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 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 VaporWorx PressureWorx Pulse Width Modulation control system:

Walbro F90000267 450lph E85 compatible pump(s).
AEM 320lph E85 compatible pump(s).
Aeromotive Stealth 340 pump(s).
Deatschwerks DW300 pump(s).

Please consult with VaporWorx on the maximum horsepower capability of each arrangement. Many variables can affect the amount of fuel delivered to the engine. Typical horsepower ratings can be found below and include wiring power loss and safety facors. Fuel line pressure loss is not included.

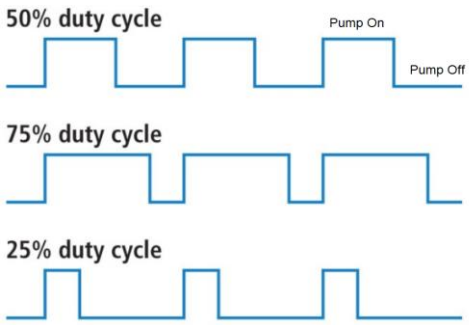
Approximate piston horsepower at 0.65BSFC @ 13.5v gasoline.

	Walbro 450	AEM 320	Stealth 340	DW300
70psi	F90000267	50-1200		
Dual	1400	985	935	1106
Triple	2100	1631	1550	1814

What is PWM?

In simplest terms, what PWM does is turn 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 VaporWorx PWM control adjusts the duty cycle by increasing the speed of the pump. 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.

Unlike many other controllers, including some OE types, the VaporWorx PWM systems can operate at 100% duty cycle. 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 PWM to work properly some fuel must be pumped during operation. Idle fuel is not enough, so a bypass must be used. Usually an in-tank bypass/controlled leak is the best and cleanest solution. A bypass/controlled leak with a 0.025" hole usually works quite well. See Diagram 2 near the end of this document for a typical bypass arrangement. This bypass is not needed for applications where a jet-suction pump/crossover line is used such as the Pontiac G8, Gen5 Camaro, C6 Corvette, and CTS-V2 systems. The high-pressure fuel used to drive these devices is usually sufficient.

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.

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 3bar MAP sensors. For other sensors, please contact VaporWorx.

To use a PressureWorx system in constant fuel pressure mode, do not connect the MAP wiring to the VaporWorx controller and adjust the fuel pressure accordingly.

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.

The choice between the constant or manifold referenced fuel pressure should be decided between you and your engine tuner. The tuner is key to getting the engine running correctly, and his/her input in this matter is critical to making both of your jobs easier.

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 show. So, some of the instructions may not be needed for your application.

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)498-3791

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.

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. 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 immediately 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.

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 four-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. White 20ga from MAP - (PressureWorx only)
   F. Violet 20ga from MAP + (PressureWorx only)

NOTE: For Pontiac G8 applications, connect Pin D: Blue wire to OE Fuel Pump + Grey wire.
For constant (non-manifold referenced) fuel pressure, leave the white and violet wires disconnected from the plug.

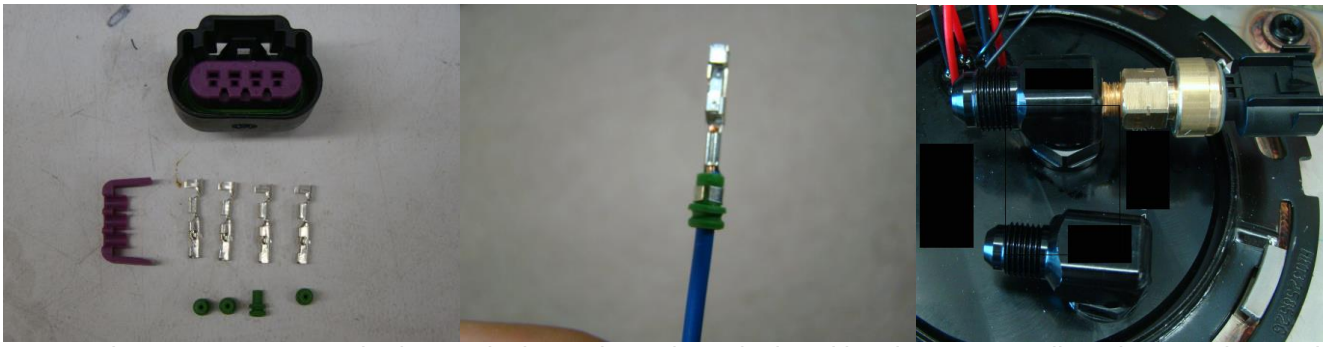


Photo 1A-B: The GT150 connector body, terminals, seals, and terminal positional assurance clip. Photo 2. The terminal is crimped to the wire and seal. The part number for the Delphi terminal is 12191818. The seal is 15366022. Photo 1C. Note that the sensor was installed by drilling/tapping a hole into the outlet fitting. Side installation may be possible as well and allow for more side clearance.

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 connector.

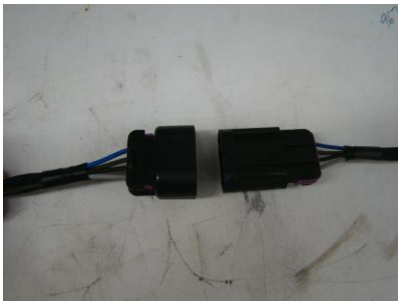


Photo 3: Delphi GT150 female connector (LH). Note that the colors align to each other on both plugs.

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 4.

Photo 4: The purple terminal position assurance clip is installed. Six cavity plug similar.

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.

11) See Diagram 1 for Steps 12-18

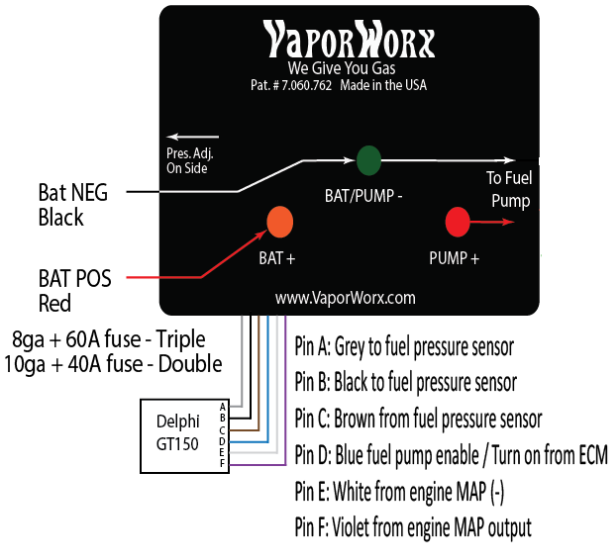


Diagram 1. Battery connections come from the left, the output to the fuel pump to the right. The fuel pressure adjustment is on the left-hand side wall of the controller as noted by the arrow on the lid. A 40A fuse is used for dual pumps, 60A for triple pumps.

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 one end of the 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 may require heat shrink insulation tubing to be installed. Extending the wire from the fuse holder to the VaporWorx controller can be done by using the 8-10ga wire and butt connectors provided in the kit. Use heat shrink tubing to insulate the butt splice. Secure, but do *not over-tighten the brass nuts on the VaporWorx controller.* Though there is excessive wire length, keep the wire lengths as short as practical. Do not bundle or coil excess wiring. Keeping these lengths below 24" is good practice.

15) Route the 6-8ga black wire from the battery negative terminal to the VaporWorx controller negative input. 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.

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. Some kits may have pre-terminated relay kits with pump wiring already attached.

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.

See wiring diagram for the following steps.

18) Attach the 10-12ga red wire from the primary fuel pump to the PUMP + on the VaporWorx controller. Ring terminals are provided. Do not tighten the brass nuts at this time.

19) Unbundle the relay(s) harness. Route the 12ga green wire in the Pin 30 plug to the PUMP + of the VaporWorx controller. Relay terminal numbers can be found on the bottom of the relay body. Ring terminals are provided as well as a relay plug and terminal kit. Do not tighten the brass nuts at this time.

20) Route the 12ga orange wire in the Pin 30 plug to the PUMP + of the VaporWorx controller. Relay terminal numbers can be found on the bottom of the relay body. Ring terminals are provided as well as a relay plug and terminal kit. *Secure, but do not over tighten, the brass nuts.*

NOTE: The 12ga red, green, and orange wires in 18-20 can be combined into a single crimped ring terminal.

21) On one end of the 8ga black wire are three short pigtails that will route to the fuel pump negative attachment points. After making these connections, route the 8ga black wire to the negative terminal on the VaporWorx controller. *Secure, but do not over tighten, the brass nuts.*

22) Route the 12ga green wire from the second fuel pump to the relay Pin 87 output. Relay terminals are provided. Crimp the terminals as required for a secure connection and insert into the relay plug body.

23) Route the 12ga orange wire from the third fuel pump to the relay Pin 87 output. Relay terminals are provided. Crimp the terminals as required for a secure connection and insert into the relay plug body.

24) Install the 4psi Hobb's switch on to the engine using the 1/8" NPT fitting. The switch must be installed after the supercharger outlet. This is typically where the engine MAP sensor is located, and where an auxiliary in-cabin boost gauge would be connected. Due to many unknowns, adapters may be needed to make this connection. Many aftermarket ECM's have programmable outputs which can be used in place of the Hobb's switch. A good place to start would be for the output to be 12v+ output at 4psi boost/125kpa absolute.

25) From the relay harness, route the 20ga green wire to one of the terminals of the Hobb's switch. Red insulated ring terminals are provided. Wiring loom is also provided if desired. The other end of the green wire goes to Pin 85 ONLY on the relay for the second and third pumps.

26) A 20ga black wire is provided for grounding the other terminal of the Hobb's switch. One end of this wire goes to chassis or engine ground, the other to the second terminal on the Hobb's switch. Red insulated ring terminals are provided in the kit.

27) The 20ga orange wire in the relay harness should be routed to a fused IGN + source and connected to relay(s) terminal Pin 86 ONLY. Red insulated ring terminals are provided in the kit.

28) Connect the tan wire in the VaporWorx long power harness to your fuel gauge wire (if applicable). *NOTE:* For Pontiac G8 owners using twin Walbro or other non-OE fuel modules, extra lengths of brown and violet wire are included in the kit to allow extending the OE harness to the new fuel hangar/hat. Brown is the reference voltage, violet the sensor output.

29) Connect the black or white wire for the fuel level sensor ground to a suitable chassis ground (if applicable.)

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

31) Insert the 40A (dual pumps) or 60A (three pumps) fuse into the fuse holder.

Preparation Required Prior to Engine Startup

32) 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.

33) 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.

34) 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.

35) 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.

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

37) 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.

38) 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.

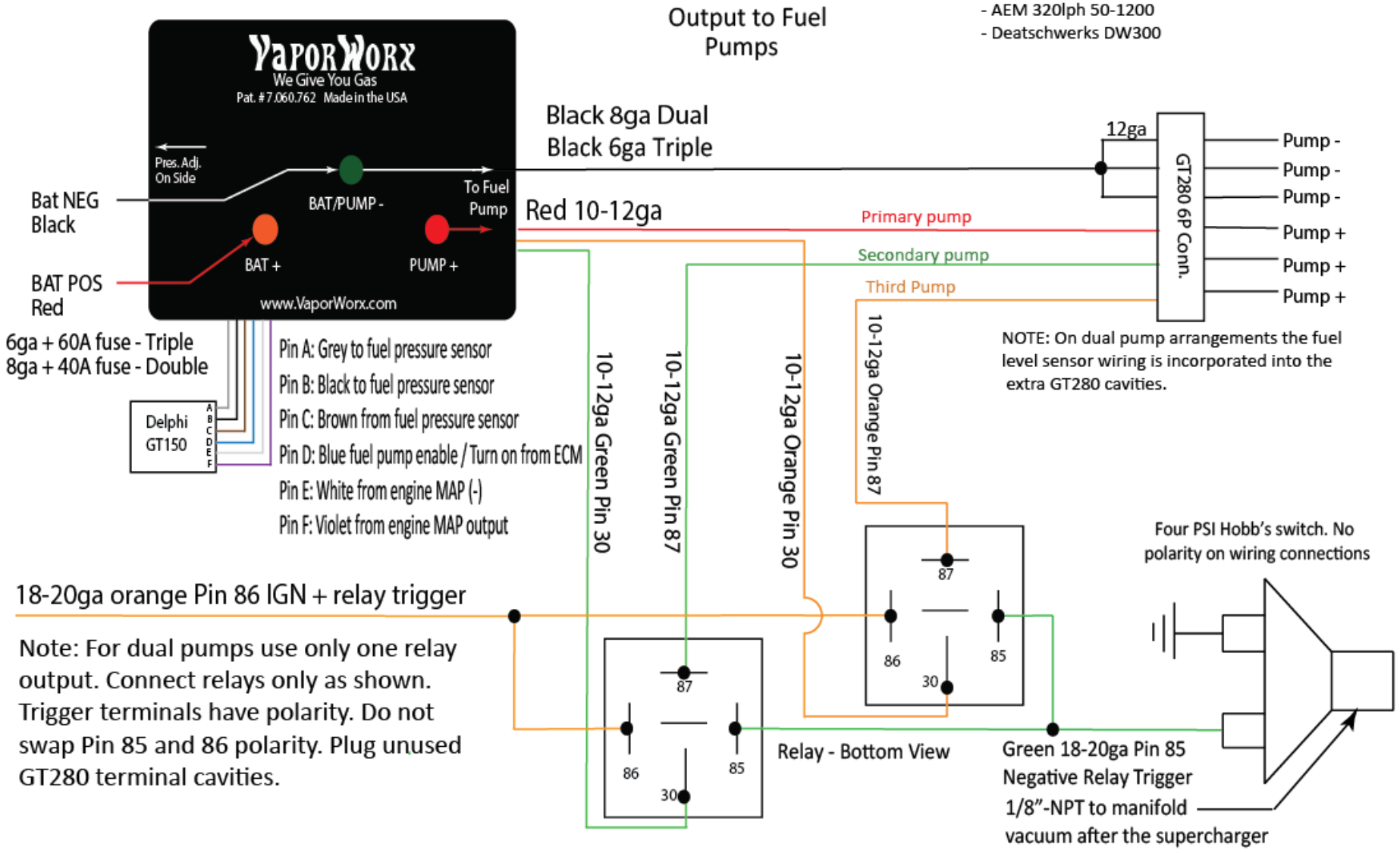
39) On the side of the controller near the sensor input wiring is a small hole. This hole will be on the centerline of the controller between the BAT + and BAT – input terminals. Inside the hole is a brass potentiometer screw that is used to adjust the fuel pressure. Use the blue adjustment tool included in the hardware kit. Typical fuel pressure settings are 58-60psi for constant pressure, 36-42psi for manifold referenced. The tool can be cut shorter for easier access.

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

41) Restart the engine. Quickly depress and release the throttle pedal. The fuel pressure should remain constant with perhaps a 1-2psi drop-off for constant pressure applications. Manifold referenced systems will change the same amount as the manifold pressure.

VaporWorx Dual and Triple Fuel Pump Wiring Diagram

VaporWorx validated pumps for dual or triple use:
- Walbro 450lph F90000267
- Aeromotive Stealth 340
- AEM 320lph 50-1200
- Deatschwerks DW300



Note: For dual pumps use only one relay output. Connect relays only as shown. Trigger terminals have polarity. Do not swap Pin 85 and 86 polarity. Plug unused GT280 terminal cavities.

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 one voltmeter to the inputs of the VaporWorx controller (BAT+ and BAT-) and the other to the output (PUMP+ and BAT-). These connections must be made on the controller terminals. In a safe and legal way, have an assistant watch the meters as the car is driven at wide open throttle/maximum fuel demand. Once the output of the controller is 0.2volts less than the input, 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.

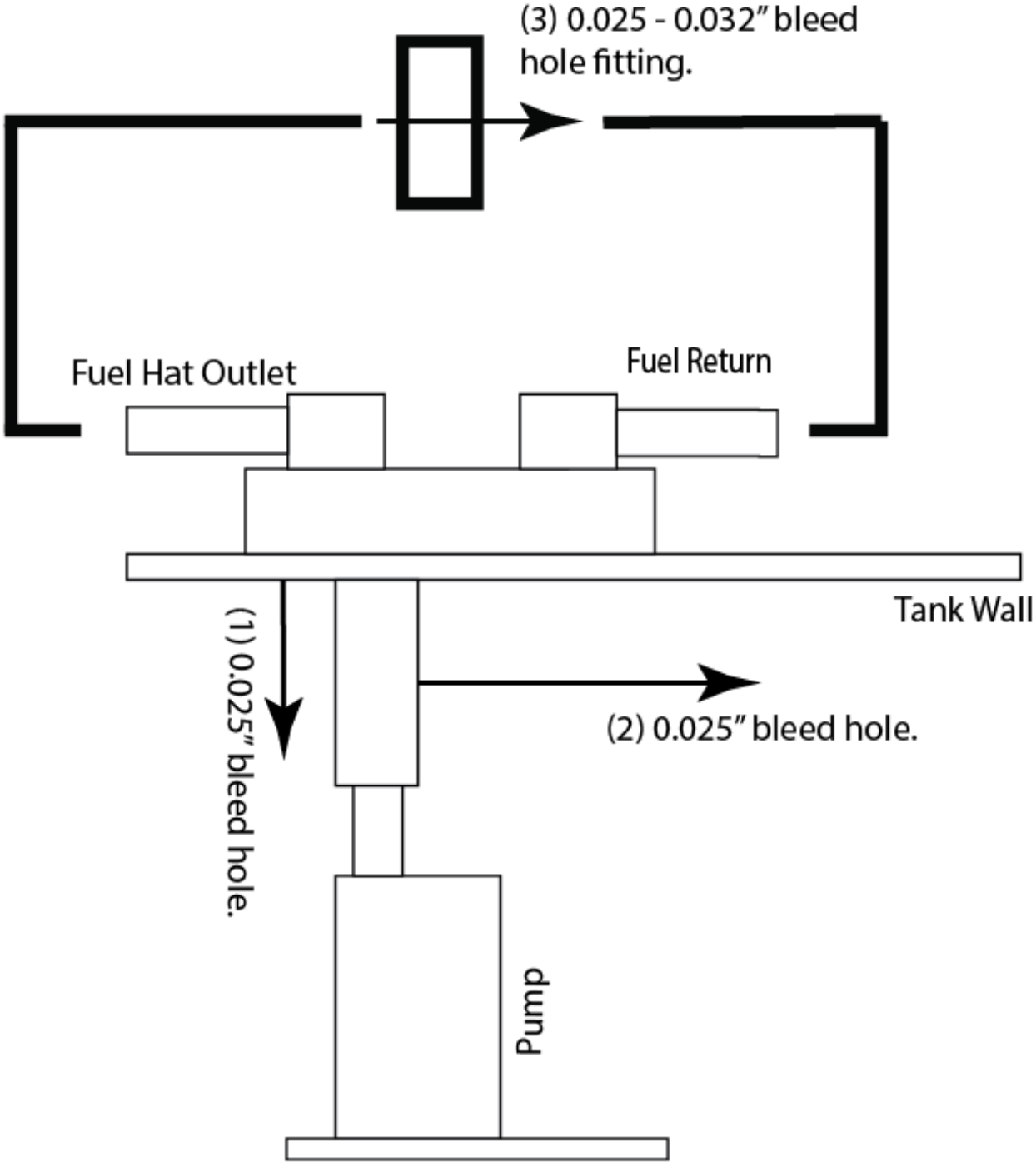


Diagram 2 showing three different bleed types. Note that only one bleed hole is needed. For (1) above, the underhat bleed is often a pipe plug drilled for PWM usage.

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