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.

Installation instructions for the VaporWorx BoostWorx Ford fuel module control system

Thank you for your purchase of the VaporWorx fuel module speed control system. These "Smart" systems are designed to work with the following Ford Mustang fuel modules:

MOTORCRAFT PFS1215 2018 – 2021 Mustang.
MOTORCRAFT PFS-1354 Mustang GT500 Mustang with Gen3 Coyote.

These instructions will cover both fuel module types. The primary difference is the GT500 fuel module requires a six pin electrical plug and must be used with the supplied MAP sensor.

These systems may also be compatible with many Ford and other OEM fuel pumps that utilize a returnless pulse width modulated factory fuel control system (check with VaporWorx for compatibility.) These are stand-alone systems and require minimal ECM commands: Only a 12+ turn on signal is needed. Hence, it will work with any EFI control system.

The purpose of the VaporWorx fuel module control system is to allow the fuel module pump(s) to adjust their speed based on the fuel demand. As fuel demand increases, the VaporWorx pulse width modulation (PWM) controller will also increase the fuel pump speed. As fuel demand decreases, so will the pump speed. This allows a large pumping system to run reliably with significantly reduced heat generation. It effectively makes a very large pump seem much smaller during cruise/low fuel demand conditions. Typically, the minimum power reduction at idle and cruise is 50% for a 60psi constant pressure system. Up to 2/3 power reduction can be obtained with lower fuel pressures.

The BoostWorx system will provide a 1:1 rate of fuel pressure change with manifold pressure. For these systems idle fuel pressure can be as low as 36psi. Wiring connections to the engine MAP sensor are not required since the BoostWorx kit has its own remote MAP sensor. However, an ECM commanded fuel pump enable circuit is needed to tell the VaporWorx controller to turn on/off. An IGN+ signal must not be used since the fuel module will continue to pump fuel in case of an accident.

These controllers are intended to be used in any application that needs a manifold referenced fuel pressure requiring a separate MAP sensor. The following is specific for Ford Coyote applications, and other references may be made throughout these instructions.

The controller will be set to approximately 42psi at idle. Following the instructions for the Ford 2018-2020 5.0L Controls Pack the fuel pressure must be increased to 65psi across the injector (approx. 58psi at idle).

NOTES:

Exercise caution and restraint when installing fuel fittings and lines to the fuel modules. The fuel module outlets are plastic and will break if excessive strain is applied. Use cushion clamps to support the fuel lines so that their weight is not supported by the fuel module outlet. The fuel module can only be replaced as a complete assembly, no parts are available. Breaking the outlet can become an expensive repair.

The single pump PFS1215 fuel module does not require an external filter or fuel safety overpressure valve. Just a single line to the engine is needed. **No external fuel filter is recommended since some offered by the aftermarket have a check valve that will cause hot start problems.**

The dual pump PFS-1354 GT500 fuel module requires an inline fuel filter. It does not require a fuel safety overpressure valve. Just a single line to the engine is needed. When using a filter confirm it does not have an internal check valve. VaporWorx has OEM filtration quality inline filters appropriate for these applications.

The single pump VaporWorx fuel module control system can be upgraded to be used with the GT500 fuel module. A new wiring plug will be needed, and a controller re-tune performed by VaporWorx.

Teflon / PTFE flex lines are recommended at the pump and engine. These will hold up against any manner of fuels that will be encountered. Goodridge and Fragola are excellent sources. All flex or a combination of hard/flex will work well.

VaporWorx has various fuel fittings to convert the quick connect fittings on the fuel module / fuel rail to AN6 and/or AN8. Check the Fittings and Hardware section of the VaporWorx website for examples.

AN6 / 3/8” lines are acceptable for both fuel modules. Larger lines can be used with no drawback besides cost and space.

No external regulators should be used. The VaporWorx PWM controller is an electronic, variable pump speed pressure regulation system. If a mechanical pressure regulator is used it is very likely the VaporWorx controller will always run full speed.

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 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 available, ready, and functional at all times. If unsure of your work seek immediate assistance from an experienced automotive specialist.

1) 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 directly to the battery as practical. If not connected directly to the battery with short wires an excessive amount of electrical noise may be generated and heard through the vehicle stereo speakers. 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. #8 x ¾" 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 near the fuel module outlet like that in Photo 5. The sensor must be mounted near the fuel module outlet so that pressure pulses due to fuel injector and/or engine mechanical pump operation are minimized. If the sensor is mounted near the engine rapid pressure pulses may occur. Use a small amount of Teflon paste to seal ***just the threads*** of the sensor. VaporWorx offers a variety of gauge port adapters to mount the fuel pressure sensor to the fuel line. https://www.vaporworx.com/shop/products/fittings-and-hardware/

3) If desired, the supplied braided loom can be installed over the fuel pressure sensor wiring. If so, slip a ½" 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 near the plugs. Cutting and sealing the ends of the braided loom with a hot soldering iron will help keep them from fraying. The ECM fuel pump enable/turn-on and heavy gauge fuel module wiring may also be integrated into this harness.

4) Find a suitable place to mount the VaporWorx MAP sensor bracket. The assembled MAP sensor bracket will look similar to that in Photo 1. Install the brass barb fitting and route the wiring to the VaporWorx controller using a small amount of Teflon paste to seal just the threads. Similar to the fuel pressure sensor, wiring loom is provided. The vacuum hose must be connected to the pressurized side of the intake manifold on supercharged/turbocharged applications, and after the throttle body on naturally aspirated applications. Hose sizes and barb fittings may be changed as needed. The thread in the bracket is 1/8"-NPT.

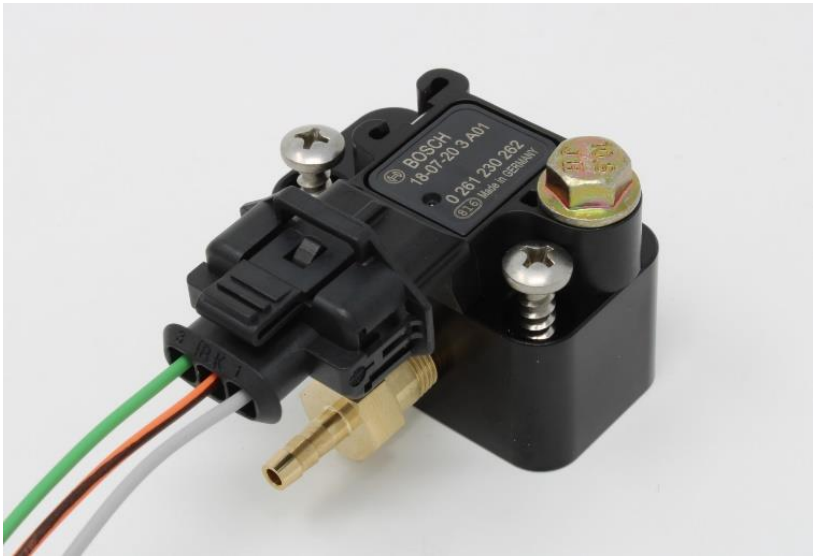


Photo 1. The assembled MAP sensor bracket. The rubber hose will attach to the barb fitting. The MAP sensor has a 4bar operating range.

5) Insert the three-cavity plug into the MAP sensor. Route and secure the MAP sensor wiring to 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, rotating parts, exhaust, etc. and verify that the cable will not be chaffed or cut on sharp edges. Use rubber grommets to protect the wiring where needed.

6) Route and secure the fuel pressure sensor wiring harness to 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, rotating parts, exhaust, etc. and verify that the cable will not be chaffed or cut on sharp edges.

7) Route the ECM fuel pump enable signal wire to the VaporWorx controller. This may be either the ECM fuel relay trigger wire or the power center fuel pump + output. If using the power center output, a large gauge wire is not needed, 20ga is sufficient. It is suggested to use the same color wire from the ECM/power center all the way to the controller to make diagnostics easier.

8) The VaporWorx GT150 eight-pin connector provides fuel pressure sensor, MAP sensor, and fuel pump enable circuit connections. Using the terminals and seals provided as seen in Photo 2A-C, crimp the terminals to the wires like that shown in Photo 2B. Solder the terminals to the wires if needed. GT150 female connector pinout schedule follows:

    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 the ECM fuel pump enable circuit
    e. Orange/Black 20ga for the remote pressure sensor
    f. Light Green 20ga for the remote pressure sensor
    g. Grey 20ga for the remote pressure sensor
    h. Red 20ga for JMS voltage booster (optional)

    The grey wires are interchangeable. Just connect like colors across the connector bodies. Using the ECM fuel pump enable circuit will allow the safety features of the ECM to remain functional and must be used. If only an IGN + signal is used the fuel system may continue running after an accident. If the fuel lines, tank, fuel module, or other components are damaged, fuel may be pumped in an uncontrolled manner. Modern ECM's will shut down the fuel pump enable circuit if engine rotation is not sensed, hence making for a safer condition. It is the imperative that these features remain functional for your safety.

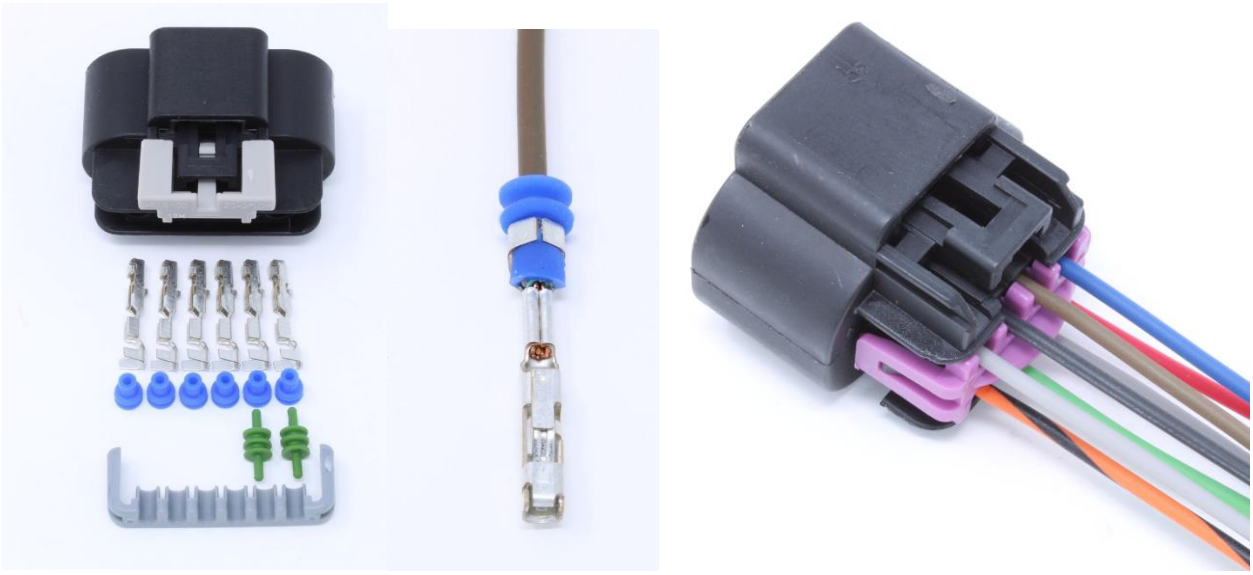


Photo 2A: A GT150 connector body, terminals, and seals are shown. Six, eight, and 10 cavity plugs similar. Photo 2B. The terminal is crimped to the wire and seal. The part number for the Delphi terminal is 12191818. The seal is 15366060. Several extra terminals and seals are provided in the kit. Extras are also available from VaporWorx. Photo 2C: Finished eight cavity plug.

9) Insert the wires into the Delphi GT150 female connector body as shown in Photo 2C. The pinout schedule is listed in Step 7. Capital letters can be found on the connector body. **Just align the colors to the VaporWorx controller connector**. As long as the colors line up there is no concern as to their pin placement. In other words, the grey wires are all connected internally to the same position, so as long as the colors line up the assembly will be acceptable.

10) Re-verify that the wires have been properly placed in the connector and that the colors align. This is the single most common assembly error, so please verify your work. If the wiring is incorrect, or the crimp not satisfactory, 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. 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 purple 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. Fully seat the cap once terminal installation is completed.

11) Once the correct wiring has been confirmed, install the purple terminal position assurance clip as shown in Photo 2C.

12) See Diagram 1 for Steps 12-18

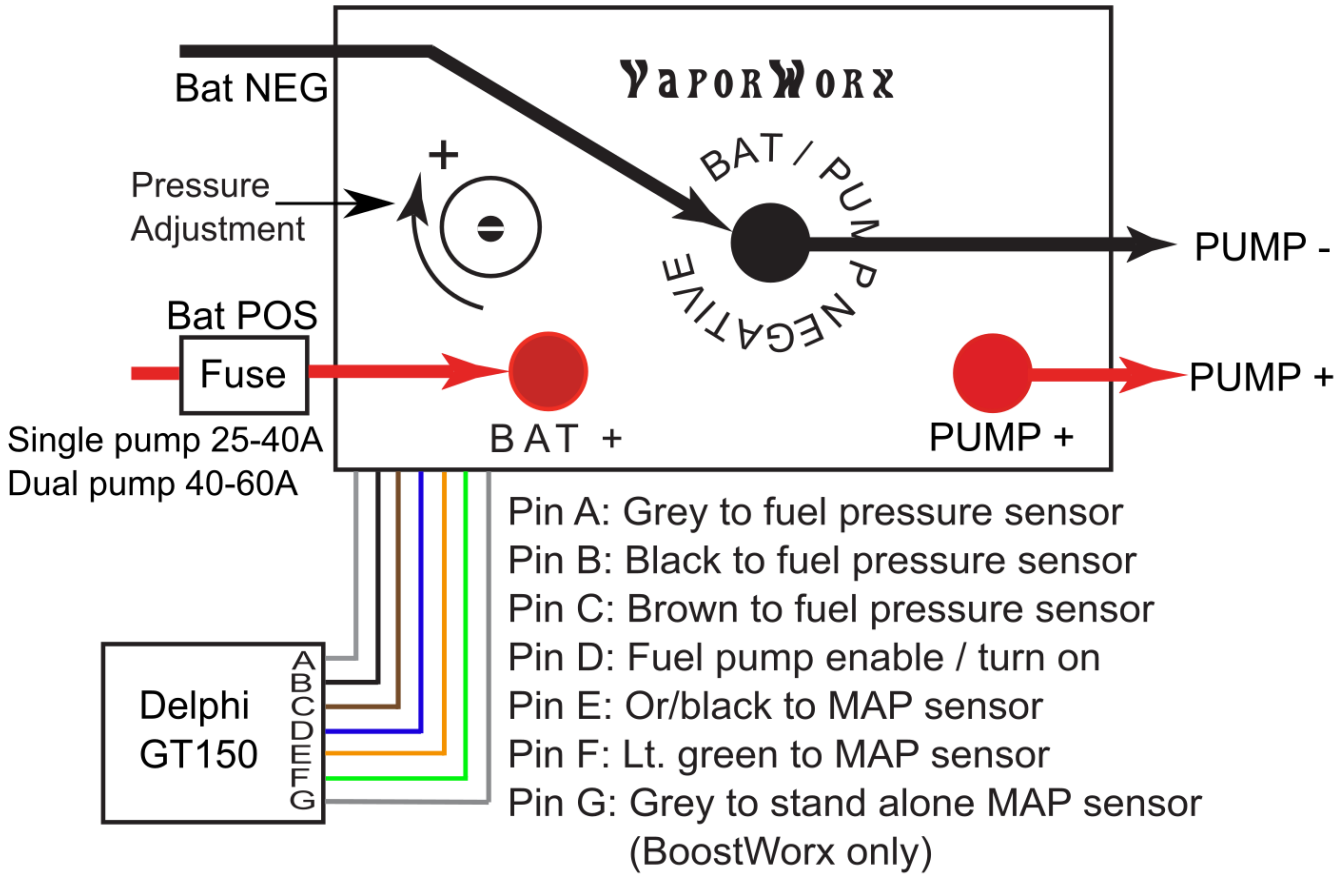


Diagram 1. Basic wiring layout for the VaporWorx controller. The wiring may enter/exit the controller area as needed provided that there is no chance of shorting between connections.

13) The labels on the top of the VaporWorx controller lid shows the input and output of the positive side of the controller. Using the supplied fused link, connect the short end of the fused link directly to the battery positive and the other to the controller BAT+ lug. Ring terminals are provided in the kit. Use the provided heat shrink to insulate the crimp. *Do not over-tighten the brass nuts on the controller. Maximum torque is 10 in-lbs.*

14) Using the supplied black 4' wire supplied in the kit, connect the end with the ring terminal to the controller BAT- lug on the controller and the opposite end directly to the battery negative. Do not tighten the brass nut on the controller. NO CHASSIS GROUNDS.

15) Install the long wiring harness starting at the fuel module. The OEM Ford wiring plugs also have an orange sliding secondary lock than can be used. Route and secure the wiring away from sources of heat, sharp edges, and any other potential damage points. Install the supplied woven braid to protect the harness and use rubber grommets when passing through sheet metal/sharp holes. Fuel pressure sensor, MAP, fuel pump enable signal, and fuel level sensor wiring can share this harness. See Photo 4.

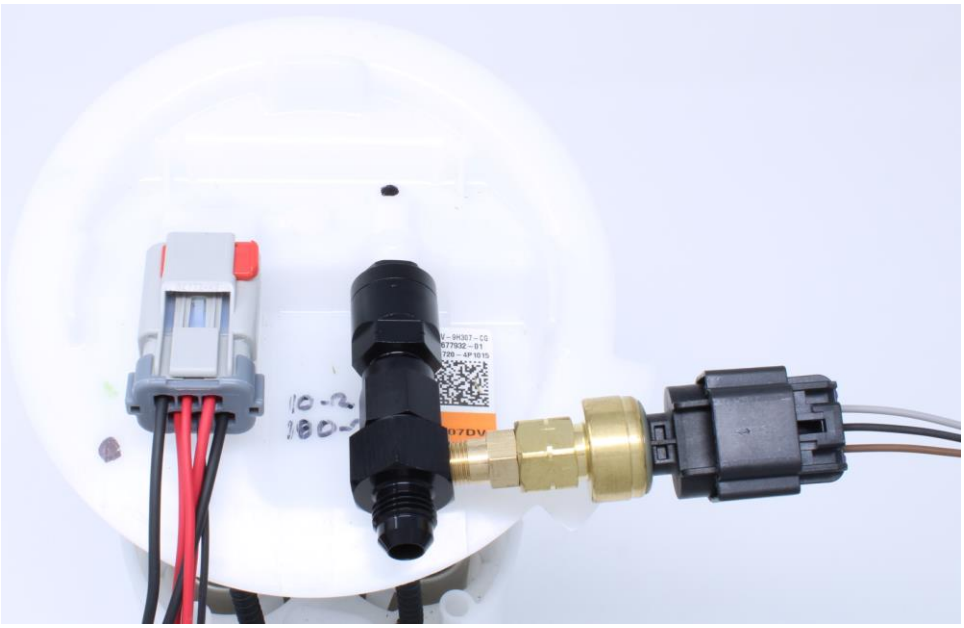


Photo 4. Route the harness towards the controller. The fuel pressure sensor may be clocked as needed. NOTE: An AN6 outlet and gauge port adapter typically works well to adapt the fuel pressure sensor. These are available from VaporWorx. GT500 fuel module shown, GT similar.

16) Fuel level sensor wiring is included but is not required for controller operation. The 20ga black wire is for gauge ground, the 20ga red routes to the gauge. Route the wire(s) to tie into the vehicle fuel gauge wiring. The fuel level sensor range is 10F/180E ohms.

17) Attach the red pump positive wire from the fuel module wiring harness to the PUMP 1+ output lug on the VaporWorx controller. Ring terminals are provided. Use the provided heat shrink to insulate the crimps. *Do not over-tighten the brass nuts on the controller. 10 in-lbs maximum.*

18) Attach the black wire from the fuel module wiring harness to the negative terminal on the VaporWorx controller BAT/PUMP - lug using the ring terminals and heat shrink provided. *Do not over-tighten the brass nuts screws on the controller. 10 in-lbs maximum.*

Preparation Required Prior to Engine Startup

1) Fill the fuel tank to 3/4-full minimum. Check for any leaks.

2) 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.

3) Insert the 25A (single pump fuel module) or 40A (GT500) fuse into the WeatherPack fuse link. A small spark will occur that is normal.

4) Note the fuel pressure arrow and hole on the lid of the controller. Inside the hole is a brass potentiometer screw that is used to adjust the fuel pressure. For Ford 2018-2020 5.0 Controls Power Pack where a 65psi across the injector fuel pressure is needed, turn the fuel pressure adjustment screw clockwise 1-1/2 turns. This is an approximate setting. Final pressure must be verified with a fuel pressure gauge. Approximate idle fuel pressure for Gen1-2 Ford Controls Power Pack = 43psi, Gen3 2018-2020 Ford Controls Power Pack = 58psi. Confirm with the instructions supplied with your engine.

5) Turn on the ignition switch. The fuel pump should start spinning up and fuel should begin to flow in several seconds. If the ECM controls the fuel turn-on circuit (Pin D blue wire) then it may take several cycles to prime the fuel system. Most ECM's have a safety feature that turns off the fuel pump after 2-3 seconds if it does not sense that the engine is running. Do not run the pump for more than five seconds with the fuel line removed from the rail. After five seconds,

allow at least one minute before repeating the turn-on cycle so that the fuel module reservoir can refill. NOTE: The fuel module venturi pumps do not work unless there is high fuel pressure. With the fuel line disconnected, no fuel pressure is available to power the venturi pumps. The pause between flushing cycles is to allow the module reservoir to refill with fuel. Stop immediately if the pump sounds as if it running out of fuel.

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, 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.

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

7) 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. Like before, it may take several cycles to fill the fuel rails and create pressure.

8) If no leaks are found, start the engine. Fuel pressure may increase 2-3psi higher than what was observed during engine-off. Again, check for leaks.

9) Adjust the fuel pressure to the pressure needed. CW = Pressure Increase. ½-turn = approximately 8psi pressure change. Refer to your Ford engine installation instructions for at-idle fuel pressure requirements and adjust as needed.

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

11) Restart the engine. Quickly depress and release the throttle pedal. The fuel pressure should rise and fall with manifold pressure. For engines that are not under load it may be difficult to note a significant fuel pressure change.

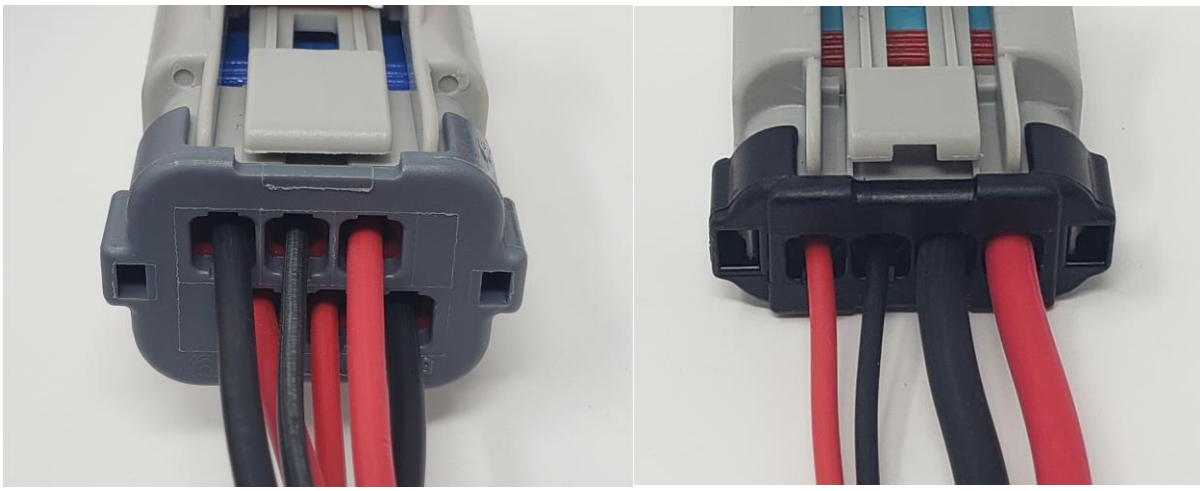
Troubleshooting

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. The voltage in the grey wire should be approximately 5 volts with the system on. The voltage in the brown wire 2.5-3 volts with the system on.
    c. Confirm that the input and output main power wires from the battery and to the fuel module are correct/not reversed and connected directly to the battery.

2) Fuel pump does not run:
    a. Check the input fuse. A 25-40A fuse has shown to be adequate in most situations for single module with no voltage increasing devices (Boost a Pump).
    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 a minimum of 10v is available to the VaporWorx 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.
    e. Check the brass nuts that are under the heavy gauge battery and fuel module ring terminals. These may loosen over time. Retighten 10in-lbs 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 210*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.

3) The fuel pressure rapidly fluctuates, especially at idle:
    a. The fuel pressure sensor is too close to the fuel rail. 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. In rare cases a Radium Engineering pulse damper may be needed.
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. Check that the connections from the VaporWorx controller to the fuel module are good.
    c. Confirm the fuel module plug wiring is correct. Refer to Photos 6/7.
    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 massive leak. The most common cause of fuel pump damage is running the pumps dry. Fuel is the life blood for pumps. If the pump does not run then there is a problem with the electrical wiring at the module connection.
5) A single power wire connection becomes hot/discolored:
    a. The cause is likely an insufficient terminal crimp. Replace the terminal.



Photos 6/7. Left is the GT500 plug, right is the single pump module plug.

GT500: Top row: [14ga Pump1 -] [20ga FLS ground] [14ga Pump2 +]
Bottom row: [14ga Pump1 +] [20ga FLS gauge] [14ga Pump2 -]

Single pump module: [20ga FLS to gauge] [20ga FLS to ground] [10ga Pump -] [10ga Pump +]

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.