

MASONEILAN ValVue®

EW1000
04/99

SOFTWARE INTERFACE TO SVI®



INSTRUCTION MANUAL

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SAFETY LABEL COMPONENTS



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

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



DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

IMPORTANT: SVI SAFETY WARNING	
<p>Please read these instructions carefully BEFORE SVI is installed or maintained.</p> <p>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.</p> <p>Products certified for use in explosionproof / flameproof or intrinsically safe installations MUST:</p> <ul style="list-style-type: none"> 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 the SVI Instruction Manual (EW2000). 	<ul style="list-style-type: none"> c) Only be maintained by qualified personnel with adequate training on hazardous area instrumentation. <p>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.</p> <p>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.</p> <p>Dresser Masoneilan reserves the right to discontinue manufacture of any product or change product materials, design, or specifications without notice.</p>

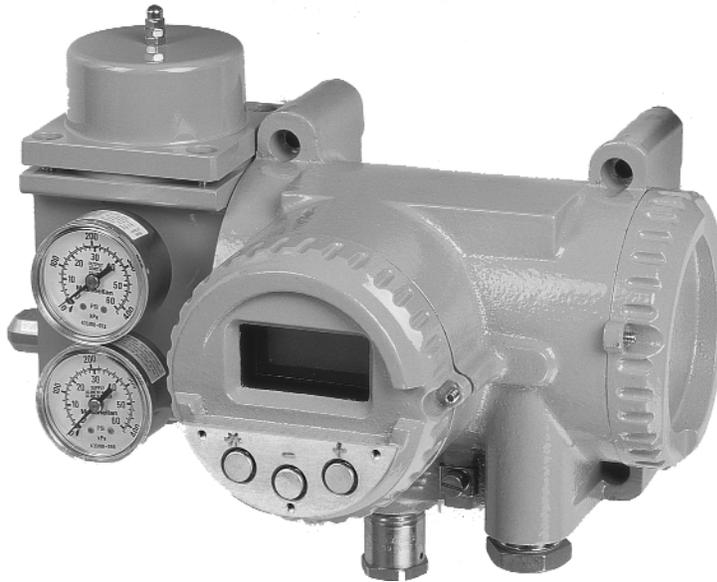
Chapter 1: Overview

Scope of Manual

ValVue is a software package that provides an interface to Masoneilan's Smart Valve Interface (SVI®) and other HART® instruments. This manual describes the functionality of ValVue® and contains information needed to install and use ValVue with SVI.

SVI and ValVue

The Smart Valve Interface, shown below, is a digital valve positioner and/or process controller that can be configured, calibrated, and operated locally or remotely using ValVue software, a Windows® based computer, and a HART® modem.



For more information on SVI refer to the Masoneilan SVI Instruction Manual (EW2000). It is possible to monitor, configure, calibrate, control and perform valve diagnostics using ValVue software and an SVI mounted on a valve. ValVue can also provide a basic interface to other HART instruments.

ValVue Features and Functions

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

ValVue also supports the MTL multiplexer. Multiple SVIs can be monitored and operated from a single computer by using the multiplexer version of ValVue.

SVI Features and Functions

- Precision valve positioning control
- Advanced valve diagnostics
- Automatic setup and tuning
- Local operation/calibration/configuration using optional explosion proof pushbuttons and digital display
- Remote operation/calibration/configuration/diagnostics using ValVue software, or a handheld with SVI Device Description (DD).
- Two-way data communication using industry-standard HART protocol
- User-configurable tight shutoff adjustment
- Optional PID controller with remote set point and process variable inputs
- 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 limits
 - Display and/or set parameters for valve configuration
 - NORMAL OPERATE valve in manual mode or 4-20 mA mode
 - 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

Chapter 2: ValVue Installation and Computer Requirements

The ValVue installation procedures outlined in this chapter assume a working knowledge of Microsoft Windows® and the Masoneilan SVI. For further information about SVI, see Masoneilan SVI Instruction Manual (EW2000).

Hardware and Software Requirements

ValVue runs on a standard IBM-compatible computer. To successfully install and run ValVue, the computer system must meet minimum hardware and software requirements as follows:

- Windows version 3.1 or later operating system
- 386, 486, Pentium or better microprocessor
- A 3.5-inch diskette drive
- An available serial communication port
- A HART modem or RS232/485 converter for HART Multiplexer
- 10 MB of free hard disk space to install and run ValVue

Installing ValVue

Before installing ValVue, determine what port the computer uses for RS-232 communication (COM1 or COM2). The HART modem (or RS232/485 converter for ValVue multiplexer version) will use this port for communication with SVI.

There are two different ValVue installation disks for different Windows operating systems:

- ValVue for Windows 3.1 and
- ValVue for Windows 95, Windows 98, or Windows NT operating systems.

Before installing the ValVue software, make sure that the appropriate disk is used. To support the MTL HART multiplexer, the multiplexer version of ValVue must be used.

To install the ValVue software from the disk:

1. Insert the ValVue installation disk in the 3.5-inch diskette drive.
2. In Windows 95, 98 or Windows NT, select Start->Run from the task bar. In Windows 3.1, select File->Run from the main menu.
3. Type x:\setup.exe (for example a:\setup) where x is the letter for the 3.5-inch diskette drive. Press Return or click OK.
4. Follow the prompts on your screen to complete the installation process.

An administrative program, SviAdmin, is also installed along with ValVue. After successful installation of the ValVue software, the system administrator of ValVue should change the default logon and password (defaults, Login: masoneilan; Password: new (case sensitive)) and set up user accounts through the SviAdmin program. Secure the ValVue setup disk in order to provide system security. Anyone with access to the setup disk could reload the software and thereby get access to SVI devices. For more detail, see Chapter 4: System Administration, Passwords, and Privilege Levels.

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

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)

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).

Chapter 3: SVI Modes

Modes

SVI functions in normal operating, manual operating, configuration, calibration, diagnostic and fail-safe modes. The definitions of these SVI modes are:

- **Normal Operating Mode:** In this mode, the SVI controls the valve in responds to the 4-20 mA input signal. When the built-in process controller is enabled and SVI is in normal mode, the valve responds to the output of the process controller.
- **Manual Mode:** Both the controller setpoint and valve position can be adjusted manually using ValVue and HART commands. When entering this mode, the SVI leaves the valve in the last position after leaving Normal Operating Mode. The SVI will no longer respond to the 4-20 mA input signal. When the built-in process controller is enabled, the output of the process controller and valve position is fixed.
- **Configuration Mode:** In this mode, the valve remains in place and no longer responds to the 4-20 mA input signal. Configuration mode is used to display SVI configuration and modify the configuration as necessary.
- **Calibration Mode:** In this mode, the valve no longer responds to the 4-20 mA input signal. Calibration mode is used to scale and calibrate analog inputs, valve position, out pressure, and tune the valve position control algorithm.

 WARNING	Since some calibrate functions stroke the valve over its full range, the valve should be isolated from the process before moving to the Calibrate Mode.
--	--

- **Diagnostic Mode:** Diagnostic mode allows the user to run several useful test procedures that provide information on the valve and its performance. In this mode, the valve no longer responds to the 4-20 mA signal. The valve may be stroked over a narrow or full range depending on the type of test and parameters selected.

 WARNING	Since some diagnostic functions stroke the valve over part or full range, the valve should be isolated from the process before moving to the Diagnostics Mode.
--	---

- **Failsafe Mode:** SVI does not go to failsafe mode if it is functioning normally. If a problem occurs that causes the SVI to enter the failsafe mode, the SVI will attempt to drive the valve fully open or fully closed, depending on the configuration settings.

Usually, SVI is in normal mode during operation. SVI may be switched from normal mode to manual mode for manual manipulation of the valve. In manual mode, SVI may be switched back to normal mode, or switched to configuration mode, calibration mode, or diagnostic mode. SVI may fail to the failsafe mode in any mode when a predefined problem occurs.

Chapter 4: System Administration, Passwords, and Privilege Levels

In a plant with many users with various levels of training and responsibility, it is often desirable to allow certain users access to only a limited range of functions. To start the ValVue program requires a valid account with a user name and a password. The privilege level associated with the ValVue account determines what functions of the program the user is allowed to access.

The SVI Administration program SviAdmin allows the administrator to perform all user account administrative functions related to run ValVue and limit the access to the functionality of SVI.

These administrative functions include:

- Adding new user accounts
- Deleting existing user accounts
- Changing existing user accounts

Start the Administration Program

After installation of ValVue, the ValVue administrator should change the default passwords, set up the initial user accounts through the SviAdmin program, and secure the setup disk. Anyone with access to the setup disk could reload the software and thereby get access to SVI devices.

To start SviAdmin, double-click the SviAdmin icon, or select Start->Program->ValVue6->SviAdmin. The administrative program prompts you for a logon name and password. To login in with an administrator account, enter the default logon name and password listed on the installation disk label for the first time. (Note: The system is case sensitive, and you must type the default names in lower case.) Then clicking OK brings the VALVUE SYSTEM ADMINISTRATION window.

The program already contains two accounts. One account is the administrator account you are using simulator with logon name of masoneilan and password of new (case sensitive). The other account is for the SVI process controller simulator with logon name of training and password of training (case sensitive). The process control simulator will simulate, in software, a process with a dead time of one second and a lag of five seconds. The process controller simulator is useful for training users on the many functions and features of the SVI positioner and the SVI controller.



It is important that the administrator change the default logon names and passwords for the administrator account and the training account. Continued use of the default logon account names and passwords makes the system less secure.

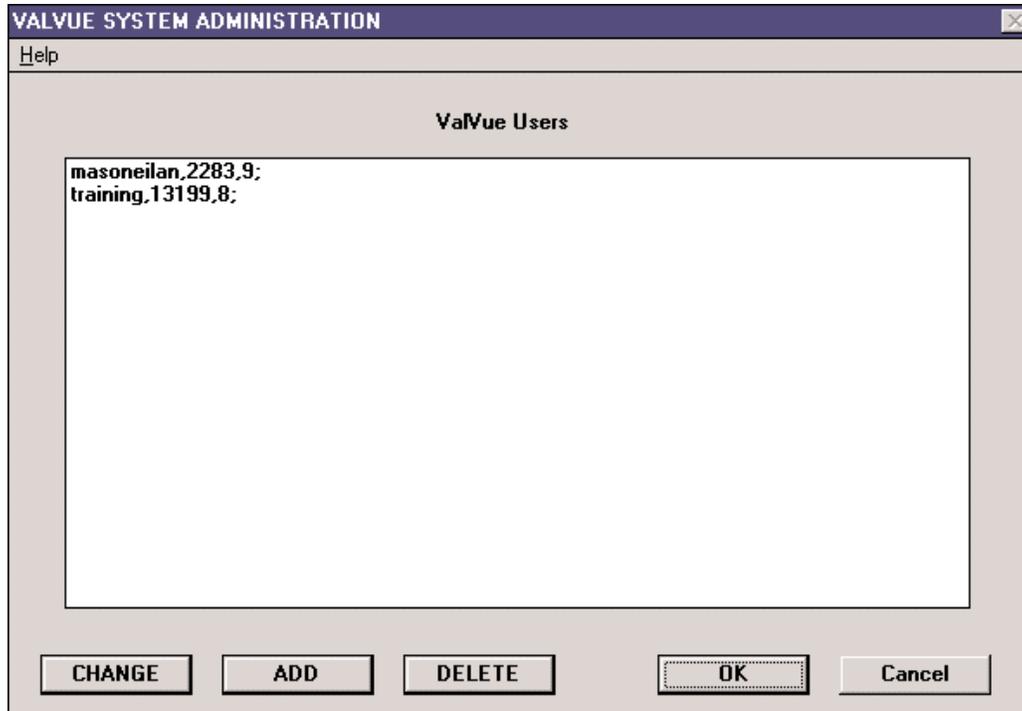


Figure 1. ValVue System Administration

Privilege Level

Each user is assigned with an account. Each account, has a privilege level associated with it. You provide ValVue users an appropriate privilege level so you can keep field devices secure from the actions of unknowledgeable or unauthorized users.

Privilege level ranges from 0 to 9, and level 0 is the lowest and 9 the highest. The following defines privilege levels, which control access to specific functions of the ValVue program.

- **Level 0:** Allows the user to logon to ValVue only if the connected SVI is in normal operating mode. The user can send commands that will reply with configuration, calibration, and status information, but the user can not change any information. Level 0 users cannot go to manual mode.
- **Level 1:** Allows the user access to either normal operating mode or manual mode. The user can transfer from one to another mode (i.e. the user can take the SVI out of normal mode and put it in manual mode). The user cannot, however, change the calibration or configuration.
- **Level 3:** Allows the user to change the configuration or calibration values, but does not allow the user to perform operations that stroke the valve (Find Stops and diagnostics).
- **Level 4:** Allows the user to perform all operations except “Save Factory” standard valve signature and “Restore SVI Memory”.
- **Level 8:** This level is intended for training and should be used cautiously. It grants all of the privileges of level 4 plus allows access to the simulation mode of the process controller. (The simulation mode of the controller allows the user to run the process controller without connecting a process variable input to the SVI and is useful for learning how to operate the process controller).

- **Level 9:** Allows accesses to all SVI functions. In addition, it is the only level allowed to logon to the administration program.

The administrator has an account of privilege level 9. There must be at least one user of privilege level 9 in order to get access to the administration program.

Note: It is good practice for the administrator to assign him/herself a second logon name and password with a lower privilege.

Adding and Changing a User Account

The administrator can add a new user by clicking the ADD button, and change a logon name/password/privilege by double clicking an existing account or by clicking an account and clicking the CHANGE button. In the case of adding or changing a user account, the User Add/Change window will pop up. The administrator will be required to enter a logon name, a privilege level, and a password. The password must be entered identically twice to insure that it is typed correctly.

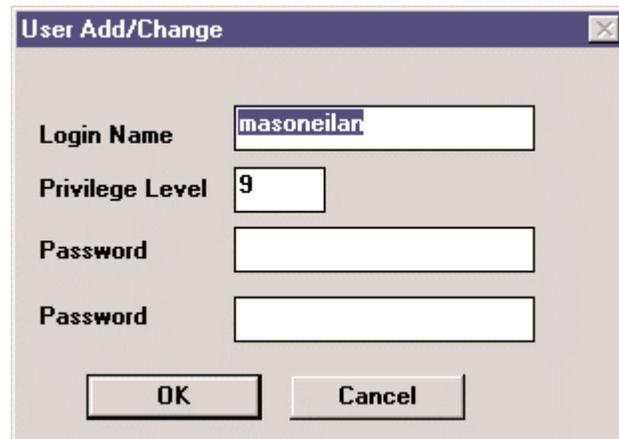


Figure 2. User Add/Change Window

- **Login Name:** Must not be blank and may be up to 20 characters. Embedded blanks are allowed and the name is case sensitive.
- **Privilege level:** Must be a number between 0 and 9.
- **Password:** Must not be blank and may be up to 20 characters. Embedded blanks are allowed and the password is case sensitive. The password must be entered identically in both edit boxes.

When finished click the OK button to accept the changes. Otherwise, clicking Cancel discards the changes made.

Deleting a User Account

The program allows you to delete a user account from the database of ValVue users. To delete a user account, clicking on a user account in the list box to select it and then click the DELETE button.

After you complete the task, click the OK button to accept the changes made and exit the program. Clicking the Cancel exits without changing the account file.

Chapter 5: Starting ValVue

ValVue provides a Windows-based interface that can operate, configure, calibrate, and diagnose Masoneilan SVI positioners and controllers. ValVue can also communicate with other HART devices at a basic level using HART Universal Commands. To communicate with a SVI or a HART device, you need to connect the device to the computer's RS-232 serial port through a HART modem, or through a MTL multiplexer and a RS232-485 converter. Without a real HART device, ValVue allows you to run offline with a simulated SVI.

ValVue provides an on-line help utility that provides information on how to use various functions of the SVI and ValVue. To access the help utility, you can select ValVue Help from the Help menu.

After completing the hardware connections, communicating with a SVI or a HART device can begin. The following describes the procedure to start ValVue.

Logon

Starting ValVue for the First Time

ValVue software must be registered to activate the permanent installation. Registration allows Dresser Valve Division to keep track of all ValVue users so that we may notify you of any changes or important information about new software features and updates.

To register your software, you will have to contact Masoneilan and provide your name, company name, contact information, the disk serial number, and the installation ID number from the ValVue displays. A Masoneilan customer service person will provide you with a password to enter the next time you run the program. Contact Masoneilan for a new password if re-installing ValVue on a different computer.

Double click the ValVue icon to start the ValVue application. For Windows 95 and NT systems, you may also select Start → Program → ValVue7 → ValVue to start the application.

Agreement with the ValVue license agreement is necessary to continue. Read the license agreement then click OK to accept the agreement.

At this point, the ValVue Registration window pops up. In order for ValVue to function permanently, you must register it. The registration window requires entering information including Name, Company, and ValVue Serial Number. Enter the Name and Company in their edit boxes and leave the edit box of Password blank at this time. Click OK to continue.



44. ValVue Registration

Name

Company

ValVue Serial Number

Password

If you don't know your password, leave it blank now.

OK Cancel

Figure 3. ValVue Registration Window

The following window appears. Write down the ValVue Serial Number and Installation ID Number displayed on the screen. Please contact a Masoneilan customer service person and give your name, company, and the above numbers. They will supply you with the password you will need next time you start the program. Without the password you will only be able to run this program for 60 days. Clicking OK will bring a window with the warning message for remaining days to run ValVue without a password.



Figure 4. Svi Windows Application Window

Click OK again to continue. The LOGON window appears. Enter the appropriate name and password assigned by a ValVue administrator in the LOGON window and click OK to continue.

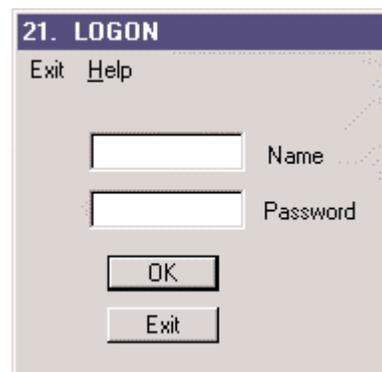


Figure 5. Logon Window

ValVue will pop up the Device Selection window and search devices connected and list the devices found. To stop the searching process, click the Stop button.

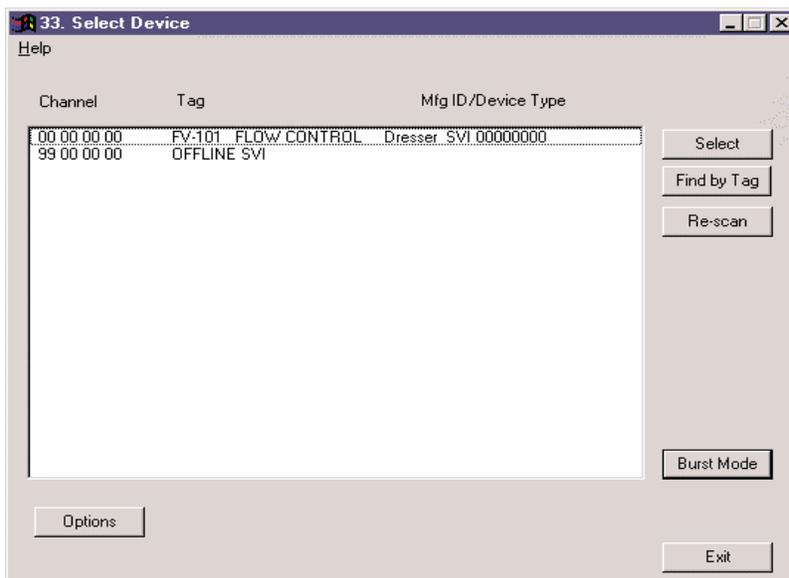


Figure 6. Device Selection Window

Starting ValVue with a Password after Registration

To start ValVue with the password from the ValVue Registration process, follow the procedure below.

Double click the ValVue icon to start the ValVue application. For Windows 95 and NT systems, you may also select Start → Program → ValVue7 → ValVue to start the application. Follow the instructions.

In the ValVue Registration window, enter the password obtained from Masoneilan in the password edit box. Click OK. If the password is correct, the LOGON window is presented immediately. The rest of the logon procedure is the same as the above for Starting ValVue for the First Time.

ValVue records the user name, company, disk serial number, and password for future reference when contacting Masoneilan. This can be viewed at any time from the Help menu - registration info.

Starting ValVue with a Valid Password

If ValVue has been run with a valid password from Masoneilan, ValVue will be started in a simpler way. When ValVue is started, the license agreement and registration window is no longer displayed. The user is immediately prompted with the LOGON window for a user name and password.

Device Selection

Once the user is logged into ValVue, the program displays the Device Selection window, searches devices connected, and lists devices found.

The Device List box displays a list of all of the devices on the loop (or in the multiplexer version of the program, of all devices connected to the multiplexer). The list displays a line for each device and lists the device address (channel), tag, manufacturer's ID, device type, and device ID. ValVue can be connected to a device in the list by double clicking on the line or by selecting the line and clicking on the Select button.

In the multiplexer mode, the nodes and sub nodes are listed for information purposes. These devices may not be selected.

Devices connected to a HART loop must have a polling address between 0 and 15. ValVue supports devices operating at any of these addresses and supports multiple devices (with different addresses) on the same loop if multidrop option is selected.

In the multiplexer version of the program, each device has an extended address that includes the node (0-31), the sub node (0-31), the loop (0-15) and the polling address (0-15). These addresses are displayed in device list box under title channel. The node, sub node, and loop are determined by the connection to the multiplexer. The polling address of a device can be set with software from ValVue or with a handheld.

Clicking on a line in the device list box selects the HART device that the program will communicate with. In the direct connect version of the program, devices at any polling address may be selected. In the multiplexer version of the program, any device connected to the multiplexer may be selected. Double clicking on the line containing the tag name and device ID in Device List box starts communication with the device.

Non-SVI devices on the loop or multiplexer are listed. ValVue can connect to these devices, however when connected, ValVue is limited to sending Universal HART commands.

From the device selection window, the following can be performed:

- Click the Select button or double click the selected device to cause ValVue to connect and communicate with the selected device. If the device is SVI type, it typically brings the Normal Operating or Manual Mode window according to the current mode of the SVI device. In the multiplexer version of the program, the Select action is ignored if the selected device is a node or sub node.
- Click the Options button and enter into the Options window to setup options that control how ValVue performs HART and multiplexer communications as well as the option for hiding background display of ValVue.
- Click the Find by Tag button to bring up a window. Enter a tag in the window to allow ValVue to search from the device list for a device with a matching tag. If found, the device will be selected and the window scrolled so that the line is visible. This function is most useful in the multiplexer version where the device list may be very long.
- Clicking the Re-scan button causes ValVue to build a new device list. In the direct connect version of ValVue, all polling addresses are checked (if the options allow multidrop). In the multiplexer version of the program, all nodes are checked. If there are a large number of devices connected to the multiplexer, this function can take some time to complete. When the re-scan is completed, the user may optionally save the device list to a file so that re-scanning is not necessary every time ValVue is started.
- Click the Burst Mode button to bring the Burst Mode Control window to allow the user to turn burst mode on or off for any selected device on the device list. The window below will be shown. Click the appropriate button to turn burst mode off or on using the HART command 1 or 3, then click OK to accept the selection and exit the window.
- Click the Mux Setup button to bring the Mux Setup window, which allows the user to change the options provided by the MTL multiplexer. This button is enabled and used only in the multiplexer version of the program. The user should also see the multiplexer supplier's manual for further information. See Chapter 17: Multiplexer Setup and Operation for detail.

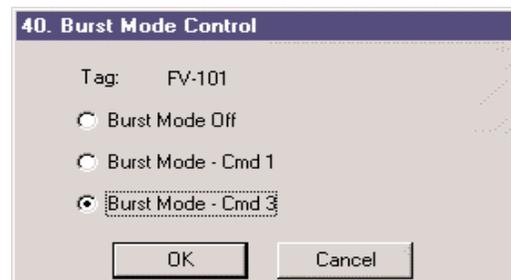


Figure 7. Burst Mode Control

- Click the Mux Reset button to issue a reset command to a node of the multiplexer. This button is enabled and used only in the multiplexer version of the program. The user will be prompted for the node that is to be reset. When reset, the multiplexer node will re-scan all of the devices connected to it and depending upon the options set for the multiplexer, may take some time to complete.

Note: This hardware re-scan is different from the re-scan performed by ValVue from the Re-scan button. No communication between ValVue and any devices takes place on the node until the reset is completed.

- Click the Add Device button to add a device to the device list without re-scanning the entire network. This button is enabled and used only in the multiplexer version of the program. To complete this function, enter the device address (node, sub node, loop, and polling address). The function will add the device both to the multiplexer hardware list and to the device list in ValVue.
- Click Exit to end this program.

Hart Options

The Options window allows the user to set options related to HART and multiplexer communications. Click the Options button in the Select Device window to bring up the window below:

One option a user must select is the computer communication serial port to use for HART communication. Once selected in the Options window, this selection overrides any selection on the command line that starts the program.

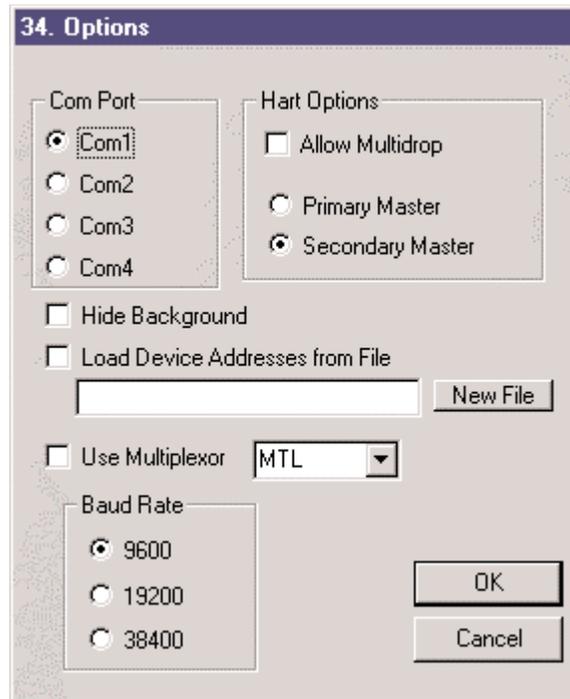


Figure 8. Options Window

If the Allow Multidrop box in HART Options is selected, ValVue will support HART devices (including SVIs) with non-zero polling addresses and will support multiple devices on the same loop (for split ranging for example). If the box is unchecked, ValVue will look for devices only at polling address 0. When in multidrop mode, even if a device is found at polling address 0, ValVue searches for devices with other polling addresses. For example, this allows a loop with a transmitter operating at 4-20 mA with polling address 0, and an SVI operating as a controller and positioner with polling addresses 1-15.

ValVue can send commands to a HART device as a primary master or as a secondary master. In most cases the selection between the two does not matter since using ValVue with a device that is communicating with another HART master is discouraged. When used with a multiplexer, however, operation with a second HART master (such as a DCS system) is allowed. The ValVue program must be configured to match the configuration of the multiplexer. That is, if the multiplexer is a primary master, ValVue must also be configured to be a primary master.

If the option of Hide Background is selected, the ValVue background is hidden. Otherwise, the background will cover the whole screen.

The device list may be saved in a file in order to eliminate the necessity of re-scanning each time connect is selected. Unless the option of Load Device Addresses from File is selected, the file used is temporary and a re-scan is done each time the program is restarted. If selected, the user may select a file in which to save the device list. This file will be read whenever the program is started and the list displayed. This will save the time required to re-scan and is particularly useful for a multiplexer connected to many devices.

Multiplexer Options

In the multiplexer version of the program, the option of Use Multiplexer allows the user to select either direct connect (through a HART modem) or multiplexer operation.

The MTL multiplexer supports baud rates of 9600, 19200, and 38400. The user must select the baud rate at which the hardware has been configured. In the direct connect mode, 1200 baud (the HART standard) is used automatically.

After the options are selected, you can:

- Click OK to accept the changes and exit to Select Device window.
- Click Cancel to discard the changes and exit to Select Device window.

More detail regarding multiplexer setup can be found in Chapter 18: Multiplexer Setup and Operation.

Offline SVI Mode

There is always a simulated SVI device, SVI OFFLINE, on the list of Device List in the Select Device window. Using the offline feature allows access to ValVue screens even if there is no HART modem or multiplexer connected to a computer serial port. When SVI OFFLINE is selected, you are prompted to select a dump file containing configuration and calibration data of the SVI to run. The SVI OFFLINE serves two purposes:

- Allow a user to view configuration, calibration and diagnostic data (of a real SVI) that have been saved in dump and diagnostic files.
- Demonstrate the feature and functions of both SVI and ValVue.

To run ValVue for SVI OFFLINE, Click SVI OFFLINE in the device list box and click the Select button or double click the selected item. A file open window will then pop up as shown below for selection of a dump file as a simulated device. There is a dump file installed with ValVue and can be used for demonstration purposes.

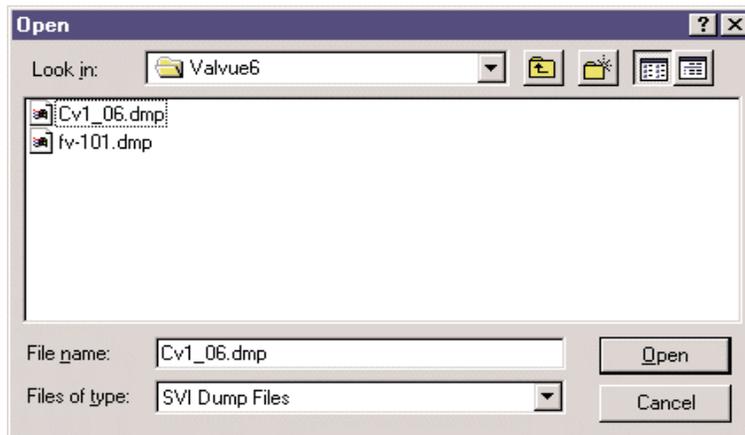


Figure 9. Open Dump File Window

Once an SVI dump file is selected, clicking Open brings up a window with a message about the revision level of the SVI and dump file. Clicking OK pops up the Normal Operating Mode window. OFFLINE in green is displayed, indicating that ValVue is using a SVI dump file to simulate a SVI rather than communicating with a real SVI device.

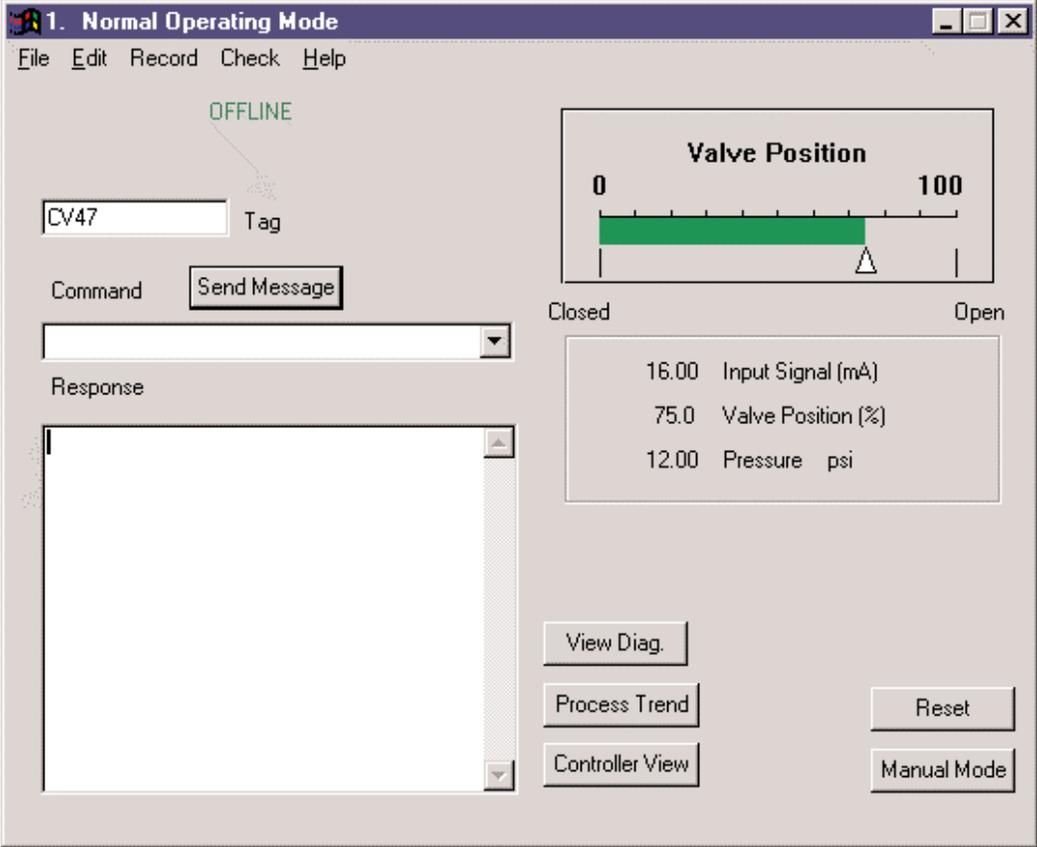


Figure 10. Normal Operating Mode - Offline Window

Chapter 6: Quick Tour of ValVue Windows for SVI

SVI functions in normal operating, manual operating, configuration, calibration, diagnostic and fail-safe modes. ValVue has windows to interface with each of different mode.

In this chapter, the ValVue windows for SVI screens are introduced. More details about these windows can be found in the following chapters.

The first window is the Normal Operating Mode. This window is displayed after an SVI device in normal operating mode has been selected in the Select Device window. In normal operating mode, the SVI controlled valve responds to the 4-20 mA input signal, if the SVI is configured as a positioner. If the SVI is configured as a controller, it responds to the output of the built-in process controller.

The normal operating mode monitors a valve's normal operation. This window displays and updates real time values for input signal, valve position, valve setpoint and pressure; numerically and graphically.

Normal Operating Mode

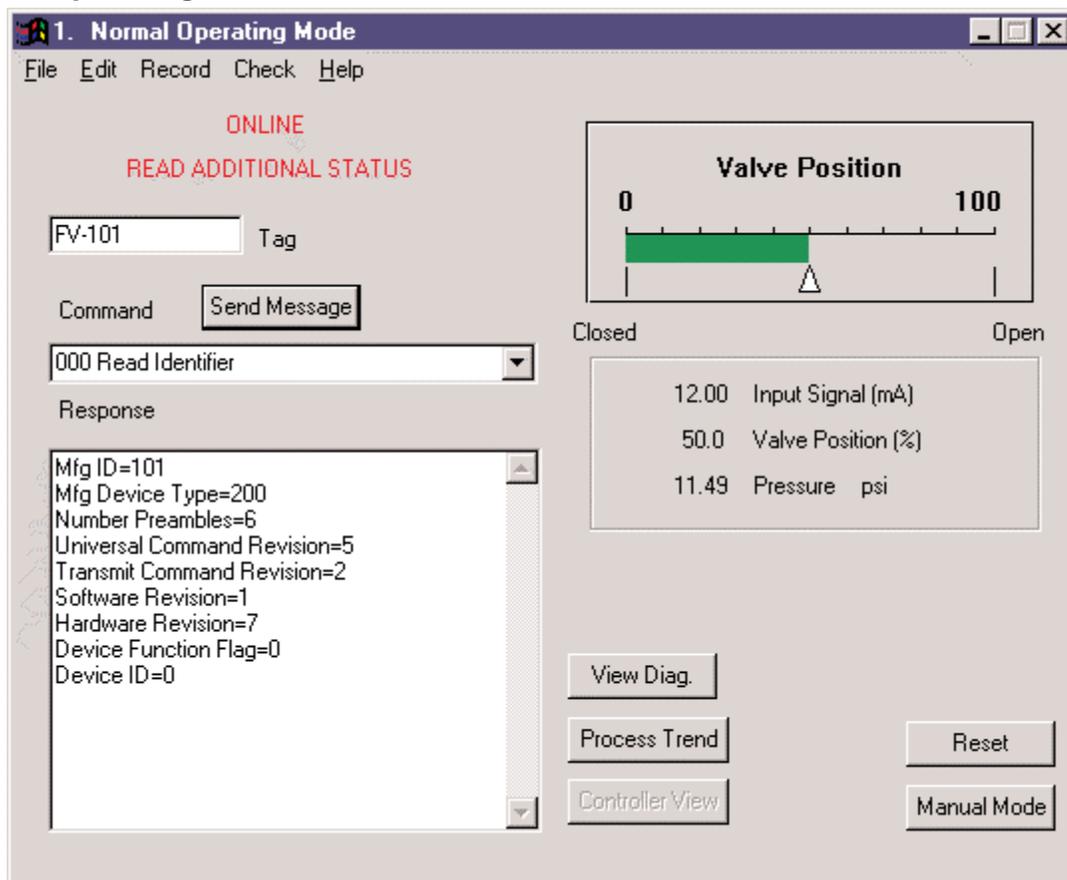


Figure 11. Normal Operating Mode - Online Window

In the Normal Operating Mode window, ValVue provides a drop-down list of HART commands that can be selected and sent to the SVI. ValVue lets you:

- Send HART commands to the SVI device
- Display the SVI responses to the HART commands.

Process Trend Data

Clicking the Process Trend button in Normal Operating window brings up the Process Trend Data window, which records valve position and valve setpoint over the last 90 seconds. If the process controller is enabled, then a process variable and its setpoint will also be recorded.

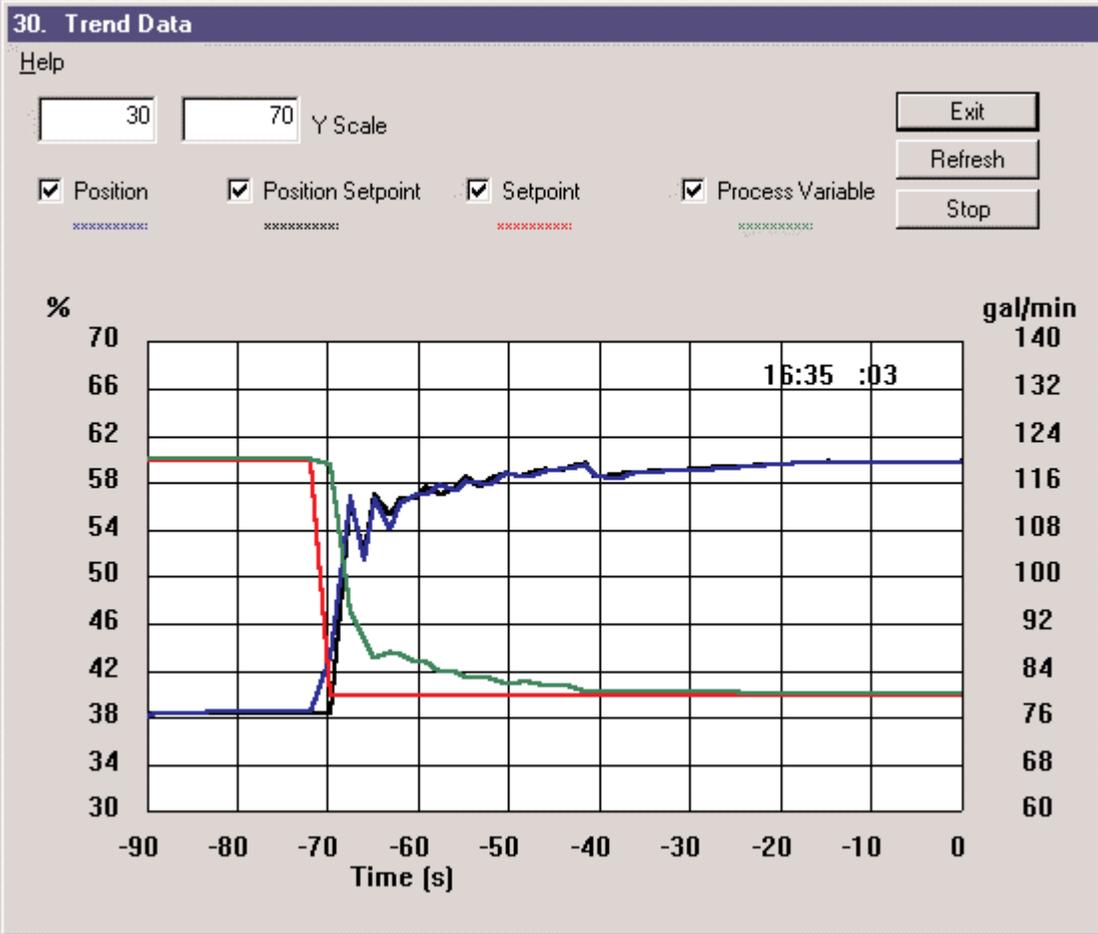


Figure 12. Trend Data Window

Manual Mode

Clicking the Manual Mode button from the Normal Operating window leads to the Manual Mode window. In manual operating mode, the SVI controlled valve remains in place and no longer responds to the 4-20 mA input signal. The valve can be moved by entering the desired valve position setpoint. From manual operating mode, the SVI can be switched to Configure, Calibrate or Diagnostics mode.

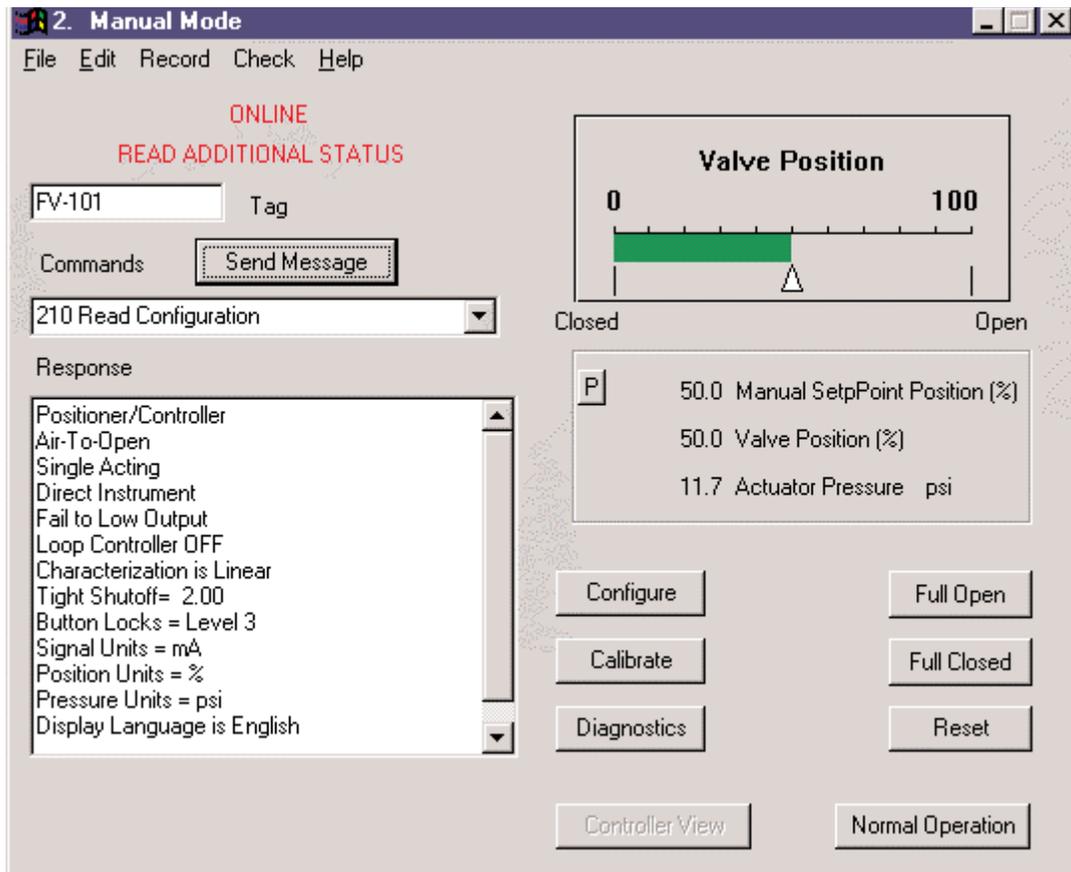


Figure 13. Manual Mode Window

The Manual Mode window shown below, displays and updates real time values for valve position and actuator pressure.

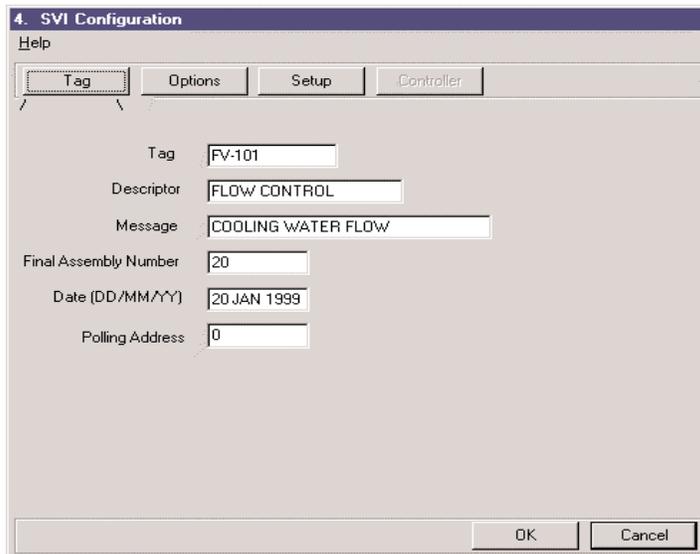
As in the Normal Operating Mode window, ValVue provides a drop-down list of HART commands that you can select and send to the SVI. ValVue lets you send HART commands to the SVI device and display the SVI responses to the HART commands.

Configuration Mode

Clicking the Configure button in the Manual Mode window brings up the SVI Configuration window. Configuration mode displays SVI configuration, modifies the configuration as necessary and downloads to the SVI device. In this mode, the valve remains in place and does not respond to the 4-20 mA input signal.

The SVI Configuration window has four tabs: Tag, Options, Setup, and Controller. Clicking a tab brings you to a corresponding page to examine and modify configuration parameters.

The Tag page is displayed when entering configuration mode. This page allows the user to examine and modify the tag, descriptor, message, final assembly number, date and polling address.



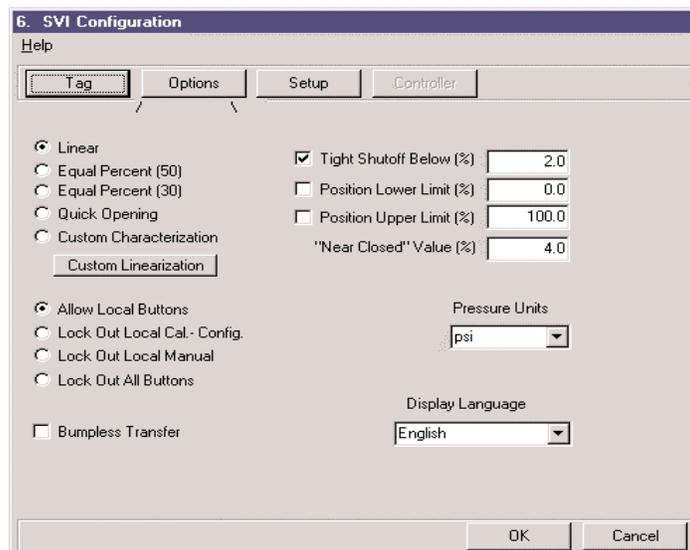
The screenshot shows a window titled "4. SVI Configuration" with a "Help" button. It has four tabs: "Tag", "Options", "Setup", and "Controller". The "Tag" tab is selected. The window contains the following fields:

- Tag: FV-101
- Descriptor: FLOW CONTROL
- Message: COOLING WATER FLOW
- Final Assembly Number: 20
- Date (DD/MM/YY): 20 JAN 1999
- Polling Address: 0

At the bottom, there are "OK" and "Cancel" buttons.

Figure 14. SVI Configuration Tag Page Window

The Options page is displayed by clicking the Options Tab in the SVI Configuration window. A typical Options page is shown below. This page allows the user to choose and set positioner characteristics, linkage linearization, SVI local pushbutton control levels, bumpless transfer, tight shutoff and its value, position software limits, near closed value, pressure units, and display language.



The screenshot shows a window titled "6. SVI Configuration" with a "Help" button. It has four tabs: "Tag", "Options", "Setup", and "Controller". The "Options" tab is selected. The window contains the following controls:

- Positioner Characteristics:
 - Linear
 - Equal Percent (50)
 - Equal Percent (30)
 - Quick Opening
 - Custom Characterization
- Custom Linearization: [Button]
- Local Button Control:
 - Allow Local Buttons
 - Lock Out Local Cal. Config.
 - Lock Out Local Manual
 - Lock Out All Buttons
- Bumpless Transfer:
- Tight Shutoff Below (%): [2.0]
- Position Lower Limit (%): [0.0]
- Position Upper Limit (%): [100.0]
- "Near Closed" Value (%): [4.0]
- Pressure Units: [psi]
- Display Language: [English]

At the bottom, there are "OK" and "Cancel" buttons.

Figure 15. SVI Configuration Options Window

The setup window appears after clicking the Setup Tab in the SVI Configuration window. A typical Setup page is presented here. This page allows the user to choose and set configuration parameters such as air to open or close valve, single or double acting actuator, process controller on or off, direct or reverse, position and pressure fault limits.

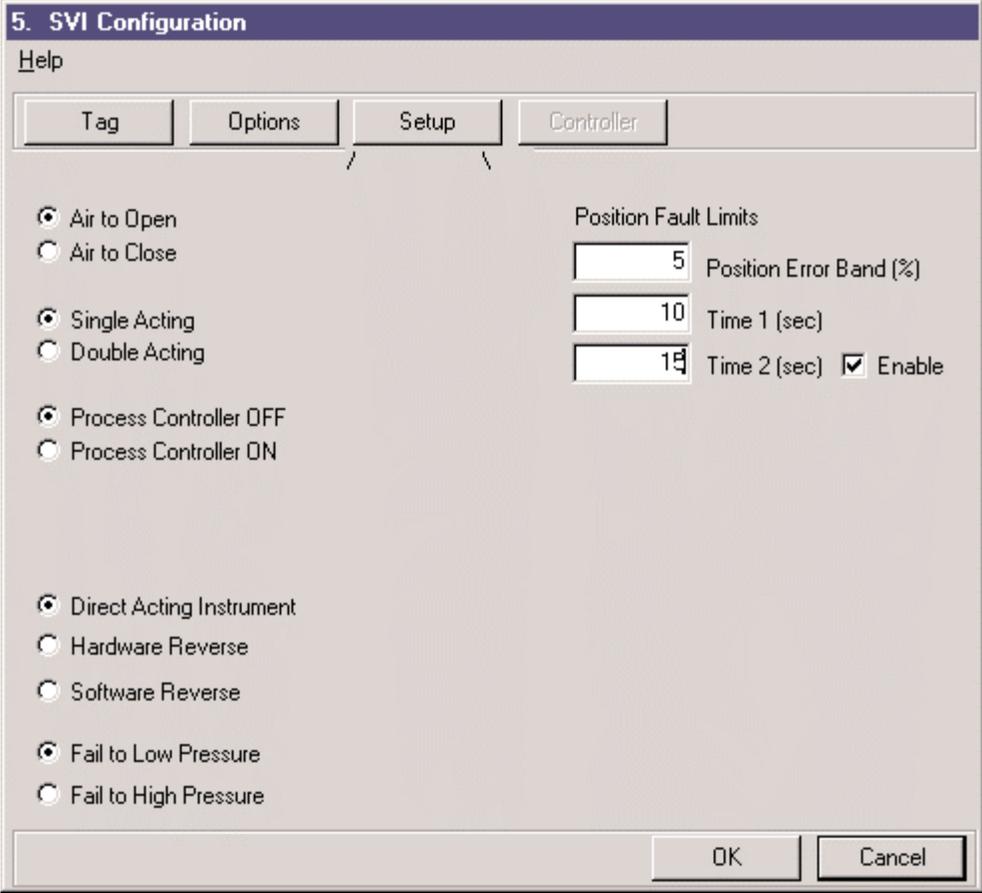


Figure 16. SVI Configuration Setup Window

Process Controller

If “Process Controller” On in the Setup page is selected, the windows and buttons associated with the process controller are enabled. The Controller Tab in the SVI Configuration window is enabled for basic process controller configuration.

The Controller window is displayed by clicking the Controller Tab in the SVI Configuration window (figure 17). A typical Controller page is shown below. This page allows the user to choose and set startup mode, initial setpoint, controller period, PV and SP units, and controller action. More controller parameters are configured through the Controller Parameters window, which can be accessed through the Set Param. button in the Controller Monitor window. (See pages 27-29 for more on Controller Configuration).

Figure 17.
SVI Configuration
Controller Window

7. SVI Configuration

Help

Tag Options Setup Controller

Startup Mode

Startup Local
 Startup Remote
 Startup Last Mode
 Local Only

50.00 Initial SetPoint (PV units)
0.2 Controller Period (sec)

Ratio control

PV Units Code: gal/min
Remote SP Units Code: gal/min

Action: Direct Acting
 Reverse Acting

OK Cancel

After completing configuration in the SVI Configuration window, click

- OK button to accept the change, download to the SVI, and exit to manual mode
- Cancel button to discard the change and exit to manual mode

Calibration

Clicking the Calibrate button in the Manual Mode window will retrieve current calibration data from the SVI and display them in the SVI Calibration window.

Calibration mode is used to scale and calibrate analog inputs, valve position, output pressure, and tune valve position controller. In this mode, the valve does not respond to the 4-20 mA input signal. The SVI Calibration window has three tabs: Range, Tuning, and Signal Cal. Clicking a tab brings you a corresponding page to examine and modify calibration parameters and initiate calibration procedures.



CAUTION

Some calibrate functions stroke the valve over its full range. Isolate the valve from the process before moving to the Calibrate Mode.

Range Values

The Range page (figure 18) allows the user to enter low and high values for the primary input signal, and allows automatic and manual calibration of the valve position sensor. If the built-in process controller is enabled the remote set point and process variable can be set.

9. SVI Calibration

Help

Range Tuning Signal Cal.

CLOSED At Low Signal OPEN At High Signal

4.00 Low Signal (mA) 20.00 High Signal (mA)

30.00 Supply Pressure psi

0.00 Low Remote Set Point gal/min 200.00 High Remote Set Point gal/min

0.00 Low Process Variable gal/min 200.00 High Process Variable gal/min

Auto Stop Limits Manual Stop Limits

Open Stop Adjustment

OK Cancel

Figure 18. SVI Calibration Range Window

Position Controller Parameters

The Tuning page is displayed by clicking the Tuning Tab in the SVI Calibration window (figure 19). This page allows the user to examine position controller parameters and tune the positioner automatically or manually. The user can also open the valve position control loop and manually set an output to the built-in I/P in SVI. The output feature is used to adjust the bias of the SVI.

Figure 19. SVI Calibration Tuning Window

10. SVI Calibration

Help

Range Tuning Signal Cal.

156 P (%) 31 Padj (%)

115 I (1/10 s) 3 beta

47 D (ms) 5 Position Compensation Coefficient

0.00 Dead Zone (%) 0 Damping Coefficient

Auto Tune Output

Output Value to I/P

OK Cancel

Signal Calibration

The Signal Calibration page (figure 20) is displayed by clicking the Signal Cal. Tab in the SVI Calibration window. This page allows the user to recalibrate primary signal and output pressure sensors, as well as secondary signal if the process controller function is enabled. These sensors are calibrated at the factory and do not usually require re-calibration, but if needed, this page provides a convenient method. The Reset to Factory button returns the calibrations to those that were set before delivery of the SVI.

Note: SVI sensors are calibrated at the factory and do not require re-calibration.

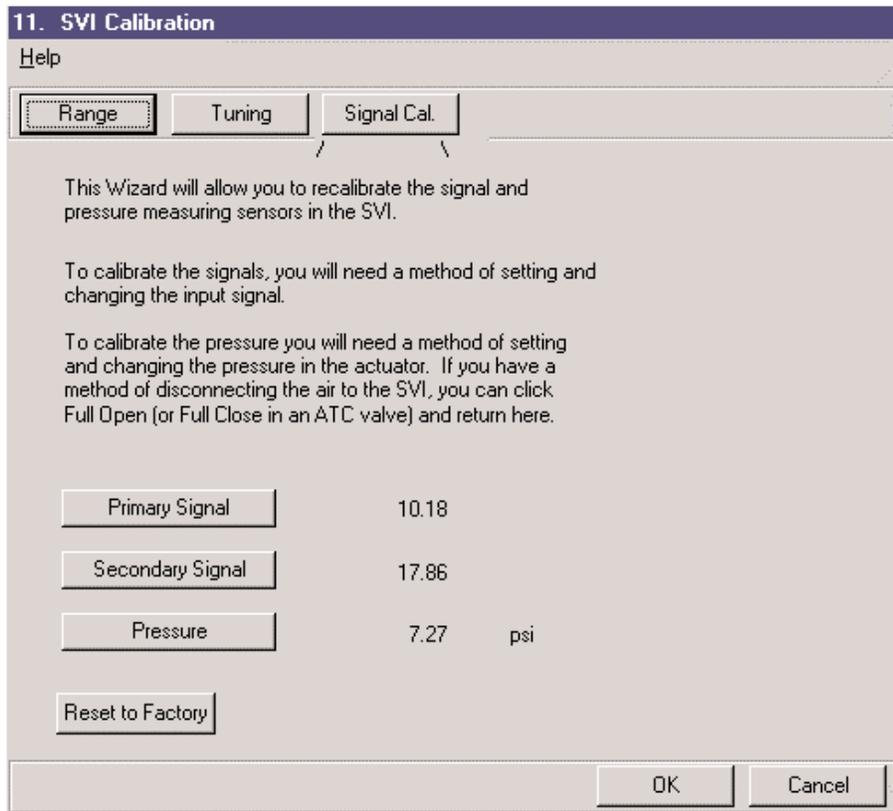


Figure 20. SVI Signal Calibration Window

The currently measured values of the primary input signal, secondary input signal (if the process controller is enabled), and output pressure are displayed and can be compared to reference signals to determine whether re-calibration is necessary.

After completing calibration from a page, click:

- OK button to accept changes entered, download to SVI, and exit to manual mode.
- Cancel button to discard changes entered and exit to manual mode.

Diagnostic Data

Clicking the Diagnostic button in the Manual Mode window will retrieve current continuous diagnostic data from the SVI and display them in the Diagnostics window (figure 21). These data include Total Travel, Number of Cycles, Time Open, Time Closed, and Time Near Closed.

The screenshot shows a software window titled "12. Diagnostics" with a menu bar containing "Record" and "Help". The window is divided into several sections:

- Perform Diagnostics:** Contains a "Standard" button, a text input field with the value "2" labeled "Speed", and a "Show Valve Signature" button.
- Type:** Contains an "Extended" button and a dropdown menu currently set to "1. Act. Signatur".
- Position and Speed Inputs:** Three empty text input fields labeled "Start Position (%)", "End Position (%)", and "Speed".
- Signature Button:** A "Show Valve Signature" button at the bottom of the diagnostic controls.
- Manual:** A "Manual" button at the bottom left.
- Continuous Diagnostic Data:** A box on the right containing the following data:
 - Total Travel = 39 strokes
 - Number of Cycles = 6
 - Time Open = 100 hours
 - Time Closed = 256 hours
 - Time Near Closed = 0 hours
- Diagnostic Data:** A box at the bottom right containing the following data:
 - Friction = 0.51 psi
 - Lower Spring Range = 2.78 psi
 - Upper Spring Range = 20.66 psi
 - Lower Pressure = 0.06 psi
 - Upper Pressure = 27.08 psi
 - Stroking Time Open = 1.4 s
 - Stroking Time Close = 2.0 s
- Reset:** A "Reset Continuous Data" button at the bottom right.

Figure 21. Diagnostics Window

Diagnostic mode allows the user to run several useful procedures that provide information about the SVI/valve system and its performance. If running ValVue offline, previously saved test data can be retrieved and displayed in graphs.

To perform the standard valve diagnostic test, type a speed between 1 and 10 (this number is approximately proportional to the valve size in inches) and click the Standard button in the Diagnostics window. The slower this test is performed (1 being the slowest speed) the better the valve diagnostics. It is important to re-test a valve at the same speed number for comparison of diagnostic information.

	CAUTION	Some diagnostic functions stroke the valve over part or full range. The isolate the valve from the process before moving to the Diagnostics Mode.
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The diagnostic procedure strokes the valve over its full range. On test completion, maximum friction, computed spring range, minimum and maximum output pressure, and stroking times are displayed in the Diagnostic Data box at the lower right of the window.

Actuator Signature

To access the actuator signature, click the Show Valve Signature button. Valve Signature window (figure 22) will appear with a current valve signature depicted as two red curves. The standard valve signature graph also provides access to the saved and factory signatures from previous tests stored in SVI's non-volatile memory.

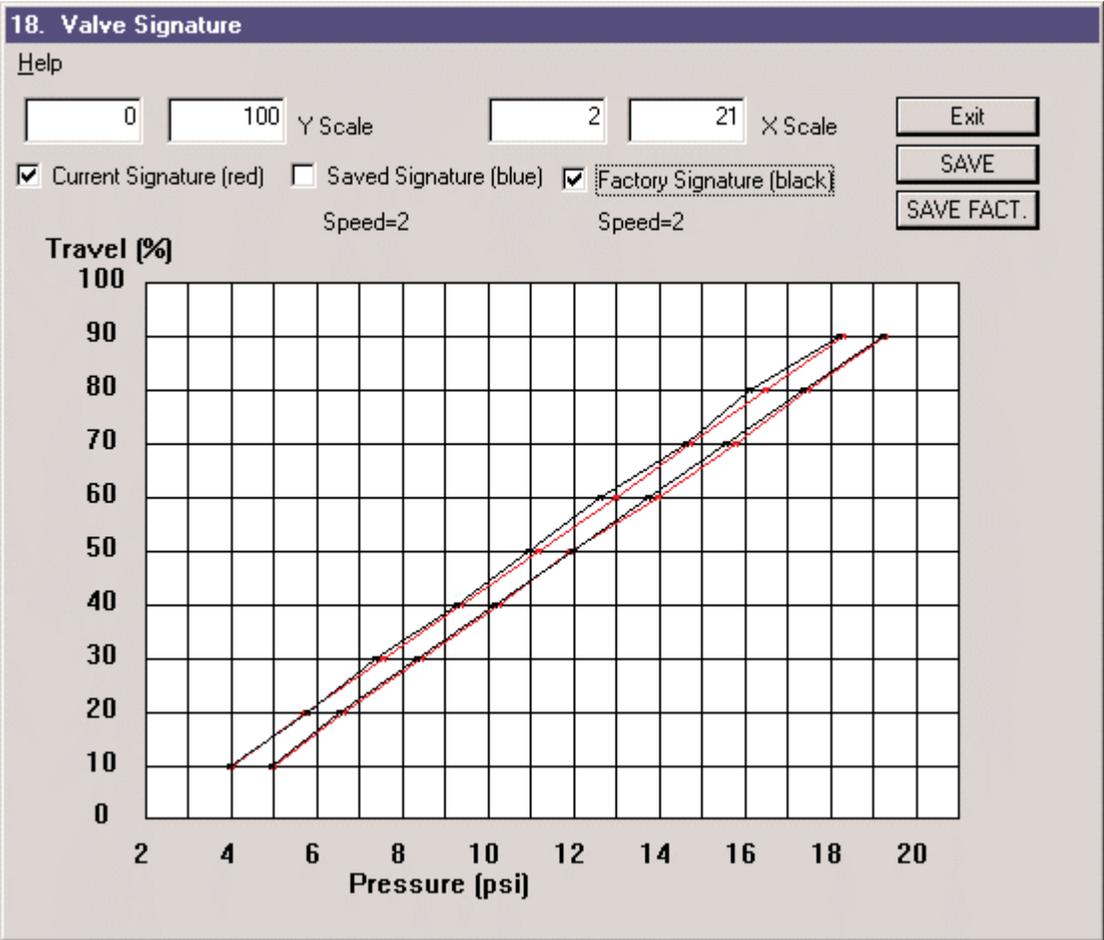


Figure 22. Valve Signature Window

Extended Actuator Signature

The extended actuator signature test is run over a user-specified range of valve travel. To obtain an extended actuator signature go to the diagnostics screen, select Act Signature in the Type list box, enter values in the Start Position and End Position boxes, and choose a value between 1 and 9 in Speed and, click the Extended button to begin test. The test result is presented in the Diagnostic Graph window.

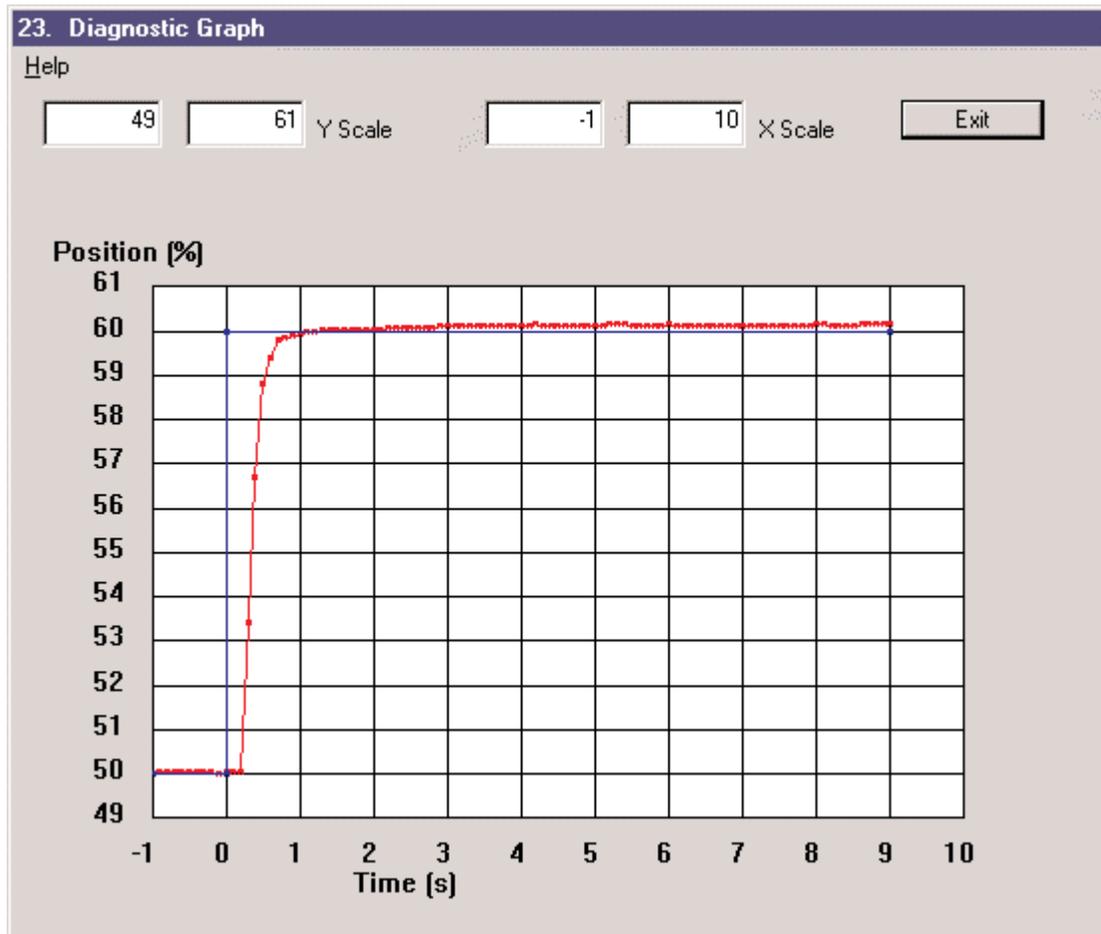


Figure 23. Extended Actuator Signature

A step response of valve position can be used to examine the dynamic characteristics of a valve system. The step response test is run over the user-specified range of valve travel. ValVue produces a Position vs. Time graph after the test. A step response appears in Diagnostic Graph window as illustrated in figure 23 above with a step change from 50 to 60% of valve travel.

Positioner Signature

A positioner signature can be used to examine the stability and dead band of a valve system. The positioner signature test is run over the user specified range of input signal and ValVue produces a Position vs. Signal graph for both increasing and decreasing signal directions. To perform a positioner signature test, select Pos. Signature in the Type list box, enter values in the Start Current and End Current boxes, click the Extended button to begin test. The test result is presented in the Diagnostic Graph window typical positioner signature (figure 24).

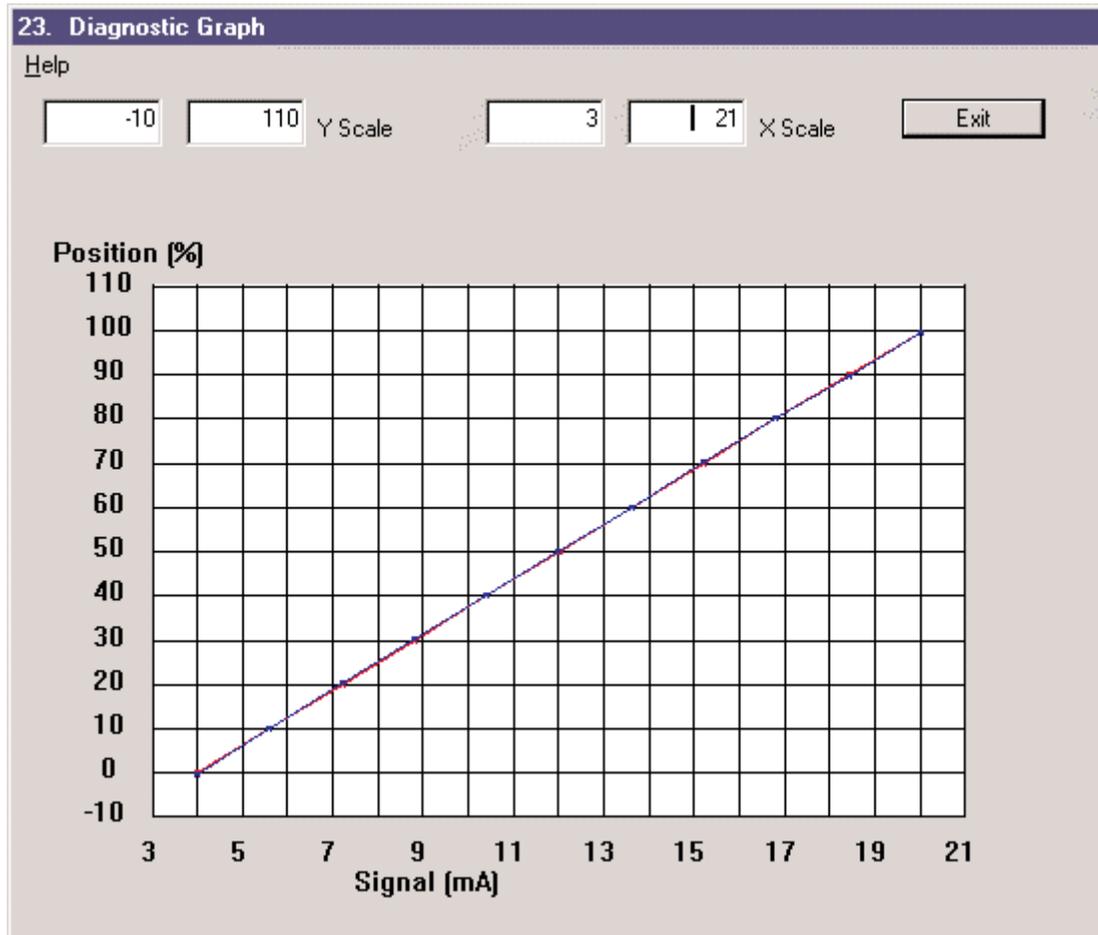


Figure 24. Typical Positioner Signature

Controller

SVI has a built-in PID process controller, which can be enabled in configuration mode if the controller option is purchased. ValVue provides interfaces for this controller to allow a user monitor, manipulate, and tune the controller.

Controller Monitor

Pressing the Controller View button in either the Normal Operating or Manual Mode window brings up the Controller Monitor window (figure 25).

The monitor displays values for the process variable, its setpoints and controller output, both numerically and graphically. The current controller mode is indicated by a red light next to the corresponding R (Remote Automatic), L (Local Automatic), or M (Manual) button on the left top of the window. Operation data of valve position and actuator pressure are displayed on this window. If the process controller is configured for ratio control, both the measured setpoint and the remote setpoint calculated are displayed in their corresponding engineering units.

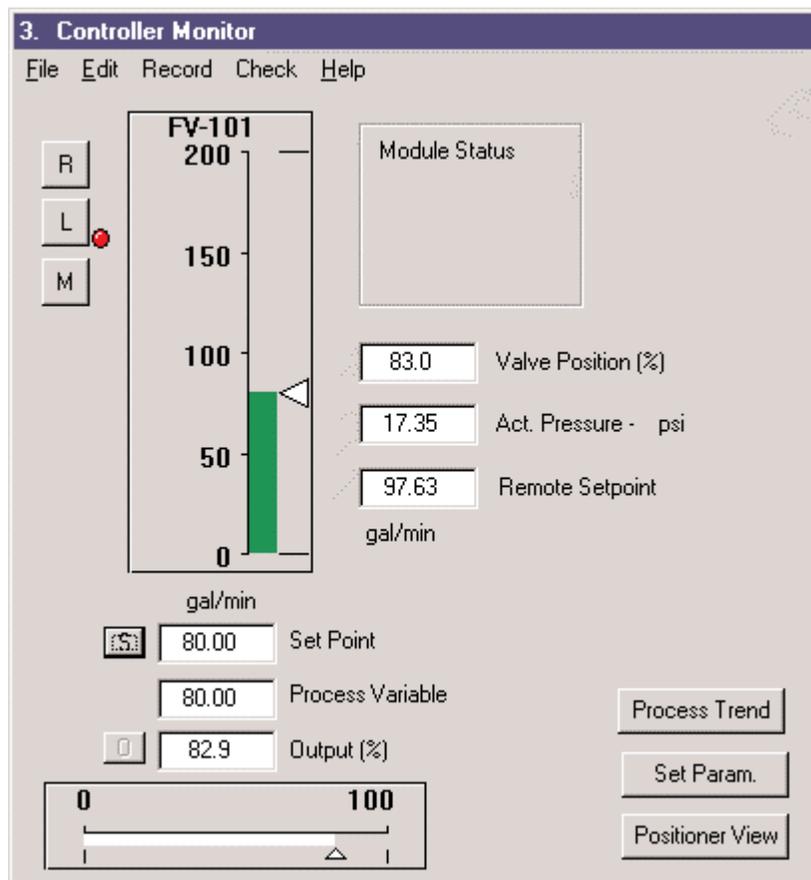


Figure 25. Controller Monitor Window

From the Controller Monitor window the controller mode can be switched from remote automatic to local automatic or manual mode. Local setpoint and controller output can be changed when in manual mode.

Controller Parameters

Some parameters of the process controller can be displayed and modified in any controller mode. To access these parameters, click the Set Param. button in Controller Monitor window. The controller parameters will be retrieved from the SVI and presented in the Controller Parameters window (figure 26).

Parameter	Value	Parameter	Value
Proportional Gain (%)	75	Ratio Gain	0.50
Integral Time (s)	15	Ratio Bias gal/min	50.00
Derivative Time (ms)	0	Low Alarm Limit gal/min	50.00
Derivative Gain	8	High Alarm Limit gal/min	150.00
Beta (non_linear)	0	Manual Reset Bias (%)	50
Set Point Low Limit gal/min	50	Output Rate Limit (%/s)	200
Set Point High Limit gal/min	150	Controller Dead Zone (%)	0.0

Derivative Source
 PV Error

Alarm Type
 Absolute Deviation

Setpoint Tracking
 Freeze on Bad Value

OK Cancel

Figure 26. Controller Parameters Window

The parameters and options are determined based on specific application. After the configuration of the controller parameters, click:

- **OK** button to accept changes entered, download to SVI, and exit to Control Monitor window.
- **Cancel** button to discard changes entered and exit to Control Monitor window.

Clicking the Positioner View button (figure 25) returns to the positioner view where the valve position can be monitored. When the controller is configured in local or remote automatic mode, the positioner is operating in normal operating mode and clicking the positioner view button will return the user to the Normal Operating Mode window. If the controller is in manual mode the Position View button will return the user to the Manual Mode window.

To stop the communication between ValVue and the SVI device and return to the Device List window, select Exit from File menu in the Normal Operating Mode window, Manual Mode window, or Controller Monitor window. Make sure positioner or controller mode is appropriate before returning to the Device List window.

Fail Safe Mode

The SVI does not go to failsafe mode if it is functioning normally. If a problem occurs and causes the SVI to go to the fail-safe mode, the SVI will attempt to drive the internal I/P to either high or low output based on SVI's failsafe configuration and the appropriate failure statuses are set in the SVI. HART command #136 Read Status can be sent to the device to find out the problem. After the problem is fixed, the device can be restarted by either resetting the power or clicking the reset button in manual mode.

These are some problems which may cause SVI go to failsafe mode.

- Position Error
- Position Sensor Error
- Current Sensor Error
- Reference Voltage Error
- Self Check Failure
- Software Error

When SVI is in failsafe mode, ValVue will detect it during mode transfer and display the FAIL SAFE MODE window (figure 27). In this window, HART command #136 Read Status can be sent to the device to determine out the problem. In this case, Position Error caused by air supply loss is the reason the SVI failed.

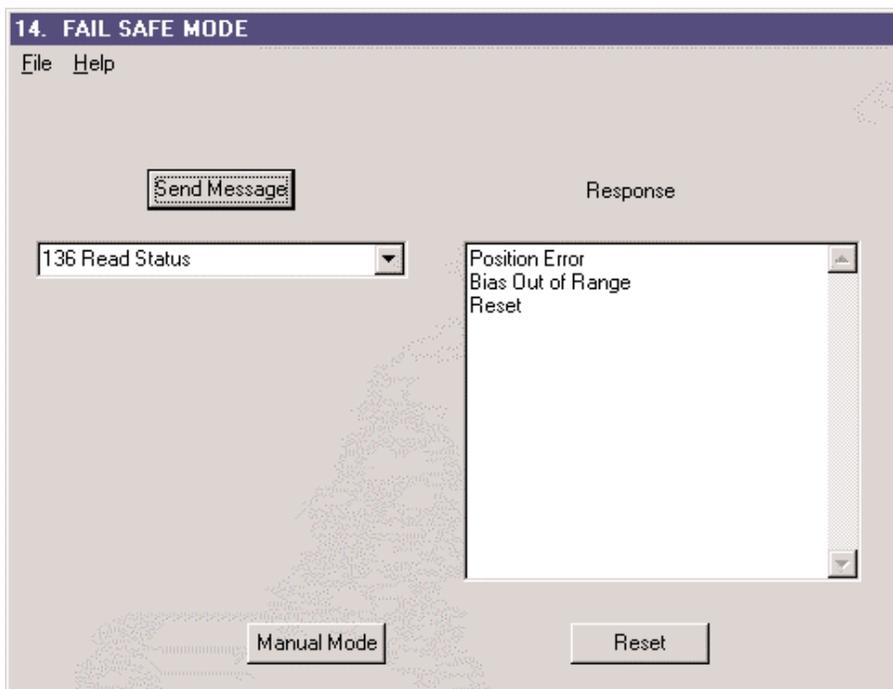


Figure 27. Fail Safe Mode Window

Once the problem is found and solved, the SVI can be restarted by resetting the power.

Clicking the Manual button in the FAIL-SAFE MODE window switches the SVI to manual mode. From there you can click the reset button to reset the device.

If the problem is caused by inappropriate configuration parameters, click the Manual button in the FAIL SAFE MODE window and then click the Configure button to enter into configuration mode.

Chapter 7: Normal Operating Mode

SVI functions in normal operating, manual operating, configuration, calibration, diagnostic and fail-safe modes. Correspondingly, ValVue has various windows to interface with these different modes. In the normal operating mode, the SVI controlled valve responds to the 4-20 mA input signal directly if the SVI is configured as a positioner only. When the built-in process controller is enabled and SVI is in normal mode, the valve responds to the output of the process controller.

In the Select Device Window of ValVue, click on an SVI device and press the Select button or double click the SVI device to bring up a window representing SVI in either normal or manual operating mode depending on the current SVI mode. Figure 28 below shows an example of the Normal Operating Mode window. ONLINE is displayed in the Window indicating communication with the SVI has been established and valve tag is shown in Tag field.

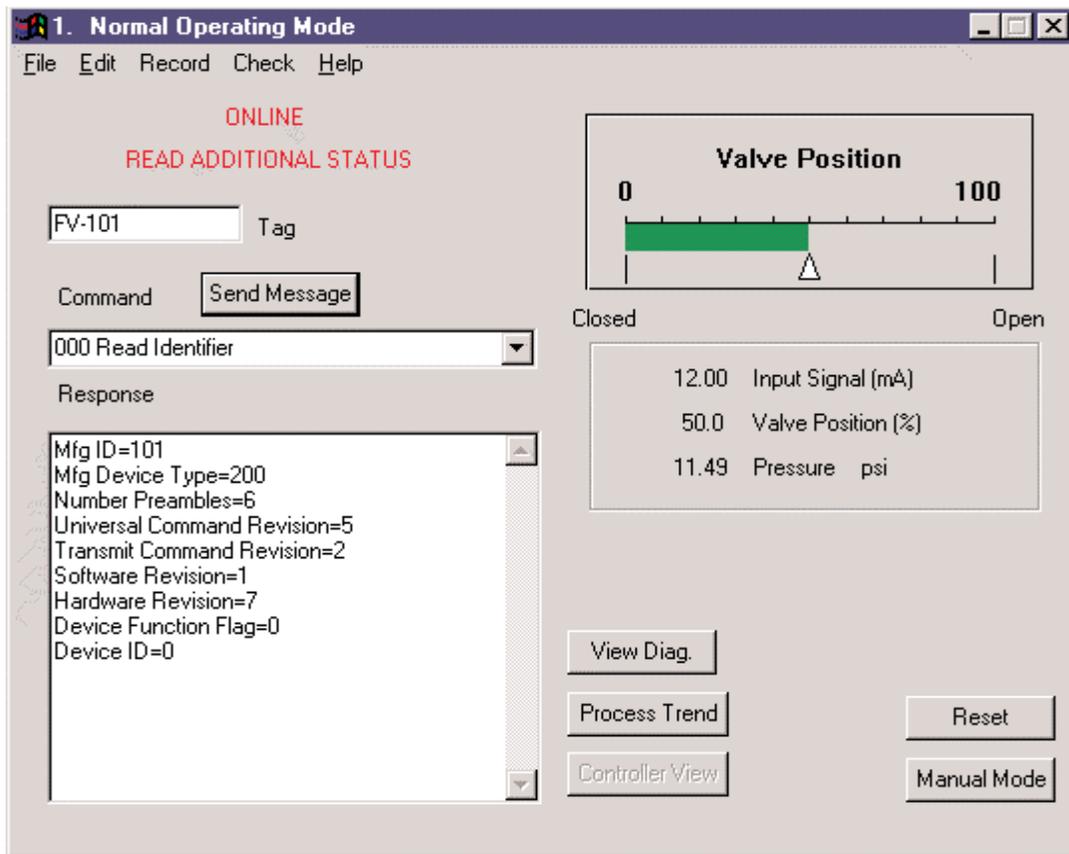


Figure 28. Normal Operating Mode Window

Valve Monitoring

The Normal Operating Mode window monitors a valves normal operation. This window displays and updates real time values for input signal, valve position and pressure as defined below.

- **Input Signal:** This indicates the current in mA into the SVI.
- **Valve Position:** This indicates valve stem or shaft position in percent of ranged travel.
- **Pressure:** This indicates the SVI output pressure for a single acting positioner or differential pressures for a double acting positioner.

The bar graph shows the valve moving towards the position setpoint (setpoint is displayed as a triangle) in a transient state and how closely the valve matches its setpoint in a steady state. A typical deviation between valve position and its setpoint is less than 0.2% plus dead zone if the valve and positioner are functioning properly. The dead zone can be automatically set during an auto-tune process and manually adjusted in calibration mode. The dead zone is usually set to 0.0% except for valves using high friction packing.

The position setpoint is derived from the input signal based on the calibration parameters defined in the Calibrate mode, the valve characterization and the configuration of air-to-open or air-to-close as defined in the Configure mode. If linear characteristics and air-to-open are configured, the position setpoint is equal to input signal expressed in percentage. For example, if the input signal is 12 mA, which is equivalent to 50% of a 4 to 20 mA signal range, then the valve is positioned to the midpoint of travel range.

There are status codes set in SVI that indicate events or faults that have occurred since the last time they were cleared. When the status codes set, "READ ADDITIONAL STATUS" will be displayed in red under "ON LINE" in the normal and manual operating windows. The user should send the SVI a "Read Status" message (Command #136) and the status codes will be displayed in the response box. Sending the SVI a "Clear Status" (Command #138) message will clear these status codes (if the problem no longer exists) and the "READ ADDITIONAL STATUS" message will go away.

Note: Reading additional status helps diagnosing valve and positioner problems.

Reading Configuration and Calibration Data

In the Normal Operating window, ValVue provides a drop-down list of HART commands that you can select and send to the SVI.

ValVue can perform the following operations:

- Send HART commands to the SVI device
- Display the SVI responses to the HART commands
- Read configuration (Commands #210 and #221)
- Read calibration data (Commands #213 and #214)
- Read and clear device status (Commands #136 and #138)

For detail descriptions of these HART commands, refer to Chapter 13, SVI Message Responses.

To select a HART command, click the pull-down box under the Send Message button and highlight the command. The command enters the command box. Then click the Send Message button. The Response Box displays the response from the SVI unit. Figure 28 displays the result of sending Read Identifier command to a SVI.

HART is a master slave protocol. An SVI (the slave device) can not send information unless requested by the master device. You must click the send button to send the message and get a response.

Process Trends

Clicking the Process Trend button in the Normal Operating window brings you the Trend Data window (figure 29), which records 90 seconds of position and its setpoint. The time range is fixed at 90 seconds and the default range for Y-axis is 0 to 100%. You can adjust the Y-axis range precisely by entering Y-axis limits into the boxes at the left-top window and pressing Tab (or click in another box in the window). You can also drag the mouse over part of the graph to zoom in for more detail. To reset to the default range, click the right mouse button.

Process trend can be used to monitor the performance of a positioner. With an enabled built-in process controller, process variable and its setpoint are also recorded in the process trend. Therefore, the trend can also be used to test, tune and monitor the process loop. Since the process trend update rate is 1 to 2 seconds, the trend recording does not accurately describe the fore-mentioned variables, especially that of valve position during a transient state. To obtain a precise record of valve response to setpoint change, run the step profile test described in Diagnostic Mode. (Chapter 11).

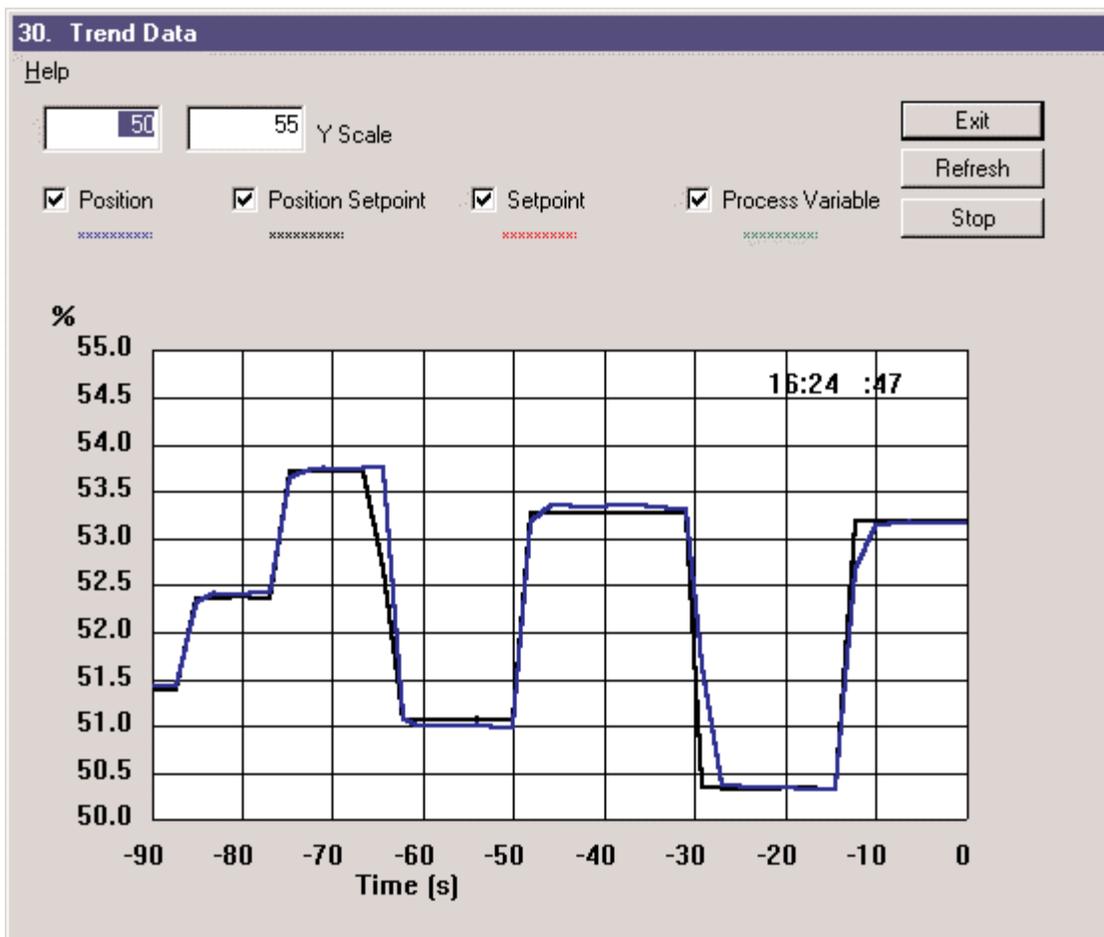


Figure 29. Trend Data Window

Viewing Valve Signatures

In normal operating mode, valve signatures can be retrieved from SVI's non-volatile memory and compared to the current valve position, output pressure and other process information with valve signatures to determine if there is a shift in system performance.

Clicking the View Diag. button in the Normal Operating window brings you to the Valve Signature window (figure 30). Valve signature graphically depicts Travel versus Pressure in both open and close directions. This window can display up to three valve signatures: current (in red), saved (in blue) and factory (in black). A valve's signature can be turned on or off by clicking the corresponding check box.

To zoom on any area of the display, enter X- and Y-axis limits and press Tab (or click in another box on the screen). Alternatively, you may zoom in by dragging with the left mouse button and out by clicking with the right mouse button.

To exit Valve Signature window, click the Exit button.

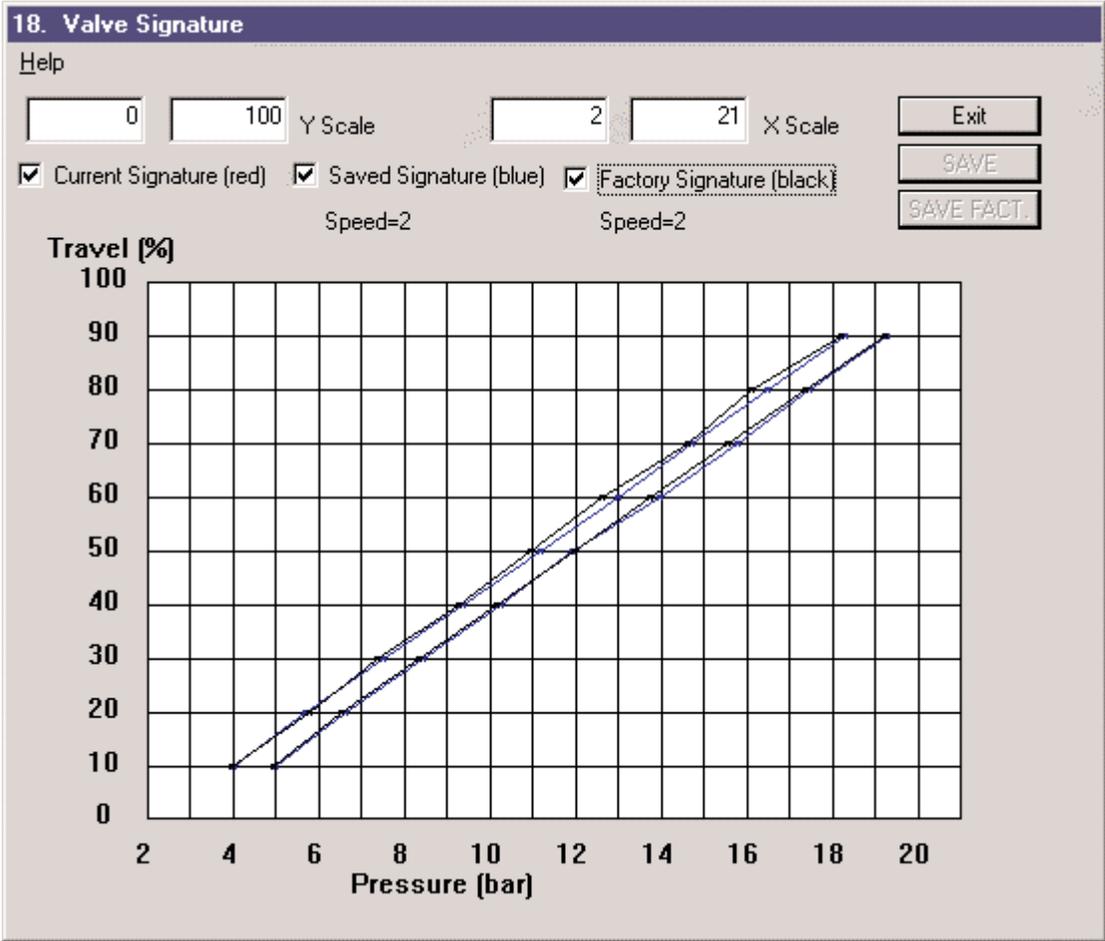


Figure 30. Valve Signature Window

Reports

Various reports can be generated in normal operating mode. The report can contain configuration, calibration, and diagnostic data. You select a report format by selecting a RTF file and a window application such as winword.exe or wordpad.exe to display and print the report.

Selecting Report Preference from File menu in the Normal Operating window will pop up the Report File Selection dialog box. Click Browse buttons to select a RTF file with the desired fields and an application to process the RTF file. Click the OK button to accept these choices.

To create the report, select Print Report from File menu. It may take about 30 seconds to retrieve data from the SVI and start the application to display the created file temp.rtf. You can edit the file, save it in a different name and print it out. See Chapter 14, SVI Reports for more detail about the SVI report function.

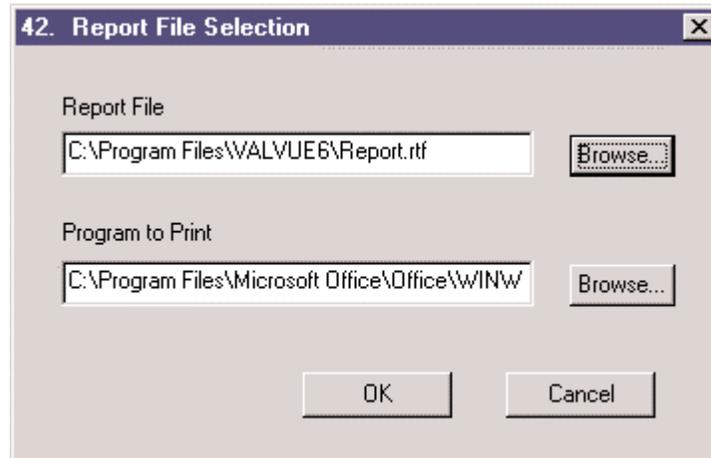


Figure 31. Report File Selection Window

Check SVI

Selecting Check SVI from Check menu brings up a bar graph display (figure 32). The right bar graph indicates the current temperature inside a SVI. The left bar graph represents the current output (in the range of -1000 to 5000 counts) to an I/P inside the SVI.

The bar is in green when the current output to I/P is between 2100 and 3400. When this output is between 1900 and 2100, or between 3400 and 3600, the bar color changes to yellow. When this value is below 1900 or above 3600, the bar color changes to red.

When the valve is positioned between 1 and 99% and is in steady state, the current to I/P is stable and normally between 2100 and 3400 with a bar in green color. There are a lot of factors that affect this the bias value like environmental temperature and supply pressure. However, a yellow or red bar is cause for analysis and correction.

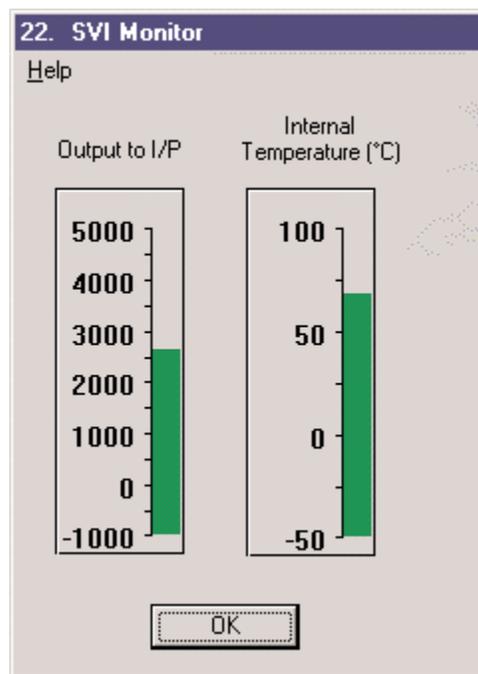


Figure 32. SVI Monitor Window

Saving and Restoring SVI Data

ValVue allows you to upload configuration, calibration and diagnostic data from the SVI device memory to a computer and save it as a .dmp file. Downloading this .dmp file to a SVI will overwrite existing data.

To save the data from a device, select Save SVI Memory from Record menu. A window will pop up to enter the name of a .dmp file. This uploading process takes about 20 seconds after clicking the Save button.

To download data from a .dmp file to a SVI device, select Restore SVI Memory from Record menu. A window will pop up to select a .dmp file to download to the SVI. This downloading process takes about 20 seconds after clicking the Open button. The SVI must be restarted after a restore of the SVI memory. Position sensor calibration (Find Stop) is usually required if a .dmp file is created from another SVI.

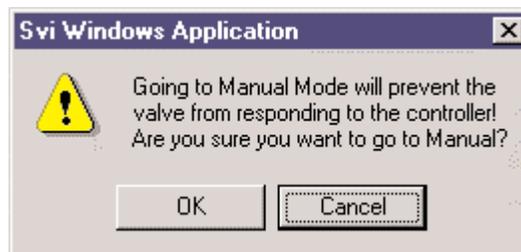
Note: Check configuration, calibration and diagnostic data after the restore.

Going to Other Modes

Going to Manual Mode

In manual mode, the valve does not respond to the input signal and you can manipulate the valve through ValVue. Before beginning configuring, calibrating, or diagnosing the SVI must be put in the manual mode.

To go to manual mode, click button **Manual Mode**. The following window will pop up and warn you that the valve will not respond to the input signal or a controller output in manual mode. Clicking **OK** will switch SVI to manual mode. Click Cancel to return to normal mode.



Exit to Device List Window

Select Exit from File menu to exit to the Device List window.

Chapter 8: Manual Operating Mode

In manual operating mode, the SVI controlled valve remains in place and no longer responds to the 4-20 mA input signal. You can manipulate the valve by entering the desired valve position setpoint. From manual operating mode, the SVI can be switched to Configure, Calibrate or Diagnostics mode to access the functions available only in these specific modes.

 WARNING	Entering manual mode removes the valve from system control. Obtain control room permission prior to entering manual mode.
--	--

In the Select Device window, click on an SVI device and press the Select button or double click the SVI device to bring up a window representing SVI in either normal or manual operating mode depending on the current SVI mode. Clicking the Manual Mode button from Normal Operating window switches SVI to the Manual Mode window (figure 33).

ONLINE will be displayed in the Manual Mode Window indicating communication with the SVI has been established and valve Tag Number will be shown in Tag Number field.

Valve Monitoring

Manual Mode window monitors a valve operation in manual mode similar to the normal mode. This window displays and updates real time values for valve position and pressure as defined in normal operating mode. Manual Setpoint Position indicates the manual position setpoint in percentage.

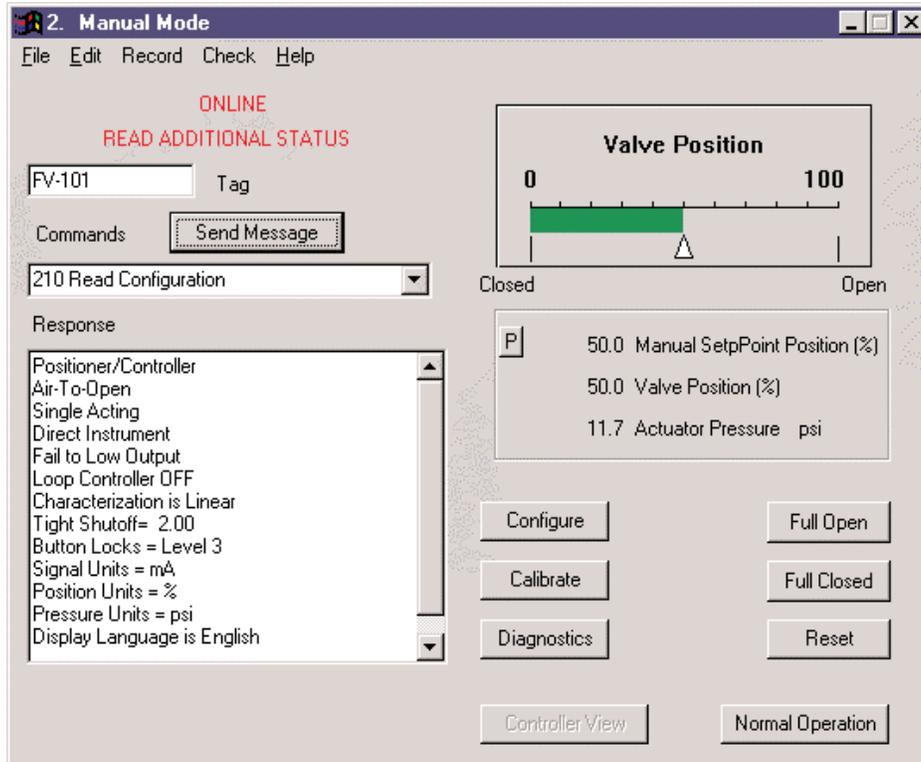


Figure 33. Manual Mode Window

The bar graph shows how the valve moves towards the position setpoint displayed as a triangle in a transient state and how the valve closely matches its setpoint in a steady state. A typical deviation between valve position and its setpoint is less than 0.2% plus dead zone if valve and position function properly. The dead zone can be automatically set during an auto-tune process and manually adjusted in calibration mode. The dead zone is usually set to 0.0% except for some high friction valves.

There are status codes set in the SVI that indicate events or faults that have occurred since the last time they were cleared. When the status codes is set, "READ ADDITIONAL STATUS" will be displayed in red under "ON LINE" in normal and manual operating windows. The user should send the SVI a "Read Status" message (Command #136) and the status codes will be displayed in the response box. Sending the SVI a "Clear Status" (Command #138) message will clear status code (if the problem no longer exists) and the "READ ADDITIONAL STATUS" message will go away.

Valve Manual Control

In manual mode, you can manually control the valve. To reposition a valve, use one of the following methods:

- Click the P button below the bar graph, type a valve position setpoint such as 55.0 in the popup Input Data window and click OK, the setpoint is set at 55.0% and the valve will move toward the new setpoint.
- Drag the triangle in the bar graph to a desired position. The position setpoint to be set is indicated beside the P button. Release the mouse to set the new setpoint.
- Clicking on each side of the triangle in the bar graph moves the valve by 5%.

The following action fills valve actuator to the supply pressure or exhausts the actuator to atmosphere, so the valve will be tightly shut off or fully opened:

- Click button Full Open in Manual Mode window
- Click button Full Closed in Manual Mode window.

Note: Full Open and Full Close bypass SVI programming and are useful diagnostic tools.

Reading Configuration and Calibration Data

ValVue provides a drop-down list of HART commands that you can select and send to the SVI. The same command set is available in normal mode and manual mode.

ValVue performs the following functions:

- Send HART commands to the SVI device
- Display the SVI responses to the HART commands.

Use these available HART commands to:

- Read configuration (Commands #210 and #221)
- Read calibration data (Commands #213 and #214)
- Read and clear device status (Commands #136 and #138).

For detail descriptions of these HART commands, refer to Chapter 13: SVI Message Responses.

To select a HART command, click the pull-down box under the Send Message button and highlight the command. The command enters the command box. Then click the Send Message button. The Response Box displays the response from the SVI unit.

Reports

You can create various reports while in manual mode. Please refer to Chapter 14: SVI Reports for detail.

Check SVI

For detail, refer to section Check SVI of Chapter 7: Normal Operating Mode.

Saving and Restoring SVI Data

For detail, refer to section Saving and Restoring SVI Data of Chapter 7: Normal Operating Mode.

Going to Other Modes

Going to Normal Operating Mode

From manual mode, click Normal Operation button to return to normal operating mode. It is important to switch SVI to normal operating mode first before exiting to Device List window so the valve responds to the input signal.

Exit to Device List Window

ValVue can directly return to Device List window from manual mode and leave a SVI in manual mode if desired. Select Exit from File menu to exit to Device List window directly.

Going to Configure, Calibrate or Diagnostics Mode

In manual mode, the SVI can be switched to configuration, calibration or diagnostics mode by clicking the corresponding Configure, Calibrate, or Diagnostics buttons.

Chapter 9: Configuration Mode

Configuration mode is used to display SVI configuration, modify the configuration as necessary and download to the SVI device. In this mode, the valve remains in place and does not respond to the 4-20 mA input signal.

Note: Perform configuration before running calibration functions.

SVI must be switched to manual mode first in order to access configuration mode. Clicking the Configure button in the Manual Mode window will retrieve current configuration data from the SVI and present them in the SVI Configuration window. Figure 34 shows an example of the Tag page of the SVI Configuration window.

The SVI Configuration window has four tabs:

- **Tag**
- **Options**
- **Setup**
- **Controller**

Clicking a tab shows the corresponding page to examine and modify configuration parameters. After making your choices from a page, click:

- Tag, Options, Setup, or Controller tab to continue examine and modify configuration.
- OK button to accept the change, download to SVI, and exit to manual mode
- Cancel button to discard the change and exit to manual mode

Note: Clicking OK downloads current configuration data to the SVI. The previous configuration is lost.

Masoneilan strongly recommends saving SVI memory prior to configuration or calibration.

Tag Page

The Tag page (figure 34) is the page displayed when entering configuration mode. The tag page allows the user to view and modify the tag, descriptor, message, final assembly number, date and polling address.

- **Tag:** is a user-entered value. It may be up to 8 characters long and is used to identify the valve within a plant. HART can use the tag to verify that it is communicating to the desired valve.
- **Descriptor:** A description with up to 16 characters for the device or application.
- **Message:** is a user-entered value. It may be up to 32 characters long and may contain any text the user wishes.
- **Final Assembly Number:** This field contains a user-entered number. When the SVI is mounted on a valve and installed in the field, the user can assign the assembly a unique number for their internal use.
- **Date:** This field contains a user entered date value with the format DD/MM/YY. The value is stored inside the device. It can be used however the user wishes and is often used to track the date of the last valve maintenance.
- **Polling Address:** HART can communicate with up to 15 devices on a single pair of wires. These devices are distinguished by their polling addresses, which are numbers from 0 to 15. If there is a device at polling address 0, it must be the only device on the loop. There may be up to 15 devices with non-zero polling addresses on the loop (subject to power and intrinsic safety constraints). Devices which operate 4-20 mA are generally required to have polling address 0, however with split range valve positioners, several 4-20 mA devices may be wired in series. These devices should be set up with non-zero polling addresses.

The screenshot shows a software window titled "4. SVI Configuration". At the top left is a "Help" link. Below it are four tabs: "Tag", "Options", "Setup", and "Controller". The "Tag" tab is active. The main area contains several input fields with labels to their left: "Tag" with the value "FV-101", "Descriptor" with "FLOW CONTROL", "Message" with "COOLING WATER FLOW", "Final Assembly Number" with "20", "Date (DD/MM/YY)" with "20 JAN 1999", and "Polling Address" with "0". At the bottom right of the window are "OK" and "Cancel" buttons.

Figure 34. SVI Configuration - Tag Window

Options Page

The Options page (figure 35) is displayed by clicking the Options tab in the SVI Configuration window. This page allows the user to choose and set positioner characteristics, linkage linearization, SVI local pushbutton control levels, bumpless transfer, tight shutoff and its value, position software limits, near closed value, pressure units, and display language.

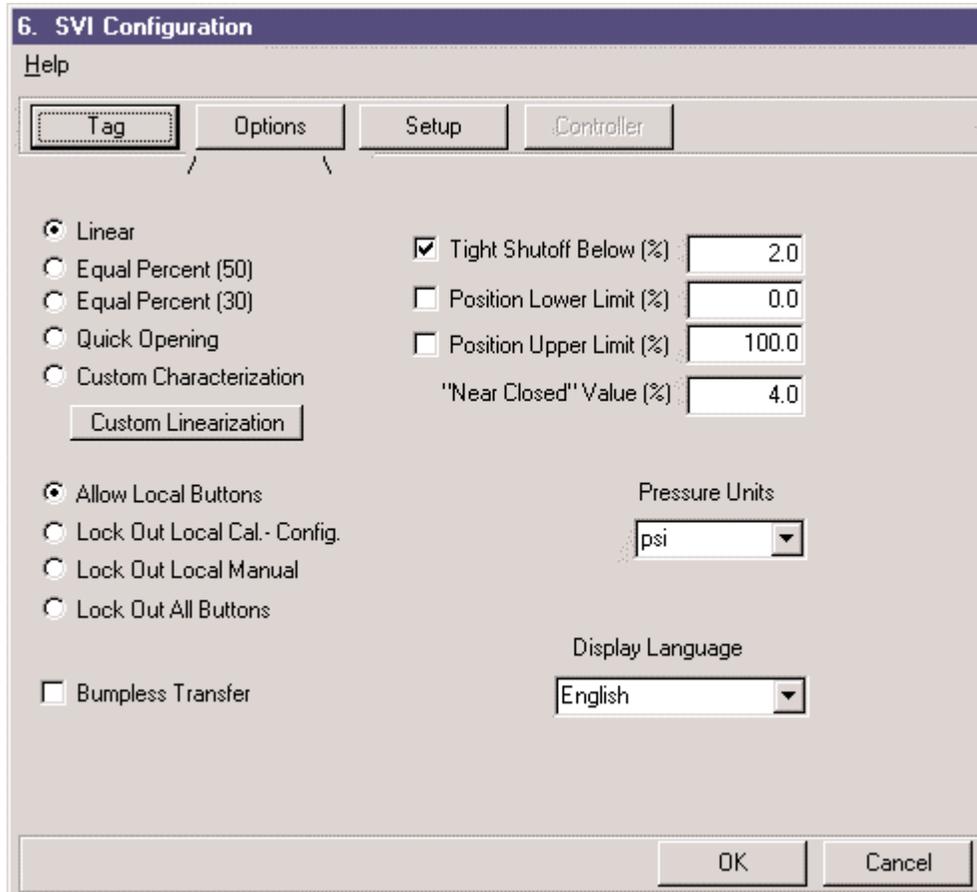


Figure 35. SVI Configuration - Options Window

Positioner Characterization

A control valve characteristic is the relationship between flow capacity (Cv) and percent opening of the valve. A positioner is also given a characteristic or relationship between percent opening of the valve and its input signal. The overall characteristic between flow capacity and input signal is the combination of valve and positioner characteristics.

SVI smart positioner provides typical characteristics of linear, equal percentage and quick opening as well as a user adjustable custom characterization. The choice of positioner characteristics should be based on overall loop characteristics. The following fields in the Options page are related to SVI positioner characteristics.

- **Linear:** The valve position is proportional to the input to SVI positioner.
- **Equal Percent (50):** The same as equal percentage with rangeability of 50. For equal increments of the input, the valve position has equal percentage changes of current valve position.
- **Equal Percent (30):** The same as equal percentage with rangeability of 30. For equal increments of the input, the valve position has equal percentage changes of current valve position.

- **Quick Opening:** The quick opening characterization is the inverse to the Equal Percentage (50) characterization curve.
- **Custom Characterization:** A custom characterization defines the relationship between the input signal and the output position of the valve. Selecting this option will display an additional window where you can configure a characterization curve with 10 adjustable segments to fit your needs. The curve can have up to 9 adjustable points and points in between are linearly interpolated

Note: Linear positioner characteristic is generally used when the valve trim is characterized.

To configure a customer characteristic curve, you enter the values in the edit boxes at the bottom of the screen and pressing the Tab key. The graph is updated when the value is entered. Alternatively, you can use a mouse to do the job:

- Change the shape of the curve by clicking a point, holding the left mouse button down, and dragging the cursor to a new position before releasing the mouse button.
- Add a point by clicking the left mouse button at the desired location.
- Delete a point by clicking the point with the right mouse button.

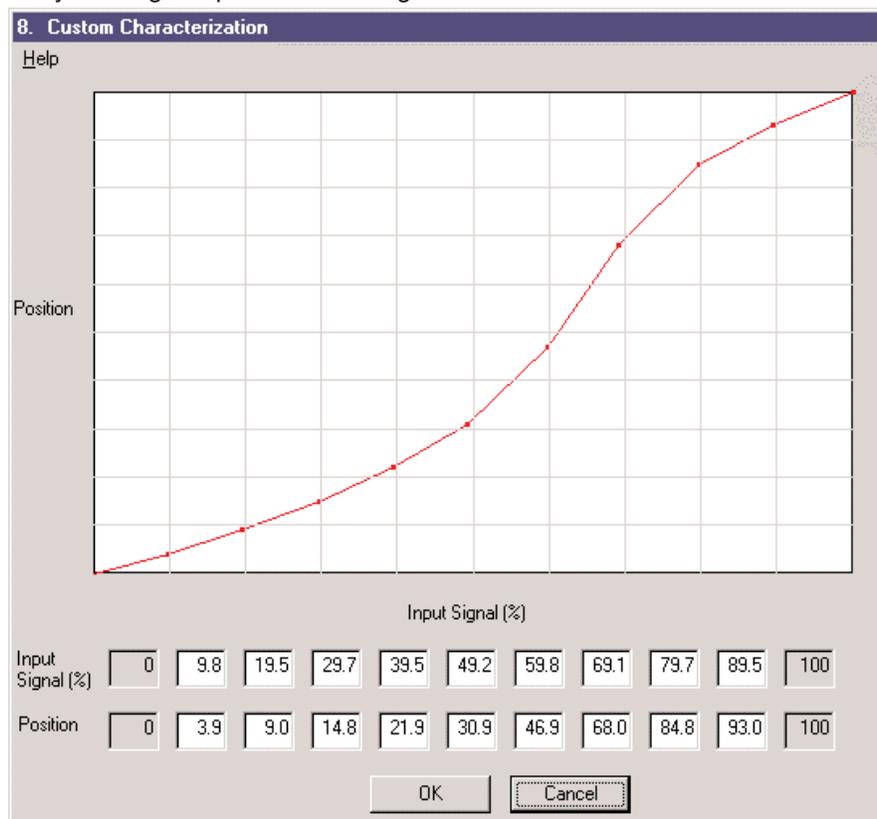


Figure 36. Custom Characterization Window

After configuring the curve, click the OK button to accept the value and exit the Custom Characterization window, or click the Cancel button to exit without changing the values. To prevent a user to enter unreasonable points, ValVue will check the curve based on established rules and pop up warning message when the curve does not meet the rules. In addition, these points are saved in SVI with a resolution of 0.4%, the entered value and its saved value may differ slightly by 0.2%. It is important to reenter the Custom Characterization window and make sure the curve is as desired.

Custom Linearization

When SVI is mounted on a reciprocating valve, linkage configuration may cause a small non-linearity in the valve position measured by the SVI position sensor versus actual valve position. This non-linearity is usually insignificant in a closed loop system and has the least effect on the closed loop performance. **Therefore, it is usually unnecessary to correct this non-linearity.**

A custom linearization method built in ValVue can be used to correct this non-linearity. The method automatically generates a custom characterization that matches the specific linkage used. Custom characterization must be the selected configuration option to use the generated curve. This option is selected automatically when the user clicks OK to accept the displayed curve.

To configure custom linearization, click the Custom Linearization button. The Custom Linearization window will appear (figure37).

Two types of linkages are modeled: simple and compound. Most linkages use the compound linkage system.

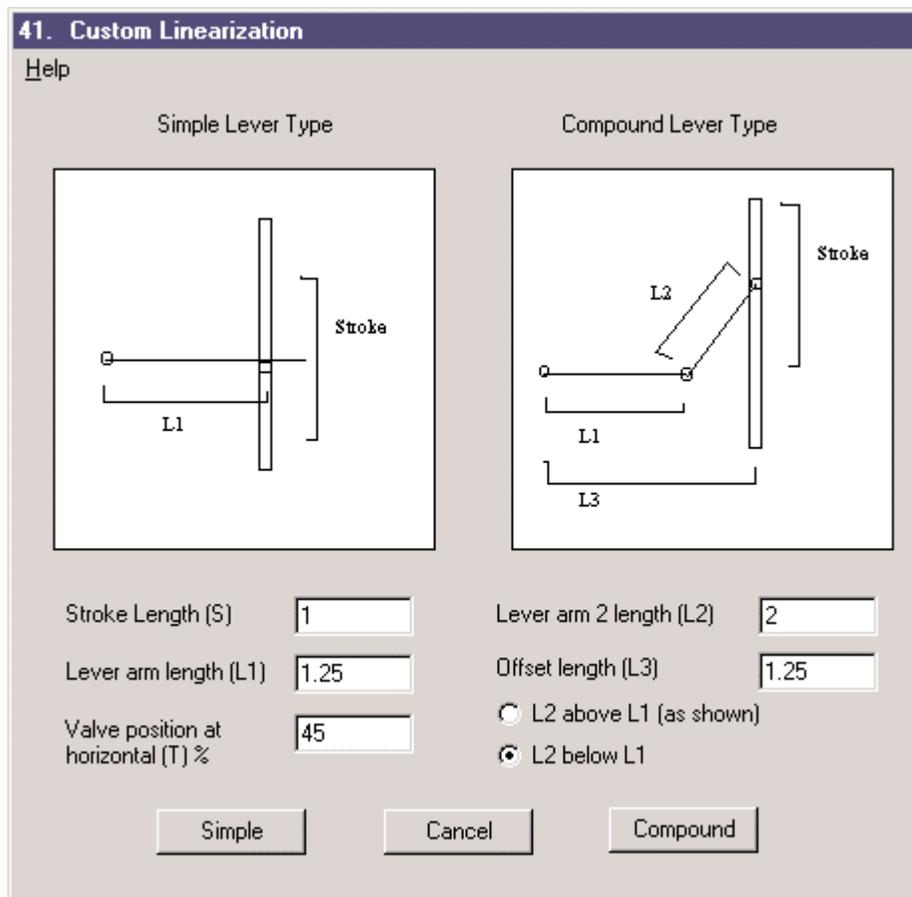


Figure 37. Custom Linearization Window

The simple lever has the pivot point (the position sensor in the SVI) mounted a fixed distance (L1) from the valve stem pickup point. In order to compute the proper correction curve, the stroke length, the distance from the pivot to the valve stem pickup point and the valve position at horizontal must be entered. Clicking the Simple button will compute the correction and display the curve.

The compound linkage has two lever segments attached at one end to the pivot (the position sensor in the SVI) and the other end to the valve stem pickup point. In order to compute the proper correction curve, the user must enter the stroke length, first lever segment length (L1), second lever segment length (L2), the distance from the pivot to the valve stem pickup (L3), and the valve position at horizontal. Clicking the Compound button will compute the correction and display the curve.

Most linkages use a linkage with L3 equal to L1, i.e. the second lever arm is vertical when the first lever arm are horizontal. The correction computation will correctly compute the correction curve when L3 is not equal to L1. However, L3 must be greater than 0, which requires that the valve stem pickup not be lined up with the pivot and that the pickup be on the same side of the pivot as the link between the first and second lever segments.

Local Button Lock

SVI comes with an optional local display and three explosion-proof pushbuttons for data entry. These buttons can be used to perform basic SVI setup and operation without the need for ValVue or a handheld. Refer to Masoneilan SVI Instruction Manual for the functions of these buttons. It may be desirable after initial setup to "lock" the buttons so that the SVI parameters cannot be inadvertently changed from the buttons. Several levels of locks are provided:

- **Allow Local Buttons:** Buttons on the SVI are fully enabled (level 3).
- **Lock Out Local Cal. - Config.:** The user may use the buttons to perform operations in normal operating mode and manual mode, however he/she may not go to configure or calibrate mode (level 2).
- **Lock Out Local Manual:** The user may examine variables in normal operating mode but may not put the valve in manual operating mode and therefore cannot get to calibrate or configure modes (level 1).
- **Lock Out All Buttons:** The buttons are disabled (level 0).

Bumpless Transfer

When this option is selected, returning from manual to normal operating mode is deferred until the current valve position matches the input position.

While in manual mode, the valve position may be changed. It is possible that the normal position setpoint may also change during the time when SVI is in manual mode. If SVI is switched from manual to normal mode, the valve will move toward the normal position setpoint and cause a bump that might be unexpected. This option gives an operator a chance to adjust the normal position setpoint or manually move valve position so they can match each other. When SVI is switch to normal mode, a smooth resumption of control with little disturbance will result.

Note: When using the SVI's built-in process controller, do not select bumpless transfer because this function is handled automatically by the process controller.

Tight Shutoff and Position Limits

- **Tight Shutoff Below (%):** When selected, if the valve position setpoint is below the tight shutoff value (entered in the edit box to the right), full supply pressure or atmosphere pressure is supplied to the actuator as needed to close the valve with maximum seating force available.
- **Position Lower & Upper Limit (%):** When selected, these limits act as software position limit stops. SVI will not allow the valve to go below the lower position limit or above the upper position limit. These limits may be turned on individually, i.e., the user can select a lower position limit without an upper limit. It should be noted that these are software limits only, and will not act as limits when power and/or air is lost, when the valve goes to fail-safe, or when full open or full close buttons are selected.
- **"Near Closed" Value (%):** This value determines the value of position below which the valve is considered "near closed" and SVI will record total time the valve stays in near closed region. The near closed time is very useful for diagnostic purposes. Near closed time is particularly helpful for estimating when it may be time to change the valve trim.

Pressure Unit and Display Language

- **Pressure Unit:** The output pressure reported by SVI can be in psi, bar, or kPa. If the pressure unit is changed after the SVI has been fully set up, the SVI will automatically convert all of its internal parameters to the appropriate units. Diagnostic and memory dump data saved to a computer file will not be converted.
- **Display Language:** SVI LCD display can be in English or French. This list box allows the user to choose which language should be used in SVI LCD display. The ValVue program will not be affected by this option. Different language versions of ValVue are available.

Setup Page

The Setup page (figure 38) appears when clicking Setup Tab in the SVI Configuration window. This page allows the user to choose and set configuration parameters such as air action, single or double acting actuator, process controller on or off, direct or reverse, position and pressure fault limits.

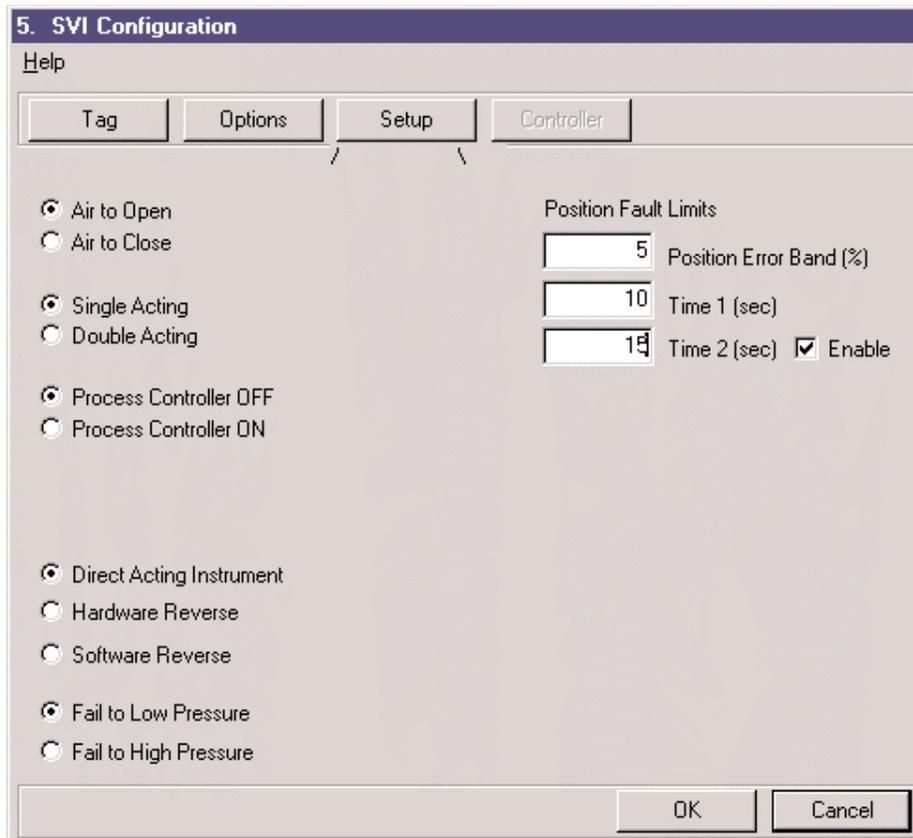


Figure 38. SVI Configuration - Setup Window

- **Air to Open / Air to Close:** Select whether the SVI is put on an air to open or air to close valve.
- **Single Acting / Double Acting:** Select whether the type of actuator is a single or double acting.
- **Process Controller ON/OFF:** This option will enable or disable the process PID process controller inside SVI. When process controller is enabled, the process variable must be connected to the auxiliary input channel (see SVI operating manual for detail). This option is available only if the device has been purchased with the process controller option. If the built-in process controller is not to be used, i.e., SVI is used as a positioner only; Process Controller OFF should be selected.

Note: When Process Controller ON is selected, windows and buttons associated with the process controller are enabled. The Controller Tab in the SVI Configuration window is enabled for basic process controller configuration. See Chapter 15 for Controller Configuration.

- **Direct Acting Instrument:** Selecting SVI as a direct acting instrument or positioner is the right choice for most applications. Direct action will increase output pressure to the valve for increasing input signal. Reverse action decreases the output pressure for increasing input signal.
- **Hardware Reverse:** Reverse mode operation may be accomplished by hardware or software means. Hardware reverse is an option that must be ordered from the factory (the device cannot be hardware reversed in the field).
- **Software Reverse:** Selecting this option to configure SVI as a reverse acting instrument by software. In the software reverse mode, care must be taken to insure that the input signal is not less than 3.8 mA. As the input signal drops, the air pressure to the actuator would increase in this reverse mode. However, below 3.8 mA, the SVI would not have sufficient power to run. When power is insufficient to run, the output to the I/P would drop to 0 and the output air pressure would decrease to atmosphere pressure (rather than increase as in the case of Hardware Reverse).

 WARNING	<p>Reverse mode is a rarely used option and may cause unexpected results in the event of a power and/or air failure. Be sure you understand the operation of the SVI in reverse mode before selecting either hardware or software reverse and thoroughly test it before use. The following list the valve positions when electrical failure and/or air loss occurs for various SVI configurations.</p>
--	---

Air-To-Open

Direct
Hardware Reverse
Software Reverse

Electrical Failure

Closed
Open
Closed

Air Failure

Closed
Closed
Closed

Sensor Failure

Configurable
Configurable
Configurable

Air-To-Close

Direct
Hardware Reverse
Software Reverse

Electrical Failure

Open
Closed
Open

Air Failure

Open
Open
Open

Sensor Failure

Configurable
Configurable
Configurable

- **Fail to Low/High Signal (to I/P):** This selection is activated only if Hardware Reverse or Software Reverse are selected and determines, in case SVI fails, whether it will fail to low or to high signal to the internal I/P transducer. Fail to Low Signal is the most common choice and is equivalent to fail to low output pressure. Fail to High Signal option is used almost exclusively for the SVI with the hardware reverse. For hardware reverse SVI, fail to high signal may be preferred (where fail high would result in a low actuator pressure). Note, however, that in an electrical failure, the SVI will no longer operate and will not likely fail to high signal.

Positioner Error

The user may configure how position errors are handled. A position error occurs when the valve position differs from the requested position by more than the Position Error Band for more than the position error Time 1. When this occurs, a status flag is set which is reported during the next HART message. The user must send a Read Status message to find out the cause of the status flag.

 WARNING	Enabling Time 2 may cause the valve to move to its Failsafe position.
--	--

Care should be taken in selection of Time 2 to avoid un-necessary transitions to Fail Safe Mode. This latter action may be enabled and disabled by checking and unchecking the check box.

For practical considerations, Position Error Band must be no less than 0.5% and no larger than 200%. Time 2 (if enabled) must be larger than Time 1, and Time 2 must be no less than 5 seconds. Time 1 must be no less than 1 second or equal to -1 to disable the alarm function. Time 1 should be set at least as long as the time required to fully open the valve from fully close or fully close the valve from fully open. Otherwise, unnecessary position errors may be reported. The maximum time limit for both Time 1 and Time 2 is 327 seconds.

Controller Page

SVI has a built-in process PID controller which is enabled only for SVI purchased with process controller option. When Process Controller On is selected in Setup page, the Controller Tab in the SVI Configuration window is enabled for basic process controller configuration.

For detail regarding the configuration of process controller, refer to Chapter 15: Controller Configuration.

Note: Entering -1 in Time parameters disables the Position Error function.

Chapter 10: Calibration Mode

Calibration mode is used to scale and calibrate analog inputs, valve position, output pressure and tune valve position controller. In this mode, the valve no longer responds to the 4-20 mA input signal.



CAUTION

Some calibrate functions stroke the valve over its full range. Isolate the valve from the process before moving to the Calibrate Mode.

Configure the SVI before calibration. Access the calibration screens by clicking on the calibrate button in manual mode. ValVue will display the current calibration data from the SVI.

The SVI Calibration window has three tabs:

- **Range**
- **Tuning**
- **Signal Calibration**

Clicking a tab brings you a corresponding page.

- **Range, Tuning, or Signal Cal.** tab to continue examine and modify calibration.
- **OK** button to accept changes entered, download to SVI, and exit to manual mode.
- **Cancel** button to discard changes entered and exit to manual mode. Note that finding valve stops (Auto Stop Limits and Manual Stop Limits), Auto Tune, Reset to Factory, and any of the signal calibrations in the Signal Cal. Page occur immediately when they are performed and are saved even if the cancel button is clicked instead of the OK button.

Range Page

The Range page is displayed when entering calibration mode. The Range page allows the user to enter the low and high range values for the primary input signal, as well as remote setpoint and process variable if the built-in process controller is enabled (see Chapter 16: Controller Calibration) and allows automatic and manual calibration of the valve position sensor.

9. SVI Calibration

Help

Range Tuning Signal Cal.

CLOSED At Low Signal OPEN At High Signal

4.00 Low Signal (mA) 20.00 High Signal (mA)

30.00 Supply Pressure psi

Low Remote Set Point gal/min High Remote Set Point gal/min

Low Process Variable gal/min High Process Variable gal/min

Auto Stop Limits Manual Stop Limits

Open Stop Adjustment

OK Cancel

Figure 39. SVI Calibration Range Window

- **Low Signal (mA):** This is the value (in mA) of the primary analog input that corresponds to fully close for air-to-open valve or fully open for air-to-close valve for a SVI configured as a positioner. A typical value is 4.00 mA. However, if a valve is split ranged, for example, 12.00 to 20.00 mA, the Low Signal is 12.00 mA instead of 4.00 mA.
- **High Signal (mA):** This is the value (in mA) of the primary analog input that corresponds to fully open for air-to-open valve or fully close for air-to-close valve for a SVI configured as a positioner. A typical value is 20.00 mA. However, if a valve is split ranged, for example, 4.00 to 12.00 mA, the High Signal is 12.00 mA instead of 4.00 mA.
- **Supply Pressure:** Air supply pressure should be entered in this box. This value is used only for scaling SVI output pressure signal to engineering units and need not be exact.

Note: The remote setpoint and process variable range boxes are valid only for SVI built-in controller and are disabled for SVI as positioner only. See Chapter 16 for controller related calibration.

Note: Low Signal and High Signal are used to split range the SVI positioner.

Range Calibration



Range calibration moves the valve over its entire stroke. Isolate the valve from the process prior to calibration.

Through ValVue, the SVI position sensor can be calibrated either automatically or manually using the Auto Stop Limits or Manual Stop Limits method. The supply pressure must be at least 5 psi above the upper spring range of the valve so that mechanical stops can be reached by exhausting and filling the valve actuator.

- **Auto Stop Limits:** Clicking the Auto Stop Limits button initiates the automatic position calibration process in the SVI. The actuator is fully exhausted and then fully filled, and the position signal corresponding to each position stop is measured and saved. For some cases like extremely large size actuators, this procedure may fail due to time out. Manual Stop Limits method should be applied if Auto Stop Limits fails. After position calibration, check if the calibration is done properly by clicking the Full Open and Full Closed button and valve positions at stops are displayed correctly.
- **Manual Stop Limits:** Clicking the Manual Stop Limits button initiates the manual position calibration process in the SVI. The valve is moved to one mechanical stop and waits for user's confirmation, and then is moved to another mechanical stop and waits for user's confirmation.
- **Open Stop Adjustment:** For some valves the open position stop exceeds the nominal travel of the valve. By entering a value in the Open Stop Adjustment, and clicking the Auto Stop Limits or Manual Stop Limits button to run the calibration, the valve position can be adjusted to nominal travel. For a valve with fully close and open corresponding to its mechanical stop, the value is simply 100. Otherwise, you may use the following procedure to determine the value:
 1. Enter 100 in Open Stop Adjustment and choose either Auto Stop Limits or Manual Stop Limits to complete initial position calibration. This will calibrate the valve position as 100% at the open mechanical stop.
 2. Click OK to return to manual mode.
 3. Manually adjust the valve position (using the scroll bar or the set position button) until the valve is at the full open nominal position. Make note of the valve position reading, for example, 80%.
 4. Return back to this Range page.
 5. Enter the position reading, e.g., 80 in the Open Stop Adjustment edit box and repeat the position calibration procedure again.

The valve will now be calibrated for nominal travel. If position calibration is run subsequently, do not enter any value in the Open Stop Adjustment - the SVI will remember the proper value to use.

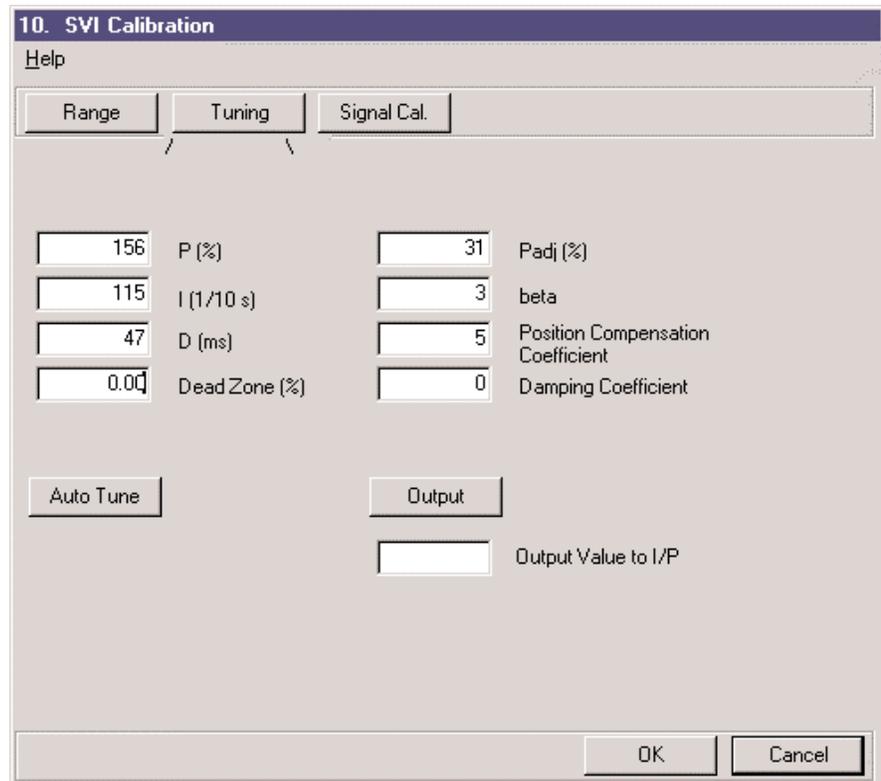
Note: Valve supply pressure must be at least 5 psi higher than the upper spring range of the valve.

Tuning Page

 WARNING	Autotune moves the valve over its entire stroke. Isolate the valve from the process prior to Autotune.
--	---

Tuning page (figure 40) is displayed by clicking the Tuning Tab in SVI Calibration window. This page allows the user to examine position controller parameters and tune the positioner automatically or manually. The user can also open the valve position control loop and manually set an output to the internal I/P in SVI to adjust the bias.

Figure 40. SVI Calibration - Tuning Window



10. SVI Calibration					
Help					
Range		Tuning		Signal Cal.	
<input type="text" value="156"/>	P (%)	<input type="text" value="31"/>	Padj (%)		
<input type="text" value="115"/>	I (1/10 s)	<input type="text" value="3"/>	beta		
<input type="text" value="47"/>	D (ms)	<input type="text" value="5"/>	Position Compensation Coefficient		
<input type="text" value="0.00"/>	Dead Zone (%)	<input type="text" value="0"/>	Damping Coefficient		
<input type="button" value="Auto Tune"/>		<input type="button" value="Output"/>			
		<input type="text"/>	Output Value to I/P		
		<input type="button" value="OK"/>		<input type="button" value="Cancel"/>	

Tune Positioner

In SVI, there is a self-tuning algorithm called Auto Tune which will determine the parameters for valve positioning control. You can manually adjust these parameters based on the Autotune results or based on trial and error method. The Step Profile test available from diagnostic mode is useful to tune the positioner and check its performance.

Clicking the Auto Tune button starts the procedure to automatically determine the positioner tuning parameters. To run Auto Tune smoothly and successfully, it is important to place the valve between 10 to 90% (preferably 50%) in manual mode and wait until the position matches its setpoint within 0.2%

before entering into calibration mode to start the Auto Tune. The tuning procedure will stroke the valve back and forth several times and must not be run with the valve in service. The entire process takes about 3 to 12 minutes. The resulting position controller parameters will be presented when the procedure is finished and a graph of the positioner step response will be displayed. Figure 41 shows a typical step response for a high friction valve after a successful Auto Tune.

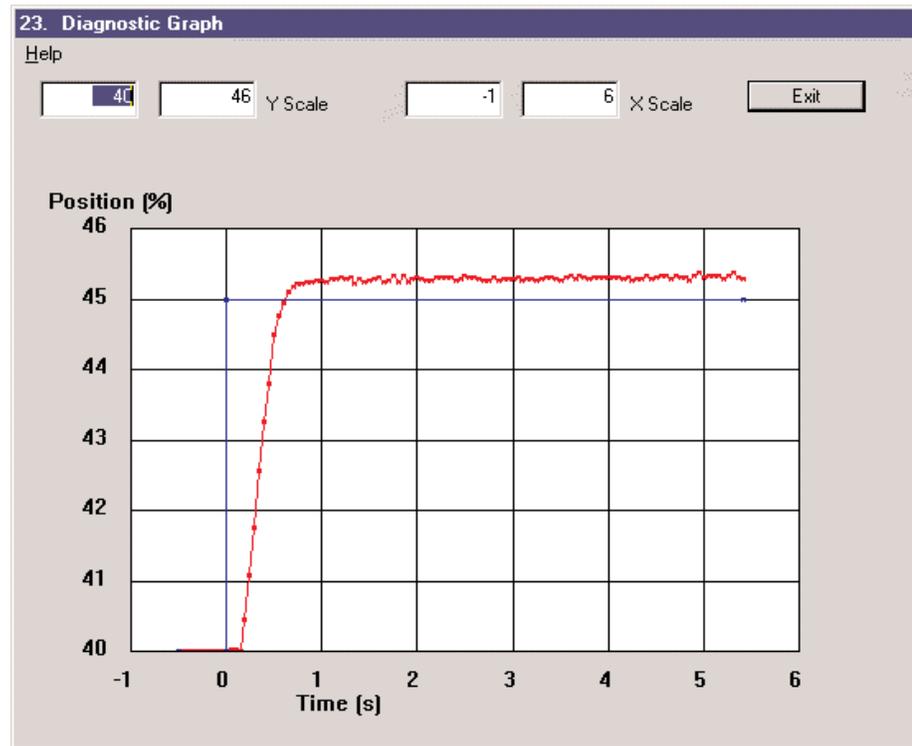


Figure 41. Diagnostic Graph - Typical Step Response

Note: For a SVI positioner system using air booster or quick exhaust, the Auto Tune may fail and manual adjustment of the positioner parameters therefore becomes necessary.

The position controller is a type of non-linear PID controller with eight adjustable parameters. The maximum range of the positioner parameters is as listed below. For typical values, see the parameters description.

Parameter	Range
Proportional Gain	0 to 5000%
Integral Time	0 to 1000 seconds
Derivative	0 to 200 seconds
Padj	+ / - 3000 (depends on P)
Beta	- 8 to + 9
Position Compensation Coefficient	0 to 9
Dead Zone	0 to 1%
Damping Coefficient	0 to 9

Parameter Descriptions

- **P (%):** Proportional gain P is the ratio of change of output due to proportional control action to the change in position error. Common values for the positioner are 50 for small actuators and up to 5000 for large actuators. The larger this gain, the faster the valve will respond with larger tendency to overshoot. Air supply pressure affects this value. Therefore, the position controller should be re-tuned if air supply pressure is changed.
- **I (1/10 s):** Integral time or reset time, is the time constant of integral control. Higher values of I cause less integral control action and increase loop stability. However higher values of I will also increase the time to eliminate a steady-state position error. Common values are 10 to 400. Special value of 0 turns off integral action and will result in a steady-state position error. Therefore value 0 should not be used in any real application.
- **D (ms):** Derivative time or rate time is the time constant of derivative control. Common values are 10 to 150. Larger derivative time causes more derivative control action.
- **Padj (%):** Valves often have significantly different responses when air filling verses air exhausting. To achieve uniform responses in both moving directions or manipulate different response speeds, the proportional gain is adjusted by adding Padj to P when the valve actuator is exhausting. The common values are ranging from $-P/2$ to $P/2$. Increasing air supply pressure and re-running Auto Tune will typically reduce P and increase Padj.
- **Beta:** Beta is a nonlinear gain factor, ranging from -8 to 9. When beta is 0, the controller gain is linear. Otherwise the gain is the function of error. The larger the beta, the smaller the gain for small error. Typical beta value for a valve position controller is 0 to 8.
- **Position Compensation Coefficient:** The response of the valve is different when the valve is nearly closed than when the valve is nearly open. The position compensation coefficient, which is a number between 0 and 9, allows the user to make adjustments to try to equalize the valve response. The normal value is 6.
- **Dead Zone (%):** When the valve position is within its setpoint +/- the dead zone, no additional position control is performed. This value is normally 0%, however for high friction valves (e.g. valves with graphite packing) a higher dead zone will help avoid limit cycling due to the stick/slip action of the valve. In these cases the dead zone may be set at 0.1% to 0.5%.
- **Damping Coefficient:** The valve response may be made slower for some applications. A value of 0 gives no damping, and a value of 9 gives maximum damping of valve motion. A successful Auto Tune set this value to 0. A failure of Auto Tune sets error codes listed below through this variable. You must manually set a value other than 0 for damping purpose.

Auto Tune Error Codes

Auto Tune Error Code	Message	Action
0	Self-tuning is successful	Check the step response
33	Fail in open loop test	Check if an air booster or quick exhaust is Used; Check the supply pressure
44	Fail to find a Bias. Self-tuning is canceled	Check if an air booster is used Place the valve at 50% and restart tune
55	The found Bias is not in the required range, and self-tuning is canceled	Adjust the Bias
66	Self-tuning for air fill direction fails	Check supply pressure; Check the linkage; Check the grounding; Check the pneumatic block especially spool S/A
77	Self-tuning for air exhausting direction fails	Check the pneumatic block especially spool S/A

Bias Adjustment

Clicking the Output button sets the D/A value sent to the internal I/P in SVI. This is useful for setting the Bias adjustment of the SVI. When the button is clicked, a light will appear indicating that position control loop is open and the output to the I/P has been set. Clicking the button a second time will close position control loop and place the valve under control in manual mode.

The open-loop method for adjusting the bias is:

1. Enter the proper bias value for SVI. The most common value is 2750.
2. Click the Output button (the light should go on).
3. Turn the adjustment screw on top of the SVI pneumatics block until the valve is positioned approximately at mid range and the valve remains nearly motionless.
4. Click the Output button again, the light should go off and the valve returns to its position prior to this procedure.

Signal Calibration Page

The Signal Calibration page (figure 42) appears when clicking the Signal Cal. Tab in the SVI Calibration window. This page allows the user to re-calibrate the primary signal, the output pressure sensors, and the secondary signal if it is connected. These sensors are calibrated at the factory and do not usually require re-calibration. The Reset to Factory button returns the calibrations to those that were set before delivery of the SVI.

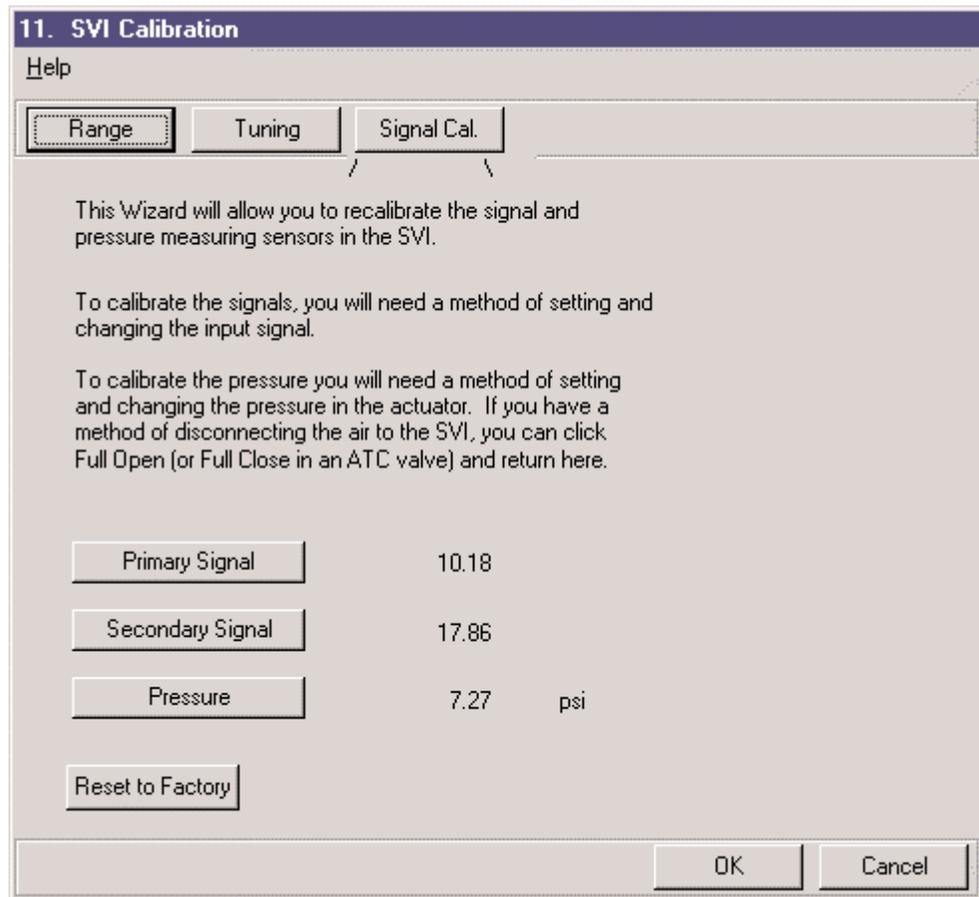


Figure 42. SVI Calibration - Signal Calibration Window

The currently measured values of the primary input signal, secondary input signal (if the process controller is enabled), and output pressure are displayed and can be compared to reference signals.

Clicking any of the buttons Primary Signal, Secondary Signal, or Pressure starts the calibration procedure for their respective sensors. The procedure will ask the user to:

1. Enter a low value for the measurement.
2. Set the input to that value.
3. Enter a high value for the measurement.
4. Set the input to that value.

Calibrating the primary signal can be done most easily with a variable current source. Calibrating the secondary signal can be done most easily with a 1 - 5 voltage source or a variable current source with a 250 Ohm resistor across the A and B terminals in the SVI connection entry. Changing the value of the resistor calls for re-calibration of the secondary signal, since the secondary signal sensor actually measures voltage across the resistor rather than current.

Calibrating pressure can be done most easily with a method of turning the air supply off. From the manual mode select full open or full closed (whichever fills the actuator to supply pressure). Go to the signal calibration page and start the pressure calibration procedure. Turn the air supply off to get the low value and turn the air supply back on to get the high value.

After complete calibration from a page, click:

- OK button to accept changes entered, download to SVI, and exit to manual mode.
- Cancel button to discard changes entered and exit to manual mode.

Note: Finding valve stops (Auto Stop Limits and Manual Stop Limits), Auto Tune, Reset to Factory and any of the signal calibrations in the Signal Cal. Page occur immediately when they are performed and are saved even if the cancel button is clicked instead of the OK button.

Chapter 11: Diagnostic Mode

Introduction

Diagnostic mode allows the user to run several useful procedures that provide information about the SVI installed valve and its performance. Previous test data can be retrieved and graphically displayed in the diagnostic mode when running ValVue in offline mode.

 CAUTION	Some diagnostic functions stroke the valve over part or full range. Isolate the valve from the process before moving to the Diagnostics mode.
--	--

ValVue offers five types of diagnostic tests: continuous diagnostics, standard valve diagnostic signatures, extended valve actuator signature, positioner signature, and step profile as described below:

- **Continuous Diagnostics:** ValVue retrieves continuous diagnostic data from the data stored in SVI's non-volatile memory. The continuous diagnostic data include Total Travel, Number of Cycles, Time Open, Time Closed and Time Near Closed.
- **Standard Valve Diagnostic Test:** The standard diagnostic test produces a valve travel vs. pressure graph for both increasing and decreasing pressure. The data is gathered from 10 to 90% of valve travel. The current valve signature can be compared to the factory and/or saved signatures stored within the SVI non-volatile memory. This testing analyzes just the valve and actuator only, i.e., as if a positioner were not on the valve. If an abnormal signature is found, the problem can be further analyzed by disconnecting the actuator connection to the valve and running the test again. This allows the user to pin point the problem to either the actuator or the valve. The results of the Standard Valve Diagnostic test include: Friction, Stroking Time open and closed, Upper and Lower Spring Range, and Upper and Lower actuator Pressure Range. The standard diagnostic is useful for trending valve performance.
- **Extended Actuator Signature:** The valve is put through a diagnostic test and ValVue produces a valve travel vs. pressure graph for both increasing pressure and decreasing pressure directions similar to the Standard Valve Diagnostic test. The data can be gathered over a user-specified range (minimum of 10% of span, maximum of -5% to 105% of span). The data is gathered in the burst mode so that the maximum possible number of points may be provided.
- **Positioner Signature:** the valve is put through a diagnostic test and ValVue produces a position vs. input signal graph for both increasing and decreasing signal directions. This test is similar to the Extended Actuator test, however, the SVI positioner is included in the test as well as the valve and actuator.
- **Step Profile:** the valve is put through a step response test and ValVue produces a position vs. time graph. The graph contains data collected every 0.1 seconds for a period of 2 to 10 seconds.

Among the aforementioned five types of the diagnostic tests, the standard valve diagnostic test strokes the valve over its full range and should not be run with the valve in service and the process running. The extended valve actuator signature, positioner signature and step profile tests allow the user to enter the starting point, end point, time duration or number of sampling of the test. Clicking the Stop Procedure button in Diagnostic window that appears during the test can halt any of the valve diagnostic tests.

Note: Limiting a signature or step test to a small range may allow you to conduct the test with an acceptable upset to the process under some circumstances.

SVI must be switched to manual mode first in order to access the diagnostic mode. Clicking the Diagnostic button in the Manual Mode window will retrieve current continuous diagnostic data from the SVI and display them in the Diagnostics window (figure 43 shown on next page).

To exit the Diagnostics window, click the Manual button to exit to manual mode.

Continuous Diagnostics

ValVue retrieves current diagnostic data from the SVI and display them in Continuous Diagnostic Data box in the Diagnostics window. These data include:

- **Total Travel:** Valve travel accumulated in the unit of number of full strokes.
- **Number of Cycles:** The number of times the valve travel changes direction.
- **Time Open:** The time the valve has spent fully open
- **Time Closed:** The time the valve has been fully closed
- **Time Near Closed:** The time the valve has spent throttling near the seat.

These continuous diagnostic data are also accessible via a HART command #139 Read Continuous Diagnostic Data in the normal operating mode or manual mode.

To reset continuous data, click the Reset Continuous Data button under the Diagnostic Data box. A warning message box will appear. If you click OK, the continuous diagnostic data (Total Travel, Number of Cycle, Time Open, Time Closed, and Time Near Closed) will be reset to 0. When reset, the previous values are lost. We recommend recording the continuous diagnostic data before clearing.

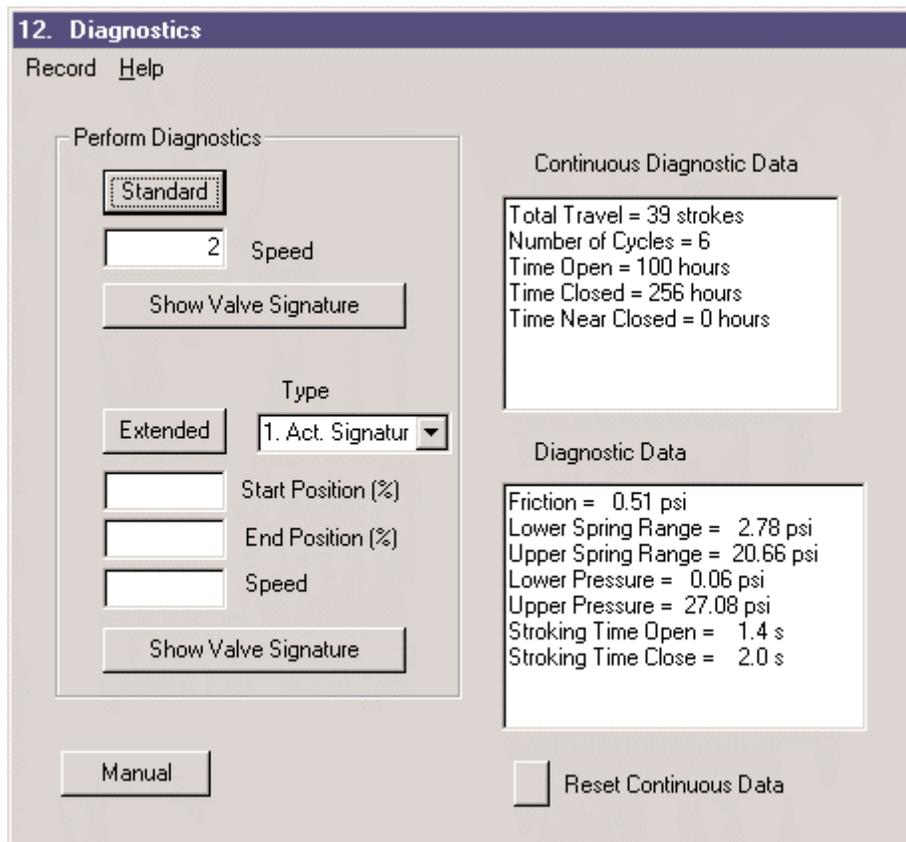
Standard Valve Diagnostic Test

 WARNING	Standard valve diagnostic strokes the valve over its full range. Isolate the valve from the process prior to running standard diagnostic.
--	--

To perform the standard valve diagnostic test, type a speed between 1 and 10 in the “speed” box and click the Standard button. This procedure strokes the valve over its full range and should not be run with the valve in service and the process running.

A speed between 1 and 10 must be entered. This determines the speed at which the valve will travel during the travel vs. pressure test points. A speed of 1 or 2 is appropriate for valves with small actuators. A speed of 3 or 4 is appropriate for valves with medium actuators. Higher speeds will be required for larger actuators. During the test, if the valve moves too slowly or stops moving completely, stop the procedure and restart it with a higher speed number. The speed number is approximately associated with the size of the valve. For example, enter a speed of 2 for a 2-inch size valve.

When the test is finished, maximum friction, the computed spring range, minimum and maximum output pressures, and stroking times are displayed in the Diagnostic Data box at the lower right of the window.



12. Diagnostics
Record Help

Perform Diagnostics

Speed

Type

Start Position (%)

End Position (%)

Speed

Continuous Diagnostic Data

Total Travel = 39 strokes
Number of Cycles = 6
Time Open = 100 hours
Time Closed = 256 hours
Time Near Closed = 0 hours

Diagnostic Data

Friction = 0.51 psi
Lower Spring Range = 2.78 psi
Upper Spring Range = 20.66 psi
Lower Pressure = 0.06 psi
Upper Pressure = 27.08 psi
Stroking Time Open = 1.4 s
Stroking Time Close = 2.0 s

Figure 43. Diagnostics Window

To access the actuator signature, click the Show Valve Signature button. The Valve Signature window will appear with a current valve signature depicted as two red curves. One curve shows the Travel vs. Pressure while the valve ramps in open direction; the other shows Travel vs. Pressure while valve ramps in close direction.

In addition to current valve signature, the standard valve signature graph also provides access to the saved and factory signatures. The Saved and Factory signatures are stored in SVI's non-volatile memory.

- **Saved Signature:** The user may choose to save one valve signature curve. Selecting this box plots the last saved valve signature in blue.
- **Factory Signature:** Selecting this box plots the valve signature saved when the SVI was first mounted on the valve.

To display the signatures check any of the three boxes: Current Signature (red), Saved Signature (blue) and Factory Signature (black). For example, current and factory signatures are selected to plot in the graph in the Valve Signature window (figure 44).

There are three buttons in this window.

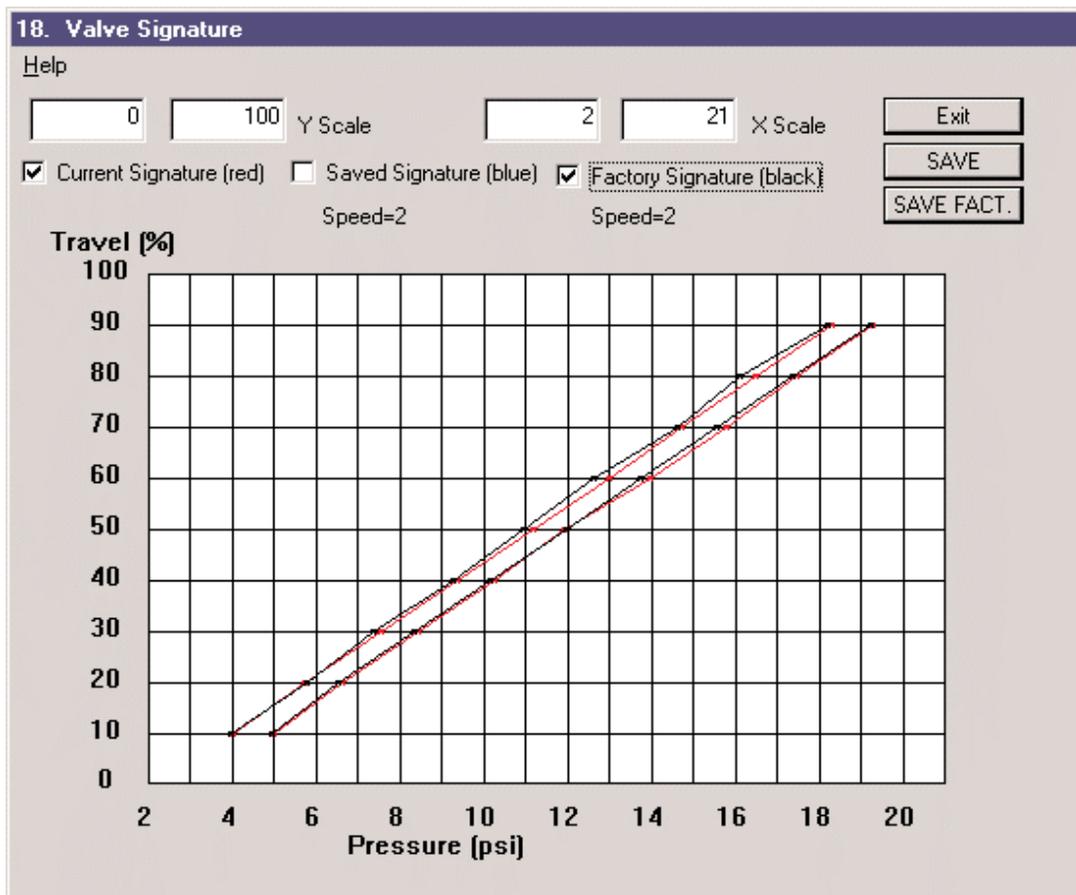


Figure 44. Valve Signature Window

Valve Signature Window - Button Descriptions

- **SAVE Button:** Click this button to save the current signature in the SVI as the saved signature and override the previous saved signature. It will then be available for comparison to future signatures. Only one signature may be saved at a time (in addition to the factory signature).
- **SAVE FACT. Button:** Click this button to save the current signature in the SVI as the factory signature and override the previous factory signature. This should generally only be used when the SVI is first mounted on the valve. To save a signature to the Factory memory location in SVI, the user must be logged on with a privilege level of 9.
- **Exit Button:** Click this button to exit the Valve Signature window and return to the main Diagnostics window.

Extended Actuator Signature

The extended actuator signature test is run over the user-specified range of valve travel. The minimum range is 10%. The positions may range from -5% to 105% with the ranges outside of 0-100 providing data from atmosphere pressure to supply pressure.

To obtain an extended actuator signature, follow these steps:

1. Select **1. Act Signature** in the Type list box.
2. Enter a value in **Start Position (%)** box
3. Enter a value in **End Position (%)** box
4. Enter a value between 1 and 9 in **Speed**
5. Click the **Extended** button to begin test.
6. Read the warning message from a pop up window and click **OK** button to continue.
7. Wait until the test is finished.

For the extended actuator signature test, the range must be at least 10% and the starting position must be less than the ending position. The speed for the extended actuator signature is the same speed used for the standard valve signature.

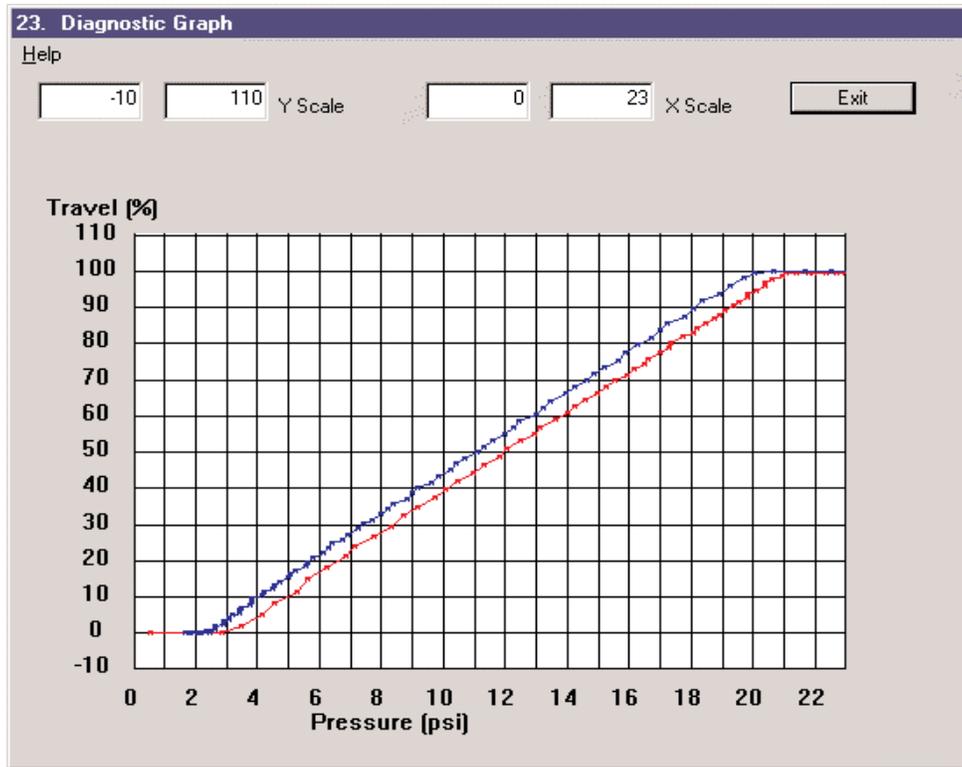


Figure 45. Diagnostic Graph - Extended Actuator Signature

During the test, the valve moves from original position to the start position specified in the Start Position box, then ramps to the end position specified in the End Position box. After reaching the end position, it returns to the original position. In the second part, valve moves to the end position, then ramps to start position at the specified speed. After reaching at start position, it returns to the original position and finishes the test. The results appear in the Diagnostic Graph window as illustrated in the figure below with a full range of valve travel (-5 to 105% range).

Step Response Test

A step response of valve position can be used to examine the dynamic characteristics of a valve system. The step response test is run over the user-specified range of valve travel. ValVue produces a Position vs. Time graph after the test. Since the user can specify the start position and end position without a limit, the size of a step change can be from full range down to less than 0.1%.

To perform a step response test, follow these steps:

1. Select **3. Step Profile** in the Type list box.
2. Enter a value in the Start Position (%) box, e.g., 50;
3. Enter a value in the End Position (%) box, e.g., 60;
4. Enter a value between 2 and 10 seconds in the Time box.
5. Click the Extended button to begin test.
6. Read the warning message from a pop up window and click the OK button to continue.
7. Wait until the test is finished.

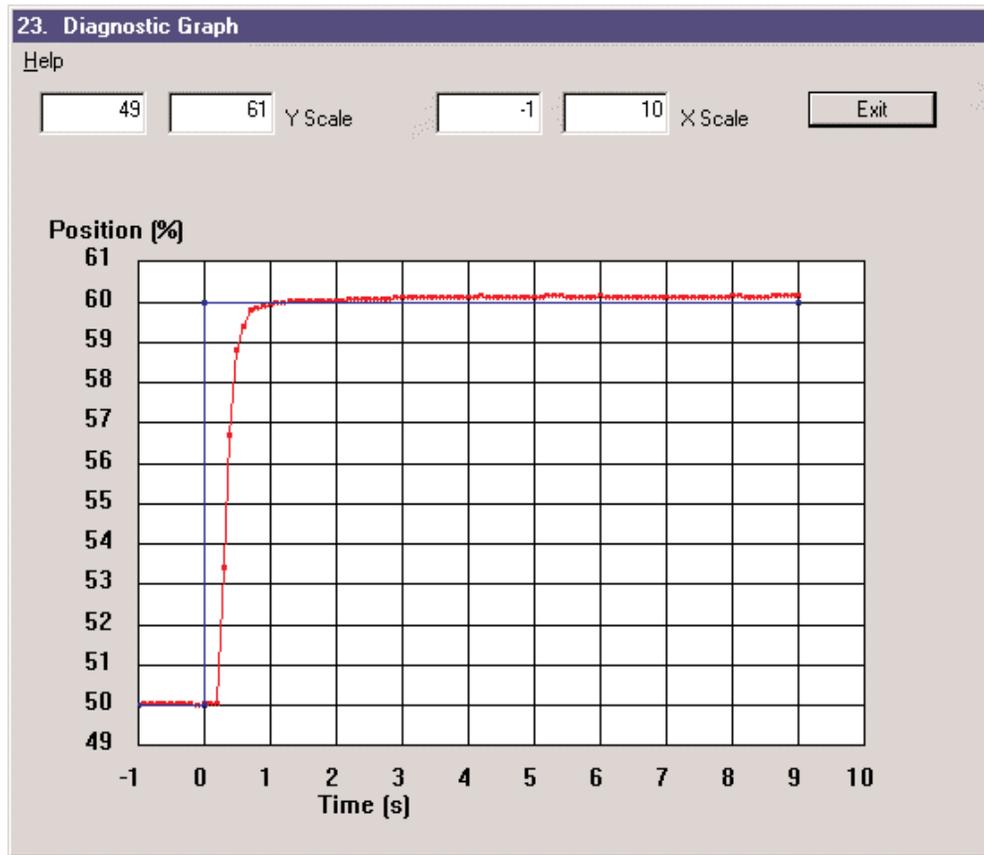


Figure 46. Diagnostic Graph - Step Response Test

During the test, the valve moves from original position to the start position specified in the Start Position box first, then move to end position specified in the End Position box and stay there until the specified time is reached. It then returns back to the original position and finishes the test. The results appear in the Diagnostic Graph window as illustrated in the figure 46 with a step response from 40 to 50% of valve travel.

Positioner Signature

A positioner signature can be used to examine the stability and dead band of a valve system. The positioner signature test is run over the user specified range of input signal and ValVue produces a Position vs. Signal graph for both increasing and decreasing signal directions. The user can specify the start current in the Start Current box and end input current in the End Current box.

To perform a positioner signature test, follow these steps:

1. Select **2. Pos. Signature** in the Type list box.
2. Enter a value in the Start Current (mA) box, e.g., 4;
3. Enter a value in the End Current (mA) box, e.g., 20;
4. Enter a value between 2 and 20 in the Samples box, e.g., 10.
5. Click the Extended button to begin test.
6. Read the warning message from a pop up window and click the OK button to continue.
7. Wait until the test is finished.

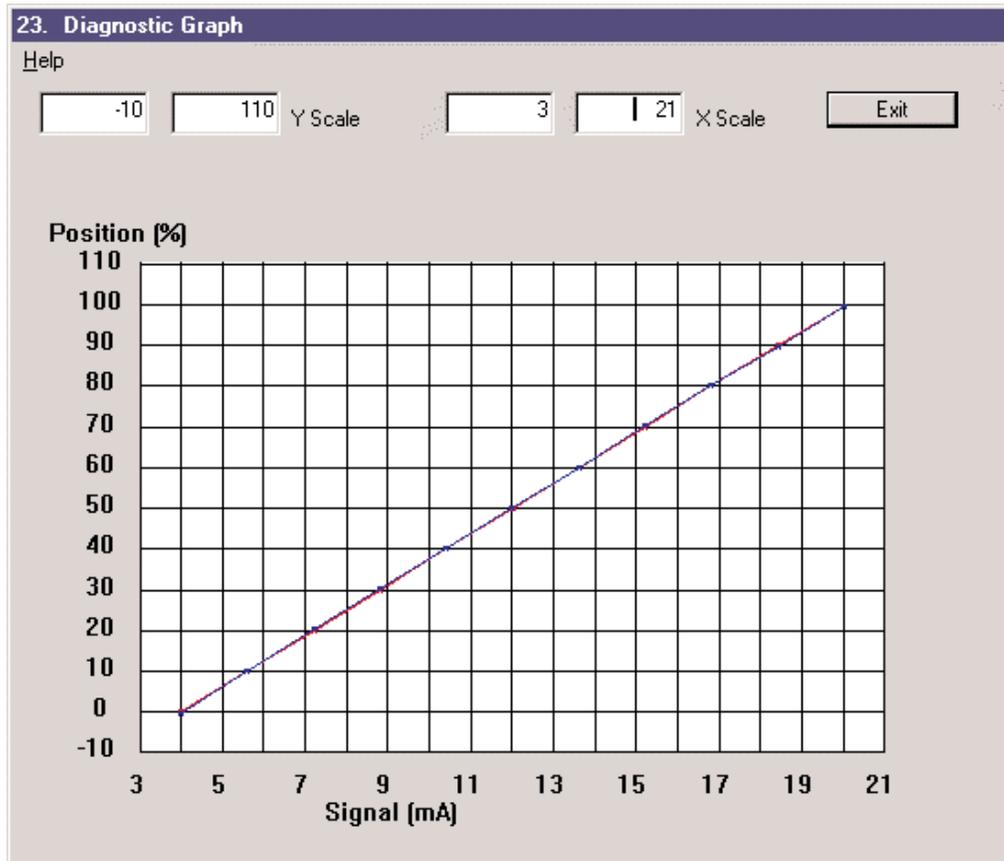


Figure 47. Diagnostic Graph - Positioner Signature

During the test, the valve responds to the simulated current which ramping from start current to end current and then from end current to start current. It then returns back to the original position and finishes the test. The results appear in the Diagnostic Graph window as illustrated in the figure 47 with a full range of 4 to 20 mA consisting of 10 sampling points.

Saving and Retrieving Signatures

Saving Signatures

The data obtained from all diagnostic tests used to produce graphs can be saved in text files. These text files can then be used to reproduce graphs in ValVue or read into a spreadsheet or other similar program that accepts tab delimited files. Multiple signatures may be saved in a single file and signatures and step profiles may be mixed in the same file. It is required that only signatures from the same tag name are saved in a single file. Each entry is time stamped.

To save test data, click the corresponding Show Valve Signature button to review the graph and then exit it. Click menu Record and pick the appropriate one from the following list:

- Save Valve Signature
- Save Saved Signature
- Save Factory Signature
- Save Actuator Signature
- Save Positioner Signature
- Save Step Profile

The following window (figure 48) appears for you to either choose an existing dgn file or type a new file name to create one to save the data. Click the Open button to open the selected file and save data. The default file extension name is dgn.

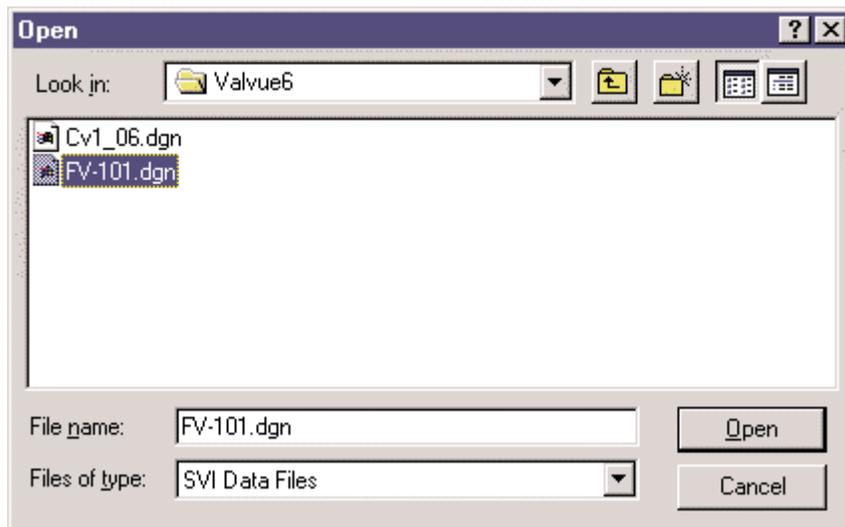


Figure 48. Saving Signatures Window

Retrieving Signatures

To retrieve the saved data from a text file, you must select the OFFLINE SVI device from the Select Device window. Then pick up an SVI dump file from the pop-up file selection window. Click the Manual Mode button in the Normal Operating Mode window to enter into the Manual Mode window. Enter into the Diagnostics window by clicking the Diagnostics button.

- To display a standard valve signature, click the Standard button. If there is a .dgn file that matches the .dmp file name used, the Load Diagnostic Data window appears immediately. Otherwise, select the dgn file, which contains the data from the pop-up file selection window. Pick SIG-S with time stamp from the list in Load Diagnostic Data window and click the Load and then Exit button. Click the Show Valve Signature button to bring the valve signature graph.
- To display an extended test graph, click the Extended button. Follow the same procedure as above to pick the desired graph and click the Show Valve Signature button to display the graph.

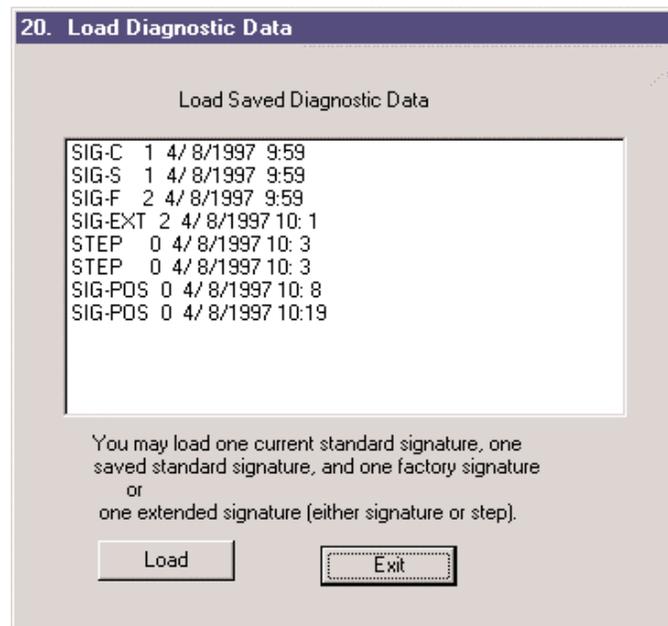


Figure 49. Load Diagnostics Window

Exporting Signatures to Spreadsheets

In addition to running ValVue in offline to retrieve test data saved in a text file, these data can also be read into a spreadsheet or other similar program that accepts tab delimited files. The following are steps to use Microsoft Excel 97 to read these data.

1. Start Microsoft Excel 97 Application
2. Select File-Open. Find the dgn file with file types of *.* and open it
3. In Text Import Wizard - Step 1 of 3, choose the file type of Delimited and click Next
4. In Text Import Wizard - Step 2 of 3, choose the tab as delimiter and click Next
5. In Text Import Wizard - Step 3 of 3, choose the general as column data format and click Finish
6. The test data with associated time and test type are imported into the Excel spreadsheet.

Chapter 12: Failsafe Mode

SVI functions in normal operating, manual operating, configuration, calibration, diagnostic and fail-safe modes. Accordingly, ValVue has various windows to interface with these different modes. SVI does not go to failsafe mode if it functions normally. However, if a problem occurs the SVI will go to the safe mode, SVI will attempt to drive its output either to low signal or high signal to I/P based on its configuration. In addition, the appropriate failure statuses are set in SVI, and HART command #136 Read Status can be sent to the device to find out the problem. After the problem is fixed, the device can be restarted by either resetting the power or clicking the reset button in manual mode.

Fault Message

Following is a list of problems which may cause SVI go to failsafe mode.

- Position Error
- Position Sensor Error
- Current Sensor Error
- Reference Voltage Error
- Self Check Failure
- Software Error

When SVI is in failsafe mode, ValVue will automatically detect it in normal or manual mode and display the FAIL SAFE MODE window below (figure 50). In this window, HART command #136 Read Status can be sent to the device to find out the problem. In this example, the Position Error was caused by air supply loss causing the SVI to the FAIL SAFE MODE.

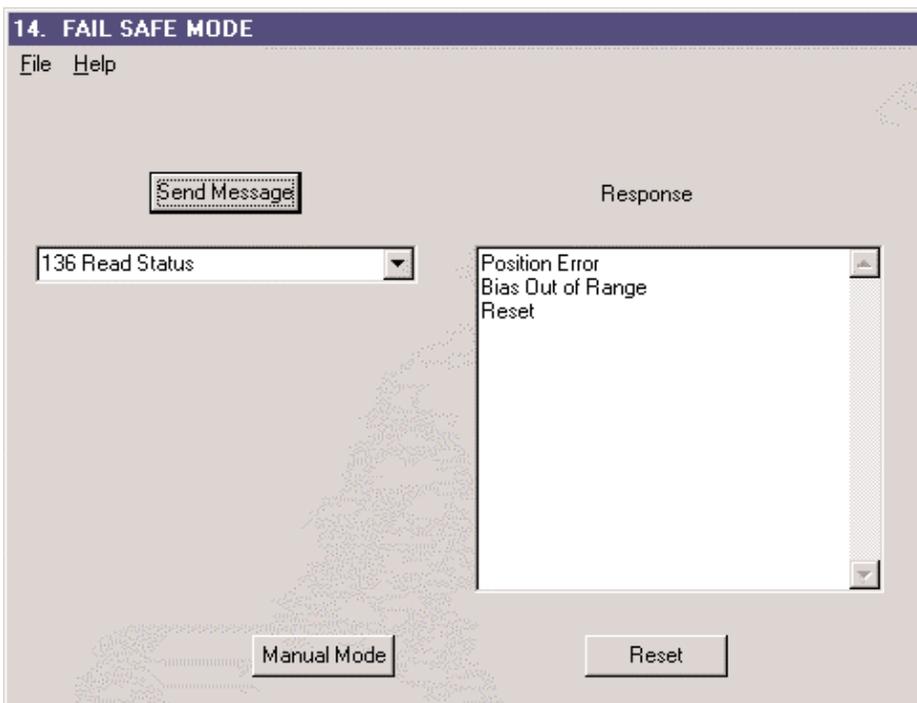


Figure 50. Fail Safe Mode Window

Among the list of problems, which may cause SVI to enter the FAIL SAFE MODE, inappropriate installation or configuration, loss of air supply or insufficient air supply can cause the position error and position sensor error conditions. Other problems are more likely related to SVI hardware or software.

Timeout of hardware watchdog timer clamps output to fail-save condition and initiates CPU reset.
Timeout of software (microprocessor COP watchdog timer initiates CPU reset.

A position error occurs when the valve position differs from the requested position by more than the Position Error Band for more than the position error Time 1. See Chapter 9: Configuration Mode. However a position error does not cause SVI to enter the FAIL SAFE MODE unless the Time 2 is enabled and the position error persists for more than the position error Time 2. The user should decide if fail-to-safe mode is desirable for a position error for a specific application. If not, position error Time 2 should not be enabled. To avoid unnecessary position error, Position Error Band should not be configured too small (2 to 10% is typical) and Time 1 and 2 should be larger than the time required to stroke the valve from fully close to fully open and from fully open to fully close. If these parameters are set appropriately, loss of air supply or insufficient air supply is probably the reason that causes a position error.

The active range of a standard SVI position sensor is 120 degree. A position sensor error may occur when the SVI position sensor is out of the active range. Check the SVI linkage and position sensor orientation to make sure the installation is appropriate (see MASONEILAN SVI Instruction Manual).

Alternatively send the Clear Status and Read Status commands to check if the problem is corrected.

Exiting Failsafe Mode

Once the problem is found and solved, the SVI can be restarted by resetting the power to the SVI or clicking the Manual button in the FAIL SAFE MODE window then clicking the reset button to reset the SVI device.

If the problem is caused by inappropriate configuration parameters, click the Manual button in the FAIL SAFE MODE window, then immediately clicking the Configure button in the Manual Mode window to enter the configuration mode to change configuration parameters.

Chapter 13: SVI Message Responses

ValVue communicates with field device SVI through HART commands or message. These HART commands are available to access in the Normal Operating Mode window, Manual Mode window and FAIL SAFE MODE window. In each of these windows, ValVue provides a drop-down list of HART commands that you can select and send to the SVI, as illustrated in the Figure below. The HART commands are used as follows:

1. Select a command from the drop-down list.
2. Click the Send Message button to send the selected HART command to the SVI device.
3. SVI response to the selected HART command is displayed in the Response Box.

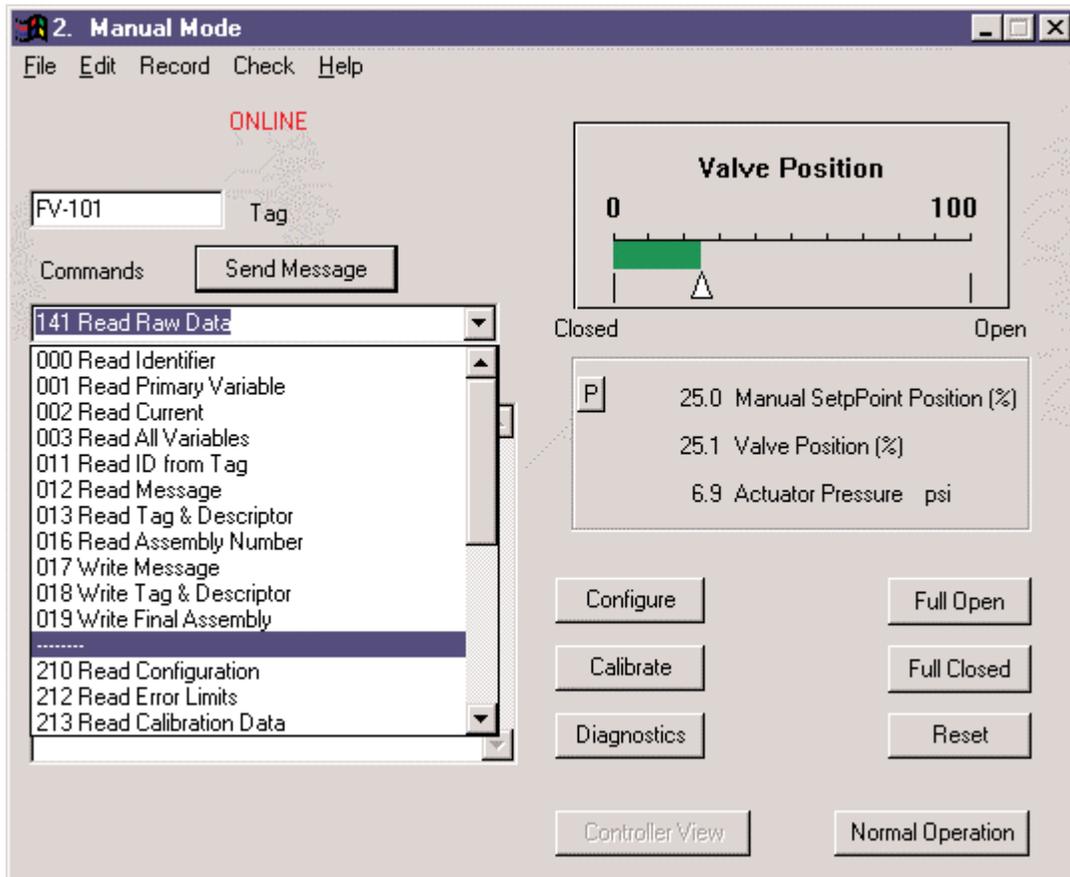


Figure 51. Manual Mode Window

To select a HART command, click the arrow in pull-down box under the Send Message button and highlight the command to send. The command enters the command box. Then click the Send Message button. The Response Box displays the response from the SVI device. Figure 52 below displays the result of sending HART command #141 Read Raw Data to a SVI.

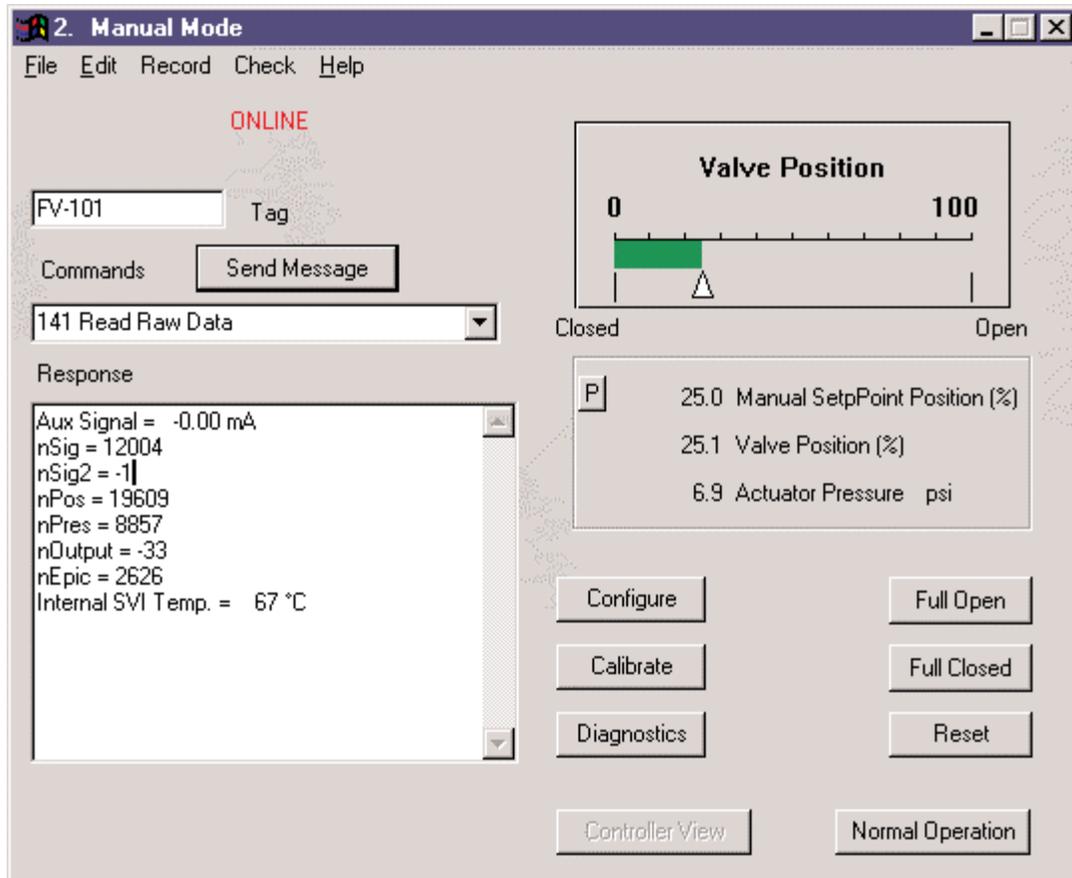


Figure 52. Result of HART Command #141 Red Raw Data to SVI Window

The HART commands are defined in three groups:

- Universal Commands: Provide functions that are implemented in all field devices.
- Common-Practice Commands: Provide functions common to many field devices, but not all.
- Device-Specific Commands: Provide functions that are unique to a particular field device.

Following list commands available for a user to select and send to SVI by clicking the Send Message button:

- **000 Read Identifier:** Returns the unique identifier from the device including manufacturers ID (101-Masoneilan), device ID, device type (200-SVI), hardware and software revisions.
- **001 Read Primary Variable:** Returns primary variable (valve position) in percent open.
- **002 Read Current:** Returns the input signal in mA and in percent of range.

- **003 Read All Variables:** Returns the input signal in mA, Variable 1 (position) in percent open, Variable 2 (pressure), Variable 3 (process variable), and Variable 4 (setpoint of process variable). Process variable and its setpoint are invalid if process controller option is not enabled.
- **011 Read ID from Tag:** Prompts the user for a tag of device. The tag is sent in a HART command and if received by a device with a matching tag, the ID of the device is returned. The format of the ID is the same as command 001 Read Identifier.
- **012 Read Message:** Reads message that was stored in the device when it was configured.
- **013 Read Tag & Descriptor:** Reads tag, descriptor and date that were stored in the device when it was configured.
- **016 Read Assembly Number:** Reads final assembly number that was stored in the device when it was configured.
- **017 Write Message:** Selecting this command brings up a dialog, which lets a user enter a message. This message is written to the SVI.
- **018 Write Tag and Descriptor:** Selecting this command brings up a dialog, which lets a user enter a tag and descriptor, message, and date. The data is written to SVI.
- **019 Write Final Assembly:** Selecting this command brings up a dialog, which lets a user enter a final assembly number. This number is written to SVI.

Masoneilan Extended Commands include:

- **210 Read Configuration:** Reads the configuration data from the device and displays it in the response box. The data include Air-To-Open or Air-To-Close, Single or Double Acting, Fail to Low or High, Loop (Process) Controller ON or OFF, Characterization, Tight Shutoff, Button Lock Level, Units and Language.
- **212 Read Error Limits:** Reads and displays the position band and time-outs associated with position and pressure errors, as well as near closed limit.
- **213 Read Calibration Data:** Reads and displays the input ranges that correspond to the open and closed positions of the valve, as well as pressure range.
- **216 Read PID:** Reads and displays the positioner tuning parameters include P, I, D, Padj, beta, Damping, Position Dead Zone, and Position Compensation.

- **136 Read Status:** Reads and displays the status flags. These flags describe error conditions that have occurred since the last time they were cleared. The following is the list of possible codes.

POSITION_ERROR: The position error occurs when the valve position differs from the requested position by more than the Position Error Band for more than the position error Time 1.

POSITION_SENSOR_ERROR: The position sensor is oriented out of its valid range, or has failed or its connection is open.

PRESSURE_SENSOR_ERROR: The pressure sensor has failed.

CURRENT_SENSOR_ERROR: The input signal measurement sensor has failed.

REFERENCE_VOLTAGE_ERROR: The primary reference voltage inside the SVI is incorrect and all other measurements will likely be affected.

BIAS_OUT_OF_RANGE: The signal to the I/P, which causes no valve movement (called the bias), has changed and is outside of the normal operating range.

SELF_CHECK_FAILURE: On startup, the SVI did not pass a self-check.

SOFTWARE_ERROR: An inconsistency has been detected within the SVI.

RESET_OCCURRED: A reset has occurred either because of a power interruption or because of an external request for reset.

DATA_OVERRUN: The SVI is not processing acquired data.

INTERNAL_TEMP_ERROR: Internal temperature of the SVI is above or below the rated temperature.

EEPROM_WRITE_FAILED: A write to the SVI's internal memory failed.

FIND_STOPS_FAILED: The calibration procedure for position failed to find reasonable values.

- **138 Clear Status:** Clears the status flags.
- **137 Read Limit Switches:** Reads and displays the status of two limit switches if they are configured and connected. The limit switches may be ON (closed) or OFF (open).
- **139 Read Continuous Diagnostic Data:** Reads and displays the continuous diagnostic data including total accumulated travel the valve has made, the number of cycles (direction changes), the time the valve has been open, the time the valve has been closed, and the time the valve has spent throttling near the seat (defined by the Near Closed parameter in the Configuration/Options window).
- **191 Read Signature Results:** Displays the results of the last run of standard valve signature test. The results include friction, lower and upper spring ranges, supply pressure, stroking

time open and close. (The last run data remains in the positioner until a power off and then it is lost. Therefore this data will not be meaningful if the diagnostics have not been run since the last power off). Valve Signatures saved in SVI's non-volatile memory can be viewed from the Normal Operate Model or from the Manual Mode/Diagnostics/Show Valve Signature window.

- **221 Read Configuration 2:** Displays configuration of the process controller including process variable and setpoint units, controller period, and initial setpoint.
- **214 Read Loop Calibration:** Display the ranges of process variable and setpoint.
- **217 Read Loop PID:** Displays the values of the process controller PID parameters including P, Ti, Td, Kd, and beta.
- **218 Read Loop Parameters 1:** Displays the values of the parameters used by the process controller including lower and upper setpoint limits, lower and upper alarm limits, output rate limit, dead zone, setpoint tracking on or off and derivative source PV or error.
- **219 Read Loop Parameters 2:** Displays the values of parameters (ratio control gain and bias) used by the process controller for ratio control.
- **220 Read Loop Mode:** Read the process controller mode for the setpoint and process variable: either remote (measured from the primary and auxiliary input channels respectively) or local (set manually by HART command or pushbuttons and remains constant until changed by another HART command or pushbuttons).
- **141 Read Raw Data:** Returns information from the SVI that is useful to Masoneilan technicians for diagnostic purposes. The information includes the input current on the auxiliary input channel, the A/D values from the pressure, signal, and position measurements, the D/A value of the signal to the I/P, and the internal SVI temperature.

Chapter 14: SVI Reports

Custom reports can be created for the currently connected SVI device using ValVue. These reports can be generated from the following SVI operating modes: Normal Operating Mode, Manual Mode and Controller Monitor window. The report can contain information about the device including configuration, calibration and diagnostic data as well as current operating data. The content and format of a report created are determined by a format file of type either text (.txt) or rich text format (.rtf), which can be edited by a window's program such as NotePad, WordPad, or Microsoft Word.

Report Format Files

To create a report, a user must select a report format file, which is either a text (.txt) or rich text (.rtf) file. A standard report format file (report.rtf) comes installed with ValVue and is listed below together with a generated report by ValVue based on the report format file report.rtf in **Supplied Report Format File and A Generated Report** section.

The user can create different format files to generate different reports. To create a custom SVI report, a user needs to create a text or rich text format file that is laid out in the format of the desired report. ValVue will substitute the value of its parameter into the text file wherever it finds a parameter name that matches an SVI parameter. For example: for Tag=\$\$Tag in the format file, ValVue will substitute the actual tag name retrieved from the SVI in place of the \$\$Tag and produce the tag number in the report file.

Any text can be used in a .txt file and printed with NotePad. With WordPad or Microsoft Word, the user can use a .rtf format file which can contain special formatting (fonts, sizes, tabs, etc.) and can contain bitmaps. Some .rtf formatting is accepted in Word which is not available in WordPad - the user should check the documentation of these programs to determine what options are available (e.g. right alignment tabs is allowed in Word but not in WordPad).

The allowed SVI Parameters are listed in the report file (report.rtf) shipped with the application.

Creating Reports

To create a report, the first step is to create a report format file. You can use the standard file report.rtf directly or a customized format file using programs such as WordPad, NotePad, or Microsoft Word.

The second step is to let ValVue know which report format file to use and which program (WordPad, NotePad, or Microsoft Word) to run to generate report file. Select Report Preference from File menu in the Normal Operating window or Manual Mode windows. The Report Format File Selection window appears (Figure 53). To change a report format file, click the Browse buttons next to report format file edit box to pop up a window for selecting an appropriate format file. To change the program, click the Browse buttons next to the program edit box to pop up a window to select a proper program to use. NotePad and WordPad are often installed in the directory c:\Program Files\Accessories\ or in c:\windows\. The actual location of these files or Microsoft Word program will vary from computer to computer. Click OK in the Report Format File Selection window to accept these choices and exit the window.

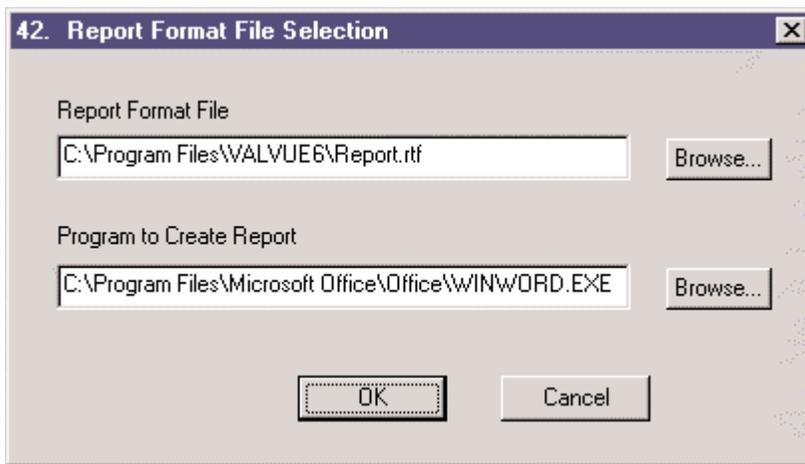


Figure 53. Report Format File Selection Window

The final step to create the report is to retrieve data from the connected SVI and create the report that has the format of the selected report format file and data from the SVI. To complete this step, select Print Report from File menu. It may take up to about 30 seconds to retrieve data from the SVI device and start the program selected to display the created report file. The generated report file can then be edited, saved and printed out if necessary. A report created based on the standard report format file (report.rtf) is shown on the next page.

Supplied Report Format File and A Generated Report

The following is supplied report format file report.rtf.

MASONEILAN SVI



Company _____
Tag Name __ \$\$Tag _____
Descriptor __ \$\$Descriptor[2] _____
Message __ \$\$Message _____
Device ID __ \$\$DeviceID _____

General Information

Tag,	\$\$Tag,
Descriptor,	\$\$Descriptor,
Date,	\$\$Date,
Message,	\$\$Message,
AssemblyNum,	\$\$AssemblyNumber,
MfgID,	\$\$MfgID,
DeviceType,	\$\$DeviceType,
DeviceID,	\$\$DeviceID,
HWRev,	\$\$HWRev,
SWRev,	\$\$SWRev,
PollingAddress,	\$\$PollingAddress,

Dynamic Information

Position,	\$\$Position,
Pressure,	\$\$Pressure,
Signal,	\$\$Signal,
Setpoint,	\$\$Setpoint,
ProcessVar,	\$\$ProcessVar,
Temperature,	\$\$Temperature,
Bias,	\$\$Bias,
Output,	\$\$Output,
Mode,	\$\$Mode,
ContModeSP,	\$\$ControllerModeSP,
ContModePV,	\$\$ControllerModePV,
SignalPercent,	\$\$SignalPercent,

Configuration Information

AirAction,	\$\$AirAction,
ActuatorType,	\$\$ActuatorType,
ControllerSw,	\$\$ControllerSwitch,
DirectReverse,	\$\$DirectReverse,
ReverseType,	\$\$ReverseType,
FailDirection,	\$\$FailDirection,
PosErrorBand,	\$\$PosErrorBand,

PosErrorTime,	\$\$PosErrorTime,
PosErrorFail,	\$\$PosErrorFailtime,
Charact,	\$\$Charact,
CustomCharact,	\$\$CustomCharact,
CustomCharact0,	\$\$CustomCharact[0],
CustomCharact1,	\$\$CustomCharact[1],
CustomCharact16,	\$\$CustomCharact[16],
ButtonLock,	\$\$ButtonLock,
Bumpless,	\$\$Bumpless,
TightShutoff,	\$\$TightShutoff,
TSValue,	\$\$TSValue,
ULimitStop,	\$\$ULimitStop,
ULSValue,	\$\$ULSValue,
LLimitStop,	\$\$LLimitStop,
LLSValue,	\$\$LLSValue,
NearClosed,	\$\$NearClosed,
PresUnits,	\$\$PresUnits,
PosUnits,	\$\$PosUnits,
PVUnits,	\$\$PVUnits,
SPUnits,	\$\$SPUnits,
Language,	\$\$Language,

Calibration Information

StartupMode,	\$\$StartupMode,
InitialSetpoint,	\$\$InitialSetpoint,
ControllerRate,	\$\$ControllerRate,
RatioControl,	\$\$RatioControl,
ContrDirRev,	\$\$ContrDirRev,
LowSignal,	\$\$LowSignal,
HighSignal,	\$\$HighSignal,
HighPres,	\$\$HighPres,
LowPV,	\$\$LowPV,
HighPV,	\$\$HighPV,
LowSP,	\$\$LowSP,
HighSP,	\$\$HighSP,
P,	\$\$P,
I,	\$\$D,
Padjust,	\$\$Padjust,
Beta,	\$\$Beta,
PosComp,	\$\$PosComp,
DeadZone,	\$\$DeadZone,
Damping,	\$\$Damping,

Diagnostic Information

Travel,	\$\$Travel,
Cycles,	\$\$Cycles,
TimeOpen,	\$\$TimeOpen,
TimeClosed,	\$\$TimeClosed,
TimeNearCl,	\$\$TimeNearClosed,

Signature,	\$\$Signature,
SigSaved,	\$\$SigSaved,
SigSavedSpeed,	\$\$SigSavedSpeed,
SigFactory,	\$\$SigFactory,
SigFactorySpeed,	\$\$SigFactorySpeed,
Friction,	\$\$Friction,
LSpringRange,	\$\$LSpringRange,
USpringRange,	\$\$USpringRange,
ResponseOpen,	\$\$ResponseOpen,
ResponseCl,	\$\$ResponseClosed,
LSprRngSaved,	\$\$LSprRngSaved,
USprRngSaved,	\$\$USprRngSaved,
LSprRngFac,	\$\$LSprRngFac,
USprRngFac,	\$\$USprRngFac,

Controller Information

ContP,	\$\$ContP,
ContI,	\$\$ContI,
ContTD,	\$\$ContTD,
ContKD,	\$\$ContKD,
ContBeta,	\$\$ContBeta,
LSPLimit,	\$\$LSPLimit,
USPLimit,	\$\$USPLimit,
LowAlarm,	\$\$LowAlarm,
HighAlarm,	\$\$HighAlarm,
ManResetBias,	\$\$ManResetBias,
OutRateLim,	\$\$OutRateLim,
ContDZ,	\$\$ContDZ,
DevSource,	\$\$DevSource,
AlarmType,	\$\$AlarmType,
SPTracking,	\$\$SPTracking,
FreezeOnBad	\$\$FreezeOnBad

The following is an example of a SVI report created by ValVue and Microsoft Word based on the supplied report format file (report.rtf).

MASONEILAN SVI



Company _____
 Tag Name __FV-101 _____
 Descriptor __FLOW CONTROL _____
 Message __COOLING WATER FLOW _____
 Device ID __ 0 _____

General Information

Tag, FV-101 ,
 Descriptor, FLOW CONTROL ,
 Date, 11 JAN 1999,
 Message, COOLING WATER FLOW ,
 AssemblyNum, 20,
 MfgID, Dresser ,
 DeviceType, 200,
 DeviceID, 0,
 HWRev, 7,
 SWRev, 1,
 PollingAddress, 0,

Dynamic Information

Position, 53.2,
 Pressure, 12.25,
 Signal, 12.51,
 Setpoint, 1.#R,
 ProcessVar, 1.#R,
 Temperature, 68,
 Bias, 3108,
 Output, -0,
 Mode, NORMAL,
 ContModeSP, Local,
 ContModePV, Remote,
 SignalPercent, 53.2,

Configuration Information

AirAction, ATO,
 ActuatorType, Single Acting,
 ControllerSw, OFF,
 DirectReverse, Direct,
 ReverseType, ,
 FailDirection, Low,
 PosErrorBand, 10.0,
 PosErrorTime, 10,

PosErrorFail,	,
Charact,	Linear,
CustomCharact,	
9.8 19.5 29.7 39.8 49.6 59.8 69.5 79.7 89.5	Input
9.8 19.9 29.7 39.8 49.6 59.8 69.5 79.7 89.5	Output
CustomCharact0,	9.8,
CustomCharact1,	9.8,
CustomCharact16,	89.5,
ButtonLock,	Level 0,
Bumpless,	OFF,
TightShutoff,	ON,
TSValue,	2.0,
ULimitStop,	OFF,
ULSValue,	100.0,
LLimitStop,	OFF,
LLSValue,	0.0,
NearClosed,	5.0,
PresUnits,	psi,
PosUnits,	%,
PVUnits,	gal/min,
SPUnits,	gal/min,
Language,	English,

Calibration Information

StartupMode,	Startup Local,
InitialSetpoint,	50.00,
ControllerRate,	1.00,
RatioControl,	OFF,
ContrDirRev,	Direct,
LowSignal,	4.0,
HighSignal,	20.0,
HighPres,	30.00,
LowPV,	0.00,
HighPV,	200.00,
LowSP,	0.00,
HighSP,	200.00,
P,	172,
I,	48,
Padjust,	-19,
Beta,	3,
PosComp,	5,
DeadZone,	0.00,
Damping,	0,

Diagnostic Information

Travel,	38,
Cycles,	28,
TimeOpen,	55,
TimeClosed,	254,

TimeNearCl, 0,
Signature,
10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 Position
5.0 6.7 8.4 10.1 11.9 13.7 15.4 17.3 19.1 Act. Pres (Up)
4.0 5.6 7.2 9.2 10.9 12.6 14.4 16.2 18.0 Act. Pres (Down)
,
SigSaved,
10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 Position
5.1 6.8 8.5 10.4 12.1 14.0 15.6 17.6 19.4 Act. Pres (Up)
4.2 5.8 7.6 9.4 11.2 12.9 14.7 16.4 18.1 Act. Pres (Down)
,
SigSavedSpeed, 3,
SigFactory,
10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 Position
4.9 6.6 8.4 10.2 12.0 13.7 15.5 17.3 19.2 Act. Pres (Up)
4.0 5.8 7.4 9.3 10.9 12.6 14.6 16.1 18.2 Act. Pres (Down)
,
SigFactorySpeed, 2,
Friction, 0.61,
LSpringRange, 2.74,
USpringRange, 20.44,
ResponseOpen, 1.50,
ResponseCl, 2.00,
LSprRngSaved, 2.92,
USprRngSaved, 20.61,
LSprRngFac, 2.72,
USprRngFac, 20.55,

Controller Parameters

ContP, 20,
ContI, 3,
ContTD, 0,
ContKD, 8,
ContBeta, 7,
LSPLimit, 10.00,
USPLimit, 190.00,
LowAlarm, 50.00,
HighAlarm, 150.00,
ManResetBias, 50,
OutRateLim, 61,
ContDZ, 0.50,
DevSource, PV ,
AlarmType, Absolute,
SPTracking, ON,
FreezeOnBad ON

Chapter 15: Controller Configuration

Chapter 9 of Configuration Mode describes the configuration of SVI as a positioner only. If the SVI Controller version is purchased and is enabled, the process controller is partly configured in configuration mode and partly in the Controller Parameters window, which is accessible from the Controller Monitor window (see Chapter 17 of Controller View). This chapter concentrates on the controller configuration in configuration mode.

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 ValVue, HART Communicator or the local pushbuttons. (Local pushbuttons support limited controller functions).

To setup a process controller, follow the following steps:

1. Turn the controller on in Setup page and complete basic controller configuration in Controller page in SVI Configuration window. Click OK to exit to the Manual Mode window.
2. Calibrate the controller in SVI Calibration mode and click OK to exit to the Manual Mode window (see Chapter 16).
3. Click the Controller View button to enter into the Controller Monitor window. Click the Set Param. button to enter into the Controller Parameters window to finish controller configuration and set initial PID parameters (see Chapter 17).
4. Tune the process control loop to refine PID parameters. The process trend graph can be used in the tuning process.

SVI must be switched to manual mode first in order to access configuration mode. Clicking the Configure button in the Manual Mode window will retrieve current configuration data from the SVI and present them in the SVI Configuration window.

Turning Process Controller On

To enable the built-in process controller, go to the Setup page of the SVI Configuration window. The Setup page appears when clicking the Setup Tab in the SVI Configuration window. A typical Setup page is shown below. This page allows the user to choose and set configuration parameters such as air to open or close valve, single or double acting actuator, process controller on or off, direct or reverse, position and pressure fault limits. These selection and values are described in Chapter 9 of Configuration Mode.

If the SVI is purchased with the process controller option, the selection of process controller ON is valid in the Setup page. To enable the controller, click on the process controller ON button. When Process Controller On is selected, windows and buttons associated with the process controller are enabled to allow configuration, calibration and operation of the built-in PID process controller. The Controller Tab in the SVI Configuration window is enabled for basic process controller configuration. After the configuration in the Controller page is completed, click OK to accept the changes and return back to the Manual Mode window.

Controller Configuration in Controller Page

The Controller page is displayed by clicking the Controller Tab in the SVI Configuration window. A typical Controller page is shown below (figure 54). This page allows the user to choose and set startup mode, initial setpoint, controller period, PV and SP units, and controller action. More controller parameters are configured through the Controller Parameters window, which can be accessed through the Set Param. button in the Controller Monitor window.

The screenshot shows the '7. SVI Configuration' window with the 'Controller' tab selected. The 'Startup Mode' section has four radio buttons: 'Startup Local' (selected), 'Startup Remote', 'Startup Last Mode', and 'Local Only'. The 'Initial SetPoint' is set to 50.00 (PV units), and the 'Controller Period' is set to 0.2 (sec). The 'Ratio control' checkbox is unchecked. The 'PV Units Code' and 'Remote SP Units Code' are both set to 'gal/min'. The 'Action' section has two radio buttons: 'Direct Acting' (selected) and 'Reverse Acting'. The 'OK' and 'Cancel' buttons are located at the bottom right of the window.

Figure 54. Controller Parameters Window

When power is applied to SVI (after being off longer than 3 seconds) the SVI will perform a "cold start" where its memory is restored from parameters stored in non-volatile memory. This option determines the initial controller mode after start up.

- **Startup Local:** This option sets the controller in local mode after SVI startup.
- **Startup Remote:** This places the controller in remote mode after SVI startup.
- **Startup Last Mode:** This sets the controller in the mode that was in before power was lost.
- **Local Only:** This option allows the controller function only in local mode anytime. When controller is configured in this mode, you can not switch the controller to remote mode. In this configuration, the +/- input terminals on SVI serve as the power source for the SVI device.

- **Initial Setpoint:** This parameter determines the initial local setpoint value if the startup mode is local, and the local setpoint when controller is switched from remote to local when the startup mode is remote and setpoint tracking is not selected. An appropriate value based on the specific application should be entered.
- **Controller Period:** The controller can process the setpoint and process variable data every 0.15 seconds (6.7 times per second) to 10 seconds. (Note: at 0.15 seconds the local LCD display and button response might be degraded.) For fast processes, a period of 0.2 seconds would be a reasonable value, and for slow processes 1 or 2 seconds would be common.
- **Ratio Control:** This option turns ratio control on or off. For ratio control, the remote process variable setpoint is in ratio to another independent variable (measured setpoint or input signal). The relationship between the remote setpoint for process variable and the measured setpoint is given by:

$$\text{Remote Setpoint} = \text{Ratio Gain} \times \text{Measured Setpoint} + \text{Ratio Bias}$$
 The Ratio Gain and Ratio Bias are set in the Controller Parameters window.
- **PV Units Code:** The user may select the units for the process variable and setpoint. HART defines unit codes for many commonly used units. ValVue is programmed to recognize many of these and the user can select them from the list box. If the unit used is not in the list box, the user can type the HART unit code in the list box (in which case ValVue will only report the code, not the text version of the units).
- **Remote SP Units Code:** For non-ratio controller, this unit must be the same as PV Units Code. For ratio controller, this unit may or may not be the same as PV Units Code selected.
- **Direct Acting:** Set the controller in direct acting (its output increases when the process variable is greater than the setpoint).
- **Reverse Acting:** Set the controller in reverse acting (its output decreases when the process variable is greater than the setpoint).

After making your choices from a page, click:

- **OK** button to accept the change, download to SVI, and exit to manual mode
- **Cancel** button to discard the change and exit to manual mode
- **Tag, Options, Setup, or Controller** tab to continue examine and modify configuration.

Chapter 16: Controller Calibration

Chapter 10 of Calibration Mode describes the calibration for SVI as a positioner only. If the built-in process controller option is purchased and enabled, the process controller is also calibrated in calibration mode. This chapter deals with controller related calibration in calibration mode.

 CAUTION	Since some calibrate functions stroke the valve over its full range, the valve should be isolated from the process before moving to the Calibrate Mode.
--	--

To setup a process controller, follow the following steps:

1. Turn the controller on in the Setup page and complete basic controller configuration in the Controller page in the SVI Configuration window. Click OK to exit to the Manual Mode window. See Chapter 15 for detail.
2. Calibrate the controller in SVI Calibration mode and click OK to exit to the Manual Mode window.
3. Click the Controller View button to enter into the Controller Monitor window. Click the Set Param. button to enter the Controller Parameters window to finish controller configuration and set initial PID parameters (see Chapter 17).
4. Tune the process control loop to refine PID parameters. Process trend graph can be used in the tuning process.

The controller must first be configured in configuration mode (see Chapter 15) before calibrating the controller. Clicking the Calibrate button in the Manual Mode window retrieves current calibration data from the SVI and display them in the SVI Calibration window. Figure 55, shown on page 89, is a typical Range page of the SVI Calibration window when the process controller is enabled.

Four (4) remote setpoint and process variable range boxes are valid only for a SVI with the built-in PID process controller enabled.

Range Page

The Range page is the page displayed when entering the calibration mode. The Range page allows the user to enter the low and high range values for the primary and secondary input signals as well as corresponding remote setpoint and process variable.

- **Low Signal (mA):** This is the common value (in mA) of both the primary and secondary analog inputs that correspond to Low Remote Setpoint and Low Process Variable in engineering units. A typical value is 4.00 mA.
- **High Signal (mA):** This is the common value (in mA) for both the primary and secondary analog inputs that correspond to High Remote Setpoint and High Process Variable in engineering units. A typical value is 20.00 mA.
- **Low Remote Setpoint:** This is a value in engineering unit that corresponds to the Low Signal of the primary analog input in mA. SVI uses Low Remote Setpoint values to convert the primary input signal in mA to Remote Setpoint in engineering units. This edit box is enabled only for a SVI with the built-in PID process controller.
- **High Remote Setpoint:** This is a value in engineering unit that corresponds to the High Signal of the primary analog in mA. SVI uses High Remote Setpoint values to convert the primary input signal in mA to Remote Setpoint in engineering units. This edit box is enabled only for a SVI with the built-in PID process controller.
- **Low Process Variable:** This is a value in engineering unit that corresponds to the Low Signal of secondary analog input in mA. SVI uses Low Process Variable values to convert the secondary input signal in mA to Process Variable in engineering units. This edit box is enabled only for a SVI with the built-in PID process controller.
- **High Process Variable:** This is a value in engineering unit that corresponds to the High Signal of secondary analog input in mA. SVI uses High Process Variable values to convert the secondary input signal in mA to Process Variable in engineering units. This edit box is enabled only for a SVI with the built-in PID process controller.

CLOSED	At Low Signal	OPEN	At High Signal
4.00	Low Signal (mA)	20.00	High Signal (mA)
		30.00	Supply Pressure psi
0.00	Low Remote Set Point gal/min	200.00	High Remote Set Point gal/min
0.00	Low Process Variable gal/min	200.00	High Process Variable gal/min

Auto Stop Limits Manual Stop Limits

Open Stop Adjustment

OK Cancel

Figure 55. SVI Calibration Range Window

Signal Calibration Page

When the built-in process controller is enabled, input from a separate process signal is measured and controlled by the built-in PID process controller. The calibration procedure for secondary analog signal is similar to that for primary analog signal.

The Signal Calibration page (figure 56) appears when clicking the Signal Cal. tab in the SVI Calibration window. A typical Signal Calibration page is shown below. This page allows the user to recalibrate the primary and secondary signals and output pressure sensors in the SVI. These sensors are calibrated at the factory and do not usually require re-calibration, but if needed, this page provides a convenient method to perform signal calibration. The Reset to Factory button returns the original sensor calibrations to the value set when the SVI was manufactured.

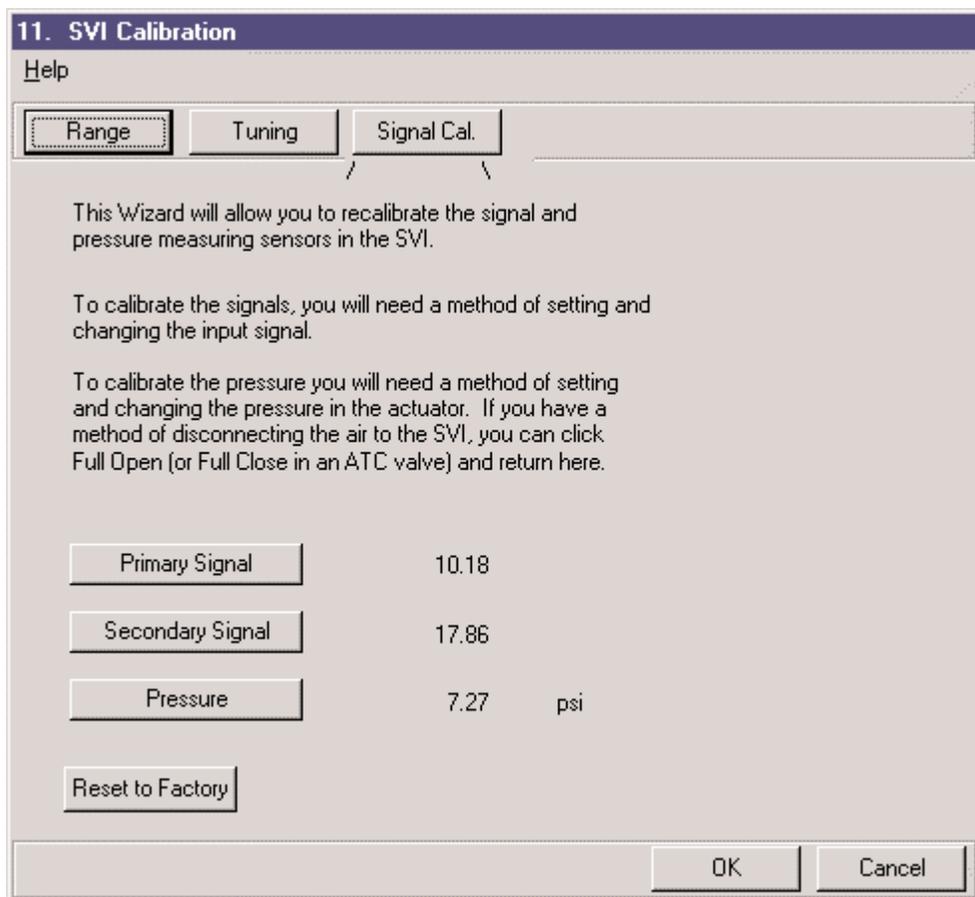


Figure 56. SVI Calibration Signal Calibration Window

The currently measured values of the primary input signal, secondary input signal (if the process controller is enabled), and output pressure are displayed and can be compared to reference signals to see if re-calibration is necessary.

Clicking the Secondary Signal button starts the calibration procedure for the secondary input signal sensor. The procedure will ask the user to:

1. Enter a low value for the measurement (e.g. 4.00 mA).
2. Set the input to that value.
3. Enter a high value for the measurement (e.g. 20.00 mA).
4. Set the input to that value.

Calibrating the secondary signal can be done most easily with a variable current source with a 250 ohm resistor (actually used!). Changing the value of the resistor calls for re-calibration of the secondary signal, since the secondary signal sensor actually measures voltage rather than current.

Clicking a tab brings up the corresponding page to examine and modify calibration parameters and initiate calibration procedures. After complete calibration from a page, click:

- **OK** button to accept changes entered, download to SVI, and exit to manual mode.
- **Cancel** button to discard changes entered and exit to manual mode.
- **Range, Tuning, or Signal Cal.** tab to continue examine and modify calibration.

Chapter 17: Controller View

SVI has a built-in PID process controller, which can be enabled in configuration mode if the controller option is purchased. The process controller is integrated with the SVI smart positioner to give a fast response to process changes and disturbances, gain a tight control of process variable, and facilitate a high level of loop monitoring functions.

ValVue provides interfaces for this controller to allow a user to monitor, manipulate, and tune the controller. The interfaces for the controller include Controller Monitor window, Controller Parameters window and Process Trend window.

To setup a process controller, follow the following steps:

1. Turn the controller on in the Setup page and complete basic controller configuration in the Controller page in the SVI Configuration window. Click OK to exit to the Manual Mode window (see Chapter 15 for details).
2. Calibrate the controller in the SVI Calibration window and click OK to exit to the Manual Mode window (see Chapter 16).
3. Click the Controller View button to enter into the Controller Monitor window. Click the Set Param. button to enter into the Controller Parameters window to finish controller configuration and set initial PID parameters.
4. Tune the process control loop to refine PID parameters. The process trend graph can be used in the tuning process while adjusting PID parameters.

Controller Monitor

The Controller Monitor window (figure 57 shown on page 93) is a graphic interface for the SVI process controller. Pressing the Controller View button, which is activated when the controller is enabled, in either the Normal Operating or Manual Mode window will bring up the Controller Monitor window as illustrated below.

Display of Process Controller

On the monitor are the displays for the values of process variable, its setpoints and controller output, both numerically and graphically. The process variable value as read from the secondary analog channel is displayed as a green bar. The setpoint is displayed as a solid white triangle. The display is updated approximately every 2 seconds.

Current (mA) controller mode, remote automatic (R), local automatic (L) or manual (M), is also indicated by a red light next to the corresponding R, L, or M button on the left top of the window.

The following describes variables related to the process controller:

- **Remote Setpoint:** For a non-ratio controller, this is the same as the measured setpoint, which is read from the primary 4-20 mA input channel and scaled to engineering units. For a ratio controller, remote setpoint is calculated from measured setpoint by

$$\text{Remote Setpoint} = \text{Ratio Gain} \times \text{Measured Setpoint} + \text{Ratio Bias}$$

- **Local Setpoint:** This is set to a constant value, which is manually adjustable, and is not read from the input channel (and thus will not respond to signal changes from the DCS or other controller). In local setpoint mode, the setpoint can be changed by local pushbutton or using HART commands through ValVue.
- **Output:** This is the process controller output to SVI positioner. The output is characterized first then is reversed if configured as an air-to-close valve to become the valve position setpoint. For a linear and air-to-open valve, the controller output is equal to position setpoint.
- **Remote Automatic Mode:** In this mode, controller output is calculated based on the error between process variable and remote setpoint.
- **Local Automatic Mode:** In this mode, controller output is calculated based on the error between process variable and local setpoint that is adjustable manually.
- **Manual Mode:** In this mode, controller output is kept constant until manually adjusted. It is no longer calculated by the PID algorithm.

In this illustration, the controller is in local automatic mode with local setpoint at 80.00 gpm, process variable at 80.00 gpm, and output at 82.9%. Remote setpoint 97.63 gpm is also displayed in the Remote Setpoint box and to alert the user of the setpoint change when the controller is transferred back to the remote automatic mode.

Valve operation data, valve position and actuator pressure are also displayed on this window.

If the process controller is configured for ratio control application, both the measured setpoint and the remote setpoint calculated are displayed in their corresponding engineering units.

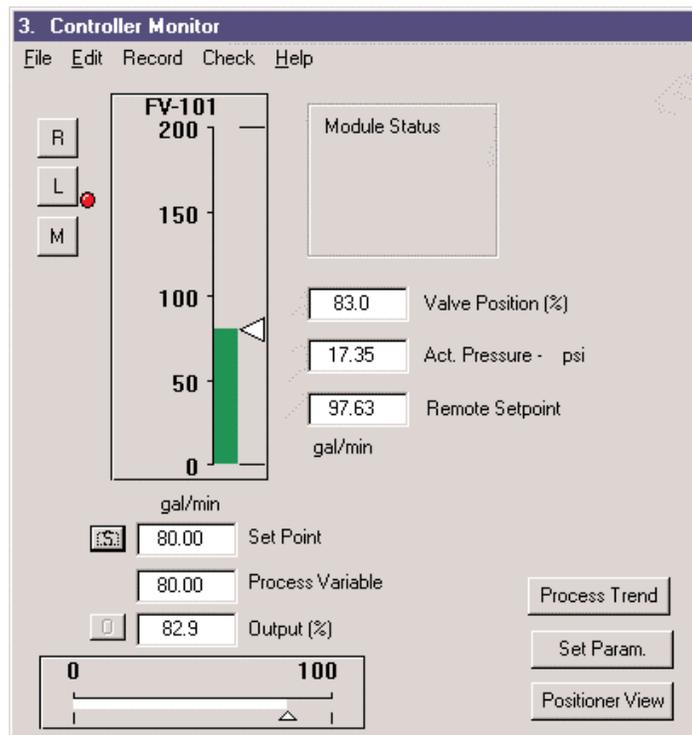


Figure 57. Controller Monitor Window

Alarm Status

There is a Module Status box in the top right of Controller Monitor window. This box displays the status of the process variable alarms. The alarms may be absolute or deviation alarms and are configured in Controller Parameters window:

- Absolute alarms: If the process variable is below the low alarm limit or above the high alarm limit, the alarm light is turned on.
- Deviation alarms: If the difference between the setpoint and the process variable is below the low alarm limit or above high alarm limit, the alarm light is turned on.

Changes of Setpoint and Output of Process Controller

In manual mode, controller output is set to its previous value at transfer. The O button is enabled in manual mode. The output value can be changed by one of the following methods:

- Click the O button beside the Output box, type an output value in the popup Input Data window and click OK. The output is set and the valve should move toward the new position setpoint, which corresponds to new controller output.
- Drag the triangle in the horizontal (output) bar graph to a desired output. The output to be set is indicated in the output box. Release the mouse to set the new output.
- Click on each side of the triangle in the output bar graph moves the output by 5%.

If the S button beside the Set Point box is enabled, the previous controller mode is in local automatic. Otherwise, the previous mode is remote automatic. The local setpoint value can be changed if the S button is enabled and the setpoint tracking is not selected. Click the S button, type a setpoint value in the popup Input Data window and click OK. The setpoint is set and is used at the moment of transfer from manual to local automatic mode.

In local automatic mode, controller output is calculated by the PID algorithm. Therefore, the output can not be changed manually. The O button is disabled in local automatic mode. Local setpoint is used for the calculation of controller output. The local setpoint can be changed by one of the following methods:

- Click the S button beside the Setpoint box, type a setpoint value in the popup Input Data window and click OK. The setpoint is set and indicated numerically in the setpoint box and graphically in the vertical bar graph.
- Drag the triangle in the vertical bar graph to a desired setpoint. The setpoint to be set is indicated in the output box. Release the mouse to set the new output.
- Clicking on each side of the triangle in the vertical bar graph moves the setpoint by 5%.

In remote automatic mode, the setpoint is from the primary channel (+ and - terminals) and output is calculated by the PID algorithm. Both the setpoint and output of the controller can not be manually set in this mode.

Controller Fault Messages

Controller fault messages and fail save are the same as for the positioner version. Refer to Chapters 12 and 13 for details.

Mode Transfer of Process Controller

The interface of the Controller Monitor window (figure 58) provides three buttons for mode transfer of process controller. These buttons are labeled as R for remote automatic, L for local automatic, and M for manual.

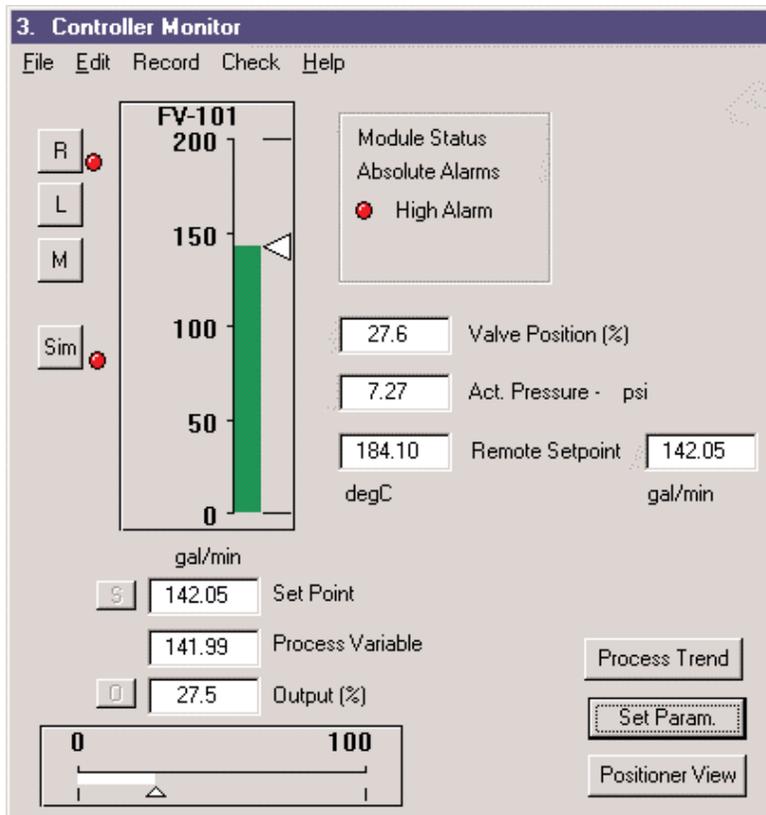


Figure 58. Controller Monitor Mode Transfer Window

- **Remote to Local Automatic Control:** Click the L button to make this transfer. The red mode light moves to the L button. The controller output remains unchanged at the moment of the transfer, so the transfer is bumpless. If the option of setpoint tracking is selected, the value of local setpoint is set to the value of remote setpoint at the moment of the transfer. Otherwise, the value of local setpoint is set to the last local setpoint or initial setpoint if this is the first time in local automatic mode upon power being applied to the SVI controller.
- **Remote Automatic to Manual Control:** Click the M button to make this transfer. The red mode light moves to M button. The controller output remains unchanged at the moment of the transfer.
- **Local to Remote Automatic Control:** Click the R button to make this transfer. The red mode light moves to the R button. The controller output remains unchanged at the moment of the transfer, so the transfer is bumpless. The new setpoint is the real time remote setpoint from the primary signal. Before the transfer, compare the values of remote and manual setpoints displayed in the window so the impact of the transfer can be estimated before the transfer.

- **Local Automatic to Manual Control:** Click the M button to make this transfer. The red mode light moves to the M button. The controller output remains unchanged at the moment of the transfer.
- **Manual to Remote Automatic Control:** Click the R button to make this transfer. The red mode light moves to the R button. The controller output remains unchanged at the moment of the transfer, so the transfer is bumpless. The new setpoint is real time remote setpoint from the primary signal. Controller output is calculated based on the measured setpoint and process variable. Before the transfer, compare the values of remote and process variable displayed in the window so the impact of the transfer can be estimated before the transfer.
- **Manual to Local Automatic Control:** Click the L button to make this transfer. The red mode light moves to the L button. The controller output remains unchanged at the moment of the transfer. If the option of setpoint tracking is selected, the value of local setpoint is set to the value of process variable at the moment of the transfer. Otherwise, the value of local setpoint is set to the last local setpoint or initial setpoint if this is the first time in local automatic mode since power has been applied to the SVI.

Process Trends

Clicking the Process Trend button in Controller Monitor window displays the Trend Data window (figure 59), which records position and process variable and their setpoints for the last 90 seconds. The time range is fixed at 90 seconds and the default range for Y-axis is 0 to 100%. However, you can adjust the Y-axis range precisely by entering Y-axis limits into the boxes at the left-top window and pressing Tab (or click in another box in the window). You can also dragging the mouse over part of the graph to zoom in to see the details. To reset to the default range, simply click the right mouse button.

Process trend can be used to monitor the performance of both controller and positioner. The trend can be used to test, tune and monitor the process loop. The trend data window is a modeless dialog, so you can leave the window open. You can change controller parameters, make a step change and watch the process trend to judge the performance of the loop.

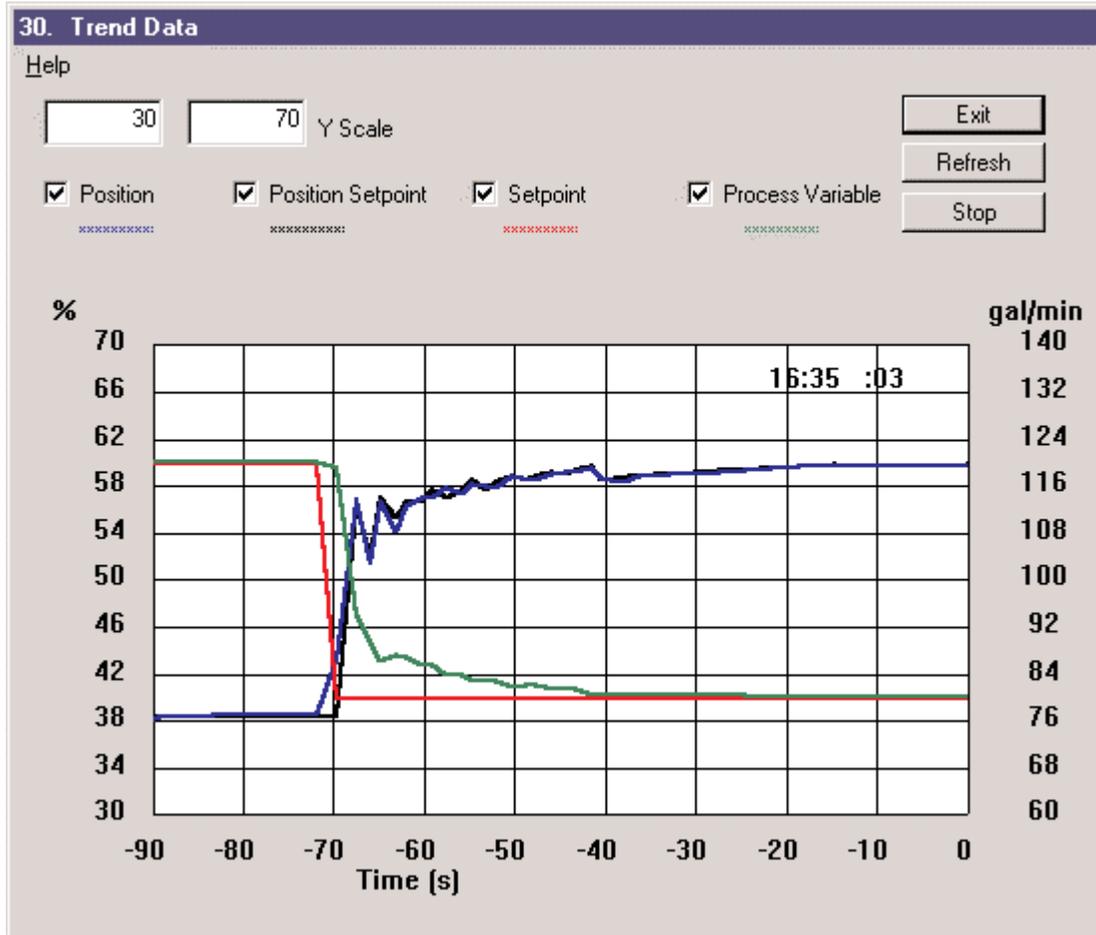


Figure 59. Trend Data Window

Controller Parameters

Some parameters of the process controller can be displayed and modified in any controller mode. To access these parameters, click the Set Param. button in the Controller Monitor window. The controller parameters will be retrieved from SVI device and presented in the following Controller Parameters window (figure 60).

Figure 60. Controller Parameters Window

The maximum range of the controller parameters is as listed below. Typical values for each of the parameters is shown in the parameter descriptions.

Parameter	Range
Proportional Gain	0 to 1000%
Integral Time	0 to 1000 seconds
Derivative Time	0 to 32 seconds
Derivative Gain	2 to 100
Beta	- 9 to + 9
Hi / Lo Setpoint Limits	25% above hi PV or below low PV
Manual Reset Bias	0 to 90%
Output Rate Limit	0 to 61% per sampling period
Dead Zone	0 to 20%

Controller Parameter Descriptions

- **Proportional Gain (%):** Proportional gain P is the ratio of proportional action (part of controller output) to error. The error is the difference between the setpoint and process variable. If the proportional gain is 50%, i.e., 0.5, the corresponding proportional band is 200%.
- **Integral Time (s):** Integral time or reset time, is the time constant of integral control.
- **Derivative Time (ms):** Derivative time or rate time is the time constant of derivative control.
- **Derivative Gain:** Derivative gain is a parameter for derivative control. The typical range is 8 to 16.
- **Beta (non_linear):** Beta is nonlinear gain factor, ranging from -9 to 9. When beta is 0, the controller gain is linear. Otherwise the gain is the function of error. The larger the beta, the smaller the gain for small error.
- **Setpoint Low and High Limits:** The setpoint used for the calculation is constrained to be between the low and high limits. The limits apply for both local and remote automatic modes. The limits are entered in the same engineering units as the process variable.
- **Ratio Gain and Bias:** Only applicable for ratio control. In ratio control, the setpoint and process variable may be in different engineering units or on different scales. The relationship between the remote setpoint in process variable units and the measured setpoint is given by:

$$\text{Remote Setpoint} = \text{Ratio Gain} \times \text{Measured Setpoint} + \text{Ratio Bias}.$$

The remote setpoint in process variable units is used in the PID calculation to compute the error.

- **Low and High Alarm Limits:** Define when the alarm lights on the controller view will be lit. If absolute alarms are selected and the process variable is not between the low and high alarm limit, the alarm light will be on. If deviation alarms are set and the difference between the setpoint and the process variable is not between the low and high alarm limit, the alarm light will be on. The alarm limits are entered in the same units as the process variable.
- **Manual Reset Bias (%):** Manual reset bias is constant part of controller output. It is very important value in minimizing the steady-state error for P or PD type process control. It is the controller output at a typical operating point. If the controller outputs range from 30 to 50% at normal operation, the manual reset bias should be set at 40% in order to minimize steady state error for P or PD control. For controller with I term, the value is less important and can be typically set at 50%. This value can be changed during the automatic operation of the controller to introduce a disturbance without the need to transfer the controller to manual mode.
- **Output Rate Limit (%/s):** Limits how fast the output can change. It is expressed as the percent of full output range per second and can be set between 1 and 200 % per second and 1 and 61% per controller period depending on the selected controller period.
- **Controller Dead Zone:** When the difference between the setpoint and the process variable is less than the dead zone, the controller will take no action to change the output.

- **Derivative Source:** Determines whether derivative action is applied to a change in the process variable or to a change in the error (setpoint - process variable).
- **Alarm Type:** Determines whether an alarm is of the type absolute or deviation from setpoint.
- **Setpoint Tracking:** If setpoint tracking is selected, when the controller is changed from the manual mode to local mode, the setpoint is set to equal the current process variable. Also, the setpoint is set to the value of the remote setpoint at the moment of transfer from remote automatic to local automatic. In this way, the process upset is minimized. However, the setpoint tracking may not be desirable for an application with a preset fixed local setpoint.
- **Freeze Output:** When enabled, if the process variable from the auxiliary input channel (A and B terminals) is not a valid reading, the controller output will not be changed.

Based on the specific application, the above parameters and options are determined. After the configuration of these controller parameters, click:

- **OK** button to accept changes entered, download to SVI, and exit to Control Monitor window.
- **Cancel** button to discard changes entered and exit to Control Monitor window.

Going to Other ValVue Windows

Going to Normal or Manual Mode

Clicking the Positioner View button returns to the positioner view where the valve position can be monitored. When the controller is in local or remote automatic mode, the positioner is in normal operating mode and clicking button will return the user to the Normal Operating Mode window. If the controller is in manual mode the button will return the user to the Manual Mode window.

Exit to Device List Window

Select Exit from File menu to exit to the Device List window.

Simulation

For demonstration and training purposes a process simulator is included in SVI. When turned on, the simulator provides a simulated signal for the process variable. So the process loop is closed in local and remote automatic mode. The user can manipulate the controller in different modes and make mode transfer as well.

The simulation can only be accessed if the user is logged in at a privilege level of 8. A default login of "training" and a password of "training" are provided at level 8 with the installation.

The system administrator at the user site may remove or change this login.

When login at a privilege level of 8, there is a Sim button in Controller Monitor window. Click it to turn the simulator on or off. When the simulator is running, a red light appears next to the Sim button.

The simulation mode is automatically ended whenever the power is removed from the SVI. The user must restart the simulation mode each time the SVI is powered up.

Chapter 18: Multiplexer Setup and Operation

Introduction

ValVue can support multiple SVI devices using a MTL HART multiplexer that allows a user to monitor and operate several SVI devices from a single computer.

The MTL 4840 HART maintenance system is one of the most widely used multiplexer for communicating with HART instruments. Connecting a computer serial port with a RS232/RS485 converter, the multiplexer is capable of supporting up to 31 nodes, each with the capability of supporting up to 16 sub nodes. Each sub node can control 16 loops. Therefore the multiplexer provides the potential to communicate with a maximum of 7936 HART loops, i.e., 31 (nodes) x 16 (sub nodes) x 16 (loops) using one computer interface. Additionally, the multiplexer supports the multidrop connection of HART devices on a single loop. Therefore, using the multidrop feature it is possible to expended capacity of a system beyond 7936 HART devices.

For more information regarding the MTL multiplexer, refer to the manufacturer's documents and ValVue Mux Connection Guide.

ValVue Multiplexer Options

Using the multiplexer version of ValVue and the MTL multiplexer communicating and monitoring of many SVIs and other HART devices is possible. After starting up and login on to the ValVue program, the Select Device Window is displayed and provides options to setup the multiplexer.

Options Window Setup

The first step to setup the multiplexer is clicking the Options button in the Select Device Window. The Options window (figure 61) allows the user to set options that relate to HART and multiplexer communications.

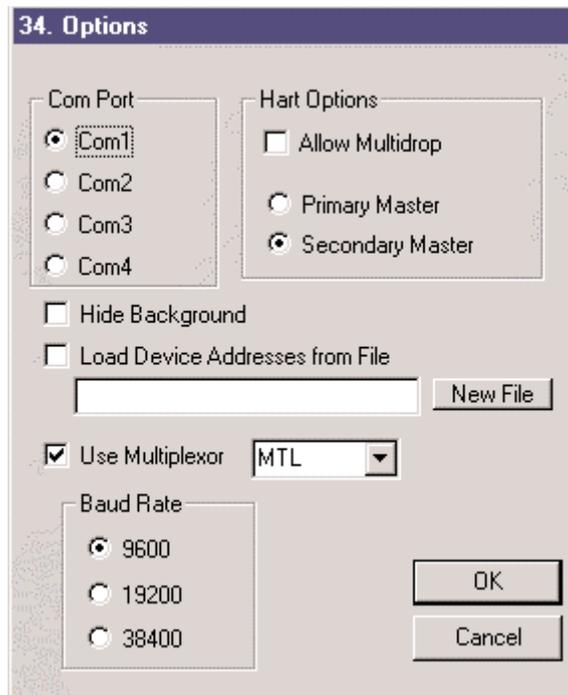


Figure 61. Options Setup Window

One option a user must select correctly is which communication serial port the computer uses for the HART communication channel. Once selected in the Options window, this selection overrides any selection on the command line that starts the program.

If the Allow Multidrop box in HART Optional is checked, ValVue supports HART devices (including SVIs) with non-zero polling addresses and supports multiple SVIs on the same loop (for split range applications). If the box is unchecked, ValVue will look for devices only at polling address 0. When in multidrop mode, even if a device is found at polling address 0, ValVue searches for devices with other polling addresses. This allows a loop with a transmitter operating 4-20 mA with polling address 0 and an SVI operating as a controller and positioner with polling address 1-15.

ValVue running on a PC can send commands to a HART device as a primary master or a secondary master. The ValVue program must be configured to match the configuration of the multiplexer. That is, if the multiplexer is a primary master, ValVue must also be configured to be a primary master.

If the option of Hide Background is selected, the ValVue background is hidden. Otherwise, the background will cover the whole screen.

The device list may be saved in a file in order to eliminate the necessity of re-scanning each time connect is selected. Unless the option of Load Device Addresses from File is selected, the file used is temporary and a re-scan is done each time the program is restarted. If selected, the user may select a file in which to save the device list. This file will be read whenever the program is started and the saved device list is displayed. This will save the time required to re-scan and is particularly useful for a multiplexer connected to many devices.

In the multiplexer version of the program, the option of Use Multiplexer allows the user to select either direct connect (through a Hart modem) or multiplexer operation. Check the Use Multiplexer box to enable the ValVue support of the MTL multiplexer.

The MTL multiplexer supports baud rates of 9600, 19200, and 38400. The user must select the baud rate at which the hardware has been configured.

After the options are selected, you can click OK to accept the changes and exit to Select Device window (figure 62). Three multiplexer-related buttons, Add Device, Mux Setup, and Mux Reset are enabled and appear near the Options button.

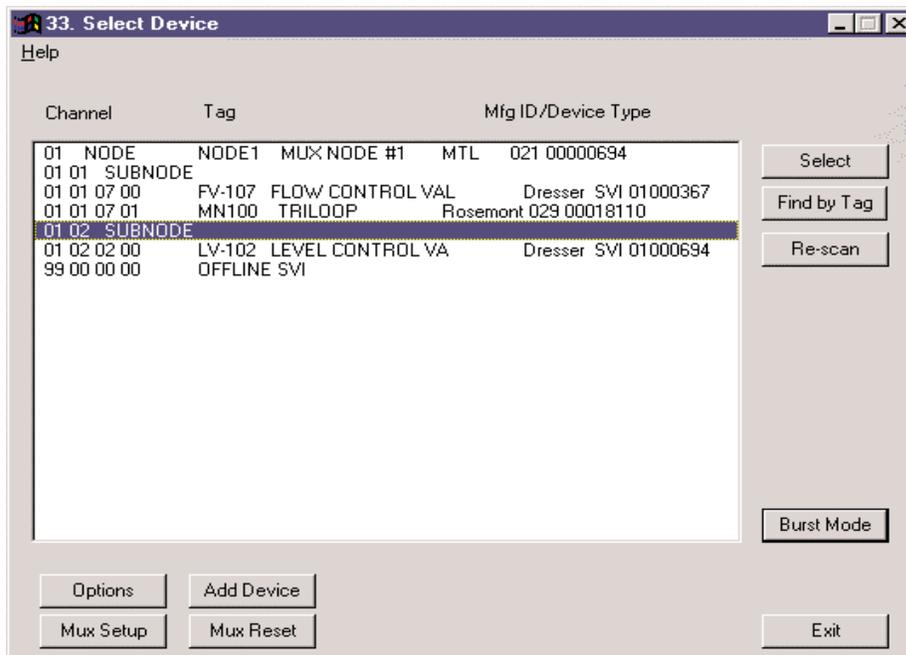


Figure 62.
Select Device
Window

Multiplexer Setup

Click the Mux Setup button to setup the nodes used on the MTL multiplexer. The Device Address window appears and prompts for the nodes to be configured. Type a number between 1 and 31 for the desired node, ex. 1 for node 1 and click OK. The Multiplexer Setup window (figure 63) appears. Setup includes the following options and parameters.

The screenshot shows a dialog box titled "35. Multiplexer Setup". It contains the following fields and options:

- Tag: NODE1
- Descriptor: MUX NODE #1
- Retry Count: 3
- Preamble Count: 5
- Scan Age Time (sec.): 30
- Master Mode:
 - Primary Master
 - Secondary Master
- Search Method:
 - Polling Address 0 only
 - One Device
 - Multidrop
- Scan Option:
 - Scanning OFF
 - Scan Cmd 1
 - Scan Cmd 2
 - Scan Cmd 3

Buttons: OK, Cancel

Figure 63. Multiplexer Setup Window

- **Tag:** This is a user-entered value. It may be up to 7 characters long and is used to identify the node of MTL multiplexer in the system. The tag is displayed in Device List box in Select Device window.
- **Descriptor:** A description with up to 15 characters for the node of MTL multiplexer.
- **Retry Count:** The number of times the multiplexer will retry sending a command to a Hart device before returning with an error. The valid range for this number is 0 to 5. 3 is the recommended number for use with ValVue.
- **Preamble Count:** The number of preambles prefixed to each Hart command sent to a device. The valid range is 2 to 20. 3 to 5 is the recommended value for this parameter.
- **Scan Age Time:** The length of time in seconds that scan data will remain valid. An error will be returned when scan data is requested more than the age time since the data was last updated. This parameter is available here to set for other applications that will use the multiplexer. ValVue does not support the scanning feature.

- **Multiplexer Master Mode:** The multiplexer can communicate with a Hart device in primary master mode or secondary master mode. For ValVue use, this mode does not matter. However, ValVue must use the same mode set in Options window as the multiplexer. For other applications that use the multiplexer or when other Hart masters will be used, a particular selection may be necessary. See the multiplexer documentation for further information.
- **Search Method:** When building a device list, the multiplexer can use one of three methods:
 1. **Polling Address 0 only:** This method looks only at polling address 0 for each loop. Any devices on a loop with a non-zero polling address will not be found.
 2. **One Device:** For each loop, all polling addresses will be searched until a device is found. The multiplexer will not continue the search on a loop after the first device is found.
 3. **Multidrop:** For each loop polling address 0 will be checked. If a device is found, no further search is performed on that loop. If no device is found at polling address 0, polling addresses 1 - 15 are searched and any devices found and are added to the device list.
- **Scan Option:** The MTL multiplexer has the capability to continually scanning the Hart devices connected and report the results. ValVue does not use this feature, but the option is provided to configure the multiplexer as needed by other applications.

Multiplexer Operation

The multiplexer can be used to request information about HART devices, Click the Mux Reset button to issue a reset command to a node of the multiplexer. The user will be prompted for the node that is to be reset. When reset, the multiplexer node will re-scan all of the devices connected to the node (this hardware re-scan is different from the re-scan done by ValVue from the Re-scan button). Depending upon the options set for the multiplexer this may take a while to complete. No communication may be done with devices on the selected node until the reset is completed. After the reset is finished, click the Re-scan button to build a device list.

If a few HART devices are added into the multiplexer system and resetting the multiplexer is not desired, click the Add Device button to add a device to the device list each time without re-scanning the entire network. To complete this function, enter the device address (node, sub node, loop, and polling address). The function will add the device both to the multiplexer hardware list and to the saved device list in ValVue.

A device list is arranged in the order found on the multiplexer's channels. This list may be very long if there are a lot of devices connected. To find a device by its tag, click the Find by Tag button to bring a window. Enter a tag to allow ValVue to search the device list for a device with a matching tag. If found, the device will be selected and the window scrolled so that the line is visible.

Clicking the Re-scan button causes ValVue to build a new device list. All nodes are checked. If there are a large number of devices connected to the multiplexer, this function can take some time to complete. When the re-scan is completed, the user may optionally save the device list to a file so that re-scanning is not necessary every time ValVue is started.

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