FLOWSERVE

User Instructions

StarPac 3

Intelligent Control System

FCD VLENMN0066-2 11/15

User Interface Manual

Experience In Motion

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Operation

1 Getting Started

This manual is designed to help you become familiar with, and efficiently operate, the StarPac® 3 Intelligent Control System. While the information presented in this manual is believed to be accurate, it is supplied for informative purposes only and should not be considered to be certified or as a guarantee of satisfactory results by reliance thereon. Specific instructions for the installation, wiring, operation and maintenance of the StarPac 3 are contained in the StarPac 3 IOM manual. For information on Personal Computer software, see the StarTalk XP Manual.

Because Flowserve is continually improving and upgrading its product design, the specifications and information included herein are subject to change without notice.

Flowserve will continue to provide its customers with the best possible products and service available. Should you have any questions about these provisions, or about Flowserve products, contact your local Flowserve representative or the Advanced Product Development Group directly (801 489-8611). You can also access Flowserve information via the internet HTTP: // www.flowserve.com.

2 Restrictions

 Due to product changes and periodic review, the information contained in this manual is subject to change without notice. All correspondence should be addressed to Flowserve Control Division Marketing, 1350 Mountain Springs Parkway, Springville, Utah 84663-0903.

NOTE: This manual is not intended to be a replacement for the many manuals already available for teaching and understanding instrumentation and process control (such as the Instrument Society of America's Instrument Engineers Handbook, Revised Edition, 1982, etc.). A copy of these manuals may prove valuable to the user in determining what StarPac 3parameters need to be set with respect to a particular application or process.

3 StarPac 3 Local Interface vs. LC/DCS Conflicts

The StarPac 3 allows the user the ability to control and program a field device remotely through a PLC or DCS interface. Since the StarPac 3 has a local interface, it is important to remain cognizant of who has command of the StarPac 3 control system. If the StarPac 3 is being commanded by a PLC or DCS it is possible that any calibrations or mode changes being made at the local user interface will be overwritten by the supervisory PLC or DCS.

Be sure to disable or suspend communications with the supervisory system while using the local user interface.

It is recommended that an "off line" feature be programmed into the supervisory system to only monitor the system so that the local user interface can be used. This will prevent someone from modifying the StarPac 3 without permission of the control room.

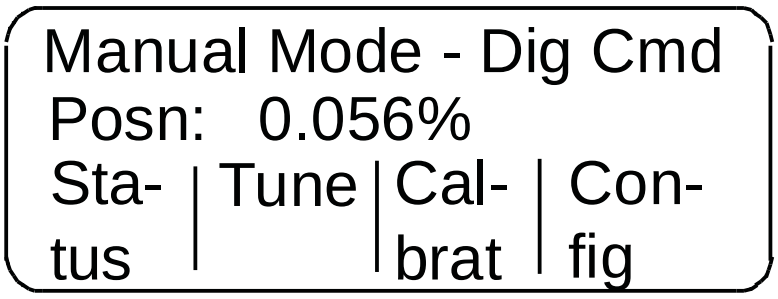
4 StarPac 3 Local Interface Structure & Operation

The StarPac 3 local user interface allows complete user access to configure and calibrate a StarPac 3 Intelligent Control Valve System. The interface consists of a Liquid Crystal Display (LCD) and a membrane-covered keypad. The LCD is a 4 X 20 character display with the top two lines user configured for normal operation, or for displaying instructions or options during configuration. The bottom two lines are used to indicate menu options that are selected with the four function keys. To the right of the menu options, on the bottom two lines, are two normally blank spaces that indicate Alarm or Error conditions, indicated by a flashing "A" and/or "E". A flashing "T" on the right side of the display indicates that the unit is in Test mode and will not respond to commands until the unit is set to Manual or Auto mode in the **TUNE** menu.

The keyboard has three types of keys; the menu control keys (which consist of the LAST OPTION, F1, F2, F3, and F4 keys); the alpha-numeric keys; and the colored shift keys. The F1, F2, F3, and F4 keys refer to the menu options listed in the LCD of the interface. The LAST OPTION key is used to move back through the menus. The alpha-numeric keys are used to enter data requested in various options. The red, blue and green shift keys are used to select the corresponding colored letter on the alpha-numeric keypad.

The various menu options have three basic forms. The first type is a list that is scrolled through by using the F1 and F2 keys labeled NEXT and PREVIOUS. The second type uses the F1 and F2 keys to adjust a value up or down, and the third type uses the F1 and F2 keys to move the cursor to a position. The keypad is used to enter characters. In all of the options, the F3 key is used to cancel the operation. If the F3 key is pressed before the system returns to the menu, then all variables are returned to their old values. The F4 key is used to accept the current values in the display and continue.

Figure 1: Home Menu



The HOME menu has selections of **STATUS, TUNE, CALIBRATE**, and **CONFIGURE.** Each of these menus has several sub-menus. The bottom two lines define the function keys that control the individual menus. The top two lines in the display are user configurable and may not look like Figure 1.

The menus shown in the figures in this manual represent how the information is laid out in the local display menu tree. The top row of the figures shows the bottom two rows of the display. One of the fields is in Bold type. Press the F key under this field to bring up the choices shown on the bottom row. If you see the word 'Next,' then push the F4 button to bring up the continuation of that row. To move back up the menu tree, push the button labeled 'Last Option' to see the preceding row.

5 Initial Startup

The StarPac 3 system is designed to interface with a variety of DCS systems using analog, discrete, and digital communications. Because of the processing power of the StarPac 3 system, a separate 24 VDC power connection is required and connected to terminals 1 (+) and 10 (-). This power supply should have a minimum current capacity of 100 mA, and 150 mA if using to power Analog Inputs or using StarPac power for Analog Outputs.

Before powering up the unit - Read the section “Setting the System Jumpers” and set them according to the instructions and particular application.

Powering up the unit on the bench - When the unit is first powered up, the display will show the version number of the firmware for two seconds before beginning operation. The StarPac 3 system sensors are calibrated at the factory and the fluid data is entered as specified on the order. However, due to the differing nature of installations, the units and ranges of the analog and discrete I/O are not configured at the factory.

The suggested process for setting up a new system on the bench is:

1. In the CONFIGURE menu, select the engineering units you will be using.
2. If you will be using analog I/O signals, use the CONFIGURE menu to set up the analog channels to indicate the proper process variables and ranges you will be using. Note that the StarPac 3 system treats gas flow and liquid as different variables and they must each be specified.
3. Connect the instrument air supply (40-150 psi) to the ¼-inch NPT air supply port located on the back of the unit.
4. Use the STATUS menu and set the Row Two variable to “valve position.”
5. Use the TUNE menu to put the unit in to Manual mode with a digital command.
6. Using the “Command %” option in the TUNE menu, enter a 0 percent command and verify that the position follows to within 0.5 percent.
   NOTE: Command is a term with two meanings. For a traditional control valve, the command is the signal a controller sends to the I/P. to position the stem. For the StarPac 3, this meaning refers to the signal sent to the positioning module. When the StarPac 3 is in Manual mode, Command also refers to the signal sent to the StarPac 3 via analog input No. 1, a digital Modbus channel, or the front keypad. These commands may differ due to the internal stroke calibration and an inverted signal for air to close valves.
7. Using the Command % option in the TUNE menu, enter a 100 percent command and verify that the position follows to within

0.5 percent.

8. If the unit fails either of the tests above, perform a QUICK-CAL in the CALIBRATE menu.
9. Use the STATUS menu and set the Row Two variable to be "ISA upstream pressure."
10. Verify that the unit is correctly indicating the ambient pressure.
11. Use the STATUS menu and set the Row Two variable to be "ISA downstream pressure."
12. Verify that the unit is correctly indicating ambient pressure.
13. If the unit fails the above tests, re-zero the transducers using the P1 & P2 option in the CALIBRATE menu. You may also need to pressurize the sensors and verify the Span if the calibration is suspect.
14. Use the STATUS menu and set the Row Two variable to be "process temperature."
15. Verify that the unit is correctly indicating ambient temperature.
16. If the unit fails the above test, re-calibrate the transducer using the thermocouple option in the CALIBRATE menu. (This calibration requires a Type-K thermocouple simulator or a temperature bath.)
17. Use the CALIBRATE menu to check the analog channels that you will be using.
18. Finally, use the TUNE menu to select the process variable that you will be controlling and set the range.

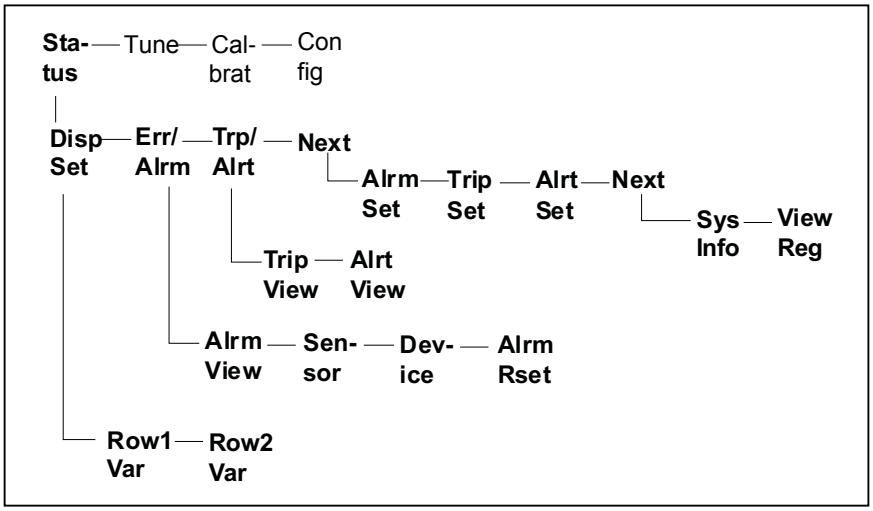
Putting The Unit Online - menu to configure the setpoint signal to the proper source for your DCS system. If you will be using the system in the Automatic mode, adjust the Proportional-Integral-Derivative (PID) parameters so the loop responds satisfactorily.

Backing up the system - When you have your unit calibrated and working according to your needs, back up the configuration into the safe memory area. This is done in the Save Backup choice in the Tech option of the CONFIGURE menu.

6 Status Menu

The STATUS menu is used to view information about the configuration and operation of the system. Errors and alarms can also be viewed from this menu. The STATUS menu is arranged as shown in Figure 2.

Figure 2: Status Menu



Each option may have other menus or options to choose from.

Disp Set – Displays a menu to select the information that will be displayed on row 1 or row 2 of the display during normal operation. Each selection has the same list of options except where noted.

Mode/Status - Lists the operating mode and any current alarm or trip conditions. (This option is only available on Row One.)

Scanning Display - Rotates automatically through a list that is configured through PC software. (This option is only available on Row Two.)

Valve Position - Current valve position in percent open. (Designated as "Posn" in the display.)

Valve Command - Current valve command in percent open. (Designated as "Comnd" in the display.)

Liquid Flow - Current liquid flow rate in user-defined units. (Designated as "FlowQ" in the display.)

Gas Flow - Current gas flow rate in user-defined units. (Designated as "FlowW" in the display.)

ISA Up Stream Press - Current compensated upstream line pressure in user-defined units. (Defined as two pipe diameters upstream of the valve, designated as "P1isa" in the display.)

ISA Dn Stream Press - Current compensated downstream line pressure in user-defined units. (Defined as six pipe diameters downstream of the valve, designated as "P2isa" in the display.)

ISA Delta Pressure - Current differential pressure using the pressure definitions above in user-defined units. (Designated as "dPisa" in the display.)

Process Temperature - Current process temperature in user-defined units. (Designated as "Temp" in the display.)

Liquid Flow Totalizer - Totalized liquid flow in user-defined units. (Designated as "TotlQ" in the display, the totalizer is reset from the TUNE menu.)

Gas Flow Totalizer - Totalized gas flow in user-defined units. (Designated as "TotlW" in the display, the totalizer is reset from the TUNE menu.)

Totalizer Time - Operating time since the totalizer was last reset. (Designated as "TotTm" in the display.)

Valve Cv - Current valve C_v at present valve position. (Designated as "Cv" in the display.)

Setpoint (%) - Controller setpoint as a percent of the maximum. (Designated as "SP" in the display. The process maximum is set in the TUNE menu with the process variable for the controller operation.)

Process Variable (%) - Process variable in percent of maximum. (Designated as "PV" in the display. The process maximum is set in the TUNE menu with the process variable for the controller operation.)

Setpoint (units) - Current controller setpoint in user units. (Designated as "SP" in the display.)

PV (units) - Current process variable in user-defined units. (Designated as "PV" in the display.)

fl - Current F_L at present valve position. (Designated as "fl" in the display.)

xt - Current X_T at present valve position. (Designated as "xt" in the display.)

z - Current compressibility factor at existing process conditions. (Designated as "z" in the display.)

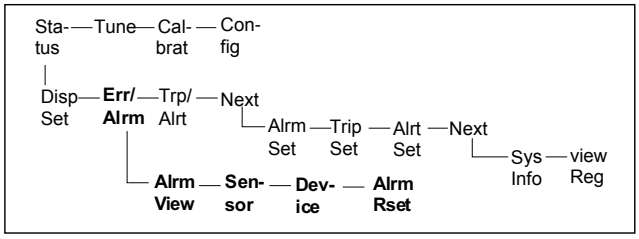
Cylinder Top Press - Current pressure above the actuator piston in user-defined units. (Designated as "Ptop" in the display.) **Cylinder Bot Press** - Current pressure below the actuator piston in user-defined units. (Designated as "Pbot" in the display.) **Time & Date** - Current time and date of the internal clock.

Auxiliary 4-20 Input - Auxiliary input signal in percentage. (Designated as "AuxIn" in the display.)

Flow State - Liquid non-choked, liquid choked, gas non-choked, gas choked.

Errors/Alarms allows the user to view any current errors and alarms that are indicated by the flashing "A" and/or "E" on the right side of the display. This option displays three menu choices

Figure 3: Alarms/Errors Tree



Alarm View - Allows the user to view any current alarms using the NEXT or PREVIOUS function keys. Possible alarms are:

Setpoint Deviation - The controller is unable to maintain the process at the current setpoint. (Sensitivity is adjusted using StarTalk software.)

Positioner Deviation - The positioner is unable to maintain the valve position at the current command. (Sensitivity is adjusted using StarTalk software.)

Trip Condition - The unit is in a trip condition of either loss of command, low supply air, or a low flow cutoff. Low flow is determined when the pressure drop across the valve is less than 0.5% of the calibrated range of the pressure sensors. The valve must be in

AUTO mode for the low flow trip to occur. (Use the Row 1 Variable MODE/STATUS menu selection to display the type of trip.)

Override Condition - Indicates the controller is not currently capable of doing any more to achieve the setpoint (or valve position). This can be any of the trip conditions, or a mechanical or software travel limit has been reached and the controller has exceeded the 5 percent current limit.

Sensor Malfunction - One of the sensors has a suspect output. (See sensor errors for detail.)

Device Malfunction - The electronics has an internal error. (See device errors for detail.)

Sensor Errors - Allows the user to view any current sensor errors using the NEXT or PREVIOUS function keys. Possible sensor errors are:

Upstream Pressure - The output of the upstream pressure sensor is out of range.

Downstream Pressure - The output of the downstream pressure sensor is out of range.

Cylinder Top Press - The output of the top actuator pressure sensor is out of range.

Cylinder Bot Press - The output of the bottom actuator pressure sensor is out of range.

Process Temperature - The output of the process temperature sensor is out of range.

Ambient Temperature - The output of the ambient temperature sensor is out of range.

Position Feedback - The output of the position feedback sensor is out of range.

Device Errors - Allows the user to view any device errors using the NEXT or PREVIOUS function keys. Possible device errors are:

Watch Dog Timeout - The watchdog timer error on the StarPac is an indication of the health of the unit and its installation.
This error does not prevent the StarPac from operating.
It is triggered by instability of the CPU. This is usually caused by the following events:

1. Low power. If the power supply drops to around 18 Vdc instead of the required 24 Vdc this will cause the timing of the CPU to become erratic and triggers the error.
2. Excessive noise and spikes on the power supply. A good regulated 24 Vdc power supply is required for the StarPac 3. Bad power may eventually damage the unit.
3. Improper Grounding and Shielding of the wiring. Proper instrumentation wiring techniques must be used when installing the StarPac system. This is a high precision instrument and should be installed accordingly. Refer to Installation, Operation, and Maintenance Instructions (IOM) the StarPac 3 for guidelines.
4. Excessive noise on the RS-485 data communications. Noise problems on the communications can upset the CPU. Follow the guidelines for wiring and termination.
5. Electronics problem. Very rare and unlikely.

Once triggered, this alarm remains active until the unit is reset. This can be accomplished by simply cycling the power off and on. Even though the alarm is continuously indicated once it is set, it does not prevent the StarPac 3 from operating. Normal operation is still possible. The alarm is set this way so that these transient conditions are caught and notify the operator that something is not right.

If the problem occurs intermittently, this is a common symptom of a power supply or noise problem. Re-check the installation wiring and power supply.

SRAM R/W Failure - The static RAM had an error. This is a serious error usually requiring hardware replacement if it persists. This error can only be cleared by turning off the device and then turning it on again.
Flash Checksum Failure - Check the integrity of the firmware. This error usually occurs when the firmware is changed and must be cleared with an initialization. (This is done by holding down the "0" on the keypad while powering up the unit).
WARNING: An initialization will also reset the communication parameters, password, and PID control parameters.
NVRAM R/W Failure - The non-volatile RAM had an error. This is a serious error usually requiring hardware replacement if it persists. This error can only be cleared by turning the device off and then turning it on again.

+5V reference Out of Tolerance - An internal power supply is operating out of tolerance.

Illegal Pointer - One of the configurable arrays is using an invalid register. StarTalk Software can be used to find and correct the invalid pointer.

NVRAM Checksum Error - A value in the non-volatile RAM was changed without resetting the checksum. Performing any write function, such as a setpoint or command change should reset the error. If the system behaves erratically after receiving an

error, the NVRAM may have been corrupted and you should reload the factory configuration table from the disk provided using the StarTalk for Windows software.

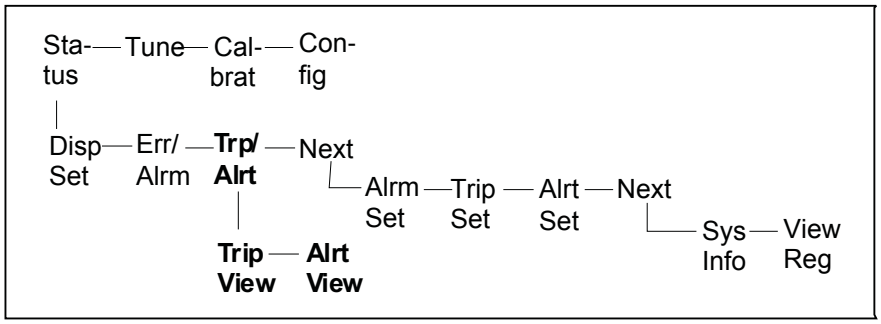
Divide by Zero - The StarPac 3 unit attempted an illegal math operation due to bad calibration or configuration settings. Reload the factory configuration table from the disk provided, using StarTalk software.

MCU SPI Comm failure - The StarPac 3 has experienced an internal communications failure. The StarPac 3 will attempt to correct this problem automatically. If this persists the StarPac 3 will stop functioning. A power reset may clear this problem if the StarPac 3 stops functioning.

Alarm Reset - Allows the user to clear all alarms and alerts:

Trip/Alert View - Allows the user to view Trips or alerts generated by the StarPac 3 in response to user programmed limits of operation.

Figure 4: Trip/Alert Menu



Trip View – Trips are conditions that take the StarPac 3 system out of service and drive it to a fail condition.

Position Sensr Fault

Supply Air Loss Trip

Anlg Signl Loss Trip

Rmt Cmd Timeout Trip

Alert View – Alerts inform the user of conditions or limits that are currently active. Alerts are configured by the user to limit response or inform that a limit is affecting the operation of the unit.

Stroke Rate Limit Soft

Limit Alert High Min Sig

Cutoff Low Min Sig

Cutoff Low dP Alert

Anti-Reset Wnd Alert

Position Travel Alrt

Travel Accumulator

Cycle Counter Alert

Alarm Set - Allows the user to enable or disable individual alarm functions.

Setpoint Deviation - The controller is unable to maintain the process at the current setpoint. (Sensitivity is adjusted using StarTalk software.)

Positioner Deviation - The positioner is unable to maintain the valve position at the current command. (Sensitivity is adjusted using StarTalk software.)

Trip Condition - The unit is in a trip condition of either loss of command, low supply air, or a low flow cutoff. Low flow is determined when the pressure drop across the valve is less than 0.5% of the calibrated range of the pressure sensors. (Use the Row 1 Variable MODE/STATUS menu selection to display the type of trip.) The low flow trip will only occur when the StarPac is in AUTO mode and the Process Variable is Liquid Flow or Gas Flow.

Override Condition - Indicates the controller is not currently capable of doing any more to achieve the setpoint (or valve position). This can be any of the trip conditions, or a mechanical or software travel limit has been reached and the controller has exceeded the 5 percent current limit.

Sensor Malfunction - One of the sensors has a suspect output. (See sensor errors for detail.)

Device Malfunction - The electronics has an internal error. (See device errors for detail.)

Trip Set - Allows the user to enable or disable trips generated by the StarPac 3 in response to user programmed limits of operation. Trips are conditions that take the StarPac 3 system out of service and drive it to a fail condition. Note that disabling the indication does not stop the trip from occurring.

Position Sensr Fault

Supply Air Loss Trip

Anlg Signl Loss Trip

Rmt Cmd Timeout Trip

Alert Set – Allows the user to enable or disable individual alert functions. Alerts inform the user of conditions or limits that are currently active. Alerts are configured by the user to limit response or inform that a limit is affecting the operation of the unit.

Stroke Rate Limit Soft

Limit Alert High Min Sig

Cutoff Low Min Sig

Cutoff Low dP Alert

Anti-Reset Wnd Alert

Position Travel Alrt

Travel Accumulator

Cycle Counter Alert

System Information - Allows the user to check the factory hardware configuration for reference or spare parts. The following list shows the items listed:

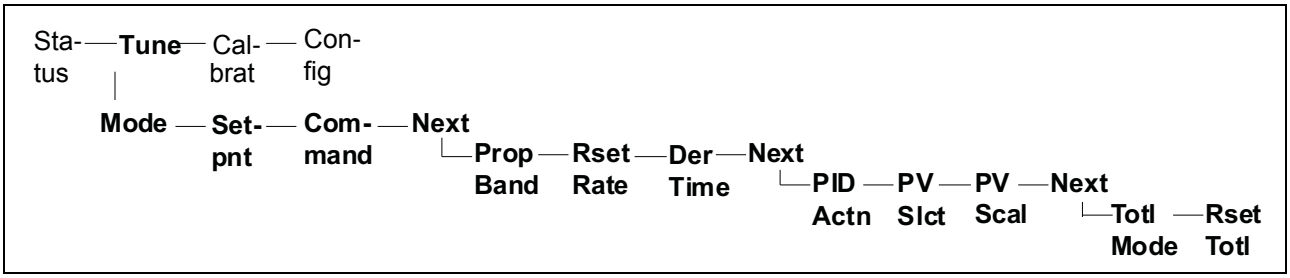
Valve Serial Number:	Spring:
Trim Number:	Spring Type:
Trim Characteristic:	Air Action:
Trim Type: Pressure	Electronics S/N:
Class: Valve Model:	EPROM Version:
Flow Direction:	Sensor Rating:
Body Size:	Sensor Drawing No.:
Body Material:	P1 Serial Number:
Packing Style:	P2 Serial Number:
Packing:	P1 Calibration Date:
Gasket Material:	P2 Calibration Date:
Actuator Size:	Miscellaneous No. 1:
	Miscellaneous No. 2: Actuator
	Calibration Date Positioner
	Calibration Date Thermocouple
	Calibration Date

View Registers - Allows the user to view any internal integer or floating point Modbus register using the register map provided (see appendix for a list of registers). String registers cannot be viewed with this function.

7 Tune Menu

The TUNE menu is used to view and configure the controller variables and gains, change modes, and reset the totalizer. The TUNE menu is arranged as shown in Figure 5.

Figure 5: Tune Menu Tree



Setpoint User Units - Allows the direct input of the setpoint in the configured engineering units, provided the unit is in Auto mode with the digital setpoint selected.

Analog/Digital - This option selects where the StarPac 3 system will receive the setpoint information.

"Digital" indicates that the keypad or the StarTalk software can be used to change the setpoint.

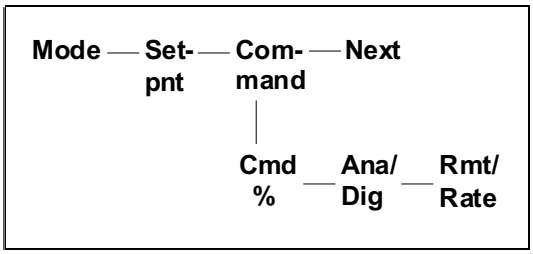
"Analog" prompts the StarPac 3 to use the 4-20 mA signal from analog input No. 1 as the controller setpoint.

"Remote" is used when a host system such as a PLC or DCS is used to write the setpoint to the unit digitally.

Remote Refresh Rate - This option sets up a time-out on the receipt of fresh setpoint data when set to operate with a remote setpoint. If the setpoint is not refreshed within the time frame entered in this field, the unit will go into a loss-of-command trip as set up in the CONFIGURE menu. A value of "0" disables this feature and makes the electronics think that the Mode source is digital. Note that if the digital source is selected, the unit will hold at the last setpoint indefinitely.

Command - Provides three options used to change the valve position command and configure the source of the valve command.

Figure 8: Command Menu



Command % - Allows the direct input of the valve position command as a percentage of valve travel. Zero percent is closed and 100 percent is open--provided the unit is in Manual mode with the digital command selected.

Analog/Digital - This option selects where the StarPac 3 system will receive the valve position command information.

"Digital" indicates that the keypad or the StarTalk software can be used to change the valve position command.

"Analog" prompts the StarPac 3 to use the 4-20 mA signal from analog input No. 1 as the valve position command.

"Remote" is used when a host system such as a PLC or DCS is used to write the valve position command to the unit digitally.

Remote Refresh Rate - This option sets up a "timeout" on the receipt of fresh, valve-position command data when set to operate with a remote command. If the valve position command is not refreshed within the time frame entered in this field, the unit will go into a loss of command trip (as set up in the CONFIGURE menu). A value of "0" disables this feature. Note that if the digital source is selected, the unit will hold at the last valve position command indefinitely.

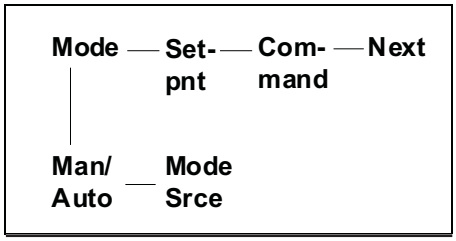
Proportional Band - Sets the proportional band for the controller. Proportional Band = 100/gain or gain =100/prop. band. Since proportional band is the inverse of gain, the larger the band value, the smaller the controller gain.

Reset Rate - This is the integrator term in the PID controller, referring to the action at which the rate of change of output is proportional to the error input. "Reset" is the parameter that controls how the integral control action affects the final control element. The larger the value, the faster the system tries to eliminate the offset error. Units are repeats/min.

Derivative Time - Sets the time on the derivative control action of the PID controller. This time is the interval at which the rate action advances the effect of the gain on the final control element. Units are in minutes.

PID Action - This variable determines the response of the controller to error. Reverse action will cause an air-to-open valve to begin to close when the process variable is greater than the setpoint. Direct action has the opposite effect. The following table gives some

Mode - Has two options for defining the current mode and the source of the mode. ***Figure 6: Mode Menu***



Man/Auto - This option selects or changes the operating mode if the mode source has been set to digital. If the mode source is set to Remote or Discrete, the mode can only be changed using the discrete input or the remote register. In Manual mode the unit operates as a normal control valve, positioning the valve according to its current command signal.

In Auto mode the unit will operate as a controller using the PID settings, process variable, and control action currently defined using a bumpless transfer algorithm. (Note that if the unit is using an analog command source, the system will bump because the 4-20 signal will change from indicating position command to process setpoint.)

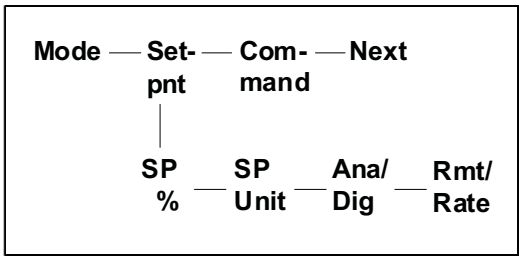
Test mode takes the unit off-line and the system *DOES NOT* update the indicated pressures, temperatures, flow, or PID values; nor does it support setpoints or any analog or digital commands. Test mode is the beginning mode after an initialization and is used during calibration. If power is lost during a calibration setup, the unit will remain in Test mode and the mode will have to be reset. If the unit is in Test mode, the letter "T" will flash on the right side of the display.

Mode Source - This selects where the StarPac 3 unit will receive the mode information. "Digital" indicates that the keypad or the StarTalk software can be used to change the mode. "Discrete" indicates that an external signal applied to terminals 9 and 18 will be used to switch the unit between Auto and Manual modes. The definition is fixed with an energized state indicating Auto mode. Remote mode is used when a host system such as a PLC or DCS is used to set the mode via digital communications.

"Remote Mode Source" **-** Configures the unit so that floating point register 40703 sets the operating mode. Valid values are: 0 = Manual, 100 = Auto. Remote Mode Source is used when a host system such as a PLC or DCS or a Flowserve StarPac Analog Interface Box (SPAIF) is used to set the mode via digital communications. The difference between Remote and Digital modes is that in Remote mode the only time that the bumpless transfer calculation is done is after the mode in register 40703 has *changed* from one value to another. With a Digital mode source selected, every time that any value is written (even if it is not changed) to register 40038, the StarPac system executes a transfer algorithm that may impede control.

Setpoint - Provides four options used to change the setpoint and configure the source of the setpoint.

Figure 7: Setpoint Menu



Setpoint % - Allows the direct input of the controller setpoint as a percentage of maximum, as setup with the process variable, provided the unit is in the Auto mode with the digital setpoint selected.

guidelines for control action settings:

Table 1: PID Action

Process Variable	Air-to-Open Valve	Air-to-Close Valve
Flow	Reverse	Direct
Upstream Pressure	Direct	Reverse
Downstream Pressure	Reverse	Direct
Differential Pressure	Direct	Reverse
Process Temperature	Depends on Installation	Depends on Installation
Auxiliary 4-20 Input	Depends on Installation	Depends on Installation

If the PID action is not set correctly, the controller will hold the valve either full open or full closed and there will be no control.

Process Variable Select - Selects the process variable that will be used to control the process.

Liquid Flow - Sets the system to control liquid flow. (If the flow is gaseous, the system will read the liquid flow value as zero and respond accordingly.)

ISA Up Stream Press - Sets the system to control using the current compensated upstream line pressure. (Defined as two pipe diameters upstream of the valve.)

ISA Dn Stream Press - Sets the system to control using the current compensated downstream line pressure. (Defined as six pipe diameters downstream of the valve.)

ISA Delta Pressure - Current differential pressure using the pressure definitions above.

Process Temperature - Sets the system to control the process temperature.

Gas Flow - Sets the system to control gaseous flow (if the flow is liquid, the system will read the gas flow value as zero and respond accordingly).

Auxiliary 4-20 Input - Sets the system to use a 4-20 mA signal attached to Analog Input 2 as the process variable.

Process Variable Scaling - This option sets the full scale process value that the controller will use in the PID algorithm, using the units that have been selected in the CONFIGURE menu (except for Auxiliary, which is always in units of percent). This step should be completed before tuning because the relative size of the error is determined by the scaling entered.

Totalizer Mode – This option allows the user to set the totalizer to liquid or gas mode.

Reset Totalizer - Selecting this option resets the time and amount in the flow totalizer to zero.

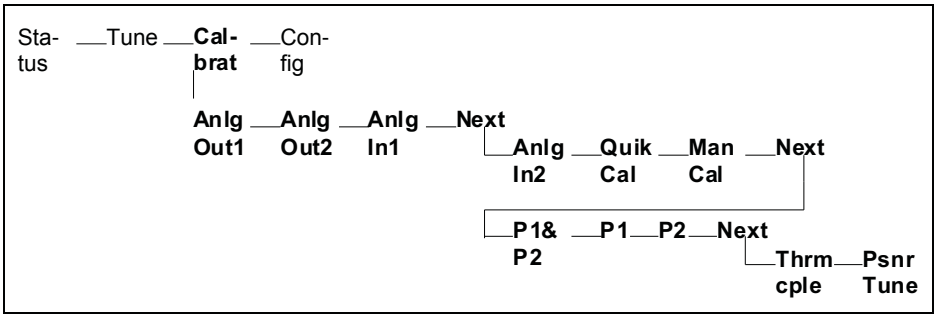
8 Calibration Menu

The CALIBRATE menu is used to calibrate the analog inputs and outputs, process pressure and temperature sensors, as well as the actuator position and pressure sensors. Before entering the CALIBRATE menu, the display will indicate that the system will be taken off-line and will ask the user to accept the condition.

WARNING: Taking the StarPac 3 unit offline may cause the valve to stroke unexpectedly. Notify personnel working nearby that the valve may stroke.

While the CALIBRATE menu is open, the system is in Test mode and will not respond to control signals. To put the unit back on line you must press the LAST OPTION key until the display prompts you, and then press ACCEPT. While you are in the CALIBRATE menu, the letter "T" will flash on the right side of the display, indicating that the unit is in Test mode. The unit may also change the valve position during some of the calibration processes that could affect the process if it is not properly isolated. The CALIBRATE menu is arranged as shown in Figure 9 below.

Figure 9: Calibration Menu Tree



Analog Out No. 1 - This option is used to calibrate the first analog output of the StarPac 3 device. During the calibration procedure, a reference milliamp meter in series with a power supply (nominal 24 VDC) must be connected to terminals 6(+) and 15(-) of the terminal block. The display will give instructions to use the F1 and F2 keys to adjust the signal until the reference meter reads 4 mA. When the 4 mA value has been accepted, you will be prompted to set the 20 mA value. If the CANCEL key is pressed at any time, all of the calibration values are returned to their original value. The number shown at the end of the second line indicates the raw D/A value that the unit is outputting, which is only used for reference during calibration. Configuration of the variable and scaling for the channel is performed in the CONFIGURE menu.

Analog Out No. 2 - This option is used to calibrate the second analog output of the StarPac 3 system. During the calibration procedure a reference milliamp meter in series with a power supply (nominal 24 VDC) should be connected to terminals 7(+) and 16(-) of the terminal block. The display will give instructions to use the F1 and F2 keys to adjust the signal until the reference meter reads 4 mA. When the 4 mA value has been accepted, the user is then prompted to set the 20 mA value. If the CANCEL key is pressed at any time, all of the calibration values will be returned to their original value. The number shown at the end of the second line indicates the raw D/A value that the unit is outputting, which is only used for reference during calibration. Configuration of the variable and scaling for the channel is performed in the CONFIGURE menu.

Analog In No. 1 - This option is used to calibrate the first analog input of the StarPac 3. During the calibration, a reference milliamp source should be connected to terminals 4(+) and 13(-) of the terminal block. The display will give instructions to adjust the signal until the reference meter reads 4 mA. When the 4 mA value has been accepted, the user is then prompted to set the 20 mA value. If the CANCEL key is pressed at any time, all of the calibration values are returned to their original value. The number shown at the end of the second line indicates the raw A/D value that the unit is receiving and is only for reference during calibration. Configuration of the variable and scaling for the channel is done in the TUNE menu.

Analog In No. 2 - This option is used to calibrate the second analog input of the StarPac 3 system. During the calibration, a reference milliamp source should be connected to terminals 5(+) and 14(-) of the terminal block. The display will give instructions to adjust the signal until the reference meter reads 4 mA. When the 4 mA value has been accepted, you are then prompted to set the 20 mA value. If the CANCEL key is pressed at any time, all of the calibration values are returned to their original value. The number shown at the end of the second line indicates the raw A/D value that the unit is receiving and is only for reference during calibration. Configuration of the variable and scaling for the channel is done in the CONFIGURE menu.

Quick Calibration - This option calibrates the actuator pressure sensors, the position feedback sensor, and auto calculates the positioner command gains. in the unit. The process requires that the valve stroke from full open to full closed several times. Because the valve will change position during this process you must confirm that you want to proceed. You will then be prompted for the instrument air supply pressure to the unit. If the air supply varies by more than 1 psi during the calibration, the test may abort. Hence, a regulator may be required if the air supply is not stable. The unit will then complete the calibration process by stroking the valve open and closed over 30 to 60 seconds. Upon successful completion, the display will show the message “Calibration Successful”.

WARNING: Notify personnel working nearby that the valve will stroke during this procedure; otherwise, serious injury may occur.

Manual Calibration - This option gives the options to run the actuator calibration or the positioner stroke calibration independent of each other.

Span - Apply the maximum pressure you want to use for your reference and press ACCEPT. The numbers on the right side of the display indicate how steady the pressure is in the valve body. Next, enter the actual pressure applied in the indicated engineering units and press ACCEPT.

P2 - This option calibrates the downstream process pressure sensor in the unit. You will then have two more menu options to set for Zero and Span.

Zero - Apply the atmospheric pressure or the minimum pressure you want to use for your reference and press ACCEPT. The number on the right side of the display indicates how steady the pressure is in the valve body. Next, enter the actual pressure applied in the indicated engineering units and press ACCEPT.

Span - Apply the maximum pressure you want to use for your reference and press ACCEPT. The number on the right side of the display indicates how steady the pressure is in the valve body. Next, enter the actual pressure applied in the indicated engineering units and press ACCEPT.

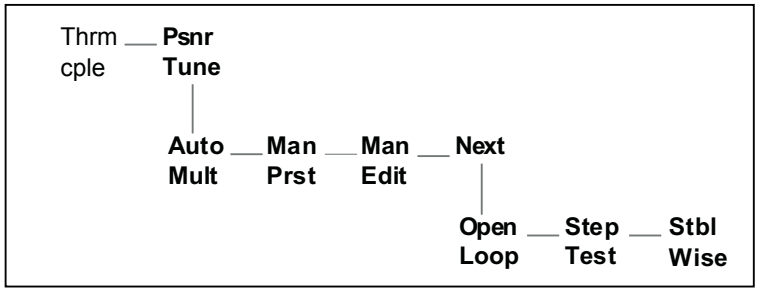
Thermocouple - This option is used to calibrate the Type-K thermocouple temperature sensor in the unit. You will then have two more menu options to set for Zero and Span. Normally this calibration is done using a temperature controlled bath or a Type-K thermocouple simulator connected to terminals 9 (yellow) and 10 (red) on the sensor terminal which can be found a the bottom of the main PCB circuit board assembly. If a temperature controlled bath or Type-K thermocouple simulator is not available, refer to Appendix

Zero - Apply a signal equal to the minimum temperature you want to use for your reference and press ACCEPT. The number on the right side of the display indicates how steady the temperature input is reading. Next enter the actual temperature applied in the indicated engineering units and press ACCEPT.

Span - Apply a signal equal to the maximum temperature you want to use for your reference and press ACCEPT. The number on the right side of the display indicates how steady the temperature input is reading. Next, enter the actual temperature applied in the indicated engineering units and press ACCEPT.

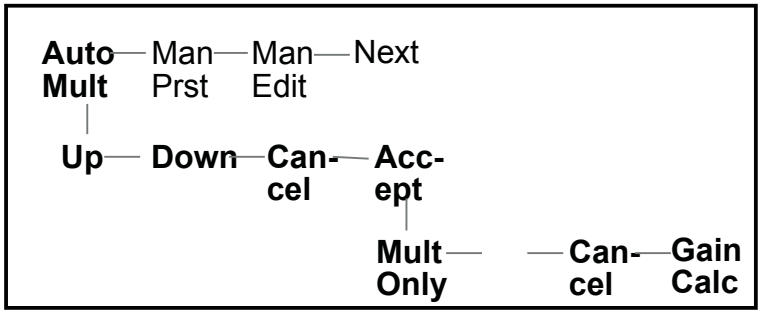
Positioner - This option is used to set the control gains for the positioner and also test for proper response.

Figure 11: Positioner Menu Tree



Auto Tune / Multiplier - This option allows the user to adjust the gain multiplier and/or commands the positioner to automatically compute the gains to be used by the positioner based upon the stroke time of the valve.

Figure 12: Auto Tune/Multiplier



Displayed on Row 1 will be the multiplier value with selections from A to H. These are represented in table 2. These values are multiplied by the final gain to allow the user to adjust the responsiveness of the valve.

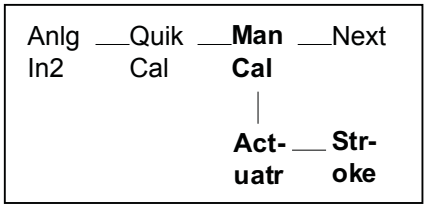


Figure 10: Manual Calibration

Actuator - This option calibrates the actuator pressure sensors in the unit. The process requires that the valve stroke from full open to full closed. Because the valve will change position during this process you must confirm that you want to proceed. You will then be prompted for the instrument air supply pressure to the unit. If the air supply varies by more than 1 psi during the calibration, the test may abort. Hence, a regulator may be required if the air supply is not stable. The unit will then complete the calibration process by stroking the valve open and closed over 30 to 60 seconds. Upon successful completion, the display will momentarily flash the message "Calibration Successful".

Stroke - This option calibrates the position feedback sensor in the unit. The process requires that the valve stroke from full open to full closed. Because the valve will change position during this process you must confirm that you want to proceed. You will then be prompted for the valve type; linear or rotary. You will then be prompted to do a Jog Calibration or an Auto Calibration.

Jog – A jog calibration should be performed if there is no physical stop in the valve or actuator that prevents the valve from over-stroking and causing damage to the actuator. When Jog is selected a prompt will appear to move the valve to the 100% open position. This can be done by using the F1 and F2 keys to move the valve up and down. Use these keys to position the valve at 100% open. When the 100% position is accepted, the calibration procedure will continue automatically and the valve will move to the 0% open position and the calibration will be completed. Upon successful completion of the process, the system will momentarily flash the message "Calibration Completed".

Auto – An auto calibration should be performed if there are physical stops that limit how far the valve strokes open. Valtek valves have stops which allow an Auto calibration to be performed. During this calibration the valve will automatically open and close and the feedback sensor will calibrate automatically. Upon successful completion of the process, the system will momentarily flash the message "Calibration Completed".

WARNING: Notify personnel working nearby that the valve will stroke during this procedure; otherwise, serious injury may occur.

P1 and P2 - This option simultaneously calibrates the process pressure sensors in the unit and is the recommended sensor calibration method. Because it calibrates both sensors at the same time, this procedure automatically moves the valve's stroke to mid-stroke. *This calibration should always be done with the flow through the valve blocked. If there is flow through the valve you must use the individual calibration options*. Because the valve will change position during this process, you must confirm that you want to proceed. You will then have three more menu options to set for ZERO, SPAN and SENSOR GAIN.

Zero - Apply the atmospheric pressure or the minimum pressure you want to use for your reference and press ACCEPT. The two numbers on the right side of the display are register values that indicate how steady the pressure is in the valve body. Next, enter the actual pressure applied in the indicated engineering units and press ACCEPT.

Span - Apply the maximum pressure you want to use for your reference and press ACCEPT. The two numbers on the right side of the display indicate how steady the pressure is in the valve body. Next, enter the actual pressure applied in the indicated engineering units and press ACCEPT.

Sensor Gain - This option configures the input amplifier range for the installed sensors using the ***Up*** and ***Dn*** function keys. Flowserve's standard sensors normally use the 30mV < out < 60mV selection. Normally, you should not have to change this option. If you have questions, consult your Flowserve representative.

P1 - This option calibrates the upstream process pressure sensor in the unit. You will then have two more menu options to set for Zero and Span.

Zero - Apply the atmospheric pressure or the minimum pressure you want to use for your reference and press ACCEPT. The number on the right side of the display indicates how steady the pressure is in the valve body. Next, enter the actual pressure applied in the indicated engineering units and press ACCEPT.

Table 2: Auto Tune Multipliers

Selection	Value
A	0.30
B	0.44
C	0.66
D	1.00
E	1.50
F	2.20
G	3.30
H	5.00

Up and Down - This option allows the user to scroll through the available gain multipliers. The gain multipliers are listed in Table 1.

Cancel - This option returns to the top level menu with no action taken.

Accept – Accepts the selected gain multiplier then prompts the user to either exit with only the new multiplier change or to do a complete gain calculation.

Mult Only – Accepts the selected gain multiplier and returns to the top level menu.

Cancel - This option returns to the top level menu with no action taken. (This will not change the multiplier.)

Gain Calc – Commands the positioner to calculate the proportional gain, static gain, and error gain automatically. These gains are based on the stroke time of the valve. This option will cause the value to open and close.

Manual Presets - This option sets the default gain for the positioner. Select the desired default gains from the list using the UP and Down function keys on the menu. Default selections exist for A - H. Note that the factory default setting is E. The following table shows the default gains associated with each setting:

Table 3: StarPac 3 Default Gains

Selection	Prop Gain	Static Gain	Error Gain
A	500	300	0
B	1000	500	0
C	1700	800	0
D	2600	1200	0
E	3800	3000	5000
F	6000	4800	11000
G	8500	6500	13000
H	11000	8000	15000

Manual Edit- This option allows you to view or change the gains from the default value to customize the response of the system.

Proportional Gain - Controls the overall speed of response of the system. Larger values will speed up the response of the system.

Static Gain - Controls the response to steps of less than two percent. Larger values will speed up the response of the system to small steps (the effect of static gain is more evident on larger actuators).

Error Gain - This is a dynamic gain variable that increases the gain with error size to speed the response in larger actuators. Note that smaller values increase the gain, and a setting of zero turns it off.

Open Loop- This test is a diagnostic test to check the mechanical operation of the positioner module. During this test the valve is forced to full open and full closed by driving the positioner output to its maximum and minimum values.

WARNING: Notify personnel working nearby that the valve will stroke during this procedure; otherwise, serious injury may occur.

Step Test - Allows you to monitor the response of the system to any step size that you input after pressing the function key. (Be aware that this operation will cause the valve to stroke.) The system reports the overshoot and rise time (Tr) for each step. Pressing ACCEPT will continue to stoke the system up and down and report on the response for each step. To quit the positioner tuning press CANCEL.

Stablewise – If Stablewise is not enabled, the StarPac 3 constantly attempts to obtain zero position deviation with respect to the command signal that it is receiving. On high friction valves, a small amount of "hunting" can occur. If Stablewise is enabled, additional stability will be provided on a high friction valve.

Ena/Dis – This allows the Stablewise feature to be enabled or disabled.

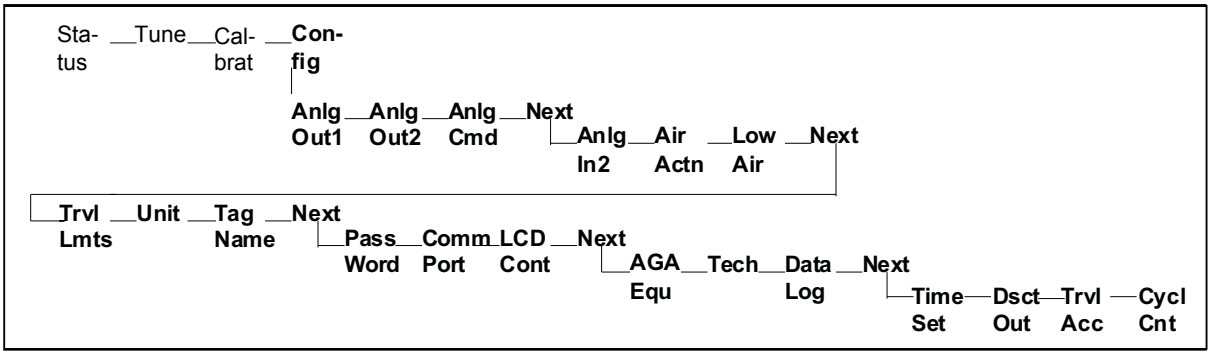
Lock Set – This determines the range of deviation within which the Stablewise algorithm will be active. When the Stem Position falls inside this window lock point, the positioner will not continue to "hunt" for zero deviation.

Rel Set – This determines the range of deviation that will need to occur for the positioner to initiate valve movement. If the positioner deviation is outside the window unlock point, the positioner will cause valve movement to occur until the deviation is back in an acceptable range.

Configuration Menu

The CONFIGURE menu is used to set up the variables and scaling for the analog inputs and outputs, actuator configuration, air supply and trip limits, units, tag name, communications, LCD controls, and individual register editing and viewing. Before entering the CALIBRATE menu, the display will indicate that the system will be taken off-line and ask you to accept that condition. While the CONFIGURE menu is open, the system is in Test mode and will not respond to control signals. To put the unit back on line, press the LAST OPTION key until the display asks, "do you want to put the unit back on line," and press ACCEPT. When you are in the CALIBRATE menu, a flashing "T" on the right side of the display will indicate that the unit is in Test mode. Certain functions may cause valve position to change unexpectedly that could affect the process if the unit is not properly isolated. The CONFIGURE menu is arranged as shown in Figure 13.

Figure 13: Configuration Menu Tree



Analog Out 1 - This option configures the first analog output channel. Select a variable from the list using the NEXT and PREVIOUS function keys on the menu. You will then be asked for a full scale output value in your selected user units. (This is the process value that corresponds to 20 mA.) The last step is to enter the offset or Zero output value in your selected user units. (This is the process value that corresponds to 4 mA.) Available output variables are:

Valve Position - Current valve position.

Liquid Flow - Current liquid flow rate.

ISA Up Stream Press - Current compensated upstream line pressure (defined as two pipe diameters upstream of the valve).

ISA Dn Stream Press - Current compensated downstream line pressure (defined as six pipe diameters downstream of the valve).

ISA Delta Pressure - Current differential pressure using the pressure definitions above.

Process Temperature - Current process temperature.

Gas Flow - Current gaseous flow rate.

Auxiliary 4-20 Input - Re-transmits the 4-20 mA signal from analog in No. 2.

Positioner Output – Current positioner output.

Register Number - Allows the selection of any internal register value as an output. If a string register is selected, zero will be displayed in the data field.

Analog Out 2 - This option configures the second analog output channel. Select a variable from the list using the NEXT and PREVIOUS function keys on the menu. You will then be asked for a full scale output value in your selected user units. (This is the process value that corresponds to 20 mA.) The last step is to enter the offset or zero output value in your selected user units. (This is the process value that corresponds to 4 mA.) Available output variables are:

Valve Position - Current valve position.

Liquid Flow - Current liquid flow rate.

ISA Up Stream Press - Current compensated upstream line pressure (defined as two pipe diameters upstream of the valve).

ISA Dn Stream Press - Current compensated downstream line pressure (defined as six pipe diameters downstream of the valve).

ISA Delta Pressure - Current differential pressure using the pressure definitions above.

Process Temperature - Current process temperature.

Gas Flow - Current gaseous flow rate.

Auxiliary 4-20 Input - Re-transmits the 4-20 mA signal from analog in No. 2.

Analog Command - This option sets up the first analog input (analog No. 1) in the StarPac 3 system. This analog channel is reserved as a control input. The signal is used either as a valve position command, if the StarPac 3 is in Manual mode, or as the controller setpoint if the StarPac 3 is in Auto mode. (The source of the command or setpoint is selected in the TUNE menu after it has been configured here.) When this option is selected you are first prompted for the interpretation of the analog signal. The signal can be interpreted as Normal (4- 20 mA = 0-100%), which means that 4 mA will indicate the 0 percent signal, or as Reverse (4-20 mA = 100-0%), which then interprets 20 mA as the 0 percent signal.

Next, you are prompted for the hold time (in seconds) that you want the system to hold the last command if the 4-20 mA signal should be lost (defined as having the signal drop below 3 mA). The last prompt requests a ramp rate that the system will use to fail the valve if the signal has been lost and the hold time has expired. A negative value will ramp the valve closed at the selected rate, and a positive value will open the valve at the selected rate. (Note that this value may be set different from the spring failure of the actuator.)

Analog In 2 - This option sets up the second analog input in the StarPac 3 system. This input can be used as an external input that is used with the internal PID controller, or as an external sensor input for the StarPac 3 to use in its internal operation. If you wish to use the input as a controller input, you must select the External PID Sensor option and the scaling for the PID input is done in the TUNE menu with the Process variable selection. If you want to feed an external sensor into the StarPac 3, select the variable from the list using the NEXT and PREVIOUS function keys on the menu. Next, you will be asked for a full scale input value in your user-defined units. (This is the process value that corresponds to the 100 percent signal.) The last step is to enter the offset or Zero input value in your user-defined units. (This is the process value that corresponds to the 0 percent signal). The available input variables are:

External PID Sensor - Configures the StarPac 3 unit to ignore the input as an internal variable, but the input may still be used as an input to the controller that is configured with the process variable selection in the TUNE menu.

Process Temperature - Uses the value from the Auxiliary input channel as the process temperature for all internal calculations in place of the StarPac 3 sensor. The electronics assumes that the Auxiliary input channel gets its signal from a temperature transmitter.

Up Stream Pressure - Uses the signal from an external pressure transmitter connected to the Auxiliary input channel as the process pressure for all internal calculations in place of the StarPac 3 sensor.

Down Stream Pressure - Uses an external pressure input as the process pressure for all internal calculations in place of the StarPac 3 sensor.

Valve Delta Pressure - Uses an external pressure input as the process differential pressure for all internal calculations (in place of the StarPac 3 differential pressure calculated by the difference from the StarPac 3 internal pressure sensors). The most common example is when a separate differential pressure transmitter is used for cases when the application cannot withstand pressure drops of at least ten percent of inlet pressure.

Molecular Weight - Uses an external molecular weight input for all internal calculations in place of the static value stored in the

StarPac 3 configuration.

Specific Gravity - Uses an external Specific Gravity input for all internal calculations in place of the static value stored in the StarPac 3 configuration.

Liquid Multiplier - This input allows you to make dynamic adjustments to the liquid flow calculation based on the value of the input.

Gas Multiplier - This input allows you to make dynamic adjustments to the gaseous flow calculation based on the value of the input.

Air Action - Used to set up the StarPac 3 for the configured actuator failure mode. ATO (Air-to-Open) is normally used for fail-closed valves, ATC (Air-to-Close) is normally used for fail-open valves. If ATC is selected and you will be using an analog command source, configure the analog command to reverse so that 4 mA equals the 100 percent position (open). The following table lists the possible configurations for linear actuators:

Table 4: Actuator Air Actions

Failure Mode	Output 2: (bottom port) is Connected to:	Output 1 (top port) is Connected to:	Spring Failure Position	Air Action
Air loss, fail-closed; Power loss, fail-closed	Actuator Top	Actuator Bottom	Above Position	ATO
Air loss, fail-closed; Power loss, fail open	Actuator Bottom	Actuator Top	Above Piston	ATC
Air loss, fail-open; Power loss, fail-open	Actuator Bottom	Actuator Top	Below Piston	ATC
Air loss, fail-open; Power loss, fail-close	Actuator Top	Actuator Bottom	Below Piston	ATO

Low Air - This option is used to set the trip parameters for low supply air to the system, which is continuously monitoring the air supply in the actuator. Using the actuator pressures, the StarPac 3 can infer the supply pressure to within five to 10 psi. If the supply pressure drops below the Low Air Trip Pressure then the positioner will attempt to hold the valve for the time specified in the hold parameter and then ramp to the spring failure position at the specified Low Air Ramp Rate.

Travel limits - (Travel limits are limits set and maintained by the system's electronics and software. These limits are only in effect when the unit has power and is not in Test mode. When power has failed or cut off to the StarPac 3, the valve will fail to its mechanical stops or limits.) This option allows you to set software limits on the travel of the valve. These limits are active in Auto and Manual modes, but they do not affect failure modes. There are three limit settings that can be independently set.

Minimum Soft Limit- This setting will stop the valve from closing beyond the specified limit even when commanded to close further. (Default value is -10 percent of travel so as to not affect valve operation)

Maximum Soft Limit- This setting will stop the valve from opening beyond the specified limit even when commanded to open further. (Default value is 110 percent of travel so as to not affect valve operation)

Minimum Travel Alert- This setting activates an alert any time that the position is below the specified limit. (Default value is -10 percent of travel turn off the indication in the normal travel range)

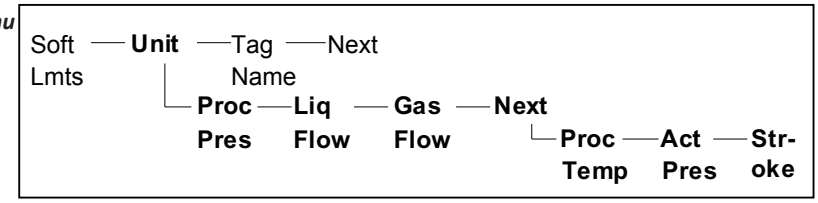
Maximum Travel Alert- This setting activates an alert any time that the position is above the specified limit. (Default value is 110 percent of travel turn off the indication in the normal travel range)

Low Minimum Signal Cutoff- When the signal drops below the specified cutoff point the positioner will fully saturate the actuator in the closed position. (Default value is 1% to insure tight shutoff at 0% signal level)

High Minimum Signal Cutoff- When the signal rises above the specified cutoff point the positioner will fully saturate the actuator in the open position. (Default value is 99% to insure full opening at 100% signal level)

Units -The StarPac 3 system has individually configurable units for Process Pressure, Liquid flow, Gas flow, Process temperature, and actuator pressure. Units for each type of process variable are set in the Unit menu. (See Figure 14)

Figure 14: Units Menu



Process Pressure - This option sets the process pressure engineering units for the StarPac 3 system. Use the NEXT and PREVIOUS function keys to select units from the following list:

PSIG - Pounds per square-inch gauge

PSIA - Pounds per square-inch absolute

kPa G - Kilopascals gauge

kPa A - Kilopascals absolute

kgscmG - Kilograms per square-centimeter gauge

kgscmA - Kilograms per square-centimeter

absolute **Bar G** - Bar gauge

Bar A - Bar absolute

Liquid Flow - Sets the liquid flow engineering units for the StarPac 3 system. Use the NEXT and PREVIOUS function keys to select units from the following list:

Usgpm - US gallons per minute

l/m - Liters per minute

lbs/hr - Pounds per hour

kg/hr - Kilograms per hour

cm/hr - Cubic meters per hour

bbl/dy - Barrels per day (42 gal/bbl)

Ukgpm - Imperial gallons per minute

CUSTOM - Allows you to create your own custom units by first entering a multiplier that will operate on the StarPac native liquid flow units which are Gallons/Minute to create your new units. Next, select the time base that relates to your flow rate of seconds, minutes, hours, or days for the totalizer to use. Then enter the name for the units you want to display. The name is limited to six characters. Lastly, enter the name that you want the totalizer to display for the totalized units.

Gas Flow - Sets the gaseous flow engineering units for the StarPac 3 system. Use the NEXT and PREVIOUS function keys to select units from the following list:

lbs/hr - Pounds per hour

kg/hr - Kilograms per hour

SCFH - Standard cubic feet per hour **MMSCFD**

- Million standard cubic feet per day

SCFM - Standard cubic feet per minute

SCMH - Standard cubic meters per hour

CUSTOM - Allows you to create your own custom units by first entering a multiplier that will operate on the StarPac native gas flow units which are Pounds/Hour to create your new units. Next you select the time base that relates to your flow rate of seconds, minutes, hours, or days for the totalizer to use. Next enter the name for the units you want to display. The name is limited to six characters. Last enter the name that you want the totalizer to display for the totalized units.

Process Temperature - Sets the process temperature engineering units for the StarPac 3 system. Use the NEXT and PREVIOUS function keys to select units from the following list:

^{0}C - Degrees Celsius

^{0}F - Degrees Fahrenheit

^{0}R - Degrees Rankine

^{0}K - Degrees Kelvin

Actuator Pressure - Sets the actuator pressure engineering units for the StarPac 3 system. Use the NEXT and PREVIOUS function keys to select units from the following list:

PSIG - Pounds per square-inch gauge

PSIA - Pounds per square-inch absolute

kPa G - Kilopascals gauge

kPa A - Kilopascals absolute

kgscmG - Kilograms per square-centimeter gauge

kgscmA - Kilograms per square-centimeter

absolute **Bar G** - Bar gauge

Bar A - Bar absolute

Stroke Unit – Sets the stroke engineering unit for the StarPac 3 system. Use the NEXT and PREVIOUS function keys to select units from the following list:

INCH – Inches **MM** –

Millimeters **CM** –

Centimeters **°Angle**

– Degrees **%** -

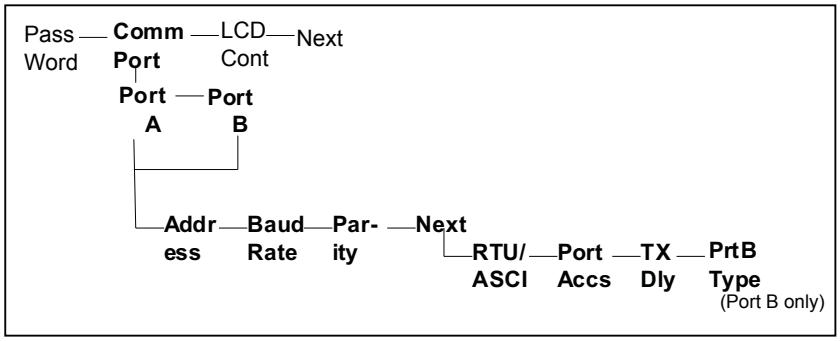
Percent

Tag Name - This option allows the user to enter a tag name that will be used as an identifier for the unit on a Modbus network.

Password - This option sets up a password to control access to the local interface. Access to the TUNE, CALIBRATE, and CONFIGURE menus is allowed only with the password after the password has been enabled. The STATUS menu is still accessible even when the password is enabled. To enable the password, press F1 and enter the password. The default password is "1234." (If the system is initialized by pressing the "0" while powering up the unit, the password will be reset to "1234." Note that control and communication parameters will also be reset with an initialize.) To disable the password, press F2. To change the password, select F3 and enter the old password, then enter the new password. Note that when entering a new password the characters are visible on the screen for verification.

Communication Settings - This option configures the communication settings for the Modbus communications ports on the StarPac 3 system. Both COMM port A and COMM port B use the same settings--they cannot be set independently. The communication settings are set in the COMM PORT menu (Figure 15).

Figure 15: Comm Port Menu



Port A / Port B - This option allows the user to configure Port A and Port B independently. By selecting Port B there is an added menu item to be able to select which input from Port B to use.

Address - This option sets the Modbus address of the StarPac 3 system. Both the A and B COMM ports have the same address; therefore, they cannot be hooked together on the same network and must be connected to different networks. The default address for a StarPac 3 is "1" after an initialization. Use the ***Up*** or ***Dn*** function keys to select the proper address. If using multiple StarPac 3 devices, begin your addressing at 2 and go up from there.

Baud Rate - This option sets the Baud Rate for the Modbus communications. Available Baud Rate settings are: 2400, 9600, 19200, 38400, and 57600. The default setting is 19200 Baud after an initialization. Use the ***Up*** or ***Dn*** function keys to select the desired Baud Rate. The baud rate will automatically change to 57600 when the USB connection is used.W

Parity - This option sets the Parity for the Modbus communications. Available Parity settings are: None, Even, and Odd. The default setting is Odd after an initialization. Use the NEXT or PREVIOUS function keys to select the proper Parity.

RTU / ASCII - This option sets the communication mode for the Modbus communications. Available communications mode settings are: ASCII and RTU. The default setting is RTU after an initialization. Use the NEXT or PREVIOUS function keys to select the proper communication mode. When ASCII mode is selected, Parity must be set to None.

Port Access - This option allows you to control the priority of the communication ports. A port may be configured so that it can only be used for monitoring by a remote device. Use the NEXT and PREVIOUS function keys to select the access from the following list:

A - R/W B - R/W - Both ports allow read/write access

A - R/W B - RO - "A" port allows read/write access; "B" port is read only.

A - RO B - R/W - "A" port is read only; "B" port allows read/write access.

Port B Type (only when port B is selected) - This option allows you to configure Communication Port B port on the StarPac 3. The port can be configured for the following:

RS-485 – You can configure Communication Port B for RS 485 communications. It will be necessary to connect wires to terminals 3 (+) and 12 (-) on the StarPac 3 terminal block.

USB – When a 2.0 mini-Ba USB cable is plugged into the StarPac 3 on the Customer Interface Board, Com Port B will automatically be configured for communication through the USB cable. The baud rate will be set to 57600. When using the StarTalk XP software, make sure the computer Com Port baud rate in is also configured to 57600.

Infrared – You can configure Communication Port B for infrared communications. It will be necessary to communicate with the infrared port on the front of the StarPac 3. The port can be located directly above the StarPac 3 label located on the keypad. You will need to use a PDA device with a keypad simulator to communicate with Communication Port B.

Transmit Delay - This setting controls the time that the StarPac 3 system will wait before answering a Modbus request. The 3.5 character setting provides the best performance for most systems. Available transmit delays are: 3.5 characters, 50 millisecond, 75 millisecond, 100 millisecond, 150 millisecond, 250 millisecond, 500 millisecond, and 1 second.

LCD Contrast – This option adjusts the viewing angle of the LCD. Use the *Up* and *Dn* function keys to adjust the viewing angle

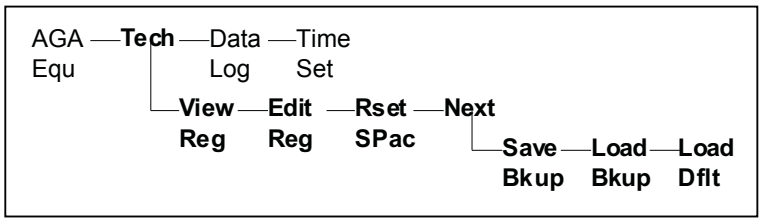
AGA Equations - This option allows you to view and select the AGA equations for calculating gas flows. Enable or Disable will be displayed on the screen. Enabling the AGA equations must be accompanied by a download of the AGA gas tables.

Enable - This option allows you to enable the AGA equations.

Disable - This option allows you to disable the AGA equations.

Technician - This option allows you to view and manipulate internal Modbus registers, backup a configuration in non-volatile RAM and reset the system operation. These options are selected from the TECHNICIAN menu. (See Figure 16 below.)

Figure 16: Technician Menu



View Register - This option allows you to view any integer or floating point Modbus register. A register map is located in the appendix. (String registers cannot be viewed with this function; however, they can be viewed by using the StarTalk software.)

Edit Register - This option allows you to view and change any read/write integer or floating point Modbus register. A register map is located in the appendix.

CAUTION: Changing register values will affect the operation of the system. String registers cannot be edited with this function. You must use the StarTalk software to edit string registers.

Reset StarPac 3 - This option will reset the system's operation (the same as powering up the unit) and will also reset some error conditions while displaying the firmware revision on the display.

Save Backup - This option will backup the current configuration to a safe area in the non-volatile RAM. Flowserve suggests that you use this option before attempting to reconfigure your system to ensure that you can restore the configuration should something go wrong.

Load Backup - This option allows you to restore a known configuration to the system by working registers from the backup NVRAM.

Load Default - This option will overwrite the complete register map in the StarPac 3 with default data. If you choose this option *all of the flow characterization data, configuration data and calibration data will be lost.* This option should only be used in the rare case that the configuration of a system has become so corrupt that all of the data will be re-entered from scratch. It is recommended that you use the StarTalk for windows software to reload your system information from the factory supplied disk.

Data Logger - This option sets the interval between data points on the internal data logger. ***NOTE:*** *You must use StarTalk software to download a data logger file from the StarPac 3.*

Time Set - This option sets the internal StarPac 3 clock. The internal clock is battery driven and keeps time whether the unit is powered or not. Use the F1 and F2 function keys to select the field to edit. Note that the time is in the 24 hour format and the date is the mm/dd/yy format.

Discreet Output – The discreet output on the StarPac 3 can be configured for an Alarm Relay Output or a Pulse Relay Output.

Alarm Relay Output – When the discreet output is configured for Alarm Relay output mode then the alarm relay will trip when an alarm occurs. The relay can be configured for normally open or normally closed. See the Contact Relay setting instructions on page 31 of this manual.

Pulse Relay Output - Configures the Pulse Out channel on the StarPac 3 system for the process variable and scaling. First you must select a variable from the list using the *Next* and *Previous* function keys on the menu. Next you are asked for a full scale output value in your selected user units. (This is the process value that corresponds to the maximum frequency.) The last step is to enter the offset or zero output value in your selected user units (this is the process value that corresponds to 0 Hz). Available output variables are the following:

Valve Position - Current valve position.

Liquid Flow - Current liquid flow rate.

ISA Up Stream Press - Current compensated upstream line pressure (defined as two pipe diameters upstream of the valve).

ISA Dn Stream Press - Current compensated downstream line pressure (defined as six pipe diameters downstream of the valve).

ISA Delta Pressure - Current differential pressure using the pressure definitions above.

Process Temperature - Current process temperature.

Gas Flow - Current gaseous flow rate.

Auxiliary 4-20 Input - Re-transmits the 4-20 mA signal from analog in No. 2.

Positioner Output – Current positioner output.

Register Number - Allows the selection of any internal register value as an output.

10 Edit & View Fluid Specifications

The StarPac 3 system must be configured for the exact fluid that you have in your process. The factory configures the system with fluid data for your system using the information supplied with the order. Verify that the fluid data is correct for your process. The StarPac system requires the following fluid data for accurate flow calculation:

Antoine's A coefficient	register 40499
Antoine's B coefficient	register 40501
Antoine's C coefficient	register 40503
Critical Pressure in psia	register 40511
Critical Temperature in ºR	register 40513
F_K coefficient (=K/1.4)	register 40515
Molecular Weight	register 40517
Specific Gravity Reference temp in	register 40519
ºR Specific Gravity at reference	register 40521
temp Viscosity A	register 40523
Viscosity B	register 40525

The Antoine coefficients are used to calculate the vapor pressure of the fluid at the temperature measured by the K thermocouple in the StarPac according to the following equation:

$$VP = \exp\left(A - \frac{B}{T+C}\right)$$

where VP is the vapor pressure in psia, T is the temperature in R, and A, B, and C are the Antoine coefficients.

Viscosity is calculated according to the following equation:

$$Visc = A * \exp(B * T)$$

Where Visc is the fluid viscosity in centipoise, T is the process temperature measured by the thermocouple in F, and A and B are the viscosity coefficients.

These registers can be checked using either the View option of the STATUS menu or the View selection in the Tech option of the CONFIGURE menu. They can be changed using the Edit selection in the Tech option of the CONFIGURE menu.

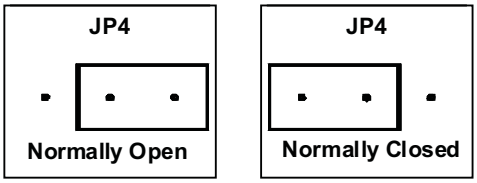
11 Setting the Jumpers

The StarPac 3 system has several jumpers that are used to configure the digital, analog and discrete I/O. The keypad needs two retaining screws removed, and the keypad connector can remain attached while the jumpers are changed or viewed as needed.

RS- 485 Termination - On the top electronic board to right of the LCD display there are two termination jumpers for the RS-485 communications. The jumper labeled JP1 enables the termination resistor for Comm A and the jumper label JP2 enables the termination resistor for Comm B. These jumpers should only be installed on the two most remote devices on the network. Count the host computer as any other device. For example, a single StarPac 3 system is communicating with a host PC in the control room. The StarPac 3 unit and the RS-485 driver in the host computer would each require a termination jumper. Remove the termination jumpers in the devices not considered to be the most remote. Using more than two termination jumpers in a network may cause the RS-485 communications to fail.

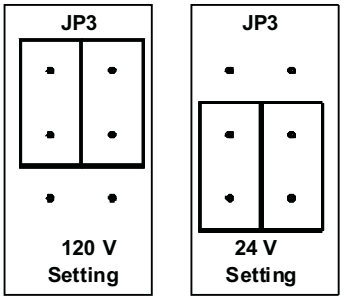
Contact Relay Setting – On the lower right hand side of the electronic board assembly on the bottom board is a three position jumper labeled "JP3." This jumper, if set in the A-B position, configures the relay to Normally-open operation. If set to the B-C position, the jumper configures the relay to Normally-closed operation.

Figure 17: Contact Relay Jumper



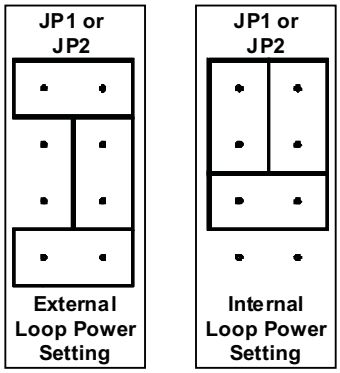
Discrete Input Range Selection - On the lower right hand side of the electronic board assembly on the bottom board is a six position jumper labeled "JP4." There are 2 jumpers that must be moved together to set the voltage input range. The jumpers are oriented vertically and with both jumpers in the upper position the input is set to trigger on 120V AC or DC. With both jumpers in the lower position the input is set to trigger on 24V AC or DC.

Figure 18: Discrete Input Range Jumper



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

Figure 19: Analog Input Power Jumpers



12 Troubleshooting

If you experience problems with your system, check the following list for some common solutions.

LCD blank and no system response - Check 24 VDC supply polarity and capacity (>100 mA). Verify top board connector is fully engaged.

LCD Hard to view - In the CONFIGURE menu adjust the contrast for a better viewing angle.

LCD active, unit will not respond to position or control commands, and the analog outputs do not change - Check to see if the unit is in Test mode by looking for a flashing "T" on the right side of the display. The unit will be in Test mode any time you are in the CALIBRATE or CONFIGURE menu. If you are in the CALIBRATE or CONFIGURE menu, use the LAST OPTION key to move up to the top of the menu and exit from Test mode. If that does not clear the flashing "T" from the display, go to the TUNE menu and use the mode command to put the system in Auto or Manual mode. If the system displays a flashing "E" or "A" on the left side of the display, check the cause of the error or alarm using the ERR/ALRM option in the STATUS menu. If the Alarm is a trip condition, then you can view the cause of the trip by setting the ROW1 variable to show Mode/Status in the STATUS menu.

System will not respond to discrete commands - Check jumper selection to make sure the input is set to the proper range and that the system is not in Test mode.

Pressure sensors appear to saturate prematurely - Check the rating of the sensors in the system information option of the STATUS menu to verify the rating (the rating is also etched on the sensor). Check the sensor gain (set in the CALIBRATE menu) in the P1 & P2 option (the standard range is 30 mV < out < 60 mV).

Stroke calibration aborts or hangs - Check the air supply and make sure it is stable. A regulator may be required to stabilize the air supply in some systems.

Appendix A

System Setup Checklist

A. Power

- (24) VDC Power at least 100 mA, 150 mA if using StarPac 3 power for the Analog Inputs
- Polarity correct.
- Local Display ON. If not check Power Supply

B. System Communications (if connected to a remote computer)

- RS-485 converter properly installed or attached to computer
- Signal polarity correct.
- Modbus device address set in StarPac 3 device; refer to StarPac 3 IOM
- Start StarTalk software or DTM
- Configure communications in software and hardware to match. Refer to Communications section of this manual and the onboard Help in the StarTalk XP Software or DTM. If using USB cable, the configuration is automatically 57600 Baud.
- Communications work. If not, recheck settings.

C. Calibration Checks

- Air supply turned on
- Check status screens to verfy system calibration; refer to software section.
- Valve stroke calibration to remove installation and handling offsets; refer to calibration section.
- Verify process sensor calibration; recalibrate if needed.
- It is recommended that a Quick-Cal before after the valve is installed on site.

D. System Configuration; refer to Configure StarPac section for details

- Set or verify failure modes.
- Set or verify analog output.
- Set or verify command and mode source.
- Set or verify stroke limits
- Set or verify LCD display options.
- Check positioner response and set gain to control speed.
- Set units.
- Set or verify tag name.

E. Automatic PID Operation; refer to Tune PID section

- Select process variable.
- Input full scale range.
- Set initial PID parameters. Default PID settings should be P (Band) = 250, I = 50, D = 0.
- Begin Automatic mode and tune system.

F. Other Options; refer to Monitor Operation section

- Reset Totalizer

G. Other Options; refer to Data Acquisition section

- Set and start Data Logger function.
- Collect and save installed signature, if desired.

H. Save Installed Configuration

- Save configuration on device and on computer
- Make backup copy and archive.

Appendix B
Detailed StarPac 3 Register Menu

This reference will aid you in understanding the configuration of the StarPac 3 register table. Registers are described and notes are provided that give the range and more detailed information.

The StarPac 3 register table consists of three different types of information: integers, IEEE floating point numbers and strings. These types can have a read only (RO) access attribute or a read/write (RW) access attribute. You can only read RO registers. Writing to a RO register will generate an exception error. You can both read and write to RW registers.

The register numbering is as follows: a 30000 base indicates RO integers, a 40000 base indicates RW integers, a 70000 base indicates floating point numbers, and a 50000 base indicates strings. For example, a register number of 30003 indicates a RO integer.

Two contiguous integer registers make up a floating point register. You will get an exception response if you try to access into the middle of a floating point register.

Registers making up bit fields follow the MSB/LSB (Most Significant Byte/Least Significant Byte) format.

Internally, Flowserve calculates the StarPac 3 variable numbers by taking the module of the register number and 10,000 and subtracting 1. For example, register number 30001 would become variable number 0.

Table 4: Integer Registers

Register Number	Attribute	Description	Notes
30001	RO	ADC value for cylinder bottom pressure	-32768 to 32767
30002	RO	ADC value for cylinder top pressure	-32768 to 32767
30003	RO	ADC value for 4-20mA command	0 to 16383
30004	RO	ADC value for ambient temperature	-32768 to 32767
30005	RO	ADC value for 4-20mA auxillary	0 to 16383
30006	RO	ADC value for P1 channel	-32768 to 32767
30007	RO	ADC value for P2 channel	-32768 to 32767
30008	RO	ADC value for position channel	0 to 65535
30009	RO	ADC value for process temperature channel	0 to 16383
30010	RO	Current flow state (liquid/gas)	0 = liquid choked 1= liquid non-choked 2= gas non-choked 3 = gas choked
30011	RO	Fixed scale normalized process variable	0 to 9999
30012	RO	Variable scale normalized liquid flow	0 to 9999
30013	RO	Variable scale normalized gas flow	0 to 9999
300014	RO	Variable scale normalized P1 isa	0 to 9999
30015	RO	Variable scale normalized P2 isa	0 to 9999
30016	RO	Variable scale normalized delta P	0 to 9999
30017	RO	Variable scale normalized process temperature	0 to 9999

Register Number	Attribute	Description	Notes
30018	RO	Variable scale normalized auxiliary input	0 to 9999
30019	RO	Fixed scale normalized 4-20mA command	0 to 9999
30020	RO	Fixed scale normalized position	0 to 9999
30021	RO	Fixed scale normalized set point command	0 to 9999
30022	RO	Data from parallel input channel	-32768 to 32767
30023	RO	Device address of valve	0 to 255
40024	RW	Process Pressure Unit Selection	40 = Pounds/square inch gage 41 = pounds/square inch absolute 42 = kilopascals gage 43 = kilopascals absolute 44 = kilograms/square centimeter gage 45 = kilograms/square centimeter absolute 46 = bar gage 47 = bar absolute 48-59 = expansion
40025	RW	Liquid flow unit selection	1 = US gallons/minute 2 = liters/minute 3 = pounds/hour 4 = kilograms/hour 5 = cubic meters/hour 6 = barrels/day 7 = UK gallons/minute 8 = User supplied conversion 9-19 = expansion
40026	RW	Gas flow unit selection	20 = pounds/hour 21 = kilograms/hour 22 = standard cubic feet/hour 23 = million standard cubic feet/day 24 = standard cubic feet/minute 25 = standard cubic meters/hour 26 = User supplied conversion 27-39 = expansion
40027	RW	Actuator press unit selection	40 = Pounds/square inch gage 41 = pounds/square inch absolute 42 = kilopascals gage 43 = kilopascals absolute 44 = kilograms/square centimeter gage 45 = kilograms/square centimeter absolute 46 = bar gage 47 = bar absolute 48-59 = expansion
40028	RW	Process temperature unit selection	60 = degrees Celsius 61 = degrees Fahrenheit 62 = degrees Rankine 63 = degrees Kelvin 64-69 = expansion

Register Number	Attribute	Description	Notes
40029	RW	Atmospheric press unit selection (Inactive)	40 = pounds/square inch gage 41 = pounds/square inch absolute 42 = kilopascals gage 43 = kilopascals absolute 44 = kilograms/square centimeter gage 45 = kilograms/square centimeter absolute 46 = bar gage 47 = bar absolute 48-59 = expansion
40030	RW	Mechanical stroke unit selection	70 = percent 71 = inches 72 = millimeters 73 = centimeters 74 = degrees rotation
30031	RO	Process variable unit type	0 to 70 see unit list above
40032	RW	PID proportional band (%)	1 to 9999
40033	RW	PID derivative time (minutes)	0 to 9999
40034	RW	PID reset rate (repeats/minutes)	0 to 9999
40035	RW	Fixed scale normalized digital SP	0 to 9999
40036	RW	Fixed scale normalized digital command	0 to 9999
40037	RW	Base mode source (digital/discrete/ remote)	0 = digital 1 = discrete 2 = remote
40038	RW	Base mode selection	0 = calibration mode 1 = manual mode 2 = automatic mode
40039	RW	Process variable source	1 = liquid flow 2 = upstream (P1) pressure 3 = downstream (P2) pressure 4 = differential pressure 5 = process temperature 6 = gas flow 7 = auxiliary 4-20mA input
40040	RW	PID reverse/direct action	0 = reverse 1 = direct
40041	RW	Command source (analog/digital/remote)	0 = analog 4-20mA input 1 = digital 2 = remote
40042	RW	Air-to-open/close	0 = Air-to-open 1 = Air-to-close
40043	RW	4-20mA feedback output source variable	0 = Position 1 = Liquid flow 2 = Upstream (P1) pressure 3 = Downstream (P2) pressure 4 = Delta pressure 5 = Temperature 6 = Gas flow 7 = Auxiliary 4-20mA input 8 = Positioner Output 9 = Register Number

Register Number	Attribute	Description	Notes
40044	RW	Flow totalizer source (liquid/gas)	0 = liquid 1 = gas
40045	RW	Positioner source (bypass/normal)	0 = bypass 1 = normal
40046	RW	Analog command signal state	0 = normal (4mA = 0%) 1 = inverted (20mA = 0%)
40047	RW	Time to hold SP on loss of command (sec)	0 to 9999
40048	RW	Pbot ADC value corresponding to 0 psig	-32768 to 32767
40049	RW	Pbot ADC value corresponding to MAX_PRESS	-32768 to 32767
40050	RW	Ptop ADC value corresponding to 0 psig	-32768 to 32767
40051	RW	Ptop ADC value corresponding to MAX_PRESS	-32768 to 32767
40052	RW	Cmd ADC value corresponding to 4mA	0 to 16384
40053	RW	Cmd ADC value corresponding to 20mA	0 to 16384
40054	RW	DAC #1 output code	0 to 65535
40055	RW	DAC #1 value corresponding to 0% position	0 to 65535
40056	RW	DAC #1 value corresponding to 100% position	0 to 65535
40057	RW	DAC #2 output code	0 to 65535
40058	RW	DAC #2 value corresponding to 4mA output	0 to 65535
40059	RW	DAC#2 value corresponding to 20mA output	0 to 65535
40060	RW	Tamb ADC value corresponding to 0 degrees F	-327680 to 32767
40061	RW	Tamb ADC value corresponding to 185 degrees F	-32768 to 32767
40062	RW	Aux ADC value corresponding to 4mA	0 to 16384
40063	RW	Aux ADC value corresponding to 20mA	0 to 16384
40064	RW	P1 ADC value corresponding to 0 psig	-32768 to 32767
40065	RW	Value corresponding to PROC_MAX_PRESS	-32768 to 32767
40066	RW	P2 Adc value corresponding to 0 psig	-32768 to 32767
40067	RW	Value corresponding to PROC_MAX_PRESS	-32768 to 32767
40068	RW	Value corresponding to 0% position	-32768 to 32767
40069	RW	Value corresponding to 100% position	-32768 to 32767
40070	RW	Value corresponding to minimum Tpro	0 to 16384
40071	RW	Value corresponding to PROC_MAX_TEMP	0 to 16384
40072	RW	Number of seconds between data points	0 to 9999
40073	RW	Triggers a totalizer reset	0 = totalize normally 1 = reset totalizer
40074	RW	Triggers a travel accumulator reset	0 = accumulate travel normally 1 = reset travel accumulator

Register Number	Attribute	Description	Notes
40075	RW	Triggers a cycle counter reset	0 = accumulate cycles normally 1 = reset cycle counter
40076	RW	Loads real time register 41275 from the RTC	0 = normal operation 1 = triggers transfer of time/date to register 41275
40077	RW	Loads the RTC from real time register 41275	0 = normal operation 1 = triggers setting of rime/date to register 41275
40078	RW	Triggers scaler factors to be recalculated	0 = normal operation 1 = triggers recalculation
40079	RW	Signature flag	0 = function complete 1 = start ramp test 2 = start step test
40080	RW	Number of data packet to be read	1 to 650
40081	RW	Loads a signature packet into register space	0 = normal operation 1 = triggers packet number requested 40080 to be loaded in packet registers 30661-30681
40082	RW	Loads a logger packet into register space	0 = normal operation 1 - triggers packet number requested in 40080 to be loaded in packet registers 30661-30685
30083	RO	Number of signature packets available	0 to 650
30084	RO	Number of logger packets available	0 to 300
30085	RO	Signature/Logger ttl_in data	-32768 to 32767
30086	RW	Variable pointer for Tpro (flow calc)	-1 to 1023
40087	RW	Variable pointer for P1 (flow calc)	-1 to 1023
40088	RW	Variable pointer for P2 (flow calc)	-1 to 1023
40089	RW	Variable pointer for gf (flow calc)	-1 to 1023
40090	RW	Variable pointer for M (flow calc)	-1 to 1023
40091	RW	Variable pointer for liquid correction factor	-1 to 1023
40092	RW	Variable pointer for gas correction factor	-1 to 1023
40093	RW	Variable pointer for dP (flow calc)	-1 to 1023
40094	RW	FB 17 input '#1' variable pointer	-1 to 1023
40095	RW	FB 17 input '#2' variable pointer	-1 to 1023
40096	RW	FB 17 input '#3' variable pointer	-1 to 1023
40097	RW	FB 17 input '#4' variable pointer	-1 to 1023
40098	RW	FB 17 input '#5' variable pointer	-1 to 1023
40099	RW	FB 17 input '#6' variable pointer	-1 to 1023
40100	RW	FB 17 input '#7' variable pointer	-1 to 1023

Register Number	Attribute	Description	Notes
40101	RW	FB 17 input '#8' variable pointer	-1 to 1023
40102	RW	FB 17 input '#9' variable pointer	-1 to 1023
40103	RW	FB 17 input '#10' variable pointer	-1 to 1023
30104	RO	Alarm status	-32768 to 32767
30105	RO	Hardware status	-32768 to 32767
30106	RO	Sensor status	-32768 to 32767
30107	RO	Alert/Trip status	-32768 to 32767
40108	RW	Time to hold SP on loss of pressure (sec)	0 to 9999
40109	RW	Remote command refresh rate (sec)	0 to 30000
40110	RW	Enable mask for alarm_source bit fields	0 to 1023
40111	RW	Relay function	0 = alarm output 1 = pulse output
40112	RW	Communication port access	0 = A-RW B-RW 1 = A-RW B-RO 2 = A-RO B-RW
40113	RW	Flow factor time base	0 = /sec 1 = /min 2 = /hr 3 = /day
40114	RW	Perform positioner calibrations	0 to 4
40115	RW	Return Message delay time (see table below)	0 to 7
40116	RW	LCD display mode register	-32768 to 32767
40117	RW	LCD row #1 variable pointer	-1 to 1023
40118	RW	LCD row #2 variable pointer	-1 to 1023
40119	RW	Positioner null deadband bump	0 to 4095
40120	RW	Normal mode proportional gain for positioner	0 to 20000
40121	RW	Zero-velocity gain for positioner	0 to 20000
40122	RW	Null offset for positioner	2250 to 3250
40123	RW	Initiates FLASH program function	0 to 1
30124	RO	ADC value for inner loop hall sensor	0 to 16383
30125	RO	Void Integer Register	0
30126	RO	Void Integer Register	0
40127	RW	Enable register for keypad password function	0 to 1
40128	RW	Variable pointer for Analog Output #1	-1 to 1023
40129	RW	Variable pointer for Pulse Relay Output	-1 to 1023
30130	RO	DAC value for positioner	0 to 4095

Register Number	Attribute	Description	Notes
40131	RW	Actuator type: 0 - Linear, 1 - Rotary	0 to 1
40132	RW	P1 & P2 ADC PGA selection	0 to 14
40133	RW	WDT reset exception vector # (CPU32 pg 6-2)	0 to 1
40134	RW	Error dependent gain for positioner	0 to 65535
40135	RW	LCD viewing angle bias (default: 117)	0 to 255
40136	RW	LCD backlight on time (seconds) (NOT ACTIVE IN SP3)	-1 to 3600
40137	RW	Positioner characterization enable	0 = Disabled 1 = Enabled
40138	RW	Actuator stabilization timeout (sec)	10 to 600
40139	RW	Time between training log data points (sec)	0 to 9999
40140	RW	Number of data points taken before & after an event	1 to 20
40141	RW	Loads a training log packet into register space	0 to 1
30142	RO	Number of logger packets available	0 to 300
40143	RW	Triggers the training log buffer to be filled with 0's	0 to 1
30144	RO	Void Integer Register	0
40145	RW	External keypad data entry (see Keypad.doc)	0 to 255
40146	RW	Enable mask for alert_status bit fields	0 to 511
40147	RW	1: Store to baseline, 2: Read from baseline	0 to 2
40148	RW	AGA 8 gas equations enable (1=enable, 0=disable)	0 to 1
40149	RW	AGA Table download Index	0 to 512
40150	RW	Inner Loop Gain value	0 to 16
40151	RW	Inner Loop Neg Gain value	0 to 16
40152	RW	Auto Tune Enabled (1=enabled, 0=disabled)	0 to 1
40153	RW	Tuning switch Position (A - H)	0 to 8
40154	RW	Stable Wise Enabled (1=enabled, 0=disabled)	0 to 1
40155	RW	Reset alarms (1=reset)	0 to 1
30350	RO	Void Integer Register	0
42051	RW	Integer table pointer #1 (Flowserve use only)	0 to 349
42052	RW	Integer table pointer #2 (Flowserve use only)	0 to 349
42053	RW	Integer table pointer #3 (Flowserve use only)	0 to 349
42054	RW	Integer table pointer #4 (Flowserve use only)	0 to 349
42055	RW	Integer table pointer #5 (Flowserve use only)	0 to 349
42056	RW	Integer table pointer #6 (Flowserve use only)	0 to 349
42057	RW	Integer table pointer #7 (Flowserve use only)	0 to 349

Register Number	Attribute	Description	Notes
42058	RW	Integer table pointer #8 (Flowserve use only)	0 to 349
42059	RW	Integer table pointer #9 (Flowserve use only)	0 to 349
42060	RW	Integer table pointer #10 (Flowserve use only)	0 to 349
42061	RW	Integer table pointer #11 (Flowserve use only)	0 to 349
42062	RW	Integer table pointer #12 (Flowserve use only)	0 to 349
42063	RW	Integer table pointer #13 (Flowserve use only)	0 to 349
42064	RW	Integer table pointer #14 (Flowserve use only)	0 to 349
42065	RW	Integer table pointer #15 (Flowserve use only)	0 to 349
42066	RW	Integer table pointer #16 (Flowserve use only)	0 to 349
42067	RW	Integer table pointer #17 (Flowserve use only)	0 to 349
42068	RW	Integer table pointer #18 (Flowserve use only)	0 to 349
42069	RW	Integer table pointer #19 (Flowserve use only)	0 to 349
42070	RW	Integer table pointer #20 (Flowserve use only)	0 to 349
42071	RW	Integer table pointer #21 (Flowserve use only)	0 to 349
42072	RW	Integer table pointer #22 (Flowserve use only)	0 to 349
42073	RW	Integer table pointer #23 (Flowserve use only)	0 to 349
42074	RW	Integer table pointer #24 (Flowserve use only)	0 to 349
42075	RW	Integer table pointer #25 (Flowserve use only)	0 to 349
42076	RW	Integer table pointer #26 (Flowserve use only)	0 to 349
42077	RW	Integer table pointer #27 (Flowserve use only)	0 to 349
42078	RW	Integer table pointer #28 (Flowserve use only)	0 to 349
42079	RW	Integer table pointer #29 (Flowserve use only)	0 to 349
42080	RW	Integer table pointer #30 (Flowserve use only)	0 to 349
42081	RW	Integer table pointer #31 (Flowserve use only)	0 to 349
42082	RW	Integer table pointer #32 (Flowserve use only)	0 to 349
42083	RW	Integer table pointer #33	0 to 349
42084	RW	Integer table pointer #34	0 to 349
42085	RW	Integer table pointer #35	0 to 349
42086	RW	Integer table pointer #36	0 to 349
42087	RW	Integer table pointer #37	0 to 349
42088	RW	Integer table pointer #38	0 to 349
42089	RW	Integer table pointer #39	0 to 349
42090	RW	Integer table pointer #40	0 to 349
42091	RW	Integer table pointer #41	0 to 349

Register Number	Attribute	Description	Notes
42092	RW	Integer table pointer #42	0 to 349
42093	RW	Integer table pointer #43	0 to 349
42094	RW	Integer table pointer #44	0 to 349
42095	RW	Integer table pointer #45	0 to 349
42096	RW	Integer table pointer #46	0 to 349
42097	RW	Integer table pointer #47	0 to 349
42098	RW	Integer table pointer #48	0 to 349
42099	RW	Integer table pointer #49	0 to 349
42100	RW	Integer table pointer #50	0 to 349
42101	RW	Integer table pointer #51	0 to 349
42102	RW	Integer table pointer #52	0 to 349
42103	RW	Integer table pointer #53	0 to 349
42104	RW	Integer table pointer #54	0 to 349
42105	RW	Integer table pointer #55	0 to 349
42106	RW	Integer table pointer #56	0 to 349
42107	RW	Integer table pointer #57	0 to 349
42108	RW	Integer table pointer #58	0 to 349
42109	RW	Integer table pointer #59	0 to 349
42110	RW	Integer table pointer #60	0 to 349
42111	RW	Integer table pointer #61	0 to 349
42112	RW	Integer table pointer #62	0 to 349
42113	RW	Integer table pointer #63	0 to 349
42114	RW	Integer table pointer #64	0 to 349
42115	RW	Floating-point table pointer #1 (Flowserve use only)	350 to 1248
42116	RW	Floating-point table pointer #2 (Flowserve use only)	350 to 1248
42117	RW	Floating-point table pointer #3 (Flowserve use only)	350 to 1248
42118	RW	Floating-point table pointer #4 (Flowserve use only)	350 to 1248
42119	RW	Floating-point table pointer #5 (Flowserve use only)	350 to 1248
42120	RW	Floating-point table pointer #6 (Flowserve use only)	350 to 1248
42121	RW	Floating-point table pointer #7 (Flowserve use only)	350 to 1248
42122	RW	Floating-point table pointer #8 (Flowserve use only)	350 to 1248
42123	RW	Floating-point table pointer #9 (Flowserve use only)	350 to 1248
42124	RW	Floating-point table pointer #10 (Flowserve use only)	350 to 1248
42125	RW	Floating-point table pointer #11 (Flowserve use only)	350 to 1248

Register Number	Attribute	Description	Notes
42126	RW	Floating-point table pointer #12 (Flowserve use only)	350 to 1248
42127	RW	Floating-point table pointer #13 (Flowserve use only)	350 to 1248
42128	RW	Floating-point table pointer #14 (Flowserve use only)	350 to 1248
42129	RW	Floating-point table pointer #15 (Flowserve use only)	350 to 1248
42130	RW	Floating-point table pointer #16 (Flowserve use only)	350 to 1248
42131	RW	Floating-point table pointer #17 (Flowserve use only)	350 to 1248
42132	RW	Floating-point table pointer #18 (Flowserve use only)	350 to 1248
42133	RW	Floating-point table pointer #19 (Flowserve use only)	350 to 1248
42134	RW	Floating-point table pointer #20 (Flowserve use only)	350 to 1248
42135	RW	Floating-point table pointer #21 (Flowserve use only)	350 to 1248
42136	RW	Floating-point table pointer #22 (Flowserve use only)	350 to 1248
42137	RW	Floating-point table pointer #23 (Flowserve use only)	350 to 1248
42138	RW	Floating-point table pointer #24 (Flowserve use only)	350 to 1248
42139	RW	Floating-point table pointer #25 (Flowserve use only)	350 to 1248
42140	RW	Floating-point table pointer #26 (Flowserve use only)	350 to 1248
42141	RW	Floating-point table pointer #27 (Flowserve use only)	350 to 1248
42142	RW	Floating-point table pointer #28 (Flowserve use only)	350 to 1248
42143	RW	Floating-point table pointer #29 (Flowserve use only)	350 to 1248
42144	RW	Floating-point table pointer #30 (Flowserve use only)	350 to 1248
42145	RW	Floating-point table pointer #31 (Flowserve use only)	350 to 1248
42146	RW	Floating-point table pointer #32 (Flowserve use only)	350 to 1248
42147	RW	Floating-point table pointer #33	350 to 1248
42148	RW	Floating-point table pointer #34	350 to 1248
42149	RW	Floating-point table pointer #35	350 to 1248
42150	RW	Floating-point table pointer #36	350 to 1248
42151	RW	Floating-point table pointer #37	350 to 1248
42152	RW	Floating-point table pointer #38	350 to 1248
42153	RW	Floating-point table pointer #39	350 to 1248
42154	RW	Floating-point table pointer #40	350 to 1248
42155	RW	Floating-point table pointer #41	350 to 1248
42156	RW	Floating-point table pointer #42	350 to 1248
42157	RW	Floating-point table pointer #43	350 to 1248
42158	RW	Floating-point table pointer #44	350 to 1248
42159	RW	Floating-point table pointer #45	350 to 1248

Register Number	Attribute	Description	Notes
42160	RW	Floating-point table pointer #46	350 to 1248
42161	RW	Floating-point table pointer #47	350 to 1248
42162	RW	Floating-point table pointer #48	350 to 1248
42163	RW	Floating-point table pointer #49	350 to 1248
42164	RW	Floating-point table pointer #50	350 to 1248
42165	RW	Floating-point table pointer #51	350 to 1248
42166	RW	Floating-point table pointer #52	350 to 1248
42167	RW	Floating-point table pointer #53	350 to 1248
42168	RW	Floating-point table pointer #54	350 to 1248
42169	RW	Floating-point table pointer #55	350 to 1248
42170	RW	Floating-point table pointer #56	350 to 1248
42171	RW	Floating-point table pointer #57	350 to 1248
42172	RW	Floating-point table pointer #58	350 to 1248
42173	RW	Floating-point table pointer #59	350 to 1248
42174	RW	Floating-point table pointer #60	350 to 1248
42175	RW	Floating-point table pointer #61	350 to 1248
42176	RW	Floating-point table pointer #62	350 to 1248
42177	RW	Floating-point table pointer #63	350 to 1248
42178	RW	Floating-point table pointer #64	350 to 1248
42179	*	Integer variable #1 (Flowserve use only)	*
42180	*	Integer variable #2 (Flowserve use only)	*
42181	*	Integer variable #3 (Flowserve use only)	*
42182	*	Integer variable #4 (Flowserve use only)	*
42183	*	Integer variable #5 (Flowserve use only)	*
42184	*	Integer variable #6 (Flowserve use only)	*
42185	*	Integer variable #7 (Flowserve use only)	*
42186	*	Integer variable #8 (Flowserve use only)	*
42187	*	Integer variable #9 (Flowserve use only)	*
42188	*	Integer variable #10 (Flowserve use only)	*
42189	*	Integer variable #11 (Flowserve use only)	*
42190	*	Integer variable #12 (Flowserve use only)	*
42191	*	Integer variable #13 (Flowserve use only)	*
42192	*	Integer variable #14 (Flowserve use only)	*
42193	*	Integer variable #15 (Flowserve use only)	*

Register Number	Attribute	Description	Notes
42194	*	Integer variable #16 (Flowserve use only)	*
42195	*	Integer variable #17 (Flowserve use only)	*
42196	*	Integer variable #18 (Flowserve use only)	*
42197	*	Integer variable #19 (Flowserve use only)	*
42198	*	Integer variable #20 (Flowserve use only)	*
42199	*	Integer variable #21 (Flowserve use only)	*
42200	*	Integer variable #22 (Flowserve use only)	*
42201	*	Integer variable #23 (Flowserve use only)	*
42202	*	Integer variable #24 (Flowserve use only)	*
42203	*	Integer variable #25 (Flowserve use only)	*
42204	*	Integer variable #26 (Flowserve use only)	*
42205	*	Integer variable #27 (Flowserve use only)	*
42206	*	Integer variable #28 (Flowserve use only)	*
42207	*	Integer variable #29 (Flowserve use only)	*
42208	*	Integer variable #30 (Flowserve use only)	*
42209	*	Integer variable #31 (Flowserve use only)	*
42210	*	Integer variable #32 (Flowserve use only)	*
42211	*	Integer variable #33	*
42212	*	Integer variable #34	*
42213	*	Integer variable #35	*
42214	*	Integer variable #36	*
42215	*	Integer variable #37	*
42216	*	Integer variable #38	*
42217	*	Integer variable #39	*
42218	*	Integer variable #40	*
42219	*	Integer variable #41	*
42220	*	Integer variable #42	*
42221	*	Integer variable #43	*
42222	*	Integer variable #44	*
42223	*	Integer variable #45	*
42224	*	Integer variable #46	*
42225	*	Integer variable #47	*
42226	*	Integer variable #48	*
42227	*	Integer variable #49	*

Register Number	Attribute	Description	Notes
42228	*	Integer variable #50	*
42229	*	Integer variable #51	*
42230	*	Integer variable #52	*
42231	*	Integer variable #53	*
42232	*	Integer variable #54	*
42233	*	Integer variable #55	*
42234	*	Integer variable #56	*
42235	*	Integer variable #57	*
42236	*	Integer variable #58	*
42237	*	Integer variable #59	*
42238	*	Integer variable #60	*
42239	*	Integer variable #61	*
42240	*	Integer variable #62	*
42241	*	Integer variable #63	*
42242	*	Integer variable #64	*

RO - Read Only
RW - Read/Write
* - Dependent upon the selected register

Floating Point Registers

Notice that floating point register numbers go up by two instead of up by one. This is because floating point registers consist of two adjacent registers. this allows the device to have a four byte area in which to store IEEE floating point values.

Table 5: Floating Point Registers

Register Number	Attribute	Description	Notes
30351	RO	Fluid vapor pressure	IEEE 754
30353	RO	Fluid specific gravity	IEEE 754
30355	RO	Process temperature (deg. R)	IEEEE754
30357	RO	Calculated Fl	IEEE 754
30359	RO	Calculated z	IEEE 754
30361	RO	Calculated Xt	IEEE 754
30363	RO	Valve delta pressure to produce choked flow	IEEE 754
30365	RO	Valve delta pressure	IEEE 754
30367	RO	Totalized flow (user units)	IEEE 754
30369	RO	Totalized time (seconds)	IEEE 754
30371	RO	Totalized liquid flow (user units)	IEEE 754

Register Number	Attribute	Description	Notes
30373	RO	Totalized gas flow (user units)	IEEE 754
30375	RO	Position (%) before temperature comp.	IEEE 754
30377	RO	DAC #2 output (%)	IEEE 754
30379	RO	Ambient Temperature (deg. F)	IEEE 754
30381	RO	P1 valve (psig)	IEEE 754
30383	RO	P2 valve (psig)	IEEE 754
30385	RO	Cylinder bottom pressure (user units)	IEEE 754
30387	RO	Cylinder top pressure (user units)	IEEE 754
30389	RO	DAC #1 output (%)	IEEE 754
30391	RO	Valve Cv at current position	IEEE 754
30393	RO	Calculated liquid flow (user units)	IEEE 754
30395	RO	Calculated gas flow (user units)	IEEE 754
30397	RO	P1 ISA (user units)	IEEE 754
30399	RO	P2 ISA (user units)	IEEE 754
30401	RO	Delta P ISA (user units)	IEEE 754
30403	RO	Process temperature (user units)	IEEE 754
30405	RO	4-20mA command (%)	IEEE 754
30407	RO	Position feedback (%)	IEEE 754
30409	RO	4-20mA auxiliary input (%)	IEEE 754
30411	RO	Set point command (user units)	IEEE 754
30413	RO	Current process variable (user units)	IEEE 754
40415	RW	Measured mechanical stroke of valve	0.0001 to 100
40417	RW	Fixed scale normalized max. position stop	-20 to 120
40419	RW	Fixed scale normalized min. position stop	-20 to 120
40421	RW	Auxiliary input (%) equal to 100% of PV	0.1 to 10E3
40423	RW	Dpisa (user units) equal to 100% of PV	0.1 to 1E9
40425	RW	Liquid flow (user units) = 100% of PV	0.1 to 1E9
40427	RW	Gas flow (user units) equal to 100% of PV	0.1 to 1E9
40429	RW	P1isa (user units) equal to 100% of PV	0.1 to 1E9
40431	RW	P2isa (user units) equal to 100% of PV	0.1 to 1E9
40433	RW	Tpro (user units) equal to 100% of PV	-500 to 5000
40435	RW	Tpro (user units) equal to 0% of PV	-500 to 5000
40437	RW	Position (%) equal to 20mA at DAC #2	0.1 to 10E3
40439	RW	Position (%) equal to 4mA at DAC #2	-20 to 120

Register Number	Attribute	Description	Notes
40441	RW	Auxiliary input (%) equal to 20mA at DAC #2	0.1 to 10E3
40443	RW	Auxiliary input (%) equal to 4mA at DAC#2	-20 to 120
40445	RW	Dpisa (user units) = 20mA at DAC #2	0.1 to 1E9
40447	RW	Dpisa (user units) = 4mA at DAC #2	0 to 1E9
40449	RW	Liquid flow (user units) = 20mA at DAC #2	0.1 to 1E9
40451	RW	Liquid flow (user units) = 4mA at DAC #2	0 to 1E9
40453	RW	Gas flow (user units) = 20mA at DAC #2	0.1 to 1E9
40455	RW	Gas flow (user units) = 4mA at DAC #2	0 to 1E9
40457	RW	P1isa (user units) = 20mA at DAC #2	0.1 to 1E9
40459	RW	P1isa (user units) = 4mA at DAC #2	0 to 1E9
40461	RW	P2isa (user units) = 20mA at DAC #2	0.1 to 1E9
40463	RW	P2isa (user units) = 4mA at DAC #2	0 to 1E9
40465	RW	Tpro (user units) = 20mA at DAC #2	-500 to 5000
40467	RW	Tpro (user units)= 4mA at DAC #2	-500 to 5000
40469	RW	Calibration slope for cylinder bottom	-1E9 to 1E9
40471	RW	Calibration slope for cylinder top	-1E9 to 1E9
40473	RW	Calibration slope for 4-20mA command	-1E9 to 1E9
40475	RW	Calibration slope for DAC #1	-1E9 to 1E9
40477	RW	Calibration slope for Tamb	-1E9 to 1E9
40479	RW	Calibration slope for 4-20mA aux. input	-1E9 to 1E9
40481	RW	Calibration slope for P1vlv	-1E9 to 1E9
40483	RW	Calibration slope for P2vlv	-1E9 to 1E9
40485	RW	Calibration slope for position	-1E9 to 1E9
40487	RW	Calibration slope for Tpro	-1E9 to 1E9
40489	RW	Calibration slope for DAC #2	-1E9 to 1E9
40491	RW	LOC Trip condition ramp rate (%/min)	-1E6 to 1E6
40493	RW	Maximum SP error without alarm	0.1 to 100
40495	RW	Maximum SP change over 1 sec., steady state	0.1 to 100
40497	RW	Minimum supply pres without alarm (psig)	0 to 200
40499	RW	Antoines A fluid coefficient	-1000 to 1000
40501	RW	Antoines B fluid coefficient	0 to 1E6
40503	RW	Antoines C fluid coefficient	-10E3 to 10E3
40505	RW	Local atmospheric pressure (user units)	0.1 to 1000
40507	RW	Liquid flow fudge factor mulitplier	0.1 to 100

Register Number	Attribute	Description	Notes
40509	RW	Gas flow fudge factor multiplier	0.1 to 100
40511	RW	Fluid critical pressure	0.1 to 100E3
40513	RW	Fluid critical temperature	0.1 to 100E3
40515	RW	Fluid Fk coefficient	1 to 10
40517	RW	Fluid Molecular Weight	0 to 1000
40519	RW	Fluid reference temperature	0.1 to 10E3
40521	RW	Fluid specific gravity at t_ref	0.001 to 100
40523	RW	Viscosity A coefficient	-1E9 to 1E9
40525	RW	Viscosity B coefficient	-1E9 to 1E9
30527	RO	Visconsity correction factor	IEEE 754
40529	RW	Offset for Dpisa calculation	0 to 100
40531	RW	Design stroke of valve	0.001 to 100
40533	RW	A1 variable used in gas flow calculation	-1000 to 1000
40535	RW	A2 variable used in gas flow calculation	-1000 to 1000
40537	RW	Cv A1 curve fit coefficient	-1E9 to 1E9
40539	RW	Cv B1 curve fit coefficient	-1E9 to 1E9
40541	RW	Cv C1 curve fit coefficient	-1E9 to 1E9
40543	RW	Cv D1 curve fit coefficient	-1E9 to 1E9
40545	RW	Cv E1 curve fit coefficient	-1E9 to 1E9
40547	RW	Cv A2 curve fit coefficient	-1E9 to 1E9
40549	RW	Cv B2 curve fit coefficient	-1E9 to 1E9
40551	RW	Cv C2 curve fit coefficient	-1E9 to 1E9
40553	RW	Cv D2 curve fit coefficient	-1E9 to 1E9
40555	RW	Cv E2 curve fit coefficient	-1E9 to 1E9
40557	RW	Cv curve fit break point	0 to 100
40559	RW	DP A1 curve fit coefficient	-1E9 to 1E9
40561	RW	DP B1 curve fit coefficient	-1E9 to 1E9
40563	RW	DP C1 curve fit coefficient	-1E9 to 1E9
40565	RW	DP D1 curve fit coefficient	-1E9 to 1E9
40567	RW	DP E1 curve fit coefficient	-1E9 to 1E9
40569	RW	DP A2 curve fit coefficient	-1E9 to 1E9
40571	RW	DP B2 curve fit coefficient	-1E9 to 1E9
40573	RW	DP C2 curve fit coefficient	-1E9 to 1E9
40575	RW	DP D2 curve fit coefficient	-1Ei to 1E9

Register Number	Attribute	Description	Notes
40577	RW	DP E2 curve fit coefficient	-1E9 to 1E9
40579	RW	DP curve fit break point	0 to 100
40581	RW	Fl A1 curve fit coefficient	-1E9 to 1E9
40583	RW	Fl B1 curve fit coefficient	-1E9 to 1E9
40585	RW	Fl C1 curve fit coefficient	-1E9 to 1E9
40587	RW	Fl D1 curve fit coefficient	-1E9 to 1E9
40589	RW	Fl E1 curve fit coefficient	-1E9 to 1E9
40591	RW	Fl A2 curve fit coefficient	-1E9 to 1E9
40593	RW	Fl B2 curve fit coefficient	-1E9 to 1E9
40595	RW	Fl C2 curve fit coefficient	-1E9 to 1E9
40597	RW	Fl D2 curve fit coefficient	-1E9 to 1E9
40599	RW	Fl E2 curve fit coefficient	-1E9 to 1E9
40601	RW	Fl curve fit break point	0 to 100
40603	RW	Xt A1 curve fit coefficient	-1E9 to 1E9
40605	RW	Xt B1 curve fit coefficient	-1E9 to 1E9
40607	RW	Xt C1 curve fit coefficient	-1E9 to 1E9
40609	RW	Xt D1 curve fit coefficient	-1E9 to 1E9
40611	RW	Xt E1 curve fit coefficient	-1E9 to 1E9
40613	RW	Xt A2 curve fit coefficient	-1E9 to 1E9
40615	RW	Xt B2 curve fit coefficient	-1E9 to 1E9
40617	RW	Xt C2 curve fit coefficient	-1E9 to 1E9
40619	RW	Xt D2 curve fit coefficient	-1E9 to 1E9
40621	RW	Xt E2 curve fit coefficient	-1E9 to 1E9
40623	RW	Xt curve fit break point	0 to 100
40625	RW	Liquid flow min. scaling variable	0 to 1E9
40627	RW	Liquid flow max. scaling variable	0.1 to 1E9
40629	RW	Gas flow min. scaling variable	0 to 1E9
40631	RW	Gas flow max. scaling variable	0.1 to 1E9
40633	RW	P1isa min. scaling variable	0 to 1E9
40635	RW	P1isa max. scaling variable	0.1 to 1E9
40637	RW	P2isa min. scaling variable	0 to 1E9
40639	RW	P2isa max. scaling variable	0.1 to 1E9
40641	RW	Delta Pisa min. scaling variable	0 to 1E9
40643	RW	Delta Pisa max. scaling variable	0.1 to 1E9

Register Number	Attribute	Description	Notes
40645	RW	Process temp. min scaling variable	-500 to 5000
40647	RW	Process temp. max scaling variable	-500 to 5000
40649	RW	Auxiliary input min. scaling variable	-1E9 to 1E9
40651	RW	Auxiliary input max. scaling variable	-1E9 to 1E9
40653	RW	Ramp signature rate (%/min)	10 to 150
40655	RW	Step signature time (sec)	1 to 20
40657	RW	Signature starting position	-10 to 110
40659	RW	Signature stopping position	-10 to 110
30661	RO	Signature time data	IEEE 754
30663	RO	Signature/Logger Ptop data	IEEE 754
30665	RO	Signature/Logger Pbot data	IEEE 754
30667	RO	Signature/Logger dac1 data	IEEE 754
30669	RO	Signature/Logger posn data	IEEE 754
30671	RO	Signature/Logger Tpro data	IEEE 754
30673	RO	Signature/Logger P1isa data	IEEE 754
30675	RO	Signature /Logger P2isa data	IEEE 754
30677	RO	Signature/Logger flow_q data	IEEE 754
30679	RO	Signature/Logger flow_w data	IEEE 754
30681	RO	Signature/Logger aux data	IEEE 754
30683	RO	Logger setpoint data	IEEE 754
30685	RO	Logger process variable data	IEEE 754
40687	RW	Calibration offset for Tpro (deg. F)	-10E3 to 10E3
40689	RW	Maximum Posnr error without alarm	0.1 to 100
40691	RW	Maximum Posnr chg over 1 sec., steady state	0.1 to 100
40693	RW	LOP Trip condition ramp rate (%/min)	0 to 1E6
40695	RW	Cylinder supply pressure (psig)	0 to 200
30697	RO	Set point command (%)	IEEE 754
30699	RO	Current process variable (%)	IEEE 754
30701	RO	Alarm state as float	0 to 100
40703	RW	Remote mode change register	-50 to 150
40705	RW	Remote command	-50 to 150
30707	RO	Cylinder top pressure (psig)	IEEE 754
30709	RO	Cylinder bottom pressure (psig)	IEEE 754
40711	RW	user units = 20mA at AI #2	-1E9 to 1E9

Register Number	Attribute	Description	Notes
40713	RW	user units = 4mA at AI #2	-1E9 to 1E9
30715	RO	AI #2 (user units)	IEEE 754
40717	RW	User flow unit multiplier	-1E9 to 1E9
30719	RO	Void Floating-Point Register	0.0
30721	RO	Void Floating-Point Register	0.0
30723	RO	Void Floating-Point Register	0.0
30725	RO	Positioner Command (%)	IEEE 754
40727	RW	user units = 20mA at DAC #1	-1E9 to 1E9
40729	RW	user units = 4mA at DAC #1	-1E9 to 1E9
40731	RW	Full-scale pulse relay output value	-1E9 to 1E9
40733	RW	Offset pulse relay output value	-1E9 to 1E9
40735	RW	Pulse relay full scale rate (Hz)	0.1 to 256
30737	RO	Minimum recorded ambient temperature (deg. F)	IEEE 754
30739	RO	Maximum recorded ambient temperature (deg. F)	IEEE 754
30741	RO	Minimum recorded process temperature (deg. F)	IEEE 754
30743	RO	Maximum recorded process temperature (deg. F)	IEEE 754
40745	RW	Positioner characterization x-axis input point (%)	-20 to 120
40747	RW	Positioner characterization x-axis input point (%)	-20 to 120
40749	RW	Positioner characterization x-axis input point (%)	-20 to 120
40751	RW	Positioner characterization x-axis input point (%)	-20 to 120
40753	RW	Positioner characterization x-axis input point (%)	-20 to 120
40755	RW	Positioner characterization x-axis input point (%)	-20 to 120
40757	RW	Positioner characterization x-axis input point (%)	-20 to 120
40759	RW	Positioner characterization x-axis input point (%)	-20 to 120
40761	RW	Positioner characterization x-axis input point (%)	-20 to 120
40763	RW	Positioner characterization x-axis input point (%)	-20 to 120
40765	RW	Positioner characterization x-axis input point (%)	-20 to 120
40767	RW	Positioner characterization x-axis input point (%)	-20 to 120
40769	RW	Positioner characterization x-axis input point (%)	-20 to 120
40771	RW	Positioner characterization x-axis input point (%)	-20 to 120
40773	RW	Positioner characterization x-axis input point (%)	-20 to 120
40775	RW	Positioner characterization x-axis input point (%)	-20 to 120
40777	RW	Positioner characterization x-axis input point (%)	-20 to 120
40779	RW	Positioner characterization x-axis input point (%)	-20 to 120

Register Number	Attribute	Description	Notes
40781	RW	Positioner characterization x-axis input point (%)	-20 to 120
40783	RW	Positioner characterization x-axis input point (%)	-20 to 120
40785	RW	Positioner characterization x-axis input point (%)	-20 to 120
40787	RW	Positioner characterization y-axis output point (%)	-20 to 120
40789	RW	Positioner characterization y-axis output point (%)	-20 to 120
40791	RW	Positioner characterization y-axis output point (%)	-20 to 120
40793	RW	Positioner characterization y-axis output point (%)	-20 to 120
40795	RW	Positioner characterization y-axis output point (%)	-20 to 120
40797	RW	Positioner characterization y-axis output point (%)	-20 to 120
40799	RW	Positioner characterization y-axis output point (%)	-20 to 120
40801	RW	Positioner characterization y-axis output point (%)	-20 to 120
40803	RW	Positioner characterization y-axis output point (%)	-20 to 120
40805	RW	Positioner characterization y-axis output point (%)	-20 to 120
40807	RW	Positioner characterization y-axis output point (%)	-20 to 120
40809	RW	Positioner characterization y-axis output point (%)	-20 to 120
40811	RW	Positioner characterization y-axis output point (%)	-20 to 120
40813	RW	Positioner characterization y-axis output point (%)	-20 to 120
40815	RW	Positioner characterization y-axis output point (%)	-20 to 120
40817	RW	Positioner characterization y-axis output point (%)	-20 to 120
40819	RW	Positioner characterization y-axis output point (%)	-20 to 120
40821	RW	Positioner characterization y-axis output point (%)	-20 to 120
40823	RW	Positioner characterization y-axis output point (%)	-20 to 120
40825	RW	Positioner characterization y-axis output point (%)	-20 to 120
40827	RW	Positioner characterization y-axis output point (%)	-20 to 120
40829	RW	Low minimum positioner command cutoff (%)	-20 to 120
40831	RW	Upper position alert (%)	-20 to 120
40833	RW	Lower position alert (%)	-20 to 120
30835	RO	Time of operation (hours)	IEEE 754
30837	RO	Travel accumulator (same units as MECH_STROKE)	IEEE 754
40839	RW	Travel accumulator deadband	0.01 to 100
40841	RW	Travel accumulator limit alert	0 to 1E20
30843	RO	Cycle counter	IEEE 754
40845	RW	Cycle counter deadband (%)	0.01 to 100
40847	RW	Cycle counter limit alert	0 to IE20

Register Number	Attribute	Description	Notes
40849	RW	High minimum positioner command cutoff (%)	-20 to 120
40851	RW	Stroke open rate limit (%/min)	0 to 1E5
40853	RW	Stroke close rate limit (%/min)	0 to 1E5
40855	RW	Gas Composition 1	0 to 100
40857	RW	Gas Composition 2	0 to 100
40859	RW	Gas Composition 3	0 to 100
40861	RW	Gas Composition 4	0 to 100
40863	RW	Gas Composition 5	0 to 100
40865	RW	Gas Composition 6	0 to 100
40867	RW	Gas Composition 7	0 to 100
40869	RW	Gas Composition 8	0 to 100
40871	RW	Gas Composition 9	0 to 100
40873	RW	Gas Composition 10	0 to 100
40875	RW	Gas Composition 11	0 to 100
40877	RW	Gas Composition 12	0 to 100
40879	RW	Gas Composition 13	0 to 100
40881	RW	Gas Composition 14	0 to 100
40883	RW	Gas Composition 15	0 to 100
40885	RW	Gas Composition 16	0 to 100
40887	RW	Gas Composition 17	0 to 100
40889	RW	Gas Composition 18	0 to 100
40891	RW	Gas Composition 19	0 to 100
40893	RW	Gas Composition 20	0 to 100
40895	RW	Gas Composition 21	0 to 100
40897	RW	AGA Z parameter 1	-10 to 10
40899	RW	AGA Z parameter 2	-10 to 10
40901	RW	AGA Z parameter 3	-10 to 10
40903	RW	AGA Z parameter 4	-10 to 10
40905	RW	AGA Z parameter 5	-10 to 10
40907	RW	AGA Z parameter 6	-10 to 10
40909	RW	AGA Z parameter 7	-10 to 10
40911	RW	AGA Z parameter 8	-10 to 10
40913	RW	AGA Z parameter 9	-10 to 10
40915	RW	AGA Z parameter 10	-10 to 10

Register Number	Attribute	Description	Notes
40917	RW	AGA Z parameter 11	-10 to 10
40919	RW	AGA Z parameter 12	-10 to 10
40921	RW	AGA Z parameter 13	-10 to 10
40923	RW	AGA Z parameter 14	-10 to 10
40925	RW	AGA Z parameter 15	-10 to 10
40927	RW	AGA Z parameter 16	-10 to 10
40929	RW	AGA Z parameter 17	-10 to 10
40931	RW	AGA Z parameter 18	-10 to 10
40933	RW	AGA Z parameter 19	-10 to 10
40935	RW	AGA Z parameter 20	-10 to 10
40937	RW	AGA Z parameter 21	-10 to 10
40939	RW	Stable Wise Lock window percent	0 to 100
40941	RW	Stable Wise Unlock window percent	0 to 100
30943	RO	Void Floating-Point Register	0.0
31249	RO	Void Floating-Point Register	0.0
42243	*	Floating-point variable #1 (Flowserve use only)	*
42245	*	Floating-point variable #2 (Flowserve use only)	*
42247	*	Floating-point variable #3 (Flowserve use only)	*
42249	*	Floating-point variable #4 (Flowserve use only)	*
42251	*	Floating-point-variable #5 (Flowserve use only)	*
42253	*	Floating-point-variable #6 (Flowserve use only)	*
42255	*	Floating-point-variable #7 (Flowserve use only)	*
42257	*	Floating-point variable #8 (Flowserve use only)	*
42259	*	Floating-point variable #9 (Flowserve use only)	*
42261	*	Floating-point variable #10 (Flowserve use only)	*
42263	*	Floating-point variable #11 (Flowserve use only)	*
42265	*	Floating-point variable #12 (Flowserve use only)	*
42267	*	Floating-point variable #13 (Flowserve use only)	*
42269	*	Floating-point variable #14 (Flowserve use only)	*
42271	*	Floating-point variable #15 (Flowserve use only)	*
42273	*	Floating-point variable #16 (Flowserve use only)	*
42275	*	Floating-point variable #17 (Flowserve use only)	*
42277	*	Floating-point variable #18 (Flowserve use only)	*
42279	*	Floating-point variable #19 (Flowserve use only)	*

Register Number	Attribute	Description	Notes
42281	*	Floating-point variable #20 (Flowserve use only)	*
42283	*	Floating-point variable #21 (Flowserve use only)	*
42285	*	Floating-point variable #22 (Flowserve use only)	*
42287	*	Floating-point variable #23 (Flowserve use only)	*
42289	*	Floating-point variable #24 (Flowserve use only)	*
42291	*	Floating-point variable #25 (Flowserve use only)	*
42293	*	Floating-point variable #26 (Flowserve use only)	*
42295	*	Floating-point variable #27 (Flowserve use only)	*
42297	*	Floating-point variable #28 (Flowserve use only)	*
42299	*	Floating-point variable #29 (Flowserve use only)	*
42301	*	Floating-point variable #30 (Flowserve use only)	*
42303	*	Floating-point variable #31 (Flowserve use only)	*
42305	*	Floating-point variable #32 (Flowserve use only)	*
42307	*	Floating-point variable #33	*
42309	*	Floating-point variable #34	*
42311	*	Floating-point variable #35	*
42313	*	Floating-point variable #36	*
42315	*	Floating-point variable #37	*
42317	*	Floating-point variable #38	*
42319	*	Floating-point variable #39	*
42321	*	Floating-point variable #40	*
42323	*	Floating-point variable #41	*
42325	*	Floating-point variable #42	*
42327	*	Floating-point variable #43	*
42329	*	Floating-point variable #44	*
42331	*	Floating-point variable #45	*
42333	*	Floating-point variable #46	*
42335	*	Floating-point variable #47	*
42337	*	Floating-point variable #48	*
42339	*	Floating-point variable #49	*
42341	*	Floating-point variable #50	*
42343	*	Floating-point variable #51	*
42345	*	Floating-point variable #52	*
42347	*	Floating-point variable #53	*

Register Number	Attribute	Description	Notes
42349	*	Floating-point variable #54	*
42351	*	Floating-point variable #55	*
42353	*	Floating-point variable #56	*
42355	*	Floating-point variable #57	*
42357	*	Floating-point variable #58	*
42359	*	Floating-point variable #59	*
42361	*	Floating-point variable #60	*
42363	*	Floating-point variable #61	*
42365	*	Floating-point variable #62	*
42367	*	Floating-point variable #63	*
42369	*	Floating-point variable #64	*

RO - Read Only
RW - Read/Write
* - Dependent upon the selected register

String Registers

The register numbers in this table are not consecutive because of the varying length of each string in this area of the StarPac 3 memory. Most of these strings are available as RW strings; however, we suggest that you write to 50617 (TAGNAME) and 50625 (Real time and date) and leave the others as they are because that information is factory set.

NOTE: Trying to access the middle of a string will result in an exception response from the device.

Table 6: String Registers

Register Number	Attribute	Description	Notes
31251	RO	Embedded software version (16 bytes)	ASCII String
41259	RW	Valve serial number (16 bytes)	ASCII String
41267	RW	Local process identifying text (16 bytes)	ASCII String
41275	RW	Real time & date information (32 bytes)	ASCII String
41291	RW	User Text string #1 (32 bytes)	ASCII String
41307	RW	User Text string #2 (32 bytes)	ASCII String
41323	RW	User Text string #3 (32 bytes)	ASCII String
41339	RW	User Text string #4 (32 bytes)	ASCII String
31355	RO	Description of device (16 bytes)	ASCII String
31363	RO	Logger real time/date data (32 bytes)	ASCII String
41379	RW	Trim Number (16 bytes)	ASCII String
41387	RW	Trim Characteristics (16 bytes)	ASCII String
41395	RW	Trim Type (16 bytes)	ASCII String

Register Number	Attribute	Description	Notes
41403	RW	Pressure Class (16 bytes)	ASCII String
41411	RW	Valve Model (16 bytes)	ASCII String
41419	RW	Flow Direction (16 bytes)	ASCII String
41427	RW	Body Size (16 bytes)	ASCII String
41435	RW	Body Material (16 bytes)	ASCII String
41443	RW	Packing Style (16 bytes)	ASCII String
41451	RW	Packing (16 bytes)	ASCII String
41459	RW	Gasket Material (16 bytes)	ASCII String
41467	RW	Actuator Size (16 bytes)	ASCII String
41475	RW	Spring (16 bytes)	ASCII String
41483	RW	Spring Type (16 bytes)	ASCII String
41491	RW	Air Action (16 bytes)	ASCII String
41499	RW	Electronics S/N (16 bytes)	ASCII String
41507	RW	EPROM Version (16 bytes) (NA for StarPac 3)	ASCII String
41515	RW	Pressure Sensor Rating (16 bytes)	ASCII String
41523	RW	Sensor Drawing Number (16 bytes)	ASCII String
41531	RW	P1 Serial Number (16 bytes)	ASCII String
41539	RW	P2 Serial Number (16 bytes)	ASCII String
41547	RW	P1 Calibration Date (16 bytes)	ASCII String
41555	RW	P2 Calibration Date (16 bytes)	ASCII String
41563	RW	Miscellaneous data (16 bytes)	ASCII String
41571	RW	Miscellaneous Data (16 bytes)	ASCII String
41579	RW	Miscellaneous Data (16 bytes)	ASCII String
41587	RW	Fluid Type Name (16 bytes)	ASCII String
41595	RW	User Unit Flow Type String (16 bytes)	ASCII String
41603	RW	User Unit Totalizer Type string (16 bytes)	ASCII String
41611	RW	User text string #5 (16 bytes)	ASCII String
41619	RW	User Text string #6 (16 bytes)	ASCII String
41627	RW	User Text string #7 (16 bytes)	ASCII String
41635	RW	User Text string #8 (16 bytes)	ASCII String
41643	RW	User Text string #9 (16 bytes)	ASCII String
41651	RW	User Text string #10 (16 bytes)	ASCII String
41659	RW	User Text string #11 (16 bytes)	ASCII String
41667	RW	Password string (16 bytes)	ASCII String

Register Number	Attribute	Description	Notes
41675	RW	Actuator Calibration Date (16 bytes)	ASCII String
41683	RW	Positioner Calibration Date (16 bytes)	ASCII String
41691	RW	Thermocouple Calibration Date (16 bytes)	ASCII String
31699	RO	Tamb Low Time/Date (32 bytes)	ASCII String
31715	RO	Tamb High Time/Date (32 bytes)	ASCII String
31731	RO	Tpro Low Time/Date (32 bytes)	ASCII String
31747	RO	Tpro High Time/Date (32 bytes)	ASCII String
31763	RO	Void String Register (16 bytes)	ASCII Spaces
32043	RO	Void String Register (16 bytes)	ASCII Spaces

RO - Read Only
RW - Read/Write
* - Dependent upon the selected register

Appendix C

Table 7: Fluid Table

Name	Critical Press	Critical Temp	Temp Ref	Spec Gr	Mol Wt	Ratio of Spec Heat Fk	Ant A	Ant B	Ant C	Visc A	Visc B
Air	492.445007	227.160004	140.600006	0.804000	28.980000	1.00	11.009000	1059.699951	11.880000	1.0	0.0
Ammonia	1636.089966	730.080017	491.799988	0.639000	17.031000	0.94	13.002000	3838.500000	-59.630001	1.0	0.0
Argon	707.062012	271.399994	162.000000	1.373000	39.948002	1.19	11.287000	1260.900024	-10.510000	1.0	0.0
Benzene	710.000000	1011.780029	520.200012	0.885000	78.113998	0.79	11.955000	5019.299805	-94.250000	1.0	0.0
Butane	551.250000	765.359985	527.400024	0.579000	58.124001	0.78	11.733000	3878.800049	-61.959999	1.0	0.0
Carbon Dioxide	1070.189941	547.559998	527.400024	0.777000	44.009998	0.92	13.734500	3803.010010	14.539000	1.0	0.0
Carbon Monoxide	507.148010	239.220001	148.800003	0.803000	28.010000	1.00	10.423000	954.359985	-23.670000	1.0	0.0
Chlorine	1117.189941	750.599976	430.399994	1.563000	70.905998	0.95	12.015000	3560.899902	-48.619999	1.0	0.0
Dowtherm-A	454.695007	1386.800049	960.000000	0.870000	166.000000	0.75	12.500000	7897.640137	-149.100006	1.0	0.0
Ethane	708.531006	549.719971	329.399994	0.548000	30.070000	0.85	11.718000	2720.500000	-30.889999	1.0	0.0
Ethylene	730.578003	508.320007	293.399994	0.577000	28.054001	0.89	11.591000	2424.600098	-32.669998	1.0	0.0
Fluorine	757.046997	259.739990	153.000000	1.510000	37.997002	0.97	11.724000	1285.400024	-10.800000	1.0	0.0
Fuel Oil	330.000000	10000.000000	1335.000000	0.880000	0.000000	0.00	-6.910000	0.000000	100.000000	1.0	0.0
Gasoline	367.500000	529.640015	67.400002	0.695000	114.232002	0.75	11.797400	5278.500000	-104.540001	1.0	0.0
Glycol	1117.189941	1161.000000	527.400024	1.114000	62.069000	0.78	16.304001	10840.000000	-50.879998	1.0	0.0
Helium	32.929699	9.340000	7.700000	0.123000	4.003000	1.19	8.306000	60.720001	3.220000	1.0	0.0
Hydrogen	188.156006	59.759998	36.000000	0.071000	2.016000	1.00	9.688000	296.820007	5.740000	1.0	0.0
Hydrogen Chloride	1205.380005	584.280029	338.600006	1.193000	36.460999	1.00	12.158000	3085.600098	-59.669998	1.0	0.0
Isobutane	529.187988	734.580017	527.400024	0.557000	58.124001	0.78	11.592000	3658.899902	-59.669998	1.0	0.0
Isobutylene	580.640991	752.219971	527.400024	0.594000	56.108002	0.79	11.807000	3826.300049	-59.669998	1.0	0.0
Kerosene	350.000000	10000.000000	935.000000	0.820000	3.000000	0.00	8.730000	4091.399902	159.199997	1.0	0.0
Methane	667.375000	343.079987	201.100006	0.425000	16.042999	0.94	13.470000	2880.510010	69.860001	1.0	0.0
Natural Gas	667.375000	343.079987	201.100006	0.425000	16.042999	0.94	13.470000	2880.510010	69.860001	1.0	0.0
Nitrogen	492.445007	227.160004	140.600006	0.804000	28.013000	1.00	11.009000	1059.699951	-11.880000	1.0	0.0
Nitrous Oxide	1051.089966	557.280029	330.500000	1.226000	44.013000	0.91	12.181000	2711.500000	-46.779999	1.0	0.0
Oxygen	732.046997	278.279999	162.000000	1.149000	31.999001	1.00	11.462000	1322.099976	-11.610000	1.0	0.0
Phosgene	823.187988	819.000000	527.400024	1.381000	98.816002	0.84	11.811000	3901.100098	-77.669998	1.0	0.0
Propane	615.921997	665.640015	415.799988	0.582000	44.097000	0.81	11.780000	3370.300049	-45.290001	1.0	0.0
Propylene	670.312012	657.000000	401.399994	0.612000	42.018002	0.82	11.757000	3253.500000	-47.070000	1.0	0.0
Refrigerant 11	639.437988	848.159973	0.000000	0.000000	137.369995	0.80	11.906000	43323.000000	-65.339996	1.0	0.0
Refrigerant 12	598.281006	693.000000	284.399994	1.7500000	120.910004	0.79	-3.946000	0.000000	0.000000	1.0	0.0
Refrigerant 22	721.953003	664.500000	520.200012	1.230000	86.500000	0.84	11.600000	3068.600098	-74.300003	1.0	0.0
Sea Water	3200.000000	1165.140015	672.000000	0.940000	18.000000	0.95	14.390000	6910.799805	-83.029999	1.0	0.0
Steam	3208.250000	1165.140015	527.400024	0.998000	18.020000	0.95	14.358000	6869.500000	-83.029999	1.0	0.0
Water	3208.250000	1165.140015	527.400024	0.998000	18.020000	0.95	14.358000	6869.500000	-83.029999	1.0	0.0

Appendix D

StarPac Wiring and Grounding Guidelines

This guideline will help you in achieving maximum noise rejection and performance with a StarPac Intelligent Control System. This guide must NOT be used to supersede local electrical code or plant safety wiring practices.

Shielding Versus Grounding

All signals to the StarPac system should be in shielded cables. Shields must be tied to a ground at only one end of the cable to provide a place for environmental electrical noise to be removed from the cable. A ground wire, unlike a shield, is attached at both ends to provide a continuous path for electrical conductivity.

Grounding Screw

The grounding screw by the user interface terminal block should be used to provide the unit with an adequate and reliable earth ground reference. Either one of the mounting screws holding the terminal block may be used as a grounding screw. This ground should be tied to the same ground as the electrical conduit. Additionally, the electrical conduit connecting to the StarPac unit should be earth grounded at both ends of its run. The StarPac 3 grounding screw should not be used to terminate any signal shield wires.

24 VDC Power

The 24 VDC connection points will work best with shielded twisted pair wire with the shield wire connected only at the source. The input power is isolated within the StarPac 3 system and may be referenced to whatever level is necessary. For best performance the 24 VDC power supply should not be connected to earth ground.

RS-485 Communication

RS-485 wiring requires shielded twisted pair wire. Maximum performance will be attained when using cable with a characteristic impedance of 120 ohms. The shield should be connected only at the source, not in the StarPac unit. The StarPac 3 internal system ground is isolated and not earth ground referenced. The RS-485 port can float to whatever common mode voltage appears at its input terminals. These signals are referenced to the StarPac internal system ground, and because of this it is the main fault path when one of the isolation points fail. For this reason special care must be taken to ensure that the RS-485 cable is wired correctly. The RS-485 allows only a -7 to 12V common mode voltage differential between stations. This means that an RS-485 network connected to multiple devices must not have more than one grounding point. Flowserve's RS-232/RS-485 converter is not a grounded connection, it is fully isolated and is not a ground point. However, PC's with internal RS-485 cards are often earth grounded and if another communication device is on the network that also has an earth ground, a fault condition will almost certainly exist due to transient and steady state differences in ground potential.

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

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

Discrete Input and Output

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

Appendix E

Manual Thermocouple Calibration

The best way to calibrate a StarPac 3 thermocouple is to do a calibration while using a thermocouple calibrator. If a temperature calibrator is not available, the following instructions can be used to calibrate a StarPac 3 in the field.

Use the following table to enter the calibration ADC factors for the temperature sensing of the StarPac 3. This is one of the advantages of using a K-type thermocouple and the linearization circuit as we do. You can obtain an acceptable temperature calibration by simply these values into the StarPac 3 calibration factors.

1. Determine the working temperature range. Remember to try and keep the window as small as possible. The temperature range of the type K thermocouple is large and non-linear. By keeping the window small the accuracy of the temperature is increased. Example: The process runs between 100 °F and 200 °F with little or no chance of seeing a temperature outside of the range. Calibrate 70 °F to 212 °F. Select you Tmax and Tmin and corresponding ADCmax and ADCmin from the table below.

Ref. Temperature (°F)	StarPac 3 ADC Counts
-400	675
-350	715
-300	777
-250	860
-200	959
-150	1073
-100	1202
-60	1313
-40	1371
0	1491
32	1591
70	1712
100	1810
150	1975
200	2140
212	2180
260	2337
300	2466
350	2626
400	2784
450	2943
500	3105
550	3267
600	3432
650	3597
700	3762
750	3928
800	4095
850	4262
900	4429
950	4597
1000	4764
1050	4931
1100	5098

2. Calculate the calibration slope for the thermocouple. Use the information gathered from the table above in the equation:

$$CalSlope = \frac{(Tspan(^\circ F) - Tzero(^\circ F))}{(ADC\,span - ADC\,zero)}$$

3. Use the EDIT REGISTER OR Edit Variables to enter the gathered information to the device. Use the StarTalk XP software, the ValveSight DTM software, or the local user interface of the device. Be sure to use the variable name to ensure you are modifying the correct location regardless of the method used.

   Register Locations for StarTalk software:
   Tmin => Register 70686
   ADCmax => Register 70070
   ADCmin => Register 40069
   CalSlope => Register 70486

   Register Locations for Local User Interface and Modbus Access:
   Tmin => Register 70687
   ADCmax => Register 70071
   ADCmin => Register 40070
   CalSlope => Register 70487

Additional Information:

StarPac 3 Equations

The StarPac 3 uses the following equation to calculate the process temperature:

*Tprocess (°F) = (ADC Current – ADC min) * Cal Slope + Tmin (°F)*

ADC Current => Register 30009 (Local User Interface)
ADC Current => Register 30008 (StarTalk Software or ValveSight DTM)

NOTE – You must use the temperature in Fahreheit (°F) values for these calculations, as those are the native units the StarPac 3 calculates. It then converts this calculation to the desired units and outputs the result to Process Temperature User Units. *ADC value process temp => Register 30009 (Local User Interface)*
ADC value process temp => Register 3008 (StarTalk Software or ValveSight DTM).

If you want to 'fine tune' the reading make small adjustments to the slope value in register for CalSlope. Increasing the value will increase the reading and decreasing the value will decrease the reading.

CalSlope => Register 30487 (Local User Interface)
CalSlope => Register 30486 (StarTalk Software or ValveSight DTM)

Cryogenic Usage

Because of how the type-K Thermocouple reacts at cryogenic temperatures, we recommend calibrating the system at the working temperature. Use the actual ADC values read from *ADC Current => Register 30009 (Local User Interface), ADC Current => Register 30008 (StarTalk Software or ValveSight DTM)* and the corresponding temperatures in the above equations to accomplish the calibration. The StarPac 3 will indicate correctly at the narrow operating temperature range but will not be correct at ambient temperatures due to the response curve of the thermocouple. This is normal operation for cryogenic applications. Please contact Flowserve Springville APD Engineering if you need more help with you application.

An Excel program is available from Flowserve Springville APD Engineering, which will calculate the amount of error you can expect.

The formula for converting to °C from °F is:
°C = (°F-32) / 1.8

And from °F to °C is:
°F = 1.8 °C +32

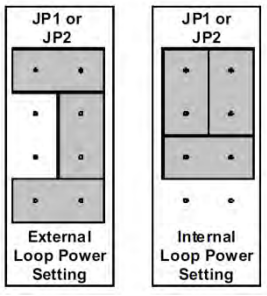
Appendix F

DP Cell Calibration Procedure for StarPac 3

WARNING: Depressurize the line to atmospheric pressure and drain all fluids from the valve body and pressure sensor tubing before working on the valve. Failure to do so can cause serious injury.

Set the StarPac 3 jumpers to configure the analog input power selection for the DP cell. On the lower tight hand side of the electronic board assembly on the bottom of the board are two, 8 position jumper arrays labeled “JP1” and “JP2”. Each of the 4-20 mA analog inputs can be configured for either an external power supply such as exists in a DCS, or powered internally so a transmitter or other 2 wire device can be directly connected to the terminals. The JP2 configures the analog input 2. The jumpers should be configured as shown for the desired operation.

The JP2 jumpers should be configured as shown in the picture below for the desired operation depending on your choice of internal or external loop power.



Wire Connections:

- **Negative Terminal** on the DP Cell to **Terminal No. 14** on the StarPac 3 User Interface Block
- **Positive Terminal** on the DP Cell to **Terminal No. 5** on the StarPac User Interface Block.
- **Set SPI on IP2** as shown in figure 19.

1. Close the upstream and downstream valves and open the bridge valve on the Pressure Manifold.
2. Remove the Vent/Drain Plug from the upstream side of the DP Cell. Connect a calibrated pressure reference and a regulated pressure source to the Vent/Drain Plug port.
3. Remove the covers from both ends of the DP Cell. Verify that the DP Cell is wired according to the description above and that the Span Switch on the DP Cell is set to the appropriate range.
4. Connect a Current Meter in series in the current loop by disconnecting the wire from Terminal No. 5 on the StarPac 3 User Interface Block and connecting it to the positive terminal on the Current Meter. Connect the negative terminal on the Current Meter to Terminal No. 5 on the StarPac User Interface Block.
5. Verify that power is reaching the StarPac 3 electronics.
6. Connect a computer loaded with StarTalk XP or the ValveSight DTM to the StarPac 3. Run StarTalk XP, find the device and establish a connection. Go to the Calibration menu and select Analog Input #2.
7. Perform the **Zero calibration** on the Analog Input #2 and the DP Cell by doing the following:
   Verify that the upstream and downstream valves on the Pressure Manifold are closed and that the bridge valve is open.
   Adjust the Zero Adjustment Screw on the DP Cell until the Current Meter reads 4 mA.
   From the StarTalk XP software, accept the zero point calibration.
8. Perform the **Span calibration** on the Analog Input #2 and the DP Cell by doing the following:
   - Close the bridge valve on the Pressure Manifold.
   - Expose the downstream side of the DP Cell to atmospheric pressure by opening the downstream valve on the Pressure Manifold.
   - Using the regulator, adjust the pressure on the upstream side of the DP Cell to the desired Max DP. Record the Max DP for future use.
   - Adjust the Span Adjustment Screw on the DP Cell until the Current Meter reads 20 mA.
   - From the StarTalk XP software, accept the span point calibration.

9. Check the Zero and Span output of the DP Cell and reading on the Analog Input #2 Channel to verify that the calibration is successful.
10. Configure device using on of the following three methods:

    1. StarPac 3 Device Local User Interface
        a. Navigate to the Analog In 2 Menu and select “Valve Delta Pressure”. (Config >> Accept >> Next >> Anlg In2 >> Valve Delta Pressure >> Accept.)
        b. Enter the MaxDP(psig) value recorded in step 8. (Accept)
        c. Enter the zero calibration point. (Accept)
    2. StarTalk DTM Software
        a. Navigate to the “Special Configuration” menu.
        b. Select the “DP Cell Wizard”.
        c. Select the “Use External DP Cell” option.
        d. Follow the step by step instructions in the wizard.
    3. StarTalk XP Software
        a. Navigate to the configure Analog In 2 menu.
        b. Change the Function “Input to Flow Calculation”.
        c. Change the Flow Calc Variable to “Pressure Drop”.
        d. Enter the MaxDP(psig) value recorded in step 8 for the “Value at 4mA”.
        e. Enter the zero calibration point for the “Value at 20 mA”.
        f. Click the “Apply” button.

11. Close the bridge valve on the Pressure Manifold and open the upstream and downstream valves.
12. Remove the Pressure Reference and regulated pressure source from the DP Cell and replace the Vent/Drain Plug.
13. Remove the Current Meter from the current loop and reconnect the wire to Terminal No. 5 on the StarPac User Interface Block.
14. Replace the covers on both ends of the DP cell.

Appendix G

Primary Control Registers and Modes for StarPac 3 Systems Using Modbus

Introduction

This document covers the basic knowledg of the operating mode and key control registers when a host device such as a PLC or DCS is being used to directly access a StarPac intelligent control system. For complete access to the StarPac system, both integer and floating point registers must be accessed. However, basic operation can be accomplished using only integer registers if necessary. This paper describes some of the basic registers and how to use them for general operation. All of the registers described here are supported in StarTalk for Windows™ software. Most applications could have the scaling and control registers setup using StarTalk for Windows and then have the host device only responsible for working with those registers necessary for the process.

Operating Modes

The StarPac system has three operating modes: Manual, Automatic and Test. The mode is set as described in the mode source section below. In Manual mode the unit operates as a normal control valve, positioning the valve according to its current command signal that can be received digitally via Modbus or from a 4-20 mA signal. In Auto mode the unit operates as a controller, using the PID settings, process variable and control action currently configured. The setpoint can be received digitally via Modbus or from a 4-20 mA signal. Test mode takes the unit off-line and the system *does not* update the indicated pressures, temperatures, flow, or PID values; nor does it respond to any setpoint or command changes. Test mode is the beginning mode after an initialization and is used during calibration. If power is lost during a calibration setup, the unit remains in Test mode and the mode has to be reset to Auto or Manual for proper operation. Any time the unit is in Test mode, the letter 'T' flashes on the right side of the display for StarPac 3.

Base Mode Source

The base mode source controls where the StarPac 3 unit receives the mode information. Integer register 40037 sets the mode source for how the unit is changed between Automatic and Manual modes. Valid values are: 0 = Digital, 1 = Discrete, 2 = Remote.
Digital Mode Source - Configures the unit so that Integer register 40038 sets the operating mode. Valid values are: 0 =Calibration, 1 = Manual, 2 = Auto.

NOTE: Every time that a 2 is written to register 40038, the StarPac system performs a bumpless transfer on the setpoint. It does this calculation even if the previous value was a 2 in register 40038. The bumpless transfer function sets the setpoint in register 40035 equal to the current PV. If the system needs to continuously update the mode register see remote mode source description below.

Discrete Mode Source - Configures the StarPac system so that an external signal applied to the discrete input terminals (9 and 18 for StarPac 3) will be used to switch the unit between Automatic and Manual modes. The definition is fixed with an energized state indicating Automatic mode.
Remote Mode Source - Configures the unit so that floating point register 40703 sets the operating mode. Valid values are: 0 = Manual, 100 = Auto. Remote Mode Source is used when a host system such as a PLC or DCS or a Flowserve StarPac Analog Interface Box (SPAIF) is used to set the mode via digital communications. The difference between Remote and Digital modes is that in Remote mode the only time that the bumpless transfer calculation is done is after the mode in register 40703 has *changed* from one value to another. With a Digital mode source selected, every time that any value is written (even if it is not changed) to register 40038, the StarPac system executes a transfer algorithm that may impede control.

Setpoint source

This controls where the StarPac unit receives the valve command or controller setpoint information. Integer register 40041 sets the setpoint source for how the unit receives control information. Valid values are: 0 = 4-20 mA, 1 = Digital, 2 = Remote.
Digital - Configures the unit so that integer register 40035 sets the controller setpoint as a scaled integer if the StarPac unit is in Automatic mode. Integer register 40036 sets the valve position command as a scaled integer if the StarPac unit is in Manual mode. The scale for digital source using the integer registers is fixed for both position command and controller setpoint with 0 = -12.5 percent and 9999 = 112.5 percent. The valve command is defined as 0 percent = closed and 100 percent = open. The scaling for the process controller setpoint is shown in Table I.
Analog - Prompts the StarPac unit to use the 4-20 mA signal from the analog input as the valve position command or as the controller

setpoint, depending on whether or not the unit is in Manual or Automatic mode. It can be set so that 4-20 mA = 0 to 100 percent or 100 to 0 percent, using integer register 40046 (1 = normal, 2 = inverted). The scaling for the process controller setpoint is shown in Table I. **Remote -** Configures the unit so that floating point register 40705 sets the controller setpoint in percent of maximum (see Table I) or the valve position command in percent open, depending on the selected mode. Remote differs from Digital in that the remote register must be updated within the number of seconds set in integer register 40109 or the unit will go into a Loss of Command Trip mode. When the Loss of Command Trip occurs the system will initially hold the last setpoint if in auto, or the last position if in manual for the number of seconds specified in integer register 40047. When the timer expires the valve will then ramp open or closed at the rate set in floating point register 40491 (a negative rate will ramp closed and a positive rate will ramp open).

Note: When writing software to interface with the StarPac 3 where changes are being made to the operating modes and setpoints are being sent, it is important to program the software to change the mode prior to sending the setpoint. This is important because the bumpless transfer routine in the StarPac 3 may change the setpoint back to the previous value.

Process maximum

Setup for the controller setpoint using any setpoint or command source (Analog, Digital or Remote) is set in the floating point registers shown in Table I according to the selected control variable selected in integer register 40039.

Table 9: Control Variable Selection

Variable Number for Register 40039	Process Variable Scaling Register	Description
1	40425	Full scale liquid flow control range in selected engineering units. The minimum is fixed at zero flow.
2	40429	Full scale upstream pressure (P1) control range in selected engineering units. The minimum is fixed at zero pressure in engineering units.
3	40431	Full scale downstream pressure (P2) control range in selected engineering units. The minimum is fixed at zero pressure in engineering units.
4	40423	Full scale delta P control range in selected engineering units. The minimum is fixed at zero differential pressure.
5	40433	Full scale process temperature control range in selected engineering units.
5	40435	Minimum process temperature control range in selected engineering units.
6	40427	Full scale gas flow control range in selected engineering units. The minimum is fixed at zero flow.
7	40421	Full scale auxiliary input control range in percent (used if an external sensor is attached to the 4-20mA input as the process feedback). The minimum is fixed at zero percent.

Writing Scaled Setpoint or Valve Command - When using the digital setpoint source, the setpoint for register 40035 or valve command for register 40036 is calculated using the following formula:

$$\text{SCALED\_INTEGER} = (80)x(\text{SP\%}+12.5)$$

As shown in the equation, SP% is the setpoint (in percent of the scaled process maximum set in the register described in Table I) for register 40035 or the valve command (in percent open) for register 40036.

Tuning Registers

The PID tuning parameters for Proportional band, Reset Rate, Derivative Time, and controller action are all set using integer registers. Once tuning values are properly set they normally do not require adjustment unless the process gain has changed significantly. Each of the tuning parameters has a different affect on the controller performance.

Proportional Band sets the gain for the controller. Proportional Band = 100/gain or gain =100/prop. band. Since proportional band is the inverse of gain, the larger the band value, the smaller the controller gain. Register 40032 sets the Proportional Band in units of percent.
Reset Rate is the integrator term in the PID controller, referring to the action at which the rate of change of output is proportional to the error input. "Reset" is the parameter that controls how the integral control action affects the final control element. The larger the value, the faster the system tries to eliminate the offset error. Register 40034 sets the Reset in units of repeats/min.
Derivative Time sets the time on the derivative control action of the PID controller. This time is the interval at which the rate action advances the effect of the gain on the final control element. Derivative action in normally not used since it tends to amplify noise that exists in most process measurements. Register 40033 sets the Derivative Time in units of Seconds.
PID Action - This variable determines the response of the controller to error. Reverse action will cause an air-to-open valve to begin to close when the process variable is greater than the setpoint. Direct action has the opposite effect. Register 40040 sets is controller action, 0=Reverse action, 1=Direct action.

Basic Floating Point Registers

The easiest way to read the process information is through the floating point registers using the IEEE format. Since floating point numbers are 32 bits and Modbus registers are only 16 bits, two consecutive registers are used for each floating point number. When requesting only one register in the floating point range an error will be indicated. Table II contains a list of commonly accessed floating point registers for basic valve and process information.

Table 10: Common Floating Point Registers

Floating Point Register Number	Description
30379	Ambient Temperature in Degrees Fahrenheit
30393	Liquid flow rate in selected units
30395	Gas flow rate in selected units
30397	Upstream pressure in selected units
30399	Downstream pressure in selected units
30401	Valve pressure drop in selected units
30403	Process temperature in selected units
30407	Valve position in percent open
30411	Current setpoint in selected units (note that this tracks the PV when in manual mode)
30413	Current process variable in selected units
30371	Totalized liquid flow in selected units since last reset (reset by writing a 1 into register 40078)
30373	Totalized gas flow in selected units since last reset (reset by writing a 1 into register 40078)
30369	Totalized time in seconds since last reset (reset with 40078 above)
30707	Actuator pressure in the top of the actuator in psig
30709	Actuator pressure in the bottom of the actuator in psig

Scaled Integers

Several scaled integer registers provide access to process information using integer registers for those devices that do not support floating point registers. These registers are listed in Table III. The scaling registers must be set for the variable scale registers before the scaled value can be interpreted. The minimum scale register sets the engineering value that will equal a register value of 0 and the maximum scale register sets the engineering value that will equal a register value of 9999. After changing the scaling registers you must

write a 1 to register 40081 to signal the system to recalculate the scalar range after they have been changed (resetting the system will also force the system to recalculate the scalar range. StarPac 3 devices with outerloop code V3.0 or higher no longer require this. The scaler ranges are no calculated constantly).

Table 11: Scale Integer Registers

Modbus Register	Type	Range	Minimum Scale Register	Maximum Scale Register	Description
30012	RO	0 to 9999	40625	40627	Variable scale normalized liquid flow in currently selected engineering units.
30013	RO	0 to 9999	40629	40631	Variable scale normalized gas flow in currently selected engineering units.
30014	RO	0 to 9999	40633	40635	Variable scale normalized P1 isa in currently selected engineering units.
30015	RO	0 to 9999	40637	40639	Variable scale normalized P2 isa in currently selected engineering units.
30016	RO	0 to 9999	40641	40643	Variable scale normalized delta P in currently selected engineering units.
30017	RO	0 to 9999	40645	40647	Variable scale normalized process temperature in currently selected engineering units.
30018	RO	0 to 9999	40649	40651	Variable scale normalized auxiliary input in percent.
30019	RO	0 to 9999	Fixed at 12.5%	Fixed at 112.5%	Fixed scale normalized 4-20mA command in percent
30020	RO	0 to 9999	Fixed at 12.5%	Fixed at 112.5%	Fixed scale normalized position in percent.
30021	RO	0 to 9999	Fixed at 12.5%	Fixed at 112.5%	Fixed scale normalized set point command in percent of maximum. (See Table 9)
40078	RW	0 or 1	N/A	N/A	Register 40078 must be set to 1 in order to signal the system to recalculate the scalar range after the range has been changed. This step is longer required with outerloop codes of V3.0 or or higher

Scaled integers can be interpreted using the following method:

$$\left(\left(\text{LED\_MAX}\right)-\left(\text{SCALED\_MIN}\right)\right)+\left(\text{SCALED\_MIN}\right)$$

$$\text{ENGINEERING\_VALUE} = \left(\frac{\text{SCALED\_INTEGER}}{10000}\right) \times \text{SCA}$$

For example, to read the process temperature with a range of 15 to 100 Celsius, set register 40645 to 15 and register 40647 to 100. The StarPac will then calculate a scaled integer for register 30017 based on the current temperature. If the value in register 30017 is 4378 then the temperature in engineering units will be:

$$\text{TEMPERATURE} = \left(\frac{4378}{10000}\right) \times \left((100)-(15)\right)+(15) = 52.213$$

Alarm registers

In the StarPac registers, three integer registers contain alarm, sensor and hardware error status information. The user can decode this information to determine the state of the StarPac device. If these registers contain zeroes, the device is functioning correctly. However, if one of these registers reports a value other than zero, the device is not functioning correctly. Refer to Read and Interpret StarPac Alarms and Errors in the next section for more details. The following tables show you the register and mapping for each indicator:

Alarm Register 30104

Bit	Meaning
0	Setpoint error
1	Positioner deviation error
2	Trip condition present
3	Not used
4	Not used
5	Not used
6	Sensor malfunction
7	Hardware malfunction
8	Not used
9	Not used
10	Not used
11-15	Not used

If bit number 6 is "ON," check the sensor status register. This register indicates the status of all sensors. See the next table for sensor status. If bit number 7 in the alarm register is "ON," check the hardware status register. This register contains the status of the StarPac electronics. See the following table for the mapping of these registers.

Sensor Status Register 30106

Bit	Meaning
0	P1 sensor error
1	P2 sensor error
2	Top actuator sensor error
3	Bottom actuator sensor error
4	Thermocouple sensor error
5	Ambient temperature sensor error
6	Position sensor error
7-15	Not used

Hardware Status Register 30105

Bit	Meaning
0	Watchdog reset occurred
1	SRAM R/W failure
2	EPROM checksum error
3	NVRAM R/W failure
4	MCU Comm failure
5	Not used
6	Not used
7	Not used
8	Not used
9	Not used
10	Not used
11	Not used
12	Illegal pointer assignment
13	+10V reference failure
14	NVRAM checksum error
15	Divide by Zero trap

Virtual registers

The StarPac system has 32 virtual floating point registers and 32 virtual integer registers that can be used to group registers for better block read and write support from remote devices. To use the virtual registers, load the pointer register with the desired internal register in the corresponding virtual register. The pointer register must use the actual StarPac internal register number —not the Modbus register number. To determine the internal StarPac register number take the Modbus register number and remove the first digit and any remaining zeros preceding the significant digits and then subtract one. For example, to put the current valve position in the first virtual floating point register 71361 (floating-point variable number 33) set the corresponding pointer register 41201 (floating-point table pointer number 33) to a value of 252 (corresponding to Modbus register 70253).

Table 12: Virtual Register Table Variable Description

Modbus Register	Type	Range	Description
42083	RW	0 to 199	Integer table pointer number 33
42084	RW	0 to 199	Integer table pointer number 34
42085	RW	0 to 199	Integer table pointer number 35
42086	RW	0 to 199	Integer table pointer number 36
42087	RW	0 to 199	Integer table pointer number 37
42088	RW	0 to 199	Integer table pointer number 38
42089	RW	0 to 199	Integer table pointer number 39
42090	RW	0 to 199	Integer table pointer number 40
42091	RW	0 to 199	Integer table pointer number 41
42092	RW	0 to 199	Integer table pointer number 42
42093	RW	0 to 199	Integer table pointer number 43
42094	RW	0 to 199	Integer table pointer number 44
42095	RW	0 to 199	Integer table pointer number 45
42096	RW	0 to 199	Integer table pointer number 46
42097	RW	0 to 199	Integer table pointer number 47
42098	RW	0 to 199	Integer table pointer number 48
42099	RW	0 to 199	Integer table pointer number 49
42100	RW	0 to 199	Integer table pointer number 50
42101	RW	0 to 199	Integer table pointer number 51
42102	RW	0 to 199	Integer table pointer number 52
42103	RW	0 to 199	Integer table pointer number 53
42104	RW	0 to 199	Integer table pointer number 54
42105	RW	0 to 199	Integer table pointer number 55
42106	RW	0 to 199	Integer table pointer number 56
42107	RW	0 to 199	Integer table pointer number 57
42108	RW	0 to 199	Integer table pointer number 58
42109	RW	0 to 199	Integer table pointer number 59

Modbus Register	Type	Range	Description
42110	RW	0 to 199	Integer table pointer number 60
42111	RW	0 to 199	Integer table pointer number 61
42112	RW	0 to 199	Integer table pointer number 62
42113	RW	0 to 199	Integer table pointer number 63
42114	RW	0 to 199	Integer table pointer number 64
42147	RW	200 to 598	Floating-point table pointer number 33
42148	RW	200 to 598	Floating-point table pointer number 34
42149	RW	200 to 598	Floating-point table pointer number 35
42150	RW	200 to 598	Floating-point table pointer number 36
42151	RW	200 to 598	Floating-point table pointer number 37
42152	RW	200 to 598	Floating-point table pointer number 38
42153	RW	200 to 598	Floating-point table pointer number 39
42154	RW	200 to 598	Floating-point table pointer number 40
42155	RW	200 to 598	Floating-point table pointer number 41
42156	RW	200 to 598	Floating-point table pointer number 42
42157	RW	200 to 598	Floating-point table pointer number 43
42158	RW	200 to 598	Floating-point table pointer number 44
42159	RW	200 to 598	Floating-point table pointer number 45
42160	RW	200 to 598	Floating-point table pointer number 46
42161	RW	200 to 598	Floating-point table pointer number 47
42162	RW	200 to 598	Floating-point table pointer number 48
42163	RW	200 to 598	Floating-point table pointer number 49
42164	RW	200 to 598	Floating-point table pointer number 50
42165	RW	200 to 598	Floating-point table pointer number 51
42166	RW	200 to 598	Floating-point table pointer number 52
42167	RW	200 to 598	Floating-point table pointer number 53
42168	RW	200 to 598	Floating-point table pointer number 54
42169	RW	200 to 598	Floating-point table pointer number 55
42170	RW	200 to 598	Floating-point table pointer number 56
42171	RW	200 to 598	Floating-point table pointer number 57
42172	RW	200 to 598	Floating-point table pointer number 58
42173	RW	200 to 598	Floating-point table pointer number 59
42174	RW	200 to 598	Floating-point table pointer number 60
42175	RW	200 to 598	Floating-point table pointer number 61

Modbus Register	Type	Range	Description
42176	RW	200 to 598	Floating-point table pointer number 62
42177	RW	200 to 598	Floating-point table pointer number 63
42178	RW	200 to 598	Floating-point table pointer number 64
42211	*	*	Integer variable number 33
42212	*	*	Integer variable number 34
42213	*	*	Integer variable number 35
42214	*	*	Integer variable number 36
42215	*	*	Integer variable number 37
42216	*	*	Integer variable number 38
42217	*	*	Integer variable number 39
42218	*	*	Integer variable number 40
42219	*	*	Integer variable number 41
42220	*	*	Integer variable number 42
42221	*	*	Integer variable number 43
42222	*	*	Integer variable number 44
42223	*	*	Integer variable number 45
42224	*	*	Integer variable number 46
42225	*	*	Integer variable number 47
42226	*	*	Integer variable number 48
42227	*	*	Integer variable number 49
42228	*	*	Integer variable number 50
42229	*	*	Integer variable number 51
42230	*	*	Integer variable number 52
42231	*	*	Integer variable number 53
42232	*	*	Integer variable number 54
42233	*	*	Integer variable number 55
42234	*	*	Integer variable number 56
42235	*	*	Integer variable number 57
42236	*	*	Integer variable number 58
42237	*	*	Integer variable number 59
42238	*	*	Integer variable number 60
42239	*	*	Integer variable number 61
42240	*	*	Integer variable number 62
42241	*	*	Integer variable number 63

Modbus Register	Type	Range	Description
42242	*	*	Integer variable number 64
42307	*	*	Floating-point variable number 33
42309	*	*	Floating-point variable number 34
42311	*	*	Floating-point variable number 35
42313	*	*	Floating-point variable number 36
42315	*	*	Floating-point variable number 37
42317	*	*	Floating-point variable number 38
42319	*	*	Floating-point variable number 39
42321	*	*	Floating-point variable number 40
42323	*	*	Floating-point variable number 41
42325	*	*	Floating-point variable number 42
42327	*	*	Floating-point variable number 43
42329	*	*	Floating-point variable number 44
42331	*	*	Floating-point variable number 45
42333	*	*	Floating-point variable number 46
42335	*	*	Floating-point variable number 47
42337	*	*	Floating-point variable number 48
42339	*	*	Floating-point variable number 49
42341	*	*	Floating-point variable number 50
42343	*	*	Floating-point variable number 51
42345	*	*	Floating-point variable number 52
42347	*	*	Floating-point variable number 53
42349	*	*	Floating-point variable number 54
42351	*	*	Floating-point variable number 55
42353	*	*	Floating-point variable number 56
42355	*	*	Floating-point variable number 57
42357	*	*	Floating-point variable number 58
42359	*	*	Floating-point variable number 59
42361	*	*	Floating-point variable number 60
42363	*	*	Floating-point variable number 61
42365	*	*	Floating-point variable number 62
42367	*	*	Floating-point variable number 63
42369	*	*	Floating-point variable number 64

RO = Read Only; RW = Read/Write; * = Dependent upon the selected integer

Example 1: StarPac system is attached to a PLC that has both integer and floating point Modbus communication capability. For system startup, the unit needs to be put in Manual mode and hold a position of approximately 16 percent without updates from the PLC. When in operation the StarPac system will be in Automatic mode, controlling liquid flow at approximately 225 gpm with a range of 0 to 500 gpm. Normal system updates should be at two-second intervals. If the system looses communications then the system should initially stay on line for five minutes and then close the valve if no update is received. The PLC needs to monitor the valve position, flow rate, process temperature, and upstream pressure—regardless of the current operating mode.

Initialization values for Manual startup mode

Register	Value	Description
40037	0	Sets the mode source to Digital
40038	1	Puts the unit into Manual mode
40041	1	Sets the setpoint source to Digital (in Digital mode the data never expires - even when not updated)

Control Register for Manual Mode

Register	Value	Description
40036	2280 (16%)	Valve Command scaled as an integer 0-9999 with 0=-12.5% and 9999=112.5% Example: 16% ⇨ (16%-(-12.5%))*1000 counts/125%=2280 counts

Initialization Values for Automatic Mode

Register	Value	Description
40037	0	Set the mode source to Digital
40038	2	Puts the unit into Automatic mode
40041	2	Sets the setpoint source to Remote
40109	5	Sets the communication timeout to 5 seconds maximum between updates to register 40705.
40047	300	Sets the hold last position to 300 seconds (5 minutes) if register 40705 is not updated within the time interval set in 40109 (5 seconds).
40039	1	Selects liquid flow as the control variable
40491	-100	Ramp closed rate of 100 percent/min when time in 40047 expires
40425	500	Full scale flow of 500 gpm for controller.

Control Register for Automatic Mode

Register	Value	Description
40705	45 (225 gpm)	Setpoint in percent of the process max set in 40425 (500gpm)

Registers for Monitoring Process

Register	Description
30407	Reads the current valve position in percent.
30393	Reads the current liquid flow rate in engineering units.
30403	Reads the current process temperature in engineering units.
30397	Reads the current upstream process pressure in engineering units.

Example 2: StarPac system is attached to a PLC that has only integer Modbus communication capability. When in operation, the StarPac will be in automatic mode, controlling gas flow at approximately 4500 LB/HR with a range of 0 to 5000 LB/HR. The PLC needs to monitor the valve position, flow rate, process temperature, and upstream pressure, regardless of the current operating mode. The pressure will range from 100 to 600 psi, and the temperature will range from 30 to 300 degrees Fahrenheit (-1 to 149° Celsius).

Initialization Values for Automatic Mode

Register	Value	Description
40037	0	Sets the mode source to Digital
40038	2	Puts the unit into Automatic mode
40041	1	Sets the setpoint source to Digital
40039	6	Selects gaseous flow as the control variable
40427	5000	Full scale flow of 5000 LB/HR for controller (must be set using Valtek StarTalk user interface because it is a floating point register).

Control Register for Automatic Mode

Register	Value	Description
40035	8200 (4500 lb/hr=90% of 5000 lb/hr and 8200 counts represents scaled 90%)	Setpoint scaled as an integer 0-9999 with 0 = -11.25% (a 125% range) of the maximum process variable set in register 70271. Example: 90% ⇨ (90%=(-12.5%))*1000 counts/125%=8200 counts

NOTE: Any setpoint must be written after setting the mode to auto because the bumpless transfer that occurs when the unit is switched from auto to manual overwrites the existing setpoint with the current PV. When the mode change occurs, any value that is in the setpoint register is overwritten even if the value was placed there just prior to the mode change.

Scaling the Integer Registers

Variable	Minimum Scale Register	Maximum Scale Register	Description
Gas Flow	40629 (set to 0)	40631 (set to 5000)	Sets the normalized range for gaseous flow in lb/hr (these must be set using Valtek StarTalk user interface because they are floating point registers).
Upstream Pressure	40633 (set to 100)	40635 (set to 600)	Sets the normalized range for upstream pressure in psi (these must be set using Valtek StarTalk user interface because they are floating point registers).
Process Temperature	40645 (set to 30)	40647 (set to 300)	Sets the normalized range for process temperature in Deg F (these must be set using Valtek StarTalk user interface because they are floating point registers).
Valve Position	fixed at -12.5%	fixed at 112.5%	The position is fixed range where 0 = -12.5% and 9999 = 112.5%
Re-calculate Flag	40078 (set to 1)	N/A	Register 40078 must be set to 1 in order to signal the system to recalculate the scalar range after they have been changed. This only needs to be written one time after each change in scaling.

Integer Registers for Monitoring Process

Register	Description
30020	Reads the normalized valve position in current percent open. Position percent open = (counts (125)/1000) + (-12.5)
30013	Reads the normalized gaseous flow in currently selected engineering units. Flow lb/hr = (counts (5000-0)/10000) + 0
30017	Reads the normalized process temperature in currently selected engineering units. Temperature Deg F = (counts (300-30)/10000) + 30
30014	Reads the normalized upstream process pressure in currently selected engineering units. Pressure in psi = (counts (600-100)/10000) + 100

Appendix H

StarPac 3 NS (No Sensors) Setup

This guide is a setup tool for configuring a StarPac 3 NS option. NS means that the StarPac has no integrated process sensors attached. However, an external 4-20 mA process transmitter can be used as the process variable input to the StarPac PID controller. Hence it is a high performance valve positioner with a PID controller feature.

The StarTalk DTM software that supports the StarPac 3 has a special configuration option in the Configuration menu that makes setting up the SP3 NS very easy. Refer to the StarTalk DTM User's Manual (*VLENSF0001-00 10/13*) for more information.

This document is an addendum to the StarPac Users Interface manual and outlines setting up StarPac using the local keypad.

1. As processor sensors are not physically wired to the StarPac module, their alarm functions must be disabled to prevent nuisance alarming. This is accomplished by using the alarm masking feature of the StarPac. On the StarPac key pad under the **STATUS** menu, press **NEXT → Alrm Set**. Use the NEXT/PREV buttons to choose **Sensor Malfunction**. Press **Disable**. Alarm: will indicate 'Disabled' Press **Last Option**.
2. Press **Alrt Set**. Select **Low dp Alert**. Press **Disable**. Alert: will indicate 'Disabled' Press **Last Option**.
3. Press **NEXT → Sensor Set**. Select: **Upstream Pressure**; **Downstream Pressure**; **Process Temperature** each in turn and disable each sensor. Press **Last Option** to return to top menu. You have now disabled and masked off the sensor alerts and alarms.
4. Next, go to the **Configuration** menu. Press **Accept** to take the StarPac Offline. Press **NEXT → Anlg In 2**. If not selected, use NEXT/PREV buttons to select '**External PID Sensor**'. Press **Accept**. Press **Last Option** to return to top menu. You will need to press **Accept** to put the StarPac back online (Indicated by the flashing T on the right side of the display will disappear). This has now told the PID controller to look at the 4-20 mA input signal connected to the Analog In 2 (Auxiliary Input) terminals for the PV to control.
5. Go to the **TUNE** menu. Press **NEXT** twice → **PV Slct**. Use NEXT/PREV buttons to select '**Auxiliary 4-20 mA Input**'. Press **Accept**. You have now selected your 4-20 mA signal from your process transmitter as the process variable to control for the PID controller. **The default scaling for this variable is 0-100%.**
6. You must now go to **PID Actn** to set the proper controller action for the process variable you want to control. Either **Direct or Reverse** acting. This will depend on your actual control loop construction. This is the same functionality as any PID controller.

You have now configured the StarPac 3 NS as the controller for your process variable. You are now ready, when safe conditions exist, to change the controller Mode to Automatic and tune your control via the **Prop Band**; **Rset Rate** and **Der Time** variables in the menu structure. Refer to pages 7- 11 of the User Interface Manual for details of using the Tune menu and options.

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