MASONEILAN SVI®

EW2000

01/99

SMART VALVE INTERFACE

Digital Positioner and Controller

INSTRUCTION MANUAL

DRESSER VALVE DIVISION

TABLE OF CONTENTS

Diagrams

Tables

Use of **DANGER, WARNING, CAUTION**, and **NOTE**.

These instructions contain **DANGER**, **WARNING**, **CAUTION**, and **NOTE** where necessary to alert you to safety related or other important information.

DANGER - Hazards which result in severe personal injury or death.

WARNING - Hazards which could result in personal injury.

CAUTION - Hazards which could result in equipment or property damage

NOTE - Alerts you to pertinent facts and conditions

Although **DANGER** and **WARNING** hazards are related to personal injury, and the **CAUTION** hazards involve equipment or property damage, it should be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process system performance which may lead to personal injury or death. Therefore, comply fully with all **DANGER, WARNING**, and **CAUTION** notices.

IMPORTANT: SAFETY WARNING

Please read these instructions carefully **BEFORE** this instrument is installed or maintained.

These positioners and controllers are intended for use with industrial compressed air systems only. Ensure that adequate pressure relief provision is installed if application of system supply pressure could cause downstream equipment to malfunction. Installation should be in accordance with local and national compressed air and instrumentation codes.

Products certified for use in explosionproof / flameproof or intrinsically safe installations MUST:

a) Be installed in accordance with local and national codes for hazardous area installations.

b) Only be used in situations which comply with the certification conditions stated in this handbook.

c) Only be maintained by qualified personnel with adequate training on hazardous area instrumentation.

Before using these products with fluids other than air or for non-industrial applications, consult Dresser Masoneilan. Not intended for use in life support systems.

Items sold by Dresser Masoneilan are warrantied to be free from defects in materials and workmanship for a period of one year from the date of shipment, provided said items are used according to Dresser Masoneilan's recommended usages.

Dresser Masoneilan reserves the right to discontinue manufacture of any product or change product materials, design, or specifications without notice.

Chapter 1 - Overview

Scope of Manual

This manual describes the procedures for installing,configuring, calibrating, operating and troubleshooting the Masoneilan® Smart Valve Interface (SVI®) Positioner and Controller. A companion software product, ValVue®, can be used to configure, calibrate, and perform valve diagnostics with the SVI from a remote Windows-based computer. In addition, SVI can be configured, calibrated and perform valve diagnostics with a HART hand-held communicator.

Product Description

The Smart Valve Interface, as shown in Figure 1, is a digital valve positioner and/or process controller that can be either configured, calibrated, and operated locally or remotely. Local functions are controlled by means of local pushbuttons and digital display. Remote operation requires the use of the ValVue product, or a hand-held unit loaded with the registered HART Device Description (DD).

The SVI controller version can also function as a single-loop PID controller which accepts standard inputs for process variable and set point. It positions the valve to achieve the desired value of the process variable. The Controller version can be configured as either a positioner or controller; however entering of some of the controller parameters requires use of either ValVue software or a HART protocol hand-held unit.

ValVue, the software for remote communication of the SVI, runs on standard IBM-compatible computers such as 486 or Pentium. Minimum requirements are 4 MB RAM, Windows 3.1 or better, one available serial port with a HART® modem, and a hard disk drive. The basic functions performed by ValVue are:

- Remote display of valve position, actuator pressure, set point, calibration parameters, con figuration parameters, and status/error indicators
- Remote calibration of the SVI
- Remote configuration of the SVI
- Remote operation of the SVI
  - Manual control of valve position
  - Perform valve diagnostics and display results (signature, friction, stroking speed, cumulative travel, cycles, and operation in near-closed position)
  - Recall previous test results for comparison with current data

For more details on ValVue software, refer to the ValVue Users Manual.

These remote functions can also be performed with a hand-held unit, however, the handheld unit cannot display graphical representation of the diagnostics.

Figure 1. Smart Valve Interface

SVI Features and Functions

- Precision valve positioning control
- Advanced valve diagnostics
- Automatic setup and tuning
- Local operation/calibration/configuration using optional explosionproof pushbuttons and digital display
- Two-way data communication using industry-standard HART protocol
- Remote operation/calibration/configuration/diagnostics using ValVue software or a HART hand-held
- User-configurable tight shutoff adjustment
- Optional PID controller with remote set point and process variable input
- User-adjustable response times
- Direct or reverse acting operation
- Compatible with air-to-close or air-to-open actuators
- Span and zero configurable for split-range operation
- Local operation functions include:
  - Calibrate valve stroke range, tight shutoff point, position limit stops
  - Display and/or set parameters for valve configuration
  - Select characterization (linear, equal percentage 50, equal percentage 30, quick opening, or custom)
  - Display/clear fault codes
- Display valve position
- Display faults
- Remote operation functions include all of the above plus:
  - Display totalized stem travel, number of valve cycles and other data useful for predicting valve life
  - Run valve diagnostics

Performance Specifications

Table 1. Performance Specifications (Positioner Mode Only)

CAUTION: Do not exceed operative limits. This may cause damage and/or performance of the positioner or controller.

Item	Specification
Positioner Inputs	4-20 mA signal input with HART protocol.
Split Range Capabilities	Programmable zero and span adjustments, 5 mA minimum span.
Minimum Current for Operation	3.6 mA operating minimum.
Compliance Voltage	12 volts maximum loop voltage drop in mA mode (typical 10.5 volts).
Digital Communication	HART ® Communication protocol signal from ValVue® software on personal computer or from HART Hand-held Communicator. HART slave and burst modes multidrop, up to 5 loops with 20 volts minimum at SVI. 4 mA load at 20 volts.
Controller (Process Variable) Input	Nominally 1-5 volts or 4-20 mA with a 250 Ohm resistor.
Local Display - Liquid Crystal (optional)	One seven character line of 14 segment alpha numeric. One six character line of 7 segment numeric. 22 segment bar graph.
Push Button	Three (3) explosionproof / flameproof push buttons.
Limit Switch Input	Two SPST with common. Cold contacts. Non isolated.
Remote Position Sensing	10 K Ohms potentiometer.
Accuracy	Total accuracy 0.5% of span (typical 0.25%).
Linearity (conformity)	< 0.2% (typical 0.1%).
Hysteresis Plus Deadband	< 0.2% of span (typical 0.1%).
Actuator Pressure Measurement Accuracy	< 0.3% of full scale.
Start-Up Drift	Less than 0.02% during first hour.
Long Term Drift	Less than 0.003% per month
Supply Pressure	20-100 psi (1.4 - 7 bar)
Air Delivery at 60 PSI	25 cubic meters / hour (15 SCFM)
Air Consumption	0.4 cubic meters / hour (7SLPM)

Table 1. Performance Specifications (cont.)

Item	Specification
Operating Temperature Limits	- 40° C to 80° C
Storage Temperature Limits	- 45° C to + 93° C
Temperature Effect	< 0.01% / degree C typical.
Supply Pressure Effect	0.05% psi
Relative Humidity	0 to 100%
Humidity Effect	Less than 0.2% after 2 days at 40° C, 95% RH.
Insulation Resistance	Greater than 10 G Ohms at 50% RH.
MTBF	50 years based on MIL handbook calculation for electronic parts and field data on mechanical parts.
Electromagnetic Compatibility	Electrostatic discharge -- No effect with contact discharge level of 4KV and air discharge level of 8 KV (IEC 1000-4-2). Radio frequency interference -- Less than 0.2% at 10 volts per meter (EN 50140).
Fast Transient Burst	No effect at 2 KV (Coupling clamp IEC 1000-4-4).
Magnetic Field	Negligible at 30 A/m (EN61000-4-8). EC MARK certified to EN50081-2 and EN50082-2.
Connections: Pneumatic - Electrical -	1/4 inch NPT Two (2) 1/2 inch NPT or M20
Enclosure Rating	IP 65, NEMA 4X. Suitable for coastal environment, atmosphere with acids, atmosphere with dust (fly ash).
Position Travel Limits	Rotary: 18 to 100 degrees (short travel version 9 - 50 degrees). Reciprocating: 12 to 64 mm, 0.5 to 4.5 inches. Short travel version 6 to 32 mm, 0.25 to 1.25 inches. Above 64 mm consult factory for mounting.
Flow Characterization	Linear Equal percentage (50:1 or 30:1) Quick opening (inverse of 50:1 equal percentage) User configurable for 10 segments Tight Shut-off (0 - 20% of input)

Table 1. Performance Specifications (cont.)

Item	Specification
Positioner Auto Tune	SVI performs an automatic determination of the optimal valve position control parameters. In addition to P, I, D, the position algorithm uses damping, symmetry for exhaust and fill time constants, dead zone and magnitude characterization parameters. Auto Tune is optimized for 5% step changes with negligible overshoot. After the Auto Tune process is completed the user can further adjust the positioner tuning parameters to more conservative or to more responsive values to produce various dynamic response to the control signal. Proportional gain: 0 to 5000% Integral time: 0 to 1000 seconds Derivative: 0 to 200 seconds Dead Zone: 0 to 1% (0 to 2% deadband) Padj: +/- 3000 (depends on P) NL Coefficient: -8 to -9 Damping: 0 to 9 Full open position*: 60 to 100% * (if not at stop)
Action	Direct, increasing signal increases output. Reverse, increasing signal decreases output (software or hardware reversible).
Instrument Air	Best performance is obtained with supply pressure regulated 5 to 10 psi higher than spring range of actuator. Air quality requirement per ISA S7.3.
Vibration Limits Measured at the SVI Housing	4 mm at 5 to 15 Hz -- negligible. 2 G at 15 to 150 Hz -- less than 2% of span. 1 G at 150 to 2000 Hz -- less than 2% of span.
Shock Limit	5 G
Security	Timeout of hardware watchdog timer clamps output to failsafe condition and initiates CPU reset. Timeout of software (microprocessor COP) watchdog timer initiates CPU reset. Pushbuttons include four levels of authorization. Level is set using ValVue or HART hand-held controller. ValVue includes six levels of authorization. Password protected.
Positioner Alarms	Hi / Low limits (not latched) Deviation * time (not latched) Deviation* time (latched, initiates failsafe) Failsafe Unread status messages

Table 1. Performance Specifications (cont.)

Item	Specification
Controller Alarms	Programmable Hi / Lo process alarms 0 to 100%, absolute or deviation
Process Controller Functions	Local setpoint, remote setpoint, manual. Ratio control with setpoint bias Local setpoint tracking.
Process Controller Settings	Output rate limit: 0 to 61% per sampling period. Manual reset: 0 to 90%. Proportional gain: 0 to 1,000% Integral time: 0 to 1,000 seconds Derivative time: 0 to 32 seconds Derivative gain: 2 to 100 Gain non-linearity: - 9 to 9 Dead zone: 0 to 20% Hi/lo set point limits: 25% above hi PV or below low PV.
Status Messages	POSITION ERROR PRESSURE ERROR POSITION SENSOR ERROR PRESSURE SENSOR ERROR CURRENT SENSOR ERROR REFERENCE VOLTAGE ERROR BIAS OUT OF RANGE SELF CHECK FAILURE HART ERROR SOFTWARE ERROR RESET OCCURRED DATA OVERRUN INTERNAL TEMP ERROR EEPROM WRITE FAILED FIND STOPS FAILED
Diagnostics Stored in SVI Non-Volatile Memory (can be accessed using a HART Hand-held Communicator or ValVue Software).	Friction (in units of pressure) Lo spring (in units of pressure) Hi spring (in units of pressure) Lo pressure (full exhaust) Hi pressure (full supply) Time to open Time to close Time open Time closed Time near closed Reversals (cycles) Total accumulated stem travel
Diagnostics Plots Using ValVue	Position vs. time Stem position vs. actuator pressure Stem position vs. position setpoint Process, process setpoint, position, position setpoint vs. time (90 second window)

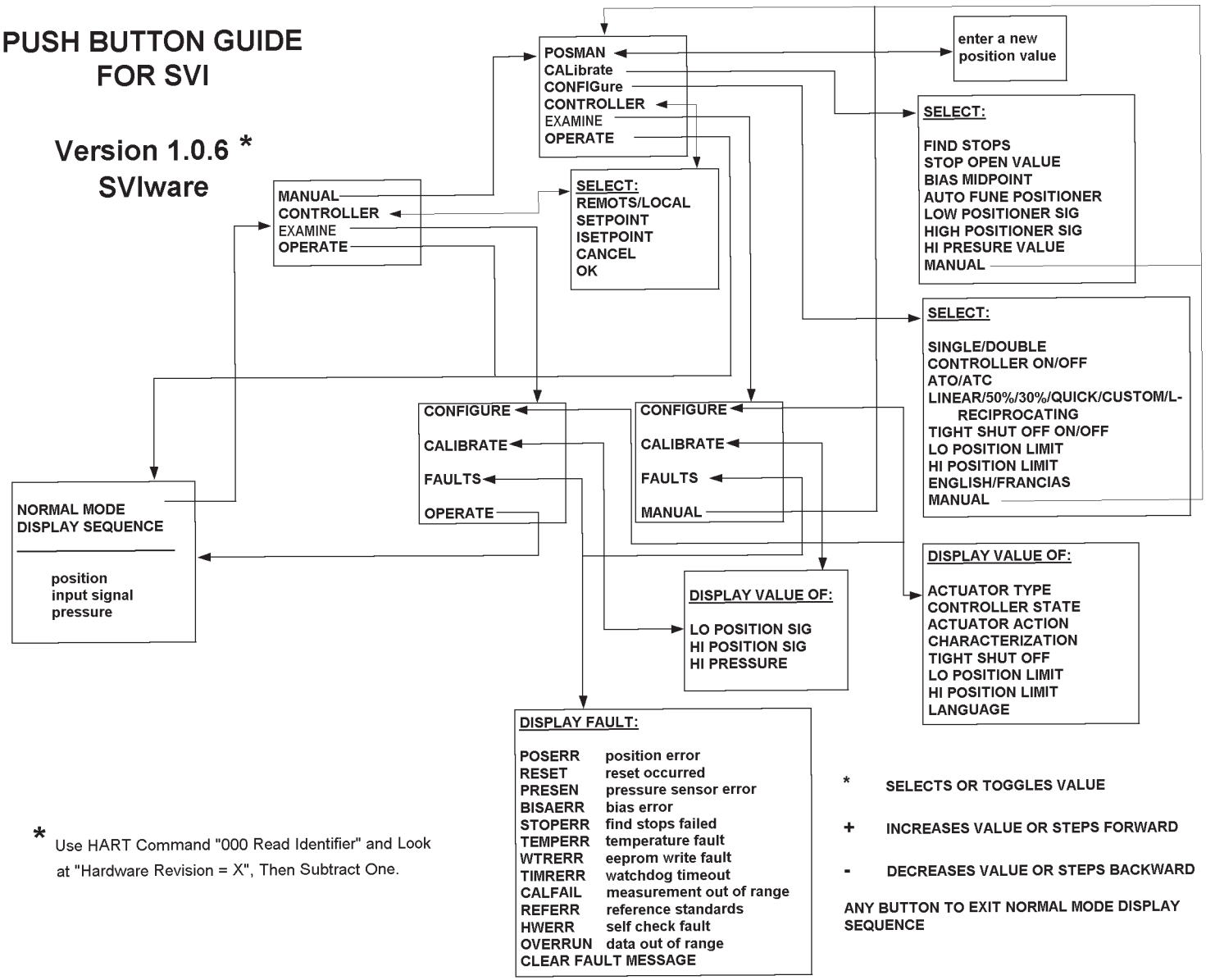
Electrical Safety Specifications

Table 2. Electrical Safety Design Specifications

Agency	Service	Applicable Class
Factory Mutual Approvals	Explosionproof	Class I, Division 1, Groups B, C, and D
	Dust-ignitionproof	Class II, III, Division 1, Groups E, F, and G
	Intrinsically Safe	Class I, II, III, Division 1, Groups A, B, C, D, E, F, and G
	Non-incendive	Class I, Division 2, Groups A, B, C, and D
	Suitable for	Class II, III, Division 2, Groups F and G
	Enclosure Rating	NEMA 4X
CSA Approvals	Explosionproof	Class I, Division 1, Groups B, C, and D
	Dust-ignitionproof	Class II, III, Division 1, Groups E, F, and G
	Intrinsically Safe	Class I, II, III, Division 1, Groups A, B, C, D, E, F, and G
	Non-incendive	Class I, Division 2, Groups A, B, C, and D
	Suitable for	Class II, III, Division 2, Groups F and G
	Enclosure Rating	Type 4X
CENELEC Approvals	Flameproof	EEx d IIB + H2 T5 (ambient temp. not to exceed 80°C) per EN 50014 and EN 50018
	Intrinsic Safety	EEx ia IIC T4 (ambient temperature not to exceed 80°C) per EN 50014 and EN 50020
	Enclosure Rating	IP 65 per EN 60529
CE Conformity		Yes

PUSH BUTTON GUIDE FOR SVI

Version 1.0.6 *
SVIware



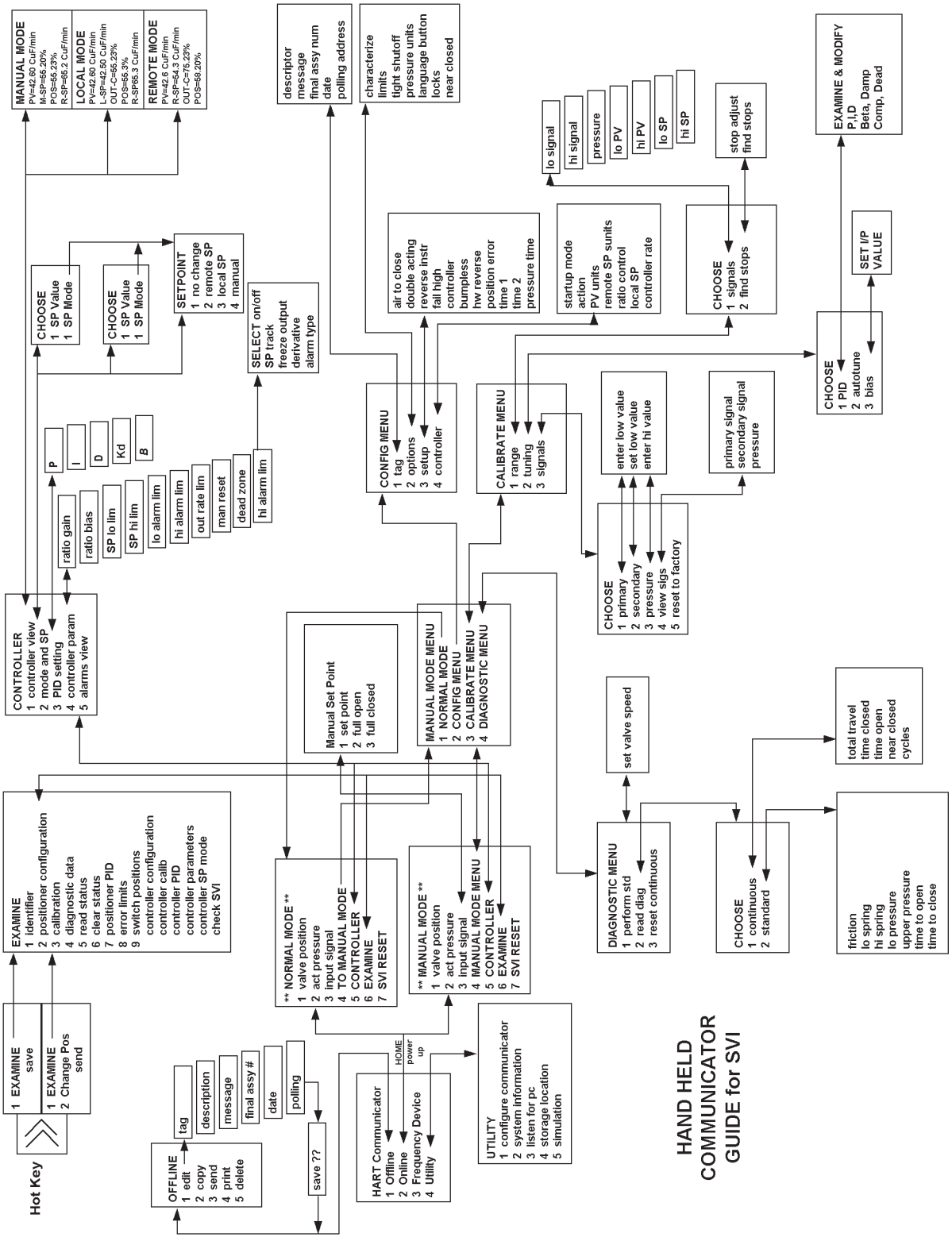
* Use HART Command "000 Read Identifier" and Look at "Hardware Revision = X", Then Subtract One.

* SELECTS OR TOGGLES VALUE

\+ INCREASES VALUE OR STEPS FORWARD

\- DECREASES VALUE OR STEPS BACKWARD

ANY BUTTON TO EXIT NORMAL MODE DISPLAY SEQUENCE


HAND HELD
COMMUNICATOR
GUIDE for SVI
Hot Key
1 EXAMINE save
1 EXAMINE
2 Change Pos send
EXAMINE
1 identifier
2 positioner configuration
3 calibration
4 diagnostic data
5 read status
6 clear status
7 positioner PID
8 error limits
9 switch positions
controller configuration
controller calib
controller PID
controller parameters
controller SP mode
check SVI
OFFLINE
1 edit
2 copy
3 send
4 print
5 delete
tag
description
message
final assy #
date
polling
save ??
HART Communicator
1 Offline
2 Online
3 Frequency Device
4 Utility
HOME
power up
UTILITY
1 configure communicator
2 system information
3 listen for pc
4 storage location
5 simulation
CONTROLLER
1 controller view
2 mode and SP
3 PID setting
4 controller param
5 alarms view
ratio gain
ratio bias
SP lo lim
SP hi lim
lo alarm lim
hi alarm lim
out rate lim
man reset
dead zone
hi alarm lim
P
I
D
Kd
B
CHOOSE
1 SP Value
1 SP Mode
CHOOSE
1 SP Value
1 SP Mode
SETPOINT
1 no change
2 remote SP
3 local SP
4 manual
SELECT on/off
SP track
freeze output
derivative
alarm type
MANUAL MODE
PV=42.60 CuF/min
M-SP=66.20%
POS=66.23%
R-SP=66.2 CuF/min
LOCAL MODE
PV=42.60 CuF/min
L-SP=42.60 CuF/min
OUT-C=66.23%
POS=65.3%
R-SP66.3 CuF/min
REMOTE MODE
PV=42.6 CuF/min
R-SP=64.3 CuF/min
OUT-C=76.23%
POS=68.20%
descriptor
message
final assy num
date
polling address
characterize
limits
tight shutoff
pressure units
language button
locks
near closed
** NORMAL MODE **
1 valve position
2 act pressure
3 input signal
4 TO MANUAL MODE
5 CONTROLLER
6 EXAMINE
7 SVI RESET
** MANUAL MODE **
1 valve position
2 act pressure
3 input signal
4 MANUAL MODE MENU
5 CONTROLLER
6 EXAMINE
7 SVI RESET
Manual Set Point
1 set point
2 full open
3 full closed
MANUAL MODE MENU
1 NORMAL MODE
2 CONFIG MENU
3 CALIBRATE MENU
4 DIAGNOSTIC MENU
CONFIG MENU
1 tag
2 options
3 setup
4 controller
air to close
double acting
reverse instr
fail high
controller
bumpless
hw reverse
position error
time 1
time 2
pressure time
CALIBRATE MENU
1 range
2 tuning
3 signals
CHOOSE
1 primary
2 secondary
3 pressure
4 view sigs
5 reset to factory
enter low value
set low value
enter hi value
primary signal
secondary signal
pressure
startup mode
action
PV units
remote SP sunits
ratio control
local SP
controller rate
lo signal
hi signal
pressure
lo PV
hi PV
lo SP
hi SP
CHOOSE
1 signals
2 find stops
stop adjust
find stops
EXAMINE & MODIFY
P,I,D
Beta, Damp
Comp, Dead
CHOOSE
1 PID
2 autotune
3 bias
SET I/P
VALUE
DIAGNOSTIC MENU
1 perform std
2 read diag
3 reset continuous
set valve speed
CHOOSE
1 continuous
2 standard
total travel
time closed
time open
near closed
cycles
friction
lo spring
hi spring
lo pressure
upper pressure
time to open
time to close

Principle of Operation

When configured as an electropneumatic valve positioner, (Figure 2) the SVI accepts a 4-20 mA current signal from a controller or other device,(i.e. HART protocol digital signal) and compares the input signal to the valve position. The difference between the input and position feedback is conditioned by the position control algorithm and converted to a pneumatic signal. This signal is boosted by a pneumatic relay and drives the actuator. When the valve position agrees with the value called for by the position setpoint input signal, the system stabilizes with no further movement of the actuator.

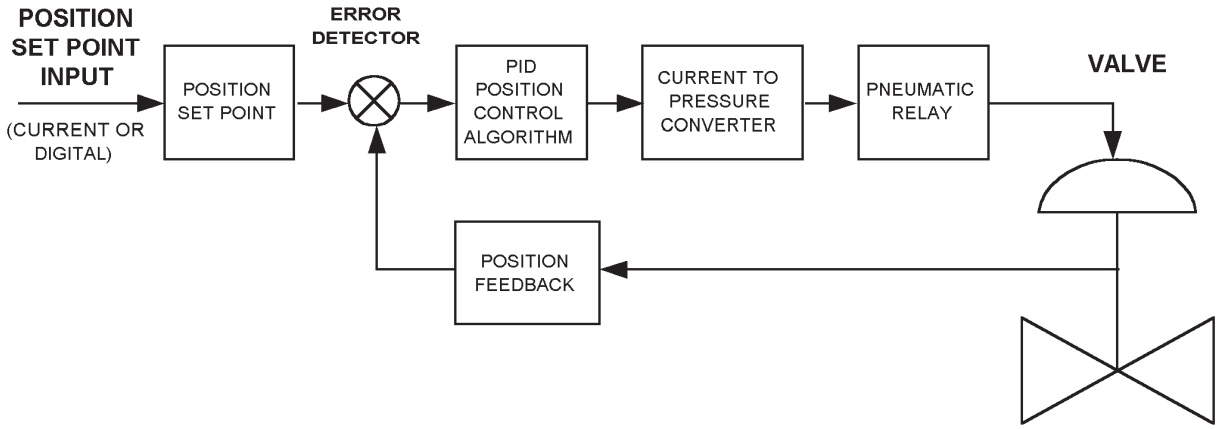


Figure 2. Block Diagram of SVI Positioner

When configured as a PID controller, (Figure 3) the SVI accepts a local control setting, (4-20 mA signal or a HART communications protocol signal). The primary process measurement made by the process transmitter is fed to the controller as a voltage signal of 1 to 5 V dc. The difference between the set point and process measurement is conditioned by both the PID controller algorithm and position control algorithm and converted to a pneumatic signal. This signal is boosted by a pneumatic relay and drives the actuator. When primary measurement and set point signals agree there is no further movement of the actuator and system is in stable control.

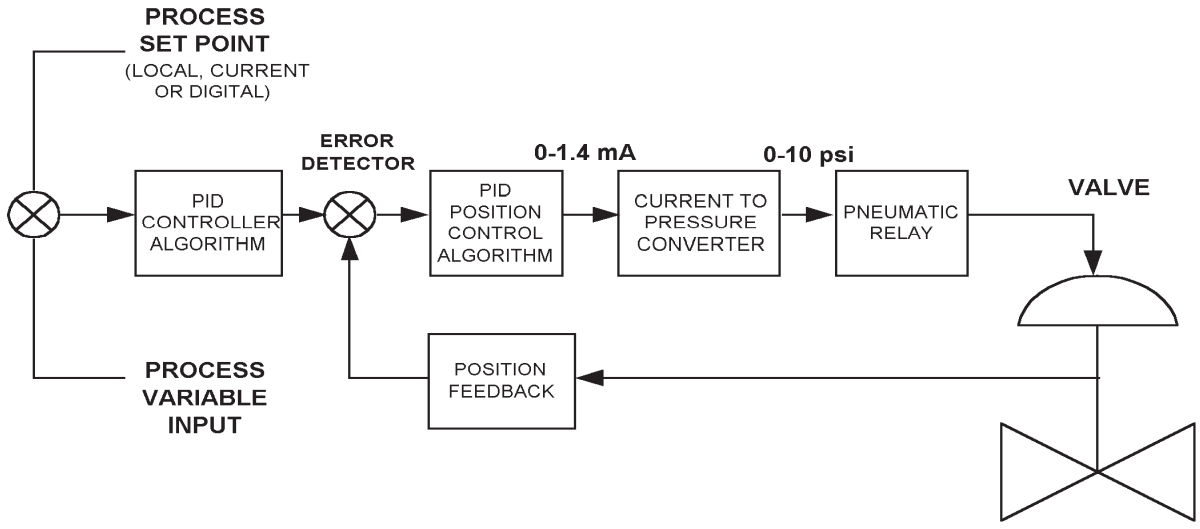


Figure 3. Block Diagram of SVI Controller/Positioner

Hardware Description

The SVI is housed in a rugged, weatherproof, corrosion resistant aluminum housing which has been designed for operation in hazardous areas as listed in Table 2.

Two 1/2 NPT conduit entries and three 1/4 NPT pneumatic ports provide signal connections to the SVI.

Within the housing are the following components interconnected as shown in Figure 3a, "SVI Block Diagram".

- Electronics Module
- Display and Pushbuttons
- Electropneumatic Converter (EPC)
- Spool Valve
- Sensors (position, pressure and temperature)

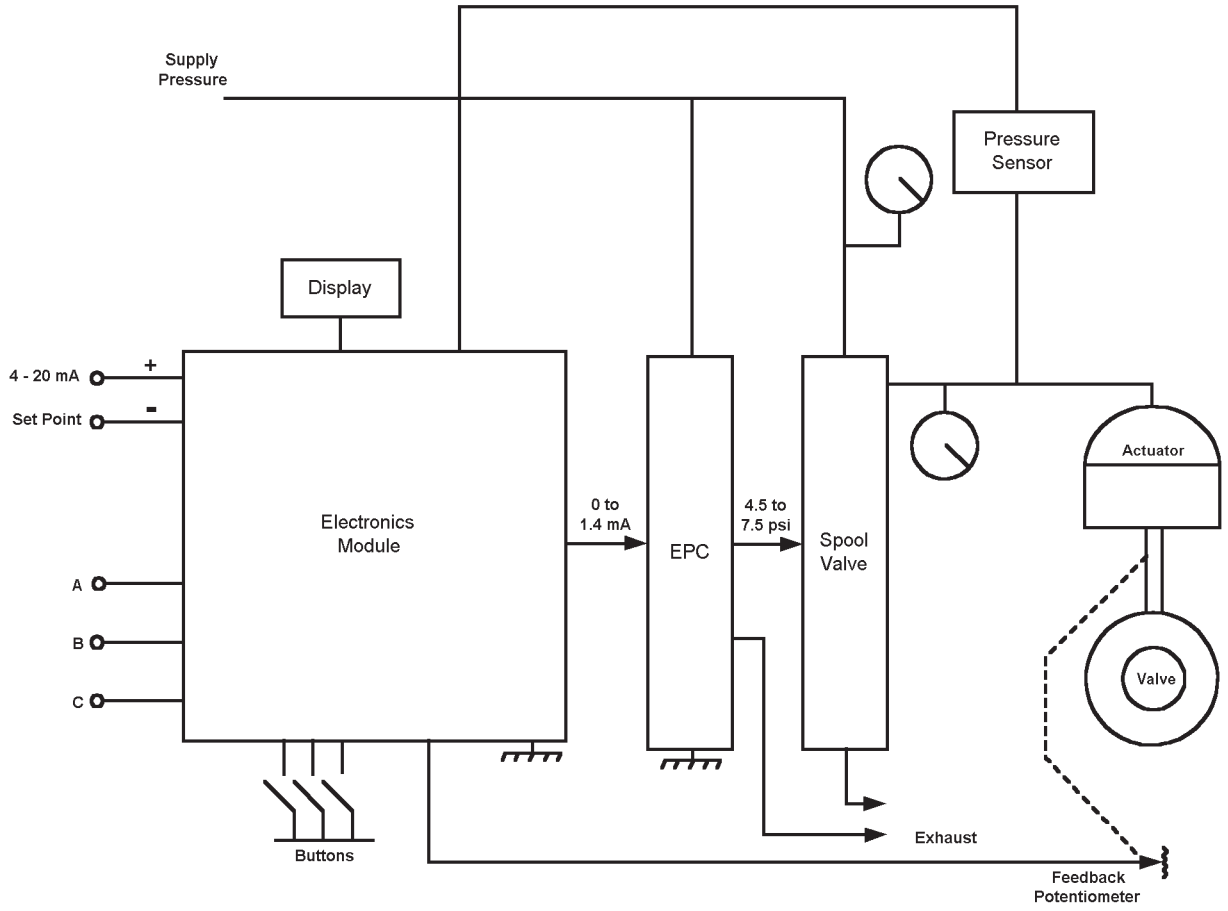


Figure 3a. SVI Block Diagram

Electronics Module

The electronics module contains the power supply, 16 Bit A/D Converters, 12 Bit D/A Converters and the microprocesser. Using the internal programmed Positioner and/or Process Control algorithm, it computes the required output based on information received from the measurement sensors. If the display and push-button option is selected it contains the electronics for these functions.

Pushbutton Switches

Three pushbutton switches operating in conjunction with the display permit reading and modification of the instrument operating parameters without a PC or HART hand-held communicator.
These switches perform "generic" functions - Increase, Decrease, and Accept by movement through a conventional menu structure.
The switches can be operated in a hazardous environment without compromising the flameproof enclosure.

EPC (Electropneumatic Converter)

The EPC converts a current signal to a pressure signal in the following manner. A coil operating in a magnetic field is mechanically connected to a flapper. Movement of the coil when current is changed causes the flapper to move towards a nozzle and restrict the air flow through the nozzle. The restricting action causes the back pressure on the nozzle to increase with an increase in the coil current.

Removing electrical power from the EPC causes the output pressure to go low. This defines the startup and fail-safe characteristics of the SVI.

Spool Valve

The spool valve is a two way, air-piloted valve that can supply or exhaust air. The pilot pressure, which is controlled by the EPC, in turn controls the rate of air flow that fills or exhausts the actuator.

Sensors (Position, Pressure and Temperature)

Position sensing of the valve stem is accomplished by use of an internally mounted potentiometer mechanically linked to the stem. The output of the potentiometer is connected to the electronics module and provides the input signal to the position control algorithm.

The potentiometer resistance is 10,000 ohms and has a full scale travel range of 120 degrees rotation. Full valve stroke must provide 18 degrees minimum * and 100 degrees maximum rotation from reference position. "Open" or "Closed" valve settings establish the reference position.

The position sensor also provides, through the electronics module, readout of valve position on the display, communication of valve position via HART protocol and on newer SVI models a 4-20 mA signal proportional to valve position transmitted on a separate pair of leads.

If the SVI cannot be mounted on the valve, an optional remote feedback potentiometer can be used to supply the position signal to the SVI.

The pressure sensor measures the pressure to the actuator with a range of 0 to 100 psi. This pressure can be read out on the internal display, Hart communicator or Val Vue PC.

The temperature sensor is located in the electronics module and measures ambient temperature. This measurement is used to provide temperature compensation for the pressure sensor and other internal electronic components.

* A short stroke version SVI is available; Consult Factory.

SVI Inputs/Outputs

As shown in the block diagram below, the SVI unit has the following inputs and outputs:

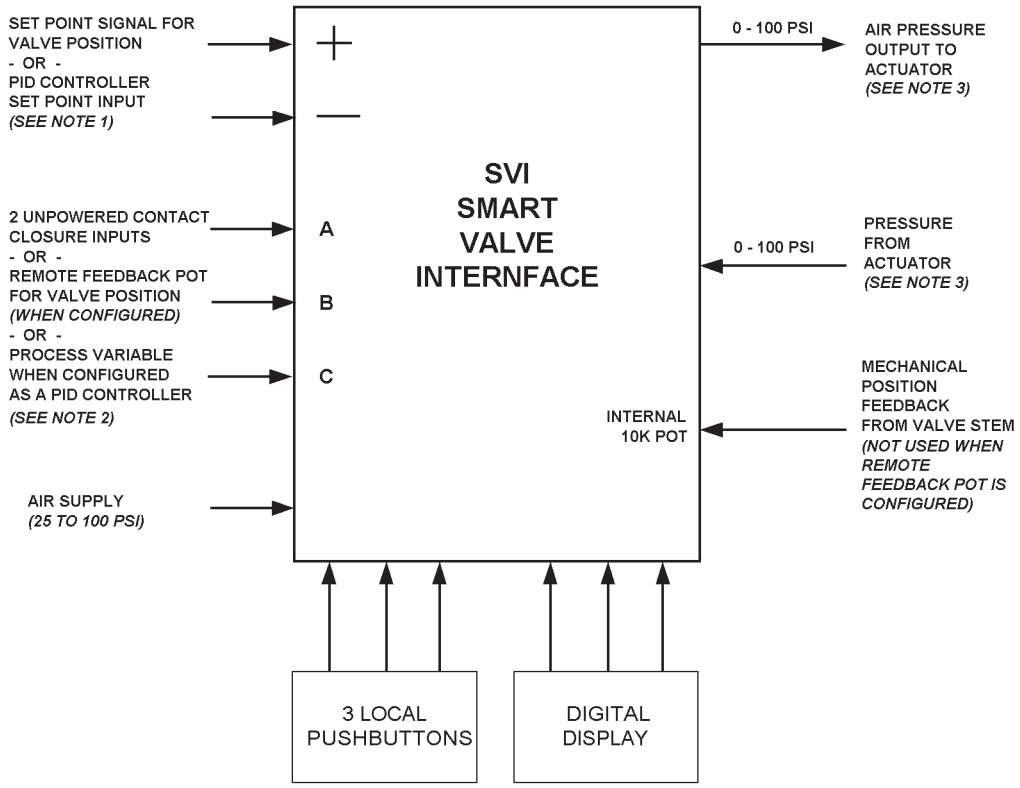


Figure 4. Input/Output Diagram of SVI Unit

NOTES:

1. Set point signal can come from a 4-20 mA current input or from HART protocol digital input. With digital input, operating power can be from 4-20 mA input or from 12/24 V dc Multidrop Supply.

2. PID Controller Process Variable signal must be dc voltage signal of 1.0-5.0 V dc or a 4-20 mA signal through a 250 Ohm resistor.

3. User configurable as dictated by actuator operating pressure range.

NOTE:

When SVI Positioner or Controller are ordered without pushbuttons or display, configuration and calibration must be done using HART protocol Handheld Communicator or from ValVue software on personal computer.

The SVI unit accepts the following inputs:

- Set point signal for valve position (when configured as a positioner) or for a PID controller (when configured as a controller)
- Actuator pressure
- Valve position
- Remote valve position

As an alternative, the remote valve position input connection can be assigned as follows:

- Up to two “cold” contact closures (unpowered for intrinsic safety), or
- A process variable input signal (when the PID controller function is configured)

System Description-Positioner

Typical system setups are shown in Figures 5 and 6. In these diagrams, the SVI is configured as a positioner and is located in a hazardous area (wiring diagrams are descriptive only, actual wiring must adhere to Electrical Installation section of manual and local electrical codes). Valve position is determined by an internal feedback potentiometer mechanically linked to the valve stem. The SVI input signal can be a 4-20 mA or a HART communication protocol signal from ValVue software on a personal computer or from a HART Hand Held Communicator. The process controller (or other source of input signal to the SVI) is located in a non-hazardous location and an intrinsic safety barrier (with ground) may be placed between the controller and the SVI or the system can be installed as explosionproof (flameproof). Communication with the remote PC is handled via a modem connected to the remote PC through a serial port. Communication can also be established from a HART Hand-held Communicator. The PC, which is not intrinsically safe, must be connected to the circuit on the non-hazardous side of the intrinsic safety barrier if the valve is located in a hazardous area. The SVI unit can be operated, calibrated, configured, and interrogated either by using local pushbuttons/display, or using a remote PC running ValVue software or with the Hand-held Communicator.

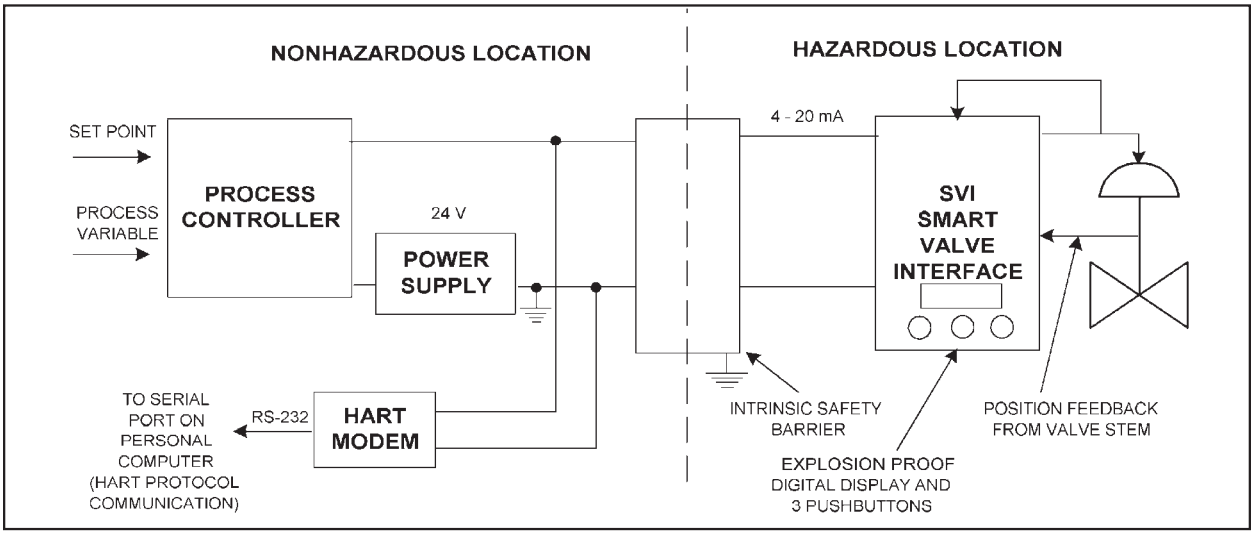


Figure 5. System Diagram – Intrinsically Safe Installation

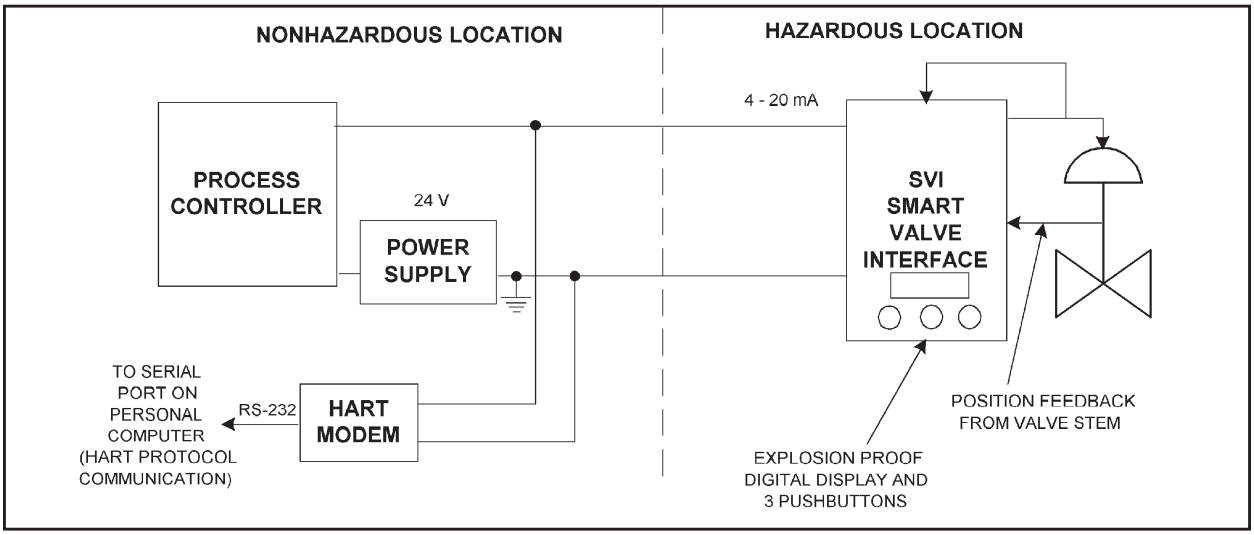


Figure 6. System Diagram – Explosionproof (Flameproof) Installation

System Description- PID Controller

When the SVI unit is configured as a PID controller, the + and - terminals are used to power SVI and to remotely set the controller's input. The primary process measurement, made by the process transmitter is fed to the controller as a 1-5 V dc signal, and connected to terminals marked A and B. Various configuration schemes using remote set point input are illustrated in Figure 7, Figure 8, and Figure 9. (Wiring diagrams are descriptive only, actual wiring must adhere to Electrical Installation section of manual).

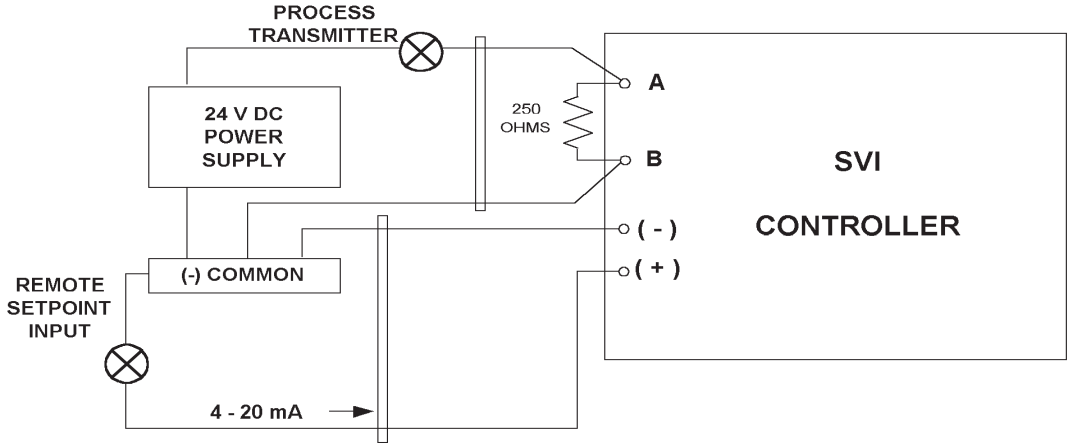


Figure 7. Single Loop PID Configuration with No Process Feedback

Figure 7 is the simplest configuration for the controller. It requires two 2-wire lines to the field. The sense resistor is located across the A and B terminals of the SVI unit. There is no sensing of the controlled variable in the control room - which is acceptable for applications such as a heat exchanger where the primary variable is temperature and the secondary is flow. In such a case, the SVI is the flow controller and the control room temperature controller sets flow based on the requirements of the temperature loop (with no need to monitor flow in the control room).

In the configuration shown in Figure 8, there are three 2-wire connections to the field. With this connection the process transmitter output can be monitored in the control room. The 250 Ohm resistor is located in the control room in this configuration.

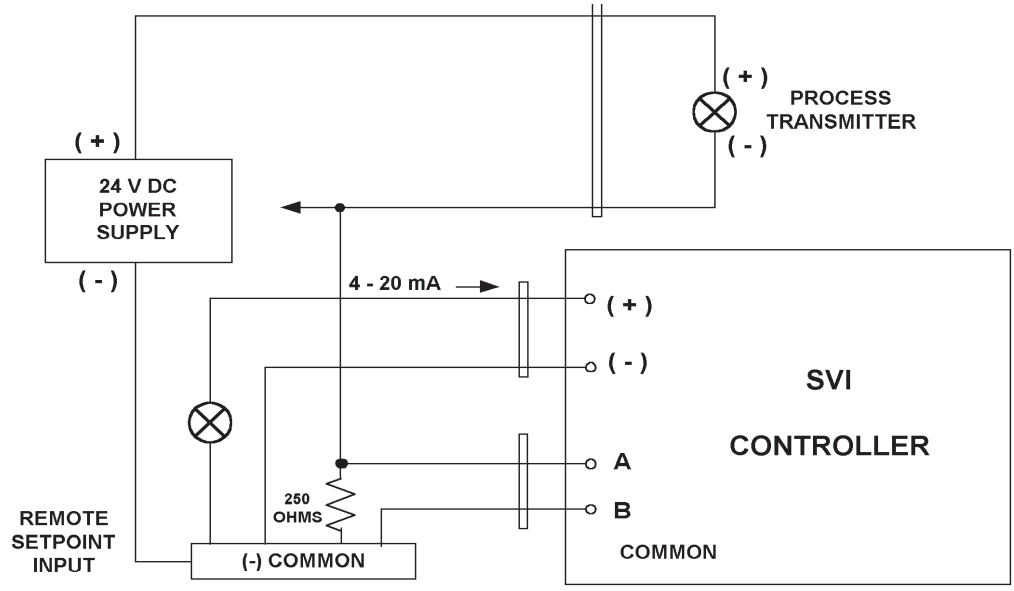


Figure 8. Single Loop PID Configuration with Process Feedback

The circuit shown in Figure 9 is an intrinsically safe configuration. The 788R+ barrier supplies the operating power to the 4-20 mA process transmitter. This barrier contains a 250 ohm resistor in its current return leg across which a 1-5 V dc voltage is developed. This voltage is fed through the 710+ or 728+ barrier to the A and B (process variable input) terminals in the SVI Controller. The 4-20 mA remote control setpoint, and power to the SVI are supplied through the 728+ barrier.

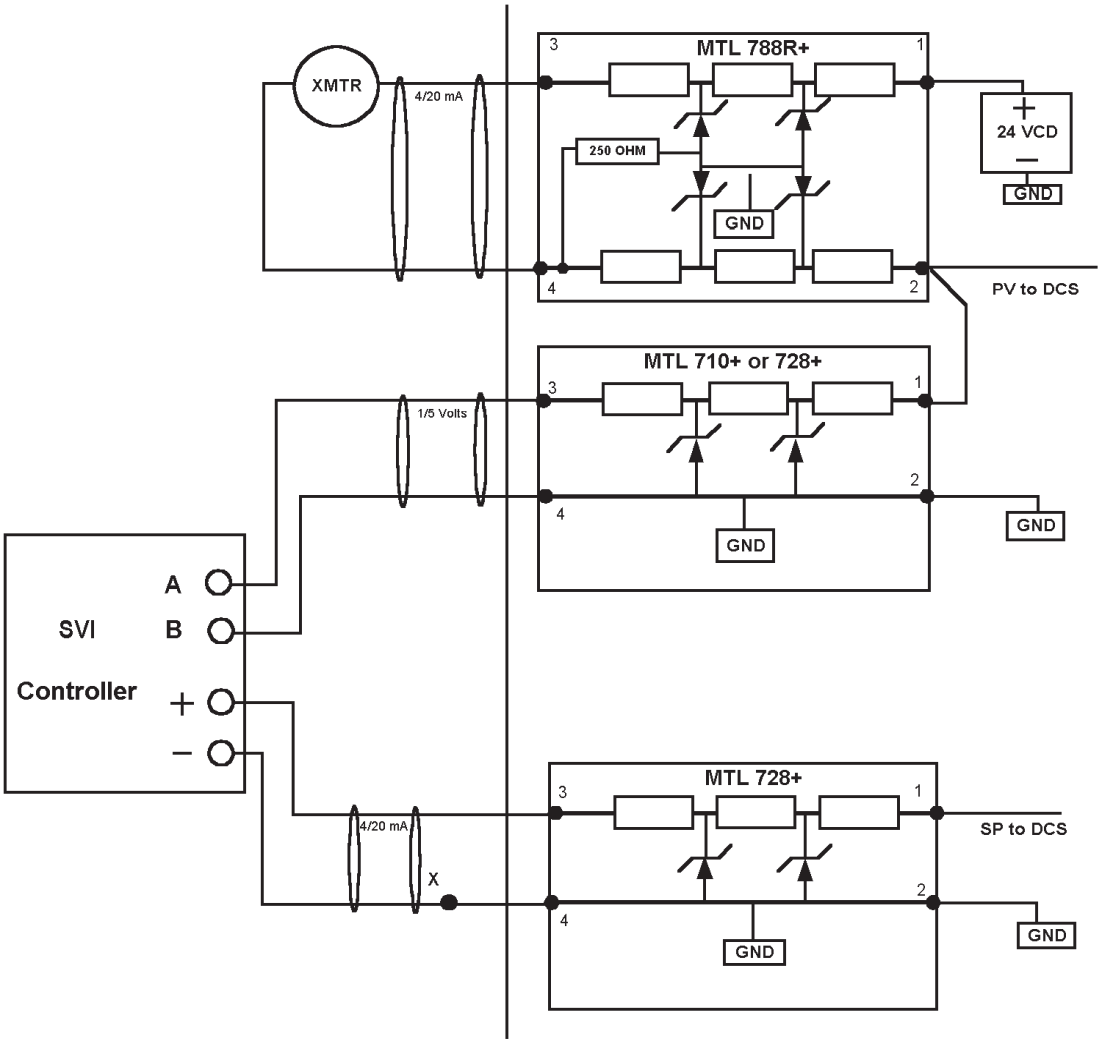


Figure 9. Intrinsically Safe Single Loop PID Configuration

The circuits shown in Figures 10 and 11 are Controllers with local setpoint set by the pushbuttons on the housing. The 24 V dc supply with a series current limiting resistor replaces the 4-20 mA source and can also be used to power the process transmitter. If these circuits are used in hazardous areas, the wiring and mounting of the external resistors must conform to explosionproof requirements, or I.S. barriers must be used on all wiring between the control room and the hazardous area.

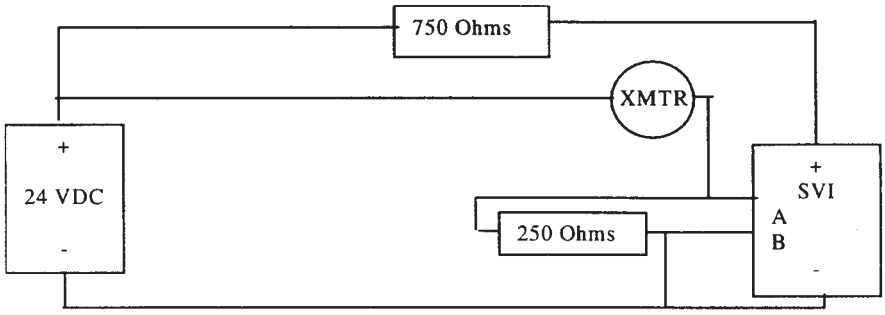


Figure 10. Local Set with Voltage Source

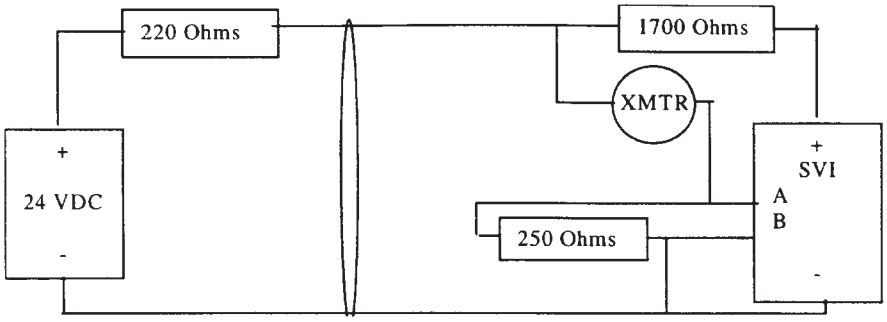


Figure 11. Local Set with Voltage Source-Two Leads to Field

Chapter 2 - Mounting

WARNING:

If the SVI is to be mounted on an existing valve in a process line, the following procedures and precautions are mandatory.

- If valve is located in a hazardous area make sure area has been certified as “safe” or that all electrical power to the area has been disconnected before removing any covers or disconnecting any leads.
- Shut off air supply to the actuator and to any valve mounted equipment.
- Ensure the valve is isolated from the process by either shutting off process or using bypass valves for isolation. Tag shutoff or bypass valves to guard against turn-on while work is in progress.
- Bleed air from actuator and check that valve is in its un-energized position.

It is now safe to disconnect and remove any valve mounted equipment that is being replaced.

NOTE:

The SVI should be mounted with the conduit connections down in order to facilitate drainage of condensate from the conduit and ensure the best dynamic performance.

Standard Rotary Valve Mounting

This section describes the procedure for mounting the SVI on all Masoneilan rotary control valves.
Tools required:

- 3/16 inch Hex Wrench
- 4 mm Hex Wrench
- 7/16 inch Combination Wrench

1. Mount the SVI mounting bracket to the valve actuator using two (2) 5/16 - 18 UNC flat-head cap screws. Unless otherwise specified the SVI will be mounted assuming the actuator/valve will be mounted in the normal upright position (i.e., lettering on actuator right side up). This requires the long end of the mounting bracket to be to your right when facing the actuator. Note that the mounting bracket for ball and butterfly valves differs slightly from the Camflex and Varimax bracket but the mounting is identical.

2. Bolt the valve side lever to the valve position take-off shaft using a 1/4 - 28 UNF cap screw, spacer and washer. The spacer goes between the take off shaft and lever, and the washer under the head of the cap screw. On Camflex and Varimax valves, orientate valve side lever 90(from valve position indicator as shown in Figure 12 and securely tighten cap screw. On ball and butterfly valve actuators, orientate the lever so it is midway between the two bracket mounting holes (45^{o} from horizontal) as shown in Figure 13 and tighten cap screw. Alternatively, for all rotary mountings, the actuator can be pressurized to mid-stroke and lever secured in a horizontal position.

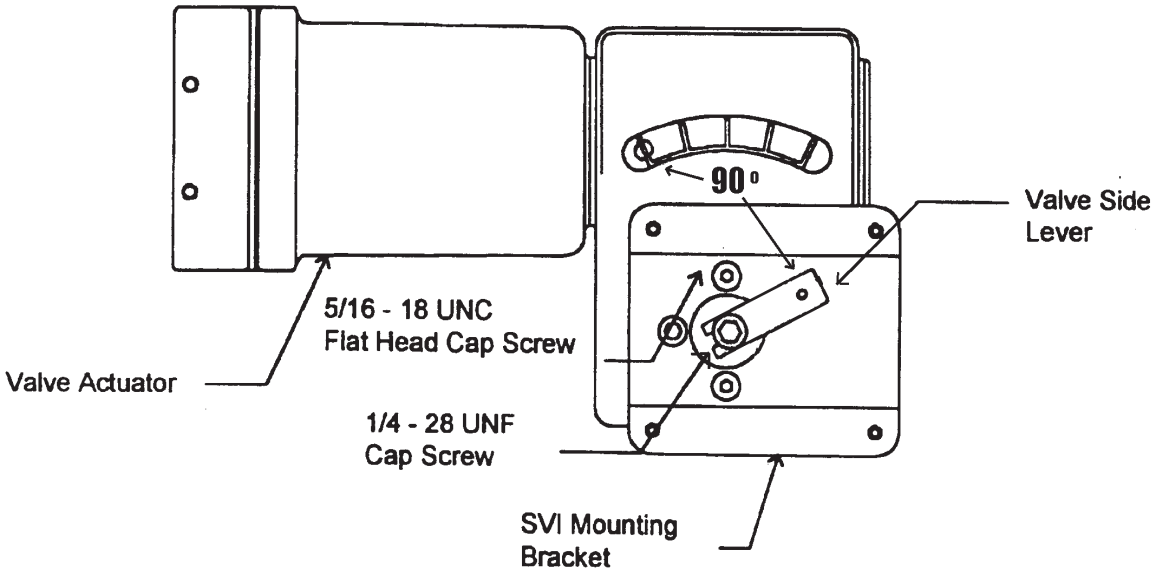


Figure 12. SVI Rotary Mounting Bracket with Valve Side Lever on Camflex Valves

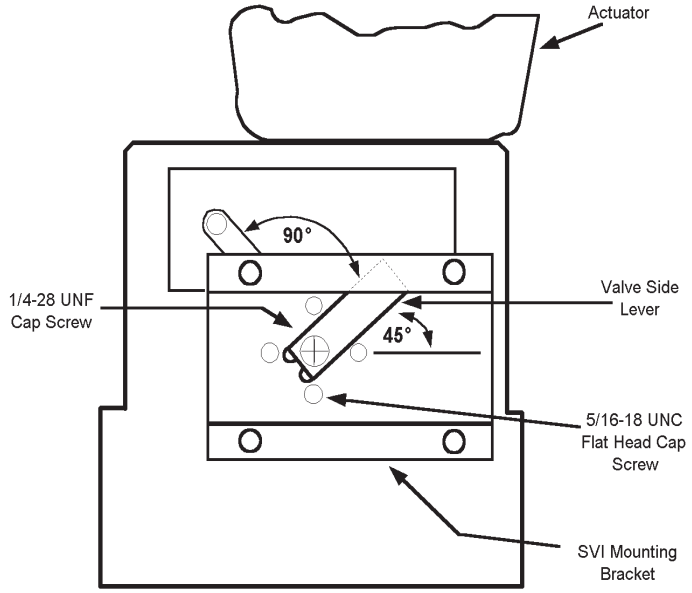


Figure 13. SVI Rotary Mounting Bracket with Valve Side Lever on Ball and Butterfly Valves

3. Clamp the SVI lever to the SVI shaft. The flat on the SVI shaft must always face the pneumatic block with the lever orientated facing the cover as shown in Figure 14. When using a standard lever, the orientation of the lever to the SVI is set by clamping screw location relative to flat on shaft. Leave approximately 1/16 space the SVI housing and back of lever. See Figure 15.

4. Loosely assemble the SVI to the mounting bracket using only the two top 1/4 - 20 UNC socket-head cap screws. Pull the SVI away from the actuator to allow the pin on the valve side lever to be inserted into the slot in the SVI lever under the anti-backlash spring. See Figure 15. Assemble the two bottom bolts and securely tighten all four bolts.

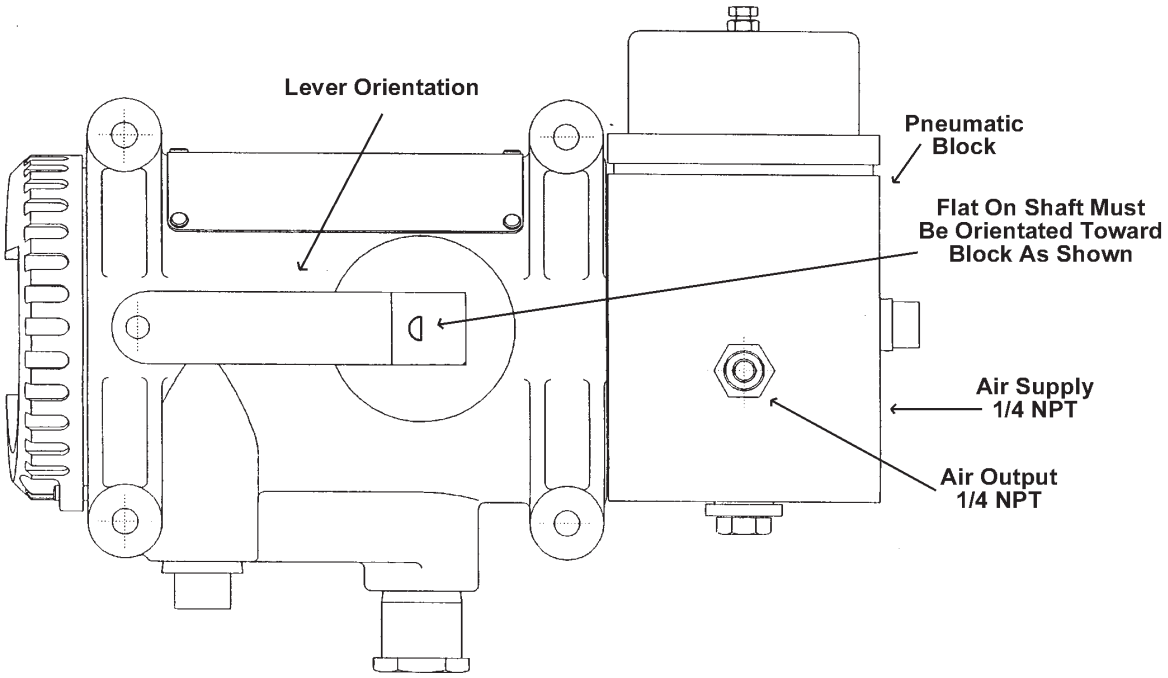


Figure 14. Orientation of SVI Lever and SVI Shaft

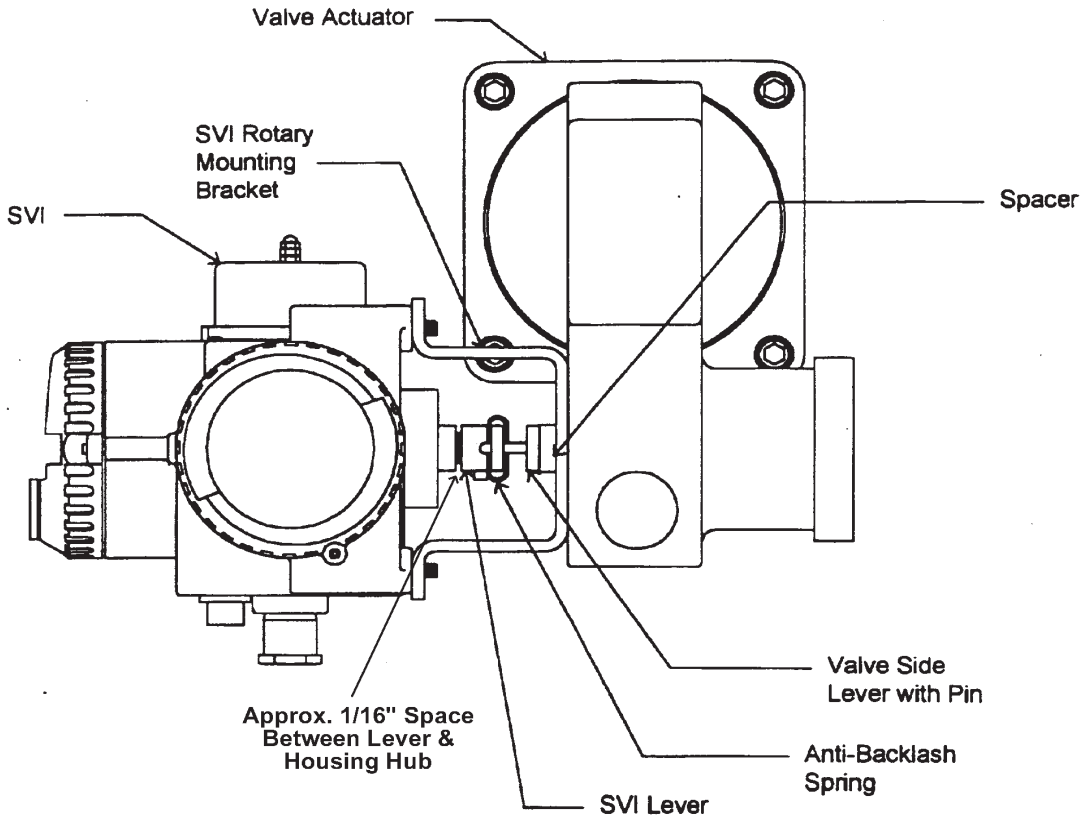


Figure 15. SVI Mounting on Rotary Valves

Standard Reciprocating Valve Mounting

Mounting the SVI on Masoneilan 87/88 Multi-Spring actuators.

Tools required:

- 7/16 inch Combination Wrench (2 required)
- 3/8 inch Combination Wrench
- 1/2 inch Combination Wrench
- 4 mm Hex Wrench
- 3/16 inch Hex Wrench

1. Mount the SVI mounting bracket to the actuator using two (2) 5/16 - 18 UNC cap screws. Unless otherwise specified, the SVI mounting assumes that the actuator is in the normal upright position. The slotted opening of the mounting bracket is to be to the left when facing the actuator.

2. Clamp the SVI lever to the SVI shaft. The flat on the SVI shaft must always face the pneumatic block with the lever orientated facing the cover as shown in Figure 14. When using a standard lever, the orientation of the lever to the SVI is set by clamping screw location relative to flat on shaft. Leave approximately 1/16 space the SVI housing and back of lever. See Figure. 16.

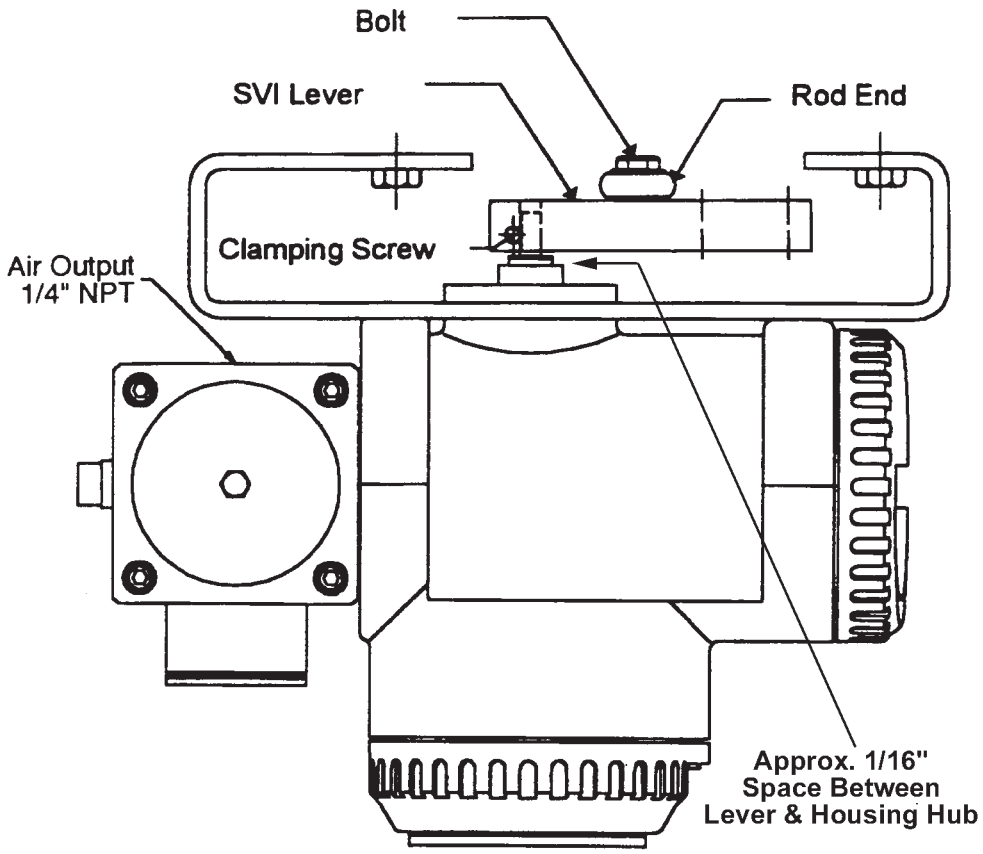


Figure 16. Top View of SVI Mounted on a Reciprocating Valve

3. Attach the right hand threaded rod end to the SVI lever using a 1/4 - 20 x 1” cap screw. The lever hole position to be used is dependent upon the specific valve stroke. Refer to Figure 17 and Table 3 (shown below).

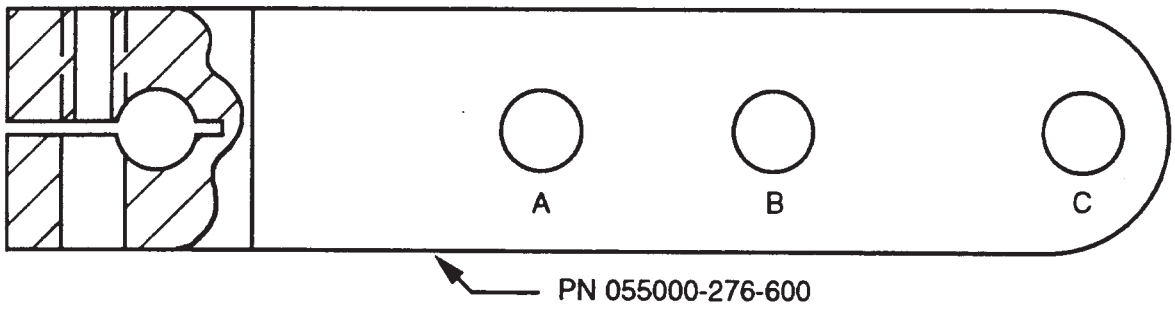


Figure 17. SVI Lever for 87/88 Multi-Spring Actuator

Valve Stroke mm (inches)	Lever Hole
20.3 (0.8)	A
25.4 (1.0)	A
38.1 (1.5)	B
50.8 (2.0)	C
63.5 (2.5)	C

Table 3. SVI Lever Hole Locations for 87/88 Multi-Spring Actuator

Note: For valve strokes less than 19.1 mm (.75 in.) use the “Short Stroke” model SVI with the rod end attached to the lever “A” hole.

4. Mount the SVI to the mounting bracket using four 1/4 - 20 UNC socket-head cap screws. The set of mounting holes to be used is dependent upon the specific valve stroke. Refer to Figure 18.
5. Screw the take-off rod to the actuator stem connector, refer to Figure 19. Ensure that the travel pointer is correctly positioned.
6. Bolt the left hand threaded rod end to the take-off rod with 1/4 - 20 UNC nut.
7. Connect turnbuckle and lock nuts to each rod end. Refer to Figure 19. Turnbuckle length is a function of actuator size. Verify proper length per following: #6 and #10 Actuators, length = 1.25”. #16 Actuator, length = 2.90”. #23 Actuator, length = 5.25”.
8. Position valve at mid-stroke by supplying air to the actuator or using a manual handwheel if applicable.
9. Adjust the turnbuckle such that the SVI lever is horizontal. Tighten the turnbuckle lock nuts.

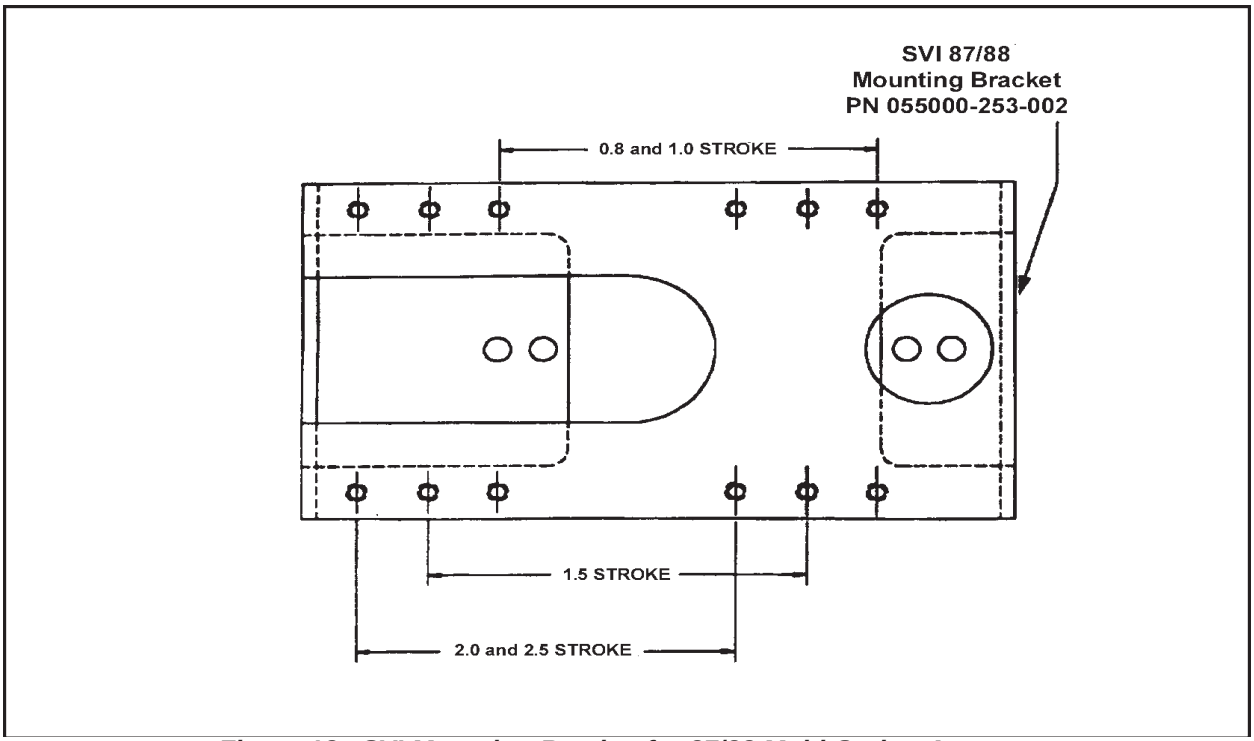


Figure 18. SVI Mounting Bracket for 87/88 Multi-Spring Actuator

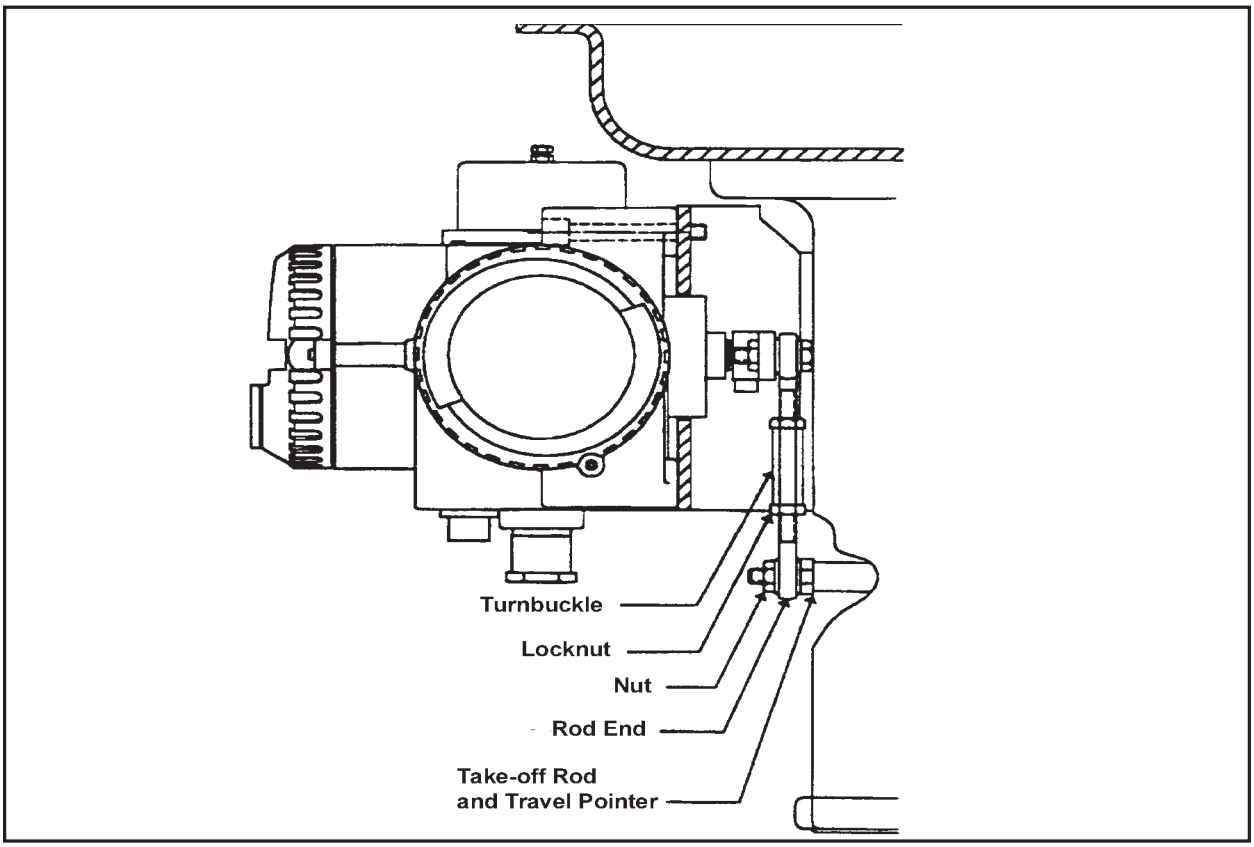


Figure 19. Side View of SVI Mounted on a Reciprocating Valve

Mounting the SVI on other Valves

The SVI can be mounted on many other valve types of both Masoneilan design and those of other manufacturers. Typical mounting on Masoneilan Type 37/38 and 84/85 Actuators is shown in Figures 20 and 21. Figure 21a “Smart Valve Interface Outline Drawing” shows mounting and overall dimensions. When mounting the SVI to other valves use it as a guide to ensure proper clearances, access room for cover removal and making of pneumatic and electrical connections.

The following section describes the general requirements for mounting the SVI on any valve.

This section is intended to be used by an Engineering group with basic understanding of instrument mounting on control valves. The following minimum technical requirements must be adhered to:

Minimum SVI shaft rotation for full travel is 18°.
Maximum recommended linkage assembly non-linearity is +/- 1.0%.
Minimum mounting bracket thickness is 5.0 mm.

In order to mount a SVI on a valve the following parts are required:

- Mounting Bracket
- SVI Lever and Linkage for Position Feedback (Reciprocating)
- SVI Lever and Valve Side Lever for Position Feedback (Rotary)

To ensure that the SVI position feedback performs correctly, the plane of the flat on the SVI shaft must be vertical and facing the pneumatic block of the SVI when the valve is at mid travel. The lever must point away from the pneumatic block. See Figure 14.

For a reciprocating valve,the bracket, lever, and linkages should be designed such that the lever is perpendicular to the actuator stem when the valve is at mid-stroke. The linkage pivot point on the SVI lever should be on the same centerline as the valve stem at mid-stroke. (turnbuckle centered on and parallel to stem).

For a rotary valve it is recommended that the Masoneilan design valve side lever and SVI lever be used since they incorporate an anti-backlash spring feature.

The mounting bracket should accommodate the four mounting holes of the SVI. Adequate space must be left between the SVI and the Actuator to accommodate the lever and linkage or the rotary lever coupling. Clearance space is required for the output air connection and SVI end cover. See Figure 22 for mounting interface requirements.

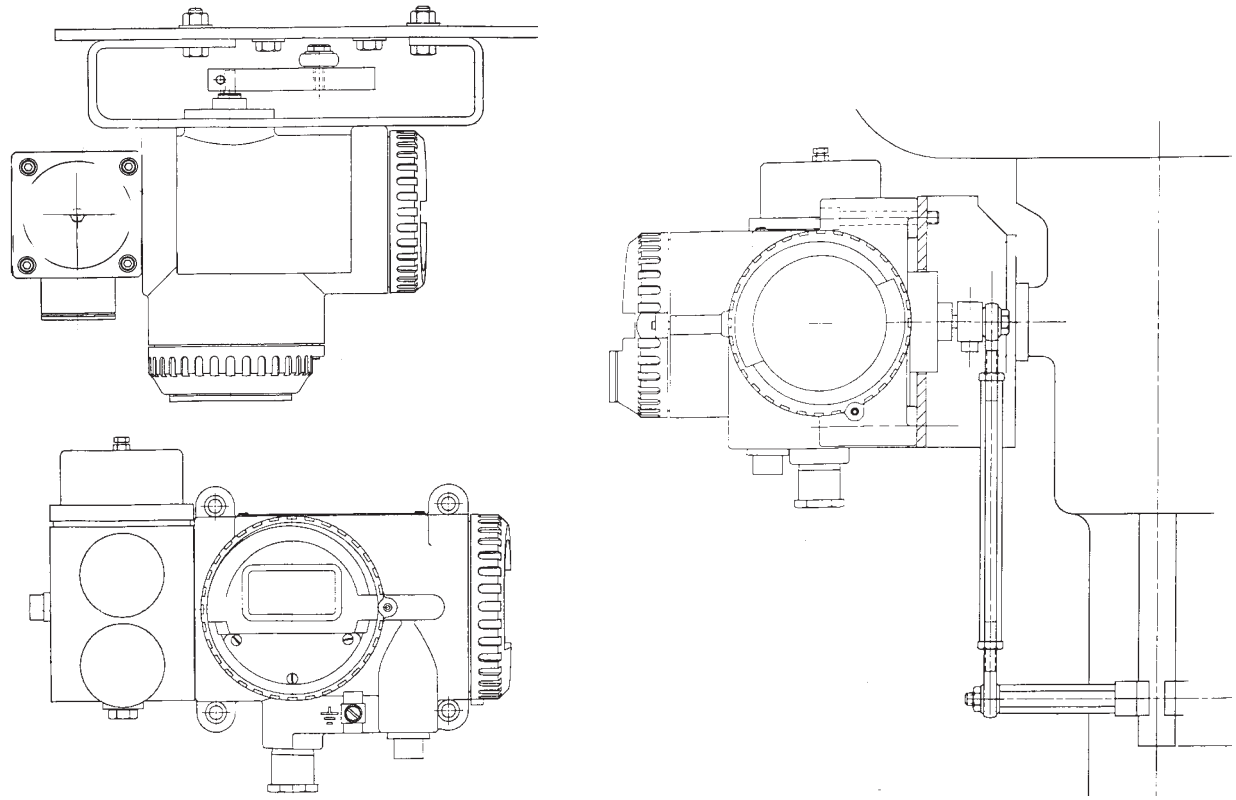


Figure 20. Typical SVI Mounting on 37/38 Actuator

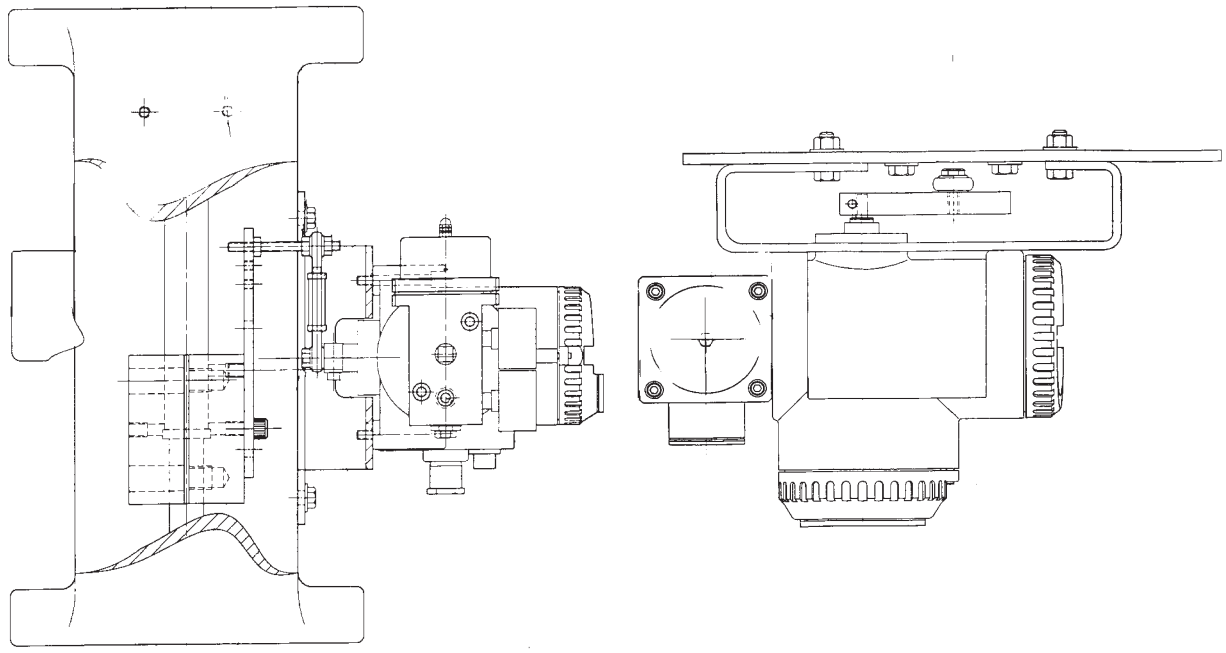


Figure 21. Typical SVI Mounting on 84/85 Actuator

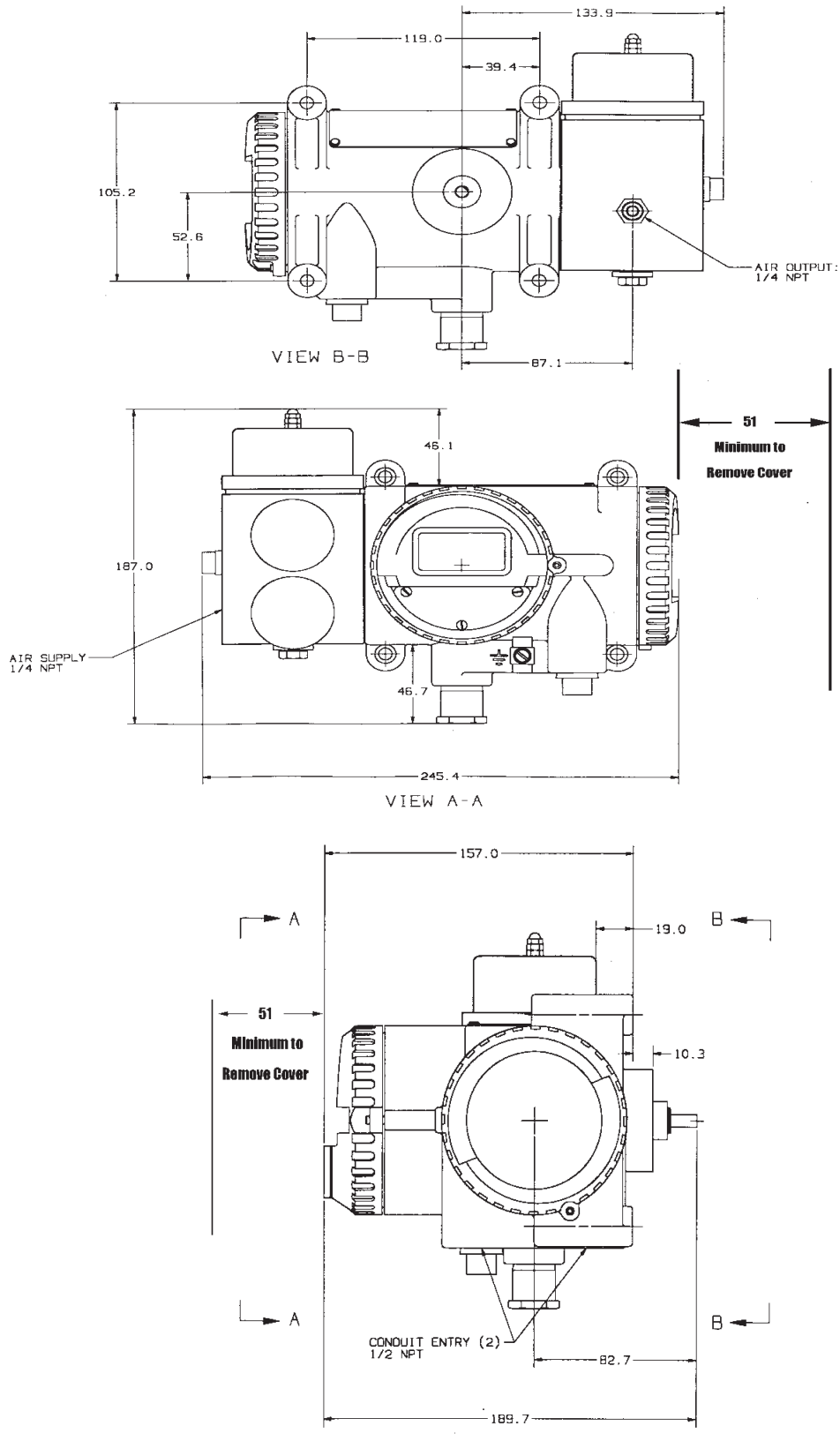


Figure 21a. Smart Valve Interface Outline Drawing

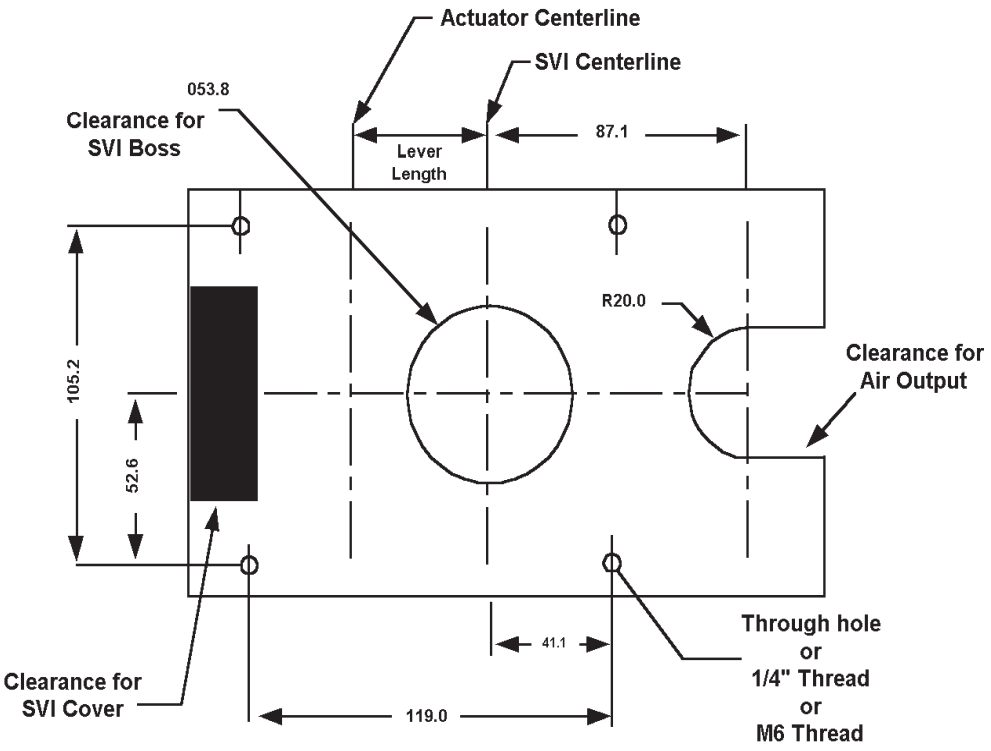


Figure 22. SVI Mounting Interface

Lever and Linkage Design

A lever length should be chosen depending on the stroke of the given actuator. Table 4 can be used as a guide in determining lever lengths.

The recommended lever material is aluminum 6061 temper TI, anodized for corrosion protection. This lever should be designed to the basic dimensions as shown in Figure 23. If designed in a material other than aluminum, the clamping effort for the M5 screw must be reviewed to ensure proper attachment to the SVI shaft.

Valve Stroke mm (inches)		Lever Length mm (inches)	
12.7	(0.5)	19.1	(0.75)
25.4	(1.0)	31.8	(1.25)
50.8	(2.0)	76.2	(3.00)
101.6	(4.0)	139.7	(5.50)
152.4	(6.0)	203.2	(8.00)

Table 4. Recommended Lever Lengths

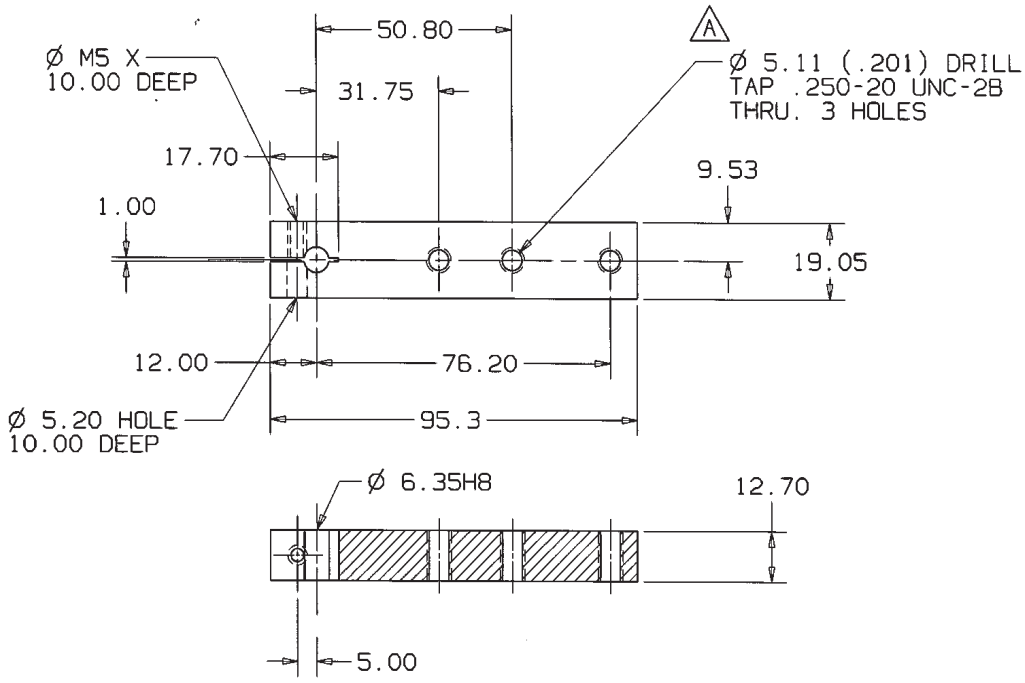


Figure 23. SVI Lever Design

The linkage design is usually made up of two rod ends. One each attached to the SVI lever and the valve stem. A turnbuckle is used to attach the rod ends together and for final adjustment. Table 5 may be used as a guide to determine the proper linkage lengths. Lock nuts should be provided to ensure that the set length of the linkage is not changed. See Figure 19 for typical mounting on a reciprocating actuator.

Valve Stroke mm (inches)		Linkage Length mm (inches)	
12.7	(0.5)	25.4	(1.00)
25.4	(1.0)	50.8	(2.00)
50.8	(2.0)	76.2	(3.00)
101.6	(4.0)	127.0	(5.00)
152.4	(6.0)	228.6	(9.00)

Table 5. Recommended Linkage Lengths

Pneumatic Installation

The SVI Positioner and Controller are designed to operate only with clean, dry, oil-free, instrument grade air to ANSI/ISA-57.3 1975 (R1981) or ISA-S7.3-1975 (R1981).

Dew Point:	At least 18° F (10° C) below minimum anticipated ambient temperature.
Particulate matter:	Filtered to below 5 microns.
Oil content:	Less than 1 ppm w/w or v/v.

Contaminant's: Free of all corrosive contaminants and hazardous gasses, flammable or toxic.

The supply, output and exhaust connections for the SVI (located on the pneumatic block) are tapped 1/4" NPT. The output connection is located on the back of the block. The supply and exhaust are located on the side of the block with the exhaust above the supply and fitted with a plastic plug. Two pressure gauges, output on top, supply on bottom, are located on the front of the pneumatic block.

The use of a Masoneilan filter regulator with a 5 micron filter is recommended for the air supply. Tubing used for piping between filter regulator, SVI , and actuator should be 1/4" minimum with 3/8" used for larger actuators.

CAUTION: Do not use pipe thread sealant tapes on pneumatic fittings as it tends to shred small particles which can cause instrument malfunction.

The use of a soft setting anaerobic hydraulic seal such as Loctite Hydraulic Seal 542 is recommended. Follow manufacturers instructions.

CAUTION: Do not use an excessive amount as it will not set and may migrate into the instrument.

Maximum allowable air supply pressure to the SVI varies according to actuator and valve size and type. See pressure drop tables in valve specification sheets to determine correct positioner supply pressure. Minimum supply pressure should be no less than 10 psi above maximum spring pressure.

DANGER: Never exceed actuator or SVI maximum supply pressure. Damage to equipment or injury to personnel may result.

Electrical Installation

Electrical connections are made to the main terminal board as shown on Figure 24. The terminals will accept wire sizes up to A.W.G 14

Figure 24 shows layout of terminal board currently in production.

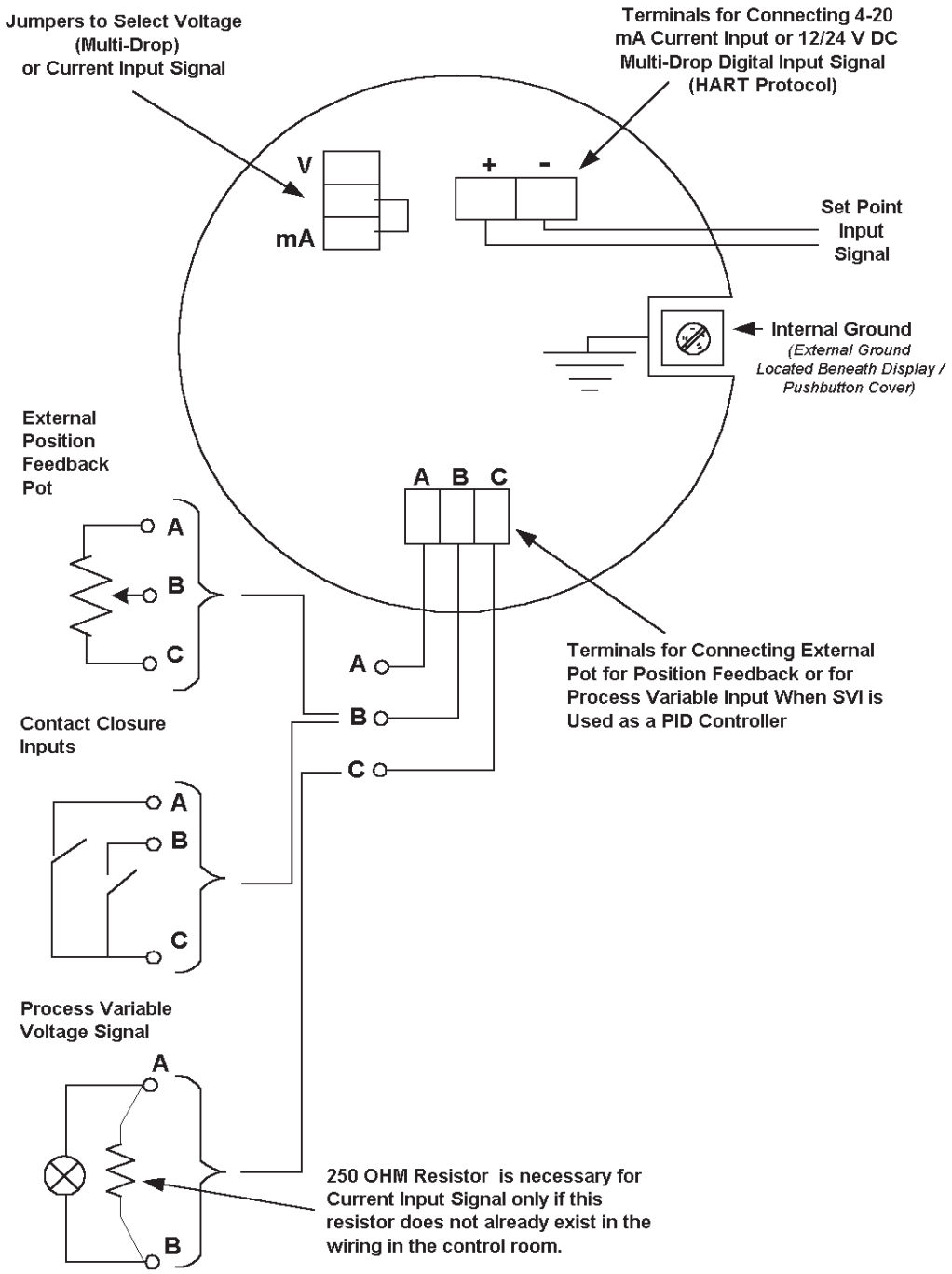


Figure 24. Electrical Connections to Main Terminal Board
(Current Production)

Figure 24a reflects a design change to be released in early 1999 which incorporates the following enhancements.

- Additional terminals D and E allow the contact input feature to be used with the controller option.
- Optional terminals POS + and POS - provide an isolated 4-20 mA signal related to **characterized** valve stem position. The voltage compliance of the position output terminals is 11-50 V dc. The HART® signal is **not** available on the position terminals. The HART protocol is available on the +/- LOOP terminals.
- The software revision reported by the HART ID command is 6.

All terminals (both versions) accept wire sizes up to A.W.G. 14.

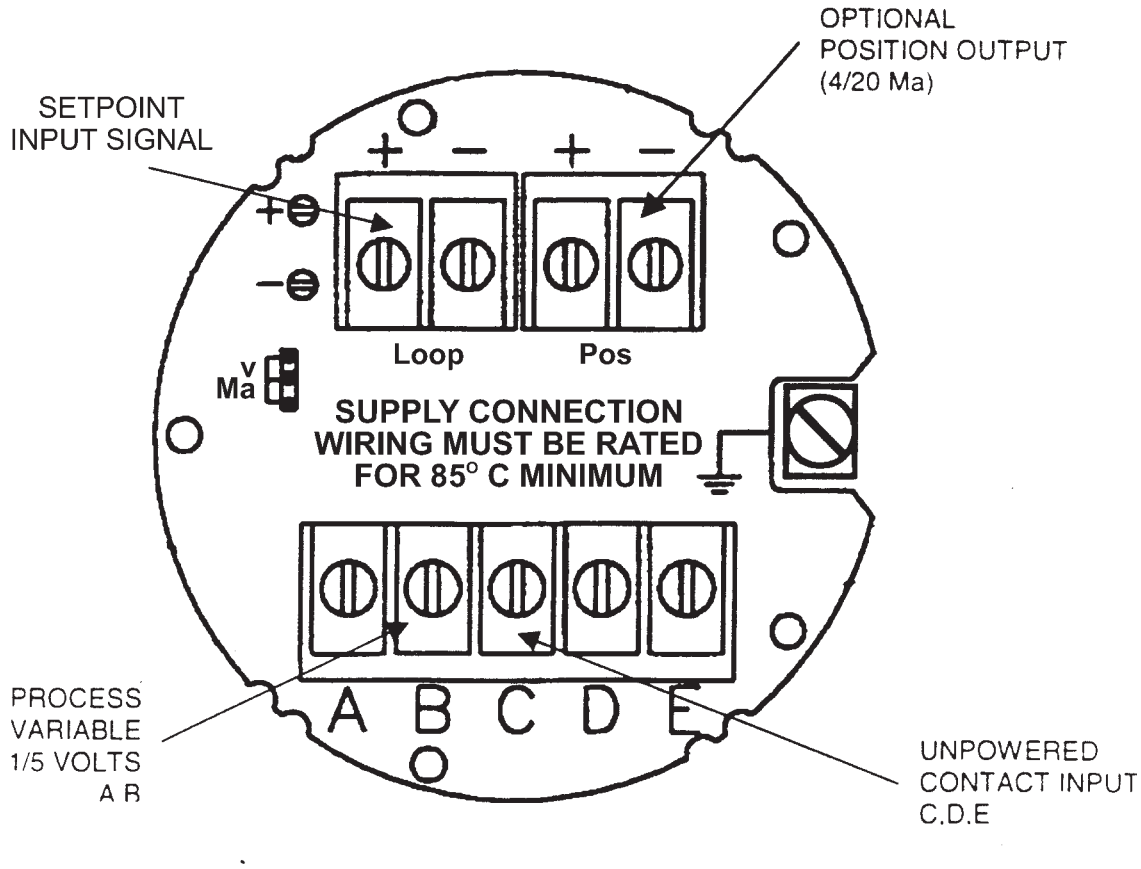


Figure 24a. Electrical Connections to Main Terminal Board

When operated with current input, the loop controller or any other current source must be capable of supplying 4-20 mA with an output voltage compliance of at least 12 V. Before applying power to the SVI make sure current/voltage jumper is in correct position.

The available output voltage of a current source will be reduced by loop wiring resistance. This can be checked by connecting a resistor of value (600 ohms + loop resistance) across the output of the current source and verifying that 20 mA is obtainable at full scale output.

The SVI is normally supplied with two 1/2" NPT conduit entries. (M20 adapters are available) Internal and external ground terminals are provided for use if grounding is required.

WARNING: The SVI must be installed in accordance with local and national codes of practice in both general purpose and hazardous area locations. The electrical components are fully isolated from ground and therefore grounding is unnecessary for functional purposes. Grounding may be necessary to conform to installation codes.

Figure 24b is a composite wiring installation diagram applicable to both SVI versions and to the controller option. It is suitable for general purpose locations and to explosionproof (flameproof) installations when applicable wiring codes are observed.

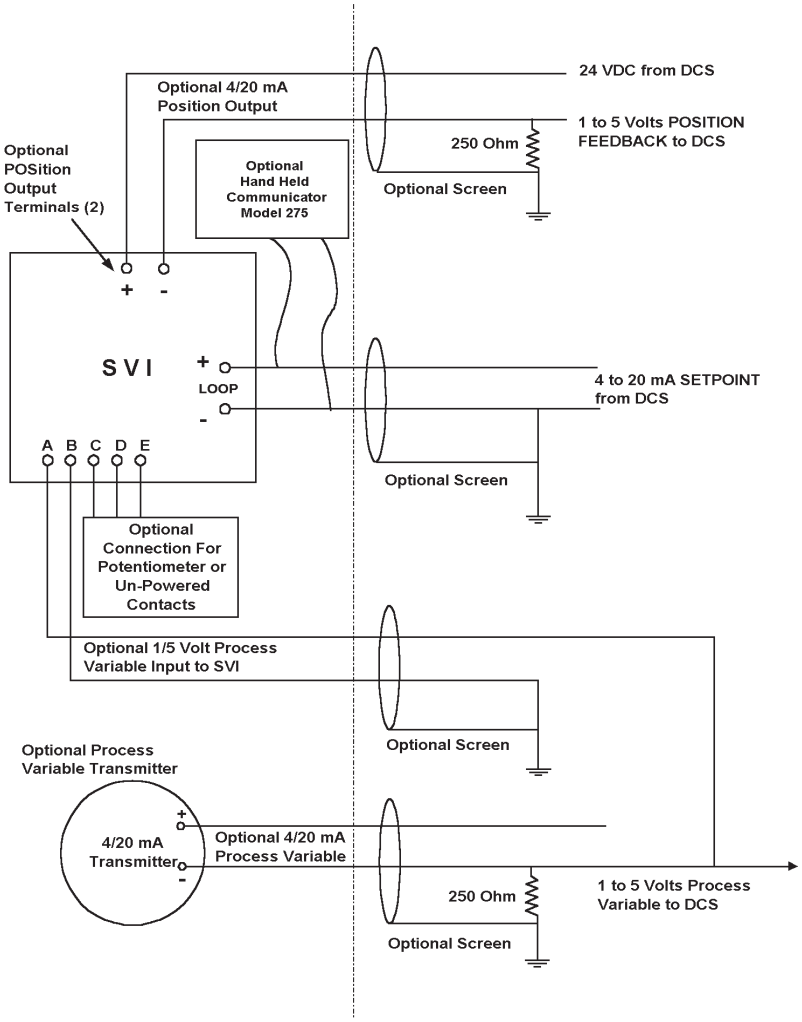


Figure 24b. General Area Purpose Installation

Hazardous Area Installations

The SVI is available in versions suitable for use in hazardous areas. The labeling on the positioner indicates approved areas of use.

WARNING: Installation of any hazardous area equipment must be made in accordance with the appropriate hazardous area installation codes and the manufacturers installation and operating instructions. The user must make no changes or attempt any repairs of a certified instrument since this will invalidate the certified design.If a certified instrument should fail it must be returned to the manufacturer for repair.

Factory Mutual approved model

Explosionproof: Class I, Division 1, Groups B, C, and D. Temperature Classification T6 @ 75° C ambient, T5 @ 82° C ambient, indoor and outdoor (NEMA Type 4X) hazardous (classified) locations.

Dust-Ignitionproof: Class II / III, Division 1, Groups E, F, and G.

Non-Incendive: Class I, Division 2, Groups A, B, C, and D.

Suitable for: Class II / III, Division 2, Groups F and G.

Installation must be in accordance with the current edition of the National Electrical Code ANSI / NFPA-70, any applicable local codes and manufacturers instructions.

Intrinsically Safe: Class I / II / III, Division 1, Groups A, B, C, D, E, F, and G hazardous indoor / outdoor NEMA 4X locations. Temperature Classification T4 @ 40° C ambient, T3B @ 70° C ambient, T3A @ 82° C ambient.

Installation must be in accordance with the current edition of the National Electrical Code ANSI / NFPA-70, ANSI / ISA RP 12.6 “Installation of Intrinsically Safe Instrument Systems in Class I Hazardous (Classified) Locations”, Figure 25 - Installation Control Drawing ES-641 - on Page 34, and manufacturers instructions.

CSA (Canadian Standards Association) approved model

Explosionproof: Class I, Groups B, C, and D, Class II, Groups E, F, and G, Class III. Supply 28 Vdc, 4-20 mA. Enclosure Type 4X, Temp. Code T6 @ 75° C, T5 @ 82° C. Max. Ambient 82° C.

Division 2: Class I, Division 2, Groups A, B, C, and D, Class II, Division 2, Groups F and G, Class III. Supply 28 Vdc, 4-20 mA, Enclosure Type 4X, Temp. Code T6 @ 75° C Ambient, T5 @ 82° C. Max Ambient 82° C.

Installation must be in accordance with the current edition of the Canadian National Electrical Code Part I, any applicable local codes and manufacturers instructions.

Intrinsically Safe: Class I, Groups A, B, C, and D, Class II, Groups E, F, and G, Class III. Supply 28 Vdc 4-20 mA. Enclosure Type 4X. Temp. Code T4 @ 40° C Ambient; T3B @ 70° C Ambient; T3A @ 82° C Ambient. Max. Ambient 82° C.

Installation must be in accordance with the current edition of the Canadian National Electrical Code Part 1, Figure 25 - Installation Drawing ES-641 - (shown below), and manufacturers instructions.

SVI (SMART VALVE INTERFACE)
FACTORY MUTUAL AND CANADIAN STANDARDS ASSOCIATION
APPROVED INTRINSICALLY SAFE INSTALLATION CONTROL DRAWING

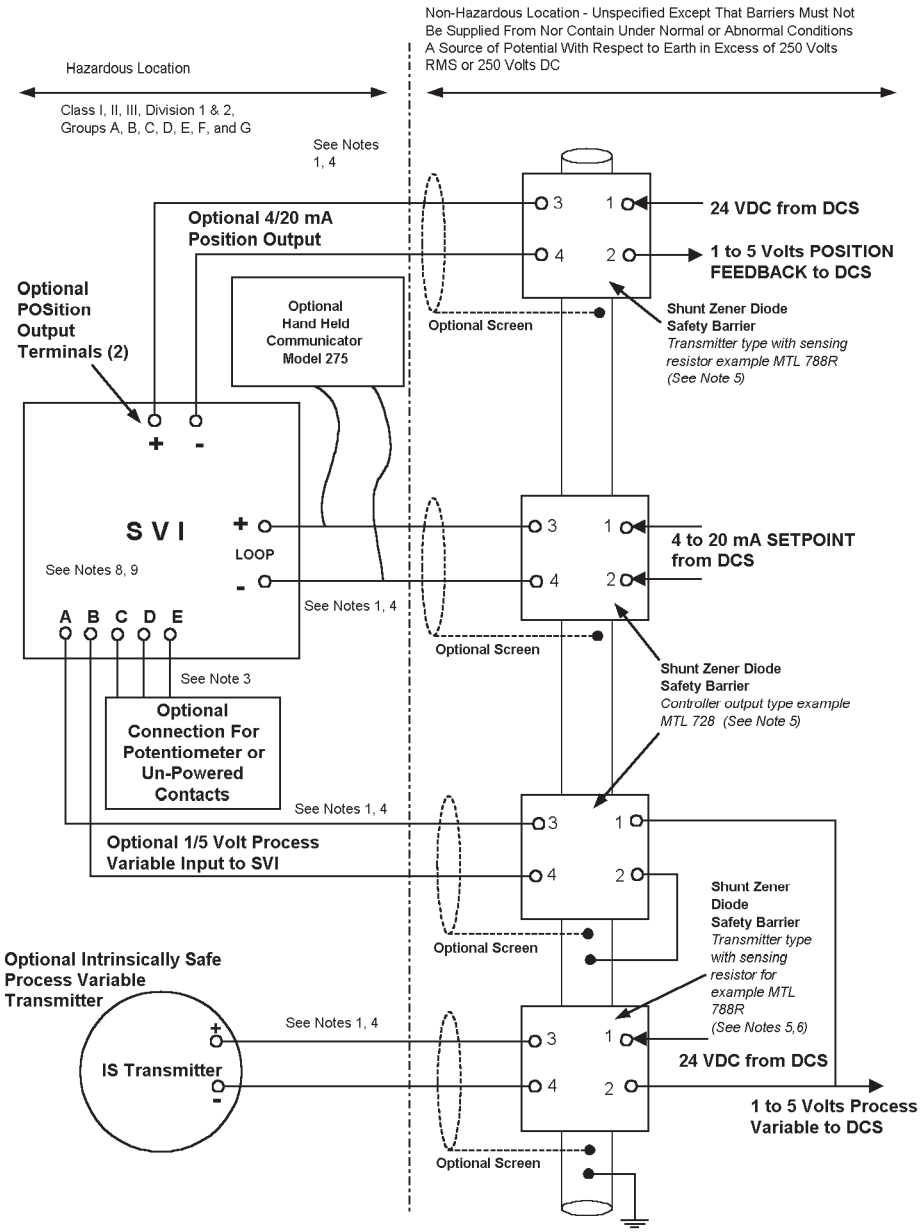


Figure 25. Approved Intrinsically Safe Installation Control Drawing

Notes:

1. The electrical circuit in the hazardous area must be capable of withstanding an A.C. test voltage of 500 volts R.M.S. to earth or frame of the apparatus for 1 minute.

2. Entity Parameters:
SVI (+) and (-) LOOP Terminals

Vmax = 30 Vdc Imax = 125 mA Ci = 2.2 nF Li = 96 uH Pmax = 900 mW

SVI (+) and (-) POS Terminals

Vmax = 30 Vdc Imax = 125 mA Ci = 2.2 nF Li = 96 uH Pmax = 900 mW

SVI (A), (B), (C), (D), AND (E) Terminals

Vmax = 30 Vdc Imax = 125 mA Ci = 0 nF Li = 0 uH

3. Terminals (C), (D), and (E) may be connected to an external position sensing potentiometer or to unpowered switch contacts, both of which fall in the category of “simple apparatus” and located in the hazardous area within 10 feet of the SVI positioner.

4. Cable capacitance and inductance plus the I.S. apparatus unprotected capacitance (Ci) and inductance (Li) must not exceed the allowed capacitance (Ca) and inductance (La) indicated on the associated apparatus. If the optional Hand Held Communicator is used, then the capacity and inductance must be added. Also, the current output of the Hand Held Communicator must be included in the current output of the associated equipment.

5. Positive polarity shunt zener diode safety barrier approved by FMRC or CSA for groups A, B, C, D, E, F, and G with output parameters:

Voc or Vt $\leq$ 30 Vdc Isc or It $\leq$ 125 mA Ca $\geq$ Ci + C cable La $\geq$ Li + L cable

6. The intrinsically Safe Transmitter is any transmitter approved by FMRC or CSA for groups A, B, C, D, E, F, and G having entity parameters consistent with the connecting FM or CSA approved barrier.

7. The installation including the barrier earthing requirements must comply with the installation requirements of the country of use, i.e., ANSI/ISA RP12.6 (Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations) and the National Electrical Code. ANSI/NFPA 70 or Canadian Electrical Code Part 1. Installation must be in accordance with manufacturers guidelines. Division 2 installations must be installed per the National Electrical Code. ANSI/NFPA 70 or Canadian Electrical Code Division 2 Wiring Methods.

8. SVI Temp Code: T4 at 40° C. Maximum Ambient Temperature
T3B at 70° C. Maximum Ambient Temperature
T3A at 82° C. Maximum Ambient Temperature

9. Dust-tight conduit seal must be used when installed in Class II and Class III environments.

10. The model 275 Hand Held Communicator is Factory Mutual approved with the entity parameters printed on the 275 label.

CENELEC Approved Model

Flameproof: Coded as EEx d IIB + H2 T5 (Ta +80° C.)

Installation must be in accordance with current editions of applicable country codes and manufacturers instructions.

Intrinsically Safe: Coded as EEx ia IIC T4 Tamb = - 40° C to +80° C

Installation must be in accordance with current editions of applicable country codes and manufacturers instructions. The intrinsic safety barriers must be suitable for use with the SVI safety description given below:

Field Connector, +, - (Power Input)

Ui = 30 Vdc Ii = 125 mA Pi = 0.9 W Ci = 2.2nF Li = 96 uH

Field Connector, A, B, C (Controller Link)

Ui = 30 Vdc Ci = 0 uF Li = 0 mH

Housing Protection Rating: IP 65

SVI Interconnections

Basic Positioner

The basic positioner functions to position the valve in response to the magnitude of the 4-20 mA current input. The connection between the positioner and control system is by a two conductor cable. The recommended configuration is use of twisted pair, shielded cable, with the shield and loop grounded at one point only.

Positioner or Controller with HART Communication

Impedance Constraints

HART communication is based on the “talking” device generating an AC current superimposed on the 4-20 mA control signal. Two frequencies are generated; one representing the digital value “0” and one representing the digital value “1”. the “listening” device responds to the voltage generated when the AC current flows through the loop impedance. (In order to generate a voltage from a current there must be an impedance.) HART Protocol required that this impedance be at least 220 Ohms at the tone signaling frequencies. At DC (zero frequency) a current source presents a very high impedance. (Little change in current for a large change in voltage.)

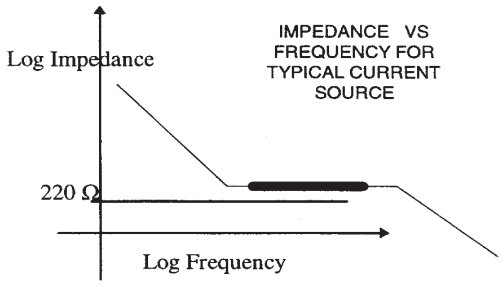


Figure 26. Impedance vs Frequency for Typical Current Source

However, at higher frequencies, the impedance may be lower. For example, a noise reduction capacitor across the output of a current source will lower the impedance at higher frequency and thus lower the signaling voltage. Ideally the current source will be supplied with an impedance versus frequency characteristic (see fig 26). The heavy band in the sketch represents the range of frequencies for signaling tones. In practice, this detailed information is seldom available. To be certain that at least 220 Ohms of impedance is presented by the current source a resistor may be added in series with the current source (see figure 27). However, this will reduce the effective compliance voltage of the current source by 20 mA times the value of the series resistor. for example, a 250 Ohm resistor will reduce the effective compliance voltage by 5 Volts. Consider that the compliance voltage of a typical current source is 24 Volts, and the voltage requirement of the SVI is 12 Volts (typically only about 10.5 Volts) there is plenty of compliant voltage even with 5 volts dropped by the series resistor.

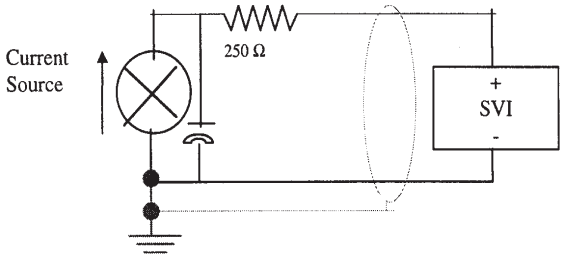


Figure 27. Resistor Add in Series with Current Source

Noise Constraints

Hart Communication depends on converting two frequencies into digital values “0” and “1”. Noise can cause errors in the conversion. Conventional good wiring practice such as use of twisted shielded pair cable with the shield and signal loop grounded at one point only will minimize the effects of noise.

Interference with DCS

The HART signaling frequencies are a 1mA peak AC current. This AC current, flowing in the DSC output, can cause a shift in the DCS 4/20 mA DC signal. both Honeywell and Moore Products DCS require a filter between the DCS and the HART signaling devices to prevent the HART frequencies from upsetting the DCS output. The filter also serves to establish a minimum impedance of greater then 250 Ohms, and to prevent AC frequencies generated in the DCS from interfering with the HART communication.

Cabling and Interconnection Constraints

Interconnections should be made using shielded twisted pair cables. The shield must be connected to ground at one point only. The signal loop should also be grounded at one point only.

Split Range

Split range SVI requires special consideration of the compliance voltage. the SVI requires about 11 Volts (the spec is 12 Volts). Two SVI in series will therefore require about 22 Volts. But the typical current source can only deliver about 24 Volts, so the system will be “Voltage starved”.

One solution is to use an active barrier for each loop. Using an active barrier allows up to three SVI to be operated from a single 4/20 mA DCS output. Each barrier has a low compliance Voltage input requirement and a high voltage output capacity. So three barriers can be connected in series input. Figure 28 shows the same barriers as are used in the multiplexer.

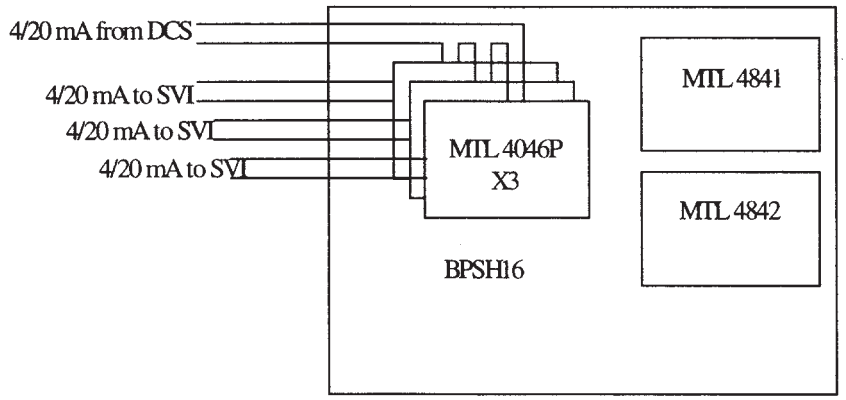


Figure 28. Split Range - Active Barrier

Another approach is to boost the compliance voltage of the DCS using a power supply (see figure 29). The DCS vendor should be contacted to validate this approach.

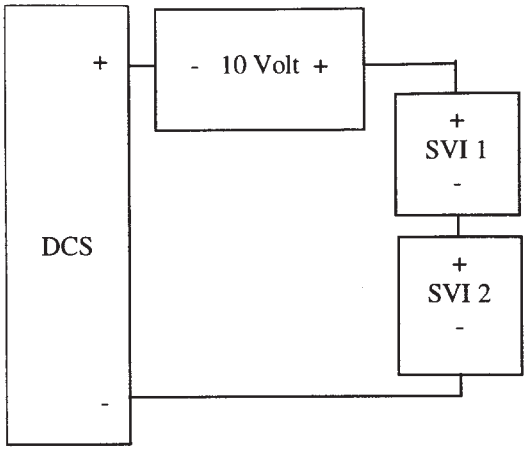


Figure 29. Compliance Voltage Boost

A further constraint on the split range system is that the minimum span is 5 mA, the upper range value is 8 to 20 mA and the lower range value is 4 to 14 mA. (Example 4-9 mA; 9-14 mA, 14-20 mA.

Chapter 3 - Operation - SVI Positioner

Introduction

Operation of the SVI Positioner as a local device is controlled through the optional device-mounted pushbuttons and digital display, as shown in Figure 30. Using the display, you can read: (1) the input signal (2) pneumatic output signal, and (3) valve position. The display sequences from one variable to the next every 1.5 seconds.

Using the pushbuttons, you can exit from operating mode at any time and step through a menu structure to perform a wide range of manual operation, calibration, configuration, and monitoring functions, all of which are described later in this section. Before you can perform any of these functions, however, you must first ensure that the ValVue software (if used) has placed the pushbuttons in the “unlocked” mode. (See ValVue User Manual for more details.) The pushbuttons do not support any diagnostics functions.

NOTE: If the SVI unit is specified without local pushbuttons and display, local operation is not available.

Pushbuttons/Display

As shown in Figure 30, the upper line is a 7-digit numeric display and the lower line is a 7-digit alphanumeric display. The upper line is used for displaying values such as input signal or valve position, and the lower one is primarily used for messages and parameter identification.

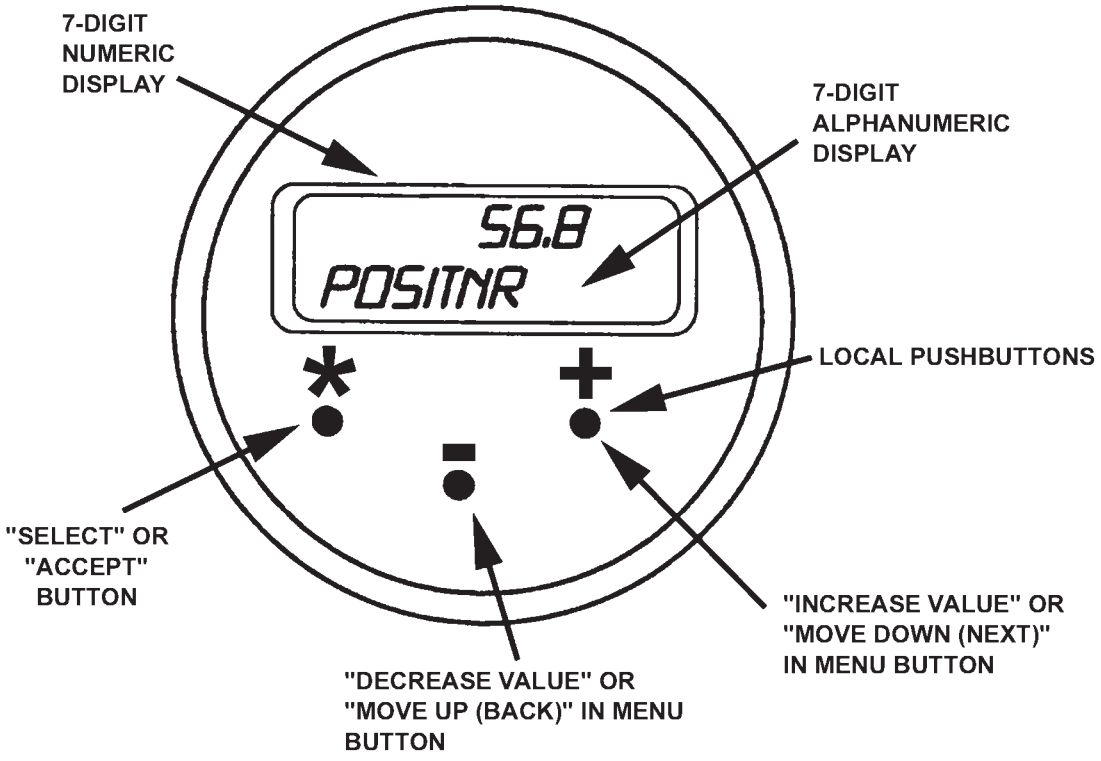


Figure 30. Local Display and Pushbuttons

The three pushbuttons perform the following functions:

- The left button, marked with *, permits you to “select” or “accept” the value or parameter option currently displayed.

- The middle button, marked (–), permits you to move back through the menu structure to the previous item in the menu, or to decrement the value currently shown in the digital display. When used to decrease a displayed value, holding this button down causes the value to decrease at a faster rate.
- The right button, marked (+), permits you to move down through the menu structure to the next item in the menu, or to increment the value currently shown in the digital display. When used to increase a displayed value, holding this button down causes the value to increase at a faster rate.

To determine how to display and/or select a particular parameter value or configuration option, refer to the menu structure diagrams in Figure 31 through Figure 35. By using these diagrams as a map, you can quickly move through the menus to the function you want to perform.

NOTE:

If the buttons are pushed after being locked by the ValVue software, the message “LOCKED” will appear. Please refer to ValVue Software Manual to unlock pushbuttons.

NOTE:

When an SVI is turned on, it is advisable to apply the air supply before applying the electrical input signal.

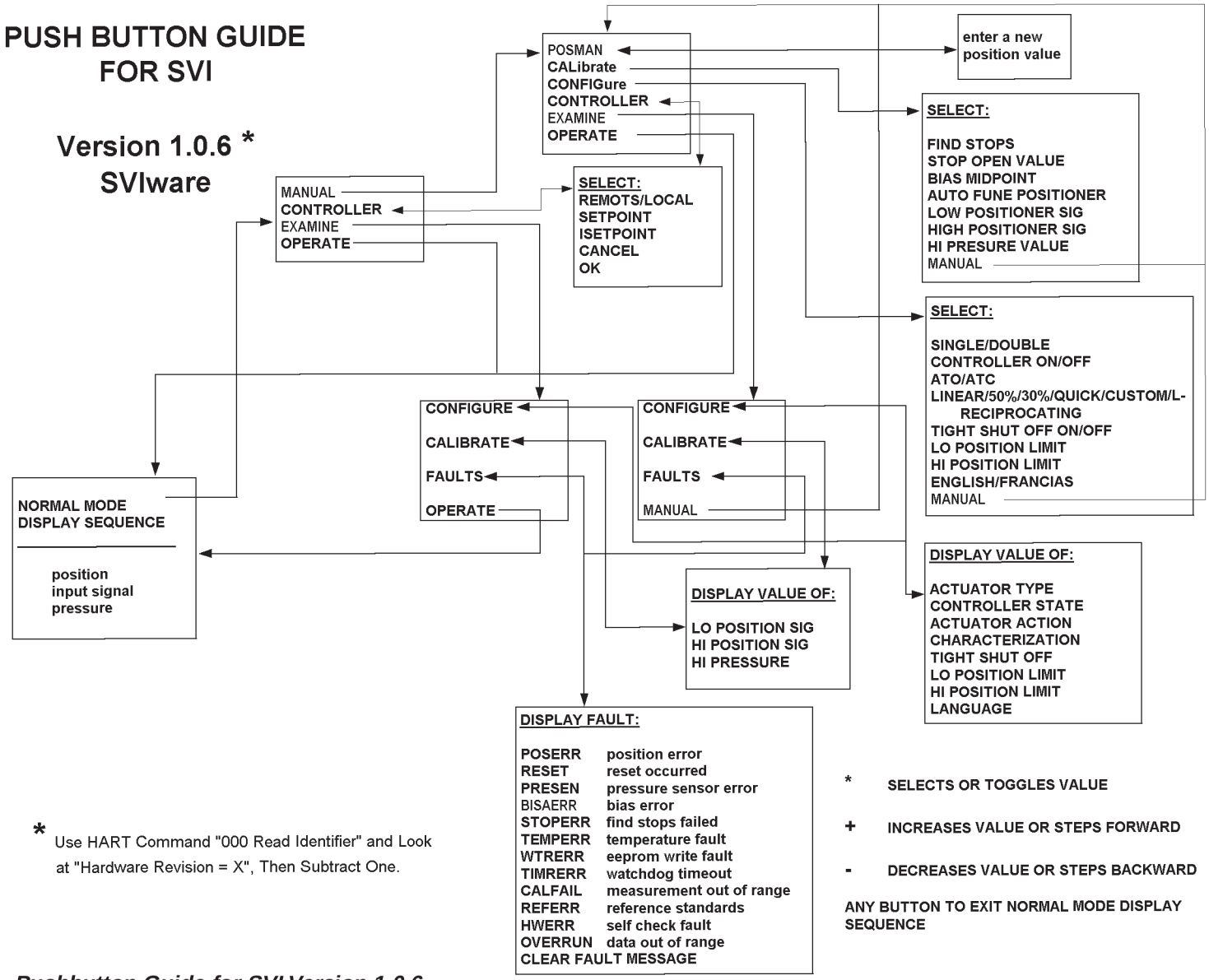


Figure 30a. Pushbutton Guide for SVI Version 1.0.6

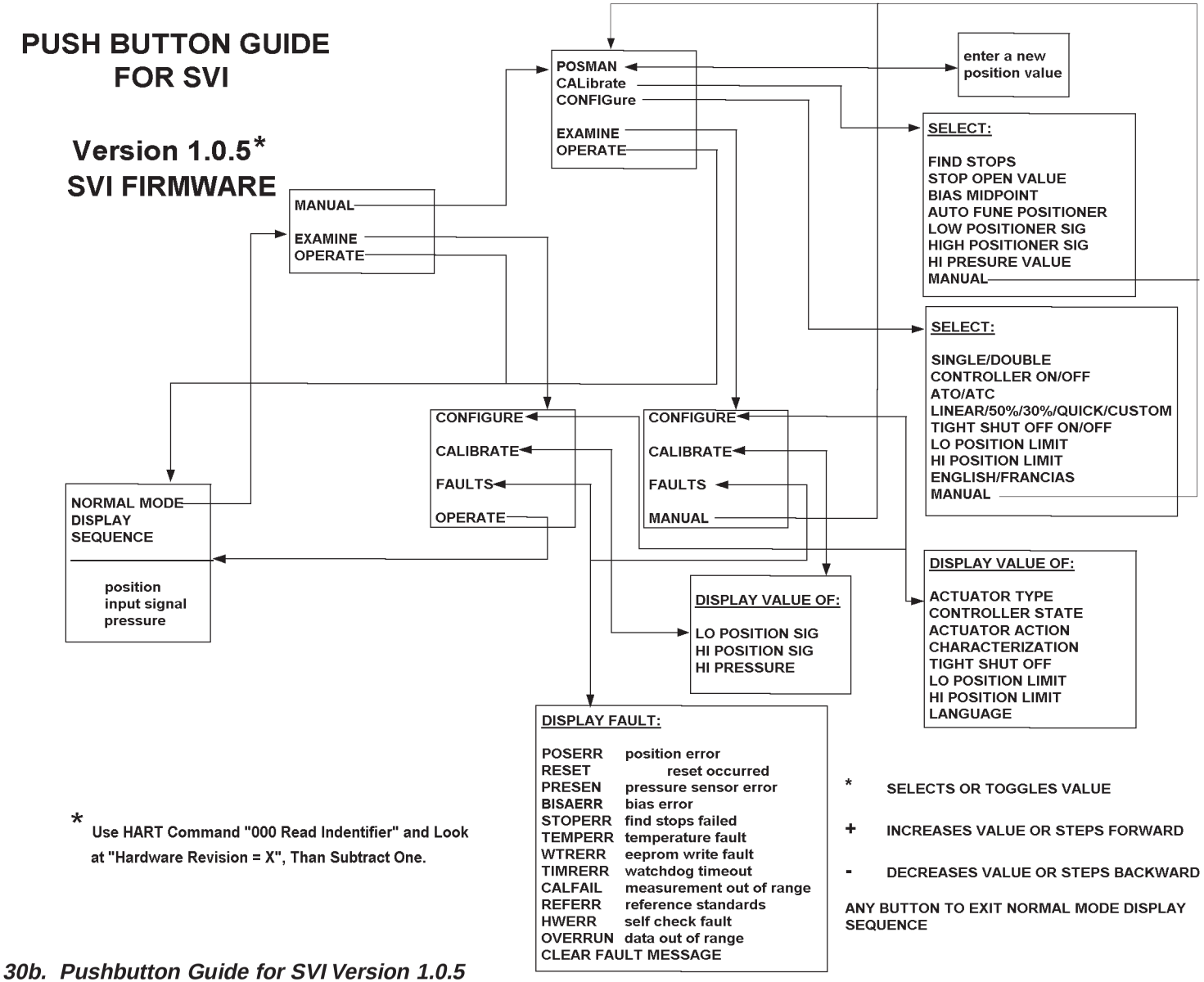


Figure 30b. Pushbutton Guide for SVI Version 1.0.5

Menu Structure

The menu structure for operating the SVI from the local pushbuttons and display is shown in Figure 31 to Figure 35 on the following pages.

NORMAL OPERATE Mode and Manual Mode Menus

Note that when you leave the NORMAL OPERATE mode to go to MANUAL mode, the valve is placed in the last position it was in when it left NORMAL OPERATE. When in the MANUAL mode, the device will not respond to the 4-20 mA signals. However, the SVI unit can still respond to HART commands, including HART commands to position the valve. Note also that when you go to EXAMINE from the normal OPERATE MODE MENU, the valve is still in “NORMAL OPERATE” mode and still responds to the 4-20 mA signal.

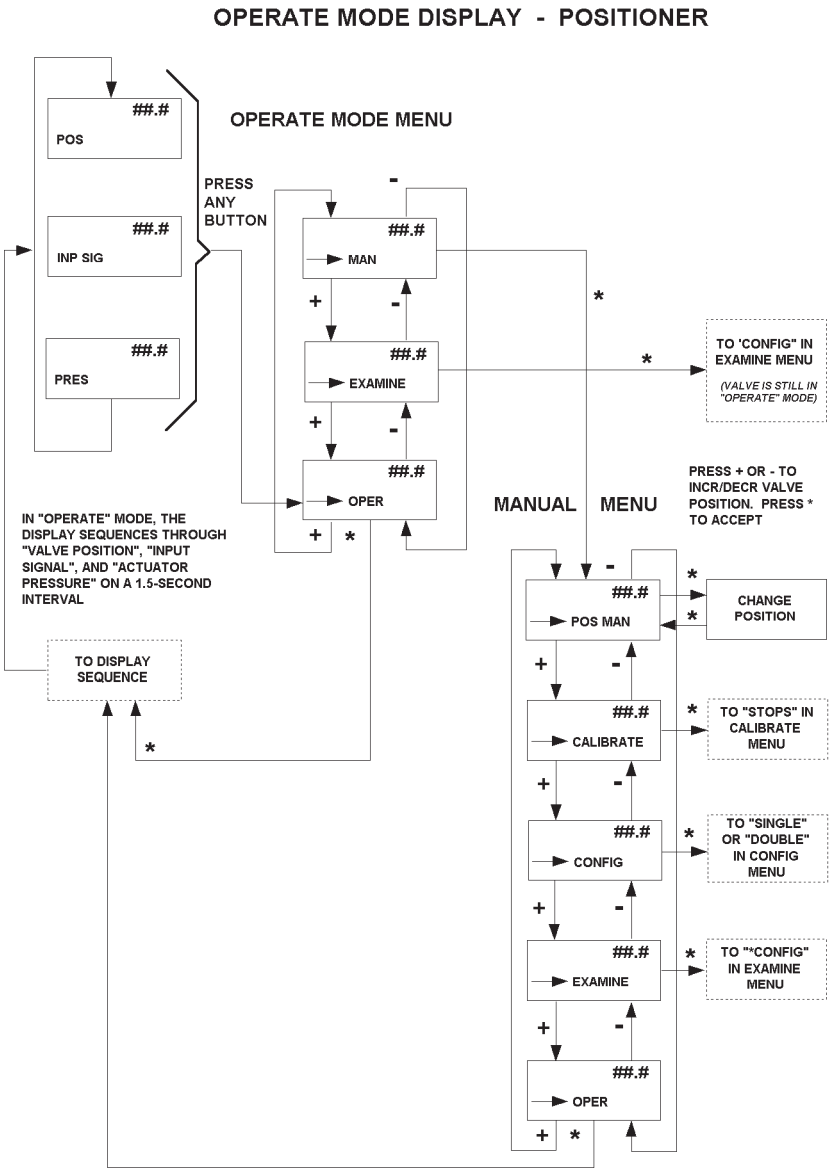


Figure 31. NORMAL OPERATE, MODE SELECT, and MANUAL Menu Structures

Configure Menu

Because calibration depends on certain configuration options, you must perform “Configuration” before you perform “Calibration” when installing the SVI the first time.

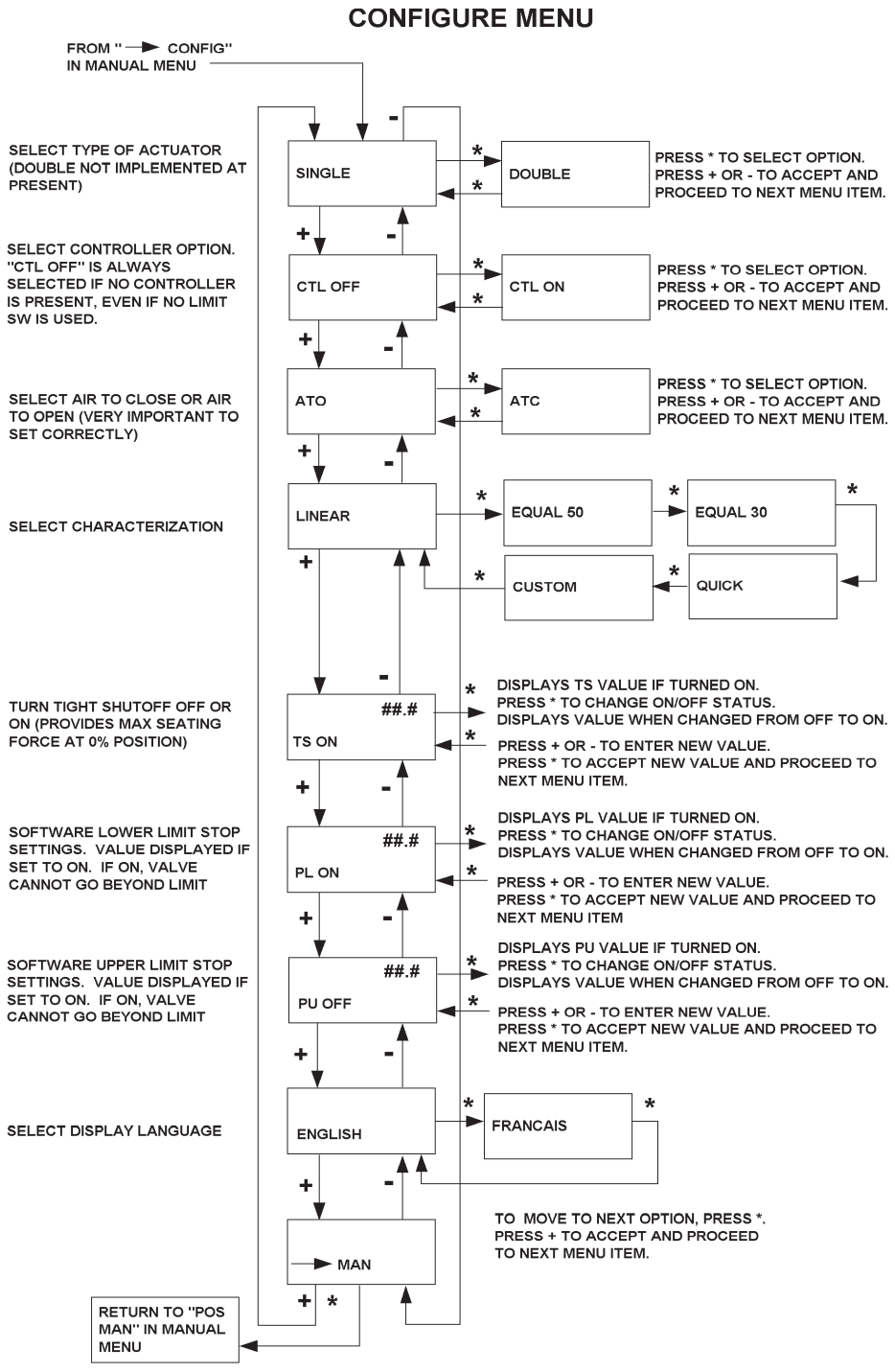


Figure 32. CONFIGURE Menu Structures

Calibrate Menu

If a change is made in the Air-to-Open/Air-to-Close or Direct/Reverse configuration options, or if you move the SVI to a different valve or make any change to the valve position linkage, you must run the find “STOPS” calibration again.

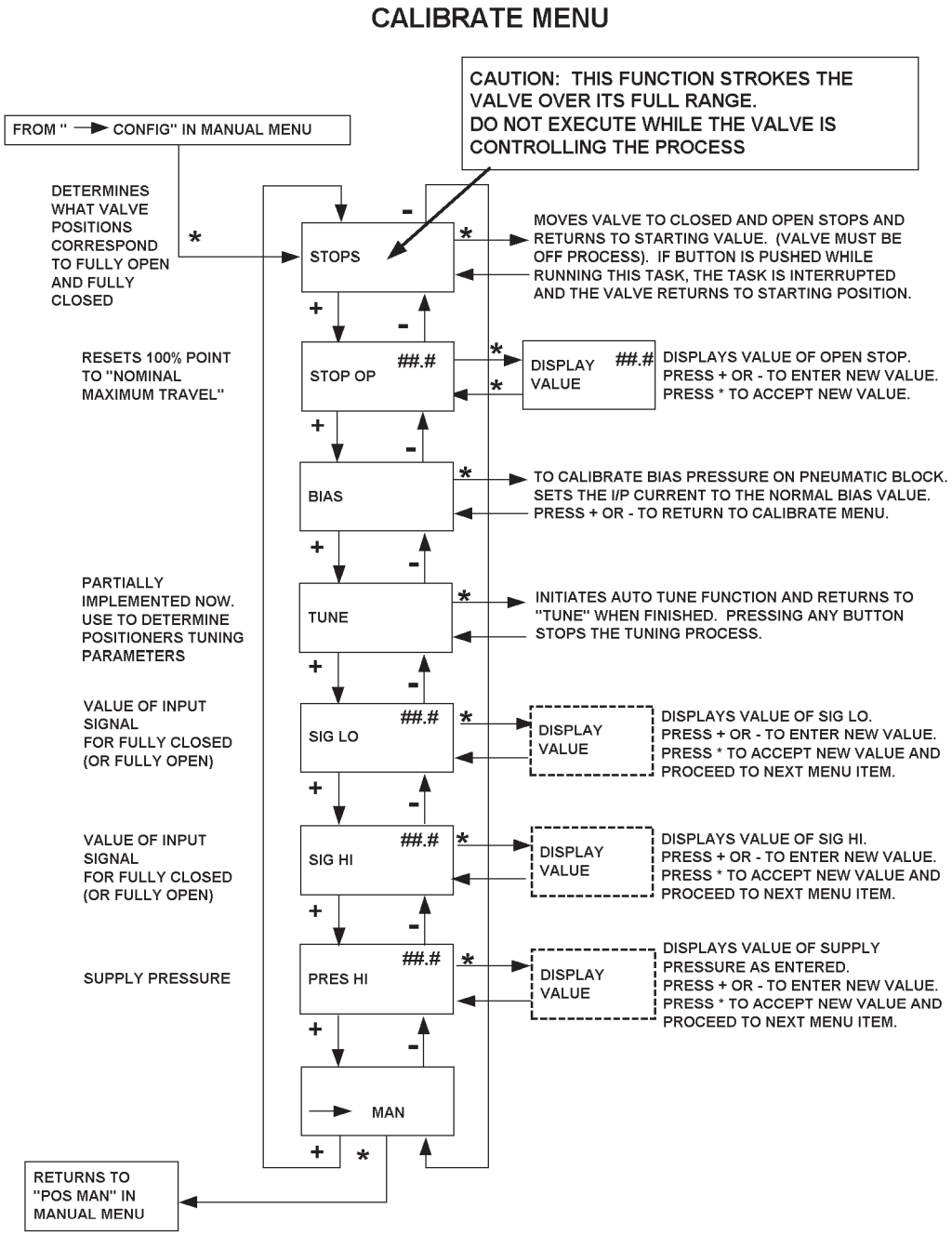
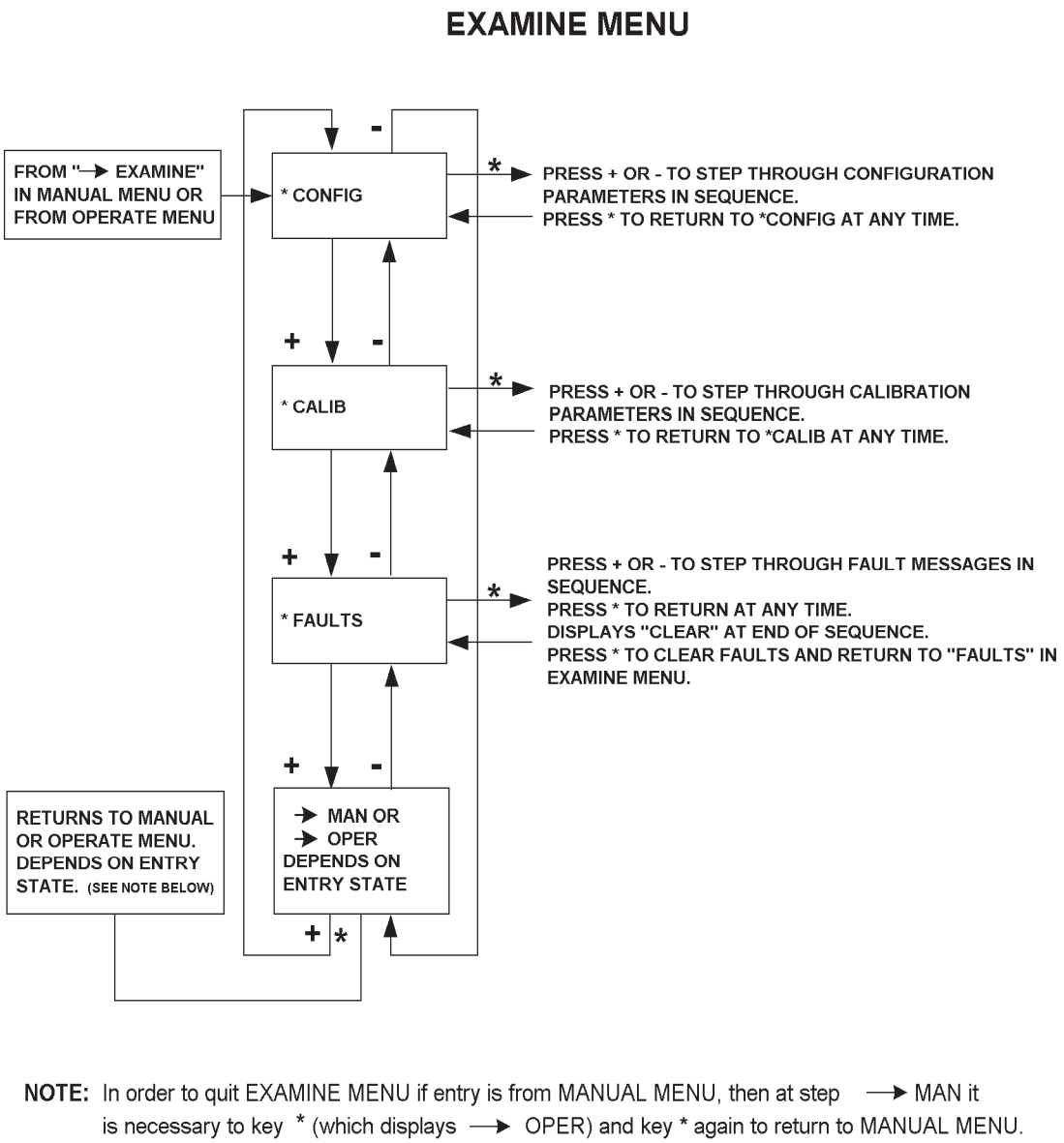


Figure 33. CALIBRATE Menu Structures

Examine Menu

This menu can be entered either from the Manual Mode Menu or from the NORMAL OPERATE Mode Menu. The EXAMINE menu allows the user to read the current configuration, calibration, and status information. This information, however, cannot be changed from the EXAMINE menu.

When you exit from the EXAMINE menu, you return to the menu from which you entered.



NOTE: In order to quit EXAMINE MENU if entry is from MANUAL MENU, then at step → MAN it is necessary to key * (which displays → OPER) and key * again to return to MANUAL MENU.

Figure 34. EXAMINE Menu Structure

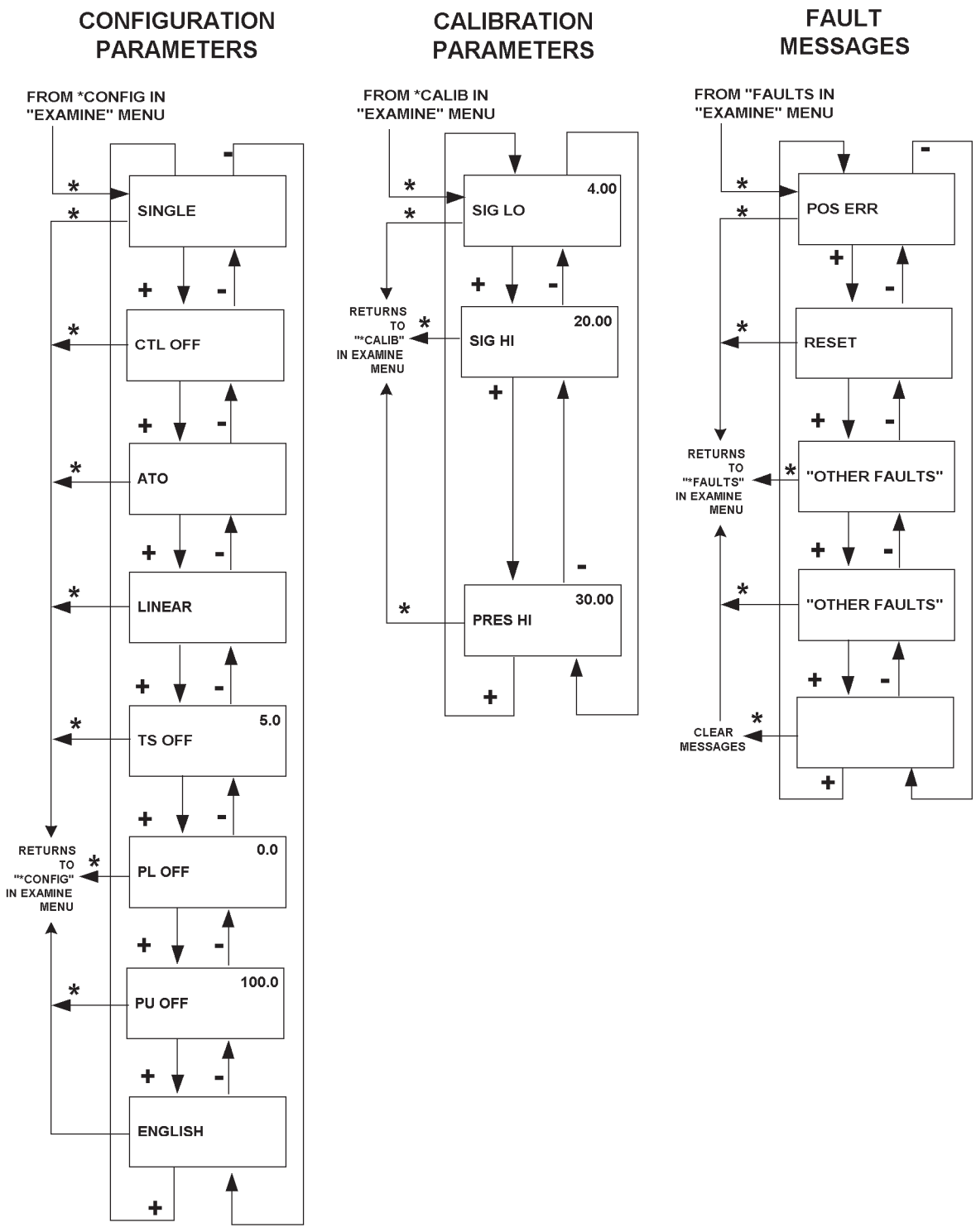


Figure 35. Parameter and Message Displays

Normal Operation - Positioner

Functions

In normal operation, the SVI unit operates as a positioner using a 4-20 mA input signal as set point. The local digital display sequentially displays valve position, input signal, and actuator pressure on a 1.5-second interval. Pressing any button moves you to the (OPER option in the OPERATE MODE MENU, as shown in Figure 31 on page 34.

The OPERATE MODE MENU has 3 options: → MAN (put valve in manual mode and go to MANUAL Menu), → EXAMINE (go to EXAMINE Menu), and →OPER (return to display of current position, pressure, and signal). Use the pushbuttons to move from one option to the next. Press the * button to go to the item displayed in the menu.

Configuration

Parameters and Options Available
You can configure the following options by pressing the local pushbuttons in the procedure described below. We recommend that you use the menu structure diagrams in Figure 31 to Figure 35 on pages 34 to 38 as a road map in following the procedures described.

As noted previously, configuration should be performed before calibration. Also note that configuration can be performed only when the valve is in manual mode.

The configurable options are as described in Table 6.

MENU ITEM	DESCRIPTION OF OPTIONS
SINGLE (or DOUBLE)	Select single or double acting actuator (not presently available)
CTL OFF (or ON)	Select PID Controller function (OFF or ON)
ATO (or ATC)	Select Air-to-Open or Air-to-Close actuator operation
LINEAR (or EQUAL 50, EQUAL 30, QUICK, CUSTOM)	Select desired valve characteristic curve (linear, equal percentage 50, equal percentage 30, quick opening, or custom curve). The custom curve must have been entered through the remote PC.
TS (OFF or ON)	Display and set value of tight shutoff point. Default is 0.0%
PL (OFF or ON)	Display is set value of the lower software position limit stop. Default is 0.0%
PU (OFF or ON)	Display is set value of the upper software position limit stop. Default is 0.0%
ENGLISH (or FRENCH)	Select language for displays (English or French)

Table 6. Local Configuration Options

Procedures

To configure the SVI unit, execute the following procedure:

1. If in NORMAL OPERATE mode, press any button. →OPER will be displayed. Press + to get to the →MAN menu item.
2. Press * to move to MANUAL menu. (“POS MAN” displayed) This locks the valve in position and places it in Manual Mode.
3. Press + twice to move to →CONFIG option.
4. Press * to put the SVI in the configure mode and display the first item in the CONFIGURE menu.
5. If Single or Double displayed is the one desired, press + to move to the next item. If not, press * to select the alternate choice. When OK, press + to move to next item. (Note: DOUBLE is not presently implemented.)
6. In CTL ON (OFF), OFF should be displayed for positioner. If display shows ON press * to select OFF. Press + to move to the next item.
7. In ATO (ATC), if option displayed is correct, press + to move to the next item. If not, press * to select the alternate choice. When OK, press + to move to the next item.
8. In LINEAR (or other curve), if option displayed is the one desired, press + to move to the next item. If not, press * to select the other options. When OK, press + to move to next item. If “custom” is selected, the custom curve must have been entered through the ValVue software program. The curve itself cannot be entered from the local pushbuttons.
9. The tight shutoff (TS) option allows the user to configure the positioner to apply full supply pressure (or atmospheric pressure) to the actuator whenever the signal directs the valve “near” the closed position. If the tight shutoff option is on, the value of the TS option determines the “near” value at which the valve is forced fully shut. In TS OFF (ON), if status and value displayed are satisfactory, press + to move to next item. If not, press * to change on/off status and display value. Then press + or - buttons to increase or decrease value displayed. (When status is changed from ON to OFF, no value is displayed). When value is OK, press * to accept value and move to next item.
10. The SVI allows the user to configure a lower (PL) and upper (PU) software position limit stop. When in operation with these limits on, the valve will not move below the lower limit stop or above the upper limit stop. (Caution: These are software limit stops. If the SVI fails for any reason including power fail ure or air failure, the SVI cannot enforce these limit stops and the valve will go to fail-safe. Furthermore, the FULL OPEN AND FULL CLOSED buttons in ValVue bypass the limit stop controls. If safety requires the use of limit stops, mechanical limit stops should be used). In PL OFF (ON), if status and value displayed are satisfactory, press + to move to next item. If not, press * to change on/off status and display value. Then press + or - buttons to increase or decrease value displayed. (When status is changed from ON to OFF, no value is displayed). When value is OK, press * to accept value and move to next item.
11. In PU OFF (ON), if status and value displayed are satisfactory, press + to move to next item. If not, press * to change on/off status and display value. Then press + or - buttons to increase or decrease value displayed. (When status is changed from ON to OFF, no value is displayed.) When value is OK, press * to accept value and move to next item.
12. The SVI local display may be configured to display English or French. If the language displayed is correct, press + to move to next item. If not, press * repeatedly to display other language options. When the desired language is displayed, press + to move to next item.
13. At → MAN, press + to move to the top of the CONFIGURATION menu or - to move back to the previous item. To leave the CONFIGURATION menu, press *. This returns you to the MANUAL menu. (“POS MAN” displayed)

    This completes the configuration procedure
14. To continue with calibration press - to move to →CAL option. Continue with Step 4 below.

Local Calibration

NOTE:

Perform configuration before running calibration functions.

Functions

You can perform the following calibration functions with the SVI product:

- Low and high values for input signal
- Low and high values for actuator pressure output
- Set the minimum and maximum stops for valve position

Procedures

Refer to the menu structure diagrams in Figures 31 through 35 on pages 46 to 50 for assistance in following the procedures described.

To “calibrate” the SVI unit using the local pushbuttons, execute the following procedure:

CAUTION:

Since some calibration functions stroke the valve over its full range, the valve should be isolated from the process before starting calibration.

1. If in NORMAL OPERATE mode, press any button, →OPER will be displayed. Press + to get to the →MAN menu item.
2. Press * to move to MANUAL MENU (POS MAN displayed)
3. Press + to move to →CAL option.
4. Press * to go to CALIBRATE menu. STOPS will be displayed.
5. In STOPS, press * to initiate the operation, which moves the valve to fully closed, then fully open, and then returns to the starting position. (This operation calibrates the end points for the position feedback potentiometer.) When the operation is complete, press + to move to the next item.

CAUTION:

This function strokes the valve over its full range. Do not execute while valve is controlling the process.

6. On some valves, the full travel is larger than the nominal travel of the valve and it may be desirable to have the reported 100% position correspond to the nominal travel rather than the full stroke. The STOP OP option allows this correction. If a correction is to be made, press * to move valve to the 100% position. Using the + and - buttons, position the valve to the nominal full open position. Press * to accept this position as the new 100% position.
7. The Bias is the signal sent to the internal I/P that causes the actuator to neither fill nor exhaust. The pneumatics are adjusted at the factory and should not need further adjustment. If the pneumatics need to be readjusted for any reason, the BIAS option should be selected by pressing *. This will output a value of 2750 to the I/P. The adjustment screw on the top of the pneumatics section can be adjusted until the valve is nearly stationary near mid travel. See “Bias Adjustment” in “Troubleshooting”. Press + to move to the next menu item.
8. The TUNE menu item allows the user to initiate the automatic position control tuning function which will select appropriate PID parameters for the position controller. Press * to initiate AUTO TUNE function. This procedure may take from 1 to 5 minutes. During this time the valve will make a series of steps (Caution: This procedure should not be performed while the valve is controlling the process.) When the function is completed, you return to TUNE. Press + to advance to the next item.

9. SIG LO displays the input signal that should correspond to the full closed or full open position of the valve (depending upon whether the valve is air-to-open or air-to-close and whether the positioner is direct or reverse). In SIG LO, if the displayed value is correct, press + to advance to the next item. If not, press * to display value of SIG LO. Use + and – buttons to change the value. When OK, press * to return to menu and move to next item.
10. SIG HI displays the input signal that should correspond to the full open or full closed position of the valve (depending upon whether the valve is air-to-open or air-to-close and whether the positioner is direct or reverse. SIG HI must be larger than SIG LO by at least 5 mA. In SIG HI, if the displayed value is correct, press + to advance to the next item. If not, press * to display value of SIG HI. Use + and – buttons to change the value. When OK, press * to return to menu and move to next item.
11. The PRES HI menu item allows the user to enter the supply pressure. This pressure is used for scaling of the pressure data in the SVI. In PRES HI, if the displayed value is correct, press + to advance to the next item. If not, press * to display value of PRES HI. Use + and – buttons to change the value. When OK, press * to return to menu and move to next item.
12. Calibration as a positioner is now complete. At →MAN, press * to return to the MANUAL mode. (POS →MAN displayed)

Return to Normal Operation

To return to NORMAL OPERATE mode from any menu, press + or - repeatedly until →MAN (or →OPER) is displayed. If →OPER appears, press * to return to NORMAL OPERATE mode. If →MAN appears, press * to return to Manual Mode Menu. Then press + repeatedly until →OPER appears. Then press * to return to NORMAL OPERATE mode and normal operation.

Examine

Functions

The EXAMINE menu permits you to display calibration parameters, configuration parameters, and to display and/or clear fault status messages and codes. (Refer to the Table 8 for explanations of fault messages.)

You may enter the Examine menu either from NORMAL OPERATE Mode or from Manual Mode. When entered from NORMAL OPERATE mode the valve still responds to changes in set point input signal and the values displayed change in accordance with changes in input signal.When entered from Manual mode, the valve is locked in position.

When you exit from the EXAMINE menu, you return to the menu from which you entered.

Procedures

Examine Calibration Parameters
To examine the calibration parameters, execute the following procedure:

1. If in NORMAL OPERATE mode, press any button.
2. Press + to move through the options until you reach the EXAMINE menu item. Press * to go to EXAMINE menu. (This leaves valve in NORMAL OPERATE mode.) If in MANUAL mode, press + repeatedly until the EXAMINE menu item is reached. Press * to select the EXAMINE mode.
3. Press + repeatedly to move through the EXAMINE menu until *CALIB is reached. Press * to display the list of calibration values. To move forward through the calibration parameters in sequence, press +. To move back through the list, press –. Press * at any time to return to *CALIB in the EXAMINE menu.

Examine Configuration Parameters
To examine the configuration parameters, execute the following procedure:

1. If in NORMAL OPERATE mode, press any button.
2. Press + to move through the options until you reach the EXAMINE menu item. Press * to go to EXAM INE menu. (This leaves valve in NORMAL OPERATE mode.) If in MANUAL mode, press + repeated ly until the EXAMINE menu item is reached. Press * to select the EXAMINE mode.
3. Press + repeatedly to move through the EXAMINE menu until *CONFIG is reached. Press * to display the list of configuration values.
4. To move forward through the configuration parameters in sequence, press +. To move back through the list, press –.
5. At any time, to return to *CONFIG in the EXAMINE menu, press *.

Display/Clear FAULTS
To examine and /or clear fault codes and messages, execute the following procedure:

1. If in NORMAL OPERATE mode, press any button.
2. Press + to move through the options until you reach the EXAMINE menu item. Press * to go to EXAM INE menu. (This leaves valve in NORMAL OPERATE mode.) If in MANUAL mode, press + repeated ly until the EXAMINE menu item is reached. Press * to select the EXAMINE mode.
3. Press + repeatedly to move through the EXAMINE menu until *FAULTS is reached. Press * to display the list of status values. To move forward through the faults in sequence, press +. To move back through the list, press –. The last item in the list is CLEAR. When this message is displayed, you can clear all faults by pressing *. This will also return you to FAULTS in the EXAMINE menu. If you do not want to clear all fault messages, press + or - to move to another item in the list. You can then press * to return to FAULTS in the EXAMINE menu without clearing fault messages.

   This completes the EXAMINE functions.

Positioner Fault Messages

Table 7 lists the fault codes/messages that may appear on the display. The table also explains the meaning of each message, the probable cause of the fault, and recommended action you should take to correct the fault.

Table 7. Positioner Fault Messages

Display Code	Fault Message	Meaning	Latched Error *	Probable Cause
POS ERR	Position Error	Valve position did not agree with SVI output command within acceptable time		Valve is stuck or feedback linkage is disconnected or broken
BIAS ERR	I/P Output at null point is out of range	Bias is out of range	✓	Supply pressure too low or incorrect pneumatic block adjustment
POS SEN	Position Sensor Error	The position sensor has failed or is not aligned properly		Failed or linkage aligned incorrectly
PRES SEN	Pressure Sensor Error	The pressure sensor has failed		Failure
SIG SEN	Current Sensor Error	The primary signal (4-20) sensor has failed		Failure
REF ERR	Reference Voltage Error	The A/D reference voltage is incorrect	✓	Failure
SW ERR	Self Check Failure	SVI failed self-check diagnostics		Failure
RESET	Reset	SVI has reset since last status clear	✓	Power loss
OVER RUN	Data Overrun	Internal check failed to process data in time		Hardware failure

***** Latched Errors are historical data that may or may not effect valve operation. To check Latched Errors, use the “Clear Status” command via pushbuttons, valve, or HART handheld.

Table 7. Positioner Fault Messages (continued)

Display Code	Fault Message	Meaning	Latched Error *	Probable Cause
TEMP ERR	Circuit Temperature Error	Internal SVI temperature out of range	✓	
WRT ERR	EEP Prom Write Failed	Device failed to write to nonvolatile memory		Hardware failure
TIMER SEN	Watchdog Timer Timeout	SVI failed to send D/A output within timeout		Hardware failure
CAL FAIL	Calibration Failed	Signal or pressure calibration		Bad value set in calibration mode
STOP ERR	Find Stops Failed	The auto POS calibration failed		Pressure sensor not working or bias adj. not correct, or valve will not move
FAIL SAFE	Fail-Safe Position	Valve has been placed in the fail-safe position		Primary sensor failure or linkage not aligned correctly on the potentiometer

***** Latched Errors are historical data that may or may not effect valve operation. To check Latched Errors, use the “Clear Status” command via pushbuttons, valve, or HART handheld.

Chapter 4 - Operation-SVI Controller

Introduction

NOTE: The SVI must have the controller option installed at the factory. With this option installed, the SVI can be operated as either a positioner or controller, selectable by Val-Vue, HART Communicator or the local pushbuttons. (Local pushbuttons support limited controller functions.)

Operation of the SVI Controller with firmware version 1.0.5 requires that all controller operating parameters be entered from either ValVue software or from a HART 275 Hand Held Communicator with Masoneilan SVI Software. The operating parameters that are used for both controllers and positioners can be entered either from the local pushbuttons or ValVue or the Hand-held. The primary process measurement, made by the process transmitter is fed to the controller as a 1-5 V dc signal and connected to terminals “A” and “B” on the SVI terminal board.

An SVI with firmware version 1.0.6 allows local pushbutton entry of setpoint values and choice of local or remote setpoint. The main controller operating parameters (P, I, D, etc.) still must be entered via ValVue or HART Handheld Communicator.
The version 1.0.6 display shows: (1) setpoint-remote or local as configured (2) process variable (3) valve position and (4) pneumatic output signal pressure. The display sequences from one variable to the next every 1.5 seconds.

Using the pushbuttons, you can exit from operating mode at any time and step through a menu structure to perform a wide range of manual operation, calibration, configuration, and monitoring functions, all of which are described later in this section. Before you can perform any of these functions, however, you must first ensure that the ValVue software (if used) has placed the pushbuttons in the “unlocked” mode. (See ValVue User Manual for more details).

NOTE: If the SVI unit is specified without local pushbuttons and display, local operation is not available, therefore, ValVue Software or a HART handheld communicator is required.

NOTE: When an SVI is turned on, it is advisable to apply the air supply before applying the electrical input signal.

Pushbuttons/Display

As shown in Figure 36, the upper line is a 7-digit numeric display and the lower line is a 7-digit alphanumeric display. The upper line is used for displaying values such as input signal or valve position, and the lower one is primarily used for messages and parameter identification.

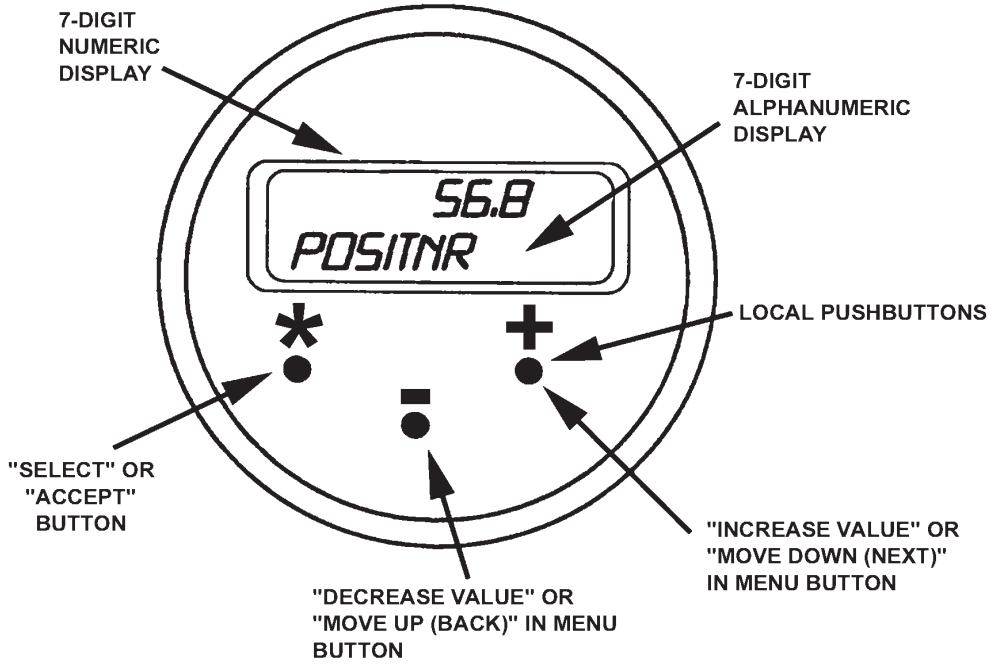


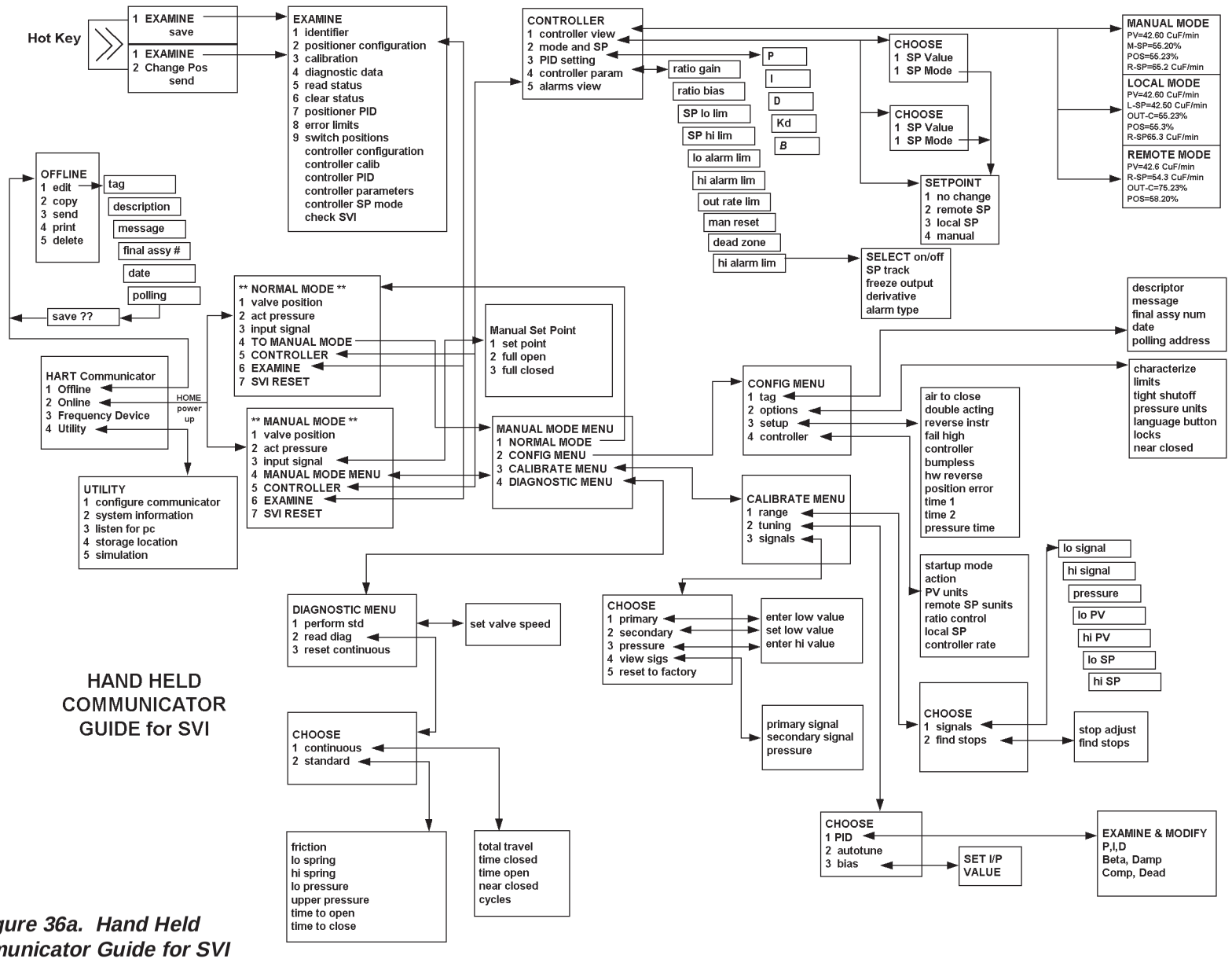
Figure 36. Local Display and Pushbuttons

The three pushbuttons perform the following functions:

- The left button, marked with *, permits you to “select” or “accept” the value or parameter option currently displayed.
- The middle button, marked (–), permits you to move back through the menu structure to the previous item in the menu, or to decrement the value currently shown in the digital display. When used to decrease a displayed value, holding this button down causes the value to decrease at a faster rate.
- The right button, marked (+), permits you to move down through the menu structure to the next item in the menu, or to increment the value currently shown in the digital display. When used to increase a displayed value, holding this button down causes the value to increase at a faster rate.

To determine how to display and/or select a particular parameter value or configuration option, refer to the menu structure diagrams in Figure 37 through Figure 42. By using these diagrams as a map, you can quickly move through the menus to the function you want to perform.

NOTE: If the buttons are pushed after being locked by the ValVue software, the message “LOCKED” will appear. Please refer to ValVue Software Manual to unlock pushbuttons.



HAND HELD COMMUNICATOR GUIDE for SVI

Figure 36a. Hand Held Communicator Guide for SVI

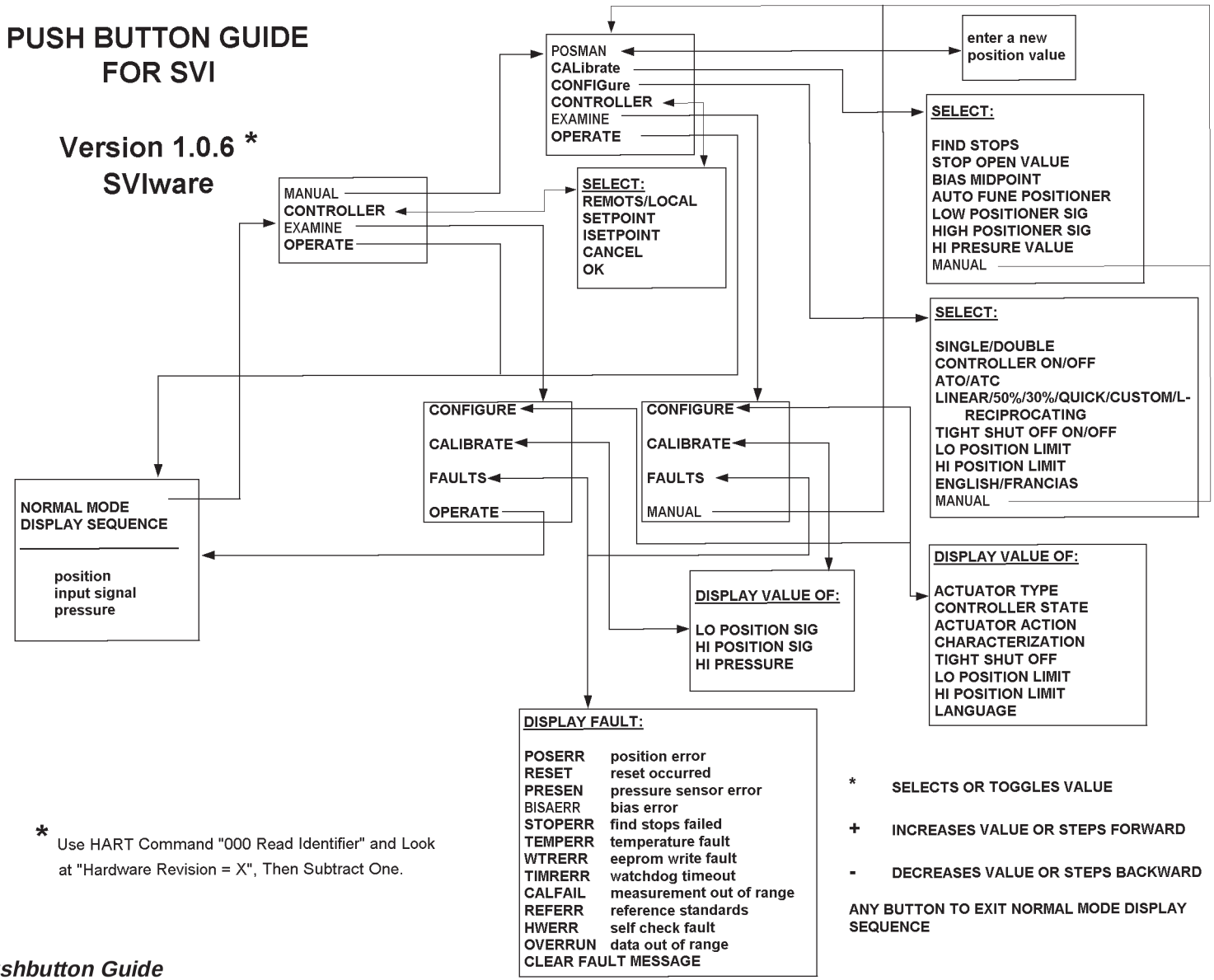


Figure 36b. Pushbutton Guide for SVI Version 1.0.6

Menu Structure

The menu structure for operating the SVI from the local pushbuttons and display is shown in Figures 37 through 42 on the following pages.

Normal Operate Mode and Manual Mode Menus

Note that when you leave the NORMAL OPERATE mode to go to MANUAL mode, the valve is placed in the last position it was in when it left NORMAL OPERATE. When in the MANUAL mode, the device will not respond to the 4-20 mA signals. However, the SVI unit can still respond to HART commands, including HART commands to position the valve. Note also that when you go to EXAMINE from the NORMAL OPERATE MODE MENU, the valve is still in “NORMAL OPERATE” mode and still responds to the 4-20 mA signal.

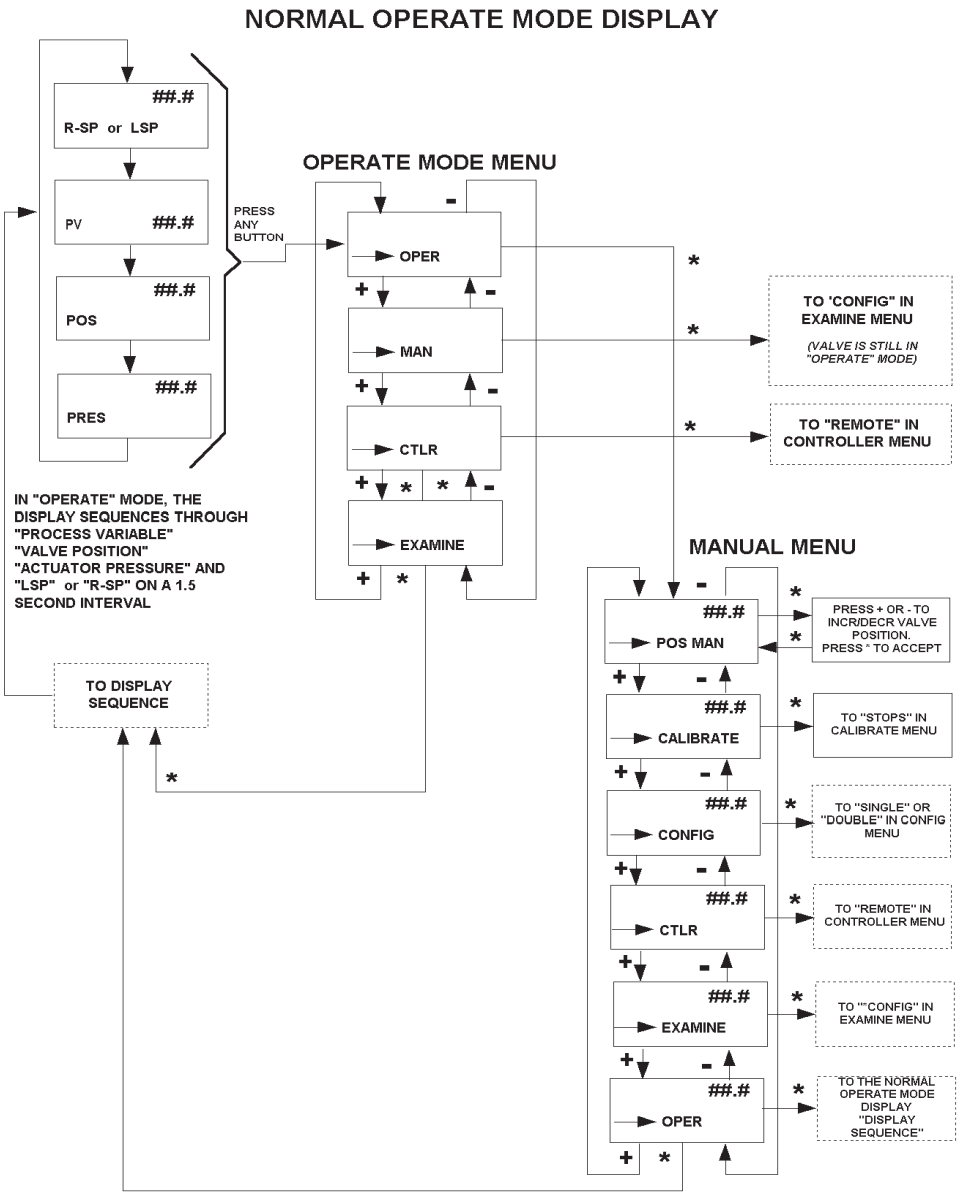


Figure 37. Normal Operate, Mode Select, and Manual Mode Menus

Configure Menu

Because calibration depends on certain configuration options, you must perform “Configuration” *before* you perform “Calibration” when installing the SVI the first time.

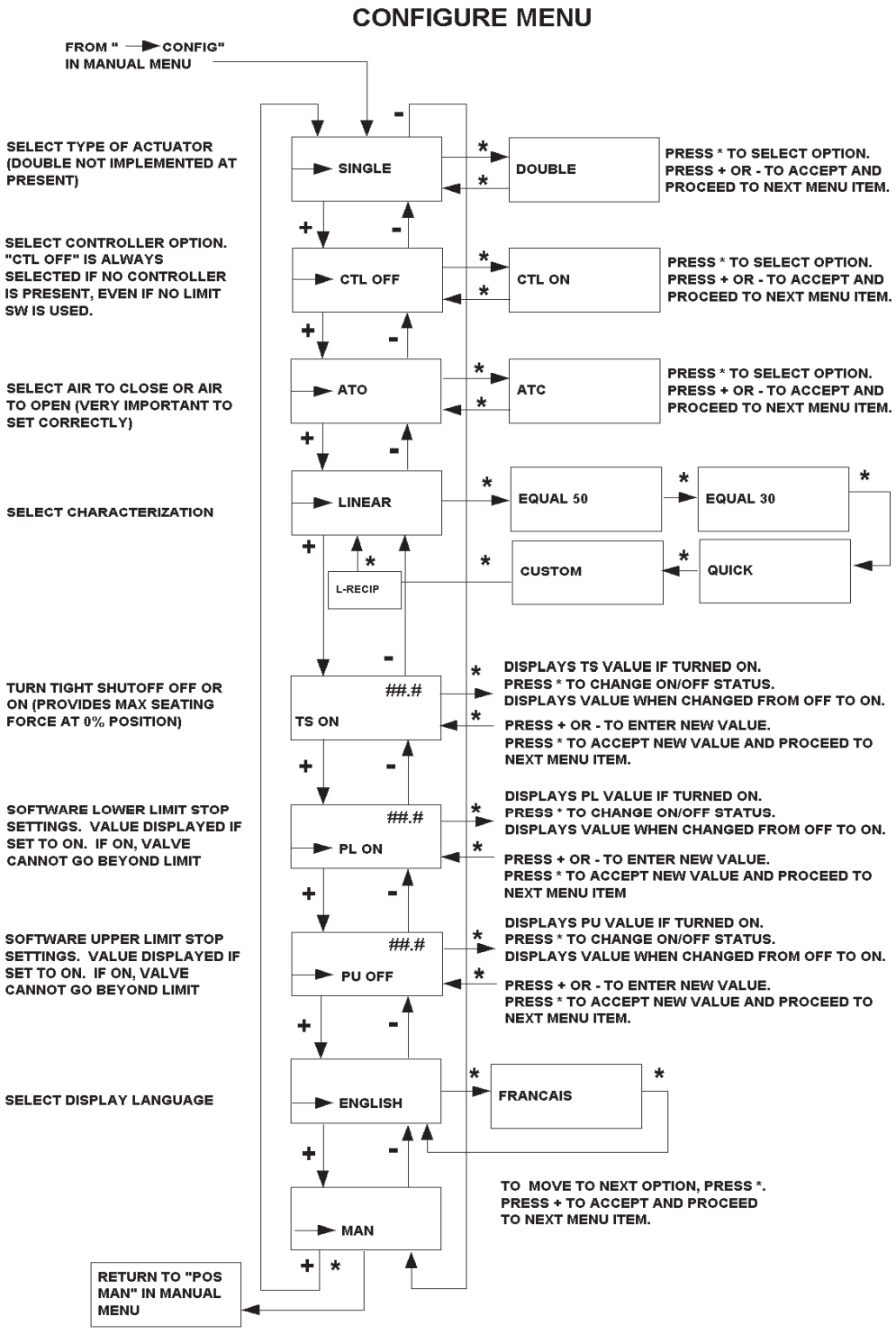


Figure 38. Configure Menu Structures

Calibrate Menu

If a change is made in the Air-to-Open/Air-to-Close or Direct/Reverse configuration options, or if you move the SVI to a different valve or make any change to the valve position linkage, you must run the find “STOPS” calibration again.

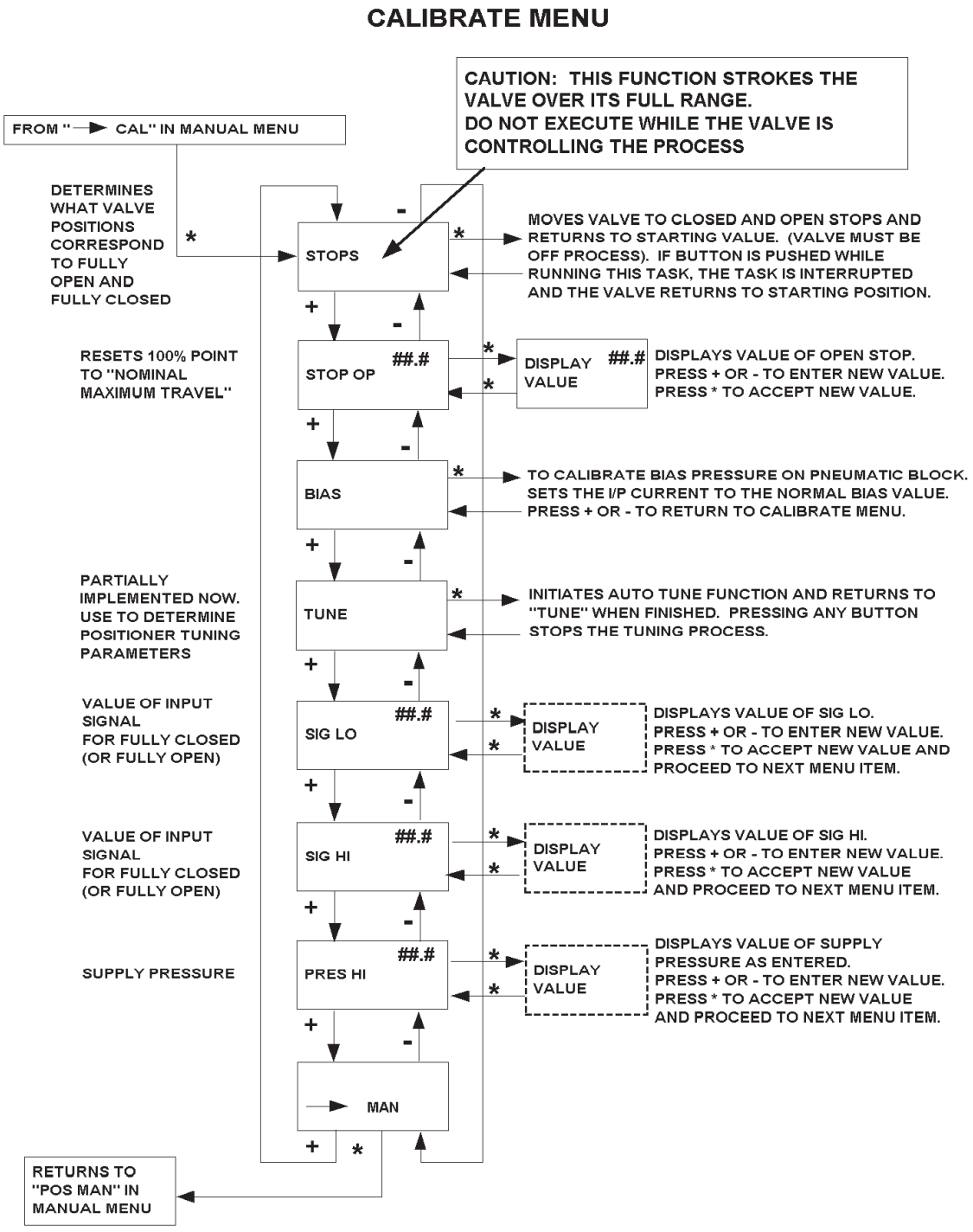


Figure 39. Calibrate Menu Structures

Controller Menu

This menu can be entered from either the MANUAL Mode Menu or the NORMAL OPERATE Mode Menu. The Controller menu allows the user to read and change the controller mode, local setpoint, and startup setpoint. When you exit from the CONTROLLER menu, you return to the menu from which you entered.

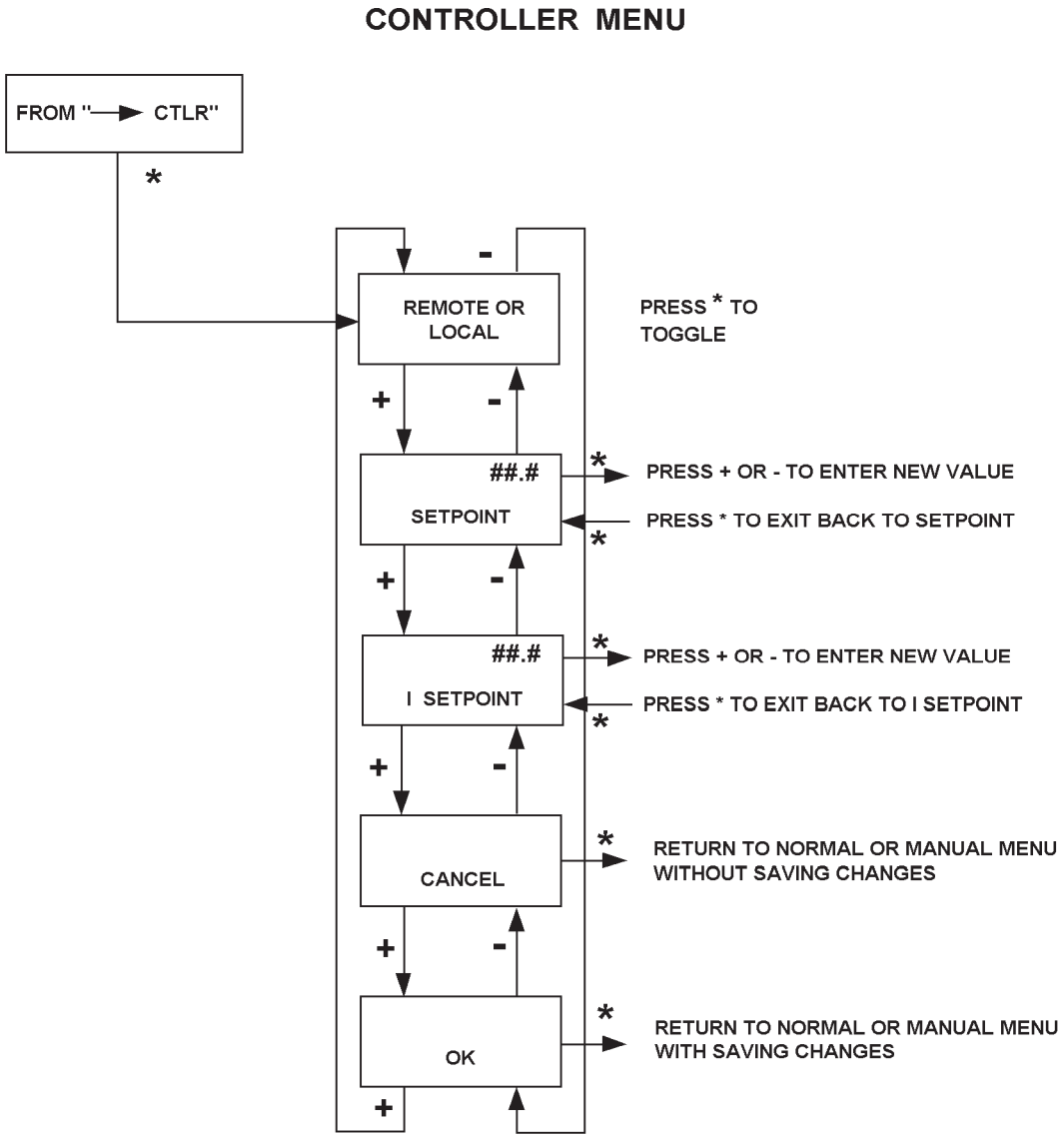
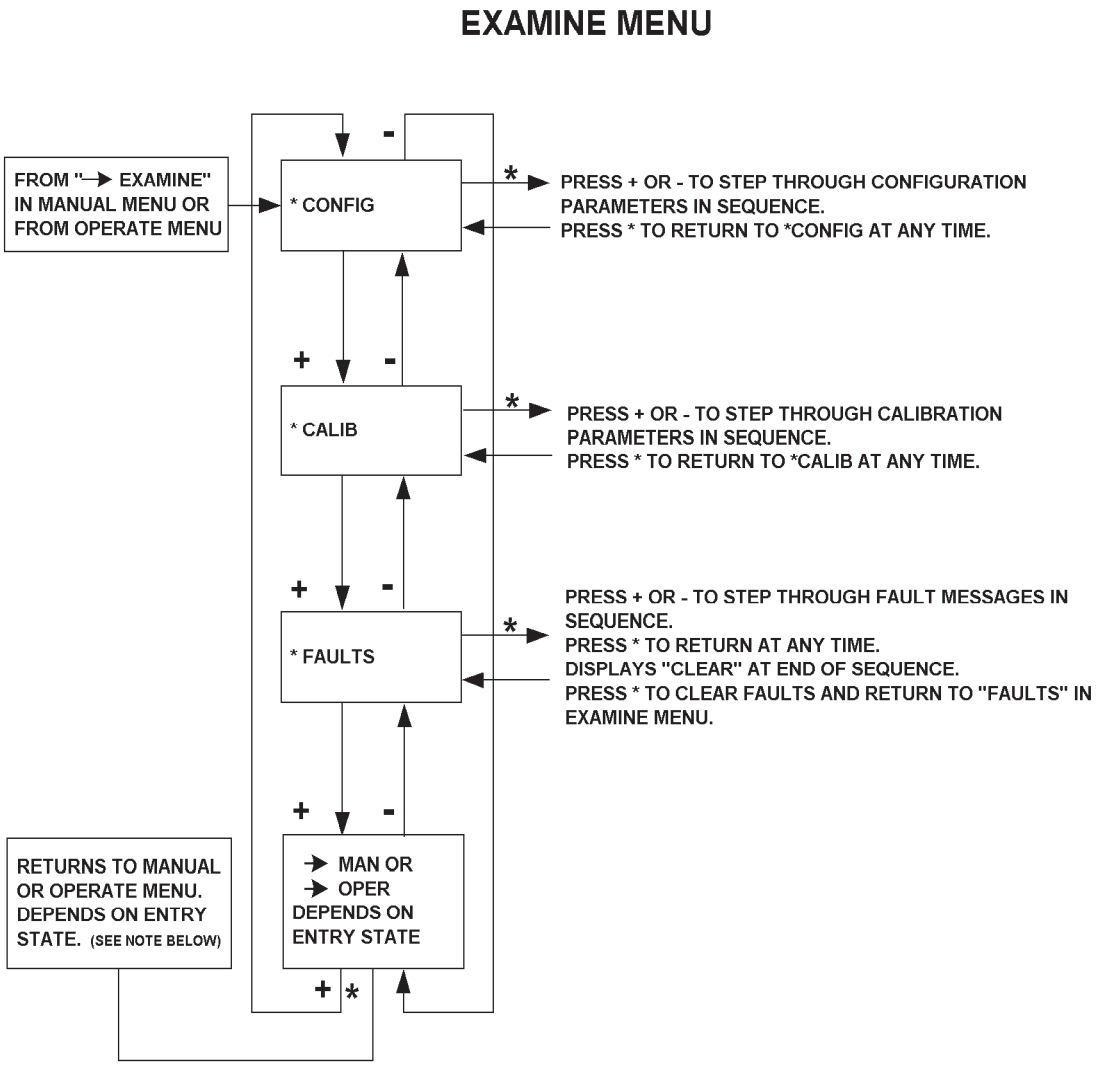


Figure 40. Controller Menu Structures

Examine Menu

This menu can be entered either from the MANUAL Mode or from the NORMAL OPERATE Mode. The EXAMINE menu allows the user to read the current configuration, calibration, and status information. This information, however, cannot be changed from the EXAMINE menu.

When you exit from the EXAMINE menu, you return to the menu from which you entered.



NOTE: In order to quit EXAMINE MENU if entry is from MANUAL MENU, then at step → MAN it is necessary to key * (which displays → OPER) and key * again to return to MANUAL MENU.

Figure 41. Examine Menu Structures

Parameter and Message Displays

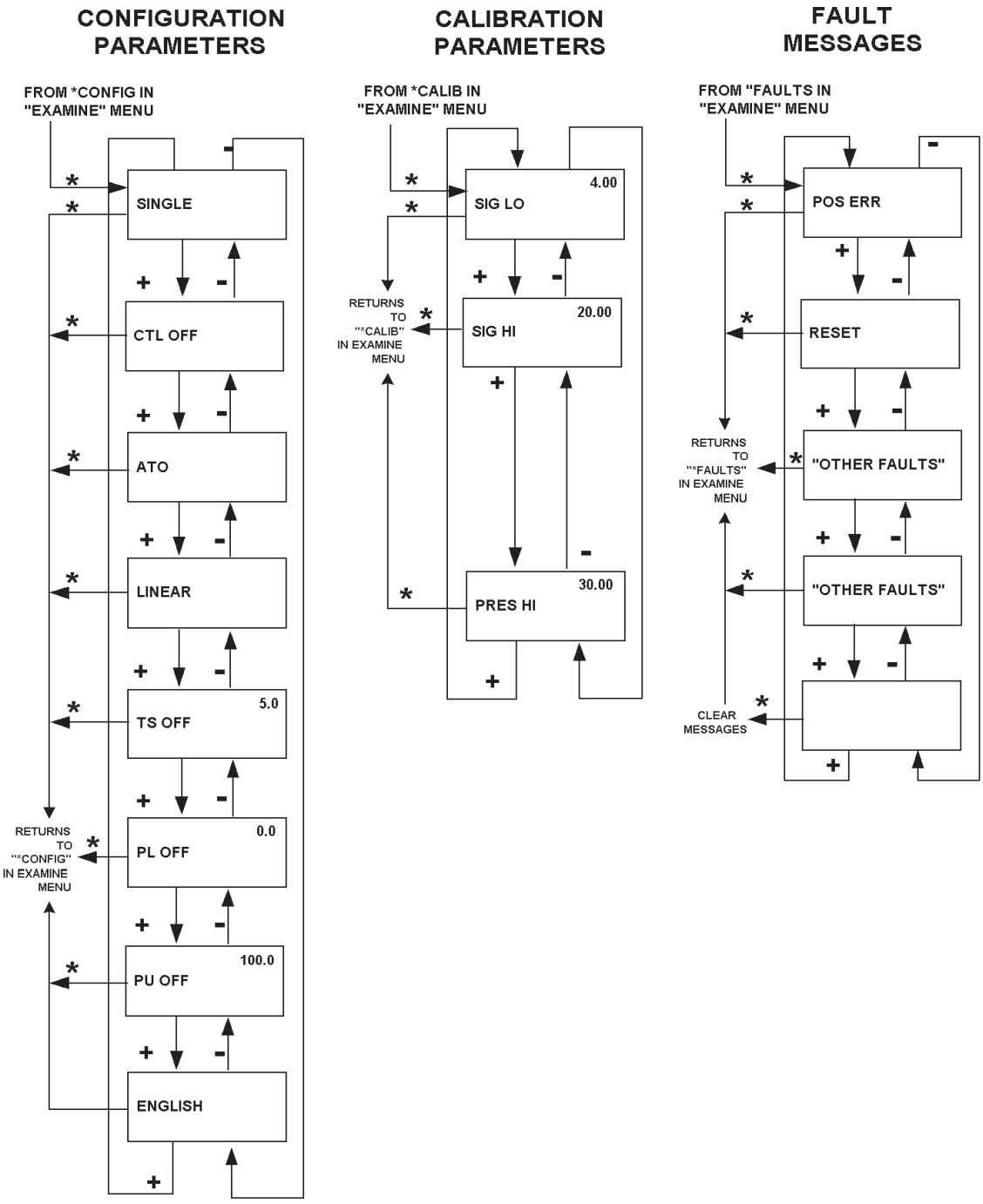


Figure 42. Parameter and Message Displays

Normal Operation - Controller

Functions

In normal operation, the SVI unit operates as a controller using a local or remote input signal as set point. The primary process measurement, made by the process transmitter, is fed to the controller as a 1-5 Vdc signal. The local digital display sequentially displays set point-remote or local as configured, process variable, valve position, and actuator pressure on a 1.5-second interval. Pressing any button moves you to the →OPER option in the OPERATE MODE MENU, as shown in Figure 37 on page 62.

The OPERATE MODE MENU has 4 options: →MAN (put valve in manual mode and go to MANUAL Menu), (CTLR (go to CONTROLLER Menu), →EXAMINE (go to EXAMINE Menu), and →OPER (return to display of current position, pressure, and signal). Use the pushbuttons to move from one option to the next. Press the * button to go to the item displayed in the menu.

Configuration

Parameters and Options Available

The Controller version of SVI must have the controller parameters configured from either Val-Vue or a HART Hand Held Communicator. Normally all of the operating parameters will be configured from Val-Vue or the Hand Held Communicator, however any parameters common to both the positioner and controller versions can be entered or changed via the pushbuttons. Controller setpoint values and selection of local or remote setpoint can also be entered via the pushbuttons. You can configure the following options by pressing the local pushbuttons in the procedure described below. We recommend that you use the menu structure diagrams in Figures 37 through 42 (pages 62 to 67) as a road map in following the procedures described.

As noted previously, configuration should be performed before calibration. Also note that configuration *can be performed only when the valve is in manual mode*.

The configurable options are as described in Table 8.

MENU ITEM	DESCRIPTION OF OPTIONS
SINGLE (or DOUBLE)	Select single or double acting actuator (not presently available)
CTL OFF (or ON)	Select PID Controller function (OFF or ON)
ATO (or ATC)	Select Air-to-Open or Air-to-Close actuator operation
LINEAR (or EQUAL 50, EQUAL 30, QUICK, CUSTOM), L-RECIP	Select desired valve characteristic curve (linear, equal percentage 50, equal percentage 30, quick opening, or custom curve). The custom curve must have been entered through the remote PC.
TS (OFF or ON)	Display and set value of tight shutoff point. Default is 0.0%
PL (OFF or ON)	Display is set value of the lower software position limit stop. Default is 0.0%
PU (OFF or ON)	Display is set value of the upper software position limit stop. Default is 100.0%
ENGLISH (or FRENCH)	Select language for displays (English or French)

Table 8. Local Configuration Options

Procedures

To configure or modify the SVI controller pushbutton configurable parameters, execute the following procedure:

1. If in NORMAL OPERATE mode, press any button. →OPER will be displayed. Press + to get to the →MAN menu item.
2. Press * to move to MANUAL menu. (“POS MAN” displayed) This locks the valve in position and places it in Manual Mode.
3. Press + twice to move to →CONFIG option.
4. Press * to put the SVI in the configure mode and display the first item in the CONFIGURE menu.
5. If Single or Double displayed is the one desired, press + to move to the next item. If not, press * to select the alternate choice. When OK, press + to move to next item. (Note: DOUBLE is not presently implemented.)
6. In CTL ON (OFF), ON should be displayed for controller. If display shows OFF press * to select ON. Press + to move to the next item. NOTE: Any SVI that has been factory set for controller operation can be operated as a positioner by simply changing CTL ON-OFF back to OFF.
7. In ATO (ATC), if option displayed is correct, press + to move to the next item. If not, press * to select the alternate choice. When OK, press + to move to the next item.
8. In LINEAR (or other curve), if option displayed is the one desired, press + to move to the next item. If not, press * to select the other options. When OK, press + to move to next item. If “custom” is selected, the custom curve must have been entered through the ValVue software program. The curve itself cannot be entered from the local pushbuttons.
9. The tight shutoff (TS) option allows the user to configure the positioner to apply full supply pressure (or atmospheric pressure) to the actuator whenever the signal directs the valve “near” the closed position. If the tight shutoff option is on, the value of the TS option determines the “near” value at which the valve is forced fully shut. In TS OFF (ON), if status and value displayed are satisfactory, press + to move to next item. If not, press * to change on/off status and display value. Then press + or - buttons to increase or decrease value displayed. (When status is changed from ON to OFF, no value is displayed.) When value is OK, press * to accept value and move to next item.
10. The SVI allows the user to configure a lower (PL) and upper (PU) software position limit stop. When in operation with these limits on, the valve will not move below the lower limit stop or above the upper limit stop. (Caution: These are software limit stops. If the SVI fails for any reason including power fail ure or air failure, the SVI cannot enforce these limit stops and the valve will go to fail-safe. Furthermore, the FULL OPEN AND FULL CLOSED buttons in ValVue bypass the limit stop controls. If safety requires the use of limit stops, mechanical limit stops should be used). In PL OFF (ON), if status and value displayed are satisfactory, press + to move to next item. If not, press * to change on/off status and display value. Then press + or - buttons to increase or decrease value displayed. (When status is changed from ON to OFF, no value is displayed.) When value is OK, press * to accept value and move to next item.
11. In PU OFF (ON), if status and value displayed are satisfactory, press + to move to next item. If not, press * to change on/off status and display value. Then press + or - buttons to increase or decrease value displayed. (When status is changed from ON to OFF, no value is displayed.) When value is OK, press * to accept value and move to next item.
12. The SVI local display may be configured to display English or French. If the language displayed is correct, press + to move to next item. If not, press * repeatedly to display other language options. When the desired language is displayed, press + to move to next item.
13. At →MAN, press + to move to the top of the CONFIGURATION menu or - to move back to the previous item. To leave the CONFIGURATION menu, press *. This returns you to the MANUAL menu. (“POS MAN” displayed). This completes the configuration procedure.

Controller Functions

If the controller set point parameters were not set during initial configuration using Val-Vue or HART Hand Held, they may be set by the following procedure.

1. Press + to move to CONTROLLER Menu
2. Press * to toggle between “REMOTE” AND “LOCAL.” Leave on desired action and press + to move to SETPOINT.
3. Press + or - to enter new value. Press * to exit back to SETPOINT. Press + to move to “I SETPOINT.”
4. Press + or - to enter new value. Press * to exit back to I SETPOINT. Press + to move to “CANCEL.”
5. Press * to return to NORMAL or MANUAL Menu without saving changes. Press + to move to “OK.”
6. Press * to return to NORMAL or MANUAL Menu with changes saved.
7. To continue with calibration press - twice to move to →CAL option. Continue with Step 4 below.

Local Calibration

NOTE: Perform configuration before running calibration functions.

Functions

You can perform the following calibration functions with the SVI product:

- Low and high values for input signal
- Low and high values for actuator pressure output
- Set the minimum and maximum stops for valve position

Procedures

Refer to the menu structure diagrams in Figures 37 through 42 (pages 62 to 67) for assistance in following the procedures described.

CAUTION:
Since some calibration functions stroke the valve over its full range, the valve should be isolated from the process before starting calibration.

To “calibrate” the SVI unit using the local pushbuttons, execute the following procedure:

1. If in NORMAL OPERATE mode, press any button, (OPER will be displayed.) Press + to get to the → MAN menu item.
2. Press * to move to MANUAL MENU (POS MAN displayed.)
3. Press + to move to →CAL option.
4. Press * to go to CALIBRATE menu. (STOPS will be displayed.)
5. In STOPS, press * to initiate the operation, which moves the valve to fully closed, then fully open, and then returns to the starting position. (This operation calibrates the end points for the position feedback potentiometer.) When the operation is complete, press + to move to the next item.

CAUTION:
This function strokes the valve over its full range. Do not execute while valve is controlling the process.

6. On some valves, the full travel is larger than the nominal travel of the valve and it may be desirable to have the reported 100% position correspond to the nominal travel rather than the full stroke. The STOP OP option allows this correction. If a correction is to be made, press * to move valve to the 100% position. Using the + and - buttons, position the valve to the nominal full open position. Press * to accept this position as the new 100% position.
7. The Bias is the signal sent to the internal I/P that causes the actuator to neither fill nor exhaust. The pneumatics are adjusted at the factory and should not need further adjustment. If the pneumatics need to be readjusted for any reason, the BIAS option should be selected by pressing *. This will out put a value of 2750 to the I/P. The adjustment screw on the top of the pneumatics section can be adjusted until the valve is nearly stationary near mid travel. See “Bias Adjustment” in “Troubleshooting”. Press + to move to the next menu item.
8. The TUNE menu item allows the user to initiate the automatic position control tuning function which will select appropriate PID parameters for the position controller. Press * to initiate AUTO TUNE function. This procedure may take from 1 to 5 minutes. During this time the valve will make a series of steps (Caution: This procedure should not be performed while the valve is controlling the process.) When the function is completed, you return to TUNE. Press + to advance to the next item.
9. SIG LO displays the input signal that should correspond to the full closed or full open position of the valve (depending upon whether the valve is air-to-open or air-to-close and whether the positioner is direct or reverse). In SIG LO, if the displayed value is correct, press + to advance to the next item. If not, press * to display value of SIG LO. Use + and – buttons to change the value. When OK, press * to return to menu and move to next item.
10. SIG HI displays the input signal that should correspond to the full open or full closed position of the valve (depending upon whether the valve is air-to-open or air-to-close and whether the positioner is direct or reverse). SIG HI must be larger than SIG LO by at least 5 mA. In SIG HI, if the displayed value is correct, press + to advance to the next item. If not, press * to display value of SIG HI. Use + and – buttons to change the value. When OK, press * to return to menu and move to next item.
11. The PRES HI menu item allows the user to enter the supply pressure. This pressure is used for scaling of the pressure data in the SVI. In PRES HI, if the displayed value is correct, press + to advance to the next item. If not, press * to display value of PRES HI. Use + and – buttons to change the value. When OK, press * to return to menu and move to next item.
12. Calibration as a positioner is now complete. At →MAN, press * to return to the MANUAL mode. (POS MAN displayed)

Return to Normal Operation

To return to NORMAL OPERATE mode from any menu, press + or - repeatedly until →MAN (or →OPER) is displayed. If → OPER appears, press * to return to NORMAL OPERATE mode. If → MAN appears, press * to return to Manual Mode Menu. Then press + repeatedly until →OPER appears. Then press * to return to NORMAL OPERATE mode and normal operation.

Examine

Functions

The EXAMINE menu permits you to display calibration parameters, configuration parameters, and to display and/or clear fault status messages and codes. (Refer to Table 9 for explanations of fault messages.)

You may enter the Examine menu either from NORMAL OPERATE Mode or from Manual Mode. When entered from NORMAL OPERATE mode the valve still responds to changes in set point input signal and the values displayed change in accordance with changes in input signal.When entered from Manual mode, the valve is locked in position.

When you exit from the EXAMINE menu, you return to the menu from which you entered.

Procedures

Examine Calibration Parameters
To examine the calibration parameters, execute the following procedure:

1. If in NORMAL OPERATE mode, press any button.
2. Press + to move through the options until you reach the EXAMINE menu item. Press * to go to EXAMINE menu. (This leaves valve in NORMAL OPERATE mode.) If in MANUAL mode, press + repeat edly until the EXAMINE menu item is reached. Press * to select the EXAMINE mode.
3. Press + repeatedly to move through the EXAMINE menu until *CALIB is reached. Press * to display the list of calibration values. To move forward through the calibration parameters in sequence, press +. To move back through the list, press –. Press * at any time to return to *CALIB in the EXAMINE menu.

Examine Configuration Parameters
To examine the configuration parameters, execute the following procedure:

1. If in NORMAL OPERATE mode, press any button.
2. Press + to move through the options until you reach the EXAMINE menu item. Press * to go to EXAMINE menu. (This leaves valve in NORMAL OPERATE mode.) If in MANUAL mode, press + repeated ly until the EXAMINE menu item is reached. Press * to select the EXAMINE mode.
3. Press + repeatedly to move through the EXAMINE menu until *CONFIG is reached. Press * to display the list of configuration values.
4. To move forward through the configuration parameters in sequence, press +. To move back through the list, press –.
5. At any time, to return to *CONFIG in the EXAMINE menu, press *.

Display/Clear FAULTS

To examine and /or clear fault codes and messages, execute the following procedure:

1. If in NORMAL OPERATE mode, press any button.
2. Press + to move through the options until you reach the EXAMINE menu item. Press * to go to EXAMINE menu. (This leaves valve in NORMAL OPERATE mode.) If in MANUAL mode, press + repeatedly until the EXAMINE menu item is reached. Press * to select the EXAMINE mode.
3. Press + repeatedly to move through the EXAMINE menu until *FAULTS is reached. Press * to display the list of status values. To move forward through the faults in sequence, press +. To move back through the list, press –. The last item in the list is CLEAR. When this message is displayed, you can clear all faults by pressing *. This will also return you to FAULTS in the EXAMINE menu. If you do not want to clear all fault messages, press + or - to move to another item in the list. You can then press * to return to FAULTS in the EXAMINE menu without clearing fault messages.

   This completes the EXAMINE functions.

Controller Fault Messages

Table 9 lists the fault codes/messages that may appear on the display. The table also explains the meaning of each message, the probable cause of the fault, and recommended action you should take to correct the fault.

Table 9. Controller Fault Messages

Display Code	Fault Message	Meaning	Latched Error *	Probable Cause
POS ERR	Position Error	Valve position did not agree with SVI output command within acceptable time		Valve is stuck or feedback linkage is disconnected or broken
BIAS ERR	I/P Output at null point is out of range	Bias is out of range	✓	Supply pressure too low or incorrect pneumatic block adjustment
POS SEN	Position Sensor Error	The position sensor has failed or is not aligned properly		Failed or linkage aligned incorrectly
PRES SEN	Pressure Sensor Error	The pressure sensor has failed		Failure
SIG SEN	Current Sensor Error	The primary signal (4-20) sensor has failed		Failure
REF ERR	Reference Voltage Error	The A/D reference voltage is incorrect	✓	Failure
SW ERR	Self Check Failure	SVI failed self-check diagnostics		Failure
RESET	Reset	SVI has reset since last status clear	✓	Power loss
OVER RUN	Data Overrun	Internal check failed to process data in time		Hardware failure

Table 9. Controller Fault Messages (cont.)

Display Code	Fault Message	Meaning	Latched Error *	Probable Cause
TEMP ERR	Circuit Temperature Error	Internal SVI temperature out of range	✓	
WRT ERR	EEP Prom Write Failed	Device failed to write to nonvolatile memory		Hardware failure
TIMER SEN	Watchdog Timer Timeout	SVI failed to send D/A output within timeout		Hardware failure
CAL FAIL	Calibration Failed	Signal or pressure calibration		Bad value set in calibration mode
STOP ERR	Find Stops Failed	The auto POS calibration failed		Pressure sensor not working or bias adj. not correct, or valve will not move
FAIL SAFE	Fail-Safe Position	Valve has been placed in the fail-safe position		Primary sensor failure or linkage not aligned correctly on the potentiometer

Operation - SVI Positioner / Controller using HART Handheld Communicator

A HART 275 Handheld Communicator with Masoneilan SVI Software can be used to set up and calibrate an SVI Positioner or Controller. It's capabilities extend well beyond the range of pushbutton functions in that it allows positioner tuning and controller tuning parameters to be individually entered, and it also supports limited diagnostics.

Refer to HART Communicator Manual MAN 4250 for basic instructions on using the Handheld communicator. The manual covers General Instructions, Hot Key customization, connections, and Off-line functions.

The menu structure on Page 60 is a guide to all the operations which can be performed on both SVI Positioners and SVI Controllers using the HART Handheld.

Operation - SVI Positioner / Controller using ValVue Software

Use of ValVue Software provides the most comprehensive menu selections for configuring, calibrating and monitoring the SVI Positioner and Controller. All operating and calibration parameters be entered and additionally a very comprehensive diagnostics program is available. The diagnostics program allows recall of stored test data to compare current performance of the valve, positioner and actuator with previous test results or factory data.

Operation of the SVI Positioner and Controller with ValVue is covered in the separate manual furnished with ValVue software.

Chapter 5 - Troubleshooting

Introduction

This section of the manual offers procedures and options to confirm setup and configuration and allows you to exhaust many service options before seeking assistance from a factory-trained technician. By first following these procedures, you can save time, prevent costly downtime, and provide the service technician with more detailed information about the possible problem.

Although this section is written primarily for use with the pushbutton/local display version of the SVI Positioner, it also applies to Val-Vue and HART handheld operation and in applicable areas, to the PID Controller version.

Factory Service

Trained service personnel perform high-level SVI troubleshooting and servicing. Should the SVI unit require replacement of internal parts, the unit will be replaced with a new or rebuilt unit. An extensive replacement inventory is available for immediate shipment. If this service is needed, contact your local salesperson or contact Masoneilan Dresser at **www.masoneilan.com**.

Common Problems

The troubleshooting checklist guides the user through a number of possible faults. However prior to utilizing this list, the user should make an initial assessment of the installation; looking at the following items:

- Is the mounting of the SVI correct and the linkage orientation proper? Are all linkage mechanical connections securely tightened?
- Are all pneumatic connections tight and is the supply pressure the correct value for actuator being used?
- Are electrical connections made to the correct terminals and securely tightened?
- Assuming the display is active, the user should carefully check that all configuration parameters are compatible with the valve under control and properly entered in to the positioner.
- If the SVI has been under control of ValVue and left in the full open or full closed position, the buttons cannot take control of position in the Manual Mode. To regain control, go to Normal Mode in ValVue and then to Manual before exiting ValVue or power down/power up the SVI.

Pneumatic Connections

The SVI requires a regulated air supply of clean, dry, oil-free instrument air conforming to the requirements od ISA-S-7.3, Quality Standard for Instrument Air. Figure 43 shows the locations of supply, output,and exhaust connections on the pneumatic block.

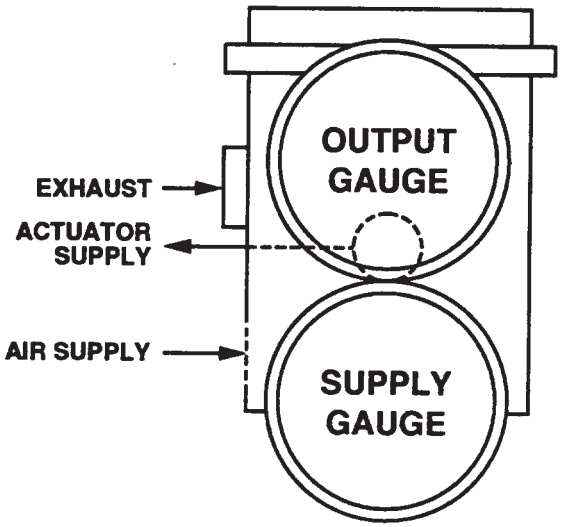


Figure 43. Exhaust, Actuator and Air Supply Connections

Additionally the following conditions must be met:

- Ensure that the exhaust port can vent to atmosphere (e.g., no obstructions or foreign matter blocking ports).
- Connect the actuator port (behind the pneumatic block) to the actuator. For best response times use 3/8 tubing.
- Confirm that the supply pressure gauge reads the supply pressure and that the supply pressure registers 20 psi minimum. (Actual supply pressure used is a function of actuator supply rating).
- Momentarily disconnect the supply current (voltage) to the SVI and verify that the output pressure registers close to 0 psi and that the valve sits against a stop.

Note: Air-to-open (ATO) requires a normally closed valve; Air-to-close (ATC) requires a normally open valve.

Supply Pressure

SVI requires sufficient supply pressure to drive the valve against the stops. For best results the supply pressure should be 5 to 10 psi higher than the actuator nominal pressure range as shown on the data plate.

For example, if the spring range is 11-23 psi, set supply to between 28 and 33 psi. The maximum pressure rating of the SVI is 100 psi; however in most cases the actuator pressure rating is the controlling factor in determining supply pressure. If pressures higher than 100 psi are required, consult factory.

DANGER:
Never exceed actuator or SVI maximum pressure. Damage to equipment or injury to personnel may result.

Verifying Supply Pressure

The following procedure may be used to verify whether supply pressure is sufficient to drive valve against stops.

Close the holes in the exhaust plug by blocking air path. The output pressure should slowly rise to supply pressure and the valve should drive to the high pressure stop.

- If output pressure does not go to or close to supply pressure, there may be a leak within the pneumatic block. Consult Factory.

- If the valve does not drive against the stops when the output gauge reads a pressure higher than the actuator specification, then the actuator may be defective or improperly installed, the valve may be jammed due to improperly installed packing, or the valve body contains an obstruction.

Electrical Connections

The SVI requires an electrical input from a 4-20 mA current source or a voltage input from a 12/24 V dc Multidrop supply. The 4-20 mA signal can provide both operating power and signal information, or if a digital input signal is used, provide only operating power. The 12/24 V dc Multidrop supply can be used only when the input signal is digital. Selection of current or voltage input is by position of a jumper on the main terminal board. See Figures 44 and 44a.

Caution:
Make sure the voltage/current jumper is in the proper position (V or mA) before applying power . Failure to do so may result in damage to the SVI.

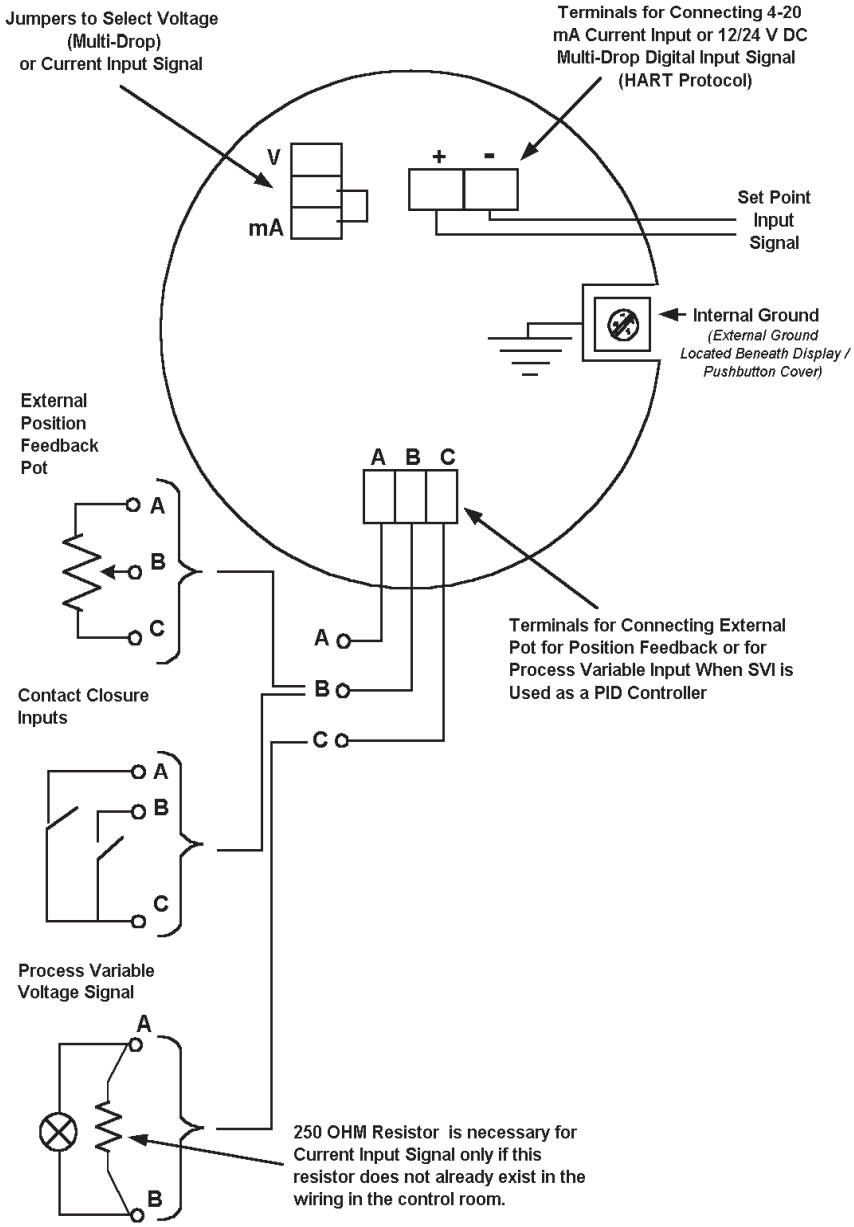


Figure 44. Wiring Connections

The terminal board shown in Figure 44a reflects a design change to be released in early 1999 which incorporates the following enhancements.

- Additional terminals D and E allow the contact input feature to be used with the controller option.
- Optional terminals POS + and POS - provide an isolated 4-20 mA signal related to **characterized** valve stem position. The voltage compliance of the position output terminals is 11-50 V dc. The HART® signal is **not** available on the position terminals. The HART protocol is available on the +/- LOOP terminals.
- The software revision reported by the HART ID command is 6.

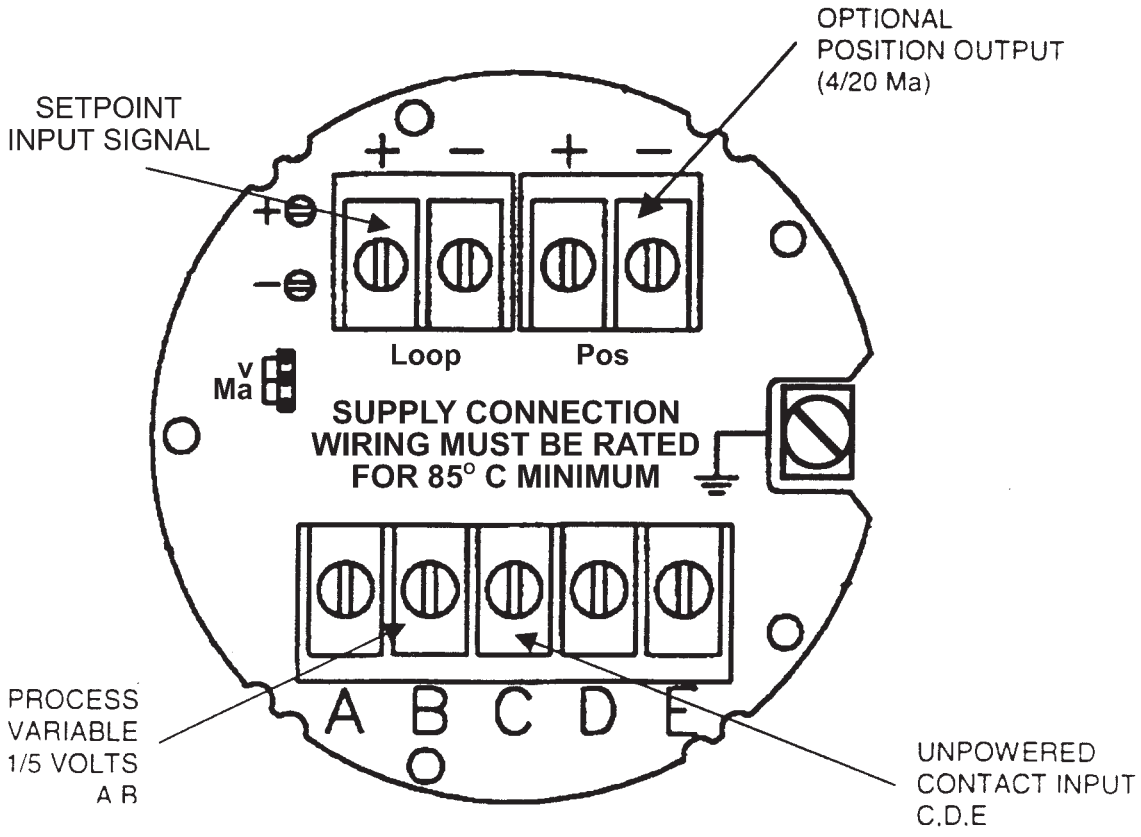


Figure 44a. Wiring Connections - 1999 Release

The SVI is polarity sensitive so the positive lead must be connected to the positive (+) terminal and the negative lead to the negative (-) terminal. Reversal of input will not cause damage but the unit will not function.

Verify Wiring and Connections

Check that the SVI is properly powered per following:

Connect a dc voltmeter across the input terminals.

Note: Test pins, located adjacent to the terminal strip facilitate connection of the voltmeter. For any input current value between 3.8 and 22 mA the voltage should be between 9.5 and 11 V.

- If voltage exceeds 11.5 V check that polarity is correct and that V/mA jumper is in correct position.
- If voltage is less than 9.5 volts and polarity and jumper are correct, voltage compliance of current source may be inadequate. Connect milliammeter in series with current signal and verify that source can supply 20 mA to SVI input. If 20 Ma is not attainable, current source may be inadequate for this type of service, or other loads or inclusion of Intrinsic Safety barriers may be limiting the source drive capability.

Ground Practice

Make sure that case, signal and if utilized, process controller, ground connections are made in compliance with plants normal grounding practices.

The case grounding screw is located on the outside of the case to the lower right of the display cover. Signal grounding should follow normal rules for the facility. Any point in the loop may be referenced to ground but there should never be more than one ground point.

If the SVI has the Process Controller option, auxiliary terminal “B” must be connected to the same ground reference as the negative input current terminal.

Note: Improper or inadequately grounded installations may cause noise in or instability of the control loop.

If noise or instability are present, set positioner to “Manual Mode” of operation and manually position valve over its entire range. If valve is stable in manual mode, then problem may be noise in control loop. Recheck all wiring connections and ground points. If noise and instability are still present in manual mode, problem is most likely with electronics module. Consult Factory.

HART Compliance

SVI requires a HART-compliant communications loop. The HART protocol specifies the noise level, impedance requirements and configuration of the loop.

Note: When an intrinsically safe barrier separates the communicating device, a HART-compliant barrier must be used.

Conventional current output loops consisting of the following components usually meet requirements for HART compliance.

- Quality current source (e.g. low noise, high impedance)
- Minimum loop impedance of 250 ohms
- Twisted pair cable suitable for 4-20 mA current loops

Note: If there are suspected HART compliance problems, prepare a detailed description of the loop, including all devices on the loop, type of wiring used, loop length, and presence of any possible interference sources before contacting the factory for assistance.

Power-on Check

After checking pneumatic and electrical connections, apply power to the SVI.

Restoring power will result in one of five possible images on the local display.

- Normal
- Blank
- “Fail-Safe”
- Random segments displayed
- “Reset”

The normal display is an alpha-numeric reading in the manual or operate mode. The display may sequence between three variables (four in controller) at a 1.5 second rate.

If a normal display is seen, no further action is required.

If the display is not normal, go to appropriate problem listing in “Troubleshooting Checklist”.

TROUBLESHOOTING CHECKLIST

PROBLEM	POSSIBLE CAUSE	ACTION
Totally unresponsive SVI; no display on LCD read-out	Instrument not receiving power due to: • Improper Wiring • Faulty Electronics module	 See “Electrical Connections” Contact Factory Service
LCD readout shows random segments	• Faulty Electronics module	Contact Factory Service
LCD readout active with unresponsive or incorrect valve position	• Pneumatic supply/ connection problem • Improper Configuration • Improper Calibration / Bias Error	See “Pneumatic Connections” See “Testing valve Performance” and continue with sections following
“FAILSAFE” shown on display	• Potentiometer shaft orientation or linkage incorrect • Hardware/Software fault	Check that mounting and linkage are correctly installed. Refer to “Mounting” in instructions Use “Examine” menu to view error(s). Take required corrective action. See “Fail-Safe Display”
“RESET” appears on display	• Momentary display on power-up is normal • Continued display indicates problem	 Contact Factory Service

TROUBLESHOOTING CHECKLIST (CONT.)

PROBLEM	POSSIBLE CAUSE	ACTION
Valve will not stroke over full travel range	• Insufficient compliance voltage from current source	See “Electrical Connections”
	• Potentiometer shaft orientation or linkage incorrect	Check that mounting and linkage are correctly installed. Refer to “Mounting” in instructions
	• Insufficient pressure to fully stroke actuator	See “Pneumatic Connections”
	• Incorrect software position limits	See “confirming Configuration...”
Valve position exhibits unstable oscillation or hunting behavior	• Improperly grounded unit	See “Electrical Connections”
	• Slipping or loose linkage	Check and tighten
	• Defective spool sub-assembly	See “Spool Valve Maintenance”
	• Incorrect positioner PID values	See “Testing Valve Performance”
Valve works for some input values, and goes to “Fail-Safe” operation for others	• Potentiometer shaft orientation or linkage incorrect	Check that mounting and linkage are correctly installed. Refer to “Mounting” in instructions
	• Linkage produces more than 120 degrees of potentiometer shaft rotation	Check that mounting and linkage are correct for actuator travel

Testing Valve Performance

The following preliminary valve performance test checks the physical part of the system and isolates several potential problems. It bypasses the microprocessor configuration.

1. Place the SVI in Manual mode using pushbuttons, Val Vue or handheld. If using pushbuttons, in Manual mode select “POS MAN”

2. By holding the “+” and “-” buttons down confirm that the valve moves to open and closed positions. This may take some time with a large actuator. (If using ValVue or handheld, use the “FULL OPEN” and “FULL CLOSED” commands).

    - If the valve correctly performs the open/close command in manual mode, continue with “Confirming Configuration” procedure below.

    - If the valve does not perform the open/close command, review the following:

1. Confirm that the air pressure is on, set to proper pressure and connected to proper port.

2. Check that spool valve is not sticking. Refer to “Spool Valve Maintenance” on Page.

3. See “Bias Adjustment” on Page 92 and adjust bias if necessary.

4. If “FAILSAFE” shows on display refer to “FAILSAFE” on Troubleshooting Checklist for appropriate action.

5. If items 1, 2, 3, and 4 above are OK, the EPC (electropneumatic converter) may be faulty. SVI must be returned to factory for service on this component.

Confirming Configuration, Setup, Calibration, and Limit Stops

If the valve has performed properly in the manual mode, continue with following procedure. This series of checks confirms proper configuration, setup, calibration, and establishes parameters for further testing.

1. Place the SVI in the Manual Mode using ValVue, the handheld, or the pushbuttons.

2. Check the following conditions:

    - Confirm the accuracy of configuration and setup parameters by going to “Configure” and “Calibrate” menus and verifying that the parameters are correct.

    - Run “Find Stops”.

    - Perform an “Auto Tune” from the Calibration section.

    - If continuing to experience problems, run “AutoTune” again. If using ValVue or the handheld set the PID parameters to values recommended in the PID parameters list. If problems persist, consult factory.

3. If above test results are satisfactory, continue with “Initiate Valve Movement (50%)”

Initiate Valve Movement (50%)

Use the series of checks in this procedure to confirm that the configuration is correct.

1. Place the SVI in Manual Mode using ValVue, handheld or the pushbuttons. Set the position setpoint to 50%.

2. Confirm whether valve moved to set position.

    - If valve is in proper position; continue with Initiate Valve Movement (95%) procedure below.

    - If valve is not in proper position, set to full open and check whether position is at 100%. If not, re-run “Find Stops”. If this does not correct problem return unit to factory.

    - If valve oscillates review the following conditions:

    1. Check for improper tuning. Perform either another Auto Tune or if ValVue or handheld are available, input manual values from the parameters table and re-test. (Manually inputting values of P=50, I=100, D=10, Padj=0, Beta=8, PosComp=6, and Damping=0 should produce stable but perhaps sluggish operation on any valve.)

    2. Check that ground connections are made to correct ground points and that connections are secure.

    3. Check the linkage between the position sensor and valve for excessive play.

    4. Check that spool valve is not sticking.

    5. Check for excessive friction in the valve packing; it is one cause of limit cycling.

        Limit cycling can be caused by tight valve stem packing, an undersized actuator, or foreign material in the spool valve. Identify limit cycling conditions by a process of elimination (e.g. not noise, not oscillation). Install valve packing only tight enough to prevent leakage. Evaluate the valve packing by running the ValVue diagnostic program to determine if the friction is consistent with the type of valve. If you determine that the spool valve is the source of limit cycling, it should be cleaned or replaced.

Initiate Valve Movement (95%)

Use this procedure to confirm that the SVI and valve systems are performing properly.

1. Place the SVI in Manual mode using ValVue, handheld or the pushbuttons. Set the position setpoint to 95%.

2. Confirm that valve is in the set position (95%).

    - If valve is in proper position, the SVI and valve systems are functioning properly. Place the SVI in “OPERATE” mode. It is recommended that if possible the valve be cycled through its full stroke using the control room 4-20 mA source. This will verify

that the valve control loop is not noisy and that compliance voltage is high enough to properly drive the SVI.

- If the valve does not travel to 95%, review the following:

1. Check that air supply pressure is adequate for actuator.

2. Repeat previous tests as necessary to determine cause of problem. If consistent and proper operation cannot be obtained, return SVI to factory.

Fail-Safe Display

A reading of Fail-Safe on the display indicates a fatal or non-fatal error in the SVI and acknowledges that the computer holds the output in a fail-safe condition. Use the pushbuttons, Hand Held or ValVue to see the cause of the fail-safe condition, a list of error codes, and the necessary corrective action.

Note: Not all errors are fatal (e.g., not all errors cause a fail-safe condition.)

Latches:

Certain errors occur and self-correct. The SVI clears the bit in the status when the error disappears and uses latches to show you an error occurred (although it is not currently an error). Errors that latch include RESET, POSSEN, PRESSEN, REFERR, and TEMPERR. Table contains a description of fatal and non-fatal SVI errors. The following list of error latches defines each term:

DRIFT	**Drifting of bias**
HARTERR	**Continuous communication error**
HWERR	**Hardware failed self-check**
OVERRUN	**Data overrun error (processor error)**
POSERR	**Position error**
POSSEN	**Position sensor error**
PRESSEN	**Pressure sensor error**
REFERR	**Reference voltage error**
RESET	**Reset occurred**
SIGSEN	**Current sensor error**
STOPERR	**Find stops procedure failed**
SWERR	**Software error**
TEMPERR	**Circuit board temperature out of range**
WRT ERR	**A write to the EPROM failed**

AutoTune

Running the positioner AutoTune procedure automatically determines position control parameters such as P, Padj, I, D, and dead zone. If the SVI is a Positioner/Controller model running autotune sets the positioner tuning parameters; the controller tuning parameters have to be entered via a Hand Held or ValVue.

Note: Confirm that the Bias settings appear in a reasonable range, with a low signal-noise level, before running AutoTune.

AutoTune Procedures

Initiate positioner AutoTune either by selecting the AutoTune button in the ValVue SVI Calibration Window or by using the SVI local buttons (Refer to Calibrate menu in Operation section of manual) or by initiating auto tuning from the hand-held. The AutoTune procedure includes three steps:

- Bias search
- Estimate control parameters
- Refine control parameters

In Bias Search, the SVI local displays values (such as 23530 and 27610) that approach, or converge on, a real Bias value. Expect the valve to move back and forth, slow down, and remain still by the end of this step.

In estimating control parameters, SVI displays three types of values: input step sizes (such as 80 and 320), valve relative opening (such as 1874 and 1756), and dead time (such as 4.00 and 7.00). Expect the valve to move back and forth several times. SVI uses these tests to estimate the preliminary control parameters based on position control characteristics.

In refining the estimated control parameters, SVI displays several numbers (such as 1211 and 6). Interpret the number 1211 as the rising time (T98 is 12 x 0.05 sec = 0.6 sec) and overshoot is 11%. The code number 6 indicates a specific control parameter adjustment.

Auto Tune Results

A successful AutoTune provides position step responses, in both air fill and exhausting directions, that meet the tuning criteria. Overshoots range between 0 and 8%, and rising times range from 0.3 second for a small actuator to 1.5 second for a large actuator. A successful AutoTune updates the previous control parameters.

AutoTune usually results in fast position responses (0 to 8% overshoots). If you prefer a smooth response without overshoots, reduce the P value by 10 to 20%. If you prefer a slow response, set the damping coefficient at 1 to 9 (e.g., zero equals no damping, 9 equals maximum damping)

Damping Coefficient

The following chart lists the damping coefficient, which displays after AutoTune and indicates the AutoTune result:

Damping Coefficient	Message	Action
0	Self-tuning is successful	None
44	Bias searching fails after 20 times trying	Stabilize the SVI in the range between 20-80% open and wait until the valve is stable at its setpoint. Then re-run the self-tuning again.
55	The found Bias is not in the required range, and self-tuning is cancelled	Adjust the Bias
66	Self-tuning for air fill direction fails after 30 times trying	Check supply pressure; check noise; check the pneumatic block, especially spool S/A
77	Self-tuning for air exhausting direction fails after 30 times trying	Check the pneumatic block, especially spool S/A

Note: The Damping Coefficient adjustment range is 0 to 9. The out-of-range value is equivalent to 0, or no damping.

Unacceptable Response Characteristics

Valve position responses depend on many factors including the condition of the valve, actuator, and process; ambient temperature; noise; the SVI itself; supply pressure; and the setup and step change size for the positioner control parameters.

Note: A 5% step change should be made when the valve is in the 20 to 80% opening range.

With damping coefficient of zero (no damping), consider the following valve responses unacceptable:

- Overshoot greater than 20%
- Rising time (T98) greater than 1.5 seconds for small actuators and 2.5 seconds for large actuators
- Dead time greater than 0.5 seconds
- Limit cycling peak-to-peak measurement greater than 0.5%
- Position steady-state error greater than 0.5% if the dead zone is less than 0.2%.

Position Instability

The possible sources of position instability include:

- Control loop (measurement) noise
- Process noise
- Line frequency noise
- Oscillation
- Limit cycling

Control loop noise only appears in the Normal mode (never the Manual mode). For best control, reduce control loop noise by re-tuning the process controller (in the SVI or an external controller). You may also dampen the SVI response.

Process noise results from process pressure and flow changes that apply forces to the valve plug and cause changes in position. Although the SVI restores the plug position, the response is not instantaneous.

Poor grounding of the signals and case, or power supply ripple in the 4-20 mA control signal, can introduce line frequency noise. Line frequency noise converts to low-frequency noise when a noisy signal sampling occurs during a period not integrally related to the line frequency. The resulting frequency measures more than 1 Hz, a frequency too high for resolution by the process trend record.

A pulsating sound of escaping air at the exhaust port usually indicates line frequency noise. In extreme cases, the valve stem may appear to pulsate

Correct a line frequency noise problem by proper grounding (page 82) or by eliminating ripple noise from the current source. (HART compliance requires less than 4 *A of current ripple).

Oscillation

If using a HART Communicator or ValVue, set the following values to identify PID oscillation: If SVI is push-button model, re-run auto-tune. If oscillations persist contact factory.

P = 20	Padj = 0
I = 0	Beta = 0
D = 0	Damping = 0
Dead zone = 0	Position Compensation Coefficient = 0

If the position remains stable, then the problem is related to the positioner settings of the PID. Re-run AutoTune.

Limit Cycling

The characteristics of limit cycling include at least a 4-second period and a squared off (as opposed to sinusoidal) trend record. Excessive friction in the valve/actuator assembly, or dirt in the spool valve assembly, can cause limit cycling. The SVI diagnostic identifies excessive friction in the valve/actuator assembly as a reported friction value greater than 30% of the actuator span.

Bias Adjustment

Masoneilan adjusts the bias of the pneumatic block at the factory in order to accommodate most environmental effects. This setting usually makes bias adjustment neither necessary or desirable. Situations do arise, however, when bias adjustment becomes necessary. For example, after replacing the spool valve, or when the unit experiences extreme environmental conditions, adjusting the bias can optimize positioner performance.

For either of the following cases, do not adjust bias:

- After calibrating the limit stops of the valve and setting the parameters, an offset may occur between the SVI position indicated on ValVue (or in the push-button display) and the actual valve position.
- On start-up, after leaving the unit without power for an extended period of time, an offset sometimes occurs between the signal and actual valve position. On startup, this offset begins moving slowly. This offset exists because the present bias setting differs from the setting recorded when the unit last saved the bias.

Note: These offsets resolve themselves because the SVI saves the bias value every hour, which provides a more accurate signal/valve position reading. For more rapid adjustment, select the Calibrate screen and return to Manual Mode which automatically saves the value.

For the following case bias may need to be adjusted:

If full open or full close won't cause the valve to move fully to the stops, you may need to adjust the bias.

Bias Adjustment Procedure

An SVI-generated pilot pressure controls the spool position. The pilot pressure range is displayed as a dimensionless value between 0 and 5500. The exact number can be displayed when using ValVue or a Handheld Configurator for calibrating the SVI. The value is not displayed when using pushbuttons, but is automatically set to the calibrate value of 2750 when in bias adjust mode.

If using pushbutton model SVI, follow menu steps to "CAL" and then to "BIAS" . Press the "*" button.

If using Handheld or ValVue, go to manual screen, click Calibrate button, enter 2750 in "Output Value to I/P" box, then click on "Output"

Note valve position. If near to 50%, adjustment is not required. If adjustment is required, using a 7 mm open end wrench, remove the cap nut on the top of the pneumatic block and loosen the locknut. Using a 2 mm hex wrench, adjust the bias screw until the valve is at 50% position and stable. If movement of the adjusting screw does not re-position valve, return unit to factory for servicing.

After adjustment is complete, tighten locknut and replace cap nut.

Spool Valve Maintenance

If troubleshooting procedures have shown the spool valve to be a suspect component, use the following procedures to clean the pilot subassembly and replace deteriorated parts.

This procedure describes the steps necessary to disassemble the spool valve. To minimize maintenance time, Masoneilan recommends replacing the entire pilot subassembly. Using a replacement subassembly allows you to work on the old unit as time permits. Prior to any disassembly, make sure new "O" rings of proper material are available. The old rings should not be re-used.

Warning:
Cleaning the pilot subassembly and replacing deteriorated parts requires shutting down the positioner and isolating the valve from the process. Failure to do so can result in damage to the system or personal injury.

Figure 45 illustrates the components of the pilot subassembly.

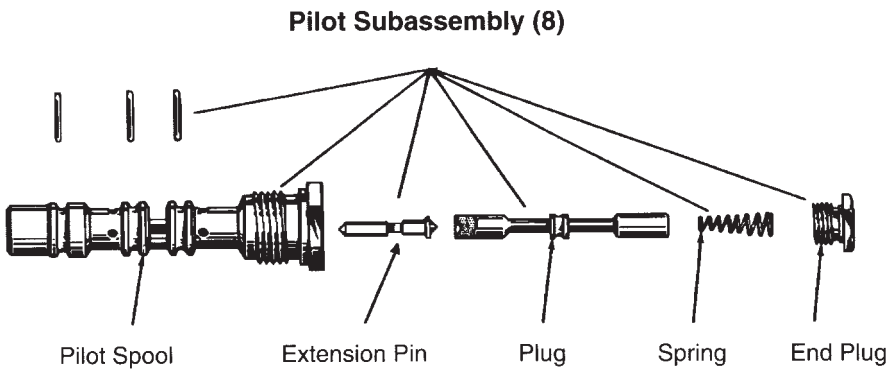


Figure 45. Pilot Subassembly

Disassembly Procedure

Completely shut down the SVI.

- Isolate the valve from the process
- Put the positioner out of service
- Shut off air supply
- Install warning signs or lockouts as necessary to ensure against accidental re-activation of SVI.

WARNING:
Failure to completely shut down SVI can damage the system or result in personal injury.

Unscrew pilot subassembly and disengage it from the body.

Note: Turn the pilot subassembly while removing to prevent damage to "O" rings.

Remove the end plug and withdraw the spring, plug, and extension pin. Do not disassemble or adjust the extension pin.

Wipe the parts with a clean soft cloth and blow clean compressed air through the orifices. Clean all surfaces with isopropyl alcohol only. Do not use chloride-based solvents

Reassembly

Install three new "O" rings on the pilot spool. Apply a light coating of a compatible lubricant to each ring.

Insert the extension pin and the plug into the pilot spool, with the countersunk end first. Note: The plug should slide into the spool by its own weight.

Install the spring in the pilot spool with the small diameter end contacting the plug.

Screw the pilot end plug into the pilot spool.

Install the pilot subassembly into the body.

HART Communications

This section contains information about computer and peripheral connections necessary to achieve proper communication, so that SVI can communicate with ValVue or a Hand-Held device.

The ValVue manual contains setup and administration procedures for HART communications. Refer to HART Communicator manual MAN 4250 for for basic instructions on using the Hand Held communicator. The manual covers General Instructions, Hot Key Customization, Connections, and Off-Line functions. Use of the Hand Held with SVI is facilitated by use of the Hand Held Communicator Guide flowchart in the Instructions section of this manual.

Setup and Administration

Load ValVue version 1.0.4, or higher, for proper operation of the PC. The ValVue version number and the SVI version number must match (or use a higher ValVue version than the SVI version software).

Note: ValVue demo software does not communicate with SVI.

Communication Port and Settings

Plug the modem into the serial port (COM1 or COM2) of the PC. The user selects the serial port during ValVue installation, or in the properties of the ValVue icon, or you manually can set ValVue to use the same port as the modem.

The user manual for your computer contains more information about proper use of serial ports.

Typical PC operation includes the following settings:

- COM1 or COM2 as the physical connector
- Default settings for the interrupt level and interrupt address (e.g., the correct BIOS settings use the serial port with a modem and enable the interrupt)

Use of Laptop Computers

Laptop computers sometimes require non-conventional settings and support Power Management features that can disable the COM ports. Check your laptop user manual for additional information.

Mouse Interference

Modem settings sometimes conflict with proper mouse operation, and the mouse "hangs up" after initiating ValVue. Select another port for either the mouse or the modem.

Hand Held Considerations

A hand-held terminal must include the SVI device description in order to perform diagnostic and calibration functions. The HART 275 hand-held terminal will report the primary and secondary variable, tag, message, and other basic values.
Note: The communication connection of a PC with ValVue or a HART 275 hand-held terminal is not polarity sensitive.

Failure to Communicate

If the PC fails to communicate with the SVI (the PC displays the message "No Hart Device" or "Device Not Responding") then the PC cannot establish a link to the SVI. Possible causes of communications failure related to installation include:

- Poor wiring contacts
- Improper connection of the HART modem to the computer
- Incorrect serial port
- Using ValVue with another HART master terminal in service
- Insufficient loop impedance (Require a minimum of 250 ohms)
- Polling address set to non-zero value. The polling address, which can be set only by using the HART 275 Hand-held must be set to 0 in order for ValVue to communicate with the SVI. Do not change polling address from 0 with HART 275 Communicator.

Note: You cannot use ValVue and attempt to connect another HART master terminal device (e.g., a hand-held device). ValVue will not operate with a second terminal device (either primary master or secondary master).

Fatal and Non-Fatal Errors

Fatal Errors:
The following definitions describe typical fail-safe (fatal) errors:

Error	Description	Explanation	Likely Cause(s)
POSERR	Position Error	The valve did not go to the requested position within the time configured in "Position Error Time 2"	• Valve lost air pressure • Valve movement is blocked • Setting of "Position Error Time 2" is too low for the size of valve
POSSEN	Position Sensor Error	Position sensor failed	• Improperly adjusted linkage resulting in the potentiometer out of range at one limit or the other • Potentiometer connector is disconnected • A broken wire
SIGSEN	Current Sensor Error	The input signal sensor has failed	Electronic failure within the module
REFERR	Reference Voltage Error	The reference voltage within the SVI is out of range	Electronic failure within the module
HWERR	Self-Check Failure	The SVI failed an internal self-check	Electronic failure within the module
OVERRUN	Data Overrun	The SVI could not process the input data	Electronic failure within the module

Non-fatal Errors

The following definitions describe typical non-fatal errors. SVI reports these errors; they do not cause a fail-safe condition.

Error	Description	Explanation	Likely Cause(s)
POSERR	Position Error	The valve did not go to the requested position within the time configured in "Position Error Time 1"	• Valve lost air pressure • Valve movement is blocked • Setting of "Position Error Time 1" is too low for the size of valve
Note: Setting "Position Error Time 2" to a positive number may cause the device to fail-safe on a POSERR.			
PRESSEN	Pressure Sensor Error	The pressure sensor failed	While the SVI can function in normal operation with a failed pressure sensor, other calibration functions depend upon the pressure sensor.
BIASERR	Bias Out or Range	The bias (the output to the EPC within the SVI that controls the actuator fill/exhaust) is out of normal range	• This error indicates an improperly adjusted bias. Adjust the bias as needed. If the SVI once functioned properly, this error usually indicates an improperly working pneumatics section.
RESET	Reset Occurred	A SVI reset occurred	SVI reset occurred because of a power loss or a command from ValVue.
STOPPERR	Position Calibration Failed	The self-position calibration routine failed	The most likely causes are loss of air pressure or the pressure or position sensor not working properly.
TEMPERR	Circuit Temperature Error	The internal SVI temperature is outside the normal operating temperature range in the SVI specifications	

Non-Fatal Errors Continued.

Error	Description	Explanation	Likely Cause(s)
WRTERR	EEPROM Write Failed	A write of data to the internal permanent memory of the SVI Failed.	If you detect this error, issue a reset and check the configuration and calibration parameters
TIMRERR	Watchdog Timer Time-out	An internal timer that checks proper SVI operation has timed out, indicating improper operation of the SVI.	On watchdog timer time-out, the SVI issues a self reset. This error indicates that such a reset already occurred
CALFAIL	Signal Calibration Failed	An attempt to recalibrate the primary of secondary signal or the pressure sensors failed.	The normal cause is sending the SVI calibration values outside the allowed range, or trying to calibrate two values too close together (e.g., with insufficient range for accurate calibration).