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 origins. 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 Dual and Triple Fuel Pump 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. The following pumps have been validated for use with the returnless VaporWorx PressureWorx Pulse Width Modulation control system:

All TI Automotive/Walbro F900002XX fuel pumps (400, 450, 525, and 535lph versions)
AEM 320lph (all versions)
Aeromotive Stealth 340
Deatschwerks DW300/400
Bosch -044

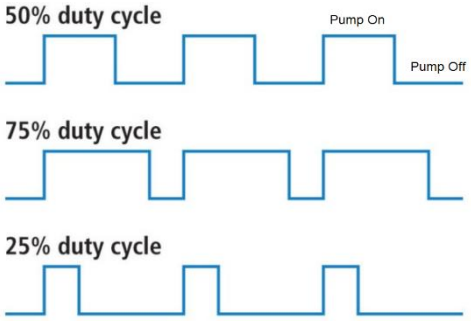
Other pumps may also be compatible. Please contact VaporWorx regarding your application.

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

What is PWM?

In simplest terms, PWM turns the power on and off very quickly to the fuel pumps. If the power is on for 10ms, then off for 10ms, the duty cycle is 50%. As the fuel line pressure decreases due to engine demand, the controller changes the output duty cycle to increase the speed of the pump(s). The opposite happens when the fuel demand falls. This allows a large pumping system to run reliably with significantly reduced heat generation. It effectively makes a very large pumping system seem much smaller during cruise/low fuel demand conditions.

The graph below shows what a typical set of duty cycles look like:



With the above pumps and a few modifications, a true PWM controlled returnless system is possible. For returnless PWM to work properly some fuel must be bypassed during operation. Idle fuel to the engine is not enough, so a bypass must be used. Usually an in-tank bypass/controlled leak is the best and cleanest solution. For the Fore Innovations dual and triple arrangements, a modification should be made and is outlined in another attached instruction sheet.

The hole for each pump is listed below and should be approximately 1/8" long with a diameter as follows:

1) Aeromoitve Stealth 340: 0.025" 2) Walbro F90000267: 0.041" 3) Walbro F90000285/295: 0.051". 4) Bosch -044: 0.041"

The Aeromotive Phantom module has a provision on the bottom of the hat to drill the bypass hole (only one needed) in a threaded pipe plug. VaporWorx has bypass fittings available if needed.

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 ground signal. In these cases a different controller is available from VaporWorx for these systems. A relay can also be used to change the input polarity.

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. From a tuning standpoint, the ECM should have the fuel mapping done just like a return style regulator. The injector does not know if the fuel system is return or returnless.

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.

This kit must operate in manifold/boost referenced fuel pressure mode to operate properly.

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.

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. 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.

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).

VaporWorx carlc@vaporworx.com
(805)390-6423

The following steps will help to ensure good fuel system 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 available, ready, and functional at all times.

Please read these instructions before beginning installation. There are some steps that may change later wiring decisions.

MAP Wiring Attachment is mandatory for this kit to function.

Refer to the wiring diagram on Page 7 for wiring layout.

1) Disconnect the battery. Find a suitable place 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, radiators, etc. The cooler the electronics are during operation, the longer their expected life will be. Underhood and trunk mounting are acceptable. Do not mount the controller where it will be exposed to significant water/road splash. Undercarriage mounting is acceptable if appropriate splash protection is provided. 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 immediately after the fuel module outlet. The sensor must be mounted near the fuel module outlet/rear of the car. If the sensor is mounted in the engine fuel rail rapid pressure fluctuations due to injector/mechanical pump pressure pulses may occur. Use a small amount of Teflon paste to seal ***just the threads*** of the sensor. For Fore Innovations installations mounting sensor as shown in Photo 1C has worked well. If a “Y” block is used near the fuel tank the fuel pressure sensor can be mounted there 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. This wiring can be combined with the fuel pump power wiring in a common loom.

4) Plug the three-cavity fuel pressure sensor plug into the fuel pressure sensor. 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.

5) Connect the MAP sensor wiring as shown in Page 7. Similar to the fuel pressure sensor wiring, route the MAP sensor wiring toward the VaporWorx controller. Making a two-pin connector/pigtail near the MAP sensor is good practice for long-term service needs

6) Route to the VaporWorx controller the ECM fuel pump enable wire. This must be a 12v+ signal A blue wire with a grey end for G8 applications and a green end for Gen5/CTS-V/FSCM applications is included.

   NOTE: For Pontiac G8 applications, connect Pin D Blue wire to OE Fuel Pump + Grey wire.

   For Gen5 Camaro/ CTS-V applications use the Green/White wire in the fuel system control module and disconnect the FSCM plug from the OE controller. ECM tuning will be needed to disable the FSCM. Other GM models with an FSCM will be similar but may have a different wire color. The wire needed is what tells the FSCM to turn on.

7) The VaporWorx controller Delphi GT150 six-pin connector provides all signal wiring connections. Using the terminals and seals provided as seen in Photo 1A-B, crimp the terminals to the wires like that shown in Photo 1B. Solder the terminals to the wires if needed. There will be a total of 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 12v+ enable circuit.
   E. Orange/Black 20ga from MAP -
   F. Light Green 20ga from MAP +

8) Insert the wires into the Delphi GT150 female connector body as shown in Photo 1A. 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 controller GT150 connector.

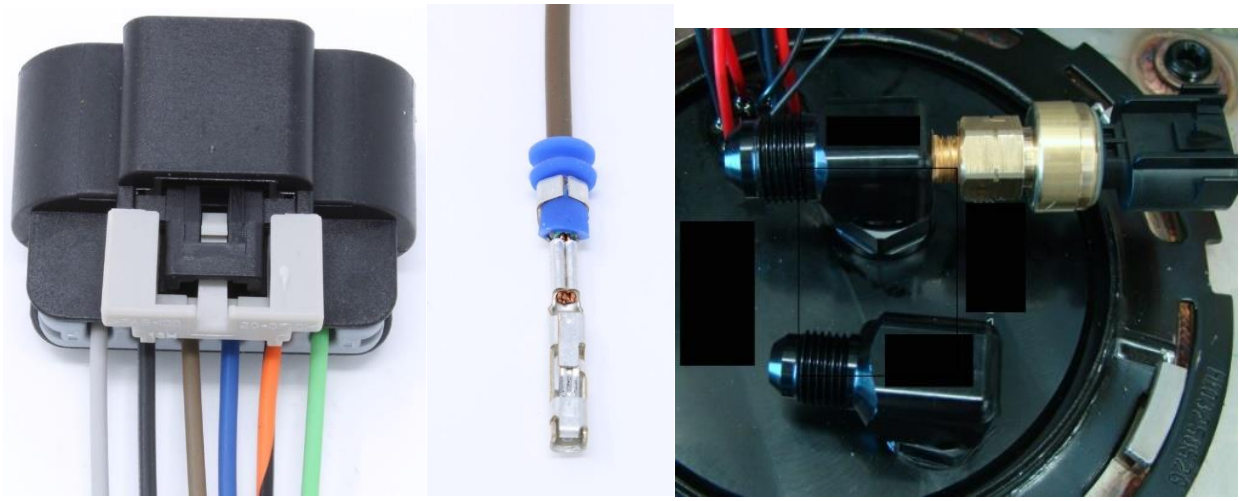


Photo 1A-C: The GT150 connector body, terminals, seals, and grey terminal positional assurance clip. The terminal is crimped to the wire and seal. The part number for the Delphi terminal is 12191818. The seal is 15366022. Note that the sensor was installed by drilling/tapping a hole into the outlet fitting. Side installation may be possible as well and allow for more clearance. Installation into a downstream “Y” connector is also acceptable as long as the “Y” is in the rear of the car.

9) 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.

10) Once the correct wiring order has been confirmed, install the grey terminal position assurance clip as shown in Photo 1A.

11) See Diagram 1 for Steps 12-22

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, if applicable, in a secure location so that one end can be connected directly to the battery positive terminal.

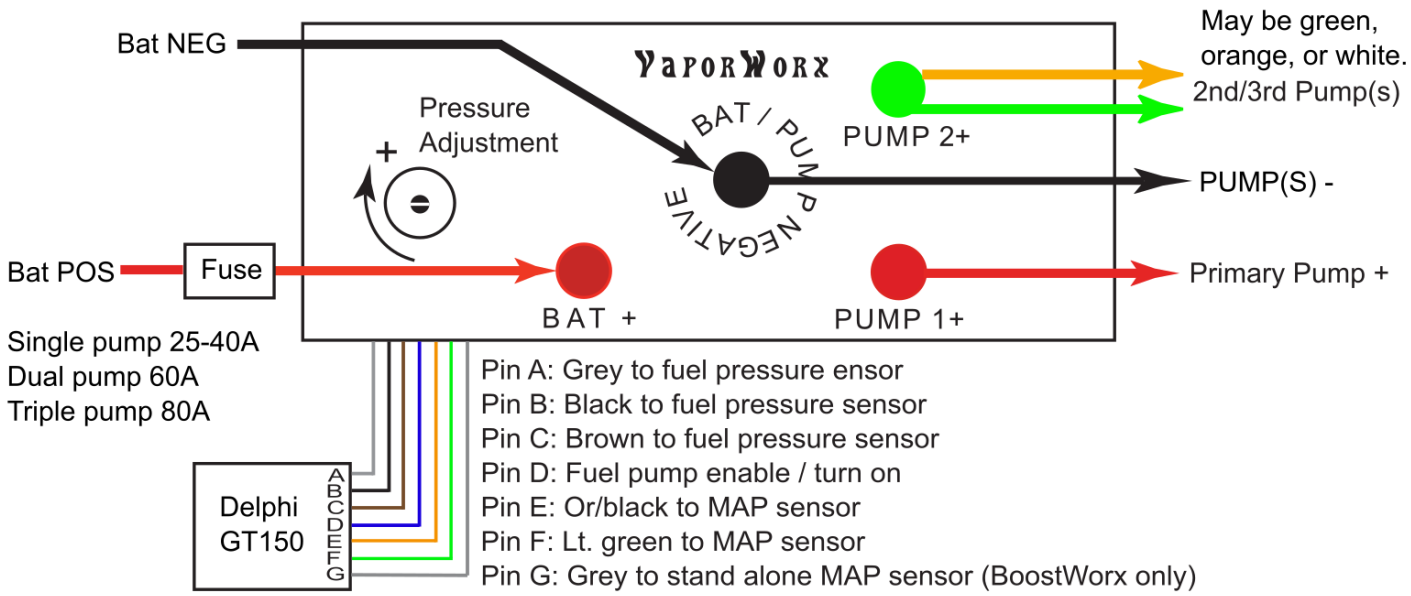


Diagram 1. Battery connections come from the left, the output to the fuel pump to the right for illustration purposes only. Negative wiring may be combined into a single ring terminal if desired. Dual kits have only a single wire routing to Pump 2+.

14) Route the short 6/8ga black wire from the VaporWorx controller BAT/PUMP- terminal to the battery negative terminal. Ring terminals are provided in the kit, and use heat shrink tubing to insulate if needed. Do not tighten the brass nut on the VaporWorx controller at this time.

15) Begin routing the wiring from the VaporWorx controller to the fuel pump. 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.

16) Attach the long 6/8ga negative wire to the BAT/PUMP- terminal on the controller. Tighten the nut to 10-inlbs.

17) The long negative wire includes a “Y” that splits for each pump negative. Cut the long wire to length and crimp the large butt connector to the end. Seal the butt connector with heat shrink.

18) Attach ring terminals to the short pigtails coming from the “Y” to the fuel pump(s) negative wires/terminals. Insulate and heat shrink as needed.

19) Attach the 10ga red wire for the primary fuel pump to the PUMP 1+ on the VaporWorx controller. Tighten the terminal nut to 10-inlbs.

20) Attach the 10ga green/orange/white for the second/third fuel pump(s) to the Pump 2+ terminal on the VaporWorx controller. Tighten the terminal nut to 10-inlbs.

21) Attach the red and green/orange/white 10ga wires to their respective fuel pumps. Install protective wire braid.

22) Re-check and secure all connections and verify that all wiring is routed away from sources of potential damage and is not pinched.

23) Verify the torque for the terminal stud nuts on the VaporWorx controller have been tightened to 10-inlbs.

24) Insert the 60A (dual pumps) or 80A (three pumps) fuse into the fuse holder. A small spark is normal.

Preparation Required Prior to Engine Startup

25) The controller is set to turn on the second and third pumps at approximately 3psi atmospheric pressure when used with the GM LSA/LS9 MAP sensor. No adjustment is needed.

26) The controller comes pre-set to approximately 42psi at-idle fuel pressure. A fuel pressure gauge must be used to verify and adjust actual pressure.

27) 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 28-31 can be skipped. However, please read Step 31 about priming time.

28) 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.

29) 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.

30) In some cases, after several cycles the ECM may not turn the fuel circuit on until it senses engine rotation. In this happens, 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.

31) Reconnect the fuel line to the engine fuel rail and attach a fuel pressure gauge to the engine fuel rail.

32) 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

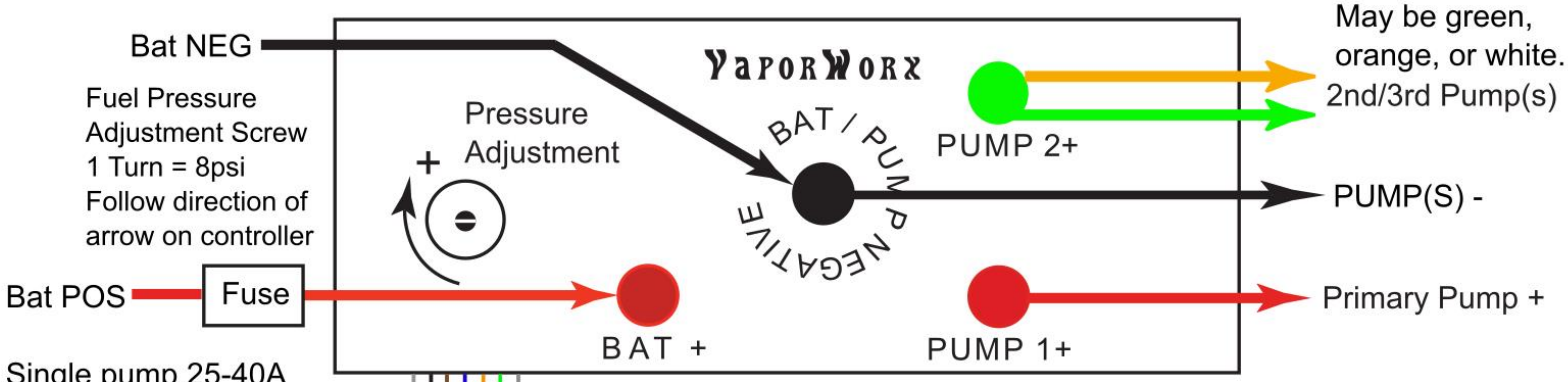
33) If no leaks are found, start the engine. Again, check for leaks and repair as needed.

34) Use the blue adjustment tool included in the hardware kit to adjust the fuel pressure. Typical fuel pressure settings are 36-43psi at idle.

35) Shut down the engine as soon as practical and check the fuel system for leaks. Repair any leaks before continuing.

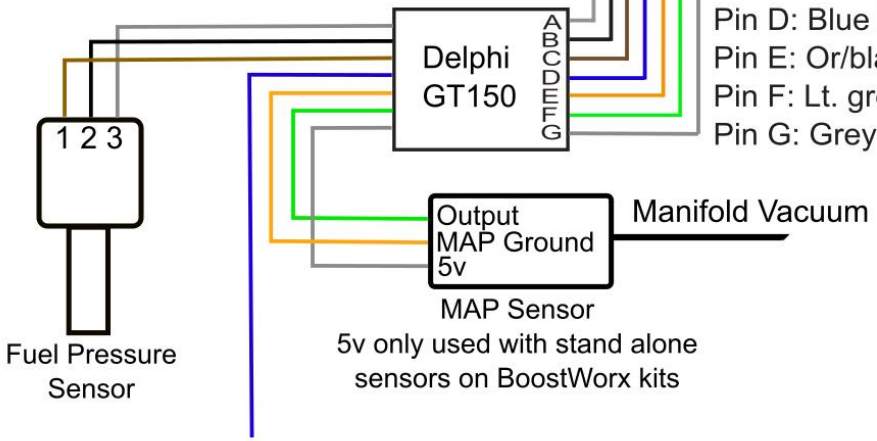
36) Restart the engine. Quickly depress and release the throttle pedal. The fuel pressure should change the same amount as the manifold pressure. In other words, the fuel pressure should increase as heavy throttle is applied, and decrease on lighter throttle.

Main portion of box is 2" x 3"



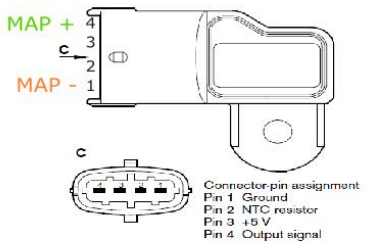
Single pump 25-40A
Dual pump 60A
Triple pump 80A

Pin A: Grey to fuel pressure ensor
Pin B: Black to fuel pressure sensor
Pin C: Brown to fuel pressure sensor
Pin D: Blue ECM fuel pump enable / turn on
Pin E: Or/black to MAP sensor
Pin F: Lt. green to MAP sensor
Pin G: Grey to stand alone MAP sensor (BoostWorx only)



ACDELCO 12592525
LSA/LS9 3bar Map Sensor

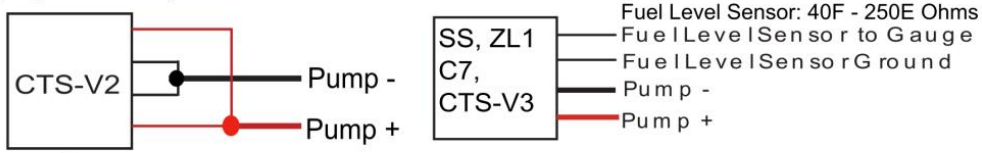
LT-Series 3bar Map Sensor



MAP Sensor Pinout Schedules.

ECM Fuel Pump Enable Signal
ECM fuel pump enable signal (+) or ECM fuel pump relay output (Pump+)
Vehicles with FSCM: FSCM power turn on from ECM (green/grey for GM)
G8: To 14ga grey wire at fuel pump connector

Manifold referenced fuel pressure required for dual pump operation. ECM calibration may be required.



GM White Fuel Module Plugs -Top View

Troubleshooting

- 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.

- 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 to 10-inlbs 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 205*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.
k. Check the fuel pressure. If excessively high due to heat soak at key-off the line pressure may cause the fuel injectors to lock up. A bypass regulator set to 10psi higher than the maximum expected fuel pressure will cure this issue.

- 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.
b. Insufficient bypass fuel through the pump at low engine demand. Extra bypass fuel may be needed. Please consult with VaporWorx.

- 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. 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.
d. Check that the connections from the VaporWorx controller to the fuel module are good.

VaporWorx

We Give You Gas

WARNING

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Modifying the Fore Innovations transfer pump bypass hole for use with VaporWorx PWM systems.

In order for PWM to work with any closed-loop control system, a small amount of fuel is needed to pass through the pump(s) during operation to allow for smooth control. In the factory OE fuel modules this high pressure fuel is used to drive the transfer suction pumps that moves fuel from remote sections of the tank that will not gravity feed to the main module, and to help keep the module full. In the case of the TI 450/525lph pumps, this small amount of fuel needs to be increased due to the increased size of the pump.

1) Note on your Fore Innovations Fuel Pump Module the fuel pump bridge support, mid-span platform, and bulkhead hat as shown in Photo 1. The mid-span platform will need to be removed in Steps 3-6 below.
2) Exercise care to not place excessive loads/strain on the fuel pump outlets. They are plastic and can break.
3) Remove the two screws that hold the pump bridge to the mid-span platform as shown in Photo 1. Slide the bridge toward the large end of the pumps like that in Photo 2.
4) On triple fuel pump modules one pump will need to be removed to gain access to the hole that needs to be drilled. Remove the pump that is not shown in the photos.
5) On the top of the hat there is a single screw that secures the mid-span support. Remove the screw shown in Photo 3. Support the mid-span platform by hand so it does not fall off. The mid-span platform has o-rings and dowel pins between it and the hat mounting surface.
6) Remove the mid-span platform being careful to keep the o-rings and dowel pins in position. The result should be like that in Photo 4.
7) Note the small hole shown in Photo 5. Using the drill bits provided, increase the size of the hole. For TI450 pumps, use the 0.041" bit, for TI525, the 0.051: bit. Be careful, take your time, and use a drill cutting lubricant to make the cut. Once the drill breaks through to the manifold passage, be sure to clear the hole of chips by moving the drill bit in and out of the hole, spinning the drill bit, etc. The hole must be clear of chips and burrs.
8) Check the position of the o-rings and dowel pins in the mid-span platform. Be sure all are in place and clean like that in Photo 6. Reinstall the platform.
9) Re-assemble the fuel module in the reverse order.

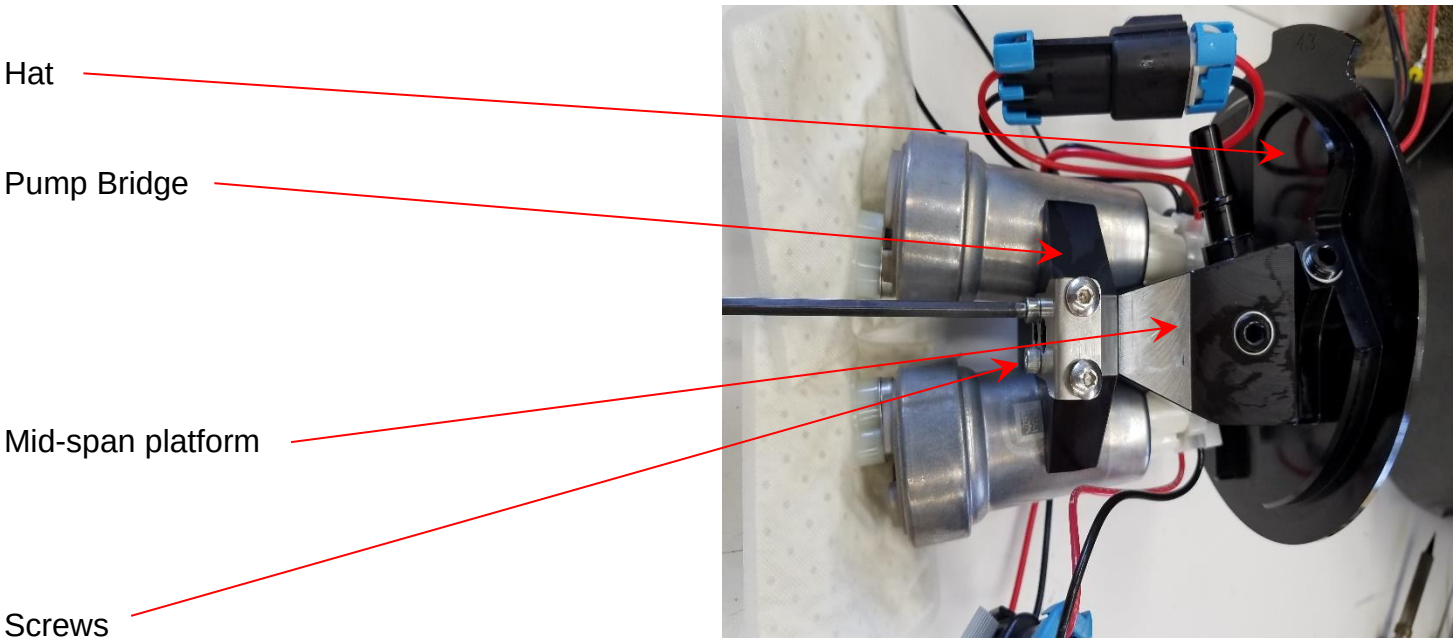

Photo 1. Note the hat, mid-span platform, and fuel pump bridge. Triple fuel pump systems will require the removal of one pump.

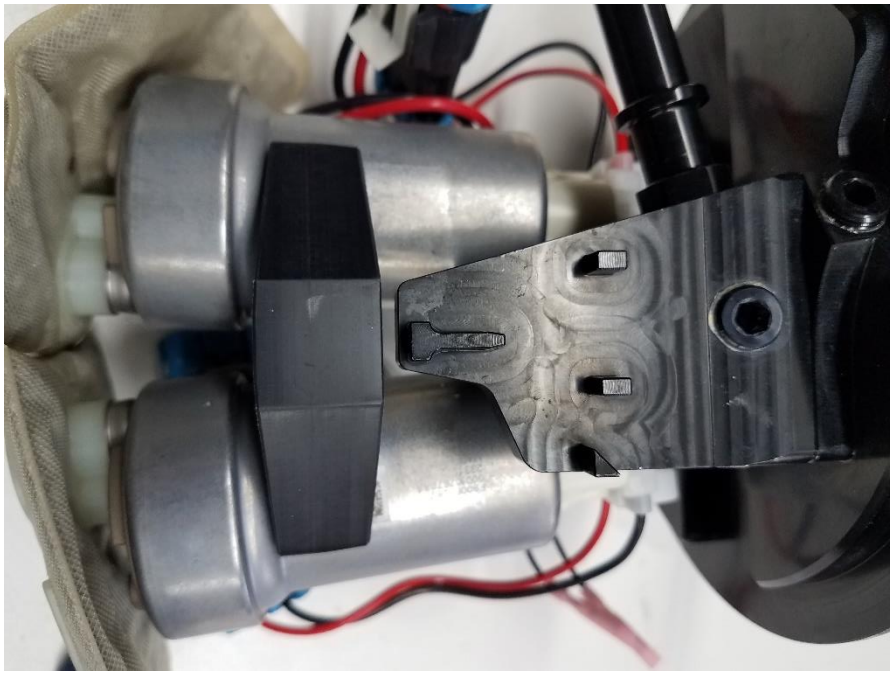

Photo 2. Slide the fuel pump bridge toward the large end of the pumps.

Photo 3. Remove the single screw from the top of the module hat. Support the mid-span platform by hand so it does not fall off.

Photo 4. The disassembled module should look like this.

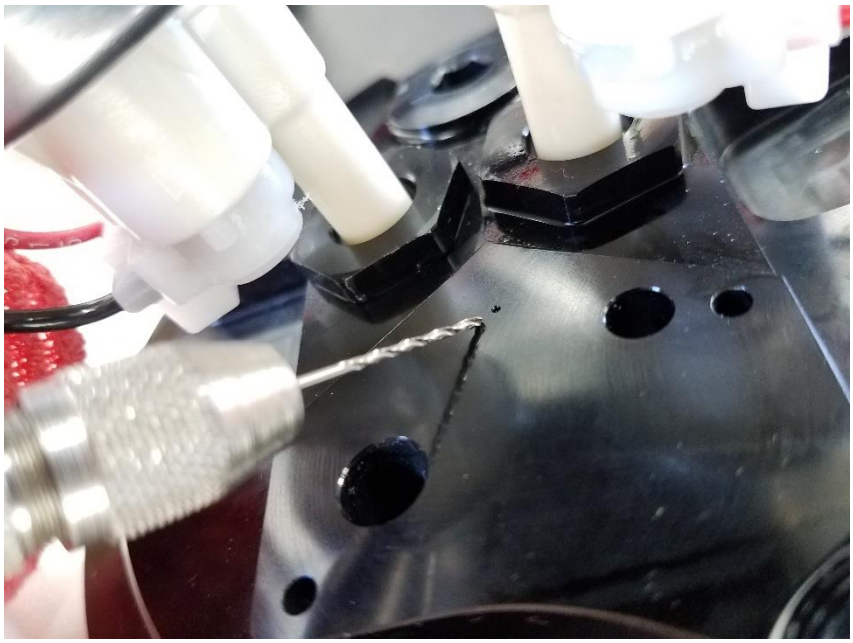

Photo 5. Using the drill bits provided, drill out the hole as shown. For TI450 pumps, use the 0.041” bit. For TI525 pumps, use the 0.051” bit. Only increase the size of this hole, do not drill past the manifold passage and into the hat. A pin vise works well to hold the drill bit. BE SURE TO USE THE BIT TO CLEAR THE HOLE OF BURRS AND CHIPS.

Photo 6. Confirm that all of the o-rings and dowel pins are in place and seated correctly. Some versions may appear a bit different, but the premise is the same.