



Installation Instructions For Marelli EFI Conversion With AutoTune Closed Loop

READ ALL INSTRUCTIONS FIRST! If you do not have a H-D® service manual for the year and model of the motorcycle you are working on, get one before starting the installation to use for reference. The factory ECM you are replacing is triggered by signals from the cam position and crankshaft position sensor (CPS), while the ThunderMax, like the later Delphi® system, uses only the signal from the crankshaft position sensor. We recommend disconnecting the cam position sensor and installing a new crankshaft sensor and in-tank fuel filter on your (at least) 15-year old motorcycle during installation. Verify charging system operation and battery condition; check both ends of battery cables for clean, tight connections. See Pages 2, 7&8 for special procedures regarding certain model years. *This product is legal in California only for racing vehicles which may never be used upon a highway.*

1. Disconnect the battery positive terminal before proceeding to step one. Remove the Marelli intake assembly from the engine. Remove also the top engine mount with the stabilizing link attached to it.

2. The new throttle body and manifold assembly are pre-assembled as delivered. Remove the intake manifold assembly from the throttle body.

3. Install the manifold assembly using lightly lubricated new intake seals (supplied).

4. Remove the stabilizing link from the top engine mount, noting which side of the link was attached to the engine mount. Re-mount the link to the chassis mount using the supplied 3/8-24 button head bolt, 12pt nut and original washer under the nut as shown (nut up). Tighten to 40 ft/lbs.



5. Attach supplied special high pressure 5/16" EFI hose to fuel rail fitting using supplied EFI

hose clamp (the hose and clamps supplied are special high pressure EFI compatible components, **NEVER** replace these with standard hose or clamps).



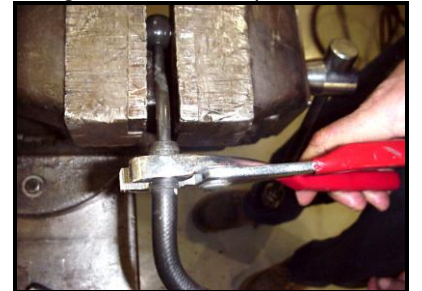
6. The original rubber fuel lines will be retained, but the banjo ends must be removed (inspect the rubber line condition; contact Zipper's if the lines show damage from rubbing against the horn housing for replacement options). Using a pair of dial calipers, mark the crimped factory fitting .210" from the crimp housing.



7. Using a tubing cutter, cut through the crimped end.



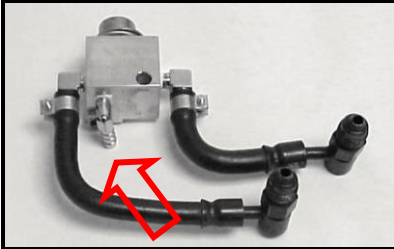
8. Grasp the fitting with pliers and twist the line loose from the fitting and separate it.



9. Remove the remaining ring from the rubber hose. Repeat this process on the 2nd hose.



10. Attach the fuel supply and return hoses to the manifold using the supplied EFI clamps.



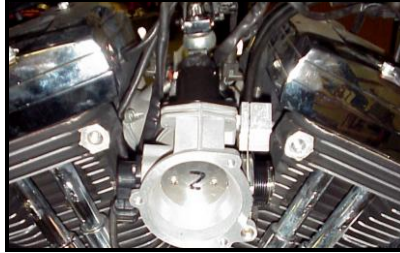
11. Place the manifold in location under the stabilizing link; align with supplied 3/8-16 hex bolt. Route EFI hose from fuel rail to fitting (arrow) on manifold block (trim for best fit; allow gentle loop without permitting hose to kink or touch cylinder fins). Attach with provided EFI hose clamps.



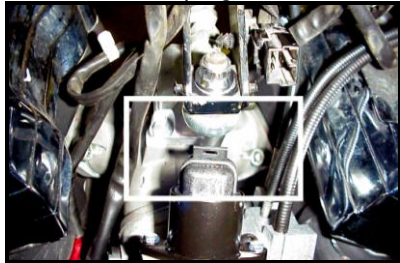
12. Re-install top engine mount with link and regulator manifold (rotate manifold assembly as required for clearance) using provided 3" 3/8-16 hex bolt and existing nut and washers on left side (tighten to 40 ft/lbs). Use supplied buttonhead bolt and 12pt nut for the right side link (nut on top).



13. Install throttle cables and throttle body assembly. Attach harnesses for TPS, MAT sensor and IAC motor. Adjust throttle cables for proper closed free-play and wide-open operation.



14. Verify clearance between buttonhead stabilizing link bolt and IAC motor plug.



15. Install air cleaner (follow instructions included with air cleaner kit).



16. Install fuel tank. Re-attach fuel hoses to tank.



17. **For steps 17 & 18 the battery positive cable should still be disconnected.** There are several relays installed in the factory wiring harness. Locate and remove the “**ECM Power Relay**” usually under seat. This will be replaced with supplied relay **AFTER** the battery cable is reconnected. This specially modified relay is configured with a “stay alive” circuit, required for your new ECM. 2000-2001 models, see special instructions on page 7 before proceeding.



18. If the exhaust system you are using is not equipped with oxygen sensor bungs, bungs will need to be added to the exhaust pipes. Bungs must be located within 3”-6” from the cylinder head. Install supplied wide band oxygen sensors in the front and rear exhaust pipes. Route and tie down the sensor harnesses away from the engine.

19. Locate supplied ThunderMax oxygen sensor harness and apply supplied dielectric grease to the harness connector terminals for improved conductivity, and to the outer harness plug housing to prevent binding upon installation to the ECM. Connect harness to the ThunderMax ECM using supplied screws.



Loosen the Phillips screw holding the stainless strap and rubber seal from the USB cable communication port on the ThunderMax ECM. Since the communication port is difficult to access once the module is installed, it is recommended that the cable is installed before installing the ECM to the motorcycle and secured with the stainless strap. Apply dielectric grease to the cable end before installing and securing it.



20. Remove factory ECM and replace with supplied ThunderMax ECM. **1995-1998 EV models, install included Bank Angle Switch and harness now per included instructions).**

After the ECM is plugged in, route front and rear (marked) oxygen sensor harnesses to oxygen sensors, away from the engine and along the frame when possible, above the lowest frame point to avoid the possibility of dragging ground during operation. **Avoid routing harnesses where engine movement or sharp edges can contact and cut into the harnesses or connector plugs.** Tie the harnesses to the frame or existing component harnesses, taking care to avoid contact with any vibrating component that may chafe the sheathing or wires. Some disassembly of bike components may be required for best harness routing.

21. Connect the battery positive cable, then install the new ECM Power Relay. If the lights come on or the fuel pump runs upon relay connection (with ignition off), the wrong relay was replaced in step 17 (correct this).

22. Insert the supplied TMax Tuner CD for into your computer. TMaxTuner should automatically open the InstallShield Wizard when the computer finds the CD-Rom (if not, open the CD and double-click the .exe file). Follow the instructions and install the software on your computer. Once installed, open your TMax Tuner software (there is no need to link to the module at this time). To ensure you are working with the latest version of TMax Tuner software and have the most up-to-date selection of base maps, it is suggested that you establish an Internet connection and click **[Configure]** on the tool bar, then **[TMax Software Update]** and follow the prompts.

After uploading new software (if found), next click **[EFI Maps]** **[EFI Map Listings (Throttle Cable)]**, double-click any map;



when the Base Map Name Encoding window appears, click the **[Check Internet For Updates]** button and follow the prompts. Close window after updating.

Next, the TMax Tuner software contains the correct Windows® drivers required for USB interface with the ECM. Connect the USB cable **to the specific port on your PC that the driver will be configured to**, and to the ThunderMax ECM connection port located under the retainer plate (loosen retainer screw, rotate retainer plate and open rubber weather seal). Open the TMax Tuner software and turn the bike's ignition and handlebar switches to the on/run positions. Follow the prompt instructions for installing the driver. You will then be prompted to enter your bike's VIN (CAPITAL LETTERS ONLY); after that, to register your module for support and warranty purposes. Once these one-time steps are complete, you can move to selecting and loading your base map.

Confirm that a base map was loaded into your module by Zipper's for your application:

_____ **Base Map Loaded**
 _____ **Base Map NOT Loaded**

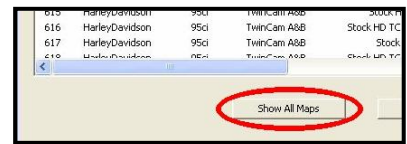
(If a base map was loaded by Zipper's, skip step 23.)

23. **If a base map was NOT loaded**, the TMax Tuner EFI Map Database will help you chose a Base Map for your application. To open the Map Database, select from the toolbar **[EFI Maps]** **[EFI Map Listings (Throttle Cable)]**.



Available base maps will be shown (if the **[Show All Maps]** button at the lower left of the

screen is highlighted, click it to



clear any filtered maps so all maps will be shown). You will now be able to select the closest Base Map for your engine combination. Please read the following section on Key Elements before proceeding; this will help you quickly narrow down the selection of available Base Maps and find the right one for your application.

Base Map “Key Elements”

The reason for selecting a Base Map by “Key Elements” is to find the closest Base Map match available for your combination, identified by the most critical components. These include:

Engine Size. A correct match to the engine's stroke is more important than an exact match of engine displacement. Stroke and cam timing influence engine pumping pressures. The correct shape of spark curves in the base map will be best matched by engine stroke.

Throttle Body / Injector Size. Choose the throttle body size and injectors being used for your application.

Camshaft. Many popular short duration aftermarket cams (less than 240° intake duration) perform well when using a stock-cam base map. With broader timing cams (more than 240° intake duration) you may find that choosing a base map developed for an aftermarket cam to be a better choice.

Exhaust System Design. There is no need for concern if an exact brand match does not appear in the Base Map library. Simply select the Base Map with the closest style of exhaust system (Slip-ons, 2:1, True Duals). Choosing the closest style will yield excellent results. Group your exhaust system in one of the following three categories:

Factory Head Pipe with Crossover: Dual exhaust

systems with a cross over pipe that connects the front and rear exhaust pipes. Typically used with accessory slip-on mufflers.

2 into 1: Both head pipes converge into one collector.

True Dual Exhaust: 100% separate exhaust pipes.

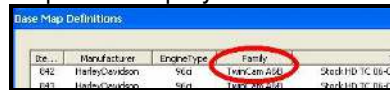
ThunderMax's AutoTune system allows you to choose a Base Map that isn't an exact match of components and still have excellent results. Even if your combination isn't listed, select the closest Map match and let the AutoTune create your custom Base Map while you ride. The closer the match that the Base Map is to your combination, the faster the system will achieve the desired AFR Targets. This simply means less time to establish and maintain a great tune. Once you have allowed the system to establish custom AFR fuel-flow adjustments, you can use the AutoMap function to create an all-new Base Map based upon the AutoTuned learned adjustments. To use the AutoMap feature, see the tuning manual for the procedure on how to create your custom base map using AutoMap.

Base Map File Browsing / Selection

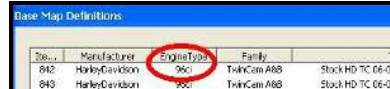
With your Base Map Definitions window open, you may begin narrowing down the list of maps for your application. To sort the map files by a particular key element, left-click on the column heading to arrange the Base Maps in alpha/numeric order. All of the columns can be sorted in this manner for filtering purposes. Filter the maps to identify the base map that best matches your application by following these steps:

First (in order of importance) place your cursor over the 'Family' heading and left-click to change the sort order of that column. Place your mouse pointer over you bike's family match and right-click to filter out no-match applications from the list. **Tip -** Notice that the [Show

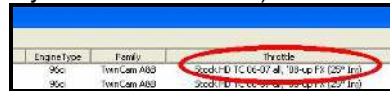
All Maps] button at the bottom left is now selectable. At any time if you want to return to the complete library listing, select the [Show All Maps] button and you will start over with all Base Map Files displayed.



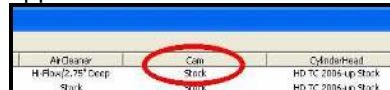
Second, right-click the engine size under 'Engine Type' that matches your engine. All maps that do not match your selection will be filtered from the screen.



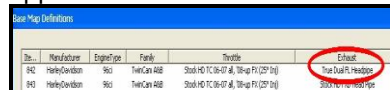
Third, place your cursor over the 'Throttle' column and right click your match (injector size is more important than throttle body size if you have to choose).



Fourth, right-click the 'Cam' that closest matches your application.



Fifth, right click the 'Exhaust' that closest matches your application.



Keep right-clicking the application columns until you have located the best map match (in the case of identical maps, choose the latest date). Highlight the map you've chosen (left-click; blue bar indicates selected map) and click the [Close] button.

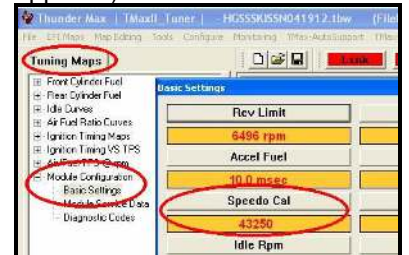
This brings you to the 'Base Map Name Encoding' page, from which you can review the map parameters. Once verified, click the [Load BaseMap] button to load the map into the software.

Note - If you're still unsure of which Base Map to select, please email the specifications of your Key Elements to Support@Thunder-Max.com. Please title the email "Base Map Selection" for a faster response.

Next, go to the [Tuning Maps]



Tree and click the [+] sign next to [Module Configuration] to reveal the [Basic Settings] command. Open the Basic Settings window and click the [Speedo Cal] button (list window appears).



Verify that the Speedometer Calibration is set to 4352. If it is, click [Cancel]; if it is not, enter 4352 & click [OK], then [Close] the Basic Settings window.

Now that the Base Map is loaded into the Tmax Tuner software; you must 'Write' (transfer) the Base Map to your ThunderMax ECM. With the communication cable connected, linking to the module is now automatically performed with the Tmax Tuner software when the handle bar and key switch are in the on/run positions. The red [Link] button turns green to indicate a successful link.

Once linked, from the toolbar, click [File] [Write Module Maps and Settings], answer [OK] to the message that informs you that you are about to overwrite the current map in the module; the transfer bar appears during the map load. Once the Base Map has been written to the module, clear any active Diagnostic Code readings and

Learned Fuel Adjustments that may have been created during the live module testing session that each ThunderMax module must pass. While linked, from the Tuning Tree select **[Module Configuration] [Diagnostic Codes]**. When the Diagnostic Codes window appears, select **[Clear Diagnostic Codes]**. After completing this step, proceed to Map Editing menu on the tool bar and select **[Clear “Learned Fuel Adjustments (CLP OFFSET)”]**. These steps ensure you will be starting with a “clean slate” Base Map.

IMPORTANT STEP BEFORE STARTING

Before starting the engine for the first time, Thoroughly check motorcycle for:

Fuel leaks at all line connections including the pressure regulator block, fuel rail fittings and all hose connections; tight battery and ground connections; proper throttle cable adjustment (throttle closes and opens fully with proper free-play), smooth throttle operation (ensure that the throttle returns to the idle position quickly and automatically), and a full fuel tank with fresh high-test fuel. Perform the next steps after all systems have been verified as operational from re-assembly.

24. Initialization Procedure

This procedure allows the ThunderMax to “learn” the “home” position for the Idle Air Control (IAC) motor. This is the only setting within the system that is not retained during 12 volt power interruption. It is required

only for new module installation, or when interruption of 12v power takes place. Example: battery change, removal of maxi fuse, etc. Turn the ignition switch on and the handlebar rocker switch to run (without starting the engine) for 30 seconds, uninterrupted. Cycle the ignition switch off for 30 seconds (**time it**) and then back on for 30 seconds. **Repeat the 30 on / 30 off cycles three times;** after the 3rd off cycle, start the engine. Let the motorcycle idle on its own for 15 seconds. Cycle the ignition off, then restart the motorcycle; normal idle speed should be attained depending on engine temperature. Warm-up cycle will have slightly elevated idle speed (approximately 1200 rpm) until engine reaches operating temperature. To disconnect from the PC, click the Unlink button (turns to red), remove the USB cable and snap the weather seal plug into the USB cable port. Position the retainer plate over the weather seal and tighten the retainer plate screw.

*If during this process you encounter wandering or unstable idle, the map selected may not be the best match for your application, or a mechanical problem may be present on your motorcycle. Please contact Product Support (from your toolbar, select **[TMax AutoSupport] [Collect TMax Support Data]** and follow the prompts (Internet connection required). This process copies your map and adjustments and automatically transmits the data to Product Support for evaluation.*

Congratulations! You have successfully installed and set up your ThunderMax ECM. Now

it's time to ride the bike and let ThunderMax optimize your EFI system! Several riding sessions that allow the engine to reach normal operating temperature should be completed with as much variation in terrain and RPM as possible. During this process, the IAC virtual stops are further refined and your air/fuel ratio is automatically adjusted to the map's targets. Your ThunderMax customizes your map based on your engine, ambient conditions and your riding habits. Once several sessions have been logged, link to your ThunderMax and select **[TMax Module Control Center]** for an automatic analysis of the adjustments that have been made, and follow prompts for further action if more optimization is suggested.

WARNING: ANY TUNING OPERATION INVOLVING ACTUAL OPERATION OF THE MOTORCYCLE ON PUBLIC STREETS OR HIGHWAYS IS DANGEROUS! FULL ATTENTION TO TRAFFIC CONDITIONS SHOULD ALWAYS BE YOUR FIRST FOCUS ANYTIME YOU ARE OPERATING A MOTORCYCLE ON PUBLIC ROADS. INATTENTION TO CONDITIONS CAN LEAD TO ACCIDENTS AND PERSONAL INJURY INCLUDING DEATH.

TIPS AND GENERAL INFORMATION

Several support features are located under the [Help] menu:

- A comprehensive tuning manual
- Links to allow transmission of module and map data via E-mail directly to ThunderMax support
- Links to allow transmission of monitor logs (recorded riding sessions) via E-mail directly to ThunderMax support
- Links to Thunder-Max.com web site for support documents and videos

TMax Control Center provides a snapshot of AutoTuned fuel flow adjustments, RPM time logs in increments of 100 RPM's, engine temperature logs and diagnostic codes. Valuable information about the condition of your tune and how you ride. **AutoMap**, located within the TMax Control Center, feature creates a custom base map based on AutoTuned fuel flow adjustments. Create a custom base map with just a few clicks!

When the Tmax Tuner program is opened, it will automatically retrieve and open the last map that was open.

Any time you link to your motorcycle: Read the map that is installed in the ThunderMax ECM by selecting **[File]** then **[Read Module Maps and Settings]** on the SmartLink toolbar. This will synchronize the map file loaded into the ThunderMax ECM with the SmartLink software.

Accel Fuel is be used to tune throttle response (go to [Module Configuration] [Basic Settings]).

AFR Correction vs. Engine Temperature page is used to adjust warm-up AFR's. If the engine requires more fuel during warm-up (start to 200°), use this function to adjust. See Tuning Manual for procedures.

AFR vs. Engine Temperature - During warm-up, the AFR on both cylinders will show richer than the target AFR at operating temperatures; this is a normal part of the warm-up map. No permanent changes to AFR targets and adjustments are made below 200 degrees. See Tuning Manual for applications and procedures.

Air/Fuel-TPS @ RPM These pages reflect selected targets of AFR to throttle position at every 256 RPM when system is in closed loop. Example: if you desire a leaner mixture for added fuel economy then you can easily make multi-tiered AFR targets at specific throttle positions and RPM's that will be learned during riding sessions.

During warm-up, the AFR on both cylinders will be richer than the target AFR at normal operating temperatures; this is a normal part of the warm-up map. AutoTune and its targets are inactive below 200 degrees.

Writing new or modified maps to the module requires the system to be re-initialized, and any existing learned fuel and IAC adjustments to be cleared (Map Editing, clear). Linking and editing an existing map within the module does not require above steps.

System Updates are available through the software with an internet connection. Software, Firmware and Map updates can be downloaded; check frequently for updates.

In-Tank Fuel Filters should be inspected as a part of routine maintenance. The filter is small and one bad load of fuel can clog it. The factory recommended service interval is 25K miles.

Fuel Pressure Should Be Checked during periodic service; this is also the first thing to check should you experience sudden or gradual decreasing performance. For any EFI system to operate properly, your fuel system should build and maintain 55-62 PSI of fuel pressure; your dealer can perform this simple test quickly.

The factory ECM you are replacing is triggered by signals from the cam position and crankshaft position sensors, while the ThunderMax uses only the signal from the crankshaft position sensor. We recommend disconnecting the cam position sensor, and installing a new crankshaft position sensor and in-tank fuel filter on your (at least) 11-year old motorcycle during installation. Verify charging system operation and battery condition; check both ends of battery cables for clean, tight connections.

Save your edited maps to your hard drive using the [Save As] command. Document the changes in [Map Notes] located under [EFI Maps on the toolbar. These notes are stored with the saved map; remember to edit them when making changes for future reference.

DON'T unplug the ECM without first removing the "System Relay". "Hot Swapping" the module can damage the electronics by spiking the circuits. Don't forget to reinitialize the IAC using step 24 above any time power is interrupted to the ECM.

DON'T attempt to program the ECM or start the engine when the ECM is in any position other than its natural installed position. There is a bank angle switch within the ECM that will interrupt power, corrupting programming.

Oxygen Sensor Care Items that can damage or shorten the life of your sensors:

- Leaded fuel – Race fuel
- Oil deposits from oil consumption problems
- Excessive moisture exposure
- Extreme heat

Damaged sensors will have a significant effect to the performance of the motorcycle and should be replaced. Replacement sensor P/N is 309-355.

Special Procedures For Certain Year Installations

2000 and Early Model 2001 Motorcycles – Page 7

2000 and Early Model 2001 Motorcycles

For the year **2000** and **some early 2001** FL models, the **Vehicle Speed Sensor (VSS)** signal output wire from the speedo terminates at the 8-pin main harness connector (see illustration below), **#8A, pin 5**. There is no connection from there to the ECM and therefore no **VSS** signal to the **ECM**. This lack of data renders the ThunderMax's Automatic Idle Air Control Correction features inoperable and must be corrected. For late-year **2001** FL models, this same VSS signal output is continued to the ECM from connector **#8- pin 5** to **ECM pin 8** (White/Green color wire, no modification required). Simply view the Main Harness Connector to verify if the wire is needed.

The VSS wire is added to the harness as follows;

1. Remove the **ECM relay** and unbolt the **ECM bracket** from the bike.
2. Disconnect the main harness from the ECM and pull the rubber boot back to expose the **ECM connector**. Clip any wire ties and remove the screw that secures the plastic terminal cover and remove the cover.

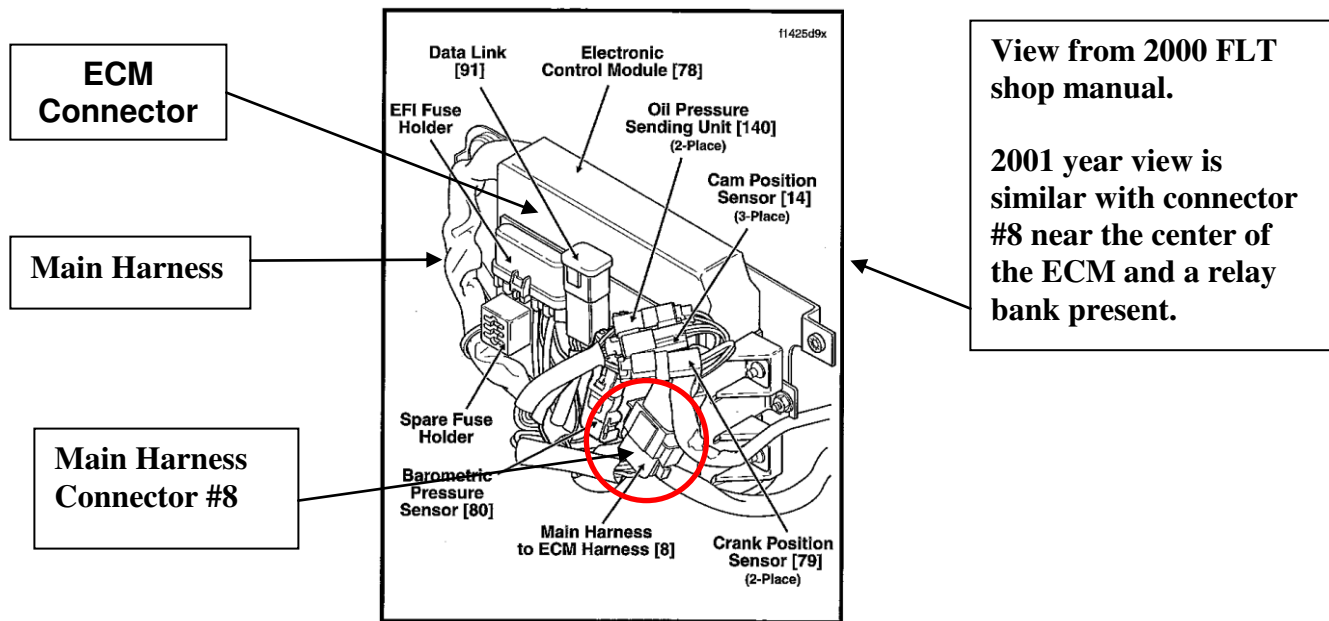


Figure A-32. Electrical Bracket - Fuel Injected Models (Under Right Side Cover)

3. Slide a common plastic wire tie through the plastic **main harness cover** toward the **ECM connector**. (See Fig. A-32, **Main harness to ECM harness [8]**) Using a piece of tape, attach 2" of the new wire to the wire tie and carefully pull it through the plastic wire cover. From there it can easily be routed with the existing wires to connector **#8B, pin 5**. Use a magnifying glass if necessary to identify terminal location (numbers are on connector). Terminals 72326-95 (ECM) and 72191-94 (Main Harness Connector) are included; identify the correct terminals and use the correct tool to crimp the terminals on the wire.

NOTE: Alternately, the new wire may be routed outside of the plastic harness cover and wire tied to the harness.

4. Separate connector **#8** and remove the plastic retainer and rubber seal from side **B** where the terminal will be installed (carefully pry out with a small screwdriver). Use care to insert the new wire terminal into the **pin 5** opening so that it's positioned correctly. Replace the plastic retainer then re-install the seal last so as not to twist or damage it. Re-connect connector ends **8A to 8B**.

5. Insert the **ECM** end of the new wire into the **ECM connector pin 8** and replace the cover. Use wire ties as needed. **Use care** when inserting the new terminal so that it's positioned the same as the existing terminals. Note the tabs on the terminal which lock into the connector. Make sure they are tapering outward and not flattened.



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