



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.

Fuel Module Control System for the GM Performance LSA Engine Controller Kit.

Thank you for your purchase of the VaporWorx fuel module controller for the GM Performance LSA engine control system. These "Smart" fuel systems are designed to work with the GM Gen5 ZL1 or the Cadillac CTS-V2 fuel modules. These are stand-alone systems that require minimal ECM commands.

The purpose of the VaporWorx fuel module control system is to allow the fuel module pump(s) to adjust their speed based on the actual fuel demand. As fuel demand increases, the VaporWorx pulse width modulation control will also increase the fuel pump speed. As fuel demand decreases, so will the pump speed. This allows a large pumping system like the CTS-V to run reliably with significantly reduced heat generation. It effectively makes a very large pump seem much smaller during cruise/low fuel demand conditions.

The PressureWorx LSA system will provide a 60-65psi rate of fuel pressure change with manifold pressure. Wiring connections to the engine MAP sensor are required.

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. 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).

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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. An ABC rated fire extinguisher must be kept at the ready at all times.

NOTE:

The GM LSA engine controller kit uses a 12-14ga grey fuel pump power/enable wire. This wire will be used to turn the VaporWorx controller on and off. Do not use it to provide the main power to the VaporWorx controller.


- 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 controller malfunction will result. 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 3/4" 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 5A. The sensor must be mounted near the fuel module outlet (up to 24" past the outlet is acceptable) so that pressure fluctuations due to fuel injector operation are minimized. 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. Do not use tape. A small piece of loose tape can clog fuel injectors.
- 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 near the plugs. Sealing the ends of the braided loom with a soldering iron will help keep them from fraying.
- 4) Plug the three-cavity fuel pressure sensor plug into the fuel pressure sensor.
- 5) Route and secure the fuel pressure sensor wiring harness to the VaporWorx controller box. 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 chafed or cut on sharp edges.
- 6) From the GM Performance wiring harness, route the 12-14ga grey fuel pump power wire to the VaporWorx controller. Included in the VaporWorx hardware kit is a short 20ga blue wire. Attach the 20ga blue to the 12ga grey securely and heat shrink the connection. The blue wire will insert into cavity D in Step 8.
- 7) Locate the orange/black and light green wiring harness with a 12-pin plug attached. This plug will attach to the mating 12-pin plug near the GM power center. If a GM transmission controller is to be used, then splice the light green VaporWorx wire into Pin E and the orange/black into Pin M, the same locations as they are installed in the plug. A pinout schedule for this connector is included in the GM LSA instruction manual (shown below.) Install the loom braid over the orange/black and light green and route to the controller in the same manner as the fuel pressure sensor wiring. Photo 1 below shows the location of the 12-pin GM bulkhead connector.



Photo 1: GM 12-pin bulkhead shown with purple cap. Extra terminals and seals are provided in the hardware kit to connect the tachometer, fused BAT and IGN power, etc.

- A vehicle speed output is included in the bulkhead connector for use with auto-scaling speedometers. The vehicle speed sensor connector in the harness must be attached to a variable reluctance type speed sensor (typical of most late model GM automatic transmissions) for this to function.

Bulkhead Connector Outputs

Bulkhead Connector	Mating Connector
	15326849 Connector
	15326854 Connector
	12191818 Female Terminal
	15304701 Male Terminal
	15366021 Seal
	15366021 Seal
	15305171 Plug
	15305171 Plug
	15430903 TPA
	15430903 TPA
	15317832 CPA

Circuit #	Position	Wire Gauge	Color	Description
2501A	A	22	Tan	GMLAN Low Speed (-)
-	B	-	Plug	empty
121	C	22	White	Engine Speed
818	D	22	Brown	Vehicle Speed - Out
432B	E	22	Lt. Green	MAP Signal
-	F	-	Plug	empty
2500A	G	22	Tan/Black	GMLAN High Speed (+)
331B	H	22	Tan/White	Oil Pressure Signal
486B	J	22	Purple	Throttle Pos #2 (0.5v - 4.5v)
40F	K	18	Orange	Battery Power Fuse
5292	L	18	Pink	Ignition "On" Power
50B	M	18	Black	Ground

Bulkhead Connector Outputs—terminals for the included mating connector can be acquired at a GM dealership in the Delphi Terminal Service kit. Terminals are Delphi part number 15326269 (GM part number 19167018), and wire seals are Delphi part number 15366021 (white seal). At many dealerships these can be found in the Parts Department.

- GMLAN Communication Link (TAN/BLACK STRIPE [+], TAN [-])** – This provides the MLAN communication messages containing engine operating parameters for potential use in future add on modules – any current integration of this is left to the user. Can be used with a LAN dash or an electronic dash readout display.
- Tachometer Signal (WHITE)** – This is a 2 pulse/rev output (see features above).
- Vehicle Speed (BROWN)** – This is a non scaled output for use with auto-scaling speedometers and will not function unless a vehicle speed sensor (VSS) is connected to the ECM through the VSS wire in the harness.
- MAP (LT GREEN)** – This is an output for use in gauges or for load indication in transmission controllers (any connection must be to high-impedance device). The output is a 0-5 Volt signal ranging from 10 – 105 KPa (1.5 – 15.2 psia). Use the ground wire in the bulkhead connector as the low reference (ground).
- Oil pressure Sensor (TAN/WHITE STRIPE)** – This is the output from the oil pressure sensor which can be used for monitoring (Pressure (psig) = [32*Sensor Voltage]-16). Use the ground wire in the bulkhead connector as the low reference (ground).
- Throttle Position (PURPLE)** – This is an output for use in gauges or for load indication in transmission controllers (any connection must be to a high-impedance device). The output is a 0.5 – 4.5 volt signal ranging from 0 – 100 %. Use the ground wire in the bulkhead connector as the low reference (ground).
- 10A Fused 12V Power (ORANGE)** – This is a power output supply and is always enabled.
- 15A Fused 12V Ignition Power (PINK)** – This is a power output supply and is enabled only when the ignition is on.
- Ground (BLACK)** – This is used as the low reference (ground) for completion of the MAP, TPS, and oil pressure output circuits. It can also be used for modules connected to either of the fused 12V outputs.

GM LSA 12-pin Bulkhead Pinout Schedule. Pin E for light green, Pin M for orange/black.

- 8) The VaporWorx GT150 six-pin connector provides fuel pressure sensor, MAP sensor, and fuel pump enable circuit connections. Using the terminals and seals provided in the hardware kit, crimp the terminals to the wires like that shown in Photo 3. Solder the terminals to the wires if needed.

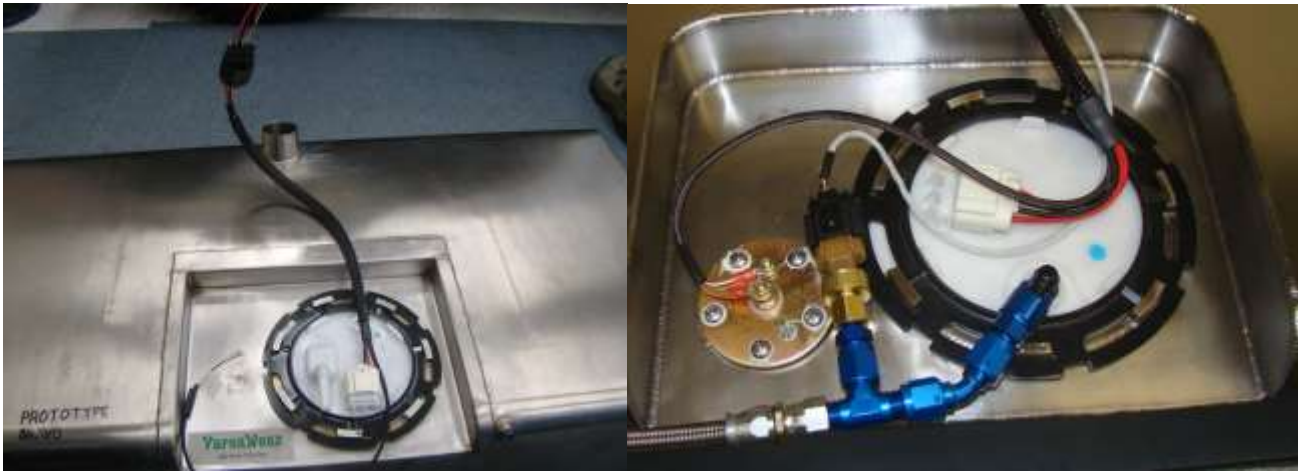
- A: Grey 20ga from the fuel pressure sensor
- B: Black 20ga from the fuel pressure sensor
- C: Brown 20ga from the fuel pressure sensor
- D: Blue 20ga attaches to the GM Performance Fuel Pump 12ga gray wire
- E: Orange/Black 20ga from the engine MAP (-) sensor. Pin M on 12-pin bulkhead.
- F: Light green 20ga from the engine MAP (output) sensor. Pin E on 12-pin bulkhead.

Using the GM ECM fuel pump enable circuit will allow the safety features of the ECM to remain functional. 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 2: The GT150 connector body, terminals, seals, and terminal positional assurance clip. Photo 3: The terminal is crimped to the wire and seal. The Delphi terminal is P/N 12191818. The seal is 15366060.

- 9) Insert the wires into the Delphi GT150 female connector body as shown in Photo 2. The pinout schedule is listed in Step 8. Capital letters can be found on the connector body on one side only near the wire insertion holes. Just align the colors to the mating VaporWorx controller connector.
- 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 Terminal Position Assurance clip and 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 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 grey terminal position assurance clip as shown in Photo 1.
- 12) See Diagram 1 for Steps 13-18
- 13) The labels on the VaporWorx controller lid shows the input and output for the positive (+) side of the controller. Using the supplied 10ga orange WeatherPack fused link, connect one end of the fused link directly to the battery positive terminal and the other to the controller BAT+ input terminal. Ring terminals are provided in the kit. When using non-insulated terminals be sure to install heat shrink over the crimp section to avoid shorts. Tighten the brass terminal nut to 10inlbs. *Do not over-tighten the brass nuts on the controller.*
- 14) A 10ga x 4' black BAT(-) wire is provided in the hardware kit. Connect one end to the battery negative, and the other to the VaporWorx controller BAT/PUMP – terminal. Ring terminals are included in the kit. When using non-insulated terminals be sure to install heat shrink over the crimp section to avoid shorts. *Do not tighten the brass nut on the controller at this time.*
- 15) If applicable, install the short harness that plugs into the fuel module on the fuel tank (if applicable). If the VaporWorx controller is mounted in the engine compartment, connect the longer section of harness to the shorter and route accordingly. Route and secure the wiring away from sources of heat, sharp edges, and any other potential damage points. It is highly recommended that the wiring be installed into some kind of protective sheath, such as split-loom or woven tubing. If the controller is to be mounted in the trunk near a trunk mounted battery, route the wiring such that the disconnect plug is easily accessible. For example, on some applications the harness length is such that the plug is located near the tail panel just under the trunk floor near where the original fuel level sensor wiring is routed. See Photo 3 and 4.



Photos 3 and 4. Note the black GT280 four-pin connector. Route the harness along the top of the tank to a convenient location, such as behind the license plate. Forward or other routing is acceptable as long as the wiring is not pinched, overstretched, etc. The fuel pressure sensor can often be placed in the recess of the tank, providing protection and making for a clean installation. The fuel level sensor wiring is optional. It does not need to be used for controller function.

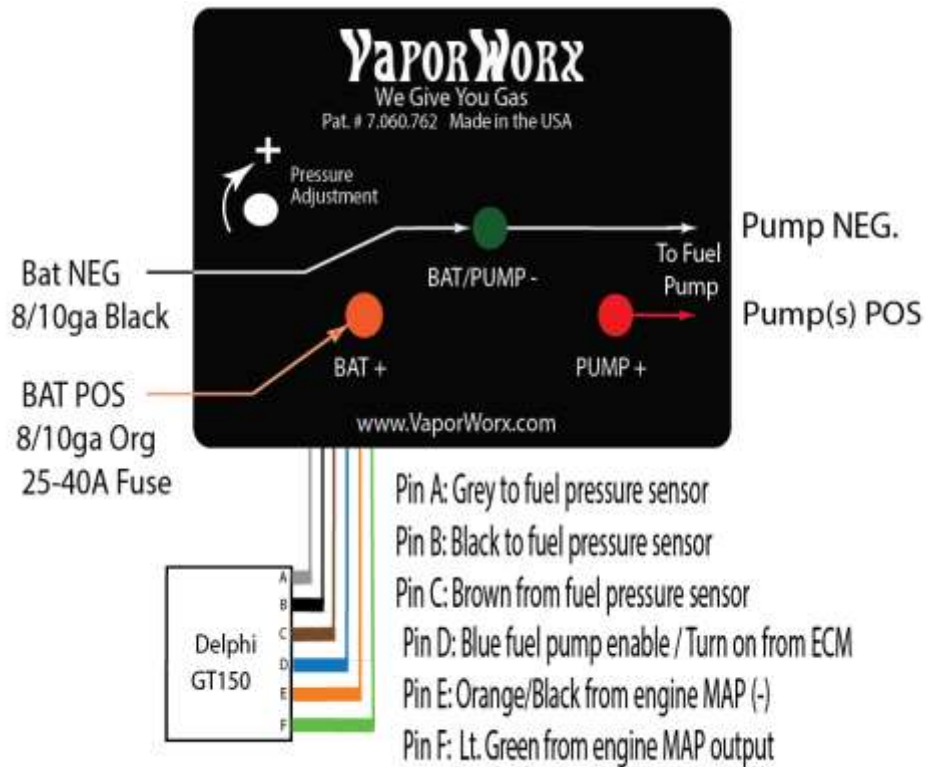


Diagram 1. Basic wiring layout for the VaporWorx controller. The wiring may enter/exit the controller area as needed provided that there is no chance of shorting between connections.

- 16) Fuel level sensor wiring is included in some kits. The black wire is for gauge ground, the other routes to the gauge. Route the wire(s) to tie into the vehicle fuel gauge wiring.
- 17) Attach the red wire from the fuel module wiring harness to the PUMP + on the VaporWorx controller. Ring terminals are provided. When using non-insulated terminals be sure to install heat shrink over the crimp section to avoid shorts. Tighten the brass terminal nut to 10inlbs. *Do not over-tighten the brass nuts on the controller.*
- 18) Attach the black wire from the battery and the fuel module wiring harness to the negative terminal on the VaporWorx controller. Tighten the brass terminal nut to 10inlbs. *Do not over-tighten the brass nuts on the controller.*

Preparation Required Prior to Engine Startup

- 1) The VaporWorx controller will be pre-set for approximately 60psi of fuel pressure at idle. Due to system voltage variations the **actual fuel pressure must be checked with a pressure gauge**. There is a fuel system diagnostics port on the LSA engine for this purpose.
- 2) Fill the fuel tank to 3/4-full minimum. Check for any leaks.
- 3) 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.
- 4) Insert the supplied fuse into the WeatherPack fuse link.
- 5) 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. 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.

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 even with the ignition key off. 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. The 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) On the side of the controller there is a small hole where the fuel pressure adjustment screw is located. Note the arrow on the lid of the controller. Inside the hole is a brass potentiometer screw that is used to adjust the fuel pressure. Using the smaller exposed blade on the supplied blue trimmer tool, adjust the fuel pressure to 60psi at idle. If access is tight, cut the plastic tool shorter to fit. CW = Pressure Increase. ½-turn = approximately 5psi pressure change.
- 10) Shut down the engine as soon as practical and check the fuel system for leaks. Repair any leaks before continuing.

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. A 20A 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 and free of contamination and corrosion.
 - e. Check the brass nuts that are under the 10-12ga 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. 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. For the CTS-V fuel module, there are four wires entering the plug (Pontiac G8 disregard.) The two outboard wires should be red, the two middle black. If these are incorrect, remove the terminals/wires from the plug body and re-orient. Gen 5 LS3 and ZL1 have BAT + on the far left of the plug body, BAT – is next to BAT +. See Photo 5 for LS3/ZL1, Photo 5A for CTS-V.
 - e. 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.

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 digital voltmeter to the BAT (+) and Pump (+) terminals. 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 voltage is less than 0.2volts, 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.