

CS400™

Commercial Backwash Controller



Installation and User's Guide

IMPORTANT SAFETY INSTRUCTIONS
READ AND FOLLOW ALL INSTRUCTIONS
SAVE THESE INSTRUCTIONS



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IMPORTANT WARNINGS AND SAFETY PRECAUTIONS



IMPORTANT NOTICE - Attention Installer: This Installation and User's Guide ("Guide") contains important information about the installation, operation and safe use of the CS400 Controller. This Guide should be given to the owner and/or operator of this equipment.

Read and Follow all Safety Instructions

The CS400 Controller is designed and manufactured for safe and reliable service when installed, operated and maintained according to the information and installation codes referred to in this manual.

WARNING

Before installing this product, read and follow all warning notices and instructions in this Guide. Failure to follow warnings and instructions can result in severe injury, death, or property damage. Call (800) 831-7133 for additional free copies of these instructions. Please refer to www.pentair.com for more information related to this product.



DANGER

Risk of Electrical Shock or Electrocution!

This product must be installed by a qualified pool or spa professional. Installations must comply with:

- The National Electric Code (NEC) or Canadian Electrical Code (CEC).
- All applicable local codes and ordinances.
- Always disconnect power at the circuit breaker before servicing the load center. Failure to do so could result in death or serious injury to installer, service person, pool users, or others due to electrical shock.
- Improper installation can create an electrical shock hazard that can result in death or serious injury.

WARNING

Water temperature in excess of 100° Fahrenheit may be hazardous to your health. Prolonged immersion in hot water may induce hyperthermia. Hyperthermia occurs when the internal temperature of the body reaches a level several degrees above normal body temperature of 98.6° F. (37° C.). Effects of hyperthermia include: (1) Unawareness of impending danger. (2) Failure to perceive heat. (3) Failure to recognize the need to leave the spa. (4) Physical inability to exit the spa. (5) Fetal damage in pregnant women. (6) unconsciousness resulting in danger of drowning. The use of alcohol, drugs, or medication can greatly increase the risk of fatal hyperthermia in hot tubs and spas.

WARNING

The CS400 Controller is intended to control heaters with built-in high limit circuits **ONLY**. Failure to do so may cause property damage or personal injury.

WARNING

Do not use this product to control an automatic pool cover. Swimmers may become entrapped underneath the cover.

WARNING

To reduce the risk of injury, do not permit children to use this product.

WARNING

Most states and local codes regulate the construction, installation, and operation of public pools and spas, and the construction of residential pools and spas. It is important to comply with these codes, many of which directly regulate the installation and use of this product. Consult your local building and health codes for more information.

IMPORTANT WARNINGS AND SAFETY PRECAUTIONS

General Installation Information

1. All work must be performed by a licensed electrician, and must conform to all national, state, and local codes.
2. Install to provide drainage of compartment for electrical components.
3. The electrical supply for this product must include a suitably rated switch or circuit breaker to open all ungrounded supply conductors to comply with Section 422-20 of the National Electrical Code, ANSI/NFPA 70.1987. The disconnecting means must be readily accessible to the tub occupant but installed at least 10 ft. (3.05 m) from the inside wall of the pool.

Two Speed Pump Controls Notice (Title 20 Compliance)

Please read the following important Safety Instructions - When using two-speed pumps manufactured on or after January 1, 2008, the pump's default circulation speed **MUST** be set to the **LOWEST SPEED**, with a high speed override capability being for a temporary period not to exceed one normal cycle, or two hours, whichever is less.

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CS400™ Backwash Controller Overview

Introduction

The CS400™ Backwash Controller, by Paragon Aquatics®, has simplified the backwash cycle of Stark™ and THS Series® filtration systems equipped with diaphragm-valve face piping kits.

This semi-automatic programmable controller, with Acu-Trol® Intelligence, can backwash up to six (6) filters in sequence via the integral multiport pressure distribution valve.

A backwash can be initiated in three ways: true semi-automatic backwash at the single touch of a button, via an external signal from a master filter room controller such as the Acu-Trol® AK600™ or by a signal from an optional differential pressure switch for basic, automatic backwash functionality.

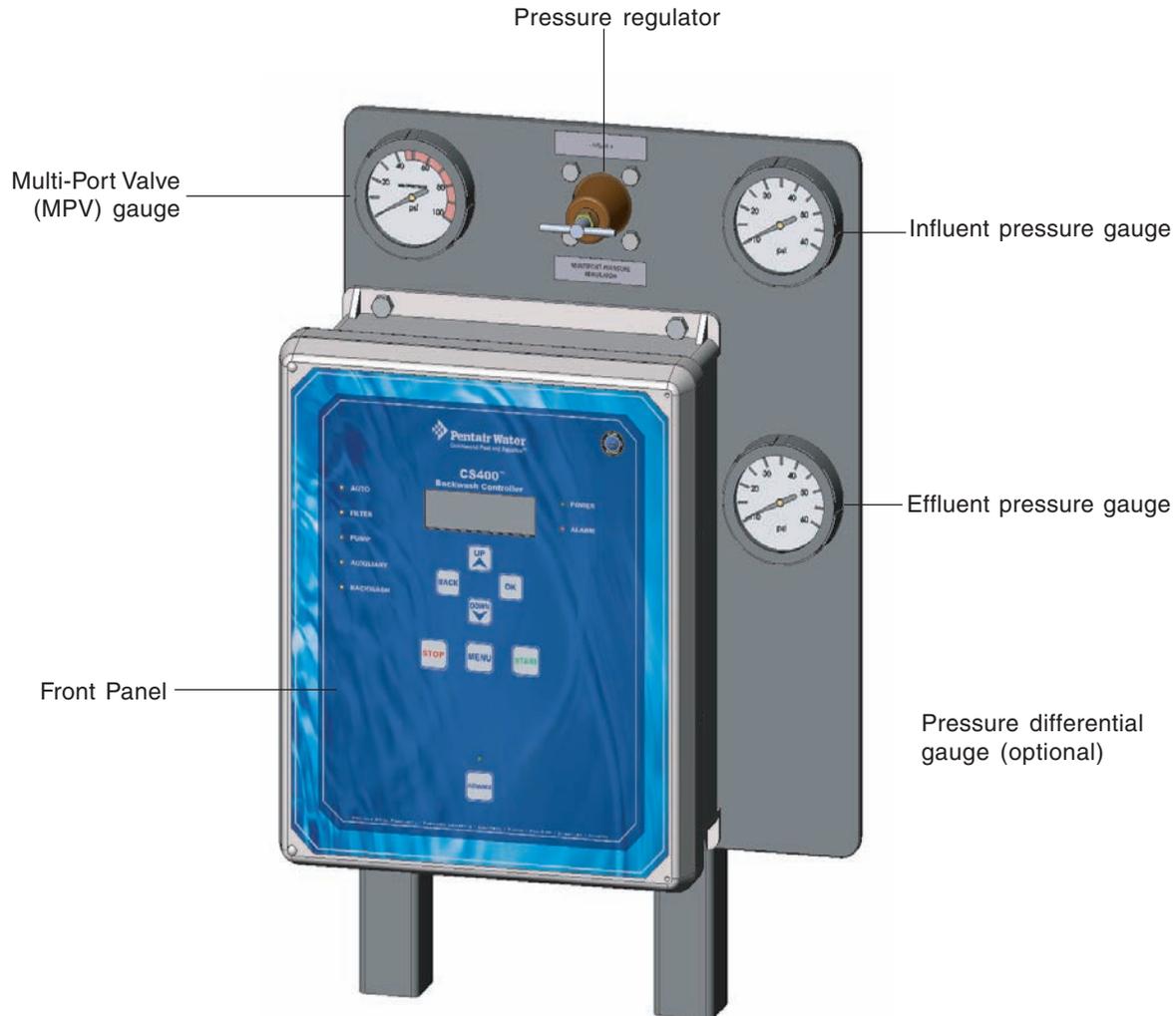
The enhanced efficiency and economy makes the CS400 one of the most eco-friendly commercial backwash controllers on the market.

Features include user-configurable settings, alarms, automatic calculated backwash cycle time and valve control to ensure pump and heater protection prior to the start of the backwash cycle.

- Compatible with Stark™ and THS Series® filters with diaphragm-style backwash valves.
- The “Advance” feature saves energy and conserves water. This feature allows you to advance to the next process within the backwash cycle, to save energy and conserve water.
- Multiport pressure distribution valve actuate diaphragm-style backwash valves using city water pressure or compressed air.
- A RS-232 Serial Interface is included to provide access to all system operations from a host computer. This computer can be located up to 50 feet away with a standard RS-232 cable, up to 1000 feet away with optional RS-422 converters, or any distance with optional telephone modem. With modem operation, multiple pool locations can be controlled from one central location. For more information, see page 26.
- Custom programming services are available to adapt the controller for custom requirements.

Features

- Manual Backwash: Backwash cycle initiated manually from the control panel Start button.
- Auto Backwash: External input signal from pool controller or differential pressure switch. Requires normally-open dry contact or input signal either 10-32 VDC or 12-32 VAC.
- Internally Fused: Input fused at 5 Amps. Each output fused at 4 Amps.
- Security: Enclosure has a latch that can accept an optional padlock.
- Computer Control: Firmware driven system that can be updated in the field
- Eight-Button control panel: For the entry of configuration information, including start & stop.
- LCD Display: Includes a status screen with active information and backlight.
- Eight LED Indicators: Power, Alarm, Auto, Filter, Pump, Backwash, Auxiliary, and Advance.



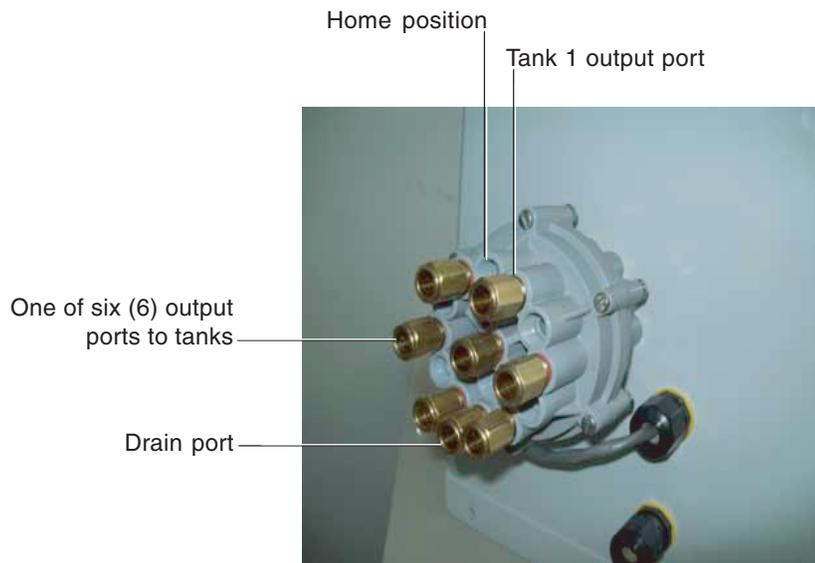
CS400 Electronics Enclosure (with pressure regulator and gauges)

System Overview

Influent gauge and Effluent gauge: These gauges monitor the current influent and effluent operating pressures for multiple tank systems. The gauges indicate to the operator when a backwash process is required to clean the filter media.

Multiport Valve (MV250): MPV is mounted in the CS400 controller enclosure. The multiport valve takes water (or air) from a source supply (well, city water, air, etc.) and distributes the water to actuate a diaphragm valve.

Multiport valve gauge: The multiport valve receives water (or air) from a source supply (well, city water, air, etc.) from 35 to 40 psi and distributes the water or air to actuate a diaphragm valve. This gauge monitors the regulated supply pressure (Water or Air) to the multiport valve.



Multiport valve (Rear view of CS400 enclosure)

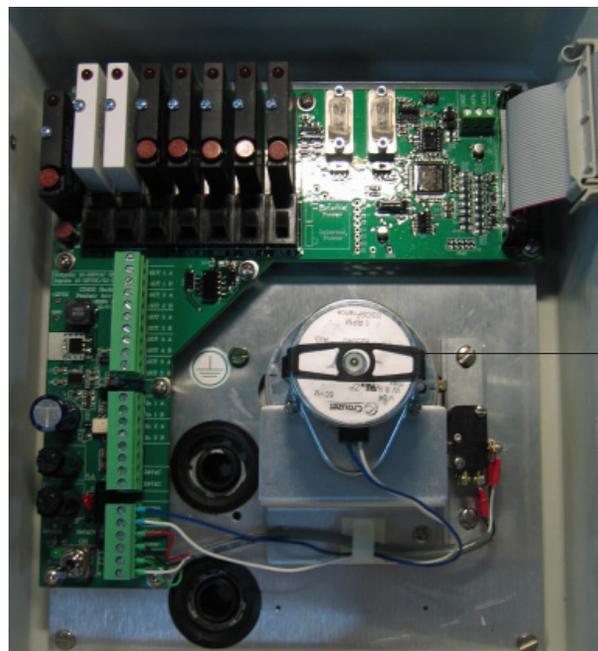
Pressure regulator: The pressure regulator regulates the pressure from the source supply to the multiport valve by reducing the incoming source supply pressure of 45 psi (or higher) to the required system operating pressure of 35 to 40 psi.

Check Valve: A system check valve prevents loss of water pressure to the multiport valve which may have otherwise been interrupted due to fluctuations or loss of water pressure from the source supply.

Multiport Valve Control Knob: The multiport valve control knob is used to change the multiport valve from the filter mode of operation to a backwash mode of operation (see page 22).

The processor controlled multiport valve knob is driven by a 24 VAC, 1 RPM motor. The multiport valve housing includes a six (6) position tank selection knob. Cams on the knob drive two micro switches which monitor the knob's rotational position. There are up to 12 cams in the outer perimeter of the knob that signal when the knob is in the backwash position. There is one inner cam that signals when the knob is in the home position. Knobs are custom-ground according to the number of tanks in the system.

When in backwash mode (the pump may remain on during valve actuation, however it is recommended that the pump be shut off to assist in faster valve actuation) the multiport control knob is automatically rotated from the home (filter mode of operation) position to the position of the tank to be backwashed. Once the knob is rotated to the desired tank position, pressure is supplied from the multiport valve to the diaphragm valve or valves to actuate the valves for the backwash cycle. The source supply pressure on the multiport gage (35-40 psi) will drop momentarily and then rise to the required multiport pressure at this time the operator can determine that the valve is actuated. If the pump was turned off for valve actuation it must be turned on at this time for the backwash cycle. This process is repeated as necessary when valves need to be actuated. After each backwash cycle is completed for each tank (usually 3- 5 minutes per tank or until the water runs clear) the knob is rotated to the home position. When in the home position, the (air/water) pressure supplied to the valves for actuation is drained and the valves return to normal filter mode operation.



24 VAC motor
(Multiport valve)

Multiport valve motor (Inside enclosure view)

Timers and Power Outage Restart

Timers consist of counters that will display in days, hours, minutes, and seconds. The CS400 does not provide a real time clock (time-of-day or calendar-date). The system does not keep track of time if power is off. When the CS400 is restarted after a power outage, the Multiport valve rotates to the HOME position and the main screen displays "CS400 System Ready." Press the **OK button** to restart the "Filter Mode Timer." Press the **Menu button** to access the menus.

Output Relays

Output Relays

Relays are provided for three commonly-used backwash controls:

- Master Relay, which for the most part, encompasses the entire backwash cycle,
- Pump Relay, a normally closed contact that opens to stop the pump while rotating the in-line valves.
- Auxiliary Relay, configurable as either a Heater Cool-Down relay or a Priority Valve (PV) relay, each with its own purpose and function.

Master Relay

This relay contact engages upon the start of a Backwash Cycle along with the front-panel Backwash LED and starting of the backwash mode timer. Following a 15 second delay, the sequence continues. If the Interfilter Delay is greater than 15 minutes, the Master Relay will disengage during the Interfilter Delay period and engage again before turning the pump off and rotating to the next valve. The Master Relay disengages upon returning to Filter Mode.

Pump Relay

The pump drives a normally-closed contact that is disengaged to stop water flow. The pump is stopped prior to rotating valves or disengaging the Priority Valve. It is turned on for the Backwash Duration, Interfilter Delay, and Filter Mode.

Auxiliary Relay (Heater / Priority-Valve)

A configuration parameter allows the Auxiliary Relay #3 to be used either as a Heater Cool-Down control (Fireman's Delay) or Priority Valve control. As a Heater Cool-Down (Fireman's Delay) control, the relay is disengaged for a specified duration prior to turning the pump off. As a Priority Valve control, the relay is engaged after rotating the multiport valve to the selected tank prior to turning on the pump for a backwash-duration. It is then disengaged after the backwash-duration and turning off the pump, prior to the Interfilter Delay process.

Heater Relay Control

If Auxiliary Relay #3 is set to HEATER, the solid-state relay (SSR) output will be controlled to drive a normally-closed magnetic relay contactor, just like the pump output. When the front panel Auxiliary LED is lit, the Relay #3 output will be OFF; when the Auxiliary LED is off, the Relay #3 output will be ON. Note that this inverse control is not true when Auxiliary Relay #3 is set to Priority Valve.

Outputs 4 & 5: (for future use)

Backwash Process

The CS400 controller can perform backwash operations for a total of six (6) filters based on an external start signal or pressing the Start button. The controller performs the following sequence of operations to initiate a backwash cycle:

- First, the controller energizes the “Master” relay (Output 1) which is intended to signal other devices such as ozone and chemical controllers that a backwash is in process.
- Next, the controller instructs the multiport valve to switch the first filter into its backwash configuration. When moving the multiport valve, the controller waits an additional 15 seconds (15 seconds default). See “Valve Shift Duration” in Configuration menu for the hydraulic valves to switch to their new positions.
- The controller then waits for a user specified period of time for the filter to backwash (“Backwash Duration”).
- The pump is switched off and the controller instructs the Multiport valve to suspend backwash operations (waiting 15 seconds for the hydraulic valves to finish shifting) and then waits for a user selected time interval (“Interfilter Delay”) before moving to the next filter.
- The multiport valve then switches to the next filter.

This cycle is repeated for each filter in the system. After all filters have been backwashed, the controller moves the multiport valve to the “Home” position and turns the Master relay (Output 1) off. After this entire sequence of events has been completed, the CS400 controller waits until conditions once again call for a backwash.

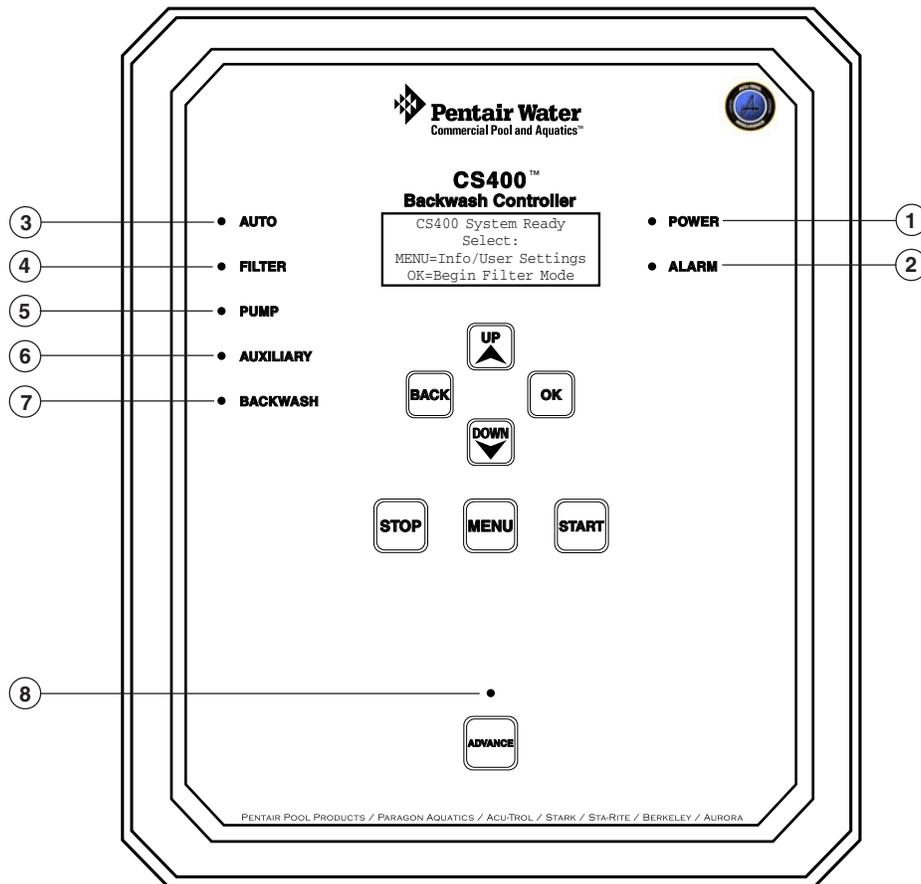
Watchdog Timer and Alarm Conditions

The CS400 automatically monitors valves and sensors in the pumping system to ensure that excess water is not consumed in the backwash process. A “watchdog” timer is initialized at the beginning of a backwash cycle and an alarm condition is activated if system backwash does not complete on time. If a backwash cycle has been requested based on differential pressure across the filter system, and three consecutive backwash operations within a predetermined amount of time have not succeeded in bringing the pressure or flow rate back into acceptable ranges, the alarm is activated and backwash operation is suspended.

Operator Control Panel

This section describes the CS400 Backwash Controller operator controls and LEDs.

Operator Control Panel



Control Panel LEDs

LCD: The 1" x 3" alphanumeric LCD screen is a four row by 20 column backlit screen which displays alphanumeric characters with automatic shut off feature. When the backlight is off, the first button pressed will switch on the backlight.

- ① **Power:** Green LED on indicates 24 VAC power is supplied and the 5 VDC power supply is functional (Fuse okay).
- ② **Alarm:** Red LED on indicates an alarm condition exists. See Information Menu for more information about how to clear an alarm condition.
- ③ **Auto:** Yellow LED on, indicates Start Option menu item is set to monitor external input signal for a backwash start command.
- ④ **Filter:** Yellow LED on, indicates system is in Filter Mode, on with Backwash LED in Interfilter Delay process.
- ⑤ **Pump:** Yellow LED on, indicates the pump relay is de-energized (relay contacts are closed for normal operation).
- ⑥ **Auxiliary:** Yellow LED on, indicates Heater or Priority Valve is engaged.
- ⑦ **Backwash:** Yellow LED on, indicates system is in the backwash cycle, full cycle including Interfilter Delay process.
- ⑧ **Advance:** Green LED on, indicates the user can advance through the current process.

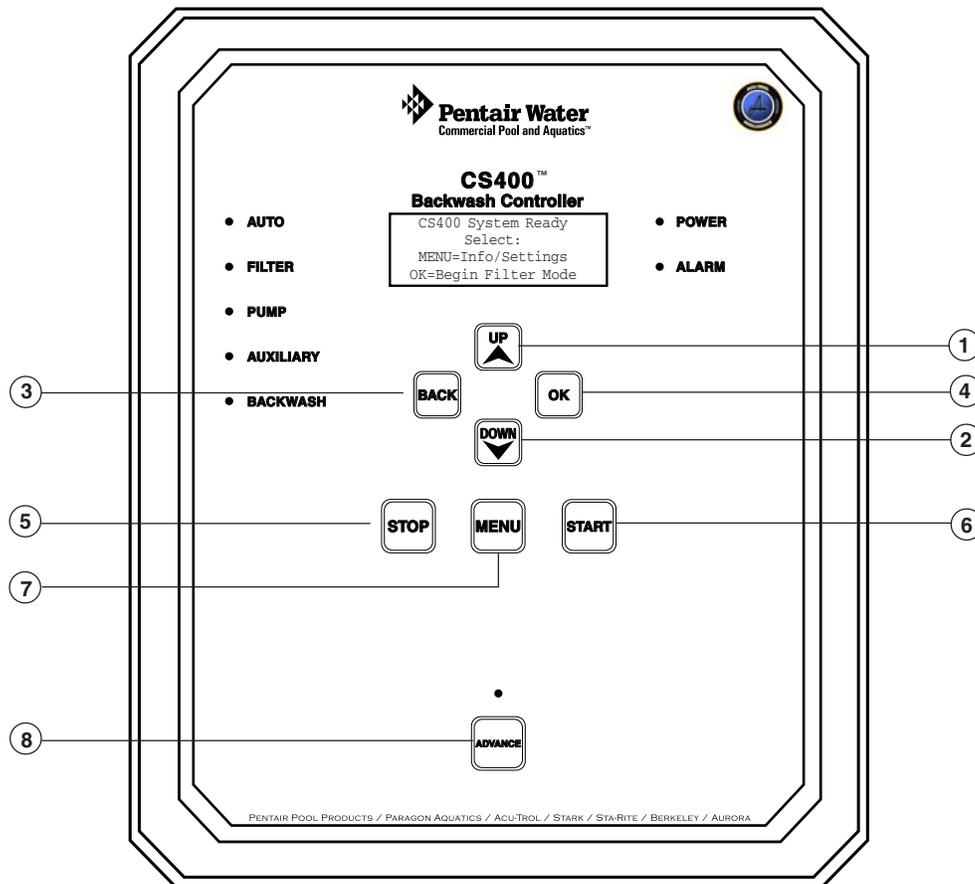
Control Panel Buttons

Control panel buttons include: MENU, UP, DOWN, BACK, OK, ADVANCE, START and STOP. Pressing any button will enable the display's backlight.

Buttons active during a backwash cycle

The control panel buttons active during a backwash cycle are:

- **STOP** button: Ends the current backwash cycle. If the external input signal is not disabled within the calculated total backwash cycle time period (plus three (3) minutes), an alarm will be generated.
- **MENU** button: Press to display "Total Backwash Cycle Time." Press again to display the current backwash status.
- **ADVANCE** button: During a water-saver process, press this button to skip to the end of the current process step.



- ① **Up arrow:** Move one level up in the menu tree or increase a value when editing a setting. While in Menu mode, press UP/DOWN button to select menus.
- ② **Down arrow:** Move one level down in the menus or decrease a value when editing a setting.
- ③ **Back button:** Returns to previous menu or Exit menu mode.
- ④ **OK button:** Saves current menu item setting, acknowledge alarms and warning alerts.
- ⑤ **Stop button:** Stop a backwash cycle and return to "Filter Mode Timer" mode.
- ⑥ **Start button:** Start a backwash cycle. A "Start Input Signal" can also start a backwash cycle. This feature can be changed in the "User Settings" menu, see page 10.
- ⑦ **Menu button:** Access menu items. While in "Filter Mode Time" pressing the MENU button toggles display between backwash start prompts and menu selection.
- ⑧ **Advance button:** Green LED on, indicates the user can press the Advance button to advance through the current process (see page 12).

Backwash Operations

This section describes how to operate the CS400 backwash controller.

Begin a Backwash Cycle

To begin a backwash cycle.

1. Power on the CS400 Controller.

```
CS400 System Ready
      Select:
MENU=Info/Settings
OK=Begin Filter Mode
```

After power up, press the **OK** button to display the “Filter Mode Timer” or press the **MENU** button to access the menu settings (see page 10).

2. Press the **OK** button to start the “Filter Mode Timer.”

```
Filter Mode Timer
      H:00 M:00 S:04
START Button or Signal
to begin Backwash
```

Filter Mode Timer: The “Filter Mode Time” is the elapse time after the Backwash cycle ends. It is the initial state when flow control valves are in the “filter” position and the Multiport valve is at home position.

3. Press the **START** button to begin a backwash cycle for tank #1.

```
Filter Mode Timer
      H:00 M:00 S:05
Begin Backwash?
Press OK to confirm
```

A backwash cycle can be started by pressing the **Start** button or when an external **Start Input Signal** is initiated. This feature can be changed in the “User Settings” menu, “Start Options” setting (see page 11).

```
BW Cycle. Tank #1
Backwash Duration
Timer M:02 S:03
Press STOP to Exit
```

As the backwash cycle proceeds, the screen displays the current backwash duration for tank #1.

```
BW Cycle. Tank #1
Total BW Cycle Time
___H:00 M:02 S:07___
Press STOP to Exit
```

Press the **MENU** button to toggle the display to view the “Total Backwash Cycle Time.”

```
Rotating to
HOME Position

Please wait
```

After the backwash cycle for all filters/tanks has been completed, the total backwash time is displayed and the screen returns to the “Filter Mode Timer” which shows the total time since entering this mode.

Stop a Backwash Cycle

The **STOP** button is used to exit a backwash cycle. At any time, you can abort the backwash cycle, return the multiport valve to home position and re-enter “Filter” mode. Control panel screen prompt messages are displayed to confirm that you really intend to exit the backwash cycle. When the **STOP** button is pressed once, you are prompted to either press **STOP** again or press **START** to continue. If **STOP** is only pressed once, it will stop when the nine (9) second countdown timer expires. This way, a single **STOP** button press will still stop (after nine seconds). If **STOP** is pressed by mistake, you still can continue the backwash cycle by pressing the **START** button.

Note: Although not recommended, the user may switch the controller AC power OFF then ON to restore power. The Multiport valve will rotate to “HOME” position. The powered down state is, all relays off.

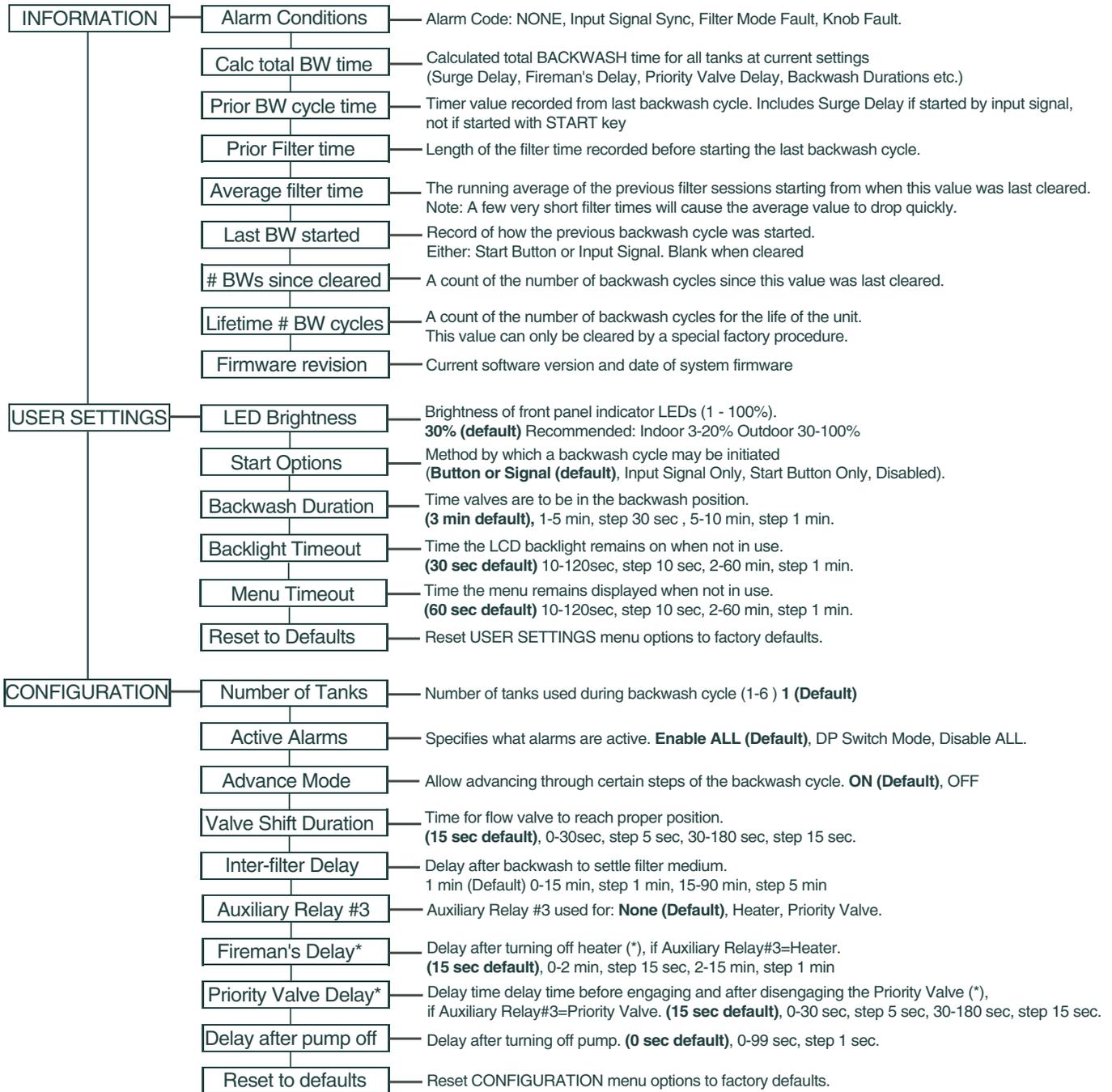
```
Filter Mode Timer
      H:00 M:00 S:04
START Button or Signal
to begin Backwash
```

Menus

MENU Button: Menu items can be accessed after power up, or when “Filter Mode Timer” is displayed.

```
CS400 System Ready
Select:
MENU=Info/Settings
OK=Begin Filter Mode
```

```
Filter Mode Timer
H:00 M:00 S:05
-----MENU #1 -----
INFORMATION MENU
```



Starting a Backwash cycle from an external input signal

An external input signal can start a backwash cycle. The external input signal is typically driven by a remote master controller or in some applications by a differential pressure switch, commonly referred to as a “Murphy” switch. The CS400 controller does not use a calendar clock and cannot be scheduled to start a backwash cycle at a specific time of day or specific date.

A backwash cycle can be started from an external input signal if the “User Settings” menu “Start Options” is set to “Button or Signal” or “Input Signal Only.” The control panel Auto LED is illuminated when these settings are selected.

To avoid unintended or excessive starts, the following conditions are imposed:

1. Alarms must be cleared.
2. The START button must be pressed and confirmed.
3. The Input Signal must be:
 - De-energized within three (3) minutes of the end of the backwash cycle.
 - De-energized for at least 30 continuous seconds since the last backwash was completed.
 - Energized for at least 30 continuous seconds (SurgeDelay), since de-energized (line above).
 - No more than two (2) auto backwash cycles less than five (5) minutes apart.

The CS400 calculates the total time to backwash all tanks and provides that value in the “Information” menu. This “CalcTotalBwTime” is a critical value calculated by the controller to disable chemistry monitoring and control processes that would be adversely affected by the backwash cycle; this value should be used by the master controller to assert the backwash signal duration.

If an Auto backwash (Input signal) command is received during an active backwash cycle, the input signal will be ignored. If the input signal is still asserted three (3) minutes after the manual cycle is complete, an alarm will be generated.

If an Auto backwash (Input signal) is received while in Menu Mode, the signal will be ignored until the menus are exited and returned to Filter-mode.

Start Options Menu

From the “Start Options” menu you can define the backwash start method. The default backwash start setting is “Button or Signal” which automatically starts a backwash cycle from either an external input signal or the control panel Start button.

To change the backwash start option:

1. From the main screen, press the **MENU** button.
2. Press the **DOWN** button then the **OK** button to access the “User Settings” menu.
3. Press the **DOWN** button then the **OK** button to access the “Start Options” settings.
4. Press the **UP/DOWN** button to scroll through the settings. Select the desired start option setting: (Button and Signal (default), Input Signal Only, Start Button Only, Disabled).
5. Press the **OK** button to save. Press the **BACK** button until the main screen displays.

Advance Button Backwash Process (water saving feature)

The “Advance” feature can prevent excessive water from being dumped to the drain. This water-saving eco-friendly feature allows you to advance or skip to the end of each of the following backwash process steps:

- Priority Valve Delay
- Valve Shift Duration
- Backwash Duration
- Interfilter Delay

At these times during the backwash cycle, the Advance LED will illuminate indicating that you can skip to the end of the current process. When the user determines that this step has reached a satisfactory level of completion, press the Advance button to advance the countdown “eggtimer” to zero.

To skip to the end of the current process.

1. While the Advance green LED is on or flashing, Press the **Advance** button.
2. Depending on the process and how far along it is, the screen will display one of the following prompts before going to the next process in the cycle:

"Confirm:Advance,Back." or "Save?OK,Advance,Back."

If the process timer has reached what has been determined a minimum amount of time (one (1) minute for the Backwash Duration, one (1) second for all others), the LED will no longer flash, but remain lit constantly. You will have an additional option to save the present timer, overwriting the menu parameter’s value by pressing OK. In this way, a process can be finely tuned to shorter, more efficient intervals without the need to go back to the menus to change the values. Changes at this point affects all future backwash cycles.

- Pressing **OK** will save the present process duration as the new value for the associated menu setting
- Pressing **ADVANCE** again will advance to the next process without overwriting the saved time interval
- Pressing **BACK** will cancel the request and return to the current process

The “Advance Mode” feature can be disabled in the “Configuration” menu (see page 10).

A special note about the over-written time value when subsequently accessing the menu:

Menus only allow the operator to select from predetermined fixed values. If the operator “Advances” and overwrites the menu setting, when subsequently accessing the menu, the UP or DOWN menu buttons will only show the next or previous predefined value. You will be unable to set the exact value through the menu that was assigned by “Advancing”.

Backwash Duration Menu

From the “Backwash Duration” menu you can define the time period for the backwash position.

To adjust the backwash time value setting:

1. From the main screen, press the **MENU** button.
2. Press the **DOWN** button then the **OK** button to access the “User Settings” menu.
3. Press the **DOWN** button then the **OK** button to access the “Backwash Duration” setting.
4. Press the **UP/DOWN** button to set the minutes and seconds settings (1-5 minutes, in increments of 30 seconds), 5-10 minutes (in increments of one minute).
5. Press the **OK** button to save. Press the **BACK** button until the main screen displays.

Priority Valve Delay Menu

The “Priority Valve Delay” feature defines the delay time before engaging and after disengaging the priority valve. This setting only applies if the “Configuration” menu item “Auxiliary Relay #3” is set to “Priority Valve.”

To adjust the Priority Valve delay time:

1. From the main screen, press the **MENU** button.
2. Press the **DOWN** button then the **OK** button to access the “Configuration” menu.
3. Press the **DOWN** button then the **OK** button to access the “Priority Valve Delay” setting, only if “Auxiliary Relay #3” is set to “Priority Valve.”
4. Press the **UP/DOWN** button to set the minutes and seconds settings (0-30 seconds, in increments of 5 seconds), 30 seconds to 3 minutes (in increments of 15 seconds).
5. Press the **OK** button to save. Press the **BACK** button until the main screen displays.

Set the Number of Tanks/Filters Being Used

You can define the number tanks/filters being used in a backwash cycle from the Configuration menu, “Number of Tanks” setting. This cannot be set to a value that exceeds the factory configuration of the multiport valve and associated knob.

Number of Tanks Menu

The “Number of Tanks” feature sets the number of tanks used during the backwash cycle.

To set the number of tanks used during the backwash cycle:

1. From the main screen, press the **MENU** button.
2. Press the **UP/DOWN** button until the Configuration menu is displayed. Press **OK** button to access the “Configuration” menu.
3. Press the **OK** button then the **UP/DOWN** button to set the number of tanks being used for a backwash cycle (1-6). The maximum number is set by a factory setting based on the multiport valve installed in the unit. For more information, consult the factory.
4. Press the **OK** button to save. Press the **BACK** button until the main screen displays.

Fireman’s Delay Time

The “Heater Cool-Down / Fireman's Delay” is a step of the backwash process, before the pump relay contacts de-energize, when the heater relay is off, this allows time for the heater to cool down before switching the pump off. The backwash process includes this procedure when the “Auxiliary Relay #3” is defined as a “Heater,” in the “Configuration” menu (see page 10),

Fireman’s Delay Menu

To change the Fireman’s Delay time:

1. From the main screen, press the **MENU** button.
2. Press the **UP/DOWN** button until the “Configuration” menu displays. Press the **OK** button to access the menu.
3. Press the **DOWN** button then the **OK** button to access the “Fireman's Delay” setting, only if “Auxiliary Relay #3” is set to “Heater.”
4. Press the **OK** button access the settings.
5. Press the **UP/DOWN** button to select the desired delay time (minutes and seconds). The delay time is from 0-2 minutes (in 15 seconds increments) and 2-15 minutes (in one minute increments).
6. Press the **OK** button to save. Press the **BACK** button until the main screen displays.

Troubleshooting

Alarm Fault Conditions

If an alarm or fault condition occurs, the alarm LED flashes on and off and a screen prompt message relating to the condition is displayed on the operator control panel LCD's "Information" menu. The screen message prompts determine if the alarm condition should be ignored or if immediate action should be taken to stop a backwash cycle that is in progress. When an alarm condition exists, the Master, Pump and Heater (Auxiliary) relays switch off.

An alarm or fault condition can occur due to the following conditions:

1. While rotating Multiport valve knob, the micro switch does not detect movement within specified time.
2. More than two (2) consecutive backwashes with less than five (5) minute filter intervals.
3. If a remote master controller is not synchronized with the backwash cycle, the external input signal duration will not coincide with the envelope of the backwash. This can be checked by monitoring the signal to verify it is not still asserted for more than three (3) minutes after the completion of a backwash cycle. This alarm message condition is displayed as "Input Signal Sync:4."

Active Alarm Menu Setting

Depending on the value set in the "Configuration" menu item "Active Alarms", alarm conditions may be ignored. The menu item "Active Alarms" can be set to:

Disable All: Ignore all alarm conditions.

DP Switch Mode: Ignore input signal alarms that may be associated with using a dP switch.

Enable All: Record all alarm conditions.

INFORMATION MENU Alarm Conditions Knob Fault: 6 BACK, UP/DN Clear: OK
--

Alarms are displayed on the INFORMATION menu, under the item "Alarm Conditions." To clear an alarm condition, press the **OK button**.

Input Signal Sync Alarm Condition

“Input Signal Sync” code alarms are related to the Start Signal timing intended to prevent a backwash cycle from operating if out of synchronization with the master controller. These conditions are only checked if the auto start Input Signal mode [not to be confused with the signal itself] is enabled.

Code	Possible Cause	Corrective Action
1*	Start input signal was not de-asserted within a 3 minute window either side of ending the backwash cycle.	Check settings of master controller. If using a differential pressure switch as the input control, set Configuration menu's item "Active Alarms" to "DP Switch Mode". Contact Technical Support for further assistance.
2*	Start input signal has been stopped (de-asserted) during the middle of the BW Cycle.	Check settings of master controller. If using a differential pressure switch as the input control, set Configuration menu's item "Active Alarms" to "DP Switch Mode". Contact Technical Support for further assistance.
4	Start input signal remained asserted too long after end of BW Cycle. This can also occur if the input signal was not unasserted (cleared) long enough between BW cycles. In that case, it treats it as if the signal was never off.	If using a dP switch, check filter media. Check settings of master controller or differential pressure switch. Contact Technical Support for further assistance.

* Alarm conditions 1 and 2 can be disabled by setting the “Active Alarms” menu item to “DP Switch Mode”.

Filter Mode Fault Alarm Condition

“Filter Mode Fault” code alarms are related to the filter timing (the time between backwash cycles).

Code	Possible Cause	Corrective Action
1*	More than 2 backwash cycles have been started with too short of a filter time between the cycles.	Check filter media. Check settings of master controller or differential pressure switch. Contact Technical Support for further assistance.

* The counter is incremented for each fault iteration. The alarm condition is only checked if the auto start Input Signal is enabled.

Knob Fault Alarm Condition

“Knob Fault” codes 1 to 6, each represents a unique stage of the motor control. If corrective action shown below does not resolve the condition, contact Technical Support for assistance.

Code	Possible Cause	Timeout	Corrective Action
1	Knob not at HOME position at start of the Backwash cycle.	Either SW_home or SW_cam are not closed when knob starts to move toward Tank 1.	Check position of knob, alignment of switches, wiring harness, J8 terminals Home+/- and Cam+/-
2	Knob has not started moving away from HOME.	Waiting for SW_home to open.	Check 1-RPM motor, alignment and functionality of SW_home.
3	Knob has not started moving away from HOME.	Waiting for SW_cam to open.	Check 1-RPM motor, alignment and functionality of SW_cam.
4	Knob has not reached next Tank's position within allotted time.	Waiting for SW_cam to close at next tank's position.	Check 1-RPM motor, alignment and functionality of SW_cam. wiring harness, J8 terminals Cam+/-
5	Knob has not moved away from Tank's last position within allotted time.	Waiting for SW_cam to open when moving away from last tank's position.	Check 1-RPM motor, alignment and functionality of SW_cam.
6	Knob has not returned to HOME position.	Waiting for SW_home to close within a certain time based upon number of tanks remaining to reach home.	Check 1-RPM motor, alignment and functionality of SW_home. Check position of knob, wiring harness, J8 terminals Home+/-.

Replacing CS400 Controller Fuses

The CS400 controller contains circuit board and relay replaceable fuses. To access the fuses:

1. Remove the AC power supply plug from the power source and all external supplies connected to the inputs and outputs.
2. Unlatch the front CS400 controller enclosure door and open the door. Switch OFF the power switch inside the controller enclosure.

- **Replacing F1 and F2 fuse:** Using your thumb or a flat-blade screwdriver, gently press the fuse-cap in and rotate the cap counterclockwise to unlock the cap. Pull the fuse-cap and fuse out to remove.

Replace the fuse in the fuse-cap:

For continued protection from electrical hazard, use only properly rated fuses.

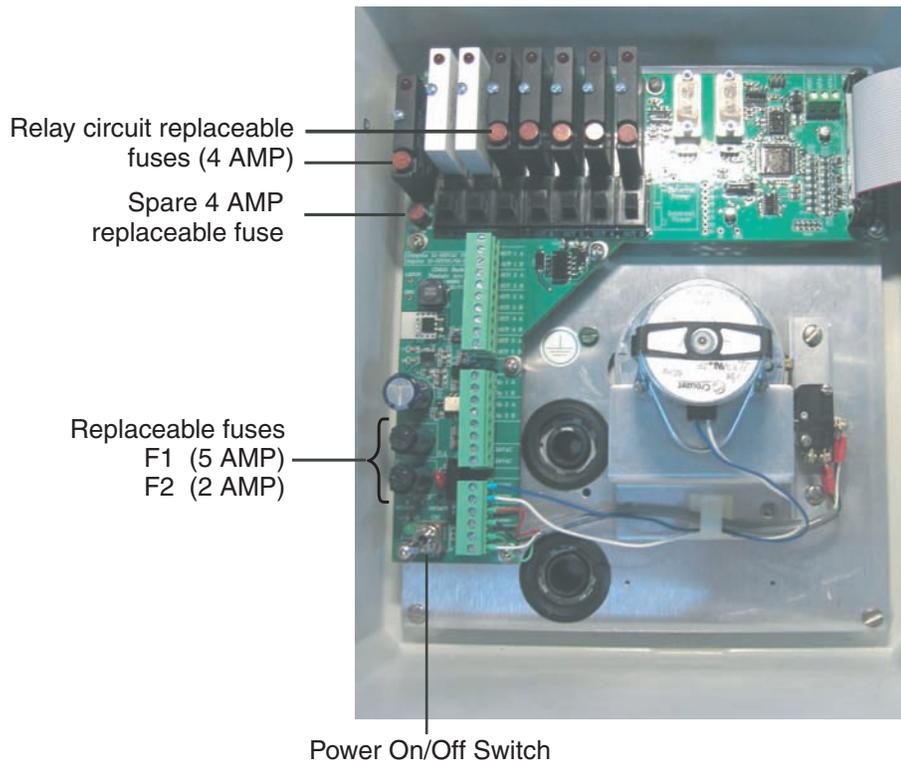
Both F1 and F2 are Bussmann S500/GDB, Fast Acting, 250V, 5mm x 20mm, UL Recognized. F1 is 5 ampere F2 is 2 ampere.

Align the fuse-cap slot in a horizontal position and carefully insert the fuse-cap into the fuse holder. Using your thumb or a flat-blade screwdriver, press the cap in and rotate clockwise to lock the fuse-cap and fuse in place.

- **Replacing a relay fuse:** Using your fingers, gently grasp the fuse and pull out to remove. For continued protection replace only with OPTO-22 model FUSEG4.

Carefully align the fuse pins with the relay pin holes. Press the fuse in to secure in place.

3. Plug the AC power supply plug into the power source and all external supplies connected to the inputs and outputs.
4. Switch ON the CS400 controller power switch inside the controller enclosure.



CS400 Replaceable Fuses

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Installation

The following information describes how to install the CS400 controller.



When using electrical products, basic precautions should always be followed, including the following:

- **DANGER: RISK OF ELECTRIC SHOCK, WHICH CAN RESULT IN SERIOUS INJURY OR DEATH.** Before attempting installation of the CS400 Controller, be sure all power to the circuit supplying power to the CS400 is disconnected/ turned off at the circuit breaker.
- The CS400 controller external power supply must be connected to a circuit protected by a ground fault circuit-interrupter (GFCI).
- **Read Safety Precautions and Important Instructions (page ii and iii). Before attempting any electrical wiring, be sure to read and follow Safety Instructions. Wiring should only be performed by a qualified pool and spa professional.**

Kit Contents

- CS400 Controller (includes mounting hardware)
- Installation and User's Guide

Mounting the CS400 Enclosure

With the two controller enclosure supports attached to the back of the front gauge panel, secure the two supports to a horizontal pipe with the two clamps as shown in Figure 2.



Figure 1. Enclosure attached to gauge panel (Front view)

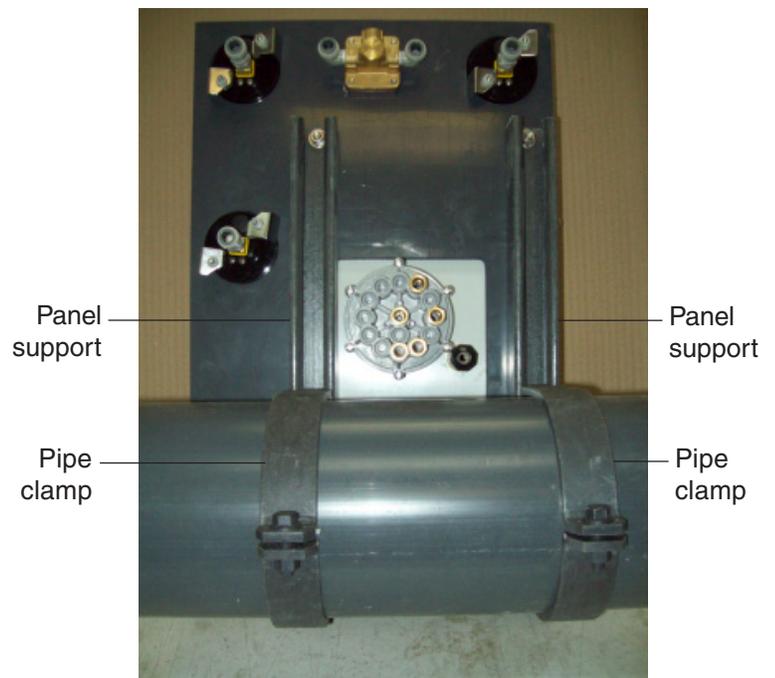


Figure 2. Enclosure attached to pipe (Rear View)

Connecting 24 VAC Power and Ground Wire to the CS400 Controller

The CS400 Controller must be connected to a UL Listed Class II, 24VAC, 100VA power source that is properly rated for the environment for which it is installed. Consult national and local codes for transformer requirements and suitable environmental conditions. For assistance in selecting a power supply, contact Technical Support.

To connect AC power to the CS400 controller:

1. Unlatch the two front door latches and open the door of the CS400 Controller enclosure.
2. Route an appropriately rated two wire cable from the 24 VAC power supply, through the rear opening of the controller enclosure.
3. **24 VAC connection:** Connect the two 24 VAC wires from the external power supply to the 24VAC screw terminals, as shown in Figure 3.
4. **Earth Bonding (Grounding):** As required by the latest national and local codes, attach the incoming GROUND wire to the GROUND BONDING LUG located on the aluminum panel inside the enclosure (see Figure 3). Earth bonding is necessary to ensure personal safety and safety of equipment.

IMPORTANT: A number 8-gauge (8.4 mm) wire is recommended when connecting the controller to a Protective Earth Ground connection that is acceptable to the local inspection authority. Attach to bonding point located on the back panel inside the enclosure.

5. Close the controller front door and latches.
6. Connect the CS400 controller external VAC power supply to a circuit protected by a ground fault circuit-interrupter (GFCI). The power supply provides 24 VAC to the controller.

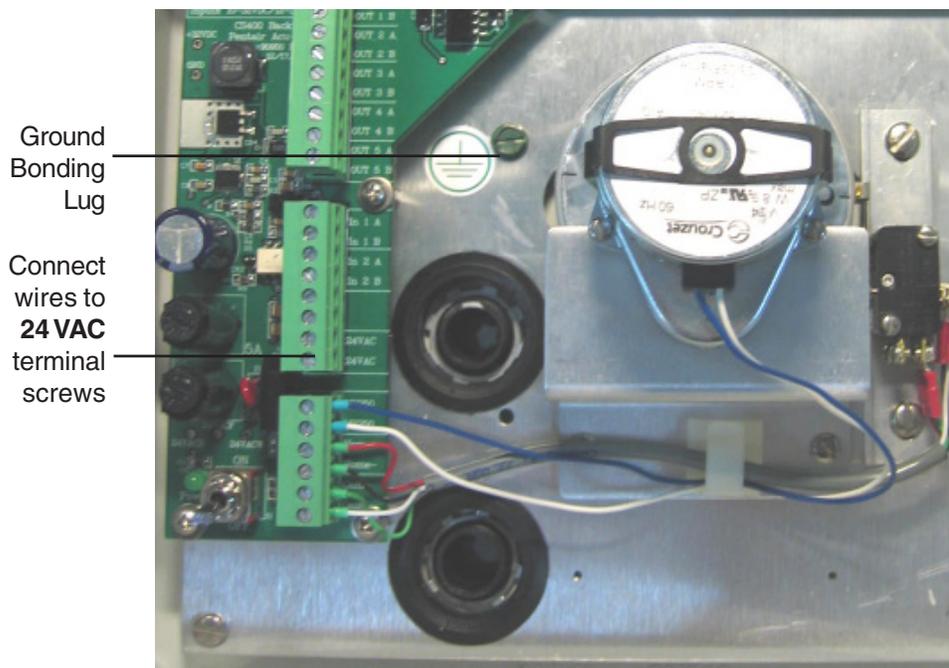


Figure 3: External 24VAC Power Supply Connections (inside enclosure view)

Powering up the CS400 Controller

To power up the CS400 Controller:

1. With the external power supply connected into a 120 VAC power source. Unlatch the two front door latches and open the door of the CS400 Controller enclosure.
2. Locate the ON/OFF power toggle switch on the controller circuit board. Lift the power switch up to switch power ON. The green power LED is on when 24 VAC is applied to the controller providing both fuses are good and the 5 VDC internal power supply is functioning properly.
3. Close the controller front door and latches.

Powering down the CS400 Controller

Off-Season, Sleep Mode Feature

The environmentally-conscious owner may want to power off the unit during the long winter months. The power ON/OFF toggle switch is inside the enclosure and not as convenient as a front panel ON/OFF feature. Making use of the existing front-panel green "START" button and red "STOP" button, the operator can put the CS400 to sleep (or hibernate mode). Press and hold the STOP button for five (5) seconds while in Filter Mode. A message is displayed that indicates the unit is going into Sleep Mode and to press START to power back up. During sleep mode: timer mode stops and all reference to time is lost, all inputs are ignored, all outputs are placed in the power-off state (solid-state relays are turned off), and the LEDs and LCD display are blanked. This puts the CS400 into a low-power state, reducing energy consumption. Just as your computer briefly blinks its power light in sleep mode, the CS400 blinks its power light for 1/10th of a second every four (4) seconds to give the owner an indication that it is in sleep mode and not completely turned off. Approximately twice a minute, the display will flash a message on the screen for one (1) second informing the operator to bring it out of sleep mode by pressing START. The green power light inside the enclosure near the power switch remains on. If supply power is removed and restored, the CS400 will turn on like normal.

To power down the CS400 Controller:

1. Unlatch the two front door latches and open the door of the CS400 Controller enclosure.
2. Press the power switch down to switch power OFF (green power LED is off).
3. Close the controller front door and latches.

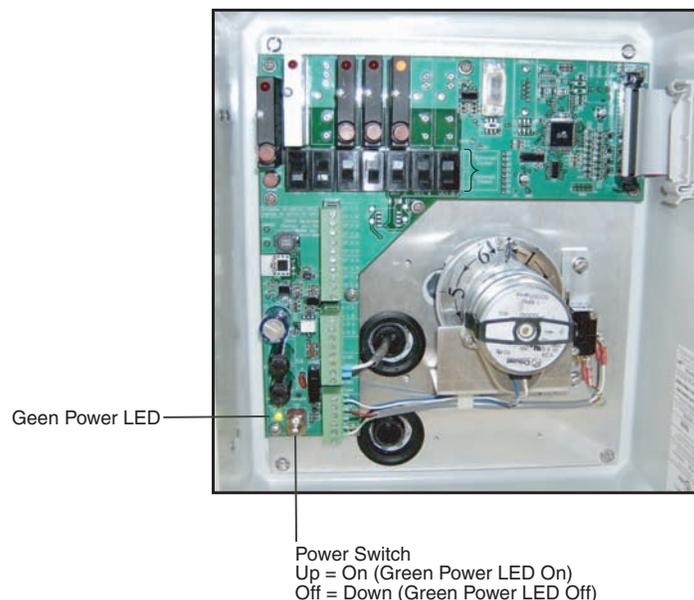


Figure 4: CS400 Power Switch (inside enclosure view)

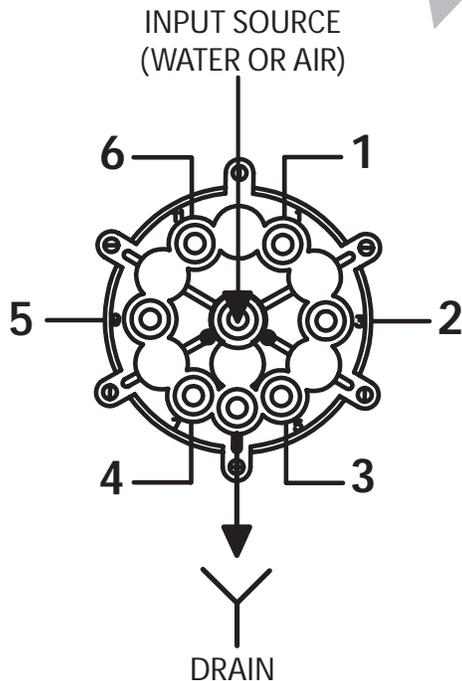
Multiport Valve Tank Output Ports

The CS400 Multiport valve provides the source water (or air) pressure to each backwash valve installed on the tanks. When the controller initiates a backwash cycle, the Multiport valve rotates the supply water (or air) to the first backwash valve installed on tank number one. When the backwash has been completed, the controller rotates the Multiport valve to the next tank to continue the backwash cycle. After all filters have been cleaned, the controller rotates the Multiport valve to “filter/home” position.

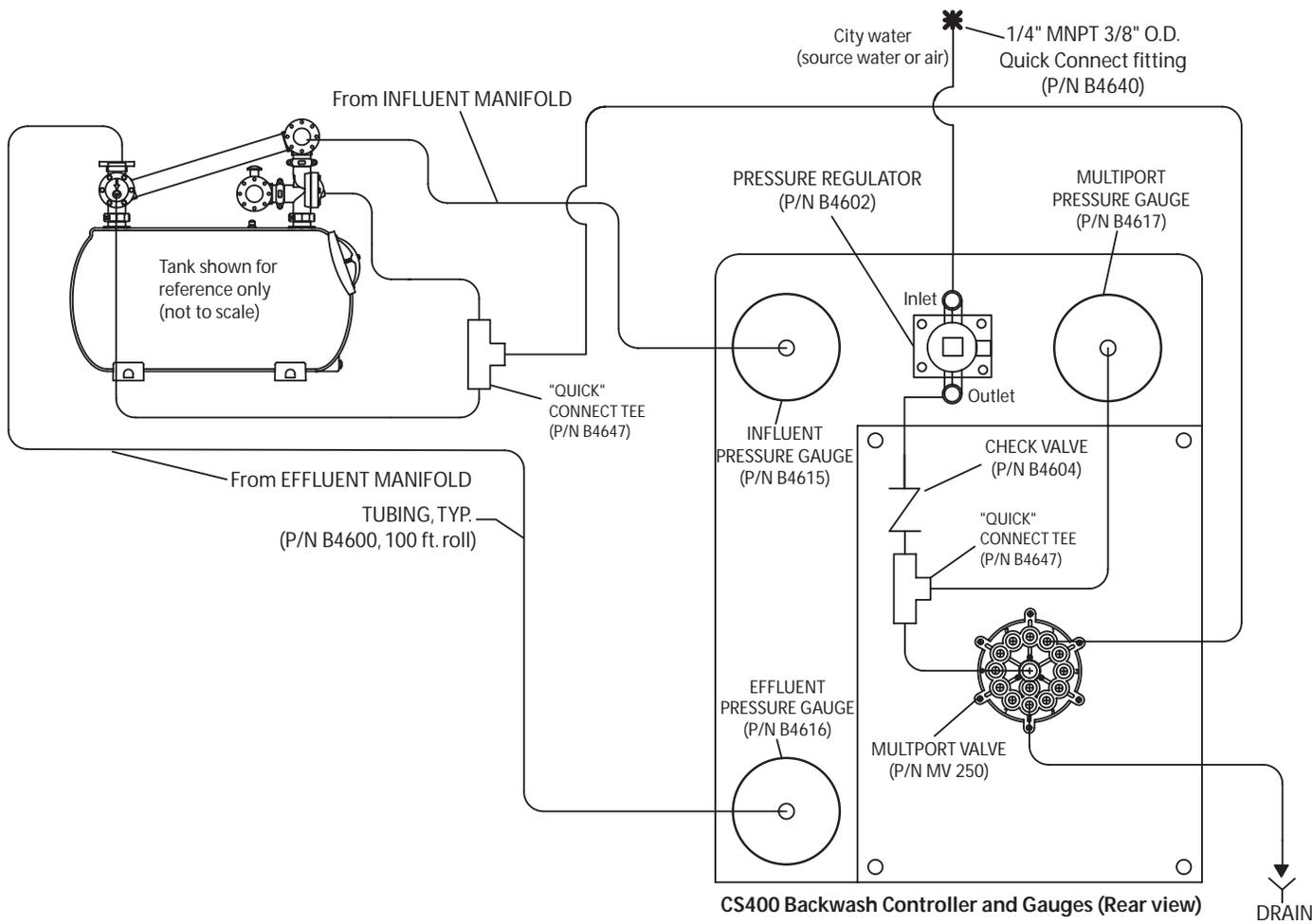
The following diagram shows the tank output ports (1 through 6). For CS400 Controller system hydraulics for single, dual and multiple tanks/filters, see page 23, 24, 25.



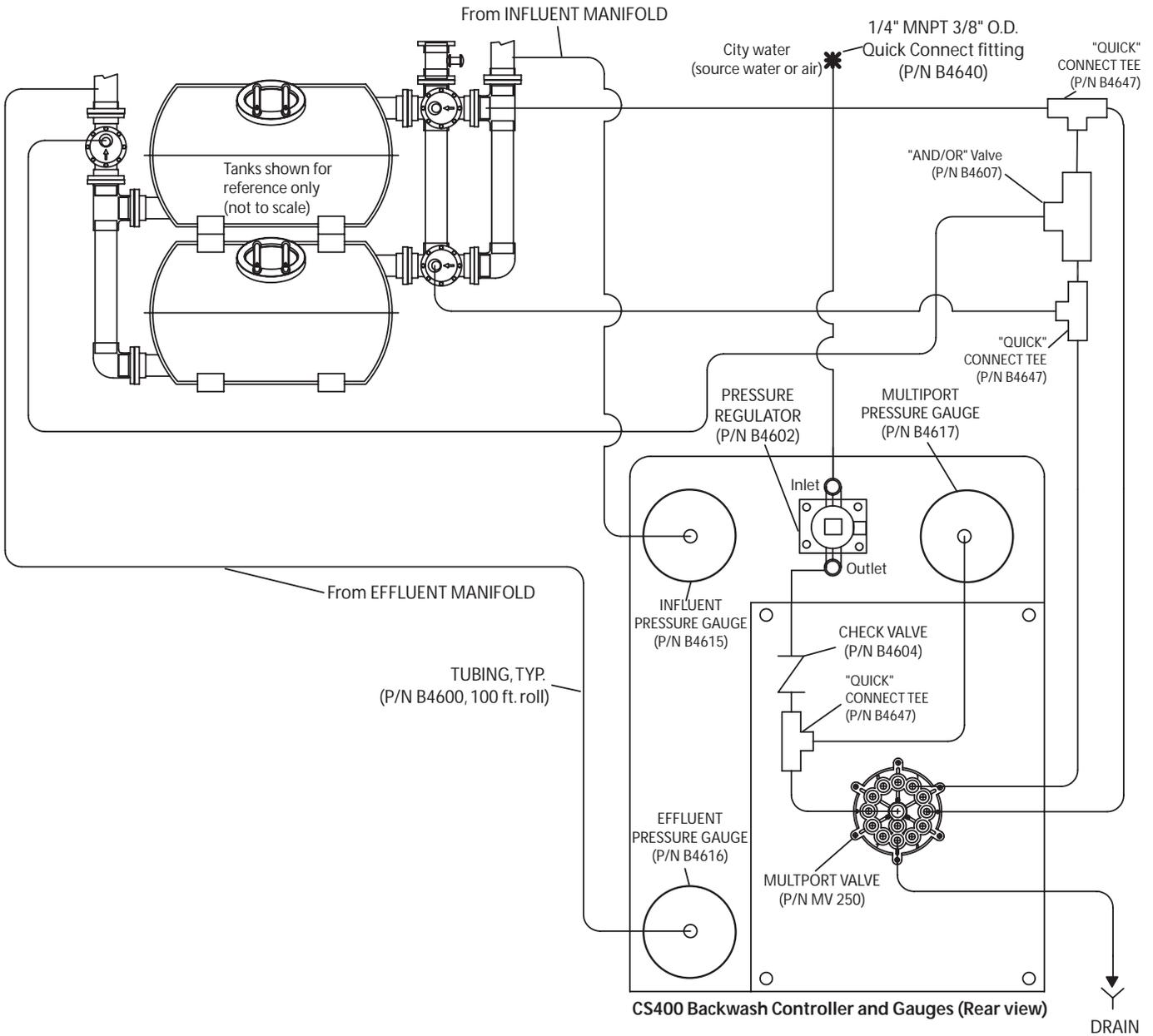
Multiport valve (Rear view of CS400 enclosure)



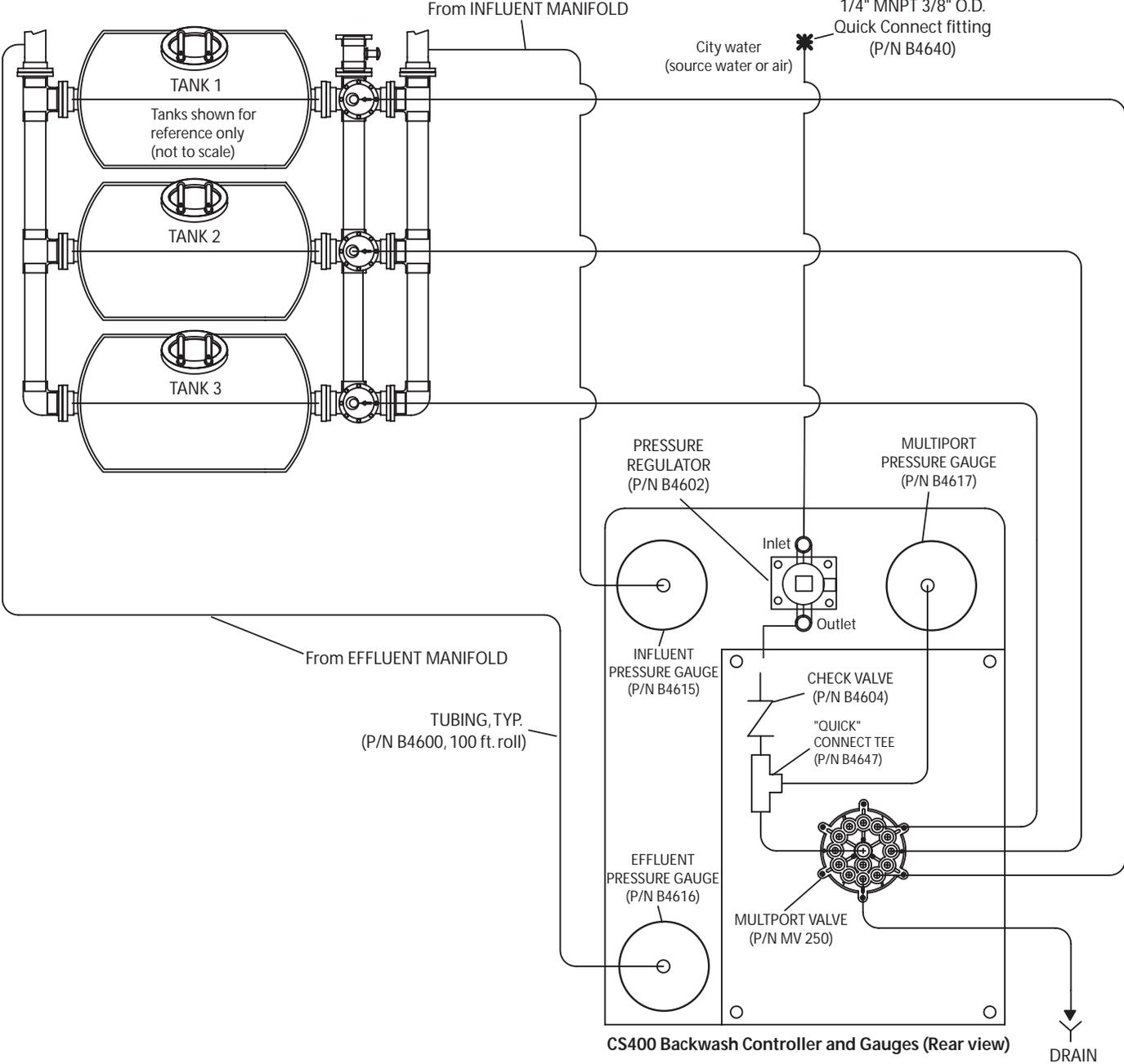
Multiport Valve
Output Ports to Tanks (1 - 6)



CS400 System Hydraulics Schematic (single tank configuration)



CS400 System Hydraulics Schematic (dual tank configuration)



CS400 System Hydraulics Schematic (multiple tank configuration)

CS400 Controller Communication Ports and Configuration Switches

There are two serial RS-232 female DB-9 connectors on the main circuit board with two mini-slide switches located under each serial communication port. These configuration switches allow the communication ports and other input/output relays dual functions. Switch assignments are as follows:

- Switches S2 and S3 provide for selection of the Serial communication and programming ports (see Figure 5).
- Switches S4 and S5 select the configuration of the input signals (see Figure 6).
- Switches S6 - S10 select the configuration of the optically-isolated output relays (see Figure 6).

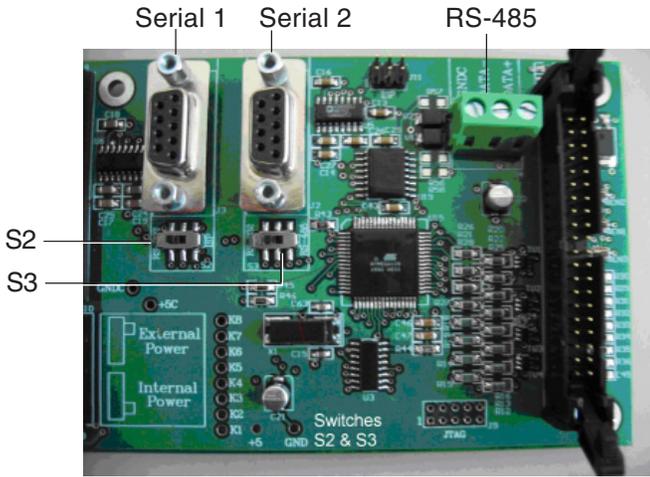


Figure 5: Switches S2 and S3

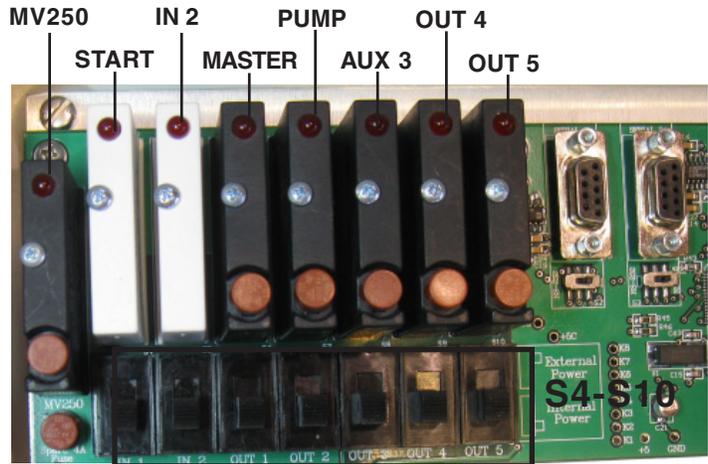


Figure 6: Switch S4-S5 and S6-S10

Switches S2 and S3

The two communication port switches S2 and S3 (see Table 1) can be configured as follows:

Switch S2: Select the first serial port to either:

- **Serial-1 (J3) DB9 RS-232** connector for diagnostics and control by computers such as a laptop or control room monitor, or
- **In-System Programming (ISP)** port 6-pin header (J11) for firmware updates to flash memory via the factory's keyfob programmer.

Switch S3: Select the second serial port to either:

- **Serial-2 (J2) DB-9 RS-232** connector for diagnostics and control by computers such as a laptop or control room monitor, or
- **RS-485 (J4) terminals** at the top of the circuit board to link to other pump room equipment such as the IntelliFlo® pump or the AcuPort®.

Table 1 - Switches S2 and S3 Communication Port Configuration.

Switch	Position	Function	Connector	Description
S2	Left - RS-232 *	Serial Port 1	J3	Primary RS-232 serial com port
	Right - ISP	Programming	J11	Firmware updates to flash memory
S3	Left - RS-232 *	Serial Port 2	J2	Secondary RS-232 serial com port
	Right - RS-485	Serial Port 2	J4	Primary RS-485 serial com port

(*) Factory default

Switches S4 and S5 (Input 1 and 2)

As outlined in Table 2, the CS400 can be configured to accept input signals from either:

- A remote "dry" relay contact. This "Internal Powered" configuration is desirable when the master controller's signal is beyond that of the input's rated voltage and an intermediary relay must be used, or when a simple differential pressure switch is used.
- A driven signal (12-32VAC or 10-32VDC) of a master controller. This "External Powered" configuration is designed for compatible master controllers such as the Pentair Water Commercial Pool and Aquatics™ series programmable controllers.

Note: Input 1 is dedicated to the remote Start Backwash signal; Input 2 may be used for other programmable functions.

Table 2 - Switches S4 and S5 Input Signal Configuration. (*) Factory default

Switch	Connector	Position	Description
S4	In 1 A,B (J6)	Down - Internal *	Input-1 is a dry-relay contact
		Up - External	Input-1 is driven signal (12-32 VAC or 10-32 VDC)
S5	In 2 A,B (J6)	Down - Internal *	Input-2 is a dry-relay contact
		Up - External	Input-2 is driven signal (12-32 VAC or 10-32 VDC)

Input Switches Configured for Internal Power

With configuration switches S4 and S5, inputs 1 and 2 respectively, in the "Internal Power" (downward) position, the CS400 controller supplies 24 VAC voltage to the remote contacts via terminals "In #A". When the contacts are closed (circuit is completed) the appropriate signal is provided to the processor's input via terminals "In #B". Contact ratings must meet or exceed 24 VAC, 5 amperes (see Figure 7).

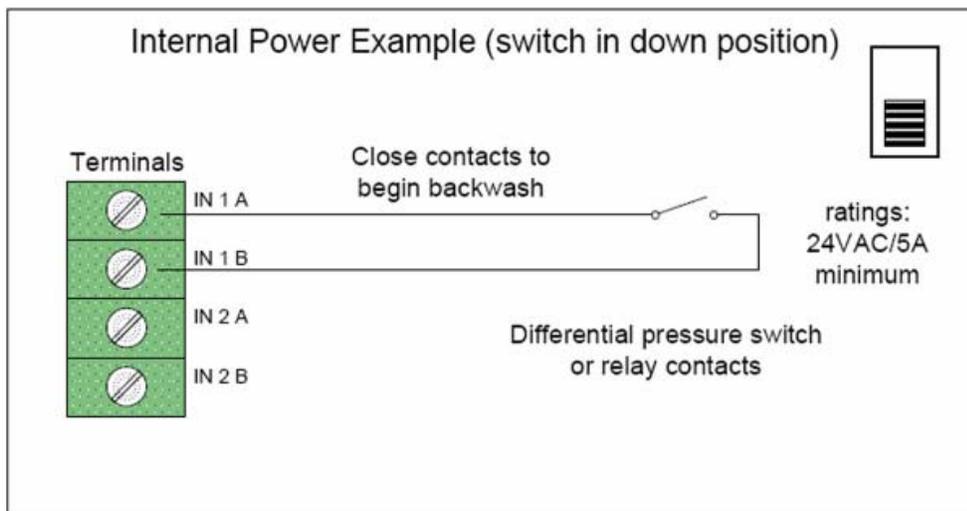


Figure 7: Input internally powered

Input Switches Configured for External Power

With configuration switches S4 and S5, Inputs 1 and 2 respectively, in the "External Power" (upward) position, the CS400 controller will perform the associated task when the proper voltage (12-32 VAC or 10-32 VDC) is detected across terminals "In # A" and "In # B". The input circuitry is an optically-isolated detector requiring a maximum current of 25 milliamperes, insensitive to DC voltage polarity (see Figure 8).

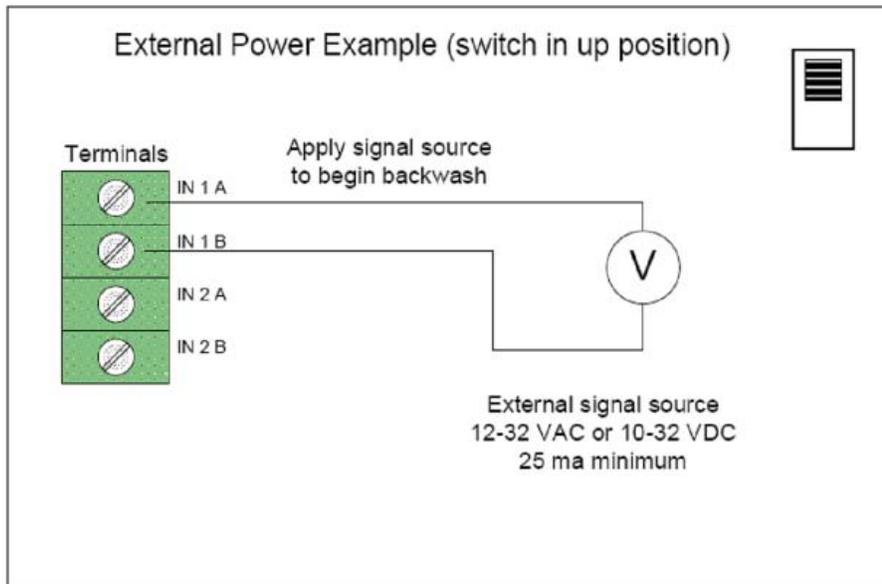


Figure 8: Input externally powered

Switches S6 through S10 (Outputs 1 through 5)

The CS400 controller contains five optically-isolated output relays (K4-K8), each with either a dedicated function or a user-configurable choice of functions within the CS400 controller menus.

Table 3: Output Relay Functions

Output #	Function
1 A/B	Master Relay
2 A/B	Pump**
3 A/B	Heater** or Priority Valve
4 A/B	N/A
5 A/B	N/A

** Note: For safety purposes, the pool's recirculation pump and heater must use a normally-closed contactor (supplied by others). Output 2 is turned on to disengage the pump and Output 3 is turned on to disengage the heater. In the event that the CS400 Controller supply power was to fail, these outputs return to the normal state so the pump and heater will re-engage. The front-panel LED represents the running state of the pump and heater not the output relay; e.g. the LED will be on when the output relay is off and the contactor is on.

Each optically-isolated relay output (OUT 1 A/B - OUT 5 A/B) has the ability to supply 24 VAC to activate a low-power device such as a contactor, solenoid, light, or alarm (supplied and installed by others). For this configuration, the associated switch (S6-S10) must be set to "Internal Power" (downward) position as shown in Figure 9. The capacity of the CS400 Class-II power supply allows a current rating to 0.5 amp per output or 2.5 amps total for all five outputs. Each optically-isolated relay (K4-K8) contains a replaceable 4 amp fuse. A spare fuse (F3) resides on the circuit board.

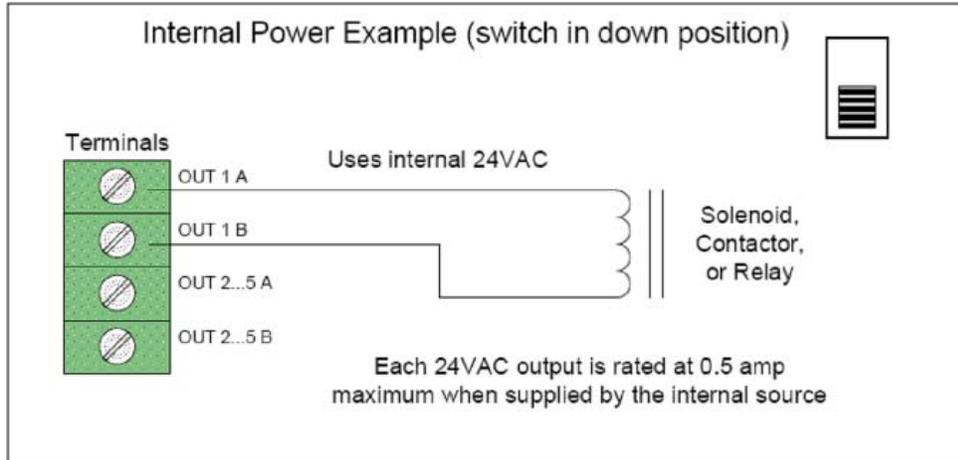


Figure 9: Output internally powered

For use with devices of other power requirements, switches S6-S10 may be set to the "External Power" (upward) position as shown in Figure 10. In this configuration, devices powered by their own external 12-32 VAC source, using the optically-isolated output "OUT 1..5 A/B" as a relay, can be turned on and off. The current rating of this configuration is limited by the optically-isolated relay (K4-K8), each with its own replaceable 4 amp fuse.

Caution: These outputs relays will not function properly with a DC voltage.

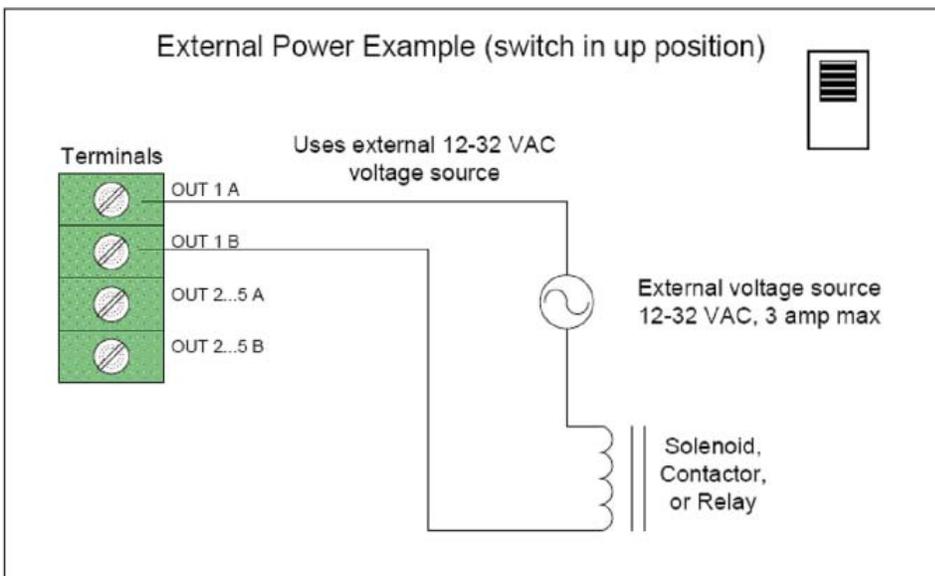


Figure 10: Output externally powered

Specifications

CS400 Controller

Description

Signal Input(s):

Voltage Rating: 10 VDC to 32 VDC / 12 VAC to 32 VAC, 50 - 60 Hz

Current Draw: 15 ma each

Relay Outputs:

Voltage Rating: 12 VAC to 32 VAC

Current Rating:

- sourced from internal supply: 0.5 AMPS each (2.5 AMP maximum combined)
- sourced from external supply: 3 AMPS each

CS400 Controller External AC Power Supply

Description

24 VAC Power Supply, 50 - 60 Hz, Class 2 transformer

100VA, 4.0 AMP rating

Internal Fuse, 24 VAC, 5 AMP

CS400-DP Differential Pressure Switch Installation



The CS400DP (Mounted Differential Pressure Switch) from Pentair Water Commercial Pool and Aquatics™ allows the CS400 Backwash Controller to backwash filter system automatically based on differential pressure. While the CS400 Backwash Controller is in filtration mode, the system has a Normal (Clean) Influent and effluent operating pressure. The pressure difference between the influent and effluent pressure is know a “Differential pressure”. As Dirty water enters the filter tank by being pumped under pressure through the influent pipe it’s distributed across the top of the inner tank chamber through diffusers. The water is then forced downward through the sand filter bed. Dirt and debris is collected in the sand bed allowing clean water to pass through. The clean water then passes through the collection laterals and exits the filter through the effluent piping and is

returned to the pool. As the filter gets dirtier, the “Differential pressure” will increase. When this pressure rises to the set point of the differential switch a signal is sent to the CS400 controller and a backwash is initiated automatically.

Mounting the CS400DP

Note: Instructions shown are for mounting to a CS400, necessary hardware included in kit. Unit may be mounted to wall or alternate location up to 10 feet away, for this mounting, hardware is to be supplied by others.

1. Hold unit up to bottom of CS400 leave minimum 1/2 “clearance (leave room for door of both units to open).
2. Using mounting feet as template, mark strut of CS400 in (4) Places.
3. Pilot drill at (4) marks with 1/8” drill bit.
4. Attach CS400DP to strut using hardware provided.

Step 1



Step 2



Step 3



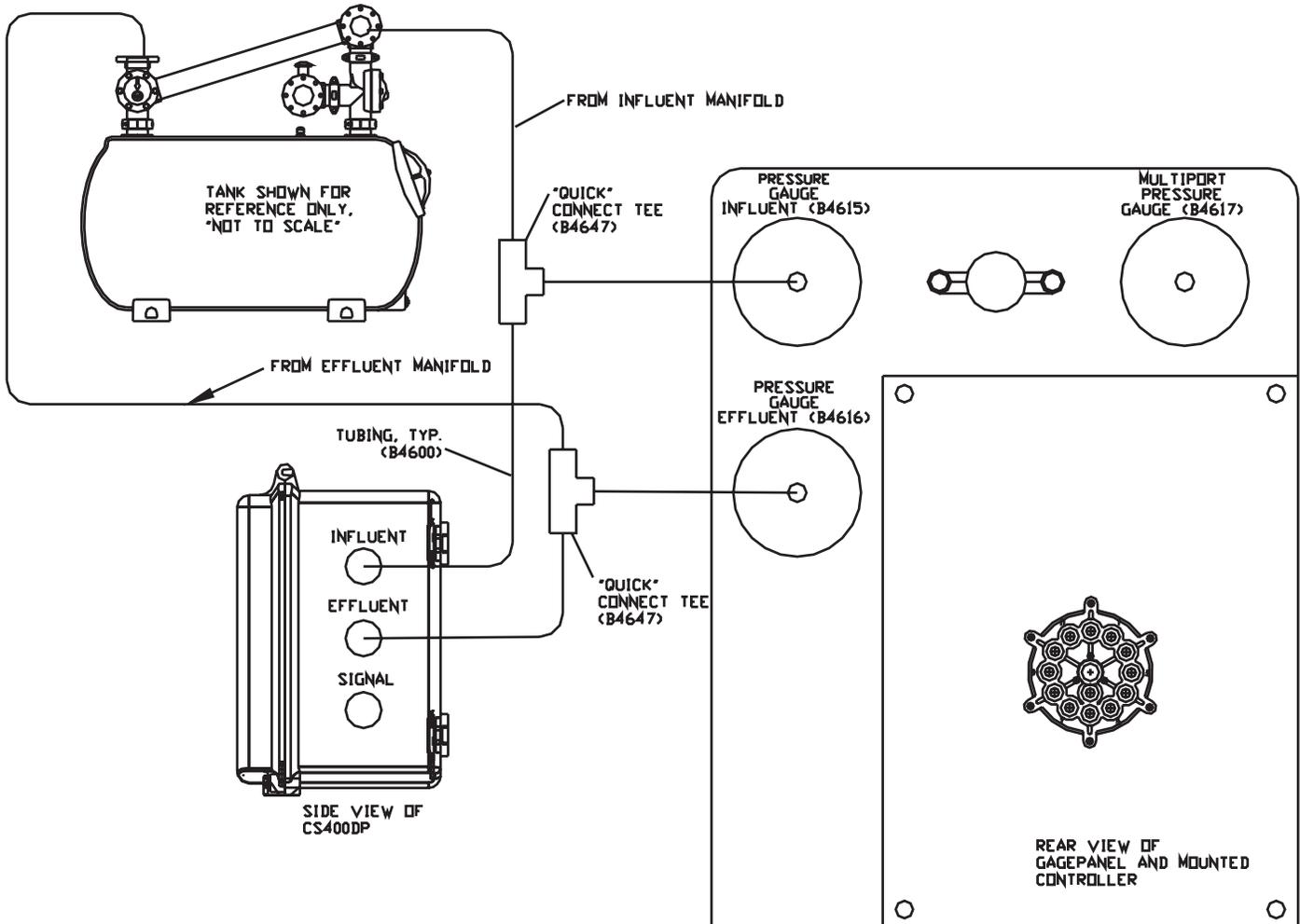
Step 4



Connecting Hydraulic lines of CS400DP to CS400 backwash controller

(See schematic below, shown for reference only.)

1. Be sure the filter system is switched OFF and no water is in Influent /effluent pressure lines to corresponding gauges mounted on CS400 backwash controller gauge panel.
2. At rear of Influent gage on CS400 backwash controller, leaving at least 2” of tubing in quick connect fitting cut tubing and insert (1) Quick Connect Tee provided. Be sure both ends of tubing are fully inserted into branches of Tee. Using remaining open branch of tee, with tubing provided, run tubing to connector on CS400DP labeled “INFLUENT”. Ensure Tubing is fully inserted into connector.
3. At rear of Effluent gage on CS400 backwash controller, leaving at least 2” of tubing in quick connect fitting cut tubing and insert (1) Quick Connect Tee provided. Ensure both ends of tubing are fully inserted into branches of Tee. Using remaining open branch of tee, with tubing provided, run tubing to connector on CS400DP labeled “EFFLUENT”. Ensure Tubing is fully inserted into connector.



Connecting Interconnect cable of CS400DP to CS400 backwash controller

(See Figure 11 below and also refer to the wiring label on the inside of the CS400 backwash controller enclosure door)

1. Unlatch the two front door latches and open the door of the CS400 Controller enclosure.
2. Route cable from CS400DP through the rear opening of the enclosure.
3. Install pin connections of cable into IN1A and IN1B.
4. Set the IN1 slide switch S4 to "Internal".
5. Connect ring terminal to the grounding screw located on rear aluminum panel.
6. Close the controller front door and latches.

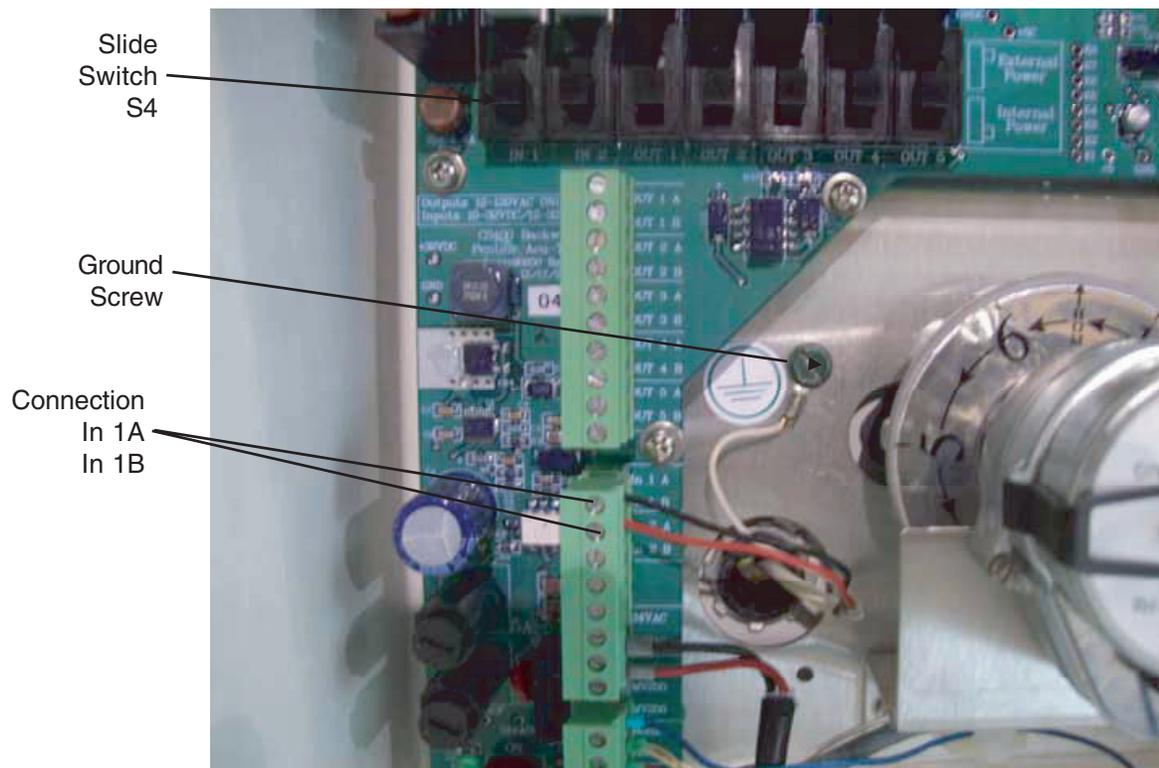


Figure 11

Set the differential pressure switch set point

- Using the knob on front of DP gauge set desired set point (see Figure 12). A starting point of 15 psi is recommended. This number represents a five (5) psi differential pressure start with a clean sand bed and adding 10 psi above this number. Actual filter system's clean sand bed DP will vary.

Note: It may take several backwashes to achieve actual desired DP set point.



Figure 12

Verify CS400 is set to accept External Input Signal

- Using CS400 Controller display and key pad, go to “User Settings” menu. Verify “Start Options” is set to “Button or Signal” or “Input Signal only”. The control panel Auto LED is illuminated when these settings are selected.

