Haltech™
ENGINE MANAGEMENT SYSTEMS

PLATINUM PLUG N PLAY

350Z

USER MANUAL

VERSION
1.6

FIRMWARE: 350Z v1.0.0

SOFTWARE: ECU MANAGER v 1.0.0

Prepared	NSC	Path:		
Date	13/03/08	Filename:		
		Title:	Haltech Platinum Series - 350Z User Manual	
Firmware	350Z v1.0.0		*Document Number:* *Code:*	Sheet
Software	v1.0.0		1.6	1 of 1

WARNING:

AFTERMARKET ENGINE MANAGEMENT

THIS ECU IS DESIGNED AND SOLD FOR RACING USE ONLY.
USING THIS PRODUCT FOR STREET/ROAD USE MAY BE PROHIBITED BY LAW.
PLEASE CHECK WITH YOUR LOCAL VEHICLE AUTHORITY BEFORE USING THIS PRODUCT.

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3. The ECU Patch harness

3.1 Harness overview

The ECU patch harness is designed as a plug and play solution for the 350Z. It allows the user to have control of the engine quickly & easily.

The ECU patch harness is designed for the supported vehicles only. Please do not attempt to modify this harness, as doing so will void warranty as well as potentially damaging the ECU or vehicle.

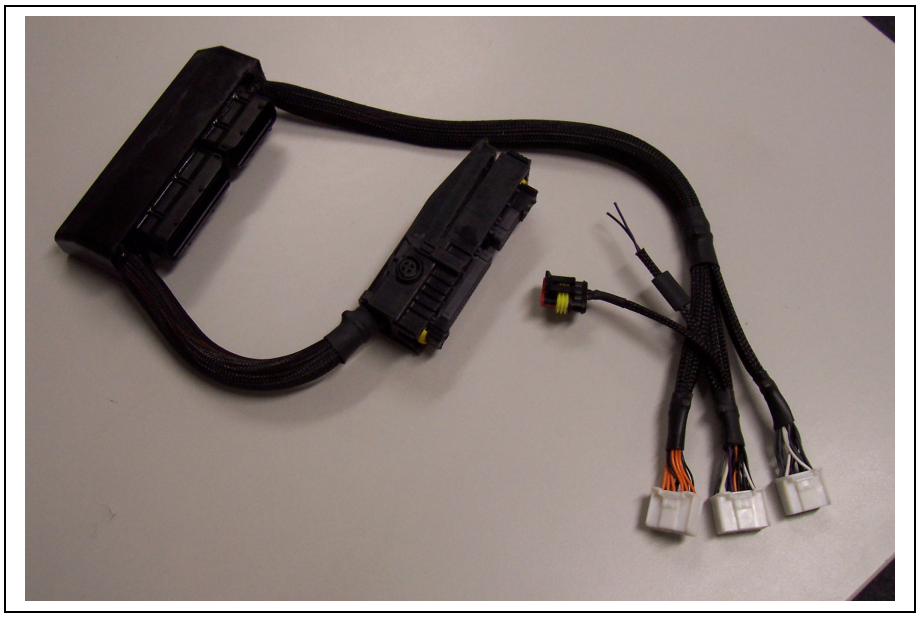


Figure4. The 350Z ECU Patch harness

3.2 Installing the harness

Please install the Haltech ECU. The factory ECU can be found underneath the dashboard on the passenger's side of the vehicle. The Factory ECU connector is a lever type connector.

1. Please disconnect the factory ECU's harness from the factory ECU.
2. Connect the Haltech 350Z Harness connector to the factory ECU
3. Connect the factory ECU's harness connector to the Haltech patch loom.
4. Connect the three white connectors of the Haltech patch harness to the Haltech 350Z ECU.
5.

WARNING:

PLEASE DO NOT DISCONNECT ANY ECU CONNECTOR WHY THE ECU IS STILL POWERED. DOING SO MAY BLOW THE FACTORY ECU 15A FUSE. PLEASE WAIT 10 SECONDS AFTER TURNING OFF THE IGNITION SWITCH BEFORE UNPLUGGING ANY COMPONENT

3.3 Manifold Pressure Reference

The ECU is fitted with an internal MAP sensor rated to 22PSI (150 KPa). Alternatively an external MAP sensor can be fitted to the ECU allowing higher manifold pressures. A Manifold Absolute Pressure sensor is required for all tuning methods. The Manifold Pressure Reference can be set in the Main Setup Page.

Figure3. The ECU showing External MAP sensor port

3.3.1 Installing an external MAP sensor (Optional Accessory)

An external MAP sensor can be fitted to Patch loom via the AMP 4 POS connector.

The wiring for this connector is as follows:

Position	Function
1	Ground (0V)
2	Signal
3	+5V
4	No Connection

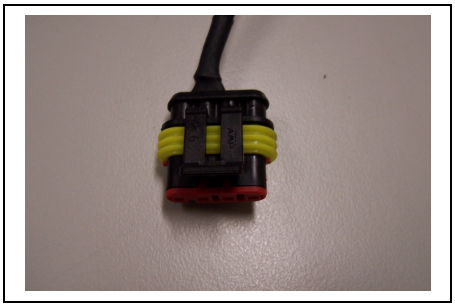


Figure5. The External MAP sensor connector (4 Position)

Once the MAP sensor has been wired, a calibration must be entered for this sensor to read correctly. This can be done in the ECU Navigator, Calibrations Group, under MAP Sensor.

3.4 Auxiliary Outputs

The ECU has two Auxiliary Outputs that can be configured via the ECU Manager.

Both outputs can be found on the 3 POS AMP connector fitted to the Patch Harness.

The wiring for this connector is as follows:

Position	Function
1	Boost Solenoid Output (Aux Out 1)
2	+12V
3	AUX Out 2

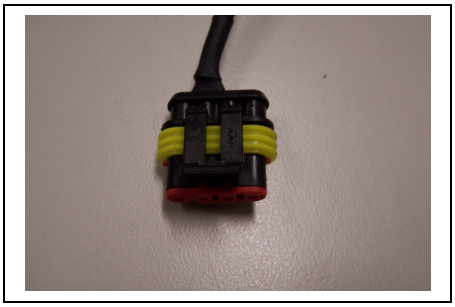


Figure5. The Auxiliary Output Connector (3 Position)

3.4.1 Installing a Boost Control Solenoid (Optional Accessory)

An external Boost Control Solenoid can be fitted to Patch loom via the AMP 3 POS connector.

The wiring for the Boost Control solenoid should be as follows:

Once the Boost control Solenoid has been wired, the ECU must be configured to operate correctly. This can be done via the Main Setup Page.

3.5 Auxiliary Rev Limiter Input

The ECU has an Auxiliary Rev Limiter that can be configured via the ECU Manager.

The Aux Rev Limiter Input can be found on the 2 POS AMP connector fitted to the Patch Harness.

To activate the Aux Rev Limiter, connect the Aux Rev Limiter Input to the Ground wire.

The wiring for this connector is as follows:

Position	Function
1	Aux Rev Limiter Input
2	GND

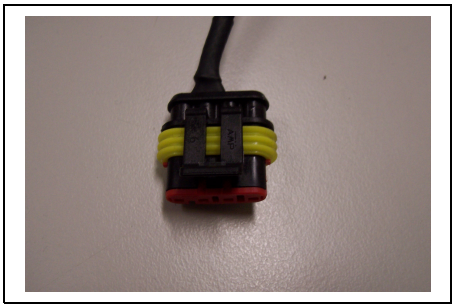


Figure5. The Auxiliary Rev Limiter Input Connector (2 Position)

4. Installing Software

Please insert the ECU Manager Installation CD and follow the instructions given.

4.1 Minimum System Requirements

Operating System:	Windows 2000 SP4 / Windows XP / Windows Vista
Processor Speed:	1GHz
RAM:	256 Kb
Video Card:	128MB graphics card with 3D acceleration
USB:	1.1
Hard Drive:	250MB
Other:	CD Drive

THE ECU MANAGER

To start the ECU Manager please click on the newly created ECU Manager desktop Icon to start the software.

Figure 6: The ECU Manager desktop

Area's of the ECU Manager

1. ECU Navigator
2. Tuning Pages
3. Menu
4. Navigator Description Box
5. ECU Status indicator
6. Status Bar
7. Tuning Page with displays

4.1 Communication

To communicate with the ECU, please connect the USB cable between the ECU and the laptop.

Select the connect/disconnect icon, or use the F5 key.

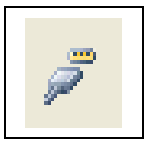


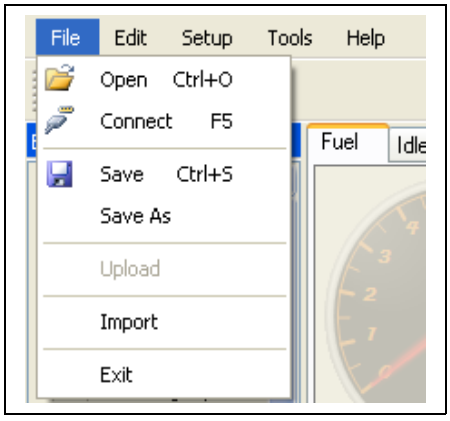
Figure 7: The ECU Connect/disconnect icon.

Once the ECU has been connected, the ECU manager will begin to download the data stored in the ECU. Once this download has been completed, the ECU status indicator will display "Connected"

4.2 Menu

4.2.1 File

The file menu has options relating to the ECU tuning maps.



Open: Opens a tuning map. If the ECU is currently online, the ECU manager will disconnect from the ECU before opening this file. If you want to load a new tuning map into the ECU, please use the Upload feature.

Connect: This will start the connection between the ECU and the software. Please make sure the ECU is powered before selecting "Connect"

Save: This saves the current map to the file already open. If the file has not been saved before, the user will be prompted to name the file and a location to save the file to.

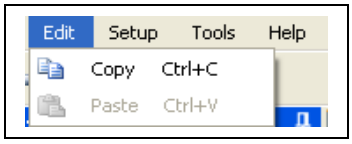
Save As: The "Save As" button will prompt the user for a name for the file and a location to save the file.

Upload: Upload is to be used when a saved file is to be loaded into the ECU. This will overwrite any existing file in the ECU. If you wish to only view the saved file, please use the Open button.

Import: The Import function allows the user to import tuning tables or settings from another file.

Exit: To exit the ECU manager software.

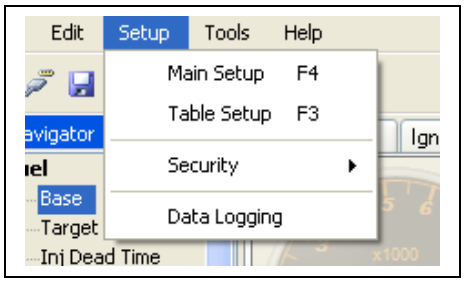
4.2.2 Edit



Copy: Copies the currently selected values.

Paste: Pastes the any copied values.

4.2.3 Setup



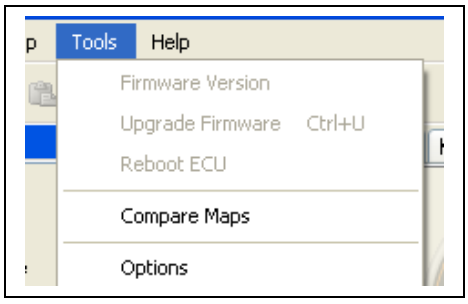
Main Setup: Settings for the ECU configuration can be found here.

Table Setup: Settings for the currently selected Tuning table can be found here.

Security: The ECU's security functions such as password protection can be configured here.

Data Logging: Data Logging can be configured here.

4.2.4 Tools



Firmware Version: The firmware version in the ECU can be checked here.

Upgrade Firmware: The ECU's firmware can be upgraded from this menu.

Reboot ECU: This will reload the ECU Manager software. This is to be used when prompted only.

Compare Maps: The Compare maps feature will allow the user to compare tuning tables with saved files.

Please note that only tuning tables with the same axis are able to be compared.

Options: All settings regarding the display of the software can be found in the options menu.

5. The Main Setup

The Main Setup page allows the user to configure the ECU. The Main Setup page can be accessed by selecting the Setup > Main Setup in the Menu, or by pressing F3. The Main Setup page is split into two pages; the first page "Main" contains the critical engine running settings, with the second page "Inputs/Outputs" containing the settings for the Auxiliary functions.

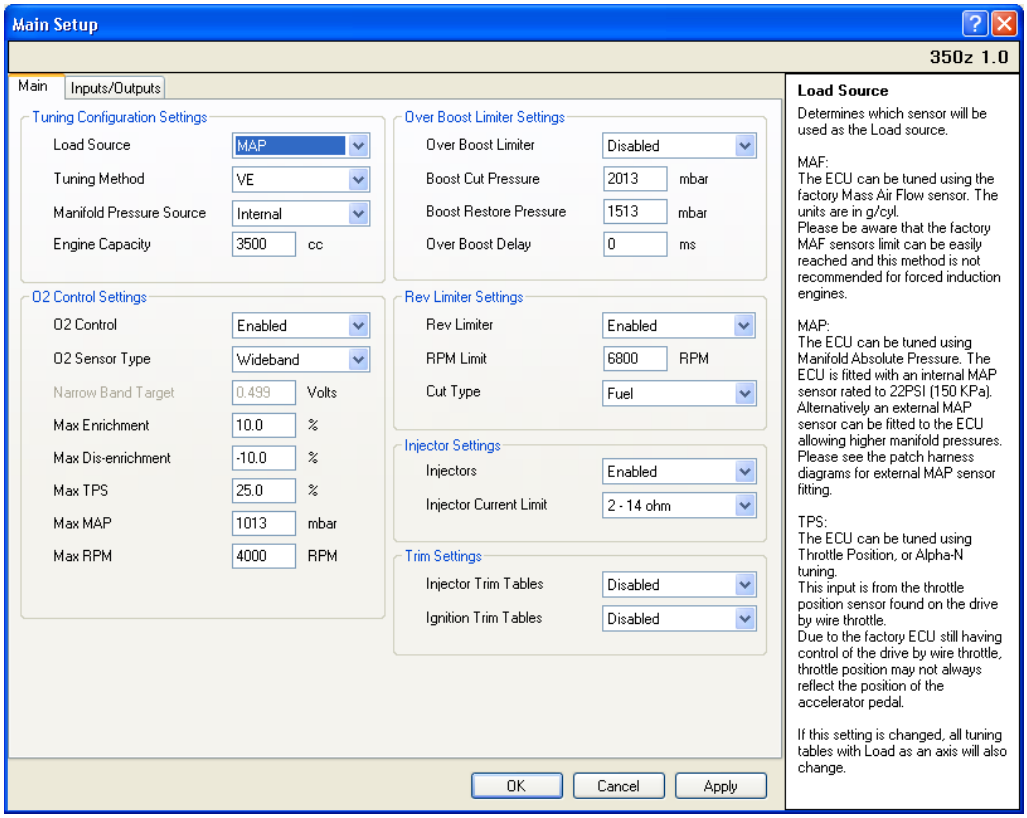


Figure 8: The Main Setup window

5.1 Tuning Configuration

5.1.1 Load Source

MAF: The ECU can be tuned using the factory Mass Air Flow sensor. The units are in g/cyl. Please be aware that the factory MAF sensors limit can be easily reached and this method is not recommended for forced induction engines.

MAP: The ECU can be tuned using Manifold Absolute Pressure. The ECU is fitted with an internal MAP sensor rated to 22PSI (150 KPa). Alternatively an external MAP sensor can be fitted to the ECU allowing higher manifold pressures. Please see the patch harness diagrams for external MAP sensor fitting.

TPS: The ECU can be tuned using Throttle Position, or Alpha-N tuning. This input is from the throttle position sensor found on the drive by wire throttle. Due to the factory ECU still having control of the drive by wire throttle, throttle position may not always reflect the position of the accelerator pedal.

Tuning Mode

Depending on the Load source, the tuning modes available may change.

	MAF	MAP	TPS
Volumetric Efficiency (VE)	✗	✓	✓
Injection Time (mS)	✓	✓	✓
Lambda Correction (y)	✓	✗	✗

Volumetric Efficiency (VE): VE tuning is available when MAP or TPS is selected as the Main Load source. VE or Volumetric efficiency allows the ECU to determine the injection time based on the Engine Capacity, Desired AFR, Injector Flow and Volumetric Efficiency table. For more information on VE tuning, please go to Appendix A.

Injection Time: The Injection time to be used by the ECU is obtained directly from the Base Fuel Table. Please note that the Injector Dead Time table value will be added to the final Injection Time.

Lambda Correction: Lambda Correction tuning is available when the MAF sensor is selected as the Main Load source. The ECU calculates the Injection time based on the signal from the MAF sensor. The values entered into the Base MAF Table are theoretical values, and may not exactly reflect what is measured in the exhaust. Correction tables can be used to correct for any differences.

5.1.2 Manifold Pressure Source

The ECU is fitted with an internal MAP sensor rated to 22PSI (150 KPa). Alternatively an external MAP sensor can be fitted to the ECU allowing higher manifold pressures. Please see the patch harness diagrams for external MAP sensor fitting. A Manifold Absolute Pressure sensor is required for all tuning methods.

5.1.3 Engine Capacity

The engines capacity is required by the ECU whenever Volumetric Efficiency (VE) tuning is selected. An incorrect engine capacity value will give incorrect fuelling.

5.2 O2 Control

The ECU is capable of correcting the fuel injection time to 14.7:1 or Lambda 1 for both idle and cruise conditions using the factory O2 sensors. Early 350Z models were fitted with Narrow band oxygen sensors and later models are equipped with Wide band oxygen sensors. It is recommended to disable the O2 control during engine tuning.

O2 Control: This setting allows the O2 Controller to be switched on or off.

O2 Sensor Type: Determines the sensor used for the O2 control. Please check which sensors are fitted to your vehicle. Incorrect sensor choice may provide erratic O2 control.

Narrow Band Target (V): Determines the voltage the O2 controller will try to target. When operating the O2 sensor voltage will constantly oscillate either side of this target voltage.

WARNING:
O2 CONTROL LIMITS SHOULD BE CONFIGURED SO THAT THE ENGINE AIR FUEL RATIO MIXTURES WILL STILL BE SAFE UNDER SENSOR FAULT CONDITIONS.

5.3 Over Boost Limiter

Boost Control: This setting allows the Boost Controller to be switched on or off.

Boost Cut Value: The boost cut value is the manifold pressure value at which the ECU will cut all fuel injection. This feature is to be used as an engine protection device only.

Boost Restore Value: The boost restore value is the manifold pressure value in which the ECU will restore fuel after the boost cut has occurred.

Over Boost Delay: The over boost delay is the period of time the manifold pressure needs to exceed the Boost cut value before implementing the fuel cut. This is useful for overcoming any quick boost spikes that would otherwise activate the boost cut.

WARNING:
THE OVER BOOST LIMITER IS PROVIDED AS A ENGINE SAFETY DEVICE, AND SHOULD NOT BE HIT UNDER NORMAL OPERATING CONDITIONS.

5.4 Rev Limiter Settings

The ECU can provide a hard RPM limit. This RPM limit is not an adjustment on the factory ECU's RPM limit. This RPM limit is purely for engines not fitted with electronic throttle control.

Rev Limiter: This setting allows the Rev Limit to be switched on or off.

Rev Limit: Determines the RPM at which the RPM limit will be activated.

Cut Type: Determines how the Rev cut will be applied. This can either be through the cutting of Fuel or Ignition Pulses.

5.5 Injector Settings

Injectors: This setting allows the injectors to be switched off or disabled.

Injector Current Control:

The injector drivers in the ECU are capable of operating both saturation and peak and hold mode injectors. Injector current is monitored by the ECU and will be adjusted automatically.

The Injector current control has two settings, which relates to the resistance of the injectors used.

1 - 2 Ohms: This setting is for motor sport injectors with a resistance equal to or less than 2 Ohms.

2 - 14 Ohms: This setting is for all other injectors having a resistance greater than 2 Ohms.

Please note that using the incorrect setting may cause poor operation or damage to the injectors and/or ECU.

WARNING:
THE CURRENT CONTROL MUST BE SET CORRECTLTY. EXCESSIVE CURRENT PASSED THROUGH AN INJECTOR LOAD FOR A LONG PERIOD OF TIME MAY DAMAGE THE INJECTORS

5.6 Trim Settings

Injector Trim Tables: This allows the injector trim tables to be enabled and viewed in the ECU Navigator.

Ignition Trim Tables: This allows the ignition trim tables to be enabled and viewed in the ECU Navigator.

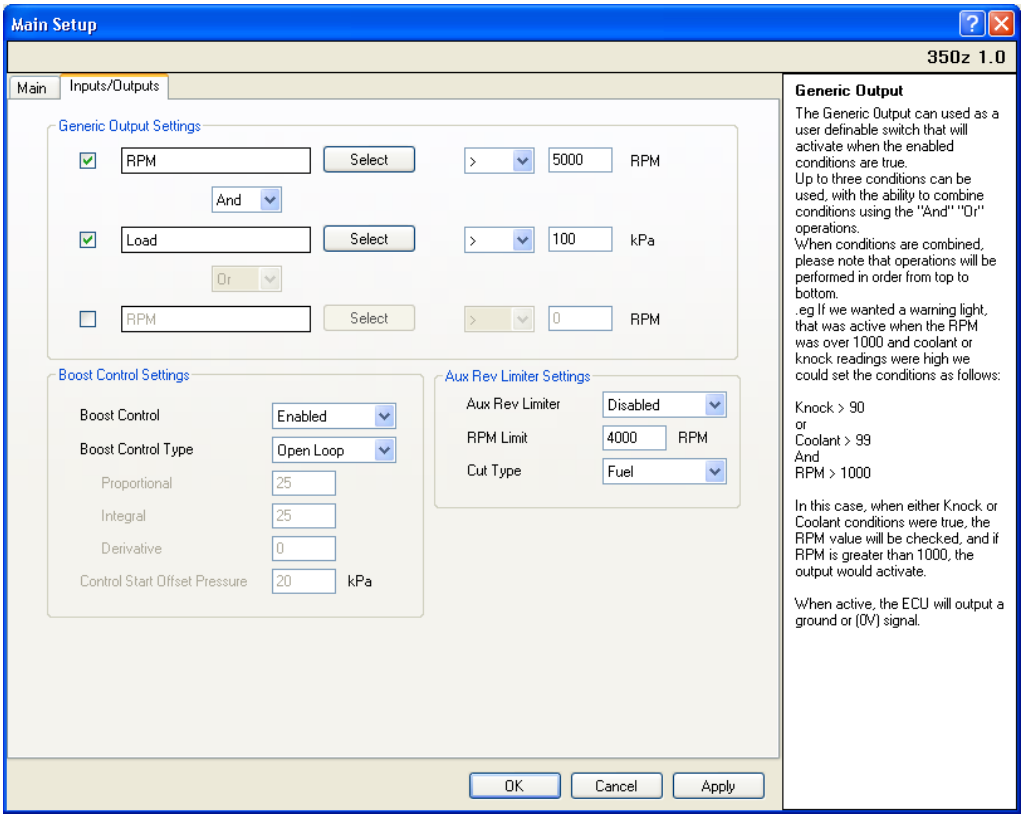


Figure 8: The Input/Output Setup window

5.7 Generic Output settings

The Generic Output can be used as a user definable switch that will activate when the enabled conditions are true. Up to three conditions can be used, with the ability to combine conditions using the "And" "Or" operations. When conditions are combined, please note that operations will be performed in order from top to bottom. .eg If we wanted a warning light, that was active when the RPM was over 1000 and coolant or knock readings were high we could set the conditions as follows:

Knock > 90

or

Coolant > 99

And

RPM > 1000

In this case, when either Knock or Coolant conditions were true, the RPM value will be checked, and if RPM is greater than 1000, the output would activate.

When active, the ECU will output a ground or (0V) signal.

5.8 Boost Control

The ECU has a built in boost controller. The boost controller allows the control of a turbocharger's waste gate through a boost control solenoid (sold separately Haltech Part # 34800). The boost controller can be configured as an open loop (Duty Cycle %) or as a closed loop controller.

Open Loop Boost Control: In Open loop mode, the duty cycle is taken directly from the Boost Control>>Open Loop Table, found in the ECU Navigator.

Closed Loop Boost Control: The Closed Loop Boost controller requires a MAP sensor to operate correctly. The ECU will constantly adjust the duty cycle of the boost control solenoid to meet the boost target found in the Boost Control>>Closed Loop Table.

WARNING:
CAUTION IS NEEDED WHEN USING THE BOOST CONTROL FEATURE. EXCESSIVE BOOST PRESSURES MAY CAUSE ENGINE FAILURE. IT IS HIGHLY RECOMMENDED THAT THE OVER BOOST LIMITER IS ENABLED & CONFIGURED CORRECTLY.

5.9 Aux Rev Limiter Settings

The ECU can provide a hard Aux RPM limit. This Aux RPM limit is useful for drag racing.

When enabled, the Aux Rev limit will commence whenever the Aux Digital Input (B12) is connected to 0V or ground.

Aux Rev Limiter: This setting allows the Rev Limit to be switched on or off.

Aux Rev Limit: Determines the RPM at which the RPM limit will be activated.

Cut Type: Determines how the Rev cut will be applied. This can either be through the cutting of Fuel or Ignition Pulses.

WARNING:
EXCESSIVE USE OF AUX REV LIMITER MAY CAUSE DAMAGE TO ENGINE AND ASSOCIATED COMPONETS. PLEASE USE WITH CAUTION.

6. THE ECU NAVIGATOR

The ECU navigator allows quick access to all tuning tables.

6.1 Selecting Tuning Tables

The currently view tuning table can be changed at any time by the following methods.

1. Click on the desired table using the left mouse button. or
2. **Using the** Alt-UpArrow or Alt-DownArrow **keys will change the currently viewed table.**

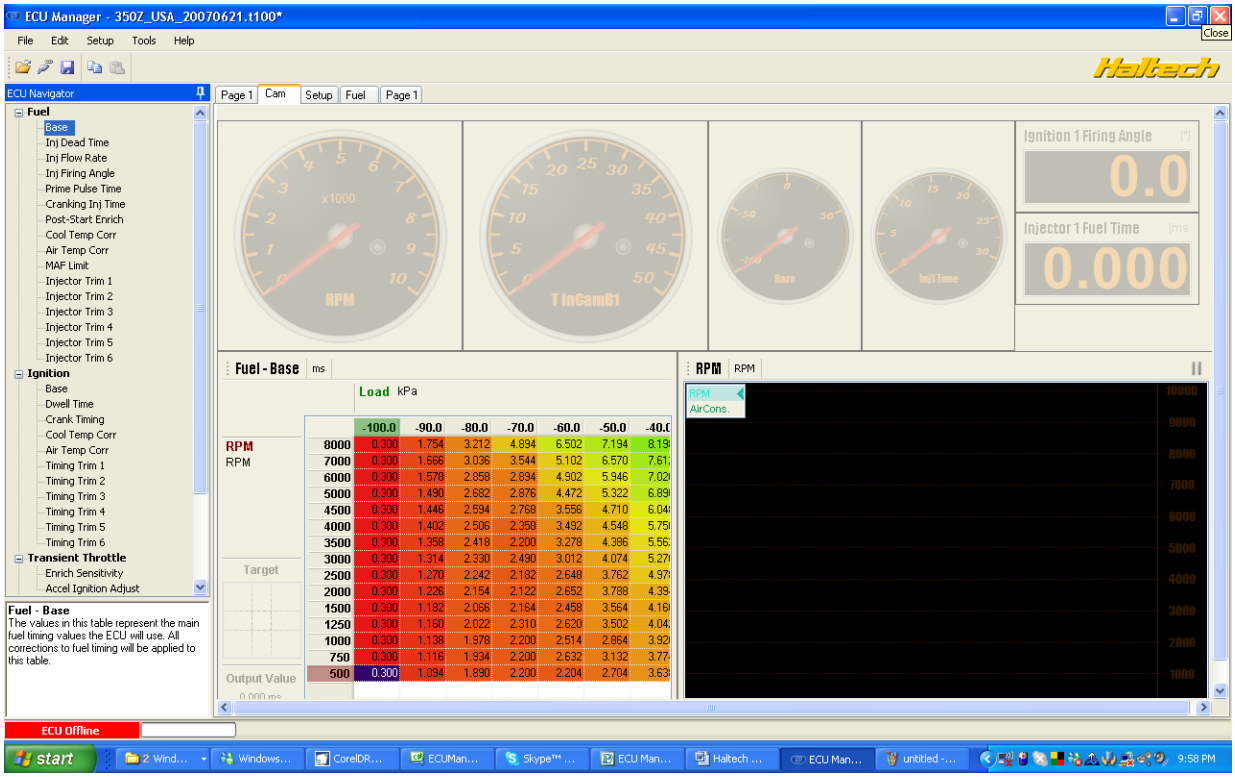


Figure9. ECU Manager with ECU Navigator

The ECU Navigator menu can also be unpinned to allow more area on the tuning desktop.

To unpin the ECU navigator, click on the pin icon. This will then allow the ECU Navigator to retract whenever it is not being accessed. The ECU navigator will appear once the Alt-UpArrow or Alt-DownArrow keys are used or if the mouse is hovered over the ECU navigator button on the left hand panel.

Groups

The Navigator tree contains multiple groups. These groups are designed to differentiate the functions of the ECU and to gain quick access to related tuning tables.

6.1.1 Expanding / Contracting groups

To expand the tree, click on the (+) with the mouse, or alternatively using the keyboard, use the Alt-RightArrow keys.

To contract the tree, click on the (-) with the mouse, or alternatively using the keyboard, use the Alt-LeftArrow keys.

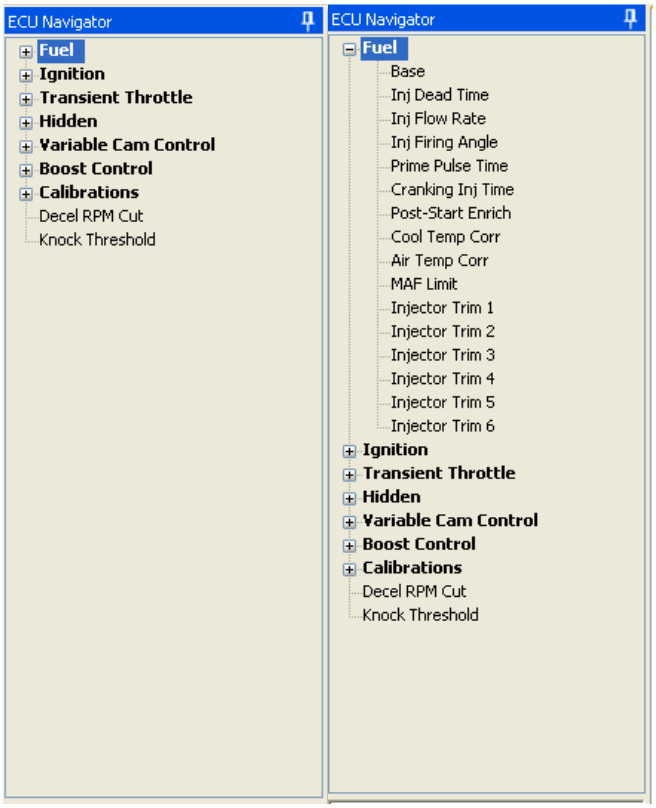


Figure 10: Expanding & contracting the ECU Navigator groups

6.1.2 Calibration Group

The ECU has a set number of tuning maps that are sensor calibrations. These calibrations can be modified just like any other tuning table, but this should only be done if the alternate sensors are used.

7. Modifying Tuning Tables

WARNING:
WHEN TUNING AN ENGINE, ESPECIALLY UNDER LOAD, IT IS ADVISABLE TO HAVE AN INDICATION OF THE AIR-FUEL RATIO AT WHICH THE ENGINE IS RUNNING. IT IS RECOMMENDED THAT A WIDE-BAND OXYGEN SENSOR BE USED FOR THIS SINCE IT DISPLAYS THE AIR-FUEL RATIO QUICKLY.

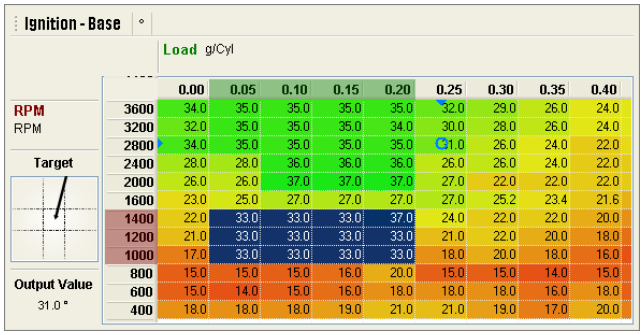
All tuning tables in the ECU Navigator can be modified. Once a tuning table has been selected, cells can be selected and modified.

7.1.1 Selecting cells

By default, one cell will always be selected in the tuning table. The selected cell is blue in colour and can be moved around the tuning table by using the arrow keys.

If required, multiple cells can be selected, by holding down the Shift key, then any arrow key.

Shift-UpArrow — Will expand the selected cell/s up the tuning table.
Shift-DownArrow — Will expand the selected cell/s down the tuning table.
Shift-LeftArrow — Will expand the selected cell/s left in the tuning table.
Shift-RightArrow — Will expand the selected cell/s right in the tuning table.



RPM \ Load g/Cyl	0.00	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40
3600	34.0	35.0	35.0	35.0	35.0	32.0	29.0	26.0	24.0
3200	32.0	35.0	35.0	35.0	34.0	30.0	28.0	26.0	24.0
2800	34.0	35.0	35.0	35.0	35.0	31.0	26.0	24.0	22.0
2400	28.0	28.0	36.0	36.0	36.0	26.0	26.0	24.0	22.0
2000	26.0	26.0	37.0	37.0	37.0	27.0	22.0	22.0	22.0
1600	23.0	25.0	27.0	27.0	27.0	27.0	25.2	23.4	21.6
1400	22.0	33.0	33.0	33.0	37.0	24.0	22.0	22.0	20.0
1200	21.0	33.0	33.0	33.0	33.0	21.0	22.0	20.0	18.0
1000	17.0	33.0	33.0	33.0	33.0	18.0	20.0	18.0	16.0
800	15.0	15.0	15.0	16.0	20.0	15.0	15.0	14.0	15.0
600	15.0	14.0	15.0	16.0	18.0	18.0	18.0	16.0	18.0
400	18.0	18.0	18.0	19.0	21.0	21.0	19.0	17.0	20.0

Figure 11: The text view table with a 4 x 3 cell selection

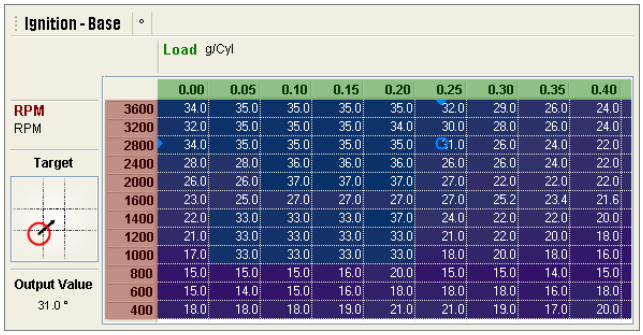


Figure 12: The text view table with all cells selected

Ctrl-A — Will select all cells in the tuning table.

When multiple cells are selected, cell operations will be applied to all cells.

7.1.2 Deselecting cells

Deselecting cells can be done by holding down the Ctrl key, then any arrow key.
For example, pressing Ctrl-RightArrow will reduce the selected area by one column, by deselecting the far left column.
Ctrl SPACE— Will deselect all cells in the tuning table.

7.1.3 All Ranges mode

All ranges mode allows the user to expand their current cell selection across all rows.
This can be useful when editing a table for the first time or when an adjustment across rows needs to be made.

To enable All ranges use the **R** key
To disable All ranges use the **R** key again

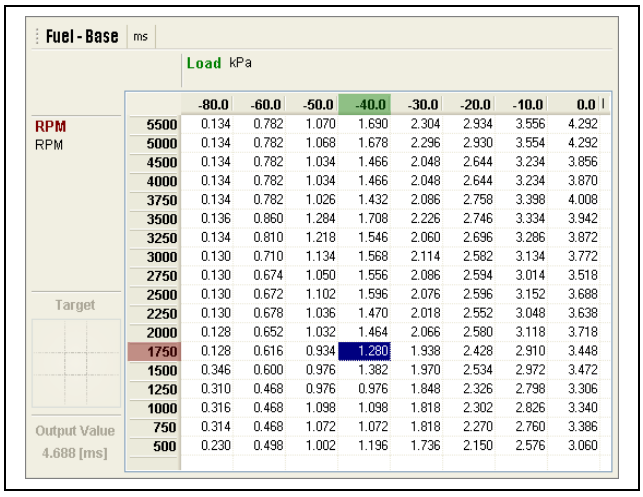


Figure 13: The text view table with one cell selected

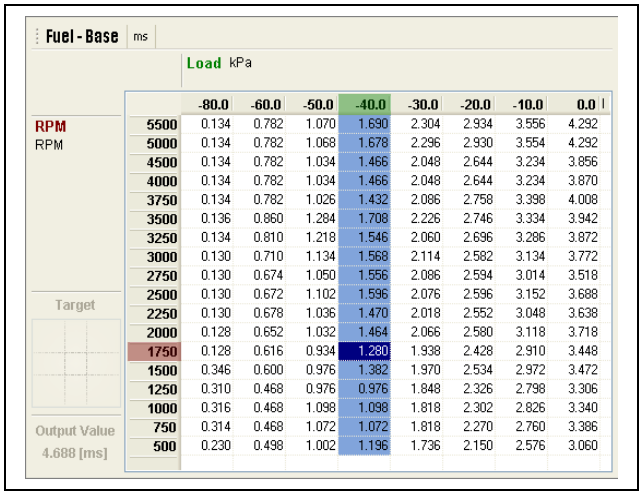


Figure 14: The text view table with All ranges enabled

7.1.3.1 All Ranges above mode

When in All ranges mode, using the **A** key will slightly change the way in which All ranges works. The area of selected cells is only set to above the current position.

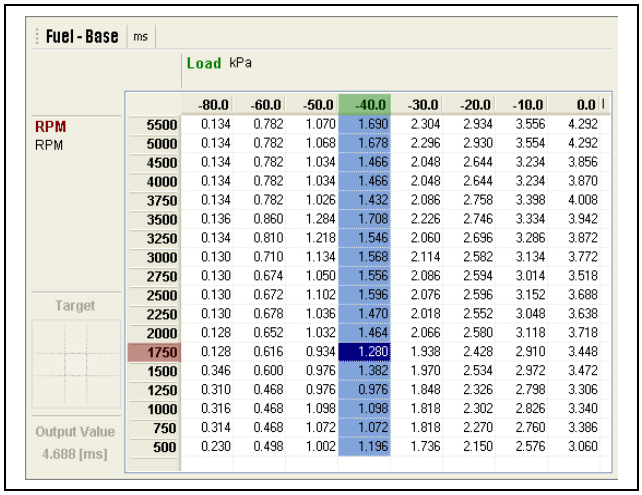


Figure 15: With All ranges enabled

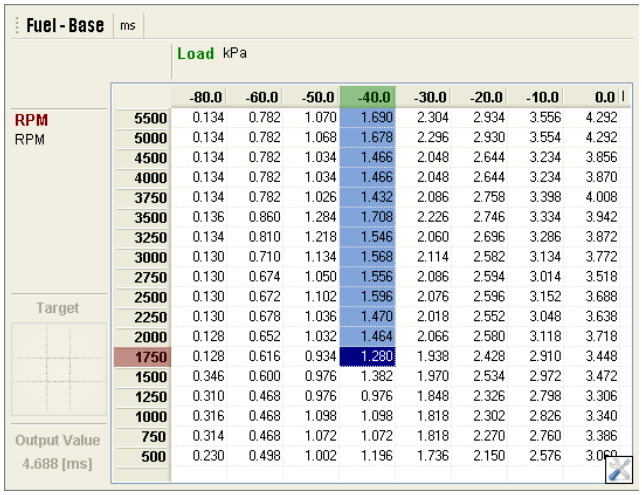


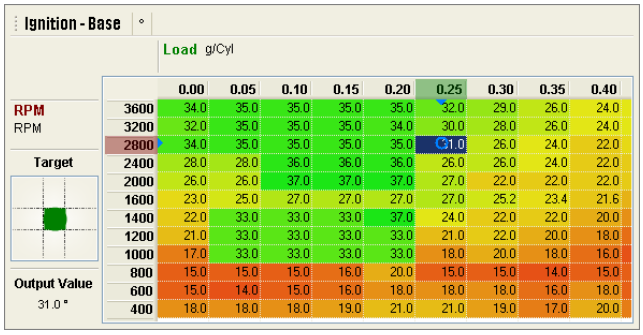
Figure 16: With All ranges above enabled

7.1.4 Currently used cell

When the engine is running, the ECU will be using values from the tuning table. The value currently being used by the ECU is indicated by the reference marker.

Figure 14: The Reference marker

At any point, you can align your currently selected cell/s with the cell/s the ECU is using. This can be done using the spacebar.



7.1.5 Increasing / decreasing cell value

Once a cell selection has been made, its value can then be changed. The following is how cell values can be changed.
Cell values can be increased by using the PgUp key.
Cell values can be decreased by using the PgDown key.
If smaller changes are required the Ctrl key can be held down while adjusting cells.
If larger changes are required the Shift key can be held down while adjusting cells.

7.1.6 Direct Entry

The cell value can be changed to the new value, just by typing the new value.
A direct entry dialog will appear, showing the allowable values for this table.

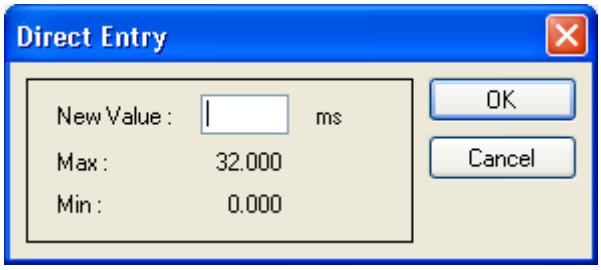


Figure 15: The Direct Entry dialog

7.1.7 Percentage Change:

Cell values can be changed by a percentage if required. This percentage can be either positive or negative.
A percentage change can be made by using the **P** key.

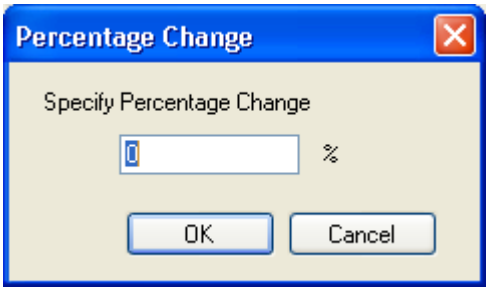


Figure 16: The Percentage Change dialog

7.1.8 Linearizing cells

Whilst tuning, it can become useful to linearize between cells. That is to make a range of cells linear between the two end cells. This feature can be used any time more than two cells are selected by using the **L** key.
The linearize feature can be used in the 2D, 3D & Text View tuning table displays.

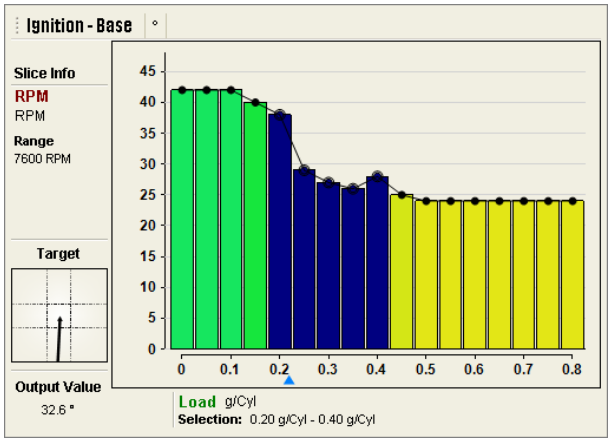


Figure 17: Selected cells before linearizing

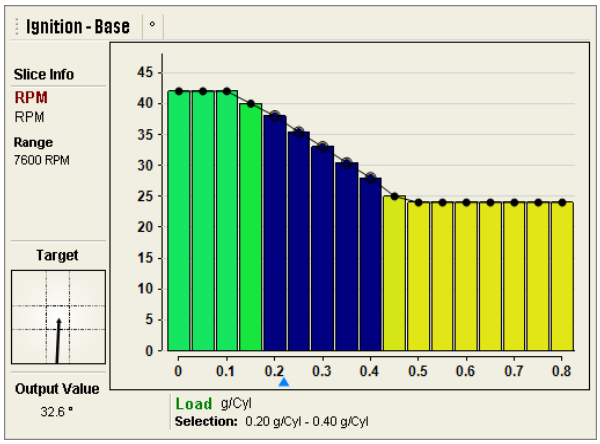


Figure 18: Selected cells after linearizing

7.1.9 Copying and Pasting cells

At any time cells can be copied and pasted like any other windows application.
To copy a cell selection, use the Ctrl-C keys or the (insert copy icon here) icon.
To paste a cell selection, use the Ctrl-V keys or the (insert paste icon here) icon.

Cell values can be copied between tuning tables if the selection area and type are the same.

7.1.10 Quick Copy:

Cell values can be quickly copied to the adjacent cells by holding the Ctrl-Shift and an arrow key.
The direction of the arrow key will decide which direction the cell will be copied.
Please note that this feature will only work when either the row or column is still one cell wide.
ie, a 6 x 1 cell selection will work, as will a 1 x 6, but a 6 x 2 or a 2 x 6 will not.

7.2 Inserting & deleting Axis Points

Tuning table axis points can be added and removed by using the Insert & Delete keys.

7.2.1 To insert a new axis point

To insert a new axis point, select the Insert key. An insert dialog will appear.
If axis points are available, it will allow you to insert a row or column, and allow you to select a axis value. Once this has been competed, the new axis value will appear in the tuning table. The values in the new cells will be interpolated from those either side.

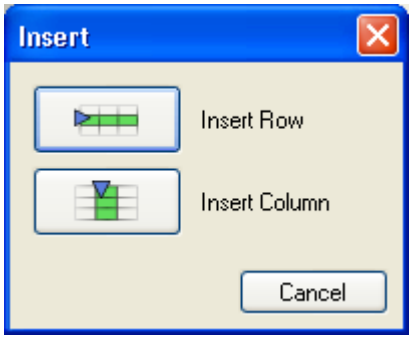


Figure 19: The Insert new axis point dialog

Please note once the predefined maximum number of axis points has been reached, the insert & delete icons will appear grayed out.

7.2.2 To delete an existing axis point

To delete an axis point, select the Delete key. A delete dialog will appear. It will prompt you to delete either the current row/s or column/s.

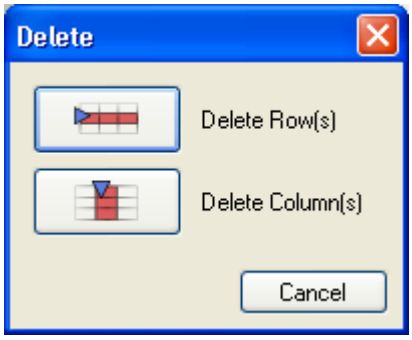


Figure 20: The Delete axis point dialog

7.2.3 The Axes Setup

If changes to tuning table axes are required, they can be performed in the Axes Setup page.

The Axes Setup allows the user to:

- Change multiple axis points for both the row & column axis
- Insert & delete axis points,
- Change the channel used for the axis as well as
- Enable and disable individual axis
- Load and save axis channels & points.

Axis points can be increased up until the Maximum Length is reached. The Maximum Length can be found in the Axes Setup.

The Axis values can be modified as any other tuning table.

Access to the Axes Setup can be made by right clicking on the Tuning table, or by pressing the F3 key.

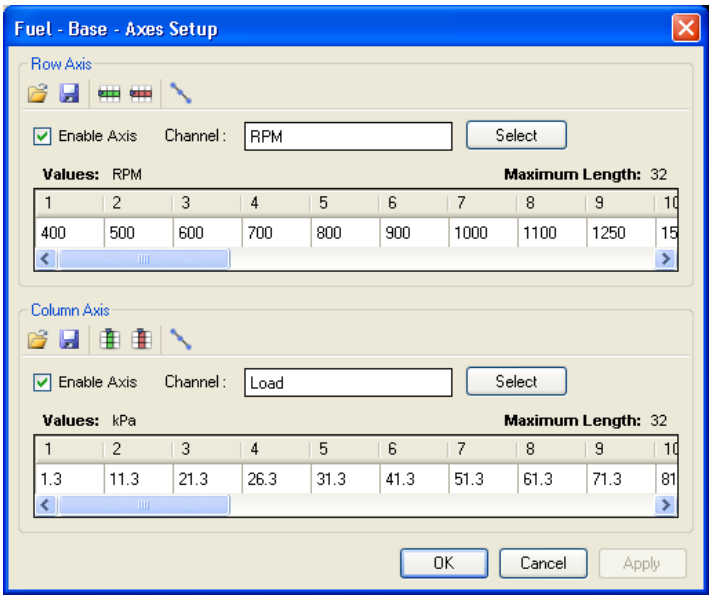


Figure 21: The Axis Setup dialog

7.3 Copy through Feature

The copy through feature allows the Haltech ECU to output the factory ECU's fuel and ignition timing values, wherever the user specifies. This feature allows mildly modified engines to retain the factory operation without having to tune the entire ECU.
Copy through can be enabled in the Base Fuel & Base Ignition tables by pressing "C" in the desired cells. Multiple cells can also be selected and set to Copy through.

Please note, that when the engine is operating in Copy through mode, all corrections will be ignored.

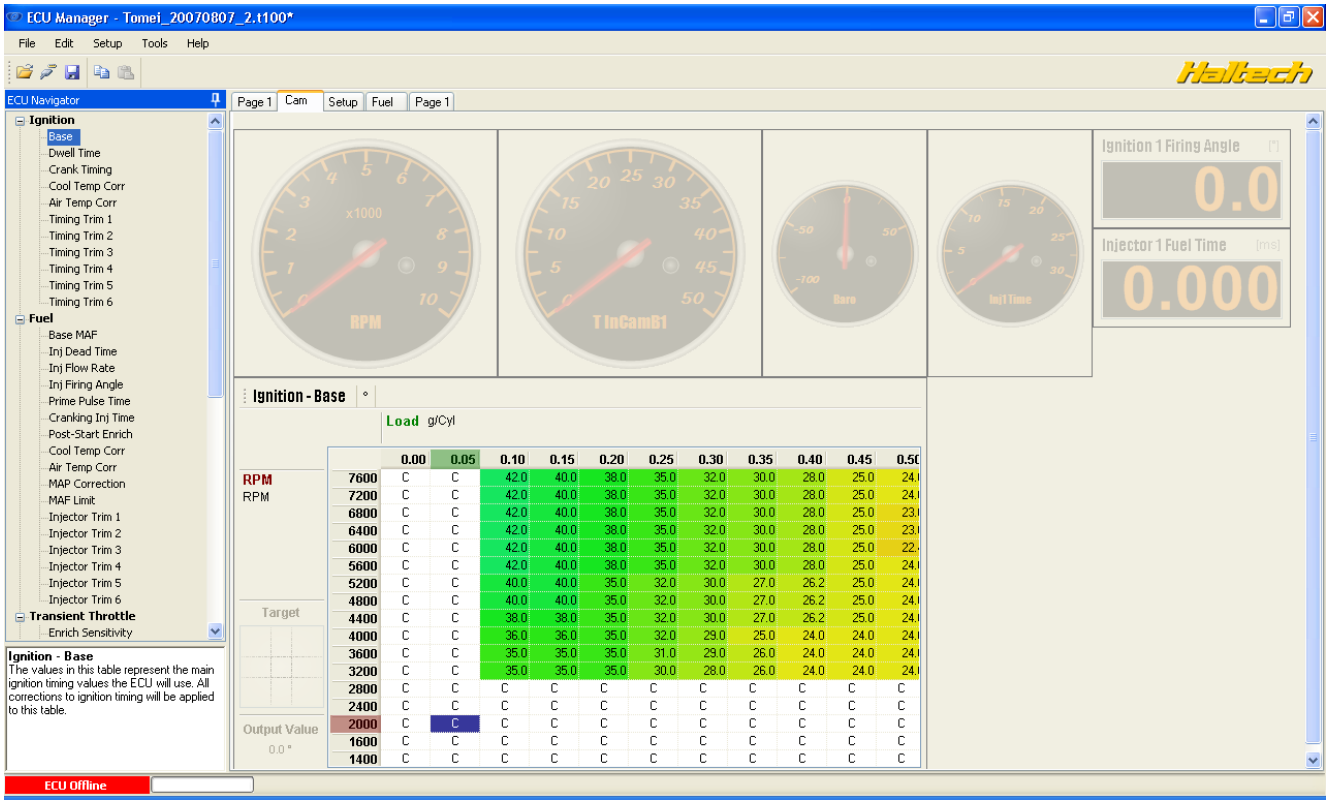
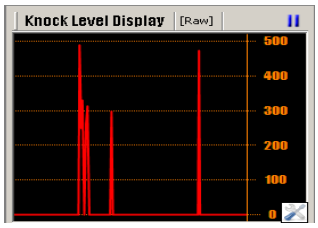


Figure 21: The Base Fuel Table showing the Copy Through feature enabled

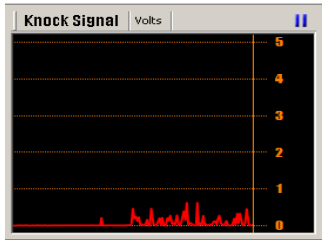
7.4 Knock detection

The 350Z ECU has a built in knock detection circuit that allows the filtered output of the knock sensor to be viewed and logged via the Knock Level Display channel.

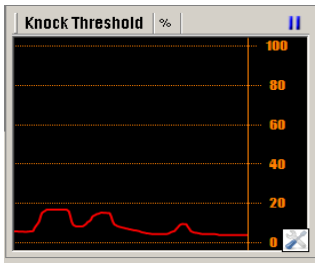
- Knock Level Display – When knock is detected which exceeds the noise threshold, then spikes will appear in this trace. The height of the spike indicates how severe the knock event was.



- Knock Signal – This is the raw signal from the Knock sensor. It is only displayed as a reference.



- Knock Threshold – This is the noise threshold which is used to mask the engine's background noise. The table is where the thresholds are entered. When displayed as a trace, the line on the trace follows the noise thresholds.



Calibrating the Knock Threshold Table

The Knock Threshold table is filled out to mask any non knock related engine noise.

- To calibrate this table, drive the car at the RPM and Load and adjust the map until no spikes appear in the Knock Level Display channel.
- Start with numbers that are low, then increase them until the spikes disappear from the Knock Level Display.
- You may need to set the threshold higher under light load to ensure that noises under deceleration are not mistaken for Knock. An engine under rapid deceleration can often generate noises that are similar to knock.

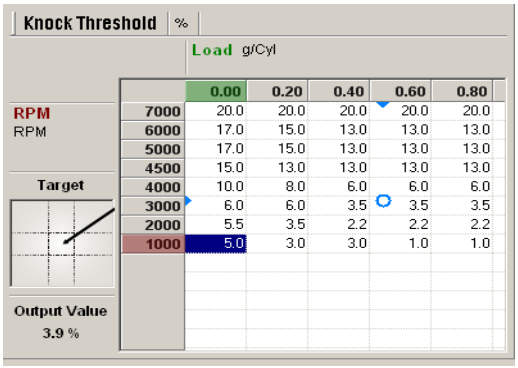
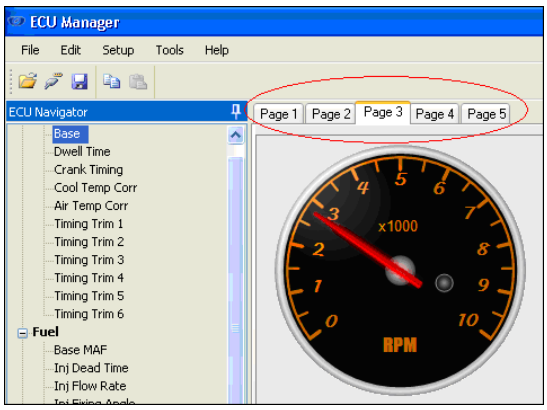


Figure 21: The Knock Threshold Table

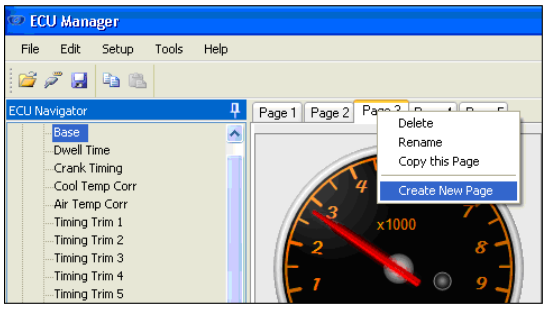
7.5 Tuning Pages (Tabs)

The ECU Manager allows the user to setup multiple tuning pages, or tabs. These tuning pages can be configured individually and populated with displays.



To move between Tuning Pages, use the Tab key or alternatively click on the required tab with the mouse.

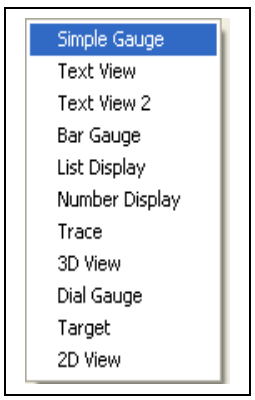
Tuning Pages can be added as well as renamed, copied and deleted by right clicking on the desired tab.



7.6 Displays

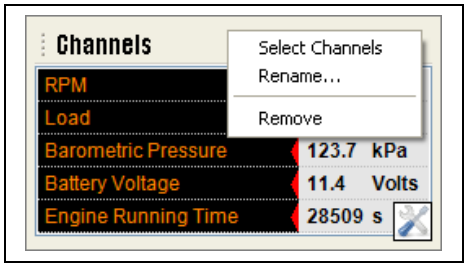
The ECU Manager is loaded with various displays to make engine tuning and diagnosis easy. These displays can be added and configured as the user wishes.

To add a display, right click on any unused portion of the tuning page and select the required display.



To remove a display, right click on the display and select remove.

To customise a display, right click on the display itself or the displays tooltip  , which will reveal the associated displays options.

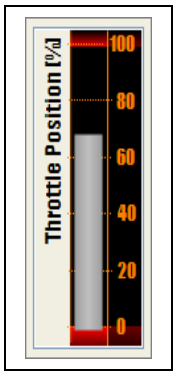


7.6.1 Dial Gauge

The dial gauge is an analogue representation of an ECU channel. The displayed channel can be changed by right clicking on the display.

7.6.2 Bar Gauge

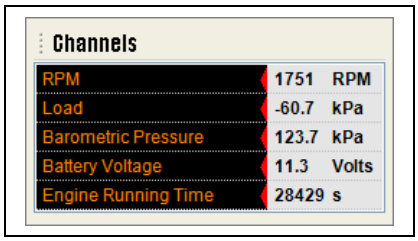
The bar gauge is a graphical display that allows an ECU channel to be viewed as a rectangular bar. The displayed channel can be changed by right clicking on the display.



7.6.3 List Display

The list display allows multiple ECU channels to be viewed together. The list display can also be given a name.

Channels can be added and removed by right clicking on the display.



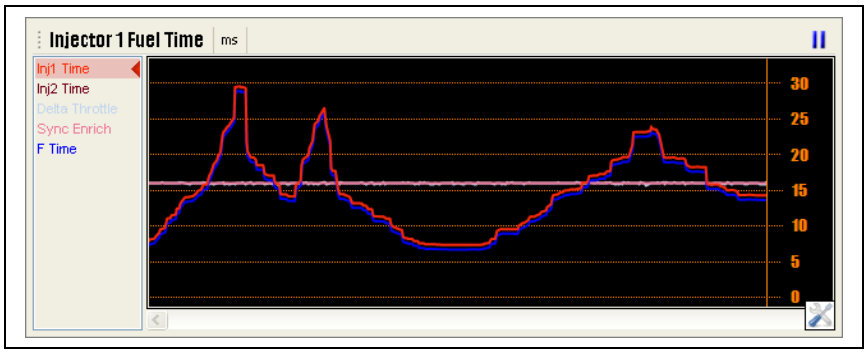
7.6.4 Number Display

The number display allows an ECU Channel to be boldly displayed. The label on the number display can be hidden, which is useful when number displays are combined with dial gauges. The displayed channel can be changed by right clicking on the display.

7.6.5 Trace Display

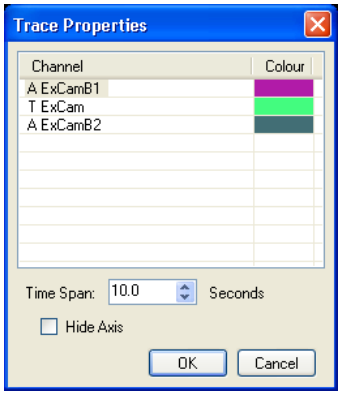
The trace display shows the graphical history of any selected ECU channel. The trace display can have up to 5 channels at once. The focus of the trace display can be changed between the selected channels by clicking on the channel name within the display. The trace display name & axis values will change to the channel in focus. The individual trace display can be paused at any time by clicking on the play/pause button in the top right hand corner of the display. The display can be resumed at any time by clicking back on the play/pause button.

To add or remove channels or to view the trace displays properties, right click on the display.



Trace properties

Within the properties window, the colour of each channel can be configured, as well as the time span of the display.

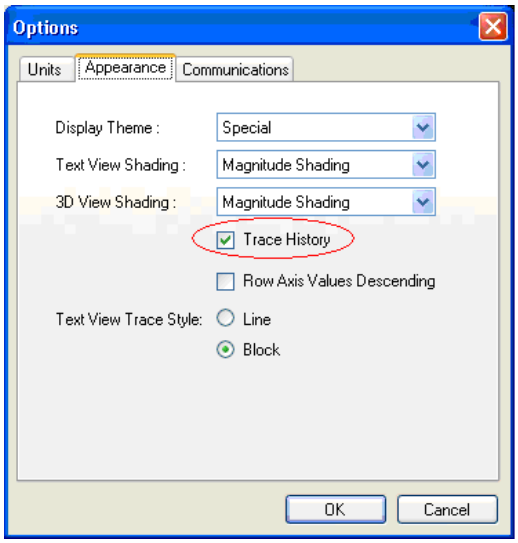


Trace History

The trace display has the option of allowing the user to view the history of the currently displayed channels.

The trace history can only be viewed when the display is paused. A scroll bar will appear, allowing the user to move along the trace history.

This feature can be enabled in the Tools>Options>Appearance window.



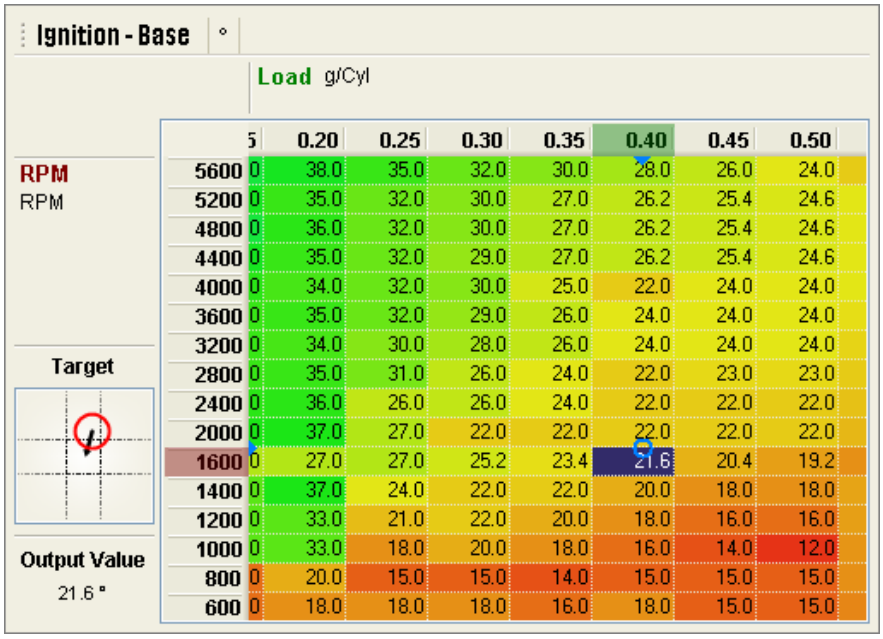
7.6.6 Text View

The text view allows the selected tuning table to be displayed as a spreadsheet. The tuning table can be navigated by using the arrow keys, and the cell value modified by using the PgUp & PgDownkeys.

The currently selected cell can be seen below highlighted in blue, with the current engine position indicated with a blue circle.

The Output Value shown in the bottom left hand corner of the display indicates the value that this table is producing. This value is linked to this table only and may not represent the final value used by the ECU, as correction tables may affect any final values.

For more information on tuning please see Modifying Tuning Tables



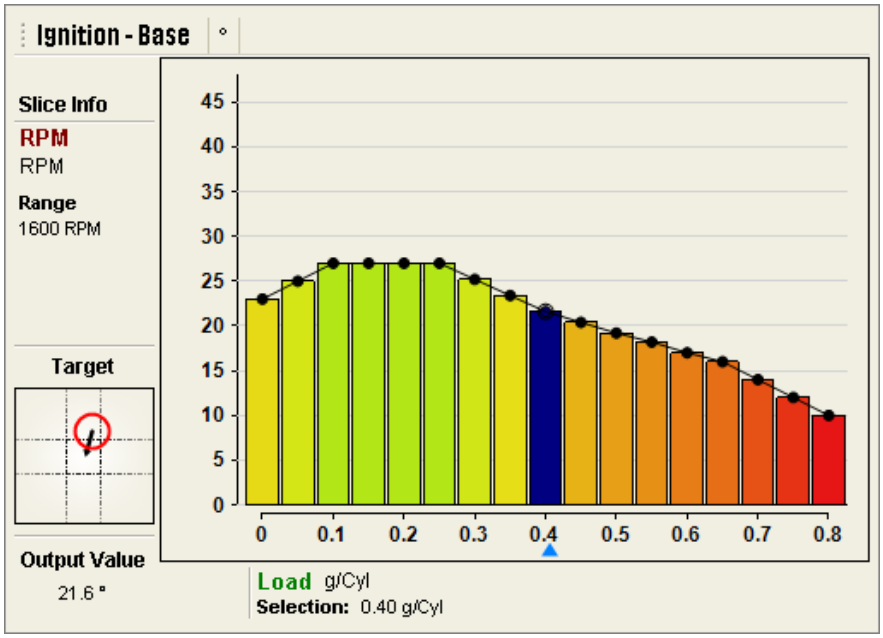
RPM	0.20	0.25	0.30	0.35	0.40	0.45	0.50
5600	38.0	35.0	32.0	30.0	28.0	26.0	24.0
5200	35.0	32.0	30.0	27.0	26.2	25.4	24.6
4800	36.0	32.0	30.0	27.0	26.2	25.4	24.6
4400	35.0	32.0	29.0	27.0	26.2	25.4	24.6
4000	34.0	32.0	30.0	25.0	22.0	24.0	24.0
3600	35.0	32.0	29.0	26.0	24.0	24.0	24.0
3200	34.0	30.0	28.0	26.0	24.0	24.0	24.0
2800	35.0	31.0	26.0	24.0	22.0	23.0	23.0
2400	36.0	26.0	26.0	24.0	22.0	22.0	22.0
2000	37.0	27.0	22.0	22.0	22.0	22.0	22.0
1600	27.0	27.0	25.2	23.4	21.6	20.4	19.2
1400	37.0	24.0	22.0	22.0	20.0	18.0	18.0
1200	33.0	21.0	22.0	20.0	18.0	16.0	16.0
1000	33.0	18.0	20.0	18.0	16.0	14.0	12.0
800	20.0	15.0	15.0	14.0	15.0	15.0	15.0
600	18.0	18.0	18.0	16.0	18.0	15.0	15.0

7.6.7 2D View

The 2D view allows the selected tuning table to be displayed as a slice. The tuning table can be navigated by using the arrow keys, and the cell value modified by using the pgUp & pgDown keys.

The currently selected cell can be seen below highlighted in blue, with the current engine position indicated by the blue arrow. The slice info can be seen in the left column.

The Output Value shown in the bottom left hand corner of the display indicates the value that this table is producing. This value is linked to this table only and may not represent the final value used by the ECU, as correction tables may affect any final values.



7.6.8 3D View

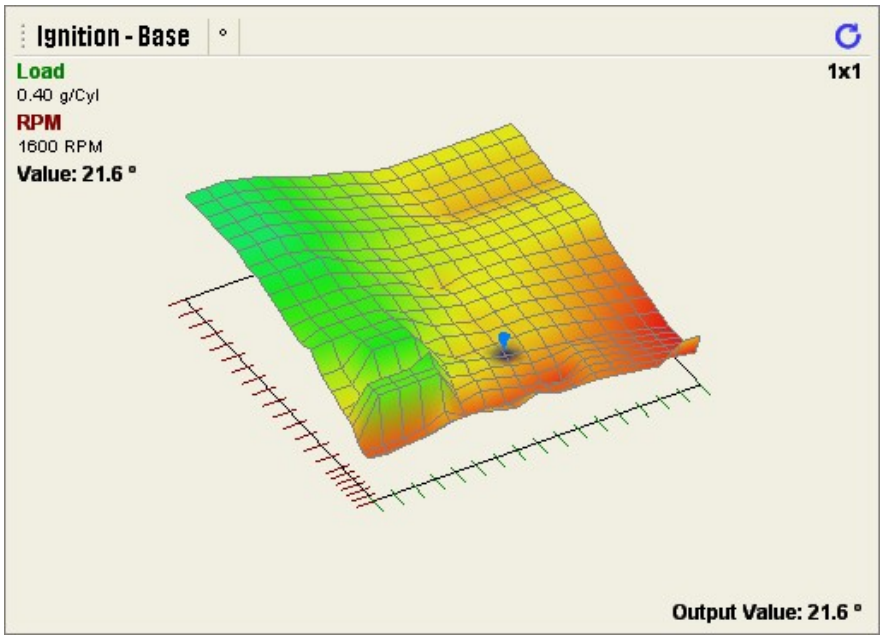
The 3D view allows the selected tuning table to be displayed as a surface. The tuning table can be navigated by using the arrow keys, and the cell value modified by using the pgUp & pgDown keys.

The currently selected cell can be seen below highlighted in blue, with the current engine position indicated by the

blue arrow. The current selection size is indicated in the top right hand corner, with the currently selected cells value shown on the left.

The Output Value shown in the bottom right of the display indicates the value that this table is producing. This value is linked to this table only and may not represent the final value used by the ECU, as correction tables may affect any final values.

The 3D table can be rotated to provide a better angle of the surface by using the left mouse button. The surface can be reset back to the default angle at any time by clicking on the return to default angle button located in the top right hand corner.



7.6.9 Target

The Target display allows the user to see the position of the engine in relation to the currently selected tuning table cell. As the current engine position approaches the selected cell, the cursor in the target display will be shown as a red circle. If the cursor becomes closely aligned, the cursor will highlight green. When the cursor is green, any changes made will affect the current running of the engine. At any time the selected cell can be aligned with the current engine position by using the spacebar.

Figure1. The target display

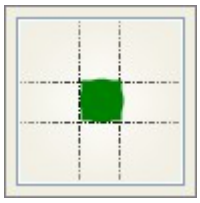


Figure1. The selected cell aligned with the current engine position

Appendix

8. Speed – Density Fuel Calculation & VE Tuning

The Speed-Density algorithm is a method of calculating fuel injection pulse width for a given engine speed and load. The VE table is a table that describes the volumetric efficiency of an engine.

If you wish just learn how to tune the VE table, then jump ahead to the ***Tuning a Car by VE and the Speed-Density Calculation*** section. The following section covers the concepts involved in how Speed-Density works which may help in understanding the implications of tuning certain tables and parameters.

8.1 Inputs to the calculations

The Speed-Density calculation uses the following inputs to determine injector pulse width:

- Engine speed in RPM
- Manifold Pressure (MAP, or air Density)
- Air Temperature
- Engine displacement
- Injector flow & dead time
- Air Fuel Ratio Target
- Volumetric Efficiency of the given engine

8.2 Calculating the amount of Air

To determine the amount of air that is consumed by an engine at any instant in time, we use the following measurements:

1. Manifold pressure from a MAP sensor measuring the pressure of air in the manifold, which is also the pressure behind the intake valve.
2. The Air Temperature entering the engine from an Air Temp sensor.
3. The RPM from a crank angle sensor.

8.2.1 Calculating Air Volume

By combining the *Engine speed*, with the known volume of the engine (*Engine Displacement*), the amount of swept volume per second can be calculated.

8.2.2 Volumetric Efficiency

An engine is not a perfect air pump however, so even though an engine's pistons might sweep through a theoretical volume every revolution, the cylinder is not always filled 100% with an amount of air that is available from the other side of the intake valve. Similarly, it may not exhaust the full amount through the exhaust valve.

The fraction of air that is effectively moved through the engine, compared to the air that is available in the intake manifold, is called the **Relative* Volumetric Efficiency** of the engine.

* - It is called 'Relative' because it is compared to the air available in the intake manifold.

8.2.3 Calculating Air Density

When we combine fuel with air, we are combining molecules of fuel with molecules of air. So even if we know

the volume of air, we are really interested in knowing the number of molecules of air that we have. In order to determine this, we apply the A*ir Temperature* and *Manifold Pressure* from the manifold to the volume of air that managed to get inside the cylinder.

8.3 Calculating the amount of Fuel

Given that the amount of air in the cylinder is now calculated, we can now use the *Air Fuel Ratio Target* to determine how much fuel is required. The density of fuel is known, so the injector can be pulsed to supply to required amount of fuel.

To calculate how much fuel goes into the engine when we pulse an injector, we need to know the fuel injector flow and its dead time.

If the car uses a fuel pressure regulator that keeps a constant pressure relative to the manifold pressure, then this fuel flow for an injector is typically its size in CC/min.

The dead time of an injector is the time from the start of the electrical pulse to begin injection, until the point in time where the injector is close to flowing its rated flow capacity. This dead time is added to the theoretical injection pulse to account for the injector dead time.

8.4 Effects of VE

The main tuning variable for a given engine is the Volumetric Efficiency (VE). The other inputs are obtained through calibrated sensors or from known quantities.

The VE of an engine is affected by:

1. Intake and exhaust valve geometry, size, lift and timing.
2. Intake and exhaust manifold and port design.
3. Compression Ratio.
4. Engine speed.
5. Pressure ratio across inlet and exhaust.
6. Mixture temperature.
7. Fuel type and vaporization of fuel.

The main parameters that vary and contribute most to changes in VE are points 4 and 5. The VE map is typically a table consisting of Engine Speed down one axis and Manifold Pressure across the other.

Within this table, the VE can be changed to affect the fuel requirements of the engine. For a given Air/Fuel Ratio, if an engine's VE is high, then more fuel will be injected to compensate for the extra air. If an engine's VE is low, then less fuel will be injected to achieve this Air/Fuel Ratio.

9. Tuning a Car by VE and the Speed-Density Calculation

9.1 Setting up the Parameters

Before tuning the VE table, it is very important that you set all the supporting parameters and tables as accurately as possible, otherwise your VE table will not calibrated correctly and you will lose many of the advantages of this tuning method.

1. **Load source –** Select MAP.
2. **Manifold Pressure Source –** Choose Internal or External senor.
3. **Sensor Calibrations –** Check that your Air Temp Calibration Table is correct. If External MAP sensor is selected, then also check your MAP sensor calibration table corresponds to your MAP sensor.
4. **Engine Capacity –** Check that your engine capacity value is correct.
5. **Injector Flow Rate –** Check your injector flow rate table and adjust to suit your injector.
6. **Injector Dead Time –** Check your injector dead time table and adjust to suit your injector.
7. **Target AFR –** Check your Target AFR table and adjust to your desired AFR for the given engine operating point.

9.2 Tuning the VE table

To calibrate the VE table, a calibrated Air/Fuel ratio meter can be used to measure the resulting Air/Fuel Ratio for a given VE and comparing it to the Target Air/Fuel Ratio table.

If the measured Air/Fuel Ratio is richer than the targeted Air/Fuel ratio, then the VE value in the table at that engine speed and manifold pressure is too high.

Similarly, if the measured Air/Fuel Ratio is leaner than the targeted Air/Fuel ratio, then the VE value in the table at that engine speed and manifold pressure is too low.

Increasing the VE value results in richer mixture, lowering the VE value results in a leaner mixture.

The aim of calibrating the VE table is to make the measured AFR match the Target AFR table. When they match, the VE value in the VE table is a good representation of the VE of the engine for that operating point.

Do not use the VE table to tune mixtures to values other than what is in the Target AFR table. If you wish to have a richer or leaner mixture for a given engine operating point, then alter the Target AFR table once the VE table is calibrated.

9.3 Advantages of using VE & Speed-Density

Once the VE table is calibrated to the engine, then any of the other parameters can be changed to affect fuelling.

The advantage is that if the desired AFR changes for a given operating condition (MAP and RPM), then this can be altered in the Target AFR table and the AFR at that point will move toward that new target. It may not precisely land on the target due to any error in any of the calibrations of the sensors or VE table, but it if the

vehicle has been calibrated satisfactorily, then changing the target AFR will change the engine to operate sufficiently close to the new AFR to only require minor tuning or checking. This is far quicker than the trial and error method required when manipulating injection times directly.

Similarly, if injector sizing is changed, then a change to the injector flow and dead time parameters will adjust the fuelling to suit the new injectors.

The tuning of the VE table is typically much easier than manipulating injection time because the values of the VE table a typically very similar across an operating range of the engine. For example, the majority of engines have a relative VE between 45% and 90%. This results in a map with a flatter shape than an injection time map.

To illustrate the effectiveness of VE tuning, it is often possible to use a single VE value of approximately 80% across the entire table to get an engine started and running, assuming all the other parameters are correctly set up. This reduces the set up time of the fuel maps to getting a car to a stage where the main tuning can begin.

10. Keyboard Reference

PgUp	Increase Cell Value
PgDn	Decrease Cell Value
Ctrl + PgUp	Small Increase of Cell Value
Ctrl + PgDn	Small Decrease of Cell Value
Shift + PgUp	Large Increase of Cell Value
Shift + PgDn	Large Decrease of Cell Value
0 - 9	Set the Tuning Table cell value
Arrow	Moves the selected cell/s pointer
Shift + Arrow	Increases the number of selected cells
Ctrl + Arrow	Decreases the number of selected cells
Alt + Arrow	Change the selected map
Tab	Selects the next Tuning Page
Shift + Tab	Selects the previous Tuning Page
Space	Aligns the cursor to current engine operating point
Ctrl + Space	Shrinks the selection to a single cell
F1	Open Help Window
F3	Axes Setup
F4	Main Setup
F5	Connect / Disconnect from ECU
Ctrl - A	Select all the cells in the current Tuning Table
Ctrl - C	Copy
Ctrl - V	Paste
L	Linearize across the selected cells
P	Percentage increase or decrease the selected cells
Q	Will alter the current Base Fuel table value to attempt to make the actual AFR meet the Target AFR. (Wideband sensor required)

R	Enables/disables “All ranges” mode.
T	Enables/Resets/Disables Trace in Text View
W	Same as Q, but operation will also be performed to the cell above and across the current cell.
Insert	To insert a Row/Column in Tuning Table
Delete	To delete a Row/Column in Tuning Table
Home	Moves the selected cell/s to the Left of the Tuning Table
End	Moves the selected cell/s to the Right of the Tuning Table
Pause	Pauses/resumes all Trace displays
Ctrl+Shift+Arrow	Copy the current Tuning Table value to an adjacent cell.

LIMITED WARRANTY

Lockin Pty Ltd trading as Haltech warrants the Haltech™ Programmable Fuel Injection System to be free from defects in material or workmanship for a period of ninety days from the date of purchase.

Proof of purchase, in the form of a bill of sale or receipted invoice, which indicates that the product is within the warranty period must be presented to obtain warranty service. Lockin Pty Ltd trading as Haltech suggests that the purchaser retain the dealer's dated bill of sale as evidence of the date of retail purchase.

If the Haltech™ Programmable Fuel Injection System is found to be defective as mentioned above, it will be replaced or repaired if returned prepaid along with proof of purchase. This shall constitute the sole liability of Lockin Pty Ltd trading as Haltech.

To the extent permitted by law, the foregoing is exclusive and in lieu of all other warranties or representations, either expressed or implied, including any implied warranty of merchantability or fitness. In no event shall Lockin Pty Ltd trading as Haltech be liable for special or consequential damages.

Revision History

Date	Version	Author	Changes
12/09/07	1.1	NC	Updated All ranges, axes setup and Rev limit settings.
22/11/07	1.3	NC	Updated Axes Setup
29/11/07	1.4	NC	Added warnings, knock instructions, aux i/o
	1.6		Added VE text, removed keystroke font