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Digital Data Systems Directly Online

In Association with:

Perfect Power

Introduces:

E-TUNE DIY TUNING MANUAL

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1. INTRODUCTION

Welcome to the E-TUNE Technical Manual. Before getting excited about your purchase and installing it, I like you to acknowledge the following disclaimer:

Working with engines is dangerous. If you have no experience with this, then seek help from experienced installers. Tuning an engine is dangerous as well, and can damage the engine. The danger is in tuning the engine too "LEAN", which increases exhaust temperatures and may lead to valve damage. Having said this, I only experienced ONE valve failure in my life, done by a person in Germany, doing 220Km/h on full throttle with a super lean engine for 5 minutes. So, relax, with simple common sense you are good, and if in doubt go a little "RICH".

2. THE AIM OF THE E-TUNE

The purpose or aim of the E-TUNE is to provide a fuel-controlling unit with a "Plug-and-Play" facility. The E-TUNE is slightly more expensive than traditional piggyback products, but it requires no engineering, no cutting of wires and installs in minutes. In other words, it is GUARANTEED to work!

The E-TUNE applies to the environmentally conscious installer, who would like to reduce fuel consumption or maximize the best possible fuel consumption in various situations, or it serves as an Ethanol adaptor. The E-TUNE also applies to the "performance" enthusiast, who would like to run his/her engine at the most powerful fuel ratio possible. Equally, the E-TUNE applies to aftermarket turbo and supercharger installations, which require more fuel under full boost. The performance side may require some engineering.

In any event, the E-TUNE simply connects to the fuel-injected petrol engine's injector connectors, and this completes the minimum or basic installation for modifying fuel.

There are more powerful units available for the ultimate performance enthusiast but not with this DIY capability and with this performance/price ratio.

3. WHO SHOULD READ THIS?

With tongue-in-cheek I like to say: No one! That's because I designed it, and I believe the subject to be boring. However, if you have a question, or you wonder about certain aspects, then you may read on.

More practical: If you apply the unit for Ethanol, then read the Ethanol and installation section. If you like to 'tune' your engine, skip the Ethanol section and choose a section applicable to you from the following road map.

3.1 MANUAL ORGANISATION

This manual is structured around the E-TUNE application as follows and amount of "TUNING" to be done. The following table explains it:

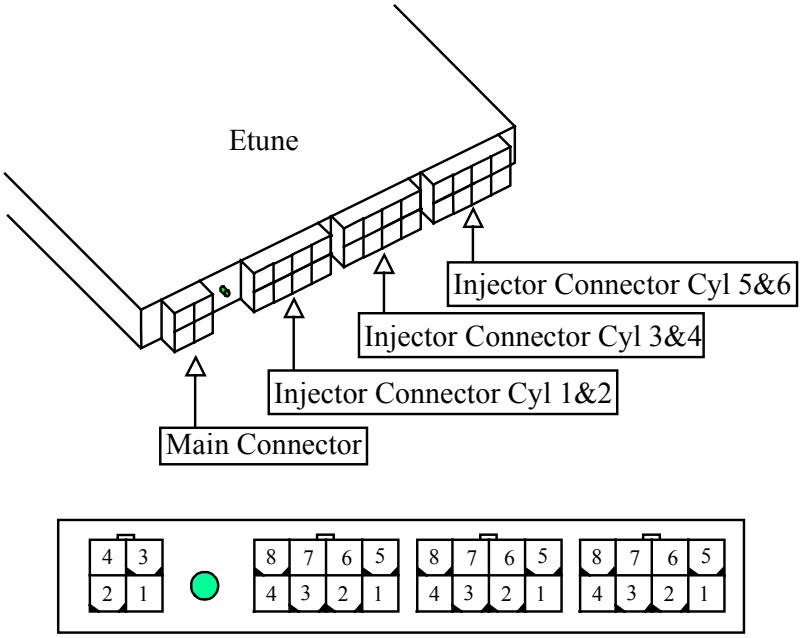
Application	Fuel change	PC required	Engineering	Installation	Section
Ethanol	0-33% manual	No	No	BASIC	**Ethanol**
Fuel	0-33% manual	No	No	BASIC	**Fuel UP**
Fuel	+-50% manual	Yes	No	BASIC	**Fuel Tuning**
Fuel	Automatic	Yes	Yes	ADVANCED	**Adv. Tuning**

There are other units available for Ethanol with automatic fuel change, and there are other units for Fuel tuning in the Perfect Power SMT8 range.

4. CONNECTIONS

The E-TUNE has a 4 pin auxiliary connector and an 8-pin connector for every 2 cylinders.

4.1 PIN-OUT TABLE



E-TUNE PINS

E-TUNE Main Connector (4 Pin Connector)

Pin	Signal	Description
1	GROUND	CHASSIS
2	RS232	Rx/Tx signal
3	3.3V SUPPLY	Potentiometer pull up
4	POTI/LOAD	0-5V Load input

INJECTOR HARNESS FOR TWO CYLINDERS

PIN	DESCRIPTION	SIGNAL	I/O
1	INJECTOR #2 DRIVE	IJ2	O
2	GROUND	GND	O Chassis
3	INJECTOR #1 DRIVE	INJ1	O
4	COMMON FOR IJ1, IJ2	+12	O
5	ECU INJECTION #2	E2B	I
6	ECU INJECTION #2	E2A	I
7	ECU INECTION #1	E1B	I
8	ECU INJECTION #1	EIA	I

Note: The above injector numbering applies to all cylinders.
Cylinder/Injector #1 stands for: #1, #3, #5
Cylinder/Injector #2 stands for: #2, #4, #6

5. ETHANOL

If you don't know this stuff then read on. Ethanol is a BIOFUEL made from sugarcane or maize or any other fermentable produce. It is mixed with 15% carbon fuel and called E85, and supposed to be sold cheaper than carbon fuel.

5.1 GOOD AND BAD

Ethanol is an alcohol and thus can be diluted with water. It has a very high flaming point. The result of this is that Ethanol does not burn at 0 Centigrade. When it burns it approx. 28% less energy per volume, which means you need more fuel to travel the same distance. The stuff is not readily available when you want it.
Having said all this: Why would anyone tank this stuff? Here is why:
It burns absolutely clean (discounting the 15% carbon in E85), it is renewable, and it is supposed to be cheap. It also has a very high OCTANE rating. Effectively the octane number can't be measured with the present system.
Ethanol applications can be divided in to two areas:

5.2 LESS POLUTION, CHEAPER TRANSPORT

Most people fall in to this category. What ever your motivation, the engine will last longer, but you may have to replace some old rubber fuel components which are not compatible with alcohol.

5.3 MORE PERFORMANCE

Depending on your engine you may get 5-8% more power from your engine, provided you put 33% more fuel in to the engine when driving on E85. If you plan to modify your engine, raise the compression, or change the ignition timing, or use forced induction, then the very high Octane rating of E85 does wonders for you.

5.4 APPLICATION

It uses the **BASIC INSTALLATION**.

No PC interface is required. Ethanol requires up to 33% more fuel. Depending on other factors, the maximum may be 29%. In any event, this is not a science. If you are within 5-10% of the actual number then you are OK, as long as the engine feels OK, and you are not operating at full throttle.

Our experience with Ethanol is as follows:

COLD STARTING: Full 33% until engine is warm then reduce fuel until comfortable.

CRUISING: 10-25%! Save as much fuel as possible. If the engine feels sluggish during a sudden acceleration, then you are too lean. You will be surprised as to how much fuel you can save!

FULL THROTTLE: 25-33%! DO NOT SAVE FUEL! You are demanding power – give it fuel!

You may get 5-8% more power out! **To take the car up on full power you require a laptop. With it you have to check once that the injectors are not "maxing out".**
See: PC OPERATIONS, DISPLAY

The above figures are based on pure E85. Unless you have flushed the tank this is hardly applicable. The actual fuel addition is depending on the TANK MIXTURE as follows:

E85	**Fuel**	**Ethanol**	**Addition**	
100%	15%	85%	29-33%	Full tank E85
50%	57.5%	42.5%	14-16%	Half tank fuel, half tank E85
0	100%	0%	0	Full tank fuel

Any tank mixture in-between can be judged, unless you operating the engine at full throttle as outlined above.

NOTE: The Ethanol application does NOT benefit from the ADVANCED INSTALLATION. For automatic ETHANOL TANK MIXTURE RECOGNITION a different unit is available. This unit adjusts the fuel addition automatically by monitoring the engine behavior. This unit is not for DIY application.

6. FUEL UP

It uses the **BASIC INSTALLATION**.

No PC is required, unless you like to display some engine measurements. If you are performance orientated then I suggest connecting a laptop while you are driving.

In this mode you can add up to 33% fuel by turning the potentiometer fully clockwise, or any value in-between. This mode of operation is used when you:

a. Lowered the fuel pressure (New regulator?)
b. Improved the airflow and require more fuel
c. Installed a free-flow exhaust system
d. Improved the engine power

In most of the above applications you would (eventually) proceed to the next section, because it gives you MUCH MORE flexibility.

7. FUEL TUNING

This operation requires a PC or laptop computer. With the PC you can REPLACE the loaded default map with your own map, and you can load any of the supplied application maps from the CD.

The deflection is from the potentiometer, and the RPM come from the engine. Now you can set a fuel addition (or subtraction) for any of the 384 map sites, although the 16 deflection (y) columns are chosen by the potentiometer.

This is great, but better performance is achieved in the next section with a little engineering.
In the FUEL TUNING mode you can chose between 16 (manual deflection) columns each having 24-RPM sites. Each site can adjust the fuel down by 50% (Enter -50) or up by 50% (enter 50).

Here are some applications:

a. Higher fuel pressure, lower injection times at all points
b. Bigger injectors, lower injection times at all map points
c. More injection at low RPM for off-road performance
d. Improved engine power requires fuel enhancement at certain spots

Check the PC operation; it gives valuable hints as to the display and calibration.

This mode is limited by the MANUAL DEFLECTION (potentiometer) adjustment. But, without any engineering you can get more fuel in to the engine.

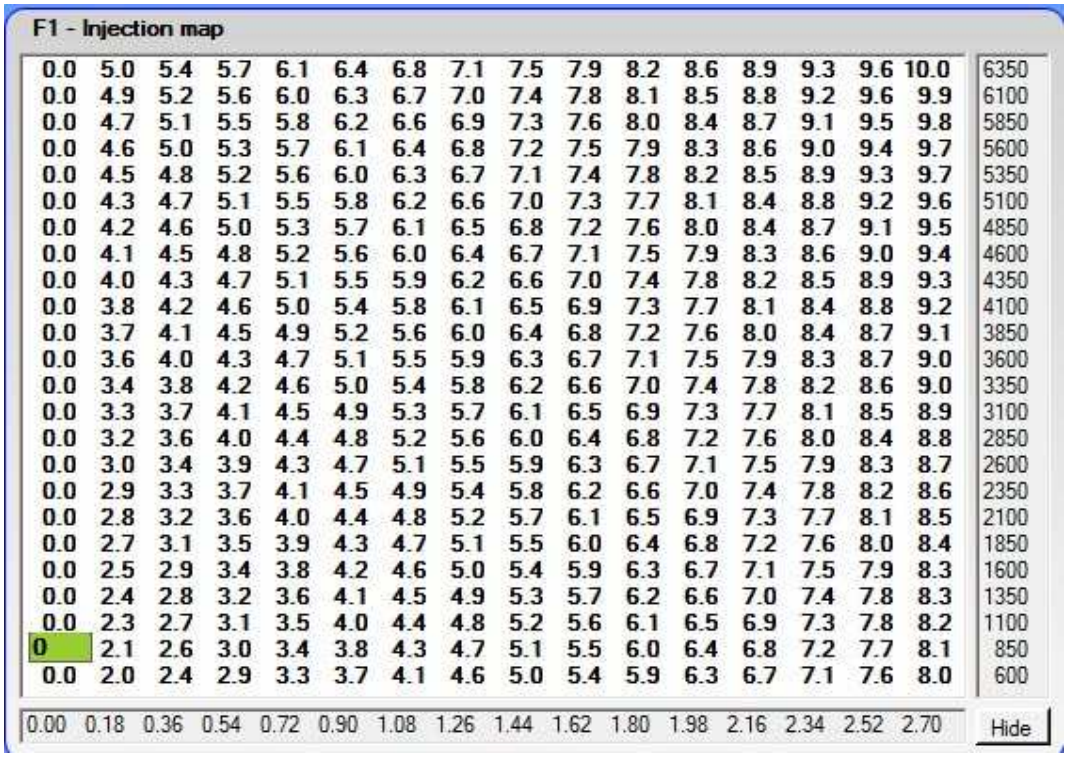
8. ADVANCED FUEL TUNING

Of course, this is the best. It unleashes the full potential of the E-TUNE. However, it requires the ADVANCED INSTALLATION and a PC (Laptop).

The major difference to the FUEL TUNING above is that the potentiometer is cut off, and the wire is connected to a LOAD signal, which comes from either:

a. The Throttle position sensor
b. The Manifold pressure sensor
c. The Air Mass meter
d. The ETC feedback position

The result is that the E-TUNE monitors the RPM and the LOAD (deflection) and adjusts the fuel according to the relevant RPM and LOAD positions. Now the engine can be mapped with all 384-map sites, without any manual adjustments.



This versatility comes at a price: You need to find a LOAD signal in your car, and you have to calibrate the LOAD signal. SEE: ADVANCED INSTALLATION

8.1 TUNING

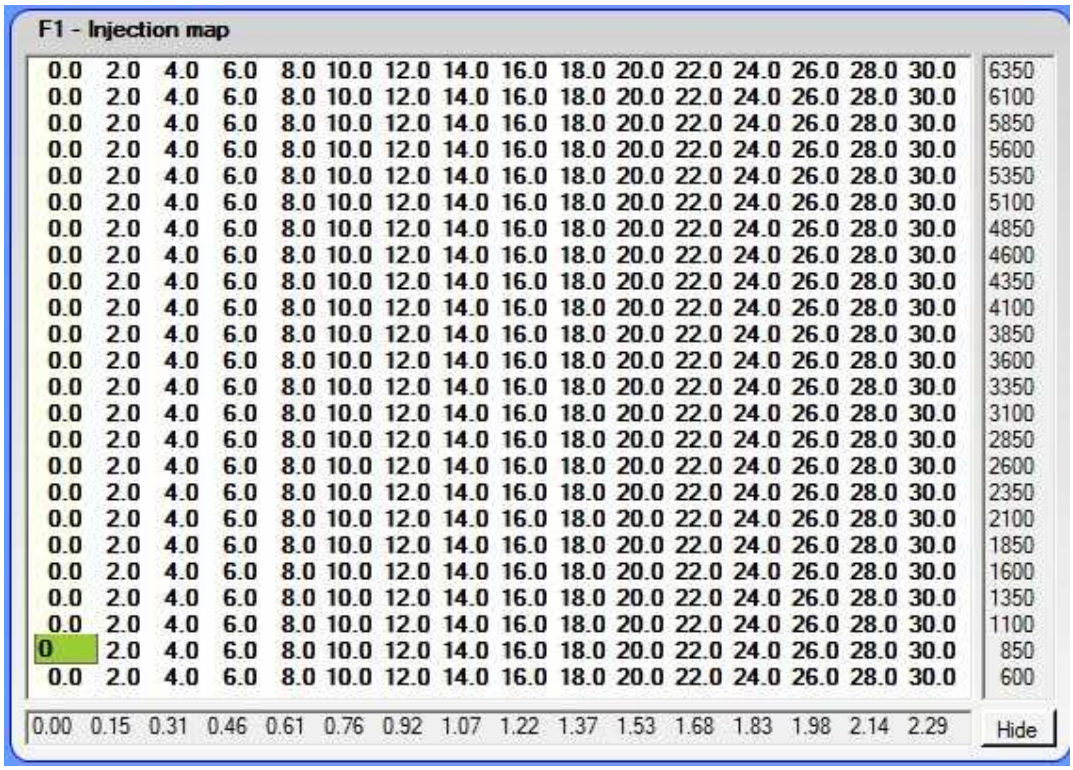
This is the process of changing the amount of fuel your engine gets with the same amount of air. Some or most engines run a closed loop system: it measures the exhaust fumes and adjusts the fuel accordingly. Changing the fuel with the E-TUNE will not help in this instance: whatever fuel you put in extra, the stock ECU will take out again because it upsets the exhaust gas. However, and this is important, most closed loop systems stop operating at approximately 2500 RPM. You have to try it!

Most modern engines have a short and long term fuel control loop strategy. This may affect you in a couple of days. This can be found out with an OBD scanner. The good news is that the ECU may not have any long-term strategy, or the closed loop system is compromised, in not operating.

Most likely you have a reason for tuning the fuel. In this instance the ECU does not execute the fuel control loop (anymore) and you have a 'free hand'.

8.2 FUEL MAP

The fuel map is displayed with the F1 key.
The following appears:



Negative numbers reduce the fuel by the entered percentage, and positive numbers enhance the fuel.

NOTE: The max fuel tuning is limited to +50 to -50 percent. A zero entry does nothing!

8.3 SELECTING THE MAP POSITION

Which map point do you need to change? This is best observed with a laptop while driving the engine. A cursor moves automatically through the map and indicates which point (of the 384) the E-TUNE uses to change the fuel. Of course, the RPM and LOAD should be calibrated so that the cursor moves through ALL map points.

You may also display various engine measurements and plot them. You can also LOGG the performance while you drive. All these options are explained in the: DDS Direct Software User Guide.

With all these displays can pinpoint the troubled area very fast, and change the fuel to your liking. You can also use the UP/DOWN buttons to change the fuel at the spot the engine is operating. Finally, you can type in a number in the site you have identified. The PC software is full of options to help you tune your engine fast and professional.

9. PC OPERATIONS

The E-TUNE unit can be operated from the supplied PC software. The PC software is explained in the DDS Direct Software User Guide. which is part of this CD. You will find the PC software overwhelming at start, but as soon as you get to know its idiosyncrasies you will enjoy a very powerful tuning platform. The same PC software is used for all of our products.

9.1 COMMUNICATION WITH THE E-TUNE

The E-TUNE comes with a 19.2KB serial RS232 communication. Since most laptops and PC's don't have RS232, you need to use a USB to RS232 adaptor. Most adaptors have their own driver requirements and you need to install the driver as instructed. Please install it on port 1-4.
Then open the ddsDirect software, and find TOOLS, Communication, click on 19.2 and the chosen port.

9.2 POWERING THE UNIT ON THE BENCH

This is only required if you like to play with the unit before installing it in the car.
You require: An 8-12V-power source, for 100mA (0.1A), **Max. 15Volts**
Some 0.5 to 1.0mm blank wire

1. Insert one of the injector harnesses in to the unit
2. Connect the ground lug to the NEGATIVE of the power source
3. Insert a piece of blank wire in to the ECU (female) injector connector, any pin.
4. The green LED should flash.
5. You can't damage the unit in any way!

Once the LED is flashing it signifies that the microprocessor is operating, and that you can communicate with it.

9.3 DEFAULT MAPS

The unit has 3 default maps, which you can invoke from the TOOLS dropdown menu. Prior to shipment the DEFAULT MAP #1 was loaded, which is for ETHANOL and FUEL UP operations. Have a look at the map (F1 key) and see how it is organized. Observe that it INCREASES the fuel from 0-33%.

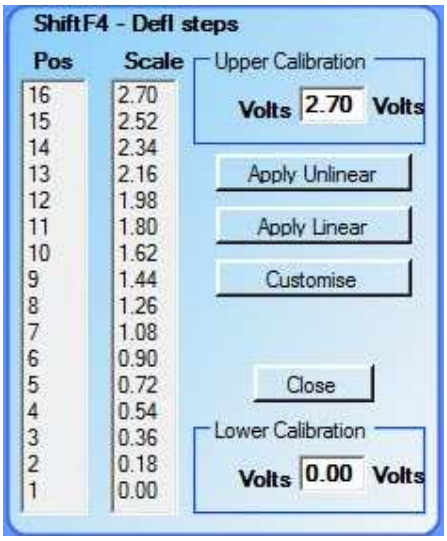
Load the DEFAULT MAP #2 (TOOLS, dropdown menu) and check how this is organized.
It decreases the fuel by 43% on the left side (potentiometer turned anti clock wise), is zero in the center, and increases the fuel to +50% on the right.
This map in essence varies the fuel by 43% up and down!
This map applied to FUEL TUNING ONLY. DO NOT USE IT FOR ETHANOL!

Load the DEFAULT MAP #3 (TOOLS, dropdown menu) and check how this is organized.
It is filled with zeros, it does not add or subtract any fuel. This is the starting map for advanced fuel tuning.
If you check the DEFLECTION CALIBRATION you will see that it has a 0 to 5V deflection input.

9.4 DEFLECTION CALIBRATION

The deflection axis (left to right, Y) comes from the input, in most cases the potentiometer.
In the ADVANCED TUNING section it is replaced by an engine input. The scale of the deflection can be set with a calibration procedure.
Calibration is a process to align the input variation to some meaningful deflection. If you are using the potentiometer then no deflection calibration is required.

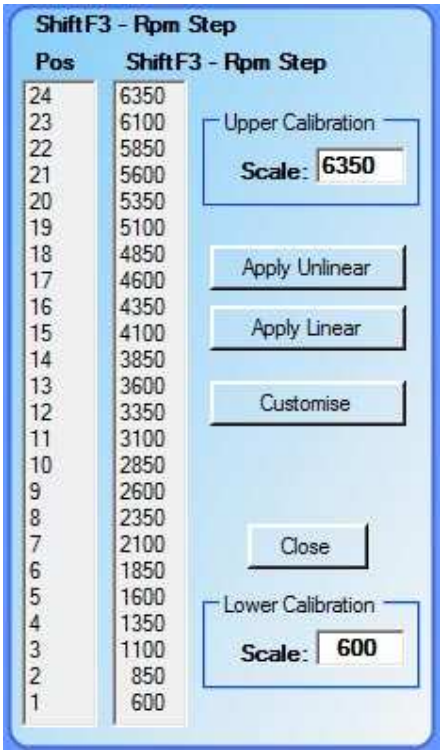
To calibrate the deflection: click on the CONFIG, and select Deflection Cal. The following screen should appear:



Change it to your liking by selecting the end point values and press apply. If you get it wrong, then load the default map and start fresh.

9.5 RPM CALIBRATION

The RPM scale (up, X) can be changed as applicable to your engine. Click on CONFIG, RPM CALIBRATION and the following screen appears:



Change it to your liking! If you get it wrong then load the default map again and start fresh.

9.6 RPM SYNC

If the RPM displayed by the software is not the same as the Rev counter RPM.

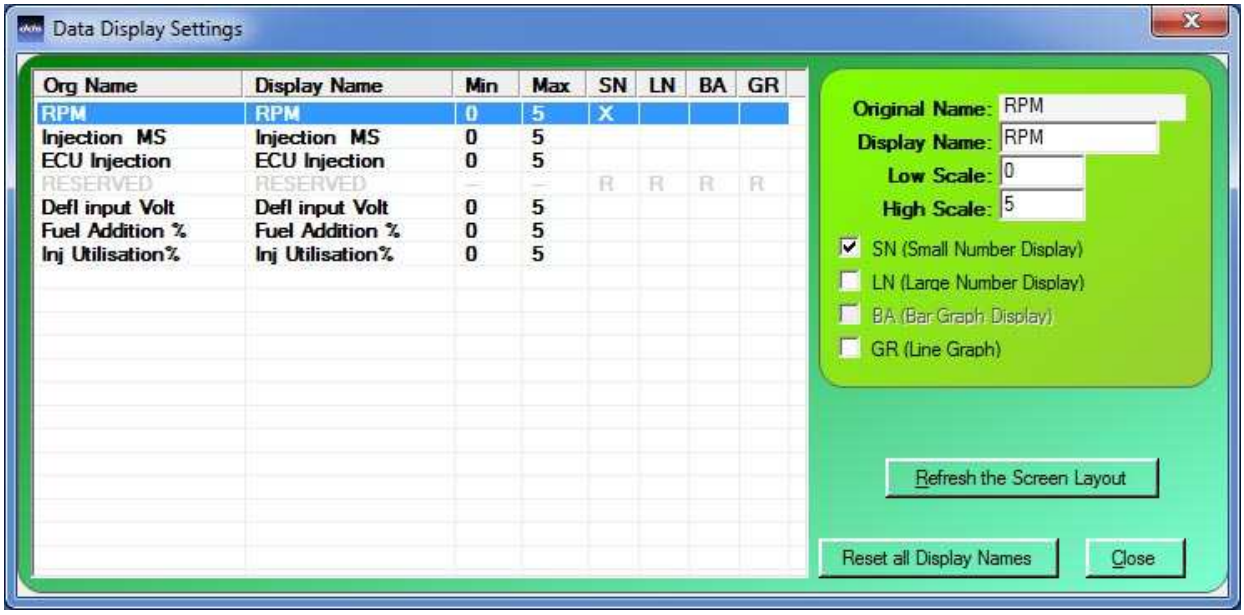
9.7 HELP

Help is available in various forms:

A) Right click on any item and a short explanation is available
B) This TECHNICAL MANUAL
C) The LETRIPP SOFTWARE USER GUIDE
D) Some WINDOWS ITEMS are explained 'ONLINE'

9.8 DISPLAY

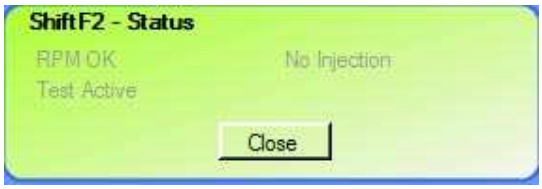
The E-TUNE can display various items, which are sometimes useful while tuning and driving. The items are selected from a list by: DISPLAY, then chose an item, then click on the form to select the way you like to see it.



The Injection utilization display is very important. It tells you when the injectors 'max out': that is to say when the injectors are 100% ON, and you can't inject more fuel. If the engine requires more fuel, then it would run LEAN. This is OK at cruising, but dangerous at full throttle.

9.9 STATUS AND SYSTEM DEFINITION

The status display is selected by CONFIG, Status. It displays actively what the unit is doing.



The SYSTEM DEFINITION is your way of telling the unit what you like it to do.

10. SPECIFICATIONS

This is for the technical minded!

Power consumption:	~ 100mA (0,1A)
Power supply voltage:	8 – 15 Volts
Reverse Polarity Protection:	Yes
Momentary power supply:	up to 40 V, 5 ms
Signal input impedance:	>10 K Ohm
Ambient temperature:	Up to 60 deg C (Passenger compartment)
Injector drive:	1 Amp, 13-Ohm injector

11. BASIC INSTALLATION

The "Minimum Installation" is a good way to start getting acquainted with your E-TUNE. It is quick, requires very few tools but does not allow you to enjoy the full potential of the product. The E-TUNE can do so much more, and its power and the benefits to you are unleashed when you connect a few more wires (see the section on the ADVANCED INSTALLATION.)

11.1 PRACTICAL STEPS

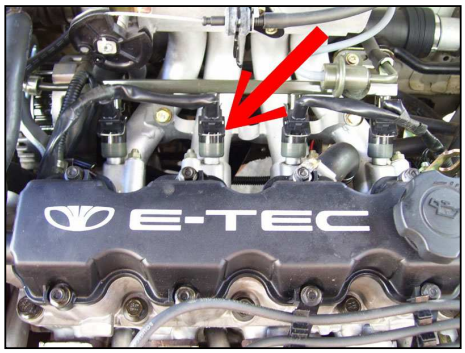
The Basic Installation has been broken down into 6 (six) practical steps, with photos. These steps cover the installation of the unit into the vehicle. Once the physical installation has been completed the engine will run as before, provided the potentiometer is turned full anti-clock wise.

STEP 1: FINDING A SUITABLE LOCATION TO MOUNT/INSTALL THE UNIT

a. Find a suitable location for the unit, i.e.:
- Away (or shielded) from hot surfaces
- Within harness reach of the injectors and the vehicle's ECU (Engine Control Unit)
- Protected from water, water spray, or high pressure water cleaning. This is because the unit is not water-resistant or water-proof
- If possible, in a ventilated area

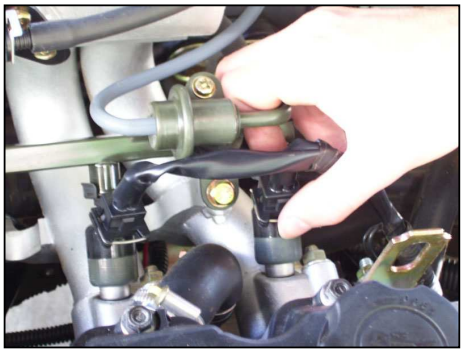
The ideal location would be as close as possible to the battery of the vehicle, in the engine bay. This is the coolest place in an engine. However, you would need to seal the unit in a plastic bag to ensure that the connectors would not get wet.

STEP 2: LOCATING THE INJECTORS OF THE ENGINE

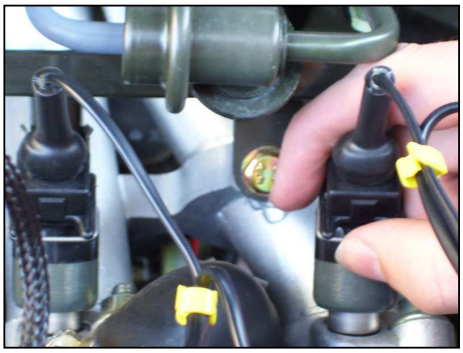


a. Look around your vehicle's engine and locate the injectors of the fuel injected petrol engine.
b. Connect the loose wire (ground) of the injector harness(es) to a suitable place on the metallic chassis. This is to GROUND the unit.

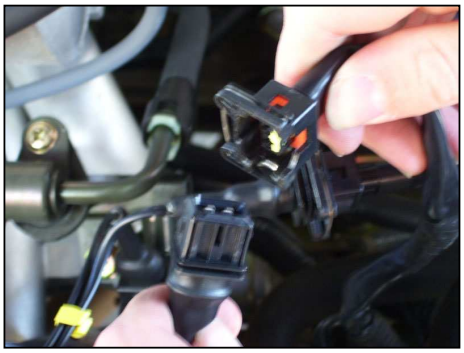
STEP 3: CONNECTING THE PLUG-AND-PLAY INJECTOR HARNESS



a. Remove the existing injector caps/plugs, by unclipping them. As shown in the photo on the left.



b. Using the plug-and-play harness supplied with the kit, connect the injector harness to the injectors (if you are installing on a 4-cylinder engine, you'll have two sets of plug-and-play injector harnesses). As shown in the photo on the left.



c. The photograph on the left shows the injector plug of the engine and the harness injector clip.

STEP 4: CONNECTING THE GROUND WIRES

a. Connect the ground wire(s) to a suitable metallic place on the chassis. In the photo on the left, there were two screws in the chassis, which made it easy to attach the lugs to the chassis.

NOTE: If there is no metallic section exposed on your vehicle's chassis, you may need to scratch some of the paint off to expose the metal.

STEP 5: CONNECTING THE HARNESS TO THE UNIT

Connect the connector plugs from the harness to the matching connector on the unit. As shown in the photo.

STEP 6: ADAPTING THE INJECTOR HARNESS

The E-TUNE plug-and-play injector harness can be ordered with 6 different injector clips. If you find that your vehicle does not have the correct connectors, you will need to replace the injector clips on the E-TUNE plug-and-play harness, with the applicable injector clips for the injectors in your vehicle. The polarity of the wires is not important. However, the male/female connectors must not be swapped. If you have problems with the correct injector clips, you may contact the factory. May be they can help and send you the correct harness.

12. ADVANCED INSTALLATION

This section follows the BASIC INSTALLATION above, but the potentiometer (wiper) signal is replaced with a LOAD signal from the engine. It can come from:

The Throttle position sensor
The Manifold pressure sensor
The Air Mass meter
The ETC feedback position

The common thread to all of the above signals is that they somehow reflect the LOAD and that they are a voltage (as opposed to a frequency) signal.

Cut the potentiometer wiper signal (Pin 4 of 4 of the auxiliary connector).

12.1 FINDING A LOAD (DEFLECTION) SIGNAL

There is no sure way as every car is different. The best advice is to contact a friendly garage and obtain the wiring diagram of your engine. Even with the best help it is difficult to find this red/yellow wire in a bunch of 50 tightly wrapped wires. It can be done, and it is definitely worth doing the effort!

Once you have the correct wire you may like to check it. This is best done by pocking a needle through it (watch your fingers!) and connecting the wire from the potentiometer wiper (connector pin4) to it. Put some load on to the engine and observe that the deflection is changing. You can change the direction and scale later.
If this is the correct wire, then solder the E-TUNE pin 4 wire to it and insulate the joint with some tape or heat-shrink.

12.2 CALIBRATING THE LOAD SIGNAL INPUT

If it is a TPS signal, then it is easy. However, some signals require that the engine is running under full load, which is difficult. Another way is to get the voltage versus load curve of the sensor and then calibrate the E-TUNE to it.

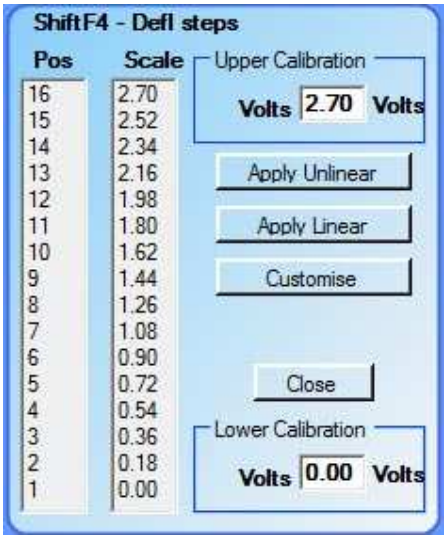
Before calibrating check the load deflection DIRECTION: No load should be at the left and full load at the right. If not you can change the direction with:

CONFIG, SYSDEF, Inverse Defl En

The calibration is affected by:

CONFIG, Defl Calibration

The following screen appears:



The following entries are required

Top box: "Upper Calibration"
- Full load voltage
- Position of full load

Bottom box: "Lower Calibration"
- No load voltage at position
- Position with no load

Then press 'apply' and the unit is calibrated!

Hint: You can record the Full load voltage max while driving around the block, and calibrate the unit while the car is standing.

12.3 RPM CALIBRATION

If the supplied RPM scale is not to your liking you can change it by:

CONFIG, RPM CALIBRATION

Enter the top and bottom RPM points and chose: LINEAR, or UNLINEAR interpolation. Or manually set each point by using CUSTOMISE.

13. KEYWORDS

13.1 ECU

The computer "box", which is controlling the engine's operation

13.2 MAPPING

A process by which, a signal is manipulated via the various tuning maps.

13.3 INTERCEPTING

A wire is cut, and the two ends are "routed" through the E-TUNE for the purpose of changing the signal.

13.4 TEE IN

A wire from the E-TUNE is joined to the standard wiring loom. The signal is only read, and no modifications take place.

13.5 LAMBDA, OXYGEN, AFR

A lambda probe, oxygen probe, or AFR sensor all measure the oxygen content in the exhaust pipe. At lambda 1.00 the AFR=14.7 and a narrow band sensor generates a voltage between 0.4 and 0.5 Volts. A wide band LSU-4 can't be measured in volts, but it generates a ZERO-CURRENT.

13.6 CHIPPING

Traditionally this applies to changing the "chip" of the ECU to provide better performance. When ECU's started to control the engine it meant changing an EEPROM. The term now also applies to adding an E-TUNE to the car, without changing any chips or EEPROMS. The E-TUNE has the advantage over chipping because of the online tune and the E-TUNE capability.

13.7 MAF

Mass Air Flow Sensor. It could be a device with a "FLAP" or a solid-state "hot wire" sensor. It generates basically an analog output voltage, which increases with higher airflow. Some devices compensate for air temperature (density).

13.8 MAP

Manifold Absolute Pressure. It is a solid-state device with 3 wires and provides an analog output voltage, which increases as the manifold pressure increases. Since it measures the absolute pressure the output voltage DECREASES at idle. We don't like this term because is also applies to a tuning map.

13.9 AMP

Absolute Manifold Pressure. The same thing as a MAP! We like this term because it can't be confused with a tuning "map". The E-TUNE has a built-in AMP sensor.

13.10 PWM

Pulse Width Modulation. The information is in the ON to OFF signal ratio. The E-TUNE can modify am incoming PWM signal (BOOST IN, pin4) and drive a boost solenoid (BOOST OUT, pin10).

13.11 WIDE BAND LAMBDA

This is a 5-wire lambda probe (BOSCH LSU-4) with the part number starting with 025800. The E-TUNE can operate this probe and retrieve the AFR reading from it.

13.12 PICKUP

It is a sensor, which "picks up" an engine measurement like temperature or crank angle position. The sensor can be a Hall Effect (square wave) or magnetic (sine wave).

13.13 FEED-THRU

A method where a wire is cut, routed through the E-TUNE for the purpose of modifying the electrical signal.

13.14 INJECTOR DRIVE

The E-TUNE switches to ground. The current rating is sufficient for ONE 13 ohm injector per output.