



Warning! This product can expose you to chemicals such as styrene which is known to the State of California to cause cancer. For more information, visit www.P65Warnings.ca.gov

California Proposition 65 Warning Label

VaporWorx

We Give You Gas

WARNING

Working with fuel is dangerous. If fuel is handled improperly it can lead to fires and death. It is imperative above anything else that all appropriate safety measures be used to control the fuel and any ignition sources, including static electricity, heat, sparks, and any other sources. Proper high-pressure fuel lines and connections must be used in accordance to the manufacturer's specifications and routed away from any potential sources of heat, ignition, and protected from mechanical damage. If you are unsure about your work or safety, stop work immediately and consult with a qualified automotive technician and/or safety official.

VaporWorx PressureWorx DualX ZL1 and CTS-V Installation Instructions.

Thank you for your purchase of the VaporWorx fuel module speed control system. These "Smart" systems are designed to work with many aftermarket PWM compatible fuel pumps in single, dual, and triple arrangements.

Please consult with VaporWorx on the maximum horsepower capability of each arrangement. Many variables can affect the amount of fuel delivered to the engine.

The VaporWorx standard system uses a 12v+ signal from the ECM for turn-on. However, some aftermarket EFI systems such as those made by FAST, provide a 12v- signal. In these cases, a different controller is available from VaporWorx for these systems. A simple relay can also be used to change the input polarity. On GM and most aftermarket ECM/engine wiring harnesses a 12-14ga grey wire is provided for fuel pump power. This wire will be used to turn the VaporWorx controller on/off.

The PressureWorx system will provide a 1:1 rate of fuel pressure change with manifold pressure. Wiring connections to the engine MAP sensor are required. VaporWorx kits are specific to each MAP sensor, so ordering must be done accordingly (1bar, 2bar, 2.5bar, or 3bar.) The standard VaporWorx controller is tuned for GM LSA/3bar MAP sensors. For other sensors, please contact VaporWorx. VaporWorx recommends using a manifold referenced fuel pressure due to the extra amount of power reduction, but the fuel injector ECM tuning must match this strategy.

Unless otherwise specified the PressureWorx kits are tuned for 3-bar MAP sensors. Typical 3-bar sensors such as GM P/N 12592525 used on the LSA and ZR1 crate engines are a good choice.

These instructions are a general guideline. For example, your application may have a different fuel level sensor wiring callout, or be a modern OE plastic tank vs. the photos shown. So, some of the instructions may not be needed for your application.

The VaporWorx PWM controller supplied in your kit has also been tuned for the pumps specified. The controller may not work properly if used with a different pump(s). Please contact VaporWorx for compatibility questions.

Unlike some of the earlier VaporWorx dual pump kits, this system has no Hobb's switch or relay to control the second pump. Instead, there is a primary (Pump 2) and follower (Pump 1) fuel pump. The follower pump typically operates at a duty cycle 20-25% behind the primary. Once the primary reaches 100% duty cycle, the follower will continue, if needed, to 100% DC as well. The benefit of this arrangement is that the second pump is always filling the bottom reservoir. In some road course conditions the second pump was starving due to there being insufficient time for the module reservoir to refill. The other benefit is if the primary pump fails, the follower pump will continue to operate.

VaporWorx was founded on Customer Satisfaction and Service. We strive to treat people and our products the way we would want others to treat us and the products we purchase. That is why our electronics products are tested thoroughly before they are packaged and shipped. VaporWorx stands behind our products for one full year after purchase with a well-stocked repair facility and quick turnaround times. VaporWorx does not want to be the reason you cannot enjoy your car. For off-road use only. The Terms of Warranty and Service are as follows:

Limited Warranty

VaporWorx warrants its products to be free from defects in material and workmanship under normal use and if properly installed for a period of one year from date of purchase. If found to be defective as mentioned above, it will be replaced or repaired if returned along with proof of date of purchase. This shall constitute the sole remedy of the purchaser and the sole liability of VaporWorx to the extent permitted by law, the foregoing is exclusive and in lieu of all other warranties or representations whether expressed or implied, including any implied warranty of merchantability or fitness. In no event shall VaporWorx be liable for special or consequential damages. This warranty is only valid on products purchased from VaporWorx or their Authorized Dealers. For off road use only.

Service

In case of malfunction, your VaporWorx component will be repaired free of charges according to the terms of the warranty. When returning VaporWorx components for warranty service, Proof of Purchase must be supplied for warranty verification. After the warranty period has expired, repair service is charged based on a minimum and maximum charge rate. (Contact VaporWorx for current rates).

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The following steps will help to ensure good fuel module operation and long life. Careful attention to wire routing, protection, strain relief, connectors, crimps, etc. will lead to a longer lasting and more reliable installation. Be sure to use appropriate personal protective equipment and safe automotive lifting, support, and working methods. A fire extinguisher must be kept at the ready at all times.

- 1) Disconnect the battery. Find a suitable flat surface to mount the VaporWorx pulse width modulation controller (black box) near the vehicle battery. **It is imperative that the box be mounted as close, and the wiring connected directly to, the battery as practical.** If not wired directly to the battery an excessive amount of electrical noise may be generated, causing radio noise. Grounding to the chassis can cause signal interference, causing controller malfunction. Do not mount the controllers near sources of heat such as exhaust systems. The cooler the electronics are during operation, the longer their expected life will be. Screws are provided for mounting.
- 2) Install the fuel pressure sensor into a 1/8"-NPT female fitting that is tapped into the fuel line either in the outlet fitting as seen in Photo 1C, or soon after the fuel module outlet. **The sensor must be mounted near the fuel module outlet.** If the sensor is mounted in the engine fuel rail rapid pressure fluctuations may occur. Use a small amount of Teflon paste to seal **just the threads** of the sensor. Often the dual pumps are tied into a "Y" block. Sensor installation into the "Y" should work as well.
- 3) If desired the supplied braided loom can be installed over the fuel pressure sensor wiring. If so, slip a 1" piece of heat shrink tubing on the wiring first, then install the loom. The heat shrink will secure the ends of the loom to the wiring. The blue ECM fuel-enable wiring may also be integrated into this harness if desired.
- 4) Plug the three-cavity fuel pressure sensor plug into the fuel pressure sensor.
- 5) Route and secure the fuel pressure sensor wiring harness toward the VaporWorx controller. Be sure to leave sufficient wire length so that there is no strain on the wiring near the connectors. Secure the harness to the vehicle away from where it may become damaged from road hazards, chaffed or cut on sharp edges, etc.
- 6) The VaporWorx controller GT150 six-pin connector provides both fuel pressure sensor and fuel pump enable circuit connections. Using the terminals and seals provided as seen in Photo 1A-B, crimp the terminals to the wires like that shown in Photo 2. Solder the terminals to the wires if needed. There will be a total of four-six wires to crimp:
 - A. Grey 20ga from the fuel pressure sensor
 - B. Black 20ga from the fuel pressure sensor
 - C. Brown 20ga from the fuel pressure sensor
 - D. Blue 20ga from ECM fuel pump + enable circuit.
 - E. Orange/Black 20ga to MAP - (manifold/boost referenced only. Leave disconnected for constant pressure.)
 - F. Light Green 20ga to MAP + (manifold/boost referenced only. Leave disconnected for constant pressure.)

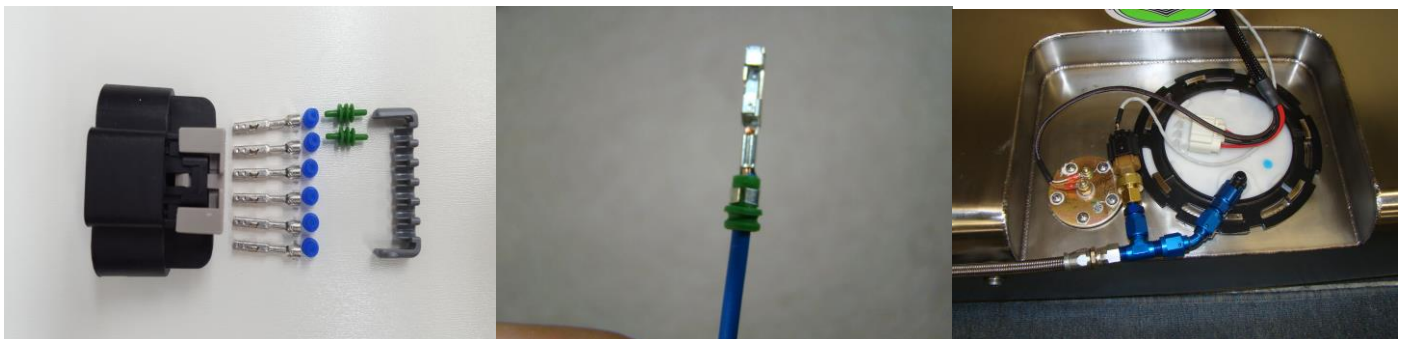


Photo 1A-C: The GT150 connector body, terminals, seals, and terminal positional assurance clip. The terminal is crimped to the wire and seal. The part number for the Delphi terminal is 12191818. The seal is 15366022. Photo 2. Note that the fuel pressure sensor is installed just downstream of the module outlet. Placing the sensor in the recess of the tank, when applicable, safeguards the sensor from damage. The sensor can also mount in the "Y" connector that ties both fuel module outlets together.

- 7) Insert the wires into the Delphi GT150 female connector body as shown in Photo 3. The pinout schedule is listed in Step 6 for the connector body. A capital "A" and "F" can be found on the connector body. Just align to the colors from the VaporWorx GT150 male connector.

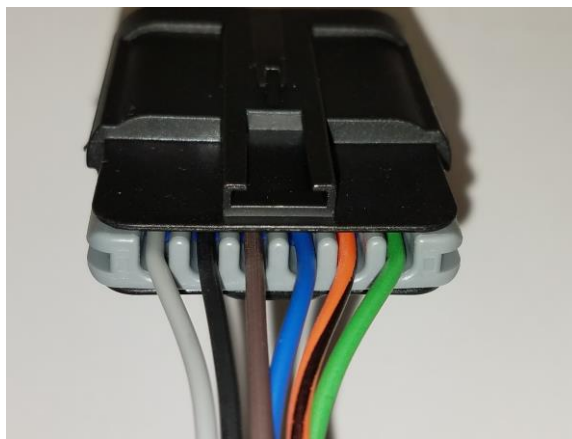


Photo 3: Delphi GT150 female connector. Note that the colors must align to each other on both plugs. Some kits may have an orange/black and light green MAP wiring.

- 8) Re-verify that the wires have been properly placed in the connector and that the colors align. If the wiring is incorrect then the terminals will need to be removed and placed in the proper cavity. This can be done by removing the purple cap on the inside of the connector body face using a small screwdriver to pry up on the sides. The terminal can then be released by very gently prying back on the locking tab that secures the terminal to the body. Once corrected re-install the purple connector body cap. NOTE: The cap acts as a terminal locking device. Once the cap is fully seated removal and installation of the terminals is very difficult. The cap has a pre-terminal installation position where it is located in the body but not fully seated. Seat the cap once terminal installation is completed.
- 9) Once the correct wiring has been confirmed, install the terminal position assurance clip as shown in Photo 3.
- 10) Connect the blue wire to the ECM fuel system enable circuit. The VaporWorx controller requires a 12v positive signal to operate. If a negative signal is used the system will not function. See Page 1 for information. For GM crate engine harnesses, the 12-14ga grey wire can be routed to the blue wire Pin D and be used as the turn-on circuit. This is common in many other aftermarket wiring harnesses and can be used as described.
- 11) See Diagram 1 for Steps 12-18

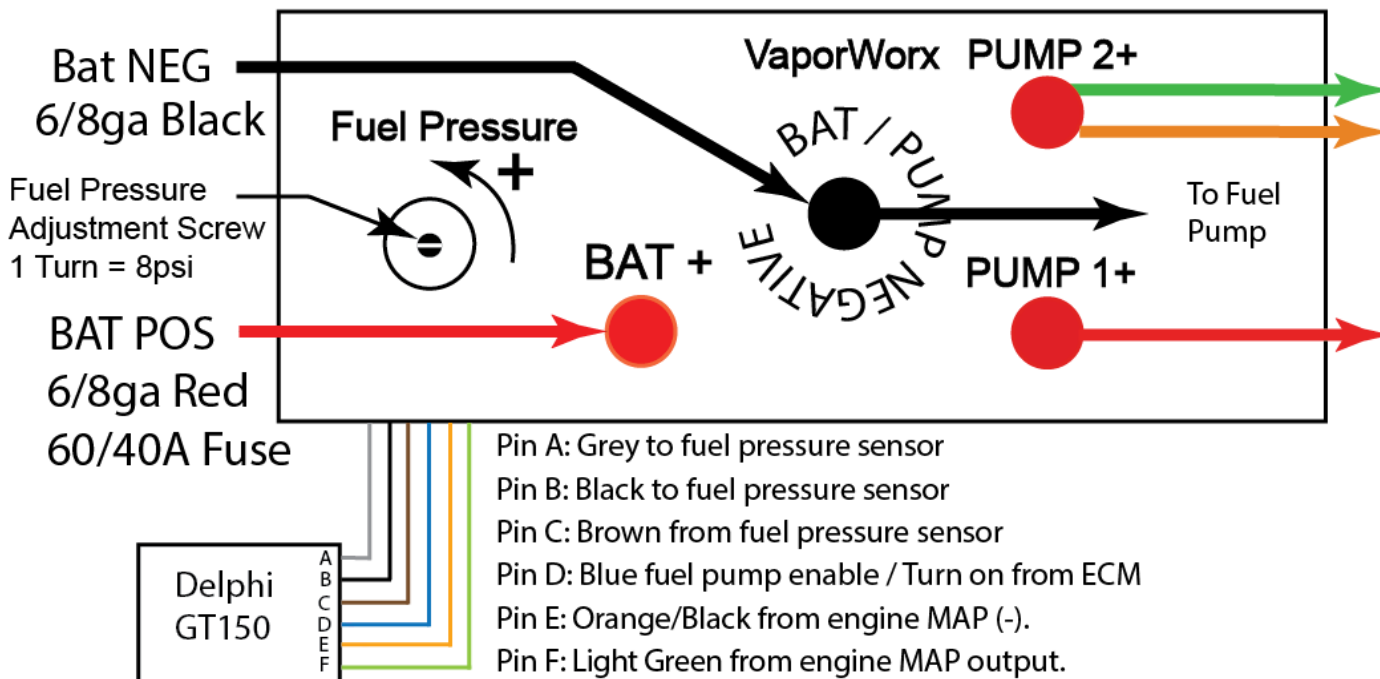


Diagram 1. Battery connections come from the left, the outputs to the right for illustration purposes only. **NOTE: Pump 2 insulation color may be green or orange.**

- 12) Plan the routing of your power input and output harnesses. Woven braid should be installed before terminals are crimped on the ends of the wires. The ends of the braid can be sealed from fraying with a soldering iron and to the wire bundle using heat shrink tubing.
- 13) Unbundle the main power harness. Mount the fuse holder in a secure location so that one end can be connected directly to the battery positive terminal.
- 14) The label on the top of the VaporWorx controller shows the input (BAT +) and output (PUMP +) terminals. Attach the short end of the red fuse holder to the battery positive terminal. Route the other end of the fuse holder to the VaporWorx controller BAT + terminal. Ring terminals are provided in the kit and will require heat shrink insulation tubing to be installed. Secure the nut to 10in-lbs. Though there should be excessive wire length, keep them as short as practical. Do not bundle or coil excess wiring. Keeping these input lengths below 24" is good practice.
- 15) Route the 8ga black wire from the battery negative terminal to the VaporWorx controller BAT / PUMP NEGATIVE terminal. Ring terminals are provided in the kit, and use heat shrink tubing to insulate. Do not tighten the brass nut on the VaporWorx controller at this time.
- 16) Begin routing the wiring from the fuel pumps to the VaporWorx controller. The VaporWorx controller is usually mounted in the trunk with a trunk mounted battery, so route the wiring harness using appropriate rubber grommets and protective sleeve.
- 17) Fuel level sensor wiring may be included in the kit. The black or white wire is for gauge ground, the tan routes to the fuel gauge. Route the wire(s) to tie into the tank fuel gauge wiring. The colors of these wires may not match the wiring color of your sensor. Verify that the sensor ground is connected to the VaporWorx black/white, and the output connected to the VaporWorx tan wire. Fuel level sensor wiring connections are not needed for controller function.

See wiring diagram for the following steps.

- 18) Attach the twin plug harness to the dual fuel modules. One leg may be shorter than the other so verify best fitment. One of the modules will be designated Pump 1+, the other Pump 2+ on the controller. Pump 2+ will be the primary. Usually taping this harness to the top of the tank to take advantage of trunk floor recesses for clearance works well when running the wiring aft. Be sure the wiring does not become pinched between the tank and trunk floor. When running the wiring forward loop the wiring so as not to interfere with fuel lines or fuel level sensor wiring.
- 19) The longer wiring harness is plugged in to the twin plug harness. If the battery is in the trunk, the long harness is installed from the bottom of the car, typically through the trunk floor. Use a protective grommet to protect the wiring.
- 20) Route the wiring to the VaporWorx controller. Plan on when and how to install the supplied braided sleeve and shrink tubing to seal the ends. Connect, using the ring terminals provided, the black 8ga wire to the BAT – terminal on the controller along with the wire from the battery. Secure the brass nuts to 10in-lbs.
- 21) Attach the 10-12ga red and orange wires to the Pump 1+ and Pump 2+ terminals on the VaporWorx controller using the ring terminals provided. Pump 2+ will be the higher output, Pump 1+ the follower. There typically is no preference on which fuel module is the primary. Secure the brass nuts to 10in-lbs.
- 22) Connect the black or white wire for the fuel level sensor ground to a suitable chassis ground (if applicable.)
- 23) Re-check and secure all connections and verify that all wiring is routed away from sources of potential damage and is not pinched.
- 24) Insert the 40A fuse into the fuse holder.

Preparation Required Prior to Engine Startup

- 25) The controller comes pre-set to approximately 60psi constant at idle fuel pressure with no MAP reference wiring connected unless otherwise noted. For manifold referenced fuel pressure turn the fuel pressure adjustment screw two turns clockwise for initial setup. **In all cases a fuel pressure gauge must be used to verify actual pressure with the engine running.**
- 26) Fill the fuel tank to 3/4-full minimum. Check for any leaks. If a fuel filter is installed just prior to the fuel rail connection and the hoses have been cleaned, the flushing sequence in Steps 33-36 can be skipped. However, please read Step 34 about priming time.
- 27) Disconnect the fuel line from the engine fuel rail. Route or extend this line to a fuel-rated and approved container. Secure the line to the container so that it will remain in place when fuel is pumped through the line. High-pressure fuel flow will cause a flexible line to whip if not secured.

- 28) Turn on the ignition switch. Fuel should begin to flow in several seconds. If the ECM controls the fuel turn-on circuit (blue wire) then it may take several cycles to flush the system. Most ECM's have a safety feature that turns off the fuel pump after 1-2 seconds if it does not sense that the engine is running.
- 29) In some cases, after several cycles the ECM may not turn the fuel circuit on until it senses engine rotation. In this case, if needed, using a jumper wire 12v+ can be applied to the VaporWorx controller blue wire for a few seconds. The pump should begin to run. The fuel pressure sensor wiring must remain in place and not be disconnected.
- 30) Reconnect the fuel line to the engine fuel rail and attach a fuel pressure gauge to the engine fuel rail.
- 31) Turn on the ignition switch but do not start the engine. The fuel pressure gauge should rise and settle near its pre-set value. Turn off the ignition key and inspect the fuel system and engine fuel rails for leaks. It is normal that the fuel pressure will spike after fuel system shutdown. Fuel pressure should return to normal after engine start-up. The two-second priming rule is still in effect, so use the procedure in Step 35 to turn on the controller using the blue wire if needed.
- 32) Re-connect the blue wire to the ECM if it was removed. If no leaks are found, start the engine. Fuel pressure may increase 2-3psi higher than what was observed during engine-off due to system voltage increases. Again, check for leaks.
- 33) Use the blue adjustment tool included in the hardware kit to adjust the fuel pressure. Typical fuel pressure settings are 36-45psi at idle for manifold referenced with 42psi the most common, and 60psi for constant pressure.. The tool can be cut shorter for easier access.
- 34) Shut down the engine as soon as practical and check the fuel system for leaks. Repair any leaks before continuing.
- 35) Restart the engine. Quickly depress and release the throttle pedal. For constant pressure systems, the fuel pressure should remain at the set value. For manifold referenced, the fuel pressure should change the same amount as the manifold pressure. If checking while not driving the car a 3-5psi change is normal since it is difficult to have sufficient engine load for large MAP changes to occur.

Troubleshooting

- 1) Fuel pump runs at full speed when the engine is on:
 - a. Adjust the fuel pressure via the small screw on the side of the box.
 - b. Check fuel pressure sensor wiring connections. On the fuel pressure sensor plug Pin 1 = Brown, Pin 2 = Black, Pin 3 = Grey. Confirm that these wires align with the same wires on the controller GT150 plug. It is possible to crimp across the insulation of the wire and not obtain a good circuit pathway, hence, causing a controller malfunction.
 - c. Confirm that the input and output main power wires from the battery and to the fuel module are correct/not reversed.
 - d. Confirm the controller is connected directly to battery power. No chassis grounds.
- 2) Fuel pump does not run:
 - a. Check the input fuse.
 - b. Check fuel pressure sensor wiring connections. On the fuel pressure sensor plug Pin 1 = Brown, Pin 2 = Black, Pin 3 = Grey. Confirm that these wires align with the same color wires on the controller GT150 plug. It is possible to crimp across the insulation of the wire and not obtain a good circuit pathway, hence causing a controller malfunction.
 - c. Confirm that a minimum of 10v is available to the VaporWorx controller and blue wire Pin D. 12v + can be applied directly to the GT150 Pin D blue wire for testing only.
 - d. Check that the brass nuts for the battery and fuel module power wiring terminals are properly tightened and free of contamination and corrosion.
 - e. Check the brass nuts that are under the battery and fuel module ring terminals. These may loosen over time. Retighten them and test the system.
 - f. Excessive fuel pressure due to engine shutoff. After ignition shutoff the injectors shut but the pump still spins, causing a pressure spike. This is normal, but until the pressure drops below the set pressure, the controller will not send power to the fuel module.
 - g. Check the temperature of the VaporWorx controller black aluminum lid. If the lid is over 225°F the controller will shut down.

- h. Confirm that the battery and butt-joint connections are good. Use a volt-ohm meter to check connections.
 - i. Confirm that the input and output main power wires from the battery and to the fuel module are correct/not reversed.
 - j. Confirm the controller is connected directly to battery power. No chassis grounds.
- 3) The fuel pressure rapidly fluctuates, especially at idle:
- a. The fuel pressure sensor is too close to the fuel rail or insufficient fuel is being bypassed. The VaporWorx system can react fast enough to chase individual injector pulses at idle, hence causing rapid fuel pressure gauge readings. Once engine speeds increase this tendency reduces. Move the fuel pressure to as close to the fuel module as practical. In some case where a very short primary fuel line is used, a longer line from a "T" may be needed to install the fuel pressure sensor into. This extra head length acts a damping system for the injector pulses.
- 4) Fuel pump does not have adequate pressure:
- a. Turn the fuel pressure adjustment screw inside the hole on the side of the controller. A small eyeglass screwdriver can be used, as well as the tool supplied in the kit.
 - b. Remove the power wiring from the brass terminals on the top of the controller. Confirm that the lower brass nuts are tight.
 - c. Check that the connections from the VaporWorx controller to the fuel module are good.
 - d. Using a heavy gauge jumper wire, connect the BAT+ to the PUMP+ on the VaporWorx controller. If the fuse is good the pump should run. If the pump is running but little or no fuel pressure exists, then either the fuel module is internally damage (broken plastics), the fuel pump(s) have been damaged, or there is a large leak. The most common cause of fuel pump damage is running the pumps dry. Fuel is the life blood for pumps.

Fuel Module Output Testing

One question that often arises is how to monitor pump output. This is good to know in order to determine if the pump is adequate for the power produced. To test this, connect a voltmeter to the BAT+ to the PUMP 1+ terminals. In a safe and legal way, have an assistant watch the meter as the car is driven at wide open throttle/maximum fuel demand. Once the voltage 0.25volts or less than the, the controller is effectively sending maximum power to the pump(s). After this point is reached fuel pressure will begin to fall due to a pump over-capacity condition.