinder retaining ring and actuator stem guide to check for air leaks through the O-rings.

11. Clean any dirt and other foreign material from the plug stem.

12. If an air filter is supplied, check and replace cartridge if necessary.

6 Valve Disassembly and Inspection

The StarPac 3 Control Intelligent Control System can be mounted to a variety of different control valves. To disassemble and inspect the control valve that the StarPac 3 is mounted to, refer to the Installation, Operation and Maintenance (IOM) instructions for that particular valve (i.e. Mark One, Mark 100, ShearStream or MaxFlo 3). Refer to section 14 of this manual for instructions on how to remove the pressure sensor cables and thermocouple prior to valve disassembly.

7 StarPac 3 Operation

7.1 Overview

The StarPac 3 is double-acting, capable of supplying air to either side of the actuator piston while exhausting the other side to the atmosphere. Also, the positioner can be mounted on either Flowserve Valtek linear or rotary actuators without modification to the actuator.

Since the positioner is insensitive to supply pressure changes and can handle supply pressures from 30 to 150 psig, a supply regulator is usually not required; however, an air filter is required due to the close tolerances of the spool assembly.

7.2 Specifications

Table I: Flow Accuracy

The accuracy of the standard StarPac 3 model is +/- 2 percent of full scale flow over the turndown of the control valve, normally 30:1 for a globe valve. This can be improved by using characterized trim or reducing the turndown of the high accuracy range.

Table II: Electrical Specifications

Power Supply	Nominal 24 VDC (19 to 36 VDC allowable) providing 150 mA
Analog Inputs	Isolation protection to 1000 V
Analog Outputs	Two (2) 4-20 mA that each drive up to 750 Ω
Discrete Input	Jumper selectable input voltages of 120 and 24 V accept either AC or DC signals, pulse width >1/16 sec.
Discrete Output: Pulse Relay	24 VAC or VDC operation, max. output switching frequency of 166 Hz
Discrete Output: Alarm Relay	Jumper selectable NO or NC contacts; maximum relay contact rating: 24 VDC resistive. Groups A & B - 230 mA, Group C - 590 mA, Group D - 800 mA
Overload protection	Minimum 500 volt isolation; 24 V power fuse protected
Serial Interface	Dual RS-485 ports; Modbus Protocol
USB Interface	2.0 mini-B; Modbus Protocol
Infrared	PDA Keypad Emulation

Table III: 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 USB connection)
StarPacs per network	Up to 31

Table IV: Environmental Specifications

Ambient	-40° to 170° F (-40 to 75° C)
Process Media	-320° to 1500° F (-195 to 815° C)
Temperature Effect	-40° to -10° F (-40 to 23° C): (0.07% °F) -10° to 150° F (-23 to 66° C): (0.02% °F) 150° to 185° F (66 to 88° C): (0.07% °F)
Transport and Storage Temperature Range	-40° to 170° F (-40 to 76° C)
Operating Humidity	0 - 100% non-condensing

Note: The air supply must conform to ISA standard ISA 7.0.01 (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).

Table V: Physical Specifications

Housing Material	powder painted aluminum	stainless steel
Soft Goods	Buna-N	
Weight	10.3 pounds (kg) aluminum	26.5 pounds (kg) stainless steel
Pressure Sensor	316 L stainless steel	
Pressure Sensor Over-range	Two times maximum operating pressure with negligible change in output	
Pressure Sensor Seals	Viton, Kalrez, EPDM O-rings PTFE, Spiral Wound Gaskets	
Tubing	316 stainless steel with Swagelok® fittings	

Table VI: Positioner Specifications

Deadband	<0.1% full scale
Repeatability	<0.05% full scale
Linearity	<0.5% (rotary), <0.8 (sliding stem) full scale
Air Consumption	<0.3 SCFM (0.5 Nm3/hr) @ 60 psi (4 barg)

Table VII: Measurement Repeatability

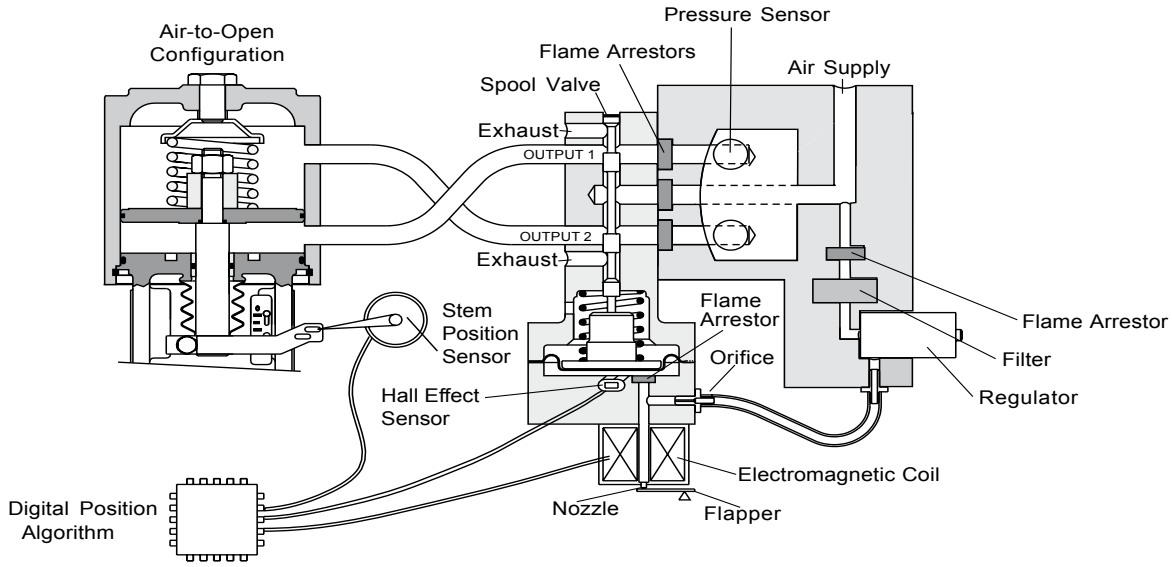
Flow	0.25% full scale
Pressure (max.)	0.1% full scale
Temperature	1° C body temperature measured by Type K thermocouple
Drift	1% full scale / 6 months
Calibration	Independent zero and span adjustment for all sensors

Table VIII: Hazardous Area Certifications

Explosionproof / Flameproof		**Nonincendive/Div 2**	
FM APPROVED	Class I, Div 1, Groups B,C,D Class II, Div 1, Groups E,F,G Class III With Non-Incendive Outputs T6 Max ambient 75º C	C SA US	Class I, Div 2, Groups A,B,C,D Zone 2, Ex nIIC

7.3 Positioner Operation

Figure 1: StarPac 3 Positioner Schematic (air-to-open configuration)



The StarPac 3 Positioner is an electric feedback instrument. Figure 1 shows a StarPac 3 installed on a double-acting actuator for air-to-open action. Positioning is based on a balance of two signals: one proportional to the modulator input signal and the other proportional to the stem position.

The supply pressure for the positioner modulator is tapped off the main supply and is filtered as it passes through a field-replaceable, coalescing filter element in the module. Next it passes through an internal pressure regulator that regulates it to approximately 21.5 psig. The air then goes through an orifice that restricts the flow and air consumption (refer to Figure 1).

The air is further controlled to 6-12 psig using a spring-diaphragm flapper that is attracted by an electromagnet to a nozzle. A temperature compensated Hall Effect sensor mounted on a circuit board senses the spool valve position. The Hall Effect sensor and circuitry create a feedback loop, which determines how much current to send to the electromagnet for a desired spool valve position. The electromagnet in the feedback loop varies the nozzle-flapper spacing, which regulates the output pressure to 6-12 psig proportional to the command input signal.

When these opposing signals are equal, the system will be in equilibrium and the stem will be in the position called for by the command signal. If these opposing signals are not equal, the spool valve will move up (or down) and, by means of the modulator, will change the output pressures and flow rate. This will cause the piston to move until the signal of the feedback sensor equalizes with the command signal.

The detailed sequence of positioner operations are as follows: An increase in the command signal forces the modulator signal capsule and spool valve upward. This motion of the modulator also pushes the pilot valve spool upward from its equilibrium position. This opens the pilot valve ports, supplying air to port one and exhausting air from port two. This

causes the actuator piston to move upward.

This upward motion of the piston is transmitted back to the positioner through the feedback linkage and position feedback potentiometer signal changing proportionally to the valve position. The piston continues to stroke upward until the signal of the feedback sensor increases sufficiently to counter the signal being sent to the modulator. At this point, the spool is at its equilibrium position as the pressures in the cylinder stabilize and the air flow to the actuator decreases.

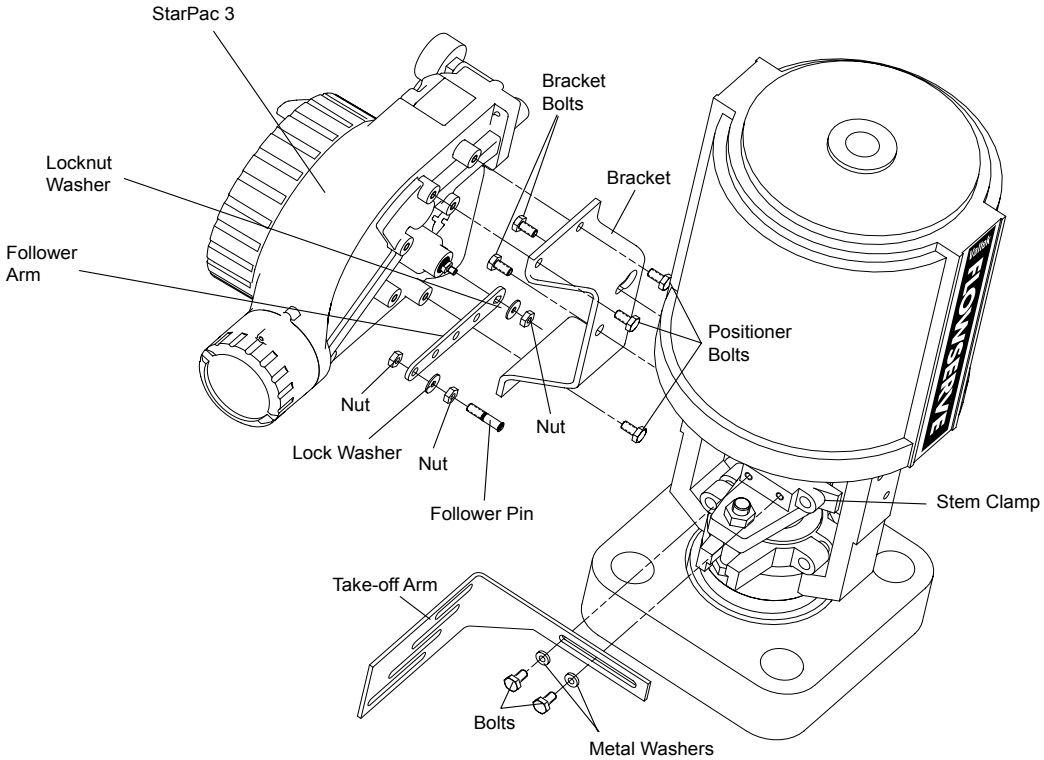
After the piston has reached the required position, the feedback signal will equal the spool position generated in the modulator capsule. The computer will then make small null adjustments to fine-tune the desired position and compensate for changes in dynamic loading.

A decrease in the command signal reverses the described actions causing a proportional downward movement of the actuator piston and stem.

8 Mounting and Installation

8.1 Mounting to Flowserve Valtek Linear Mark One Valves

Figure 2: Linear Mark One Control Valve Mounting (Sensor Mounting not shown)



To mount the StarPac 3 positioner to a Flowserve Valtek linear Mark One valve, refer to Figure 2 and proceed as outlined below. The following tools are required:

- 9/16” open-end wrench (or 1/2” for spud sizes 2.88 and smaller)
- 7/16” box wrench
- 3/8” open-end wrench

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. Re-install lock washer and tighten nut to complete follower arm assembly.

2. Slide double-D 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 customer interface side of the positioner. Slide lock washer over the threads on the shaft and tighten down the nut.
3. Line up the mounting bracket with the mounting holes on the actuator yoke. Bolt the mounting bracket on to actuator yoke.
4. Align the three outer mounting holes on the positioner with the three positioner mounting holes on the bracket. Fasten with 1/4-20 x1/2" bolts.
5. Position the take-off arm mounting slot against the stem clamp mounting pad. Apply Loctite 222 to the take-off arm bolting and in and insert through washers into the stem clamp. Leave bolts loose.
6. 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.
7. Center the take-off arm on the rolling sleeve of the follower pin.
8. Align the take-off arm with the top plane of the stem clamp and tighten bolting. Torque to 120 in-lb.

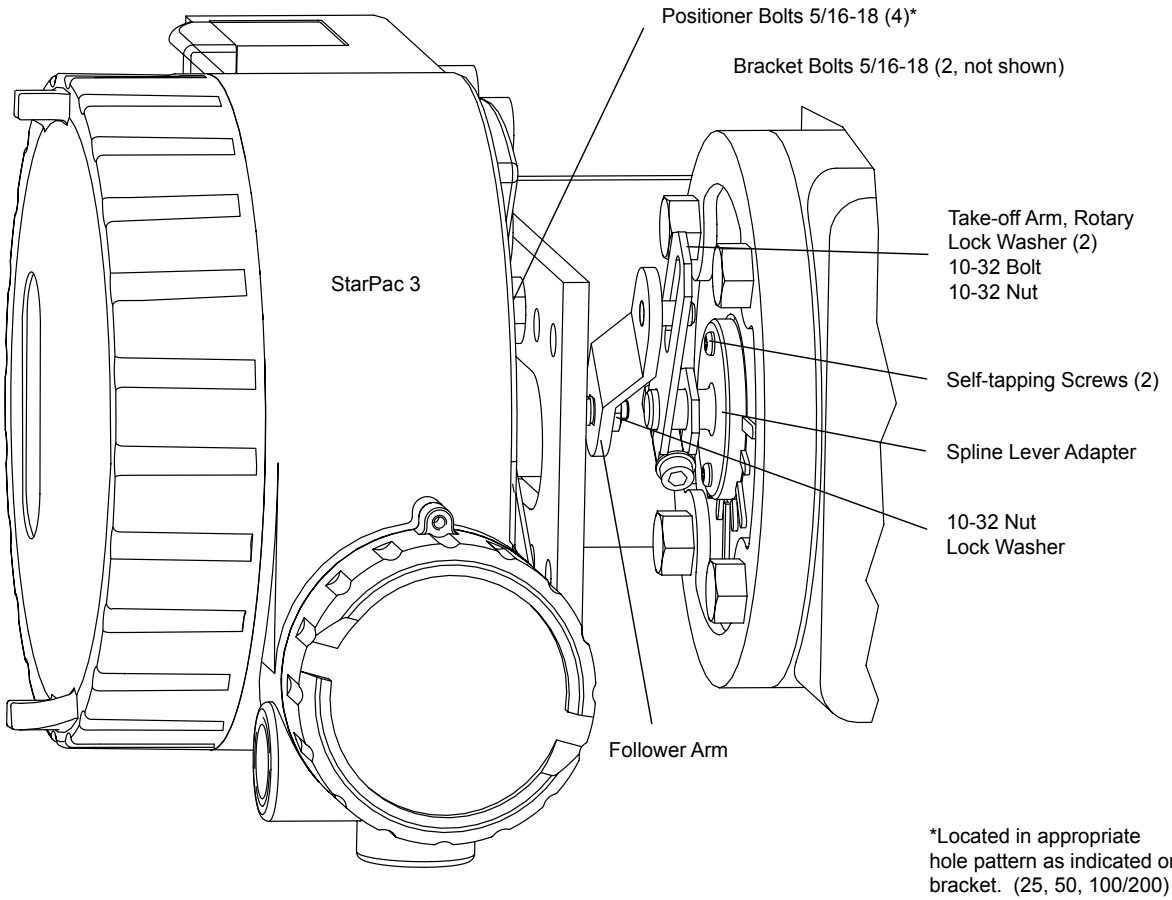
NOTE: If mounted properly, the follower arm should be horizontal when the valve is at 50% stroke and should move approximately ±30° from horizontal over the full stroke of the valve. If mounted incorrectly, a stroke calibration error will occur. Reposition the feedback linkage or rotate the position sensor to correct the error.

8.2 Mounting to Standard Flowserve Valtek Rotary Valves

The standard rotary mounting applies to Flowserve Valtek valve/actuator assemblies that do not have mounted volume tanks or handwheels. The standard mounting uses a linkage directly coupled to the valve shaft. This linkage has been designed to allow for minimal misalignment between the positioner and the actuator. The tools required for the following procedure are:

- 5/32" Allen wrench
- 1/2" open-end wrench
- 3/8" socket with extension
- 3/16" nutdriver

Figure 3: Standard Rotary Mounting (Sensor Mounting not shown)



1. Fasten the splined lever adapter to the splined lever using two #4-40 x 1/2" self-tapping screws.
2. Slide the take-off arm assembly onto the splined lever adapter shaft. Insert the screw with star washer through the take off arm and add the second star washer and nut. Tighten nut with socket so arm is lightly snug on the shaft but still able to rotate. This will be tightened after linkage is correctly oriented.
3. Attach follower arm to positioner feedback shaft using the star washer and 10-32 nut.

NOTE: The arm will point up when feedback shaft is in the free position.

4. Using four 5/16"-18 x 5/8" bolts, fasten positioner to universal bracket using appropriate hole pattern (stamped on bracket).
5. Using a 1/2" end wrench and two 5/16"-18 x 1/2" bolts, attach bracket to actuator transfer case pad. Leave these bolts slightly loose until final adjustments are made.
6. Rotate take-off arm so the follower pin will slide into the slot on the take-off arm. Adjust the bracket position as needed noting the engagement of the follower pin and the take-off arm slot. The pin should extend approximately 1/16" past the take-off arm. When properly adjusted, securely tighten the bracketing bolts.
7. Tube the StarPac 3 positioner to the actuator according to the instructions given in Section 8.4, "Tubing Positioner to Actuator."
8. With supply pressure off, rotate the follower arm in the same direction the shaft would rotate upon a loss of

supply pressure. When the mechanical stop of the follower arm (positioner) is reached, rotate back approximately 15 degrees.

9. Hold the take-off arm in place; tighten the take-off arm screw.

NOTE: The take-off arm should be snug enough to hold the follower arm in place but allow movement when pushed.

10. Connect regulated air supply to appropriate port in manifold.

11. Remove main cover and perform a stroke calibration using the key pad (refer to the StarPac 3 User Interface Manual. Make sure the StarPac 3 has been configured with the proper air action.

12. If the calibration was successful, continue with step 9. If the calibration failed, the A/D feedback values were exceeded and the arm must be adjusted away from the positioners limits. Return to step 2 and rotate the arm back approximately 10 degrees.

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

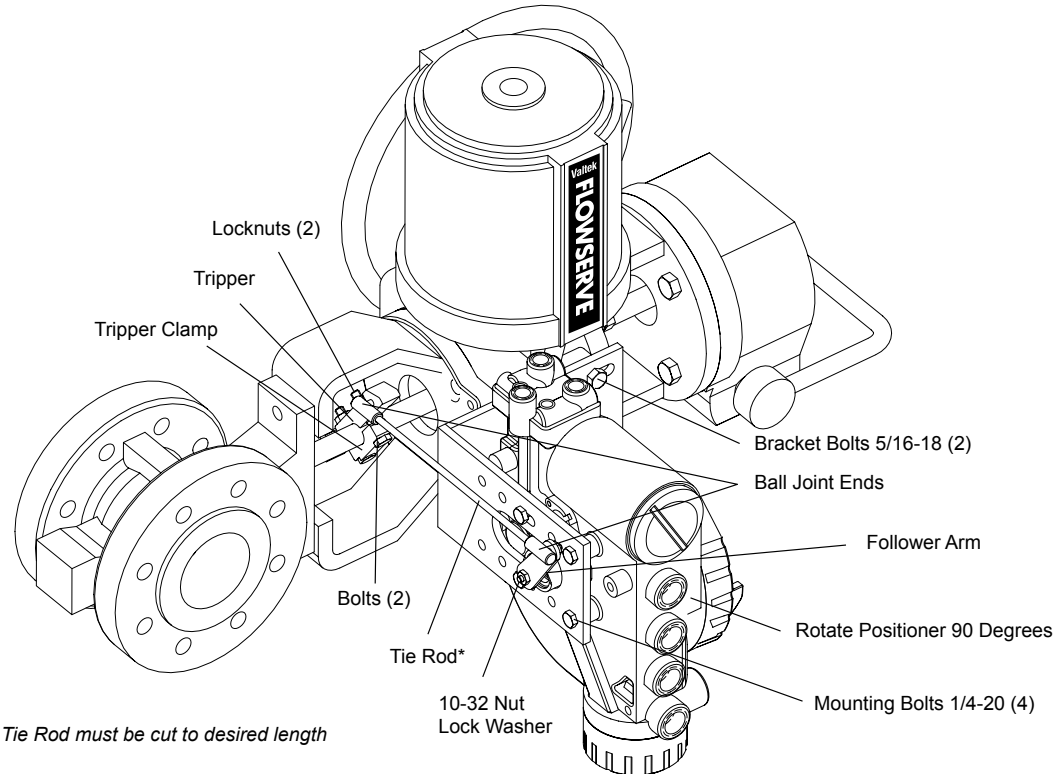
13. Tighten the nut on the take-off arm. The socket head screw of the take-off arm must be tight, about 40 in-lb.

NOTE: If the take-off arm slips, the positioner must be recalibrated.

WARNING: Failure to follow the procedure will result in positioner and/or linkage damage. Check air-action and stroke carefully before lockdown of take-off arm to splined lever adapter.

8.3 Optional Flowserve Valtek Rotary Mounting Procedure

Figure 4: Optional Rotary Mounting (Sensor Mounting not shown)



** Tie Rod must be cut to desired length*

The optional rotary mounting applies to Flowserve Valtek valve/actuator assemblies that are equipped with mounted volume tanks or handwheels. The optional mounting uses a four-bar linkage coupled to the valve shaft. The follow tools are required:

- 3/8" open-end wrench
- 1/2" open-end wrench

1. Using a 1/2" open-end wrench and two 5/16-18 x 1/2" bolts, attach bracket to actuator transfer case pads. Leave bracket loose to allow for adjustment.
2. Using four 5/16"-18 x 5/8" bolts and a 1/2" open-end wrench, fasten positioner to universal bracket, using the four-hole pattern that locates the positioner the farthest from the valve. Rotate positioner 90 degrees from normal so gauges are facing upward.
3. Attach follower arm to positioner feedback shaft, using the star washer and 10-32 nut.
4. Attach tripper and tripper clamp to valve shaft using two 1/4-20 bolts and two 1/4-20 locknuts. Leave tripper loose on shaft until final adjustment.
5. Thread ball joint linkage end to tripper and tighten (thread locking compound such as Loctite is recommended to prevent back threading). Adjust the length of tie rod so follower arm and tripper rotate parallel to each other (the rod must be cut to the desired length). Connect the other ball joint end to follower arm using a star washer and 10-32 nut.
6. Tighten bracket and tripper bolting.
7. Check for proper operation, not direction of rotation.

WARNING: If rotating in wrong direction, serious damage will occur to the positioner and/ or linkage. Check air action and stroke direction carefully before initiating operation.

8.4 Tubing Positioner to Actuator

The StarPac 3 positioner is insensitive to supply pressure changes and can handle supply pressures from 30 to 150 psig. A supply regulator is recommended if the customer will be using the diagnostic features of the StarPac 3 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 (not to be confused with operating range). An air filter is highly recommended for all applications where dirty air is a possibility.

NOTE: The air supply must conform to ISA Standard ISA 7.0.01 (a dew point at least 18°F below ambient temperature, particle size below five microns – one
micron recommended – and oil content not to exceed one part per million).

Air-to-open and air-to-close are determined by the actuator tubing, not the software. When air action selection is made during configuration, that selection tells the control which way the actuator has been tubed. The top output is labeled Output 1. Output 1 should be tubed to the side of the actuator that must receive air to begin the correct action on increasing signal. Verify that tubing is correct prior to a stroke calibration. Proper tubing orientation is critical for the positioner to function correctly and have the proper failure mode. Refer to Figure 1 and follow the instructions:

1. Linear Double-acting Actuators

For a linear air-to open actuator, the Output 1 port of the positioner manifold is tubed to the bottom side of the actuator. The Output 2 port of the positioner manifold is tubed to the top side of the actuator. For a linear air-to-close actuator the above configuration is reversed.

2. Rotary Double-acting Actuators

For a rotary actuator, the output 1 port of the positioner manifold is tubed to the bottom side of the actuator. The Output 2 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.

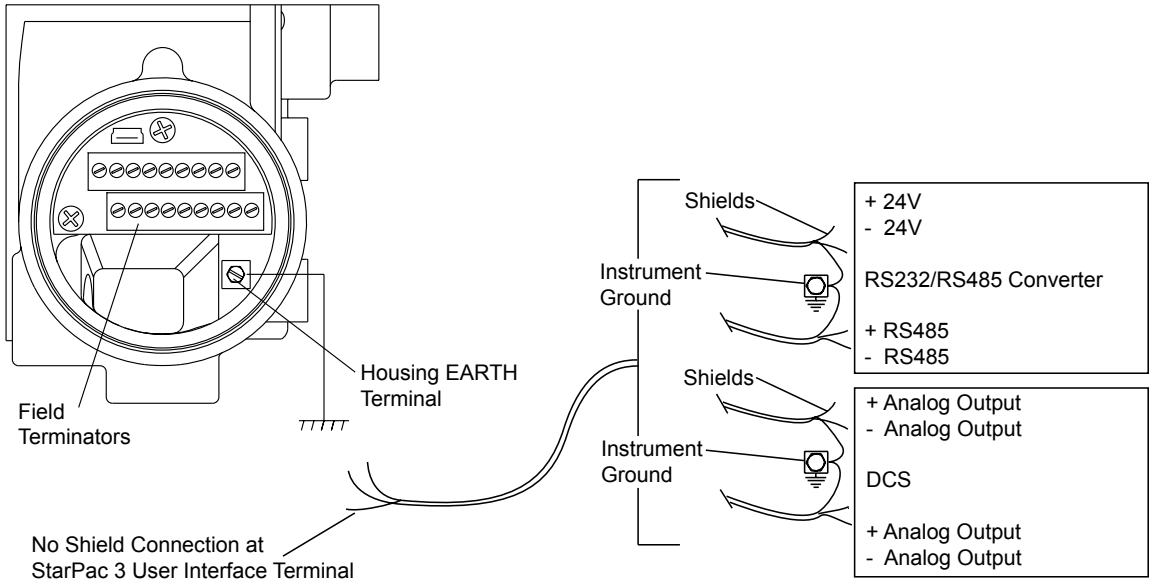
3. Single-acting Actuators

For single-acting actuators, the Output 1 port is always tubed to the pneumatic side of the actuator regardless of air action. The Output 2 port must be plugged.

9 Wiring and Grounding Guidelines

WARNING: This product has electrical conduit connections in either thread sizes 1/2" NPT or M20 which appear identical but are not interchangeable. Housings with M20 threads are stamped with the letters M20 above the conduit opening. Forcing dissimilar threads together will damage equipment, cause personal injury and void hazardous location certifications. Conduit fittings must match equipment housing threads before installation. If threads do not match, obtain suitable adapters or contact a Flowserve representative. In all cases always use suitable rated cable glands. Unused openings shall be installed with suitably rated close-out plugs.

Figure 5: Shielded Wire Diagram



9.1 Shielding Versus Grounding

All signals to the StarPac 3 unit should be in shielded cables. 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. A ground wire (unlike a shield) is attached at both ends to provide a continuous path for electrical conductivity.

9.2 Grounding Screw

The green grounding screw, located by the customer interface terminal block 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 connecting to the unit should be earth grounded at both ends of its run.

WARNING: The green grounding screw must not be used to terminate signal shield wires.

9.3 24 VDC Power

The 24 VDC connection points will work best with shielded twisted pair wire with the shield wire connected only at the source. The input power is isolated within the unit and may be referenced to whatever level is necessary.

WARNING: The 24 VDC power supply should not be connected to earth ground.

9.4 RS-485 Communications

RS-485 wiring requires the use of a shielded twisted pair cable, which is grounded only at the source and not in the unit. (For maximum performance, wire should have a characteristic impedance of 120 ohms.) The RS-485 input is fully isolated, using opto-isolators.

The RS-485 allows only a 7 to 12 V common mode voltage differential between stations. RS-232 to RS-485 converters are not a grounded connection. PC‘s with internal RS-485 cards, on the other hand, are often grounded. If another ground communication device is on the network, a fault condition will almost certainly exist due to transient and steady state differences in ground potential.

9.5 4-20 mA Command Input, Auxiliary Input and Feedback Output

These signals are isolated but shielded twisted pair wire should be used to reduce crosstalk from other signals. The shield should be connected only at the source.

9.6 Discrete Inputs and Outputs

These signals are isolated, but because they are frequently used to switch high voltage (120 VAC), they should be run in separate shielded wire paths away from the other StarPac 3 signals.

9.7 RS-232 to RS-485 Converter Connection

When connecting a StarPac 3 unit to a communication device, no shield or ground connections exist. Hence, the 24 VDC power and RS-485 communication shield drain wires must be connected to a convenient ground near the converter.

10 Wiring the StarPac 3 System

10.1 General

All electrical connections must be done according to local and industry electrical codes. Flowserve recommends a shielded cable be used for the RS-485 command signal wire (e.g., Belden 9841 or equivalent).

When connecting multiple StarPac 3 units, a parallel daisy-chain wiring pattern is used. Connect unit's branch lines to main line, keeping branch lines as short as possible. The total length of wiring should not exceed 4,000 feet (1,200 meters) without use of repeaters.

Avoid devices producing electrical 'noise' while installing the cable.

CAUTION: The following procedure should be performed on the bench or with the unit isolated so that unexpected valve stroking will not adversely affect the process.

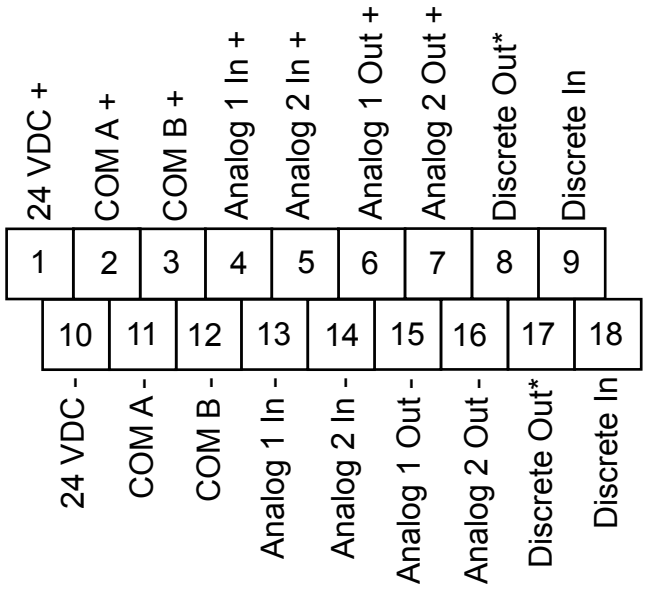
WARNING: The following procedures may cause the valve to stroke, causing pressures and temperatures to vary from their norms. Notify appropriate personnel that the valve may stroke unexpectedly. It is recommended that the system be isolated from the process, if installed in line.

WARNING: Cable entry temperature may exceed 70^0 C. Therefore, select appropriate rated cable.

10.2 Wiring Connections

To connect the wiring to the StarPac 3 unit, refer to Figures 6 and Table IX, and then proceed as follows.

Figure 6: User Interface Terminal Pinouts



*Discrete Output can be configured for a pulse output or an alarm relay

Table IX: User Interface Terminal Connections

Signal	Positive Terminal Number	Negative Terminal Number
24 VDC power	1	10
Primary RS-485 communication link	2	11
Secondary RS-485 communication link	3	12
Valve command signal	4	13
Auxiliary input (4-20 mA)	5	14
Analog output (4-20 mA) 1	6	15
Analog output (4-20 mA) 2	7	16
Discrete output (pulse or alarm relay)	8	17
Discrete input - switch/ solenoid monitoring (discrete mode source input)	9	18

1. Remove the customer interface cover.

WARNING: Do not remove the electronic housing covers in flammable atmospheres; otherwise, possible injury to personnel or equipment may occur.

2. Connect the required wires to the terminal interface block and computer as described in Figure 6 and Table IX. (The system must have 24 VDC power for operation).

NOTE: The StarPac 3 unit remembers the operating mode setting (automatic or manual) from the last time the unit had power. When power to the system is turned on again, the unit will resume operation in the previous mode. Normally the unit arrives from the factory set in the manual analog operating mode. This means a command signal will position the valve the same as a traditional control valve, providing a plug position proportional to the 4 - 20 mA signal.

3. To avoid upsetting the process because of improper operating mode selection:

Ensure that the system arrived from factory with the proper operating mode setting in the shop prior to installation by connecting air supply and command signal, then turning on the power and looking at the mode value on the local display, or;

Set the proper operating mode for the particular application in the shop prior to installation by selecting the desired operating mode from the local interface or in the Tuning/Tune screen of the StarTalk software, or;

Ensure that the block valves in the process line around the unit are closed and the process is diverted around the unit.

4. Turn on the 24 VDC power to the unit, and verify that it has been correctly wired by checking the following:

- 24 VDC power is at least 150 mA and between 18.0 and 64.0 VDC
- Polarity is correct
- Local display is on; if not, check the power supply

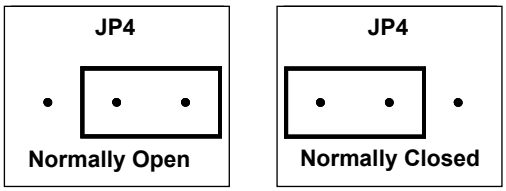
After the verification is completed, replace the main and user interface covers on the housing.

10.3 Setting the Jumpers

The StarPac 3 system has several jumpers that are used to configure the analog and discrete I/O. The keypad must be removed to view or change the jumper settings.

1. Contact Relay Setting
On the lower right hand side of the electronic board assembly is a three position jumper labeled "JP4." If the jumper is set on the two pins furthest to the right the relay is configured to Normally-open operation. If set on the two pins furthest to the left, the jumper configures the relay to Normally-closed operation. See Figure 7.

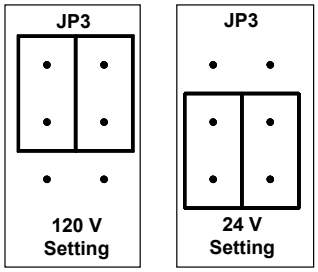
Figure 7: Contact Relay Jumper Settings



2. Discrete Input Range Selection

On the lower right hand side of the electronic board assembly is a six position jumper labeled "JP3." There are 2 jumpers that must be moved together to set the voltage input range. The jumpers are oriented vertically and with both jumpers in the upper position the input is set to trigger on 120V AC or DC. With both jumpers in the lower position the input is set to trigger on 24V AC or DC. See Figure 8.

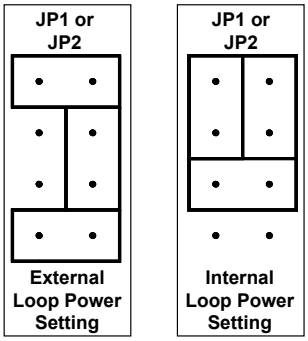
Figure 8: Discrete Input Range Jumper Settings



3. Analog Input Power Selection

On the lower right hand side of the electronic board assembly are two, 8 position jumper arrays labeled "JP1" and "JP2." Each of the 4-20 mA analog inputs can be configured for either an external power supply such as exists in a DCS, or powered internally so a transmitter or other 2 wire device can be directly connected to the terminals. JP1 configures analog input 1 and JP2 configures analog input 2. The jumpers should be configured as shown for the desired operation. See Figure 9.

Figure 9: Analog Input Power Jumper Settings



11 RS-485 Communication Configurations

11.1 System Communication Default Configuration

The StarPac 3 has two communication ports (Com A and Com B) that can be used for RS-485 communications. Refer to Figure 6 and Table IX for wiring connection instructions.

StarPac 3 units are shipped from the factory ready for installation and operation. Rarely do the units need to be re-configured prior to operation. Table X lists the factory default communication settings. If these settings are not correct for the equipment being used, proceed to sections 11.2 to 11.5. The communication settings for each port will need to be set on the StarPac 3 device through the keypad. Refer to the StarPac 3 User Interface Manual for instructions on how to change the communication settings on the StarPac 3.

Table X: Factory Default Mode Settings

Description	Setting
Address	1
Parity	Odd
Baud Rate	19,200
Modbus Communication Mode	RTU
RS-485 Termination Resistors	Installed

11.2 Selecting Correct Address Setting

If the StarPac 3 unit is the only StarPac unit on the communication network, the default address (1) is fine.

If multiple units will be operating on the same communication network, each unit must have a unique address. Before changing the address, the StarTalk XP software can be used to determine what devices are on the line. (Remember to include devices that may be temporarily off line).

If the default address setting needs to be changed, use the 'Comm Port' option in the configuration menu of the local keypad interface to change the settings.

11.3 Selecting Correct Baud Rate Setting

StarPac 3 units support baud rates of 2400 up to 57,600 baud. However, the Starpac 3 system is shipped from the factory with COM A set to 19,200 baud and COM B set to 57,600 baud. If the default baud rate setting needs to be changed, use the 'Comm Port' option in the configuration menu of the local keypad interface to change the settings.

11.4 Selecting Correct Modbus Transmission Mode

Two transmission modes exist in a Modbus system, ASCII and RTU (default). Use the ASCII mode when transmitting information through a device that uses ASCII control codes; for example, a modem. When ASCII mode is used, Parity must be set to None. Use the RTU mode when connecting directly to both devices; for example, an RS-485 interface card wired directly to a StarPac 3 system.
If the default Modbus transmission mode setting needs to be changed, use the 'Comm Port' option in the configuration menu of the local keypad interface to change the settings.

11.5 Selecting Proper RS-485 Termination Resistor Setting

A termination resistor must be installed on the two most remote devices on the network, counting the host computer as any other device.

(For example, a single 3 unit and the RS-485 driver in the host computer would each require the termination resistor to be installed. If four units were on the network with a host computer, decide which of the two devices have the most combined cable length between them. These two devices should have the termination resistors installed. The termination resistors should be disabled in the devices not considered to be the most remote using the instructions in the next section. Using more than two termination resistors in a network can cause the RS-485 communications to operate erratically or fail).

On the top electronic board there are two termination jumpers for the RS-485 communications to the right of the LCD display. The jumper labeled JP1 enables the termination resistor for Com A and the jumper labeled JP2 enables the termination resistor for Com B. To enable 120 ohms termination, insert both jumpers for A and B channels. To disable termination, remove both jumpers from each channel.

11.6 Communication Port B

Com Port B can be set for the following three configurations;

- RS-485
- USB
- Infrared

1. When RS-485 is selected, the StarPac 3 device will need to be wired correctly. Refer to Figure 6 and Table IX for wiring connection instructions. Follow the instructions as outlined in sections 11.2 to 11.5 to configure Com Port B.
2. When a 2.0 mini-B USB cable is plugged into the StarPac 3 on the Customer Interface Board, Com Port B will automatically be configured for communication through the USB cable. The baud rate will automatically be set to 57600. When using StarTalk XP, make sure the computer com port baud rate setting is also set to 57600.
3. When Infrared is selected, the StarPac 3 will be able to receive communication through the glass on the main cover. It is not necessary to remove the main cover. Communication will need to occur using a PDA with special software. The software will contain a keypad simulator that will have the same functionality as the local keypad.

12 StarPac 3 Calibration

For complete calibration instructions, refer to the StarPac 3 Interface Manual or the on board help in the StarTalk XP interface software.

13 StarPac 3 Configuration

For complete configuration instructions, refer to the StarPac 3 User Interface Manual or the on board help in the StarTalk XP interface software.

14 System Maintenance

14.1 Overview

It is recommended that the StarPac 3 system calibration be checked every six months. If, after checking the unit, a component is determined to be defective, the following section will help with the component replacement.

The following items may be needed to install, start up and calibrate the unit‘s electronics.

- Power supply: 24 VDC, 150 mA
- Digital volt meter with 4 - 20 mA range
- Air supply: 50 psig minimum, 80-100 psig preferred
- Gauges or the ability to accurately determine process pressures and valve air supply pressures
- 4 - 20 mA command source
- Thermocouple calibrator or simulator with 0 to 500° Celsius range

14.2 Mechanical Subsystem Maintenance

Refer to the appropriate Flowserve Installation, Operation & Maintenance (IOM) instructions for details on repair and maintenance of the control valve actuator components. Please refer to the manufacturers’ manuals for maintenance and operation instructions for non-pneumatic actuators, e.g., electric or electro-hydraulic actuators.

WARNING: The process line must be depressurized and drained of process fluid and decontaminated prior to working on internal valve components. Failure to do so may cause serious injury to personnel.

1. Depressurize the line, decontaminate the valve (if needed) and shut off the air supply to the valve positioner.
2. Disconnect the actuator air tubes from the unit.
3. Disconnect the two mounting bolts that attach the StarPac 3 system bracket.
4. Disconnect the follower arm from the unit base. This is done by removing the follower arm nut and washer and pulling the arm off the shaft. Notice that the shaft is slightly spring loaded.
5. The actuator subassembly is now isolated and is removed by loosening the bonnet bolts and lifting the actuator away from the body.
6. The tubing holds the StarPac 3 base in place, eliminating the need to disconnect wiring or air connections.

7. Standard valve maintenance may now be done on the actuator or valve body components. Refer to the Flowserve IOM instructions for details on such things as trim or packing replacement. If you have to replace the trim, use the same trim number and characteristic as the original trim so the flow calculations are not affected. If a trim size change is needed, contact your Flowserve representative to find out about flow characterization options.
8. Reassemble the system by reversing the above steps. Be sure to follow the procedures outlined in the Flowserve Installation, Operation and Maintenance (IOM) instructions for valve reassembly. When reconnecting the follower arm, make sure that the arm fits correctly on the keyed shaft and has a positive spring action.
9. Turn on the air supply to the valve and check for leaks in the reattached actuator tubing lines.
10. Turn on power to the unit. Check the system calibration and perform a Valve Stroke Calibration to reset the position feedback. Refer to the Calibration section of the StarPac 3 User Interface Manual.

14.3 Position Feedback System

The position feedback linkage of the StarPac 3 system is a critical part of the system. This linkage is also used in the StarPac 3 to calculate the valve's CV for a given stroke for flow measurement. This linkage should be lubricated and checked periodically for tight, smooth operation. The follower arm should operate smoothly with no binding and have a positive spring loading on the arm. Inspect the follower arm pin for excess wear and replace if needed. The take-off arm attached to the stem clamp must be firmly secured to the stem clamp and perpendicular to the actuator stem. If this takeoff arm is canted or misaligned, problems may occur with positioner calibration and the position reading on the unit may go out of range.

On rotary actuators, make sure the adjustment linkage locknut is tight and has no excessive play in the ball joints. The rotary shaft clamp must be tight and should not freely rotate on the shaft.

14.4 Pressure Sensor Replacement

Standard StarPac 3 pressure sensors are typically installed directly into the control valve body. Before they can be removed, the process line must be depressurized and drained of all fluids and the valve decontaminated.

To replace a pressure sensor, refer to Figure 10 then proceed as follows.

WARNING: The process line must be depressurized and drained of process fluid, and decontaminated prior to working on internal valve components. Failure to do so may cause serious injury to personnel.

WARNING: If the pressure sensors are remote mounted, the sensor will be located in a sensor housing in the tubing line and not in the sensor housing located on the valve body. This section of the tubing contains process fluid and must be drained and decontaminated before the sensor is removed. The procedure for sensor removal and replacement will be similar to that outlined below.

(Refer to alternate sensor information when this type of sensor is included with system.)

1. Depressurize and decontaminate the line and valve. Loosen the tubing nuts on the conduit leading to the pressure sensor, if applicable.
2. Loosen the sensor nut.
3. Gently pull the conduit and sensor nut approximately 1/2" to 3/4" from the sensor. Use needle nose pliers to

release the locking sleeve of the Lemo™ connector by moving the collar away from the sensor and disconnect the connector from the sensor. Swing the sensor conduit out of the way (refer to Figure 10).

Figure 10: Disconnecting Lemo™ Connector

4. Unscrew the sensor from the sensor boss.
5. Remove the sensor O-ring or gasket and replace with a new one. Make sure the environmental O-ring seal is in good condition and in place on the new sensor.
6. Install the new sensor into the sensor port making sure the O-ring or gasket remains properly in place while tightening the sensor. Tighten the sensor until it seats metal-to-metal at the gasket section of the sensor port, ensuring the proper compression of the process O-ring or gasket seal.
7. Plug the pressure sensor cable connector into the pressure sensor. Align the red dots on the sensor and connector to reconnect the Lemo™ connector to the pressure sensor. Fully seat the connector until the locking sleeve latches. Replace the sensor nut and tighten.
8. Pressurize the valve body to make sure the sensors are properly seated before attaching the sensor conduit and tightening.
9. Reattach the conduit lines and securely tighten the fittings.

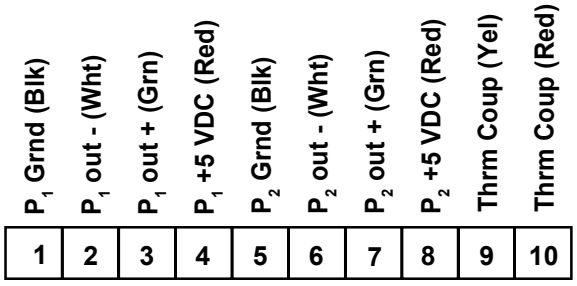
14.5 Pressure Sensor Cable Replacement

It is not necessary to remove the pressure sensor prior to replacing the pressure sensor cable.

1. Loosen the tubing nuts on the conduit leading to the pressure sensor, if applicable.
2. Loosen the sensor nut.
3. Gently pull the conduit and sensor nut approximately 1/2" to 3/4" from the sensor. Use needle nose pliers to release the locking sleeve of the Lemo™ connector by moving the collar away from the sensor and disconnect the connector from the sensor. Swing the sensor conduit out of the way (refer to Figure 10).
4. Remove the main cover.
5. Remove the two keypad retaining screws. Carefully pull the keypad away from the main PCB board. Unplug the keypad ribbon cable from the main PCB board and remove the keypad.
6. The pressure sensor cable has four wires that are terminated in a terminal strip found at the bottom of the main PCB board assembly. Remove the four pressure sensor cable wires from the terminal connector. Refer to figure 11 to make sure the correct sensor cable is being removed. Gently pull the cable out of the housing.

NOTE: On certain applications, the cables may be potted inside the fitting at the bottom of the positioner housing. To remove the cable it will be necessary to cut the existing cable on both sides of the fitting. The fitting will need to be removed from the housing and a new replacement fitting will need to be installed. After the new cable is installed it will be necessary to repot the cable inside the new fitting.

Figure 11: Pressure Sensor and Thermocouple Terminal Strip



7. Remove the pressure sensor cable from the conduit.
8. Feed the new pressure sensor cable into the conduit. Then feed the bare end of the cable into the StarPac 3 housing through the conduit entry.
9. Plug the pressure sensor cable Lemo™ connector into the pressure sensor. Align the red dots on the sensor and connector to reconnect the Lemo™ connector into the pressure sensor. Fully seat the connector until the locking sleeve latches. Replace the sensor nut and tighten.
10. Cut the bare end of the cable in the housing to the proper length so that the wires can be terminated properly. Terminate the wires in the terminal strip. Refer to Figure 11 to make sure that the wires are terminated properly according to the correct color scheme.

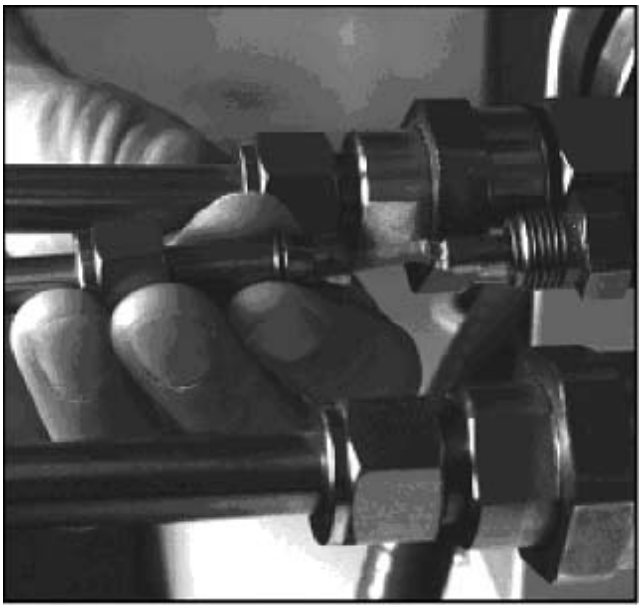
14.6 Thermocouple Replacement

In normal configuration, the thermocouple does not penetrate the valve body wall. Depressurizing the body is not necessary when replacing the thermocouple.

WARNING: If the StarPac II was ordered with a special thermocouple option, verify the need to depressurize the body before proceeding.

1. Disconnect power and air supply to the unit.
2. Remove the main cover.
3. Remove the two keypad retaining screws. Carefully pull the keypad away from the main PCB board. Unplug the keypad ribbon cable from the main PCB board and remove the keypad.
4. Disconnect the red and yellow thermocouple wire. Refer to Figure 11.
5. Loosen the tubing nuts on both ends of the thermocouple assembly (refer to Figure 12).

Figure 12: Thermocouple Replacement



6. Pull the wires out of the StarPac base and slip the tubing off the wires.

NOTE: On certain applications, the cables may be potted inside the fitting at the bottom of the positioner housing. To remove the cable it will be necessary to cut the existing cable on both sides of the fitting. The fitting will need to be removed from the housing and a new replacement fitting will need to be installed. After the new cable is installed it will be necessary to repot the cable inside the new fitting.

7. Unscrew the old thermocouple from the body.

8. Install the new thermocouple.
9. Feed the wires back through the tubing and into the StarPac housing.
10. Tighten the tubing nuts.
11. Cut the thermocouple wires to length. Strip and reattach wires to the terminal block, noting color polarity. (The red wire is the negative signal).
12. Check that all the fittings are tight.

14.7 Keypad Assembly Replacement

If, after consulting with the local Flowserve or factory representative, the StarPac 3's keypad is found to be defective and needs replacement, refer to Figure 24 and proceed as follows.

1. Make sure valve is by-passed and in a safe condition.
2. Disconnect the power and air supply to the unit.
3. Remove main housing cover.
4. Remove the two keypad retaining screws. Carefully pull the keypad away from the main PCB board. Unplug the keypad ribbon cable from the main PCB board and remove the keypad.
5. Install the new keypad assembly by first plugging the keypad ribbon cable into the connector on the main PCB board. Carefully place the keypad over the main PCB board.
6. Re-insert the two keypad retaining screws. Do not over-tighten.

14.8 Driver Module Assembly Replacement

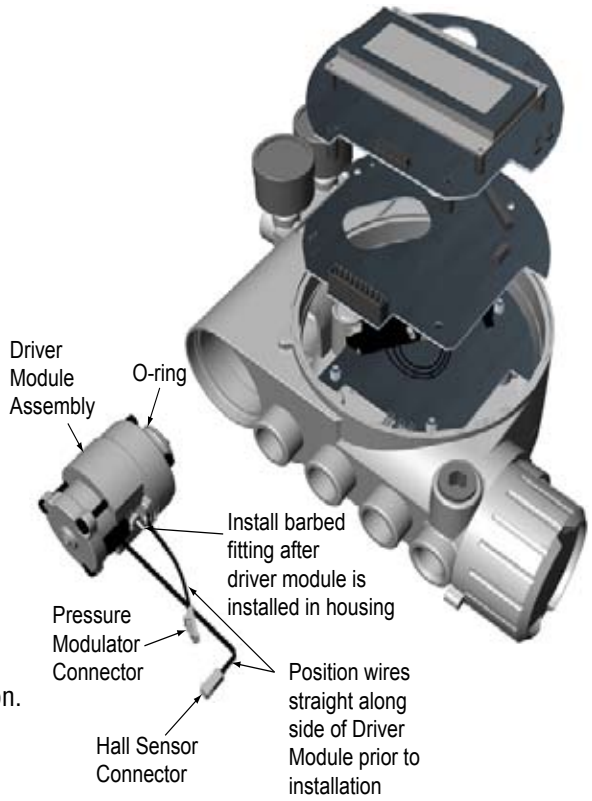
The driver module assembly moves the spool valve by means of a differential pressure across its diaphragm. Air is routed to the driver module from the regulator through a flexible hose. A barbed fitting connects the flexible hose to the driver module assembly. Wires from the driver module assembly connect the hall effect sensor and modulator to the main PCB assembly.

To replace the driver module assembly, refer to Figures 13, 14, 15 and 16 and proceed as outlined below. The following tools are required:

- Flat plate or bar about 1/8" thick
- Phillips screwdriver
- 1/4" nutdriver

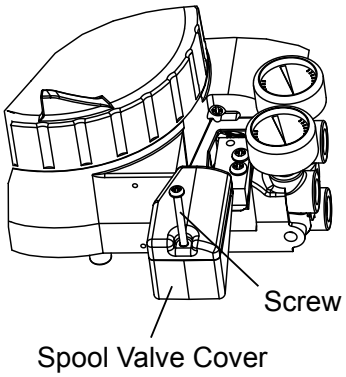
WARNING: Observe precautions for handling electrostatically sensitive devices.

Figure 13: Driver Module Assembly



1. Make sure the valve is bypassed or in a safe condition.
2. Disconnect the power and air supply to the unit.
3. Remove the driver module cover, placing a flat bar or plate in the slot to turn the cover.
4. Remove the spool valve cover by removing the screw and sliding the cover assembly backwards until the tab is clear of the slot (Figure 14). The sheet metal cap, hydrophobic filter, and O-ring should be removed with the spool valve cover. It is not necessary to take these parts out of the spool valve cover.

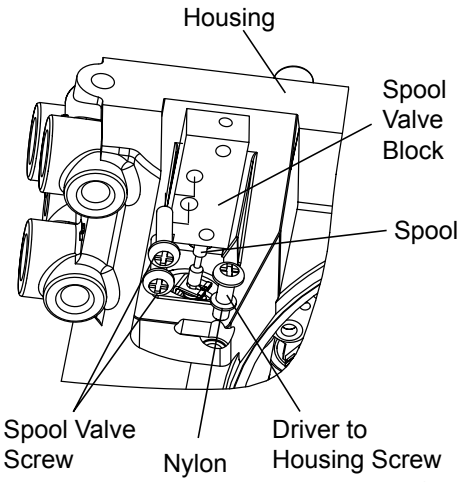
Figure 14: Spool Valve Cover Assembly



5. Remove the Phillips-head screw that attaches the driver module to the main housing (Figure 15). Be careful not to lose the nylon washer as the screw is removed.

WARNING: Spool (extending from the driver module assembly) is easily damaged. Use extreme caution when handling spool and spool valve block. Do not handle the spool by the machined portions of spool. The tolerances between the block and spool are extremely tight. Contamination in the block or on the spool may cause the spool to hang.

Figure 15: Spool and Block



6. Remove the spool valve by the two Phillips head screws and carefully sliding the block off the spool (Figure 15).

7. Carefully remove the spool by sliding the end of the spool out of the connection clip. Excessive force may bend spool.

8. Remove the main cover.

9. Remove the two keypad retaining screws. Carefully pull the keypad away from the main PCB board. Unplug the keypad ribbon cable from the main PCB board and remove the keypad.

10. Remove the main PCB assembly by following the instructions in section 14.15 of this manual.

11. Disconnect the flexible tubing from the barbed fitting at the driver module assembly (see Figure 16).

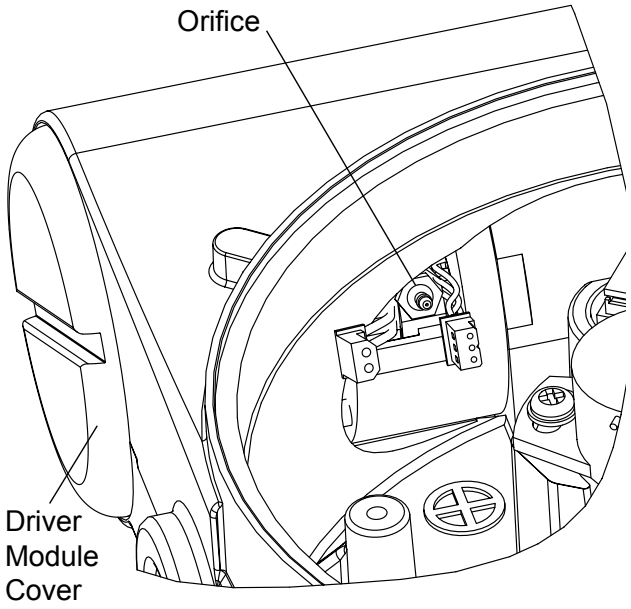
12. Use the 1/4" nutdriver to remove the barbed fitting from the driver module assembly.

13. Feed the two wire connectors on the driver module back into the driver module compartment so that they stick out the driver module opening (See Figure 13). This will allow the driver module to thread out without tangling or cutting the wires.

14. Grasp the base of the driver module and turn it counter clockwise to remove. After it is threaded out, carefully retract the driver module from the housing.

15. Remove the barbed fitting orifice (See Figure 16) from the side of the new driver module using the 1/4" nut-driver.

Figure 16: Driver Module Barbed Fitting



16. Verify the O-ring is in place on the top of the new driver module. Lay the wires back along the side of the driver module as shown in Figure 13 and hold the wires in position by hand.

17. Gently insert the driver module into the driver module compartment in the housing. Turn the driver module clockwise to thread it in the housing. Continue rotating the driver module until it bottoms out.

18. Once the driver module has bottomed out so that the threads are fully engaged, rotate the driver module counter clock wise until the flat on the driver module and the flat on the housing are aligned. This will align the screw hole for the next step.

19. Verify that the nylon gasket is in the counter bore in the driver module retaining screw hole as shown in Figure 15. Seal around the screw using an RTV sealant.

20. Insert a driver-to-housing screw into the driver housing through the counterbored hole in the positioner main housing. Tighten with a Phillips screwdriver.

21. Reach through the main compartment into the driver module compartment of the positioner and install the barbed fitting on the side of the driver module using the 1/4" nutdriver.

22. Reconnect the flexible tube coming from the regulator to the barbed fitting.

23. Feed the driver module wires into the main chamber of the housing, and connect them to the main PCB Assembly.

24. Verify that the three O-rings (item 35) are in the counter bores on the machined platform where the spool valve block is to be placed (Figure 24).

25. Carefully slide the spool into the connecting clip on the top of the driver module assembly.

26. Carefully slide the block over the spool, using the machined surface of the housing base as a register (Figure 15). Slide the block toward the driver module until the two retaining holes line up with the threaded holes in the base.

27. Install two spool-valve screws and tighten securely with a Phillips screwdriver (See Figure 15).

28. Slide the spool valve cover assembly over the spool valve until the tang engages in the housing slot. Install spool valve cover screw and tighten securely (see Figure 14).

29. Re-install the main PCB assembly following the instructions found in section 14.15 of this manual.

30. Re-install the keypad. Insert the two retaining screws and tighten evenly, using a Phillips a screwdriver. Do not over-tighten.

31. Reconnect power and air supply to the positioner and perform a stroke calibration. Refer to the Calibration section of the StarPac 3 User Interface Manual.

32. Reinstall all covers.

14.9 Regulator Replacement

The Regulator reduces the pressure of the incoming supply air to a level that the driver module can use.

To replace the regulator, refer to Figure 24 and proceed as outlined below. The following tools are required:

- Phillips screwdriver
- 1/4" nutdriver

WARNING: Observe precautions for handling electrostatically sensitive devices.

1. Make sure valve is bypassed or in a safe condition.

2. Disconnect the power and air supply to the unit.

3. Remove the main cover.

4. Remove the two keypad retaining screws. Carefully pull the keypad away from the main PCB board. Unplug the keypad ribbon cable from the main PCB board and remove the keypad.

5. Remove the main PCB assembly by following the instructions in section 14.15 of this manual.

6. Remove the four screws from the regulator base. Verify that as the regulator is removed, the O-ring and filter remain in the counterbore (see Figure 20).

7. Remove tubing and barbed fitting from the regulator base.

8. Install barbed fitting and tubing to the new regulator.

9. Verify that the O-ring and filter are in the counterbore. Install new regulator using 8-32 x 1/2" screws.

10. Install the main PCB assembly into the housing by following the instructions in 14.15 of this manual.

11. Reinstall the keypad. Insert the two retaining screws. Do not over-tighten.

12. Reinstall all covers.

14.10 Checking or Setting Internal Regulator Pressure

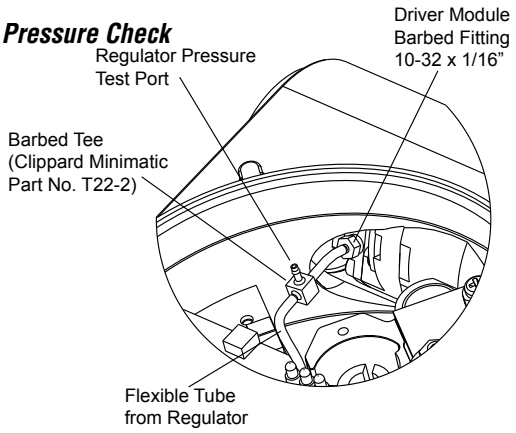
To check or set the internal regulator pressure, refer to Figure 16 and proceed as outlined below. The tools and equipment used in the next procedure are from indicated vendors. The following tools are required:

- Calibrated pressure gauge (0 to 30 psi)
- 1/16” flexible tubing
- Barbed Tee (Clippard Minimatic part number T22-2 or equivalent)
- 3/32” Allen wrench
- 3/8” open-end wrench

WARNING: Observe precautions for handling electrostatically sensitive devices.

1. Make sure the valve is bypassed or in a safe condition.
2. Remove the main cover.
3. Remove the two keypad retaining screws. Carefully pull the keypad away from the main PCB board. Unplug the keypad ribbon cable from the main PCB board and remove the keypad.
4. Remove the main PCB assembly by following the instructions in section 14.15 of this manual.
5. It will be necessary to plug the actuator pressure sensor ports. Make sure the pressure sensor o-rings are still in place. Install plug plate (Part Number 185162.601.003) below the pressure sensor board stiffener (item 9) and tighten the pressure sensor board stiffener screws (item 8).
6. Remove the 1/16” flexible tubing from the barbed fitting on the side of the driver module.
7. Obtain a barbed tee and two pieces of 1/16” flexible tubing a few inches in length each.
8. Position the barbed tee between the internal regulator and the driver module by connecting the 1/16” flexible tubing, found in the positioner, to one side of the barbed tee. Using one of the new flexible tubing pieces, connect the barbed tee to the barbed fitting on the side of the driver module. Connect the remaining port on the barbed tee to a 0 to 30 psig pressure gauge.

Figure 17: Driver Module Regulator Pressure Check



9. Reconnect the air supply to the positioner and read the internal regulator pressure on the 0 to 30 psig gauge. The internal pressure should be set to 21.5 +/- .2 psig. If adjustment is needed, loosen the set screw retaining nut on the top of the regulator using the 3/8” open-end wrench. Then adjust the regulator pressure by turning the set screw on the top of the regulator with the 3/32” Allen wrench.
10. Once the regulator pressure is set, tighten the set screw retaining nut on the top of the regulator, remove the air supply to the positioner, remove the barbed tee, and reconnect the flexible tubing from the regulator to the barbed fitting on the side of the driver module.

11. Remove the stiffener plate and plug plate. Make sure that the o-rings stay in place.

12. Re-install the main PCB assembly following the instructions found in section 14.15 of this manual.

13. Re-install the keypad. Insert the two retaining screws and tighten evenly, using a Phillips a screwdriver. Do not over-tighten.

14. Re-install all covers.

14.11 Checking or Setting the Driver Module Minimum Pressure

To check or set the driver module minimum pressure, refer to Figure 18 and proceed as outlined below. The tools and equipment used in the next procedure are from indicated vendors. The following tools are required:

- Calibrated pressure gauge (0 to 30 psi)
- 1/16" flexible tubing
- Barbed Tee (Pneumadyne part No. SFL-10 or equivalent))
- No. 10-32 extension (Clippard part No. 15010 or equivalent)
- 9/64" Allen wrench
- 3/8" open-end wrench

WARNING: Observe precautions for handling electrostatically sensitive devices.

1. Make sure valve is bypassed or in a safe condition.

2. Disconnect power and air supply from the positioner.

3. Remove the main cover.

4. Remove the two keypad retaining screws. Carefully pull the keypad away from the main PCB board. Unplug the keypad ribbon cable from the main PCB board and remove the keypad.

5. Remove the main PCB assembly by following the instructions in section 14.15 of this manual.

6. It will be necessary to plug the actuator pressure sensor ports. Make sure the pressure sensor o-rings are still in place. Install plug plate (Part Number 185162.601.003) below the pressure sensor board stiffener (item 9) and tighten the pressure sensor board stiffener screws (item 8).

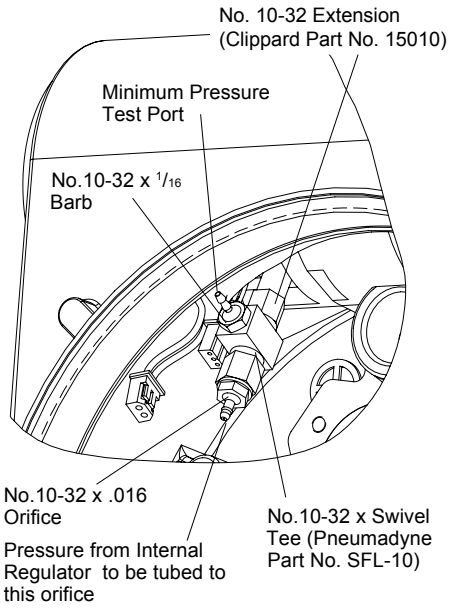
7. Remove the 1/16" flexible tubing from the orifice.

8. Obtain a No. 10-32 swivel run tee (Pneumadyne part No. SFL-10 or equivalent) and a No. 10-32 extension (Clippard part No. 15010 or equivalent).

9. Remove the No. 10-32 x 1/16 orifice (Figure 16) from the driver module using a 1/4-inch nut driver.

10. Screw in the 10-32 extension followed by the 10-32 x swivel run tee.

Figure 18: Driver Module Minimum Pressure Check



11. Direct the swivel run tee so the minimum pressure test port is accessible.

12. Screw a No. 10-32 x 1/16-inch barb fitting into the test port, and screw a No. 10-32 x 1/16 barb fitting into the end of the elbow as shown.

13. Connect the tubing from the internal regulator output port to the orifice.

14. Using some 1/16-inch flexible tubing, connect a 0 to 30 psi gauge to the minimum pressure set port.

15. Once the gauge is connected, re-apply the positioner air supply (do not apply power). The minimum pressure should now be registering on the gauge and must be 1.8 to 2.2 psi. If the minimum pressure is not correct, take a 9/64 allen wrench and turn the minimum pressure set screw located at the bottom of the driver module (Figure 12) until the pressure is in the range indicated. Cycle the positioner air supply several times and recheck the minimum pressure and re-adjust, if necessary, to ensure that the pressure has settled within the range specified.

16. When the pressure is set, remove the air supply.

17. Remove the No. 10-32 x 1/16 barb fittings from the swivel run tee and then remove the extension.

18. Replace the No. 10-32 x 1/16 barb fitting as shown in Figure 16 and reconnect the 1/16" flexible tubing from the internal regulator output port to the orifice.

19. Remove the stiffener plate and plug plate. Make sure that the o-rings stay in place.

20. Re-install the main PCB assembly following the instructions found in section 14.15 of this manual.

21. Re-install the keypad. Insert the two retaining screws and tighten evenly, using a Phillips a screwdriver. Do not over-tighten.

22. Re-install all covers.

23. Reconnect the positioner air supply and power. The positioner should now be ready to calibrate.

14.12 Spool Valve Cover Replacement

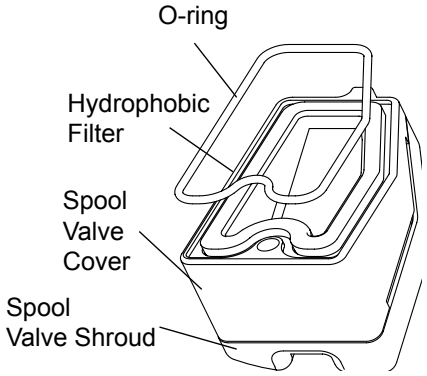
The spool valve cover incorporates a coalescing filter element in a two-piece cover. This protects the spool valve chamber from dirt and moisture and provides a low back pressure vent for exhaust air from the spool valve.

To replace the filter in the spool valve cover, refer to Figures 14 and 19 and proceed as outlined below. The following tools are required:

- Phillips screwdriver

1. Remove spool cover by removing the screw and sliding the cover assembly backwards until the tab is clear of the slot. The sheet metal cover may be removed and cleaned with a brush or by blowing out with compressed air (Figure 14).

Figure 19: Spool Valve Cover Assembly



2. Remove the O-ring from around the hydrophobic filter element and set aside (Figure 19).

3. Remove the molded filter element by pulling it straight out of the chamber cover vent piece.

4. Install O-ring into base of chamber cover vent piece as shown in Figure 19.

5. Place new molded filter element in to the chamber cover vent piece. This filter element provides part of the track to secure the O-ring installed in the last step.

6. Place spool valve shroud onto spool valve cover.

7. Place the spool valve cover assembly in place by setting it on the ramp and sliding it until the tab seats in the slot (Figures 14 and 19) and secure with an 8-32 screw.

14.13 Spool Valve Replacement

The spool valve routes the supply air to one side of the actuator while venting the opposite side (see Figure 1). The position of the spool valve is controlled by the driver module.

Replacing the Spool Valve

To replace the spool valve, refer to Figures 14, 15 and 24 and proceed as outlined below. The following tools are required:

- Phillips screwdriver

1. Make sure the valve is bypassed or in a safe condition.
2. Disconnect the power and air supply to the unit.
3. Remove the spool valve cover by removing the screw and sliding the cover assembly backwards until the tab is clear of the slot. It is not necessary to remove the sheet metal cap, hydrophobic filter, or O-ring from this assembly (Figure 14).

WARNING: The spool (extending from the driver module assembly) is easily damaged. Use extreme caution when handling spool and spool valve block. Do not handle the spool by the machined portions of spool. The tolerances between the block and spool are extremely tight. Contamination in the block or on the spool may cause the spool to hang.

4. Remove the spool valve block by removing the two Phillips-head screws and carefully sliding the block off the spool (Figure 14).
5. Carefully remove spool by sliding end of spool out of connecting clip. Excessive force may bend the spool.
6. Verify that the three O-rings are in the counter bores on the machined platform where the new spool valve block is to be placed (Figure 24).
7. Carefully slide the spool into the connecting clip on the top of the driver module assembly.
8. Carefully slide the block over the spool, using the machined surface of the housing base as a register (Figure 15). Slide the block toward the driver module until the two retaining holes line up with the threaded holes in the base.
9. Install two spool-valve screws and tighten securely with a Phillips screwdriver (See Figure 15).
10. Slide the spool valve cover assembly over the spool valve until the tang engages in the housing slot. Install spool valve cover screw and tighten securely (see Figure 14).
11. Reconnect power and air supply to the positioner and perform a stroke calibration.

14.14 Stem Position Sensor Replacement

The position feedback assembly transmits valve position information to the processor. This is accomplished by means of a rotary position sensor that connects to the valve stem through a feedback linkage. To provide for accurate tracking of the pin in the slot, the follower arm is biased against one side of the slot.

To replace the stem position sensor, refer to Figure 20 and proceed as outlined below. The following tools are required:

- Phillips screwdriver

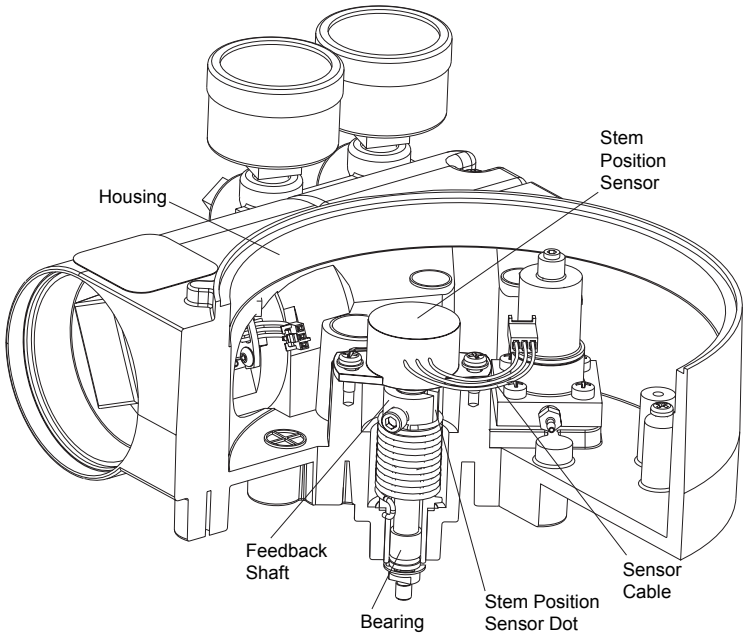
WARNING: Observe precautions for handling electrostatically sensitive devices.

1. Make sure the valve is bypassed or in a safe condition.
2. Disconnect the power and air supply to the unit.
3. Remove the main cover.
4. Remove the two keypad retaining screws. Carefully pull the keypad away from the main PCB board. Unplug the keypad ribbon cable from the main PCB board and remove the keypad.
5. Remove the main PCB assembly by following the instructions in section 14.15 of this manual.

6. Remove the two rotary position sensor-retaining screws and lift the sensor out of the housing.

7. Turn the new position sensor shaft until the dot on the side of the shaft is aligned with the wires on the side of the position sensor (Figure 20).

Figure 20: Stem Position Sensor Orientation



8. Insert the position sensor into the shaft with the wires pointing toward the main PCB assembly. Turn the position sensor clock-wise until bolting slots align with the housing screw holes and the wires on the sensor protrude over the main PCB assembly.

9. Carefully center the position sensor on the shaft bore, insert and tighten the screws. Do not over-tighten.

10. Route the wires along the side of the position sensor and reconnect to the main PCB assembly.

11. Re-install the main PCB assembly following the instructions found in section 14.15 of this manual.

12. Re-install the keypad. Insert the two retaining screws and tighten evenly, using a Phillips a screwdriver. Do not over-tighten.

13. Reinstall all covers.

14. Reconnect power and air supply to the positioner and perform a stroke calibration.

14.15 Main PCB Assembly Replacement

The main printed circuit board (PCB) assembly contains the circuit board and processor that perform control functions of the positioner. The main PCB is to be replaced as a unit. None of the components on the main PCB are serviceable.

To replace the main PCB assembly, refer to Figure 20 and proceed as outlined below. The main PCB assembly consists of three boards. The top board will have to be separated from the assembly. The bottom two boards will not have to be separated and will remain together.

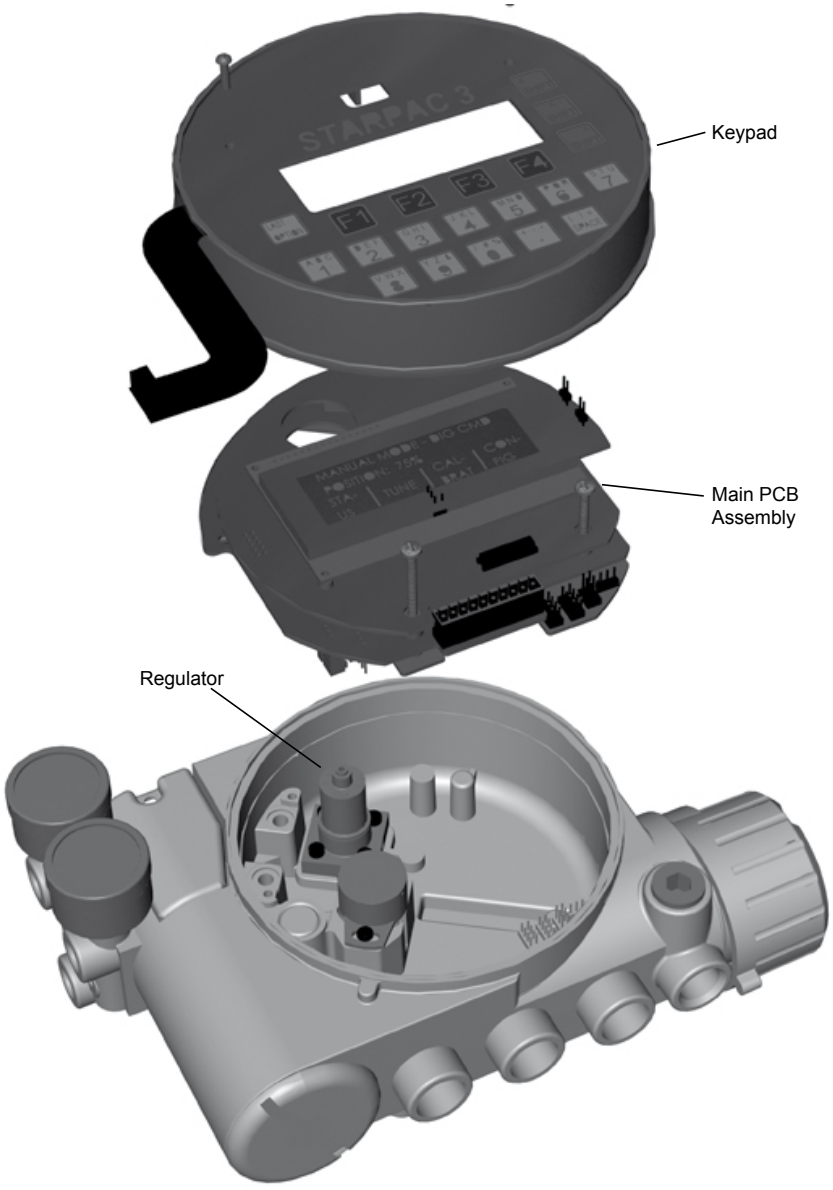
The following tools are required:

- Phillips screwdriver

WARNING: Observe precautions for handling electrostatically sensitive devices.

1. Make sure the valve is bypassed or in a safe condition.
2. Disconnect the power and air supply to the unit.
3. Remove the main cover.
4. Remove the keypad by removing the two retaining screws. Unplug the keypad ribbon cable from the main PCB board and remove the keypad.

Figure 21: Main PCB Assembly



5. Unplug the wire harness that terminates the pressure sensors and thermocouple from the main PCB assembly.
6. Remove the three retaining screws (item 6) from the main PCB assembly.
7. Carefully unplug and remove the top display board from the main PCB assembly. The bottom two boards of the main PCB assembly will remain in the housing.
8. Remove the two screws (item 8) retaining the lower two boards of the main PCB assembly. Remove the metal pressure sensor board stiffener.
9. Carefully lift the lower two boards out of the main PCB assembly. Disconnect the three wire connections and user interface ribbon cable from the back of the lowest board of the main PCB assembly.
10. Remove the lower two boards of the main PCB assembly out of the housing.
11. Prior to installing the new main PCB assembly, remove the top display board of the new main PCB assembly.
12. Connect the three wire connections and user interface ribbon cable on to the back of the lowest board of the main PCB assembly.
13. Verify that the two pressure sensor O-rings (item 10) are in place in the housing.
14. Place the lower two boards of the main PCB assembly into the positioner and onto the bosses in the housing. Make sure all wires are clear and do not get pinched between bottom circuit board and the housing bosses.
15. While holding the metal pressure sensor board stiffener in place, insert the two retaining screws through the metal pressure sensor board stiffener and circuit board and fasten the lower two boards to the housing. An outline of where the where the metal stiffener needs to be placed can be seen on the middle board of the main PCB assembly. Tighten the screws evenly to 8 in-lb.
16. Connect the pressure sensor/thermocouple wire harness to the middle board of the main PCB assembly.
17. Carefully plug the top display board of the main PCB assembly into the middle board of the main PCB assembly.
18. Insert the three retaining screws through the mounting holes of the fully assembled main PCB assembly and tighten evenly.
19. Carefully re-install the keypad assembly. Make sure that the connector on the back of the keypad assembly connects correctly to the connector on the main PCB board.
20. Insert the two retaining screws through the keypad and tighten evenly. Do not over-tighten.

14.16 Customer Interface Board Replacement

The customer interface board provides a connection point inside the explosion-proof housing for all hookups to the positioner.

To replace the customer interface board, refer to Figures 5 and 24 and proceed as outlined below. The following tools are required:

- Phillips screwdriver

WARNING: Observe precautions for handling electrostatic sensitive devices.

1. Make sure the valve is bypassed or in a safe condition.
2. Remove the main cover.
3. Remove the keypad assembly by removing the two retaining screws. Unplug the keypad ribbon cable from the main PCB board and remove the keypad.
4. Remove the main PCB assembly as outlined in section 14.15.
5. Remove the user interface cover.
6. Disconnect the field wiring from the customer interface board terminals and remove the two screws (Item 19) that hold the customer interface board in the housing (See Figure 5).
7. Remove the customer interface board by gently pulling it out of the housing.
8. Install the replacement customer interface board by sliding it into place.
9. Connect the ribbon cable on the customer interface board to the main PCB assembly. Install the main PCB assembly as outlined in section 14.15.
10. Secure the customer interface in place with the two mounting screws (see Figure 5).
11. Reconnect the field wiring to the customer interface board terminals.
12. Install the keypad assembly and secure with the two retaining screws.
13. Reinstall all covers.

15 Optional Vented Design

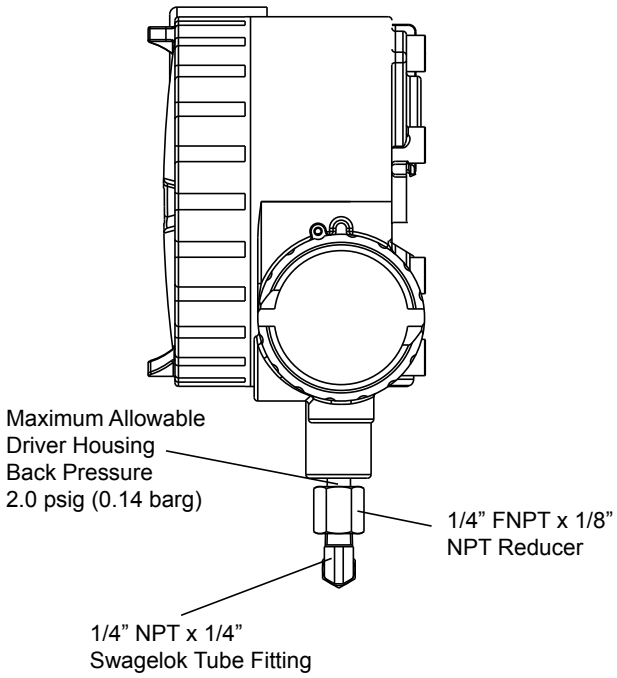
A standard StarPac 3 is vented directly to the atmosphere. When supply air is substituted with sweet natural gas, piping must be used to route the exhausted natural gas to a safe environment. This piping system may cause some positioner back pressure in the main chamber (from the modulator) and spool chamber (from the actuator). Back pressure limitations are described below.

Two chambers must be vented on the StarPac 3: the driver module and the spool valve chamber (Figures 22 and 23). The driver module vent is located on the driver module cover. Install a tube fitting into the driver module cover (Figure 22). Connect the necessary tubing/piping to this fitting to route the exhausted natural gas to a safe environment.

The maximum allowable back pressure from the collection device on the driver module vent is 2.0 psig (0.14 barg). Vent flow rate is 0.5 std ft3/min (1.4 std liter/min).

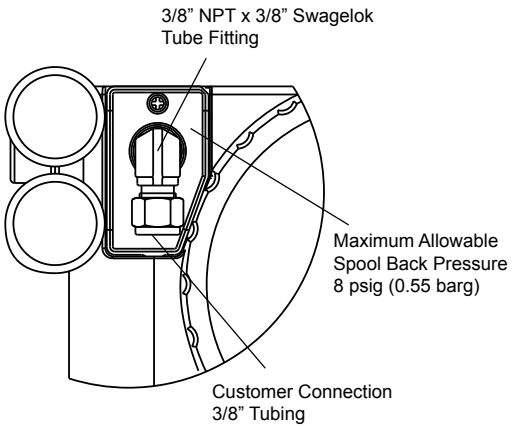
WARNING: The back pressure in the driver module housing must never rise above 2.0 psig (0.14 barg).

Figure 22: Driver Module Vent



The spool valve chamber (see Figure 23) must also be vented through the spool valve cover. Install a tube fitting into the spool valve cover (part no. 179477). Connect the necessary tubing/piping to this fitting to route the exhausted natural gas to a safe environment. The maximum allowable back pressure in the spool valve chamber is 8 psig (.55 barg). Pressures greater than 8 psig will cause vented gas to leak past the spool cover O-ring to the atmosphere and will result in overshoot of the positioner.

Figure 23: Spool Cover Vent

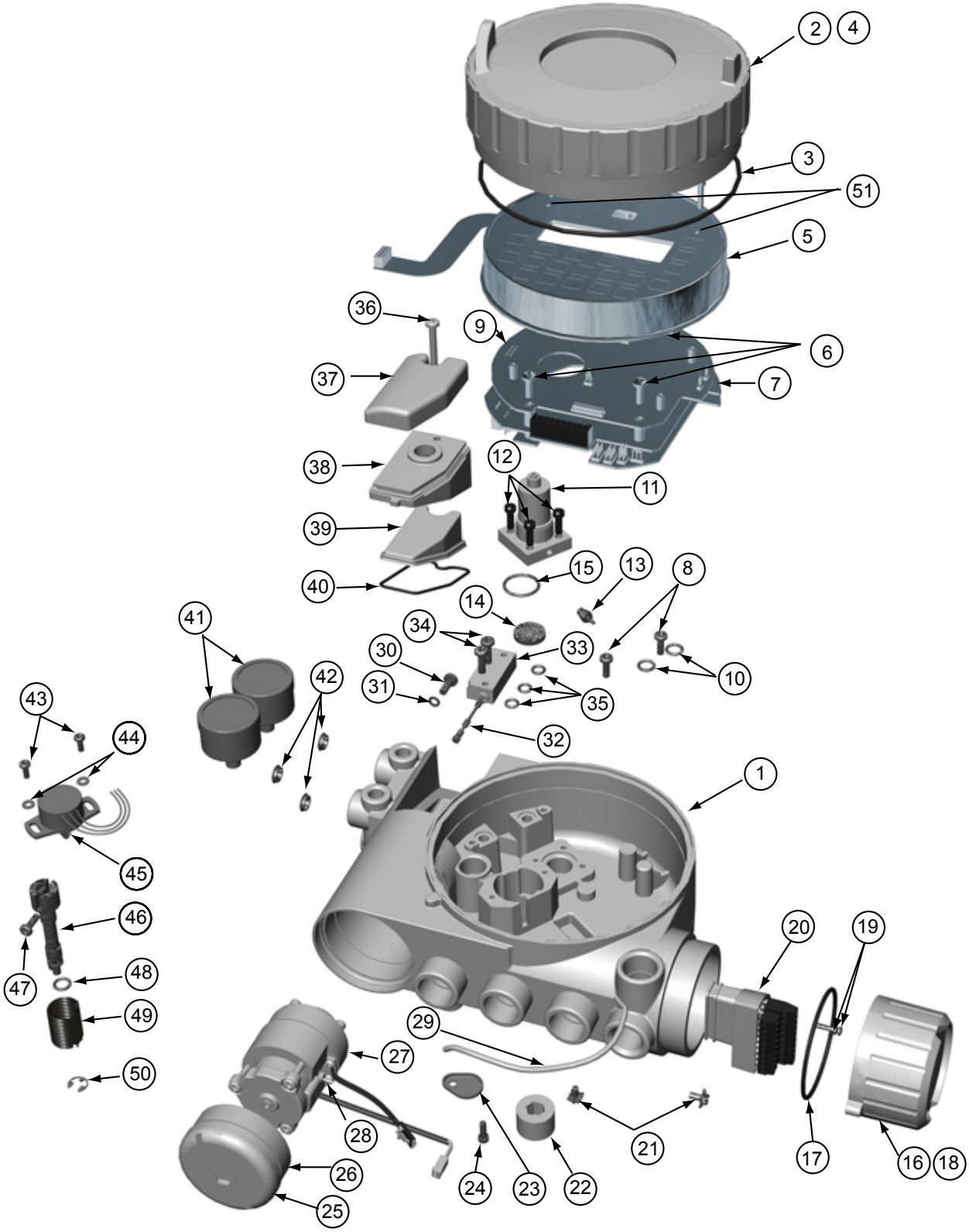


16 Parts List

Table XI: Positioner Parts List

Item No.	Part	Item No.	Part
1	Housing StarPac 3 Positioner	27	Driver Module Assembly
2	Main Housing Cover	28	Hex Barbed Fitting with Captive O-ring
3	O-ring, Main Housing Cover	29	Flexible Tubing
4	Screw, Anti-rotation	30	Screw, Driver to Housing
5	Keypad	31	Nylon Washer
6	Screw, Main PCB to Housing (3)	32	Spool Valve
7	Main PCB Assembly	33	Spool Valve Block
8	Screw, Pressure Sensor Stiffner Board to Housing (2)	34	Screw, Spool Valve to Housing (2)
9	Pressure Sensor Board Stiffener	35	O-ring, Spool Valve (3)
10	O-ring, Pressure Sensor to Housing (2)	36	Screw, Spool Valve Cover
11	Pressure Regulator, 5 to 30 psig (Includes 2 O-rings)	37	Spool Valve Shroud
12	Screw, Regulator Plate to Housing (4)	38	Spool Valve Cover
13	Hex Barbed Fitting with Captive O-ring	39	Hydrophobic Filter, Spool Valve Chamber
14	Internal filter	40	O-ring, Spool Valve Cover
15	O-ring, Interface Plate to Housing Seal	41	Pressure Gauge, 0-160 psig (2)
16	Customer Interface Cover	42	Air Screen (3)
17	O-ring, Customer Interface Cover	43	Screw, Position Feedback Potentiometer to Housing (2)
18	Screw, Anit-rotation	44	Metal Washer (2)
19	Screw, Customer Interface Board (2)	45	Position Feedback Potentiometer
20	Customer Interface Board	46	Feedback Shaft
21	Grounding Screw (2)	47	Screw, Spring to Feedback Shaft
22	Threaded Plug	48	O-ring, Feedback Shaft
23	Main Vent Cover	49	Torsion Spring
24	Screw, Main Vent Cover	50	E-ring
25	Driver Module Cover	51	Screw, Keypad to Main PCB
26	O-ring, Driver Module Cover		

Figure 24: Positioner Exploded View



17 StarPac 3 Spare Parts Kits

Table XII: StarPac 3 Spare Parts Kits

Item No.	Description	Quantity
Kit 1: Driver Module Assembly (Non-vented), P/N 226733.999.000		
11	Pressure Regulator	1
12	Screw, Regulator to Housing	4
27	Driver Module Assembly	1
13	Hex Barbed Fitting w/ Captive O-ring	1
30	Screw, Driver to Housing	1
31	Nylon Washer	1
Kit 2: Driver Module Assembly (Vented), P/N 226736.999.000		
11	Pressure Regulator	1
12	Screw, Regulator to Housing	4
27	Driver Module Assembly	1
13	Hex Barbed Fitting w/ Captive O-ring	1
30	Screw, Driver to Housing	1
31	Nylon Washer	1
Kit 3: Spool Assembly Valve Kit, P/N 226727.999.000		
32	Spool	1
33	Spool Valve Block	1
34	Screw, Spool Valve to Housing	2
35	O-ring, Spool Valve to Housing	3
Kit 4: Pressure Regulator, P/N 215814.999.000		
11	Pressure Regulator	1
12	Screw, Regulator to Housing	4
Kit 5: Feedback Shaft Kit, DD, P/N 199788.999.000		
46	Feedback Shaft	1
47	Screw, Spring to Feedback Shaft	1
48	O-ring, Feedback Shaft	1
49	Torsion Spring	1
50	E-ring	1
Kit 6: Feedback Shaft Kit, Namur, P/N 215805.999.000		
46	Feedback Shaft	1
47	Screw, Spring to Feedback Shaft	1
48	O-ring, Feedback Shaft	1
49	Torsion Spring	1
50	E-ring	1

Item No.	Description	Quantity
Kit 7: Soft Goods Kit, P/N 199789.999.000		
3	O-ring, Main Housing Cover	1
10	O-ring, Pressure Sensor to Housing	2
15	O-ring, Interface Plate to Housing	1
17	O-ring, Customer Interface Cover	1
29	Flexible Tube	1
31	Nylon Washer	1
35	O-ring, Spool Valve to Housing	3
39	Hydrophobic Filter, Spool Valve Chamber	1
40	O-ring, Spool Valve Cover	1
48	O-ring, Feedback Shaft	1
Kit 8: Main PCB Assembly Kit, P/N 234427.999.000		
6	Screw, Main PCB Long	3
8	Screw, Main PCB Pressure Sensor	2
7	Main PCB	1
Kit 9: Keypad Assembly, P/N 234428.999.000		
51	Screw, Keypad to Main PCB	2
5	Keypad	1
Kit 10: Customer Interface Board Kit, P/N 234429.999.000		
19	Screw, Customer Interface to Housing	2
20	Customer Interface Board	1
Kit 11: Position Feedback Potentiometer Kit, P/N 199794.999.000		
43	Screw, Feedback Potentiometer to Housing	2
44	Metal Washer	2
45	Position Feeback Potentiometer	1

18 StarPac 3 Mounting Kits

Table XIII: Flowserve Valtek Linear Mounting Kits

Spud	25 in²		50 in²		100-200 in²	
	Standard	Handwheel	Standard	Handwheel	Standard	Handwheel
2.00	234430	234431	234432	234433		
2.62			164435	164436	164437**	164436
2.88					164437	164438
3.38					164439	164440
4.75					164439	164440

**Live-loading is not available on a 100 in2, 2.62 spud.

Shaft Size	25 in²		50 in²		100-200 in²	
	Standard	Optional	Standard	Optional	Standard	Optional
0.44	135429	135432				
0.63	135429	135437	135430	135433		
0.75	135429	135438	135430	137212		
0.88	135429	135439	135430	137213	135431	135434
1.12			135430	137214	135431	137218
1.50					135431	137216
1.75					135431	137217

*Standard: All rotary valves with standard accessories (end of shaft mount). Optional: All rotary valve with handwheels or volume tanks (linkage design).

19 Pressure Sensor Part Numbers

Table XV: Pressure Sensor Part Numbers

Description	Diaphragm Material 316 Stainless Steel
Pressure sensor, 0-50 PSIA	101577.999.000
Pressure sensor, 0-100 PSIA	101551.999.000
Pressure sensor, 0-300 PSIA	101579.999.000
Pressure sensor, 0-500 PSIA	101564.999.000
Pressure sensor, 0-1000 PSIA	101559.999.000
Pressure sensor, 0-3000 PSIA	101582.999.000
Pressure sensor, 0-5000 PSIA	101583.999.000

20 Pressure Sensor Spare Parts Kits

Table XVI: Pressure Sensor Gasket Kits (See Body Mount Sensor Configurations Drawing and Remote Sensor Configuration for item numbers.

Note: Kits 1 thru 4 will service two body or two remote-mount pressure sensors from any one of the pressure sensor configuration drawing numbers listed below each table.

Item No.	Description	Quantity
Kit 1 - Viton O-ring Replacement Kit, Part No. 134559.999.000		
6	Environmental O-ring, Viton	2
8	Environmental O-ring, Viton	4
10	O-ring seal, Viton	2
20	Environmental O-ring, Viton	2
21	O-ring seal, Viton	2

Applies to Configuration Drawing Numbers: 83883, 83891, 83904, 83884, 83892, 101565, 83887 83900, 127586, 83888, 83901

Item No.	Description	Quantity
Kit 3 - Teflon Gasket Replacement Kit Part No. 134561.999.000		
6	Environmental O-ring, Viton	2
8	Environmental O-ring, Viton	4
10	Teflon gasket seal	2
20	Environmental O-ring, Viton	2
21	Teflon™ gasket seal	2

Applies to Configuration Drawing Numbers: 122513, 127565

Item No.	Description	Quantity
Kit 2 - Spiral Wound Gasket Replacement Kit, Part No. 134560.999.000		
6	Environmental O-ring, Viton	2
8	Environmental O-ring, Viton	4
10	O-ring seal, Viton	2
20	Environmental O-ring, Viton	2
21	Spiral wound gasket seal	2

Applies to Configuration Drawing Numbers: 83938, 83890, 122670, 83886, 83903, 127563, 83899, 127632

Item No.	Description	Quantity
Kit 4 - Kalrez O-ring Replacement Kit, Part No. 134562.999.000		
6	Environmental O-ring, Viton	2
8	Environmental O-ring, Viton	4
10	O-ring seal, Kalrez™	2
20	Environmental O-ring, Kalrez	2
21	O-ring seal, Kalrez	2

Configuration Drawing Numbers: 83885, 83889, 127665, 83893, 83902

Table XVII: Pressure Sensor Hardware Kits

Item No.	Description	Quantity
Kit 5 - Pressure Sensor Connection Kit Configuration, Part No. 134555.999.000		
3	Swagelok nut	2
4	Swagelok ferrules	2
5	Sensor nut	2
6	Environmental O-ring, Viton®	2
7	Division II sensor fitting	2

NOTE: Kit will service two pressure sensors. For class I, Division II, Group A, B, C, & D. See Table XIIX for Tubing.

Item No.	Description	Quantity
Kit 6 - Remote Mount Pressure Sensor Hardware Kit, Part No. 134557.999.000		
3	Swagelok nut	4
4	Swagelok ferrules	4
15	Temperature extended fitting	2
19	Adapter fitting	2

NOTE: Kit will service two remote-mount pressure sensors. See Table XIIX for tubing. (Wet-leg tubing wall thickness must be 0.065-inch).

Item No.	Description	Quantity
Kit 7 - Remote Mount Pressure Sensor Hardware Kit with Purge and Isolation Valves, Part No. 134558.999.000		
3	Swagelok nut	4
4	Swagelok ferrules	4
15	Temperature extended fitting	2
16	Purge valve	2
17	Isolation valve	2
19	Adapter fitting	2

NOTE: Kit will service two remote-mount pressure sensors. See Table XIIX for tubing. (Wet-leg tubing wall thickness must be 0.065-inch).

Item No.	Description	Quantity
Kit 8- Pressure Sensor Electrical Cable Replacement Kit, Part No. 134563.999.000		
1	Electrical connector cable	2
22	Four-pin connector	2
23	Wire crimp terminal	16

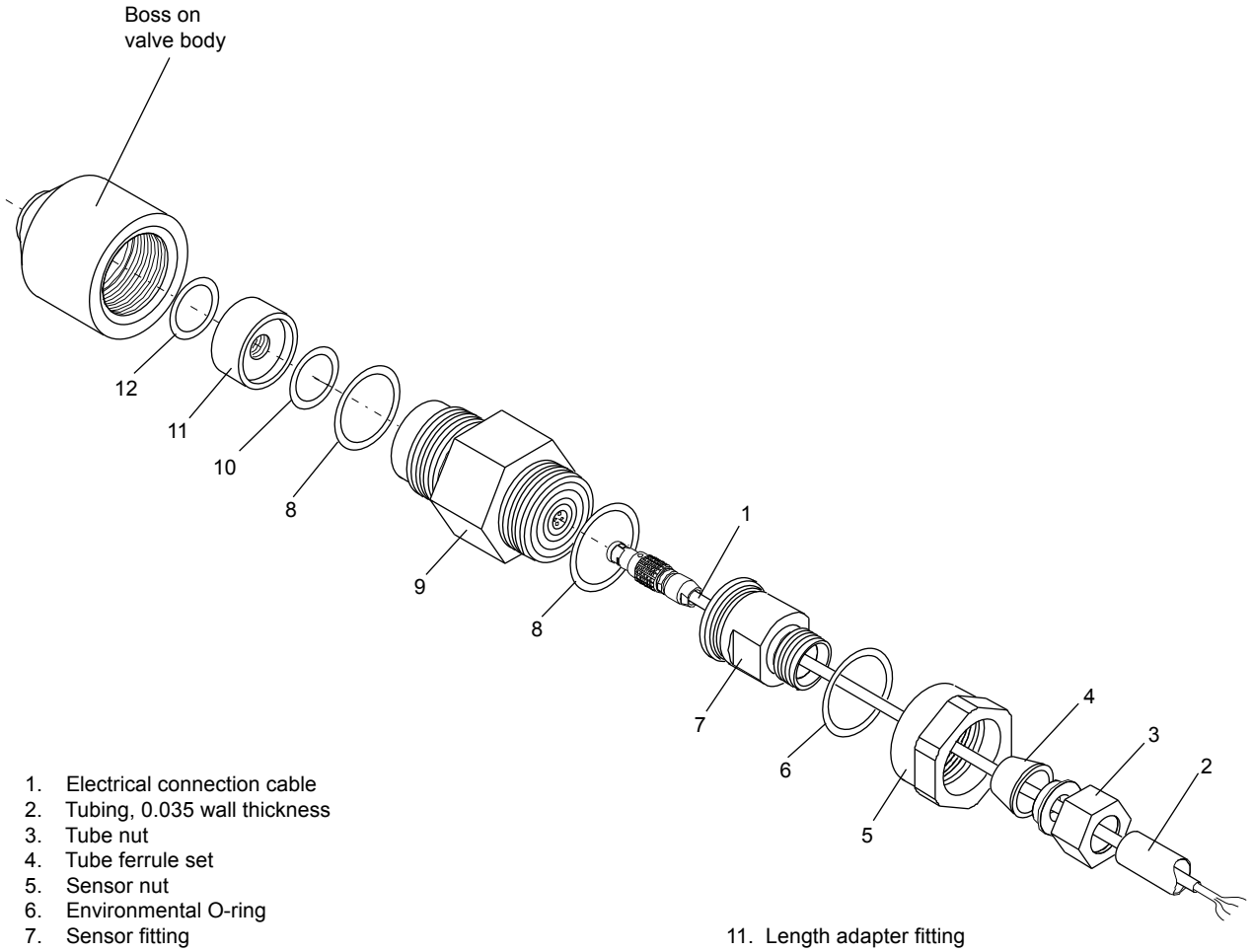
NOTE: Kit will service two pressure sensors.

Description	Quantity
Kit 9 - Pressure Sensor Electrical Extension Cable, Part No. 127645.999.000	
Electrical connector extension cable	1

Description	Quantity
Kit 10 - Pressure Sensor Calibration Kit, Part No. 134564.999.000	
Pressure sensor calibration fixture	1
Electrical connector extension cable	2
O-ring seal, Viton	2

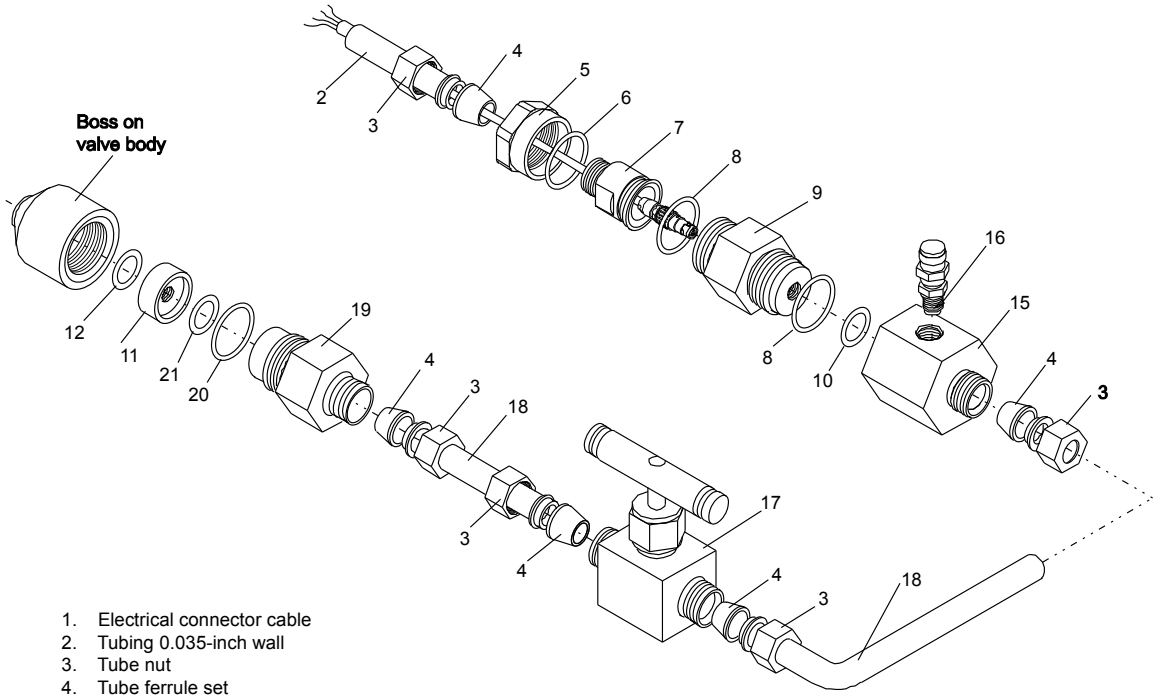
Description	Quantity
Kit 11 - DP Cell Manifold Replacement, 3-Valve, Part No. 134564.999.000	
Valve Manifold	1

Figure 25: Body-mount Sensor Configurations



1. Electrical connection cable
2. Tubing, 0.035 wall thickness
3. Tube nut
4. Tube ferrule set
5. Sensor nut
6. Environmental O-ring
7. Sensor fitting
8. Environmental O-ring
9. Pressure sensor
10. O-ring Seal
11. Length adapter fitting
12. O-ring seal

Figure 26: Remote-mount Sensor Configurations



1. Electrical connector cable
2. Tubing 0.035-inch wall
3. Tube nut
4. Tube ferrule set
5. Sensor nut
6. Environmental O-ring
7. Sensor fitting
8. Environmental O-ring
9. Pressure sensor
10. O-ring seal
11. Length adapter fitting
12. O-ring seal
15. Temperature extended fitting
16. Purge Valve
17. Isolation valve
18. Wet-leg tubing, 0.065-inch wall
19. Adapter fitting
20. Environmental O-ring
21. O-ring seal

21 Temperature Sensor Spare Parts Kits

Table XXVIII: Temperature Probe Kits (See temperature sensor configuration drawing for item numbers.)

Item No.	Description	Quantity
Kit 12 - Standard Temperature Probe Replacement, Configuration, Part No. 083855.999.000		
2	Standard temperature probe	1

Item No.	Description	Quantity
Kit 13 - Through Hole Temperature Probe Replacement, Part No. 105646.999.000		
2	Through hole temperature probe	1

22 StarPac 3 Stainless Steel Tubing Kits

Figure 27: StarPac 3 Temperature Sensor, Flush-mount Version

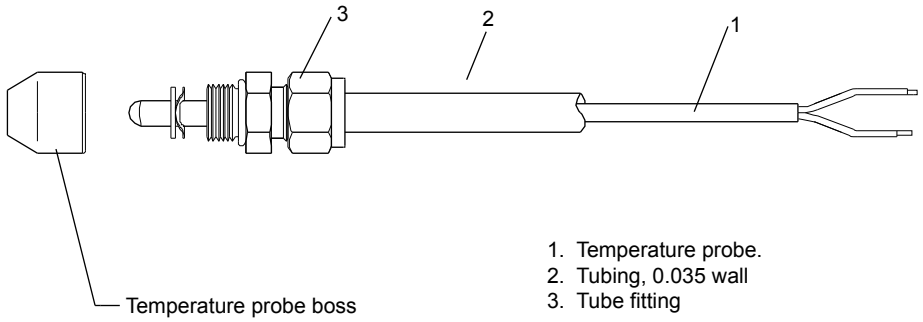


Table XXIX: 316 Stainless Steel Tubing

Description	Number
Pressure sensor wire tubing (0.50-inch diameter 0.035-inch thick)	063200.150.000
Extended temperature wet leg tubing (0.50-inch diameter 0.065-inch thick)	083565.150.000
Thermocouple tubing (3/8-inch diameter, 0.035-inch thick)	007537.150.000

NOTE: On remote mount pressure sensor configurations, the wet-leg tubing must have a wall thickness of 0.065” or 0.083” depending on the pressure/temperature of the process.

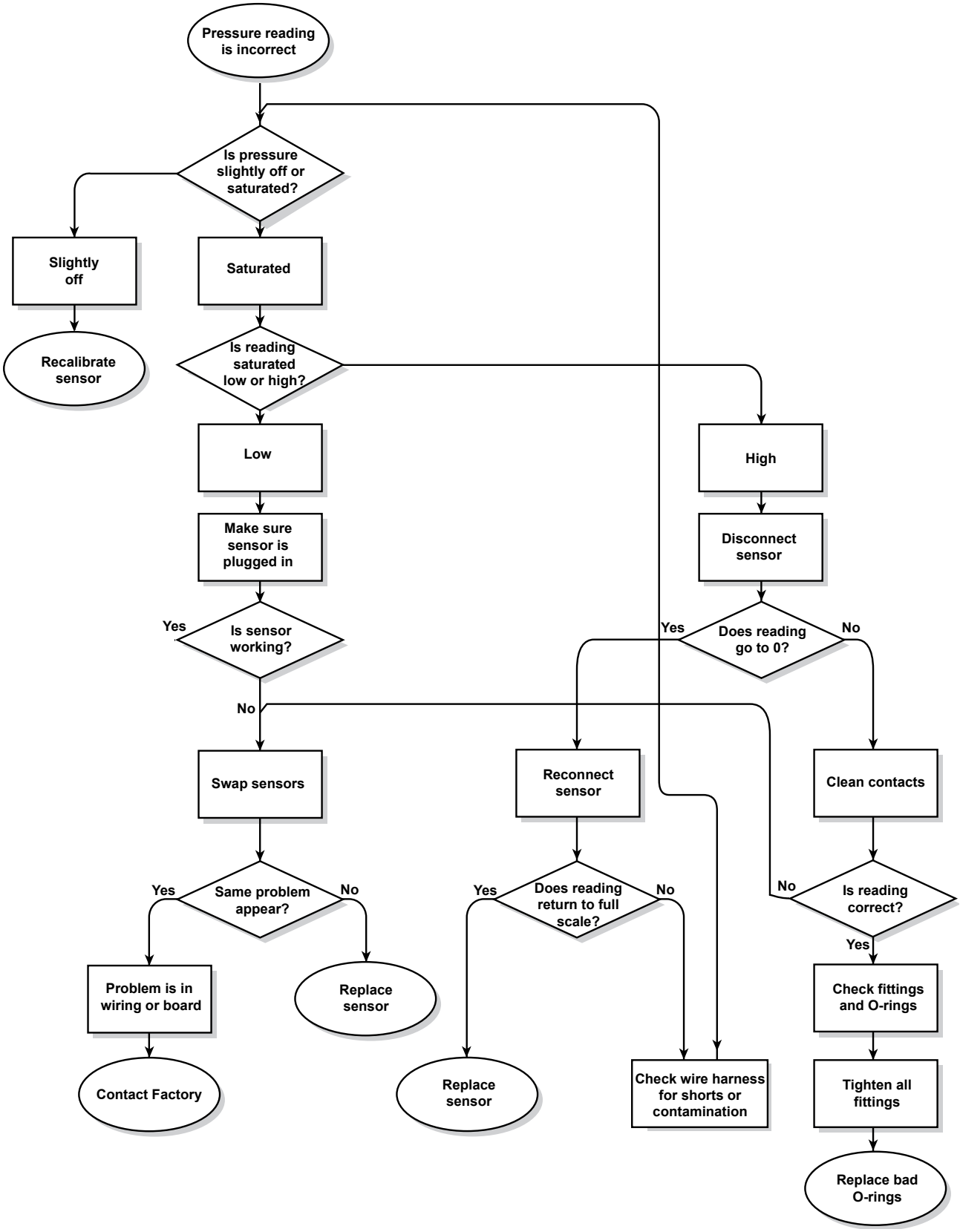
23 StarPac 3 System Troubleshooting

Table XXX: StarPac 3 System Troubleshooting Chart

Failure	Probable Cause	Corrective Action
Local display not on	24 VDC not on or set correctly	Verify power supply is outputting 24 VDC (terminals 1 and 10)
	Incorrect wiring polarity	Check wiring for correct polarity
	Interface connections on bottom are not correct	Make sure connections are correctly aligned and fully plugged in
Erratic communications	Multiple units have same address on network line	Change each unit to a unique, sequential address (refer to Address Setting in Maintenance section)
	Proper polarity not maintained	Check all network connections for correct positive and negative connections
	Individual units not properly wired	Begin with shortest RS-485 run, checking polarity and communication; continue checking units throughout network
	Termination jumpers not installed	Install termination jumper on two most distant devices. Remove jumper from all other devices
The unit does not respond to analog commands	Unit still in initialize mode	Put unit in operation mode. Select analog input
StarPac 3 data is not correct	Improper configuration file was loaded onto system	Find the correct file for this system and load onto the unit
Valve position reading is not correct	Stroke not calibrated	Calibrate valve stroke
Sticking or hunting operation of the positioner	Contamination of the spool valve Assembly	Check air supply for proper filtering and meeting ISA Specification S7.3. Clean spool valve assembly with a non residue cleaner.

24 StarPac 3 Pressure Sensor Troubleshooting

Figure 28: StarPac 3 Pressure Sensor Troubleshooting Chart



25 StarPac 3 Electronics Initialization Procedure

The StarPac 3 has an initialize interlock feature. Every time power is cycled the unit will not return to normal operation, but will be interlocked out in TEST mode until the unit is manually put back into operation. The non-volatile RAM is not cleared, or affected, by this operation. The StarPac 3 has a set of contacts located on the back of the main PCB board assembly marked Init. When a jumper is placed on these pins, it will cause the initialization to occur. To manually put the valve back into operation, use the Load Backup feature from the keypad.

An initialization can also be performed by holding down the ZERO (0) key while applying power to the StarPac 3. Table XXXI outlines the procedure required to perform the initialization and it contains a list of parameters that are affected by the initialization.

Table XXXI: Initialization Procedure

StarPac 3 Electronics Initialization Procedure
To re-initialize the electronics: 1. Turn **OFF** the 24V power. 2. Press and hold down the ZERO (0) key on the keypad while turning the 24V power **ON** 3. Release the key after the display has booted and is active (approx. 5 seconds) The following conditions are set upon re-initialization. Those items that have been previously configured by the user may need to be reconfigured when the unit is put back into operation:

• Watchdog timer is reset	• Flow Totalizer Source = Liquid
• Mode source is set to Digital	• Communications is set to 19200 baud, Odd parity, RTU mode
• Data Logger is disabled	• 3.5 character delay time
• Test mode is set	• Communication Port B is set to Infrared
• Process variable = Liquid Flow	• Modbus address is set to 1
• Command source = Analog	• Communication Ports A & B set to R/W
• Positioner Source = Normal	• LCD Contrast = 117
• Actuator type = Linear	• LCD Backlight = 60 seconds
• Analog Command = Normal	• External Variables for flow calculation disabled
• Positioner Characterization is disabled	• LCD display status reset. Row 1 = Mode/ Status Row 2 = Scan
• Analog Feedback = Position	• Travel accumulator reset to 0
• PID action = Normal	• Cycle counter reset to 0
• Air Action = Air-To-Open	• Step size in Position StepTest Changed to 0
• Flow Totalizer is reset	• Autotune = Disabled
• Tune Switch Position = Position E	• Stablewise = Disabled & Unlocked
• AGA 8 = Disabled	• Stablewise Lock % = 1.0%
• Keypad Password = 1234	• Stablewise Unlock % = 2.0%

26 How to Order

Table XXXII: How to order Positioner Replacement

Selection		Code	Example
		SP	SP
Model	StarPac 3	3	3
Communication	Modbus	M	M
Housing Material	Aluminum, white paint (Valtek)	0	0
	Stainless, No paint (Valtek)	1	
Certifications	General Purpose	14	14
	$_{C}CSA_{USA}$ Class I, Div 2, Groups A,B,C,D	30	
	Explosionproof FM Class I, Div 1, Groups B,C,D	31	
Feedback Shaft	DD Shaft - 316 SS (Valtek Standard)	D6	D6
	Namur Shaft - 316 SS (VDI/VDE 3845)	N6	
Conduit Connections	1/2˝ NPT	E	E
	M20	M	
Action	Four-way (Double-Acting)	04	04
	Three-way (Single-Acting)	03	
	Four-way Vented (Double-Acting)	4V	
	Three-way Vented (Single-Acting)	3V	
Gauges	Gauges (Valtek Standard)	0G	0G
	Stainless Steel Gauges	0S	
	SS with brass internals, psi (kg/cm2)	KG	
	SS with SS internals, psi (kg/cm2) KS	KS	
	No Gauges	0U	
Special Options	No Specials	00	00
	Fail open, feedback spring bias	SF	

Flowserve Headquarters
5215 N. O'Connor Blvd., Suite 2300
Irving, TX 75039
Telephone: 972 443 6500

Control Valve Manufacturing
1350 Mountain Springs Parkway
Springville, UT 84663-3004 USA
Telephone: 1 801 489 8611
Fax: 1 801 489 3719

Singapore
12 Tuas Ave. 20, 638824
Republic of Singapore
Telephone: +65 862 3332
Fax: +65 862 4940

Austria
Kasernengasse 6
Villach Austria 9500
Telephone: +43 0 4242 41181 0
Fax: +43 0 4242 41181 50

Australia
14 Dalmore Dr.
Scoresby, Victoria, Australia 3179
Telephone: +61 3 9759 3300
Fax: +61 3 9759 3301

China
585, Hanwei Plaza
7 Guanghua Road
Beijing, China 100004
Telephone: +86 10 6561 1900

FCD VLENIM0066-02 02/10 Printed in USA.

To find your local Flowserve representative:

For more information about Flowserve Corporation, visit www.flowserve.com or call USA 1 800 225 6989