PRO-JECTION® 2D

DIGITAL REPLACEMENT FOR THE ELECTRONIC CONTROL UNIT

INSTALLATION, TUNING, & TROUBLESHOOTING MANUAL

OPTIONAL EQUIPMENT

534-54	Closed Loop Kit for Digital Replacement ECU
534-50	Rich/Lean Indicator without O_2 Sensor
534-51	Rich/Lean Indicator with O_2 Sensor
534-56	Replacement Closed Loop Kit Harness

NOTE: These instructions must be read and fully understood before installation. If this manual is not fully understood, installation should not be attempted.

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INTRODUCTION:

The replacement digital ECU is designed for reliable repeatable performance. Because the ECU utilizes digital electronics, it is not affected by variations in temperature or humidity.

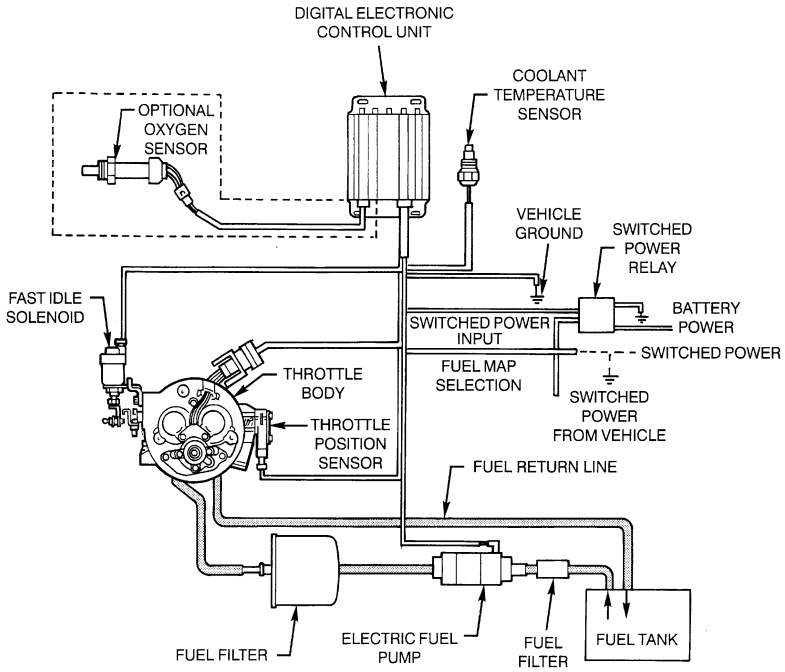
The Digital ECU has adjustments for Choke, Acceleration, Idle, Main, and High RPM settings. By simply dialing in the appropriate fuel curve, fuel delivery can be accurately matched to the engine's requirements across its entire power band.

The ECU is factory-programmed with fuel maps for both small block and big block engine applications and controls the amount of fuel delivered to the engine by pulsing each of the two fuel injectors for precisely controlled periods of time. The rate and length of time at which the injectors are pulsed is calculated from various inputs such as engine speed, throttle position, engine coolant temperature, and an optional oxygen sensor.

Although the digital ECU is pre-programmed at the factory, the amount of fuel delivered to the engine under various operating conditions is user-adjustable through the use of five adjustments knobs located on the front panel of the digital ECU. These adjustment knobs are used to tune the system.

WARNING! **The Digital Replacement ECU system is NOT recommended for high-speed, high-performance engine applications.**

WARNING! **This ECU is NOT to be used for MARINE or AIRCRAFT applications.**



Pro-Jection 2D Fuel Injection System -- Overview

Figure 1

NOTE: Although every possible precaution was taken in the design of the digital ECU to prevent interference from radio sources, the use of solid core spark plug wires may interfere with the operation of the ECU. Holley recommends the use of either suppression or spiral wound spark plug wires.

NOTE: Installation of the optional Closed Loop Kit on a vehicle equipped with emissions control devices, such as an AIR pump, may cause extremely rich fuel mixtures, resulting in possible damage to your engine. Federal Law prohibits the disconnection of AIR pumps. Ensure that all local, state, and federal laws are adhered to when any modifications are made to the emissions control devices on your vehicle.

ILLUSTRATED PARTS LIST:

Electronic Control Unit
P/N 534-55

TOOLS / ADDITIONAL MATERIALS REQUIRED FOR INSTALLATION:

The following tools and materials are required to complete the installation:

- Electric Drill
- Miscellaneous Hardware
- Digital Volt / Ohm Meter (10 Megohm)

MOUNTING THE ELECTRONIC CONTROL UNIT (ECU):

DANGER! **ALWAYS DISCONNECT YOUR VEHICLE'S BATTERY BEFORE PERFORMING ANY WORK ON THE VEHICLE'S ELECTRICAL OR FUEL SYSTEM. FAILURE TO DO SO MAY PRODUCE SPARKS, CAUSING A FIRE OR EXPLOSION, RESULTING IN PROPERTY DAMAGE, PERSONAL INJURY, AND/OR DEATH.**

WARNING! **Do not open the ECU. The digital electronics contained within this ECU are sensitive to static electricity. Opening this ECU WILL VOID THE WARRANTY.**

WARNING! **Do not mount the ECU in an enclosed area such as the glove compartment. Mount the ECU in an area that will allow air to flow freely across the ECU to dissipate heat generated by the ECU.**

WARNING! **When mounting the ECU, care must be taken that none of your vehicle's other systems, such as the electrical system, air conditioning, or heating components, are damaged by either drilling holes or using mounting screws. Always check on the other side of the location that is to be drilled to ensure that no damage will occur.**

WARNING! **Do NOT mount the ECU in the engine compartment. The ECU is not designed for the environment (heat, moisture) present in the engine compartment. Premature failure of the ECU will result.**

WARNING! **The *PRO-JECTION* 2D system must be appropriately grounded to ensure proper system performance and to prevent any damage to the system. To ensure a good grounding plane, connect a ground strap between the engine and the chassis.**

The digital ECU is designed to operate in either a small block or a big block mode. The mode in which this ECU operates is selected by connecting one of the wires in the wiring harness to either ground or a switched positive (+) 12 volt source. Further instructions relative to this selection are located in P/N 199R9777-6.

NOTE: All connections shown MUST be made in order for the ***PRO-JECTION* 2D** system to operate properly.

1. Pick a suitable location on the interior of the vehicle in which the ECU can be mounted. Ensure that the mounting location allows for sufficient length of the wiring harness and clearance for connectors and that the adjustment knobs on the front of the ECU are accessible before mounting the ECU.

2. Using the ECU base plate as a template, drill 4 pilot holes, ensuring that no damage will result to any of your vehicle's other systems.

3. Mount the ECU with 4 self-starting sheet metal screws (not included).

NOTE: Further instructions are available on the operation of the digital fuel injection system in the ***PRO-JECTION 2D*** fuel injection installation manual.

SELECTION BETWEEN SMALL BLOCK / BIG BLOCK OPERATION:

WARNING! If this ECU was purchased to replace an analog ECU, the pink wire previously connected to the starter must be removed from the starter and hooked up as described below. Failure to do so will result in possible damage to the ECU.

WARNING! One of these two modes of operation must be selected. Failure to properly connect the pink wire will result in system failure.

The digital ECU is programmed at the factory with fuel maps applicable for both small and big block applications. Selection between the two modes of operation is made by hooking the pink wire in the system's primary harness to either ground or a switched positive (+) 12 volt source. For **stock** engine sizes of 360 c.i.d or smaller, small block operation should be selected. For **stock** engine sizes of 361 c.i.d. or larger, big block operation should be selected.

After you have made the proper connection and have begun to tune the system, you may find that the selection of either small block or big block operation for your application results in either not enough or too much fuel. Simply change the hook-up of the pink wire to select between the two fuel maps.

SMALL BLOCK OPERATION:

Connect the pink wire located in the ***PRO-JECTION*** system's harness to a good chassis or engine ground with a ring terminal. Ensure that the crimp connection between the wire and the terminal is secure by pulling on both the terminal and the wire. Make sure that the grounding surface is clean and located away from any direct sources of heat.

BIG BLOCK OPERATION:

Connect the pink wire located in the ***PRO-JECTION*** system's harness to a switched positive (+) 12 volt source that is energized both in the "ON" and "CRANK" positions of the ignition switch. **DO NOT** connect the pink wire directly to your vehicle's battery.

OPERATIONAL OVERVIEW OF THE DIGITAL ECU:

This digital ECU is programmed at the factory with fuel maps applicable to both small block and big block operation. The ECU utilizes inputs from various sensors and from the adjustment knobs located on the front of the ECU to calculate the appropriate fuel delivery to the engine.

When the ignition is initially turned on, power is applied to the digital ECU. At this time, the ECU provides power to the fuel pump for several seconds to prime the fuel lines and to build pressure in the fuel injection system. The digital ECU senses whether the pink wire in the harness is attached to switched 12 volts or to ground. The ECU then internally selects whether to operate in small block or big block mode by selecting between two fuel maps programmed into the ECU.

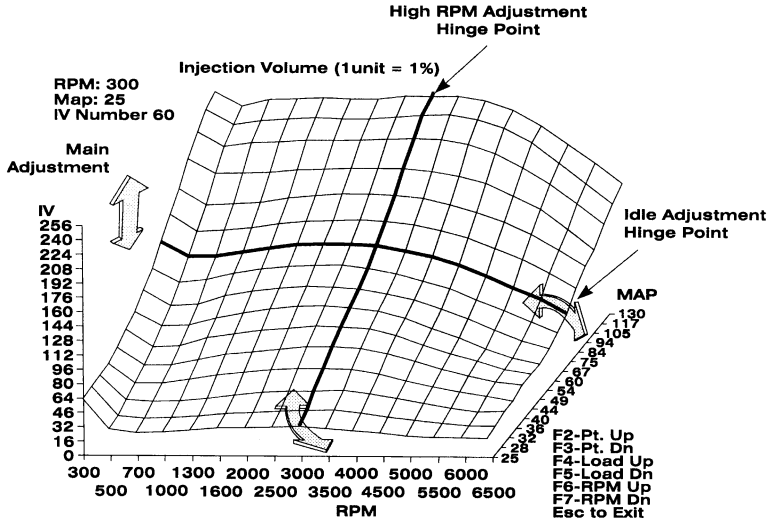
During cranking, the ECU begins receiving tach signals from the engine through the white wire in the wiring harness. At this time, power is applied to the fuel pump for continuous operation and the fuel injectors are fired to deliver fuel to the engine. The appropriate amount of fuel is calculated by taking into account; throttle position, engine coolant temperature, and an optional oxygen sensor feedback voltage. The throttle position sensor provides information relative to how far and how fast the throttle is being opened or closed. The oxygen sensor provides information on whether the engine is running rich or lean. Even though the oxygen sensor is heated, the ECU will continue to operate in an open loop mode for a short period of time after initial start-up. This combined information is then used by the ECU to adjust the fuel delivery to the engine.

The ECU also powers the fast idle solenoid, which works in direct conjunction with the engine coolant temperature sensor. During cold starts, the fast idle solenoid will remain extended until the engine reaches an operating temperature of 75° F. If the engine temperature is already above 70° F when starting the engine, the fast idle solenoid will remain in the extended position for a factory-set period of time. The amount of time that the fast idle solenoid remains extended is factory set and **CAN NOT BE CHANGED** by the user. In addition to operating the fast idle solenoid, the signal received from the engine coolant temperature sensor also provides information to the ECU relative to enriching or leaning out the fuel delivery. When the engine is cold, more fuel will be delivered and the fuel delivery is adjusted as the engine warms up.

During vehicle operation, the fast idle solenoid is also utilized to allow for a smoother deceleration. During deceleration, the fast idle solenoid is activated for a pre-determined period of time and prevents stalling, as would an idle air control motor. In addition to all of the aforementioned features, a "CLEAR FLOOD" mode has also been programmed into the ECU to aid in vehicle startup in case excessive fuel has entered the intake manifold. Should the engine flood during start up, the clear flood mode can be initialized by turning the ignition off, pressing the accelerator all the way to the floor, and cranking the engine until it starts.

In addition to the information provided to the ECU by the various sensors, the user is also able to adjust the fuel delivery through the use of the five adjustment knobs on the front of the ECU. The user is able to adjust fuel delivery for Choke, Accelerator Pump, Idle, Main, and High RPM settings. A detailed description of each adjustment is given below. Refer to Figure 2 during the discussion of each of the adjustments.

The fuel map that is programmed into the digital ECU is comprised of 256 individual points. Each point has a throttle position and rpm value assigned to it. These values are used by the digital ECU to determine the appropriate fuel delivery when the system is in operation.



Fuel Map Areas of Adjustment

Figure 2

MAIN

The MAIN adjustment knob allows the user to adjust the fuel delivery of the entire fuel map 50% above or below the values set at the factory. Rotating the knob clockwise will raise the fuel map vertically, therefore increasing the fuel delivery for all points in the map. Rotating the knob counter-clockwise will lower the map vertically, therefore decreasing the fuel delivery for all points in the map.

NOTE: In tuning the system, the MAIN is the first value to be adjusted. All other adjustments are made AFTER the MAIN has been properly set.

IDLE

The IDLE adjustment knob allows the user to adjust the fuel delivery in the idle region of the fuel map 30% above or below the values that are set at the factory. This is accomplished by moving the lower part of the fuel map either up or down along a hinged horizontal line as indicated in Figure 2. Adjustments to the idle region of the fuel map are made AFTER the MAIN Adjustment knob has been properly adjusted. Turning the knob clockwise increases the fuel delivery, while a counter-clockwise rotation decreases the amount of fuel delivered to the engine during idle.

HIGH RPM

The HIGH RPM adjustment knob allows the user to adjust the fuel delivery for engine speeds over 3000 rpm 50% above or below the values that are set at the factory. This is accomplished by moving the fuel map either up or down along a diagonal hinged line as indicated in Figure 2. Turning the adjustment knob clockwise increases the fuel delivery, while a counter-clockwise rotation decreases the amount of fuel delivered to the engine at high engine speeds.

ACCEL PUMP

The ACCEL PUMP adjustment knob allows the user to adjust the addition of fuel for acceleration 50% above or below the value set at the factory. Rotating the adjustment knob clockwise results in additional fuel being added to the fuel enrichment set at the factory, while rotating the adjustment knob counter-clockwise will result in less fuel being added during acceleration. The proper adjustment is made while performing acceleration tests which are described later on in this section.

CHOKE

The CHOKE adjustment knob allows the user to adjust the amount of fuel enrichment while the engine is warming up 20% above or below the value set at the factory. Rotating the adjustment knob clockwise will increase the amount of fuel added while the engine is warming up. Rotating the adjustment knob counter-clockwise will decrease the amount of fuel added while the engine is warming up. The CHOKE adjustment knob **DOES NOT** control the length of time that the fast idle solenoid is on.

BEFORE STARTING THE ENGINE:

DANGER! **NEVER MAKE ANY ADJUSTMENTS TO THE POTENTIOMETERS ON THE FRONT OF THE DIGITAL ECU WHILE THE VEHICLE IS IN MOTION. BE SURE THAT THE VEHICLE IS IN PARK OR NEUTRAL WITH THE PARKING BRAKE SET. FAILURE TO DO SO MAY RESULT IN PROPERTY DAMAGE, PERSONAL INJURY, AND/OR DEATH.**

WARNING! **The adjustment knobs on the front of the ECU are precision manufactured parts and do not require a great deal of force to turn. Do not apply excessive force to the adjustment knobs. Full adjustment range for the knobs is 3/4 of a turn.**

1. After all electrical connections have been made, double-check all connections to ensure that they are tight and secure.

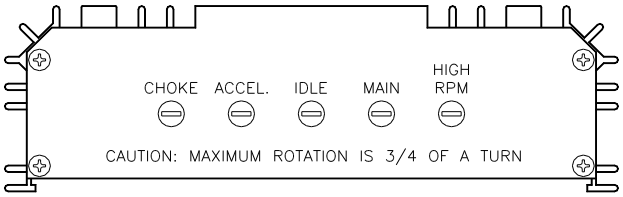
2. Reconnect the battery.

3. If installed, remove the oxygen sensor harness from the digital ECU by unplugging the harness from the rear of the ECU.

4. Although the adjustment potentiometers on the front of the digital ECU were set at the factory in the null position, check to ensure that they were not moved. If necessary, rotate the potentiometers so that they are positioned as shown in Figure 3.

5. Turn the ignition key to the “RUN” position. DO NOT START THE ENGINE. Listen for the fuel pump. The fuel pump should run for several seconds before shutting off.

6. Turn the ignition key to the “OFF” position.



Adjustment Potentiometer Settings for Initial Startup

Figure 3

SETTING THE MECHANICAL IDLE:

The setting of the mechanical idle speed is critical in the operation of the Digital ECU and is best accomplished by using a tachometer. If your vehicle is not equipped with a tachometer, Holley highly recommends one be used. To adjust, follow the instructions carefully.

1. Disconnect the yellow wire from the fast idle solenoid by unplugging the female quick disconnect terminal from the tab at the base of the solenoid.

2. Start the engine. With the engine running at idle, insert a flat blade screwdriver into the head of the idle adjustment screw located on the front of the throttle body on the driver’s side of the vehicle.

3. Turn the idle adjustment screw clockwise to increase the engine idle speed, or counterclockwise to decrease the engine idle speed, until the engine speed is approximately 750 to 800 rpm.

4. Have another person depress the brake pedal and set the parking brake. Put the car in gear (automatic transmissions only) and allow the engine speed to stabilize while continuing to apply both the brakes and the parking brake. Turn the air conditioning on high, if so equipped, and turn on your high beam lights.

5. Adjust the idle adjustment screw until the engine speed is set at approximately 700 rpm.

6. With the parking brake set and while continuing to apply the brakes, shift the transmission back into “Park” and allow the engine speed to stabilize.

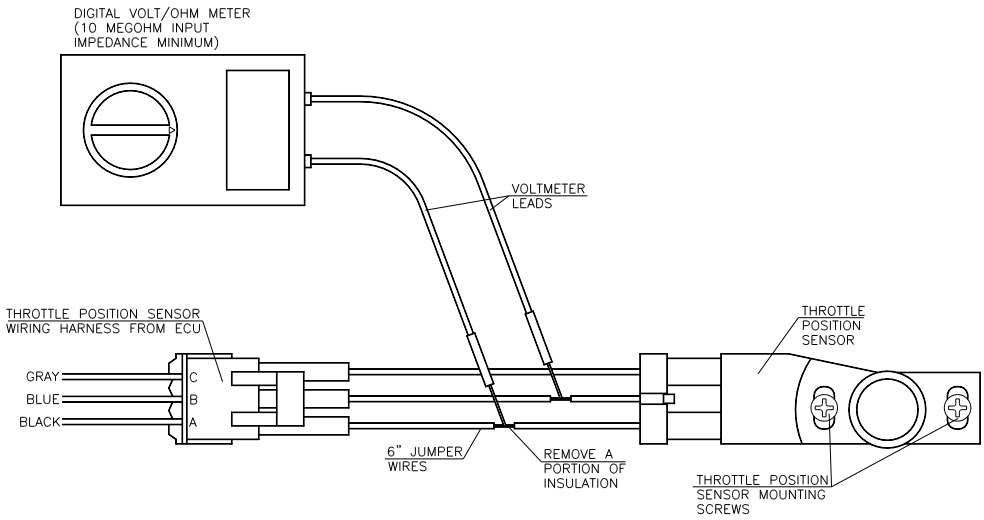
7. Once again, shift the transmission into gear while applying the brakes and having the parking brake set. Check the engine speed to verify that the engine idles at approximately 700 rpm.

8. Do not reconnect the yellow wire to the fast idle solenoid at this time.

NOTE: The idle speed required for your vehicle may differ. Set the engine idle for a speed that best suits your application.

9. Shift the engine back into “Park” and shut off the engine.

SETTING THE THROTTLE POSITION SENSOR (TPS):



TPS Adjustment and Jumper Placement

Figure 4

The setting of the throttle position sensor is critical in the operation of the Digital ECU and is best accomplished by using a digital voltmeter. To adjust, follow the instructions carefully.

NOTE: Fuel delivery can **NOT BE ADJUSTED** by changing the positions of the TPS. The TPS must be set in the position outlined below.

1. Unplug the three-position connector from the TPS and attach jumper wires between the TPS and the connector.

2. Remove a portion of the insulation on the jumper wires connecting to both the black and the blue wires leading to the TPS as shown in Figure 4.

3. Attach the positive (+) lead of a digital volt meter to the jumper wire connected to the blue wire.

4. Attach the negative (-) lead of a digital volt meter to the jumper wire connected to the black wire.

5. Turn the ignition key to the “RUN” position. Do not start the engine.

6. Slightly loosen the two screws that hold the TPS in place with a Phillips screwdriver.

7. Adjust the TPS until the voltage between the blue and black wire measures 0.63 to 0.65 volts.

8. Tighten the two screws that hold the TPS in place and verify that the voltage between the blue and black wires on the TPS continues to read between 0.63 to 0.65 volts. Readjust the TPS if necessary to obtain this voltage reading.

9. Turn the ignition key to the “OFF” position.

10. Remove the jumper wires and plug the three-position connector back into the TPS, ensuring that the safety latch snaps into place.

NOTE: Once the TPS and mechanical idle have been set, you are ready to tune the system.

TUNING THE DIGITAL ECU FOR PERFORMANCE:

DANGER! **NEVER MAKE ANY ADJUSTMENTS TO THE POTENTIOMETERS ON THE FRONT OF THE DIGITAL ECU WHILE THE VEHICLE IS IN MOTION. BE SURE THAT THE VEHICLE IS IN PARK OR NEUTRAL WITH THE EMERGENCY BRAKE SET. FAILURE TO DO SO MAY RESULT IN PROPERTY DAMAGE, PERSONAL INJURY, AND/OR DEATH.**

WARNING! **The adjustment knobs on the front of the ECU are precision manufactured parts and do not require a great deal of force to turn. Do not apply excessive force to the adjustment knobs. Full adjustment range for the knobs is 3/4 of a turn.**

WARNING! **Initial tuning of the system should be completed in an area free of traffic, such as in a large parking lot. Do not attempt to tune this system on a busy road, where a possible stall may result in an accident.**

NOTE: A small change in the adjustment knob settings will have a large effect on the amount of fuel delivered to the engine under various operating conditions. Make small adjustments to the adjustment knob setting when tuning the system.

NOTE: Holley recommends the use of a Rich / Lean indicator that will provide information relative to the air and fuel delivery to the engine when tuning the system. A Rich / Lean indicator with an Oxygen Sensor is available from Holley as Part #534-51 and without an Oxygen Sensor as P/N 534-50. Use P/N 534-50 if you have already installed a closed loop kit.

NOTE: When tuning the system for future closed loop operation, all potentiometer settings must be set slightly richer then stoichiometric in case an oxygen sensor failure should occur. This will prevent damage to your engine due to lean operating conditions.

NOTE: The tuning of the digital ECU is critical in the operation of the fuel injection system and is best accomplished by using a tachometer. If your vehicle is not equipped with a tachometer, Holley highly recommends one be used. To adjust, follow the instructions carefully.

TUNING THE MAIN:

As described earlier, the MAIN adjustment knob controls the fuel delivery across the entire operating range by raising or lowering the fuel delivery 50% above or below the values programmed at the factory. Therefore, adjustments made with the MAIN adjustment knob will affect the fuel delivery in all modes of engine operation.

1. Disconnect the closed loop harness, if installed, from the rear of the digital ECU. Initial tuning should be completed with the system operating in open loop mode.

2. Start the engine and allow the engine to reach operating temperature.

3. Once the engine has reached operating temperature, set the parking brake and depress the brake pedal. Increase engine speed until the engine operates at 3000 rpm and hold the accelerator pedal in this position.

4. Turn the adjustment knob labeled MAIN, clockwise until the engine rpm reaches a maximum value and the engine rpm just begins to drop. If your vehicle is equipped with a Holley rich / lean indicator, adjust the MAIN adjustment knob until the green center light on the unit remains stable.

5. Rotate the main adjustment knob counter-clockwise back to the point where the engine rpm started to drop, until maximum engine rpm is once again achieved.

6. Let off the throttle and allow the engine to return to idle.

TUNING THE IDLE:

Adjustments made to the IDLE adjustment knob will affect the area of the fuel map that relates to the idle operation of the vehicle.

1. Turn the IDLE adjustment knob either clockwise or counter-clockwise until maximum engine rpm is achieve and the engine idles smoothly. If you are using a rich / lean indicator to tune the system, turn the IDLE adjustment knob until the green center LED is lit.

NOTE: Many engines require a richer fuel mixture at idle. Therefore it may not be possible to maintain the fuel mixture at a stoichiometric level while maintaining the engine at a smooth idle. Adjust the idle fuel delivery that best meets your engine's requirements.

2. Turn on the air conditioner and your high beam lights. Set the parking brake and depress the brake pedal. Shift the transmission into gear.

3. Adjust the IDLE adjustment knob as described in Step 1.

4. Shift the transmission into neutral or back into park. To stabilize the idle quickly press the accelerator to the floor and release. Shift the transmission back into gear. Allow the idle to stabilize and adjust if necessary.

5. Once the idle has been properly set, turn off the air conditioner and the high beam lights. Shift the transmission back into Park.

NOTE: If you are unable to adjust the IDLE adjustment knob to achieve a proper idle, it may be necessary to once again adjust the mechanical idle adjustment screw located on the driver's side front of the throttle body to a higher setting, as described on Page 7 of this manual. If you change the setting of the idle adjustment screw, it will be necessary to once again adjust the TPS to the proper idle setting as described in this manual. Once the TPS and idle have been adjusted, it will also be necessary to adjust the MAIN adjustment knob as described in the "TUNING THE MAIN" section.

6. Now return to **SETTING THE THROTTLE POSITION SENSOR (TPS)** and follow the steps outlined to adjust the TPS again. Once the TPS has been reset return to **TUNING THE MAIN** and adjust again. Then return to step one of this section and tune the idle again.

TUNING THE ACCEL:

The ACCEL adjustment knob controls the amount of fuel that is added to the engine when accelerating. Adjustments made here allow for a quick, crisp response during acceleration.

WARNING! Do not attempt to perform acceleration tests on a busy road or highway. Complete this stage of the tuning process in an area free of traffic, such as a large parking lot. Failure to do so may result in property damage, personal injury, and/or death.

1. Shift the transmission into gear and slowly accelerate the vehicle to approximately 20 mph.

2. Quickly depress the accelerator pedal and note the performance of the engine. If the engine bogs (falls flat) and black smoke comes out of the exhaust, the ACCEL adjustment is set too high. If the engine bogs and no black smoke comes out of the exhaust, the ACCEL adjustment is set too low.

3. Adjust the ACCEL adjustment knob accordingly and continue performing acceleration tests you achieve a quick, crisp response during acceleration and no black smoke comes from the exhaust.

TUNING THE HIGH RPM:

The HIGH RPM adjustment knob changes the fuel delivery to the engine at engine speeds over 3000 rpm.

DANGER! NEVER MAKE ANY ADJUSTMENTS TO THE POTENTIOMETERS ON THE FRONT OF THE DIGITAL ECU WHILE THE VEHICLE IS IN MOTION. BE SURE THAT THE VEHICLE IS IN PARK OR NEUTRAL WITH THE EMERGENCY BRAKE APPLIED. FAILURE TO DO SO MAY RESULT IN PROPERTY DAMAGE, PERSONAL INJURY, AND/OR DEATH.

WARNING! Do not attempt to perform acceleration tests on a busy road or highway. Complete this stage of the tuning process in an area free of traffic, such as a large parking lot. Failure to do so may result in property damage, personal injury, and/or death.

NOTE: To properly set the HIGH RPM setting, it will be necessary to operate your engine at a steady speed while determining the proper fuel delivery.

1. Shift the transmission into second gear or the automatic transmission equivalent.

2. Begin to smoothly accelerate the vehicle until the engine speed is above 3000 RPM. Now quickly press the accelerator and perform a hard acceleration. Note the performance of the engine.

3. Bring the vehicle to a complete stop and set the parking break. Increase or decrease the amount of fuel delivered during high engine speeds by turning the HIGH RPM adjustment knob either clockwise or counter-clockwise. If your vehicle is equipped with a Rich / Lean indicator, adjust the HIGH RPM adjustment knob until the meter indicates a stoichiometric fuel mixture at high engine speeds.

4. Adjust the HIGH RPM adjustment knob accordingly and continue performing acceleration tests until you achieve a quick, crisp response during acceleration.

TUNING THE CHOKE:

The CHOKE adjustment knob controls the fuel delivery to the engine during a cold start. The CHOKE adjustment knob **DOES NOT** control the "ON" time for the fast idle solenoid. Adjustment to the CHOKE should be made after the engine has cooled down completely.

1. After the engine has cooled down completely (Holley recommends allowing the engine to sit overnight), start the engine.

2. Immediately after starting the engine, shift the transmission into gear and accelerate slowly.

3. Turn the CHOKE adjustment knob to achieve a clean drive-away from a cold start. Several cold starts will be necessary to zero in on the proper CHOKE setting.

CLOSED LOOP INSTALLATION AND CONNECTION (OPTIONAL):

DANGER! **NEVER WORK UNDER A VEHICLE SUPPORTED ONLY BY A JACK. ALWAYS SUPPORT THE VEHICLE WITH JACK STANDS THAT ARE IN GOOD OPERATING CONDITION. FAILURE TO DO SO MAY RESULT IN PROPERTY DAMAGE, SERIOUS INJURY, AND/OR DEATH.**

WARNING! **If you are currently using a Holley analog closed loop kit, P/N 534-27 (no longer available), all electrical wiring connecting to this kit must be removed and replaced with a new wiring harness, Holley P/N 534-56. Failure to replace this wiring harness will result in improper fuel delivery and possible damage to ECU.**

WARNING! **Use only unleaded fuels when operating an oxygen sensor. Use of Leaded fuels will DESTROY the oxygen sensor and will result in incorrect exhaust gas oxygen readings.**

WARNING! **The use of some RTV Silicone sealant will destroy the oxygen sensor. Ensure that the RTV silicone sealant that you use is compatible with oxygen sensor vehicles. To determine compatibility, check the packaging of your RTV silicone or contact the sealant's manufacturer.**

NOTE: Federal Law prohibits the disconnection of AIR pumps. The use of an oxygen sensor in conjunction with an AIR pump may result in an extremely rich fuel mixture, resulting in possible damage to your engine.

NOTE: The installation of an oxygen sensor will operate with the digital ECU. This requires use of the Holley Digital ***PRO-JECTION* 2D** Closed Loop Kit for 1 and 2-Barrel Applications, P/N 534-54.

The digital ECU is designed to utilize a heated, three-wire oxygen sensor to operate the system in a closed loop mode. When operating in a closed loop mode, the electronic control ECU utilizes a reference signal from the oxygen sensor to determine whether the engine is running too rich or too lean. The ECU then adjusts the fuel delivery to maintain a stoichiometric fuel delivery (14.7:1 Air / Fuel Ratio).

1. Disconnect the ***PRO-JECTION* 2D** wiring harness from the rear of the ECU by depressing the small latch on top of the harness connector and gently pulling the connector out of its socket on the ECU.

2. Determine a location in the exhaust system in which to mount the oxygen sensor. This location must be as close to the engine as possible. Good mounting locations are in a header collector, the drop pipe, or the "Y" pipe on a single exhaust system.

WARNING! **The oxygen sensor must be mounted in a location that will prevent the sensor from being damaged by road hazards or moving parts on your vehicle. Failure to do so will cause damage to the oxygen sensor, resulting in substandard system performance.**

NOTE: If your vehicle is equipped with catalytic converters, the oxygen sensor MUST be located between the engine and the catalytic converters.

3. Drill a 7/8" hole into the exhaust pipe where the oxygen sensor will be mounted.

WARNING! **Ensure that no metal shavings enter the exhaust that may cause damage to either your catalytic converters or mufflers. To remove any metal shavings, insert a small magnet into the hole and use the magnet to collect the shavings.**

4. Insert the weld ring into the hole and carefully weld the ring in place by placing a bead all the way around the outer edge of the weld ring to ensure a leak proof connection. Ensure that you do not damage the threads inside the weld ring. If you damage the threads inside the weld ring, use a 18 mm tap to re-thread the weld ring.

NOTE: Someone with experience welding exhaust should install the oxygen sensor weld ring. Any competent exhaust shop will be able to accomplish this task at a minimum cost.

5. Although the oxygen sensor is supplied with a small amount of anti seize compound applied to the oxygen sensor threads, Holley recommends that the thread be thoroughly coated with additional anti-seize compound. When applying the anti-seize compound, ensure that the stainless steel sensor head remains clean. Insert the oxygen sensor into the weld ring and tighten it securely with a 7/8" open end wrench. **DO NOT OVERTIGHTEN THE OXYGEN SENSOR!**

6. Connect the wiring harness to the oxygen sensor by pressing the two three position connectors together until the locking latch on the oxygen sensor connector snaps into place.

7. Route the wiring harness, away from any direct sources of heat and moving parts, from the oxygen sensor to the rear of the ECU. Secure the wiring harness with wire ties or wire clamps.

8. Reconnect the primary wiring harness, previously disconnected, to the ECU. Plug the small, black connector on the oxygen sensor wiring harness into the 6 position connector on the rear of the ECU.

NOTE: The oxygen sensor should only be used AFTER the ***PRO-JECTION* 2D** system has been properly tuned in an open loop mode (oxygen sensor is disconnected). Utilizing the oxygen sensor without first tuning the ***PRO-JECTION* 2D** system in an open loop mode may result in engine fuel requirements that are outside the range of adjustment of the closed loop system.

NOTE: The digital ECU utilizes only three of the six positions in the small connector on the rear of the ECU. The other three positions are for FACTORY USE ONLY and no connections should be made to these 3 connector positions.

SYSTEM MAINTENANCE:

The ***PRO-JECTION* 2D** system is virtually maintenance free. To ensure performance and reliability, periodically check all fuel lines for leaks and replace them as needed. Also ensure that all electrical connections remain secure and that all wires are routed away from and direct sources of heat, such as the exhaust system, and any moving parts.

If a decrease in system performance is noticed, a dirty or clogged fuel filter may be the cause. Holley recommends that both fuel filters (installed with the ***PRO-JECTION* 2D** system) be changed every 20,000 miles of normal operation. These filters are non-serviceable and must be replaced. Contact your local parts dealer for replacement fuel filters.

TROUBLESHOOTING AND COMPONENT TESTING:

Double check all wiring connections and installed components for their proper operation before replacing any parts. If you suspect an unlikely ECU failure, check all other system components before replacing this ECU. Also ensure that all other systems on your vehicle are in proper working condition. Experience has shown that most problems can be traced to something other then an ECU failure.

If you experience any problems with your ***PRO-JECTION* 2D** fuel injection system, complete the following checklist before contacting Holley's Technical Service Department at 1-270-781-9741.

	PROBLEM	POSSIBLE CAUSE	SOLUTION
A	Fuel Pump Does Not Operate	- Open or blown fuse - Poor ground connection - Loose connector - Broken or burned wire - No power to pump from ECU - No power to the ECU - Faulty fuel pump	- Replace fuse - Clean ground location and tighten connection - Check Connection - Replace or repair wire - Check for voltage and ground at the pump. If proper is present, replace the ECU. - Check power out from relay. Test relay and replace, if faulty. See Testing the Power Relay section. - Replace the fuel pump
B	No Fuel From the Injectors	- Open or blown fuse - Poor ground connection - No power to the ECU - Loose injector harness connection - No fuel in tank - Low fuel pressure - Kinked or restricted fuel line - Fuel pump does not operate - No TACH signal - Faulty ECU	- Replace fuse - Clean ground location and tighten connection - Check power out from relay. Test relay and replace, if faulty. See Testing the Power Relay section. - Inspect and clean connection, reconnect - Add fuel to tank - Install pressure gauges and adjust fuel pressure. See Adj. Fuel Pressure section. - Repair kinks and remove obstructions from fuel line. - See Item A - Check for proper wire connection. See TACH Signal connections in the Fuel injection manual. - Replace ECU
C	Engine starts but stalls after starter motor disengages	- No voltage to relay switched power input with ignition in "RUN" position - No TACH signal	- Check switched power connection to relay with ignition in "RUN" position - Check for proper ignition system operation. - Check for proper wire connection. See TACH Signal connections in the Fuel injection manual.
D	Injector flows fuel with ignition switch in the "RUN" position and engine not running	- Poor Engine ground wire connection - Leaky fuel injector	- Clean ground location and tighten connection - Replace fuel injector
E	"CLEAR FLOOD" mode does not operate while cranking the engine	- Throttle does not open fully - Faulty TPS - Low voltage to ECU during cranking - ECU does not supply 5 volt signal to TPS	- Check for interference between the throttle linkage and surrounding components. Adjust throttle linkage. - Test TPS. See Testing the TPS section. Replace TPS - Ensure that voltage to ECU is above 8 volts during cranking. Replace battery or starter. - Check all wire connections. Replace ECU
F	Engine Runs Rich	- ECU adj. knobs are set too high - High supply fuel pressure - High return fuel pressure - Incorrect TPS adjustment - Faulty TPS - Oxygen sensor is mounted wrong. - Faulty oxygen sensor - Leaking fuel injector	- Adjust knob settings. See Tuning section - Install pressure gauges and adjust fuel pressure. See Adjusting fuel pressure section. - Kinked or restricted fuel return line. Repair kinks and remove obstructions from fuel line. - Adjust TPS position. See Adjusting the TPS section. - Test TPS. See Testing the TPS section. Replace TPS - See Optional Closed Loop System install. Section. - Replace the oxygen sensor - Replace fuel injector

G	Engine Runs Lean	- ECU adj. knobs are set too low - Low supply fuel pressure - Incorrect TPS adjustment - Faulty TPS - Restricted Fuel Injector - Vacuum Leak - Water in fuel - Faulty oxygen sensor	- Adjust knob settings. See Tuning section. - Install pressure gauges and adjust fuel pressure. See Adjusting Fuel Pressure section. - Adjust TPS position. See Adjusting the TPS section. - Test TPS. See Testing the TPS section. Replace TPS - Remove fuel inj. and clean injector screen and throttle body. Replace injector. - Locate vacuum leak and repair. - Remove water from fuel with proper fuel additive. - Replace the oxygen sensor.
H	Hard Starting (Cold Engine)	- "CHOKE" knob adj. set too low - Non-functional coolant temp. sensor - Non-functional fast idle solenoid - Fuel pump not flowing fuel	- Increase "CHOKE" setting - Test temperature sensor. See Testing the Temp. Sensor section. Replace sensor, if necessary. - Check wire connection to solenoid. - Test solenoid. See Testing the Fast Idle Sol. Section. Replace solenoid, if necessary. - See Item A
I	Hard Starting (Warm Engine)	- Engine is flooding - Non-functional coolant temp. sensor. - Fuel pump not flowing fuel	- Use "CLEAR FLOOD" mode. Inspect injectors after shutting off engine for injector leakage. Replace leaking injectors. - Test temperature sensor. See Testing the Temp. Sensor section. Replace sensor, if necessary. - See Item A
J	Fuse blows repeatedly	- Improper fuse installed - Fuel pump motor is locked - Wire insulation is broken resulting in a short to ground - Faulty ECU	- Install 10 Amp Fuse - Test Fuel Pump. See Item A - Inspect wiring harness and repair wire - Replace ECU
K	Low Fuel Pressure	- Low Voltage at fuel pump - Kinked or restricted fuel line - Faulty fuel pump - Throttle body pressure regulator improperly adjusted - Low fuel level in tank - Restrictive screen in tank	- Check voltage to pump from ECU. Inspect wiring harness. Check battery volts. - Repair kinks and remove obstructions from fuel line. - See Item A - See Adjusting Fuel Pressure section - Add fuel to tank - Clean fuel tank and increase screen size
L	High Fuel Pressure	- Kinked or restricted fuel return line - Return line diameter too small - Throttle body pressure regulator improperly adjusted	- Repair kinks and remove obstructions from fuel line. - Replace fuel return line with larger dia. fuel line. - See Adjusting Fuel Pressure section

ADJUSTING THE FUEL PRESSURE:

The pressure regulator located at the rear of the throttle body is factory set at 15 PSI. A slight adjustment may be necessary to allow for proper system operation.

1. Install a pressure gauge into the fuel supply line. This gauge must be removed after the fuel pressure has been properly adjusted.

2. Start the engine and verify that the fuel lines do not leak. If any leaks are found, turn off the engine and repair the leaks before continuing.

3. Insert a 5/32" Allen wrench into the pressure regulator screw on the top of the throttle body.

4. Turn the screw into the throttle body to increase the fuel supply pressure or out of the throttle body to decrease the fuel supply pressure.

TESTING THE COOLANT TEMPERATURE SENSOR:

The coolant temperature sensor used with the ***PRO-JECTION* 2D** system is a single wire sensor. The ECU supplies a fixed voltage to the sensor. The resistance within the sensor varies with temperature and this variation in resistance is used by the ECU to determine the engine's coolant temperature.

1. Drain enough coolant out of the radiator to drop the coolant level below the point in which the engine coolant temperature sensor is installed in the manifold.

2. Remove the sensor from the manifold and allow the sensor to reach room temperature, approximately 70° F.

3. Connect the positive (+) lead of a digital voltmeter set to measure resistance to the metal tab located at the top of the sensor and the negative (-) voltmeter lead to the sensor's body.

4. Measure the resistance. The resistance value of the temperature sensor at room temperature should be approximately 3.8 kΩ.

5. Submerse the body of the coolant temperature sensor in boiling water (212° F) and measure the resistance as described in Step 3. The resistance value of the temperature sensor in boiling water should be approximately 182 kΩ.

NOTE: If the resistance values of your engine coolant temperature sensor do not match these values, the temperature sensor must be replaced.

TESTING THE THROTTLE POSITION SENSOR:

A properly adjusted and functioning throttle position sensor is essential to the proper operation of the ***PRO-JECTION* 2D** system. The TPS is a precision electrical component that acts as a variable resistor. The ECU provides a reference voltage to the TPS. As the resistance varies with the throttle angle, the TPS provides a return signal to the ECU.

1. Disconnect the three-position connector from the TPS and install three jumper wires as shown in Figure 5.

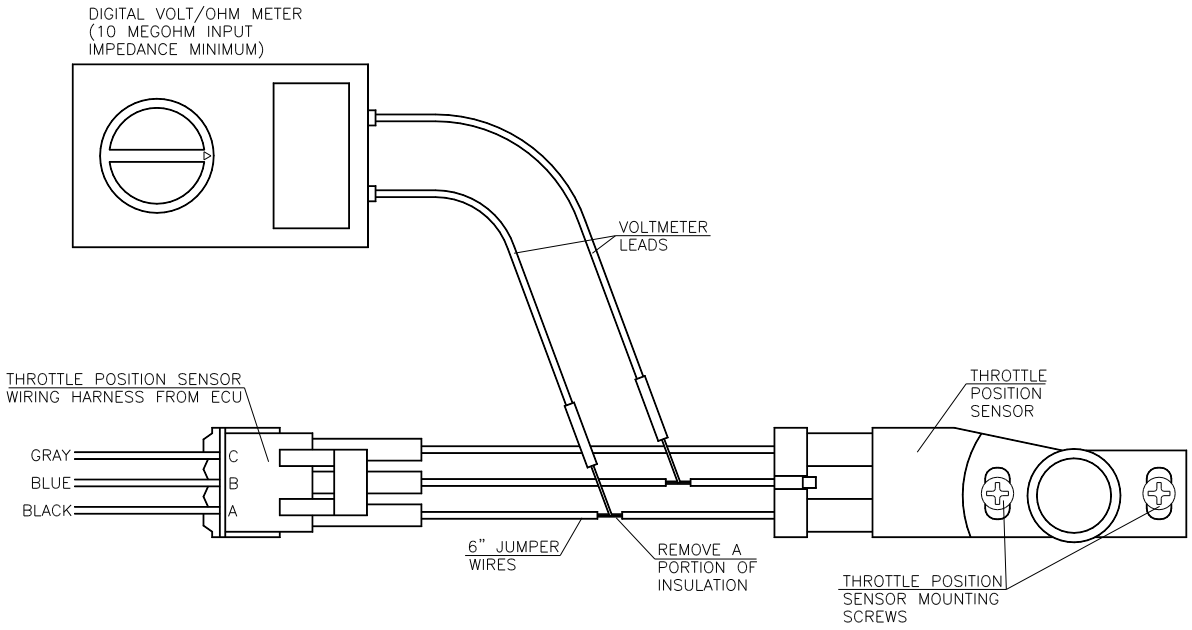
2. Connect the positive (+) lead of a digital voltmeter set to measure DC voltage to the blue wire leading to the TPS and the negative (-) lead of the voltmeter to the black wire leading to the TPS.

3. Turn the ignition key to the "RUN" position. Do not start the engine.

4. Observe the voltmeter and verify that the voltmeter indicates between 0.63 to 0.65 volts with the TPS set at idle.

5. Slowly open the throttle and observe the voltmeter's readout. The voltage should increase smoothly from 0.63 volts at idle to 4.5 to 5.0 volts at wide-open throttle. If the voltmeter readings fluctuate or seem jumpy, the TPS is intermittent and will need to be replaced.

6. Remove the jumper wires and reinstall the 3-position connector.



TPS JUMPER INSTALLATION
FIGURE 5

TESTING THE POWER RELAY:

The power relay used with the ***PRO-JECTION* 2D** Fuel Injection System is a normally open type of relay. When Power is applied across the relay's coil (terminals 85 and 86) the magnetic field generated closes the contacts between terminals 30 and 87.

1. Unplug all wires from the relay and remove the relay from your vehicle.
2. With a digital volt/ohm meter, check the continuity between terminals 85 and 86 on the relay. If there is no continuity between these two terminals, the relay must be replaced.
3. With a digital volt/ohm meter, ensure that there is no continuity between terminals 30 and 87 on the relay. If continuity exists between these two terminals with no power applied to the relay's coil, the relay must be replaced.
4. Connect terminal 86 to ground.
5. Connect terminal 85 to a positive (+) 12 Volt power source.
6. With a digital volt/ohm meter, check for continuity between terminals 30 and 87 when power is applied. If there is no continuity between terminals 30 and 87 with power applied to the relay's coil, the relay must be replaced.

TESTING THE FAST IDLE SOLENOID:

1. Remove the yellow wire from the tab located at the base of the fast idle solenoid.
2. Attach a temporary jumper wire to the positive (+) terminal on your battery.
3. Attach the other end of the temporary jumper wire to the tab located at the base of the fast idle solenoid.
4. If the plunger at the top of the fast idle solenoid does not extend with power applied to the fast idle solenoid, the solenoid must be replaced.

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199R9975
Revision Date: 10-15-12