Holley®
PERFORMANCE PRODUCTS INC

MPI PRO-JECTION®

INSTALLATION TUNING AND TROUBLESHOOTING MANUAL

NOTE: **These instructions must be read and fully understood before beginning installation. If this manual is not fully understood, installation should not be attempted. Failure to follow these instructions, including the pictures may result in subsequent system failure.**

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1.0 INTRODUCTION

Holley Performance Products has written this manual for the installation of the ***MPI PRO-JECTION*** fuel injection system. This manual contains all the information needed to install this system. Please read all the **WARNINGS, NOTES** and **TIPS**, as they contain valuable information that can save you time and money. It is our intent to provide the best possible products for our

customer; products that perform properly and satisfy your expectations. Should you need information or parts assistance, please contact our technical service department at 1-270-781-9741, Monday through Friday, 7 a.m. to 5 p.m. CST. Please have the part number of the product you purchased when you call.

WARNING! **The *MPI PRO-JECTION* systems consist of a number of sophisticated components. Failure of any one component does not constitute, nor does it justify, warranty of the complete system. Individual service items are available for replacement of components. If assistance is required or if you need further warranty clarification, you can call Holley Technical Service at the number shown above.**

WARNING! **To preserve warranty, these instructions must be read and followed thoroughly and completely before and during installation. It is important that you become familiar with the parts and the installation of the *MPI PRO-JECTION* system before you begin. Failure to read and understand these instructions could result in damage to *PRO-JECTION* components that are not covered by the warranty and could result in serious personal injury and property damage.**

WARNING! **For closed loop systems using an oxygen sensor, use only unleaded fuels with this product. Use of leaded fuels will destroy the oxygen sensor and will result in incorrect exhaust gas oxygen readings and improper fuel delivery. Failure to follow these directions does not constitute the right to a warranty claim.**

WARNING! **Failure to follow all of the above will result in an improper installation, which may lead to personal injury, including death, and/or property damage. Improper installation and/or misuse of this or any Holley product will void all warrantees.**

WARNING! **Use of some RTV silicone sealers will destroy the oxygen sensor used with this product. Ensure the RTV silicone sealant you use is compatible with oxygen sensor vehicles. This information should be found on the oxygen sensor package.**

2.0 BEFORE YOU BEGIN

Fuel injection systems have proven to increase engine performance by allowing the engine to operate to the best output it is capable of producing. Make sure your engine is in good basic running order before installing the ***MPI PRO-JECTION*** fuel injection system.

Anything that increases the power of your engine demands more from all the components and systems. If your engine is in poor condition before you begin this installation, you won't get the results you want.

Fuel injection is more efficient, but also less forgiving than a carburetor. A properly tuned EFI system can disclose hidden problems your carburetor may have concealed. Corroded terminals or a weak battery, alternator or ignition system will not adversely affect your carburetor, but they will interfere with the precision functions of an EFI system.

The engine cooling system must have a working 140°F to 210°F thermostat. The intake manifold needs to be hot enough to completely vaporize the injected fuel.

3.0 WARNINGS, NOTES AND NOTICES

WARNING! **For the safety and protection of yourself and others, the installation, adjustment, and repair must be performed only by a trained mechanic having adequate fuel system experience. It is particularly important to remember one of the very basic principles of safety: fuel vapors are heavier than air and tend to collect in low places where an explosive fuel/air mixture may be ignited by any spark or flame resulting in property damage, personal injury and/or death. Extreme caution must be exercised to prevent spillage and thus eliminate the formation of such fuel vapors.**

WARNING! **These instructions are provided as a general guideline for installation. Each user must use his own judgement to determine whether his own, or the engine's safety will be endangered by any procedure selected. The user should consult factory engine manuals to ensure compliance with fastener torque and other important specifications unique to each engine.**

WARNING! **This type of work MUST be performed in a well-ventilated area. Do not smoke or have an open flame present near gasoline vapors or a explosion may result.**

4.0 SKILL LEVEL REQUIRED

Installation of the ***MPI PRO-JECTION*** intake system and the ECU requires approximately the same level of skill and experience

to replace or service an induction system consisting of a carburetor and conventional intake manifold (as well as basic wiring skills for the installations of the ECU).

Adequate skills for modifying the vehicle fuel supply are critical, and will vary widely, depending upon the selected components and methods of fuel line plumbing. The most basic level will require the user to plumb a high-pressure supply fuel line and a tank return fuel line to the fuel rails. The most complex level may require the user to modify the fuel tank, re-route or add fuel lines, or mount various combinations of electrical and/or mechanical fuel pumps. Some fabrications may be required, depending on applications, for throttle cable assemblies, throttle cable bracket and thermostat housings.

NOTICE: **If you are not absolutely certain that you have the skills and experience required to perform these procedures, we strongly recommend you have this system installed and tested by a technician with specialized training in EFI and fuel systems service.**

5.0 ADDITIONAL ITEMS REQUIRED FOR INSTALLATION

The following is a list of materials that are needed, depending on the application.

- 3/8" fuel hose (must meet SAE J30)
- 5/16" steel fuel line (must meet SAE J526)
- Tee fitting for fuel gauge
- Silicone Electrical Connector Sealant
- Teflon pipe sealing compound
- Mechanical fuel pump block off plate
- 5/16" fuel hose (must meet SAE J30)
- 0-50 psi fuel gauge
- RTV sealant (O_2 sensor compatible)
- Selection of 1/2" and 3/8" pipe plugs
- Heat Shrink
- Parts to mount the throttle cable

6.0 TOOLS REQUIRED FOR INSTALLATION

The following is a list of materials that are needed, depending on the application.

- Standard wrench set
- Medium blade screwdriver
- Drill and assorted bit sizes
- Engine tachometer
- IBM compatible laptop PC
- Set of Allen wrenches
- Small blade screwdriver
- #2 Phillips screwdriver
- Hole saw (2”)
- 10” adjustable wrench
- Factory service Manual
- Timing/Advance Light
- Digital Volt-Ohm meter
- Terminal crimping tool
- Gasket Scraper
- Torque wrench

7.0 *MPI PRO-JECTION* SYSTEM OPTIONS

MPI PRO-JECTION systems offer several optional brackets and spacers designed to simplify installation in certain applications. These parts can be ordered separately by contacting our sales department. (See figures 17-21 for dimensions and applications.)

8.0 PLANNING THE INSTALLATION

Before starting the installation of the ***MPI PRO-JECTION*** system several things must be decided.

- Mounting location of the fuel pump
- Mounting location of the 10u fuel filter
- Routing of the fuel supply line from the tank, to the filter, to the pump.
- Routing of the high pressure fuel supply line from the pump to 10u fuel filter to the fuel rails on top of the manifold
- Routing of the fuel return line from the pressure regulator to the fuel tank.
- Mounting locations of the power relays and the ECU
- Proper throttle cable installation
- Proper thermostat housing clearance

9.0 REMOVAL OF EXISTING FUEL SYSTEM

1 - Disconnect the ground side of battery.

2 - Drain cooling system

3 - Remove cooling system hoses and thermostat housing.

4 - Drain fuel tank, then disconnect fuel supply line or disconnect fuel supply line and plug the hose.

5 - Disconnect all throttle linkages.

6 - Identify or number the ignition wires. Numbering the ignition wires will help in reconnecting them during MPI system assembly. Remove ignition wires from the coil and spark plugs.

7 - Remove ignition cables and distributor cap as one unit.

8 - Note the position of the rotor and the distributor housing. Mark rotor position on the distributor and mark distributor housing position on the engine block to ensure accurate re-assembly. After marking the position of the rotor and the distributor, remove the distributor.

9 - Loosen all manifold bolts before removal. Remove the manifold bolts.

DANGER! **FROM THIS POINT FORWARD, USE EXTRA CAUTION TO ENSURE NO GASKET MATERIAL, OR OTHER FOREIGN MATTER ENTERS OIL PASSAGES, HEAD PORTS, OR ANY OTHER LOCATION WHERE AN OBSTRUCTION MIGHT CAUSE DAMAGE.**

10 - Remove the existing manifold. If required, remove valve covers.

11 - Remove the mechanical fuel pump and pusher rod and install a mechanical fuel pump block-off plate.

9.1 Preparing the Manifold for Installation

1 - Protect the lifter galley with clean shop rags. Close off the ports by stuffing them with clean shop rags.

WARNING! **Failure to cover the intake opening with a clean towel could result in dirt or debris entering the engine. Dirt or debris in the induction system can cause engine damage which may require a complete engine overhaul.**

2 - Using a gasket scraper, remove gasket material from heads and block. When all loose material is removed, carefully remove the shop rags from the ports, ensuring that no material falls into passages. Using a shop vac, remove all debris from the lifter gallery.

3 - Inspect carefully. Use a flashlight to inspect the interior of all air, oil, and water passages.

4 - Soak a clean shop rag with solvent, and clean all sealing surfaces. Surfaces must be completely clean to ensure a reliable seal between the components and gaskets.

9.2 Installation of *MPI Pro-Jection* Manifold

WARNING! **Use new gaskets. Be sure you are using the proper gasket for your engine, for aluminum manifolds, as recommended by the manufacturer.**

1 - Install the manifold gasket, carefully following the instructions provided by the gasket manufacturer.

2 - Use O_2 sensor compatible RTV (again following manufacturer's instructions) around all ports and water passages.

3 - Carefully position the manifold on the heads, so the bolt holes in the manifold are centered over bolt hoses in the heads.

4 - Hand start bolts, but do not tighten.

NOTE: Because the MPI Projection system is shipped fully assembled, you may need to temporarily remove the fuel rails or other components, to access the center manifold bolts. Refer to Fig 1.

5 - Remove the four bolts which hold the air valve body (1).

6 - Remove the throttle cable bracket.

7 - Lift the map sensor (12) out of the way and let it rest on top of the air valve (1).

8 - Remove air valve (1).

9 - Remove the four bolts holding down the fuel rails (4) and (7) and retrieve the fuel rails with the fuel injectors.

10 - Torque down the manifold bolts as recommended in the engine manual.

NOTE: Consult your engine manual for proper fastener torque, bolt tightening pattern and other manifold installation specifications.

11 - Lubricate the fuel injector top and bottom O-rings and place the injectors in the manifold. Use only lubricant recommended for O-rings or clean mineral motor oil to lubricate the O-rings. Do not use synthetic, animal or vegetable oils.

12 - Loosen the front and back fuel crossover lines (5) and (16).

13 - Carefully push one fuel rail on the fuel injectors being careful in not cutting an O-ring.

WARNING! Damage of the O-ring can cause fuel leakage. A fuel leak may result in a fire or an explosion hazard which could cause serious injury or death.

14 - Once the rail is in position, replace and hand-tighten the fuel rail Allen bolts. Proceed in with the other fuel rail repeating steps 12 and 13.

15 - Replace MAP sensor and throttle cable bracket.

16 - Replace the air valve bolts. Torque to 25 ft. lbs.

17 - Check the front fuel rail cross over tubing. This line may shift during the foregoing operations, so ensure that the line cannot interfere against the manifold runner or the water cross-over. Adjust if necessary.

18 - Install new thermostat housing gasket, replace thermostat housing, replace the coolant hoses and refill the cooling system.

19 - Attach throttle cable.

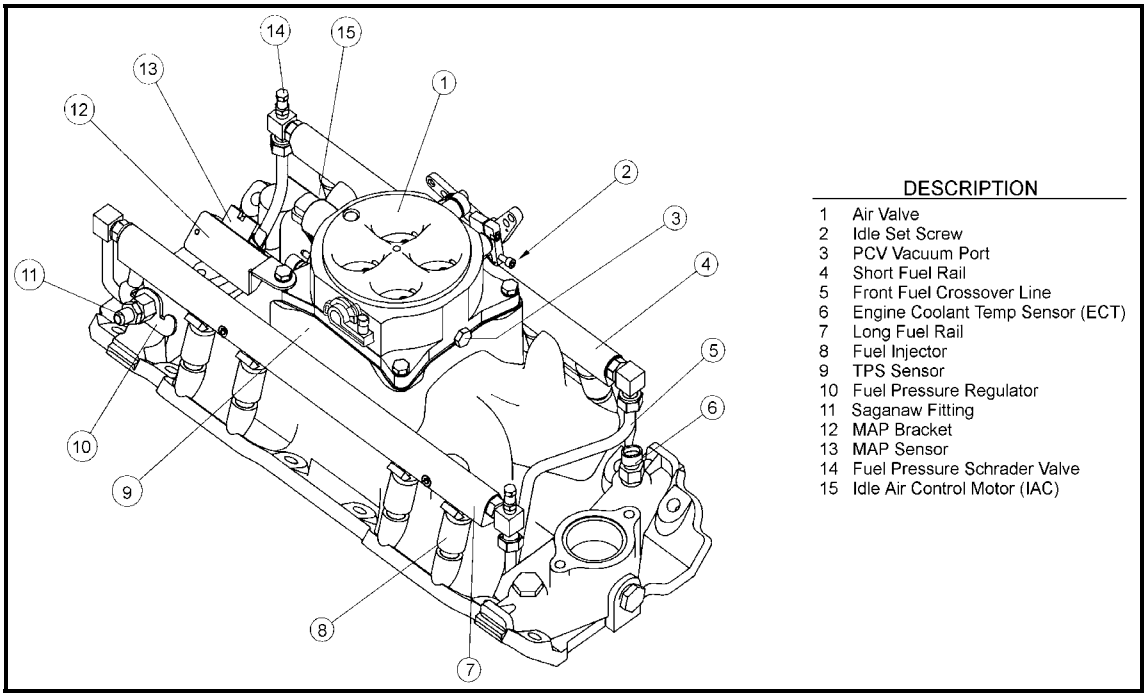


Figure 1

9.3 Installing the distributor

Follow the manufacturer's recommended procedures for the following steps:

1 - Align rotor with marks made during disassembly.

2 - Align distributor housing with marks made on block during disassembly.

3 - Ensure the distributor seats properly against

manifold.

4 - Ensure the distributor shaft is fully engaged in the oil pump.

5 - Bolt the distributor hold down clamp to the manifold.

6 - Replace the distributor cap.

7 - Replace the spark plug wires and check that they are in the correct firing order.

9.4 Vacuum Line Connections

1 - Install vacuum hoses to the appropriate port on the throttle body (See Fig 2). Use the diagrams made during removal of the existing fuel system to locate the correct port. The vacuum ports of the throttle body are labeled in the figure to the right.

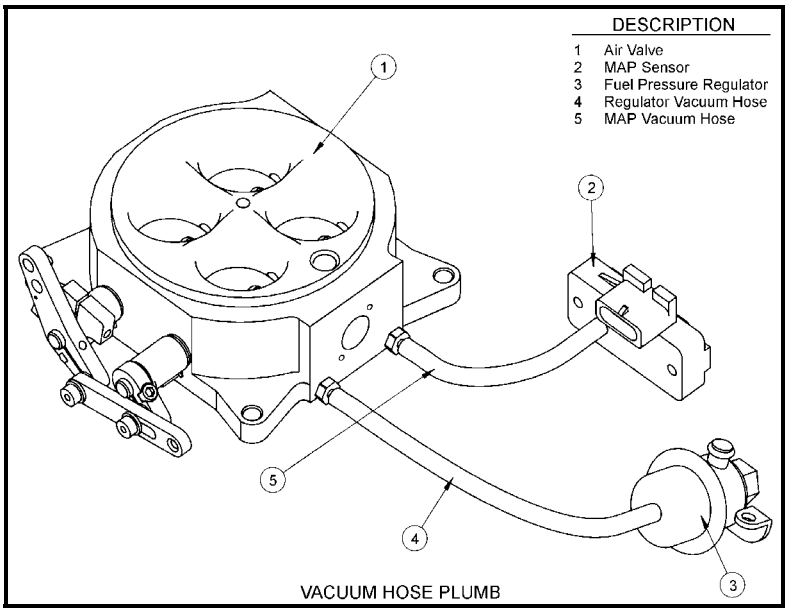


Figure 2

10.0 SUPPLY AND RETURN FUEL SYSTEM INSTALLATION

The MPI fuel system is a fuel metering system based on a time/pressure principle. The longer the injector is open the lager the amount of fuel per fueling event is delivered to the engine. Fuel pressure also plays a direct role in how much fuel is delivered to the engine. The higher the fuel pressure the more fuel is delivered during the fueling event. It is crucial for the proper operation of a high performance MPI system that the fuel system be installed and sized correctly. Unlike a carburetor where low-pressure fuel is delivered at an "as need" rate, the MPI supply system must continuously deliver fuel at the correct high pressure in a volume greater than the engine requires at maximum load. The excess fuel the injectors do not use is returned to the fuel tank. At idle, most of the fuel is returned to the tank, but a wide-open throttle (WOT) under full load nearly all of the fuel is used by the engine and only a small amount is returned to the fuel tank. An improperly installed or sized MPI supply fuel system may deliver enough fuel at low engine speeds but will starve the engine at WOT.

10.1 Fuel Supply/Return System Description

The high pressure fuel supply system consists of the following sub-systems: the fuel pick-up, the 73u fuel pump filter, the high pressure electric fuel pump, the 10u fuel filter and a 3/8" ID fuel line (See Fig.3). The fuel pick-up delivers fuel from the tank to the inlet of the fuel pump filter. From the filter the fuel line supplies filtered fuel to the high pressure pump inlet. The high pressure electric fuel pump delivers pressurized fuel to the 10u fuel filter, which in turn delivers filtered pressurized fuel to the fuel rails, fuel injectors, and the fuel pressure regulator. The function of the regulator is to maintain a constant fuel pressure of 300kPa (43.5psi). The outlet of the regulator returns the excess fuel back to the fuel tank. The kit contains the required hardware for the supply and return system.

10.2 Fuel Pressure Regulator

The function of the fuel pressure regulator is to provide constant fuel pressure for the fuel injectors. Constant fuel pressure is essential to ensure an accurate fuel metering process. The fuel pressure regulator of the system is set to 300kPa (43.5 psi) to match the flow characteristics of the fuel injectors. The pressure regulator is reference to the manifold pressure to ensure the required differential pressure for the metering event. Thus at high manifold vacuum (i.e. idle) the fuel pressure gage will read a fuel pressure that is slightly lower than 300kPa (43.5 psi) because the gage is referenced to atmospheric conditions and not to the intake conditions. The pressure reading at idle will vary with the application as manifold vacuum changes from engine to engine and from application to application.

All fuel injection systems are tuned for optimum engine performance. Every engine needs a proper mix of air and fuel to achieve complete combustion. Complete combustion is achieve when 14.7 parts of air are burnt with one part of fuel on a mass basis. Peak power is achieved at a slightly richer air to fuel mixture while best fuel economy is achieved at a slightly leaner air to fuel mixture. In an event that the application requires more or less fuel, the fuel pressure can be adjusted by turning the vacuum reference fitting. By turning the fitting CW the pressure increases and by turning the fitting CCW the pressure decreases.

NOTE: Increasing the fuel pressure by 50 kpa (7.25 psi) results in an fuel metering increase of about 8%. The same is true when reducing the fuel pressure.

NOTE: Each time the fuel pressure is adjusted, the fueling maps must be retuned. Failure to retune may cause poor fuel economy, rich or lean misfire or engine damage.

DANGER! INCREASING THE FUEL PRESSURE BEYOND THE OPERATING POINT OF THE FUEL PUMP MAY RESULTS IN POOR ENGINE PERFORMANCE AND COULD CAUSE FUEL LEAKAGE ON COMPONENTS THAT ARE NOT RATED FOR EXCESSIVE HIGH FUEL PRESSURES. LEAKAGE OR BURSTING OF FUEL SYSTEM COMPONENTS MAY RESULT IN A FIRE OR EXPLOSION HAZARD WHICH COULD CAUSE SERIOUS INJURY OR DEATH.

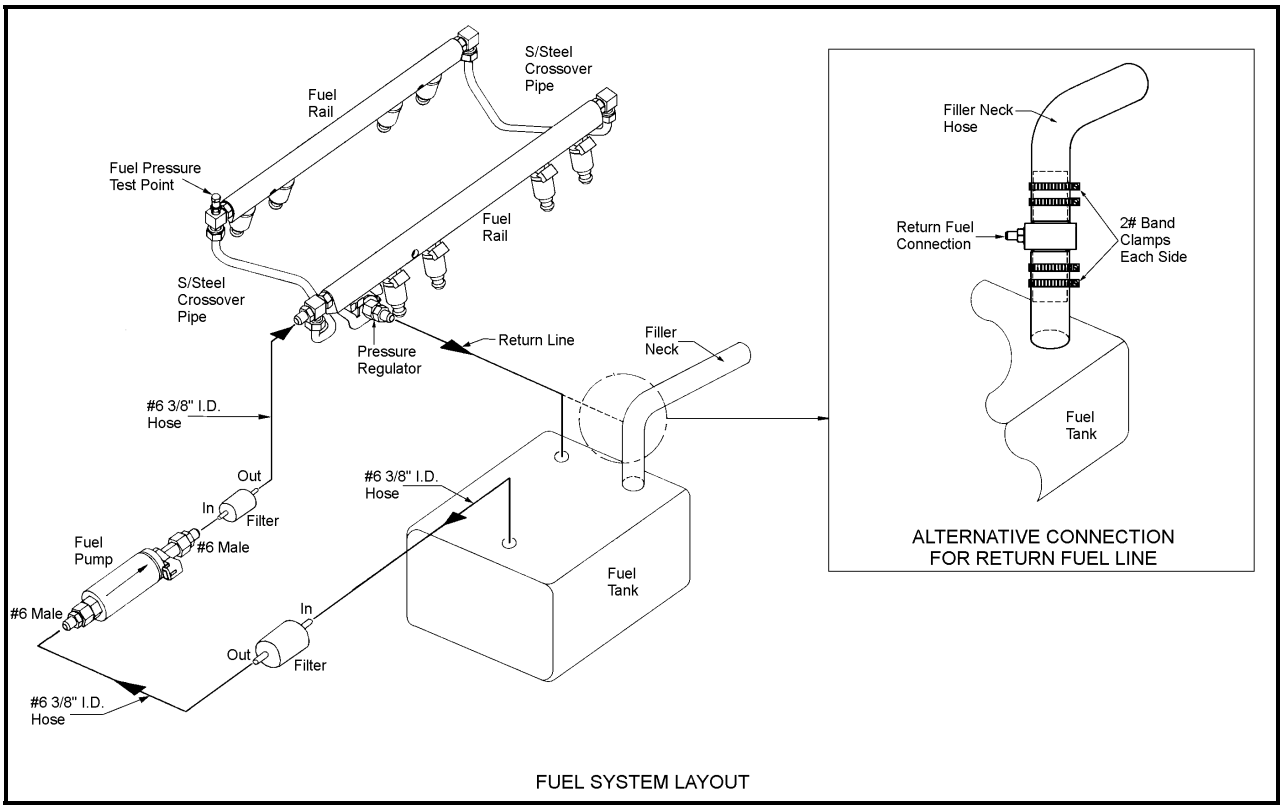


Figure 3

10.3 Fuel Pump

DANGER! NEVER GET UNDER A VEHICLE SUPPORTED ONLY BY A JACK. SERIOUS INJURY OR DEATH CAN RESULT FROM VEHICLES FALLING OFF OF JACKS. BEFORE WORKING UNDERNEATH A VEHICLE, SUPPORT SOLIDLY WITH JACK STANDS.

The ***MPI PRO-JECTION*** fuel pump is a high quality pump that supplies at least 45 gph at 300kPa (43.5psi). The high-pressure fuel pump has limited suction characteristics so it needs to be mounted as low as possible and should be mounted no higher than the top of the fuel tank. The pump can be mounted either horizontally or vertically. When mounting the fuel pump, check to make sure that you have the fuel flow in the correct direction. This may sound like a foolish reminder, but it is a common installation error. To prevent damage to the fuel pump before the fuel system is filled with fuel, drip/spray some light lubricant (such as 10w motor oil) into the inlet side of the pump.

1 - Make sure fuel tank is properly vented.

2 - Mount the electric fuel pump as close to the fuel tank outlet as possible with the bracket provided. Mounting the fuel pump in this manner will insure that the pump will prime easily and purge fuel vapors in the fuel lines to insure faster starts.

DANGER! TAKE PRECAUTIONS TO ENSURE THAT ALL FUEL LINE ROUTINGS ARE AWAY FROM HEAT SOURCES, SUCH AS THE ENGINE, CATALITIC CONVERTER OR EXHAUST PIPES. A FIRE OR EXPLOSION HAZARD COULD CAUSE SERIOUS INJURY OR DEATH.

DANGER! ENSURE THAT THE FUEL PUMP MOUNTING LOCATION WILL NOT INTERFERE WITH ANY UNDER THE VEHICLE COMPONENTS, ESPECIALLY AT THE EXTREME LIMITS OF THE SUSPENSION TRAVEL. A FIRE OR EXPLOSION HAZARD COULD CAUSE SERIOUS INJURY OR DEATH.

3 - Connect the pump to the tank using 3/8” I.D. fuel hose. Connect the outlet of the pump to the steel line which runs to the front of the vehicle with 3/8” I.D. fuel hose, depending on the diameter of the steel fuel line. All fuel hose used must meet SAE J30 performance standards.

10.4 Fuel Line Mounting

All the supplied fuel fittings on the fuel pump, manifold and fuel filter are #6. The fuel line connecting these components should be 3/8" ID or larger.

DANGER! FAILURE TO USE A FUEL HOSE THAT MEETS SAE J30 STANDARDS COULD RESULT IN FUEL LEAKS. A FUEL LEAK MAY RESULT IN A FIRE OR EXPLOSION HAZARD WHICH COULD CAUSE SERIOUS INJURY OR DEATH.

1 - If using existing fuel lines, inspect and replace any hose, clamps, or fuel line showing any sign of aging or does not meet SAE J30 fuel hose specifications. If you are not using existing fuel lines, you will need a fuel line routed to and from the engine compartment and fuel rails. Use a 3/8” steel fuel line available at any auto parts store. All steel fuel line must meet SAE J526 standards.

DANGER! FAILURE TO USE STEEL FUEL LINE THAT MEETS SAE J526 STANDARDS COULD RESULT IN FUEL LEAKS. A FUEL LEAK MAY RESULT IN A FIRE OR EXPLOSION HAZARD WHICH COULD CAUSE SERIOUS INJURY OR DEATH.

DANGER! TAKE PRECAUTIONS TO ENSURE THAT ALL FUEL LINE ROUTINGS ARE AWAY FROM HEAT SOURCES, SUCH AS THE ENGINE, CATALYTIC CONVERTER, OR EXHAUST PIPES. A FIRE OR EXPLOSION HAZARD COULD CAUSE SERIOUS INJURY OR DEATH.

DANGER! RIGID FUEL LINE TUBING SHOULD BE USED FOR UNDER VEHICLE RUNS, SUCH AS ALONG VEHICLE FRAME RAILS OR UNDER FLOOR PANS. FAILURE TO DO SO IS A POTENTIAL FIRE OR EXPLOSION HAZARD, WHICH COULD CAUSE SERIOUS INJURY OR DEATH.

2 - Anchor all fuel lines securely to solid chassis members at 1 ½ foot intervals using rubber coated steel clamps. Use of only approved steel fuel line tubing will afford maximum fuel line protection against road hazards, gravel bombardment and premature wearing due to flexing, temperature extremes, road salt, weather, etc.

10.5 Fuel Filters

WARNING! It is very important the fuel filters have the proper flow capacity, burst pressure rating and filter size. The flow capacity of the filters must at least 60 gallons per hour (gph), and the filter size must be no bigger than 10 microns for the high fuel pressure filter and not bigger than 75 microns for the fuel pump inlet filter. The high-pressure fuel filter should be rated for at least for 150 psi burst pressure.

DANGER! FAILURE TO USE HIGH PRESSURE FUEL FILTER LINE RATED FOR A MINIMUM OF 100 PSI BURST PRESSURE COULD RESULT IN FUEL LEAKS OR BURSTING OF THE FUEL FILTER. A FUEL LEAK MAY RESULT IN A FIRE OR EXPLOSION HAZARD, WHICH COULD CAUSE SERIOUS INJURY OR DEATH.

The fuel filter supplied by Holley meets or exceeds the above specifications. Most filters for carburetor systems and other EFI systems do not.

The fuel pump inlet filter must be plumbed between the fuel tank and the fuel pump. It should be mounted as close to the fuel tank as possible and should be mounted no higher than the top of the fuel tank. The high-pressure fuel filter should be plumbed between the fuel pump and the fuel rail. It should be mounted as close to the fuel rail as possible but should not be mounted above the fuel rail level.

Be careful to ensure the suction part of the fuel system contains no air leaks. Air leaks are caused by holes and/or crevices so small that they will not leak fuel. Just because fuel is not leaking out does not mean air is not leaking in. Common causes of air leaks are not using thread sealing compound on fittings and cracks or holes in fuel lines. Air leaks could potentially cause fuel pump failure and or inadequate fuel supply to the fuel rails.

10.6 Return Line Installation

DANGER! DO NOT USE THE VAPOR CANISTER LINES AS A FUEL RETURN LINE. POSSIBLE FUEL LEAKS MAY CREATE A FIRE OR EXPLOSION HAZARD, CAUSING SERIOUS INJURY OR DEATH.

WARNING! Use only approved steel fuel line. The return fuel line should enter the fuel tank at the “fuel level

sending unit flange" or at the "filler neck". The connection should be made below the flapper valve of the filler neck. The filler neck or sending unit must be removed from the tank to perform this operation.

DANGER! PROPER INSTALLATION OF THE FUEL RETURN LINE MAY REQUIRE THE COMPLETE REMOVAL OF THE FUEL TANK. THIS WORK SHOULD BE DONE BY A FUEL TANK SPECIALIST, WHO REGULARLY DOES THIS WORK AND IS FAMILIAR WITH SAFETY REGULATIONS AND PRECAUTIONS NECESSARY TO DO THIS WORK. IF A PERSON ATTEMPTS THIS WORK WHO IS NOT FAMILIAR WITH THE SAFETY REGULATIONS AND PRECAUTIONS, AN EXPLOSION HAZARD MAY RESULT CAUSING SERIOUS INJURY OR DEATH.

The fuel return line from the fuel pressure regulator must go back to the fuel tank and enter the fuel tank with a fitting that has an internal diameter of at least 3/8".

The #6 fitting on the fuel pressure regulator is internally sealed with an O-ring. This fitting should only be finger tight in the regulator or it will leak.

Returning fuel should be routed back to the tank away from the fuel tank pick-up tube. This will allow air bubbles from the returned fuel to dissipate before they are drawn into the pick-up tube.

There are several options including the following that meet the above criteria for returning the fuel to the fuel tank.

- Use a fitting already in the fuel tank
- Use the vent fitting. Be very careful not to block the fuel vapor from escaping the tank.

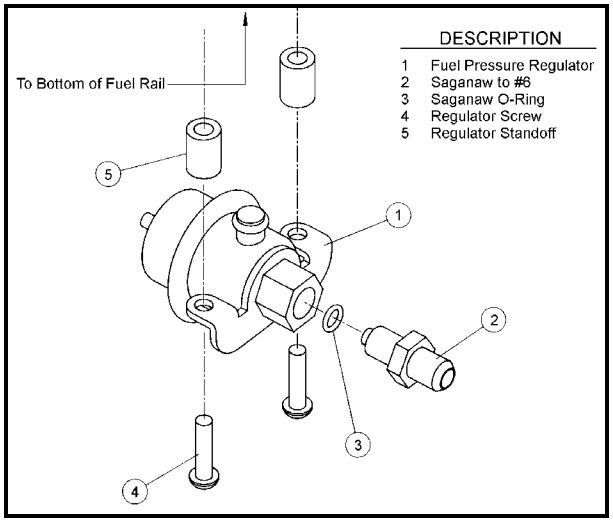


Figure 4

- Route the return line into the filler neck. This can be done by cutting the filler neck, Inserting a welded "T" fitting, and securing the neck with multiple clamps.
- Drill and weld a new fitting into the tank

NOTICE: For best performance of your fuel supply system an in tank pump is recommended. Such an installation can be achieved by either buying a late model fuel tank or have your tank modified by professional companies that install an in-tank pump with the required swirl pods and baffles.

DANGER! MODIFICATIONS TO FUEL TANKS SHOULD BE DONE BY FUEL TANK SPECIALIST, WHO REGULARLY DOES THIS WORK AND IS FAMILIARM SAFETY REGULATIONS AND PRECAUTIONS NECESSARY TO DO THIS WORK. IF A PERSON ATTEMPTS THIS WORK WHO IS NOT FAMILIAR WITH THE SAFETY REGULATIONS AND PRECAUTIONS, AN EXPLOSION HAZARD MAY RESULT CAUSING SERIOUS INJURY OR DEATH.

10.7 Oxygen Sensor Installation

10.7.1 Oxygen Sensor Function, Theory, and Use

The ***MPI PRO-JECTION*** system allows the user to operate their engine in a closed loop fuel management mode using the oxygen sensor. The oxygen sensor monitors the exhaust gases and generates a voltage output signal that corresponds to the fuel/air mixture ratio. The range of voltage output signal from the oxygen sensor is 0.0 to 1.0 volts. A lean fuel/air mixture gives a lower oxygen sensor voltage output signal while a rich fuel/air mixture gives a higher oxygen sensor voltage output signal. The stoichiometric or chemically perfect fuel/air mixture gives an oxygen sensor output of approximately 0.45 volts. The engine ECU reads this output from the oxygen sensor and adjusts the fuel delivery to maintain a stoichiometric fuel/air mixture. Most automobiles, both currently and for the past 15 years, are using oxygen sensors to monitor the engine fuel/air mixture. This is done primarily to improve engine emissions. It also gives the advantage of maintaining a stoichiometric fuel/air mixture under varied operating conditions giving generally better engine performance and fuel economy.

Holley includes oxygen sensor feedback capability with the ***MPI PRO-JECTION*** system and recommends the user to use the oxygen sensor. For most user applications, better performance and fuel economy will be obtained by using the oxygen sensor. In addition, the oxygen sensor can make the tuning process much easier since the user can monitor the ECU functions as it adjusts the fuel to meet a stoichiometric fuel/air mixture.

The user should read paragraph 4 of section 13.3 on engine configuration related concerns to help them determine whether an

oxygen sensor should be used for their engine installation.

10.7.2 Oxygen Sensor Mounting Procedure

NOTE: The oxygen sensor boss should be installed by someone with experience welding exhaust systems. Any competent exhaust shop is able to perform this task at a minimal cost.

WARNING! Use only unleaded fuel when operating an oxygen sensor. Use of leaded fuels will destroy the oxygen sensor and will result in incorrect exhaust gas oxygen-content readings.

WARNING! Use of some RTV silicone sealers will destroy the oxygen sensor used with this product. Ensure the RTV silicone sealant you use is compatible with oxygen sensor vehicles. This information should be found on the oxygen sensor package.

1 - Locate a position for the oxygen sensor as close to the engine as possible. If your vehicle has catalytic converters, the oxygen sensor MUST be located between the engine and the catalytic converters. Good locations are in the drop pipe, or in the ""Y" pipe on single exhaust systems. Pick a location that allows easy installation of the oxygen sensor, but will protect the sensor from road hazards.

2 - Drill a 7/8" hole in the location picked for the sensor. Weld the threaded boss into the 7/8" hole. An old spark plug with matching threads will avoid thread damage during the welding process. Weld all the way around the boss to insure a leak proof connection. Install the oxygen sensor into the threaded boss and tighten securely. It is a good idea to add anti-seize to the threads to aid in removal.

3 - On vehicles equipped with an AIR pump, the oxygen sensor must be mounted before the AIR injection into the exhaust, or the AIR pump must be disconnected. Holley recommends that if the AIR is injected into both exhaust manifolds, mount the oxygen sensor into the pipe immediately after the exhaust manifold. Disconnect the AIR pump tube from the exhaust manifold and plug both ends. Check with local ordinances for the legality of this procedure in your area.

WARNING! Failure to disconnect the AIR pump or locating the oxygen sensor downstream from AIR injection will result in an extremely rich mixture which could cause driveability problems and severe engine damage.

10.8 Electronic Control Unit (ECU) Mounting

1 - Pick a suitable location outside of the engine compartment but in a dry area for mounting of the Electronic Control Unit (ECU), preferable in the passenger compartment. Check for sufficient length of the wiring harness and clearance for connectors before mounting ECU.

WARNING! Do not mount the ECU in the engine compartment or in an area exposed to the elements of weather or areas that can get wet during use. The ECU is not designed for an environment with significant amounts of heat or moisture. Premature failure of the ECU will result.

WARNING! Before drilling, check both sides of the bulkhead for possible interference with electrical systems, etc. Failure to do so can result in damage to one of the vehicle systems.

2 - Drill 4 pilot holes using the ECU as a template.

3 - Use the 4 short self tapping screws provided to securely mount the ECU.

10.9 Engine Wiring Harness

1 - At a location near the ECU mounting, pick a suitable location on the engine compartment bulkhead/firewall for the wiring harness to pass through. A 2" diameter hole will be required for the wiring harness. Check both sides of the bulkhead/firewall for interference.

WARNING! Before drilling, check both sides of the bulkhead/firewall for possible interference with electrical systems, etc. Failure to do so can result in damage to one of the vehicle systems.

2 - Use a 2" hole saw, available at any hardware store, or a punch out tool to cut through the bulkhead/firewall as necessary.

3 - Feed the wiring harness from the location of the ECU to the engine compartment. Check to ensure sufficient length of harness is available for attaching to the ECU.

4 - Slit the 2” grommet provided and position around the wiring harness. Slip the grommet into the 2” hole to prevent the wiring harness from chaffing. A light application of WD-40 on the grommet will ease the installation.

5 - Connect the wiring harness to the ECU. Push the plug into the ECU until the lock snaps into position.

11.0 ELECTRICAL CONNECTIONS

An electrical diagram is provided for reference during connection of electrical components. This diagram shows the connectors included with the wiring harness and table shows the color codes and connections for all of the loose wires without connectors. See page 32 for the wiring harness diagram.

LOOSE WIRE COLOR AND DESCRIPTION	*WIRE CONNECTION LOCATION*
Black	Ground connection
Red with fuse	12 Volt - attach to t battery
Red/White	Switched ignition wire, positive side of the coil
Yellow	Ignition/tachometer wire, negative side of the coil - factory ignition only
Orange/Red	Oil pressure switch wire
Yellow/Black	Ignition/tachometer wire, aftermarket ignition only

WARNING! **Keep all wires away from hot exhaust components. Bare or frayed wires can result in electrical short circuits which can cause system or vehicle damage, or a fire hazard resulting in property damage, serious injury and/or death.**

11.1 Air Charge Temperature Sensor

Locate the 2 wire flat connector with BLUE and BLACK/WHITE wires. This is the wire set that is bundled with the injector connector. Plug this connector into the air charge temperature sensor on the throttle body.

11.2 Coolant Temperature Sensor

Locate the 2 wire flat connector with BROWN and BLACK/WHITE wires. Plug this connector into the coolant temperature sensor mounted earlier.

11.3 Throttle Position Sensor

Locate the 3 wire flat connector with BLACK/WHITE, GREEN, and ORANGE wires. Plug this connector into the throttle position sensor located on the throttle body.

11.4 Idle Air Control (IAC) Motor

Locate the 4 wire flat connector with the PURPLE wires. Plug this connector into the mating connector on the throttle body.

11.5 Injectors

Locate two bundles with four square injector connectors in each. One bundle will contain four connectors with RED and WHITE wires and the other will contain four connectors with RED and BLUE wires. These wires should be routed underneath the independent runners of the manifold. One bundle should connect to the injectors on the right side of the engine and the other bundle should connect to the injectors on the left side of the engine. Plug the connectors into the female mating connector of the injectors.

11.6 Manifold Absolute Pressure (MAP) Sensor

Locate the 3 wire flat connector with the following color wires: BLACK/WHITE, ORANGE, AND RED/BLACK. Plug this connector into the MAP sensor.

11.7 Oxygen Sensor

Locate the 3 wire flat connector with RED, BLACK, and WHITE wires. Feed this harness to the exhaust manifold area where the oxygen sensor is located. Plug the 3 wire flat connector into the mating connector on the oxygen sensor.

11.8 Fuel Pump

Locate the single GREEN/BLACK wire at the fuel pump relay. Feed this wire down through the engine compartment to the underside of the vehicle. Route the GREEN/BLACK wire to the fuel pump. Connect the fuel pump pigtail connector to the fuel pump. Crimp an insulated female spade terminal on the GREEN/BLACK wire and securely fasten to the RED wire (+) of the fuel pump pigtail connector.

Crimp an insulated male spade terminal on a length of BLACK or GREEN wire and securely fasten it to the GREEN wire of the fuel pump pigtail connector. Fasten the remaining end to a suitable ground connection under the vehicle using the appropriate ring terminals. Improper ground connection will result in the failure of the fuel pump to function properly, creating driveability problems. Securely fasten all wires with the supplied cable ties along the frame rails of the vehicle.

WARNING! **Keep all wires away from hot, moving parts or exposure to road debris. Bare or frayed wires can result in electrical short circuits which can cause system or vehicle damage.**

11.9 Fuel Pump and System Power Relays

1 - Two relays are provided in the kit. One relay is for the ECU system power and the other controls the fuel pump. Locate a suitable position on or near the engine compartment. Make sure that the wiring harness lengths will work with the location chosen for the relays.

2 - Mark the location of the mounting holes. Drill two holes for mounting the relays.

WARNING! **Before drilling, check both sides of the bulkhead for possible interference with electrical systems, etc. Failure to do so can result in damage to one of the boat systems.**

3 - Mount the relays with the remaining 2 short self tapping screws provided, being careful not to over tighten.

4 - Locate the power relay connector and the fuel pump relay connector on the wiring harness. The connectors are rectangular in shape and identical in appearance. Connect the connector plugs to the relays.

11.10 System Power

Using the assorted connector package and a terminal crimping tool, assemble and connect the wiring as follows:

A - BLACK wire (ground) - Install suitable connector and attach to a good ground. Make sure that the wire is connected to ground in an area free of paint, dirt or rust. Poor grounds cause many electrical system problems.

B - RED wire with fuse (12 volt) - Install suitable connector and attach to battery. Make sure that 12 volt connections make good connection and use good quality connectors. Voltage drop due to poor connection can cause electrical system problems.

C - RED/WHITE (switched ignition) - Install suitable connector and attach to (+) terminal of coil, or a switched ignition volt power source.

NOTE: If you use a switched ignition power source, make sure the power source remains energized when the key is in the crank position.

WARNING! **Do not connect to coil positive (+) side if using a capacitive discharge ignition**

11.11 Tachometer/Ignition

YELLOW wire (ignition) - For stock ignition systems only, install a suitable terminal to the yellow wire in the harness and attach to the (-) side of the ignition coil.

YELLOW/BLACK - For EST(Ford) and TFI (GM) ignition, install a suitable terminal to the yellow wire in the harness and attach to the (-) side of the ignition coil.

NOTE: If you are using an aftermarket ignition, connect the YELLOW/BLACK wire from the distributor connector to the ignition system's tach output.

11.12 Oil Pressure Switch

On engines with a single-wire oil pressure switch, connect the ORANGE/RED wire to the single oil pressure switch wire. This will not allow the engine speed to go above 2500 RPM in the event of an oil pressure problem. The vehicle can be moved slowly to a safe location.

NOTE: This feature will not work with vehicles equipped with an oil pressure gauge. An oil pressure switch can be purchased and installed in the oil circuit should the user desire this feature.

12.0 MECHANICAL CHECKOUT BEFORE STARTING ENGINE

Before starting engine, review and check off the following items:

- ☐ Are electrical connections correct?
- ☐ Are all fuel lines hooked up and correct?
- ☐ Is throttle linkage hooked up?
- ☐ Have fuel lines been leak checked?
- ☐ Are all vacuum hoses connected?
- ☐ Are all sensors installed and hooked up properly?

1 - Reconnect the battery.

2 - Install fuse in the fuse holder on the wiring harness. Before attempting to start the engine, perform the following to ensure that the system is properly connected:

3 - While listening carefully, turn the key to the RUN position. The fuel pump will turn on and run for a few seconds before being shut off by the ECU. This shutoff occurs when the key is in the run position and the ECU does not receive any engine speed signal. At the first startup of the system after installation when the fuel system is dry, the fuel pump may need to run longer than a few seconds. This may require additional cranking time to get fuel to the fuel injectors. A fuel pressure gauge in the fuel supply line is an excellent way to tell whether the system is getting fuel. **DO NOT** crank the engine for more than 15 seconds at a time and always allow adequate starter cool-down time between cranking.

4 - Make sure that there is no leakage from any fuel lines when the fuel system has been pressurized. With the air cleaner removed, activate the throttle control to wide open once while listening for injector operation. The injectors will buzz momentarily and fuel will spray from all 8 injectors.

5 - Ensure that all vacuum and port connections have been plugged or made. Now install the air cleaner.

DANGER! MOVE THE THROTTLE INTO LINKAGE INTO WIDE OPEN CONDITION AND CHECK THAT IT DOES NOT INTERFERE WITH AIR CLEANER OR OTHER COMPONENTS OF THE ENGINE AND MAKE SURE THAT IT RETURNS FREELY TO IDLE CONDITION WHEN RELEASED. THROTTLE RETURN ACTION CAN BE ENHANCED BY ADDING ADDITIONAL SPRINGS THAT PULL THE THROTTLE INTO CLOSED CONDITIONS. FAILURE OF TESTING THROTTLE ACTUATION PERFORMANCE MAY CAUSE UNSAFE DRIVING CONDITIONS, WHICH COULD CAUSE SERIOUS INJURY OR DEATH.

6 - Use the software to monitor some of the system parameters prior to engine startup. The monitor feature can find and correct many potential installation problems before starting the engine. For first time users, you may need to read section 14.0 for a description of the ***MPI PRO-JECTION*** system software. Turn the ignition on and connect the PC to the ***MPI PRO-JECTION*** wiring harness. Change to the monitor screen and monitor the data as shown in figure 4. The Mode should be shown as idle. As the throttle is slowly opened, the mode should change from idle to run to full and wide open throttle. The TPS should be reading 29-31 at closed throttle conditions. If the TPS is not in this range, the user must adjust the TPS as outlined in section 18.3. However, the user should be aware this value will probably change and will have to be readjusted after the final idle stop settings have been made in section 14.6 paragraph 7. Check the MAP sensor readings without the engine running. Read section 18.2 for a description of the MAP sensor readings. Both the air temperature and the engine temperature should be checked and should be very close to ambient temperatures. The battery voltage should reflect the actual battery voltage or 12.5-13.5 volts. If any of these parameters or other parameters are not reading properly, the installation should be double checked for that particular sensor. Refer to the troubleshooting help in section 17.0 for additional assistance.

13.0 PRO-JECTION SYSTEM TUNING THEORY AND PHILOSOPHY

13.1 Tuning Goals

The purpose of the Tuning Goals section of this manual is not to give step by step details on how the actual tuning process

is done, but to have the user start thinking about the conceptual process that they are about to begin during tuning of the ***MPI PRO-JECTION*** System.

In general, the goal of the tuning process should be to develop a fuel map that corresponds to a slightly "richer than stoichiometric" (or chemically perfect) fuel mixture. It is preferable to run the engine slightly rich particularly at high throttle settings. Significant engine damage can occur quickly from overheating inside the cylinders, if extended running is done at a high throttle position and with a lean fuel mixture. Many engines will make slightly more power running at a slightly lean condition but the user should be discouraged from running at this condition. Holley engineers have found that the best engine performance can be felt in a “band” around the optimum fuel mixture. A minimum amount of performance difference can be found within the extremes of this band and Holley recommends that the user tune to the rich side of this band. This will generally result in a slightly rich map (around 10-20%) that will give very good performance without sacrificing performance, economy, driveability, or engine durability.

13.2 Oxygen Sensor Effect on Performance

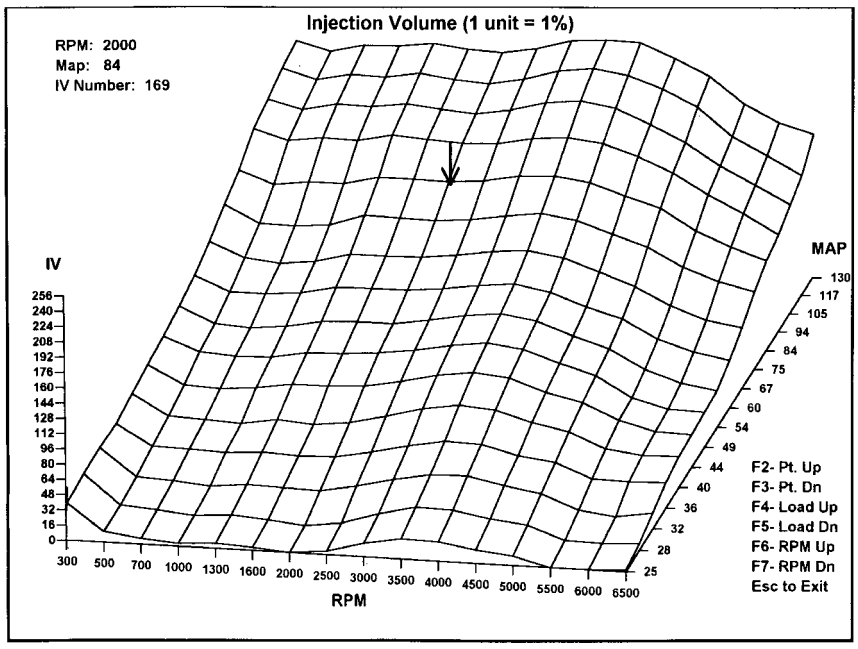
For some users, it may seem like a waste of fuel to map the system richer than stoichiometric. For those users who may be running a fairly stock engine and are interested in fuel economy, they should keep in mind that running a system in closed loop (relying primarily on oxygen sensor-fuel mixture feedback) will safely adjust all part-throttle operation back to stoichiometric.

Therefore, the ***MPI PRO-JECTION*** systems will give optimum fuel economy during normal engine operation. However, any of the ***MPI PRO-JECTION*** systems will revert to open loop operation at wide open throttle settings which rely on the users fuel tuning process. With this in mind, at high throttle settings, the system needs to be tuned richer than stoichiometric.

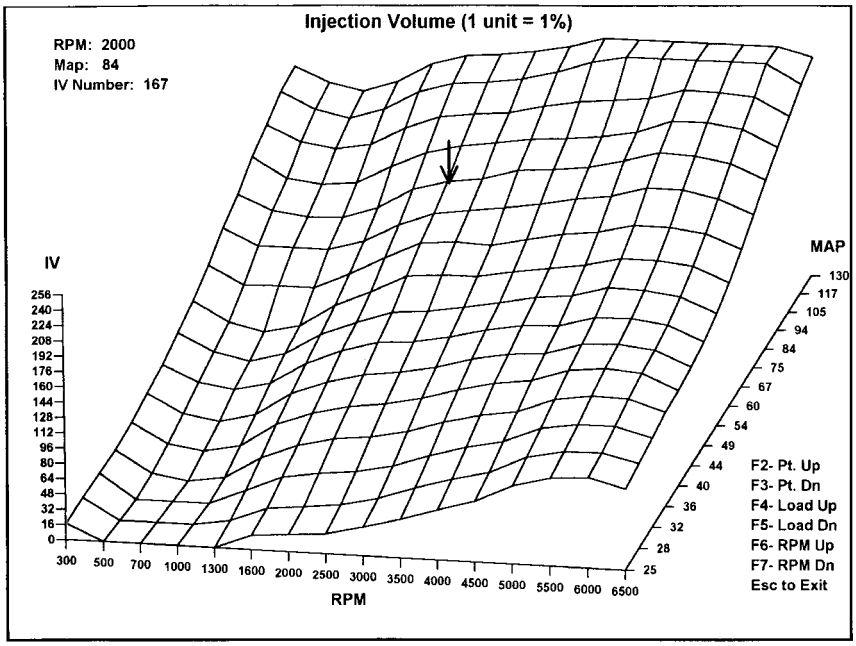
13.3 Engine Configuration Related Concerns

The Holley ***MPI PRO-JECTION*** systems have been designed to provide the versatility needed to be custom tailored to most any applications and will provide very good performance for a variety of engine sizes and engine types. In addition, the user can make the tuning process much easier and understandable by knowing a little about their engine and understanding how the fuel system delivery interacts with their engine requirements.

The system allows the user to custom tune the engine fuel curve to match the engine requirements. The system allows the user to visually see the Injection Volume fuel map using Holley software and a PC connected to the ***MPI PRO-JECTION*** ECU. An example of this Injection Volume fuel map is shown below. The user should notice that the fuel delivery will generally increase steadily as the MAP Pressure (or engine load) increases or vacuum decreases. This can be seen by looking at a particular engine speed on the graph and following that same engine speed line in the direction of increasing MAP Pressure. The increase in this direction at a given speed will be fairly linear or be a fairly smooth straight line that is always increasing. However, the fuel map curve looks very different when looking at constant map pressure values and looking across increasing speed values. The fuel curve in this direction will generally steadily increase to a peak and start to drop off above some speed. In the example figure, this speed of peak fuel injection amount is approximately 3500 RPM. The peak Injection Volume amount will correspond to the engine speed where maximum torque is developed or in more technical terms, the peak engine volumetric efficiency.



For an additional example, a higher performance engine with a torque peak at 5000 RPM would have a curve that would peak very close to 5000 RPM. See the figure below for an example of a fuel map for a moderately built 502 cubic inch Chevrolet engine. By having a fairly good idea of what the torque curve of the particular engine the system is being installed on, the user can better custom tailor the Injection Volume curve in the increasing engine speed direction to match the fuel requirements of their engine.



These fuel injection systems use an oxygen sensor feedback system. With these systems, most users can obtain excellent fuel economy along with good driveability and performance. The purpose and nature of the oxygen sensor is to maintain the fuel system delivery in a range very close to a stoichiometric mixture. In addition, the ***MPI PRO-JECTION*** system allows some degree of adjustment from stoichiometric fuel/air mixtures. This system works very well on stock or near stock engines. However, Holley engineers have found that some engines, typically very high specific output engines, may require a richer than stoichiometric fuel/air mixture to run properly. These engines may need more fuel due to the fact that fuel is lost from the intake track to the exhaust track during valve overlap periods when using a high lift cam with high overlap profiles. Since this type of engine may require a richer stoichiometric fuel mixture than what the oxygen sensor will control to, these engines may run best in open loop mode. The user may find that best performance of their vehicle will be obtained by using the oxygen sensor to tune the engine slightly richer than stoichiometric and then making settings in the software or disconnecting the oxygen sensor to allow the engine to run in open loop. This should only be necessary in the case where an engine has been custom built by a high performance engine builder.

14.0 GETTING STARTED TUNING AND PROGRAMMING

14.1 Software Installation and Software Operational Description

An IBM compatible personal computer (preferably a laptop for portability) with EGA (or better) monitor is required for adjustment with the ***Di*** system. The PC must have DOS level 6.0 or Windows 3.1 or Windows 95 to run the Holley software package. The software is not designed to use a mouse with the DOS and Windows 3.1 Versions, but will run with Windows 95. The Holley software package allows modification of the Spark Advance, Oxygen Trigger Voltage, Idle RPM Parameters, Temperature Compensation tables, and the complete fuel map.

NOTE: Read through the entire **tuning and adjustment** portion of the manual before attempting to modify any maps.

DANGER! HAVE AN ASSISTANT TO MONITOR THE SOFTWARE PACKAGE OR TO OPERATE THE VEHICLE DURING TUNING AND ADJUSTMENT. FAILURE TO KEEP A SAFE DISTANCE FROM OTHER VEHICLES AND FOLLOW ALL SAFETY PRECAUTIONS. LAWS, RULES AND REGULATIONS CAN LEAD TO PROPERTY DAMAGE, SERIOUS INJURY AND/OR DEATH!

14.1.1 Windows 95

1 - Insert disk **1** of **4** labeled for **Windows 95**.

2 - Select the **START** menu at the bottom left hand area of the computer screen.

3 - On the pop up menu select **RUN**.

4 - Type **A:\SETUP.EXE** in the command line box and click **OK**. This will begin the installation of the software. Follow the on-screen information.

14.1.2 Windows 3.1

1 - Insert Disk labeled for **Windows 3.1** and **DOS** into the floppy drive. Type **SETUP A: or(B:) C: EEV30** and press **Enter**. You may substitute another drive for "C:" which is the destination drive. You may substitute another directory name for EEV30. When the DOS portion of the installation is completed, exit the DOS session.

2 - From the **Window Program Manager** menu: Select **File**. Select **New**. On the **New Program Object** dialog box Select the **Program Group Radio Button**. Click the **OK** button.

3 - On the Program Group Properties dialog box: For **Description** type **Holley EEV 3.0**. For the **Group File** type **EEV**. Click the **OK** button.

4 - From the Windows Program Manger menu: Select **File**. Select **New**. Click the **OK** button. On the **New Program Object** dialog box select the **Program Item Radio Button**. Click the **OK** button.

5 - On the **Program Item Properties** dialog box: For Description type **EEV 3.0**. For Command Line type the **Drive**, **Directory** and **EEV30WIN.EXE**. If you installed the software on the **C:** drive in the **EEV30** directory then you would type **C:\EEV30\EEV30WIN.EXE**. For Working Directory type the **Drive** and **Directory** where the software was installed. For **Shortcut** Key leave **None**.

6 - Click the **Change Icon** button. Click **Ok** button on the message box that comes up. On **the Change Icon** dialog box, click the **Browse** button. On the Browse dialog box: For **Drives** select the **Drive** onto which you installed the software. For **Directories** select the **Directory** into which you installed the software. For **File Name** click on the **HOLLEY.ICO** file. Click the **OK** button.

7 - On the **Change Icon** dialog box: Click the **OK** button.

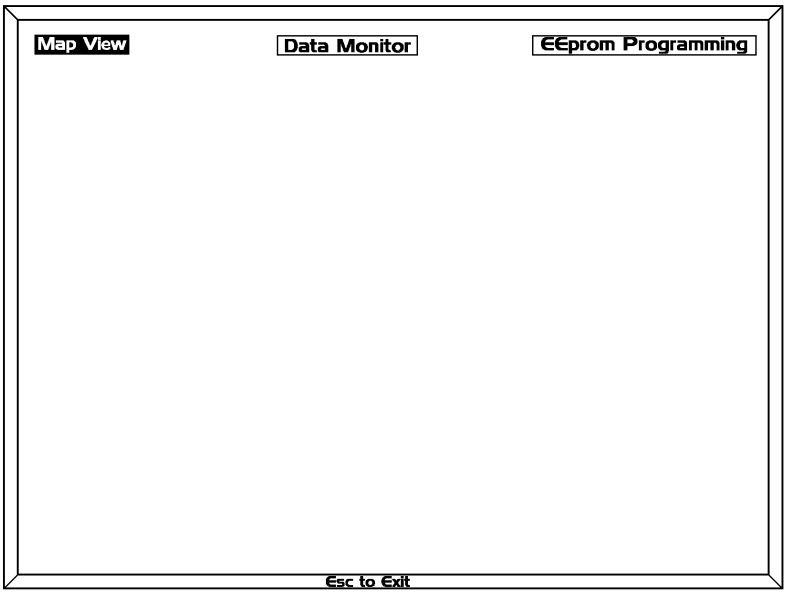
8 - On **the Program Item Properties** dialog box: Click the **OK** button.

14.1.3 DOS Installation

Insert disk labeled for **Windows 3.1** and **DOS** into the floppy drive. Type **Install A:(or B:) C: EEV30** and press **Enter**. You may substitute another drive for "C:", which is the destination drive. You may substitute another directory name for EEV30. When the DOS portion of the installation is completed, you can start the program by typing **EEV** and pressing the **Enter** key

This software is comprised of three development tools: Mapview, Data Monitor, and EEprom Programming. Mapview displays the main Injection Volume map and is used while the engine is running. Data Monitor provides system information while the engine is running. EEprom Programming allows modification of the fuel and spark values used by the ECU.

The first screen you will enter will look like the following:



14.2 Mapview

Once the ECU is connected and the engine is running, Mapview can be selected from the main menu. If the PC is connected correctly and the ECU is active, the Injection Volume map will be displayed in graphical form.

The displayed graph shows the Injection Volume curve. The X (horizontal) axis of the graph is engine RPM. The Y (vertical) axis is manifold pressure in kPa. A moving pointer indicates the current operating point of the running engine. As RPM increases, the pointer will move to the right. As the load increases, the pointer will move towards the top of the graph. When changes are made to the Injection Volume map, either with the calibration module or EEprom programmer, they are displayed in Mapview.

Press the “Esc” key to exit from Mapview.

14.3 Data Monitor

The Data Monitor program requires that the ECU be active and connected to the PC. This program displays the sensor values and operating parameters in text form.

NOTE: If your screen displays the following message: *“Data Transmission Error!! Trying to fix Error!!”* Make sure that the key has been turned on, the ECU is getting power, and check to make that there is not a loose connection between the ECU and the PC. This message may display occasionally due to the communication speed difference between the laptop and the ECU.

This information can be used to troubleshoot the system installation. In the event that the engine temperature, air charge temperature, manifold pressure, or throttle sensors are faulty or disconnected, the Data Monitor software will display “BAD” next to the sensor name. If the sensor is operational, the value received by the ECU will be displayed.

The Injection Volume, after Oxy Comp, will be displayed. This is in conjunction with the injector opening duration. Also displayed is the amount of compensation due to the oxygen sensor feedback signal.

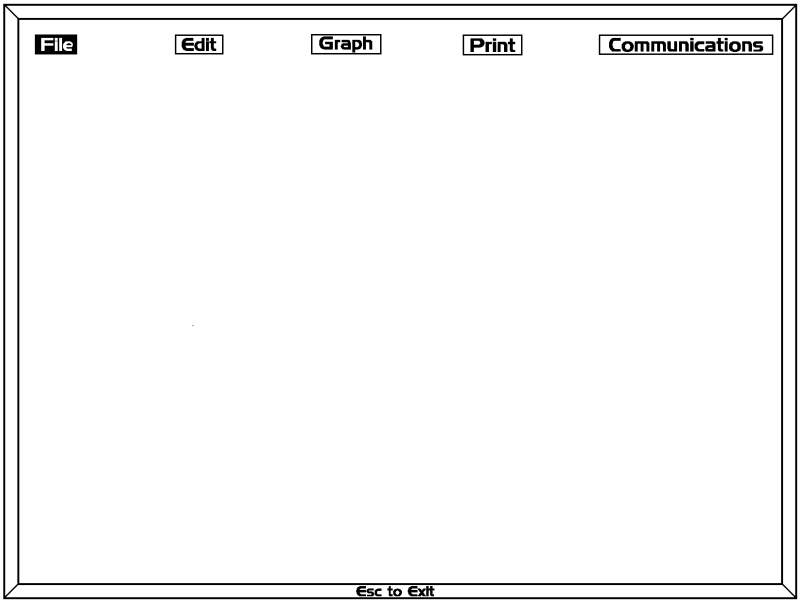
When the Ignition control function is utilized, the Ignition Type and Spark Advance will be displayed.

Calibration module values, if saved, will be displayed across the bottom of the monitor.

Press the “Esc” key to exit Data Monitor.

14.4 EEPROM Programming

This package provides extensive adjustability to the operating parameters of the ECU. Again, in order to use this package, the ECU must be active, and connected to the PC with the ignition key on. Select EEprom Programming. If “EEprom programming” is chosen, the PC screen should appear like the following:



14.4.1 File

If “File” is chosen, the following pull down menu will appear revealing the following commands on the PC screen:

1 - Load Map - Use this selection to load a previously saved Map from the hard drive of the PC to the ECU.

2 - Save Map - Use this selection to save a Map on the hard drive of the PC.

3 - Retrieve ECU Map - Use this selection to retrieve the current Map from the ECU to the PC. The key must be in the “On” position and the PC connected to the ECU.

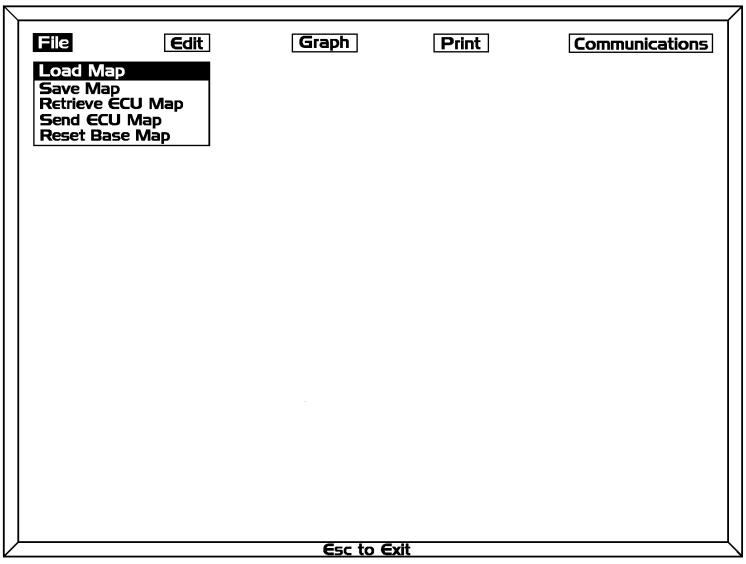
4 - Send ECU Map - Use this selection to send the current Map on the PC to the ECU. The key must be in the “On” position and the PC connected to the ECU.

5 - Reset Base Map - This selection resets the ECU to the settings programmed at the factory. The key must be in the “On” position and the PC connected to the ECU.

NOTE: A map must be loaded or retrieved into the “EEprom Programming” program before modifications can be made.

NOTE: Map modifications can be made with the PC not connected to the ECU. The PC must be connected to the ECU to monitor, retrieve, or send information.

WARNING! Any modifications made to the engine maps should be made with the vehicle stopped in a safe location. Changes made while the vehicle is in motion could result in a loss of power causing an accident resulting in property damage, personal injury and/or death.



14.4.2 Edit

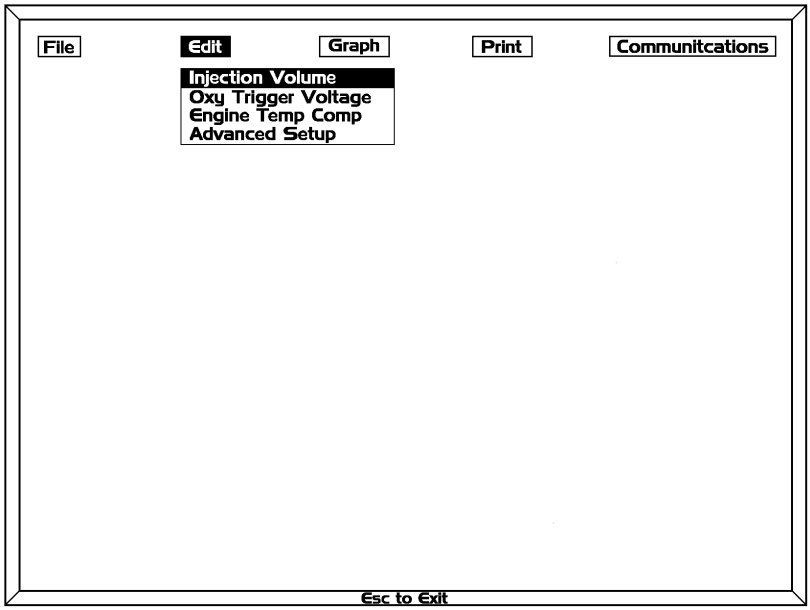
If “Edit” is chosen, the following pull down menu will appear revealing the following commands on the PC screen:

1 - Injection Volume - Use this selection to modify the loaded map Injection Volume. There are 256 fuel map points that can be modified. Move the highlighted cursor to the area you wish to modify and type in the new injection volume value. Do not enter “0” for any value on this map.

2 - Oxy Trigger Voltage - Use this selection to modify the loaded maps Oxygen Trigger Voltage. The Trigger Voltage will determine the air/fuel ratio your engine operates at. The 5 regions that can be adjusted are: idle, low throttle, part throttle, mid throttle and high throttle. A value of 55 is equivalent to 0.55 volts or a stoichiometric fuel/air mixture. NOTE: The values programmed at Holley allow for a slightly lean mixture at light cruise, and a slightly rich mixture at higher throttle applications. A maximum Oxy Trigger Value of 80 or 0.8 volts which corresponds to a slightly rich mixture can be entered into the map. The Oxygen Trigger Voltage has a relatively minor effect on the fuel/air ratio and therefore it should not be necessary to change these values. Press “Esc” to exit.

Approximate Air/Fuel ratio at given oxygen trigger voltage	
Oxy Trigger Voltage	**Air/Fuel Ratio**
.8	13.2
.75	13.9
.70	14.1
.65	14.2
.6	14.3
.55	14.35
.5	14.4
.35	14.45
.2	14.5
.15	14.6
.1	14.7
.05	15.7

3 - Engine Temp Comp - Use this selection to aid in engine warm-up. This table adds additional fuel to the Injection Volume map during warm-up to help driveability. If your engine is running rich during warm-up, decrease the values at the engine temperature (as determined in Data Monitor) at which the richness occurs. Conversely, if the engine is lean, increase the value. Press “Esc” to exit.



4 - Advanced Setup - Use this selection for the following modifications:

A - RPM scale - To modify the RPM scale, enter the appropriate values under RPM scale, then press “enter”.

B - MAP Scale - To modify the MAP scale, enter the appropriate values under MAP scale, then press “enter”

C - Idle Air Delay - This acts as a delay for closing of the idle speed motor much in the same way that a throttle stop dashpot would work on a carburetor. A higher unit value results in a longer idle air delay. Programmable from 0 to 255. A value of 0 results in no delay, a value of 100 results in a one second delay, and a value of 255 results in a 2.5 second delay.

D - Idle Air Integrator - This value changes the response speed of the IAC motor system. A higher unit value results in faster IAC response.

E - Closed Loop Activation Temp - This is the engine coolant temperature that the ECU will start using the oxygen sensor for adjusting fuel delivery or to go into closed loop operation. If this was set too low or the engine goes into closed loop too soon, adjust the closed loop activation temperature.

F - Rev Limit - Use this field to specify the rev limiter for your engine. Type in the required value and press “enter”.

G - Desired idle - Use this field to specify the desired idle speed of your engine. Type in the required value and press “enter”.

H - Duration offset - This value is preset to 55 units. Changing this value results in the same effect as adjusting the Main Jet knob on the calibration module (or changing the main jets in a carburetor). To add 10% additional fuel at all points, type in 65 (55+10). To reduce fuel by 10%, type in 45 (55-10). After typing in the required value, press “enter”.

I - Decel Wait - If the engine speed is over 2500 RPM and the throttle is released, the fuel to the injectors is cut off to increase mileage and improve emissions. Choose the desired fuel shut off delay, 0, 1.5, 3 seconds, or DISABLED, by pressing “F3” until the desired delay appears on the screen and press “enter”.

J - Ignition type - Either “Holley”, “Ford” or “GM” ignition type will be displayed. Select your ignition type by pressing “F2” until the desired type is displayed, then press “enter”.

K - Select number of cylinders - Using F4, select the number of cylinders for your application.

L - Percent (%) IAC opening - This value represents the percentage of IAC opening based upon throttle opening during the throttle follower routine. A value of 0 would disable the throttle follower routine, a value of 50 allows the IAC to open to ½ of it’s travel when the throttle is fully opened, and a value of 100 allows the IAC to fully open when the throttle is fully opened.

M - Minimum cold IAC Position - This value, programmable from 0 - 200, is the minimum position of the IAC motor during cold start up to cold loop activation temperature.

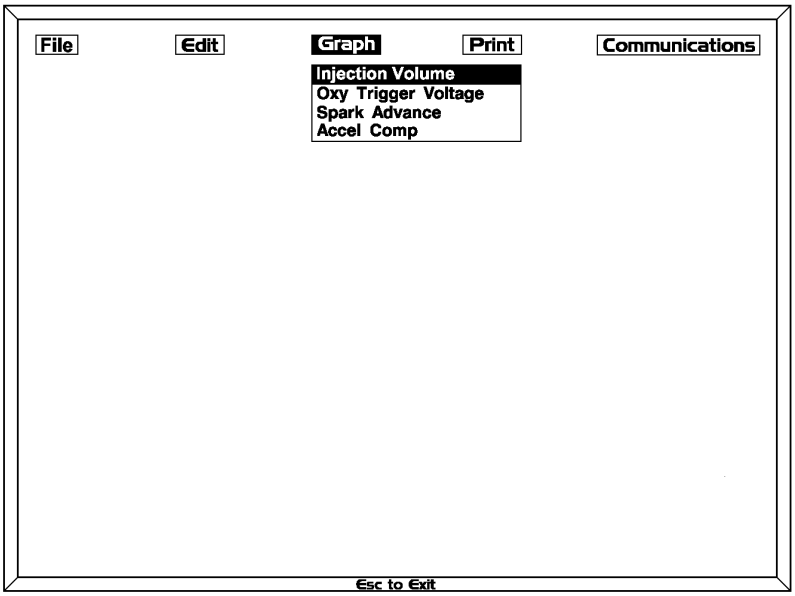
N - Decel IAC Position - Position IAC motor travels to during decel. Holds idle speed up slightly to prevent excess emissions and stalling. Programmable from 0 - 200.

O - Open loop throttle trigger - Programmable value at which the system enters open loop. Value corresponds to the throttle angle as seen on the Data Monitor screen. Programmable from 0-255. A value of 255 will prevent the system from entering open loop.

Press “Esc” to exit the Advanced Setup menu after your changes have been completed.

14.4.3 Graph

If “Graph” is chosen, the following will appear revealing the following commands on the PC screen:



1 - Injection Volume - Use this selection to modify the Injection Volume map. Move the cursor with the arrow keys to the desired point on the map you wish to modify. Use “F2” or “F3” to raise or lower the Injection Volume at this point by 1unit each keystroke. Use “F4” or “F5” to raise or lower Injection Volume across the entire load line by 1unit for each keystroke. Use “F6” or “F7” to raise or lower the Injection Volume along the RPM line by 1unit each keystroke. A legend is provided in the lower right corner of the screen for reference. Press “Esc” to exit.

2 - Oxy Trigger Voltage - Use this selection to modify the Oxygen Trigger Voltage map. This display is in graphical form. Place the cursor in the area you wish to modify. Press “F2” to raise the area, or press “F3” to lower. These values can also be easily changed in the Edit mode. The Oxygen Trigger Voltage has a relatively minor effect on the fuel/air ratio and therefore it should not be necessary to change these values. Press “Esc” to exit.

3 - Spark Advance - Use this selection to modify the Spark Advance map. Use “F2” or “F3” to advance or retard the spark at a point on the map. Use “F4” or “F5” to advance or retard the spark along a load line. Use “F6” or “F7” to advance or retard the spark along a RPM line. Maximum Spark Advance is 41.8 . Press “Esc” to exit.

4 - Accel Comp - Use this selection to modify the Acceleration Compensation map. Use “F2” to raise the amount of fuel added during acceleration and “F3” to lower the amount of fuel added. In both cases, the Acceleration Compensation is added or subtracted along an entire RPM line on each keystroke. Press “Esc” to exit.

14.4.4 Print

The Injection Volume, Spark Advance, and Accel Comp maps can be printed using this selection. This option requires that a dot matrix printer be connected to your PC. Simply highlight the desired map and press “enter”. Press “Esc” to exit this selection.

14.4.5 Communications:

The Communications allows the user to choose between the COM 1 and COM 2. COM 1 is normally the default setting on most PC’s.

14.5 Tuning Tips

An IBM compatible personal computer (preferably a laptop for portability) must be connected to the ***MPI PRO-JECTION*** ECU. The goal of this tuning process is to obtain a fuel map that is slightly rich. The advantage with this system is the personal computer can be used to monitor and change various engine parameters during the tuning process. If one is operating the system with an oxygen sensor, it becomes very easy to make fuel map changes and monitor their affect with the oxygen sensor compensation value.

14.5.1 Tuning Tips for a System With an Oxygen Sensor (closed loop)

The user can use the Data Monitor option in the personal computer software to determine the amount of fuel correction from the Oxy Comp value. The best performance results will be obtained if the engine is mapped slightly rich (10 - 20%). This value is

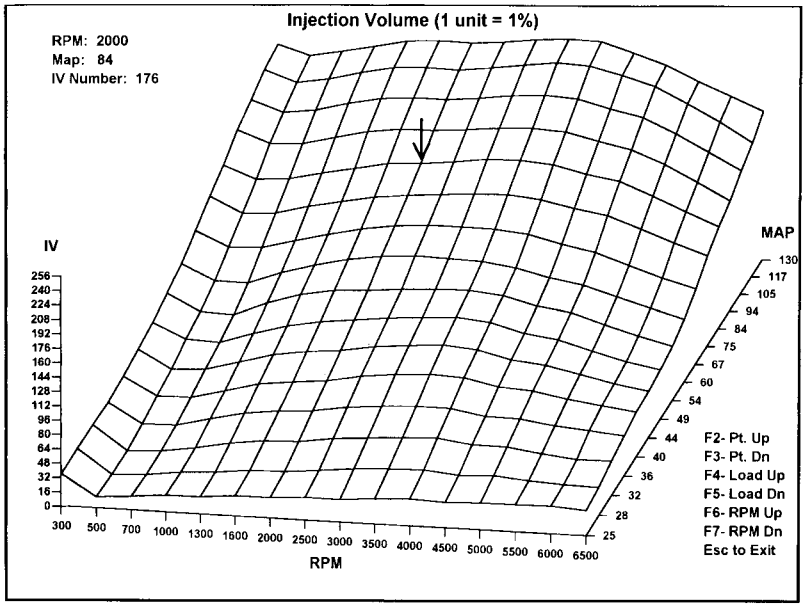
determined in Data Monitor by observing the Oxy Comp value. The user should make small changes to the map during tuning and check for the desired results before continuing. Although this tuning procedure results in a slightly rich fuel map, using a System with an oxygen sensor will correct the actual fuel delivery back to a stoichiometric fuel/air mixture at part throttle settings to obtain optimum fuel economy.

14.5.2 Other General Tuning Tips (closed and open loop)

1 - Use Mapview to determine which area of the map your engine is operating in.

2 - Use Data Monitor to determine amount of fuel correction by value of Oxy Comp and RPM (closed loop systems only).

3 - Best results are obtained if the engine map is slightly rich (10 - 20%). This value is determined in Data Monitor by observing the Oxy Comp value (closed loop systems only). To read 20% on the rich side, the Oxy Comp value would read "-20%" (meaning the map has 20% more fuel than stoichiometric and the ECU is taking out 20% of the fuel). Conversely, a positive Oxy Comp value (+20%) would indicate a lean point (meaning the map has 20% less fuel than stoichiometric and the ECU is adding 20% fuel).



4 - Make small changes to the map during tuning. Check desired results before continuing.

5 - Smooth fuel curves as much as possible. Sharp, or even slight transitions in the fuel map can be felt by some drivers. An example of a smooth fuel curve is shown o the previous page.

6 - If injection duration at idle is around 1700 μsec and the idle fuel delivery is too rich, reduce fuel pressure as outlined in the testing and adjusting fuel pressure section in the back of this manual. If this method does not increase the injector duration, then it may be necessary for you to purchase smaller injectors.

14.6 Tuning and Adjustment Procedures

This Section covers the tuning of systems both with and without an oxygen sensor feedback signal. Because much of the tuning procedure is the same to all system users, only one section has been written. However, paragraphs 6, 9, 11 and 12 can only be used by systems using an oxygen sensor. These sections should be skipped by a user without an oxygen sensor. Paragraphs 7 and 13 are added to help the user that does not have an oxygen sensor. The beginning of each of these paragraphs will inform the user to skip that paragraph if necessary. Any paragraph that does not start by specifically stating it only applies to only one system is intended for both system configurations.

1 - Load the Holley software package into your laptop computer following the procedures outlined above. Connect PC to the ECU using DB-9 cable provided.

2 - Enter EEprom Programming. Go to the File menu and select Load. Several different fuel maps are provided in the "Load Map" selection. One of these maps is the base map which is an average of all of the maps and is called Base8.216 there are 4 maps, choose the one which most closely corresponds to your engine displacement and horsepower. The user can also choose to use the average map Base8.216 as long as he realizes the average map will be a compromise for his application and may require more tuning. Make the choice that is most similar to your engine size, highlight the choice and press "enter". This map will be loaded into the PC. Turn your ignition key to the "on" position and select Send ECU Map to send the map to the ECU. This will take a few seconds and the screen will prompt you when the programming is done.

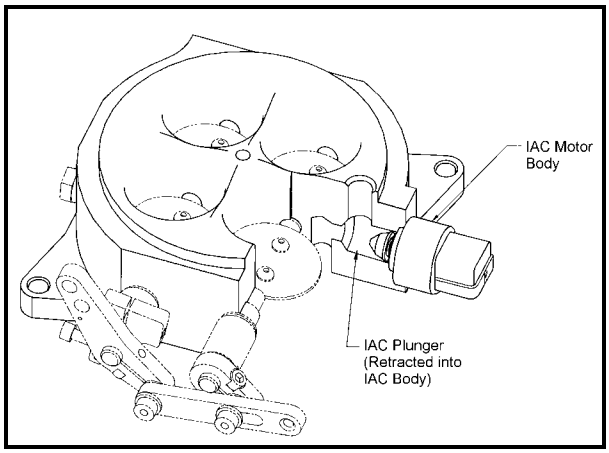
3 - The Advanced Setup parameters should be set at this time. If you plan on using Spark Control, the Spark Control must be set for the proper ignition type using the F2 key before the engine can be started. Enter into "Advanced Setup" under the Edit menu and select the proper ignition type. In addition, use the arrow keys to go to the Rev Limit section and the desired idle setting and enter your desired maximum engine and idle speed. In addition, select a temperature that you would like to have the engine enter closed loop control mode. Holley has used a value of 110° F in the base maps for marine use, and 75° F for automotive use. This value can be adjusted up or down depending on where the user wants the ECU to go into closed loop. If the coolant temp monitored in the Data Monitor screen goes below this value during operation, the closed loop activation temperature may need to be adjusted down. Use the F4 key to select the proper number of cylinders for your engine. The other parameters will not need to be set or adjusted at this time. After selecting the proper map and choosing the proper Advanced Setup parameters, save the ***PRO-JECTION*** system map to your computer using a personally selected file name of up to eight characters under the File menu and re-send the map to the ECU.

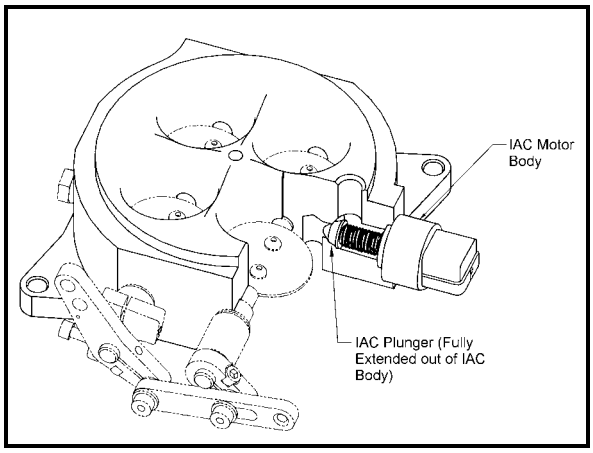
4 - Turn the ignition key to the run position. Leave the ignition key in the run position until the electric fuel pump can be heard running. The pump will run for about 10 seconds before shutting off. Start the engine and allow the engine to idle.

5 - Allow the engine to warm up before tuning the Injection Volume map. This is a good time to check the return fuel pressure. Read the value of the fuel return pressure on the gauge previously installed. A return line pressure over 5 psig when the engine is running indicates that 1) the tubing diameter may be too small or 2) there may be too many bends in the line or 3) the line is kinked or obstructed. Any high return line pressure condition should be corrected before any further fuel map tuning is done.

<u>DANGER!</u> RETURN LINE PRESSURE MUST BE LESS THAN 5 PSIG FOR THE DIGITAL *PRO-JECTION* SYSTEM TO PROPERLY OPERATE. RETURN LINE PRESSURE OF 5 PSIG OR MORE CAN RESULT IN HARD STARTING OR A FUEL LEAK. A FUEL LEAK COULD IGNITE RESULTING IN PROPERTY DAMAGE, SERIOUS INJURY, AND/OR DEATH.

6 - Skip this paragraph and go to paragraph 7 if tuning without an oxygen sensor. Enter "Data Monitor" in the program software. Watch the Oxygen Voltage value and the Oxy Comp value. If the engine is idling satisfactorily, allow the engine to reach operating temperature. Now is a good time to verify proper fuel map tuning. If the engine map is too rich at idle, the Oxy Comp will be displayed with a negative value. If the engine map is too lean at idle, the Oxy Comp will be displayed with a positive value. The Oxygen Voltage should be rapidly changing between values of 0.1-0.9 volts. This indicates normal ECU closed loop operation. If the Oxygen Voltage is 0.0, this indicates either an oxygen sensor problem, a lean condition, or a wiring problem with this circuit. A relatively constant (reading ± 0.2 volts) Oxygen Voltage and an Oxy Comp value of 0% indicates that the engine is operating in open loop mode. The engine will normally operate in open loop mode on any startup until the engine reaches the closed loop operating temperature entered in the advance setup mode. Enter "EEprom Programming" and make the "Graph", "Injection Volume" menu selections. Move the arrow around the map using the arrow keys until the map arrow is located on the line of current idle speed. Change the Injection Volume value by pressing F6 or F7 to move the entire Injection Volume line up or down to either give a richer or leaner fuel mixture at the current idle RPM. Save the map, and send the map to the ECU.





7 - After the engine reaches operating temperature, the warm idle speed must be set. Enter "Advanced Setup" under "EEprom Programming" and type in the desired warm idle speed of your engine. After saving this value and sending the map to the ECU, the throttle body curb idle speed must be set. With the engine fully warmed up and the shift lever in neutral, remove the air cleaner. Connect engine tachometer if engine is not equipped or use RPM reading in the "Data Monitor" section. Cover the IAC air passage, shown in figure, with your finger. The idle speed should be set to approximately 50 RPM below the desired idle speed entered in the Advanced Setup. If the engine idle speed is not correct, adjust idle speed set screw. This adjustment should be made when the engine has reached operating temperature.

8 - If the idle speed set screw was adjusted in the above step, the Throttle Position Sensor (TPS) will have to be readjusted.

Adjust the sensor as follows:

NOTE: If using a laptop computer, go to Data Monitor. Loosen the TPS screws. Adjust the sensor until the throttle angle reading is 28-30. If a laptop computer is not available, use the following method for setting TPS:

A - Locate the harness wiring that connects to the TPS and remove a piece of the sheathing from the GREEN wire and the BLACK/WHITE wire.

B - Attach the (+) lead of the digital voltmeter to the GREEN wire (pin B) and the (-) lead to the BLACK/WHITE wire (pin A) of the TPS.

C - Loosen the TPS and adjust until the voltage is 0.58 volts. The ignition key must be in the run position for this measurement.

D - Retighten TPS and recheck voltage. If the voltage is within adjustment range, turn ignition key off, remove jumper wires and reconnect TPS.

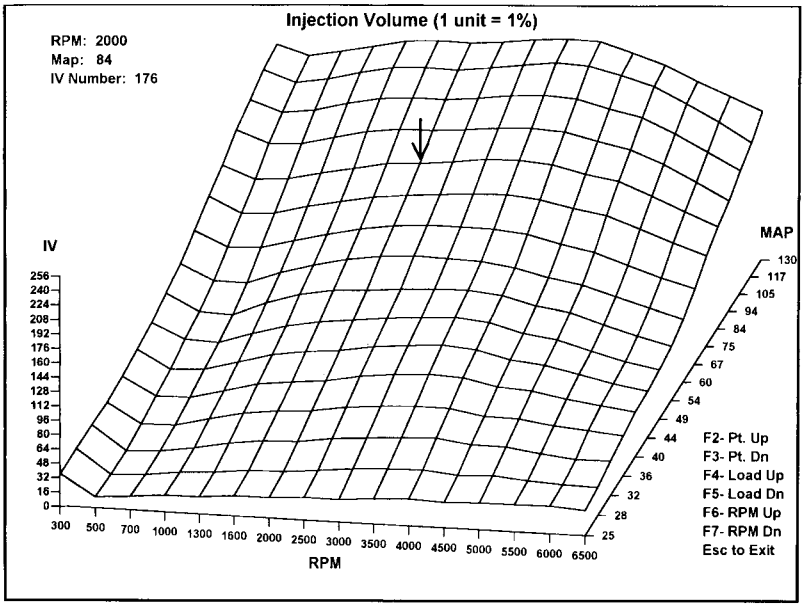
E - Reinstall air cleaner assembly. And cover the exposed wiring with electrical tape to prevent shorting.

9 - Skip this paragraph and go to paragraph 10 if tuning without an oxygen sensor. Using an assistant to monitor the PC data screen, operate the vehicle smoothly in a safe area. Maintain a constant engine speed and load long enough to obtain a steady operating condition reading at several engine operating points. Have your assistant monitor and record the Oxy Comp values at several of these points. After these values are obtained, move the vehicle to a safe location and begin programming. Go to paragraph 10.

WARNING! Have an assistant monitor the software package or to operate the vehicle during tuning and adjustment. Failure to pay attention while operating a vehicle is unsafe and can lead to property damage, serious injury and/or death!

WARNING! Any modifications made to the engine maps should be made with the vehicle stopped in a safe location. Changes made while the vehicle is in motion could result in a loss of power causing an accident resulting in property damage, personal injury and/or death.

10 - Retrieve the map from your ECU. Change the fuel as required at the operating conditions from Step 7. After changing these operating points, continue to “blend” or smooth the fuel curves around these points. Your fuel curve should always appear smooth. An example of a smooth fuel curve is shown below.



11 - Skip paragraphs 11 and 12 and go to paragraph 13 if tuning without an oxygen sensor. Repeat Steps 6 and 7 at a variety of speeds and loads until the Oxy Comp value is between “-10%” and “-20% at all operating points on the map. Go to paragraph 14.

12 - Full throttle fuel has to be set by both driver feel and by observing Oxygen Voltage. Full throttle operation will be open loop and the engine map should be set up so that the engine runs slightly rich. Good results have been achieved by Holley by setting full throttle fuel to obtain an Oxygen Voltage of 0.85 volts during full throttle acceleration. Any Oxygen

Voltage value below 0.85 volts at full throttle is an indication that the engine is running too lean for safe full throttle operation. It is helpful to observe Mapview to determine the location on the map of the full throttle conditions for your engine. Save all the above changes and send the information to the ECU.

WARNING! **Have an assistant monitor the software package or to operate the vehicle during tuning and adjustment. Failure to pay attention while operating a vehicle is unsafe and can lead to property damage, serious injury and/or death!**

WARNING! **Any modifications made to the engine maps should be made with the vehicle stopped in a safe location, Changes made while the vehicle is in motion could result in a loss of power causing an accident resulting in property damage, personal injury and/or death.**

13 - To adjust warm up on your vehicle, note the temperature of your cold start. If your engine requires more fuel during warm up, i.e. backfires through intake, stumbles, add more warm up fuel by increasing the fuel compensation values. If your engine requires less fuel during warm up, i.e. black smoke, missing, remove fuel by reducing the cold engine fuel compensation values. These values are in the Engine Temperature Compensation section under "Edit". Add or subtract fuel at the temperature of your cold start to meet the requirements of your engine. Save these changes and send the information to the ECU. These changes may take several cold starts to complete. To ensure correct test results, the car has to be exposed to cold temperatures over night.

14 - Adjust the Accel pump curve by listening to the engine sound and feel and watching the engine exhaust. If the engine bogs (acts sluggish) and a puff of black smoke comes from the exhaust, indicating too much fuel, note the engine speed and load and adjust the Accel pump curve down. If the engine hesitates or backfires and no smoke exits the tailpipe, indicating too little fuel, adjust the Accel pump curve up.

WARNING! **Any modifications made to the engine maps should be made with the vehicle stopped in a safe location. Changes made while the vehicle is in motion could result in a loss of power causing an accident resulting in property damage, personal injury and/or death.**

15.0 OPERATION OF THE PRO-JECTION SYSTEM

15.1 Normal Starting Procedure

Cold engine - Do not touch the throttle control. Crank the engine for 3-5 seconds. The engine should start, or start and stall. If the engine did not start or did not continue running, press the accelerator pedal to ¼ throttle. Crank the engine with the throttle in this position until the engine starts or for 12 seconds. If the engine does not start after 12 seconds, the engine may be flooded. Allow the starter motor to cool. To use the "**Clear Flood**" mode, increase the throttle control to wide open and hold while cranking. As soon as the engine starts, release the throttle control to the idle position. Do not crank the engine for more than 15 seconds at a time to prevent premature starter failure.

Hot engine - It is not necessary to touch the throttle control to start a warm engine.

15.2 Normal Operation and Use

The Holley ***PRO-JECTION*** fuel injection system allows the user to set up the system to obtain optimum performance and economy and not make any further adjustments. No special procedures should normally be required to operate the vehicle during everyday operation. Once the systems have been calibrated, it is not necessary to monitor the system or keep either the calibration module or the PC connected to the system.

16.0 MAINTENANCE AND STORAGE

The Holley digital ***PRO-JECTION*** system is designed to give many hours of service with minimal maintenance. The following periodic maintenance is required to ensure your continued satisfaction with the system.

1 - Use a good grade of fuel. Always use a quality gasoline from a reputable service station. Pick service stations that pump large quantities of fuel to ensure fresh gas and less contamination from underground tanks.

2 - Add Holley fuel system cleaner to the gas tank every 3 months according to the directions on the system cleaner. This will keep injector patterns optimal for best performance and economy.

3 - Change both fuel filters annually or at 500 hours. Use only filters rated for high pressure fuel injection service.

4 - To ensure safety, performance, and reliability, periodically check all fuel lines for cracks and replace as needed.

5 - Be sure all electrical connections are secure and wires are away from moving parts. Apply a fresh coat of silicone dielectric grease to all electrical terminals to help conductivity and reduce corrosion.

6 - If a drop in performance is noticed, a dirty fuel filter may be the problem. Change as required.

7 - During extended periods of storage (60 days or more) gasoline my deteriorate due to oxidation. This can damage rubber and other polymers in the fuel system. It may also clog fuel injectors. A commercially available fuel stabilizer should be added to the fuel tank whenever actual or expected storage period exceeds 60 days. Follow the product instructions for the amount of additive to use. The engine should be operated at idle for a minimum of ten minutes after the addition of the stabilizer to assure that it reaches the throttle body.

17.0 GENERAL TROUBLESHOOTING

Double check ALL wiring connections and system voltages BEFORE replacing components. If you suspect an ECU or component failure, check all other possible problems before replacing a component.

CONDITION	***POSSIBLE CAUSE***	***REMEDY***
Fuel Pump fails to operate	- Open or blown fuse	- Replace fuse
	- Poor ground connection	- Clean ground and tighten securely
	- Faulty fuel pump relay	- See Testing Relay section
	- Faulty fuel pump	- Check for voltage and ground at pump. If voltage and ground are present, replace pump.
	- Faulty ECU	- Replace ECU
No fuel from injectors	- Open or blown fuse	- Replace fuse
	- Poor ground connection	- Clean ground and tighten securely
	- Injector connection loose	- Inspect and clean connections, reconnect
	- No fuel in tank	- Add fuel to tank
	- Low fuel pressure	- Install pressure gauges and adjust pressure.
	- High return fuel pressure	- Kinked or restricted fuel line. Repair kinks and remove obstructions from lines
	- No fuel pump	- See Item 1 above
	- No tach signal	- See Tachometer section of Electrical Connections
	- Faulty ECU	- Replace ECU
Engine runs rich	- High supply fuel pressure	- Install pressure gauges and adjust pressure.
	- High return fuel pressure	- Kinked or restricted fuel line. Repair kinks and remove obstructions from lines
	- Incorrect calibration module settings	- See Tuning section
	- MAP sensor hooked up improperly	- Using vacuum gauge, ensure MAP sensor is hooked up to full manifold vacuum
	- Faulty MAP sensor	- See Testing MAP Sensor section
	- TPS setting incorrect	- Adjust TPS. See TPS Adjustment section
	- Faulty TPS sensor	- Replace TPS
	- Oxygen sensor mounted incorrectly	- See Oxygen Sensor installation section of instructions
	- Faulty oxygen sensor	- Replace oxygen sensor
Engine runs lean	- Low supply fuel pressure	- Install pressure gauges and adjust pressure.
	- Incorrect calibration module settings	- See Tuning section
	- Faulty MAP sensor	- See Testing MAP Sensor section
	- TPS setting incorrect	- Adjust TPS. See TPS Adjustment section
	- Faulty TPS sensor	- Replace TPS
	- Faulty oxygen sensor	- Replace oxygen sensor
	- Incorrect system sizing	- See Choosing the Right System
Hard starting (cold)	- Faulty coolant temperature sensor -	- See Testing Coolant Temperature Sensor section
	- Faulty air charge temperature sensor	- See Testing Air Charge Temperature Sensor section
	- Faulty IAC motor	- See Testing IAC section
	- Fuel pump not flowing fuel	- See Item 1 of Troubleshooting
Hard starting (warm)	- Engine flooding	- Use “Clear Flood” mode. See Section 15.1. Inspect injectors after shutting off engine for injector leakage. Replace leaking injectors.
	- Faulty coolant temperature sensor	- See ***Testing Coolant Temperature Sensor*** section
	- Faulty air charge temperature sensor	- See ***Testing Air Charge Temperature Sensor*** section
	- Fuel pump not flowing fuel	- See Item 1 of Troubleshooting
Poor performance	- Calibration module not adjusted properly	- See ***Tuning*** section

	- MAP sensor hooked up improperly - Faulty MAP sensor - Faulty coolant temperature sensor	- Using vacuum gauge, ensure MAP sensor is hooked up to full manifold vacuum - See ***Testing MAP Sensor*** section - See ***Testing Coolant Temperature Sensor*** section
High idle speed	- Idle speed not adjusted correctly - Binding or sticking throttle linkage - Faulty IAC motor - Faulty ECU - TPS adjusted incorrectly	- Set idle speed. See Item 4 in ***Tuning*** and ***Adjustments*** section - Find cause of binding or sticking and correct. - See ***Testing IAC*** section - Replace ECU - See ***Tuning*** and ***Adjustments*** section
Low idle speed	- Idle speed not adjusted correctly - Faulty IAC motor - Faulty ECU - TPS adjusted incorrectly	- Set idle speed. See Item 4 in ***Tuning*** and ***Adjustments*** section. - See ***Testing IAC*** section - Replace ECU - See ***Tuning*** and ***Adjustments*** section
Surging idle	Engine running rich Engine running lean Idle trim not adjusted correctly	- See Item 3 above - See Item 4 above. - See ***Tuning*** section

18.0 TESTING AND TROUBLESHOOTING ELECTRICAL COMPONENTS

18.1 Testing Relays

1 - To test the relays, apply a 12 volt power source to terminal 85 and ground terminal 86. The relay should click. Using an ohm meter, check for low resistance across terminals 87 and 30.

2 - With the 12 volt power source removed from terminal 85, check for high resistance across terminals 87 and 30.

3 - If the relay does not perform as described above, the relay is defective and must be replaced.

18.2 Testing The Manifold Absolute Pressure (MAP) Sensor

One way to check the MAP sensor is to monitor the system with the software. Check the map sensor readings with the engine turned off. It should be fairly close to 101 kPa at sea level and decrease by about 3.4-3.5 kPa per 1000 feet elevation above sea level. The MAP value may also vary a small amount due to weather conditions. The table below shows MAP values in kPa compared to the more familiar units of in Hg. The second column is gauge pressure in Hg and the third column is vacuum in units of in Hg.

MAP Value to Manifold Pressure Value to Vacuum Comparison		
MAP Value (as read on the computer)	**Manifold Pressure Value (in Hg)**	**Vacuum (in Hg) Relative to Ambient Pressure Condition (sea level)**
101 kPa	29.7	0.0
90 kPa	26.5	3.2
80 kPa	23.5	6.2
70 kPa	20.6	9.1
60 kPa	17.6	12.1
50 kPa	14.7	15.0
40 kPa	11.8	17.9
30 kPa	8.8	20.9
20 kPa	5.9	23.8

NOTE: Users at higher altitudes will have MAP values lower than 101 kPa as described in the above paragraph along with a lower corresponding manifold pressure. However, the vacuum on a typical vacuum gauge is referenced to ambient conditions and will read 0.0 with no engine vacuum regardless of MAP value unlike the sea level based third column in the above table. A MAP value lower than 20 kPa is most likely an indication of a bad MAP sensor connection or a MAP sensor problem.

1 - If you do not have a PC, use a digital voltmeter and tap into the ORANGE wire at the MAP sensor. With the engine off and the key in the run position, voltage should be close to 2.0 volts.

2 - Connect a hand vacuum pump to the MAP sensor with the key in the run position. Using the vacuum pump, the MAP sensor can be checked at the following vacuums. Voltage output should be close to these values.

20” Hg vacuum	.55 volt
15” Hg vacuum	1.0 volt
10” Hg vacuum	1.4 volts
5” Hg vacuum	1.9 volts

0” Hg vacuum	2.3 volts at sea level (less at altitude)

18.3 Throttle Position Sensor (TPS) Adjustment

Adjust the sensor as follows:

1 - Locate the harness wiring that connects to the TPS and remove a piece of the sheathing from the GREEN wire and the BLACK/WHITE wire.

2 - Attach the (+) lead of the digital voltmeter to the GREEN wire (pin B) and the (-) lead to the BLACK/WHITE wire (pin A) of the TPS.

3 - Loosen the TPS and adjust until the voltage is 0.58 volts. The ignition key must be in the run position for this measurement.

4 - Retighten TPS and recheck voltage. While watching the voltmeter, move the throttle lever from fully closed to fully open. The voltage should change smoothly from .58 volts to 4.5-5.0 volts. If the reading fluctuates, the TPS is intermittent and should be replaced. If the voltage is within adjustment range, turn ignition key off, remove jumper wires and reconnect TPS.

5 - Reinstall air cleaner assembly. And cover the exposed wiring with electrical tape to prevent shorting.

18.4 Testing Idle Air Control (IAC) Motor

A simple test for the IAC motor is as follows:

1 - Remove the air cleaner assembly. Check the electrical connections at the IAC motor and at the ECU for integrity.

2 - With the warm engine idling in neutral, place your finger slowly over the IAC opening. The idle speed should drop and the suction on your finger will increase.

3 - After 5 or 10 seconds, remove your finger from the opening. The engine idle speed should increase and then slowly return to normal.

4 - If your engine speed does not respond as described, the IAC motor is defective and must be replaced.

DANGER! **ROTATING OR HOT PARTS IN AN ENGINE COMPARTMENT CAN CAUSE BURNS, SERIOUS INJURY AND/OR DEATH IF CONTACTED WITH A PERSON. KEEP LOOSE CLOTHING AND BODY PARTS AWAY FROM ROTATING OR HOT PARTS.**

18.5 Testing Coolant Temperature Sensor

1 - Remove the coolant temperature sensor from the manifold. Allow the sensor to reach room temperature, approximately 70° F.

2 - With a digital voltmeter set to measure resistance and connected to the pins of the coolant temperature sensor, the resistance should read approximately 3,800 Ω.

3 - Place the sensor in boiling water with the voltmeter leads still connected. The resistance with the water boiling (212 F) should be approximately 182 Ω.

4 - If your coolant temperature sensor does not respond as described above, the sensor is defective and must be replaced.

18.6 Testing Air Charge Temperature Sensor

1 - Connect a digital voltmeter set to read resistance to the air charge temperature sensor leads and not the resistance value.

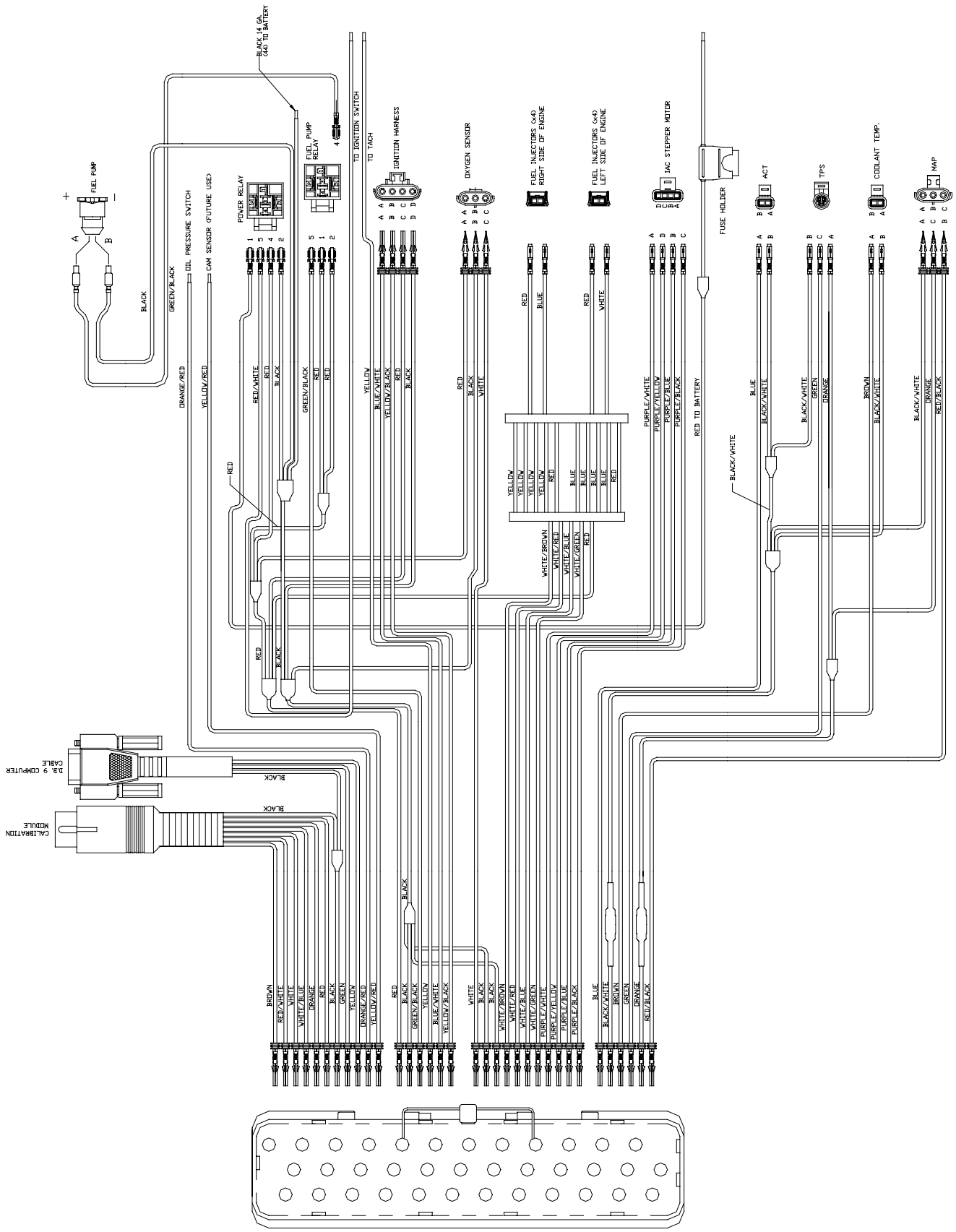
2 - Using a hair dryer, warm the tip of the air charge temperature sensor. The resistance should decrease as the tip is heated.

3 - If your air charge temperature sensor does not respond as described above, the sensor is defective and must be replaced.

18.7 Testing the Oxygen Sensor

The ***MPI PRO-JECTION*** systems oxygen sensor performance can be evaluated. The oxygen sensor voltage can be checked through the monitor option of the ***MPI PRO-JECTION*** software. The other option if no PC is available is to probe the gray wire from the oxygen sensor connector with the positive (+) lead of a digital voltmeter. With the engine running open-loop, the meter reading should be near zero or one volt. During closed-loop operation, the readings should constantly change between zero and one volt. If the reading is always zero volts, be sure +12V and ground are present on the YELLOW and BLACK wires. If so, the sensor is probably bad. If you see a changing voltage, but the readings do not vary far from 0.5 volts, the sensor is lazy and should be replaced.

WARNING! **Be sure to use a high impedance digital voltmeter. An older style analog (dial type readout) has an internal resistance that is too low and will destroy the oxygen sensor if connected to the gray wire.**



Holley
Performance Products Inc