

The DB2 Conversion Guide

by Bobbie Martin

The complete guide to convert GM 6.5L Turbo Diesels from electronic fuel injection to mechanical fuel injection

Volume 1.0 Covers 1994-95 2WD with 4L80E automatic transmission and 1994-1995 2 or 4WD with manual transmission

Important Information - Please Read First!

The information contained in this book is intended to provide instructions on how to convert a GM 6.5 diesel engine with an electronically controlled DS4 fuel injection pump to a mechanical DB2 fuel injection pump. It is intended that anyone contemplating this conversion has mechanical skills and equipment sufficient to perform these repairs on their vehicle or will hire competent individuals to perform such work. The author can confirm these procedures, if followed precisely, will produce satisfactory results but cannot assume any liability in conjunction with this conversion. It is up to the owner of the vehicle to understand fully the pros and cons of such a conversion and, after comprehensive research, proceed in an informed manner. The author in no way states the information contained herein is applicable to any or all vehicles and may, under certain circumstances, cause detrimental results. If you live in an area where it is unlawful to tamper with pollution control devices, only perform this conversion on off-road vehicles not driven on public highways.

This guide is designed for 1994 -1995 GM vehicles with a 6.5 turbo diesel engine and 4L80E automatic transmission in two wheel drive configuration and for 1994 -1995 2 or 4 wheel drive manual transmission. Post 1995 (OBD II equipped vehicles) and automatic 4X4 owners may find this information useful, but specific instructions are not provided for these vehicles.

Why convert to a mechanical injection pump ?

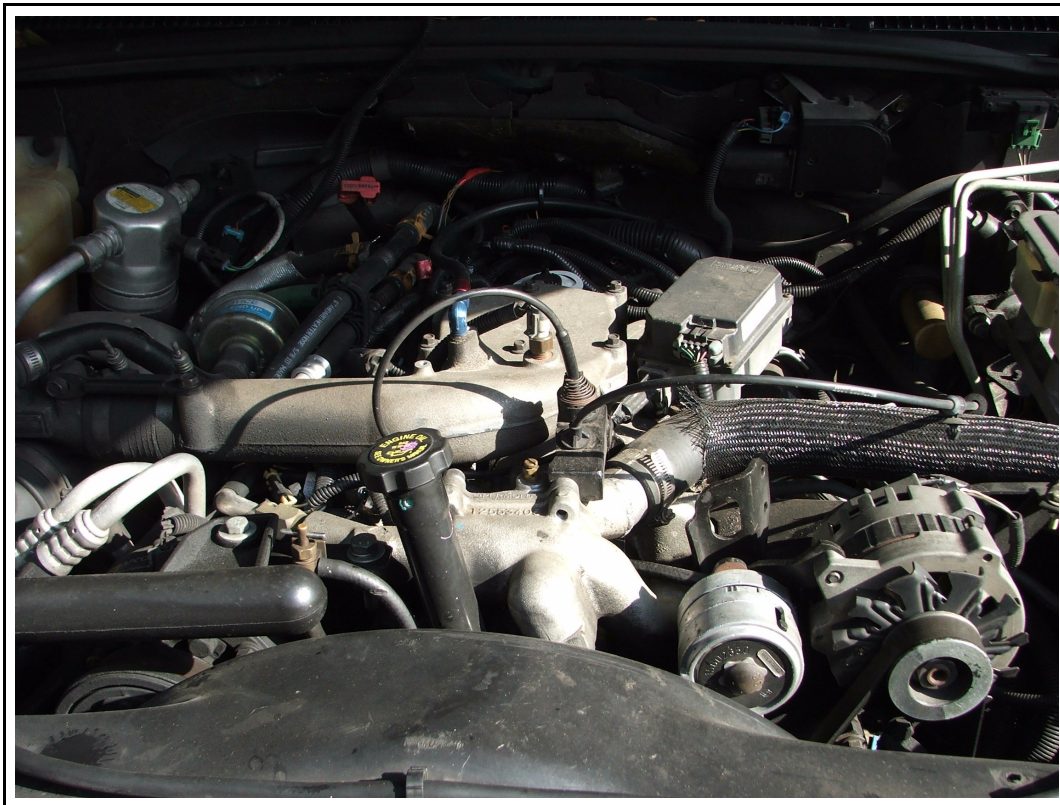


The Stanadyne DB2 Pump

In 1994 when GM came out with the electronic Diesel fuel injection pumps, it was one of the first production vehicles to use a "drive by wire" throttle. That is, it did not have a conventional throttle cable, instead the throttle pedal was actually an electronic sensor and the powertrain computer controlling all of the engine and transmission functions. When the system worked, it was fine. Unfortunately, many times it didn't work properly. Stanadyne and GM worked diligently and came out with several "updated" fuel injection pumps.

Reliability did improve, but problems still persisted. Longtime owners of these trucks know the problems with these pumps. There are several aftermarket devices designed to extend the life of the pump mounted driver (FSD) and even aftermarket PMDs. They may help but many times only prolong the inevitable failure of the pump. These devices have been on the market for a few years, but the failures of these pumps persist. Indeed for most, it's not a matter of if, only when the pump will fail. The only method this author is aware of to completely eliminate the failures of the DS4 injection pump is to replace the pump entirely!

The issues with the DS4 pump have led many owners to look for something more reliable. The Stanadyne DB2 mechanical fuel injection pumps are the natural choice. They have an excellent reputation for reliability and are bolt in replacements for the electronic DS4 pump. However, lack of information have kept many from making the swap. The DB2 pump uses a throttle cable and if you have an automatic transmission, the transmission and engine controls are integrated into a single computer. Getting the transmission to shift properly with the electronic engine controls removed can be a real problem. Modifying the throttle pedal and dealing with all the other computer controlled components only compound the issue. In the end, just replacing the PMD or the entire DS4 with the "updated pump" seemed the obvious solution, especially if it was still in warranty. This only puts you back to where you started and it's not long before the problems return. So what to do? I say, fit a DB2!



There is a DB2 pump in there!
Throttle cable and cruise control make it obvious
this truck uses a DB2 instead of the dreaded DS4.

Answers to Frequently Asked Questions

1 - I have an automatic transmission. Will it shift properly? Absolutely, it will shift just like it did before the swap - maybe better!

2 - Will the cruise control work? Sure it will. It will require a cheap and easy add on, but the same stalk you have now will do the same thing it does now.

3 - Will the glow plugs/speedometer/check engine light, etc. work? Everything that works on your truck now will work the very same when you are all done. Well, that's not exactly correct. The fuel injection pump will work much better! (The check engine light will only function on automatic transmission vehicles.)

4 - What about the electronic turbo controls? The turbo will work better than new, and the boost will be fully adjustable!

5 - Can my Wife/Daughter/Son/Mom drive the truck when it's converted or do you have to go through a startup procedure or lift the throttle to get it to shift? That's the beauty of this conversion. Your truck will operate exactly as it did. Unless the driver is a very astute 6.5 aficionado, there is no way to know anything has changed. Everything operates exactly as a stock DS4 equipped truck. My wife drives a DB2 equipped Suburban every day and we have two teenage daughters that occasionally drive it with no problems at all.

6 - What are the drawbacks? You won't be a regular customer at your friendly Diesel shop buying the latest DS4 "fix" or see your rig on a tow truck. Other than that, there aren't any!

Planning the Conversion



Here is an early attempt (one of many) at modifying the APP.
I recommend you omit this step!

If you have a manual transmission, its an easy swap. In fact, you can pretty much skip to the next section now! If you have an automatic, the real trick is getting it to shift properly. The conventional wisdom for these conversions has been to retain the factory PCM and fabricate a throttle pedal assembly by modifying the existing APP to operate a throttle cable for the DB2 pump. The factory PCM is very particular about the APP inputs as it relates to shift points. In fact, throttle position is one of the main inputs the transmission

computer uses to determine shift points. If you are off the slightest amount, shifting performance will suffer.

Another problem is the SES light will stay on without the DS4 inputs. Consequently, you will never know if the transmission sets a code. It is almost impossible to fabricate a throttle linkage that will provide the proper signals for the transmission while allowing full range operation of the mechanical DB2 throttle. You may be able to get it close, but it's my experience the shifting will be unacceptable. Typically the problem is light throttle shifting. In most cases, you have to lift off the throttle to get the transmission to shift. It's not the end of the world, but it's not "factory smooth" either. I tried the modified APP method using several different styles of fabricated throttle pedals and eventually abandoned it. I don't recommend this method, if you want the transmission to work properly.

The way I recommend and detail is to install a stand alone transmission computer. There are several reasons for this. It makes a cleaner installation and removes the APP sensor entirely.

With this method, there is no APP/throttle pedal fabrication required. In fact, a throttle pedal from a gas powered truck will bolt right in. The advantage of this method is the transmission shifts exactly as it should and all other aspects of the truck, including the check engine light, work just like they are designed to. There are several



No APP mods required here!
Throttle pedal from a gas engine truck looks right at home.

expensive transmission computers available but there is really no reason to buy one. I'll tell you how to find and install a dead reliable transmission computer available at a modest cost!

If you are thinking of using the DB2 throttle position sensor (TPS) as a replacement for the APP, in a word - don't! It doesn't work. The problem is the original APP has 3 differently scaled outputs and the mechanical pump TPS only has one output. With only one APP input connected, the PCM senses an APP failure and goes into limp home mode and the transmission won't shift properly. The PCM is designed to go into fail-safe mode if it senses APP failure and the single output of the DB2 TPS just cannot duplicate the triple APP outputs. It sure would make life easy if it did work!

Conversion Basics

For automatic transmission vehicles, the centerpiece of the conversion is a new stand alone transmission computer (TCM). You may have seen standalone 4L80E



The GM 4L80E
transmission computer (TCM)

transmission computers advertised at \$800-\$2000. You can pay this much if you want, but you don't need to do so. You may not be aware of this, but GM made DB2 equipped 6.5's with 4L80E transmissions. These are the "Y" code 6.5s. The Y code is a 6.5 non turbo (normally aspirated) diesel. It did not have an EFI pump, instead it used a DB2 mechanical pump. While that's great, our interest is not really the Y code engine but the TCM. What's a TCM? It's GM's term for a transmission computer. TCM stands for Transmission Control Module. The PCM is a Powertrain Control Module. A TCM controls only the transmission. A PCM controls the engine and transmission.

So what does all that mean? It means there are factory GM stand alone 4L80E transmission computers available from salvage yards (or eBay) at a very favorable price. They are designed for a DB2

mounted TPS sensor eliminating the need for the APP. They can be easily rewired into your existing wiring harness and they are designed for mechanically injected 6.5s with 4L80E transmissions. It's hard to believe, but GM actually made exactly what we need! Unfortunately, if you have a 4L60E transmission, these TCMs may not work and I do not know of a comparable GM factory TCM for the 4L60E. There are aftermarket TCMs for 4L60E transmissions you could use.

So where do you find these TCMs? They were used in G and P van chassis. The G vans are regular vans, van front school buses and the like. P chassis are step vans. The TCMs were in the 1994-1996 G vans and the 1994-1999 P chassis. If they have a "Y" code 6.5 diesel (the 8th digit in the VIN will be a Y) and an automatic they have the TCM you need. The GM part number for the TCM is 16196390. If you search for online salvage yard locators, such as www.car-part.com, choose a 3500 or one ton van and look for a non engine or transmission computer.



Don't be surprised if you find a TCM that looks like this one (or worse!). Most were under the seat of delivery vans and no telling what was spilled on them!

The TCM is usually located under the driver's seat, but most places incorrectly list them as in the dash. You can get a good used TCM for about \$150 - sometimes less! They are available rebuilt from GM, but are over \$200, plus a core charge of \$150.

A quick note on 4L80E transmission computers. Some might consider getting a TCM from a 4L80E equipped 1992-1993 6.5 truck. This TCM controls the transmission only and is designed for the DB2 pump and of course the DB2 TPS. Well, it sounds good but there is a problem. In 1994 GM upgraded the 4L80E transmission force motor and spacer plate in the valve body. The newer force motor operates at 614 Hz, vs 292.5 Hz for the 1993 and earlier units, which means they are not compatible with the older TCM. The existing PCM must be retained. Even if you have a manual transmission, it still performs several necessary functions, including controlling the glow plugs. I'm sure you could figure out a way to run without it, but why? It will not cause any problems if you leave it in.

Getting Started

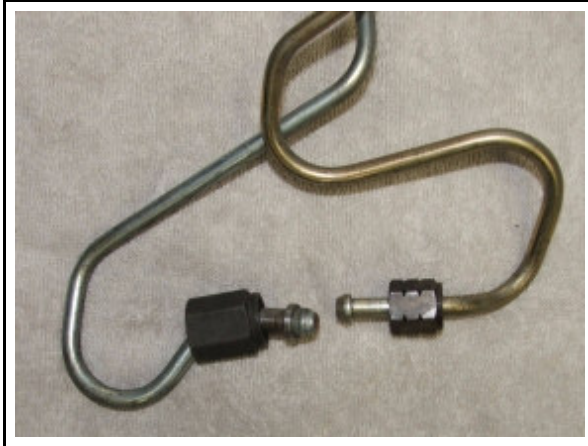
The first step is acquiring the parts necessary for the swap. Obviously, you need a DB2 fuel injection pump. They were made in a number of configurations. The pumps are identified by a model number. It should have a tag on the pump with a number like XX-DB2-831-XXXX followed by more numbers. The first letter & number is the build date code (your Stanadyne dealer can tell you when it was manufactured), DB2 indicates its the pump you want, 831 means it's for an 8 cyl with 6.5 sized plungers. The next 4 numbers indicate the specification of the pump. I recommend the 5088 or 4911 spec pump. These have the 6.5 head & rotor. The 4911 pump is calibrated for a turbo 6.5. There are some hot start problems with the earlier versions of these pumps, so have it checked out before you buy. If you get a 5088, any Stanadyne service center can easily convert it to 4911 specs. Beware of just any DB2 as these pumps



Just your ordinary DB2 equipped 6.5L Turbo Diesel Suburban.
Hard to tell from a DS4 in this picture!

were made for a number of engines and just because its a DB2 that doesn't mean it will work on a 6.5. Unless you buy a new or remanufactured pump, I strongly suggest you take it to a Stanadyne pump rebuilder and have it rebuilt and set to 4911 specifications. If you want more performance, there are 250 & 300 HP "marine" DB2 pumps available from several vendors. While you are at the Stanadyne dealer, get an injection pump gasket set. It will come with all the gaskets you need to install the pump for about \$35.00. Get the turbo gaskets as well.

Parts List



DS4 injector line (silver) is on the left, DB2 injector line (gold) is on the right. Injector ends are the same. The difference is at the pump end.

DS4 fuel injection lines will not fit a DB2, so you need a set of fuel injection lines for a DB2. If buying new, order a set for a 1993 6.5 truck at a cost of \$175 to \$250 for all 8. You should be able to get a used set for around \$100. 6.2 lines will work, but 6.5 lines have a slightly larger ID and would be better. You must use all 8 the same (internal) sized lines. Don't mix 6.2 and 6.5 lines!



The Heath Diesel Turbo Master

In the conversion, you will lose the electronic and vacuum control of the turbo wastegate. The Turbo Master from Bill Heath is what I recommend for wastegate control. It's a simple little device that mechanically controls the wastegate. It works great and is easily adjustable.

Here are the remainder of the parts needed for the conversion with GM part numbers and approximate dealer price:

HPCA sender (cold start switch) 10154649 \$15.00

Throttle Bracket (for single thermostat only) 10183972 \$10.00

Throttle Cable for 1993 6.5 TD truck 15674368 \$25.00

Throttle cable retainer clip 15567924 (order several, in case you drop one)

Timing indicator 10154638 \$5.50

DB2 pump lines; cyl 1-14098631; cyl 2-14098632; cyl 3-14098633; cyl 4-14098634; cyl 5-14098635; cyl 6-14098636; cyl 7-14098637; cyl 8-14098638 \$25 each (new)

These parts can be found at suppliers other than the dealer:

Fan Belt for 1993 6.5 TD truck - (this is the size if you have A/C) 101 5/8", 27/32" wide, 6 rib NAPA NBH25061010 \$28.00

Turbo Master boost controller, available from Bill Heath or Kennedy Diesel \$110.00

Injection pump gasket set, turbo to exhaust manifold gasket and turbo oil return gasket from a Stanadyne dealer Approximately \$40.00

I recommend you get these items from a salvage yard:

24 pin & 32 pin connectors for TCM - This will be covered in detail later

Throttle pedal assembly for 1988-1998 GM truck with gas engine approximately \$20

If you can find one, get the underhood wiring harness from a DB2 equipped truck. If you cannot find it don't worry, it's not too hard to make one.

The following parts are needed if you have an automatic. They are not necessary for a manual transmission truck.

Transmission Control Module (TCM) 16196390 (salvage yard, eBay or dealer)

Engine Speed Sensor (ESS) - This fits in the back of the block in the area a distributor would be in a gas engine. Used; under \$50. New ones are over \$150.

Gasket for ESS 14022649 \$1.00 (dealer item)

Wiring connector for ESS 12085485 new \$20.00 (salvage yard or dealer item)

Throttle Position Sensor (TPS) 10137417 new \$150.00 (salvage yard or dealer item)

Wiring connector for TPS 12117025 new \$23.00 (salvage yard or dealer item)

This should be all the parts required. If you have installed dual thermostats, you will need to modify your thermostat cover and fabricate a throttle cable bracket. You can find an excellent article on this modification in the 2001 Diesel Page reprint, available from The Diesel Page.

When you buy the TCM, TPS and ESS, get the connectors if you can. If not, I have included the GM part number for them but be aware the prices for electrical connectors are expensive. Don't worry too much about the TCM connectors. Connectors that will work are cheap & easy to come by in junkyards. If you are wondering why you need the engine speed sensor (ESS) when you have one on the front of your engine, it's because the electronic pump crank sensor (CPS) sends a digital signal and you need an analog signal for the TCM. Don't get rid of the crank sensor because you will need both.

There are several books I recommend reading before you start work on your truck. First, if you are not a member of "The Diesel Page" I suggest you join.

The Diesel Page is an online membership based web magazine dedicated to GM Diesel trucks. They offer several guides, including a R&R Guide that is very good. I also recommend the Haynes Diesel Engine Repair Manual. If you can find one (eBay is a good place) the factory GM STG manuals covering the 6.5L Diesel Electronic Fuel Injection are invaluable to trace various circuits, etc. The Helms manuals are excellent as well.

The actual installation of the DB2 is straightforward. It's one of the easier steps of the conversion. Everything fits just like they were made for each other, because they were!

I'm not going to cover the actual parts removal & replacement too much as it is detailed in the repair manuals. When there is something you need to know for the conversion, I'll point that out. While you are working on the pump, it's a great time to change the injectors and the water pump, but is not necessary for the new pump to work.

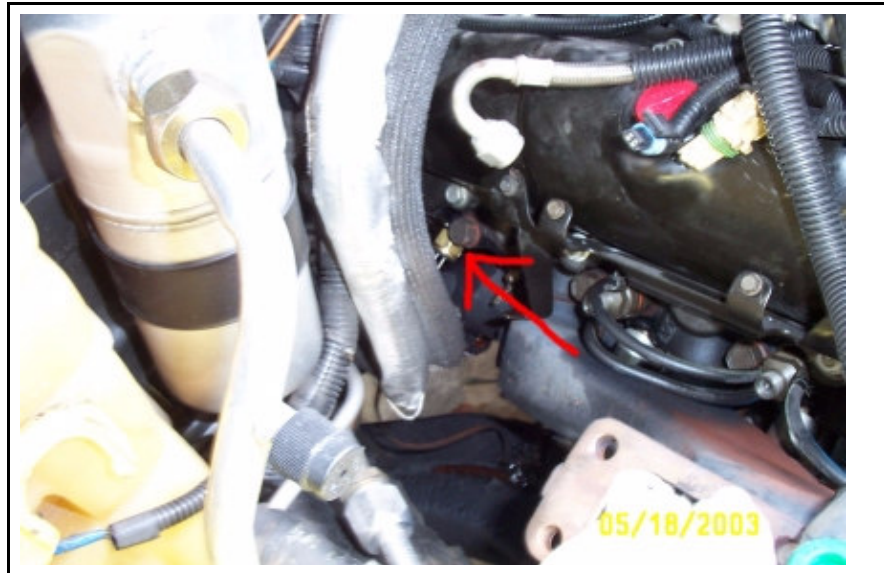
Dirty Hands Time!

Prior to getting started, clean the engine as well as you can. Following the instructions in your repair manual remove the existing DS4 pump and fuel injection lines. Remove all the wires to the DS4, wastegate, etc. and set them to the side. You will need to reuse some of them. I found it easier to remove the turbo to get to the injectors.

While the injector lines & turbo are off, install the HPCA sensor. It fits at the far rear of the RH head. To get an idea of where it goes, look at the front of the LH head. You will see the temperature gauge sensor there. Remembering the heads are the same, the sensor is in the same spot on the other head, but since they are reversed it's all the way in the back. You will have to remove a plug with a square head. It requires a 7/16" 8 point socket to

remove it. Once it's out, put a little sealer on the HPCA sensor and tighten it up.

There are two connectors on the sensor. If you don't have a DB2 wiring harness, just attach two wires with spade connectors to the HPCA sensor. Cut them long enough to reach the front of the engine for now. It doesn't matter which way they go. It's much easier to reach while the turbo is off!



HPCA sensor is a tight fit!
Install it when turbo & injector lines are out of the way.

NOTE - If you have a manual transmission, disregard the instructions on installing the additional transmission computer and relevant components, such as the ESS, TPS, etc. You don't need them!

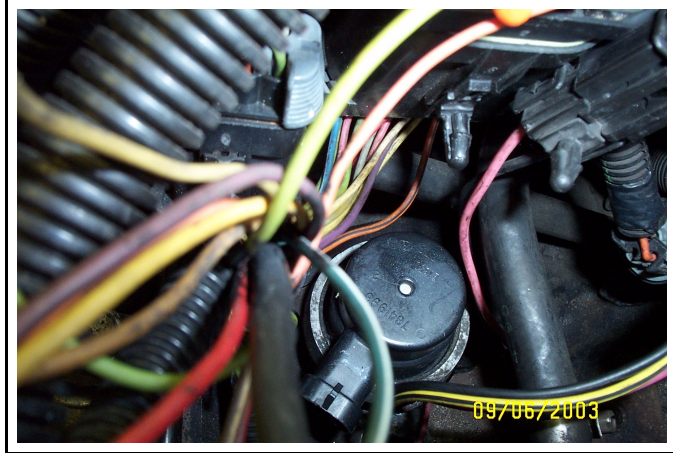
Next install the ESS. It is located under the fuel filter at the back of the engine. Look closely and you will see what looks like the ESS without the black sensor on the top. This is the oil pump drive. It's held in by a fork shaped hold down clamp. Remove the fork and give it a tug. It will come straight up. Install a new gasket and replace the oil pump drive with the Engine Speed Sensor. You may have to twist it to get it to seat. It doesn't need to be timed, just turn it so the wires will clear and bolt it down with the clamp you removed. Make sure it's fully seated because it runs the oil pump.

Connect the wires and set them to the side. The ESS fits under the fuel filter with room to spare. You will not need the oil pump drive you removed.



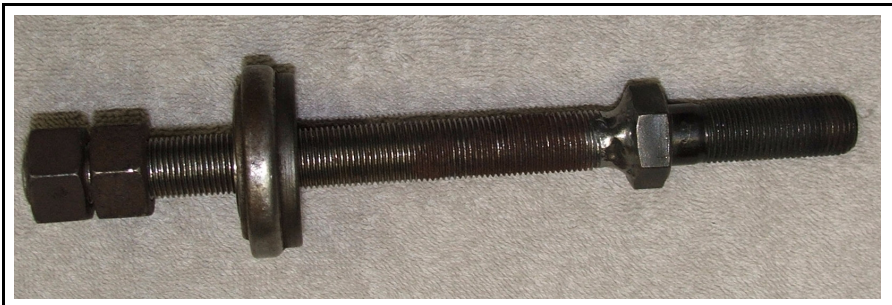
Engine Speed Sensor (ESS) replaces your existing oil pump drive.

If you are replacing the injectors or water pump do them now. Fit the TPS to the DB2 pump if it's not on there and then fit the DB2 and new lines. Don't forget the gasket! This gasket installs dry, no sealer. For initial timing, just set the DB2 pump about in the middle or maybe just somewhat advanced from the middle.

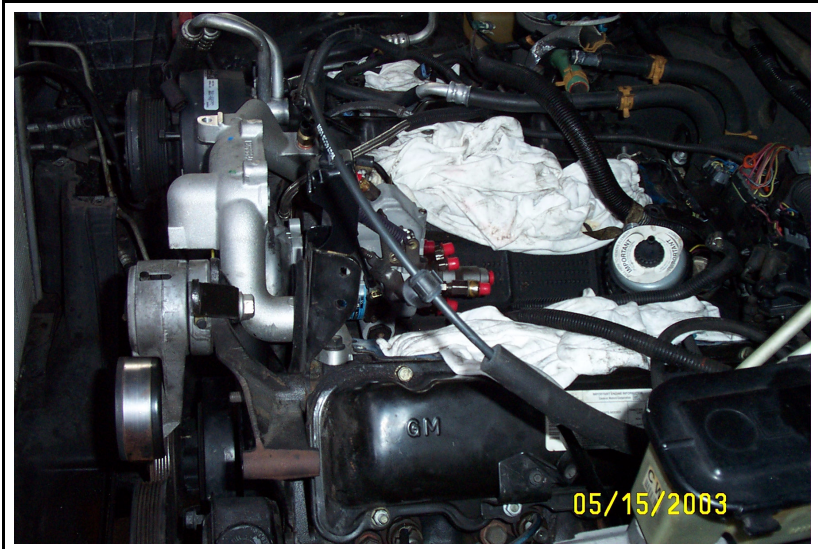


ESS installed in block.
Fuel filter is not installed in this photo.

You will have to cut and reroute the fuel supply line from the fuel filter and the fuel return lines. The DB2 fuel inlet is in the middle of the pump end where the injector lines go. The fuel return is on the top. If you have a single thermostat, you can install the fast idle solenoid. It will not fit if you have the twin thermostat crossover. The truck will work fine without the fast idle solenoid if you increase the idle. Before you button up the front of the engine, install the timing tab. By the way, if you removed the damper don't hammer it on, use an installer tool.



A cheap and easy to make damper installer like this one will save your crankshaft thrust washers from possible damage.



DB2 injection pump and thermostat crossover installed.

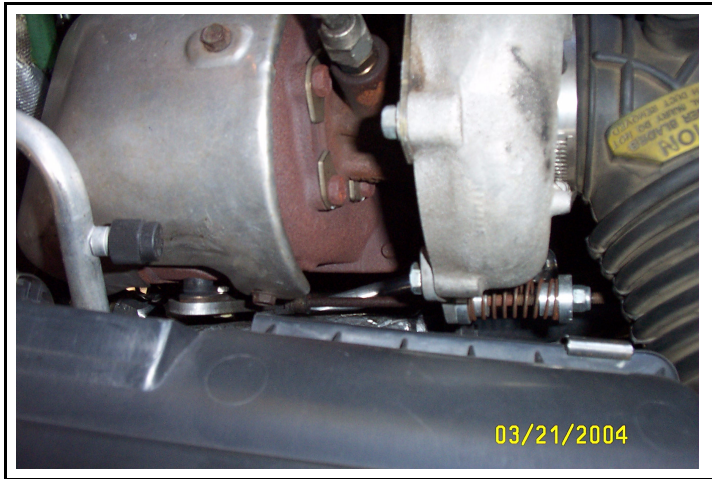
There is a lot more room with turbo, intake manifold & injector lines removed.

Use clean rags to keep debris & tools out of intake ports & exhaust manifold.

This is an early version of throttle cable bracket. It was modified several times to get it where I liked it.



Before you install the turbo, fit the Turbo Master per the instructions. Set it as recommended. There is a gasket between the turbo and exhaust manifold and for the oil return. Replace both with new gaskets. If it's not already off, remove the vacuum pump and lines. Do not refit them, they're no longer necessary! You can also remove the wastegate vacuum solenoid and the EGR ones if you have them. If you have the EGR intake manifold, I would fit a non EGR intake. It's not necessary, but the EGR won't work anymore. The boost sensor & IAT sensors can be removed from the intake manifold if you want, but you will need to plug the holes. If you are fitting a boost gauge, the boost sensor hole is a perfect place to install the tube!



Turbo Master installed on turbocharger.



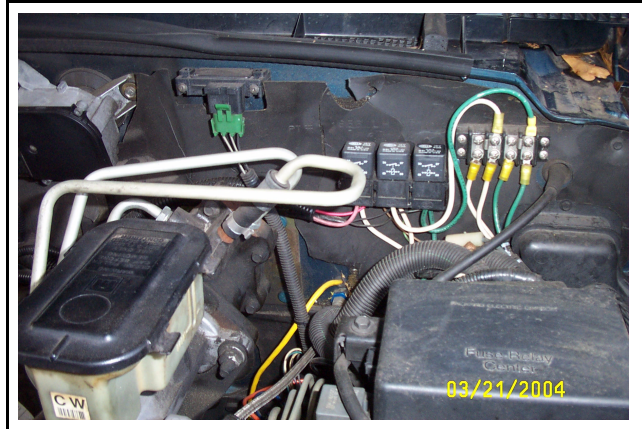
Throttle pedal bolts right in place of APP. APP connector is tied up out of the way. Splices in APP wires are left over from failed experiments!

Inside the truck, remove the APP assembly and install the new gas pedal. It fits in the same holes. Look at the firewall and you will see a plastic plug where the throttle cable fits. Remove it and the gasket. The new throttle cable snaps right in and connects to the throttle pedal. The other end connects to the DB2 pump. Have someone operate the throttle and make sure you have slack in the cable at idle and it completely opens the pump at full throttle.

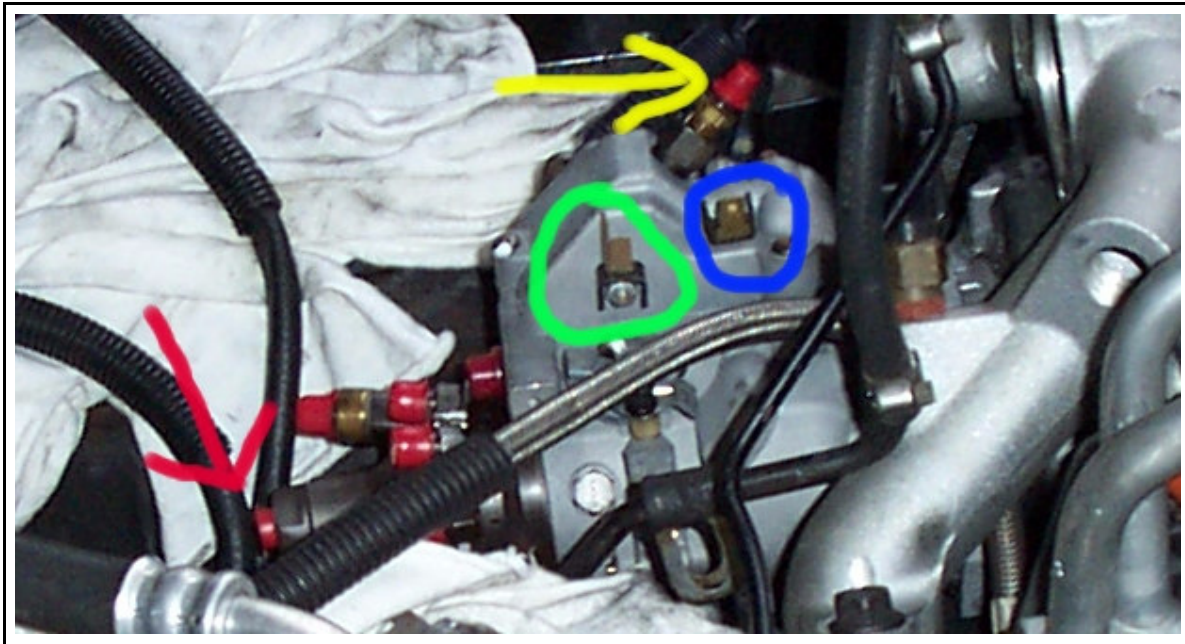
The DB2 pump only requires a couple of wires. The cold start circuit is called the HPCA. It requires 12 volts +. Connect an ignition switched 12 V positive to one side of the HPCA sensor. (These wires should have been installed earlier.)

The other spade connector on the HPCA sensor goes to the HPCA connector on the DB2 pump and the fast idle solenoid if installed. If you did not fit the fast idle solenoid, just tape up the wire and set it out of the way. There is no ground wire to the injection pump. The HPCA sensor closes when cold and opens around 95 degrees. It's a very simple circuit. It advances the pump and really makes the engine rattle when its cold!

The other connector on the pump is the fuel shutoff solenoid. It draws a fair amount of current, as the factory wire is a 12 gauge wire. I could not find a suitable 12V ignition wire in the engine compartment, so I used a relay. I used the power from the underhood fuse box. The relay is a Hella headlight relay. You should be able to find a relay, mount & connectors at your local auto parts store or online from Daniel Stern Lighting. The fuel shutoff needs +12 volts to run, zero to turn off. Use the DS4 fuel shutoff power supply wire (pink) to trigger the relay. If you use a relay, always keep a spare in the glove box as the engine won't run without it!



Hella relay on the left is for injection pump.
Other relays are for Cibie headlights.
However, this area is best used for cruise control box.

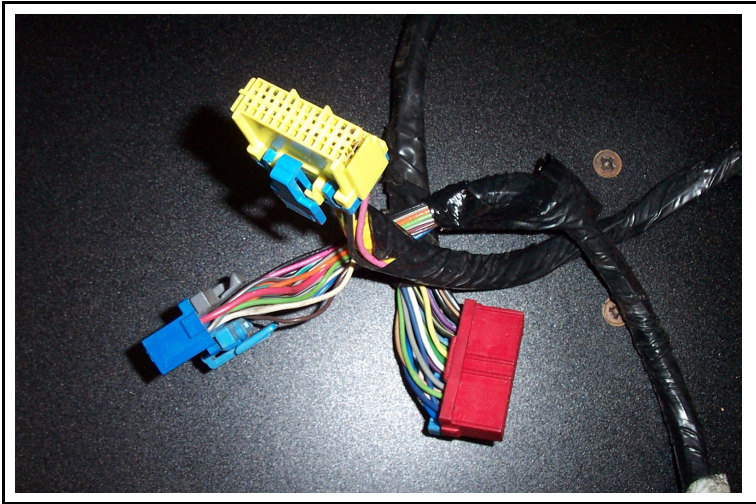


DB2 connections
Red Arrow - Fuel Supply
Yellow Arrow - Fuel Return
Green Circle - HPCA cold start wire
Blue Circle - Fuel Shutoff solenoid

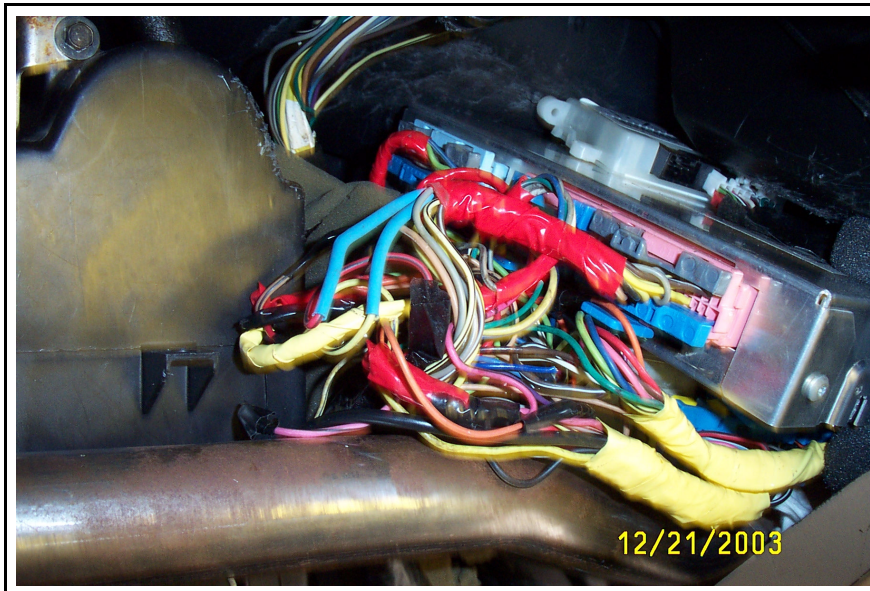
Connecting the New TCM to Your Existing Wiring Harness

This section is for automatic transmission owners only! Manual transmission owners, do not modify the wires to the PCM, except as noted later and for the cruise control.

You will need two connectors, a 24 pin and a 32 pin. They are just like the connectors used on your PCM. You can get these from most any junk GM car or truck with a computer. I recommend you visit a U-Pull-It type salvage yard and cut these from the wiring harness with as much wire as you can. It might be beneficial to get a few spares as well. When you try to install them, they will probably not fit in the TCM. If you look on the bottom of the plugs, there are several small ribs that will not match up to the PCM connectors.



TCM connectors are available in your choice of color!
Most every late model GM vehicle uses these.



Completed TCM/PCM wiring looks like this.
Knowing which wire goes where is of paramount importance!

Just take a utility knife and cut the ribs off. The plugs will now fit correctly and the lock tab will snap in place. You now have the connectors you need and can start on the wiring.

There are two ways to do this. You can cut and splice the wires, but I do not recommend this method. The fewer splices in the wiring harness, the better. The way I suggest is this: Start with the connectors from the junkyard. You will see

two plastic wire holders, one on each side. Remove these, noting there are small numbers molded into them. These are the pin numbers and you will need to know this later. Hold the connector looking at the end that fits into the TCM. You will see two rows of holes on each side.

The inner holes are the actual pins and the outer holes are the clips that hold the pins to the connector. Insert a dental pick or the like into the outer hole and with a bit of wiggling, you can remove the wire from the connector. It takes a bit of practice (that's why you start with the connectors from the junkyard!) but eventually you will get pretty good at it. You want to remove all the wires so you have two empty connectors. Retain the removed wires as you will need some of them later. Next, following the wiring chart, carefully remove the wires (one by one) from the factory PCM connectors and install in the TCM connectors. You probably bent the retaining tabs during removal, so you may have to straighten them to make sure they lock firmly into the connectors. If you break the retaining tab off, you will have to solder a new cable end on the wire. There are several wires that must go to both computers, so these have to be spliced and several new wires have to be installed for the ESS & TPS. This is why you need some of the wires you removed from the connectors. When you have all the wires in, reinstall the wire holders. You should now have 5 separate connectors, 3 for the old PCM and 2 for the new TCM. Double check all your wires and make sure they are in the right place! Don't tape up the bundles as you will need to do some more wiring if you want cruise control.



The boss where the electronic boost sensor went makes an excellent location for the boost gauge hose. Intake air temp sensor is only there to plug hole. Wire is connected to sensor, but ends at manifold. I just thought it looked better with a wire connected to it!
Steel braided hose is for boost pressure gauge. I later rerouted this & changed to a rubber hose.



Installing an inline filter under the truck before the lift pump is a good way to help protect your new injection pump.

I used a Racor R45P filter. It has a water separator on the bottom. It splices in with Earl's hoses.

TCM Wiring Chart

NOTE - This wiring chart is for 1994-1995 OBD I trucks. 1996 and later OBD II trucks use a different wiring harness. You can use this as a guide, but it is not intended to be used for OBD II trucks.

PCM connectors are as follows:

Pink 24 pin connector, PA1-12 & PB1-12

Pink 32 pin connector, PC1-16 & PD1-16

Light Blue 32 pin connector, BC1-16 & BD1-16

Column 1 Existing Harness - These are the existing PCM connectors in your truck. If the location is followed by a "-S" this means this wire is spliced, not removed from the connector.

Column 2 TCM Plugs - These are the two new connectors for the TCM.

Column 3 Color - This is the wire color to help identify the correct wire.

Column 4 Description - This is where the wire goes or what it does.

TCM Wiring Chart

Existing Harness	TCM Plugs	Color	Description
PC1-S	C1	BLK/WHT	Engine Control Module Ground - Splice
PC1-S	C2	BLK/WHT	Connect to C1 - Splice
PD6	C3	BLK	Sensor Return
PC10	C4	GRY	Reference Voltage Feed 5 volt
--	C5-C14	--	Not Used
PC11	C15	LT BLU/WHT	Transmission Force Motor Return
PA1-S	C16	PNK/BLK	Fuse Output - Ignition 1 - Splice
--	D1		Not Used
PC15	D2	BRN	Vehicle Speed Signal (move wire 2WD only)
PD12	D3	DK BLU/WHT	Transmission Input Speed Signal Return
PC12	D4	GRY/RED	Transmission Input Speed Sensor Signal
--	D5	--	Not Used
N/A	D6	NEW	Engine Speed Signal analog signal
PD6	D7	BLK	Sensor Return - Connect to C3
N/A	D8	NEW	Throttle Position Sensor (TPS) Signal
--	D9-D12	--	Not Used
PC9	D13	YEL/BLK	Transmission Temperature Sensor Signal
PC5	D14	GRY/BLK	Barometric Pressure Sensor Signal
--	D15	--	Not Used
PC6	D16	RED/BLK	Transmission Force Motor Feed
--	A1-A2	--	Not Used
BC8	A3	PNK	Transmission Pressure Switch Signal Bit 1
BC9	A4	DK BLUE	Transmission Pressure Switch Signal Bit 2
BC10	A5	RED	Transmission Pressure Switch Signal Bit 3
BC13	A6	YEL/BLK	Shift Solenoid B output - 2-3 shift
BC7	A7	LT GRN	Shift Solenoid A output - 1-2 shift
PA12	A8	WHT/BLK	Diagnostic Enable Signal
--	A9-A11	--	Not Used
BC1-S	A12	ORN	Fuse Output Battery - Splice
--	B1-B2	--	Not Used
PB4	B3	DK GRN	A/C Signal (leave empty if no Air Cond)
BD5	B4	PPL	Brake Pedal Switch Output - TCC
BC11	B5	BLK/BRN	TCC Solenoid Pulse Width Modulated
--	B6-B8	--	Not Used
BC5	B9	BRN/WHT	Service Engine Soon Light
PC14	B10	ORG/BLK	Serial Data Signal
--	B11-B12	--	Not Used

In addition to moving the wires in the wiring chart, you need to do the following:

Install new wires to the TPS and ESS. You also have to rewire the ground and the 5V+ wires on the front mounted crank position sensor (CPS) and the temperature sensor in the thermostat crossover. The existing PCM must be retained to control the glow plugs. The glow plug circuit requires inputs from the temperature sender and the CPS to function properly. All you have to do is cut and rewire several wires in the engine compartment. You will end up using both ends of these wires, so cut carefully. First, cut the black wires from the CPS and the temp sensor. Connect the wires from these two sensors to a new wire that will connect to pin PD6 on the PCM. You also have to cut the gray wire from the CPS and connect to a new wire run to PC10. At the PCM, cut wire PA5 and tape up both ends. This is the wire to the "service throttle" light. This is not entirely necessary, but the light will stay on if you don't cut the wire. You can use this if you want to install a warning light for something else. That's all you need for the PCM, except for the cruise control, which will be covered later.

For the TCM, you need new wires to the TPS and the ESS. Take the wiring harness ends of the ground wires from the temperature sensor and the CPS and you have the two ground wires you need. One connects to either terminal on the ESS. The other connects to the black wire from the TPS. The gray wire that went to the CPS will now go to the gray wire on the TPS. Then you need a new wire from the dark blue wire on the TPS to D8 on the TCM. You have one more new wire, the second wire to the ESS and this connects to TCM pin D6. You now have the wiring completed. Instead of running new wires through the firewall for the underhood components, remember you have a group of wires that went from the PCM to the DS4. Now they are available to be rewired into the new components. Plus, they have pins already on them that will fit into the TCM connectors!

Mounting the TCM



You must remove the PCM tray to gain clearance for both computers.

The TCM & PCM will fit and still allow the glove box to remain. Remove the glove box and you will see the PCM. Remove the PCM and the plastic tray it sits on. Remove the VSSB if it's in the way. Install the TCM where the tray was. There is just enough room to fit the PCM on top of the TCM. Install a thin isolator under the TCM and between the two computer boxes so they won't rattle. They wedge in tightly so you really don't need any hold down straps, but you could get some long zip ties if you want.



I used self adhesive velcro to mount the VSSB on top of the PCM. Once you get everything in place, the glove box will just clear.

If you look very closely, you can just see the TCM under the PCM. It's well hidden. The small white box on top of PCM is the VSSB.

Getting It All Adjusted

The old DS4 had some good points and one of them was that the computer would make pump and boost adjustments. Not so with the DB2. Its up to you to set it correctly. Once it's all set up, you can leave it alone, but you have to get it there first. It's not really too hard, but it does require some special equipment.

First, if you have a stock engine and replaced the pump with a 4911, you can set the timing and probably be OK. You really should set it with a timing meter, but with a little experience, you can get it reasonably close by ear. If it sounds like a Powerstroke it's probably too far advanced! It should rattle on a cold morning the when the cold start is engaged, but it should be (relatively) quiet when it warms up.

If you have a few mods and/or want to bump the boost up, then you will need a way to monitor the engine. There are two gauges that are a requirement. They are a boost gauge and an EGT gauge. The boost gauge will tell you how much boost you have and this is really the only way to fine tune the TurboMaster. Basically, it's as easy as turning the nut on the TurboMaster until you have the boost you want.

The EGT gauge tells you how hard the engine is working and will be necessary to set the fuel ratio. This requires opening the top of the DB2 and adjusting the fuel screw. Excellent instructions for doing this can be found in The Diesel Page 1997 Feature Articles and Product Reviews reprint. You will find the address at the end of this guide.



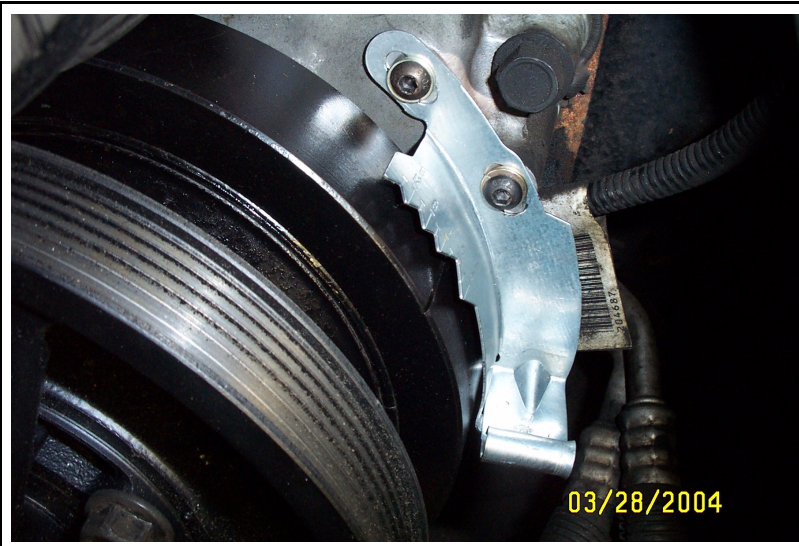
EGT and boost gauges monitor engine in real time and are essential in setting the pump. A pillar mount keeps them visible, yet out of the way.

The final setting is the timing. This sets the exact instant when the fuel is injected into the cylinder. It's basically like setting the ignition timing on a gas engine, but not as easy! There are several ways to do this, but the method I recommend is using a timing meter. A timing meter will have some sort of crank sensor to determine RPM and a Luminosity Probe to determine when the cylinder fires. This probe, sometimes



A timing meter such as this Snap-On Lumy Mag II will help you set the injection pump timing spot on.

called a Lumy Probe, is installed in a glow plug hole (with the glow plug removed, of course). When the cylinder fires, the Lumy probe senses the flash and determines the timing of the injection pump. You can find second hand timing meters on eBay. You should be able to purchase one for \$100-\$200. With the timing meter you can read the exact timing and RPM and see the pump advance, etc. Depending on your engine



You must install a timing tab like this one to hold the probe from the timing meter. Threaded holes are already there.
Caution - Threads are metric!

spec, you may have to try several settings for optimum timing. Beware of going too advanced, as it may give a bit more power but can lead to engine damage. You can hear the rattle at idle get louder as you advance the timing. If it's real loud, it's probably too advanced. A good number to start with is between 2-3 degrees BTDC at 1300 RPM. If you use the timing indicator (this is where the probe from the timing meter fits) in the parts list, the offset is 30 degrees, not 9.5 degrees the 6.2L uses.

My suggestion is to set the timing first, then get the boost where you want it and drive for a while, keeping an eye on the EGT. Keep in mind the EGTs will rise when going up hill and towing.

While there is some debate on what the maximum EGT is, I can give you some guidelines. I would recommend that 1200 degrees is the maximum you want to have. If the highest you ever have under loaded conditions (towing, uphill, etc.) is less than 1000, you could probably increase the fueling. Regularly over 1200, you need to decrease the fuel!



Throttle position sensor (TPS) installs on the DB2 pump. Slots allow adjustment as noted in text.

Once you get the fuel where you want it, reset the boost and you are done. While it may take a bit of work to get the new pump set, once its done, you can leave it alone. With the EGT & boost gauge, you can monitor the engine in real time and see if there is a problem. If you see the EGT is getting too high, just lift your foot off the throttle and it should drop.

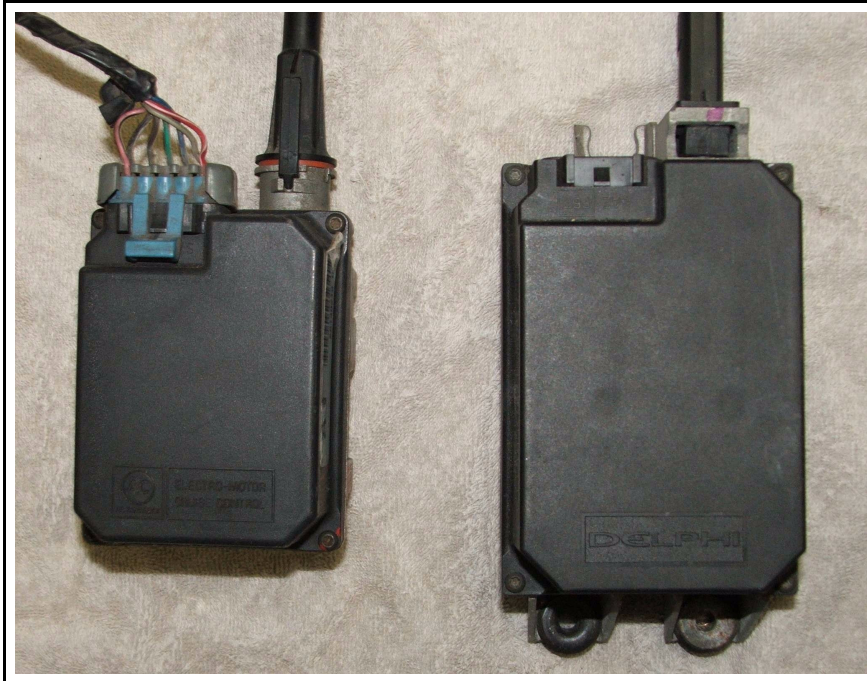
The Throttle Position Sensor (TPS) on the DB2 will also have to be adjusted. This is an important input for the transmission computer. It's much easier if you have a helper when you do this. First, turn the key on but do not start the engine. Next, using a voltmeter, check the voltage between the dark blue and black wires of the TPS (the dark blue is the + side). It should be $\frac{1}{2}$ to $\frac{3}{4}$ volt at idle and 4.2 - 4.5 volts at full throttle. The TPS is slotted, so if the voltage is off loosen the screws and adjust the TPS until you get the proper reading.

Cruise Control

One thing you lose by removing the DS4 pump is the cruise control. The PMD integrated the cruise into the engine management so it's totally incompatible with the mechanical DB2 pump. What's required is a cable operated cruise setup. Many of these are vacuum operated, but since you removed the vacuum pump, there is no vacuum to run it. You can spend about \$200 and buy a non vacuum aftermarket add on cruise, but there is no need to. If you had factory cruise control, you have a perfectly good set of cruise switches right there on the turn signal stalk. All you need is an electronic box that will take your existing inputs and pull another throttle cable routed to the DB2. Again, GM has provided exactly just what we need.

GM made dozens of vehicles with Electro-Motor cruise boxes. These are completely stand alone electronic (no vacuum required!) cable operated cruise control modules. They use standard GM cruise switches, just like the ones you already have. They can be easily wired to your wiring harness. With just a little additional fabrication to your throttle cable bracket and attaching a few wires, you are cruising!

You can find the Electro Motor box in salvage yards or on eBay for \$25-\$50. The actual boxes are almost all the same, but the cables are specific to each car.

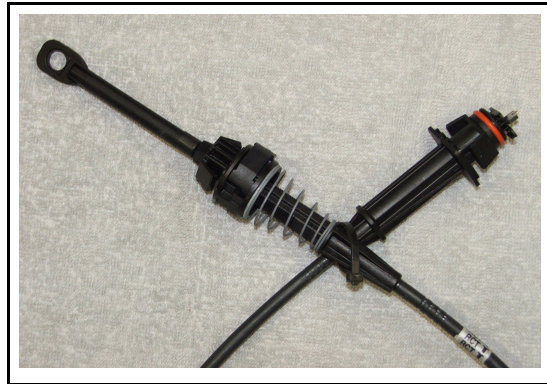
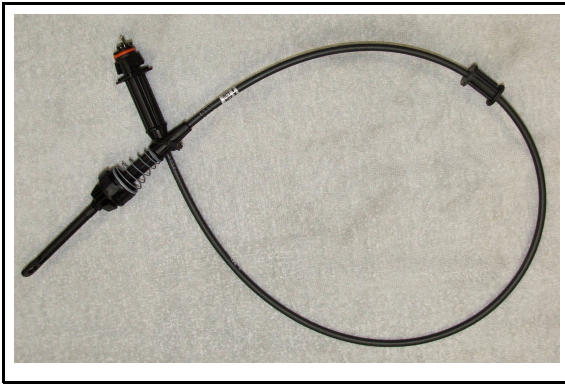


Electro Motor cruise control boxes are available at most any salvage yard.

They come in two sizes, you need the larger one as shown on the right. It is easily identified by the cast in mounting tabs, two on the bottom and one on the top.

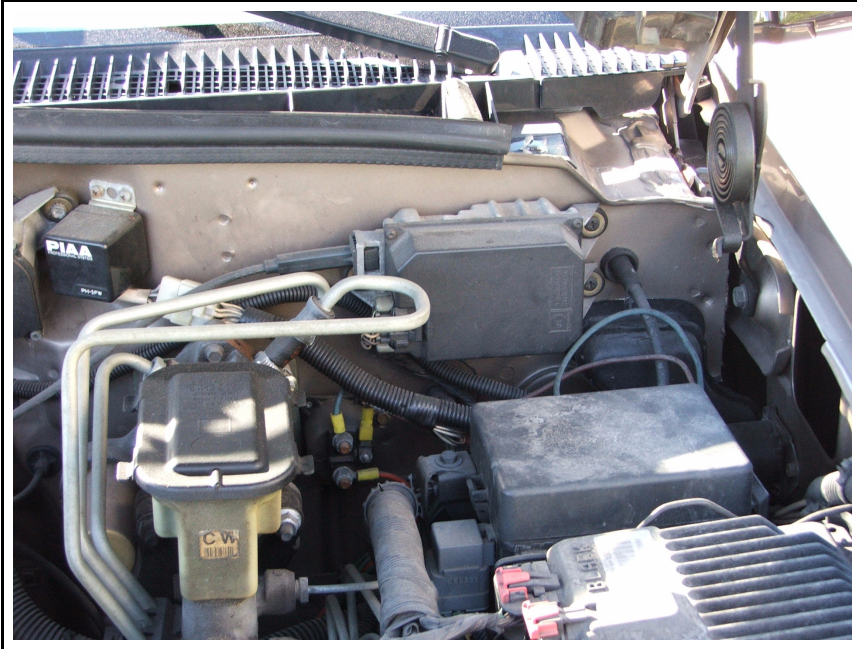
Make sure you get the wiring loom connector as shown on the left. You will need it to wire it up.

Newer boxes say Delphi, the older ones say AC but are basically the same.



The cable shown above is the factory cable to connect to the DB2 pump, which can be ordered at any GM dealer.

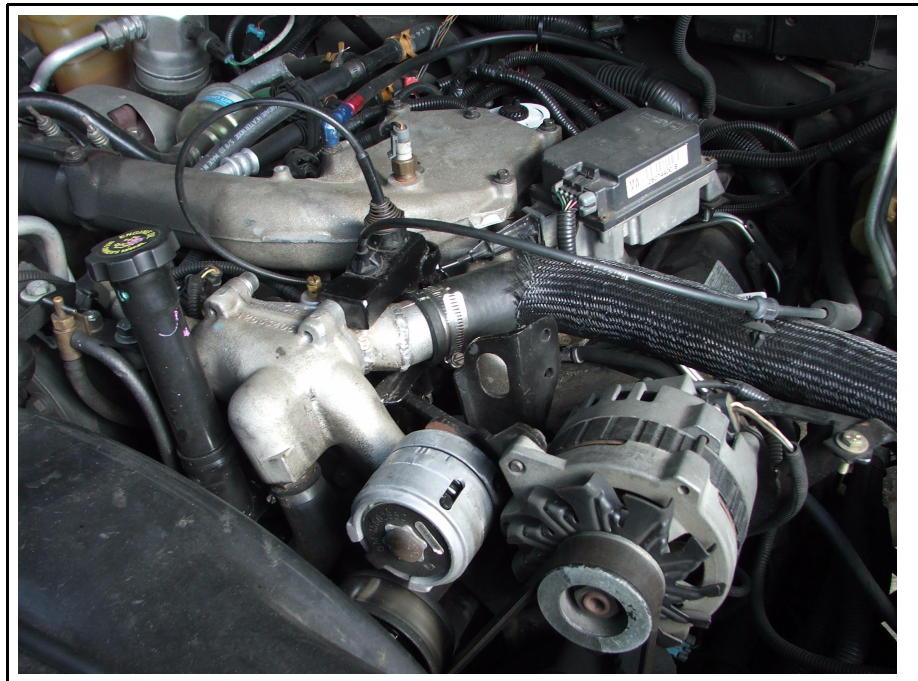
You will have a very hard time finding the correct cruise box at a salvage yard, so just get a good one (make sure it's the larger one, as shown above) from a GM car or truck. Then, go to any GM dealer and order part # 15679743 which is the correct cable for these boxes to work with a DB2 pump. The cable is around \$30. Install the cable on your box and presto, you have the setup you need! The factory bracket that mounts the cruise cable to the throttle bracket is no longer available. It shouldn't be too hard to fabricate a small tab to hold the cable. Other GM vehicles used a similar cable end, so you may be able to find a suitable bracket at the salvage yard. When you buy a cruise module, make sure you get the wiring loom connector. You will need it to wire up the cruise unit. U Pull It type junkyards are great for finding these type parts.



Here is a factory installed cruise control box on a big block gas powered Suburban. This is the preferred mounting location. The factory 6.5 cruise cable is designed for this mounting spot.

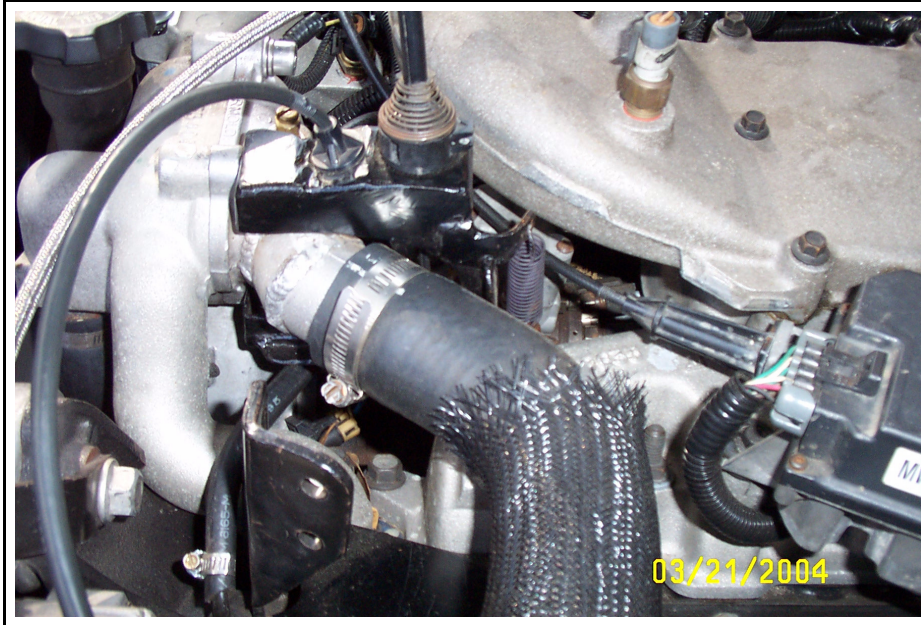
The best place to mount the Electro Motor cruise control box is on the firewall. This is where the factory mounts it in gas truck applications and there are indentations in the firewall for the mounting screws. If you buy the factory cable, the length is designed for firewall mounting. Having said that, I had previously used the firewall to mount headlight relays, so I mounted mine on the engine, using the cable which was included with the control box. **See Note on page 24**

I was concerned the heat and vibration from the engine would damage the cruise unit, but it hasn't been a problem. I used the old boost solenoid mounting bracket and modified it to mount the back of the Electro-Motor box. I bolted the front to the tapped hole in the intake manifold where the engine cover was located. Again, I recommend the firewall, but really, it can be mounted anywhere it will fit. Once you get the mechanical bits sorted out, it's time to wire up the box.



Above is the alternative mounting location for cruise box. This one uses a modified S-10 cable that goes under cable bracket and loops over to throttle arm.

Most of the wires you need are at the PCM. You have to remove the wires from the PCM and reroute them to the Electro Motor cruise box. Again, its just a matter of following the wiring diagram. Please follow the special wiring notes! Instead of running new wires through the firewall, I spliced them into the unused wires that were used on the removed electronic DS4 components. Once you get the wires sorted, splice them onto the connector to the cruise box and that's it! The cruise will work exactly as it did before.



NOTE - I suggest you do this quick test before you mount it. First, temporarily connect the cruise box (inside the truck) straight to the wires from the PCM. It's probably a good idea to have a helper with you. Pick a deserted road for the next step. With it assembled inside the cab, have your helper hold the cable as you drive. Then while at speed, engage the cruise. Let the truck coast (don't press the brake!) and as the truck loses speed, the cable should start pulling. The slower you go, the more cable it should pull. Then speed up and the cable should relax. If you hit the brake or

If you have twin thermostats, you will have to fabricate a throttle & cruise cable bracket. The 2001 Diesel Page reprint contains an excellent "how to" for this. Throttle cable bracket shown here is a little different to the one shown in the article. This one has the ability to be removed with the thermostat cover in place. Also, the return spring mounts rearward. Pieces from the factory throttle cable mount & a cruise cable bracket from a salvage yard were used in the fabrication of the finished bracket. Ideally, the cruise cable should slant slightly for more clearance. Twin thermostat cover must be modified to clear cables.

switch it off, it should immediately release. Test all the cruise buttons and when you are satisfied that all is OK, you can install it in the engine compartment.

Special Cruise Control Wiring Notes - Very Important!!

The Electro-Motor cruise control uses a 10 pin connector labeled with letters A thru K, except there is no "I".

Two of the wires must be spliced into existing wires going to the computer(s). **WIRING IS DIFFERENT FOR AUTOMATIC & MANUAL TRANSMISSIONS!!** Automatic "D" splices into the TCM (Transmission computer) wire B4. Manual transmission "D" splices into BD5. For both, "F" splices into PCM (Powertrain computer) wire PA1. Do not remove these two wires from their respective computers.

Wires A,B,C,F,G & K in column 3 are removed from the PCM - that is, you want the wires that are going to the PCM. Do not connect these to the PCM! Again, these are the wires connecting to the cruise control box to the cruise buttons on the stalk.

E & H can be connected to any ground in the engine compartment and J is not used.

Cruise Control Wiring Chart

Column 1 Existing Harness - These are the existing PCM / new TCM connectors in your truck. If the location is followed by a "-S" this means this wire is spliced, not removed from the connector.

Column 2 Wire Color - This is the wire color to help identify the correct wire.

Column 3 E-M Cruise Connector - This is the new connector for the cruise module.

Column 4 Description - This is where the wire goes or what it does.

Existing Harness	Wire Color	E-M Cruise Connector	Description/Notes
BD3	GRAY	A	On/Off
BD15	DK BLUE	B	Set/Coast
BD11	GRAY/BLK	C	Resume/Accel
TCM B4-S	PURPLE	D	Brake Signal- Automatic Splice to TCM wire B4
BD5-S	PURPLE	D	Brake Signal- Manual trans - Splice to BD5
-----	New wire	E	Ground
PA1-S	PINK/BLK	F	Ignition - Splice to PCM wire PA1
PA7	WHITE	G	Stop Lamps
-----	New Wire	H	Inhibit - Connect to ground
-----	Not Used	J	Engaged - Not Used
BD8	GRN/WHITE	K	Speed

Driving Impressions

After living with a DB2 converted 6.5 turbo diesel Suburban for over 30,000 miles, I can tell you everything is great. It starts right up, shifts like it should, has good power and never stumbles. I don't worry when the PMD is going to fail. The Suburban drives pretty much as it did with a DS4. When you turn the key, the SES light comes on with the other warning lights and the glow plugs operate the same. After starting, the SES light goes out, just like it should. Cruise works exactly as before. Hit the throttle pedal and the boost jumps up. The new TCM programming is firm but not harsh. These transmission computers came out of commercial type vehicles and the programming is designed for heavy duty use. They are tailored for a DB2 so the shift points match up perfectly with the new pump. In reality, it performs just like any other 6.5 Turbo Diesel. Well, really that's not true. It doesn't stumble or shut off when the PMD fails!

Suggested Tweaks

The “Service Throttle Soon” light is no longer used. Since there isn't an APP, you don't need this. However, you can utilize this if you want. For example, one might connect it to a fuel pressure sensor to alert you to a non working lift pump. Automatic owners cut this wire earlier at the PCM. Manual transmission owners will find this wire at the PCM, at connector PA5. It's a simple matter to splice it to whatever you choose for a warning light. Manual transmission owners, if you want to find the wire for the SES light, its at BC5. Cutting this wire will turn off the SES light.

If you want to increase the glow plug time, all you need to do is install a resistor in line to the yellow wire connecting to the temperature sensor on the crossover. This sensor is used by the PCM to determine engine temp and set glow plug time. By tricking the PCM into thinking the engine is colder than it really is, glow time is increased. You will have to play with the values, but 1000 to 5000 ohms should be about right. The higher the ohms, the more time you add to the glow plugs. There is an article detailing this in the Diesel Page 2003 Feature Articles & Product Reviews. The article shows installing a relay, but you won't need it as there is no worry about the sensor providing the wrong value for anything else as the other components that used this sensor have been removed.

If you want to modify the automatic transmission programming, there are several options. Any of the electrical add on shift modifiers will work. B&M make a cheap and easy unit to firm up the shifts if that's all you want. It has a 3 position switch, stock, firm and too much! I have this unit set to firm and it works great for our needs. There are several other aftermarket shift improvers that connect into the wiring to the 4L80E. You may need to trace a few wires, but this should be easy if you did the wiring to the new TCM. I can't see why you would want to, but the TCM does have a removable EPROM. It is possible to install a reprogrammed chip to change the transmission behavior. Finding one might be tricky, however Jet uses the same TCM in their stand alone systems so they may sell a chip separately.

DTC Codes for Automatic Transmission

The transmission computer can help diagnose transmission problems. It will set diagnostic trouble codes, just like the old PCM would. If the “Service Engine” light comes on, this means the TCM has set a code and there may be a problem with the transmission. The following list are the codes and what they mean. Check the codes using the same procedure as the old PCM, by shorting the two upper right hand pins in the data link connector under the dash.

You can find instructions on reading the codes at Kennedy Diesel's website under “Tech Tips, 6.5L Tips, Read Codes”. If you want to test the system, unplug the TPS or ESS connector and start the truck. The warning light should come on and you can then read the code. After reading the code, reconnect the sensor and all will be fine again. The system will NOT alert you of any problems with the DB2 injection pump, overboost conditions, etc. Engine malfunctions will not set any codes, only the transmission or related sensors. The following chart lists the DTC codes the transmission computer may set.

Diagnostic Trouble Code (DTC) Chart

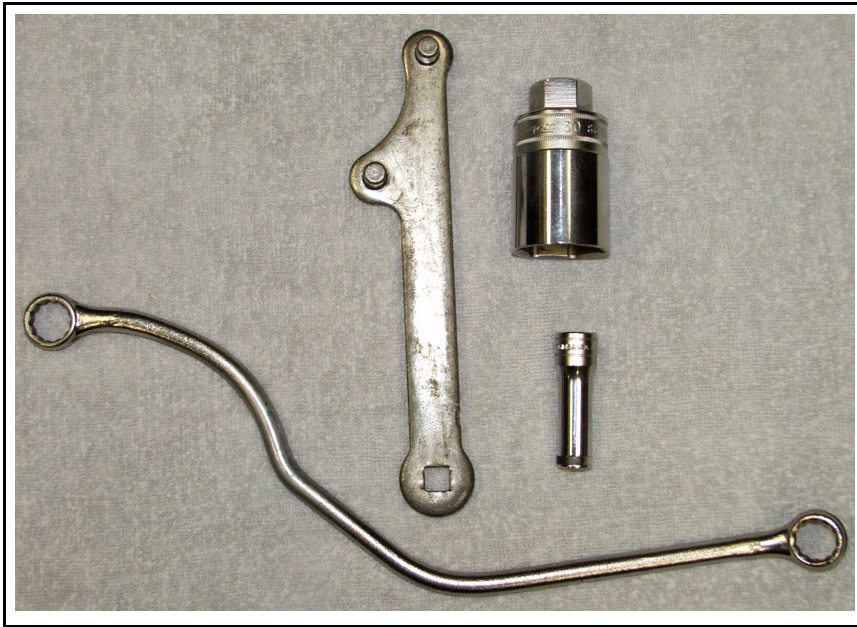
DTC	Description
21	Throttle Position Sensor Circuit High Voltage
22	Throttle Position Sensor Circuit Low Voltage
24	Output Shaft Speed (OSS) Sensor Low
28	TFP Valve Position Switch
37	TCC Brake Switch Low Input
38	TCC Brake Switch High Input
39	Torque Converter Clutch (TCC) Stuck OFF
51	Prom Error
52	System Voltage High Long
53	System Voltage High
58	Trans Fluid Temperature (TFT) Sensor Circuit High
59	Trans Fluid Temperature (TFT) Sensor Circuit Low
63	BARO Sensor Circuit High
64	BARO Sensor Circuit High
68	Transmission Component Slipping
69	Torque Converter Clutch (TCC) Stuck ON
71	Engine Speed Sensor (ESS) Circuit Low
72	Transmission Output Shaft Speed (OSS) Sensor Circuit Loss
73	Pressure Control Solenoid (PC Sol) Valve Electrical
74	Automatic Trans Input Shaft Speed (A/T ISS) Sensor Circuit
75	System Voltage Low
79	Transmission Fluid Over temperature
81	2-3 Shift Solenoid (2-3 SS) Valve Circuit Fault
82	1-2 Shift Solenoid (1-2 SS) Valve Circuit Fault
83	TCC PWM Valve Circuit Fault
85	Undefined Gear Ratio
86	Low Ratio Error
87	High Ratio Error

Special Tools for the GM 6.5L

There are several special tools made that, while not entirely necessary, can make it easier to work on the 6.5.

Snap-On makes a special 30mm socket just for the fuel injectors, S6128 for \$43.00. They also make a special 3/8 socket just for the glow plugs, S6105A for \$22.05.

Kent-Moore makes several tools, including one that really comes in handy. Its a DB2 fastener wrench, J-41089. This is made to reach the injection pump nuts. These nuts can be a real maneuver to get to. Unfortunately, this wrench is no longer made but they can be found on eBay from time to time. Another Kent Moore tool worth having is the DB2 pump turning wrench J-29872-A. This tool is still available new, but for a jaw dropping \$92.00! These (or the no longer made Snap On equivalent S6133) can be found on eBay as well, usually for much less cost.



Special 6.5 Tools

Kent Moore Injection Pump turning wrench is in center

Snap On Injector socket, top right.

Snap On glow plug socket, bottom right
Note tab on bottom of socket to hold glow plug.

The no longer made Kent Moore DB2 fastener wrench on bottom

Glossary

4L80E - GM heavy duty 4 speed overdrive transmission, electronically controlled.

APP - Accelerator Pedal Position Sensor, electronic throttle sensor used in "drive by wire" systems, reports throttle position to PCM. Triple redundant system.

CPS - Crankshaft Position Sensor - mounted on the front of the engine, sends digital signal of engine speed & position to the PCM.

DB2 - Stanadyne mechanical fuel injection pump.

DS4 - Stanadyne electronic fuel injection pump.

DTC - Diagnostic Trouble Code.

ESS - Analog Engine Speed Sensor mounts on the back of the engine.

HPCA - High Pressure Cold Advance, the "cold start" circuit for a DB2 pump.

PCM - Powertrain Control Module, computer that controls engine & transmission.

PMD - Pump Mounted Driver, electronic brain box, mounts on DS4 pump. Well known for unreliability. Sometimes called the "FSD" (Fuel Solenoid Driver)

SES - Service Engine Soon light, also known as check engine light.

TCM - Transmission Control Module - GM computer controls transmission functions.

TPS - Throttle Position Sensor mounts on DB2 pump, reports position of throttle pedal to computer.

VSSB - Vehicle Speed Sensor Buffer Module, converts speed signals from trans sensors for use in vehicle computers.

Part Suppliers

The Diesel Page is an online membership based web magazine dedicated to GM Diesel trucks. <http://www.thedieselpage.com>

Car-Part Online Salvage yard parts locator (trans computer, used parts.)
<http://www.car-part.com>

The Diesel Depot - New & used GM Diesel engines & parts (ESS, injector lines, etc.)
(800) 553-8192 <http://www.thedieselpage.com/vendors/avant.htm>

Heath Diesel Power - 6.5 parts, Turbo Master, injection pumps. (877) 894-6266
<http://www.heathdiesel.com>

Kennedy Diesel - 6.5 parts, Turbo Master, injection pumps. (715) 255-9499
<http://www.kennedydiesel.com>

B&M Transmissions - Shift improvers. <http://www.bmracing.com>

Jet Transmissions - Transmission computers & parts. <http://www.jetchip.com>

Powertrain Control Solutions - Stand alone transmission controllers
<http://www.powertraincontrolsolutions.com>

Daniel Stern Lighting - Relays. <http://www.danielsternlighting.com>

Racor Filters - <http://www.parker.com/ead/cm1.asp?cmid=392>

Snap On Tools - <http://www.snapon.com>

Kent-Moore Tools - <http://www.etoolecart.com>

Racor Filter Installation -
<http://home.bellsouth.net/p/s/community.dll?ep=87&subpageid=24541&ck=>

Bobbie Martin - DB2 Conversion Guides, tech help, damper installers, used throttle pedals, TCM computer plugs - email address: mini1275@bellsouth.net