PAXTON
CORPORATION

TVS43 Domestic Hot Water Mixing Valve

INSTALLATION MANUAL

For use in recirculation systems

209 VAN BRUNT STREET BROOKLYN, NY 11231 TEL. 718-650-5510 PAXTON@PAXTONCORP.COM NO FAX

Technical Information

The TVS43 is an ASSE 1017 Listed Electronic Tempering Valve System used to control domestic hot water temperature. The TVS43 is designed to work in domestic hot water recirculation systems.

Each system consists of:

TC250D Setpoint Controller with color screen

STI Series Immersion Sensor with ½" NPT Connection

VM800 Modulating Actuator

V43 Stainless Steel Valve Body

NEMA 4 Enclosure for the controller

Power supply with mounting kit

Features

- Default settings work in most domestic hot water applications
- Easy to set-up, simple interface, no programming laptop or software required
- Low demand dead zone temperature setback with adjustable activation point and range
- High temperature alarm with relay output
- Fast reading sensor
- Full stainless steel construction
- ModBus and BACnet MS/TP standard
- Lead free listed and certified
- Multiple valves can be installed in parallel for higher capacities

Selection

MODEL	SIZE	CV
TVS43-020	¾"	7.3
TVS43-025	1"	11.6
TVS43-032	1 ¼"	18.5
TVS43-040	1 ½"	29.0
TVS43-050	2"	46.3
TVS43-065	2 ½"	65.0
TVS43-080	3"	77.0

Valves should be selected based on a 5 to 10 PSI pressure drop.

The valve is typically smaller than the system piping for most applications.

Technical Data

CONTROLLER

Operating Voltage:	24V AC/DC 50VA
Control Signal:	0-10VDC / 2-10VDC
Action:	Direct or reverse acting
Sensor Rate:	10 samples/second
Relay:	10 Amps at 220 V

VALVE

Cold inlet:	39 F to 80 F
Hot inlet:	120 F to 205 F
Outlet:	95 F to 140 F
Maximum Temperature:	250 F
Maximum Working Pressure:	250 PSIG

⚠ WARNING

The TVS43 system is not a safety device. It is not an anti scald device. The TVS43 is a temperature control system. For anti-scald devices see consult ASSE, see point of use valves.

INSTALLATION AND FIELD ADJUSTMENTS ARE THE RESPONSIBILITY OF INSTALLER.

Incorrectly maintained, installed or sized systems will result in poor operation, premature failure and increases the risk of serious injury or death.

Capacity, Size and Ratings

Flow in GPM vs pressure drop in valve

SIZE	C_v	5 PSI	7 PSI	10 PSI	15 PSI	20 PSI
¾"	7.3	17	19	23	28	32
1"	11.6	26	31	37	45	50
1 ¼"	18.5	42	49	59	72	80
1 ½"	29.0	66	77	92	112	126
2"	46.3	105	123	147	179	201
2 ½"	65.0	148	172	206	252	283
3 "	77.0	172	204	244	298	344

$$C_V = \frac{GPM}{\sqrt{\Delta P}} \qquad GPM = C_V \cdot \sqrt{\Delta P} \qquad \Delta P = \left(\frac{GPM}{C_v}\right)^2$$

Where:

C_V = Characteristic of valve, expressed as flow in GPM at 1 psi pressure drop in valve.

GPM = Flow rate in gallons of water per minute.

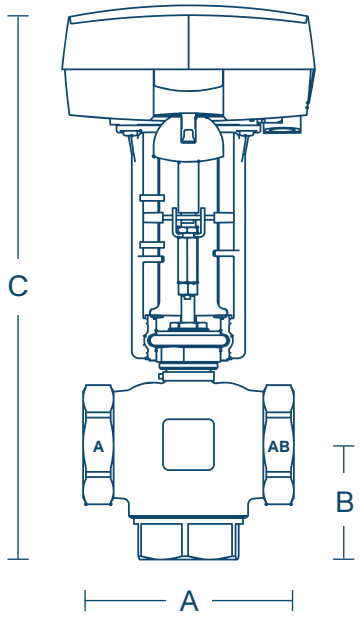
ΔP = Pressure drop in valve.

Typical DHW mixing applications should be sized between 5-10 PSI ΔP.

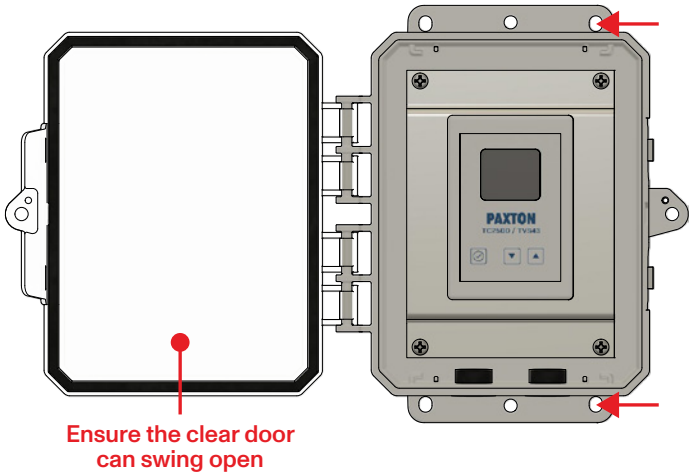
Rough In Dimensions

SIZE	¾"	1"	1 ¼"	1 ½"	2"	2 ½"
A	7.3	17	19	23	28	32
B	11.6	26	31	37	45	50
C	7.3	17	19	23	28	32

Dimensions are the same for VM900 Actuator / TVS43R.
Leave at least 4" clear on top of the actuator for cover removal.



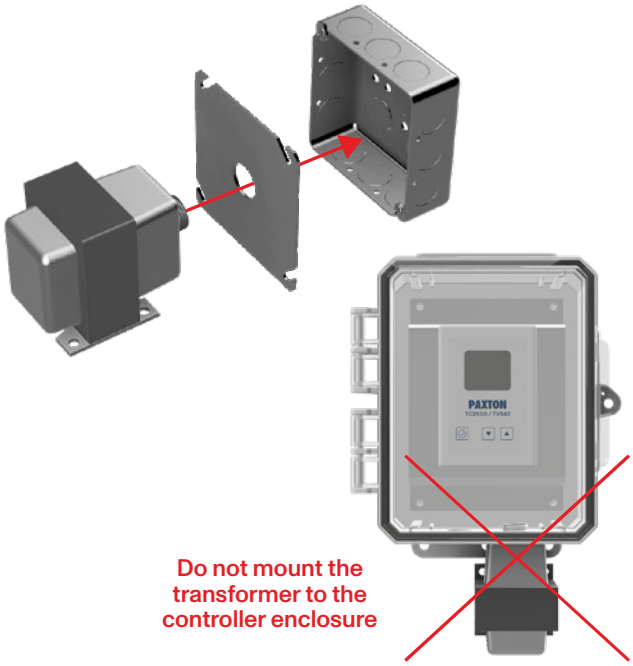
Physical Install



Controller

Mount the enclosure of the controller security to wall or strut structure using the holes in the mounting flange of the controller.

Make sure the control is level, mounted at a reasonable height for programming.



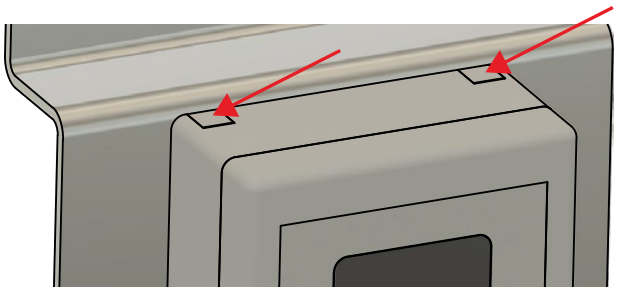
Transformer

Mount the transformer to the included mounting plate and junction box.

Mount to wall close to control.

Line voltage side of transformer should be wired to a disconnect such as a breaker or switch.

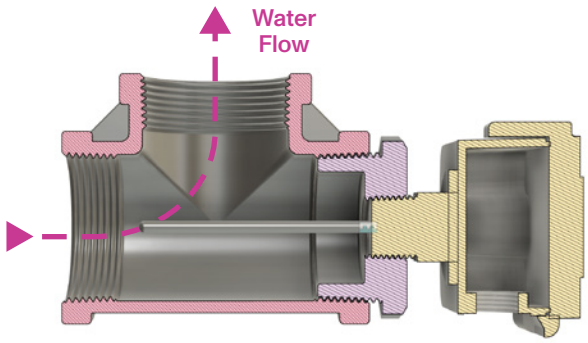
DO NOT MOUNT THE TRANSFORMER TO THE CONTROLLER ENCLOSURE.



Control Cover

Depress the two tabs on the controller and gently pull the faceplate off. This will expose the terminals. Poke holes in the bottom gray grommet to bring the wires through there or the back of the controller.

Physical Install

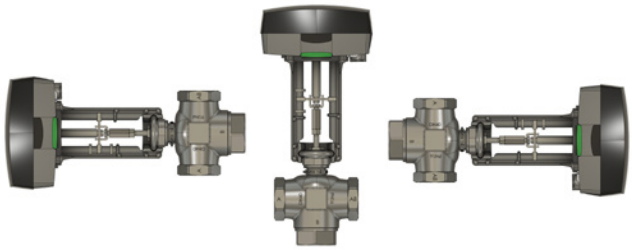


Sensor

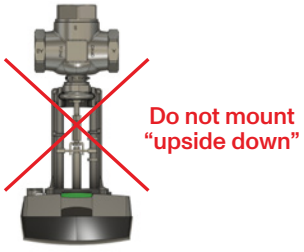
The STI series sensor has a ½" NPT connection and is to be installed directly into the water flow. DO NOT use an additional thermowell unless one is specifically provided by the factory. The STI series sensors are not compatible with thermowells. The temperature measurement will be incorrect.

It is vital to mount the sensor in the water flow. ¾" to 2" systems feature a 3 ½" long probe sensor, 2 ½" and 3" feature a 5 ½" sensor.

Mount the sensor in a tee or a heel tee in the outlet of the system piping.



Acceptable mounting positions



Valve and Actuator

The valve and actuator should be mounted vertically in the system piping as shown in the piping diagram.

It is OK to mount the valve horizontally but vertical is preferred. Do not mount the valve where the actuator is below the valve “upside down”.

It is best practice to mount the valve and actuator at “eye level” close to the controller. Leave at least 4" clearance about the actuator cover for service.

Ensure the valve and actuator are mounted far enough from the wall for actuator removal. Make sure the actuator is mounted straight onto the valve and that the u-bolt is tight.

Wiring Control

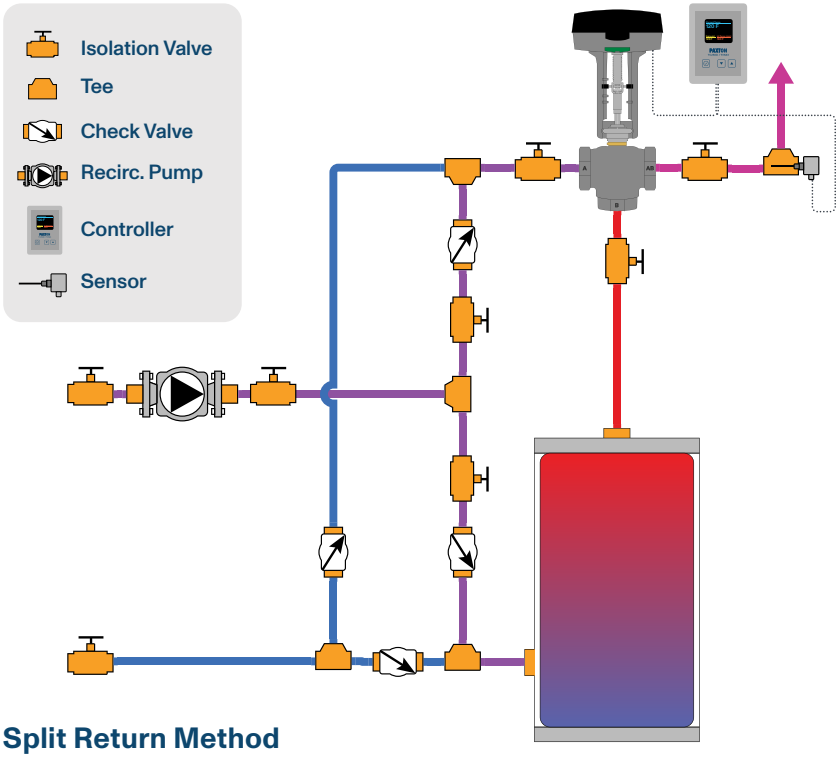
Only remove or install the ribbon cable behind the controller cover with **power off**.

Do not hot plug (power on) the ribbon cable.

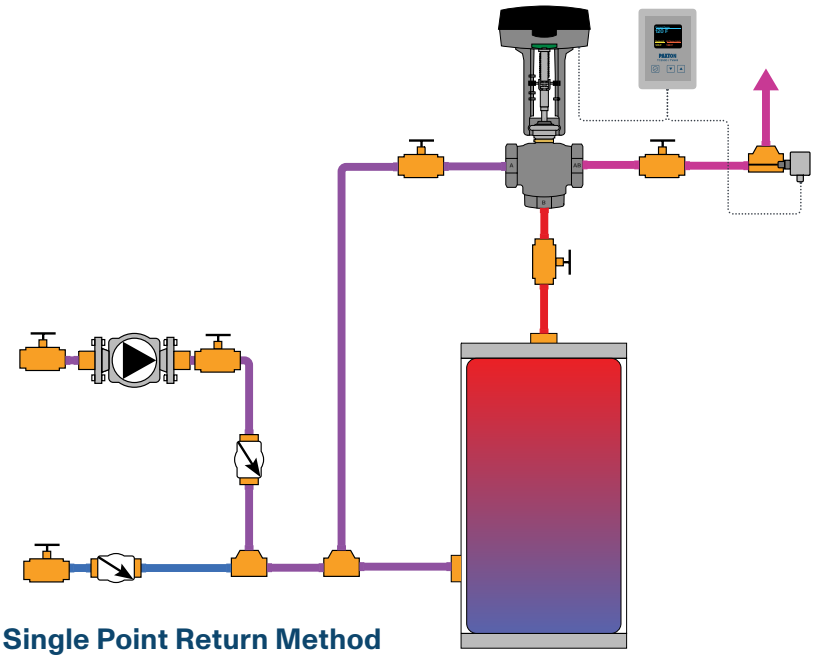
Piping Diagrams

Shown below are two methods of piping the system for master mixing application. The installer can choose to split the return and pipe the connections individually into both cold supplies or tie into a single point upstream of all take-offs.

Splitting the return is advantageous when recirculation pumps are oversized. Use a valve to throttle the return accordingly.



Split Return Method



Single Point Return Method

- The recirculation pump should run continuously.
- Ensure supply pressures are equal.
- The return must connect into both the cold side of the mixing valve and hot water source.
- Almost all technical issues stem from improper piping.
- Ensure sensor probe is in the water flow. Sensor can be located 6" to 48" from outlet.
- Connections:

Cold inlet	Port A
Hot inlet	Port B
Mixed Outlet	Port AB

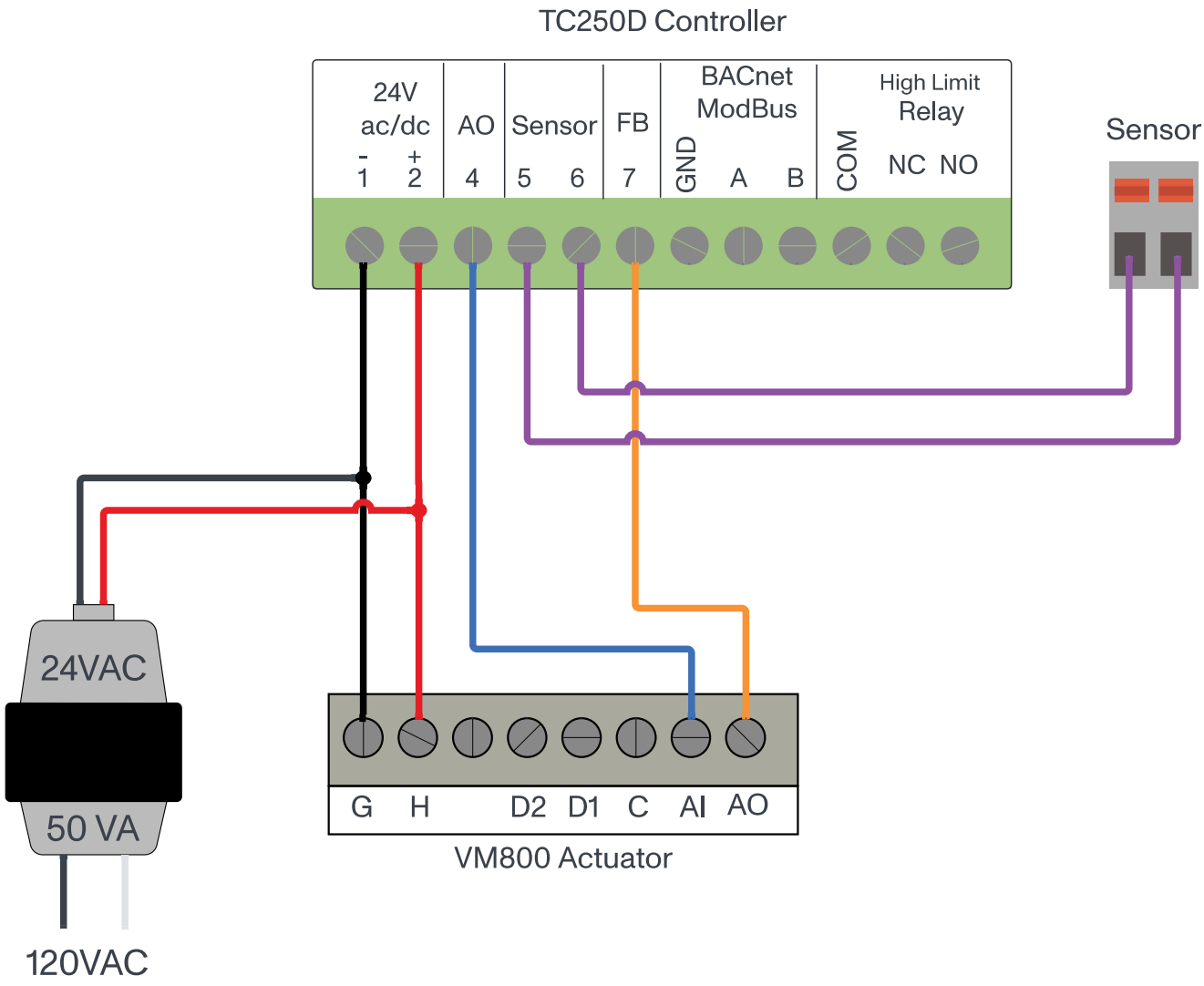
- **Hot and cold ports can be reversed, set action in controller from direct to reverse. DIP switches in actuator remain OFF.**
- It is typical for the mixing valve to be smaller than the system piping.
- Size the valve for the load, do not arbitrarily match pipe size.
- Make reductions at the valve and do not use excessive lengths of smaller piping in front of the valve. Isolation valves, unions, etc should be before the reduction in pipe size.
- If reduced, outlet should be increased directly after the valve.

⚠ ATTENTION

The installer must follow all local codes for installation and provide check valves to prevent flow between lines.

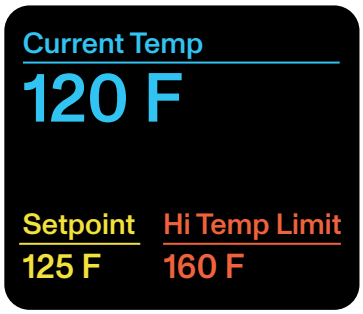
Follow heater manufacturer's drawing.

Wiring Diagram



- Wire lengths should not exceed 200'.
- Use 18 gauge shielded wire.
- Run all low voltage and sensor wires in separate conduit from 120VAC circuits.
- The common from the control signal is shared with the neutral side of the transformer. Ensure that the H terminal on the actuator is shared with the 2 (+) terminal on the TC250D control and that the G terminal is shared with the 1 (-) terminal
- The control and actuator must share the same class II transformer.
- All DIP switches in the actuator should be OFF (factory setting).
- See actuator calibration in the commissioning section.
- Check transformer label for hot and common wire designation.

How to Change Settings

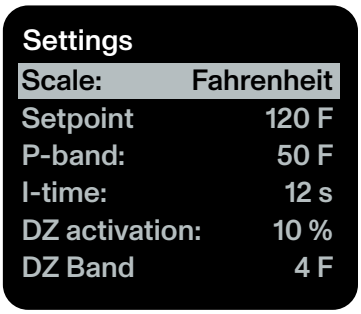


Main Screen 1

On power up, the main screen is displayed.

Use ▼ ▲ to toggle between main screen views.

To enter settings, press and hold ✓ for 3 seconds.

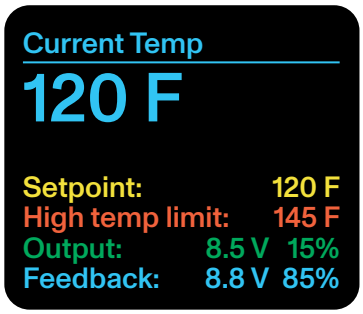


Settings Screen

Use ▼ ▲ to toggle fields.

Press ✓ once to select.

Press and hold ✓ for 3 seconds to return to Main Screen.

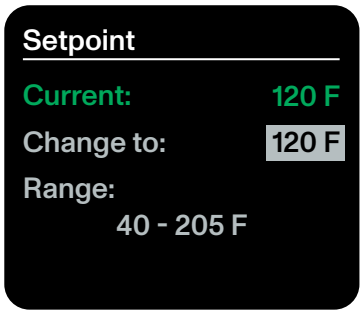


Main Screen 2

Main Screen 2 shows more information.

Output is the percentage open of the hot port.

Feedback is the reading of the actuator position.



Setting Adjustment Screen

Use ▼ ▲ to set parameter.

Press ✓ once to return to Settings.

Settings Overview

Scale — Changes the system units between Fahrenheit and Celsius.

Set Point — The desired mixed outlet temperature, set in 1 degree Fahrenheit increments or 0.5 degree increments in Celsius. Adjustable from 40-205 F or 4.5 - 96.0 C. The system will work to maintain this target temperature at all times.

P-Band and I-time — Both the Proportional Action "P-band" and Integration Time "I-time" are a function of the responsiveness and speed of the control loop signal change. The P band indicates the required change of control offset to cause a 100% output signal change. I.e., from 0 V to 10 V.

Increasing the P-band decreases the speed of change of the control signal. For example, a P-band of 100 F has a 50% slower reaction than an P-band of 50 F.

Decreasing the I-time will result in faster, but usually less responsive control.

The default settings of P-band and I-time are default for a reason and should work for most domestic hot water mixing valve installations. Let the system run and stabilize before making changes to the P-band or I-time. A valve that is hunting is usually experiencing a system issue rather than the need for adjustment of the gain settings. See troubleshooting section of manual to rule out other issues before attempting to change the P and I settings.

Settings Overview Continued

DZ Activation and DZ Band

The dead zone activation “DZ Activation” and dead zone band “DZ Band” are unique features for the TC250D controller that prevent actuator wear and tear and can be used to maximize heater recovery in off peak hours.

The dead zone is eliminated as soon as the output crosses back into normal/high load conditions.

The DZ Activation point is expressed in percentage of control signal output. This is the threshold for the DZ Band. The factory default is 10%. At conditions of low load, when the valve is 10% or less open to the hot port, the leaving water temperature is allowed to drift 4 F (adjustable up to 12 F) (2C-6.5 C) below setpoint.

The dead zone can be eliminated all together if desired by switching the DZ Activation to OFF. This should be done in alternative applications where the load is consistent such as process heating and cooling.

Feedback Range

The controller can read the feedback voltage on terminal 7 from an electronic actuator in 2-10VDC or 0-10VDC. This information is displayed through the main screen as well as the BMS communication.

The feedback is optional, has no impact on the controller output. If not connected, feedback will be displayed as 0%.

Output Range

The controllers output can be changed from 0-10VDC to 2-10VDC for flexibility with alternative actuators.

Action

The controller can be put in direct or reverse acting action.

This is useful for installations where it is desirable to reverse the hot and cold ports.

For direct action application 10 V will drive the stem down closing the B port.

For reverse action application 10 V will drive the stem up closing the A port.

When the hot water is piped to the B port, direct action should be used.
When hot water is piped to the A port, reverse action should be used.

Actuator Run Time

The controllers output speed should be set to match that of the actuators run time.
Do not change this from 30 seconds when using the VM800 actuator.
Improperly changing this setting will result in reset wind up.

High Limit and High Limit Delay

The high limit alarm is triggered when the leaving water temperature is higher than the alarm temperature setting and the delay time is passed. When this happens, the valve is closed to the hot port and the relay state changes. This is a manually reset alarm. The delay time is adjustable from 3 to 300 seconds.

For example if the high limit temperature is set for 145 F with a 20 second delay, if the leaving water temperature exceeds 145 F for 20 seconds, the alarm is triggered.

Modbus and BACnet

These screens are used in conjunction with modbus and BACnet settings for BMS connectivity. See supplemental info for communication settings, registers and wiring.

Defaults

Use this setting to restore the controller to factory default settings.

How to Commission System

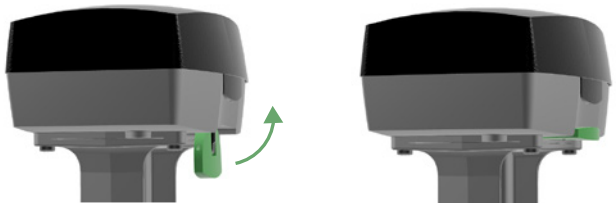
The TVS43 System does not require any special tools, software, passwords or knowledge to commission and program. The commissioning process can be done by the installing contractor, by completing the following steps.

Upon initial installation and wiring of the valve, the default settings should work. However, it is best practice to confirm that all of the desired functions work before finalizing the installation and turning over to ownership.

1. After installation, ensure that the heat source is on and the supply is sufficiently hot, at least a few degrees hotter than the setpoint of the mixing valve. Ensure that the return line circulator is running.
2. Close the hot port isolation valve and toggle DIP switch 9 on the actuator momentarily to start the calibration procedure. The valve should stroke up and down to its endpoints.
3. Leave the isolation valve on the hot supply closed and change the setpoint to 50 F. Watch to make sure the valve drives down closing the B port.
4. Raise the setpoint to 160 F (ensure the hot supply isolation valve is closed) and make sure the actuator drives up opening the B port.
5. **NOTE:** If the hot water enters on the A port, the opposite should happen.
6. Change the setpoint to the desired target and open all of the isolation valves. Allow the system to run and stabilize. The return line circulator should be running and the cold inlets to the mixing valve and hot water source should start to become warm. The return line may have to be purged of air.

Setting Actuator to Automatic Mode

Flip green tab up towards you to put in automatic mode.



MANUAL MODE AUTOMATIC MODE

Set Point Test

1. Leave all isolation valves open. Make sure the recirculation pump is running.
2. Adjust the set point to 50 F. The valve should drive down and close off the hot port.
3. Once the hot port is fully closed, watch the output leaving temperature. If this goes cold double check the return line circulator operation as well as the piping. When the recirculation is running, cold water entering should be warm. Anything less than 80 F is a sign the pump is not operational.
4. Often the pump motor will be running, but the volute is clogged or the impeller has become disconnected
5. Check for air in return line, especially after water shut down. It may have to be purged.

Troubleshooting

ISSUE	CAUSE	RESOLUTION
No display	**No power**	• Check to ensure there is 24VAC/DC +/- 10% on terminals 1 and 2. • Check to make sure the actuator has 24VAC/DC on terminals G and H. • Make sure to follow warnings and steps in regard to the ribbon cable connection. Avoid “hot plugging” - make sure power disconnected before removing or installing ribbon cable.
No movement from actuator	**Improper wiring** **Actuator set to manual**	• Ensure that the wiring from the transformer that powers the actuator and control follows the correct polarity as shown in the wiring diagram. • The wire that powers G on the actuator must be common with 1 and the wire that powers H on the actuator must be common with 2. • Make sure the green tab on the face of the actuator is in the automatic mode position. If the tab is pointing down it is the manual mode. • Do not push the tab backwards, make sure the tab is pulled forwards. The microswitch under the cover needs to be made.
Actuator drives wrong way	**Action/DIP Switches set wrong**	• Hot entering on B port Action = direct • Hot entering on A Action = reverse • All DIP switches should be set to off. The port change should be done with the action of the controller, not the DIP switches.
Lag in temperature / wrong temperature	**Sensor not in water flow**	• Ensure the sensor is in the path of the water flow and not in a “dead leg”. Do not use excessive fittings. Longer sensors are available if required. • Do not use a thermowell unless instructed otherwise. The ST series sensors are not designed for use with thermowells.
Valve Hunting	**Return recirculation not flowing properly**	• Ensure that the return is piped in such a way that it goes back to the hot water source and the mixing valve, not just one or the other. • When the pump is running, the inlet to the heater and the cold port on the valve should be warm. • Check to make sure the return pump is on and working. Many times it is reported to us that the motor of the pump is running but the impeller has failed. May require pulling the pump to check internals. • Make sure all check valves are holding. • Make sure supply pressures are within 5 PSI of one another. • If there is a pressure boosting system on site, make sure the booster system is not short cycling, this can cause issues with the mixing valve performance. • Perform “setpoint test” on the page 9 to verify return pump operation.

→ **If you are experiencing issues call or text the factory at 718-650-5510. Texting pictures can be helpful.**

PAXTON
CORPORATION

209 VAN BRUNT STREET BROOKLYN, NY 11231 TEL. 718-650-5510 PAXTON@PAXTONCORP.COM NO FAX